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LIST OF ACRONYMS AND ABBREVIATIONS

°	Degree(s)
°C	Degrees Celsius
°F	Degrees Fahrenheit
µm	Micron(s)
µs	Microsecond
abt	Adjusted Number of Bird Tracks
AIC	Akaike's Information Criterion
Alt	Altitude
AMSL	Above Mean Sea Level
AMTR	Adjusted Migration Traffic Rate
ANOVA	Analysis of Variance
arl	Above Radar Level
ARO	Avian Radar Operator
ASL	Above Sea Level
BB	Brigantine Beach
BLSC	Black Scoter
BSS	Beaufort Sea State
C	Confirmed
CAC	Corrected Altitudinal Count
CANG	Canada Goose
CFD	Cumulative Frequency Distribution
CI	Confidence Interval
CI-SIC	Corson's Inlet-Sea Isle City
CL	Confidence Level
cm	Centimeter(s)
dBZ	Decibel(s) of Reflectivity
DCCO	Double-crested Cormorant
DIVA	Dive Altitude
DVD	Digital Versatile Disc
E	East
EBS	Ecological Baseline Studies
EDT	Eastern Daylight Time
ENE	East-northeast
ESI	Environmental Sensitivity Index
EST	Eastern Standard Time
FPV	Focal Plan Array
ft	Foot(Feet)
ft/s	Feet per Second
GAM	Generalized Additive Model
GIS	Geographic Information System
GMI	Geo-Marine, Inc.
GOF	Goodness-of-Fit
GPS	Global Positioning System
GULG	Large Gull
H_o	Null Hypothesis
HERG	Herring Gull
hr	Hour
Hz	Hertz
IBSP	Island Beach State Park
ID	Identification
in.	Inch(es)
IR	Infrared
K-S	Kolmogorov-Smirnov
K-W	Kruskal-Wallis

LIST OF ACRONYMS AND ABBREVIATIONS
(*continued*)

KDIX	Fort Dix, New Jersey Doppler Radar Station
km	Kilometer(s)
km^2	Square Kilometer(s)
km^3	Cubic Kilometer(s)
KOKX	Upton, New York Doppler Radar Station
kph	Kilometer(s) per Hour
kt	Knot
kW	Kilowatt(s)
LCD	Local Climatological Data
lon-lat	Longitude-Latitude
m	Meter(s)
m/s	Meter(s) per Second
MARS®	Mobile Avian Radar System
MHz	Megahertz
mi	Mile(s)
mi^2	Square Mile(s)
min	Minute(s)
MLW	Mean Low Water
mm	Millimeter(s)
mph	Mile(s) per Hour
MTR	Migration Traffic Rate
N	North
NBB	North Brigantine Beach
NCDC	National Climatic Data Center
NE	Northeast
NEXRAD	Next Generation Radar
NJDEP	New Jersey Department of Environmental Protection
NM	Nautical Mile(s)
NNE	North-Northeast
NNW	North-Northwest
NOAA	National Oceanic and Atmospheric Administration
NOGA	Northern Gannet
ns	Nanosecond(s)
NW	Northwest
NWS	National Weather Service
PAO	Primary Avian Observer
PC	Personal Computer
PDA	Personal Digital Assistant
PRF	Pulse Repetition Frequency
QA/QC	Quality Assurance/Quality Control
Radar	Radio Detection and Ranging
RAOB	Radiosonde Observation
rpm	Revolution(s) per Minute
RSZ	Rotor-Swept Zone
s	Second(s)
S	South
SCDW	Dark-winged Scoter
SCOT	Scoter
SD	Standard Deviation
SE	Southeast
SIC	Sea Isle City
SSB	Senior Seabird Biologist
SSE	South-Southeast

LIST OF ACRONYMS AND ABBREVIATIONS
(*continued*)

SSW	South-Southwest
SUBT	Submersion Time
SUSC	Surf Scoter
SW	Southwest
T	Transect
TCC	Time Corrected Count
TI	Thermal Imaging
TV	Television
U	Unconfirmed
U.K.	United Kingdom
U.S.	United States
USFWS	United States Fish and Wildlife Service
UTC	Coordinated Universal Time
VGA	Video Graphics Array
VO	Visual Observer
VPR	Vertically Point Radar
VPS	Video Peak Store
W	West
WSR-88D	Weather Surveillance Radar-1998, Doppler
X^2	Chi-square

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LIST OF METRIC TO U.S. MEASUREMENT CONVERSIONS

To convert from	To	Multiply by
LENGTH		
Kilometer (km)	Mile, statute (mi)	0.6214
	Nautical mile (NM)	0.5400
Nautical Mile (NM)	Mile, statute (mi)	1.151
Meter (m)	Foot (ft)	3.281
	Inch (in.)	39.37
Centimeter (cm)	Inch (in.)	0.3937
Millimeter (mm)	Inch (in.)	0.03937
Micrometer or Micron (µm)	Microinch (µ in.)	39.37
DISTANCE PER UNIT TIME		
Meter per second (m/s)	Mile per second (mi/s)	0.0006214
	Foot per second (ft/s)	3.281
Centimeter per second (cm/s)	Inches per second (in./s)	0.3937
Kilometers per hours (k/h)	Mile per hour (mph)	0.6214
	Knot (nautical mile/hour)	0.5400
Knot (nautical mile/hour)	Mile per hour (mph)	1.151
AREA		
Square kilometer (km^2)	Square mile (mi^2)	0.3861
	Square nautical mile (NM^2)	0.2916
Square nautical mile (NM^2)	Square mile (mi^2)	1.324
Square meter (m^2)	Square foot (ft^2)	10.76
VOLUME		
Cubic meter (m^3)	Cubic foot (ft^3)	35.31
	Gallon (gal)	264.2
Liter (L)	Gallon (gal)	0.2642
VOLUME PER UNIT TIME		
Cubic meter per second (m^3/s)	Cubic foot per second (ft^3/s)	35.31
	Gallon per minute (gal/min)	15,850
Sverdrup (Sv) = 10^6 m^3/s	Gallon per second (gal/s)	264.2
WEIGHT		
Metric Ton (MT)	Ton, short (T)	1.102
Kilogram (kg)	Pound (lb)	2.205
DENSITY		
Kilograms per cubic meter (kg/m^3)	Pounds per cubic foot (lb/ft^3)	0.06243
CONCENTRATION		
Microgram per liter (µg/L)	Ounces per gallon (oz/gal)	1.336×10^{-7}
TEMPERATURE		
Degree Celsius (°C)	Degree Fahrenheit (°F)	1.8*(°C + 32)

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1.0 INTRODUCTION

Volume II presents the methods and results of the avian surveys and associated avian studies and modeling analyses for the New Jersey Department of Environmental Protection (NJDEP) Ocean/Wind Power Ecological Baseline Studies (EBS) project. Project location and project goals are presented in **Volume I**, **Chapter 1.0**, of this study report. Avian surveys and associated avian studies include shipboard offshore and coastal boat surveys, aerial surveys, radar surveys and studies, and predictive modeling.

The objectives of the avian coastal boat and offshore ship surveys are to determine diurnal avian species occurrence, distribution, abundance, and altitude distribution. Species occurrence data are needed to determine the presence or absence and locations of federal and state-classified, threatened, endangered, and candidate species, federal avian species of conservation concern, and state species of concern. Avian distribution and abundance data are needed to develop the avian predictive model that will determine avian abundance (densities) in the Study Area. Diurnal avian altitudinal data are used to determine the potential number of birds in the wind turbine's rotor swept zone (RSZ).

The objectives of the avian radar surveys are to identify diurnal and nocturnal altitudinal distribution of bird tracks and to determine flux (number of bird tracks moving through a set volume during a set time period) of targets below, within, and above the potential RSZ. Precise altitude distribution and flux data is needed for the RSZ to determine potential bird-turbine collision impacts. Next Generation Radar (NEXRAD) data for a five year period from nearshore and offshore sites is needed to determine migration densities between these two general potential wind power development areas and to identify weather conditions that may force birds to fly at lower altitudes (i.e., in the RSZ).

The objective of the avian predictive model is to estimate avian density data throughout the Study Area. In addition, bird density relationships between covariates (e.g., shoals, distance from shore) are needed to identify locations within the Study Area that may have lower bird densities and potential impacts.

The results of several avian studies are incorporated into an Environmental Sensitivity Index (ESI) (**Volume I: Chapter 4.0**) of the Study Area to aid offshore wind developers in selecting development sites with minimal avian environmental impacts. Predictive modeling, which includes mapping of avian densities and determination of the importance of covariates, is the primary avian data component of the ESI.

This volume is divided into 10 chapters. These chapters, including this introduction, are: Avian Shipboard Offshore and Small Boat Coastal Surveys, Offshore Aerial Surveys, Additional Avian Offshore and Onshore Surveys, Avian Radar Surveys, Thermal Imaging Vertically Pointed Radar Surveys, NEXRAD Analysis, Avian Predicative Modeling, Summary of Results, and Literature Cited. Acronyms and abbreviations and a list of metric to United States (U.S.) measurement conversions used within this volume are provided in the Table of Contents. A glossary of terms is provided at the end of the avian appendix volume.

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2.0 AVIAN SHIPBOARD OFFSHORE AND SMALL-BOAT COASTAL SURVEYS

2.1 FIELD SURVEY METHODOLOGY

2.1.1 Survey Design

2.1.1.1 Shipboard Offshore

The sampling protocol and the avian survey protocol were developed based on a review of at-sea avian standard survey methods used by American and European researchers (e.g., Camphuysen et al. 2004; Ballance 2007). A 300-meter (m) x 300-m (984-feet [ft] x 984-ft) strip transect was selected to estimate avian distribution and abundance at sea.

A 'double saw-tooth' trackline was used to maximize coverage of the Study Area (**Figure 2-1**). Ship survey line transects (tracklines) were generated monthly with the program DISTANCE (Buckland et al. 2001). Double saw-tooth lines were plotted perpendicular to the coastline from the 10-m (33-ft) isobath to the Study Area boundary, roughly 37 kilometers [km] (20 nautical miles [NM]) from the New Jersey coastline.

2.1.1.2 Small-Boat Coastal

Small-boat surveys were conducted to determine bird distribution and abundance in coastal waters that larger vessels could not access. A 300-m strip-transect method with a "single saw-tooth" sample design was implemented to survey the area. The starting location (north end or south end) for each survey was randomly determined. The entire coastal area was surveyed in one day if weather and sea state conditions allowed.

The small-boat transects were designed to cover the area between the coast and the 10-m (33-ft) isobath. Small-boat tracklines were generated after completion of the shipboard offshore surveys and incorporated the inshore termini of the shipboard offshore tracklines as the offshore termini of the small-boat tracklines (**Figure 2-1**). In instances where the shipboard offshore tracklines were incomplete, the planned inshore points were used.

2.1.2 Survey Methods

2.1.2.1 Shipboard Offshore

Tracklines were surveyed at approximately 10 knots (kts; 5 meters per second [m/s]) during daylight hours when Beaufort Sea State (BSS) was ≤5 and visibility was ≥7 km (4 NM). Between 26 and 28 tracklines, no more than 9 km (5 NM) apart, were scheduled to be surveyed per month. When weather conditions prevented completion of all tracklines in a given survey month, tracklines were spaced at intervals greater than 9 km (5 NM) apart to cover the project area from north to south.

A computer-based survey program was used to track environmental conditions throughout each survey. In addition, the computer recorded the geographic position coordinates of the ship's survey trackline.

The survey area was defined as 300 m (984 ft) ahead of the ship and 300 m (984 ft) perpendicular to one side of the ship's trackline (either the right or left side of the ship depending on which side was selected as having the least glare). When the ship changed course to investigate a marine mammal sighting, avian observers signed "off" and then "on" to separate the avian data collected on tracklines from marine mammal searches.

Survey methods were refined and improved based on reviews and subsequent consultations with the United States (U.S.) Fish and Wildlife Service (USFWS) during the first several months of the project. Changes in survey methods were documented in versions of the Avian Observer Packet (**Appendix A**).

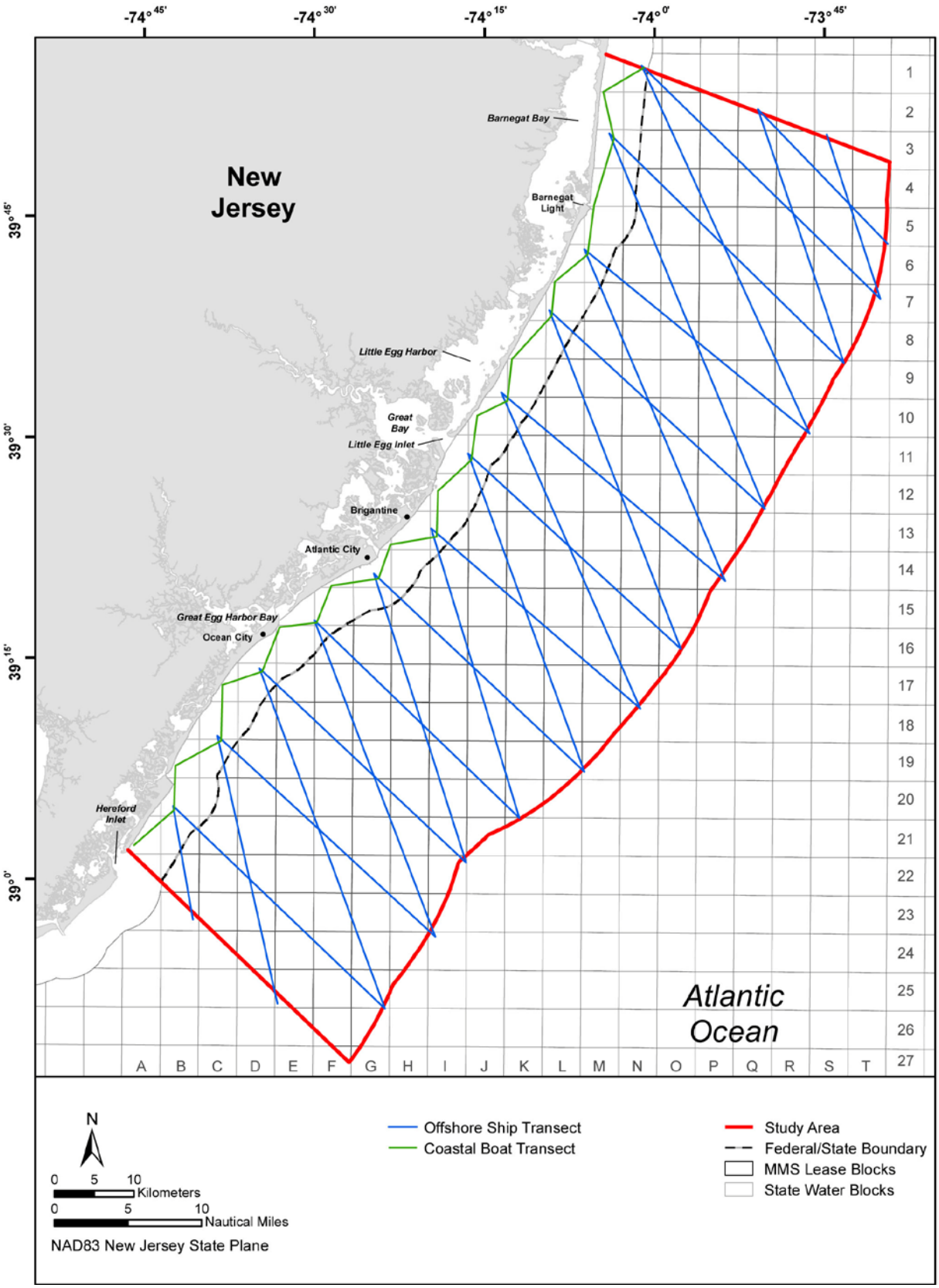

Figure 2-1. Representative double saw-tooth pattern for the shipboard line transect surveys and single saw-tooth pattern for coastal line transect avian surveys.

These three versions provide detailed descriptions of all survey methods. All noted changes were continued throughout the remainder of the study.

Initially, the avian survey team consisted of three observers rotating between two positions, one on the vessel's centerline, one on the port or starboard side (dependent on glare) of the bridge level of the ship (approximately 6 m [20 ft] above the water). The observer coverage of the Study Area from January through May 2008 was such that the observer on the vessel's centerline was responsible for surveying a 45-degree (°) area (0° to 45° or 315° to 360°) and the port/starboard biologist was responsible for surveying the remaining 45° area (45° to 90° or 280° to 315°) from the bridge level of the ship (approximately 6 m [20 ft] above the water). From June 2008 through project completion, one observer (the primary avian observer [PAO]) was responsible for the entire survey strip from the flying bridge (approximately 9 m [30 ft] above the water).

Observations were made using binoculars, scanning within the designated survey area. Sighting data were recorded for each bird observation on a hand-held computer that was synchronized to the ship's geographic positioning system (GPS). Data recorded for each observation included: the position of the observer (i.e., bow, port, or starboard), the observation time and location, species (lowest possible taxon; family, genus, or species), count (approximate number for flocks), bearing (to the nearest 5°) and range (m), estimated flight altitude in feet above sea level (ASL); 1 (skimming), 25, 50, 100, 200, 300, 500, 1,000+), and behavior (coded numerically; sitting, following the ship, feeding, piracy, other, unknown, directional flight, aimless flight, circling). Cardinal directions were used to designate flight directions (i.e., the ship's bow was considered north). Steiner© 7 X 50 binoculars equipped with a compass were used to mark bearings (in 10° increments) for each of the observer positions to increase the accuracy of bearing data and range estimation sticks specific for each observer were used to increase the accuracy of range estimates (Heinemann 1981).

In January and February 2008, the range to the bird was the perpendicular distance from the ship's track centerline to the bird. Range bins were established and included 1 to 25 m (3 to 82 ft), 26 to 50 m (85 to 164 ft), 51 to 100 m (167 to 328 ft), 101 to 200 m (331 to 656 ft), and 201 to 300 m (659 to 984 ft). Beginning in March 2008, range was redefined as the estimated distance from the observer to the bird.

The original survey protocol was modified in March 2008 to separate the avian survey area into two categories. The survey areas were defined as: 1) "in-zone": the area 300 m (984 ft) ahead by 300 m (984 ft) perpendicular to the ship's trackline (**Appendix A**) and (2) "out-zone": the area beyond the in-zone (>300 m [984 ft] from the ship). Observers gave priority to recording birds in the in-zone (the primary survey area) and recorded important birds (flocks of birds, rare species) observed in the out-zone after completing in-zone scans. Additionally in March, "observer state" (a sliding scale that rates avian observation conditions from perfect to poor) was added to the hand-held computer's data recording program. Recording of incidental avian behavior was also initiated in March with the creation of a comments section in the hand-held computer program (**Appendix A**).

The PAO ensured that the strip transect survey protocols were followed and was positioned at the front of the flying bridge on the ship's centerline. The PAO was on duty for one-hour periods before being relieved by one of the other survey team members.

A summary of data recorded:

- species (lowest possible form or taxon; standard four-letter code)
- number of individuals (or best count estimates for large flocks)
- estimated bearing (°) to the bird (the ship bow was designated as 0°)
- estimated range (m) to the bird (based on individual range estimation sticks)
- estimated flight altitude (i.e., identical to those previously discussed)
- behavior category (sitting, directional flight, non-directional flight, piracy, following the ship, and feeding)
- perceived flight direction (the bow of the ship was designated as north)

Observers opportunistically recorded the following data in the comments section:

- dive altitude (ft) of birds, especially Northern Gannet, as DIVA
- submersion time (seconds [s]) of birds after a dive (i.e., near the ship, sea state conditions permitting) as SUBT
- the life state (age, plumage, morphology) and sex of the bird (e.g., A = adult, J = juvenile, F = female)
- boat traffic observed within the survey area

The PAO contacted the off-effort observer(s; via radio) if the environmental conditions needed to be changed on the survey program or additional help was needed to record a large group of birds. When large numbers of birds were encountered, the Senior Seabird Biologist (SSB) on board called on an off-effort observer to assist with recording observations.

Because marine mammal surveys occurred simultaneously with the avian surveys, the ship deviated from the tracklines in order to identify and photograph marine mammals. In such an event the following protocol was followed:

- When the boat went off-transect to investigate a marine mammal sighting, avian data collected was considered incidental
- When the marine mammal team completed a sighting, the ship resumed course on a new heading back toward the trackline
- Avian data collection resumed following the strip-transect methodology on this new transect leg
- If an avian biologist was the first to observe a marine mammal, the observer did not point out the animal to the on-watch marine mammal observers until the mammal had passed abeam to either side of the ship

Weather data were collected up to three times per day and entered into the weather recording form found in the third version of the Avian Observer Packet (**Appendix A**). Survey conditions (e.g., cloud cover, glare, wave height) were checked and changed on the avian computer when necessary by the PAO.

2.1.2.2 Small-Boat Coastal

Field survey methods were consistent with the methods described in **Section 2.1.2.1**.

2.1.3 Data Quality Assurance

The daily survey data were downloaded to a laptop computer and reviewed by the SSB to determine if reporting errors were made; the SSB conferred with the relevant observer to resolve any errors.

2.2 DATA ANALYSIS METHODOLOGY

The survey data were checked for errors and merged with the ship's trackline (in CSV file format) to link each sighting with its time, location, and observation conditions. The merged data file was then processed to provide avian occurrence and abundance data. Data were designated as either "survey valid" or "survey not valid." A "survey valid" sighting was in-zone with the vessel moving ≥4 m/s (13 feet per second [ft/s]) and on trackline. When any of these parameters could not be precisely determined for sightings, such as when GPS errors occurred, these data were omitted from analysis.

2.2.1 Avian Occurrence

All data, "survey valid" and "survey not valid," were used to determine avian occurrence. Annual patterns, seasonal variation, and records of rare species are discussed in **Section 2.3.2**. Seasons are defined as: winter, December-February; spring, March-May; summer, June-July; and fall, August-November. Winter seasons crossed between calendar years, and winter 2008 is defined as December 2007 through

February 2008, winter 2009 as December 2008 through February 2009, and winter 2010 as December 2009.

2.2.2 Avian Distribution and Relative Abundance

Only "survey valid" data were used in the abundance analysis (birds/km) and spatial density distribution analysis (birds per square kilometer [km^2]). Data were sorted and ranked to determine the most abundant species/groups/km or km^2 within months, seasons, and years.

2.2.3 Altitude Distribution

Avian data were analyzed to determine each species'/group's frequency of occurrence within the potential RSZ, defined as 100 to 700 ft (30.5 to 213.4 m).

The dataset used for analysis of altitude distribution includes all flying birds (in-zone and incidental) recorded on shipboard offshore and small-boat coastal surveys from January 2008 through December 2009. Sightings with the following behavior categories were analyzed: directional flight, aimless flight, circling, and foraging. Sightings with the following behavior categories were omitted: piracy, following the ship, other, and unknown. All filtered sightings were sorted by species, season, and altitude. Sightings within the 200 to 1,000 ft (61.0 to 304.8 m) altitude bins (101 to 1,000 ft or 30.8 to 304.8 m) were treated as occurring in the RSZ (i.e., most sightings in the 100-ft altitude bin were actually between 75-100 ft).

2.2.4 Flight Direction

Analysis of flight direction is a useful technique for quantifying the movement of birds within an area and determining species preferences. For example, during fall and spring, some migratory species that migrate nearshore or offshore usually exhibit a tendency to fly north and south, but the actual mean flight angle may be related to the shape of the nearby coastline. Moreover, coastal-breeding species such as Herring Gull (*Larus argentatus*), Laughing Gull (*Leucophaeus atricillus*), and Common Tern (*Sterna hirundo*), may exhibit a strong directional preference when moving to and from colonies to foraging locations.

Instantaneous flight direction for birds observed flying was determined from observer data collected during the shipboard and coastal strip-transect surveys. These data were analyzed to estimate the mean and median flight angles and to investigate if birds in general exhibited a common flight direction (i.e., inshore to offshore or north and south) or whether different species showed a preference for traveling through the Study Area.

2.2.4.1 Data Analysis

A suite of circular statistics (flight directional data are distributed on a compass) to estimate the mean and median flight angles were performed to determine the nature of bird flight directions and their variability with respect to species, taxonomic group, month, and season. The hypothesis tests whether the flight directions exhibit circular uniformity (i.e., a random distribution of direction) or exhibit a mean angle (i.e., favoring a particular direction); both overall as well as for a given species, group, month, and season. For example, it may be feasible for one avian species to exhibit circular uniformity, whereas another species may exhibit a mean flight direction that may change from month to month or from season to season, reflecting, for example, seasonal flight migration patterns. This analysis is potentially important for subsequent calculations of avian mortality, since the collision rate of birds with the wind turbine blades depends on the relative directional orientation between the birds and blades.

The following statistical analyses and tests were completed to analyze flight direction data: Descriptive statistics**,** tests for circular uniformity including the Rayleigh Test and V-Test for significance of the mean angle (unimodal distribution); Hodges-Ajne, and Batschelet Omnibus tests for significance of the median angle (unimodal, bimodal, and multi-modal distributions), test for significance of the median (flight) angle (Binomial test) and test for symmetry around the median angle (Non-parametric Wilcox on paired-

sampled [signed-rank] test; Goodness-of-Fit (GOF) testing for circular distributions: Non-parametric chi-square (X^2) test, Watson's 1-sample U^2 test, Kolmogorov-Smirnov (K-S) test, and Kuiper's test. These statistics and test methods are discussed in detail in **Appendix B**.

2.3 AVIAN SURVEY RESULTS

Maps of monthly distribution and relative abundance for total birds are presented in **Appendix C: Figures C-1** through **C-25**. Distributional maps of the top five most abundant species (all behaviors) are presented in **Appendix C: Figures C-26** through **C-185**. Additional abundance and distribution maps of all-behavior and sitting birds can be found in **Appendix C: Figures C-186** through **C-412**. Bird altitude histograms are shown in **Appendix D**. Statistical analysis for avian flight direction is provided in **Appendix E** and detailed species accounts for the most abundant species are presented in **Appendix F: Figures F-1** through **F-63**. A summary of avian quality assurance/quality control (QA/QC) procedures and avian observer efficiency results are presented in **Appendix G** and incidental data is provided in **Appendix H**.

2.3.1 Survey Effort

Avian shipboard offshore surveys were conducted January 2008 through December 2009 (**Figure 2-2**; see **Volume III: Section 5.1.2**). A total of 15,483 km of trackline was surveyed. Small-boat coastal surveys were conducted each month after completion of the shipboard offshore survey and a total 2,700 km of trackline was surveyed (**Figure 2-2**; **Table 2-1**). February 2008 and December 2009 data are not included in the total due to low amounts of effort caused by poor weather conditions: <240 km of trackline were run in each month (152 in February 2008, 236 in December 2009). These were the only months in which <353 km of trackline were sampled in a period when, otherwise, an average of 737 km of trackline was surveyed (range of 353-1,003 km). No surveys were conducted during July 2009, which fell between the study's original completion date and the start of the six-month extension.

2.3.2 Avian Occurrence

A total of 176,217 birds representing 153 species were recorded from January 2008 through December 2009, with 84,428 birds of 145 species being recorded during the shipboard offshore surveys and 91,789 birds of 82 species recorded during the small-boat coastal surveys. These totals combine both "survey valid" (n = 78,391; 44.5%) and "survey not valid" (n = 97,826; 55.5%) In 2008, 122 species ("survey valid", n = 40,815) were recorded, while 123 species ("survey valid", n = 47,620) were recorded in 2009 (**Table 2-2**). Because of the high numbers of individuals and species, the data was analyzed to determine the five most abundant species for each month, season, and year. Data for the most abundant species per season and year are shown below. All monthly information can be found in **Appendix C** and **F**.

2.3.2.1 Cumulative

Although the total bird species recorded in each year were very similar, the assemblage of species observed varied between years. As expected, common species were recorded in both years, while rarer species tended to be absent in an individual year. Only Black Scoter (*Melanitta nigra*) ranked as one of the five most abundant species for a season in one year (fall 2008) but failed to rank in the top 10 for that season in the other year (fall 2009). Even this was likely due to the fact that no surveys were conducted from mid-October to mid-November 2009, the species' peak fall migration period. There were 49 species recorded in only one of the two years, with shorebirds (Charadriiformes), songbirds (Passeriformes), and other non-marine species comprising the large majority of these (**Table 2-2** which also provides scientific names of all avian species recorded during the study).

The shipboard offshore and small-boat coastal surveys recorded different assemblages of birds. The difference is attributed to more tubenose (Procellariiformes), shorebird, alcid (Alcidae), and songbird species recorded during offshore surveys. This difference is explained by the offshore and pelagic foraging needs of shearwaters, storm-petrels, phalaropes, and alcids; the wide-ranging movements of

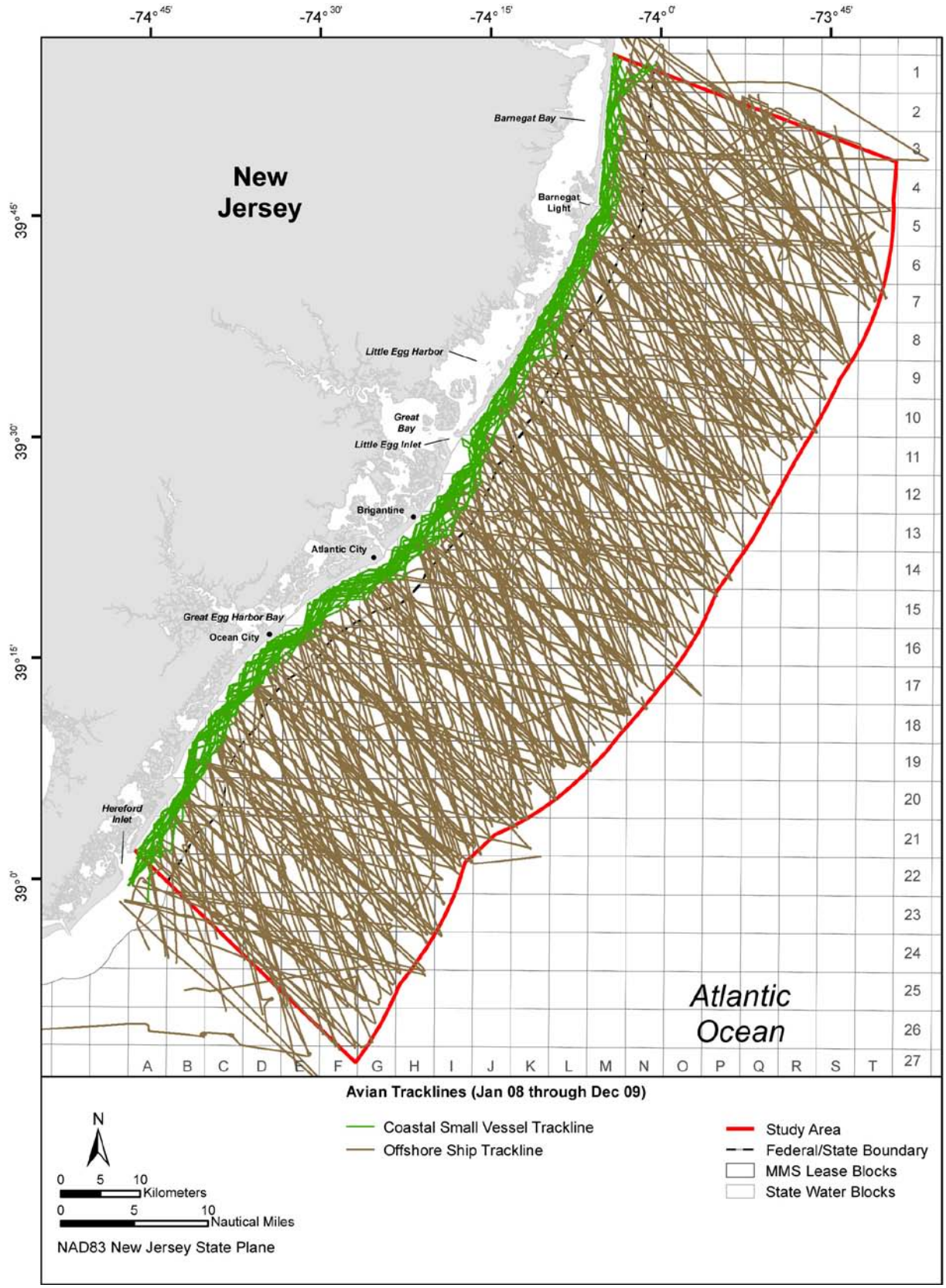

Figure 2-2. Offshore and coastal tracklines, January 2008 - December 2009.

Table 2-1. Survey effort for shipboard offshore and small-boat coastal surveys, January 2008-November 2009.

Season	Survey	Hours	Nautical Miles (NM)	Kilometers (km)	Start and End Dates of Monthly Shipboard Surveys[2]
Winter 2008	Ship	30.18	285.29	528.36	15-18 January
	Boat	6.46	62.28	115.34	
Spring 2008	Ship	123.25	1,203.00	2,227.96	07-14 March; 09-14 April; 07-11 May
	Boat	18.62	190.68	353.14	
Summer 2008	Ship	91.78	890.23	1,648.71	13-16 June; 13-16 July
	Boat	10.86	106.24	196.76	
Fall 2008	Ship	174.65	1,691.30	3,132.29	11-14 August; 12-16 September; 13-17 October; 11-17 November
	Boat	26.46	271.94	503.63	
Winter 2009	Ship	111.31	1,089.03	2,016.88	09-14 December; 06-14 January; 08-16 February
	Boat	23.97	248.50	460.22	
Spring 2009	Ship	121.82	1,162.18	2,152.36	11-16 March; 07-10 April; 02-06 May
	Boat	21.82	218.92	405.44	
Summer 2009	Ship	45.30	422.16	781.84	02-06 June
	Boat	6.95	69.00	127.79	
Fall 2009	Ship	171.80	1,616.77	2,994.26	01-05 August; 30 August - 03 September; 28 September - 02 October; 09-22 November
	Boat	27.03	290.24	537.52	
TOTAL	**Ship**	**870.09**	**8,359.96**	**15,482.65**	
	Boat	**142.17**	**1,457.80**	**2,699.85**	

[1] February 2008 and December 2009 survey efforts are not included due to weather-induced minimal effort; no July 2009 survey was planned.

[2] Column presents only shipboard dates; small-boat coastal surveys were conducted as soon as weather and boat availability allowed after the end of that month's shipboard offshore survey.

shorebirds; and the regular occurrence of songbirds in the offshore zone during migration. A number of bird species that are regionally rare or that are poorly known to the Study Area (Walsh et al. 1999) were recorded during avian surveys and include: Northern Fulmar, Audubon's Shearwater, Leach's Storm-Petrel, Sabine's Gull, Common Murre, Black Guillemot, and Atlantic Puffin. These species were found only during offshore surveys.

2.3.2.2 Seasonal

Conditions and factors that affect species diversity among years and seasons are many and varied. Small sample size of the rarer species is a major reason for the variance in species diversity between years. Finally, differences in timing of surveys within a given month/season caused additional difficulties in assigning species to patterns of occurrence. Survey vessel availability and, to a lesser extent, periods of bad weather were the causes for these difficulties. For example, the last date of the October 2009 shipboard offshore survey was the 3rd, while the first date of the October 2008 survey was the 13th (**Table 2-1**). The intervening ten days are a time of transition from early migration in which Double-crested Cormorant comprises the bulk of the flight to nearly the peak of diversity, which usually falls in mid- to late October (Sibley 1997; Cape May Bird Observatory unpubl. data). Additionally, the November survey in 2009 did not start until the 19th (**Table 2-1**), thus the fall 2009 dataset includes no effort from the peak of the massive southbound waterbird migration, particularly the immense movement of scoters (Sibley 1997). Detailed seasonal occurrence information for the more abundant species is found in **Appendix F.**

Table 2-2. Occurrence in Study Area, by season, January 2008 to November 2009.

										Number of months detected			
		2008				2009[1]				2008		2009	
Common Name	Scientific Name	W	SP	S	F	W	SP	S	F	Ship	Coastal	Ship	Coastal
Snow Goose	*Chen caerulescens*		X[s]		X[c]	X[c]				1	1	0	1
Brant	*Branta bernicla*	X[s]	X		X	X[c]	X		X[c]	3	3	3	6
Canada Goose	*Branta canadensis*		X		X	X[c]			X[c]	3	4	0	1
Tundra Swan	*Cygnus columbianus*				X[s]					1	2	0	1
Wood Duck	*Aix sponsa*				X	X	X		X[c]	1	1	1	0
Gadwall	*Anas strepera*			X[c]	X					2	1	0	0
American Wigeon	*Anas americana*								X[c]	0	0	0	1
American Black Duck	*Anas rubripes*		X		X	X	X[s]		X	5	3	2	4
Mallard	*Anas platyrhynchos*		X[c]		X					1	3	0	0
Northern Shoveler	*Anas clypeata*		X[c]							0	1	0	0
Northern Pintail	*Anas acuta*		X		X	X[s]			X	3	2	2	1
Green-winged Teal	*Anas crecca*		X		X				X[c]	4	1	0	1
Greater Scaup	*Aythya marila*				X	X[c]				1	3	0	2
Lesser Scaup	*Aythya affinis*				X[c]	X[c]				0	1	0	1
Common Eider	*Somateria mollissima*				X[s]		X[c]		X[c]	1	0	0	2
Surf Scoter	*Melanitta perspicillata*	X	X	X	X	X	X		X	7	9	6	5
White-winged Scoter	*Melanitta fusca*	X	X		X	X	X		X[s]	6	6	6	3
Black Scoter	*Melanitta nigra*	X	X		X	X	X		X	7	5	6	7
Long-tailed Duck	*Clangula hyemalis*	X	X		X	X	X		X[c]	5	4	4	5
Bufflehead	*Bucephala albeola*	X[c]	X[s]		X[c]				X[c]	1	3	0	1
Common Goldeneye	*Bucephala clangula*	X[c]	X[c]		X[s]	X[c]				1	2	0	2
Red-breasted Merganser	*Mergus serrator*	X[c]	X[s]		X	X	X		X	5	4	4	4
Ruddy Duck	*Oxyura jamaicensis*				X[c]	X[c]				0	1	0	1
Red-throated Loon	*Gavia stellata*	X	X		X	X	X		X	7	7	6	6
Common Loon	*Gavia immer*	X	X	X	X	X	X	X[s]	X	10	8	8	7
Pied-billed Grebe	*Podilymbus podiceps*				X[s]					1	0	0	0
Horned Grebe	*Podiceps auritus*		X			X				2	2	2	2
Red-necked Grebe	*Podiceps grisegena*	X[s]	X[s]			X	X[s]			1	0	2	1
Northern Fulmar	*Fulmarus glacialis*					X[s]				0	0	1	0
Cory's Shearwater	*Calonectris diomedea*			X[s]	X[s]			X[s]	X[s]	6	0	3	0

Table 2-2 (*continued*). Occurrence in Study Area, by season, January 2008 to November 2009.

										Number of months detected			
		2008				2009[1]				2008		2009	
Common Name	**Scientific Name**	**W**	**SP**	**S**	**F**	**W**	**SP**	**S**	**F**	**Ship**	**Coastal**	**Ship**	**Coastal**
Greater Shearwater	*Puffinus gravis*			X[s]	X[s]			X[s]	X[s]	2	0	4	0
Sooty Shearwater	*Puffinus griseus*			X[s]			X[c]	X[s]	X[s]	1	0	3	1
Manx Shearwater	*Puffinus puffinus*		X[s]	X[s]		X[s]	X[s]		X[s]	3	0	2	0
Audubon's Shearwater	*Puffinus lherminieri*				X[s]					1	0	0	0
Wilson's Storm-Petrel	*Oceanites oceanicus*			X[s]	X[c]			X	X	5	0	3	3
Leach's Storm-Petrel	*Oceanodroma leucorhoa*				X[s]				X[s]	1	0	1	0
Northern Gannet	*Morus bassanus*	X	X	X	X	X	X	X	X	11	11	10	10
Brown Pelican	*Pelecanus occidentalis*			X	X				X	2	4	3	3
Double-crested Cormorant	*Phalacrocorax auritus*		X	X	X	X	X	X[s]	X	8	8	6	7
Great Cormorant	*Phalacrocorax carbo*		X[c]		X	X[c]	X[c]		X[c]	1	4	0	3
Great Blue Heron	*Ardea herodias*		X		X	X[c]	X[c]		X	5	4	1	3
Great Egret	*Ardea alba*			X[c]	X[c]		X			0	2	2	1
Snowy Egret	*Egretta thula*								X[c]	0	0	1	0
Green Heron	*Butorides virescens*								X[c]	0	0	0	1
Black-crowned Night-Heron	*Nycticorax nycticorax*			X[s]						1	0	0	0
Yellow-crowned Night-Heron	*Nyctanassa violacea*		X[s]		X[s]					2	0	0	0
Turkey Vulture	*Cathartes aura*		X[s]							1	0	0	0
Osprey	*Pandion haliaetus*		X	X[c]	X		X[c]	X	X	4	6	3	7
Bald Eagle	*Haliaeetus leucocephalus*	X[c]								0	1	0	0
Northern Harrier	*Circus cyaneus*		X			X[c]	X[s]			1	1	1	1
Merlin	*Falco columbarius*		X[c]		X[s]		X[s]		X	1	1	2	1
Peregrine Falcon	*Falco peregrinus*				X[s]	X			X	2	1	1	1
American Coot	*Fulica americana*				X[s]	X[s]			X[c]	2	0	0	1
Black-bellied Plover	*Pluvialis squatarola*						X[s]			0	0	1	0
Semipalmated Plover	*Charadrius semipalmatus*				X[c]				X[c]	0	2	0	1
American Oystercatcher	*Haematopus palliatus*	X[c]	X		X[c]					1	4	0	0
Greater Yellowlegs	*Tringa melanoleuca*						X[s]		X[c]	0	0	1	1
Willet	*Tringa semipalmata*								X[s]	0	0	1	0
Lesser Yellowlegs	*Tringa flavipes*						X[s]			0	0	1	0
Whimbrel	*Numenius phaeopus*			X[c]					X[s]	0	1	2	0

Table 2-2 (*continued*). Occurrence in Study Area, by season, January 2008 to November 2009.

										Number of months detected			
		2008				2009[1]				2008		2009	
Common Name	**Scientific Name**	**W**	**SP**	**S**	**F**	**W**	**SP**	**S**	**F**	**Ship**	**Coastal**	**Ship**	**Coastal**
Marbled Godwit	*Limosa fedoa*			X[s]						1	0	0	0
Ruddy Turnstone	*Arenaria interpres*		X[c]			X[c]			X[s]	0	2	1	0
Sanderling	*Calidris alba*	X[c]	X[c]	X[c]	X	X[c]	X		X	1	8	3	4
Semipalmated Sandpiper	*Calidris pusilla*		X[c]		X				X	1	2	1	1
Least Sandpiper	*Calidris minutilla*		X[s]	X[s]	X		X[s]		X[s]	3	1	3	0
White-rumped Sandpiper	*Calidris fuscicollis*		X[s]							1	0	0	0
Pectoral Sandpiper	*Calidris melanotos*			X[s]	X[s]				X[s]	2	0	1	0
Purple Sandpiper	*Calidris maritima*					X[c]				0	1	0	1
Dunlin	*Calidris alpina*		X[s]		X	X[c]	X			2	4	1	2
Short-billed Dowitcher	*Limnodromus griseus*						X[s]		X[c]	0	0	1	1
American Woodcock	*Scolopax minor*				X[s]					1	0	0	0
Red-necked Phalarope	*Phalaropus lobatus*				X[s]			X[s]	X[s]	1	0	2	0
Red Phalarope	*Phalaropus fulicarius*		X[s]		X[s]				X[s]	2	0	1	0
Black-legged Kittiwake	*Rissa tridactyla*	X[s]				X[s]			X[s]	2	0	3	0
Sabine's Gull	*Xema sabini*				X[s]				X[s]	1	0	1	0
Bonaparte's Gull	*Chroicocephalus philadelphia*	X	X		X	X	X[s]		X	5	5	6	2
Little Gull	*Hydrocoloeus minutus*		X[s]		X[s]					2	0	0	0
Laughing Gull	*Leucophaeus atricilla*		X	X	X		X	X	X	9	9	8	7
Ring-billed Gull	*Larus delawarensis*	X[c]	X		X	X	X[c]		X	4	8	4	6
Herring Gull	*Larus argentatus*	X	X	X	X	X	X	X	X	11	11	10	10
Iceland Gull	*Larus glaucoides*				X[s]	X[s]	X[c]			1	0	1	1
Lesser Black-backed Gull	*Larus fuscus*		X[s]		X		X[s]		X[s]	5	1	3	0
Great Black-backed Gull	*Larus marinus*	X	X	X	X	X	X	X	X	11	11	10	10
Least Tern	*Sternula antillarum*		X				X[c]	X[s]	X[c]	1	1	1	2
Caspian Tern	*Hydroprogne caspia*		X		X				X[c]	3	1	0	2
Black Tern	*Chlidonias niger*				X[s]					1	0	0	0
Common Tern	*Sterna hirundo*		X	X	X		X	X	X	7	5	4	5
Forster's Tern	*Sterna forsteri*		X	X	X		X	X	X	8	8	5	7
Royal Tern	*Thalasseus maximus*		X	X	X				X	8	6	3	3
Sandwich Tern	*Thalasseus sandvicensis*				X[c]				X[c]	0	1	0	1

Table 2-2 (*continued*). Occurrence in Study Area, by season, January 2008 to November 2009.

										Number of months detected			
		2008				2009[1]				2008		2009	
Common Name	Scientific Name	W	SP	S	F	W	SP	S	F	Ship	Coastal	Ship	Coastal
Pomarine Jaeger	*Stercorarius pomarinus*								X[s]	0	0	1	0
Parasitic Jaeger	*Stercorarius parasiticus*			X[s]	X[s]		X[s]	X[s]		4	0	2	0
Dovekie	*Alle alle*	X[s]	X[s]			X[s]	X[s]			3	0	4	0
Common Murre	*Uria aalge*					X[s]	X[s]			0	0	2	0
Thick-billed Murre	*Uria lomvia*		X[s]			X[s]	X[s]			1	0	2	0
Razorbill	*Alca torda*	X	X			X[s]	X[s]			4	3	4	0
Black Guillemot	*Cepphus grylle*		X[s]							1	0	0	0
Atlantic Puffin	*Fratercula arctica*					X[s]				0	0	1	0
Rock Pigeon	*Columba livia*		X	X			X[c]			3	2	0	1
Mourning Dove	*Zenaida macroura*		X		X[c]		X[s]			2	2	1	0
Chimney Swift	*Chaetura pelagica*				X[c]		X[s]	X[s]		0	1	2	0
Ruby-throated Hummingbird	*Archilochus colubris*						X[s]			0	0	1	0
Northern Flicker	*Colaptes auratus*		X[s]		X				X[s]	3	1	1	0
Empidonax flycatcher (unknown)	*Empidonax sp*							X[s]		0	0	1	0
American Crow	*Corvus brachyrhynchos*		X[s]							1	0	0	0
Fish Crow	*Corvus ossifragus*		X			X[c]	X[c]			1	2	0	2
Purple Martin	*Progne subis*			X	X				X[s]	2	2	2	0
Tree Swallow	*Tachycineta bicolor*		X[c]	X[c]	X		X[s]		X	1	3	2	1
Bank Swallow	*Riparia riparia*			X[s]	X[c]				X[s]	1	1	1	0
Barn Swallow	*Hirundo rustica*		X	X	X		X	X[s]	X	3	3	3	3
Brown Creeper	*Certhia americana*		X						X[s]	1	1	1	0
Winter Wren	*Troglodytes troglodytes*								X[s]	0	0	1	0
Marsh Wren	*Cistothorus palustris*				X[s]					1	0	0	0
Golden-crowned Kinglet	*Regulus satrapa*				X[s]					1	0	0	0
Wood Thrush	*Hylocichla mustelina*						X[s]			0	0	1	0
American Robin	*Turdus migratorius*		X[s]							1	0	0	0
Gray Catbird	*Dumetella carolinensis*						X[s]			0	0	1	0
Northern Mockingbird	*Mimus polyglottos*						X[s]			0	0	1	0
Brown Thrasher	*Toxostoma rufum*						X[s]			0	0	1	0
European Starling	*Sturnus vulgaris*				X[s]		X[s]			1	0	1	0

Table 2-2 (*continued*). Occurrence in Study Area, by season, January 2008 to November 2009.

										Number of months detected			
		2008				2009[1]				2008		2009	
Common Name	Scientific Name	W	SP	S	F	W	SP	S	F	Ship	Coastal	Ship	Coastal
Northern Parula	*Parula americana*				X[s]		X[s]			1	0	1	0
Yellow Warbler	*Dendroica petechia*								X[s]	0	0	1	0
Magnolia Warbler	*Dendroica magnolia*						X[s]			0	0	1	0
Yellow-rumped Warbler	*Dendroica coronata*		X[s]		X[s]		X[s]			3	0	1	0
Black-throated Green Warbler	*Dendroica virens*				X[s]					1	0	0	0
Palm Warbler	*Dendroica palmarum*				X[s]					2	0	0	0
Blackpoll Warbler	*Dendroica striata*								X[s]	0	0	1	0
American Redstart	*Setophaga ruticilla*		X[s]						X[s]	1	0	2	0
Prothonotary Warbler	*Protonotaria citrea*				X[s]				X[s]	1	0	1	0
Ovenbird	*Seiurus aurocapilla*						X[s]		X[s]	0	0	2	0
Northern Waterthrush	*Seiurus noveboracensis*								X[s]	0	0	1	0
Mourning Warbler	*Oporornis philadelphia*				X[s]					1	0	0	0
Common Yellowthroat	*Geothlypis trichas*				X[s]				X[s]	1	0	1	0
Yellow-breasted Chat	*Icteria virens*						X[s]		X[s]	0	0	2	0
Eastern Towhee	*Pipilo erythrophthalmus*		X[c]							0	1	0	0
Field Sparrow	*Spizella pusilla*								X[s]	0	0	1	0
Vesper Sparrow	*Pooecetes gramineus*		X[s]							1	0	0	0
Song Sparrow	*Melospiza melodia*		X[s]		X[s]		X[s]			4	0	2	0
Swamp Sparrow	*Melospiza georgiana*				X[s]					1	0	0	0
White-throated Sparrow	*Zonotrichia albicollis*		X[s]		X[s]		X[s]			2	0	1	0
Dark-eyed Junco	*Junco hyemalis*		X[s]		X[s]		X[s]			2	0	1	0
Scarlet Tanager	*Piranga olivacea*								X[c]	0	0	0	1
Rose-breasted Grosbeak	*Pheucticus ludovicianus*						X[s]			0	0	1	0
Indigo Bunting	*Passerina cyanea*						X[s]			0	0	1	0
Red-winged Blackbird	*Agelaius phoeniceus*		X		X[s]		X[s]			4	2	1	0
Eastern Meadowlark	*Sturnella magna*		X[s]		X[s]					2	0	0	0
Boat-tailed Grackle	*Quiscalus major*		X[c]	X[c]		X[c]	X[c]			0	3	0	2
Brown-headed Cowbird	*Molothrus ater*				X[s]		X[s]		X[s]	1	0	3	0
Orchard Oriole	*Icterus spurius*						X[s]			0	0	1	0
Baltimore Oriole	*Icterus galbula*								X[s]	0	0	2	0

Table 2-2 (*continued*). Occurrence in Study Area, by season, January 2008 to November 2009.

										Number of months detected			
		2008				2009[1]				2008		2009	
Common Name	**Scientific Name**	**W**	**SP**	**S**	**F**	**W**	**SP**	**S**	**F**	**Ship**	**Coastal**	**Ship**	**Coastal**
House Finch	*Carpodacus mexicanus*				X[s]					1	0	0	0
Pine Siskin	*Spinus pinus*				X[s]					1	0	0	0
American Goldfinch	*Spinus tristis*		X[s]		X[s]					2	0	0	0

W= Winter; SP = Spring; S= Summer; F = Fall

[1] Winter 2009 is actually comprised of December 2008 and January and February 2009; the numbers in the column labeled 2009 are for the calendar year.

[s] Species was only recorded on shipboard offshore surveys

[c] Species was only recorded on small boat coastal surveys

2.3.3 Avian Distribution and Relative Abundance

Total avian abundance and distribution (all birds, all behaviors for the study) is presented in **Figure 2-3**. Avian distribution and relative abundance is discussed for cumulative (total birds), seasonal (total birds) and seasonally for the top five species.

2.3.3.1 Cumulative (Yearly; Total Birds)

The distribution and abundance of birds (all behaviors) in 2008 was similar to sitting birds, but with a coastward shift of abundance of sitting birds (**Figures 2-4** and **2-5**). A coastward shift was not apparent in 2009 (**Figures 2-6** and **2-7**). Due to the similar distribution and abundance of bird detections of all behaviors versus those of sitting birds, data and maps presented herein are for all behaviors, except in those instances in which there are notable differences.

Generally, areas of highest abundance were restricted to inshore waters, with the highest abundance (above the 80th percentile) either wholly or partially inside the state boundary (**Figures 2-4** and **2-6**). In 2008, 86% (39 of 45 grid blocks in the 80th percentile shown in the figures) of the highest avian density were inshore (**Figure 2-4**), while 89% (41 of 46 80th percentile grid blocks) were inshore in 2009 (**Figure 2-6**). Interestingly, only block E18, southeast of Ocean City, was in the 80th percentile for abundance for all years and behaviors (**Figures 2-4** through **2-7**). Overall, highest avian abundances were recorded south and east of Hereford Inlet, south and east of Ocean City, south and east of Atlantic City. Offshore, avian abundances were consistently high throughout the survey period at block R6. This block contains a shoal area that, in general, hosted relatively large numbers of birds during the whole course of the project (**Figure 2-8**). Further details of avian abundance and distribution are discussed in **Section 2.3.3.2** and in the species accounts located in **Appendix F**.

2.3.3.2 Seasonal (Total Birds)

Summary maps of eight seasons (two each of winter, spring, summer, and fall are presented in **Figures 2-9** through **2-16**. In winter 2008, only one month's data were included in the map because field efforts were not initiated until January 2008 and weather precluded surveys in February 2008. Summer of 2009 contains data from only one month, as no surveys were scheduled in July 2009. Survey efforts in December 2009 were minimal due to weather, which is the only month representing winter 2010; therefore those data are shown only in the monthly maps in **Appendix C**.

Comparisons of avian distribution and abundance between the two winter seasons (**Figures 2-9** and **2-13**) are hampered by the limited data obtained in winter 2008. Among winters there were 41 blocks of highest abundance. Only two (4.9%) of these blocks were offshore, both in winter 2009. Highest avian densities in the two springs (**Figures 2-10** and **2-14**) were shifted offshore relative to the winter seasons (**Figures 2-9** and **2-13**). Spring 2009 had higher avian densities than spring 2008. Grid blocks with the highest avian abundances during both spring seasons were similar offshore (25% of all high density blocks in 2008 and 29% in 2009); however, in spring 2008 the higher abundances were in the middle and northern portions of the Study Area and more widespread throughout in spring 2009.

High avian densities shifted more offshore during the summer seasons, compared to winter and spring seasons (**Figures 2-11** and **2-15**). For example, 47% (17 of 36) of the highest abundance grid blocks in 2008 and 68% (20 of 30) in 2009 were in offshore waters.

Patterns of abundance in the two fall seasons (**Figures 2-12** and **2-16**) were similar though with a distinct northward shift of abundance in fall 2009 relative to that of fall 2008. This difference is primarily attributable to lower avian observations in the northeast corner of the Study Area in fall 2008. Offshore densities were lower in the fall than the summer seasons, with 15% of all high abundance grid blocks offshore in fall 2008 and 21% in fall 2009.

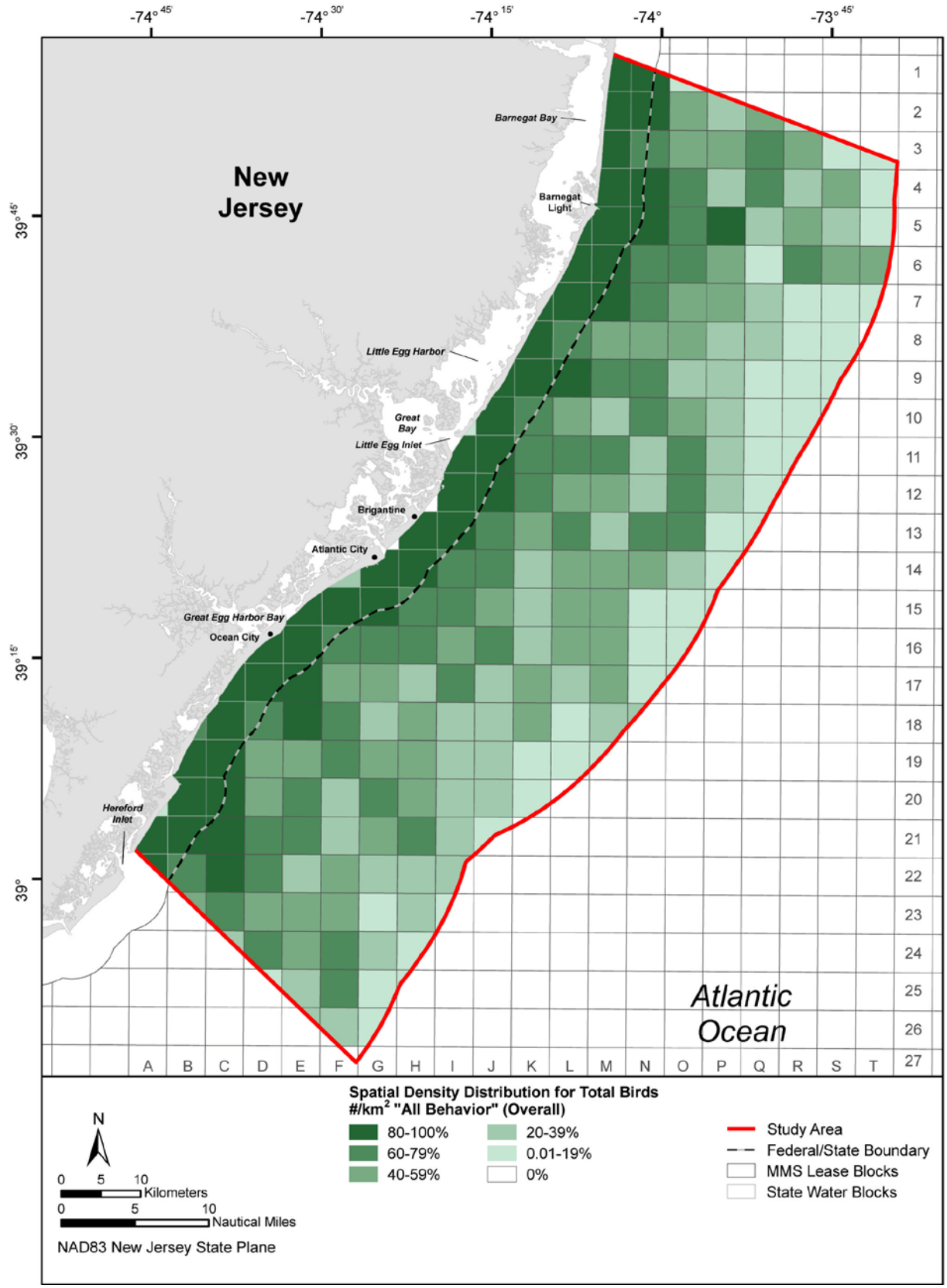

Figure 2-3. Percentile abundance for all birds (all behaviors), January 2008-November 2009 (n=64,887).

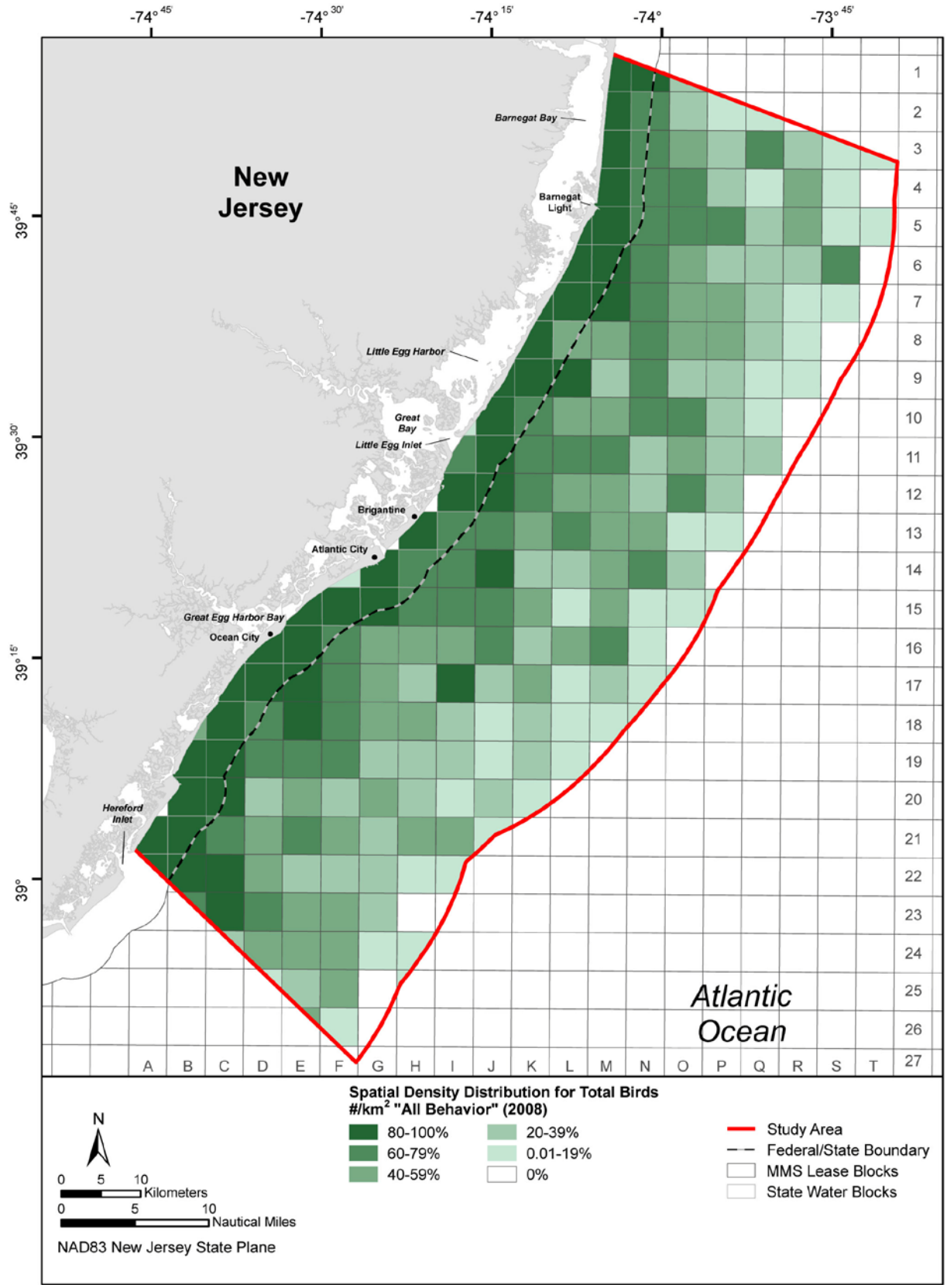

Figure 2-4. Percentile abundance for all birds (all behaviors), January-December 2008 (n=32,959).

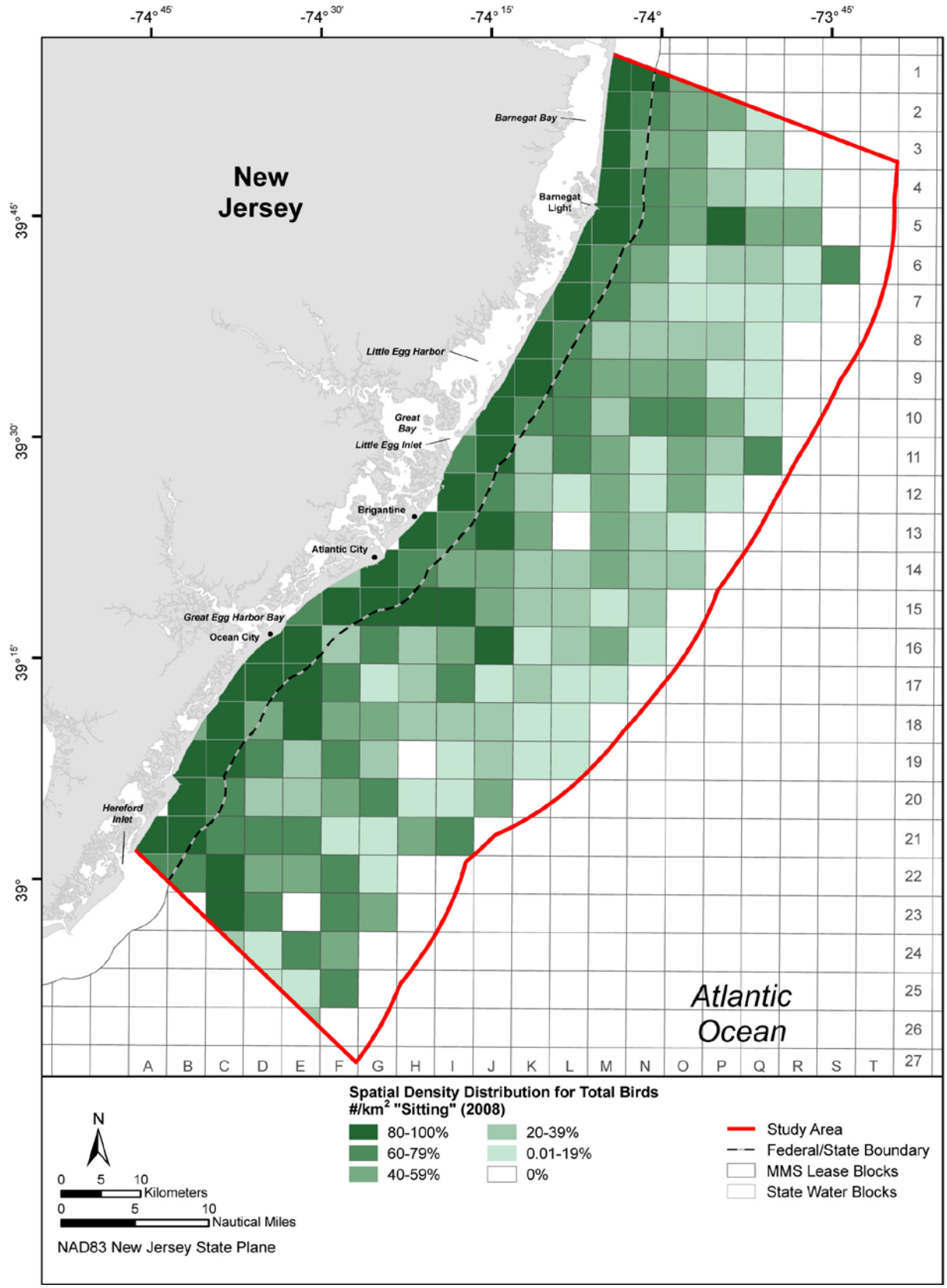

Figure 2-5. Percentile abundance for all birds (sitting), January-December 2008 (n=7,716).

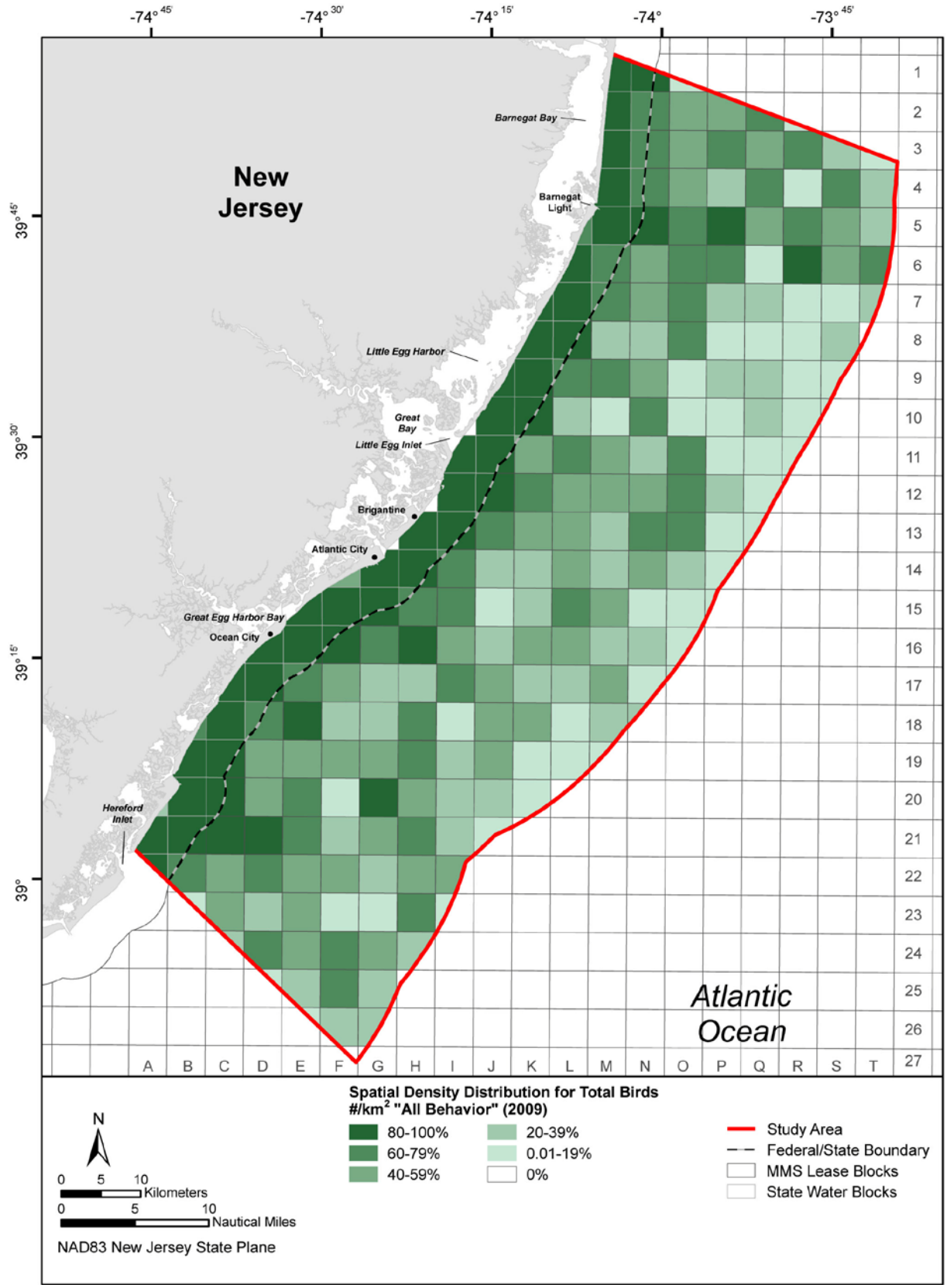

Figure 2-6. Percentile abundance of all birds (all behaviors), January-November 2009 (n=33,320).

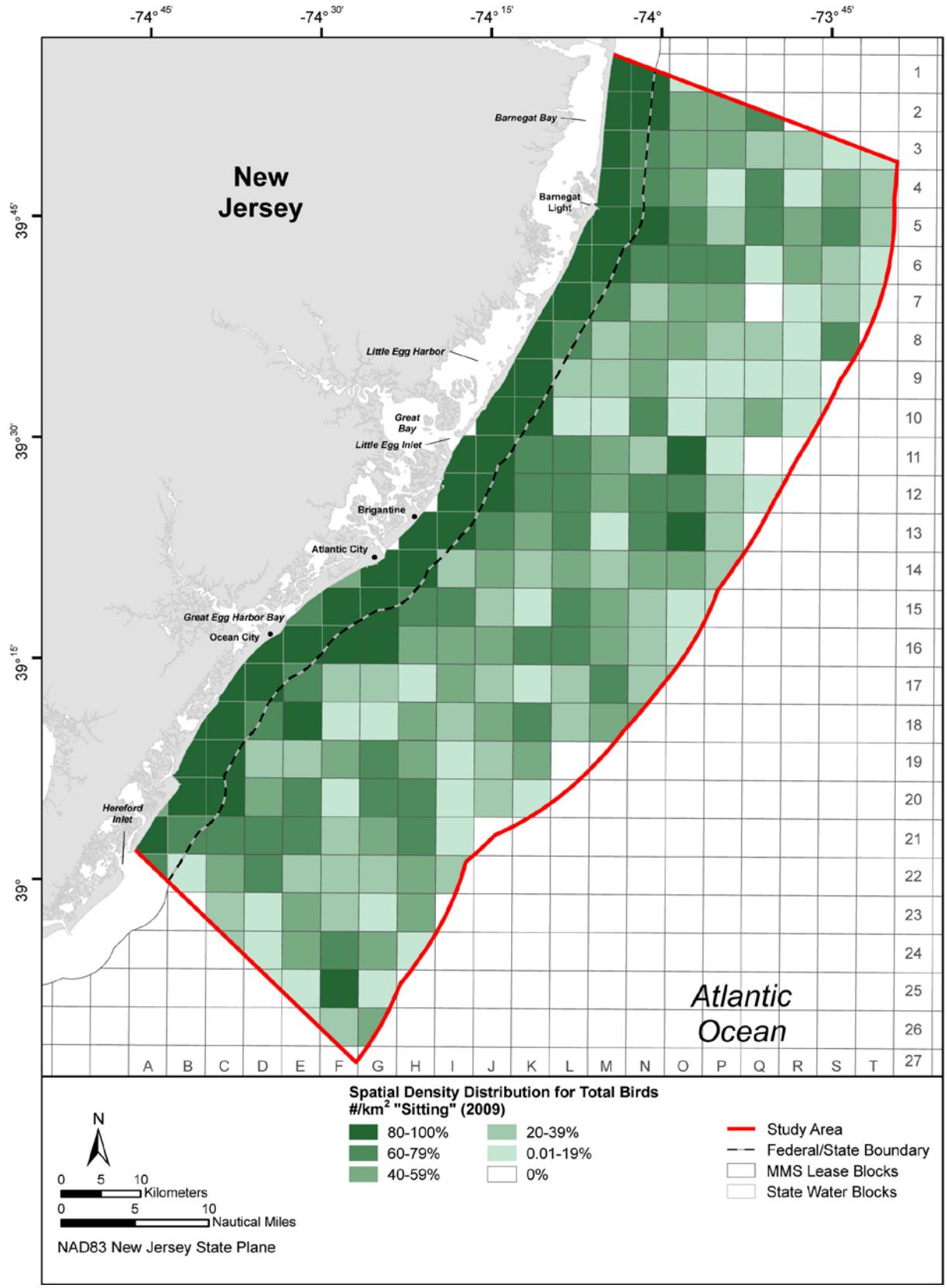

Figure 2-7. Percentile abundance by block of all birds (sitting), January-November 2009 (n=16,084).

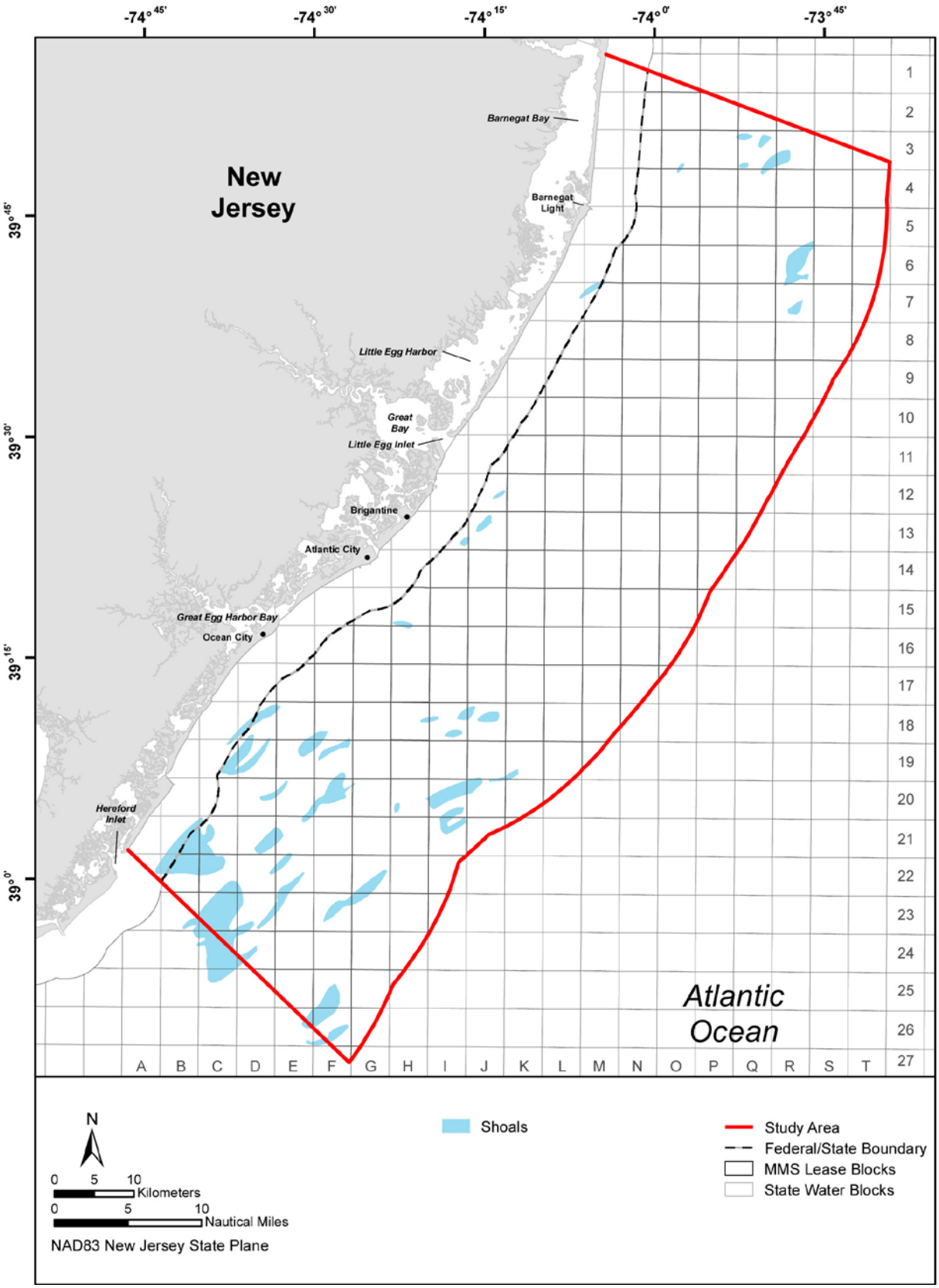

Figure 2-8. Shoal areas in the Study Area.

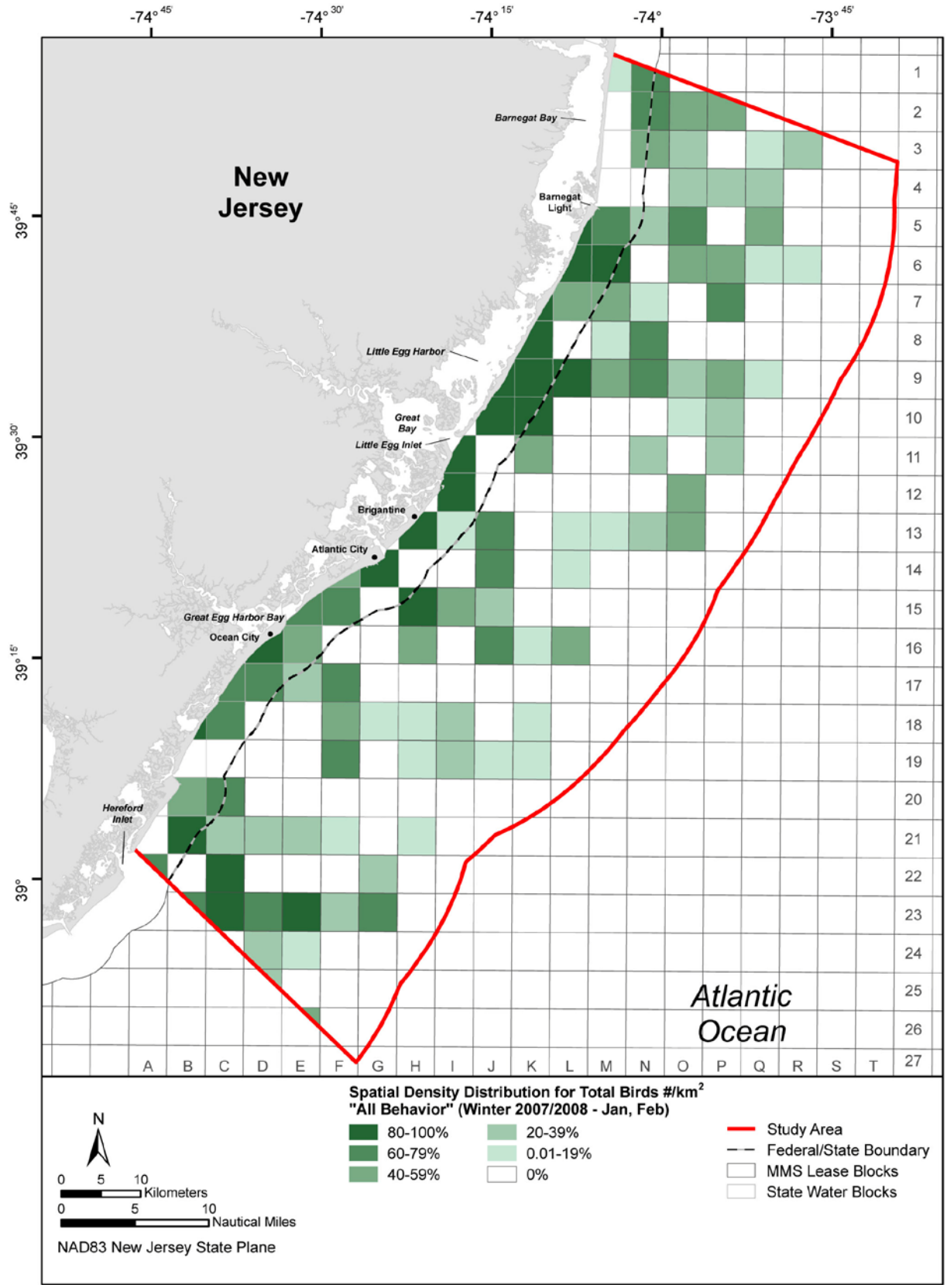

Figure 2-9. Percentile abundance of all birds (all behaviors), Winter 2008 (January 2008; n=2,435).

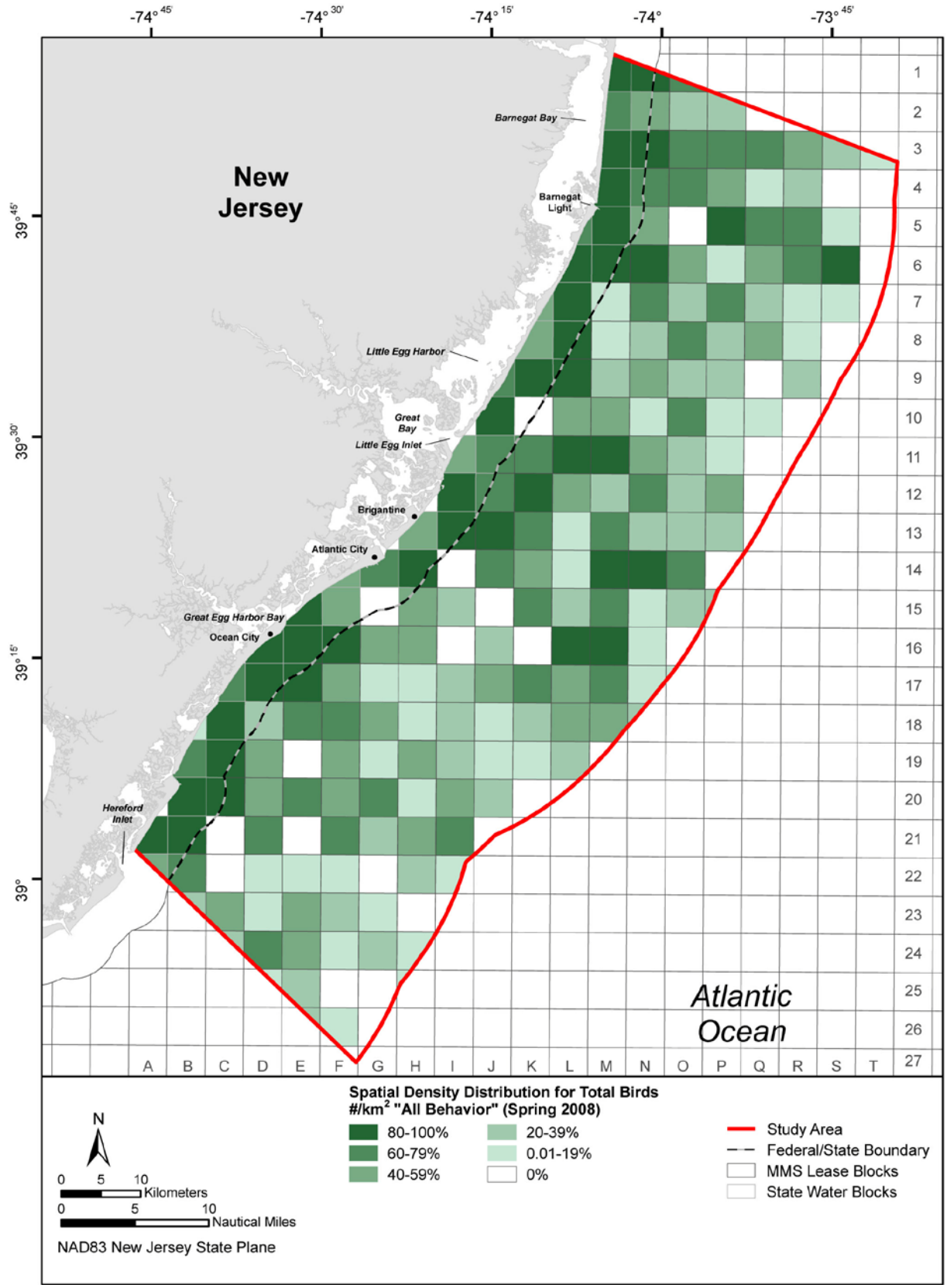

Figure 2-10. Percentile abundance of all birds (all behaviors), Spring 2008 (March-May 2008; n=4,353).

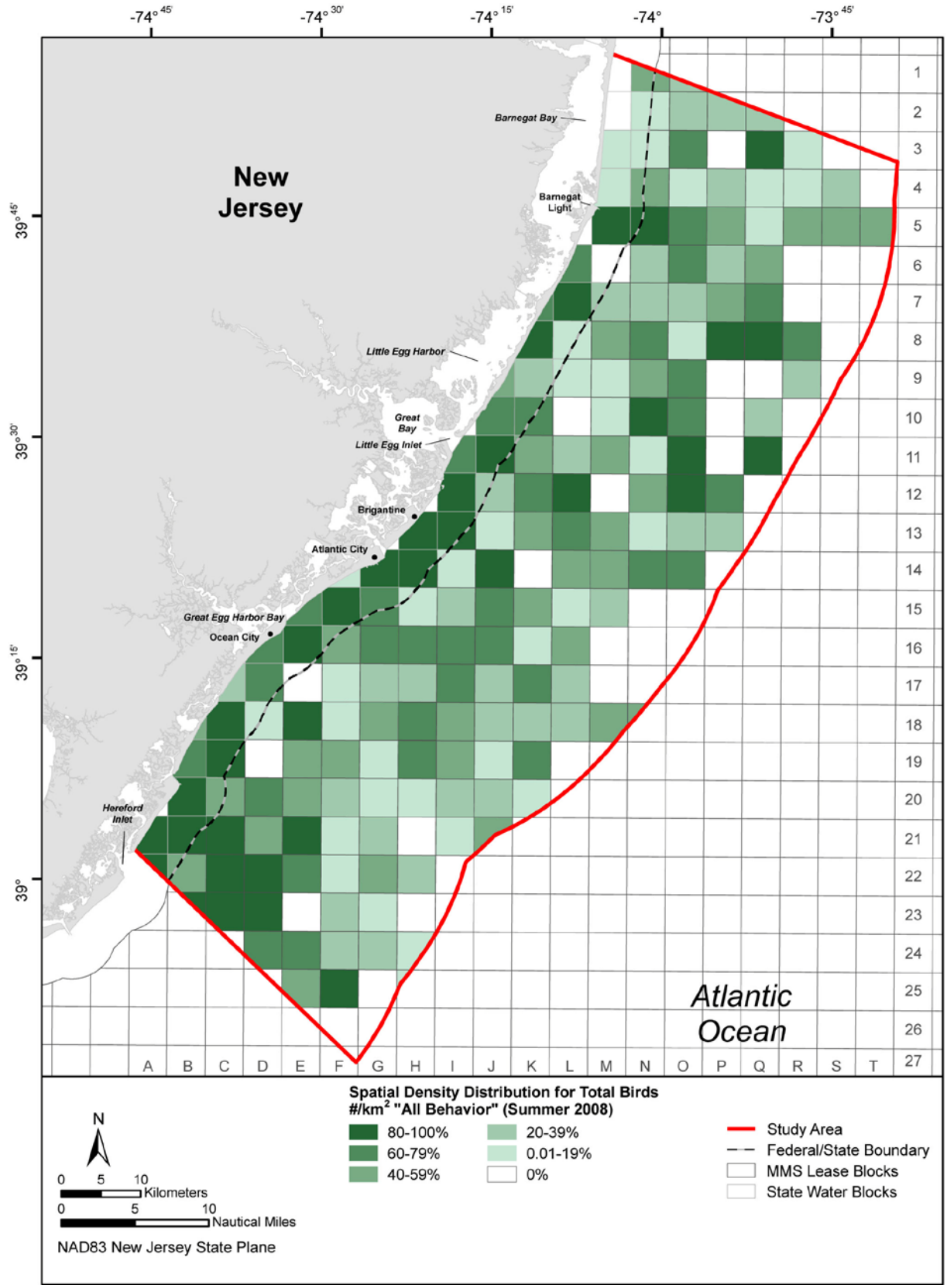

Figure 2-11. Percentile abundance of all birds (all behaviors), Summer 2008 (June-July 2008) (n=2,066).

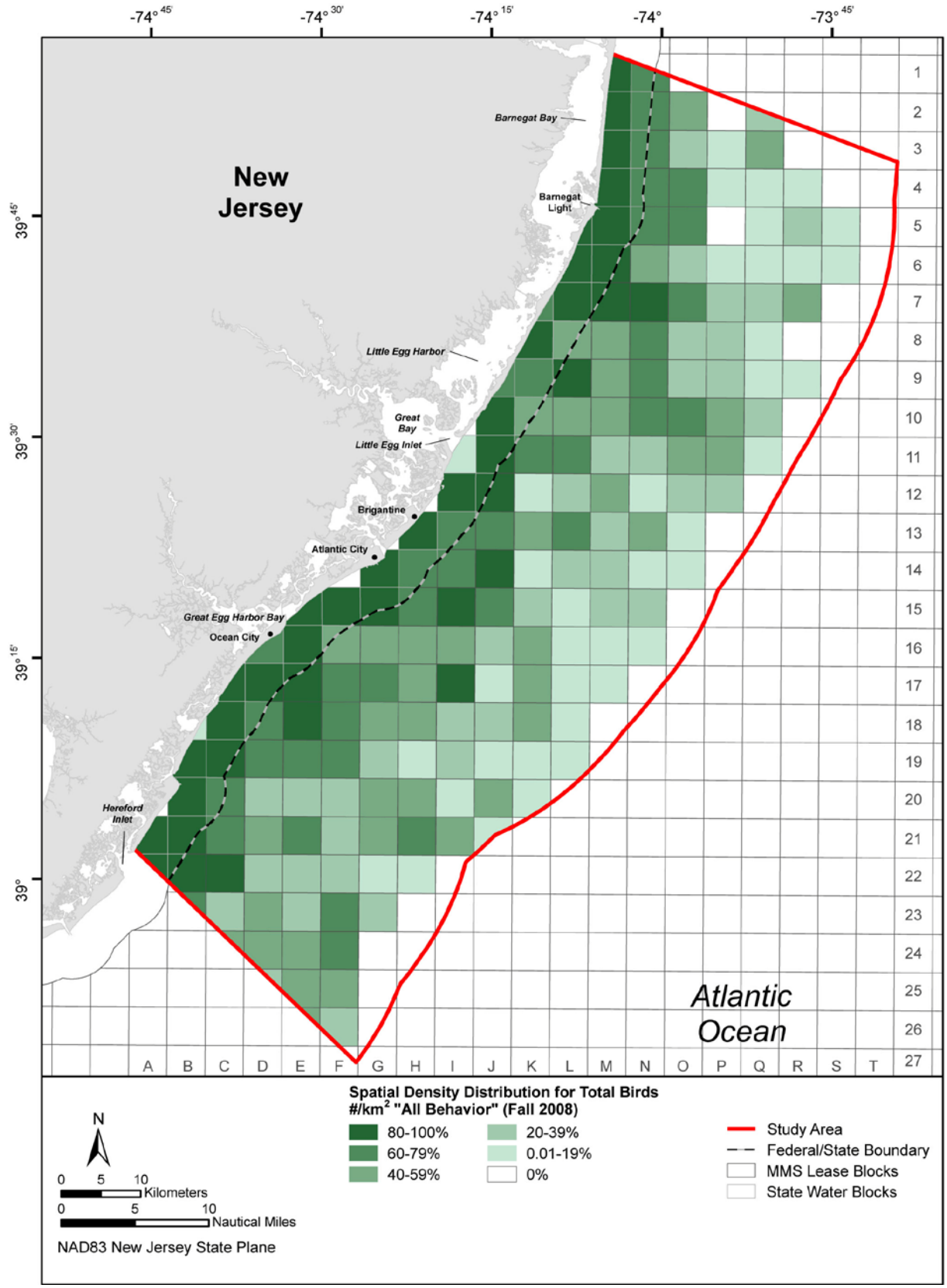

Figure 2-12. Percentile abundance of all birds (all behaviors), Fall 2008 (August-November 2008; n=23,106).

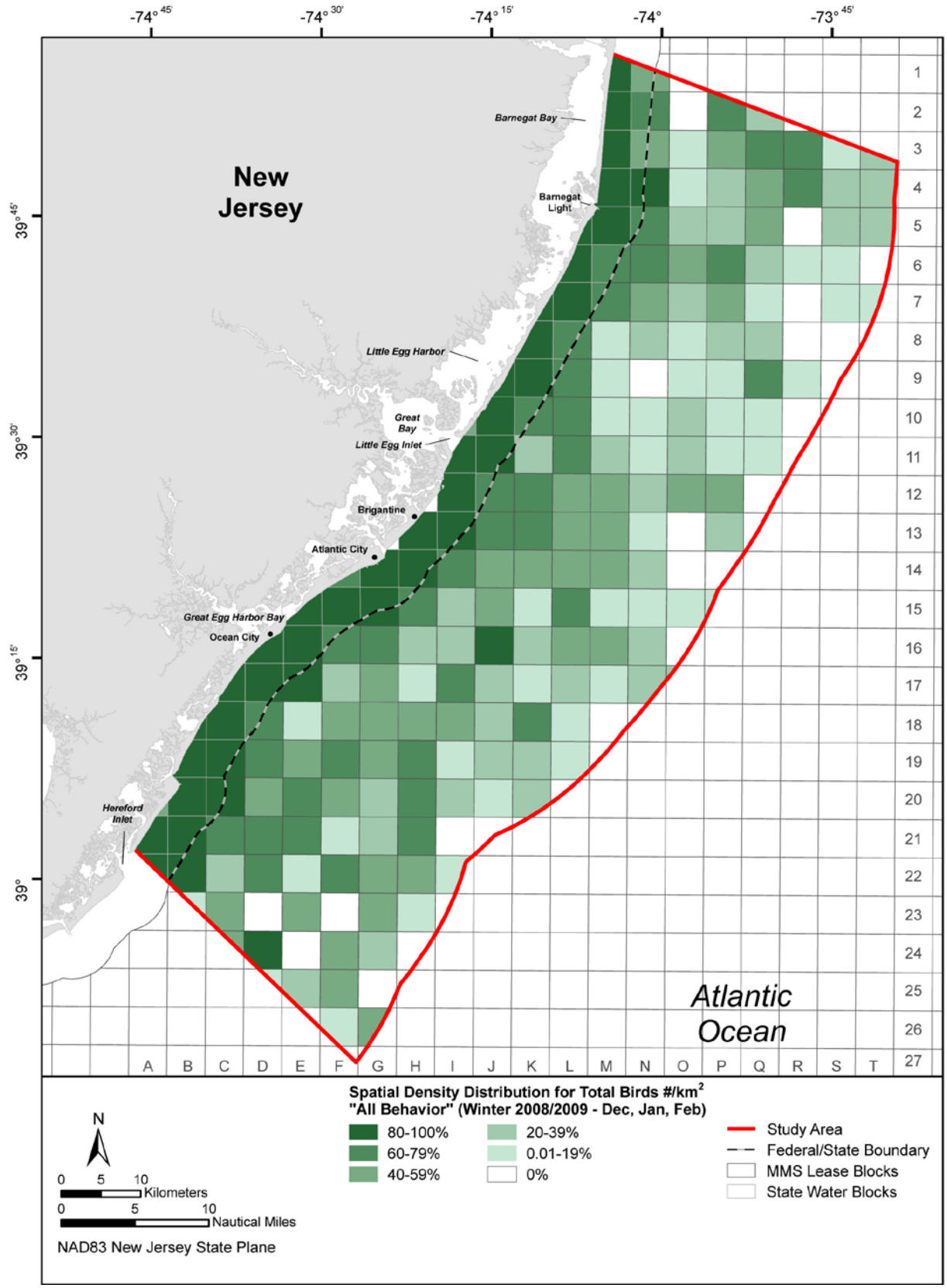

Figure 2-13. Percentile abundance of all birds (all behaviors), Winter 2009 (December 2008-January 2009; n=17,895).

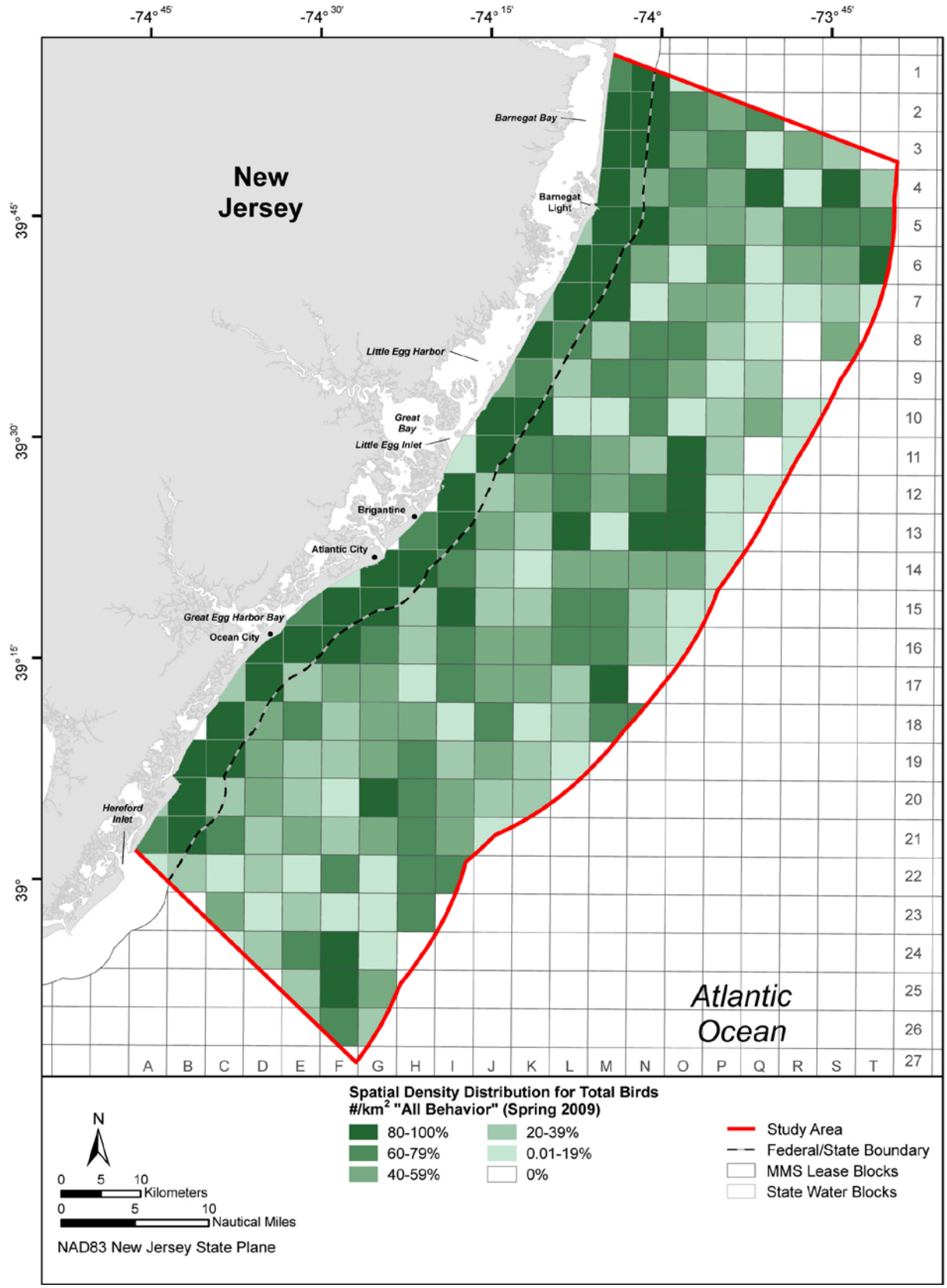

Figure 2-14. Percentile abundance of all birds (all behaviors), Spring 2009 (March-May 2009; n=7,218).

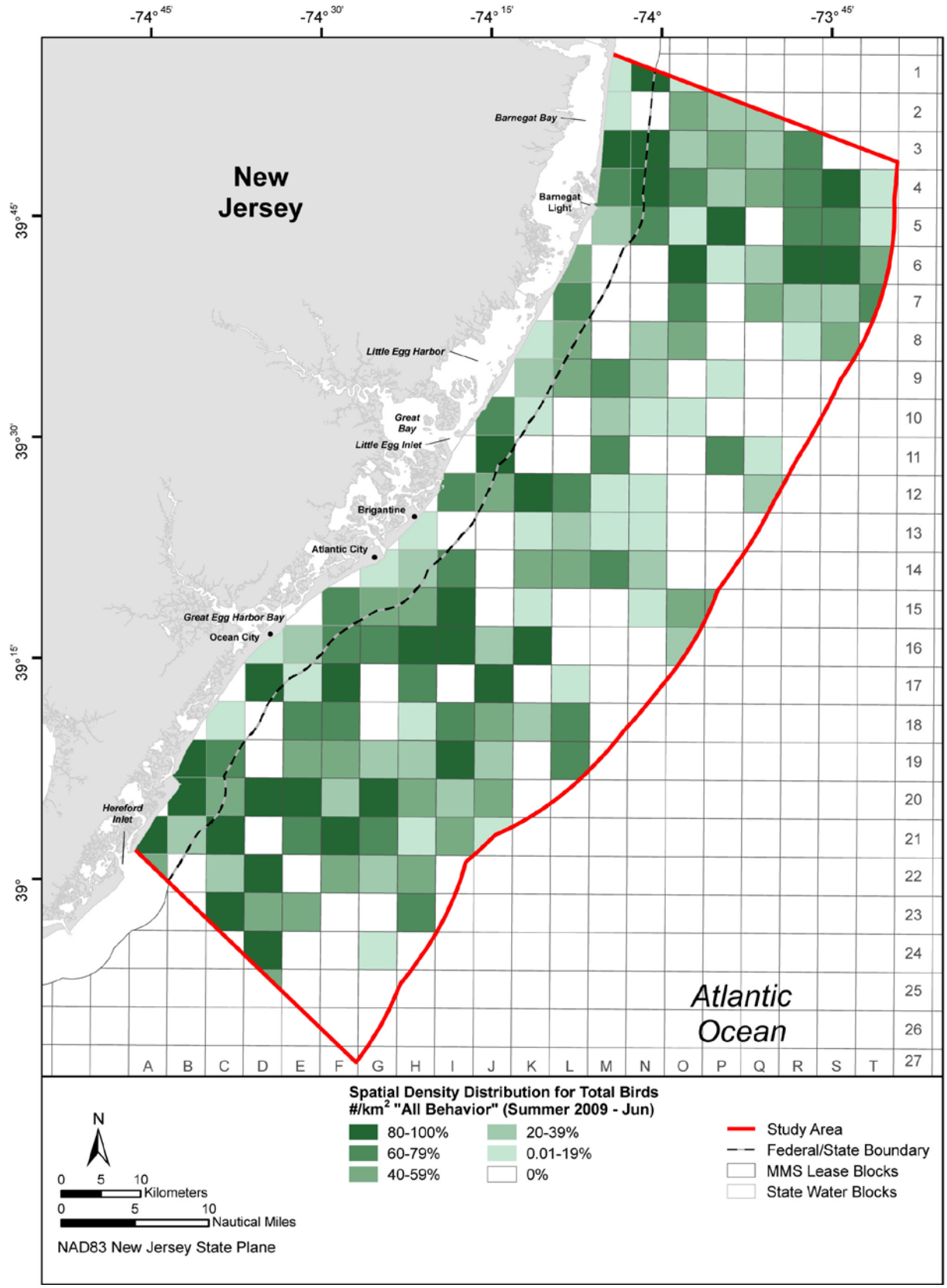

Figure 2-15. Percentile abundance of all birds (all behaviors), Summer 2009 (June 2009; n=1,164).

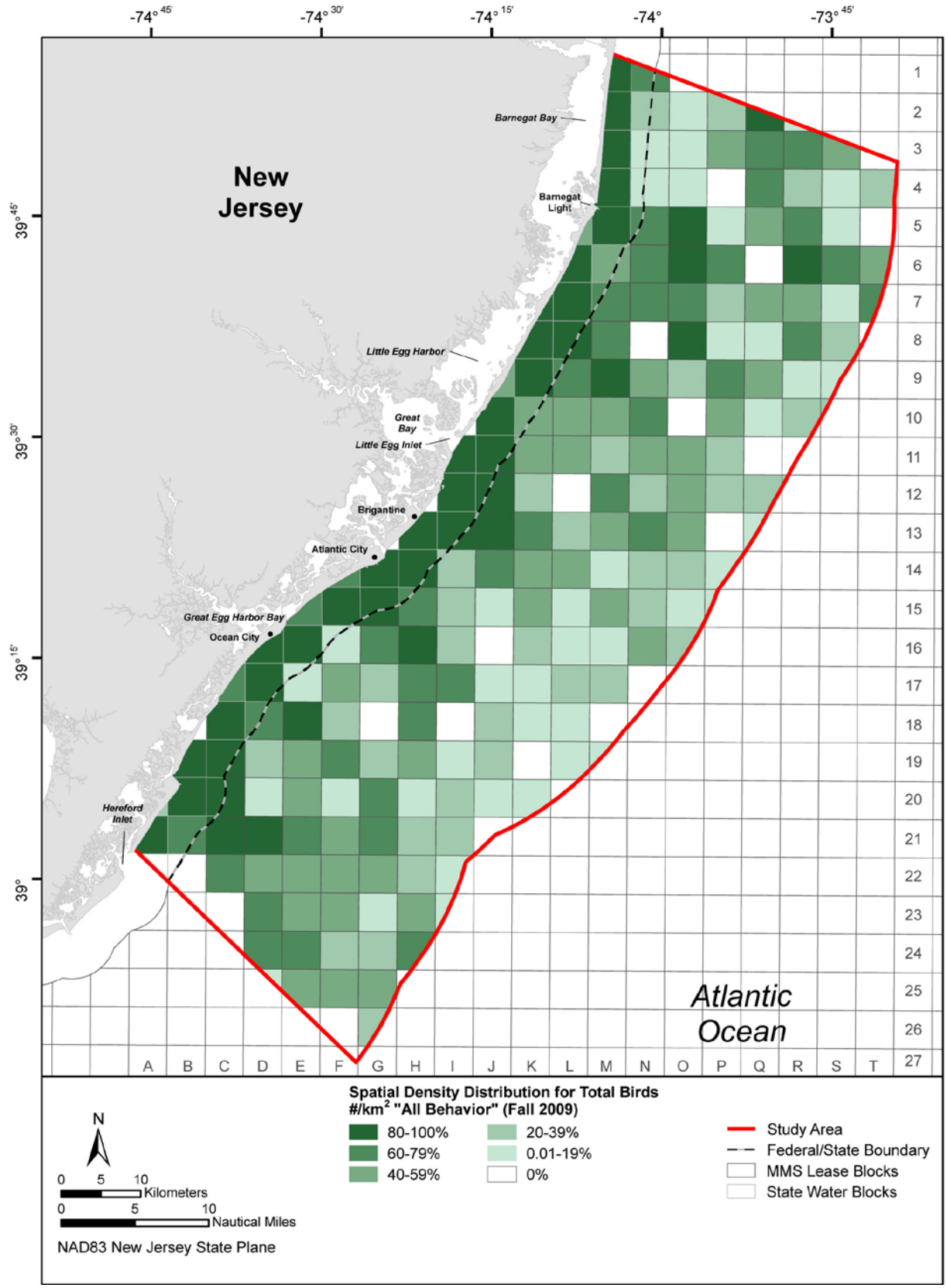

Figure 2-16. Percentile abundance of all birds (all behaviors), Fall 2009 (August-November 2009; n=8,717).

An interesting difference among these four seasons is that highest relative abundance was shifted quite noticeably from offshore in summer (56% or 37 of 66 highest-abundance blocks were offshore in the season) to nearshore in winter (3% or 2 of 65 blocks). Spring and fall are transitional seasons and were intermediate in this aspect (spring: 27.7%; fall: 18.5%). This variation is a result in differing habitat preferences between the seasonal avifauna, with the winter avifauna dominated by inshore-foraging species (e.g., scoters; **Appendix F**) and the summer avifauna dominated by offshore-foraging species (e.g., Common Tern; **Appendix F**).

The summer seasons exhibited the lowest absolute abundance (**Tables 2-3** through **2-6**), with the majority (54.4%) of individuals detected being of locally-breeding species, primarily Common Tern and the three breeding gull species (Laughing, Herring, and Great Black-backed). Further details on seasonal distribution/abundance patterns may be found in the species accounts (**Appendix F**).

The most recognizable and largest seasonal differences in both diversity and abundance occurred during the spring and fall migration periods. Migration, in general, increased diversity, but this diversity varied between seasons and among years. During offshore surveys in spring 2008, 19 American Black Ducks and 2,406 scoters were recorded (many recorded in active northbound migration), while 0 and 1,209, respectively, were counted in spring 2009 (**Appendix C: Table C-1**). While the survey area was well-covered spatially, the temporal coverage was limited (34 survey days out of a possible 184 spring days, **Table 2-1**), which decreased the chances of encountering social species in active migration which are clustered in space and time. As a result, detected occurrence and relative abundance were highly variable between and among seasons.

During offshore surveys in 2008, 105 shearwaters and 701 storm-petrels were counted in summer and 34 and 1,251 were counted in fall. In comparison in 2009, five shearwaters and 113 storm-petrels were observed in summer and 74 and 547 in fall. These differences were attributed to several factors. First, there was no survey in July 2009, thus the summer 2009 results were only based on June's data. Secondly, the June 2009 survey effort occurred very early in the month (**Table 2-1**), before the arrival of the majority of the summer avian population (Walsh et al. 1999). Lastly, a macro-scale occurrence phenomenon may have been an additional causative factor. In summer 2009, many observers north of New Jersey noted a large-scale change in the abundance of many tubenoses (Procellariidae and Hydrobatidae) in the northwest Atlantic Ocean. Some species were found in atypically large numbers off New England, particularly Cory's Shearwater, which was found in unprecedented numbers as far north as the Gulf of Maine[1] (Iliff, M., pers. comm., 15 Feb 2010; Lovitch, D., pers. comm., 15 Feb 2010). Though this distributional change would not have affected the study's summer 2009 results (due to the aforementioned survey timing), the very different fall 2009 tubenose numbers relative to those of 2008, may have been due to this macro-scale phenomenon.

Species

The ten most abundant species recorded during each season are presented in **Table 2-3** through **Table 2-6**. Although survey effort was higher in winter 2008-2009 than winter 2008 (**Section 2.3.1, Table 2-1**), four species (Black Scoter, Herring Gull, Northern Gannet, and scaup species) that ranked in the top 10 species during both winter seasons were in lower abundance and two species (Long-tailed Duck, Common Loon) were in higher abundance during winter 2008-2009 than winter 2008 (**Table 9-1**) Between spring 2008 and spring 2009 survey effort was similar. Three species (Common Loon, Long-tailed Duck, Laughing Gull) that occurred in both spring seasons were in higher abundance and four species (Northern Gannet, Surf Scoter, Herring Gull, and Red-throated Loon) that occurred in both spring seasons were in lower abundance in spring 2009 than spring 2008. No comparisons were made between summer 2008 and summer 2009 because one of the months (July 2009) was not surveyed since the project modification start date was 01 August 2009. Between fall 2008 and fall 2009 the survey effort was similar. Seven species (Surf Scoter, Northern Gannet, Laughing Gull, Herring Gull, Wilson's Storm-Petrel, Great Black-backed Gull, and Red-throated Loon) were in lower abundance in fall 2009 than fall 2008. The reason for these differences is unknown, however many variables (e.g., prey availability, weather, differences in yearly sampling dates) affect the abundance of a species recorded in a given season. Further discussion of the most abundant avian groups and species is found in **Appendix F**.

Table 2-3. Seasonal Top-10 species tables for the ship and boat surveys (Winter).

Winter 2008							
Species	**Ship n**	**#/km**	**Boat n**	**#/km**	**Total n**	**% Total**	**#/km**
Black Scoter	63	0.13	1,244	11.03	**1,307**	**24**	**2.03**
Herring Gull	66	0.13	732	6.49	**798**	**15**	**1.24**
Northern Gannet	769	1.54	10	0.09	**779**	**14**	**1.21**
Scaup, *Aythya* (unknown)	0	0	750	6.65	**750**	**14**	**1.17**
Long-tailed Duck	40	0.08	424	3.76	**464**	**9**	**0.72**
Ring-billed Gull	0	0	397	3.52	**397**	**7**	**0.62**
Red-throated Loon	116	0.23	90	0.80	**206**	**4**	**0.32**
Sanderling	0	0	206	1.83	**206**	**4**	**0.32**
Common Loon	81	0.16	49	0.43	**130**	**2**	**0.20**
Great Black-backed Gull	36	0.07	71	0.63	**107**	**2**	**0.17**
Total	**1,319**	**2.64**	**4,116**	**36.49**	**5,435**	**95**	**8.44**

Winter 2008-2009							
Species	**Ship n**	**#/km**	**Boat n**	**#/km**	**Total n**	**% Total**	**#/km**
Black Scoter	376	0.19	2,435	5.35	**2,811**	**16**	**1.13**
Long-tailed Duck	702	0.36	2,045	4.49	**2,747**	**16**	**1.11**
Surf Scoter	529	0.27	1,761	3.87	**2,290**	**13**	**0.92**
Greater Scaup	0	0.00	1,572	3.45	**1,572**	**9**	**0.63**
Common Loon	383	0.20	766	1.68	**1,149**	**7**	**0.46**
Scoter, dark-winged	29	0.01	1,104	2.42	**1,133**	**7**	**0.46**
Herring Gull	381	0.19	547	1.20	**928**	**5**	**0.37**
Northern Gannet	685	0.35	241	0.53	**926**	**5**	**0.37**
Scaup, Aythya (unknown)	0	0.00	900	1.98	**900**	**5**	**0.36**
Scoter (unknown)	17	0.01	617	1.35	**634**	**4**	**0.26**
Total	**4,105**	**2.10**	**13,205**	**28.99**	**17,310**	**87**	**6.99**

Table 2-4. Seasonal Top-10 species tables for the ship and boat surveys (Spring).

Spring 2008							
Species	**Ship n**	**#/km**	**Boat n**	**#/km**	**Total n**	**% Total**	**#/km**
Northern Gannet	2,839	1.35	442	1.26	**3,281**	**27**	**1.27**
Surf Scoter	1423	0.68	1,315	3.76	**2,738**	**23**	**1.06**
Herring Gull	824	0.39	1,058	3.02	**1,882**	**16**	**0.73**
Black Scoter	618	0.29	91	0.26	**709**	**6**	**0.27**
Common Loon	394	0.19	56	0.16	**450**	**4**	**0.17**
Red-throated Loon	364	0.17	72	0.21	**436**	**4**	**0.17**
Long-tailed Duck	307	0.15	113	0.32	**420**	**3**	**0.16**
Great Black-backed Gull	203	0.10	198	0.57	**401**	**3**	**0.16**
Scoter, dark-winged (unknown)	313	0.15	7	0.02	**320**	**3**	**0.12**
Laughing Gull	154	0.07	87	0.25	**241**	**2**	**0.09**
Total	**8,269**	**3.94**	**3,755**	**10.72**	**12,024**	**91**	**4.66**

Spring 2009							
Species	**Ship n**	**#/km**	**Boat n**	**#/km**	**Total n**	**% Total**	**#/km**
Northern Gannet	1,293	0.63	162	0.40	**1,455**	**18**	**0.57**
Surf Scoter	447	0.22	497	1.24	**944**	**12**	**0.37**
Common Loon	810	0.39	87	0.22	**897**	**11**	**0.35**
Herring Gull	584	0.28	247	0.62	**831**	**10**	**0.32**
Black Scoter	236	0.11	455	1.13	**691**	**8**	**0.27**
Long-tailed Duck	460	0.22	209	0.52	**669**	**8**	**0.26**
Razorbill	498	0.24	0	0.00	**498**	**6**	**0.19**
Laughing Gull	125	0.06	229	0.57	**354**	**4**	**0.14**
Red-throated Loon	234	0.11	100	0.25	**334**	**4**	**0.13**
Double-crested Cormorant	70	0.03	256	0.64	**326**	**4**	**0.13**
Total	**5,476**	**2.67**	**2,668**	**6.65**	**8,144**	**85**	**3.18**

Table 2-5. Seasonal Top-10 species tables for the ship and boat surveys (Summer).

Summer 2008							
Species	**Ship n**	**#/km**	**Boat n**	**#/km**	**Total n**	**% Total**	**#/km**
Laughing Gull	457	0.30	366	1.89	**823**	**31**	**0.45**
Wilson's Storm-Petrel	700	0.46	0	0.00	**700**	**26**	**0.38**
Common Tern	426	0.28	69	0.36	**495**	**19**	**0.27**
Northern Gannet	156	0.10	15	0.08	**171**	**6**	**0.09**
Great Black-backed Gull	49	0.03	58	0.30	**107**	**4**	**0.06**
Cory's Shearwater	99	0.07	0	0.00	**99**	**4**	**0.05**
Forster's Tern	3	0.01	49	0.25	**52**	**2**	**0.03**
Herring Gull	29	0.02	20	0.10	**49**	**2**	**0.03**
Whimbrel	0	0.00	49	0.25	**49**	**2**	**0.03**
Royal Tern	14	0.03	7	0.04	**21**	**1**	**0.01**
Total	**1,976**	**1.30**	**681**	**3.52**	**2,657**	**97**	**1.44**

Summer 2009							
Species	**Ship n**	**#/km**	**Boat n**	**#/km**	**Total n**	**% Total**	**#/km**
Laughing Gull	215	0.30	130	1.03	**345**	**27**	**0.38**
Northern Gannet	274	0.38	6	0.05	**280**	**22**	**0.31**
Common Tern	200	0.28	53	0.42	**253**	**20**	**0.28**
Wilson's Storm-Petrel	113	0.16	7	0.06	**120**	**10**	**0.13**
Herring Gull	75	0.11	10	0.08	**85**	**7**	**0.09**
Great Black-backed Gull	49	0.07	25	0.20	**74**	**6**	**0.08**
Forster's Tern	26	0.04	8	0.06	**34**	**3**	**0.04**
Tern (small)	20	0.03	4	0.03	**24**	**2**	**0.03**
Common Loon	17	0.02	0	0.00	**17**	**1**	**0.02**
Osprey	0	0.00	6	0.05	**6**	**<1**	**0.01**
Total	**1,010**	**1.41**	**251**	**1.99**	**1,261**	**98**	**1.39**

Table 2-6. Seasonal Top-10 species tables for the ship and boat surveys (Fall).

Fall 2008							
Species	**Ship n**	**#/km**	**Boat n**	**#/km**	**Total n**	**% Total**	**#/km**
Laughing Gull	2,683	0.89	978	1.96	**3,661**	**18**	**1.01**
Northern Gannet	1,404	0.46	1,880	3.77	**3,284**	**16**	**0.90**
Surf Scoter	2,164	0.72	81	0.16	**2,245**	**11**	**0.62**
Wilson's Storm-Petrel	1,248	0.41	0	0.00	**1,248**	**6**	**0.34**
Black Scoter	1,070	0.35	105	0.21	**1,175**	**6**	**0.32**
Double-crested Cormorant	1,012	0.34	124	0.25	**1,136**	**6**	**0.31**
Common Tern	812	0.27	228	0.46	**1,040**	**5**	**0.29**
Herring Gull	547	0.18	335	0.67	**882**	**4**	**0.24**
Great Black-backed Gull	456	0.15	409	0.82	**865**	**4**	**0.24**
Red-throated Loon	82	0.03	683	1.37	**765**	**4**	**0.21**
Total	**13,747**	**4.55**	**6,699**	**13.44**	**20,446**	**80**	**5.62**

Fall 2009							
Species	**Ship n**	**#/km**	**Boat n**	**#/km**	**Total n**	**% Total**	**#/km**
Northern Gannet	1,424	0.51	979	1.84	**2,403**	**28**	**0.68**
Laughing Gull	343	0.12	1189	2.24	**1,532**	**18**	**0.43**
Herring Gull	254	0.09	390	0.73	**644**	**8**	**0.18**
Wilson's Storm-Petrel	546	0.19	11	0.02	**557**	**7**	**0.16**
Great Black-backed Gull	197	0.07	338	0.64	**535**	**6**	**0.15**
Red-throated Loon	54	0.02	395	0.74	**449**	**5**	**0.13**
Surf Scoter	213	0.08	222	0.42	**435**	**5**	**0.12**
Bonaparte's Gull	13	0.00	228	0.43	**241**	**3**	**0.07**
Common Loon	151	0.05	45	0.08	**196**	**2**	**0.06**
Common Tern	103	0.04	74	0.14	**177**	**2**	**0.05**
Total	**3,723**	**1.33**	**4,815**	**9.07**	**8,538**	**84**	**2.42**

For additional information on abundance similarities and differences between seasons see **Appendix C: Figures C-26** through **C-70**.

2.3.4 Altitude Distribution

Altitude was estimated for each flying bird recorded. Values of altitude bins were as follows: "1"= 0-3 ft, "25"= 4 to 25 ft, "50"= 26 to 50 ft, "100"= 51 to 100 ft, "200"= 101 to 200 ft, "300"= 201 to 300 ft, "500"= 301 to 500 ft and "1000"= 501 to 1000 ft.

As mentioned above, sightings within the 100 to 1,000 ft altitude bins (101 to 1,000 ft or 30.8 to 304.8 m) were treated as occurring in the potential rotor-swept zone (RSZ,100 to 700 ft or 30.5 to 213.4 m). **Appendix D** contains figures detailing flight altitudes (**Figures D-1** through **D-40**). Although some of the sightings in the 1,000 ft altitude bin (501 to 1,000 ft or 152.7 to 304.8 m) may have occurred above the RSZ, this highest bin only accounted for 56 total individuals and the omission of these individuals from the total number occurring in the RSZ decreases the percentage of birds occurring within the RSZ by less than 0.1%.

Of 71,834 flying individuals recorded, 3,433 (4.8%) occurred in the RSZ (**Figures 2-17** and **2-18**). Birds recorded on the small-boat coastal surveys occurred in the RSZ 83% more often than birds recorded on the shipboard offshore surveys (**Table 2-7**). For histograms of seasonal and cumulative altitudinal distribution of total birds and selected species, see **Appendix D: Figures D-1** through **D-40**.

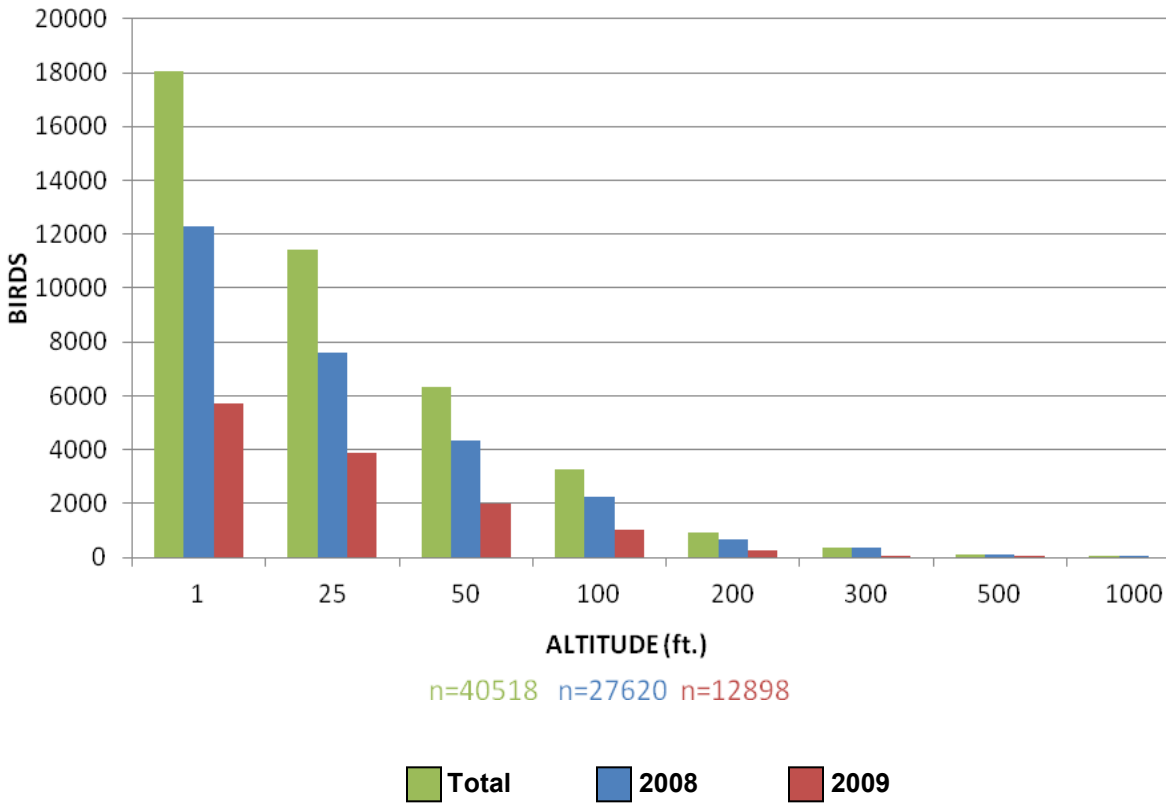

Figure 2-17. Altitudinal distribution, all birds, offshore, January 2008-December 2009.

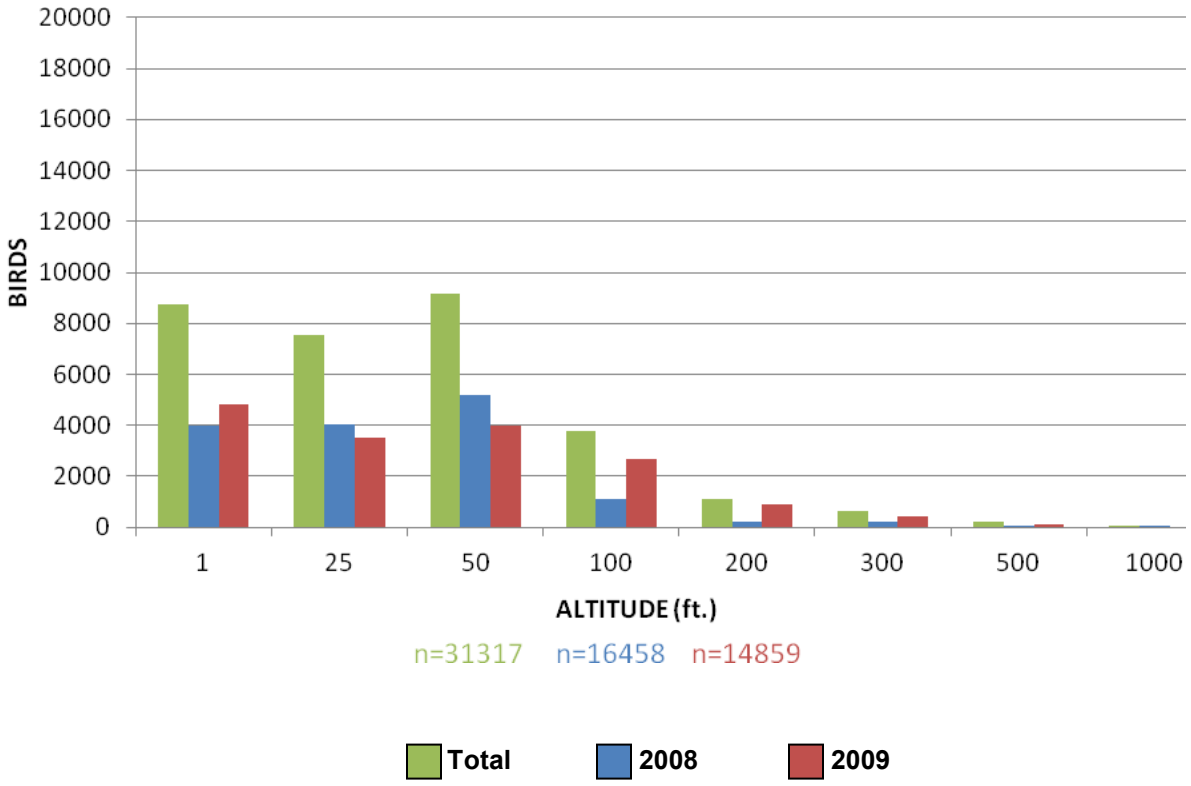

Figure 2-18. Altitudinal distribution, all birds, coastal, January 2008-December 2009.

Table 2-7. Cumulative Percentage of Birds Flying Below[1] and Within[2] the RSZ.

Survey Style	No. 1-100 ft.	No. RSZ	% RSZ	Total
Shipboard Offshore	39,085	1,432	3.5	**40,517**
Small-Boat Coastal	29,316	2,001	6.4	**31,317**
All Surveys	**68,401**	**3,433**	**4.8**	**71,834**

[1] 1-100 ft ASL
[2] 101-700 ft ASL

The species/groups with the highest overall percentage of occurrences in the RSZ are presented in **Table 2-8.** Scaup (*Aythya* spp.) represented 54.5% of all birds in the RSZ for the small-boat coastal surveys, and 31.8% of all birds in the RSZ overall. Of the 1,091 scaup recorded in the RSZ, 1,088 individuals (99.7%) were recorded on the 17 January 2009 small-boat coastal survey. On this date, a severe cold snap froze many inland bodies of water, forcing many "bay ducks" to the coast. This illustrates the potential effects of a major weather event on avian movements and distribution, as removing scaup recorded on that date causes the overall percentage of birds in the RSZ to drop from 4.8% to 3.3%. Offshore, Northern Gannet was the species occurring most often in the RSZ (594 individuals) and was also one of only three species recorded in the RSZ in every season (**Table 2-9**).

Table 2-8. Cumulative Percentage of Birds by Guild/Species in potential rotor-swept zone (RSZ; 101-700 ft or 30.5 to 213.4 m).

Species/Group	All Surveys			Shipboard Offshore			Small-Boat Coastal		
	No.	No. RSZ	% RSZ	No.	No. RSZ	% RSZ	No.	No. RSZ	% RSZ
geese	909	423	46.5	56	8	14.3	853	415	48.7
herons	48	16	33.3	28	11	39.3	20	5	25.0
scaup	3,768	1,091	29.0	30	0	0.0	3,738	1,091	29.2
dabbling ducks	391	105	26.9	206	12	5.8	185	93	50.3
Osprey	40	8	20.0	8	1	0.1	32	7	21.9
Common Loon	734	66	9.0	599	56	9.3	135	10	7.4
large gulls	5,970	492	8.2	4,044	275	6.8	1,926	217	11.3
cormorants	2,413	170	7.0	1,804	131	7.3	629	39	6.2
Northern Gannet	15,283	594	3.9	10,059	537	5.3	5,224	57	1.1
All Birds	**71,834**	**3,433**	**4.8**	**40,517**	**1,432**	**3.5**	**31,317**	**2,001**	**6.4**

Table 2-9. Seasonal occurrence of avian species in potential rotor-swept zone (RSZ; 100-700 ft or 30.5 to 213.4 m).

Common Name	Winter	Spring	Summer	Fall
Snow Goose				X
Brant		X		
Canada Goose	X			X
Wood Duck	X			
Gadwall				X
American Wigeon				X
American Black Duck	X			X
Mallard				X
Northern Pintail				X
Greater Scaup	X			X
Surf Scoter	X	X		
White-winged Scoter	X			
Black Scoter	X	X		
Red-breasted Merganser	X			
Red-throated Loon	X	X		X
Common Loon	X	X		X
Northern Gannet	X	X	X	X
Brown Pelican				X
Double-crested Cormorant	X			X
Great Blue Heron				X

Table 2-9 (*continued*). Seasonal occurrence of avian species in potential rotor-swept zone (RSZ; 100-700 ft or 30.5 to 213.4 m).

Common Name	Winter	Spring	Summer	Fall
Osprey		X	X	X
Northern Harrier		X		
Peregrine Falcon				X
Laughing Gull		X	X	X
Ring-billed Gull	X			
Herring Gull	X	X	X	X
Great Black-backed Gull	X	X	X	X
Caspian Tern				X
Common Tern		X		X
Forster's Tern		X		
Royal Tern		X		
Razorbill	X			
Barn Swallow		X		

Of all birds identified to species, 33 were recorded in the RSZ at least once. The only three species to occur in the RSZ in all four seasons were Northern Gannet, Herring Gull, and Great Black-backed Gull. Red-throated Loon, Common Loon, Osprey, and Laughing Gull were recorded in the RSZ in three of the four seasons. More species occurred in the RSZ in fall (21 species) than any other season, followed by winter (16), spring (15), and summer (five).

Seasonal altitude distributions are presented in **Table 2-10**. Winter had both the most individuals (1,551) and highest percentage of individuals (8.01%) in the RSZ, despite the fact that there were far more survey effort hours in both spring and fall. As mentioned above, this was due in large part to the 1,088 scaup recorded in the RSZ on the 17 January 2009 small-boat coastal survey. Northern Gannets and large gulls (*Larus* spp.) also accounted for a large portion of the winter RSZ totals with 138 and 160 individuals, respectively.

In spring, Northern Gannet was the most abundant species in the RSZ (385 individuals), followed by scoters (*Melanitta* spp.) with 193 individuals and large gulls with152 individuals. Loons (*Gavia* spp.) and small terns (*Sterna* spp.) accounted for 69 and 30 individuals, respectively.

Summer had both the lowest overall percentage of birds recorded in the RSZ (0.82%) and the least diversity in the RSZ (five species). This was due not only to the reduced survey effort in summer but also to the fact that most individuals of the highest-flying species/groups (Northern Gannets, Common Loon, and most ducks and geese) had departed the area for their breeding grounds. Of the 29 individuals recorded in the RSZ during summer, 20 were large gulls.

Although 21 species were recorded in the RSZ for the fall season, RSZ occurrence numbers were largely driven by Canada Geese (399 individuals) and Double-crested Cormorants (158 individuals). None of the other 19 species exceeded 65 individuals in the RSZ for the season.

Additional altitude-distribution figures are located in **Appendix D: Figures D-1** through **D-40**.

Table 2-10. Overall avian occurrence in potential rotor-swept zone (RSZ; 100-700 ft or 30.5 to 213.4 m).

Season	Year	No.	No. RSZ	% RSZ	Effort (hrs) [1]
Winter	2008	1,934	174	9.00	36.64
	2008-9	15,348	1,307	8.52	135.28
	2009	2,086	70	3.36	21.89
	Total	**19,368**	**1,551**	**8.01**	**193.81**
Spring	2008	8,809	783	8.89	141.87
	2009	7,725	177	2.29	143.64
	Total	**16,534**	**960**	**5.81**	**285.51**
Summer	2008	2,288	3	0.13	102.64
	2009	1,241	26	2.10	52.25
	Total	**3,529**	**29**	**0.82**	**154.89**
Fall	2008	23,561	675	2.86	201.11
	2009	8,843	218	2.47	198.83
	Total	**32,404**	**893**	**2.76**	**399.94**

[1] data from all surveys were used in this analysis, regardless of whether or not such were included in other analyses presented in other sections of this report

2.3.5 Flight Direction

Mean angles and median flight angles are reported for all species that were included in the top-5 list in at least one time period (month, season, year, or overall) in **Table 2-11**. In addition to abundances, observations, and cluster sizes, results are also shown for sample size n (the number of birds observed for which flight direction data are available), length vector r, angular deviation, circular standard deviation [SD], deviation, and the 95% confidence intervals (CI) for the mean angle.

Mean flight direction (mean angle) for total birds was northeast (NE) in both spring seasons (2008: 33-39° with a mean angle of 36°; and 2009: 36-45°, mean 40°), southwest (SW) in fall 2008 (228-230°, mean 229°), and west (W) in fall 2009 (246-260°, mean 253°). Flight directions (mean angles) were more variable (in terms of both directional differences and width of the 95% CI) in the summer and winter seasons across the two years. For total birds, mean angles were south (S; 165-190°, mean 177°) and NE (35-86°, mean 60°) in summer 2008 and summer 2009, respectively. A southerly component was present in the mean angle for all three winter seasons: southeast (SE; 109-134°, mean 121°) in winter 2008, S (179-186°, mean 182°) in winter 2009, and SW (229-239°, mean 234°) in winter 2010. In terms of annual averages, mean flight directions were SW (219-220°, mean 219°) and northwest (NW; 274-325°, mean 299°) in 2008 and 2009, respectively, with an overall two-year mean angle of 223° (SW).

For each individual species, flight directional results are summarized only for those time periods for which the given species was included in the top five most abundant list. Of the 35 total time periods recognized, Northern Gannet (NOGA) was in the top five list for 27 of those periods. Mean flight direction for NOGA was virtually due North (N; 345-17°, mean 1°) in spring 2008 and NE (343-83°, mean 33°) in spring 2009, reflecting the northward migration for this time of year. In fall 2008, mean angle for NOGA was SW (208-214°, mean 211°), reflecting the southward migration; however, the southward NOGA migration was apparently delayed in fall 2009, when mean angle was N (332-347°, mean 340°); the southerly component did not appear in the mean angle until winter 2010, when mean angle was SW (205-218°, mean 211°). Flight directions for NOGA were highly variable and possessed an easterly component in both summer seasons, when mean angle was SE (103-201°, mean 152°) in summer 2008 and East (E; 63-112°, mean 87°). Annual average mean flight directions were very similar between 2008 and 2009,

being SW for both years (209-221°, mean 215° and 197-221°, mean 209°, respectively). Over the entire two-year period, mean flight direction for NOGA was SW (208-219°, mean 213°).

Generally, most species exhibited a southerly component in mean flight direction in the fall and/or winter seasons and a northerly component in the spring seasons. For example, for unidentified dark-winged scoters (SCDW), mean angle was S (196-205°, mean 201°) in fall 2008, S (180-185°, mean 182°) in fall 2009, and S (186-208°, mean 197°) in winter 2010. For Herring Gull (HERG), mean angle was SE (156°) in winter 2008, E (52-83°, mean 68°, actually east-northeast [ENE]) in spring 2008, and NE (18-53°, mean 36°) in spring 2009. For Surf Scoter (SUSC), for spring 2008 and spring 2009 (the only 2 seasons in which SUSC was in the top five most abundant list), mean angles were N (18-25°, mean 22°) and NE (39-49°, mean 44°), respectively. Likewise, for Double-crested Cormorant (DCCO), a northerly directional component was present in spring 2008 (NE: 25-28°, mean 26°) and spring 2009 (NE: 28-32°, mean 30°); and a southerly component was present in fall 2008 (SW: 241-243°, mean 242°); however, mean angle for DCCO was highly variable in fall 2009 (NW: 285-352°, mean 319°), reflecting high variability typically associated with summer seasons (the off-migration season) and hence a potential delay in the southerly migration behavior (a case that was observed for NOGA, discussed earlier). For Black Scoter (BLSC), an expected southerly component was present in both winter 2008 (SE: 146-158°, mean 152°) and winter 2010 (S: 159-194°, mean 177°). Similarly, for large gulls (GULG), mean flight direction was S for fall 2009 (175-185°, mean 180°), winter 2009 (153-188°, mean 171°), and winter 2010 (87-254°, mean 170°). For unidentified scoters (SCOT), mean angle was S (157-162°, mean 159°) in winter 2009. For Canada Goose (CANG), mean flight direction in fall 2008 was SW (217-219°, mean 218°).

In summary, seasonal similarities in mean flight direction were exhibited among the various highly abundant species particularly in the migration seasons (northward in spring and southward in fall/winter). Differences among species were more highly variable in summer, when there is generally no significant net northward or southward migration, and birds are generally flying around either in circles or over short, localized distances (looking for food, etc.) where they take up residence between migration seasons. Monthly contributions to the seasonal average mean angles are also summarized, for all months for which the given species is included in the top five most abundant list.

2.3.5.1 Tests for Circular Uniformity

Results of the various statistical tests for circular uniformity are summarized in **Tables E-1** to **E-10** in **Appendix E**. The reader is referred to these tables for a more in-depth analysis concerning hypothesis testing for circular uniformity for each species (as well as for total birds) for each time period (monthly, seasonal, annual, and overall cumulative two-year period). The format of each of these tables is similar to that in the above-discussed table summarizing the mean angles. That is, results are reported for total birds for all time periods (monthly, seasonal, annual, overall cumulative two-year period) and for individual species only for those time periods in which the given species is included in the top five most abundant list (to ensure an adequate sample size).

Table E-1 summarizes the frequency distribution of flight directions in the eight directional octants (N, NE, E, SE, S, SW, W, and NW). Results in this table reinforce the results discussed above for mean angle. Generally, particularly for total birds and also for most species, the highest frequency distribution in flight directions (among the eight octants) occur in octants with a northerly component in the spring seasons and with a southerly component in the fall/winter seasons. For example, for total birds, 25.43% of flight directions in spring 2008 occur in the NE quadrant, and another 19.93% occur in the N quadrant (significantly above the 12.5% which would occur with a completely uniform distribution across the eight octants); and the percentages are similar in spring 2009 (25.49% in NE, 19.83% in N). In fall 2008, 39.41% of flight directions occur in the SW octant; and in fall 2009, 19.16% and 18.45% occur in the SW and S octants, respectively. In winter 2008, 25.50% occur in the SE octant; in winter 2009, 24.49% and 18.16% occur in the S and SW octants, respectively; and in winter 2010, 21.46% and 25.91% occur in the S and SW octants, respectively.

Table 2-11. Mean angle and median angle for total birds and individual species in the given time period.

Time Period	Species[1]	Abundance	#Observations	Cluster Size	N[2]	R[3]	AngDev[4]	CircSD[5]	Dev[6]	Mean Angle				Median Angle	
										CI_low[7]	Mean	Direction	CI_high[8]	Median[9]	Direction
Overall	TOTAL	177266	35547	4.99	109794	0.1230	75.88	117.29	0.00	223	223	SW	223	180	S
Jan-08	TOTAL	6500	1212	5.36	2081	0.2157	71.76	100.35	11.22	118	129	SE	140	135	SE
Feb-08	TOTAL	580	208	2.79	327	0.1907	72.90	104.31	34.03	351	25	NE	59	135	SE
Mar-08	TOTAL	17569	3068	5.73	9139	0.0638	78.40	134.42	18.70	285	304	NW	323	135	SE
Apr-08	TOTAL	15624	3362	4.65	10850	0.5532	54.16	62.34	1.62	40	42	NE	44	45	NE
May-08	TOTAL	4446	1901	2.34	3527	0.1371	75.27	114.21	13.79	17	30	NE	44	135	SE
Jun-08	TOTAL	1964	1198	1.64	1674	0.1769	73.51	106.64	15.46	164	179	S	195	180	S
Jul-08	TOTAL	1957	1061	1.84	1591	0.1321	75.49	115.28	21.65	153	175	S	197	180	S
Aug-08	TOTAL	4255	1457	2.92	3396	0.2696	69.25	92.77	6.90	343	350	N	357	90	E
Sep-08	TOTAL	2612	1103	2.37	2196	0.1053	76.64	121.57	23.28	251	274	W	297	180	S
Oct-08	TOTAL	11928	1729	6.90	9994	0.5505	54.32	62.60	1.70	244	245	SW	247	225	SW
Nov-08	TOTAL	27018	2694	10.03	20358	0.5776	52.66	60.03	1.11	216	217	SW	218	225	SW
Dec-08	TOTAL	9672	1150	8.41	6091	0.6565	47.49	52.57	1.65	181	183	S	184	180	S
Jan-09	TOTAL	20306	1618	12.55	9332	0.0875	77.40	126.48	13.36	138	151	SE	165	135	SE
Feb-09	TOTAL	10953	1919	5.71	3108	0.1695	73.84	107.95	11.80	300	312	NW	324	180	S
Mar-09	TOTAL	6494	2058	3.16	3193	0.2241	71.37	99.09	8.68	352	0	N	9	90	E
Apr-09	TOTAL	6122	1038	5.90	5290	0.3326	66.19	85.01	4.38	53	57	NE	61	45	NE
May-09	TOTAL	3052	1744	1.75	2071	0.1112	76.39	120.09	22.65	6	29	NE	51	135	SE
Jun-09	TOTAL	1817	1309	1.39	1411	0.1210	75.97	117.76	25.37	35	60	NE	86	135	SE
Aug-09	TOTAL	1885	1201	1.57	1500	0.0521	78.89	139.29	76.15	227	303	NW	19	180	S
Sep-09	TOTAL	1923	814	2.36	918	0.0366	79.53	147.35	0.00	304	304	NW	304	135	SE
Oct-09	TOTAL	4065	619	6.57	2151	0.0844	77.53	127.39	29.93	236	266	W	296	180	S
Nov-09	TOTAL	10757	1890	5.69	6539	0.2128	71.89	100.79	6.39	242	248	W	255	180	S
Dec-09	TOTAL	5767	1194	4.83	3057	0.3852	63.53	79.14	4.87	229	234	SW	239	225	SW
Winter2008(DJF)	TOTAL	7080	1420	4.99	2408	0.1818	73.30	105.81	12.48	109	121	SE	134	135	SE
Spring2008(MAM)	TOTAL	37639	8331	4.52	23516	0.2735	69.06	92.25	2.58	33	36	NE	39	90	E
Summer2008(JJ)	TOTAL	3921	2259	1.74	3265	0.1550	74.49	110.64	12.63	165	177	S	190	180	S
Autumn2008(ASON)	TOTAL	45813	6983	6.56	35944	0.4580	59.65	71.60	1.15	228	229	SW	230	225	SW
Winter2009(DJF)	TOTAL	40931	4687	8.73	18531	0.2354	70.85	97.45	3.41	179	182	S	186	180	S
Spring2009(MAM)	TOTAL	15668	4840	3.24	10554	0.2330	70.96	97.80	4.57	36	40	NE	45	90	E
Summer2009(JJ)	TOTAL	1817	1309	1.39	1411	0.1210	75.97	117.76	25.37	35	60	NE	86	135	SE
Autumn2009(ASON)	TOTAL	18630	4524	4.12	11108	0.1472	74.83	112.16	7.18	246	253	W	260	180	S
Winter2010(DJF)	TOTAL	5767	1194	4.83	3057	0.3852	63.53	79.14	4.87	229	234	SW	239	225	SW
2008	TOTAL	104125	20143	5.17	71224	0.1870	73.06	104.92	0.77	219	219	SW	220	180	S
2009	TOTAL	73141	15404	4.75	38570	0.0232	80.08	157.19	25.46	274	299	NW	325	180	S
Overall	NOGA	34020	9822	3.46	22856	0.1328	75.46	115.14	5.55	208	213	SW	219	180	S
Jan-08	NOGA	898	482	1.86	693	0.1453	74.91	112.53	30.50	29	60	NE	90	135	SE
Feb-08	NOGA	49	33	1.48	37	0.4761	58.65	69.81	37.66	80	117	SE	155	135	SE
Mar-08	NOGA	4980	1351	3.69	3348	0.0758	77.90	130.14	26.46	308	334	NW	1	135	SE
Apr-08	NOGA	3271	1409	2.32	2081	0.1326	75.47	115.18	18.74	345	4	N	23	180	S
May-08	NOGA	858	582	1.47	703	0.1605	74.24	109.61	27.09	35	62	NE	89	135	SE
Jun-08	NOGA	270	195	1.38	195	0.2166	71.72	100.22	39.48	128	168	S	207	180	S

Table 2-11 (*continued*). Mean angle and median angle for total birds and individual species in the given time period.

Time Period	Species[1]	Abundance	#Observations	Cluster Size	N[2]	R[3]	AngDev[4]	CircSD[5]	Dev[6]	Mean Angle				Median Angle	
										CI_low[7]	Mean	Direction	CI_high[8]	Median[9]	Direction
Oct-08	NOGA	1692	492	3.44	1380	0.5828	52.34	59.54	4.22	241	245	SW	249	225	SW
Nov-08	NOGA	9402	1045	9.00	6037	0.3472	65.47	83.34	3.91	195	199	S	203	180	S
Dec-08	NOGA	470	308	1.53	343	0.1277	75.68	116.23	55.48	116	171	S	227	180	S
Jan-09	NOGA	1849	417	4.43	1707	0.7587	39.80	42.58	2.34	180	183	S	185	180	S
Mar-09	NOGA	840	468	1.79	604	0.1199	76.02	118.01	41.40	286	327	NW	8	135	SE
Apr-09	NOGA	400	303	1.32	322	0.0595	78.58	136.12	0.00	14	14	N	14	135	SE
May-09	NOGA	1077	674	1.60	815	0.1149	76.23	119.19	36.46	48	84	E	121	135	SE
Jun-09	NOGA	431	343	1.26	237	0.2945	68.06	89.59	24.51	63	87	E	112	90	E
Nov-09	NOGA	6394	981	6.52	3495	0.2413	70.58	96.62	7.67	332	340	N	347	180	S
Dec-09	NOGA	628	331	1.90	482	0.6045	50.96	57.49	6.77	205	211	SW	218	225	SW
Winter2008(DJF)	NOGA	947	515	1.84	730	0.1523	74.60	111.16	28.12	39	67	NE	96	135	SE
Spring2008(MAM)	NOGA	9109	3342	2.73	6132	0.0909	77.26	125.48	15.92	345	1	N	17	135	SE
Summer2008(JJ)	NOGA	312	232	1.34	224	0.1725	73.71	107.41	48.67	103	152	SE	201	180	S
Autumn2008(ASON)	NOGA	11217	1631	6.88	7490	0.3649	64.57	81.35	3.31	208	211	SW	214	225	SW
Spring2009(MAM)	NOGA	2317	1445	1.60	1741	0.0611	78.51	135.46	50.13	343	33	NE	83	135	SE
Summer2009(JJ)	NOGA	431	343	1.26	237	0.2945	68.06	89.59	24.51	63	87	E	112	90	E
Autumn2009(ASON)	NOGA	6474	1050	6.17	3547	0.2373	70.77	97.19	7.75	332	340	N	347	180	S
Winter2010(DJF)	NOGA	628	331	1.90	482	0.6045	50.96	57.49	6.77	205	211	SW	218	225	SW
2008	NOGA	22055	6028	3.66	14919	0.1489	74.75	111.82	6.12	209	215	SW	221	180	S
2009	NOGA	11965	3794	3.15	7937	0.1029	76.75	122.20	12.28	197	209	SW	221	180	S
Overall	SCDW	13933	364	38.28	11113	0.3361	66.02	84.61	2.99	161	164	S	167	180	S
Mar-08	SCDW	1522	36	42.28	1509	0.4892	57.91	68.52	5.16	154	159	S	165	135	SE
Apr-08	SCDW	1885	69	27.32	1500	0.8701	29.20	30.22	1.64	53	54	NE	56	45	NE
Nov-08	SCDW	2932	30	97.73	2932	0.4418	60.54	73.24	4.22	193	197	S	201	225	SW
Dec-08	SCDW	3025	21	144.05	1465	0.9531	17.55	17.76	0.93	184	185	S	186	180	S
Apr-09	SCDW	1599	36	44.42	1569	0.5027	57.14	67.20	4.88	134	139	SE	144	135	SE
Dec-09	SCDW	473	16	29.56	243	0.5537	54.13	62.30	10.94	186	197	S	208	180	S
Spring2008(MAM)	SCDW	3407	105	32.45	3009	0.4388	60.70	73.54	4.20	83	87	E	91	90	E
Autumn2008(ASON)	SCDW	3228	49	65.88	3228	0.4122	62.12	76.28	4.37	196	201	S	205	225	SW
Winter2009(DJF)	SCDW	4468	107	41.76	2476	0.6368	48.84	54.44	2.73	180	182	S	185	180	S
Spring2009(MAM)	SCDW	1985	71	27.96	1791	0.4720	58.88	70.20	4.96	138	143	SE	148	135	SE
Winter2010(DJF)	SCDW	473	16	29.56	243	0.5537	54.13	62.30	10.94	186	197	S	208	180	S
2008	SCDW	9669	178	54.32	7705	0.3462	65.52	83.45	3.47	161	164	S	168	180	S
Overall	HERG	13790	3474	3.97	4730	0.0712	78.09	131.71	23.54	11	35	NE	59	135	SE
Jan-08	HERG	1158	129	8.98	206	0.0422	79.30	144.17	0.00	222	222	SW	222	135	SE
Feb-08	HERG	61	41	1.49	60	0.1485	74.77	111.90	0.00	93	93	E	93	135	SE
Mar-08	HERG	3785	394	9.61	725	0.1362	75.31	114.40	32.01	48	80	E	112	135	SE
May-08	HERG	568	249	2.28	322	0.1399	75.15	113.63	50.82	339	30	NE	81	135	SE
Feb-09	HERG	1710	325	5.26	377	0.0976	76.97	123.59	75.34	258	333	NW	48	135	SE
Mar-09	HERG	1037	358	2.90	500	0.2618	69.62	93.80	18.89	38	57	NE	76	90	E
Apr-09	HERG	439	138	3.18	186	0.2733	69.07	92.28	30.55	315	346	N	17	135	SE

Table 2-11 (*continued*). Mean angle and median angle for total birds and individual species in the given time period.

Time Period	Species[1]	Abundance	#Observations	Cluster Size	N[2]	R[3]	AngDev[4]	CircSD[5]	Dev[6]	Mean Angle				Median Angle	
										CI_low[7]	Mean	Direction	CI_high[8]	Median[9]	Direction
May-09	HERG	261	194	1.35	224	0.1641	74.08	108.93	52.22	328	20	N	72	135	SE
Jun-09	HERG	135	90	1.50	121	0.2714	69.17	92.54	39.56	331	10	N	50	90	E
Sep-09	HERG	352	59	5.97	54	0.2691	69.27	92.83	76.32	299	16	N	92	67.5	E
Oct-09	HERG	237	62	3.82	69	0.3449	65.59	83.61	40.63	339	20	N	60	90	E
Nov-09	HERG	416	149	2.79	224	0.0882	77.37	126.28	0.00	128	128	SE	128	135	SE
Winter2008(DJF)	HERG	1219	170	7.17	266	0.0282	79.88	153.06	0.00	156	156	SE	156	135	SE
Spring2008(MAM)	HERG	5024	1016	4.94	1483	0.1908	72.89	104.29	15.19	52	68	E	83	135	SE
Spring2009(MAM)	HERG	1737	690	2.52	910	0.2089	72.07	101.40	17.73	18	36	NE	53	135	SE
Summer2009(JJ)	HERG	135	90	1.50	121	0.2714	69.17	92.54	39.56	331	10	N	50	90	E
Autumn2009(ASON)	HERG	1032	290	3.56	368	0.1200	76.01	117.99	57.95	7	65	NE	123	135	SE
2008	HERG	7991	1810	4.41	2520	0.0454	79.17	142.50	59.29	3	63	NE	122	135	SE
2009	HERG	5799	1664	3.49	2210	0.1093	76.47	120.56	22.30	360	22	N	45	135	SE
Overall	SUSC	12463	709	17.58	6908	0.1669	73.96	108.41	8.01	246	254	W	262	180	S
Mar-08	SUSC	2181	71	30.72	934	0.5795	52.55	59.85	5.18	327	332	NW	338	0	N
Apr-08	SUSC	3048	142	21.46	1328	0.7486	40.63	43.60	2.73	43	46	NE	49	45	NE
Nov-08	SUSC	2348	52	45.15	2318	0.9013	25.46	26.12	1.12	225	226	SW	227	225	SW
Dec-08	SUSC	1029	41	25.10	292	0.3145	67.09	87.14	20.32	153	173	S	194	180	S
Feb-09	SUSC	1165	121	9.63	426	0.3650	64.57	81.35	14.05	270	285	W	299	225	SW
Mar-09	SUSC	664	84	7.90	246	0.3937	63.09	78.23	17.03	351	8	N	25	45	NE
Apr-09	SUSC	604	48	12.58	462	0.7846	37.60	39.90	4.14	46	50	NE	54	45	NE
Nov-09	SUSC	435	16	27.19	435	0.6638	46.98	51.87	6.09	208	214	SW	220	180	S
Spring2008(MAM)	SUSC	5230	214	24.44	2263	0.5571	53.92	61.97	3.52	18	22	N	25	45	NE
Spring2009(MAM)	SUSC	1292	133	9.71	732	0.6226	49.78	55.78	5.23	39	44	NE	49	45	NE
2008	SUSC	8828	336	26.27	5021	0.2378	70.74	97.10	6.49	243	250	W	256	225	SW
Overall	DCCO	10892	394	27.64	10730	0.2249	71.34	98.98	4.70	294	299	NW	303	180	S
Apr-08	DCCO	1846	64	28.84	1837	0.8318	33.23	34.77	1.75	21	22	N	24	0	N
May-08	DCCO	717	63	11.38	665	0.6898	45.13	49.38	4.58	35	40	NE	45	45	NE
Sep-08	DCCO	218	15	14.53	218	0.2825	68.63	91.10	26.92	268	295	NW	322	270	W
Oct-08	DCCO	4157	99	41.99	4154	0.8023	36.03	38.03	1.30	240	241	SW	242	225	SW
Apr-09	DCCO	1869	60	31.15	1844	0.7984	36.38	38.45	1.97	29	31	NE	33	45	NE
Oct-09	DCCO	931	19	49.00	927	0.1213	75.95	117.68	31.81	334	6	N	38	45	NE
Spring2008(MAM)	DCCO	2563	127	20.18	2502	0.7874	37.36	39.62	1.76	25	26	NE	28	45	NE
Autumn2008(ASON)	DCCO	5268	130	40.52	5265	0.7909	37.05	39.24	1.20	241	242	SW	243	225	SW
Spring2009(MAM)	DCCO	1972	83	23.76	1895	0.7903	37.10	39.31	2.00	28	30	NE	32	45	NE
Autumn2009(ASON)	DCCO	1053	31	33.97	1039	0.1088	76.49	120.68	33.78	285	319	NW	352	225	SW
2008	DCCO	7861	275	28.59	7790	0.3606	64.79	81.83	3.29	262	266	W	269	225	SW
Jan-08	BLSC	1369	51	26.84	589	0.7418	41.17	44.28	4.19	145	149	SE	153	135	SE
Feb-08	BLSC	187	9	20.78	92	0.6104	50.57	56.93	15.54	291	306	NW	322	315	NW
Dec-08	BLSC	1642	37	44.38	1344	0.6888	45.20	49.47	3.23	180	183	S	186	180	S
Mar-09	BLSC	634	57	11.12	479	0.8060	35.69	37.63	3.78	357	1	N	5	0	N

Table 2-11 (*continued*). Mean angle and median angle for total birds and individual species in the given time period.

Time Period	Species[1]	Abundance	#Observations	Cluster Size	N[2]	R[3]	AngDev[4]	CircSD[5]	Dev[6]	Mean Angle				Median Angle	
										CI_low[7]	Mean	Direction	CI_high[8]	Median[9]	Direction
Dec-09	BLSC	737	40	18.43	386	0.3127	67.18	87.37	17.68	159	177	S	194	180	S
Winter2008(DJF)	BLSC	1556	60	25.93	681	0.5664	53.36	61.09	6.28	146	152	SE	158	135	SE
Winter2010(DJF)	BLSC	737	40	18.43	386	0.3127	67.18	87.37	17.68	159	177	S	194	180	S
Jan-08	SCAU	750	1	750.00	90	0.4430	60.47	73.11	25.00	31	56	NE	81	90	E
Jan-09	SCAU	4617	32	144.28	3917	0.1350	75.36	114.66	13.29	357	10	N	23	45	NE
Winter2008(DJF)	SCAU	750	1	750.00	143	0.5660	53.38	61.13	13.90	61	75	E	89	90	E
Winter2009(DJF)	SCAU	4617	32	144.28	3917	0.1350	75.36	114.66	13.29	357	10	N	23	45	NE
2009	SCAU	4617	32	144.28	3917	0.1350	75.36	114.66	13.29	357	10	N	23	45	NE
Jan-08	LTDU	603	57	10.58	90	0.4430	60.47	73.11	25.00	31	56	NE	81	90	E
Feb-08	LTDU	82	8	10.25	53	0.8493	31.45	32.74	9.81	82	91	E	101	90	E
Feb-09	LTDU	2483	265	9.37	697	0.3373	65.96	84.48	11.98	311	323	NW	335	180	S
Mar-09	LTDU	723	87	8.31	214	0.2752	68.98	92.04	28.04	267	295	NW	323	225	SW
Dec-09	LTDU	441	72	6.13	187	0.4091	62.29	76.61	18.74	183	202	S	221	180	S
Winter2008(DJF)	LTDU	685	65	10.54	143	0.5660	53.38	61.13	13.90	61	75	E	89	90	E
Winter2009(DJF)	LTDU	4152	404	10.28	1055	0.2726	69.11	92.38	12.31	303	315	NW	327	180	S
Winter2010(DJF)	LTDU	441	72	6.13	187	0.4091	62.29	76.61	18.74	183	202	S	221	180	S
2009	LTDU	5195	563	9.23	1482	0.2508	70.14	95.29	11.34	282	293	NW	304	180	S
Feb-08	COLO	97	62	1.56	2	0.3827	63.66	79.41	0.00	203	203	SW	203	202.5	SW
Feb-09	COLO	979	333	2.94	5	0.5596	53.77	61.74	0.00	240	240	SW	240	225	SW
May-09	COLO	617	352	1.75	62	0.7396	41.35	44.50	13.30	39	52	NE	66	45	NE
Mar-08	GULG	832	29	28.69	165	0.6120	50.47	56.78	11.44	324	335	NW	347	225	SW
Jan-09	GULG	1991	17	117.12	26	0.7830	37.75	40.08	18.48	223	241	SW	260	270	W
Feb-09	GULG	1362	42	32.43	168	0.5681	53.25	60.93	12.73	142	155	SE	168	180	S
Sep-09	GULG	473	14	33.79	19	0.2075	72.13	101.61	0.00	170	170	S	170	180	S
Oct-09	GULG	598	32	18.69	78	0.4309	61.13	74.35	28.07	8	36	NE	64	45	NE
Nov-09	GULG	875	21	41.67	430	0.8963	26.09	26.81	2.69	180	183	S	186	180	S
Dec-09	GULG	472	16	29.50	31	0.3433	65.66	83.78	83.47	87	170	S	254	135	SE
Winter2009(DJF)	GULG	3377	67	50.40	218	0.4085	62.32	76.66	17.33	153	171	S	188	180	S
Autumn2009(ASON)	GULG	1989	72	27.63	529	0.6860	45.41	49.75	5.20	175	180	S	185	180	S
Winter2010(DJF)	GULG	472	16	29.50	31	0.3433	65.66	83.78	83.47	87	170	S	254	135	SE
2009	GULG	6129	204	30.04	1017	0.3601	64.82	81.89	9.17	184	193	S	202	180	S
Apr-08	SCOT	1607	50	32.14	1319	0.7840	37.66	39.97	2.45	53	55	NE	58	45	NE
Dec-08	SCOT	1328	8	166.00	1326	0.9507	17.99	18.22	1.01	178	179	S	180	180	S
Jan-09	SCOT	2811	33	85.18	450	1.0000	0.00	0.00	0.00	90	90	E	90	90	E
Winter2009(DJF)	SCOT	4943	74	66.80	1785	0.7507	40.46	43.39	2.34	157	159	S	162	180	S
May-08	LAGU	712	237	3.00	603	0.1480	74.79	112.00	32.29	184	217	SW	249	180	S
Jun-08	LAGU	531	315	1.69	421	0.0254	79.99	155.31	0.00	180	180	S	180	180	S

Table 2-11 (*continued*). Mean angle and median angle for total birds and individual species in the given time period.

Time Period	Species[1]	Abundance	#Observations	Cluster Size	N[2]	R[3]	AngDev[4]	CircSD[5]	Dev[6]	Mean Angle				Median Angle	
										CI_low[7]	Mean	Direction	CI_high[8]	Median[9]	Direction
Jul-08	LAGU	673	415	1.62	589	0.0729	78.02	131.14	61.62	180	241	SW	303	180	S
Aug-08	LAGU	1349	473	2.85	994	0.2657	69.43	93.28	13.05	9	22	N	36	90	E
Sep-08	LAGU	580	334	1.74	486	0.2539	69.99	94.88	19.84	4	24	NE	44	135	SE
Oct-08	LAGU	1027	298	3.45	708	0.3565	65.00	82.29	11.15	256	267	W	278	225	SW
Nov-08	LAGU	1738	199	8.73	458	0.2485	70.24	95.61	20.96	291	312	NW	333	180	S
May-09	LAGU	215	151	1.42	193	0.2611	69.65	93.89	31.61	338	10	N	41	90	E
Jun-09	LAGU	466	286	1.63	329	0.1282	75.66	116.14	56.97	8	65	NE	122	135	SE
Aug-09	LAGU	767	375	2.05	537	0.1728	73.69	107.36	28.87	336	5	N	34	135	SE
Sep-09	LAGU	251	180	1.39	166	0.0555	78.75	137.78	0.00	288	288	W	288	135	SE
Oct-09	LAGU	1334	170	7.85	482	0.2749	69.00	92.08	18.23	194	212	SW	230	180	S
Summer2008(JJ)	LAGU	1204	730	1.65	1010	0.0484	79.04	140.99	37.99	192	230	SW	268	180	S
Autumn2008(ASON)	LAGU	4694	1304	3.60	2646	0.1733	73.67	107.28	12.51	324	336	NW	349	135	SE
Summer2009(JJ)	LAGU	466	286	1.63	329	0.1282	75.66	116.14	56.97	8	65	NE	122	135	SE
Autumn2009(ASON)	LAGU	2404	757	3.18	1235	0.0743	77.96	130.65	48.54	211	259	W	308	180	S
May-08	GBBG	341	189	1.80	185	0.0890	77.34	126.04	0.00	35	35	NE	35	135	SE
Jun-08	GBBG	127	97	1.31	89	0.3293	66.36	85.40	37.03	66	103	E	140	90	E
Aug-08	GBBG	147	121	1.21	83	0.3994	62.80	77.63	29.97	211	241	SW	271	225	SW
Sep-08	GBBG	379	255	1.49	229	0.0747	77.94	130.50	0.00	166	166	S	166	180	S
Jun-09	GBBG	146	119	1.23	127	0.2261	71.28	98.81	49.03	347	36	NE	85	135	SE
Aug-09	GBBG	169	140	1.21	98	0.2897	68.29	90.19	41.34	202	243	SW	284	225	SW
Sep-09	GBBG	174	99	1.76	69	0.1885	72.99	104.67	41.88	323	5	N	47	135	SE
Oct-09	GBBG	471	212	2.22	146	0.0817	77.65	128.24	0.00	286	286	W	286	180	S
Summer2009(JJ)	GBBG	146	119	1.23	127	0.2261	71.28	98.81	49.03	347	36	NE	85	135	SE
Jun-08	WISP	400	199	2.01	400	0.4208	61.67	75.39	12.23	180	192	S	204	180	S
Jul-08	WISP	446	251	1.78	314	0.1823	73.27	105.71	36.75	75	112	E	148	135	SE
Aug-08	WISP	1251	175	7.15	1060	0.7430	41.08	44.16	3.11	355	359	N	2	0	N
Aug-09	WISP	374	321	1.17	368	0.0319	79.73	150.42	0.00	218	218	SW	218	180	S
Sep-09	WISP	281	247	1.14	266	0.2317	71.02	97.99	30.42	111	141	SE	172	135	SE
Summer2008(JJ)	WISP	846	450	1.88	714	0.2611	69.65	93.89	15.75	159	175	S	190	180	S
Jun-08	COTE	339	195	1.74	337	0.1592	74.30	109.83	41.59	170	211	SW	253	180	S
Jul-08	COTE	366	181	2.02	334	0.2160	71.75	100.31	29.09	125	154	SE	183	135	SE
Aug-08	COTE	798	354	2.25	775	0.2052	72.24	101.98	19.65	193	212	SW	232	180	S
Sep-08	COTE	392	133	2.95	386	0.2370	70.78	97.23	24.20	325	349	N	13	135	SE
May-09	COTE	175	83	2.11	171	0.2668	69.38	93.14	32.99	181	214	SW	247	180	S
Jun-09	COTE	290	202	1.44	288	0.0690	78.18	132.48	0.00	150	150	SE	150	135	SE
Aug-09	COTE	129	99	1.30	129	0.1445	74.95	112.70	49.76	187	237	SW	287	180	S
Summer2008(JJ)	COTE	705	376	1.88	671	0.1648	74.05	108.81	26.97	151	178	S	205	180	S
Summer2009(JJ)	COTE	290	202	1.44	288	0.0690	78.18	132.48	0.00	150	150	SE	150	135	SE
Jul-08	COSH	117	44	2.66	44	0.2497	70.19	95.45	52.40	49	101	E	154	135	SE

Table 2-11 (*continued*). Mean angle and median angle for total birds and individual species in the given time period.

Time Period	Species[1]	Abundance	#Observations	Cluster Size	N[2]	R[3]	AngDev[4]	CircSD[5]	Dev[6]	Mean Angle				Median Angle	
										CI_low[7]	Mean	Direction	CI_high[8]	Median[9]	Direction
Aug-09	COSH	72	65	1.11	65	0.3006	67.76	88.83	51.51	82	134	SE	185	135	SE
Summer2008(JJ)	COSH	188	87	2.16	97	0.1485	74.77	111.91	27.11	41	68	E	95	135	SE
Jul-08	TESM	72	11	6.55	72	0.3316	66.25	85.14	41.76	152	193	S	235	180	S
Aug-08	PASS	118	58	2.03	118	0.7602	39.68	42.42	8.94	304	313	NW	321	315	NW
Sep-08	SHSM	200	3	66.67	200	0.9887	8.62	8.64	1.21	222	223	SW	225	225	SW
Oct-08	SHSM	533	5	106.60	171	0.9837	10.33	10.37	1.58	226	227	SW	229	225	SW
Oct-08	FOTE	688	81	8.49	593	0.4557	59.78	71.84	9.06	187	196	S	205	180	S
Nov-08	CANG	2548	22	115.82	2548	0.9470	18.65	18.91	0.75	215	216	SW	217	225	SW
Autumn2008(ASON)	CANG	2637	26	101.42	2637	0.9341	20.80	21.15	0.84	217	218	SW	219	225	SW
Jan-09	GRSC	1568	9	174.22	68	0.4918	57.76	68.26	25.26	197	223	SW	248	225	SW
Nov-09	RTLO	892	259	3.44	799	0.8227	34.12	35.79	2.75	213	215	SW	218	225	SW

[1] BLSC Black Scoter
CANG Canada Goose
COLO Common Loon
COSH Cory's Shearwater
COTE Common Tern
DCCO Double-crested Cormorant
FOTE Forster's Tern
GBBG Great black-backed Gull
GRSC Greater Scaup
GULG gull large (unknown)
HERG Herring Gull
LAGU Laughing Gull
LTDU Long-tailed Duck
NOGA Northern Gannet
PASS passerine
RTLO Red-throated Loon
SCAU scaup (unknown)
SCDW scoter dark-winged (unknown)
SCOT scoter (unknown)
SHSM shorebird (small)
SUSC Surf Scoter
TESM tern (small)
WISP Wilson's Storm-Petrel

[2] N = avian abundance summed over those observations with available flight directional data (i.e., number used for flight direction analysis). This is distinct from the abundance column which is the total birds observed regardless of availability of flight directional data

[3] r = mean vector, used to divide the flight directions (angles) into horizontal (X = r*cos(angle)) and vertical (Y = r*sin(angle)) components: r^2 = X^2 + Y^2.

[4] AngDev = Angular Deviation

[5] CircSD = Circular Deviation

[6] Dev = Deviation

[7] CI Low = Low Confidence Interval/low bound

[8] CI High = Low Confidence Interval/high bound

[9] Median = Directional median (8 cardinal directions)

In the summer seasons, mean angles are distributed relatively more uniformly across the eight octants, reflecting relatively higher variability in this season compared to the other three seasons. For example, for total birds, the highest frequency distribution of flight direction among the eight octants is only 17.67% (S octant) in summer 2008 and 18.14% (SE octant) in summer 2009. Thus, unlike the other three seasons, there is no case in either of the two summer seasons in which the frequency distribution in any octant is higher than 20%, reflecting relatively higher uniformity in flight direction (correlating with high variability in mean angle, reflected by a wide 95% confidence interval) during the summer. As expected, integrating to obtain annual (2008, 2009) and two-year average frequency distributions, in most cases the distributions across the eight octants are more uniform than in the seasonal and monthly distributions, since the shorter-term variability is averaged in the longer-term integration. Conversely, also as expected, in most cases the individual monthly frequency distributions across the eight octants are more highly variable (i.e., less uniform) than the seasonal frequency distributions.

Results for individual species generally agree with those discussed above for total species, as shown in **Table E-1**. Generally, in most cases with total birds and individual species, as the length (duration) of the time period increases (i.e., from monthly to seasonal to annual to overall cumulative two-year period), the frequency distribution of flight direction across the eight octants becomes more uniform (less variable).

The more uniform (less variable) the frequency distribution of flight directions, the less variable is the mean angle (mean flight direction), reflected in a widening of the 95% CI (which measures the degree of variability or uncertainty) around the mean angle. Numerous statistical tests (e.g., Rayleigh, V-test, Hodges-Ajne, Batschelet) were conducted to assess the significance of mean angle, by testing the null hypothesis (H_o) of circular uniformity (no mean angle/direction). The Rayleigh and V-tests assume a unimodal distribution, whereas the Hodges-Ajne tests are Omnibus tests, in which the distribution can be unimodal, bimodal, or multi-modal. The nonparametric Wilcoxon test was conducted to test for the degree of symmetric distribution around the mean angle, by testing for significant differences between mean angle and median angle. The nonparametric X^2 and Watson's U^2 tests and the K-S and Kuiper tests were conducted to test for deviations from circular uniformity. Results of these statistical tests are given in **Tables E-2** to **E-10** in **Appendix E**: Rayleigh test (**Table E-2**), V-test (**Table E-3**), Hodges-Ajne test (**Table E-4**), Batschelet test (**Table E-5**), Wilcoxon test (**Table E-6**), X^2 test (**Table E-7**), Watson's U^2 test (**Table E-8**), K-S test (**Table E-9**), and Kuiper test (**Table E-10**). In each test, the relevant test statistic is calculated and summarized along with the critical value evaluated at the 95% confidence level, as well as the decision of whether to accept or reject H_o, and the associated P-value. Tests are conducted for total birds for all time periods (monthly, seasonal, annual, and overall cumulative two-year period), and for individual species only for those time periods in which the given species is included in the list of top-five most abundant birds (to ensure an adequate sample size).

Results of these hypothesis tests show that, in the majority (though not all) of cases and combinations of species and time periods, the H_o of circular uniformity is rejected, suggesting that a significant mean flight direction (mean angle) exists. These results support the visual results discussed earlier for mean angle. Frequency distribution of flight directions across the eight octants generally exhibits a distinct mean flight direction (mean angle) especially in the migration seasons, with an expected general northward tendency in spring and southward tendency in fall/winter. The frequency distributions of flight directions across the eight octants is, in many cases, far from uniform, with percentage distributions in any one octant often exceeding 20% especially in migration seasons, compared to an expected frequency distribution of 12.5% in each octant if a completely uniform distribution is assumed. In summary, the results that were visually detected in the earlier analyses of mean angle and frequency distributions across the eight octants have been statistically confirmed and validated with these various hypothesis tests.

2.3.6 Incidental Data

2.3.6.1 Avian Shipboard Out-Zone Data

After primary "survey valid"/in-zone avian data was collected, the avian observer opportunistically recorded data birds (>50 individuals) in the out-zone (i.e., "survey not valid"), beyond the 300-m X 300-m strip survey transect. Seasonal out-zone data of the shipboard avian surveys were compiled to provide

data on the number of flocking birds (n>50) present in the out-zone. All flocks detected over land during the surveys were eliminated from the flock database. Species with less than five observations per year or season were eliminated from the database. Out-zone abundances were mapped for total birds and bird guilds or species that had greater than five observations per season (**Appendix H: Figures H-1** through **H-23**). Incidental out-zone data cannot be compared directly with in-zone data because the primary survey effort responsibility of the single avian observer was the 300 X 300 m in-zone (i.e., in-zone and out-zone survey effort were not equal).

2.3.6.2 Boat Location

Boat (commercial and recreational) location data was recorded during avian shipboard, marine mammal shipboard, and marine mammal aerial surveys. Since collection of the primary data for each survey type took precedent over the collection of boat location data, the data collected cannot be considered inclusive of all the boats that may have been present during the surveys. Boat types (commercial, recreational) were not designated during times when primary survey tasks required the attention of the survey teams and therefore boat data was not separated by type. Boat location data for 2008 and 2009 were mapped for each survey type (**Appendix H: Figures H-24** through **H-26**).

3.0 AVIAN AERIAL SURVEYS

This chapter describes the avian aerial survey conducted for the NJDEP Baseline Studies Project on 16 April 2008. Survey design, methodology, results, and conclusions are presented. After review of the survey results, the NJDEP peer review committee determined that avian aerial surveys would be discontinued for the remainder of the project.

3.1 SURVEY DESIGN

The avian aerial survey design was based primarily on recommendations made by Camphuysen et al. (2004). A strip transect survey sampling design was selected to collect avian data. Transect lines were spaced 2 NM (2.3 miles [mi]) apart and orientated perpendicular to the coastline. The 34 transect lines were divided (even or odd numbered) and scheduled to be flown during separate morning and afternoon sessions (i.e., half in the morning and half in the afternoon). This design provided comparable spatial and temporal coverage of the entire Study Area.

3.2 SURVEY METHODOLOGY

On the day of the survey, a coin toss determined whether the surveys started at the north or south end of the survey area. Another coin toss determined whether the odd or even numbered survey transects were flown in the morning. After a mid-day break, the remaining transects were flown.

The survey aircraft was a twin-engine Cessna Skymaster 337. Surveys were flown at approximately 76.2 m (250 ft) altitude at a speed of approximately 220 kilometers per hour (kph; 110 kts per hour [hr]). Two avian biologists/observers conducted the avian strip transect surveys. A third scientist observer was responsible for ensuring the operational status of computer that was connected to the plane's GPS to accurately record transect sighting coordinates and transect start and end times. The data acquisition computer was interfaced with the aircraft GPS system. Automated data acquisition included the time, date, latitude, longitude, speed, and heading of the aircraft, and GPS signal strength; data were collected at 10-s intervals.

The two avian biologists were stationed at each of the back side windows; the other (third) scientist observer was stationed in the front seat next to the pilot. Avian observers recorded: transect number; transect start/end times (to the nearest second); transect side; identity (lowest practical taxon [four-letter standard code]; number of individuals (approximate number for flocks); distance bin (based on perpendicular distance from the aircraft's heading) and behavior (flying, foraging, etc.) with a digital voice recorder. The three distance bins were: A = 44 to163 m (144 to 535 ft); B = 164 to 432 m (538 to 1417 ft); and C = 433 to 1,000 m (1420 to 3281 ft). The declination in the degrees from the horizon were 60° to 25° for Bin A, 25° to 10° for Bin B, and 10° to 4° for Bin C for an aircraft flying at 76 m (250 ft) above mean sea level (AMSL). Prior to initiating the survey the biologists used an inclinometer to mark these bin lines on the aircraft window to aid in sorting observations into these distance bins. The avian biologists completed QA/QC protocols (see New Jersey Department of Environmental Protection Quality Assurance Work Plan Revision III; Geo-marine, Inc [GMI] 2008a) prior to take-off and after landing.

The avian aerial survey was conducted on 16 April 2008. Flying conditions during the survey were nearly perfect. Skies were clear, wind speeds were low (0 to 5 miles per hour [mph]), and the BSS ranged from 0 to 1. All 34 proposed transects were flown on 16 April (**Figure 3-1**). Transects were flown in an alternating pattern to provide data on temporal variation. The aerial survey was initiated at 8:52:13 AM Eastern Daylight Time (EDT) on Transect 1 (south end of the Study Area; see **Figure 3-1**). The morning flight ended at Transect 33 at 12:27:35 PM EDT. The afternoon flight started on Transect 2 at 2:12:32 PM EDT and ended at Transect 34 at 5:51:50 PM EDT. The total survey effort for the avian aerial survey was 7:04:54 hrs. The width of the strip transect was 0.956 km^2 (0.369 square miles [mi^2]). The total length of all transects flown was 1,098 km (593 NM [681.9 mi]) and the area surveyed was 1,050 km^2 (405.4 mi^2).

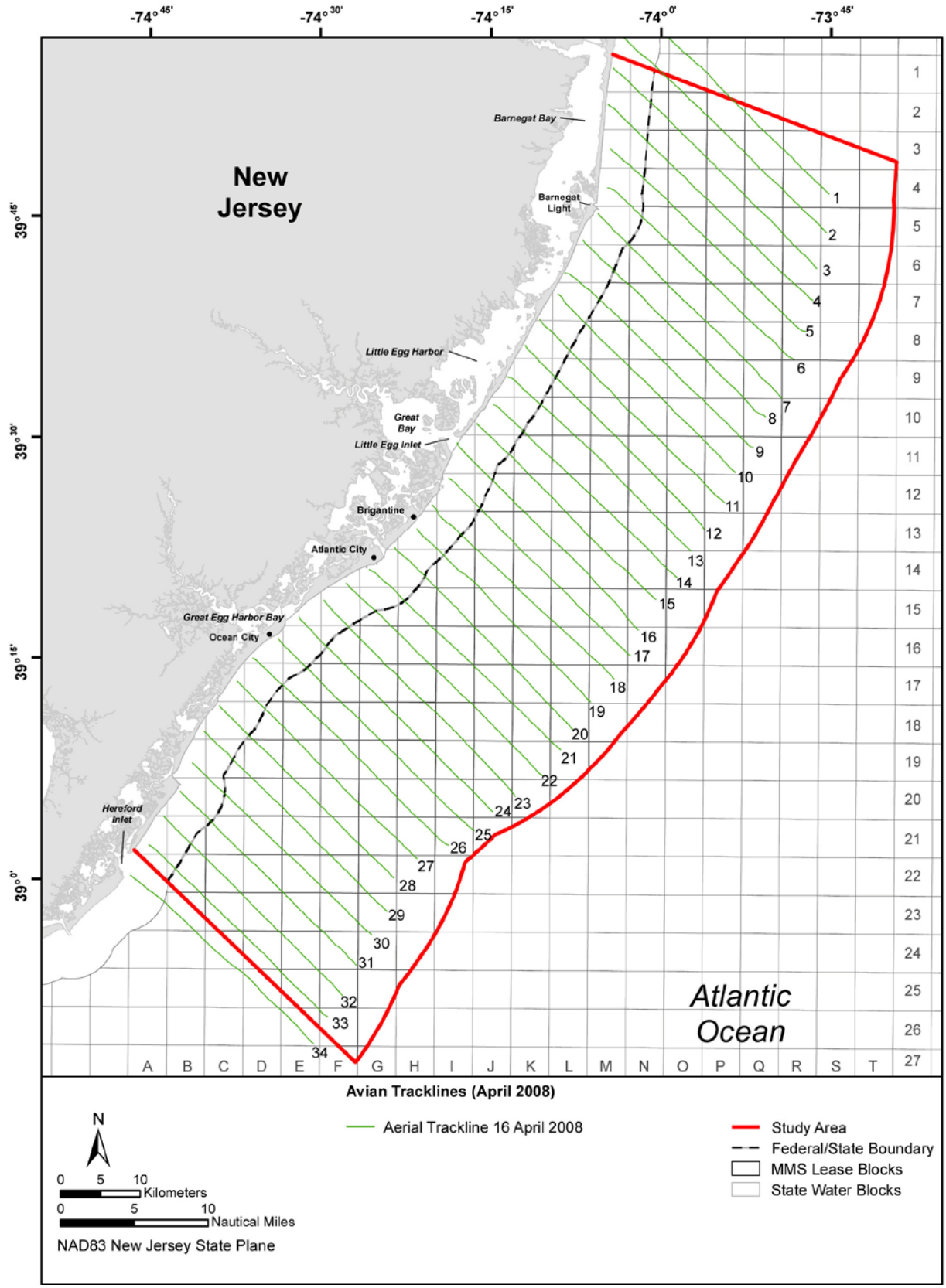

Figure 3-1. Avian aerial survey tracklines for 16 April 2008.

Transect data were transcribed from the digital voice recorders into an Excel spreadsheet. The voice recordings were not audible on one of the two recorders. An attempt was made to reduce background noise; however, the recording was still not audible. Only data from the audible recorder (half of the observed data) were analyzed.

3.3 SURVEY RESULTS AND CONCLUSIONS

Ten avian species were identified during the aerial survey ten in the morning and eight in the afternoon (**Table 3-1**). Five categories were used to designate birds that could not be identified to species. No federal or state-classified bird species were observed.

Table 3-1. Avian species observed during the 16 April 2008 aerial survey.

Family Common Name	Full-Day Survey	Morning	Afternoon
Anatidae (sea ducks)			
Surf Scoter	X		X
Black Scoter	X	X	
Scoter (unknown)	X	X	
Gaviidae (loons)			
Red-throated Loon	X	X	X
Common Loon	X	X	X
Loon (unknown)	X	X	X
Sulidae (gannets)			
Northern Gannet	X	X	X
Laridae (gulls, terns)			
Bonaparte's Gull	X	X	
Laughing Gull	X	X	X
Herring Gull	X	X	X
Great Black-backed Gull	X	X	X
Gull, small (unknown)	X	X	
Gull (unknown)	X	X	
Forster's Tern	X	X	
Unidentified			
Passerine	X	X	

Northern Gannet, Red-throated Loon, and Common Loon were the most abundant species detected during the aerial survey (**Table 3-2**). Temporal variation in abundance occurred between the morning and afternoon surveys; more birds were detected in the morning (332) than in the afternoon (199; **Table 3-2**). The primary differences between morning and afternoon counts were decreased numbers of Red-throated Loon and Common Loon. Many variables affect bird activity and behavior. For example, differences in morning and afternoon abundance may have resulted from decreased visibility from glare because of the clear weather conditions and/or increased diving activity (e.g., loons).

The total number of birds detected per transect (T) varied from 9 to 31 during the morning survey and from 1 to 43 during the afternoon (**Tables 3-3** and **3-4**). The highest number of individuals were detected on transects 25 and 27 in the morning and on transect 28 in the afternoon. More birds were detected in the northern half of the Study Area during the morning, with 177 birds present on the morning northern transects (odd-numbered transects 19 through 33) compared to 155 on the morning southern transects (odd-numbered transects 1 through 17). During the afternoon, the number of individuals on the northern half (even-numbered transects 20 through 34) of the Study Area was 108 and the southern half (even-numbered transects 2 through 18) had 91 individuals.

Table 3-2. Abundance[1] and percent numerical composition of birds observed during the 16 April 2008 aerial survey.

Family Common Name	Morning		Afternoon	
	Number	% Composition	Number	% Composition
Anatidae (sea ducks)				
Surf Scoter			15	7.5
Black Scoter	1	0.3		
Scoter (unknown)	1	0.3		
Gaviidae (loons)				
Red-throated Loon	67	20.2	18	9.1
Common Loon	59	17.8	9	4.5
Loon (unknown)	11	3.3	3	1.5
Sulidae (gannets)				
Northern Gannet	152	45.8	138	69.4
Laridae (gulls, terns)				
Bonaparte's Gull	2	0.6	3	1.5
Laughing Gull	2	0.6		
Herring Gull	25	7.5	5	2.5
Great Black-backed Gull	4	1.2	8	4.0
Gull, small (unknown)	1	0.3		
Gull, large (unknown)	3	0.9		
Forster's Tern	3	0.9		
Unidentified				
Passerine	1	0.3		
TOTAL	**332**		**199**	

[1] Total number of birds counted

During the 16 April 2008 avian aerial survey a total of 531 birds were detected. In contrast the average daily number of birds observed during the April offshore ship surveys (09, 10, 12 to 14 April) was 2,322. In April, offshore ship surveys had a total of 14.67 birds/km^2 compared to 0.50 birds/km^2 the 16 April aerial survey (**Table 3-5**). Offshore ship and aerial survey data were compared to determine if differences existed in species diversity and the detection of species.

As expected, April avian species diversity was higher during the four-day offshore ship survey than the one-day aerial survey because of the difference in survey effort. The number/km^2 for scoters, small gulls, and small terns were noticeably lower on the aerial survey than on the April offshore ship surveys. It is possible that the scoters observed on the offshore ship survey had migrated away from the Study Area prior to the aerial survey or that the dark-bodied scoters could not be distinguished during the aerial survey. Small gull and tern species (e.g., laughing gull, common tern) that are resident in the Study Area beginning in April may also occur as migrants throughout the spring. Small gulls and terns resting on the water at moderate distances from the ship can be difficult to see during the offshore survey, and unless they are flying, would be easy to miss on an aerial survey. Another possible explanation for the lower bird numbers for the aerial survey was the difference in weather conditions; the weather on 16 April (BSS of 0 to 1) was unusual for New Jersey coastal and offshore waters in April and differed from the weather for the offshore surveys (GMI 2008b).

Table 3-3. Morning avian species abundance[1] by transect during the 16 April 2008 aerial survey.

Family Common Name	Transect Number																
	T1	T3	T5	T7	T9	T11	T13	T15	T17	T19	T21	T23	T25	T27	T29	T31	T33
Anatidae (sea ducks)																	
Surf Scoter																	
Black Scoter						1											
Scoter (unknown)											1						
Gaviidae (loons)																	
Red-throated Loon	1	1	1	1		19	3	6	5	3		2	9	1	3	6	6
Common Loon	1	2	9	5	4		4	1	1	2	8	1	1	8	4	5	3
Loon (unknown)				1	1	1	1	1	1			1		2		1	1
Sulidae (gannets)																	
Northern Gannet	4	10	8	5	4	6	3	15	10	6	4	17	15	19	14	5	7
Laridae (gulls, terns)																	
Bonaparte's Gull						1					1						
Laughing Gull													1		1		
Herring Gull	3	3	2	2				1		2			4	1	3	3	1
Great Black-backed Gull		1										1	1				
Gull, small (unknown)		1															
Gull, large (unknown)				1											1		1
Forster's Tern		2	1														
Unidentified																	
Passerine																	
TOTAL	**9**	**20**	**21**	**15**	**9**	**28**	**12**	**24**	**17**	**13**	**14**	**22**	**31**	**31**	**26**	**21**	**19**

[1] number of individuals counted
T = Transect

Table 3-4. Afternoon avian species abundance[1] by transect during the 16 April 2008 aerial survey.

Family Common Name	Transect Number																
	T2	T4	T6	T8	T10	T12	T14	T16	T18	T20	T22	T24	T26	T28	T30	T32	T34
Anatidae (sea ducks)																	
Surf Scoter				15													
Black Scoter																	
Scoter (unknown)																	
Gaviidae (loons)																	
Red-throated Loon	1	1		1	2	1		1	1	1	1	3		2		1	2
Common Loon		2	1				1		2			1	2				
Loon (unknown)	2					1											
Sulidae (gannets)																	
Northern Gannet	5	2	7	9	5	6	15	8			2	13	10	37	8	6	5
Laridae (gulls, terns)																	
Bonaparte's Gull														3			
Laughing Gull																	
Herring Gull		1											2			2	
Great Black-backed Gull			1									1	2	1		3	
Gull, small (unknown)																	
Gull (unknown)																	
Forster's Tern																	
Unidentified																	
Passerine																	
TOTAL	**8**	**6**	**9**	**25**	**7**	**8**	**16**	**9**	**3**	**1**	**3**	**18**	**16**	**43**	**8**	**12**	**7**

[1] number of individuals counted
T = Transect

Table 3-5. Avian abundance and number of individuals per km^2 during the April 2008 offshore ship and aerial surveys.

Family Common Name	April Offshore Ship[1]		April Aerial	
	Number	No./km^2	Number	No./km^2
Anatidae (geese, ducks)				
Atlantic Brant	54	0.07		
Canada Goose	4	0.01		
Snow Goose	10	0.01		
American Black Duck	96	0.12		
Northern Pintail	25	0.03		
Green-winged Teal	1	*		
Duck (dabbling)	34	0.04		
Scaup (unknown), Lesser Scaup, Greater Scaup	4	0.01		
Duck (diving)	6	0.01		
Surf Scoter	2,408	3.04	15	0.01
Black Scoter	484	0.61	1	*
White-winged Scoter	8	0.01		
Scoter (dark-winged)	1,650	2.08		
Scoter (unknown)	1,425	1.80	1	*
Long-tailed Duck	3	*		
Bufflehead	2	*		
Red-breasted Merganser	19	0.02		
Duck (unknown)	102	1.02		
Gaviidae (loons)				
Red-throated Loon	564	0.71	85	0.08
Common Loon	271	0.34	68	0.06
Loon (unknown)	20	0.03	14	0.01
Podicipedidae (grebes)				
Horned Grebe	2	*		
Sulidae (gannets)				
Northern Gannet	2,793	3.53	290	0.28
Phalacrocoracidae (cormorants)				
Double-crested Cormorant	296	0.37		
Ardeidae (herons)				
Great Blue Heron	18	0.02		
Accipitridae (hawks, eagles)				
Osprey	4	0.01		
Laridae (gulls, terns)				
Little Gull	1	*		
Bonaparte's Gull	391	0.49	5	*
Laughing Gull	74	0.09	2	*
Ring-billed Gull	5	0.01		
Herring Gull	386	0.49	30	0.03
Lesser Black-backed Gull	1	*		
Great Black-backed Gull	101	0.13	12	0.01
Gull, large (unknown)	179	0.23	3	*
Royal Tern	1	*		
Common Tern	2	*		
Forster's Tern	108	0.14	3	*
Tern, small (unknown)	3	*		
Gull, small/tern	33	0.04	1	*

Table 3-5 (*continued*). Avian abundance and average number of individuals per on-effort hour during the April 2008 offshore ship and aerial surveys.

Family Common Name	April Offshore Ship[1]		April Aerial	
	Number	No./km^2	Number	No./km^2
Alcidae (auks)				
Dovekie	2	*		
Razorbill	4	0.01		
Unidentified				
Non-passerine[2]	11	0.02		
Passerine[3]	5	0.01	1	*
Unknown				
TOTAL	**11,610**	**14.67**	**531**	**0.50**

* <0.01 birds/km^2
[1] GMI 2008b
[2] Represents vultures and other non-water bird, non-passerine spp.
[3] Represents passerine spp. recorded over land, on shore, offshore, and/or on the survey vessel
Avg. = Average
No. = Number

Avian aerial surveys were initially scheduled for three separate occasions: once each in spring 2008, fall 2008, and spring 2009. After the April survey the efficacy of such limited surveying was discussed by the committee members, and the pros and cons of conducting aerial surveys were compared. Benefits consisted of better detection of peak activity (if conducted during peak activity) and a "snapshot" collection of avian data over the whole day. The negatives consisted of limited detection of small and darker-colored birds, the temporal variation of migration, the small number of planned surveys (considering the limited data already gathered), the safety of flying at low altitudes, and the cost involved. A vote was taken and it was decided to discontinue aerial surveys and instead increase radar validation surveys.

3.4 SUPPLEMENTAL AVIAN AERIAL SURVEY DATA

Avian aerial surveys were conducted offshore from northern New Jersey to just south of mouth of Chesapeake Bay, Virginia in 2001, 2002, and 2003 by the USFWS Chesapeake Bay Field Office (Forsell, D., pers. comm., 14 May 2010). The avian aerial surveys were conducted during two winters and one spring from 21 December 2001 through 08 March 2003. The aerial survey transects were flown perpendicular to shore from the coast to 22.2 km (12 NM) offshore. The aerial survey sample width was 120 m (393.7 ft). Birds were identified to the lowest identifiable taxa (i.e., species, guild, unidentified) and density maps (birds/km^2) were made for guilds and/or species.

All USFWS 2001-2003 avian aerial survey offshore data within the NJDEP EBS Study Area off the New Jersey was combined and density data was calculated for scoters (Black Scoter, Surf Scoter, White-winged Scoter, unidentified scoter), Northern Gannet, Common Loon, Red-throated Loon, and large Gulls (Herring Gull, Great Black-backed Gull, Lesser Black-backed Gull, large gull [unidentified]). Aerial survey density figures are presented in **Appendix N** and avian shipboard-small boat survey density figures are provided in **Appendix M**.

A general comparison was made between the avian densities of 2001-2003 USFWS avian aerial survey data and the 2007-2009 avian shipboard-small boat survey data collected during this study. In general, large density differences were not discernable between sitting and all behavior birds during the avian shipboard-small boat survey and therefore general comparisons were made with available data.

Scoter density during the aerial surveys was concentrated primarily along the coast in three areas, north and south of Barnegat Light, off of Little Egg Inlet, and south of Ocean City. In contrast, scoter density during the avian shipboard-small boat surveys conducted for this study was primarily along the coast from north of Little Egg Inlet south to Ocean City (**Figures N-1 and M-521**). The highest areas of Northern Gannet abundance were farther offshore during the avian aerial surveys than during the avian shipboard-small boat surveys (**Figures N-2 and M-522**). Common Loon density was similar between the aerial and avian shipboard-small boat surveys (**Figures N-3 and M-530**) Red-throated Loon density during the aerial surveys was highest in the vicinity of Barnegat Light and more concentrated within state waters. In contrast, during the avian shipboard-small boat surveys Red-throated Loon were present mostly outside of state waters (**Figures N-4 and M-130**). During the aerial surveys large gulls were more evenly distributed along all of the New Jersey coastline than during the avian shipboard-small boat surveys (**Figures N-5 and M-525** [Herring Gull, the most abundant large gull]).

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4.0 SUPPLEMENTAL AVIAN OFFSHORE AND ONSHORE SURVEYS

Supplemental shipboard avian surveys were conducted during December 2008 and from August through December 2009. Three types of supplemental surveys were conducted: shoal/station surveys, ship sawtooth transects, and land-based migration counts associated with shipboard transects. The objective of the shoal/station surveys was to help determine whether high densities of waterbirds occur in association with shoals. The objective of the shipboard sawtooth transect surveys was to determine whether increased survey effort would cause changes in abundance estimates of avian species. While the primary goal of the land-based counts and seawatch transect surveys was to determine the passage rates (number of birds/unit time) of migrating waterbirds relative to distance from shore.

4.1 FIELD SURVEY METHODOLOGY

4.1.1 Shoal Surveys

The USFWS identified the need to gather data on avian foraging locations, avian use of fishing locations, and the feeding and roosting locations of Northern Gannets. The station count method (Gould and Forsell 1989) was modified from a "snapshot" technique to continuous data collection to survey shoal areas. The survey area consisted of two concentric circles with the observer as the center of the circle. The radius of the first circle (A) ranged from 0 to 300 m (984 ft) and the radius of the second circle (B) ranged from 301 to 600 m (988 to 1969 ft).

A shoal-area map (**Section 2.3.3.1: Figure 2-8**) was generated via GIS, with shoals numbered sequentially from north to south. Shoal size varies in the Study Area (**Section 2.3.3.1: Figure 2-8**) and small shoals may require only one station, while larger shoals may have numerous stations. All shoal stations were located a minimum of 1 km (1.9 NM) apart. All other survey methodology and data-recording techniques remained consistent with those of the shipboard avian surveys (**Section 2.1.2; Appendix A**).

4.1.2 Ship Sawtooth Transect Surveys

Survey methodology was identical to that of the shipboard avian surveys (**Section 2.1.2**).

4.1.3 Seawatch: Land-based Counts/Shipboard Transect Surveys

This supplemental project was designed to determine abundance of fall-migrating waterbirds relative to distance from shore within the Study Area. It is important to stress that in this aspect of the study, only southbound waterbird migrants were counted; in all other aspects of the study, all birds were noted. Land-based surveys were conducted from Barnegat Light (39°45'30.21"N, 74°05'42.08"W) and from the north end of Avalon (39°06'35.13"N, 74°42'29.78"W). These sites were chosen for the ease of detecting southbound waterbird migration, as they project into the paths of these birds. The Avalon site has been used as a long-term waterbird migration count site by Cape May Bird Observatory and New Jersey Audubon Society[2] since before 1995. The seawatch land-based counts and shipboard transect surveys were conducted concurrently so that the migrant-passage rate along the coast could be determined to be ongoing or to have ceased, even during those times when the ship was out of sight of land.

Land-based survey methods at both sites were mirrored on those used by Cape May Bird Observatory[2] for its Avalon Seawatch waterbird migration count site in order to maintain consistency and comparability of methods. A single observer used a high-quality binocular and a high-quality spotting scope to locate migrating birds and flocks of birds over the Atlantic Ocean. At Barnegat Inlet, an assistant recorded data; however, the observer recorded the data at Avalon. Southbound birds were detected by scanning all airspace above the ocean surface in the entire arc visible from the count site (approximately 180° at Barnegat Inlet and approximately 135° at Avalon), with all detections recorded in 15-minute (min) increments. Parameters recorded included species (to lowest identifiable taxon), flock size and composition, and distance from shore (within or outside 2 km [1.1 NM] using known locations of buoys as distance markers).

Shipboard strip-transect surveys were conducted simultaneously with each seawatch survey along three 37.04-km (20-NM) transect lines spaced 2.78 km (1.5 NM) apart at their coastal origins and running perpendicularly from the coast to the offshore boundary of the project area (**Figure 4-1**). All three transects at each location were conducted on a given survey date and were considered replicates of a single sample. Start points were varied across sampling dates. Surveys were conducted from the north-facing side of the vessel and the single observer scanned the northerly 180° of view (stern to bow) for flying birds. As southbound flight is seasonally expected for fall migrants, all southbound birds crossing the transect line were recorded. Field methods were those of regular shipboard surveys (**Section 2.1.2**), except that only southbound flying birds detected in the northerly-facing 180° arc were recorded.

4.2 SURVEY EFFORT

4.2.1 Shoal Surveys

Shoal surveys were conducted 22-23 January 2009 for 12.33 hrs and covered seven shoals, once each, in the southern half of the Study Area

4.2.2 Ship Sawtooth Transect Surveys

Inclement weather limited survey efforts throughout fall 2009. Though 1-2 survey dates were scheduled for each available week of fall 2009, ship sawtooth transect surveys were conducted 14 times between 17 August and 08 December 2009, inclusive. Transects covered 1,398.28 km (755.01 NM; **Figure 4-2**) in 71.85 hrs.

4.2.3 Seawatch: Land-based Counts/Shipboard Transect Surveys

Six concurrent land-based seawatch and strip-transect surveys were conducted between 20 October and 04 December 2009, four at Avalon (22 October, 09 November, and 02 and 04 December) and two at Barnegat Light (20 October and 10 November). On 04 December at Avalon, one of the three transects was not conducted due to deteriorating weather conditions. Transects covered 635.44 km (343.11 NM) in 32.65 hrs, while the land-based survey effort totaled 36.75 hrs. Effort varied between the two survey types to ensure that all shipboard transect time was matched with land-based survey effort. The variation in effort had three causes: 1) start and/or end times could not be coordinated between ship and land, thus start and end times of the land-based survey effort were designed to encompass all shipboard transect time by starting earlier and/or ending later; 2) land-based survey efforts continued even when the ship was transiting between transects and not surveying; and 3) land-based counts were taken in mandatory 15-min intervals, even when the shipboard transects had been completed, therefore, ending after the shipboard transects. Seawatch transect-survey data were analyzed relative to distance from shore, in bands of 1.866 km (1.007 NM).

4.3 SURVEY RESULTS

4.3.1 Shoal Surveys

Although a very low survey effort did limit the amount of data collected, this supplemental survey effort did help to validate the importance of shoals as feeding areas for birds in general and for Northern Gannets in particular. Of the 928 birds recorded in-zone, over 70% (614) were Northern Gannets. The five most abundant species recorded during the shoal/station counts are presented in **Table 4-1**. The use of shoals was also verified during analysis of avian shipboard and coastal survey data (**Section 2.3.3.1; Chapter 8.0**), and various species accounts in **Appendices C** and **F**.

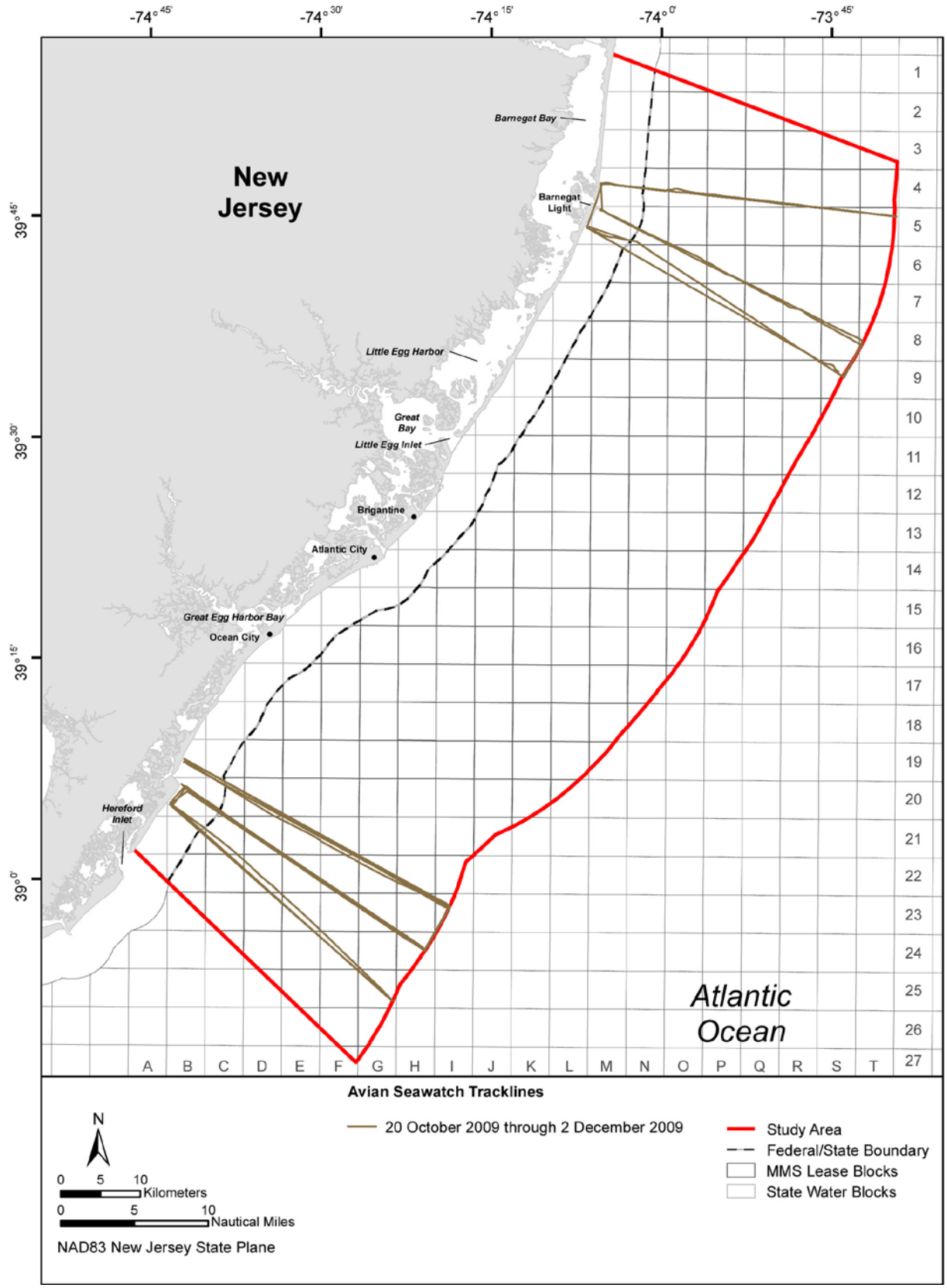


Figure 4-1. Seawatch shipboard transect tracklines, October-December 2009.

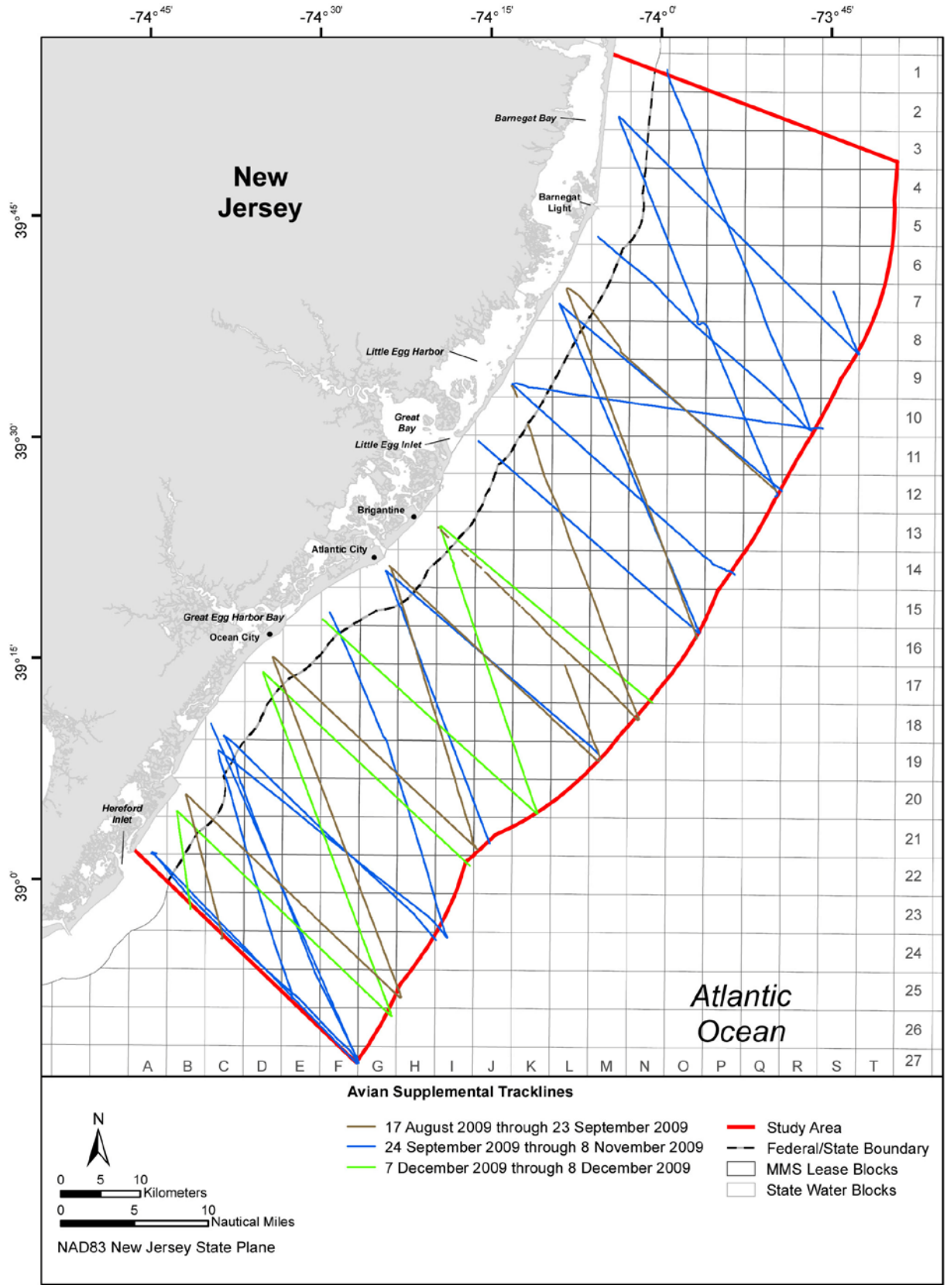


Figure 4-2. Supplemental sawtooth transect tracklines, August-December 2009.

Table 4-1. Five most numerous species, with overall total, detected on supplemental shoal and station surveys during January 2009.

Common Name	Number
Overall total (16 species)	**928**
Northern Gannet	614
Common Loon	99
Red-throated Loon	47
Black Scoter	35
White-winged Scoter	25

4.3.2 Ship Sawtooth Transect Surveys

The ten most abundant species recorded during the supplemental ship sawtooth transect surveys are presented in **Table 4-2**. For the most part, the additional survey effort conducted during this supplemental effort did not differ from the results of the regular shipboard transects during the same period; however, 237 Double-crested Cormorants were recorded during the supplemental surveys compared to only 17 during regular transects (**Appendix C: Table C-1**). This difference is due primarily to ship scheduling, as most regular transect effort in fall 2009 took place outside the period during which the bulk of Double-crested Cormorants migrate through the project area (Sibley 1997; see also **Section 4.3.2** concerning this species). Additionally, Laughing Gull comprised 19% of all birds detected on the supplemental transects and only 9% on the regular transects during the same period fall 2009 (**Appendix C: Table C-1**). These data suggest that the additional effort of offshore transects would have added materially to the understanding bird distribution and abundance, although at a finer temporal scale than intended by the scope of work.

Table 4-2. Ten most numerous species[1], with overall total and abundance, detected on supplemental sawtooth transects, August-December 2009, with standard shipboard offshore abundance for the same time period for comparison.

Common Name	Number	Supplemental Abundance[2]	Shipboard Abundance[2]
Overall total (32 species)	**2,934**	**2.10**	**1.33**
Northern Gannet	1,251	0.89	0.51
Laughing Gull	545	0.39	0.12
Double-crested Cormorant	236	0.17	0.01
Common Loon	150	0.11	0.05
Herring Gull	140	0.10	0.09
Great Black-backed Gull	123	0.09	0.07
Black Scoter	69	0.05	0.00
Scoter, dark-winged (unk.)	66	0.05	0.01
Red-throated Loon	54	0.04	0.02
Wilson's Storm-Petrel	53	0.04	0.19

[1] Includes avian observations within the 300-m x 300-m survey strip transect when the ship was traveling ≥7 kts
[2] Detected abundance = No. birds/km within the 300-m x 300-m survey strip transect when the ship was traveling ≥7 kts

4.3.3 Seawatch: Land-based Counts/Shipboard Transect Surveys

Land-based count efforts resulted in the detection of 31,169 migrating waterbirds of 38 species (**Table 4-3**). On shipboard transects, 3,925 migrating waterbirds of 30 species were detected. A combined total of 44 species was detected. Overall, shipboard-transect totals were only 12.6% of the land-based count totals (**Table 4-3**).

The four survey dates at Avalon spanned the time during which the bulk of the southbound waterbird migration passes the site (except for that of Double-crested Cormorant, noted above), but the two dates conducted at Barnegat Inlet both occurred after the main passage of Double-crested Cormorant and before the primary passage period of both Red-throated Loon and Northern Gannet (Sibley 1997). The three scoter species typically account for a large share of the waterbirds migrating past Avalon (Cape May Bird Observatory, unpubl. data) and, as a group, comprise the single largest portion of the annual Avalon count (Cape May Bird Observatory, unpubl. data). During our Avalon efforts, only the 09 November survey resulted in relatively high numbers of scoters; high single-day scoter counts at Avalon usually surpass 50,000 individuals (Cape May Bird Observatory, unpubl. data). Despite the relatively low numbers of scoters observed during these surveys, this group was still the most abundant, although the Northern Gannet total was the highest for a single species (**Table 4-3**). Scoters and Northern Gannet, together, accounted for nearly 68% of all birds counted at Barnegat Inlet and Avalon (**Table 4-3**).

More than 77% of all migrating individuals were within 9.26 km (5 NM) of shore; almost 61% were within 5.56 km (3 NM) of shore (**Tables 4-4** and **4-5**, **Figure 4-3**). The spike in abundance of total birds in the 11th bin is due to a single flock of 250 Double-crested Cormorants (of the 273 detected during the seawatch shipboard transect efforts). Although Double-crested Cormorant is one of the most abundant migrant waterbird species that passes through New Jersey in fall (Sibley 1997, Walsh et al. 1999), this project was scheduled to maximize species diversity. Thus, it was conducted outside the primary migration period of Double-crested Cormorant (September through mid-October (inferred from Sibley 1997), during which time few waterbird species are migrating.

Though nearly all species seen from the ship were detected throughout the width of the entire Study Area (shore to 37 km [20 NM] offshore), distribution and abundance is generally greater closer to shore and diminishes as distance from shore increased. The species or groups (scoters, Northern Gannet, Red-throated Loon, and gulls) highlighted in **Tables 4-4** and **4-5** were similar to that of all birds (**Figures 4-3** and **4-4**); however, the Common Loon's distribution and abundance was essentially even throughout the Study Area (**Figure 4-4**). The apparent peaks of abundance for Common Loon presented in **Figure 4-4** are due primarily to the combination of relatively low sample size and the occurrence of flocks of loons at nearly random locations. Its fall migration should be considered to be of a broad-front nature, rather than the coastal orientation of the migration routes of most waterbirds passing through New Jersey at that season.

Because the land-based counts and the shipboard transects were conducted concurrently, the much lower numbers of migrating waterbirds beyond 9.26 km (5 NM) relative to that inside 9.26 km can be shown to document actual occurrence. Overall, the land-based surveys yielded higher observations than offshore surveys.

Although these results are based on relatively few samples and, particularly, a small variety of seasonal and weather conditions, they do provide a clear pattern for southbound waterbird migration over New Jersey's marine waters: most fall-migrant waterbirds travel within sight distance of land. Thus, the long-running count of migrating waterbirds conducted at Avalon by the Cape May Bird Observatory and New Jersey Audubon Society is probably reasonably accurate in terms of the magnitude of the fall migration of waterbirds; however, caution is warranted, as distribution of migrating individuals of at least some species, such as Common Loon exhibit a more even dispersion in the Study Area. As the majority of individuals of such species pass Avalon out of sight of land, annual totals of actual migrants may be much larger than that provided by land-based counts. Further efforts to quantify abundance of migrant waterbirds relative to distance from land, with a larger variety of seasonal samples and of weather conditions, would allow for more accurate correlations of land-based migration counts to that of the actual magnitude of fall waterbird migration.

Table 4-3. Daily and total land-based seawatch counts in comparison with shipboard transect totals, Barnegat Inlet and Avalon, New Jersey, October-December 2009.

	Barnegat Inlet				Avalon						Totals		
	Land-based			Shipboard Total	Land-based					Shipboard Total	Land Total	Shipboard Total	Ship % of land
Species	10/20/09	11/10/09	Total		10/22/09	11/9/09	12/2/09	12/4/09	Total				
Land-based totals	3057	9591	12648	1229	3278	9656	3730	1857	18521	2696	31169	3925	12.6%
Scoters	1456	1201	2657	236	247	6590	1007	240	8084	1599	10741	1835	17.1%
Red-throated Loon	0	128	128	5	12	755	1869	1120	3756	168	3884	173	4.5%
Common Loon	33	49	82	28	14	5	5	14	38	128	120	156	130.0%
Northern Gannet	1292	4966	6258	517	2323	1502	320	0	4145	501	10403	1018	9.8%
Gulls	0	3380	3380	142	438	433	258	221	1350	143	4730	285	6.0%

Table 4-4. Abundance of five study species/species groups relative to distance from shore, Barnegat Inlet and Avalon, New Jersey, October-December 2009.

Species/ group	All birds		Scoters		Red-throated Loon		Common Loon		Northern Gannet		Gulls	
NM from shore	n	% of Total	n	% of Total	n	% of Total	n	% of Total	n	% of Total	n	% of Total
1	922	23.49	167	9.10	94	54.34	9	5.77	475	46.66	95	33.33
2	364	9.27	155	8.45	46	26.59	24	15.38	84	8.25	34	11.93
3	1106	28.18	934	50.90	6	3.47	6	3.85	112	11.00	35	12.28
4	459	11.69	373	20.33	8	4.62	2	1.28	50	4.91	15	5.26
5	196	4.99	98	5.34	4	2.31	7	4.49	46	4.52	21	7.37
6	55	1.40	12	0.65	3	1.73	4	2.56	31	3.05	5	1.75
7	23	0.59	0	0.00	0	0.00	7	4.49	7	0.69	6	2.11
8	33	0.84	0	0.00	0	0.00	15	9.62	10	0.98	5	1.75
9	73	1.86	28	1.53	0	0.00	5	3.21	27	2.65	8	2.81
10	56	1.43	22	1.20	5	2.89	8	5.13	15	1.47	3	1.05

Table 4-4 (*continued*). Abundance of five study species/species groups relative to distance from shore, Barnegat Inlet and Avalon, New Jersey, October-December 2009.

Species/ group	All birds		Scoters		Red-throated Loon		Common Loon		Northern Gannet		Gulls	
NM from shore	n	% of Total	n	% of Total	n	% of Total	n	% of Total	n	% of Total	n	% of Total
11	325	8.28	33	1.80	1	0.58	5	3.21	4	0.39	9	3.16
12	39	0.99	7	0.38	0	0.00	5	3.21	20	1.96	5	1.75
13	68	1.73	0	0.00	2	1.16	11	7.05	49	4.81	5	1.75
14	23	0.59	0	0.00	0	0.00	7	4.49	8	0.79	2	0.70
15	25	0.64	0	0.00	1	0.58	17	10.90	4	0.39	3	1.05
16	21	0.54	0	0.00	0	0.00	5	3.21	13	1.28	1	0.35
17	31	0.79	1	0.05	1	0.58	7	4.49	15	1.47	7	2.46
18	34	0.87	0	0.00	0	0.00	8	5.13	14	1.38	11	3.86
19	37	0.94	0	0.00	0	0.00	2	1.28	10	0.98	13	4.56
20	35	0.89	5	0.27	2	1.16	2	1.28	24	2.36	2	0.70
Totals	**3925**	**100**	**1835**	**100**	**173**	**100**	**156**	**100**	**1018**	**100**	**285**	**100**

Table 4-5. Cumulative abundance distribution in selected spans of distance from shore, Barnegat Inlet and Avalon, New Jersey, October-December 2009.

Species/ group	All birds		Scoters		Northern Gannet		Red-throated Loon		Common Loon		Gulls	
NM from Shore	n	% of Total	n	% of Total	n	% of Total	n	% of Total	n	% of Total	n	% of Total
1	922	23.49	167	9.10	475	46.66	94	54.34	9	5.77	95	33.33
2	1286	32.76	322	17.55	559	54.91	140	80.92	33	21.15	129	45.26
3	2392	60.94	1256	68.45	671	65.91	146	84.39	39	25.00	164	57.54
5	3047	77.63	1727	94.11	767	75.34	158	91.33	48	30.77	200	70.18
10	3287	83.75	1789	97.49	857	84.18	166	95.95	87	55.77	227	79.65
15	3767	95.97	1829	99.67	942	92.53	170	98.27	132	84.62	251	88.07
20	3925	100.00	1835	100.00	1018	100.00	173	100.00	156	100.00	285	100.00

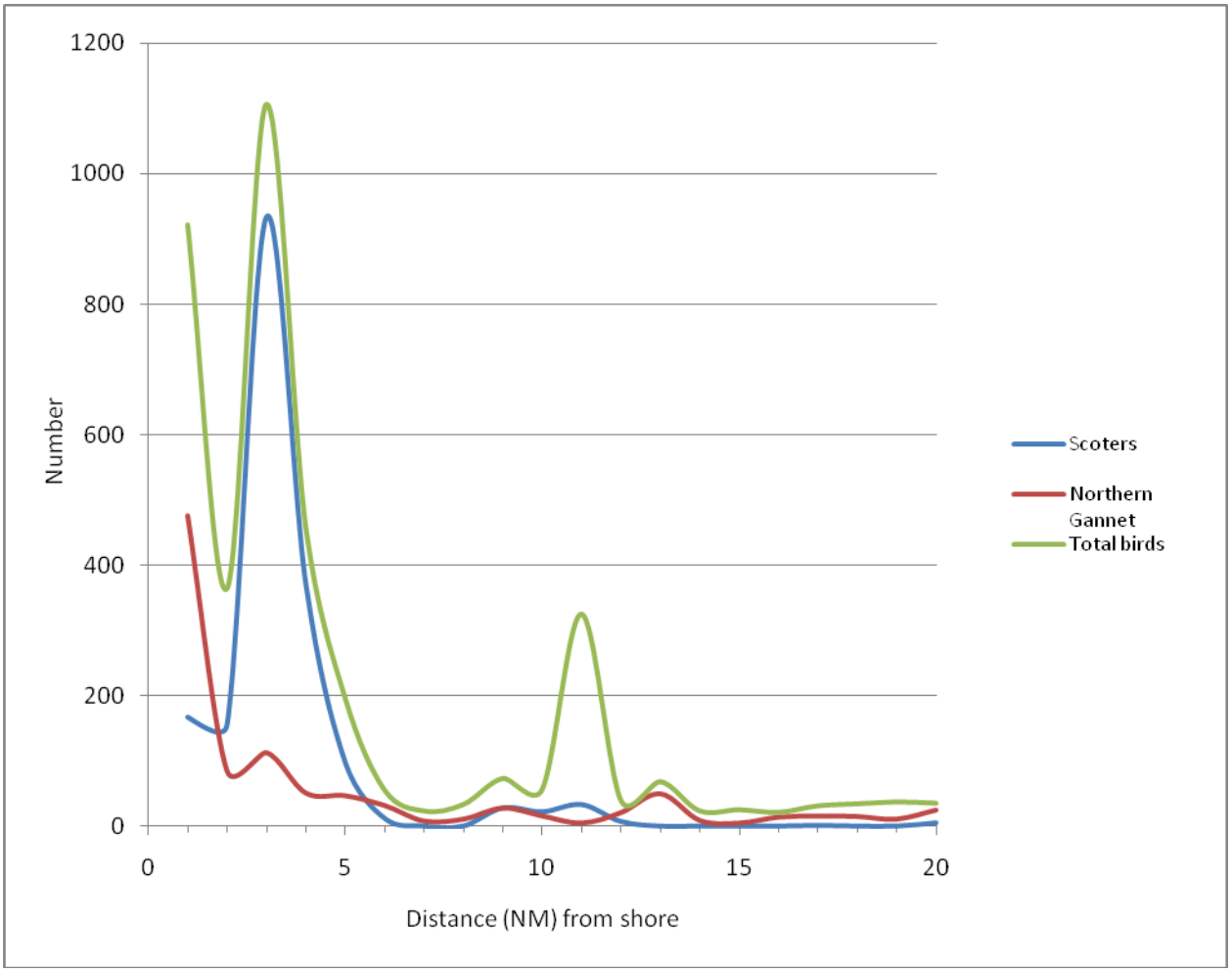


Figure 4-3. Number of individuals of all species and of scoters and Northern Gannet relative to distance from shore, Barnegat Inlet and Avalon, New Jersey, October-December 2009.

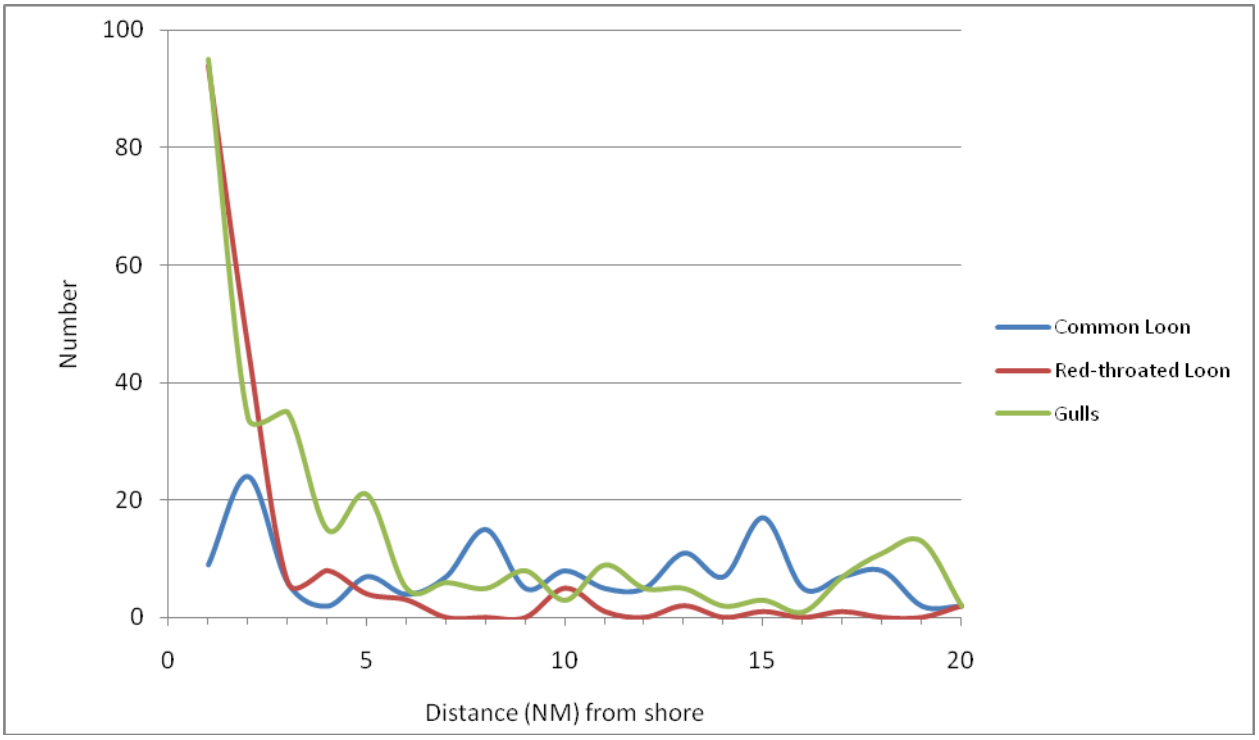


Figure 4-4. Number of individuals of Common Loon, Red-throated Loon, and all gulls relative to distance from shore, Barnegat Inlet and Avalon, New Jersey, October-December 2009.

5.0 AVIAN RADAR SURVEYS

The basic principles of radar ornithology are introduced in this chapter along with a description of the Mobile Avian Radar System (MARS®), the primary avian radar system GMI uses to monitor airborne targets (i.e., flight activity) in the Study Area. Survey design, methodology, and data analysis procedures are described in detail for each radar system used. Radar validation methods and results are presented and avian radar survey results are provided for offshore and onshore survey sites.

5.1 INTRODUCTION TO RADAR ORNITHOLOGY

Radar is an acronym for RAdio Detection and Ranging. All radars transmit a radio signal, and then receive the reflected signals (echoes) from objects in the atmosphere. The farther away a target, the longer it takes for an echo to return to the receiver and the weaker that echo is. Almost any object reflects radar signals; the strength of the echo is dependent upon the object's composition, the wavelength of the radar signal, the power of the signal, and the distance from the radar to the object. Metal objects reflect radar energy strongly; water and land reflect less strongly. A bird has approximately the same reflectivity as a similar mass of water. Bird echoes are small and weak relative to those of larger metal objects (e.g., boats, airplanes). Therefore, radars are only capable of detecting birds at shorter ranges. Empirical evidence shows that the strength of echoes, or "signals", from birds is generally related to: the wavelength of the radar signal (10 centimeters [cm; 4 inches (in.)] for S-band radars); 3 cm (1 in.; for X-band radars), the distance from the radar to the bird, the size of the bird, and the profile the bird presents towards the radar.

Bird targets are generally more difficult to detect at increasing distance from the radar because the size (reflectivity) of the return signal is smaller. The smaller the target (small reflective surface or cross-section), the more difficult it is for the radar to detect the target. Therefore, low numbers of small targets are more likely to be detected at 3 km (2 mi) from the radar than at 6 km (4 mi); larger targets (i.e., flocks or large birds) can be detected at greater distances (i.e., throughout the radar coverage area). No reliable method is known to discriminate between echoes produced by small birds and echoes produced by large birds, because several small birds in a radar pulse volume can have a combined mass similar to a single large bird and will produce a similar radar echo.

Radars work primarily along line-of-sight, and scan in a circular sweep; therefore, radars cannot detect targets behind other objects. Obstructions, such as towers or large vessels, create a shadow, which obscures objects behind them. Such obstructions, as well as the ground or sea (i.e., waves), also reflect energy back to the radar; these echoes are known as clutter echoes. Wave echoes are of similar or greater strength, than bird echoes, while tower and vessel echoes are usually much stronger than bird echoes. Combinations of topographic features (static and/or dynamic) and obstructions can block radar coverage and create "blind spots."

When the center of the beam of marine radar is horizontal, nearly half of the radar energy is directed below the horizontal and toward the sea. Sea state is directly affected by wind speed, and as the wind speed increases so does the amount of clutter from waves (**Section 5.4.1.3**). An increase in returned reflectivity from waves can obscure returned reflectivity from birds flying low above the surface of the water, because the returned signals from birds may not be distinguished from returned signals from the crest of waves. Birds flying behind and below a wave crest may not be detected, because of blockage of the radar signal.

5.2 MOBILE AVIAN RADAR SYSTEM (MARS®)

The MARS® consists of two radar systems (**Figure 5-1**):

- VerCat (X-band, 3-cm [1-in.] wavelength) determines the altitude and range of targets and is used to measure the flux of targets (the number of birds that passes through the vertical sample volume in a given unit of time).

- TracScan (S-band, 10-cm [4-in.] wavelength) determines the range, flight direction, speed, and heading of targets in a horizontal sample volume.

Figure 5-1. GMI MARS® showing both VerCat and TracScan antennae and transmitter/ receiver units.

Both VerCat and TracScan use commercially available marine-band radars to transmit radio signals and listen for echoes. **Tables 5-1** and **5-2** provide the VerCat and TracScan radar specifications for the offshore and onshore systems. These radars transmit for a very short duration (pulse length) and then listen for echoes until it is time to transmit the next pulse. The number of times per second that radar transmits a pulse and listens is the pulse repetition frequency (PRF). Radar manufacturers fix combinations of pulse length and PRF in the radar hardware. Commercially available marine-band radars effectively see in two dimensions, using the time between pulse and detection to determine the distance to the target, and the orientation of the radar antenna to determine bearing of the target.

5.2.1 VerCat Radar (X-band)

The MARS® VerCat radar scans a vertical, circular pattern of 20° from the horizon, through zenith to the opposite horizon (**Figure 5-2**). While the antenna is pointing below horizontal (i.e., toward the ocean), no signal is transmitted; however, given the 0.95° vertical resolution of the antenna, when the radar transmits a pulse horizontally, almost one half of the energy is projected in an approximate 0.5° arc below the horizon towards the water. The radar scans at 24 revolutions per minute (rpm), completing one scan (a full 360° rotation) every 2.5 s. Given a PRF of 2,200 times a second, VerCat can transmit 15.27 pulses for every degree of radar rotation. The radar signal is transmitted through a 2.4-m (8-ft) long array (T-bar) antenna (**Figure 5-1**). The antenna focuses the signals into a fan-shaped beam, which is 0.95° deep in the vertical scanning plane and extends 10° to either side of the scanning plane (20° total). Radar antennas are designed to operate scanning horizontally, not vertically. When the antenna is pointing at the sky, some radio energy leaks out the backside of the standard antenna and bounces off the ground. The MARS® VerCat antenna has been fitted with a custom-designed shield to minimize the impact of this ground-bounce clutter. **Figure 5-2** illustrates the coverage of the VerCat beam.

Table 5-1. Offshore MARS® radar parameters.

Radar Parameters	VerCat (Furuno FR-2155)	TracScan (Furuno FR-2165)
Band Type	X-band	S-band
Transmit Peak Power	50 kilowatts (kW)	60 kW
Transmit Frequency	9415 megahertz (MHz)	3040 MHz
Transmit Pulse Length	80 nanosecond (ns)	80 ns
Pulse Repetition Frequency	2200 hertz (Hz)	1900 Hz
Beamwidth	20° Horizontal	2.2° Horizontal
Beamwidth	0.95° Vertical	25° Vertical
Maximum Study Range	2.8 km downrange (1.5 NM) both directions; 5.5 km (18,200 ft; 3.0 NM) altitude	7.4 km (4 NM)
Antenna Polarization	Vertical	Horizontal
Wave Length	3 cm (1 in.)	10 cm (4 in.)

Table 5-2. Onshore MARS® radar parameters.

Radar Parameters	VerCat® (Furuno FR-2125)	TracScan® (Furuno FR-2135)
Band Type	X-band	S-band
Transmit Peak Power	25 kilowatts (kW)	30 kW
Transmit Frequency	9410 megahertz (MHz)	3050 MHz
Transmit Pulse Length	70 nanosecond (ns)	300 ns
Pulse Repetition Frequency	3000 hertz (Hz)	1100 Hz
Beamwidth	Horizontal 20°	Horizontal 1.8°
Beamwidth	Vertical 0.95°	Vertical 25°
Maximum Study Range	2.8 km (1.5 NM)	7.4 km (4 NM)
Antenna Polarization	Vertical	Horizontal
Wave Length	3 cm (1 in.)	10 cm (4 in.)

The VerCat scan pattern results in a “radar curtain,” that samples targets as they fly through the 20° by 180° scanning volume within 3 km (1.5 NM) of radar (horizontal) and up to 5.5 km (3 NM; vertical). The radar determines target altitude and downrange distance from the MARS® site. The VerCat beam depth of 0.95° provides fine angular resolution from which estimates of echo altitude can be determined. Targets flying along the axis of the VerCat scan can be tracked and accurate ground speeds measured; however, targets crossing perpendicular to the sweep of the beam appear stationary, and targets crossing the sweep at angles between parallel and perpendicular have ground speeds reduced from true ground speeds.

Because of the nature of X-band signal propagation in the atmosphere, and the generally smaller returns of targets in X-band, the operational range is limited to 3 km (1.5 NM). Furthermore, X-band is quite sensitive to precipitation (e.g., rain and high moisture content in the atmosphere) which obscures targets of interest. Wind speeds in excess of 15 to 18 m/s (49 to 59 ft/s) along the VerCat’s scan axis will trip the VerCat’s motor safety breaker. By shutting down operation, the radar protects itself from damage.

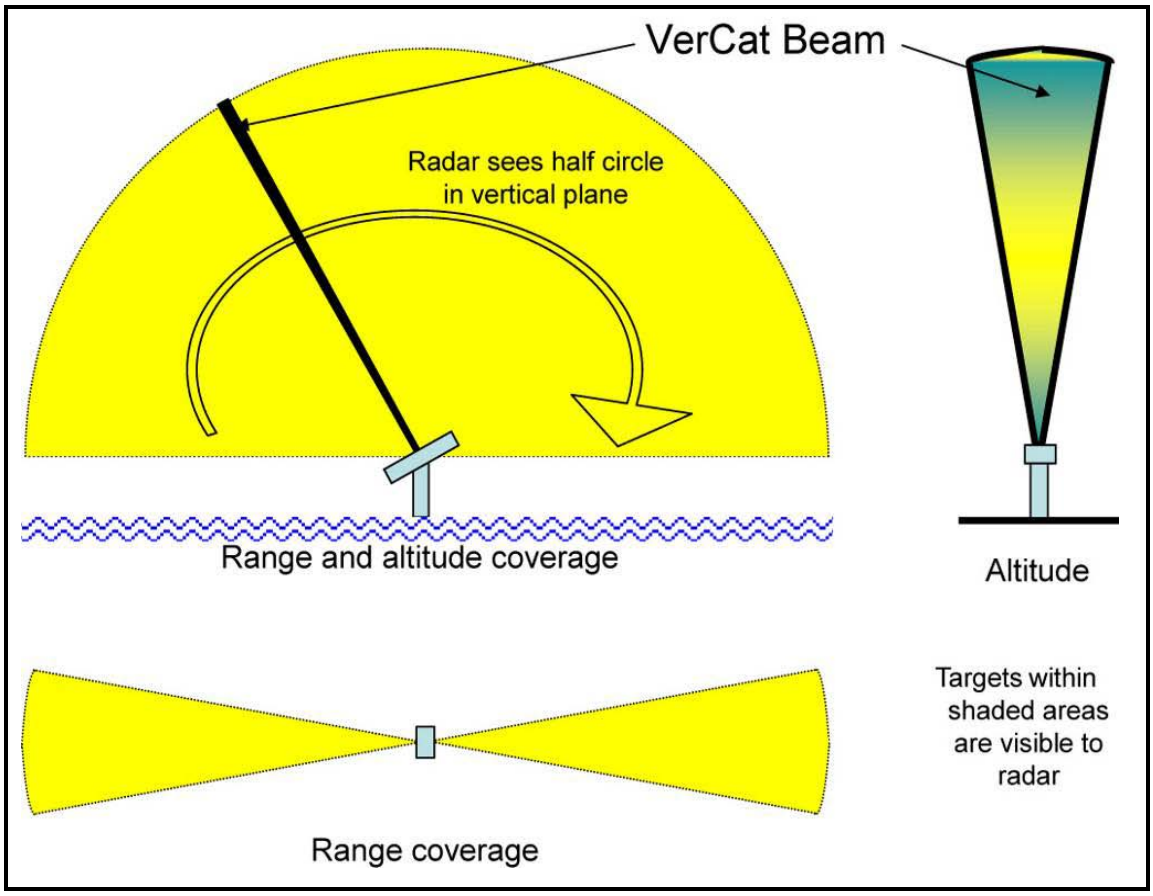


Figure 5-2. VerCat Coverage Pattern.

5.2.2 TracScan Radar (S-band)

The MARS® TracScan radar scans in the horizontal plane at 24 rpm, completing one scan (a full 360° rotation) every 2.5 s (**Figure 5-3**). Given a PRF of 1,900 pulses per second, TracScan can transmit 13.19 pulses for every degree of radar rotation. The radar signal is transmitted through an array (T-bar) antenna (**Figure 5-1**). This antenna focuses the signals into a fan-shaped beam, which is 2.2° wide in the horizontal plane and extends 12.5° above and below the horizontal plane (25° vertical beam width).

TracScan data are used to determine target position (range and bearing), speed, and heading. With its relatively wide beam width of 2.2°, TracScan is not the best radar to determine target size.

5.2.3 MARS® Surveillance Coverage

With VerCat and TracScan operating simultaneously, MARS® provides both horizontal and vertical coverage (**Figure 5-4**). The coverage for the TracScan range of 7.4 km (4 NM) is illustrated below. Concurrent radar coverage occurs only in the overlapping areas of the cross hatching of the VerCat and TracScan ranges. Therefore, targets detected by VerCat are not necessarily detected by TracScan, or the reverse.

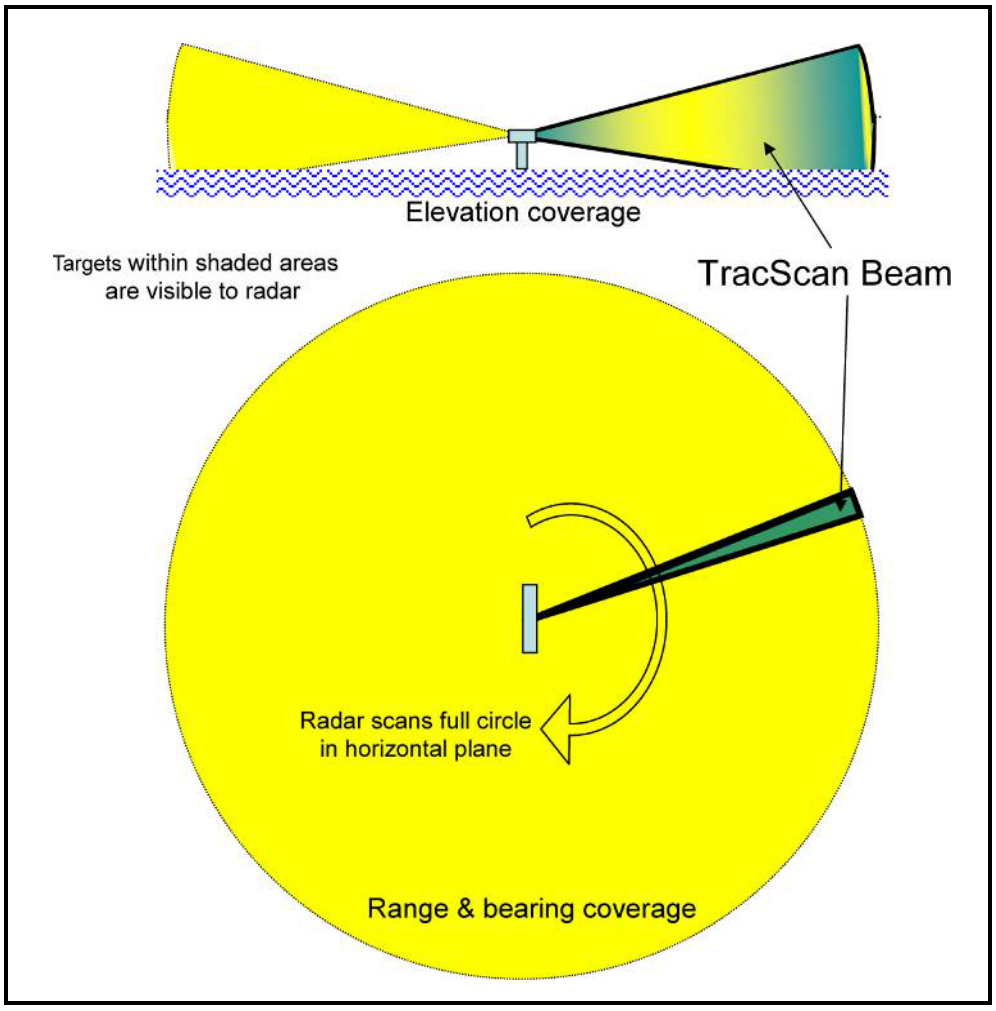
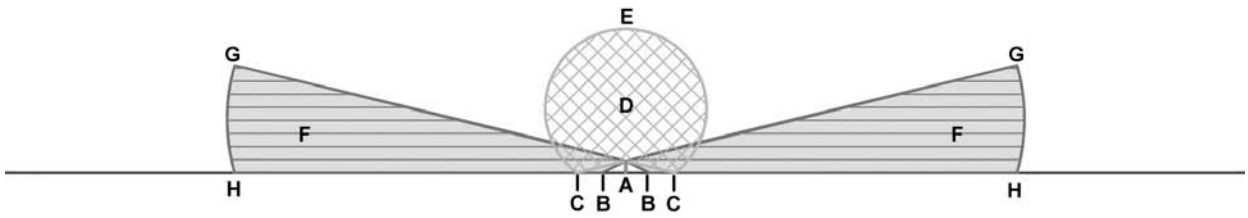


Figure 5-3. TracScan coverage pattern.



KEY TO FEATURES:

A. Radar unit
B. TracScan's horizontal beam meets ground level at approximately 61 m (200 ft) from unit
C. VerCat's vertical beam meets ground at approximately 1 km (0.5 NM) from unit
D. VerCat coverage
E. Maximum altitude of VerCat coverage at 5.5. km (18,000 ft)
F. 7.4 km (4 NM) TracScan coverage
G. Maximum altitude of 4 NM TracScan coverage at 1,629 m (5,346 ft)
H. 7.4 km (4 NM) from unit

Figure 5-4. Typical MARS® Surveillance Coverage.

5.2.4 MARS® On-Site Data Capture and Processing

The GMI MARS® replaces commercial marine radar processors with high-resolution processors. Radar echoes are digitally captured and sampled at 4,096 levels of resolution. After each radar scan, the MARS® software processes this high-resolution data to generate dynamic maps of background clutter and exploit the small differences between clutter and targets.

GMI proprietary algorithms attempt to exploit the distinction between background clutter (even temporary clutter like a rain cloud) and moving targets in order to detect small radar echoes in the presence of background clutter. The MARS® software maintains a real-time clutter map that incoming radar echoes are compared against. A "detection" is any echo with a reflectivity that is sufficiently above the real-time background clutter. The definition of "sufficient" is complicated by the variable nature of radar echoes. Target echo strength depends upon the target's reflective area (radar cross-section) and this is dependent on the size of the bird, flight orientation relative to the radar, and even wing position. These variables can change greatly and rapidly between successive 360° radar scans. After making the detection, MARS® automatically archives information about each detection in a track (range bearing, bearing, size, and strength) to a database for future analysis

5.3 THERMAL IMAGING - VERTICALLY POINTING RADAR

The Thermal Imaging (TI) - Vertically Pointing Radar (VPR) was used to validate VerCat data. Recent visual studies of migration have incorporated passive infrared (IR) cameras (Buurma 1988; Winkelmann 1992; Bruderer and Liechti 1994) that detect the heat generated by a target. The passive IR cameras make it possible to distinguish between birds, insects, and foraging bats (Zehnder et al. 2001; Gauthreaux and Livingston 2006); however, IR cameras do not provide accurate information on the distance to target or altitude of flight. According to Liechti et al. (1995), the proportion of birds detected by tracking radar and IR camera did not change with distance between 0.5 and 3 km (0.31 and 1.86 mi), and the "very rough grouping of birds into three size classes by moon-watchers and IR-operators is closely related to the distances measured by the tracking radar."

5.3.1 TI-VPR System

The TI-VPR system for this study consists of two components (**Figure 5-5**):

- TI, pointed up vertically to obtain target identification, behavior, and X/Y dimensional information.
- VPR, pointed up vertically to obtain altitude (Z dimension) of targets within the TI field of view.

The TI selected for this study is a fixed focus, un-cooled TI camera (FLIR SR-35, FLIR Systems, Inc., Goleta, California) with a 35-millmeter (mm; 1.4 in.) lens and a 20° field of view. This camera is well-suited for short range surveillance use (i.e. monitoring activity within the potential RSZ) with a minimum focus distance of only 1 m (3 ft). It has a standard resolution focal plane array (FPV) of 320 x 240 pixels with a pixel pitch of 38 microns (µm) and a spectral range of 7.5 to 13 µm. The camera is able to operate in temperatures ranging from -32 degrees Celsius (°C) to 54°C (-25 degrees Fahrenheit [°F] to 130°F).

The VPR (FURUNO FR-1525 Mark-3, FURUNO Electric Co, LTD., Nishinomiya, Japan) was coupled to a standard gain horn antenna (WR-90, Pasternack Enterprises, Inc., Irvine, California) with a beam width of 15°. A right angle waveguide elbow was used to point the horn antenna up parallel with the TI. The transmitter frequency was 9,410 ±30 megahertz (MHz; X-band, 3-cm [1-in.] wavelength) with peak power output of 25 kilowatts (kW) and a minimum range detection of 35 m (115 ft). The 463-m (0.25-NM) radar range setting was chosen to observe activity aloft within the RSZ. Additional settings were 0.07 microseconds (µs) pulse length, 3000 hertz (Hz) PRF, and 92.6-m (0.05-NM) range rings.

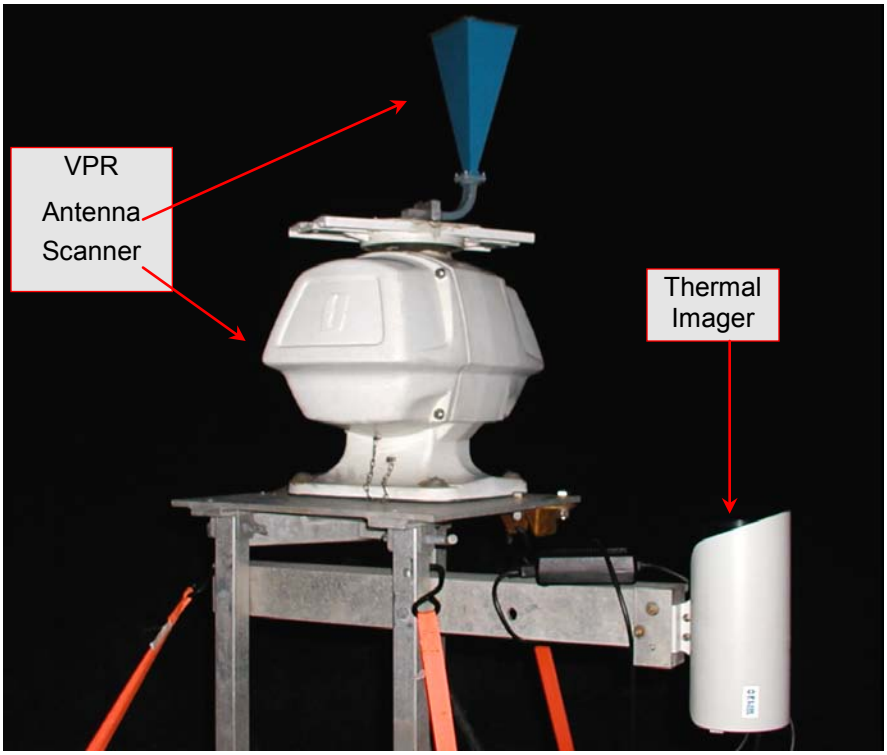


Figure 5-5. MARS® TI/VPR.

5.3.2 On-Site Data Capture and Processing

Output from the TI and VPR was combined into a single video display before being recorded. The MARS® VPR signal was converted from a video graphics array (VGA) output into composite video (personal computer [PC] to television [TV] converter). This output was then sent to a video multiplexer (Colorado Video, Boulder, Colorado) and combined with the video output from the TI into a single video display. The combined output was recorded on digital versatile disc (DVD) via a Sony Model VRD-MC5. Approximately 2 hours of data were recorded per DVD for later analysis.

5.4 SURVEY METHODOLOGY

The original Scope of Work for the avian radar survey was to collect seasonal offshore radar data from a radar mounted on a jack-up barge in spring 2008, fall 2008, and spring 2009. During spring 2008, all of the scheduled survey locations could not be reached because of barge siting and/or weather constraints. In late spring 2008, NJDEP made a decision to add onshore radar surveys at three coastal sites to recover the lost sample days offshore and to ensure coverage of nearshore areas that the offshore barge could not sample.

When the surveillance radar coverage of the coastal radar sites was compared with the original survey plan there was significant overlap with the coastal radars. Modifications to the existing sampling design were evaluated. Modification of the fall offshore radar sampling locations to emphasize radar surveys in the southern section of the project area was adopted because it would enhance areal coverage of the southern and near shore region of the survey without the overlap of the coastal radar. The offshore radars would be located in proximity to, but outside the range of, the coastal radars; however, because of a May 2008 jack-up barge accident off the coast of Delaware, the barge operator implemented two new, significant operational restrictions prior to the fall sampling season: operations could not be conducted when wind speeds over 40 kts and mean low water (MLW) was greater than 37 ft. When operational restrictions and safety concerns were evaluated the decision was to conduct the fall 2008 surveys within

the southern section of the Study Area. The original sampling design was then modified after collapse and loss of the barge in October 2008. The frequency of onshore radar surveys was increased to recover some of the data scheduled to be collected by the offshore barge of nearshore locations from mid-October through November.

In spring 2009, additional offshore radar surveys were scheduled; however, new U.S. Coast Guard restrictions severely limited operations and a decision was made to continue and increase the frequency of the onshore radar surveys in case the offshore barge would not be able to collect the scheduled radar data.

In summary, the offshore survey dates for the Study Area were:

- Spring 2008: 14 March – 11 May
- Fall 2008: 30 September – 19 October
- Spring 2009: 11-13 May

The onshore survey dates were:

- Spring 2008: 15 May – 19 June
  Island Beach State Park: 15-23 May
  North Brigantine Beach: 29 May – 08 June
  Corson's Inlet State Park: 09-19 June

- Fall 2008: 13 September – 15 December
  Island Beach State Park: 13 September – 02 October
  Brigantine Beach: 26 October - 16 November
  Sea Isle City: 05-26 October; 16 November – 15 December

- Spring 2009: 14 March- 2 June
  Island Beach State Park: 14 March – 05 April
  Brigantine Beach: 05 April – 05 May
  Sea Isle City: 07 May – 02 June

- Fall 2009: 15 September – 16 November
  Island Beach State Park: 15 September – 02 October
  Brigantine Beach: 05–26 October
  Sea Isle City: 26 October – 16 November

5.4.1 Offshore MARS® Radar Surveys

5.4.1.1 Survey Design

A stratified random sampling approach, with equal effort in each stratum, was used to design sampling sites for a barge-supported radar unit within the project area. To aid in the selection of radar sites, the project area was divided into three strata of variable area defined by contours paralleling the coastline and the outermost boundary of the Study Area (**Figure 5-6**). Each stratum consists of nine grid cells arranged in three rows and three columns. Each of the numbered grid cells (1 through 27) is an irregularly shaped, variable-area contoured grid. The latitude-longitude coordinates of the four corner points of the Study Area were first identified. Then the distance between the NW and SW corners (measured along the coast), and the distances between the NW and NE corners, NE and SE corners, and SE and SW corners (measured along the defined study-area boundary lines) were calculated. Tri-sector points along the coastline, outermost boundary, northernmost boundary, and southernmost boundary were then identified.

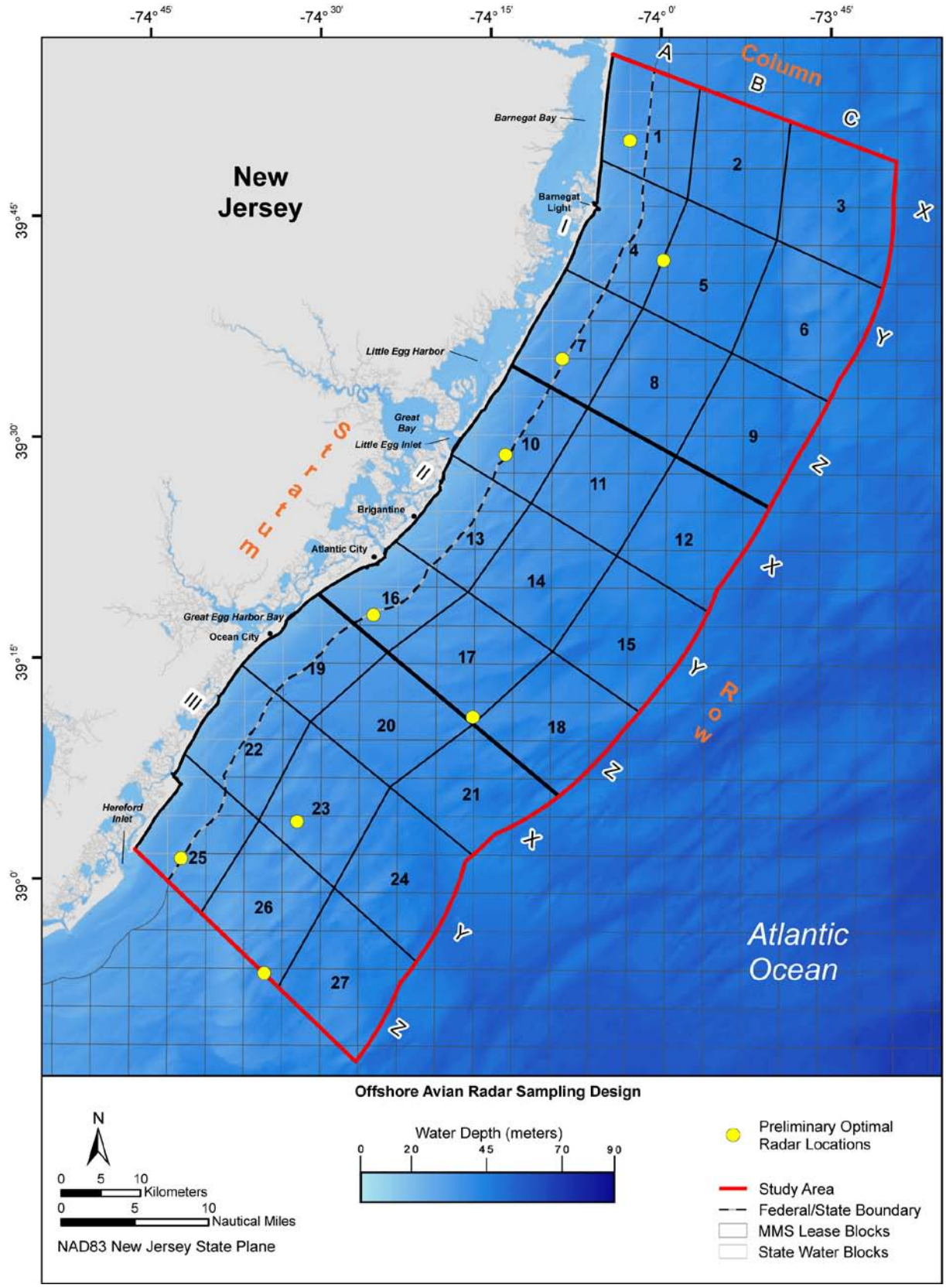


Figure 5-6. Offshore avian radar sampling design.

Straight lines were drawn between the two sets of tri-sector points between the coastline and outermost boundary, thus defining the high-latitude, mid-latitude, and low-latitude strata. Within each of these three strata, the along-coast distance between the NW and SW corners of each stratum, and the along-contour distance between the NE and SE corners (measured along the outermost boundary) were calculated, tri-sector points were located, and straight lines were drawn between each of these sets of points between the coastline and outermost boundary. Distances along each of these straight lines were then calculated, and tri-sector points for each line were identified, generating two series of points aligned roughly parallel to the coastline and outermost boundary, one-third and two-thirds of the distance between coastline and outermost boundary. Using a smoothing algorithm, these points were connected by two curves extending from the northernmost to the southernmost boundaries, defining the 27 irregularly shaped, variable-area grid cells (i.e., nine grid cells arranged 3x3 in each of the three strata). Stratum 1 is comprised of grid cells 1-9, Stratum 2 consists of grid cells 10-18, and Stratum 3 contains grid cells 19-27 (**Figure 5-6**).

The barge-supported radar was limited to a maximum operational depth of 15.24 m (50 ft), and the radar's detection range was 7.41 km (4 NM). A stratified random sampling statistical analysis was conducted to determine the radar sampling locations subject to these two constraints. The objective of this statistical analysis was to randomly select nine radar sites, with three sites in each of the three strata, off the coast of New Jersey and identify the optimal locations (latitude/longitude points) and sequential sampling of these locations that will minimize the overlapping area among the sites (i.e., maximize coverage of the radar, assuming a radar range of 7.41 km [4 NM]) while also minimizing the total travel distance and travel time of the barge among these sites (i.e., maximizing the radar's operation time for collecting data, assuming a 5.54-m/s [3-kt] barge speed). Selection of the optimal radar sites is subject to the constraint of a <15.24-m (50-ft) bottom depth, a separation distance of at least 7.41 km (4 NM; i.e., the radar's range) from the outer boundaries of the Study Area, and a separation distance of at least 14.82 km (8 NM, twice the radar's range) from adjacent neighboring radar sites, to ensure full radar coverage within the Study Area at each site as well as minimal overlapping area between adjacent sites, thus maximizing total radar coverage area. Equivalently, a 7.41 km (4-NM) wide buffer zone is defined along the inside of the Study Area's boundaries, and the point location of each radar site is excluded from this buffer zone to ensure that a 4-NM radius circle drawn around the point location

Table 5-3. Preliminary optimal locations for the offshore radar sites.

Grid Cell	Longitude (°W)	Latitude (°N)
1	-74.04709	39.83485
5	-73.99888	39.69916
7	-74.14742	39.58811
10	-74.23084	39.47996
16	-74.42404	39.29894
18	-74.27987	39.18313
23	-74.53513	39.06508
25	-74.70368	39.02345
27	-74.58290	38.89344

5.4.1.2 MARS® Survey Site Setup and Data Collection

Prior to deployment, depth data was collected from available nautical charts for all of the optimal grid locations and compared to optimal offshore barge radar sites (**Table 5-3**). If the optimal locations did not meet barge deployment criteria, alternative locations were identified in the grid. The jack-up barge proceeded to the identified location and determined whether or not the location met the jack-up barge operating requirements. If acceptable, the barge proceeded to jack-up. If the location was not acceptable, alternative locations were checked until a location met the jack-up barge requirements.

Spring 2008

The MARS® was mounted on a jack-up barge on 13 March 2008 and deployed on the morning of 14 March 2008. The barge was set-up at Grid 1 that night (**Table 5-4**; **Figure 5-8**). Initial set up and a radar validation survey occurred on 15 March 2008; avian radar surveys commenced the same day and continued until barge demobilization on 21 March 2008.

The barge was relocated to Grid 7 on 21 March 2008. Set up and a ground truth survey occurred on 22 March 2008 and radar surveys continued until 27 March 2008. On 27 March 2008 the barge moved to Grid 13 (**Table 5-3**; **Figure 5-8**), waited for 2 hrs, and then navigated to port in Atlantic City, New Jersey, as it was unable to jack up because of high sea state conditions.

The month of April began with the barge and avian radar system in port at Atlantic City because of bad weather. On 03 April 2008, the barge was able to return to sea and the avian radar was on station and collecting data at Grid 13 that afternoon. The avian radar remained at Grid 13 until the morning of 13 April 2008, at which time the barge moved to Grid 19 (**Table 5-4**; **Figure 5-8**). The avian radar collected data at Grid 19 from 13 April 2008 through 19 April 2008. A radar validation survey was conducted on 19 April 2008. After completion of the validation survey, the barge moved to Grid 26.

Table 5-4. Locations of the spring 2008 barge radar sites and VerCat azimuth(s).

Grid Cell	Longitude (°W)	Latitude (°N)	VerCat Azimuth (°)
1	-74.06454	39.82566	26
7	-74.18748	39.57974	57,35
13	-74.30098	39.38722	88
17	-74.35492	39.26475	333,320
19	-74.54988	39.2297	133
23	-74.55228	39.10084	220
26	-74.5705	38.9534	230

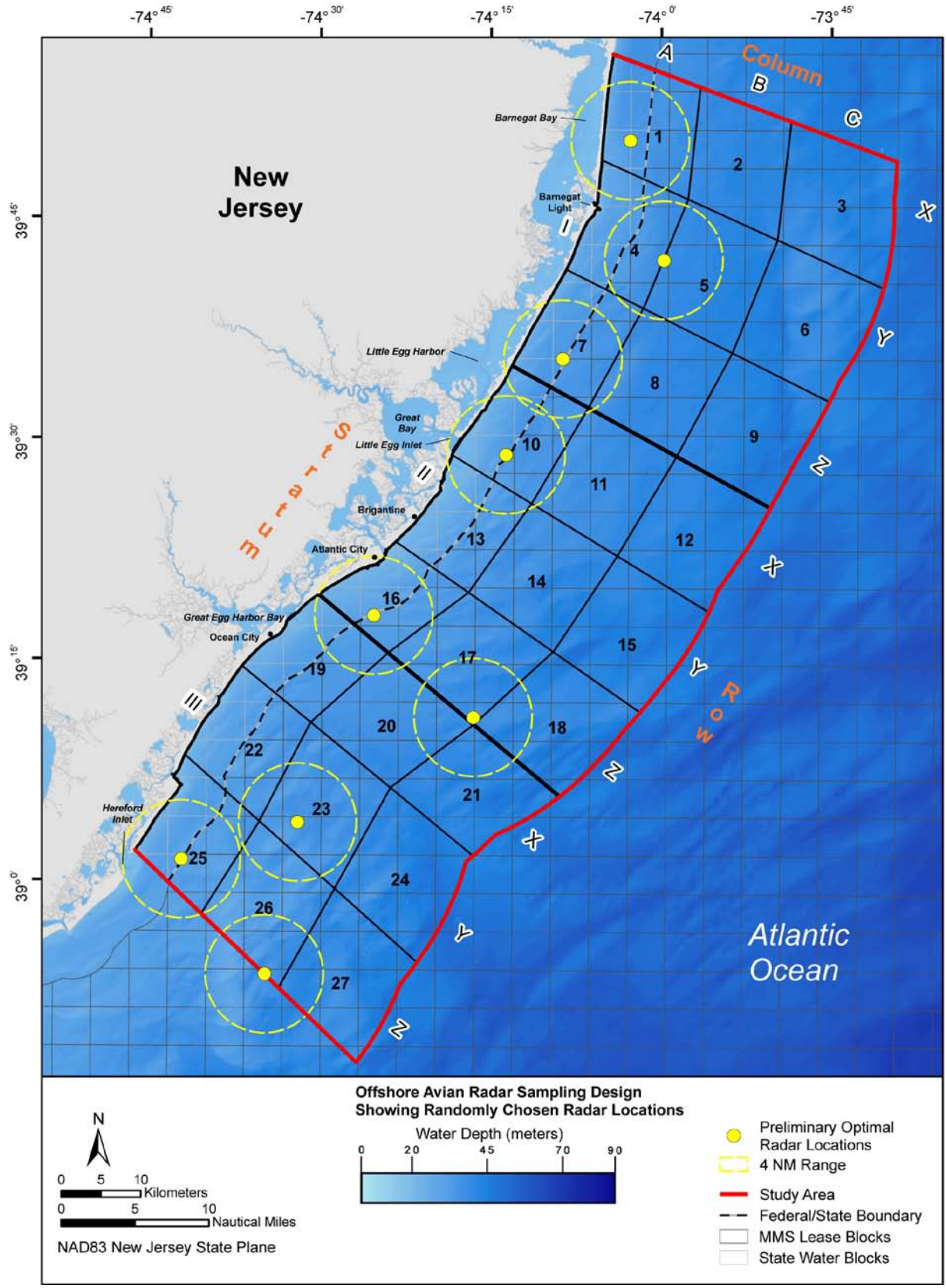


Figure 5-7. Offshore avian radar sampling design illustrating randomly chosen radar locations.

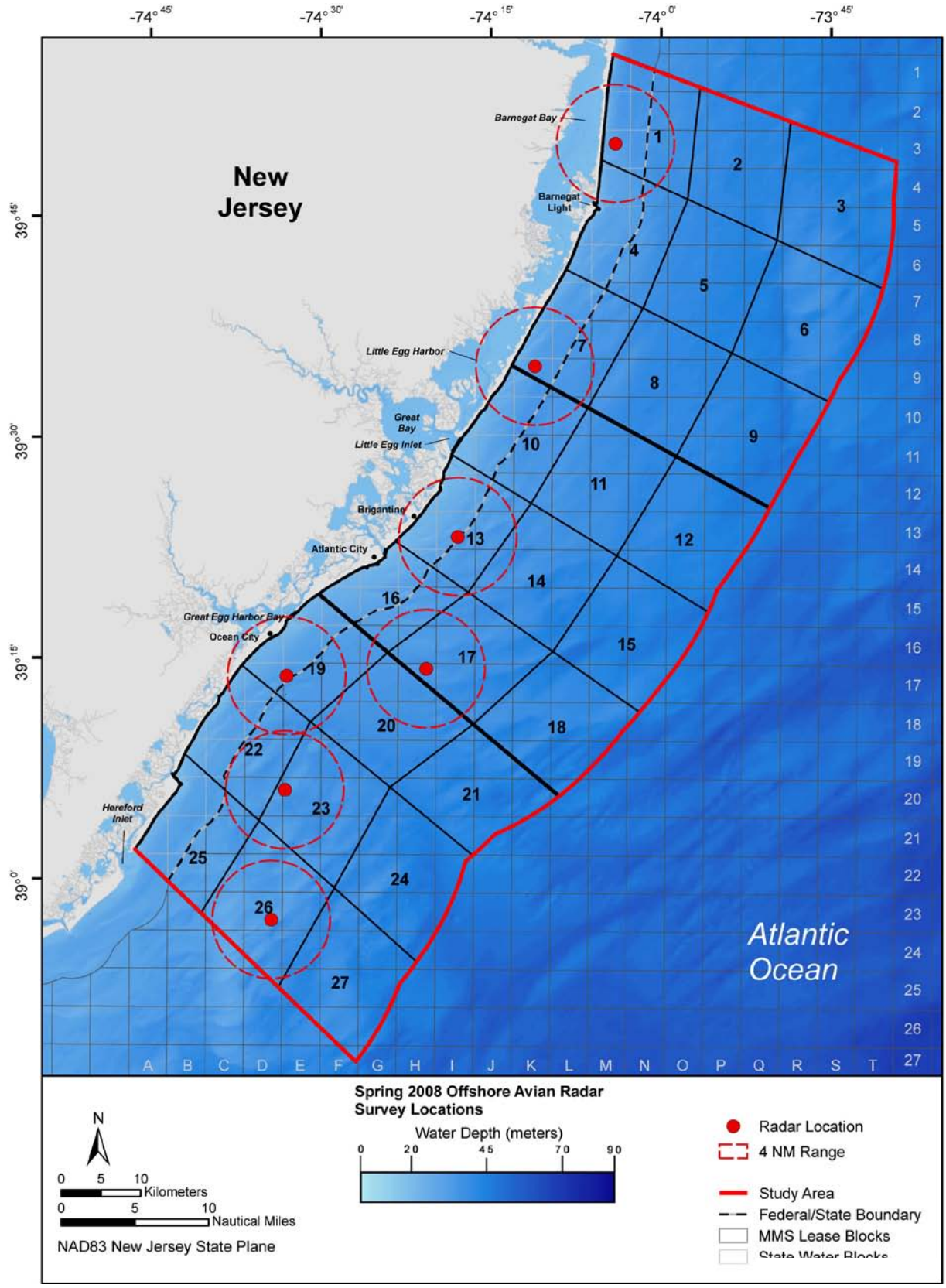


Figure 5-8. Spring 2008 offshore avian radar survey locations.

The barge attempted to jack up on station at Grid 26 on 19 April 2008, but was prevented from doing so because of rough seas at the site and had to take shelter at Cape May to await calmer seas. The barge remained at Cape May until 24 April 2008, when it was able to successfully jack up at Grid 26 (**Table 5-3**; **Figure 5-8**). The avian radar system operated at Grid 26 from 24 April 2008 through 30 April 2008.

On 30 April 2008, the barge was moved to Grid 23, and the radar began collecting data at the site (**Table 5-3**; **Figure 5-8**). The barge collected data at Grid 23 from 30 April through 07 May 2008. On 03 May 2008 a ground truth survey was conducted. On 07 May 2008 the avian radar system was turned off and the barge moved to Grid 17.

On 07 May 2008, the barge and avian radar system was moved to Grid 17 and began collecting data (**Table 5-3**; **Figure 5-8**) The avian radar remained operational at Grid 17 through 11 May 2008, at which time the barge had to return to port in Atlantic City because of an approaching weather system. The barge had to remain in port at Atlantic City until the end of the spring survey period.

Fall 2008

The original spring 2008 radar sampling locations were chosen quasi-randomly subject to the following constraints: 1) water depth less than 15.24 m (50 ft); 2) minimize overlap of the 7.41 km (4 NM) ranges of adjacent radar sites; and 3) minimize distances (travel times) from site to site.

The original sampling design was modified for the fall 2008 surveys because the coastal radar survey locations, which were added after the project was initiated, were not accounted for when the original offshore radar sites were chosen. When the surveillance radar coverage of the coastal radar sites was compared with the original survey plan there was significant overlap with the coastal radars. Modifications to the existing sampling design were evaluated.

Fall offshore radar sampling locations intended to emphasis radar surveys in the southern section of the project area because it would enhance areal coverage of the southern and near shore region of the survey without the overlap of the coastal radar. The offshore radars would be located in proximity to, but outside the range of, the coastal radars. The advantages and disadvantages of adopting this survey design were evaluated.

The statistical advantage of this modification would be the ability to scan in the offshore direction to a distance not reachable by the coastal radars. This sampling design enhances near shore areal coverage without coastal radar overlap. Under the new potential sampling design, the total number of coastal and offshore radars are more evenly distributed such that Zone A and Zone B would be more evenly sampled (**Figure 5-6**). Zone C would be poorly sampled because of water depths deeper than the new barge water depth restriction 15.24 m (50 ft). A disadvantage of the fall sampling locations is that the new design lacked true randomness because so many constraints and requirements limited the possible locations of offshore radars. With respect to offshore radars only, coverage of the southern region would be relatively over-sampled, whereas coverage of the northern region would be under-sampled. Hence, the distribution of offshore radar coverage would not be truly random, but rather clustered in mid-shore Zone B in the southern region; the northern region would not be sampled). Assessing the inter-annual variability (e.g., between spring 2008 and spring 2009) of the radar data would no longer be possible in the northern region, since the offshore radars in this region would be discontinued. It would only be possible to conduct an inter-annual variability assessment for the southern region, where the 2-3 offshore radar locations would be in operation over a sufficiently long time period to collect radar data over the same season two years in a row.

In addition, because of a May 2008 jack-up barge accident off the coast of Delaware, the barge operator implemented two new, significant operational restrictions prior to the fall sampling season: operations will not be conducted when wind speeds over 40 kts and MLW was greater than 37 ft. When operational restrictions and safety concerns were evaluated the decision was to conduct the fall 2008 surveys within the southern section of the Study Area.

On 29 September 2008, the MARS® was mounted on the jack-up barge which set sail for the Study Area that afternoon. The barge was jacked up at Grid 22 (Longitude -74.52417 W, Latitude 39.00139 N). The MARS® was set up (VerCat azimuth: 346°, 353°) and began recording on the evening of 30 September 2009 (**Figure 5-9**). Avian radar surveys continued at Grid 23 until 12 October, at which time the barge moved to Grid 26 (Longitude -74.59444 W, Latitude 39.91694 N W;) where recording began that afternoon (VerCat azimuth: 56°, 46°). Avian radar surveys continued at Grid 26 until the afternoon of 19 October 2008, at which time the barge was struck by high waves and suffered a catastrophic failure of the lifting legs, thus ending offshore avian radar sampling for the season.

Spring 2009

The jack-up barge accident which occurred during the October 2008 survey resulted in additional strict operating guidelines being imposed on the barge operator by the U.S. Coast Guard. These newly imposed restrictions included stricter wind, wave, and weather forecast guidelines. The restrictions included requiring the barge to return to port if the seas increased to 3 ft, the 24-hr forecast was for seas greater than 0.91 m (3 ft), the 24-hr forecast was for winds greater than 15 kts, and if the visibility was reduced to less than one mile (e.g., fog). The new restrictions also required the barge to return to port at least once every 24 hrs even if none of the other restrictions were applicable, and prohibited operations further than 8.05 km (5 mi) from shore.

For these reasons, no barge-based radar surveys were scheduled for April or June 2009. A total of 20 days of barge-based radar surveys were scheduled for May 2009. Based on the stated barge operational restrictions, a decision was made to concentrate the surveys on Grid 16 and Grid 22/23 (22).

The MARS® was loaded on the jack-up barge in New York harbor on 02 May 2009. The barge transited to Atlantic City on 03 May 2009, at which time the radar system was made ready for deployment at the first suitable weather window. Because weather conditions and forecasts were not compatible with the new operating guidelines, surveys were only conducted at Grid 16 (Longitude -74.37583 W, Latitude 39.29139 N; VerCat azimuth: 141°) during the night of 11–12 May 2009, and at Grid 22 (Longitude -74.55111 W, Latitude 39.19028 N; VerCat azimuth: 130°) during the night of 12–13 May 2009 (**Figure 5-9**). Two radar validation surveys were also conducted from the barge on 11 and 12 May 2009.

5.4.1.3 Data Analysis

Echoes from ground clutter on land are much more persistent and stronger than echoes from biological targets. If a biological target is flying over background clutter, then the target will be eliminated when background clutter is eliminated. At sea, clutter from waves and swells varies greatly from scan to scan, and although the MARS® algorithms take the nature of the target and the clutter variations into account when determining whether to record the detection as a moving target, the dynamic reflectivity of waves often makes this task impossible. When sea clutter is high, targets of interest may be suppressed along with sea clutter targets or blocked. If detections of sea clutter are not suppressed then they may produce false tracks. Rain also produces undesirable dynamic clutter in VerCat and TracScan. Echoes from rain may greatly inflate the number of detections. Quality Assurance/Quality Control (QA/QC) procedures have been developed to minimize this possibility.

False detections, weather, and weather effects

European radar studies of local and migratory bird movements in offshore areas selected for wind development projects have noted that rain and waves affect marine radar performance when the radar is operated in the conventional horizontal scan mode (Tulp et al. 1999; Christensen et al. 2004). Off-the-shelf marine radars with array antennas project nearly half of their radiation below the horizontal, and even slight wave action can generate sea clutter echoes that make tracking echoes from birds difficult to impossible. This problem has resulted in some studies conducting bird movement studies only when the sea is relatively calm. In a study of bird movements and collision risks at the offshore wind farms at Horns Rev, North Sea, and Nysted, Baltic Sea, in Denmark, Blew et al. (2006) used marine radar in a horizontal scanning mode with a range of 2,780 m (1.5 NM). They stated that “A prerequisite for the use of

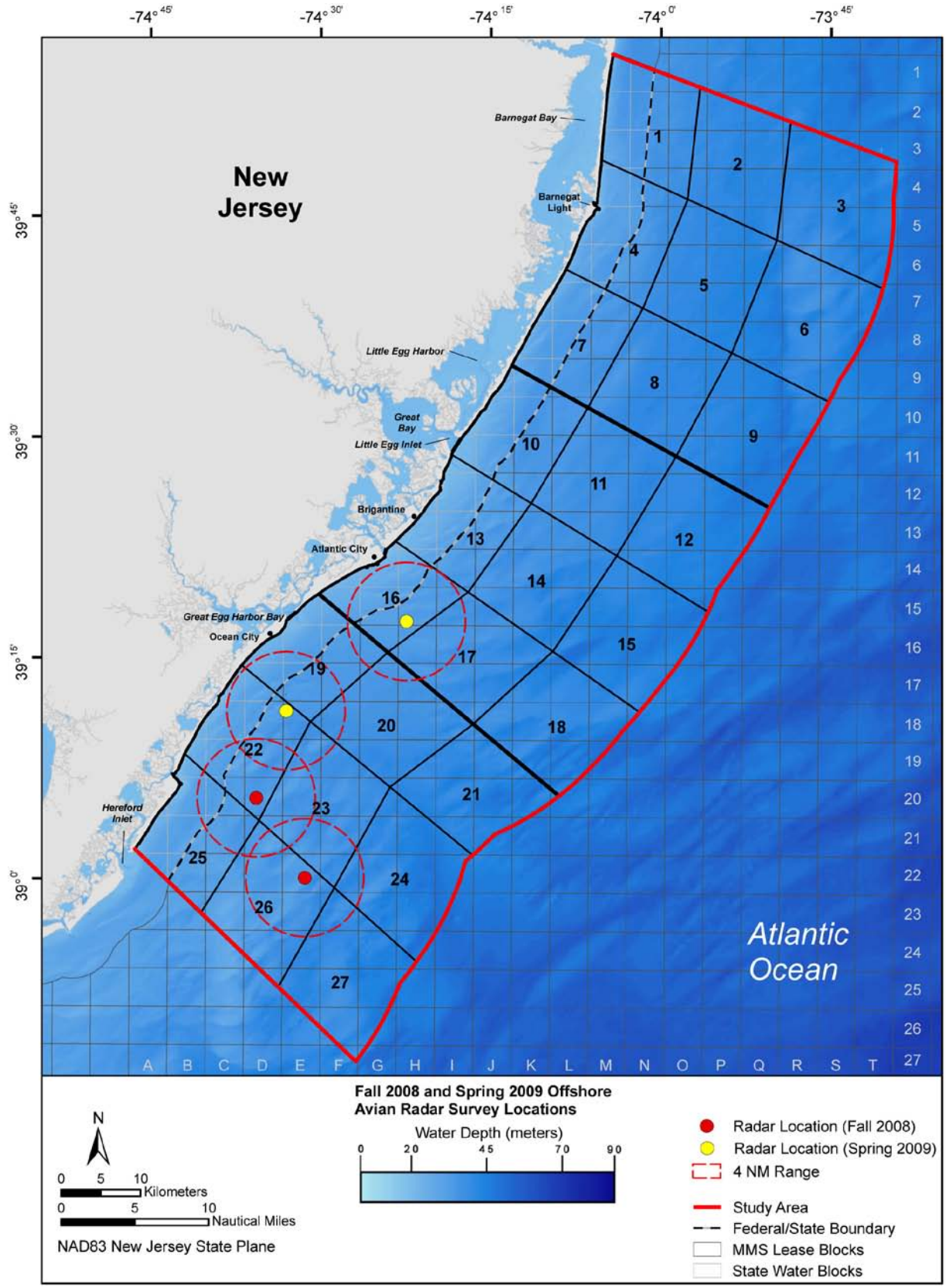


Figure 5-9. Fall 2008 and Spring 2009 offshore avian radar survey locations.

horizontal radar is a calm sea state (wind speeds less than 2 m/s [3.9 kts]). Otherwise the signals will be concealed by sea clutter, caused by the reflection of the radar waves by a rough water surface" (Blew et al. 2006). Marine radar has a sea clutter filter but use of this filter may decrease the detection of small birds.

At least one European offshore radar study has reported results from a horizontally scanning marine radar (S-band, 30 kW, 25° beam width, 11-km [6-NM] range) with digital processing similar to MARS® TracScan (Kreijgsveld et al. 2005). The authors noted that sea clutter produced 85% of the tracks (false tracks) displayed on radar and cautioned readers that even after the application of a clutter removing procedure, the data still contained an unknown number of false tracks within the ranges affected by sea clutter. MARS® TracScan also produces false tracks from sea clutter detections. Sea clutter detections are particularly evident when the velocity measured between two detections is plotted in a histogram (**Figure 5-10**). The excessively high ground speeds (51.4 m/s; 100+ kts) are not representative of biological targets and are classified as false targets. It is unknown how the plotting algorithms produce these false tracks, but sea clutter may be responsible, because the histograms of velocity measured between detections with MARS® VerCat do not contain the abnormally fast velocities (**Figure 5-11**). Filtering rules have been developed to reduce detections from rain and sea clutter and false tracks that result from these detections and these rules are discussed below.

Analysis of MARS® TracScan Data

The radar data from the first nine days of radar surveillance in this study (spring 2008) have been analyzed to examine the influence of sea clutter on MARS® TracScan data. The distribution and density of processed detections have been plotted for each day. Examples are given (**Figure 5-12**). To examine the relationship between sea clutter detections and wind velocity the maximum range of detections was determined by inspecting the daily plots of all detections. The density of detections is greatest near the radar (red colored targets) and decreases as a function of range (orange>yellow>green>light blue>dark blue; **Figure 5-12**). The range at which the outer edge of the dark blue targets occurred was recorded. These measures were then correlated with the mean wind velocity at the 1000-millibar level (approximately 91 m [300 ft] above the sea) from data posted at http://vortex.plymouth.edu/upcalc-u.html. The resulting relationship (**Figure 5-13**) indicates that about 83% of the variation in maximum range of detections can be explained by mean wind velocity. Because 85% of the recorded data from TracScan type radar can be attributed to sea clutter (Kreijgsveld et al. 2005) and sea clutter conditions are related to mean wind speed, it is possible to predict sea clutter conditions in the TracScan data from data on wind conditions. This is important because detections from sea clutter (and rain) must be removed in data processing to assure that the results of the analyses relate to biological targets and not to false detections.

Reduction of False Tracks

The following procedures were completed during the analyses of TracScan data to reduce the number of false tracks that result from detections of sea clutter:

1) Eliminated tracks with distances greater than 0.06 NM between successive detections (i.e., tracks with velocities above 51 m/s [100 kts]).

This procedure eliminated the detections with speeds greater than 185 kph (100 kts) and eliminated the mode of velocities between 51 and 162 m/s (100 and 315 kts; compare **Figures 5-14** and **5-15**).

2) All tracks with gaps in detections were treated initially as separate tracks to avoid treating two unrelated tracks as one and generating false tracks.

This procedure changed the histogram of velocities between detections very little, suggesting that this source of false echoes was not important (compare **Figures 5-14** and **5-15**).

3) Selected only tracks with nine or more continuous detections (number of echoes per track).

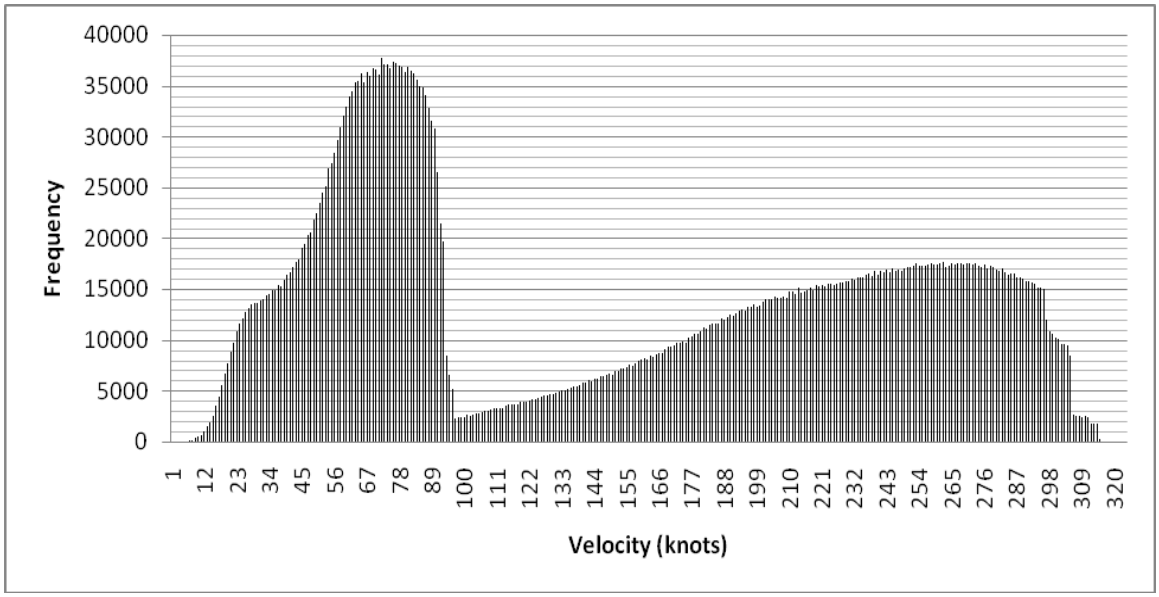


Figure 5-10. Histogram of total ground speeds between detections for 15 March 2008 from MARS® TracScan. Note the extraordinary number of detections and the extremely high velocities with no filtering.

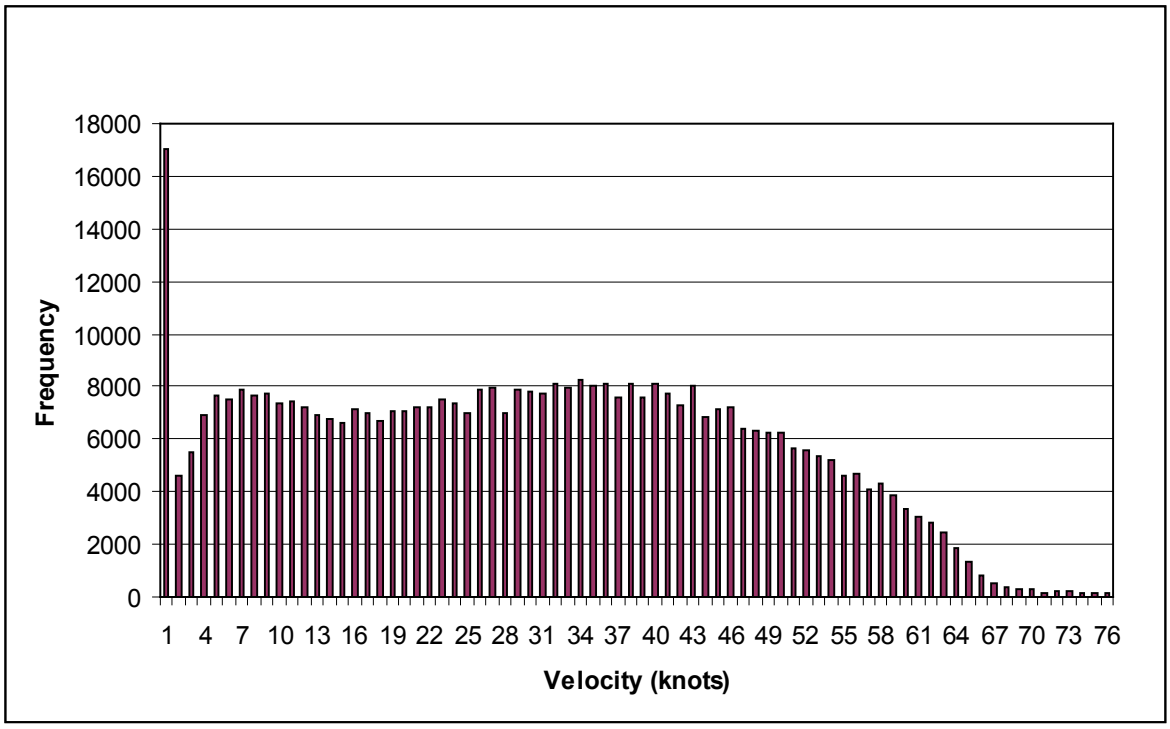


Figure 5-11. Histogram of total ground speeds between detections for 15 March 2008 from MARS® VerCat. Note the absence of a second mode of velocities and the lower frequency of velocities above 46 knots (24 m/s or 79 ft/s).

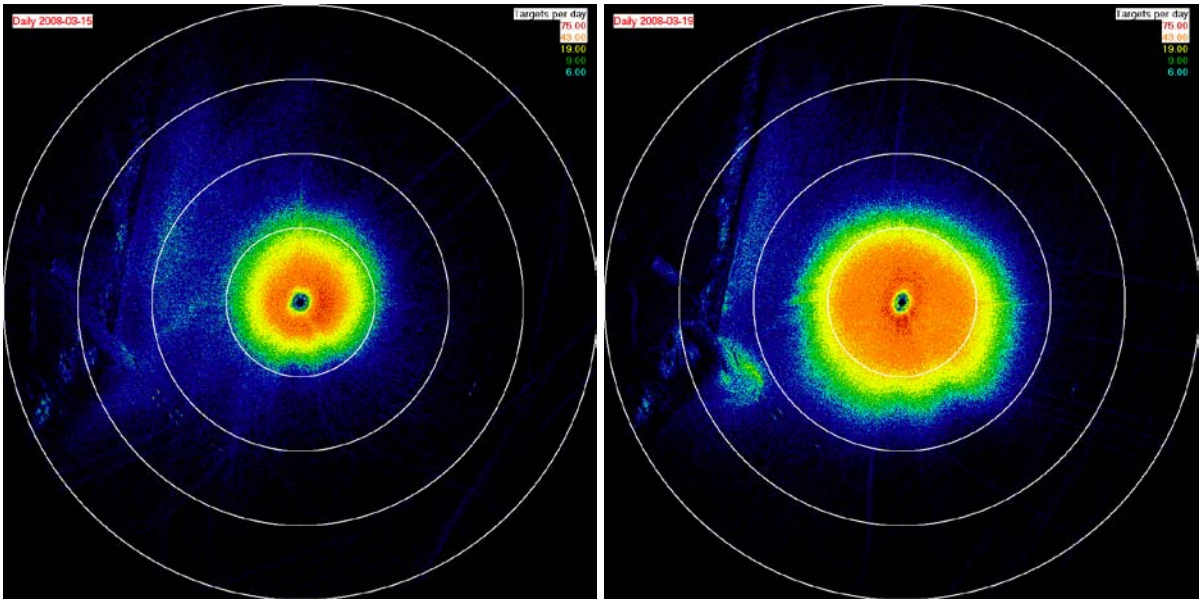


Figure 5-12. Total TracScan detections per day for 15 March 2008 (left) and 19 March 2008 (right). Maximum winds on 15 March were 7 to 8 knots and on 19 March were 18 to 19 kt.

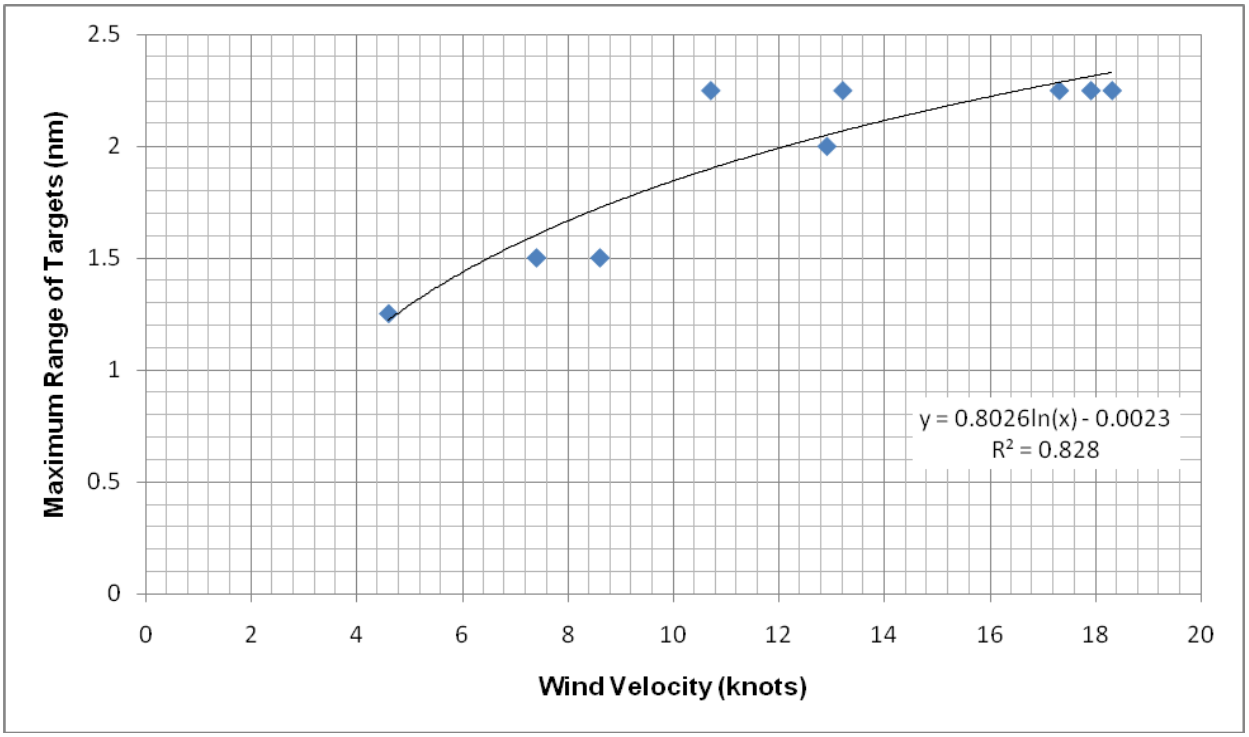


Figure 5-13. Relationship between mean wind velocity and maximum range of targets (sea clutter) in TracScan. Note that 82% of the maximum range of targets can be explained by wind velocity.

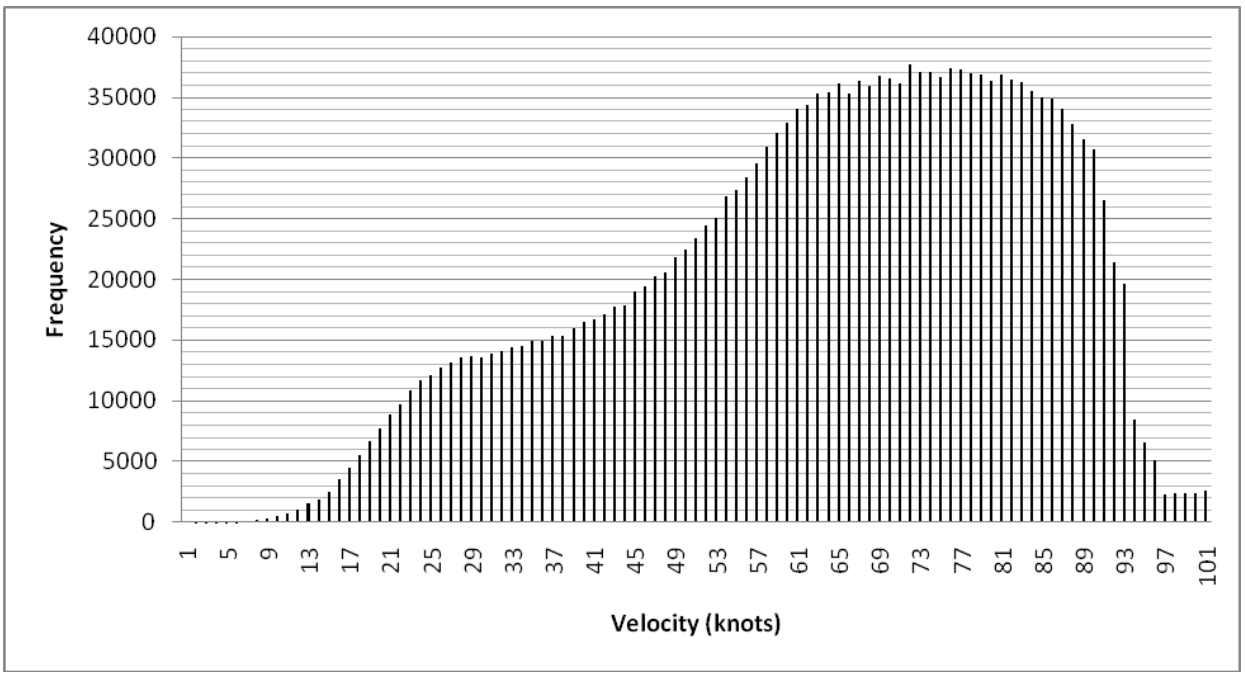


Figure 5-14. Histogram of total ground speeds between detections for 15 March 2008 with velocities greater than 100 knots (kts) removed for MARS® TracScan.

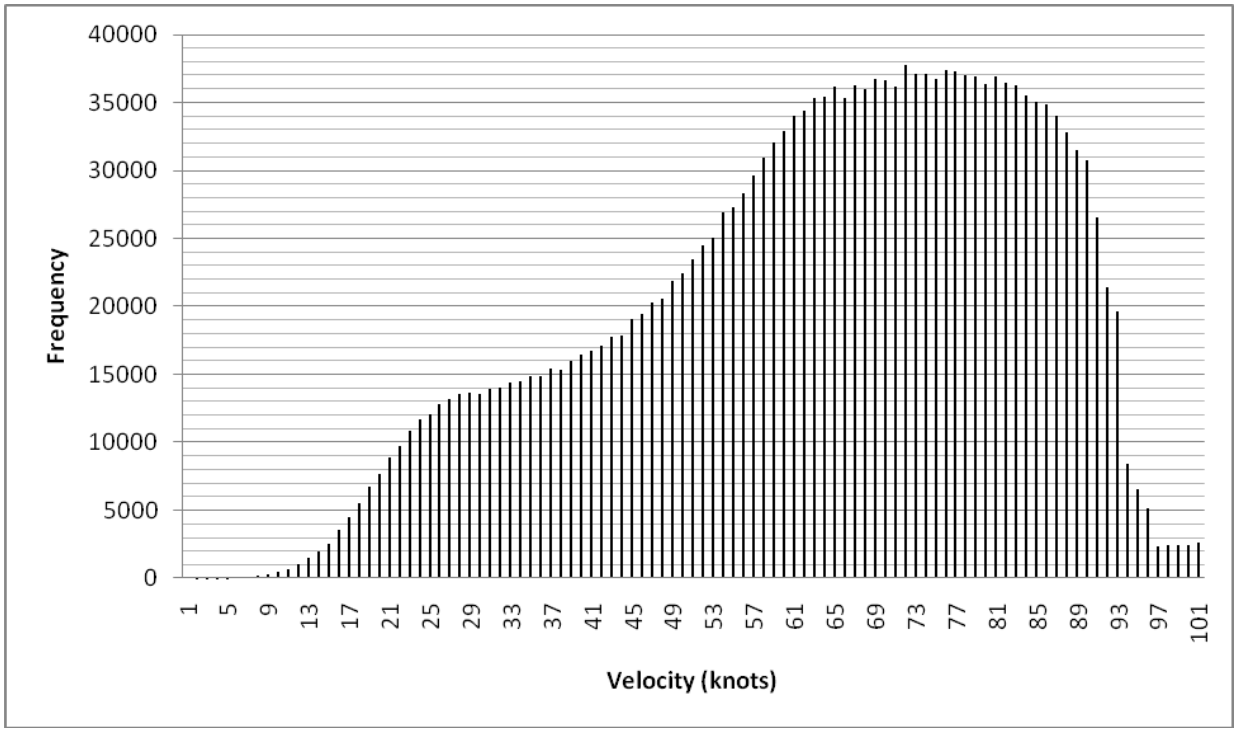


Figure 5-15. Histogram of total ground speeds between detections for 15 March 2008 after treating tracks with gaps (missing detections) as separate tracks for MARS® TracScan.

This procedure had a tremendous effect on the frequency of velocities. The highest velocity counts dropped from nearly 37,000 to approximately 3,000 and the histogram showed a bimodal distribution (compare **Figures 5-15** and **5-16**).

4) Sea clutter filter

This filter was developed to eliminate false tracks that resulted from detections of sea clutter within 3 km (1.5 NM) of the radar. When applied the second mode of the ground speed histogram was greatly reduced (**Figure 5-17**) and the speeds were comparable to those measured with VerCat (**Figure 5-11**) during the same time period.

Although the above procedures likely eliminated some real bird tracks, it is better to follow a more conservative approach and avoid the possibility of having a large number of false tracks generated by sea clutter. MARS® TracScan data were processed using all four procedures.

Rain Clutter Elimination

The following procedures were completed during the analysis of TracScan data to eliminate echoes from rain within the surveillance area:

1) Weather Surveillance Radar-1988, Doppler (WSR-88D) rain contamination analysis

This procedure involved analyzing WSR-88D data from the Fort Dix (KDIX), New Jersey radar station. Polygons were drawn over the TracScan surveillance areas, and a biologist examined each radar image file to determine if echoes from precipitation or biological targets were within the polygons. WSR-88D radar files were generated every five minutes when precipitation was present in the surveillance area and every 10 min when the surveillance area was clear of precipitation. The following data were entered into a database: time of the file, condition (clear, biological, or rain). Time periods with rain within the polygon were eliminated from radar processing.

2) Rain filter

This filtering algorithm is identical to that for sea clutter. The filter greatly reduces false tracks based on detections from rain and clouds of small insects.

Recounted Tracks

When a target is tracked it is not uncommon for a detection to be missed. If a single detection is missed while tracking a target, the processing algorithm assigns a new track identification (ID) to that target when reacquired. This could inflate the number of tracks if some of the reacquired tracts are the same as the original tract. An analysis of this problem (**Appendix J-1**) resulted in the development of a correction factor that reduces the number of total tracks by the percentage of tracks (24.87%) determined to be recounts.

Presentation of Analysis Results

The results of the TracScan data analysis are presented as flux directions. Flux is the adjusted number of birds that pass through a sample volume per hour and direction is compass direction to which a bird is moving. These results are presented in tabular form for each sample location where flux values are entered into eight cardinal directions (e.g., N = 338° to 22°, NE = 23° to 67°; E = 68° to 112°; SE = 113° to 157°; S = 158° to 202°; SW = 203° to 247°; W = 248° to 292°, NW = 293° to 337°) for diurnal and nocturnal time periods for each of three classes of wind velocity (0 to 12.87 kph [0 to 8 mph]; 14.48 to 24.14 kph [9 to 15 mph]; and greater than 25.75 kph [16 mph]).

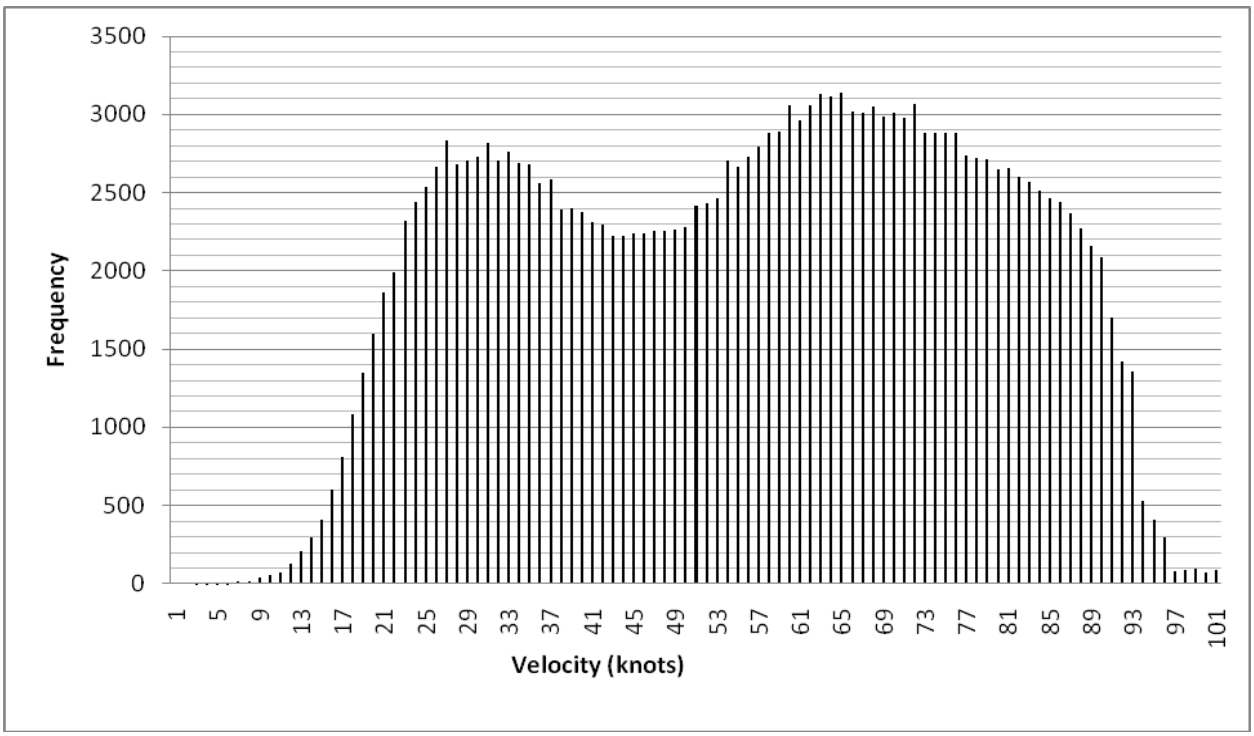


Figure 5-16. Histogram of total ground speeds between detections for 15 March 2008 after eliminating tracks that did not have nine continuous detections in a track for MARS® TracScan.

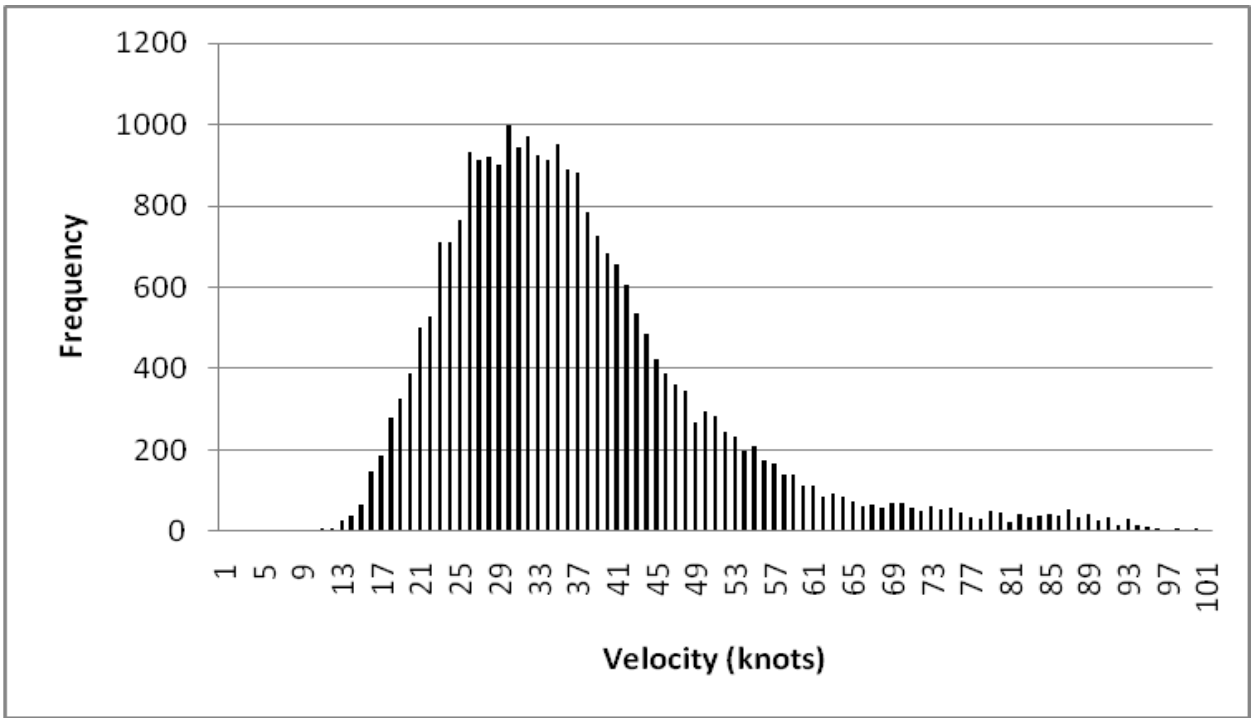


Figure 5-17. Histogram of total ground speeds between detections for 15 March 2008 after applying clutter reduction protocols and the sea clutter filter to the data from MARS® TracScan in all weather conditions.

Analysis of MARS® VerCat Data

VerCat data are used for calculating the altitudinal distribution of targets, migration traffic rate (MTR; the number of biological targets crossing a given line in a given unit of time [e.g., birds per kph]), and flux (i.e., the number of targets passing through a sample volume per unit of time). After the auto capture and on-site processing of the data were completed, the data were removed from the host computer for further analysis. Because VerCat can detect precipitation (i.e., rain, sleet, snow), the detections can be processed and generate false tracks and greatly increase the median altitude of targets aloft. It is important to remove false tracks that result from detections of sea clutter and rain to assure that the results of the analyses relate to biological targets and not to false tracks.

Rain Contamination

The following procedures were completed during the analyses of VerCat data to eliminate the number of detections from rain:

1) To eliminate rain contamination, to the extent possible, the WSR-88D inspection protocol discussed in the TracScan analysis section above was utilized. Rain contaminated data were not processed.

Reduction of Sea Clutter Detections

The following procedures were completed during the analyses of VerCat data to reduce the number of false tracks that resulted from detections of sea clutter:

1) Computed velocity between detections from raw detection data from VerCat and eliminated detections with speeds above 51.4 m/s (100 kts).

2) Split tracks with a missed detection into two separate tracks.

3) Eliminated tracks with less than seven detections.

4) Eliminated detections below 6 ft.

5) Applied Rain/insect filter to eliminate false tracks resulting from detections of precipitation that may have been undetected in the WSR-88D inspection protocol and of clouds of small insects.

Zero Target Velocities

When the velocity between two detections is plotted in a histogram for VerCat data, a large number of velocities are classified as zero knots (**Figure 5-11**). When a target flies through the radar beam perpendicular to the sweep of the beam, the target has zero velocity, because its echo appears at the same position in subsequent sweeps of the radar beam; however, the number of zero velocity entries is far too high in comparison with targets passing through the beam at angles slightly different from perpendicular. Although application of the filters reduces the number of zero velocity targets, many remain after processing. Eliminating all zero velocity targets from processing was considered, but doing so would have eliminated all birds flying perpendicular to the sweep of the beam. This was not acceptable and all zero velocity targets remaining after filtering are included in the analysis.

The resulting datasets contained information on the number of tracks within three altitudinal zones: below 30 m (100 ft), between 30 to 213.4 m (100 to 700 ft), and above 213.4 m to 5,556 m (above 700 ft to 18,228 ft) and were expressed as tracks per hour by altitude in relation to the MARS® site and MTR (tracks/hour/km of front by altitude [in relation to the MARS® unit]). Analysis of the filtered target data depended on the normality of distribution of the data. The volumes sampled by the VerCat for the three altitudinal zones listed above were computed to measure the flux of targets (the number of birds passing through a sample volume in a given amount of time).

Adjustment for Insect Contamination

The TI-VPR validation of VerCat data showed that VerCat detected a considerable number of insect targets during the offshore and onshore surveys. During the spring of 2008 the ratio of birds to insects in the TI-VPR samples was 83:248 and during the fall of 2009 the ratio of birds to insects was 61:156. The average of the two seasons showed a ratio of 363:1000 indicating that approximately 1/3 (36.06%) of the VerCat targets were birds. This figure was used to make adjustments for insect contamination in the VerCat data.

Adjusted Migration Traffic Rate

The adjusted migration traffic rate (AMTR) was calculated by applying the average bird to insect ratio of 0.363 to the MTR.

Flux

To compute flux (the number of tracks passing through a sample volume per unit time) the volumes sampled by the VerCat for the three altitudinal zones listed above was computed and the numbers of tracks passing through the sample volumes were adjusted to correct for insect contamination and ultimately expressed as adjusted tracks per cubic km per hour.

After processing the VerCat data, a biologist examined the results to see if in any samples the number of tracks and their altitudinal distribution were abnormally high. Whenever this occurred, the biologist replayed the radar data to determine if precipitation (e.g., virga) had been missed in the WSR-88D data. Whenever contaminated data were found they were removed and the remaining data reprocessed.

Data Analysis Presentation

The metric “number of bird tracks” is used throughout the data analysis sections of the report. This metric includes both tracks of birds and tracks of migratory bats however the vast majority of tracks are thought to be produced by birds.

Relevant descriptive statistics for the analyzed data include the observed diurnal and nocturnal altitude distributions include the mean, median, and the 25% and 75% quartiles. The 25% and 75% quartiles are calculated in order to assess the potential presence of altitudinal outliers at the two extremes of the altitude distribution. For example, the presence of high-altitude outliers (e.g., several high-flying birds) will tend to increase the altitude value of the 75% quartile relative to the value that would occur if no outliers were present. Likewise, the presence of low-altitude outliers (or a greater number than the usual or expected number of low-flying birds) will tend to decrease the altitude value of the 25% quartile. The median altitude (or, equivalently, the 50% quartile) was defined as that altitude at which half the total number of birds observed were flying below the median, and half were flying above the median.

Comparisons of the mean and median were conducted to obtain a rough estimate of the deviation of the given altitude data from a normal distribution and also the direction of any skew in the data. Generally, the greater the difference between mean and median, the greater the deviation from normality and the greater was the skew. If the mean altitude was greater than the median altitude, then the given altitude distribution would be skewed upward (i.e., toward higher altitudes) because of the presence of several outliers with high altitudes. Conversely, if the mean altitude was less than the median altitude, then the given altitude distribution would be skewed downward (i.e., toward lower altitudes) because of the presence of a greater number of bird counts with low altitudes. If the mean and median were equal, then there would be no skew, and the given altitude distribution would be statistically normal.

A further, more conclusive statistical test for normality is the K-S GOF test (Kolmogorov 1933; Smirnov 1939a,b; Zar 1999). According to this test, a cumulative frequency distribution (CFD) is calculated from the observed (altitude) distribution; and the GOF of this observed CFD to an expected CFD (i.e., the normal CFD) is assessed. A test statistic for each sample “i” (for i=1 to sample size n) is calculated as the

absolute magnitude of the difference between the cumulative observed frequency and the cumulative expected (i.e., normal) frequency. The maximum test statistic calculated is compared to the critical value (tabulated in published statistical tables) for the given sample size (n) and desired confidence level (e.g., a=0.05). If the test statistic is less than the critical value, then the H_o that the given distribution is normal is accepted. Otherwise, H_o is rejected.

To assess whether the observed altitude data follow a normal distribution, the K-S test can be used. If the tested data were not normal, the data were placed into a linear transformation model (logarithmic) to determine if the data could be normalized. If the data cannot be normalized, the only remaining alternative was to use a quartile system for reporting the altitudinal distribution data. Non-transformed datasets can be subject to non-parametric statistical tests, such as the Mann-Whitney test, or Kruskal-Wallis (K-W) test, which are the non-parametric equivalents of the 2-sample test t-test, paired-sample t-test, and the Analysis of Variance (ANOVA) test, respectively, to test for and the differences in diurnal and nocturnal altitude distributions.

The K-S test was run for the diurnal and nocturnal altitude distributions of all spring 2008 radar offshore and radar onshore data. The data were not normally distributed. A logarithmic linear transformation model was then run to determine if the datasets could be normalized; the datasets could not be transformed to normal. Therefore, a quartile data reporting system (cumulative and daily median with 25% and 75% quartiles) was selected to report altitudinal data.

A two-way ANOVA or K-W analysis was conducted on the avian density radar dataset, with the two factors being time of day (two levels: day and night) and wind speed (three levels: 0-8, 9-15, and >15 mph), resulting in a total of 2*3 = 6 samples, and sample size (n) for each sample is equal to the number of locations (for the onshore data) or number of grid cells (for offshore data).

For the application of a two-way ANOVA/K-W Test, the avian density radar dataset was structured into the following parameters and criteria:

1) Only the VerCat data were examined.
2) Only the altitude band within the RSZ was examined (not above or below the RSZ).
3) 2 shore types: Onshore and offshore:
    a) Onshore: 3 locations (Island Beach, Brigantine/Brigantine Beach, and Corson's Inlet/Sea Isle City) and 4 seasons (spring and autumn 2008, and spring and autumn 2009).
    b) Offshore: 3 seasons (spring/autumn 2008, spring 2009); 7 grid cells for spring 2008 (Grids 1, 7, 13, 19, 26, 23, 17), 2 grid cells for autumn 2008 (Grids 23 and 26), and 2 grid cells for spring 2009 (Grids 16 and 22).
4) Three or four seasons (depending on shore type as discussed above).
5) Two time of day periods (Day and Night).
6) Three wind speed ranges (0-8, 9-15, and >15 mph).

In initial testing for normality (K-S test) and homoscedacity (Bartlett test), if it was determined that the six-sample dataset is normal and homoscedastic, then the parametric ANOVA test was applied to the six samples (each with sample size = # locations or # grid cells). In contrast, if it was determined that the six-sample dataset was non-normal or non-homoscedastic, then the non-parametric two-way K-W test was applied. In the K-W test, the avian densities are ranked from lowest to highest, and an ANOVA-type test is conducted on the ranks (rather than on the values) of the densities to assess differences between the two time of day periods (Factor 1), among the three wind speed ranges (Factor 2), and any significance in the two-way interaction (time of day x wind speed). In the event that the ANOVA or K-W test detects a significant difference (indicated by rejection of the null hypothesis H_o of no difference), a subsequent Tukey test examined each pair-wise comparison (i.e., N*(N-1)/2 pairs for N samples) to determine the sources of variance (i.e., which specific sample pairs were significantly different from each other). Results of the two-way ANOVA/K-W tests for the 95% confidence level (CL) are given in the Radar Statistical Analyses on the Appendix CD.

5.4.2 Onshore Radar Surveys

5.4.2.1 Survey Design

Three sample sites were initially chosen in spring 2008 based on location relative to the coastline, availability, and radar line of sight coverage of the coastline and ocean from the location (**Figure 5-18**). The first site (northern most) was located at Island Beach State Park (IBSP). The second was originally located behind an observation tower in North Brigantine Beach (NBB). The third, southernmost location was at Corson's Inlet State Park. After the first survey season, the radar was re-located from Corson's Inlet State Park to Sea Isle City (SIC). In fall 2008, the North Brigantine site was moved about 137 m (449 ft) south of the original site because of access issues.

5.4.2.2 MARS® Survey Site Setup and Data Collection Schedule

Seasonal surveys were scheduled for the term of the project. The number of surveys conducted was variable between years because of different funding levels for the task (spring 2008 [37 days]; fall 2008 [67 days]; spring 2009 [63 days]; fall 2009 [59 days]).

Spring/Summer 2008

The onshore MARS® was stationed at IBSP on 13 May 2008 (**Table 5-5**). Set up occurred on 15 May 2008 and avian radar surveys commenced the same day and continued through 23 May 2008. The onshore MARS® was deployed to NBB and operated from 29 May through June 2008. The onshore MARS® was moved to Corson's Inlet and collected data from 09 June through 19 June 2008.

Fall 2008

An avian radar unit was setup at IBSP on 13 September 2008 (**Table 5-6**). Operation began the same day and continued through 05 October 2008. The radar was moved to SIC and then to Brigantine Beach (BB) where the radar operated from 05-26 October 2008 and from 26 October through 15 November 2008, respectively. The radar unit was then returned to IBSP where it operated from 15 November through 15 December 2008.

Spring 2009

Avian radar surveys were initiated at IBSP on 14 March 2009 and completed on 08 April 2009 (**Table 5-7**). The onshore MARS® was then moved to BB where the unit collected data from 09 April through 06 May 2009. The radar unit was relocated to SIC where it collected data from 07 May through 06 June 2009.

Fall 2009

The onshore MARS® was deployed to IBSP where it operated from 15 September through 02 October 2009 (**Table 5-8**). The radar unit was moved to BB on 02 October 2009; radar surveys were conducted at BB from 05 through 26 October 2009. The onshore MARS® was then relocated to SIC where it operated from 26 through 16 November 2009.

5.4.2.3 Data Analysis

Data analysis protocols for the TracScan and VerCat onshore radar data were identical to the protocols established or the offshore radar data (**Section 5.4.1.3**).

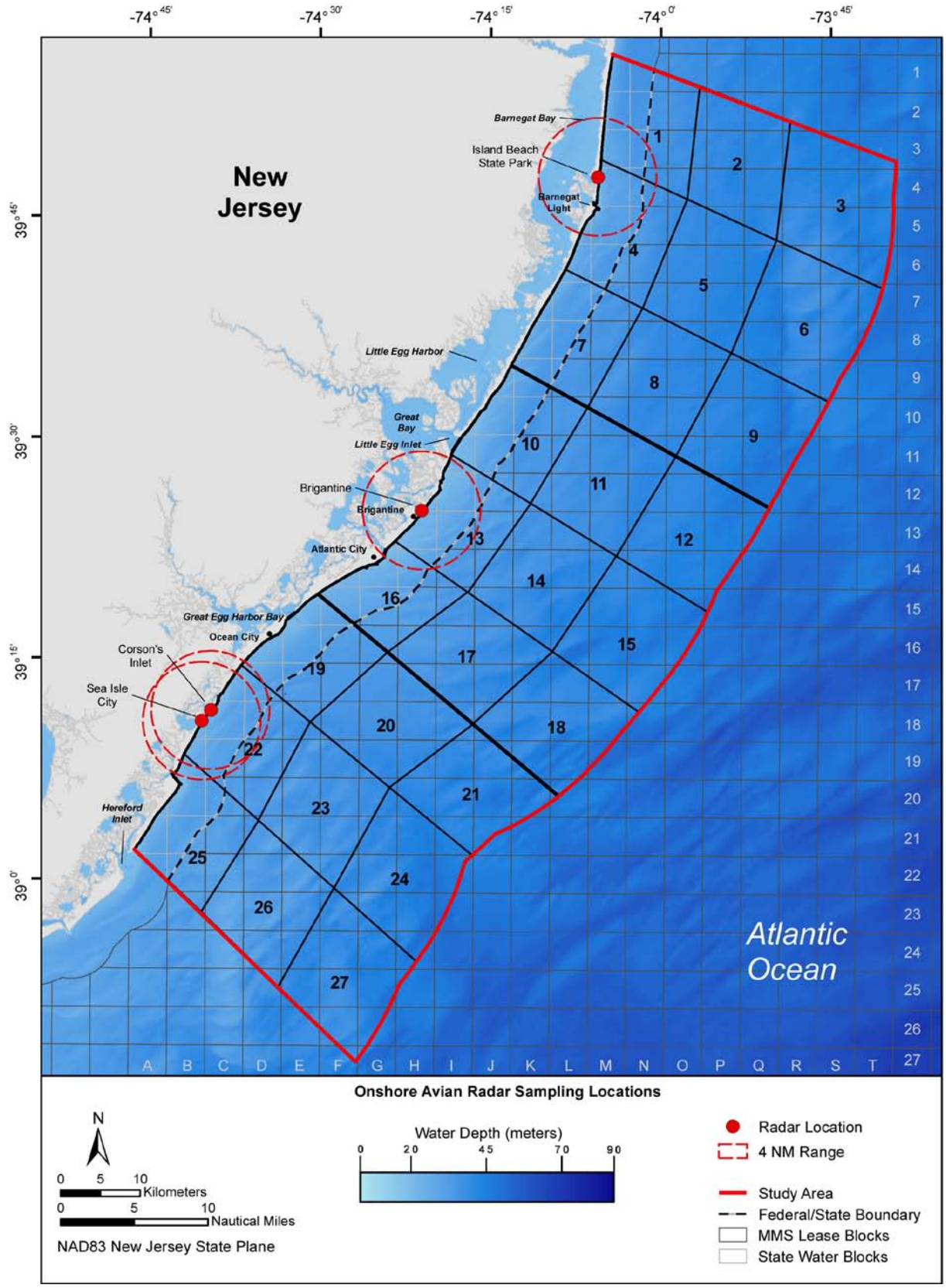


Figure 5-18. Onshore avian radar sampling locations.

Table 5-5. Locations of the spring 2008 onshore radar sites and VerCat azimuth(s).

Location	Longitude (°W)	Latitude (°N)	VerCat Azimuth (°)
Island Beach SP	-74.09139	39.79306	224
North Brigantine Beach	-74.35194	39.41806	247, 250
Corson's Inlet SP	-74.64889	39.21472	96

Table 5-6. Locations of the fall 2008 onshore radar sites and VerCat azimuth(s).

Location	Longitude (°W)	Latitude (°N)	VerCat Azimuth (°)
Island Beach SP	-74.09420	39.79330	218
Sea Isle City	-74.67306	39.17917	100
Brigantine Beach	-74.35361	39.41667	102
Sea Isle City	-74.67611	39.18028	118

Table 5-7. Locations of the spring 2009 onshore radar sites and VerCat azimuth(s).

Location	Longitude (°W)	Latitude (°N)	VerCat Azimuth (°)
Island Beach SP	-74.09417	39.79306	217
Brigantine Beach	-74.35417	39.41667	112
Brigantine Beach	-74.35361	39.41667	109
Sea Isle City	-74.67577	39.18037	87
Sea Isle City	-74.67580	39.18040	87

Table 5-8. Locations of the fall 2009 onshore radar sites and VerCat azimuth(s).

Location	Longitude (°W)	Latitude (°N)	VerCat Azimuth (°)
Island Beach SP	-74.09420	39.79310	43
Brigantine Beach	-74.35361	39.41667	8, 0
Sea Isle City	-74.67583	39.18028	92

5.4.3 Radar Validation Surveys

The results of TI-VPR surveys are used to validate VerCat radar data. The survey design, survey methods, and data analysis for radar validation are discussed in this section. All TI-VPR survey data are fully evaluated in **Chapter 6.0**.

5.4.3.1 Sample Design

Offshore Spring 2008

The proposed TI-VPR sampling scheme was chosen to enable every hour of the day to be sampled twice during a seven-day period at the site. Each sampling session was conducted over a 4-hr period, and data were recorded onto two DVDs during that sampling period. Dr. Sidney Gauthreaux, Jr., set up and tested the TI-VPR during the first deployment of the system to the project site, and determined that a modification of the TI-VPR methodology was necessary to reduce radar operator fatigue. Per Dr.

Gauthreaux's recommendations, the methodology was amended to: record 4 hrs, off 4 hrs, record 4 hrs, off 16 hrs, and repeat. This schedule was adequate to record hourly data at least once for each hour in a day at each site. Sampling was not conducted during periods of rain, drizzle, or heavy fog, and the sampling schedule was adjusted as required for changing weather conditions.

Offshore Fall 2008

The spring 2008 sample design was revised prior to the fall 2008 surveys. This was achieved by changing the recorded-to-media from DVDs to a local hard drive. This modification enabled a new sampling scheme to sample every hour of the day twice during a 5-day period (record 8 hrs, off 12 hrs, and repeat).

Offshore Spring 2009

With the new operating guidelines imposed on the barge operator by the U.S. Coast Guard (**see section 5.4.1.2: Spring 2009**) sampling efforts were limited offshore. Given these new guidelines an effort was made to collect multiple 2-hr segments (single DVD) of data throughout each evening (00:00 Coordinated Universal Time [UTC] – 12:00 UTC). This sampling scheme was adjusted as required for adverse weather conditions for TI-VPR data collection. These conditions included precipitation and fog.

Onshore Fall 2008

Sample design is identical to that discussed previously in **Section 5.2.3.1: Offshore**, **Fall 2008**.

Onshore Spring 2009 & Fall 2009

In 2009, surveys were conducted during evening hours to document activity aloft. These surveys began 30 to 45 min after sunset and lasted from two to four hrs. Because cloud cover obscured the majority of the duller heat signatures in the TI (e.g., high-flying birds (304.8 m [1,000+ ft]) or insects) we only sampled on clear nights to maximize target detections.

5.4.3.2 Survey Site Setup and Data Collection Schedule

Offshore Spring 2008

After validation surveys were completed at Grid 1 on 15 March 2008, DVD recording of the TI-VPR began. Equipment problems with the multiplexer prevented simultaneous recording of both camera and radar systems, preventing the intended functionality of the system. A new multiplexer was ordered and arrived in New Jersey approximately one week later; however, weather conditions prevented transport of the new multiplexer to the radar. The new multiplexer was installed in the radar system when the barge returned to port (because of sea conditions) on 27 March 2009.

Only TI images could be recorded at Grids 1 and 7, not VPR images. Because of bad weather and the inability to record TI and VPR images simultaneously, TI images were recorded to DVD only at times of high target activity in the VerCat radar. Ten DVDs (20 hrs) of TI images were recorded at Grids 1 and 7.

The offshore conditions during the months of April and May included large periods of heavy fog and/or rain at each site. This prevented following the proposed TI-VPR recording schedule of 4 hrs recording, 4 hrs off, 4 hrs recording, 16 hrs off, and repeat. During April, recording at Grid 13 was conducted for approximately 26.5 hrs, at Grid 19 for approximately 36 hrs, and at Grid 26 for approximately 28 hrs. In May, recording was conducted at Grid 23 for approximately 51 hrs and at Grid 17 for approximately 21.5 hrs.

Offshore Fall 2008

On 29 September 2008, the TI-VPR was mounted on the jack-up barge which left for the Study Area that afternoon. The barge was jacked up at the first study site, Grid 22, that evening. The TI-VPR was set up and began recording on 01 October 2008 and continued at Grid 22 until 12 October (approximately 99 hrs total), at which time the barge moved to Grid 26. TI-VPR surveys began on the morning of 13 October and continued until the afternoon of 19 October 2008 (approximately 62 hrs total), at which time the barge was struck by high waves and suffered a catastrophic failure of the lifting legs, thus ending offshore TI-VPR sampling for the season.

Offshore Spring 2009

The TI-VPR system was loaded on the jack-up barge in New York harbor on 02 May 2009. The barge transited to Atlantic City on 03 May 2009, at which time the TI-VPR system was made ready for deployment at the first suitable weather window. Because weather conditions and forecasts did not meet the new range of operating guidelines mandated by the U.S. Coast Guard, surveys were only able to be conducted at Grid 16 during the night of 11–12 May 2009 (approximately 11 hrs total), and at Grid 22 during the night of 12–13 May 2009 (approximately 4 hrs total).

Onshore Fall 2008

The TI-VPR system was set up at SIC, New Jersey, on the morning of 08 December 2008. TI-VPR surveys began that evening and continued until 15 December 2008 (approximately 48 hrs total). Surveys were not conducted from 10 through 12 December 2008 because of poor weather conditions.

Onshore Spring 2009

The TI-VPR system was setup at IBSP, New Jersey, on 14 March 2009. TI-VPR surveys were conducted on the evenings of 21, 22 and 27 March (approximately 10 hrs total). The system was then transported to BB, New Jersey, on 08 April 2009. No surveys were conducted at BB as the TI-VPR system was relocated to accompany the offshore MARS®.

Onshore Fall 2009

The TI-VPR system was set up at IBSP, New Jersey, on 15 September 2009. TI-VPR surveys were conducted on the evening of 19 September 2009 for 3 hrs. The system remained at IBSP until 02 October 2009, when it was taken down and brought back to GMI's Millville, New Jersey office. The system was then transported to BB, New Jersey, on 05 October 2009 and a TI-VPR survey was conducted on the evening of 20 October 2009 for 2 hrs. The TI-VPR system remained there until 26 October at which time it was removed and transported to SIC, New Jersey. TI-VPR surveys were conducted on 03, 06 and 08 November 2009 for a total of 12 hrs. The TI-VPR system was removed from SIC on 16 November and transported back to GMI's Millville, New Jersey office, ending the surveys for the fall season.

5.4.3.3 Data Analysis

To analyze the data, the combined (multiplexed) TI and VPR recorded image was separated using a model 497-2C demultiplexer (Colorado Video Inc., Boulder, Colorado). The TI image was then sent to a Model 443CS video peak store (VPS; Colorado Video, Inc., Boulder, Colorado) to analyze tracks and the VPR image was transmitted to another monitor to view target altitudes and times. The VPS works by storing a new incoming pixel if it is brighter than the corresponding pixel already stored in frame memory. This results in a visible track being displayed on the screen for a bright target moving against a dark background (i.e., a warm biological target against a cold sky). This enables the visual extraction of track characteristics which are used in determining target identifications (**Figure 5-19**). The classification criteria from Gauthreaux and Livingston (2006) were used to determine target identification. Using this method (1) bright targets with mostly straight tracks showing modulation (wing beats) were classified as birds, (2) dimmer targets with minimal to no modulation along the track at low altitudes were classified as

insects, and (3) bright targets showing irregular tracks (e.g., sharp turns, pauses) with minimal modulation were classified as foraging bats. It is impossible to distinguish between birds and bats in linear flight unless they are flying at very low altitudes and can then be identified by their shape. Although foraging birds are possible, all of the low level foraging targets were classified as bats. The speed at which a target crossed the TI screen and its altitude provided additional information that could be used to identify the type of target. It is important to note that the direction of movement is not evident from a completed VPS image; therefore the analyst must also observe the movement in time lapse to determine the direction of movement. Also, in some instances when multiple targets are present in a completed VPS image it is difficult to determine target-altitude associations, thus observations must be made as the VPS image is generated.

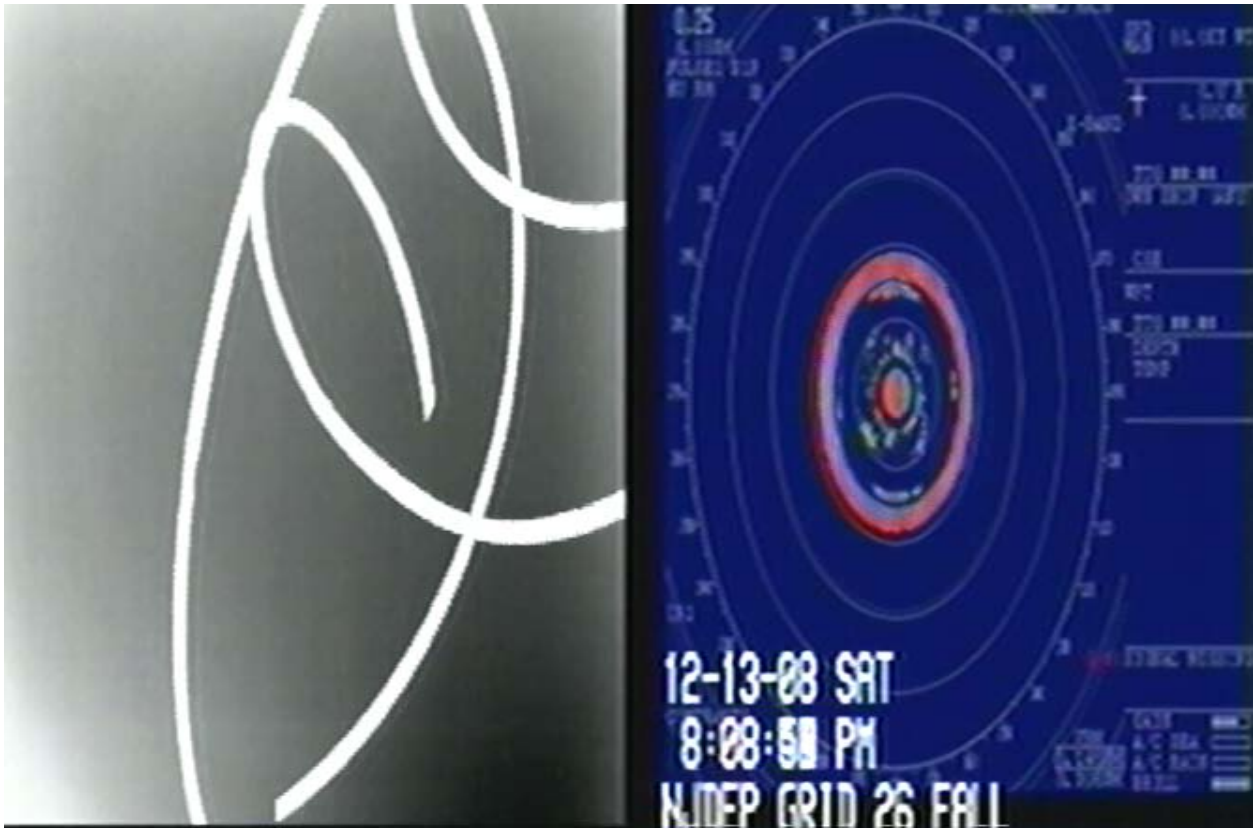


Figure 5-19. Multiplexed VPS TI-VPR image of soaring birds from 13 December 2009 over Sea Isle City, New Jersey, at 8:08 PM (UTC; 3:08 PM Eastern Standard Time [EST]). Thermal image is on the left and display of vertically pointing radar is on the right (shows birds at 550 ft [168 m]).

GMI analyzed 5-min samples for every 15 min for each hour of data collected. Each 5-min period was randomly chosen within each 15-min block for each hour, for a total of 20 min sampled for each hour. This protocol was derived from a preliminary analysis of four hrs of data.

In a preliminary analysis all targets were counted for the entire duration and two sampling protocols were tested against the total count (10 hrs from 00:00 UTC to 10:00 UTC, on the night of 11 May 2008, Grid 17). The first method used a 5-min sample for each 10-min (5/10) time block for each hour and the second method used a 5-min sample within each 15-min (5/15) time block for each hour. The results of the preliminary analysis showed the first method (5/10) had a count of 98 in comparison to the total count of 94; the second method (5/15) had a count of 93 that was closer to the total count of 94. Since the 5/10 method is more exact this sampling scheme was selected. For each data point GMI recorded the

following information: date, time, target identification (bird [BD], insect [I], foraging bat [BT], or unknown [U]), direction (degrees), altitude (ft) and comments (e.g., flight behavior, see **Appendix K**).

To obtain the percentage of birds per hour, a total count of all targets (birds, insects and bats) corrected for the time sampled was first calculated. This was done by counting the total number of targets for each 5-min sample of each hour (raw count) and then multiplying that number by 3 to obtain the total count for an hour (Time-corrected count [TCC]). Then the total TCC for birds was divided by the total TCC for all targets yielding a percentage of birds for each hour.

Altitudinal distributions for birds were obtained in 15.24-m (50-ft) bands of elevation up to 671 m (2,200 ft). Correction factors were calculated and applied to each bird based on its altitudinal band to account for the increase in the sample area of the beam with altitude. In this analysis the corrected count for birds for time sampled was multiplied by the sample size correction factor to obtain the final count within each altitudinal band (corrected altitudinal count [CAC]). This enables a comparison of the amounts of migration below, in, and above the RSZ. Directional analyses were conducted using circular statistics (Oriana 2, Kovach Computing Services, Pentraeth, Wales, United Kingdom [U.K.]) to analyze straight track data to determine mean direction of movement. The CAC for each direction was used when analyzing the directional data. In the directional analyses irregular flight tracks were not used because of the unknown heading.

5.5 RADAR VALIDATION

5.5.1 Methods

The purpose of the avian radar validation surveys was to determine MARS® performance related to target detection (i.e., number of targets present to the number of targets detected by the radar). Radar target detection is affected by many variables including the size of the target, the location of the target within the beam, flight direction of the target with reference to the radar, flight behaviors (e.g., flapping, gliding, soaring), and weather conditions. Detection of all targets decreases with increasing distance from the radar because of a decrease in target reflectivity; therefore smaller targets are more difficult to detect at increasing distances from the radar than larger targets. Large flocks are easier to detect than single individuals throughout the radar's range because of the higher reflectivity of a large flock. The upper and lower sections of the radar beam have less power than the central portion of the beam; targets in the upper and lower sections of the beam may or may not be detected at increasing distances from the radar. A small target in the center of the radar beam at 4.6 km (2.5 NM) from TracScan may be detected while the same target near the lower or upper edge of the beam at the same distance may not be detected.

Each flight profile (e.g., flapping, gliding, diving) produces a different reflectivity which may have an effect on its detection. Flight direction with reference to the radar also affects a target's reflectivity. A target flying toward or away from the radar is more likely to have a lower reflectivity than a target flying tangential (broadside) to the sweep of the radar beam. Weather conditions (e.g., wind speed) may increase sea state and sea clutter and limit detection capabilities of the radar. Even with these limitations, radar provides the best available data on flying targets in the vicinity of the radar site at night. Three validation methods were used during the study: boat-based, line transect, and TI-VPR (**Section 5.4.3**). Spring and fall 2008 validation survey methods differed from spring and fall 2009 validation methods.

5.5.1.1 Spring and Fall 2008

The validation protocol utilized communication between the avian radar operator (ARO) and the visual observer (VO). The ARO observed a track on the radar screen and communicated this to the VO, or the VO communicated an observation to the ARO. Field team members were comprised of at least two GMI biologists; one observer and a radio communicator/recorder. Validation surveys consisted of multiple observation periods scheduled over the radar season at each radar site.

The field team navigated to multiple oceanic sites at varying distances within the barge-based MARS® coverage area. In addition, radar validation surveys were conducted at onshore avian radar sites. Prior to

and during each validation event, field observers requested, from the ARO, distances to nearby vessels to establish distance estimation with the MARS®; passing and stationary ships were used to orient field observers.

The first offshore survey site was assigned to the team during the pre-event briefing. The ARO reviewed the radar clutter image at varying distances from MARS® and determined an area where both the ARO and field team could detect/observe birds. The ARO then directed the field team to traverse to the first validation location (e.g., navigate northwest 5 km [2.5 NM] from the barge).

At the arrival of each survey site, the field team recorded pertinent data on the "Ground Truth Data Sheet" (**Figure 5-20**). Data recorded included: date, time, team number, event number, observer name(s), recorder name, and location information (latitude, longitude). After the initial data were recorded, the field team reported "ready" on-station status via radio. The ARO subsequently radioed to the field team when the event would begin, which was recorded on the datasheet by the field recorder. The ARO in the MARS® began observing the radar displays surrounding the designated survey site, which encompassed a 2- to 4-km (1- to 2-NM) radius from the boat.

GROUND TRUTH VALIDATION SURVEY DATA SHEET
Date:_____
Team No: _____ Event No: _____ Observer: _____ Recorder: _____
Lat._____ Long._____ Location:_____
Time on Station: Begin: _____End: _____
Weather conditions/visibility/comments:
_____
_____
_____

Time	C/U	By Radar or Observer	Bearing from observer	Range/m	Flight heading	Altitude/ft	Count	Species

Figure 5-20. Radar validation survey data sheet.

When the ARO saw a tracked target on the radar screen (or when the field team saw a bird/flock) within the survey site, the following detection/observation information was reported: the approximate range and bearing of the detection/observation relative to the field team location, bird/target heading (using eight cardinal compass points), and the location of bird/target as it moved across the landscape/radar display. A typical radio call during each event was: "Target East (bearing 90°), range 2 km (1 NM), heading west (i.e., towards you)". The field team recorded time, detection bearing (or quadrant), and confirmed (C) or unconfirmed (U). The following data were recorded for all confirmed tracks: estimated range (m), heading, flight altitude (ft), number of birds in the tracked target/flock, species/group (e.g., Northern Gannet), and any other comments.

As workload permitted, field observers recorded observations of bird activity that were not called out by the ARO since the MARS® (or ARO) may not have been able to see all the visual observations. All bird species/groups of varying sizes, flight altitudes, and behaviors were relevant to qualifying MARS® (TracScan and VerCat) performance. Therefore, resident and migratory bird activities were recorded during avian radar validation events. In addition, visual observations were limited to areas without radar clutter and within the boundaries of the observer's vision (aided by binoculars). For each of the non-cued observations, the field team recorded observation time, observation bearing, estimated range (m),

heading, flight altitude (ft), count, and species/group. Events ended when the field team was notified by the ARO, and the event end time was recorded on the field data sheet by the recorder. The validation events were approximately 1 to 2 hrs in duration. After each validation event, the field data recorder verified that all field event data sheets were completed. The field team members and the ARO discussed validation event methods and made improvements if necessary. Significant observations were discussed and locations of successive field events were determined.

Radar validation survey data were analyzed to determine the number of confirmed and unconfirmed birds by flight altitude category (e.g., 1-25, 26-50 ft AMSL). Survey results were summarized for each season by species (e.g., Northern Gannet) or guild (ducks, loons, cormorants, and gulls), flight altitude, and location with reference to distance from the radar site. Survey data are presented in **Appendix J-2**.

5.5.1.2 Spring and Fall 2009

The radar validation survey protocol used in 2008 was evaluated at the end of the first survey season. This evaluation revealed that the radar operator may bias the surveillance of the onshore observer and the observations of the onshore observer may bias the radar operator. In addition, the quadrant validation method covers a relatively large area. When a target is called in/out by the avian observer or the radar operator the position of the target in the quadrant is difficult to describe accurately. Therefore, specific birds called in/out may be confused with other nearby birds. In addition, there is a communication time lag between the radar operator and avian observer. By the time the communication was received and understood the bird observed may have changed direction or disappeared behind a wave. Boat-based validations were also limited to times when sea states allowed small boats to safely operate and conduct the survey. Based on this evaluation a new validation protocol was developed.

The 2009 radar validation protocol represents a straight-forward way to identify the sources of radar echoes when mobile radar is in a horizontal surveillance mode and monitoring the near-shore ocean from the shore. The protocol for validating sources of radar tracks is a variation of the line-intercept sampling protocol used by ecologists to count animal tracks crossing a line or count the stems of plants touching a line of a fixed length (Sutherland 2006; Fonseca et al. 2007). Although the line in this protocol is imaginary, when a bird crosses the vertical plane above the line, the data on the bird's identity and behavior (e.g., flight altitude/direction) are recorded along with a GPS time. The protocol is used to monitor bird movements from a stationary ship, boat, or platform offshore. By using this approach, the radar operator does not bias the surveillance of the observer and the observations of the observer do not bias the radar operator.

The observer was positioned looking over an azimuth nearly perpendicular to the shore or at a set azimuth from the offshore platform or ship. The GPS position of the observer and the azimuth of their observation "line" were recorded so that the location of the observer and azimuth line could be added to the radar display for post survey analysis. Before the beginning of a validation session the GPS time on the field observer personal digital assistant (PDA) was synchronized so that the time stamp was the same as that for the radar. Sea-state and visibility conditions were recorded at the beginning of each survey. Additional weather data were recorded by the weather station at the radar site.

An observer using 10 x 50 binoculars looked for birds flying over the imaginary azimuth line (survey line). A telescope pointed down the survey line was also used to identify birds crossing too far away to be identified with 10 x 50 binoculars. When a bird crossed the vertical plane above the survey line, the bird's identity, distance, height, direction of flight, and flight behavior were recorded (along with a GPS time). In the PDA Survey Program, the "bearing" entry was the azimuth of the survey line chosen for monitoring. The altitude bins were 1 (skimming), 25 ft, 50 ft, 100 ft, 200 ft, 300 ft, 500 ft, 1,000 ft, and >1,000 ft. The distance bins were 100 m, 200 m, 300 m, 1,000 m, and >1,000 m. If a boat passed offshore the observer checked the radar to determine the distance from the observers to the boat. Flight directions were recorded in the following eight cardinal direction codes: N, S, E, W, NE, SE, SW, and NW. Flight behavior (e.g., directional flight, circling, feeding) was noted in the comment section.

Post survey GMI's radar software was used to replay the stored TracScan radar data at the same time of observers sighting to determine if the observer-recorded bird was or was not detected passing over the azimuth line. Results (confirmed or unconfirmed) were recorded on a datasheet (Fonseca et al. 2007) and analyzed to determine percentages of radar confirmed bird targets by flight altitude.

In spring 2009 the line-intercept protocol was used from the offshore barge on Grid 16. The azimuth was set looking towards shore. In fall 2009 the line intercept protocol was conducted at IBSP, BB, and SIC. It was also conducted from an anchored boat along an azimuth aimed at the radar at BB to supplement the onshore ground truth data collection. Because the radar validation exercises were designed in part to determine the extent of missed tracks obscured by sea clutter, samples were collected in different sea-state conditions because increasing sea states increases clutter distance in the radar surveillance area.

5.5.2 Radar Validation Survey Results

Validation of TracScan and VerCat radars were conducted during the radar surveys. Boat-based validation surveys were conducted during the first year of the study. Line-transect surveys, both offshore and onshore, were used during the second year of the study and TI-VPR data were used for validation of VerCat data throughout the study. Validation results for TI-VPR data have been presented previously in **Section 5.4.1.3**.

5.5.2.1 Spring and Fall 2008

Offshore

Six boat-based validation surveys, four in spring 2008 and two in fall 2008, were conducted for offshore radar sites. The total onsite survey effort was 6.6 hrs in spring and 4.0 hrs in fall.

No general trends were identified for VerCat offshore boat-based validation data during the spring surveys because adverse weather and associated sea state conditions limited the collection of validation survey data. TracScan offshore validation survey data were also limited and only general trends regarding TracScan detection of Northern Gannet were determined. Insufficient survey data were available to identify any general trends in radar detections of other birds at varying altitudes and distances from the radar site (**Appendix J: Tables J-2** through **J-11**).

TracScan target confirmation of Northern Gannets decreased with increasing distance from the radar site. At 2 km (1.00 NM) from the radar 88.23% of the Northern Gannet observations (n=17) were confirmed, and at 4 km (2.00 NM), 63.64% of the Northern Gannet observations (n=33) were confirmed (**Table 5-9**). At 6 km (3.00 NM), 28.57% of the Northern Gannet observations (n=7) were confirmed. The decrease in Northern Gannet detections resulted from decreased detection when birds were flying at lower flight altitudes (<31 m [101 ft] ASL) at increasing distances from the radar.

Survey results are summarized for the spring 2009 season are limited for TracScan (**Appendix J: Tables J-12** through **J-14**); insufficient data are available to identify any general trends in radar detections of these species/guilds at varying altitudes and distances from the radar site.

Onshore

One boat-based TracScan validation survey was conducted at each of the three onshore sites: IBSP, North Brigantine Beach, and Corson's Inlet during spring 2008. VerCat validation surveys were not conducted. Total survey effort was 3.8 hrs. No general trends were identified except for gulls. Although data were limited, gulls were confirmed at all altitudinal bands (**Table 5-10**). Data for the other guilds were analyzed; however, insufficient validation data were available to identify any general trends in radar detections of these guilds at varying altitudes and distances from the radar site (**Appendix J: Tables J-14** through **J-21**).

Table 5-9. Validation of Northern Gannet targets tracked by TracScan radar. Observations grouped by flight altitude during spring 2008 boat-based offshore validation surveys.

Grid #	Distance to Radar (NM)	Altitude (ft AMSL)											
		1-25		26-50		51-75		76-100		101+		Total	
		C	U	C	U	C	U	C	U	C	U	C	U
07	1.00	0	2	3	0	4	0	4	0	2	0	13	2
19	1.00	-	-	1	0	1	0	-	-	-	-	2	0
Subtotal	**1.00**	**0**	**2**	**4**	**0**	**5**	**0**	**4**	**0**	**2**	**0**	**15**	**2**
23	1.75	2	1	1	0	-	-	-	-	-	-	3	1
01	2.00	-	-	-	-	-	-	2	3	2	0	4	3
07	2.00	2	1	0	2	3	0	2	0	2	1	9	4
19	2.00	1	0	1	1	2	3	-	-	1	0	5	4
Subtotal	**2.00**	**5**	**2**	**2**	**3**	**5**	**3**	**4**	**3**	**5**	**1**	**21**	**12**
23	**3.00**	**1**	**4**	**0**	**1**	**1**	**0**	**-**	**-**	**-**	**-**	**2**	**5**
Total		**6**	**8**	**6**	**4**	**11**	**3**	**8**	**3**	**7**	**1**	**38**	**19**

NM = nautical miles; ft AMSL = feet mean above sea level; C = Confirmed; U = Unconfirmed

Table 5-10. Validation of gull targets tracked by TracScan radar onshore. Observations grouped by flight altitude during spring 2008 boat-based validation surveys.

Location	Distance to Radar (NM)	Altitude (ft AMSL)											
		1-25		26-50		51-75		76-100		101+		Total	
		C	U	C	U	C	U	C	U	C	U	C	U
Island Beach State Park	1	-	-	2	0	2	0	0	1	2	0	6	1
North Brigantine Beach	1	-	-	5	0	2	0	3	0	-	-	10	0
Corson's Inlet	1	2	0	4	0	3	0	4	0	3	0	16	0
Total		**2**	**0**	**11**	**0**	**7**	**0**	**7**	**1**	**5**	**0**	**32**	**1**

NM = nautical miles; ft AMSL = feet above mean sea level; C = Confirmed; U = Unconfirmed

Validation surveys were conducted at three sites: IBSP, SIC, and BB during fall 2008. At BB ground truth observations were conducted both onshore and offshore. Total survey effort was 36.26 hrs. Only TracScan validation surveys were conducted; VerCat validation surveys were not conducted. Survey results are summarized for the land-based observation sites by species (Northern Gannet) or guild (ducks, cormorants, gulls, and terns), flight altitude, and location with reference to the radar site. At all three sites surveying was constrained by access and limited field of view, and as a result, all of the observations were conducted at 2 km (1.00 NM) or less from the radar. Survey data are provided in **Appendix J: Tables J-22** through **J-25.**

The number of confirmed and unconfirmed sightings by radar was determined by guild or species (**Tables 5-11** through **5-15**). The confirmation percentages were 95.52% for Northern Gannet (n=67), 97.8 for ducks (n=182), 97.2 for cormorants (n=96), and 100% for tern sightings (n=49).

Table 5-11. Confirmation status of Northern Gannet observations by flight altitude during fall 2008 land-based TracScan radar onshore validation surveys.

Location	Distance to Radar (NM)	Altitude (ft AMSL)											
		1-25		26-50		51-75		76-100		101+		Total	
		C	U	C	U	C	U	C	U	C	U	C	U
Island Beach State Park	0.03	4	0	2	1	1	0	3	1	3	0	13	2
Sea Isle City	0.03 to 0.20	0	1	8	0	5	0	-	-	1	0	14	1
Brigantine Beach	0.10	5	0	21	0	7	0	3	0	1	0	37	0
Total		**9**	**1**	**31**	**1**	**13**	**0**	**6**	**1**	**5**	**0**	**64**	**3**

NM = nautical miles; ft AMSL = feet above mean sea level; C = Confirmed; U = Unconfirmed

Table 5-12. Confirmation status of duck (Anatidae) observations by flight altitude during fall 2008 land-based TracScan radar onshore validation surveys.

Location	Distance to Radar (NM)	Altitude (ft AMSL)											
		1-25		26-50		51-75		76-100		101+		Total	
		C	U	C	U	C	U	C	U	C	U	C	U
Island Beach State Park	0.03	6	0	1	0	-	-	-	-	1	0	8	0
Sea Isle City	0.03 to 0.40	105	0	22	1	2	0	8	0	14	2	151	3
Brigantine Beach	0.10	8	0	2	0	-	-	0	1	9	0	19	1
Total		**119**	**0**	**25**	**1**	**2**	**0**	**8**	**1**	**24**	**2**	**178**	**4**

NM = nautical miles; ft AMSL = feet above mean sea level; C = Confirmed; U = Unconfirmed

Table 5-13. Confirmation status of cormorant observations by flight altitude during fall 2008 land-based TracScan radar onshore validation surveys.

Location	Distance to Radar (NM)	Altitude (ft AMSL)											
		1-25		26-50		51-75		76-100		101+		Total	
		C	U	C	U	C	U	C	U	C	U	C	U
Island Beach State Park	0.03	3	0	2	0	-	-	-	-	-	-	5	0
Sea Isle City	0.03 to 0.40	2	0	2	1	1	0	5	0	70	0	80	1
Brigantine Beach	0.10	1	0	2	0	-	-	1	1	5	0	9	1
Total		**6**	**0**	**6**	**1**	**1**	**0**	**6**	**1**	**75**	**0**	**94**	**2**

NM = nautical miles; ft AMSL = feet above mean sea level; C = Confirmed; U = Unconfirmed

The observations taken offshore from BB during boat-based surveys were conducted at 3, 4, and 5 km (1.67, 2.00, and 2.75 NM). Total survey effort was 3.6 hrs. Data are summarized by species (Northern Gannet) or guild (gulls, ducks, and cormorants). At all distances from the radar 100% of the Northern Gannet (n=70) and gull (n=26) sightings were confirmed (**Tables 5-16** and **5-17**). Insufficient data for ducks and cormorants prevent any generalizations in radar detection trends. .

Table 5-14. Confirmation status of gull observations by flight altitude during fall 2008 land-based TracScan radar onshore validation surveys.

Location	Distance to radar (NM)	Altitude (ft AMSL)											
		1-25		26-50		51-75		76-100		101+		Total	
		C	U	C	U	C	U	C	U	C	U	C	U
Island Beach State Park	0.03 to 1.00	22	0	53	1	11	1	21	0	37	0	144	2
Sea Isle City	0.03 to 0.40	3	0	4	0	3	0	5	0	4	0	19	0
Brigantine Beach	0.10	1	0	8	0	4	0	2	0	2	0	17	0
Total		**26**	**0**	**65**	**1**	**18**	**1**	**28**	**0**	**43**	**0**	**180**	**2**

NM = nautical miles; ft AMSL = feet above mean sea level; C = Confirmed; U = Unconfirmed

Table 5-15. Confirmation status of tern observations by flight altitude during fall 2008 land-based TracScan radar onshore validation surveys.

Location	Distance to radar (NM)	Altitude (ft AMSL)											
		1-25		26-50		51-75		76-100		101+		Total	
		C	U	C	U	C	U	C	U	C	U	C	U
Island Beach State Park	0.03	6	0	9	0	3	0	13	0	13	0	44	0
Sea Isle City	0.03	-	-	4	0	-	-	-	-	-	-	4	0
Brigantine Beach	0.10	-	-	1	0	-	-	-	-	-	-	1	0
Total		**6**	**0**	**14**	**0**	**3**	**0**	**13**	**0**	**13**	**0**	**49**	**0**

NM = nautical miles; ft AMSL = feet above mean sea level; C = Confirmed; U = Unconfirmed

Table 5-16. Confirmation status of Northern Gannet observations by flight altitude during fall 2008 boat-based TracScan radar validation surveys off Brigantine Beach.

Distance to Radar (NM)	Altitude (ft AMSL)											
	1-25		26-50		51-75		76-100		101+		Total	
	C	U	C	U	C	U	C	U	C	U	C	U
1.67	-	-	7	0	4	0	5	0	2	0	18	0
2.00	4	0	12	0	3	0	2	0	-	-	21	0
2.75	15	0	16	0	-	-	-	-	-	-	31	0
Total	**19**	**0**	**35**	**0**	**7**	**0**	**7**	**0**	**2**	**0**	**70**	**0**

NM = nautical miles; ft AMSL = feet above sea level; C = Confirmed; U = Unconfirmed

5.5.2.2 Spring and Fall 2009

Offshore

Radar validation data were collected from the barge at Grid 16 on 11 May 2009. The survey effort totaled 2 hrs. The sample size was too small to make any general conclusions except that bird radar confirmation percentage mostly increased with increasing flight altitude (**Table 5-18**).

Table 5-17. Confirmation status of gull observations by flight altitude during fall 2008 offshore boat-based TracScan radar validation surveys off of Brigantine Beach.

Distance to Radar (NM)	Altitude (ft AMSL)											
	1-25		26-50		51-75		76-100		101+		Total	
	C	U	C	U	C	U	C	U	C	U	C	U
1.67	4	0	5	0	1	0	3	0	1	0	14	0
2.00	2	0	6	0	1	0	-	-	-	-	9	0
2.75	1	0	2	0	-	-	-	-	-	-	3	0
Total	**7**	**0**	**13**	**0**	**2**	**0**	**3**	**0**	**1**	**0**	**26**	**0**

NM = nautical miles; ft AMSL = feet above mean sea level; C = Confirmed; U = Unconfirmed

Table 5-18. Bird observations confirmed by radar for Grid 16 in the New Jersey Study Area, 11 May 2009.

Radar Sea Clutter Distance (NM)	Altitude (ft ASL)											
	1-5		6-25		26-50		51-100		101-200		201-300	
	No.	%C	No.	%C	No.	%C	No.	%C	No.	%C	No.	%C
0.7 to 1.2	9	11.1	11	18.2	16	37.5	12	58.3	1	0.0	1	0.0

No. = number of observations; ft ASL = feet above sea level; %C = percent confirmed

Onshore

Radar validation surveys were collected from 17 September to 02 October 2009 at IBSP (**Appendix J: Table J-26**). Survey effort totaled 23.25 hrs. For sea clutter distances from 0.9 km to 2.8 km (0.5 NM to 1.50 NM), the percentage of bird radar confirmations increased with increasing flight altitude (**Table 5-19**). Except for the skimming 0.3-1.5 m (1-5 ft) ASL altitude, the greatest bird radar confirmation percentages occurred when the sea clutter distance was 0.9 km (0.50 NM). No birds were confirmed when the sea clutter distance was 4.6 km (2.50 NM).

At BB onshore radar validation surveys were conducted from 06 to 23 October 2009 (**Appendix J: Table J-27**). The total onshore survey effort was 24.25 hrs. The sea clutter distance of 0.9 km (0.5 NM) had too few observations to make any generalizations, but for sea clutter distances of 1.9 km (1.00 NM) and 2.8 km (1.5 NM) bird radar confirmation percentage generally increased with flight altitude (**Table 5-20**). No birds were confirmed for sea clutter distances of 4.5 km (2.50 NM) and 5.6 km (3.00 NM).

Boat-based data were also conducted offshore of BB on 22 October 2009 (survey effort: 5 hrs; **Appendix J: Table J-28**). The boat-based observations were all conducted when the sea clutter distance from the radar was 1.9 km (1.0 NM; **Table 5–21**). No bird radar confirmations were made when the sea clutter distance was 3.7 km (2.00 NM); however, many of the observations were of birds that were skimming 0.3-1.5 m (1-5 ft) ASL. Based on the low percentage in the 0.3-1.5 m (1-5 ft) altitude band these birds were most likely obscured from radar by waves; however, a very small percentage of birds were confirmed flying just above the waves at 1.8-7.6 m (6-25) ft AMSL when the sea clutter distance was 4.6 km (2.5 NM).

Onshore radar validation surveys were conducted at SIC from 26 October to 15 November 2009 (**Appendix J: Table J-29**). Survey effort totaled 34 hrs. For distances of 0.9 km (0.5 NM) to 2.8 km (1.50 NM) sea clutter, bird radar confirmations generally increased with increasing flight altitude (**Table 5-22**).

Table 5-19. Bird observations confirmed by radar for Island Beach State Park, New Jersey, in fall 2009.

Radar Sea Clutter Distance (NM)	Altitude (ft ASL)															
	1-5		6-25		26-50		51-100		101-200		201-300		301-500		501-1000	
	No.	%C	No.	%C	No.	%C	No.	%C	No.	%C	No.	%C	No.	%C	No.	%C
0.50	68	14.7	49	24.5	41	34.2	53	43.4	19	73.7	4	100.0				
1.00	24	20.8	36	8.3	20	25.0	29	34.5	17	47.1	7	85.7	1	0.0	1	0.0
1.50	15	0.0	27	0.0	34	5.9	26	15.4	4	50.0						
2.50	14	0.0	101	0.0	42	0.0	15	0.0	3	0.0	1	0.0				

No. = number of observations; ft ASL = feet above sea level; %C = percent confirmed

Table 5-20. Radar validation survey observations on 22 October 2009 confirmed by radar for Brigantine Beach, New Jersey.

Distance to Radar (NM)	Altitude (ft ASL)							
	1-5		6-25		26-50		51-100	
	No.	%C	No.	%C	No.	%C	No.	%C
1.50	43	9.3	21	14.3	1	0.0		
2.00	50	0.0	14	0.0	1	0.0		
2.50	35	0.0	38	2.6	3	0.0	2	0.0

No. = number of observations; ft ASL = feet above sea level; %C = percent confirmed

Table 5-21. Bird observations confirmed by radar for Brigantine Beach, New Jersey, in fall 2009.

Radar Sea Clutter Distance (NM)	Altitude (ft ASL)															
	1-5		6-25		26-50		51-100		101-200		201-300		301-500		501-1000	
	No.	%C	No.	%C	No.	%C	No.	%C	No.	%C	No.	%C	No.	%C	No.	%C
0.50	25	16.0	8	37.5	5	80.0	2	0.0								
1.00	81	19.8	64	18.8	59	18.6	47	25.5	8	37.5	3	33.3	1	0.0		
1.50	21	23.8	20	20.0	32	31.3	14	14.3	7	57.1	3	33.3	3	66.7		
2.00	27	0.0	42	7.1	16	6.3	10	40.0	6	16.7	7	0.0	10	0.1	3	0.0
2.50	44	0.0	76	0.0	17	0.0	2	0.0								
3.00	1	0.0	7	0.0	2	0.0	1	0.0								

No. = number of observations; ft ASL = feet above sea level; %C = percent confirmed

Table 5-22. Radar validation survey observations confirmed by radar for Sea Isle City, New Jersey, in fall 2009.

Radar Sea Clutter Distance (NM)	Altitude (ft ASL)																	
	1-5		6-25		26-50		51-100		101-200		201-300		301-500		501-1000		>1,000	
	No.	%C	No.	%C	No.	%C	No.	%C	No.	%C	No.	%C	No.	%C	No.	%C	No.	%C
0.50	52	5.8	34	17.7	16	6.3	10	20.0	4	0.0							1	0.0
1.00	32	12.5	54	27.8	20	45.0	4	50.0	1	100.0								
1.50	59	18.6	152	29.6	127	32.3	38	29.0	4	50.0	2	50.0						
2.00	112	11.6	253	25.7	163	34.4	46	6.5	2	50.0	1	100.0						
2.50	28	0.0	91	3.3	100	1.0	59	0.0	27	11.1	11	18.2	1	0.0				

No. = number of observations; ft ASL = feet above sea level; %C = percent confirmed

5.5.3 Discussion

The radar validation survey protocol used in 2008 was evaluated at the end of the first survey season. This evaluation revealed that the radar operator may bias the surveillance of the onshore observer and the observations of the onshore observer may bias the radar operator. A new protocol method (line transect survey) was developed and implemented in 2009.

Radar validation survey results from 2009 were:

- Bird radar confirmations generally increased with increasing flight altitude.
- The highest percentage of bird radar confirmations occurred when the sea clutter was less than or equal to 2.8 km (1.50 NM).

The low percentage of birds detected by the radar at low flight altitudes was understandable based on operational constraints of the radar, operational capabilities of the radar, and the extent of sea clutter. At the offshore sites, the VerCat radar on the barge was, on average, approximately 9.1 m (30 ft) above the water. The VerCat radar ceased operation when it became horizontal with the sea surface. When the VerCat radar was horizontal 50% of the radar beam spreads below the horizontal and travels towards the water surface reaching it at 1 km (0.50 NM) from the barge. When sea clutter (wave height) increases the capability of detecting a bird flying at low altitudes over the water was reduced.

In contrast, the lower portion of the offshore TracScan radar contacted the water surface at 61 m (200 ft) from the radar. Because of the TracScan's operational height requirement the lower portion of the radar beam contacted the water surface at a sharper angle. This resulted in greater sea clutter returns at greater ranges and this negatively affected the detection of birds flying at low altitudes above the water.

The onshore radar sites were located only a few feet above the water and were affected by operational site requirements. The lower portion of the VerCat beam was blocked during days with high waves and/or by an obstruction (sand dunes) at one location thereby decreasing detection capability of low flying birds. In contrast, the TracScan beam angles were lower at the lower onshore operational heights thereby increasing detection of low flying birds when the wave heights were low.

As previously discussed in the radar analysis section, the effects of sea clutter were reduced during processing (**Section 5.4.3**); however, operational constraints and radar capability negatively affected the radar detection of low flying birds.

5.6 OFFSHORE SURVEY RESULTS

This section summarizes the results of the offshore and onshore radar studies. Three VerCat radar metrics, median altitude quartile, flux, and AMTR, were used to identify the altitudinal relationship of bird flight activity in the potential RSZ (100-700 ft AMSL). The median altitude (or, equivalently, the 50% quartile) was defined as that altitude at which half the total number of birds observed were flying below the median, and half were flying above the median. This metric allows for identification of bird altitude distribution with respect to the RSZ. Cumulative diurnal and nocturnal flux data (adjusted bird tracks per cub kilometer (km^3) per hour) were sorted into three altitude bands with reference to the potential RSZ: (1) below the RSZ (low altitude band, 1 to 99 ft AMSL), (2) within the RSZ (middle altitude, 100 to 700 ft AMSL), and (3) above the RSZ (high altitude band, 701+ ft AMSL). This metric allows identification of time periods (e.g., weeks, daytime, nighttime) where a majority of birds may be within the RSZ and the flux or density of bird tracks moving through the low, middle, and high altitude bands (below, within and above the RSZ). The flux value is the primary metric used to estimate bird-turbine collision mortality. The number of bird tracks crossing over a km per hour (AMTR) was calculated to provide a quantitative passage rate. Although many variables affect the possibility of bird-turbine collision risk, in general the greater the AMTR value the greater the potential for bird-turbine collision.

As discussed in the radar validation section (**Section 5.5.2**), only 10-20% of the birds flying at very low altitudes were detected with the radar. This is because of constraints of the marine radar detecting wave

clutter that obscures return from low flying birds. Consequently, bird numbers reported within the 25% altitude quartile by the radar were thought to be lower than what was present in the study area.

The results of the offshore and onshore avian radar surveys during the study are summarized below. A detailed analysis of the radar survey results is provided in **Appendix J-3**.

5.6.1 Offshore

5.6.1.1 Spring 2008

With the exception the diurnal time period during early spring at the nearshore grids 1 and 7, most of the diurnal and nocturnal offshore median altitude quartiles were within the potential RSZ band (100-700 ft AMSL; **Figure 5-21**).

VerCat cumulative diurnal flux values over nearshore grids (1, 7, 13, 19) were concentrated within the low altitude band (**Figure 5-22**). Over the offshore grids, diurnal flux values were similar within the low and middle altitude bands over grids 26 and 23. Over Grid 17 flux was greater within the middle (RSZ) band than within the low altitude band. Cumulative nocturnal flux values within the middle altitude band increased over both the nearshore and offshore grids and became greater than low altitude flux values by the end of the nearshore and offshore sampling periods. The overall diurnal nearshore and offshore trend during spring 2008 was for gradually decreasing diurnal flux values within the low altitude band and gradually increasing flux values within the middle altitude band. The overall nocturnal trend for both nearshore and offshore grids was for greater flux values within the middle (RSZ) band than the low altitude band as the spring season advanced (**Figure 5-22**).

Diurnal AMTR increased over the nearshore grids while nocturnal AMTR remained constant (**Figure 5-23**). Over the offshore grids, diurnal AMTR steadily increased; cumulative nocturnal AMTR decreased from Grid 26 to Grid 23 before increasing over Grid 17. Diurnal AMTR was greater than nocturnal AMTR over most grids. The peak diurnal AMTR occurred offshore on Grid 26 (137.0 adjusted number of bird tracks [abt]/kph) from 24-30 April and on Grid 17 (113.0 abt/kph) from 07-11 May 2008. Peak nocturnal AMTR occurred 30 April - 07 May (320.3 abt/kph) on Grid 26 and from 07-11 May 2008 (333.5 abt/kph) on Grid 17. The dominant diurnal and nocturnal nearshore and offshore flux directions during most of the survey weeks was from the south and southwest to the north and northeast.

5.6.1.2 Fall 2008

The fall 2008 radar surveys were limited to two offshore sampling grids in the southern section of the Study Area. The data are limited and insufficient to make any conclusions.

All cumulative diurnal and nocturnal median altitudes were within the RSZ (100-700 ft AMSL; **Figure 5-24**). The VerCat cumulative diurnal and nocturnal flux was greater in the mid-altitude (RSZ) band than the low altitude band (**Figure 5-25**). Cumulative diurnal and nocturnal AMTR decreased from Grid 22/23 to Grid 26 (**Figure 5-26**) Peak diurnal AMTR was 104.3 abt/kph and peak nocturnal AMTR was 134.3 abt/kph from 30 September through 12 October 2008. Directional flux occurred only from 20 September to 12 October 2008. As expected the directional movement was from the north to the south.

5.6.1.3 Spring 2009

The survey effort was limited to three days and therefore no general trends were identified from the survey results. The data presented for spring 2009 may be used as a qualitative measure of the avian activity for the days that the data were collected (11-13 May).

5.6.2 Onshore

5.6.2.1 Spring/Early Summer 2008

The majority of the median altitude quartiles were within the middle (RSZ) altitude band at all of the onshore sites (**Figure 5-27**). The cumulative diurnal flux values varied within and between the onshore sites (**Figure 5-28**). At IBSP and Corson's low altitude and middle altitude (RSZ) band flux values were generally similar. At Brigantine, cumulative diurnal flux values were greater within the low altitude band than within the middle (RSZ) band. This difference may be the result of the different migratory species passing the site or the behavior of resident species at the site. The cumulative nocturnal flux values were greater within the low altitude band than with the middle (RSZ) altitude band at all onshore sites.

The cumulative diurnal AMTR values were similar between the onshore sites (**Figure 5-29**). Nocturnal AMTR values were greater than cumulative diurnal AMTRs indicating that some nocturnal migration was probably still in progress from mid-May into mid-June. The cumulative peak diurnal AMTR (17.6 abt/kph) occurred at Brigantine from 29 May through 01 June 2008. The cumulative nocturnal AMTR decreased from IBSP to SIC indicating a decline in nocturnal migration. The cumulative peak nocturnal AMTR (66.2 abt/kph) was at IBSP from 15-18 May 2008. Overall, as expected during spring migration, the dominant movement of birds was from the south and southwest to the north and northeast.

5.6.2.2 Fall/Early Winter 2008

Cumulative diurnal median altitude quartiles varied between the onshore sites (**Figure 5-30**). Most of the cumulative median diurnal altitude quartiles were within the middle (RSZ) altitude band at IBSP in early fall 2008. In contrast, the majority of the cumulative median altitude quartiles were within the low altitude band at Brigantine, SIC, and at IBSP from mid-fall into early winter 2008. Most of the cumulative nocturnal altitude quartiles were within the middle (RSZ) altitude band.

The majority of the cumulative diurnal flux values were greater within the low altitude band than within the middle (RSZ) altitude band (**Figure 5-31**). Cumulative nocturnal flux varied at several sites. For most of the survey dates, the cumulative nocturnal flux values at the onshore sites were generally similar between the low and middle (RSZ) altitude bands. The cumulative diurnal flux values were greater within the low altitude band at IBSP from 28 September through 05 October 2008, at SIC from 20 through 26 October 2008.

Cumulative diurnal AMTR values were 10 abt/kph or less and cumulative nocturnal AMTRs were less than 30 abt/kph at all of the onshore sites (**Figure 5-32**). At each onshore site, peak cumulative AMTR occurred at night (IBSP: 19.1 abt/kph from 31-21 September 2008; SIC: 25.0 abt/kph from 05-12 October 2008; BB: 26.4 abt/kph from 26 October to 02 November 2008. Overall, as expected during fall migration, the dominant direction of movement during most weeks was from the north and northeast to the south and southwest.

5.6.2.3 Spring/Early Summer 2009

Cumulative weekly median altitude diurnal and nocturnal altitude distribution varied between sites. At IBSP, all of the cumulative weekly median diurnal altitude quartiles were within the low altitude band (**Figure 5-33**). In contrast, at BB, cumulative weekly altitude quartiles were nearly split equally between the low altitude band and the middle (RSZ) altitude band. At SIC, the cumulative weekly median diurnal altitudes were all within the low altitude band. Most of the cumulative weekly median nocturnal altitude quartiles at IBSP were within the middle (RSZ) band. At BB, most of the cumulative weekly median nocturnal altitude quartiles were in the high altitude band (above the RSZ) and at SIC all of the cumulative weekly median nocturnal altitude quartiles were within the middle (RSZ) band.

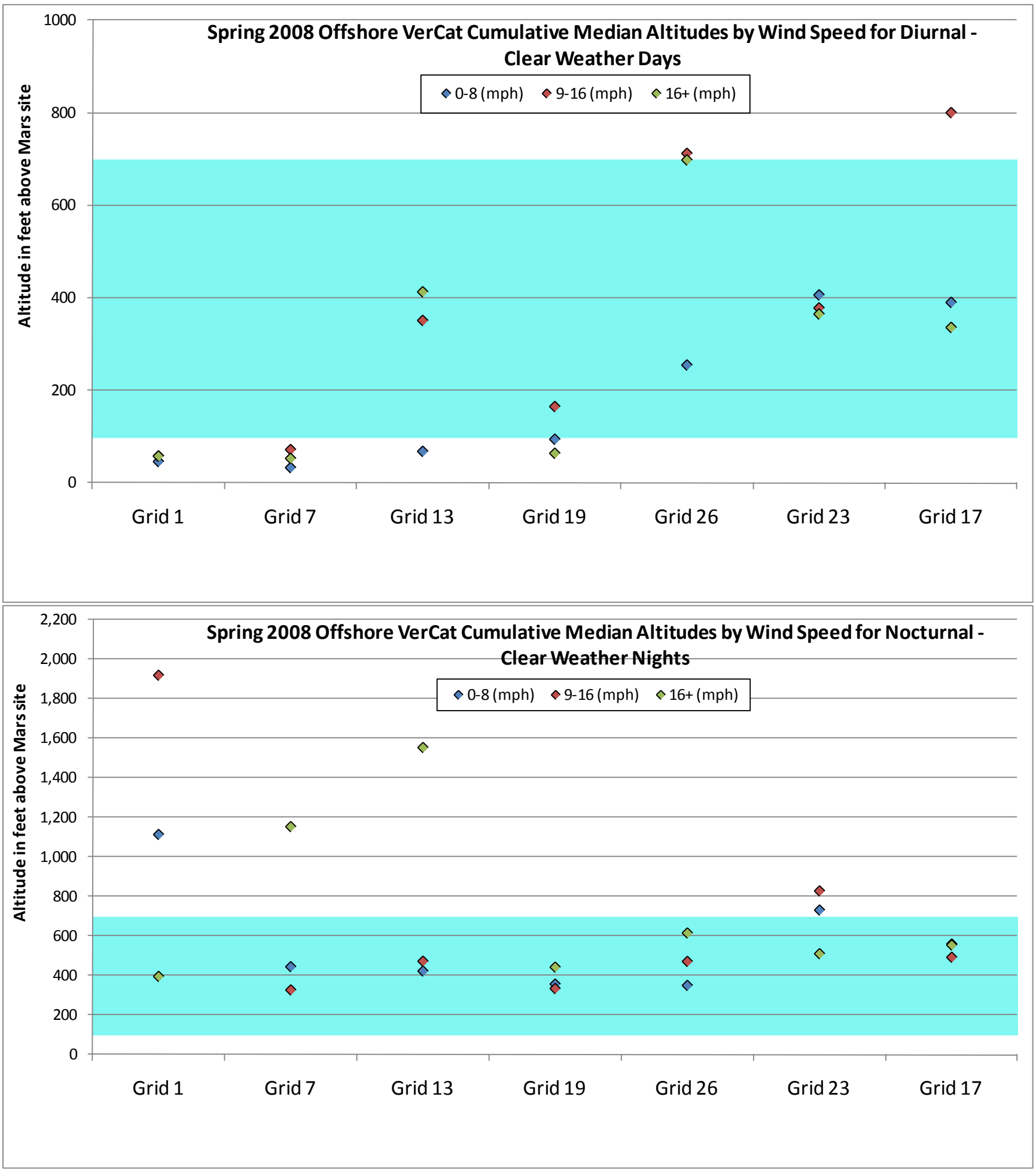


Figure 5-21. Spring 2008 Offshore Cumulative Median Altitude Quartiles (blue band is the potential RSZ).

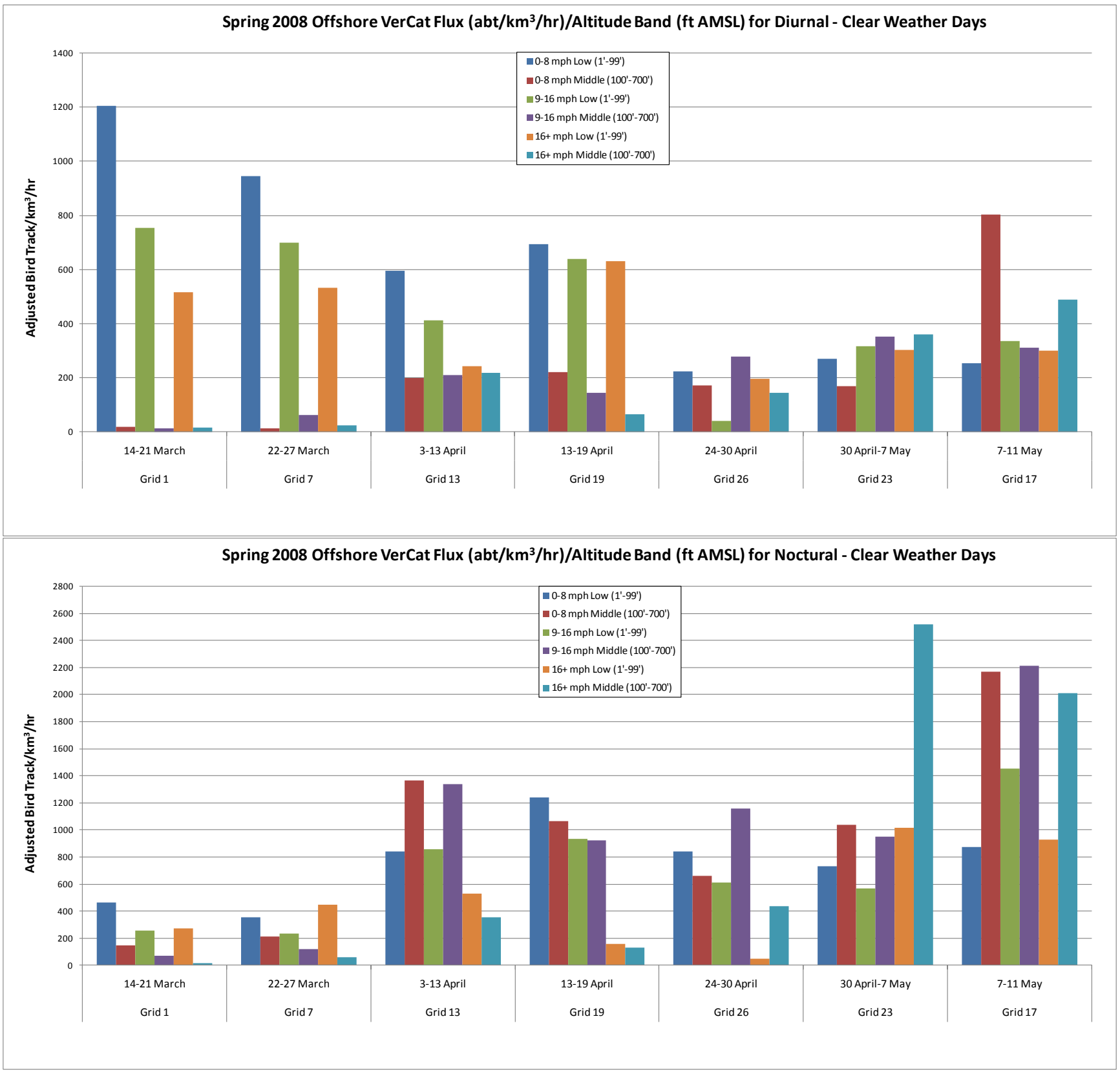


Figure 5-22. Spring 2008 Offshore VerCat Cumulative Flux.

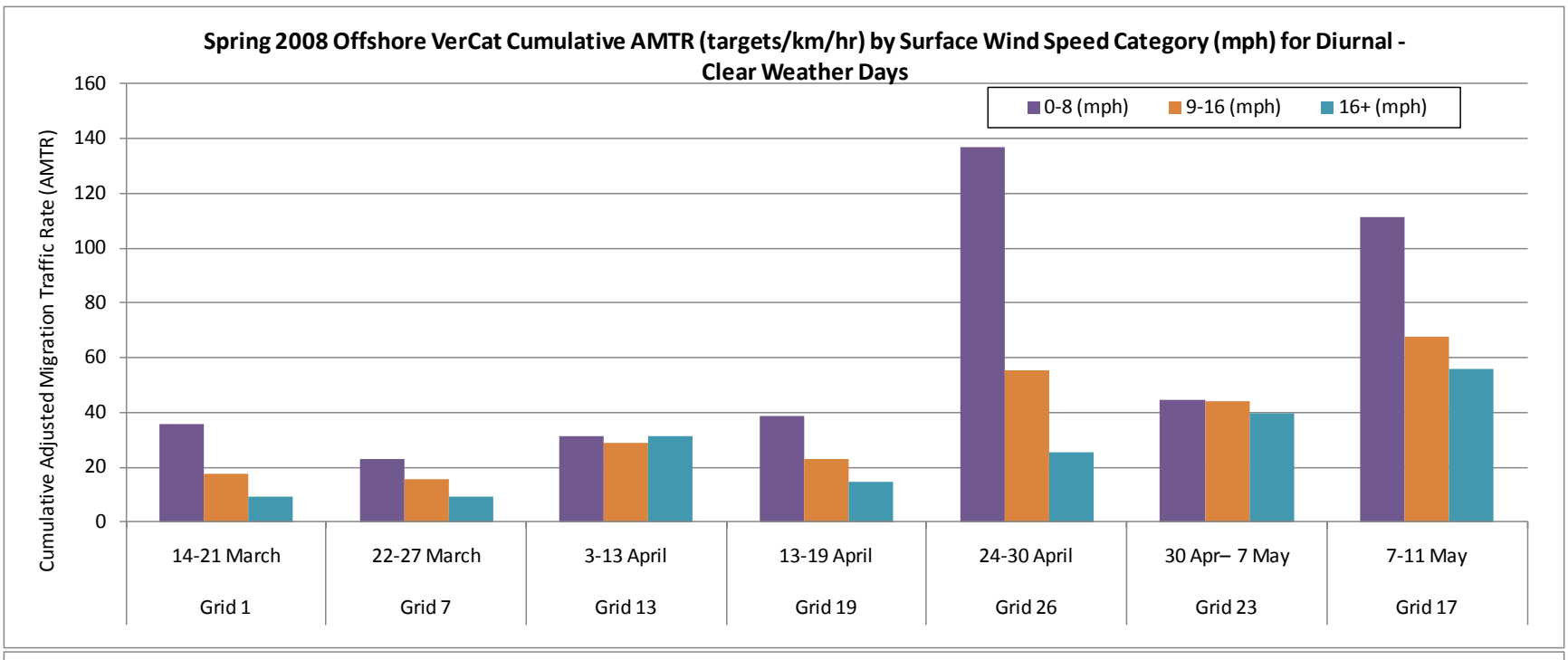


Figure 5-23. Spring 2008 Offshore Cumulative AMTR.

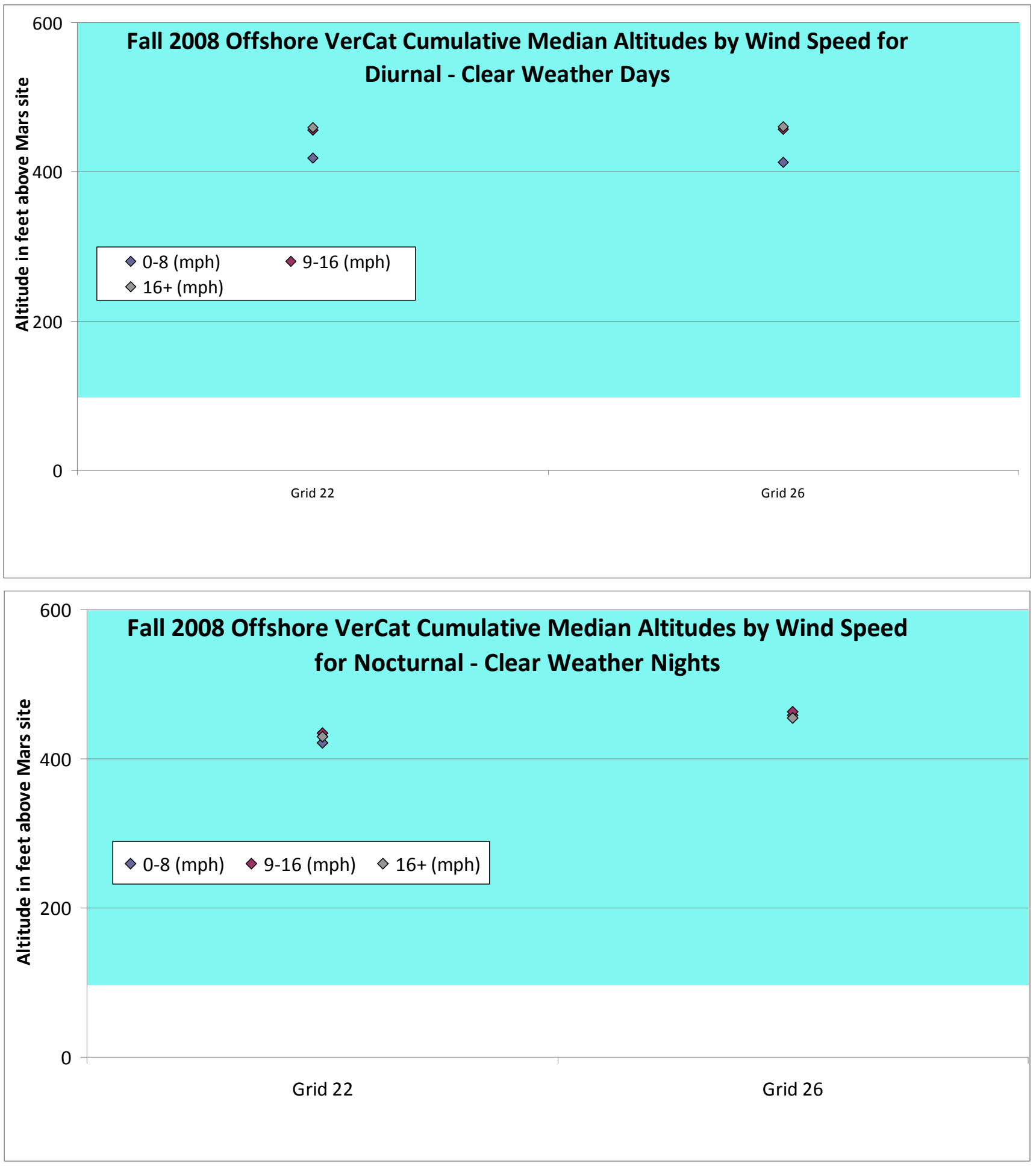


Figure 5-24. Fall 2008 Offshore Cumulative Median Altitude Quartiles (blue band is the potential RSZ).

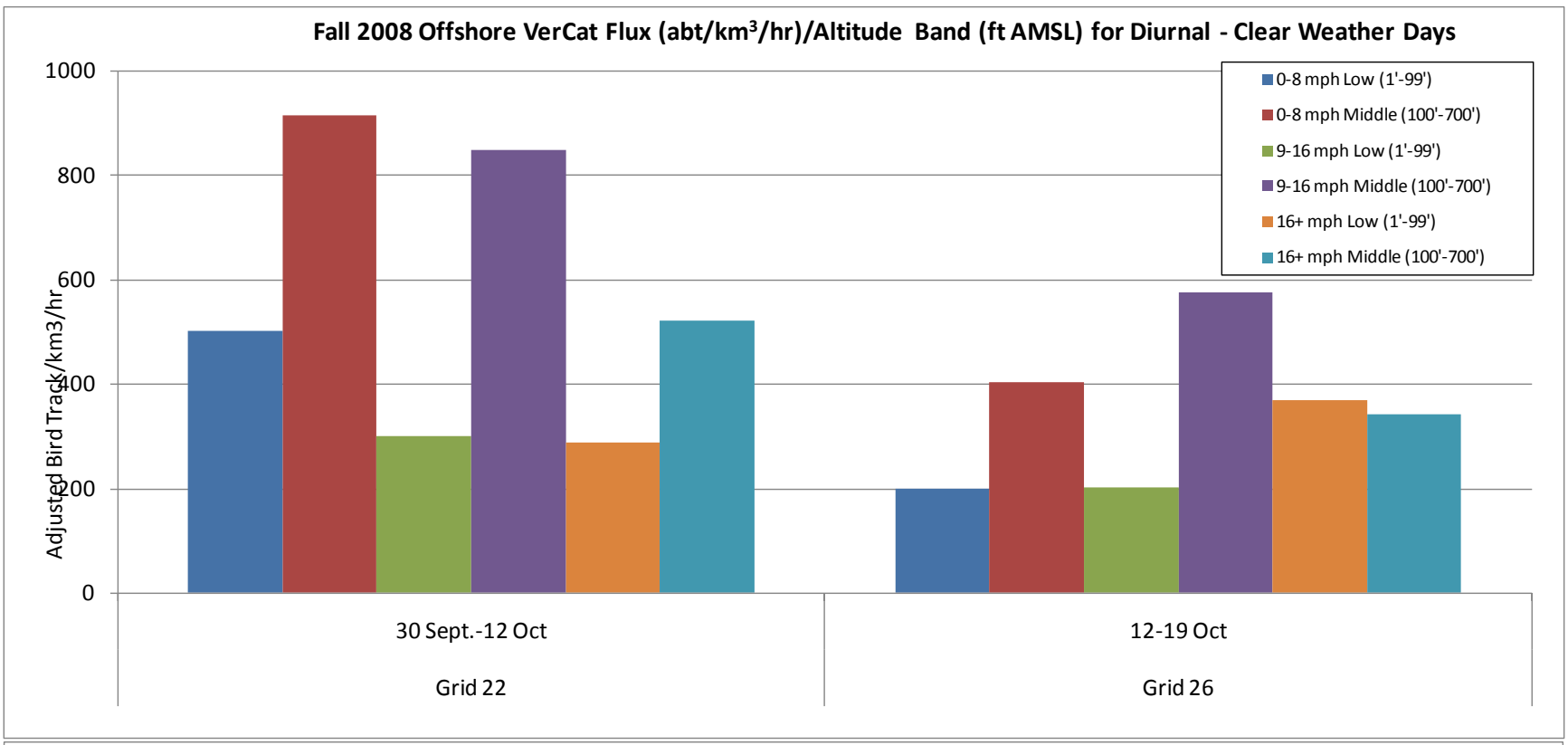


Figure 5-25. Fall 2008 Offshore VerCat Cumulative Flux.

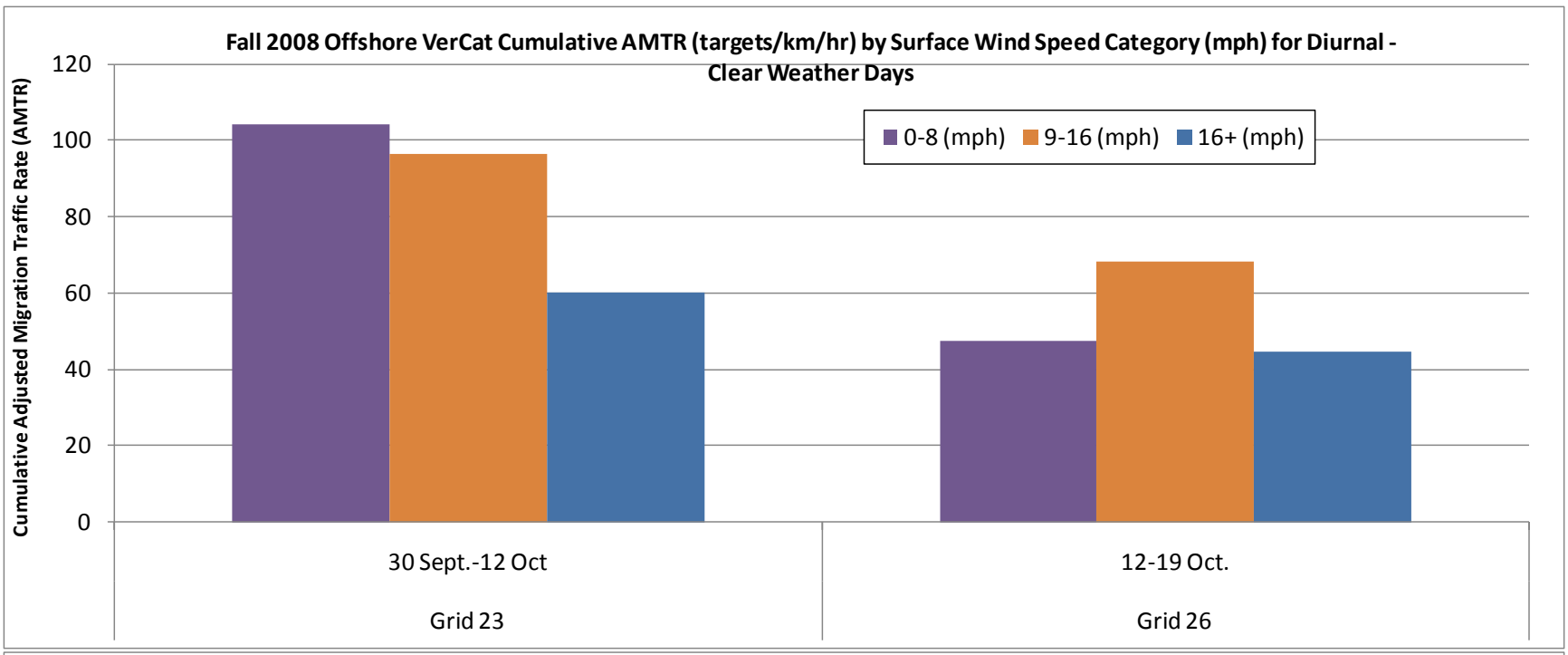
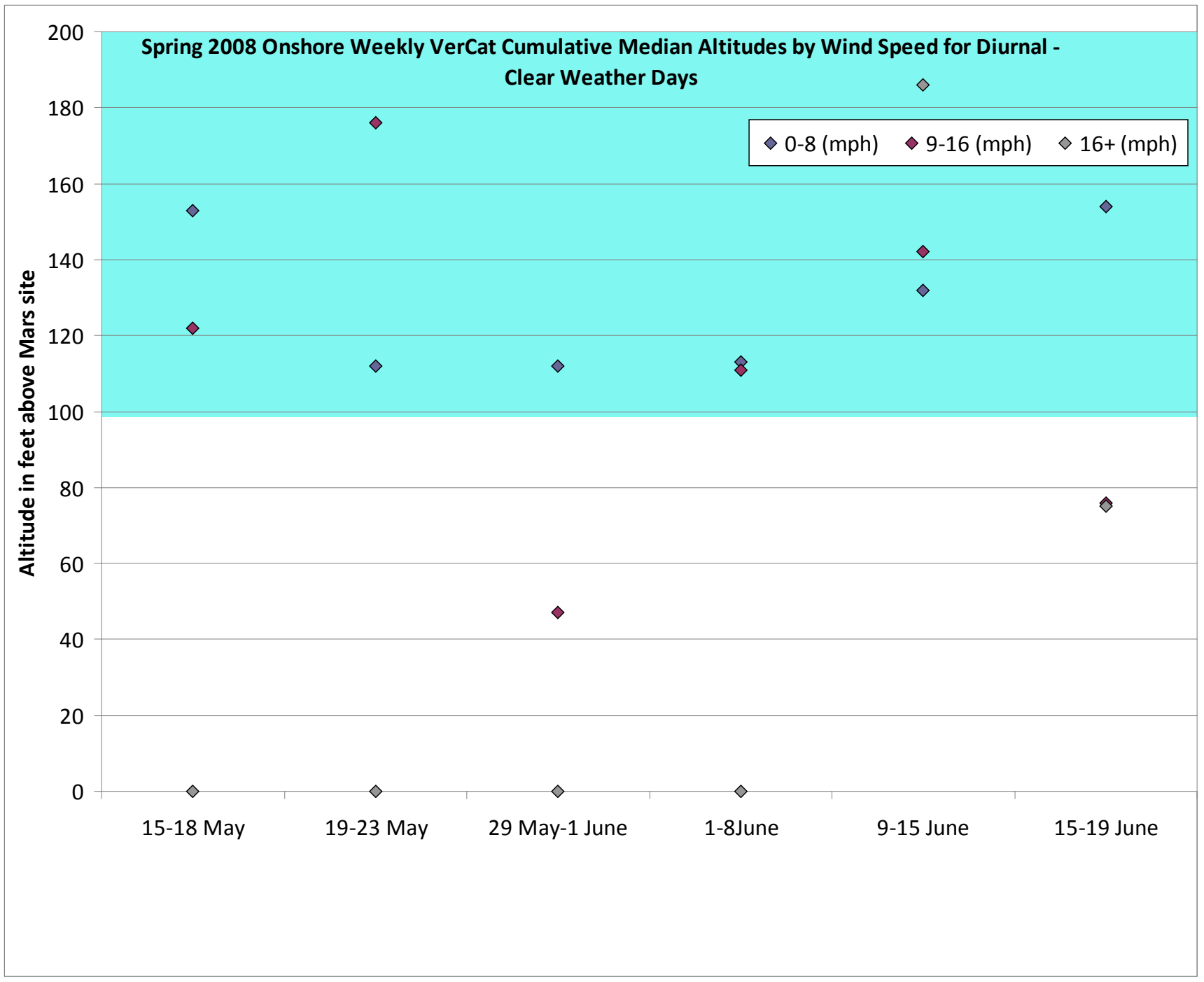


Figure 5-26. Fall 2008 Offshore Cumulative AMTR.



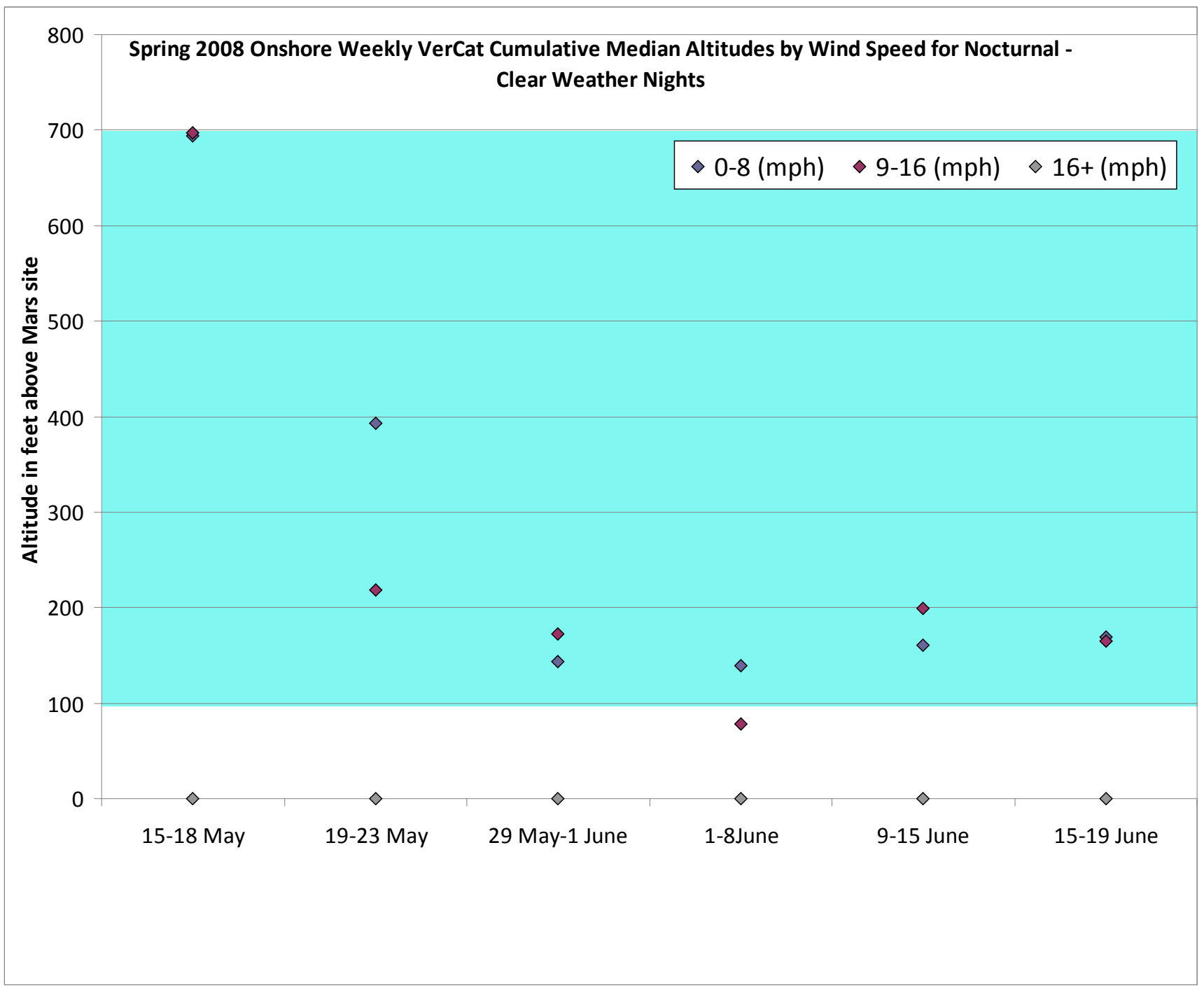
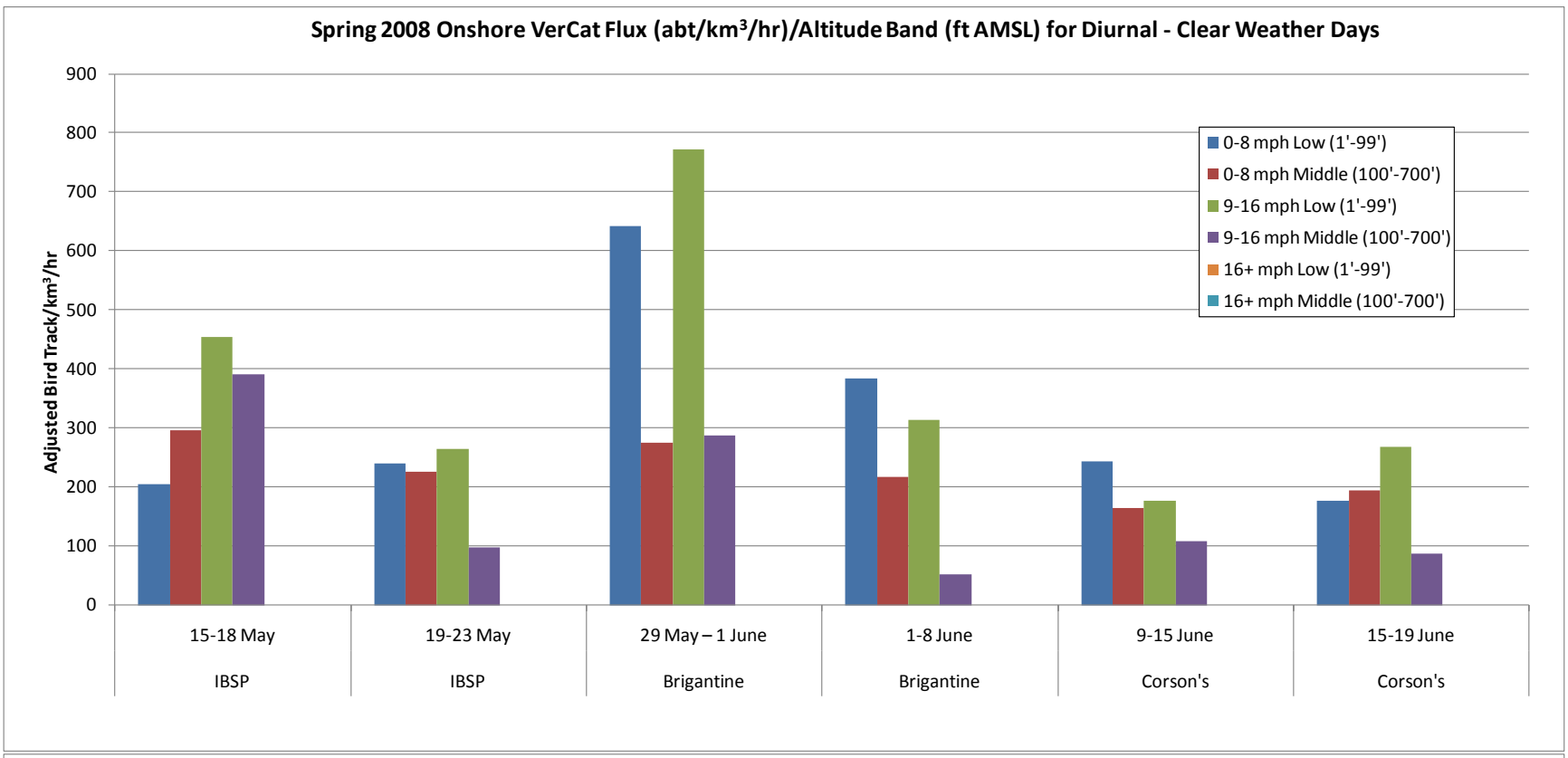


Figure 5-27. Spring 2008 Onshore Cumulative Median Altitude Quartiles (blue band is the potential RSZ).



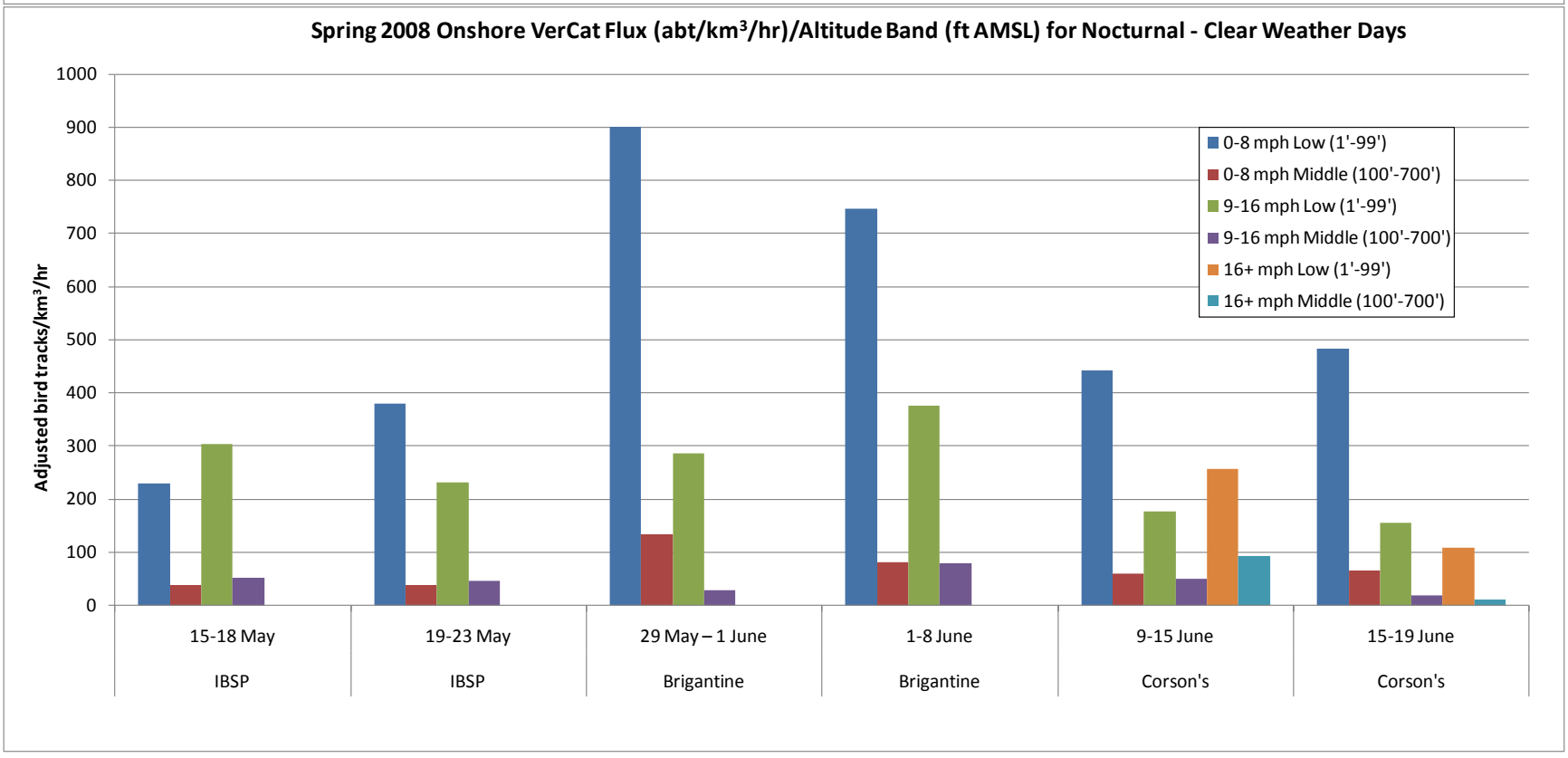


Figure 5-28. Spring 2008 Onshore VerCat Cumulative Flux.

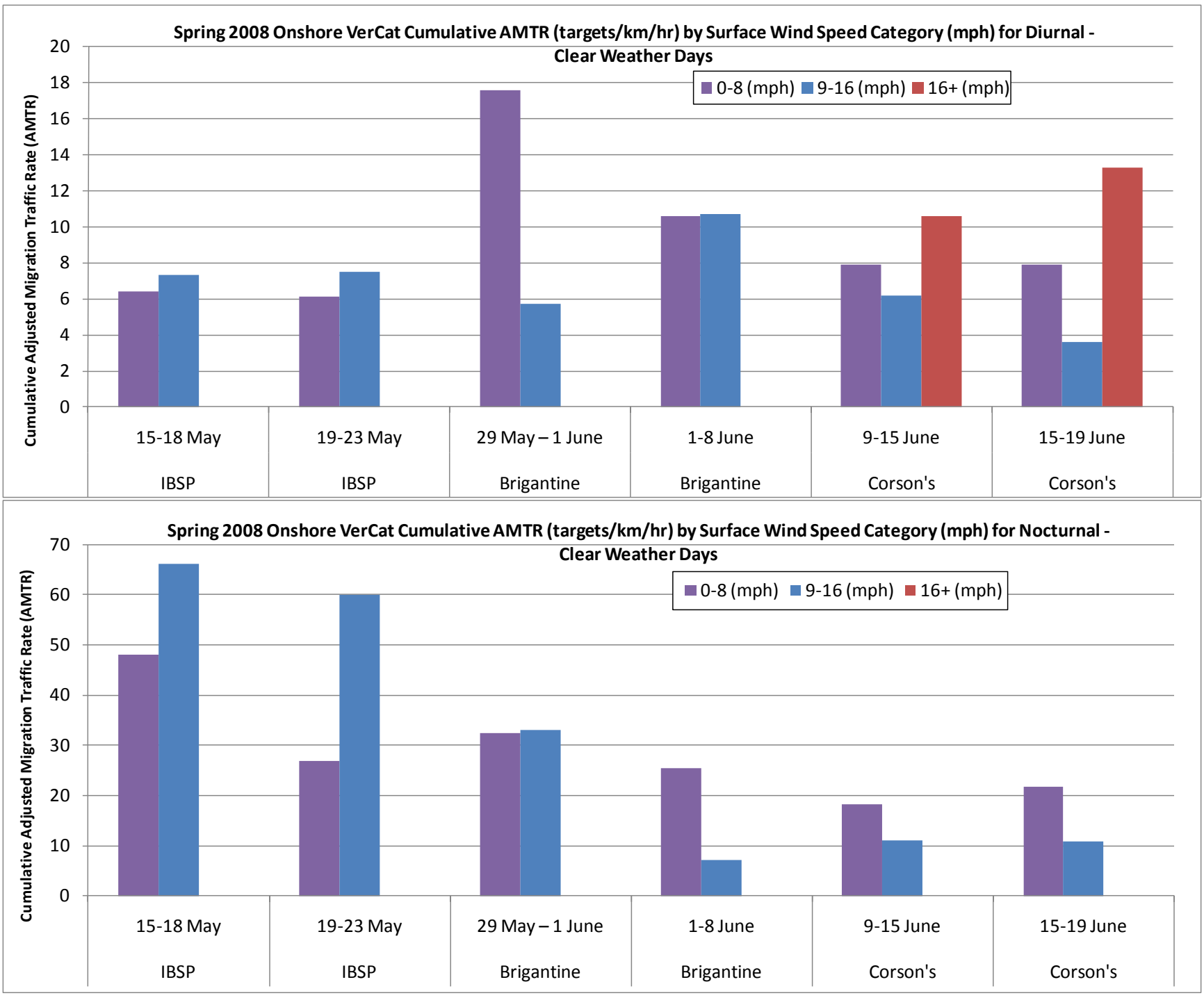


Figure 5-29. Spring 2008 Onshore Cumulative AMTR.

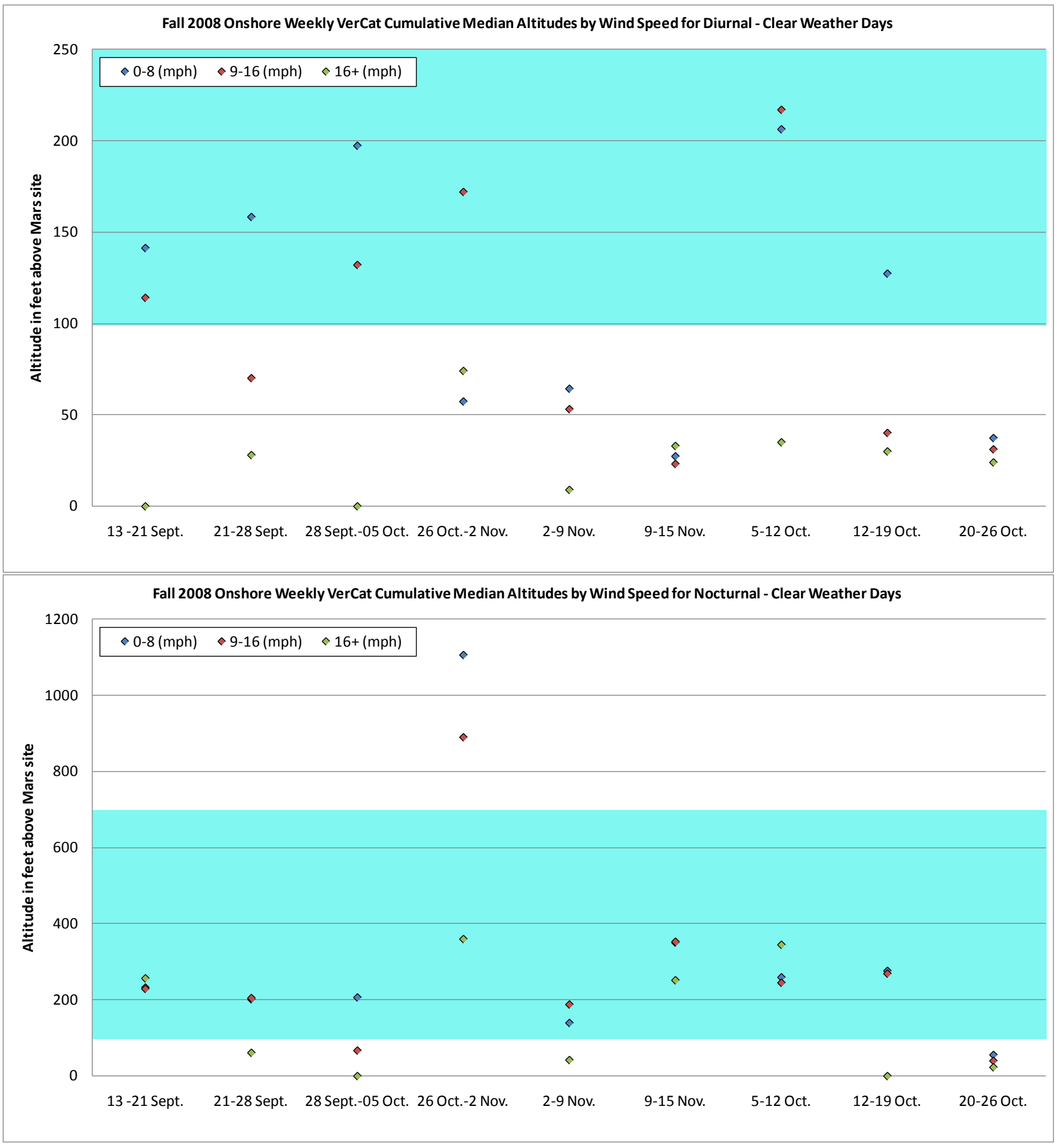


Figure 5-30. Fall 2008 Onshore Cumulative Median Altitude Quartiles (blue band is the potential RSZ).

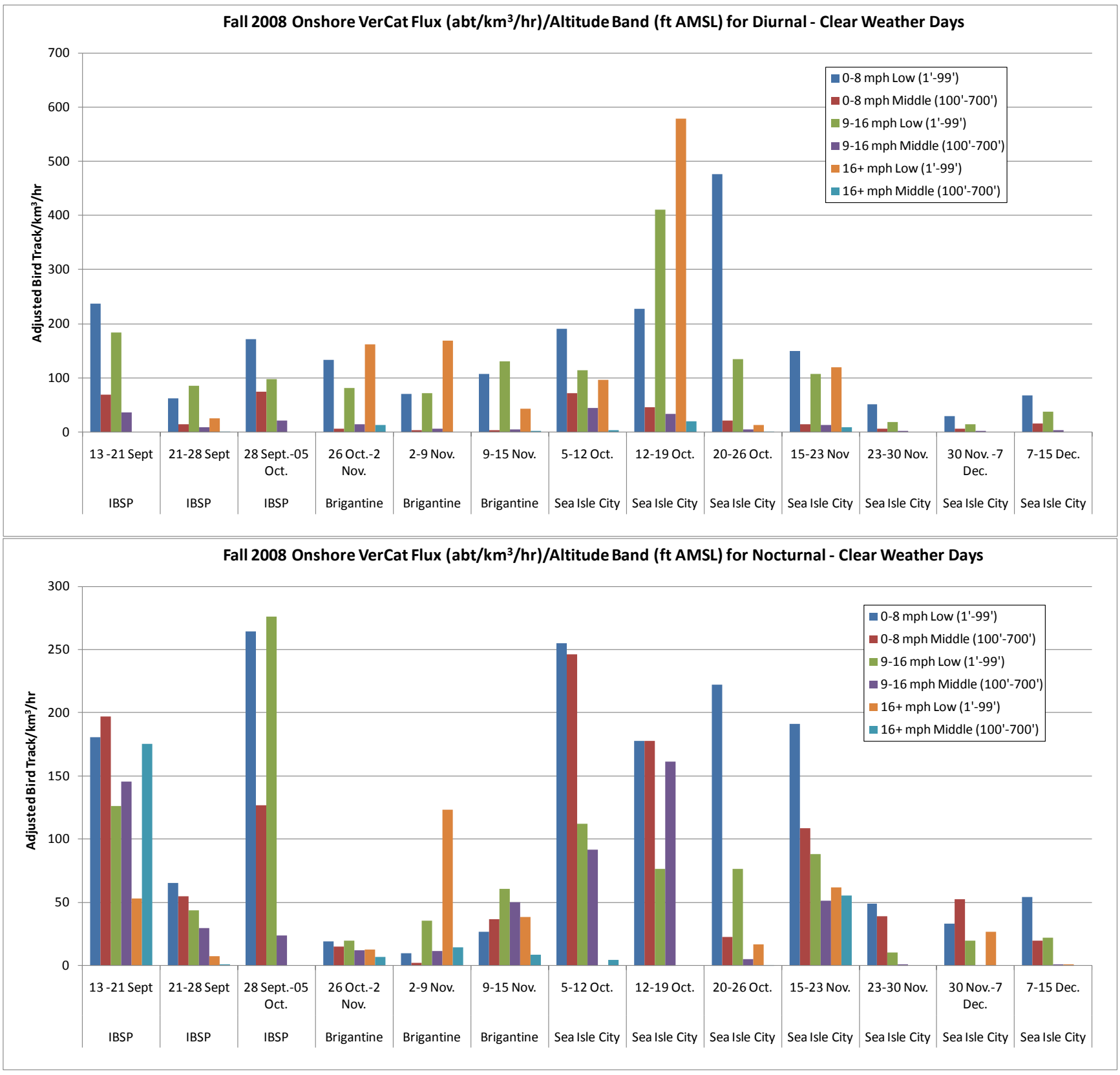


Figure 5-31. Fall 2008 Onshore VerCat Cumulative Flux.

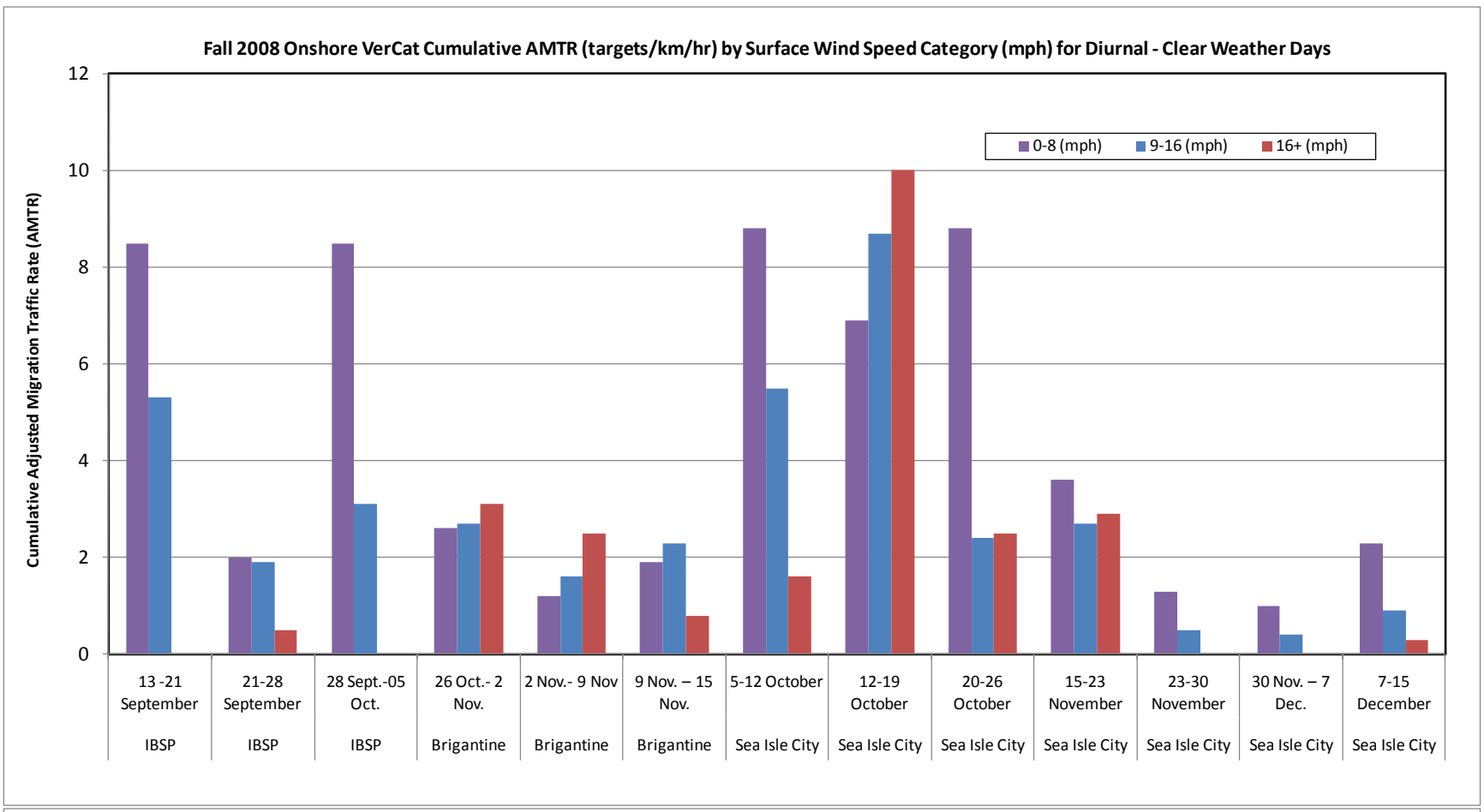


Figure 5-32. Fall 2008 Onshore Cumulative AMTR.

Cumulative weekly diurnal flux values were greater within the low altitude band than within the middle (RSZ) band (**Figure 5-34**). Cumulative weekly nocturnal flux values varied at sites and throughout the fall season. Cumulative diurnal flux values were greater within the low altitude band than within the middle (RSZ) altitude band at IBSP from 29 March - 05 April, at Brigantine from 12-19 April 2009, and at SIC on 06-10 May 2009. Cumulative weekly nocturnal flux values within the low and middle altitude bands were similar during the other sampling dates.

Cumulative diurnal AMTR values were 10 abt/kph or less and cumulative nocturnal AMTRs were less than 80 abt/kph at all of the onshore sites (**Figure 5-35**). At each onshore site, peak cumulative AMTR occurred at night (IBSP: 17.4 abt/kph from 29 March – 05 April 2009; BB: 28.6 abt/kph from 26 April - 03 May 2009; SIC: 76.0 abt/kph from 06-10 May 2009.

The dominant flux movement was from the south and southwest to the north and northeast. Some of these movements occurred even though winds were unfavorable (from north to south) for northerly movement. One small scale reverse migration was recorded.

5.6.2.4 Fall 2009

The majority of cumulative weekly diurnal and nocturnal median altitude quartiles were within the middle (RSZ) band (**Figure 5-36**). Most all of the cumulative weekly diurnal and nocturnal altitude quartiles were greater within the low altitude band than the middle (RSZ) band (**Figure 5-37**). The high flux value for the 16+ mph surface wind speed category from 08-16 November 2009 was not expected based on the steady trend in cumulative weekly diurnal flux values prior to this date. The data was replayed through the MARS® software analysis system and examined for possible contaminants that may not have been processed correctly by the radar filters. The examination revealed a large group of birds were present during the time when the surface wind speed was above 16+ mph. The duration of the 16+ mph surface wind was only 22 min. The short time duration was responsible for the high diurnal and nocturnal cumulative flux values in the 16+ surface wind speed category.

Cumulative diurnal AMTR values were <20 abt/kph during the majority of the study. The only exception was during the week of 08-16 November at SIC when the AMTR increased dramatically but only in the 16+ mph wind category (**Figure 5-38**). As previously discussed above, this is an accurate representation of the activity that occurred in the 16+ surface wind speed category. Except for peak cumulative nocturnal migration period from 05-11 October 2009, the cumulative weekly nocturnal AMTR was <50 abt/kph.

Overall, as expected during fall migration, the dominant flux direction during most weeks were from the north and northeast to the south and southwest. Many of these southerly movements occurred despite frequent unfavorable winds from the south to the north.

5.6.3 Summary

5.6.3.1 Offshore Spring 2008

Results for the spring 2008 nearshore and offshore radar sample grids were:

- Most of the offshore cumulative diurnal and nocturnal median altitude quartiles were within the potential RSZ band (100-700 ft AMSL).
- VerCat diurnal and nocturnal flux values at nearshore stations early in the season were concentrated in the low-altitude (1-99 ft AMSL) band. By mid-spring diurnal flux values at nearshore sample grids were similar in the low and middle altitude bands. Cumulative nocturnal flux values within the middle altitude band increased over both the nearshore and offshore grids and became greater than low altitude flux values by the end of the nearshore and offshore sampling periods.
- Diurnal AMTR increased over the nearshore grids while nocturnal AMTR remained constant over the offshore grids, diurnal AMTR steadily increased; cumulative nocturnal AMTR decreased from

Grid 26 to Grid 23 before increasing over Grid 17. Diurnal AMTR was greater than nocturnal AMTR over most grids.

- Peak diurnal AMTRs occurred offshore on Grid 26 (137.0 adt/kph) from 24-30 April and on Grid 17 (113.0 abt/kph) from 07-11 May 2008. Peak nocturnal AMTR occurred 30 April - 07 May (320.3 abt/kph) and from 07-11 May 2008 (333.5 abt/kph) on Grid 26 and Grid 17, respectively.
- The dominant diurnal and nocturnal nearshore and offshore flux directions during most of the survey weeks was from the south and southwest to the north and northeast.

5.6.3.2 Offshore Fall 2008

The fall 2008 radar surveys were limited to two offshore sampling grids in the southern section of the Study Area. The data are limited and insufficient to make any conclusions. The results of the fall study were:

- All cumulative diurnal and nocturnal median altitudes were within the RSZ (100-700 ft AMSL).
- The VerCat cumulative diurnal and nocturnal flux was concentrated in the mid-altitude (RSZ) band.
- Cumulative diurnal and nocturnal AMTR was greater over Grid 22 than Grid 25. The cumulative nocturnal AMTR was greater than the diurnal AMTR over both sample grids.
- Peak diurnal AMTR was 104.3 abt/kph and peak nocturnal AMTR was 134.3 abt/kph and occurred from 30 September through 12 October 2008.
- Directional flux occurred only from 20 September to 12 October 2008. As expected the directional movement was to the south.

5.6.3.3 Offshore Spring 2009

The survey effort was limited to three days and therefore no general trends were identified from the survey results. The data presented for spring 2009 may be used as a qualitative measure of the avian activity for the days that the data were collected.

5.6.3.4 Onshore Spring 2008

The results of the spring/early summer onshore radar survey were:

- The majority of weekly cumulative diurnal and nocturnal median altitude quartiles were within the potential RSZ (middle altitude band: 100-700 ft AMSL).
- At IBSP and Corson's Inlet low altitude and middle altitude (RSZ) band flux values were generally similar. At Brigantine, cumulative diurnal flux values were greater within the low altitude band than within the middle (RSZ) altitude band. This difference may be the result of the different migratory species passing the site or the behavior of resident species at the site. The cumulative nocturnal flux values were greater within the low altitude band than with the middle (RSZ) altitude band at all onshore sites.
- The cumulative diurnal AMTR values were similar between the onshore sites. Nocturnal AMTR values were greater than cumulative diurnal AMTRs indicating that some nocturnal migration was probably still in progress from mid-May into mid-June.
- The cumulative peak diurnal AMTR (17.6 abt/kph) occurred at Brigantine from 29 May-01 June 2008. The cumulative nocturnal AMTR decreased from IBSP to SIC indicating a decline in nocturnal migration. The cumulative peak nocturnal AMTR (66.2 abt/kph) was at IBSP from 15-18 May 2008.Peak AMTR occurred from 15-23 May 2009 (60-66 abt/kph).
- The cumulative diurnal AMTR for all survey sites ranged from 3.6 to 17.6 abt/kph; the cumulative nocturnal AMTR ranged from 7.1-66.2 abt/kph. Most weekly nocturnal AMTRs were greater than weekly diurnal AMTRs.
- Overall, as expected during spring migration, the dominant directions of flux were from the south and southwest to the north and/or northeast, respectively.

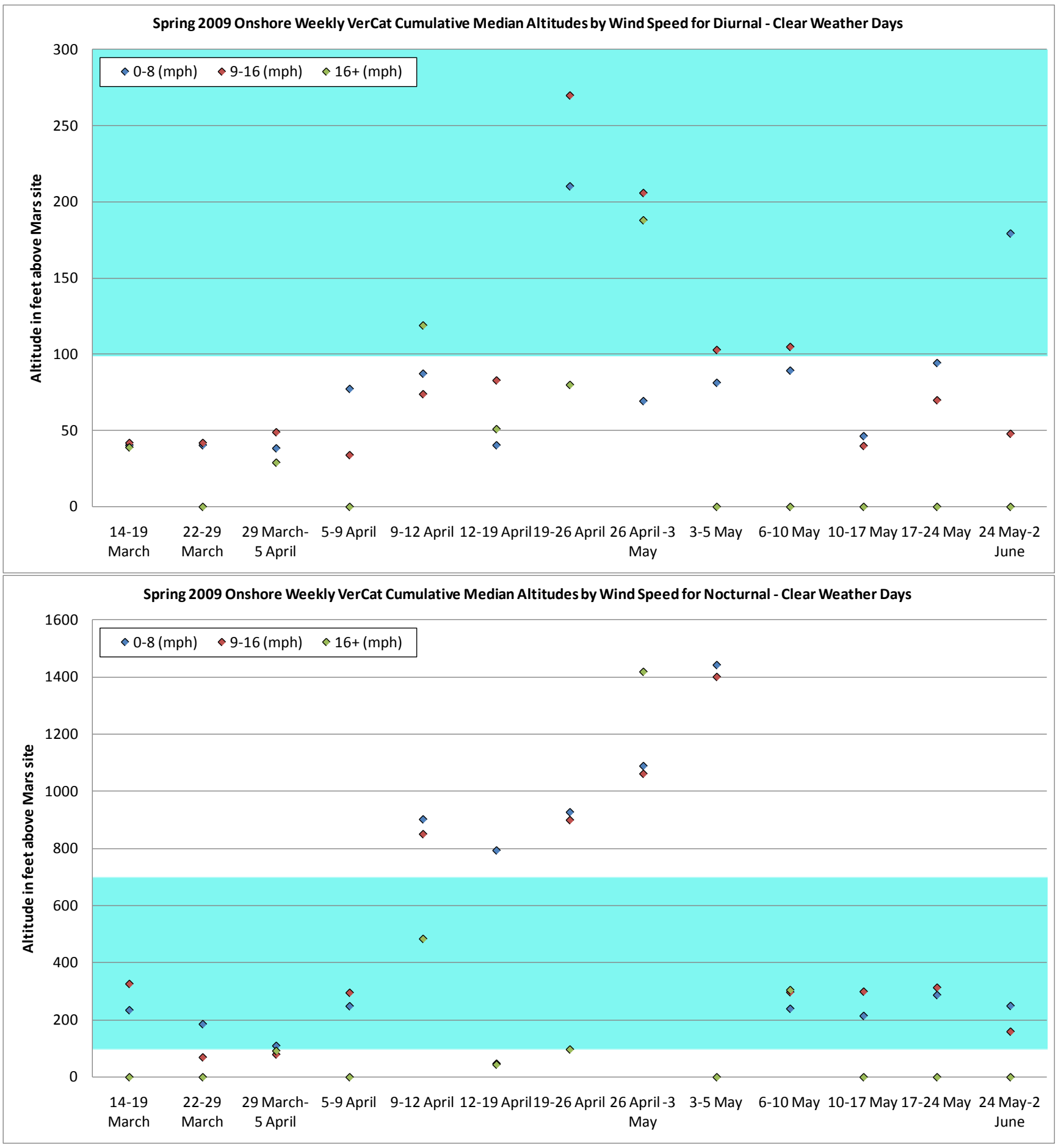
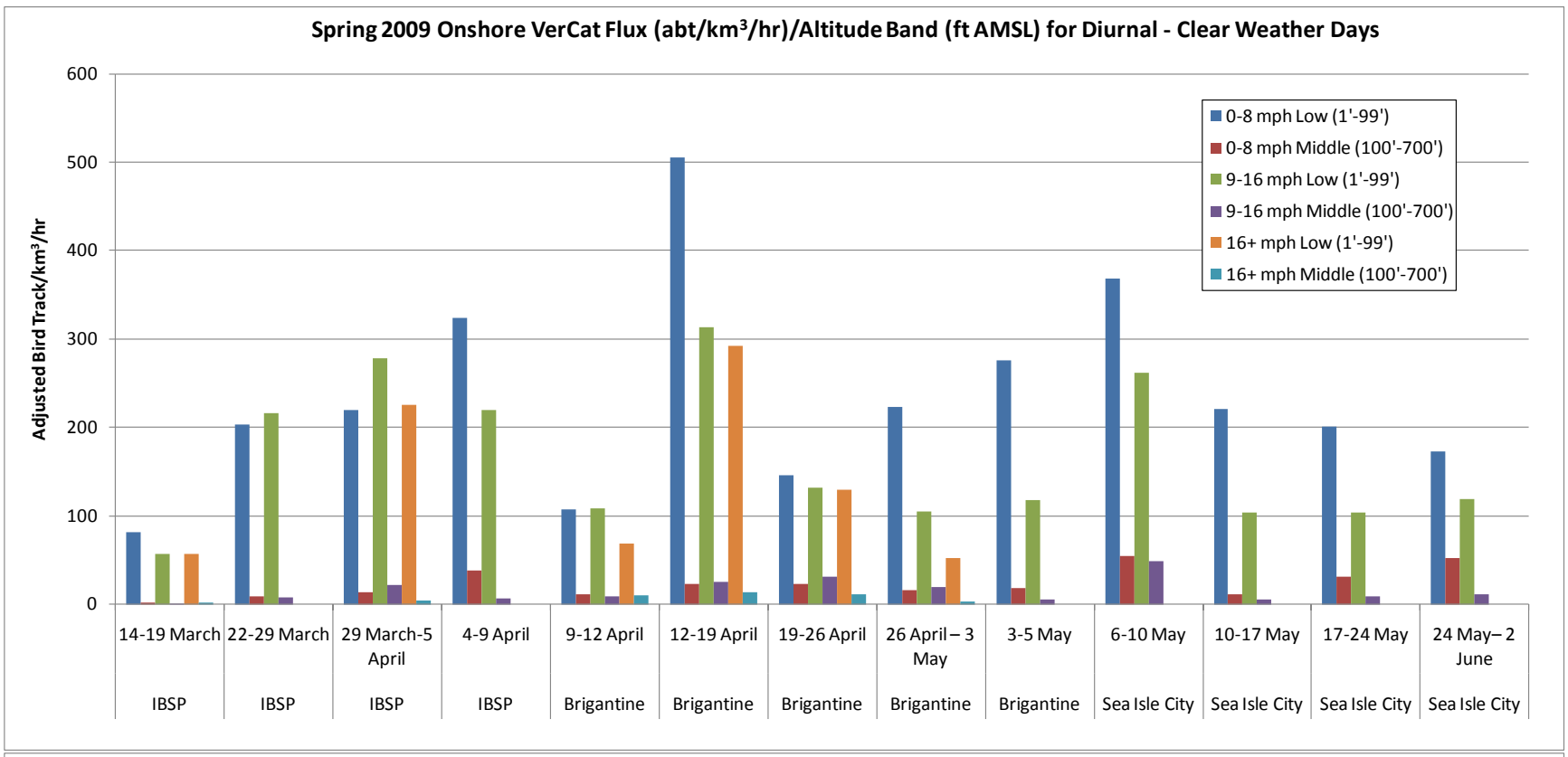


Figure 5-33. Spring 2009 Onshore Cumulative Median Altitude Quartiles (blue band is the potential RSZ).



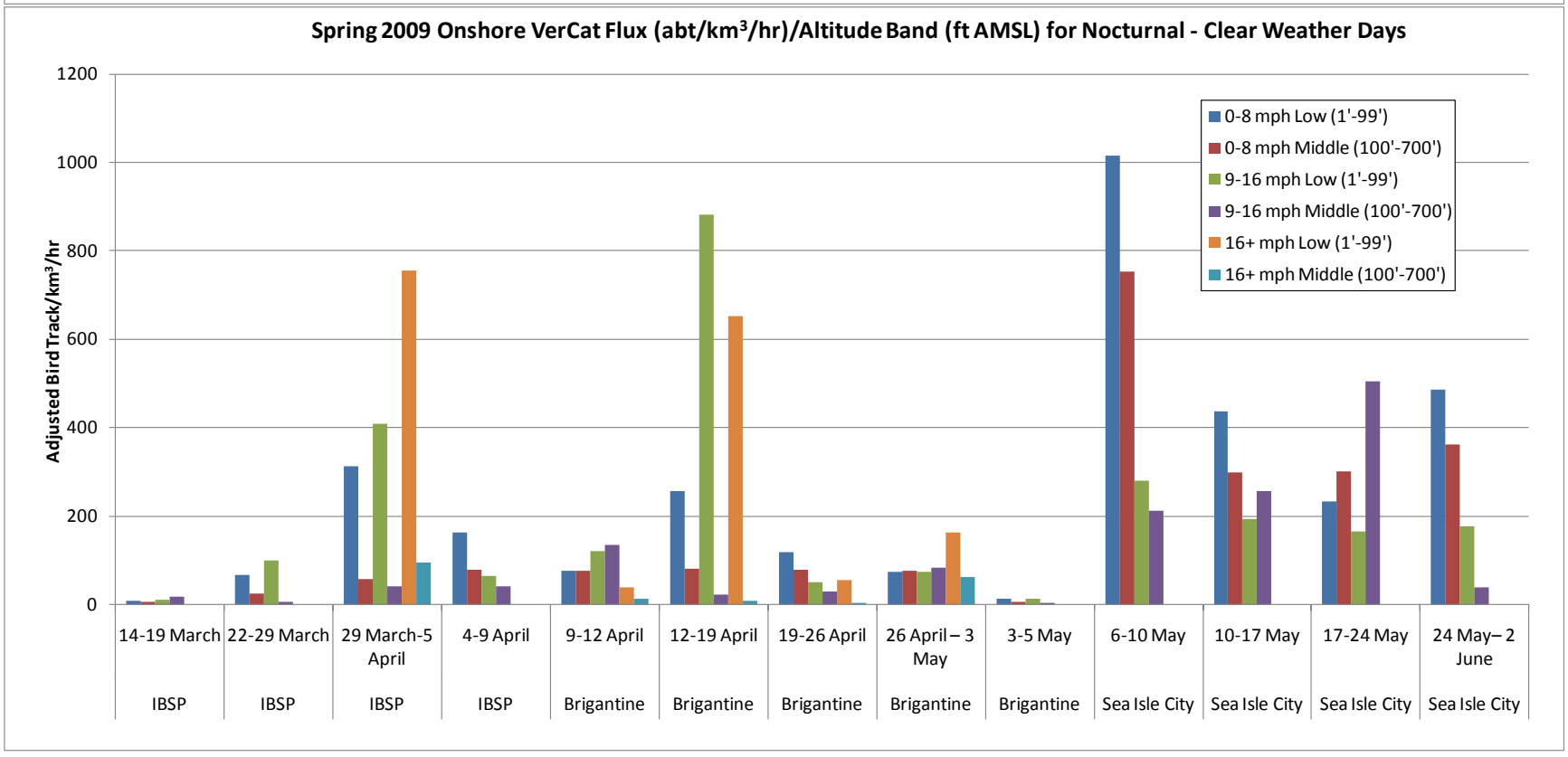


Figure 5-34. Spring 2009 Onshore VerCat Cumulative Flux.

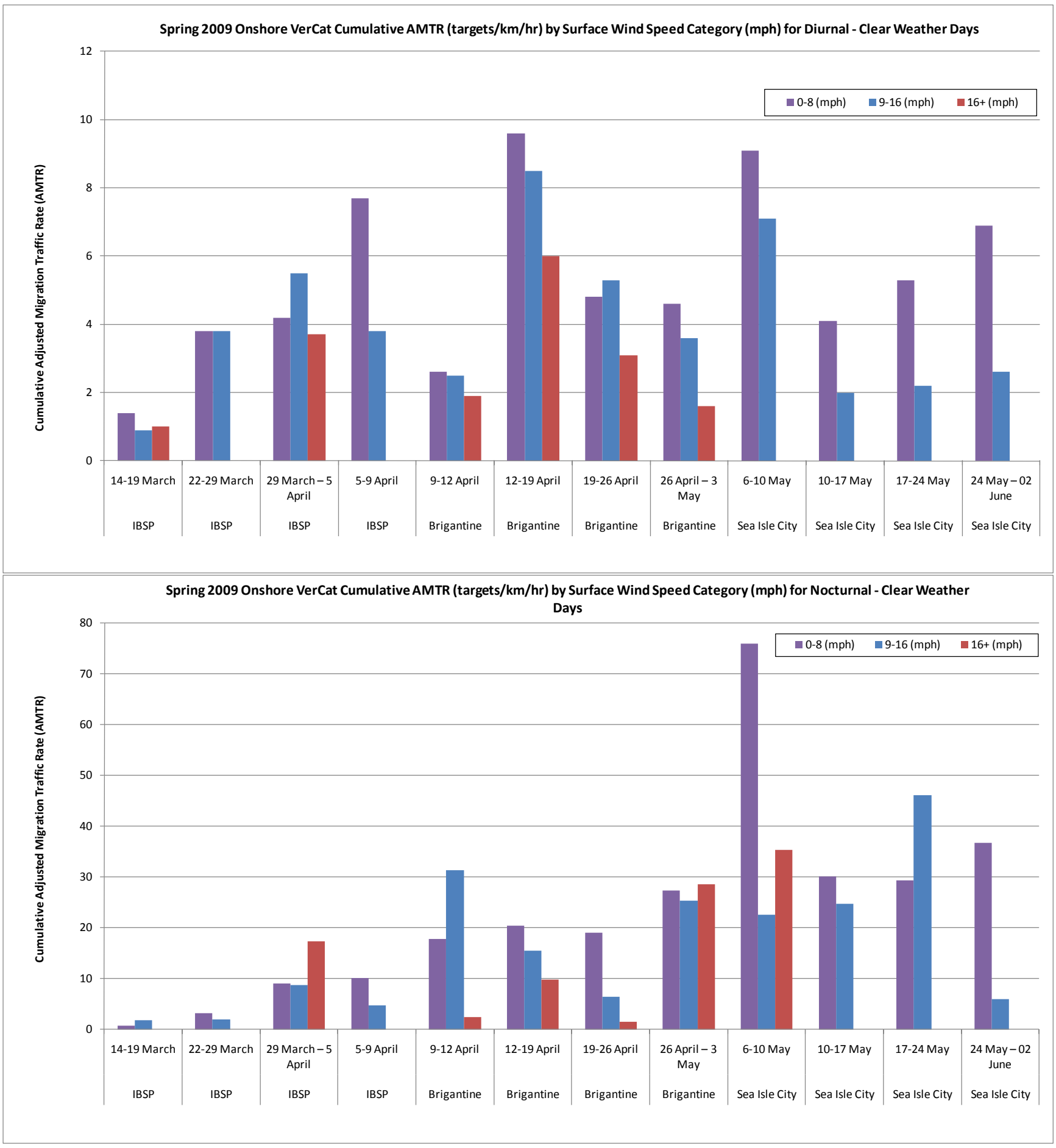
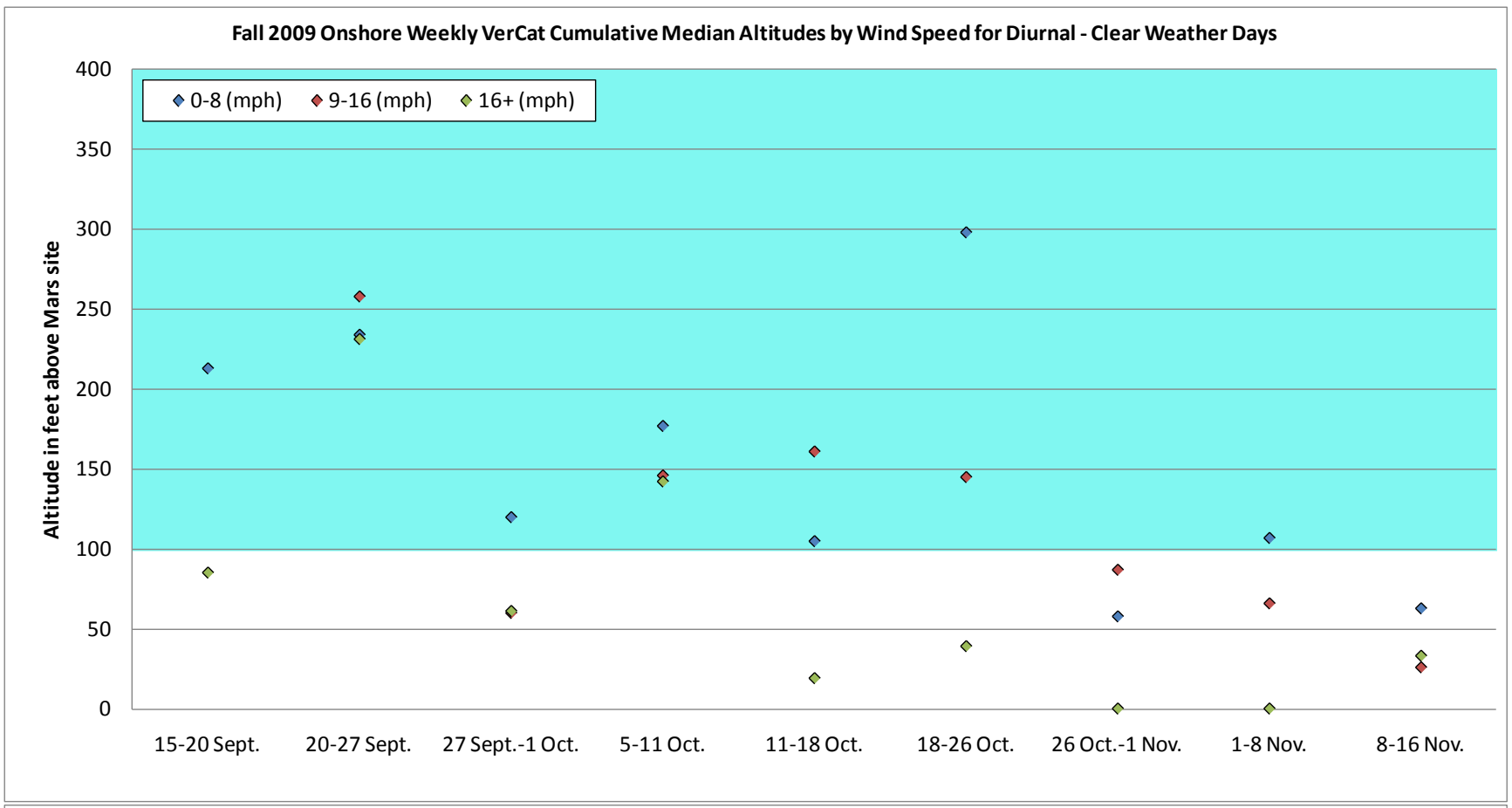


Figure 5-35. Spring 2009 Onshore Cumulative AMTR.



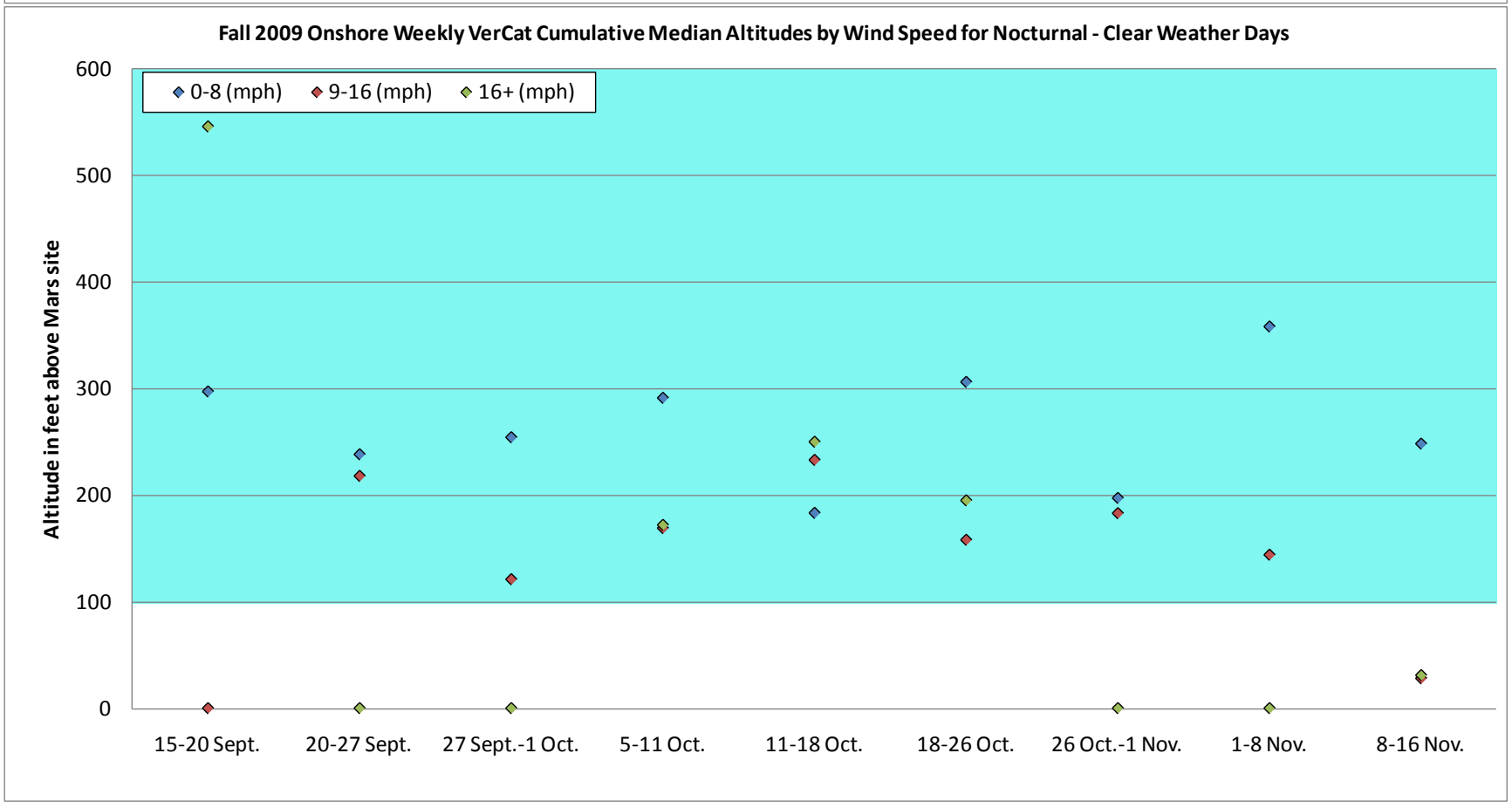


Figure 5-36. Fall 2009 Onshore Cumulative Median Altitude Quartiles (blue band is the potential RSZ).

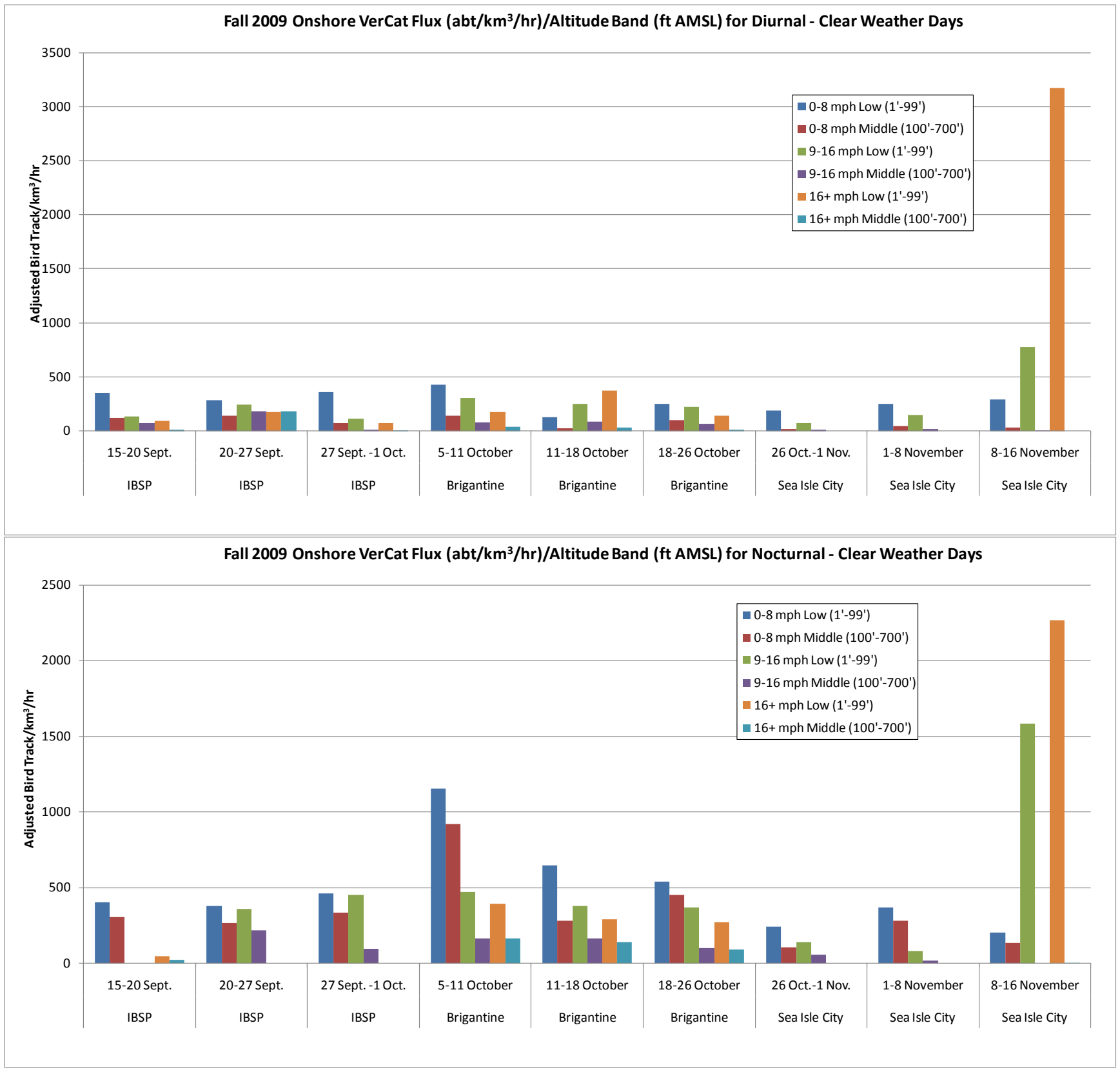


Figure 5-37. Fall 2009 Onshore VerCat Cumulative Flux.

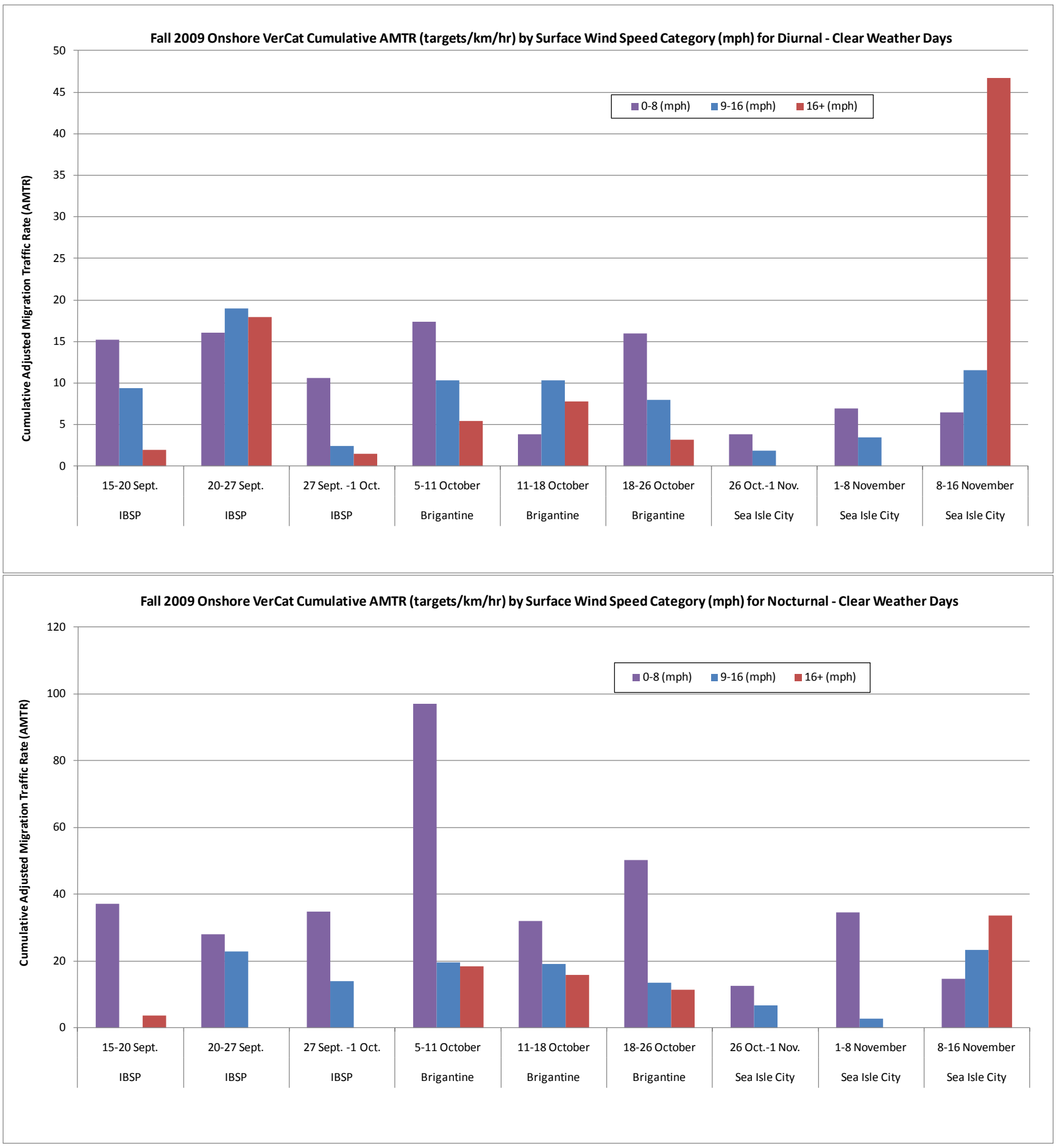


Figure 5-38. Fall 2009 Onshore Cumulative AMTR.

5.6.3.5 Onshore Fall 2008

The results of the fall/early winter 2008 onshore radar surveys were:

- Most of the cumulative median diurnal altitude quartiles were within the middle (RSZ) altitude band at IBSP in early fall 2008. In contrast, the majority of the cumulative median altitude quartiles were within the low altitude band at Brigantine, SIC, and at IBSP from mid-fall into early winter 2008. Most of the cumulative nocturnal altitude quartiles were within the middle (RSZ) altitude band.
- The majority of the cumulative diurnal flux values were greater within the low altitude band than within the middle (RSZ altitude band. Cumulative nocturnal flux varied at several sites. For most of the survey dates, the cumulative nocturnal flux values at the onshore sites were generally similar between the low and middle (RSZ) altitude bands.
- Cumulative diurnal AMTR values were 10 abt/kph or less and cumulative nocturnal AMTRs were less than 30 abt/kph at all of the onshore sites.
- Peak cumulative AMTR occurred at night at each onshore site (IBSP: 19.1 abt/kph. from 13-21 September; BB: 26.4 abt/kph from 26 October to 02 November; Sea Isle City: 25.0 abt/kph from 05 to 12 October)
- Most weekly nocturnal AMTRs were greater than diurnal AMTRs.
- Overall, as expected during fall migration, the dominant direction of movement during most weeks was from the north and northeast to the south and southwest.

5.6.3.6 Onshore Spring 2009

The results of the spring/early summer 2009 onshore radar survey varied by onshore survey site:

- At Island Beach SP, all of weekly cumulative diurnal median altitude quartiles were within the low altitude band (1-99 ft AMSL) and most of the weekly cumulative nocturnal altitudes were within the middle (RSZ) band (100-700 ft AMSL). At BB, the weekly number of cumulative diurnal median altitudes in the low altitude band and in the middle (RSZ) band was similar. Most of the cumulative nocturnal median altitudes were in the high altitude band (701+ ft AMSL). At SIC, all of the weekly cumulative diurnal median altitudes were within the low altitude band and all of the weekly cumulative nocturnal median altitudes were within the middle (RSZ) band.
- Cumulative weekly diurnal flux values were greater within the low altitude band than within the middle (RSZ) band. Cumulative weekly nocturnal flux values varied at sites and throughout the fall season. Cumulative diurnal flux values were greater within the low altitude band than within the middle (RSZ) altitude band at IBSP from 29 March - 05 April, at Brigantine from 12-19 April 2009, and at SIC on 06-10 May 2009. Cumulative weekly nocturnal flux values within the low and middle altitude bands were similar during the other sampling dates.
- Cumulative diurnal AMTR values were 10 abt/kph or less and cumulative nocturnal AMTRs were less than 80 abt/kph at all of the onshore sites. At each onshore site, peak cumulative AMTR occurred at night (IBSP: 17.4 abt/kph from 29 March – 05 April 2009; BB: 28.6 abt/kph from 26 April - 03 May 2009; SIC: 76.0 abt/kph from 06-10 May 2009.
- The dominant flux movement was from the south and southwest to the north and northeast. Some of these movements occurred even though winds were unfavorable (from north to south) for northerly movement. One small-scale reverse migration was recorded.

5.6.3.7 Onshore Fall 2009

The results of the fall 2009 onshore surveys were:

- The majority of cumulative weekly diurnal and nocturnal median altitude quartiles were within the middle (RSZ) band.
- Most to all of the cumulative weekly diurnal and nocturnal flux values were greater within the low altitude band than the middle (RSZ) band. The high flux value for the 16+ mph surface wind

speed category from 08-16 November 2009 was not expected based on the steady trend in cumulative weekly diurnal flux values prior to this date. The data was replayed on GMI's software analysis system and examined for possible contaminants that may not have been processed correctly by the radar filters. The examination revealed a large group of birds were present during the time when the surface wind speed was above 16+ mph. The duration of the 16+ mph surface wind was only 22 min. The short time duration was responsible for the high diurnal and nocturnal cumulative flux values in the 16+ surface wind speed category.

- Cumulative diurnal AMTR values were <20 abt/kph during the majority of the study. The only exception was during the week of 08-16 November at SIC when the AMTR increased dramatically but only in the 16+ mph wind category. As previously discussed above, this is an accurate representation of the activity that occurred in the 16+ surface wind speed category. Except for peak cumulative nocturnal migration period from 05-11 October 2009, the cumulative weekly nocturnal AMTR was below 50 abt/kph
- Overall, as expected during fall migration, the dominant flux direction during most weeks were from the north and northeast to the south and southwest despite frequent unfavorable winds from the south to the north.

6.0 THERMAL IMAGING – VERTICALLY POINTING RADAR

Please refer to **Section 5.3** for information on the TI-VPR.

6.1 SURVEY METHODOLOGY

Please refer to **Sections 5.4.3.1** and **5.4.3.2** for information on survey methodology.

6.2 DATA ANALYSIS

Please refer to **Section 5.4.3.3** for information on data analysis. TI-VPR raw data is presented in **Appendix K**.

6.3 OFFSHORE SURVEY RESULTS

6.3.1 Spring 2008

6.3.1.1 Target Identification

Data over Grid 7 were gathered from 24 – 26 March 2008 and covered 9:00 PM to 5:00 PM EDT (01:00 to 21:00 UTC). Over this time period only 27 total targets were identified, of which 24 targets were identified as birds (89%) and three as insects, suggesting this was not a high traffic time period, though a weak migration may have occurred (**Table 6-1**). The maximum total targets identified for an hour (12 total targets) occurred from 1:00 AM to 2:00 AM EDT (05:00 to 06:00 UTC), when nine targets were identified as birds and three as insects. There were no foraging bats identified during sampling over Grid 7.

The barge was then moved to Grid 13 for the period 03 – 12 April 2008, with data gathered from 9:00 PM to 8:00 PM (01:00 to 00:00 UTC). During this time a total of 27 targets were identified, of which 21 targets were identified as birds (78%) and six as insects, suggesting that there were minimal traffic rates, though a weak migration may have occurred (**Table 6-2**). The maximum total identified for an hour (18 total targets) occurred from 5:00 AM to 6:00 AM (09:00 to 10:00 UTC), when all targets were identified as birds. There were no foraging bats identified during sampling over Grid 13.

Data collection resumed at Grid 19 for the period 14 – 18 April 2008 and covered from 10:00 PM to 8:00 PM EDT (02:00 to 00:00 UTC). Over this period there were a total of 39 targets identified, of which 24 targets were identified as birds (62%), 12 as insects, and three as foraging bats, suggesting a weak migration may have occurred (**Table 6-3**). The maximum total identified for an hour (9 total targets) occurred from 11:00 PM to 12:00 AM EDT (03:00 to 04:00 UTC), when six targets were identified as birds and three as insects.

At Grid 26 (25 – 30 April 2008) only 21 total targets were identified from 12:00 AM to 8:00 PM EDT (04:00 to 00:00 UTC). Out of the 21 total targets six targets were identified as birds (29%), 12 as insects, and three as foraging bats (**Table 6-4**). This dataset suggests little, if any, bird migration occurred over this time period. The maximum total targets identified for an hour (12 total targets) occurred from 12:00 AM to 1:00 AM EDT (04:00 to 05:00 UTC), when three targets were identified as birds, six as insects, and three as foraging bats.

The data from Grid 23 were collected from 01–07 May 2008. This dataset covered 9:00 PM to 8:00 PM EDT (01:00 to 00:00 UTC) with a total of 783 targets identified, of which 570 targets were identified as birds (73%), 204 as insects, and nine as foraging bats (**Table 6-5**). Most bird targets were identified on the night of 06-07 May, suggesting a strong migration occurred during this time. The maximum total targets identified for an hour (168 total targets) occurred from 2:00 AM to 3:00 AM EDT (06:00 to 07:00 UTC), when 150 targets were identified as birds, 12 as insects, and six as foraging bats.

Grid 17 was the final location for the spring and data were collected from 08-11 May 2008. This dataset covered 9:00 PM to 1:00 PM EDT (01:00 to 17:00 UTC) with a total of 162 targets identified, of which 69

targets were identified as birds (43%), 87 as insects, and six as foraging bats (**Table 6-6**). These data suggest a weak migration took place while sampling at this Grid. The maximum total targets identified for an hour (42 total targets) occurred from 2:00 AM to 3:00 AM EDT (06:00 to 07:00 UTC), when 21 targets were identified as birds and 21 as insects.

Table 6-1. Numbers (TCC) of birds, insects, and foraging bats observed in TI-VPR samples over Grid 7 from 24-26 March 2008.

Hrs (EDT)[1]	Birds	Insects	Foraging Bats	Total Targets	% Birds
9:00 PM	3	0	0	3	100
10:00 PM	0	0	0	0	0
11:00 PM	0	0	0	0	0
12:00 AM	0	0	0	0	0
1:00 AM	9	3	0	12	75
2:00 AM	3	0	0	3	100
3:00 AM	0	0	0	0	0
4:00 AM	0	0	0	0	0
12:00 PM	0	0	0	0	0
1:00 PM	6	0	0	6	100
2:00 PM	3	0	0	3	100
3:00 PM	0	0	0	0	0
4:00 PM	0	0	0	0	0
Total	**24**	**3**	**0**	**27**	**89**

[1] Eastern Daylight Time, add 4 hours for UTC.

Table 6-2. Numbers (TCC) of birds, insects, and foraging bats observed in TI-VPR samples over Grid 13 from 03-12 April 2008.

Hrs (EDT)[1]	Birds	Insects	Foraging Bats	Total Targets	% Birds
9:00 PM	0	6	0	6	0
11:00 PM	0	0	0	0	0
12:00 AM	0	0	0	0	0
1:00 AM	0	0	0	0	0
5:00 AM	18	0	0	18	100
6:00 AM	0	0	0	0	0
7:00 AM	0	0	0	0	0
8:00 AM	3	0	0	3	100
11:00 AM	0	0	0	0	0
12:00 PM	0	0	0	0	0
1:00 PM	0	0	0	0	0
2:00 PM	0	0	0	0	0
5:00 PM	0	0	0	0	0
6:00 PM	0	0	0	0	0
7:00 PM	0	0	0	0	0
Total	**21**	**6**	**0**	**27**	**78**

[1] Eastern Daylight Time, add 4 hours for UTC.

Table 6-3. Numbers (TCC) of birds, insects, and foraging bats observed in TI-VPR samples over Grid 19 from 14-18 April 2008.

Hrs (EDT)[1]	Birds	Insects	Foraging Bats	Total Targets	% Birds
10:00 PM	0	0	0	0	0
11:00 PM	6	3	0	9	67
12:00 AM	0	0	0	0	0
1:00 AM	3	0	3	6	50
2:00 AM	6	0	0	6	100
3:00 AM	0	0	0	0	0
4:00 AM	0	0	0	0	0
5:00 AM	0	0	0	0	0
6:00 AM	0	0	0	0	0
7:00 AM	0	0	0	0	0
8:00 AM	0	3	0	3	0
9:00 AM	6	0	0	6	100
10:00 AM	0	0	0	0	0
11:00 AM	0	0	0	0	0
12:00 PM	0	3	0	3	0
1:00 PM	0	0	0	0	0
2:00 PM	0	0	0	0	0
3:00 PM	3	3	0	6	50
4:00 PM	0	0	0	0	0
5:00 PM	0	0	0	0	0
6:00 PM	0	0	0	0	0
7:00 PM	0	0	0	0	0
Total	**24**	**12**	**3**	**39**	**62**

[1] Eastern Daylight Time, add 4 hours for UTC.

Table 6-4. Numbers (TCC) of birds, insects, and foraging bats observed in TI-VPR samples over Grid 26 from 25-30 April 2008.

Hrs (EDT)[1]	Birds	Insects	Foraging Bats	Total Targets	% Birds
12:00 AM	3	6	3	12	25
1:00 AM	3	6	0	9	33
3:00 AM	0	0	0	0	0
11:00 AM	0	0	0	0	0
12:00 PM	0	0	0	0	0
6:00 PM	0	0	0	0	0
7:00 PM	0	0	0	0	0
Total	**6**	**12**	**3**	**21**	**29**

[1] Eastern Daylight Time, add 4 hours for UTC.

Table 6-5. Numbers (TCC) of birds, insects, and foraging bats observed in TI-VPR samples over Grid 23 from 01-07 May 2008.

Hrs (EDT)[1]	Birds	Insects	Foraging Bats	Total Targets	% Birds
9:00 PM	12	0	0	12	100
10:00 PM	72	15	0	87	83
11:00 PM	36	45	0	81	44
12:00 AM	69	36	3	108	64
1:00 AM	63	24	0	87	72
2:00 AM	150	12	6	168	89
3:00 AM	108	15	0	123	88
4:00 AM	36	12	0	48	75
5:00 AM	15	12	0	27	56
7:00 AM	0	3	0	3	0
9:00 AM	3	0	0	3	100
10:00 AM	3	0	0	3	100
11:00 AM	0	3	0	3	0
12:00 PM	0	12	0	12	0
1:00 PM	0	3	0	3	0
2:00 PM	0	0	0	0	0
3:00 PM	0	0	0	0	0
6:00 PM	0	6	0	6	0
7:00 PM	3	6	0	9	33
Total	**570**	**204**	**9**	**783**	**73**

[1] Eastern Daylight Time, add 4 hours for UTC.

Table 6-6. Numbers (TCC) of birds, insects, and foraging bats observed in TI-VPR samples over Grid 17 from 08-11 May 2008.

Hrs (EDT)[1]	Birds	Insects	Foraging Bats	Total Targets	% Birds
9:00 PM	6	3	0	9	67
10:00 PM	3	6	3	12	25
11:00 PM	3	12	0	15	20
12:00 AM	6	12	0	18	33
1:00 AM	3	6	0	9	33
2:00 AM	21	21	0	42	50
3:00 AM	3	6	0	9	33
4:00 AM	15	15	3	33	45
5:00 AM	9	3	0	12	75
12:00 PM	0	3	0	3	0
Total	**69**	**87**	**6**	**162**	**43**

[1] Eastern Daylight Time, add 4 hours for UTC.

6.3.1.2 TI-VPR Altitudinal Distribution

Over Grid 7 in spring 2008, the TCC of birds in each 15-m (50-ft) altitudinal band showed that 38% (nine of 24 birds) were at altitudes above the RSZ (213+ m [700+ ft], **Table 6-7** and **Figure 6-1**). There were no birds detected below 30 m (100 ft) and 15 birds were detected within 30 to 213 m (100 to 700 ft; i.e., within the RSZ). Occasionally, detections appeared in the VPR and not in the TI and these may represent

insects too high to be detected by the TI but reflective enough to generate an echo on the VPR. CACs adjust for the varying sample size of the TI-VPR field of view at different altitudes. The CAC were similar to the altitude distribution from the TCCs, with 17 birds from 213 to 472 m (700 to 1,549 ft) and 104 birds within the RSZ (14% above the RSZ and 86% within the RSZ).

Grid 13 analyses of the TCC for birds in each altitudinal band showed that 25% (three of 12 birds) were above the RSZ and 75% (nine of 12 birds) were within the RSZ (**Table 6-8** and **Figure 6-2**). Once again no birds were detected below 30 m (100 ft). The CAC were similar to the altitudinal distribution from the TCCs, with 8 birds from 213 to 259 m (700 to 849 ft) and 54 birds within the RSZ (13% above the RSZ and 87% within the RSZ).

Table 6-7. Numbers of birds (TCC and CAC) within 50-ft (15-m) altitudinal bands for TI-VPR samples over Grid 7 from 24-26 March 2008.

Altitudinal Band (ft)	TCC	CAC
0-49	0	0
50-99	0	0
100-149	0	0
150-199	0	0
200-249	0	0
250-299	6	52
300-349	3	22
350-399	0	0
400-449	3	17
450-499	0	0
500-549	3	13
550-599	0	0
600-649	0	0
650-699	0	0
700-749	0	0
750-799	0	0
800-849	0	0
850-899	0	0
900-949	3	7
950-999	0	0
1000-1049	0	0
1050-1099	0	0
1100-1149	0	0
1150-1199	0	0
1200-1249	3	6
1250-1299	0	0
1300-1349	0	0
1350-1399	0	0
1400-1449	0	0
1450-1499	0	0
1500-1549	3	4
Total	**24**	**121**

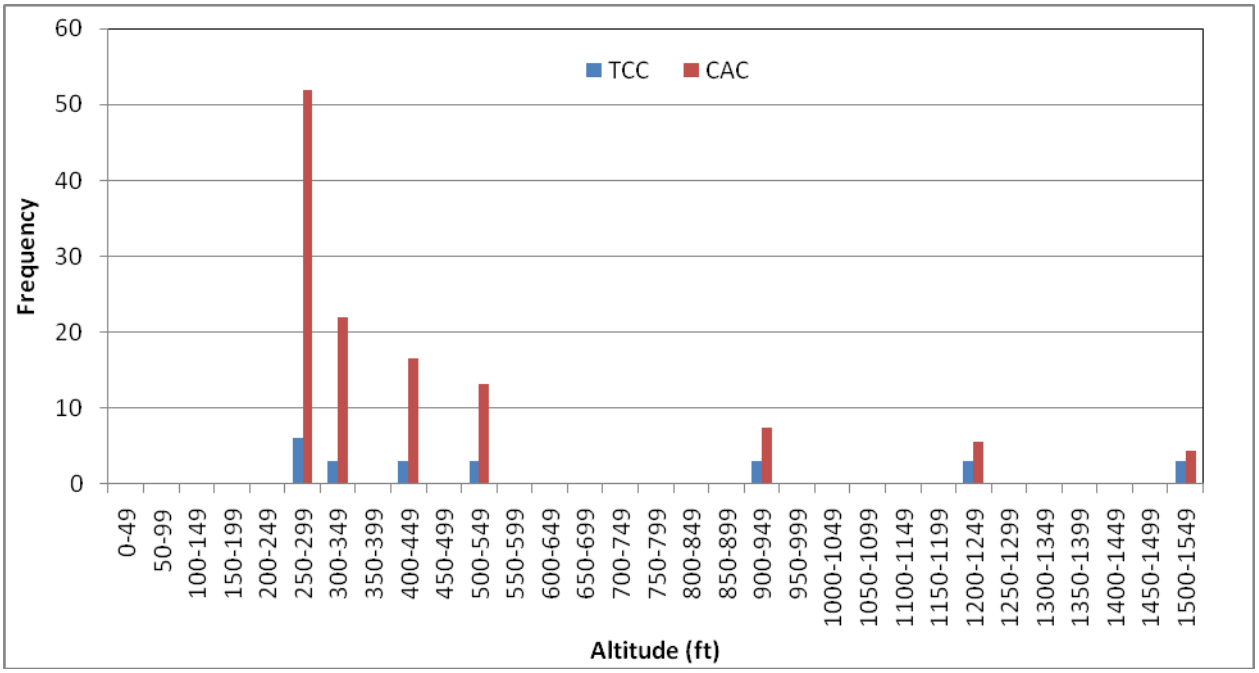


Figure 6-1. Altitudinal distribution of birds (TCC and CAC) aloft over Grid 7 from 24-26 March 2008.

Table 6-8. Numbers of birds (TCC and CAC) within 50-ft (15-m) altitudinal bands for TI-VPR samples over Grid 13 from 03-12 April 2008.

Altitudinal Band (ft)	TCC	CAC
0-49	0	0
50-99	0	0
100-149	0	0
150-199	0	0
200-249	0	0
250-299	3	26
300-349	0	0
350-399	0	0
400-449	0	0
450-499	3	15
500-549	3	13
550-599	0	0
600-649	0	0
650-699	0	0
700-749	0	0
750-799	0	0
800-849	3	8
Total	**12**	**62**

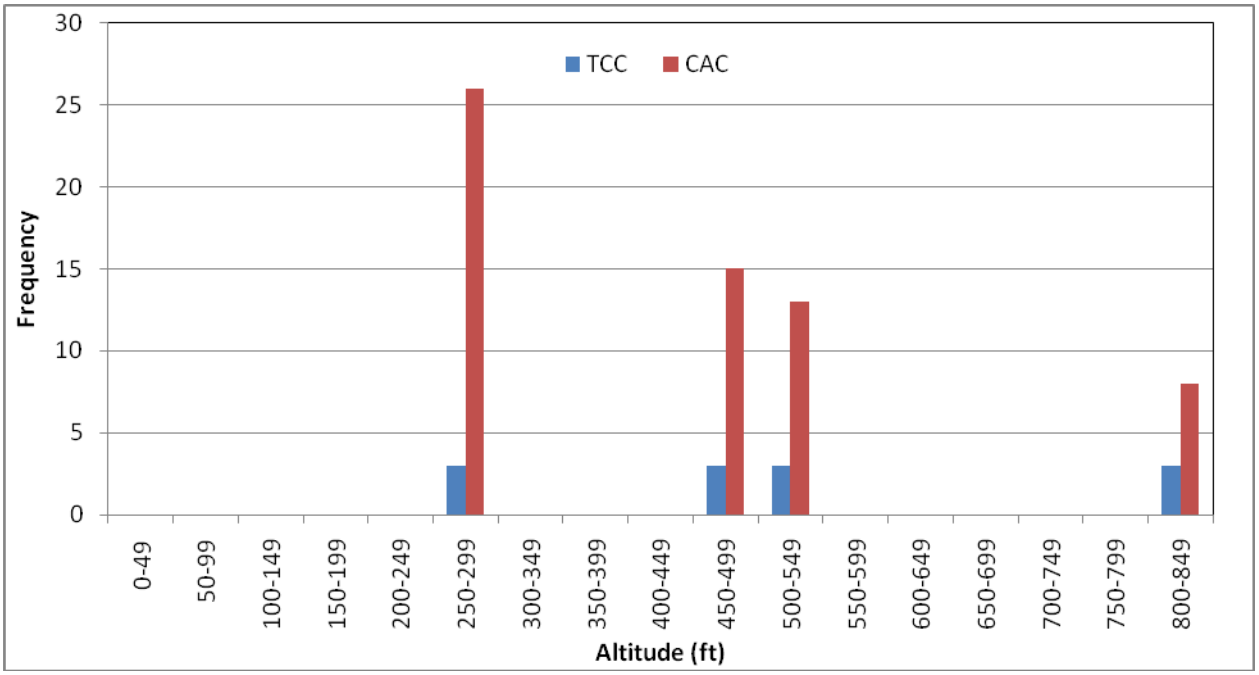


Figure 6-2. Altitudinal distribution of birds (TCC and CAC) aloft over Grid 13 from 03-12 April 2008.

Over Grid 19 the TCC for birds in each altitudinal band showed that 100% (18 birds) were within the RSZ (**Table 6-9** and **Figure 6-3**). There were no birds detected below 30 m (100 ft). The CAC showed 108 birds within the RSZ (100% within the RSZ).

Table 6-9. Numbers of birds (TCC and CAC) within 50-ft (15-m) altitudinal bands for TI-VPR samples over Grid 19 from 14-18 April 2008.

Altitudinal Band (ft)	TCC	CAC
0-49	0	0
50-99	0	0
100-149	0	0
150-199	0	0
200-249	3	33
250-299	3	26
300-349	0	0
350-399	0	0
400-449	0	0
450-499	3	15
500-549	0	0
550-599	6	24
600-649	0	0
650-699	3	10
Total	**18**	**108**

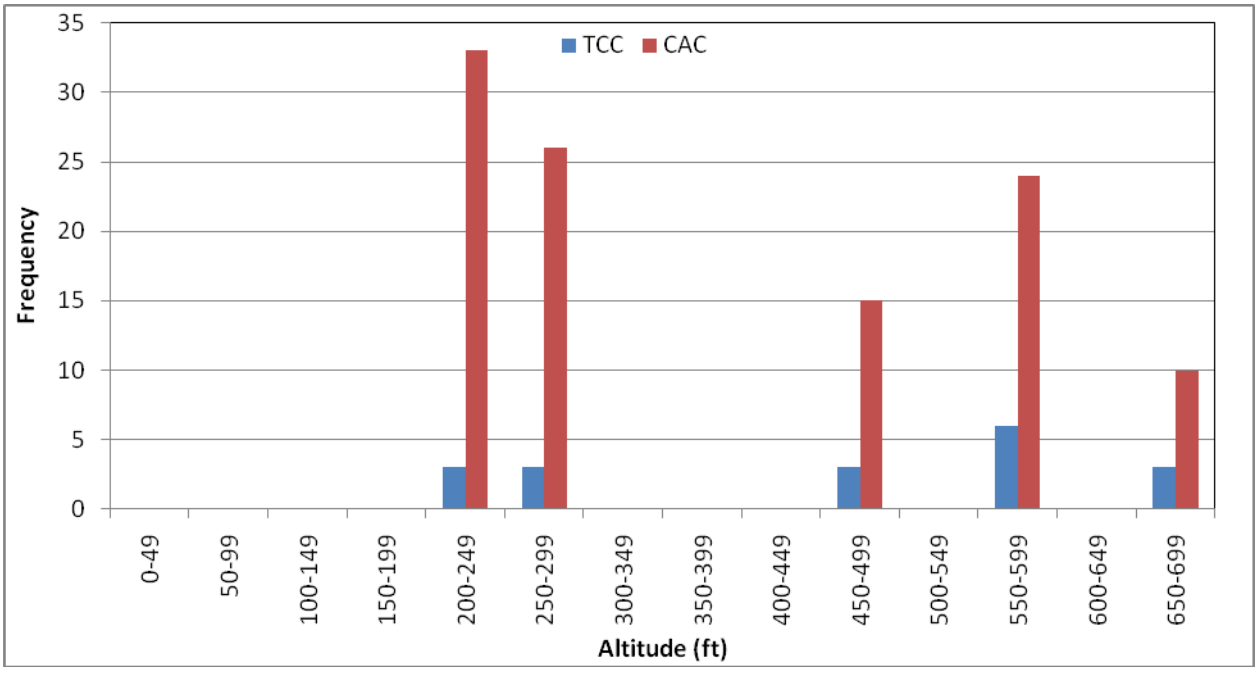


Figure 6-3. Altitudinal distribution of birds (TCC and CAC) aloft over Grid 19 from 14-18 April 2008.

Grid 26 analyses of the TCC for birds in each altitudinal band showed that 50% (3 of 6 birds) were above the RSZ and 50% were detected within the RSZ (**Table 6-10** and **Figure 6-4**). Once again there were no birds detected below 30 m (100 ft). The CAC had a change in altitudinal distribution as compared to the TCCs, with 9 birds from 213 to 244 m (700 to 799 ft) and 33 birds within the RSZ (21% above the RSZ and 79% within the RSZ).

Table 6-10. Numbers of birds (TCC and CAC) within 50-ft (15-m) altitudinal bands for TI-VPR samples over Grid 26 from 25-30 April 2008.

Altitudinal Band (ft)	TCC	CAC
0-49	0	0
50-99	0	0
100-149	0	0
150-199	0	0
200-249	3	33
250-299	0	0
300-349	0	0
350-399	0	0
400-449	0	0
450-499	0	0
500-549	0	0
550-599	0	0
600-649	0	0
650-699	0	0
700-749	0	0
750-799	3	9
Total	**6**	**42**

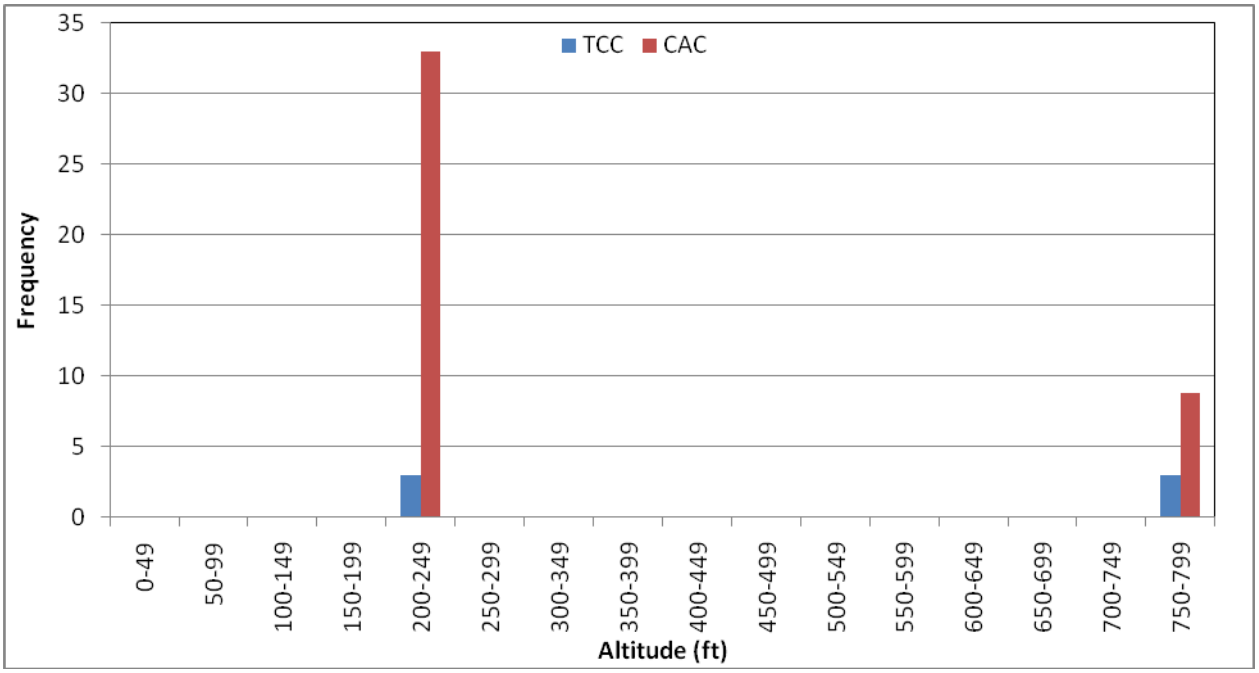


Figure 6-4. Altitudinal distribution of birds (TCC and CAC) aloft over Grid 26 from 25-30 April 2008.

Grid 23 showed the highest totals for birds of the six Grids sampled in spring 2008. The TCC for birds in each altitudinal band showed that 13% (75 of 567 birds) were above the RSZ and 87% (492 of 567 birds) were within the RSZ (**Table 6-11** and **Figure 6-5**). There were no birds detected below 30 m (100 ft). The CAC showed a similar pattern to the TCCs, with 188 birds from 213 to 442 m (700 to 1,449 ft) and 3,594 birds within the RSZ (5% above the RSA and 95% within the RSZ).

Table 6-11. Numbers of birds (TCC and CAC) within 50-ft (15-m) altitudinal bands for TI-VPR samples over Grid 23 from 01-07 May 2008.

Altitudinal Band (ft)	TCC	CAC
0-49	0	0
50-99	0	0
100-149	9	198
150-199	33	484
200-249	36	396
250-299	72	625
300-349	81	594
350-399	42	266
400-449	60	338
450-499	54	270
500-549	42	182
550-599	36	144
600-649	21	77
650-699	6	20
700-749	9	27
750-799	12	36

Table 6-11 (*continued*). Numbers of birds (TCC and CAC) within 50-ft (15-m) altitudinal bands for TI-VPR samples over Grid 23 from 01-07 May 2008.

Altitudinal Band (ft)	TCC	CAC
800-849	12	32
850-899	12	32
900-949	6	14
950-999	3	7
1000-1049	3	7
1050-1099	0	0
1100-1149	3	6
1150-1199	3	6
1200-1249	3	6
1250-1299	0	0
1300-1349	6	10
1350-1399	0	0
1400-1449	3	5
Total	**567**	**3782**

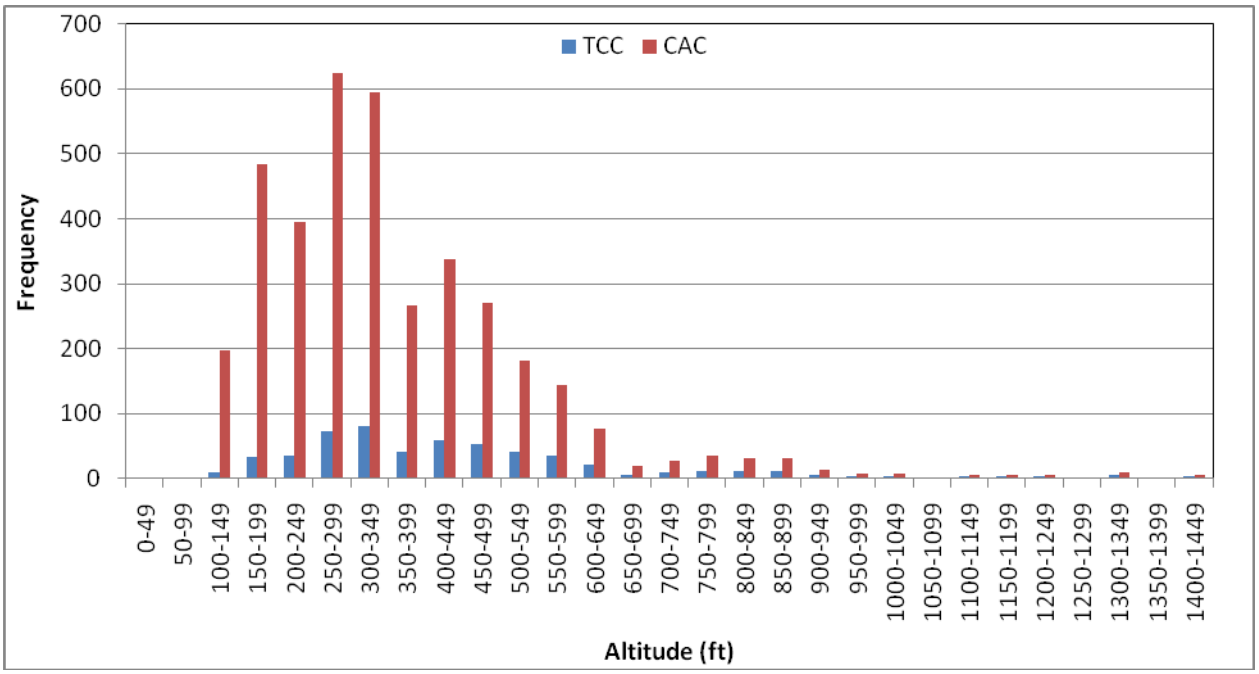


Figure 6-5. Altitudinal distribution of birds (TCC and CAC) aloft over Grid 23 from 01-07 May 2008.

Over Grid 17 the TCC for birds in each altitudinal band showed that 10% (six of 60 birds) were above the RSZ and 90% (54 of 60 birds) were within the RSZ (**Table 6-12** and **Figure 6-6**). There were no birds detected below 30 m (100 ft). The CAC were similar to the TCCs, with nine birds from 213 to 228 m (700 to 749 ft) and 339 birds within the RSZ (3% above the RSZ and 97% within the RSZ).

Table 6-12. Numbers of birds (TCC and CAC) within 50-ft (15-m) altitudinal bands for TI-VPR samples over Grid 17 from 08-10 May 2008.

Altitudinal Band (ft)	TCC	CAC
0-49	0	0
50-99	0	0
100-149	0	0
150-199	3	44
200-249	0	0
250-299	9	78
300-349	9	66
350-399	0	0
400-449	6	34
450-499	9	45
500-549	6	26
550-599	6	24
600-649	6	22
650-699	0	0
700-749	6	9
Total	**60**	**348**

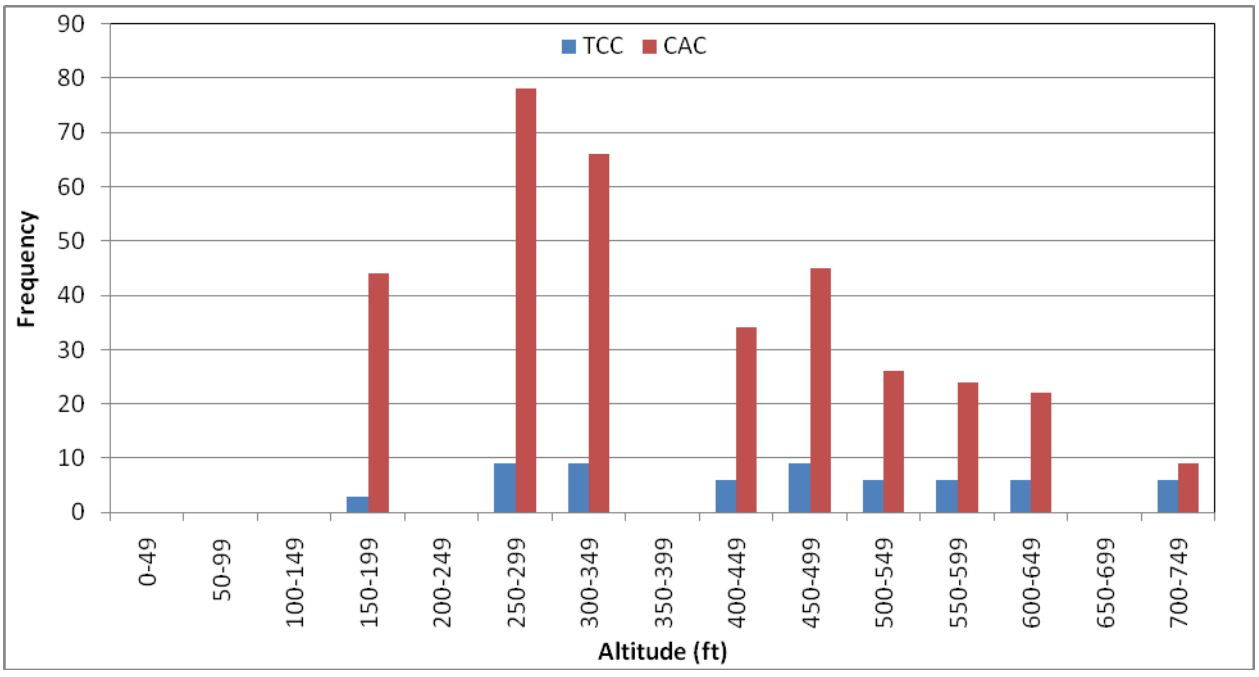


Figure 6-6. Altitudinal distribution of birds (TCC and CAC) aloft over Grid 17 from 08-10 May 2008.

6.3.1.3 TI-VPR Flight Direction

The directional tendencies of birds over all Grids are given in **Table 6-13** and illustrated in **Figure 6-7**. The mean direction for the movements for Grids 7, 13, 19, 23 and 17 ranged from north-northwest (NNW) to ENE (35.42°, 56.88°, 69.37°, 49.12°, and 352.70°, respectively), while Grid 26 showed a mean direction towards the south-southwest (SSW; 188.71°). This anomaly at Grid 26 could be explained by adverse, strong winds (~20 kts from the NW) leading to a reverse migration. Overall, the Grids showed little variability in the mean direction (see length of mean vector **Table 6-13**), with the once exception being Grid 17 as shown by the length of the mean vector (0.31) and circular SD (87.58°).

Table 6-13. Statistical analysis of direction of nightly migrations over Grids 7, 13, 19, 26, 23 and 17 during spring 2008.

3

	Grid 7	Grid 13	Grid 19	Grid 26	Grid 23	Grid 17
Number of Observations	121	71	117	42	3773	354
Mean Vector (μ)	35.42°	56.88°	69.37°	188.71°	49.12°	352.70°
Length of Mean Vector (r)	0.92	0.75	0.77	0.98	0.89	0.31
Median	45°	55°	75°	195°	50°	0°
Concentration	6.44	2.39	2.57	22.17	5.02	0.65
Circular Variance	0.08	0.25	0.23	0.02	0.11	0.69
Circular Standard Deviation	23.58°	43.14°	41.09°	12.31°	27.10°	87.58°
Standard Error of Mean	2.14°	5.07°	3.76°	1.90°	0.44°	6.75°
Rayleigh Test (Z)	102.15	40.28	69.96	40.11	3016.57	34.23
Rayleigh Test (p)	<1E-12	<1E-12	<1E-12	<1E-12	<1E-12	<1E-12
Rao's Spacing Test (U)	339.17	329.65	338.46	342.86	357.90	340.68
Rao's Spacing Test (p)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

6.3.2 Fall 2008

6.3.2.1 Target Identification

Data over Grid 23 were gathered from 01–12 October 2008 and covered 8:00 PM to 7:00 PM EDT (00:00 to 23:00 UTC). During this time a total of 1,252 total targets were identified, of which 985 targets were identified as birds (79%), 243 as insects, and 24 as foraging bats, suggesting some bird migration had taken place over this time period (**Table 6-14**). The maximum total targets identified for an hour (243 total targets) occurred from 7:00 AM to 8:00 AM EDT (11:00 to 12:00 UTC), when all targets were identified as birds.

The barge then moved to Grid 26 and collected data from 13–19 October 2008 and covered 8:00 PM to 6:00 PM EDT (00:00 to 22:00 UTC). During this time a total of 249 targets were identified, of which 192 targets were identified as birds (77%) and 57 as insects, suggesting that some migration occurred (**Table 6-15**). The maximum total targets identified for an hour (57 total targets) occurred from 1:00 AM to 2:00 AM EDT (05:00 to 06:00 UTC), when 51 targets were identified as birds and six as insects. There were no foraging bats identified during sampling over Grid 26.

6.3.2.2 Altitudinal Distribution

Over Grid 23 in fall 2008, the TCC of birds in each 15-m (50-ft) altitudinal band showed that 49% (426 of 861 birds) were at altitudes above the RSZ and 51% (435 of 861 birds) were within the RSZ (**Table 6-16** and **Figure 6-8**). There were no birds detected below 30 m (100 ft). Occasionally, detections appeared in the VPR and not in the TI and these may represent insects too high to be detected by the TI but reflective enough to generate an echo on the VPR. The CAC showed a change in altitudinal distribution from the TCCs, with 943 birds from 213 to 594 m (700 to 1,949 ft) and 3,037 birds within the RSZ (24% above the RSZ and 76% within the RSZ).

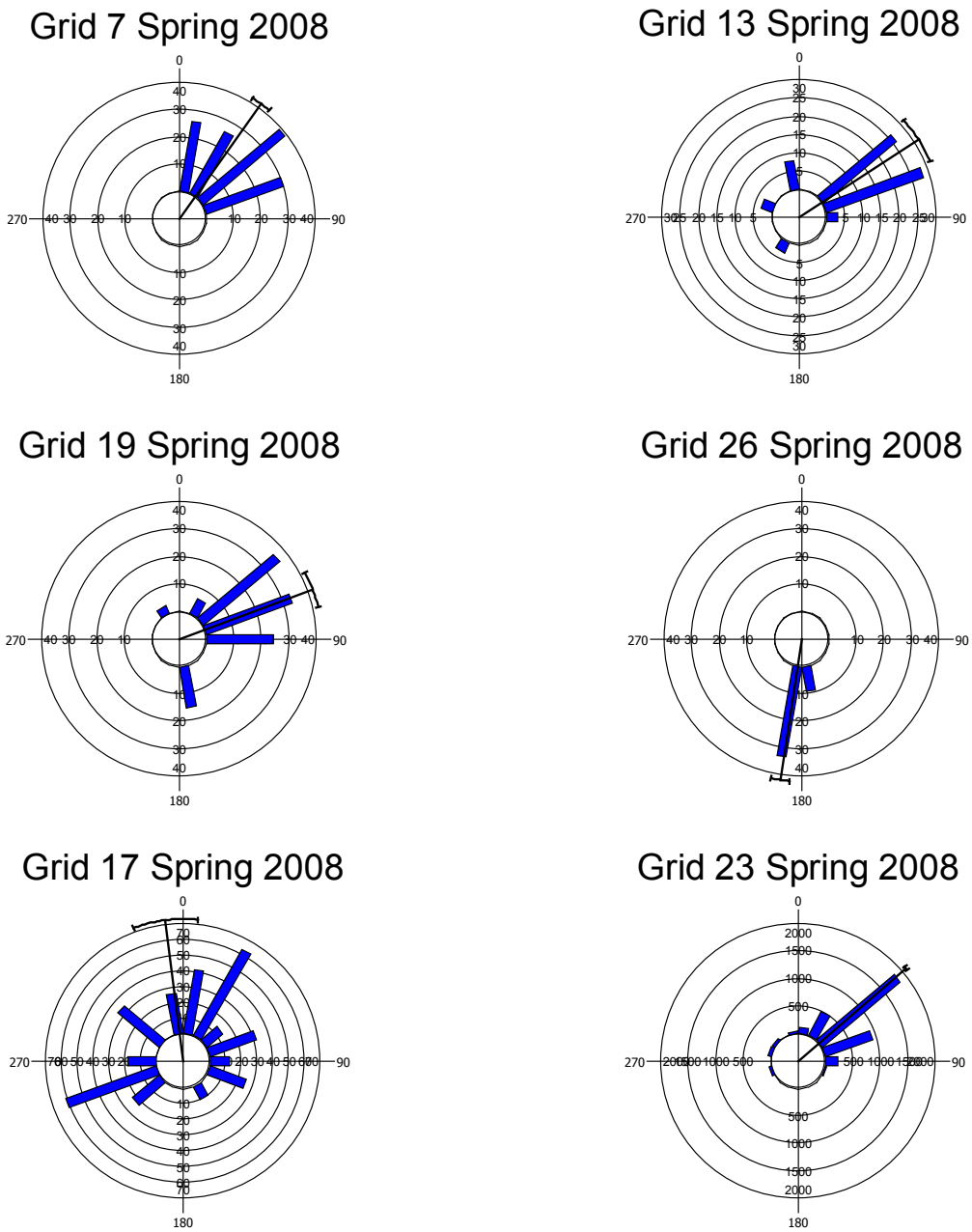


Figure 6-7. Circular diagrams showing the direction of bird movements through the TI-VPR field of view in Grids 7, 13, 19, 26, 23 and 17 for spring 2008. The dark line is the mean angle and the arc at the end shows the 95% confidence limits of the mean.

Table 6-14. Numbers (TCC) of birds, insects, and foraging bats observed in TI-VPR samples over Grid 23 from 01-12 October 2008.

Hrs (EDT)[1]	Birds	Insects	Foraging Bats	Total Targets	% Birds
8:00 PM	6	0	0	6	100
9:00 PM	39	18	3	60	65
10:00 PM	30	3	3	36	83
11:00 PM	0	9	3	12	0
12:00 AM	15	3	9	27	56
1:00 AM	12	21	0	33	36
2:00 AM	45	30	0	75	60
3:00 AM	147	21	0	168	88
4:00 AM	81	30	0	111	73
5:00 AM	99	18	0	117	85
6:00 AM	84	3	0	87	97
7:00 AM	243	0	0	243	100
8:00 AM	105	15	0	120	88
9:00 AM	39	3	0	42	93
10:00 AM	13	0	0	13	100
11:00 AM	3	0	0	3	100
2:00 PM	0	6	0	6	0
3:00 PM	9	21	3	33	27
4:00 PM	12	21	3	36	33
5:00 PM	3	15	0	18	17
6:00 PM	0	6	0	6	0
Total	**985**	**243**	**24**	**1252**	**79**

[1] Eastern Daylight Time, add 4 hours for UTC.

Table 6-15. Numbers (TCC) of birds, insects, and foraging bats observed in TI-VPR samples over Grid 26 from 13-19 October 2008.

Hrs (EDT)[1]	Bird	Insects	Foraging Bats	Total Targets	% Birds
8:00 PM	30	0	0	30	100
9:00 PM	0	3	0	3	0
10:00 PM	9	0	0	9	100
11:00 PM	6	9	0	15	40
12:00 AM	48	9	0	57	84
1:00 AM	51	6	0	57	89
2:00 AM	33	0	0	33	100
3:00 AM	9	0	0	9	100
4:00 AM	3	3	0	6	50
5:00 AM	3	9	0	12	25
12:00 PM	0	3	0	3	0
1:00 PM	0	3	0	3	0
2:00 PM	0	3	0	3	0
4:00 PM	0	3	0	3	0
5:00 PM	0	6	0	6	0
Total	**192**	**57**	**0**	**249**	**77**

[1] Eastern Daylight Time, add 4 hours for UTC.

Table 6-16. Numbers of birds (TCC and CAC) within 50-ft (15-m) altitudinal bands for TI-VPR samples over Grid 23 from 01-12 October 2008.

Altitudinal Band (ft)	TCC	CAC
0-49	0	0
50-99	0	0
100-149	0	0
150-199	33	484
200-249	24	264
250-299	39	343
300-349	54	396
350-399	42	264
400-449	9	51
450-499	42	205
500-549	45	498
550-599	33	132
600-649	51	187
650-699	63	213
700-749	12	36
750-799	36	108
800-849	24	64
850-899	48	124
900-949	63	154
950-999	36	83
1000-1049	9	21
1050-1099	9	18
1100-1149	12	24
1150-1199	27	52
1200-1249	108	198
1250-1299	3	5
1300-1349	0	0
1350-1399	3	5
1400-1449	3	5
1450-1499	0	0
1500-1549	27	39
1550-1599	0	0
1600-1649	0	0
1650-1699	0	0
1700-1749	0	0
1750-1799	0	0
1800-1849	3	4
1850-1899	0	0
1900-1949	3	3
Total	**861**	**3980**

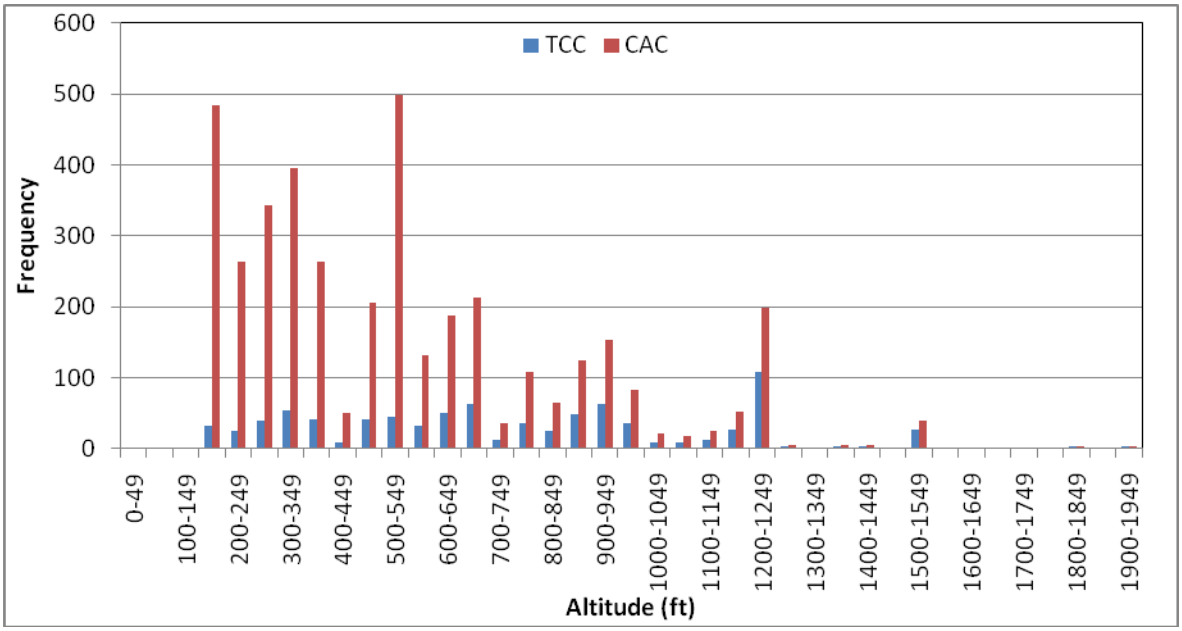


Figure 6-8. Altitudinal distribution of birds (TCC and CAC) aloft over Grid 23 from 01-12 October 2008.

Grid 26 analyses of the TCC for birds in each altitudinal band showed that 49% (93 of 189 birds) were above the RSZ and 51% (96 of 189 birds) were within the RSZ (**Table 6-17** and **Figure 6-9**). Once again no birds were detected below 30 m (100 ft). The CAC showed a change in altitudinal distribution from the TCCs, with 181 birds from 213 to 655 m (700 to 2,149 ft) and 576 birds within the RSZ (24% above the RSZ and 76% within the RSZ).

Table 6-17. Numbers of birds (TCC and CAC) within 50-ft (15-m) altitudinal bands for TI-VPR samples over Grid 26 from 13-19 October 2008.

Altitudinal Band (ft)	TCC	CAC
0-49	0	0
50-99	0	0
100-149	0	0
150-199	9	132
200-249	3	33
250-299	3	26
300-349	18	132
350-399	3	19
400-449	0	0
450-499	6	30
500-549	6	26
550-599	9	36
600-649	36	132
650-699	3	10
700-749	0	0
750-799	9	27
800-849	9	24
850-899	6	16

Table 6-17 (*continued*). Numbers of birds (TCC and CAC) within 50-ft (15-m) altitudinal bands for TI-VPR samples over Grid 26 from 13-19 October 2008.

Altitudinal Band (ft)	TCC	CAC
900-949	18	42
950-999	6	14
1000-1049	0	0
1050-1049	0	0
1100-1149	0	0
1150-1199	9	18
1200-1249	0	0
1250-1299	0	0
1300-1349	0	0
1350-1399	0	0
1400-1449	0	0
1450-1499	0	0
1500-1549	3	4
1550-1599	0	0
1600-1649	0	0
1650-1699	0	0
1700-1749	0	0
1750-1799	6	8
1800-1849	0	0
1850-1899	0	0
1900-1949	0	0
1950-1999	0	0
2000-2049	0	0
2050-2099	0	0
2100-2149	27	28
Total	**189**	**757**

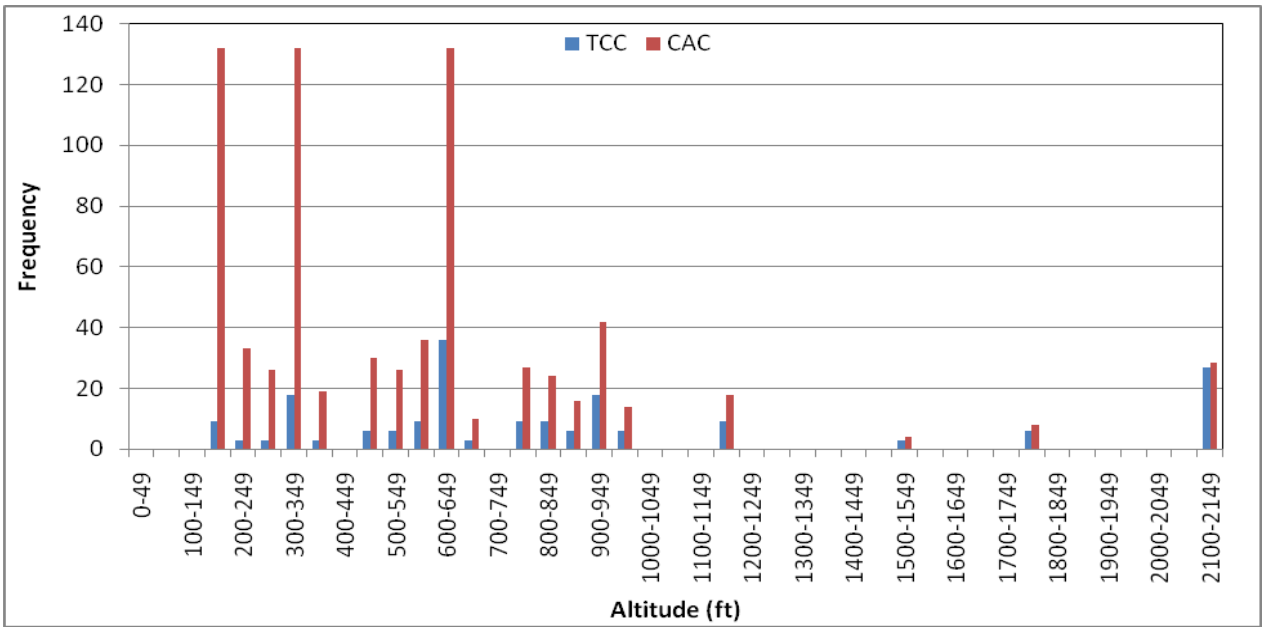


Figure 6-9. Altitudinal distribution of birds (TCC and CAC) aloft over Grid 26 from 13-19 October 2008.

6.3.2.3 Flight Direction

The directional tendencies of birds over Grids 23 and 26 are given in **Table 6-18** and illustrated in **Figure 6-10**. The mean direction for the movements for Grids 23 and 26 were towards the SW (246.17° and 254.51°, respectively). The Grids showed little variability in the mean direction as illustrated by the length of the mean vector (0.75 and 0.72, respectively) and circular SD (43.87° and 46.50°, respectively).

Table 6-18. Statistical analysis of direction of nightly migrations over Grids 23 and 26 during fall 2008.

	Grid 23	Grid 26
Number of Observations	3,734	757
Mean Vector (μ)	246.17°	254.51°
Length of Mean Vector (r)	0.75	0.72
Median	250°	245°
Concentration	2.33	2.13
Circular Variance	0.25	0.28
Circular Standard Deviation	43.87°	46.50°
Standard Error of Mean	0.71°	1.68°
Rayleigh Test (Z)	2077.88	391.83
Rayleigh Test (p)	<1E-12	<1E-12
Rao's Spacing Test (U)	355.18	347.16
Rao's Spacing Test (p)	<0.01	<0.01

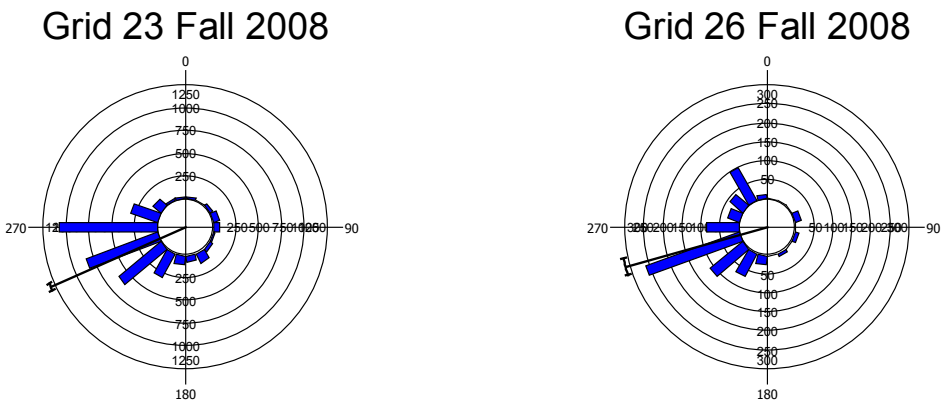


Figure 6-10. Circular diagrams showing the direction of bird movements through the TI-VPR field of view in Grids 23 and 26 for fall 2008. The dark line is the mean angle and the arc at the end shows the 95% confidence limits of the mean.

6.3.3 Spring 2009

6.3.3.1 Target Identification

Data over Grid 16 were gathered on the night of 11 May 2009 and covered 8:00 PM to 8:00 AM EDT (00:00 to 12:00 UTC). Over this time period 96 total targets were identified, of which 39 targets were identified as birds (41%) and 57 as insects (**Table 6-19**). This suggests that a weak bird migration occurred during this evening. The maximum total targets identified for an hour (27 total targets) occurred from 10:00 PM to 11:00 PM EDT (02:00 to 03:00 UTC), when 21 targets were identified as birds and six as insects. There were no foraging bats identified during sampling at Grid 16.

The barge was then moved to Grid 22 and for the night of 12 May 2009 and covered 8:00 PM to 3:00 AM EDT (00:00 to 07:00 UTC). During this time a total of 57 targets were identified, of which 39 targets were identified as birds (68%) and 18 as insects, suggesting a weak migration had occurred (**Table 6-20**). The maximum total targets identified for an hour was 15 total targets and this occurred multiple times at 10:00 to 11:00 PM, 11:00 PM to 12:00 AM and 1:00 AM to 2:00 AM EDT 02:00 to 03:00, 03:00 to 04:00 and 05:00 to 06:00 UTC, respectively). During these times the total birds identified were six, 15, and nine, respectively, while the total insects identified were nine, zero, and six, respectively. There were no foraging bats identified during sampling at Grid 22.

Table 6-19. Numbers (TCC) of birds, insects, and foraging bats observed in TI-VPR samples over Grid 16 on 11 May 2009.

Hrs (EDT)[1]	Birds	Insects	Foraging Bats	Total Targets	% Birds
8:00 PM	3	0	0	3	100
9:00 PM	0	3	0	3	0
10:00 PM	21	6	0	27	78
11:00 PM	15	9	0	24	63
12:00 AM	0	6	0	6	0
1:00 AM	0	9	0	9	0
2:00 AM	0	9	0	9	0
3:00 AM	0	6	0	6	0
4:00 AM	0	6	0	6	0
5:00 AM	0	0	0	0	0
6:00 AM	0	0	0	0	0
7:00 AM	0	3	0	3	0
Total	**39**	**57**	**0**	**96**	**41**

[1] Eastern Daylight Time, add 4 hours for UTC.

Table 6-20. Numbers (TCC) of birds, insects, and foraging bats observed in TI-VPR samples over Grid 22 on 12 May 2009.

Hrs (EDT)[1]	Birds	Insects	Foraging Bats	Total Targets	% Birds
8:00 PM	0	0	0	0	0
9:00 PM	0	0	0	0	0
10:00 PM	6	9	0	15	40
11:00 PM	15	0	0	15	100
12:00 AM	9	3	0	12	75
1:00 AM	9	6	0	15	60
2:00 AM	0	0	0	0	0
Total	**39**	**18**	**0**	**57**	**68**

[1] Eastern Daylight Time, add 4 hours for UTC.

6.3.3.2 Altitudinal Distribution

Over Grid 16 in spring 2009, the TCC of birds in each 15-m (50-ft) altitudinal band showed that 8% (three of 36 birds) were above the RSZ and 92% (33 of 36 birds) were within the RSZ (**Table 6-21** and **Figure 6-11**). There were no birds detected below 30 m (100 ft). As seen at other sites there were detections that appeared in the VPR and not in the TI which may represent insects too high to be detected by the TI but reflective enough to generate an echo on the VPR. The CAC was similar to the TCCs, with 8 birds from 213 to 274 m (700 to 899 ft) and 214 birds within the RSZ (4% above the RSZ and 96% within the RSZ).

Grid 22 analyses of the TCC for birds in each altitudinal band showed that 15% (6 of 39 birds) were above the RSZ and 85% (33 of 39 birds) were within the RSZ (**Table 6-22** and **Figure 6-12**). Once again no birds were detected below 30 m (100 ft). The CAC was similar to the TCCs, with 15 birds from 213 to 335 m (700 to 1,099 ft) and 231 birds within the RSZ (6% above the RSZ and 94% within the RSZ).

6.3.3.3 Flight Direction

The directional tendencies of birds over Grids 16 and 22 are given in **Table 6-23** and illustrated in **Figure 6-13**. The mean direction for the movements for Grids 16 and 22 were towards the north-northeast (NNE; 17.463° and 23.753°, respectively). The Grids showed little variability in the mean direction as illustrated by the length of the mean vector (0.99 and 0.97, respectively) and circular SD (10.41° and 13.10°, respectively).

Table 6-21. Numbers of birds (TCC and CAC) within 50-ft (15-m) altitudinal bands for TI-VPR samples over Grid 16 on 11 May 2009.

Altitudinal Band (ft)	TCC	CAC
0-49	0	0
50-99	0	0
100-149	0	0
150-199	0	0
200-249	0	0
250-299	6	52
300-349	12	88
350-399	3	19
400-449	6	34
450-499	0	0
500-549	0	0
550-599	0	0
600-649	3	11
650-699	3	10
700-749	0	0
750-799	0	0
800-849	0	0
850-899	3	8
Total	**36**	**222**

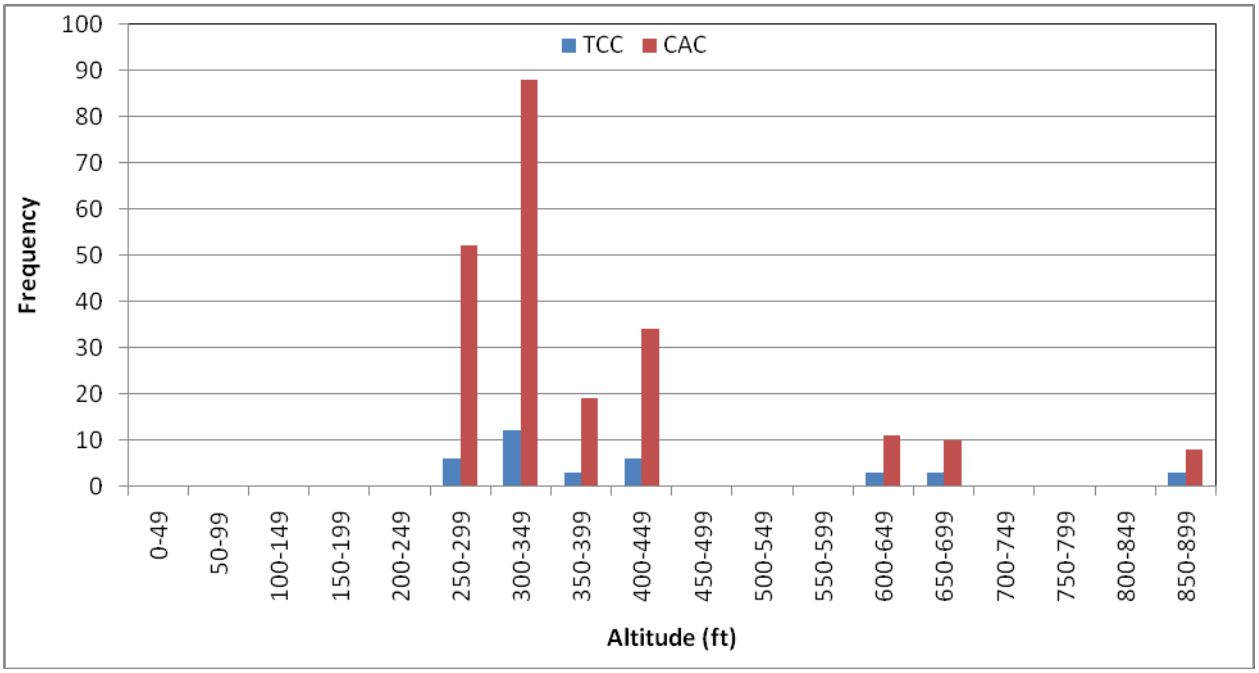


Figure 6-11. Altitudinal distribution of birds (TCC and CAC) aloft over Grid 16 on 11 May 2009.

Table 6-22. Numbers of birds (TCC and CAC) within 50-ft (15-m) altitudinal bands for TI-VPR samples over Grid 22 on 12 May 2009.

Altitudinal Band (ft)	TCC	CAC
0-49	0	0
50-99	0	0
100-149	0	0
150-199	3	44
200-249	0	0
250-299	6	52
300-349	9	66
350-399	0	0
400-449	6	34
450-499	0	0
500-549	3	13
550-599	3	12
600-649	0	0
650-699	3	10
700-749	0	0
750-799	3	9
800-849	0	0
850-899	0	0
900-949	0	0
950-999	0	0
1000-1049	0	0
1050-1099	3	6
Total	**39**	**246**

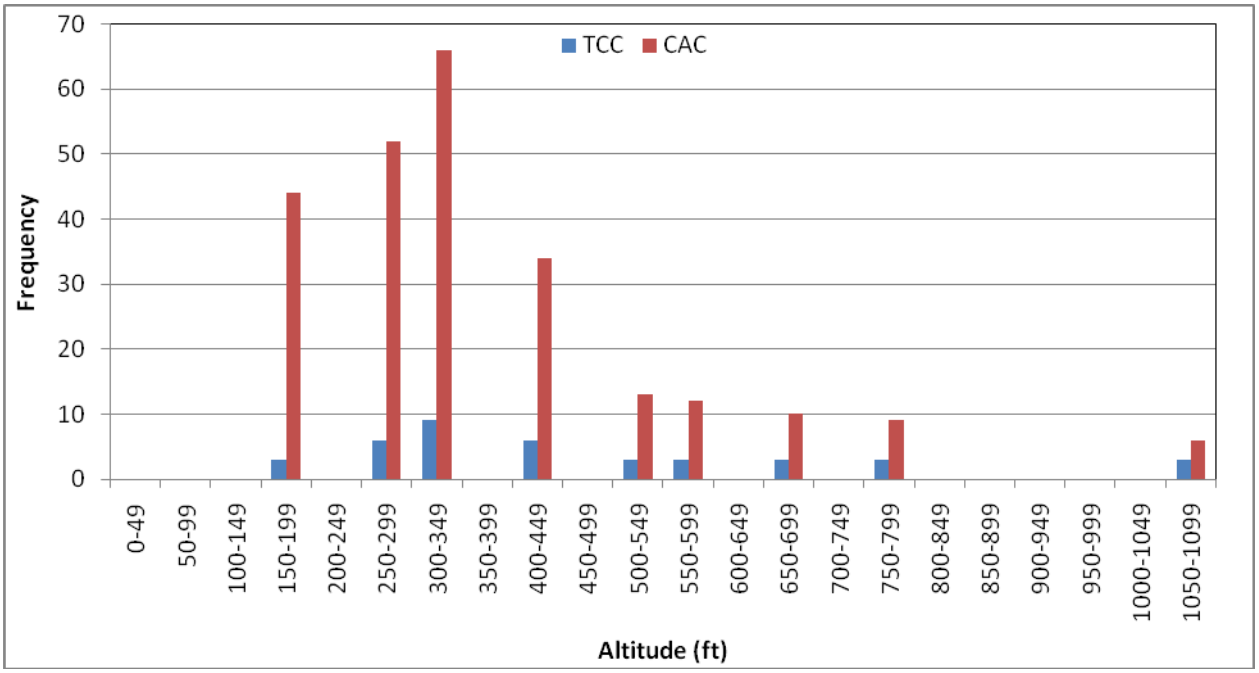


Figure 6-12. Altitudinal distribution of birds (TCC and CAC) aloft over Grid 22 on 12 May 2009.

Table 6-23. Statistical analysis of direction of nightly migrations over Grids 16 and 22 during spring 2009.

	Grid 16	Grid 22
Number of Observations	222	246
Mean Vector (μ)	17.463°	23.753°
Length of Mean Vector (r)	0.99	0.97
Median	10°	20°
Concentration	30.796	19.644
Circular Variance	0.016	0.026
Circular Standard Deviation	10.41°	13.10°
Standard Error of Mean	0.70°	0.84°
Rayleigh Test (Z)	214.79	233.473
Rayleigh Test (p)	<1E-12	<1E-12
Rao's Spacing Test (U)	350.27	348.293
Rao's Spacing Test (p)	<0.01	<0.01

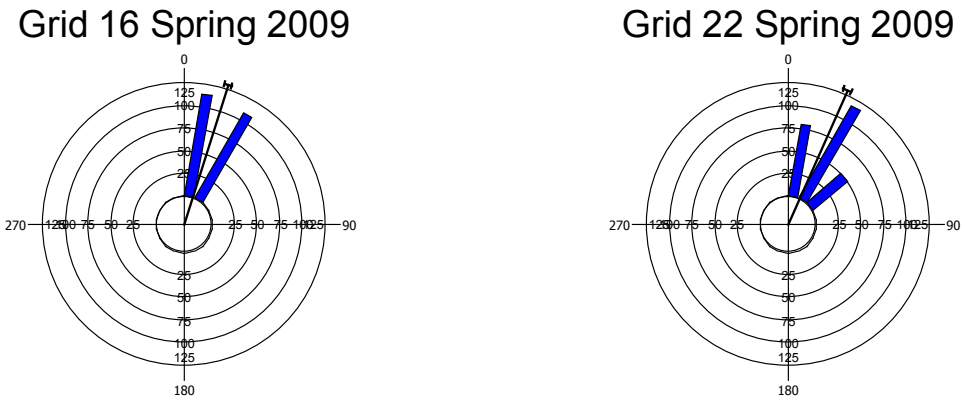


Figure 6-13. Circular diagrams showing the direction of bird movements through the TI-VPR field of view in Grids 16 and 22 for spring 2009. The dark line is the mean angle and the arc at the end shows the 95% confidence limits of the mean.

6.4 ONSHORE SURVEY RESULTS

6.4.1 Fall 2008

6.4.1.1 Target Identification

Data over SIC, New Jersey, were collected from 08–15 December 2008 and covered 9:00 PM to 4:00 PM Eastern Standard Time (EST [02:00 to 21:00 UTC]). Over this time period 285 total targets were recorded, of which 270 targets were identified as birds (95%), nine as insects, and six as foraging bats (**Table 6-24**), suggesting some bird migration occurred over this period of time. The maximum total targets identified for an hour (57 total targets) occurred from 9:00 PM to 10:00 PM EST (02:00 to 03:00 UTC), when all targets were identified as birds.

Table 6-24. Numbers (TCC) of birds, insects, and foraging bats observed in TI-VPR samples over Sea Isle City, New Jersey, from 08-15 December 2008.

Hrs (EST)[1]	Birds	Insects	Foraging Bats	Total Targets	% Birds
9:00 PM	57	0	0	57	100
10:00 PM	51	3	0	54	94
11:00 PM	33	0	0	33	100
12:00 AM	18	0	6	24	75
1:00 AM	3	0	0	3	100
2:00 AM	12	0	0	12	100
3:00 AM	6	0	0	6	100
7:00 AM	24	0	0	24	100
8:00 AM	9	0	0	9	100
9:00 AM	12	0	0	12	100
10:00 AM	15	0	0	15	100
11:00 AM	6	0	0	6	100
1:00 PM	3	0	0	3	100
2:00 PM	12	3	0	15	80
3:00 PM	9	3	0	12	75
Total	**270**	**9**	**6**	**285**	**95**

[1] Eastern Standard Time, add 5 hours for UTC.

6.4.1.2 Altitudinal Distribution

Over SIC, New Jersey, in fall 2008, the TCC of birds in each altitudinal band showed that 27% (66 of 243 birds) were at altitudes above the RSZ and 73% (177 of 243 birds) were within the RSZ (**Table 6-25** and **Figure 6-14**). There were no birds detected below 30 m (100 ft). While sampling over SIC there were detections that appeared in the VPR and not in the TI, which may represent insects too high to be detected by the TI but reflective enough to generate an echo on the VPR. The CAC was similar to the TCCs, with 142 birds from 213 to 625 m (700 to 2,049 ft) and 1,289 birds within the RSZ (10% above the RSZ and 90% within the RSZ).

Table 6-25. Numbers of birds (TCC and CAC) within 50-ft (15-m) altitudinal bands for TI-VPR samples over Sea Isle City, New Jersey, from 08-15 December 2008.

Altitudinal Band (ft)	TCC	CAC
0-49	0	0
50-99	0	0
100-149	3	66
150-199	15	220
200-249	15	165
250-299	15	130
300-349	51	374
350-399	3	19
400-449	6	34
450-499	9	45
500-549	15	65
550-599	24	96
600-649	15	55
650-699	6	20
700-749	6	18
750-799	0	0
800-849	3	8
850-899	15	39
900-949	3	7
950-999	6	14
1000-1049	0	0
1050-1099	9	18
1100-1149	3	6
1150-1199	0	0
1200-1249	0	0
1250-1299	0	0
1300-1349	15	25
1350-1399	0	0
1400-1449	0	0
1450-1499	0	0
1500-1549	3	4
1550-1599	0	0
1600-1649	0	0
1650-1699	0	0
1700-1749	0	0
1750-1799	0	0
1800-1849	0	0
1850-1899	0	0

Table 6-25 (*continued*). Numbers of birds (TCC and CAC) within 50-ft (15-m) altitudinal bands for TI-VPR samples over Sea Isle City, New Jersey, from 08-15 December 2008.

Altitudinal Band (ft)	TCC	CAC
1900-1949	0	0
1950-1999	0	0
2000-2049	3	3
Total	**243**	**1431**

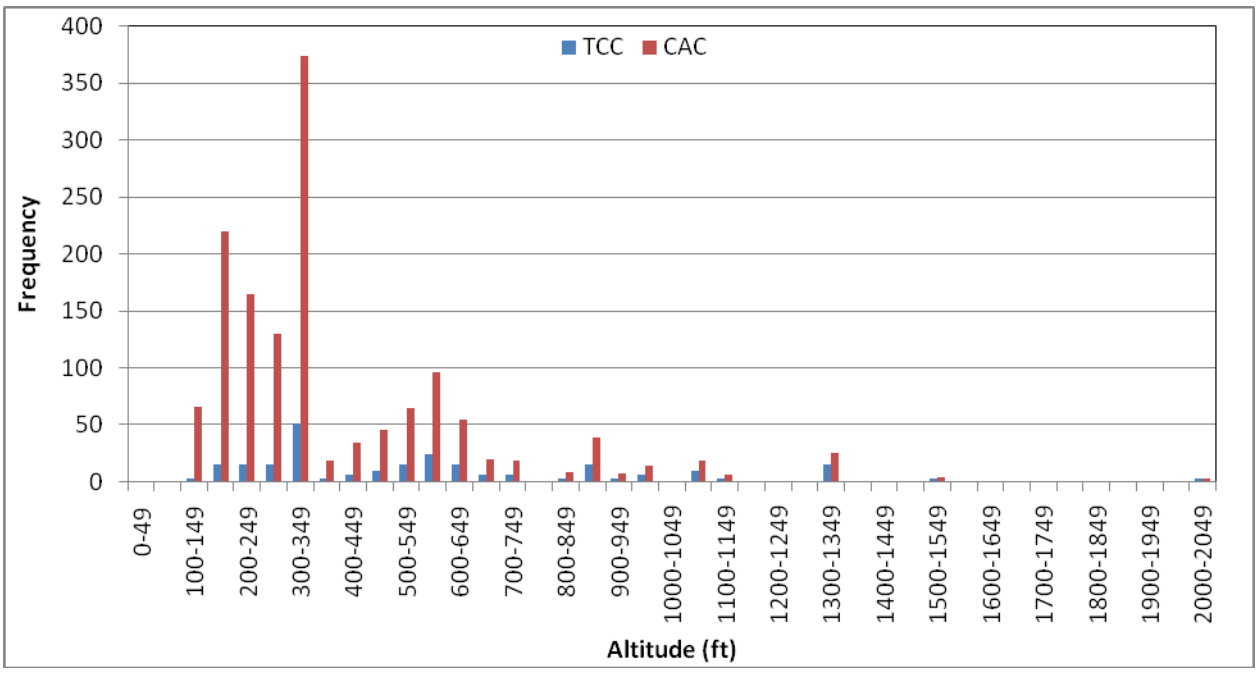


Figure 6-14. Altitudinal distribution of birds (TCC and CAC) aloft over Sea Isle City, New Jersey, from 08-15 December 2008.

6.4.1.3 Flight Direction

The directional tendencies of birds over SIC, New Jersey, are given in **Table 6-26** and illustrated in **Figure 6-15**. The mean direction for movements over SIC was towards the SSW (189.19°). The site showed some variability in the mean direction as illustrated by the length of the mean vector (0.62) and circular SD (56.42°).

6.4.2 Spring 2009

6.4.2.1 Target Identification

Data over IBSP, New Jersey, were collected from 21 – 22 and 27 March 2009 and covered the hours from 12:00 PM to 4:00 PM EDT (16:00 to 20:00 UTC). Over this time period 54 targets were identified, of which 21 targets were identified as birds (39%) and 33 as insects (**Table 6-27**), suggesting that little, if any, bird migration occurred over this period of time. The maximum total targets identified for an hour (42 total targets) occurred from 1:00 PM to 2:00 PM EDT (17:00 to 18:00 UTC), when 18 targets were identified as birds and 24 as insects. There were no foraging bats identified during sampling over IBSP.

Table 6-26. Statistical analysis of direction of nightly migrations over Sea Isle City, New Jersey, during fall 2008.

	Sea Isle City
Number of Observations	1402
Mean Vector (μ)	189.19°
Length of Mean Vector (r)	0.62
Median	180°
Concentration	1.58
Circular Variance	0.38
Circular Standard Deviation	56.42°
Standard Error of Mean	1.55°
Rayleigh Test (Z)	531.74
Rayleigh Test (p)	<1E-12
Rao's Spacing Test (U)	352.55
Rao's Spacing Test (p)	<0.01

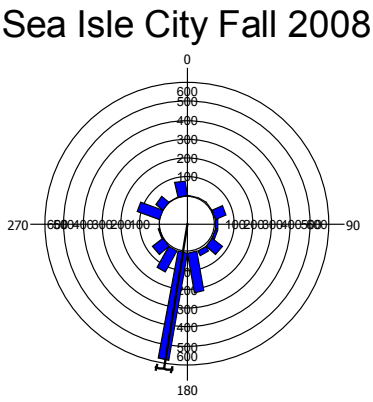


Figure 6-15. Circular diagram showing the direction of bird movements through the TI-VPR field of view over Sea Isle City, New Jersey, for fall 2008. The dark line is the mean angle and the arc at the end shows the 95% confidence limits of the mean.

Table 6-27. Numbers (TCC) of birds, insects, and foraging bats observed in TI-VPR samples over Island Beach State Park, New Jersey, from 21-22 and 27 March 2009.

Hrs (EDT)[1]	Birds	Insects	Foraging Bats	Total Targets	% Birds
12:00 PM	0	0	0	0	0
1:00 PM	18	24	0	42	43
2:00 PM	0	3	0	3	0
3:00 PM	3	6	0	9	33
Total	**21**	**33**	**0**	**54**	**39**

[1] Eastern Daylight Time, add 4 hours for UTC.

6.4.2.2 Altitudinal Distribution

Over IBSP, New Jersey, in spring 2009, the TCC of birds in each altitudinal band showed that 100% (21 birds) were at altitudes above the RSZ (**Table 6-28** and **Figure 6-16**). There were no birds detected below 30 m (100 ft). Occasionally, detections appeared in the VPR and not in the TI and these may represent insects too high to be detected by the TI but reflective enough to generate an echo on the VPR. The CAC showed the same distribution found in the TCCs, with all birds (32 total) at altitudes above the RSZ from 213 to 640 m (700 to 2,099 ft).

Table 6-28. Numbers of birds (TCC and CAC) within 50-ft (15-m) altitudinal bands for TI-VPR samples over Sea Isle City, New Jersey, from 21-22 and 27 March 2009.

Altitudinal Band (ft)	TCC	CAC
0-49	0	0
50-99	0	0
100-149	0	0
150-199	0	0
200-249	0	0
250-299	0	0
300-349	0	0
350-399	0	0
400-449	0	0
450-499	0	0
500-549	0	0
550-599	0	0
600-649	0	0
650-699	0	0
700-749	0	0
750-799	0	0
800-849	0	0
850-899	0	0
900-949	0	0
950-999	0	0
1000-1049	0	0
1050-1099	0	0
1100-1149	0	0
1150-1199	3	6
1200-1249	3	6
1250-1299	0	0
1300-1349	0	0
1350-1399	0	0
1400-1449	3	5
1450-1499	0	0
1500-1549	3	4
1550-1599	0	0
1600-1649	0	0
1650-1699	3	4
1700-1749	0	0
1750-1799	3	4
1800-1849	0	0
1850-1899	0	0
1900-1949	0	0

Table 6-28 (*continued*). Numbers of birds (TCC and CAC) within 50-ft (15-m) altitudinal bands for TI-VPR samples over Sea Isle City, New Jersey, from 21-22 and 27 March 2009.

Altitudinal Band (ft)	TCC	CAC
1950-1999	0	0
2000-2049	0	0
2050-2099	3	3
Total	**21**	**32**

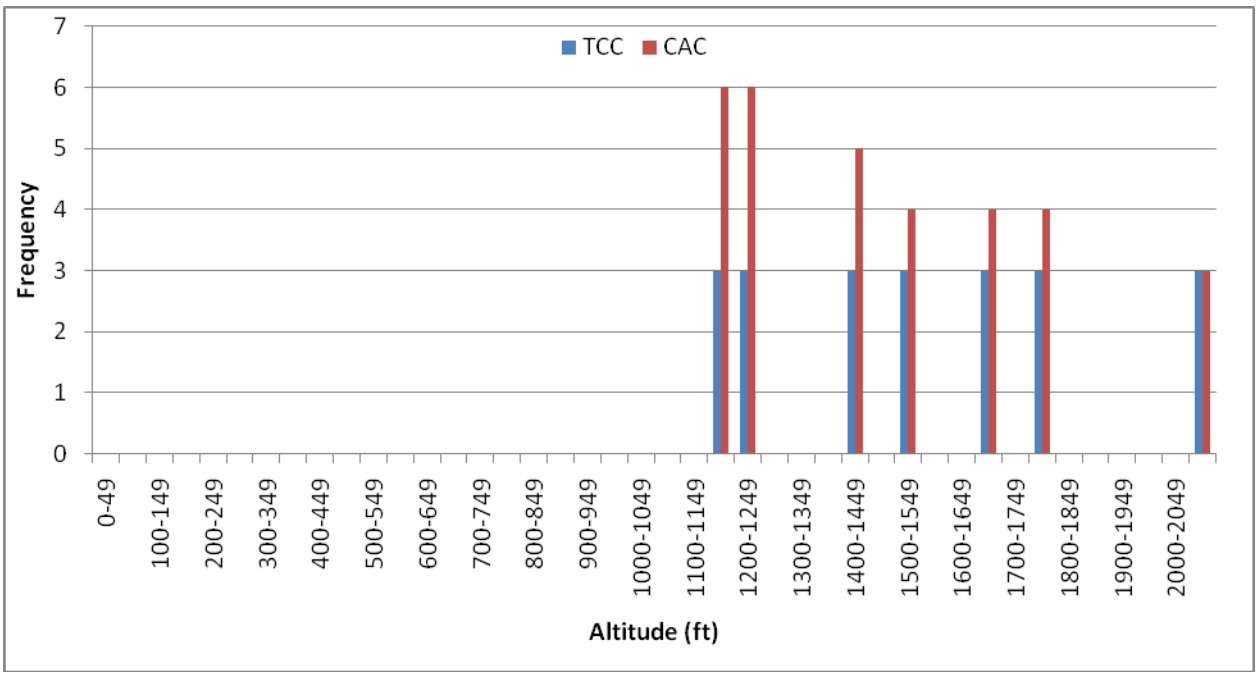


Figure 6-16. Altitudinal distribution of birds (TCC and CAC) aloft over Island Beach State Park, New Jersey, from 21-22 and 27 March 2009.

6.4.2.3 Flight Direction

The directional tendencies of birds over IBSP, New Jersey, are given in **Table 6-29** and illustrated in **Figure 6-17**. The mean direction for movement over IBSP was towards the NE (41.14°). This site showed little variability in the mean direction as illustrated by the length of the mean vector (0.77) and circular SD (41.60°).

6.4.3 Fall 2009

6.4.3.1 Target Identification

Data over IBSP, New Jersey, were collected on the night of 19 September 2009 and covered the hours from 7:00 PM to 11:00 PM EDT (23:00 to 03:00 UTC). Over this time period 219 total targets were identified, of which 144 targets were identified as birds (66%), 69 as insects, and six as foraging bats (**Table 6-30**). This suggests some bird migration occurred on this evening, though the numbers suggest a weak movement. The maximum total targets identified for an hour (93 total targets) occurred from 9:00 to 10:00 PM EDT (01:00 to 02:00 UTC), when 66 targets were identified as birds and 27 as insects.

Table 6-29. Statistical analysis of direction of nightly migrations over Island Beach State Park, New Jersey, during spring 2009.

	Island Beach State Park
Number of Observations	32
Mean Vector (μ)	41.14°
Length of Mean Vector (r)	0.77
Median	30°
Concentration	2.52
Circular Variance	0.23
Circular Standard Deviation	41.60°
Standard Error of Mean	7.27°
Rayleigh Test (Z)	18.89
Rayleigh Test (p)	5.10E-09
Rao's Spacing Test (U)	292.5
Rao's Spacing Test (p)	<0.01

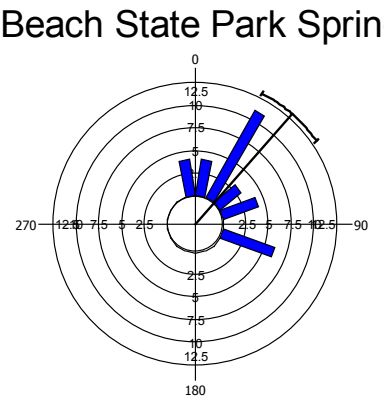


Figure 6-17. Circular diagram showing the direction of bird movements through the TI-VPR field of view over Island Beach State Park, New Jersey, for spring 2009. The dark line is the mean angle and the arc at the end shows the 95% confidence limits of the mean.

Data over BB, New Jersey, were collected on the night of 20 October 2009 and covered the hours from 8:00 PM to 10:00 PM EDT (00:00 to 02:00 UTC). Over this time period 138 total targets were identified, of which 39 targets were identified as birds (28%) and 99 as insects (**Table 6-31**). These data, though limited, suggest that little, if any, migration occurred during these times. The maximum total targets identified for an hour (111 total targets) occurred from 9:00 PM to 10:00 PM (01:00 to 02:00 UTC; 111 total targets), when 24 targets were identified as birds and 87 as insects. There were no foraging bats identified during sampling over BB.

Data over SIC, New Jersey, were collected on 03, 06, and 08 November 2009 and covered the hours from 3:00 PM to 10:00 PM EST (20:00 to 03:00 UTC). Over this time period 1,133 total targets were identified, of which 738 targets were identified as birds (65%) and 395 as insects (**Table 6-32**), suggesting some migration had taken place during these sample times. The maximum total targets identified for an hour (333 total targets) occurred from 8:00 PM to 9:00 PM EST (01:00 to 02:00 UTC),

when 270 targets were identified as birds and 63 as insects. There were no foraging bats identified during sampling over SIC.

Table 6-30. Numbers (TCC) of birds, insects, and foraging bats observed in TI-VPR samples over Island Beach State Park, New Jersey, on 19 September 2009.

Hrs (EDT)[1]	Birds	Insects	Foraging Bats	Total Targets	% Birds
7:00 PM	9	24	3	36	25
8:00 PM	45	15	3	63	71
9:00 PM	66	27	0	93	71
10:00 PM	24	3	0	27	89
Total	**144**	**69**	**6**	**219**	**66**

[1] Eastern Daylight Time, add 4 hours for UTC.

Table 6-31. Numbers (time corrected count; TCC) of birds, insects, and foraging bats observed in TI-VPR samples over Brigantine Beach, New Jersey, on 20 October 2009.

Hrs (EDT)[1]	Birds	Insects	Foraging Bats	Total Targets	% Birds
8:00 PM	15	12	0	27	56
9:00 PM	24	87	0	111	22
Total	**39**	**99**	**0**	**138**	**28**

[1] Eastern Daylight Time, add 4 hours for UTC.

Table 6-32. Numbers (time corrected count; TCC) of birds, insects, and foraging bats observed in TI-VPR samples over Sea Isle City, New Jersey, on 03, 06, and 08 November 2009.

Hrs (EST)[1]	Birds	Insects	Foraging Bats	Total Targets	% Birds
3:00 PM	9	81	0	90	10
4:00 PM	6	53	0	59	10
5:00 PM	9	12	0	21	43
6:00 PM	132	102	0	234	56
7:00 PM	183	84	0	267	69
8:00 PM	270	63	0	333	81
9:00 PM	129	0	0	129	100
Total	**738**	**395**	**0**	**1133**	**65**

[1] Eastern Standard Time, add 5 hours for UTC.

6.4.3.2 Altitudinal Distribution

Over IBSP, New Jersey, in fall 2009, the TCC of birds in each altitudinal band showed that 53% (72 of 135 birds) were at altitudes above the RSZ and 47% (63 of 135 birds) were within the RSZ (**Table 6-33** and **Figure 6-18**). There were no birds detected below 30 m (100 ft). As seen at other sites there were detections that appeared in the VPR and not in the TI which may represent insects too high to be detected by the TI but reflective enough to generate an echo on the VPR. The CAC showed a change in altitudinal distribution from the TCCs, with 153 birds from 213 to 670 m (700 to 2,199 ft) and 385 birds within the RSZ (28% above the RSZ and 72% within the RSZ).

Table 6-33. Numbers of birds (TCC and CAC) within 50-ft (15-m) altitudinal bands for TI-VPR samples over Island Beach State Park, New Jersey, on 19 September 2009.

Altitudinal Band (ft)	TCC	CAC
0-49	0	0
50-99	0	0
100-149	0	0
150-199	3	44
200-249	3	33
250-299	3	26
300-349	15	110
350-399	6	38
400-449	0	0
450-499	3	15
500-549	12	53
550-599	6	24
600-649	6	22
650-699	6	20
700-749	0	0
750-799	3	9
800-849	6	17
850-899	15	39
900-949	0	0
950-999	12	28
1000-1049	3	7
1050-1099	3	6
1100-1149	6	12
1150-1199	0	0
1200-1249	9	17
1250-1299	0	0
1300-1349	0	0
1350-1399	0	0
1400-1449	0	0
1450-1499	0	0
1500-1549	0	0
1550-1599	3	4
1600-1649	0	0
1650-1699	0	0
1700-1749	3	4
1750-1799	0	0
1800-1849	0	0
1850-1899	3	4
1900-1949	0	0
1950-1999	0	0
2000-2049	3	3
2050-2099	0	0
2100-2149	0	0
2150-2199	3	3
Total	**135**	**538**

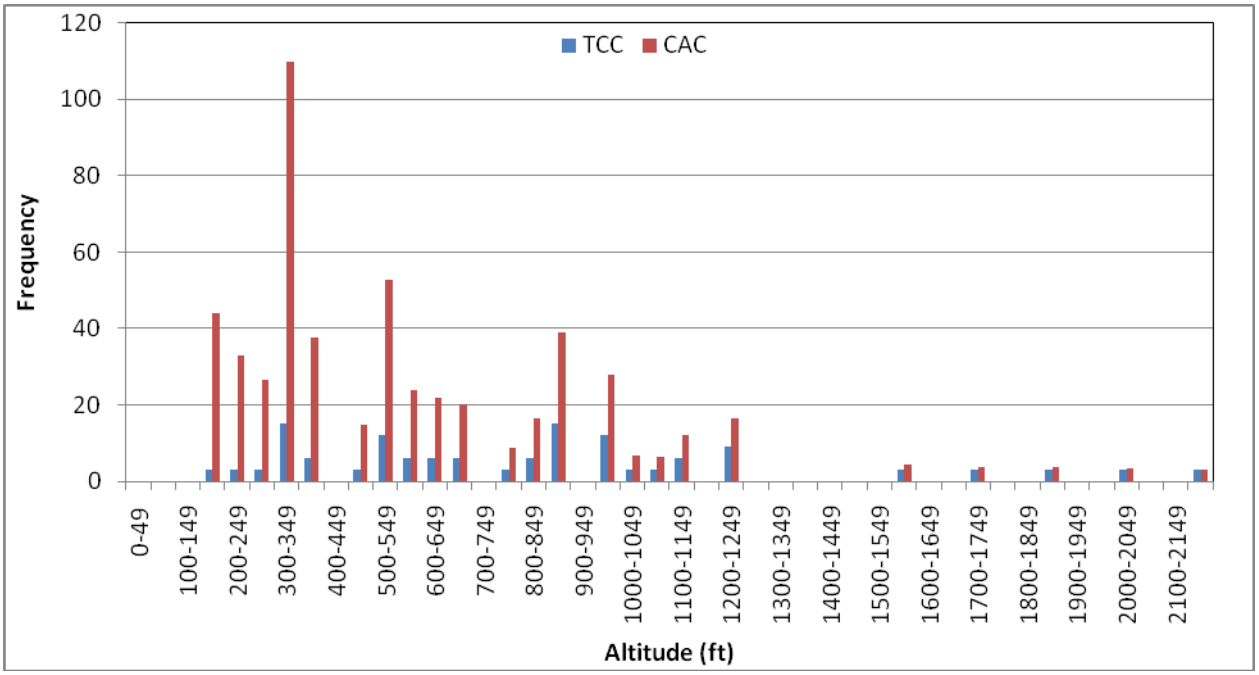


Figure 6-18. Altitudinal distribution of birds (TCC and CAC) aloft over Island Beach State Park, New Jersey, on 19 September 2009.

The TCC for birds in each altitudinal band over BB, New Jersey, showed that 75% (27 of 36 birds) were above the RSZ and 25% (nine of 36 birds) were within the RSZ (**Table 6-34** and **Figure 6-19**). Once again no birds were detected below 30 m (100 ft). The CAC showed a change in altitudinal distribution from the TCCs, with 58 birds from 213 to 503 m (700 to 1,649 ft) and 58 birds within the RSZ (50% above the RSZ and 50% within the RSZ).

The TCC for birds in each altitudinal band over SIC, New Jersey, showed that 73% (492 of 675 birds) were above the RSZ and 27% (183 of 675 birds) were within the RSZ (**Table 6-35** and **Figure 6-20**). Once again no birds were detected below 30 m (100 ft). The CAC showed a change in altitudinal distribution from the TCCs, with 926 birds from 213 to 685 m (700 to 2,249 ft) and 1,178 birds within the RSZ (44% above the RSZ and 56% within the RSZ).

Table 6-34. Numbers of birds (TCC and CAC) within 50-ft (15-m) altitudinal bands for TI-VPR samples over Brigantine Beach, New Jersey, on 20 October 2009.

Altitudinal Band (ft)	TCC	CAC
0-49	0	0
50-99	0	0
100-149	0	0
150-199	0	0
200-249	0	0
250-299	0	0
300-349	3	22
350-399	3	19
400-449	3	17
450-499	0	0
500-549	0	0

Table 6-34 (*continued*). Numbers of birds (TCC and CAC) within 50-ft (15-m) altitudinal bands for TI-VPR samples over Brigantine Beach, New Jersey, on 20 October 2009.

Altitudinal Band (ft)	TCC	CAC
550-599	0	0
600-649	0	0
650-699	0	0
700-749	0	0
750-799	0	0
800-849	3	8
850-899	3	8
900-949	3	7
950-999	6	14
1000-1049	0	0
1050-1099	3	6
1100-1149	0	0
1150-1199	3	6
1200-1249	0	0
1250-1299	0	0
1300-1349	0	0
1350-1399	0	0
1400-1449	0	0
1450-1499	3	5
1500-1549	0	0
1550-1599	0	0
1600-1649	3	4
Total	**36**	**116**

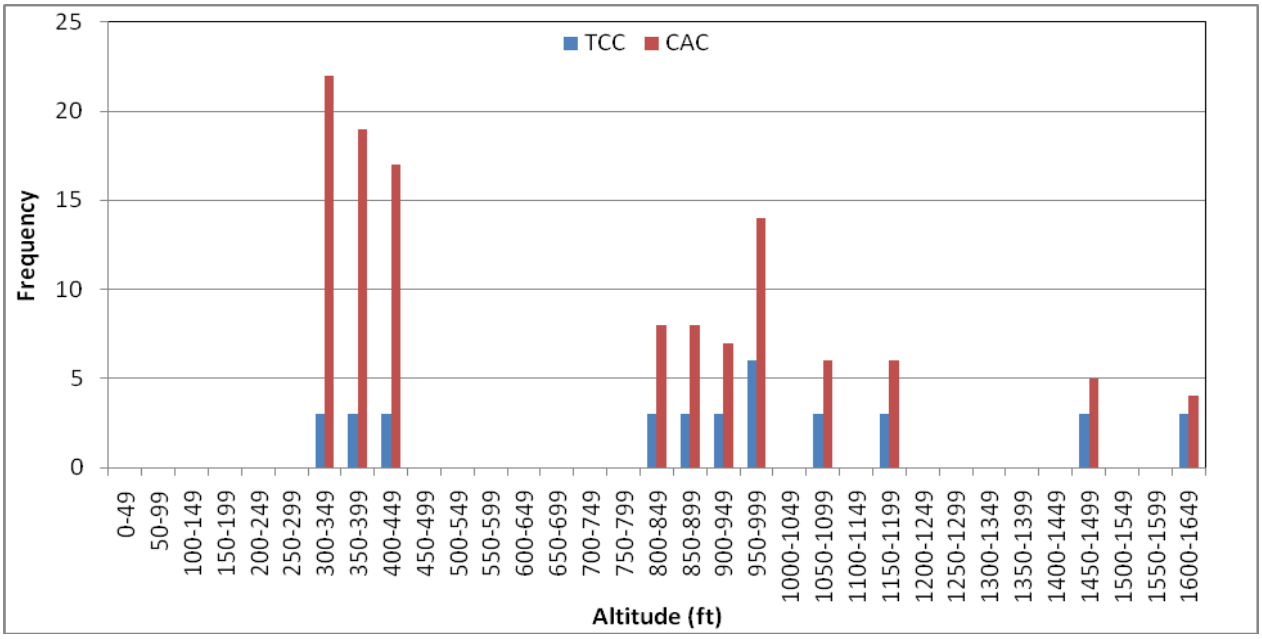


Figure 6-19. Altitudinal distribution of birds (TCC and CAC) aloft over Brigantine Beach, New Jersey, on 20 October 2009.

Table 6-35. Numbers of birds (TCC and CAC) within 50-ft (15-m) altitudinal bands for TI-VPR samples over Sea Isle City, New Jersey, on 03, 06, and 08 November 2009.

Altitudinal Band (ft)	TCC	CAC
0-49	0	0
50-99	0	0
100-149	0	0
150-199	3	44
200-249	15	165
250-299	39	341
300-349	27	198
350-399	21	133
400-449	0	0
450-499	9	44
500-549	9	39
550-599	12	48
600-649	18	66
650-699	30	100
700-749	24	73
750-799	27	81
800-849	21	56
850-899	18	48
900-949	36	94
950-999	18	42
1000-1049	3	7
1050-1099	15	30
1100-1149	12	24
1150-1199	21	42
1200-1249	27	53
1250-1299	21	35
1300-1349	12	20
1350-1399	27	45
1400-1449	18	30
1450-1499	24	40
1500-1549	15	20
1550-1599	12	16
1600-1649	12	16
1650-1699	15	20
1700-1749	21	28
1750-1799	18	24
1800-1849	15	20
1850-1899	6	8
1900-1949	15	15
1950-1999	3	3
2000-2049	9	9
2050-2099	3	3
2100-2149	15	15
2150-2199	0	0
2200-2249	9	9
Total	**675**	**2104**

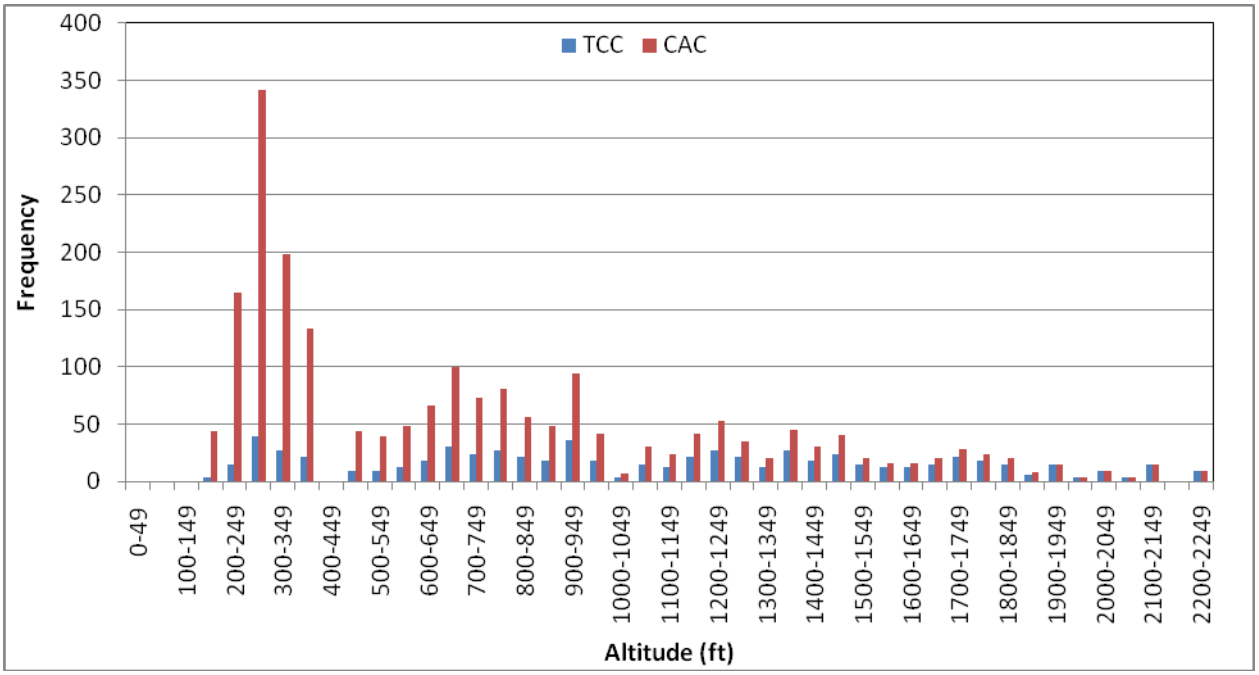


Figure 6-20. Altitudinal distribution of birds (TCC and CAC) aloft over Sea Isle City, New Jersey, on 03, 06, and 08 November 2009.

6.4.3.3 Flight Direction

The directional tendencies of birds over IBSP, BB, and SIC, New Jersey, are given in **Table 6-36** and illustrated in **Figure 6-21**. The mean directions for the movements over these onshore sites ranged from SW to SE (240.50°, 164.84°, and 196.53°, respectively). These sites showed some variability in the mean directions as illustrated by the length of the mean vectors (0.10, 0.24, and 0.63, respectively) and circular SD (124.15°, 96.82°, and 55.01°, respectively), with the most variability being shown at IBSP.

Table 6-36. Statistical analysis of direction of nightly migrations over Island Beach State Park, Brigantine Beach, and Sea Isle City, New Jersey, during fall 2009.

	Island Beach State Park	Brigantine Beach	Sea Isle City
Number of Observations	524	119	2,152
Mean Vector (μ)	240.50°	164.84°	196.53°
Length of Mean Vector (r)	0.10	0.24	0.63
Median	250°	175°	205°
Concentration	0.19	0.49	1.64
Circular Variance	0.90	0.76	0.37
Circular Standard Deviation	124.15°	96.82°	55.01°
Standard Error of Mean	18.47°	15.26°	1.21°
Rayleigh Test (Z)	4.79	6.85	855.98
Rayleigh Test (p)	0.01	0.00	<1E-12
Rao's Spacing Test (U)	344.89	323.70	354.31
Rao's Spacing Test (p)	<0.01	<0.01	<0.01

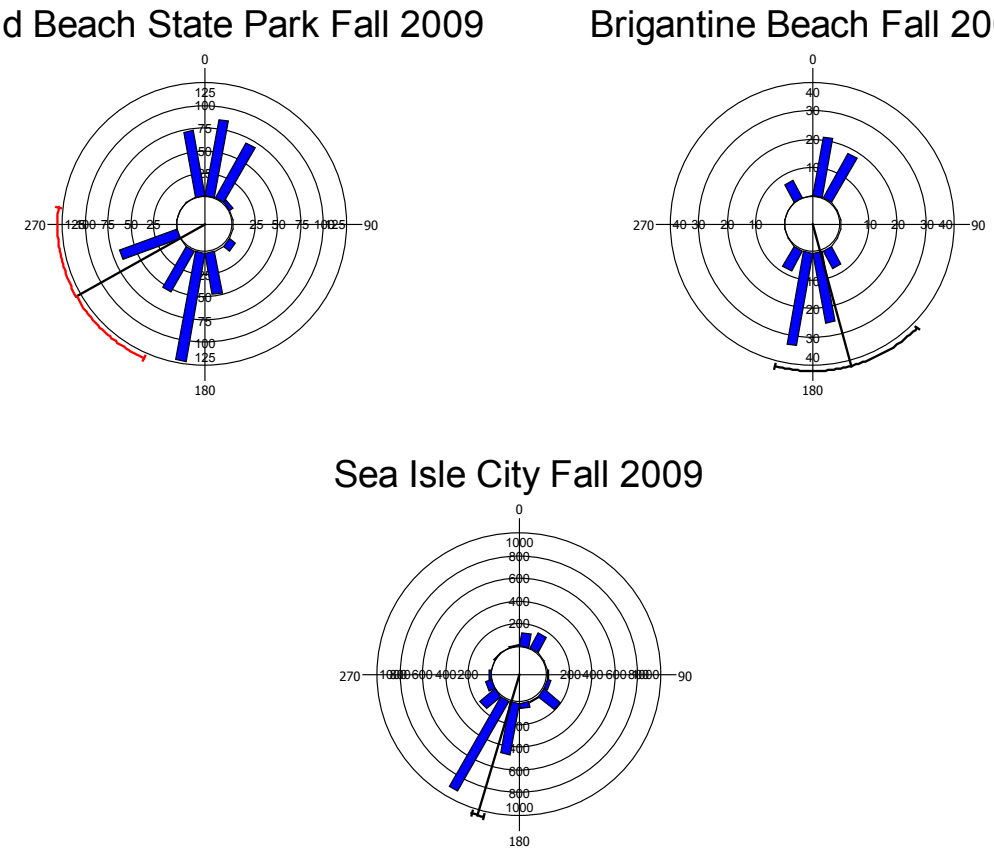


Figure 6-21. Circular diagrams showing the direction of bird movements through the TI-VPR field of view over Island Beach State Park, Brigantine Beach and Sea Isle City for fall 2009. The dark line is the mean angle and the arc at the end shows the 95% confidence limits of the mean.

7.0 NEXRAD

There is widespread interest in the environmental impacts of wind development on wildlife in general and migratory birds and bats in particular (GAO Report 2005). To assess the risk of a proposed wind project on wildlife, preconstruction studies are needed. The results of the studies provide an information base for the preparation of formal risk assessments that are considered before final approval is given for project construction.

In the case of migratory birds, the avian risk assessment requires information on the changing densities of migrants in the atmosphere from hour-to-hour, day-to-day, and year-to-year (temporal patterns) and the altitudinal and geographical distribution of the migrants relative to the project and surrounding areas (spatial patterns). Although marine radar can be used in pre-construction studies of bird movements through a project area (e.g., Mabee et al. 2006), the spatial coverage is limited to a range of 1-6 NM from the radar depending on the power of the marine radar. In order to gather migration data at greater ranges (out to 100 NM or 185.2 km), larger surveillance radars must be used.

In the U.S., one can use Doppler weather surveillance radar (WSR-88D) to detect, quantify, and monitor biological targets in the atmosphere (e.g., bird migration [Gauthreaux and Belser 1998, 1999; Gauthreaux et al. 2000; Gauthreaux and Belser 2003; Diehl and Larkin 2005], bird roosts [Russel and Gauthreaux 1998; Russell et al. 1998], bat colonies [McCracken 1996; McCracken and Westbrook 2002; Horn and Kunz 2008], and concentrations of insects aloft [Westbrook and Wolf 1998]). Although the lowest tilt of the 1°-beam of the WSR-88D is 0.5° above the horizontal, and the base of the beam is too high to detect low flying targets over most of the radar's surveillance sweep, the radar can be used to obtain information on the temporal and geographical aspects of bird migration because most bird migration occurs at altitudes higher than 250 m (820 ft) above ground level (Nisbet 1963; Able 1970; Bellrose 1971). If one documents the variability in the quantity of migration over a project area for several years and couples this information with the occurrence of weather conditions that cause migrants to fly at low altitudes, one can estimate the number of occasions per season when collision events could theoretically occur. This is valuable information for the comprehensive avian risk assessment.

The following report presents the results of a baseline study that examines nocturnal bird migration patterns over coastal and offshore New Jersey and is intended to assist the NJDEP in the assessment of the risks that offshore wind development poses to migratory birds.

7.1 EQUIPMENT AND METHODS

7.1.1 WSR-88D

The WSR-88D, also referred to as NEXRAD during the planning and development stages, is the backbone of the national network of weather radars in the U.S. operated by National Weather Service (NWS) in the National Oceanic and Atmospheric Administration (NOAA) of the Department of Commerce, the Department of Defense (units at military bases), and non-CONUS Department of Transportation Areas. There are 155 WSR-88D radars in the nation, including the U.S. Territory of Guam and the Commonwealth of Puerto Rico. Components and operational details of the radar system can be found in Crum and Alberty (1993), Crum et al. (1993) and Klazura and Imy (1993). Additional characteristics of the WSR-88D can be found in **Appendix L-1**.

7.1.2 Methods

For this study archived WSR-88D data from the KDIX station (**Figure 7-1**) were analyzed to characterize the migration patterns of birds over the coastal region of New Jersey during the spring (15 March to 31 May 2005-2009, 390 nights) and fall (15 August to 15 November 2005-2009, 465 nights) migration periods. This station provides exceptional coverage of the sample areas in this study (**Figure 7-2**). For our analysis we used the WSR-88D radar data archive at the National Climatic Data Center (NCDC) in Asheville, North Carolina. The WSR-88D radar data archive at NCDC has Level-II data from 26 April 1995

to present. We analyzed Level-II data from the NCDC archive at 0.5° antenna elevation angle for this study.

We used the following protocol during our analysis: We first established six sample areas along the coastal and offshore region of New Jersey (**Figure 7-3**). The three coastal areas were chosen to cover the three coastal MARS® surveillance areas located at IBSP, BB, and SIC, New Jersey (areas 1A, 2A, and 3A, respectively, lettered N to S respectively). The three offshore sample areas (1B, 2B, and 3B, lettered N to S respectively) were created approximately 13 to 15 km offshore and parallel with the onshore sample areas.

WSR-88D Level II data are in radial raster (1 km x 1° for base reflectivity data and 0.25 km x 1° for radial velocity data). Thus the reflectivity data array consists of 360 radials with each radial having 240 one-kilometer bins. In the fall of 2008 the NWS upgraded the existing NEXRAD stations and increased the resolution of the base reflectivity and radial velocity to 0.25 km x 0.5° resulting in an array consisting of 720 radials with each having 960 0.25-km bins. Matching (same volume scan) base reflectivity and base velocity data were downloaded from the NCDC archives for the evening hours of every 24-hr period during spring and fall migration (15 April through 31 May and 15 August through 15 November). Base reflectivity data files provide information on the density of targets in the atmosphere, and base velocity data files contain information on radial velocity of targets and direction of movement. We first examined the base reflectivity and velocity files for each night and eliminated those with precipitation in the sample area or with other issues such as excessive strobes and anomalous propagation of the radar beam. All information was recorded in a spreadsheet (Excel, Microsoft 2007) with a row for each evening.

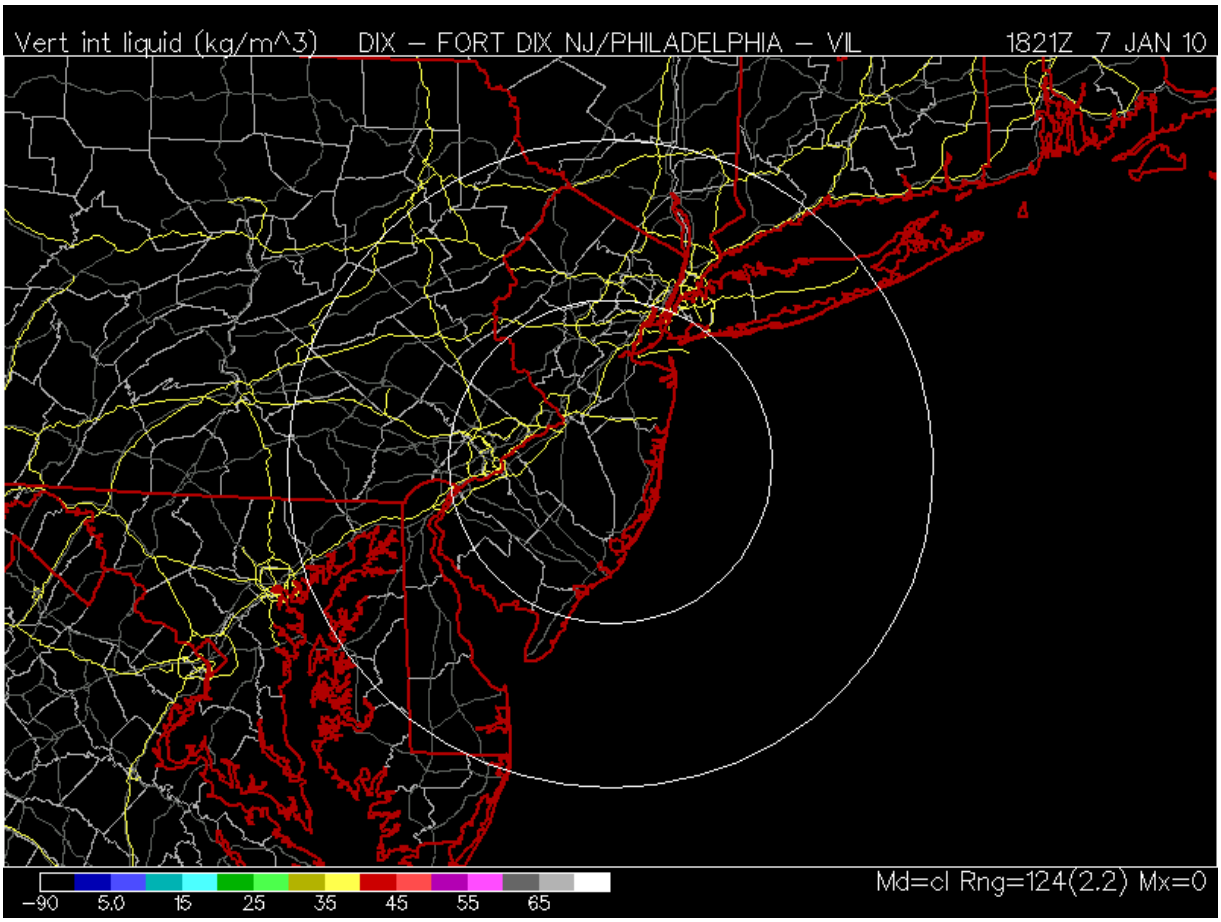


Figure 7-1. Surveillance area of WSR-88D radar at KDIX. The inner range mark is 50 NM and the outer range mark is 100 NM.

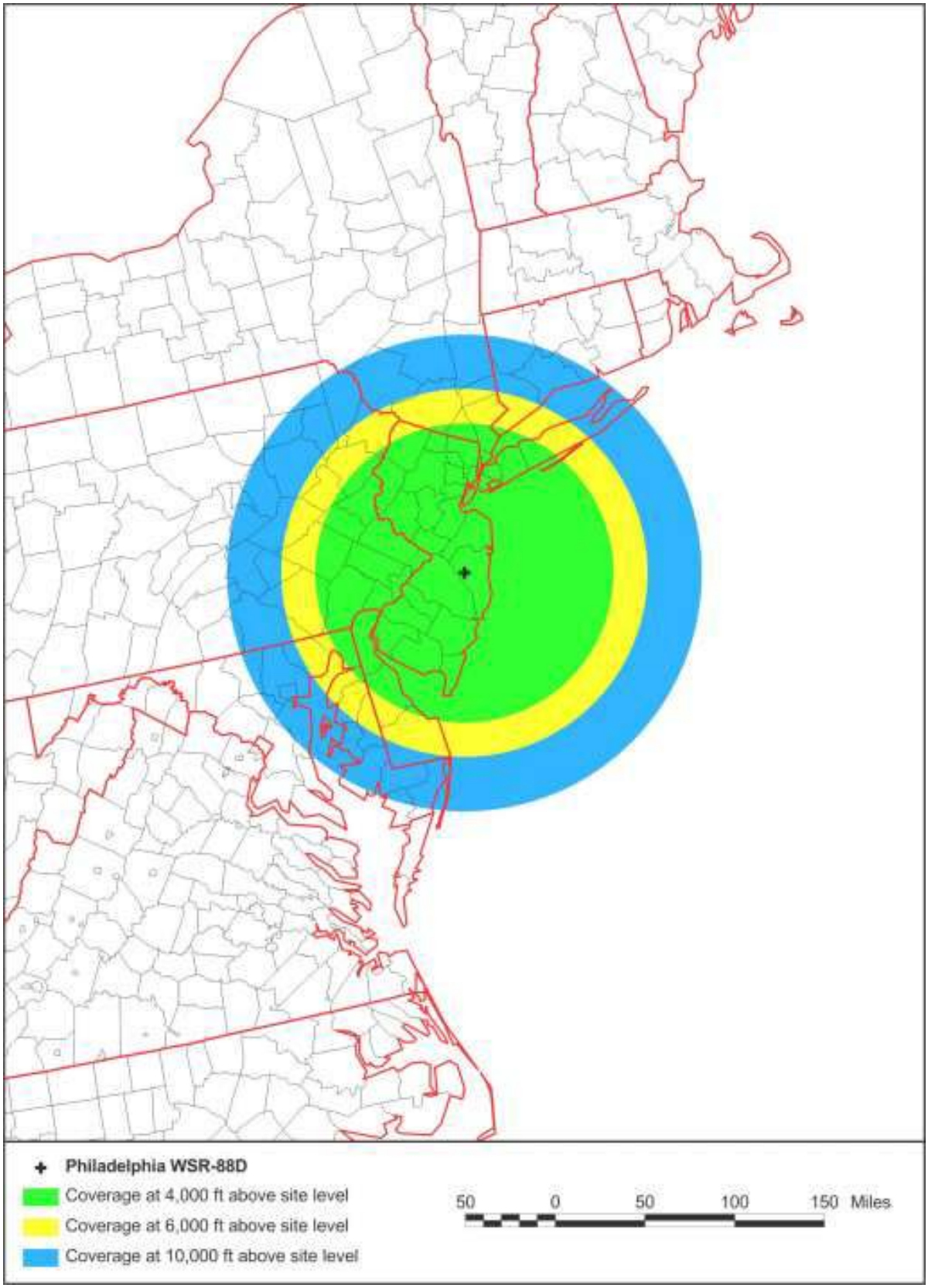


Figure 7-2. Coverage pattern of the WSR-88D at Fort Dix, New Jersey. The radar antenna is 70 m (230 ft) above sea level (ASL) and the coverage pattern is above radar antenna level (arl).

Figure 7-3. Sample areas along coastal and offshore New Jersey. The Fort Dix, New Jersey WSR-88D station (KDIX) is illustrated with a "+" sign. Onshore sample areas are 1A, 2A, and 3A (N to S respectively) and offshore sample areas are 1B, 2B, and 3B (N to S respectively).

We examined the series of saved base reflectivity and base velocity files without precipitation in the sample area for each evening and selected the files that showed peak density and eliminated those with excessive insect contamination and other aerial reflectors (e.g., smoke and dust particles). The latter was accomplished by comparing winds aloft with the mean speeds of targets in the base velocity images (Gauthreaux et al. 2008). Because no winds aloft data are taken at Fort Dix, New Jersey, archived winds aloft data measured at Upton, New York (KOKX) were obtained from the Department of Atmospheric Science at the University of Wyoming site. This dataset contains Radiosonde observations (RAOB) of upper-air conditions (e.g., winds aloft) for all stations in the U.S. and is available from 1973 to present. The observations are made near the beginning (00:00 UTC) and the end of the night (12:00 UTC). We saved text files and converted them into Excel spreadsheet files containing date, time (UTC), altitude (m), wind speed (m/s), and wind direction (from).

If the maximum mean radial velocity of the targets was within 5 m/s (18 kph) of the velocity of following winds aloft, the associated base reflectivity file was eliminated from additional analysis because of the likelihood of insect contamination. Likewise, if winds aloft were calm and the base velocity file showed no mean radial velocities in keeping with velocities of songbirds (32.4 to 54 kph; 17.5 to 29.2 kts; Bruderer and Boldt 2001), the associated base reflectivity file was eliminated. If the maximum mean radial velocity of the targets was in keeping with birds and the direction of flight was not in the direction of the winds aloft, the base reflectivity file was saved for further analysis. Remaining mean base velocity information of at least 5 m/s above wind speed was used to determine the direction of flight and to determine the relative reflectivity values (decibels of reflectivity [dBZ]) in associated relative reflectivity pixels (1° x 1 km [pre-fall 2008]) and 0.5° x 0.25 km [fall 2008 and spring 2009] pulse volumes or resolution cells). By taking this conservative approach we were able to measure the difference between the maximum relative reflectivity in a reflectivity file and the maximum relative reflectivity of the pixels that had velocities in keeping with bird flight speeds. The former is generally greater than the latter, but in some cases the two measures are the same. The greater the difference in these two measures the more likely insects and other particulates

in the atmosphere are responsible for most of the relative reflectivity. Base reflectivity files with little or no reflectivity from insects or other particulates in the atmosphere were processed with an algorithm designed to measure the base reflectivity of each surviving pixel in the sample area. The base reflectivity value was converted to a Z-value and then used to compute birds per cubic kilometer (km^{-3}; Z-value multiplied by 1.84). The sample areas in this study (11 km x 11°) have 121 radial array pixels of 1° x 1 km (pre-fall 2008) and for fall 2008 and spring 2009 have 968 radial array pixels of 0.5° x 0.25 km. The azimuth and distance (range) of the coordinates of the sample areas are given in **Table 7-1**, and the altitude of the radar beam over the sample areas is given in **Table 7-2**. The conical beam of the WSR-88D is 1° in diameter and the center of the beam is tilted 0.5° and above the horizontal.

Finally, based on the results of the processing of saved reflectivity files showing peak of movement each night, we selected a subsample of nights with good movements to measure the hour-to-hour temporal pattern of nocturnal migration. Some nights with good peak reflectivity data could not be used for the hour-to-hour analysis because precipitation moved into the sample area as the night progressed.

Table 7-1. Sample area distance and azimuth from Fort Dix, New Jersey WSR-88D station (KDIX).

Area	Distance 1	Distance 2	Angle 1	Angle 2
Onshore				
1A	27	37	117	127
2A	54	64	170	180
3A	83	93	191	201
Offshore				
1B	50	60	112	122
2B	72	82	157	167
3B	92	102	175	185

Table 7-2. Altitudes sampled by the beam of the WSR-88D over the sample areas at 0.5° antenna elevation, not corrected for height of radar antenna (230 ft [70 m] AMSL).

Area	Distance (km)	Base (m)	Center (m)	Top (m)	Width (m)
1A	27	63	282	501	438
	32	84	345	616	519
	37	111	411	711	600
2A	54	222	660	1098	876
	59	261	742	1221	957
	64	306	825	1344	1038
3A	83	495	1170	1845	1347
	88	555	1268	1983	1428
	93	618	1374	2130	1509
1B	50	192	597	1002	813
	55	228	675	1122	894
	60	270	756	1242	375
2B	72	381	966	1551	1170
	77	432	1056	1680	1251
	82	486	1152	1818	1332
3B	92	606	1353	2100	1494
	97	672	1458	2244	1575
	102	738	1566	2394	1656

The data extracted from the base reflectivity files were analyzed with Excel to reveal the year-to-year, season-to-season, night-to-night and hour-to-hour patterns of variation in the amount of migration. The statistical analysis of the direction of migratory movements extracted from the base velocity files were analyzed with the software program Oriana 2 (Version 2.01, Kovach Computing Services, Anglesey, Wales).

In an effort to determine the number of nights in a season when migrants are forced to fly low and at the same heights as man-made structures such as towers and wind turbines, we related the density of migration to weather conditions that might cause birds to fly low (Avery et al. 1977; Crawford 1981). We used data from the night-to-night peak of migration analysis and obtained local climate data (LCD) for the Atlantic City International Airport (Egg Harbor City, New Jersey) from the NCDC in Asheville, North Carolina. We recorded the nights when ceiling height was 1000 ft (305 m) or lower, the sky was overcast, and if any of the following weather conditions were present: fog, mist, rain, haze, and smoke.

7.2 RESULTS AND DISCUSSION

7.2.1 Year-to-Year Pattern of Migration

The year-to-year pattern of nightly density of migratory movements derived from Level II base reflectivity files from the WSR-88D at KDIX for spring and fall can be found in **Appendix L-2**. During the spring the sum of nightly peak density (birds/km^3) differed from year-to-year (**Table 7-3**). As expected, the maximum density of migration measured over the coastal sample areas differed from the maximum density over the offshore sample areas. This can be attributed to the bird's tendency to follow the coast line during their migration. Though each of the six sample areas represent a different altitudinal zone (**see Table 7-2**) there is some overlap of altitudes sampled between sample areas and some of the onshore sample areas are sampling higher altitudes than the offshore sample areas (compare 2A vs. 1B and 3A vs. 2B in **Table 7-2**). If the migratory birds were distributed evenly throughout a specific altitudinal zone then there should be minimal differences between density measurements between sites within this zone. The data do not support this; when comparing onshore and offshore sample areas with overlapping altitudinal zones, the onshore sample area densities are much greater than the offshore sample area densities. Over the five years of spring data the sum of the nightly peak densities measured *over the coastal sample areas* ranged from 347 in the spring of 2006 (area 1A) to 2,836 in the spring of 2009 (area 1A), and the maximum density recorded was 569 in the spring of 2005 (area 1A). The sum of nightly peak densities recorded *over the offshore sample areas* ranged from 58 (area 2B) in the spring of 2008 to 264 in the spring of 2007 (area 1B), with a maximum density of 103 recorded in the spring of 2007 in area 1B. Thus during the five-year study the amount of migration in spring passing over the onshore sample areas was much higher than the amount of migration measured over the offshore sample areas.

During the fall the sum of nightly peak density also differed from year-to-year (**Table 7-4**). Over the five years of fall data the sum of the nightly peak densities *measured over the onshore sample areas* ranged from 1,445 (area 3A) in the fall of 2004 to 4,078 (area 1A) in the fall of 2005, with a maximum density of 705 recorded in the fall of 2005 (area 1A). The range of the sum of nightly peak densities *over the offshore sample areas* ranged from 273 (area 1B) in the fall of 2004 to 658 (area 2B) in the fall of 2005, with a maximum density of 144 recorded in the fall of 2005 (area 2B). The five years of fall data showed the amount of migration passing over the onshore sample areas was much higher than the amount of migration measured over the offshore sample areas. Overall, the density of migration during the fall was on average two to three times as much as the density of migration observed during the spring.

7.2.2 Night-to-Night Pattern of Migration

Data on the night-to-night pattern of nocturnal migration over the sample areas for spring (2005-2009) and fall (2004-2008) can be found in **Appendix L-2**. Nocturnal migration during the spring and fall shows considerable night-to-night variability. In the spring migration begins to build in late April, peaks near the middle of May, and then declines towards the end of May. This pattern can be seen in both the onshore and offshore sample areas (**Figures 7-4** and **7-5**, respectively). Within the three onshore areas there were five nights with a mean density of 100 birds/km^3 or greater over the sample areas during the five years of spring migration (21 April, and 01, 04, 07, 11 May), while within the offshore sample areas the

Table 7-3. Year-to-year variation in nightly peak densities (birds/km^3) for the spring migration (2005-2009) over the onshore and offshore sample areas.

Area	2005			2006			2007			2008			2009		
	Mean	Max	Sum	Mean	Max	Sum	Mean	Max	Sum	Mean	Max	Sum	Mean	Max	Sum
Onshore															
1A	22	569	1505	12	130	347	29	367	1969	28	372	1987	44	292	2836
2A	10	119	733	25	317	756	26	504	1761	18	227	1268	19	142	1243
3A	5	49	351	12	166	350	12	290	772	10	187	739	13	234	807
Offshore															
1B	2	32	129	3	52	87	4	103	264	2	31	156	3	24	216
2B	2	57	125	3	78	92	2	58	118	1	8	58	1	8	95
3B	2	32	106	5	88	145	2	56	142	1	12	70	3	29	180

Table 7-4. Year-to-year variation in nightly peak densities (birds/km^3) for the fall migration seasons (2004-2008) over onshore and offshore sample areas.

Area	2004			2005			2006			2007			2008		
	Mean	Max	Sum	Mean	Max	Sum	Mean	Max	Sum	Mean	Max	Sum	Mean	Max	Sum
Onshore															
1A	25	528	2139	53	705	4078	42	653	2651	39	392	3066	49	268	3541
2A	24	244	2108	52	361	4040	63	668	3947	45	362	3526	34	290	2459
3A	17	195	1445	27	196	2095	28	313	1793	27	331	2070	24	167	1750
Offshore															
1B	3	52	273	8	122	650	6	46	363	7	99	583	8	48	564
2B	4	31	306	9	144	658	5	42	307	6	65	437	4	44	327
3B	4	52	341	5	83	420	5	104	314	5	100	383	5	71	371

maximum was 21 on 21 April [area 1B]). Area 1A had the most nights with mean densities of 100 birds/km^3 (4; 01, 04, 07, and 11 May) with Area 2A coming in second with two nights achieving this density (21 April and 01 May), while Area 3A never surpassed the 100 birds/km^3 density, only achieving a peak value of 84 birds/km^3 on 01 May. Within the offshore sample areas the mean migration density was considerably less than that measured over the onshore areas (mean peak density of 21 birds/km^3). Though sizable flights can occur anytime from the middle of April through the middle of May, the peak of migration through the area is in early to mid-May.

Nocturnal migration during the fall also varies from night-to-night. Fall migration builds in early September and peaks in mid-October to early November. After the peak in late October/early November the density of migration declines, and by mid-November very little migratory movement takes place. This pattern can be seen within both the onshore sample areas (**Figure 7-6**) and the offshore sample areas (**Figure 7-7**). There were 17 nights with a mean density of 100 birds/km^3 or more within the onshore sample areas during the five years of fall migration (31 August, 01, 10, 13, 15, 23, 26, 29 September and 05, 12, 14, 15, 17, 20, 25 October, and 02, 09 November), while within the offshore sample areas there were no nights. Within the onshore sample areas both 1A and 2A achieved 10 nights with mean migration densities greater than 100 birds/km^3 while Area 3A only surpassed that amount on two nights. Area 1A measured the highest density for the fall season on 15 October with a mean density of 258 birds/km^3. Similar to the spring, the offshore sample area mean migration densities were considerably less than those measured within the onshore sample area. The maximum mean density only measured 34 birds/km^3 on 12 September within Area 1B.

The density of migration over coastal New Jersey appears to be similar to the densities observed with WSR-88D in other areas of the Northeastern U.S., while the density of migration offshore appears to much less. Black (2000) reported a peak density of approximately 110 birds/km^3 from analyzed WSR-88D at Buffalo, New York (although data are limited to one night). In a study cited by Diehl et al. (2003) of the relationship between bird density data collected with a small 3-cm wavelength radar around 23:00 hrs at Brock University, St. Catherine's, Ontario and the reflectivity measured with the WSR-88D at Buffalo, New York, Black reported mean bird densities between 20 April and 16 May 1999 that ranged from approximately 5 birds/km^3 to 73 birds/km^3. In a WSR-88D study of bird migration over Buffalo, New York, over five years (2002-2006) the mean density of migrants ranged from 78-154 birds/km^3 in spring and 88-119 birds/km^3 in fall (Gauthreaux 2007b). A Long Island, New York, WSR-88D study (Gauthreaux 2007a) showed the mean density of migrants ranged from 21-29 birds/km^3 in spring (2002-2006) and 26-32 birds/km^3 in fall (2001-2005). These values compare favorably with the current New Jersey study's seasonal mean densities onshore though they are greater than those found offshore.

7.2.3 Hour-To-Hour Pattern of Migration

The data showing the hour-to-hour pattern of migration over the sample areas during the spring (2005-2009) and fall (2004-2008) are in **Appendix L-3**. In spring, migration typically started 30-45 min after sunset, peaked on most evenings between 9:00 PM – 2:00 AM EST (02:00 – 06:00 UTC), and declined until sunrise (**Figures 7-8** and **7-9**). In the fall (**Figures 7-10** and **7-11**) the quantity of migration was greater than in the spring (see **Figures 7-4** to **7-7**), and the hour-to-hour pattern of percentage of peak hourly density during the evenings was shifted slightly earlier in the evening compared to that observed in spring (compare **Figures 7-8** and **7-9** to **7-10** and **7-11**). Like in the spring, migration typically started 30-45 min after sunset and the peak of a nightly movement generally occurred from 8:00 PM – 12:00 AM EST (01:00 – 05:00 UTC). The hour-to-hour temporal patterns of migration found in this study are similar to those found in other studies (Black 2000; Farnsworth et al 2004; Gauthreaux et al. 2005; Gauthreaux et al. 2007).

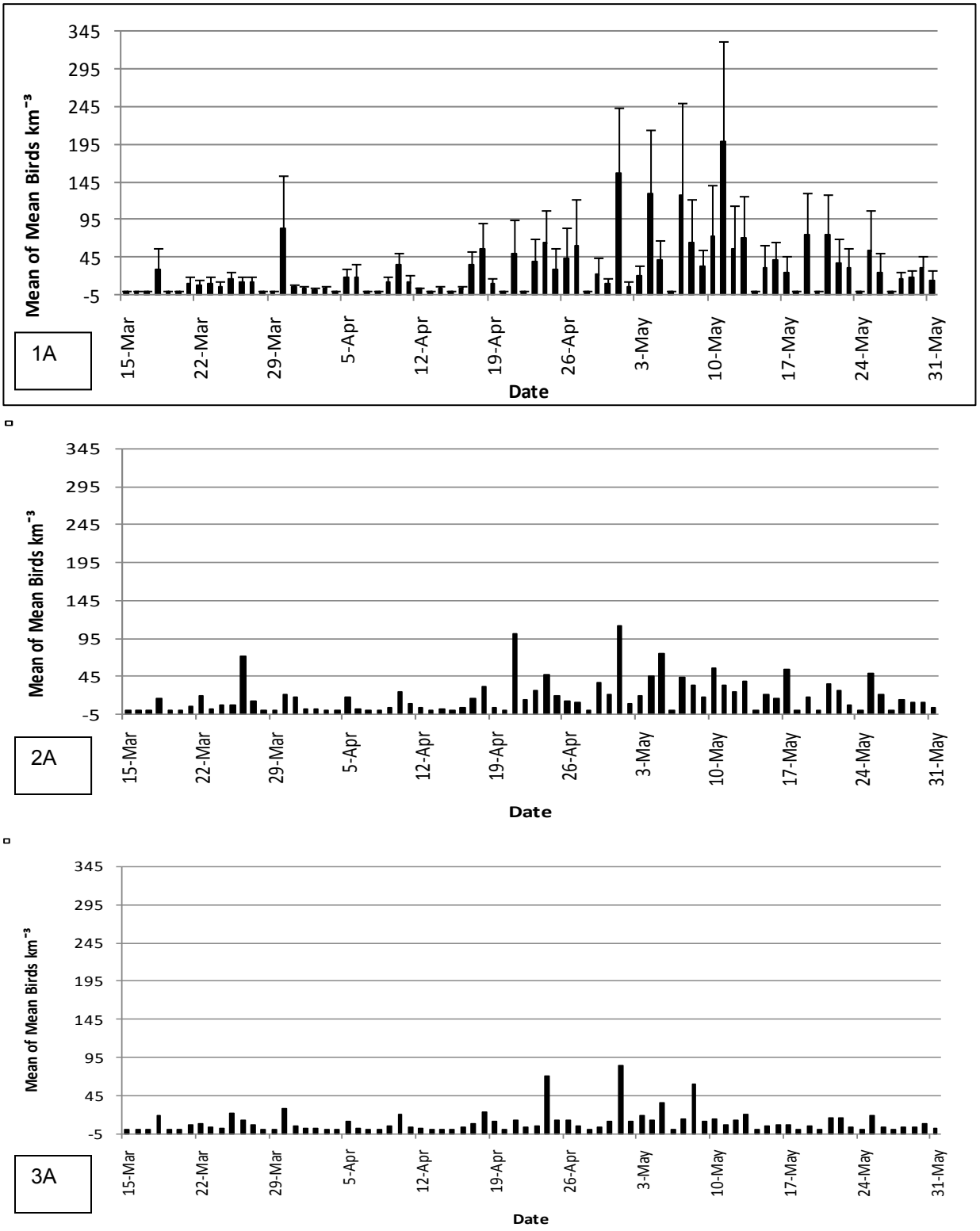


Figure 7-4. Night-to-night variation in the in the amount of nocturnal bird migration during the spring (2005-2009) over the onshore sample areas (1A, 2A, and 3A). The bars represent the mean number of birds/km^3 for that date over the five years of sample. The standard error of the mean is indicated for each mean.

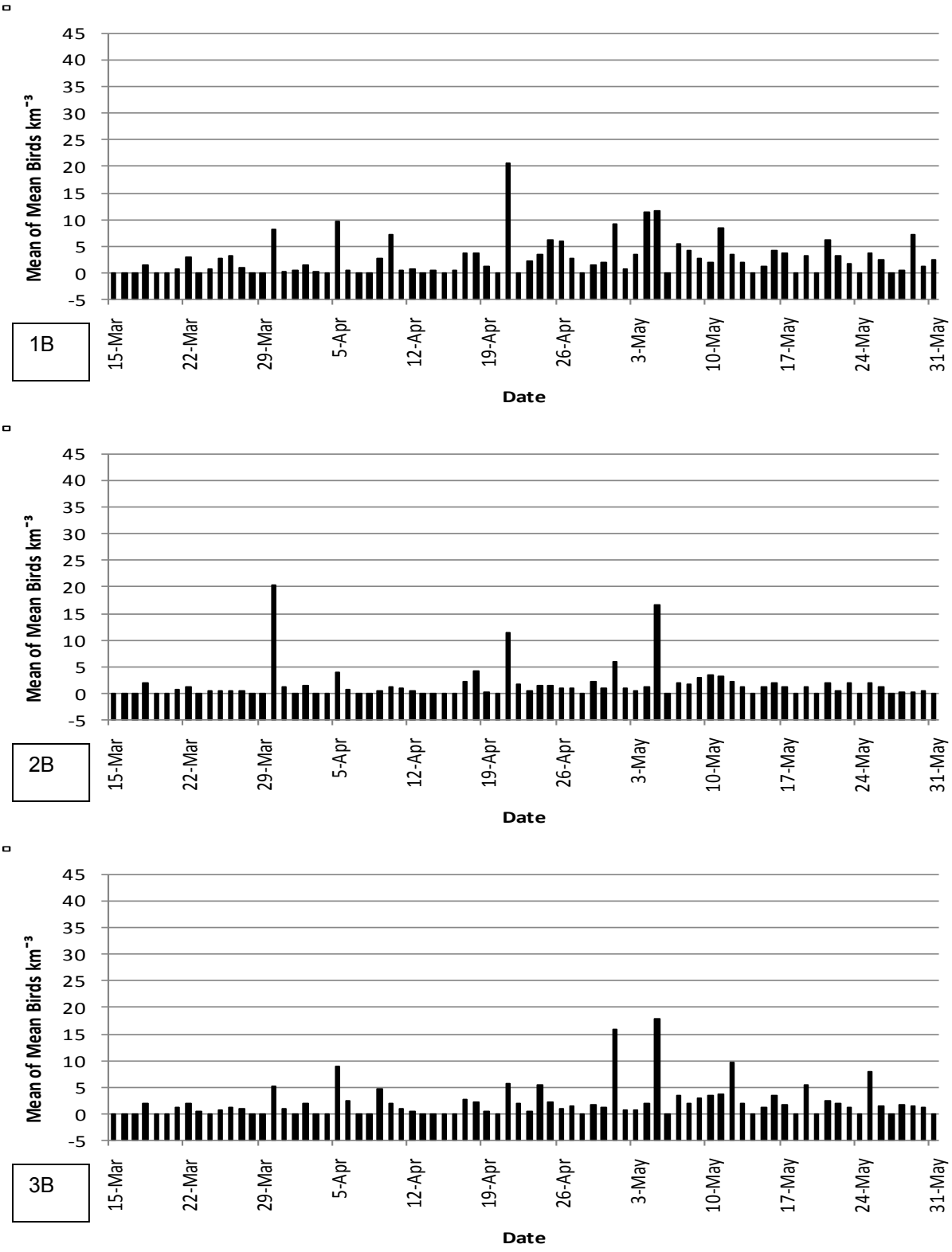


Figure 7-5. Night-to-night variation in the in the amount of nocturnal bird migration during the spring (2005-2009) over the offshore sample areas (1B, 2B, and 3B). The bars represent the mean number of birds/km^3 for that date over the five years of sample. The standard error of the mean is indicated for each mean.

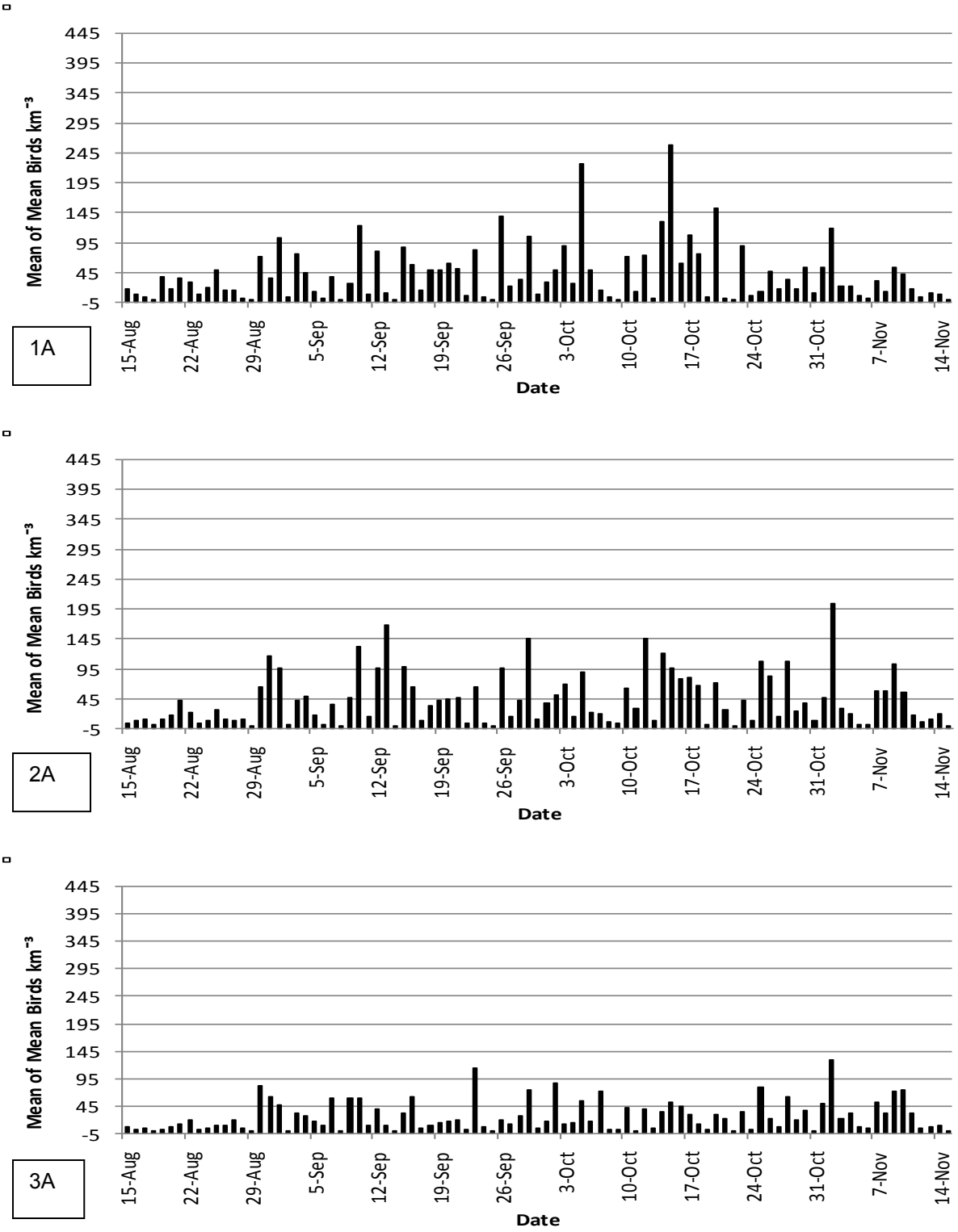


Figure 7-6. Night-to-night variation in the in the amount of nocturnal bird migration during the fall (2004-2008) over the onshore sample areas (1A, 2A, and 3A). The bars represent the mean number of birds/km^{-3} for that date over the five years of sample. The standard error of the mean is indicated for each mean.

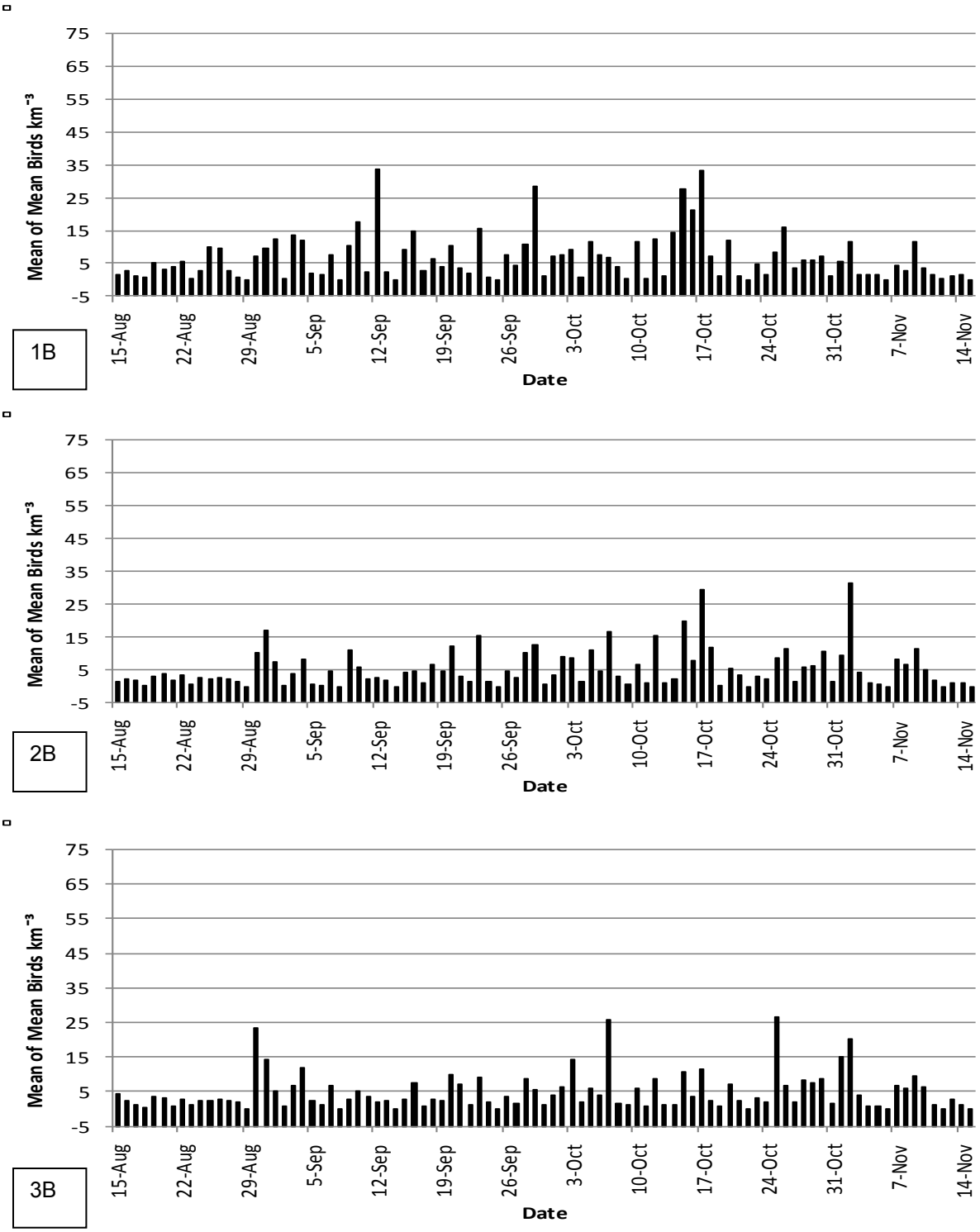


Figure 7-7. Night-to-night variation in the in the amount of nocturnal bird migration during the fall (2004-2008) over the offshore sample areas (1B, 2B, and 3B). The bars represent the mean number of birds/km^3 for that date over the five years of sample. The standard error of the mean is indicated for each mean.

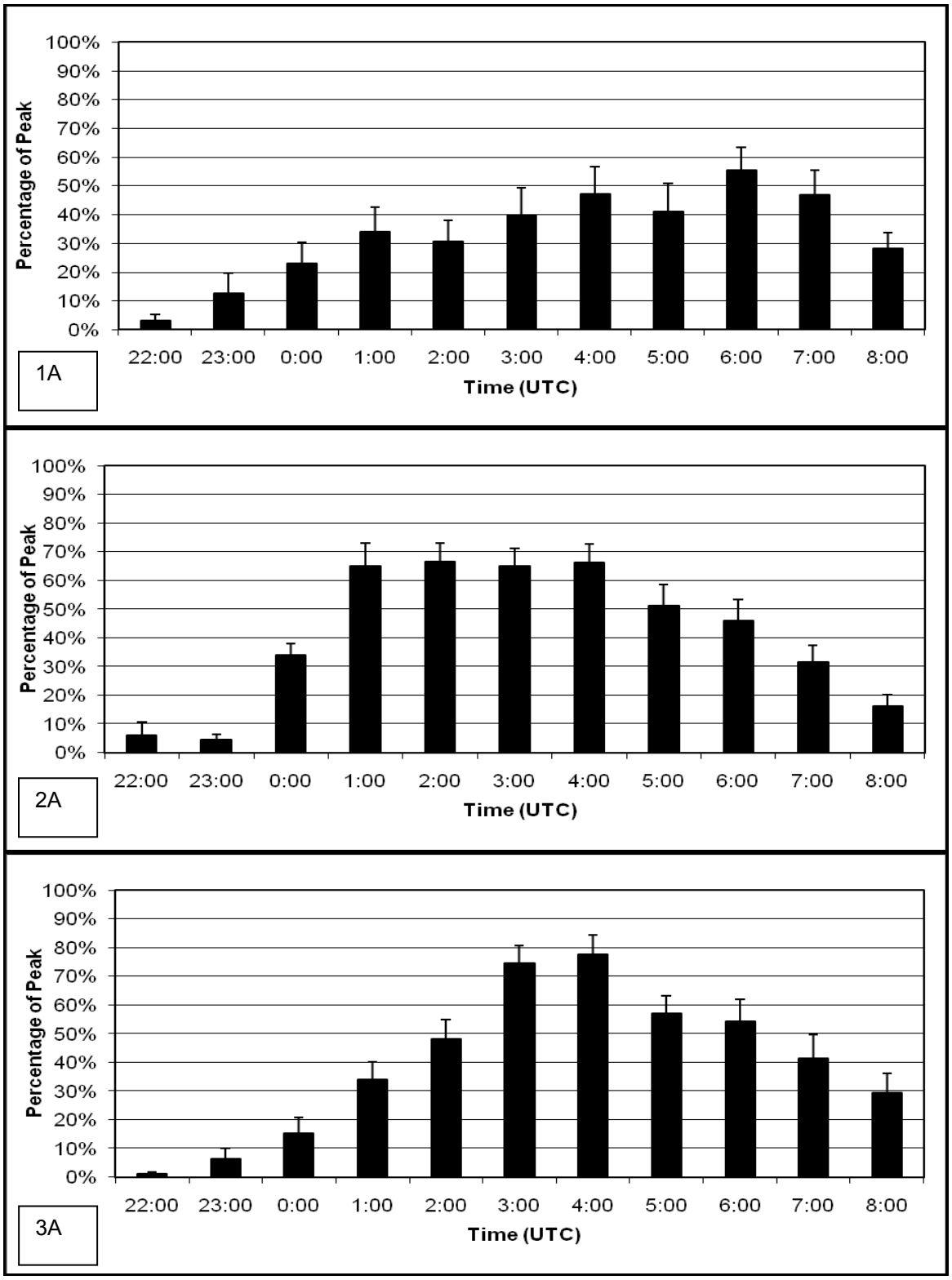


Figure 7-8. Hour-to-hour pattern of bird migration in the spring (2005-2009) within onshore sample areas (1A, 2A, and 3A). The bars show mean percentage of peak mean density (birds/km^3) and the lines indicate the standard error of the mean. To convert UTC to EST subtract 4 hours or subtract 5 hours for EDT.

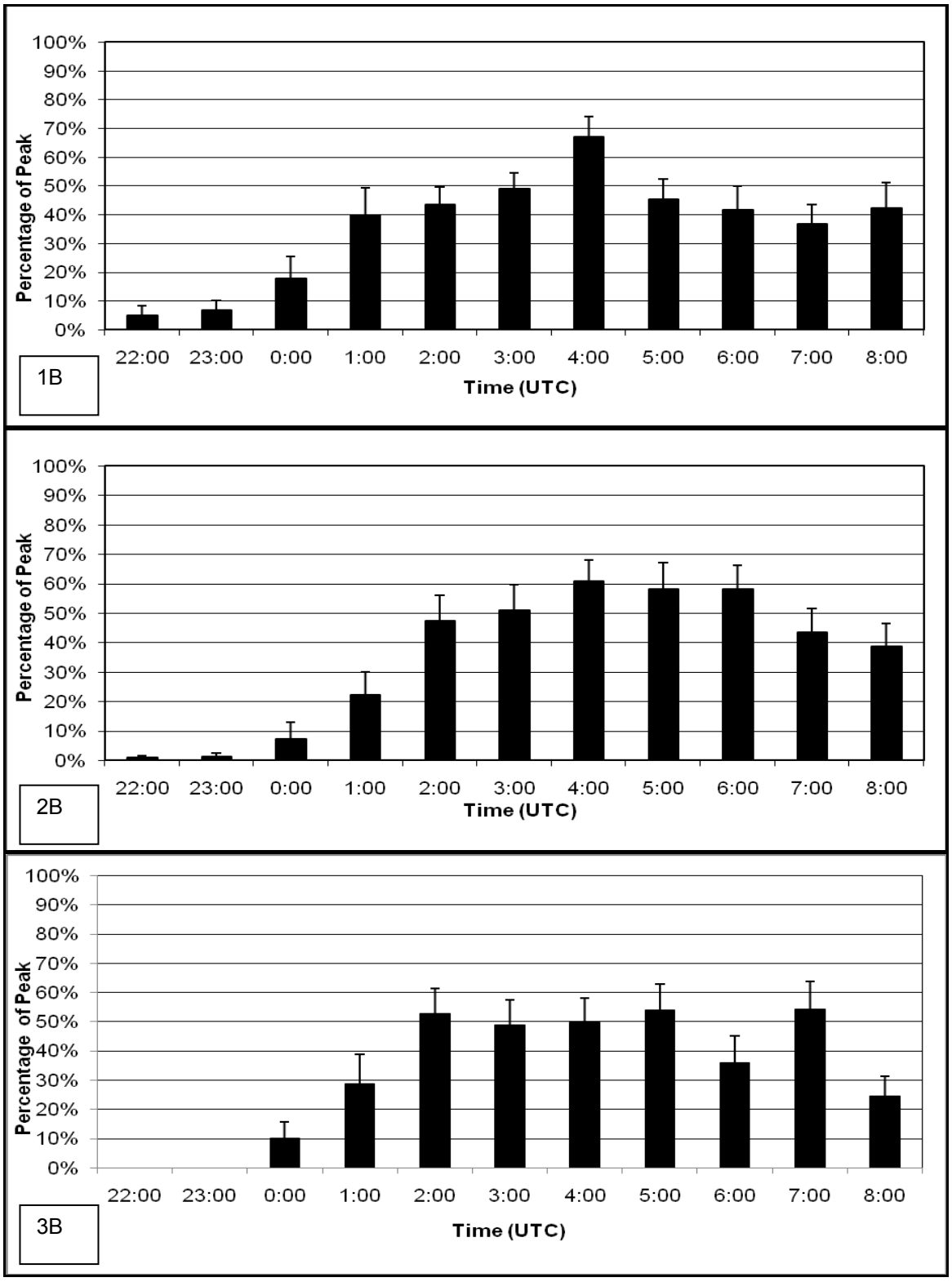


Figure 7-9. Hour-to-hour pattern of bird migration in the spring (2005-2009) within the offshore sample areas (1B, 2B, and 3B). The bars show mean percentage of peak mean density (birds/km^3) and the lines indicate the standard error of the mean. To convert UTC to EST subtract 4 hours or subtract 5 hours for EDT.

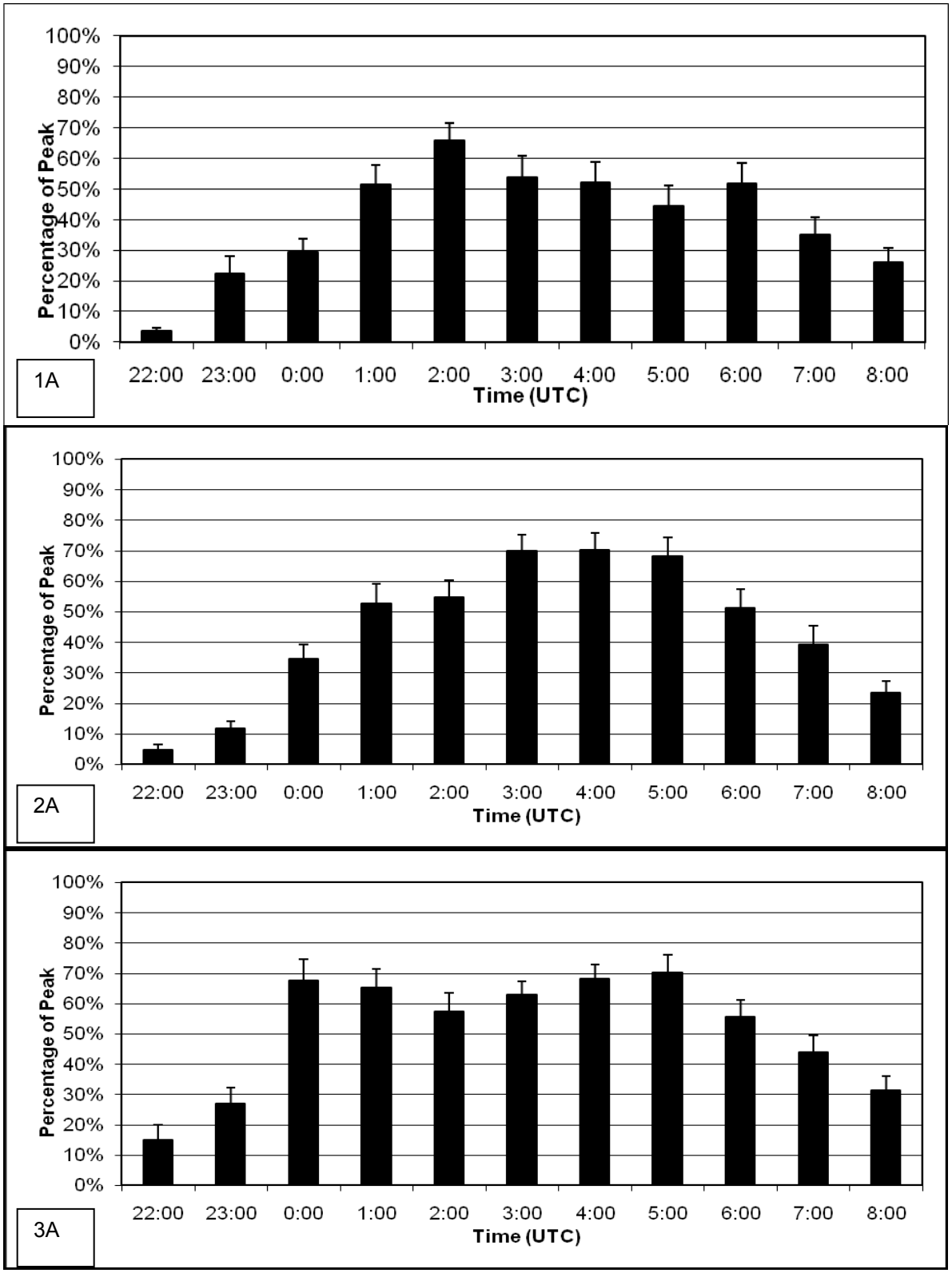


Figure 7-10. Hour-to-hour pattern of bird migration in the fall (2004-2008) within onshore sample areas (1A, 2A, and 3A). The bars show mean percentage of peak mean density (birds/km^3) and the lines indicate the standard error of the mean. To convert UTC to EST subtract 4 hours or subtract 5 hours for EDT.

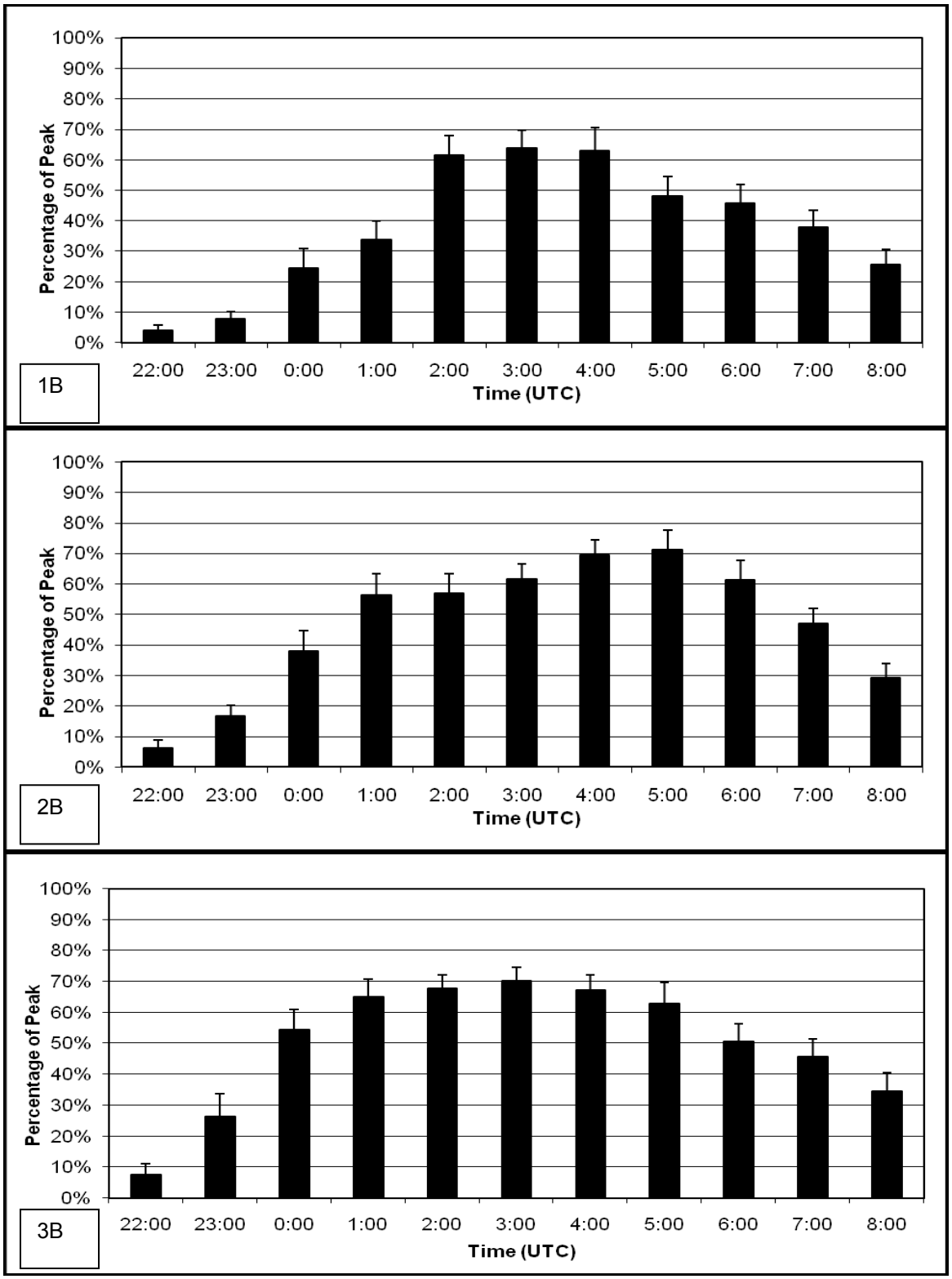


Figure 7-11. Hour-to-hour pattern of bird migration in the fall (2004-2008) within the offshore sample areas (1B, 2B, and 3B). The bars show mean percentage of peak mean density (birds/km^3) and the lines indicate the standard error of the mean. To convert UTC to EST subtract 4 hours or subtract 5 hours for EDT.

7.2.4 Direction of Migratory Movements

The directional tendencies of the migratory flights over the project area are given in **Tables 7-5** and **7-6** and illustrated in **Figures 7-12** and **7-13**. In the spring the mean directions (μ) from which the movements originated were 203.58° in 2005, 205.14° in 2006, 205.44° in 2007, 207.37° in 2008, and 211.35° in 2009. The flights were oriented toward the north-northeast (between 23° and 32°). There was some variability in mean direction from year to year but within each year there was relatively strong directionality as indicated by the length of the mean vector [r] (a statistical measure of concentration, see **Table 7-5** and **Figure 7-12**). All yearly mean directions show low circular variance and are highly significant (p<0.000).

In the fall the mean directions were from 33.57° in 2004, 28.18° in 2005, 17.68° in 2006, 17.72° in 2007, and 28.55° in 2008. The flights were oriented toward the south-southwest to southwest between 197° and 214° (**Table 7-6**, **Figure 7-13**). The lengths of the mean vectors for the fall data (**Table 7-5**), were comparable to those in spring data (**Table 7-6**). Topographic features such as the shoreline likely influence the directions of seasonal migrations, particularly those occurring at lower altitudes.

Table 7-5. Statistical analyses of direction of nightly migrations during the spring (2005-2009).

Variable	Year				
	2005	2006	2007	2008	2009
Number of Observations	27	13	26	30	24
Mean Vector (μ)	23.58°	25.14°	25.44°	27.37°	31.35°
Length of Mean Vector (r)	0.987	0.958	0.97	0.976	0.974
Circular Variance	0.013	0.042	0.03	0.024	0.026
Circular Standard Deviation	9.366°	16.8°	14.16°	12.677°	13.145°
Standard Error of Mean	1.803°	5.268°	2.777°	2.314°	2.683°
Rayleigh Test (Z)	26.288	11.929	24.459	28.567	22.769
Rayleigh Test (p)	3.61E-11	1.29E-06	1.66E-10	4.46E-12	7.31E-10
Rao's Spacing Test (U)	298.333	264.308	291.308	286	296
Rao's Spacing Test (p)	<0.01	<0.01	<0.01	<0.01	<0.01

Table 7-6. Statistical analyses of direction of nightly migrations during the fall (2004-2008).

Variable	Year				
	2004	2005	2006	2007	2008
Number of Observations	49	42	32	40	40
Mean Vector (μ)	213.57°	208.18°	197.68°	197.72°	208.55°
Length of Mean Vector (r)	0.914	0.842	0.813	0.836	0.862
Circular Variance	0.086	0.158	0.187	0.164	0.138
Circular Standard Deviation	24.354°	33.57°	36.835°	34.323°	31.203°
Standard Error of Mean	3.475°	5.151°	6.448°	5.39°	4.917°
Rayleigh Test (Z)	40.901	29.796	21.167	27.939	29.734
Rayleigh Test (p)	<1E-12	<1E-12	1.10E-09	3.67E-12	<1E-12
Rao's Spacing Test (U)	259.918	245.571	238	242	243
Rao's Spacing Test (p)	<0.01	<0.01	<0.01	<0.01	<0.01

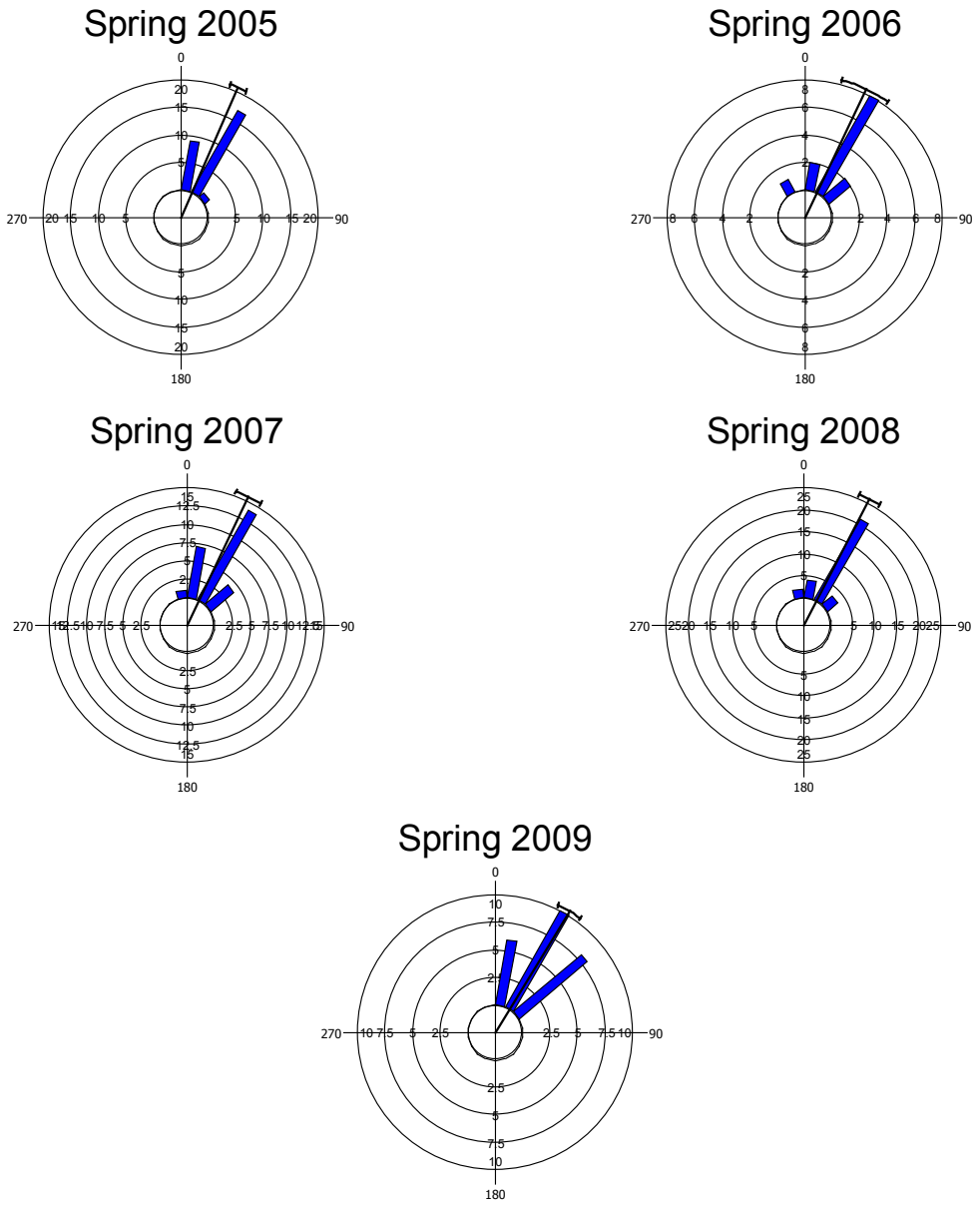


Figure 7-12. Circular diagrams showing the direction of spring migration for the years 2005-2009. The statistical details are in Table 7-5. The dark line is the mean angle and the arc at the end is the 95% confidence limits of the mean.

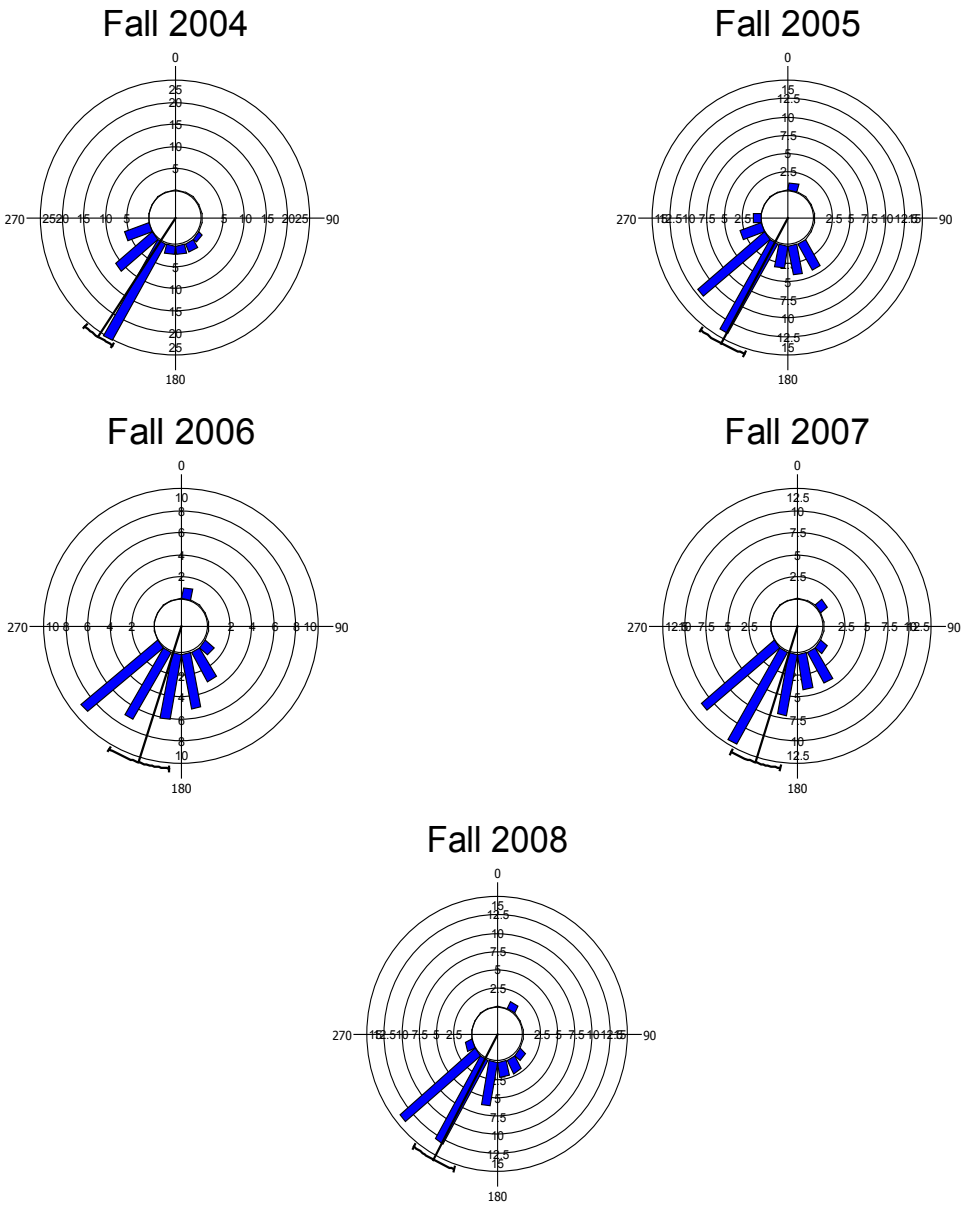


Figure 7-13. Circular diagrams showing the direction of fall migration for the years 2004-2008. The statistical details are in Table 7-6. The dark line is the mean angle and the arc at the end is the 95% confidence limits of the mean.

7.2.5 Migration, Weather Conditions, and Collisions

In an attempt to document the number of nights during spring and fall when the altitude of migration might be lowered because of low ceilings and visibility would be obscured by fog or precipitation, we recorded the number of nights with overcast and ceiling below 305 m (1,000 ft) during spring (15 March - 31 May 2005-2009) and fall (15 August - 15 November, 2004-2008) and any of the following weather conditions during the nighttime hours: fog, mist, drizzle, light rain, moderate rain, and heavy rain. We also recorded the density of migration on these nights (**Table 7-7; Appendix L-4**). During the spring seasons, 79 of 390 nights (five years total) had conditions that would cause birds to fly lower -- sometimes with reduced visibility. Twenty-nine of these nights had migration densities of 25 birds/km^3 or greater (**Table 7-7**).

During the fall seasons, 102 of 465 nights (five years total) had conditions that might cause birds to migrate at low altitudes in poor weather and 24 of these nights had bird movements of 25 birds/km^3 or greater (**Table 7-7**). There were 23 more total nights over the five fall seasons than in five spring seasons with weather conditions that could cause birds to fly at low altitudes and sometimes in poor visibility, but generally on these nights there was little or no migration taking place.

Table 7-7. Number of nights in spring (2005-2009) and in fall (2004-2008) when the density of migration was 25 birds/km^3 or greater and the ceiling was 1000 ft or lower, the sky was overcast, and one or more of the following weather conditions existed during the nighttime hours: fog, mist, drizzle, light rain, moderate rain, heavy rain.

Season	Night with low ceilings and weather	Nights with 25 birds/km^3 or more					
		1A	2A	3A	1B	2B	3B
Spring							
2005	14	1	2	1	0	0	0
2006	11	0	0	1	0	0	0
2007	14	1	2	2	0	0	0
2008	14	3	3	2	0	0	0
2009	26	4	4	2	0	0	1
Mean	**16**	**2**	**2**	**2**	**0**	**0**	**0**
Fall							
2004	18	2	1	1	0	0	0
2005	20	0	0	3	0	0	0
2006	24	0	1	1	0	0	0
2007	21	3	2	1	0	1	1
2008	19	3	2	2	0	0	0
Mean	**20**	**2**	**1**	**2**	**0**	**0**	**0**

8.0 AVIAN PREDICTIVE MODEL

8.1 INTRODUCTION

Shipboard bird surveys are routinely used for mapping and to estimate density, spatial distribution, habitat use, predator-prey interactions and potential changes due to human disturbances and climate change (Veit et al. 1997; Fauchald et al. 2002; Hyrenbach and Veit 2003; Clarke et al. 2003; Reid et al. 2004; Certain et al. 2007; Karpouzi et al. 2007; Zador et al. 2008; Santora et al. 2009). The usefulness of these surveys is that observations and distribution data for a variety of bird species can be directly integrated with geo-spatial information (i.e., bathymetry, slope) providing a comprehensive look at the spatial ecology of marine birds (Wright and Begg 1997; Certain et al. 2007; Bailey and Thompson 2009; Santora et al. 2009). Herein, the objective of this section is to model bird density and determine the probability of bird occurrence in relation to time (i.e., season) and spatial distribution.

In conjunction with the NJDEP Ecological Baseline Study, spatial models for predicting changes in density and spatial distribution of birds were developed to identify important regions used by birds within the Study Area. The objective was to quantify where birds are most likely to concentrate in relation to geo-physical habitat features (e.g. depth [**Volume I: Figure 2-1**]; shoals [**Volume II: Figure 2-8**]) and predict where birds are likely to occur seasonally. Although prey distribution is important for understanding spatial distribution of marine birds (Wright and Begg 1997; Santora et al. 2009), they were not measured during these surveys and are not available at this time for modeling bird density; however, the response of birds to prey patches occurs generally at fine scales (e.g., <1 km [0.5 NM]) where feeding events are likely to occur. Our approach was to focus on broader scales (>1 km to 50 km [0.5 to 27.0 NM]) to predict where birds are most likely to concentrate within the Study Area.

The goal was to integrate two years of bimonthly shipboard surveys to estimate spatial variability of birds within the Study Area. The focus was on a variety of species (e.g., waterfowl, gulls, petrels) to examine species-specific distribution patterns. Strip-transect data collected during bi-monthly ship surveys within the Study Area were used to examine spatial variability in bird density, using spatial interpolation (e.g. kernel density), spatial regression and Generalized Additive Models (GAMs) to quantify the relationships between spatial covariates (e.g., bathymetric and distance based metrics) and bird density and spatial distribution.

Herein, results on species density estimates and high resolution map products along with spatial models are provided to examine the effect of spatial covariates on predicting changes in bird density and spatial distribution. The following questions are addressed in this section: (1) Where and when are birds (species) most likely to concentrate within the Study Area? (2) Are birds more or less concentrated evenly along the coast, or do some species exhibit specific spatial gradients (i.e., latitude/longitude variation)? (3) What is the relationship between bird density/distribution and depth, distance to shoreline, distance to shoals, and slope?

8.2 METHODOLOGY

A total of 13,250 km (7,154 NM) of avian strip transect survey data were collected over two years to estimate bird density (number/km^2) and distribution (monthly survey kilometer mean ± SD is 552 ± 252). Details of the survey protocol and summaries of the survey results (i.e. species composition) are located in **Chapter 2.0**. Briefly, bird density estimates (number/km^2) were calculated from standard strip-transect data by calculating the total number of birds (by species) divided by the total number of kilometers surveyed multiplied by the 300-m strip width. The observation dataset was filtered to include effort when the ship was transiting at≥7 kts, and for BSS ≤ 6. For more details on the survey methodology see **Section 2.1**.

8.2.1 Modeling Analysis

An overview of the statistical methodology is as follows: 1) bimonthly survey data was used to calculate density estimates (number/km^2) of birds (e.g., total birds, by species) 2) kernel density spatial

interpolation was performed to grid bird density at un-sampled neighboring locations at seasonal scales to estimate bird probability density distributions, 3) data were stored in a GIS and grid cells were integrated with spatial covariates 4) using the seasonal gridded kernel density dataset, a series of spatially-explicit regression models were fitted to test whether spatial variability of bird density and distribution may be related to spatial covariates and 5) the effect of each spatial covariate were assessed for predicting changes in bird density.

8.2.1.1 Species Selection

The bird density variables selected for modeling are located in **Appendix M: Table M-1**. In addition to using total bird density, a variety of common species that represent a variety of avian life histories was selected. Northern Gannets were selected because they were abundant and widely distributed in the survey area and because they are the largest (body size) seabirds encountered. Northern Gannets also occur in dense flocks (i.e., gregarious) and perform plunge diving in pursuit of fish. Two species of diving ducks were modeled; Scoters and Long-tailed Ducks. These species are common in coastal waters in winter and often occur in dense aggregations near feeding locations. Herring Gull and Laughing Gulls were modeled to examine spatial distribution and habitat selection by local breeding gulls. The Common Tern was chosen to examine habitat selection by terns. Two species of loons (Common Loon and Red-throated Loon) were selected to examine difference in distribution of pursuit diving fish consumers. Lastly, spatial distribution patterns of two tube-nosed seabirds were examined: Wilson's Storm Petrel and Cory's Shearwater which are seasonal summer visitors in New Jersey waters.

8.2.1.2 Description and Derivation of Spatial Covariates

All avian density estimates were imported into ArcView 9.3 for spatial analysis. Six spatial covariates were derived to link with bird density observations. These included latitude and longitude, water depth (m), slope (degrees), distance to shoreline (feet) and distance to nearest shoal (feet). To derive the distance from shore the Point Distance geo-processing tool available in ESRI's Arc/Info® Toolbox 9.3 GIS software was used to measure the kernel density points to the coast of New Jersey. Distance from shoals was generated by the same process. Depth and slope for the kernel density points were derived using the Zonal Statistics function from ESRI's Spatial Analysis toolbox. The function compared each kernel location to a bathymetry and slope estimate and assigned the grid a value. Frequency histograms for spatial covariates are provided in **Appendix M: Figures M-1** through **M-6**.

The correlation matrix (Pearson product moment correlation coefficient) shows the relationship between derived covariates included in the modeling of bird density and distribution (**Table 8-1**). There is correlation ($p<0.001$; Zar 1999) between derived spatial covariates estimated from the observed sampling locations of bird density. This is to be expected when moving offshore or there is a strong negative relationship between depth and distance from shoreline. Moreover, the relationship between distance to shoal and slope indicates that as slope decreased, the distance to the nearest shoal decreased, indicating the movement toward shallow locations offshore the New Jersey coast.

Table 8-1. Relation between the covariates selected for modeling.

Spatial Covariate	Slope	Distance to Shoal	Depth	Distance to Shoreline
Slope	1			
Distance to shoal	-0.1485	1		
Depth	0.2229	-0.2736	1	
Distance to shoreline	-0.1082	0.2311	-0.8661	1

8.2.1.3 Geo-statistical Interpolation: Kernel Density Mapping

Kernel density spatial interpolation was used to estimate probability distribution maps for gridding bird density (number/km^2) by month and season. The kernel density (smoothing) spatial interpolation method is a non-parametric (e.g., distribution-free) method of discerning structure or relationships in the data, by estimating the probability density function of a random variable. Kernel density estimation, like any spatial interpolation method, involves estimating an attribute value (e.g., avian density) at an un-sampled site given measurements at neighboring sampled sites. An algorithm is used that incorporates a weighting function that prescribed relative contributions of individual sampled values as a function of the distance between the un-sampled and sampled sites.

The kernel density method operates on the premise that spatial autocorrelation between two points decreases (e.g., their semi-variance increases) asymptotically as their separation distance increases. For example, in the estimation of bird density at a given un-sampled site, bird count data at neighboring sites that are very close to the un-sampled site are given more weight than data at neighboring sites that are a further distance away (as parameterized by the kernel function K). Bird densities generated at each un-sampled site are estimates rather than exact values, since interpolation is required. The standard error in the estimates at a given un-sampled site generally varies directly with the magnitude of the spatial gradient (difference) in observed values in proximity to that site. The presence of anomalies can skew the data, introducing inaccuracies in the interpolation process.

The kernel density method disperses the mass of each observation around the observed value, with the amount of dispersion being governed by the kernel function K and bandwidth h (i.e., the smoothing parameter). The kernel function K is typically symmetric, such that the point mass is dispersed equally toward higher and lower values (Burt and Barber 1996). For example, narrow kernels (small h) concentrate mass more tightly around the central (observed) values than wide kernels (large h). The h value also governs the amount of detail in the estimated point density function g (x,y) and probability density function f (x,y): A large h value generates a broad, smooth density function with little fine structure, whereas a small h value generates a narrow density function with fine-scale variability.

Fine-scale variability is resolved using spatial modeling methods such as kernel density (with an appropriate bandwidth in the kernel function), which spreads the mass (e.g., abundances or counts) of each observation around the central (observed) value. The kernel function is a spatially decreasing function of distance (between the un-sampled site and a neighboring sampled site), such that the relative contribution (or weight) of each sampled site (i.e., longitude-latitude [lon-lat] location of the observed abundance) to the estimate at the un-sampled site (i.e., central lon-lat location of a grid-point) correlates negatively (inversely) with their separation distance. Generally, as separation distance increases, the degree of spatial autocorrelation decreases toward zero (and semi-variance increases asymptotically). To obtain the estimate of abundance at the un-sampled site (grid-point), the kernel values are summed over the number of neighboring sampled sites; and this process is repeated until estimates at all un-sampled sites are obtained, generating a spatial representation of the variation in the estimates.

The kernel function, modulated by the bandwidth (h) parameter, governs the degree of dispersion (spread) around the central value in a typically symmetric fashion, with relatively equal spreads toward higher and lower values. The kernel width is adjusted by the h parameter, which governs the degree of dispersion (rate of drop-off) of mass around the central value and hence the amount of spatial detail in the estimates. Narrow kernels (small h) concentrate the mass tightly around the central point, with a rapid decline in mass with increasing distance from the central point. Wider kernels (larger h) provide more dispersion or smearing.

The optimal choice of h to use in kernel density analysis depends on the underlying structure and variability in the observational data (i.e., spatial distribution of the avian sightings and measured abundances or counts). For example, if large changes in abundances are observed over small spatial scales, a large h value is recommended in order to smooth out small-scale fluctuations. Otherwise, wildly fluctuating, unrealistic estimates may be generated at nearby un-sampled sites during the interpolation

process. On the other hand, if only small variations in abundances are observed over large distances, then a small h value is recommended in order to capture small-scale variability in the data.

For a sample size n, point density g(x,y; e.g., bird density) at an un-sampled site (x,y; e.g., lon-lat location) is estimated by summing the kernel values $K(d_i/h)$ of all n data points or neighboring sampled sites around the un-sampled site (Burt and Barber 1996):

$$g(x,y) = (1/h^2)*SUM[K(d_i/h)]$$

and probability density f(x,y) is given by: $f(x,y) = g(x,y)/n$, where d_i = spatial distance between the un-sampled site and sampled site "i"; n = number of neighboring sampled sites (in the vicinity of the un-sampled site); h = bandwidth or smoothing parameter; K is the kernel weighting function that generally decreases with increasing distance between the un-sampled and sampled sites. For example, a normal kernel is given by:

$$K(d_i/h) = ([1/(2*pi)]^{0.5})*exp[-0.5*(d_i/h)^2]$$

where pi=3.1415927. This function describes a Gaussian normal curve with a maximum value of $(1/[2*pi])^{0.5}$ at zero distance (d_i=0) and decreases with increasing distance d_i. The rate of decrease in K with increasing d_i is governed by the value of h: As h decreases, the rate of drop-off becomes more rapid, effectively concentrating the mass more tightly around the central (observed) value. The summation in the above equation for g(x,y) is conducted over the number of neighboring sampled sites n around the un-sampled site.

For the bird count data collected on the coastal and offshore surveys, the sampled sites are the lon-lat locations at which bird count data were collected; and the un-sampled sites are the 100 grid-points in the above-mentioned regular lon-lat grid system.

The Gaussian kernel estimator for point location data (Silverman 1986) was modified for continuous data by multiplying values of bird density (the continuous variable) by kernel weights and computing a weighted average:

$$\hat{\mu}(y \mid x) = \frac{\sum_{i=1}^{n} w(x, X_i, h) y_i}{\sum_{i=1}^{n} w(x, X_i, h)}$$

where y_i is the observed density (birds per square kilometer per visit) for each sub-segment represented by the coordinate pair X_i, $\hat{\mu}(y \mid x)$ is the estimated mean density at grid location x, h is the bandwidth or smoothing parameter, and

$$w(x, X_i, h) = exp\left[-\frac{1}{2h^2} (x - X_i)^T (x - X_i) \right]$$

where $(x - X_i)$ is a vector of length n. In vector notation, the superscript "T" denotes transpose of the vector, such that $(x - X_i)$ is a vector with n rows and 1 column, whereas $(x - X_i)^T$ is the transposed vector with 1 row and n columns. The pre-multiplication of the vector $(x - X_i)$ by its transpose results in a scalar (Bailey and Gatrell 1995). The smoothing parameter h dictates the degree of smoothing. The weighted average, $\hat{\mu}(y \mid x)$, was computed at each intersection of a longitude-latitude regular grid.

General assumptions made in the kernel density spatial interpolation analysis include:

1) Only birds observed within 300 m (984.3 ft) of the observer (in-zone observations), and only those data that were collected with vessel speeds greater than 7 kts (8.1 mph) were included in the analysis.

2) Given the observation date and time as well as the starting/ending times and starting/ending lon-lat locations of each transect on which the given observation occurred was identified. Then, to a first order approximation, the lon-lat locations were interpolated with respect to the times to estimate the lon-lat location of the observation.

3) Given the range, heading, and lon-lat location of the observation (e.g., observer location), the approximate location (in longitude-latitude coordinates) of the actual bird(s) was calculated. The accuracy of this value may vary, and the variability may be high if the magnitude of the ship's spatial deviation from the trackline is on the order of the range of the observation.

Given these assumptions, the ship and boat transect survey data were combined with GPS lon-lat information to generate spatial density maps using the kernel density spatial interpolation method. Input data for this method includes measured avian abundance (bird counts, z) collected at sampled lon-lat locations (x, y). The abundance data were spatially interpolated to obtain estimates of bird density (number/km^2) at un-sampled sites positioned on a regular lon-lat grid system.

To obtain a uniform spatial representation of estimates in kernel density analysis, a regular lon-lat grid system is often used; and estimates are obtained at each grid point on the grid. Spatial resolution can be enhanced with a finer regular grid (by decreasing the spacing interval between adjacent grid points). A 1-km (0.5-NM) grid system with 8,364 total grid points (82 longitude values by 102 latitude values) was adopted. Each grid-point represents an un-sampled site, and estimates of density/abundance at each site were generated by calculating a kernel function (modulated by bandwidth h) based on observed counts at neighboring sampled sites (i.e., lon-lat locations along transects passing in proximity to the grid-point), with the degree of weighting being inversely related to the separation distance between the grid-point and observation location.

The top five most abundant species (for all-behavior and sitting birds) for the 23 months, nine seasons, two years, and overall periods of the two-year survey are listed in **Appendix M: Table M-44**. Abundance, density, and bandwidth (dispersion factor) h are summarized for each species. Optimal values of h used in the kernel density analysis for each species and time period are also summarized in **Appendix M: Table M-44**.

8.2.1.4 Spatial Regression and Generalized Additive Models

Two complementary modeling techniques were used to measure the influence of spatial covariates on bird density within the Study Area. Spatial regression and GAMs are particularly useful for examining the response of predator density at sea in relation to environmental covariates (Wright and Begg 1997; Clarke et al. 2003; Certain et al. 2007; Zador et al. 2008; Bailey and Thompson 2009; Santora et al. 2009). These models have been used extensively to examine and predict the response of organisms to environmental variability (Gustafson 1998; Guisan and Zimmerman 2000; Austin 2002; Ferrier et al. 2002; Dormann et al. 2007), including amphibians (Araújo et al. 2006) marine mammals (Redfern et al 2006; Bailey and Thompson 2009) and in fisheries research (Daskalov 1999; Stoner et al. 2001; Denis et al. 2002; Venables and Dichmont 2004; Jensen et al. 2005). Available models for investigating the spatial distribution patterns of species were carefully reviewed and considered based on Legendre and Legendre (1998), Austin (2002) and Dormann et al. (2007).

8.2.1.5 Spatial Regression Models

A spatially-explicit regression model was used to account for effects of spatial autocorrelation (Feguson and Bester 2002; Tobin and Bjørnstad 2003; Wintle and Bardos 2006) and to assess the contribution of covariates on predicting changes in bird aggregations in space and time (Anselin et al. 2006; Dormann et al. 2007; Santora et al. 2009). The objective of the spatial regression model is to test whether spatial autocorrelation of bird aggregations might be explained by spatial covariates. That is, do covariates influence the spatial variability and clustering of bird aggregations? A weighted spatial average was computed across all seasons and years based on the gridded kernel density estimates. The resulting matrix of bird density values at each location was used to model the probable effect of spatial covariates

on bird density. In addition, the Global Moran's I value was calculated (Anselin et al. 2006) to estimate the degree of aggregation (i.e., clumping) of birds in the study region. The Global Moran's I test is a straightforward test of spatial randomness (Getis and Ord 1992; Anselin 1995; Ord and Getis 1995) and is basically a spatially-explicit correlation coefficient that is based on the relationship between bird density values and a spatial weights matrix estimated by Euclidean distance between all sampling locations (i.e., grid points). A positive Moran's I index indicates tendency toward clustering while a negative Moran's I index value indicates tendency toward dispersion.

Spatial regression models are similar to generalized linear models, except they have spatially explicit parameters to account for both autocorrelation and spatial dependency (Anselin et al. 2006; Ferguson and Bester 2002). A spatial lag model was used (Anselin et al. 2006; GeoDaS Software) with Maximum Likelihood Estimation (Legendre and Legendre 1998; Burnham and Anderson 2002) to investigate the spatial dependency of bird density on spatial covariates. The model is:

$$Y = \rho Wy + Xi\beta + \varepsilon$$

where Y is bird density (per km^2), Xi is the covariate (i.e., latitude, longitude, depth, slope, distance metric), β is a regression coefficient, and ε is a random error term that is identically and independently distributed. The model has spatial lag components, ρ a spatial autoregressive coefficient, and Wy, a spatially varying lag term. The spatial lag model takes into account whether bird density (Y) in location i is affected by the covariates in both place i and j. That is, events in one place may predict an increased likelihood of similar events in neighboring places. The modeling procedure first fits the spatial lag component, based on a Euclidean distance weight matrix from the sampling locations, and then seeks to fit covariates using Maximum Likelihood Estimation (Burnham and Anderson 2002).

8.2.1.6 Generalized Additive Models (GAMs)

The power of GAMs is in their flexibility to combine model selection with nonparametric smoothers to examine the influence and shape of explanatory variables for predicting changes in the response variable (Hastie and Tibshirani 1990; Barry and Welsh 2002; Wood and Augustin 2002; Venables and Dichmont 2004). GAMs were used to model bird density in relation to spatial covariates (**Table M-1**). The general form of the GAMs is given by (Hastie and Tibshirani 1990):

$$E[y] = g^{-1}(\beta_0 + \sum_k S_k(x_k))$$

where E[y] is the expected value E of the response of a random variable y (bird density), g() is the link function (e.g., identity, logarithmic, exponential) defining the relationship between the response variable y and the additive predictor ($\beta_0 + \sum_k S_k(x_k)$), β_0 is an intercept term, x_k is the value of the kth spatial covariate, and $S_k()$ represents smooth functions of the k covariates. GAMs were fitted with an identity link function and Gaussian error distribution with spatial smoothed covariate terms as a cubic spline s.

Terms specified by smoothing functions are broken down into a single degree of freedom for the linear component and the remainder for the nonparametric component. A simultaneous scoring test is performed for all terms, where the nonparametric component is set to zero and the linear element is updated, while holding all other nonparametric terms fixed (Hastie and Tibshirani 1990).

GAMs were fitted using the statistical program R using the GAM package (R core development team 2008). The GAM including smoothed covariates for predicting changes in bird density is:

$$\text{Density} \sim s(\text{Depth}) + s(\text{Slope}) + s(\text{DistShore}) + s(\text{DistShoal}) + s(\text{Lon}) + s(\text{Lat})$$

where s(x) is a univariate cubic smoothing function of covariate "x" (see **Table M-1** for spatial covariates). For example, $s(x) = a_o + a_1*x + a_2*x^2 + a_3*x^3$. Year and season factor terms were included in the model where applicable (i.e. for certain seasonal species). These terms were not included in the model when species were present only in one year or season.

8.2.2 Model Validation, Evaluation, and Selection Criteria

Backward stepwise selection and Akaike's Information Criterion (AIC) minimization were used to perform model selection for continuous spatial covariates (Hastie and Tibshirani 1990; Barry and Welsh 2002; Wood and Augustin 2002; Venables and Dichmont 2004). The objective of this method is to begin with the initial fully functional model (with all terms included), and then sequentially remove model terms one at a time from the original formula to attempt to achieve a better model fit. The AIC is first computed for the initial model, and then N candidate models are generated, where N equals the number of terms in the current model. Each of the N candidate models has one less term than the original model. In each subsequent step, a single term is dropped from the initial model and the AIC is computed for each model. The model that provides the greatest reduction in AIC is selected as the best model. The significance values are presented for the smoothed spatial covariates in the initial model and the final selected model in tables for each bird variable. The output of the GAMs are tables listing the model AIC and the probability level for each covariate. The initial (global) model and the selected model are reported.

To examine the effect of each spatial covariate in the GAM, the fitted contribution of each spatial covariate on bird density was plotted against the value of the covariate (Hastie and Tibshirani 1990; Barry and Welsh 2002; Wood and Augustin 2002; Venables and Dichmont 2004). Covariates that had an effect were plotted and were selected by stepwise selection criteria using AIC minimization. The 95% CIs are plotted around the best fitted 'smooths' for the main effects. The y-axis reflects the relative effect of each covariate on bird density. The x-axis shows the density of points (i.e. rug plot) for each covariate included in the model. Importantly, the "conditional effect" of each variable is the effect of the particular covariate, given the presence of the other variables in the best fit model, based on the backward stepwise section criteria. The GAM 'effect plots' of covariates on bird density are useful because the change in bird density can be directly compared to the exact value of the covariate. These plots were used to identify the magnitude of change and range in bird density and distribution in relation to each spatial covariate selected in the final GAM. We classified the effect (partial effect of covariate X on bird density) against distance to shoreline by determining the range of successive positive values before the effect became negative (i.e. crossing the zero on the y-axis). For example, for the covariate distance to shoreline (measured in feet), we determined if there was an effective positive range on bird density by identifying the maximum range point where the effect approximately became negative (i.e. below zero on the y-axis).

The effect of each covariate on bird density was characterized as either positive '+', negative '-', or mixed/curvilinear '+/-'(**Table M-3**). For example, if depth was found to be a positive contributor to bird density, then it was concluded that bird density increased in deeper waters. In addition, if distance to shoreline was found to be a negative contributor to bird density, then it was concluded that bird density increased with proximity (closeness) to the coastline. The outline of these results is summarized in **Table M-4**.

8.3 RESULTS

General additive, spatial regression and kernel density methods were used to model the avian shipboard and coastal survey data. Supporting data for general additive and spatial regression models can be found in **Appendix M** (**Tables M-5** through **M-43** and **Figures M-1** through **M-113**). Kernel density spatial maps are shown **in Appendix M: Figures M-114** to **M-532**.

8.3.1 Estimation of Avian Density and Distribution: Kernel Density Interpolation

All density data is reported as the number of birds/km^2. The following discussion of kernel density spatial analysis results is divided into following sections:

> **Seasonal Analysis:** Each species is discussed separately one at a time based on the seasons in which the given species is among the top five most abundant (both all-behavior and sitting birds).

Total-Birds: Seasonal Analysis and Total Birds: Annual and Overall Cumulative Analyses: Total-bird results are discussed first according to season, and then according to an annual (2008, 2009) and overall cumulative two-year analysis.

Annual Analysis: Following the annual analysis of the Total-birds, the top five most abundant species in each year (2008, 2009) and the two-year period are discussed, in the context of the component species that partially (though not completely, since Total-birds encompasses ALL birds, not just the top five most abundant) contribute to the annual results for the Total-birds.

Spatial Analysis: Spatial gradients are discussed in terms of variations in the magnitude and distribution of densities (number/km^2) in the onshore-offshore direction and in the north-south direction. Nearshore (coastal) variations are discussed in terms of proximity to coastal cities (e.g., Ocean City, Atlantic City) and to bays and inlets (e.g., Barnegat Bay in the north, Great Egg Harbor Bay in the central region, Hereford Inlet in the south). The term “nearshore” refers to regions within approximately 5 km (2.7 NM) of the coastline, and the “offshore” region extends from 5 km (2.7 NM) to the outer limit of the Study Area (approximately 37 km [20 NM] away from the coast). This offshore region is divided into two sub-regions: “midshore”, extending from 5 km (2.7 NM) to approximately midway within the offshore region; and “far-offshore”, extending from this midway point to the outer limit of the Study Area.

The kernel density figures are organized into eight broad categories as follows:

- M-114 to M-251: Monthly Maps – All-Behavior Birds
- M-252 to M-388: Monthly Maps – Sitting Birds
- M-389 to M-442: Seasonal Maps – All-Behavior Birds
- M-443 to M-496: Seasonal Maps – Sitting Birds
- M-497 to M-508: Annual Maps – All-Behavior Birds
- M-509 to M-520: Annual Maps – Sitting Birds
- M-521 to M-526: Overall Maps – All-Behavior Birds
- M-527 to M-532: Overall Maps – Sitting Birds

8.3.1.1 Seasonal Analysis

The monthly components for each season of the two-year survey period are: winter 2008 (January and February); spring 2008 (March, April, and May); summer 2008 (June and July 2008); fall 2008 (August, September, October, and November); winter 2009 (December 2008, January and February 2009); spring 2009 (March, April, and May); summer 2009 (02 June [no surveys in July); fall 2009 (August, September, October, and November); and winter 2010 (December 2009).

Species abundances for each season are calculated by combining the abundances in each month comprising the given species. Likewise, annual abundances are calculated by combining the abundances over all of the months in the given year. Some similarities in the identities of the top five most abundant species are noted among a given season and its composite months, since each month provides a weighted contribution to seasonal totals; however, it is noted that some differences may arise in the identities of the top five most abundant species between the season and the composite months. For example, if a certain species is highly abundant in one month but virtually absent in the other two months comprising a given season, it's possible that this species may be ranked Number 1 in its abundant month but not rank in the top five in its season, particularly if other species are moderately abundant in all three months so as to displace the given species due to higher cumulative seasonal abundances. On the other hand, it is possible for a given species to be ranked in the top five seasonal list while not ranked in the top five in any of the component months. For example, this species may be ranked Number 6 in each of the months comprising the season, while species ahead of it in any one month may have very low abundances in the other months, thus enabling the given species to displace them and rank in the top five for the season.

Because of the extensive number of spatial maps, the following discussion is restricted to the seasonal, annual, and overall (cumulative two-year) analysis of results (**Appendix M: Figures M-389** to **M-532**). For individual monthly results, the reader is referred to **Appendix M: Figures M-114** to **M-388**, while recognizing the specific individual months comprising each season.

The following species are analyzed separately according to the seasons in which the given species is among the five most abundant (**Appendix M: Table M-44**).

- Scoter: winter 2008, spring 2008, fall 2008, winter 2009, spring 2009, fall 2009, and winter 2010 (all-behavior); winter 2008, spring 2008, winter 2009, spring 2009, and winter 2010 (sitting; **Appendix M: Figures M-389, M-395, M-408, M-413, M-419, M-434, M-437, M-444, M-449, M-467, M-473,** and **M-491**).

Scoters comprise the individual species, Black Scoter, Surf Scoter, White-winged Scoter, and Dark-winged Scoter (Black Scoter and/or Surf Scoter).

In winter 2008, elevated Scoter densities occurred in a small coastal region between Atlantic City and Brigantine, with a maximum of 475. Moderate densities on the order of 25 occurred in the coastal region both north (from Brigantine to Little Egg Inlet) and south (from Ocean City to midway between Ocean City and Hereford Inlet) of the maximum. In comparison, two years later, in winter 2010, Scoter maximum density migrated slightly northward along the coast, to between Brigantine and Little Egg Inlet, and decreased in magnitude from 475 to 115. A sub-maximum occurred just off the coast of Brigantine, and moderate densities on the order of 25 to 50 occurred along most of the entire coastline. In both winter seasons, Scoter density was lower offshore than nearshore. Spatial variability was detected throughout the offshore region. In the intervening winter season, winter 2009, Scoter densities were relatively more abundant, with numerous density maxima occurring nearshore along most of the coastline, including Barnegat Light (with maxima of 835 and 310), in the vicinity of Little Egg Inlet (205), region between Atlantic City and Brigantine (185 and 290), just south of Atlantic City (275), Ocean City (470), and midway between Ocean City and Hereford Inlet (150). Moderate densities on the order of 25 occurred midshore in the central and southern regions of the Study Area.

In spring 2008, a Scoter maximum density of 730 occurred nearshore off Ocean City, with a smaller density maximum of 135 occurring further offshore southeast of Ocean City. Elevated densities also occurred in a nearshore localized region northeast of Hereford Inlet. One year later, in spring 2009, the maximum density that was previously at Ocean City moved slightly eastward and decreased in magnitude, to 145. In addition, a density maximum of 355 was present nearshore just south of Barnegat Light. Several additional localized regions of elevated densities (on the order of 50 and higher) occurred nearshore between Little Egg Inlet and Ocean City. In both spring seasons, densities were relatively uniformly distributed (on the order of 25-50) elsewhere along the coastline, and densities were generally lower and more patchily distributed moving offshore. Comparison of the all-behavior and sitting maps for spring 2008 shows that most of the observed Scoters were sitting nearshore and flying offshore: In spring 2008, the nearshore density maximum of 730 occurs for both all-behavior and sitting Scoters, whereas the offshore density maximum of 135 for all-behavior Scoters did not occur for sitting Scoters. In spring 2009, the nearshore density maximum of 355 for all-behavior Scoters decreased to 150 for sitting Scoters, whereas the nearshore density maximum of 145 for all-behavior decreased slightly to 140 for sitting.

In fall 2008, a string of maximum Scoter densities occurred along a northwest-to-southeast transect extending from nearshore to midshore southeast of Little Egg Inlet, with maxima of 1,445, 1,710, 235, and 235 moving offshore. Additional density maxima were present nearshore in the vicinity of Barnegat Light (115), midshore off Little Egg Inlet (145), and midshore south of Ocean City (225). In contrast, Scoter densities were lower one year later, in fall 2009, when only one relatively minor density maximum (110) occurred nearshore off Little Egg Inlet, and other minor localized regions of elevated densities (on the order of 50 and higher) occurred nearshore north of Little Egg Inlet and around and south of Ocean City and Great Egg Harbor Bay. In both fall seasons, densities were generally higher nearshore than offshore.

Comparison of the Scoter all-behavior and sitting-bird maps shows that the majority of Scoter occurring at the maximum (115) and sub-maximum regions in winter 2010 were sitting. In contrast to all-behavior Scoter, which exhibit a continuous band of moderate densities along the coastline, the moderate densities of sitting Scoter occurred in clumps in localized regions along the coastline: in the vicinity of Barnegat Light; in the northern part of Little Egg Inlet; and a southern region between Ocean City and Hereford Inlet. Sitting Scoter, like all-behavior Scoter, exhibit relatively lower and a more spatially homogeneous distribution of densities offshore than nearshore. In winter 2009, most of the all-behavior Scoter density maxima occurring nearshore in the central and southern regions also occurred for sitting Scoter, indicating that a majority of the observed Scoters in these regions were sitting; however, the two all-behavior Scoter density maxima (835 and 310) occurring nearshore around Barnegat Light did not occur for sitting Scoter, indicating that most of the Scoters observed in this northern region were flying. In winter 2008, the all-behavior Scoter density maximum (475) between Atlantic City and Brigantine did not occur for sitting Scoters, indicating that most of the Scoters comprising this density maximum were flying rather than sitting.

- Bonaparte's Gull: spring 2008 and fall 2009 (sitting; **Appendix M: Figures M-453** and **M-489**).

In fall 2009, sitting densities were generally higher and more spatially heterogeneous nearshore than offshore, with a maximum density of 185 occurring on the coastline from Atlantic City southward to a point midway between Atlantic City and Great Egg Harbor Bay, and a sub-maximum density occurring around Barnegat Light. In contrast, in spring 2008, sitting densities were higher and more spatially heterogeneous offshore than nearshore, with a moderate maximum density on the order of 25 occurring just outside the coastal region offshore of Brigantine. Further offshore, sub-maximum densities (less than 25) occurred in four separate localized regions uniformly distributed spatially in the northeast-to-southwest direction. Thus, it appears that Bonaparte's Gull prefers to sit nearshore in fall and migrate to sit offshore in spring.

- Common Loon – All-Behavior: spring 2008, spring 2009, winter 2009, and winter 2010 (**Appendix M: Figures M-398, M-416, M-421,** and **M-440**).

In these two spring seasons, all-behavior density ranges between low and moderate (less than 25/km^2) are distributed relatively uniformly in the coastal and offshore regions. In spring 2009, a vague maximum density (approximately 25) occurred just on the border between the nearshore and offshore regions, in the southern part of the Study Area between Ocean City and Hereford Inlet. In the two winter seasons, while Common Loon species occurred both nearshore and offshore, densities were slightly higher nearshore than offshore. In winter 2009, a maximum density of 170 occurred on the coastline at Hereford Inlet, and several regions of vague sub-maximum densities occurred along the coast, at Brigantine, Little Egg Inlet, and Barnegat Light. Nearshore and offshore densities were lower in winter 2010 than in winter 2009, with a maximum density (approximately 25 km [13.5 NM]) occurring nearshore north of Hereford Inlet. Densities were generally higher and more spatially homogeneous nearshore along the coastline than offshore. In the offshore region, densities were generally higher in the northern and southern regions than in the central region, reflecting greater survey effort in the former two regions than in the latter region for this season (winter 2010).

- Common Loon - Sitting: winter 2008, spring 2008, fall 2008, winter 2009, spring 2009, summer 2009, and winter 2010 (**Appendix M: Figures M-446, M-451, M-465, M-470, M-476, M-481,** and **M-493**).

In fall 2008, sitting densities were generally low (on the order of 25 and less) and sporadically distributed in the nearshore and offshore regions, with the lowest densities occurring in the northeast region of the Study Area. Nearshore densities were lower in the coastal region extending from Brigantine to a point midway between Atlantic City and Great Egg Harbor Bay, compared to the other nearshore regions in the Study Area. Densities were also higher mid-shore than far offshore, particularly in the northeastern and eastern regions of the Study Area. In the two spring seasons, densities were generally low to moderate (up to approximately 25) and sporadically distributed in the nearshore and offshore regions. In spring 2008, nearshore densities were lower just off Little Egg Inlet and Brigantine than in other nearshore

regions, and these two locations exhibited higher densities in spring 2009 than in spring 2008. Offshore densities were also generally higher in spring 2009 than in spring 2008, particularly in the south-central offshore region. In summer 2009, both nearshore and offshore densities were generally lower than in the above mentioned fall and spring seasons, with higher densities occurring in some localized south-central offshore regions than in nearshore regions. Within the nearshore region, the highest densities occurred off Little Egg Inlet, but overall densities were generally low (approximately 25 and less) for the entire Study Area in summer 2009. In winter 2008, densities were low (less than 25) throughout most of the Study Area, with the highest densities occurring in the northern offshore region. The highest nearshore density occurred in proximity to Barnegat Light. Higher densities occurred (with relatively homogeneous spatial distributions) one year later, in winter 2009, with relatively higher densities nearshore. In winter 2009, a maximum nearshore density of 170 occurred at Hereford Inlet (in the southern region of the Study Area), and several high densities occurred nearshore off Barnegat Light, Great Egg Inlet, Little Egg Inlet, and Brigantine. Densities were relatively spatially uniform in the nearshore and mid-offshore regions (with a slight decrease in density with increasing offshore distance), and were lower in far-offshore regions.

- Common Tern: summer 2008, fall 2008, and summer 2009 (all-behavior; **Appendix M: Figures M-402, M-411,** and **M-427**).

In the two summer seasons (2008 and 2009), all-behavior densities were generally 25 and less. In summer 2008, densities were higher and more spatially homogeneous nearshore than offshore, with a concentration in density near Barnegat Light. Within the nearshore region, densities were lowest in the region in proximity to Barnegat Light (in the northern region of the Study Area). Within the offshore region, densities were slightly higher mid-shore than far-offshore, with the lowest densities occurring in the northeastern, south-central, and southeastern regions. In summer 2009, high densities occurred offshore. Offshore densities were distributed sporadically, with the lowest densities occurring in the north-central region, and the southern half exhibiting higher densities on average than the northern half. Nearshore densities were highest in regions just off Ocean City, Atlantic City, and the region midway between Barnegat Light and Little Egg Inlet. In fall 2008, a density maximum of 105 occurred midshore off Barnegat Light, and densities were relatively uniformly distributed (order of 25 and higher) along most of the entire coastline and in the midshore regions, with a general decrease in density moving further offshore.

- Cory's Shearwater: summer 2008 (all-behavior and sitting) **Appendix M: Figures M-405** and **M-457**).

In summer 2008, all-behavior densities were 25 and sporadically distributed throughout the nearshore and offshore regions, with slightly higher densities offshore than nearshore. The highest nearshore densities occurred in the region spanning from Brigantine to Ocean City (in the central region of the Study Area). Offshore, relatively high-density regions include the northeast corner and north-central far-offshore regions, and low-density regions include the southeast corner and the north-central midshore regions. In contrast, sitting densities throughout the Study Area in this same season were lower than all-behavior densities, indicating that most of the birds observed were flying rather than sitting. Highest nearshore sitting density occurred just south of Ocean City, and the highest offshore sitting density occurred in the north-central far-offshore region at the same latitude as Little Egg Inlet.

- Great Black-backed Gull: summer 2008, fall 2008, summer 2009, and fall 2009 (sitting; **Appendix M: Figures M-458, M-463, M-482,** and **M-488**).

Sitting densities were higher, particularly nearshore, in fall 2008 than in 2009. In both seasons, densities were higher and more uniform nearshore than offshore. In fall 2008, a maximum nearshore density of 130 occurred north of Barnegat Light, in the northern region of the Study Area; and a sub-maximum density occurred in the extreme northern part of the nearshore region, north of Barnegat Light. Within the offshore region, the highest densities were located midshore, particularly in the central, northern, and southern midshore regions, with lower densities located offshore. In fall 2009, densities were generally lower (on the order of 25 and less) than in fall 2008. Nearshore densities were more homogeneously dispersed (with no localized regions of maximum density). Comparing the two summer seasons to the two fall

seasons, sitting densities were generally lower in summer than in fall, with higher densities occurring nearshore compared to offshore. In summer 2008, highest nearshore densities occurred in four localized regions: around Barnegat Light; northern part of Little Egg Inlet; region extending from the southern part of Little Egg Inlet to Brigantine; and a region between Ocean City and Hereford Inlet. Offshore densities were very low throughout (on the order of 10 and less). Overall densities were even lower in summer 2009 than in summer 2008, with two localized regions of higher nearshore density: region around and extending south of Barnegat Light; and in the vicinity of Little Egg Inlet. One small area of higher offshore density occurred midshore just outside the nearshore region, southeast of Little Egg Inlet.

- Herring Gull – All-Behavior: winter 2008, spring 2008, spring 2009, summer 2009, fall 2009, and winter 2010 (**Appendix M: Figures M-390, M-397, M-422, M-429, M-433,** and **M-441**).

In fall 2009, densities were higher and more uniform nearshore than offshore, with regions of maximum densities (order of 50) occurring just north of Barnegat Light and in a region midway between Barnegat Light and Little Egg Inlet. A nearshore sub-maximum density was located south of Ocean City. Lowest nearshore densities occurred just off Hereford Inlet and in the vicinity of Little Egg Inlet. Offshore densities were broadly distributed, with a maximum density (order of 25 to 50) occurring in the north-central midshore region at a latitude slightly south of Barnegat Light. In the two spring seasons (2008 and 2009), densities were relatively uniform in spatial distribution, with slightly higher densities nearshore than offshore. No nearshore maximum density was detected in spring 2008, with lowest densities located near Brigantine, and Hereford Inlet. Offshore, low densities were located midshore in the southern region of the Study Area (offshore between Ocean City and Hereford Inlet). In spring 2009, maximum nearshore density (on the order of 50) occurred at Little Egg Inlet, with vague sub-maximum densities occurring midway between Barnegat Light and Little Egg Inlet, and in the northern part of the nearshore region. Offshore densities, like nearshore densities, were relatively spatially uniformly distributed. Offshore densities were generally higher in the northern and southern regions than in the central region. Overall densities were generally lower in summer 2009 than in the two spring seasons (2008 and 2009), with highest densities on the order of 25 and less. Within the nearshore region, lowest densities occurred between Little Egg Inlet and Brigantine, and in the northern part off Little Egg Inlet. Densities were patchily distributed within the offshore region, with higher densities in the north and less and uniformly distributed throughout. In winter 2008, a density maximum occurred nearshore between Great Egg Harbor Bay and Atlantic City, with smaller density maxima occurring south of Ocean City. Densities were generally lower two years later, in winter 2010, when these density maxima were less. In both of these winter seasons, densities outside of these density maxima were generally low (order of 25 and less) and patchily distributed along the coastline, and densities decreased moving offshore.

- Herring Gull - Sitting: spring 2008, fall 2008, winter 2009, summer 2009, fall 2009, and winter 2010 **(Appendix M: Figures M-452, M-464, M-471, M-483, M-487,** and **M-494**).

In fall 2008, sitting densities were generally higher nearshore than offshore, with a maximum nearshore density of 170 occurring in the vicinity of Barnegat Light. A vague sub-maximum nearshore density also occurred in the region midway between Barnegat Light and Little Egg Inlet. Lowest nearshore densities occurred around and south of Great Egg Harbor Bay and Ocean City, and around and north of Hereford Inlet. Offshore densities were patchily distributed throughout the offshore region, with generally higher densities in the northern region. Both nearshore and offshore densities were generally lower in fall 2009 than one year earlier (fall 2008). The spatial patterns of sitting densities for fall 2009 mimics those of all-behavior densities for this same season, except that sitting densities were generally lower than all-behavior densities, indicating the presence of both flying and sitting birds. In fall 2009, the sitting densities (like the all-behavior densities) were higher and more spatially uniform nearshore than offshore, with regions of maximum densities (order of 50) located north of Barnegat Light, and in a region between Barnegat Light and Little Egg Inlet. A nearshore sub-maximum density was located south of Ocean City. Offshore densities were patchily distributed, with a maximum density occurring in the north-central midshore region south of Barnegat Light.

In spring 2008, nearshore and offshore sitting densities were sporadically distributed, with generally higher densities nearshore than offshore. A maximum density was located midshore in the north-central

region, south of Barnegat Light. In summer 2009, sitting densities were generally very low (order of 5-10 and less), with higher densities nearshore than offshore. Highest nearshore densities occurred in the region between Barnegat Light and Little Egg Inlet, and in the region north of Hereford Inlet. In winter 2009, sitting densities were higher nearshore than offshore, with a maximum nearshore density (order of 25 to 50) occurring between Ocean City and Hereford Inlet. A sub-maximum nearshore density was located at Little Egg Inlet. Offshore densities were sporadically distributed, with some local far-offshore regions (northeast and south-central areas) exhibiting slightly higher densities than adjacent midshore regions. Densities were low in winter 2010 than one year earlier (winter 2009), with nearshore densities generally higher than offshore densities. The highest densities occurred in the northern regions of the Study Area, both nearshore and offshore (midshore region). Nearshore densities were higher north of Little Egg Inlet than south of Little Egg Inlet. Maximum nearshore densities (order of 25 and less) occurred just south of Seaside Heights and of Barnegat Light.

- Laughing Gull: summer 2008, fall 2008, summer 2009, and fall 2009 (all-behavior and sitting; **Figures M-401, M-407, M-425, M-432, M-455, M-461, M-480,** and **M-486**).

In fall 2008, high localized densities occurred nearshore and offshore for both all-behavior and sitting birds, with nearshore densities generally higher than offshore densities. In the nearshore region, a maximum all-behavior density of 725 and a maximum sitting density of 585 occurred in the vicinity of Barnegat Light. In addition, a maximum all-behavior density of 140 and a sub-maximum sitting density (order of 25 to 50) located just north of Hereford Inlet. A sub-maximum all-behavior density was also located nearshore just off Little Egg Inlet. In the offshore region, a maximum all-behavior density of 150 and a maximum sitting density of 140 occurred in the southern region of the Study Area, southeast of Hereford Inlet. In the offshore region, spatial distribution was more uniform for all-behavior birds than for sitting birds, with generally higher densities midshore than far-offshore. Both the all-behavior and sitting were somewhat lower in fall 2009 compared to one year earlier (fall 2008), with the maximum nearshore densities migrating southward (from north of Barnegat Light to the region around and north of Little Egg Inlet) and decreasing in magnitude (e.g., from 585 to 135 sitting density) over the one-year period. Sub-maximum nearshore densities occurred at and around Ocean City for both all-behavior and sitting birds. In fall 2009 (like fall 2008), both the all-behavior and sitting densities were higher nearshore than offshore, all-behavior densities were higher than sitting densities, and offshore densities were more uniformly distributed for all-behavior birds than for sitting birds, with generally higher densities midshore than far-offshore.

Both the all-behavior and sitting densities were lower in the two summer seasons (2008 and 2009) than in the two fall seasons (2008 and 2009), with densities generally higher nearshore than offshore. In summer 2008, a maximum nearshore all-behavior density of 110 occurred at Ocean City. The corresponding sitting density at Ocean City was not nearly as high but was locally higher than in the regions immediately north and south of Ocean City. Outside of Ocean City, nearshore densities were otherwise more uniformly distributed along the coastline for all-behavior birds than for sitting birds. Nearshore sitting densities were highest along the central coastline, moderate in the south, and lowest in the north. Offshore densities were more homogeneously distributed for all-behavior birds than for sitting birds, with lowest densities occurring far-offshore in the northeast and southeast regions of the Study Area. Both all-behavior and sitting densities were lower in summer 2009 compared to one year earlier (summer 2008). In summer 2009, the lowest nearshore densities occurred just south of Ocean City, just south of Barnegat Light, and of Seaside Heights. Nearshore densities are lower and more sporadically distributed for sitting birds than for all-behavior birds, with highest nearshore densities occurring around Brigantine, around and south of Atlantic City, and in the region midway between Ocean City and Hereford Inlet. In summer 2009 (like summer 2008), offshore densities were generally lower than nearshore densities; however, offshore all-behavior densities were more sporadically distributed in summer 2009 than in 2008. Offshore densities of sitting birds were very low in summer 2009, with midshore densities slightly higher than density offshore.

- Long-tailed Duck: winter 2008, winter 2009, spring 2009, and winter 2010 (all-behavior and sitting; **Appendix M: Figures M-392, M-414, M-423, M-438, M-447, M-468, M-475,** and **M-492**).

In spring 2009, high localized densities occurred nearshore for both all-behavior and sitting birds, with nearshore densities generally greater than offshore densities. In the nearshore region, a maximum all-behavior density on the order of 250 and a maximum sitting density of 215 occurred just south of Barnegat Light. Sub-maximum nearshore densities (for all-behavior and sitting birds) also occurred in the vicinity of Barnegat Light. The lowest nearshore densities were located south of Atlantic City to north of Hereford Inlet. Offshore densities are generally low, with the highest offshore densities occurring midshore in the north-central region (in proximity to Barnegat Light) and in the southern region (in proximity to Hereford Inlet).

Among the three winter seasons (2008, 2009, and 2010), all-behavior and sitting densities were lowest in winter 2008, highest in winter 2009, and moderate in winter 2010, with nearshore densities generally higher than offshore densities. In winter 2008, localized regions of maximum nearshore density occurred along Little Egg Inlet, with generally higher densities in the region from Barnegat Light to Brigantine and in the region north of Hereford Inlet. In winter 2009, nearshore densities were high for both all-behavior and sitting birds, with numerous regions of maximum nearshore density occurring in the vicinity of Barnegat Light and in the vicinity of Little Egg Inlet. Maximum nearshore all-behavior densities were on the order of 200 to 300 and higher. Maximum nearshore sitting densities were 110, 275, and 175 north of Barnegat Light, south of Barnegat Light, and Little Egg Inlet, respectively. Smaller sub-maximum nearshore densities also occurred in the region between Ocean City and Hereford Inlet, and the lowest nearshore density occurred just south of Atlantic City.

Offshore densities were lower and more uniformly distributed in space compared to nearshore densities (for both all-behavior and sitting birds), with relatively higher densities midshore than far-offshore. In winter 2010, overall densities for both all-behavior and sitting birds were intermediate between those for winter 2008 (low) and winter 2009 (high). A maximum nearshore all-behavior density (on the order of 50 and higher) occurred just north of Barnegat Light, with a smaller sub-maximum density occurring south of Seaside Heights. Nearshore densities were generally higher along the northern and central coastlines than along the southern coastline, and offshore densities were very low (order of 5-10 and less) throughout the offshore region, for both all-behavior and sitting birds, reflecting the relatively lower survey effort offshore in winter 2010.

- Northern Gannet: spring 2008-2009, summer 2008-2009, fall 2008-2009, and winter 2008, 2009, 2010 (all-behavior and sitting; **Appendix M: Figures M-391, M-396, M-404, M-409, M-417, M-420, M-426, M-431, M-439, M-443, M-450, M-456, M-462, M-474, M-479, M-485,** and **M-495**).

In the two fall seasons (2008 and 2009), high localized densities occurred nearshore for both all-behavior and sitting birds, with nearshore densities higher than offshore densities. In fall 2008, a maximum nearshore all-behavior density of 300 occurred just off Ocean City. A smaller nearshore maximum density (on the order of 50 and higher) was located in the vicinity of Barnegat Light for both all-behavior and sitting birds. Additional nearshore sub-maximum densities were located between Ocean City and Hereford Inlet for all-behavior birds. Offshore, several localized regions of maximum density (for all-behavior birds only) were located midshore in the southern region of the Study Area, southeast of Ocean City. In fall 2009, several nearshore maximum densities occurred for both all-behavior and sitting birds. For all-behavior birds, a maximum nearshore density of 160 occurred between Little Egg Inlet and Barnegat Light, and another maximum density of 290 occurred midshore between Little Egg Inlet and Brigantine. Analogous sitting maximum densities were on the order of 50 and 200. Other regions of sub-maximum densities for all-behavior birds included the nearshore region of Barnegat Light and midshore regions south of Atlantic City, south of Ocean City, and the region between Ocean City and Hereford Inlet.

Comparing the two spring seasons (2008 and 2009) to the two fall seasons (2008 and 2009), overall densities (number/km^2) were generally lower in spring than in fall, with nearshore densities higher than offshore densities. In spring 2008, a localized maximum nearshore density of 240 occurred for all-behavior birds just north of Hereford Inlet. For sitting birds, an analogous maximum nearshore density of a lower magnitude (on the order of 50 and higher) occurred in the same region. A sub-maximum nearshore density also occurred just south of Barnegat Light for both all-behavior and sitting birds.

Densities for both all-behavior and sitting birds were generally lower in spring 2009 compared to one year earlier (spring 2008). In the northern offshore region, a localized maximum density of 155 occurred for all-behavior birds.

Comparing the two summer seasons (2008 and 2009) to the above spring and fall seasons, overall densities were generally lower in summer than in fall and spring, with no localized regions of maximum densities. Densities were generally distributed sporadically in the nearshore and offshore regions, with nearshore densities generally higher than offshore densities. Within the nearshore region, both the all-behavior and sitting densities were generally higher in the northern region (in the vicinity of Barnegat Light) than in the central and southern regions. Within the offshore region, midshore densities were generally higher than far-offshore densities.

Among the three winter seasons (2008-2010 for all-behavior birds, 2008 and 2010 for sitting birds), overall densities were generally lower in winter and summer (non-migration seasons) than in spring and fall. In winter 2008, densities were higher offshore than nearshore. Within the nearshore region, densities were higher in the northern (in the vicinity of Barnegat Light) and central (Little Egg Inlet) regions than elsewhere. In winter 2009, localized regions of maximum density were located nearshore off Barnegat Light and off Little Egg Inlet. The lowest nearshore densities occurred in the southern region, from Hereford Inlet extending up halfway to Ocean City. In winter 2010, nearshore all-behavior density distribution along the coastline was relatively homogeneous, whereas sitting densities exhibited minor localized maxima nearshore in the vicinity of Barnegat Light and around Ocean City and Great Egg Harbor Bay; and nearshore densities were higher than offshore densities for both all-behavior and sitting birds.

- Red-throated Loon: spring 2008 (all-behavior) and winter 2008 (all-behavior and sitting; **Appendix M: Figures M-393, M-399,** and **M-445**).

In spring 2008, bird densities were higher and more uniformly dispersed than offshore densities. Nearshore densities were on the order of 25 and relatively constant over the entire coastline of the Study Area. In the offshore region, low-density patches (order of 5 to 10 and less) occurred in the northern region (in the vicinity of Barnegat Light), south-central region (southeast of Atlantic City and Ocean City), and the extreme southern tip of the Study Area (southeast of Hereford Inlet). In winter 2008, for both all-behavior and sitting birds, both the nearshore and offshore densities are sporadically distributed; however, the offshore gradient in density is reversed between the all-behavior birds (higher densities nearshore than offshore) and sitting birds (higher densities offshore than nearshore), indicating that a greater relative proportion of sitting birds (compared to flying birds) occurs offshore. In the nearshore region, the lowest all-behavior densities occurred in the vicinity of Barnegat Light, in a small region off Little Egg Inlet, and just south of Atlantic City; and the highest sitting densities occurred south of Seaside Heights, along Little Egg Inlet, and in a small region halfway between Ocean City and Hereford Inlet.

- Scaup species: winter 2009 (all-behavior and sitting; **Appendix M: Figures M-415** and **M-469**).

In winter 2009, maximum nearshore densities were located at Little Egg Inlet (1,885) north of Hereford Inlet (510), and near Ocean City (105). Within the nearshore region, densities were generally higher in the central and southern regions (south of Little Egg Inlet) than in the northern regions. Densities were higher nearshore than offshore. Within the offshore region, no spatial gradients were detected for either the all-behavior or the sitting birds, with densities (outside of the above-mentioned localized maxima) generally on the order of 5 to 10 or less.

- Scoter species: fall 2008-2009 (all-behavior), winter 2008 (sitting), spring 2008-2009, summer 2008-2009, winter 2009-2010 (all-behavior and sitting; **Appendix M: Figures M-395, M-408, M-413, M-419, M-434, M-437, M-444, M-449, M-467, M-473,** and **M-491**).

In fall 2008, numerous localized regions of maximum density (all-behavior) were located nearshore and midshore. A nearshore maximum density of 115 occurred in the vicinity of Barnegat Light. Several midshore maximum densities occurred, including: 145 in proximity to Little Egg Inlet; 225 (one among four

localized maxima) southeast of Ocean City; and maxima of 1,445, 1,710, 235, and 235 along a line transect extending southeast of Little Egg Inlet. Because of the magnitude, location, and number of these localized maximum densities, density was higher offshore than nearshore in fall 2008; however, the general offshore density gradient was reversed in fall 2009 (one year later), with higher densities nearshore than offshore. Overall densities were lower in fall 2009 than in fall 2008. In fall 2009, a nearshore maximum density of 110 occurred between Little Egg Inlet and Brigantine, with several nearshore density maxima (order of 25) occurring off Ocean City and Great Egg Harbor Bay and in a region further south of Ocean City. Within the offshore region, densities were generally higher midshore than far-offshore in both fall seasons (2008 and 2009).

In spring seasons (2008 and 2009), localized nearshore and midshore density maxima occurred but in different locations, with sitting densities generally mirroring (but lower in magnitude than) all-behavior densities, reflecting the presence of both flying and sitting birds. For both spring seasons, densities were generally higher nearshore than offshore, and densities were higher in spring 2008 than in spring 2009. In spring 2008 for all-behavior birds, a nearshore maximum density of 730 occurred just south of Ocean City, a maximum that was mirrored by sitting birds, indicating that most/all of the birds in this region were sitting rather than flying. In addition, a sub-maximum nearshore density (on the order of 50 and higher) occurred north of Hereford Inlet, and a maximum midshore density of 135 occurred southeast of Ocean City. In spring 2009, for all-behavior birds, localized nearshore maximum densities of 355 and 145 occurred just south of Barnegat Light, and off Great Egg Harbor Bay, respectively. Analogous density maxima at these two locations were mirrored by the sitting birds but with lower density magnitudes (150 and 140, respectively), reflecting the contributions of both flying and sitting birds to the all-behavior densities. Within the offshore region, midshore densities were generally higher than far-offshore densities, for both spring seasons for both all-behavior and sitting birds.

In winter 2008 for sitting birds, densities were very low (on the order of 5 to 10 and less) in both the nearshore and offshore regions, with the higher densities occurring offshore of Little Egg Inlet, Atlantic City, and Ocean City. Aside from these three broad regions of moderately higher densities, no spatial variability in density was detected in the nearshore or offshore regions.

Both all-behavior and sitting densities were higher in winter 2009 than in winter 2010, reflecting the relatively lower survey effort in winter 2010. In winter 2009, numerous localized density maxima occurred nearshore for all-behavior birds, including: 835 and 310 at and just south of Barnegat Light (not mirrored by sitting birds); 205 in the vicinity of Little Egg Inlet (mirrored by sitting birds at 195); 290, 185, and 275 stretching from Brigantine to south of Atlantic City (mirrored by sitting birds at 285, 285, and 370); 470 just south of Ocean City (mirrored by sitting birds at 460); and 150 between Ocean City and Hereford Inlet (mirrored by sitting birds at 150). The two northern density maxima that were not mirrored by sitting birds indicate that most of the birds in the Barnegat Light region were flying rather than sitting. There were a fewer number of localized nearshore density maxima in winter 2010 than in winter 2009. In winter 2010, a nearshore density maximum of 115 occurred for both all-behavior and sitting birds between Brigantine and Little Egg Inlet (indicating that all of the birds in this region were sitting rather than flying). Several sub-maximum densities (order of 25 and less) occurred at Brigantine and just north of Barnegat Light for both all-behavior and sitting birds. Moving offshore, densities generally decreased, and a sub-maximum density occurred midshore southeast of Atlantic City for all-behavior birds, which was not mirrored by the sitting birds (indicating that most of the birds in this midshore region were flying rather than sitting). For winter seasons (2009 and 2010), all-behavior and sitting densities were higher nearshore than offshore, and densities were higher midshore than far-offshore. In winter 2010, offshore densities were higher in the northern and southern regions than in the central region, reflecting the relatively lower survey effort in the latter region.

- Wilson's Storm-Petrel: fall 2008, fall 2009, summer 2009 (all-behavior), summer 2008 (all-behavior and sitting; **Appendix M: Figures M-403, M-410, M-428, M-435,** and **M-459**).

In fall 2008, a sharp localized offshore density maximum of 485 was located in the southern tip of the Study Area, southeast of Hereford Inlet. Offshore densities were generally higher and more spatially uniform than nearshore densities. Furthermore, within the nearshore region, the highest densities

occurred at the offshore edge rather than up against the coastline. Maximum nearshore densities occurred off the coast in the vicinity of Barnegat Light, in the northern region of the Study Area. In fall 2009, both nearshore and offshore densities were relatively low (order of 25 and less), and densities in both regions were higher in the northern regions of the Study Area than in the southern region. Nearshore densities were lower off Little Egg Inlet, between Brigantine and Atlantic City, and from Hereford Inlet to just south of Ocean City. Likewise, in summer (2008 and 2009), nearshore and offshore densities were similarly lower in magnitude (order of 25 and less), with no distinct localized density maxima. In summer, densities were patchily distributed and were higher offshore than nearshore. In summer 2008, offshore densities were generally higher in the southern than in the northern regions, whereas in summer 2009, offshore densities were highest in the northern region, moderate in the southern region, and lowest in the central region. In summer 2008, nearshore densities were higher around Little Egg Inlet and in regions around and north of Hereford Inlet, compared to other nearshore regions. Densities were relatively lower in summer 2009 than in summer 2008, with the highest nearshore densities occurring in a small region midway between Hereford Inlet and Ocean City.

8.3.1.2 Total-Birds: Seasonal Analysis

Kernel density maps for total all-behavior birds and total sitting birds reflect all bird species in the given time period. For most seasons, nearshore densities were higher than offshore densities (for both all-behavior and sitting birds). Within the offshore region, densities were generally higher midshore than far-offshore.

In fall 2008, numerous localized density maxima were located nearshore, midshore, and offshore as a result of contributions of individual species. A total of 24 detectable density maxima occurred for all-behavior birds within the Study Area, ranging in magnitude from 105 to 1,740 (the latter of which is located midshore southeast of Little Egg Inlet. The majority of these maxima were not mirrored by the sitting birds, indicating that most of the total birds in the regions of these density maxima were flying rather than sitting. Compared to 24 density maxima for all-behavior birds, only four density maxima occurred for the sitting birds: 1) 945 nearshore in the vicinity of Barnegat Light (compared to 1,420 for all-behavior birds); 2) 120 nearshore in the region midway between Little Egg Inlet and Barnegat Light (compared to 135 for all-behavior birds); 3) 145 midshore southeast of Hereford Inlet (compared to 170 for all-behavior birds); 4) 140 far-offshore southeast of Hereford Inlet (compared to 565 for all-behavior birds). Except for this far-offshore density maximum, far-offshore densities were generally lower than midshore densities. Total bird density (all-behavior and sitting) were generally lower in fall 2009 than in fall 2008 (a year earlier). In fall 2009, five localized density maxima occurred for all-behavior birds: 1) 180 nearshore at Barnegat Light (compared to 125 for sitting birds); 2) 260 nearshore between Barnegat Light and Little Egg Inlet (compared to 145 for sitting birds); 3) 300 midshore southeast of Little Egg Inlet (compared to 215 for sitting birds); 4) 300 nearshore just south of Atlantic City (compared to 235 for sitting birds); 5) 100 nearshore just south of Ocean City (mirrored by a sub-maximum density on the order of 50). In addition, numerous density maxima (on the order of 50) for all-behavior birds also occurred, both nearshore and midshore, some of which were mirrored by the sitting birds.

Comparing spring and fall for the 2008 and 2009, densities were relatively lower in spring than in fall. In spring 2008, three distinct localized density maxima occurred for all-behavior birds: 1) 745 nearshore just off Ocean City (compared to 730 for sitting birds, indicating that the majority of the birds in this region were sitting rather than flying); 2) 335 nearshore off Hereford Inlet (mirrored by a sub-maximum density on the order of 50 for sitting birds); 3) 135 km^{-2} midshore southeast of Ocean City (which is not mirrored by the sitting birds). In spring 2009, four distinct localized density maxima occurred for all-behavior birds: 1) 585 nearshore just south of Barnegat Light (compared to 370 for sitting birds); 2) 130 offshore east of Barnegat Light (which is not mirrored by the sitting birds); 3) 150 nearshore between Great Egg Harbor Bay and Atlantic City (compared to 140 for sitting birds); 4) 120 nearshore just off Hereford Inlet (compared to 110 for sitting birds).

Overall densities were generally lower in summer than in fall and spring for 2008 and 2009. In summer 2008, only one distinct localized density maximum occurred: 110 nearshore off Ocean City. Several sub-maximum densities (on the order of 25) occurred for all-behavior birds around Atlantic City and

Brigantine. Densities were generally higher nearshore than offshore, and offshore densities were more patchily distributed for sitting birds than for all-behavior birds. Overall densities were slightly lower in summer 2009 than in summer 2008. In summer 2009, the spatial distribution of all-behavior density was more uniform nearshore than offshore Nearshore sitting bird densities were lowest around Ocean City and Great Egg Harbor Bay, the region between Brigantine and Little Egg Inlet, and a small region just north of Little Egg Inlet.

Among winter and summer, overall densities were generally higher in winter than in summer (for both all-behavior and sitting birds). Among the three winter seasons, densities were generally lowest in 2008, highest 2009, and intermediate in 2010, partly reflecting the lower survey effort in the latter season. In all three winter seasons, densities were higher nearshore than offshore, and all-behavior densities were higher than sitting densities, reflecting the presence of both flying and sitting birds. In winter 2008, two localized density maxima occurred for all-behavior birds: 1) 475 nearshore between Atlantic City and Brigantine; 2) 120 nearshore between Great Egg Harbor Bay and Atlantic City. In winter 2009, densities were higher than in winter 2008 (one year ago), with 13 localized nearshore density maxima occurring for all-behavior birds (ranging from 125 to 1,740) along the entire coastline, from Seaside Heights to Hereford Inlet. Eight of these 13 density maxima were mirrored by the sitting birds (ranging from 170 to 1,715). In winter 2010, five localized nearshore density maxima occurred: 1) 135 nearshore in the vicinity of Barnegat Light (compared to 110 for sitting birds); 2) 105 nearshore between Little Egg Inlet and Barnegat Light; 3) 235 nearshore between Brigantine and Little Egg Inlet (compared to 105 for sitting birds); 4) 120 nearshore at Brigantine (compared to 50 for sitting birds); 5) 105 nearshore midway between Ocean City and Hereford Inlet (compared to 50 for sitting birds).

8.3.1.3 Total Birds: Annual and Overall Cumulative Analysis

Kernel density maps were estimated for all-behavior and sitting densities for 2008 and 2009, and the combined two-year period 2008-2009. Numerous localized density maxima for all-behavior and sitting birds were located nearshore, midshore, and far-offshore, with the vast majority of these maxima occurring nearshore. A small portion of these density maxima for all-behavior birds are mirrored by the sitting birds, reflecting differences in the numbers of flying and sitting birds. For example, eight and 15 localized sitting density maxima occurred in 2008 and 2009, respectively; and 24 such maxima occurred in the overall cumulative two-year period, most of which occurred nearshore. In 2008, the eight sitting density maxima ranged from 110 to 830 (the latter occurring in the vicinity of Barnegat Light); and in 2009, the 15 sitting density maxima ranged from 115 to 735 (the latter occurring in the vicinity of Little Egg Inlet). In the overall cumulative two-year period, the 24 sitting density maxima ranged from 115 to 1,480 (the latter occurring in the vicinity of Little Egg Inlet). For the all-behavior birds, the highest density maxima were 1,425 in 2008 (midshore southeast of Little Egg Inlet), 1,730 in 2009 (nearshore in the vicinity of Little Egg Inlet), and 1,805 (on the offshore edge of the nearshore region, between Little Egg Inlet and Brigantine).

Observing these annual and overall cumulative spatial kernel density maps, the following general conclusions can be made:

1) Nearshore densities are higher than offshore densities, supporting an offshore gradient of decreasing densities with increasing offshore distance.

2) Within the offshore region, midshore densities were generally higher than far-offshore densities.

3) All-behavior densities were higher than sitting densities, reflecting the presence of both all-behavior and sitting birds.

4) The highest nearshore densities occurred up against the coastline rather than on the offshore edge of the nearshore region.
5) All-behavior density maxima that are mirrored by sitting birds reflect a balance between flying and sitting birds. If the sitting density is less than the all-behavior density, then both flying and sitting

birds are present. If the sitting density is equal to or near the all-behavior density, then most/all of the birds in the given region are sitting rather than flying.

6) All-behavior density maxima that are not mirrored by sitting birds indicate that the majority of birds in the given region were flying rather than sitting.

8.3.1.4 Annual Analysis

- Year 2008 (**Appendix M: Figures M-497** to **M-502** and **Figures M-509** to **M-514**).

For 2008, the top five most abundant all-behavior species were Scoter species, Northern Gannet, Laughing Gulls, Herring Gull, and Wilson's Storm-Petrel; and the top five most abundant sitting species were Scoter species, Laughing Gull, Northern Gannet, Great Black-backed Gull, and Herring Gull (**Appendix M: Table M-44**).

For Scoter species, ten localized all-behavior density maxima (along with several sub-maximum densities on the order of 25 to 50 and higher) were estimated nearshore and midshore, ranging from 120 to 760 (the latter occurring midshore southeast of Little Egg Inlet). In addition to 760, other high density maxima include 720 (nearshore off Barnegat Light), 660 (nearshore off Little Egg Inlet), and 530 (nearshore off Ocean City). Most of these ten maxima are clustered nearshore around Barnegat Light, midshore southeast of Little Egg Inlet, nearshore off Atlantic City, and nearshore/midshore around Ocean City. Only two of these ten density maxima were mirrored by the Scoter species sitting birds: 1) 165 (all-behavior) versus 120 (sitting) nearshore just south of Atlantic City; 2) 775 (all-behavior) versus 530 (sitting) nearshore off Ocean City.

For Northern Gannet, two localized all-behavior density maxima (along with several sub-maximum densities on the order of 25 to 50) were estimated: 1) 250 nearshore off Ocean City (which was not mirrored by the sitting birds); 2) 245 nearshore north of Hereford Inlet (compared to 105 for sitting birds). In addition, a vague sub-maximum density (on the order of 25 to 50) for both all-behavior and sitting birds was located nearshore in the vicinity of Barnegat Light.

For Laughing Gull, four localized all-behavior density maxima (along with several sub-maximum densities on the order of 25 to 50) were estimated: 1) 685 nearshore in the vicinity of Barnegat Light (compared to 555 for sitting birds); 2) 110 nearshore off Ocean City (which was not mirrored by the sitting birds); 3) 145 nearshore north of Hereford Inlet (compared to a sub-maximum density on the order of 25); 4) 200 midshore southeast of Hereford Inlet (compared to 185 for sitting birds).

For Herring Gull, two localized all-behavior density maxima (along with several sub-maximum densities on the order of 25 to 50) were estimated: 1) 180 nearshore midway in the vicinity of Barnegat Light (compared to 130 for sitting birds); 2) 110 nearshore south of Ocean City (which was not mirrored by the sitting birds). In addition, sub-maximum densities (on the order of 25 to 50) were located nearshore between Atlantic City and Great Egg Harbor Bay (for all-behavior birds only), and between Barnegat Light and Little Egg Inlet (for both all-behavior and sitting birds).

For Wilson's Storm-Petrel, one localized all-behavior density maximum was estimated: 500 offshore in the southeast corner of the Study Area, southeast of Hereford Inlet. Moderate densities (on the order of 25-50) were patchily distributed nearshore and were generally higher offshore than nearshore.

For Great Black-backed Gull, one localized sitting density maximum was estimated: 130 nearshore in the vicinity of Barnegat Light. In addition, one sub-maximum density on the order of 25 to 50 was located nearshore just north of this maximum density.

- Year 2009 (**Appendix M: Figures M-503** to **M-508,** and **Figures M-515** to **M-520**).

For 2009, the top five most abundant all-behavior species were Scoter species, Northern Gannet, Long-tailed Duck, Herring Gull, and Scaup species; and the top five most abundant sitting species were Scoter

species, Long-tailed Duck, Northern Gannet, Common Loon, and Scaup species (**Appendix M: Table M-44**).

For Scoter species, nine localized all-behavior density maxima (including one vague sub-maximum density on the order of 50) were estimated in nearshore and midshore waters, ranging from 135 to 345 (the latter occurring nearshore just south of Barnegat Light). Each of these nine density maxima was mirrored by the sitting Scoter species: 1) 345 (all-behavior) versus 135 (sitting) nearshore just south of Barnegat Light; 2) 215 (all-behavior) versus 205 (sitting) nearshore in the vicinity of Little Egg Inlet; 3) 145 (all-behavior) versus 115 (sitting) nearshore southeast of Little Egg Inlet; 4-6) 235, 240, and 295 (all-behavior) versus 230, 230, and 250 (sitting) nearshore around Atlantic City and Brigantine; 7) 135 (all-behavior) versus 145 (sitting) nearshore at and north of Ocean City and Great Egg Harbor Bay; 8-9) 215 and a sub-maximum density on the order of 50 and higher (all-behavior) versus 205 and 105 (sitting) midshore midway between Hereford Inlet and Ocean City.

For Northern Gannet, four localized all-behavior density maxima (along with several vague sub-maximum densities on the order of 25 to 50 and higher) were estimated: 1) 140 offshore east of Barnegat Light (which was not mirrored by the sitting birds); 2) 155 nearshore between Little Egg Inlet and Barnegat Light (mirrored by a sub-maximum sitting density on the order of 25 to 50 and higher); 3) 305 midshore southeast of Little Egg Inlet (compared to 225 for sitting birds); 4) 110 midshore south of Atlantic City (mirrored by a sub-maximum sitting density on the order of 50 and higher).

For Long-tailed Duck, four localized all-behavior density maxima (along with several sub-maximum densities on the order of 25 to 50 and higher) were estimated: 1) 265 nearshore south of Seaside Heights (compared to 125 for sitting birds); 2-3) 230 and 390 nearshore around Barnegat Light (compared to 220 and 340 for sitting birds); 4) 180 nearshore in the vicinity of Little Egg Inlet (compared to 165 for sitting birds). In addition, a sub-maximum density (on the order of 50 and higher) was located for both all-behavior and sitting birds nearshore midway between Hereford Inlet and Ocean City.

For Scaup species, two localized all-behavior density maxima were estimated: 1) 1,885 nearshore in the vicinity of Little Egg Inlet (compared to 1,885 for sitting birds); 2) 510 nearshore north of Hereford Inlet (which was not mirrored by the sitting birds). In addition, a sub-maximum density (on the order of 25 to 50) was located nearshore south of Ocean City for all-behavior birds.

For Herring Gull, several maximum all-behavior densities (on the order of 25 to 50 and higher) were located nearshore and offshore. Nearshore locations include a region midway between Hereford Inlet and Ocean City, and a stretch of isolated regions from south of Seaside Heights to Little Egg Inlet; and the offshore regions include sporadic areas east of Barnegat Light.

For Common Loon, one localized sitting density maximum was generated: 160 nearshore at Hereford Inlet. In addition, several sub-maximum sitting densities (on the order of 25 and less) were located: nearshore region north of Hereford Inlet; regions along Little Egg Inlet; and a region at Barnegat Light.

- Overall Cumulative Two-year Period (**Appendix M: Figures M-521** to **M-532**).

For the two-year period, the top five most abundant all-behavior species were Scoter species, Northern Gannet, Laughing Gull, Long-tailed Duck and Herring Gull; and the top five most abundant sitting species were Scoter species, Northern Gannet, Long-tailed Duck, Common Loon and Laughing Gull (**Appendix M: Table M-44**).

For scoter species, 15 localized all-behavior density maxima (along with several sub-maximum densities on the order of 25 to 50 and higher) were estimated in nearshore and midshore waters, ranging from 115 to 945 (the latter occurring midshore southeast of Little Egg Inlet). Eight of these density maxima were mirrored by sitting Scoter species, including: 1) 305 (all-behavior) versus (sitting) nearshore south of Barnegat Light; 2) 220 (all-behavior) versus 210 (sitting) nearshore in the vicinity of Little Egg Inlet; 3) 945 (all-behavior) versus 120 (sitting) nearshore between Little Egg Inlet and Brigantine; 4) 285 (all-behavior) versus 280 (sitting) nearshore south of Brigantine; 5) 420 (all-behavior) versus 345 (sitting) nearshore just

south of Atlantic City; 6) 155 (all-behavior) versus 150 (sitting) nearshore between Atlantic City and Ocean City; 7) 725 (all-behavior) versus 690 (sitting) nearshore between just off Ocean City; 8) 220 (all-behavior) versus 210 (sitting) nearshore midway between Hereford Inlet and Ocean City.

For Northern Gannet, eight localized all-behavior density maxima (along with several sub-maximum densities on the order of 25 to 50 and higher) were estimated: 1) 130 offshore east of Barnegat Light (which was not mirrored by the sitting birds); 2) 105 nearshore at Barnegat Light (which was not mirrored by the sitting birds); 3) 135 and 160 nearshore between Little Egg Inlet and Barnegat Light (mirrored by a sub-maximum sitting density on the order of 50 and higher); 4) 275 midshore southeast of Little Egg Inlet (compared to 205 for sitting birds); 5) 255 just off Ocean City (which was not mirrored by the sitting birds); 6) 180 nearshore midway between Hereford Inlet and Ocean City (mirrored by a sub-maximum sitting density on the order of 50 and higher); 7) 260 nearshore north of Hereford Inlet (compared to 110 for sitting birds).

For Laughing Gull, nine localized all-behavior density maxima (along with several vague sub-maximum densities on the order of 25 to 50 and higher) were estimated: 1-2) 110 and 555 nearshore in the vicinity of Barnegat Light (compared to 110 and 430 for sitting birds); 3) 165 nearshore midway between Little Egg Inlet and Barnegat Light (compared to 155 for sitting birds; 4) 120 nearshore along Little Egg Inlet (mirrored by a sub-maximum sitting density on the order of 25 to 50 and higher); 5) 100 nearshore just off Ocean City (which was not mirrored by the sitting birds); 6) 105 nearshore south of Ocean City (compared to 105 for sitting birds); 7) 125 nearshore north of Hereford Inlet (compared to 125 for sitting birds); 8) 130 nearshore off Hereford Inlet (compared to 110 for sitting birds); 9) 195 midshore southeast of Hereford Inlet (compared to 180 for sitting birds).

For Long-tailed Duck, five localized all-behavior density maxima (along with several vague sub-maximum densities on the order of 25 to 50 and higher) were estimated: 1) 250 nearshore in the vicinity of Barnegat Light (mirrored by a sub-maximum sitting density on the order of 25 to 50 and higher); 2-4) 150, 245, and 375 in the vicinity of Little Egg Inlet (compared to 115, 230, and 325 for sitting birds); 5) 200 nearshore in the vicinity of Little Egg Inlet (compared to 180 for sitting birds). In addition, a sub-maximum density (on the order of 50 and higher) occurred for both all-behavior and sitting birds nearshore midway between Hereford Inlet and Ocean City.

For Herring Gull, three localized all-behavior density maxima (along with several sub-maximum densities on the order of 25 to 50) were estimated: 1) 205 nearshore in the vicinity of Barnegat Light; 2) 155 nearshore between Little Egg Inlet and Barnegat Light; 3) 105 nearshore south of Ocean City. Herring Gull sitting birds were not included among the top five most abundant species.

For Common Loon, one localized sitting density maximum was estimated: 205 nearshore at Hereford Inlet. In addition, several vague sub-maximum sitting densities (on the order of 25 and less) occurred: nearshore region north of Hereford Inlet; regions along Little Egg Inlet; and a region at Barnegat Light. Common Loon all-behavior birds were not included among the top five most abundant species.

8.4 GENERALIZED ADDITIVE MODELS AND SPATIAL REGRESSION MODELS

Spatial models were used for assessing relationships between covariates on avian density and distribution. Figures and tables for these tables are located in **Appendix M**.

8.4.1 Modeling Summary Total Birds: All Years and Seasons

Total bird density (all behavior) was modeled to determine the primary attributes (among the candidates longitude, latitude, depth, slope, distance to shoreline, and distance to nearest shoal) for predicting where birds are likely to concentrate along the New Jersey coastline. In summary, across all years and seasons, the spatial lag model shows that the density of total birds is spatially auto-correlated and related to depth and distance to shoreline (**Table M-1**). Furthermore, slightly more birds were encountered in 2008 than in 2009 (**Figure M-7**), but overall, bird density is greatest in the fall (**Figure M-8**). The best selected GAM included depth, distance to shoreline, longitude, and latitude (**Table M-2**). For example, the effect of

depth on predicting changes in total bird density was positive, indicating that bird density declined in waters greater than 20 m (65.6 ft; **Figure M-9**). The effect of distance from shoreline shows that bird density declined with increasing distance from the shoreline, especially with distances greater than 40,000 ft (7.6 mi, **Figure M-10**). Overall, in examining the combined effects of latitude and longitude, spatial distribution of bird density was greatest in the southwest region of the Study Area (**Figures M-11** and **M-12**).

8.4.1.1 Total Birds: Fall

Total bird density and distribution in fall was clustered and bird aggregations were dense and patchy (**Table M-6**). The spatial lag model shows that depth was the most important factor for predicting the spatial variability of bird aggregations in fall (**Table M-6**). The best selected GAM for predicting changes in bird density and distribution in fall included depth, distance to shoreline, longitude, and latitude (**Table M-7**). Bird density and distribution declined steeply in waters greater than 20 m (65.6 ft; **Figure M-13**), and approximately 40,000 ft (7.6 mi) from the coastline (**Figure M-14**). Furthermore, the effect of spatial variation attributed to longitude and latitude on bird density indicates that during fall there are more birds in the southwest region of the Study Area (**Figures M-15** and **M-16**).

8.4.1.2 Total Birds: Spring

Total bird density and distribution in spring was spatially auto-correlated indicating that bird aggregations were dense and patchy (**Table M-8**). The spatial lag model shows that longitude and latitude are the important factors for predicting the spatial variability of bird aggregations in spring (**Table M-8**). The best selected GAM for predicting changes in bird density and distribution in spring included depth, distance to shoreline, longitude, and latitude (**Table M-9**). Bird density and distribution increased in waters greater than 20 m (65.6 ft; **Figure M-17**), and approximately 30,000 ft (5.7 mi) from the coastline (**Figure M-18**). Furthermore, the effect of spatial variation attributed to longitude and latitude on bird density indicates that during spring there are more birds in the western region along the entire north-south extent of the Study Area (**Figures M-19** and **M-20**).

8.4.1.3 Total Birds: Summer

Although bird density in summer was less than in other seasons, they were still found in dense patches and were spatially auto-correlated (**Table M-10**). The spatial lag model shows that depth, distance to shoreline, and latitude are important factors for predicting the spatial variability of bird aggregations in summer (**Table M-10**). The best selected GAM for predicting changes in bird density and distribution in summer included depth, distance to shoreline, distance to nearest shoal, longitude and latitude (**Table M-11**). The effect of depth on summer bird density and distribution showed that birds were concentrated in waters <10 m (32.8 ft) and increased in waters greater than 30 m (98.4 ft; **Figure M-21**). The effect of distance to shoreline indicated that bird density and distribution declined steeply after approximately 60,000 ft (11.4 mi) from the coastline (**Figure M-22**). In addition, bird density was associated with shoals (**Figure M-23**). The effect of spatial variation attributed to longitude and latitude on bird density indicates that during summer there are more birds in the southeastern region of the Study Area (**Figures M-24 and M-25**).

8.4.1.4 Total Birds: Winter

Total bird density and distribution in winter is clustered, indicating bird aggregations were dense and patchy (**Table M-12**). The spatial lag model shows that depth and distance to nearest shoal are important factors for structuring the spatial variability of bird aggregations in winter (**Table M-12**). The best selected GAM for predicting changes in bird density and distribution in winter included all variables: depth, slope, distance to shoreline, distance to nearest shoal, longitude, and latitude (**Table M-13**). Bird density and distribution decreased steeply in waters greater than 15 m (49.2 ft; **Figure M-26**), and approximately 40,000 ft (7.6 mi) from the coastline **Figure M-28**). The effect of distance to nearest shoal was a predictor of bird density and distribution indicating that birds exhibited an affinity for shallow water (**Figure M-29**). Furthermore, the effect of spatial variation attributed to longitude and latitude on bird density indicates

that during spring there are more birds in the western region along the entire north-south extent of the Study Area (**Figures M-30** and **M-31**). Together, the effect of spatial covariates on winter bird density suggests the importance of shallow habitat features in the southeast.

8.4.1.5 Total Sitting Birds: All Years and Seasons

In summary, across all years and seasons, the spatial lag model shows the density of total sitting birds is clustered and the spatial variability of bird aggregations is related to depth and distance to nearest shoal (**Table M-14**). Furthermore, the probability of encountering sitting birds was greater in 2009 than in 2008. (**Figure M-32**), but overall, sitting bird density is similar in fall, spring, and winter with fewer birds in summer (**Figure M-33**). This is likely attributed to the seasonal presence/absence of wintering diving ducks.

The best selected GAM for predicting changes in total sitting bird density included depth, distance to shoreline, and latitude (**Table M-15**). For example, the effect of depth on predicting changes in total bird density was positive, indicating that bird density declined sharply in waters greater than 15 m (49.2 ft; **Figure M-34**). The effect of distance from shoreline shows that sitting bird density declined with increasing distance from the shoreline; approximately around distances greater than 20,000 ft (3.8 mi) from the coastline (**Figure M-35**). The effect of latitude (north/south variation) suggests that sitting bird density was relatively evenly concentrated along the coastline (**Figure M-36**). This is likely attributed to seasonal concentrations of diving ducks.

8.4.1.6 Total Sitting Birds: Fall

The spatial lag model shows that the density of total sitting birds in fall is clustered and the spatial variability of bird aggregations is related to depth, slope, and distance to nearest shoal (**Table M-16**). The best selected GAM for predicting changes in sitting bird density in fall included all covariates: depth, slope, distance to shoreline, distance to nearest shoal, latitude, and longitude (**Table M-17**). For example, the effect of depth on predicting changes in total bird density was positive, indicating that bird density declined sharply in waters greater than 20 m (65.6 ft; **Figure M-37**). The effect of slope indicated an increase in sitting bird density in waters where the slope increased by one degree (**Figure M-38**). The effect of distance from shoreline shows that sitting bird density in fall declined with increasing distance from the shoreline; approximately around distances greater than 20,000ft (3.8 miles) from the coastline (**Figure M-39**). The effect of latitude and longitude (northeast/southwest variation) suggests that sitting bird density similar in the north and south portion of the Study Area (**Figures M-41** and **M-42**).

8.4.1.7 Total Sitting Birds: Spring

The spatial lag model shows that the density of total sitting birds in spring is clustered and the spatial variability of bird aggregations is related to distance to nearest shoal and longitude (**Table M-18**). The best selected GAM for predicting changes in sitting bird density in spring included depth, distance to shoreline, longitude, and latitude (**Table M-19**). For example, the effect of depth on predicting changes in total sitting bird density was negative, indicating that bird density declined in waters less than 20 m (65.6 ft; **Figure M-43**). The effect of distance from shoreline shows that sitting bird density in spring declined approximately 20,000 ft (3.8 mi) from the coastline, but increased again after 90,000 ft (17 mi; **Figure M-44**), indicating that sitting birds occurred in both inshore and offshore waters. The effect of latitude and longitude on total sitting birds in spring suggests that birds were more abundant in the northwest region of the Study Area (**Figures M-45** and **M-46**).

8.4.1.8 Total Sitting Birds: Summer

The spatial lag model shows that the density of total sitting birds is spatially auto-correlated and the spatial variability of bird aggregations is related to distance to nearest shoal (**Table M-20**). The best selected GAM for predicting changes in sitting bird density in summer included depth, distance to shoreline, distance to nearest shoal, longitude, and latitude (**Table M-21**). The effect of depth on predicting changes in total sitting bird density showed that bird density increased in waters greater than 30m (**Figure M-47**). Moreover, the effect of distance from shoreline shows that sitting bird density in spring declined approximately 60,000 ft (11.4 mi) from the coastline, but increased again at 120,000 ft (22.3 mi) from the coastline (**Figure M-48**), indicating that sitting birds occurred in both inshore and offshore waters. Sitting birds were positively associated with shoals and density peaked around 60,000ft (11.4 miles), possibly indicating that birds were present between shoals (**Figure M-49**). The effect of latitude and longitude on total sitting birds in summer suggests that birds were abundant inshore and offshore, especially at mid-latitudes in the Study Area (**Figures M-50** and **M-51**).

8.4.1.9 Total Sitting Birds: Winter

The spatial lag model shows that the density and spatial variability of total sitting birds is related to depth and distance to nearest shoal (**Appendix M: Table M-22**); however, the best selected GAM for predicting changes in sitting bird density in winter included depth, and distance to shoreline, (**Table M-23**). Bird density declined in waters greater than 10 m (32.8 ft), indicating that birds were selecting to sit in shallow waters depth (i.e., principally diving ducks closer to the coastline; **Figure M-52**). Moreover, the effect of distance from shoreline shows that sitting bird density in winter declined approximately 20,000 ft (3.8 mi) from the coastline, further supporting the importance of nearshore habitat utilized by birds (**Figure M-53**).

8.4.2 Modeling Summary Species Accounts

8.4.2.1 Northern Gannet

Northern Gannets were highly conspicuous members of the avian community and were present in all seasons. There were slightly more gannets present in 2009 than in 2008 (**Figure M-54**), and there were more gannets in fall and spring than in summer and winter (**Figure M-55**), indicating that seasonal transitions are important factors for predicting the presence of gannets in the Study Area. The spatial variability of northern gannet density was modeled across all seasons using spatial regression models. A relationship was not found between spatial covariates and the spatial variability of Northern Gannet aggregations (**Table M-24**); however, a GAM fitted to the density of Northern Gannets revealed a complex relationship between spatial covariates and predicting changes in bird density at sea (**Table M-25**). The best selected GAM included depth, distance to shoreline, distance to nearest shoal, longitude and latitude (**Table M-25**). The density of Northern Gannets were chiefly found in waters greater than 10 m (**Figure M-56**), and ranged approximately 50,000 ft (9.5 mi) from the coastline (**Figure M-57**). In addition, Northern Gannets were highly associated with shoals and were typically found within 10,000 ft (1.9 mi) from the nearest shoal (**Figure M-58**). In relation to changes in latitude and longitude, the probability of encountering Northern Gannets increased in the southwest region of the Study Area (**Figures M-59** and **M-60**). Together, these results suggest that predicting changes in density of Northern Gannets is governed by the presence of shoals, within 50,000 ft (9.5 mi) from the coastline in the southwest region of the Study Area.

8.4.2.2 Diving Ducks

Changes in density of diving ducks were modeled to assess the importance of coastal habitat for these species that are abundant in winter off of New Jersey. These species are typically found in large aggregations that are persistent throughout winter months in coastal waters. The spatial variability of Scoters and Long-tailed Ducks was chosen to be modeled.

Species of Scoters (Surf, Black, and White-winged) were combined to examine the relative importance of coastal habitat utilized by these diving birds. There were slightly more Scoters present in 2008 than in

2009 (**Figure M-61**), and there were more Scoters in winter than in fall and/or spring (**Figure M-62**), indicating these birds reach peak density levels in winter. The spatial variability of Scoter density across all seasons was modeled using spatial regression models. The spatial variability of Scoter aggregations was found to be influenced by distance to shoreline and longitude and latitude (**Table M-26**), indicating that Scoters were selecting specific regions along the New Jersey coastline. This is visualized in the kernel density maps. A GAM fitted to the density of Scoters shows the effect of each spatial covariate on predicting changes in bird density (**Table M-27**). The best selected GAM included depth, distance to shoreline, distance to nearest shoal, longitude, and latitude (**Table M-27**). The density of Scoters peaked in waters 10 m (**Figure M-63**), and ranged approximately 20,000 ft (3.8 mi) from the coastline, but declined 40,000-60,000 ft (7.6-11.4 mi) and increased again offshore at approximately 100,000 ft (19 mi) from the coast (**Figure M-64**). In addition, Scoters were highly associated with shoals and were typically found within 10,000 ft (1.9 mi) to 20,000 ft (3.8 mi) from shoals (**Figure M-65**), which may possibly indicate that they are feeding at and between shoals. In relation to changes in latitude and longitude, the probability of encountering Scoters increased moving west (inshore) and north in the Study Area (**Figures M-66** and **M-67**).

There were more Long-tailed Ducks in 2009 than in 2008 (**Figure M-68**), and there were more ducks present in winter than in spring (**Figure M-69**). The spatial variability of Long-tailed Duck density was modeled across winter and spring using spatial regression models. The spatial variability of Long-tailed Duck aggregations was found to be influenced by depth, slope and distance to shoals (**Table M-28**), indicating that Long-tailed Ducks were selecting specific regions along the New Jersey coastline. This is visualized in the kernel density maps. A GAM fitted to the density of Long-tailed Ducks shows the effect of each spatial covariate on predicting changes in bird density (**Table M-29**). The best selected GAM included slope, distance to shoreline, distance to nearest shoal, longitude, and latitude (**Table M-29**). The density of Long-tailed Ducks peaked in waters where the slope was 2° (**Figure M-70**), and ranged approximately 50,000 ft (9.5 mi) from the coastline, but declined steadily thereafter (**Figure M-71**). In addition, Long-tailed Ducks were positively associated with distance to shoals and were typically found 30,000 ft (5.7 mi) from shoals (**Figure M-72**). In combination with the effect of slope, it is possible that Long-tailed Ducks are concentrating on the edges of the shoals. In relation to changes in latitude and longitude, the probability of encountering Long-tailed Ducks increased greatly beyond -74.2°W (moving east) and their density was greater in the southern portion of the Study Area (**Figures M-73** and **M-74**).

8.4.2.3 Loons

The survey data reported more Common Loons in 2009 than in 2008 (**Figure M-75**) and were present in spring, fall and winter (**Figure M-76**) (loons migrate further north to breeding grounds during summer). The spatial variability of Common Loons was modeled across fall, winter and spring using spatial regression models. We found that the spatial variability of Common Loons is influenced by depth (**Table M-30**). A GAM fitted to the density of Common Loons shows the effect of each spatial covariate on predicting changes in bird density (**Table M-31**). The best selected GAM included depth and longitude (**Table M-31**). The density of Common Loons declined steeply with increasing depth and the density of loons is generally located in water depths up to 10 m (32.8 ft; **Figure M-77**). This can also be seen in the effect of longitude on Common Loon density (**Figure M-78**). Loon density declined steeply between -74.8° to -74.6° longitudes and change in density flattened out thereafter suggesting that Common Loons are tightly coupled to the coastline of New Jersey. Therefore, the probability of encountering Common Loons decreases greatly beyond -74.6°W (moving east).

The survey data reported more Red-throated Loons in winter than in spring (**Figure M-79**). The spatial variability of Red-throated Loons was modeled across winter and spring using spatial regression models. The spatial variability of Red-throated Loons was found to be influenced by distance to shoreline, longitude, and latitude (**Table M-32**). A GAM fitted to the density of Red-throated Loons shows the effect of each spatial covariate on predicting changes in bird density (**Table M-33**). The best selected GAM included depth, distance to shoreline, distance to shoal, longitude, and latitude (**Table M-33**). The density of Red-throated Loons declined gradually with increasing depth and showed no effect after 20 m (65.6 ft), indicating that loons were utilizing waters ranging from 1 to 20 m (3.3 to 65.6 ft) in depth (**Figure M-80**). The effect of distance to shoreline showed that the density of loons utilizing onshore and offshore waters

(**Figure M-81**, ranging between 0 to 40,000 ft (7.6 mi) inshore and 90,000 (17 mi) to 120,000 ft (23 mi) offshore). The effect of distance to shoal shows that the density of loons was generally located between 20,000 (3.78 mi) and 60,000 ft (11.4 mi) from shoals (**Figure M-82**). The probability of encountering Red-throated Loons increased when moving west at mid-latitudes in the survey area (**Figures M-83** and **M-84**).

8.4.2.4 Gulls and Terns

Changes in density of Herring Gulls were modeled to determine factors important for predicting their location. The survey data reported more Herring Gulls in 2009 than in 2008 and slightly fewer gulls in summer compared to fall, spring, and winter (**Figures M-85** and **M-86**). The spatial variability of Herring Gulls was modeled using spatial regression models and found that all spatial covariates were important in predicting the clustering of gull aggregations (**Table M-34**). A GAM fitted to the density of Herring Gulls shows the effect of each spatial covariate on predicting changes in bird density (**Table M-35**). The best selected GAM included depth, slope, distance to shoreline, distance to shoal, longitude, and latitude (**Table M-35**); however, due to their conspicuousness in coastal waters, the only clear effects on gull density were depth, distance to shoreline, longitude, and latitude. The effect of depth on gull density declined steeply and showed that gulls were chiefly occupying water depths between 1 to 15 m (3.3 to 49.2 ft; **Figure M-87**). The largest gull densities were encountered offshore (distances greater than 60,000 ft (11.4 mi) from the coastline, (**Figure M-89**). The probability of encountering Herring Gulls increased moving west and there were more birds at southern latitudes (**Figures M-91** and **M-92**).

The survey data reported no difference in density of Laughing Gulls in 2008 and 2009, but there were more gulls present in fall than in summer (**Figures M-93** and **M-94**). This is attributed to the fact that Laughing Gulls are local breeders off New Jersey and the increase in gull density in fall is likely attributed to young birds recruiting to the population. The spatial variability of Laughing Gulls was modeled using spatial regression models. Depth and distance to shoal were important in predicting the clustering of gull aggregations (**Table M-36**). A GAM fitted to the density of Laughing Gulls shows the effect of each spatial covariate on predicting changes in bird density (**Table M-37**). The best selected GAM included depth, distance to shoreline, longitude, and latitude (**Table M-37**). The effect of depth on gull density showed that gulls were chiefly occupying water depths between 1 to 15 m (**Figure M-95**). The effect of distance to shoreline on gull density declined steeply with increasing distance and showed that gulls were found from the shoreline up to 25,000 ft (4.7 mi) from the coast (**Figure M-96**). The probability of encountering Laughing Gulls declined when west and north (**Figures M-97** and **M-98**).

Changes in density of Common Terns were modeled to determine factors important for predicting their location. Common Terns are local breeders in New Jersey and are typically found during summer months (**Figure M-99**). The spatial variability of Common Terns was modeled using spatial regression models. Distance to shoreline, longitude and latitude were important in predicting the clustering of tern aggregations (**Table M-38**). A GAM fitted to the density of Common Terns shows the effect of each spatial covariate on predicting changes in bird density (**Table M-39**). The best selected GAM included distance to shoreline, distance to shoal, longitude, and latitude (**Table M-39**). The effect of distance to shoreline on tern density showed that terns were found from the shoreline up to 60,000 ft (11.4 mi) from the coast (**Figure M-100**). In addition, tern density increased slightly with increasing distance from shoals (**Figure M-101**). The probability of encountering Common Terns increased greatly when moving south and east in the survey area (i.e., declined moving northwest, **Figures M-102** and **M-103**).

8.4.2.5 Storm-Petrels and Shearwaters

Although storm-petrels and shearwaters occur less frequently than the other species reported, their densities tend to dominate the summer avifauna off of the coast of New Jersey. In 2008, there was an influx of Wilson's Storm-Petrels and Cory's Shearwaters in the survey area. The densities of storm-petrels and shearwaters were modeled to investigate the effect of spatial covariate on predicting changes in their density in the Study Area. These species are generally found in offshore waters.

The spatial variability of Wilson's Storm-Petrels was modeled using spatial regression models and found that depth and distance to shoreline are important in predicting the clustering of storm petrel aggregations (**Table M-40**). A GAM fitted to the density of Wilson's Storm-Petrels shows the effect of each spatial covariate on predicting changes in bird density (**Table M-41**). The best selected GAM included depth, distance to shoreline, distance to shoal, longitude, and latitude (**Table M-41**). The effect of depth on storm-petrel density showed that petrels were found in waters up to 20 m (**Figure M-104**). The effect of distance from shoreline on storm-petrels showed that storm-petrel density increased sharply after 50,000 ft (9.8 mi) from the coastline (**Figure M-105**). In addition, storm-petrel density increased slightly with increasing distance from shoals (**Figure M-106**). The probability of encountering Wilson's Storm-Petrels increased greatly when moving north and west in the survey area (i.e., declined moving southeast; **Figures M-107** and **M-108**).

The spatial variability of Cory's Shearwaters was modeled using spatial regression models. Distance to shoals was important in predicting the clustering of shearwater aggregations (**Table M-42**). A GAM fitted to the density of Cory's Shearwaters shows the effect of each spatial covariate on predicting changes in bird density (**Table M-43**). The best selected GAM included depth, distance to shoreline, distance to shoal, longitude, and latitude (**Table M-43**). The effect of depth on shearwater density showed that shearwaters were principally found in deeper waters, with their density steeply increasing in waters greater than 30 m (98.4 ft; **Figure M-109**). The effect of distance from shoreline on shearwaters showed that their density decreased moving offshore to 20,000 ft (3.29 mi) and increased abruptly after 90,000 ft (17 mi) from the coastline (**Figure M-110**). Shearwater density showed a peak around 60,000 ft (11.4 mi) from shoals (**Figure M-111**). The effect of longitude shows that increased shearwater density occurred in the east at mid-latitudes in the survey area (**Figures M-112** and **M-113**).

8.5 DISCUSSION

Two years of shipboard surveys were synthesized to model and predict the spatial distribution of birds using kernel density interpolation and spatial regression. Spatial models were developed to quantify the effect of each spatial covariate for predicting changes in bird density and distribution. In summary, along with the kernel density maps that show where/when birds are likely to concentrate, the modeling showed that distance to shoreline and depth are useful and important predictors of changes in bird density and distribution. The total bird density was greater in the southeast portion of the Study Area during fall, summer, and winter, but was more concentrated in the north during spring; however, this pattern was not consistent across all species (**Appendix M: Tables M-2** and **M-3**). Therefore, the density and distribution of bird species in New Jersey coastal waters is dynamic with respect to seasonality and is driven by species specific responses.

Using the kernel density maps, spatial covariates were calculated to develop insight into the geographic distribution to describe the basic attributes of coastal habitat utilized by birds. By incorporating these data in a geographic information system, changes in bird density were quantified as a function of depth, slope, distance to shoreline, and distance to shoals. In addition, it was determined whether there was a spatial gradient in bird density (north/south or east/west) for a variety of species. The collection of kernel density maps were a valuable tool for identifying important locations where and when (by month and season) birds are most likely to concentrate. These data were also used to develop a semi-qualitative environmental sensitivity index that is discussed in **Volume I: Chapter 4.0**.

Spatial regression and GAMs were used to assess the contribution of each covariate in predicting spatial variability of bird aggregations and to plot their effect on bird density. A summary of these results is outlined in **Appendix M: Tables M-2** and **M-3**. In general, depth and distance to shoreline were important predictors of bird density and distribution. For example, using the combined two-year dataset, it was determined that bird density and distribution declined in waters greater than 20 m and 7.6 mi from the coastline; however, there was a strong seasonal effect in these values that is important to consider. Although bird density was generally greater in the fall (migration and seasonal visitors take up residence along the New Jersey coastline), birds were principally concentrated in waters up to 20 m in depth and 7.6 mi from the coastline; the same result observed for the entire dataset. In spring, birds were concentrated in deeper waters (>20 m) than in the fall (<20 m). Moreover, in summer, bird density ranged

further offshore (11.4 mi) and increased in waters greater than 30 m in depth. In winter, we found that bird density was concentrated in waters less than 15 m in depth and within 7.6 mi from the coastline.

Total sitting bird densities were modeled to identify where birds are most likely to reside, concentrate, and for some species, feed (i.e., loons, ducks, and gulls sitting on the water may indicate foraging locations). In general, sitting birds were most likely to occur in waters less than 15 m in depth and within 3.8 mi from the coastline. In fact, in fall, spring, and winter, sitting bird density was concentrated in waters within 3.8 mi from the coastline, whereas in summer the distance increased to 11.4 mi.

The seasonal changes in density and distribution of total birds were dynamic and related to changes in bird community composition. For example, in the fall and winter there were dense concentrations of diving ducks that are absent in the summer when the bird community was primarily composed of terns, gulls and storm-petrels. This difference in community composition was likely responsible for the varying degree of bird density clustered inshore and offshore. The models detected this and quantified the usage of coastal habitat by total birds as a function of depth and distance to shoreline. These dynamics were investigated further to quantify the effect of covariates for predicting changes in species distribution. Scoter density and distribution exhibited a peak in waters 10 m in depth and were concentrated within 3.8 mi from the coast and increased offshore around 19 mi from the coast. Northern Gannets, which were present in each season, were generally concentrated in waters greater than 10 m in depth that was within 9.5 mi from the coastline. Laughing Gulls and Common Terns, which are seasonal summertime breeders in New Jersey, displayed interesting distribution patterns. Laughing Gulls were generally concentrated within 4.7 mi from the coast and decreased in waters greater than 15 m in depth. On the other hand, Common Terns ranged further offshore and their density declined around 11.4 mi from the coast, and thereby occupied a wider range of coastal habitat than Laughing Gulls. The density and distribution of Cory's Shearwaters, which were also summertime visitors, showed an increase in density offshore in waters greater than 30 m in depth around 17 mi from the coastline.

In conclusion, bird density and spatial distribution exhibited a striking onshore to offshore gradient that was highly variable among seasons and linked to changes in community composition. The results in this section pinpoint where repeated maximum densities were likely to occur in relation to a variety of species. This information is integral to the understanding of the spatial ecology of marine birds along the New Jersey coastline and should be used to examine potential changes in habitat due to environmental changes from human activity. Physical attributes were used for describing species density and distribution. Future studies should investigate the biological aspects (i.e., prey distributions) for predicting finer scale species distribution. We found predictable locations where large concentrations of sitting (rafting) birds were found. These locations likely represent important feeding areas for birds and more information is needed on why these areas are attractive to birds. For example, some of these locations were distributed at or near the location of river mouths which may enhance the likelihood of nutrient flux and or prey concentration. Although more birds were present in fall and winter in comparison to spring and summer, in these latter seasons, the locations highlighted as important bird concentration likely reflect the habitat selection for foraging by coastal breeding species that may be sensitive to offshore development (in and around breeding colonies). Therefore, future studies ought to address these potential changes to coastally breeding species (e.g. common tern, laughing gulls) to determine their specific habitat requirements.

The modeling results in this section provide a baseline understanding on where birds are likely to concentrate in geographic space along the NJ coast with respect to season. Although we focused on understanding the broad scale distribution patterns of birds among seasons, the modeling framework can be scaled down to specific locations (i.e. database can be sectioned to smaller areas) and similar question can be addressed on finer scales all along the coast. The data and modeling results presented in this section can be used to address questions regarding birds and offshore wind energy development. The main result coming from this section is that water depth, distance to shoreline and distance to shoals are important for understanding the spatial distribution patterns of total bird density and for a variety of species from difference families (e.g. gannets, gulls, ducks). The basic effects of covariates listed and described in this section should provide management with a basic understanding of where and when birds are likely to concentrate and ultimately in what water depths and how close to shore. To generalize,

determining suitable offshore wind energy development may be considered as a tradeoff between distance to shoreline and water depth. The data and modeling results presented in this section focused on this tradeoff for birds as well. This study on the baseline distribution characteristics of birds off NJ represents a first step in making this a reality to potentially minimize the effect of offshore wind energy development on birds.

8.6 SUMMARY

In conjunction with the NJDEP Ecological Baseline Study, spatial models were developed for predicting changes in density and spatial distribution of birds to identify important regions used by birds within the Study Area. Our objective was to quantify where birds were most likely to concentrate in relation to geo-physical habitat features (e.g., depth, shoals) and predict where birds were likely to occur seasonally.

8.6.1 Methods

Two years of bimonthly shipboard surveys were investigated to estimate spatial variability of birds within the Study Area. The focus was placed on a variety of species (e.g., waterfowl, gulls, storm-petrels) to examine species-specific distribution patterns. Strip-transect data collected during bimonthly ship surveys within the Study Area were examined to determine spatial variability in bird density. Interpolation (e.g., kernel density), spatial regression, and GAMs were used to quantify the relationship between spatial covariates (e.g., bathymetric- and distance-based metrics) and birds.

8.6.2 Results and Main Conclusions

In summary, along with the kernel density maps that show where/when birds were likely to concentrate, it was determined that distance to shoreline and depth were useful and important predictors of changes in bird density and distribution. The collection of kernel density maps were a valuable tool for identifying important locations where and when (by month and season) birds were most likely to concentrate. Depth and distance to shoreline were important predictors of bird density and distribution. Overall, bird density declined in waters greater than 20 m and 7.6 mi from the coastline. Total bird density was greater in the southeast portion of the Study Area during fall, summer, and winter but was more concentrated in the north during spring; however, there was a strong seasonal effect in these values that was important to consider. Although bird density was generally greater in the fall (migration and seasonal visitors take up residence along the New Jersey coastline), birds were principally concentrated in waters up to 20 m in depth and 7.6 mi from the coastline; the same result observed for the entire dataset. When we modeled spring, it was determined that birds were concentrated closer to the coast (most density was within 5.7 mi), but occurred in deeper waters (>20 m) than in the fall (<20 m). Moreover, in summer, bird density ranged further offshore (11.4 mi) and increased in waters greater than 30 m in depth. In winter, bird density was concentrated in waters less than 15 m in depth and within 7.6 mi from the coastline.

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9.0 SUMMARY OF RESULTS

This chapter presents the results of the avian surveys and studies conducted for NJDEP Wind Ocean Ecological Baseline Surveys project. For specific information on design, methodology, and results of avian surveys and studies please refer to the section number noted.

9.1 AVIAN SHIPBOARD AND SMALL BOAT COASTAL SURVEYS

The primary goal of the avian shipboard surveys was to collect avian occurrence, distribution, and abundance data within the project area for the development of a Study Area avian predictive model. A secondary goal was to collect diurnal avian flight altitudinal distribution data to determine bird altitude distribution relative to the RSZ. For information on the survey design and methodology see **Section 2.1.**

9.1.1 Survey Results

Avian shipboard offshore surveys were conducted January 2008 through December 2009, with associated small-boat coastal surveys being conducted each month after completion of the shipboard offshore survey. A total of 15,483 km (8,360 NM) and 2,700 km (1,457 NM) of trackline were surveyed on the offshore and coastal surveys, respectively, with >1,100 hrs of combined survey effort. The resultant dataset fills a large gap in our understanding of at-sea bird distribution in the western North Atlantic Ocean.

9.1.1.1 Avian Occurrence

A total of 176,217 birds representing 153 species were recorded, with 84,428 birds of 145 species being recorded during the shipboard offshore surveys and 91,789 birds of 82 species recorded during the small-boat coastal surveys. Federally endangered, threatened, and candidate species were not detected during avian surveys. Fourteen of the 21 federally listed species of concern and 16 of the 20 state-classified endangered, threatened, and special concern species potentially occurring in coastal and offshore waters were observed during the survey.

9.1.1.2 Distribution and Abundance

Cumulative: Total Birds

Avian densities were highest near shore at all seasons, although this finding was much more pronounced in winter than in summer (ratio of abundance on offshore surveys vs. small-boat coastal surveys ranged from 2:5 to 1:5). This was due primarily to the and the large numbers of coastal-breeding gulls and terns and wintering waterfowl along the New Jersey coast and the relative lack of true pelagic seabirds in the Study Area (although there were large numbers of Wilson's Storm-Petrels, an austral migrant from the Southern Ocean, present offshore in the summer). Overall, the areas of highest abundance were restricted to inshore waters, with the highest avian abundances recorded south and east of Hereford Inlet, south and east of Ocean City, and east of Atlantic City. Offshore, the most consistent area of high avian abundance was near a shoal area east of Barnegat Inlet (**Section 2.3.3.1**; **Figure 2-7**).

Seasonal: Total Birds

Comparisons of avian distribution and abundance between the two winter seasons (**Figures 2-9** and **2-13**) were difficult because of the limited data obtained in winter 2008. The majority of the high abundance areas in winter were nearshore. Only two high abundance areas were found offshore (both in winter 2009). Highest avian densities in the two springs were shifted offshore relative to the winter seasons. Spring 2009 had higher avian densities than spring 2008. Areas with the highest offshore avian abundances during both spring seasons were similar offshore; however, in spring 2008 the higher abundances were in the middle and northern portions of the Study Area and more widespread throughout the Study Area in spring 2009 (**Section 2.3.3.2**).

High avian densities shifted more offshore during the summer seasons, compared to winter and spring seasons. For example, 47% of the highest abundance areas in 2008 and 68% in 2009 were in offshore waters.

Patterns of abundance in the two fall seasons were similar though with a distinct northward shift of abundance in fall 2009 relative to that of fall 2008. This difference was primarily attributable to lower avian observations in the northeast corner of the Study Area in fall 2008. Offshore densities were lower in the fall than the summer seasons,

An interesting difference among these four seasons was that highest relative abundance was shifted quite noticeably from offshore in summer to nearshore in winter. Spring and fall were transitional seasons and both nearshore and offshore areas were intermediate in abundance. This variation is a result in differing habitat preferences between the seasonal avifauna, with the winter avifauna dominated by inshore-foraging species (e.g., scoters; **Appendix F**) and the summer avifauna dominated by offshore-foraging species (e.g., Common Tern; **Appendix F**).

The summer seasons exhibited the lowest absolute abundance, with the majority of individuals detected being of locally-breeding species, primarily Common Tern and the three breeding gull species (Laughing, Herring, and Great Black-backed). Further details on seasonal distribution/abundance patterns may be found in the species accounts (**Appendix F**).

Species

The ten most abundant species recorded during each season are presented in **Table 9-1** through **Table 9-4.** Although survey effort was higher in winter 2008-2009 than winter 2008 (**Section 2.3.1, Table 2-1**), four species (Black Scoter, Herring Gull, Northern Gannet, and scaup species) that ranked in the top 10 species during both winter seasons were in lower abundance and two species (Long-tailed Duck, Common Loon) were in higher abundance during winter 2008-2009 than winter 2008 (**Table 9-1**) Between spring 2008 and spring 2009 survey effort was similar. Three species (Common Loon, Long-tailed Duck, Laughing Gull) that occurred in both spring seasons were in higher abundance and four species (Northern Gannet, Surf Scoter, Herring Gull, and Red-throated Loon) that occurred in both spring seasons were in lower abundance in spring 2009 than spring 2008. No comparisons were made between summer 2008 and summer 2009 because one of the months (July 2009) was not surveyed since the project modification start date was 01 August 2009. Between fall 2008 and fall 2009 the survey effort was similar. Seven species (Northern Gannet, Laughing Gull, Herring Gull, Wilson's Storm-Petrel, Great Black-backed Gull, and Red-throated Loon) were in lower abundance in fall 2009 than fall 2008. The reason for these differences is unknown, however many variables (e.g., prey availability, weather, differences in yearly sampling dates) affect the abundance of a species recorded in a given season. Further discussion of the most abundant avian groups and species is found in **Appendix F**. For additional information on abundance similarities and differences between seasons see **Appendix C: Figures C-26** through **C-70**.

9.1.1.3 Altitude Distribution

In addition to examining abundance and distribution, data were also analyzed to determine frequency of occurrence within the potential RSZ of power-generating wind turbines, defined as 100 to 700 ft (30.5 to 213.4 m).Of a total 71,834 individuals recorded, 3,433 (4.8%) occurred in the potential RSZ. Birds recorded on the small-boat coastal surveys occurred in the RSZ 83% more often than birds recorded on the shipboard offshore surveys.

The species/groups with the highest overall percentage of occurrences in the RSZ were: geese (46.5); herons (33.3). scaup (29); dabbling ducks (26.9); Osprey (20.0); Common Loon (9.0); large gulls (8.2), cormorants (7.0), and Northern Gannet (3.9). For histograms of cumulative and seasonal altitudinal distribution of total birds and selected species, see **Section 2.3.4** and **Appendix D: Figures D-1** through **D-40.**

Table 9-1. Seasonal Top-10 species tables for the ship and boat surveys (Winter).

Winter 2008				Winter 2008-2009		
Species	**Total n**	**#/km**		**Species**	**Total n**	**#/km**
Black Scoter	1,307	2.03		Black Scoter	2,811	1.13
Herring Gull	798	1.24		Long-tailed Duck	2,747	1.11
Northern Gannet	779	1.21		Surf Scoter	2,290	0.92
Scaup (unknown), *Aythya* (unknown)	750	1.17		Greater Scaup	1,572	0.63
Long-tailed Duck	464	0.72		Common Loon	1,149	0.46
Ring-billed Gull	397	0.62		Scoter dark-winged (unknown)	1,133	0.46
Red-throated Loon	206	0.32		Herring Gull	928	0.37
Sanderling	206	0.32		Northern Gannet	926	0.37
Common Loon	130	0.20		Scaup (unknown), Aythya (unknown)	900	0.36
Great Black-backed Gull	107	0.17		Scoter (unknown)	634	0.26
Total	**5,435**	**8.44**		**Total**	**17,310**	**6.99**

Table 9-2. Seasonal Top-10 species tables for the ship and boat surveys (Spring).

Spring 2008				Spring 2009		
Species	**Total n**	**#/km**		**Species**	**Total n**	**#/km**
Northern Gannet	3,281	1.27		Northern Gannet	1,455	0.57
Surf Scoter	2,738	1.06		Surf Scoter	944	0.37
Herring Gull	1,882	0.73		Common Loon	897	0.35
Black Scoter	709	0.27		Herring Gull	831	0.32
Common Loon	450	0.17		Black Scoter	691	0.27
Red-throated Loon	436	0.17		Long-tailed Duck	669	0.26
Long-tailed Duck	420	0.16		Razorbill	498	0.19
Great Black-backed Gull	401	0.16		Laughing Gull	354	0.14
Scoter dark-winged (unknown)	320	0.12		Red-throated Loon	334	0.13
Laughing Gull	241	0.09		Double-crested Cormorant	326	0.13
Total	**12,024**	**4.66**		**Total**	**8,144**	**3.18**

Table 9-3. Seasonal Top-10 species tables for the ship and boat surveys (Summer).

Summer 2008			Summer 2009		
Species	**Total n**	**#/km**	**Species**	**Total n**	**#/km**
Laughing Gull	823	0.45	Laughing Gull	345	0.38
Wilson's Storm-Petrel	700	0.38	Northern Gannet	280	0.31
Common Tern	495	0.27	Common Tern	253	0.28
Northern Gannet	171	0.09	Wilson's Storm-Petrel	120	0.13
Great Black-backed Gull	107	0.06	Herring Gull	85	0.09
Cory's Shearwater	99	0.05	Great Black-backed Gull	74	0.08
Forster's Tern	52	0.03	Forster's Tern	34	0.04
Herring Gull	49	0.03	Tern (small)	24	0.03
Whimbrel	49	0.03	Common Loon	17	0.02
Royal Tern	21	0.01	Osprey	6	0.01
Total	**2,657**	**1.44**	**Total**	**1,261**	**1.39**

Table 9-4. Seasonal Top-10 species tables for the ship and boat surveys (Fall).

Fall 2008			Fall 2009		
Species	**Total n**	**#/km**	**Species**	**Total n**	**#/km**
Laughing Gull	3,661	1.01	Northern Gannet	2,403	0.68
Northern Gannet	3,284	0.90	Laughing Gull	1,532	0.43
Surf Scoter	2,245	0.62	Herring Gull	644	0.18
Wilson's Storm-Petrel	1,248	0.34	Wilson's Storm-Petrel	557	0.16
Black Scoter	1,175	0.32	Great Black-backed Gull	535	0.15
Double-crested Cormorant	1,136	0.31	Red-throated Loon	449	0.13
Common Tern	1,040	0.29	Surf Scoter	435	0.12
Herring Gull	882	0.24	Bonaparte's Gull	241	0.07
Great Black-backed Gull	865	0.24	Common Loon	196	0.06
Red-throated Loon	765	0.21	Common Tern	177	0.05
Total	**20,446**	**5.62**	**Total**	**8,538**	**2.42**

Scaup (*Aythya* spp.) represented 54.5% of all birds in the RSZ for the small-boat coastal surveys alone, and 31.8% of all birds in the RSZ overall. Of the 1,091 scaup recorded in the RSZ, 1,088 individuals (99.7%) were recorded on the 17 January 2009 small-boat coastal survey. On this date, a severe cold snap froze many inland bodies of water, forcing many “bay ducks” to the coast. This illustrates the potential effects of a major weather event on both the dataset and avian mortality, as removing the scaup recorded on that date causes the overall percentage of birds in the RSZ to drop from 4.8% to 3.3%. Offshore, Northern Gannet was the species occurring most often in the RSZ (594 individuals) and was also one of only three species recorded in the RSZ in every season. The fact that Northern Gannet forages on the wing, takes 4-7 years to reach maturity, and lays only one egg per breeding season make

it, perhaps, the most likely species to be impacted negatively by turbine-related mortalities within the Study Area.

Winter had both the most individuals (1,551) and highest percentage of individuals (8.01%) in the RSZ, despite the fact that there were far more survey effort hours in both spring and fall. As mentioned above, this was due in large part to the 1,088 scaup recorded in the RSZ on the 17 January 2009 small-boat coastal survey. Northern Gannets and large gulls (*Larus* spp.) also accounted for a large portion of the winter RSZ totals with 138 and 160 individuals, respectively.

In spring, Northern Gannet was the most abundant species in the RSZ (385 individuals), followed by scoters (*Melanitta* spp.) with 193 individuals and large gulls with152 individuals. Loons (*Gavia* spp.) and small terns (*Sterna* spp.) accounted for 69 and 30 individuals, respectively.

Summer had both the lowest overall percentage of birds recorded in the RSZ (0.82%) and the least diversity in the RSZ (five species). The reduced survey effort in summer was a factor but in addition, most individuals of the highest-flying species/groups (Northern Gannets, Common Loon, and most ducks and geese) had departed the area for their breeding grounds. Of the 29 individuals recorded in the RSZ during summer, 20 were large gulls.

Although 21 species were recorded in the RSZ for the fall season, RSZ occurrence numbers were largely driven by Canada Geese (399 individuals) and Double-crested Cormorants (158 individuals). None of the other 19 species exceeded 65 individuals in the RSZ for the season.

9.1.2 Flight Direction Analysis

9.1.2.1 Mean and Median Flight Direction

Mean angles and median flight angles are reported for all species that were included in the top five list in at least one-time period (month, season, year, or overall) in **Appendix E; Table 2-11**. In addition to abundances, observations, and cluster sizes, results are also shown for sample size n (the number of birds observed for which flight direction data are available), length vector r, angular deviation, circular SD, deviation, and the 95% CI for the mean angle.

Mean flight direction (mean angle) for total birds was NE in both spring seasons (2008: 33-39° with a mean angle of 36°; and 2009: 36-45°, mean 40°), SW in fall 2008 (228-230°, mean 229°), and W in fall 2009 (246-260°, mean 253°). Flight directions (mean angles) were more variable (in terms of both directional differences and width of the 95% CI) in the summer and winter seasons across the two years. For total birds, mean angles were S (165-190°, mean 177°) and NE (35-86°, mean 60°) in summer 2008 and summer 2009, respectively. A southerly component was present in the mean angle for all three winter seasons: SE (109-134°, mean 121°) in winter 2008, S (179-186°, mean 182°) in winter 2009, and SW (229-239°, mean 234°) in winter 2010. In terms of annual averages, mean flight directions were SW (219-220°, mean 219°) and NW (274-325°, mean 299°) in 2008 and 2009, respectively, with an overall two-year mean angle of 223° (SW). For additional details relating to mean and median flight direction see **Section 2.3.5.1**.

9.1.2.2 Tests for Circular Uniformity of Flight Direction

Results of these hypothesis tests to test for circular uniformity of flight direction show that, in the majority (though not all) of cases and combinations of species and time periods, the H_o of circular uniformity is rejected, suggesting that a significant mean flight direction (mean angle) exists. These results support the visual results discussed earlier for mean angle. Frequency distribution of flight directions across the eight octants generally exhibits a distinct mean flight direction (mean angle) especially in the migration seasons, with an expected general northward tendency in spring and southward tendency in fall/winter. The frequency distributions of flight directions across the eight octants is, in many cases, far from uniform, with percentage distributions in any one octant often exceeding 20% especially in migration seasons, compared to an expected frequency distribution of 12.5% in each octant if a completely uniform

distribution is assumed. In summary, the results that were visually detected in the earlier analyses of mean angle and frequency distributions across the eight octants have been statistically confirmed and validated with these various hypothesis tests. For additional details circular uniformity testing see **Section 2.3.5.2**.

9.2 OFFSHORE AVIAN AERIAL SURVEYS

Avian aerial surveys were initially scheduled for three separate occasions: once each in spring 2008, fall 2008, and spring 2009. After the April survey the efficacy of such limited surveying was discussed by the NJDEP committee members, and the pros and cons of conducting aerial surveys were compared. Benefits consisted of better detection of peak activity (if conducted during peak activity) and a "snapshot" collection of avian data over the whole day. The negatives consisted of limited detection of small and darker-colored birds, the temporal variation of migration, the small number of planned surveys (considering the limited data already gathered), the safety of flying at low altitudes, and the cost involved. A vote was taken and it was decided to discontinue aerial surveys and instead increase radar validation surveys.

9.3 SUPPLEMENTAL AVIAN OFFSHORE AND ONSHORE SURVEYS

Supplemental shipboard avian surveys were conducted during December 2008, and from August through December 2009. Three types of supplemental surveys were conducted: shoal/station surveys, ship sawtooth transects, and land-based migration counts associated with shipboard transects. The primary goal of the shoal/station surveys was to help determine whether high densities of waterbirds occur in association with shoals. The primary goal of the ship sawtooth transect surveys was to determine whether increased survey effort would cause changes in abundance estimates of avian species. The primary goal of the land-based counts and seawatch transect surveys was to determine the passage rates of migrating waterbirds relative to distance from shore. For information on the survey design and methodology see **Section 4.1**.

9.3.1 Survey Results

The results of the supplemental avian offshore and onshore surveys during the study are summarized below. For additional details regarding results please refer to **Section 4.3**.

9.3.1.1 Shoal Surveys

Although a very low survey effort did limit the amount of data collected, this supplemental survey effort did help validate the importance of shoals as feeding areas for birds in general, for Northern Gannets in particular.

9.3.1.2 Ship Sawtooth Transect Surveys

For the most part, the additional survey effort conducted during this supplemental effort did not differ from the results of the regular shipboard transects during the same period; however, some differences were noted. For example, 237 Double-crested Cormorants were observed during the supplemental surveys and only 17 during regular transect surveys (**Section 4.3.2**). This difference is due primarily to ship scheduling, as most regular transect effort in fall 2009 took place outside the period during which the majority of the Double-crested Cormorants migrate through the project area (Sibley 1997; see also **Section 4.3.2** concerning this species). Additionally, Laughing Gull comprised 19% all birds detected on the supplemental transects and only 9% on the regular transects during the same period (**Section 4.3.2**). These data suggest that, indeed, additional effort at offshore transects would have added materially to the understanding of the dynamic bird distribution and abundance within the Study Area, although the additional survey data would probably result in an understanding at a finer temporal scale than intended by the scope of work of this study.

9.3.1.3 Seawatch: Land-based Counts/Shipboard Transect Surveys

Fall seawatch transect-survey data from Avalon and Barnegat Light were analyzed relative to distance from shore, in bands of 1.866 km (1.007 NM). More than 77% of all migrating individuals were within 9.26 km (5 NM) of shore; almost 61% were within 5.56 km (3 NM) of shore.

Though nearly all species seen from the ship were detected throughout the width of the entire Study Area (shore to 20 NM offshore), distribution and abundance is generally greater closer to shore and diminishes as distance from shore increased. Because the land-based counts and the shipboard transects were conducted concurrently, the much lower numbers of migrating waterbirds beyond 9.26 km (5 NM) relative to that inside 9.26 km can be shown to document actual occurrence. Overall, the land-based surveys yielded higher observations than offshore surveys. For more detailed information see **Section 4.3.3**.

9.4 AVIAN RADAR SURVEYS

The primary goals of the avian radar surveys were to determine seasonal bird altitudinal distribution over offshore and nearshore sites within the Study Area and determine the density of flight activity moving through the radar survey area over a specific time period. A secondary goal was to identify dominant bird flight directions. For information on the survey design and methodology see **Section 5.4**.

Vertically scanning radar (VerCat) and horizontally scanning radar (TracScan) data were analyzed and data filters were developed to remove detections from rain (especially virga) and sea clutter, because these detections generate false tracks. Track counts were adjusted for dropped tracks that received a new track ID when the target was the same as the original track. The TI-VPR system sampled targets passing through a 20° cone directed vertically to determine the proportion of each type of biological target (e.g., birds, bats, insects) detected by VerCat. The TI-VPR data were used to develop a correction factor for insects in the radar count data from the VerCat. Data from barge-based, boat-based, and onshore-based observer validation surveys were analyzed and used to evaluate the results of radar analyses.

The results of the studies with VerCat are expressed in terms of three metrics: **median altitude quartile** (the 50% quartile containing the altitude at which half the total number of birds observed were flying below the median, and half were flying above the median), **flux** (adjusted bird tracks/km^3/hour), and **AMTR** (number of bird tracks crossing over a kilometer per hour). Data related to cumulative diurnal and nocturnal flux were sorted into three altitude bands with reference to the potential RSZ: (1) below the RSZ (low altitude band, 1 to 99 ft AMSL), (2) within the RSZ (middle altitude band, 100 to 700 ft AMSL), and (3) above the RSZ (high altitude band, 701+ ft AMSL). The AMTR provides a quantitative passage rate. Although many variables affect the possibility of bird-turbine collision risk, in general the greater the AMTR value the greater the potential for bird-turbine collision.

Median altitude quartiles provide information on the frequency of occurrence of birds in the RSZ. The AMTR provides a quantitative passage rate. Although many variables affect the possibility of bird-turbine collision risk, in general the greater the AMTR value the greater the potential for bird-turbine collision. Flux is a measure of bird density in the RSZ and is the most important metric for determining bird collision risk impacts.

Based on the direct visual validation studies, only 10-20% of the birds flying at very low altitudes were detected with the radar. This is because of constraints of the marine radar detecting wave clutter that obscures return from low flying birds. Consequently, in the lowest altitude quartile the reported bird counts are underestimated (i.e., lower than the number actually present) and the radar measured median altitudes are likely lower than those given in this report. Bird counts in the RSZ are affected less by return from wave clutter, because the effect is reduced as the height of the radar beam increases.

The TracScan radar was used primarily to determine direction of target movement. Because different offshore study sites were sampled at different times during a season, it is difficult to attribute changes to time of season, or location, or both. Monitoring all offshore sites throughout each season would have been prohibitively expensive even if equipment and personnel had been available (and they were not).

9.4.1 Offshore

9.4.1.1 Spring 2008

During spring of 2008 the VerCat radar operated for 940.5 hours and the TracScan radar operated for 1,044.3 hours. Daytime flux values gradually decreased within the low altitude band and gradually increased within the RSZ for nearshore and offshore sites. During the night greater flux values occurred within the RSZ than below the RSZ as the spring season advanced for both nearshore and offshore grids. The dominant diurnal and nocturnal nearshore and offshore flux directions during most of the survey weeks was from the south and southwest to the north and northeast. AMTR increased as season progressed near shore and offshore. The peak diurnal AMTR occurred offshore on Grid 26 (137.0 abt/k/h) from 24-30 April and on Grid 17 (113.0 abt/k/h) from 07-11 May 2008. Peak nocturnal AMTR occurred 30 April - 07 May (320.3 abt/k/h) on Grid 26 and from 07-11 May 2008 (333.5 abt/k/h) on Grid 17. Because the offshore grids were sampled later in the season, one cannot conclude that more birds were offshore than nearshore, because the high counts may have been the result of more migration occurring later in the season than earlier in the season.

9.4.1.2 Fall 2008

During fall 2008 radar surveys were limited to two offshore sampling grids in the southern section of the Study Area. The VerCat operated for 442.5 hours and the TracScan operated for 415.1 hours. The data are limited and insufficient to make any conclusions. All the median altitudes were within the RSZ for daytime and nighttime samples. The flux was greater in the RSZ than the low altitude band during daytime and nighttime and there was no difference in flux between daytime and nighttime. Cumulative diurnal and nocturnal AMTR decreased from Grid 22 to Grid 26, but Grid 26 was sampled later in the fall. Peak diurnal AMTR was 104.3 abt/k/h and peak nocturnal AMTR was 134.3 abt/k/h from 30 September through 12 October 2008. The direction of movement was from the north to the south.

9.4.1.3 Spring 2009

The VerCat radar operated for 39.8 hours and the TracScan radar operated for 41.3 hours. The data collected were limited and insufficient to analyze and make any conclusions. Three onshore sites were sampled: IBSP, Brigantine, and Corson's Inlet-Sea Isle City (CI-SIC).

9.4.2 Onshore

9.4.2.1 Spring/Early Summer 2008

VerCat operated for 657.9 hours and TracScan operated for 657.3 hours. The majority of the median altitude quartiles were within the RSZ at all of the onshore sites. The cumulative diurnal flux values varied within and between the onshore sites and were in general greater during the daytime than at night in the RSZ. The cumulative nocturnal flux values were greater within the low altitude band than within RSZ at all onshore sites. At IBSP and CI-SIC flux values were generally similar for low altitude and RSZ. At Brigantine, cumulative diurnal flux values were greater within the low altitude band than within the RSZ. This difference may be the result of the different migratory species passing the site or the behavior of resident species at the site. AMTR values were similar between the onshore sites during the daytime. AMTR values were greater at night than during daylight indicating that some nocturnal migration was probably still in progress from mid-May into mid-June. The cumulative peak diurnal AMTR (17.6 abt/k/h) occurred at Brigantine from 29 May through 01 June 2008. The cumulative peak nocturnal AMTR (66.2 abt/k/h) was at IBSP from 15-18 May 2008. Overall, as expected during spring migration, the dominant movement of birds was from the south and southwest to the north and northeast.

9.4.2.2 Fall/Early Winter 2008

VerCat operated for 2,090.2 hours and TracScan operated for 2,039.4 hours. Most of the cumulative median diurnal altitude quartiles were within the RSZ at IBSP in early fall 2008, and the majority of the

cumulative median altitude quartiles were within the low altitude band at Brigantine, CI-SIC, and at IBSP from mid-fall into early winter 2008. Most of the cumulative nocturnal altitude quartiles were within the RSZ. The majority of the cumulative diurnal flux values were greater within the low altitude band than within the RSZ. For most of the survey dates, the cumulative nocturnal flux values were generally similar between the low altitude band and the RSZ. Cumulative diurnal AMTR values were 10 abt/k/h or less and cumulative nocturnal AMTRs were 30 abt/k/h or less at all of the onshore sites. At each onshore site peak cumulative AMTR occurred at night. The dominant direction of movement during most weeks was from the north and northeast to the south and southwest.

9.4.2.3 Spring/Early Summer 2009

VerCat operated for 1,902.1 hours and TracScan operated for 1,872.2 hours. All of the cumulative weekly median altitude quartiles during the daytime were within the low altitude band at IBSP while at Brigantine cumulative weekly altitude quartiles during the day were split almost equally between the low altitude band and the RSZ. At CI-SIC, the cumulative weekly median altitudes during the daytime were all within the low altitude band. Most of the cumulative weekly median altitude quartiles at night at IBSP were within the RSZ. At Brigantine most of the cumulative weekly median altitude quartiles during the night were in the high altitude band (above the RSZ), and at CI-SIC all of the cumulative median altitude quartiles at night were within the RSZ. Cumulative weekly flux values during daylight were greater within the low altitude band than within the RSZ. Cumulative weekly flux values at night varied among sample periods and were likely dependent on when conditions were favorable for migration. The trend was for greater flux values in the low altitude band during migration events. Cumulative diurnal AMTR values were 10 abt/k/h or less and cumulative nocturnal values were less than 80 abt/k/h at all of the onshore sites. At each onshore site, peak cumulative AMTR occurred at night. The dominant direction of migration was from the south and southwest to the north and northeast. Some of these movements occurred even though winds were unfavorable, and one small scale reverse migration (towards the SW) was recorded.

9.4.2.4 Onshore Fall 2009

VerCat operated for 1,299.5 hours and TracScan operated for 1,372.9 hours. Most of the median quartiles were below the RSZ during daylight, but most were in the RSZ at night. Flux values in the RSZ were greater at night than during the day and this was particularly so during migration events. The exceptionally high flux rate during the period 08-16 November 2009 was associated with a 22 minute period of high winds and many birds aloft. Cumulative AMTR values during daylight hours were <20 abt/k/h during the majority of the study. The only exception was during the week of 08-16 November at CI-SIC when the AMTR increased dramatically but only in the 16+ mph wind category. Except for the peak cumulative nocturnal migration period 05-11 October 2009, when the AMTRs were approximately 90 abt/k/h, the cumulative weekly AMTRs at night were below 50 abt/k/h. The direction of migration during most sample weeks was from the north and northeast to the south and southwest, and many movements occurred with opposing winds from the south to the north.

9.4.3 Offshore-Onshore Comparisons

It is important to realize that statistical comparisons between onshore and offshore samples are possible only when the samples are collected at the same time. Concurrent offshore radar (Grid 22 and Grid 26; 30 September – 12 October 2008) and onshore radar (CI-SIC; 05-19 October 2008) sampling only occurred during 05-19 October 2008. Radar data from these locations were compared statistically to provide quantitative information on any onshore-offshore differences in cumulative median flight altitudes, cumulative flux values, and cumulative AMTR. The cumulative median altitude quartiles over the offshore girds were all within the RSZ during the daytime, while over the onshore site half of the cumulative altitudes during daylight were within the RSZ and half below. The cumulative median altitude quartiles over the offshore grids and over the nearshore site at night were all within the RSZ. Cumulative flux values were higher over the offshore grids than the onshore site during daylight and dark. The cumulative AMTRs were noticeably greater over the offshore grids than over the onshore site. For the limited time period of 05-19 October 2008, avian activity was concentrated at the offshore sites.

9.5 THERMAL IMAGING VERTICALLY POINTED RADAR

Use of thermal imagery and vertically pointing radar proved to be very valuable in identifying the sources of echoes detected in VerCat. The TI-VPR system could easily detect targets flying through the rotor swept zone. The vertically pointing radar provided accurate altitudes of flight and the thermal imaging video provided enough information on targets to identify them as birds, foraging bats, or insects. We recommend that all future studies use this technique to validate the identity of the sources of radar echoes.

9.5.1 Offshore

9.5.1.1 Spring 2008

TI-VPR offshore barge-based surveys were conducted at six sites for a total of 180 hrs. Grid 23, approximately 10 mi offshore, in the southern section of the Study Area, showed the highest total target count for the season (783 targets), of which 570 targets (73%) were identified as birds, 204 as insects and 9 as foraging bats. Other grids had fewer birds (69-21) birds, and overall 75% of birds were within the RSZ. The mean directions of the movements were towards the NNW-NE and one movement was a reverse migration toward the SSW.

9.5.1.2 Fall 2008

TI-VPR offshore barge-based surveys were conducted at two sites for a total of 161 hrs. Grid 23 once again showed the highest total target count (1,252 targets) for the seasonal, of which 985 targets were identified as birds (79%), 243 as insects, and 24 as foraging bats. The second grid sampled (Grid 26, also approximately 10 NM offshore in the southern section of the Study Area, had a total target count of 249, and 192 were identified as birds (77%), 57 as insects, and no foraging bats. The mean directions of the movements for both grids were towards the SW.

9.5.1.3 Spring 2009

TI-VPR offshore barge-based surveys were conducted at two sites for a total of 15 hrs. Grid 16 (nearshore in the central section of the Study Area) showed the highest total target count (97 targets), of which 39 were identified as birds (41%), 57 as insects, and no bats. Grid 22 (nearshore in the southern section of the project area) had a total target count of 57 targets, with 39 targets being identified as birds (68%), 18 as insects, and no bats. The majority (96% and 94%) of the bird movements aloft occurred within the RSZ. The mean directions of the movements for Grids 16 and 22 were towards the NNE.

9.5.2 Onshore

9.5.2.1 Fall 2008

TI-VPR surveys were conducted at the SIC site from 08 to15 December for a total of 48 hrs. The site had a total target count of 285. 270 targets were identified as birds (95%), 9 as insects, and 6 as foraging bats. Although the date is late the mean direction of the movement toward the SSW suggested a migratory movement; 90% of the birds flew at altitudes within the RSZ.

9.5.2.2 Spring 2009

TI-VPR surveys were conducted at the IBSP site during the period 21-22 and 27 March 2009 for a total of 17 hrs. The site had a total target count of 54, of which 21 targets were identified as birds (95%), and 33 as insects. Foraging bats identified were not identified. The mean direction for movement was towards the NE, and100% of the birds were at altitudes above the RSZ.

9.5.2.3 Fall 2009

TI-VPR surveys were conducted at SIC, IBSP, and BB for a total of 10 hrs. SIC had the highest total target count for the season (1,133 targets), of which 738 targets were identified as birds (65%), and 395 as insects (both season highs). IBSP had the second highest total target count with 219 targets, of which 144 targets were identified as birds (66%), 69 as insects and 6 as foraging bats. BB had 138 targets detected, with 39 targets being identified as birds (28%) and 99 as insects. 66.2% of the birds were flying in the RSZ and 33.8 % were flying above the rotor swept zone. The mean directions of the movements over the three sites were toward the SW-south-southeast (SSE), but the movements over IBSP and BB showed some variability in direction.

9.6 NEXRAD

9.6.1 Year-to-Year Pattern of Migration

During the spring the sum of nightly peak density (birds/km^3) differed from year-to-year. As expected, the maximum density of migration measured over the coastal sample areas differed from the maximum density over the offshore sample areas. This can be attributed to the bird's tendency to follow the coast line during their migration. Over the five years of spring data the sum of the nightly peak densities measured over the coastal sample areas ranged from 347 in the spring of 2006 (area 1A) to 2,836 in the spring of 2009 (area 1A), and the maximum density recorded was 569 in the spring of 2004 (area 1A). The sum of nightly peak densities recorded over the offshore sample areas ranged from 58 (area 2B) in the spring of 2008 to 264 in the spring of 2007 (area 1B), with a maximum density of 103 recorded in the spring of 2007 in area 1B. Thus during the five-year study the amount of migration in spring passing over the onshore sample areas was much higher than the amount of migration measured over the offshore sample areas.

During the fall the sum of nightly peak density (birds/km^3) also differed from year-to-year. Over the five years of fall data the sum of the nightly peak densities measured over the onshore sample areas ranged from 1,445 (area 3A) in the fall of 2004 to 4,078 (area 1A) in the fall of 2005, with a maximum density of 705 recorded in the fall of 2005 (area 1A). The range of the sum of nightly peak densities over the offshore sample areas ranged from 273 (area 1B) in the fall of 2004 to 658 (area 2B) in the fall of 2005, with a maximum density of 144 recorded in the fall of 2005 (area 2B). Just as in the spring the amount of migration passing over the onshore sample areas was much higher than the amount of migration measured over the offshore sample areas. Once again, these results suggest that birds have a tendency to follow the coast line during migration. Overall, the density of migration during the fall was on average two to three times as much as the density of migration observed during the spring.

9.6.2 Night-to-Night Pattern of Migration

Nocturnal migration during the spring and fall shows considerable night-to-night variability. In the spring, migration begins to build in late April, peaks near the middle of May, and then declines towards the end of May. This pattern can be seen in both the onshore and offshore sample areas. Within the three onshore sample areas there were 5 nights with a mean density of 100 birds/km^3 or greater over the sample areas during the five years of spring migration (21 April, and 01, 04, 07, 11 May), while within the offshore sample areas the maximum was 21 on 21 April [area 1B]). Within the offshore sample areas the mean migration density was considerably less than that measured over the onshore areas (mean peak density of 21 birds/km^3). Though sizable flights can occur anytime from the middle of April through the middle of May, the peak of migration through the area is in early to mid-May. Fall migration builds in early September and peaks in mid-October to early November. After the peak in late October/early November the density of migration declines, and by mid-November very little migratory movement takes place. This pattern can be seen both within the onshore sample areas and within the offshore sample areas. There were 17 nights with a mean density of 100 birds/km^3 or more within the onshore sample areas during the five years of fall migration (31 August, 01, 10, 13, 15, 23, 26, 29 September and 05, 12, 14, 15, 17, 20, 25 October, and 02, 09 November), while within the offshore sample areas there were zero nights with a mean density of 100 birds/km^3 or more. Area 1A measured the highest density for the fall season on 15

October with a mean density of 258 birds/km^3. Similar to the spring, the offshore sample area mean migration densities were considerably less than those measured within the onshore sample area. The maximum mean density only measured 34 birds/km^3 on 12 September within Area 1B.

9.6.3 Hour-To-Hour Pattern of Migration

The hour-to-hour pattern of migration over the sample areas during the spring (2005-2009) typically started 30-45 min after sunset, peaked on most evenings between 02:00 – 06:00 UTC (11:00 PM – 2:00 AM EST), and declined until sunrise. In the fall (2004-2008) the quantity of migration was greater than in the spring (see year-to-year pattern), and the hour-to-hour pattern of percentage of peak hourly density during the evenings was shifted slightly earlier in the evening compared to that observed in spring. Like the spring, migration typically started 30-45 minutes after sunset and the peak of a nightly movement generally occurred from 01:00 – 05:00 UTC (10:00 PM – 12:00 AM EST). The peak density for the night in the spring appears to be slightly later in the evening and more defined when compared to the peak density for the night in the fall.

9.6.4 Direction of Migratory Movements

In the spring the mean directions (μ) from which the movements originated were 203.58° in 2005, 205.14° in 2006, 205.44° in 2007, 207.37° in 2008, and 211.35° in 2009. The flights were oriented toward the north-northeast (between 23° and 32°). There was some variability in mean direction from year to year but within each year there was relatively strong directionality as indicated by the length of the mean vector [r] (a statistical measure of concentration). All yearly mean directions show low circular variance and are highly significant ($p<0.000$). In the fall the mean directions were from 33.57° in 2004, 28.18° in 2005, 17.68° in 2006, 17.72° in 2007, and 28.55° in 2008. The flights were oriented toward the southeast to south-southwest between 197° and 214°. The lengths of the mean vectors from the fall data were comparable to those in spring data. Topographic features such as the shoreline likely influence the directions of seasonal migrations, particularly those occurring at lower altitudes.

9.6.5 Migration, Weather Conditions, and Collisions

During the five years of spring data, 79 of 365 nights had conditions that would cause birds to fly lower -- sometimes with reduced visibility. Twenty-nine of these nights had migration densities of 25 birds/km^3 or greater. During the five years of fall data, 102 of 465 nights had weather conditions that might cause birds to migrate at low altitudes and 24 of these nights had bird movements of 25 birds/km^3 or greater. There were 23 more total nights over the five fall seasons than in five spring seasons with weather conditions that could cause birds to fly at low altitudes and sometimes in poor visibility, but generally on these nights there was little or no migration.

9.7 AVIAN PREDICTIVE MODELING

The primary goal of the study was to develop spatial models for predicting changes in density and spatial distribution of birds and to identify important regions used by birds within the Study Area. The objective was to quantify where birds are most likely to concentrate in relation to geophysical habitat features (e.g. depth, shoals) and predict where birds were likely to occur seasonally. The following questions were addressed: (1) Where and when are birds (species) most likely to concentrate within the Study Area? (2) Are birds more or less concentrated evenly along the coast, or do some species exhibit specific spatial gradients (i.e. latitude/longitude variation)? (3) What is the relationship between bird density/distribution and depth, distance to shoreline, distance to shoals, and slope?

Interpolation (e.g. kernel density), spatial regression, and GAMs were used to quantify the relationship between spatial covariates (e.g. bathymetric and distance based metrics) and birds. The spatial models were developed to quantify the effect of each spatial covariate for predicting changes in bird density and distribution. In summary, along with the kernel density maps (**Appendix M**) that identified where and when birds were likely to concentrate, spatial covariates were calculated to develop insight into the geographic distribution and describe the basic attributes of habitat utilized by birds. By incorporating

these data in a geographic information system, changes in bird density were determined as a function of depth, slope, distance to shoreline, distance to shoals, and whether there was a spatial gradient in bird density (north/south or east/west) for a variety of species. Collection of kernel density maps was a valuable tool for identifying important locations where and when (by month and season) birds were most likely to concentrate.

9.7.1 Kernel Density Interpolation

Kernel density maps were estimated for all-behavior and sitting densities (number of birds/km^2) 2008 and 2009, and the combined two-year period 2008-2009. Numerous localized density maxima for all-behavior and sitting birds were located nearshore, midshore, and far-offshore, with the vast majority of these maxima occurring nearshore. A small portion of these density maxima for all-behavior birds are mirrored by the sitting birds, reflecting differences in the numbers of flying and sitting birds. For example, eight and 15 localized sitting density maxima occurred in 2008 and 2009, respectively; and 24 such maxima occurred in the overall cumulative two-year period, most of which occurred nearshore. In 2008, the eight sitting density maxima ranged from 110 to 830 (the latter occurring in the vicinity of Barnegat Light); and in 2009, the 15 sitting density maxima ranged from 115 to 735 (the latter occurring in the vicinity of Little Egg Inlet). In the overall cumulative two-year period, the 24 sitting density maxima ranged from 115 to 1,480 (the latter occurring in the vicinity of Little Egg Inlet). For the all-behavior birds, the highest density maxima were 1,425 in 2008 (midshore southeast of Little Egg Inlet), 1,730 in 2009 (nearshore in the vicinity of Little Egg Inlet), and 1,805 (on the offshore edge of the nearshore region, between Little Egg Inlet and Brigantine).

Observing these annual and overall cumulative spatial kernel density maps, the following general conclusions can be made:

1. Nearshore densities are higher than offshore densities, supporting an offshore gradient of decreasing densities with increasing offshore distance.

2. Within the offshore region, midshore densities were generally higher than far-offshore densities.

3. All-behavior densities were higher than sitting densities, reflecting the presence of both all-behavior and sitting birds.

4. The highest nearshore densities occurred up against the coastline rather than on the offshore edge of the nearshore region.

5. All-behavior density maxima that are mirrored by sitting birds reflect a balance between flying and sitting birds. If the sitting density is less than the all-behavior density, then both flying and sitting birds are present. If the sitting density is equal to or near the all-behavior density, then most/all of the birds in the given region are sitting rather than flying.

6. All-behavior density maxima that are not mirrored by sitting birds indicate that the majority of birds in the given region were flying rather than sitting.

9.7.2 Total Birds Seasonal Analysis

For most seasons, nearshore densities were higher than offshore densities (for both all-behavior and sitting birds). Within the offshore region, densities were generally higher midshore than far-offshore.

In fall 2008, numerous localized density maxima were located nearshore, midshore, and offshore as a result of contributions of individual species. A total of 24 detectable density maxima occurred for all-behavior birds within the Study Area, ranging in magnitude from 105 to 1,740 (the latter of which is located midshore southeast of Little Egg Inlet. The majority of these maxima were not mirrored by the sitting birds, indicating that most of the total birds in the regions of these density maxima were flying rather than sitting. Compared to 24 density maxima for all-behavior birds, only four density maxima

occurred for the sitting birds: 1) 945 nearshore in the vicinity of Barnegat Light (compared to 1,420 for all-behavior birds); 2) 120 nearshore in the region midway between Little Egg Inlet and Barnegat Light (compared to 135 for all-behavior birds); 3) 145 midshore southeast of Hereford Inlet (compared to 170 for all-behavior birds); 4) 140 far-offshore southeast of Hereford Inlet (compared to 565 for all-behavior birds). Except for this far-offshore density maximum, far-offshore densities were generally lower than midshore densities. Total bird density (all-behavior and sitting) were generally lower in fall 2009 than in fall 2008 (a year earlier). In fall 2009, five localized density maxima occurred for all-behavior birds: 1) 180 nearshore at Barnegat Light (compared to 125 for sitting birds); 2) 260 nearshore between Barnegat Light and Little Egg Inlet (compared to 145 for sitting birds); 3) 300 midshore southeast of Little Egg Inlet (compared to 215 for sitting birds); 4) 300 nearshore just south of Atlantic City (compared to 235 for sitting birds); 5) 100 nearshore just south of Ocean City (mirrored by a sub-maximum density on the order of 50). In addition, numerous density maxima (on the order of 50) for all-behavior birds also occurred, both nearshore and midshore, some of which were mirrored by the sitting birds.

Comparing spring and fall for the 2008 and 2009, densities were relatively lower in spring than in fall. In spring 2008, three distinct localized density maxima occurred for all-behavior birds: 1) 745 nearshore just off Ocean City (compared to 730 for sitting birds, indicating that the majority of the birds in this region were sitting rather than flying); 2) 335 nearshore off Hereford Inlet (mirrored by a sub-maximum density on the order of 50 for sitting birds); 3) 135/km^2 midshore southeast of Ocean City (which is not mirrored by the sitting birds). In spring 2009, four distinct localized density maxima occurred for all-behavior birds: 1) 585 nearshore just south of Barnegat Light (compared to 370 for sitting birds); 2) 130 offshore east of Barnegat Light (which is not mirrored by the sitting birds); 3) 150 nearshore between Great Egg Harbor Bay and Atlantic City (compared to 140 for sitting birds); 4) 120 nearshore just off Hereford Inlet (compared to 110 for sitting birds).

Overall densities were generally lower in summer than in fall and spring for 2008 and 2009. In summer 2008, only 1 distinct localized density maximum occurred: 110 nearshore off Ocean City. Several sub-maximum densities (on the order of 25) occurred for all-behavior birds around Atlantic City and Brigantine. Densities were generally higher nearshore than offshore, and offshore densities were more patchily distributed for sitting birds than for all-behavior birds.

Overall densities were slightly lower in summer 2009 than in summer 2008. In summer 2009, the spatial distribution of all-behavior density was more uniform nearshore than offshore Nearshore sitting bird densities were lowest around Ocean City and Great Egg Harbor Bay, the region between Brigantine and Little Egg Inlet, and a small region just north of Little Egg Inlet.

Among winter and summer, overall densities were generally higher in winter than in summer (for both all-behavior and sitting birds). Among the three winter seasons, densities were generally lowest in 2008, highest 2009, and intermediate in 2010, partly reflecting the lower survey effort in the latter season. In all three winter seasons, densities were higher nearshore than offshore, and all-behavior densities were higher than sitting densities, reflecting the presence of both flying and sitting birds. In winter 2008, two localized density maxima occurred for all-behavior birds: 1) 475 nearshore between Atlantic City and Brigantine; 2) 120 nearshore between Great Egg Harbor Bay and Atlantic City. In winter 2009, densities were higher than in winter 2008 (1 year ago), with 13 localized nearshore density maxima occurring for all-behavior birds (ranging from 125 to 1,740) along the entire coastline, from south of Seaside Heights to Hereford Inlet. Eight of these 13 density maxima were mirrored by the sitting birds (ranging from 170 to 1,715). In winter 2010, five localized nearshore density maxima occurred: 1) 135 nearshore in the vicinity of Barnegat Light (compared to 110 for sitting birds); 2) 105 nearshore between Little Egg Inlet and Barnegat Light; 3) 235 nearshore between Brigantine and Little Egg Inlet (compared to 105 for sitting birds); 4) 120 nearshore at Brigantine (compared to 50 for sitting birds); 5) 105 nearshore midway between Ocean City and Hereford Inlet (compared to 50 for sitting birds).

9.7.3 Modeling Results

Modeling results are outlined in **Tables 9-5** and **9-6**. In general, depth and distance to shoreline were found to be important predictors of bird density and distribution. For example, using the combined two

year dataset, it was determined that bird density and distribution declined in waters greater than 20 m (65.6 ft) in depth and 12.2 km (7.6 mi) from the coastline; however, there was a strong seasonal effect in these values that is important to consider. Although bird density was generally greater in the fall (i.e., migration and seasonal visitors take up residence along the New Jersey coastline) and birds were principally concentrated in waters up to 20 m (65.6 ft) in depth and 12.2 km (7.6 mi) from the coastline; the same result was observed for the entire dataset. When the spring season was modeled, birds were found concentrated in deeper waters (>20 m [65.6 ft]) than in the fall (<20 m [65.6 ft]). Moreover, in summer, bird density ranged further offshore (18.3 km [11.4 mi]) and increased significantly in waters greater than 30 m (98.4 ft) in depth. In winter, bird density was concentrated in waters less than 15 m (49.2 ft) in depth and within 12.2 km (7.6 mi) from the coastline.

Table 9-5. General summary of effect of spatial covariates on bird density based on GAM results: (a) description of effect.

Covariate	Effect on bird density		
	+	-	+/-
Depth	Density increases in shallower water	Density increases in deeper water	Effect on density is mixed
Slope	Density increases with slope	Density decreases with slope	Effect on density is mixed
DistShore[1]	Density increases with distance from shoreline	Density decreases with distance from shoreline	Effect on density is mixed
DistShoal	Density increases with distance to nearest shoal	Density decreases with distance from nearest shoal	Effect on density is mixed
Longitude[2]	Density increase indicates more bird in the eastern portion of the Study Area	Density decrease indicates more birds in the western portion of the Study Area	Effect on density is mixed
Latitude	Density increase indicates more birds in the northern portion of the Study Area	Density increase indicates more birds in the southern portion of the Study Area	Effect on density is mixed

[1] Distance from shore
[2] Distance from shoal

Table 9-6. Covariate effect on bird density.

Bird Variable	Depth	Slope	DistShore[1]	DistShoal[2]	Longitude	Latitude
Total birds	+		-		+	-
Total birds 'Fall'	+		-		+	-
Total birds 'Spring'	-		-		-	
Total birds 'Summer'	+/-		-	+/-	+	-
Total birds 'Winter'	+	-	-		+	-
Total sitting birds	+	-				
Total sitting birds 'Fall'	+	+	-			+/-
Total sitting birds 'Spring'	-	+/-			-	+
Total sitting birds 'Summer'	+/-		+/-	+/-	+/-	
Total sitting birds 'Winter'	+		-			
Northern Gannet			-	+	+	-
Scoter Species			+/-	+	-	+
Long-tailed Duck		+/-	-		+	-

Table 9-6 (*continued*). Covariate effect on bird density.

Bird Variable	Depth	Slope	DistShore[1]	DistShoal[2]	Longitude	Latitude
Common Loon	-				-	
Red-throated Loon			+/-	+	-	
Herring Gull	+		+	+	-	+
Laughing Gull	+		-		+	-
Common Tern			-	+/-	+	-
Wilson's Storm Petrel			+		-	+
Cory Shearwater	-		+/-	+/-	+/-	

[1] Distance from shore
[2] Distance from shoal

Total sitting bird density was modeled to identify where birds are most likely to reside, concentrate, and for some species, feed (i.e. loons, ducks, and gulls sitting on the water may indicate foraging locations). In general, sitting birds were most likely to occur in waters less than 15 m in depth and within 3.8 mi from the coastline. In fact, in fall, spring, and winter, sitting bird density was concentrated in waters within 6.1 km (3.8 mi) from the coastline, whereas in summer the distance increased to 18.3 km (11.4 mi).

The seasonal changes in density and distribution of total birds were dynamic and related to changes in bird community composition. For example, in the fall and winter there were dense concentrations of diving ducks that were absent in the summer when the bird community was primarily composed of terns, gulls and petrels. This difference in community composition was likely responsible for the varying degree of bird density clustered inshore and offshore. The models detected this and quantified habitat use by total birds as a function of depth and distance to shoreline. These dynamics were investigated further to quantify the effect of covariates for predicting changes in species distribution. Scoter density and distribution exhibited a peak in waters 10 m (32.8 ft) in depth and were concentrated within 6.1 km (3.8 mi) from the coast and decreased offshore to approximately 30.6 km (19 mi) from the coast. Northern Gannets, which were present in each season, were generally concentrated in waters greater than 10 m (32.8 ft) in depth that was within 25.3 km (9.5 mi) from the coastline. Laughing Gulls and Common Terns, which were seasonal summertime breeders in New Jersey, displayed interesting distribution patterns. Laughing Gulls were generally concentrated within 7.6 km (4.7 mi) from the coast and decreased in waters greater than 15 m in depth. On the other hand, Common Terns ranged further offshore and their density declined around 18.3 km (11.4 mi) from the coast, and thereby occupied a wider range of coastal habitat than Laughing Gulls. The density and distribution of Cory Shearwaters, which were also summertime visitors, showed an increase in density offshore in waters greater than 30 m (98.4 ft) in depth to approximately 27.3 km (17 mi) from the coastline.

Overall, bird density and spatial distribution exhibited a striking onshore to offshore gradient that was highly variable among seasons and lined to changes in community composition. The results pinpoints where repeated maximum densities are likely to occur in relation to a variety of species. This information was integral to the understanding of the spatial ecology of marine birds along the New Jersey coastline and should be used to examine potential changes in habitat due to environmental changes from human activity (e.g., offshore wind development, water quality degradation, etc.).

Along with the kernel density maps that show where and when birds are likely to concentrate, it was determined that distance to shoreline and depth were useful and important predictors of changes in bird density and distribution. Kernel density maps were a valuable tool for identifying important locations where and when (by month and season) birds are most likely to concentrate. Depth and distance to shoreline were important predictors of bird density and distribution. Overall, bird density declined significantly in waters greater than 20 m (65.6 ft) and 12.2 km (7.6 mi) from the coastline. Total bird density was greater within the southeast portion of the Study Area during fall, summer, and winter but was more concentrated in the northern section of the Study Area during spring.

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APPENDICES

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APPENDIX A

AVIAN SURVEY PROTOCOLS AND METHODS: VERSIONS I - III

AVIAN OBSERVER PACKET

Ocean/Wind Power Ecological Baseline Studies

New Jersey Department of Environmental Protection
Division of Science, Research, & Technology

GEO-MARINE INCORPORATED

Version 1
04 January 2008

AVIAN OBSERVER MANUAL
NJDEP Baseline Survey Research Cruise 2008
4 January 2008

INTRODUCTION

The NJDEP has contracted GMI to conduct avian line transect surveys along the New Jersey coastline. The current study area is depicted in **Figure 1**. This manual is intended as an introduction to the field methodologies, project objectives, and as a general information guide for the biological observers who will be participating in the surveys.

AVIAN SHIP AND SMALL BOAT SURVEYS

Ship and small boat line-transect surveys will be conducted during daylight hours. Depending on visibility (e.g., cloud cover, fog) surveys will be started no earlier than 0.5 hours after sunrise and end no later than 0.5 after sunset. Two (2) experienced seabird biologists will use the appropriate sized stabilized binoculars to enumerate, estimate flight altitude, identify bird species out to an established range, and record other observations (e.g., behaviour, sources of food). Survey methods follow Gould and Forsell (1989) and Camphuysen et al., (2004). The objective of the line-transect method, as presented by Gould and Forsell (1989) is to obtain density estimates for seabirds. Gould and Forsell (1989) discussed and analyzed variables associated with the estimation of seabird density and concluded that counting all birds flying through the transect area would greatly exaggerate water density estimates. In other words counting all birds would represent birds using the air corridor over the water and not the birds associated with the water itself. Therefore, Gould and Forsell (1989) recommended counting flying birds once every 1 km (0.54 NM) along the transect line. Since the primary objective of the seabird surveys is to determine avian abundance, distribution, and flight behaviour (flight altitude and direction), Gould and Forsell's method will be modified to count all birds encountered in the survey strip (300 m).

SHIPBOARD OFFSHORE SURVEYS

Sample Design

Line-transect survey methods (Buckland et al. 2001) will be used to conduct avian, sea turtle, and marine mammal ship surveys. Survey tracklines will be plotted in a 'double saw-tooth' configuration with lines running perpendicular to the bathymetry from the 10-meter (m) isobath to the study area boundary (**Figure 1**). Waypoints for the tracklines will be generated for every survey using the program DISTANCE (Buckland et al. 2004); thereby allowing a true random design to the Study Area coverage.

Starting locations (North or South and East or West) will be decided by the flip of a coin for every survey. Tracklines will be surveyed at approximately 10 knots (kts) during daylight hours when Beaufort sea state (BSS) is ≤5 and visibility is ≥4 NM. This survey as designed will require 5 to 8 days to complete each month, depending on sea conditions and available daylight.

Standard Operating Procedures, Data Recording, Instrument Calibration

Avian

Hard copies of maps illustrating the numbered transect locations and coordinates of way points (transect start and endpoints) will be produced and given to the boat captain prior to the survey. The avian team will consist of three (3) biologists, one on the bow and one on the port or starboard side of the ship (i.e., dependant on glare), and one biologist off-effort. The survey area will be a 300-m strip on either side of the ship track line. The bow biologist will be responsible for surveying a 45-degree (°) area (0-45° or 315-360°) and the port/starboard biologist will be responsible for surveying the remaining 45° area (45-90° or 280-31°). Detailed standard operating procedures including information on data recording and instrument calibration are presented in **Appendix 1.**

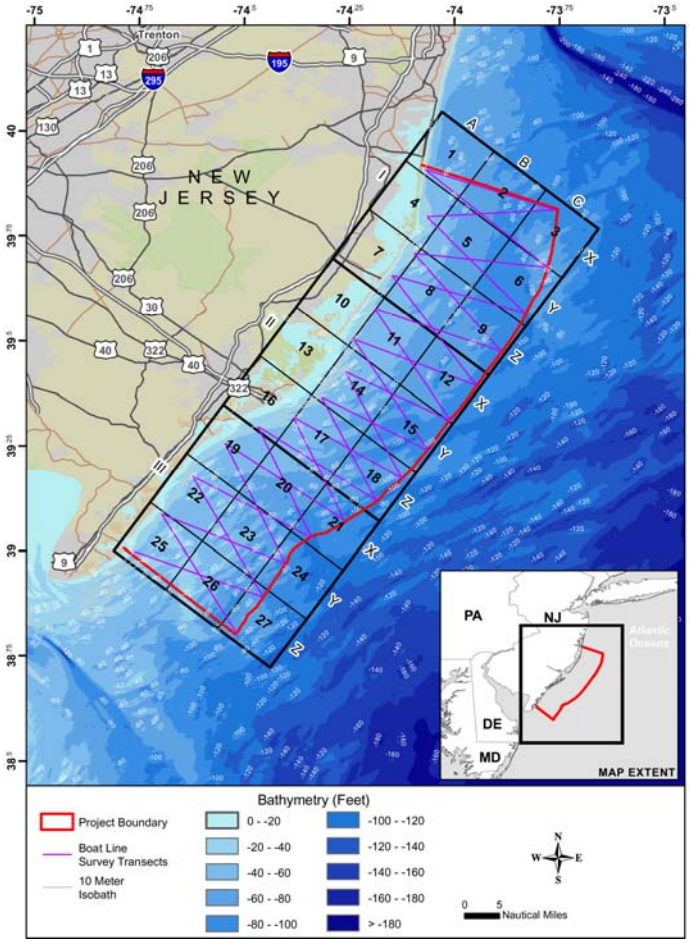

Figure 1. Map showing shipboard survey sampling design with representative tracklines.

Quality Assurance/Control

Avian

Data

The data will be downloaded to a lap top computer and reviewed by the senior seabird biologist after each survey to determine if reporting errors were made. If errors are present, the observer(s) (staff seabird biologists) will meet with the senior seabird biologist to resolve the error(s) the evening following the survey. Any necessary corrections will be made to the data file and noted in the file by the senior seabird biologist. The file will renamed (QA-QC added to file name) and be saved on a lap top computer and external hard drive (see **Appendix 1** for a detailed protocol).

Observer Efficiency

At least once monthly avian observer efficiency will be determined for each observer. The avian biologist not in the current rotation will randomly select one of the "on duty" avian biologists (i.e., the bow [1] or port/starboard biologists [2]) to conduct an hour-long observer efficiency survey. This biologist will stand behind the selected on duty observer and simultaneously and independently record survey data for a one-hour period. After the data has been downloaded, the two data sets will be compared.

SMALL VESSEL COASTAL SURVEYS

Small boat surveys will be conducted to capture nearshore coastal bird activity. These surveys will capture nearshore activity that may be missed by the ship due to depth limitations. The small boat coastal surveys will provide additional statistical power to the avian predictive model.

Sample Design

Trackline survey methods (Buckland et al. 2001) will be used to conduct coastal avian boat surveys along the nearshore area extending out to the 10-m isobath. A "single saw-tooth" sample design will be implemented to adequately survey the entire area. Individual transects will be numbered consecutively (**Figure 2**). A total of 67 single-sawtooth transects span three strata, numbered from the northernmost to the southernmost shoreline location in the study area, such that transects 1-22 are in the high-latitude stratum, transects 23-44 are in the mid-latitude stratum, and transects 45-67 are in the low-latitude stratum. The starting location for each survey will be randomly determined selecting among four starting points, A, B, C, and D (see **Figure 2**). Point A (at the beginning of transect 1) is the northernmost shoreline location of the high-latitude stratum, point B (between transects 22 and 23) divides the high-latitude stratum from the mid-latitude stratum, point C (between transects 44 and 45) divides the mid-latitude stratum from the low-latitude stratum, and point D (at the end of transect 67) is the southernmost shoreline location of the low-latitude stratum. In order to minimize down-time for ship relocation to start

sampling a new stratum, the starting direction (north or south) will not be randomly selected, but instead will automatically be determined from the results of the random starting location selection. Specifically, the starting direction for points A and B will be south, and the starting direction for points C and D will be north, allowing at least two complete strata to be sampled before the ship may be required to relocate to start sampling the remaining stratum. If point A or D is chosen as the starting location, then no ship relocation is required. Transect lines will be surveyed until dusk and therefore the area covered will be dependent upon the available daylight during the time of the survey. This approach will allow a truly random sampling (with respect to starting location) of the shoreline and the shoal areas for seabird roosting/resting and feeding areas, while maximizing available ship sampling time (i.e., minimizing ship down time or relocation time).

Quality Assurance/Control

Quality assurance/control would be identical to that described previously for the shipboard surveys.

Standard Operating Procedures, Data Recording, Instrument Calibration

Surveys will be conducted once monthly during months when aerial surveys are not conducted. A total of 12 monthly surveys will be completed. Standard operating procedures, data recording, and instrument calibration are identical to those described for shipboard avian surveys.

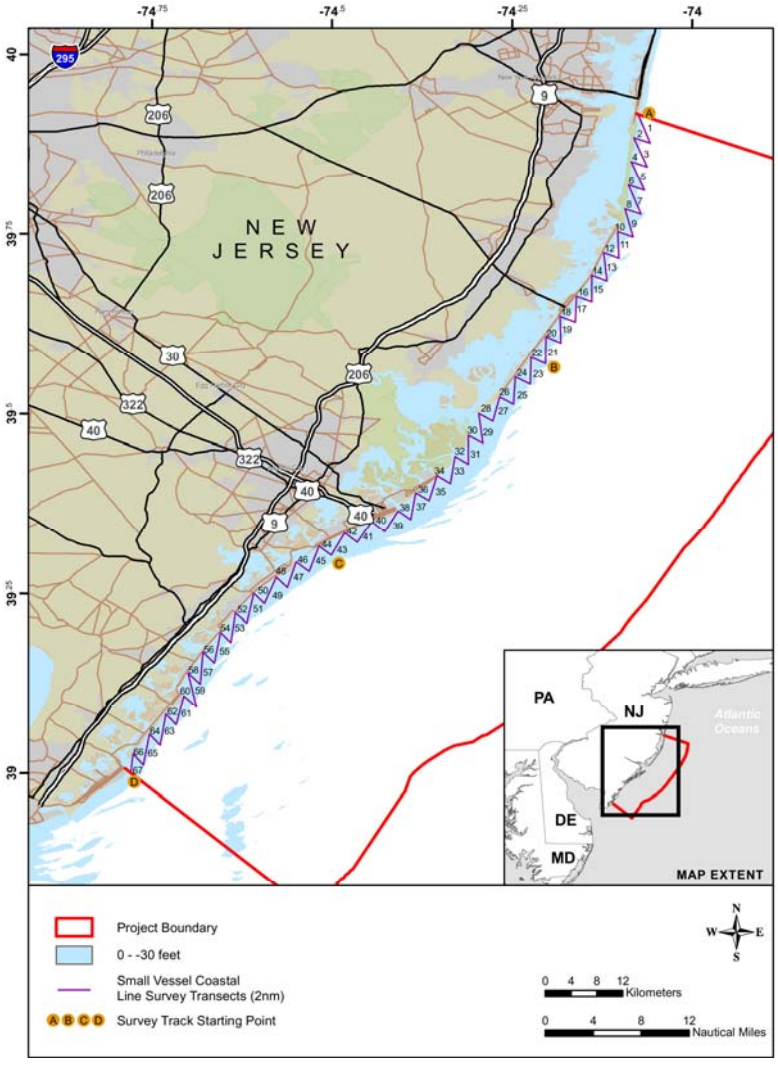

Figure 2. Map showing survey design for the small boat coastal surveys with representative tracklines.

APPENDIX 1

AVIAN SHIP SURVEY STANDARD OPERATING PROCEDURES

AVIAN SHIP AND SMALL BOAT SURVEY STANDARD OPERATING PROCEDURES

I. Personnel

The ultimate responsibility for the avian ship surveys rests with the senior seabird biologist. The senior seabird biologist reports to and coordinates the avian survey effort with the Chief Scientist. In confusing or unique field situations, the senior seabird biologist will consult with the Chief Scientist prior to making a decision.

I.A. Identification Specialists (one)

The senior seabird biologist is an experienced observer who has conducted avian at sea and coastal ship and small boat-based surveys. He has the ability to identify avian species known to occur in the project area, conduct observer efficiency quality assurance protocols, and to complete data quality control procedures. The experience of the senior seabird biologist will maintain the consistency of the data collected during each survey.

The senior seabird biologist is the avian team leader and works with the other team members to make decisions and act by consensus. If team members understand and agree with a particular decision, the avian team will work better together. The senior seabird biologist will be a part of the observation team.

I.B. Observers (three)

Avian seabird biologists (observers) are responsible for collecting the primary avian survey data. The observers use Fujinon 14 X 40 image stabilizing binoculars to identify the birds observed in the survey area. The avian observers are proficient in sighting and identifying birds and recording accurate data on hand-held data recorders. Observers will work together as a team to sight and identify birds in the survey area.

II. Watch Rotations

The primary duties of the three avian observers are conducted during a rotation through two positions. During a given watch, the observers rotate through the positions, normally for a period of forty minutes per position. Observer on duty watch shifts will be 80 minutes (min) followed by a 40 min break. During severe glare or high sea conditions the team may select watch periods of shorter duration to lessen fatigue. The observer will arrive at the position 3-5 min before beginning a watch.

III. Duties

III.A. Pre-Survey

The Chief Scientist will determine if sea state conditions are acceptable (<6 on the Beaufort scale) to begin the survey. If sea state conditions are acceptable, the starting transect number will be selected with a random number generator by the Chief Scientist. The pre-survey section of the avian boat survey checklist (**Appendix 2**) will be completed by the senior seabird biologist prior to leaving port and before the beginning of each survey.

III.B. Survey

A weather form will be completed prior to initiating the survey, at mid-day, and at the end of the survey. Changes in weather between these times will be documented on the weather data form(s) (**see Quality Assurance/Quality Control Plan**). The observers will select the side of the ship with the least glare and position themselves at the two survey positions (bow [observer 1] and port/starboard [observer 2]). Both avian observers will scan the survey area for birds with “naked eyes”. The survey area will be a 300-m strip on either side of the ship track line. The bow biologist will be responsible for surveying a 45-degree (°) area (0-45° or 315-360°) and the port/starboard biologist will be responsible for surveying the

remaining 45° area (45-90° or 280-315°). Observers will identify the birds spotted with image-stabilizing binoculars. Surveys will be conducted daily from dawn to dusk until the double sawtooth survey design is completed. If the boat goes off-transect to investigate a marine mammal sighting, avian data collection will continue. A new transect number will be assigned and the survey effort will continue every time the ship changes direction.

Data will be recorded on a hand-held computer for each bird observation. Data recorded will include: transect number, identity (lowest practical taxon; family, genus, species [four letter standard code]), number of individuals (approximate number for flocks), perpendicular distance from the boat transect line to the bird(s), estimated flight altitude, and behavior (flying, foraging, etc). Cardinal directions will be used to designate flight directions.

III.C. Post Daily Survey

Each night of the cruise, the senior seabird biologist will download the day's data into an Excel spreadsheet on a laptop computer. After downloading is complete, the Chief Seabird Biologist (CSB) will check the data for transcription and downloading errors. If necessary, the CSB will meet with members of the avian team at night to resolve transcription errors and make database corrections. The pre-survey section of the avian boat survey checklist will be finalized by the CSB each night.

III.D. Post Cruise

Survey data is downloaded from the laptop computer onto the field office desktop computer and then to the master project directory on the Geo-Marine, Inc. (GMI) Plano Corporate Office server. The post cruise section of the avian boat survey checklist (**Appendix 2**) will be completed by the CSB when the cruise has been completed.

IV. Data Recording

IV.A. Computer Program

A hand-held computer program was developed by GMI to record avian ship survey data. The program simultaneously records the location of ship (transect line) through a connection to the ship's global positioning system (GPS). When prompted the time and transect location of a bird sighting is recorded.

The data file is divided into two sections. The first section contains general data and lists all of the codes used in the data section. General data categories include: Survey Type, Vehicle, Time Zone Delta, Location Interval, and Altitude. These categories are defined below:

Survey Type
"Bird" or "Mammal"
Vehicle
e.g. "Boat", "Plane", etc.
Time Zone Delta
Value, in hours, added to Zulu time to give local time (May be a decimal).
Location Interval
Time in seconds between writing out location records
Altitude
In feet above sea level
Observers may be at a different altitude.

The second section contains the survey data. Each record in the data section is stored as a single line with identical format. Observers, species, behaviors, weather conditions, sea states, water turbidity, water color, glare, and sunlight are all given codes.

Each entry in the data section has the following fields, separated by commas:

Card:
- Year-Month-Day
- Hour; Minute: Second
- GPS State
- Latitude
- Longitude
- Heading
- Speed
- Species1
- Count1
- Behavior1
- Range1
- Bearing1
- Elevation1
- Latitude1
- Longitude1
- Species2
- Count2
- Behavior2
- Range2
- Bearing2
- Elevation2
- Latitude2
- Longitude2
- Species3
- Count3
- Behavior3
- Range3
- Bearing3
- Elevation3
- Latitude3
- Longitude3
- Observer
- Weather
- Sea State
- Turbidity
- Water Color
- Water Temperature
- Sun Strength
- Glare

The interpretation of the fields:

Card:
- A0 Beginning of survey
- A9 End of survey
- B0 Beginning of transect
- B9 End of transect
- C0 Going on effort
- C9 Going off effort
- D0 On effort sighting
- D1 Off effort sighting
- E0 On Effort location only
- E1 Off Effort location only
- F0 Change of sighting conditions

Year-Month-Day:
in Zulu time
year is four digits
Hour:Minute:Second
in Zulu time 24 hour clock
GPS State
1 – acceptable for avian surveys
2 – not acceptable for avian surveys
Latitude / Longitude
of the ship in decimal degrees, to the 0.00001 (approx. one meter at the equator)
Heading
of the ship 0 to 359°
Speed
ground speed in knots of the ship
SpeciesN
code of the species sighted. Up to three species may be designated for a given sighting.
CountN
number of individuals
BehaviorN
code for the sighting's behavior
RangeN
In meters from the observer
BearingN
from the observer to the sighting (e.g. right side observers would have a value of 0 to 180°).
ElevationN
vertical angle from the observer to the sighting (in a plane this would almost always be negative)
LatitudeN / LongitudeN
computed position of the sighting based on vehicle position and range / bearing / elevation
Observer
code of the observer
Weather
weather code, given in first section
Sea State
sea state code, given in first section
Turbidity
turbidy code, given in first section
Water Color
code for water color, given in the first section
Water Temperature
temperature of water, degrees Celsius. -9999 means unknown.
Sun Strength
Strength of sunlight code, given in first section
Glare
code for glare, given in the first section

APPENDIX 2

SHIP SURVEY QUALITY ASSURANCE/CONTROL PROTOCOL AND CHECKLIST

Ship/Small Boat Survey Quality Assurance Protocol

Protocols for conducting safety, equipment, and data checks will be followed before, during, and after every survey cruise to ensure personnel safety, equipment readiness, and collection of quality data.

Prior to beginning a survey, the chief scientist will determine sea state conditions in the project area by checking online data from National Oceanic and Atmospheric Administration (NOAA) buoys in the area. The chief scientist will then discuss these results with the ship's captain/airplane pilot, at which point the captain will determine if current and forecasted weather conditions are acceptable to begin the survey.

The senior marine mammal and seabird biologists will be responsible for completing pre- and post-survey inspections using the checklist on the following page. These inspections will ensure all necessary survey equipment is available and functional prior to surveys and that all datasheets used during the survey are complete, legible, and accurate. If errors are found on the datasheets, the biologists that logged the data will be consulted to resolve the issue. Once the datasheets are inspected, the data will be entered into an electronic spreadsheet. The spreadsheet will be checked for errors and corrected immediately. Data will be saved with a Quality Assurance-Quality Control (QAQC) notation in the file name (e.g. Avian Ship Survey 01-15-01 QAQC) and in redundant copies (hard drive and external disc). All external media storage devices will be appropriately labeled with the survey dates, type of data, and author.

After returning to shore, the senior marine mammal and/or seabird biologist will download the QAQC data to the corporate office project's drive. Once the download is complete, the project manager or principle investigator will be contacted to verify the data is present and readable.

AVIAN SHIP SURVEY CHECKLIST

DATE:_____

REQUIREMENT	Yes	No	Signature/Title	Date	Time
PRE-SURVEY	☐	☐			
Ship Ready Status	☐	☐			
Sea State Condition	☐	☐			
Meets Survey Protocol	☐	☐			
Ship Safety	☐	☐			
Crew boat safety review	☐	☐			
Survey Equipment	☐	☐			
Hand-held data recorders (3)	☐	☐			
Survey Line Map/Coordinates	☐	☐			
Laptop Computer (primary)	☐	☐			
Spare Laptop computer	☐	☐			
Spare Hand-held data recorder	☐	☐			
Binoculars (2 primary-1 spare)	☐	☐			
Field Guides	☐	☐			
Extra binocular batteries	☐	☐			
Battery charger	☐	☐			
Pre-Survey Operation Checks	☐	☐			
Ship GIS	☐	☐			
Laptop Computer (Primary)	☐	☐			
Laptop Computer (Spare)	☐	☐			
Hand-held data recorders	☐	☐			
SURVEY	☐	☐			
Data Requirements	☐	☐			
Weather Data	☐	☐			
Weather Form (AM)	☐	☐			
Weather Form (Noon)	☐	☐			
Weather Form (PM)	☐	☐			
Survey Data Downloaded	☐	☐			
Survey Data checked for errors	☐	☐			
Survey Data File Saved on PC	☐	☐			
Survey Data saved on 2nd PC	☐	☐			
Observer Efficiency Surveys	☐	☐			
POST CRUISE	☐	☐			
Survey Data Downloaded	☐	☐			
On site office PC	☐	☐			
P drive: Corporate Office	☐	☐			

Quality Assurance/Control Problems:

1._____

2._____

Corrective Actions:

1._____

2._____

Sr. Seabird Biologist:_____**Date:**_____

REVISED AVIAN OBSERVER PACKET

Ocean/Wind Power Ecological Baseline Studies

New Jersey Department of Environmental Protection
Division of Science, Research, & Technology

GEO-MARINE INCORPORATED

Revision II
28 February 2008

AVIAN OBSERVER MANUAL
NJDEP Baseline Survey Research Cruise 2008
4 January 2008

INTRODUCTION

The NJDEP has contracted GMI to conduct avian strip transect surveys along tracklines off the New Jersey coastline. The current study area is depicted in **Figure 1**. This manual provided detailed field survey methodologies and protocols, project objectives, and as a general information guide for the avian observers who will be participating in the surveys.

AVIAN SHIP AND SMALL BOAT SURVEYS

Ship and small boat strip transect-surveys will be conducted during daylight hours. Depending on visibility (e.g., cloud cover, fog) surveys will be started as soon as visibility allows and will continue to sunset (i.e., if weather conditions allow). Two (2) experienced seabird biologists will use the appropriate sized stabilized binoculars to enumerate, estimate flight altitude, identify bird species out to an established range, and record other observations (e.g., behavior, sources of food). Survey methods follow Gould and Forsell (1989) and Camphuysen et al., (2004). The objective of the method presented by Gould and Forsell (1989) is to obtain density estimates for seabirds. Gould and Forsell (1989) discussed and analyzed variables associated with the estimation of seabird density and concluded that counting all birds flying through the transect area would greatly exaggerate water density estimates. In other words counting all birds would represent birds using the air corridor over the water and not the birds associated with the water itself. Therefore, Gould and Forsell (1989) recommended counting flying birds once every 1 km (0.54 NM) along the transect line. Since the primary objective of the seabird surveys is to determine avian abundance, distribution, and flight behaviour (flight altitude and direction), Gould and Forsell's method will be modified to count all sitting and flying birds encountered in the survey strip (300 X 300 m square). In addition, avian observations will be conducted outside of the 300 X 300 survey area for "important" birds. Important birds include large flocks of birds and rare birds.

SHIPBOARD OFFSHORE SURVEYS

Sample Design

Line-transect survey methods (Buckland et al. 2001) will be used to conduct avian, sea turtle, and marine mammal ship surveys. Avian strip transects will be conducted on either side of the trackline (Gould and Forsell 1989). Survey tracklines will be plotted in a 'double saw-tooth' configuration with lines running perpendicular to coastline from the western to eastern boundary of the project area (**Figure 1**). Tracklines will be generated for every survey using the program DISTANCE (Buckland et al. 2004); thereby allowing a true random design to the Study Area coverage.

Starting locations (North or South and East or West) will be decided by the flip of a coin for every survey. Tracklines will be surveyed at approximately 10 kts when Beaufort sea state (BSS) is ≤ 6 and visibility is ≥4 NM. This survey as designed will require 5 to 7 days to complete each month, depending on sea conditions and available daylight.

Quality Assurance/Control

Avian

Data

The data will be downloaded to a lap top computer and reviewed by the senior seabird biologist (SSB) after each survey to determine if reporting errors were made. If errors are present, the observer(s) (staff seabird biologists) will meet with the SSB to resolve the error(s) the evening following the completion of each daily survey.

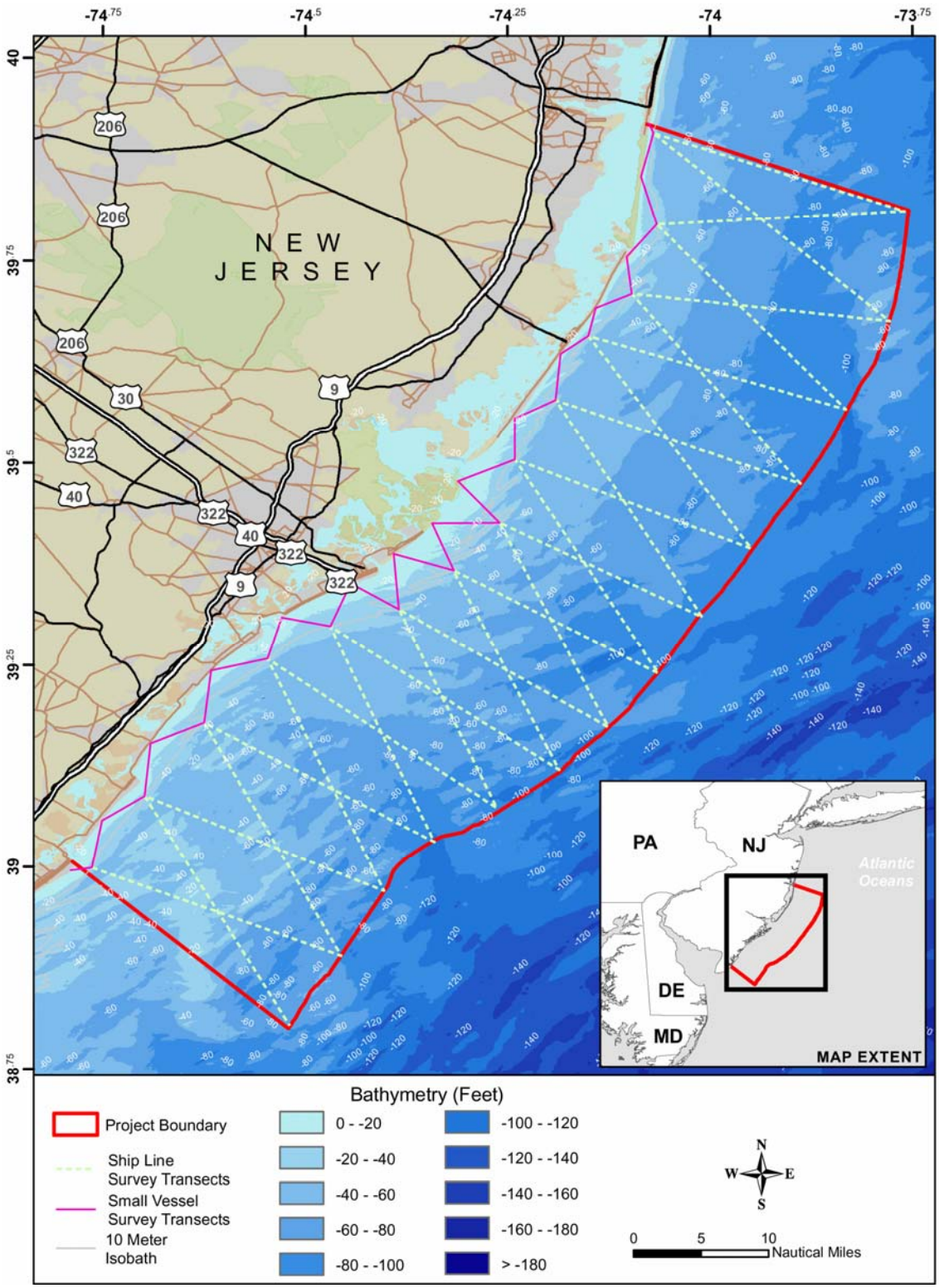

Figure 1. Map showing survey design for the ship offshore and small boat coastal surveys with representative tracklines

Any necessary corrections will be made to the data file by the SSB, as follows:

- All data files will be renamed (QAQC added to the file name) after the file has been checked.
- Upon completion of the of the QAQC check, raw data files will be placed in the "raw" folder and QAQC files will be placed in the "QAQC" folder.
- All files will then be transferred to an external hard drive for storage (see below for additional instructions).

Observer Efficiency

At least once monthly avian observer efficiency will be determined for each observer. The avian biologist assigned as the senior seabird biologist will randomly select one of the "on duty" staff seabird biologists to conduct a 40 minute observer efficiency survey. This biologist will stand behind or near the selected on duty observer and simultaneously and independently record survey data in the staff seabird biologists assigned survey area for a 40 minute period.

After the QAQC check is completed, the SSB will:

- create an observer efficiency folder
- place a copy of the QAQC staff seabird biologist file in the folder
- place a copy of the SSB observer efficiency file in the folder
- delete the SSB observer efficiency file from the QAQC and raw folders

The two data sets will be compared. Parameters to be compared include species identification, number observed, and range to the bird.

Standard Operating Procedures, Data Recording, Instrument Calibration

Avian

Hard copies of maps illustrating the numbered transect locations and coordinates of way points (transect start and projected endpoints) will be produced and given to the boat captain prior to the initial survey. The avian team will consist of three (3) biologists, one on the bow and one on the port or starboard side of the ship (i.e., dependant on glare), and one biologist off-effort. The primary survey area will be a 300 by 300-m strip on either side of the ship track line. The secondary survey area will be all visible areas outside of the primary survey area. Detailed standard operating procedures and information on data recording and instrument calibration are presented in **Appendix 1.**

SMALL VESSEL COASTAL SURVEYS

Small boat surveys will be conducted to capture nearshore coastal bird activity. These surveys will capture nearshore activity that may be missed by the ship due to depth limitations. The small boat coastal surveys will provide additional statistical power to the avian predictive model.

Sample Design

A strip transect method will be used to conduct the small vessel coastal surveys (Gould and Forsell 1989); the survey method will be identical to the method used for the avian shipboard surveys (see Section 5.1.1) except that a "single saw-tooth" sample design will be implemented to adequately survey the entire area. Nearshore ship waypoints will be plotted after the ship survey is completed. Coastal tracklines will be generated to complete the trackline to the shore. The boat captain will be requested to approach the shoreline as close as safety allows (dependant on tide and weather conditions). Transects length will vary between month and will be entirely dependant on the tide and water depth during both the shipboard and small vessel survey days.

The starting location for each survey will be randomly determined among two starting points (north end and south end). If daylight, weather, and sea state conditions allow, the entire coastal area will be

surveyed in one day. This approach will allow a truly random sampling (with respect to starting location) of shoreline and the shoal areas for seabird roosting/resting and feeding areas, while maximizing available ship sampling time (i.e., minimizing ship down time or relocation time).

Quality Assurance/Control

Quality assurance/control would be identical to that described previously for the shipboard surveys.

Standard Operating Procedures, Data Recording, Instrument Calibration

Surveys will be conducted monthly after the shipboard surveys have been completed. Standard operating procedures, data recording, and instrument calibration are identical to those described for shipboard avian surveys.

APPENDIX 1

AVIAN

APPENDIX 1A

AVIAN SHIP SURVEY STANDARD OPERATING PROCEDURES

AVIAN SHIP AND SMALL BOAT SURVEY STANDARD OPERATING PROCEDURES

I. Personnel

The ultimate responsibility for the avian ship surveys rests with the senior seabird biologist. The senior seabird biologist reports to and coordinates the avian survey effort with the Chief Science Officer (CSF). In confusing or unique field situations, the senior seabird biologist will consult with the CSF before making a decision.

I.A. Identification Specialists (one)

The senior seabird biologist is an experienced observer who has conducted avian at sea and coastal ship and small boat-based surveys. He has the ability to identify avian species known to occur in the project area, conduct observer efficiency quality assurance protocols, and to complete data quality control procedures. The experience of the senior seabird biologist will maintain the consistency of the data collected during each survey.

The senior seabird biologist is the avian team leader and works with the other team members to discuss problems and make decisions. If team members are included in the decision-making process, the avian team will work better together. The senior seabird biologist will be a part of the observation team.

I.B. Observers (three)

Avian seabird biologists (observers) are responsible for collecting the avian survey data. The observers use Fujinon 14 X 40 image stabilizing binoculars to identify the birds observed in the survey area. The avian observers are proficient in sighting and identifying birds and recording accurate data on hand-held data recorders. Observers will work together as a team to sight and identify birds in the survey area. For example, if one observer is recording data, the other will survey the area not being surveyed by the recording biologist.

II. Watch Rotations

The primary duties of the three avian observers are conducted during a rotation through two positions. During a given watch, the observers rotate through the positions. Observer on duty watch shifts will normally be 80 minutes (min) followed by a 15 min break. During the lunch hour rotations will be limited to 20 minutes to allow all observers to eat.

Upon completing a watch rotation, the observer will review set (environmental) conditions on the avian computer and make all necessary changes. The observer will return after the break and remain at the computer station to monitor and to change the environmental conditions when necessary.

The on-effort biologists and the off-effort observer will carry a radio. The on-effort observers will contact the off observer via a radio if the set conditions need to be changed or additional help is needed to record a large group of birds. When large numbers of birds are encountered, the senior seabird biologist may decide to bring the “off” observer” out to assist with identification and/or data recording. During severe glare, high sea, or severe cold conditions the team may select watch periods of shorter duration. The observer will arrive at the position 3-5 minutes before beginning a watch.

III. Duties

III.A. Pre-Survey

Prior to initiating the monthly survey effort all observers will review the standard operating procedures for the avian survey. Steiner binoculars equipped with a compass will be used to mark bearings (in 10 degree increments) for each observer position. Range estimation sticks will initially be prepared for observers < 5 ft. 10 inches tall and for individuals taller than 5 ft. 10 inches by using at dock distance

estimates from the observer positions on the ship. Distances will be marked on the range sticks distances from the docked ship (i.e., a laser range finder will be used to determine distances). The range finder stick(s) will be mounted on boards at the observer positions.

The Chief Science Officer will determine if sea state conditions are acceptable (≤ 6 on the Beaufort scale) to begin the survey. If sea state conditions are acceptable, the starting transect number will be selected with a random number generator by the Chief Science Officer. The pre-survey section of the avian boat survey checklist (**Appendix 2**) will be completed by the senior seabird biologist prior to leaving port and before the beginning of each survey. A weather form will be completed prior to initiating the survey, and each observer should synchronize his/her watch with that on the computer.

III.B. Survey

A weather form will be completed at mid-day, and at the end of the survey. Changes in weather will be documented on the weather data form(s) (**Appendix 2**). The senior seabird biologist will select the side of the ship with the least glare and position themselves at the two survey positions (bow [observer 1] and port/starboard [observer 2]). Both avian observers will scan the survey area for birds with "naked eyes". The "bow" avian observer will scan the 0-45 degree zone within 300-m of his/her position ahead of the ship while the "port/starboard" biologist will scan the remaining area 46-90 degrees. In addition to this primary survey area, observers will scan beyond this area for "important" birds. Important birds include flocks on the water and rare species.

Surveys will be conducted daily as soon as visibility allows to sunset. Observers will assist each other during the surveys. Priority will be given to birds within the primary (300 X 300 m) survey area. An observer may ask another observer to record observation data if the other observer is not busy. Observers will be aware of the activity of the other observer. If the second observer is not recording data while the first observer is recording, the second observer will scan the entire survey area and record any birds observed.

If the boat goes off-transect to investigate a marine mammal sighting, avian data collection will continue. However, the avian computers will go off-effort until the ship is back on-effort (on transect). A new transect number will be assigned and the avian survey effort will continue every time the ship changes direction.

When the ship reaches the end of a transect, observers will continue recording until a new transect is started. Observers will then go off-effort and return immediately to on-effort. When the ship is at the near shore leg; observers will focus their survey effort towards shore (i.e., one observer may have to go off-effort then on-effort to switch survey positions).

Observers will identify the birds spotted with image-stabilizing binoculars. Data will be recorded on a hand-held computer for each bird observation. Data recorded will include,

- identity (lowest practical taxon; family, genus, species [four letter standard code),
- number of individuals (approximate number for flocks),
- bearing and range (distance) to the bird(s), estimated flight altitude
- behavior (flying, foraging, etc).
- cardinal directions will be used to designate flight directions (cardinal direction will be based on the ship transect line (bow of the ship is North).
- Observer conditions (perfect to poor)

In addition, observers will incidentally record, if time is available, the following data in the comments section:

- dive altitude (feet) of northern gannets DALT ?
- submersion time of northern gannets after a dive (i.e., in front of the ship, sea state conditions permitting). SUBT=?
- the life state of the bird (A = adult; I = Immature; J = juvenile; U = unknown)

The following protocol is to be followed if an avian observer observers a marine mammal:

- all mammal observations in front of the avian observer (near the bow or along the side of the ship) must be reported to the marine mammal survey team via the radio.
- All mammal observations at a distance in front of the ship can not be reported until the the observation is BEHIND the flying bridge.

III.C. Post Daily Survey

Each night of the cruise, the senior seabird biologist will QC the data. The data will be downloaded to a lap top computer and reviewed by the senior seabird biologist (SSB) after each survey to determine if reporting errors were made. If errors are present, the observer(s) (staff seabird biologists) will meet with the SSB to resolve the error(s) the evening following the completion of each daily survey.

Any necessary corrections will be made to the data file by the SSB, as follows:

- All data files will be renamed (QAQC added to the file name) after the file has been checked.
- Upon completion of the of the QAQC check all files, raw data files will be placed in the "raw" folder and QAQC files will be placed in the "QAQC" folder.
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After the QAQC check is completed, the SSB will:

- create an observer efficiency folder
- place a copy of the QAQC staff seabird biologist file in the folder
- place a copy of the SSB observer efficiency file in the folder
- delete the SSB observer efficiency file from the QAQC and raw folders

The two data sets will be compared. Parameters to be compared include species identification, number observed, and range to the bird.

III.D. Post Cruise

Survey data is downloaded from the laptop computer onto the field office desktop computer and then to the master project directory on the GMI Plano Corporate Office server. The post cruise section of the avian boat survey checklist (**Appendix D-1a**) will be completed by the CSB when the cruise has been completed.

IV. Data Recording

IV.A. Computer Program

A hand-held computer program was developed by GMI to record avian ship survey data. The program simultaneously records the location of ship (transect line) through a connection to the ship's GPS. When prompted the time and transect location of a bird sighting is recorded.

The data file is divided into two sections. The first section contains general data and lists all of the codes used in the data section. General data categories include: Survey Type, Vehicle, Time Zone Delta, Location Interval, and Altitude. These categories are defined below:

Survey Type
"Bird" or "Mammal"

Vehicle
e.g. "Boat", "Plane", etc.

Time Zone Delta
Value, in hours, added to Zulu time to give local time (May be a decimal).

Location Interval
Time in seconds between writing out location records

Altitude
In feet above sea level
Observers may be at a different altitude.

The second section contains the survey data. Each record in the data section is stored as a single line with identical format. Observers, species, behaviors, weather conditions, sea states, water turbidity, water color, glare, and sunlight are all given codes.

Each entry in the data section has the following fields, separated by commas

Card
Year-Month-Day
Hour; Minute: Second
GPS State
Latitude
Longitude
Heading
Speed
Species1
Count1
Behavior1
Range1
Bearing1
Elevation1
Latitude1
Longitude1
Species2
Count2
Behavior2
Range2
Bearing2
Elevation2
Latitude2
Longitude2
Species3
Count3
Behavior3
Range3
Bearing3
Elevation3

Latitude3
Longitude3
Observer
Weather
Sea State
Turbidity
Water Color
Water Temperature
Sun Strength
Glare

The interpretation of the fields:

Card:
A0 Beginning of survey
A9 End of survey
B0 Beginning of transect
B9 End of transect
C0 Going on-effort
C9 Going off-effort
D0 On-effort sighting
D1 Off-effort sighting
E0 On-effort location only
E1 Off-effort location only
F0 Change of sighting conditions

Year-Month-Day:
in Zulu time
year is four digits

Hour:Minute:Second
in Zulu time 24 hour clock

GPS State
1 – acceptable for avian surveys
2 – not acceptable for avian surveys

Latitude / Longitude
of the ship in decimal degrees, to the 0.00001 (approx. one meter at the equator)

Heading
of the ship 0 to 359°

Speed
ground speed in knots of the ship

SpeciesN
code of the species sighted. Up to three species may be designated for a given sighting.

CountN
number of individuals

BehaviorN
code for the sighting's behavior

RangeN

In meters from the observer

BearingN
from the observer to the sighting (e.g. right side observers would have a value of 0 to 180°).

ElevationN
vertical angle from the observer to the sighting (in a plane this would almost always be negative

LatitudeN / LongitudeN
computed position of the sighting based on vehicle position and range / bearing / elevation

Observer
code of the observer

Weather
weather code, given in first section

Sea State
sea state code, given in first section

Turbidity
turbidy code, given in first section

Water Color
code for water color, given in the first section

Water Temperature
temperature of water, degrees Celsius. -9999 means unknown.

Sun Strength
Strength of sunlight code, given in first section

Glare
code for glare, given in the first section

V. Instrument Calibration

None

V. SHIPBOARD FACILITIES AND CONSIDERATIONS

We are fortunate to be aboard the R/V Hugh R. Sharp. Please follow link below to familiarize yourself with the vessel.

http://www.ocean.udel.edu/marine/rvhugh/index.shtml

At initial boarding of the research vessel, you will receive a briefing on the specific protocols/procedures of the vessels and there will be a safety overview which will review the protocols for fire and abandon-ship procedures.

The ship will provide all linens and pillows and depending on the time of year it may be prudent to bring additional blankets and/or cold weather gear. This survey will be conducted year-round in acceptable sea states.

V.A. CHAIN OF COMMAND

Members of the scientific party, including marine mammal observers, report directly to the Chief Scientist (or cruise leader). The Chief Scientist represents the scientific party responsible for communicating with the vessel's staff, and has sole authority to act on behalf of the NJDEP and GMI Program Manager. Any and all sensitive or operational communications from the scientific party to the ship's staff needs to pass through the Chief Scientist. The Chief Scientist is responsible for any change in operating procedures or handle any out of the ordinary matter. If you have a problem, please see the cruise leader. Please do not at any time try to resolve the situation yourself by approaching the ship's personnel directly.

V.B. RELATIONS WITH SHIP PERSONNEL

While living and working aboard the research vessel, all scientific personnel should keep in mind that the officers and crew spend a greater portion of the year on the vessel than they do on shore. Therefore, procedures and expectations of the ship personnel have become established through many projects throughout the years, not just the current survey. Please respect their experience when dealing with the ship personnel. In addition, always ask before using any ship equipment.

The daily, work-related interaction with the officers and crew that observers will have most frequently will be radio communications between the flying bridge and bridge during chase or other survey activities. A good working relationship with the bridge team can be established by maintaining a professional demeanor and framing clear and concise requests.

V.C STATEROOMS

Space is limited at sea. Bring only the necessary gear, as there will be little (or no) storage space outside your stateroom.

Noise levels should be maintained with respect for off-watch personnel. Scientific staterooms adjoin the crew's quarters and since ship personnel work throughout the night, some people will be sleeping at all times during some part of the day.

Walls in the staterooms are painted plasterboard. Nails and tack holes are unacceptable as they damage the walls. However, you are able to use Handi-tak, which is a product that can be used to mount pictures or wall decoration without harming the surface. Bedding is furnished, although some people bring their own to make their space more personal. The ship also provides bathroom towels and soap. However, the ship's towels are not allowed on deck, so bring along your own beach towel if you'll be “sun tanning” on the "steel beach."

In most cases rooms will be shared with others, so be respectful and keep your area neat and tidy.

V.D. MEALS

Three meals are served aboard ship every day at scheduled times.

Observers should be punctual to meals. The ships cook should be contacted if for any reason you will miss or be late for a meal. Except when oceanographic stations are conducted at noon, marine mammal watch does not stop during mealtime. Customarily, off-effort observers eat promptly and then replace on-effort observers for about 20 min so that the on-effort team can get their meals too. Besides regular meals, the ship has juice and milk dispensers, fresh fruit (when available), and snacks. These are accessible at all times. An attempt is made to accommodate vegetarian diets during most meals, but the non-meat selection will at times be limited. The standard vegetarian fare may contain eggs or cheese.

V.E. LAUNDRY

The ship has washer and dryer facilities with detergent. They are operated on a come first-serve basis. Please make sure that your clothes are removed promptly from the washer or dryer so the next person can use the machine.

V.F. EXERCISE ROOM

The vessel may have areas set aside for work-outs and weight training. When using those facilities, please take care of the equipment and do not abuse your privileges by spending too much time in those limited areas so that others are denied use. Additionally, make sure to wipe down any equipment you use.

V.G. FOOTWEAR

Closed-toe shoes are mandatory while traveling throughout the ship. Thongs or other open-toe sandals are permitted only while on the flying bridge (wear closed-toe shoes to and from this location) or in the living quarters.

V.H. DRUGS, ALCOHOL, AND SMOKING

1. Drugs and Alcohol

There is a zero tolerance policy on the possession of drugs and alcohol on this survey cruise.

2. Smoking

Smoking is prohibited in all interior spaces on the ship. Smoking is only allowed on the weather decks and only in designated areas.

V.I. COMMUNICATIONS

1. Phone Calls and Radio Patches

The ship is equipped with INMARSAT, a satellite phone system. Calls cost about $10.00 per minute and there is a 3 min minimum. It is expensive but nice to have in an emergency. Sometimes radio phone patches are an option. Cell phones should be available when near shore.

2. Email

The ship will have services available for use by scientific personnel to send and receive messages. The project will pay for satellite time for reasonable usage. Please do not send large files, graphics, or attachments and inform your correspondents not to send them to you.

3. Emergency Contact

In the event of an emergency on land; please provide a family member or friend the following list of contacts and their contact information.

Chief Scientist – Dr. Greg Fulling
214-578-1377
gfulling@geo-marine.com

Geo-Marine, Inc. – Main Office
Dr. Dan Wilkinson
972-423-5480

Hugh R. Sharp - Main Office:
Sharyn Bressler
Staff Assistant
Phone: 302.645.4320
Email: sharyn@udel.edu

Cruise Planning, Scheduling, and Budgets:
Matthew Hawkins
Director of Marine Ops
Office Phone: 302.645.4341
Cell Phone: 410.924.2472
Email: hawkins@udel.edu

Cruise Planning and Logistics:
Captain Bill Byam
Master
Office Phone: 302.645.4343
Cell Phone: 302.381.0346
Email: byam@udel.edu

Cruise Planning and Technical Support:
Timothy Deering
Oceanographic Coordinator
Office Phone: 302.645.4338
Cell Phone: 302.249.6149
Email: deering@udel.edu

V.J. INTER-PERSONAL RELATIONS

1. Social Considerations

People working and living together on a ship creates an unusual environment. There is minimal privacy and space for individuals spending an extended amount of time together in an isolated setting. Thus, in this environment, otherwise minor incidents can sometimes escalate unnecessarily. Be aware that your personal feelings may intensify at sea and try to keep things in perspective.

2. Problems

Sometimes challenging and difficult situations arise while out to sea. If you have difficulty working with someone, feel threatened, or discriminated against, please alert the cruise leader of your situation. Any situation will be kept confidential; your comments will only be used to resolve the issue. Please inform the cruise leaders as soon as an issue arises so that they can help resolve the issue and prevent an

exacerbation of the problem. It is of utmost importance to the Chief Scientist and the CO's that scientists are comfortable and happy working while living aboard the ship.

3. Contact Information

University of Delaware, Marine Operations – Contact Numbers	Revised: 01/15/07

Main Office	302-645-4320
Main Office Fax	302-645-4006

R/V HUGH R. SHARP:

		Comments
Alongside	302-645-4340	
Ship Cellular	302-448-5061	Within 30 nm of shore
INMARSAT Voice	011-874-764-471-442	Dialed as international call.
	Or dial: 1-800-551-7534	at prompt dial 485-837-5907 then 0-764-471-442
INMARSAT Fax	011-874-600-714-099	Used for all Faxes. Dialed as international call.
	Or dial: 1-800-551-7534	at prompt dial 485-837-5907 then 0-600-714-099

KEY PERSONNEL:

Name	Position	Office	E-mail	Cellular	Home
Sharyn Bressler	Staff Assistant	302-645-4320	sharyn@udel.edu	-	302-945-0106
Matthew Hawkins	Director, Marine Ops	302-645-4341	hawkins@udel.edu	410-924-2472	302-424-1852
Bill Byam	Master	302-645-4343	byam@udel.edu	302-381-0346	302-645-7837 843-842-4410
Jim Warrington	Chief Mate	302-645-4343	idw@udel.edu	302-373-9954	302-934-8193
Tim North	Chief Engineer	302-645-4343	tnorth@udel.edu	410-463-0205	410-476-4485
Tim Deering	Coordinator, Oceanographic Services	302-249-6149	deering@udel.edu	302-249-6149	-
Brian Kidd	Oceanographic Tech.	302-645-4336	kidd@udel.edu	302-249-1695	-
Wynn Tucker	Oceanographic Specialist	302-645-4324	tucker@udel.edu	910-547-5159	-

Policies on Harassment and Drug and Alcohol Use

The following is general policy information for all ships leased by GMI. Additional information about a specific ship can be found on that ship's home page.

* Possession or Use of Alcohol or Illegal Drugs
* Sexual Harassment
* Smoking Restrictions
* Underway Shipboard Emergencies
  - Fire
  - Abandon Ship
  - Man Overboard
* Drills at Sea
* Seasickness Working On Deck
* Firearms and Other Weapons

Please Note: As a U.S. Government commissioned vessel, all persons boarding give an implied consent to conform with all safety and security policies and regulations which are administered by the CO. All spaces and equipment on the vessel are subject to inspection or search at any time. Additionally, the following is prohibited aboard any U.S. Government vessels: possession and/or use of intoxicating alcoholic beverages, illegal drugs, controlled drugs without a prescription, sexual harassment, or use of shipboard spaces for purpose of sexual liaison. Violators may be removed from the vessel at the earliest opportunity.

Possession or Use of Alcohol or Illegal Drugs

Possession or use of alcohol, illegal drugs, or prescription medications without a prescription, on board any GMI vessel, by any member of the embarked complement is strictly forbidden and will not be tolerated. When violations of this policy are discovered, the following procedures will be adhered to:

* The alcohol will be confiscated and immediately disposed of in the presence of a witness.
* Drugs will be confiscated and placed in a secured location until the vessel reaches home port or another port of call, at which time the offense will be reported, and the drugs turned over to the appropriate authorities for action.
* Disciplinary or corrective action will be taken in accordance with the applicable Table of Offenses and Penalties.
* Department of Commerce employees will be given information regarding the availability of the Department of Commerce Employees Assistance Program.

Sexual Harassment

Sexual harassment will not be tolerated aboard GMI vessels. This applies to all persons, male and female, including members of the operating crew and any embarked scientific personnel or other personnel. Sexual harassment is sex (gender) discrimination that involves unwelcome sexual conduct, which can include both verbal and physical behavior. Some examples of such behavior are: pressure for dates or sex; sexually suggestive looks, comments or gestures; sexual jokes; displaying material of a sexual nature; and deliberate touching. Conduct is unwelcome if it is unsolicited and an individual finds it undesirable and/or offensive. All instances of sexual harassment should be immediately reported to your CO, the Chief Scientist, and project manager.

Smoking Restrictions

Smoking in Federal workplaces is prohibited by regulations applicable government-wide. Aboard GMI ships, personnel who smoke may do so only on the weather decks in designated areas. There is no smoking permitted on the interior of any GMI ship. Smokers are expected to observe particular care in

disposing of cigarettes or smoking materials. Use ashtrays or butt kits located around the ship for this purpose.
Smoking is prohibited when:

* on any part of the weather decks when the vessel is fueling or taking on flammable cargo.
* in the vicinity of any gasoline engine undergoing repair
* in the vicinity of any compressed gas cylinder carrying a flammable gas sticker, which may be stored on deck for the use of the embarked science party
* during certain types of scientific missions or in the immediate vicinity of sensitive science mission equipment

Underway Shipboard Emergencies

Fire

Fire at sea, no matter how small, can become a life-threatening situation. At sea, everyone aboard ship, be they crew, scientist, or passenger, is a member of the fire department. When the General Alarm sounds, everyone has a specific emergency billet assignment and each person is relied upon by all others aboard to carry out that assignment. Be aware of your emergency responsibilities so that carrying them out becomes second nature. Firefighting at sea is a team effort.

Emergency billet assignments are posted on the Watch, Quarter, and Station Bill. These are posted at convenient places throughout the ship. Additionally, each person is provided with a "bunk card" which lists his/her individual emergency billet assignments.

The signal for fire or emergency is a 10 second continuous ringing of the General Alarm bell and a 10 second continuous sounding of the ship's whistle. This alarm will be followed by an appropriate announcement on the general announcing system. When you hear the signal, immediately proceed to your fire and emergency billet station. Firefighting and emergency equipment is distributed throughout the ship. All hands should familiarize themselves with the locations of this equipment, as well as the Damage Control Lockers and their contents.

Abandon Ship

Abandoning ship in the open sea is an action of last resort. All reasonable efforts required of mariners for the saving of their ship must clearly have failed before any decision to abandon the vessel will be taken. Only when there is no reasonable chance of saving the ship will the order ever be given to abandon it. The decision to abandon ship is made only by the CO, or in the CO’s incapacity, the senior member of the chain of command.

The signal to abandon ship is seven (7) or more short blasts on the ship's whistle and General Alarm, followed by one (1) long blast.

When the order is given to abandon ship, all hands will proceed to their assigned life raft muster stations. Each shall bring his/her protective survival clothing, survival suit, personal floatation device life jacket), and other equipment assigned in abandon ship billet. Once the order to abandon ship has been given, the life raft Officers in Charge (OIC) will muster their respective parties and dispatch the assigned crew members to the life raft locations to launch their respective life rafts. Once launched, the remaining personnel will have to act in concert to haul the deployed rafts alongside the main deck embarkation stations. Orderly seamanlike actions at the embarkation stations will assure the rapid and efficient abandoning of the ship.

Man Overboard

Except for uncontrollable fire at sea, there is perhaps no more personally terrifying situation for a member of the ship's complement than being lost overboard. There are two basic man overboard scenarios: witnessed and unwitnessed.

Witnessed Man Overboard -Actions of the Witness

Upon observing a person going overboard, the witness shall take the following actions:

1. Call out for assistance and throw a life ring buoy into the water, preferably one equipped with a strobe light. Pass the word to the Bridge by any means possible.

2. Wait about one minute and throw a second life ring buoy (at night –one equipped with a strobe light) into the water. This will create a visual range for the OOD and the lookouts, aiding the search effort.

3. Keep the victim under surveillance if at all possible, but do not delay passing the word to the Bridge.

Unwitnessed Man Overboard

Underway, until proven otherwise, when a crew member is unaccounted, it will be presumed that the individual has been lost overboard. This situation then becomes a search and rescue problem of a far more complicated nature. The time of the casualty will be unknown, or at best, only grossly estimated. The ship's navigation record, as contained on the Marine Operations Abstract or Dead Reckoning Abstract, will be crucial for search planning, as will the hourly weather observations entered into the Weather Log. Initial actions will be to notify the Marine Operations Center Director of the situation and to notify the nearest Rescue Coordination Center for assistance. Search operations will be conducted with the advice and guidance of SAR professionals.

Drills at Sea

Emergency drills at sea will be held in accordance with the requirements of NC Instruction 5100.1B. Reporting for drills, in accordance with the billets assigned in the Watch, Quarter, and Station Bill, is mandatory for all hands, including the embarked science party, unless the absence is specifically authorized by the CO, XO, or Safety Officer.

For Abandon Ship drills, unless otherwise advised, all hands are required to wear life jackets and carry their survival suits when reporting to their life raft muster stations. All personnel shall be attired in, or bring to the muster, clothing that fully covers legs and arms, a hat, socks and shoes. Signals to call all hands to emergency stations shall be identical to those that are used for actual emergencies. When a drill is held, the OOD will always state "This is a drill. This is a drill." followed by an appropriate announcement on the general announcing system.

The signals are as follows:

Fire and Emergency	Continuous ringing of the General Alarm bell for 10 seconds and continuous sounding of the ship's whistle for 10 seconds [Image]
Abandon Ship	7 or more short blasts on the ship's whistle and General Alarm bell, followed by one prolonged blast [Image]
Man Overboard	3 prolonged blasts on the ship's whistle and General Alarm bell [Image]
Dismissal from Drill	3 short blasts on the ship's whistle and General Alarm bell [Image]

Working on deck

The following safety regulations will be observed when working on deck:

* Life vests or floats coats will be properly worn when handling equipment over the side, deploying equipment over the side, and on all launches (whether alongside the ship, launching, or recovering).
* Safety belts and lines will be worn by those handling equipment over the side.
* Hardhats will be worn by all those involved in recovery or deployment of equipment and boats.
* Proper footwear should be worn at all times (Open toe shoes are NOT proper work footwear).
* Ship's equipment is to be operated only by qualified members of the ship's complement.

Seasickness

Information on sea sickness and treatments available will be provided by the Medical Officer. Those requiring preventative treatment should see the Medical Officer prior to sailing.

One of the least pleasant aspects of sea duty is the possibility of seasickness. An individual's susceptibility to seasickness is highly variable. If you've experienced motion sickness in cars, planes, or amusement park rides, you may experience seasickness during the cruise. Regardless, most people feel some level of illness or discomfort when they first go to sea. Seasickness is a result of an imbalance in the inner ear (where the human balance mechanism resides) caused by the erratic motion of the ship through the water. Inside the cabin of a rocking boat, for example, the inner ear detects changes in linear and angular acceleration as the body moves with the boat. But since the cabin moves with the passenger, the eyes register a relatively stable scene. Agitated by this perceptual incongruity, the brain responds with a cascade of stress-related hormones that can ultimately lead to nausea and vomiting. Its effect can be magnified by strong smells (like diesel fumes or fish). It usually occurs in the first 12-24 hrs after sailing, and typically dissipates when the body becomes acclimated to the ship's motion (getting one's "sea-legs"). Rarely does anyone stay ill beyond the first couple of days at sea, regardless of sea state, but this can occur. There are several over-the-counter medications available to prevent or minimize motion sickness. These need to be taken about an hour before sailing and as needed at sea; as always, you should follow the instructions for the medication you are taking. All of these medications tend to dehydrate the body, so fluid intake is important. If you should get seasick, take comfort in the fact that recovery is usually only a matter of time, and the survival rate is 100%. Each ship has a trained medical officer who can treat severe cases of sea-sickness. However, all that is usually required for a complete recovery is some sensible eating/drinking and some patience. Here are a few tips and considerations regarding seasickness:

* Vomiting offers relief. Make an effort to continue eating items like crackers, dry toast, dry cereal, etc. (avoid anything greasy, sweet, or hard to digest). Keeping something in your stomach suppresses nausea, or, if vomiting, eliminates painful "dry heaves". Antacid tablets help some people.
* Maintain fluids. Seasickness and related medications cause dehydration and headaches. Try to drink juices low in acidity, clear soups, or water, and stay away from milk or coffee.
* Keep working. Most people find that being busy on deck keeps their minds off their temporary discomfort. Also, the fresh air out on deck is often enough to speed up recovery.
* Carry a plastic bag. This simple trick allows some peace of mind and eliminates some of the panic of getting sick. Do not vomit in sinks or trash cans. If you vomit "over the side", be aware of which way the wind and waves are coming. Going to the "lee" will ensure that an unpleasant experience doesn't become any more unpleasant.

Above all, don't be embarrassed or discouraged! If you get sick, chances are that others are sick too! No one --fishermen, ship's officers, scientists --is immune to seasickness.

Firearms and Other Weapons

Personally owned firearms are not permitted aboard the ship without the advance written approval of the CO. Any firearm permitted aboard the ship must be accompanied by any applicable permits. All firearms

and their ammunition will be locked in the ship's weapon's locker until they are removed from the vessel. Firecrackers, fireworks and similar pyrotechnics will not be permitted aboard the ship. Sheath knives are not permitted aboard the ship with the exception of fishing fillet knives which are permitted. Folding knives are permitted to be carried aboard ship and their use is encouraged.

APPENDIX 1b

SHIP SURVEY QUALITY ASSURANCE/CONTROL PROTOCOL AND CHECKLIST

Ship/Small Boat Survey Quality Assurance Protocol

Protocols for conducting safety, equipment, and data checks will be followed before, during, and after every survey cruise to ensure personnel safety, equipment readiness, and collection of quality data.

Prior to beginning a survey, the chief scientist will determine sea state conditions in the project area by checking online data from NOAA buoys in the area. The chief scientist will then discuss these results with the ship's captain/airplane pilot, at which point the captain will determine if current and forecasted weather conditions are acceptable to begin the survey.

The senior marine mammal and seabird biologists will be responsible for completing pre- and post-survey inspections using the checklist on the following page. These inspections will ensure all necessary survey equipment is available and functional prior to surveys and that all datasheets used during the survey are complete, legible, and accurate. If errors are found on the datasheets, the biologists that logged the data will be consulted to resolve the issue. Once the datasheets are inspected, the data will be entered into an electronic spreadsheet. The spreadsheet will be checked for errors and corrected immediately. Data will be saved with a QAQC notation in the file name (e.g. Avian Ship Survey 01-15-01 QAQC) and in redundant copies (hard drive and external disc). All external media storage devices will be appropriately labeled with the survey dates, type of data, and author.

After returning to shore, the senior marine mammal and/or seabird biologist will download the QAQC data to the corporate office project's drive. Once the download is complete, the project manager or principle investigator will be contacted to verify the data is present and readable.

AVIAN SHIP SURVEY CHECKLIST

DATE:_____

REQUIREMENT	Yes	No	Signature/Title	Date	Time
PRE-SURVEY	☐	☐			
Ship Ready Status	☐	☐			
Sea State Condition	☐	☐			
Meets Survey Protocol	☐	☐			
Ship Safety	☐	☐			
Crew boat safety review	☐	☐			
Survey Equipment	☐	☐			
Hand-held data recorders (3)	☐	☐			
Survey Line Map/Coordinates	☐	☐			
Laptop Computer (primary)	☐	☐			
Spare Laptop computer	☐	☐			
Spare Hand-held data recorder	☐	☐			
Binoculars (2 primary-1 spare)	☐	☐			
Field Guides	☐	☐			
Extra binocular batteries	☐	☐			
Battery charger	☐	☐			
Pre-Survey Operation Checks	☐	☐			
Ship GIS	☐	☐			
Laptop Computer (Primary)	☐	☐			
Laptop Computer (Spare)	☐	☐			
Hand-held data recorders	☐	☐			
SURVEY	☐	☐			
Data Requirements	☐	☐			
Weather Data	☐	☐			
Weather Form (AM)	☐	☐			
Weather Form (Noon)	☐	☐			
Weather Form (PM)	☐	☐			
Survey Data Downloaded	☐	☐			
Survey Data checked for errors	☐	☐			
Survey Data File Saved on PC	☐	☐			
Survey Data saved on 2nd PC	☐	☐			
Observer Efficiency Surveys	☐	☐			
POST CRUISE	☐	☐			
Survey Data Downloaded	☐	☐			
On site office PC	☐	☐			
P drive: Corporate Office	☐	☐			

Quality Assurance/Control Problems:

1._____

2._____

Corrective Actions:

1._____

2._____

Sr. Seabird Biologist:_____**Date:**_____

REVISED AVIAN OBSERVER PACKET

Ocean/Wind Power Ecological Baseline Studies

New Jersey Department of Environmental Protection
Division of Science, Research, & Technology

GEO-MARINE INCORPORATED

Version III

28 October 2008

AVIAN OBSERVER MANUAL
NJDEP Environmental Baseline Survey

INTRODUCTION

The NJDEP has contracted GMI to conduct avian strip transect surveys along tracklines off the New Jersey coast as part of an Ocean/Wind Power Ecological Baseline Studies Project. Seabird density will be determined from strip transect survey data and will be incorporated with other avian data from the project area to develop an avian predictive/probability model. This manual provides an overview of project objectives and a detailed description of field survey methodologies and protocols for the avian observers participating in the surveys.

AVIAN OFFSHORE AND COASTAL SURVEYS

Project Objectives

The primary objectives of the seabird surveys are to determine avian abundance, distribution, flight behavior (flight altitude and direction), and to develop an avian predictive model. The project's secondary objectives are to collect data on "important birds" (federal and state listed and federal species of concern) and migrating, foraging, and roosting flocks outside of the strip transect survey area. Data collection efforts for birds within the strip transect survey area will have priority over birds outside of the strip transect survey area.

Overview of the Field Survey Sample Design and Survey Method

Gould and Forsell (1989) discussed and analyzed variables associated with the estimation of seabird density and concluded that counting all birds flying through the transect area during surveys would greatly exaggerate water density estimates. In other words, counting all birds would represent birds using the air corridor over the water and not the birds associated with the water itself. Therefore, Gould and Forsell (1989) recommended counts of flying birds once every 1 km (0.54 NM) for a specified time interval. Camphuysen et al. (2004) also recommended non-continuous survey time intervals to determine seabird densities. To meet the project objectives, the data collection method used by Gould and Forsell (1989) and Camphuysen et al. (2004) will be modified to continuously count all sitting and flying birds encountered in the strip transect (300 m X 300 m) 90 degrees to one side of the ship's trackline.

SHIPBOARD OFFSHORE SURVEYS

Sample Design

Survey tracklines will be plotted in a 'double saw-tooth' configuration with lines running perpendicular to the coastline from the western to eastern boundary of the project area (**Figure 1**). Tracklines will be generated for every survey using the program DISTANCE (Buckland et al. 2004), thereby allowing a true random coverage design to the Study Area. Strip-transects will be conducted on either side of the trackline depending on viewing conditions (i.e., glare) (Gould and Forsell 1989). Tracklines will be surveyed at approximately 10 kts when the Beaufort Sea State (BSS) is ≤ 5 and visibility is ≥ 300 m.

Survey Protocols

Prior to initiating the monthly survey effort, all observers will review the standard operating procedures for the avian survey. A compass will be used to mark bearings (in 10-degree increments) for each observer position. Range estimation sticks will be prepared according to observers' individual heights by using at-dock known distances from the observer positions on the ship (Heinemann 1981). Distances of 100, 200, and 300 m will be marked on the range estimation sticks, which will be mounted at the observer positions.

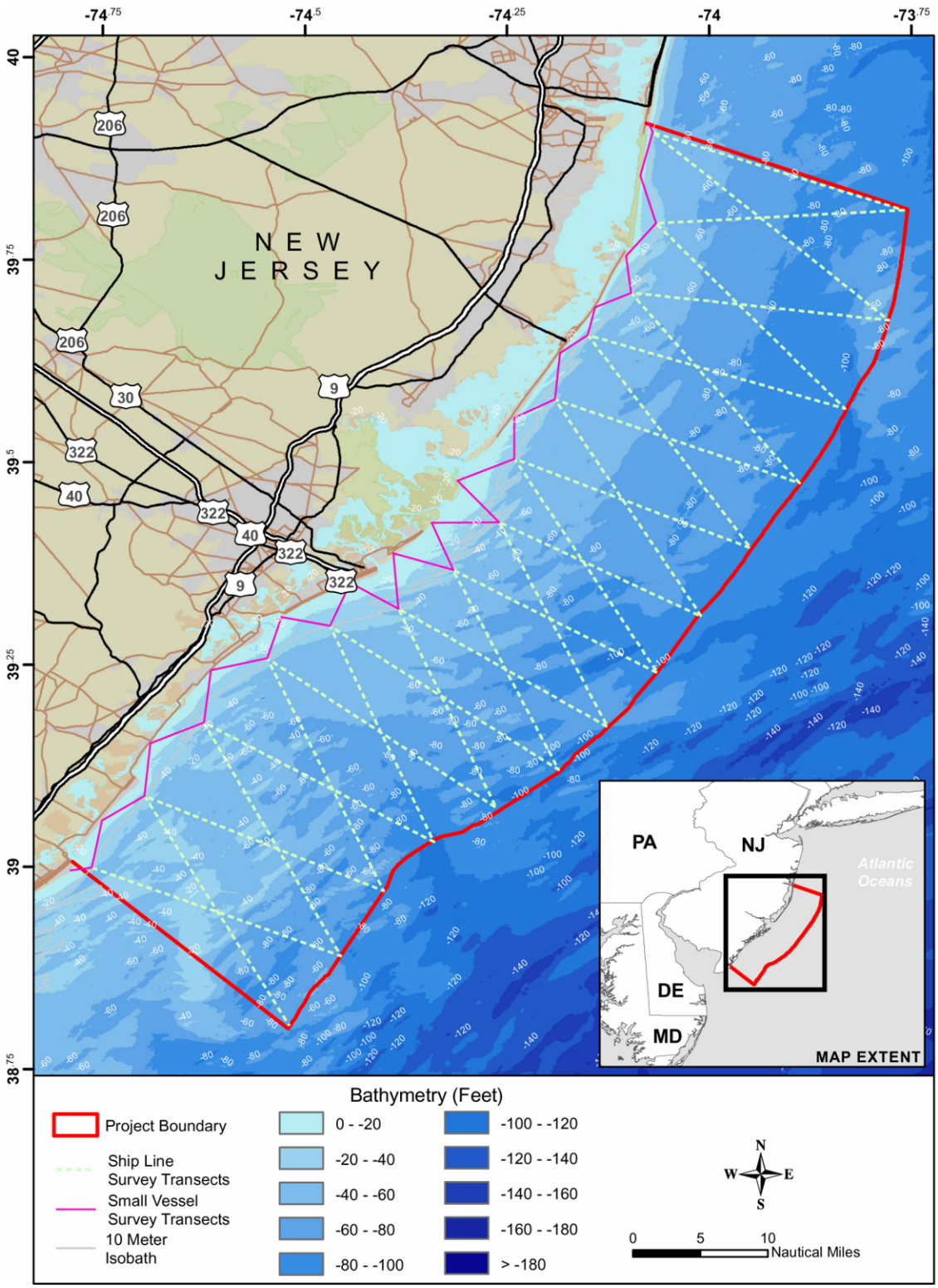

Figure 1. Map showing survey design for the shipboard offshore and small-boat coastal surveys with representative tracklines.

The Chief Science Officer (CSO) will determine if sea state conditions are acceptable (≤ 5 on the BSS) to begin the survey. If sea state conditions are acceptable, the starting transect will be selected with a random number generator by the CSO. The pre-survey section of the avian boat survey checklist will be completed by the Senior Seabird Biologist (SSB) before the beginning of each survey.

Survey protocols incorporate many of the recommendations made by Gould and Forsell (1989) and Camphuysen et al. (2004). Shipboard (NJ offshore) and small-boat (NJ coastal) strip-transect surveys will be conducted during daylight hours within the project boundary (study area). Survey team responsibilities and qualifications will follow those stated in **Appendix A**. Additionally, all members of the survey team will follow the captain's rules for shipboard facilities, emergencies, etc.

The Primary Avian Observer (PAO) will ensure the strip transect survey protocols are followed. The survey will be conducted from the flying bridge of the ship (approximately 30 feet above the water) with the PAO standing at the front of the flying bridge on the ship's centerline. The PAO will be on duty for 1-hour periods before being relieved by one of the other survey team members.

The first priority of the PAO is to identify, enumerate, and estimate bearing and distance of the bird and to record bird behavior (e.g., flying or sitting, directional or non-directional flight, feeding), flight altitude, and flock composition within the 300 m X 300 m survey area (In zone). The PAO will scan with naked eyes and binoculars the 0-90 or 270-0 degree zone (selected and switched as needed to avoid glare) within the survey area while the ship travels along the trackline.

Hand-held computers are used to record all data, and are equipped with a database program developed by GMI specifically for this project (**Appendix B**). The hand-held data recorders are synchronized for time with the field laptop, which is connected to the ship's GPS. This allows for the data entered onto the program to be merged with the resultant trackline.

Data will be recorded on a hand-held computer for each bird observation. Data recorded will include:

- identity (lowest identifiable form or taxon) with a four-letter code
- number of individuals (or best-count estimates for large flocks)
- estimated bearing and range (distance) to the bird(s) using range estimation sticks
- estimated flight altitude
- behavior category
    - sitting (includes birds seen landing or taking off)
    - directional flight (always accompanied by a cardinal direction)
    - non-directional flight
    - piracy
    - following the ship
    - feeding (may be accompanied by a cardinal direction)
- cardinal directions will be used to designate perceived flight directions (cardinal direction will be based on the ship transect line, where the bow of the ship is north).

The second priority of the PAO is to conduct observations in all visible areas outside of the 300 m X 300 m survey area (out zone) for "important" birds. Important birds include large flocks of birds and rare birds such as federal- and state-listed species and federal species of concern. The PAO visually scans the out zone area for flying birds and then scans the area with binoculars. All avian behaviors observed, with the exception of range, are recorded for out zone observations. In addition, observers will opportunistically record the following data in the comments section:

- dive altitude (in feet) of birds, especially Northern Gannets, as DIVA
- submersion time (in seconds) of birds after a dive (i.e., near the ship, sea state conditions permitting) as SUBT
- the life state (age, plumage, morphology) and sex of the bird (e.g., A = adult, J = juvenile, F = female)

- boat traffic observed during the survey, as they often serve as attractants to birds

The PAO and the off-effort observer(s) will carry radios and the PAO will contact the off-effort observer(s) if the set conditions need to be changed or additional help is needed to record a large group of birds. When large numbers of birds are encountered, the SSB on board may decide to call on an off-effort observer to assist with out of zone observations and/or data recording. The PAO/SSB may ask another observer to record observation data outside the survey zone and/or to scribe for him/her. Each observer will be aware of the activity of the other. Unless directed by the PAO, the additional observer will not record data for birds in the survey area or birds on course to enter the survey area.

Because marine mammal surveys are occurring simultaneously with the avian surveys, the ship may break tracklines in order to appropriately survey marine mammals. In the event the trackline is broken, the following protocol is to be followed if an avian observer observes a marine mammal:

- If the boat goes off-transect to investigate a marine mammal sighting, avian data collection will continue. However, since the strip-transect methodology is not applicable in such instances, all data collected during this period will become supplemental, with observations no longer being prioritized.
- When the marine mammal team has completed a sighting, the ship will resume course on a new heading back toward the trackline. Avian data collection will resume following the strip-transect methodology on this new transect leg.
- If an avian biologist observes a marine mammal, the observer should not point out the animal to on-watch marine mammal observers until the mammals have passed abeam to either side of the ship.

In addition to marine mammal surveys, oceanographic data is also collected during each survey. CTD (Conductivity-Temperature-Depth) instruments are dropped into the water at the end of each transect line, requiring the ship to stop and remain idle until data collection is complete. During CTD data collection, avian observers will continue recording as in the event of a marine mammal sighting until a new transect is started. This data will be separated from the transect data and analyzed. Additionally, when the ship is at the near-shore point for CTD data collection, observers will focus their survey effort toward shore, glare conditions permitting.

Lastly, a weather form will be completed prior to initiation of daily surveys, at mid-day, and immediately following final afternoon surveys (**Appendix C**). Surveys conditions (e.g., cloud cover, glare, sea state) will be checked and changed on the avian computer when necessary by the PAO when the PAO goes off duty.

Quality Assurance/Control

Observer Efficiency

It is important to maintain consistency among observers in their ability to detect, identify, and count birds. Observer efficiency is defined as a measure of concordance between observers in their “agreement” on the detection, identification, counts, and other metrics (e.g., altitude) of birds. To do this, we must collect data on birds simultaneously with two observers. One off-duty biologist will conduct the observer efficiency protocol. Kendall’s Coefficient of Concordance will be used to determine if the observers agree.

Monthly avian observer efficiency will be determined for each observer. One of the “off-duty” staff seabird biologists will stand behind or near the selected on-duty observer and simultaneously record survey data in the staff seabird biologist’s assigned survey area for a 30-minute period. In addition, the 30-minute period will be divided into two separate periods.

The first 15-minute period will focus on observer efficiency in detecting, identifying and enumerating birds. During this time the off-duty and on-duty observer will independently detect, identify and count birds. The second 15-minute period will be used to evaluate observer efficiency in estimating the altitude, range,

bearing, and heading of birds detected by the on-duty observer. During this time the on-duty observer will choose individual birds or flocks of birds whose altitude, range, bearing, and heading will be independently recorded by the off-duty and on-duty observer.

Post Daily Survey Checklist

Each night following a survey, the senior seabird biologist will proof the day's data and complete the QA/QC Checklist in **Appendix D**. The data will be downloaded to a laptop computer and reviewed by the SSB to determine if reporting errors were made. If errors are present, the observer(s) will meet with the SSB that evening to resolve the error(s).

Any necessary corrections will be made to the data file by the SSB, as follows:

- All data files will be renamed (QAQC added to the file name) after the file has been checked.
- Upon completion of the of the QAQC check, all raw data files will be placed in the "raw" folder and all QAQC files will be placed in the "QAQC" folder.
- All files will then be transferred to an external hard drive for storage (see below for additional instructions).

The following electronic documents will also be placed in the "QAQC" folder:

- Avian Ship Survey Daily Checklist
- Survey Daily Log
- Weather Data Form
- .csv file

On days that observer efficiency tests are performed, the SSB will:

- create an observer efficiency folder
- place a copy of the QAQC staff seabird biologist data file in the folder
- place a copy of the off-duty observer efficiency data file in the folder
- perform standard QAQC procedures on observer efficiency data file
- delete the off-duty observer efficiency data file from the raw folder

SMALL-BOAT COASTAL SURVEYS

Small-boat surveys will be conducted to capture nearshore bird activity that may be missed during shipboard surveys due to depth limitations of the ship. The small-boat coastal surveys will provide additional statistical power to the avian predictive model.

Sample Design

The survey design will be similar to the previously described ship survey design except that a "single saw-tooth" design will be implemented to survey the coastal area. Nearshore ship waypoints will be plotted after the ship survey is completed. Coastal tracklines will be generated to complete the trackline to the shore. The boat captain will be requested to approach the shoreline as close as safety allows (dependent on tide and weather conditions). Transect lengths and positions will vary monthly and will be entirely dependent on the tide and water depth during both the shipboard and small-boat survey days. In the event that an offshore survey is cancelled or incomplete, the associated coastal survey will still be performed. If the ship does not complete the scheduled number of transects, the coastal transects illustrated in **Figure 1** will be surveyed.

The starting location for each survey will be randomly determined among two starting points (north end and south end), or north or south from the inlet the vessel is departing. If daylight, weather, and sea state conditions allow, the entire coastal area will be surveyed in one day. This approach will allow for random sampling (with respect to starting location) of shoreline and the shoal areas for seabird roosting/resting and feeding areas, while maximizing available ship sampling time (i.e., minimizing ship down time or relocation time).

Survey Protocols

Pre-survey, survey, and post-survey methods and protocols will be identical to those established for the ship survey.

Quality Assurance/Control

Quality assurance/control for small-boat surveys will be identical to that described previously for the shipboard surveys.

Ship/Small-boat Pre-Survey Protocol

Protocols for conducting safety, equipment, and data checks will be followed before, during, and after every survey cruise to ensure personnel safety, equipment readiness, and collection of quality data.

Prior to beginning a survey, the chief scientist will determine sea state conditions in the project area by checking online data from NOAA buoys in the area. The chief scientist will then discuss these results with the ship's captain, at which point the captain will determine if current and forecasted weather conditions are acceptable to begin the survey.

The senior marine mammal and seabird biologists will be responsible for completing pre- and post-survey inspections using the checklist below. These inspections will ensure all necessary survey equipment is available and functional prior to surveys.

AVIAN SHIP SURVEY CHECKLIST

DATE:_____

REQUIREMENT	Yes	No	Signature/Title	Date	Time
PRE-SURVEY	☐	☐			
Ship Ready Status	☐	☐			
Sea State Condition	☐	☐			
Meets Survey Protocol	☐	☐			
Ship Safety	☐	☐			
Crew boat safety review	☐	☐			
Survey Equipment	☐	☐			
Hand-held data recorders (3)	☐	☐			
Survey Line Map/Coordinates	☐	☐			
Laptop Computer (primary)	☐	☐			
Spare Laptop computer	☐	☐			
Spare Hand-held data recorder	☐	☐			
Binoculars (2 primary-1 spare)	☐	☐			
Field Guides	☐	☐			
Extra binocular batteries	☐	☐			
Battery charger	☐	☐			
Pre-Survey Operation Checks	☐	☐			
Ship GIS	☐	☐			
Laptop Computer (Primary)	☐	☐			
Laptop Computer (Spare)	☐	☐			
Hand-held data recorders	☐	☐			

Sr. Seabird Biologist:_____**Date:**_____

APPENDIX A

AVIAN TEAM RESPONSIBILITIES AND QUALIFICATIONS

Personnel

The ultimate responsibility for the avian ship surveys rests with the senior seabird biologist. The SSB reports to and coordinates the avian survey effort with the CSO. In confusing or unique field situations, the SSB will consult with the CSO before making a decision.

Identification Specialist/Senior Seabird Biologist (one)

The SSB is an experienced observer who has conducted avian offshore and coastal surveys. He or she has the ability to identify avian species known to occur in the project area, conduct observer-efficiency quality-assurance protocols, and to complete data-quality control procedures. The experience of the SSB will maintain the consistency of the data collected during each survey.

The SSB is the avian team leader and works with the other team members to discuss problems and make decisions. If team members are included in the decision-making process, the avian team will work better together.

Observers (two to four)

Seabird biologists (avian observers) are responsible for collecting the avian survey data. The avian observers are proficient in sighting and identifying birds and recording accurate data on hand-held data recorders.

Watch Rotations

Upon completing a watch rotation, the observer going off-duty will review the set (environmental) conditions on the avian computer and make all necessary changes.

APPENDIX B

SURVEY DATA PROGRAM

Data Recording Computer Program

The data file is divided into two sections. The first section contains general data and lists all of the codes used in the data section. General data categories include: Survey Type, Vehicle, Time Zone Delta, Location Interval, and Altitude. These categories are defined below:

Survey Type
"Bird" or "Mammal"

Vehicle
e.g. "Boat", "Plane", etc.

Time Zone Delta
value, in hours, added to Zulu time to give local time (May be a decimal).

Location Interval
time in seconds between writing out location records

Altitude
in feet above sea level
observers may be at a different altitude.

The second section contains the survey data. Each record in the data section is stored as a single line with identical format. Observers, species, behaviors, weather conditions, sea states, water turbidity, water color, glare, and sunlight are all given codes.

Each entry in the data section has the following fields, separated by commas:

Card
Year-Month-Day
Hour; Minute: Second
GPS State
Latitude
Longitude
Heading
Speed
Species1
Count1
Behavior1
Range1
Bearing1
Elevation1
Latitude1
Longitude1
Species2
Count2
Behavior2
Range2
Bearing2
Elevation2
Latitude2
Longitude2

Species3
Count3
Behavior3
Range3
Bearing3
Elevation3
Latitude3
Longitude3
Observer
Weather
Sea State
Turbidity
Water Color
Water Temperature
Sun Strength
Glare

The interpretation of the fields:

Card:
A0 Beginning of survey
A9 End of survey
B0 Beginning of transect
B9 End of transect
C0 Going on-effort
C9 Going off-effort
D0 On-effort sighting
D1 Off-effort sighting
E0 On-effort location only
E1 Off-effort location only
F0 Change of sighting conditions

Year-Month-Day:
in Zulu time
year is four digits

Hour:Minute:Second
in Zulu time, 24 hour clock

GPS State
1 – acceptable for avian surveys
2 – not acceptable for avian surveys

Latitude / Longitude
of the ship in decimal degrees, to the 0.00001 (approx. one meter at the equator)

Heading
of the ship 0 to 359°

Speed
ground speed in knots of the ship

SpeciesN
code of the species sighted. Up to three species may be designated for a given sighting.

CountN

number of individuals

BehaviorN
code for the sighting's behavior

RangeN
in meters from the observer

BearingN
from the observer to the sighting (e.g. right-side observers would have a value of 0 to 180°).

ElevationN
vertical angle from the observer to the sighting (in a plane this would almost always be negative)

LatitudeN / LongitudeN
computed position of the sighting based on vehicle position and range / bearing / elevation

Observer
identification code of the observer

Observer State
1) perfect
2) excellent
3) very good
4) good
5) fair
6) poor
7) very poor

Survey Conditions (Avian Computer)

Weather
: weather code, given in first section

Sea State
: sea state code, given in first section

Turbidity
: turbidy code, given in first section

Water Color
: code for water color, given in the first section

Water Temperature
: temperature of water, degrees Celsius. -9999 means unknown.

Sun Strength
: Strength of sunlight code, given in first section

Glare
: code for glare, given in the first section

APPENDIX C

WEATHER FORM

Geo-Marine, Inc. Weather Form

General Site Data

Project Name: Project Location:

Date | | | | | | Observers:
Month Date Year

Weather Data

Weather aspect	Morning	Mid-day	Afternoon
Time			
Barometric Pressure			
Air Temperature			
Wind speed			
Wind direction			
Cloud cover (put 'X' in appropriate box)			
Clear (<10% cloud cover)			
Partly cloudy (10-50% cloud cover)			
Mostly cloudy (51-75% cloud cover)			
Overcast (76-100% cloud cover)			
Cloud ceiling (put 'X' in appropriate box)			
Low			
Middle			
High			
None			
Precipitation (put 'X' in appropriate boxes)			
None			
Fog			
Drizzle			
Rain (enter L (light), M (moderate), or H (heavy) in box)			
Hail (enter L (light), M (moderate), or H (heavy) in box)			
Sleet (enter L (light), M (moderate), or H (heavy) in box)			
Snow (enter L (light), M (moderate), or H (heavy) in box)			
Visibility (put 'X' in appropriate box)			
0-50 m			
51-100 m			
101-500 m			
501-1000 m			
1001-2500 m			
2501-5000 m			
>5000 m			

Comments (use back for additional, if necessary):

CSB/Avian observer Date

APPENDIX D

Ship/Small-boat Survey Quality Assurance Protocol

The senior seabird biologists will be responsible for completing post-survey inspections (see checklist below) of all datasheets used during the survey and ensuring they are complete, legible, and accurate. If errors are found on the datasheets, the biologists who logged the data will be consulted to resolve the issue. Once the datasheets are inspected, the data will be entered into an electronic spreadsheet. The spreadsheet will be checked for errors and corrected immediately. Data will be saved with a QAQC notation in the file name (e.g., Avian Ship Survey 01-15-01 QAQC) and in redundant copies (hard drive and external disc). All external media storage devices will be appropriately labelled with the survey dates, type of data, and author.

After returning to shore, the seabird biologist will download the QAQC data to the corporate office project's drive. Once the download is complete, the project manager or principle investigator will be contacted to verify the data is present and readable.

AVIAN SHIP SURVEY QA/QC CHECKLIST

DATE:_____

SURVEY	☐	☐			
Data Requirements	☐	☐			
Weather Data	☐	☐			
Weather Form (AM)	☐	☐			
Weather Form (Noon)	☐	☐			
Weather Form (PM)	☐	☐			
Survey Data downloaded	☐	☐			
Survey Data checked for errors	☐	☐			
.csv file copied to data folder	☐	☐			
Survey Data file saved on PC	☐	☐			
Survey Data saved on 2nd PC	☐	☐			
Observer Efficiency Surveys	☐	☐			
POST-CRUISE	☐	☐			
Survey Data downloaded	☐	☐			
On site office PC	☐	☐			
P drive: Corporate Office					

Quality Assurance/Control Problems:

1._____

2._____

Corrective Actions:

1._____

2._____

Sr. Seabird

Biologist:_____**Date:**_____

APPENDIX B

FLIGHT DIRECTION CIRCULAR STATISTICS METHODS

Circular Statistical Analysis of Avian Directional Data for the New Jersey Offshore (Ship) Surveys: Methods

OVERVIEW

The objective of the following first-order and second-order circular statistical analyses is to determine the nature of the statistical distribution of avian flight directions and their variability with respect to species, taxonomic group, month, and season. The hypothesis tests are conducted to determine whether the flight directions exhibit circular uniformity (*i.e.*, a random distribution of direction) or exhibits a mean angle (*i.e.*, favoring a particular direction), both overall as well as for a given species, group, month, and season. For example, it may be feasible for one avian species to exhibit circular uniformity, whereas another species may exhibit a mean flight direction that may change from month to month or from season to season, reflecting, for example, seasonal flight migration patterns. This analysis is potentially important for subsequent calculations of avian mortality strikes, since the collision rate of birds with the wind turbine blades depends on the relative directional orientation between the birds and blades.

DESCRIPTIVE STATISTICS

Angular (directional) data consist of a sample of "n" measurements of angle (with values ranging from 0-360°). Angular measurements (a_i for data point i, where i=1 to n) are often grouped into "J" bins, with each bin "j" defining a (usually equally-spaced) range of angles (*e.g.*, 0-10°, 10-20°, *etc.*), such that all J bins encompass the entire angular range 0-360°. Each bin "j" is characterized by a midpoint angle b_j (*e.g.*, 5°, 15°, *etc.*). The number of measured angles (data points) a_i falling into each bin "j" is termed the angular number frequency, occurrence frequency, or number of angular measurements (f_j). Summing f_j across all J bins yields the total sample size n (*i.e.*, SUM (f_j) = n, where the summation is conducted for j=1 to J, where J = total number of bins, which encompass the entire angular range 0-360°).

Angular data can thus be individual or grouped:

1) Individual data consist of individual angular values a_i (for measurement "i"), for i=1 to n, where n = sample size or total number of angular measurements.
2) Grouped data consist of an occurrence frequency f_j (*a.k.a.* number frequency or number of angular measurements) of individual angular measurements a_i occupying bin "j", which is defined by an angular range and a midpoint angle b_j. A total of J bins are defined whose collective ranges cover the entire 0-360° range. Each of the a_i individual measurements (for i=1 to n) are distributed into the J bins, such that SUM (f_j) = n.

Individual and grouped angular datasets (*i.e.*, circular distributions) can be characterized based on uniformity and modality. Uniform distribution exhibit a relatively even (or random) distribution of angular measurements over the entire circular range (0-360°), whereas a non-uniform (or clumped or aggregated) distribution tends to have a greater relative number of angular measurements concentrated around one or more particular angles or ranges of angles.

Three general types of modal distributions include unimodal, bimodal, and multimodal:

1) Unimodal distributions are characterized by a maximum occurrence frequency at one angular range (*i.e.*, the occurrence frequency for one angular bin is greater than the number frequencies for all other angular bins).
2) Bimodal distributions have a maximum occurrence frequency at 2 angular ranges (*i.e.*, 2 bins exhibit the same maximum occurrence frequency). An example is a diametrically bimodal distribution, which exhibits a maximum occurrence frequency at 2 angles spaced exactly 180° apart (*i.e.*, on opposite sides of the circle).
3) Multi-modal distributions have several angular bins exhibiting the same maximum occurrence frequency.

The angle(s) at which the maximum occurrence frequency occurs is termed the modal angle(s). In addition to the modal angle, circular distributions are also characterized by a mean angle and median angle.

MEAN ANGLE

Angular data take the form of individual angle measurements (a_i) over a sample size n (*i.e.*, i=1 to n). Mean angle (a_{bar}) for a sample of size n is calculated from the summation of the sine and cosine vectors of the individual angle measurements a_i. For each of the n measurements, given a_i (for i=1 to n), $\sin(a_i)$ and $\cos(a_i)$ are calculated and summed over n. The values of X and Y are then calculated as: $X = SUM[\cos(a_i)]/n$ and $Y = SUM[\sin(a_i)]/n$, where the summation is from i=1 to n. The length vector r is then calculated as $r = (X^2 + Y^2)^{0.5}$. Knowing X, Y, and r, the cosine and sine components of the mean angle are given by $\cos(a_{bar}) = X/r$ and $\sin(a_{bar}) = Y/r$.

Solving $\cos(a_{bar})$ by itself for a_{bar} yields 2 solutions for a_{bar}. Likewise, solving $\sin(a_{bar})$ by itself for a_{bar} yields 2 solutions for a_{bar}; however, solving both equations simultaneously yields a unique solution for a_{bar}, according to the following geometric and trigonometric guidelines:

1) If $\cos(a_{bar}) > 0$ and $\sin(a_{bar}) > 0$, then $0^o < a_{bar} < 90^o$.
2) If $\cos(a_{bar}) < 0$ and $\sin(a_{bar}) > 0$, then $90^o < a_{bar} < 180^o$.
3) If $\cos(a_{bar}) < 0$ and $\sin(a_{bar}) < 0$, then $180^o < a_{bar} < 270^o$.
4) If $\cos(a_{bar}) > 0$ and $\sin(a_{bar}) < 0$, then $270^o < a_{bar} < 360^o$.

Grouped angular data take the form of occurrence frequencies (f_i) of the given angle measurement (a_i), recorded over a sample size n (*i.e.*, for i=1 to n). The recorded angular value (a_i) is typically the midpoint of an angular measurement interval (or bin), and f_i is the occurrence frequency (*i.e.*, number of angular measurements) within the angular interval defined by the midpoint angle a_i. For example, for 2 bins defined by the angular ranges $0\text{-}10^o$ and $10\text{-}20^o$, the midpoint angles a_i are 5° and 15°, respectively.

In the case of angular data grouped into "N" bins (or a dataset consisting of an occurrence frequency f_i associated with a distinct angular value a_i), an angle a_i occurring with a frequency f_i is equivalent to repeating the value of a_i, f_i times and recording each individual occurrence of a_i in an expanded table. In this expanded table, the expanded sample size $n = SUM(f_i)$, where the summation is from i=1 to N, where N = number of DISTINCT angular values, and n = total number of angular measurements (sample size). Working with the original data table (consisting of distinct angular values a_i and associated occurrence frequencies f_i), the values of $\sin(a_i)$, $f_i*\sin(a_i)$, $\cos(a_i)$, and $f_i*\cos(a_i)$ are calculated for each measurement "i". The values of $f_i*\sin(a_i)$ and $f_i*\cos(a_i)$ are summed over the number of distinct angular value N. Values of X and Y are then calculated as: $X = SUM[f_i*\cos(a_i)]/n$ and $Y = SUM[f_i*\sin(a_i)]/n$, where the summation is from i=1 to N, and $n = SUM(f_i)$. The length vector $r = (X^2 + Y^2)^{0.5}$ is then calculated. Knowing X, Y, and r, the cosine and sine components of the mean angle are given by $\cos(a_{bar}) = X/r$ and $\sin(a_{bar}) = Y/r$. Simultaneous solution of these 2 equations yields a unique solution for a_{bar}.

However, calculation of r from grouped data (*i.e.*, data in the form of occurrence frequencies f_i associated with distinct angular values a_i) results in negative bias, generating an underestimate of r. The following correction for this bias is applicable when the distribution is unimodal and does not deviate significantly from symmetry. The r value is multiplied by a correction factor "c" to yield the corrected r value r_c: $r_c = c*r$, where $c = (d*pi/360^o)/[\sin(d/2)]$, where the data are grouped into intervals of "d" degrees each.

MEASURES OF ANGULAR DISPERSION

Classical measures of dispersion (or spread) of the data include range, standard deviation, standard error, variance, and confidence intervals; and these measures (as well as the mean, median, and mode) are analogously applicable to circular data as well as linear data. Specific circular measures of angular dispersion include range, circular variance, angular variance, variance measure, angular deviation, and circular standard deviation.

Because of the discontinuity in angular value between 0° and 360° (designating the same point on a circle), the range cannot simply defined as the difference between the lowest and highest angular value. Instead, the range in a circular distribution of angular data values is defined as the smallest arc of the circle that contains all of the angular data in the distribution.

In addition to range, other circular measures of angular dispersion include:

1) Circular variance: $S^2 = 1-r$, ranging from 0 to 1.
2) Angular variance is $s^2 = 2*(1-r) = 2*S^2$, ranging from 0 to 2.
3) Variance measure: $s_o^2 = -2*\ln(r)$, ranging from 0 to infinity.
4) Angular deviation: $s = (180/pi)*[2*(1-r)]^{0.5} = (180/pi)*(s^2)^{0.5}$, ranging from 0° to 81.03^o.
5) Circular standard deviation: $s_o = (180/pi)*[-2*\ln(r)]^{0.5} = (180/pi)*(so^2)^{0.5}$, ranging from 0 to infinity.
6) Circular mean deviation: $CMD = (SUM|a_i - a_{bar}|)/n$, where a_i = angular value of measurement "i", a_{bar} = mean angle, and the summation is from i=1 to n.

CONFIDENCE INTERVAL FOR POPULATION MEAN

The lower (L_1) and upper (L_2) confidence limits for the mean angle (a_{bar}) are given by $L_1 = a_{bar} - d$ and $L_2 = a_{bar} + d$, where:

$d = \arccos[(1/R)*\{[2*n*(2*R^2 - n*X^2)]/(4*n - X^2)\}^{0.5}]$ for $r<=0.9$, $R>(n*X^2/2)^{0.5}$, and $n>X^2/4$
$d = \arccos\{(1/R)*[n^2 - (n^2 - R^2)*\exp(X^2/n)]^{0.5}\}$ for $r>=0.9$

where $R = n*r$.

SECOND ORDER ANALYSIS: THE MEAN OF MEAN ANGLES

If the previously-described procedure of calculating the mean angle a_{bar} (along with length vector r, X, and Y) from a group of measured angles a_i (and their associated occurrence frequencies f_i) is repeated for several groups of measured angular data, then the result is a set of mean angles. For example, for each of "k" samples of circular (angular) data, values of a_{bar}, r, X, and Y are calculated via the above procedure. It is now desired to calculate the grand mean of these "k" mean angles. For each of the "k" samples, given a_{bar} and r, values of $X = r*\cos(a_{bar})$ and $Y = r*\sin(a_{bar})$ are calculated. These values of $r*\cos(a_{bar})$ and $r*\sin(a_{bar})$ are then summed over the "k" samples. The values of X_{bar} and Y_{bar} are then calculated as: $X_{bar} = SUM[r*\cos(a_{bar})]/k$ and $Y_{bar} = SUM[r*\sin(a_{bar})]/k$, where the summation is from i=1 to k. Then the length vector $r = (X_{bar}^2 + Y_{bar}^2)^{0.5}$ is calculated. Knowing X, Y, and r, the cosine and sine components of the grand mean angle are given by $\cos(a_{bar}) = X_{bar}/r$ and $\sin(a_{bar}) = Y_{bar}/r$. Simultaneous solution of these 2 equations yields a unique solution for a_{bar}.

CONFIDENCE LIMITS FOR THE SECOND-ORDER MEAN ANGLE

The precision of the above-calculated second order mean angle (*i.e.*, grand mean angle) can be quantified by the calculation of confidence limits. The following equations are used to calculate b_1 and b_2, which are instrumental in calculating the lower and upper confidence limits:

$A = (k-1)/[SUM(x^2)]$
$B = -[(k-1)*SUM(x*y)]/[SUM(x^2) * SUM(y^2)]$
$C = (k-1)/[SUM(y^2)]$
$D = 2*(k-1)*\{1 - [SUM(x*y)^2]/[SUM(x^2) * SUM(y^2)]\} * F(a(1),2,k-2)/[k*(k-2)]$
$H = A*C - B^2$
$G = A*X_{bar}^2 + 2*B*X_{bar}*Y_{bar} + C*Y_{bar}^2 - D$
$U = H*X_{bar}^2 - C*D$
$V = (D*G*H)$
$W = H*X_{bar}*Y_{bar} + B*D$
$b_1 = (W+V)/U$
$b_2 = (W-V)/U$

where $SUM(x^2) = SUM(X^2) - [SUM(X)]^2/k$, $SUM(y^2) = SUM(Y^2) - [SUM(Y)]^2/k$, and $SUM(x*y) = SUM(X*Y) - [SUM(X*Y)]/k$.

The values of b_1 and b_2 each yields one of the confidence limits (*i.e.*, either the lower limit or the upper limit). An M value is calculated for each of the b_i values as follows: $M = (1+b_i^2)^{0.5}$. Then sine = b_i/M and cosine = 1/M are calculated. A unique angle is obtained from the calculated "sine" and "cosine" value. Then, one of the confidence limits is either this unique angular value or the value of this angle plus or minus 180° (whichever is greater than 0° and less than 360°), whichever is closer to the mean angle.

TESTS FOR CIRCULAR UNIFORMITY

It is often desired to determine the nature of the distribution of the n angles (a_i) around the circle of 0-360°. Are the directional data (either individual or grouped into angular bins) distributed relatively uniformly (*i.e.*, exhibit circular uniformity) around the circle (from 0° to 360°), or do the data exhibit directional bias by favoring one or more particular angles or ranges of angles? This question can be answered via statistical tests for circular uniformity, where the null (H_o) and alternative (H_a) hypotheses are stated as:

H_o: The sample came from a population with a uniform circular distribution (no directional bias).
H_a: The sample came from a population exhibiting bias in one or more directions (*i.e.*, a non-uniform circular distribution).

Among the available parametric tests for circular uniformity, the Rayleigh test and modified Rayleigh test (or V-test) for significance of the mean angle assume a unimodal distribution, whereas the Hodges-Ajne, and Batschelet Omnibus tests for significance of the median angle do not have such a restrictive assumption (*i.e.*, can be applied to unimodal, bimodal, and multi-modal distributions).

RAYLEIGH TEST AND V-TEST FOR SIGNIFICANCE OF THE MEAN ANGLE (UNIMODAL DISTRIBUTIONS)

The parametric Rayleigh test is used to test whether the given sampled population is uniformly distributed around a circle (*i.e.*, possesses circular uniformity, having no mean direction), and is valid only for unimodal populations following a von Mises (VM) angular normal distribution. Non-unimodal (*e.g.*, axially bimodal) datasets must first be transformed into unimodal data before Rayleigh's test can be applied to test for circular uniformity. Axially bimodal data, where the 2 angles with the highest occurrence frequencies are spaced exactly 180° apart, can be transformed into unimodal data by simply doubling all of the angles. "Rao's spacing test" can be used when the circular data are neither unimodal nor axially bimodal (Batschelet, 1981: 66-69; Rao, 1976; Russell and Levitin, 1994). Populations not following the von Mises distribution must undergo the following procedure before Rayleigh's test can be applied:

1) Convert the angular data from angular scale to a linear scale.
2) Conduct statistic tests to determine if the data are normal (*e.g.*, Kolmogorov-Smirnov test) and homoscedastic (possess homogeneity of variances) (*e.g.*, Bartlett test).
3) Apply an appropriate data transformation (*e.g.*, logarithmic, arcsin, square root) to the resultant linear data if the data are found to be non-normal or non-homoscedastic.
4) Convert the transformed linear data back to the angular scale.

Once the directional dataset is confirmed to be unimodal and follow the VM angular normal distribution, then the parametric Rayleigh test can be applied to test for circular uniformity. The null (H_o) and alternative (H_a) hypotheses and assumptions of the Rayleigh test are as follows:

H_o: The population has a uniform circular distribution with no mean direction.
H_a: The population has a non-uniform circular distribution with a mean direction.

"Rayleigh's R", given by R = n*r (where n = sample size), can be used to test how large a sample r must be to confidently indicate a non-uniform population distribution. "Rayleigh's z", given by $z = R^2/n = n*r^2 = R*r$ can be used to test the null hypothesis (H_o). Critical values of z as a function of sample size n and

confidence level "a" are tabulated in published statistical tables. An approximation of the probability of Rayleigh's R is given by $P = \exp\{[(1 + 4*n + 4*(n^2 - R^2)]^{0.5} - (1+2*n)\}$. If Rayleigh's z is greater than the critical z value, then H_o is rejected. Otherwise, H_o is accepted.

The non-parametric V-test (Greenwood and Durand, 1955; Durand and Greenwood, 1958) is a modification of the Rayleigh test such that a specific mean direction or expected mean angle (*e.g.*, 90°) is specified when testing the null hypothesis (H_o). The H_o and H_a hypotheses are given by:

H_o: The population has a uniform circular distribution with no mean direction, OR has a non-uniform circular distribution with a mean direction that is different from the specified mean direction.
H_a: The population has a non-uniform circular distribution with a specified mean direction.

Because a mean direction is specified, the V test is more powerful than the Rayleigh test (Batschelet, 1972; 1981: 60). For the Rayleigh test, rejection of H_o indicates only that the population has a mean direction, without indicating the specific mean direction. In contrast, for the V test, rejection of H_o provides additional information on the specific mean direction; however, if the data has an actual mean direction that is different from the specified (tested) mean direction, the test may accept H_o for 2 reasons:

1) Either the population has a uniform circular distribution, OR,
2) The population has a non-uniform circular distribution with a mean direction that is different from the specified mean direction.

The test statistic for the V test is given by $V = R*\cos(a_{bar} - u_o)$, where u_o is the predicted mean angle. The significance of V is determined from the "u" statistic: $u = V*(2/n)^{0.5}$. Critical values of u for different values of sample size n and confidence level "a" are tabulated in published statistical tables. As sample size n increases, the "u" statistic approaches a 1-tailed normal deviate $Z_a(1)$. If the data are grouped, then R is calculated from r_c rather than from r. If the u statistic is greater than the critical u value, then H_o is rejected. Otherwise, H_o is accepted.

PARAMETRIC 1-SAMPLE TEST FOR MEAN ANGLE

The parametric 1-sample test for mean angle (analogous to the 1-sample t-test for data on a linear scale) is used to test whether the population mean angle (u_a) is equal to a specified value (u_o). The H_o and H_a hypotheses are given by:

H_o: The population has a mean angle (u_a) equal to the specified mean angle (u_o).
H_a: The population's mean angle (u_a) is NOT equal to the specified mean angle (u_o).

This test calculates the (1-a) confidence interval (CI) for u_a and determines whether u_o falls within this CI. H_o is rejected if u_o is outside the CI, and is accepted if u_o falls within the CI.

HODGES-AJNE, AND BATSCHELET OMNIBUS TESTS FOR SIGNIFICANCE OF THE MEDIAN ANGLE (UNIMODAL, BIMODAL, AND MULTI-MODAL DISTRIBUTIONS)

The Hodges-Ajne and Batschelet tests are omnibus tests in that they do not require the assumption of a unimodal data distribution (unlike the Rayleigh and V-tests). That is, these omnibus tests are applicable to unimodal, bimodal, and multimodal distributions; however, for unimodal distributions, the Rayleigh and V tests are more powerful than these omnibus tests.

The null (H_o) and alternative (H_a) hypotheses for the Hodges-Ajne test are given by:

H_o: The population has a uniform circular distribution.
H_a: The population has a non-uniform circular distribution.

The Hodges-Ajne test (Ajne, 1968) is applied by calculating, from the given sample of circular data of sample size n, the smallest number of data (m) falling within a range of 180°. The data are plotted on a

circle, a diameter line is drawn through the circle (*e.g.*, connecting 0° and 180°), and the number of data on each side of the line are counted. The diameter line is rotated by a certain angular resolution (*e.g.*, by 1°, so that the new line intersects 1° and 181°), and the above procedure is repeated until all angle pairs (spaced 180° apart) are covered. Thus, for each angle pair defining the diameter line, the numbers of data on each side of the line are counted (with the smaller of these 2 numbers being designated as "m", and the other number being "n-m"). The smallest "m" value is desired and is used as the "m" test statistic in running the Hodges-Ajne test.

The probability P of an m value at least this small is given by (Hodges *et al.*, 1955): $P = 2^{(1-n)} * (n-2m)*{}_nC_{m,}$ where ${}_nC_m = n!/[m! * (n-m)!]$. Critical values for m as a function of sample size n (up to n=50) and confidence level "a" are tabulated in published statistical tables. For larger sample sizes (n>50), P is calculated as $P = [(2*pi)^{0.5}/A]*exp[-pi^2/(8*A^2)]$, where $A = pi*(n^{0.5})/[2*(n-2*m)]$ and pi = 3.1415927. If the m statistic is less than the critical m value, then H_o is rejected. Otherwise, H_o is accepted.

The non-parametric Batschelet test (Batschelet, 1981: 64-66) is a modification of the Hodges-Ajne test such that a specific angle is specified when testing the null hypothesis (H_o). The H_o and H_a hypotheses are given by:

H_o: The population has a uniform circular distribution, OR has a non-uniform circular distribution that is concentrated around an angle that is different from the specified concentration angle.
H_a: The population has a non-uniform circular distribution that is concentrated around a specified concentration angle.

Because a concentration angle is specified, the Batschelet test is more powerful than the Hodges-Ajne test. For the Hodges-Ajne test, rejection of H_o indicates only that the population has a concentration angle, without indicating the specific angle. In contrast, for the Batschelet test, rejection of H_o provides additional information on the specific angle; however, if the data has an actual concentration angle that is different from the specified (tested) concentration angle, the test may accept H_o for 2 reasons:

1) Either the population has a uniform circular distribution, OR,
2) The population has a non-uniform circular distribution with a concentration angle that is different from the specified concentration angle.

The test statistic for the Batschelet test is given by C = n – m', where n = sample size and m' = number of data within 90° of the specified angle. A 2-tailed binomial test is then conducted, with p = 0.50 and with C counts in one category and m' counts in the other.

Critical values for C as a function of sample size n, number of tails (1 or 2), and confidence level "a" are tabulated in published statistical tables. If the C statistic is less than the critical C value, then H_o is rejected. Otherwise, H_o is accepted.

TEST FOR SIGNIFICANCE OF THE MEDIAN ANGLE: BINOMIAL TEST

This non-parametric test (Zar, 1999) can be used to determine whether the population median angle is equal to a specified value. The H_o and H_a hypotheses are given by:

H_o: The population median angle is equal to the specified value.
H_a: The population median angle is NOT equal to the specified value.

The angular data are plotted on a circle, a diameter line is drawn through the specified angle, and the data on each side of this line are counted. A 2-tailed binomial test is then conducted, with p = 0.50.

TEST FOR SYMMETRY AROUND THE MEDIAN ANGLE: NON-PARAMETRIC WILCOXON PAIRED-SAMPLED (SIGNED-RANK) TEST

The non-parametric Wilcoxon paired-sample test (or signed-rank test) is used to test the symmetry of a distribution around the median, using either 1-tailed or 2-tailed tests (Zar, 1999). The H_o and H_a hypotheses are given by:

2-tailed test:

H_o: The underlying distribution is symmetrical around the median.
H_a: The underlying distribution is NOT symmetrical around the median.

1-tailed test (with "T-" as test statistic):

H_o: The underlying distribution is NOT skewed clockwise from the median.
H_a: The underlying distribution is skewed clockwise from the median.

1-tailed test (with "T+" as test statistic):

H_o: The underlying distribution is NOT skewed counter-clockwise from the median.
H_a: The underlying distribution is skewed counter-clockwise from the median.

For each angle (X_i), the deviation of X_i from the median angle (X_{median}) is calculated: $d_i = X_i - X_{median}$. The d_i values are ranked over the number of data points (*i.e.*, sample size n), and the ranks are "signed" based on the sign of the deviation (*i.e.*, positive deviations d_i have a positive rank, and negative deviations d_i have a negative rank). All of the positive signed ranks over the sample size n are summed to obtain the "T+" value. Likewise, all of the negative signed ranks are summed, and the absolute value of this sum is calculated, to obtain the "T-" value. Critical values T_{crit} as a function of sample size n (up to n=100) and confidence level "a" for both 1-tailed and 2-tailed tests are tabulated in published statistical tables. For the 2-tailed test, H_o is rejected if either "T+" or "T-" is less than T_{crit}, and is accepted if neither "T+" nor "T-" is less than T_{crit}. For the 1-tailed test, we use either "T+" or "T" as the test statistic T_{stat}. H_o is rejected if $T_{stat} < T_{crit}$, and is accepted if $T_{stat} >= T_{crit}$.

GOODNESS-OF-FIT (GOF) TESTING FOR CIRCULAR DISTRIBUTIONS: NON-PARAMETRIC CHI-SQUARE (X^2) TEST, WATSON'S 1-SAMPLE U^2 TEST, KOLMOGOROV-SMIRNOV (KS) TEST, AND KUIPER'S TEST

Goodness of fit (GOF) tests are used to test the statistical significance of conformity of a given sample of nominal scale data (*e.g.*, counts, abundances) to a specified or expected frequency distribution. A test statistic is used to quantify the deviation of the sample from the specified theoretical distribution, and is compared to an associated tabulated critical value, the latter of which is a function of the degrees of freedom (DF) and confidence level of interest (*e.g.*, 90%, 95%, 99%). From the comparison between the test statistic and critical value, a probability is calculated along with a decision of whether to accept or reject the null hypothesis (H_o) of no difference. For GOF tests, H_o and the alternative hypothesis (H_a) can be generally stated as follows:

H_o: The sample came from a population that follows the specified theoretical (expected) frequency distribution.
H_a: The sample did NOT come from a population that follows the specified theoretical (expected) frequency distribution.

For the case of testing for uniform circular uniformity, H_o and H_a would be stated as:

H_o: The sample came from a population with a uniform circular distribution.
H_a: The sample did NOT come from a population with a uniform circular distribution.

The critical value is a threshold such that values of the test statistic in excess of the threshold represent sufficiently high deviations from the theoretical distribution to warrant a conclusion that the sample does not come from a population that follows the theoretical distribution (*i.e.*, H_o is rejected). Conversely, if the test statistic is less than the critical value (threshold), then it can be concluded that the deviation of the sample from the theoretical distribution is sufficiently small as to conclude that the sample did indeed come from a population that follows the theoretical distribution (*i.e.*, H_o is accepted, or not rejected). In summary:

1) If test statistic > critical value: H_o is rejected.
2) If test statistic < critical value: H_o is not rejected.

For the circular statistical analysis of bird directional data, the non-parametric chi-square (X^2) GOF test (Zar, 1999), Watson's 1-sample U^2 GOF test (Watson, 1961; 1962), the Kolmogorov-Smirnov (KS) GOF test (Zar, 1999), and Kuiper's GOF test are used to test the null hypothesis (H_o) of a uniform circular distribution. The H_o and H_a hypotheses are stated as:

H_o: The sample came from a population that follows a uniform circular distribution.
H_a: The sample did NOT come from a population that follows a uniform circular distribution.

CHI-SQUARE (X^2) GOF TEST

A typical sample of nominal scale data consists of "k" classes or categories, each of which is quantified by a frequency (or number of counts). In the current application of bird directional data, the nominal directional classes include the 8 directions (*i.e.*, k=8): N (0° or 360°), NE (45°), E (90°), SE (135°), S (180°), SW (225°), W (270°), and NW (315°). The non-parametric chi-square (X^2) GOF test (Zar, 1999) uses the following test statistic to measure the deviation of the sample from the specified theoretical distribution: $X^2 = SUM[f_i - f_{hat,i}]^2/f_{hat,i}$, where f_i and $f_{hat,i}$ are the actual and expected frequencies, respectively, of class "i", and the summation is conducted over the "k" classes. The f(i) values are obtained directly from the sample, and the $f_{hat,i}$ values are calculated based on the theoretical frequency distribution specified in the null hypothesis (H_o). Two checks on the calculations are the following: 1) $SUM[f_i] = n$; 2) $SUM[f_{hat,i}] = n$, where n = sample size. The X^2 test statistic is compared to the critical X^2 value (tabulated in published statistical tables) for k-1 degrees of freedom (*i.e.*, DF=k-1) for the desired confidence level CL (*e.g.*, 90%, 95%, 99%). The critical X^2 value correlates positively with DF and negatively with CL. If the X^2 statistic is greater than the critical X^2, then H_o is rejected. Otherwise, H_o is accepted.

WATSON'S 1-SAMPLE U^2 GOF TEST

The non-parametric Watson's 1-sample U^2 GOF test (Watson, 1961; 1962) normalizes the angular directional data from a 0-360° range to a range of 0-1, via the transformation: $u_i = a_i/360^o$, where a_i = angular measurement (degrees) of data point "i", and u_i = normalized value (dimensionless, range=0-1). The U^2 statistic (Mardia, 1972: 182) is calculated as: $U^2 = SUM\ u_i^2 - (SUM\ u_i)^2/n - (2/n)*SUM(i*u_i) + (n+1)*u_{bar} + n/12$, where n = sample size; the summations are conducted for i=1 to n; and the mean value $u_{bar} = SUM(u_i)/n$. The U^2 test statistic is compared to the critical $U^2[a,n_1,n_2]$ value (tabulated in published statistical tables) for n_1=n and n_2=n for the desired confidence level "a" (*e.g.*, 90%, 95%, 99%). The critical U^2 value correlates negatively with CL and n_1 and can correlate either positively or negatively with n_2. If the U^2 statistic is greater than the critical U^2, then H_o is rejected. Otherwise, H_o is accepted.

KOLMOGOROV-SMIRNOV (KS) AND KUIPER GOF TESTS

The non-parametric Kolmogorov-Smirnov (KS) GOF test (Zar, 1999) represents an improvement over the X^2 GOF test for ordered categories of data, and is more powerful than the X^2 test for small sample sizes (n) and/or small expected frequencies; however, a drawback is that the results of the KS test depend on the order of the categories, yielding different results for different starting points on a circle. Fortunately, this shortcoming is resolved with the Kuiper GOF test, which generates results that are unrelated to the starting point. The Kuiper test is preferred over the X^2 test for ungrouped data.

For each sample "i" (for i=1 to n), cumulative observed frequency F_i is calculated as the summation of observed frequency f_i as "i" is increased from 1 to n; and cumulative relative frequency (CRF_i) is simply F_i/n. The test statistic is given by $D = \max[\max(D_i), \max(D_i')]$, where $D_i = abs[CRF(i) - CRF_{exp}(i))]$ and $D_i' = abs[CRF(i-1) - CRF_{exp}(i)]$. Thus, D represents the maximum deviation between the observed frequency distribution and the expected (hypothesized) frequency distribution. The D test statistic is compared to the critical D[a,n] value (tabulated in published statistical tables) for sample size "n" and the desired confidence level "a" (*e.g.*, 90%, 95%, 99%). The critical D value correlates negatively with both n and "a". If the D statistic is greater than the critical D, then H_o is rejected. Otherwise, H_o is accepted.

APPENDIX C

AVIAN DISTRIBUTION AND ABUNDANCE DATA

Table C-1. Summary of all seasonal data, both shipboard offshore and small-boat coastal, January 2008-November 2009.

Common Name	Shipboard Offshore																Small Boat Coastal														Overall
	Winter 2008		Spring 2008		Summer 2008		Fall 2008		Winter 2009		Spring 2009		Summer 2009		Fall 2009		Winter 008		Spring 2008		Summer 2008		Fall 2008		Winter 2009		Spring 2009		Summer 2009		Fall 2009		
	No.	No./km	No.	No./km	No.	No./km	No.	No./km	No.	No./km	No.	No./km	No.	No./km	No.	No./km	No.	No./km	No.	No./km	No.	No./km	No.	No./km	No.	No./km	No.	No./km	No.	No./km	No.	No./km	Total
Total	**1319**	**2.64**	**8269**	**3.94**	**1976**	**1.30**	**13747**	**4.55**	**4105**	**2.10**	**5476**	**2.67**	**1010**	**1.41**	**3723**	**1.33**	**4116**	**36.49**	**3755**	**10.72**	**681**	**3.52**	**6699**	**13.44**	**13205**	**28.99**	**2668**	**6.65**	**251**	**1.99**	**4815**	**9.07**	**75815**
Anatidae (geese, ducks)	*170*	*0.34*	*2856*	*1.36*	*1*	*0.00*	*4011*	*1.33*	*1817*	*0.93*	*1340*	*0.65*			*256*	*0.09*	*2503*	*22.19*	*1561*	*4.46*	*13*	*0.07*	*623*	*1.25*	*10883*	*23.89*	*1252*	*3.12*			*667*	*1.26*	*27953*
Canada Goose			4	0.00																			231	0.46									235
Atlantic Brant	9	0.02									9	0.00											21	0.04	70	0.15							109
Tundra swan							8	0.00																									8
Wood Duck							47	0.02															6	0.01							1	0.00	54
Gadwall							3	0.00													2	0.01											5
American Wigeon																															4	0.01	4
American Black Duck			19	0.01			21	0.01	5	0.00													24	0.05	5	0.01					23	0.04	97
Mallard																							1	0.00									1
Northern Pintail							8	0.00	21	0.01					3	0.00							4	0.01							31	0.06	67
Green-winged Teal			1	0.00			32	0.01															30	0.06							7	0.01	70
duck dabbling (unknown)			4	0.00																			5	0.01									9
Greater Scaup							12	0.00															31	0.06	1572	3.45							1615
Lesser Scaup																							5	0.01	2	0.00							7
scaup (unknown), Aythya (unknown)			4	0.00			13	0.00									750	6.65					9	0.02	900	1.98							1676
Common Eider							6	0.00																			2	0.00			53	0.10	61
Surf Scoter	5	0.01	1423	0.68	1	0.00	2164	0.72	529	0.27	447	0.22			213	0.08	52	0.46	1315	3.76	11	0.06	81	0.16	1761	3.87	497	1.24			222	0.42	8721
White-winged Scoter	43	0.09	58	0.03			12	0.00	132	0.07	66	0.03			4	0.00	22	0.20	35	0.10			1	0.00	41	0.09	1	0.00					415
Black Scoter	63	0.13	618	0.29			1070	0.35	376	0.19	236	0.11			13	0.00	1244	11.03	91	0.26			105	0.21	2435	5.35	455	1.13			126	0.24	6832
scoter dark-winged (unknown)	7	0.01	313	0.15			599	0.20	29	0.01	116	0.06			20	0.01			7	0.02			6	0.01	1104	2.42	88	0.22			50	0.09	2339
scoter (unknown)	3	0.01	98	0.05			14	0.00	17	0.01															617	1.35							749
Long-tailed Duck	40	0.08	307	0.15					702	0.36	460	0.22					424	3.76	113	0.32			19	0.04	2045	4.49	209	0.52			146	0.27	4465
Bufflehead																	4	0.04					41	0.08	118	0.26							163
Common Goldeneye							2	0.00									6	0.05															8
Red-breasted Merganser			7	0.00					6	0.00	1	0.00			3	0.00	1	0.01							189	0.41					4	0.01	211
Ruddy Duck																							1	0.00	24	0.05							25
duck diving (unknown)											5	0.00											1	0.00									6
duck (unknown)																							1	0.00									1
Gaviidae (loons)	*198*	*0.40*	*760*	*0.36*	*9*	*0.01*	*398*	*0.13*	*641*	*0.33*	*1045*	*0.51*	*17*	*0.02*	*205*	*0.07*	*139*	*1.23*	*128*	*0.37*	*1*	*0.01*	*756*	*1.52*	*1113*	*2.44*	*187*	*0.47*			*440*	*0.83*	*6037*
Red-throated Loon	116	0.23	364	0.17			82	0.03	258	0.13	234	0.11			54	0.02	90	0.80	72	0.21			683	1.37	346	0.76	100	0.25			395	0.74	2794
Common Loon	81	0.16	394	0.19	9	0.01	315	0.10	383	0.20	810	0.39	17	0.02	151	0.05	49	0.43	56	0.16	1	0.01	72	0.14	766	1.68	87	0.22			45	0.08	3236
loon (unknown)	1	0.00	2	0.00			1	0.00			1	0.00											1	0.00	1	0.00							7
Podicipedidae (grebes)			*3*	*0.00*			*1*	*0.00*	*4*	*0.00*	*1*	*0.00*							*8*	*0.02*					*29*	*0.06*							*46*
Pied-billed Grebe							1	0.00																									1
Horned Grebe			1	0.00					1	0.00									8	0.02					28	0.06							38
Red-necked Grebe			2	0.00					3	0.00	1	0.00													1	0.00							7

Table C-1 (*continued*). Summary of all seasonal data, both shipboard offshore and small-boat coastal, January 2008-November 2009.

Common Name	Shipboard Offshore																Small Boat Coastal														Overall
	Winter 2008		Spring 2008		Summer 2008		Fall 2008		Winter 2009		Spring 2009		Summer 2009		Fall 2009		Winter 008		Spring 2008		Summer 2008		Fall 2008		Winter 2009		Spring 2009		Summer 2009		Fall 2009		
	No.	No./km	No.	No./km	No.	No./km	No.	No./km	No.	No./km	No.	No./km	No.	No./km	No.	No./km	No.	No./km	No.	No./km	No.	No./km	No.	No./km	No.	No./km	No.	No./km	No.	No./km	No.	No./km	Total
grebe (unknown)																															
Procellariidae (petrels and shearwaters)			*2*	*0.00*	*105*	*0.07*	*34*	*0.01*	*2*	*0.00*	*2*	*0.00*	*5*	*0.01*	*74*	*0.03*											*3*	*0.01*					*227*
Northern Fulmar									1	0.00																					1
Cory's Shearwater					99	0.07	29	0.01					1	0.00	58	0.02																187
Greater Shearwater					1	0.00	3	0.00					1	0.00	14	0.00																19
Sooty Shearwater					4	0.00							3	0.00	1	0.00											3	0.01				11
Manx Shearwater			2	0.00	1	0.00			1	0.00	2	0.00			1	0.00																7
Audubon's Shearwater							1	0.00																								1
shearwater (black-and-white), shearwater (unknown)							1	0.00																								1
Hydrobatidae (storm-petrels)					*701*	*0.46*	*1251*	*0.41*					*113*	*0.16*	*547*	*0.19*													*7*	*0.06*	*11*	*0.02*	*2630*
Wilson's Storm-Petrel					700	0.46	1248	0.41					113	0.16	546	0.19													7	0.06	11	0.02	2625
Leach's Storm-Petrel							1	0.00																								1
storm-petrel (unknown)					1	0.00	2	0.00							1	0.00																4
Sulidae (gannets)	*769*	*1.54*	*2839*	*1.35*	*156*	*0.10*	*1404*	*0.46*	*685*	*0.35*	*1293*	*0.63*	*274*	*0.38*	*1424*	*0.51*	*10*	*0.09*	*442*	*1.26*	*15*	*0.08*	*1880*	*3.77*	*241*	*0.53*	*162*	*0.40*	*6*	*0.05*	*979*	*1.84*	*12579*
Northern Gannet	769	1.54	2839	1.35	156	0.10	1404	0.46	685	0.35	1293	0.63	274	0.38	1424	0.51	10	0.09	442	1.26	15	0.08	1880	3.77	241	0.53	162	0.40	6	0.05	979	1.84	12579
Pelecanidae					*4*	*0.00*	*3*	*0.00*							*2*	*0.00*					*1*	*0.01*	*8*	*0.02*							*65*	*0.12*	*83*
Brown Pelican					4	0.00	3	0.00							2	0.00					1	0.01	8	0.02							65	0.12	83
Phalacrocoracidae (cormorants)			*113*	*0.05*	*1*	*0.00*	*1018*	*0.34*	*2*	*0.00*	*70*	*0.03*	*2*	*0.00*	*17*	*0.01*			*67*	*0.19*	*7*	*0.04*	*126*	*0.25*	*16*	*0.04*	*261*	*0.65*			*105*	*0.20*	*1805*
Double-crested Cormorant			113	0.05	1	0.00	1012	0.34	2	0.00	70	0.03	2	0.00	17	0.01			65	0.19	7	0.04	124	0.25	13	0.03	256	0.64			104	0.20	1786
Great Cormorant							6	0.00											1	0.00			2	0.00	3	0.01	5	0.01			1	0.00	18
cormorant (unknown)																			1	0.00												1
Ardeidae (bitterns, egrets, and herons)			*1*	*0.00*			*11*	*0.00*			*2*	*0.00*			*8*	*0.00*							*7*	*0.01*					*2*	*0.02*	*1*	*0.00*	*32*
Great Blue Heron							11	0.00							8	0.00							6	0.01					2	0.02			27
Great Egret											2	0.00											1	0.00									3
Green Heron																															1	0.00	1
Yellow-crowned Night-Heron			1	0.00																													1
Accipitridae (eagles and hawks)			*1*	*0.00*			*7*	*0.00*			*1*	*0.00*									*1*	*0.01*	*1*	*0.00*					*6*	*0.05*	*6*	*0.01*	*23*
Osprey							7	0.00													1	0.01	1	0.00					6	0.05	6	0.01	21
Northern Harrier			1	0.00							1	0.00																					2
Falconidae (falcons)							*4*	*0.00*	*1*	*0.00*	*2*	*0.00*			*3*	*0.00*															*5*	*0.01*	*15*
Merlin							1	0.00			2	0.00			2	0.00															4	0.01	9
Peregrine Falcon							3	0.00	1	0.00					1	0.00															1	0.00	6
Rallidae (rails)							*2*	*0.00*	*1*	*0.00*																					*1*	*0.00*	*4*
American Coot							2	0.00	1	0.00																					1	0.00	4

Table C-1 (*continued*). Summary of all seasonal data, both shipboard offshore and small-boat coastal, January 2008-November 2009.

Common Name	Shipboard Offshore																Small Boat Coastal														Overall
	Winter 2008		Spring 2008		Summer 2008		Fall 2008		Winter 2009		Spring 2009		Summer 2009		Fall 2009		Winter 008		Spring 2008		Summer 2008		Fall 2008		Winter 2009		Spring 2009		Summer 2009		Fall 2009		
	No.	No./km	No.	No./km	No.	No./km	No.	No./km	No.	No./km	No.	No./km	No.	No./km	No.	No./km	No.	No./km	No.	No./km	No.	No./km	No.	No./km	No.	No./km	No.	No./km	No.	No./km	No.	No./km	Total
Charadriidae (plovers)											*5*	*0.00*											*15*	*0.03*							*1*	*0.00*	*21*
Semipalmated Plover																							15	0.03							1	0.00	16
Black-bellied Plover											5	0.00																					5
Haematoodidae (osystercatchers)																	*10*	*0.09*															*10*
American Oystercatcher																	10	0.09															10
Scolopacidae (sandpipers)			*13*	*0.01*	*15*	*0.01*	*34*	*0.01*			*38*	*0.02*	*1*	*0.00*	*37*	*0.01*	*219*	*1.94*	*77*	*0.22*	*63*	*0.33*	*151*	*0.30*	*145*	*0.32*	*16*	*0.04*			*18*	*0.03*	*827*
Greater Yellowlegs											4	0.00																			7	0.01	11
Lesser Yellowlegs											1	0.00																					1
Whimbrel															3	0.00					49	0.25											52
shorebird (large)							10	0.00																									10
Ruddy Turnstone															1	0.00									7	0.02							8
Sanderling											1	0.00			7	0.00	206	1.83	76	0.22	14	0.07	77	0.15	30	0.07	16	0.04			3	0.01	430
Semipalmated Sandpiper							3	0.00							1	0.00			1	0.00			3	0.01							2	0.00	10
Least Sandpiper			6	0.00	8	0.01	9	0.00			1	0.00			4	0.00							11	0.02									39
White-rumped Sandpiper			1	0.00																													1
peep (unknown)							3	0.00							12	0.00																	15
Pectoral Sandpiper					7	0.00	1	0.00							1	0.00																	9
Purple Sandpiper																									13	0.03							13
Dunlin							1	0.00			13	0.01											12	0.02	95	0.21							121
Short-billed Dowitcher											18	0.01																			5	0.01	23
dowitcher (unknown)																							3	0.01									3
American Woodcock							1	0.00																									1
Red-necked Phalarope							2	0.00					1	0.00	3	0.00																	6
Red Phalarope			1	0.00			1	0.00							3	0.00																	5
phalarope (unknown)							1	0.00																									1
shorebird (small)			5	0.00			2	0.00							2	0.00	13	0.12					43	0.09							1	0.00	66
shorebird (unknown)																							2	0.00									2
Laridae (gulls)	*124*	*0.25*	*1622*	*0.77*	*979*	*0.64*	*5442*	*1.80*	*718*	*0.37*	*1091*	*0.53*	*596*	*0.83*	*1060*	*0.38*	*1220*	*10.82*	*1456*	*4.16*	*576*	*2.98*	*3105*	*6.23*	*776*	*1.70*	*784*	*1.95*	*230*	*1.82*	*2488*	*4.68*	*22267*
Black-legged Kittiwake	4	0.01					1	0.00	24	0.01					106	0.04																	135
Sabine's Gull							1	0.00																									1
Bonaparte's Gull	7	0.01	159	0.08			222	0.07	173	0.09	50	0.02			13	0.00	20	0.18	5	0.01			349	0.70	50	0.11					228	0.43	1276
Little Gull			1	0.00			1	0.00																									2
Laughing Gull			154	0.07	457	0.30	2683	0.89			125	0.06	215	0.30	343	0.12			87	0.25	366	1.89	978	1.96			229	0.57	130	1.03	1189	2.24	6956
Ring-billed Gull			5	0.00			91	0.03	9	0.00					13	0.00	397	3.52	20	0.06			478	0.96	69	0.15	4	0.01			74	0.14	1160
Herring Gull	66	0.13	824	0.39	29	0.02	547	0.18	381	0.19	584	0.28	75	0.11	254	0.09	732	6.49	1058	3.02	20	0.10	335	0.67	547	1.20	247	0.62	10	0.08	390	0.73	6099
Iceland Gull							1	0.00	1	0.00																							2
Lesser Black-backed Gull			2	0.00			3	0.00			1	0.00			2	0.00			1	0.00			1	0.00									10

Table C-1 (*continued*). Summary of all seasonal data, both shipboard offshore and small-boat coastal, January 2008-November 2009.

Common Name	Shipboard Offshore																Small Boat Coastal														Overall
	Winter 2008		Spring 2008		Summer 2008		Fall 2008		Winter 2009		Spring 2009		Summer 2009		Fall 2009		Winter 008		Spring 2008		Summer 2008		Fall 2008		Winter 2009		Spring 2009		Summer 2009		Fall 2009		
	No.	No./km	No.	No./km	No.	No./km	No.	No./km	No.	No./km	No.	No./km	No.	No./km	No.	No./km	No.	No./km	No.	No./km	No.	No./km	No.	No./km	No.	No./km	No.	No./km	No.	No./km	No.	No./km	Total
Great black-backed Gull	36	0.07	203	0.10	49	0.03	456	0.15	127	0.06	157	0.08	49	0.07	197	0.07	71	0.63	198	0.57	58	0.30	409	0.82	84	0.18	102	0.25	25	0.20	338	0.64	2559
gull large (unknown)	11	0.02	9	0.00			19	0.01	3	0.00	16	0.01	1	0.00	2	0.00			9	0.03			31	0.06	25	0.05					1	0.00	127
Least Tern			1	0.00									4	0.01					1	0.00							1	0.00			1	0.00	8
Caspian Tern			1	0.00			1	0.00															5	0.01							3	0.01	10
Black Tern							1	0.00							6	0.00																	7
Common Tern			152	0.07	426	0.28	812	0.27			91	0.04	200	0.28	103	0.04			43	0.12	69	0.36	228	0.46	1	0.00	78	0.19	53	0.42	74	0.14	2330
Forster's Tern			61	0.03	3	0.00	409	0.14			44	0.02	26	0.04	5	0.00			33	0.09	49	0.25	101	0.20			121	0.30	8	0.06	139	0.26	999
tern (small)			44	0.02	1	0.00	96	0.03			21	0.01	20	0.03	9	0.00					7	0.04	64	0.13			2	0.00	4	0.03			268
Royal Tern			6	0.00	14	0.01	73	0.02							6	0.00			1	0.00	7	0.04	122	0.24							50	0.09	279
Sandwich Tern																							2	0.00							1	0.00	3
tern (large)																							2	0.00									2
Pomarine Jaeger															1	0.00																	1
Parasitic Jaeger							25	0.01			2	0.00	5	0.01																			32
jaeger (unknown)													1	0.00																			1
Alcidae (alcids)	*58*	*0.12*	*29*	*0.01*					*234*	*0.12*	*536*	*0.26*					*15*	*0.13*							*1*	*0.00*							*873*
Dovekie	15	0.03	2	0.00					68	0.03	7	0.00																					92
Common Murre									14	0.01	9	0.00																					23
Thick-billed Murre			1	0.00					2	0.00	5	0.00																					8
Razorbill	35	0.07	24	0.01					139	0.07	498	0.24					15	0.13							1	0.00							712
Black Guillemot			1	0.00																													1
Atlantic Puffin									1	0.00																							1
alcid (unknown)	8	0.02	1	0.00					10	0.01	17	0.01																					36
Columbidae (pigeons, doves)			*1*	*0.00*			*2*	*0.00*			*1*	*0.00*																					*4*
Mourning Dove			1	0.00			2	0.00			1	0.00																					4
Apodidae (swifts)											*6*	*0.00*	*1*	*0.00*									*1*	*0.00*									*8*
Chimney Swift											6	0.00	1	0.00									1	0.00									8
Picidae (woodpeckers)			*2*	*0.00*			*4*	*0.00*							*1*	*0.00*							*2*	*0.00*									*9*
Northern (Yellow-shafted) Flicker			2	0.00			4	0.00							1	0.00							2	0.00									9
Tyrannidae (flycatchers)													*1*	*0.00*																			*1*
Empidonax flycatcher (unknown)													1	0.00																			1
Corvidae (crows)																			*1*	*0.00*													*1*
Fish Crow																			1	0.00													1
Hirundinidae (swallows)			*10*	*0.00*	*5*	*0.00*	*63*	*0.02*			*13*	*0.01*			*70*	*0.02*			*9*	*0.03*	*3*	*0.02*	*24*	*0.05*			*3*	*0.01*			*27*	*0.05*	*227*
Purple Martin					2	0.00	47	0.02							24	0.01					1	0.01	12	0.02									86
Tree Swallow							4	0.00			3	0.00			2	0.00					1	0.01	3	0.01							4	0.01	17
Bank Swallow					2	0.00									1	0.00							1	0.00									4
Barn Swallow			10	0.00	1	0.00	12	0.00			10	0.00			43	0.02			9	0.03	1	0.01	8	0.02			3	0.01			23	0.04	120

Table C-1 (*continued*). Summary of all seasonal data, both shipboard offshore and small-boat coastal, January 2008-November 2009.

Common Name	Shipboard Offshore																Small Boat Coastal														Overall
	Winter 2008		Spring 2008		Summer 2008		Fall 2008		Winter 2009		Spring 2009		Summer 2009		Fall 2009		Winter 008		Spring 2008		Summer 2008		Fall 2008		Winter 2009		Spring 2009		Summer 2009		Fall 2009		
	No.	No./km	No.	No./km	No.	No./km	No.	No./km	No.	No./km	No.	No./km	No.	No./km	No.	No./km	No.	No./km	No.	No./km	No.	No./km	No.	No./km	No.	No./km	No.	No./km	No.	No./km	No.	No./km	Total
Certhiidae (creepers)			*1*	*0.00*											*1*	*0.00*																	*2*
Brown Creeper			1	0.00											1	0.00																	2
Troglodytidae (wrens)															*1*	*0.00*																	*1*
Winter Wren															1	0.00																	1
Regulidae (kinglets, crests)							*1*	*0.00*																									*1*
Golden-crowned Kinglet							1	0.00																									1
Turdidae (thrushes)											*1*	*0.00*																					*1*
Wood Thrush											1	0.00																					1
Mimidae (mockingbirds, thrashers, et al)											*4*	*0.00*																					*4*
Gray Catbird											2	0.00																					2
Northern Mockingbird											1	0.00																					1
Brown Thrasher											1	0.00																					1
Sturnidae (starlings)							*1*	*0.00*			*1*	*0.00*																					*2*
European Starling							1	0.00			1	0.00																					2
Paruildae (wood-warblers)			*2*	*0.00*			*26*	*0.01*			*13*	*0.01*			*9*	*0.00*																	*50*
Northern Parula							1	0.00			1	0.00																					2
Yellow Warbler															2	0.00																	2
Magnolia Warbler											2	0.00																					2
Yellow-rumped (Myrtle) Warbler			2	0.00			14	0.00			3	0.00																					19
Black-throated Green Warbler							1	0.00																									1
Palm Warbler, Palm Warbler (yellow)							4	0.00																									4
American Redstart															2	0.00																	2
Prothonotary Warbler							1	0.00																									1
Ovenbird											1	0.00			1	0.00																	2
Northern Waterthrush															1	0.00																	1
Mourning Warbler							1	0.00																									1
Common Yellowthroat							1	0.00							1	0.00																	2
Yellow-breasted Chat											1	0.00			1	0.00																	2
warbler (unknown)							3	0.00			5	0.00			1	0.00																	9
Emberizidae (sparrows)			*10*	*0.00*			*8*	*0.00*			*4*	*0.00*			*1*	*0.00*																	*23*
Field Sparrow															1	0.00																	1
Vesper Sparrow			1	0.00																													1
Song Sparrow			7	0.00			2	0.00			2	0.00																					11
Swamp Sparrow							1	0.00																									1
White-throated Sparrow			1	0.00			3	0.00			1	0.00																					5

Table C-1 (*continued*). Summary of all seasonal data, both shipboard offshore and small-boat coastal, January 2008-November 2009.

Common Name	Shipboard Offshore																Small Boat Coastal														Overall
	Winter 2008		Spring 2008		Summer 2008		Fall 2008		Winter 2009		Spring 2009		Summer 2009		Fall 2009		Winter 008		Spring 2008		Summer 2008		Fall 2008		Winter 2009		Spring 2009		Summer 2009		Fall 2009		
	No.	No./km	No.	No./km	No.	No./km	No.	No./km	No.	No./km	No.	No./km	No.	No./km	No.	No./km	No.	No./km	No.	No./km	No.	No./km	No.	No./km	No.	No./km	No.	No./km	No.	No./km	No.	No./km	Total
Dark-eyed (slate-colored) Junco			1	0.00			2	0.00			1	0.00																			4
Cardinalidae											*2*	*0.00*																		*1*	*0.00*	*3*
Scarlet Tanager																													1	0.00	1
Rose-breasted Grosbeak											1	0.00																			1
Indigo Bunting											1	0.00																			1
Icteridae (blackbirds, meadowlarks, orioles)			*3*	*0.00*			*5*	*0.00*			*4*	*0.00*			*4*	*0.00*			*6*	*0.02*	*1*	*0.01*			*1*	*0.00*					*24*
Red-winged Blackbird			2	0.00			3	0.00			1	0.00							6	0.02											12
Eastern Meadowlark			1	0.00			1	0.00																							2
Boat-tailed Grackle																					1	0.01			1	0.00					2
Brown-headed Cowbird							1	0.00			2	0.00			2	0.00															5
Orchard Oriole											1	0.00																			1
Baltimore Oriole															2	0.00															2
Fringillidae (finches)							*14*	*0.00*																							*14*
House Finch							2	0.00																							2
Pine Siskin							8	0.00																							8
American Goldfinch							4	0.00																							4
Other			*1*	*0.00*			*3*	*0.00*			*1*	*0.00*	*1*	*0.00*	*3*	*0.00*															*9*
passerine			1	0.00			3	0.00			1	0.00			3	0.00															8

Table C-2. Summary of monthly effort and sample sizes of the five most abundant species/groups, January 2008-November 2009.

Month	2008			2009		
	Effort (hrs.)	Species	n	Effort (hrs.)	Species	n
January	36.64	Scoters	912	44.58	Scaup	2469
		Herring Gull	367		Scoters	2459
		Northern Gannet	357		Long-tailed Duck	895
		Long-tailed Duck	245		Northern Gannet	421
		Red-throated Loon	160		Common Loon	314
February	9.04	Long-tailed Duck	48	63.31	Scoters	1827
		Scoters	38		Long-tailed Duck	1756
		Common Loon	20		Common Loon	728
		Gulls	11		Herring Gull	592
		Northern Gannet	9		Red-throated Loon	134
March	55.91	Northern Gannet	682	62.00	Scoters	1375
		Scoters	301		Long-tailed Duck	659
		Herring Gull	169		Northern Gannet	534
		Long-tailed Duck	80		Alcids	508
		Red-throated Loon	74		Herring Gull	462
April	47.47	Scoters	1215	26.52	Scoters	291
		Northern Gannet	492		Northern Gannet	151
		Bonaparte's Gull	109		Herring Gull	85
		Red-throated Loon	107		Common Loon	58
		Herring Gull	102		Red-throated Loon	49
May	38.49	Northern Gannet	228	55.12	Northern Gannet	745
		Black Scoter	140		Common Loon	508
		Common Tern	94		Herring Gull	237
		Laughing Gull	85		Laughing Gull	198
		Herring Gull	83		Common Tern	169
June	55.13	Laughing Gull	332	52.25	Laughing Gull	345
		Common Tern	212		Northern Gannet	282
		Wilson's Storm-Petrel	198		Common Tern	201
		Northern Gannet	124		Wilson's Storm-Petrel	113
		Cory's Shearwater	51		Herring Gull	86
July	47.51	Laughing Gull	405	N/A[1]		
		Common Tern	273			
		Wilson's Storm-Petrel	213			
		Whimbrel	49			
		Cory's Shearwater	36			

Table C-2 (*continued*). Summary of monthly effort and sample sizes of the five most abundant species/groups, January 2008-November 2009.

Month	2008			2009		
	Effort (hrs.)	Species	n	Effort (hrs.)	Species	n
August	54.68	Wilson's Storm-Petrel	1245	63.00	Laughing Gull	440
		Laughing Gull	1110		Wilson's Storm-Petrel	322
		Common Tern	716		Great Black-backed Gull	111
		Great Black-backed Gull	131		Common Tern	105
		Small terns	78		Cory's Shearwater	55
September	56.48	Laughing Gull	415	54.20	Wilson's Storm-Petrel	248
		Common Tern	355		Laughing Gull	213
		Great Black-backed Gull	301		Herring Gull	120
		Herring Gull	172		Great Black-backed Gull	116
		Small terns	73		Common Tern	68
October	51.73	Double-crested Cormorant	1004	41.04	Laughing Gull	848
		Northern Gannet	813		Great Black-backed Gull	235
		Laughing Gull	777		Herring Gull	126
		Forster's Tern	419		Forster's Tern	112
		Great Black-backed Gull	262		Brown Pelican	37
November	38.22	Scoters[2]	3353	40.59	Northern Gannet	2358
		Northern Gannet	2380		Scoters	637
		Laughing Gull	1337		Red-throated Loon	449
		Red-throated Loon	646		Herring Gull	383
		Bonaparte's Gull	643		Bonaparte's Gull	228
December	27.39	Scoters	3557	21.89	Scoters	1264
		Northern Gannet	369		Long-tailed Duck	392
		Red-throated Loon	332		Northern Gannet	322
		Long-tailed Duck	330		Common Loon	260
		Bonaparte's Gull	187		Herring Gull	243

[1] February 2008 and December 2009 effort was considered too inconsequential to provide meaningful data; no effort was scheduled for July 2009.

[2] In November 2008, Surf and Black scoters were also listed among the Top 5, but as the "Scoters" entry was for all scoters, including Surf and Black, those two species were eliminated from this table as duplicative.

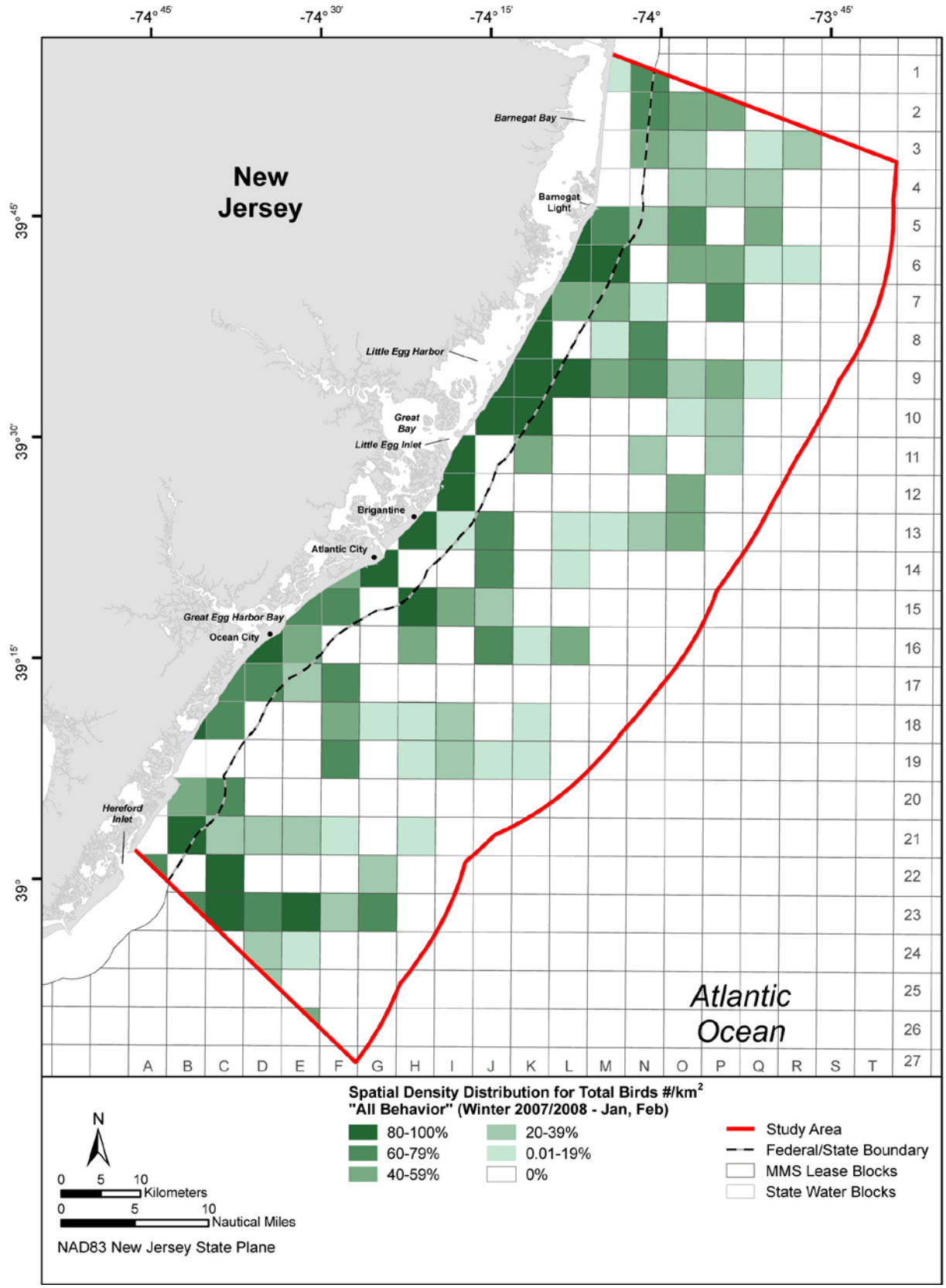

Figure C-1. Percentile abundance of all birds (all behaviors), Winter 2008 (January-February 2008) (n=2,565).

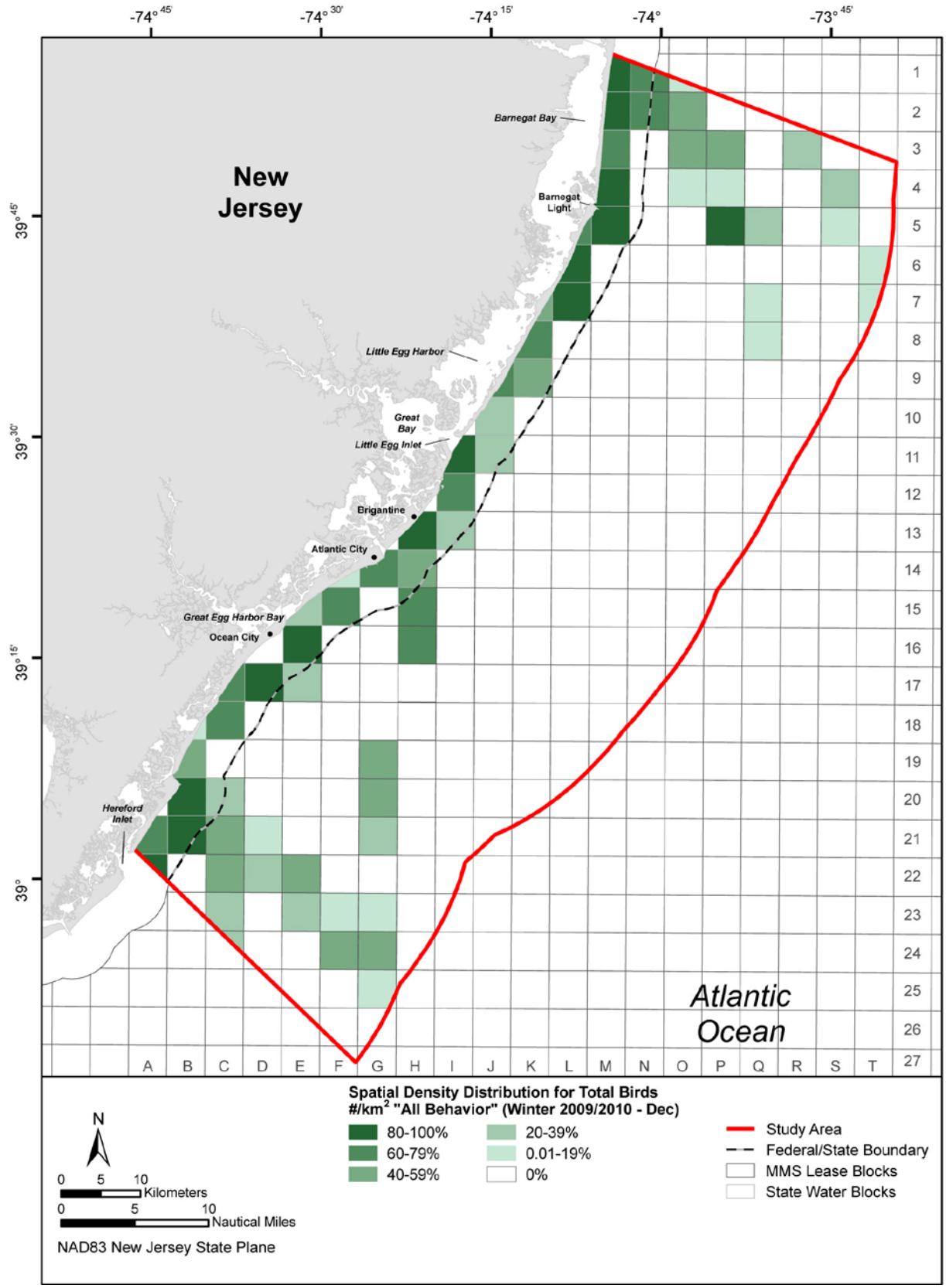

Figure C-2. Percentile abundance of all birds (all behaviors), Winter 2010 (December 2009) (n=2,743).

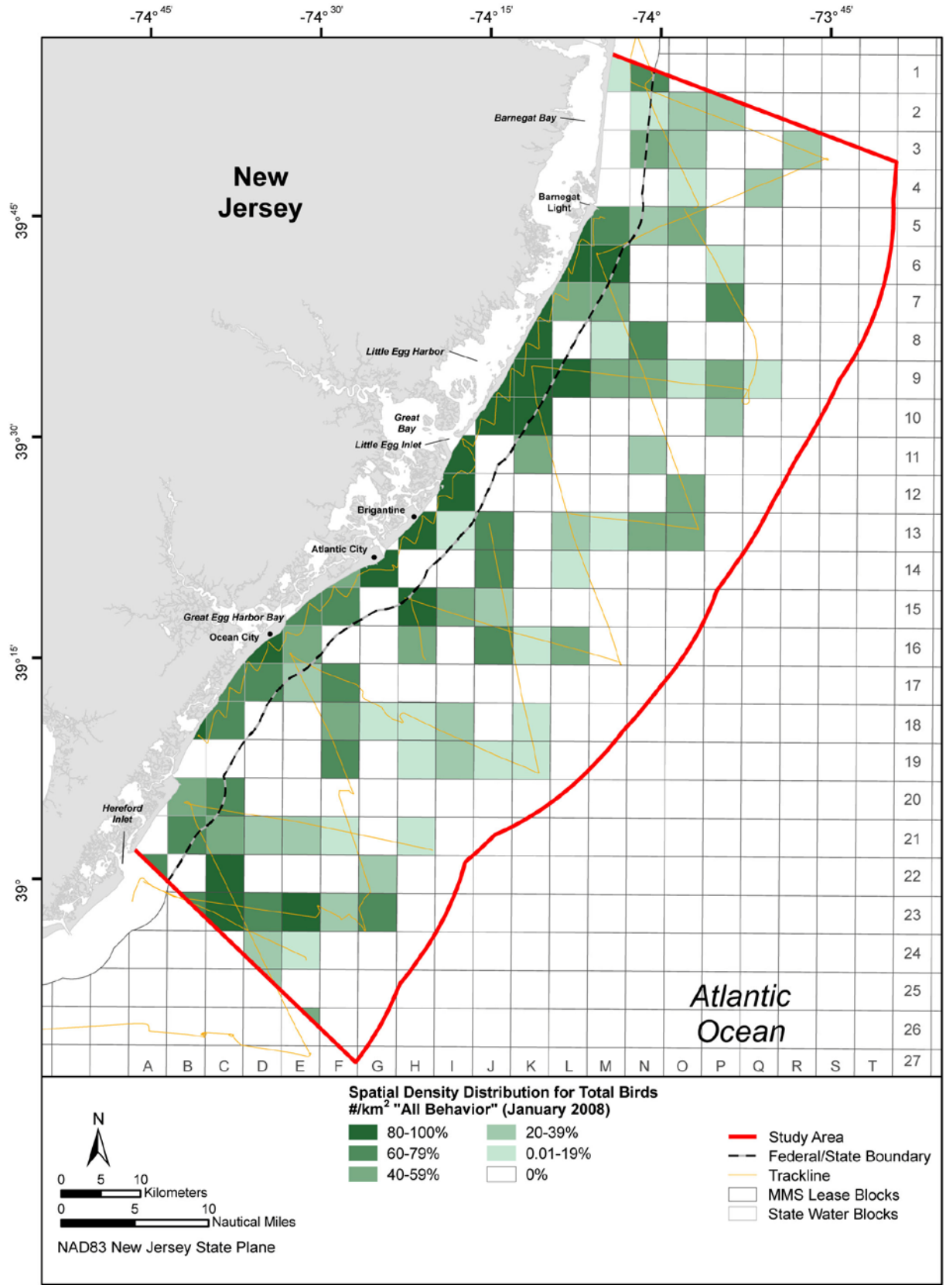

Figure C-3. Percentile abundance of all birds (all behaviors), January 2008 (n=2,435).

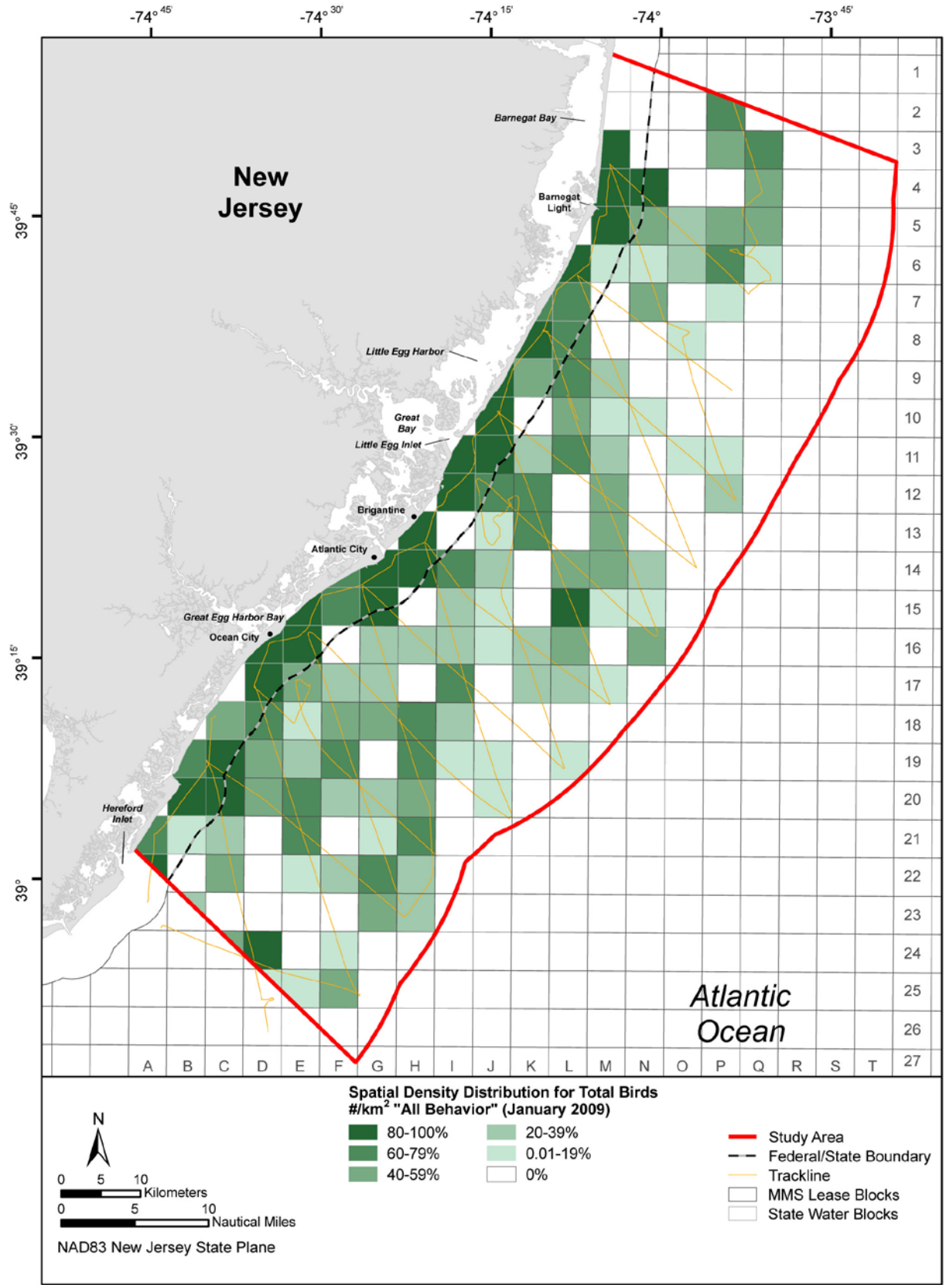

Figure C-4. Percentile abundance of all birds (all behaviors), January 2009 (n=7,326).

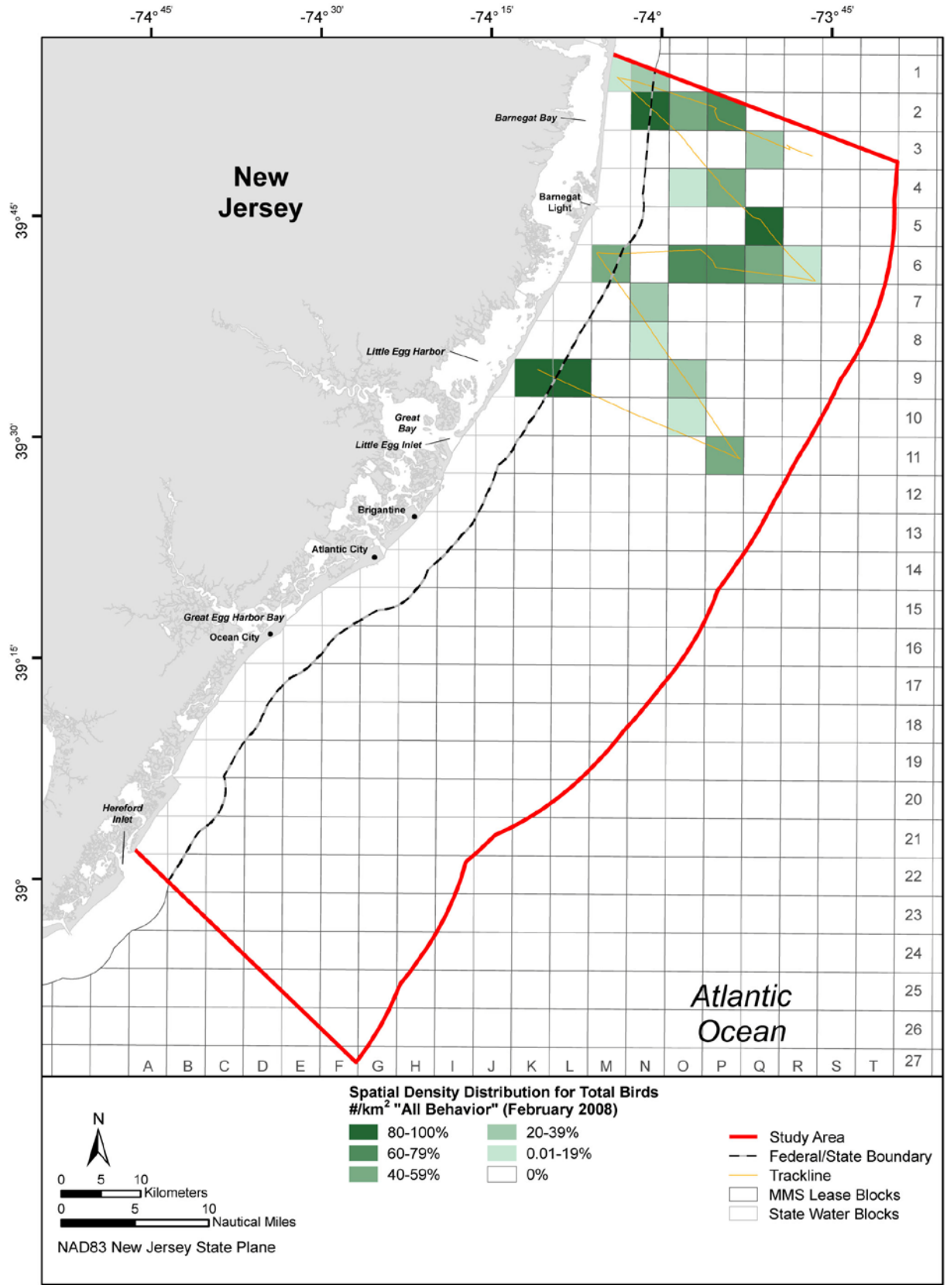

Figure C-5. Percentile abundance of all birds (all behaviors), February 2008 (n=130).

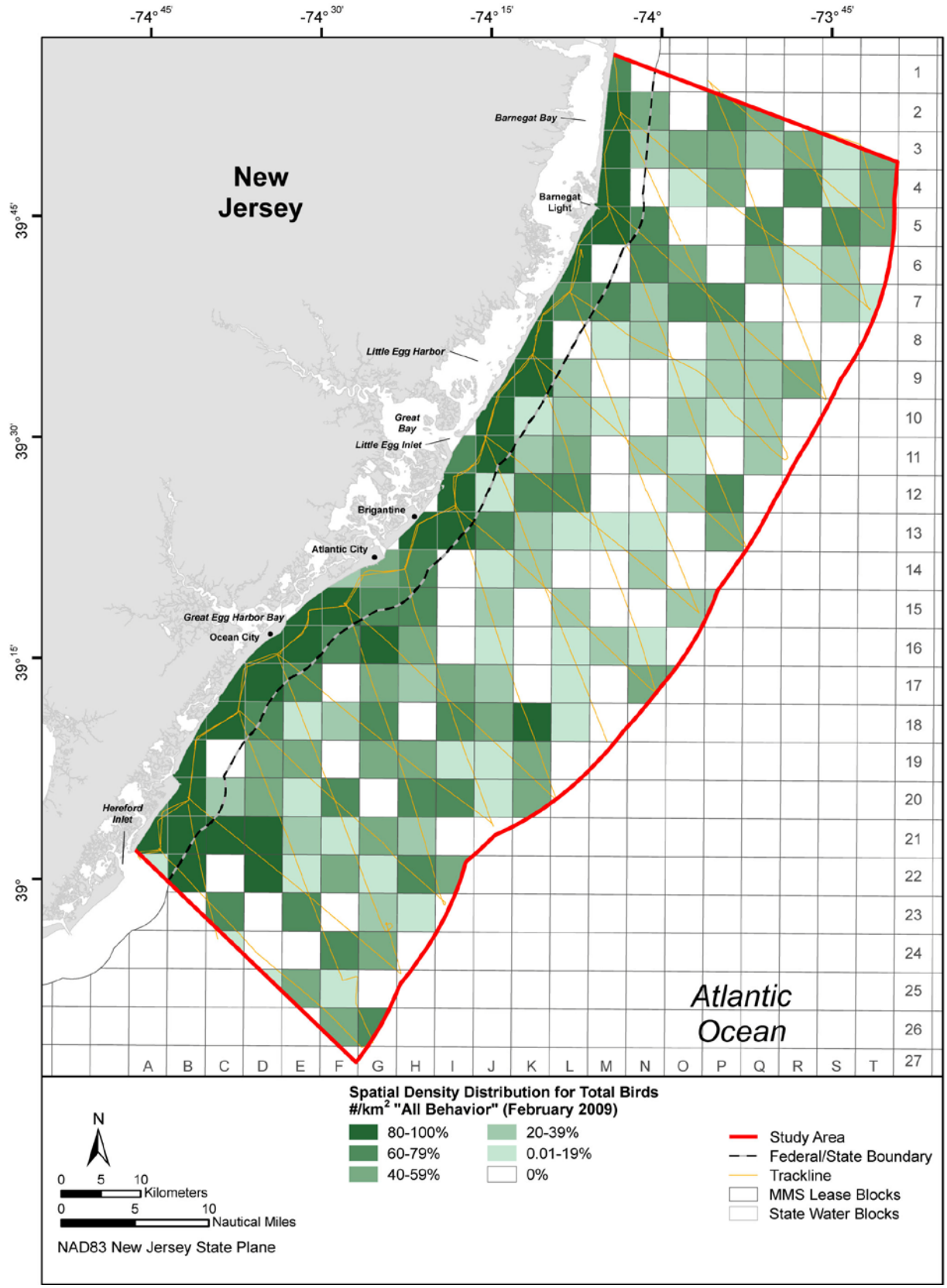

Figure C-6. Percentile abundance of all birds (all behaviors), February 2009 (n=5,321).

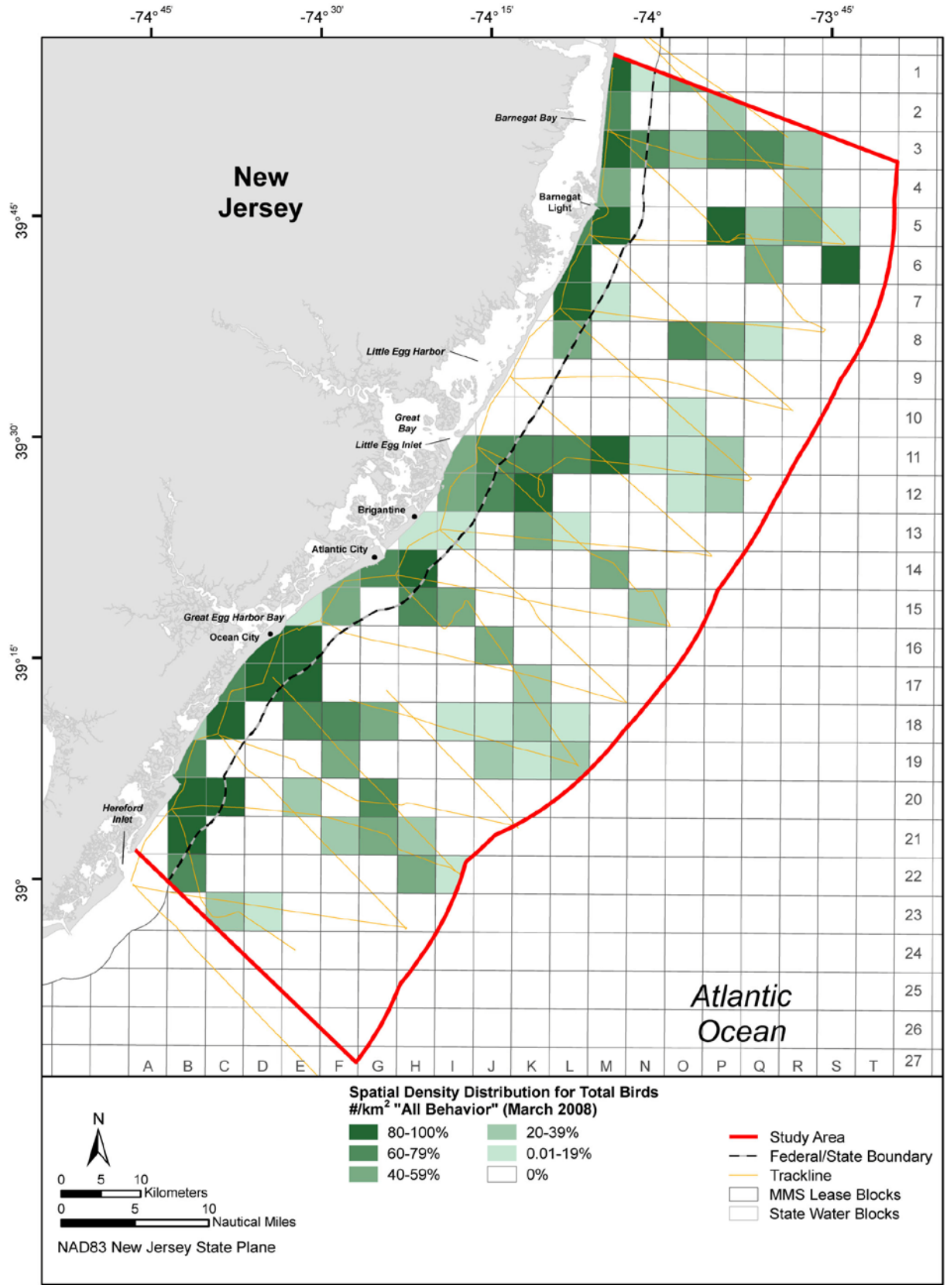

Figure C-7. Percentile abundance of all birds (all behaviors), March 2008 (n=1,457).

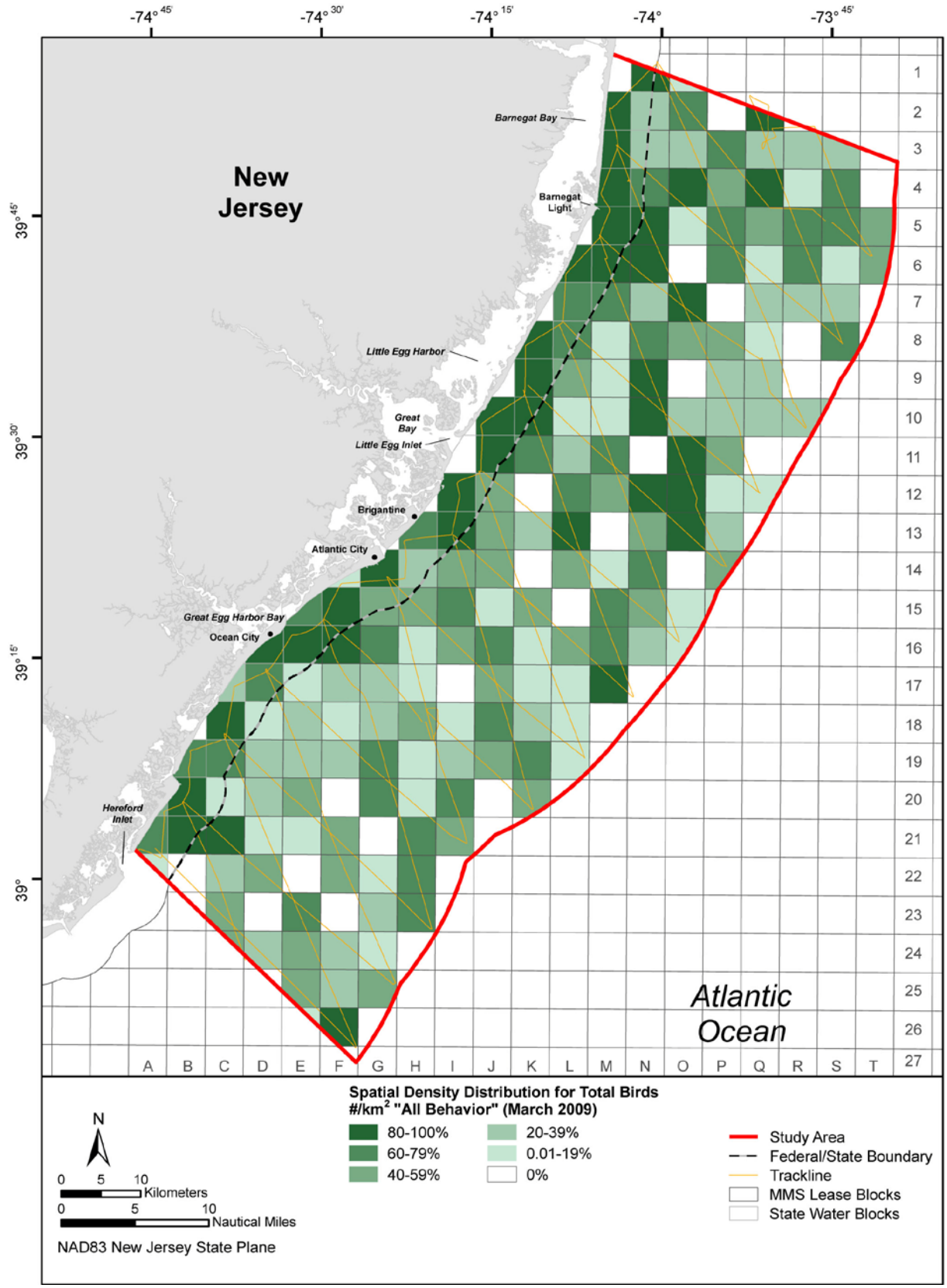

Figure C-8. Percentile abundance of all birds (all behaviors), March 2009 (n=4,241).

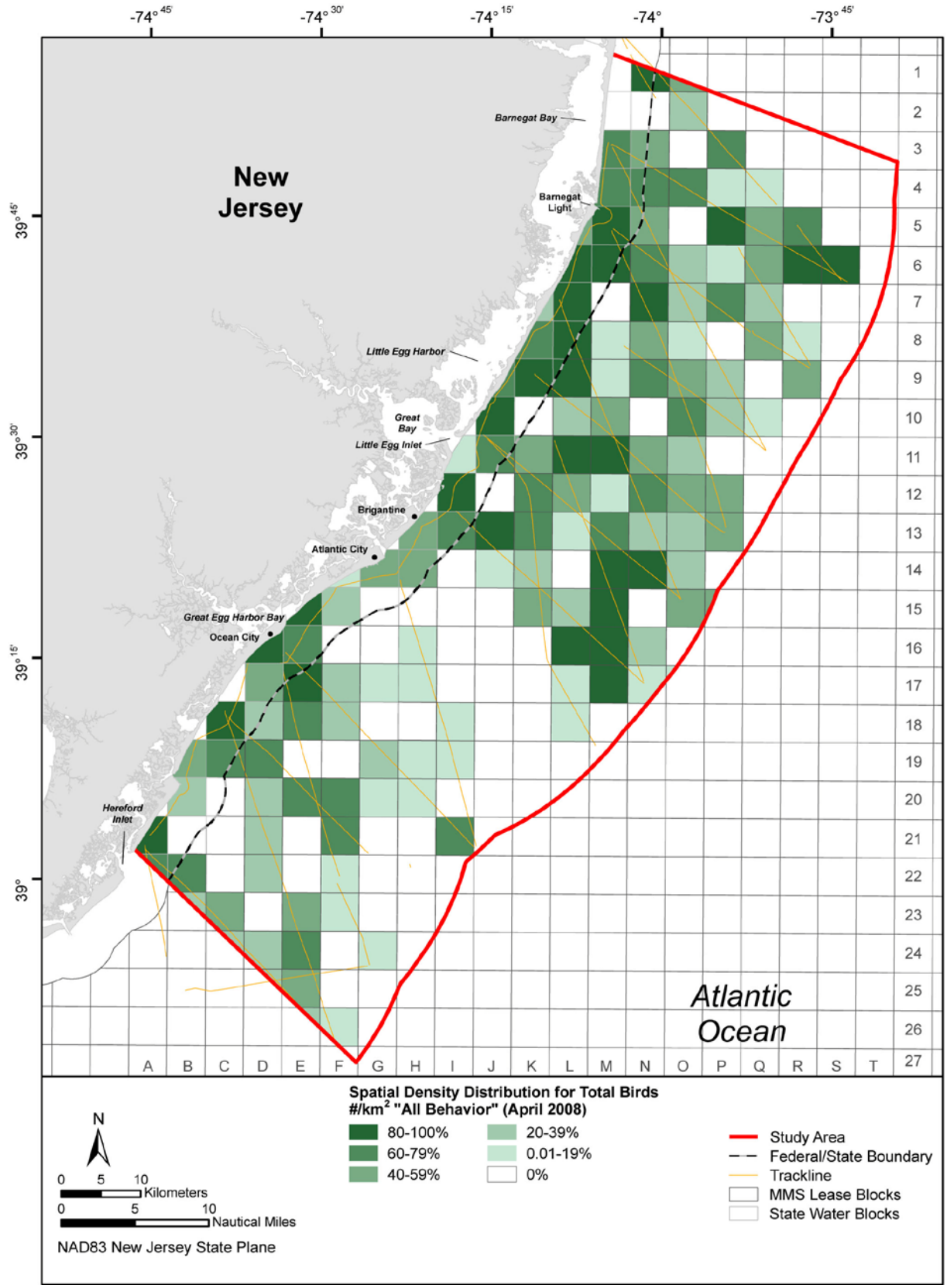

Figure C-9. Percentile abundance of all birds (all behaviors), April 2008 (n=2,183).

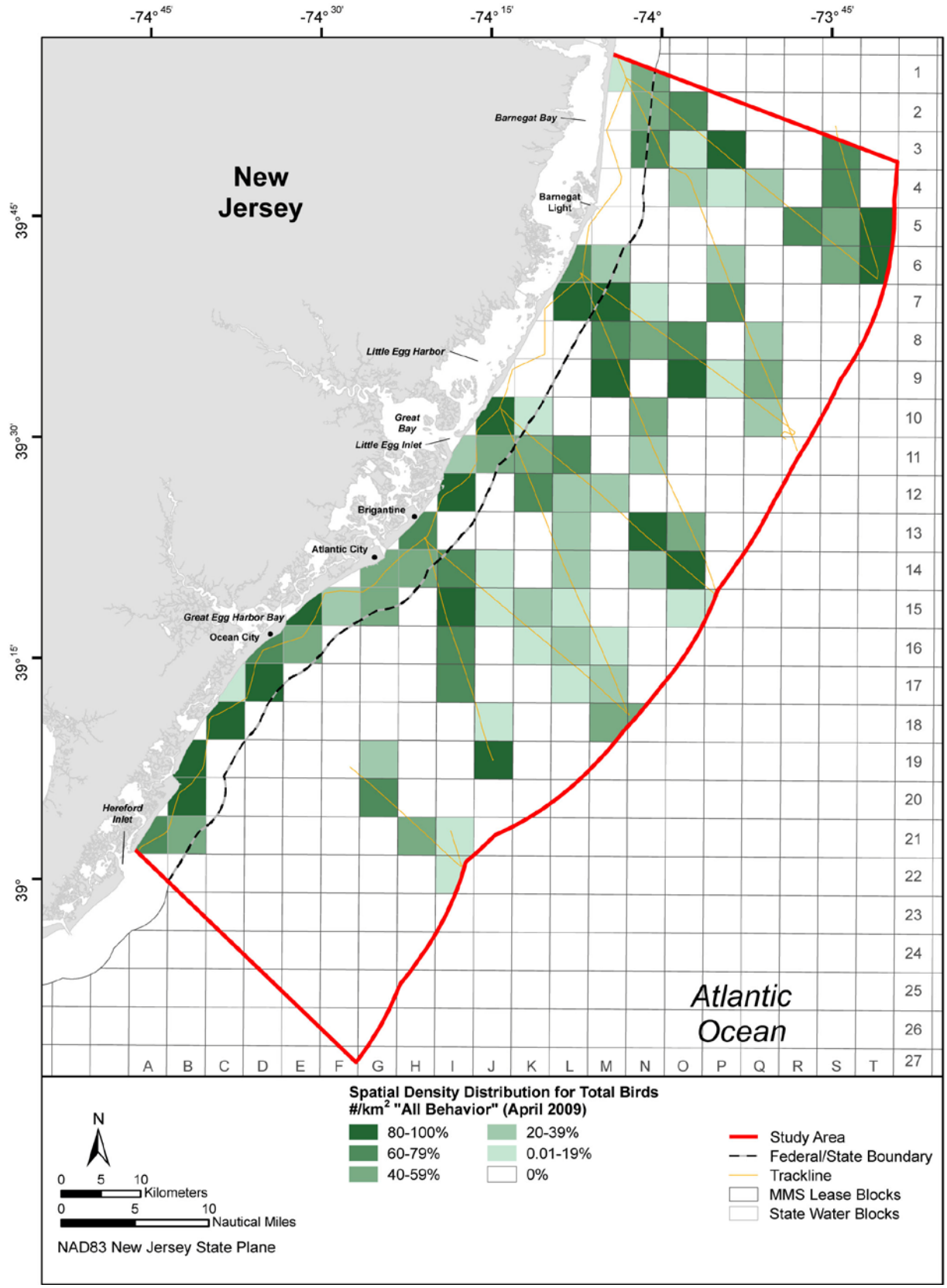

Figure C-10. Percentile abundance of all birds (all behaviors), April 2009 (n=793).

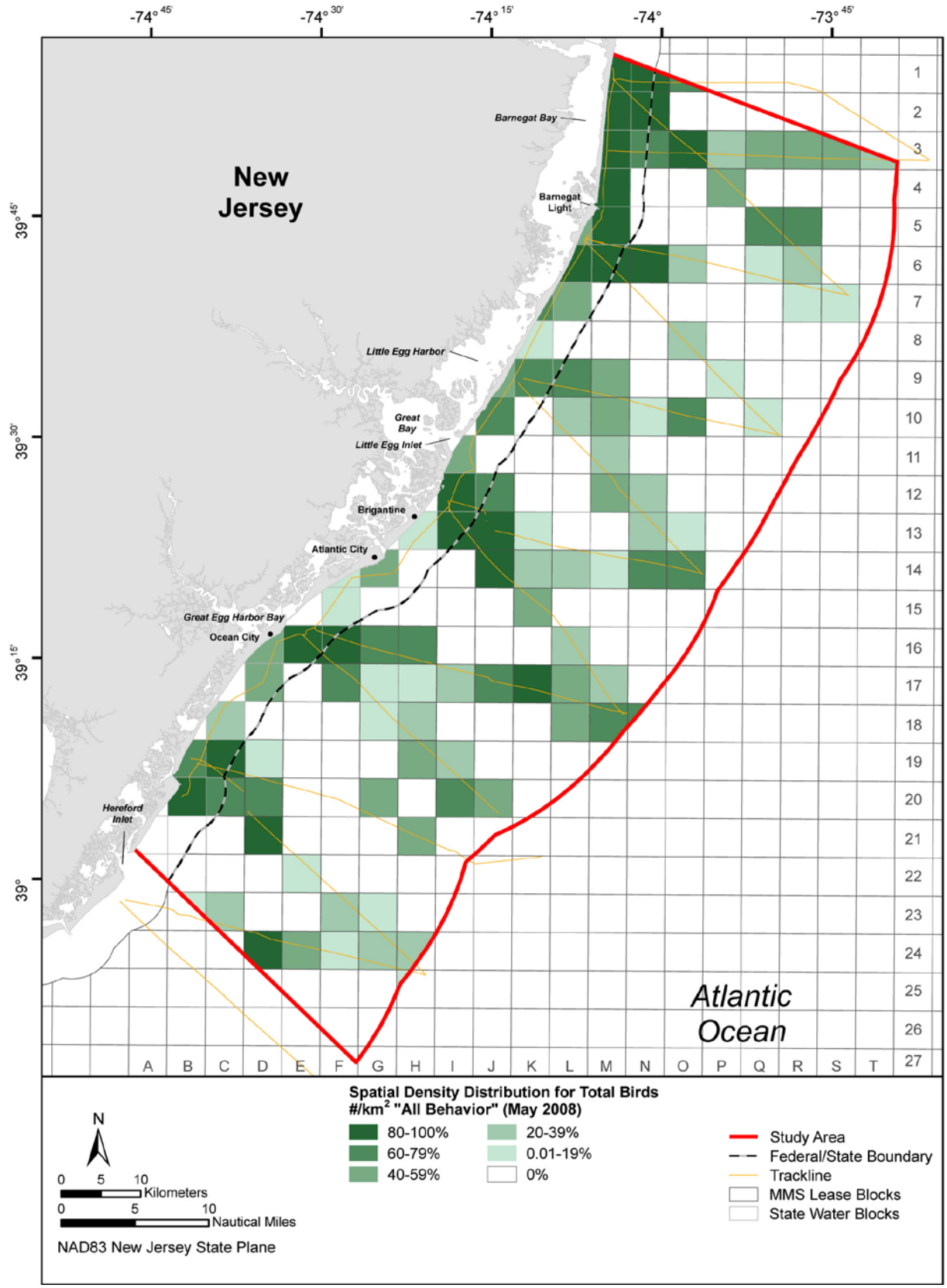

Figure C-11. Percentile abundance of all birds (all behaviors), May 2008 (n=853).

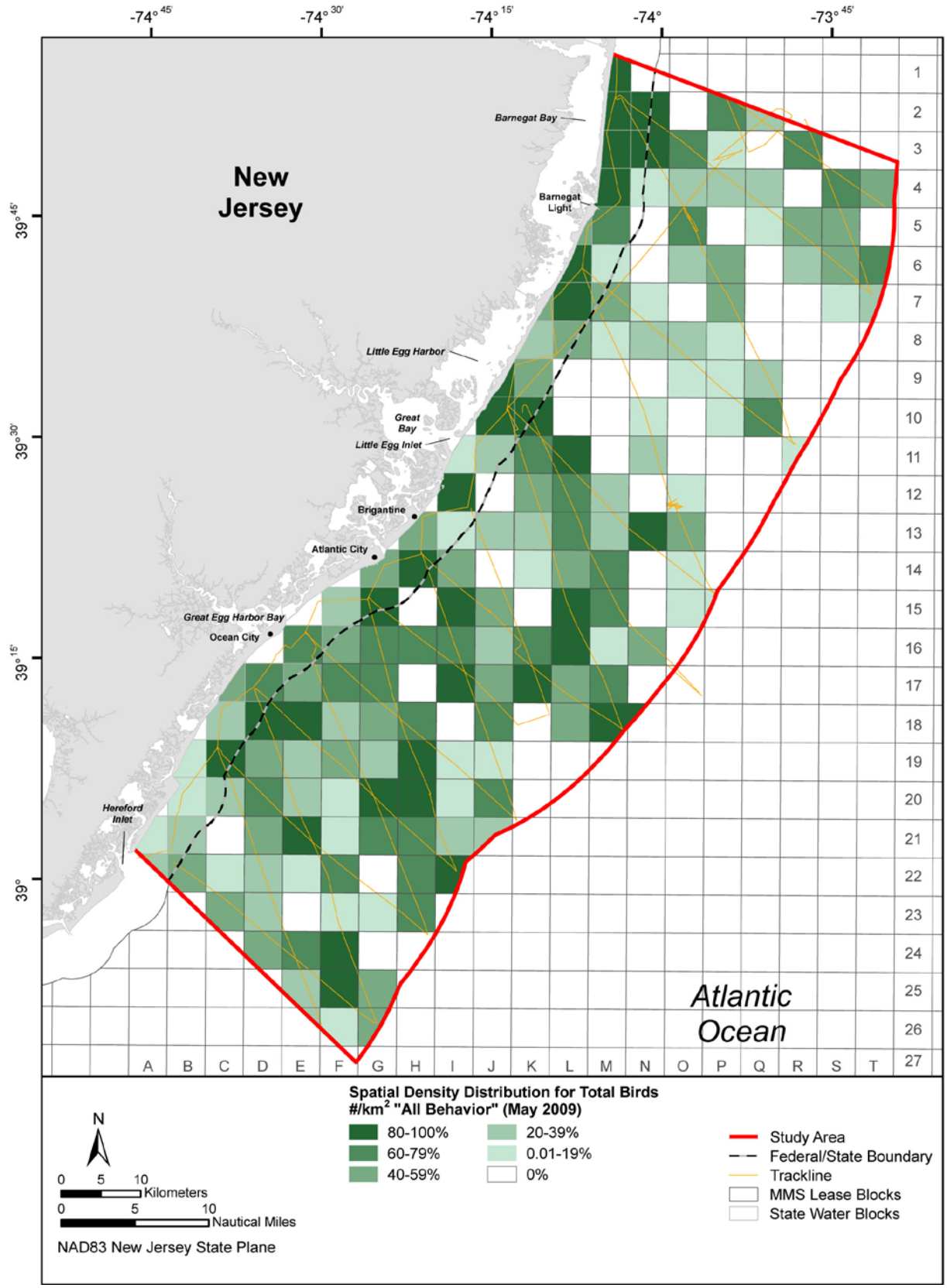

Figure C-12. Percentile abundance of all birds (all behaviors), May 2009 (n=2,184).

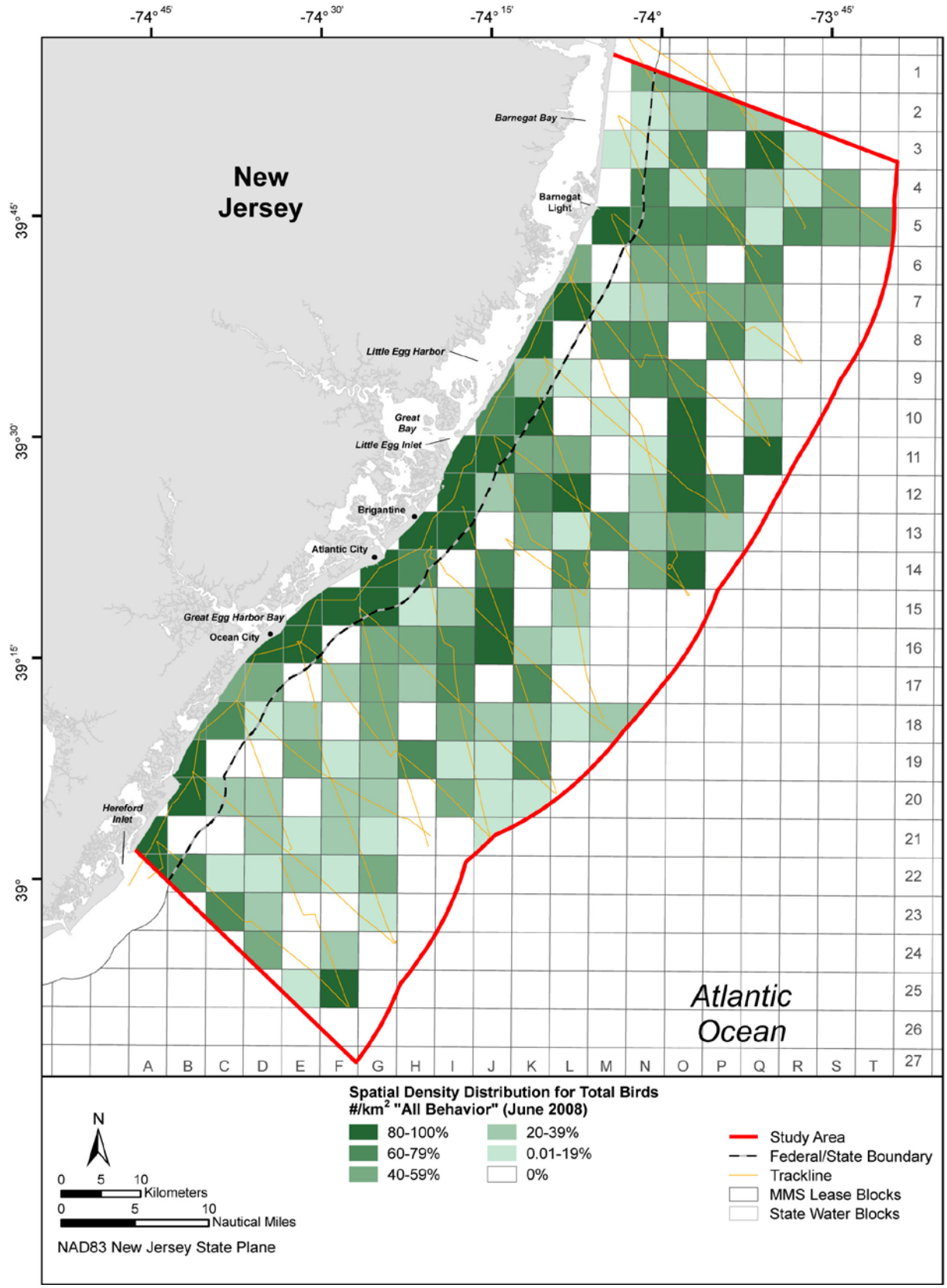

Figure C-13. Percentile abundance of all birds (all behaviors), June 2008 (n=1,004).

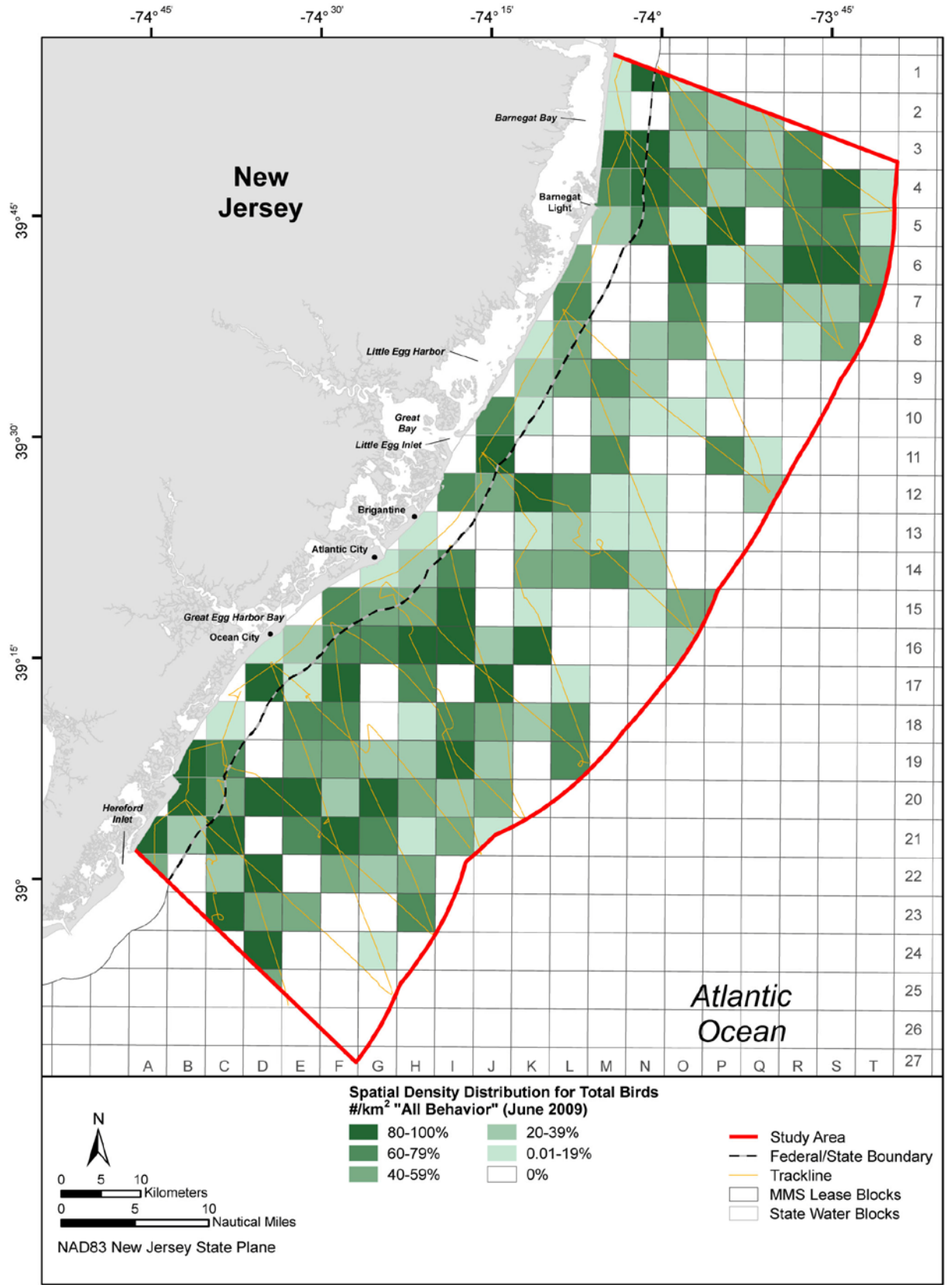

Figure C-14. Percentile abundance of all birds (all behaviors), June 2009 (n=1,164).

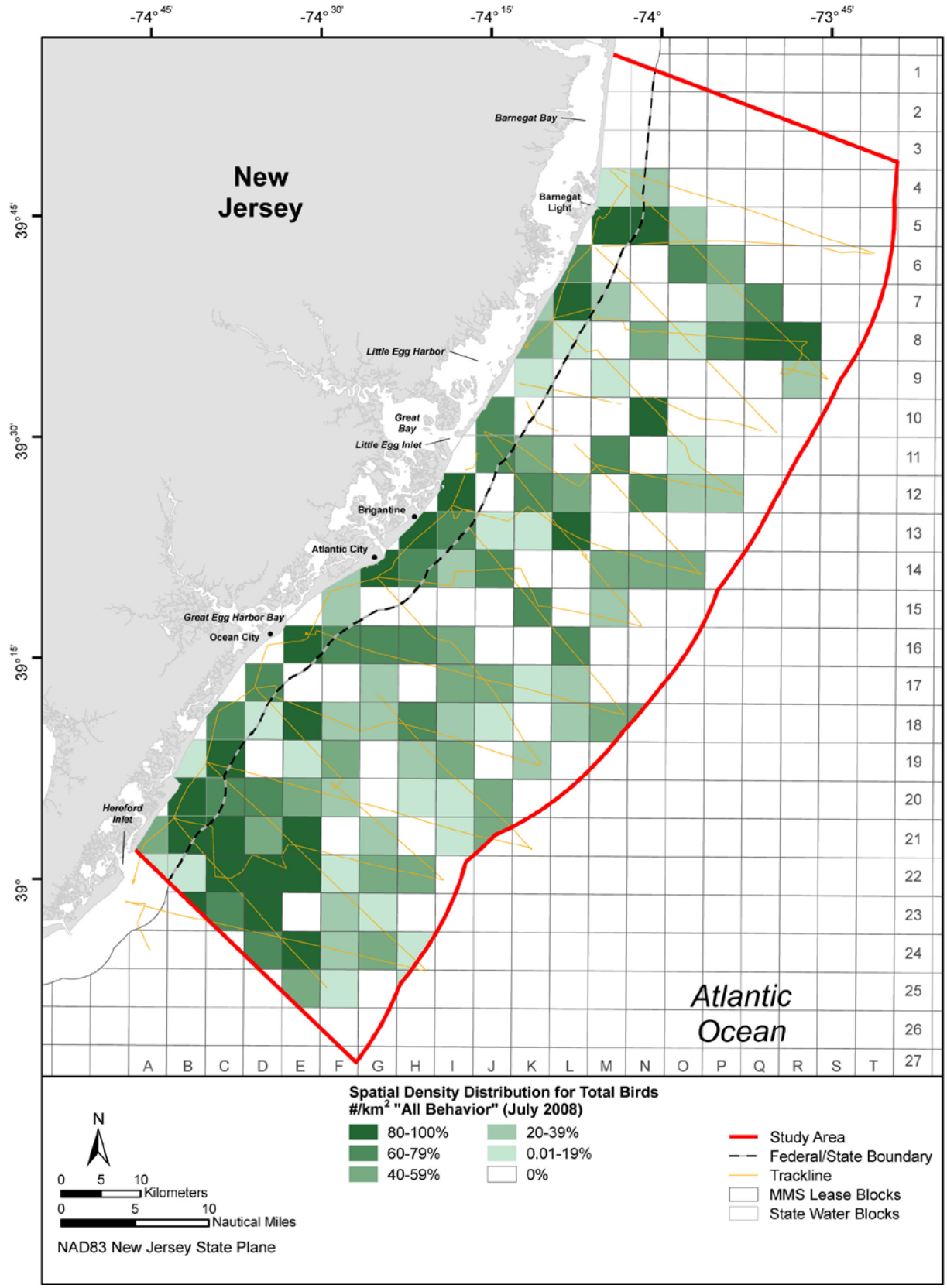

Figure C-15. Percentile abundance of all birds (all behaviors), July 2008 (n=1,062).

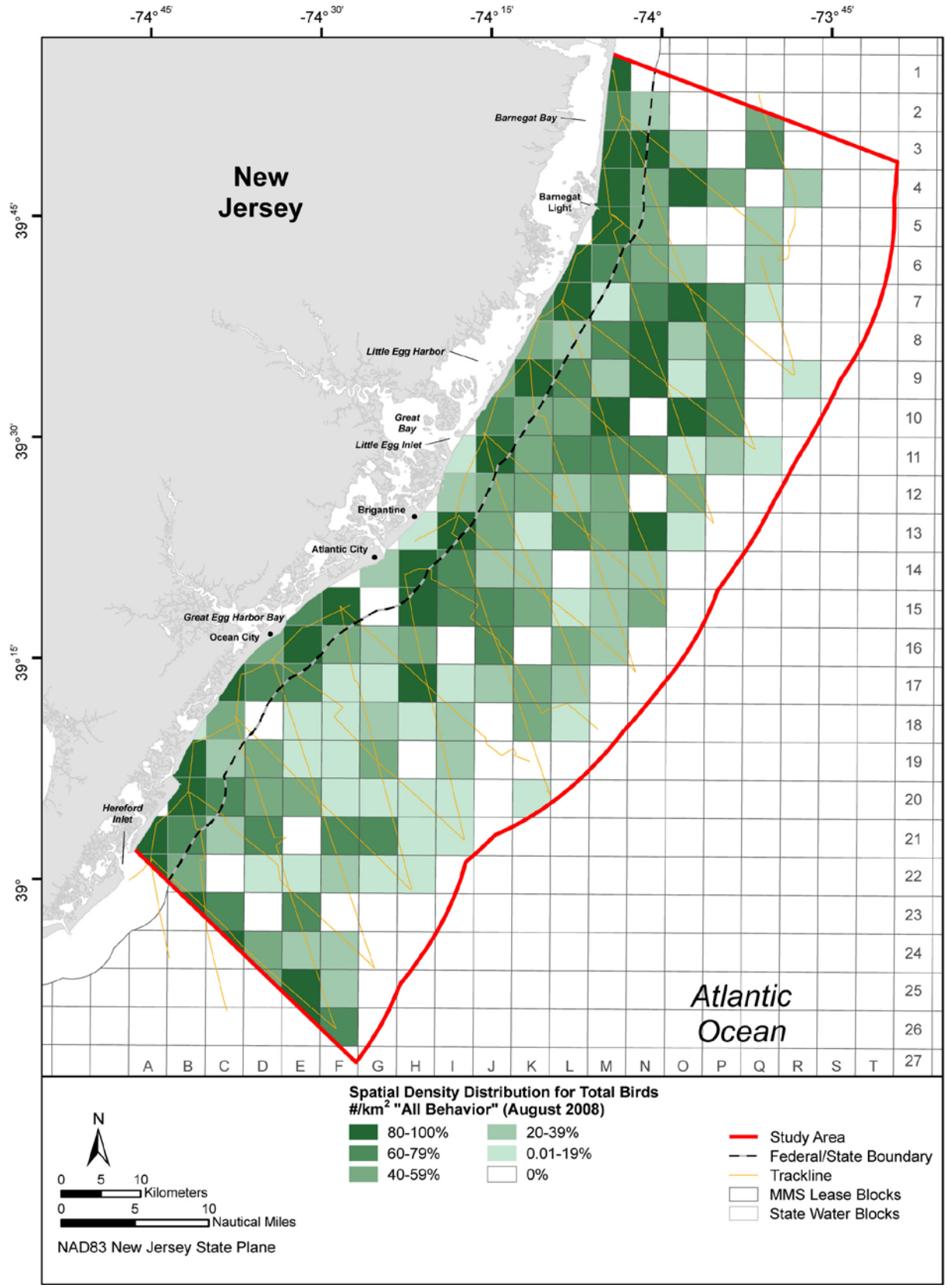

Figure C-16. Percentile abundance of all birds (all behaviors), August 2008 (n=3,486).

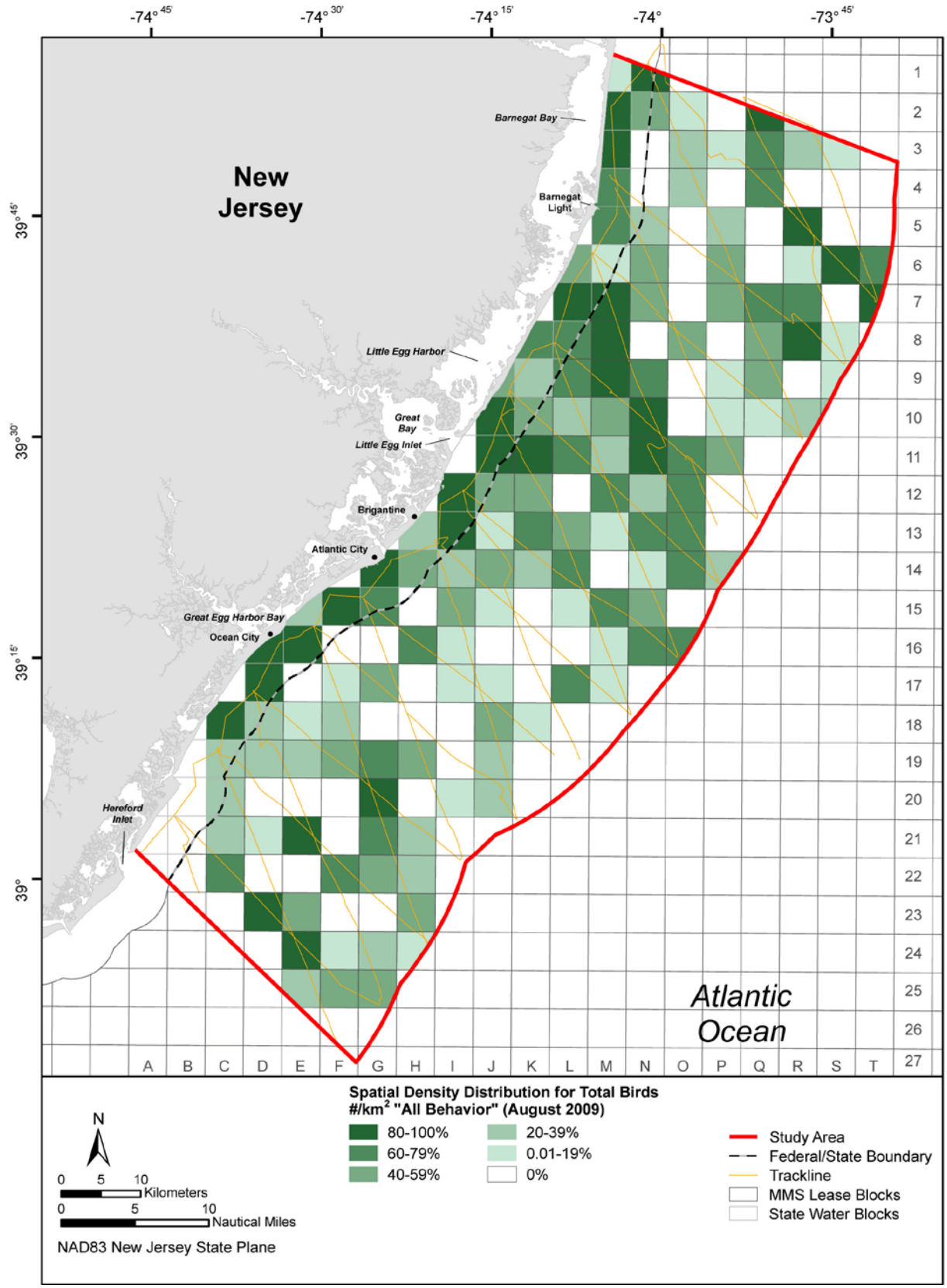

Figure C-17. Percentile abundance of all birds (all behaviors), August 2009 (n=1,151).

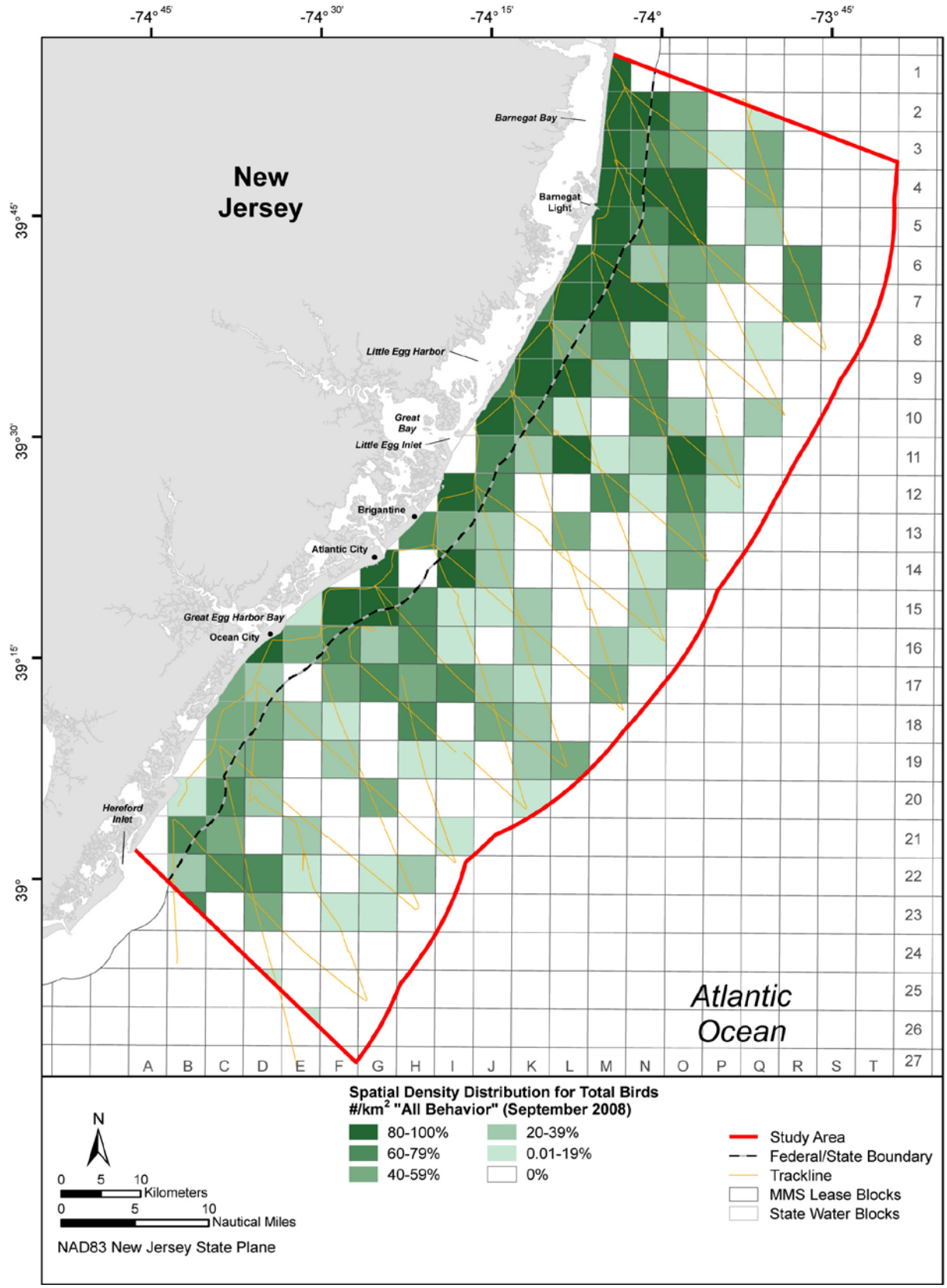

Figure C-18. Percentile abundance of all birds (all behaviors), September 2008 (n=1,553).

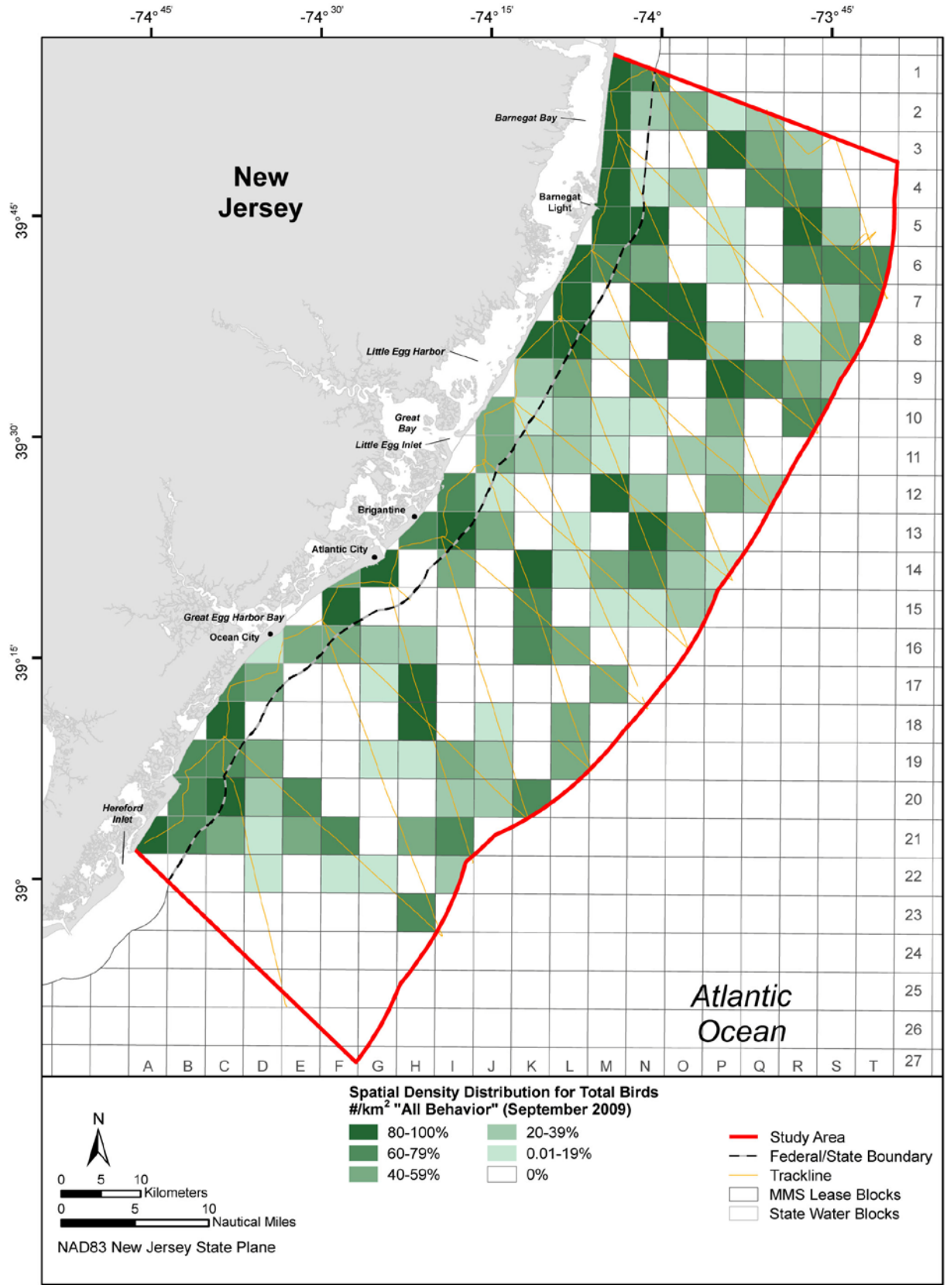

Figure C-19. Percentile abundance of all birds (all behaviors), September 2009 (n=865).

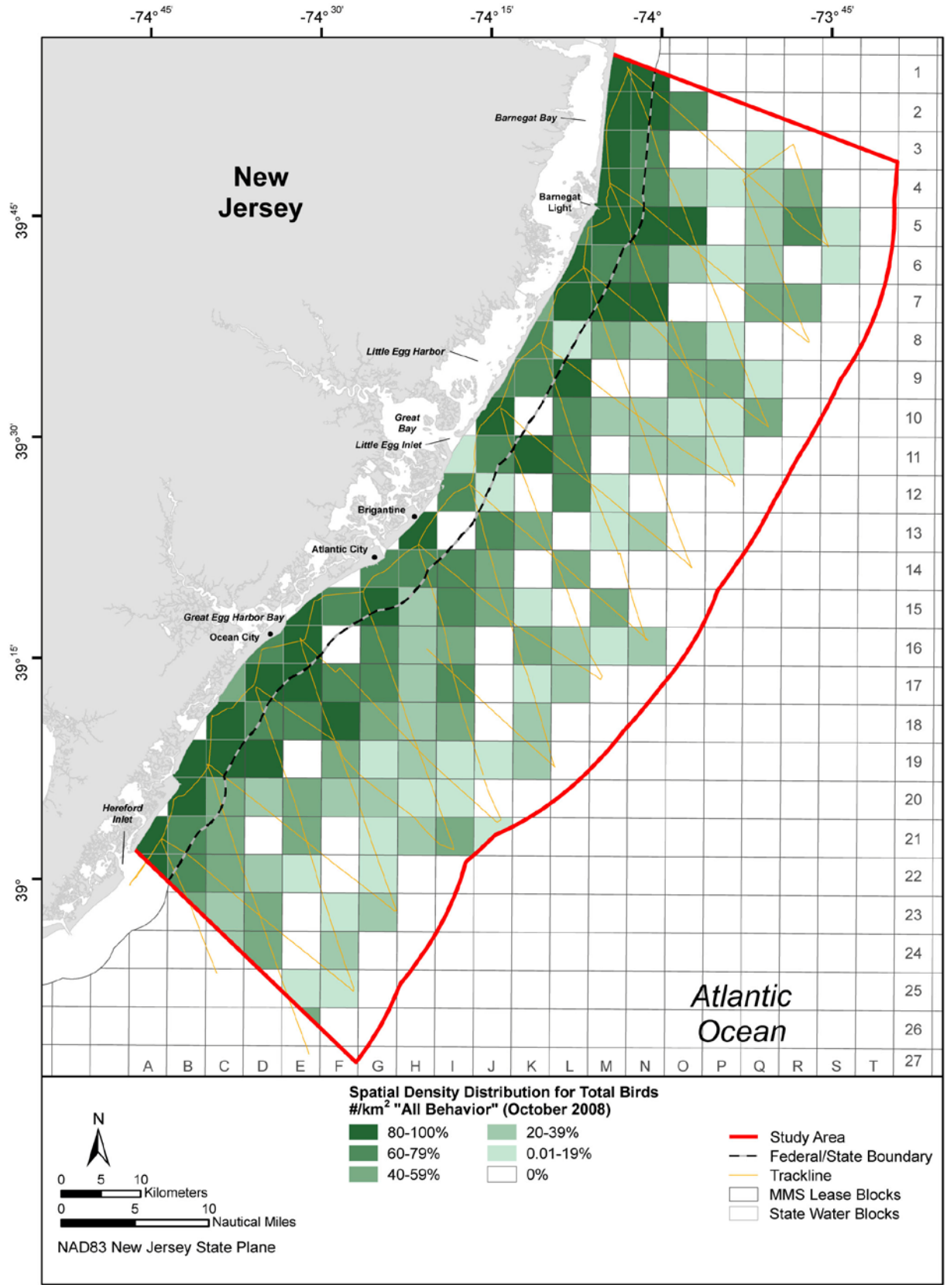

Figure C-20. Percentile abundance of all birds (all behaviors), October 2008 (n=5,178).

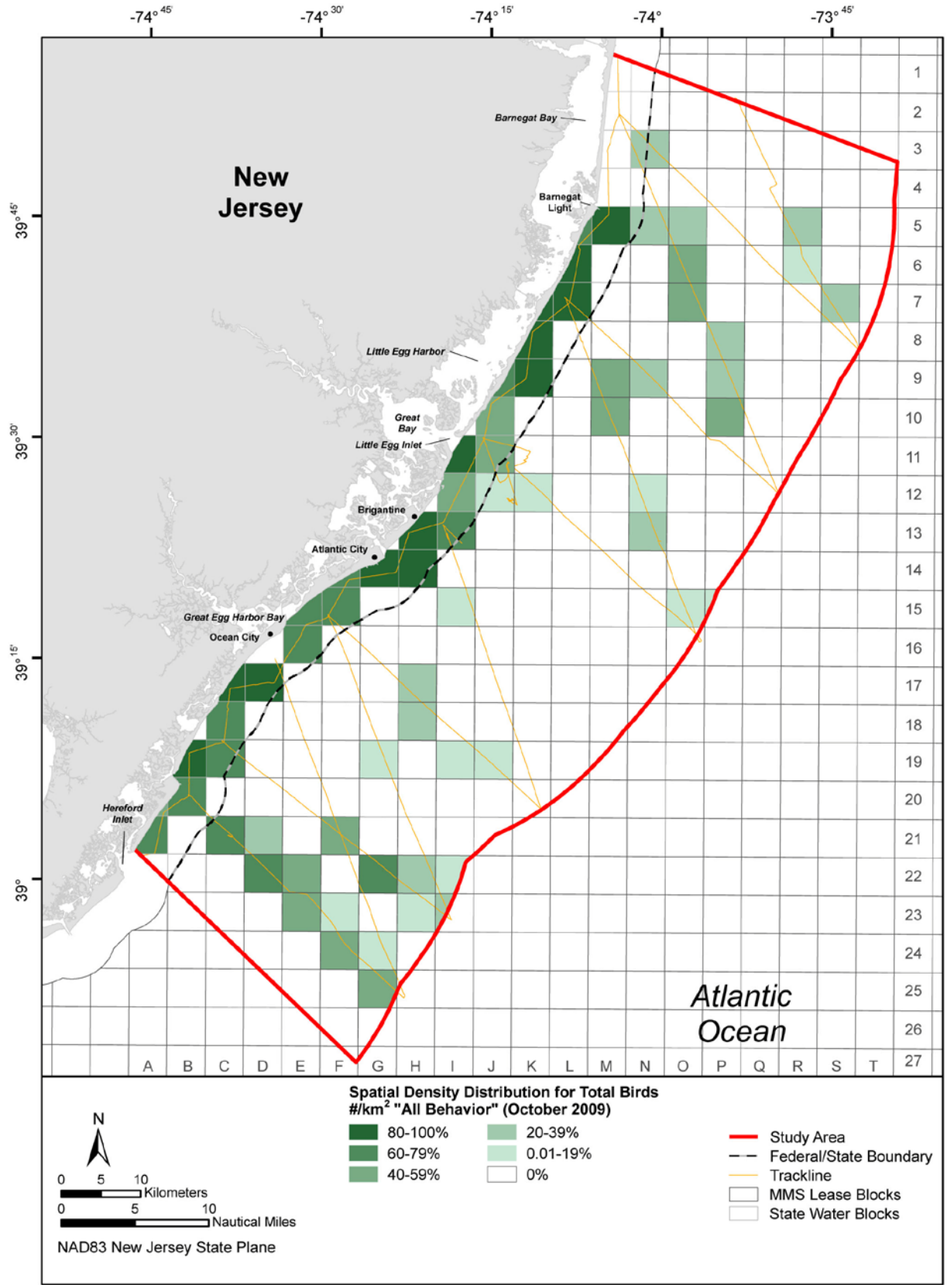

Figure C-21. Percentile abundance of all birds (all behaviors), October 2009 (n=1,401).

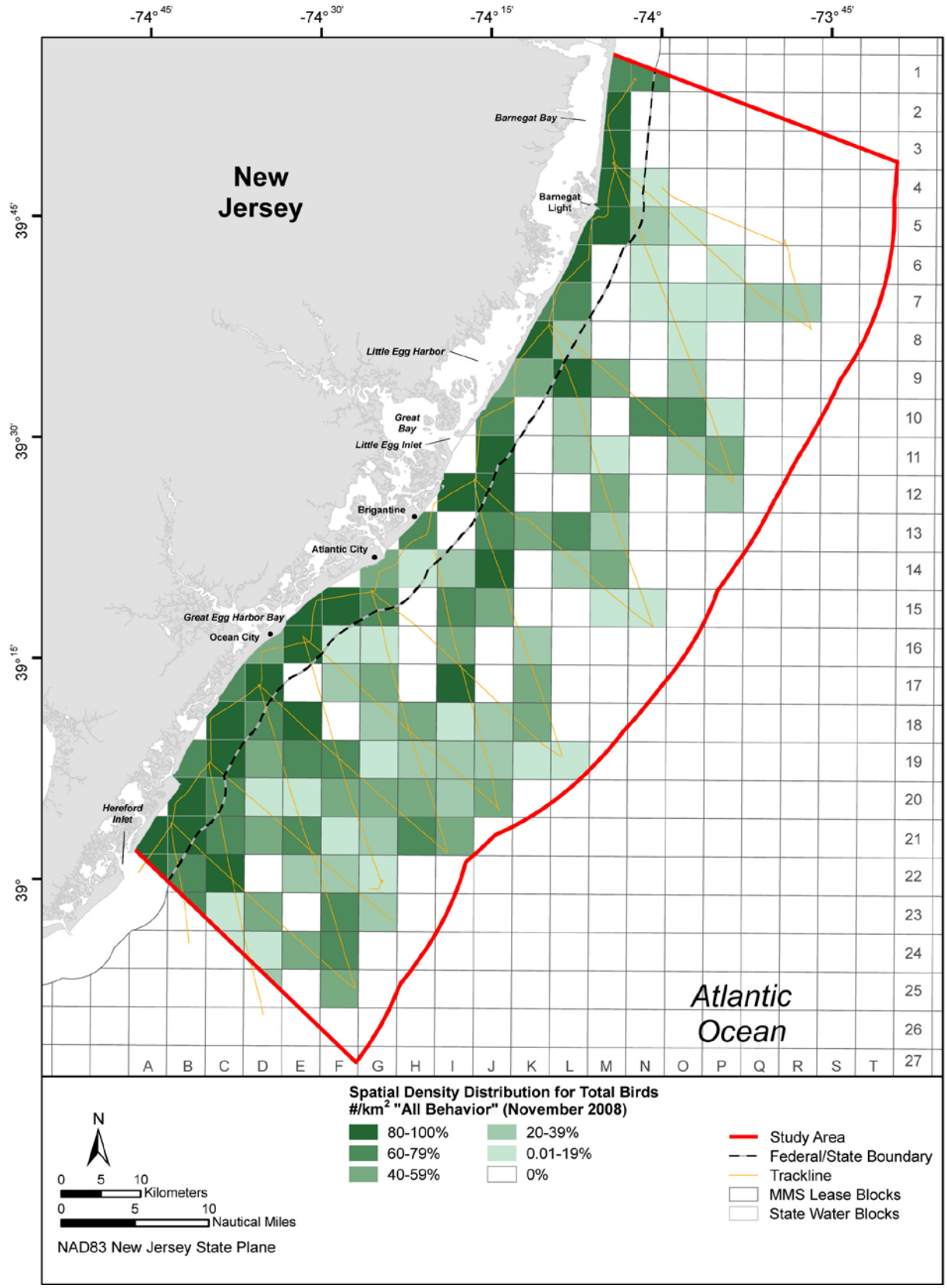

Figure C-22. Percentile abundance of all birds (all behaviors), November 2008 (n=9,847).

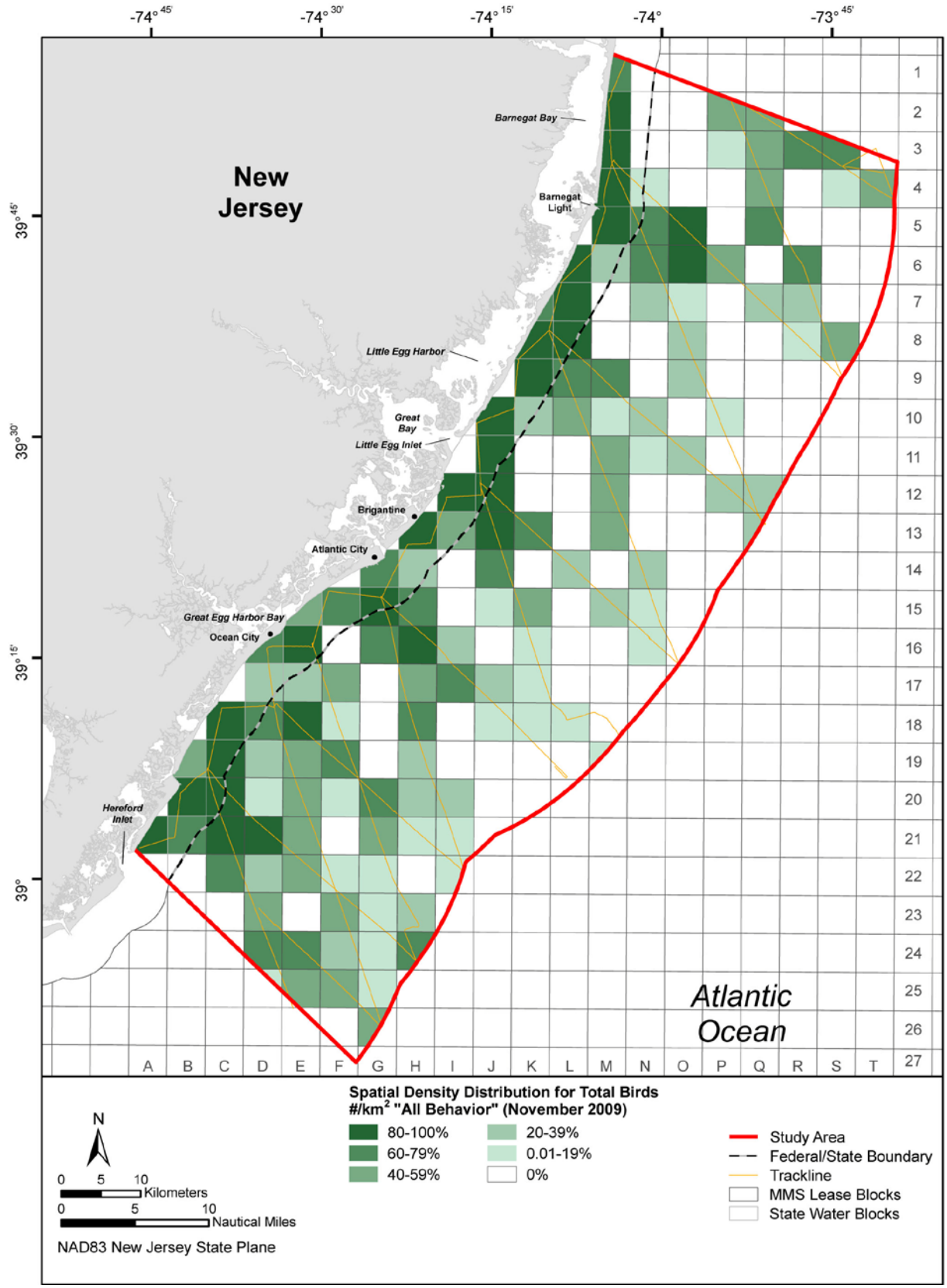

Figure C-23. Percentile abundance of all birds (all behaviors), November 2009 (n=4,750).

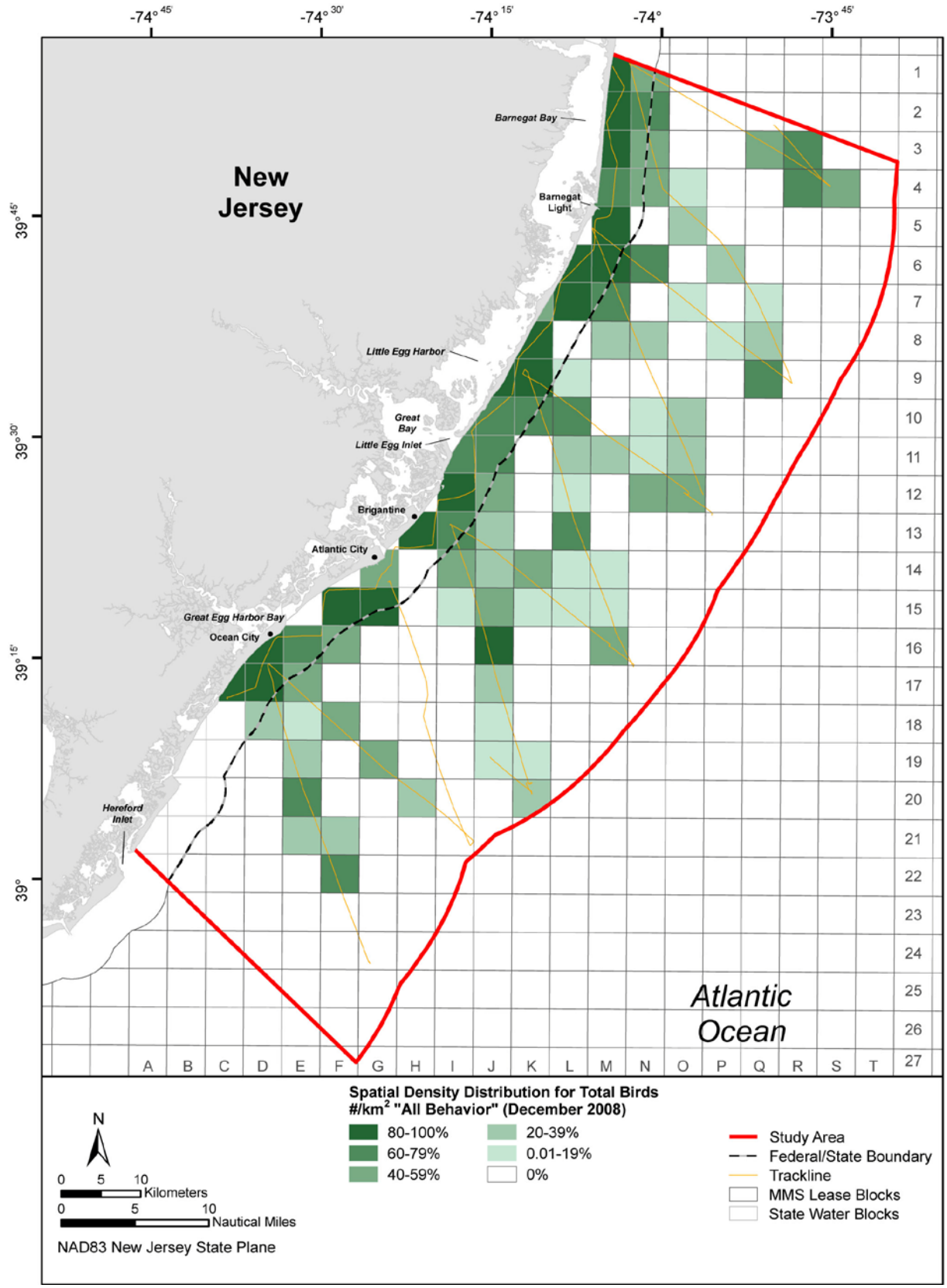

Figure C-24. Percentile abundance of all birds (all behaviors), December 2008 (n=5,248).

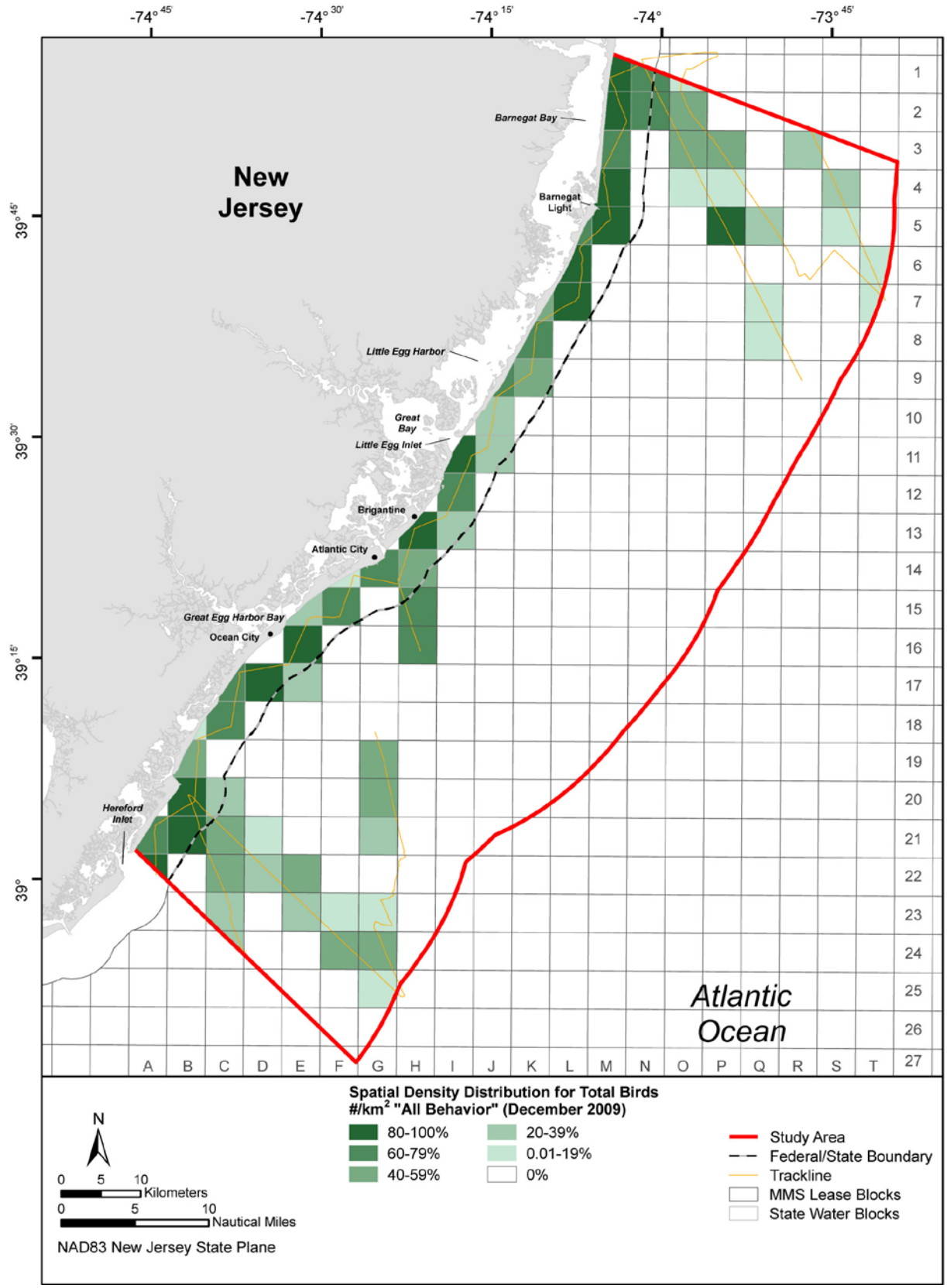

Figure C-25. Percentile abundance of all birds (all behaviors), December 2009 (n=2,743).

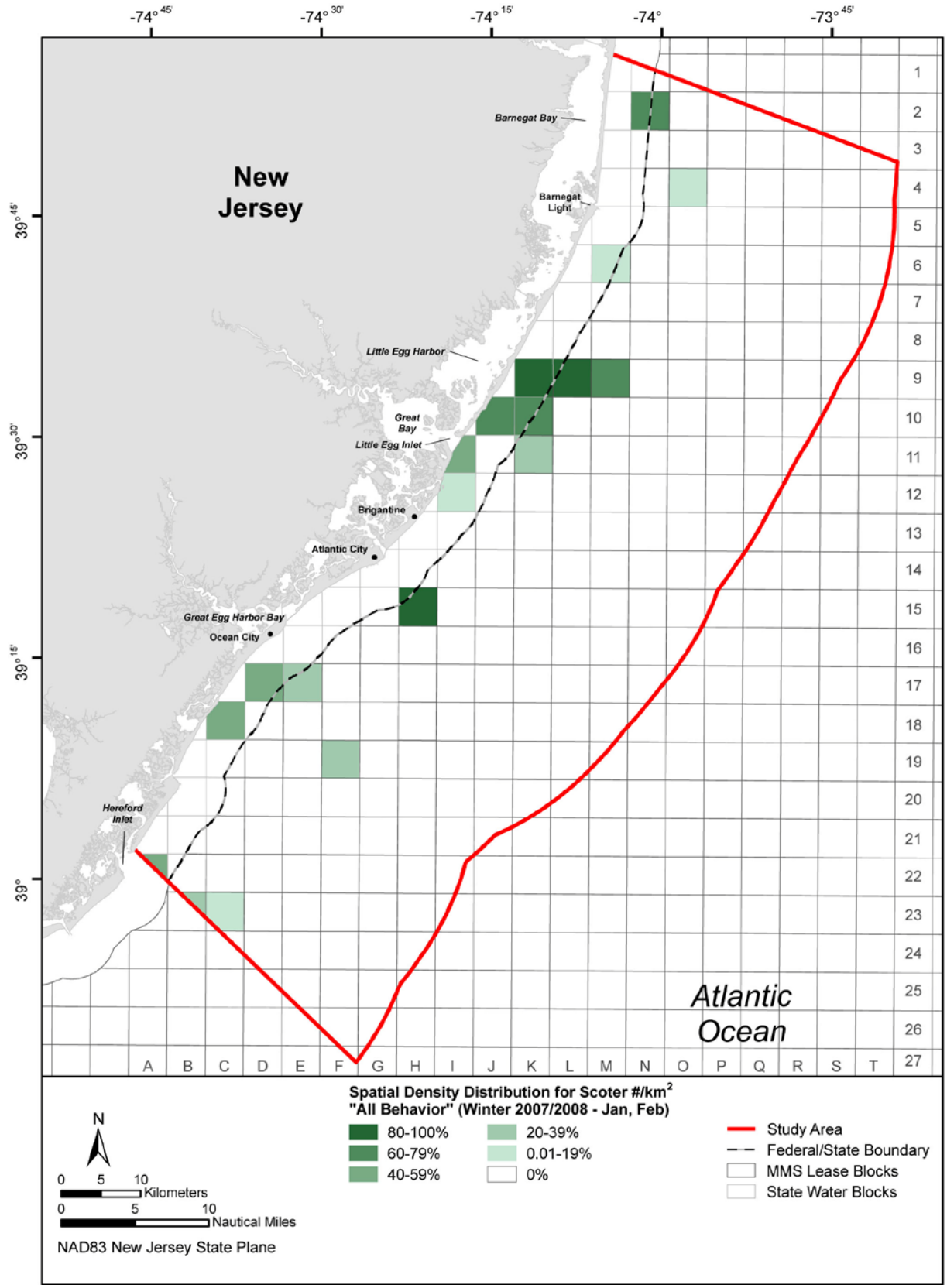

Figure C-26. Percentile abundance of scoters (all behaviors), Winter 2008 (January-February 2008) (n=847).

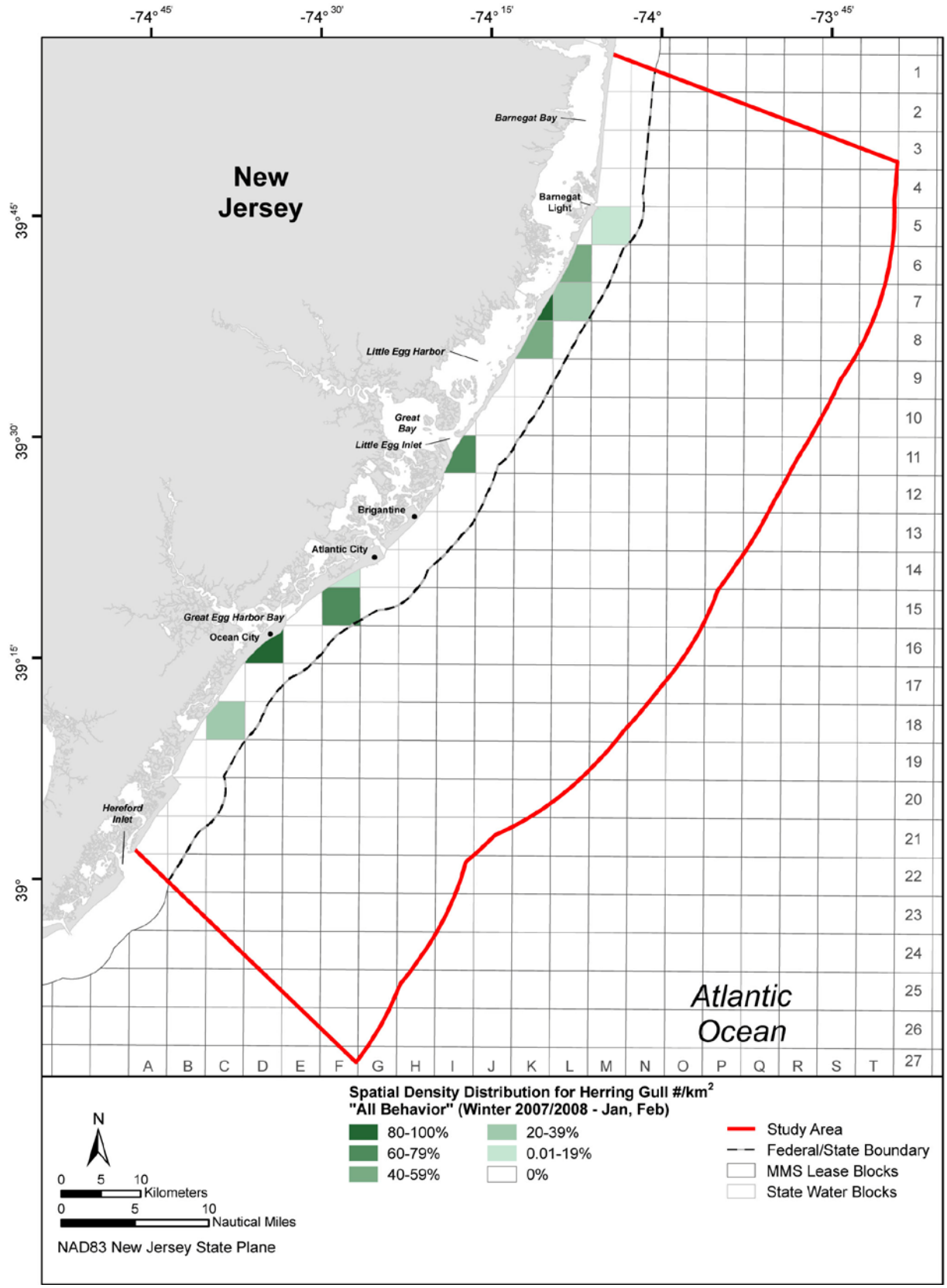

Figure C-27. Percentile abundance of Herring Gull (all behaviors), Winter 2008 (January-February 2008) (n=367).

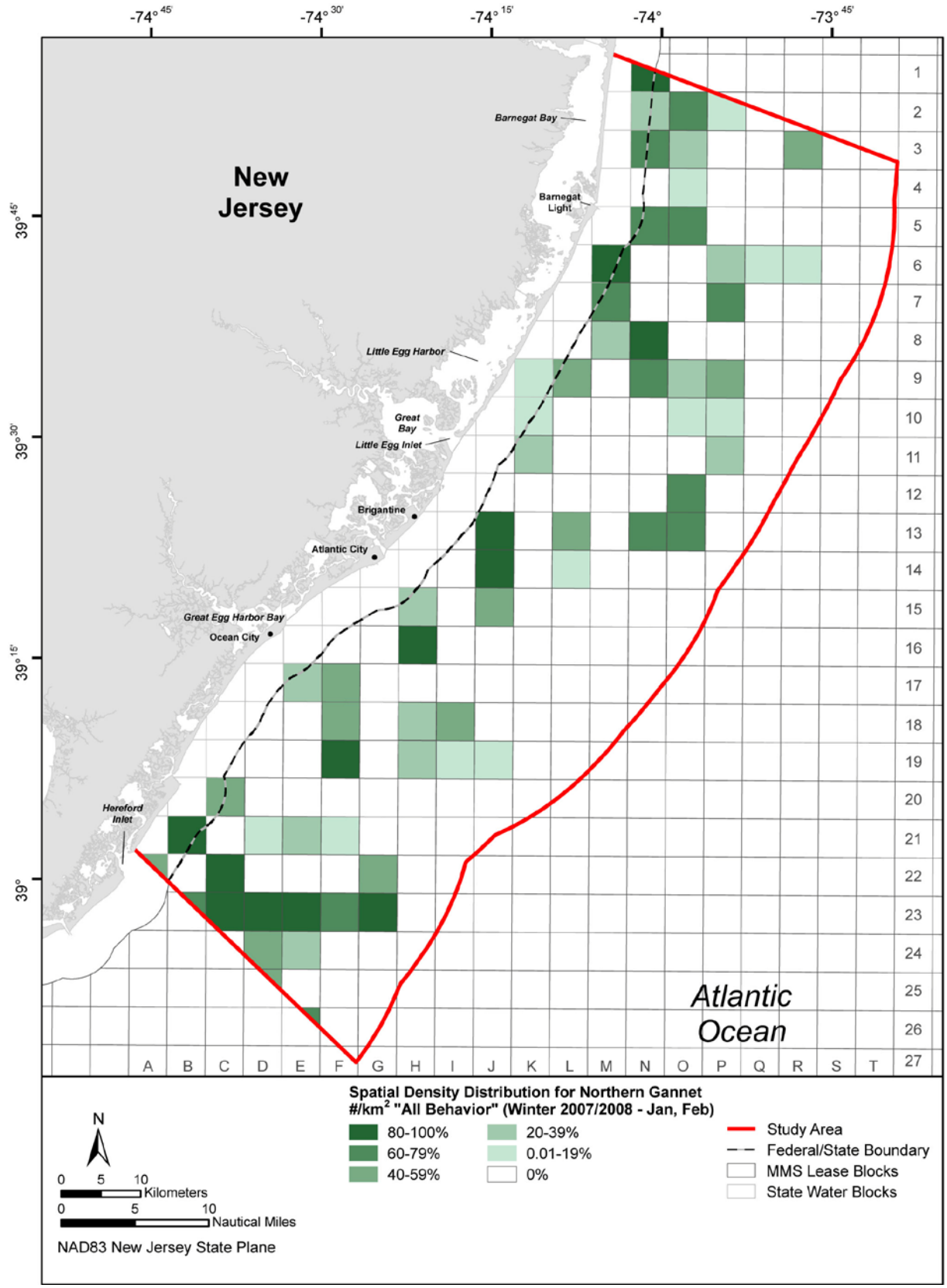

Figure C-28. Percentile abundance of Northern Gannet (all behaviors), Winter 2008 (January-February 2008) (n=357).

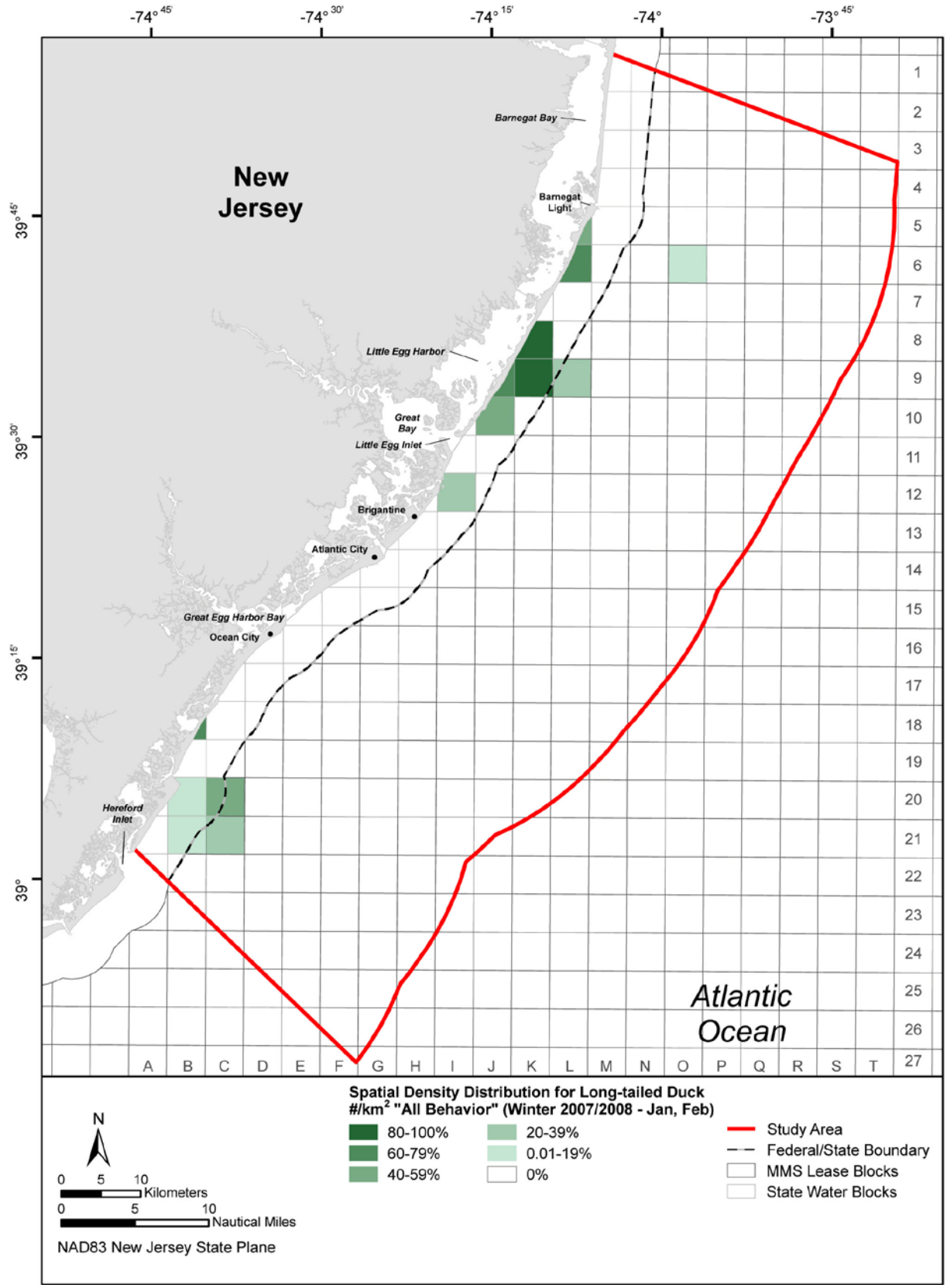

Figure C-29. Percentile abundance of Long-tailed Duck (all behaviors), Winter 2008 (January-February 2008) (n=245).

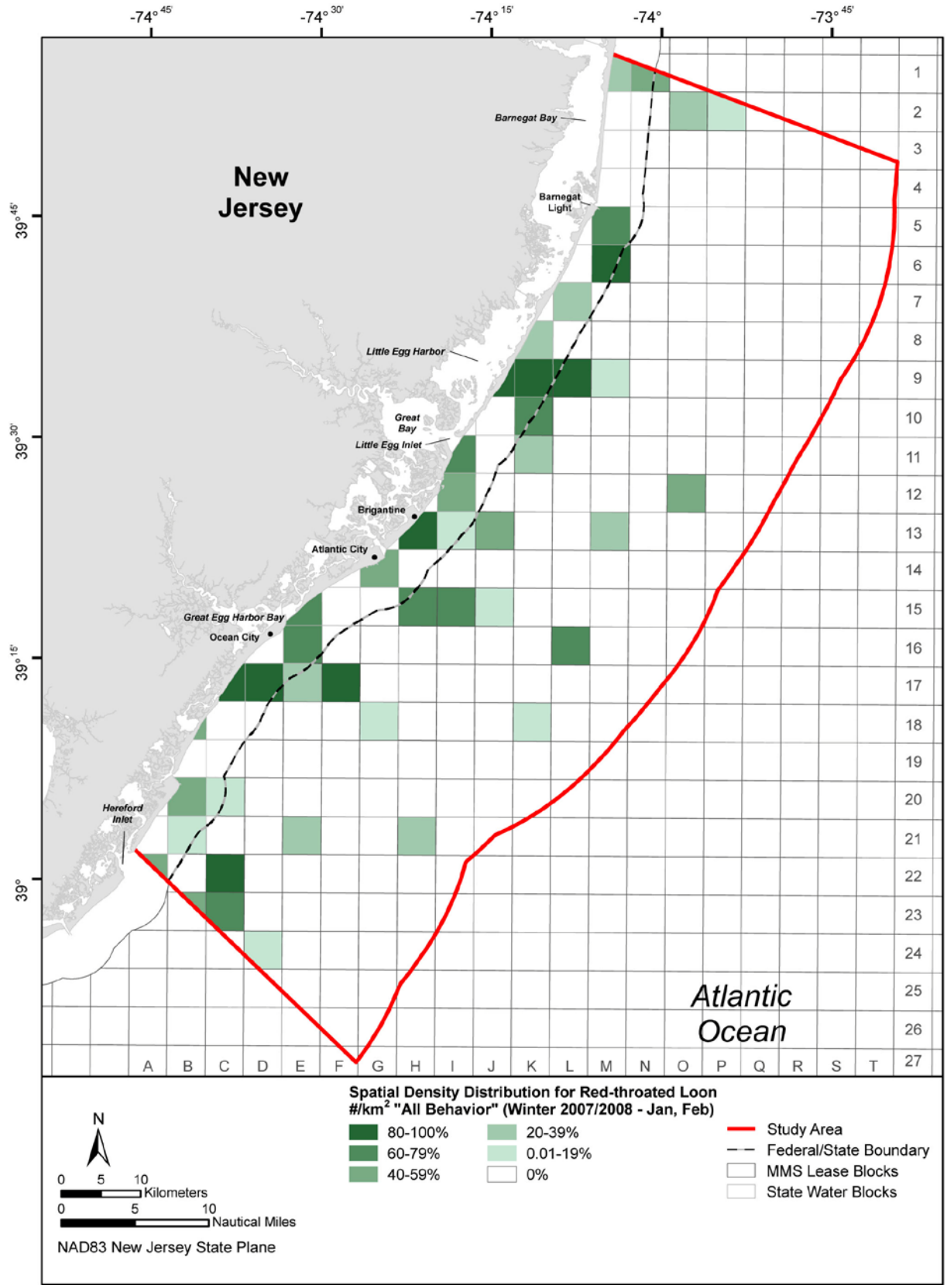

Figure C-30. Percentile abundance of Red-throated Loon (all behaviors), Winter 2008 (January-February 2008) (n=160).

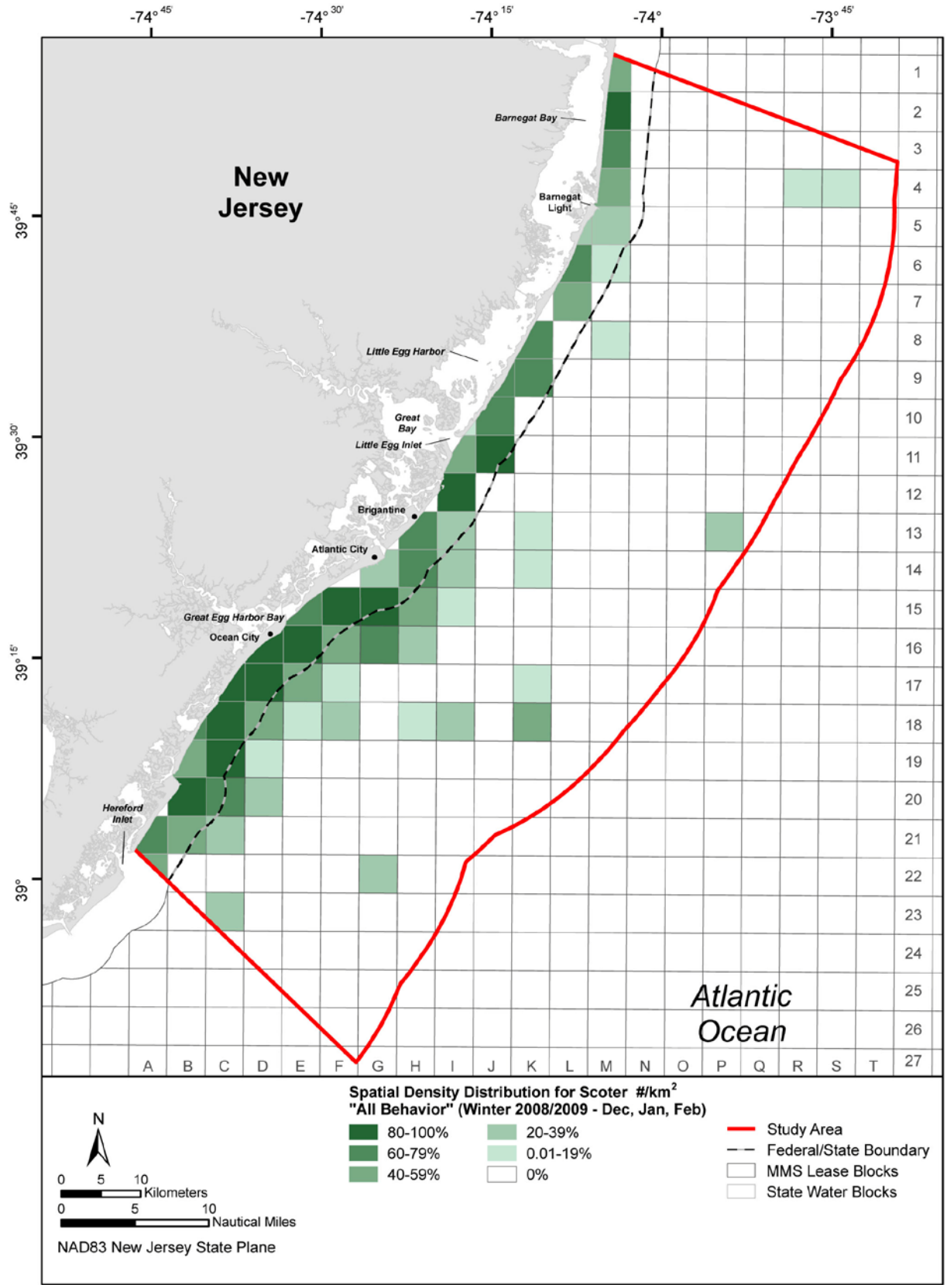

Figure C-31. Percentile abundance of scoters (all behaviors), Winter 2009 (December 2008-February 2009) (n=7,843).

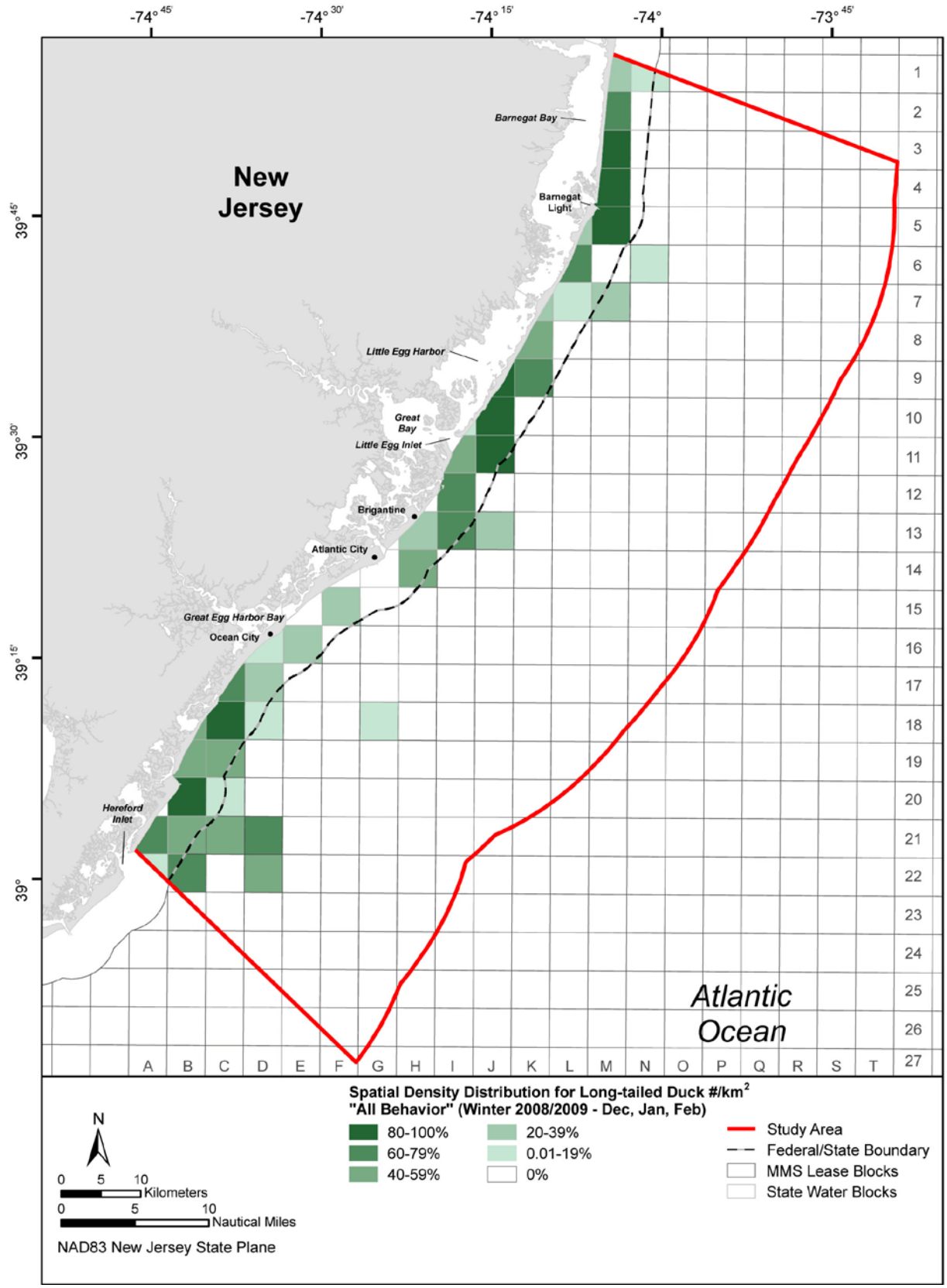

Figure C-32. Percentile abundance of Long-tailed Duck (all behaviors), Winter 2009 (December 2008-February 2009) (n=2,981).

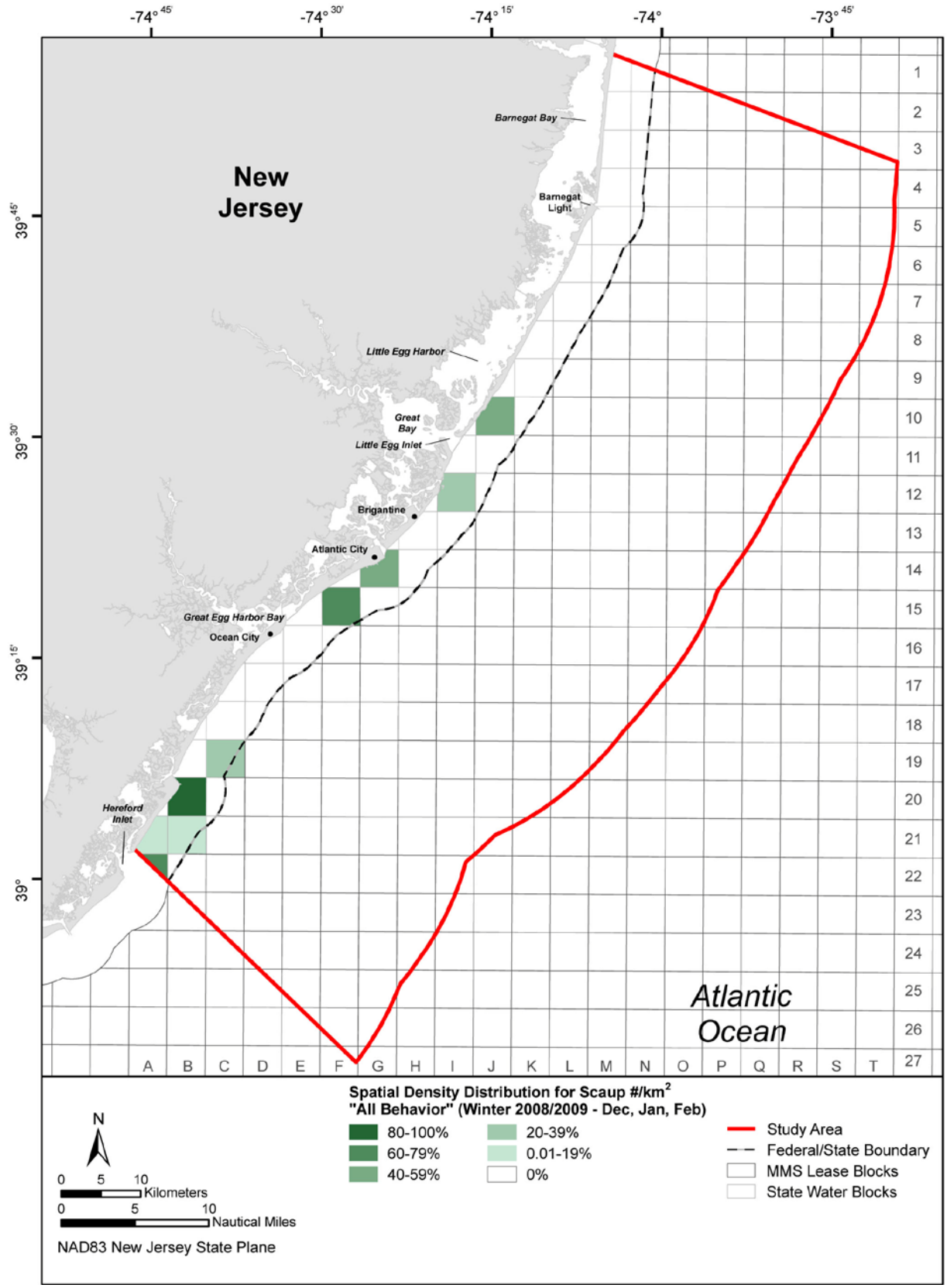

Figure C-33. Percentile abundance of scaup (all behaviors), Winter 2009 (December 2008-February 2009) (n=2,469).

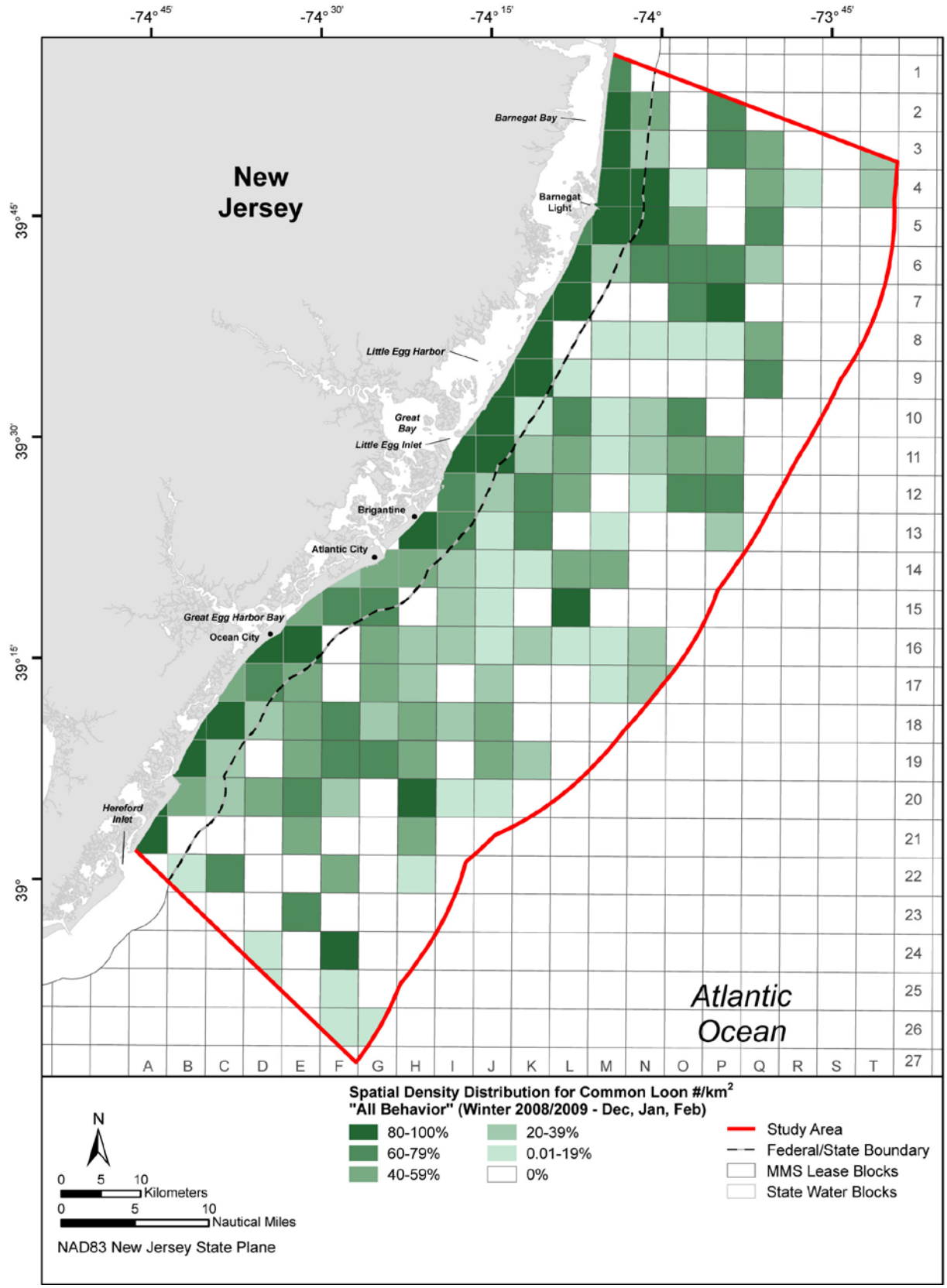

Figure C-34. Percentile abundance of Common Loon (all behaviors), Winter 2009 (December 2008-February 2009) (n=1,148).

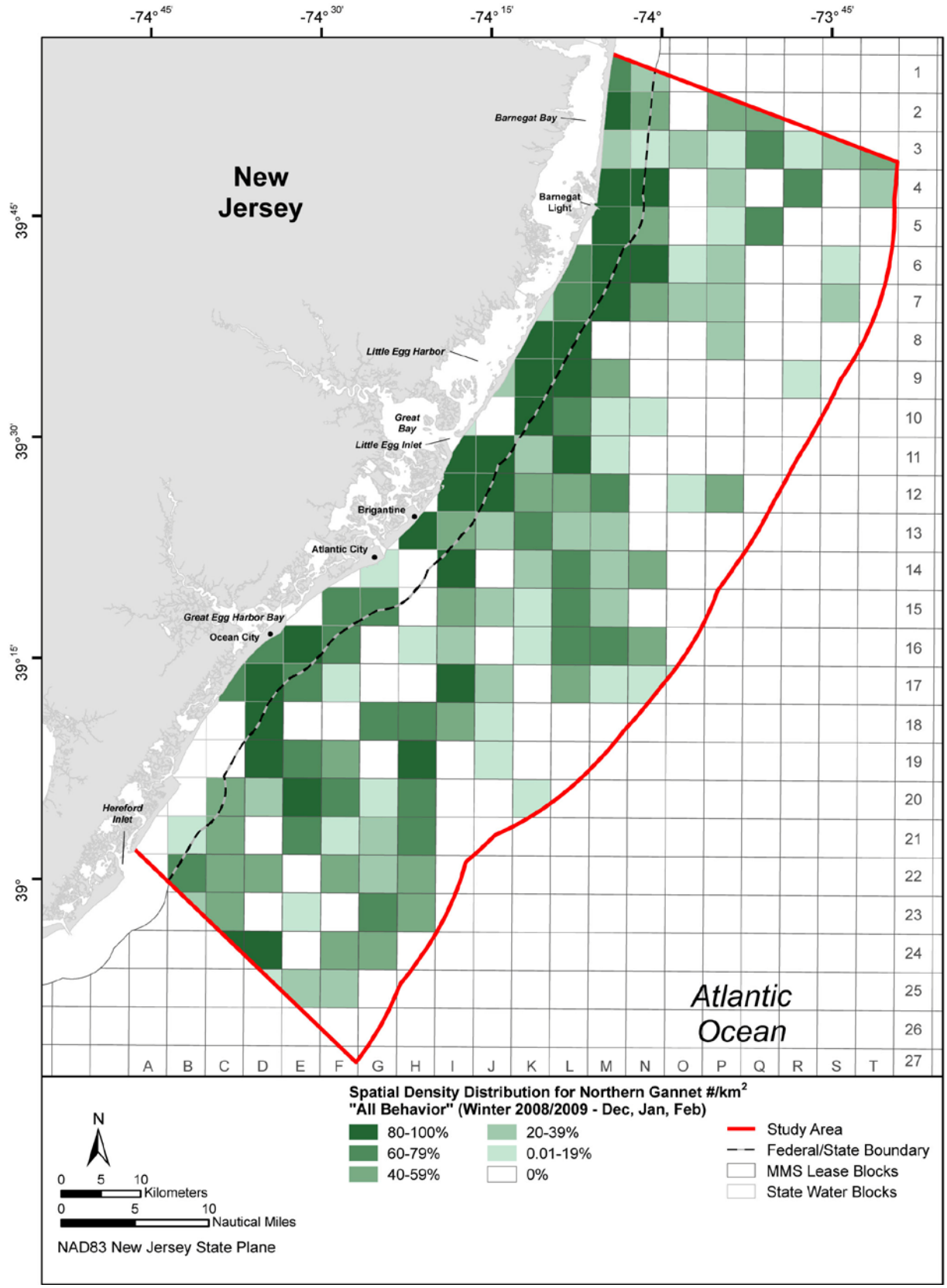

Figure C-35. Percentile abundance of Northern Gannet (all behaviors), Winter 2009 (December 2008-February 2009) (n=913).

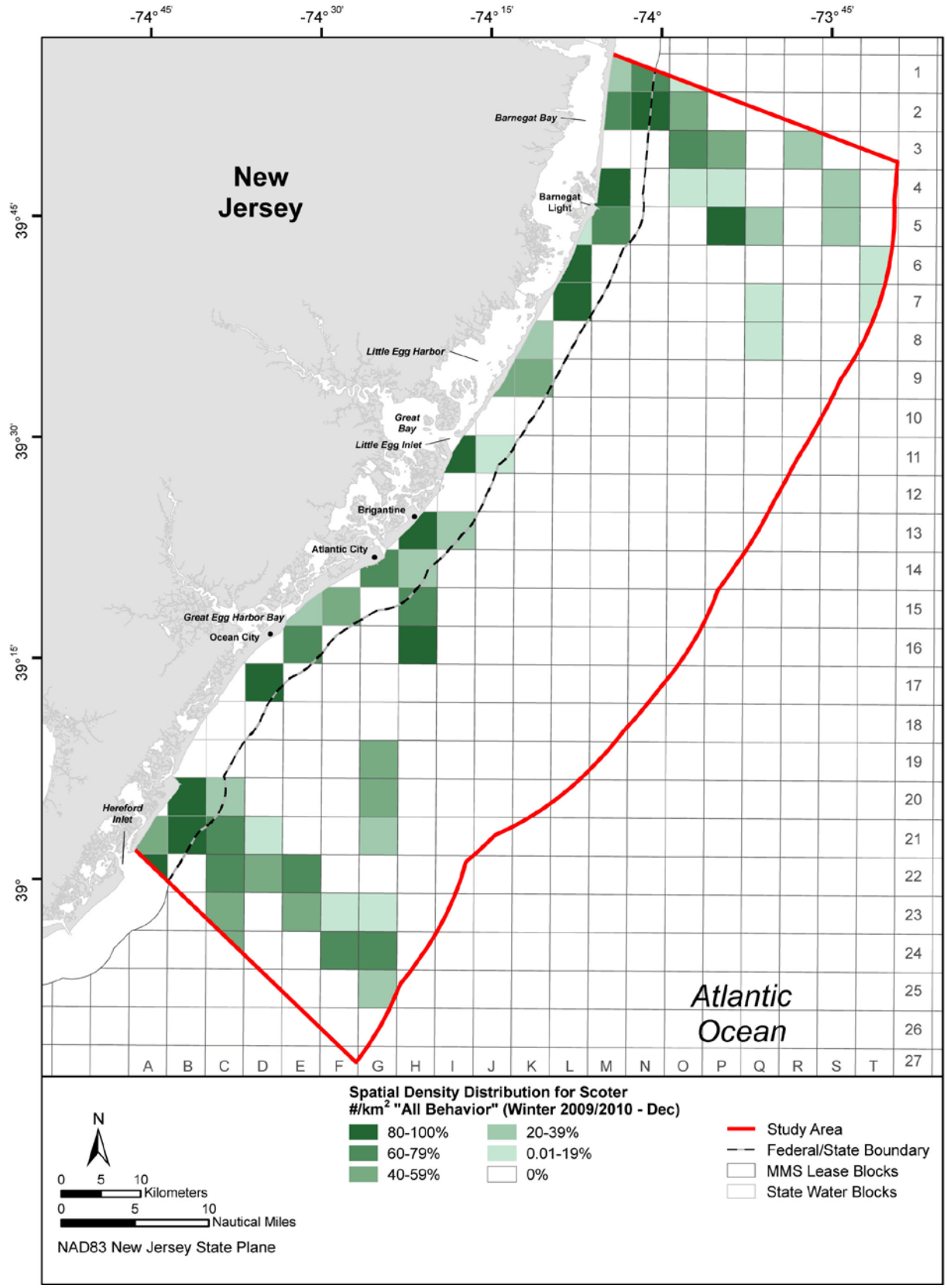

Figure C-36. Percentile abundance of scoters (all behaviors), Winter 2010 (December 2009) (n=1,264).

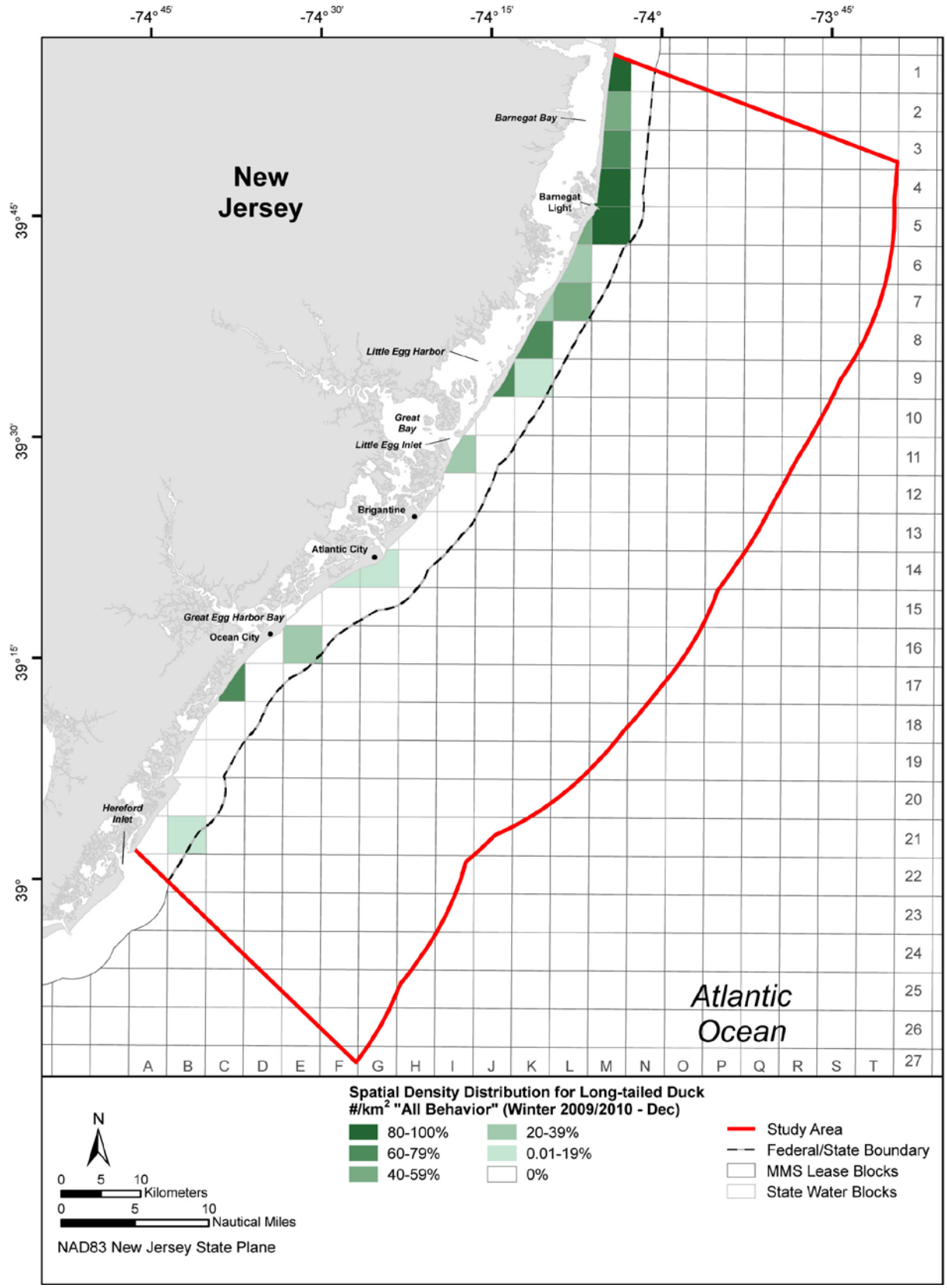

Figure C-37. Percentile abundance of Long-tailed Duck (all behaviors), Winter 2010 (December 2009) (n=392).

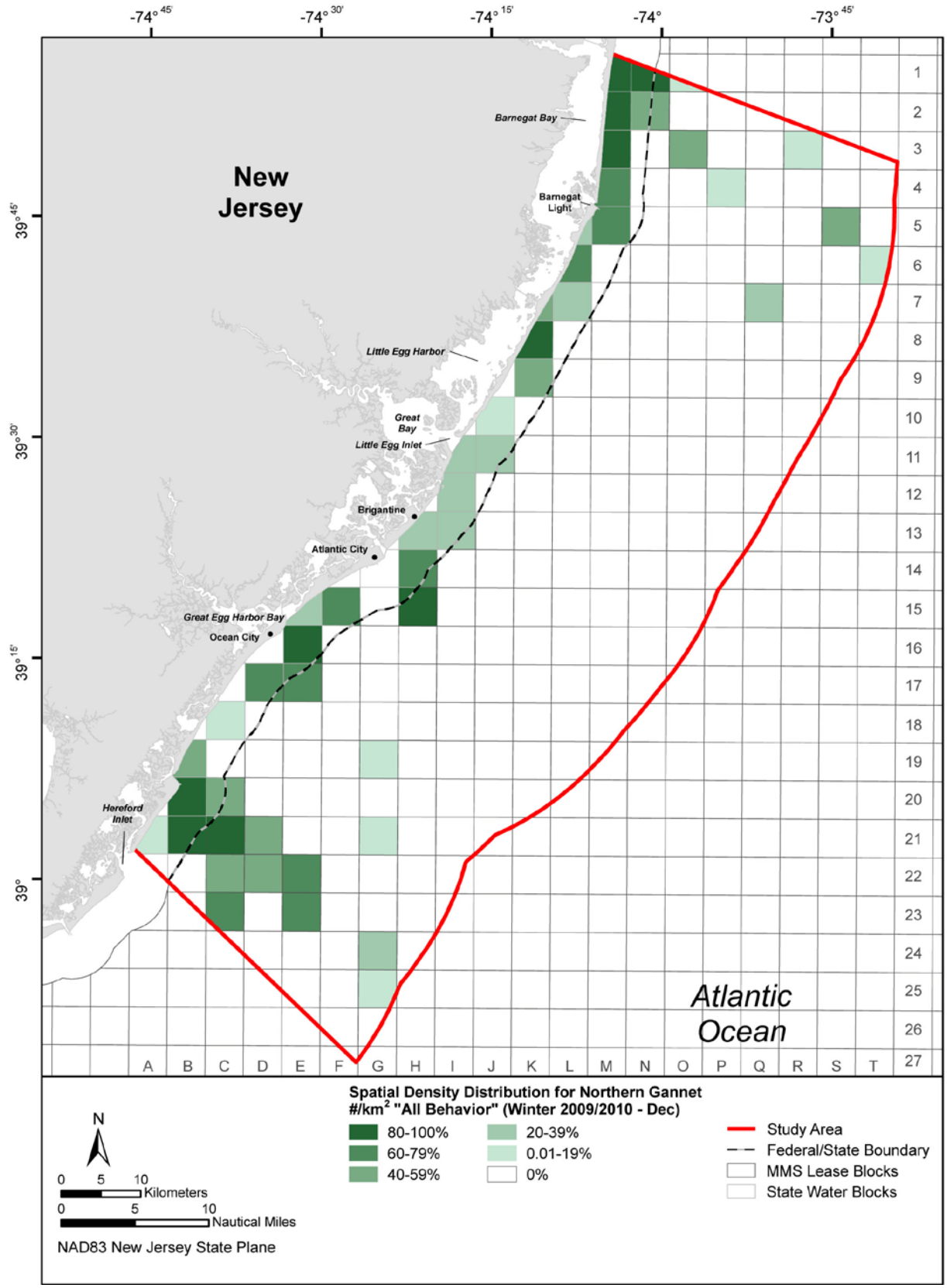

Figure C-38. Percentile abundance of Northern Gannet (all behaviors), Winter 2010 (December 2009) (n=322).

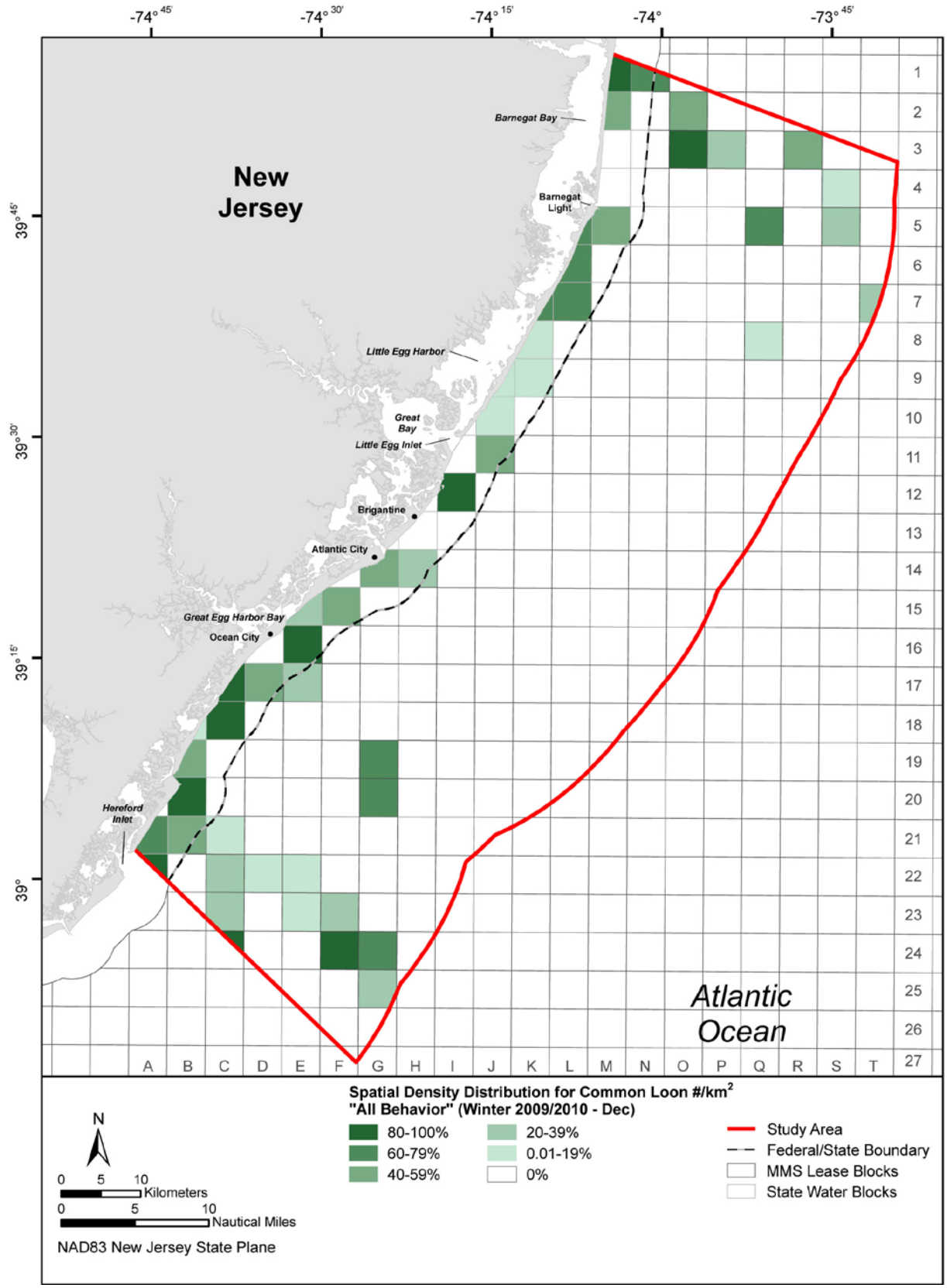

Figure C-39. Percentile abundance of Common Loon (all behaviors), Winter 2010 (December 2009) (n=260).

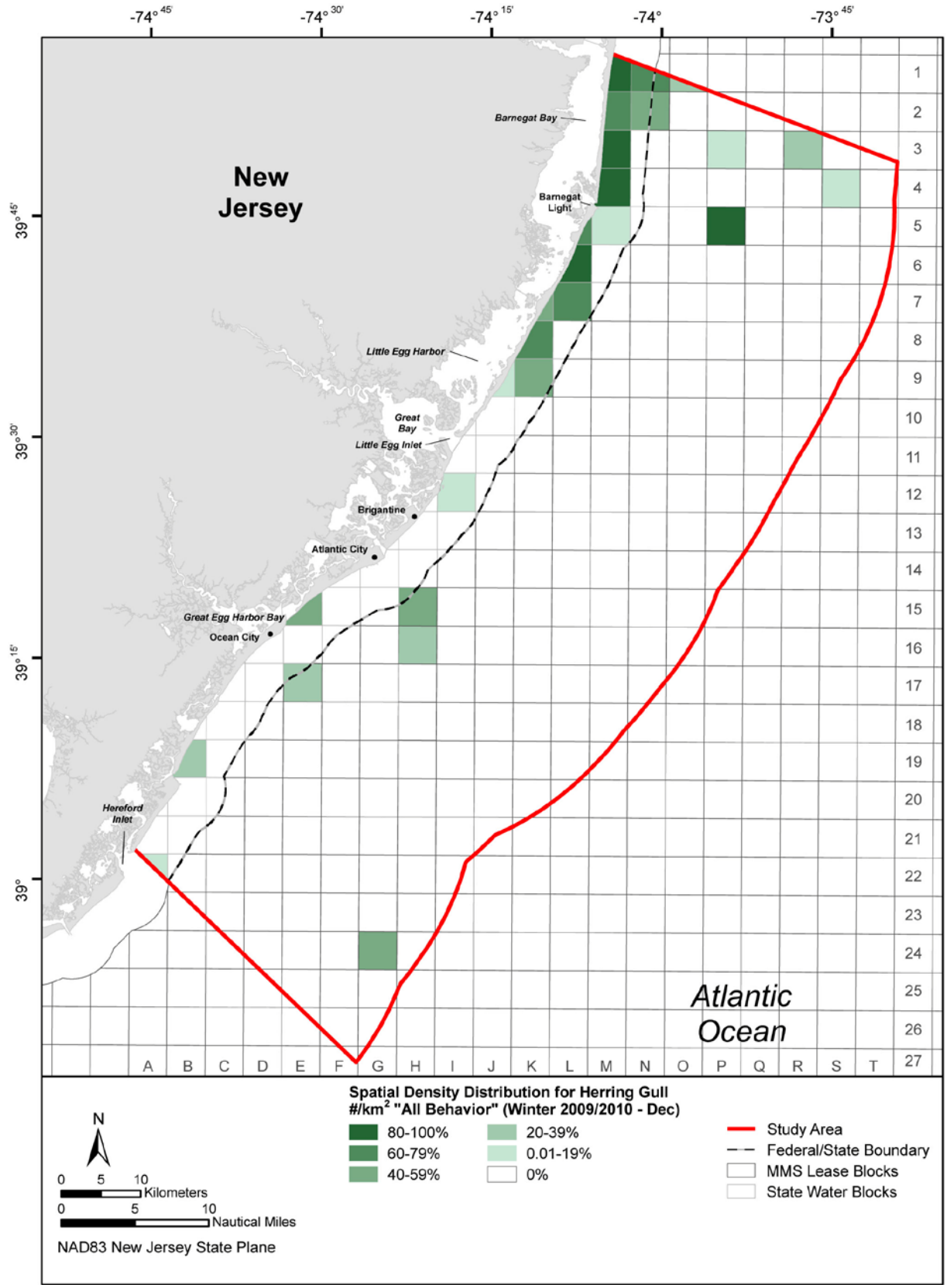

Figure C-40. Percentile abundance of Herring Gull (all behaviors), Winter 2010 (December 2009) (n=243).

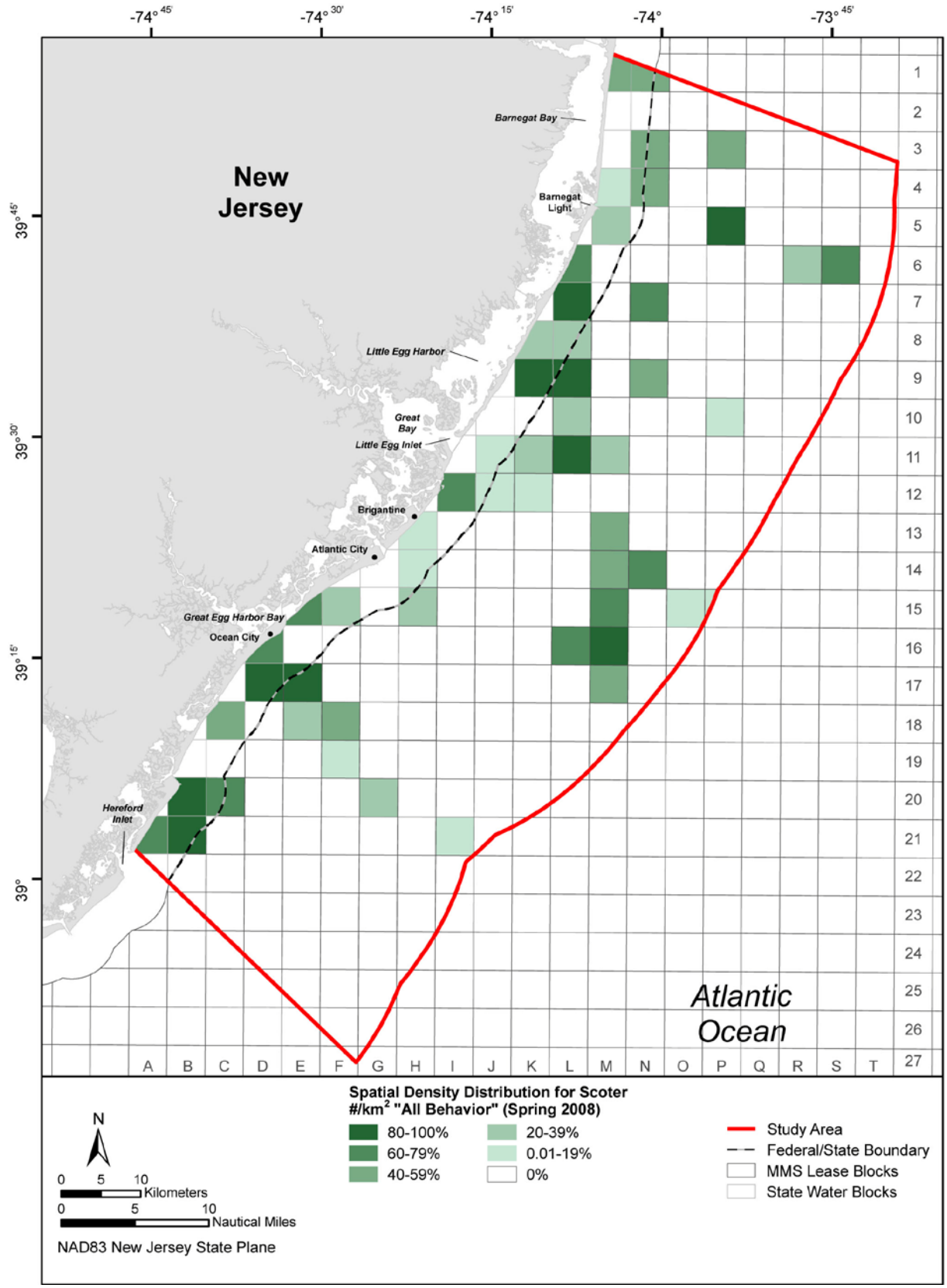

Figure C-41. Percentile abundance of scoters (all behaviors), Spring 2008 (March-May 2008) (n=1,516).

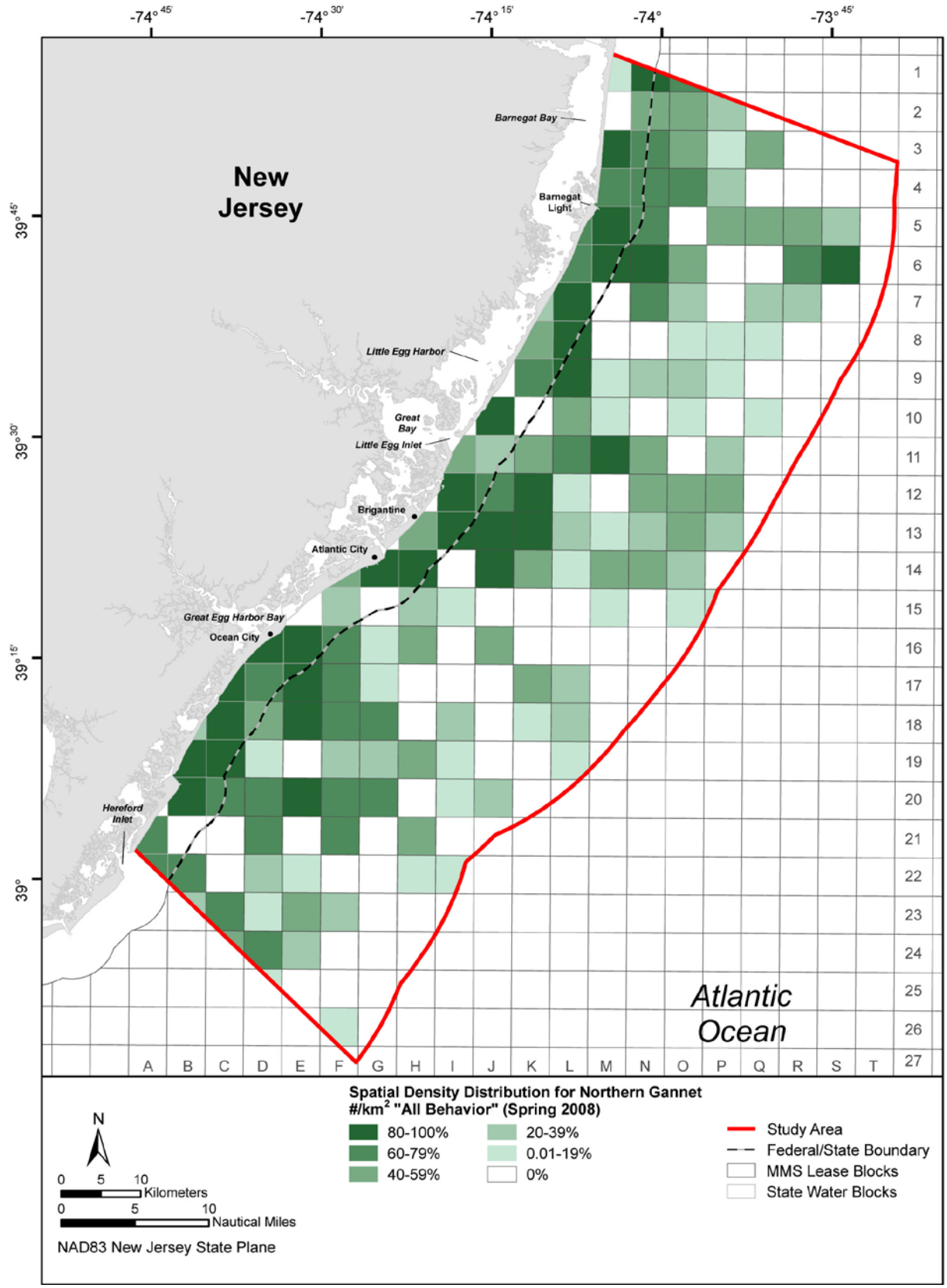

Figure C-42. Percentile abundance of Northern Gannet (all behaviors), Spring 2008 (March-May 2008) (n=1,402).

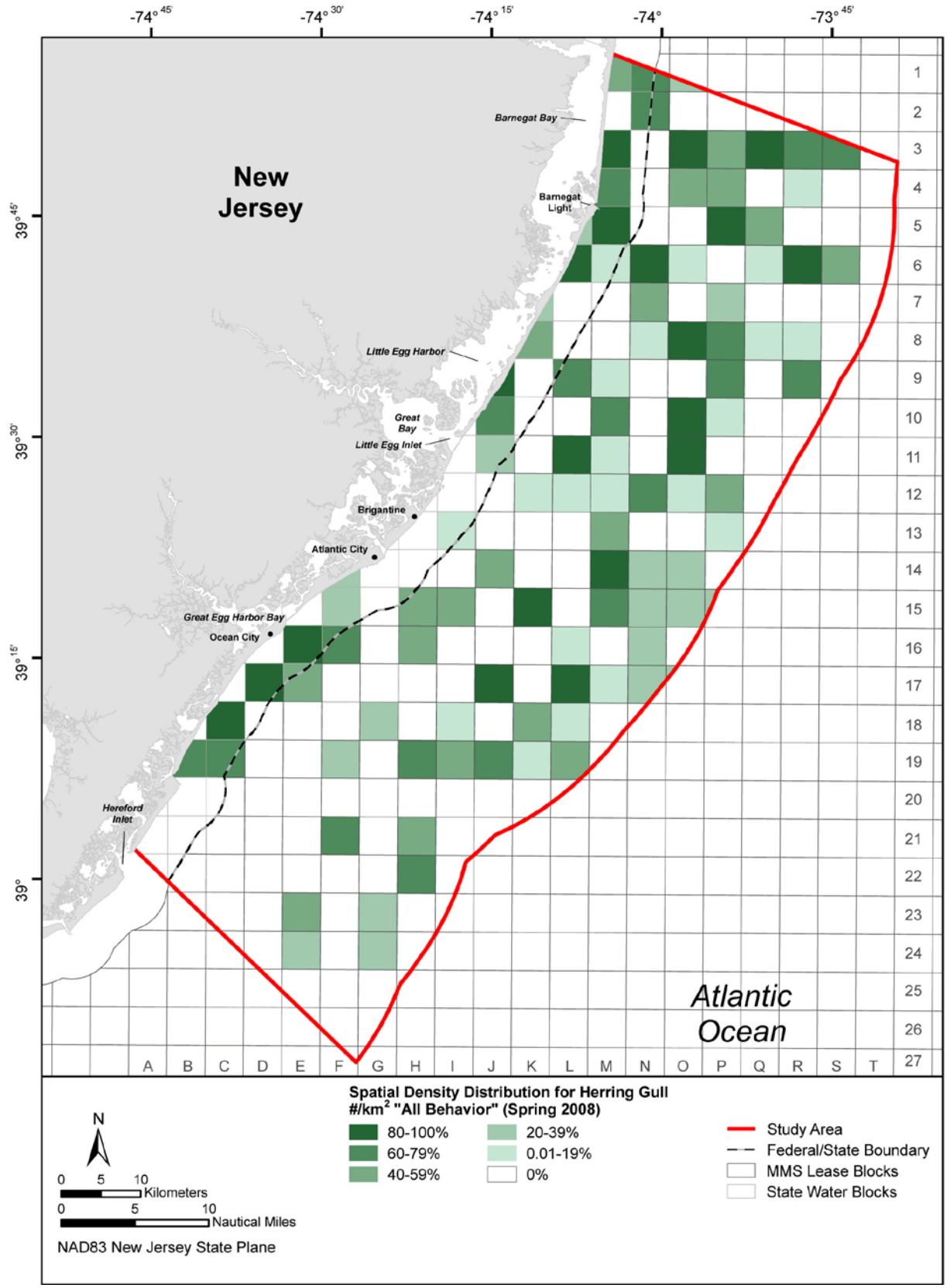

Figure C-43. Percentile abundance of Herring Gull (all behaviors), Spring 2008 (March-May 2008) (n=354).

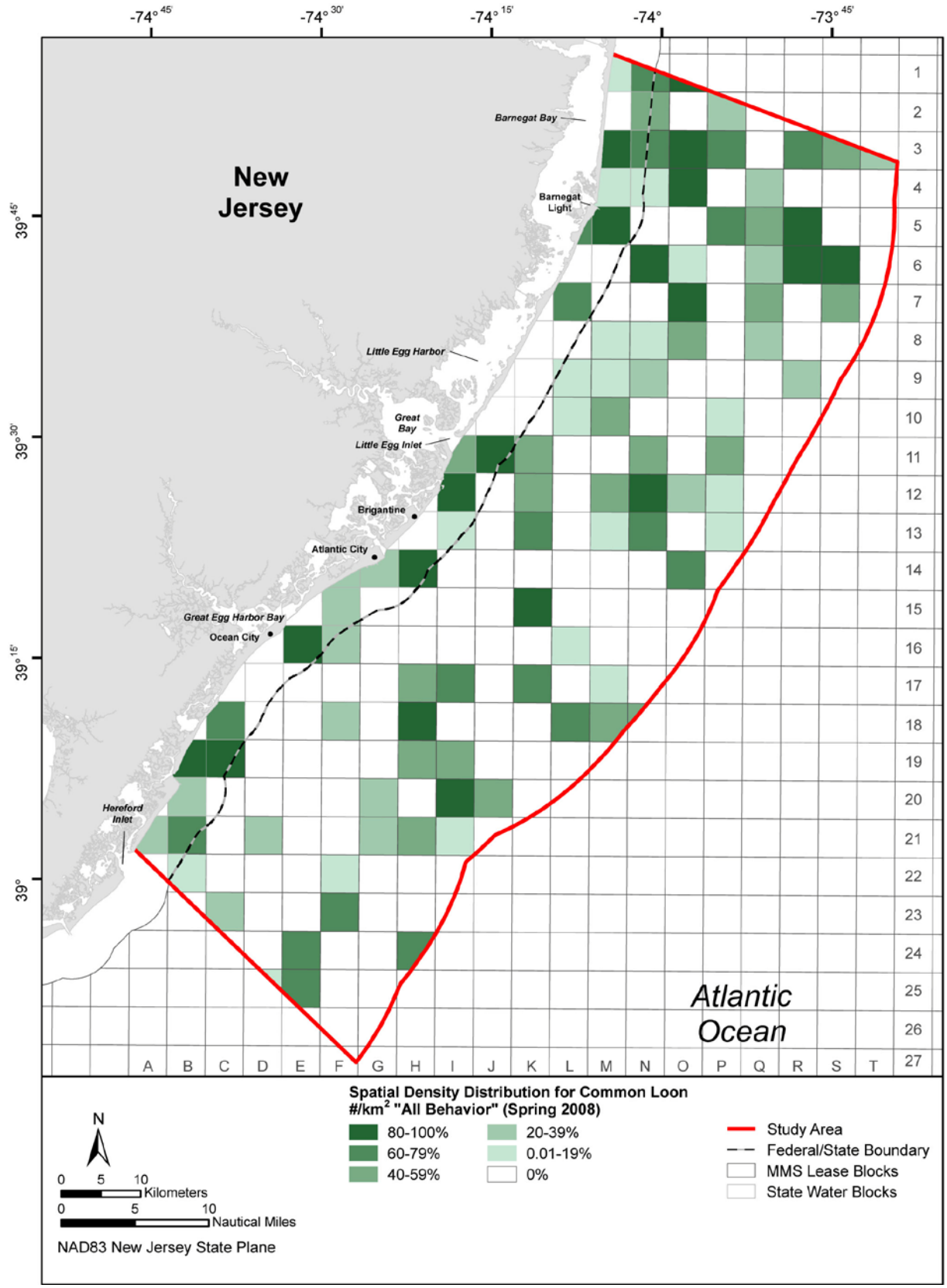

Figure C-44. Percentile abundance of Common Loon (all behaviors), Spring 2008 (March-May 2008) (n=216).

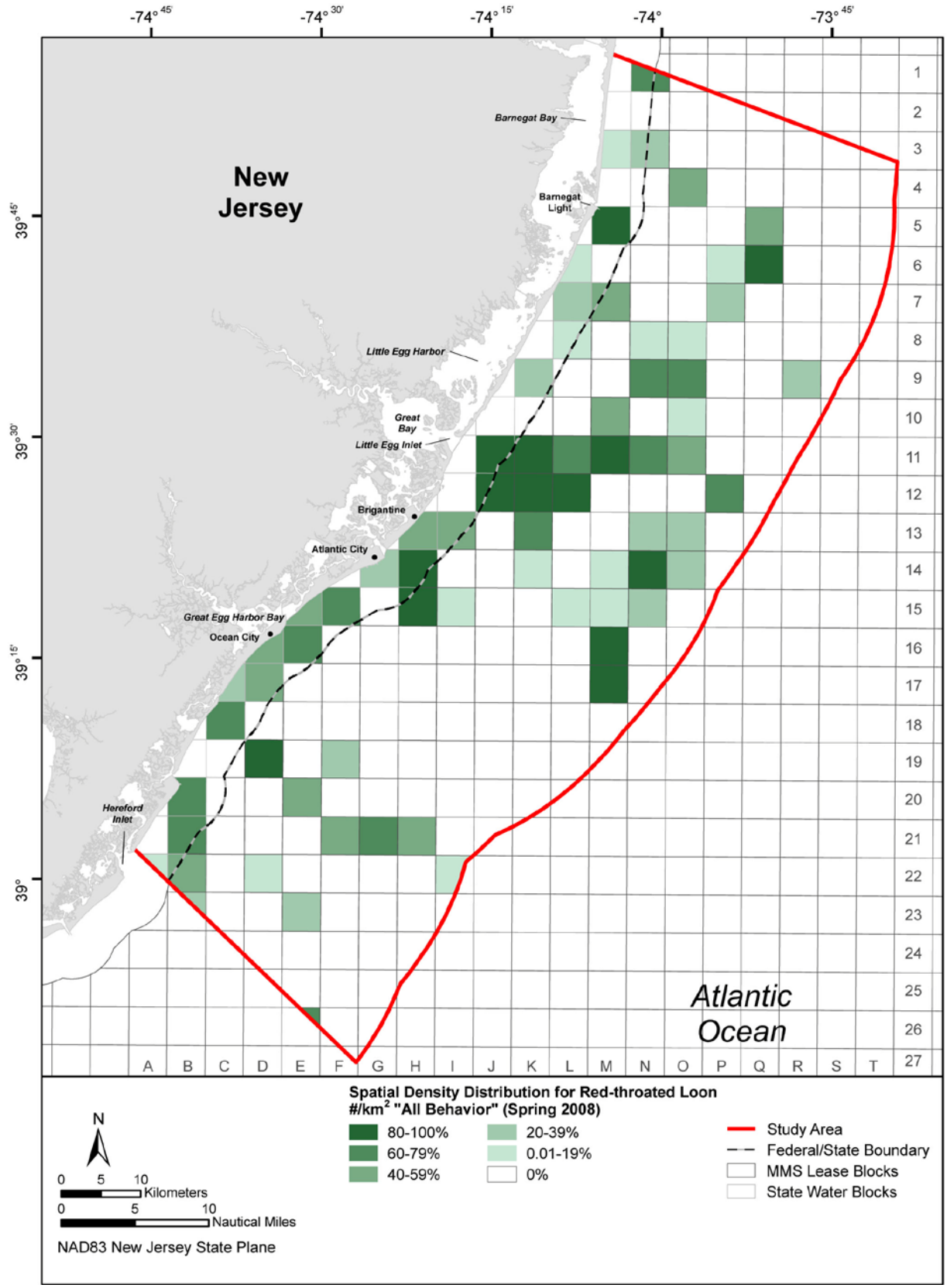

Figure C-45. Percentile abundance of Red-throated Loon (all behaviors), Spring 2008 (March-May 2008) (n=181).

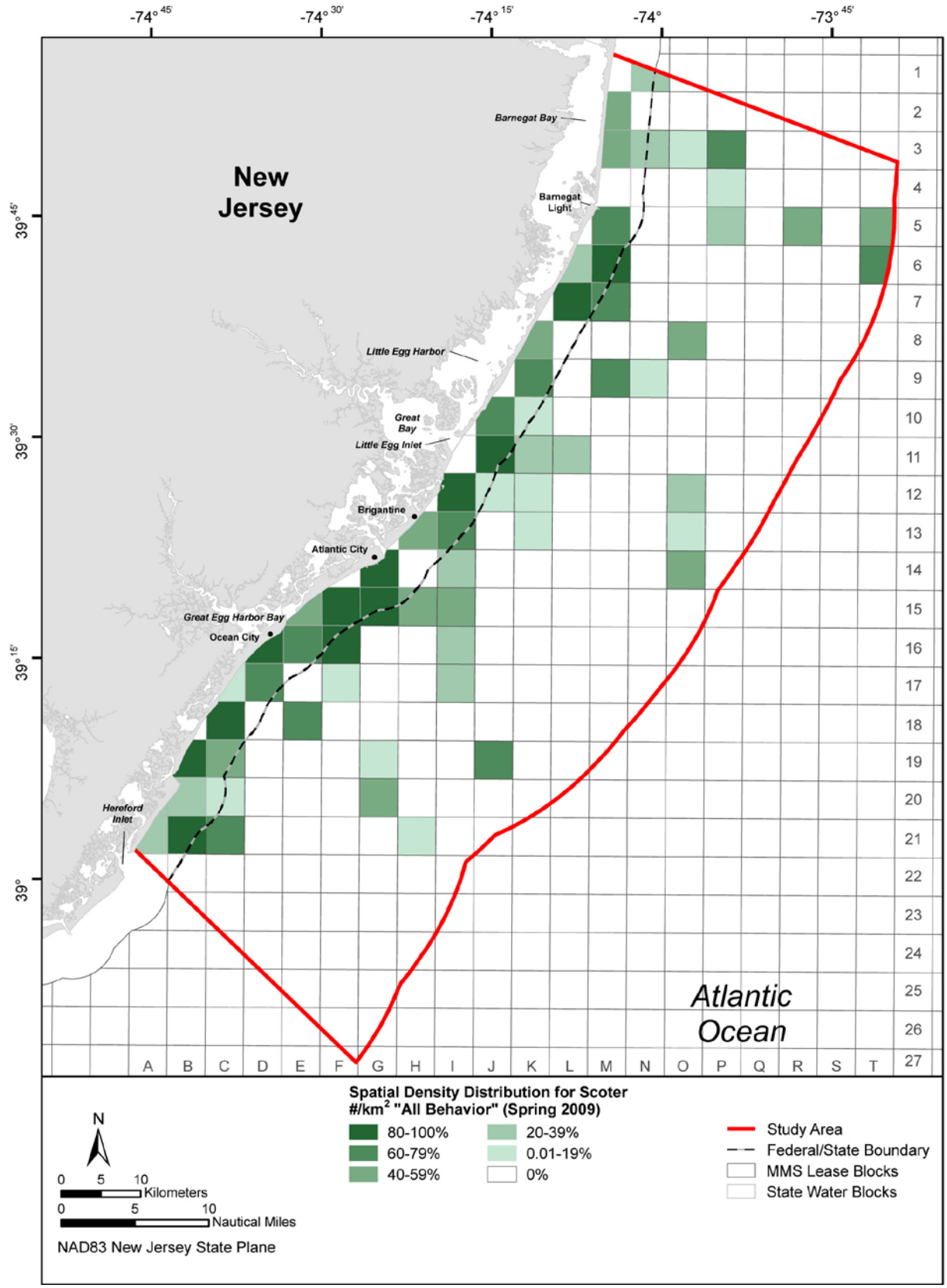

Figure C-46. Percentile abundance of scoters (all behaviors), Spring 2009 (March-May 2009) (n=1,708).

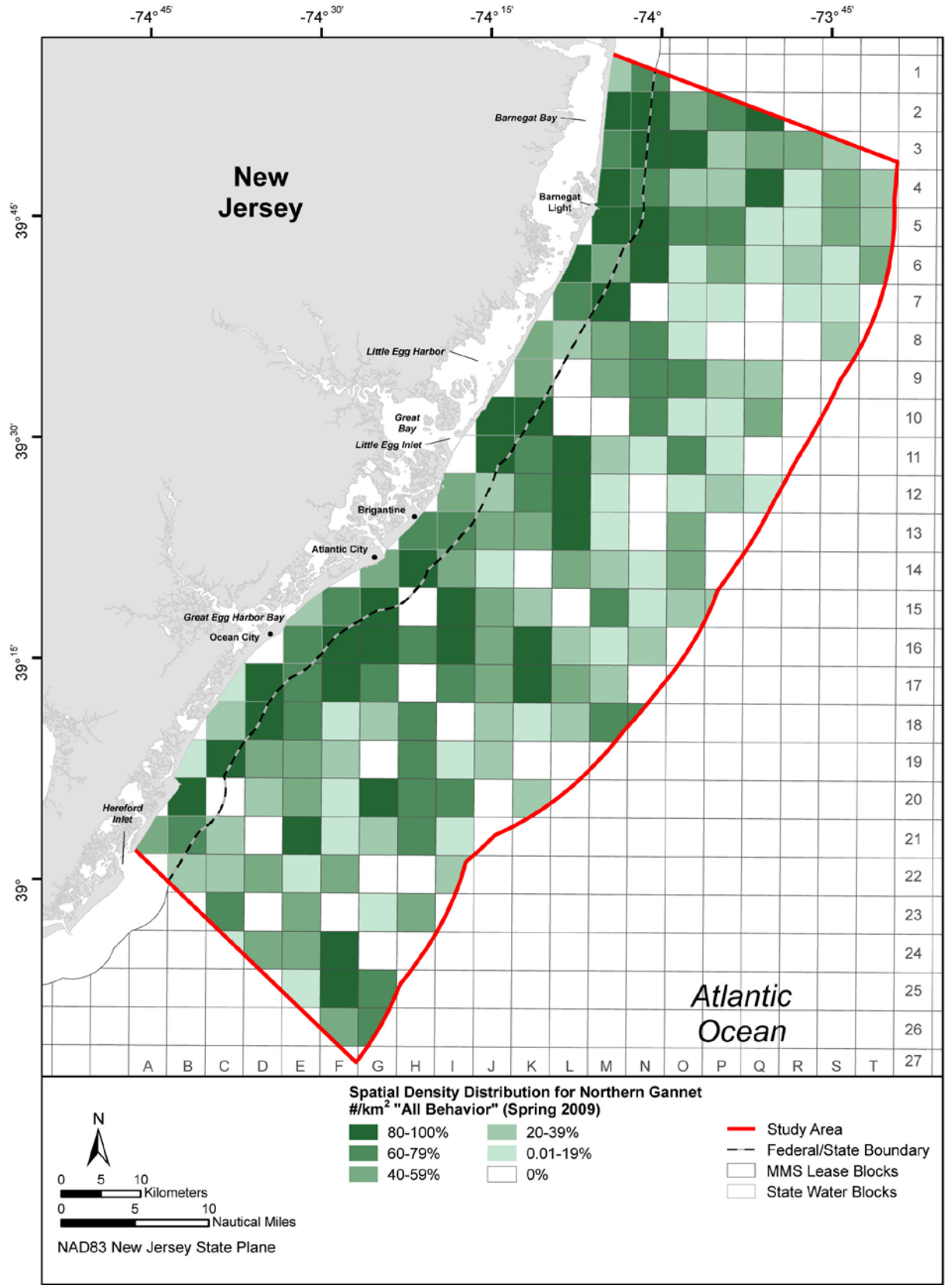

Figure C-47. Percentile abundance of Northern Gannet (all behaviors), Spring 2009 (March-May 2009) (n=1,430).

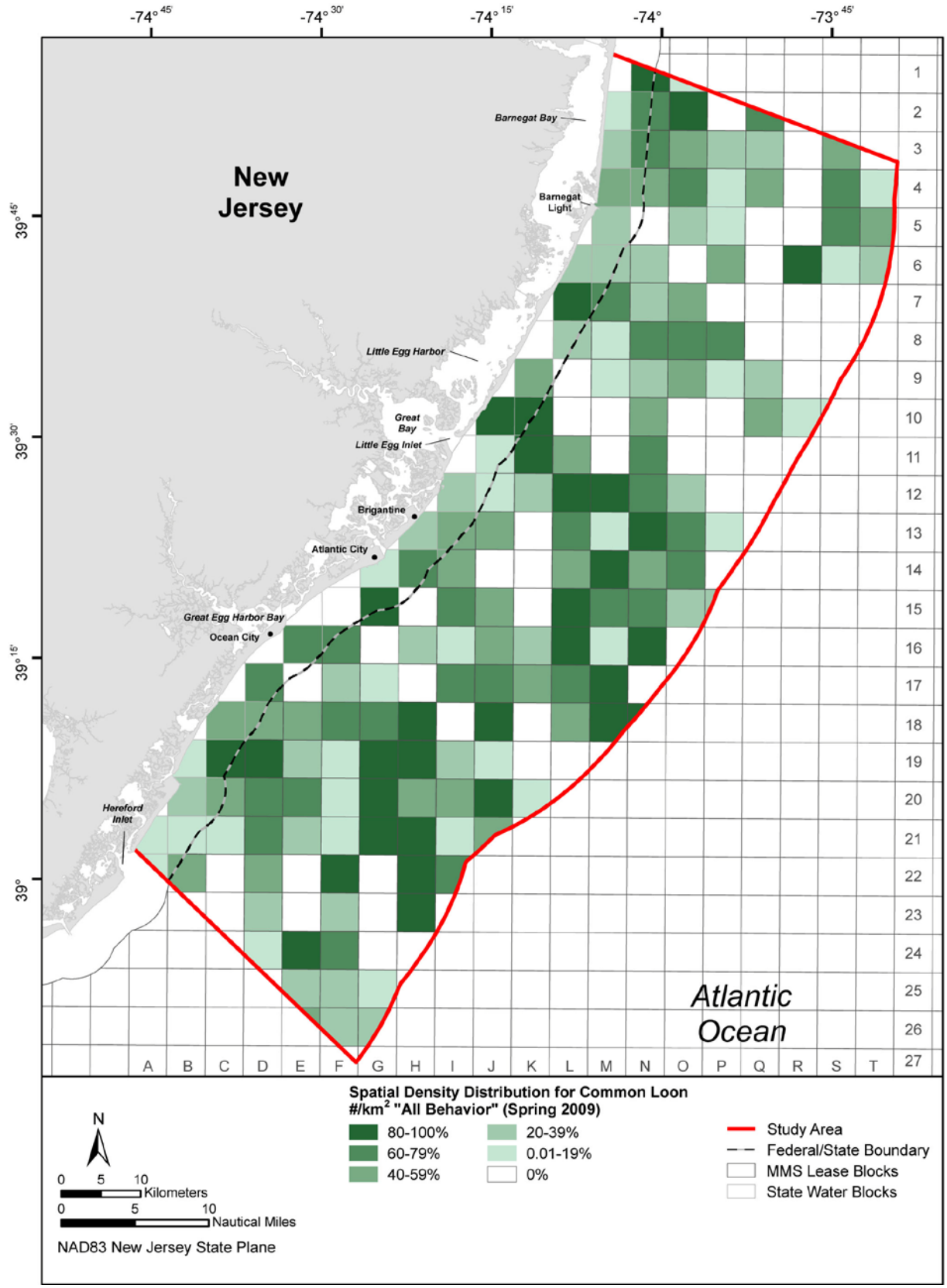

Figure C-48. Percentile abundance of Common Loon (all behaviors), Spring 2009 (March-May 2009) (n=839).

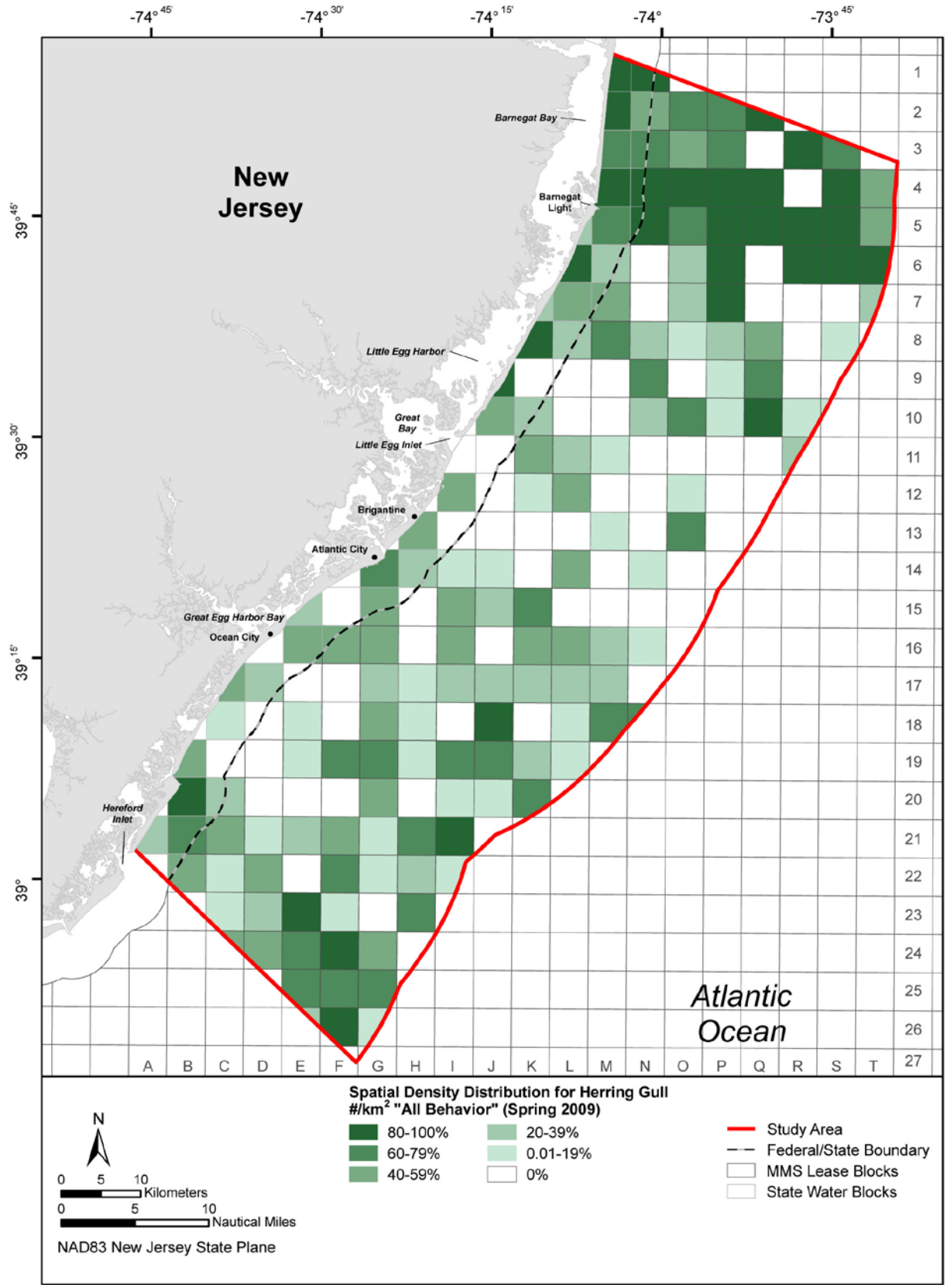

Figure C-49. Percentile abundance of Herring Gull (all behaviors), Spring 2009 (March-May 2009) (n=784).

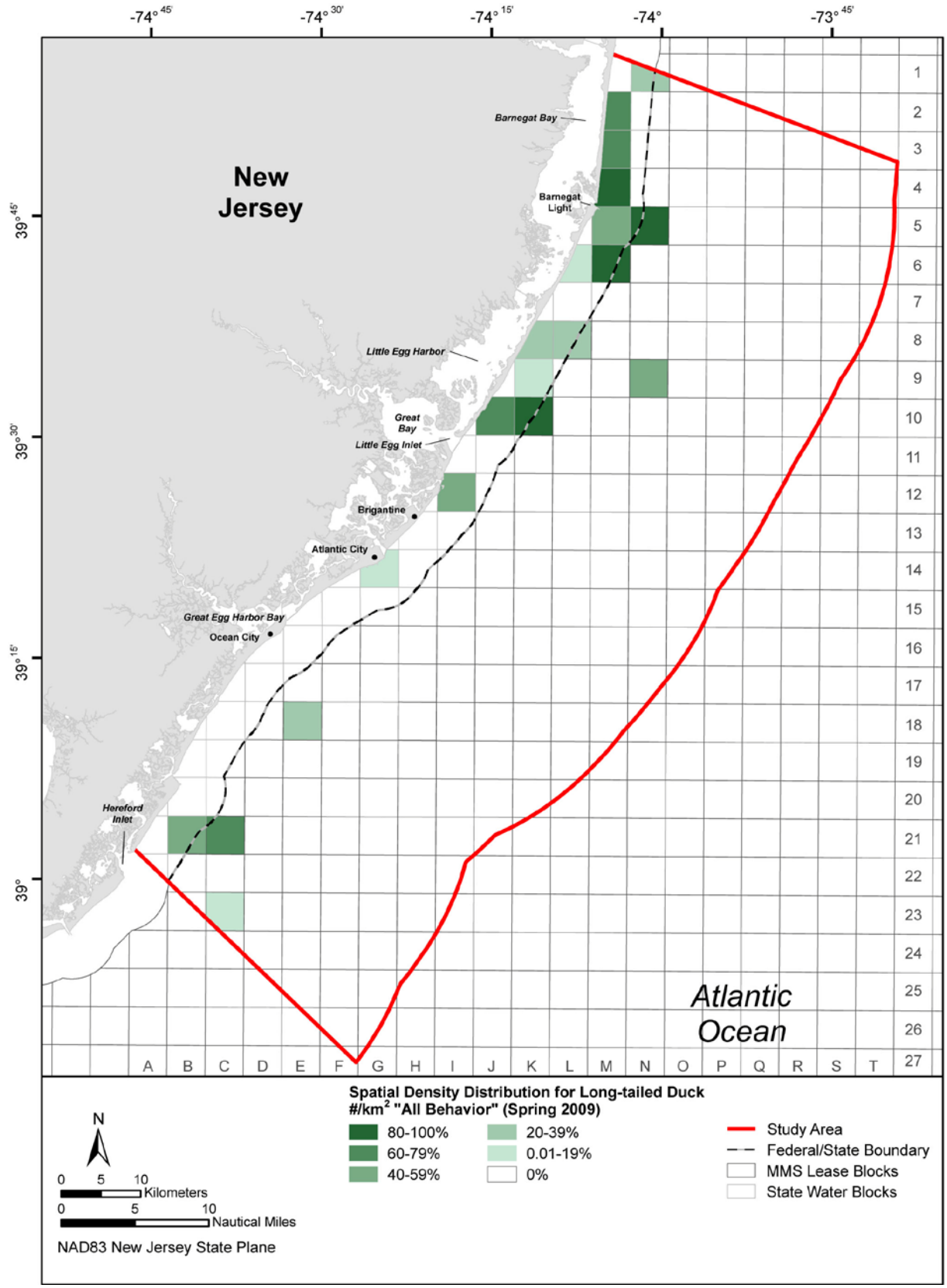

Figure C-50. Percentile abundance of Long-tailed Duck (all behaviors), Spring 2009 (March-May 2009) (n=659).

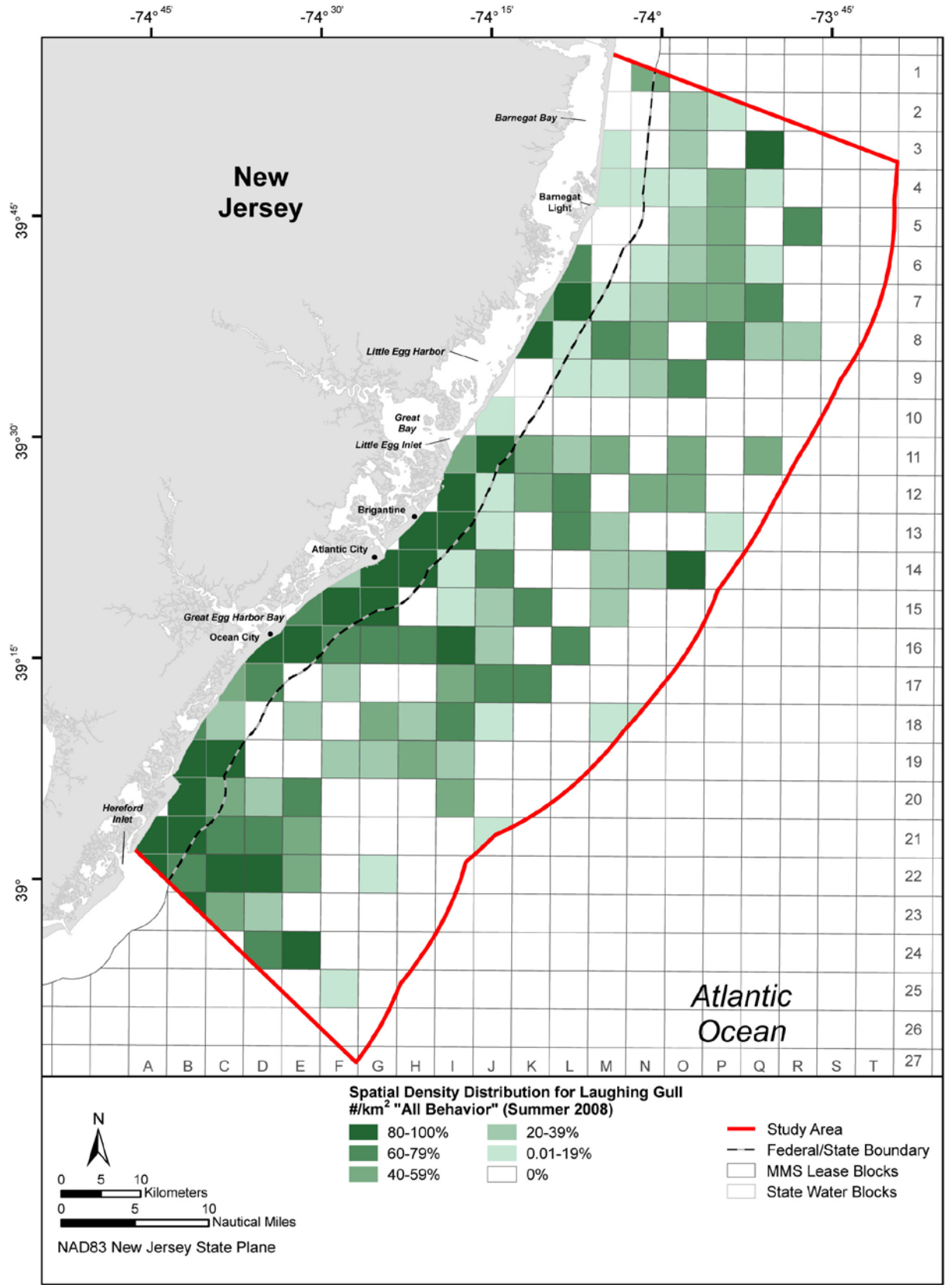

Figure C-51. Percentile abundance of Laughing Gull (all behaviors), Summer 2008 (June-July 2008) (n=737).

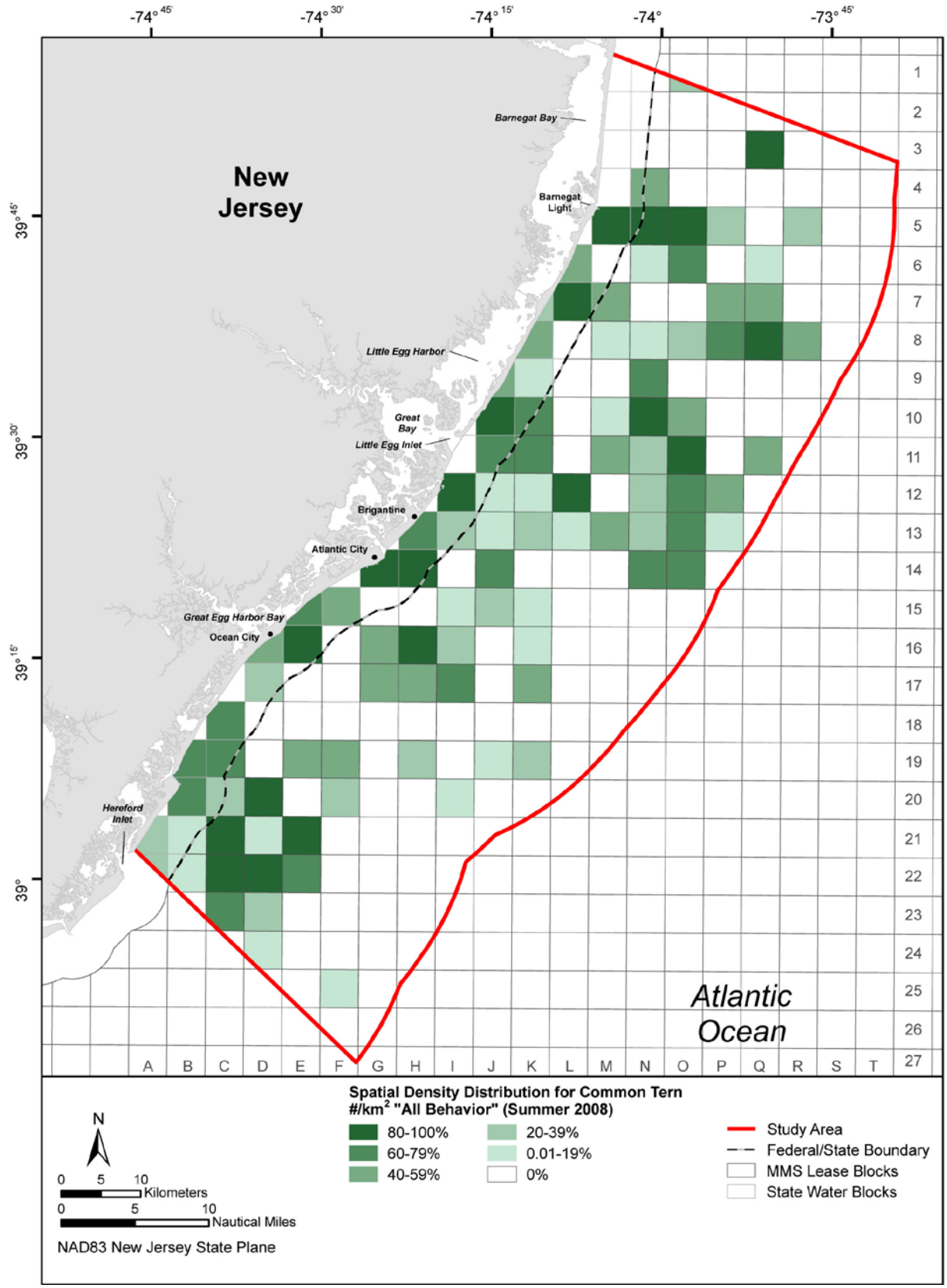

Figure C-52. Percentile abundance of Common Tern (all behaviors), Summer 2008 (June-July 2008) (n=485).

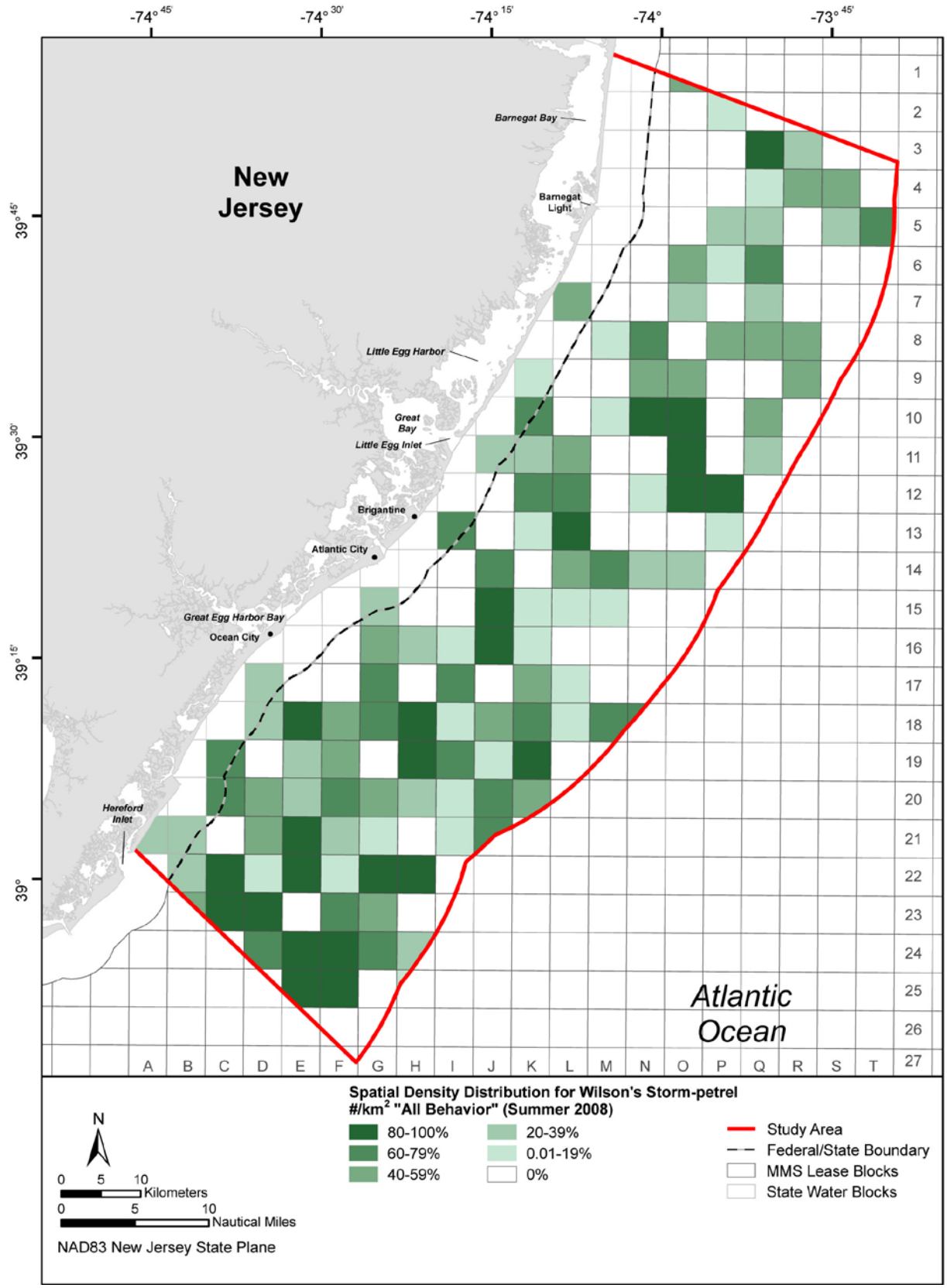

Figure C-53. Percentile abundance of Wilson's Storm-Petrel (all behaviors), Summer 2008 (June-July 2008) (n=411).

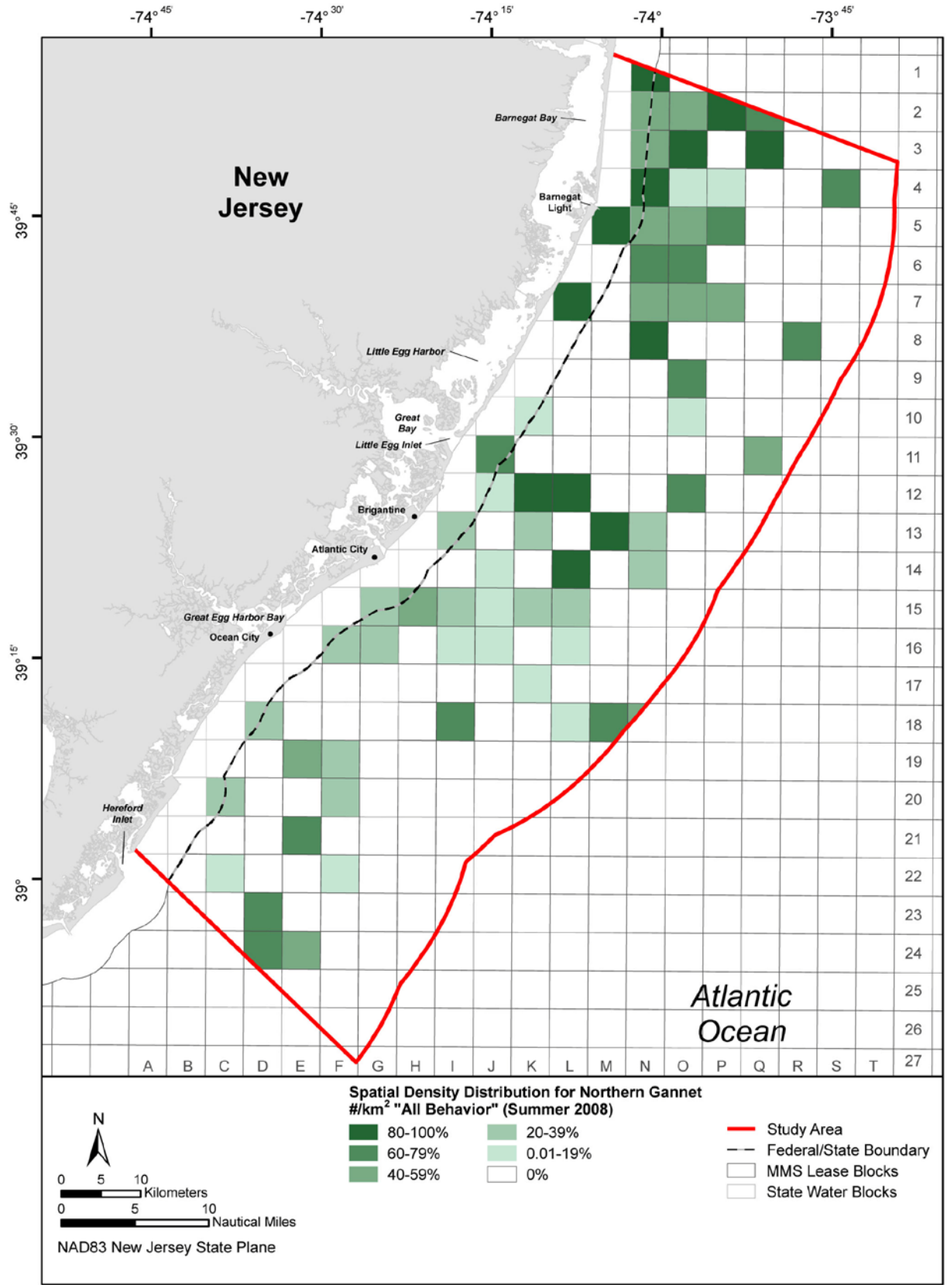

Figure C-54. Percentile abundance of Northern Gannet (all behaviors), Summer 2008 (June-July 2008) (n=138).

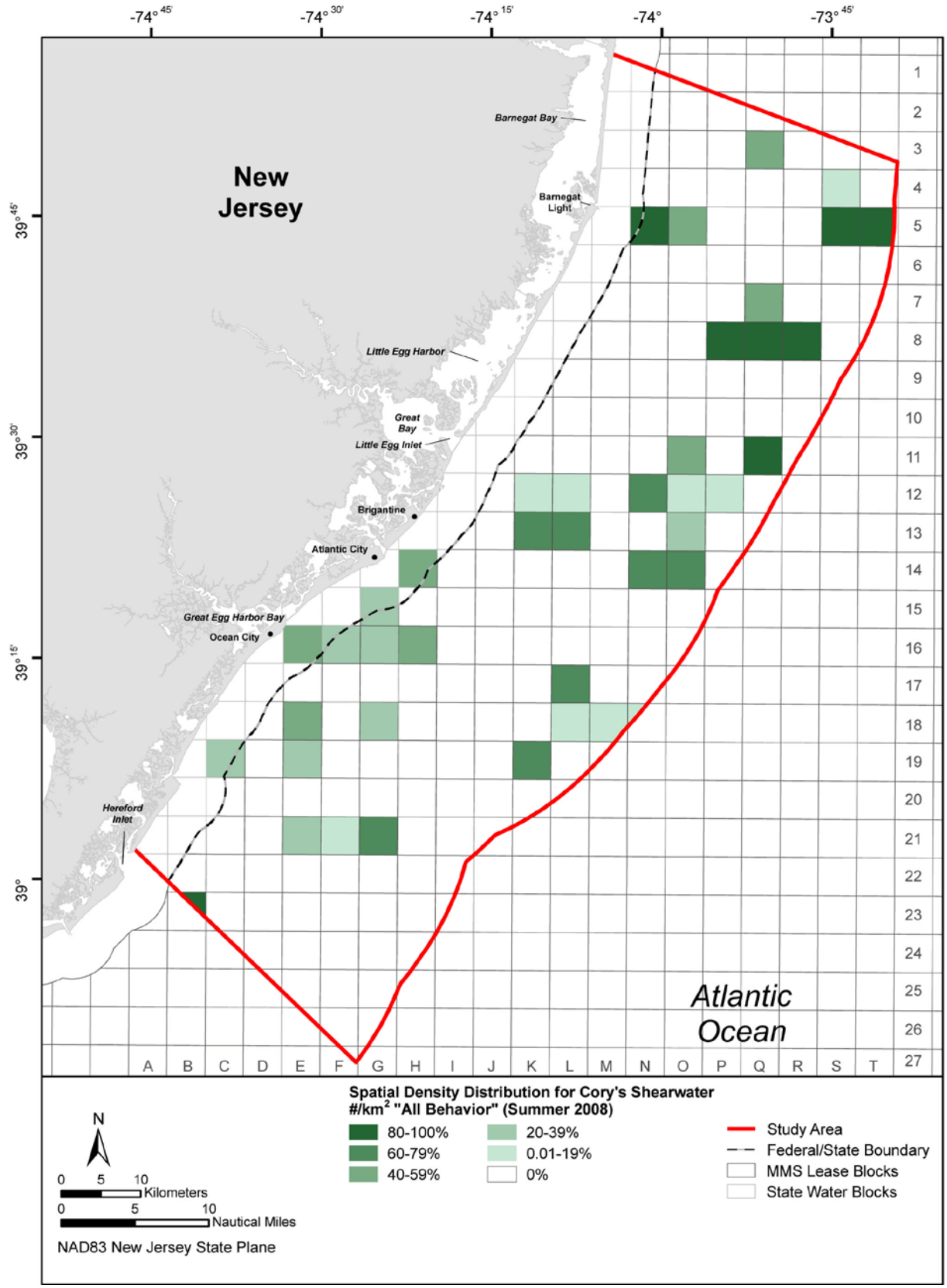

Figure C-55. Percentile abundance of Cory's Shearwater (all behaviors), Summer 2008 (June-July 2008) (n=87).

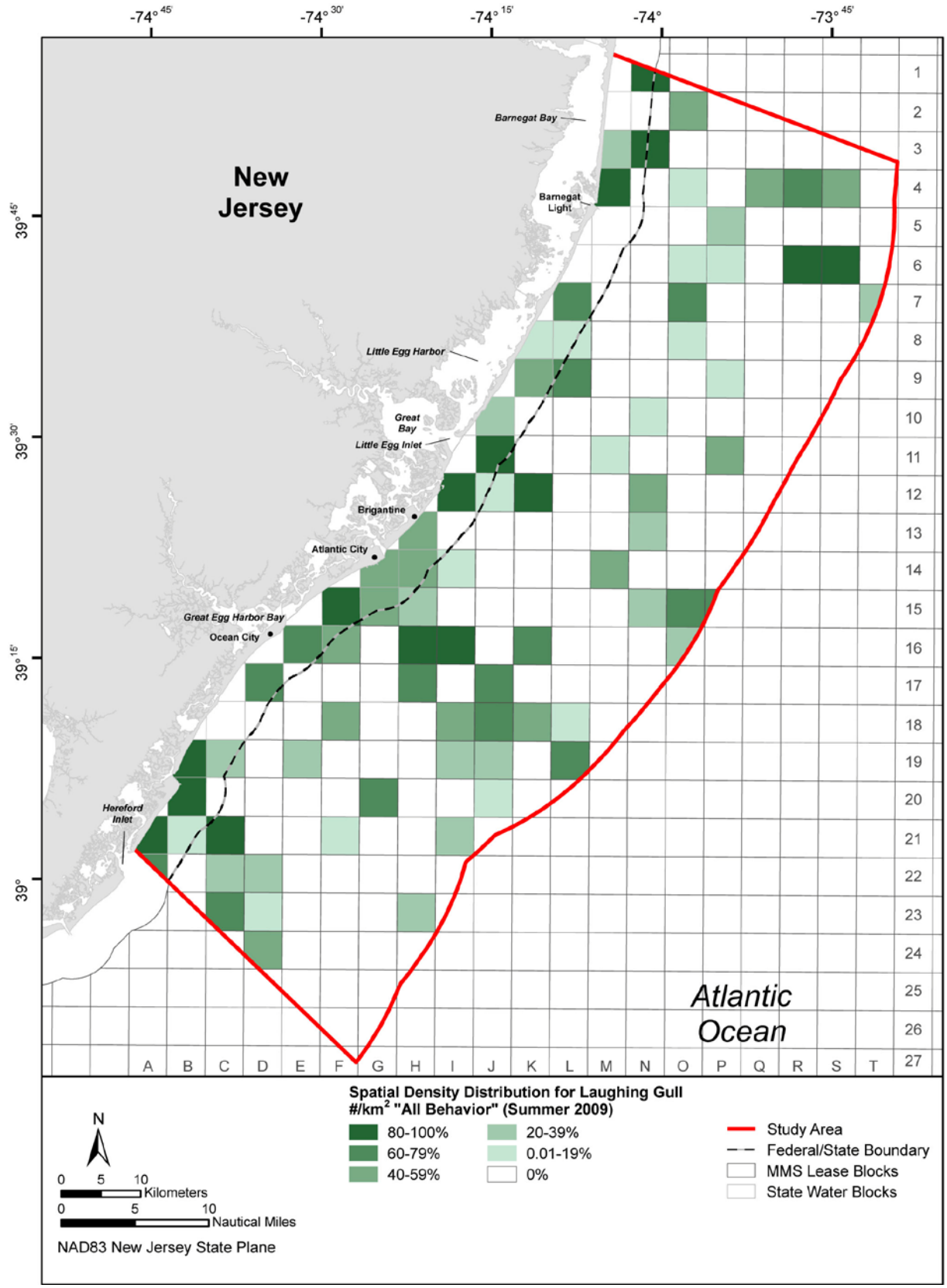

Figure C-56. Percentile abundance of Laughing Gull (all behaviors), Summer 2009 (June 2009) (n=345).

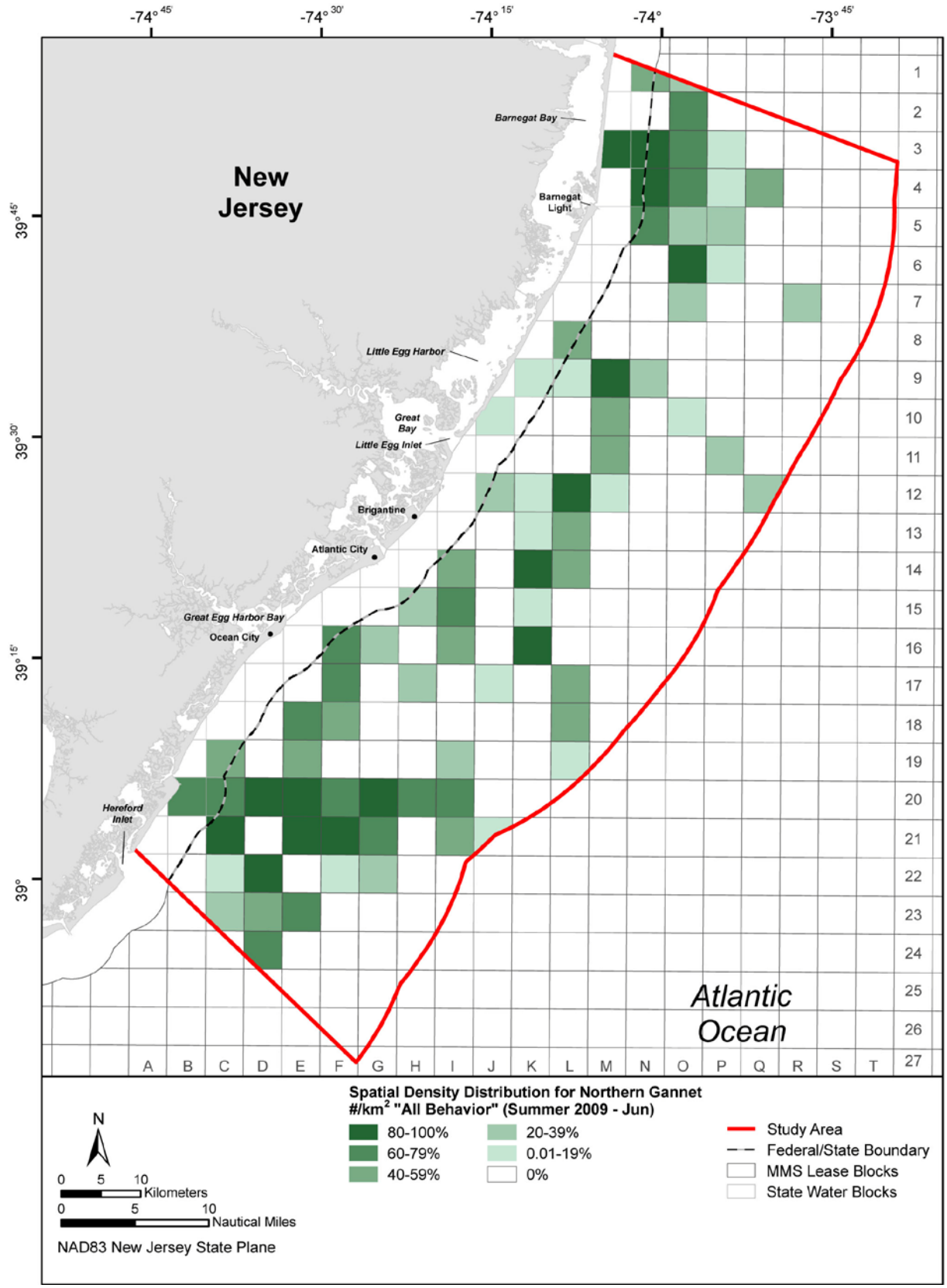

Figure C-57. Percentile abundance of Northern Gannet (all behaviors), Summer 2009 (June 2009) (n=282).

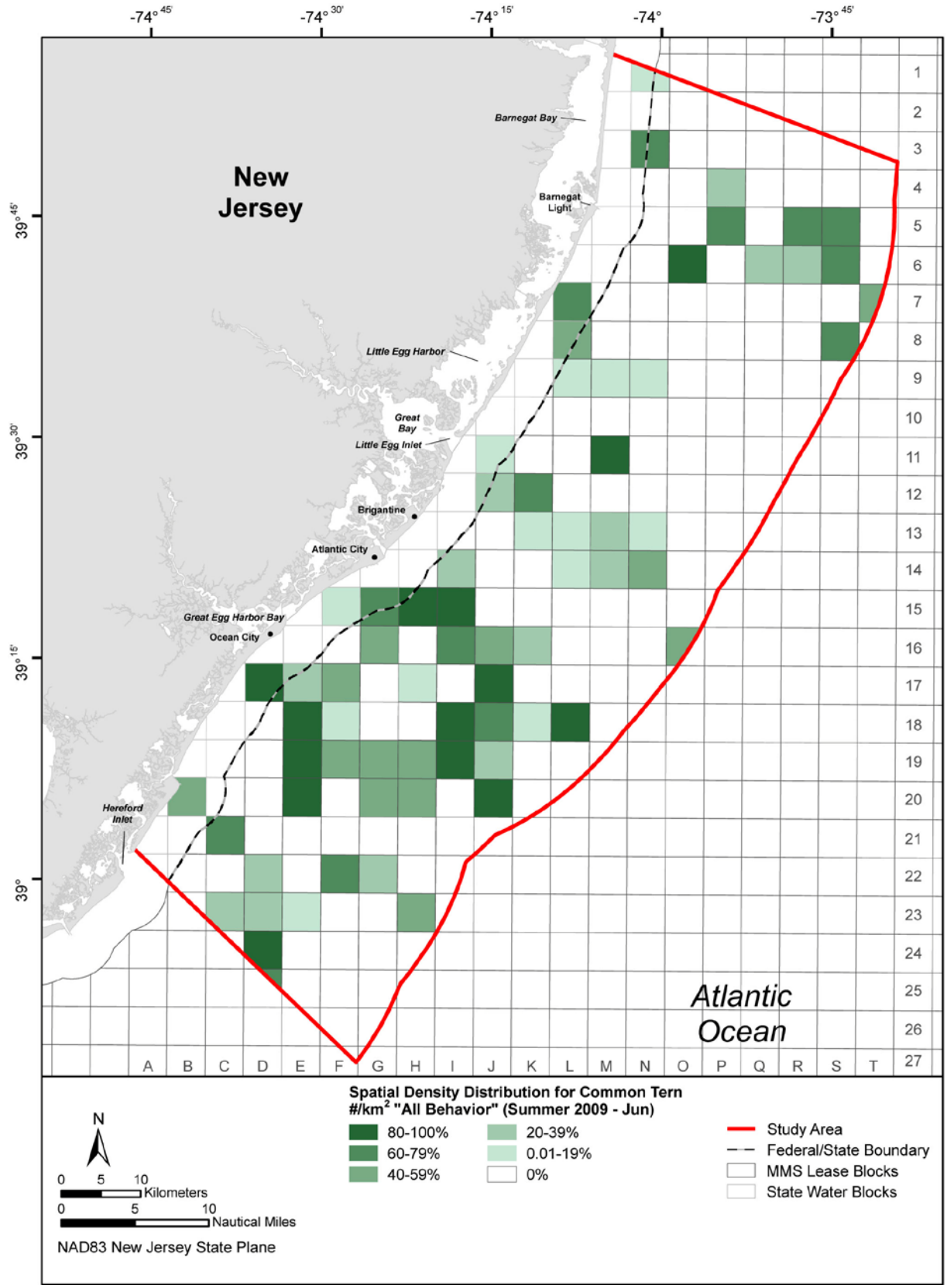

Figure C-58. Percentile abundance of Common Tern (all behaviors), Summer 2009 (June 2009) (n=201).

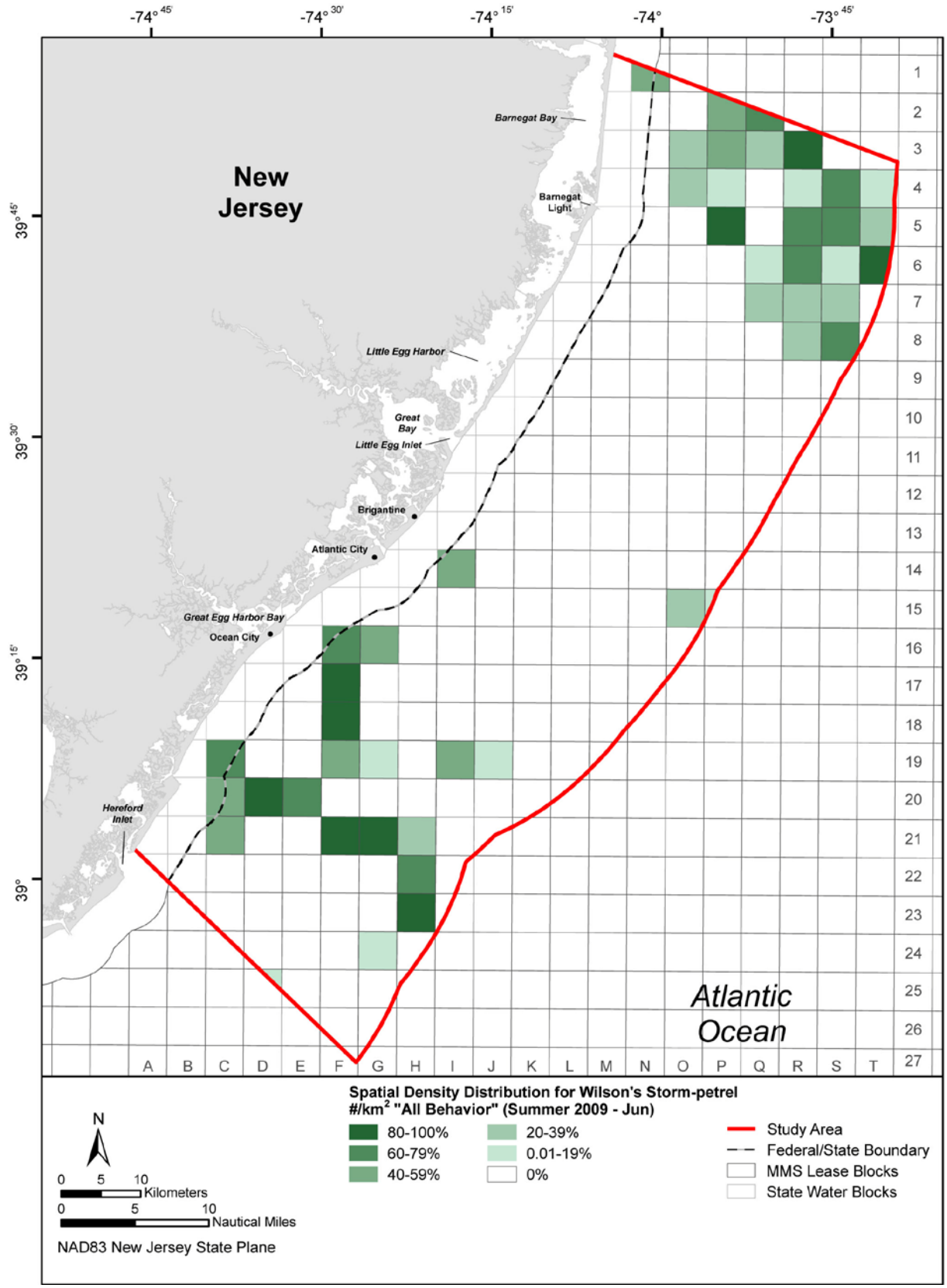

Figure C-59. Percentile abundance of Wilson's Storm-Petrel (all behaviors), Summer 2009 (June 2009) (n=113).

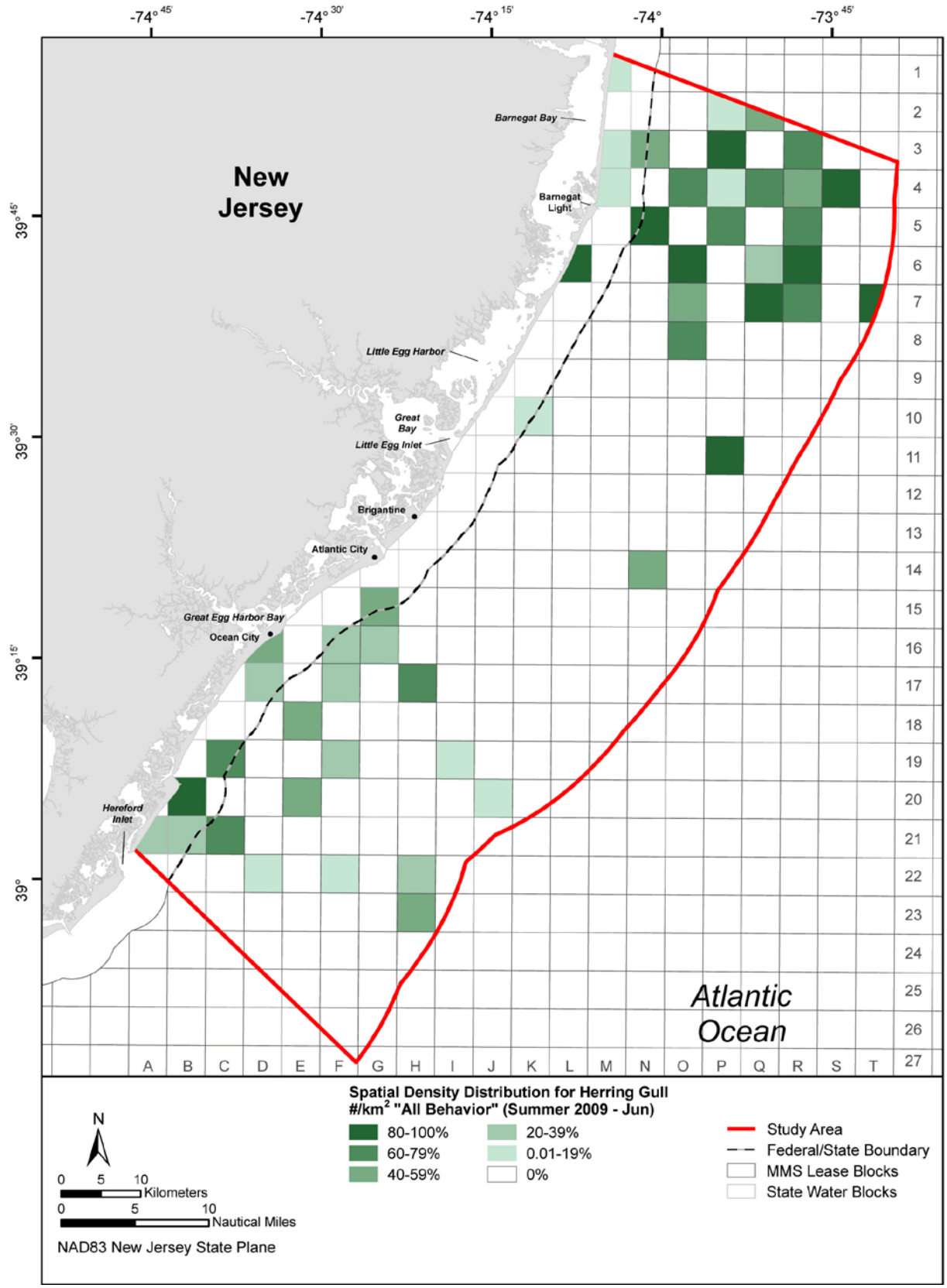

Figure C-60. Percentile abundance of Herring Gull (all behaviors), Summer 2009 (June 2009) (n=86).

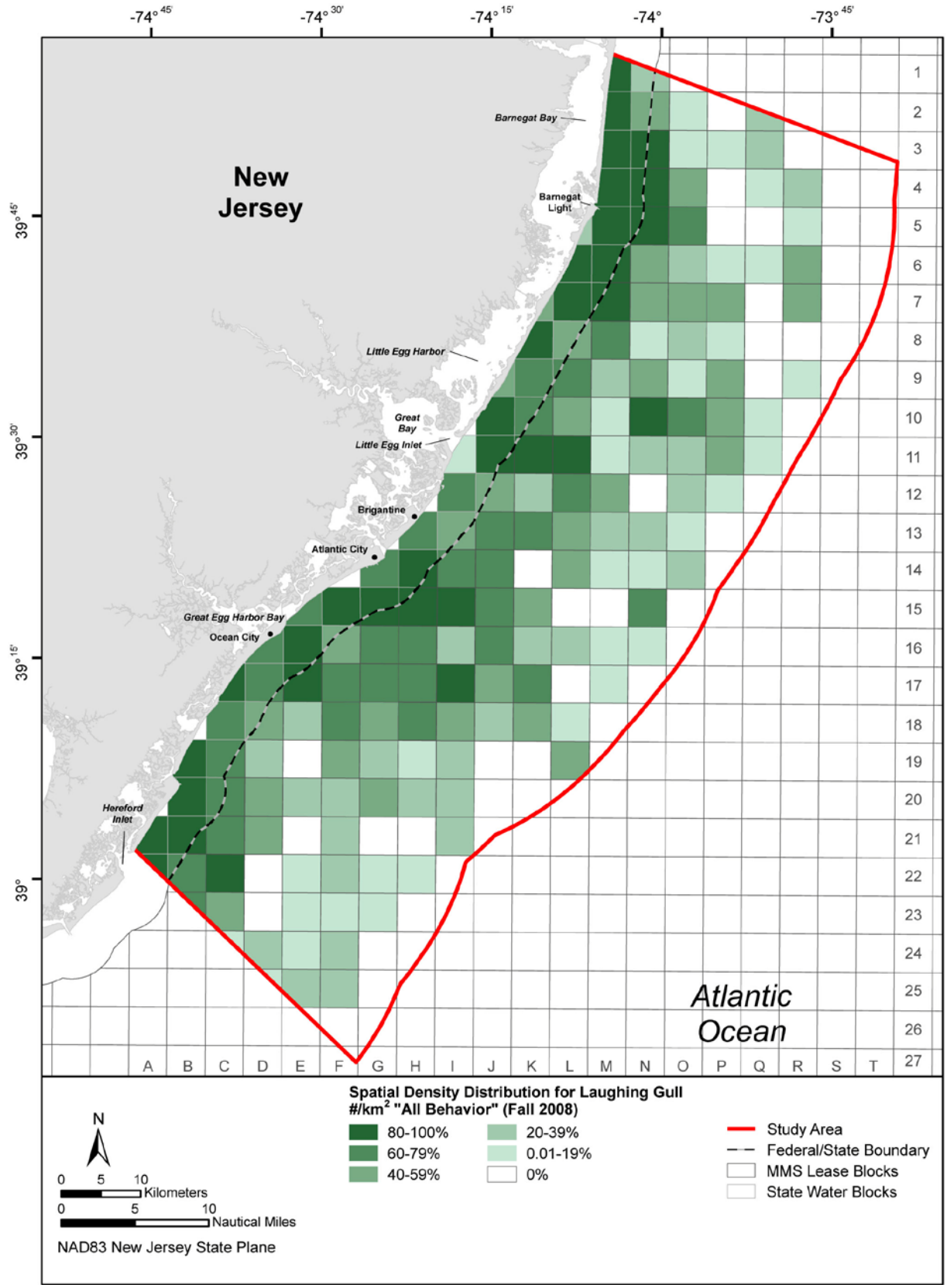

Figure C-61. Percentile abundance of Laughing Gull (all behaviors), Fall 2008 (August-November 2008) (n=3,639).

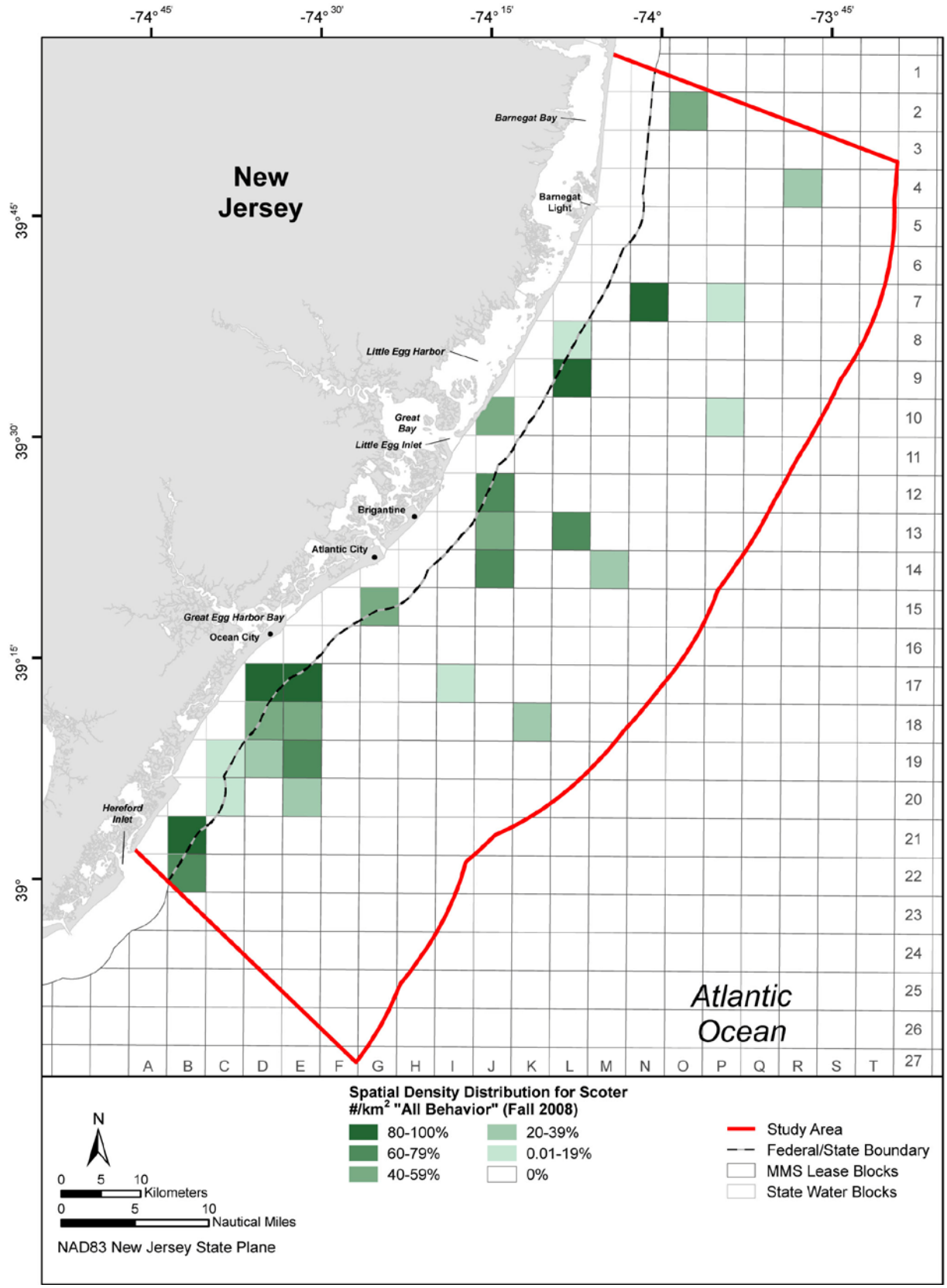

Figure C-62. Percentile abundance of scoters (all behaviors), Fall 2008 (August-November 2008) (n=3,554).

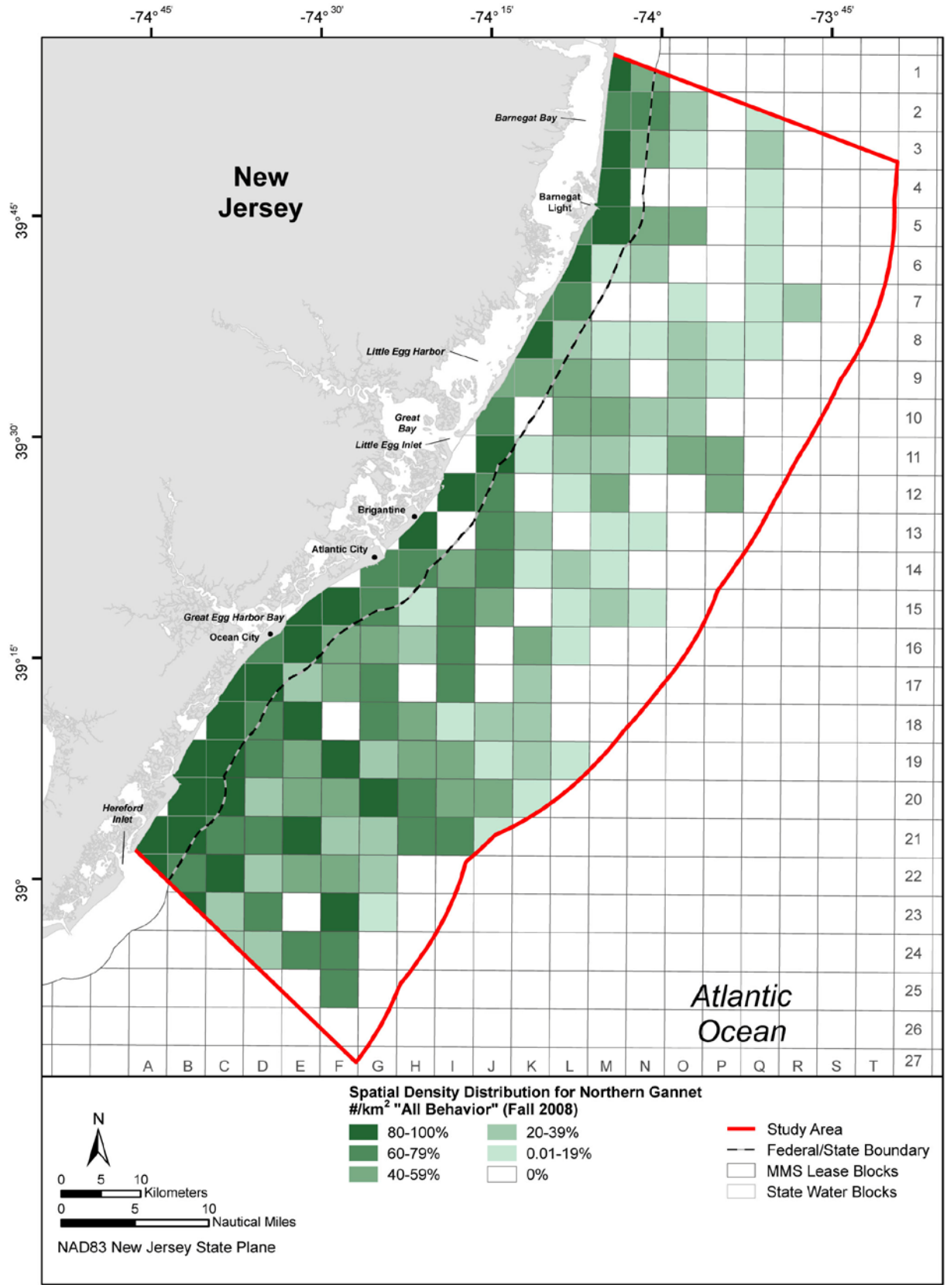

Figure C-63. Percentile abundance of Northern Gannet (all behaviors), Fall 2008 (August-November 2008) (n=3,282).

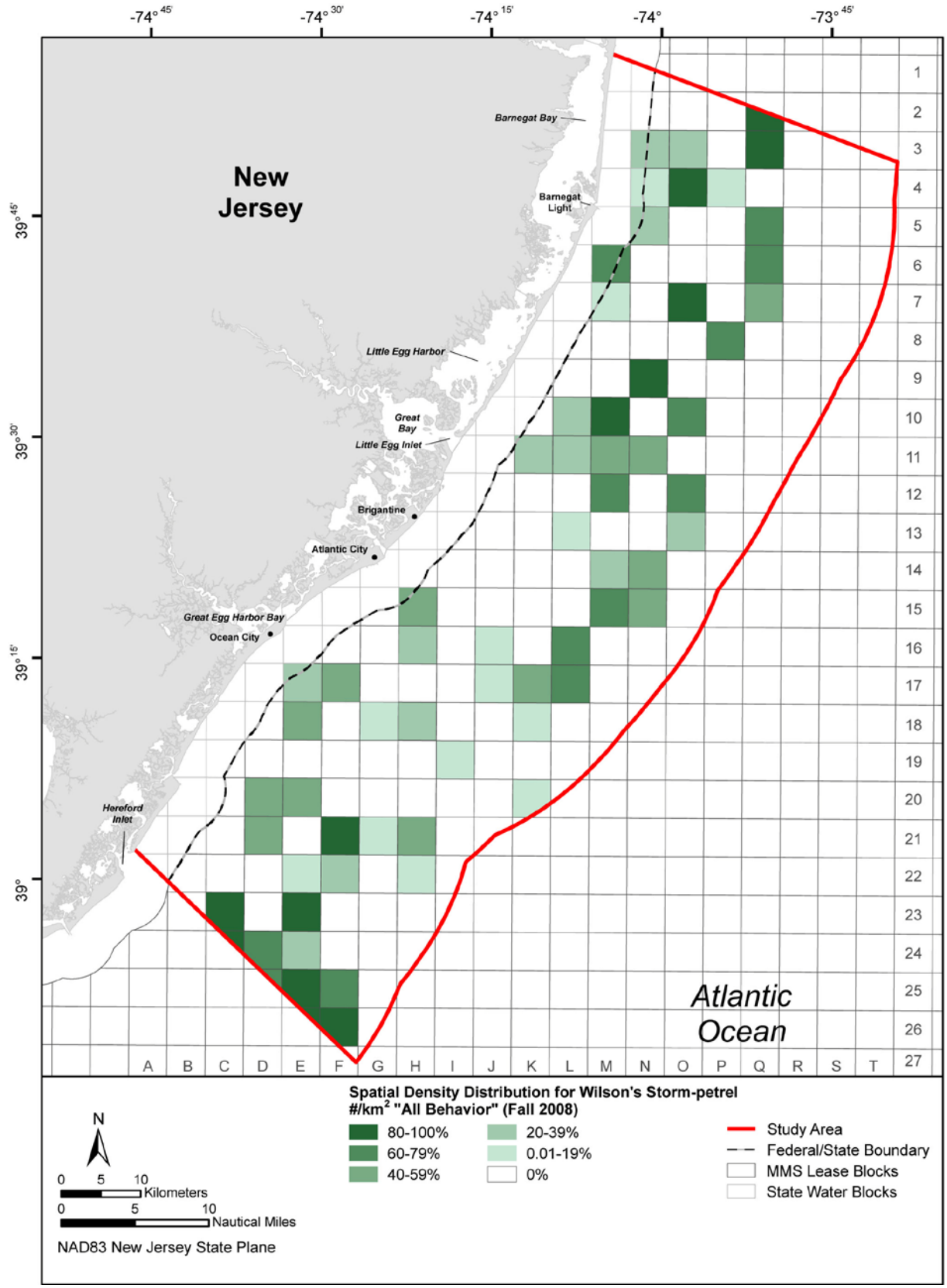

Figure C-64. Percentile abundance of Wilson's Storm-Petrel (all behaviors), Fall 2008 (August-November 2008) (n=1,245).

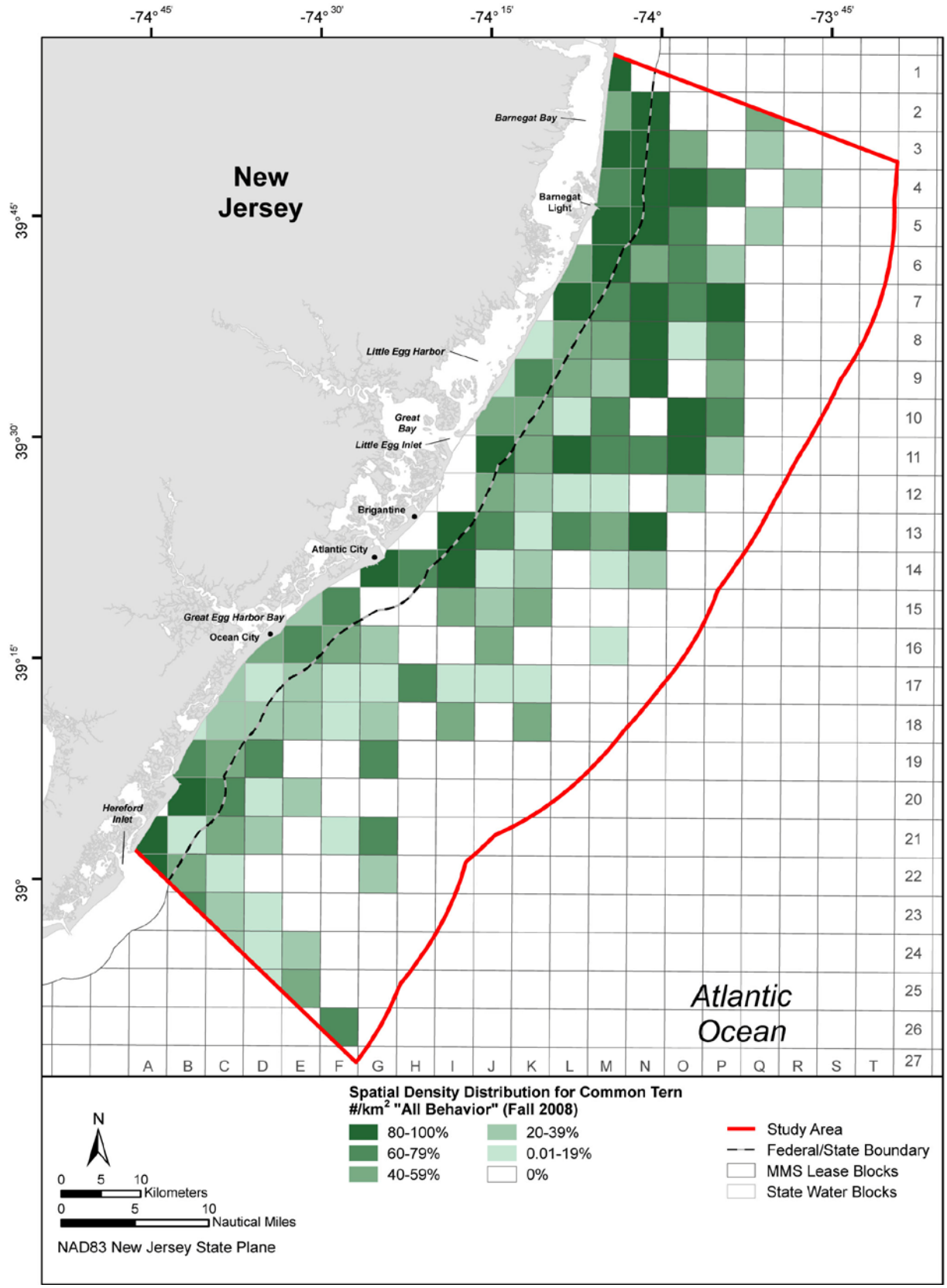

Figure C-65. Percentile abundance of Common Tern (all behaviors), Fall 2008 (August-November 2008) (n=1,071).

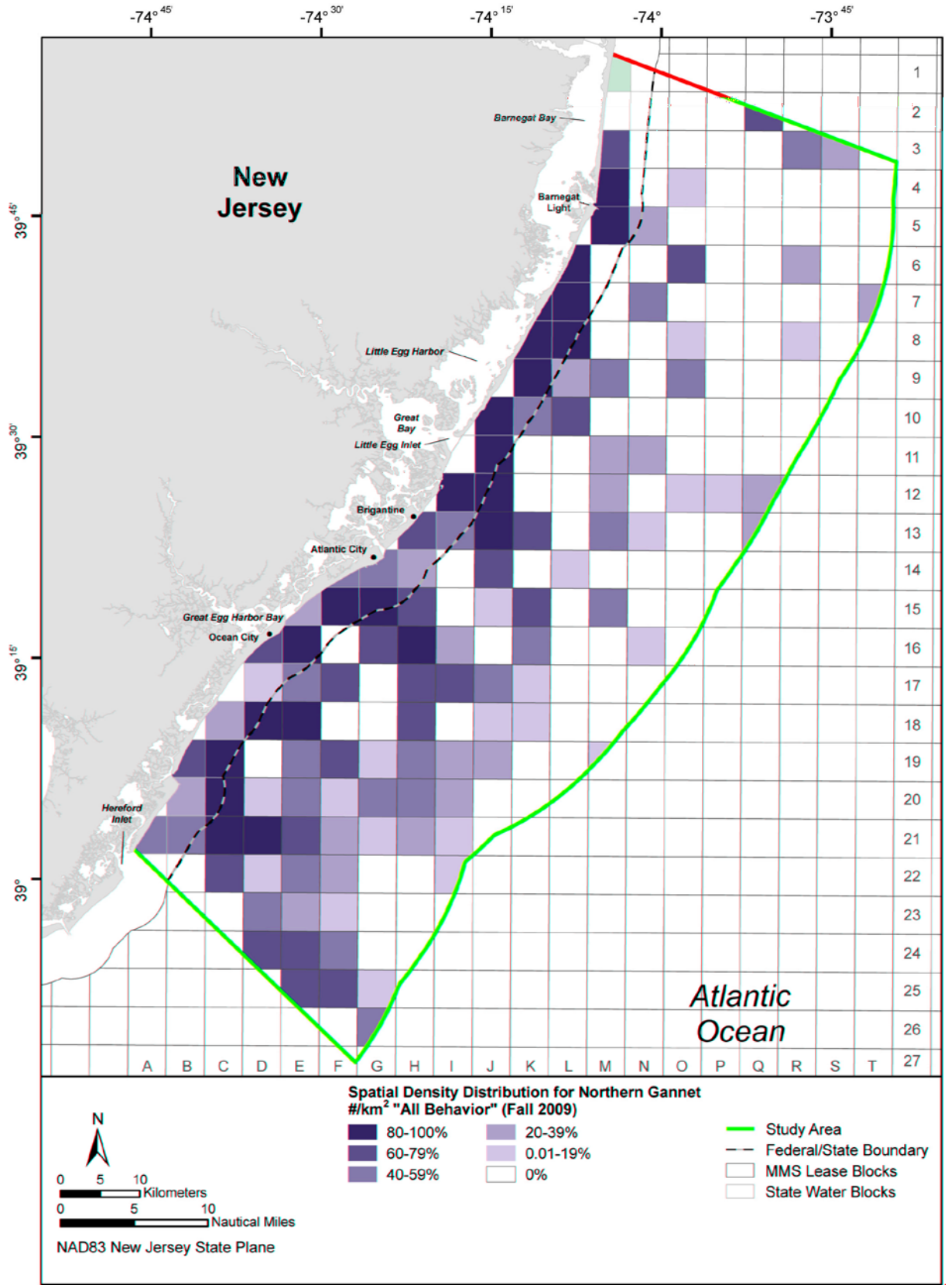

Figure C-66. Percentile abundance of Northern Gannet (all behaviors), Fall 2009 (August-November 2009) (n=2,404).

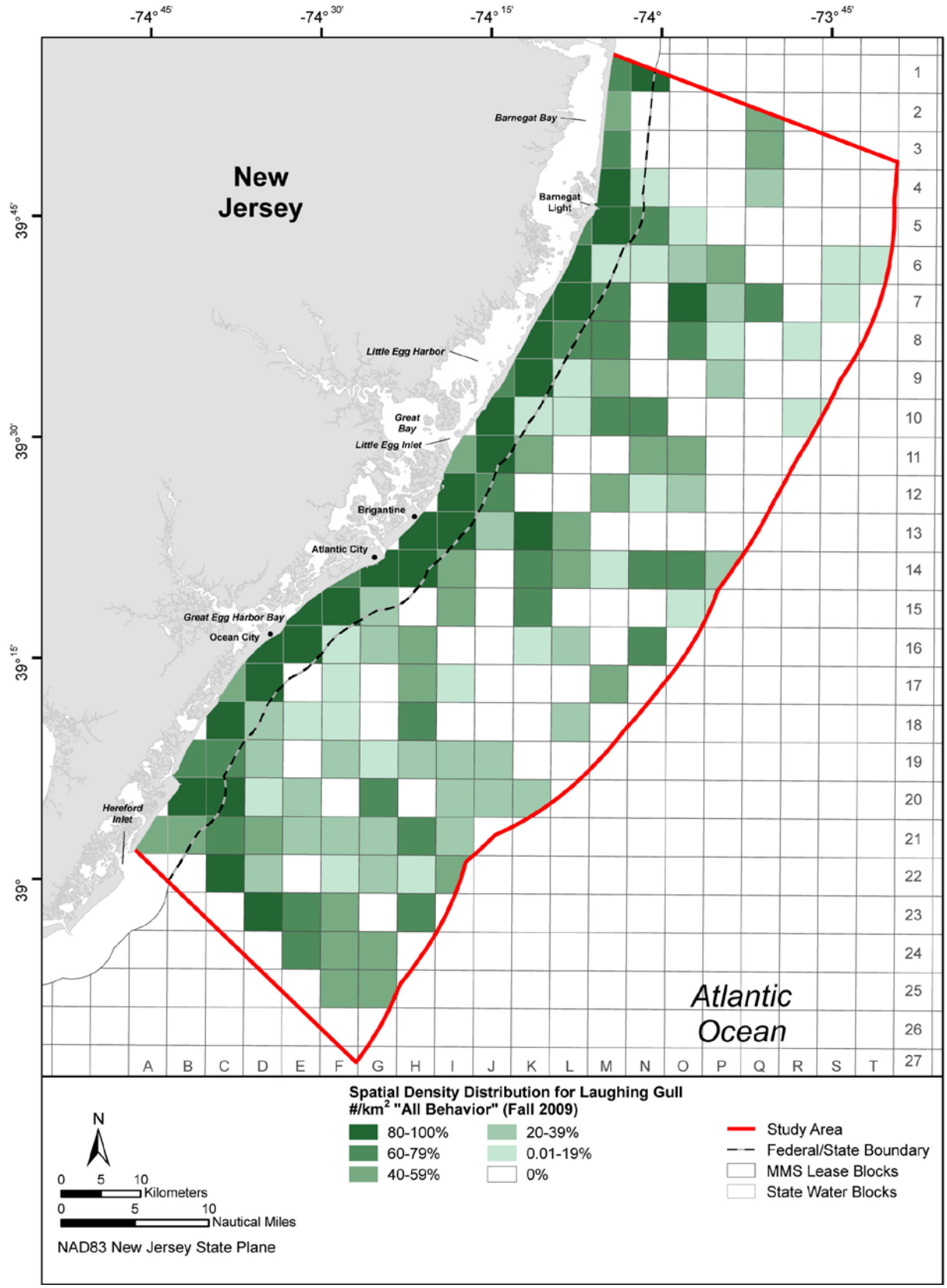

Figure C-67. Percentile abundance of Laughing Gull (all behaviors), Fall 2009 (August-November 2009) (n=1,542).

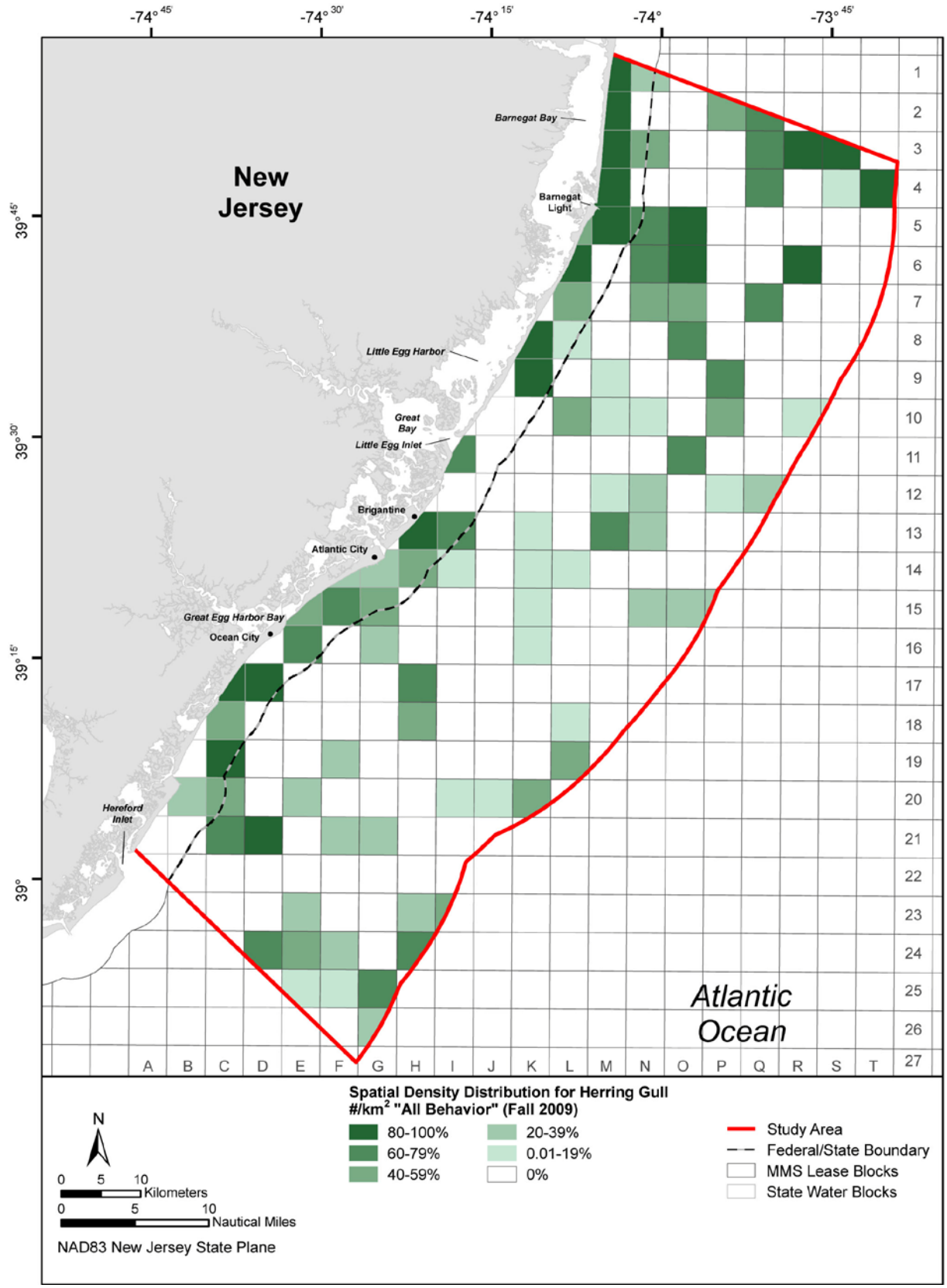

Figure C-68. Percentile abundance of Herring Gull (all behaviors), Fall 2009 (August-November 2009) (n=641).

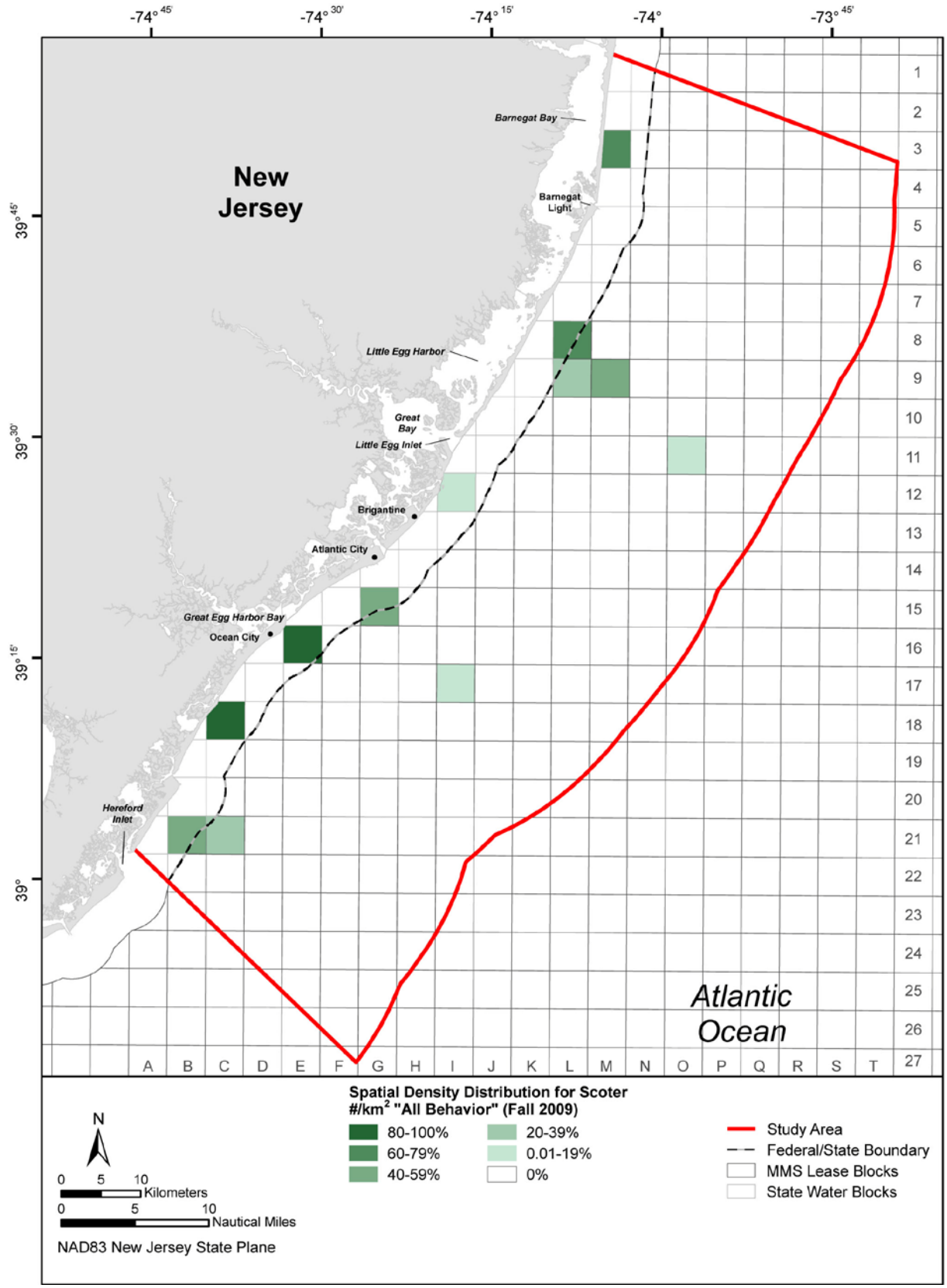

Figure C-69. Percentile abundance of scoters (all behaviors), Fall 2009 (August-November 2009) (n=637).

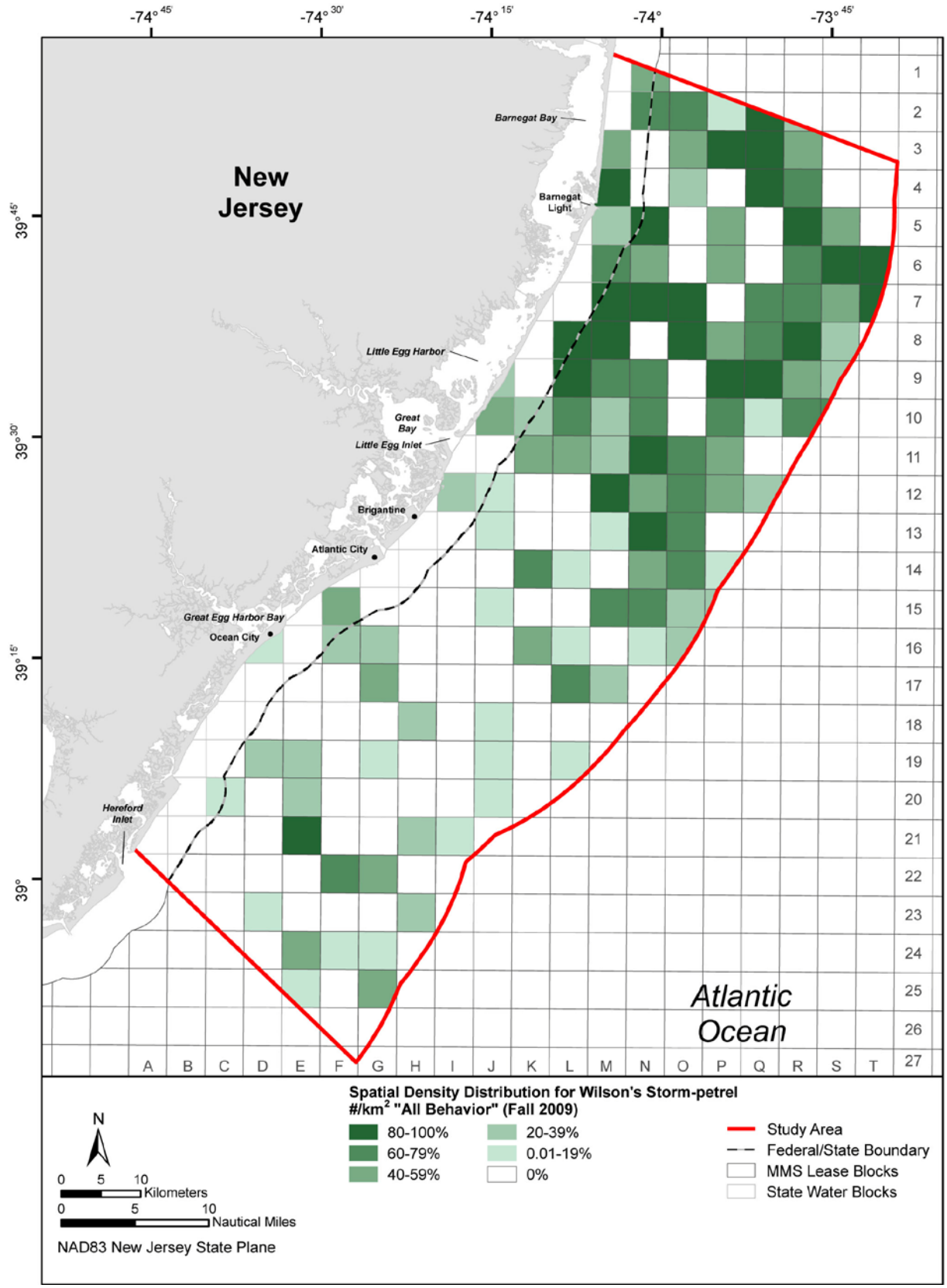

Figure C-70. Percentile abundance of Wilson's Storm-Petrel (all behaviors), Fall 2009 (August-November 2009) (n=570).

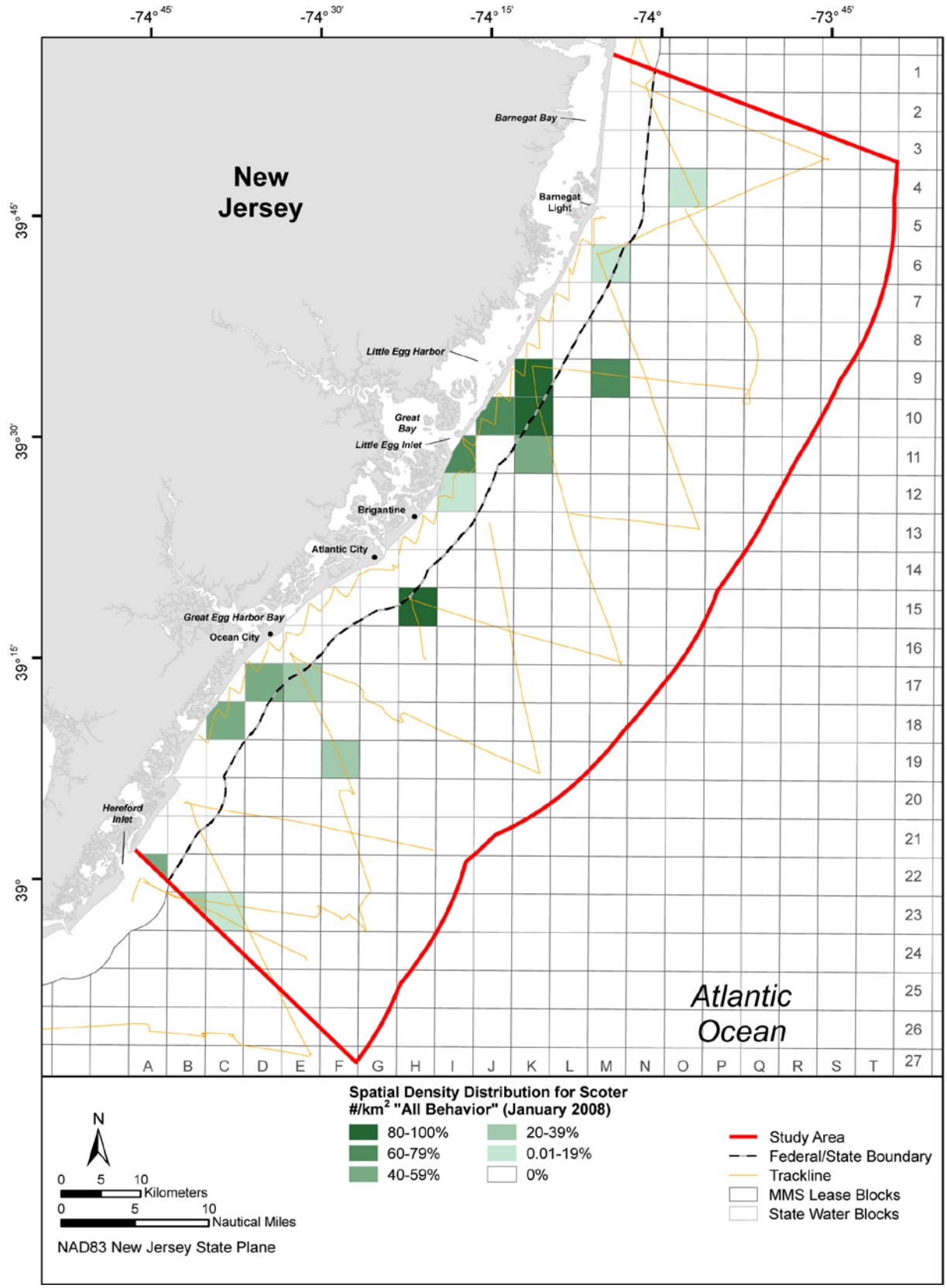

Figure C-71. Percentile abundance of scoters (all behaviors), January 2008 (n=912).

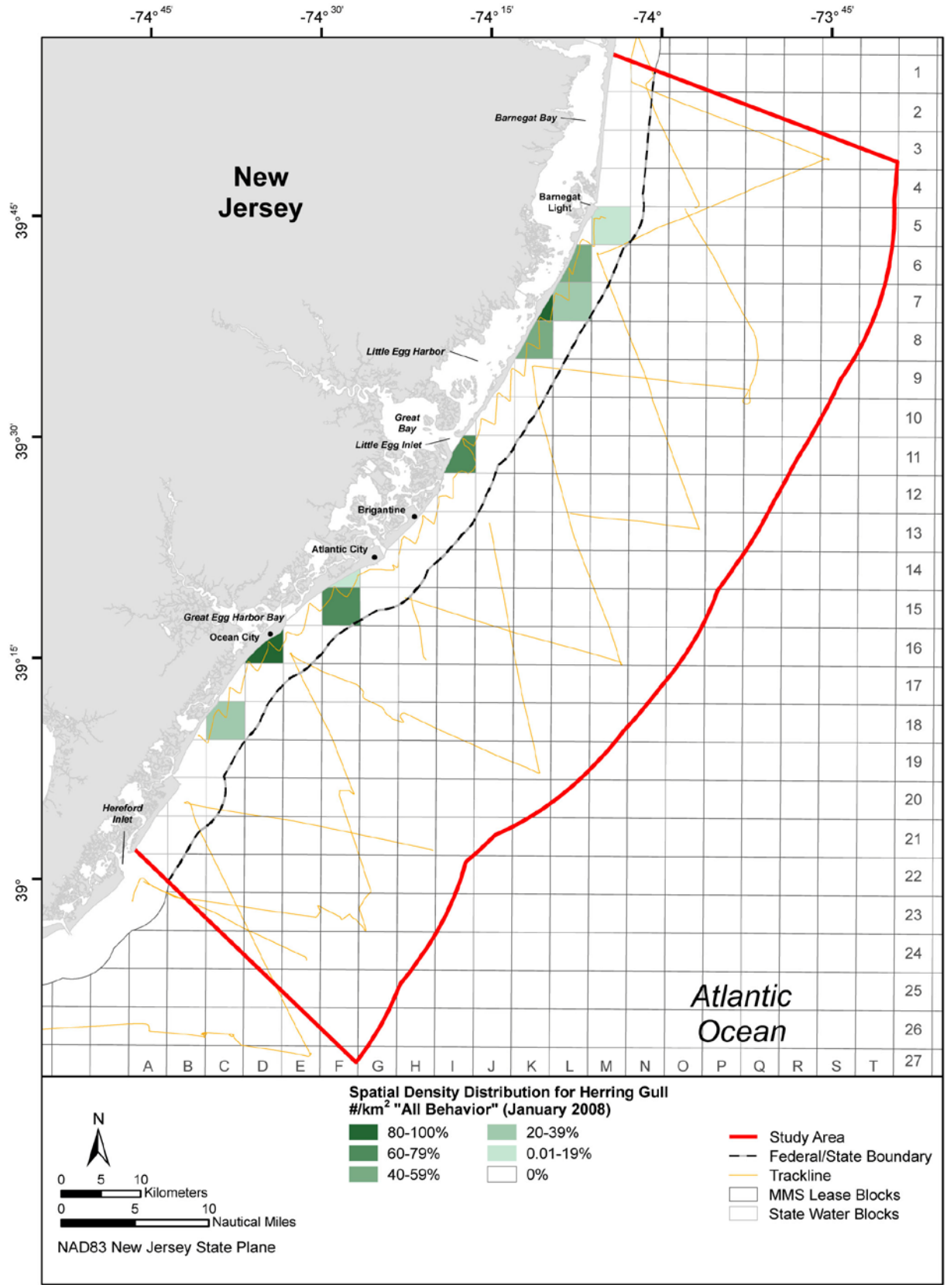

Figure C-72. Percentile abundance of Herring Gull (all behaviors), January 2008 (n=367).

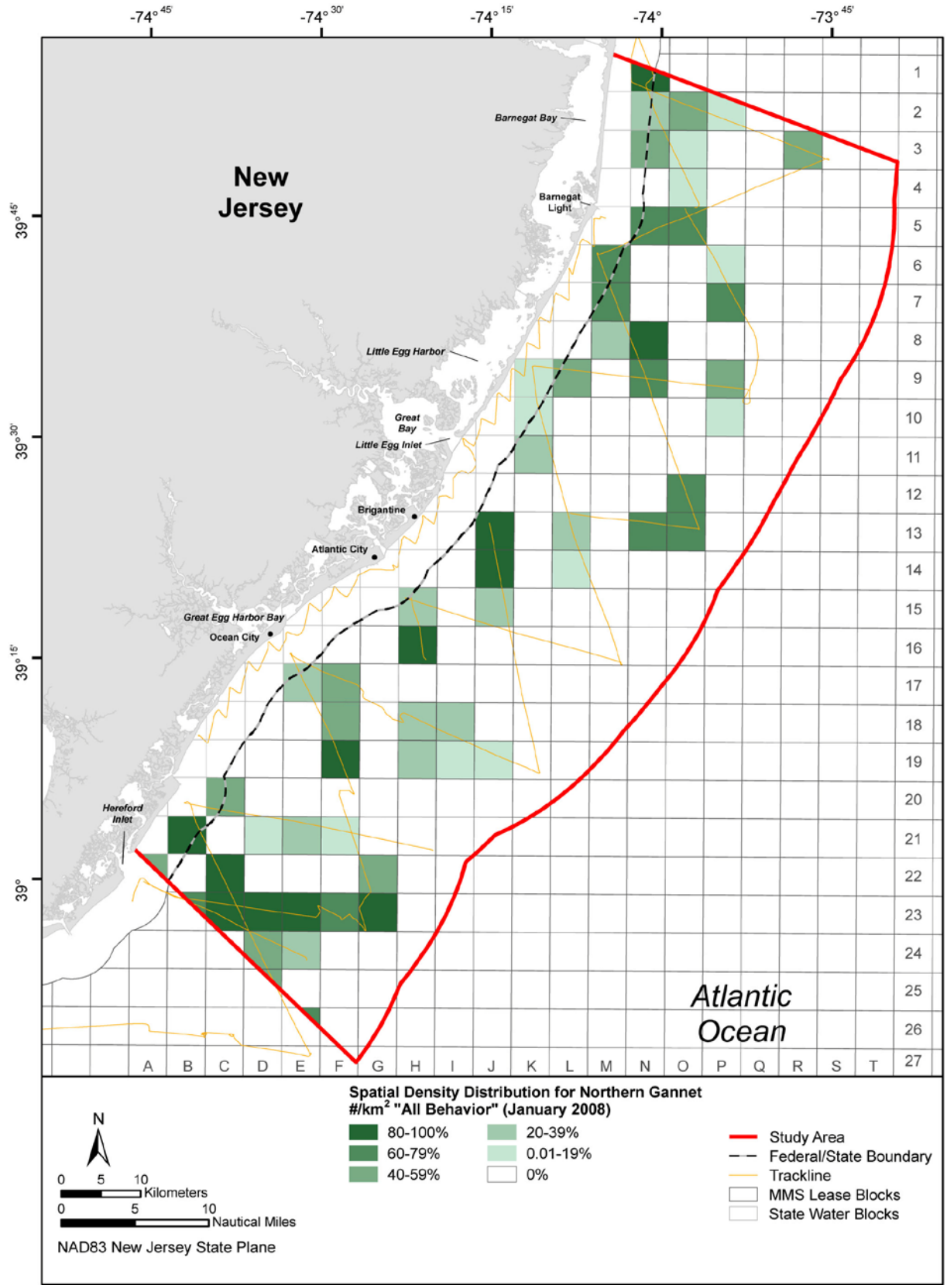

Figure C-73. Percentile abundance of Northern Gannet (all behaviors), January 2008 (n=357).

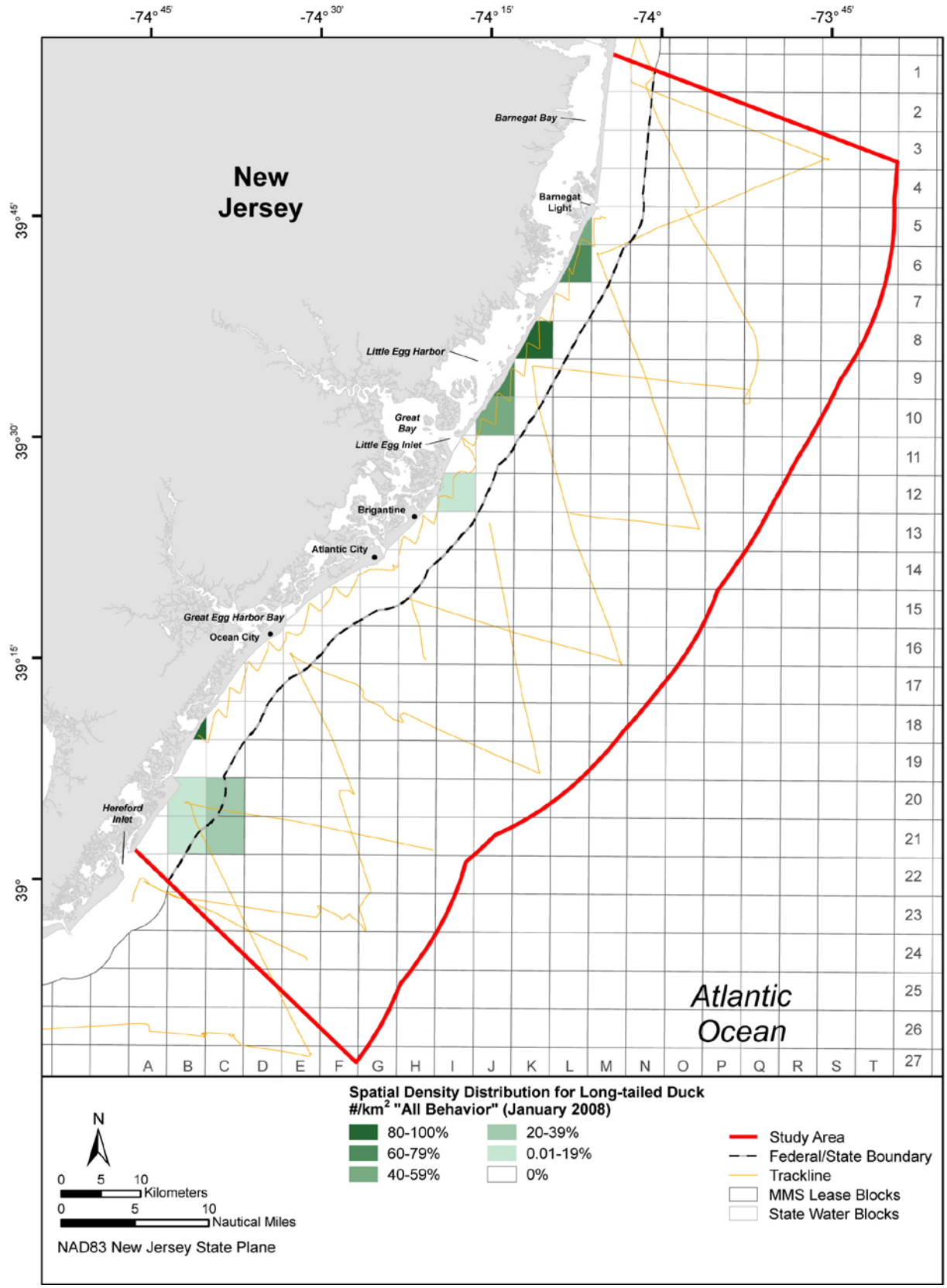

Figure C-74. Percentile abundance of Long-tailed Duck (all behaviors), January 2008 (n=245).

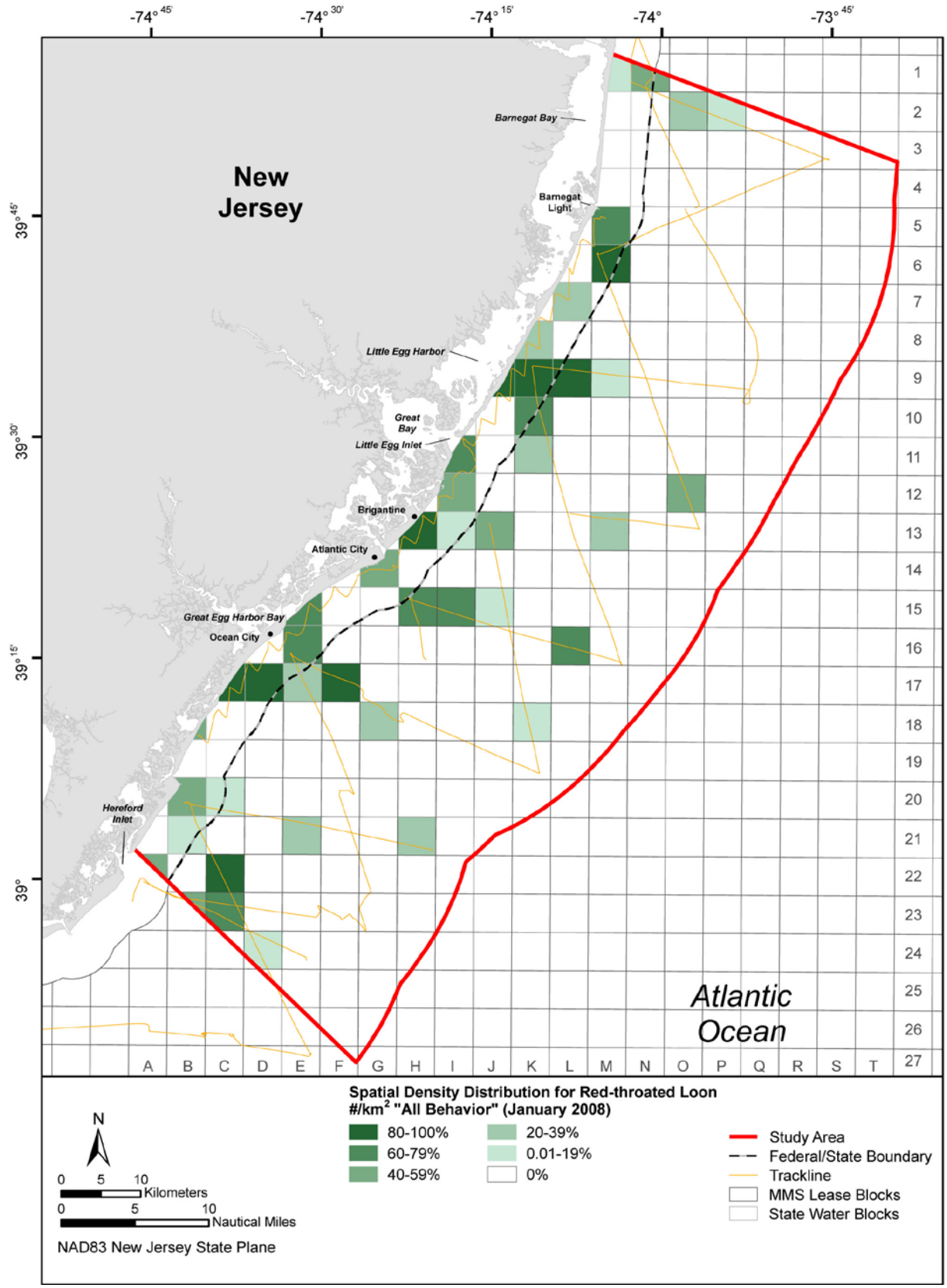

Figure C-75. Percentile abundance of Red-throated Loon (all behaviors), January 2008 (n=160).

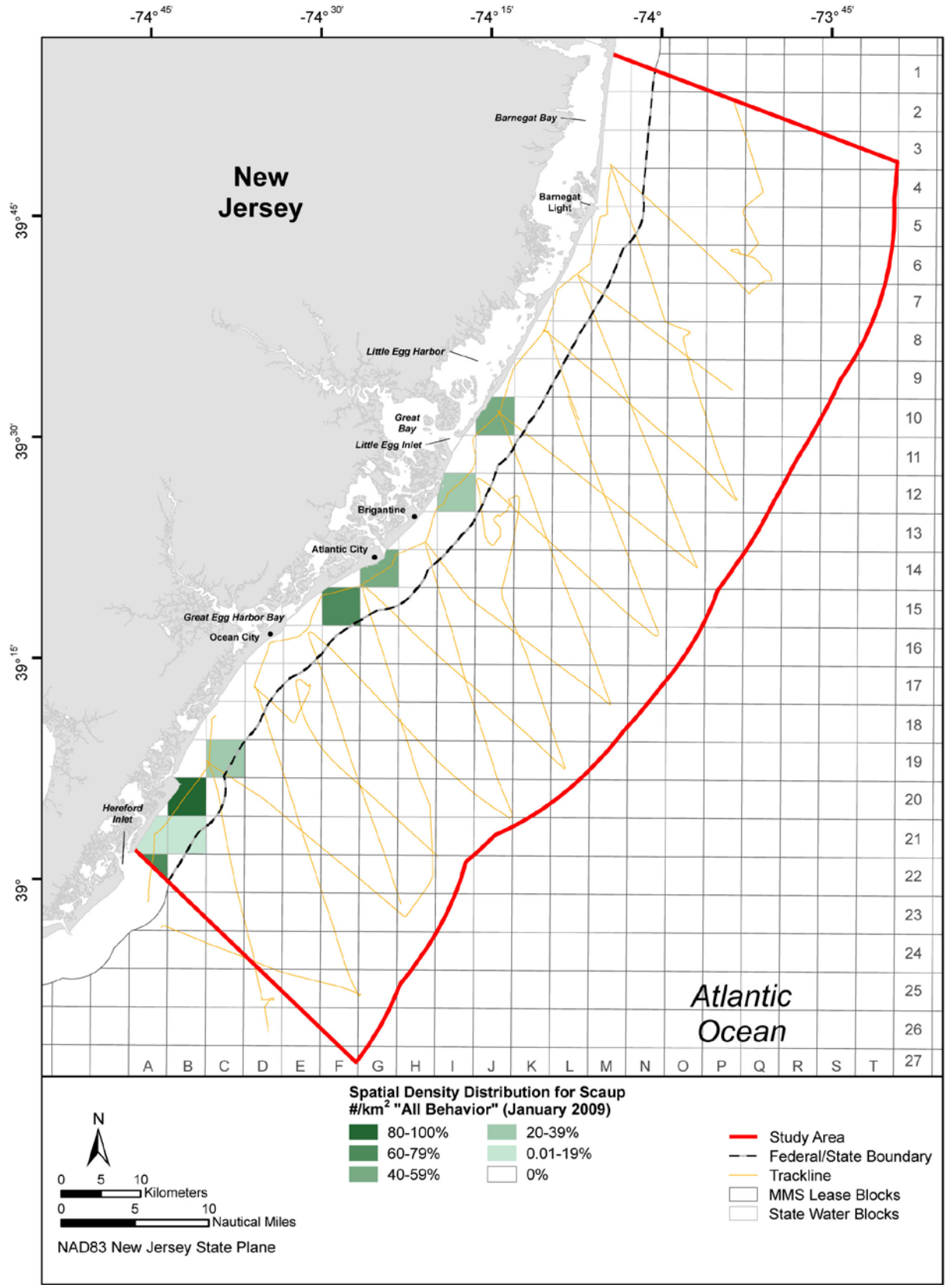

Figure C-76. Percentile abundance of scaup (all behaviors), January 2009 (n=2,469).

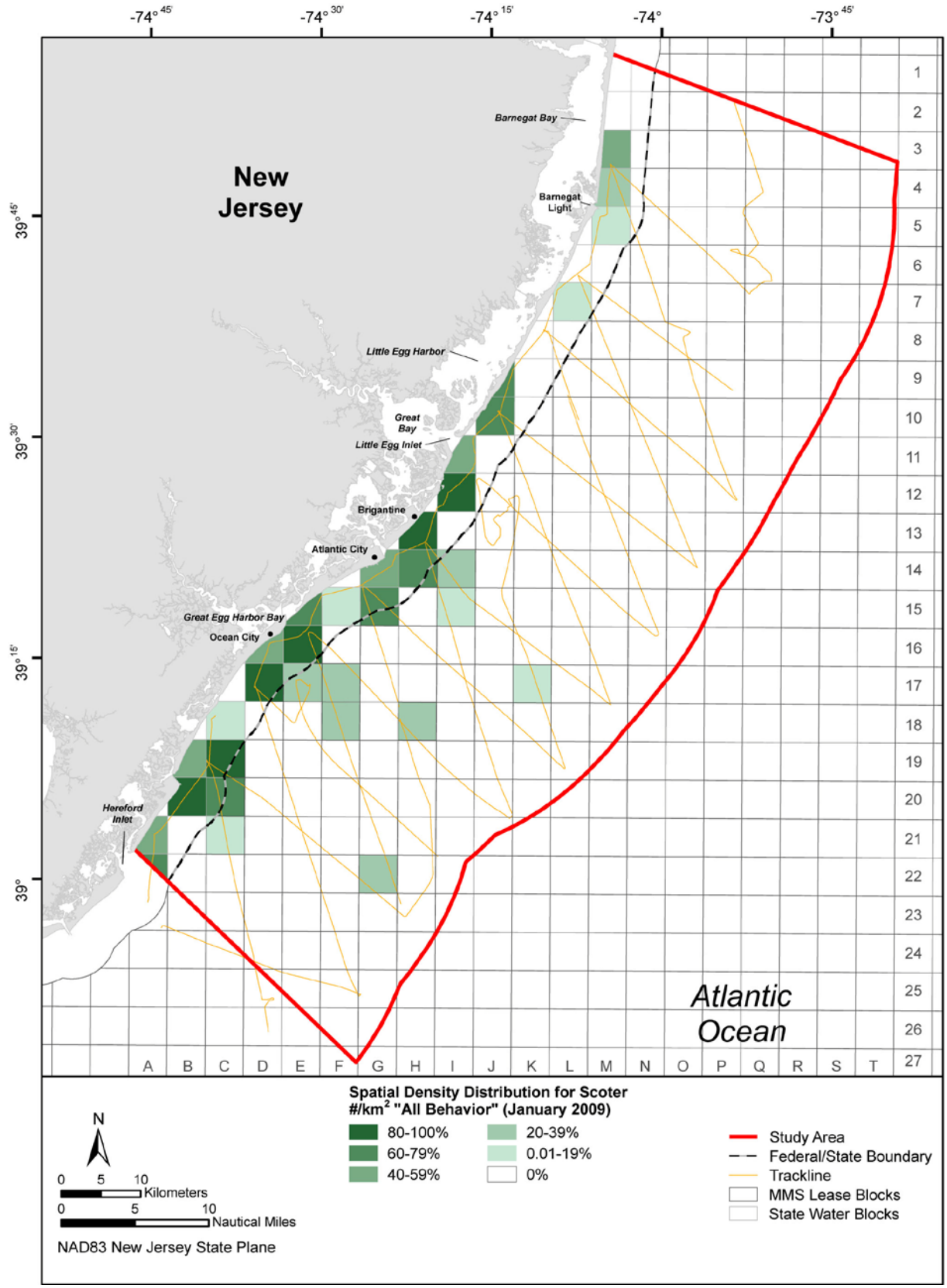

Figure C-77. Percentile abundance of scoters (all behaviors), January 2009 (n=2,459).

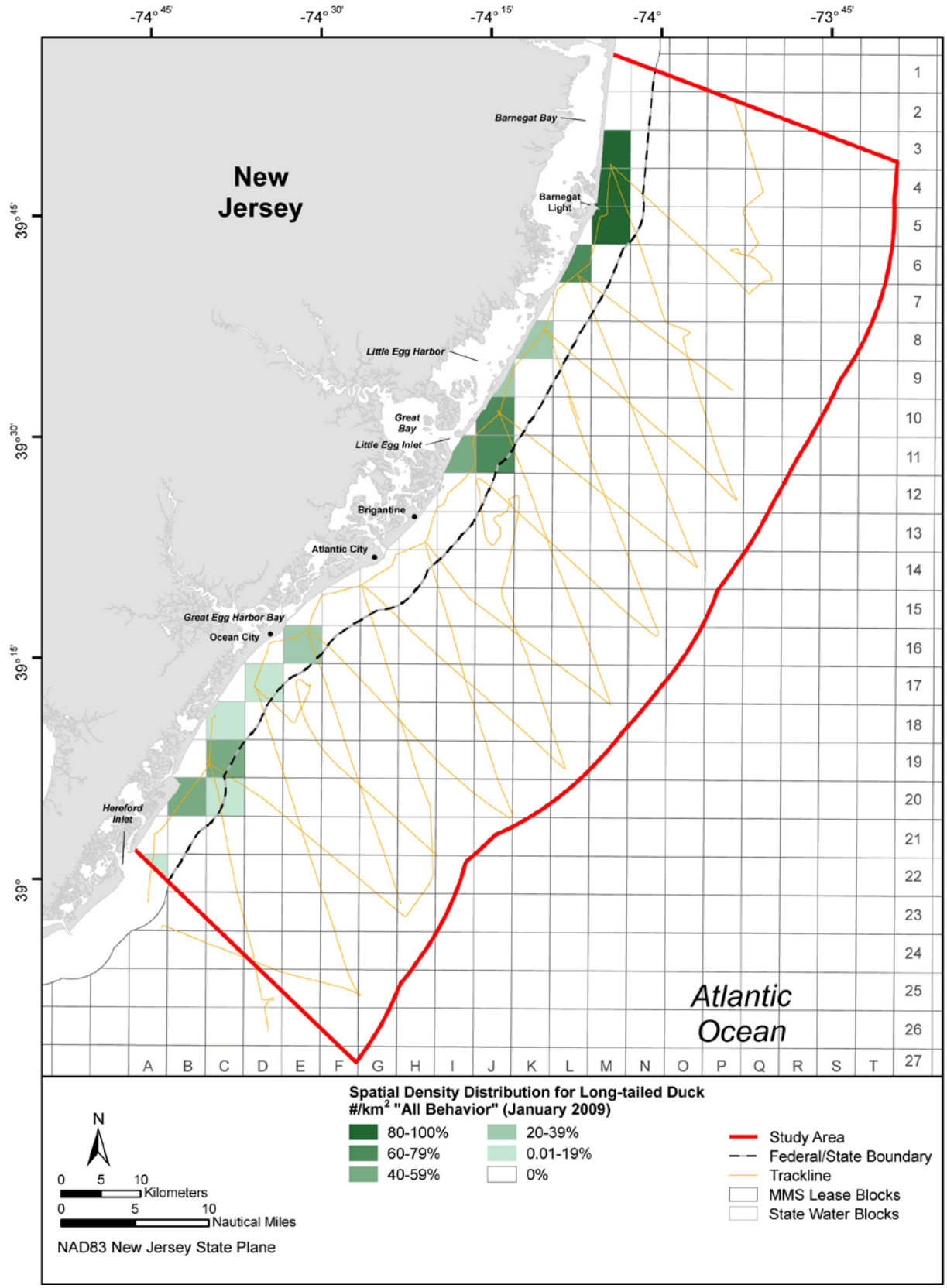

Figure C-78. Percentile abundance of Long-tailed Duck (all behaviors), January 2009 (n=895).

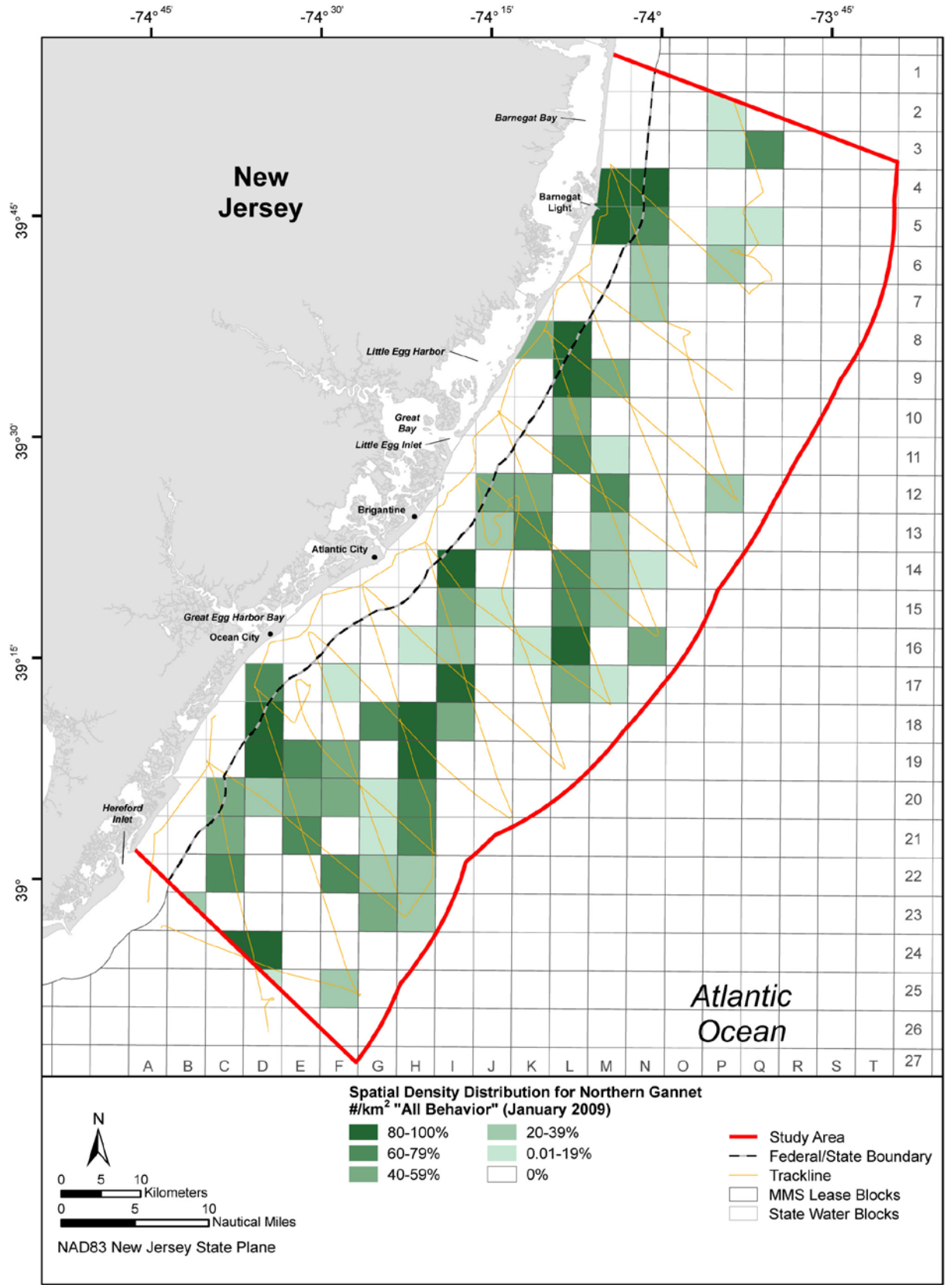

Figure C-79. Percentile abundance of Northern Gannet (all behaviors), January 2009 (n=421).

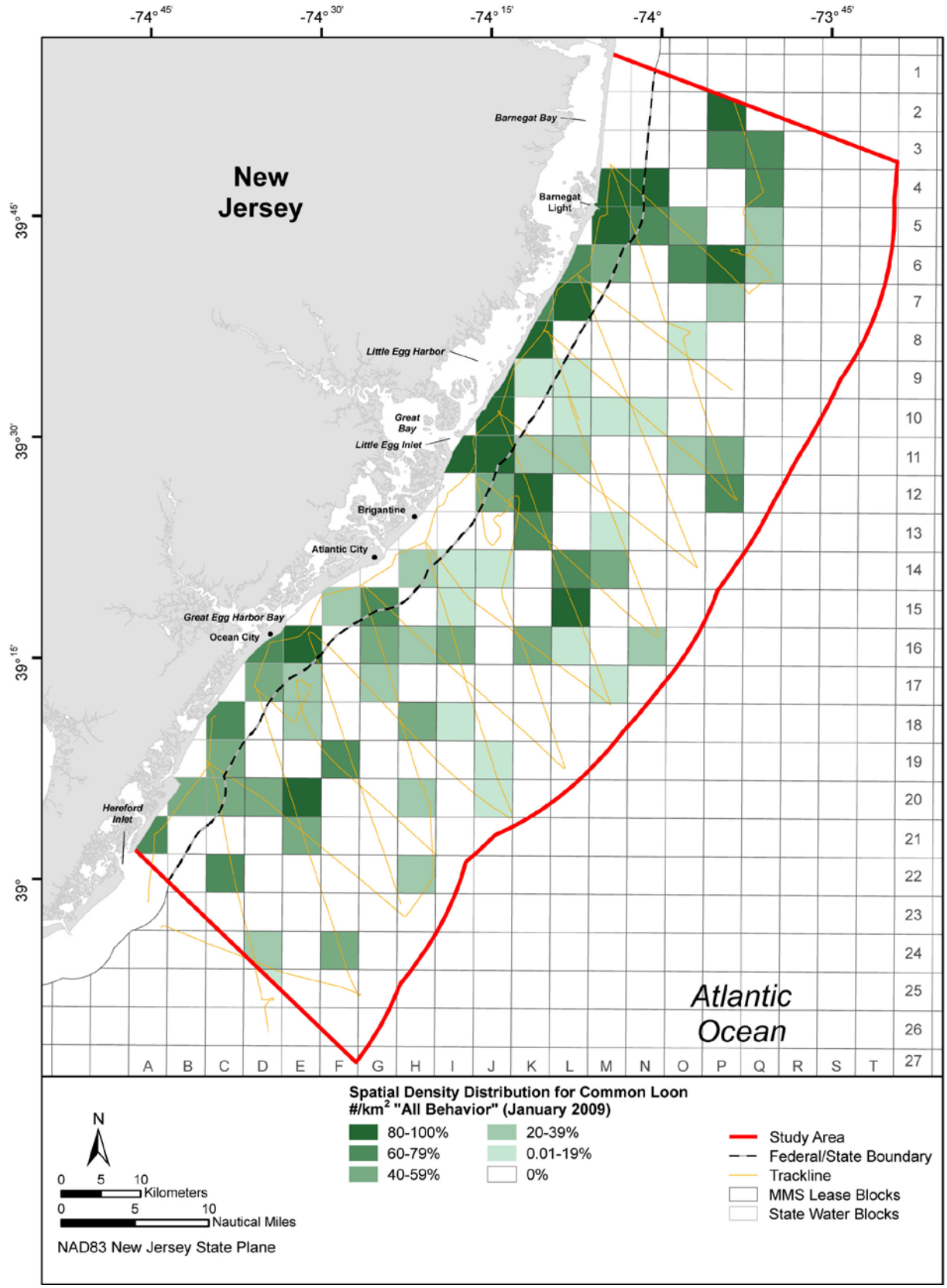

Figure C-80. Percentile abundance of Common Loon (all behaviors), January 2009 (n=314).

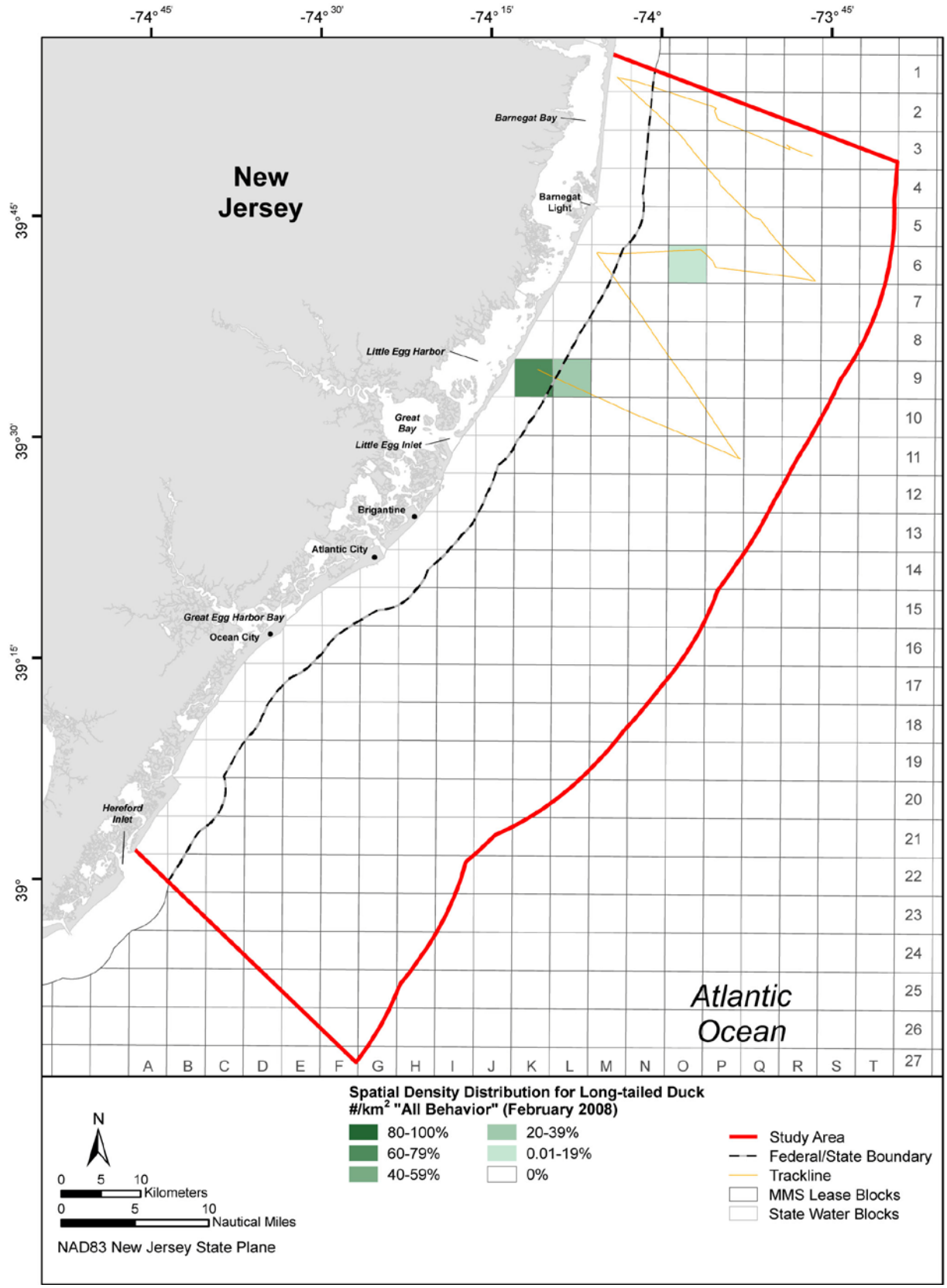

Figure C-81. Percentile abundance of Long-tailed Duck (all behaviors), February 2008 (n=48).

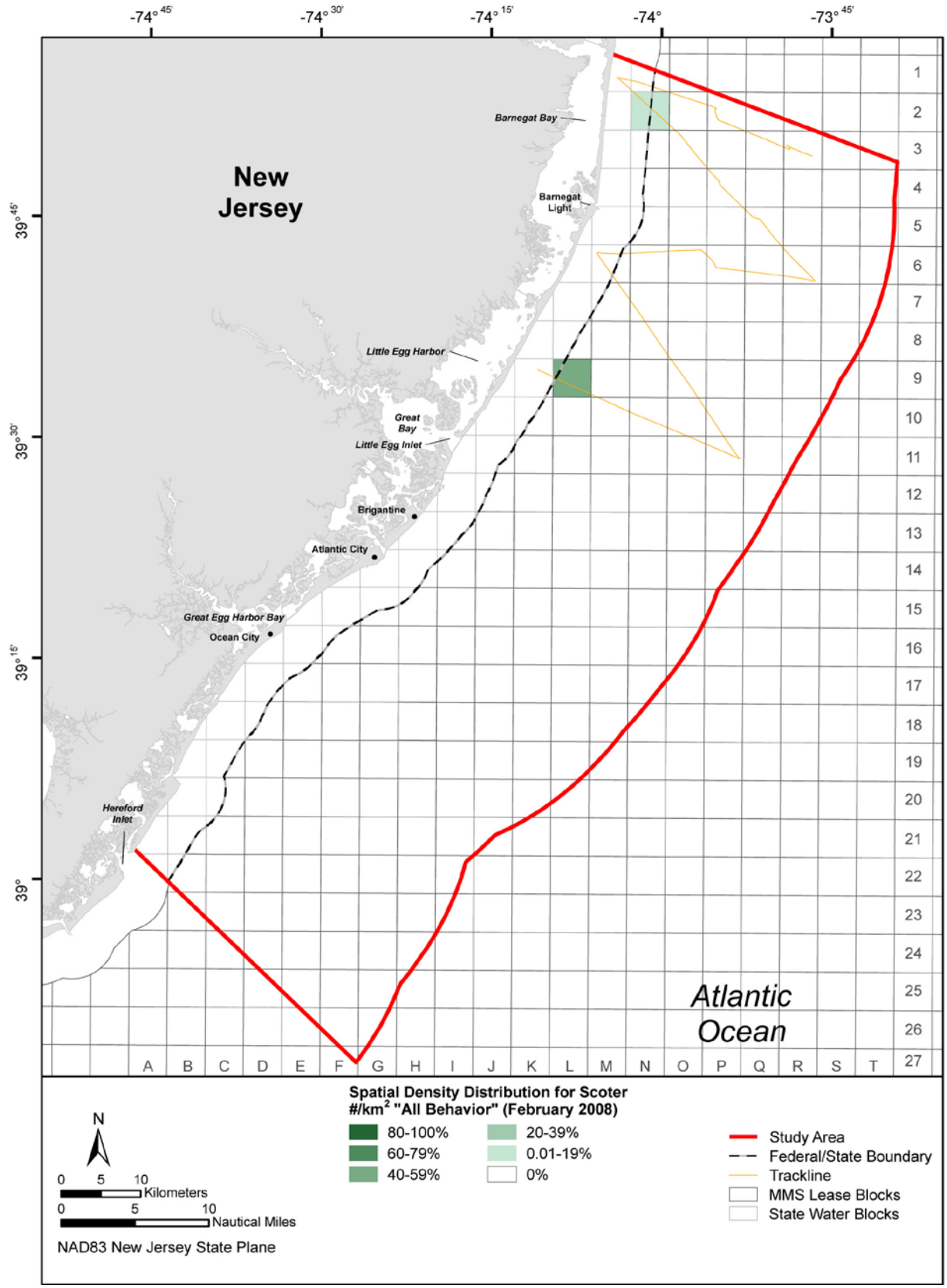

Figure C-82. Percentile abundance of scoters (all behaviors), February 2008 (n=38).

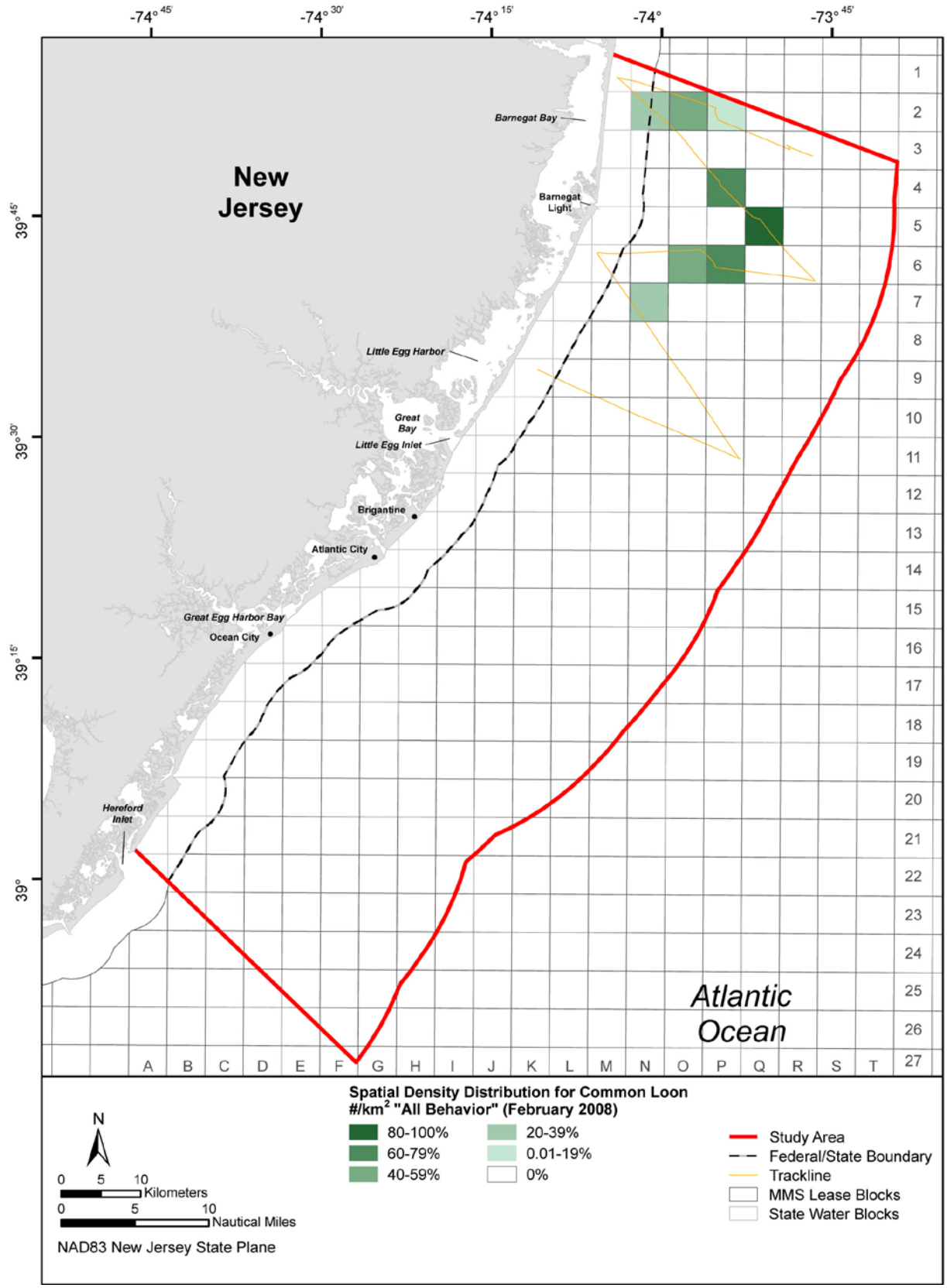

Figure C-83. Percentile abundance of Common Loon (all behaviors), February 2008 (n=20).

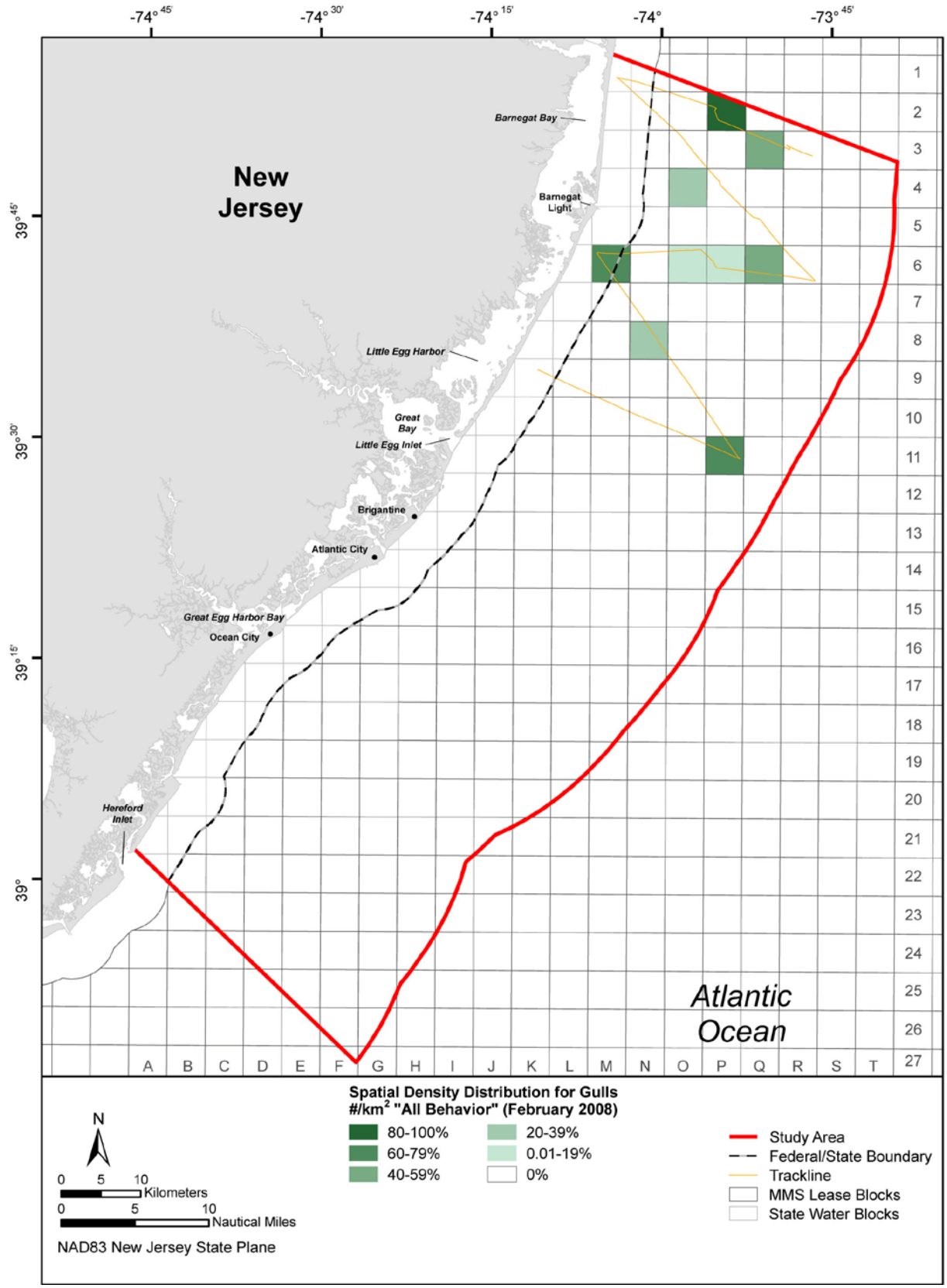

Figure C-84. Percentile abundance of gulls (all behaviors), February 2008 (n=11).

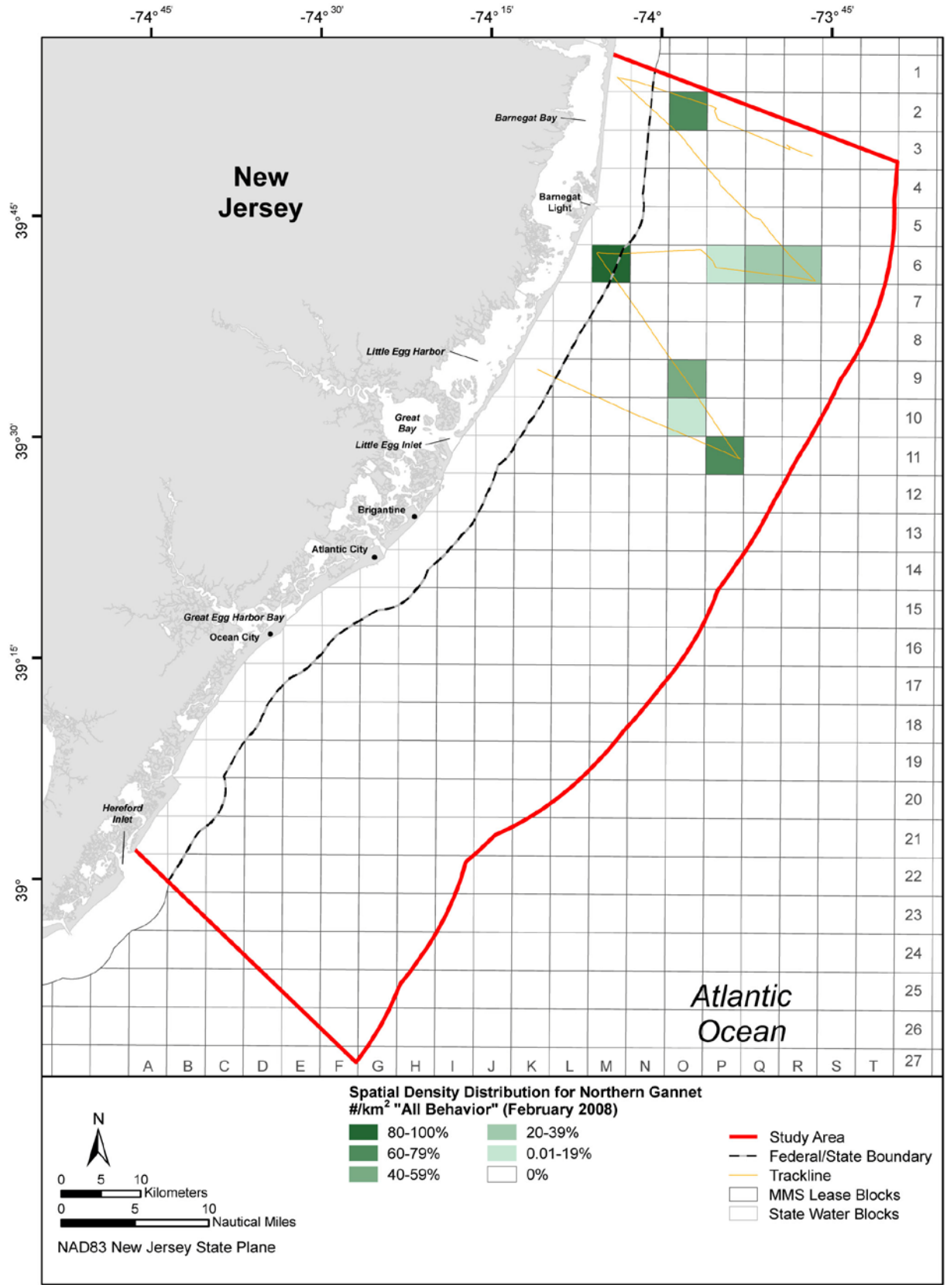

Figure C-85. Percentile abundance of Northern Gannet (all behaviors), February 2008 (n=9).

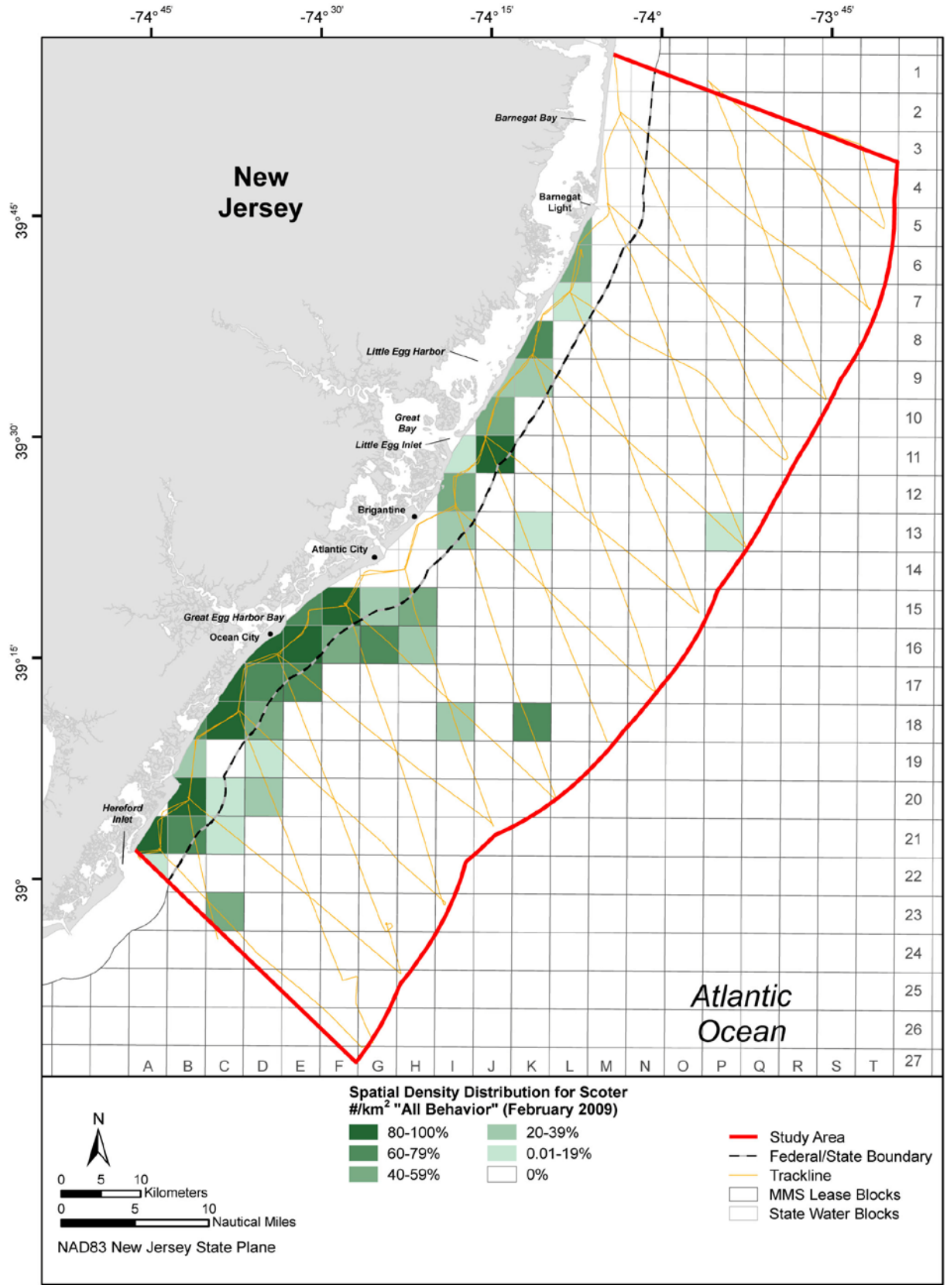

Figure C-86. Percentile abundance of scoters (all behaviors), February 2009 (n=1,827).

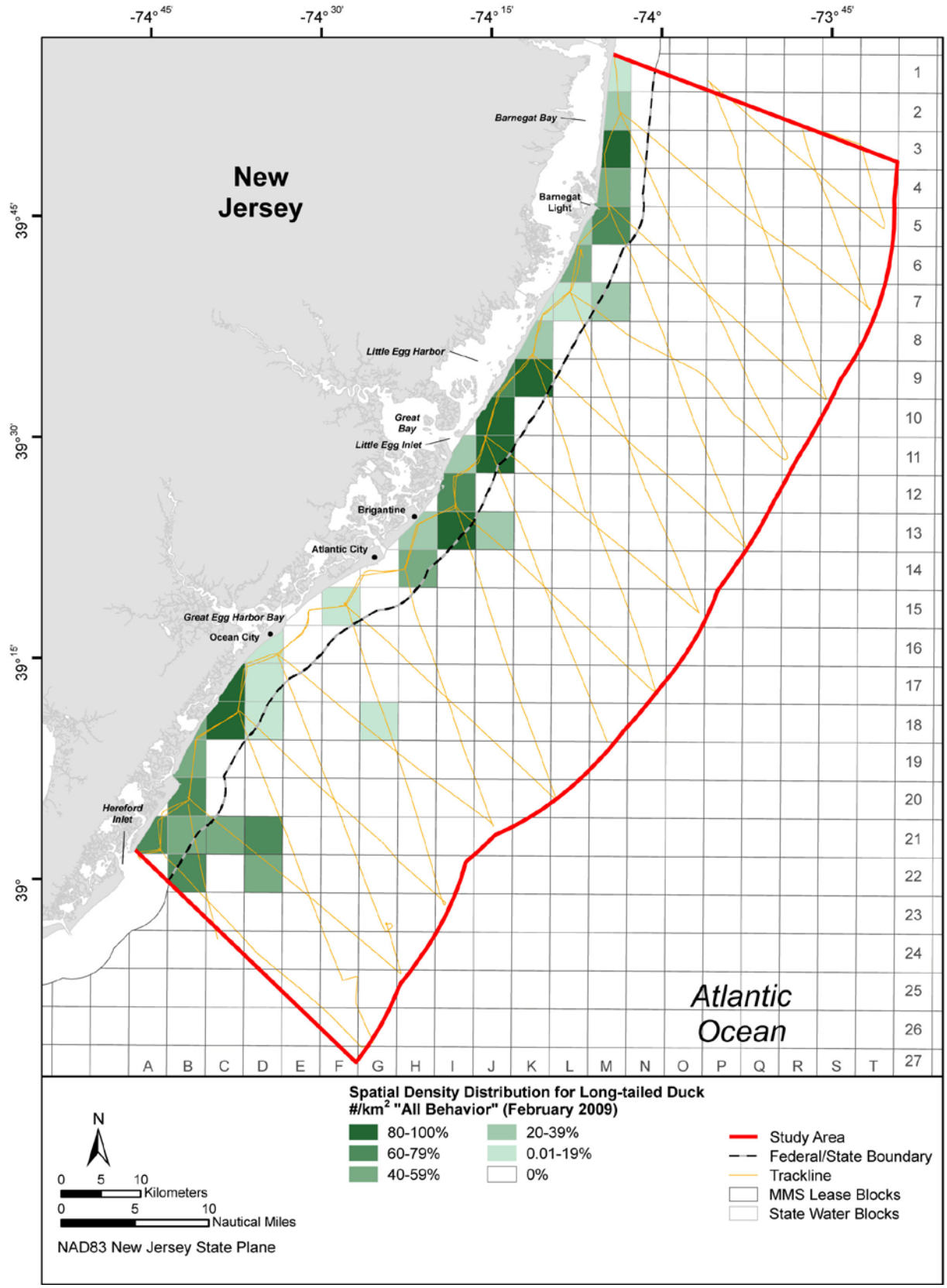

Figure C-87. Percentile abundance of Long-tailed Duck (all behaviors), February 2009 (n=1,756).

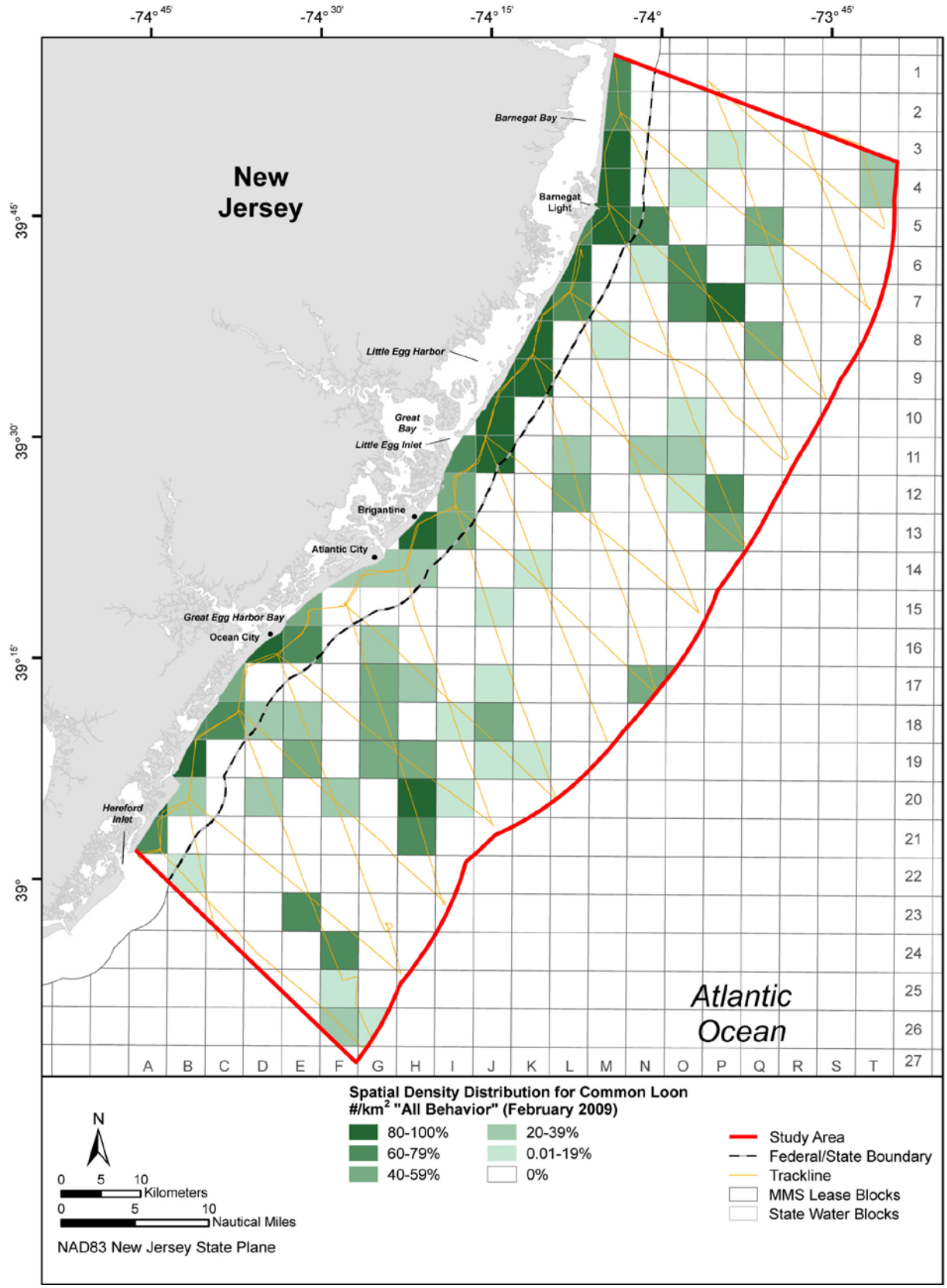

Figure C-88. Percentile abundance of Common Loon (all behaviors), February 2009 (n=728).

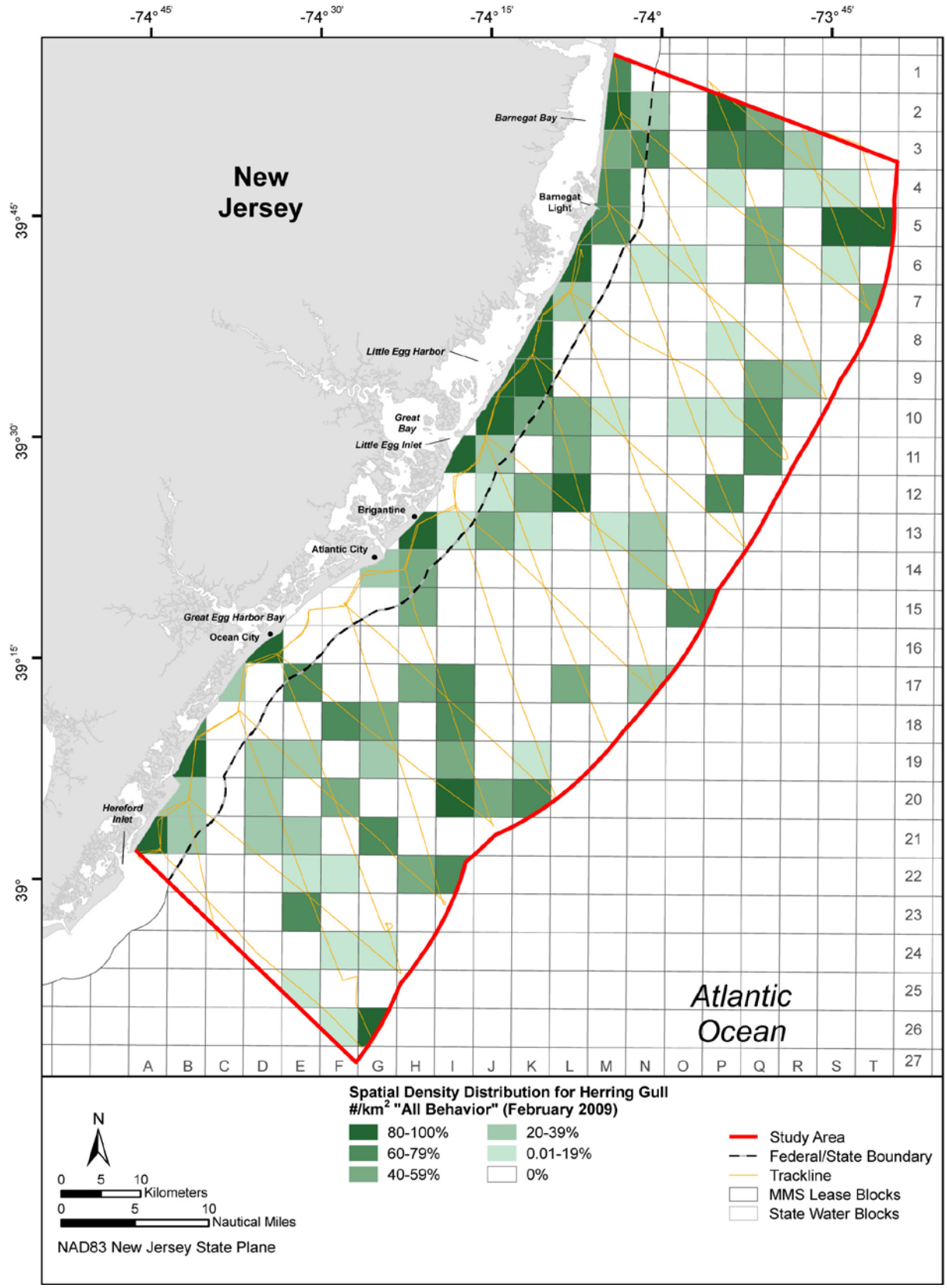

Figure C-89. Percentile abundance of Herring Gull (all behaviors), February 2009 (n=592).

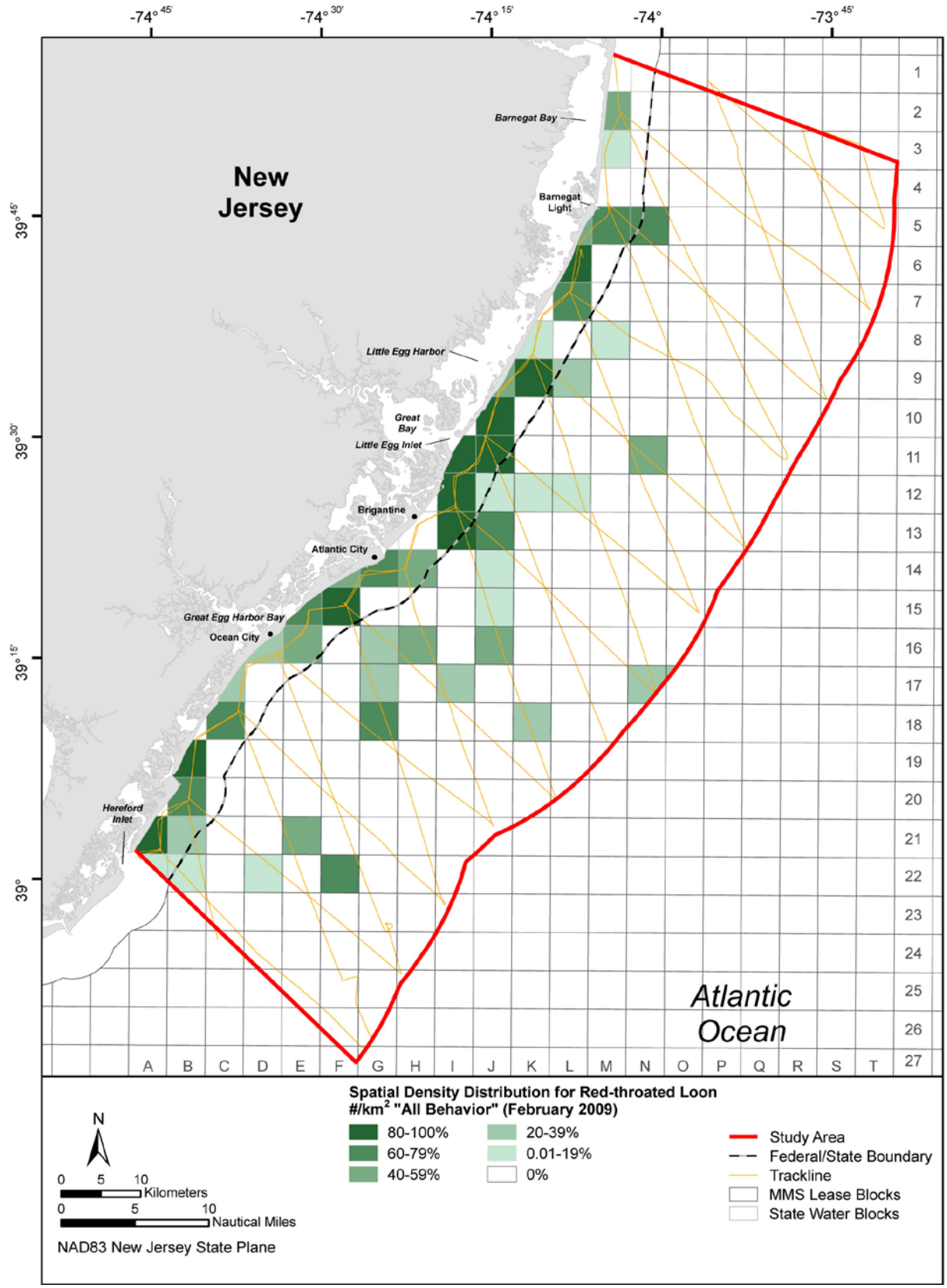

Figure C-90. Percentile abundance of Red-throated Loon (all behaviors), February 2009 (n=134).

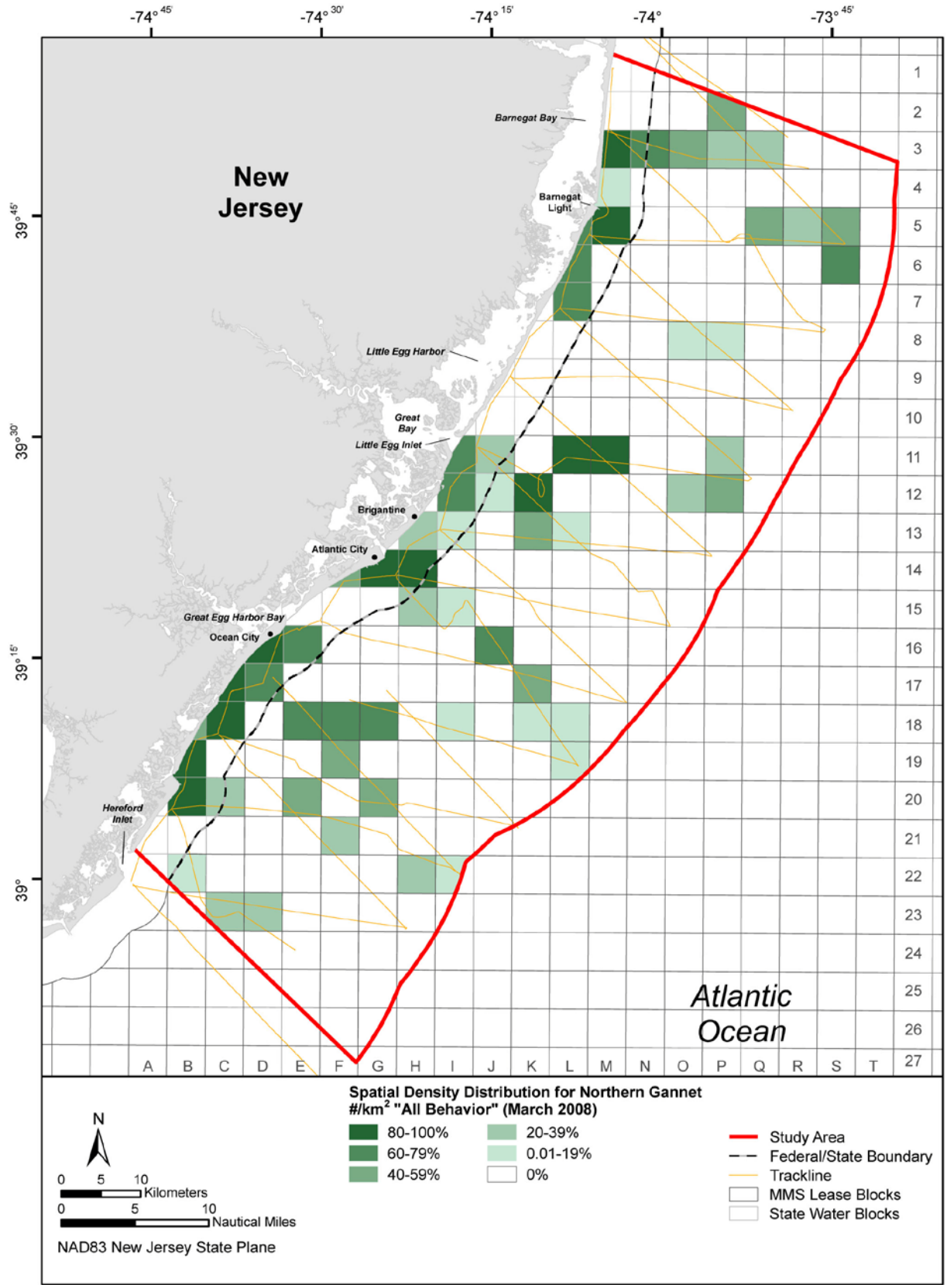

Figure C-91. Percentile abundance of Northern Gannet (all behaviors), March 2008 (n=682).

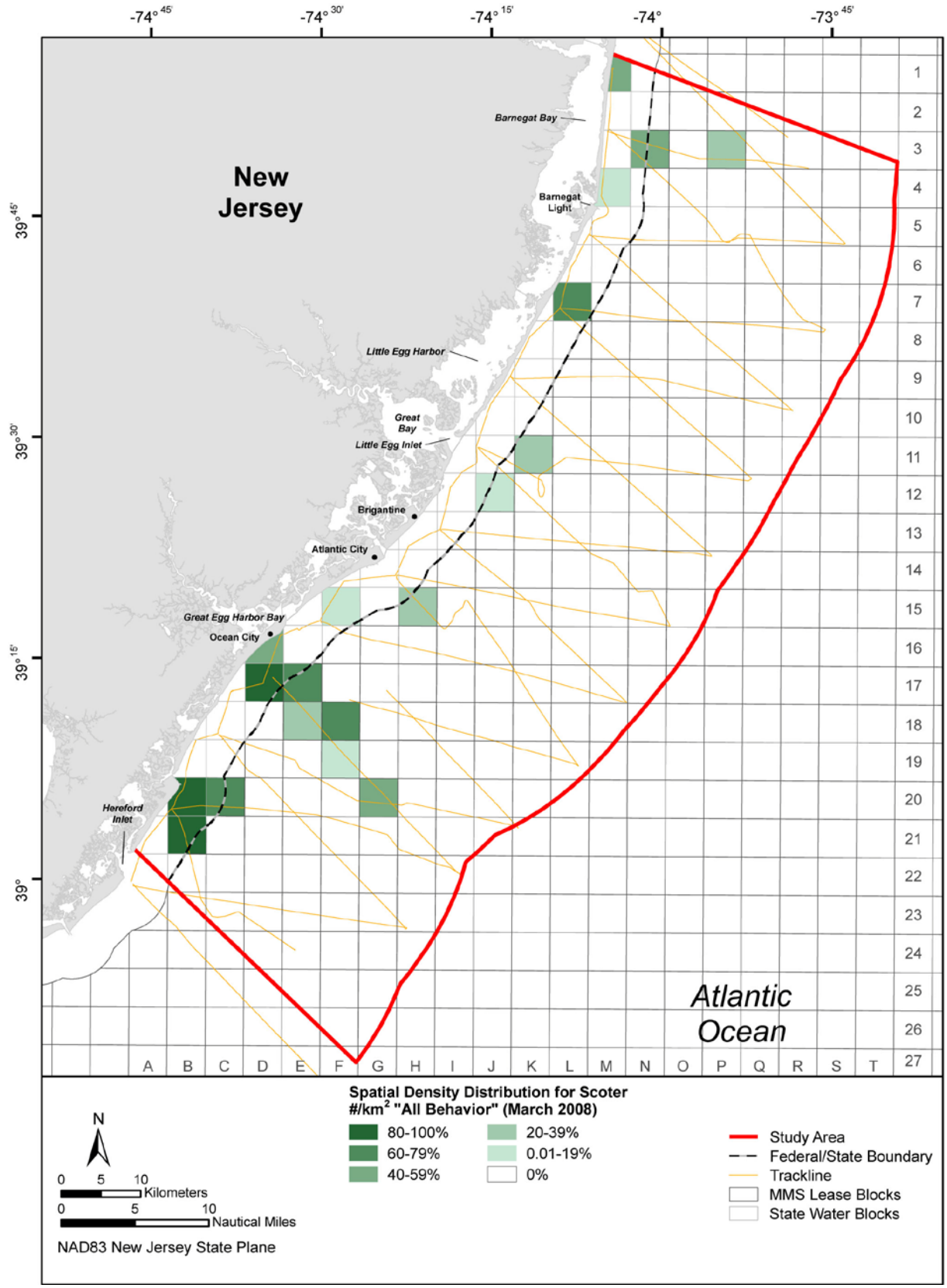

Figure C-92. Percentile abundance of scoters (all behaviors), March 2008 (n=301).

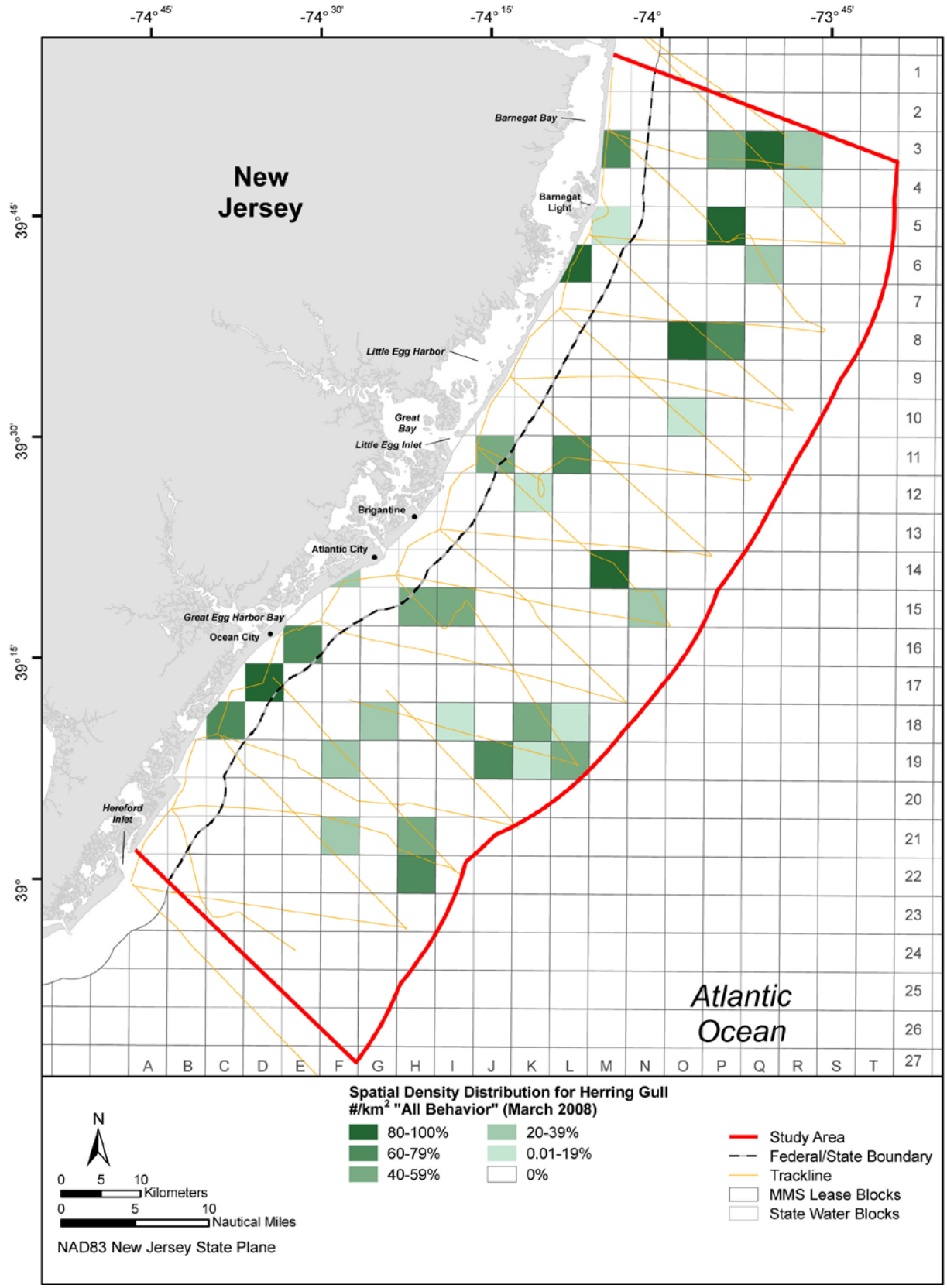

Figure C-93. Percentile abundance of Herring Gull (all behaviors), March 2008 (n=169).

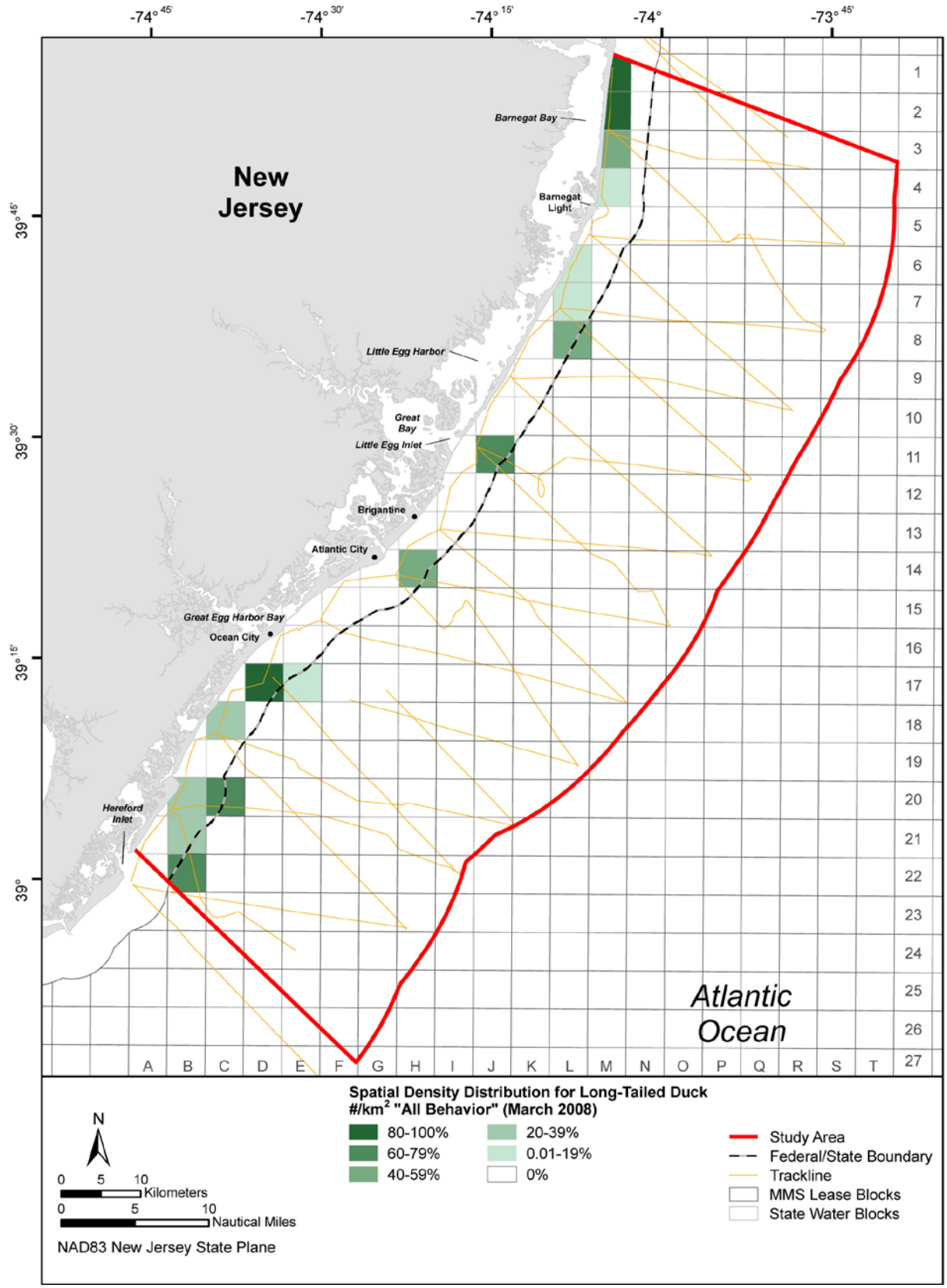

Figure C-94. Percentile abundance of Long-tailed Duck (all behaviors), March 2008 (n=80).

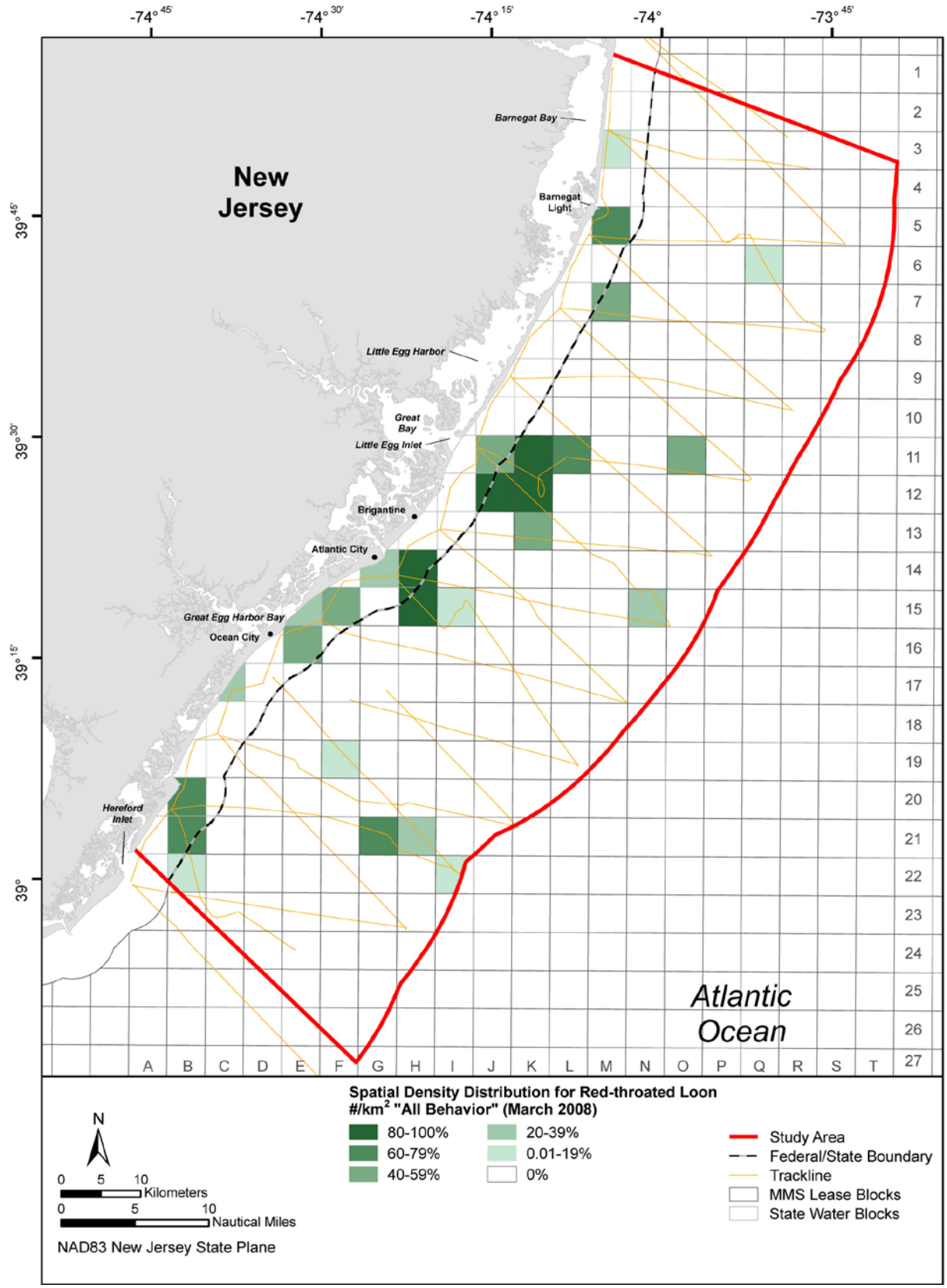

Figure C-95. Percentile abundance of Red-throated Loon (all behaviors), March 2008 (n=74).

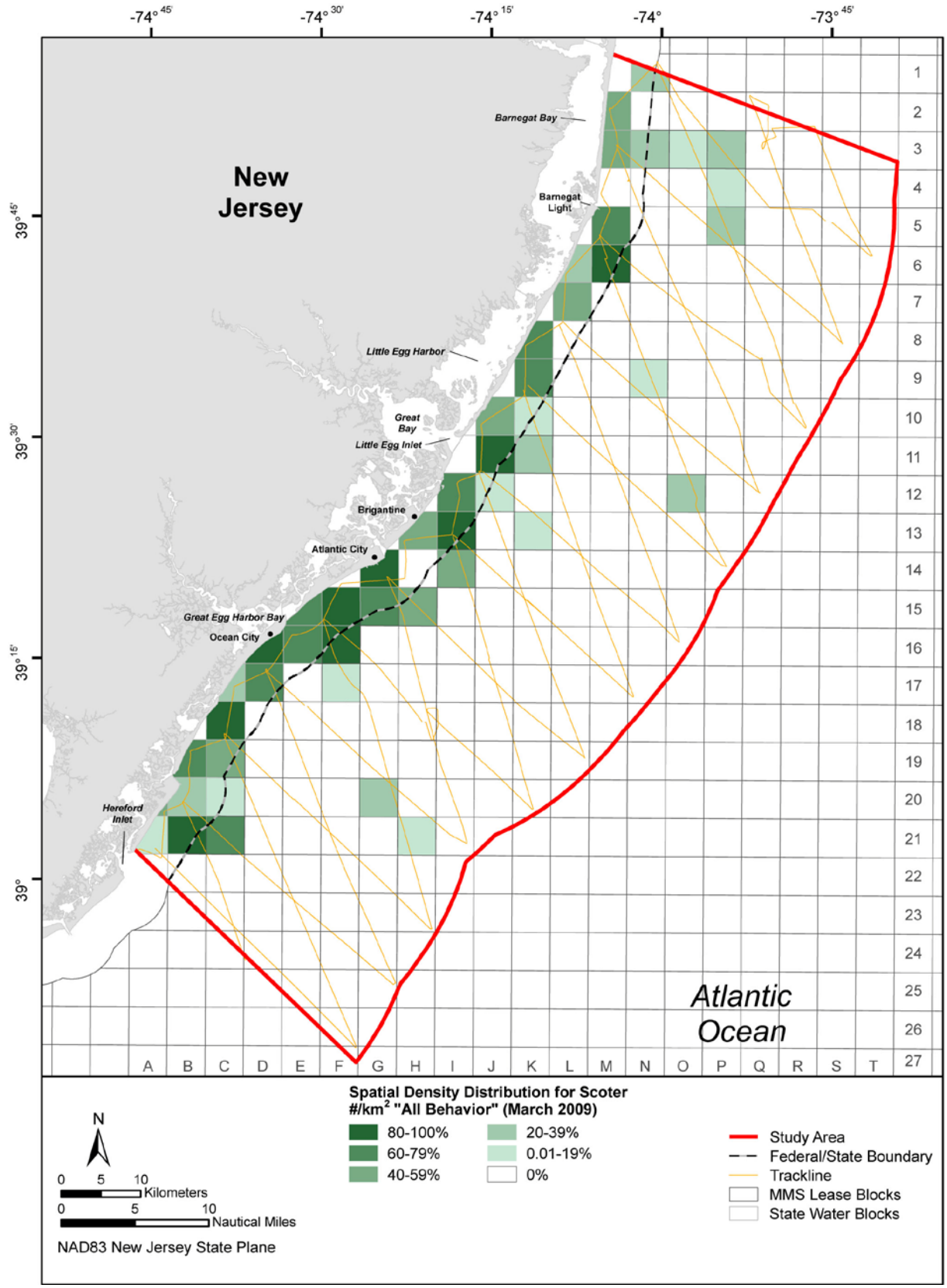

Figure C-96. Percentile abundance of scoters (all behaviors), March 2009 (n=1,375).

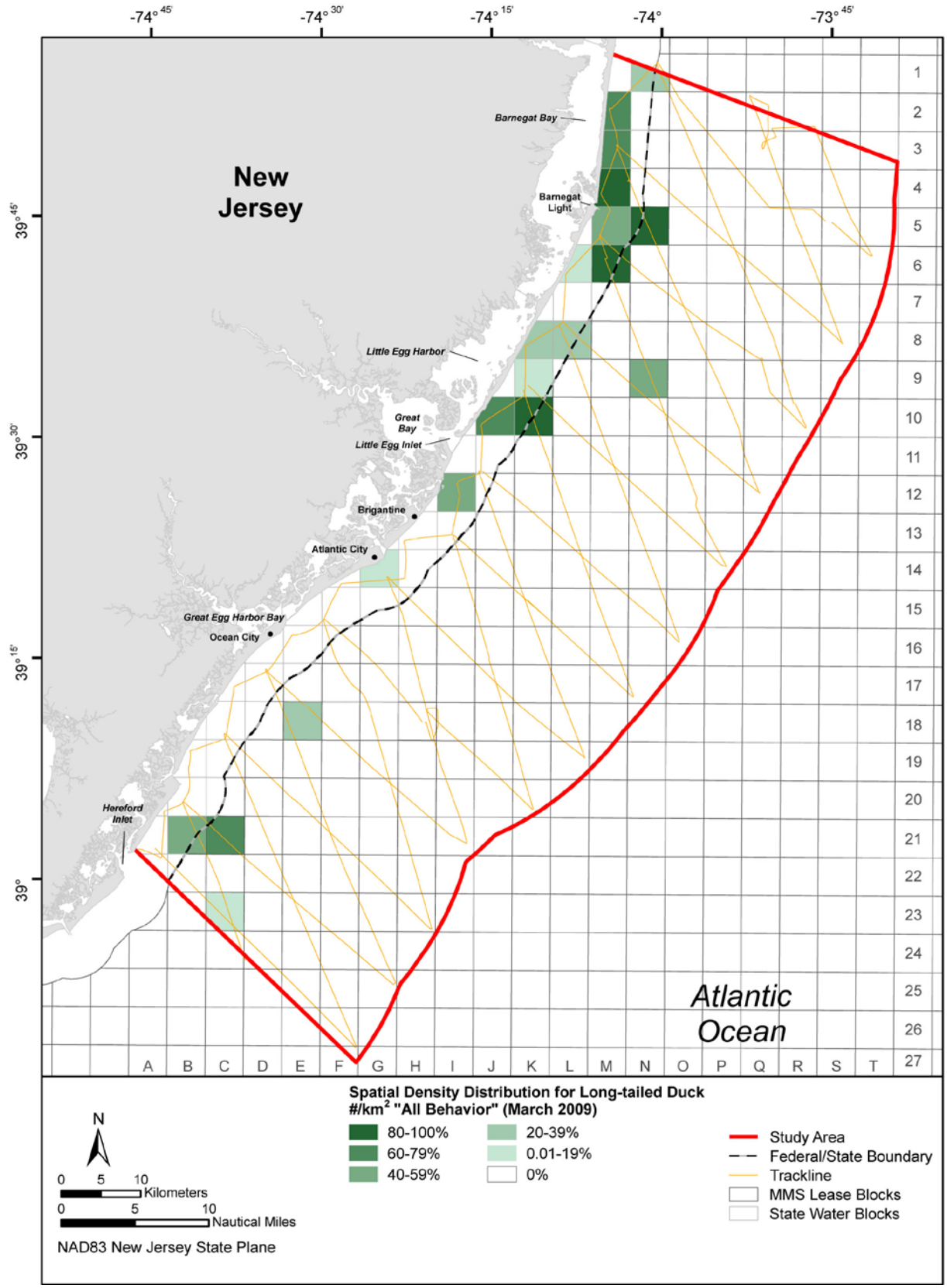

Figure C-97. Percentile abundance of Long-tailed Duck (all behaviors), March 2009 (n=659).

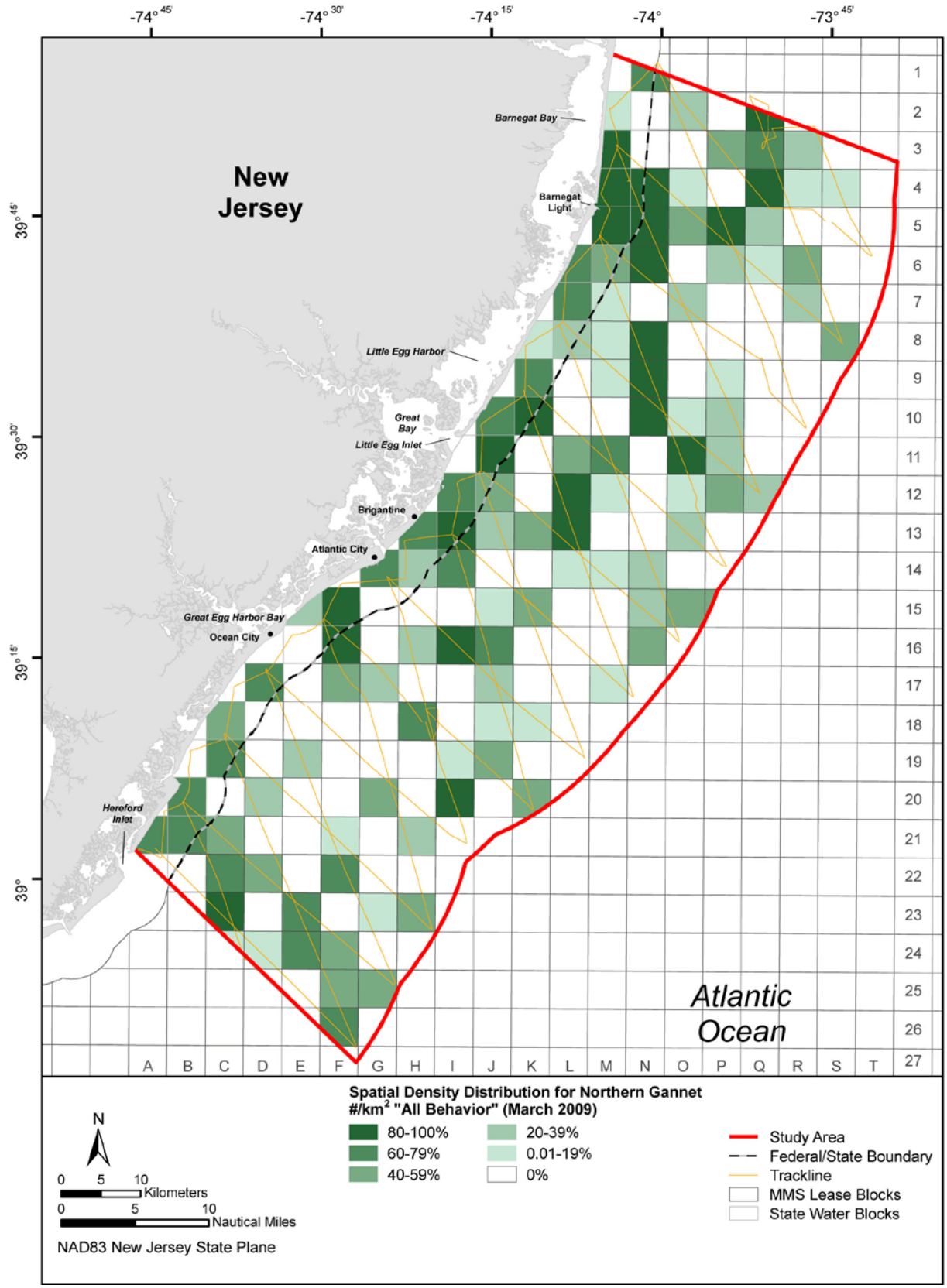

Figure C-98. Percentile abundance of Northern Gannet (all behaviors), March 2009 (n=534).

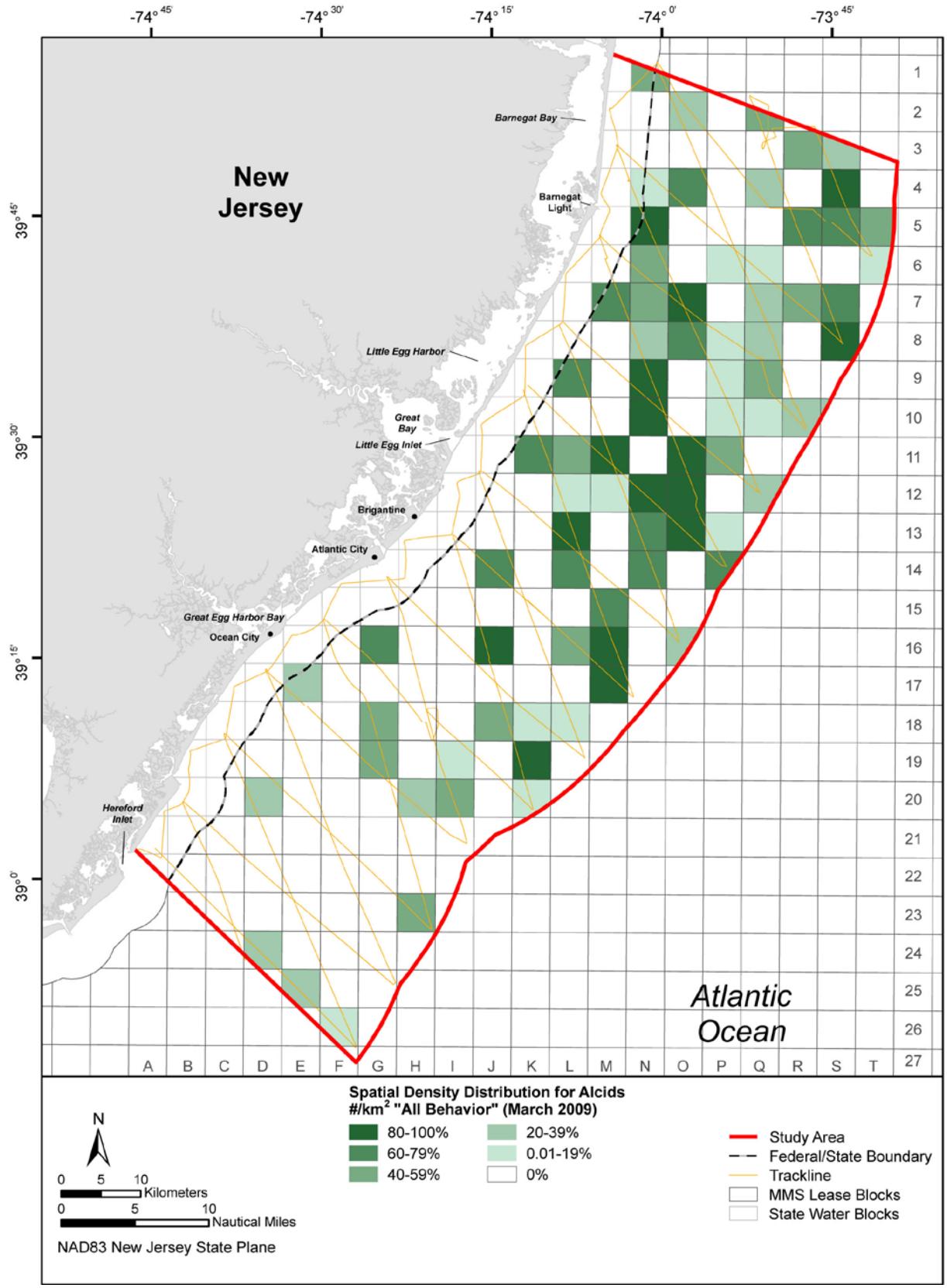

Figure C-99. Percentile abundance of alcids (all behaviors), March 2009 (n=508).

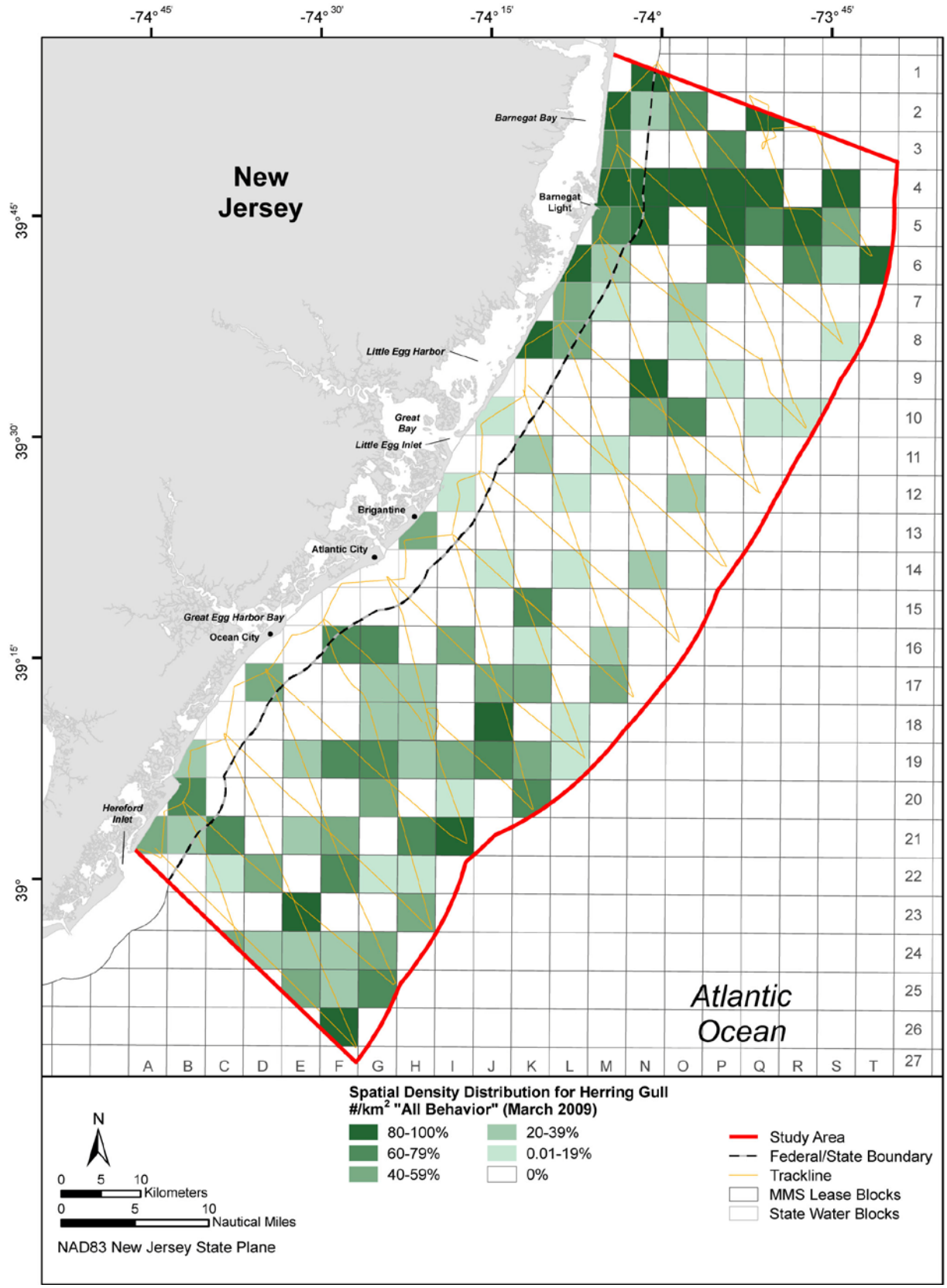

Figure C-100. Percentile abundance of Herring Gull (all behaviors), March 2009 (n=462).

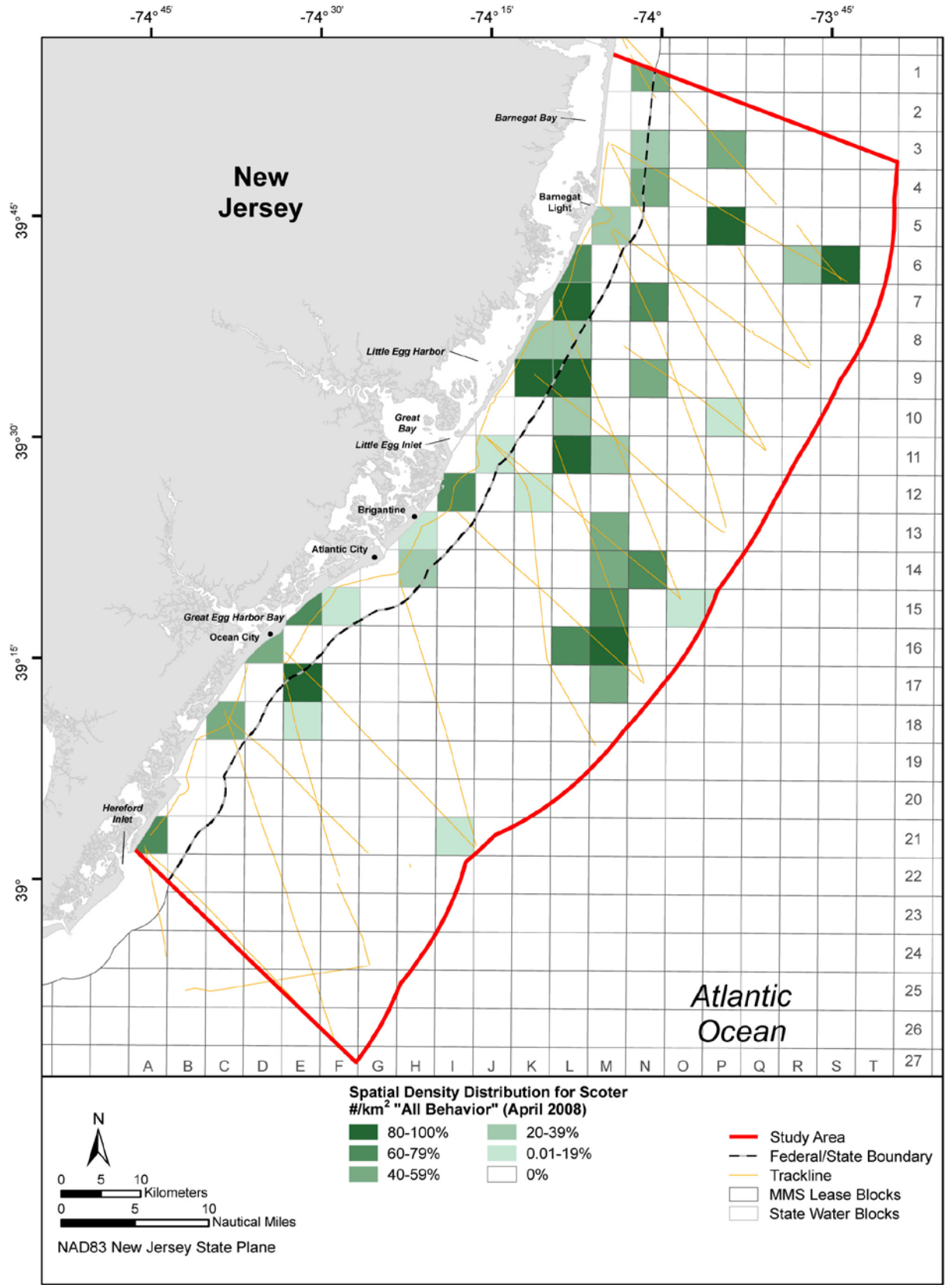

Figure C-101. Percentile abundance of scoters (all behaviors), April 2008 (n=1,215).

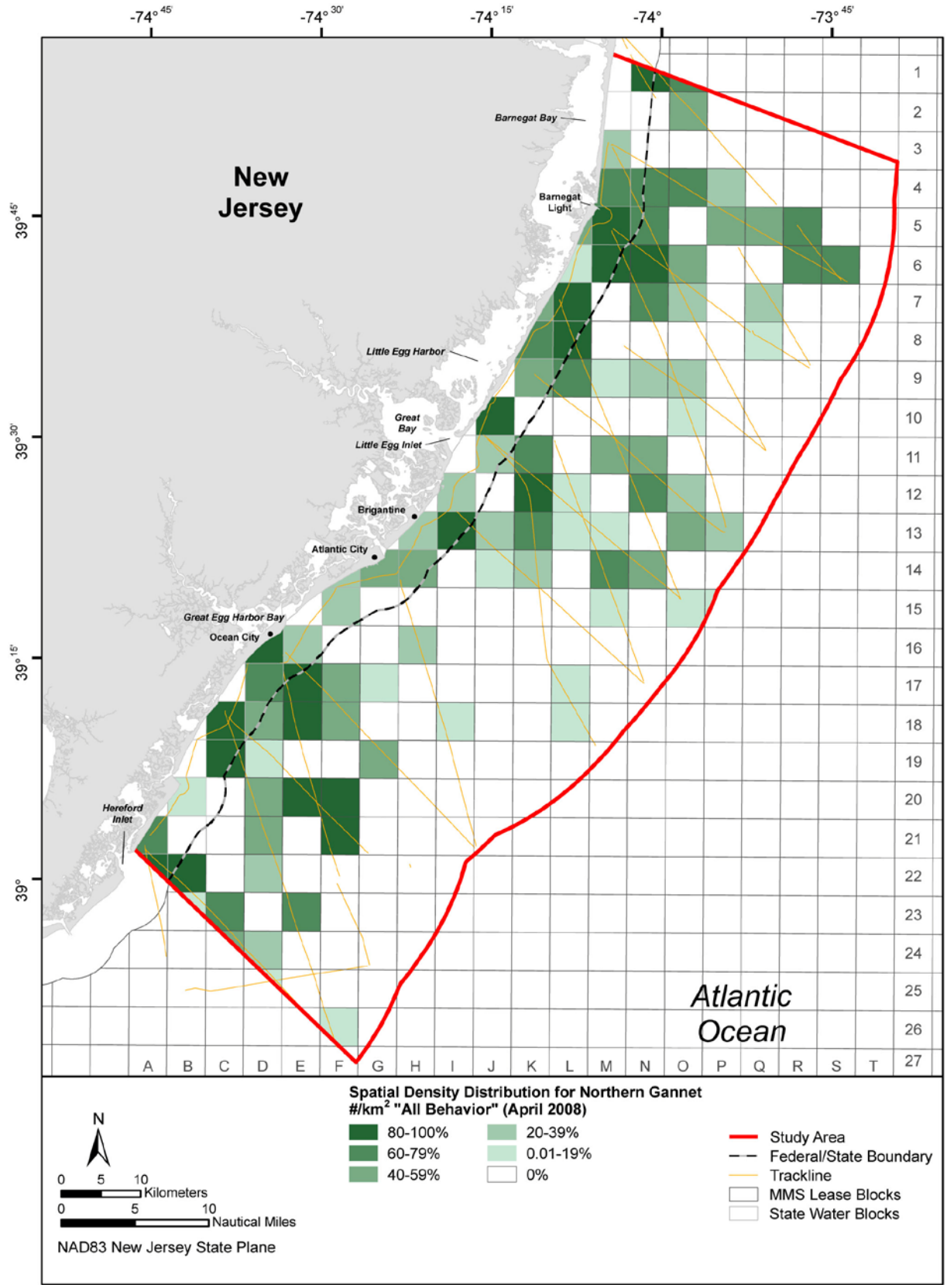

Figure C-102. Percentile abundance of Northern Gannet (all behaviors), April 2008 (n=492).

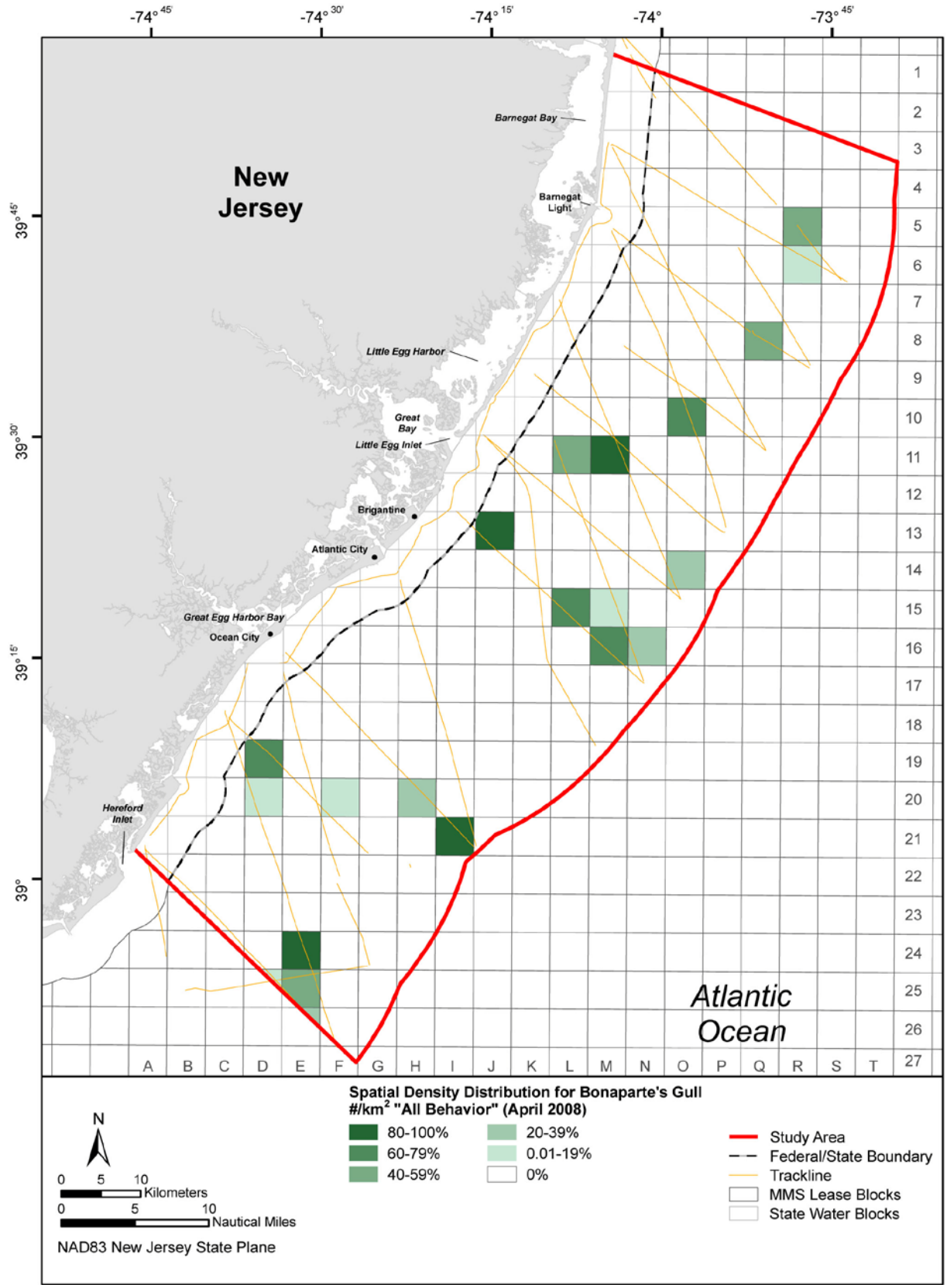

Figure C-103. Percentile abundance of Bonaparte's Gull (all behaviors), April 2008 (n=109).

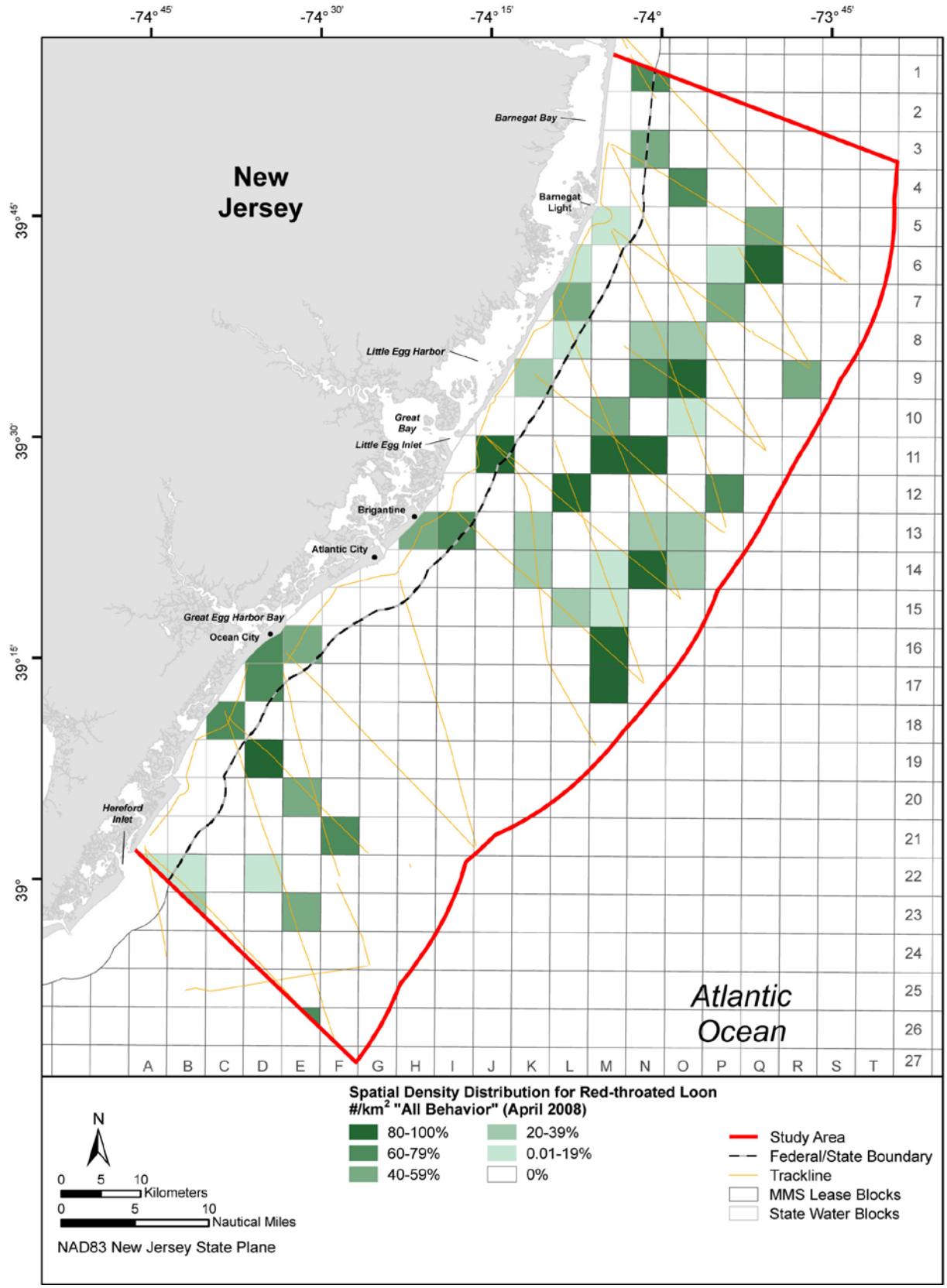

Figure C-104. Percentile abundance of Red-throated Loon (all behaviors), April 2008 (n=107).

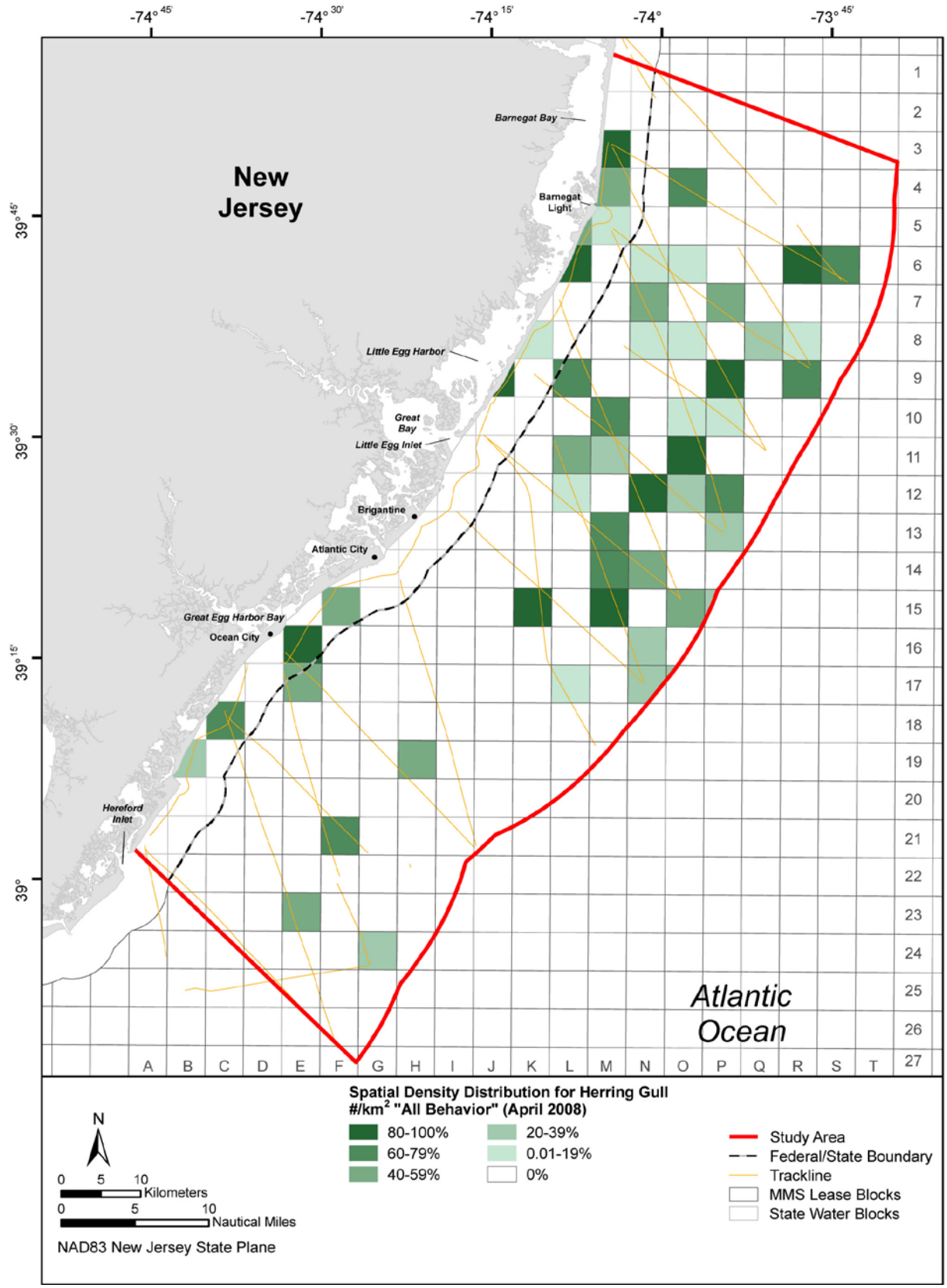

Figure C-105. Percentile abundance of Herring Gull (all behaviors), April 2008 (n=102).

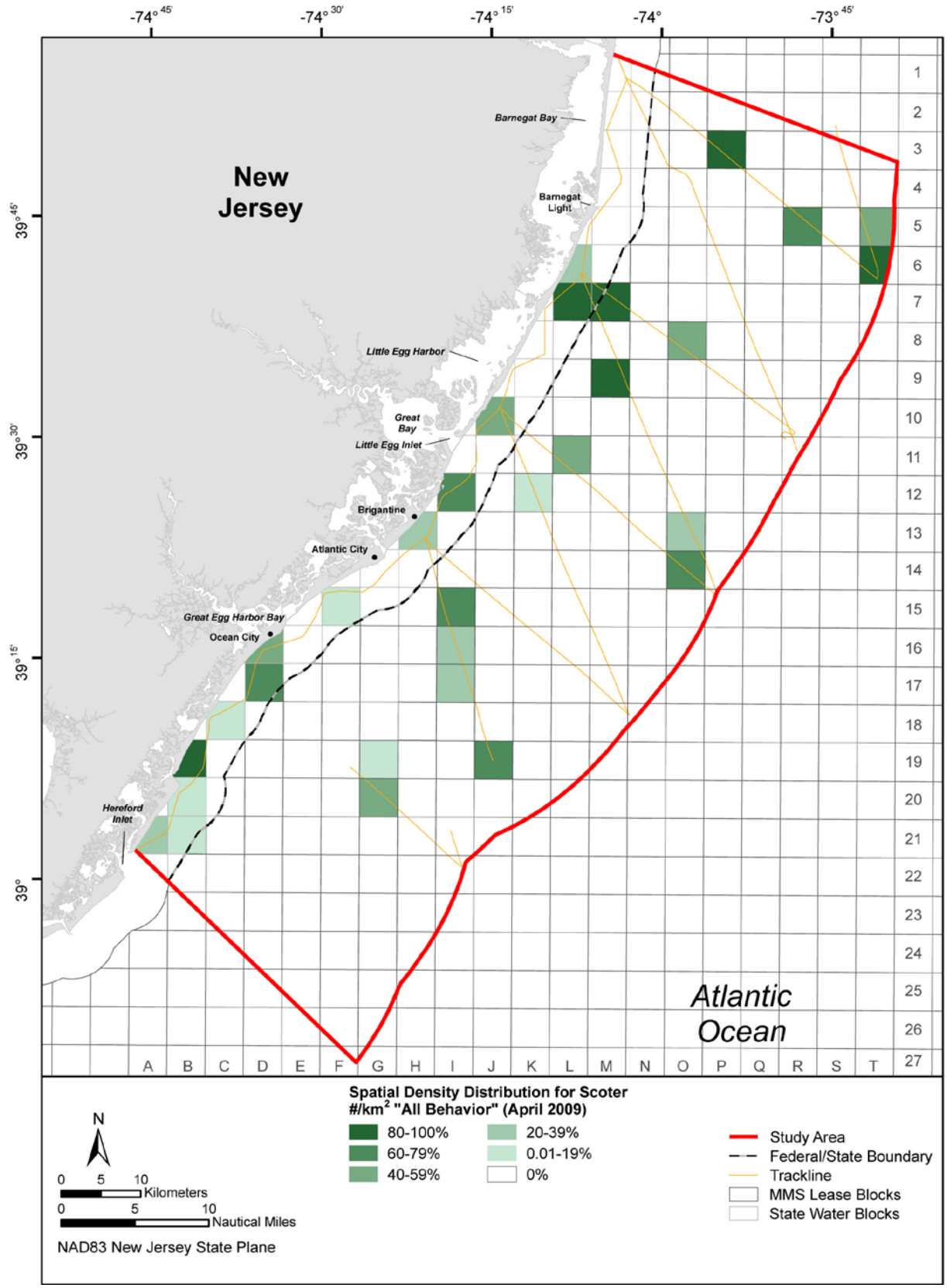

Figure C-106. Percentile abundance of scoters (all behaviors), April 2009 (n=291).

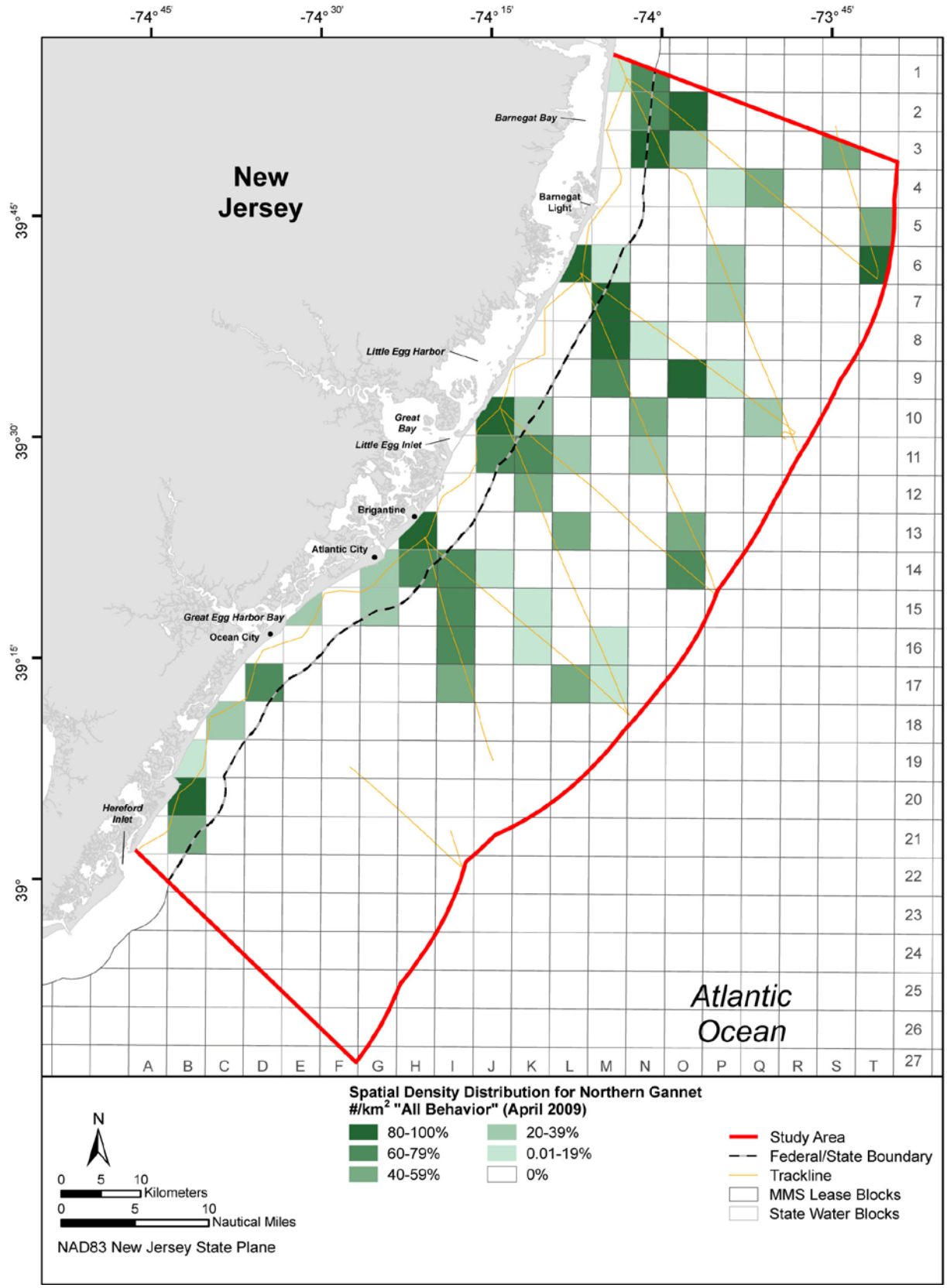

Figure C-107. Percentile abundance of Northern Gannet (all behaviors), April 2009 (n=151).

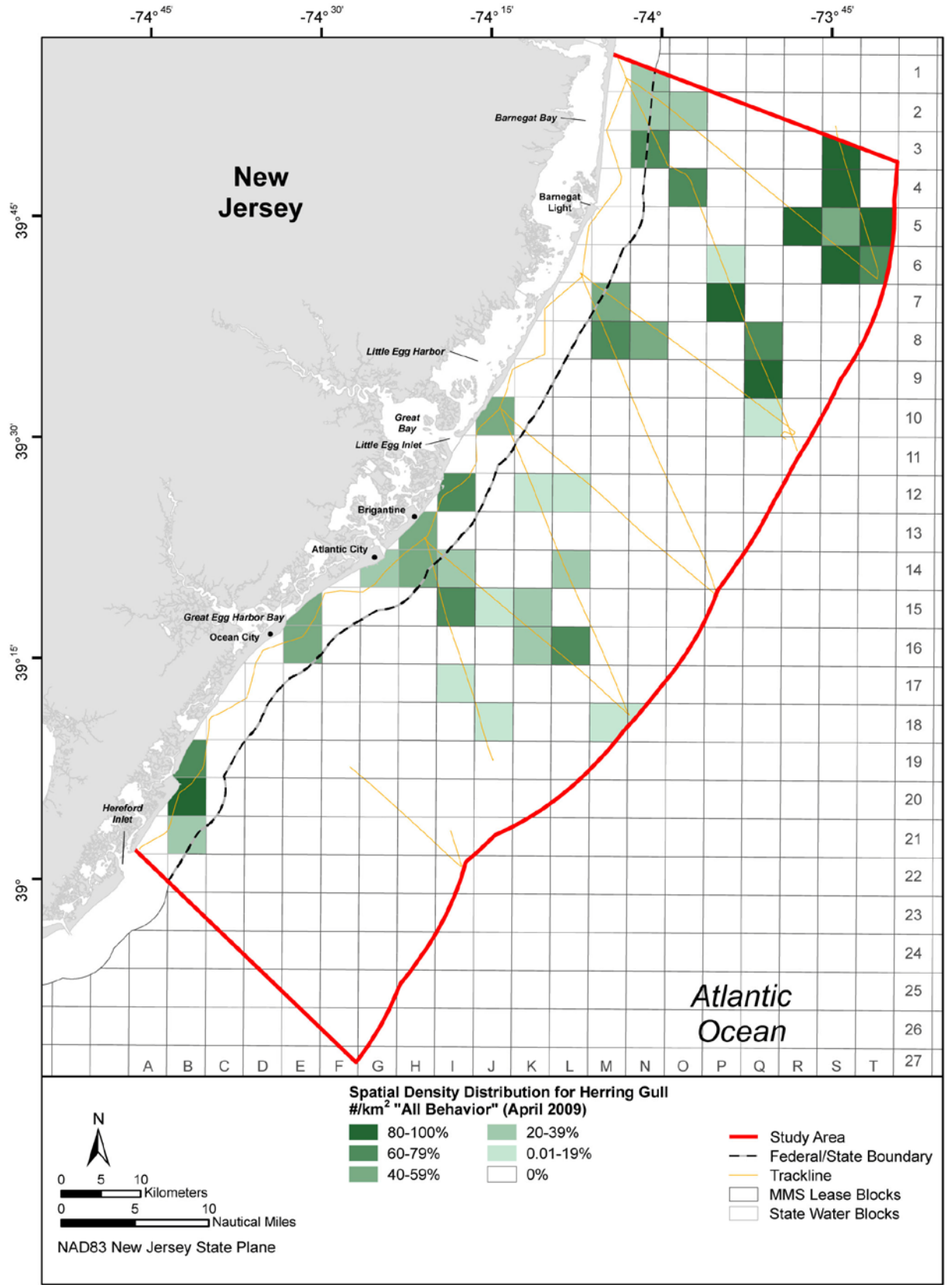

Figure C-108. Percentile abundance of Herring Gull (all behaviors), April 2009 (n=85).

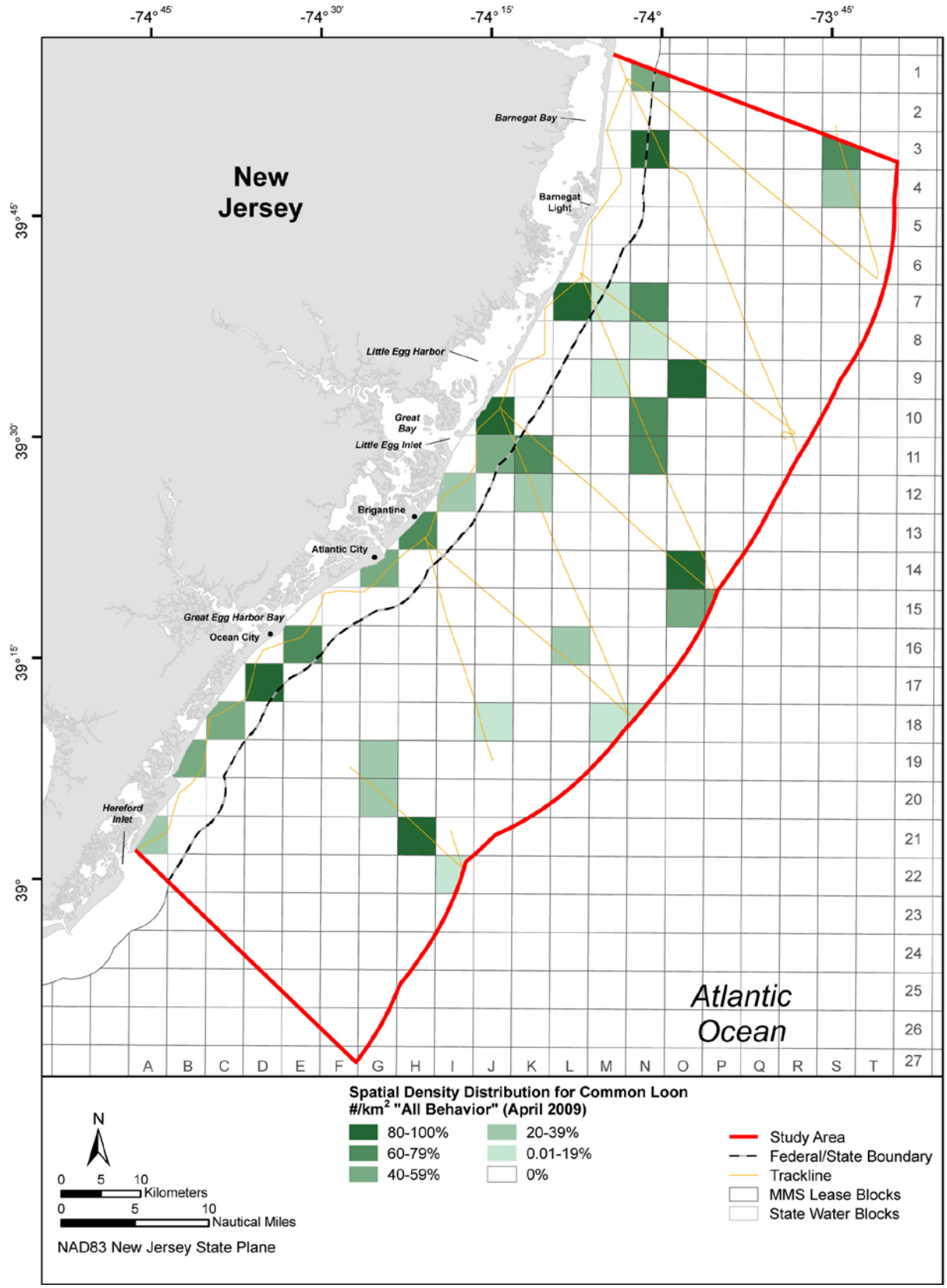

Figure C-109. Percentile abundance of Common Loon (all behaviors), April 2009 (n=58).

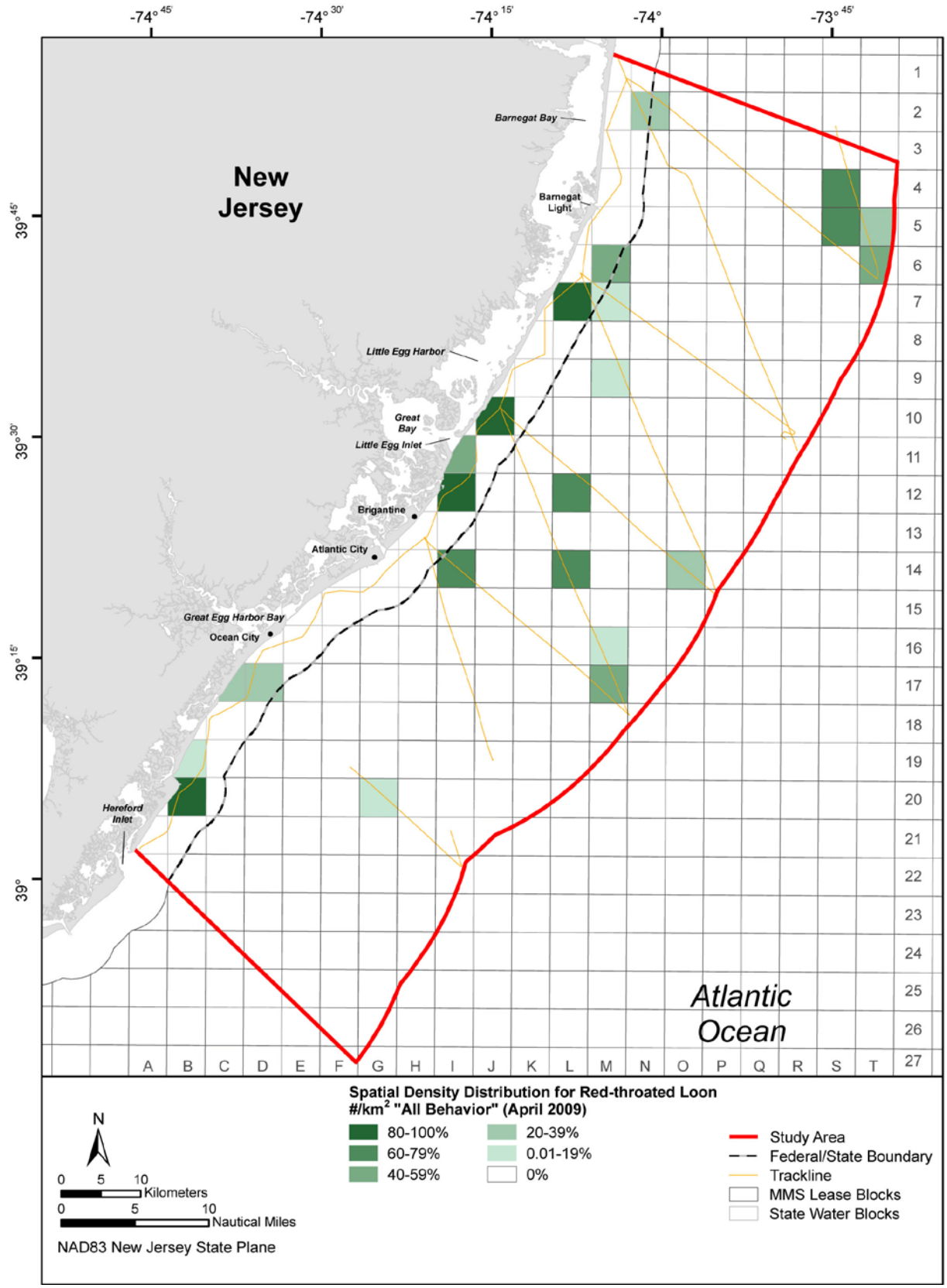

Figure C-110. Percentile abundance of Red-throated Loon (all behaviors), April 2009 (n=49).

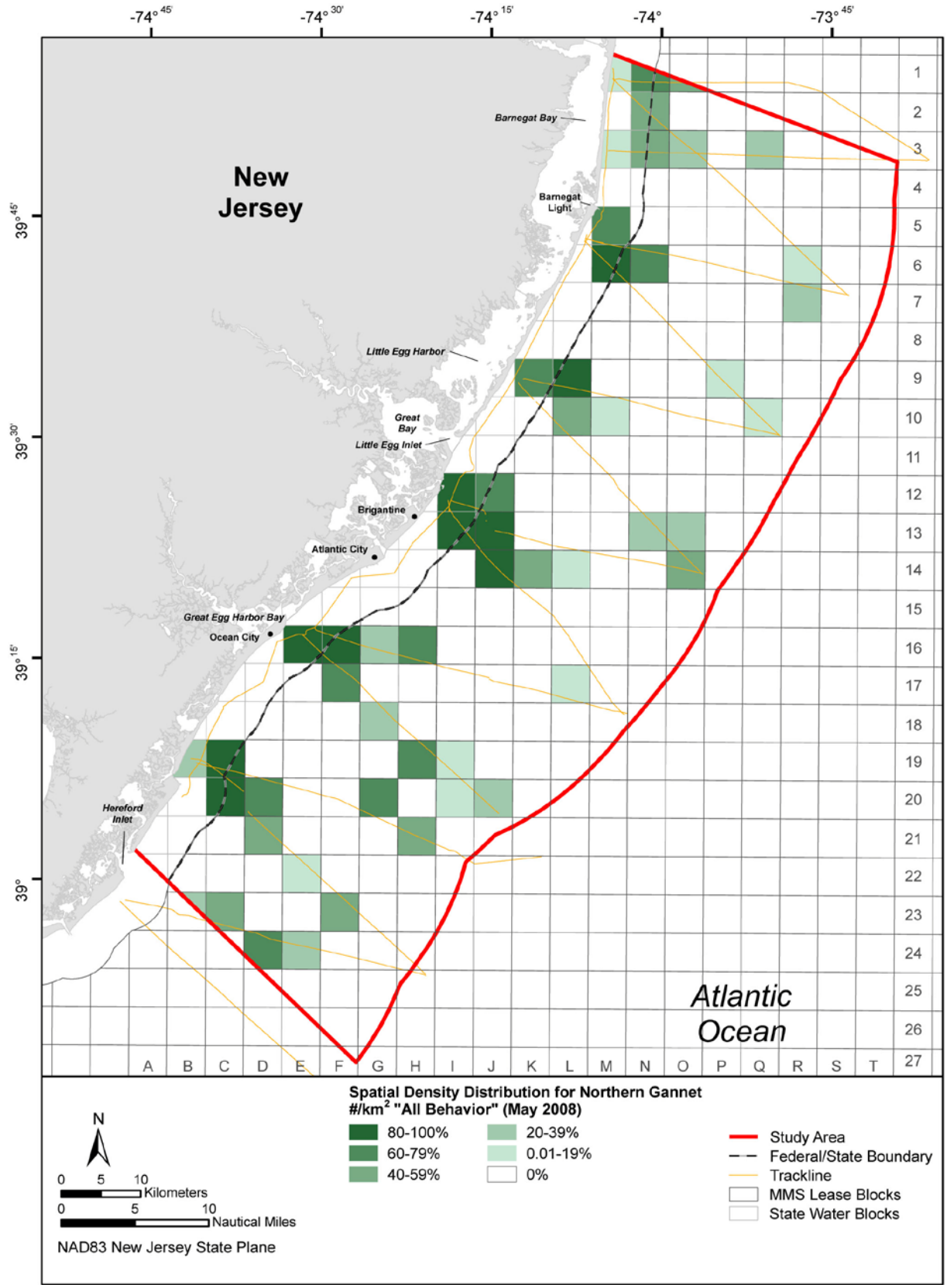

Figure C-111. Percentile abundance of Northern Gannet (all behaviors), May 2008 (n=228).

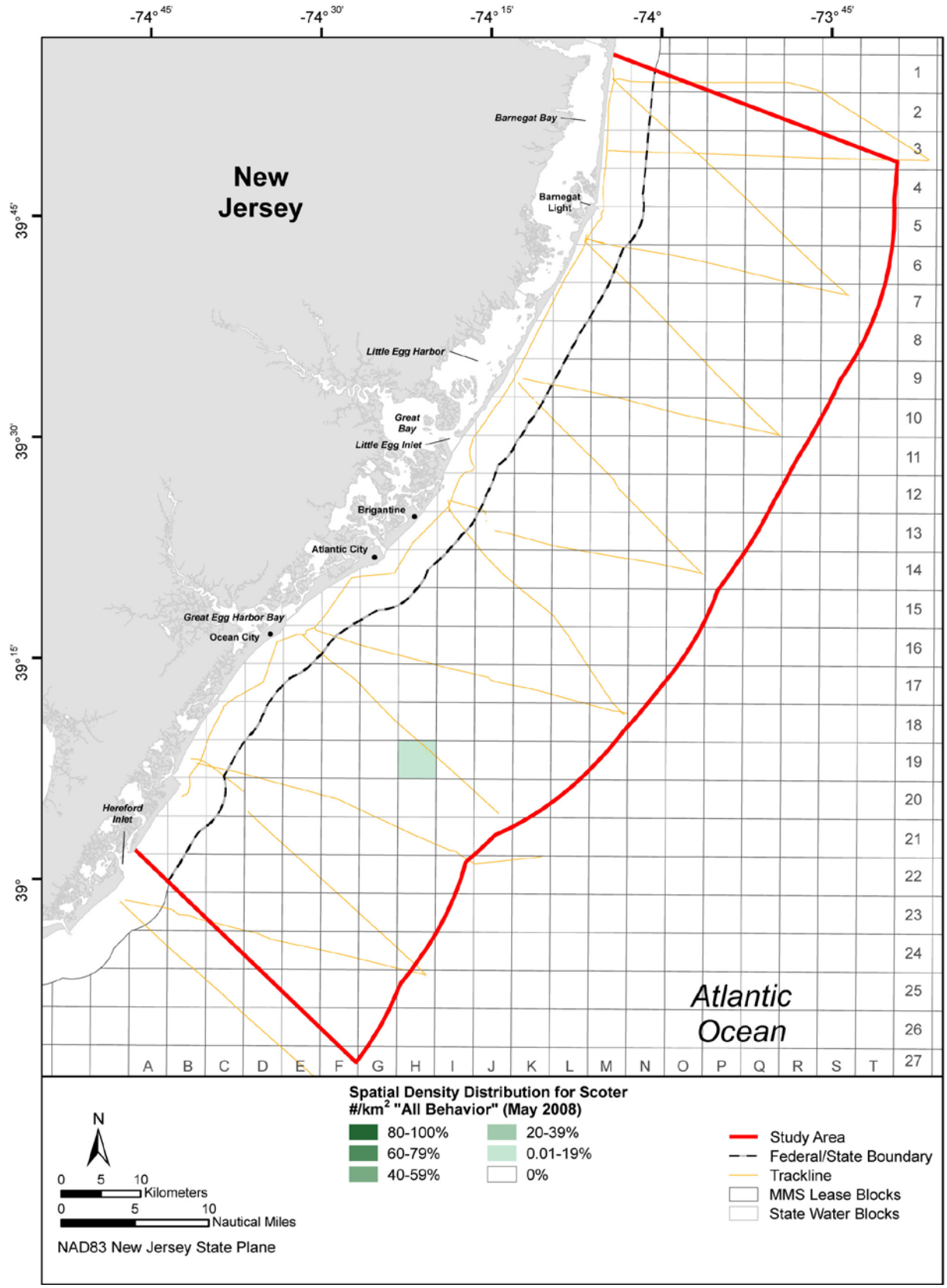

Figure C-112. Percentile abundance of scoters (all behaviors), May 2008 (n=140).

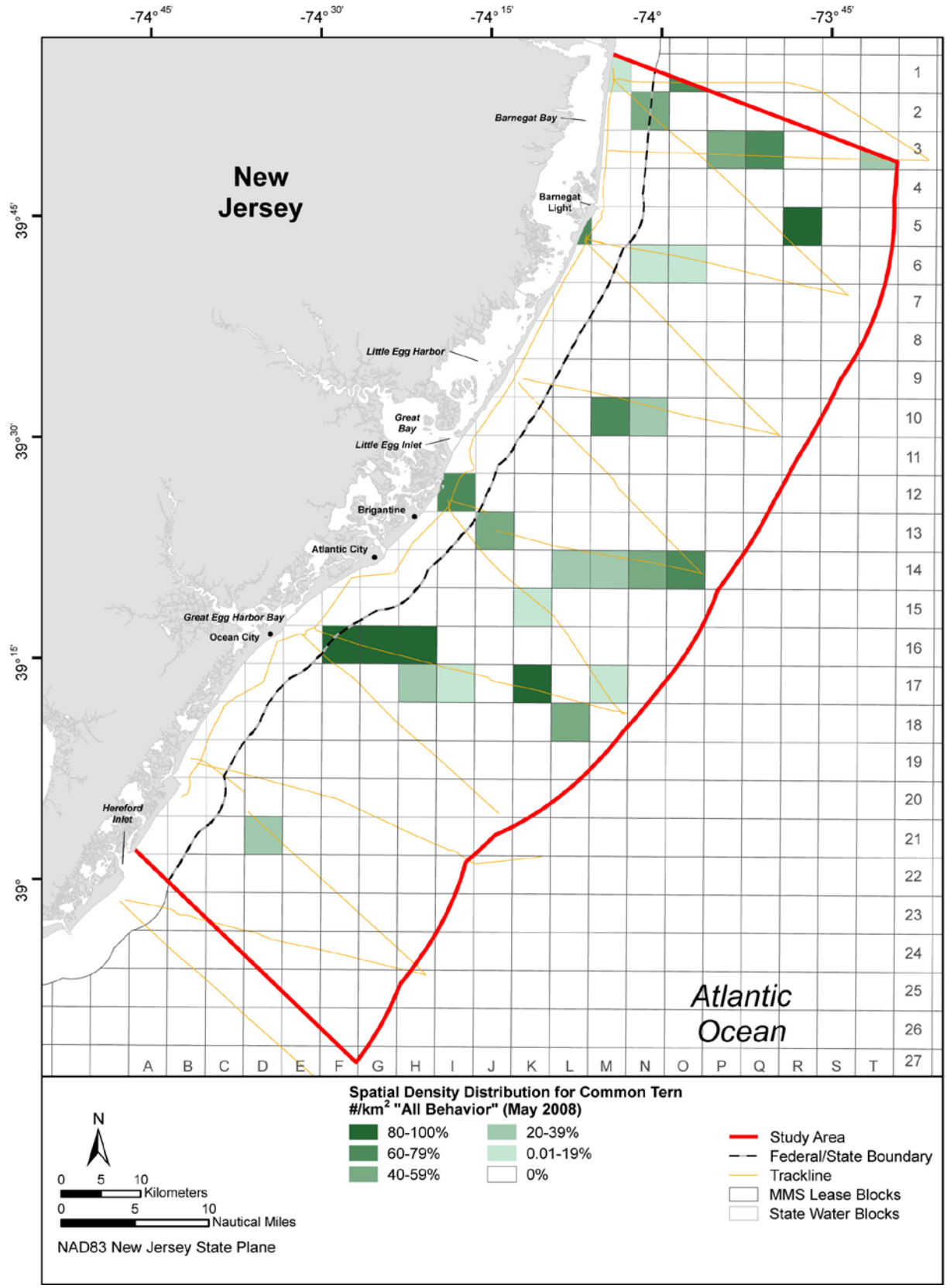

Figure C-113. Percentile abundance of Common Tern (all behaviors), May 2008 (n=94).

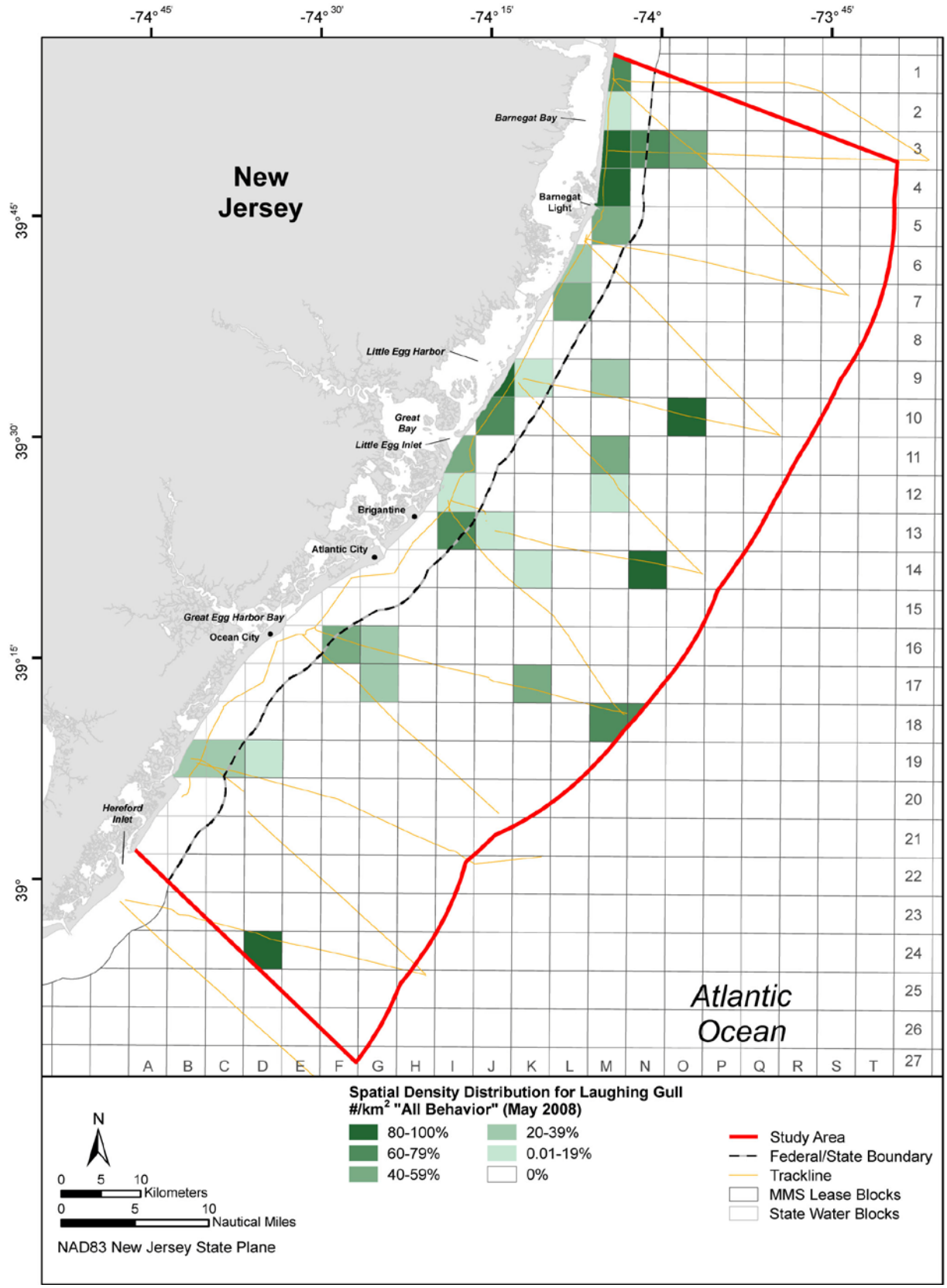

Figure C-114. Percentile abundance of Laughing Gull (all behaviors), May 2008 (n=85).

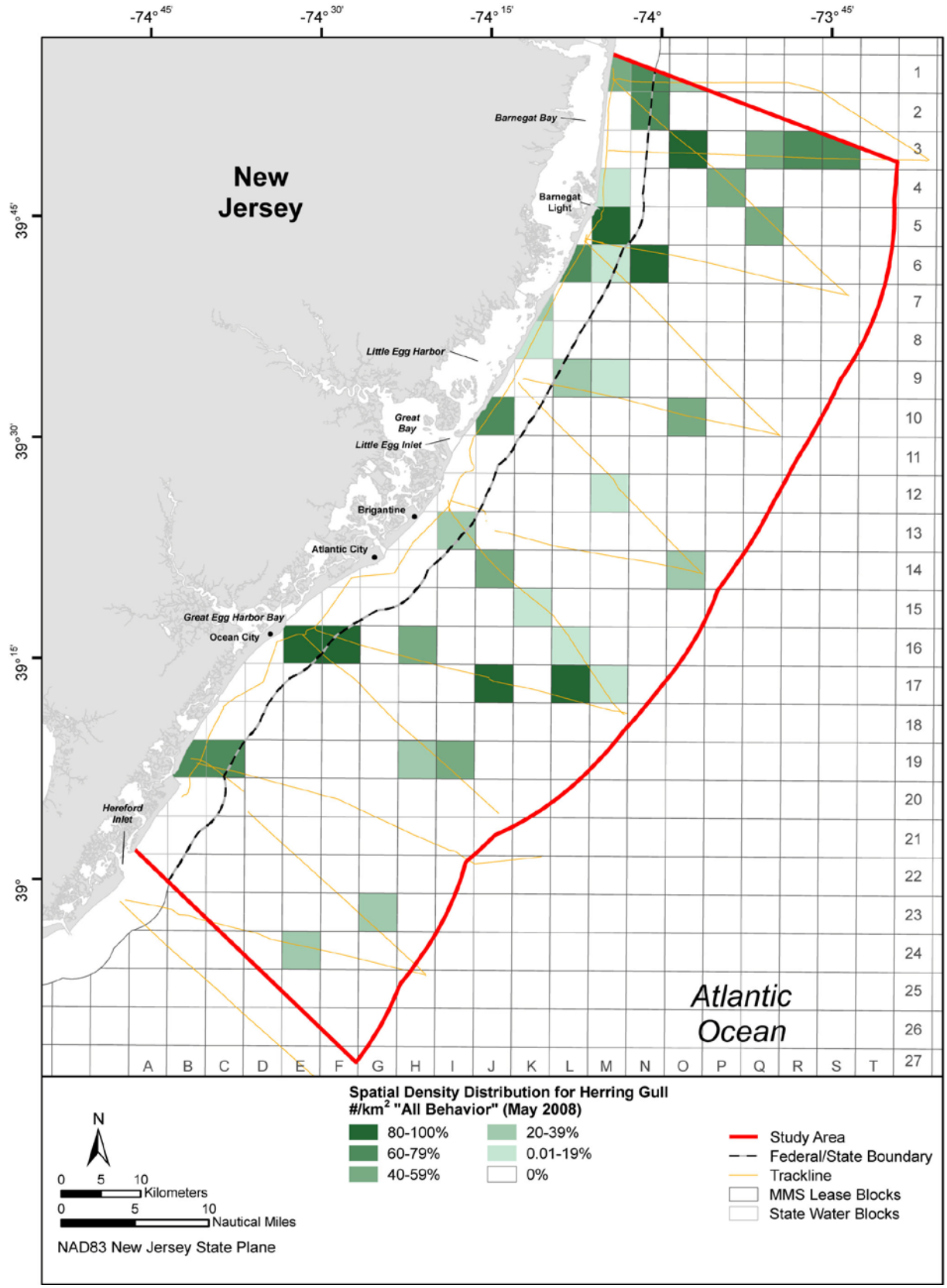

Figure C-115. Percentile abundance of Herring Gull (all behaviors), May 2008 (n=83).

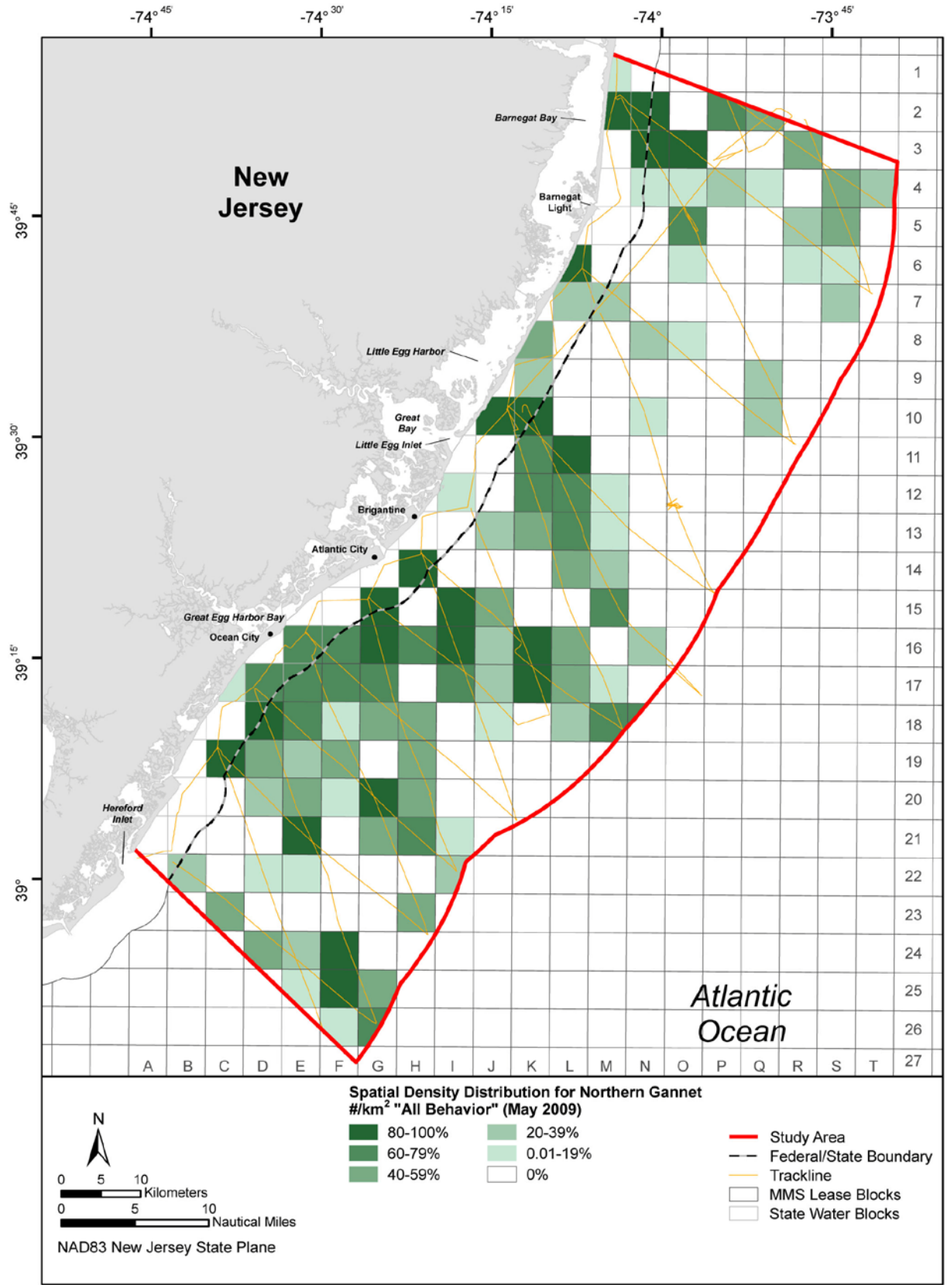

Figure C-116. Percentile abundance of Northern Gannet (all behaviors), May 2009 (n=745).

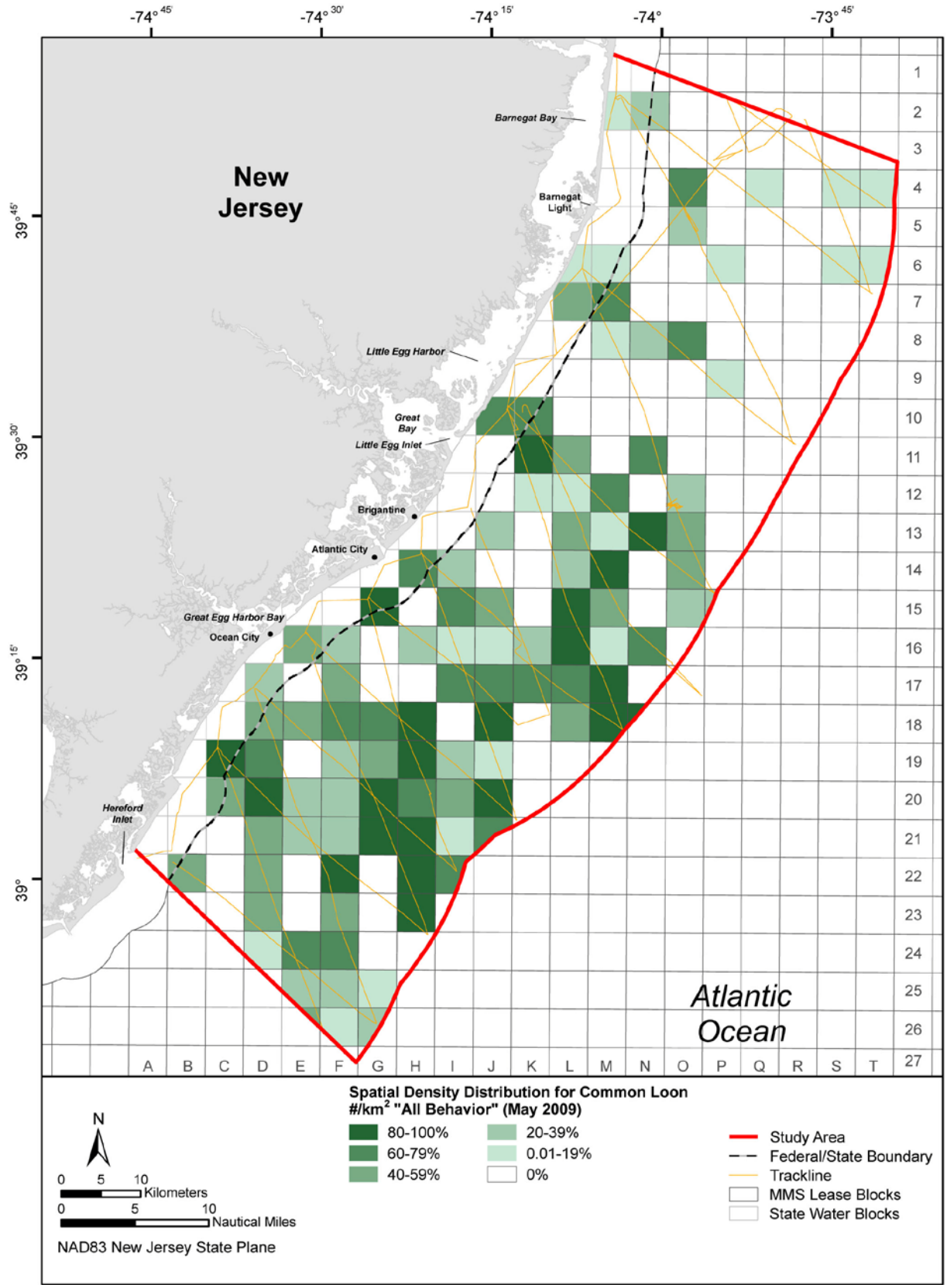

Figure C-117. Percentile abundance of Common Loon (all behaviors), May 2009 (n=508).

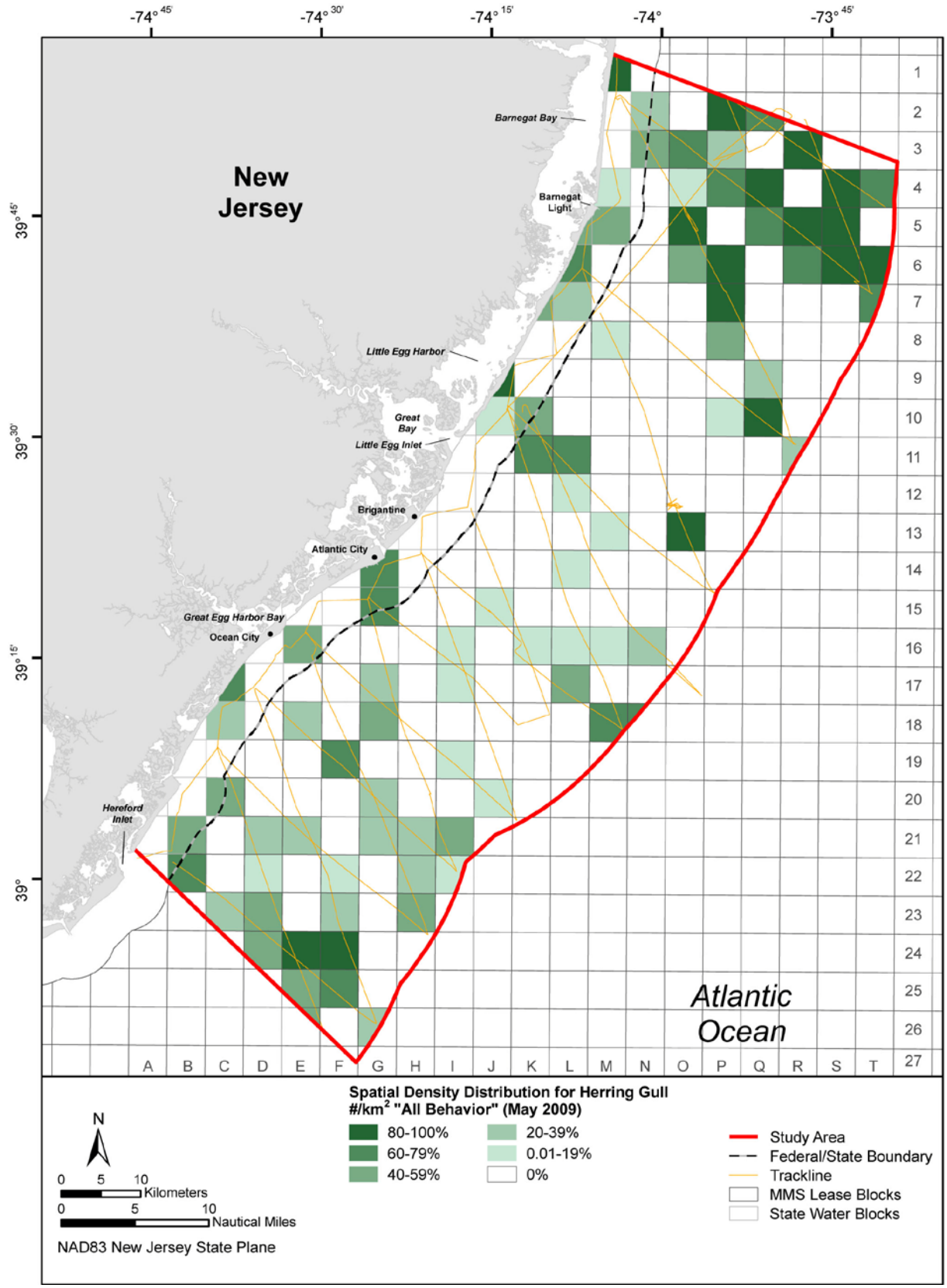

Figure C-118. Percentile abundance of Herring Gull (all behaviors), May 2009 (n=237).

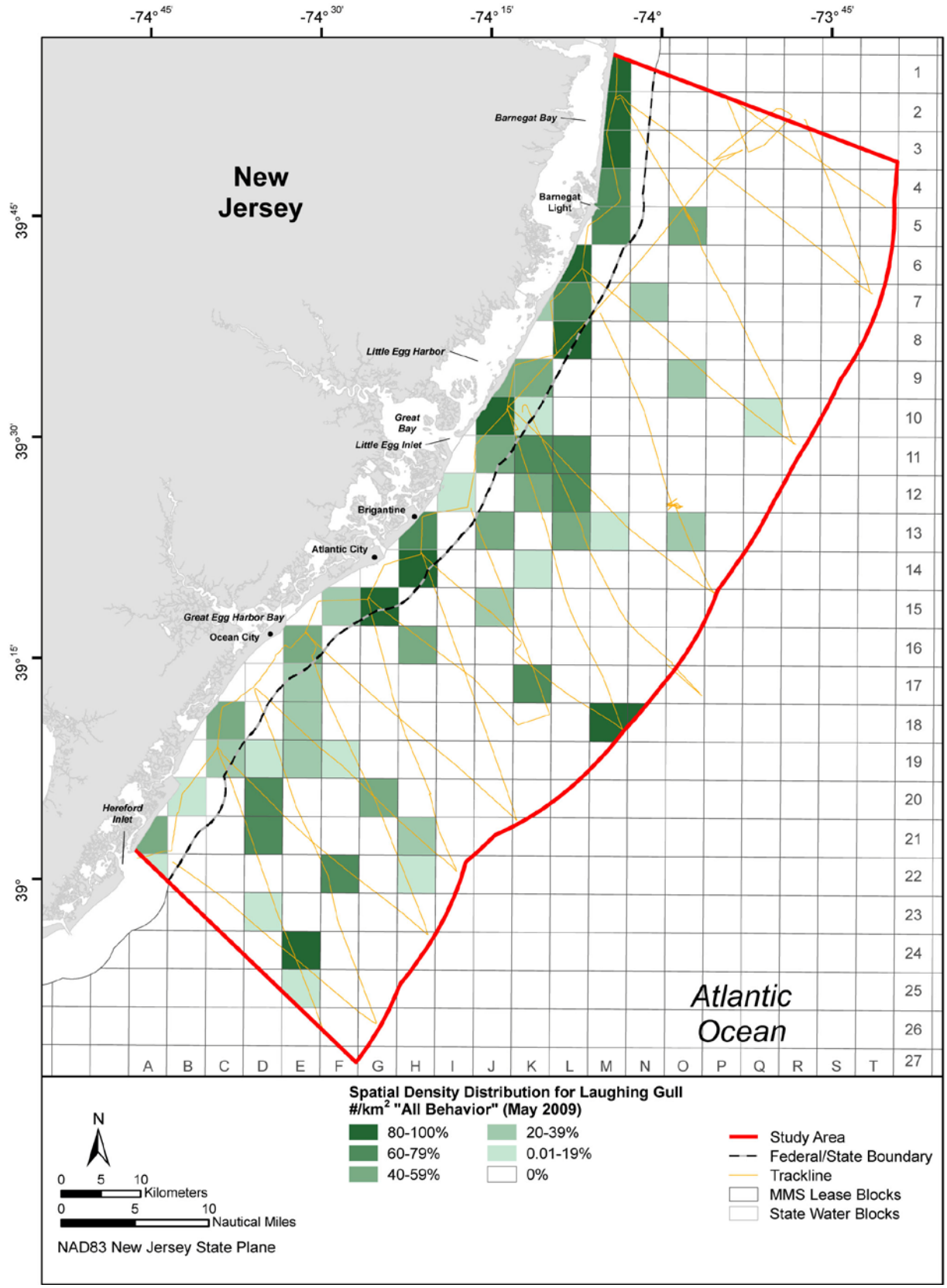

Figure C-119. Percentile abundance of Laughing Gull (all behaviors), May 2009 (n=198).

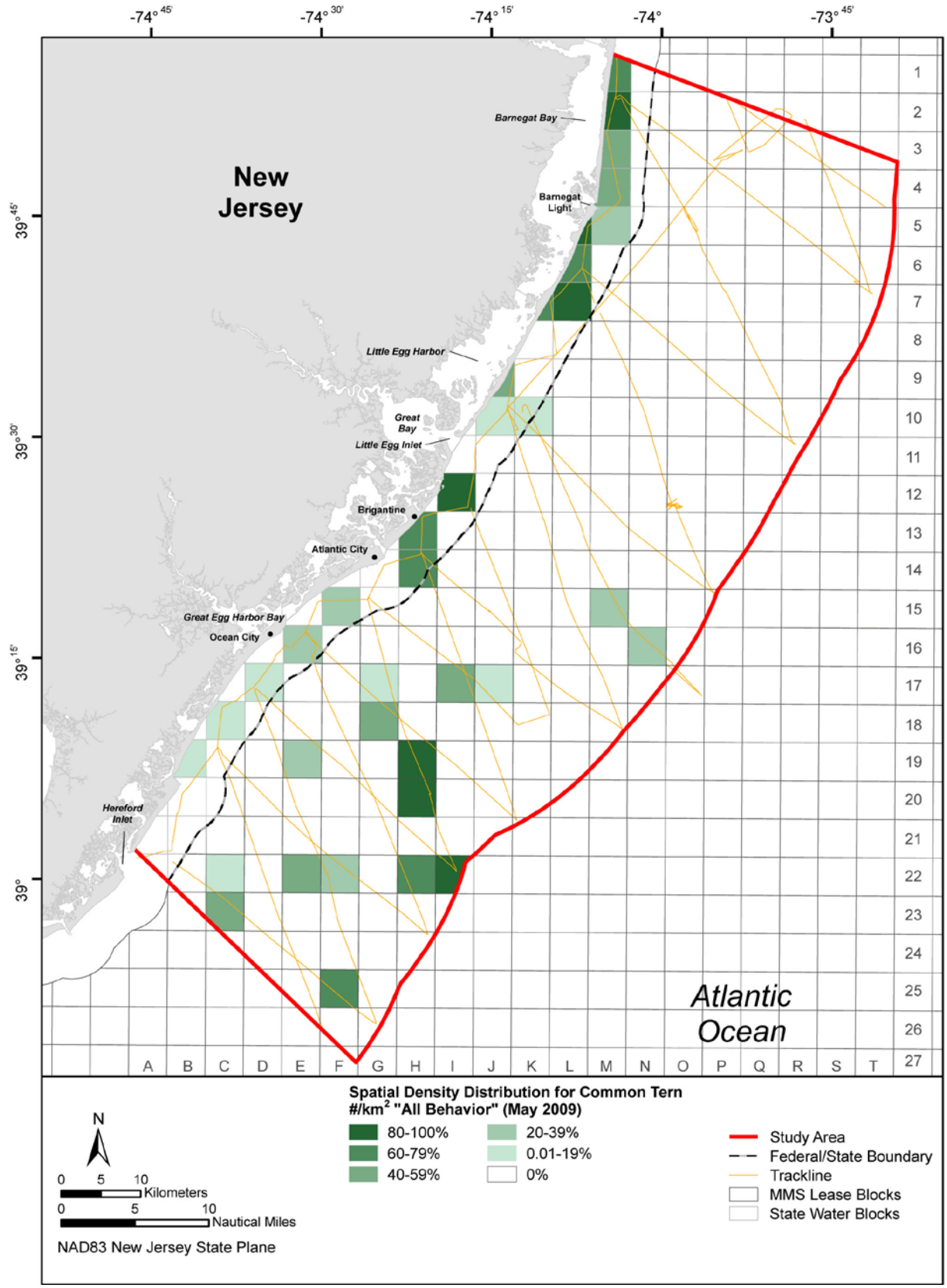

Figure C-120. Percentile abundance of Common Tern (all behaviors), May 2009 (n=169).

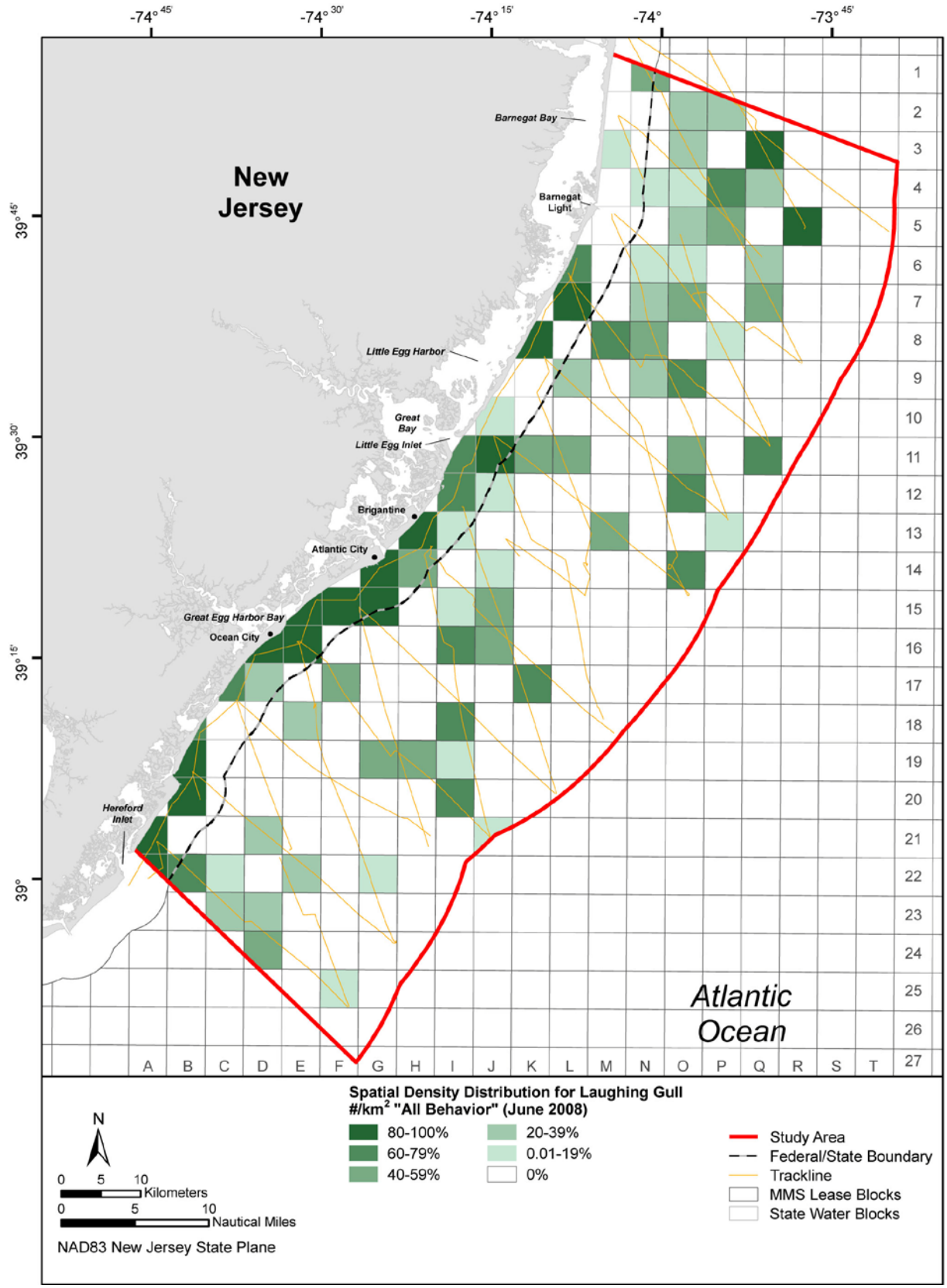

Figure C-121. Percentile abundance of Laughing Gull (all behaviors), June 2008 (n=332).

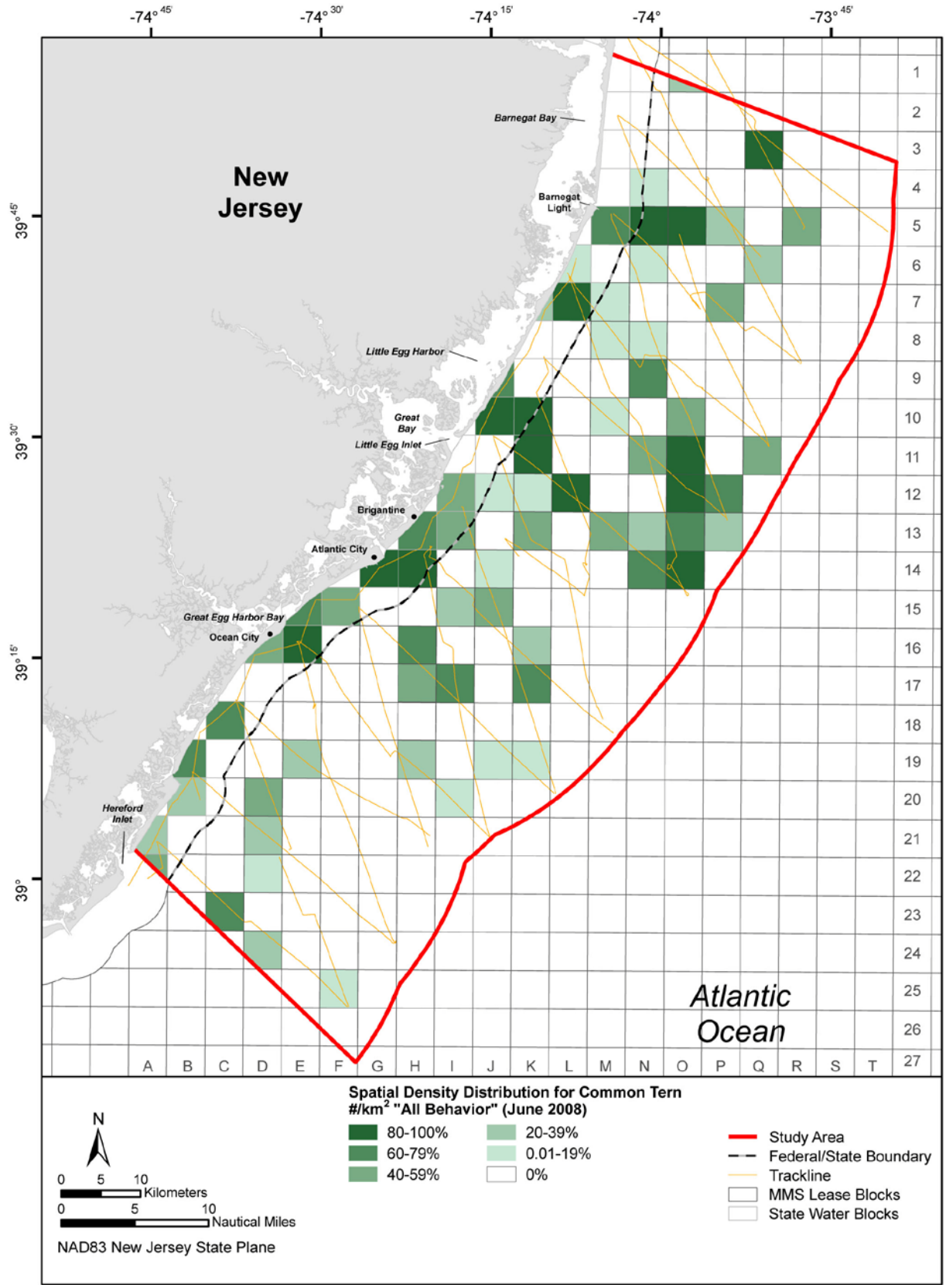

Figure C-122. Percentile abundance of Common Tern (all behaviors), June 2008 (n=212).

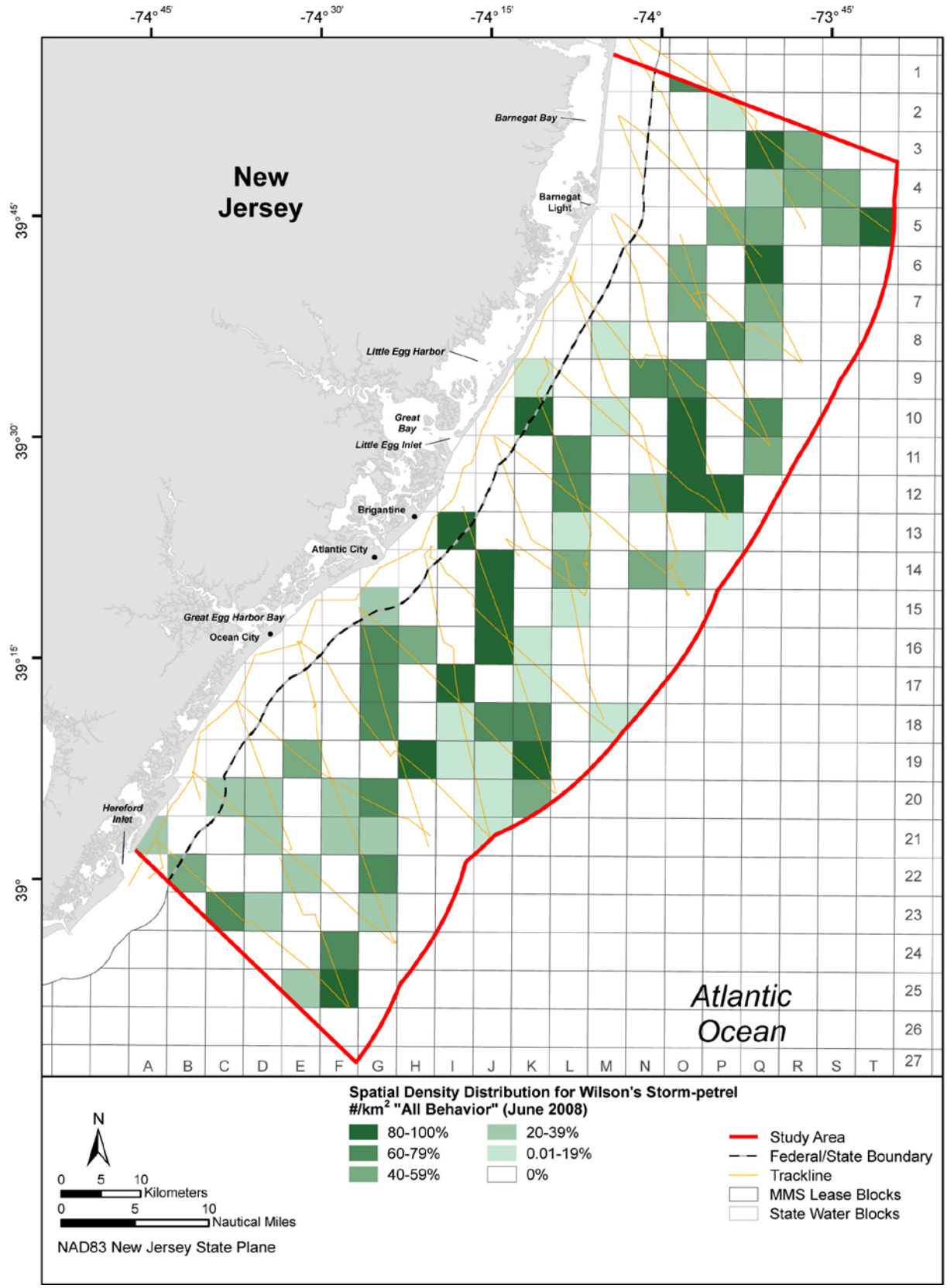

Figure C-123. Percentile abundance of Wilson's Storm-Petrel (all behaviors), June 2008 (n=198).

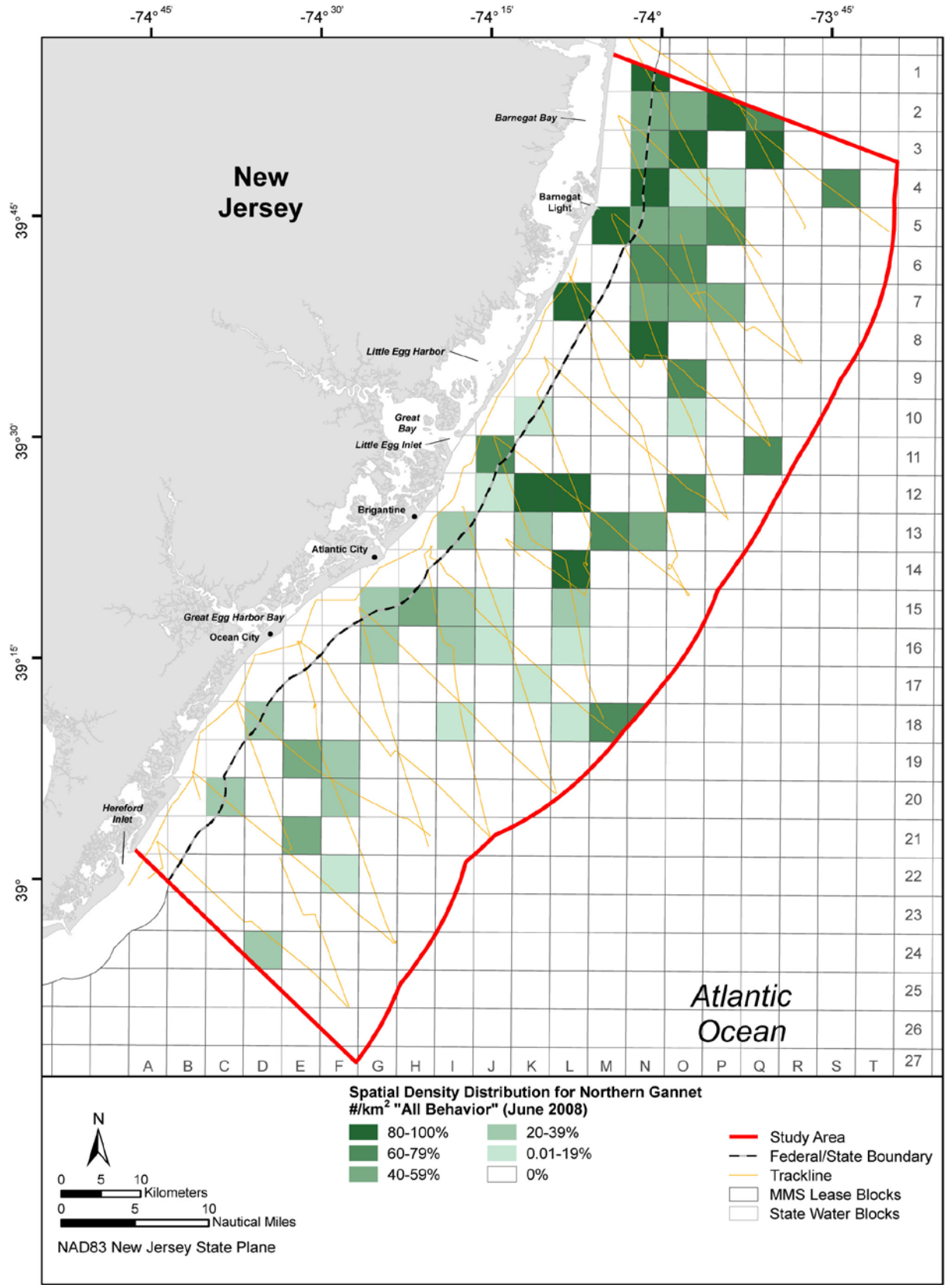

Figure C-124. Percentile abundance of Northern Gannet (all behaviors), June 2008 (n=124).

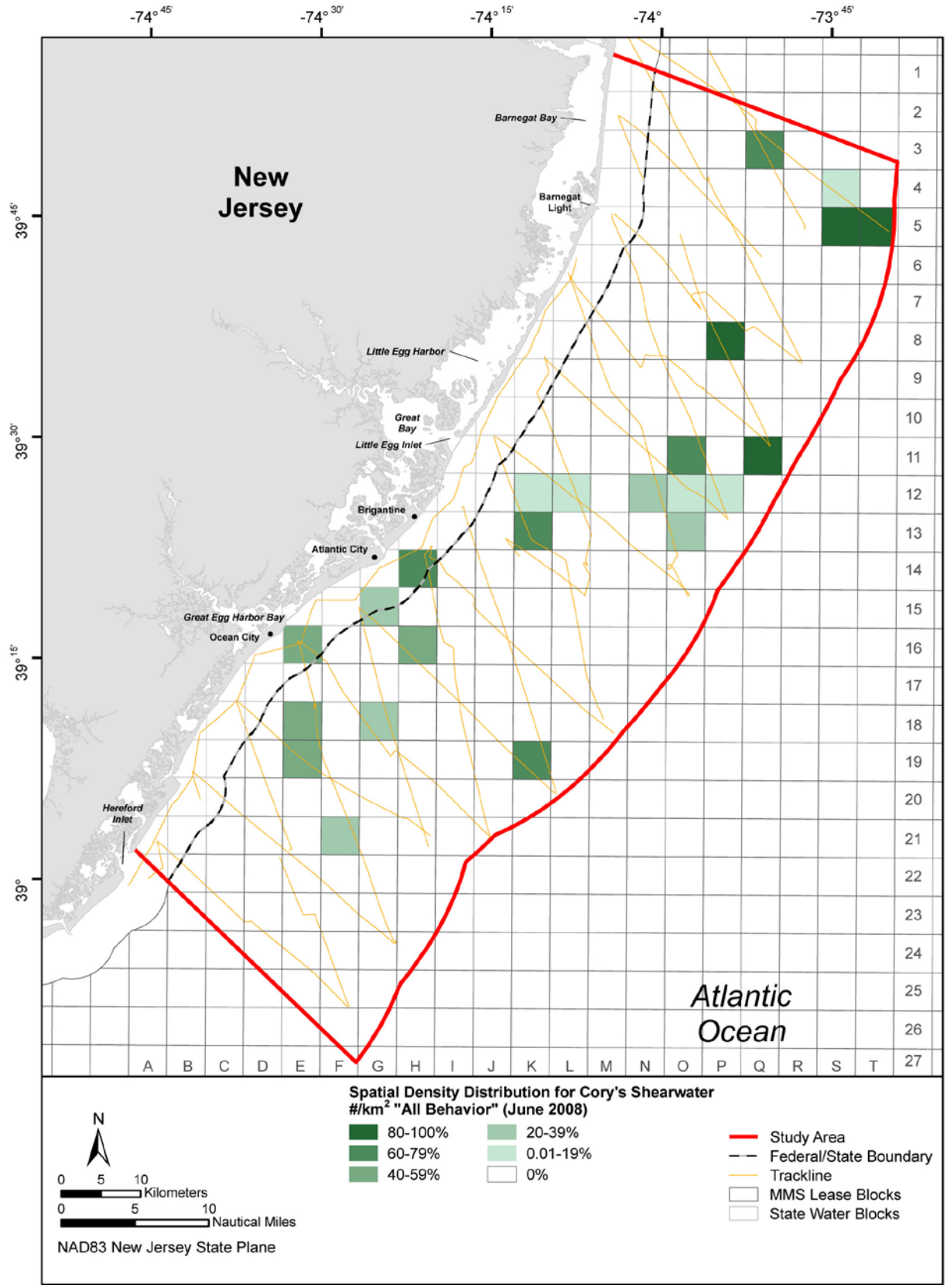

Figure C-125. Percentile abundance of Cory's Shearwater (all behaviors), June 2008 (n=51).

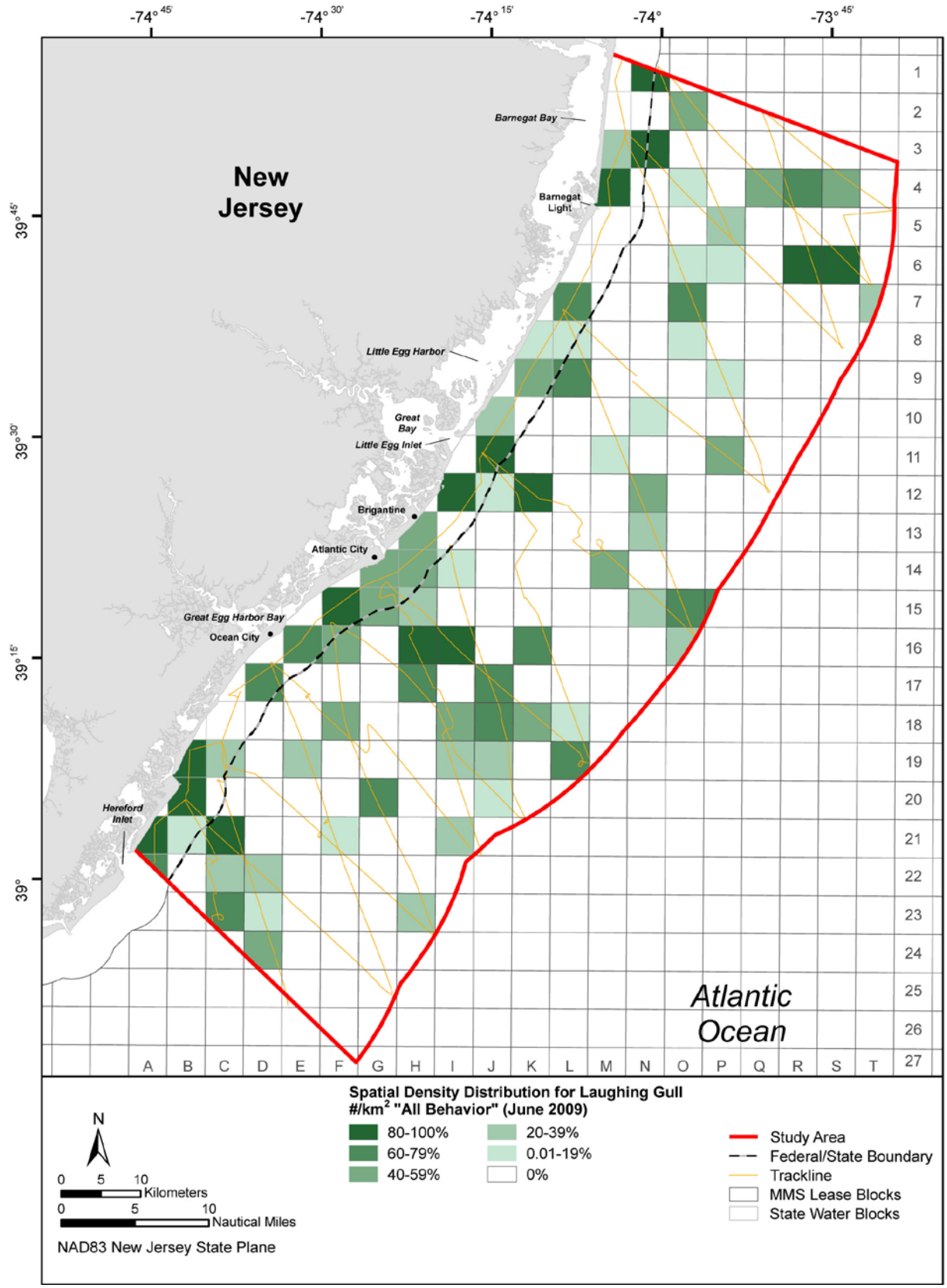

Figure C-126. Percentile abundance of Laughing Gull (all behaviors), June 2009 (n=345).

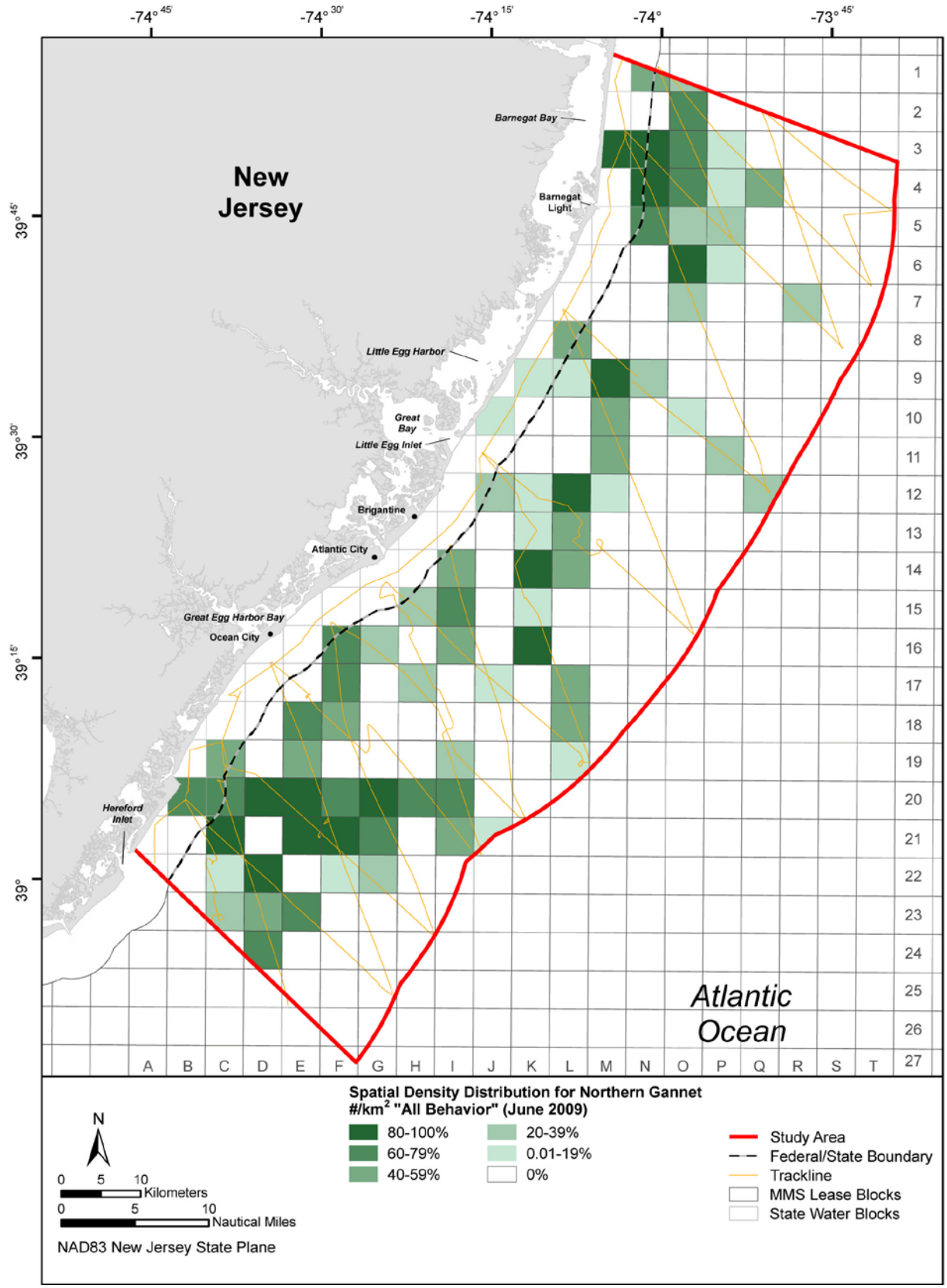

Figure C-127. Percentile abundance of Northern Gannet (all behaviors), June 2009 (n=282).

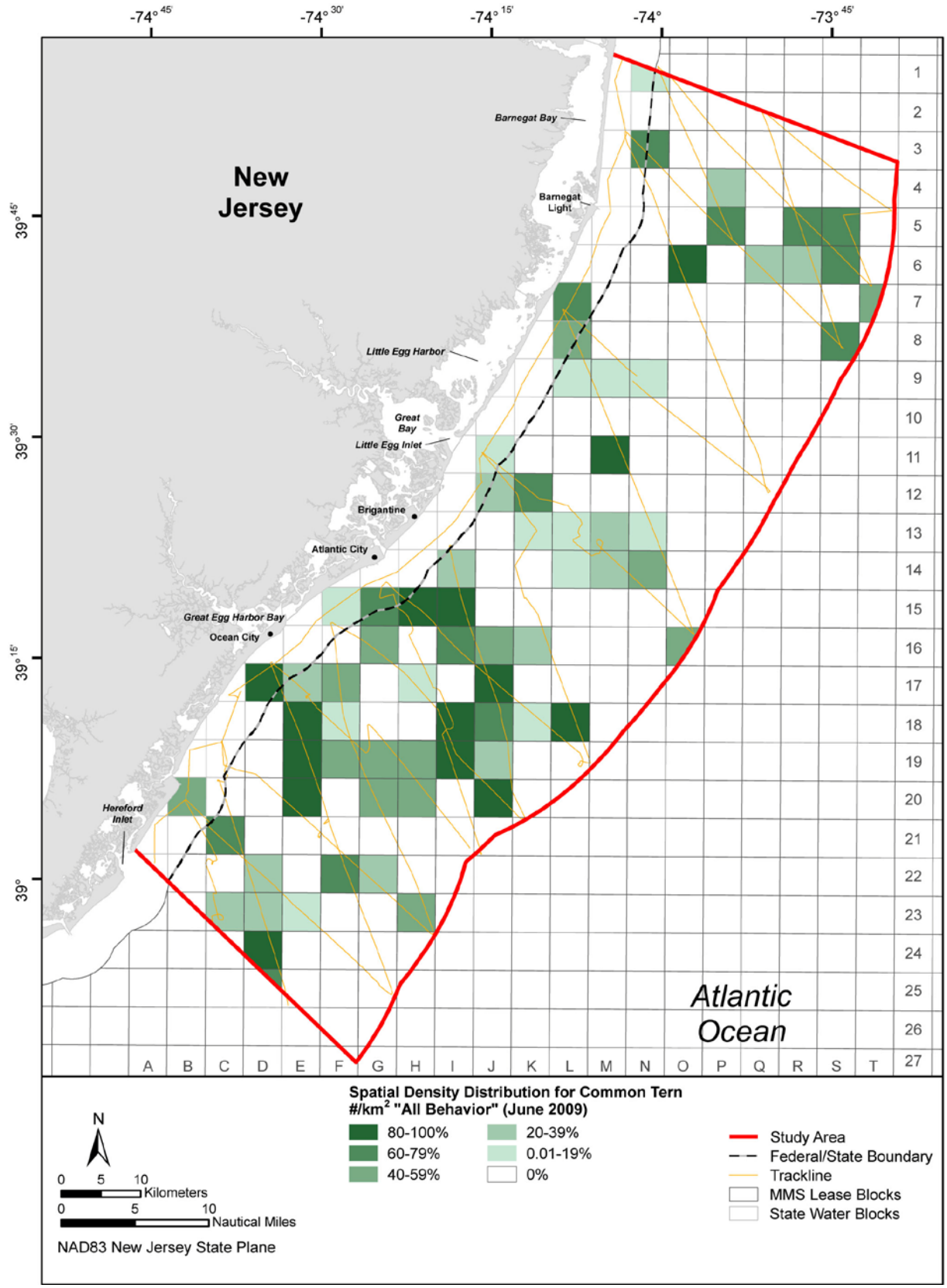

Figure C-128. Percentile abundance of Common Tern (all behaviors), June 2009 (n=201).

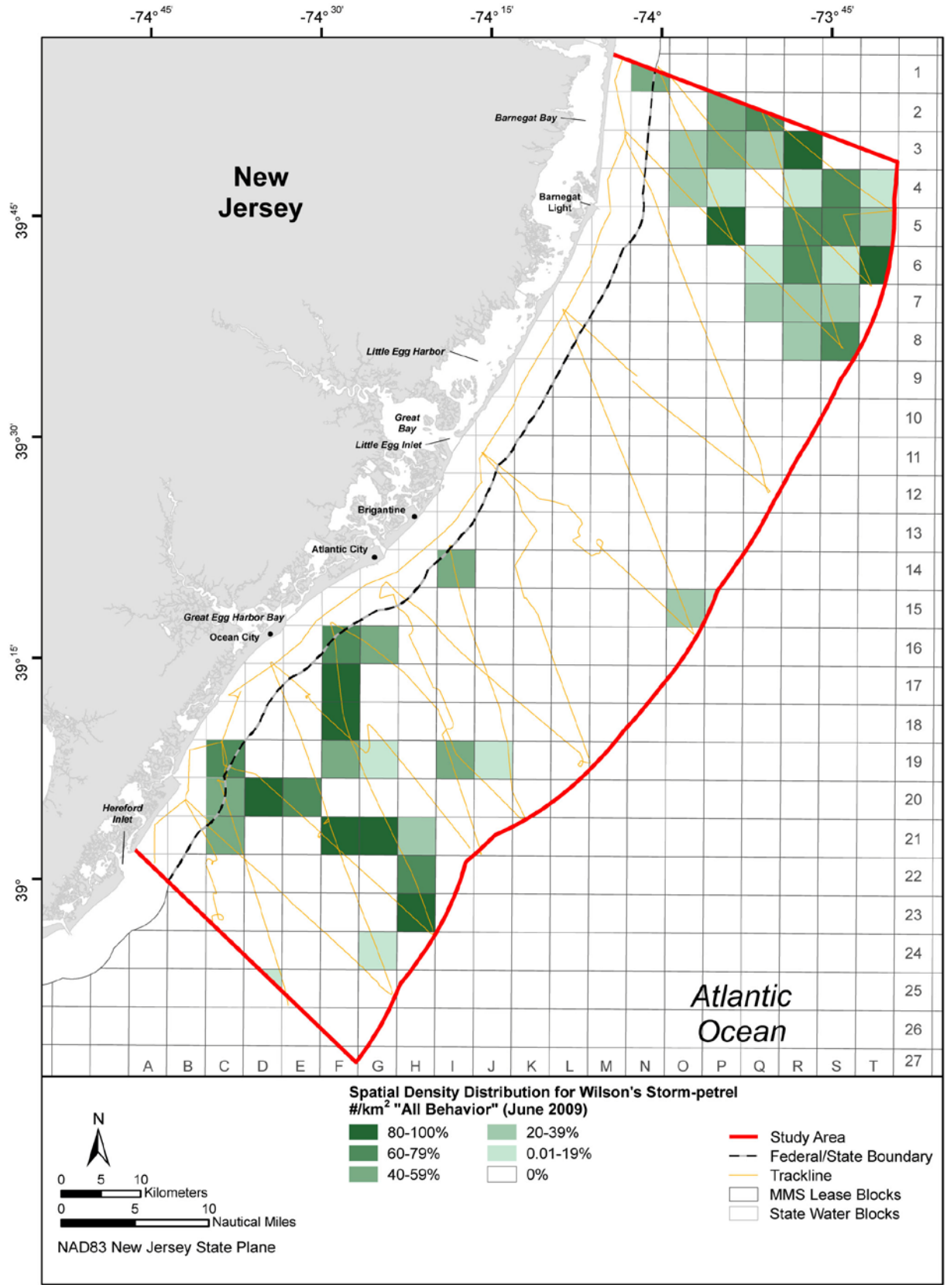

Figure C-129. Percentile abundance of Wilson's Storm-Petrel (all behaviors), June 2009 (n=113).

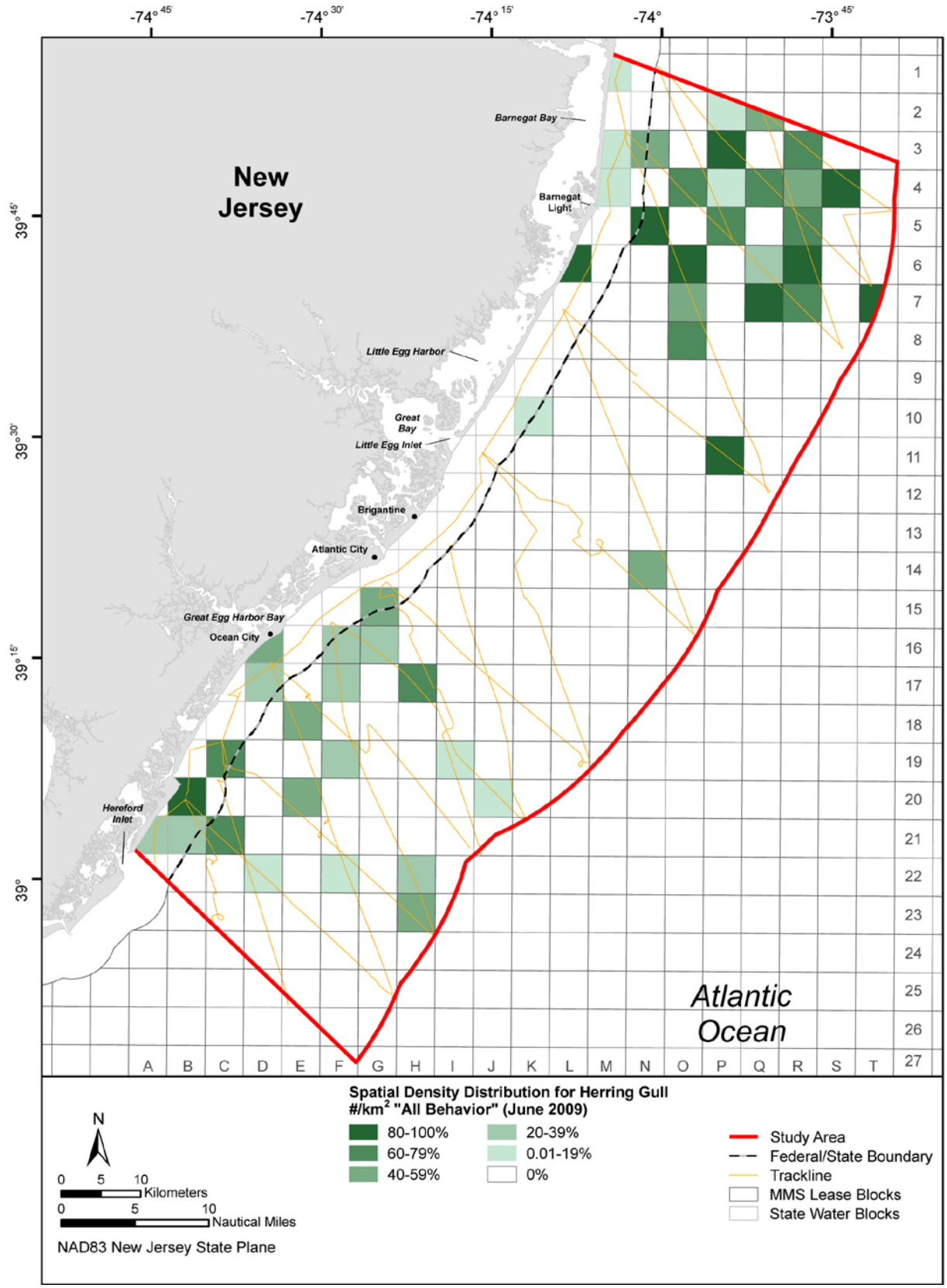

Figure C-130. Percentile abundance of Herring Gull (all behaviors), June 2009 (n=86).

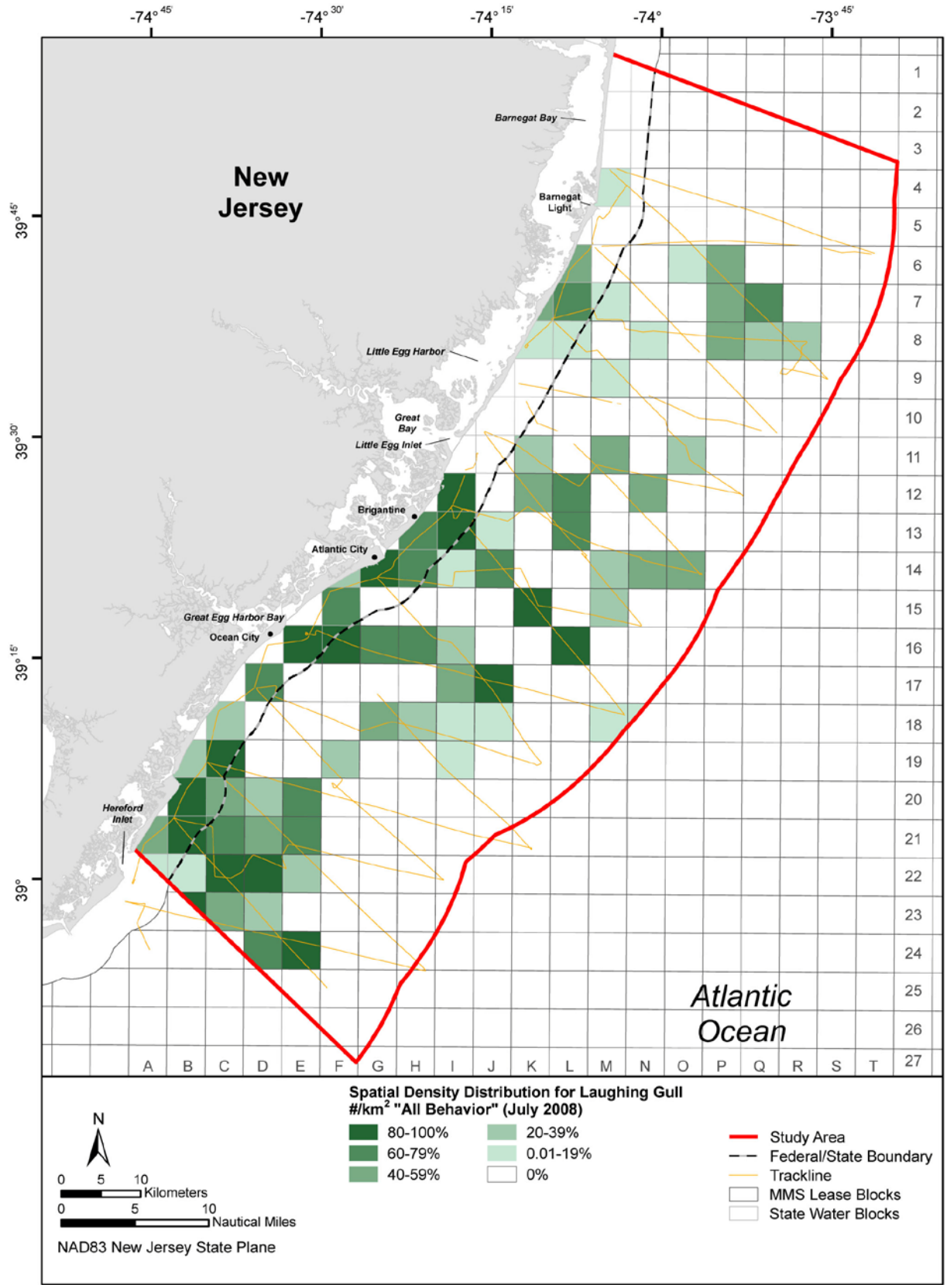

Figure C-131. Percentile abundance of Laughing Gull (all behaviors), July 2008 (n=405).

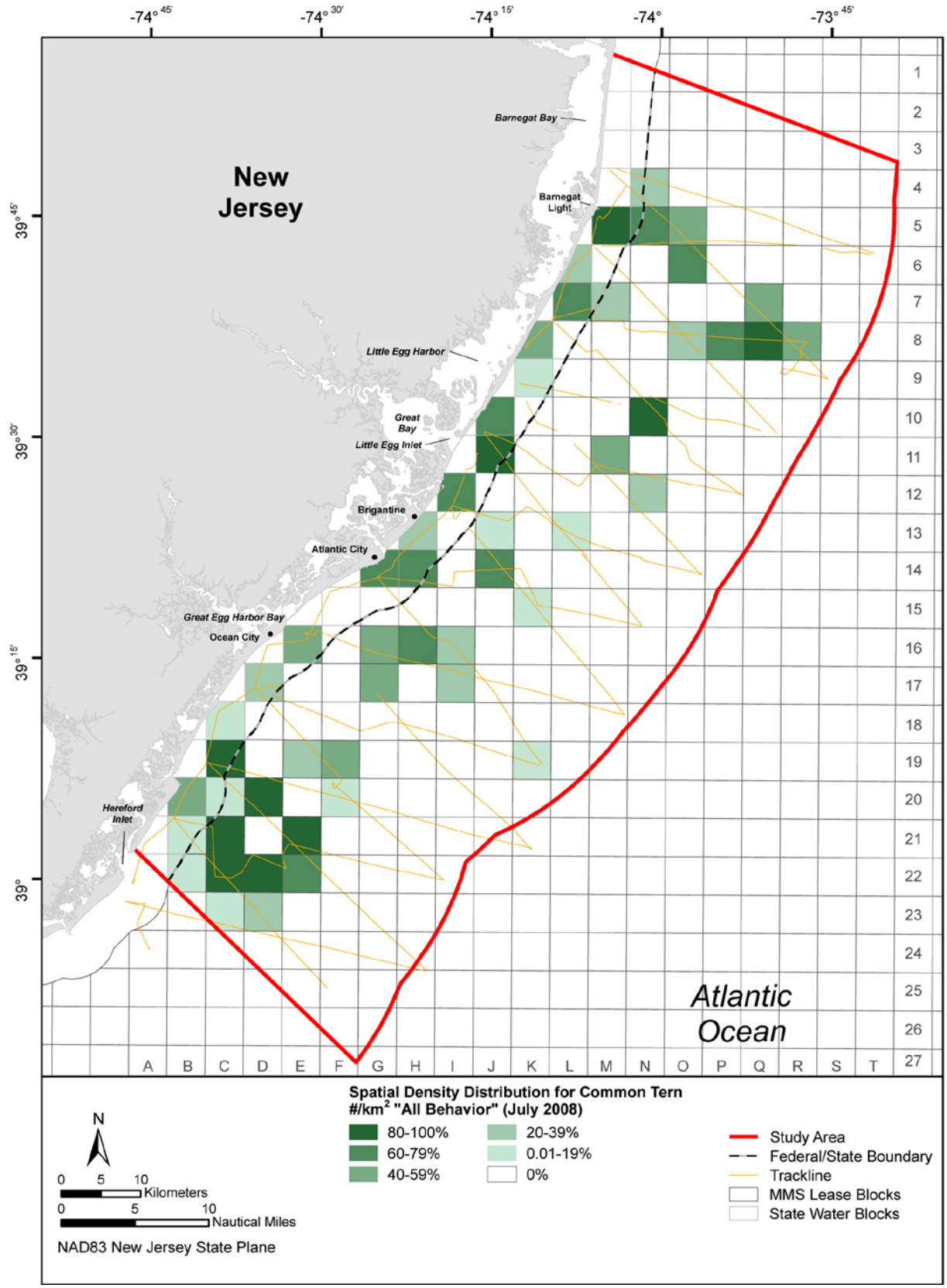

Figure C-132. Percentile abundance of Common Tern (all behaviors), July 2008 (n=273).

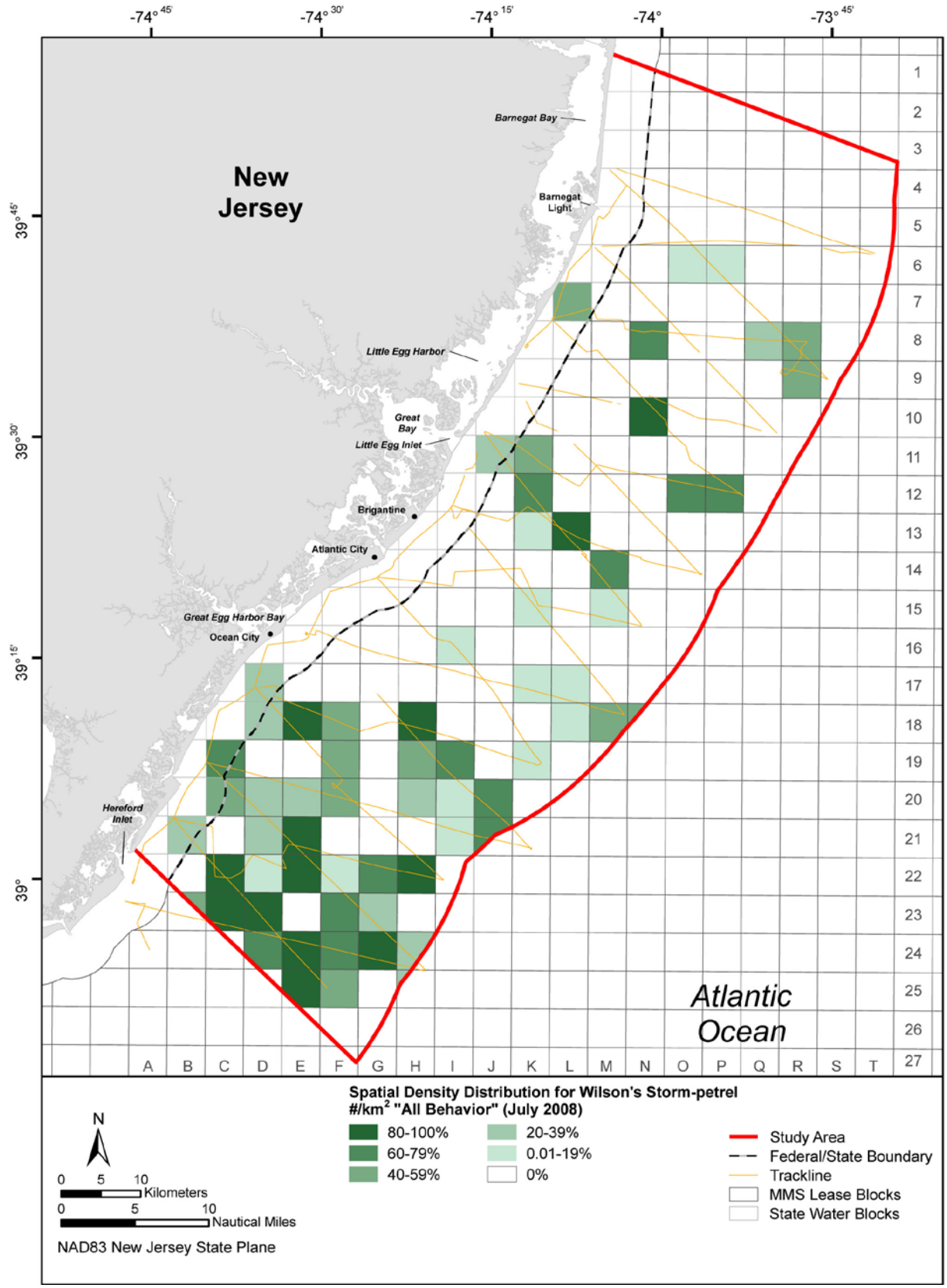

Figure C-133. Percentile abundance of Wilson's Storm-Petrel (all behaviors), July 2008 (n=213).

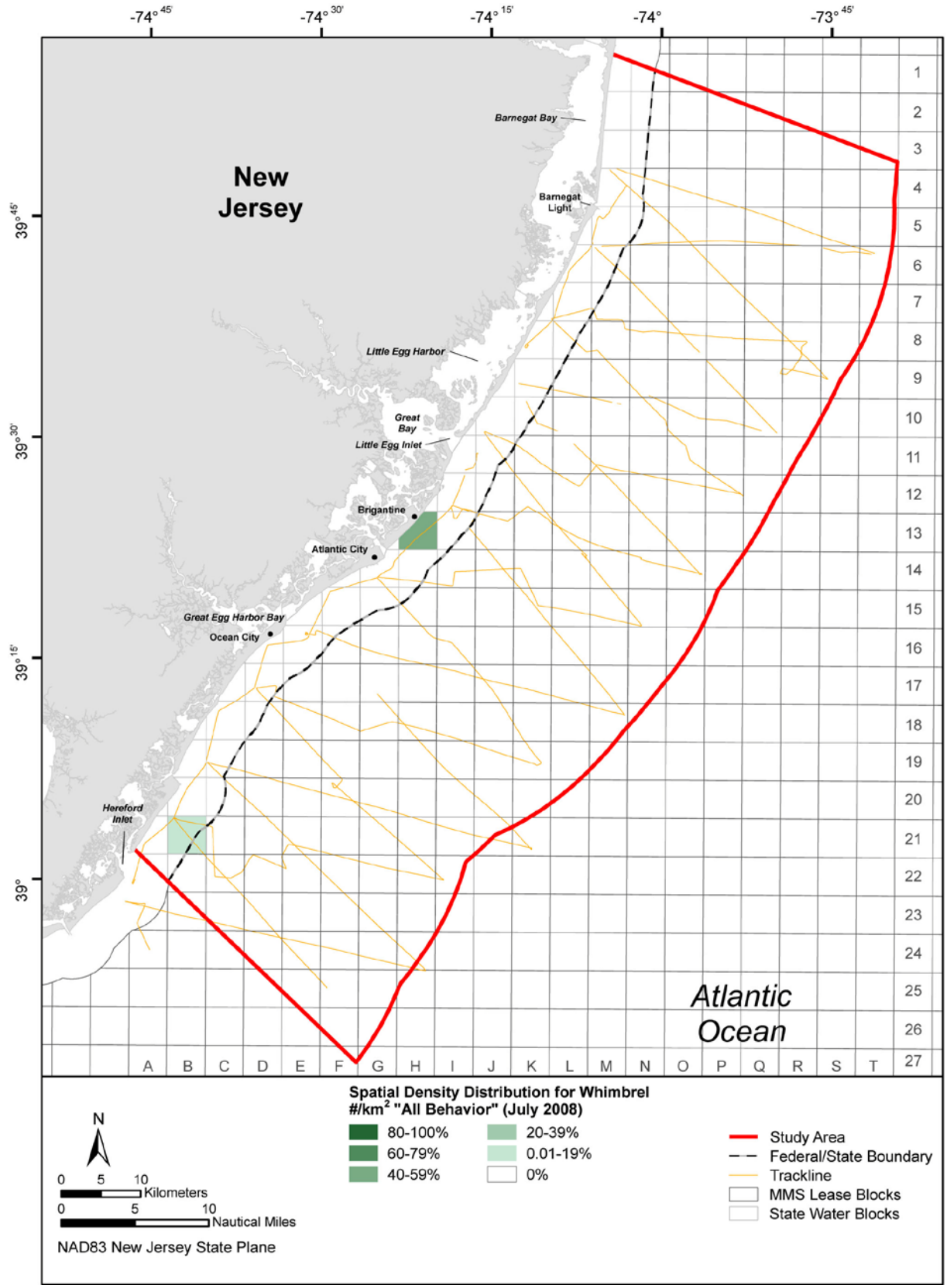

Figure C-134. Percentile abundance of Whimbrel (all behaviors), July 2008 (n=49).

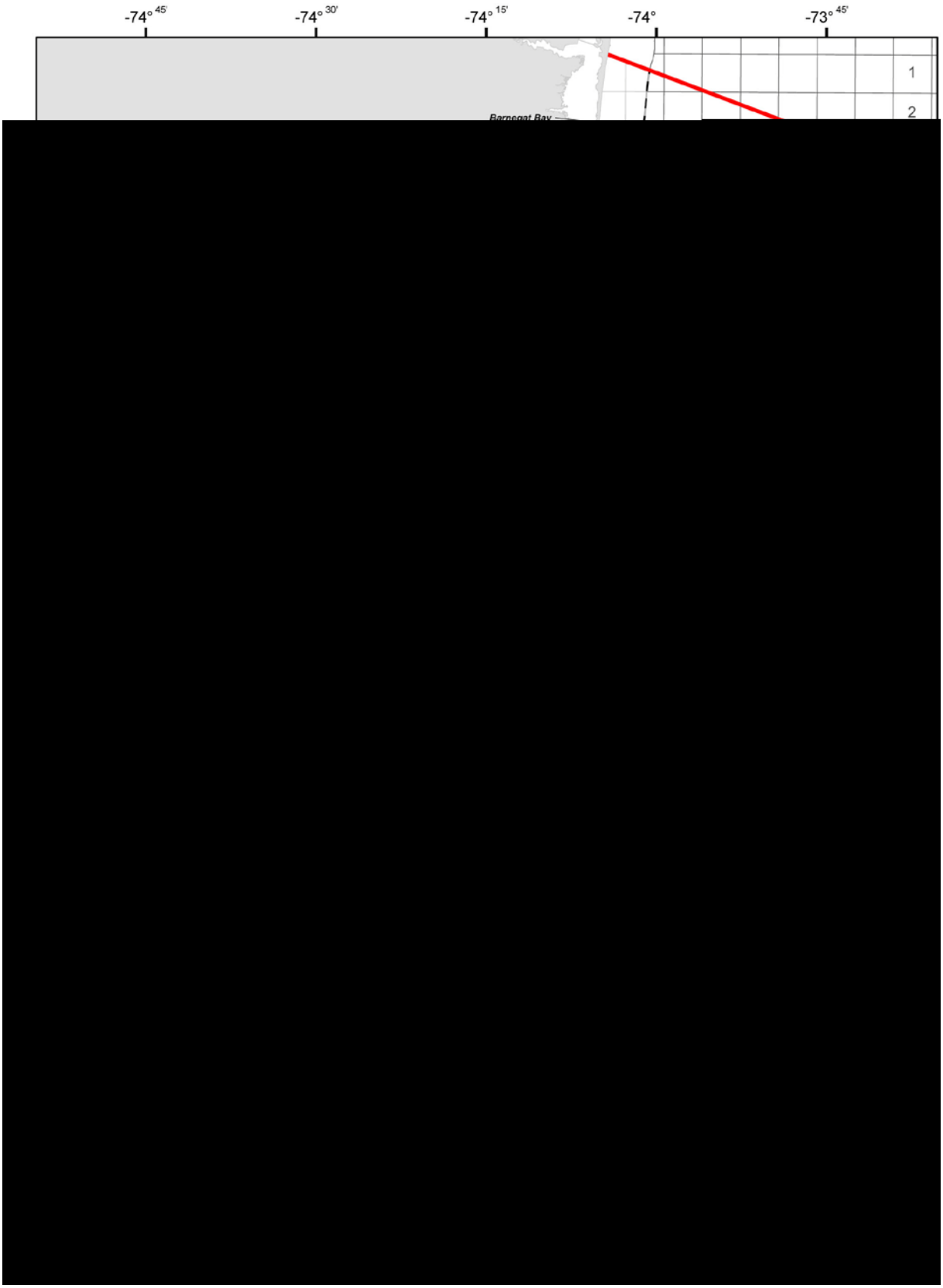

Figure C-135. Percentile abundance of Cory's Shearwater (all behaviors), July 2008 (n=36).

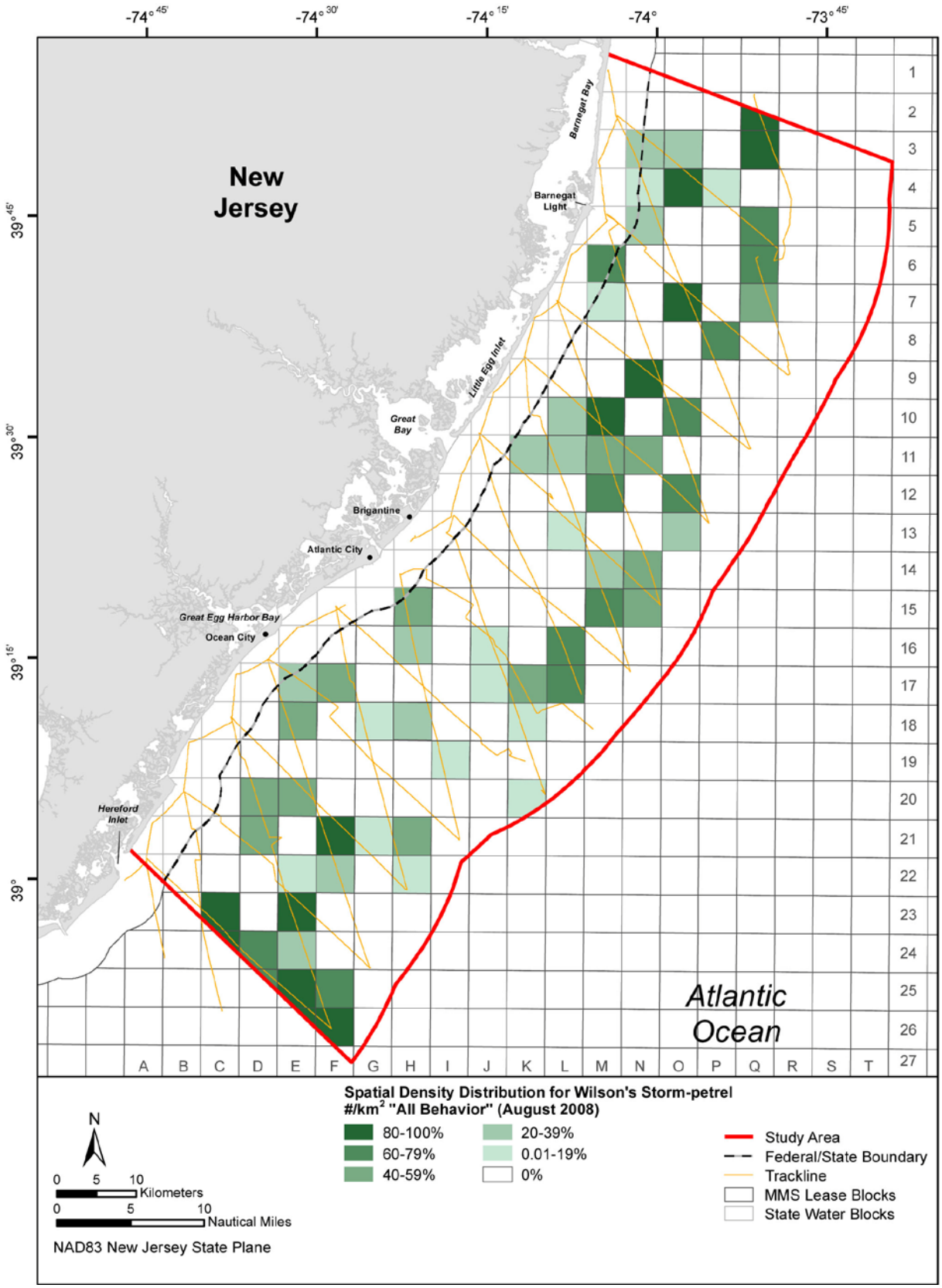

Figure C-136. Percentile abundance of Wilson's Storm-Petrel (all behaviors), August 2008 (n=1,245).

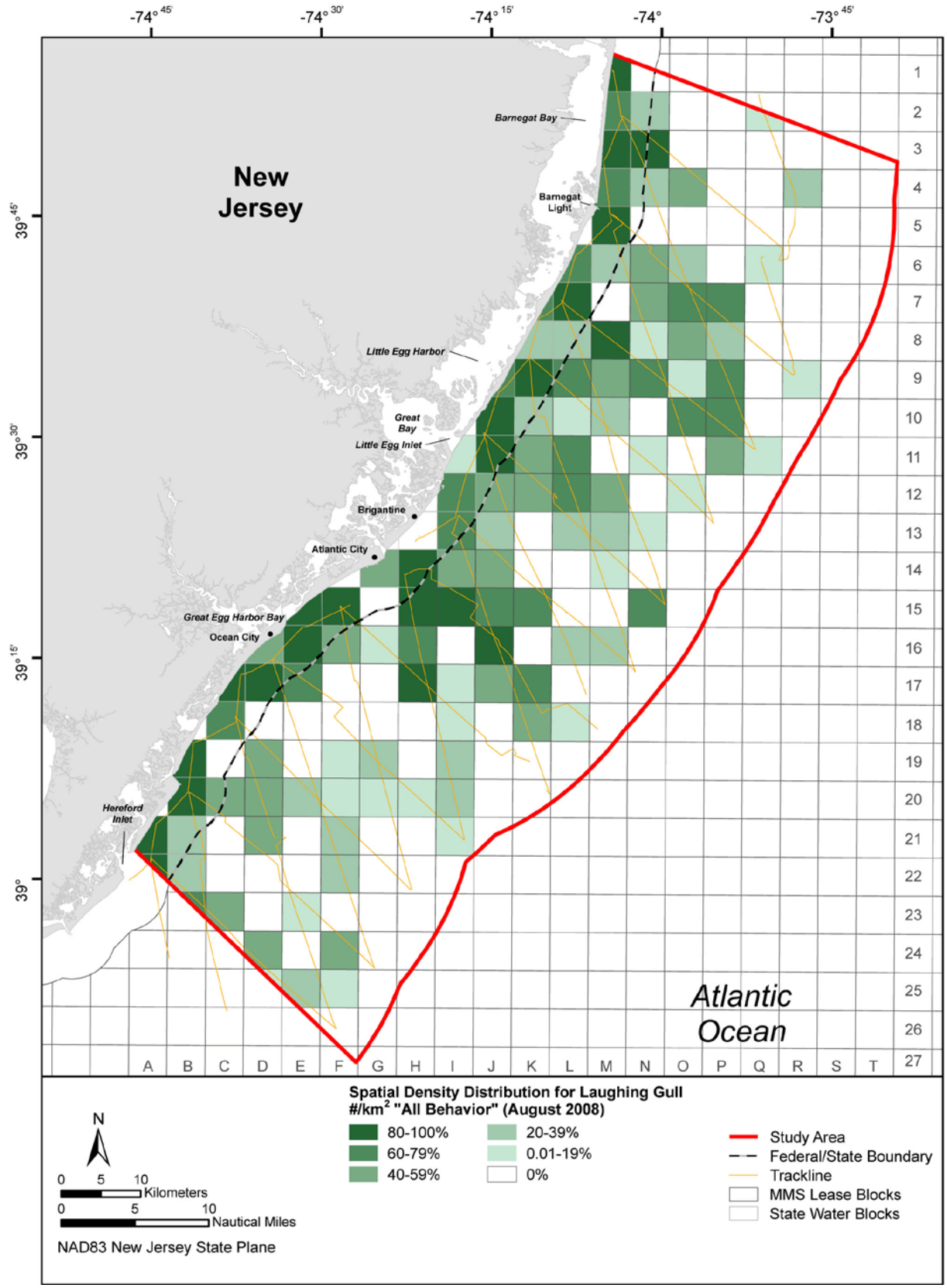

Figure C-137. Percentile abundance of Laughing Gull (all behaviors), August 2008 (n=1,110).

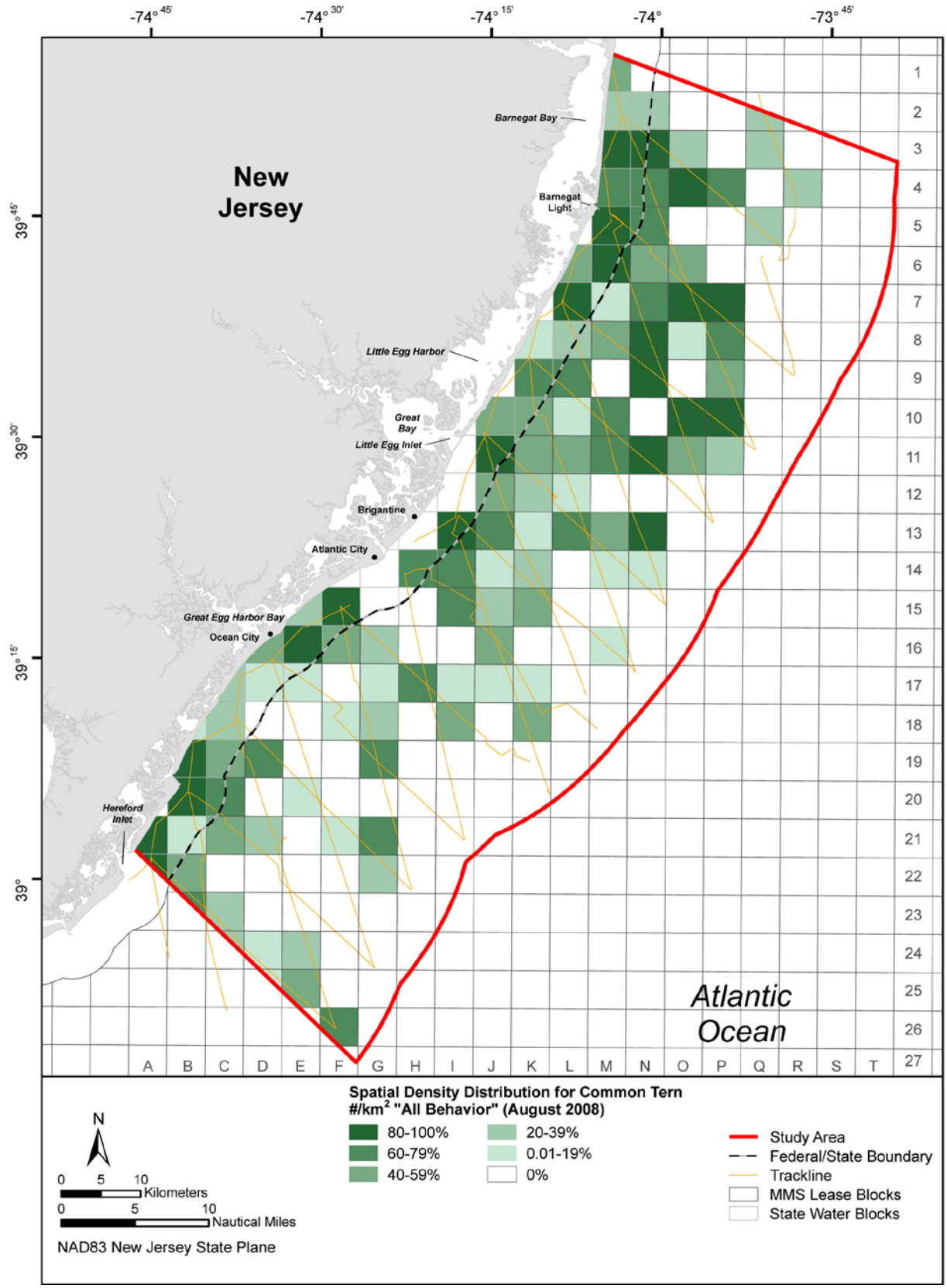

Figure C-138. Percentile abundance of Common Tern (all behaviors), August 2008 (n=716).

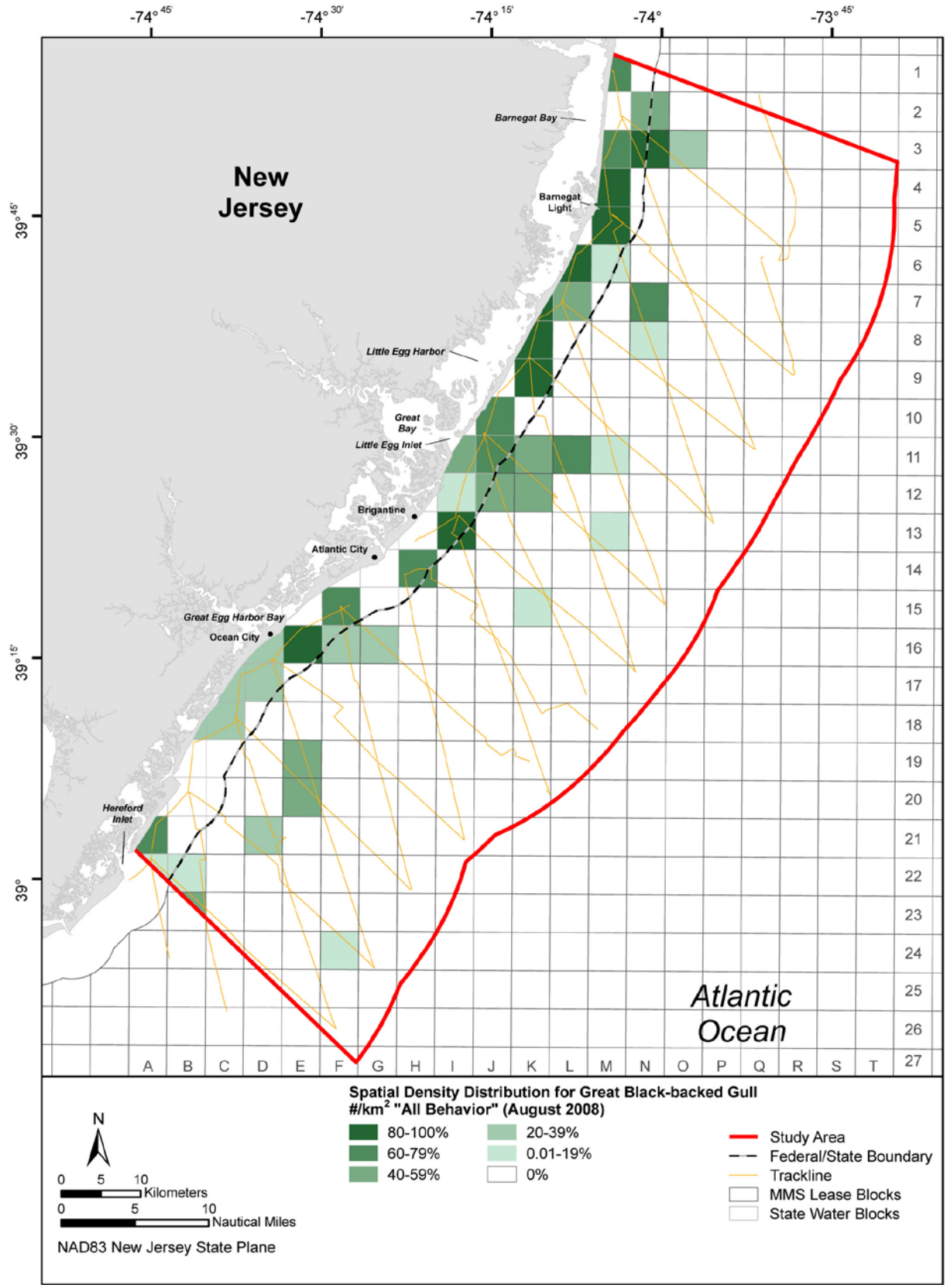

Figure C-139. Percentile abundance of Great Black-backed Gull (all behaviors), August 2008 (n=131).

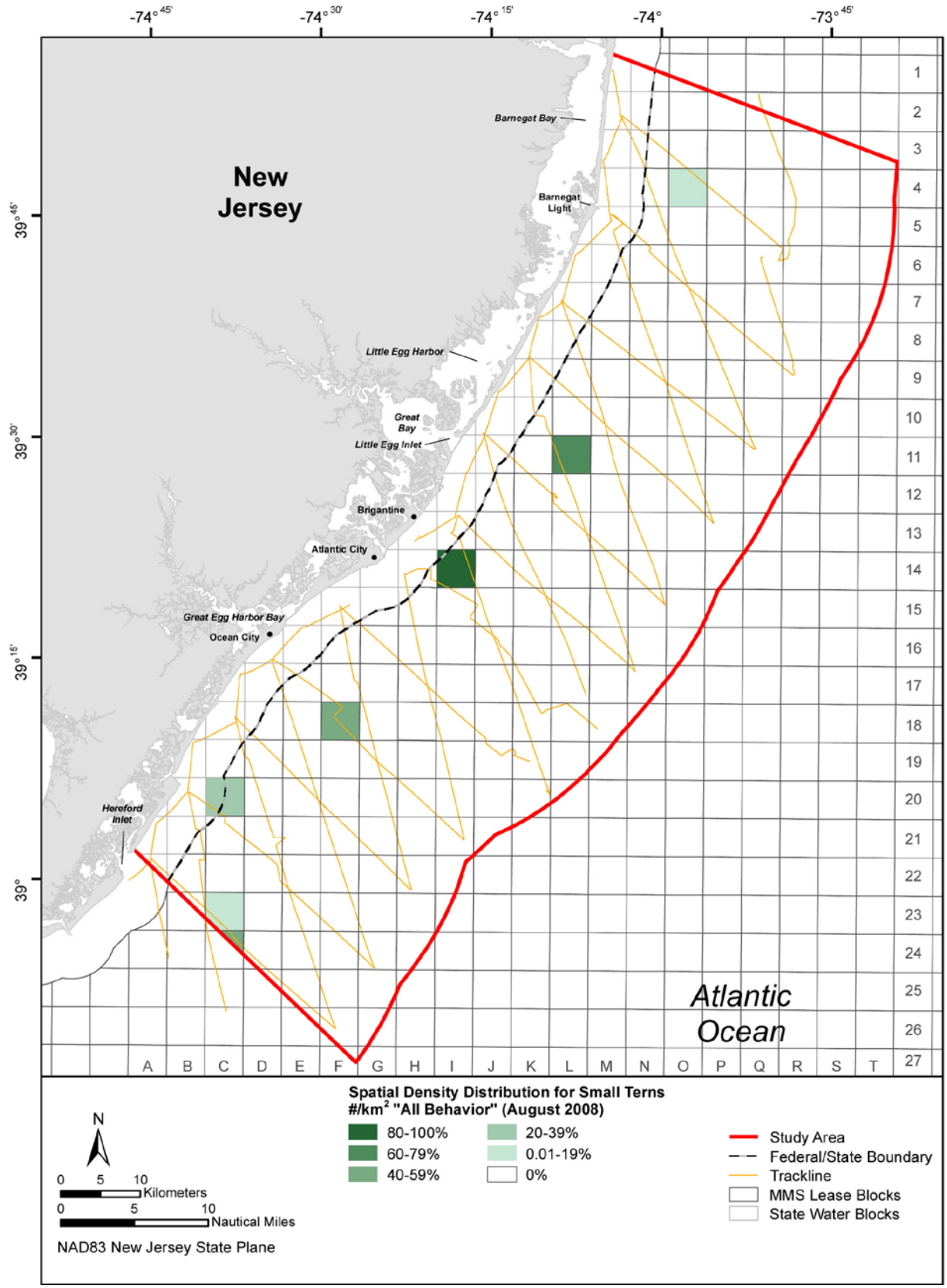

Figure C-140. Percentile abundance of small terns (all behaviors), August 2008 (n=78).

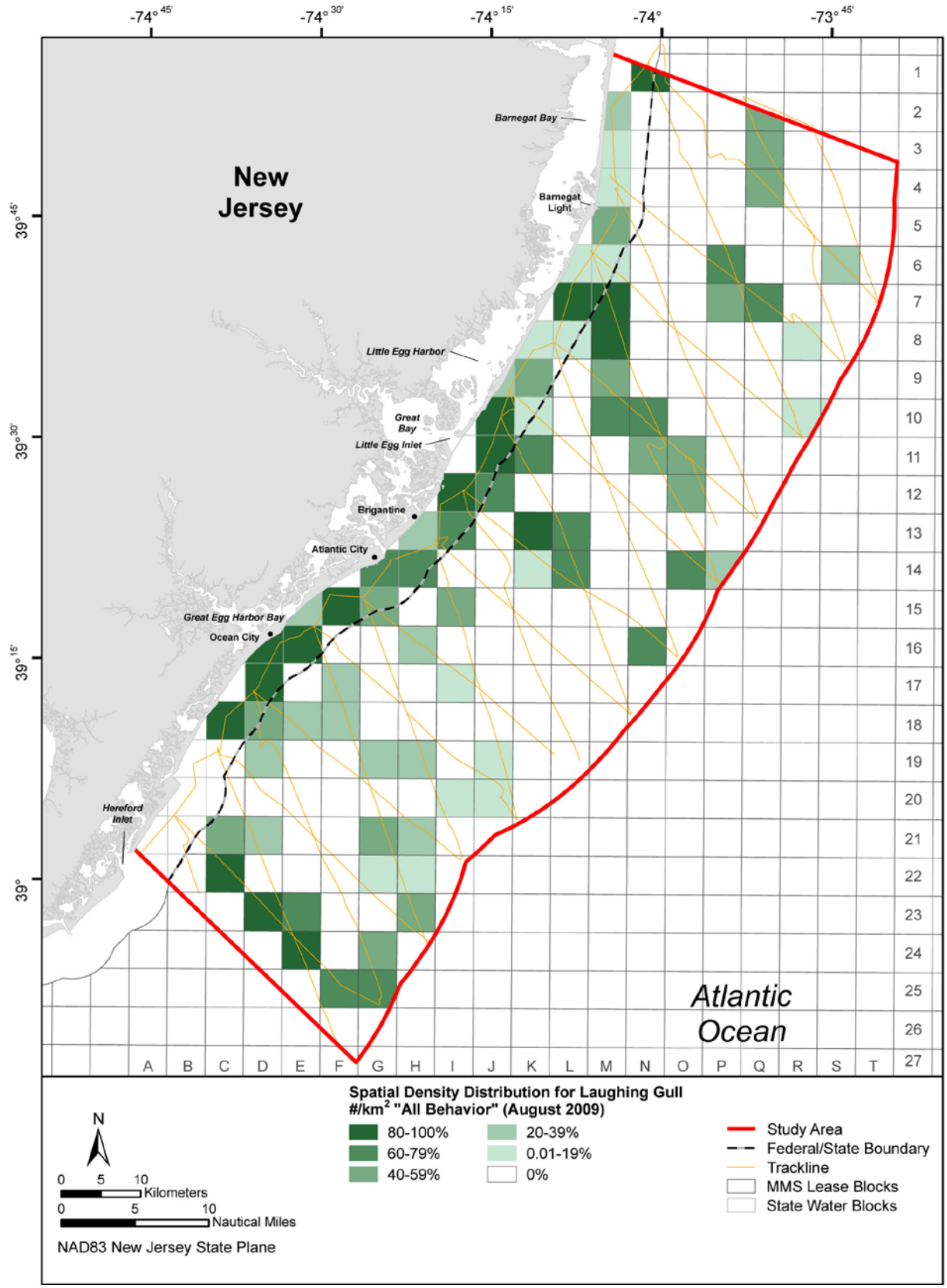

Figure C-141. Percentile abundance of Laughing Gull (all behaviors), August 2009 (n=440).

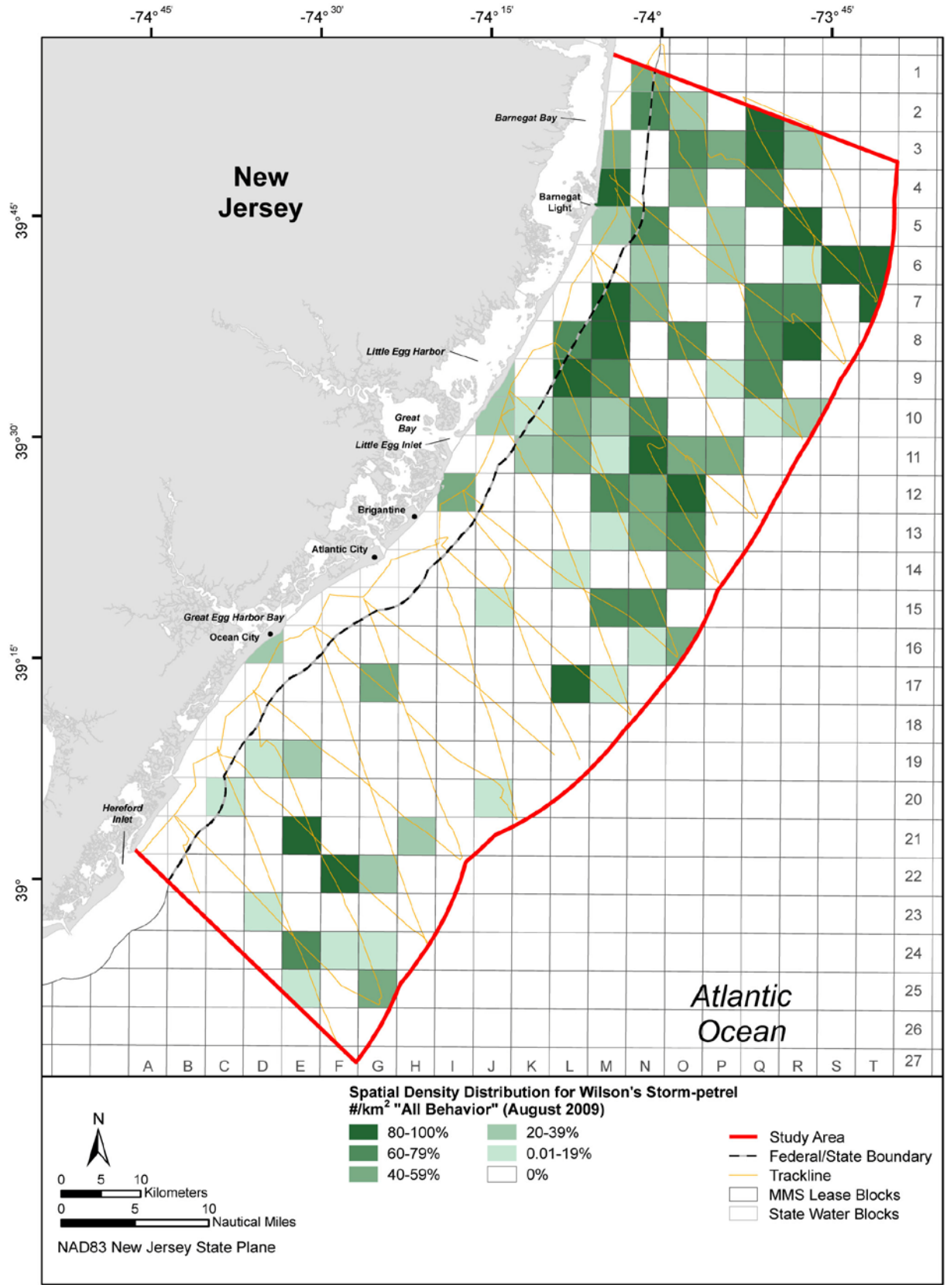

Figure C-142. Percentile abundance of Wilson's Storm-Petrel (all behaviors), August 2009 (n=322).

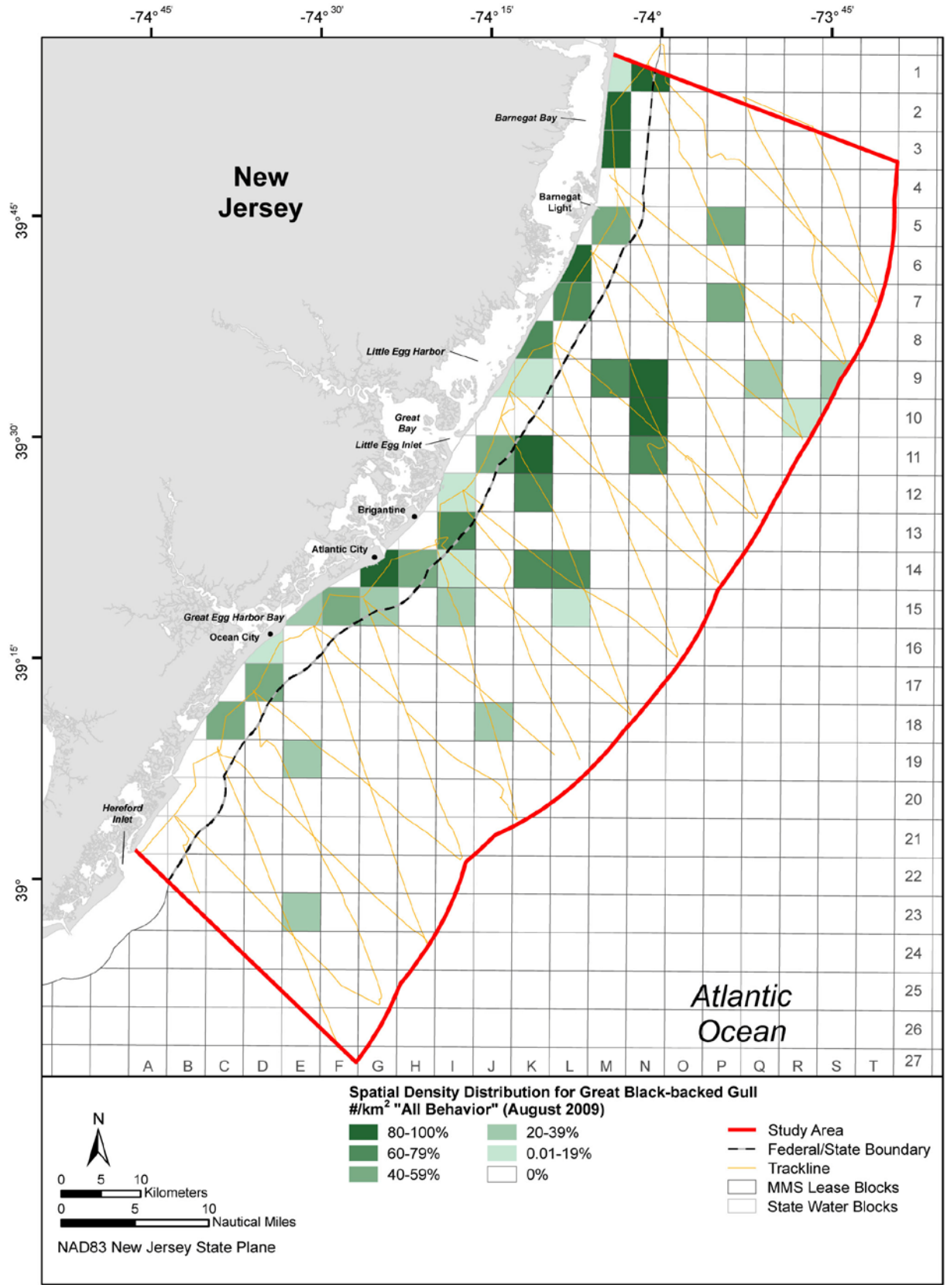

Figure C-143. Percentile abundance of Great Black-backed Gull (all behaviors), August 2009 (n=111).

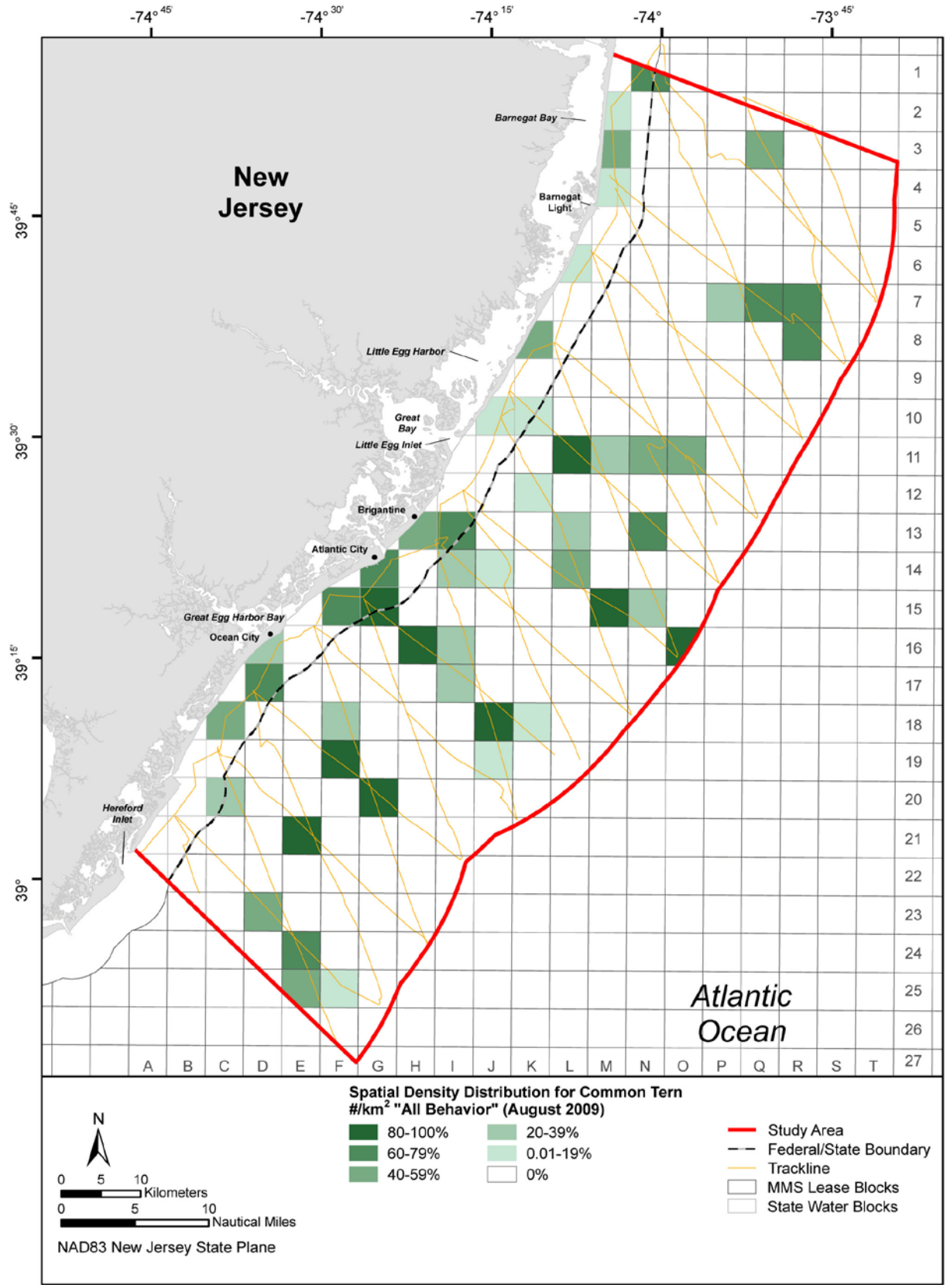

Figure C-144. Percentile abundance of Common Tern (all behaviors), August 2009 (n=105).

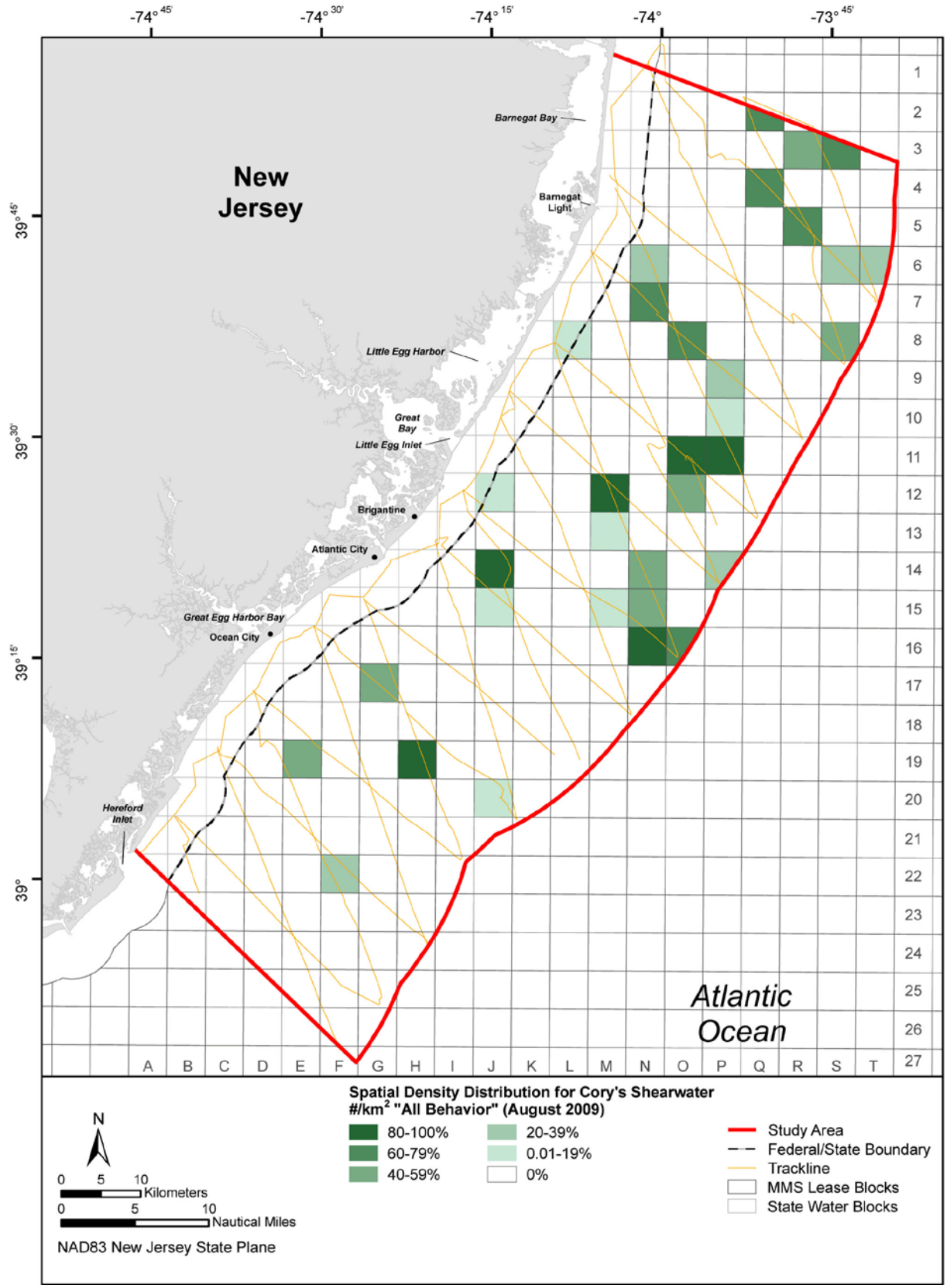

Figure C-145. Percentile abundance of Cory's Shearwater (all behaviors), August 2009 (n=55).

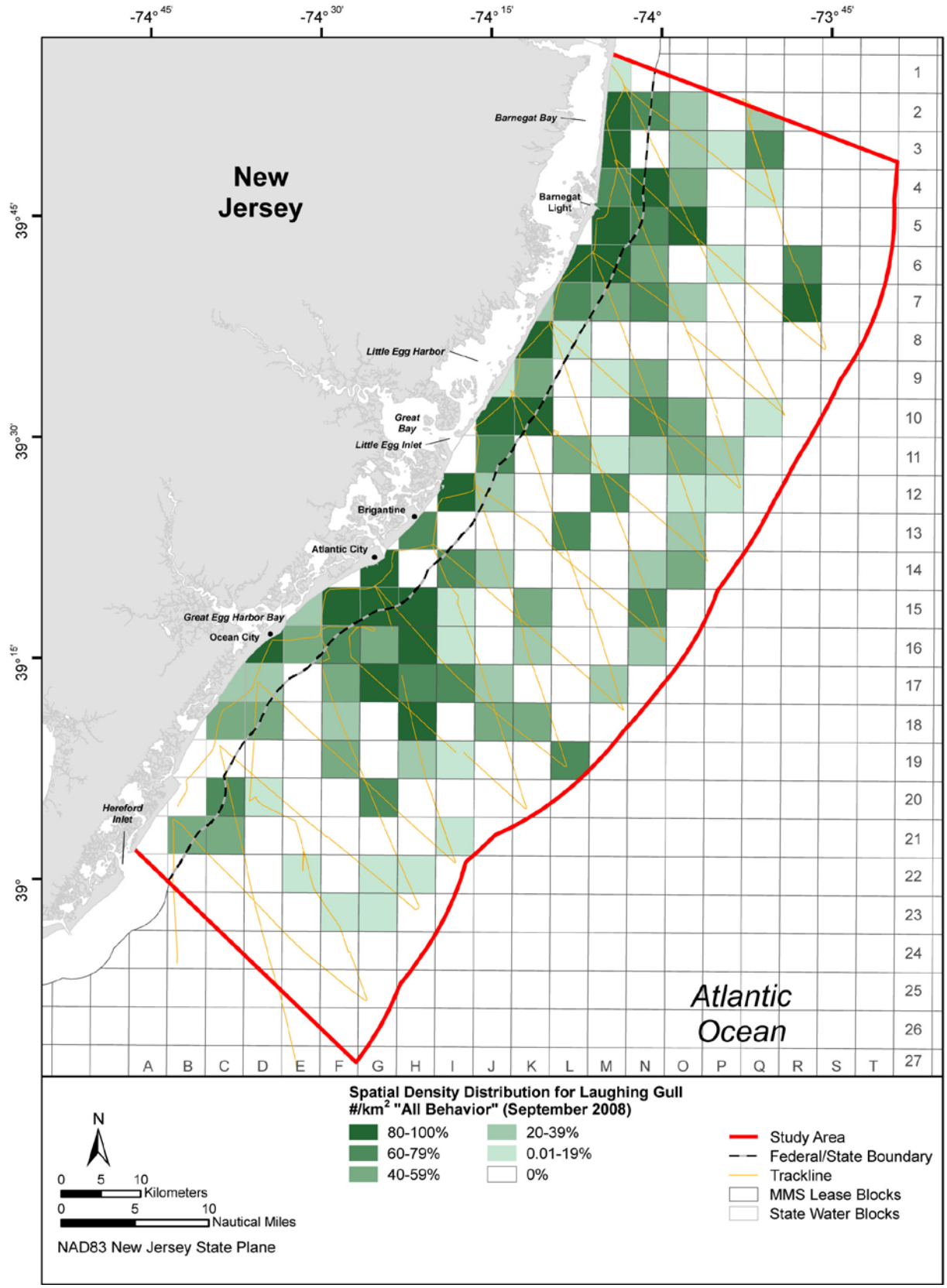

Figure C-146. Percentile abundance of Laughing Gull (all behaviors), September 2008 (n=415).

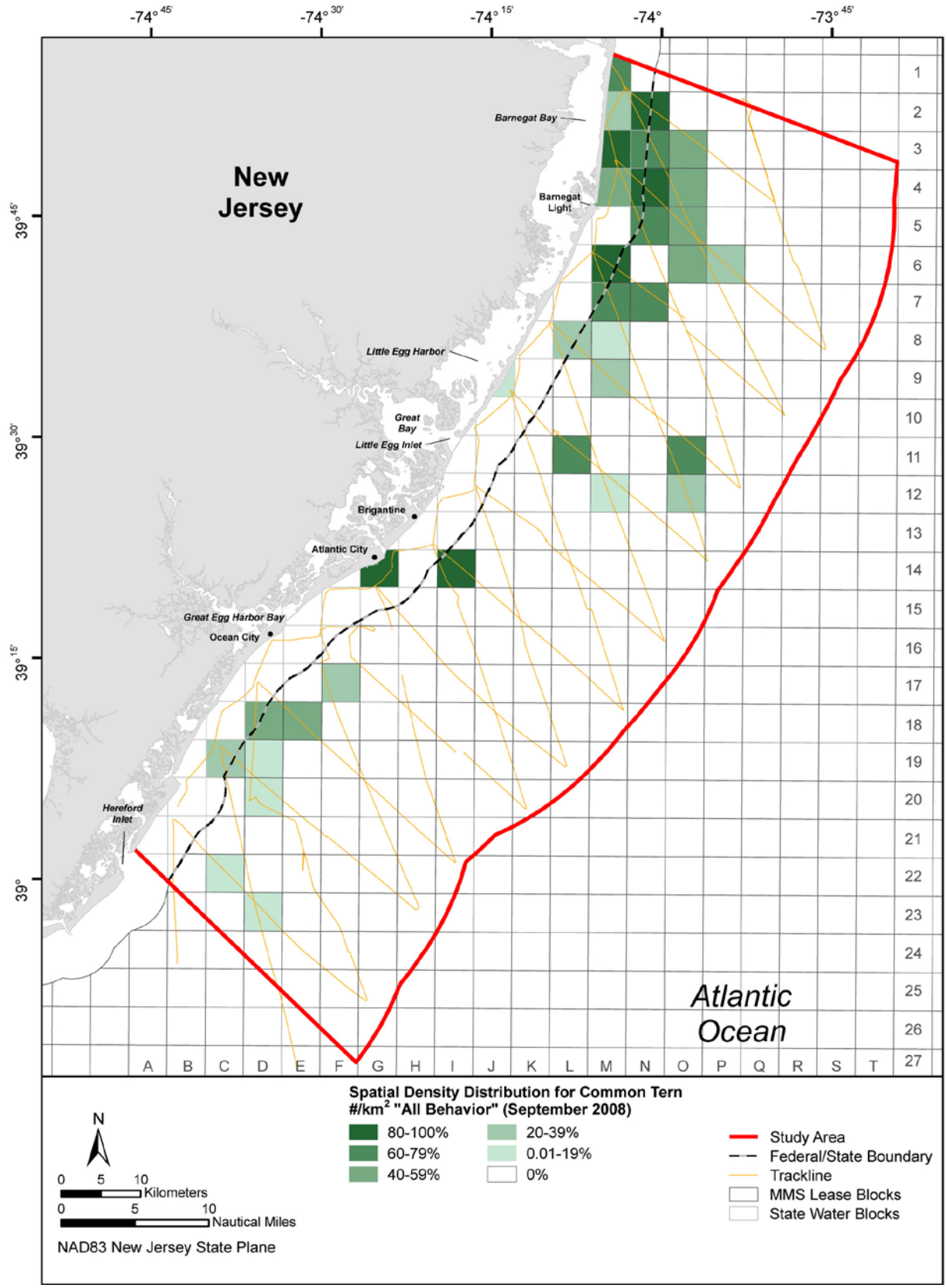

Figure C-147. Percentile abundance of Common Tern (all behaviors), September 2008 (n=355).

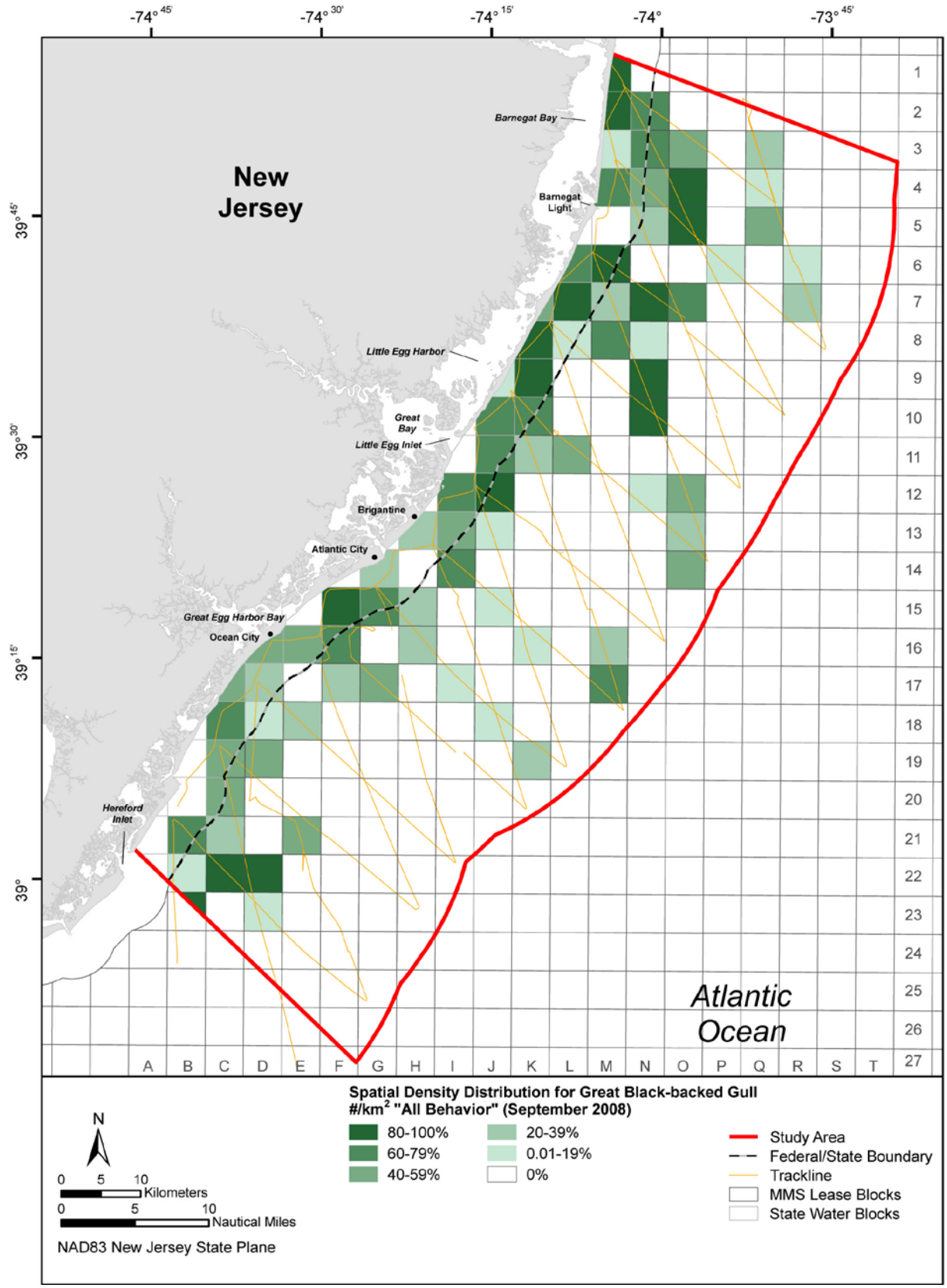

Figure C-148. Percentile abundance of Great Black-backed Gull (all behaviors), September 2008 (n=301).

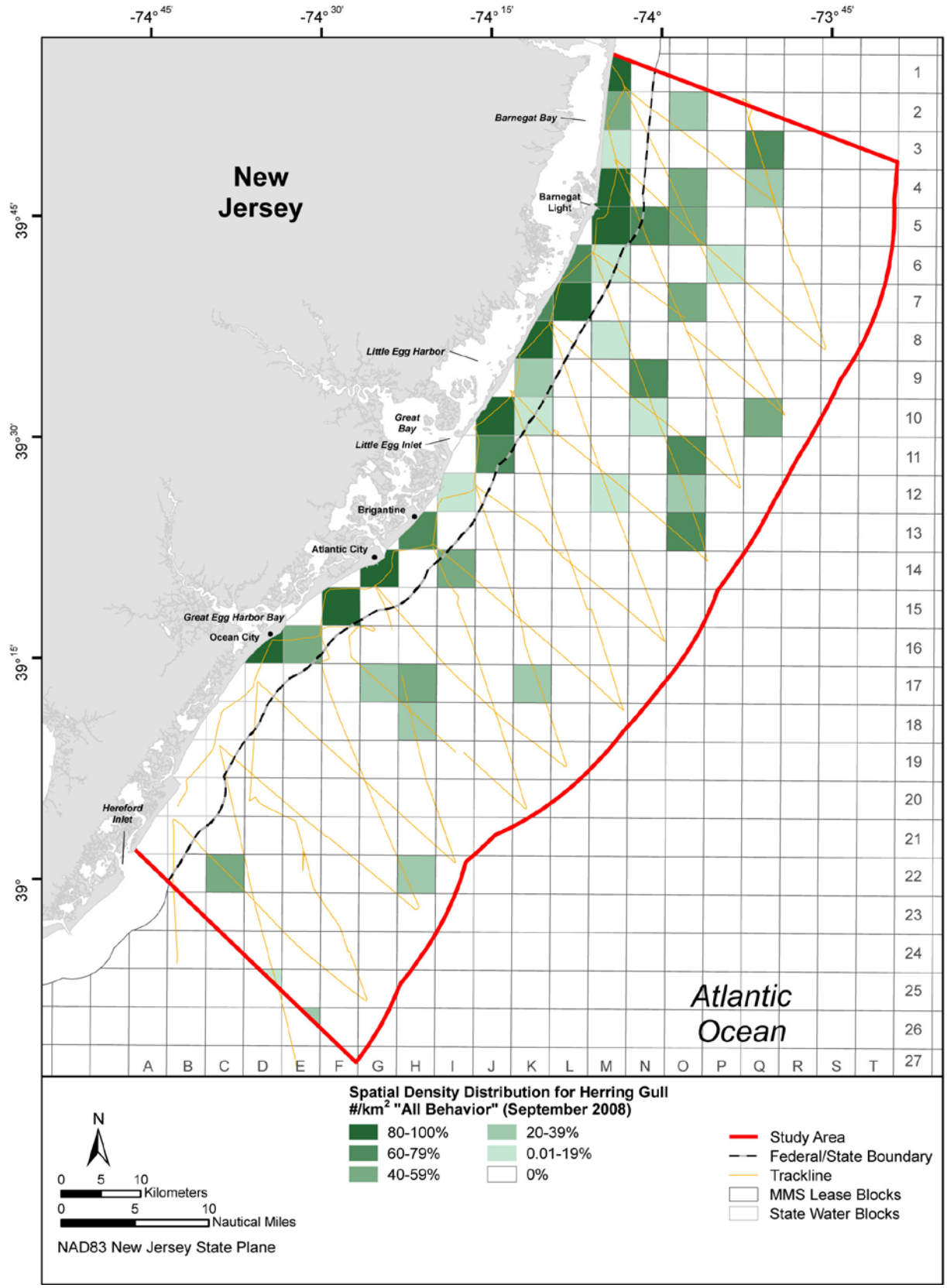

Figure C-149. Percentile abundance of Herring Gull (all behaviors), September 2008 (n=172).

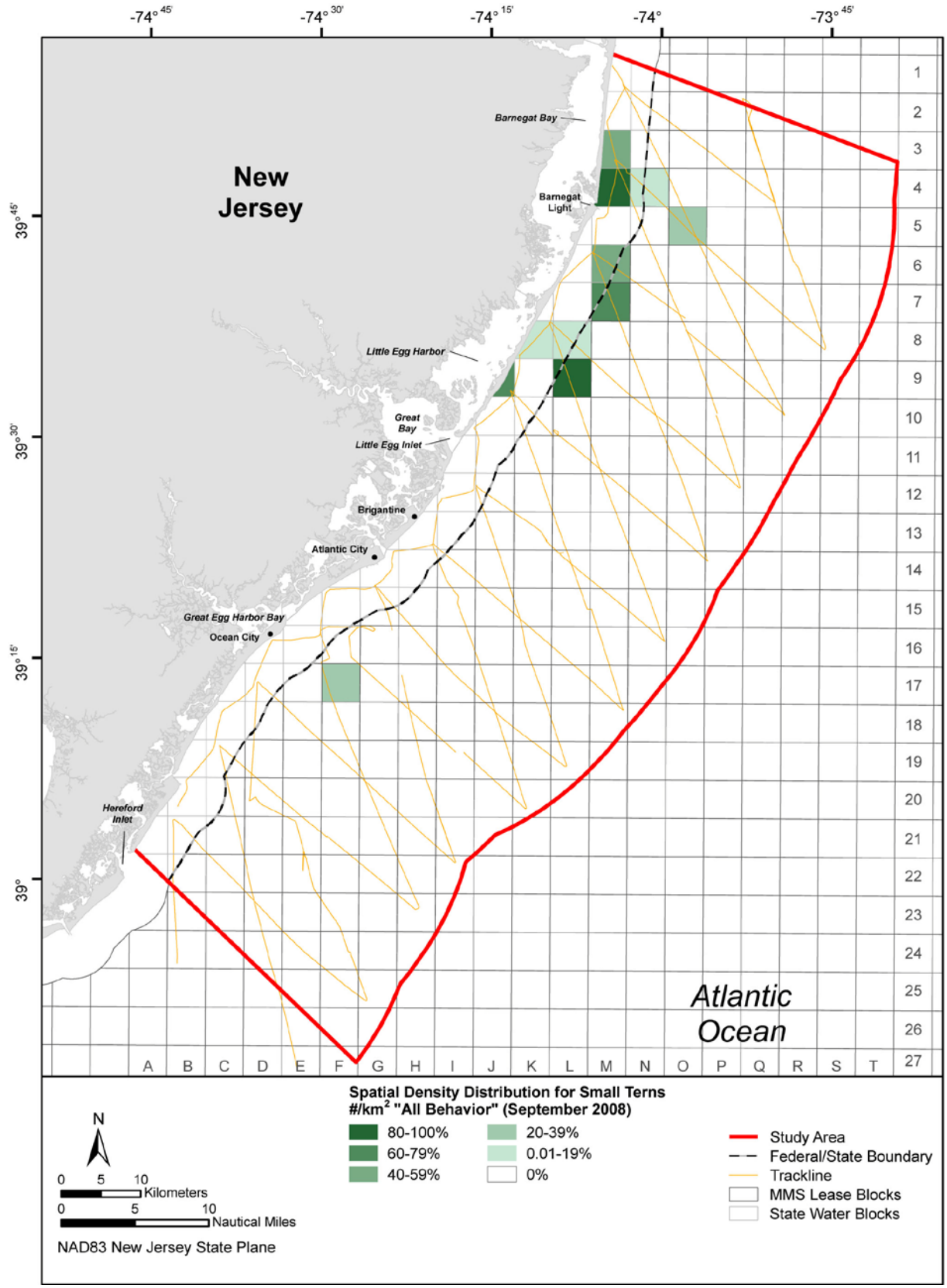

Figure C-150. Percentile abundance of small terns (all behaviors), September 2008 (n=73).

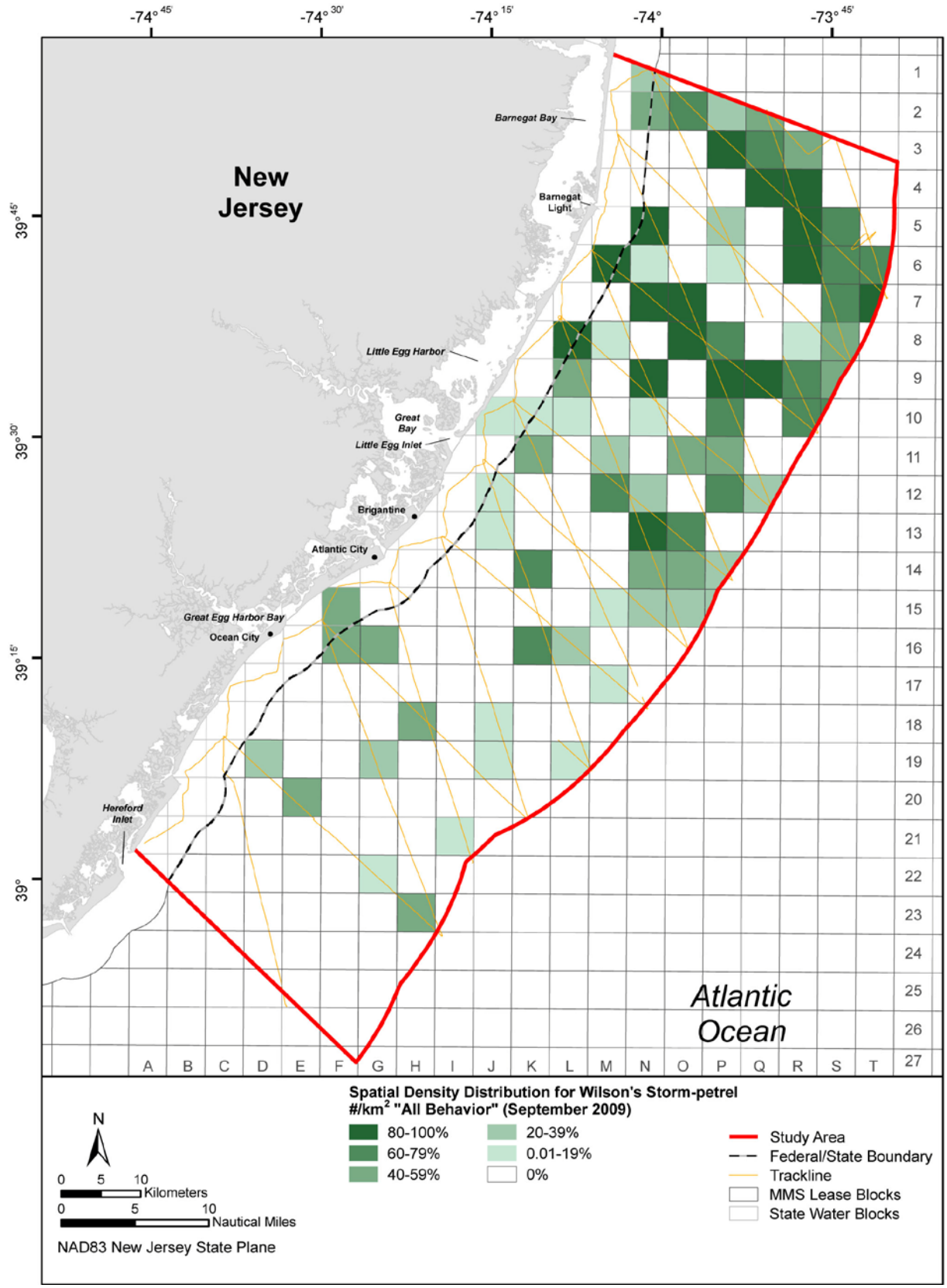

Figure C-151. Percentile abundance of Wilson's Storm-Petrel (all behaviors), September 2009 (n=248).

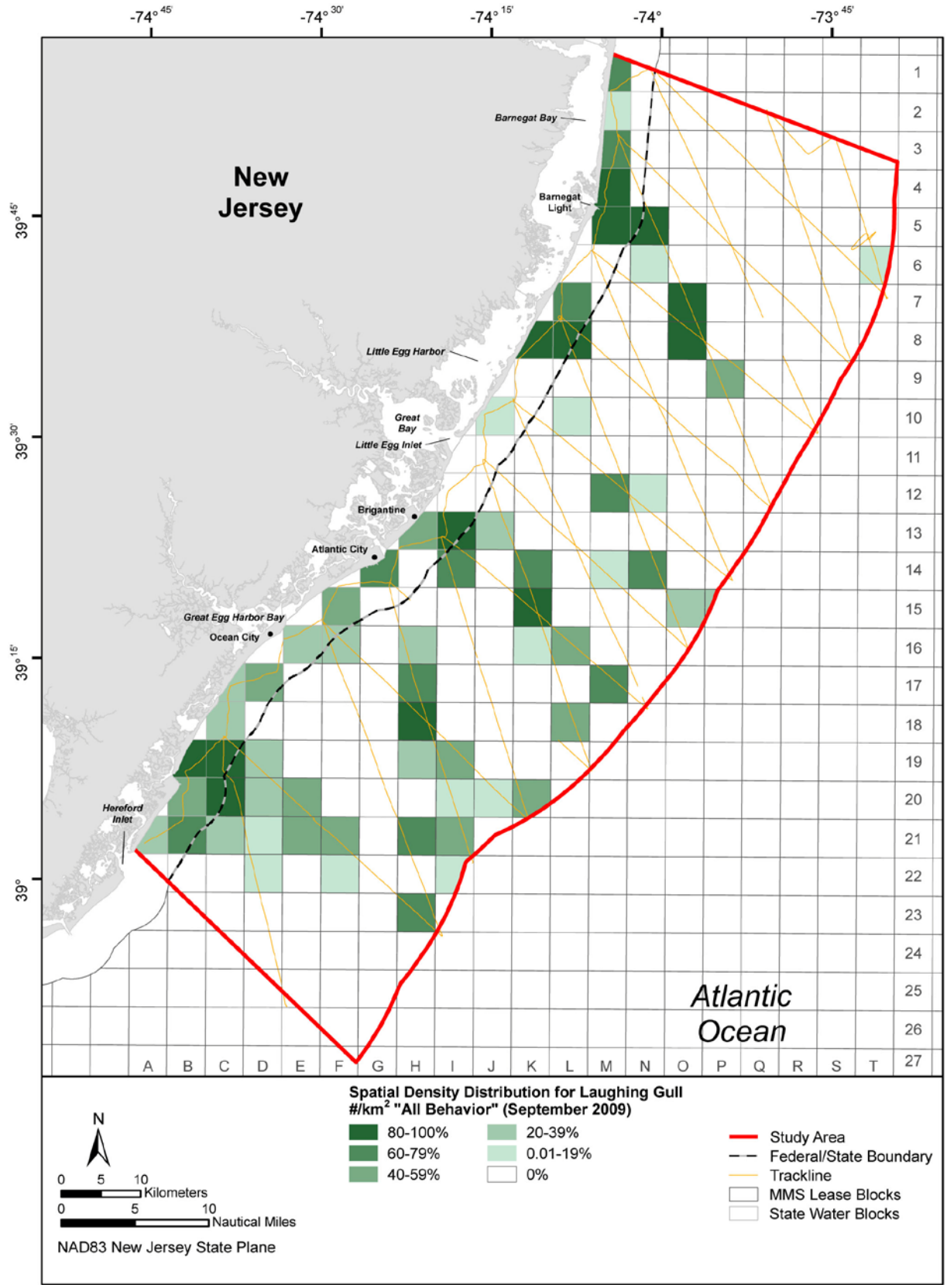

Figure C-152. Percentile abundance of Laughing Gull (all behaviors), September 2009 (n=213).

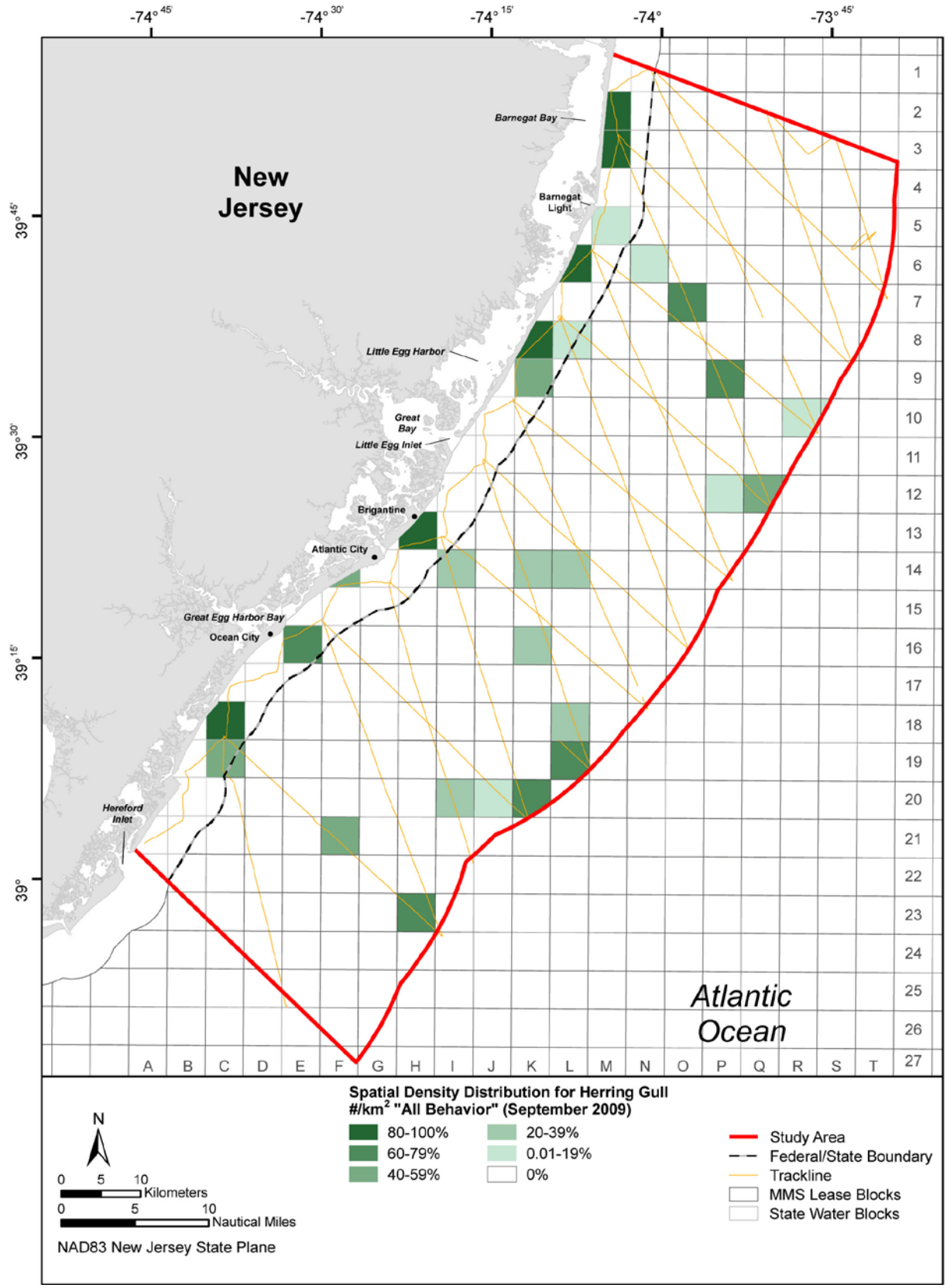

Figure C-153. Percentile abundance of Herring Gull (all behaviors), September 2009 (n=120).

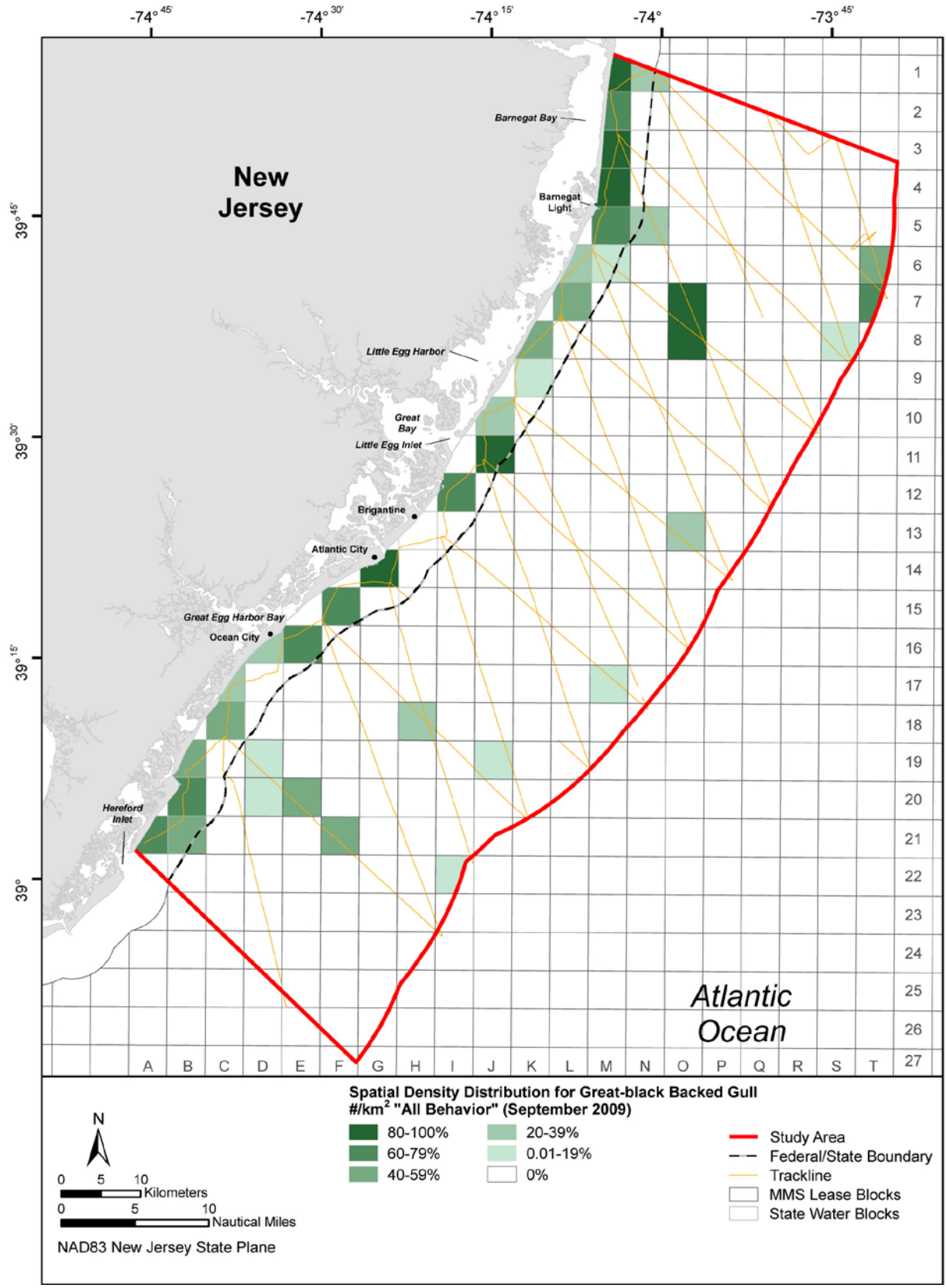

Figure C-154. Percentile abundance of Great Black-backed Gull (all behaviors), September 2009 (n=116).

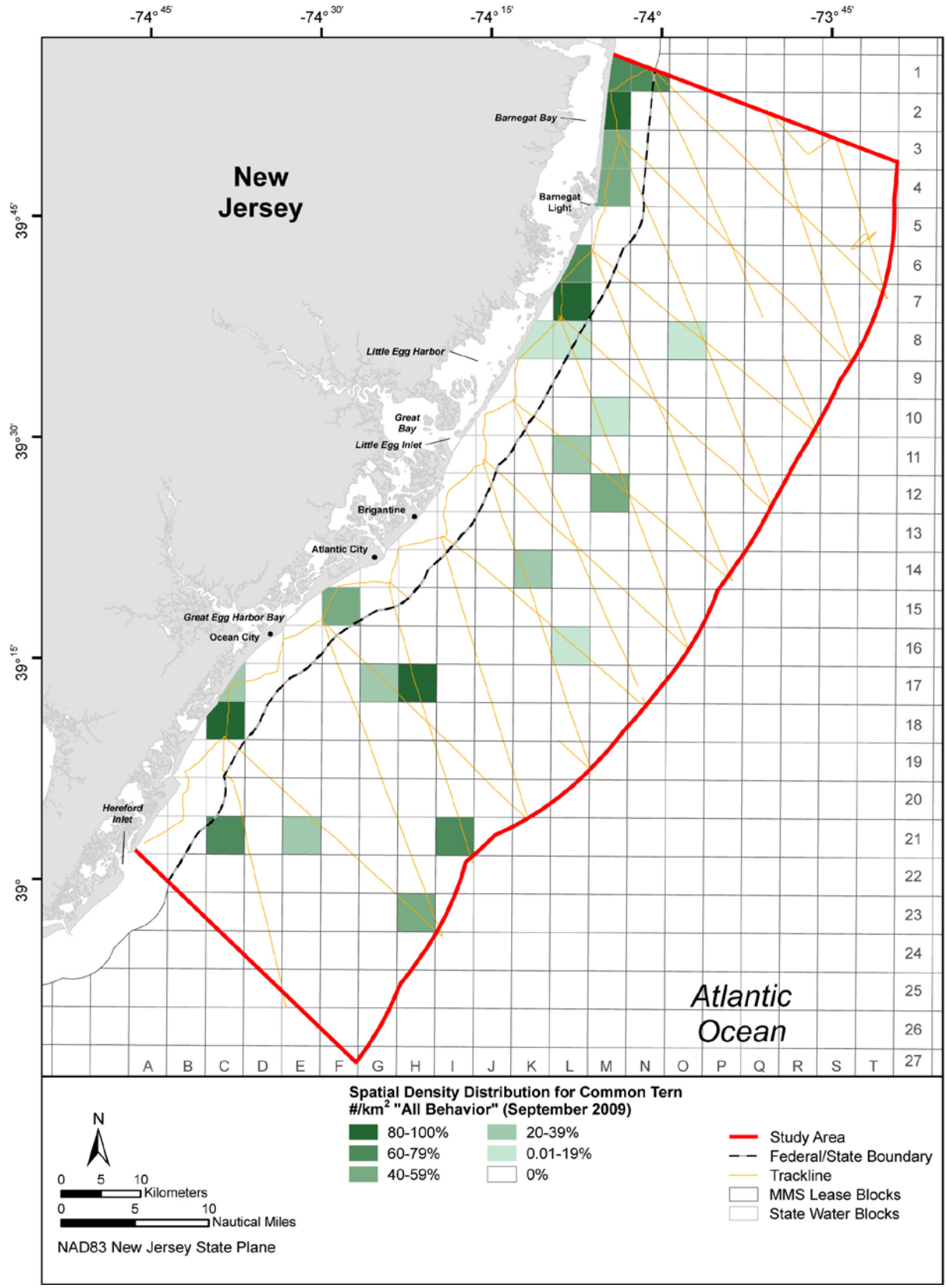

Figure C-155. Percentile abundance of Common Tern (all behaviors), September 2009 (n=68).

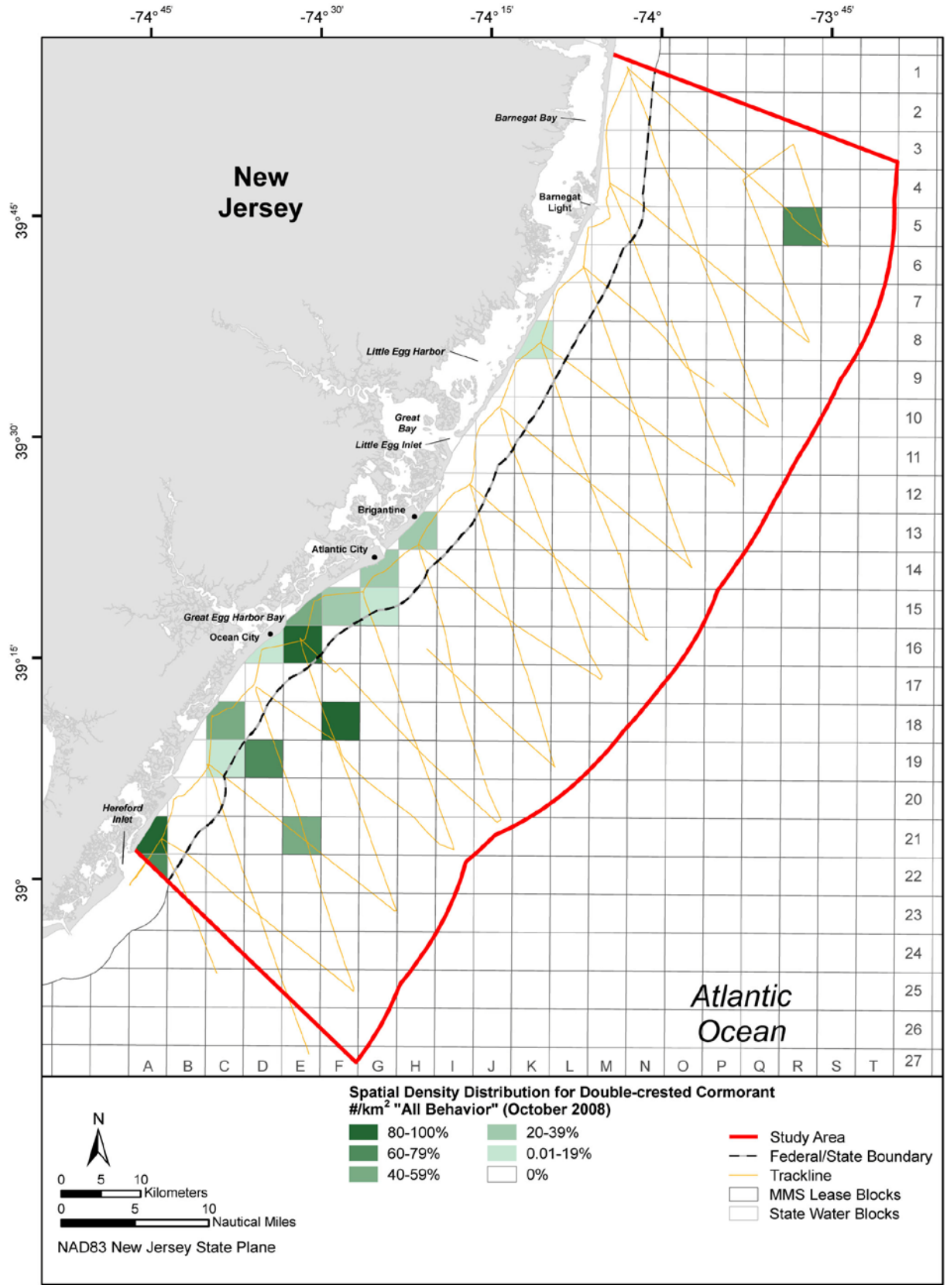

Figure C-156. Percentile abundance of Double-crested Cormorant (all behaviors), October 2008 (n=1,004).

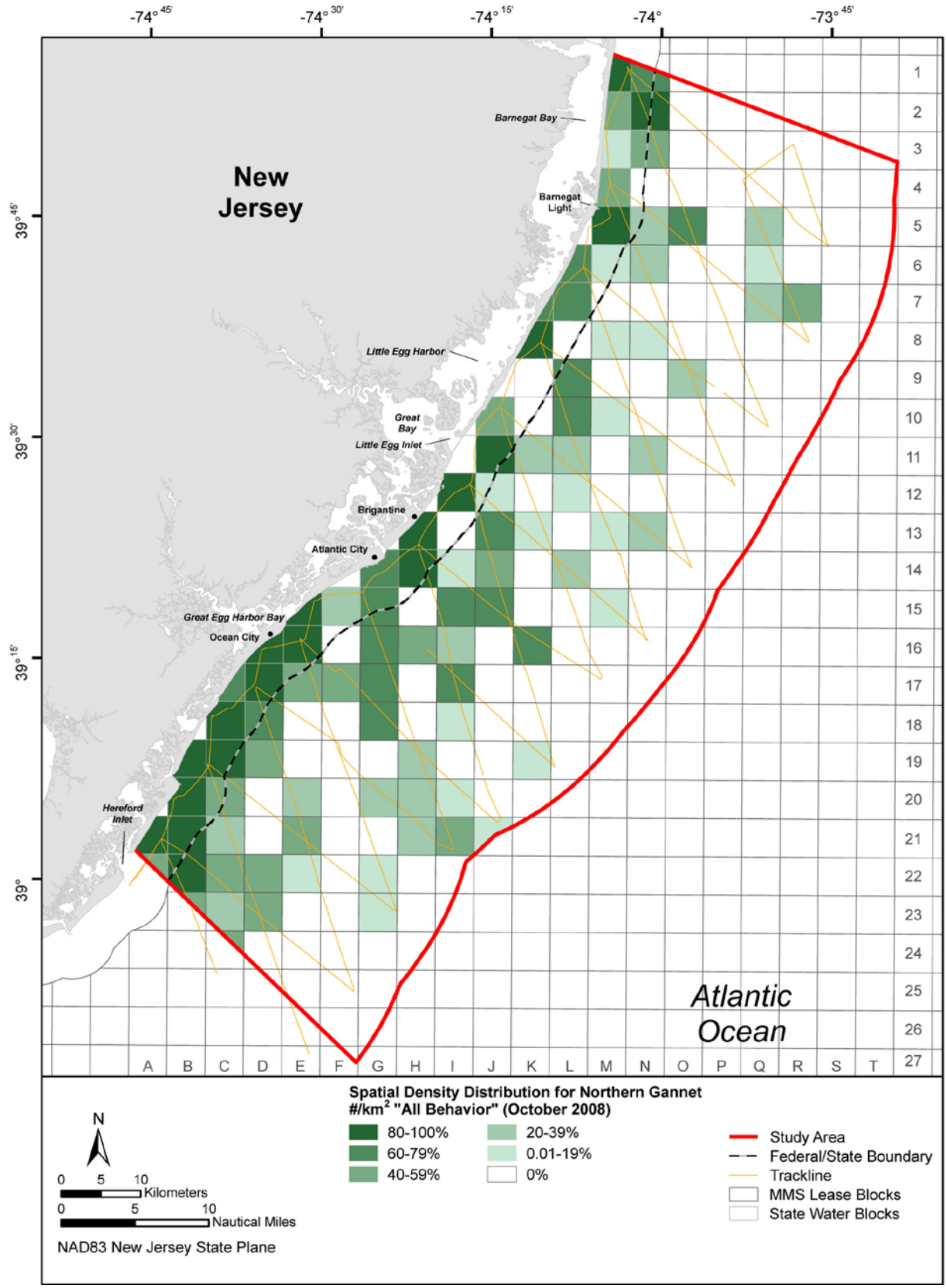

Figure C-157. Percentile abundance of Northern Gannet (all behaviors), October 2008 (n=813).

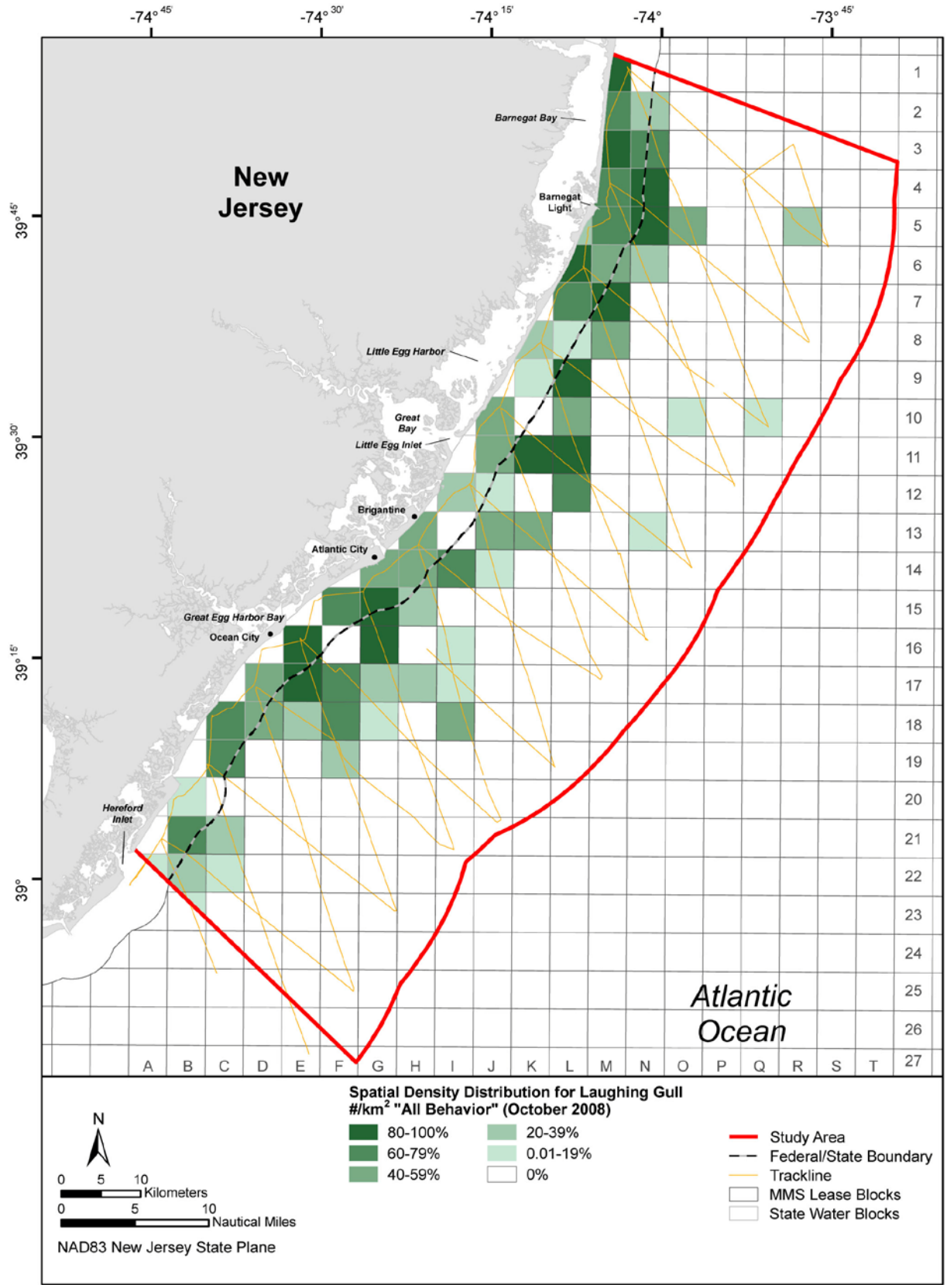

Figure C-158. Percentile abundance of Laughing Gull (all behaviors), October 2008 (n=777).

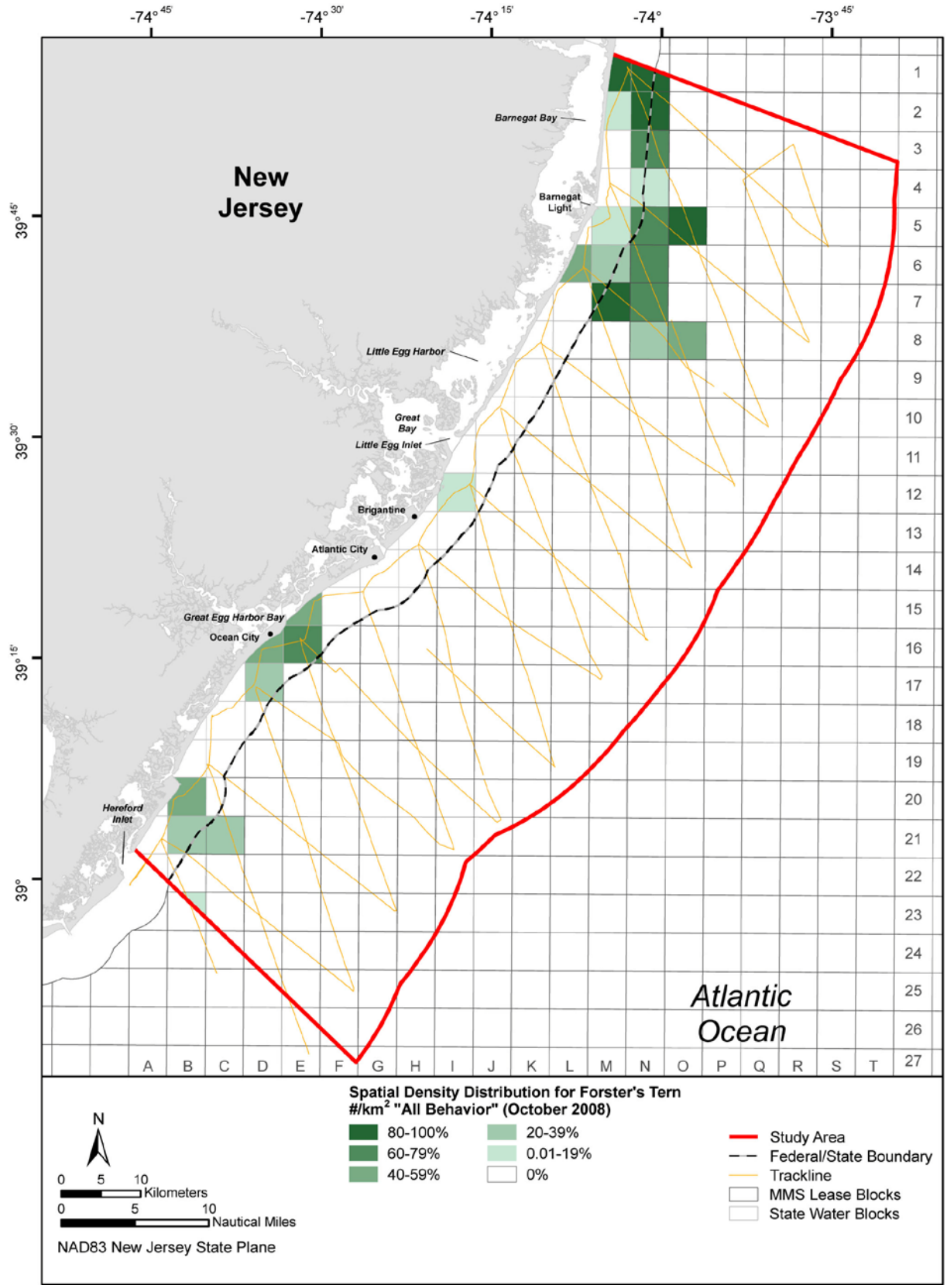

Figure C-159. Percentile abundance of Forster's Tern (all behaviors), October 2008 (n=419).

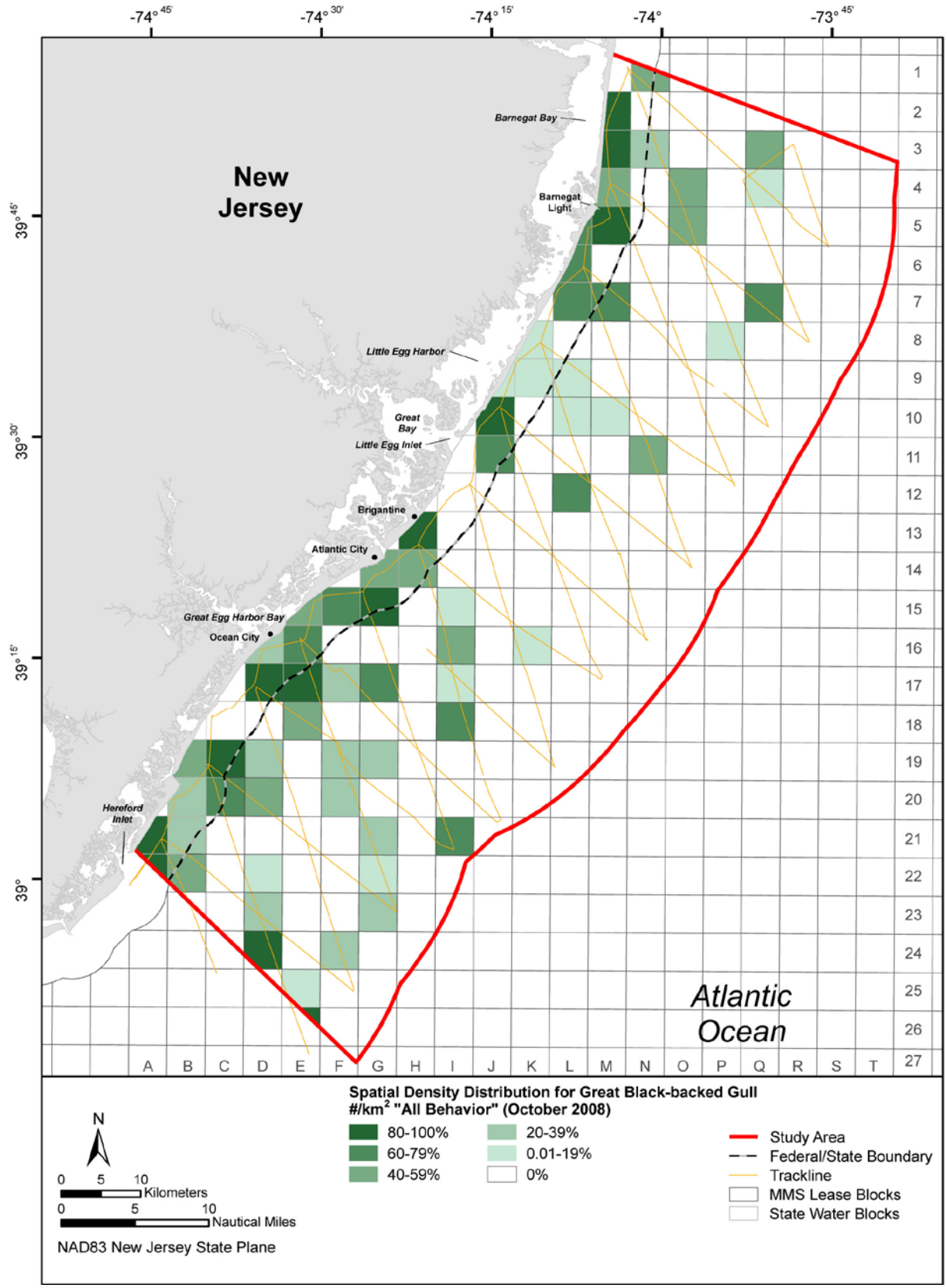

Figure C-160. Percentile abundance of Great Black-backed Gull (all behaviors), October 2008 (n=262).

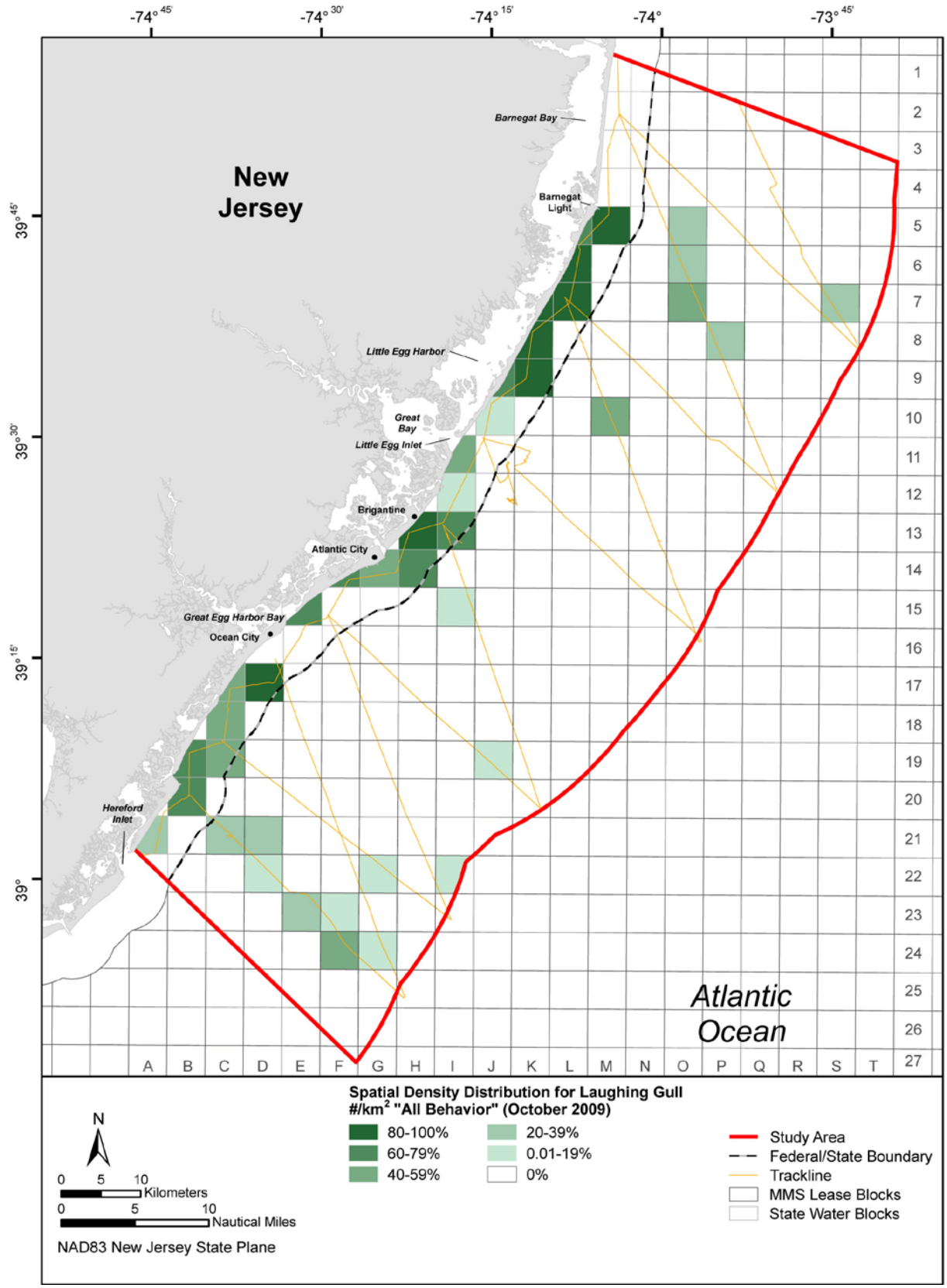

Figure C-161. Percentile abundance of Laughing Gull (all behaviors), October 2009 (n=848).

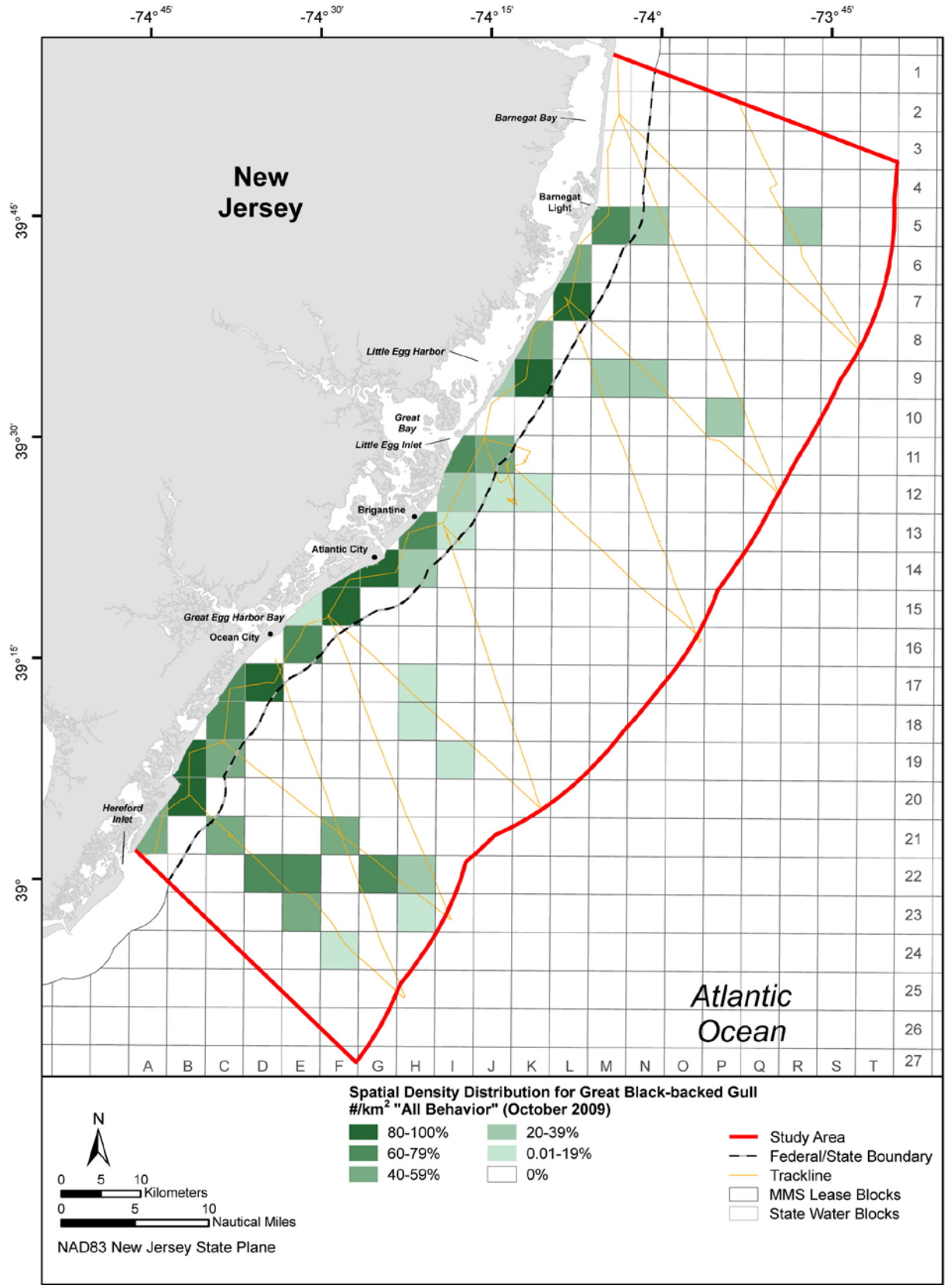

Figure C-162. Percentile abundance of Great Black-backed Gull (all behaviors), October 2009 (n=235).

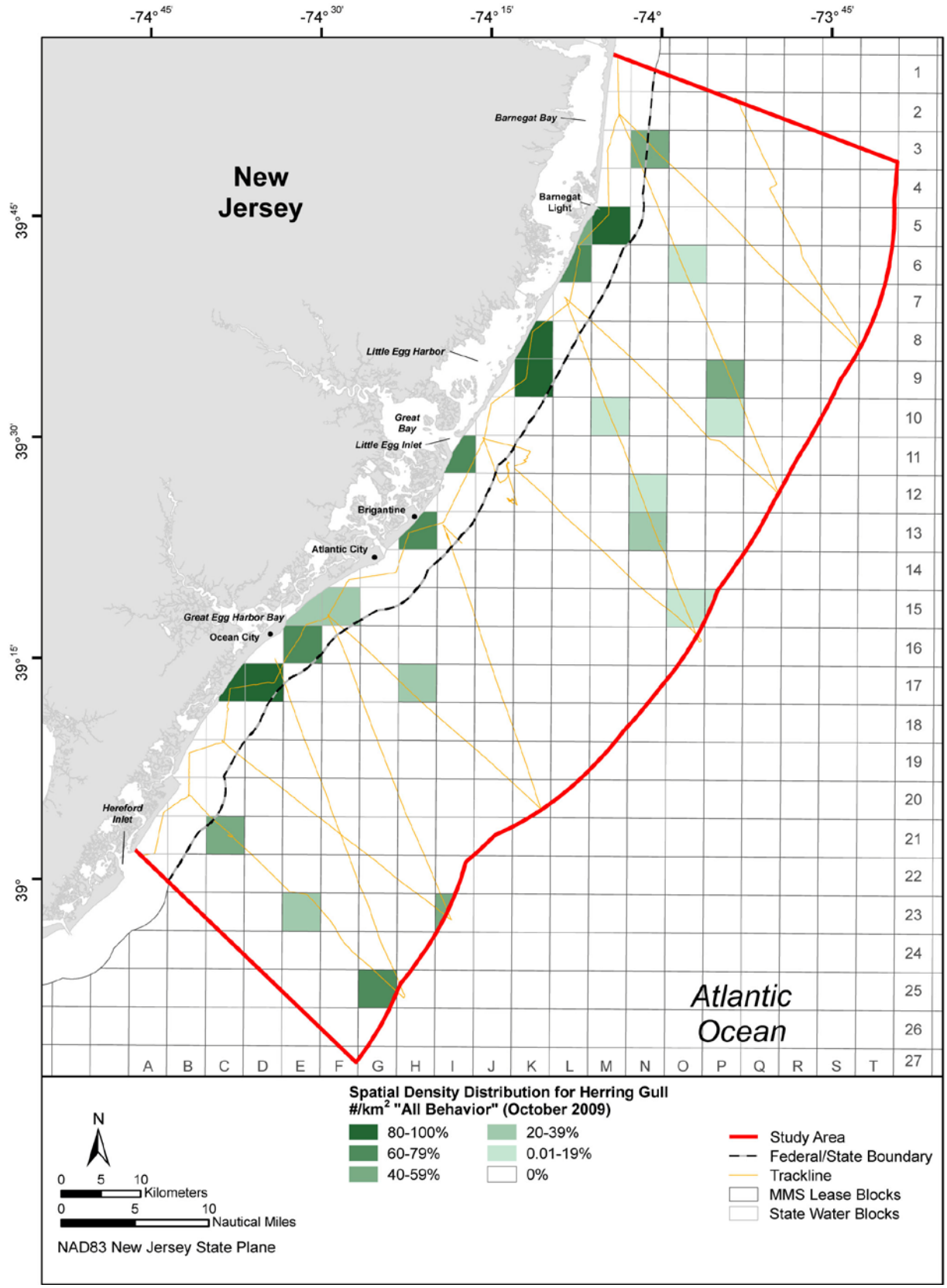

Figure C-163. Percentile abundance of Herring Gull (all behaviors), October 2009 (n=126).

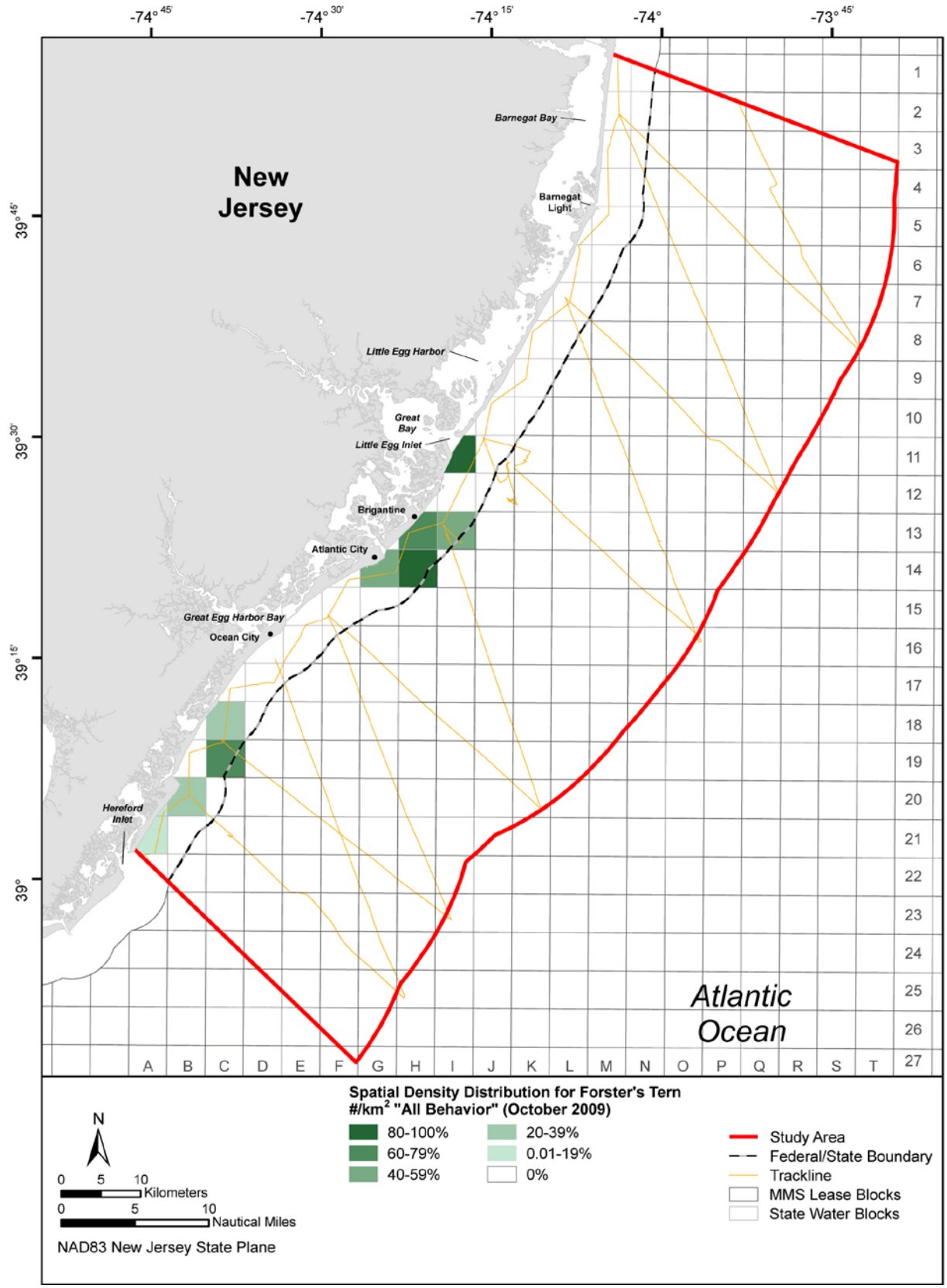

Figure C-164. Percentile abundance of Forster's Tern (all behaviors), October 2009 (n=112).

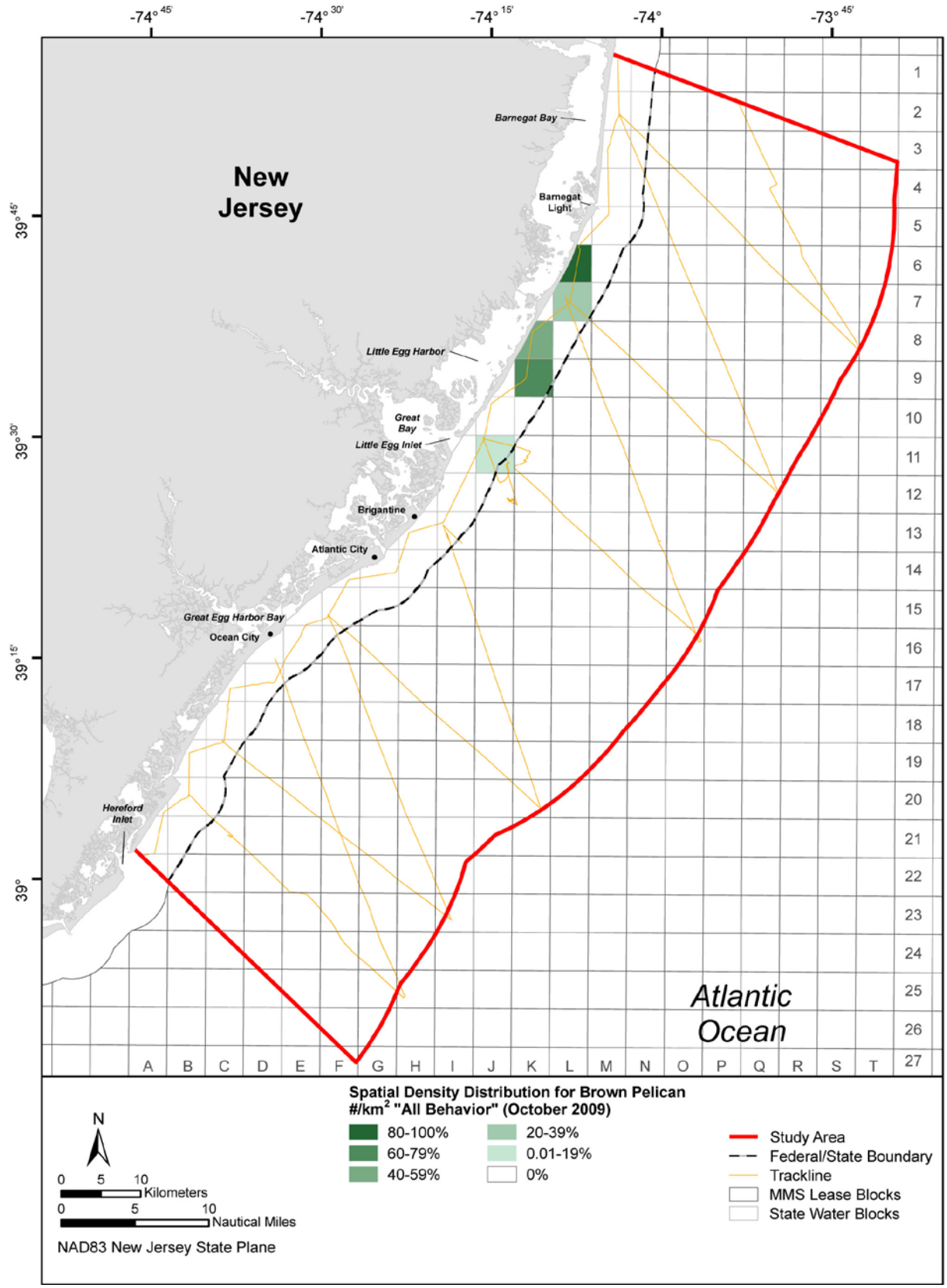

Figure C-165. Percentile abundance of Brown Pelican (all behaviors), October 2009 (n=37).

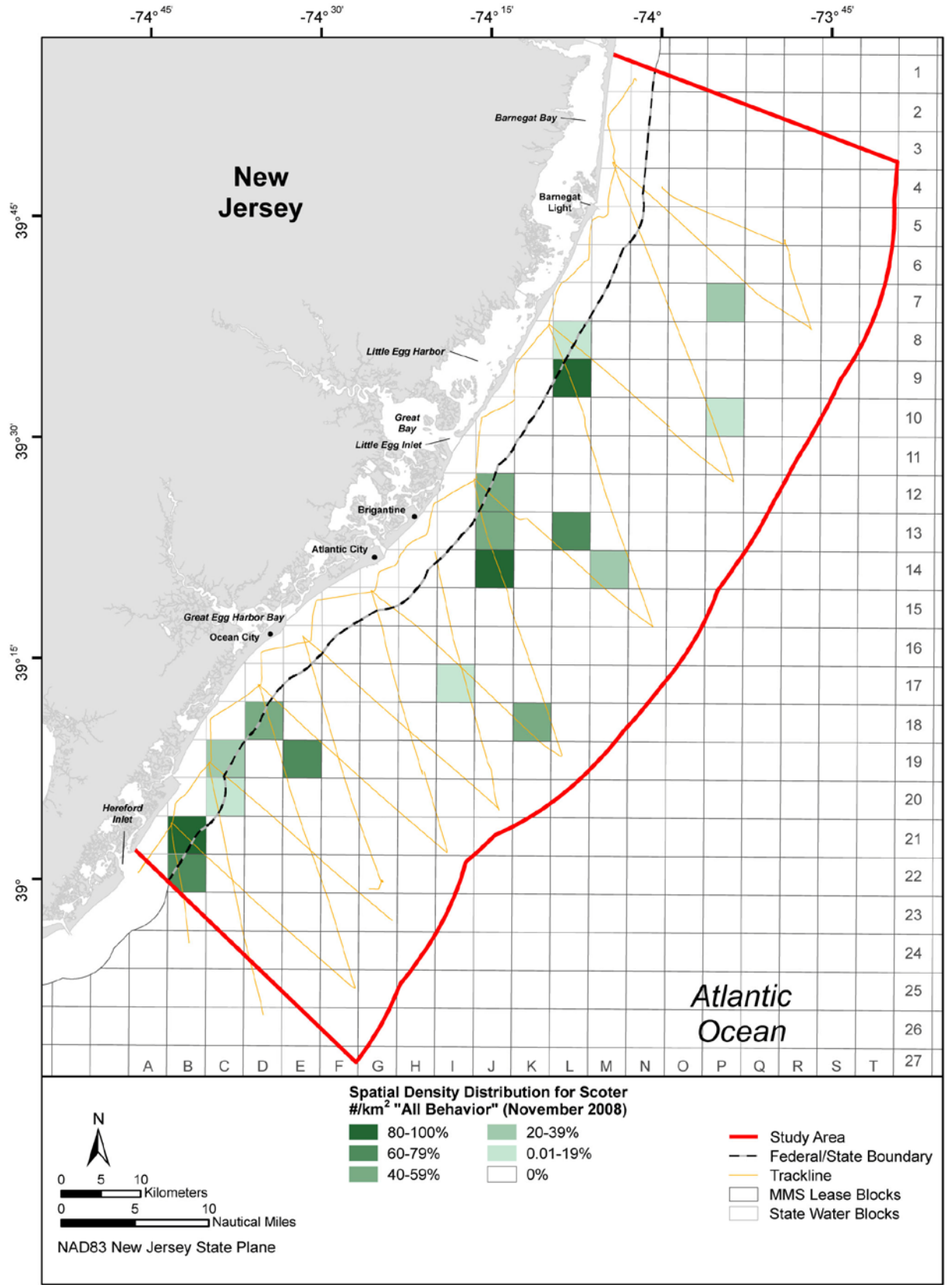

Figure C-166. Percentile abundance of scoters (all behaviors), November 2008 (n=3,353).

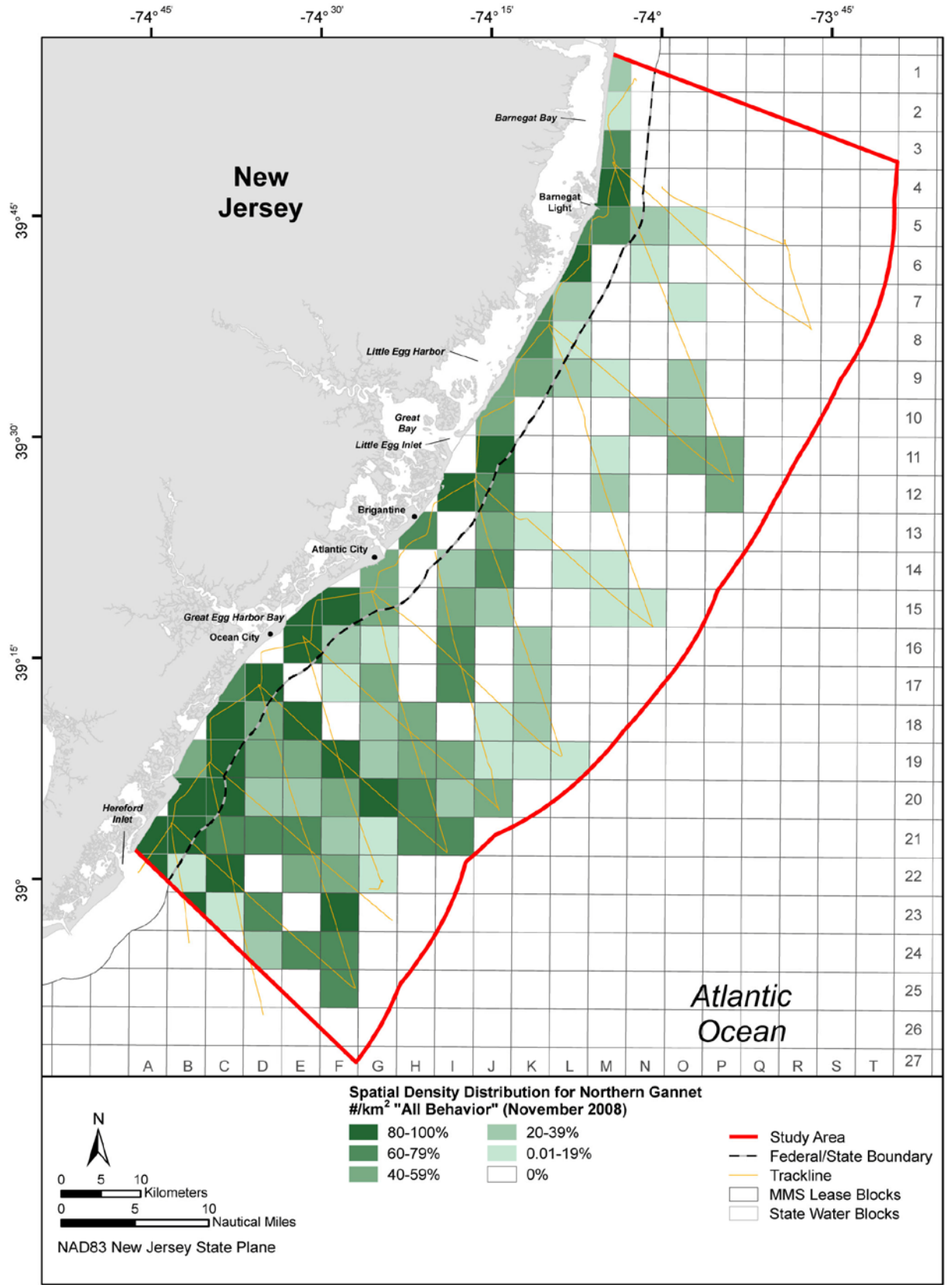

Figure C-167. Percentile abundance of Northern Gannet (all behaviors), November 2008 (n=2,380).

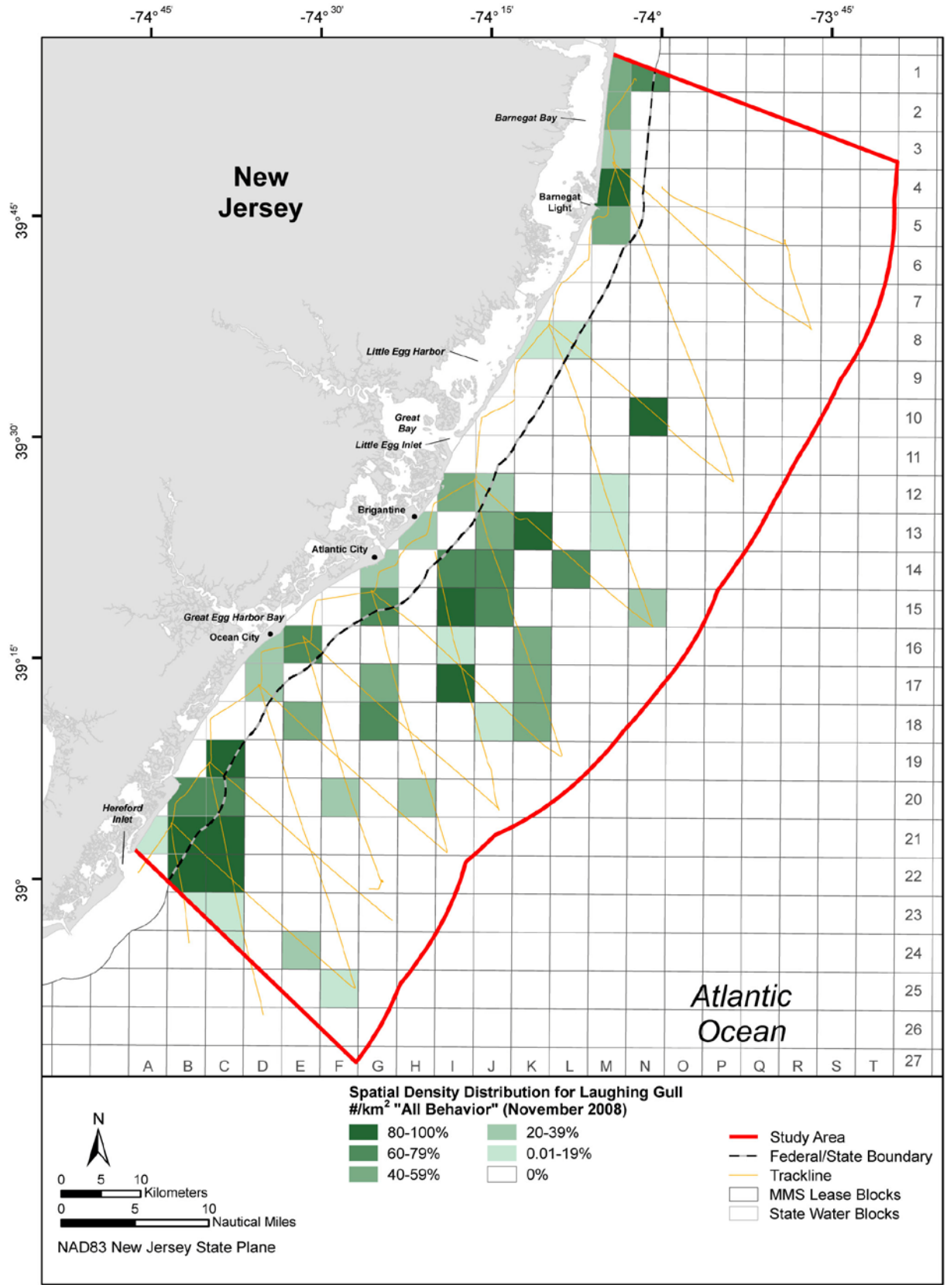

Figure C-168. Percentile abundance of Laughing Gull (all behaviors), November 2008 (n=1,337).

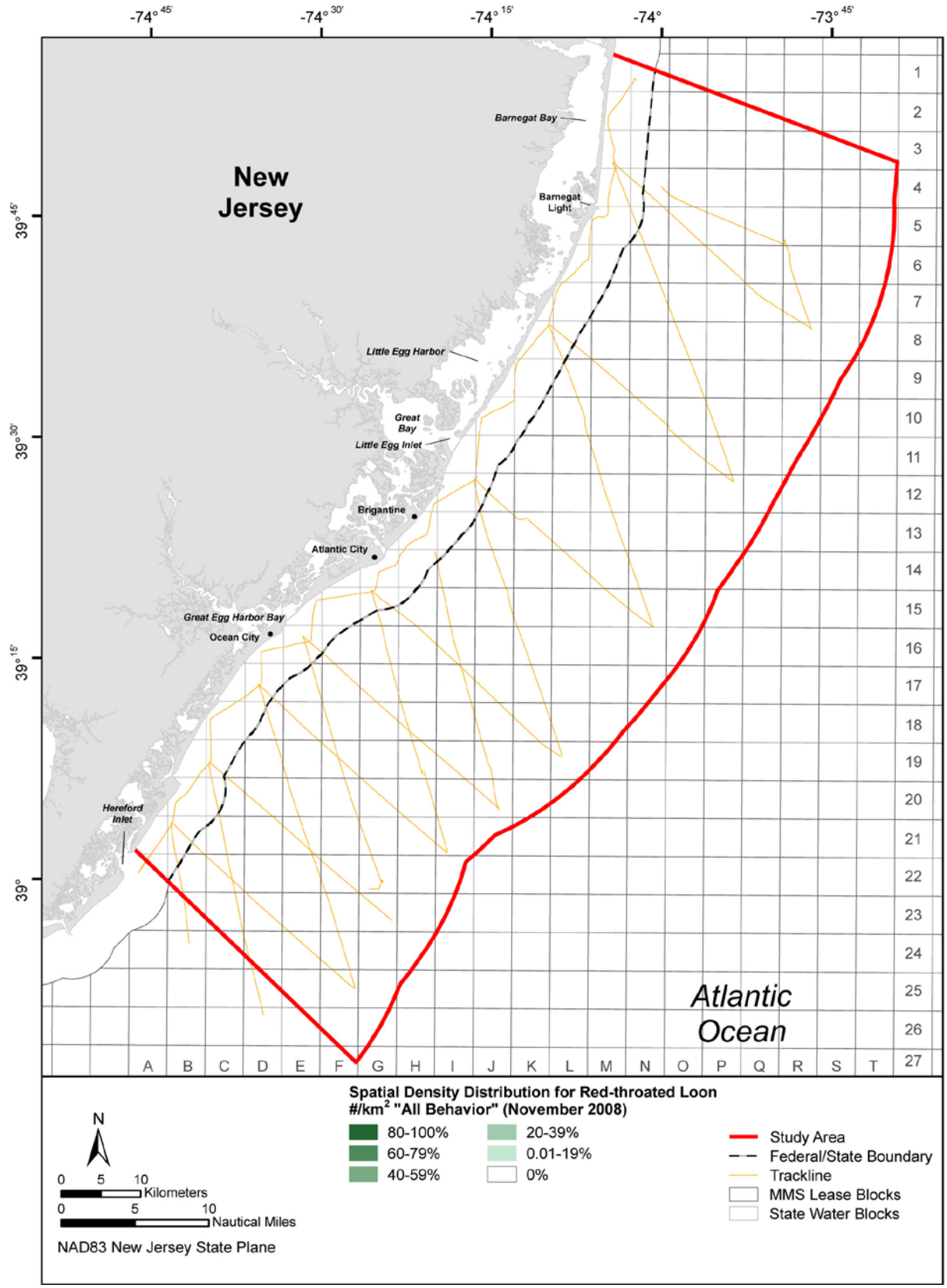

Figure C-169. Percentile abundance of Red-throated Loon (all behaviors), November 2008 (n=646).

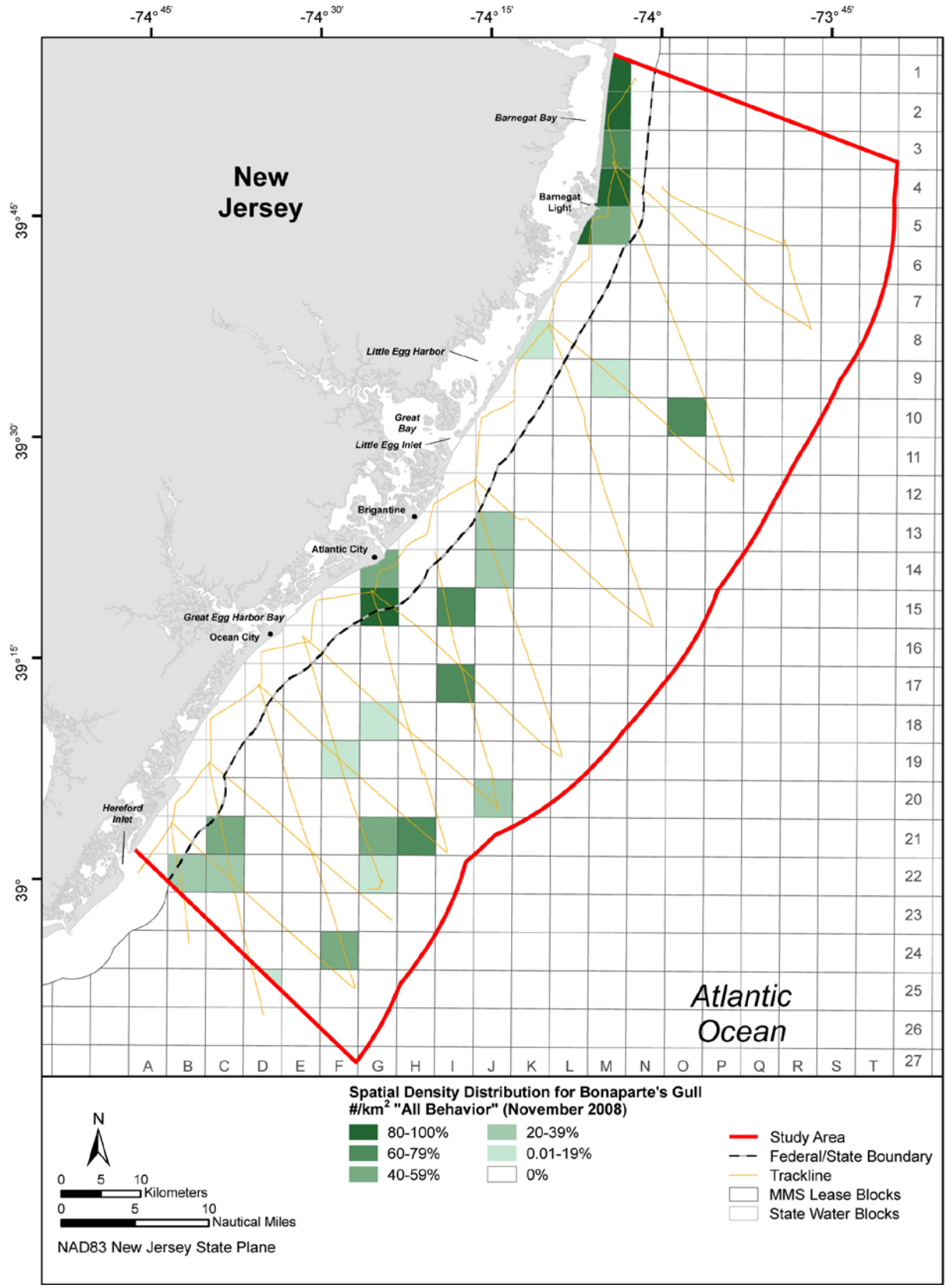

Figure C-170. Percentile abundance of Bonaparte's Gull (all behaviors), November 2008 (n=643).

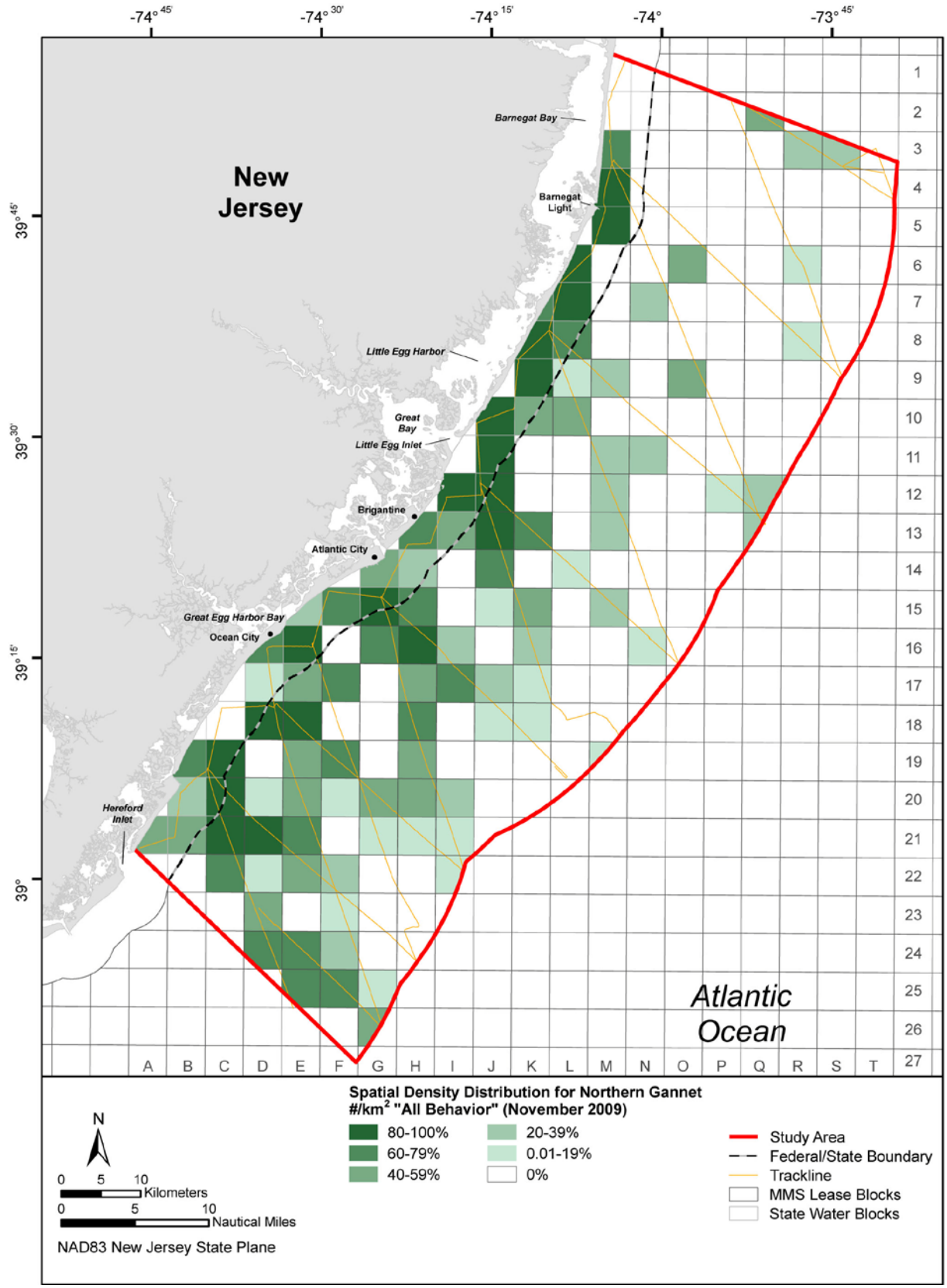

Figure C-171. Percentile abundance of Northern Gannet (all behaviors), November 2009 (n=2,358).

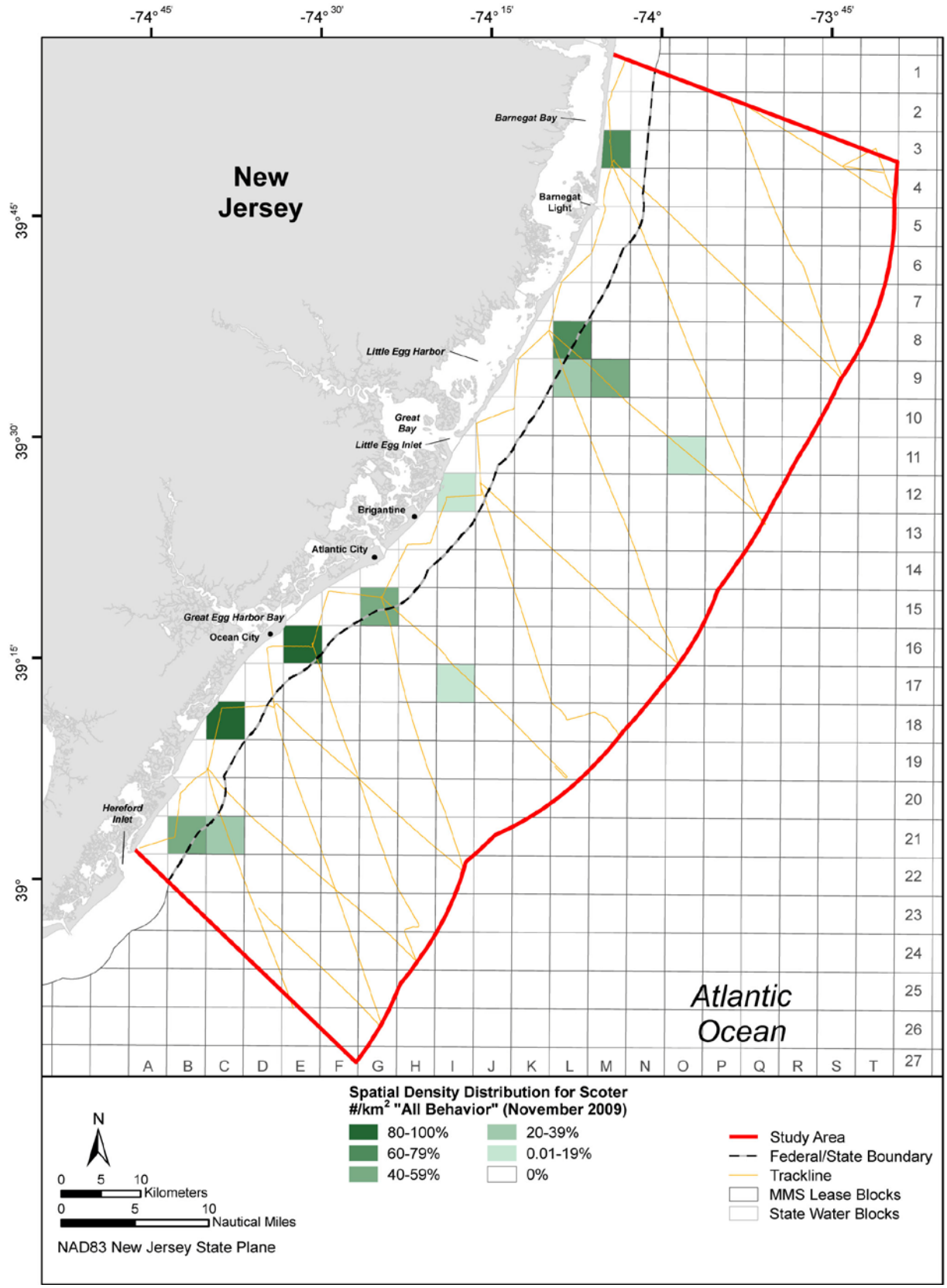

Figure C-172. Percentile abundance of scoters (all behaviors), November 2009 (n=637).

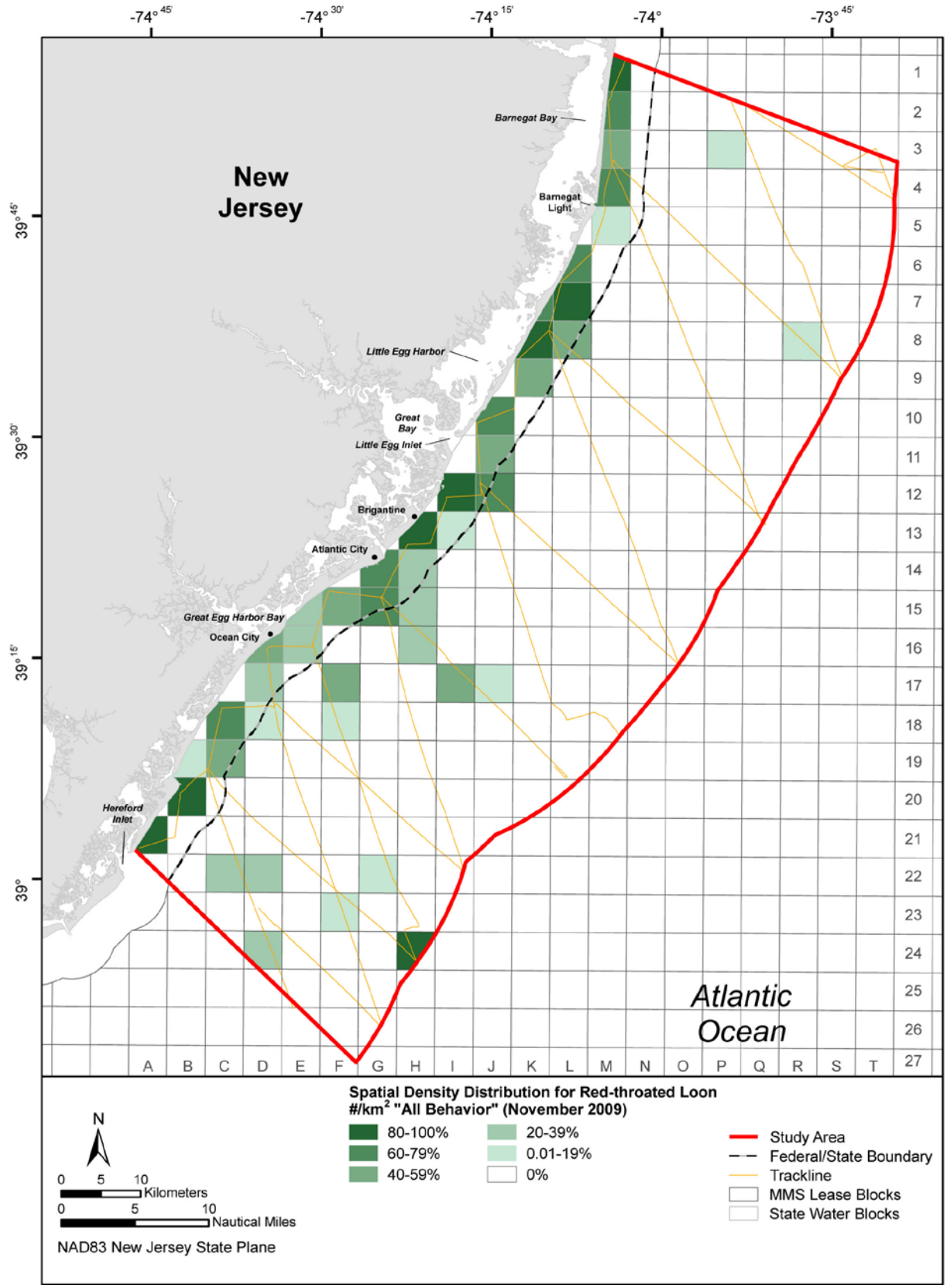

Figure C-173. Percentile abundance of Red-throated Loon (all behaviors), November 2009 (n=449).

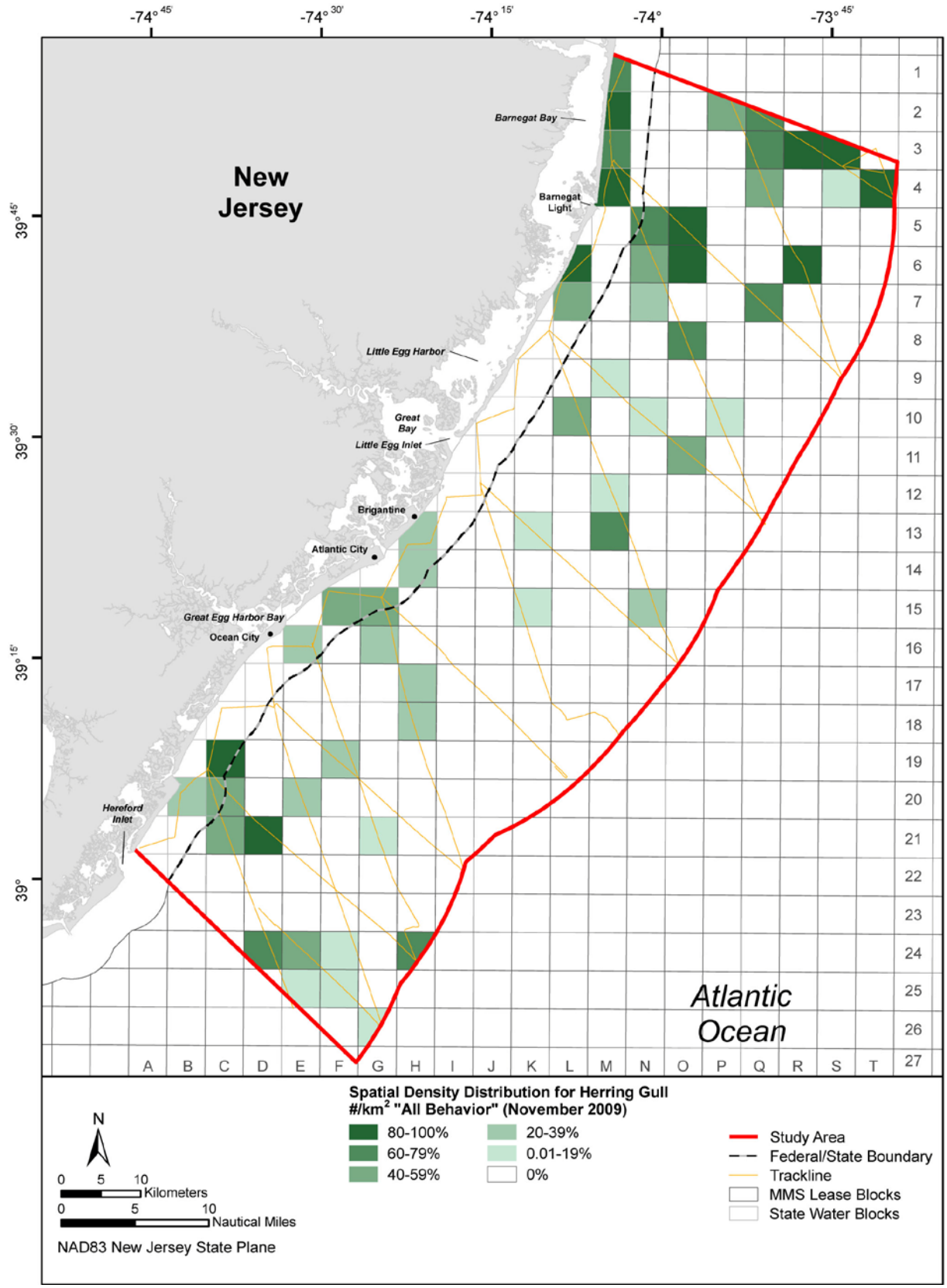

Figure C-174. Percentile abundance of Herring Gull (all behaviors), November 2009 (n=383).

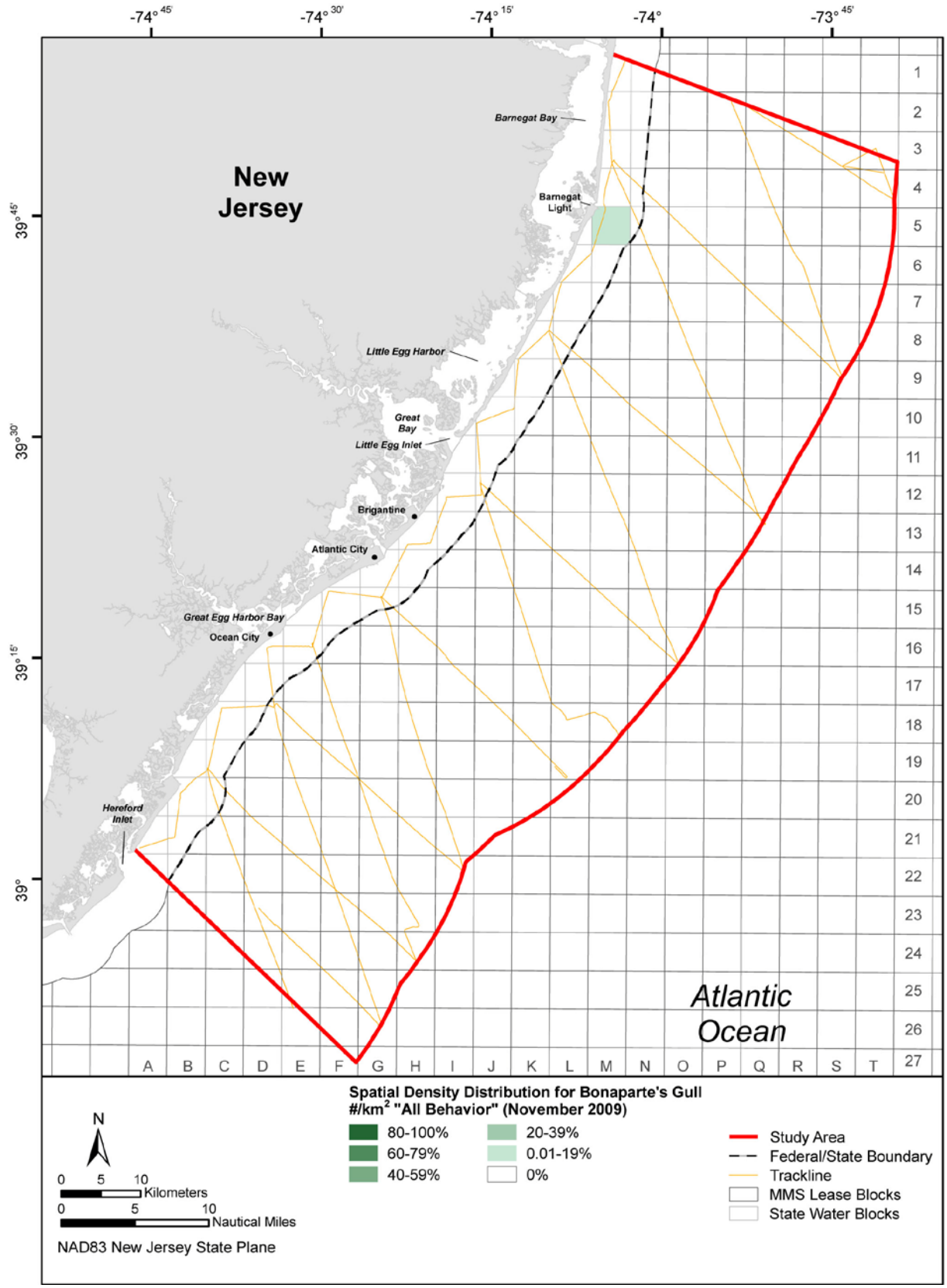

Figure C-175. Percentile abundance of Bonaparte's Gull (all behaviors), November 2009 (n=228).

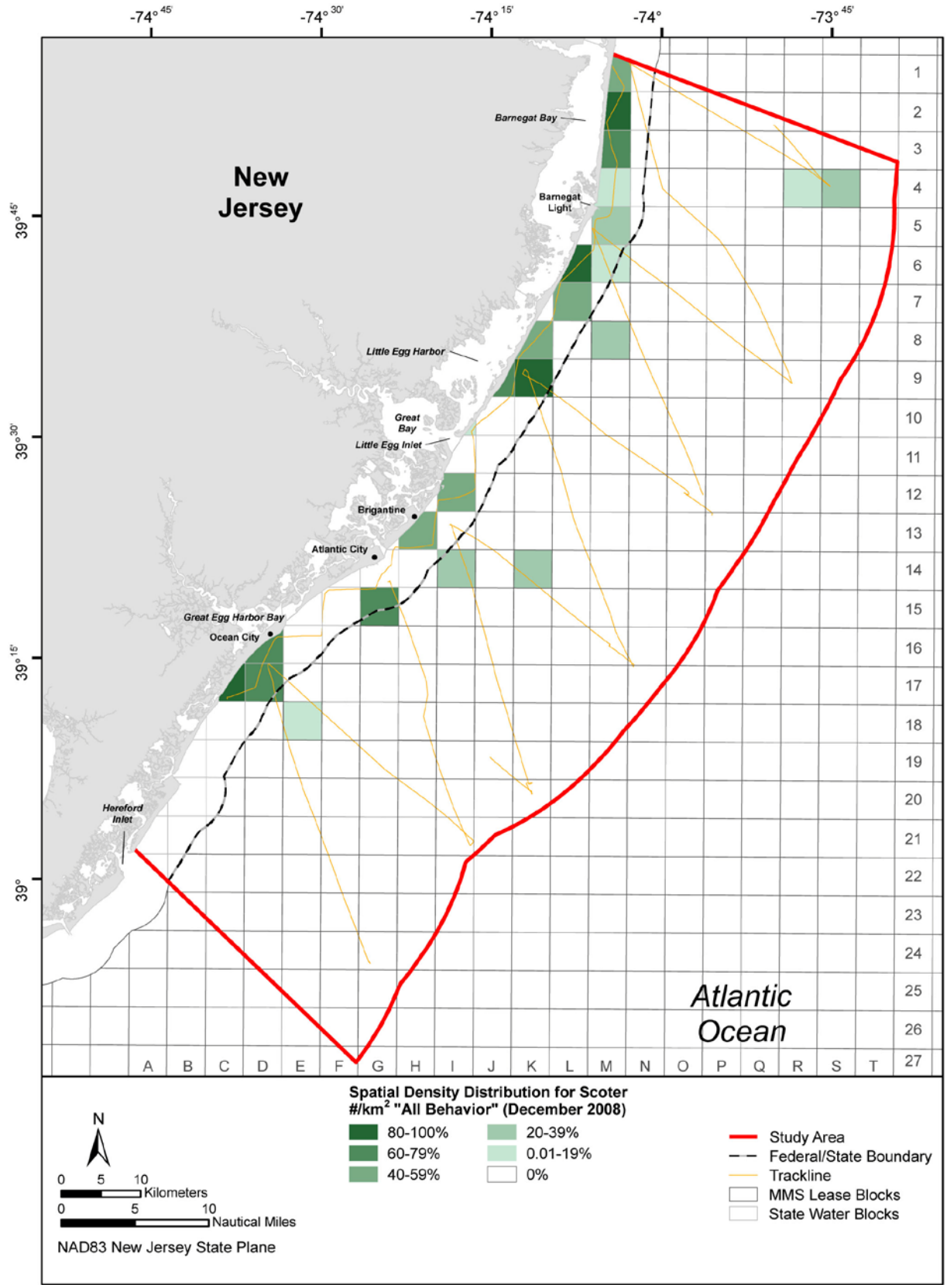

Figure C-176. Percentile abundance of scoters (all behaviors), December 2008 (n=3,557).

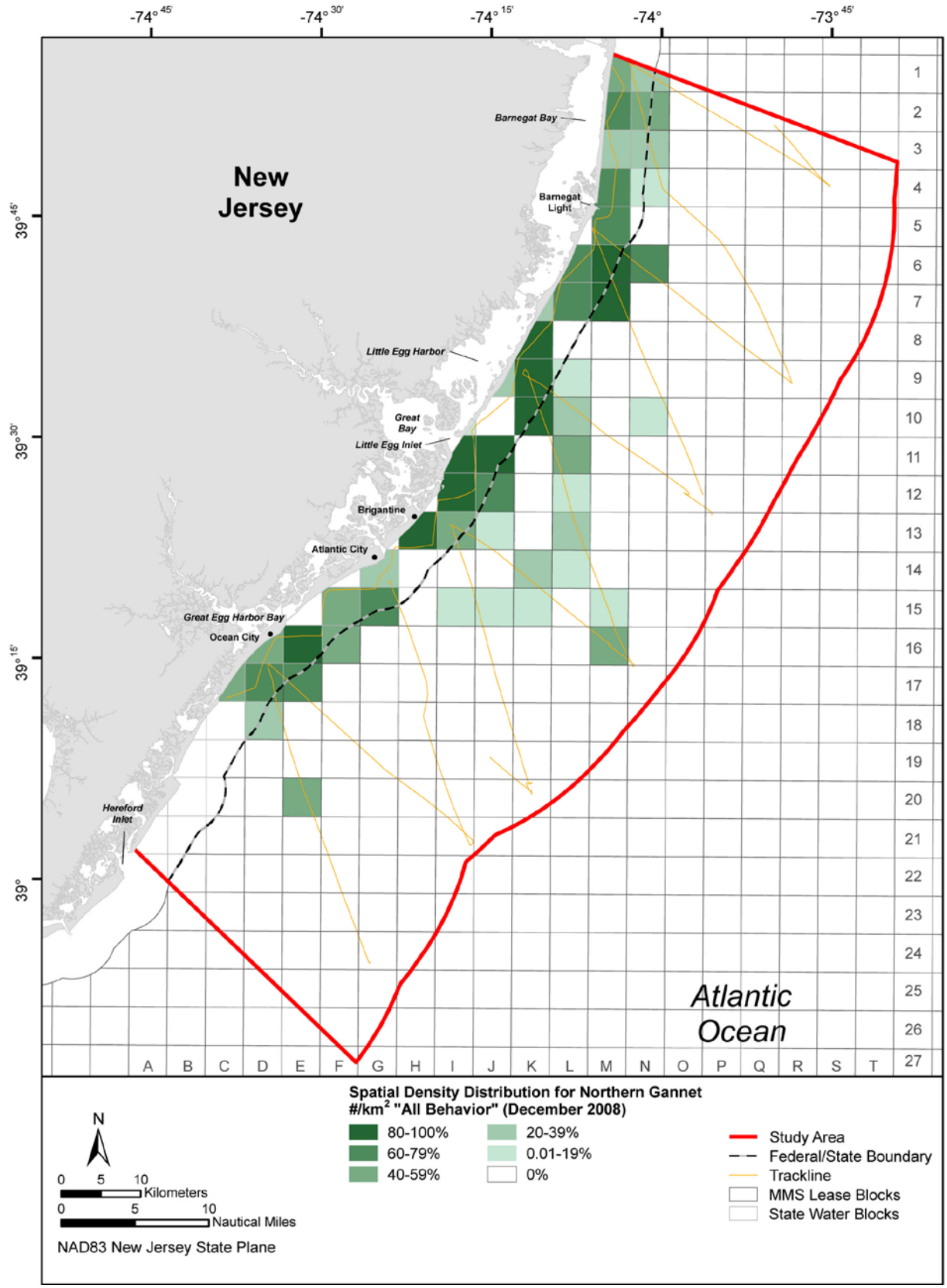

Figure C-177. Percentile abundance of Northern Gannet (all behaviors), December 2008 (n=369).

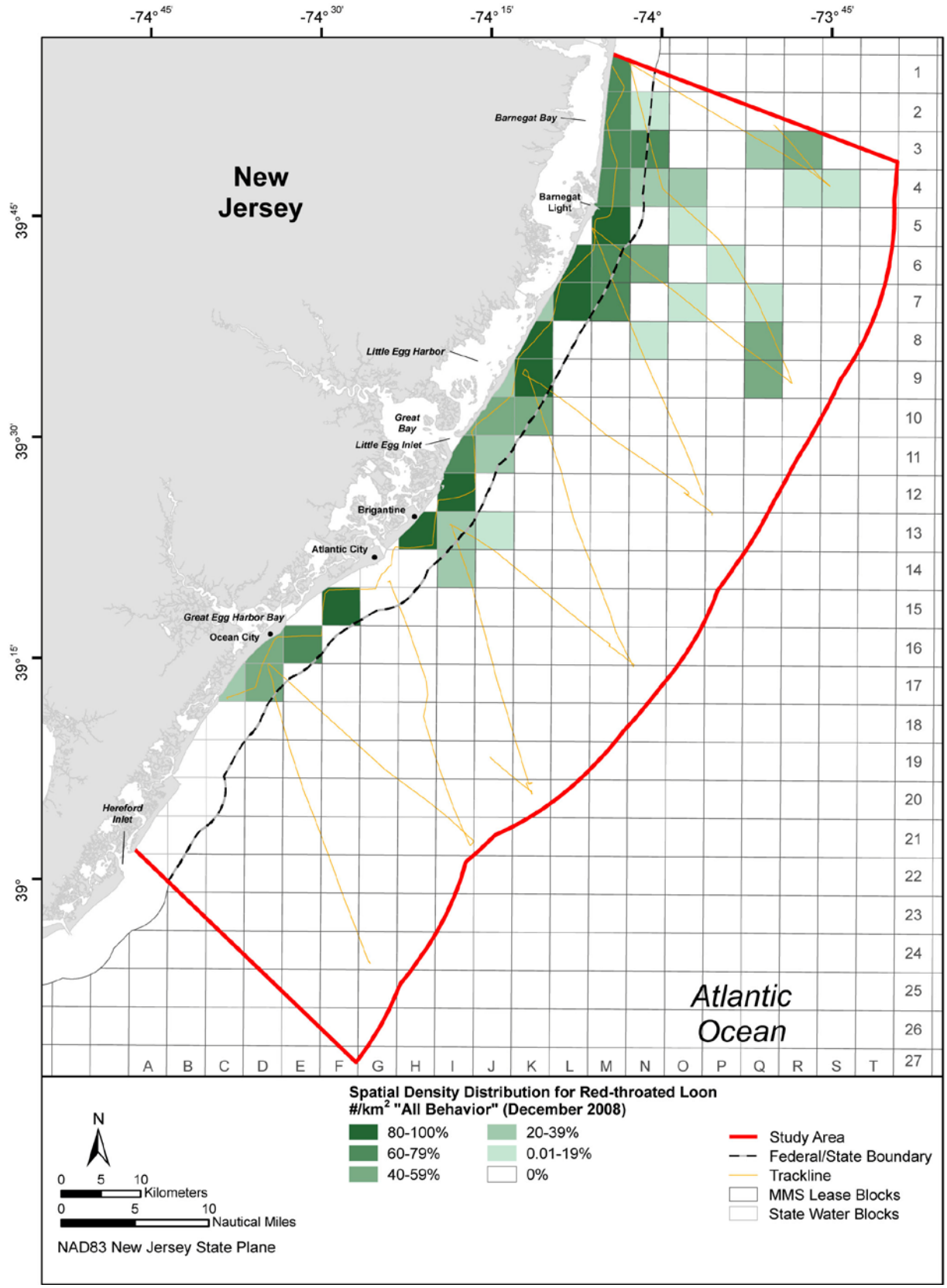

Figure C-178. Percentile abundance of Red-throated Loon (all behaviors), December 2008 (n=332).

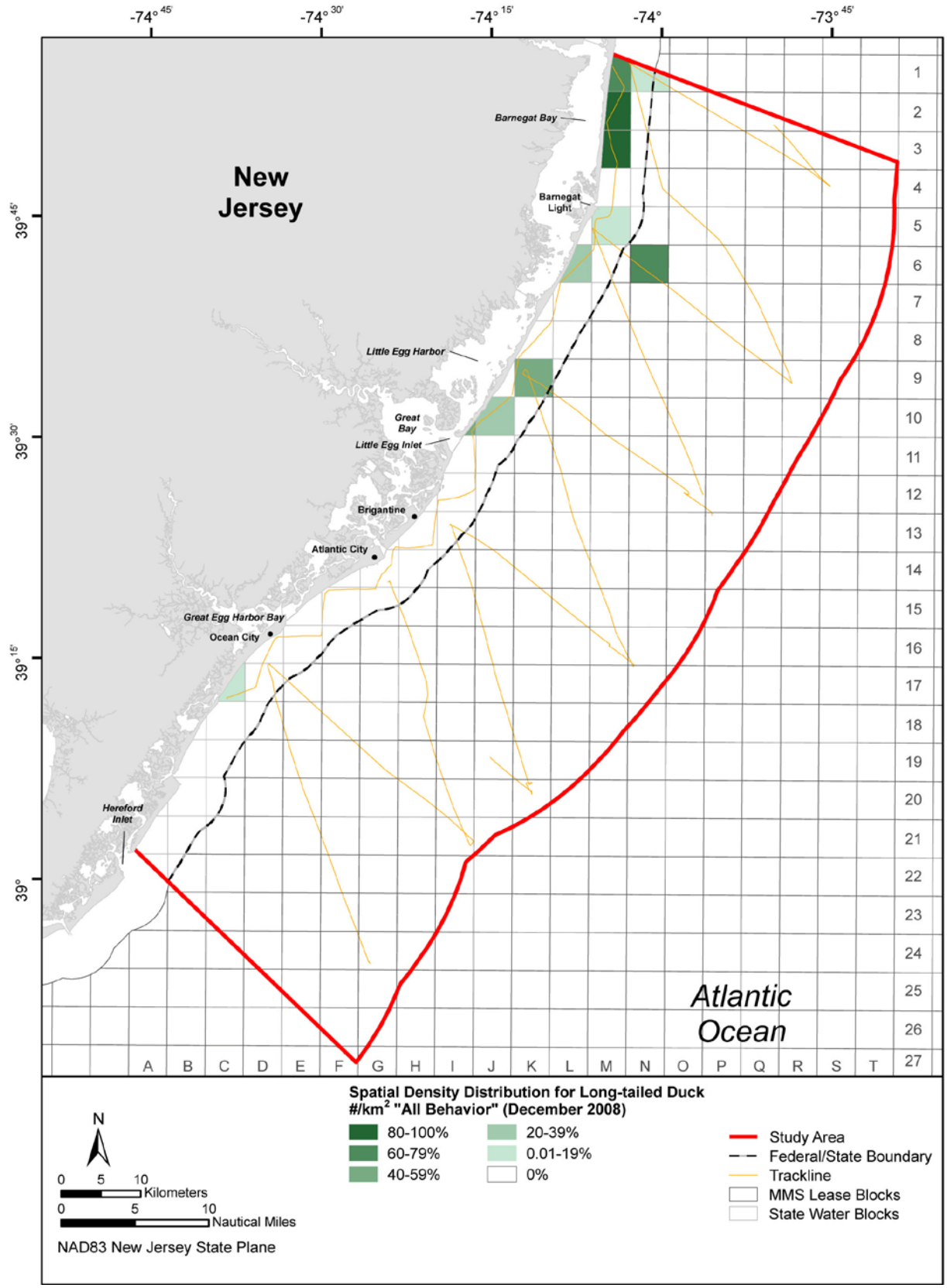

Figure C-179. Percentile abundance of Long-tailed Duck (all behaviors), December 2008 (n=330).

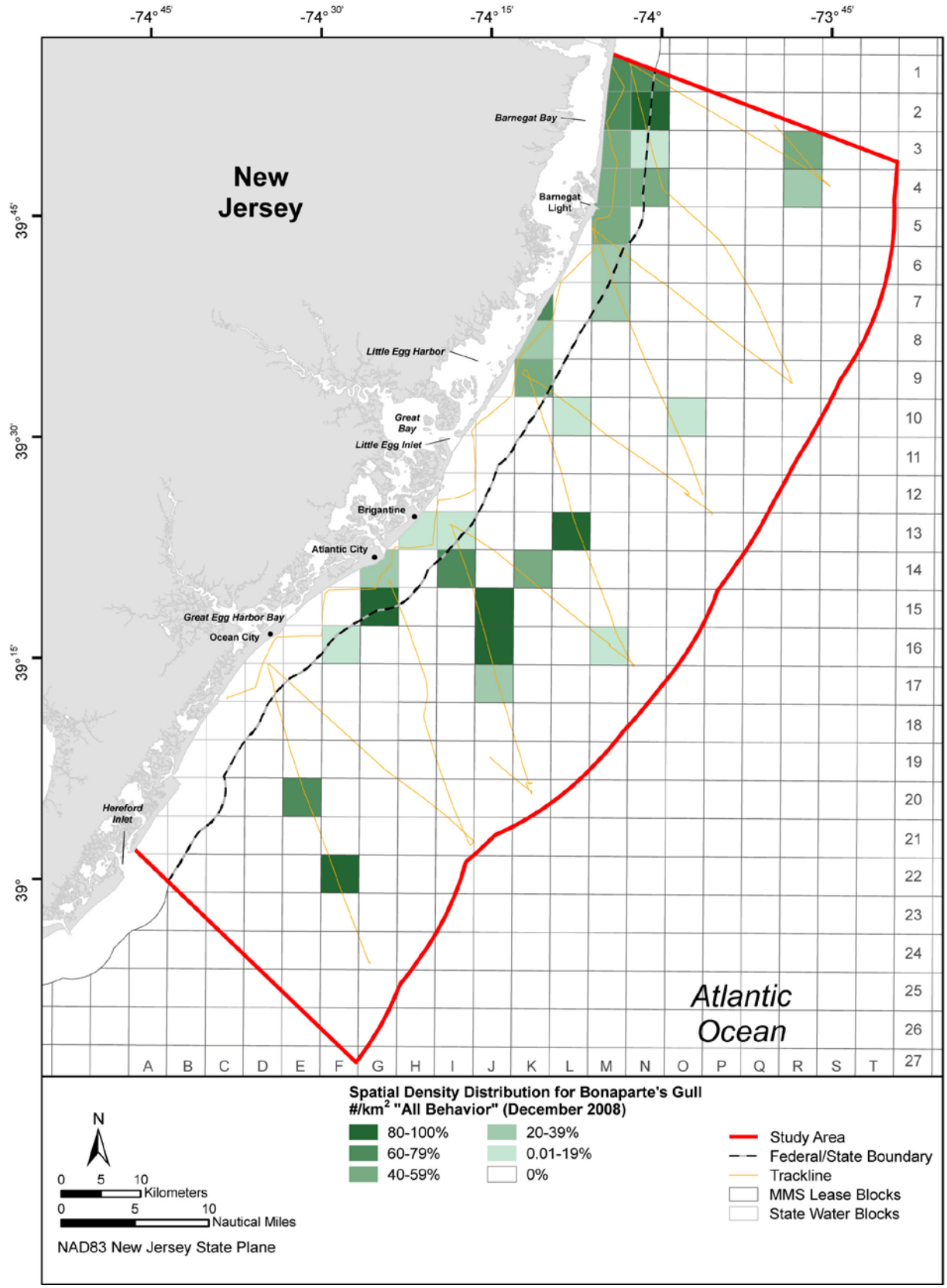

Figure C-180. Percentile abundance of Bonaparte's Gull (all behaviors), December 2008 (n=187).

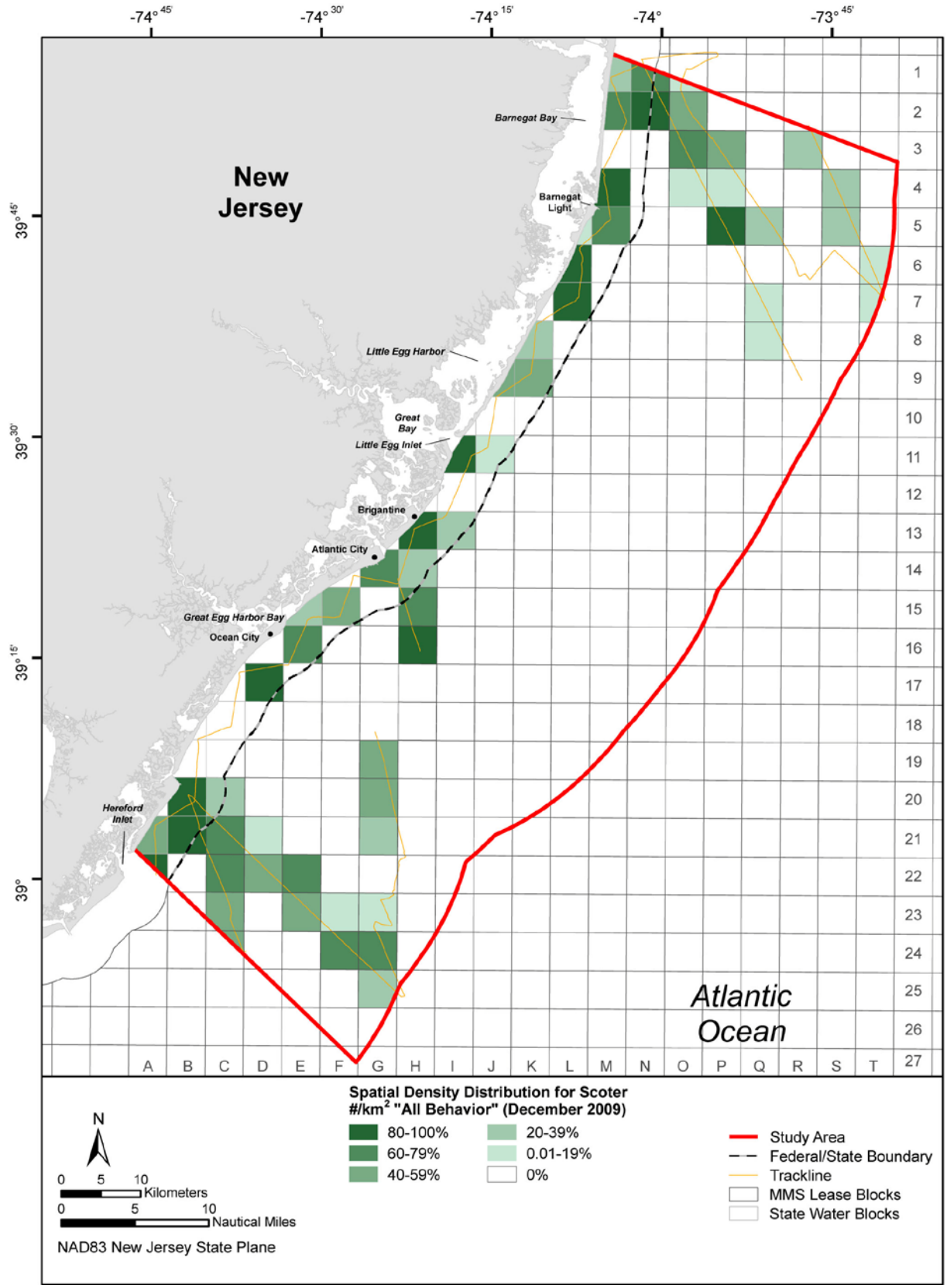

Figure C-181. Percentile abundance of scoters (all behaviors), December 2009 (n=1,264).

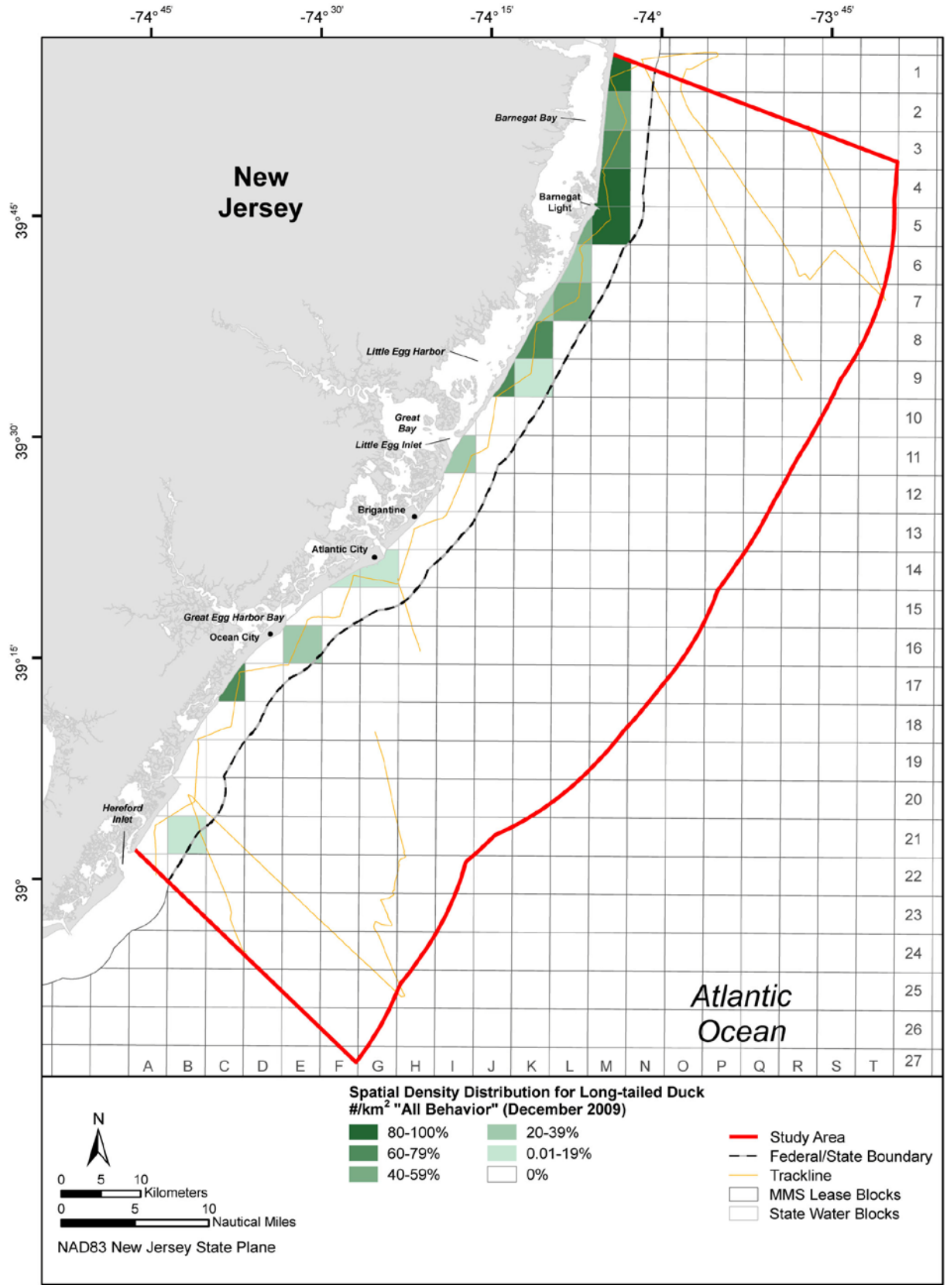

Figure C-182. Percentile abundance of Long-tailed Duck (all behaviors), December 2009 (n=392).

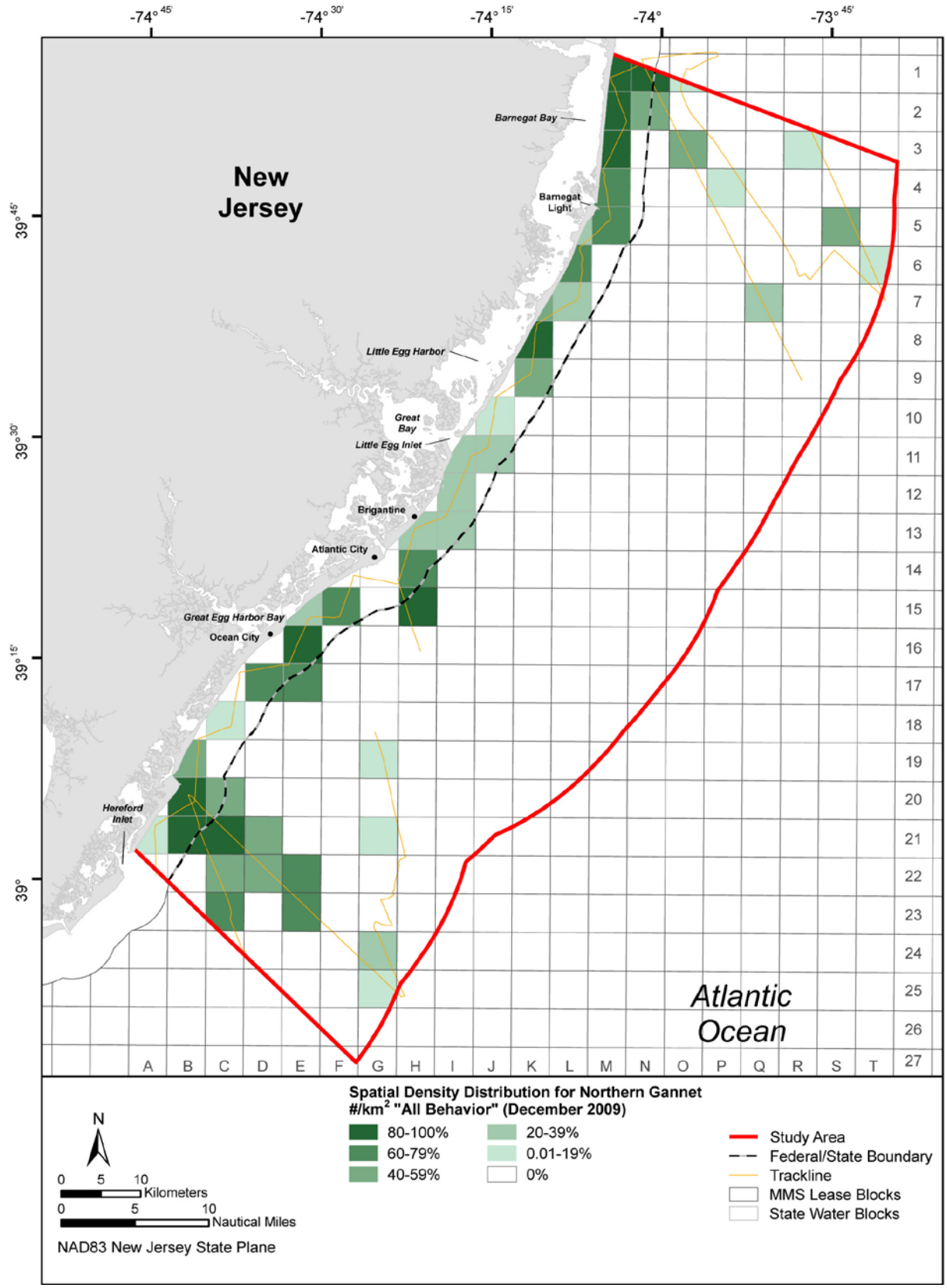

Figure C-183. Percentile abundance of Northern Gannet (all behaviors), December 2009 (n=322).

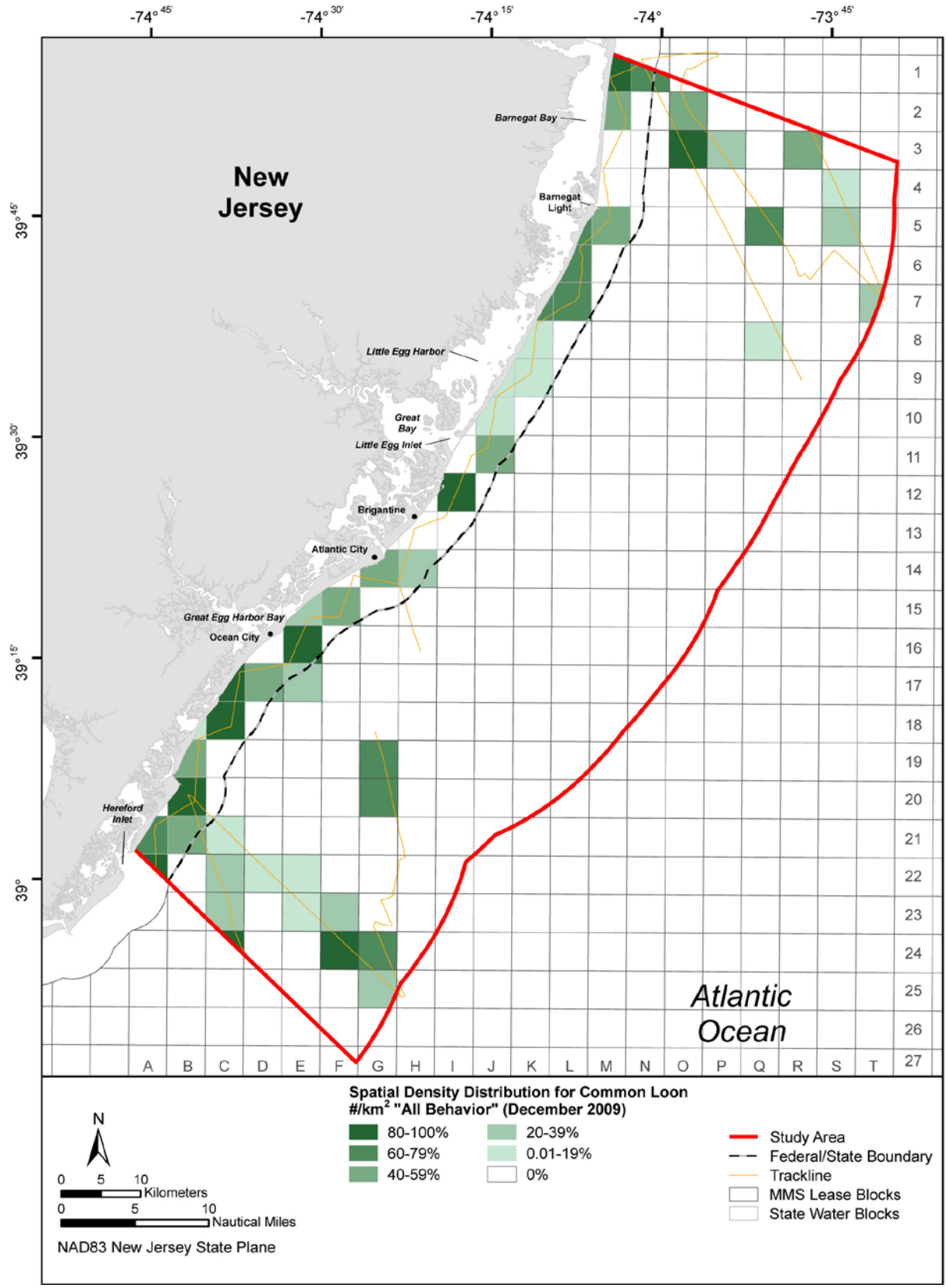

Figure C-184. Percentile abundance of Common Loon (all behaviors), December 2009 (n=260).

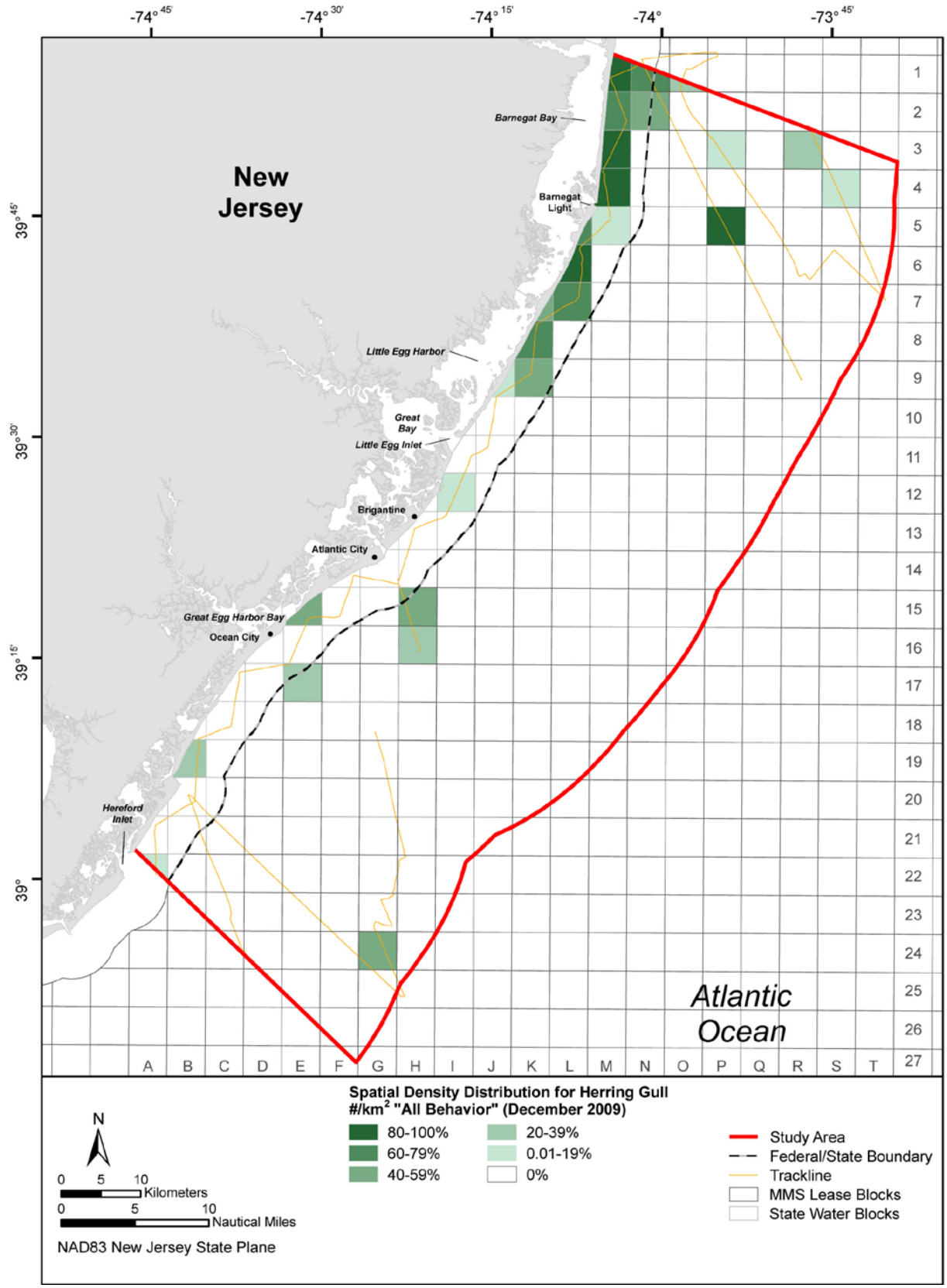

Figure C-185. Percentile abundance of Herring Gull (all behaviors), December 2009 (n=243).

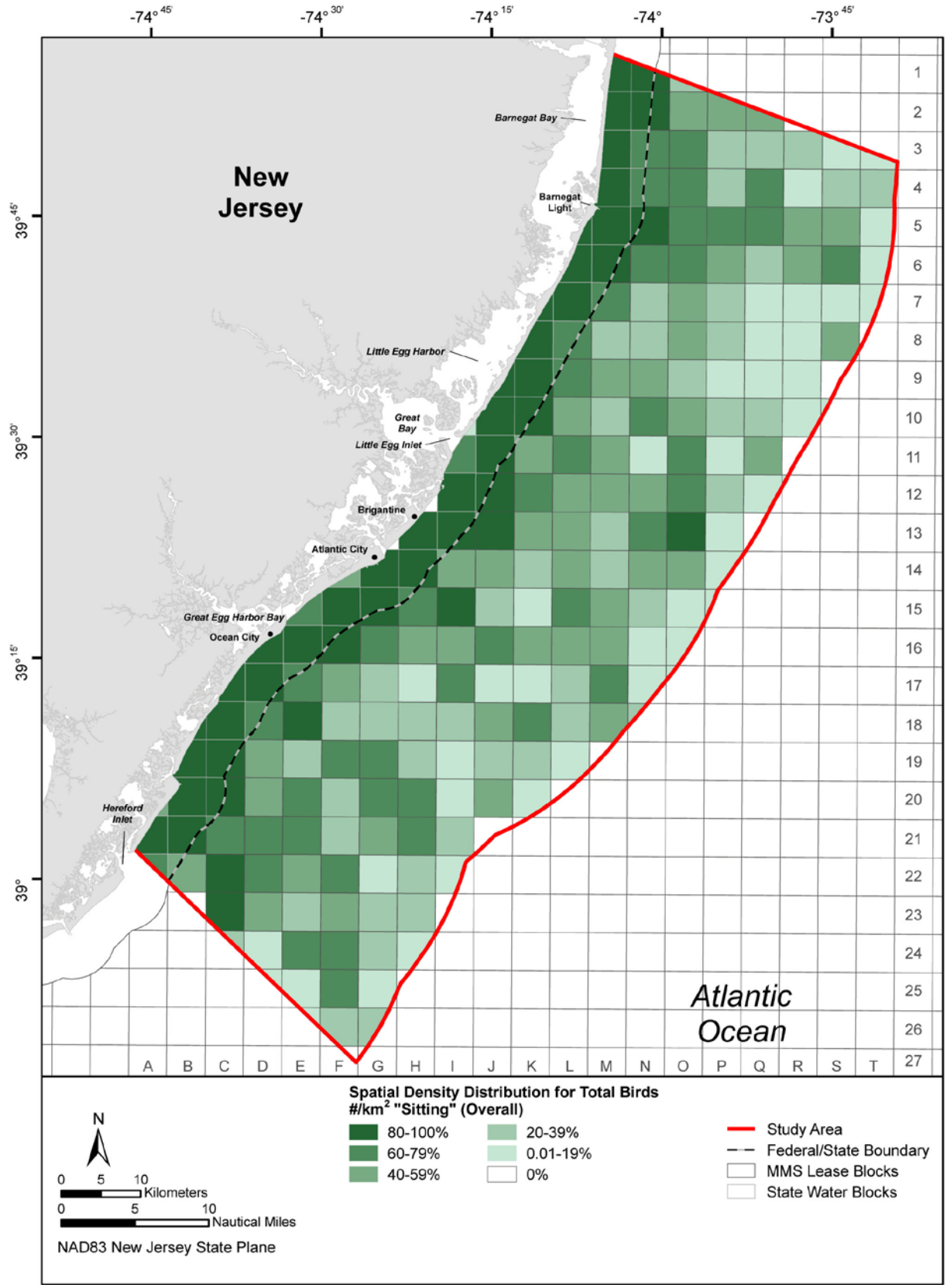

Figure C-186. Percentile abundance by block for of all birds (sitting), January 2008-November 2009 (n=23,800).

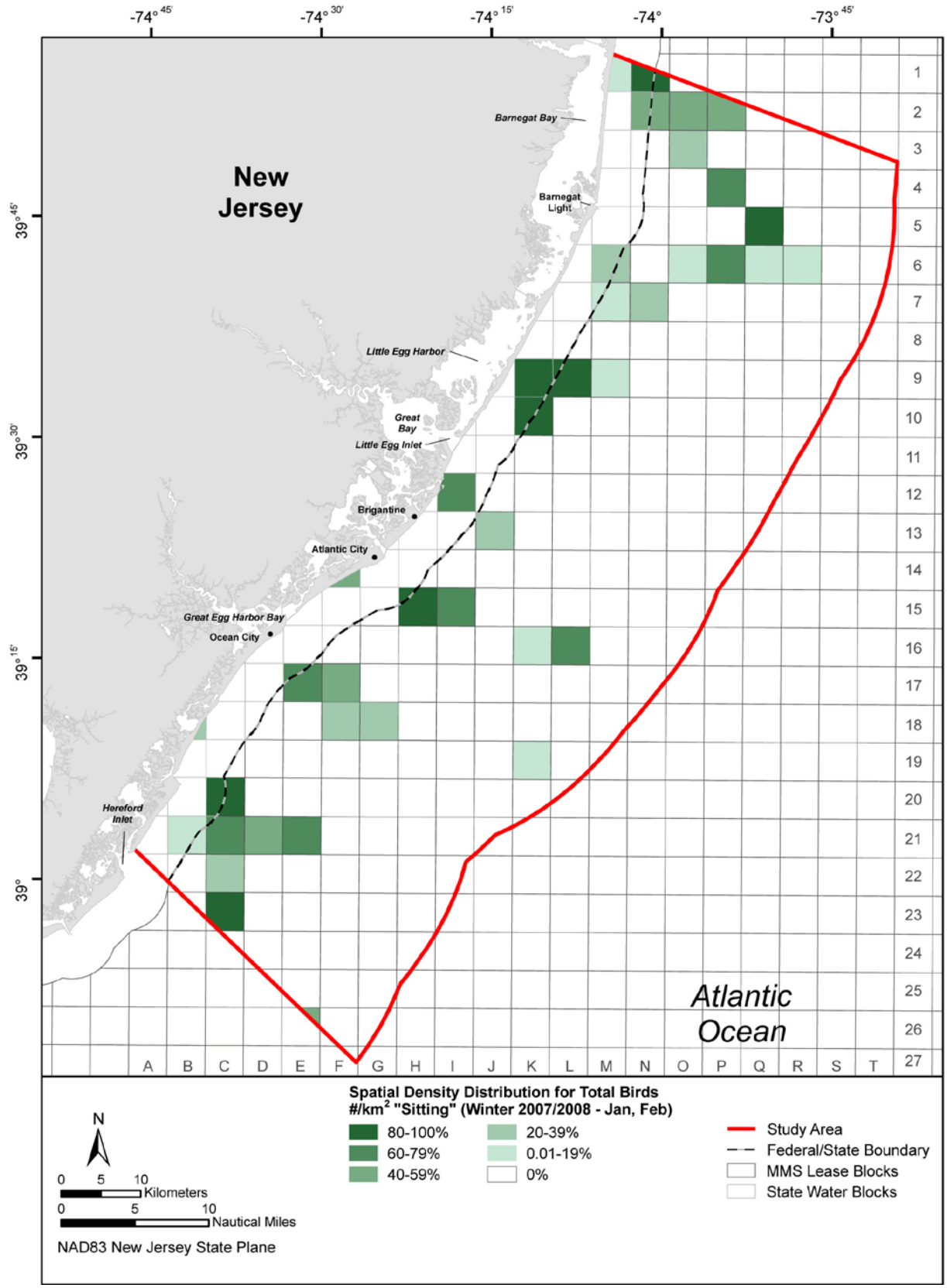

Figure C-187. Percentile abundance of all birds (sitting), Winter 2008 (January-February 2008) (n=211).

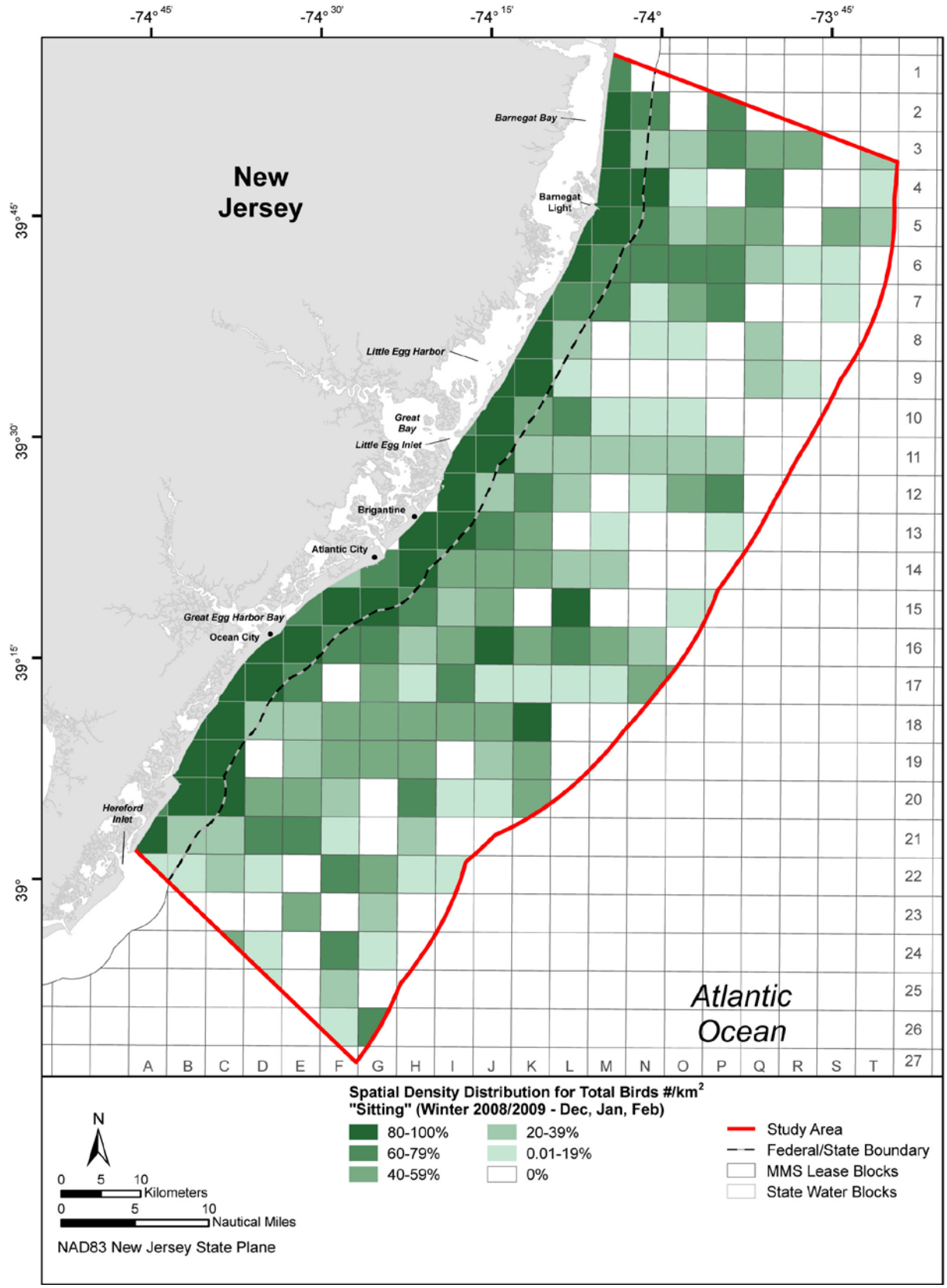

Figure C-188. Percentile abundance of all birds (sitting), Winter 2009 (December 2008-February 2009) (n=10,169).

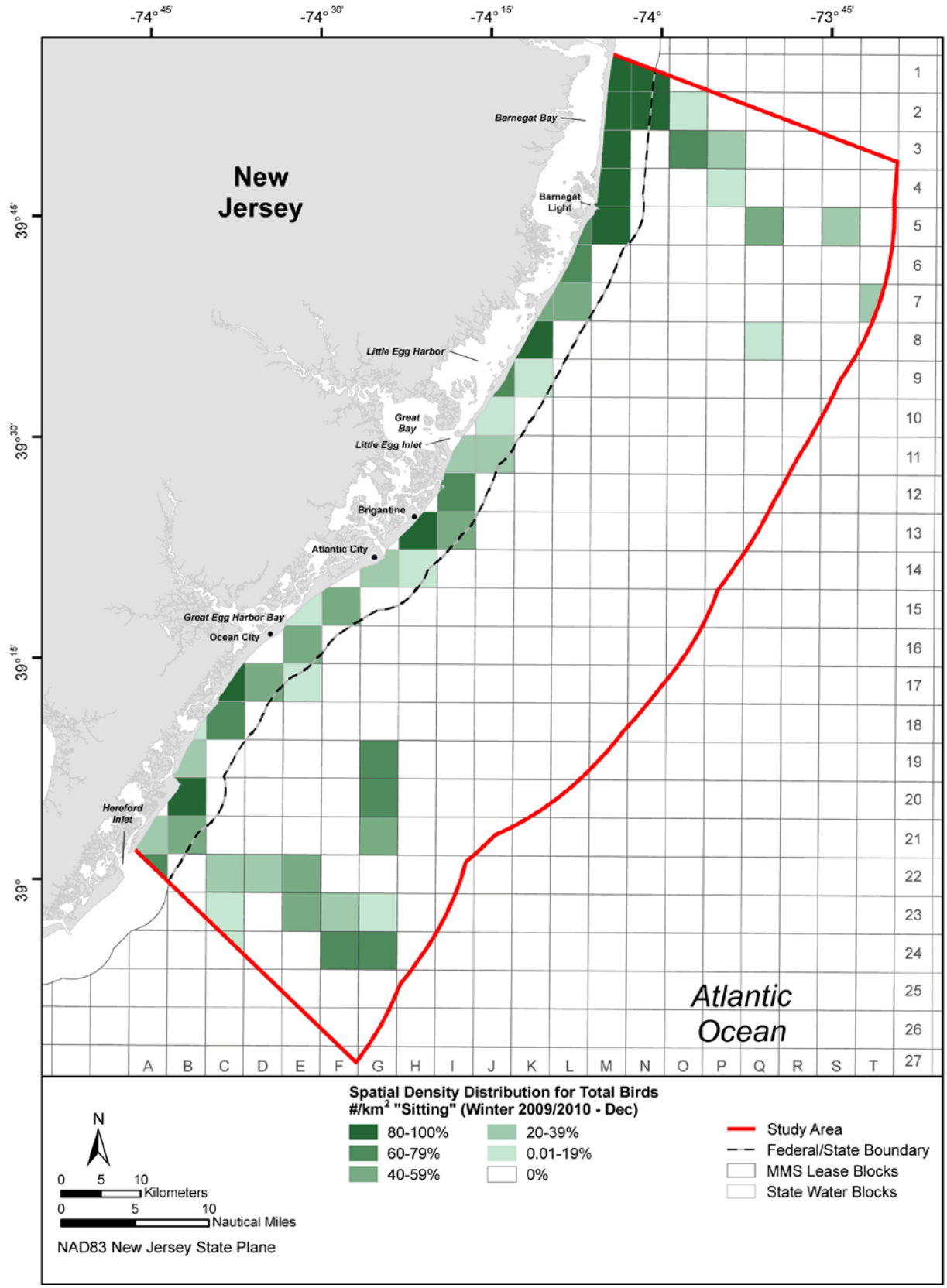

Figure C-189. Percentile abundance of all birds (sitting), Winter 2010 (December 2010) (n=1,251).

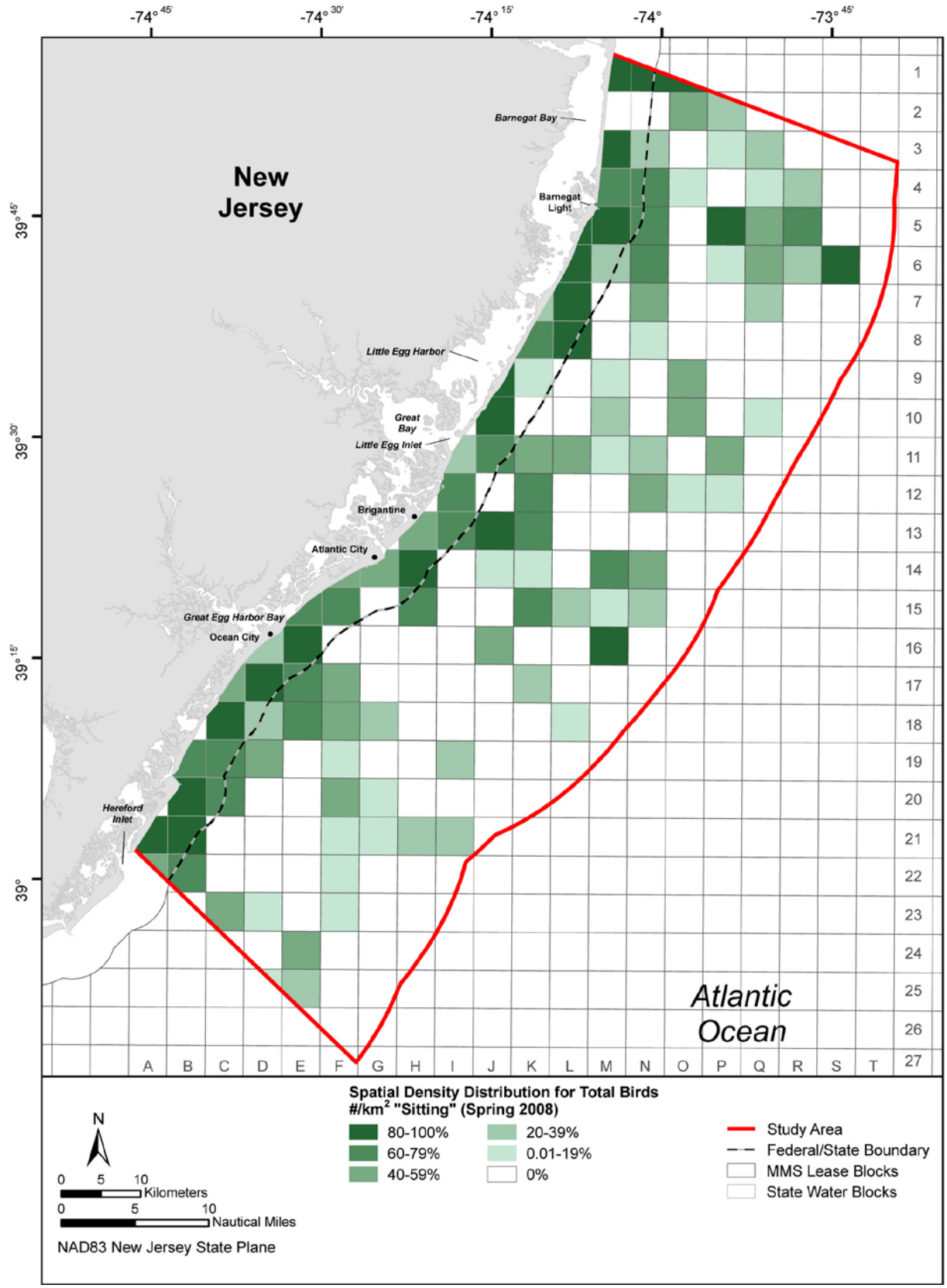

Figure C-190. Percentile abundance of all birds (sitting), Spring 2008 (March-May 2008) (n=1,439).

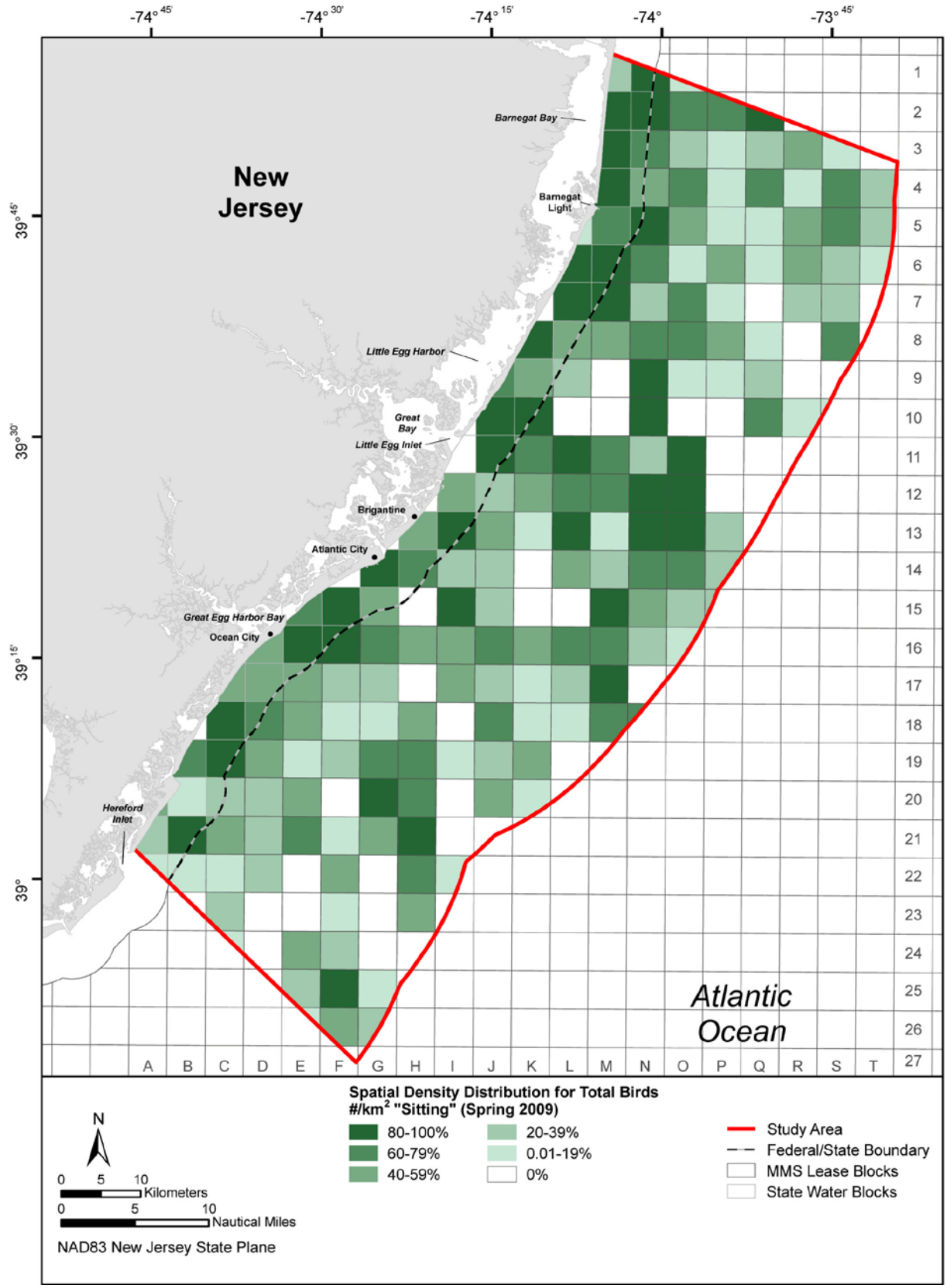

Figure C-191. Percentile abundance of all birds (sitting), Spring 2009 (March-May 2009) (n=3,044).

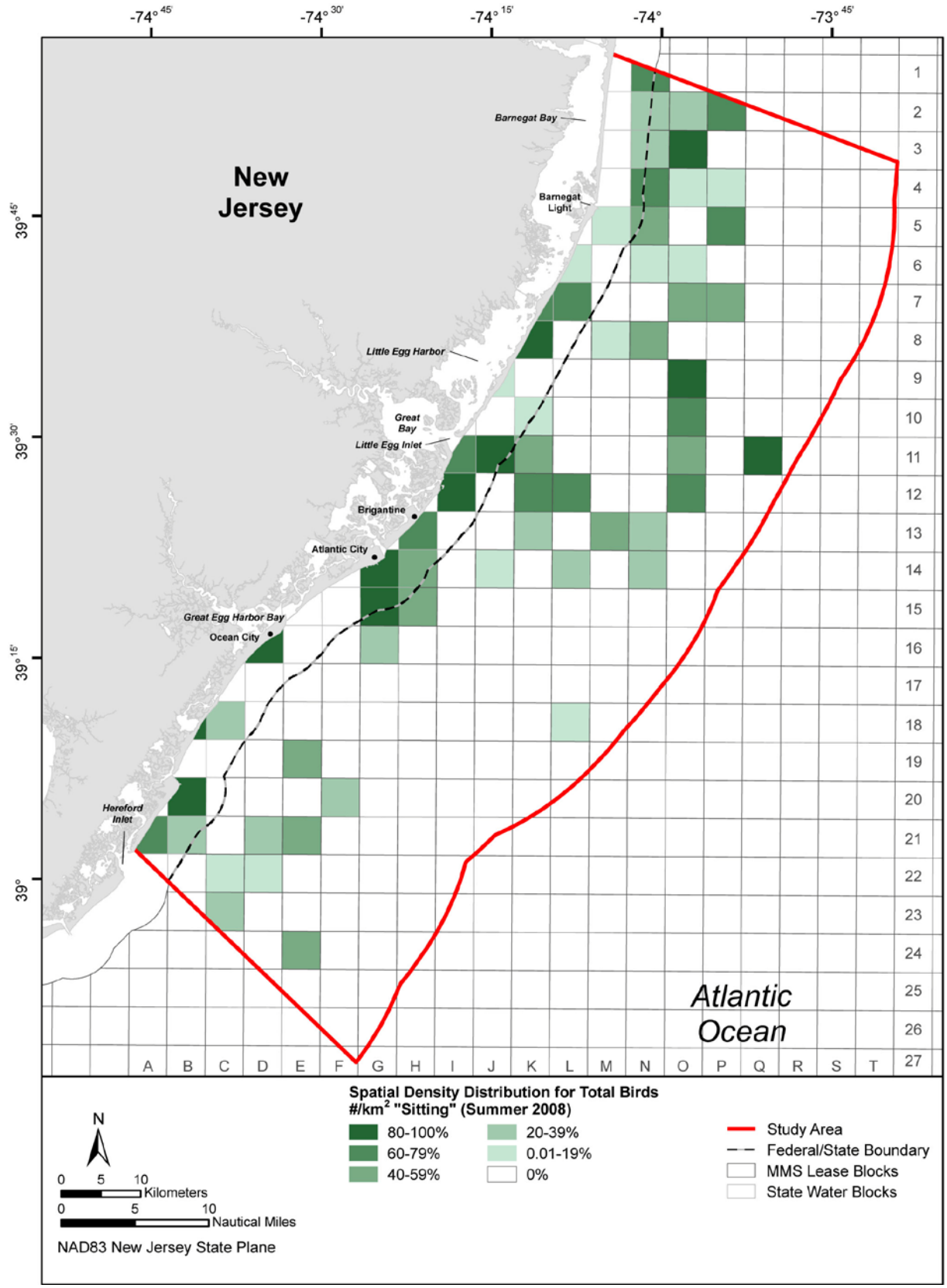

Figure C-192. Percentile abundance of all birds (sitting), Summer 2008 (June-July 2008) (n=172).

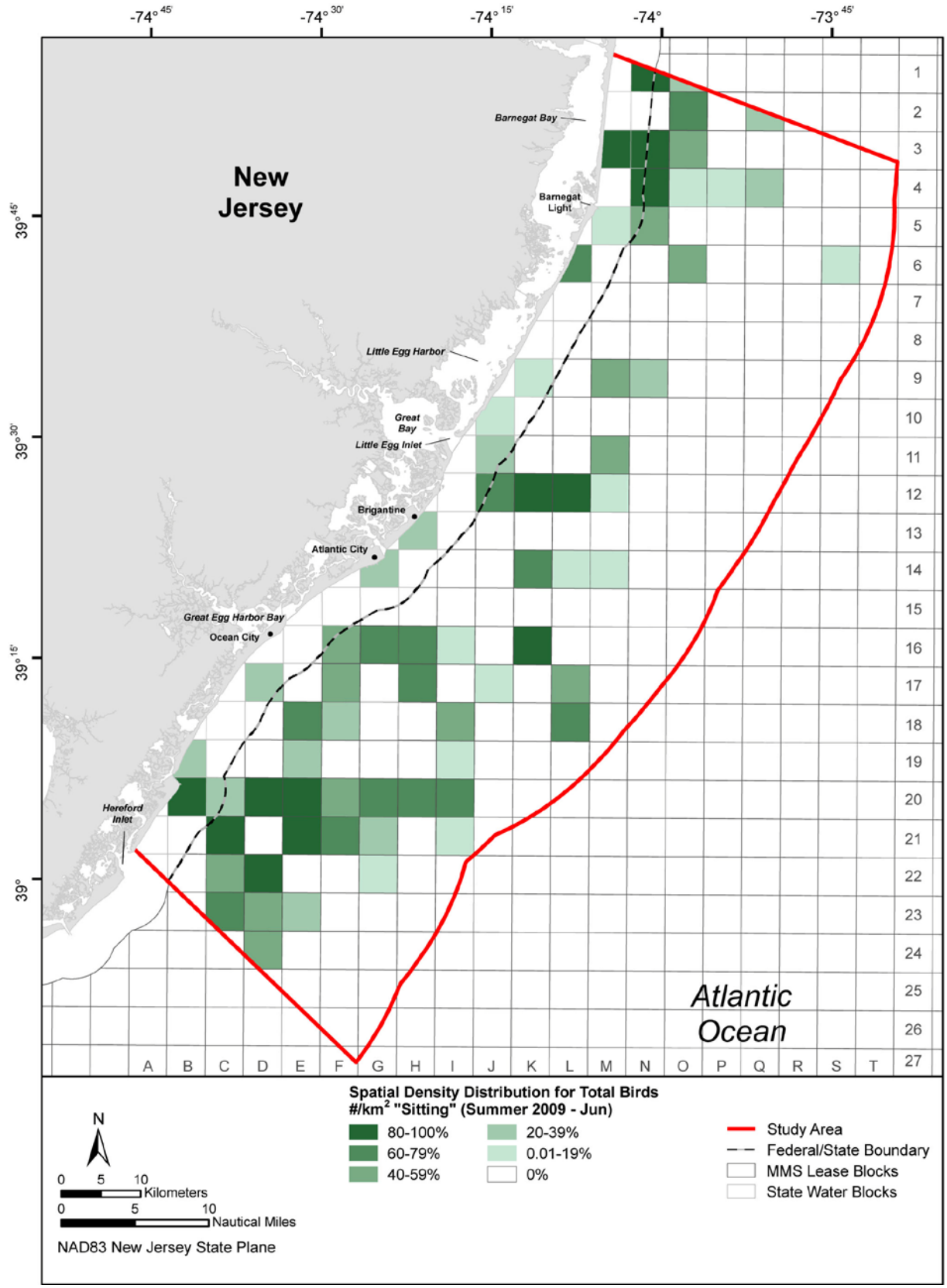

Figure C-193. Percentile abundance of all birds (sitting), Summer 2009 (June 2009) (n=204).

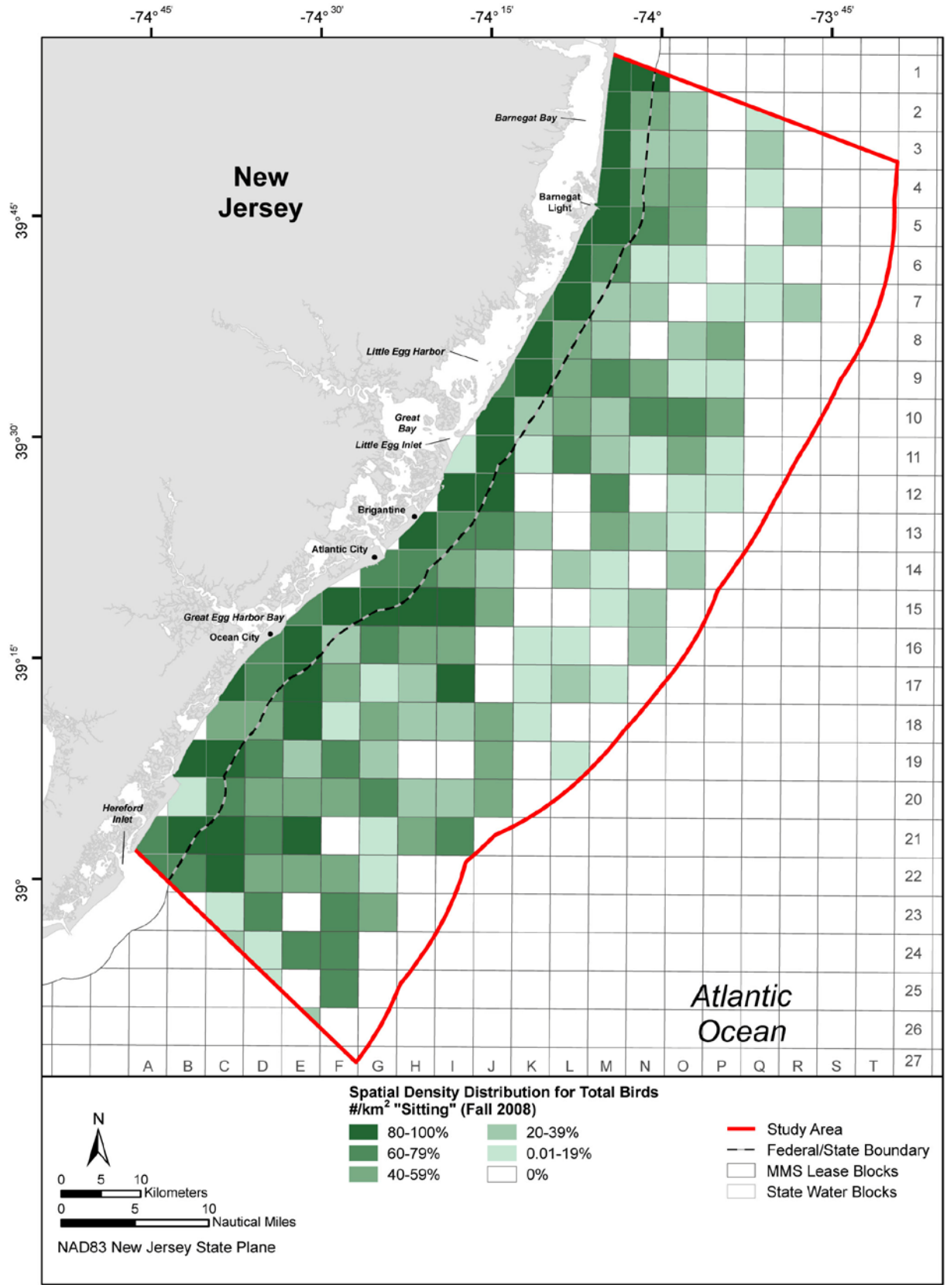

Figure C-194. Percentile abundance of all birds (sitting), Fall 2008 (August-November 2008) (n=4,218).

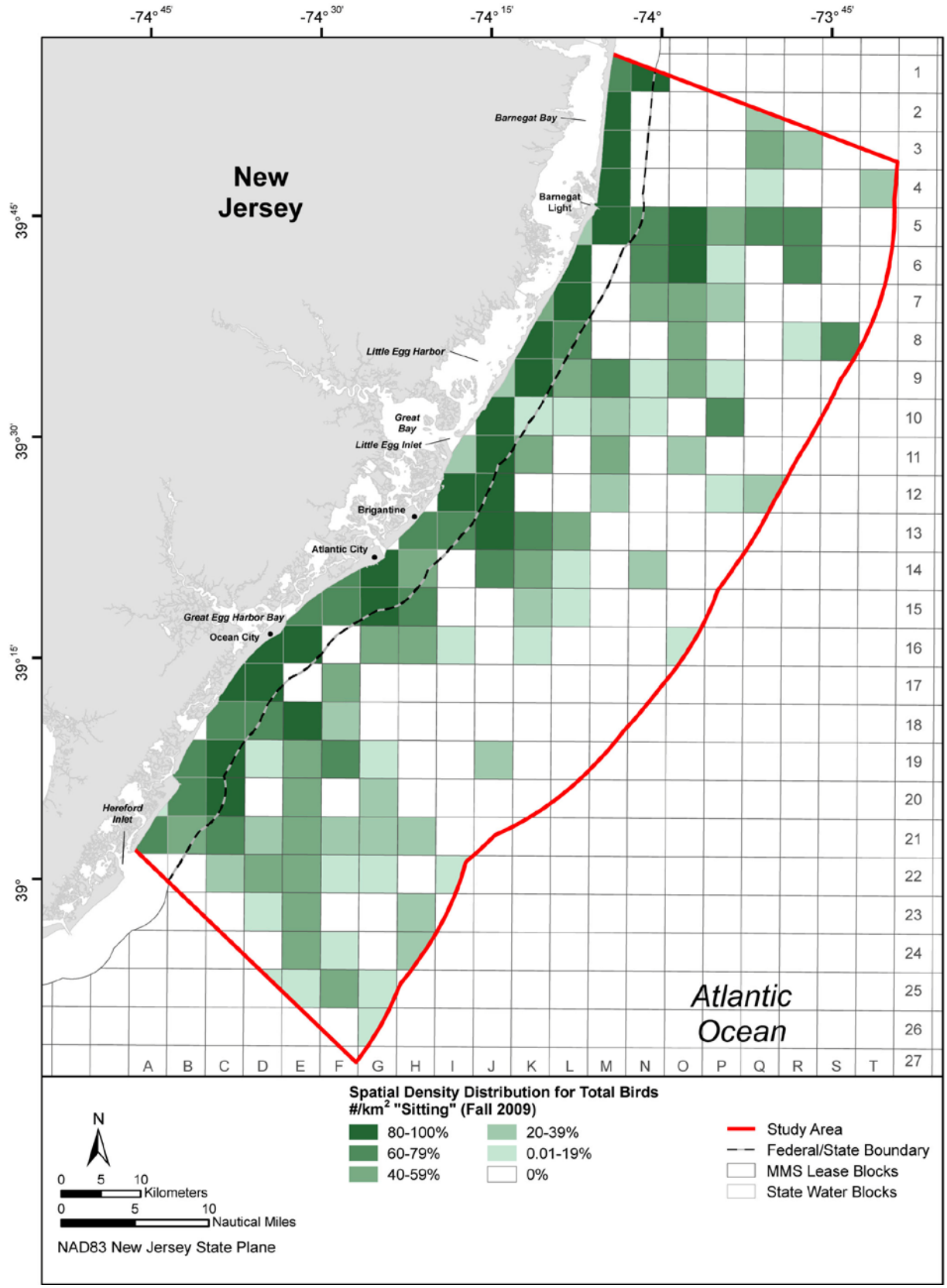

Figure C-195. Percentile abundance of all birds (sitting), Fall 2009 (August-November 2009) (n=2,700).

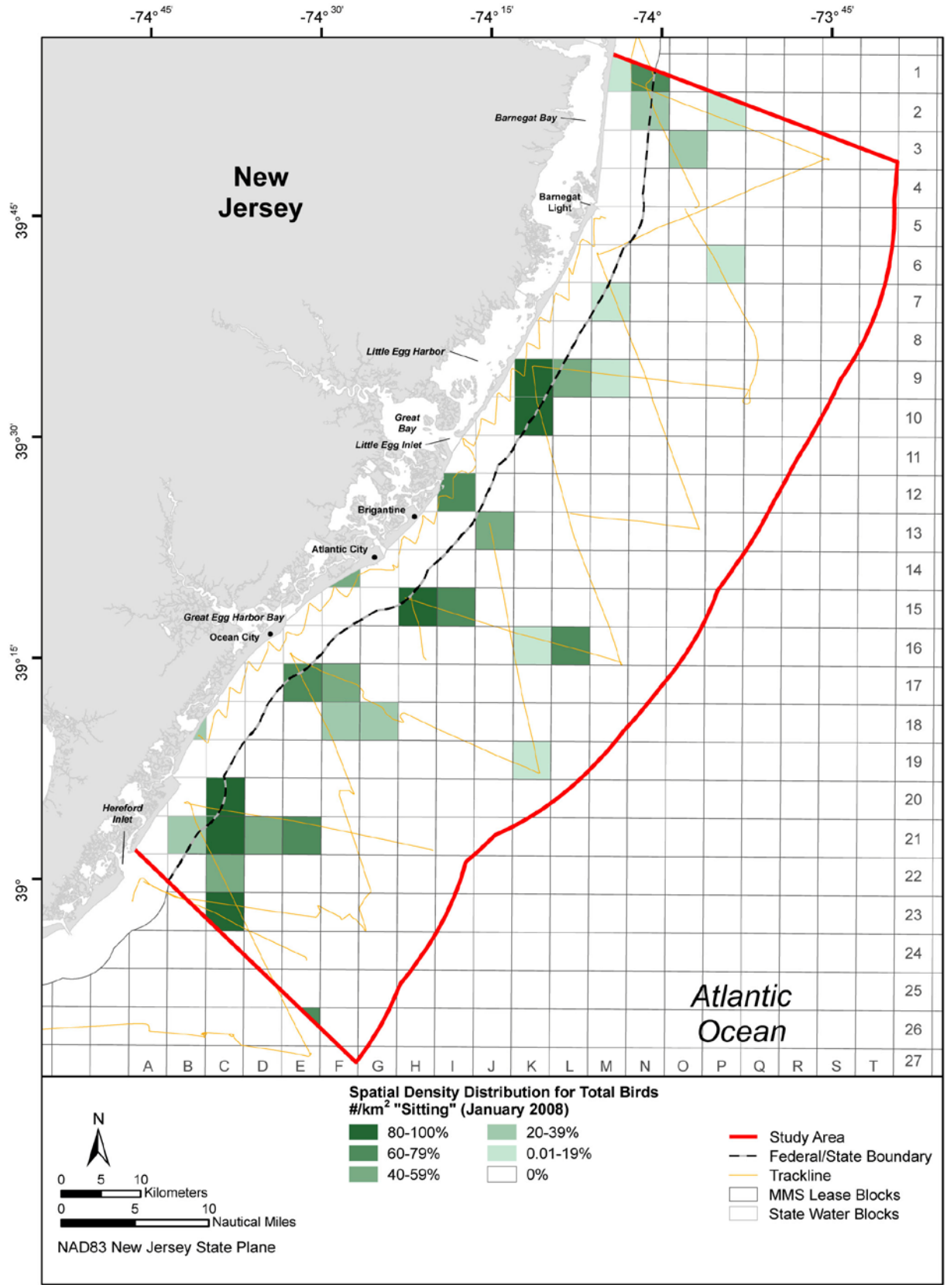

Figure C-196. Percentile abundance of all birds (sitting), January 2008 (n=170).

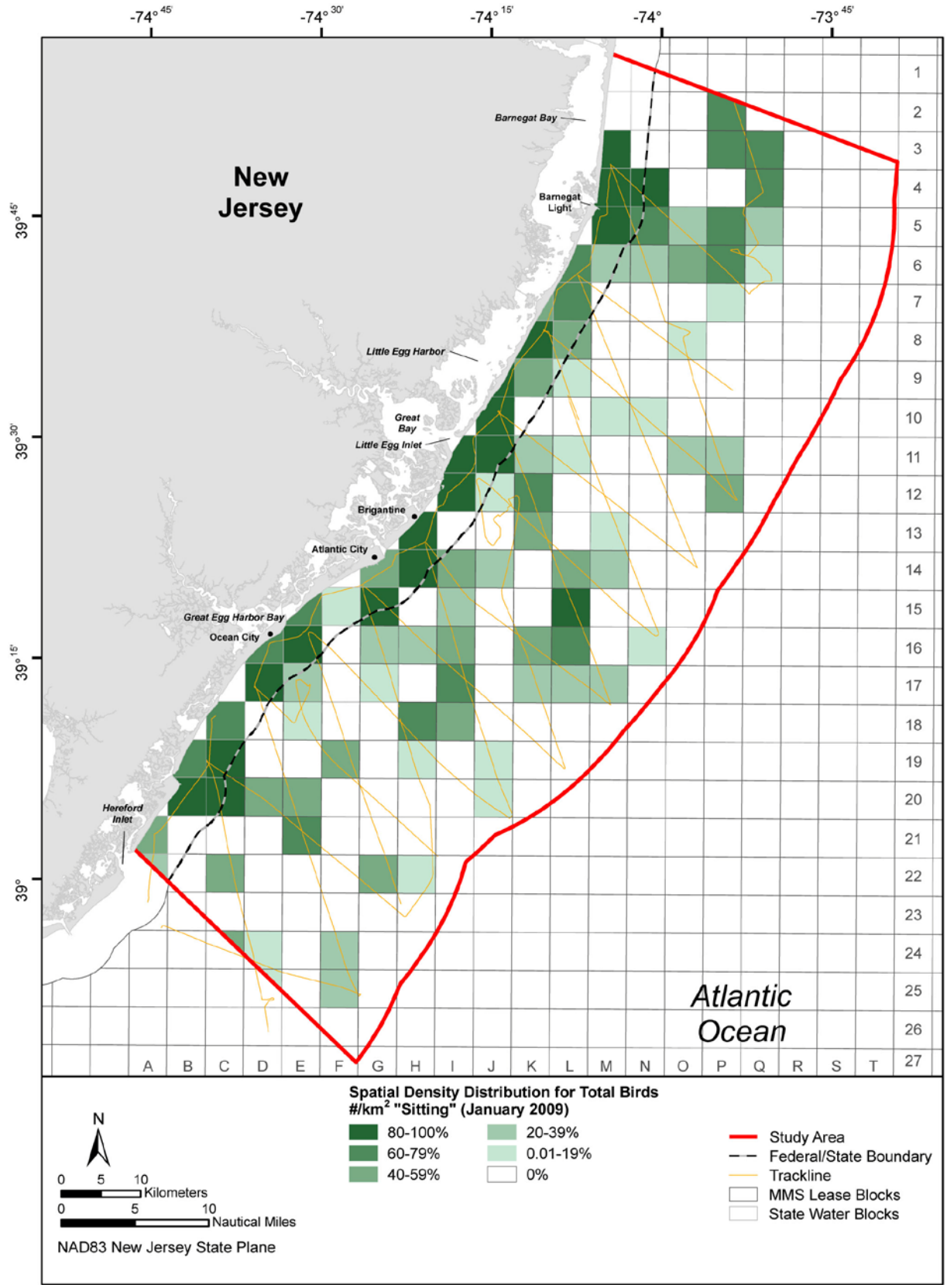

Figure C-197. Percentile abundance of all birds (sitting), January 2009 (n=4,844).

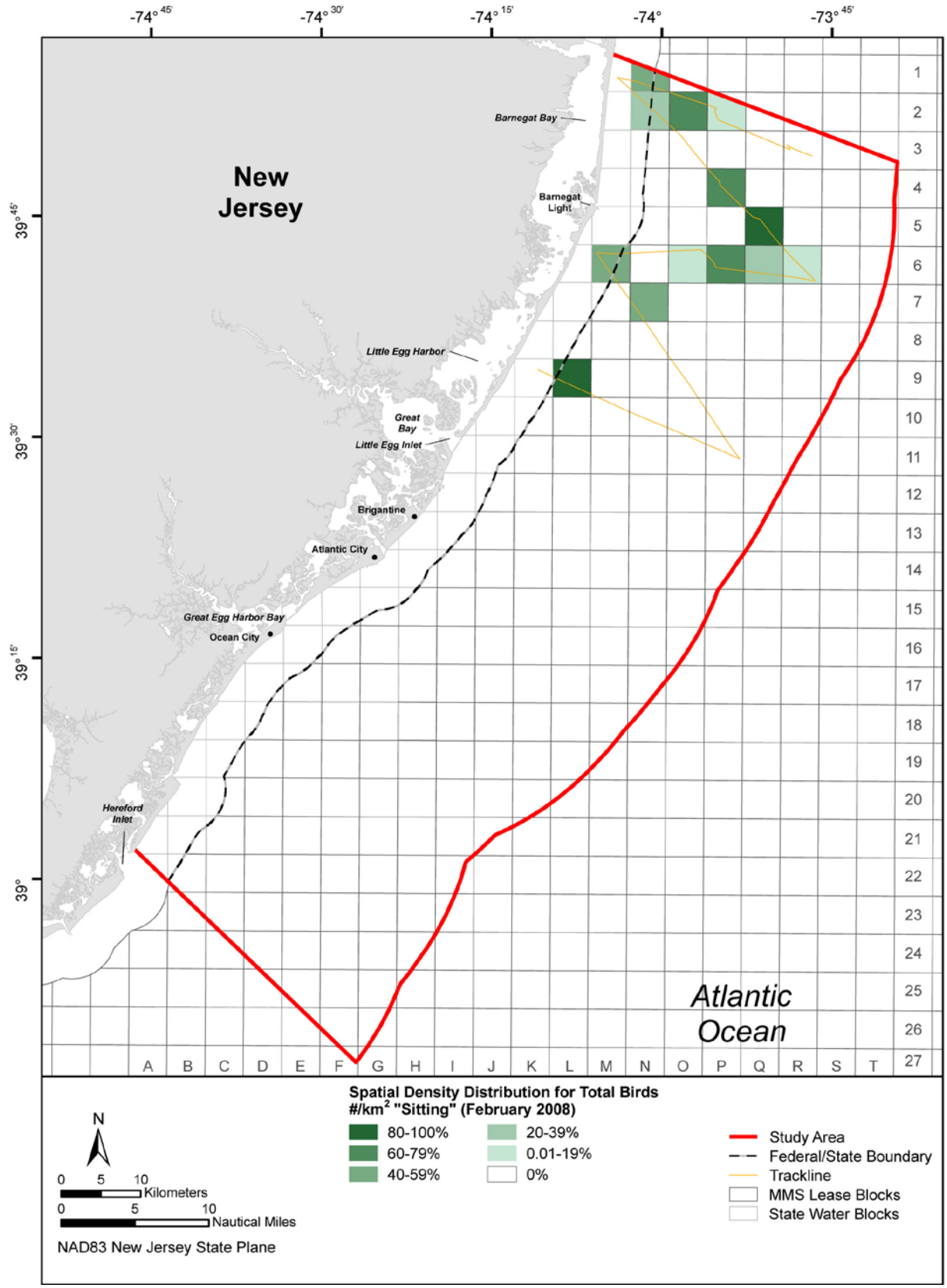

Figure C-198. Percentile abundance of all birds (sitting), February 2008 (n=41).

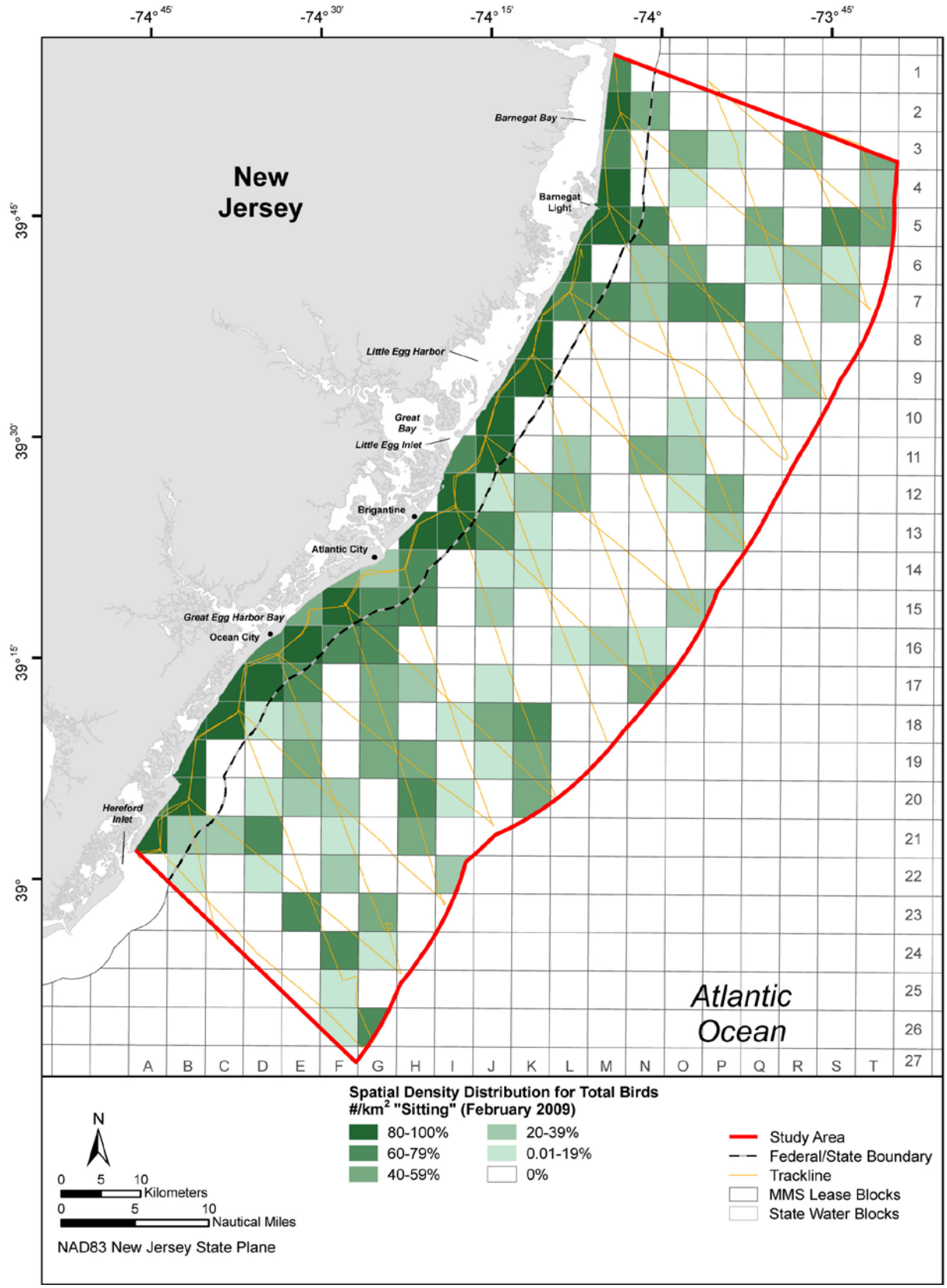

Figure C-199. Percentile abundance of all birds (sitting), February 2009 (n=3,649).

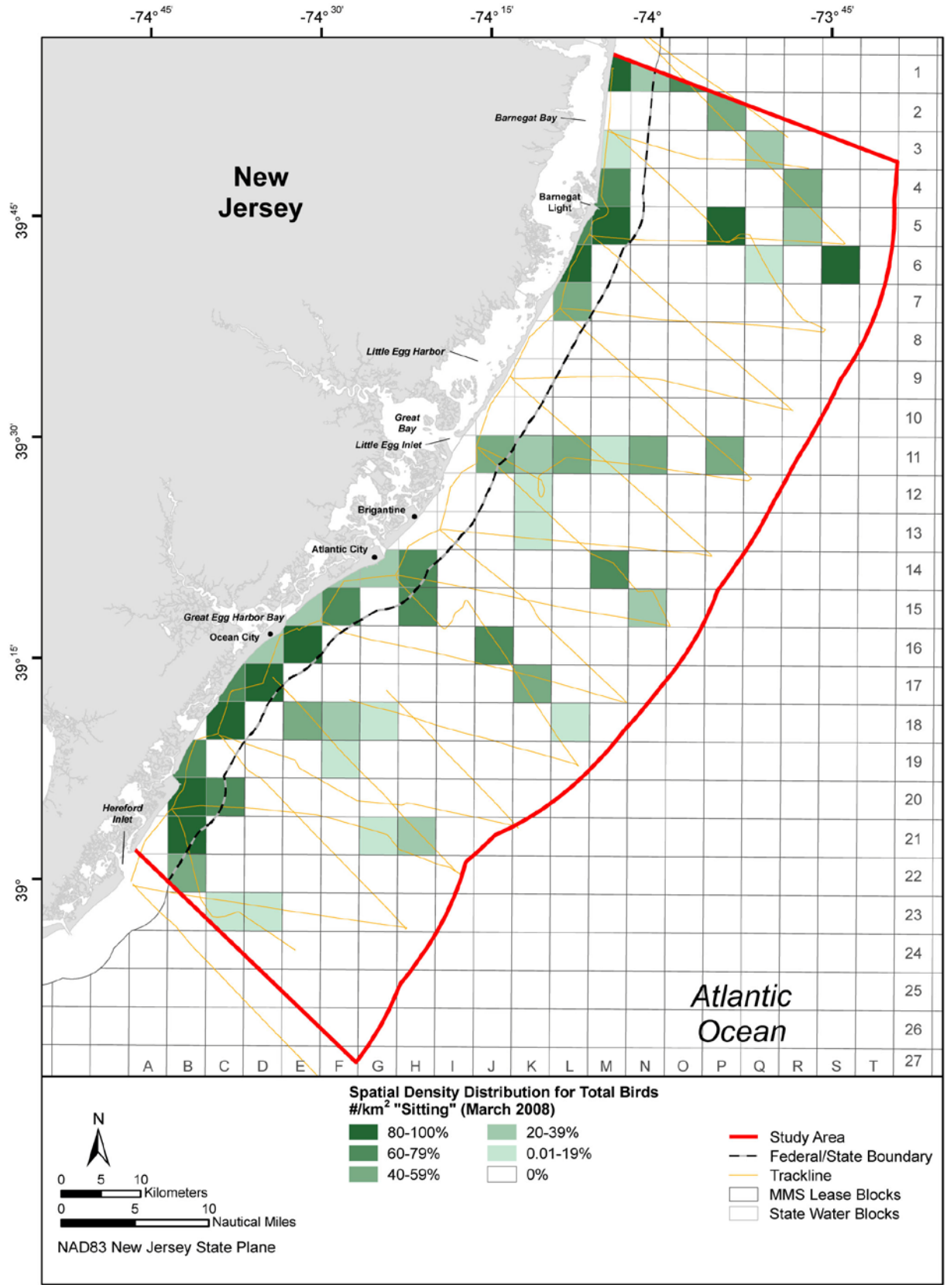

Figure C-200. Percentile abundance of all birds (sitting), March 2008 (n=424).

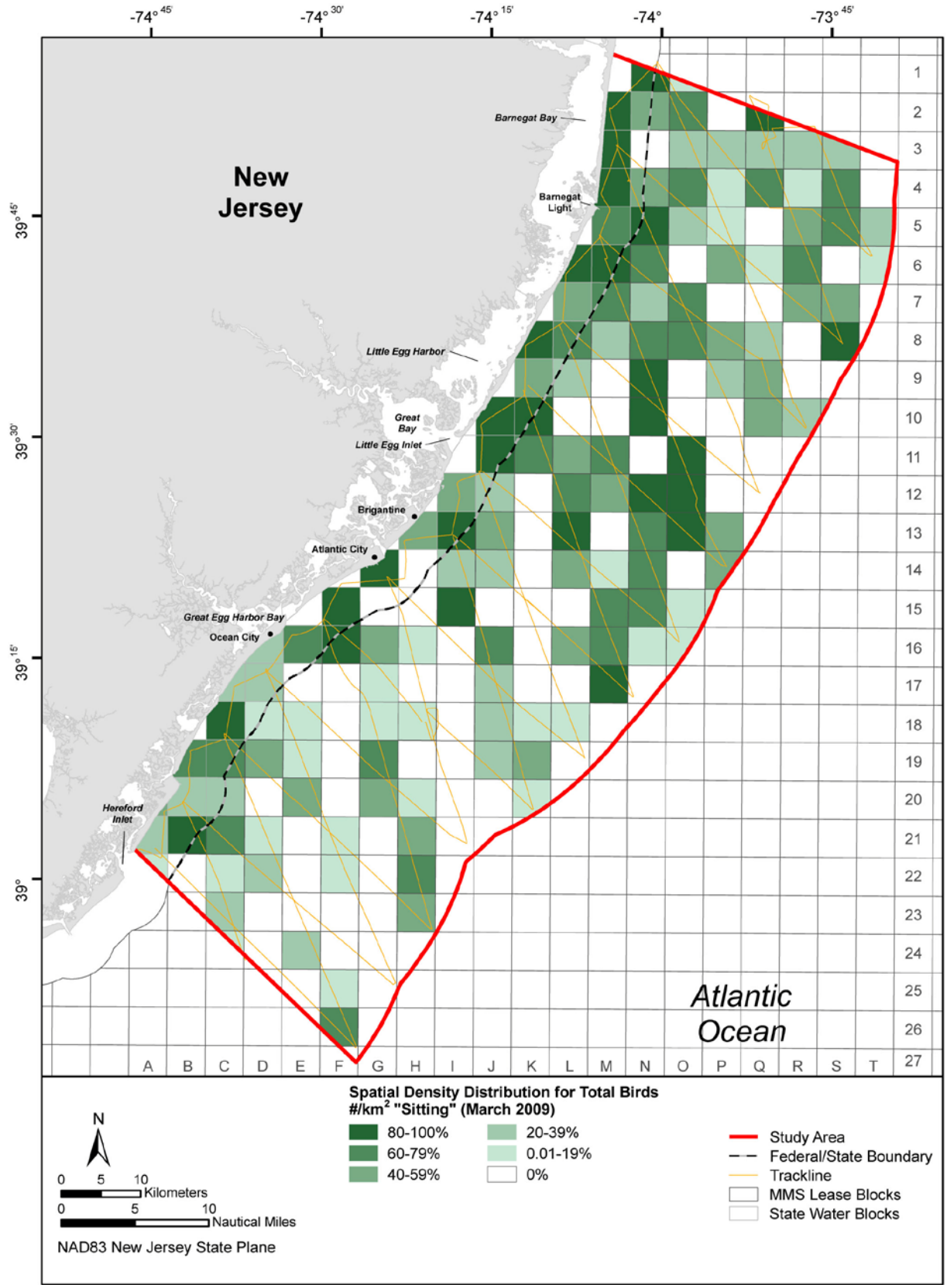

Figure C-201. Percentile abundance of all birds (sitting), March 2009 (n=2,232).

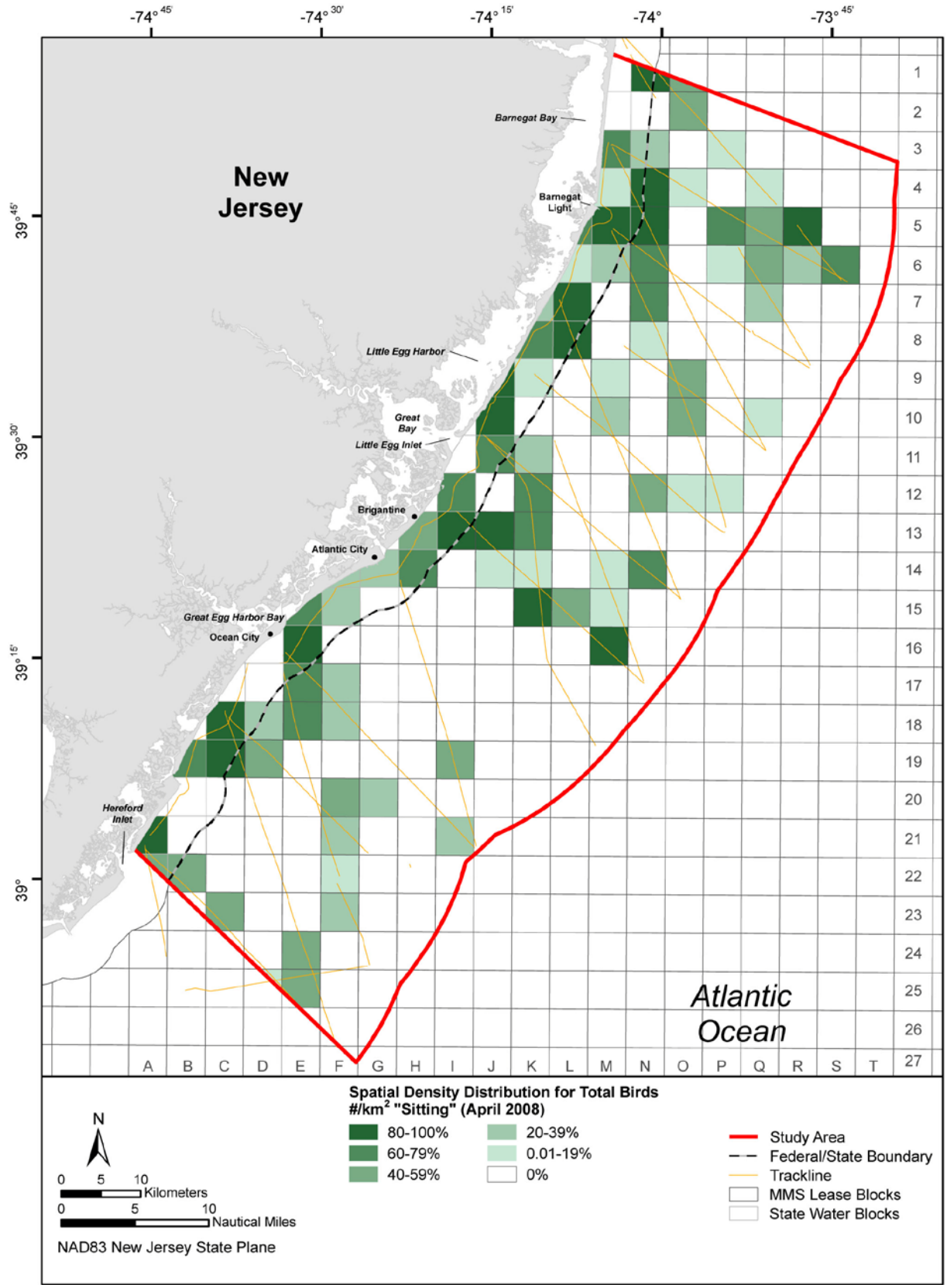

Figure C-202. Percentile abundance of all birds (sitting), April 2008 (n=997).

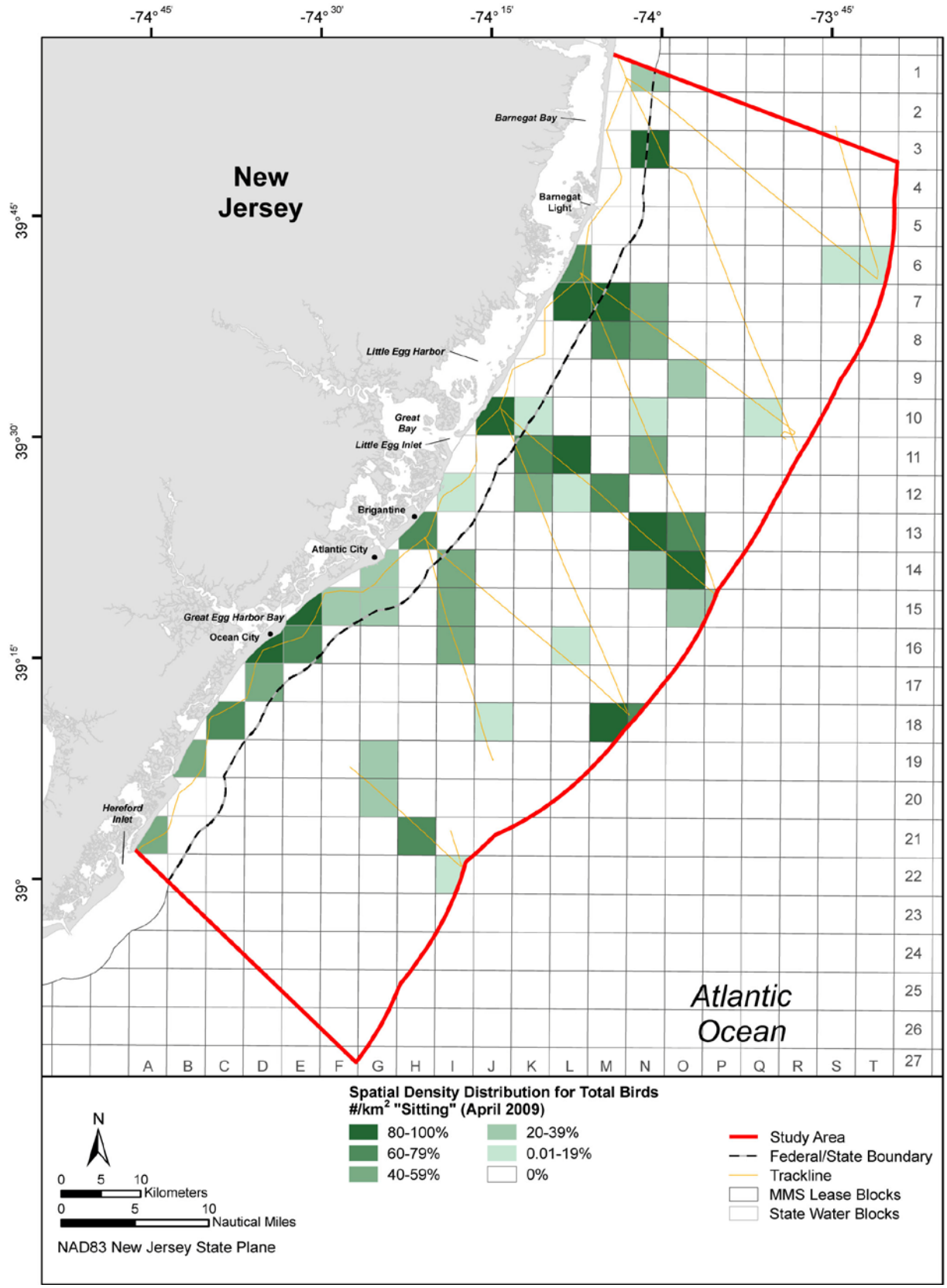

Figure C-203. Percentile abundance of all birds (sitting), April 2009 (n=154).

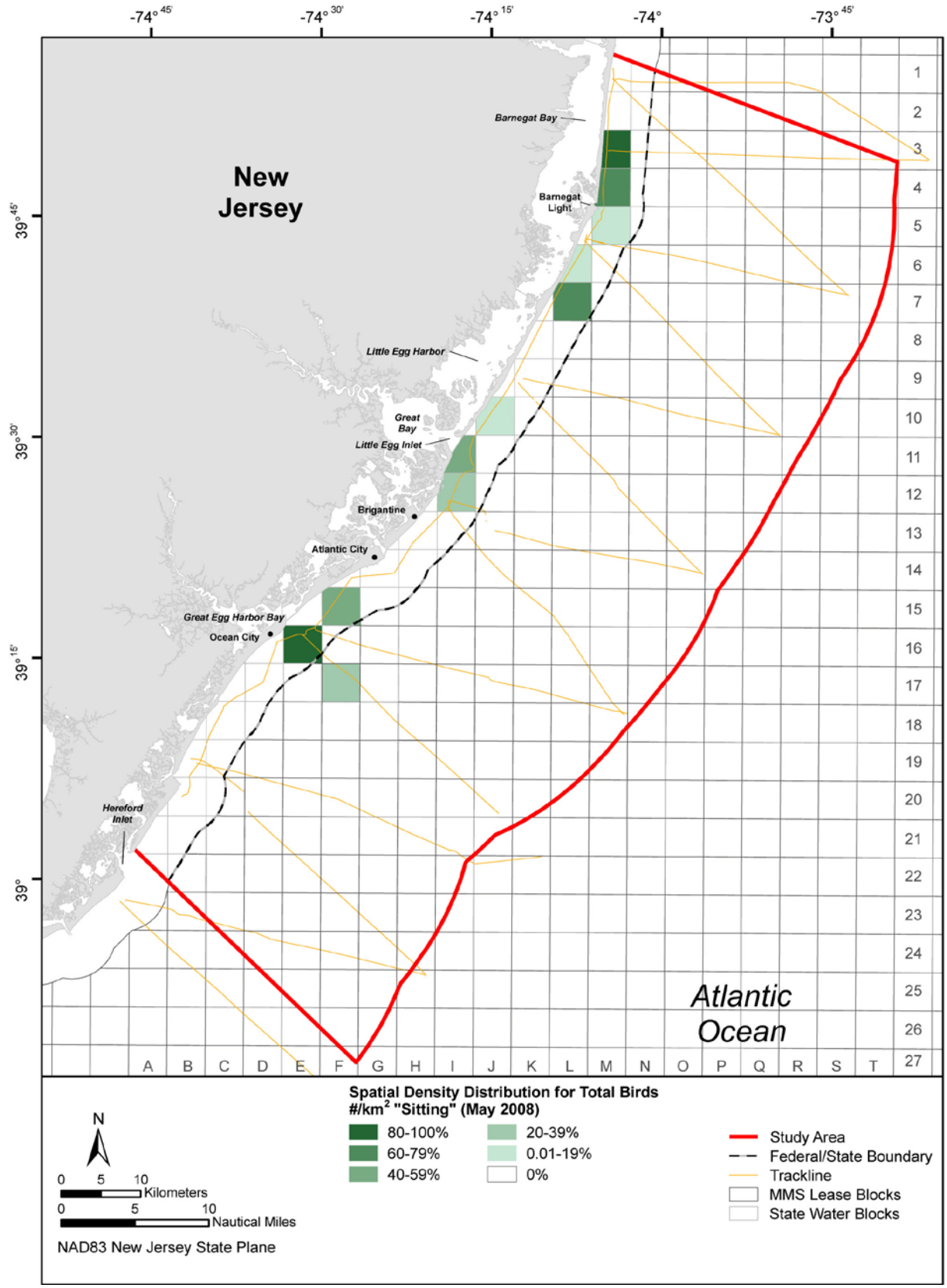

Figure C-204. Percentile abundance of all birds (sitting), May 2008 (n=18).

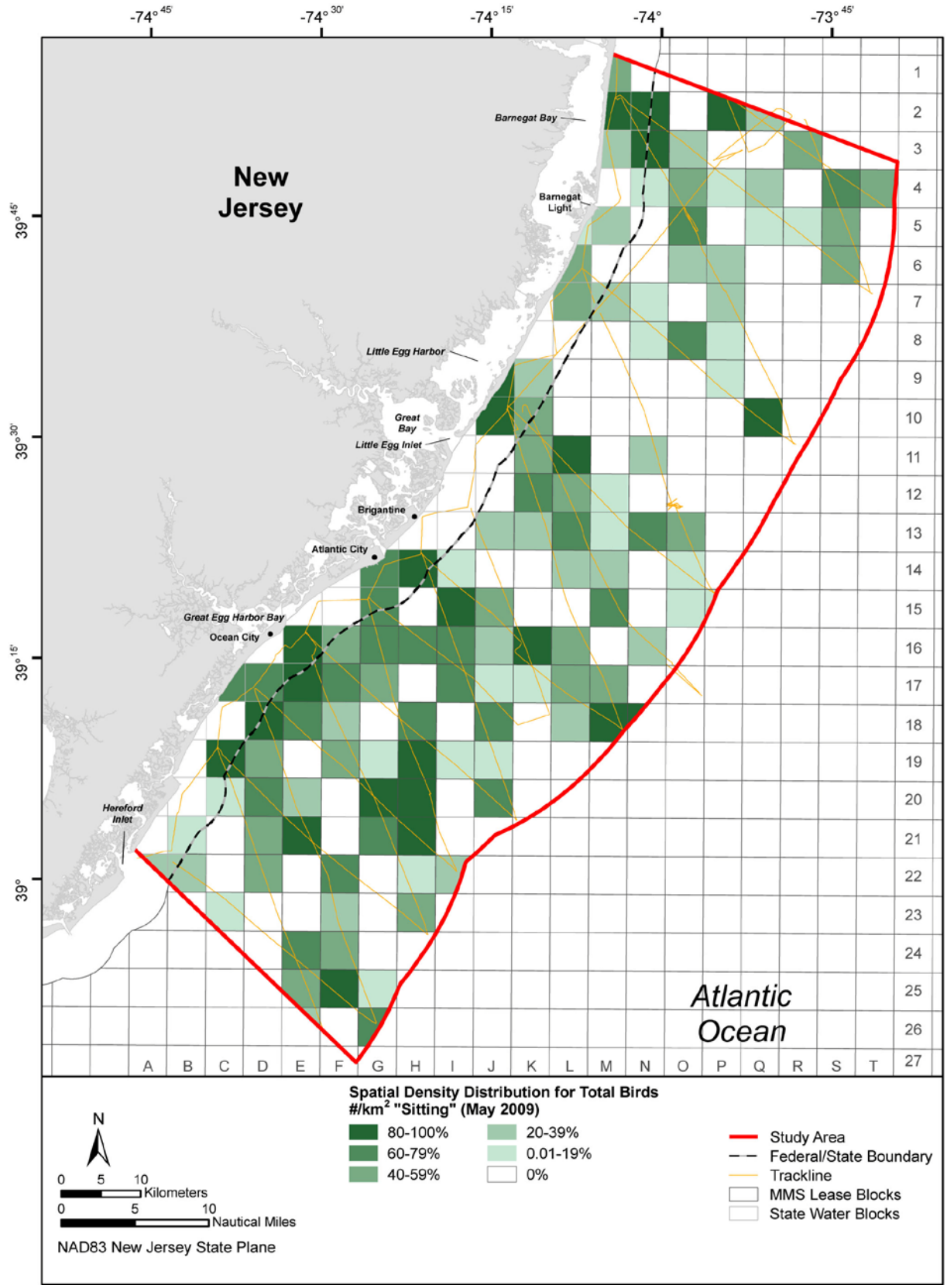

Figure C-205. Percentile abundance of all birds (sitting), May 2009 (n=658).

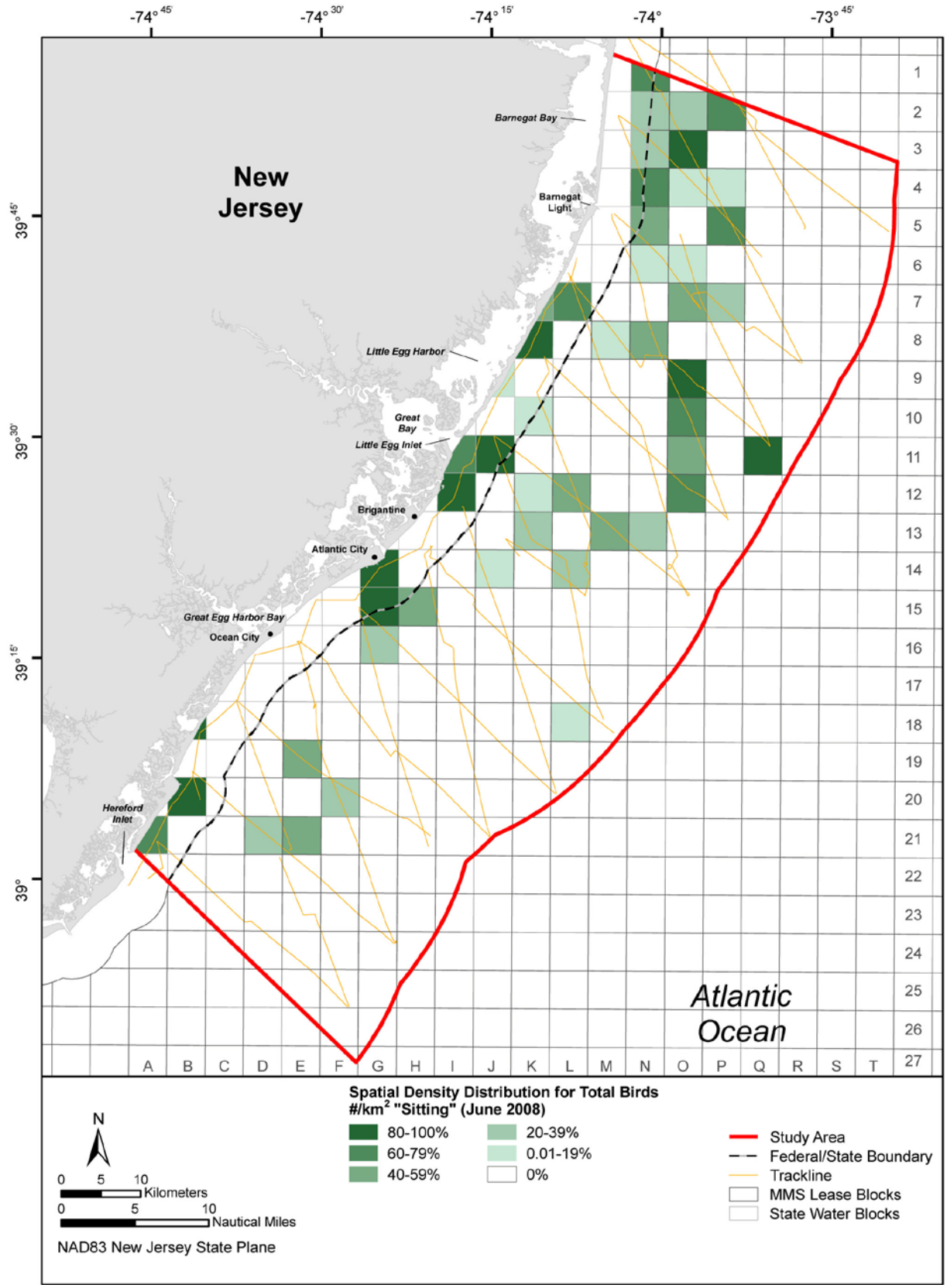

Figure C-206. Percentile abundance of all birds (sitting), June 2008 (n=150).

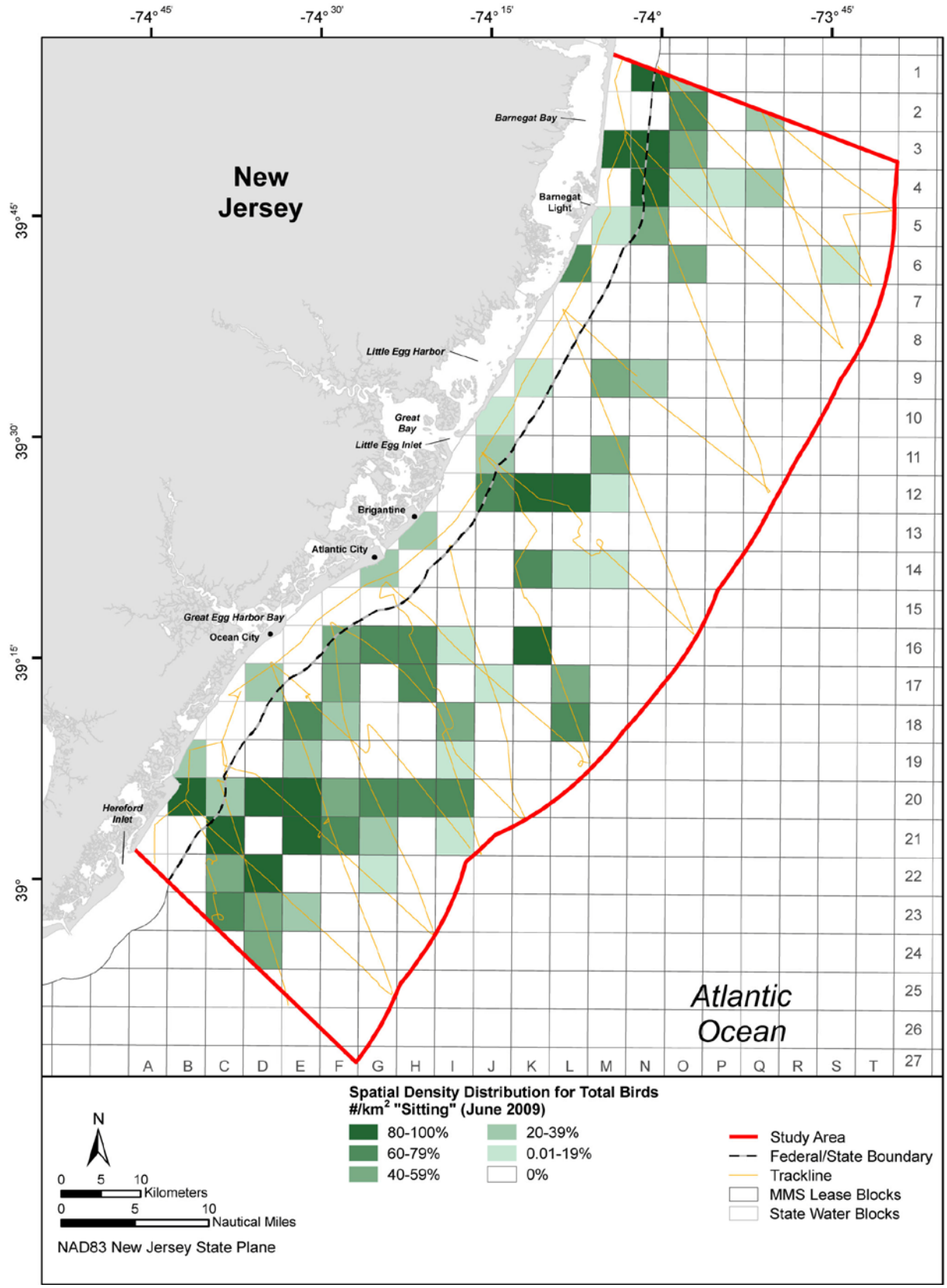

Figure C-207. Percentile abundance of all birds (sitting), June 2009 (n=204).

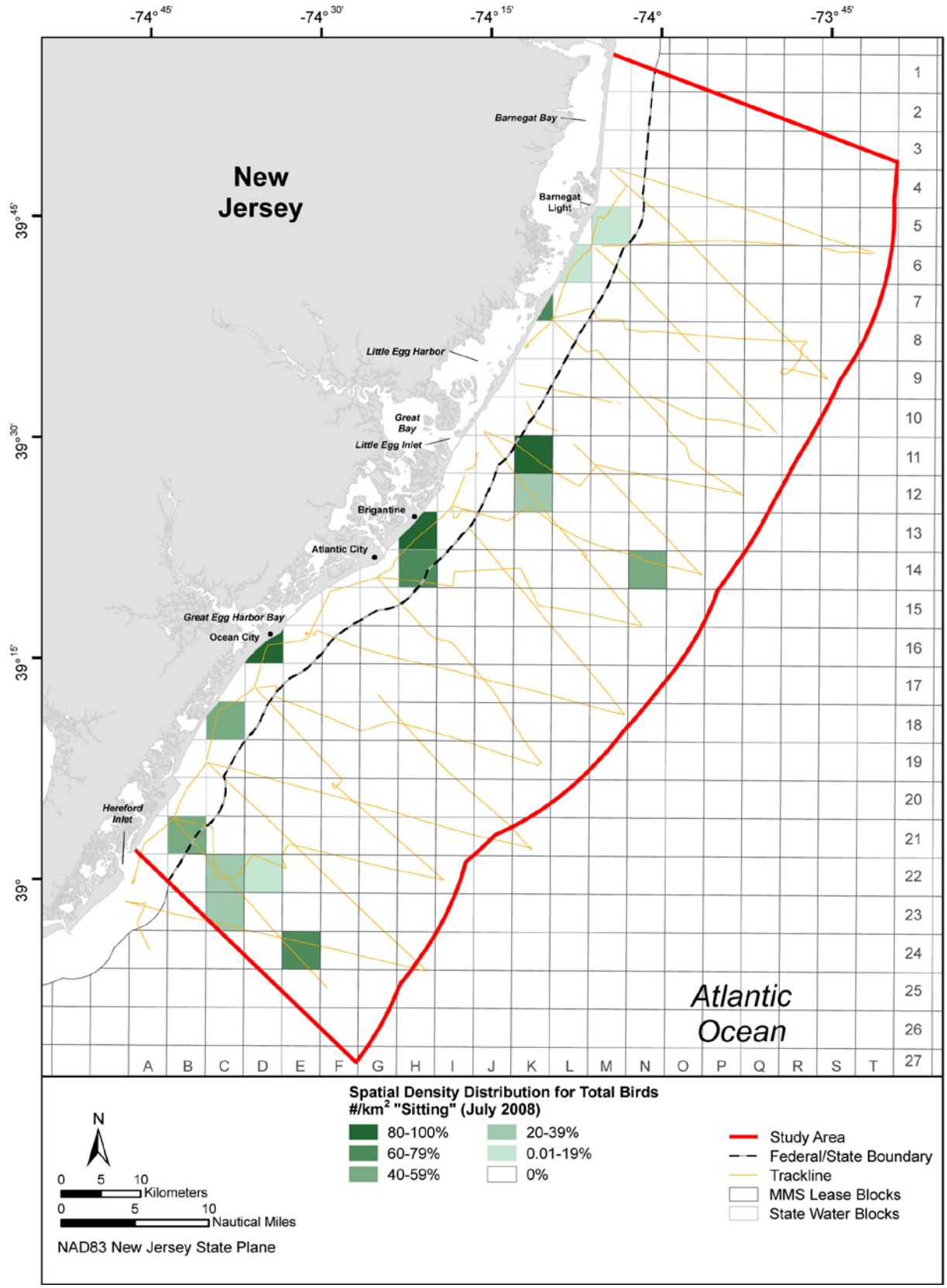

Figure C-208. Percentile abundance of all birds (sitting), July 2008 (n=22).

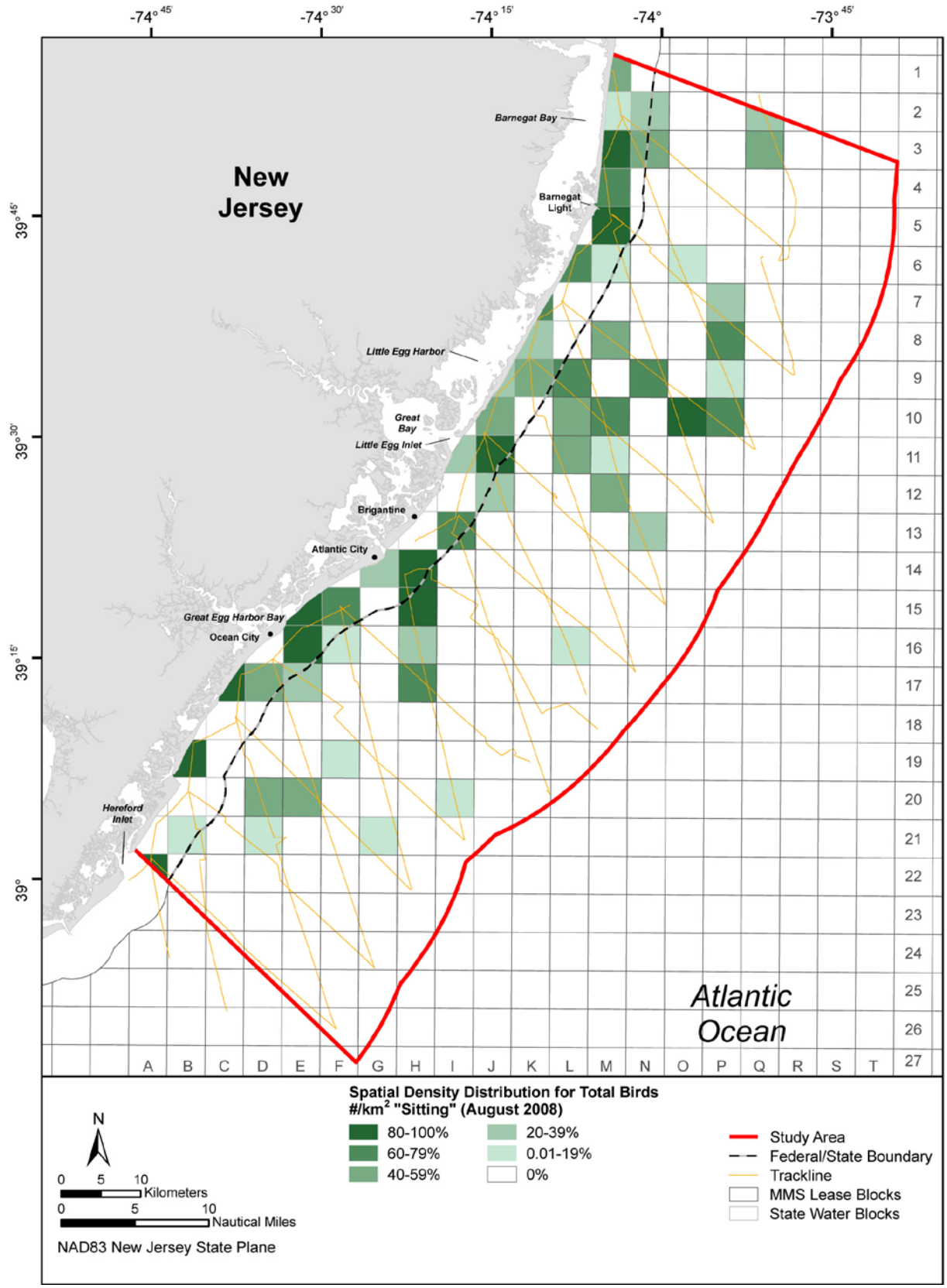

Figure C-209. Percentile abundance of all birds (sitting), August 2008 (n=737).

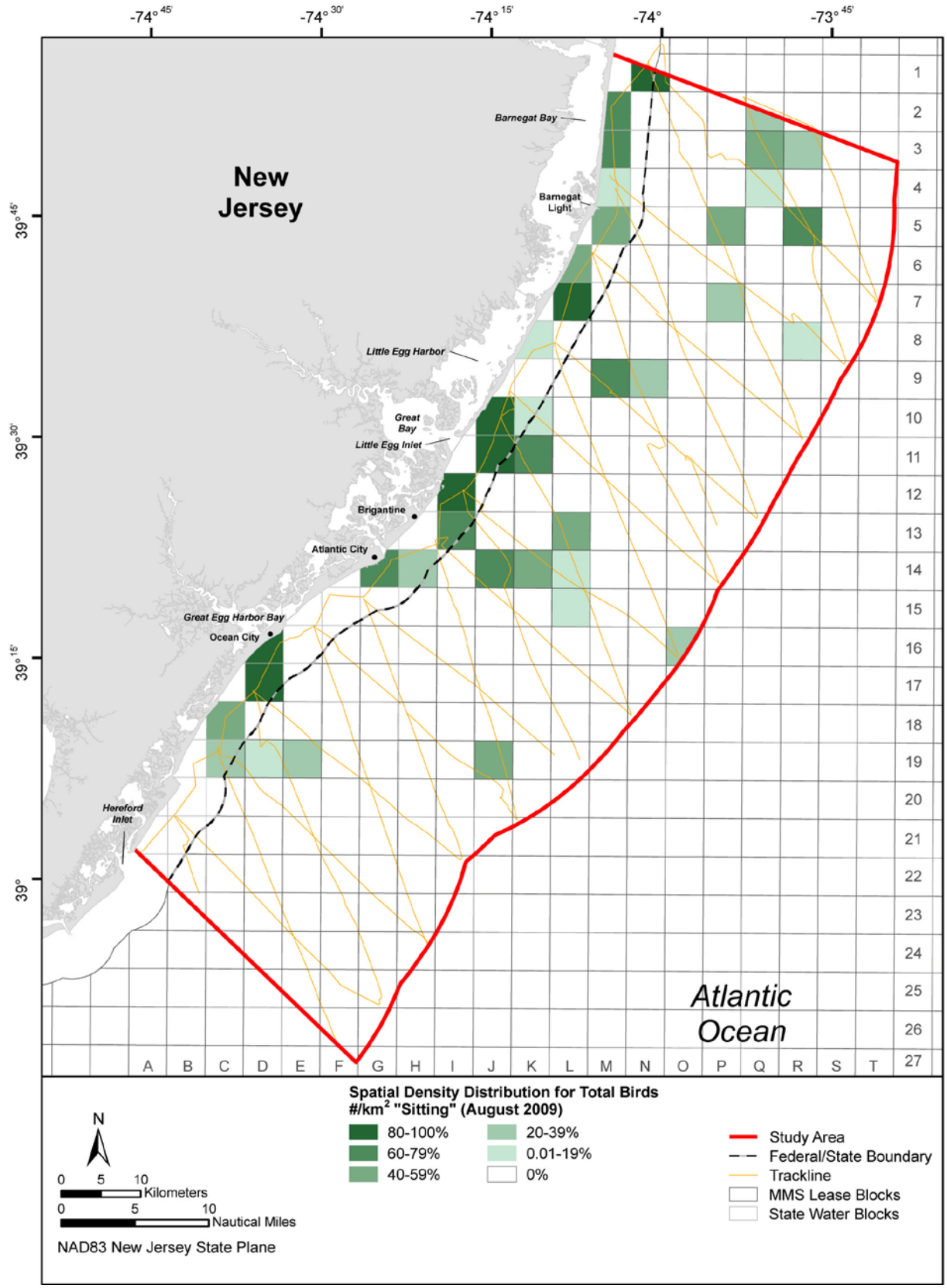

Figure C-210. Percentile abundance of all birds (sitting), August 2009 (n=223).

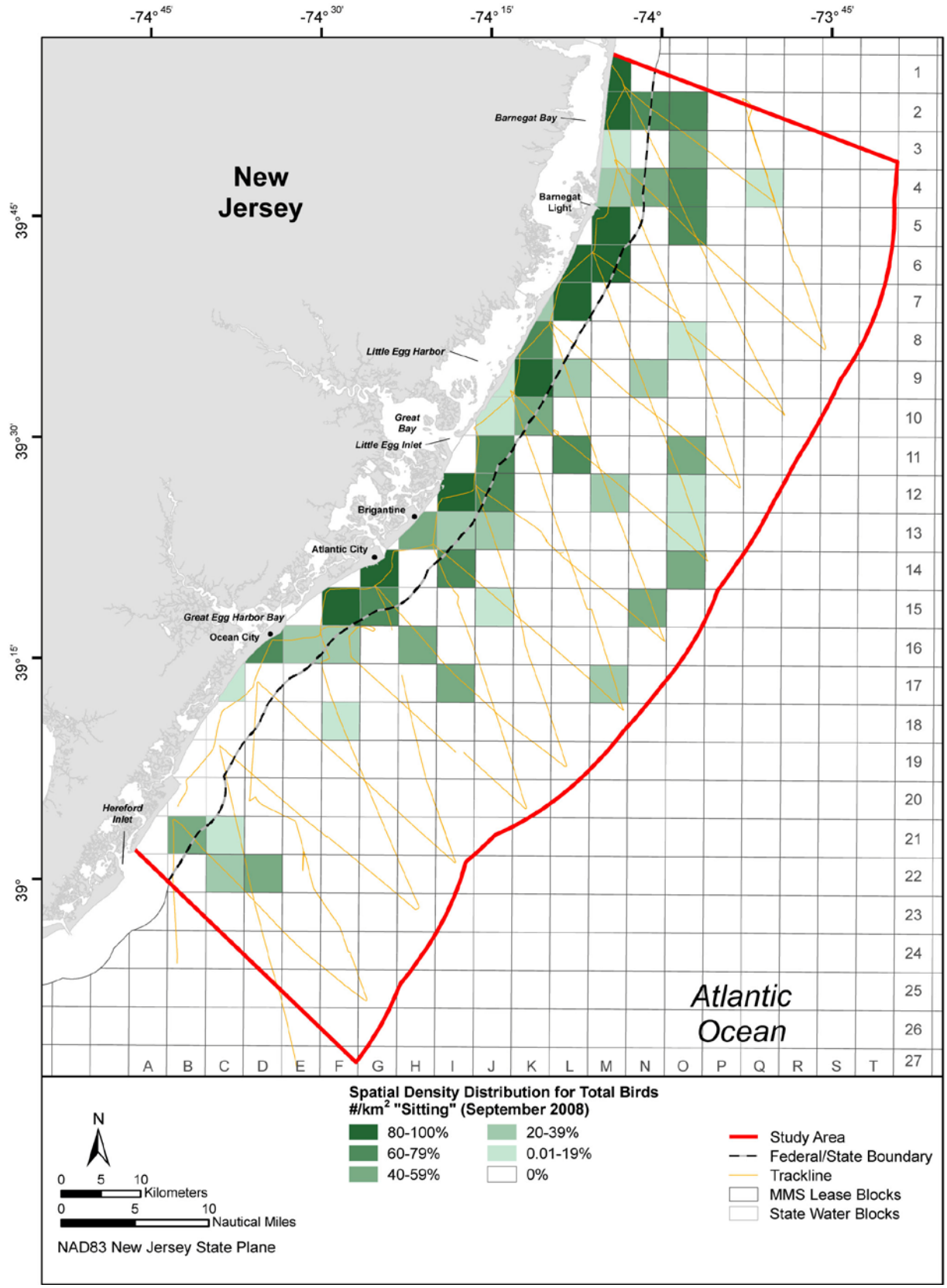

Figure C-211. Percentile abundance of all birds (sitting), September 2008 (n=342).

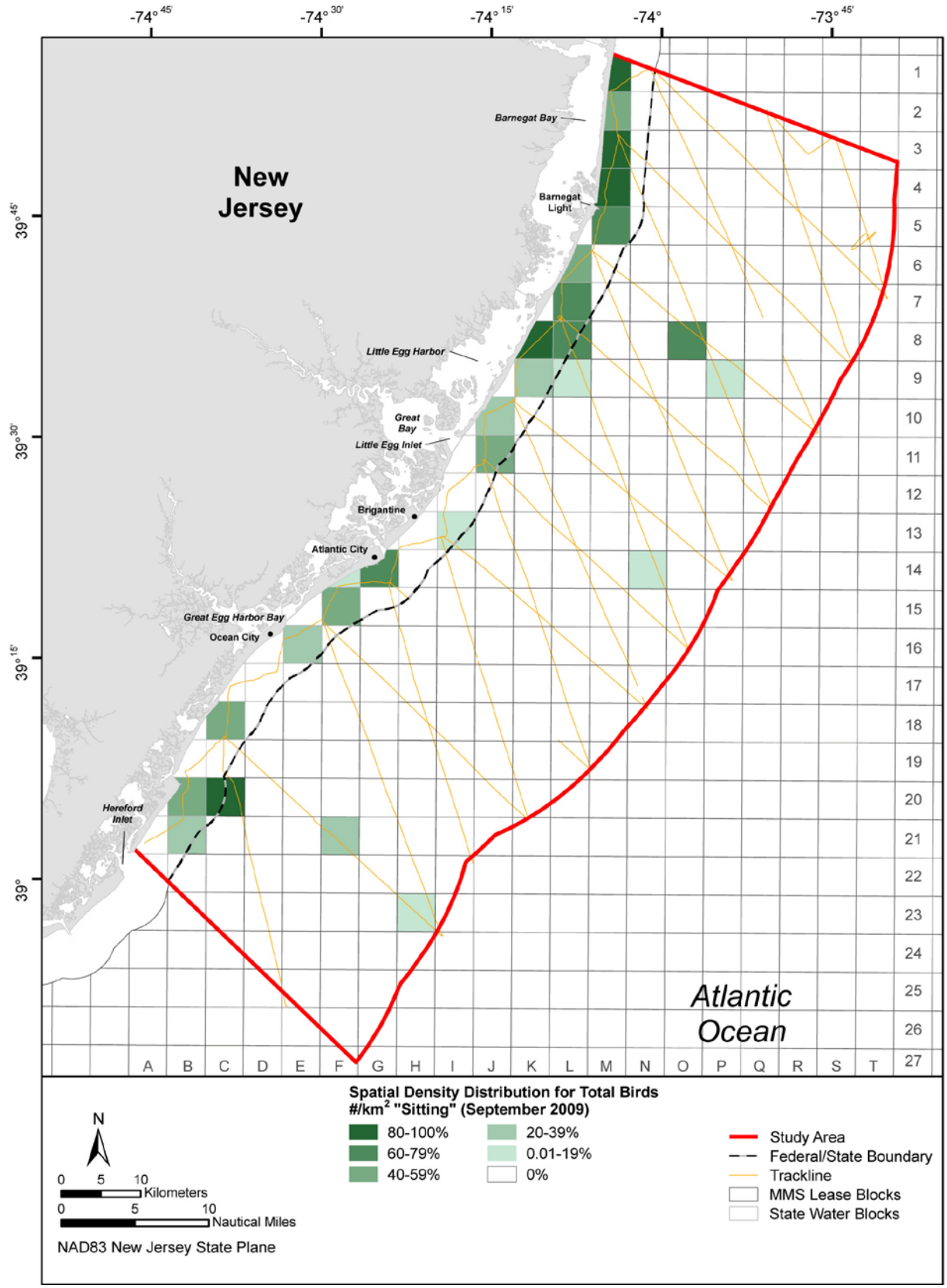

Figure C-212. Percentile abundance of all birds (sitting), September 2009 (n=220).

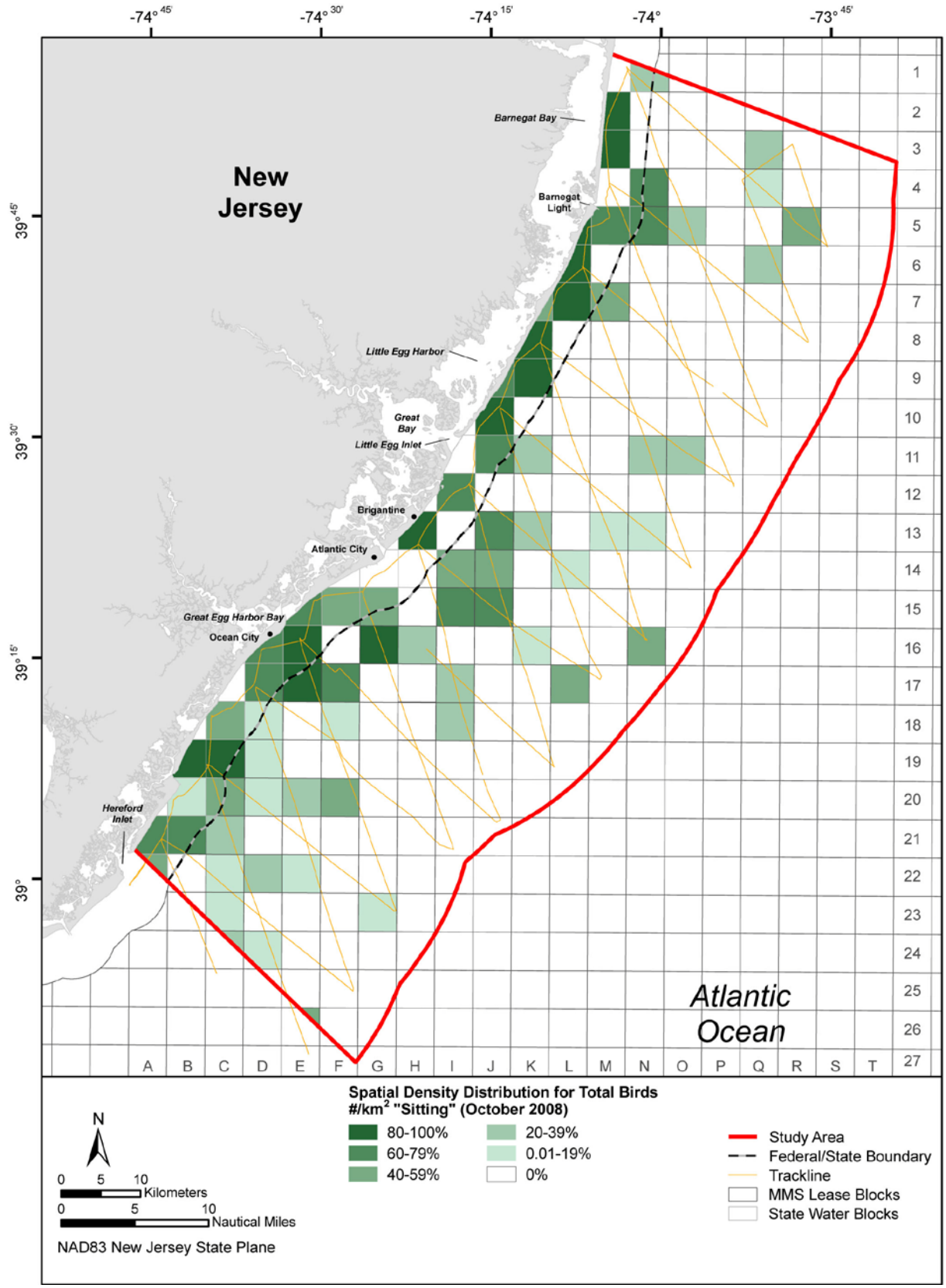

Figure C-213. Percentile abundance of all birds (sitting), October 2008 (n=840).

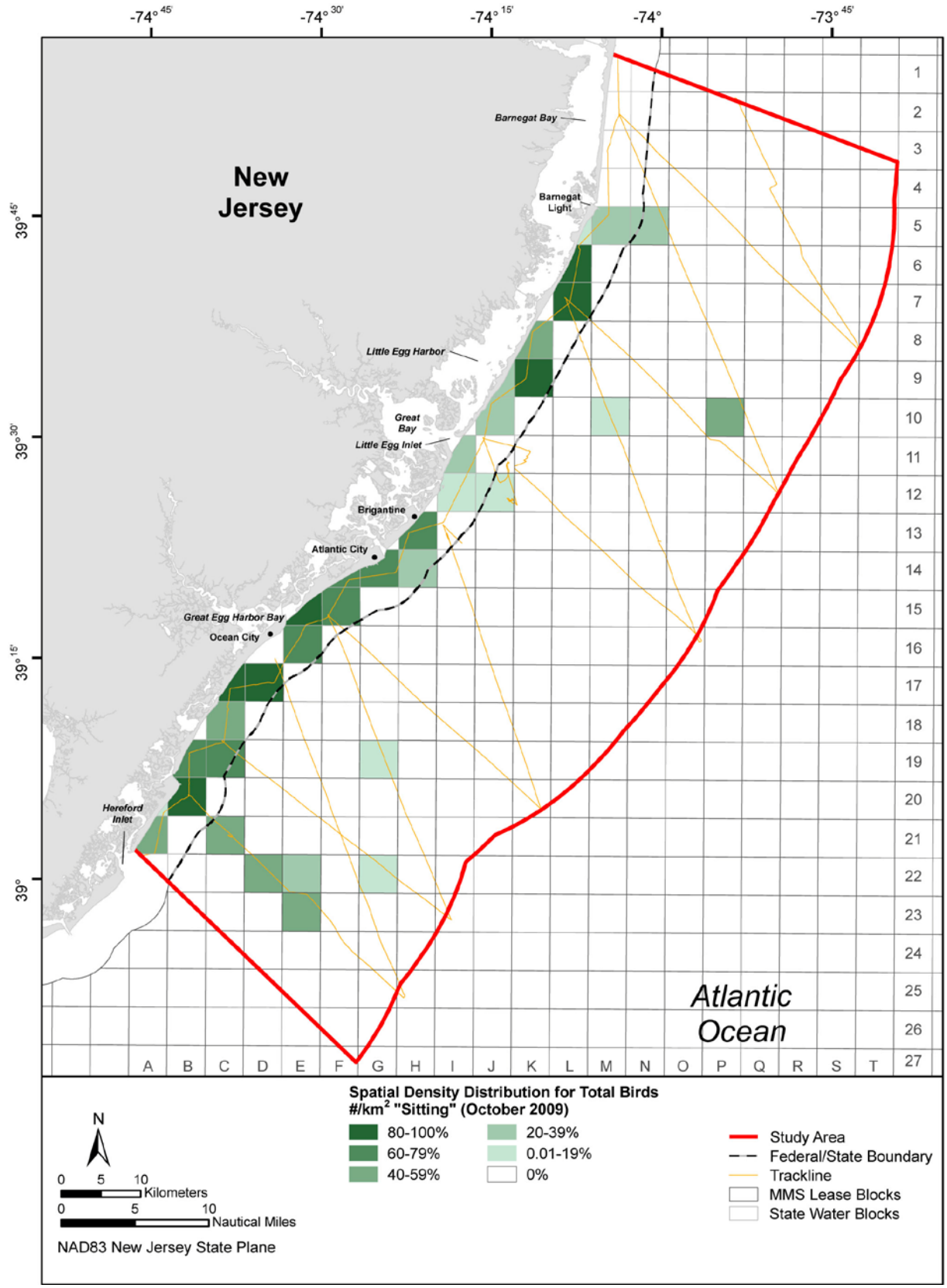

Figure C-214. Percentile abundance of all birds (sitting), October 2009 (n=539).

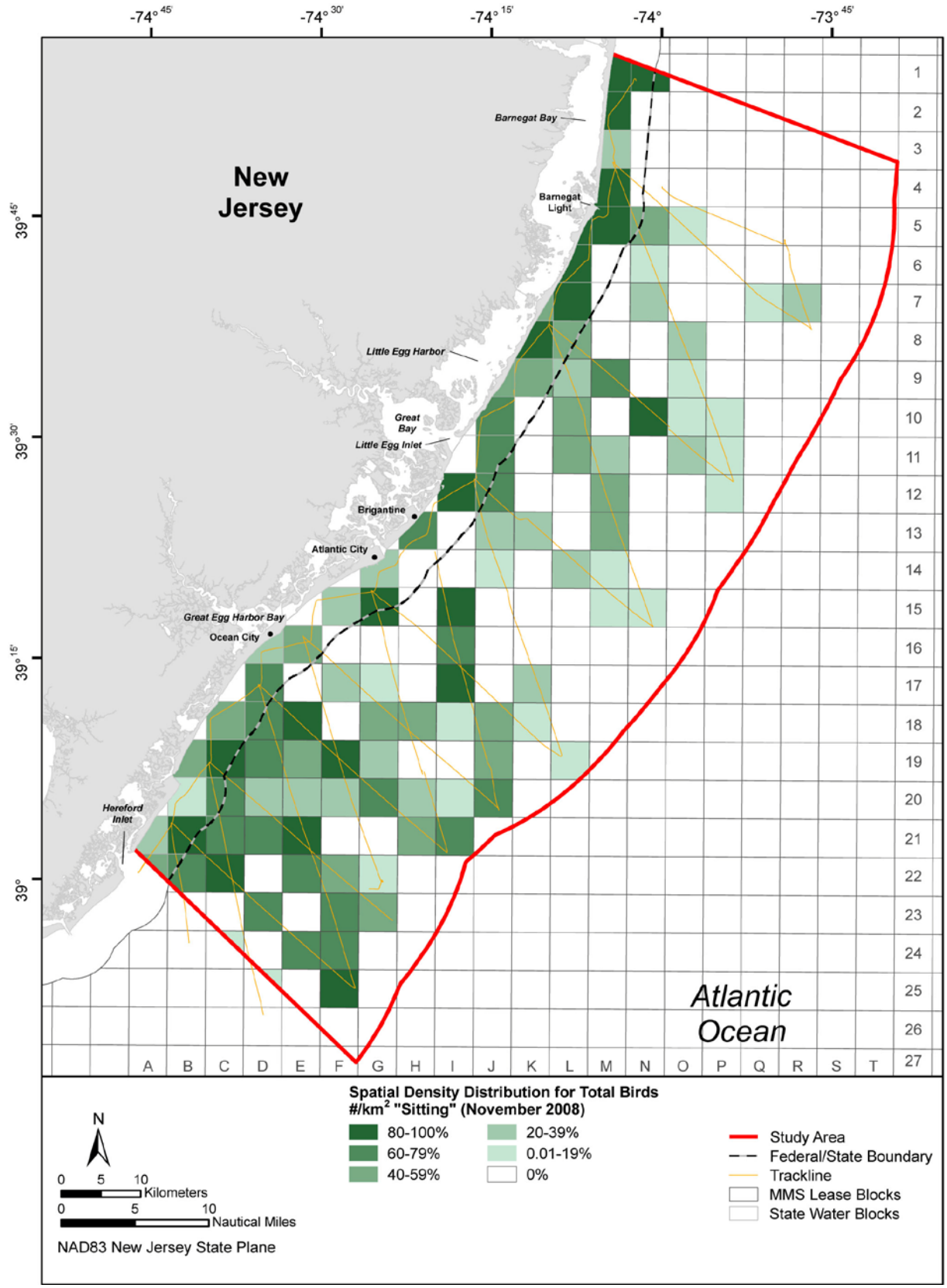

Figure C-215. Percentile abundance of all birds (sitting), November 2008 (n=2,299).

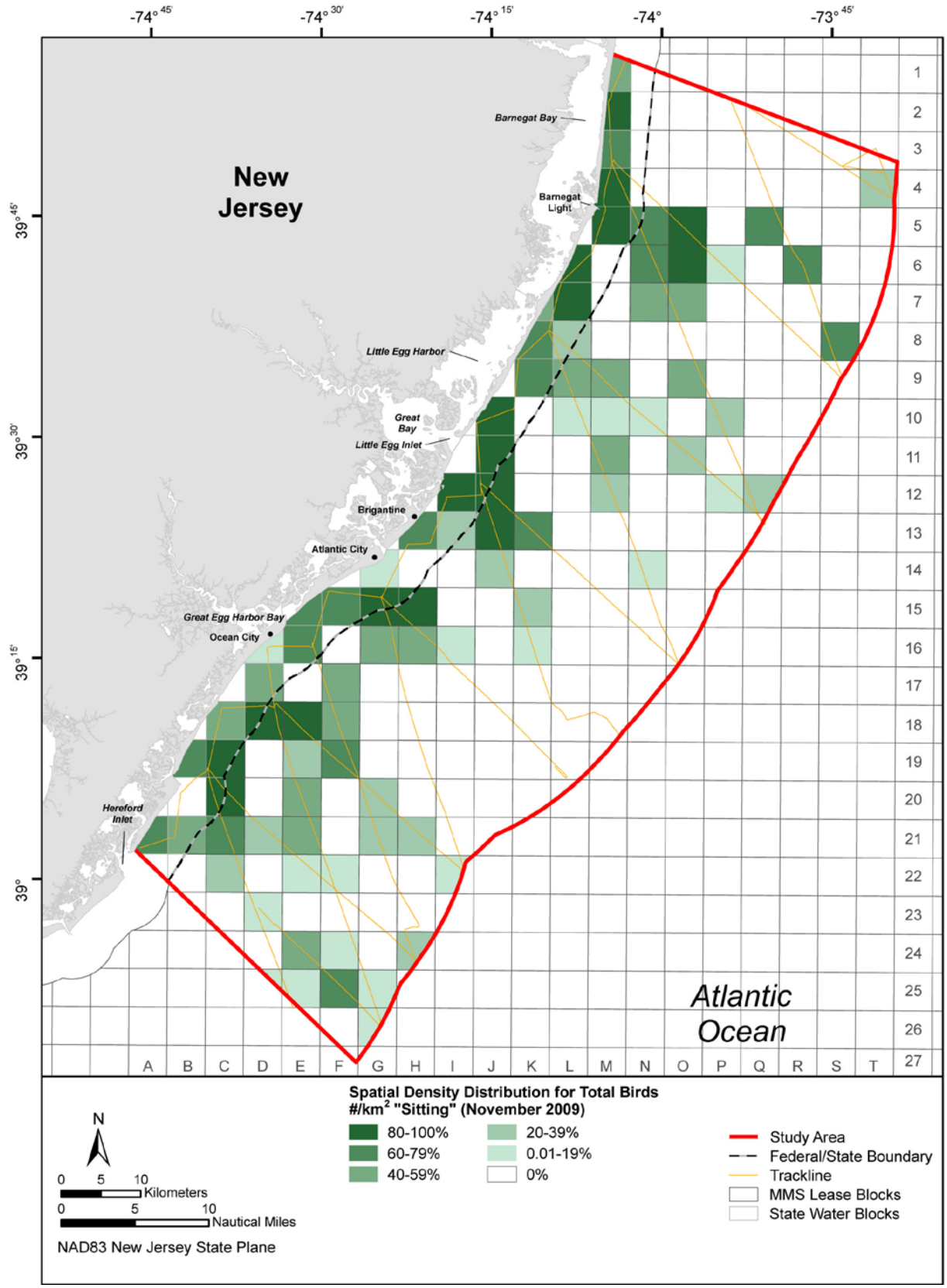

Figure C-216. Percentile abundance of all birds (sitting), November 2009 (n=1,718).

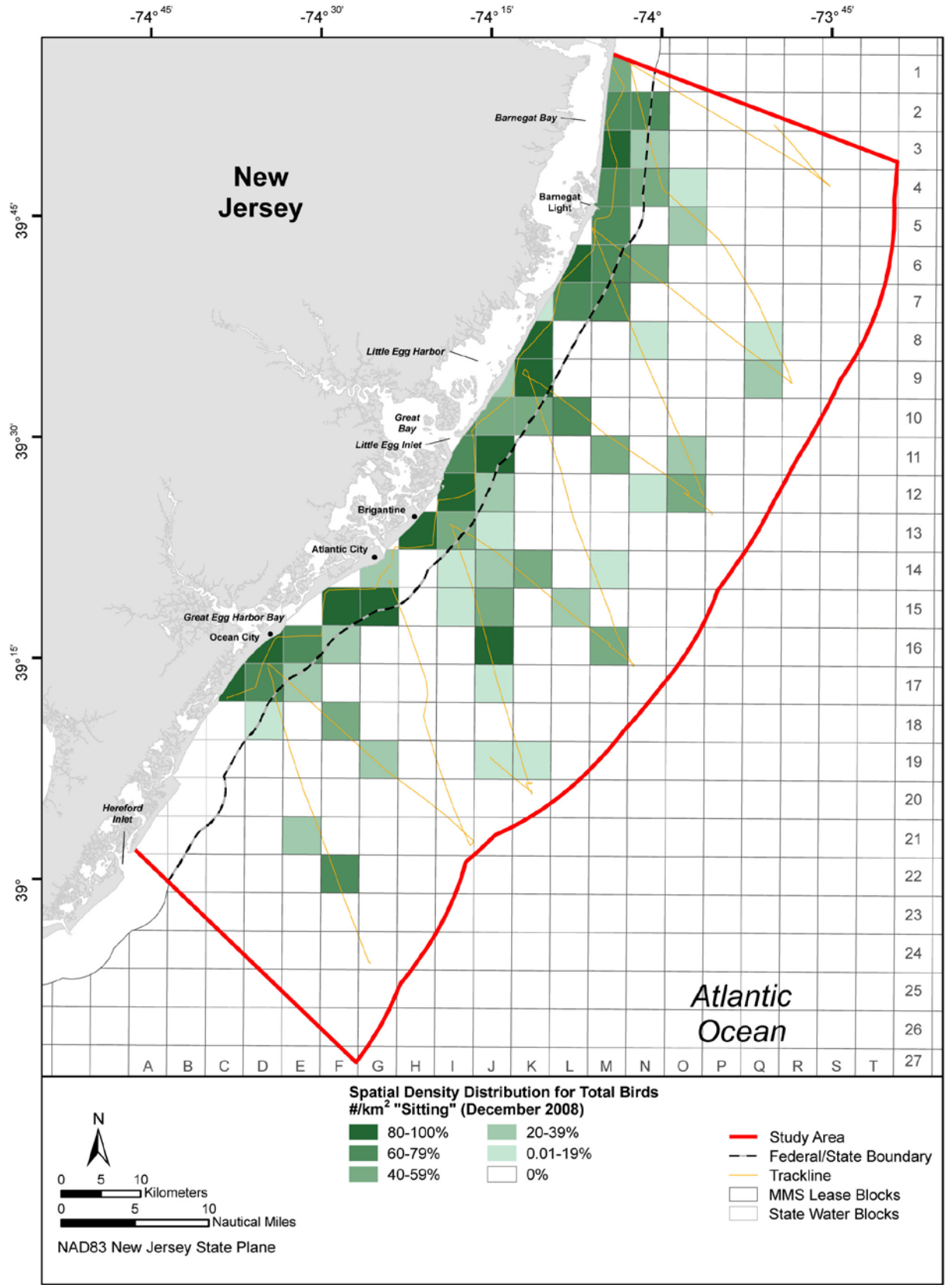

Figure C-217. Percentile abundance of all birds (sitting), December 2008 (n=1,676).

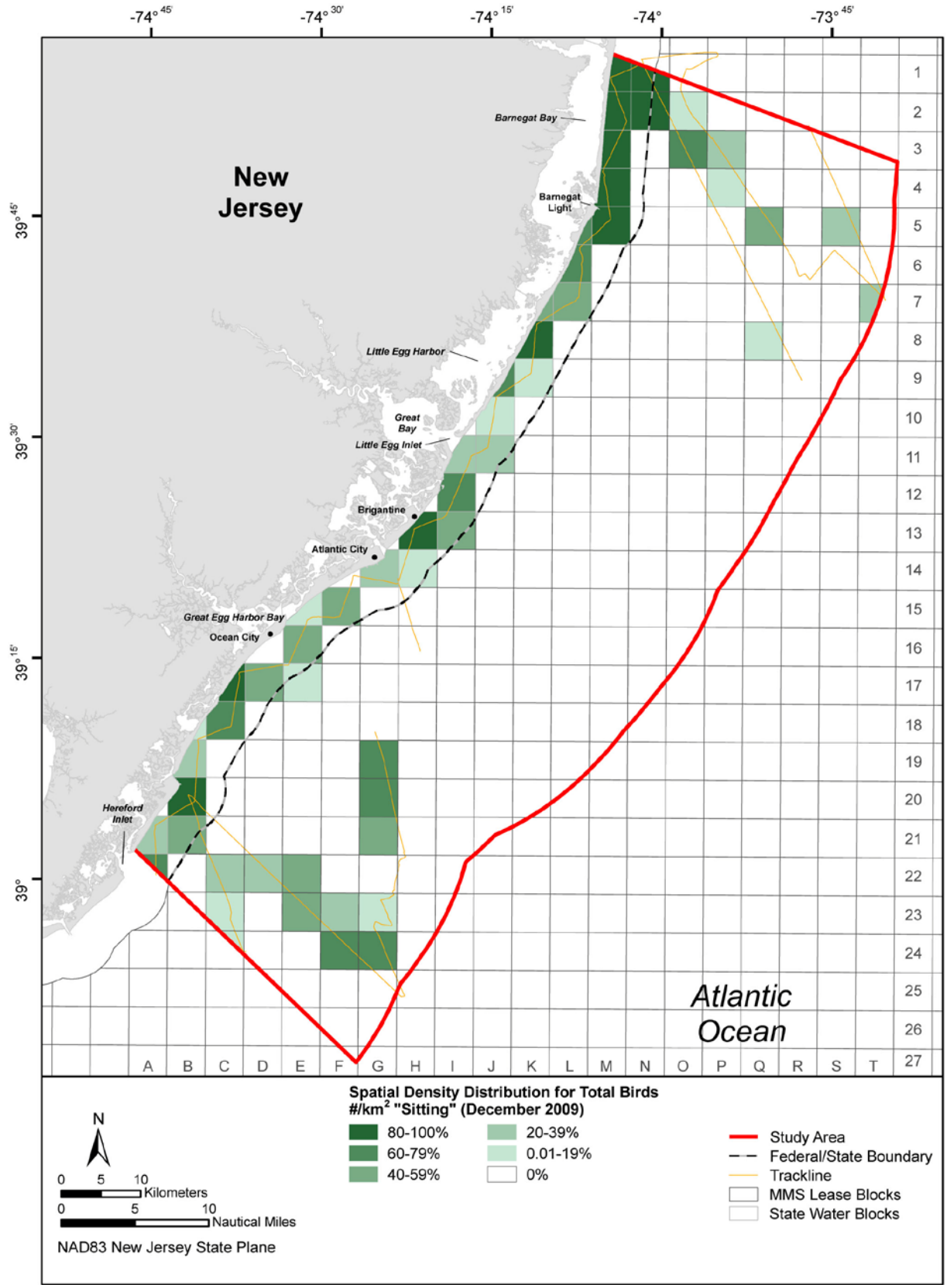

Figure C-218. Percentile abundance of all birds (sitting), December 2009 (n=1,251).

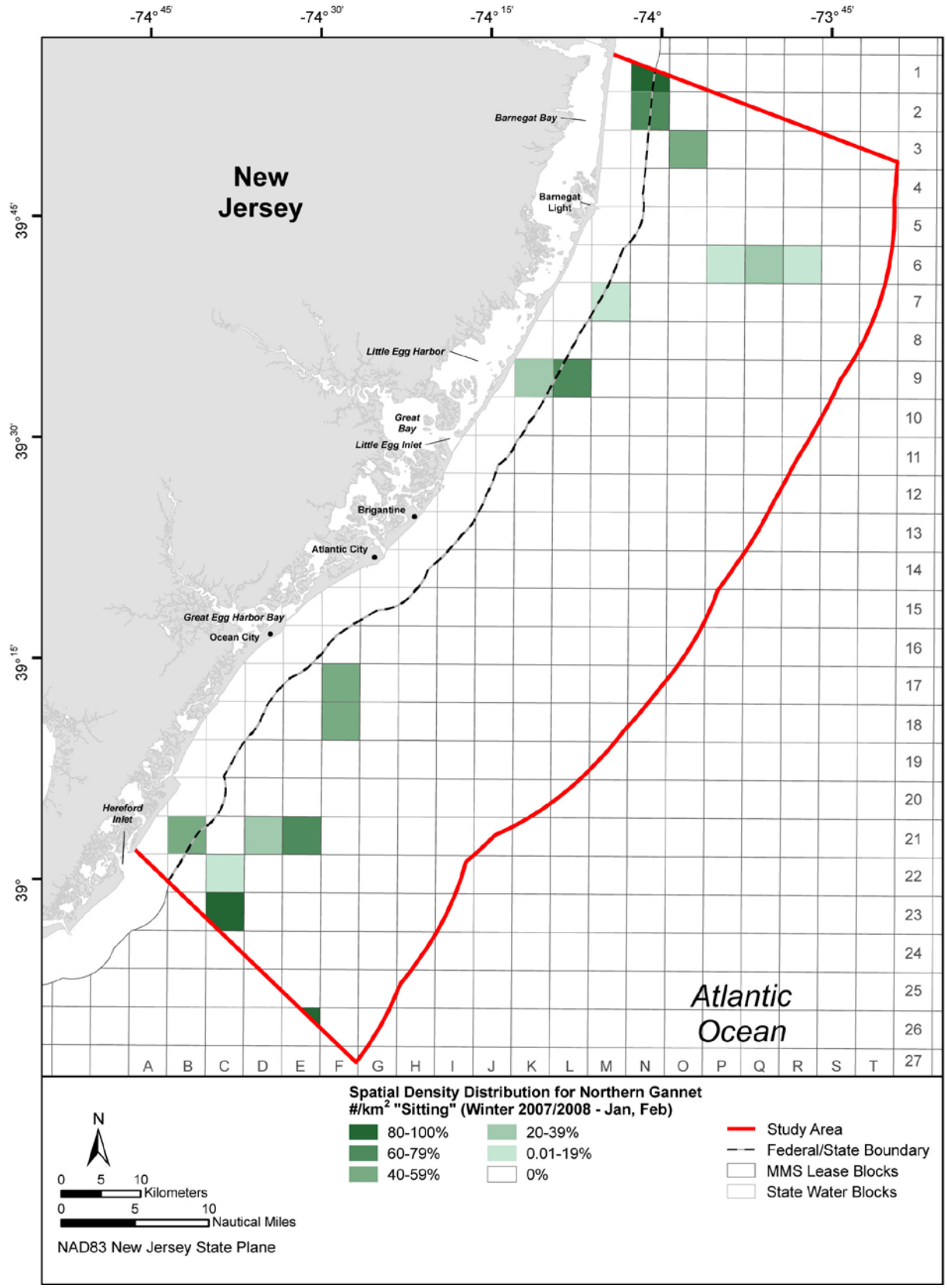

Figure C-219. Percentile abundance of Northern Gannet (sitting), Winter 2008 (January-February 2008) (n=90).

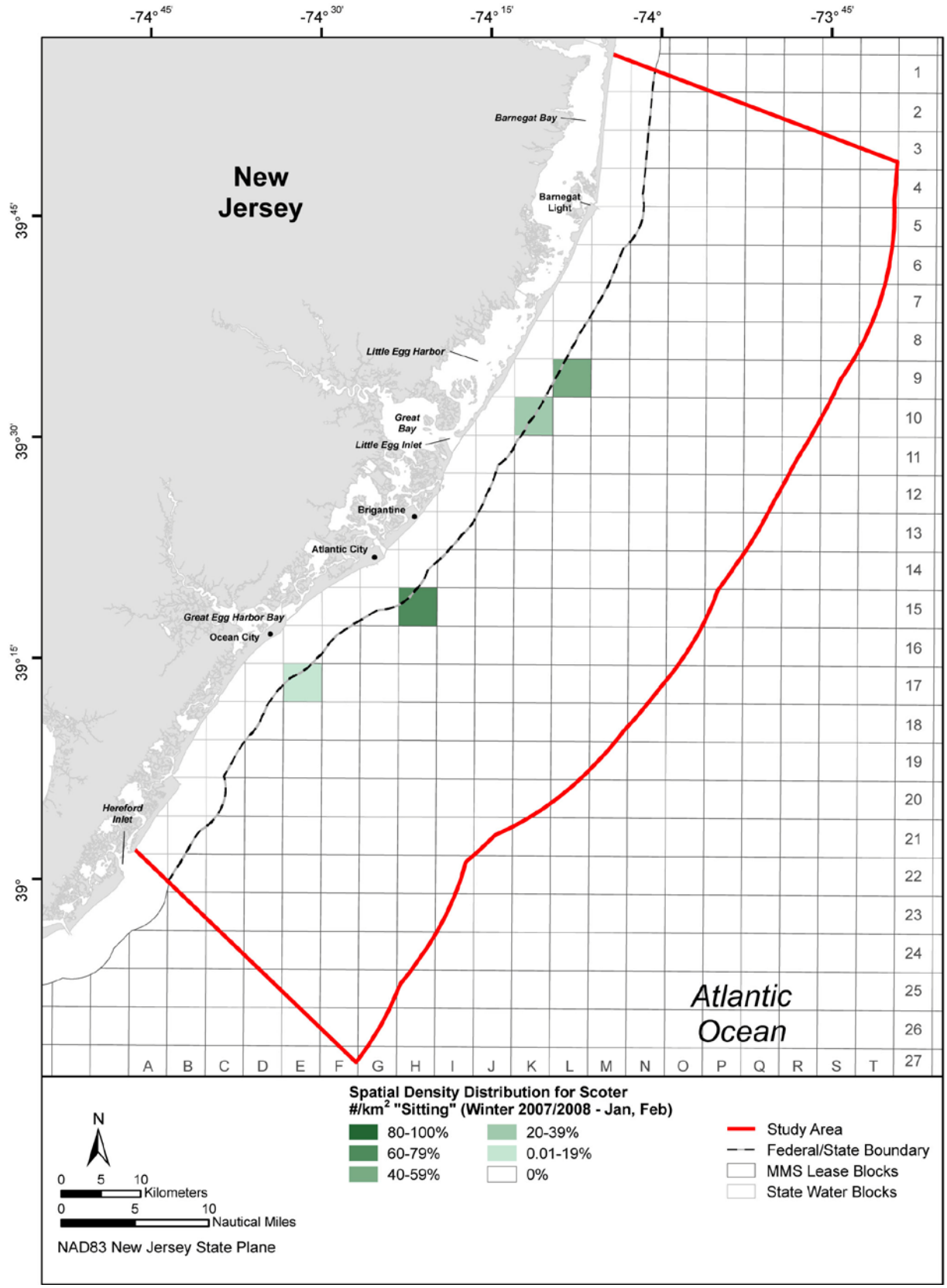

Figure C-220. Percentile abundance of scoters (sitting), Winter 2008 (January-February 2008) (n=48).

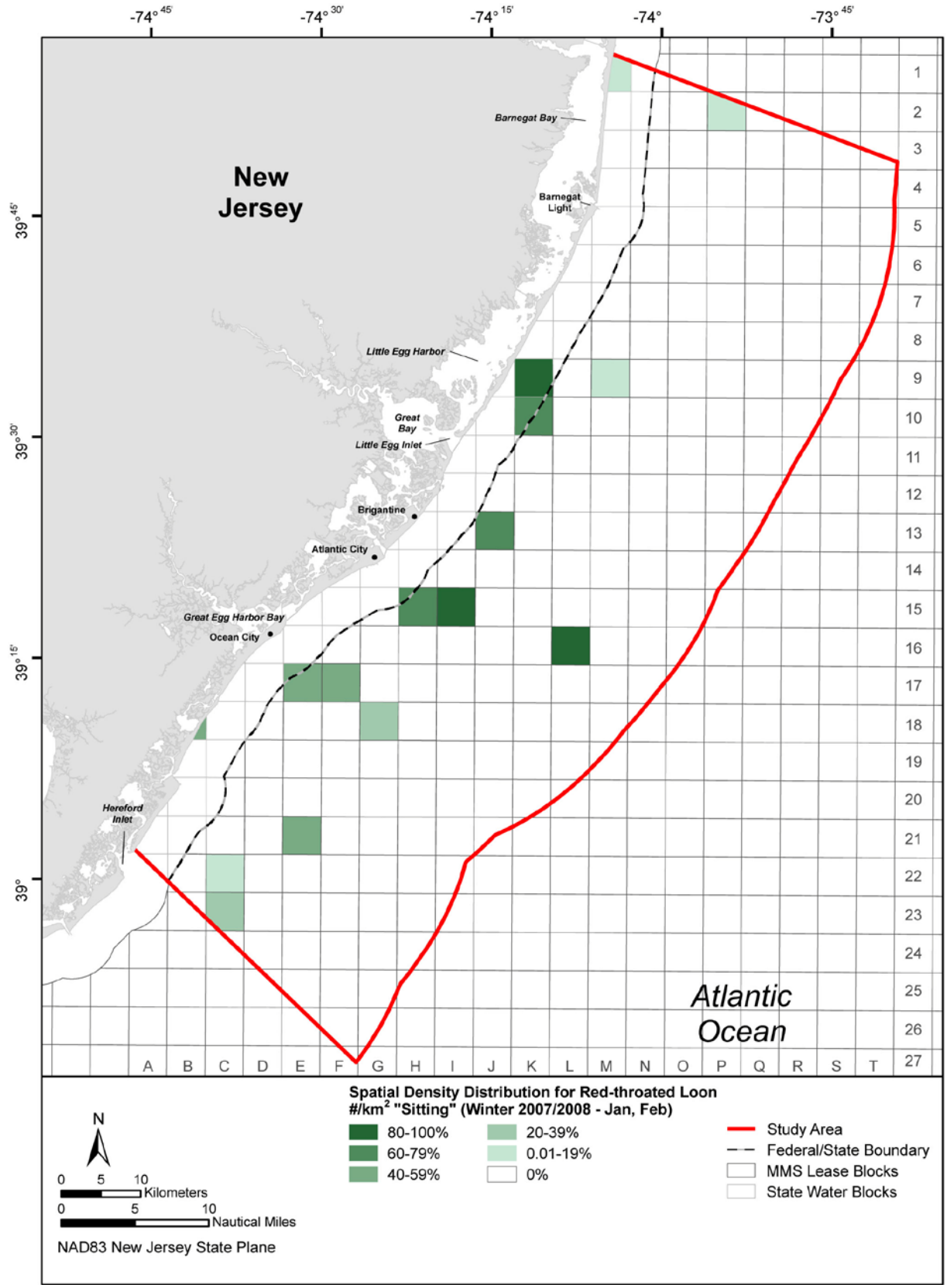

Figure C-221. Percentile abundance of Red-throated Loon (sitting), Winter 2008 (January-February 2008) (n=30).

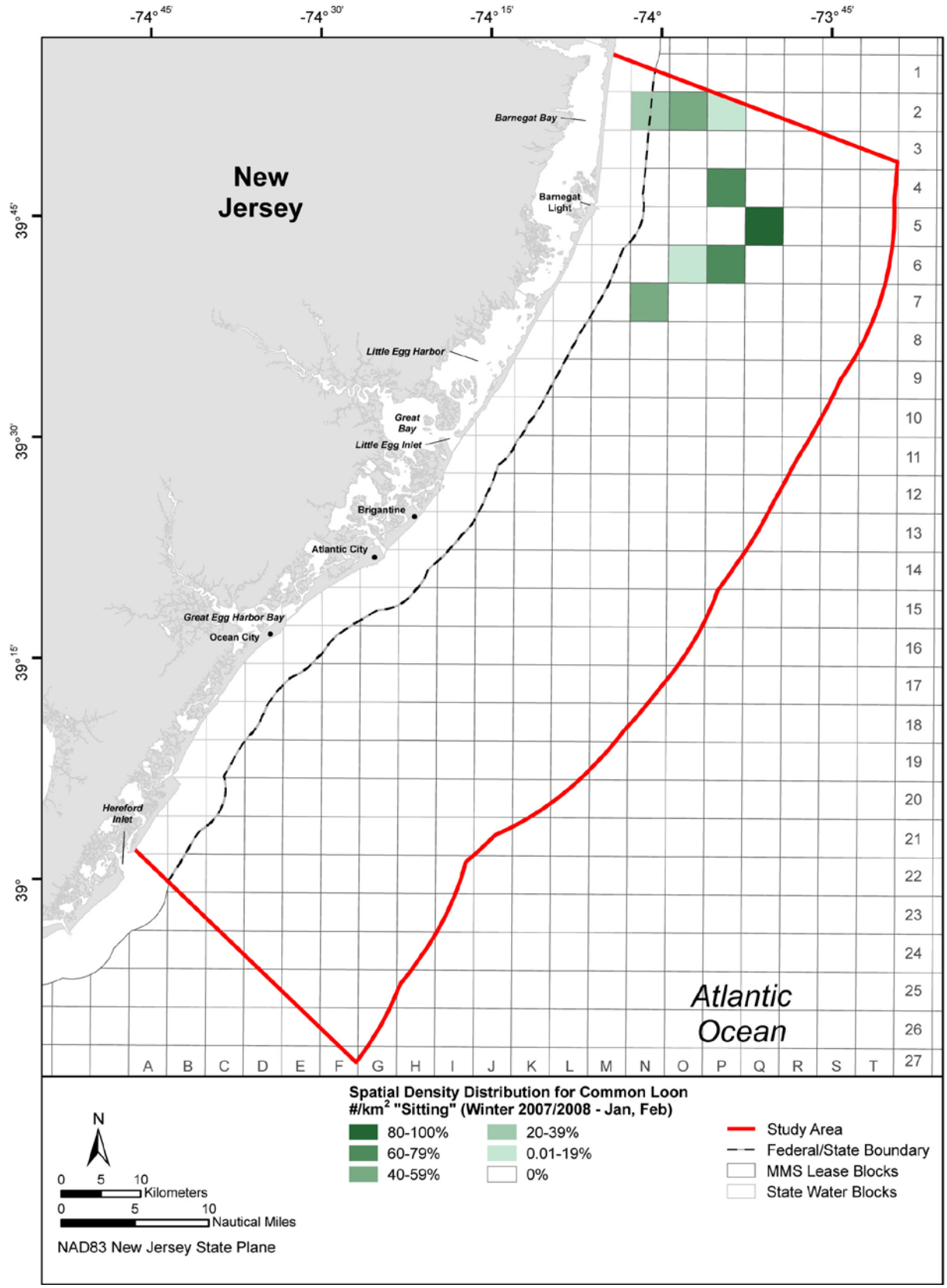

Figure C-222. Percentile abundance of Common Loon (sitting), Winter 2008 (January-February 2008) (n=19).

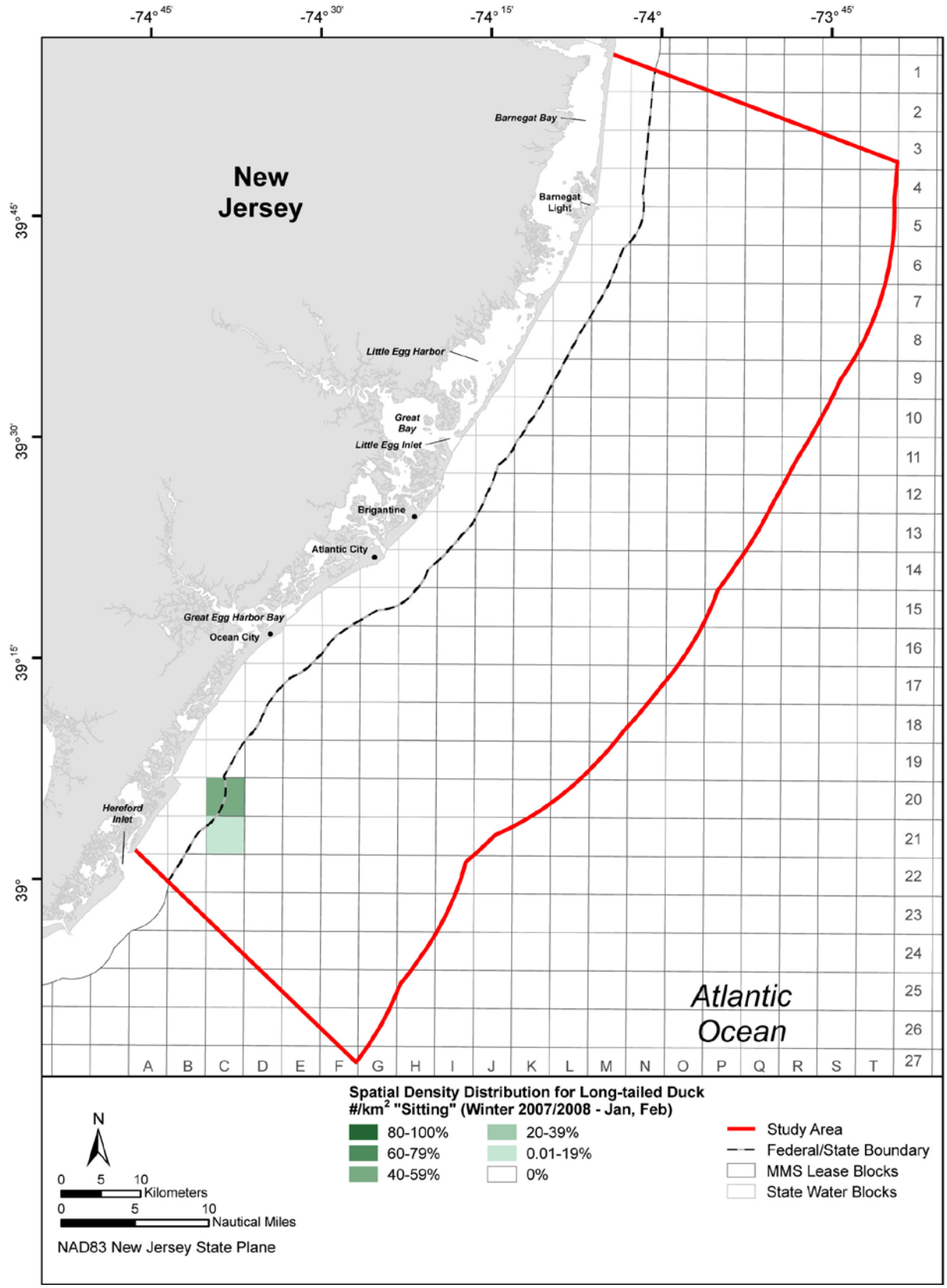

Figure C-223. Percentile abundance of Long-tailed Duck (sitting), Winter 2008 (January-February 2008) (n=10).

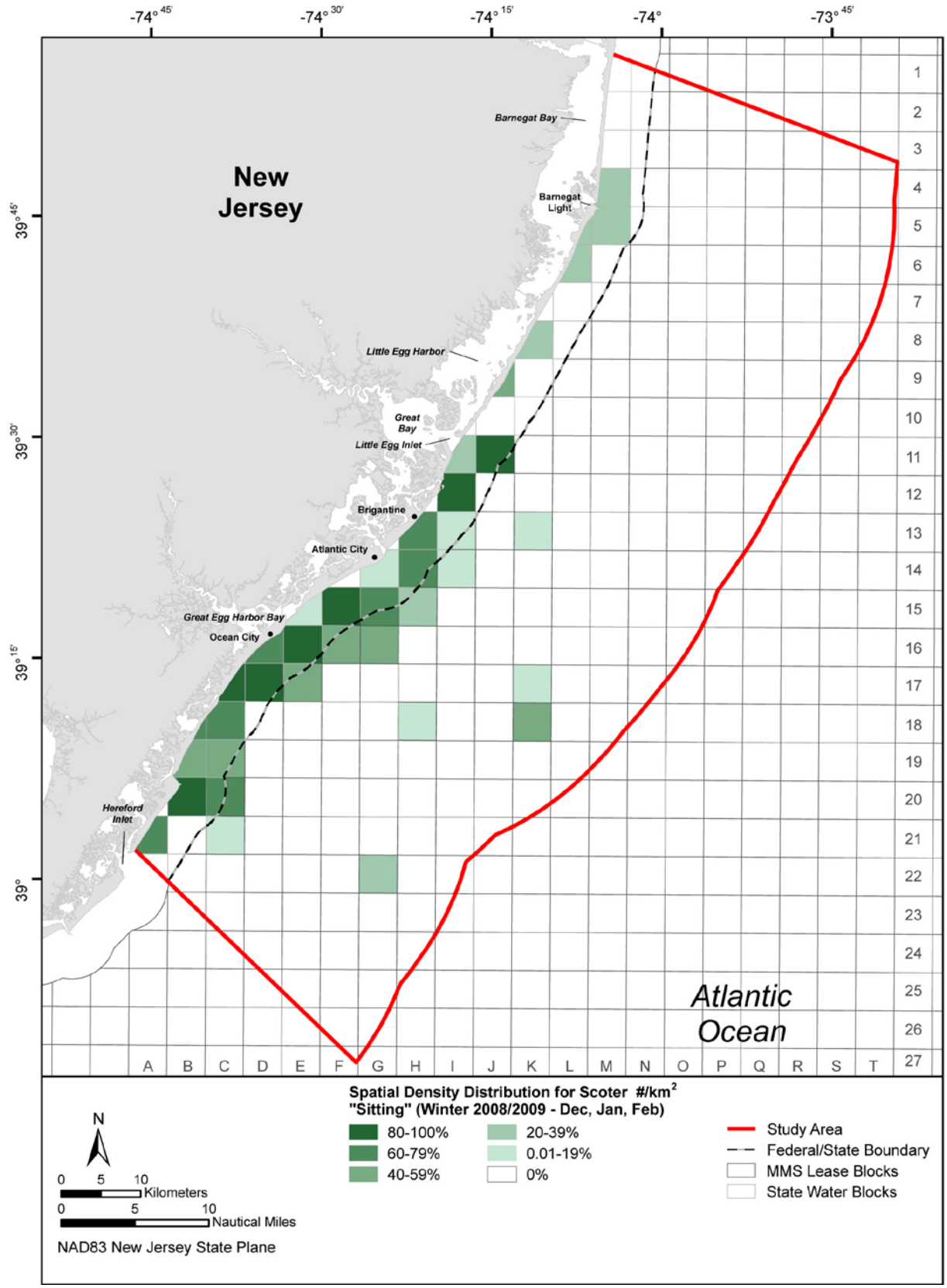

Figure C-224. Percentile abundance of scoters (sitting), Winter 2009 (December 2008-February 2009) (n=3,858).

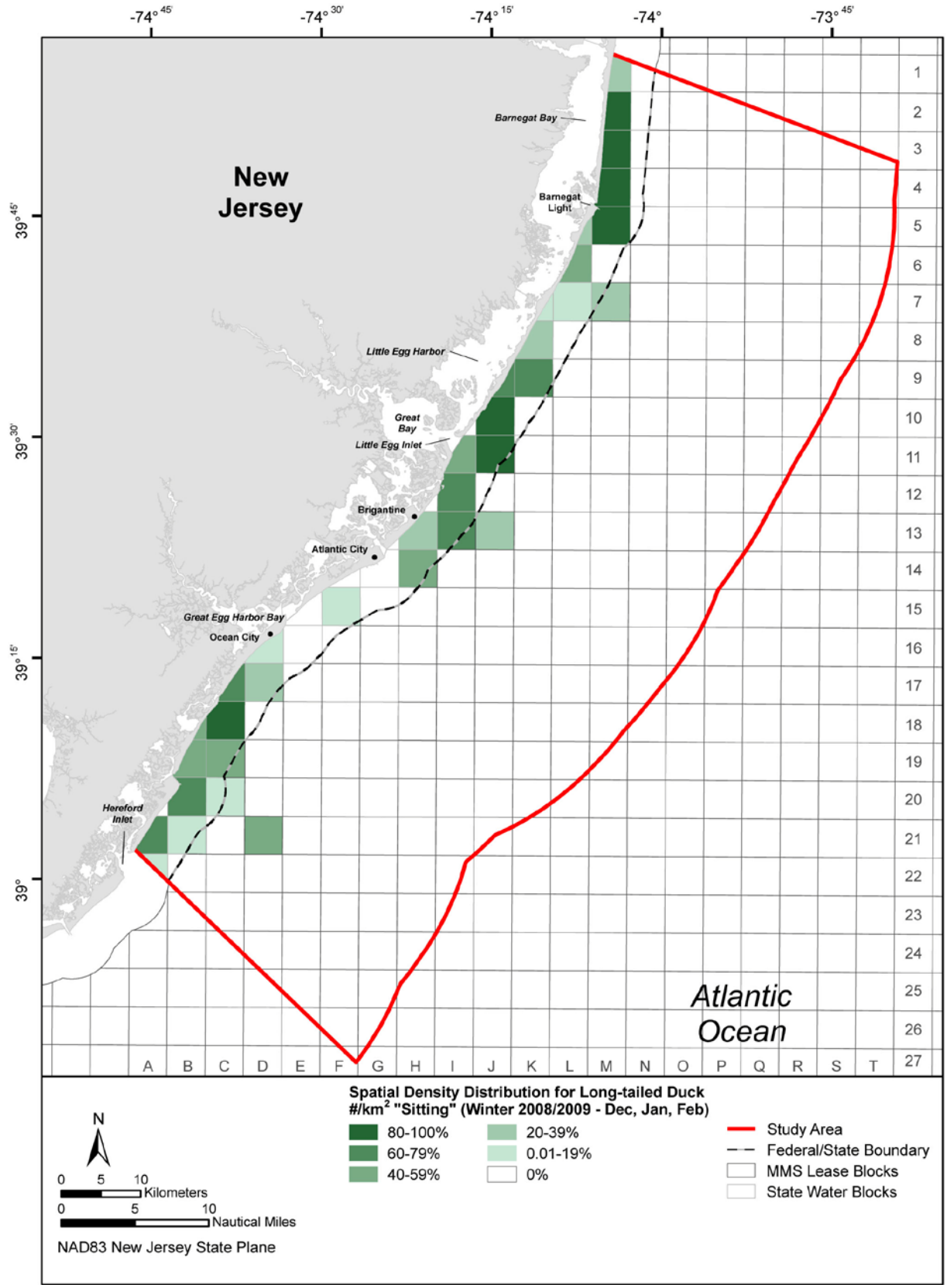

Figure C-225. Percentile abundance of Long-tailed Duck (sitting), Winter 2009 (December 2008-February 2009) (n=2,250).

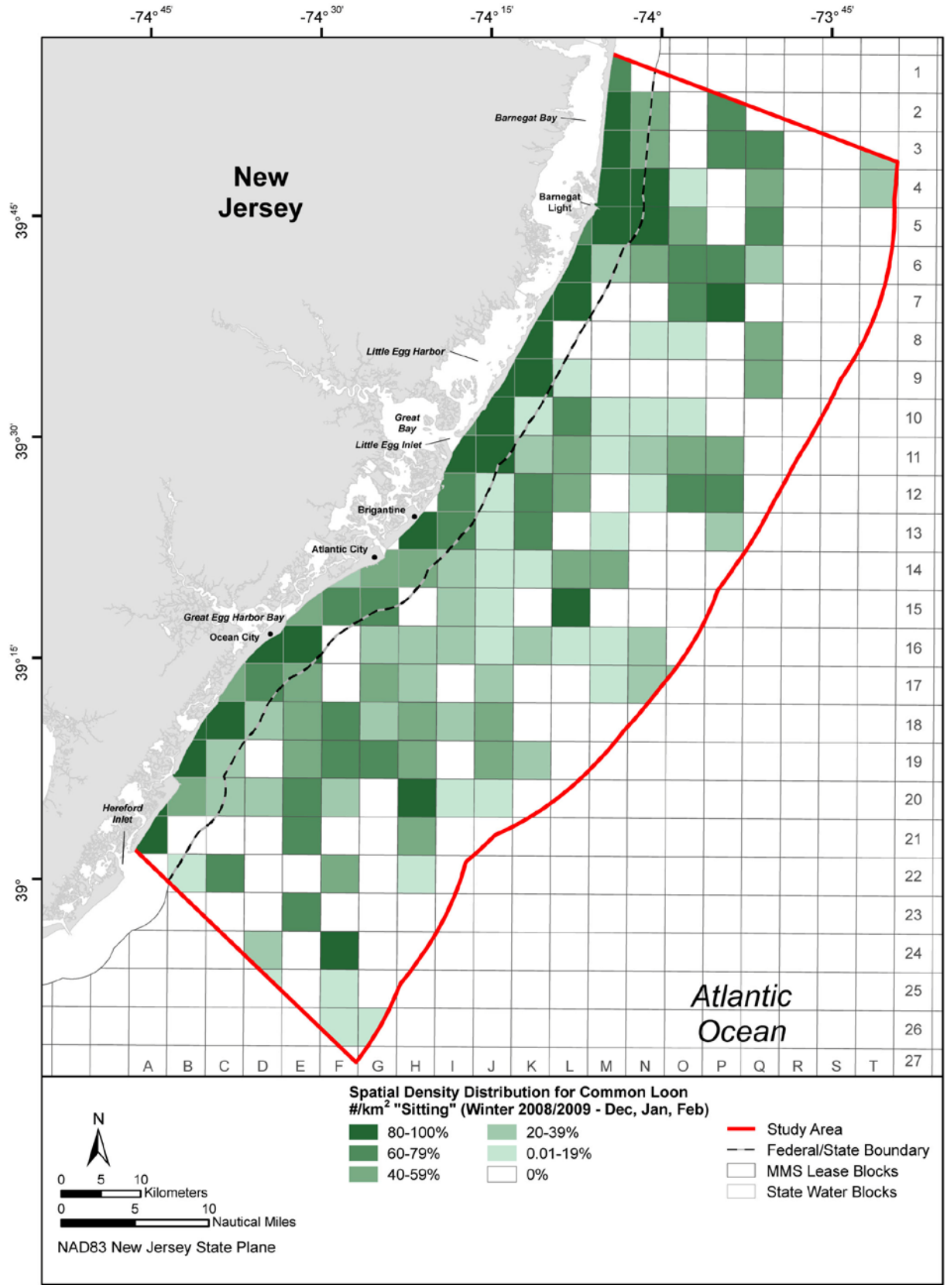

Figure C-226. Percentile abundance of Common Loon (sitting), Winter 2009 (December 2008-February 2009) (n=1,119).

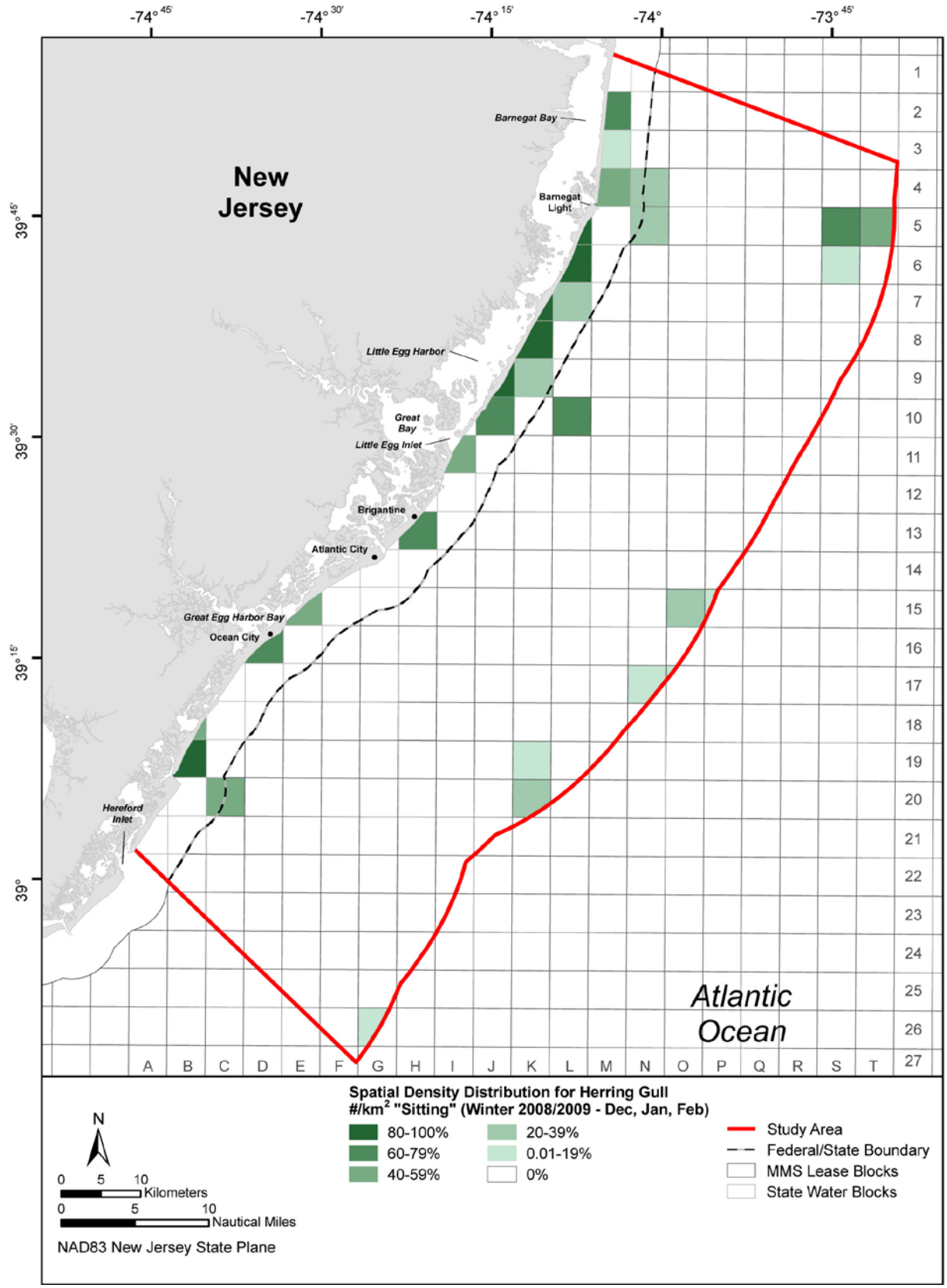

Figure C-227. Percentile abundance of Herring Gull (sitting), Winter 2009 (December 2008-February 2009) (n=441).

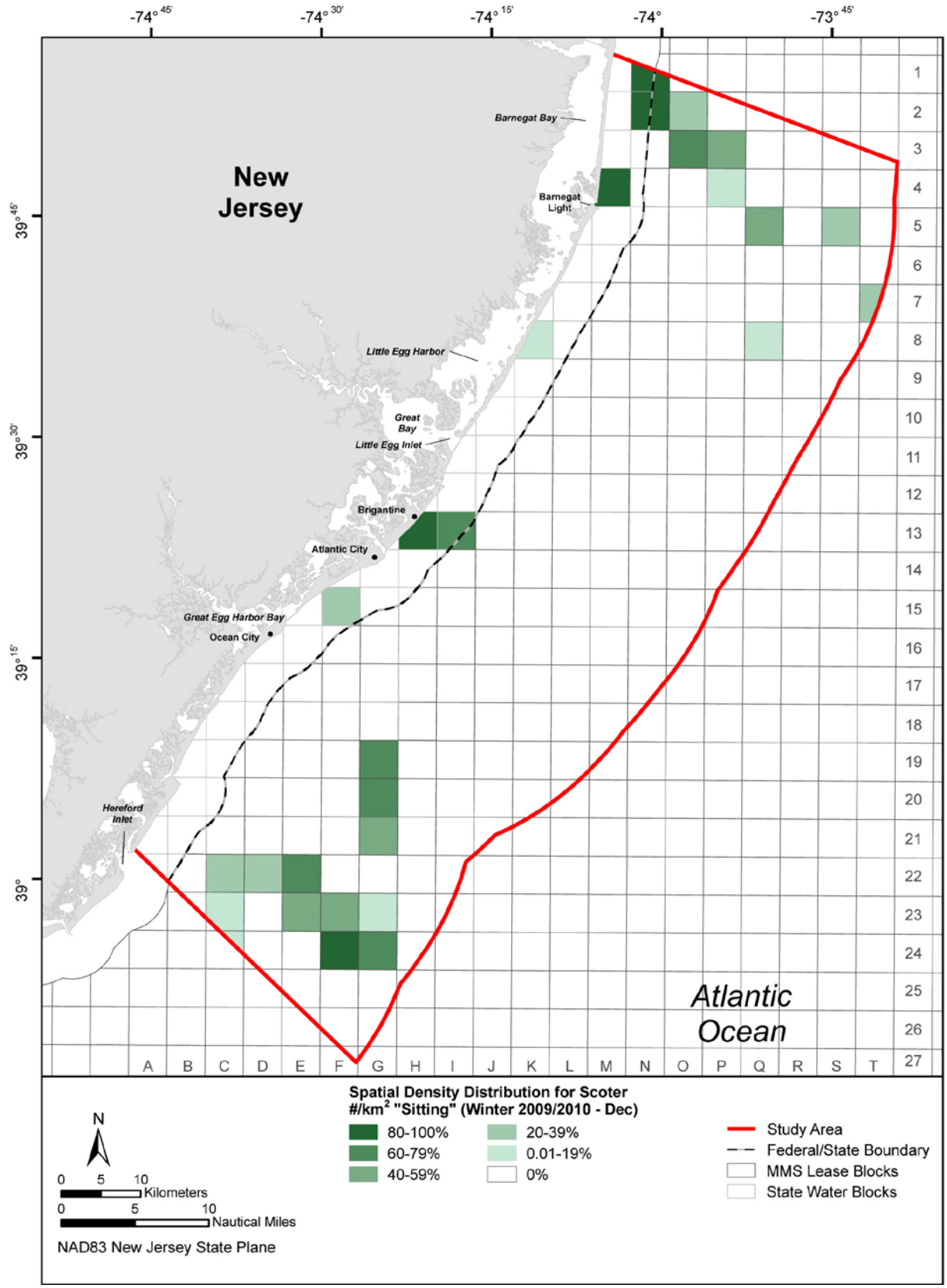

Figure C-228. Percentile abundance of scoters (sitting), Winter 2010 (December 2010) (n=514).

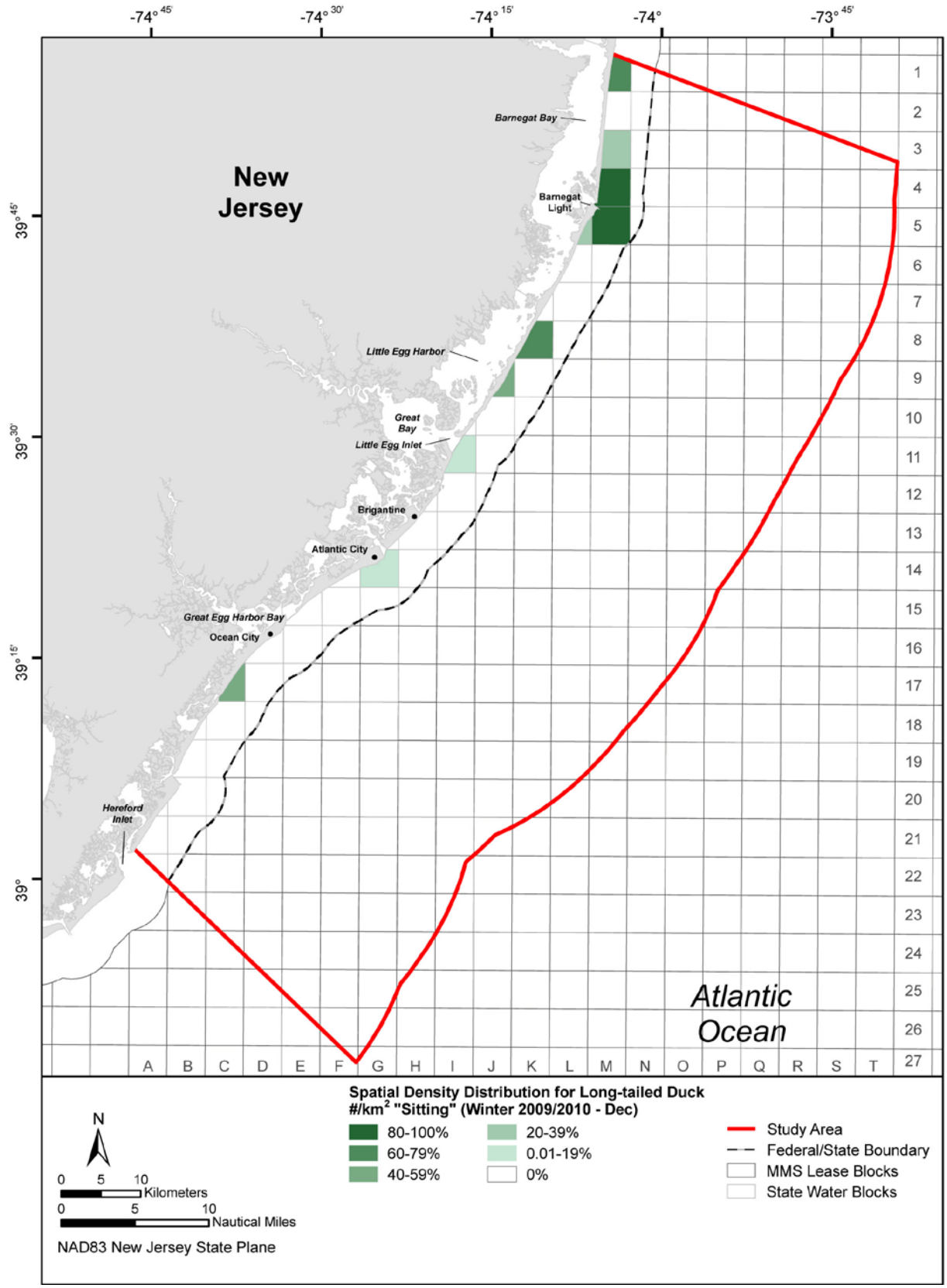

Figure C-229. Percentile abundance of Long-tailed Duck (sitting), Winter 2010 (December 2010) (n=244).

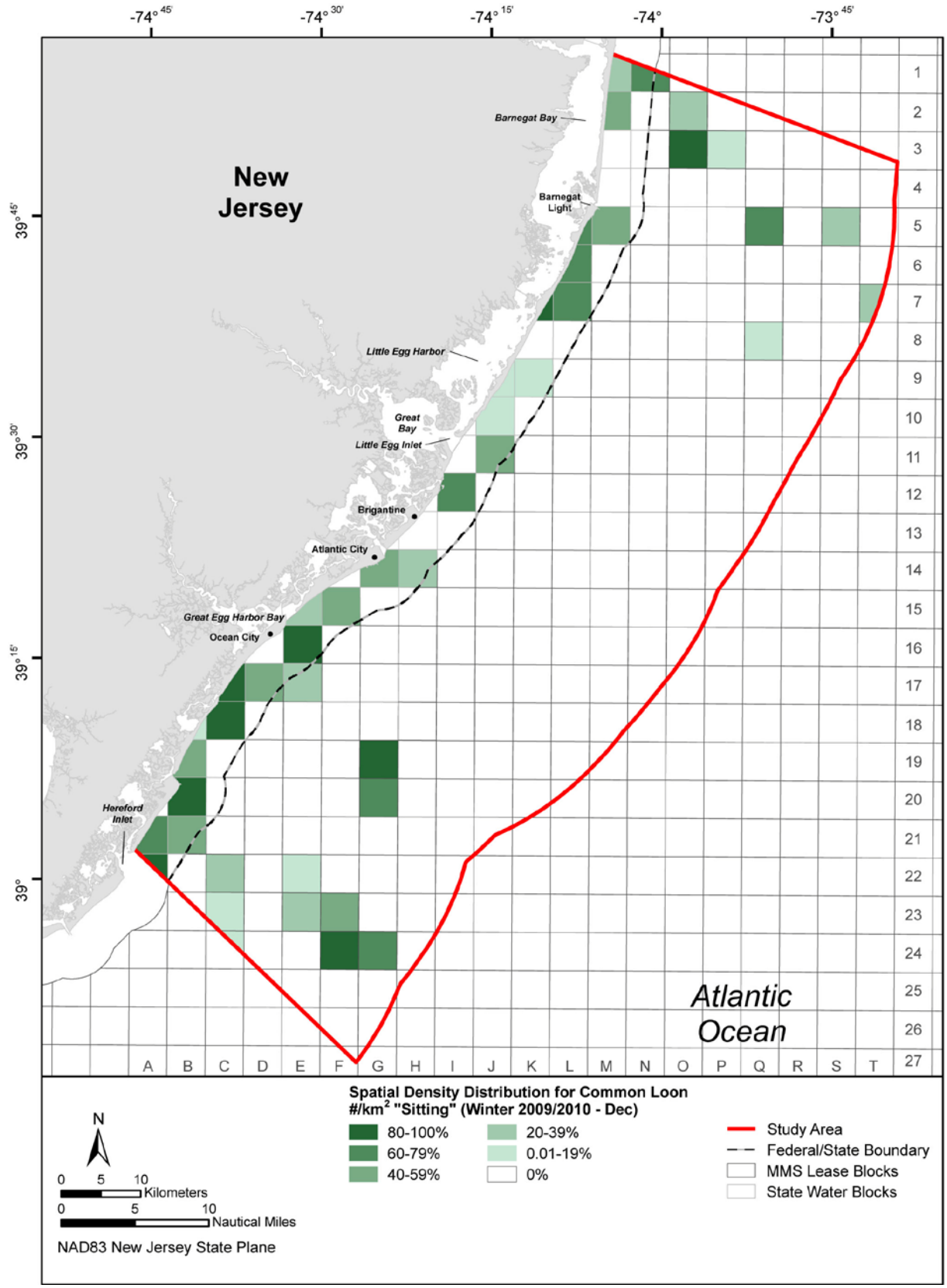

Figure C-230. Percentile abundance of Common Loon (sitting), Winter 2010 (December 2010) (n=226).

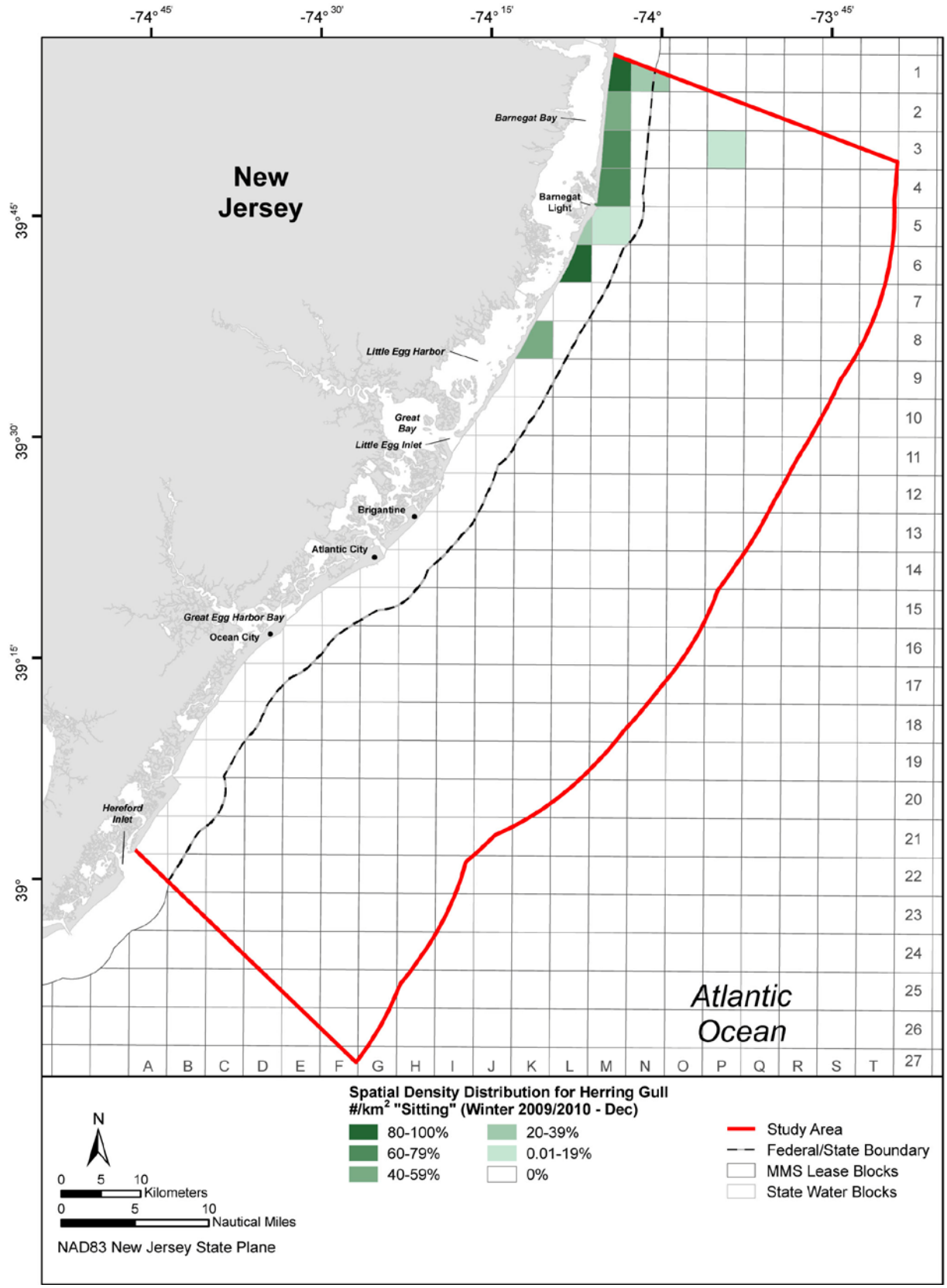

Figure C-231. Percentile abundance of Herring Gull (sitting), Winter 2010 (December 2010) (n=108).

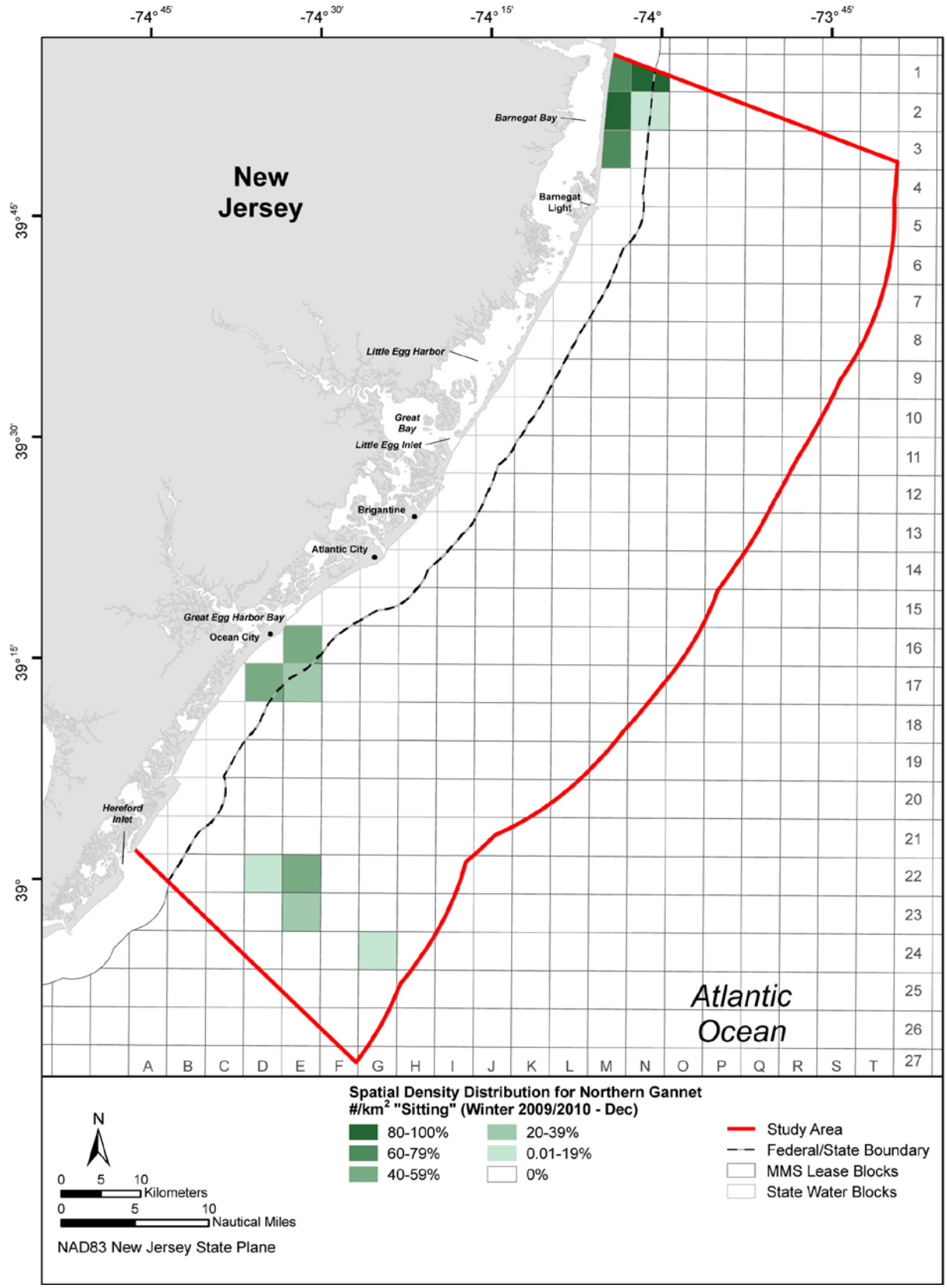

Figure C-232. Percentile abundance of Northern Gannet (sitting), Winter 2010 (December 2010) (n=95).

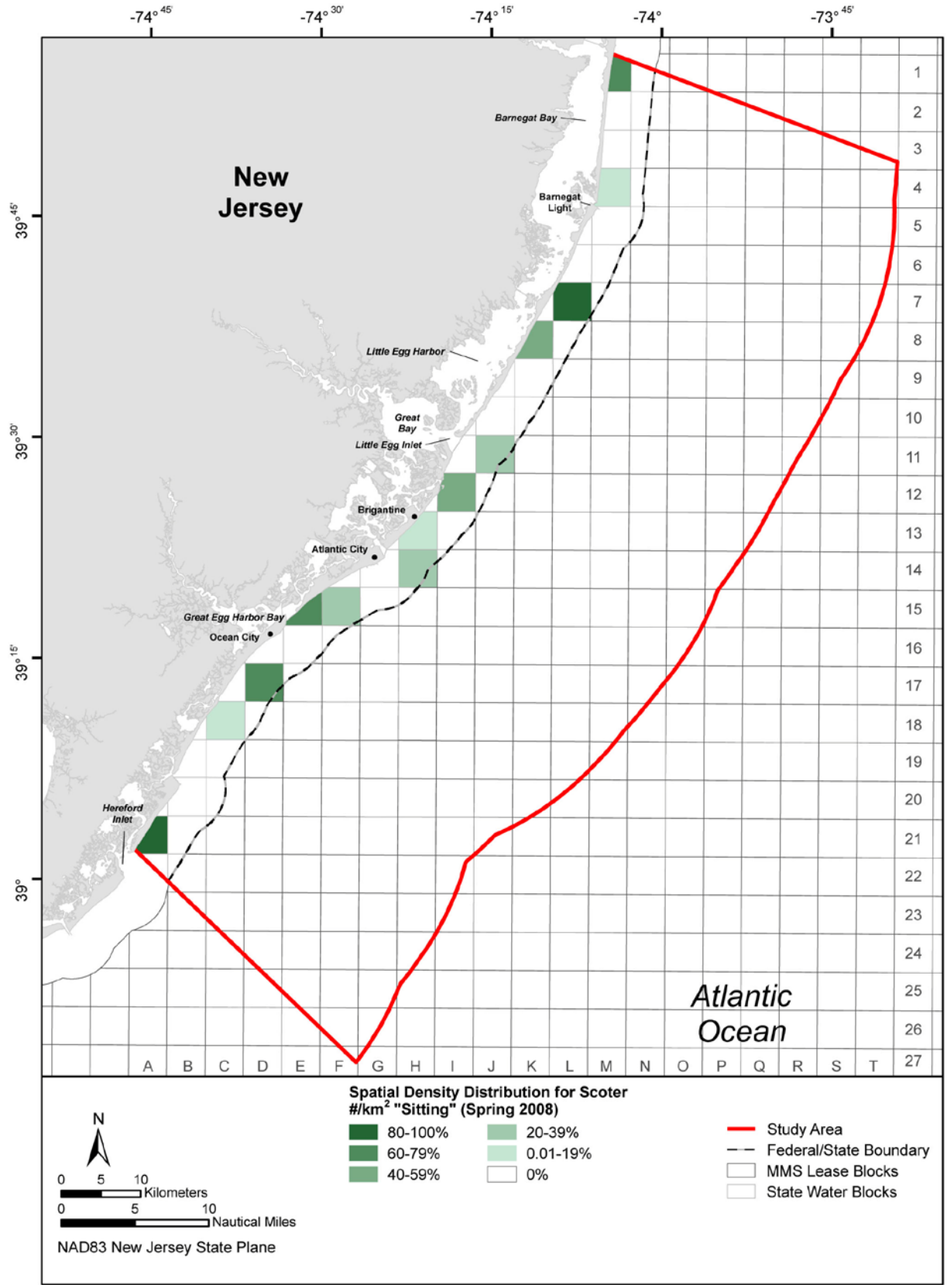

Figure C-233. Percentile abundance of scoters (sitting), Spring 2008 (March-May 2008) (n=682).

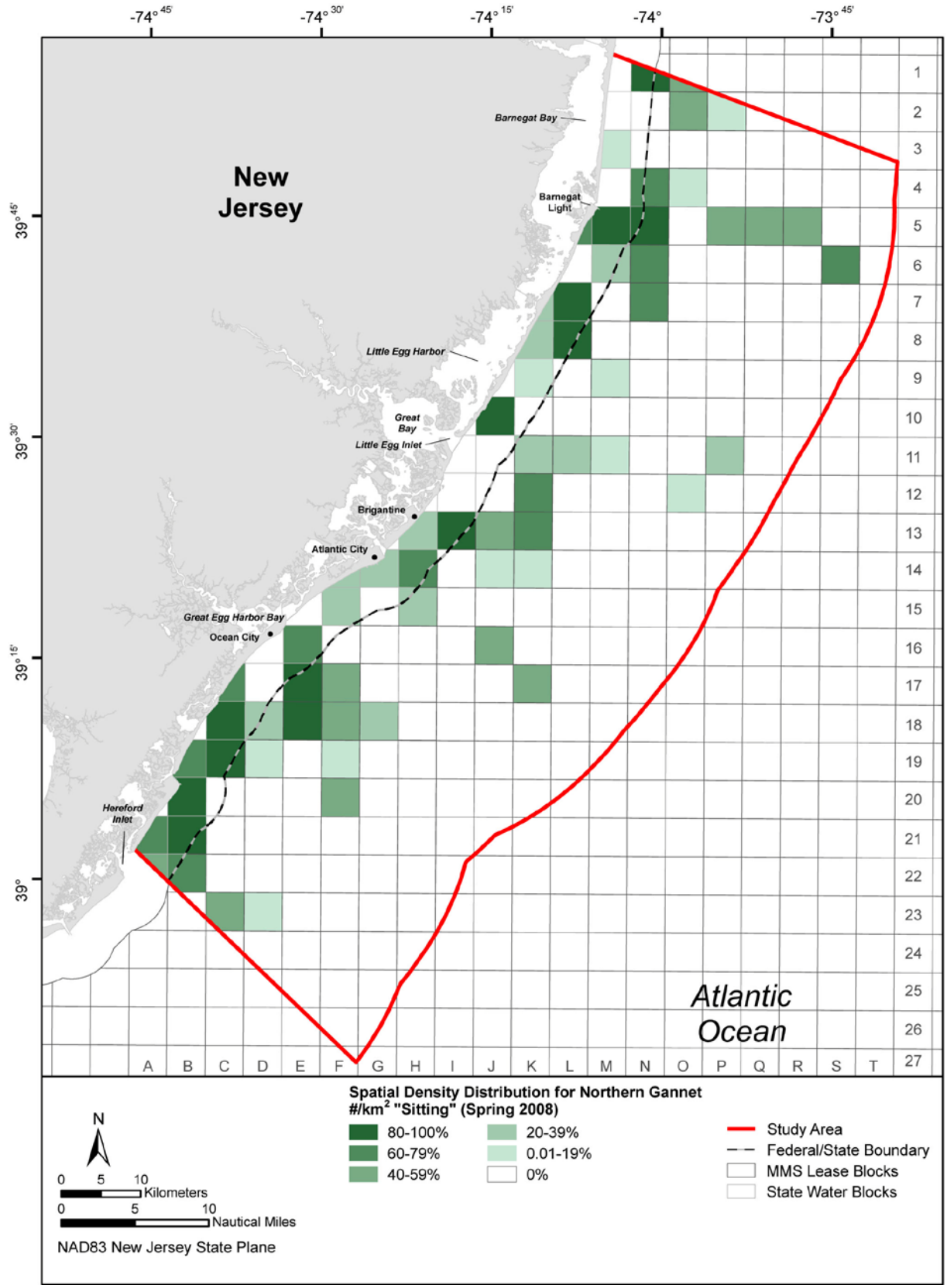

Figure C-234. Percentile abundance of Northern Gannet (sitting), Spring 2008 (March-May 2008) (n=382).

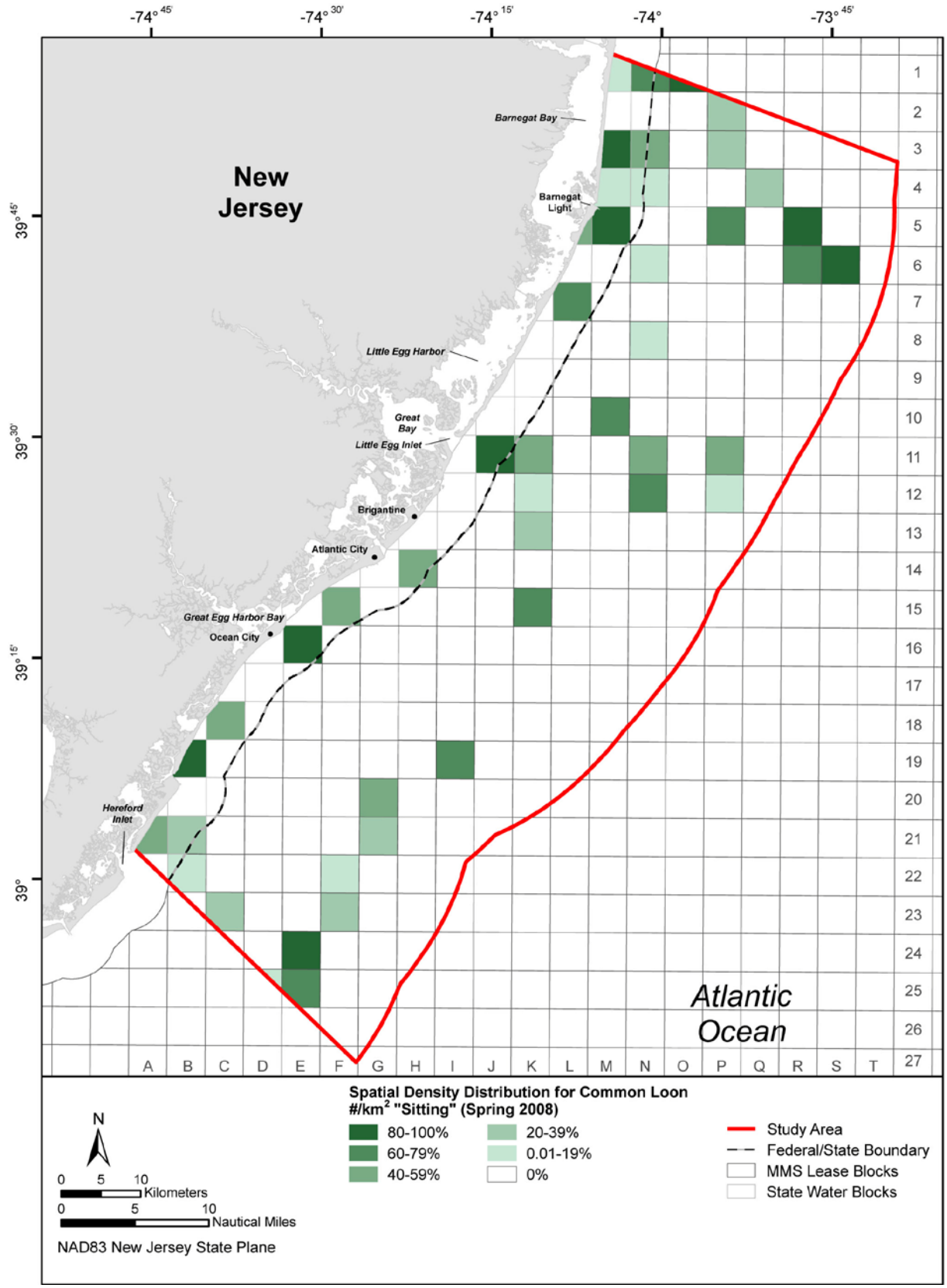

Figure C-235. Percentile abundance of Common Loon (sitting), Spring 2008 (March-May 2008) (n=102).

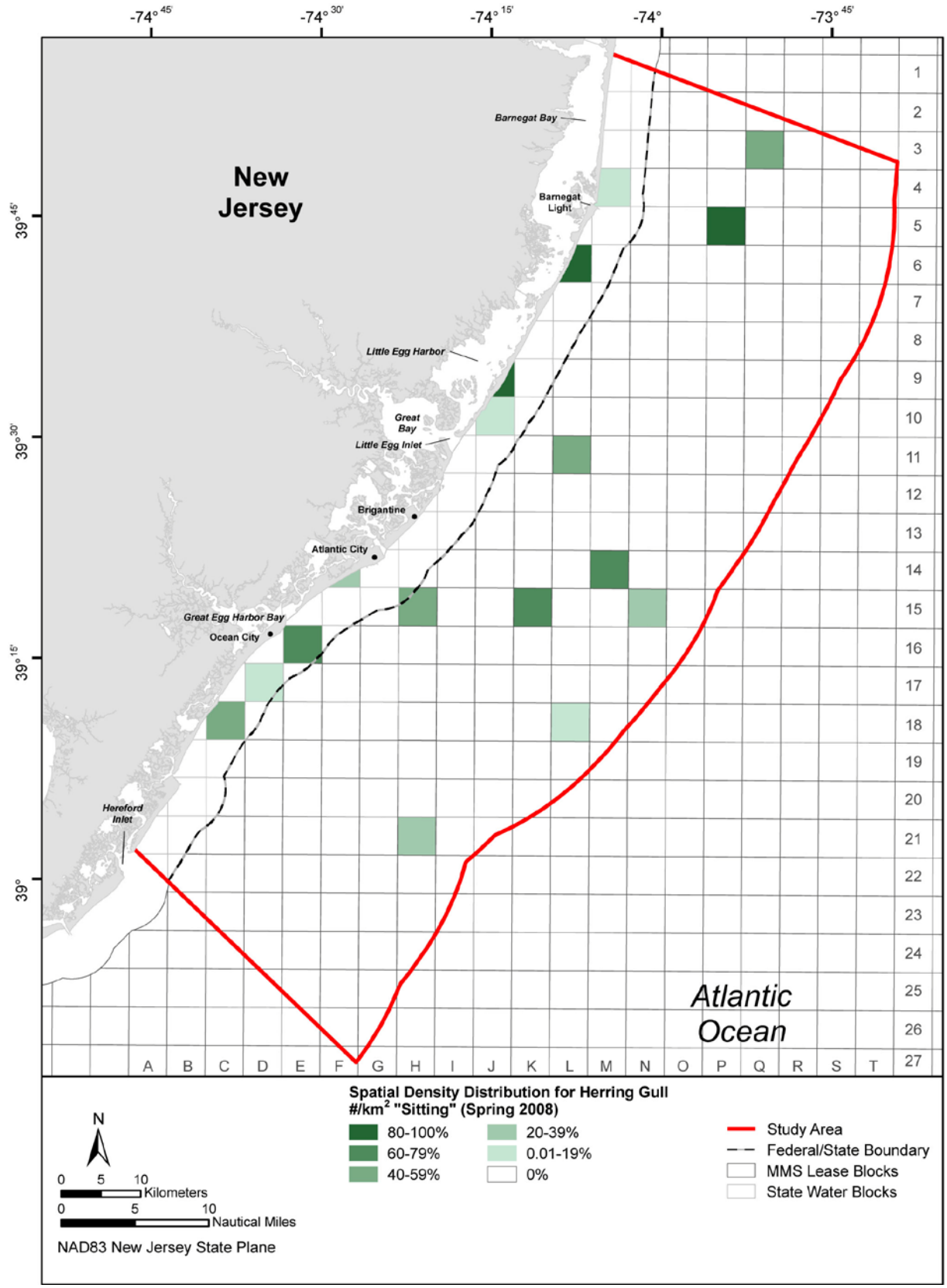

Figure C-236. Percentile abundance of Herring Gull (sitting), Spring 2008 (March-May 2008) (n=96).

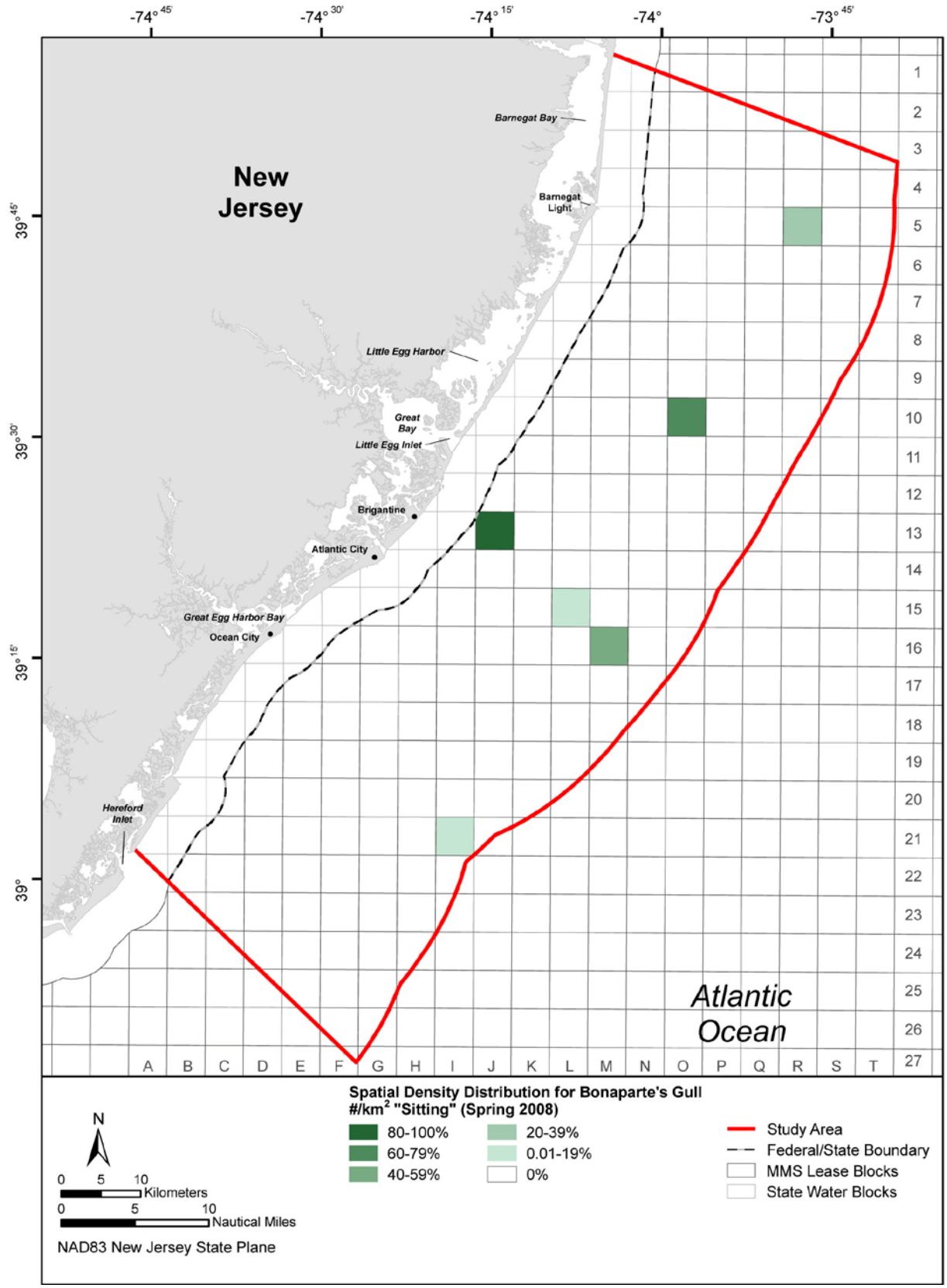

Figure C-237. Percentile abundance of Bonaparte's Gull (sitting), Spring 2008 (March-May 2008) (n=52).

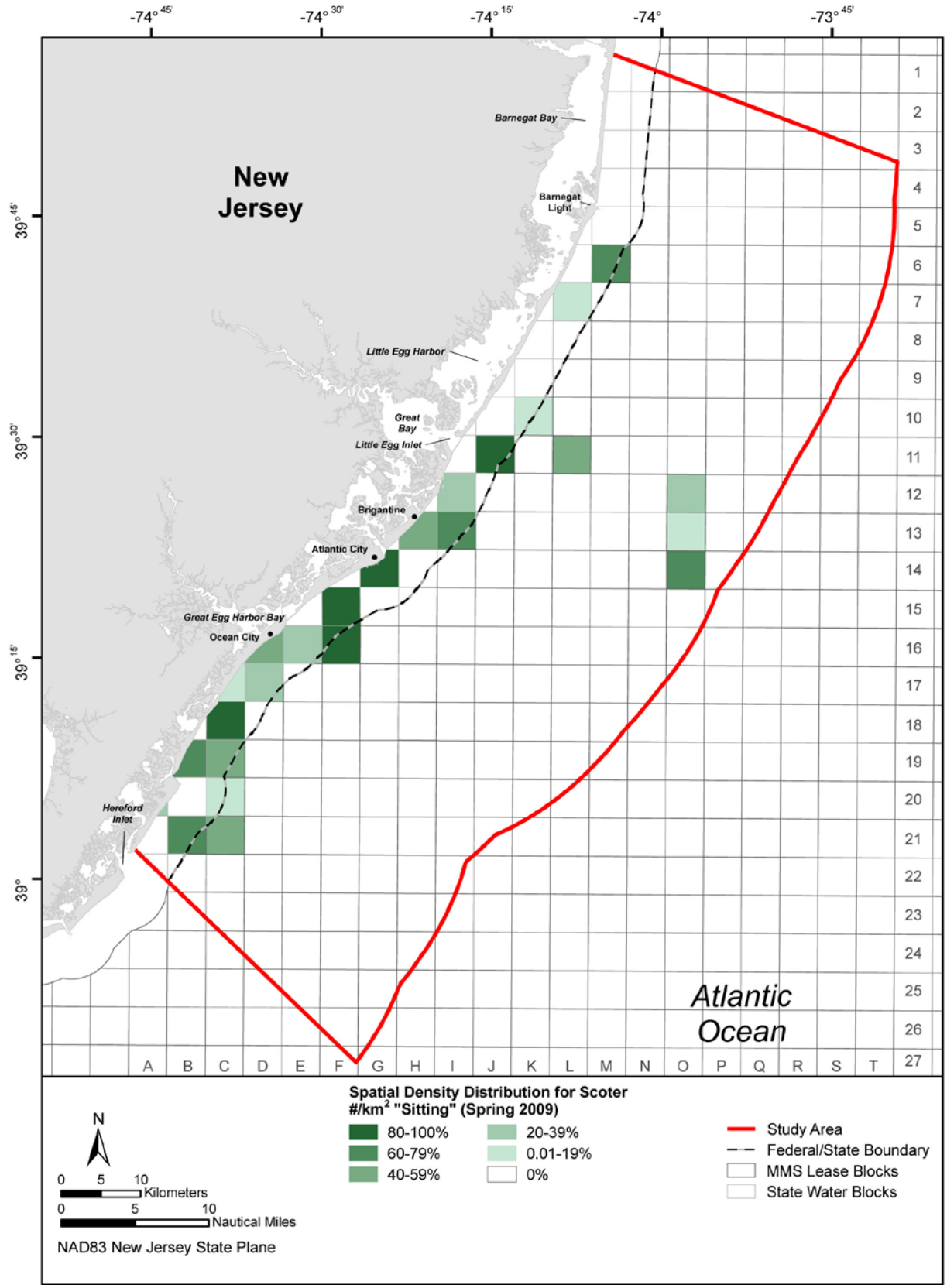

Figure C-238. Percentile abundance of scoters (sitting), Spring 2009 (March-May 2009) (n=665).

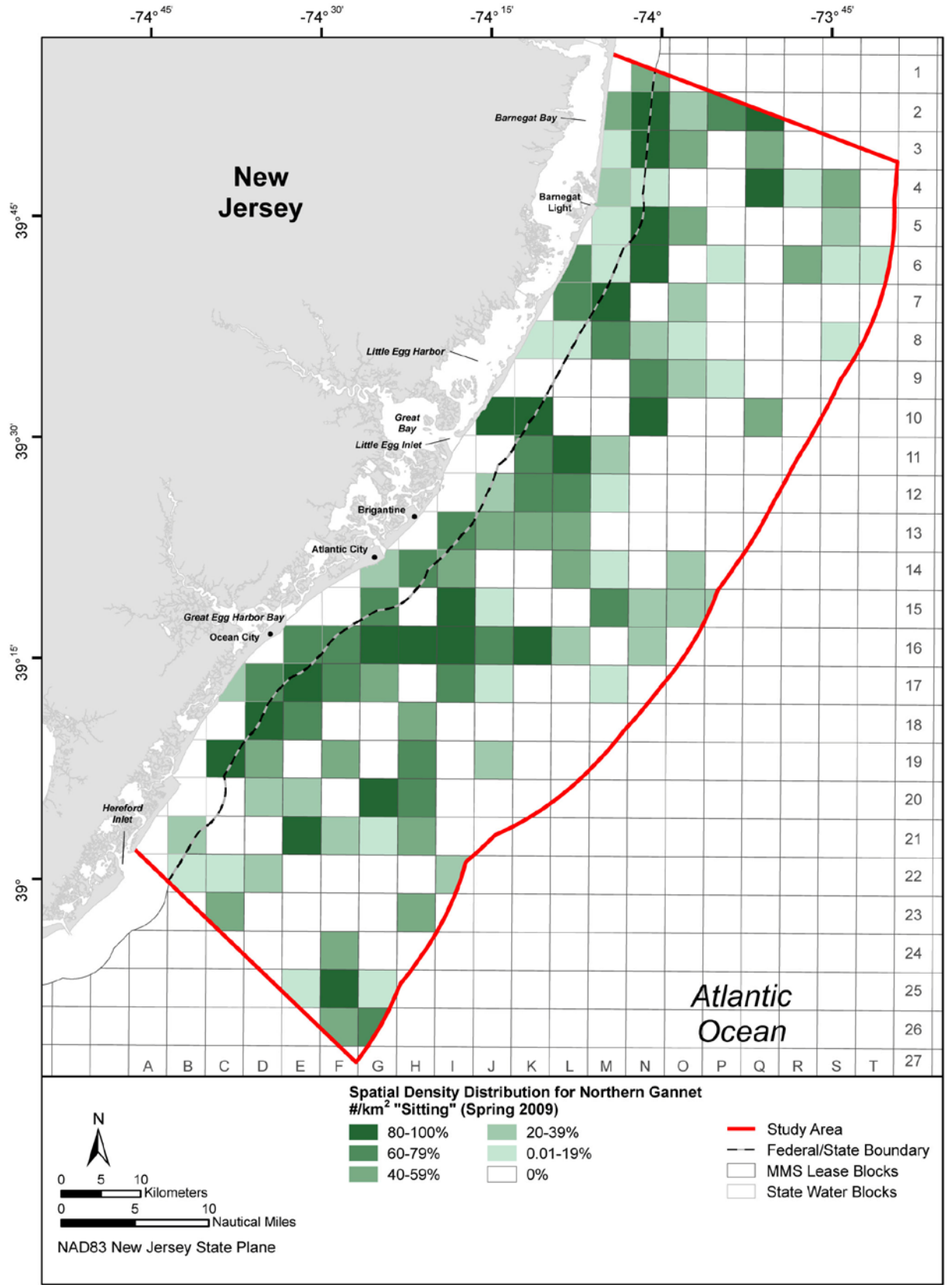

Figure C-239. Percentile abundance of Northern Gannet (sitting), Spring 2009 (March-May 2009) (n=449).

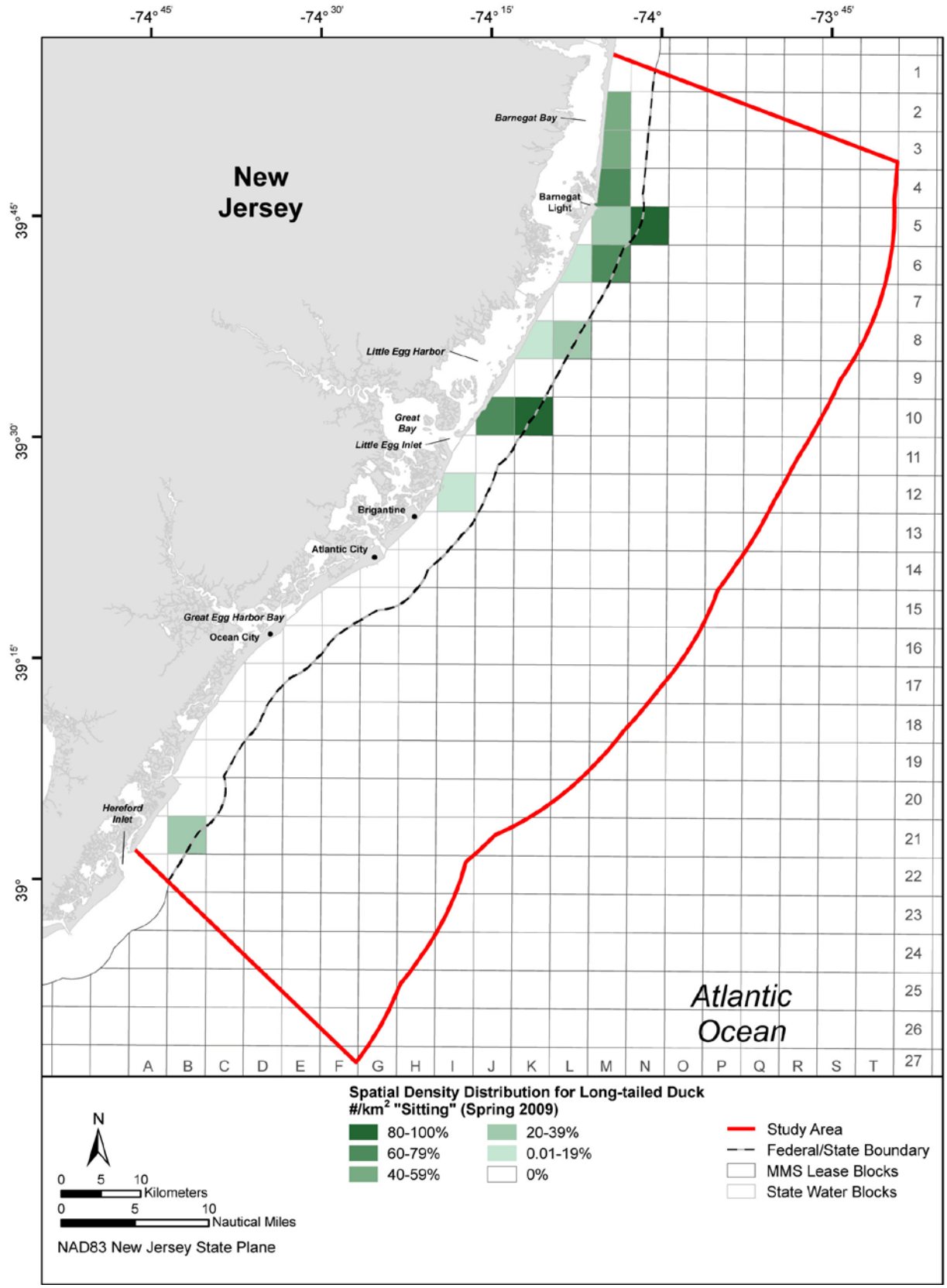

Figure C-240. Percentile abundance of Long-tailed Duck (sitting), Spring 2009 (March-May 2009) (n=481).

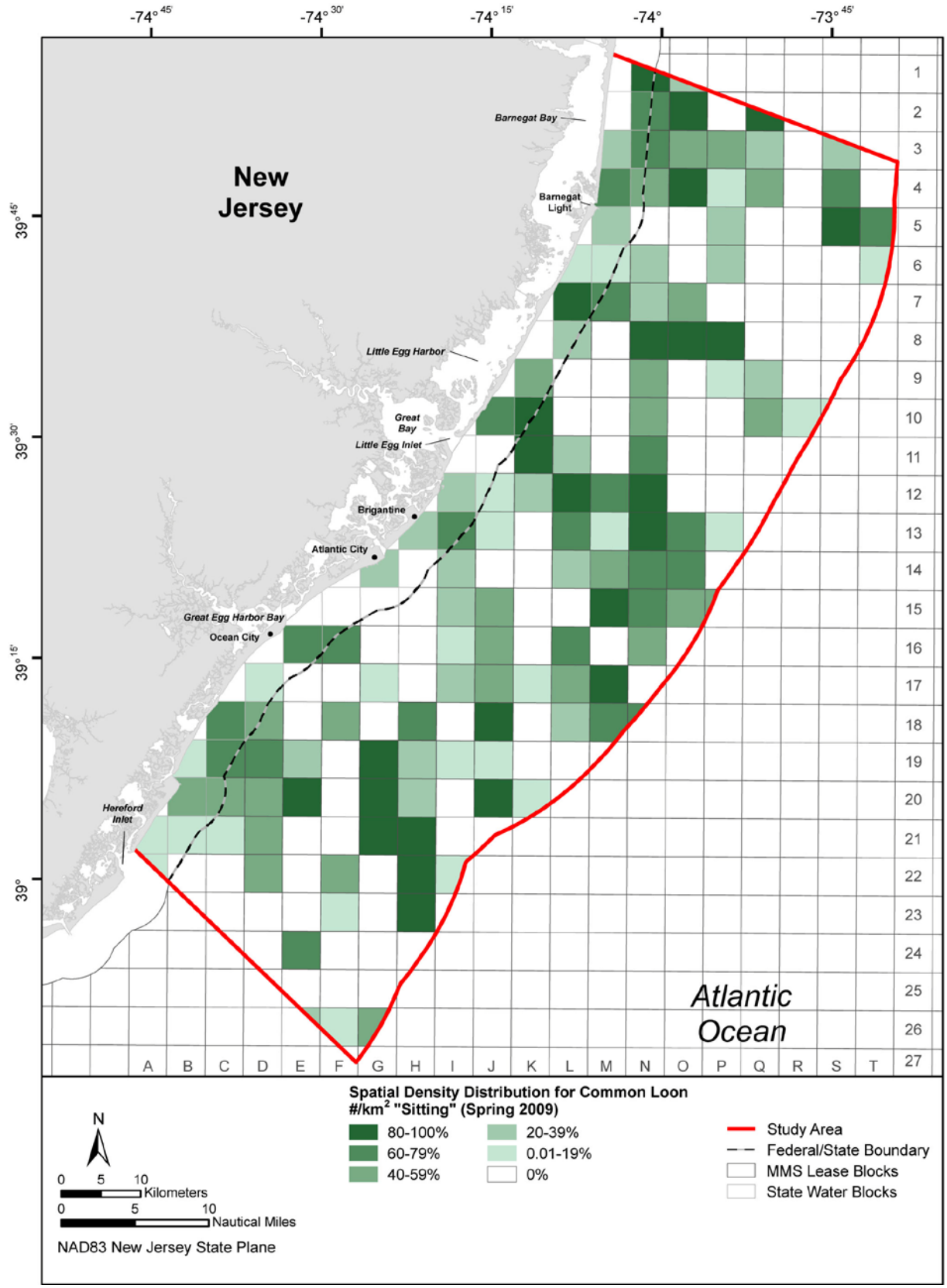

Figure C-241. Percentile abundance of Common Loon (sitting), Spring 2009 (March-May 2009) (n=438).

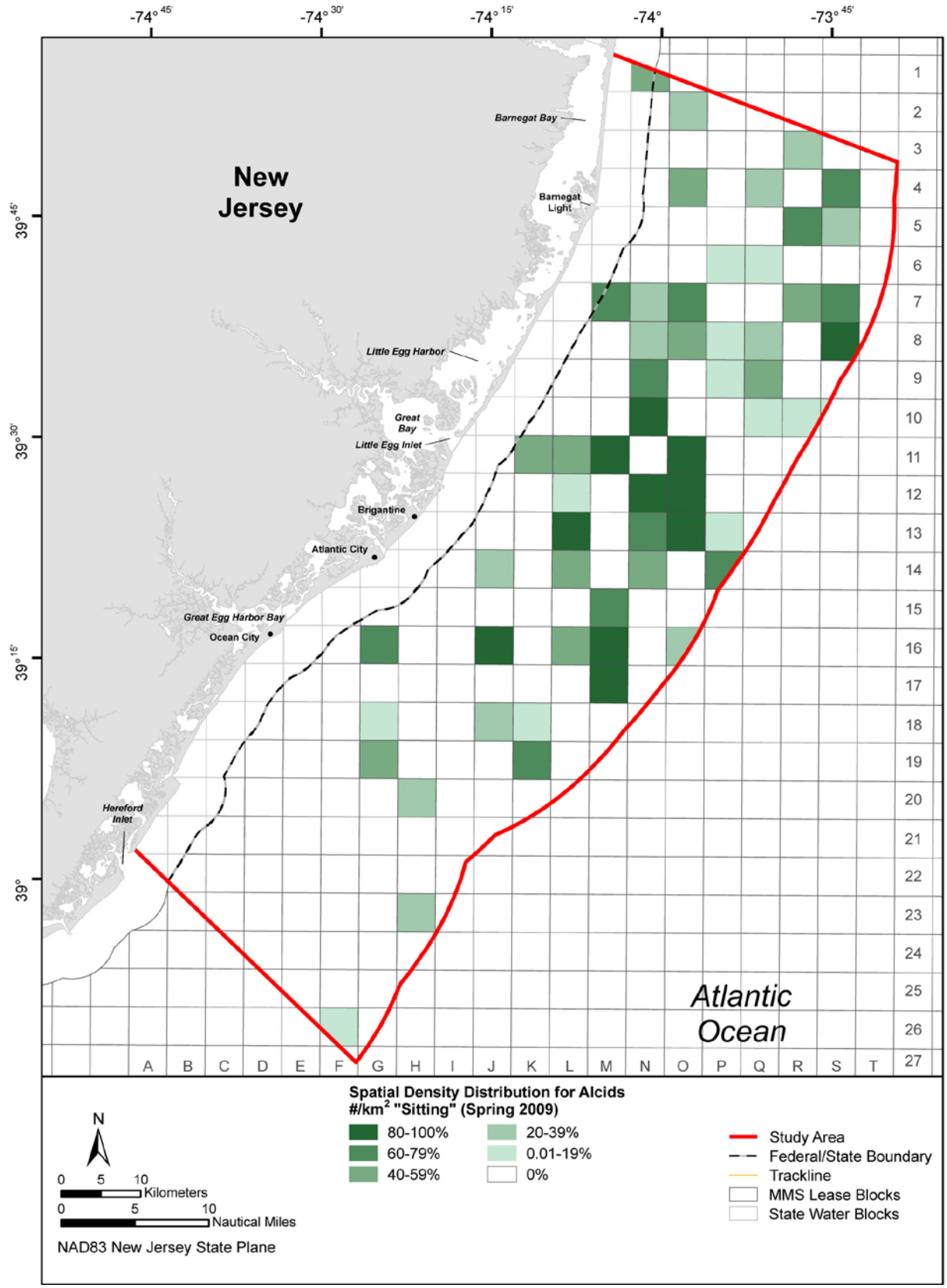

Figure C-242. Percentile abundance of alcids (sitting), Spring 2009 (March-May 2009) (n=419).

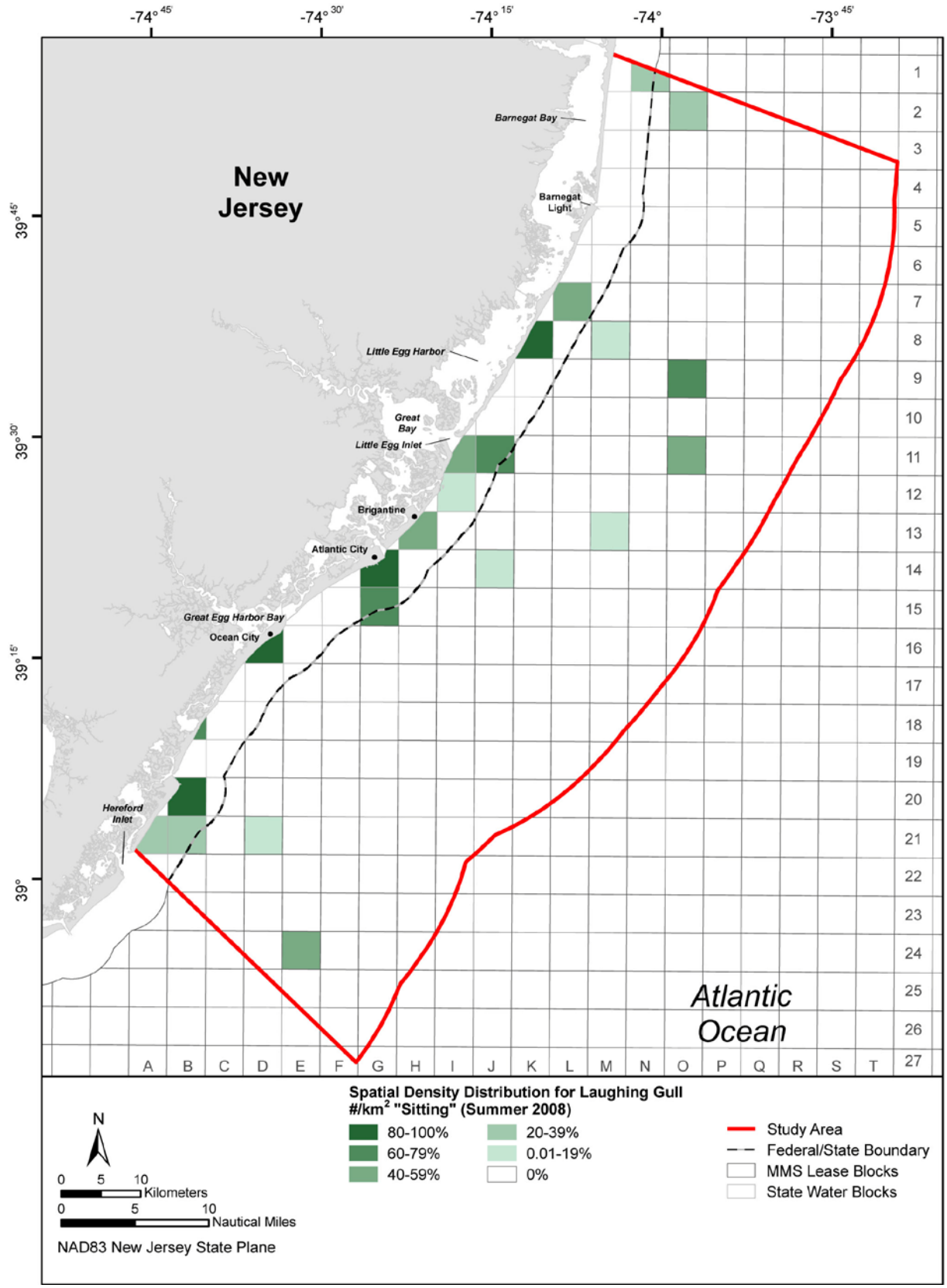

Figure C-243. Percentile abundance of Laughing Gull (sitting), Summer 2008 (June-July 2008) (n=73).

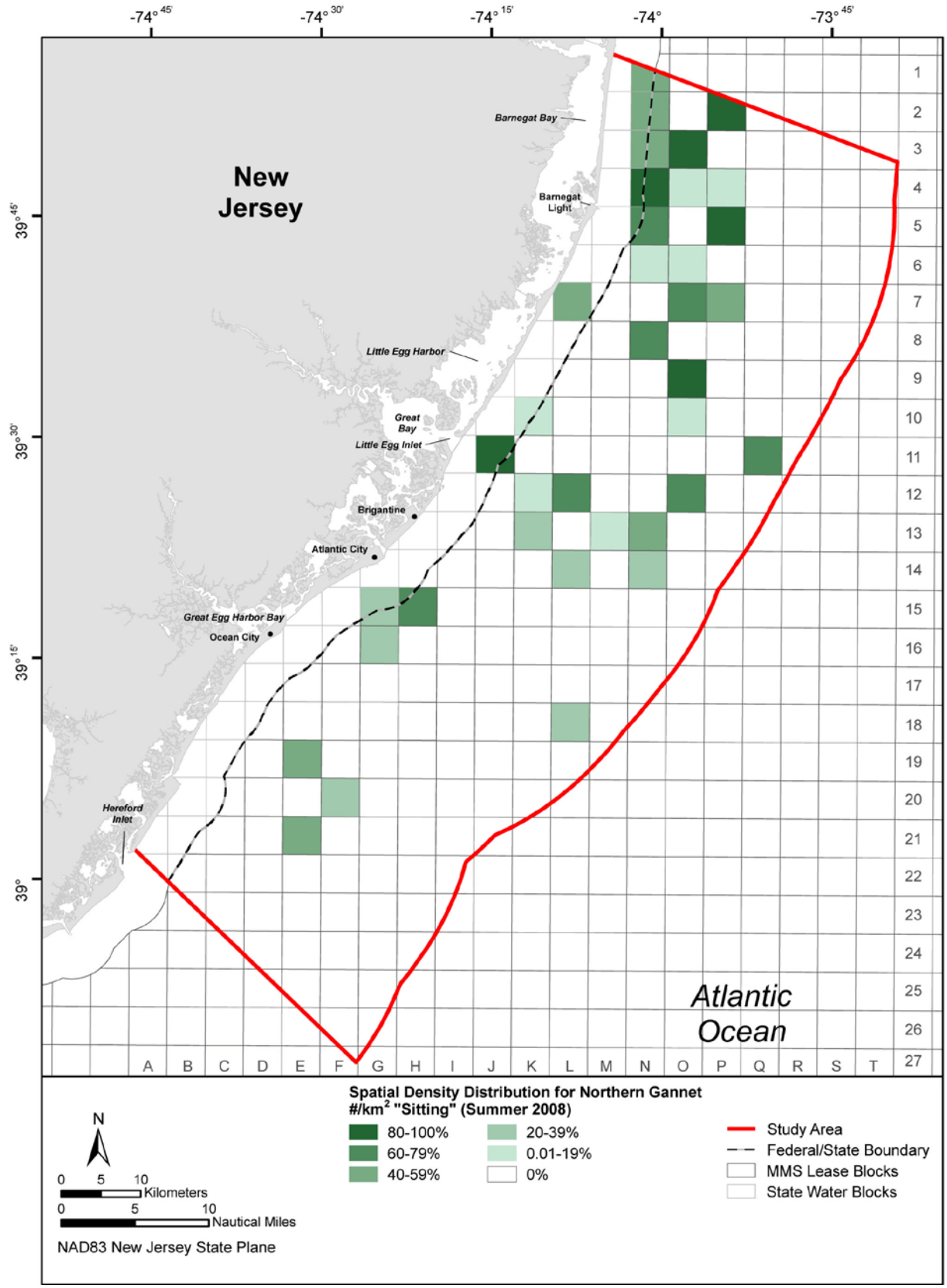

Figure C-244. Percentile abundance of Northern Gannet (sitting), Summer 2008 (June-July 2008) (n=56).

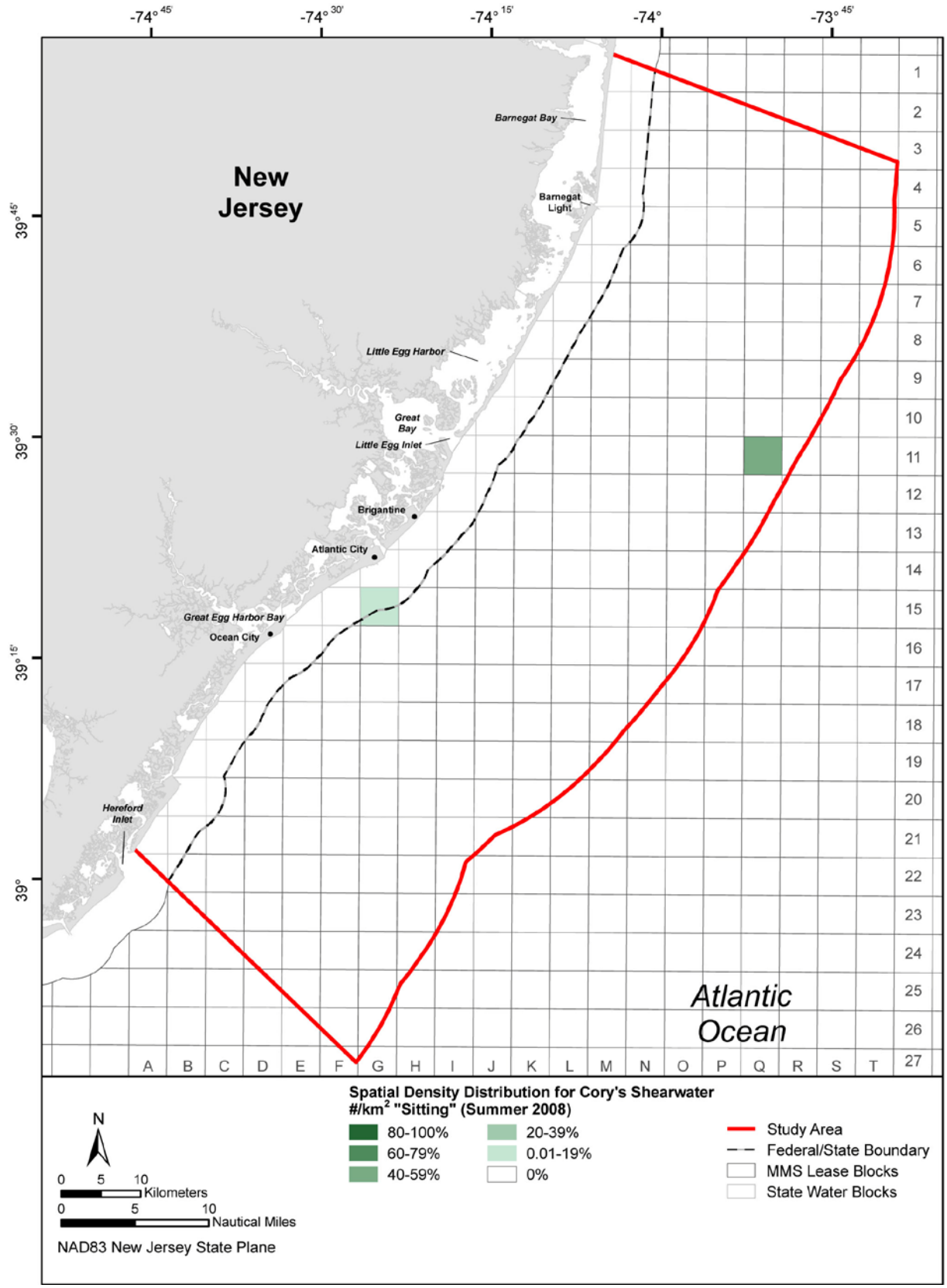

Figure C-245. Percentile abundance of Cory's Shearwater (sitting), Summer 2008 (June-July 2008) (n=18).

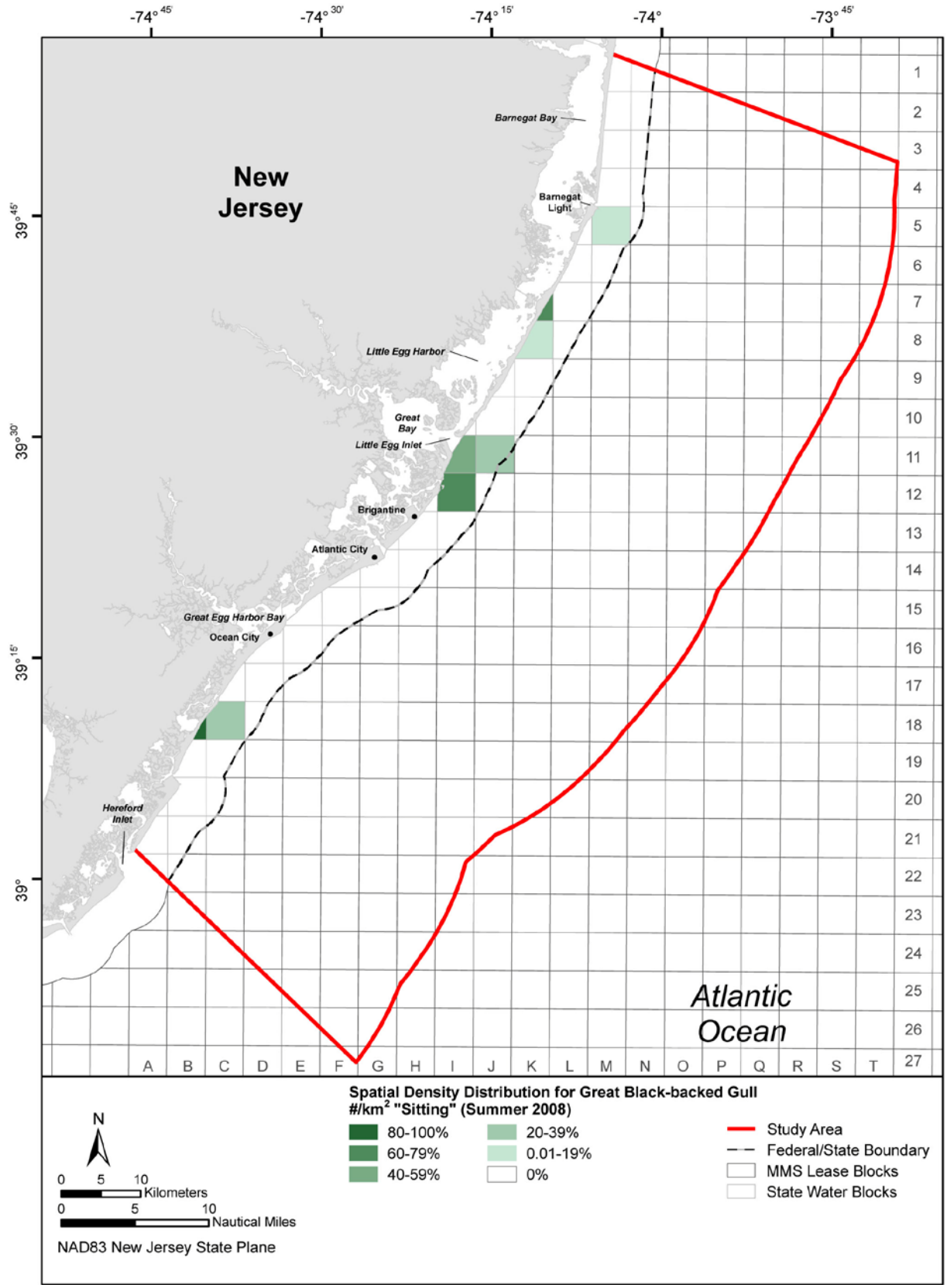

Figure C-246. Percentile abundance of Great Black-backed Gull (sitting), Summer 2008 (June-July 2008) (n=14).

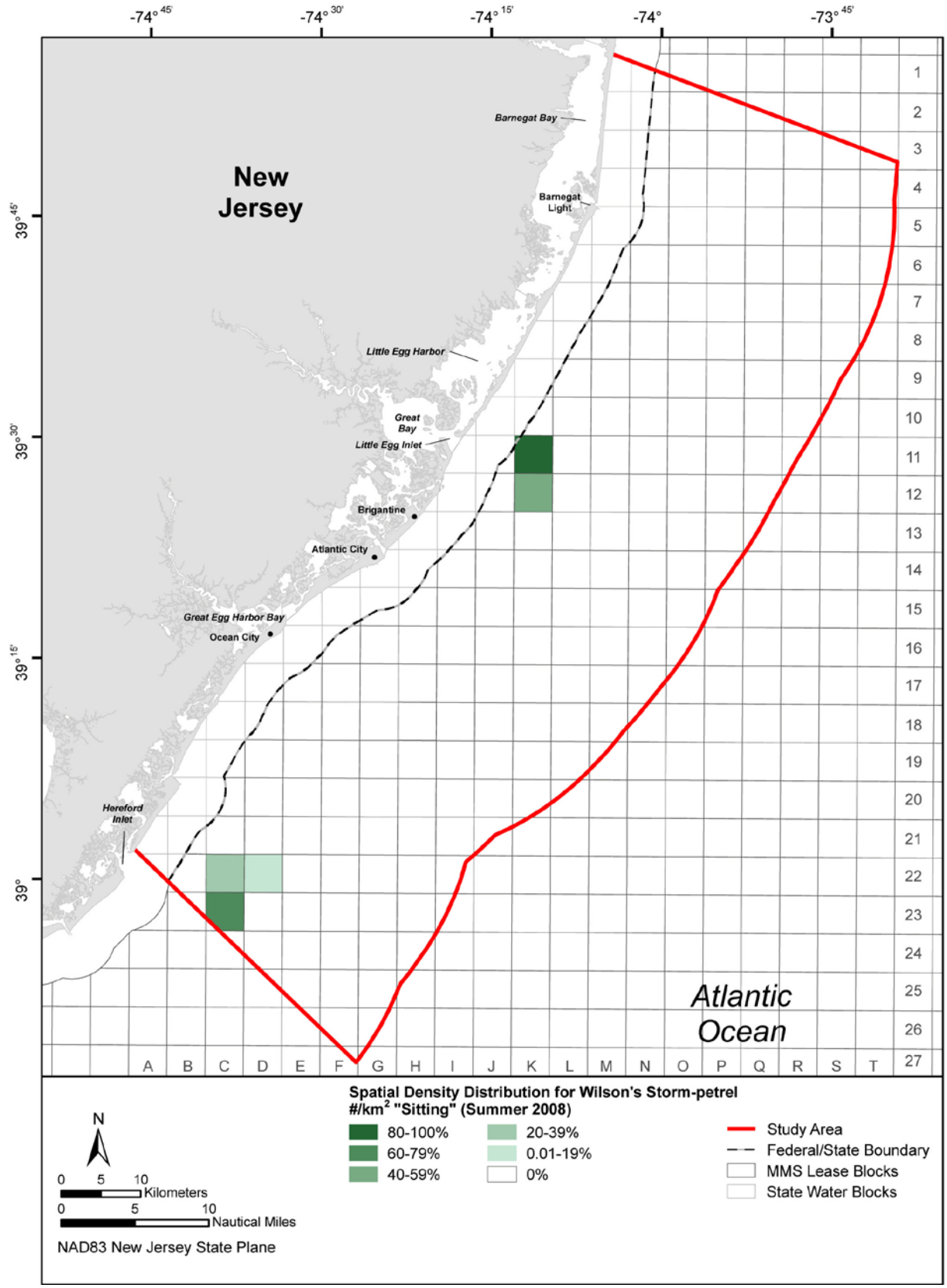

Figure C-247. Percentile abundance of Wilson's Storm-Petrel (sitting), Summer 2008 (June-July 2008) (n=5).

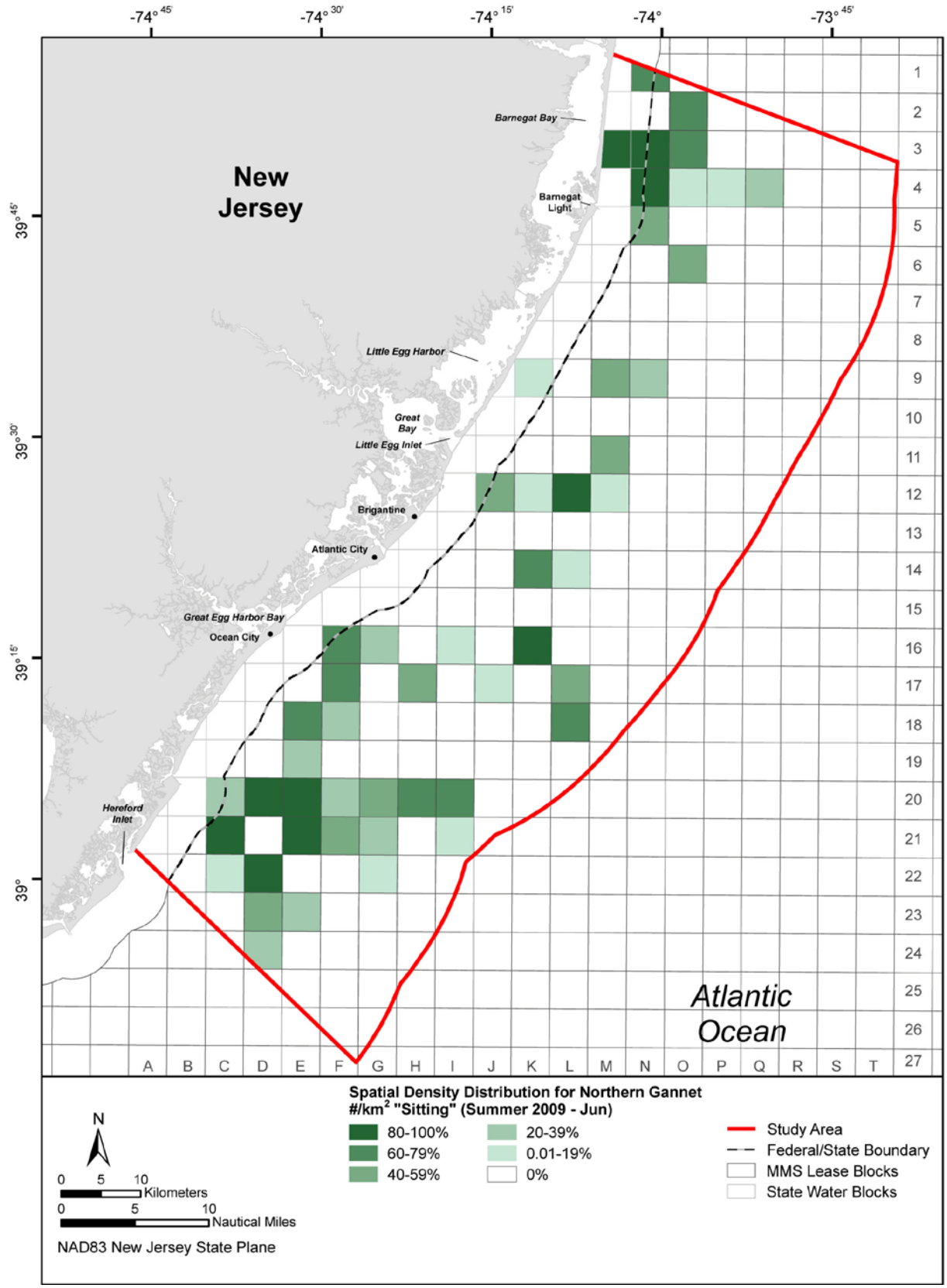

Figure C-248. Percentile abundance of Northern Gannet (sitting), Summer 2009 (June 2009) (n=143).

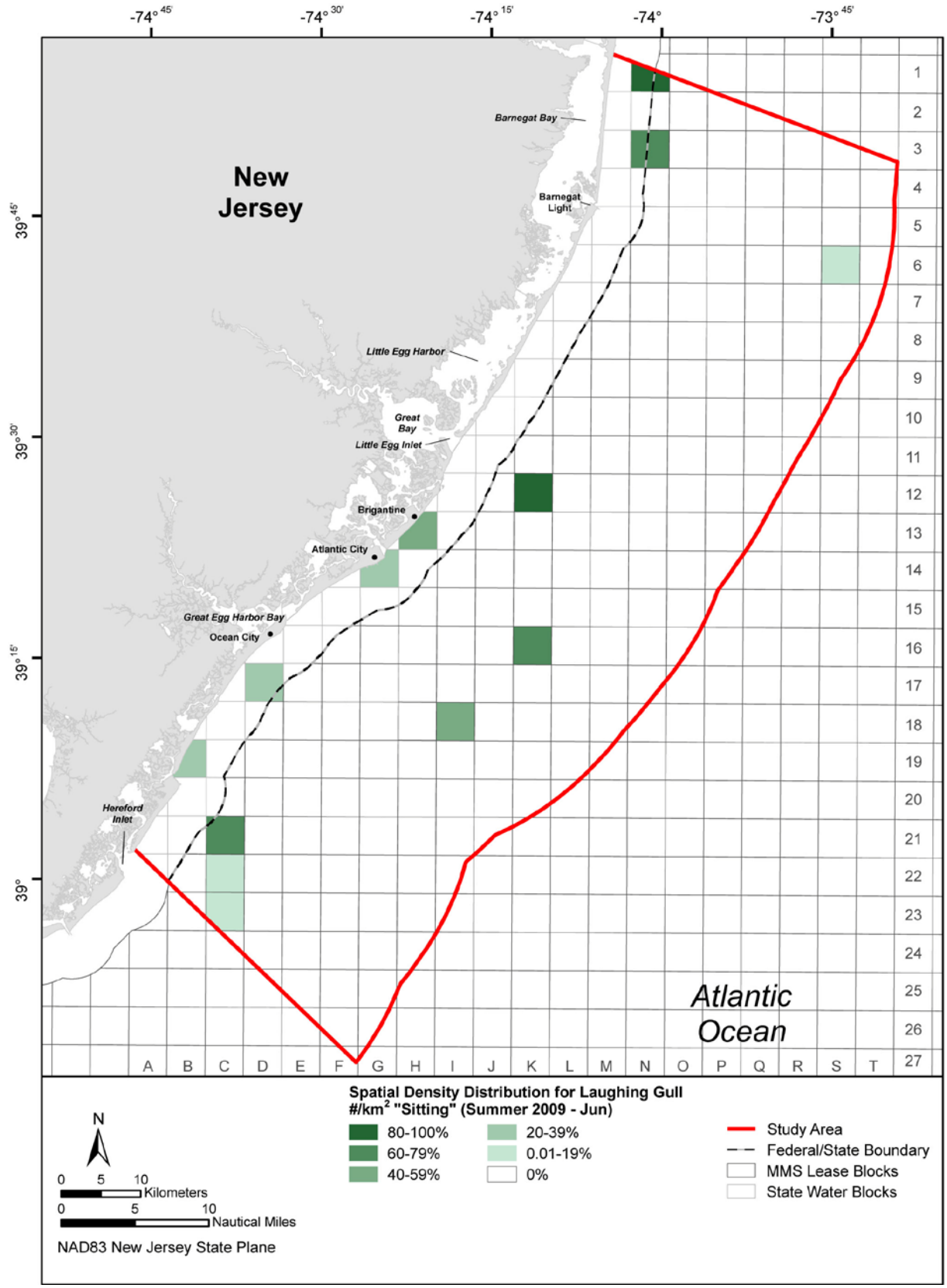

Figure C-249. Percentile abundance of Laughing Gull (sitting), Summer 2009 (June 2009) (n=24).

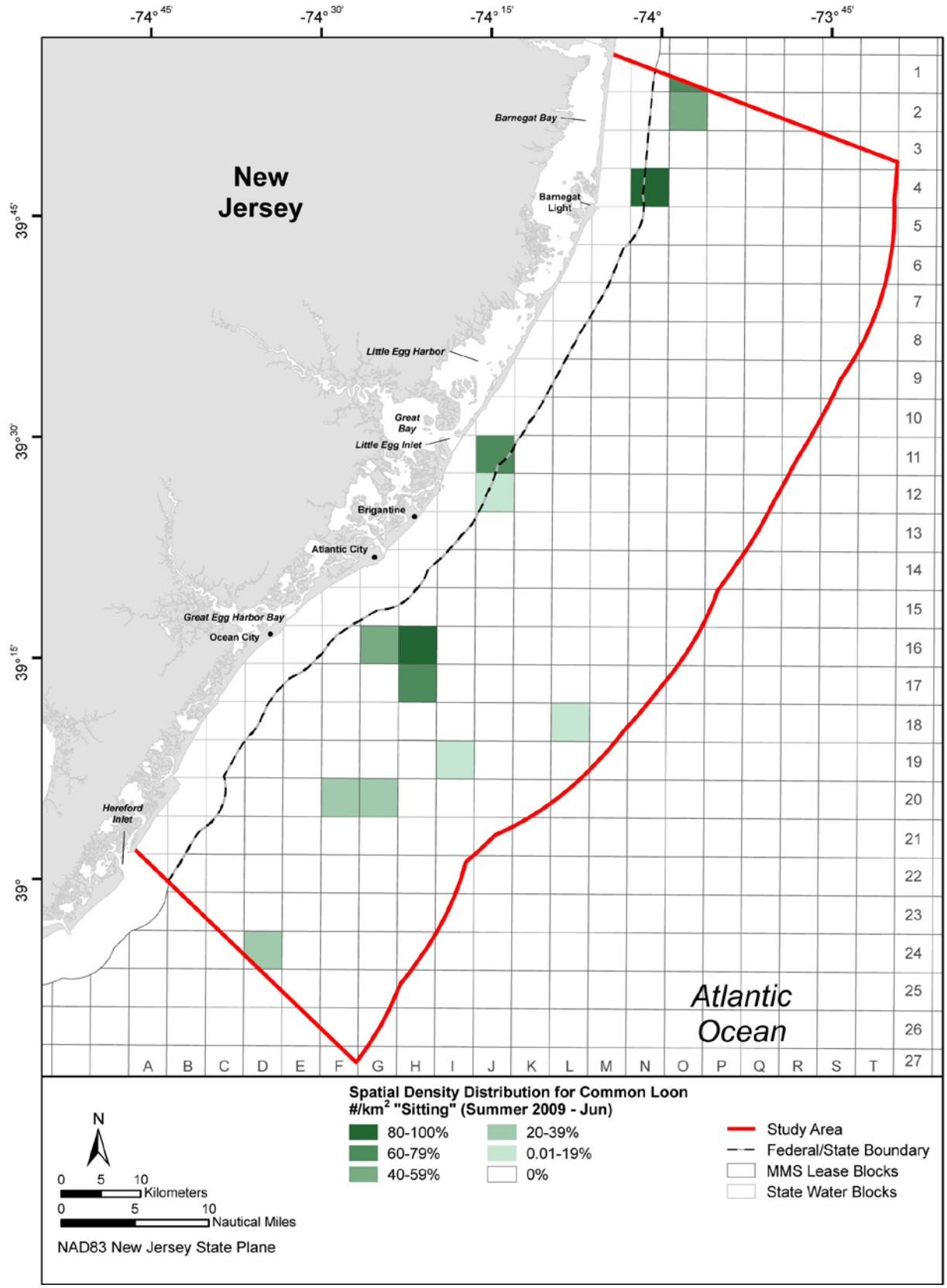

Figure C-250. Percentile abundance of Common Loon (sitting), Summer 2009 (June 2009) (n=16).

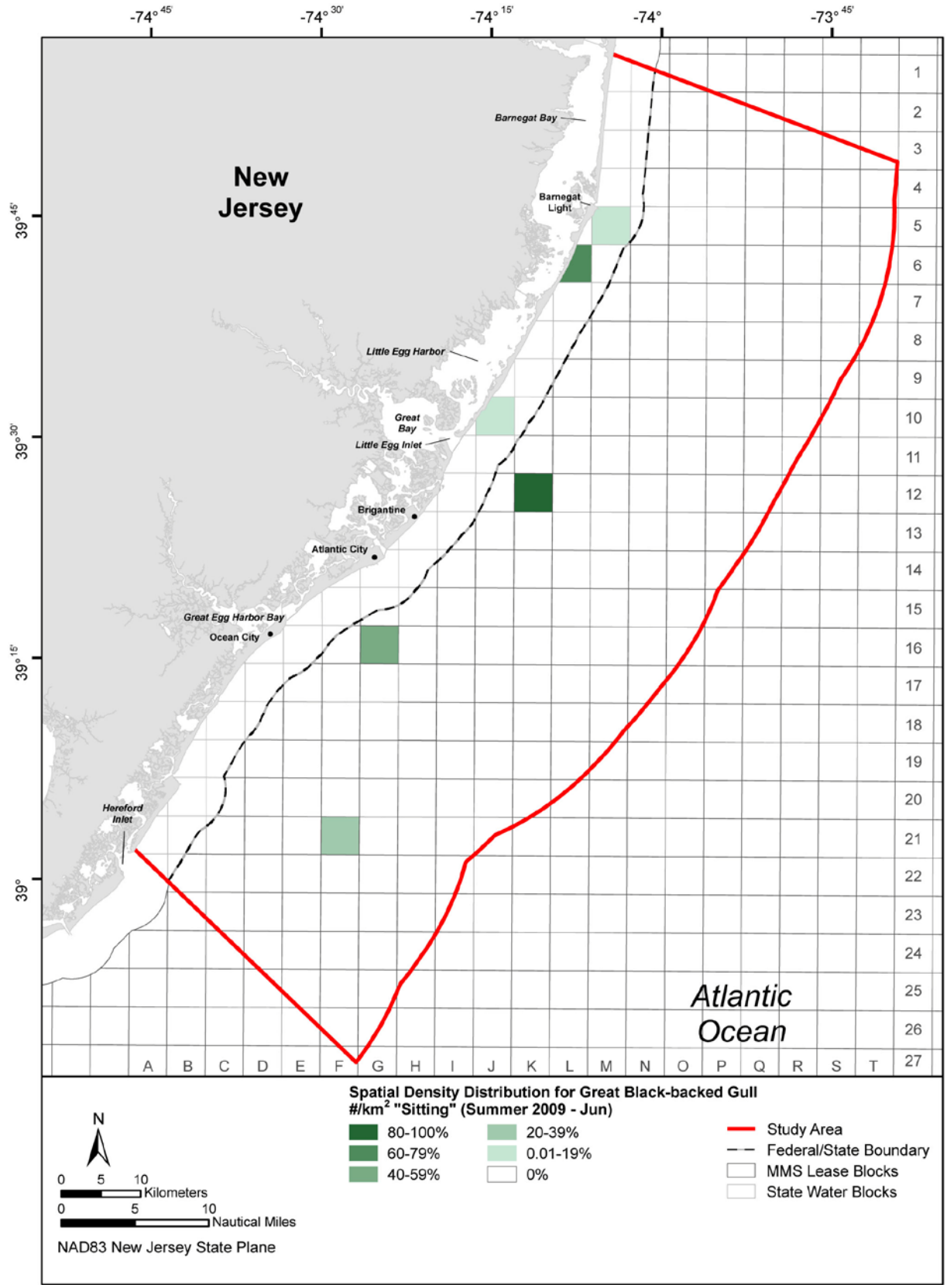

Figure C-251. Percentile abundance of Great Black-backed Gull (sitting), Summer 2009 (June 2009) (n=10).

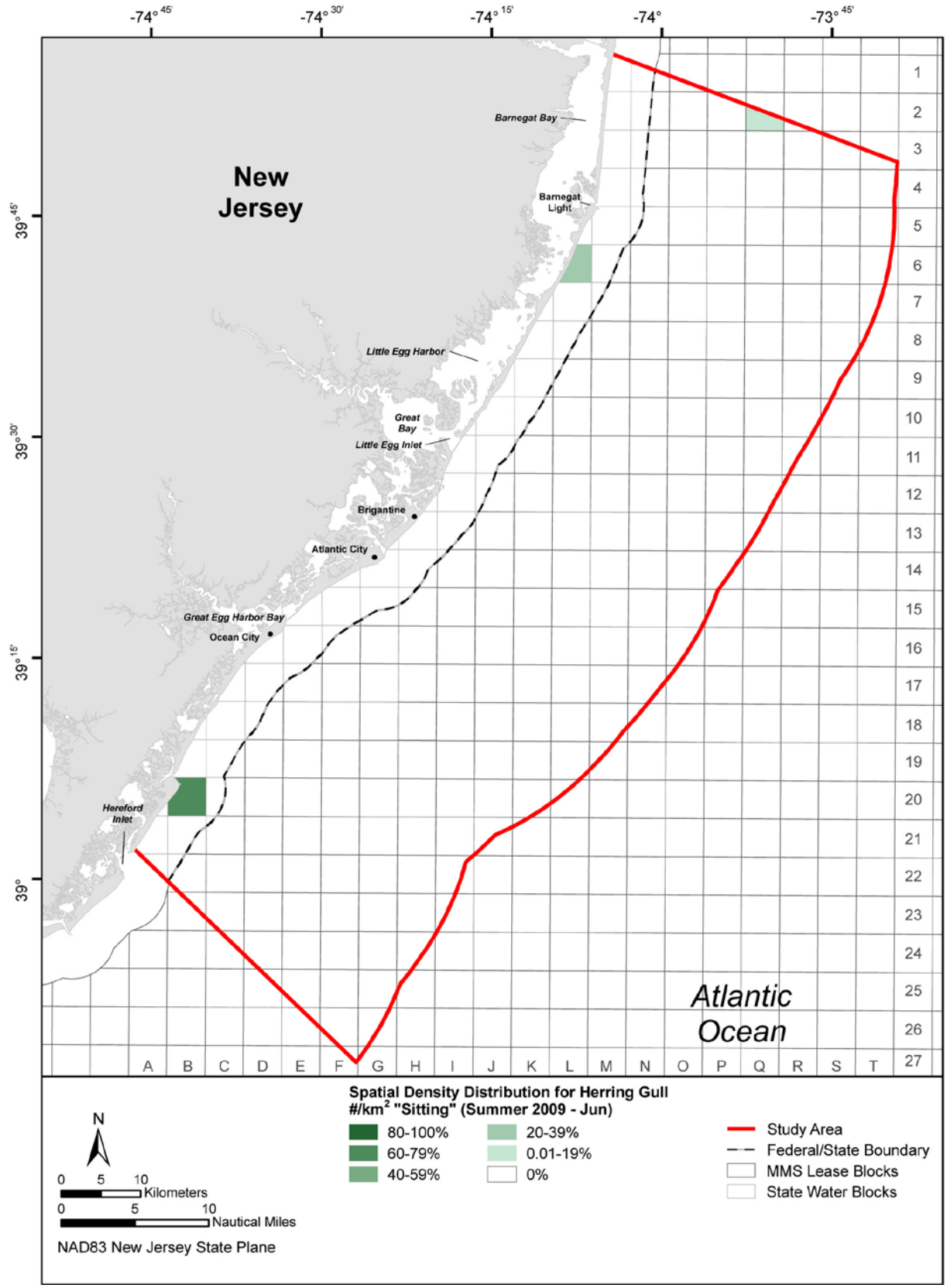

Figure C-252. Percentile abundance of Herring Gull (sitting), Summer 2009 (June 2009) (n=8).

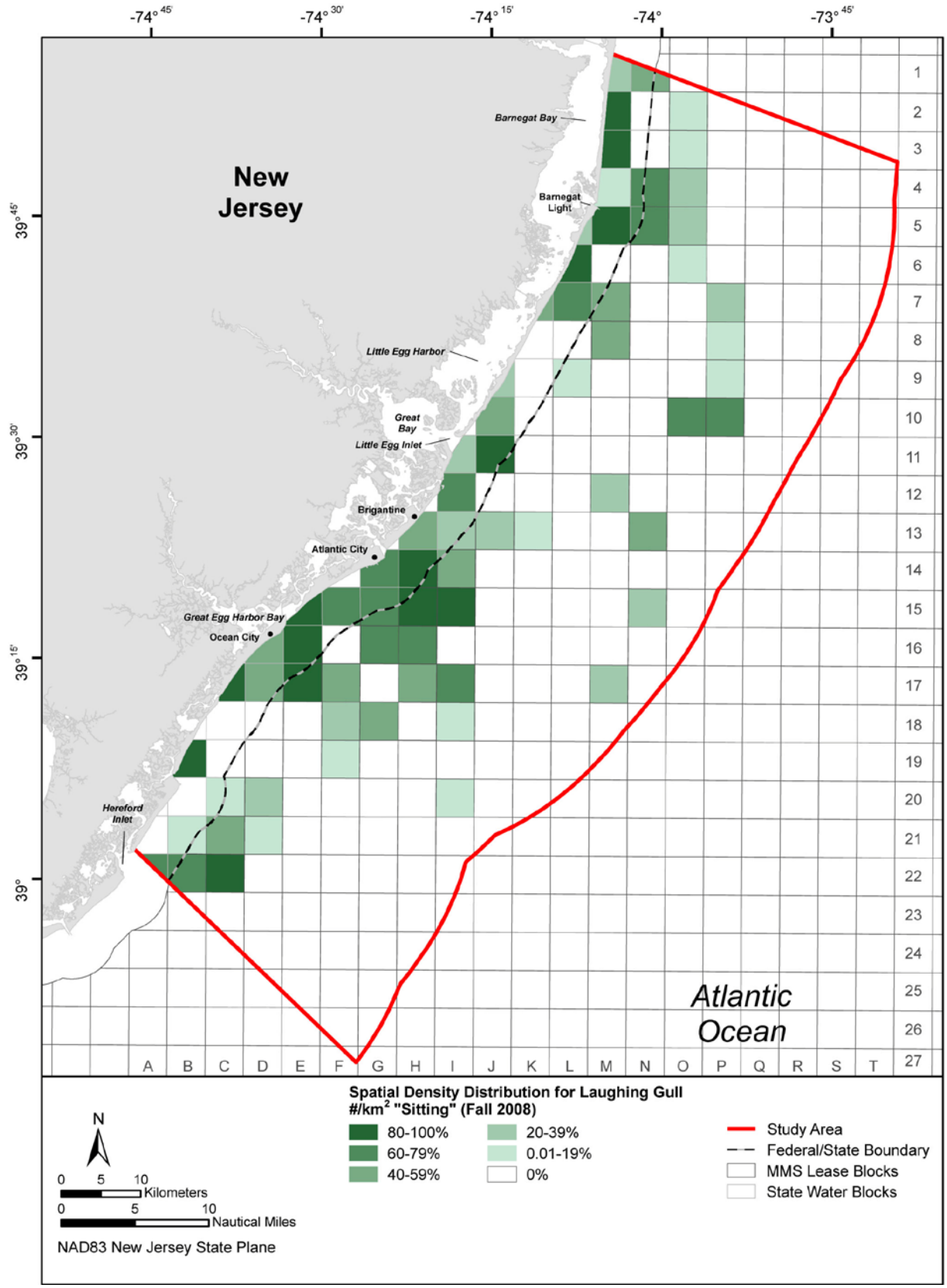

Figure C-253. Percentile abundance of Laughing Gull (sitting), Fall 2008 (August-November 2008) (n=1,433).

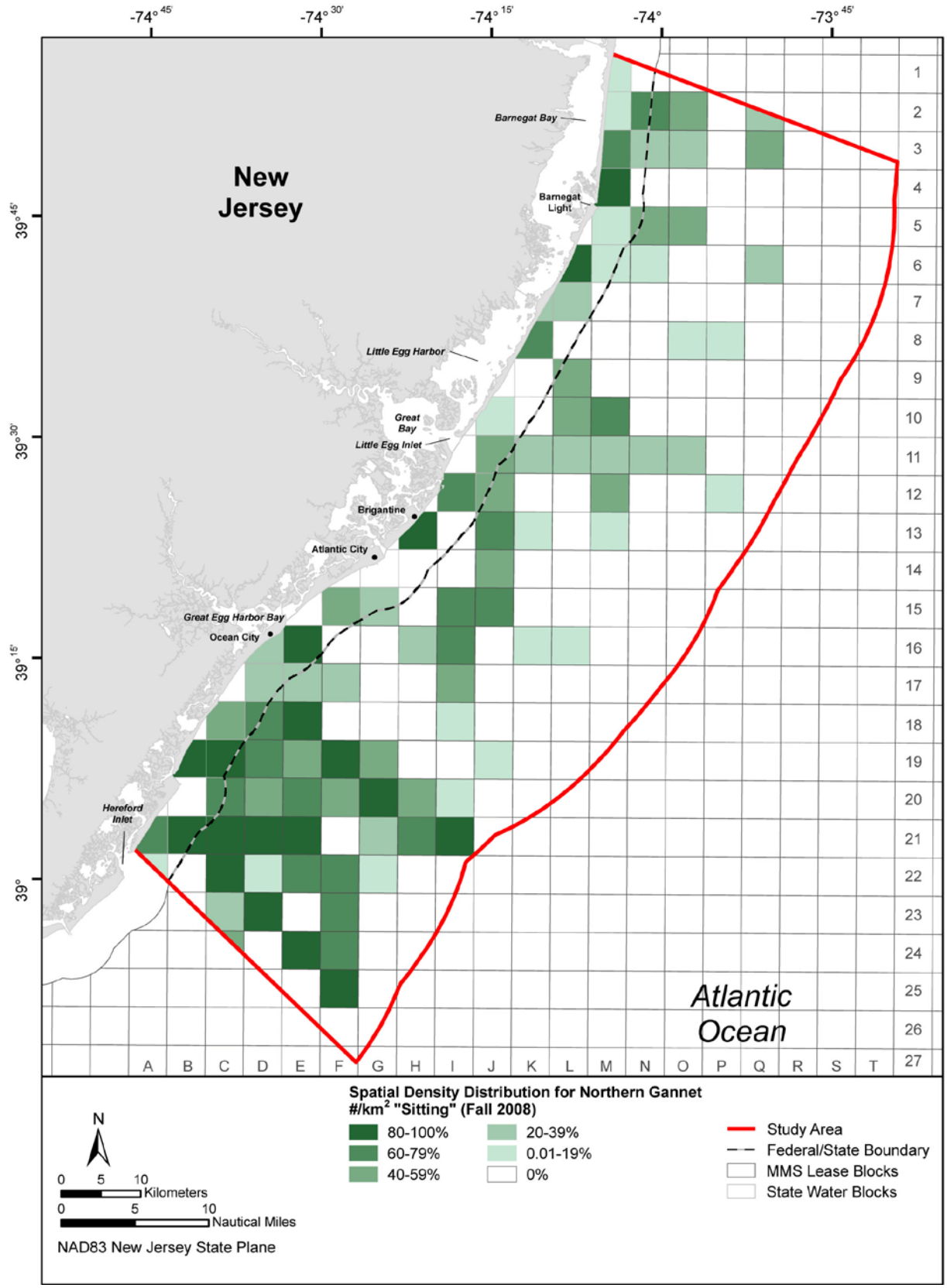

Figure C-254. Percentile abundance of Northern Gannet (sitting), Fall 2008 (August-November 2008) (n=715).

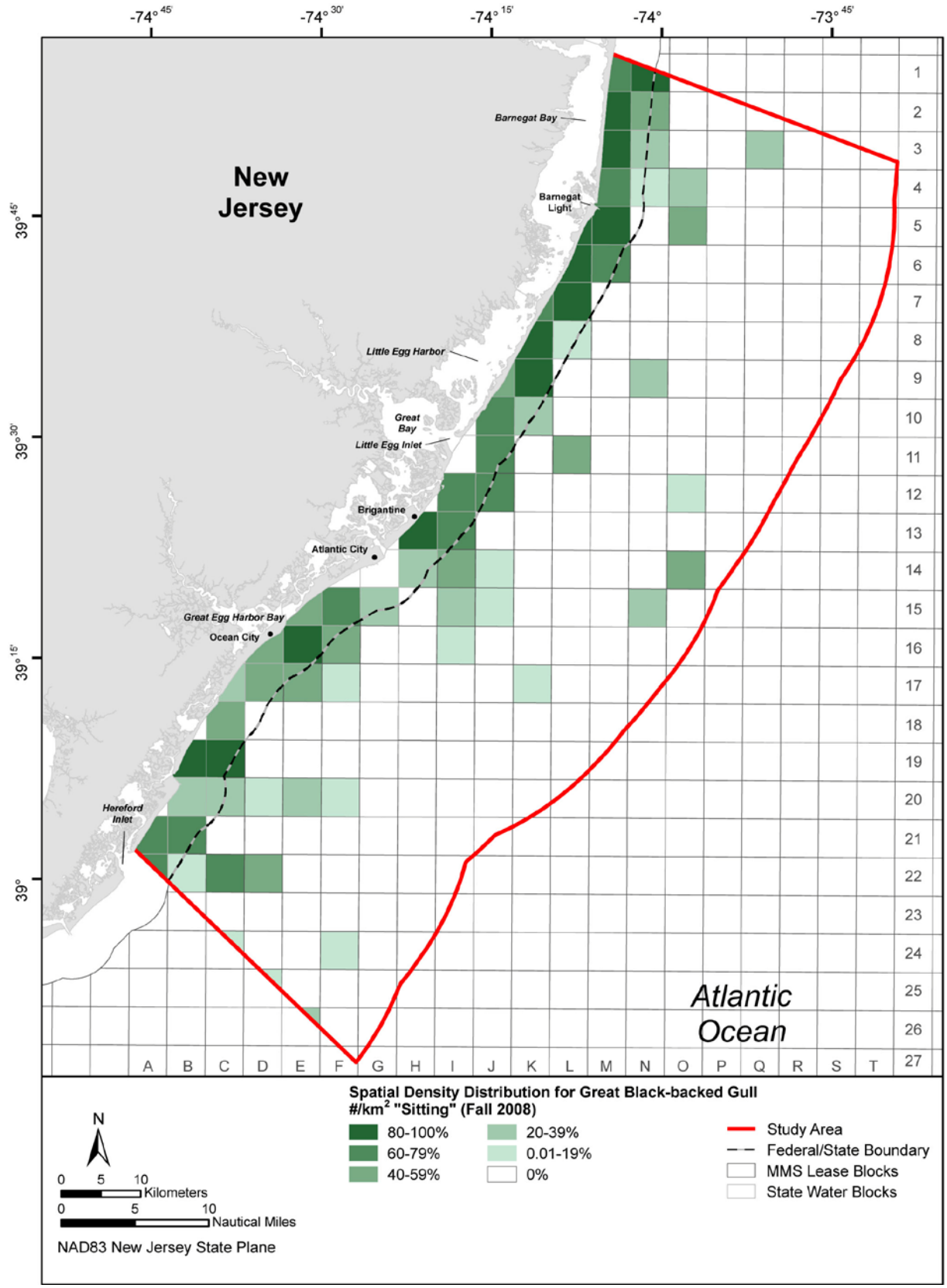

Figure C-255. Percentile abundance of Great Black-backed Gull (sitting), Fall 2008 (August-November 2008) (n=690).

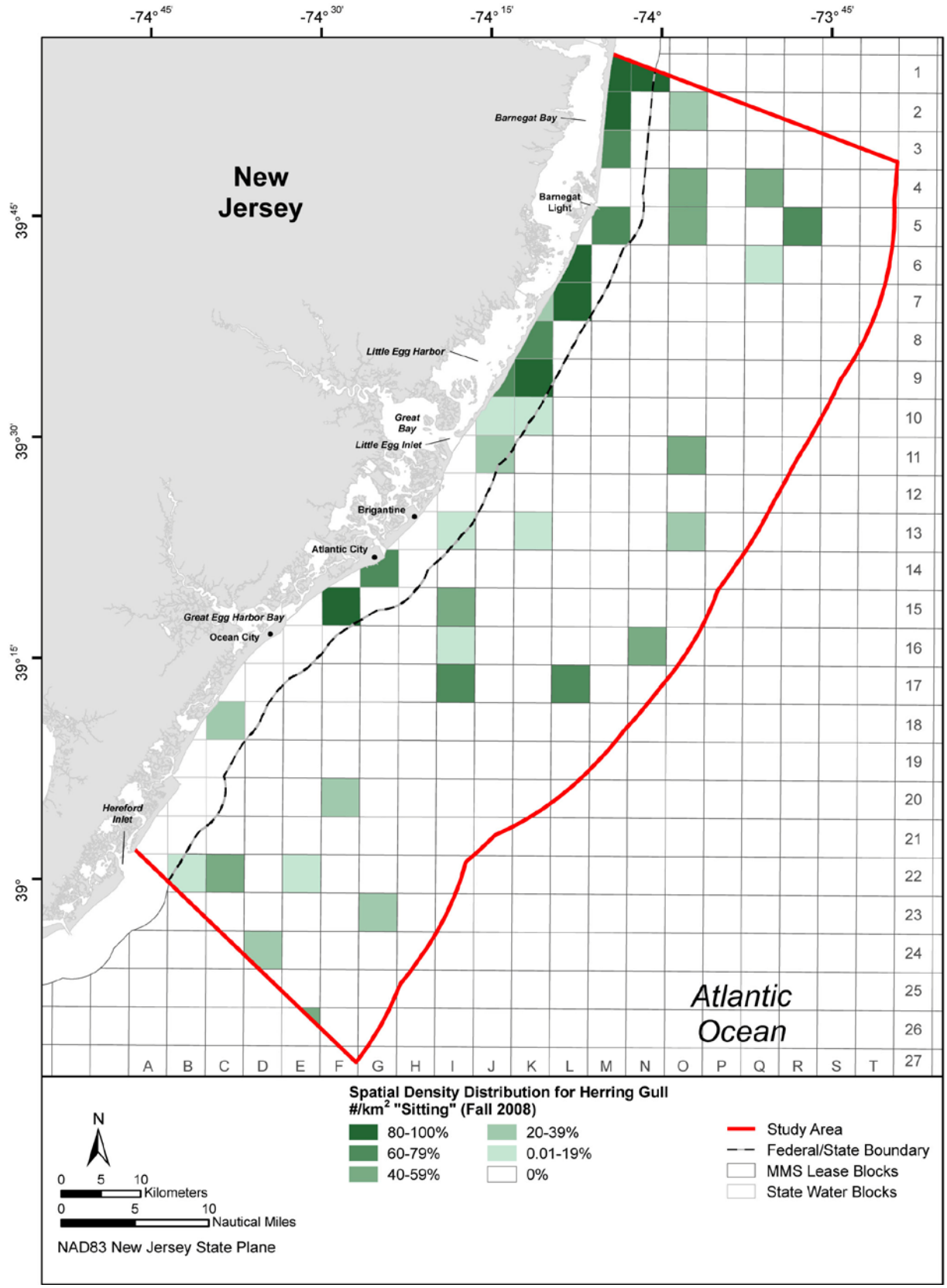

Figure C-256. Percentile abundance of Herring Gull (sitting), Fall 2008 (August-November 2008) (n=365).

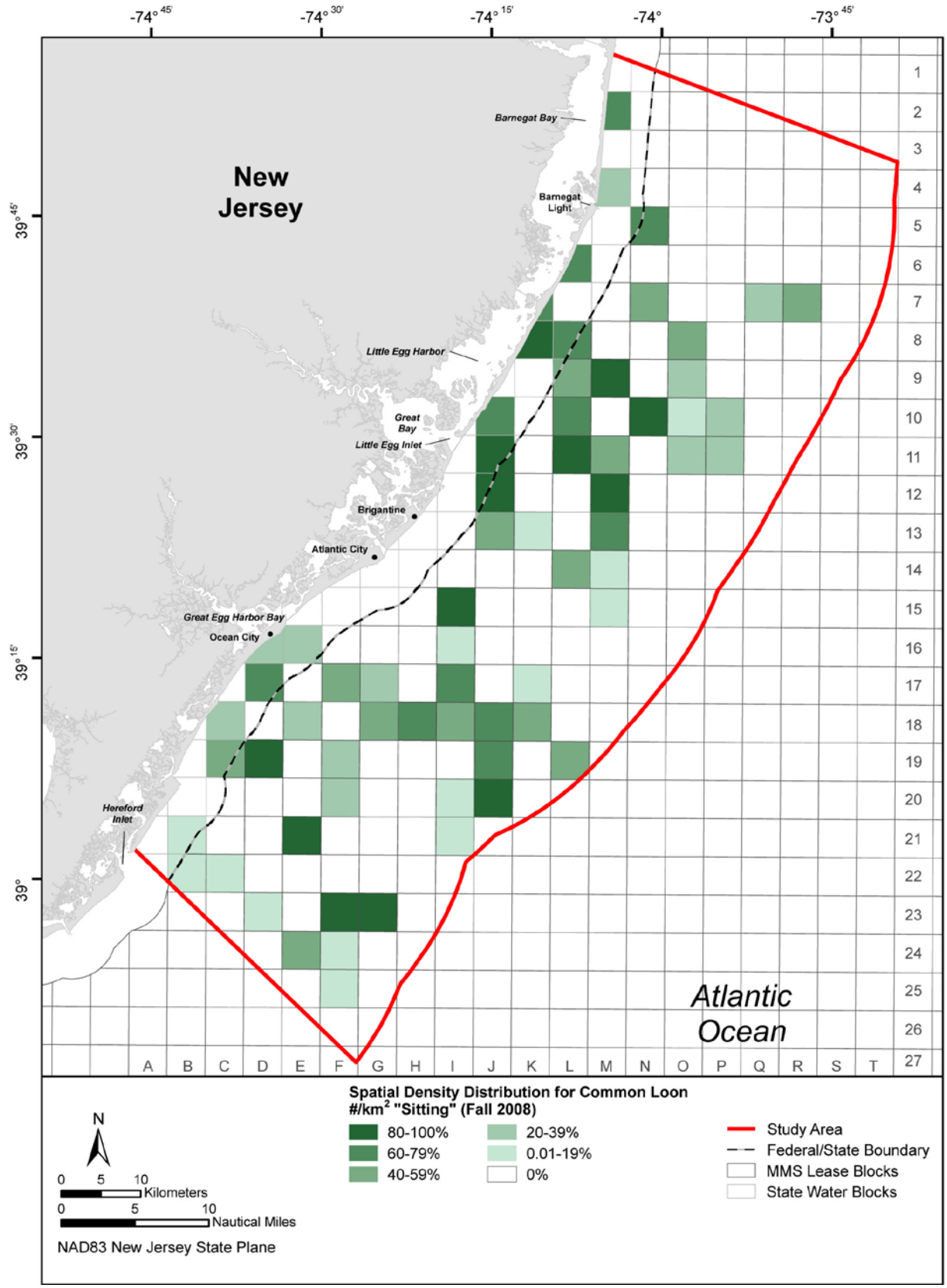

Figure C-257. Percentile abundance of Common Loon (sitting), Fall 2008 (August-November 2008) (n=233).

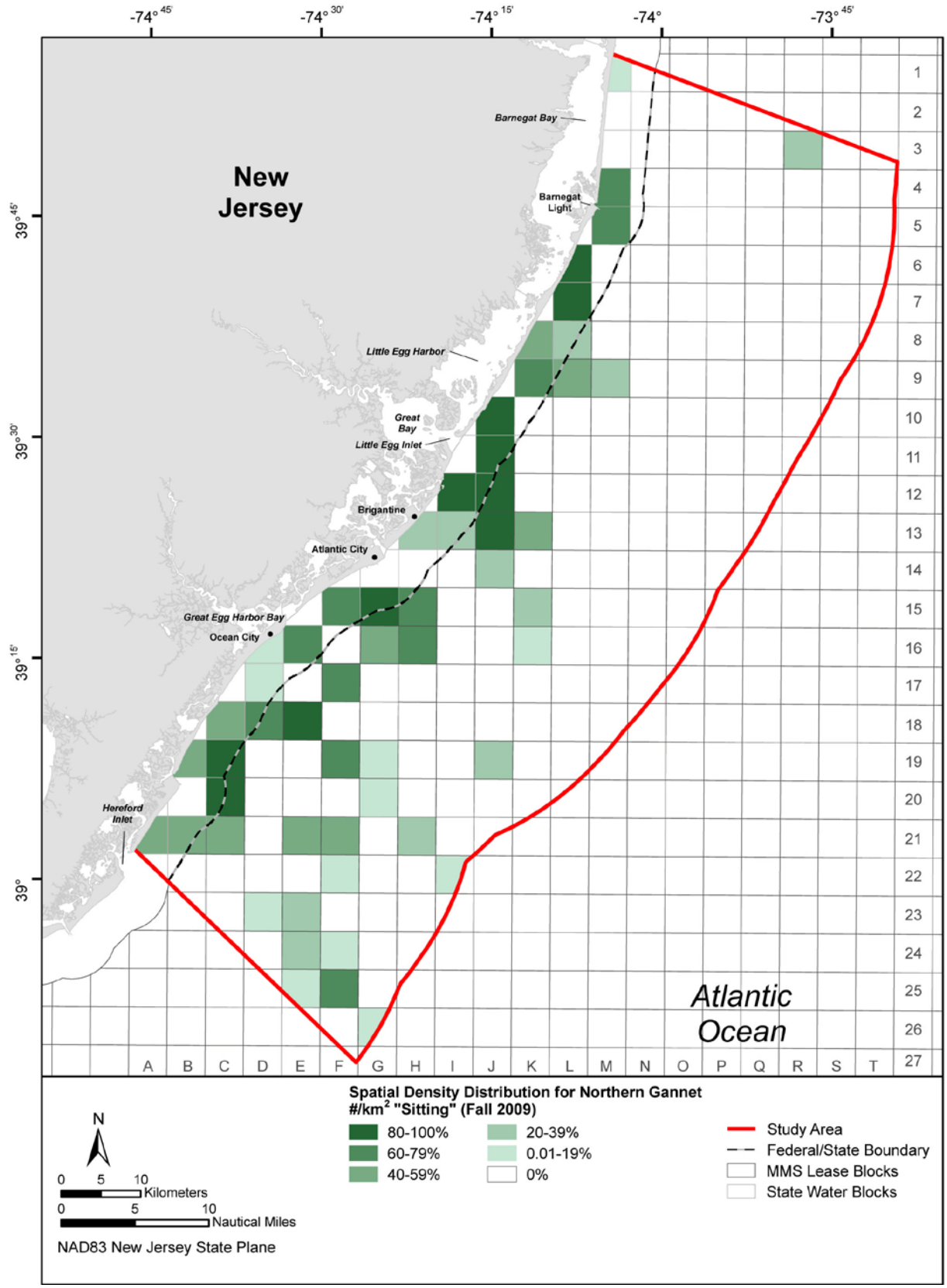

Figure C-258. Percentile abundance of Northern Gannet (sitting), Fall 2009 (August-November 2009) (n=1,001).

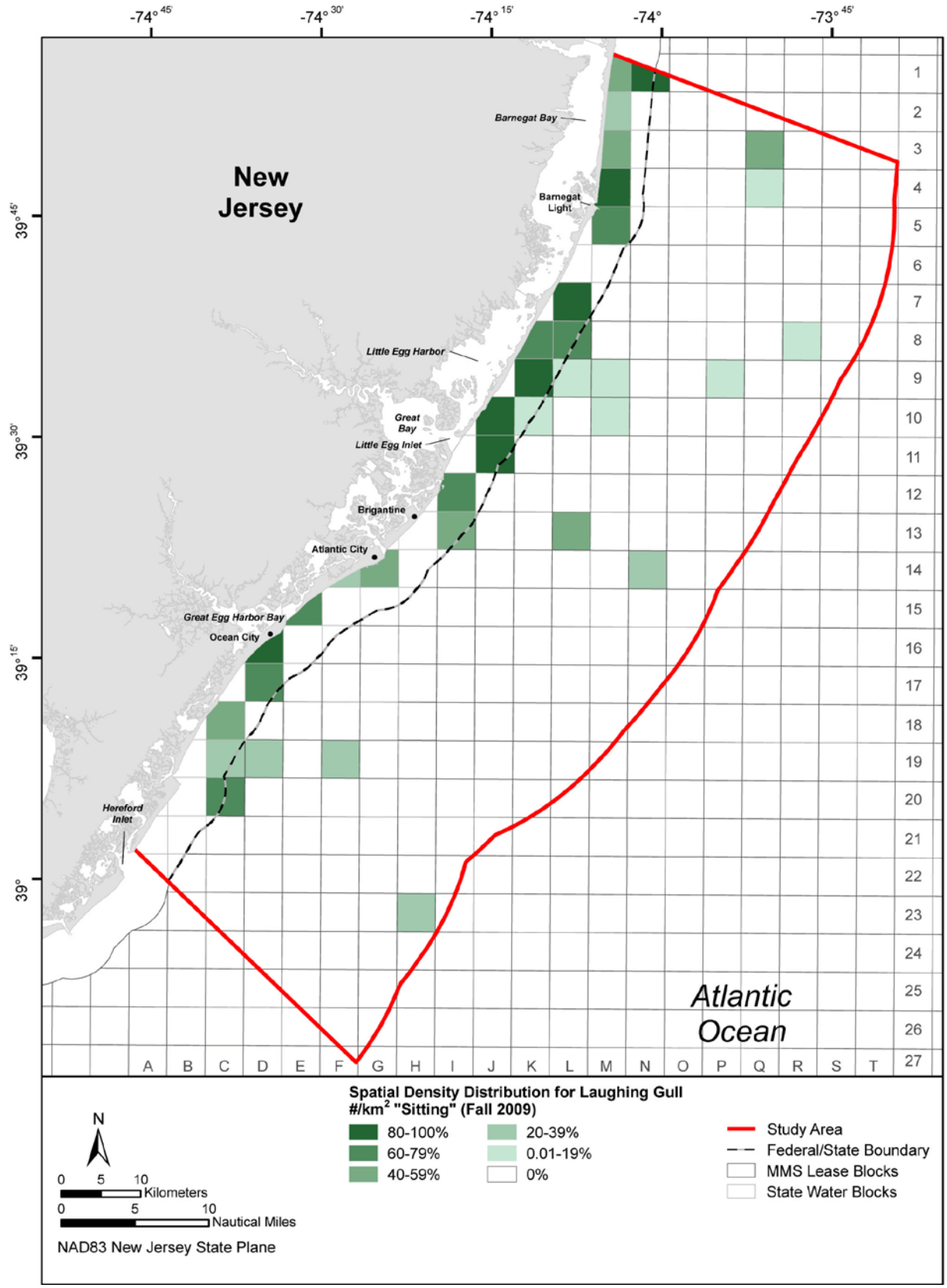

Figure C-259. Percentile abundance of Laughing Gull (sitting), Fall 2009 (August-November 2009) (n=539).

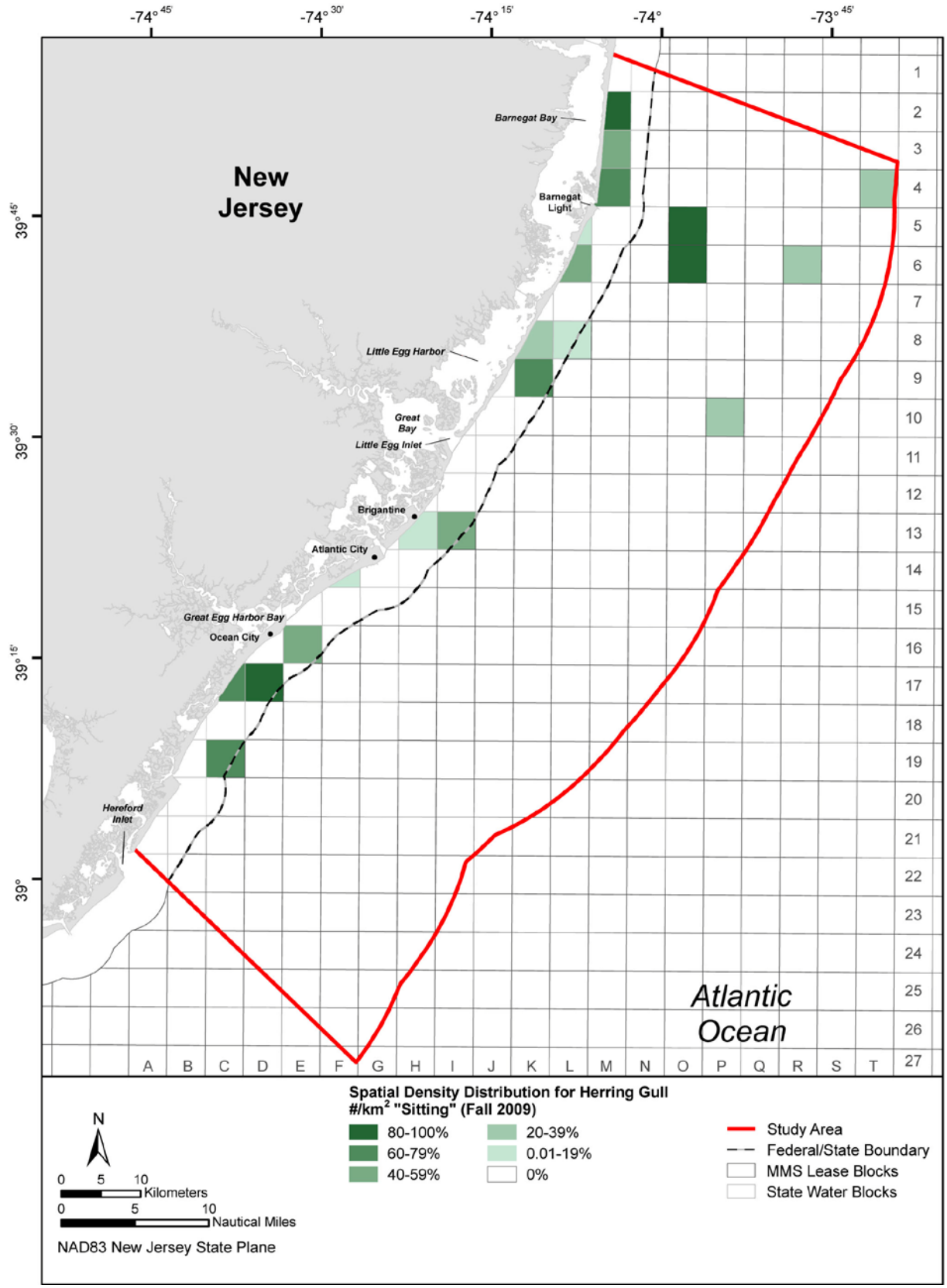

Figure C-260. Percentile abundance of Herring Gull (sitting), Fall 2009 (August-November 2009) (n=332).

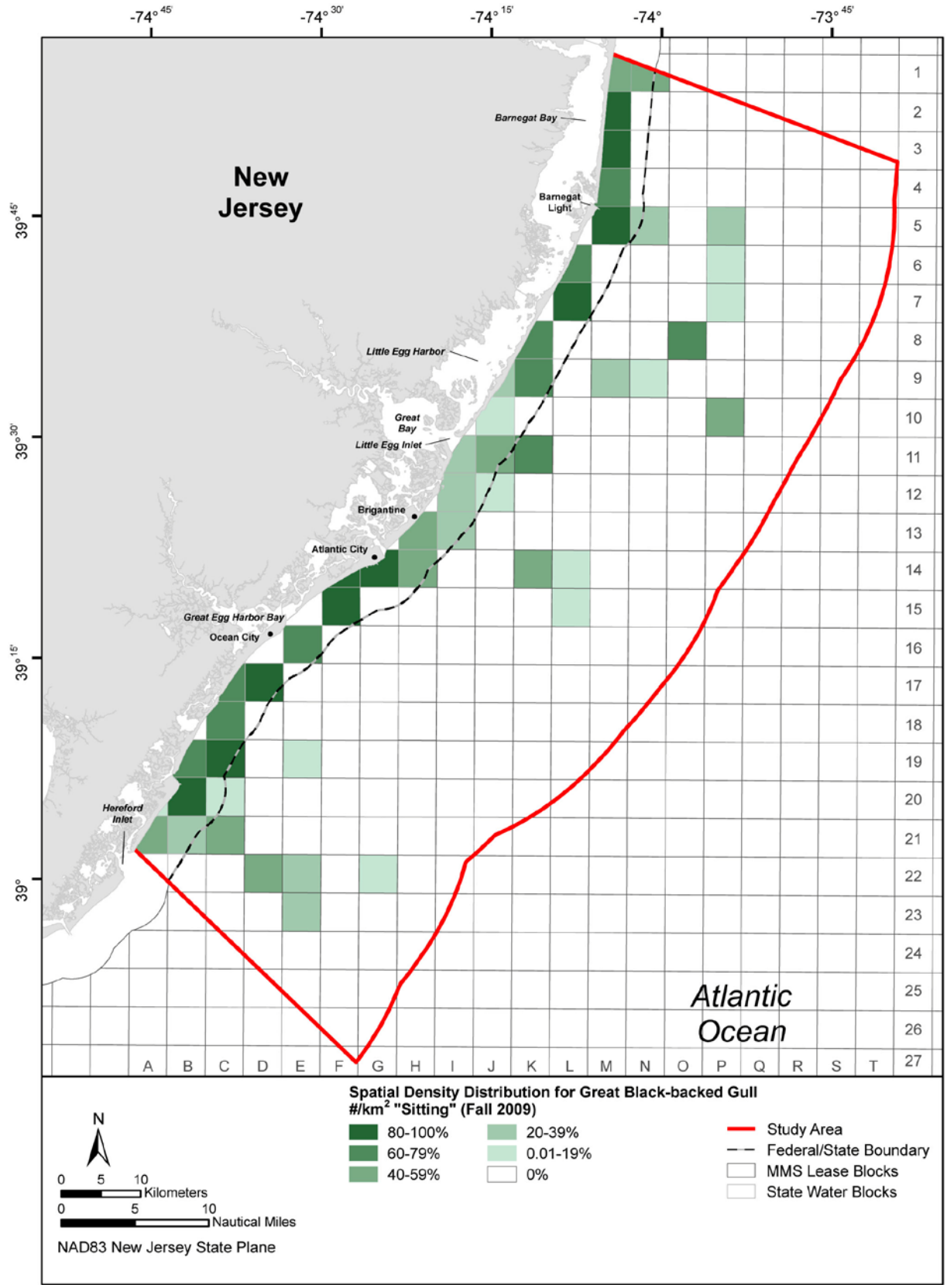

Figure C-261. Percentile abundance of Great Black-backed Gull (sitting), Fall 2009 (August-November 2009) (n=276).

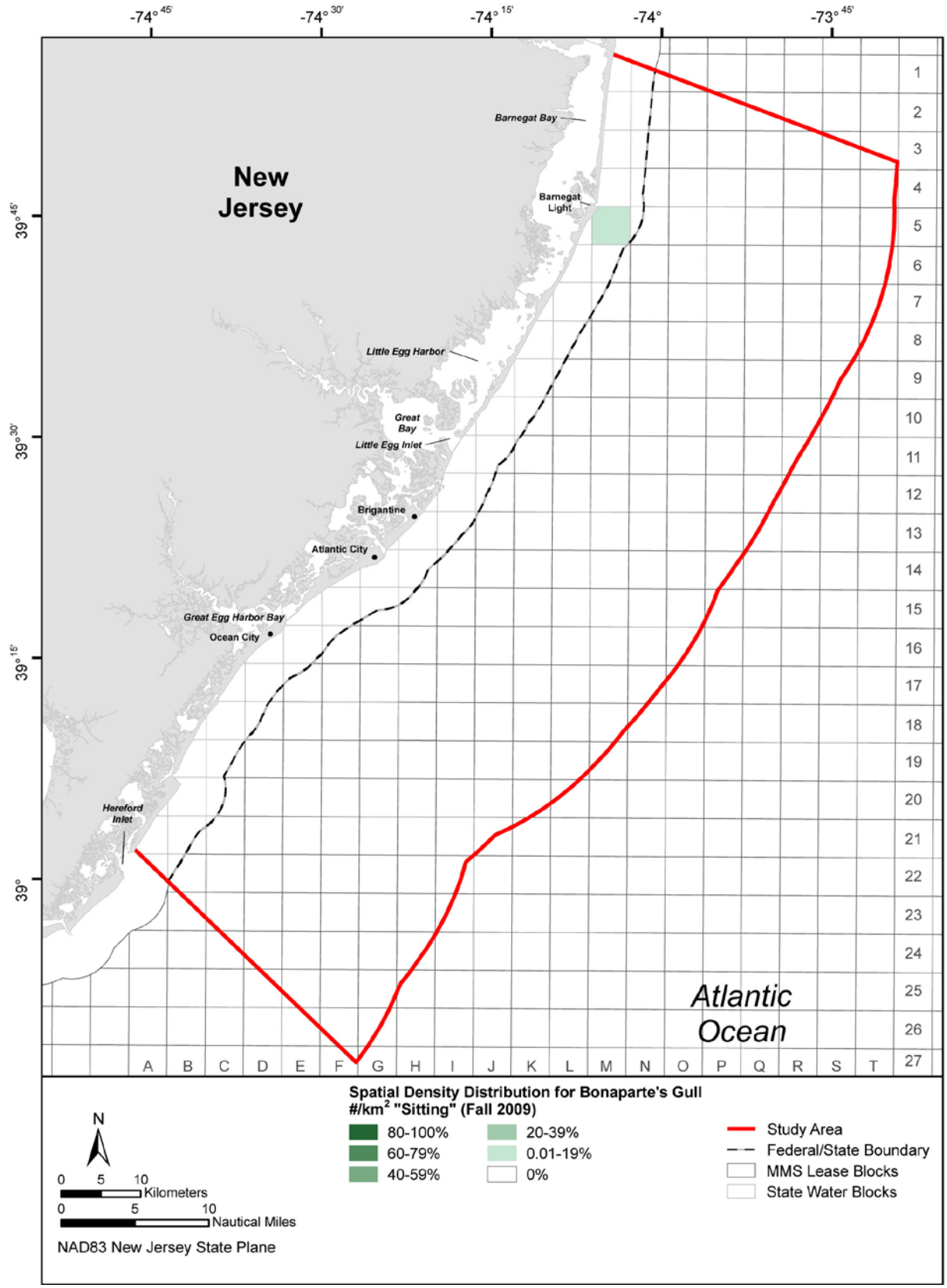

Figure C-262. Percentile abundance of Bonaparte's Gull (sitting), Fall 2009 (August-November 2009) (n=213).

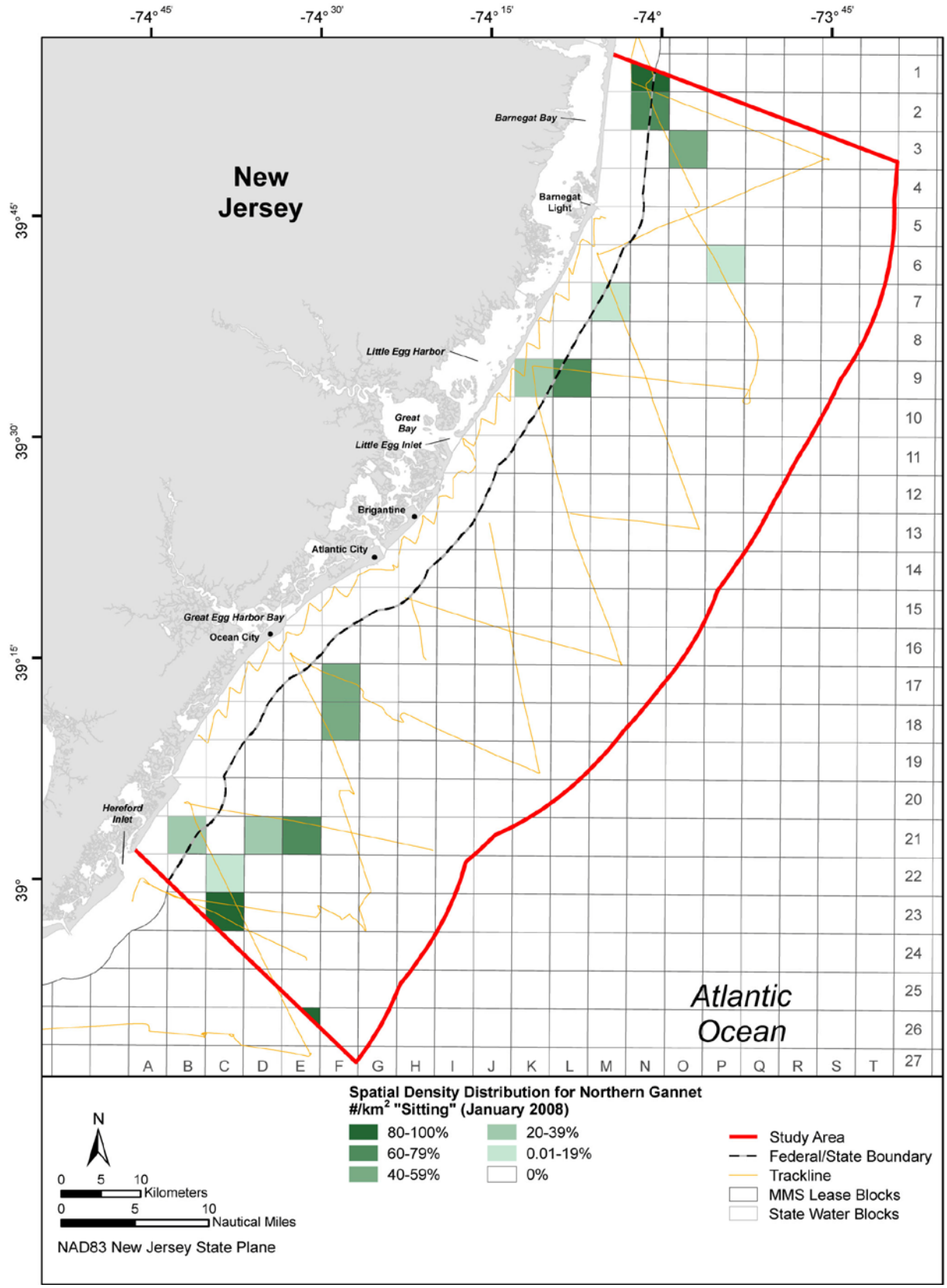

Figure C-263. Percentile abundance of Northern Gannet (sitting), January 2008 (n=88).

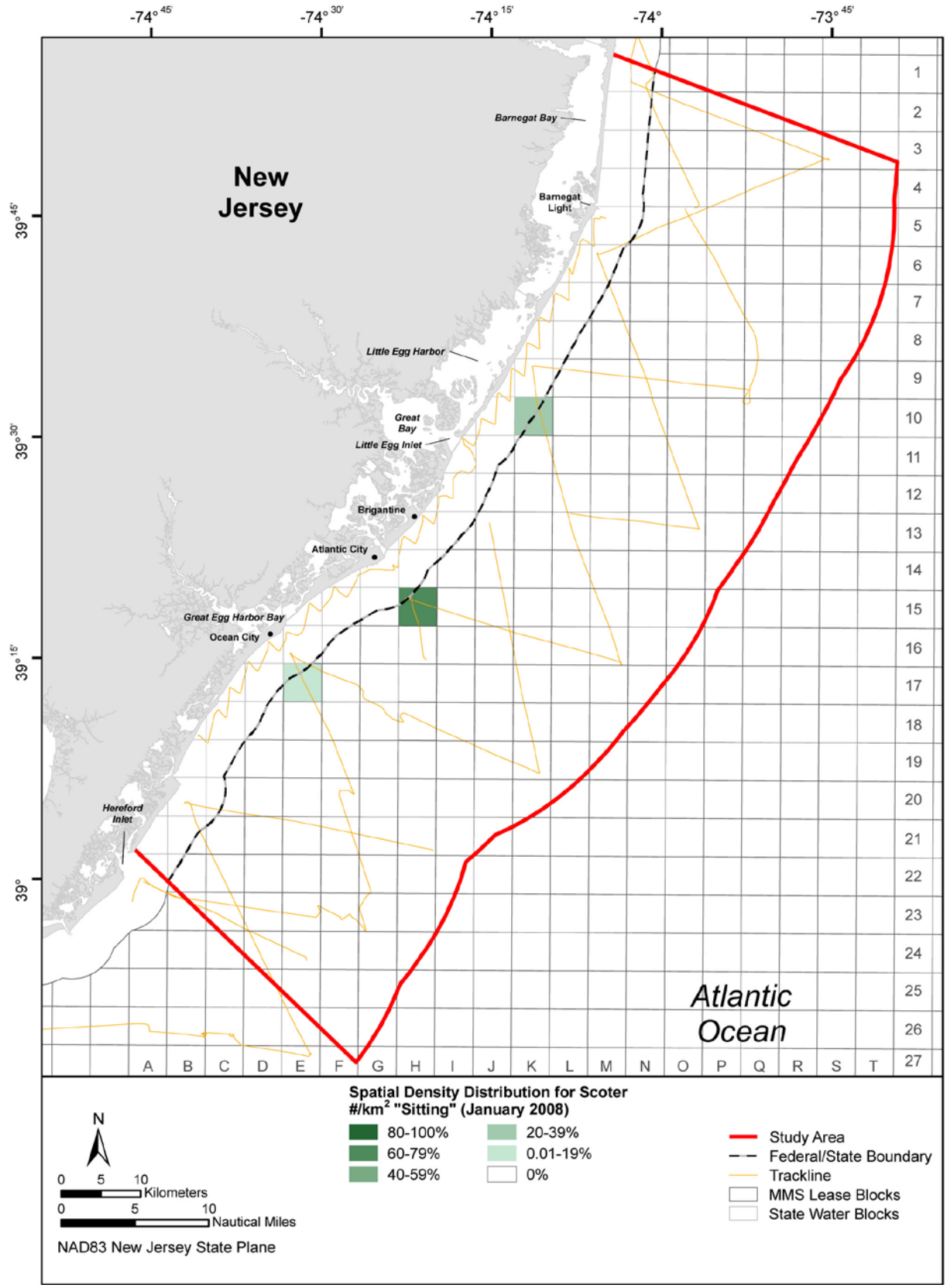

Figure C-264. Percentile abundance of scoters (sitting), January 2008 (n=31).

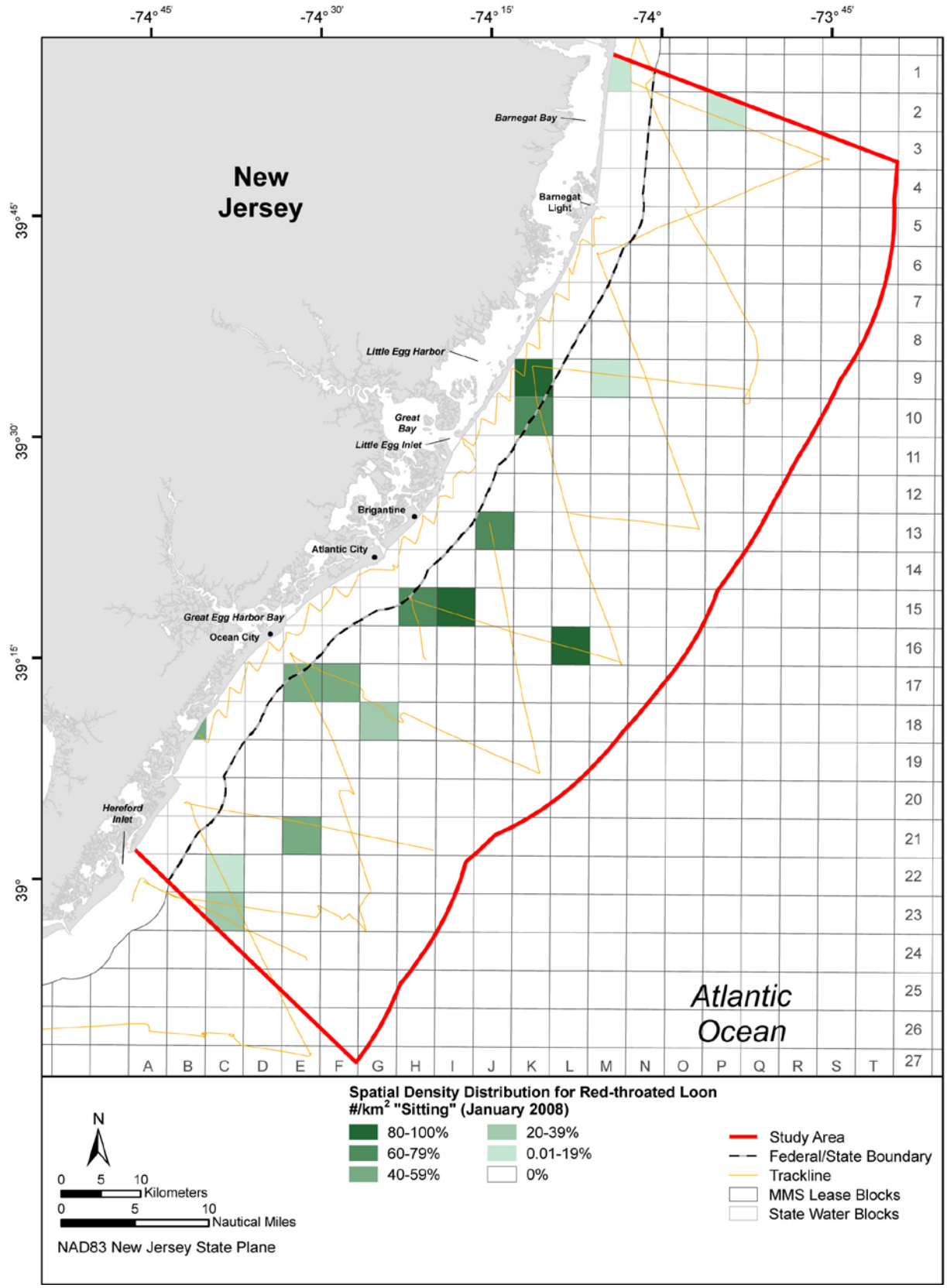

Figure C-265. Percentile abundance of Red-throated Loon (sitting), January 2008 (n=30).

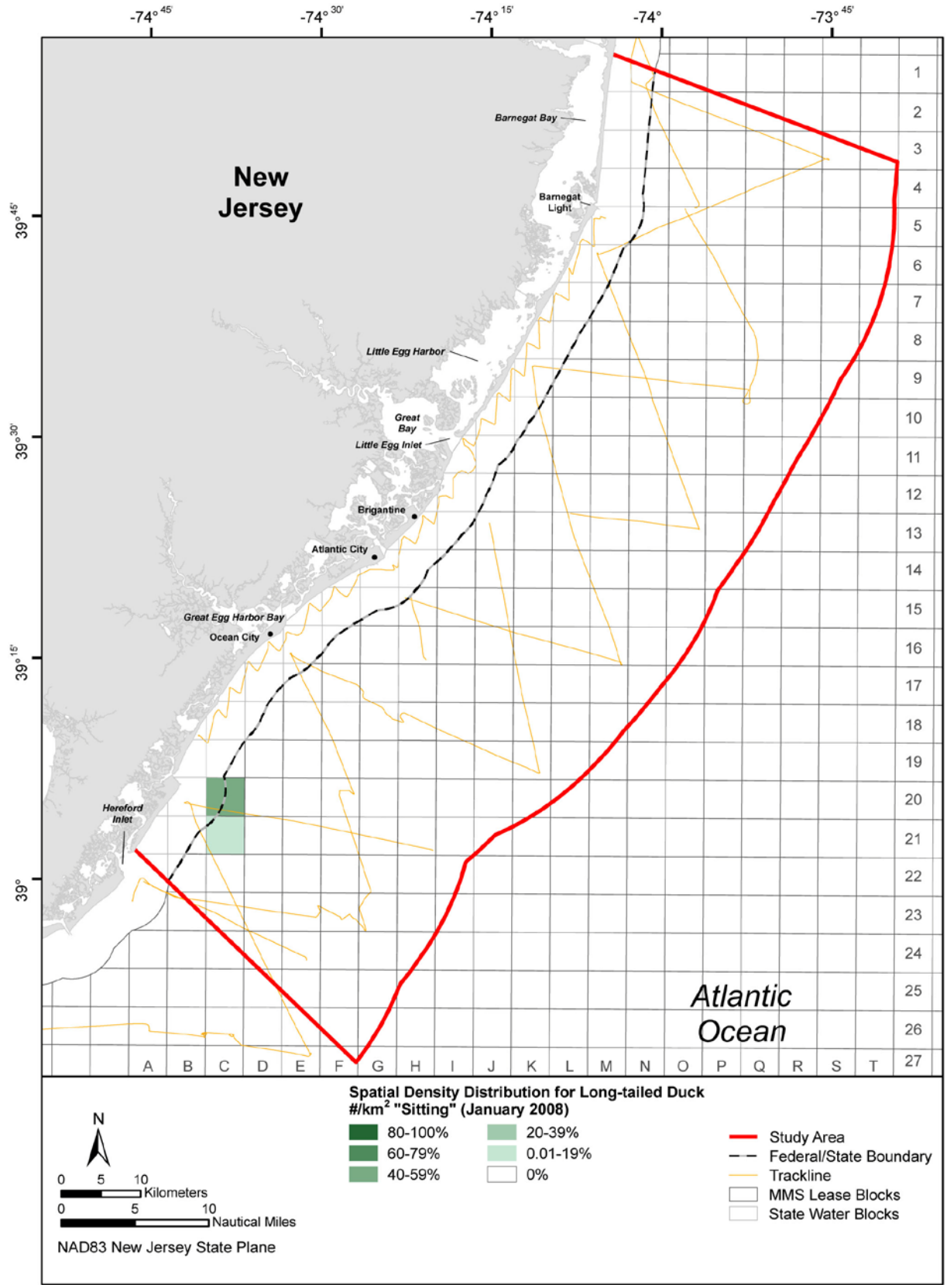

Figure C-266. Percentile abundance of Long-tailed Duck (sitting), January 2008 (n=10).

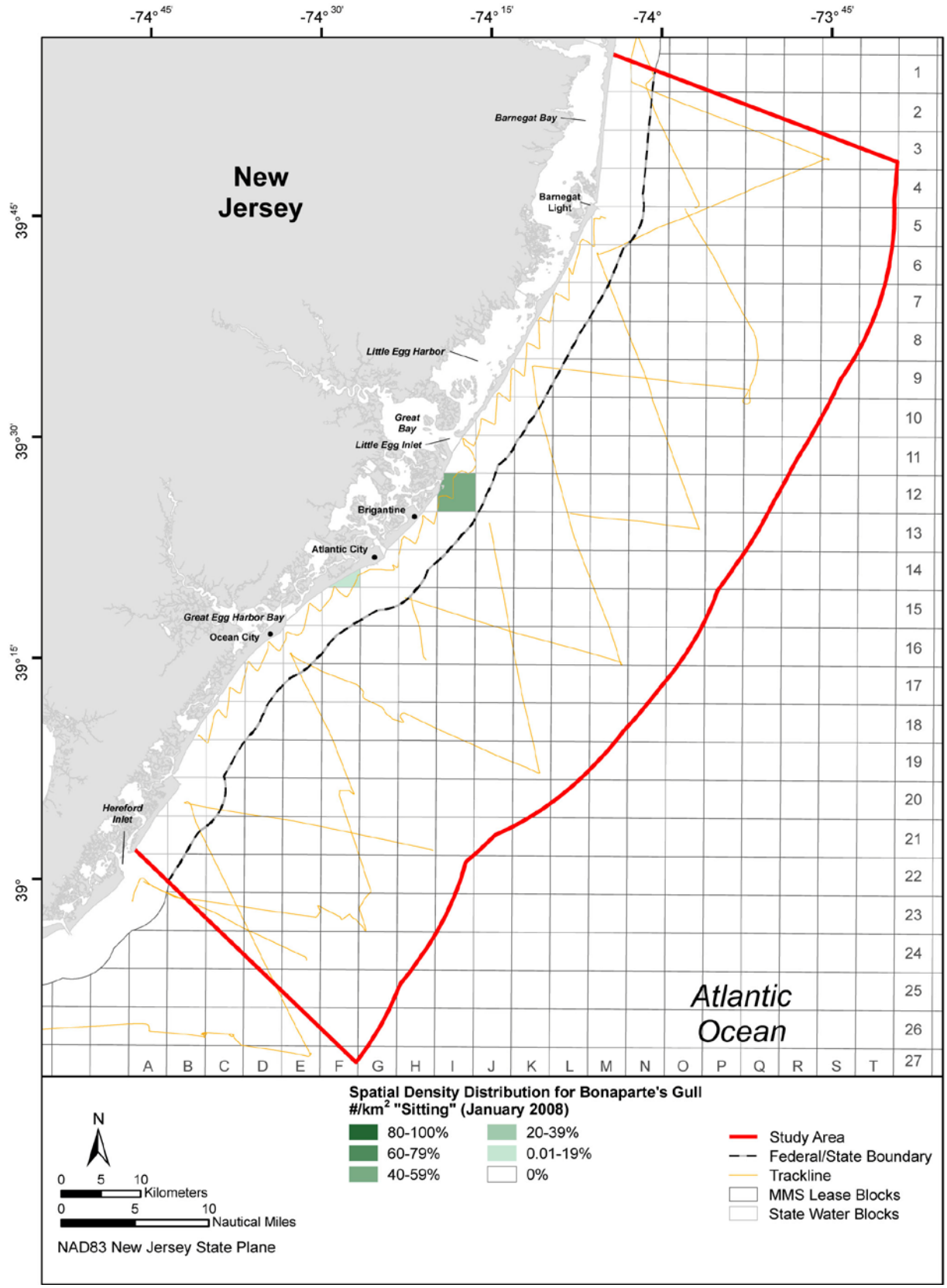

Figure C-267. Percentile abundance of Bonaparte's Gull (sitting), January 2008 (n=5).

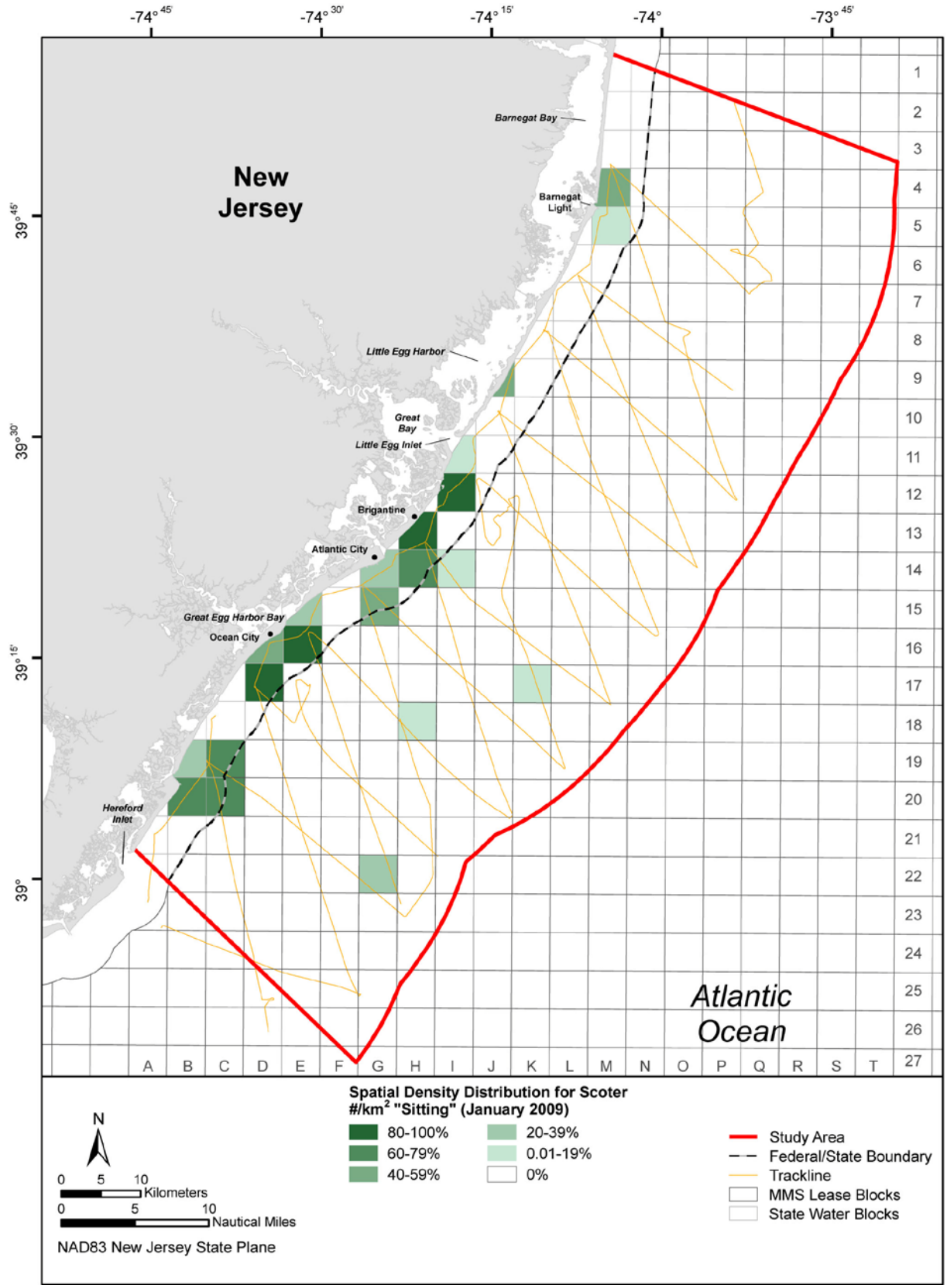

Figure C-268. Percentile abundance of scoters (sitting), January 2009 (n=1,891).

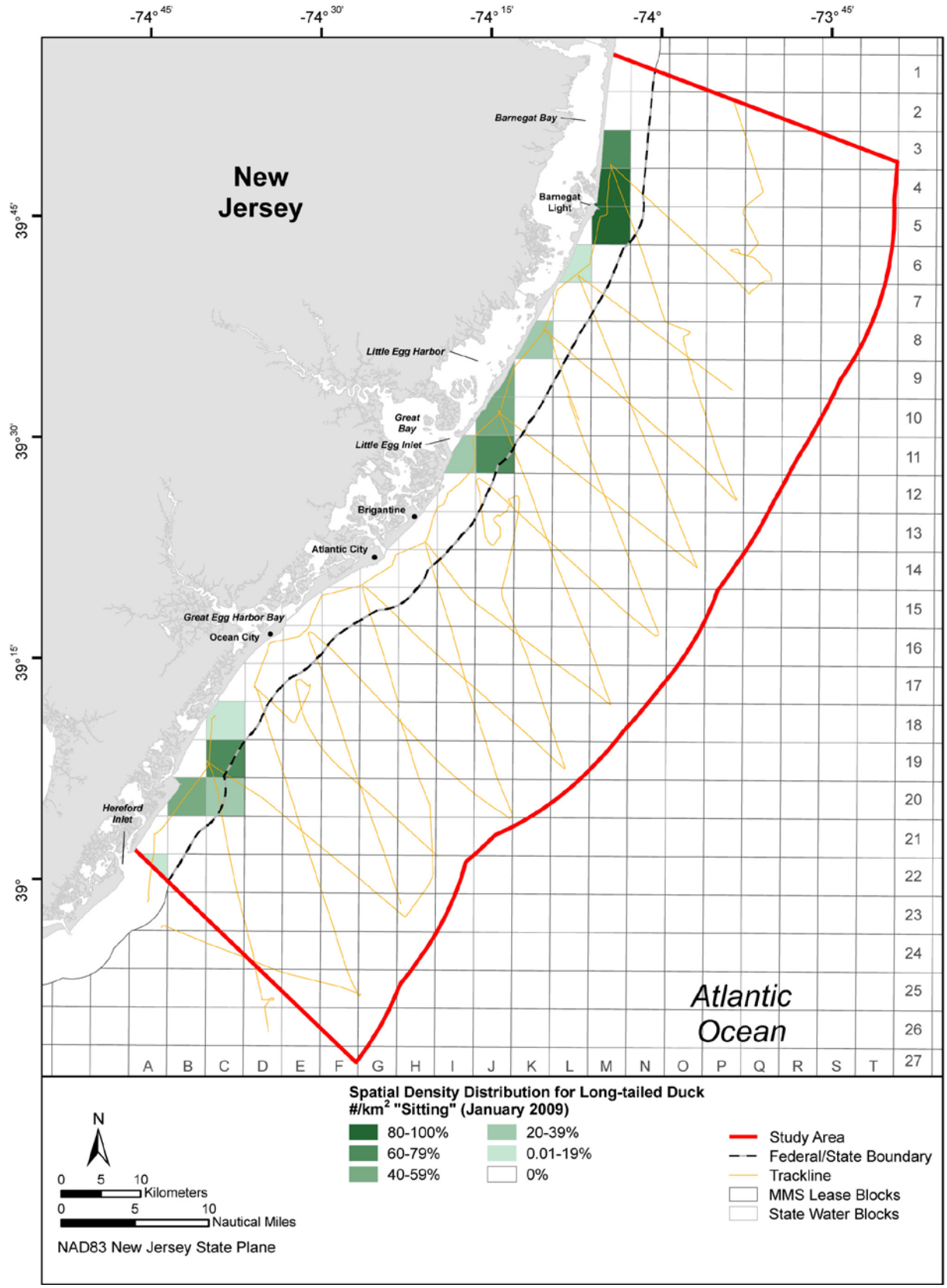

Figure C-269. Percentile abundance of Long-tailed Duck (sitting), January 2009 (n=753).

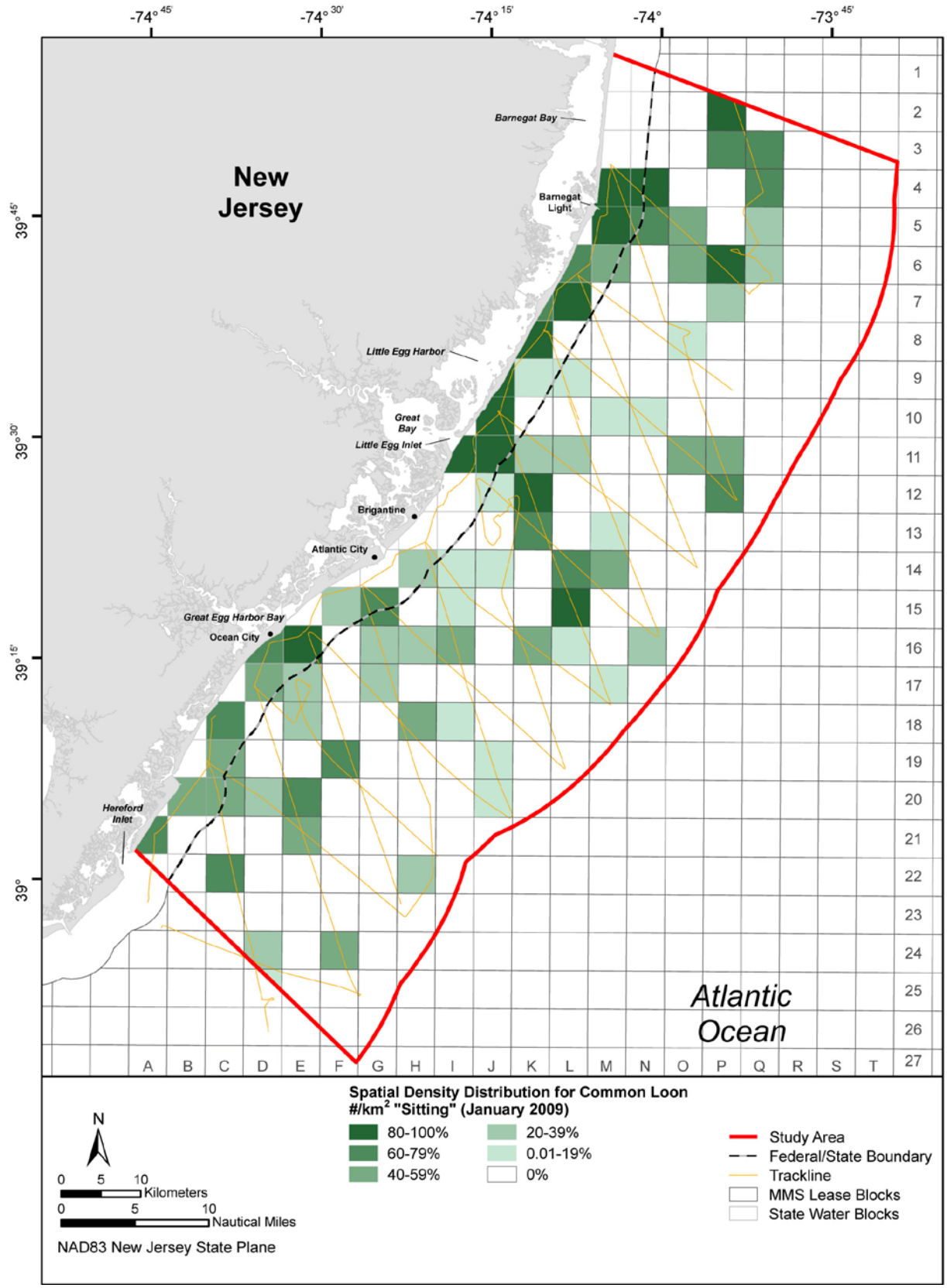

Figure C-270. Percentile abundance of Common Loon (sitting), January 2009 (n=306).

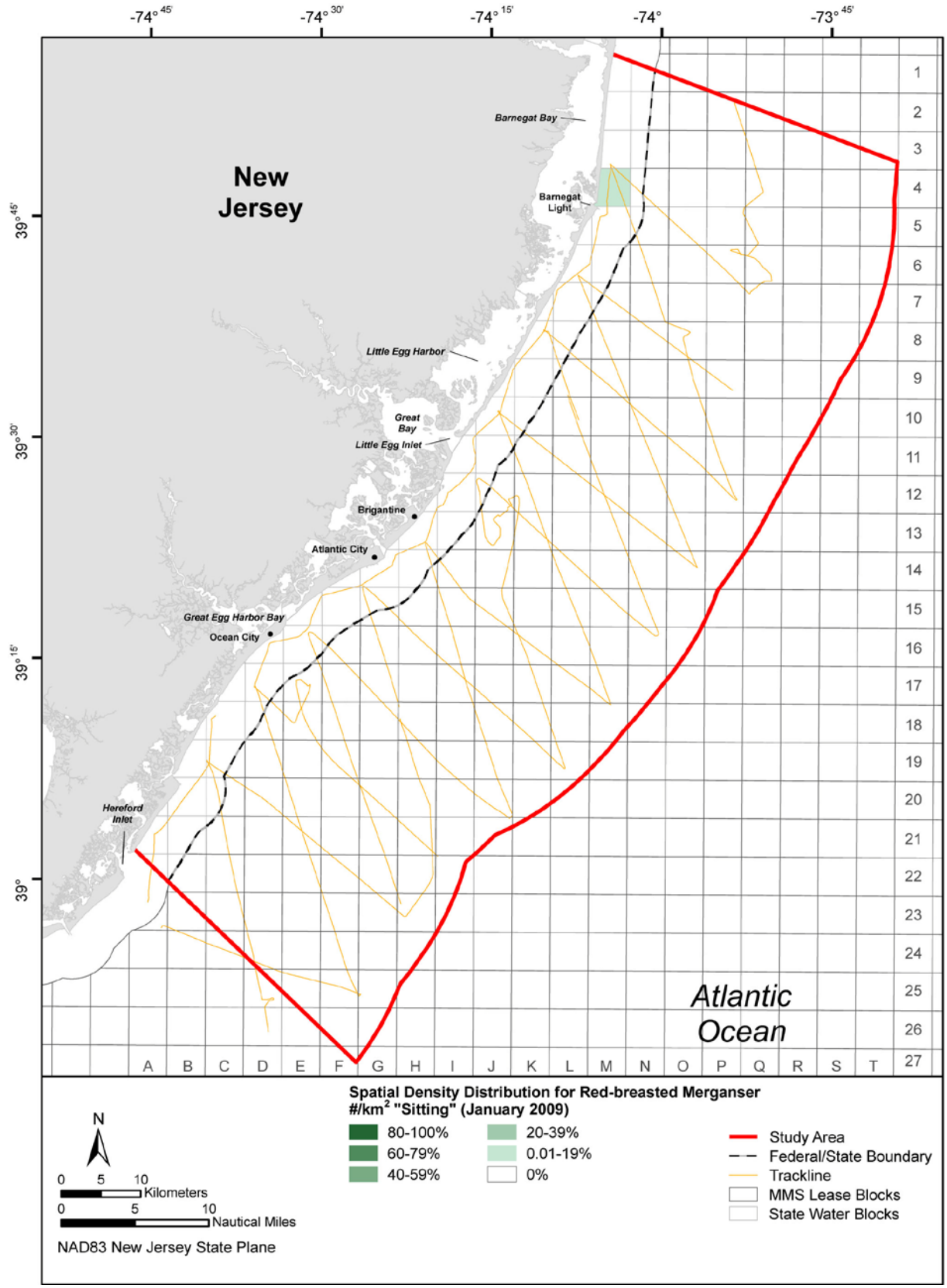

Figure C-271. Percentile abundance of Red-breasted Merganser (sitting), January 2009 (n=169).

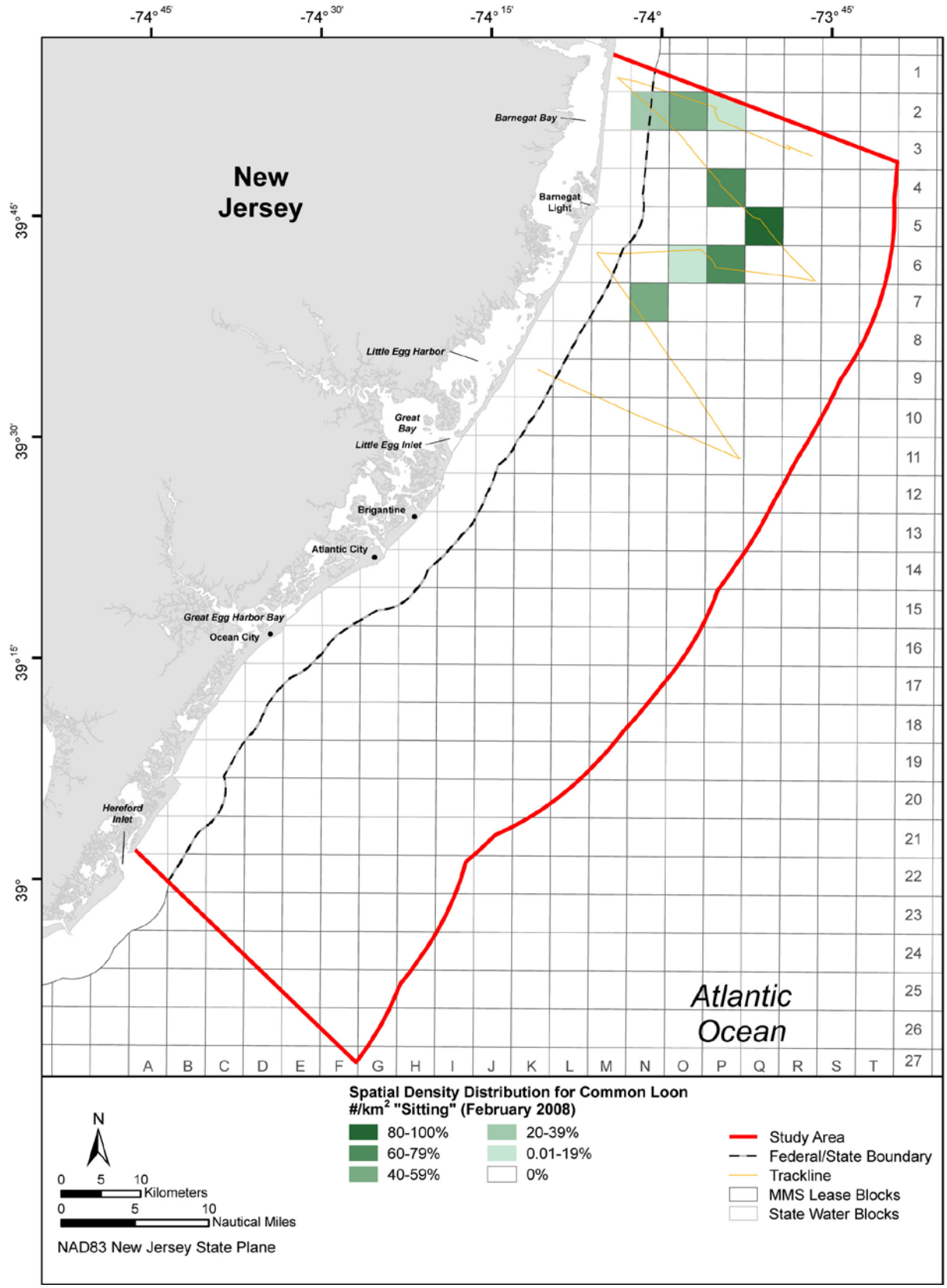

Figure C-272. Percentile abundance of Common Loon (sitting), February 2008 (n=19).

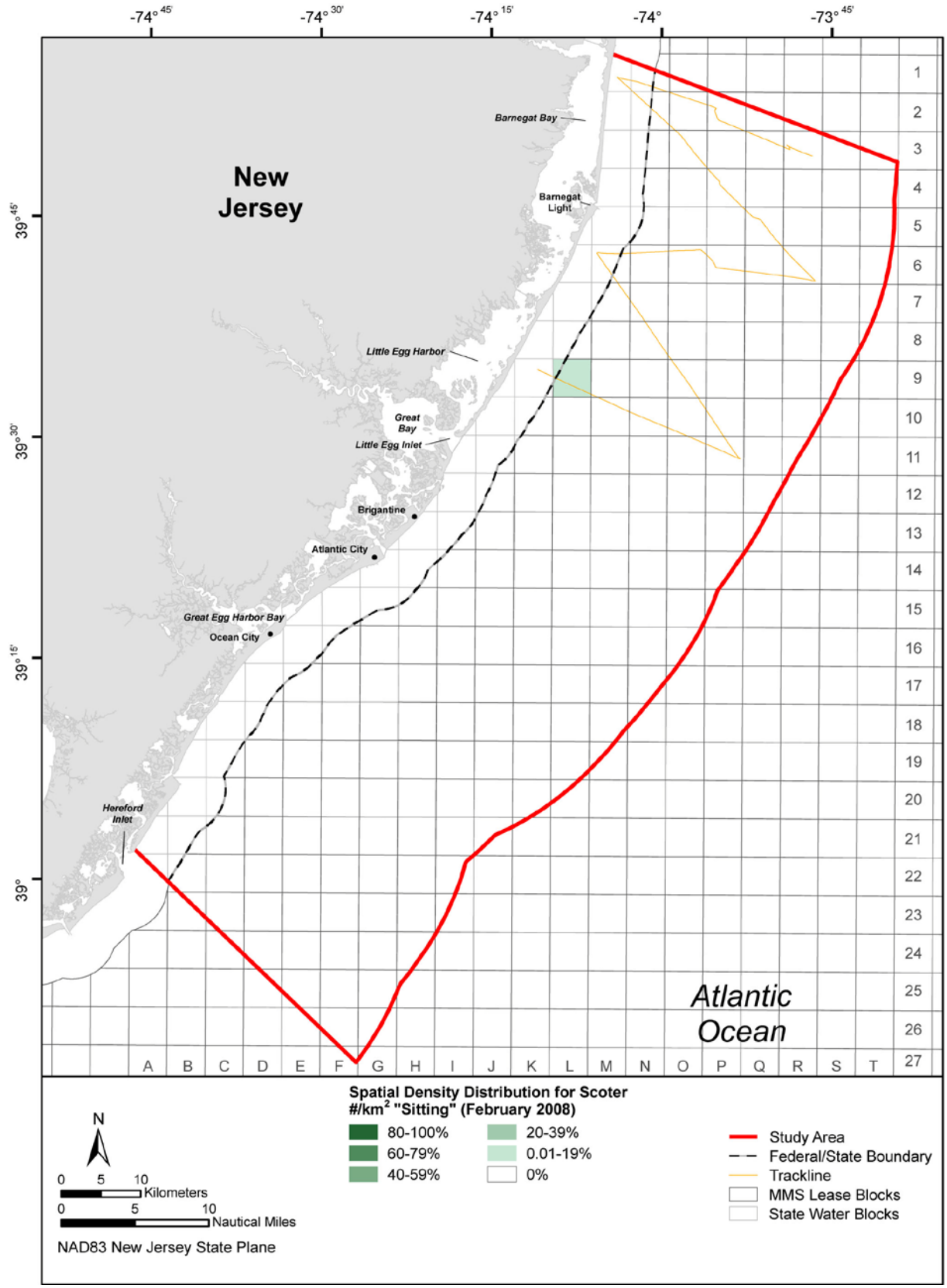

Figure C-273. Percentile abundance of scoters (sitting), February 2008 (n=17).

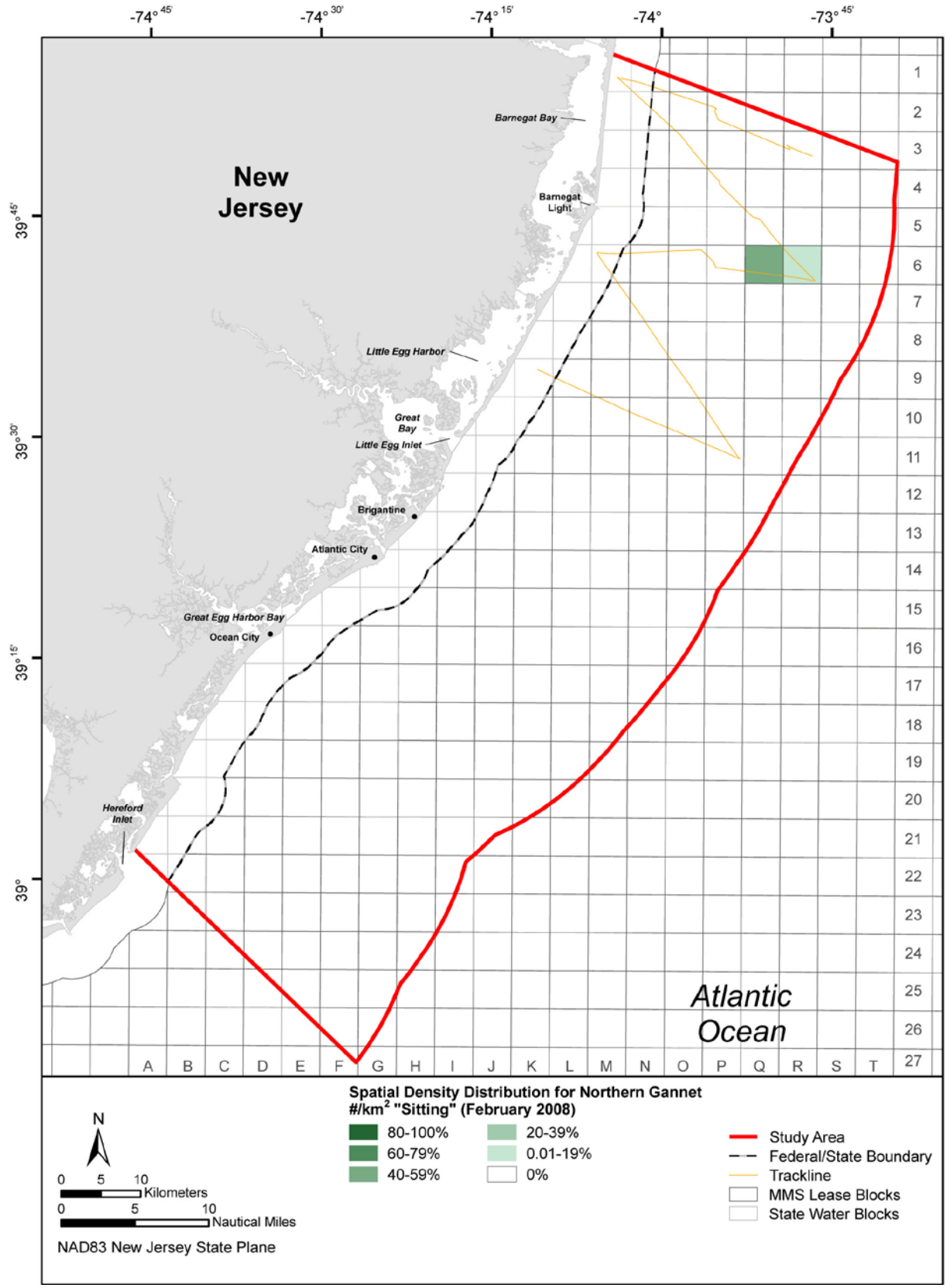

Figure C-274. Percentile abundance of Northern Gannet (sitting), February 2008 (n=2).

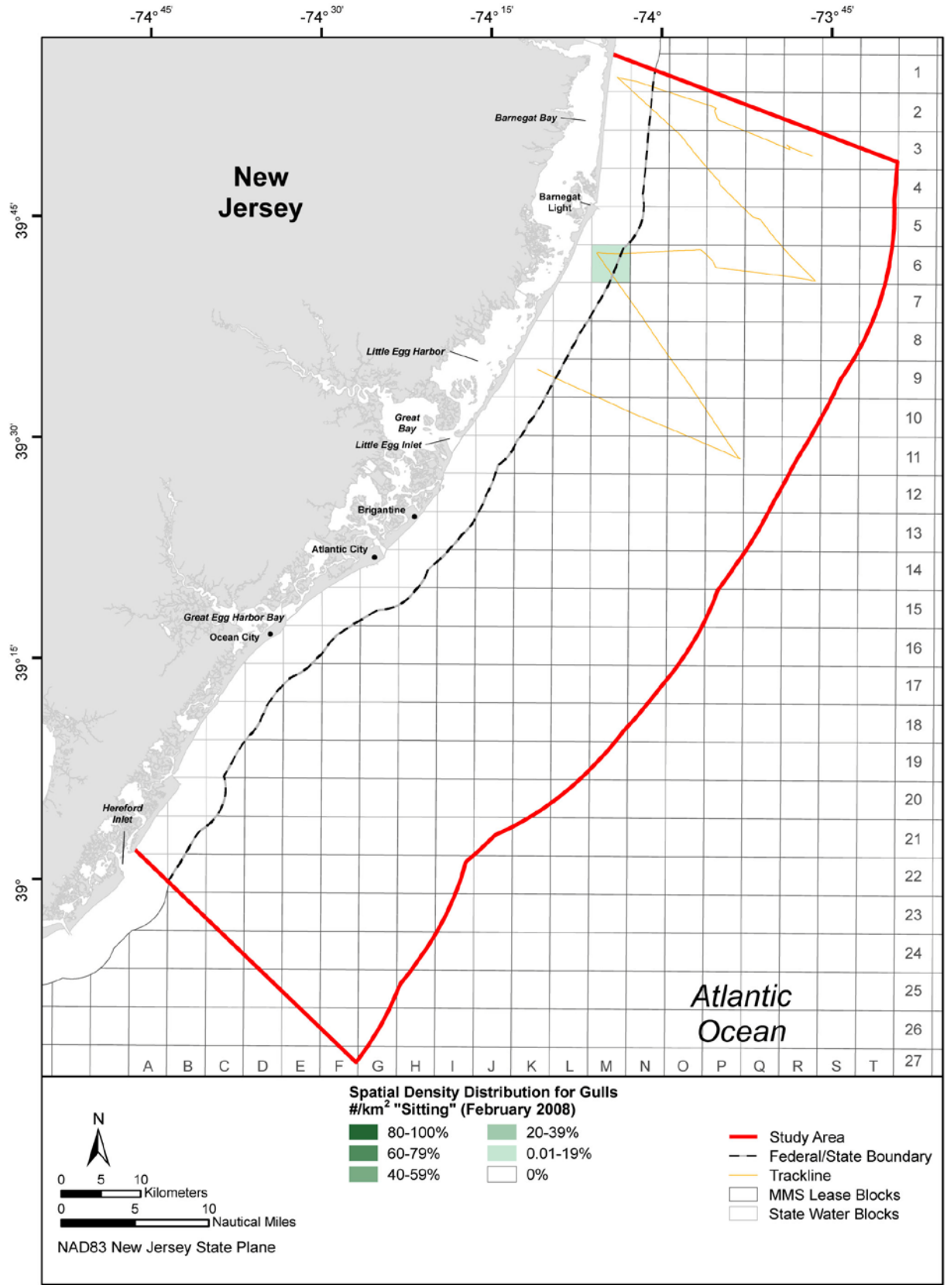

Figure C-275. Percentile abundance of gulls (sitting), February 2008 (n=2).

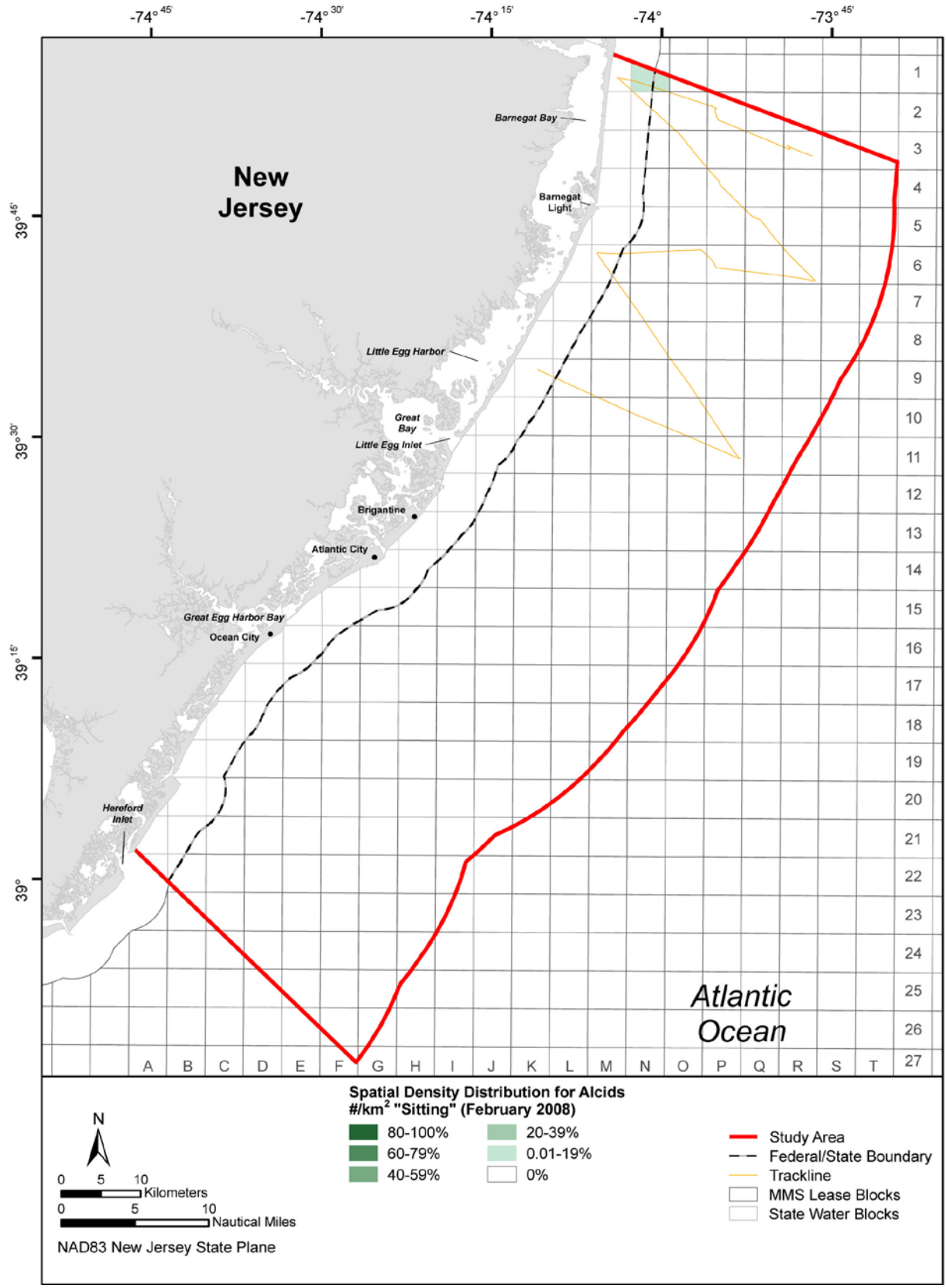

Figure C-276. Percentile abundance of alcids (sitting), February 2008 (n=1).

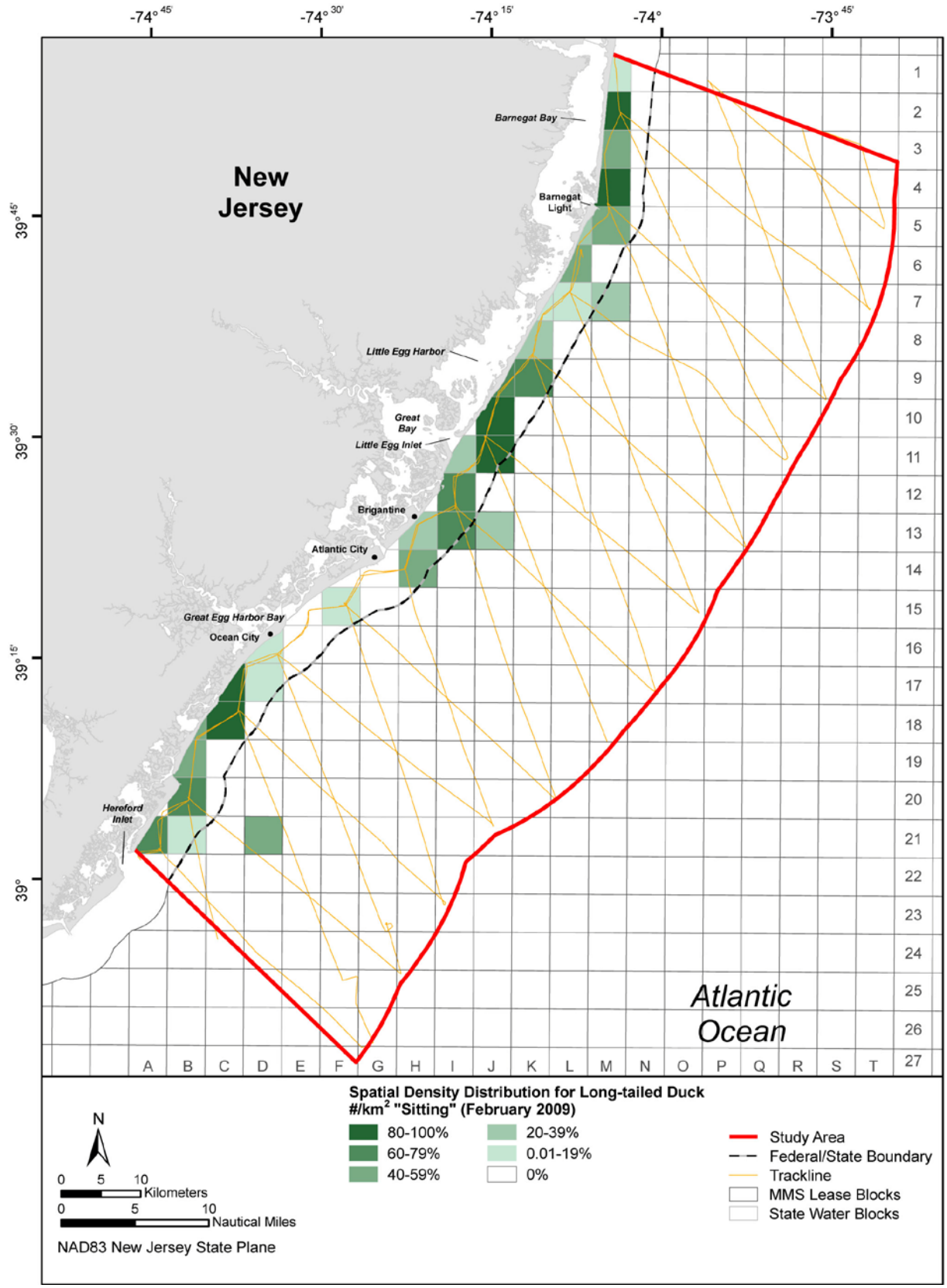

Figure C-277. Percentile abundance of Long-tailed Duck (sitting), February 2009 (n=1,237).

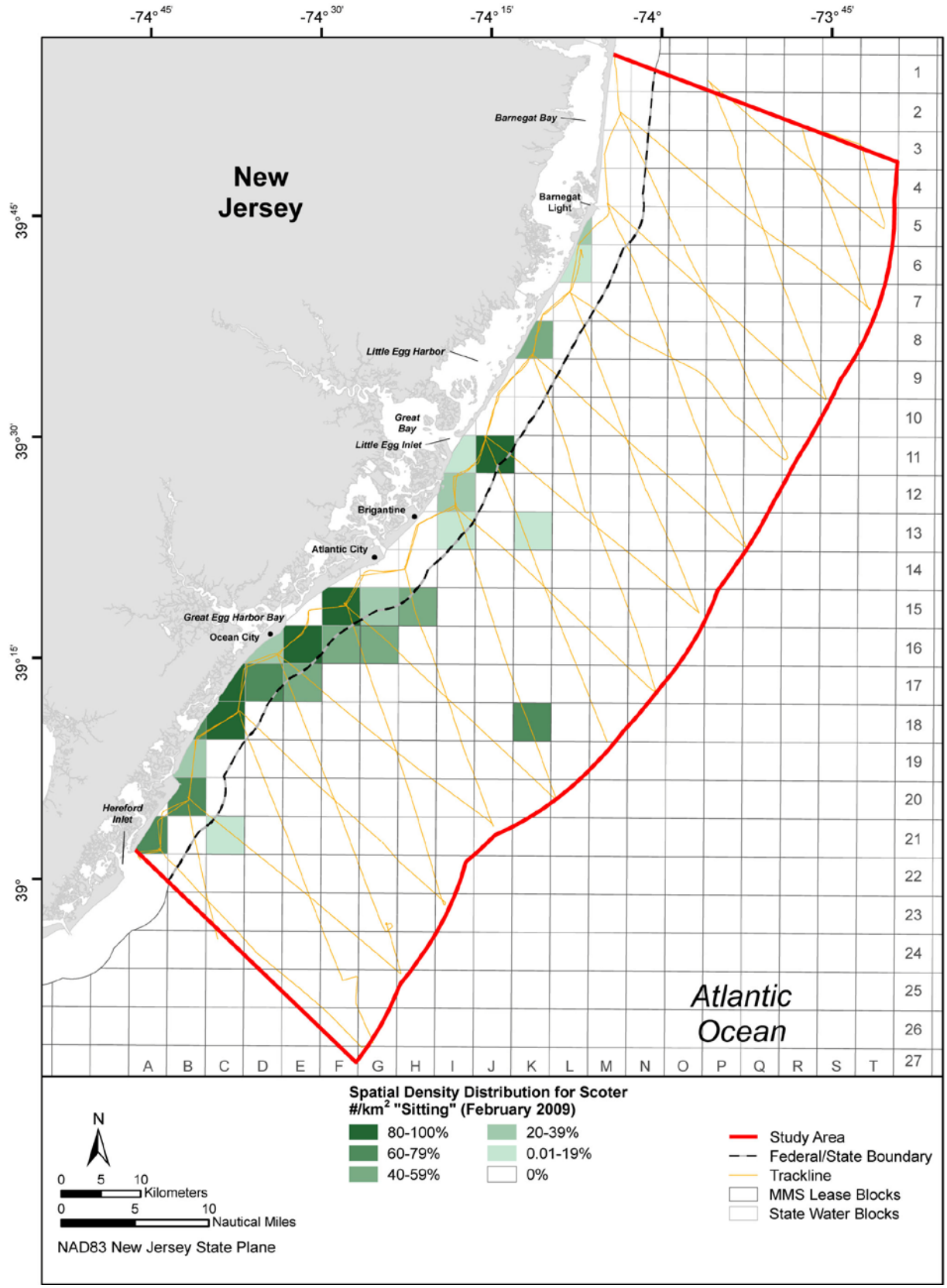

Figure C-278. Percentile abundance of scoters (sitting), February 2009 (n=1,139).

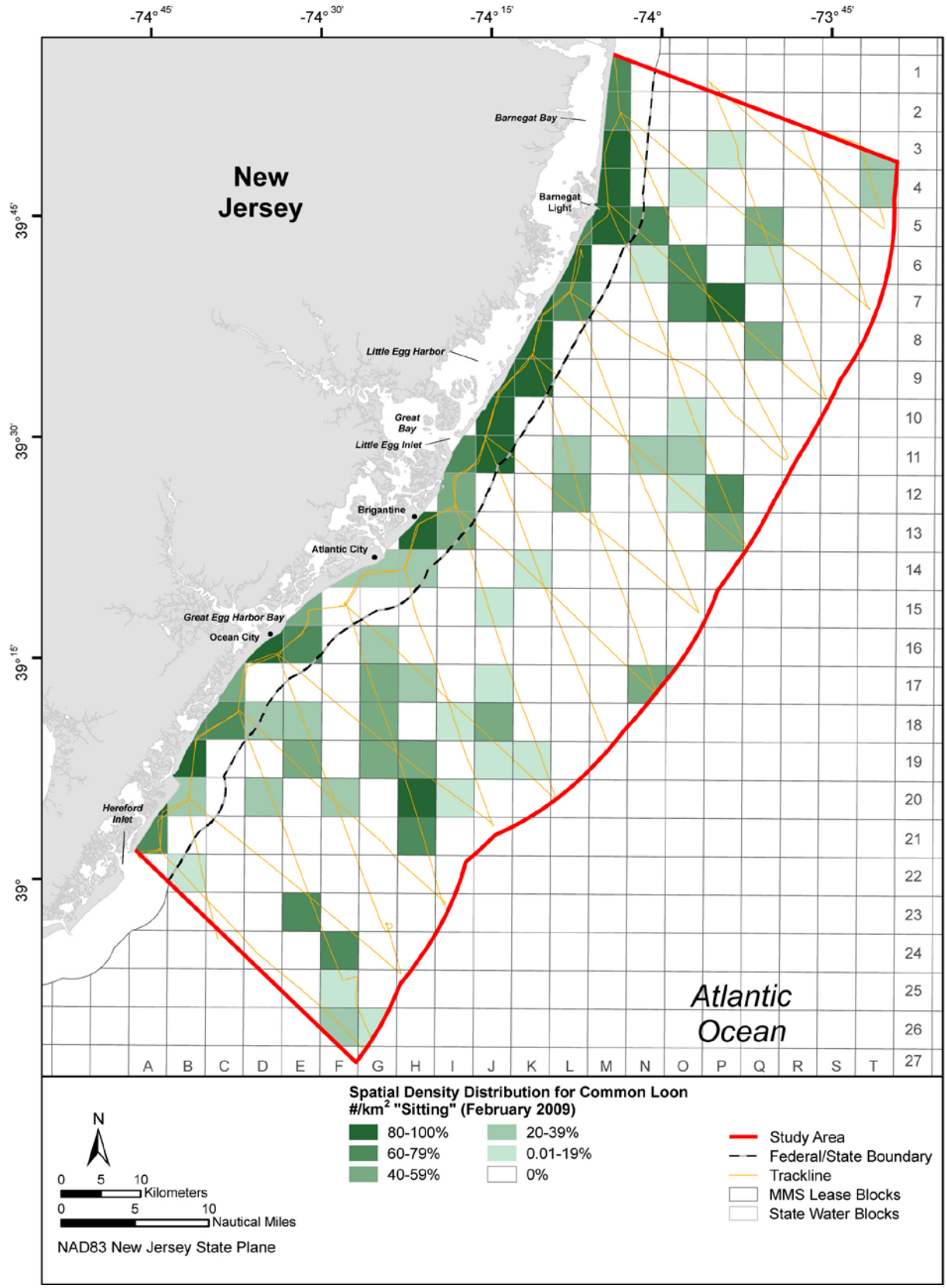

Figure C-279. Percentile abundance of Common Loon (sitting), February 2009 (n=723).

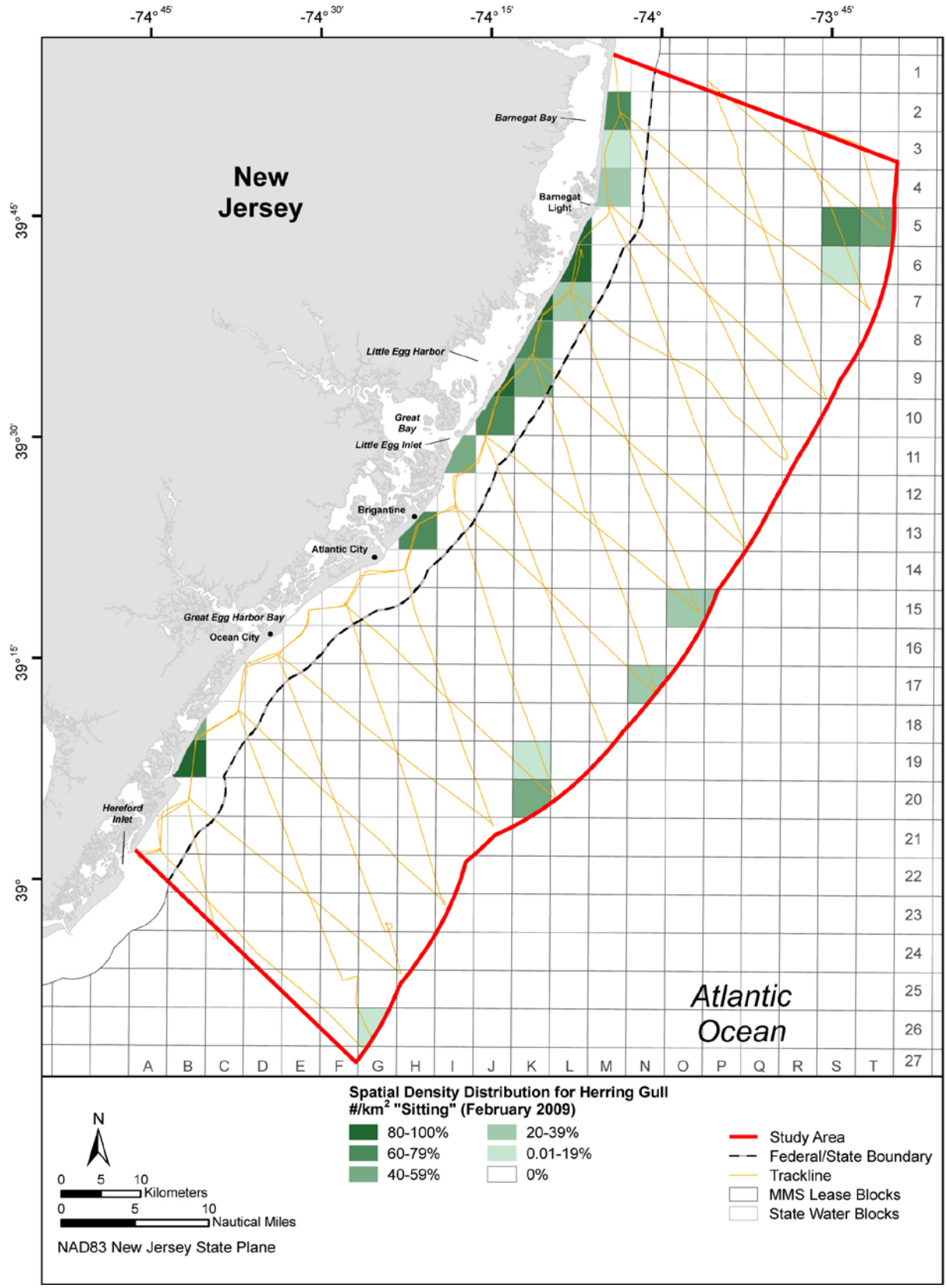

Figure C-280. Percentile abundance of Herring Gull (sitting), February 2009 (n=385).

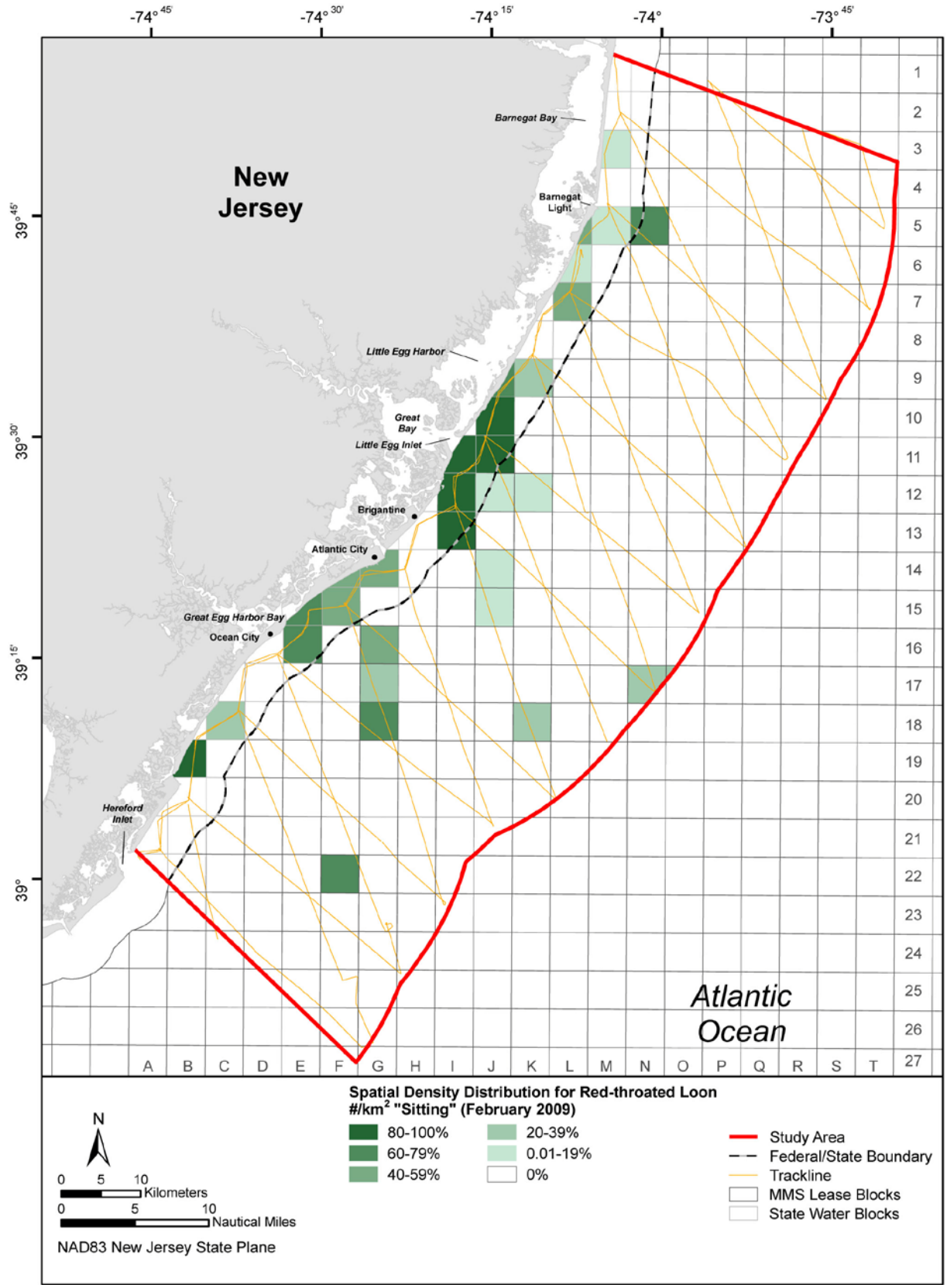

Figure C-281. Percentile abundance of Red-throated Loon (sitting), February 2009 (n=63).

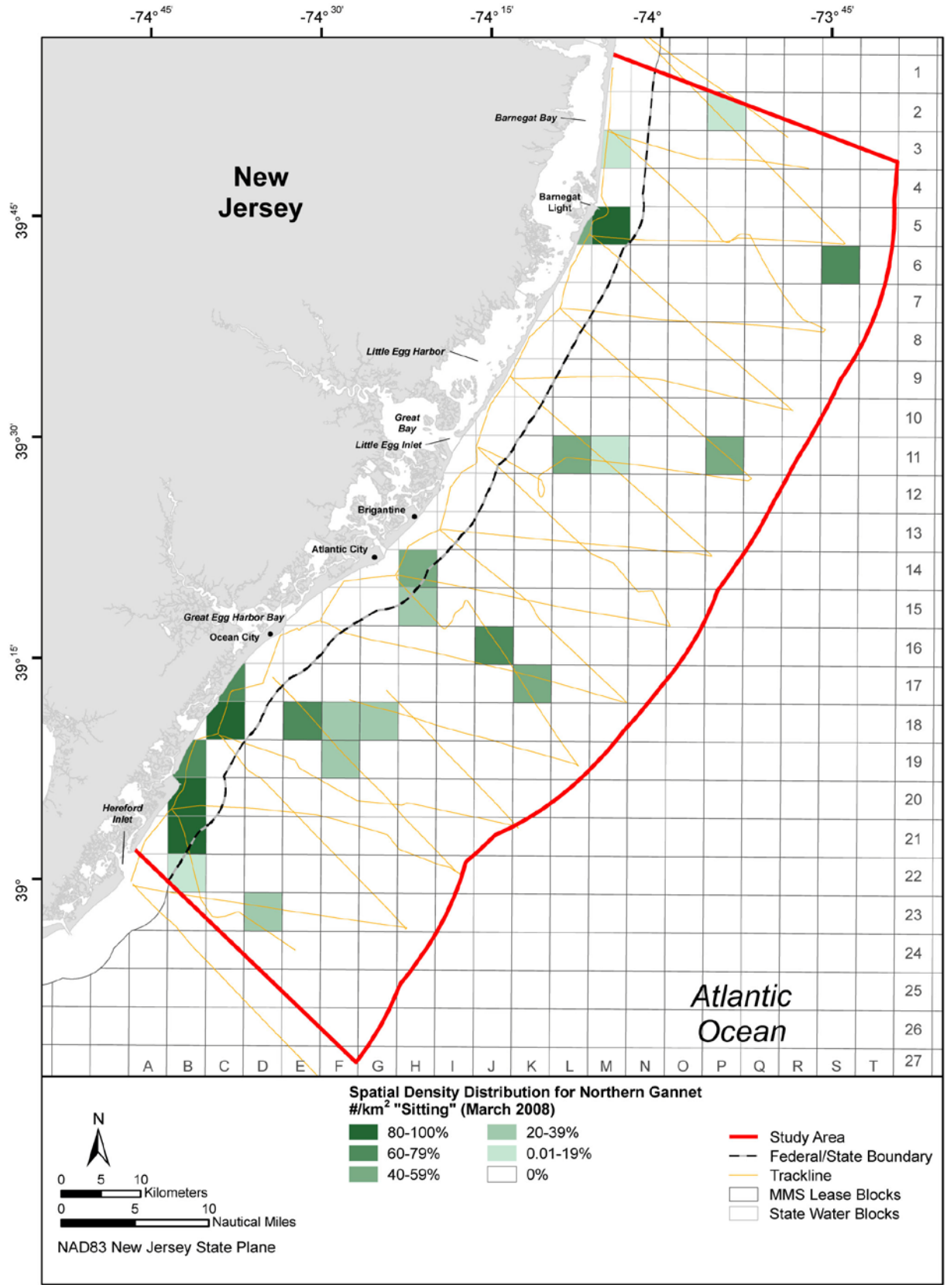

Figure C-282. Percentile abundance of Northern Gannet (sitting), March 2008 (n=193).

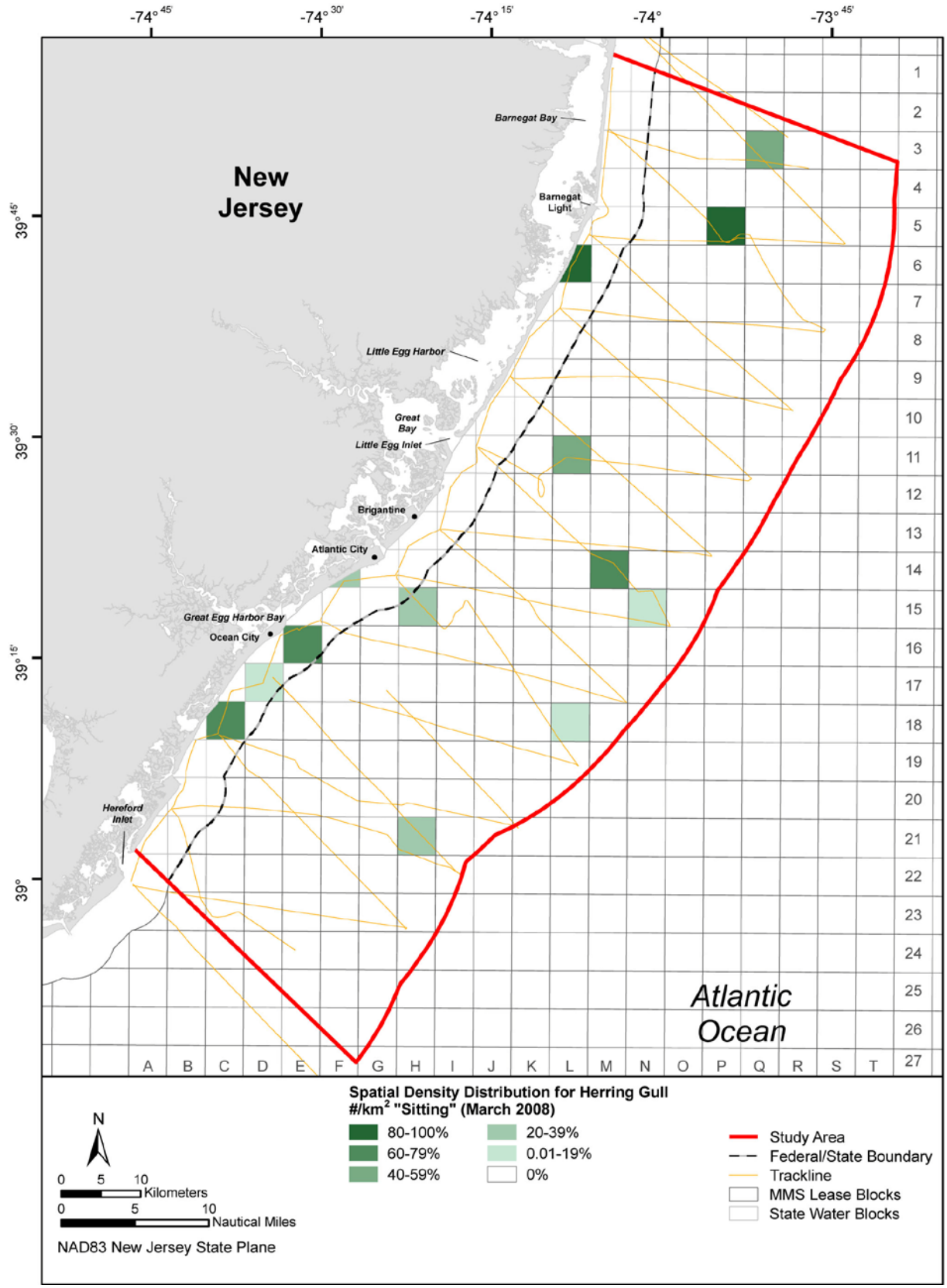

Figure C-283. Percentile abundance of Herring Gull (sitting), March 2008 (n=79).

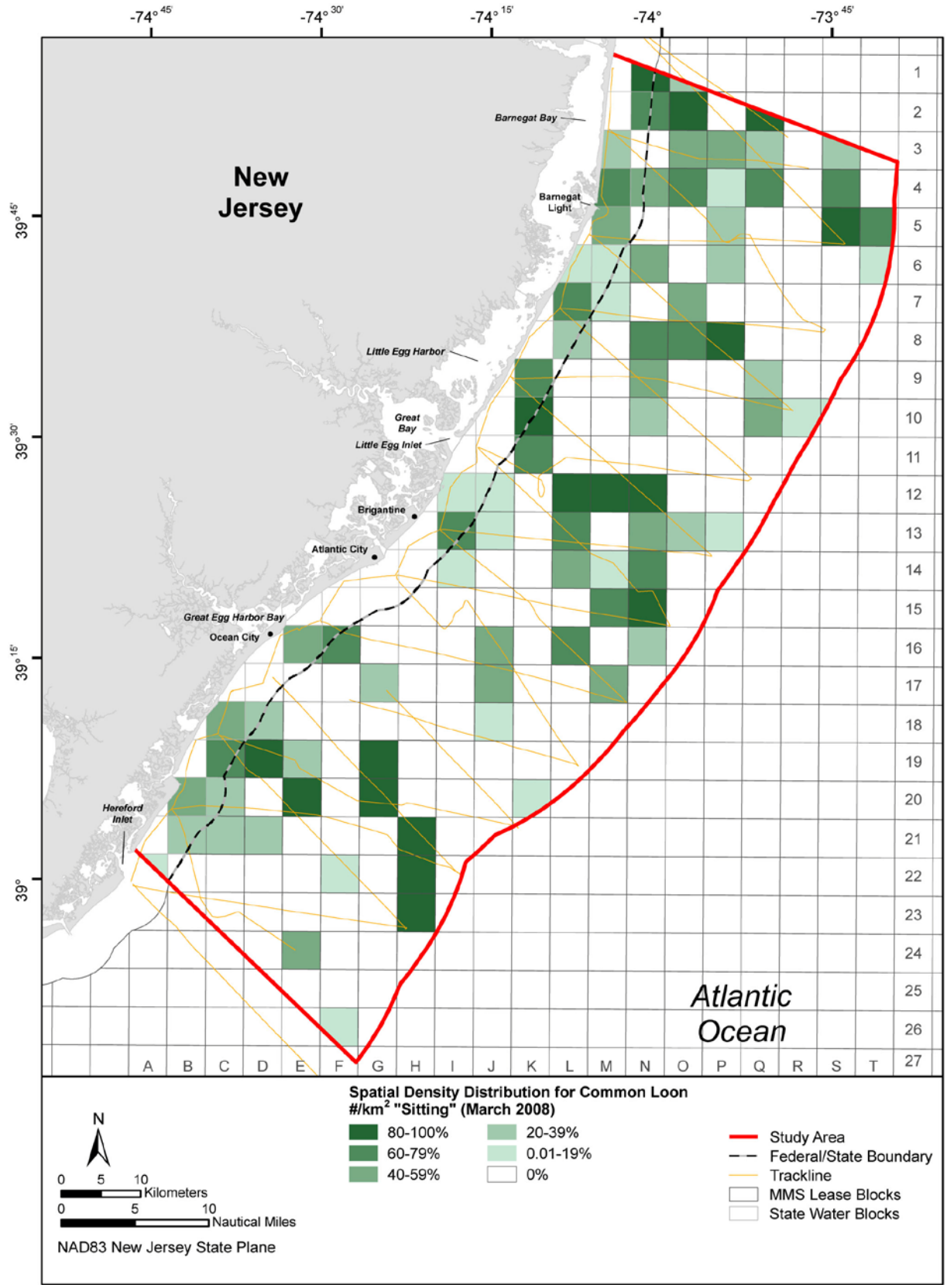

Figure C-284. Percentile abundance of Common Loon (sitting), March 2008 (n=54).

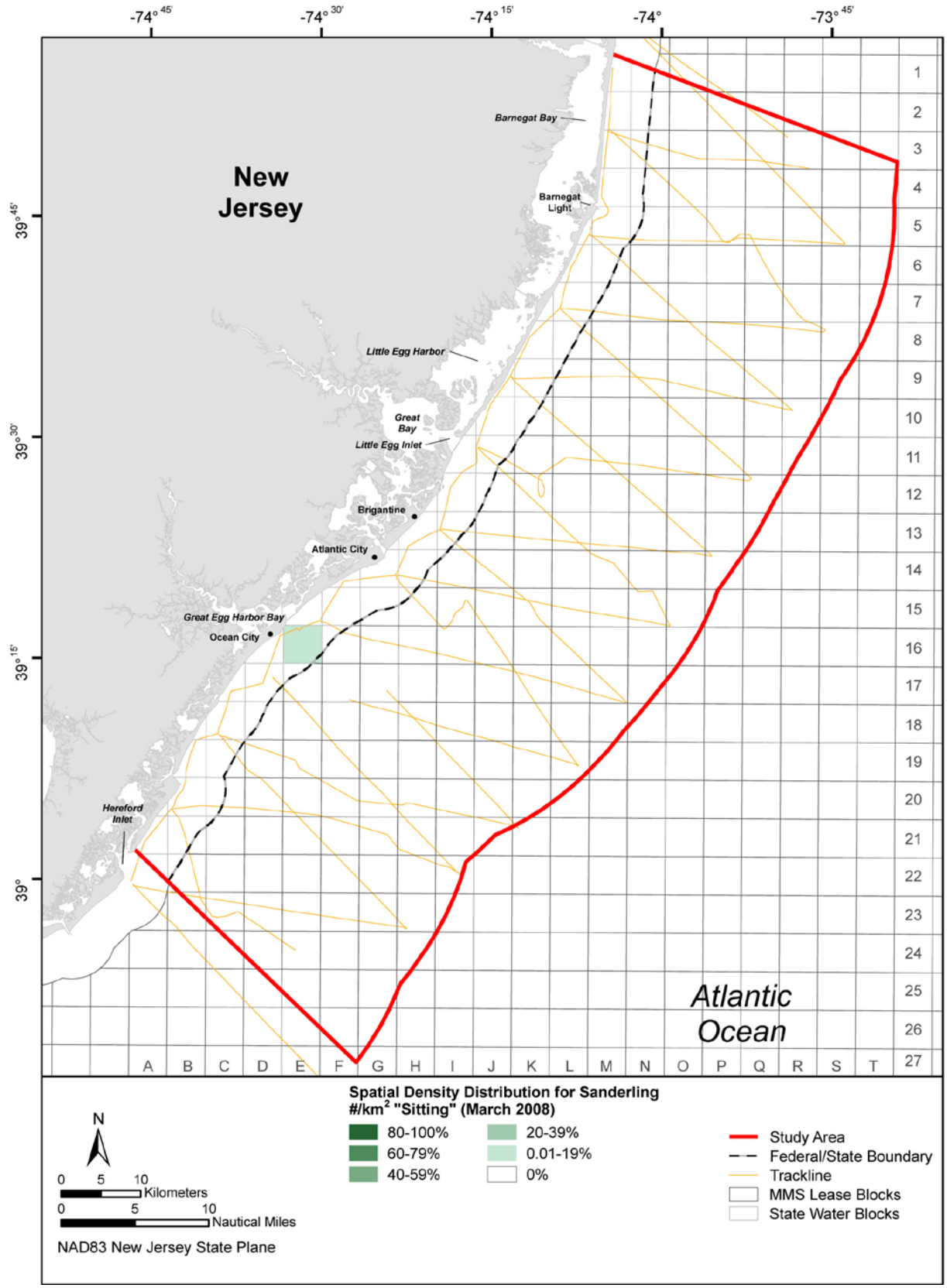

Figure C-285. Percentile abundance of Sanderling (sitting), March 2008 (n=35).

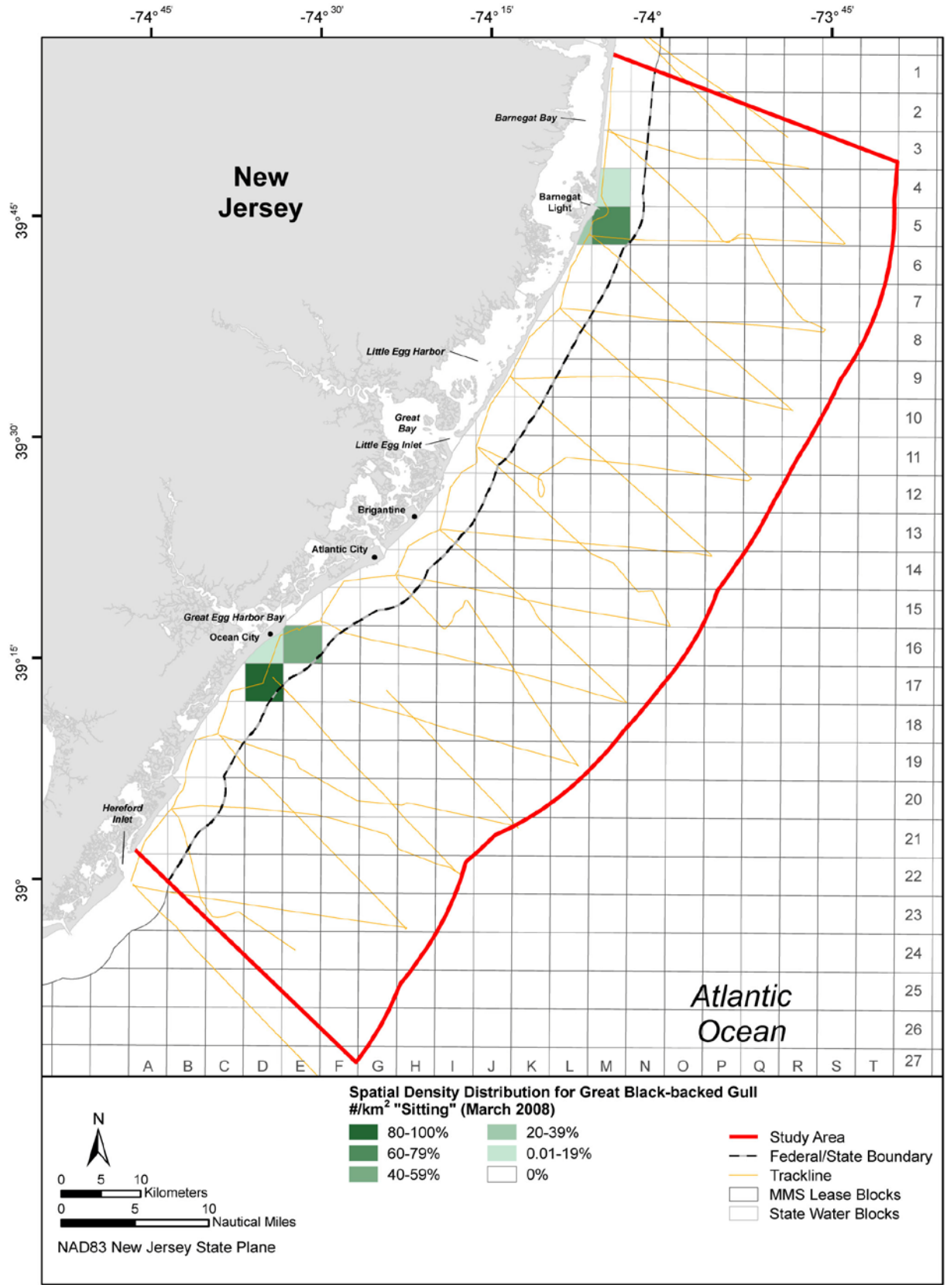

Figure C-286. Percentile abundance of Great Black-backed Gull (sitting), March 2008 (n=20).

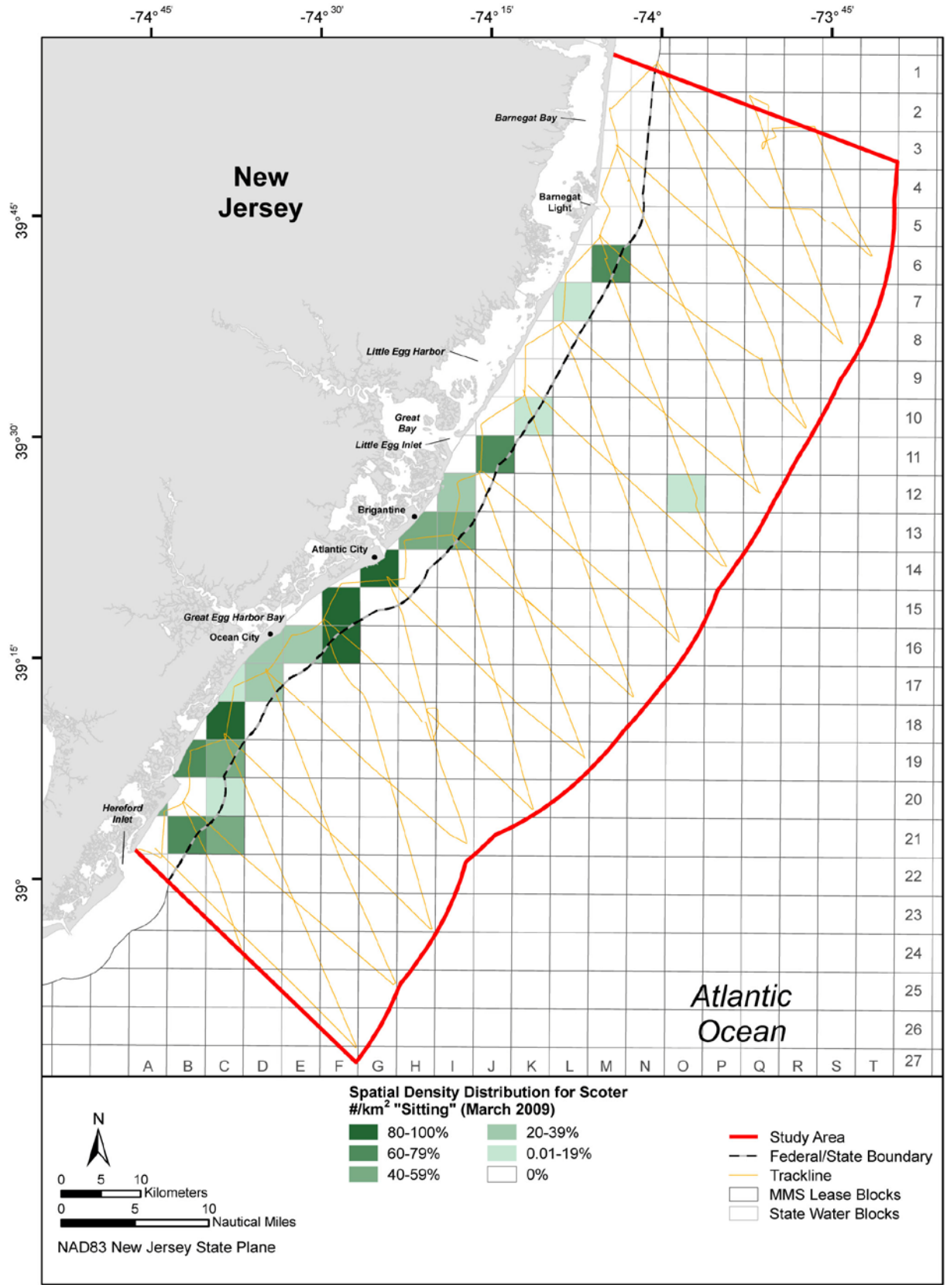

Figure C-287. Percentile abundance of scoters (sitting), March 2009 (n=636).

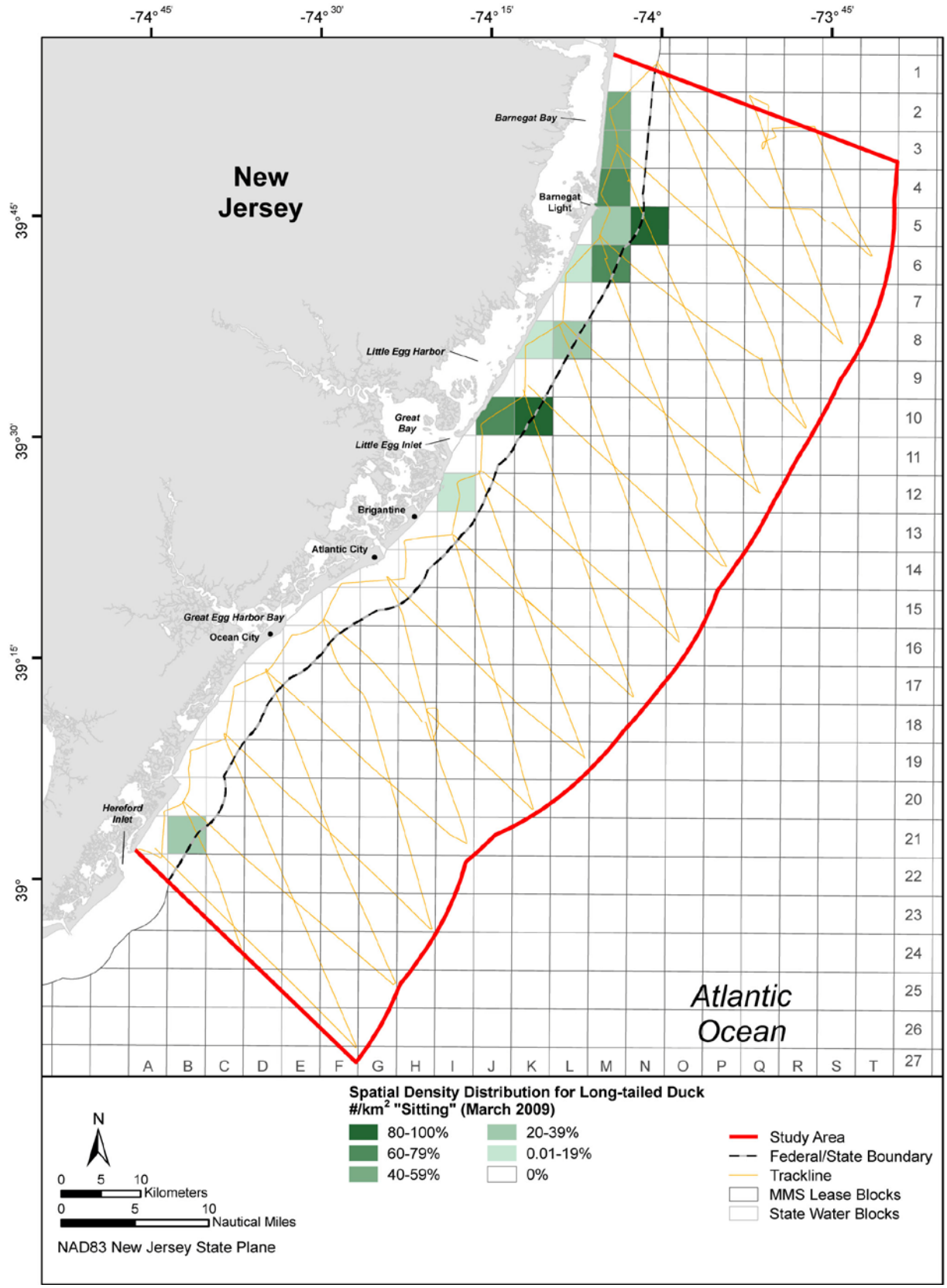

Figure C-288. Percentile abundance of Long-tailed Duck (sitting), March 2009 (n=481).

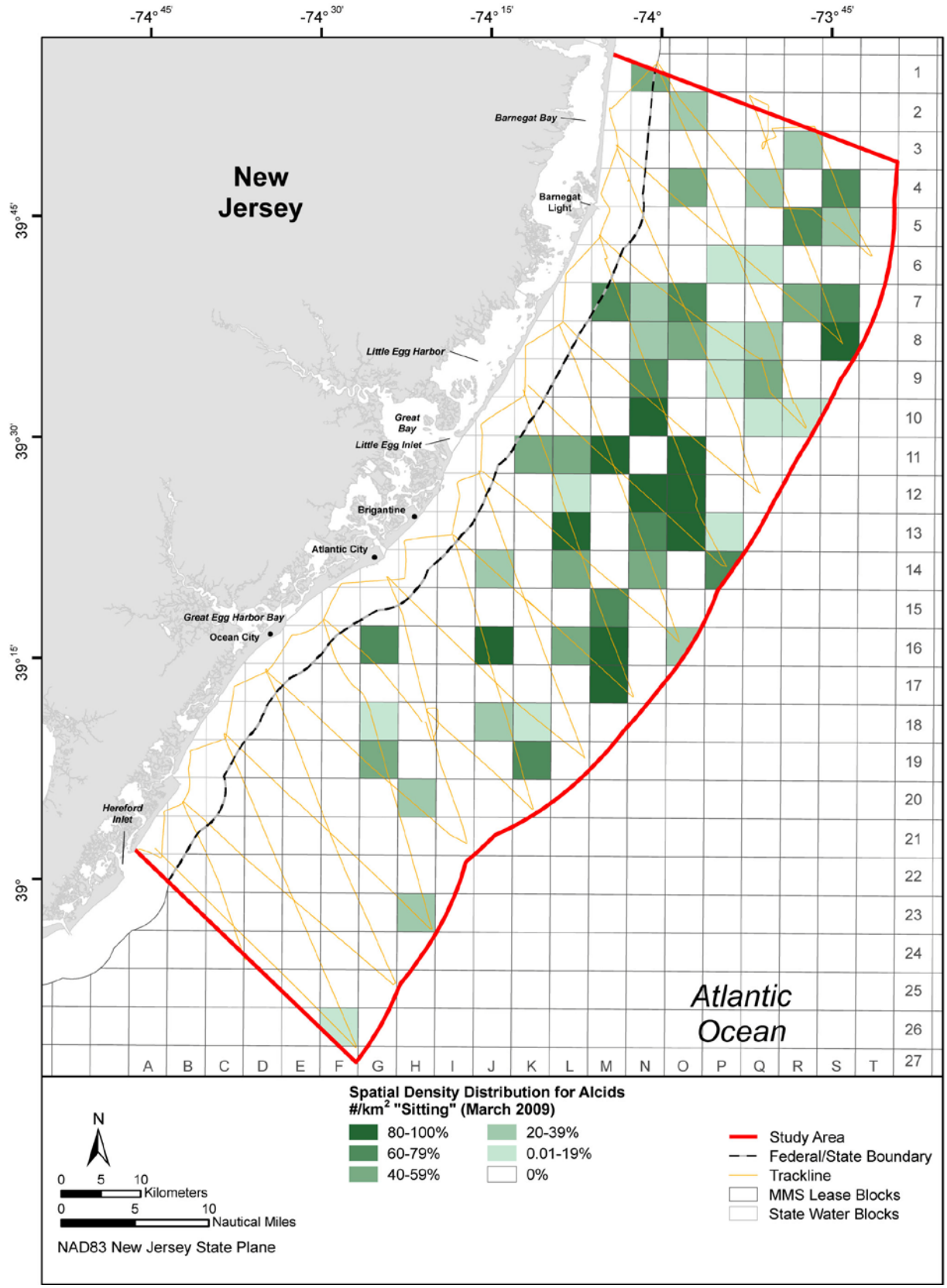

Figure C-289. Percentile abundance of alcids (sitting), March 2009 (n=419).

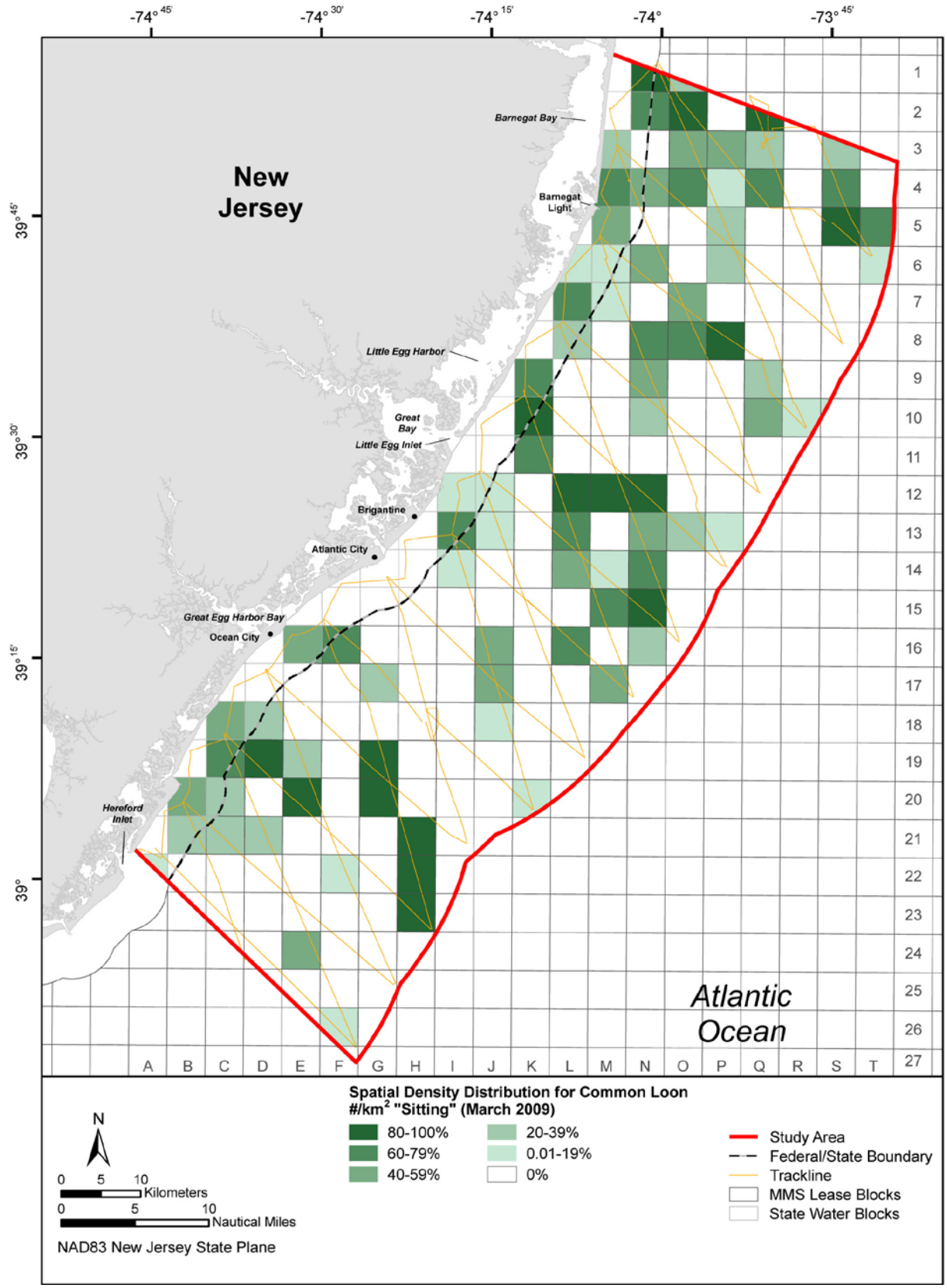

Figure C-290. Percentile abundance of Common Loon (sitting), March 2009 (n=264).

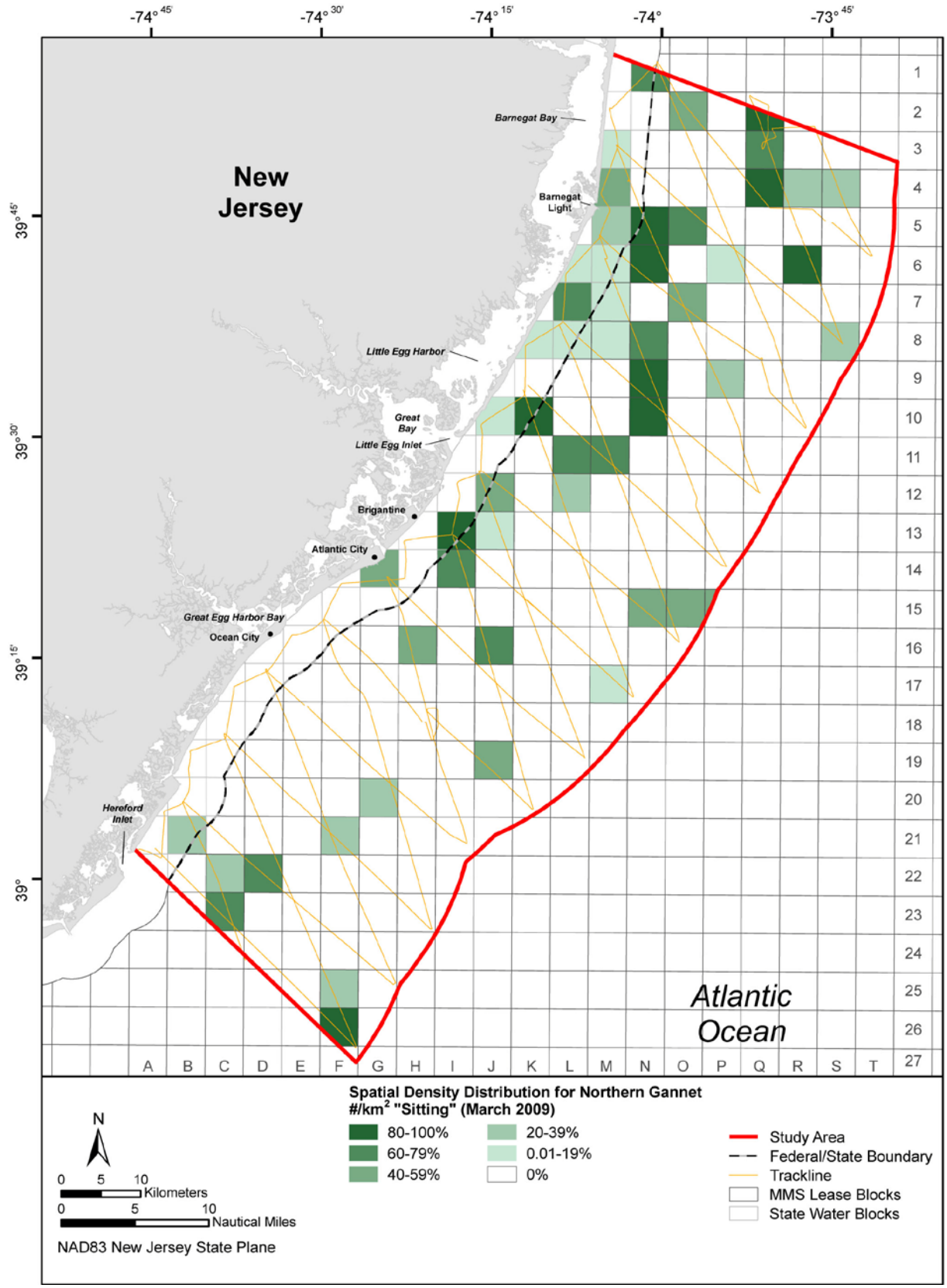

Figure C-291. Percentile abundance of Northern Gannet (sitting), March 2009 (n=151).

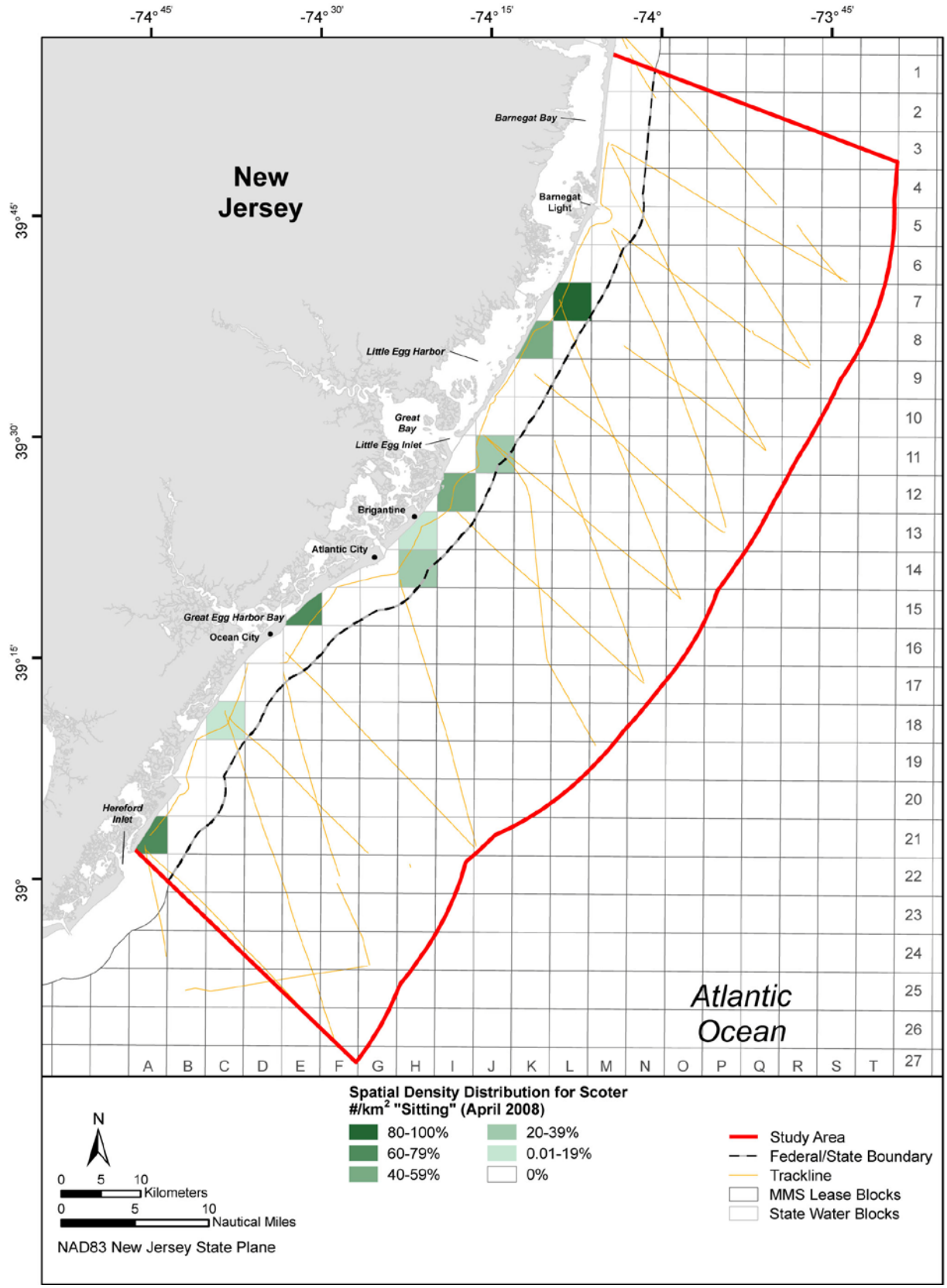

Figure C-292. Percentile abundance of scoters (sitting), April 2008 (n=664).

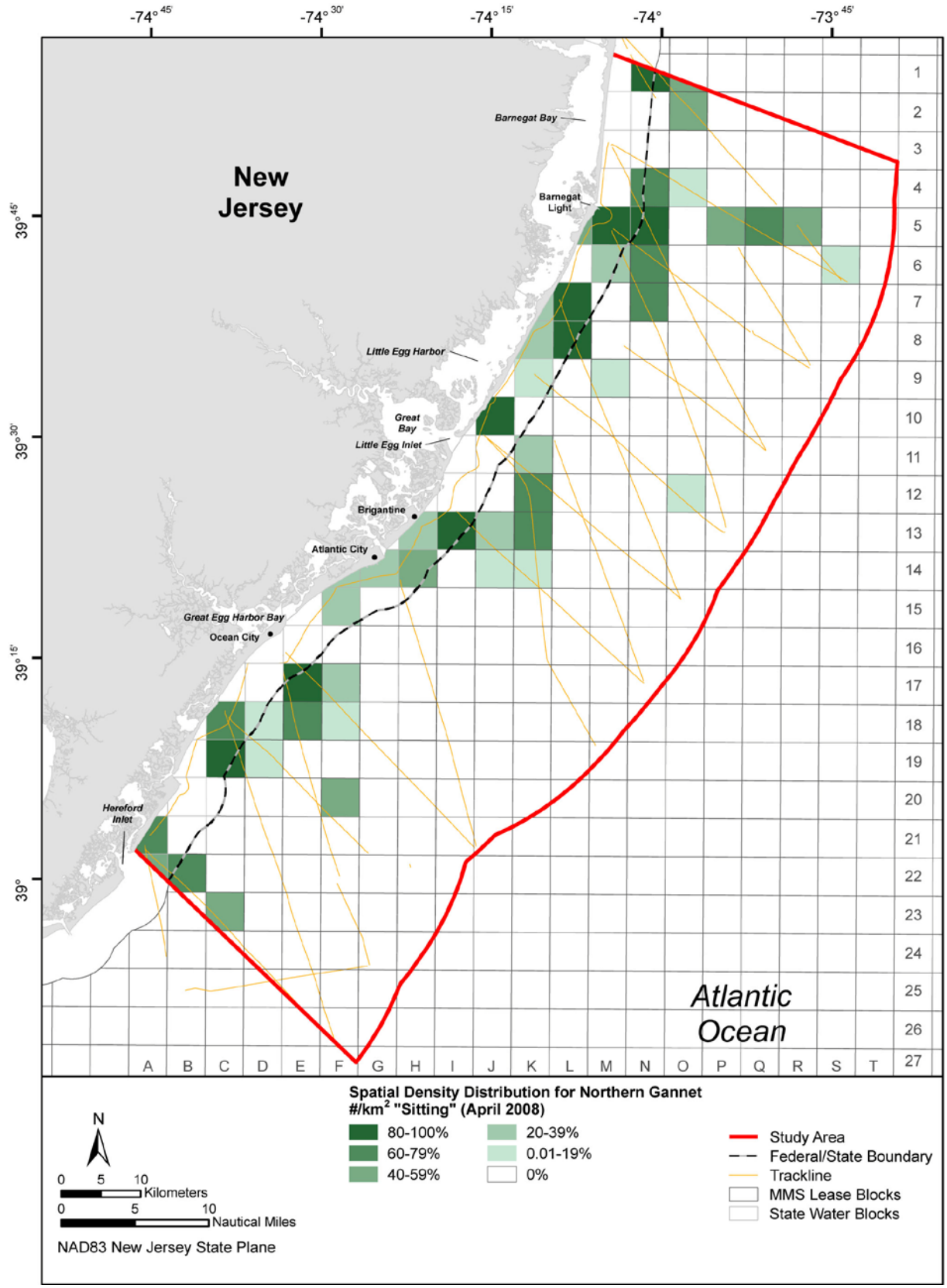

Figure C-293. Percentile abundance of Northern Gannet (sitting), April 2008 (n=185).

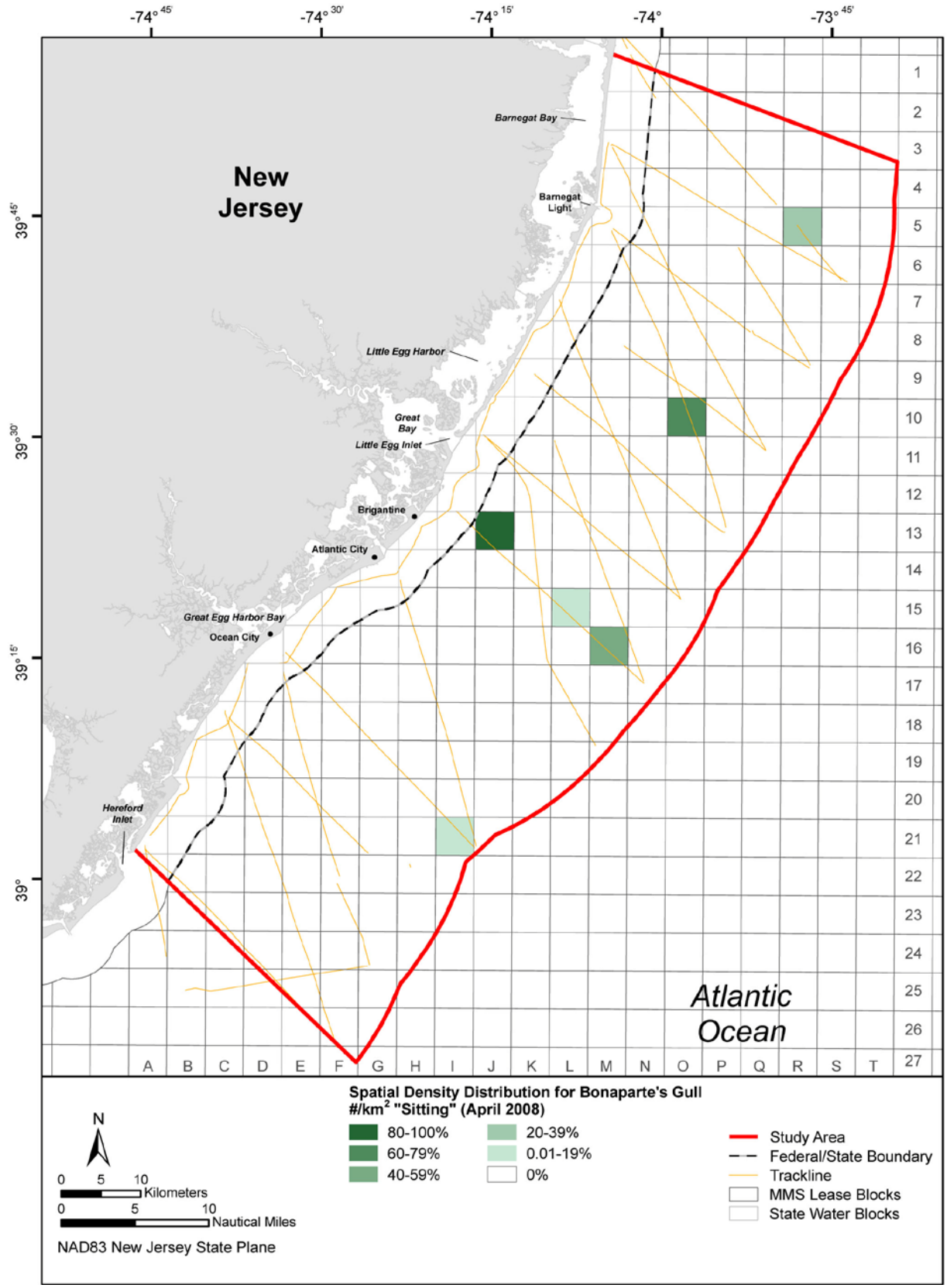

Figure C-294. Percentile abundance of Bonaparte's Gull (sitting), April 2008 (n=52).

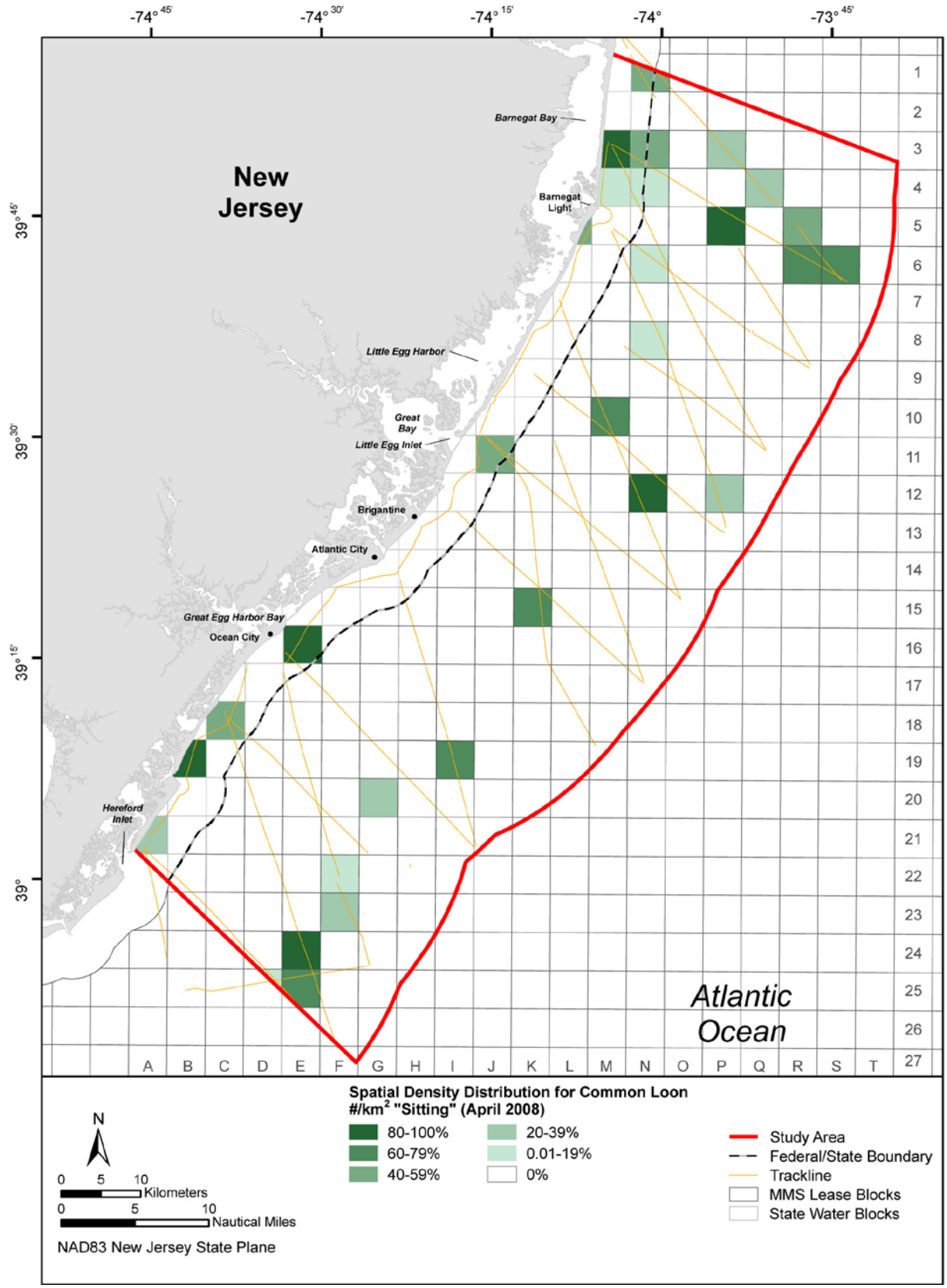

Figure C-295. Percentile abundance of Common Loon (sitting), April 2008 (n=48).

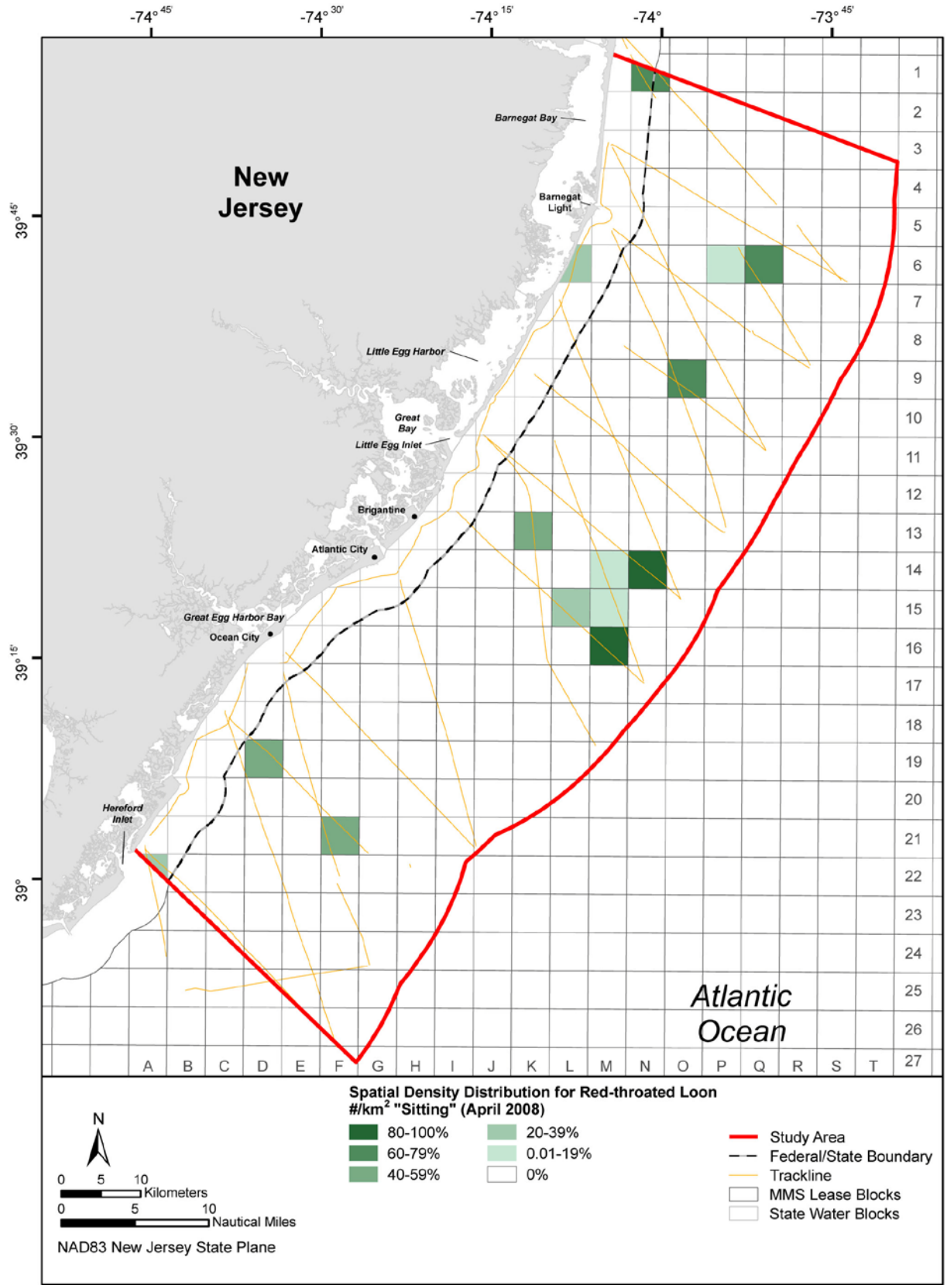

Figure C-296. Percentile abundance of Red-throated Loon (sitting), April 2008 (n=23).

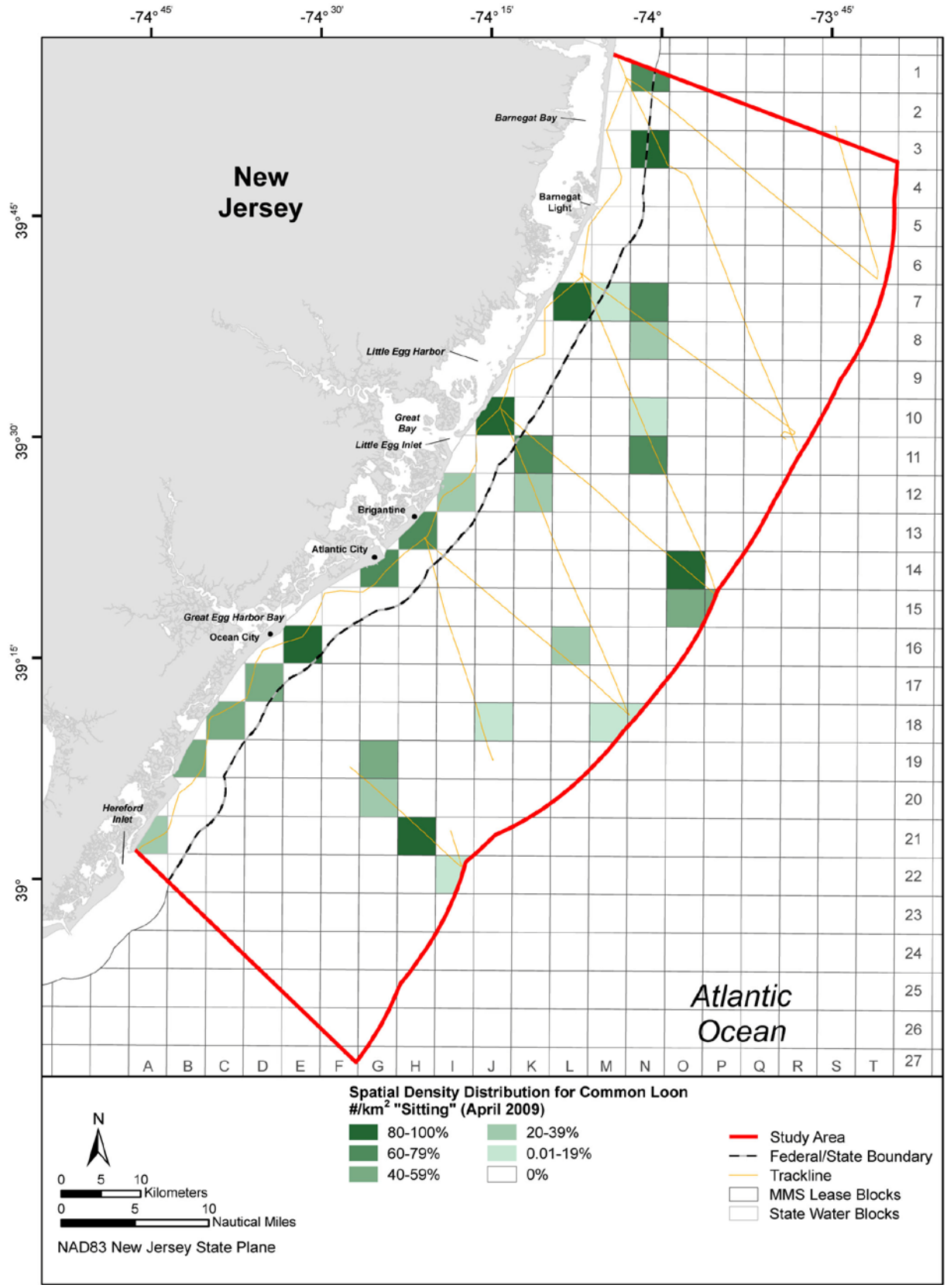

Figure C-297. Percentile abundance of Common Loon (sitting), April 2009 (n=45).

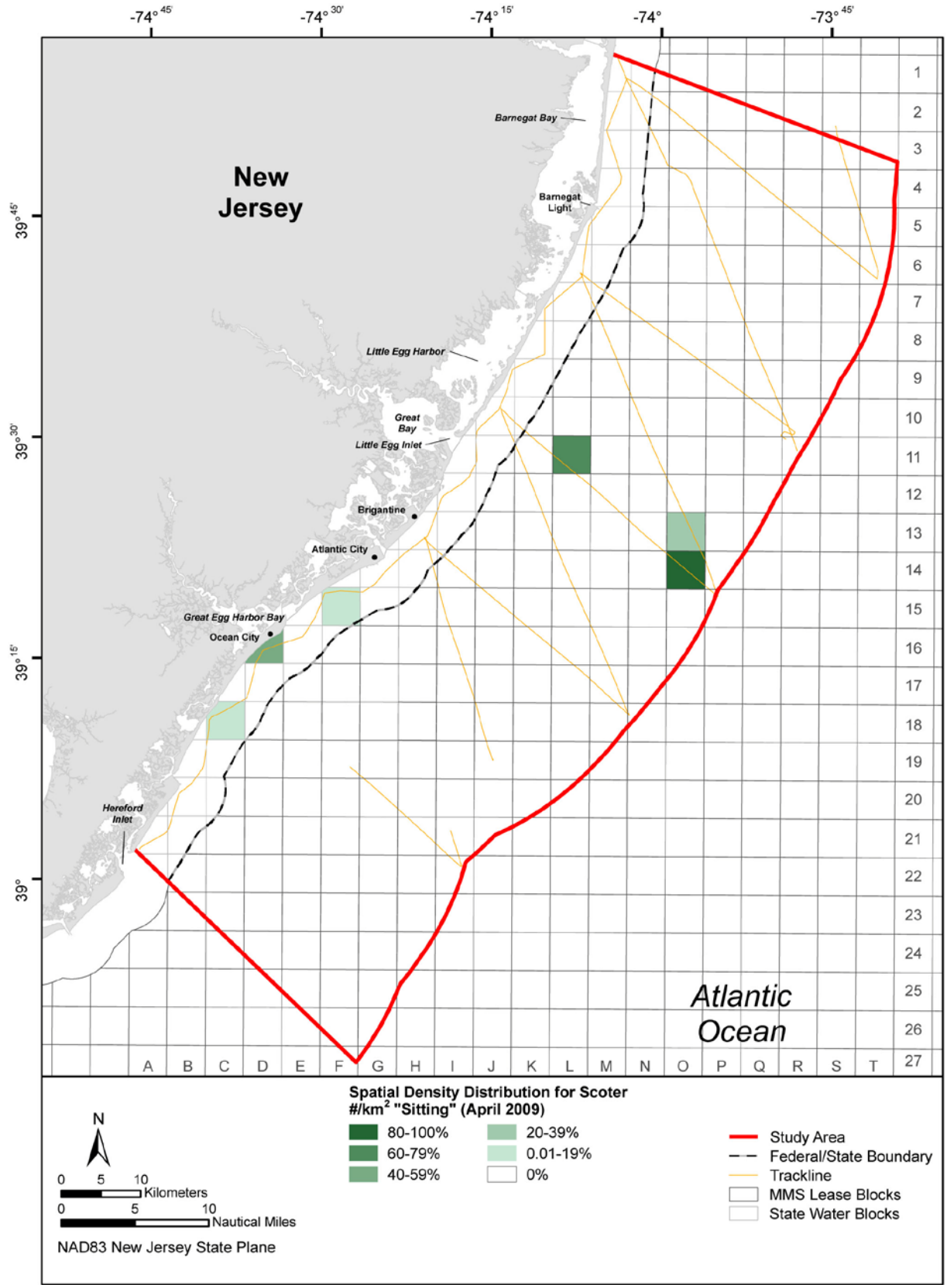

Figure C-298. Percentile abundance of scoters (sitting), April 2009 (n=29).

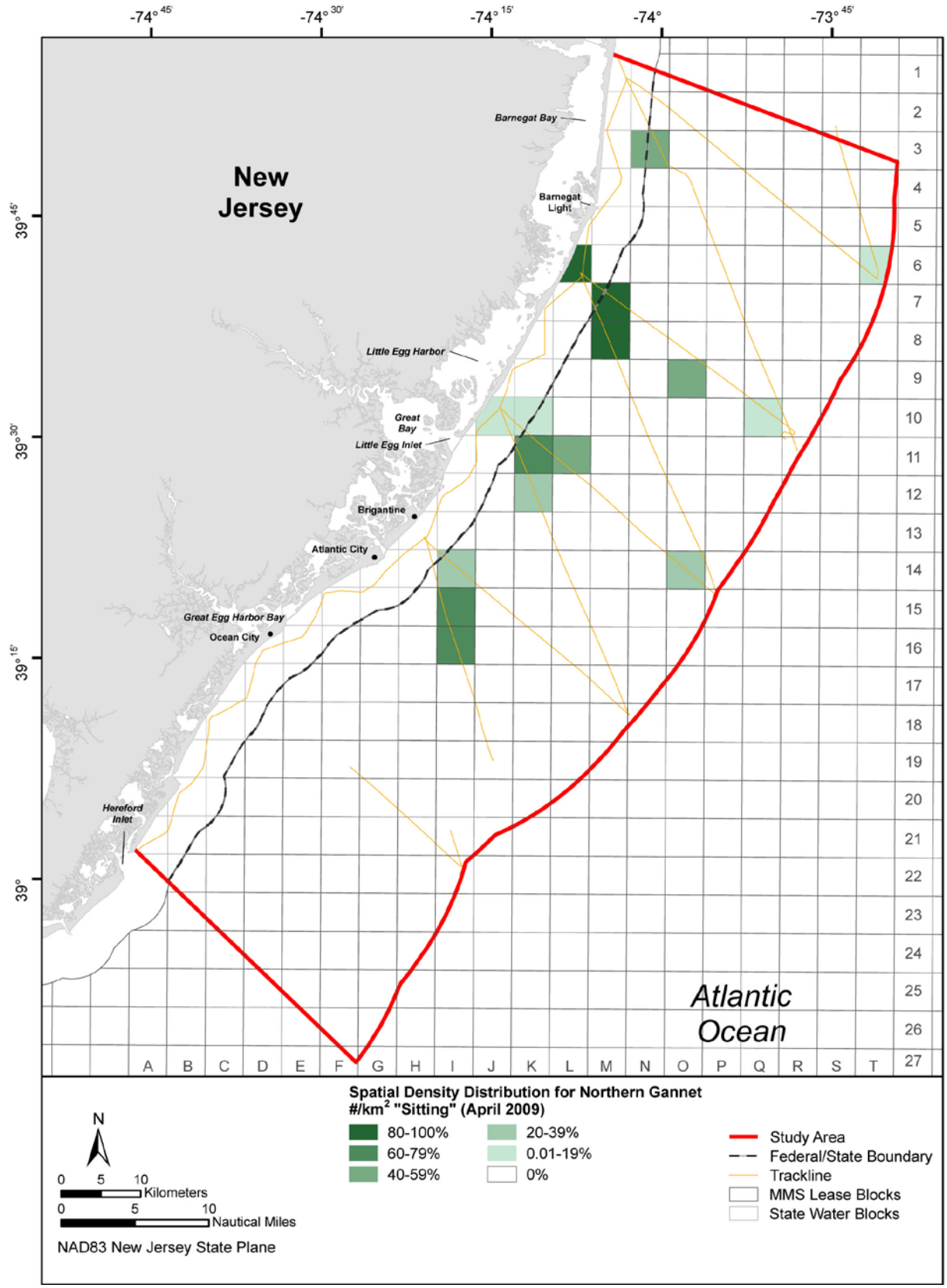

Figure C-299. Percentile abundance of Northern Gannet (sitting), April 2009 (n=27).

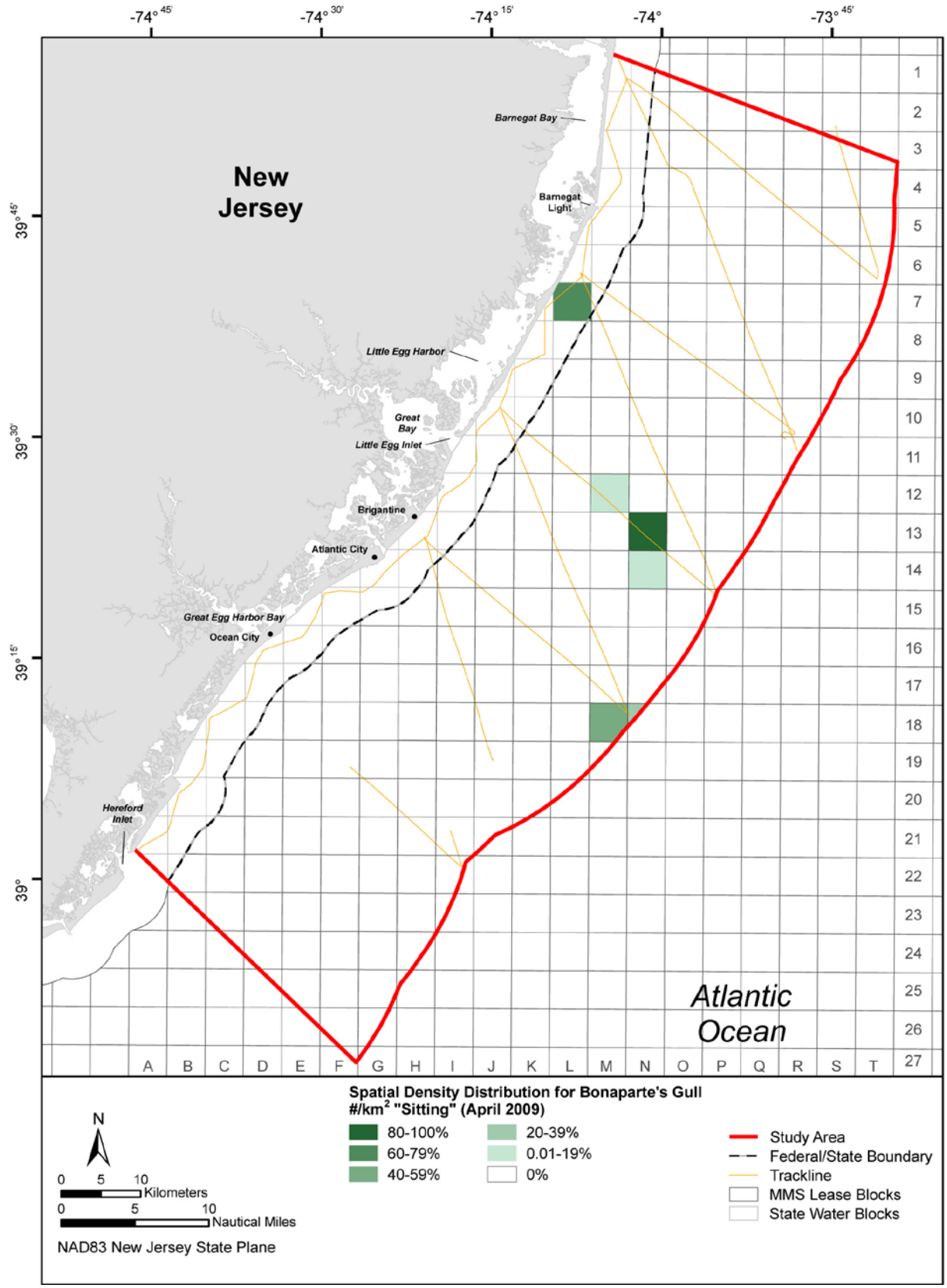

Figure C-300. Percentile abundance of Bonaparte's Gull (sitting), April 2009 (n=24).

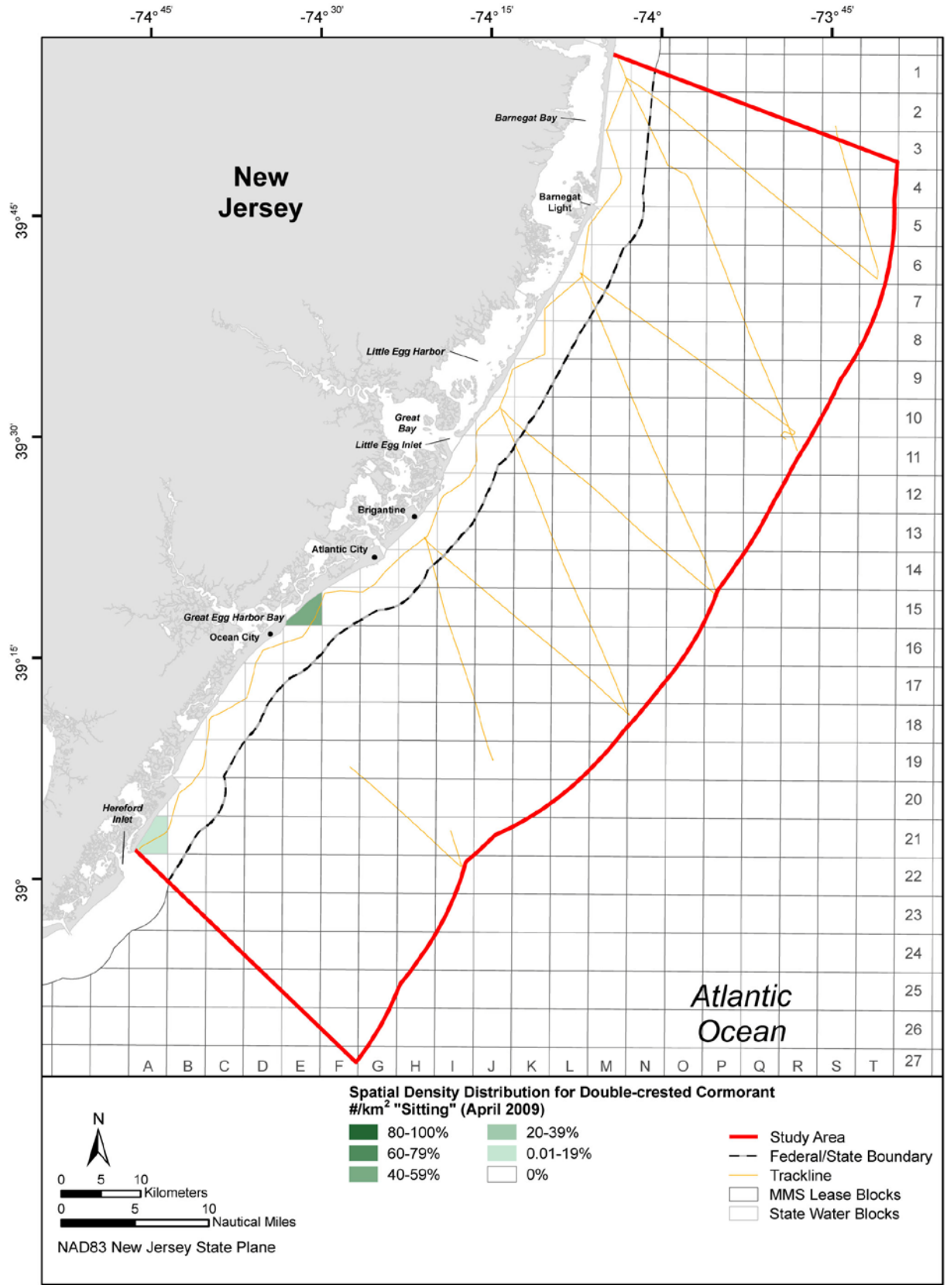

Figure C-301. Percentile abundance of Double-crested Cormorant (sitting), April 2009 (n=16).

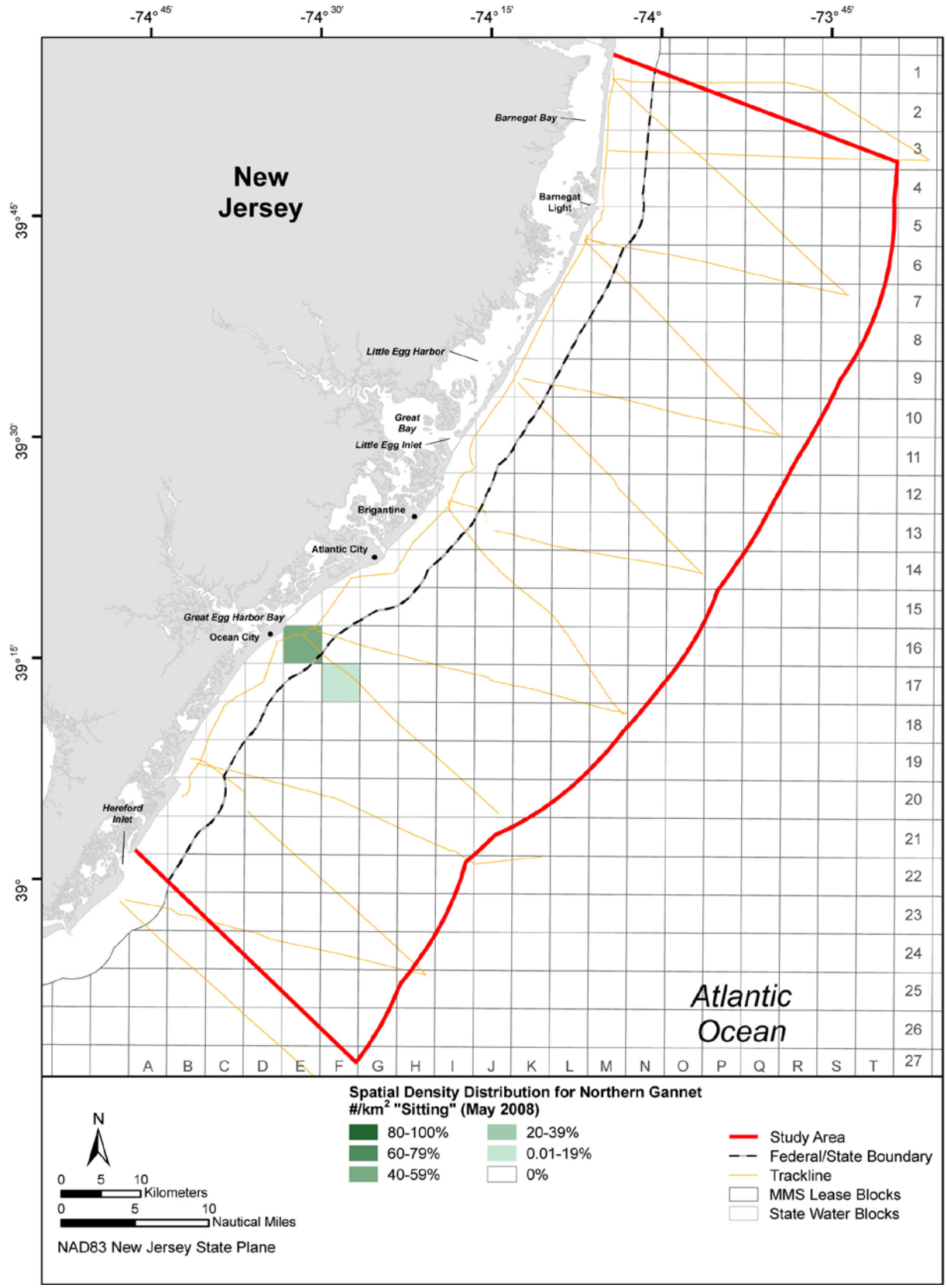

Figure C-302. Percentile abundance of Northern Gannet (sitting), May 2008 (n=4).

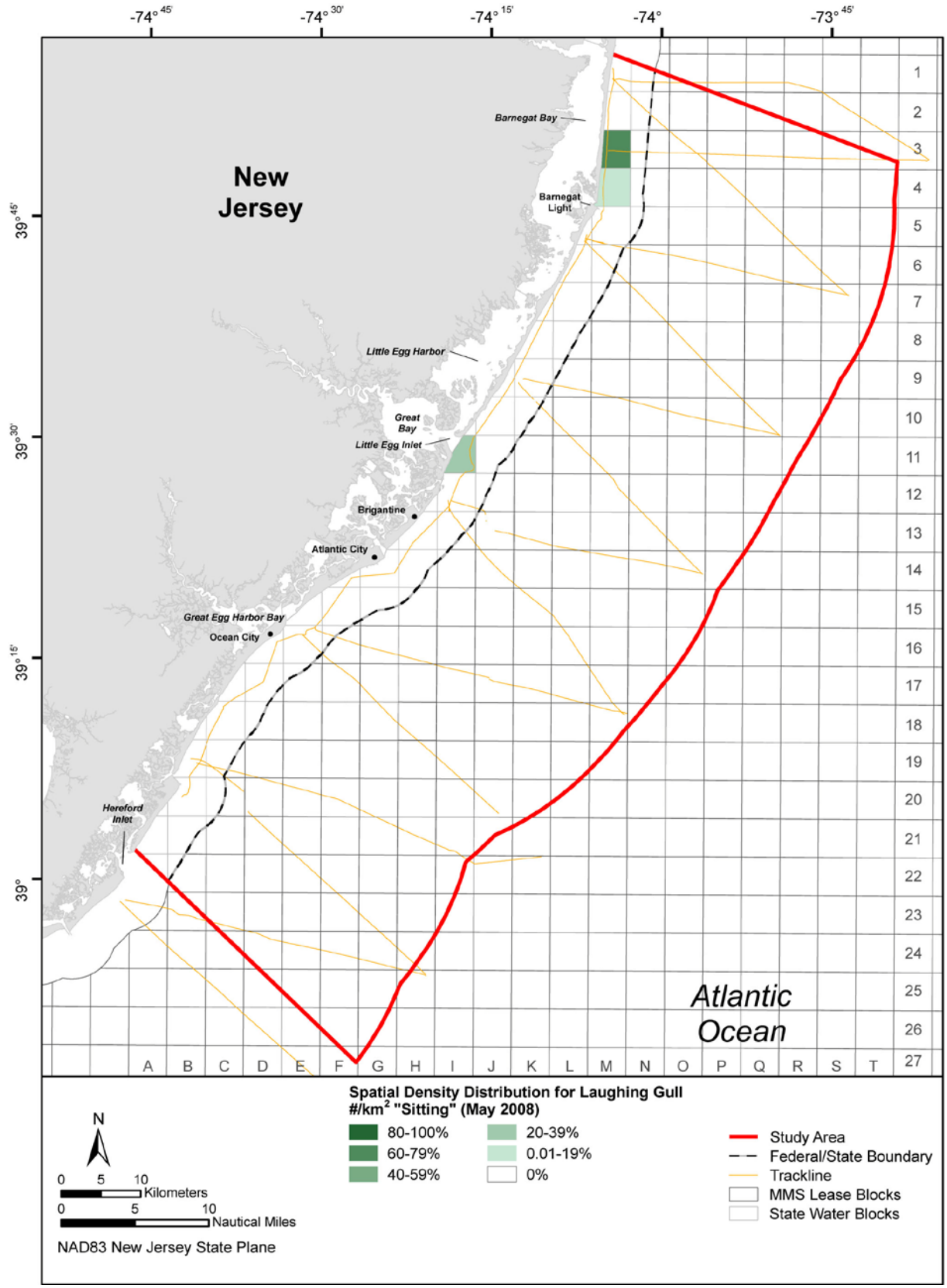

Figure C-303. Percentile abundance of Laughing Gull (sitting), May 2008 (n=4).

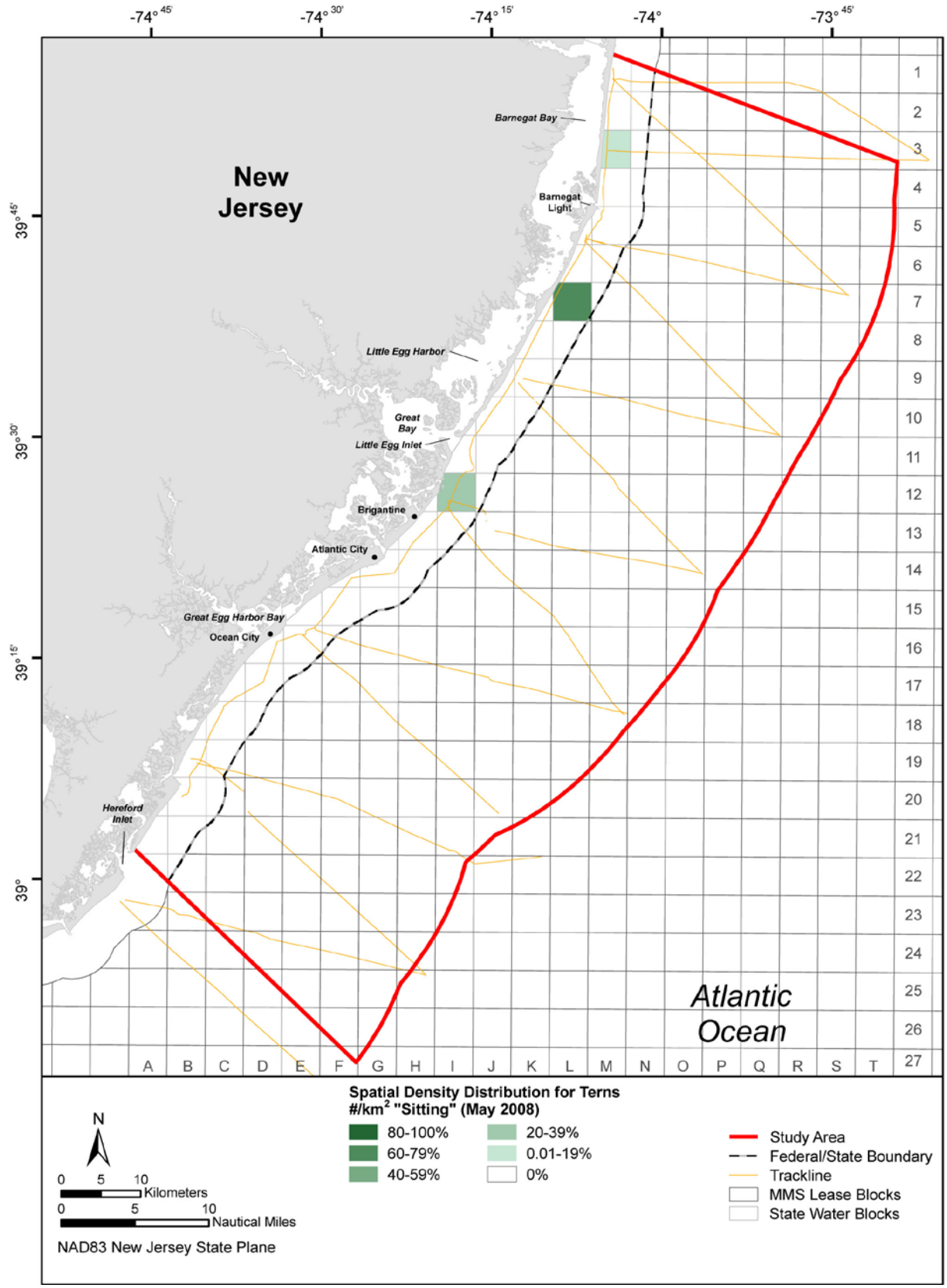

Figure C-304. Percentile abundance of terns (sitting), May 2008 (n=4).

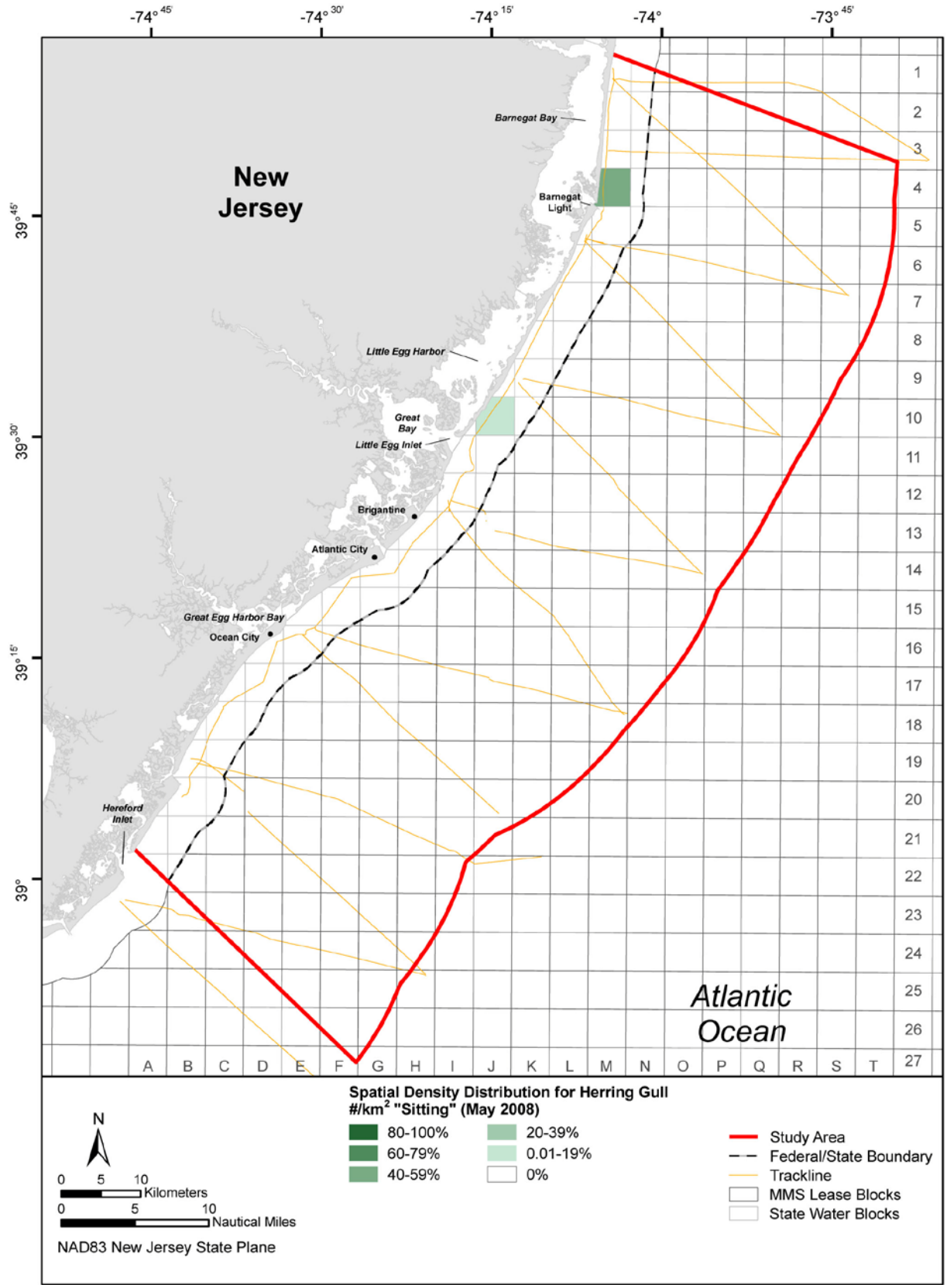

Figure C-305. Percentile abundance of Herring Gull (sitting), May 2008 (n=2).

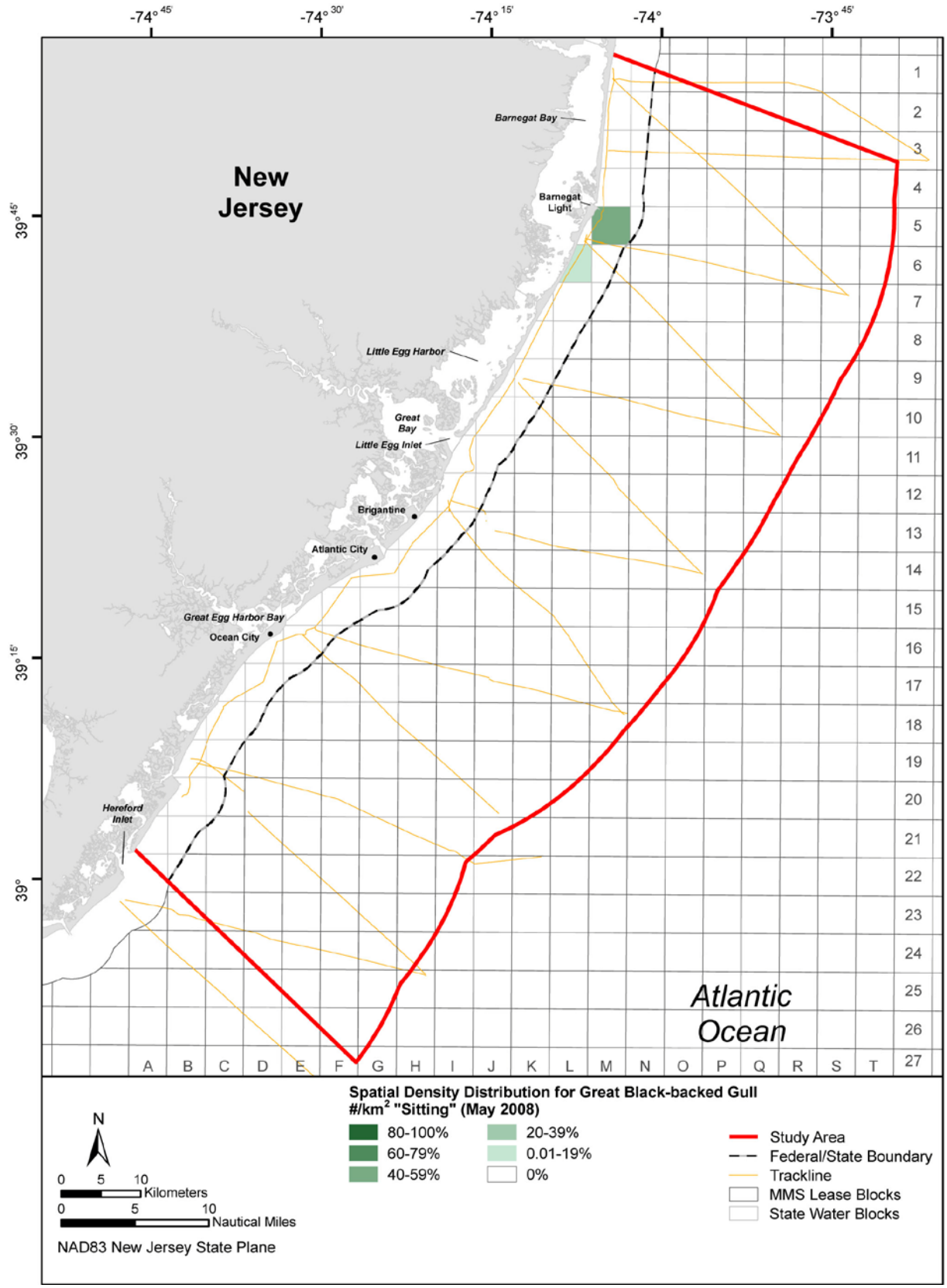

Figure C-306. Percentile abundance of Great Black-backed Gull (sitting), May 2008 (n=2).

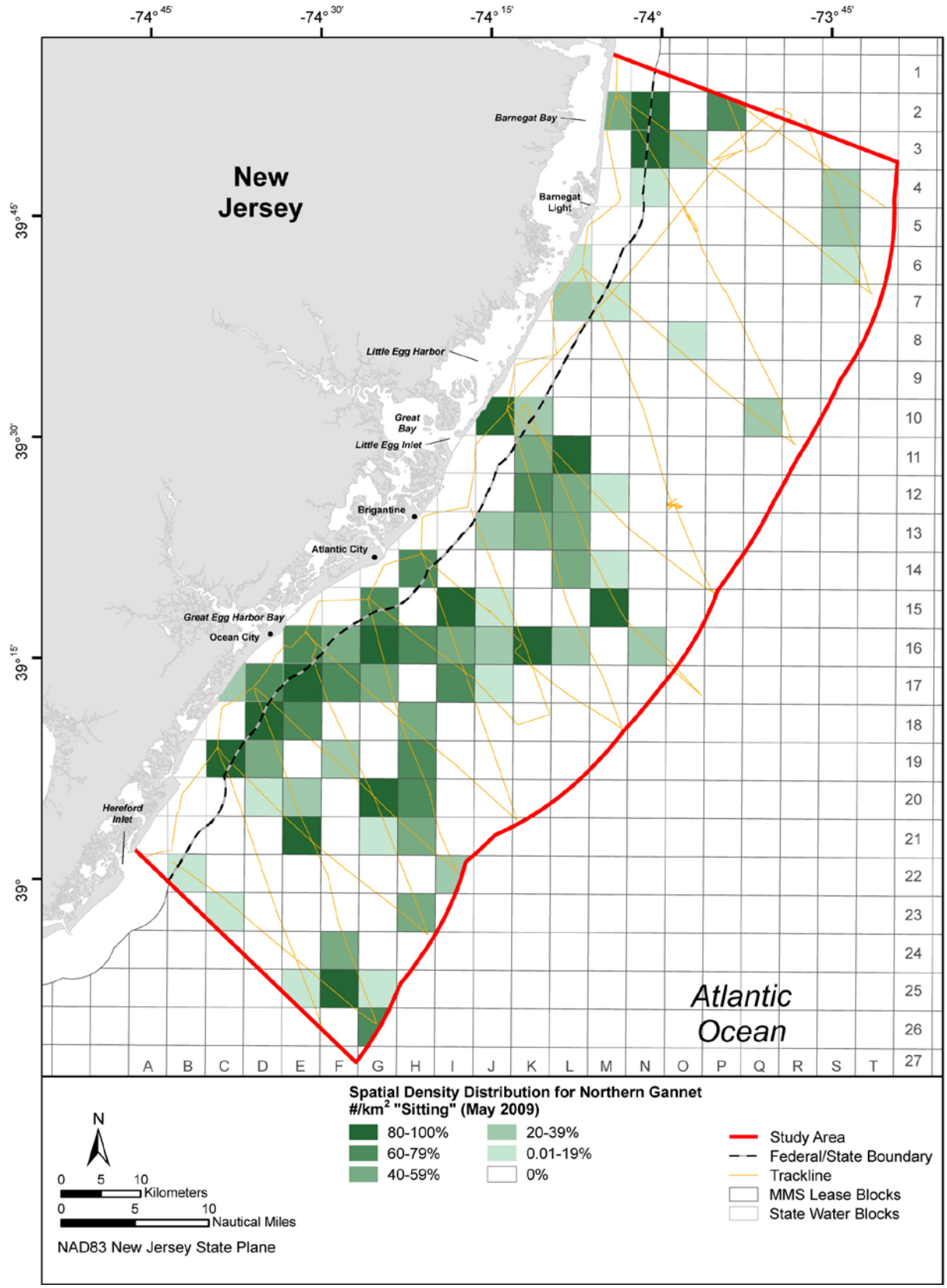

Figure C-307. Percentile abundance of Northern Gannet (sitting), May 2009 (n=321).

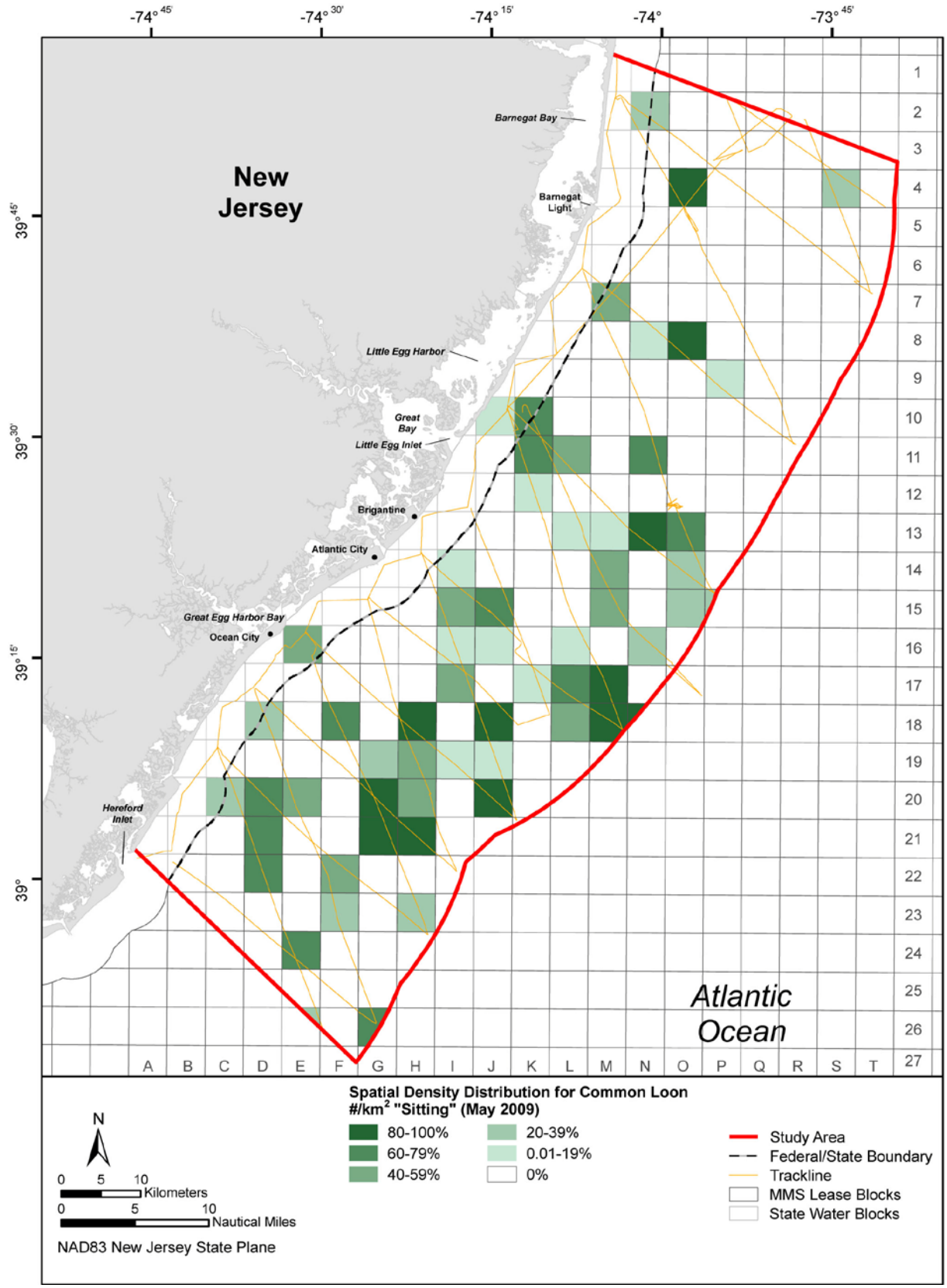

Figure C-308. Percentile abundance of Common Loon (sitting), May 2009 (n=129).

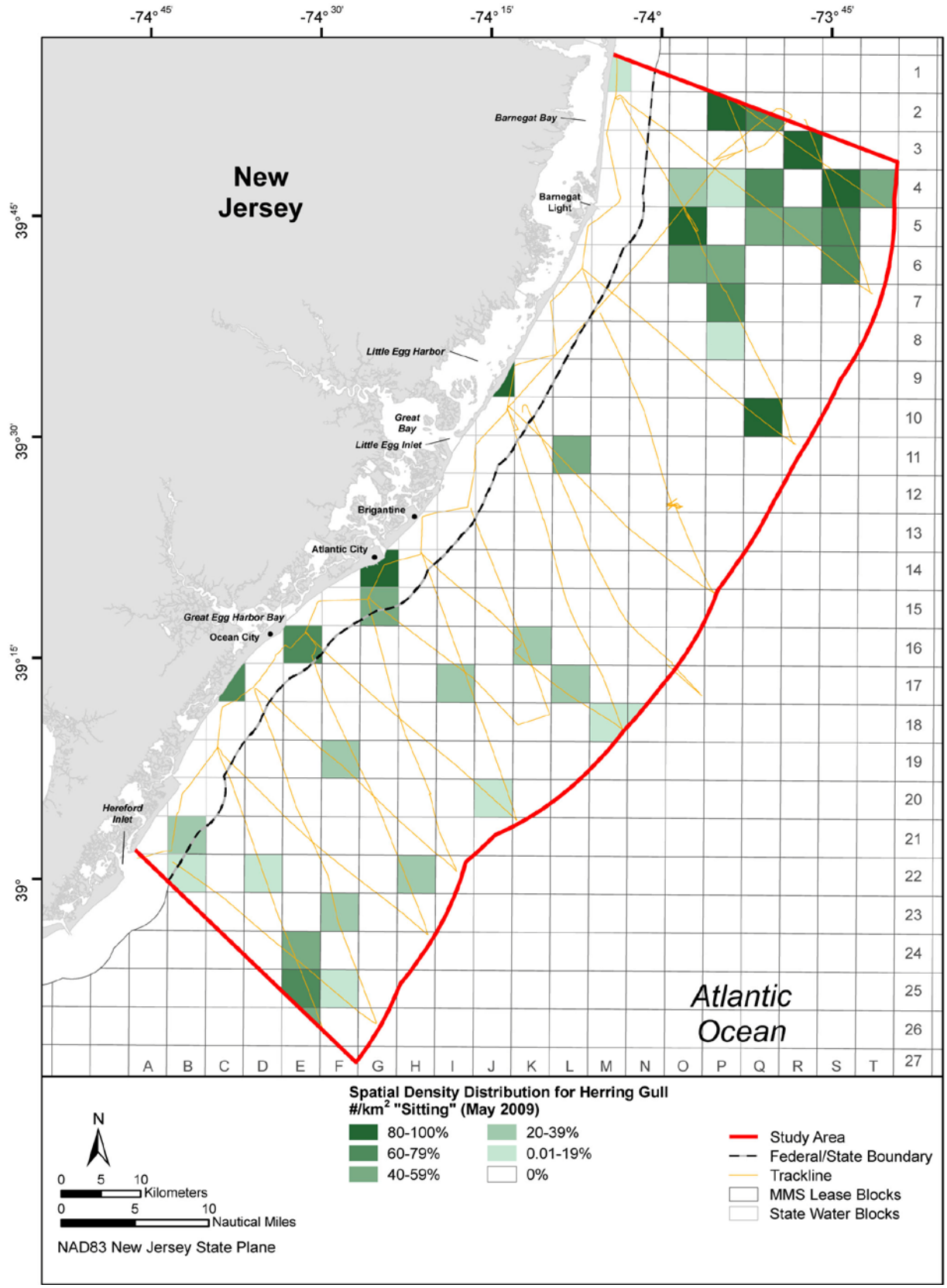

Figure C-309. Percentile abundance of Herring Gull (sitting), May 2009 (n=85).

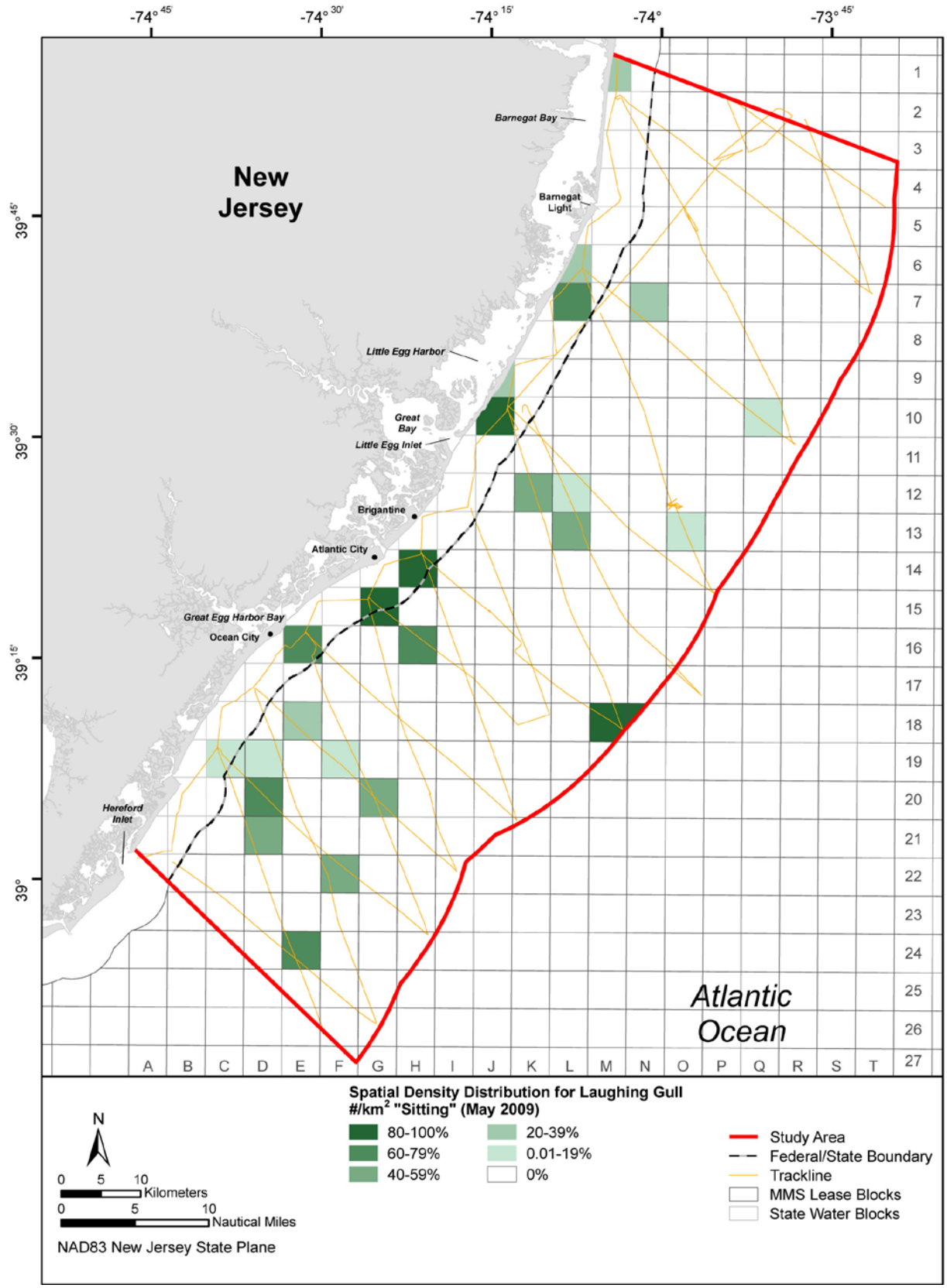

Figure C-310. Percentile abundance of Laughing Gull (sitting), May 2009 (n=56).

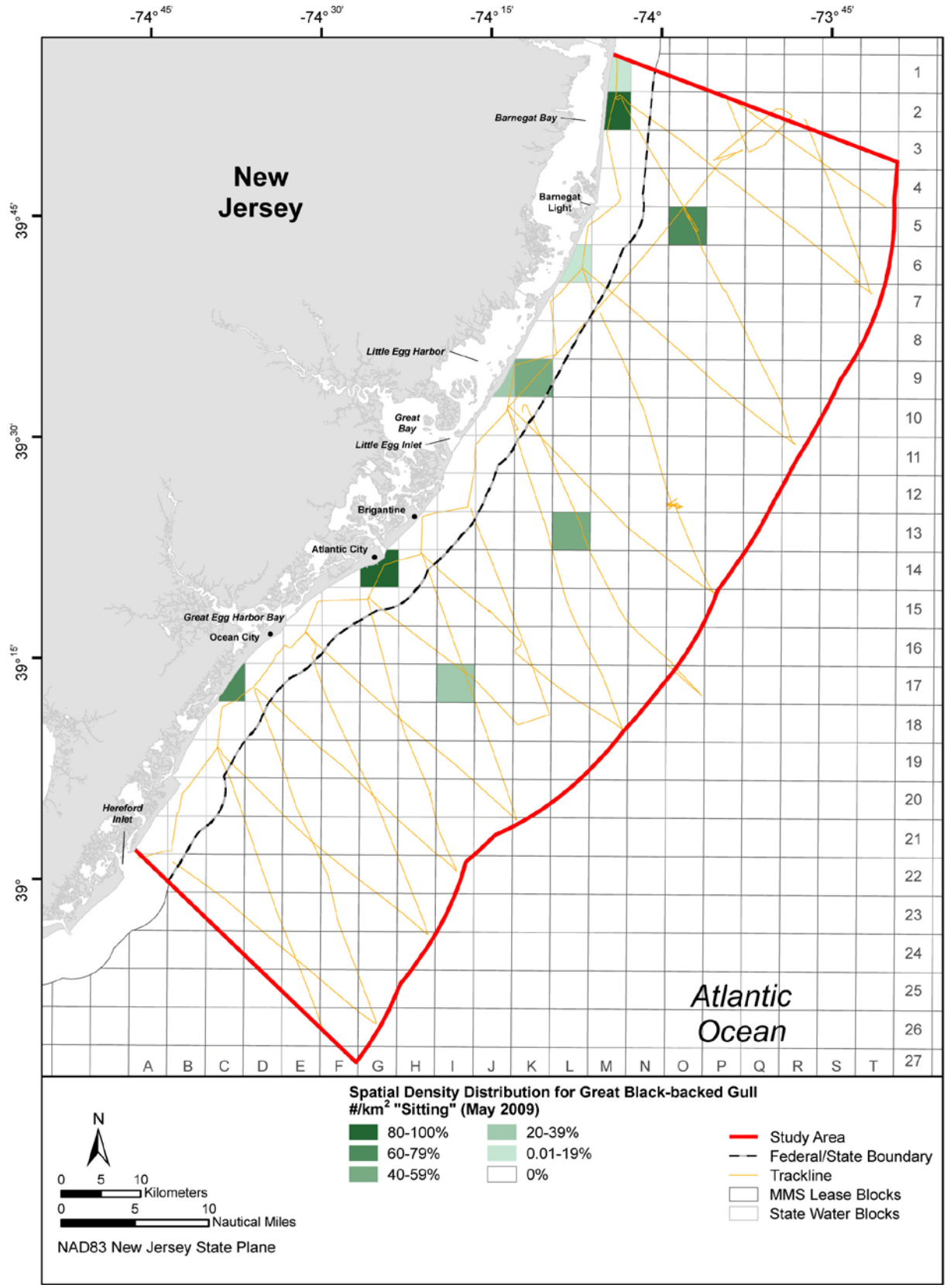

Figure C-311. Percentile abundance of Great Black-backed Gull (sitting), May 2009 (n=22).

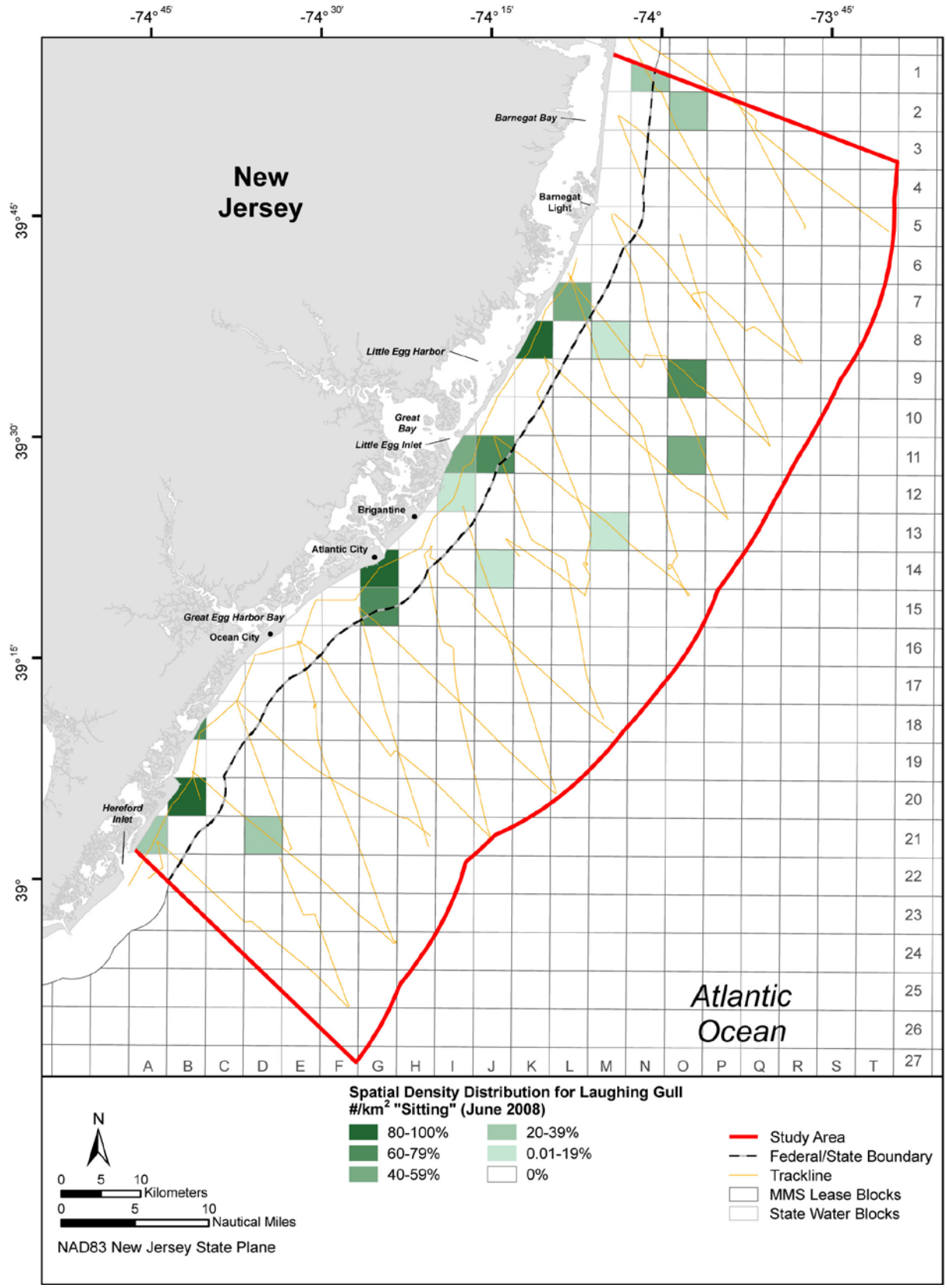

Figure C-312. Percentile abundance of Laughing Gull (sitting), June 2008 (n=62).

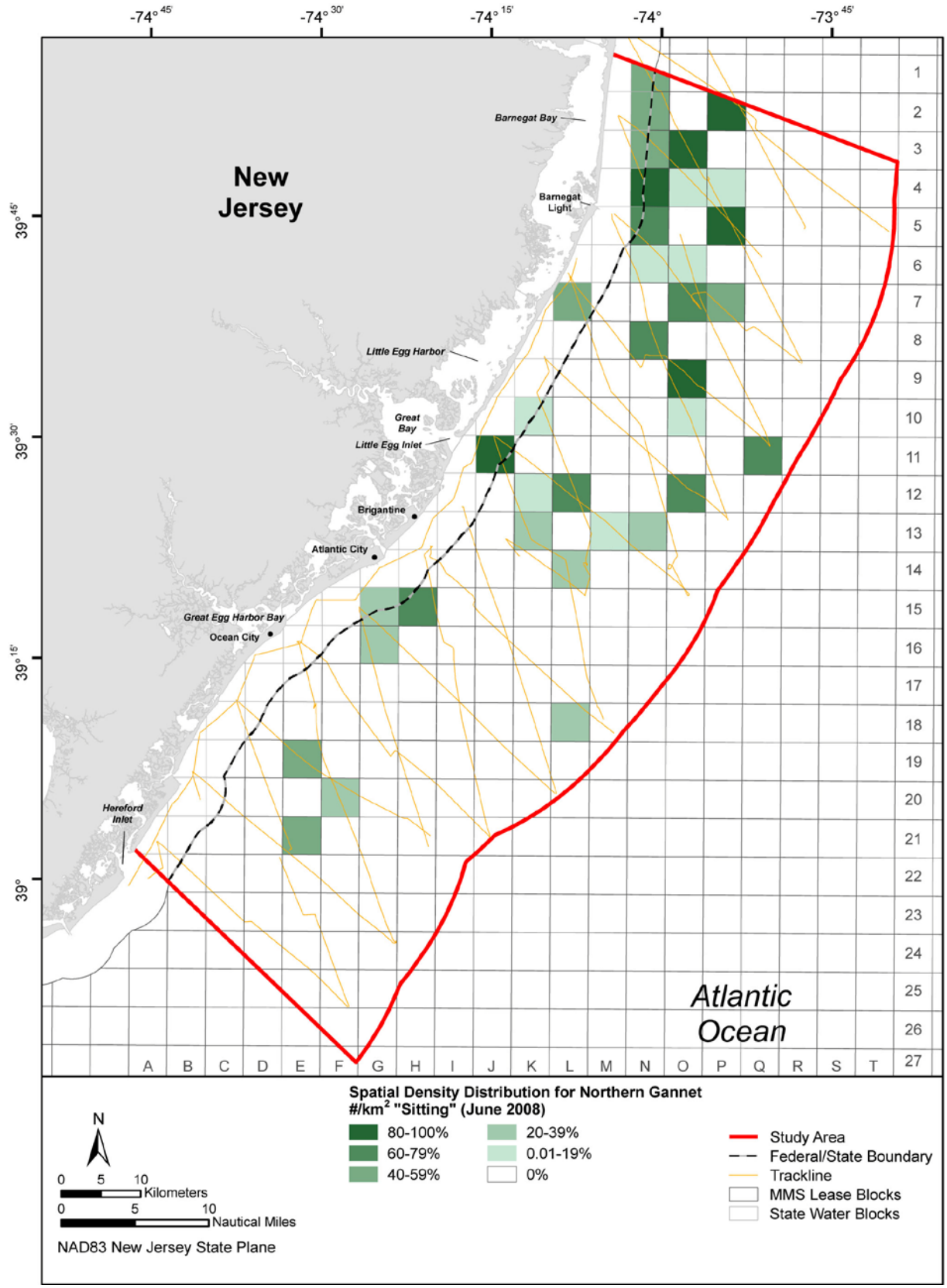

Figure C-313. Percentile abundance of Northern Gannet (sitting), June 2008 (n=55).

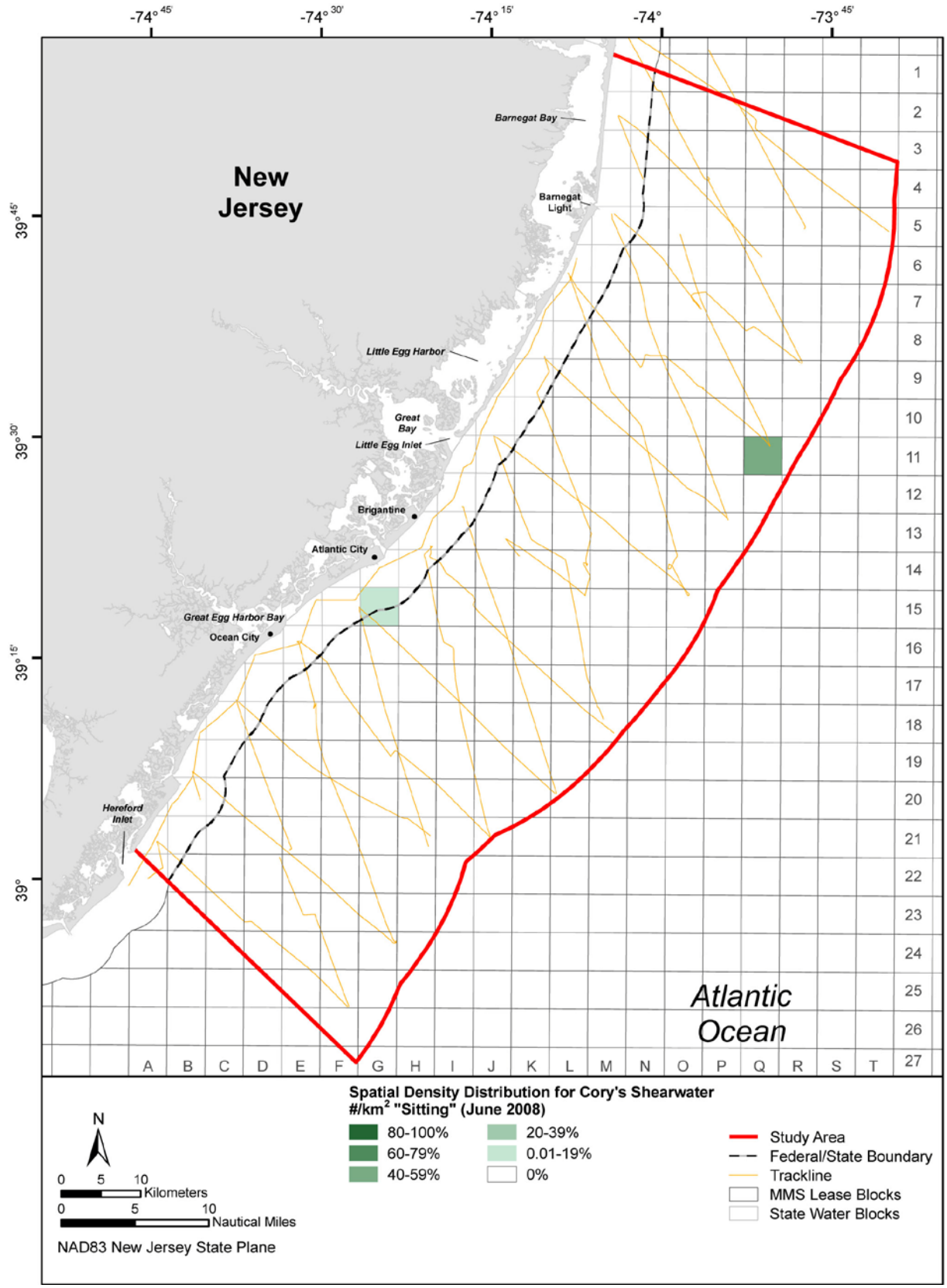

Figure C-314. Percentile abundance of Cory's Shearwater (sitting), June 2008 (n=18).

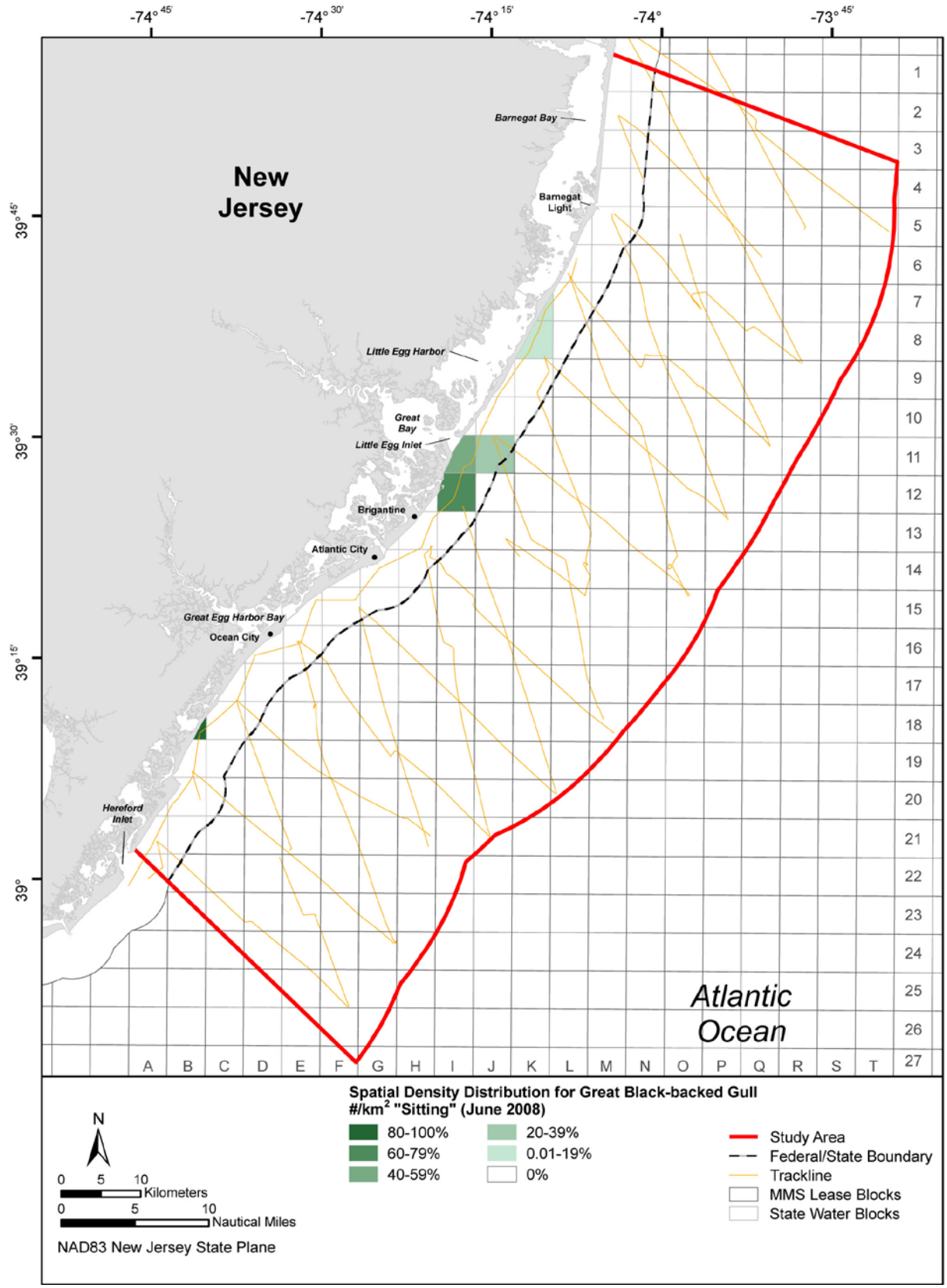

Figure C-315. Percentile abundance of Great Black-backed Gull (sitting), June 2008 (n=11).

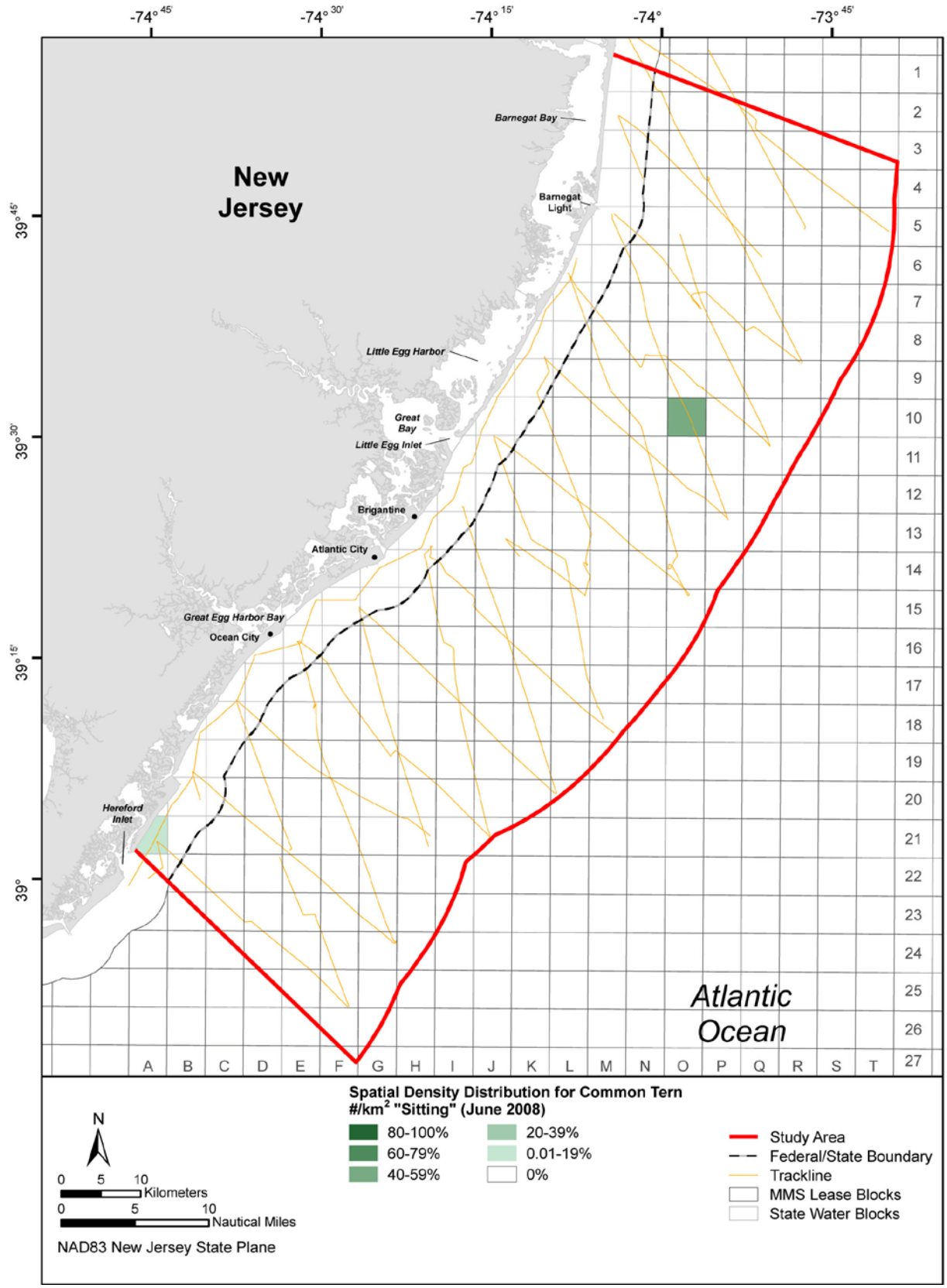

Figure C-316. Percentile abundance of Common Tern (sitting), June 2008 (n=3).

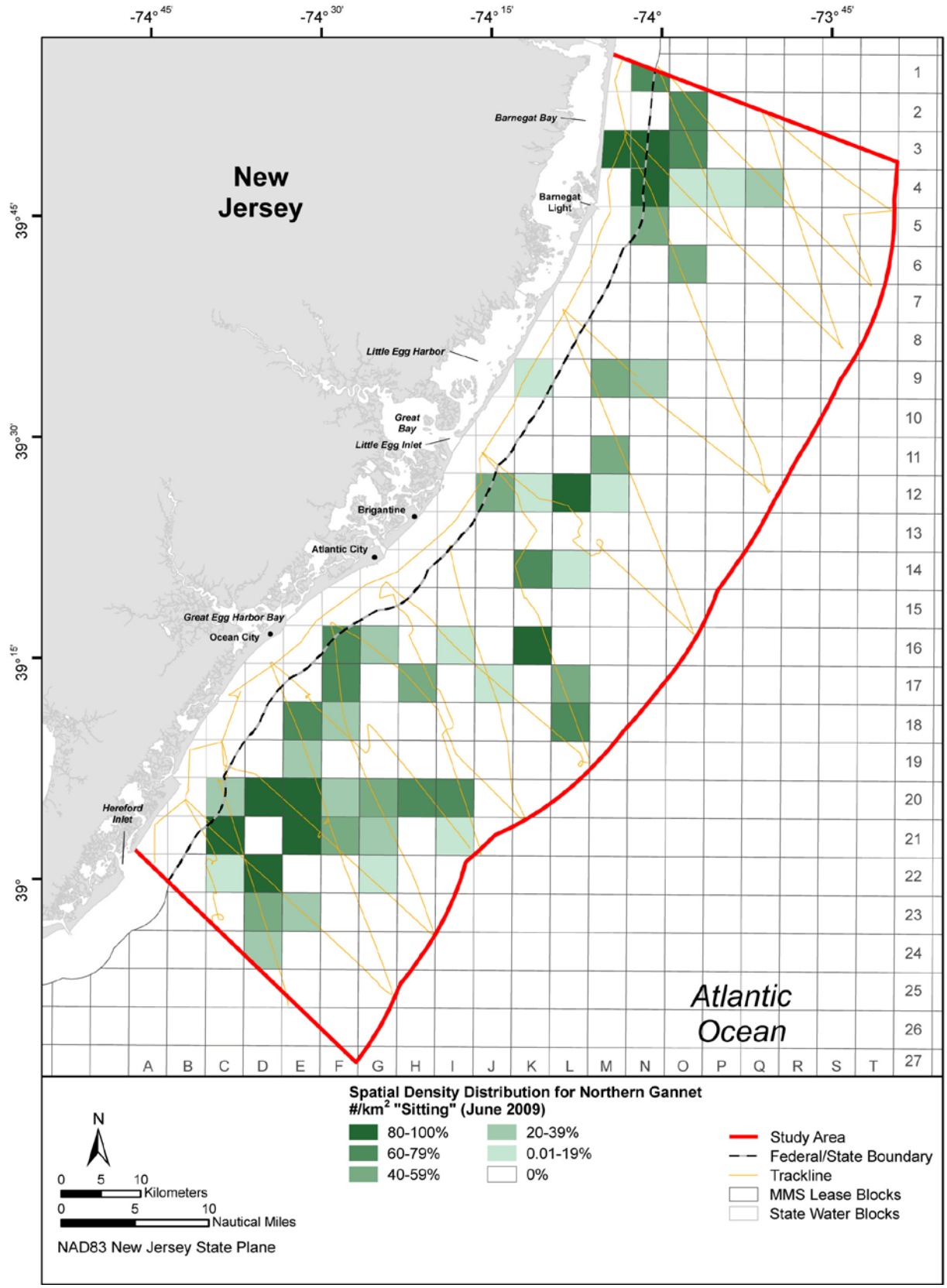

Figure C-317. Percentile abundance of Northern Gannet (sitting), June 2009 (n=143).

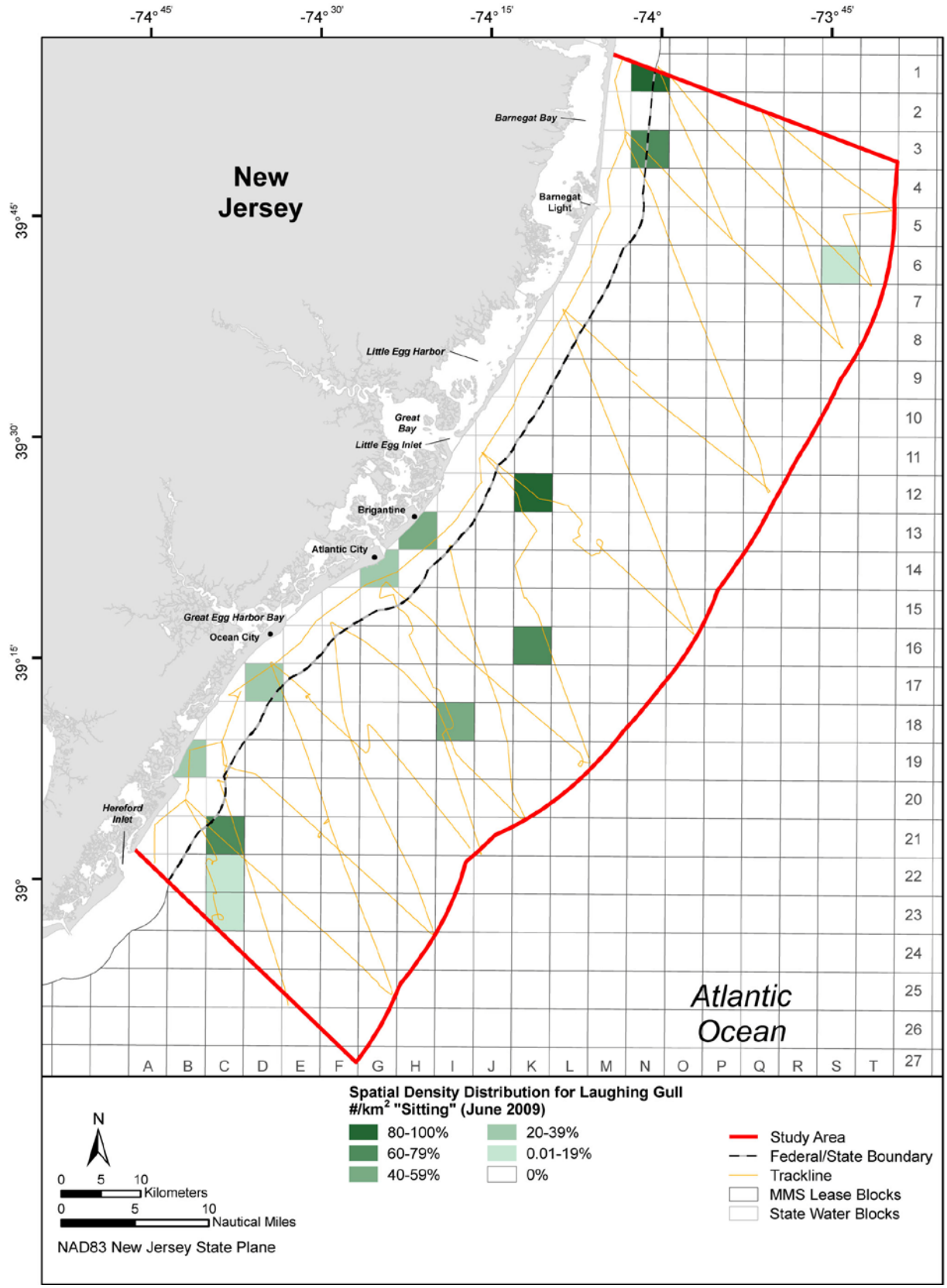

Figure C-318. Percentile abundance of Laughing Gull (sitting), June 2009 (n=24).

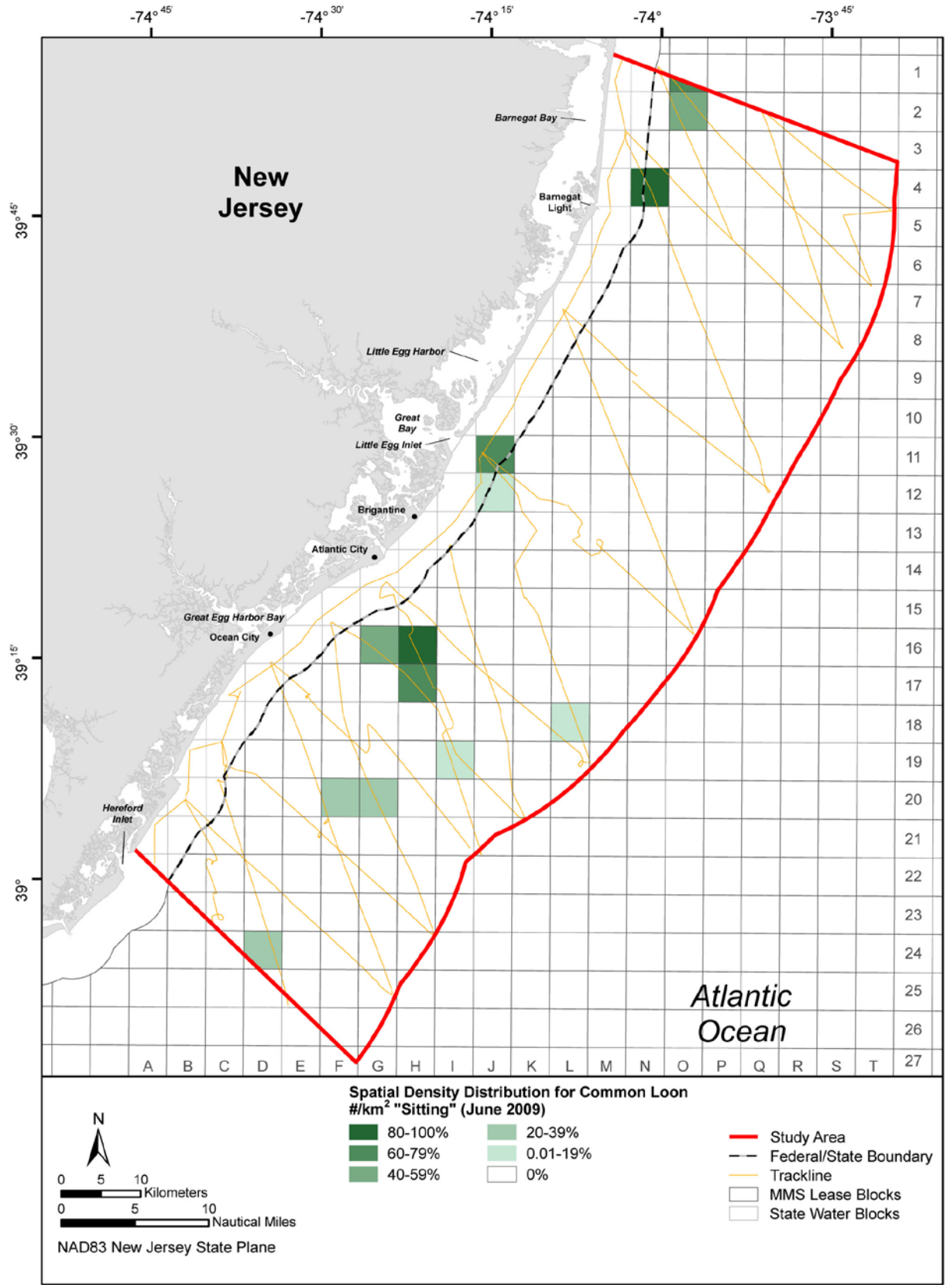

Figure C-319. Percentile abundance of Common Loon (sitting), June 2009 (n=16).

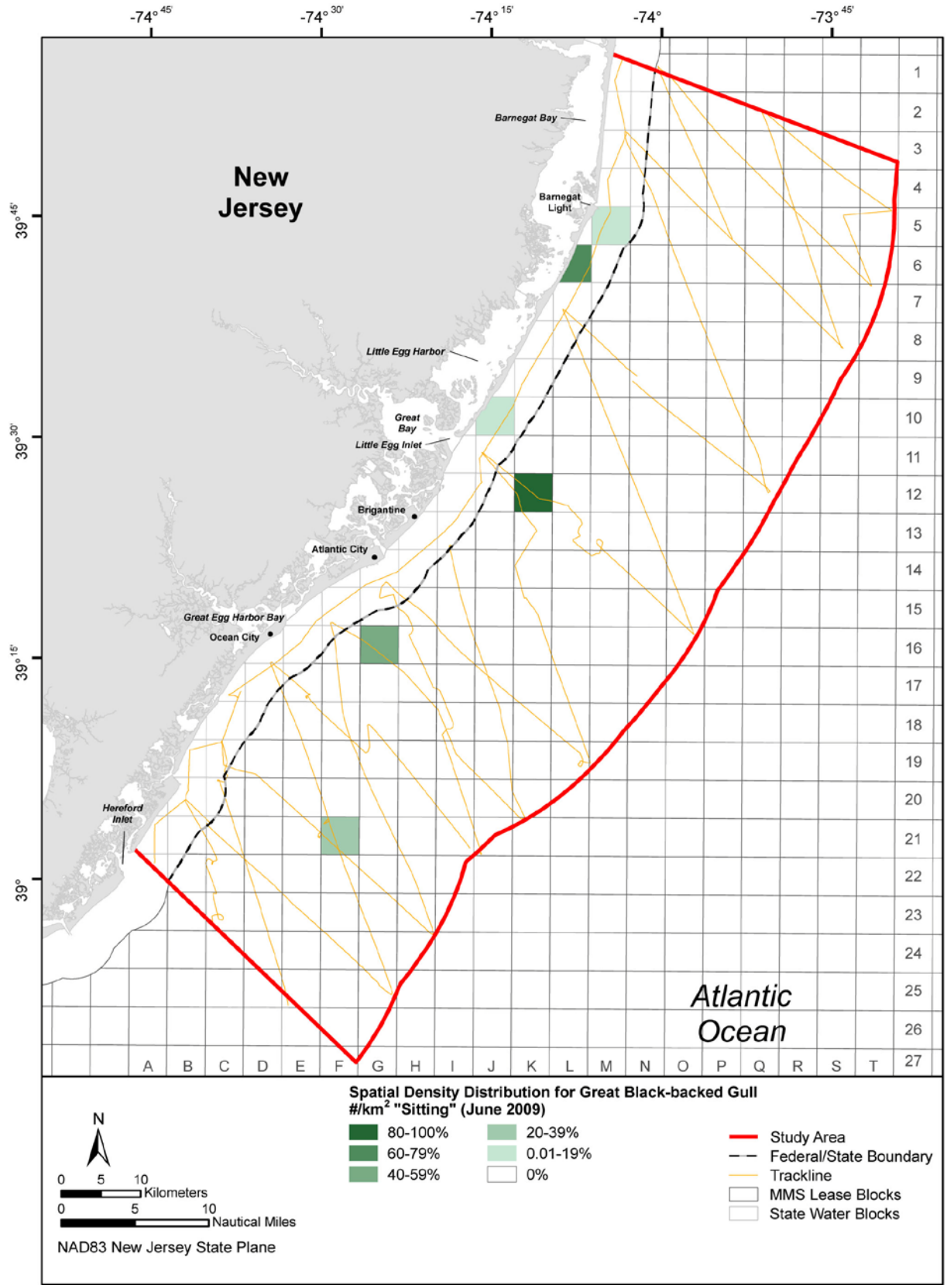

Figure C-320. Percentile abundance of Great Black-backed Gull (sitting), June 2009 (n=10).

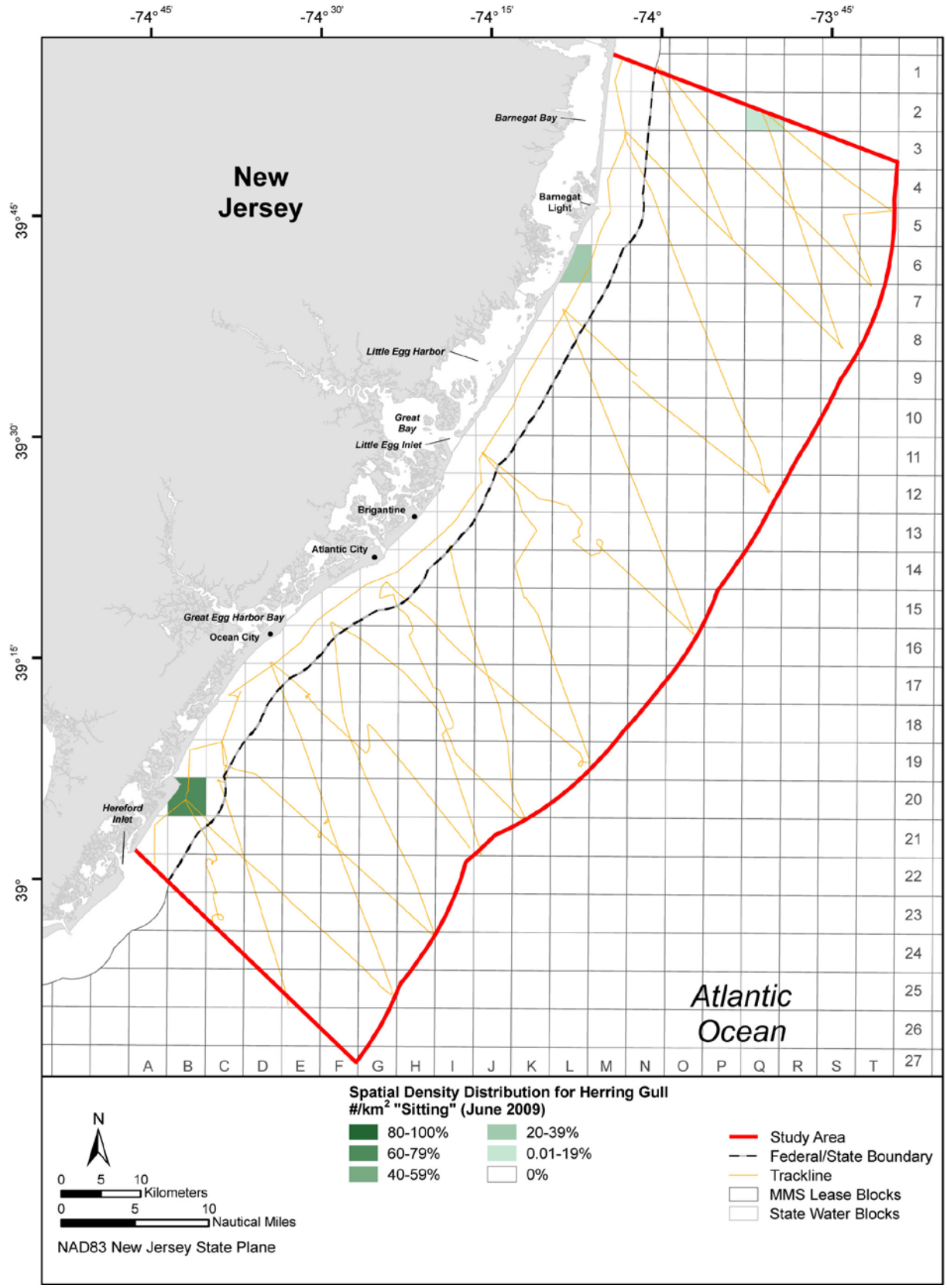

Figure C-321. Percentile abundance of Herring Gull (sitting), June 2009 (n=8).

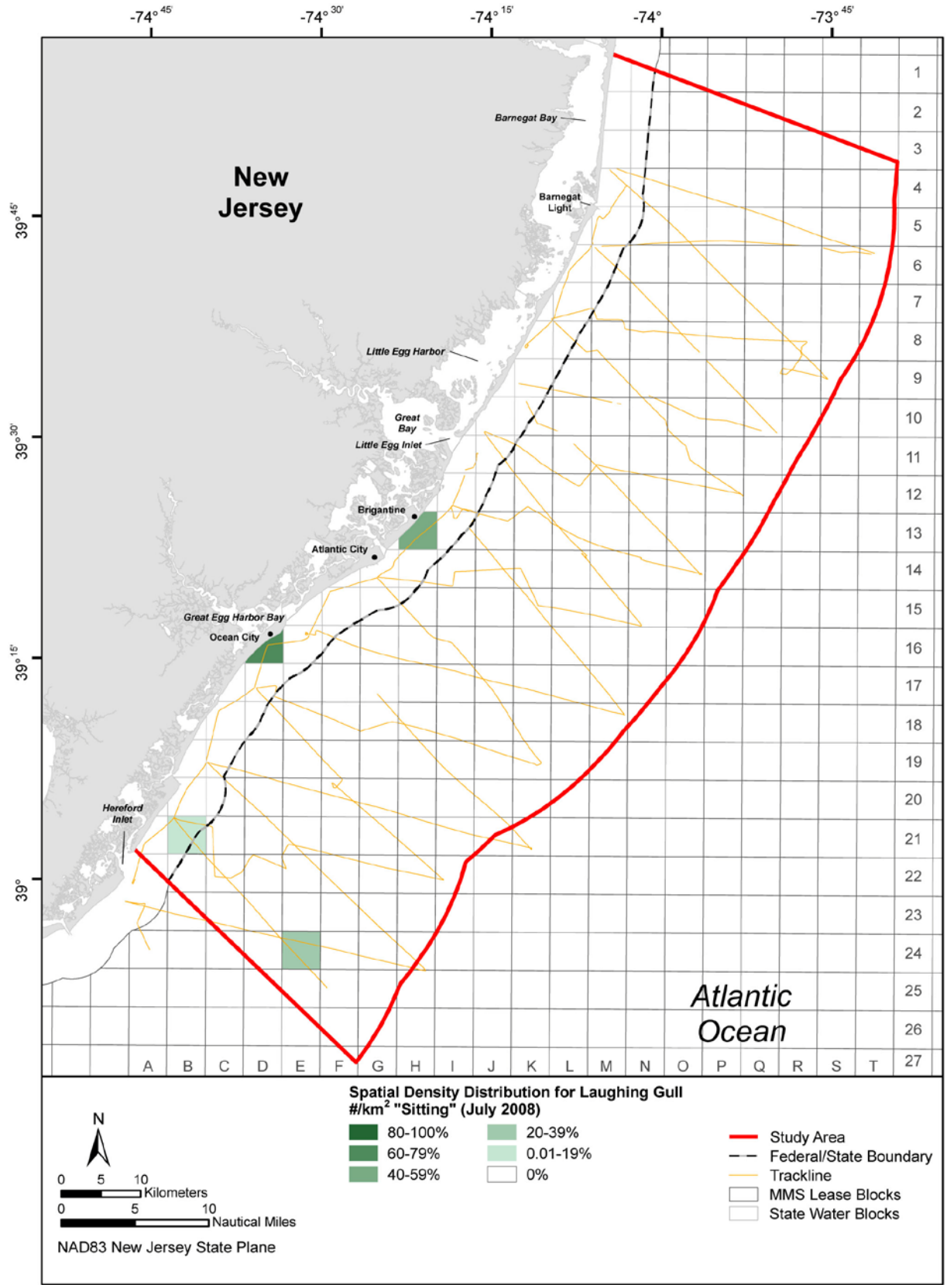

Figure C-322. Percentile abundance of Laughing Gull (sitting), July 2008 (n=11).

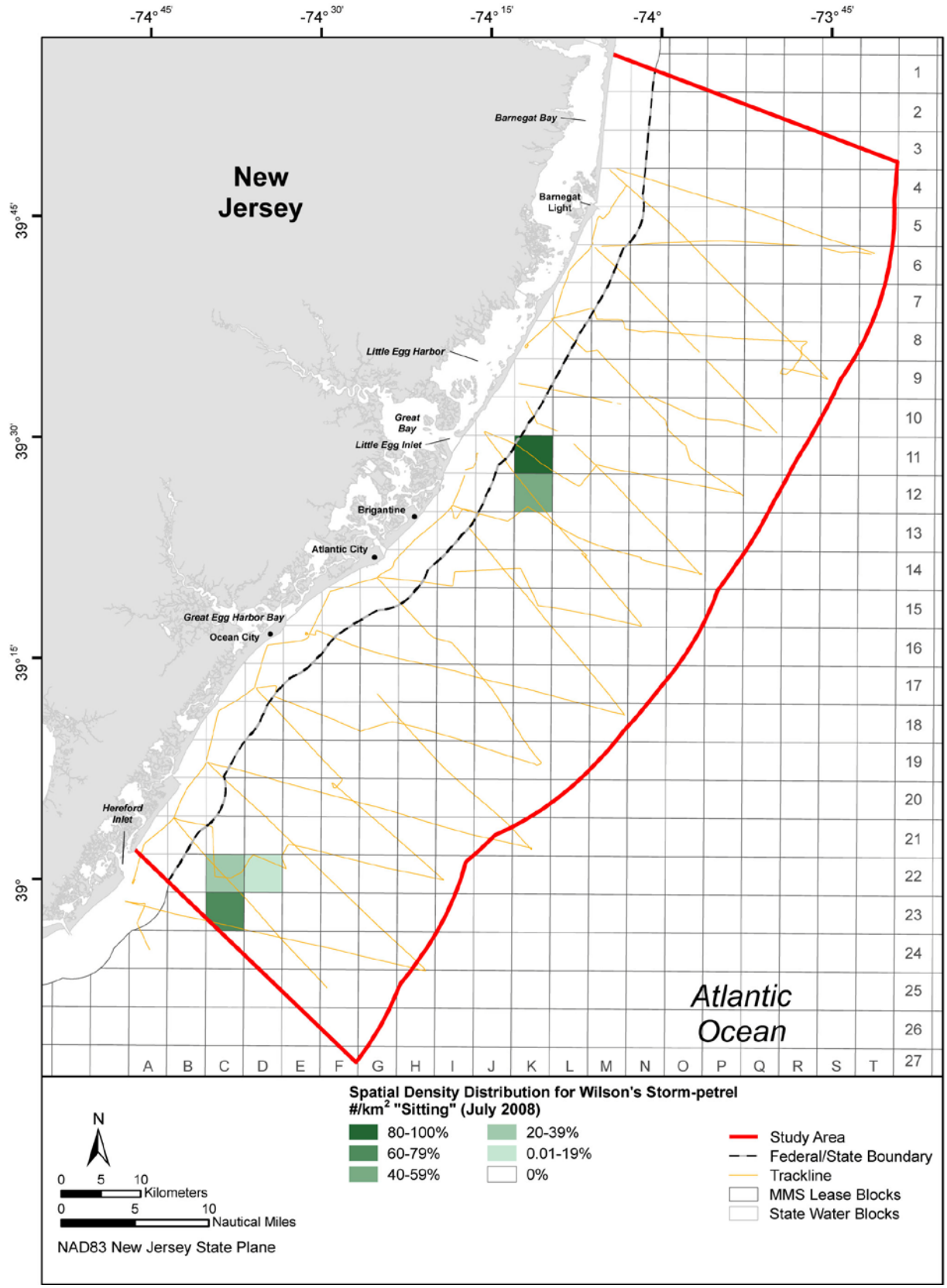

Figure C-323. Percentile abundance of Wilson's Storm-Petrel (sitting), July 2008 (n=5).

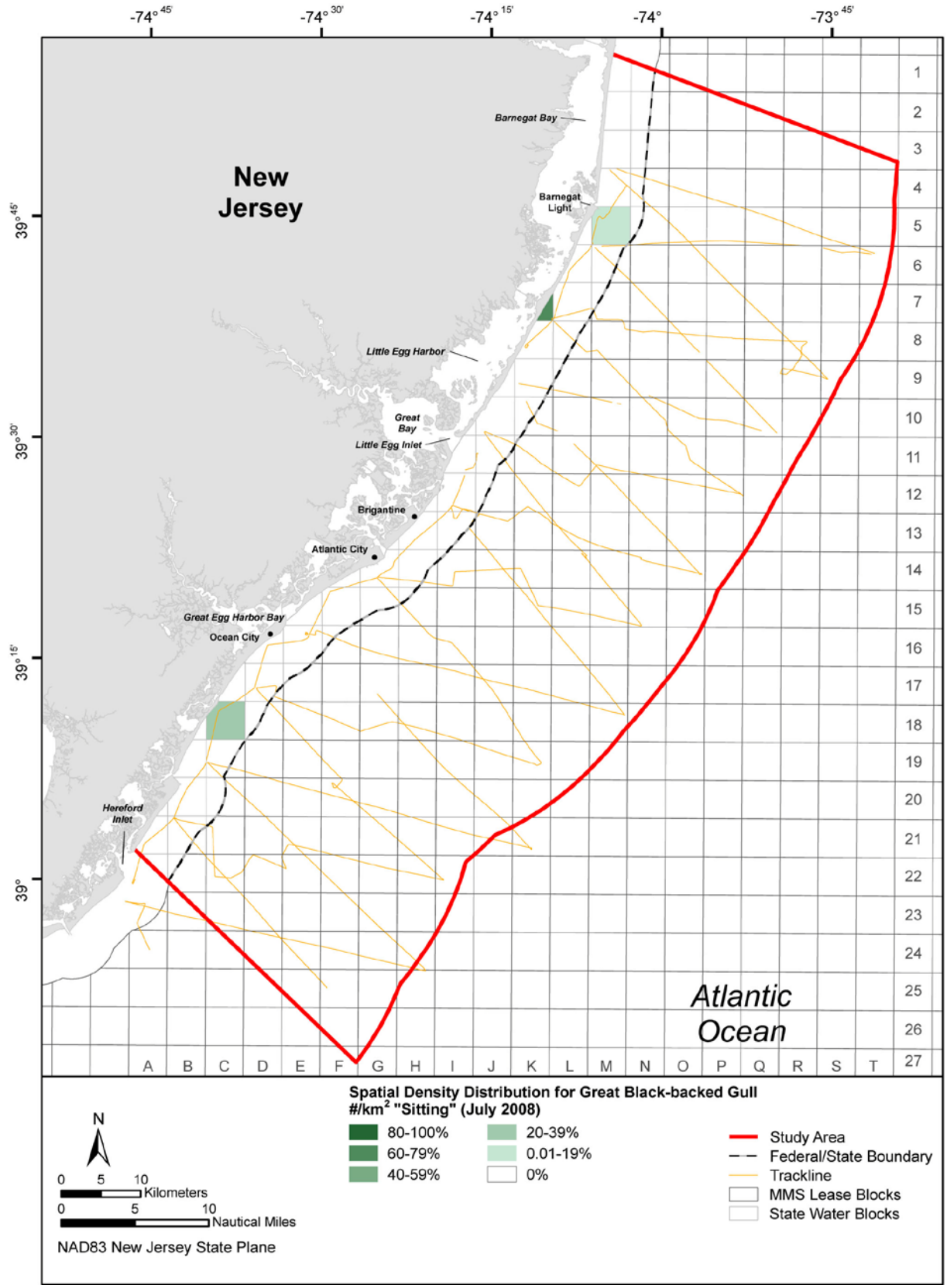

Figure C-324. Percentile abundance of Great Black-backed Gull (sitting), July 2008 (n=3).

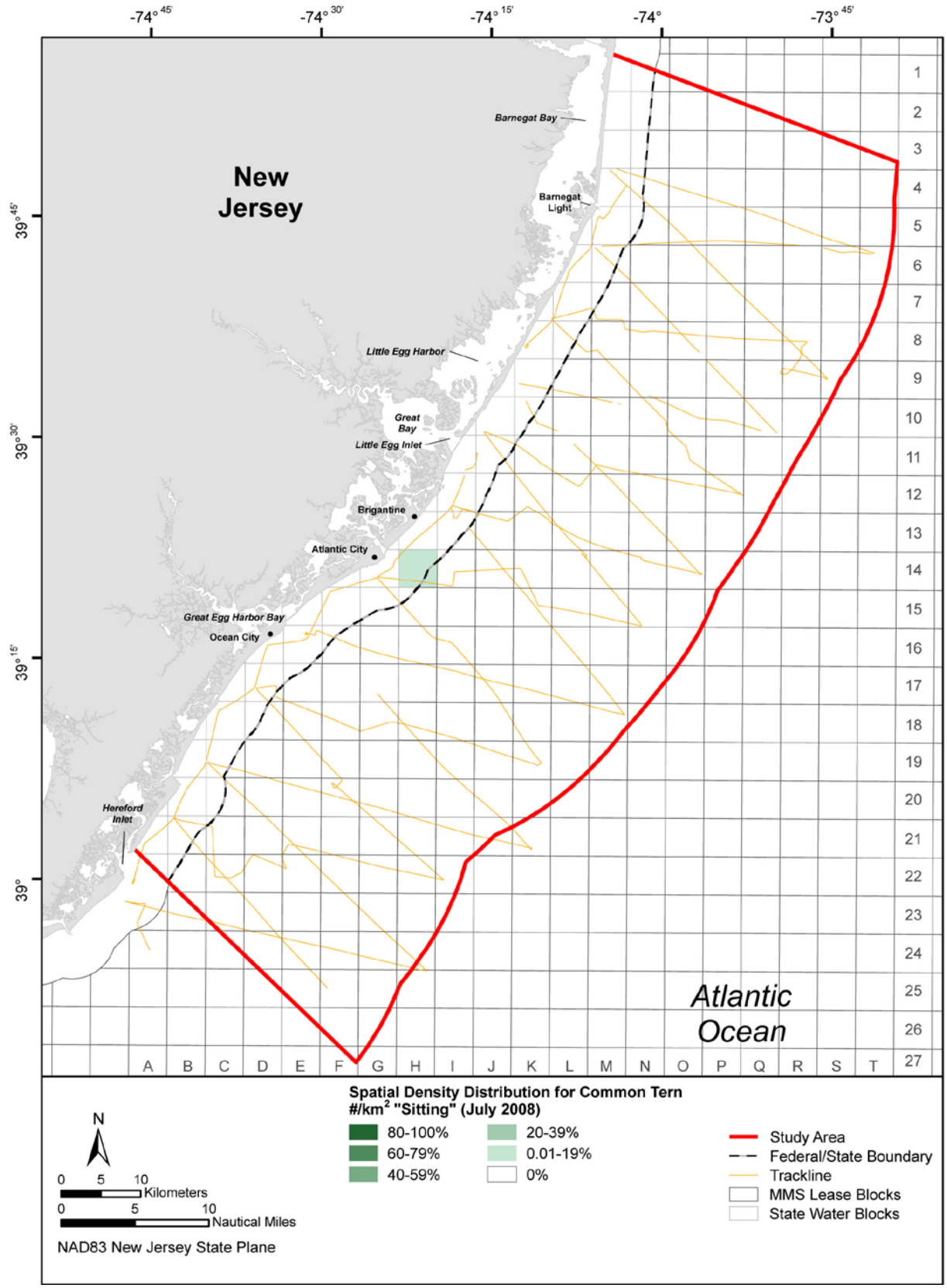

Figure C-325. Percentile abundance of Common Tern (sitting), July 2008 (n=1).

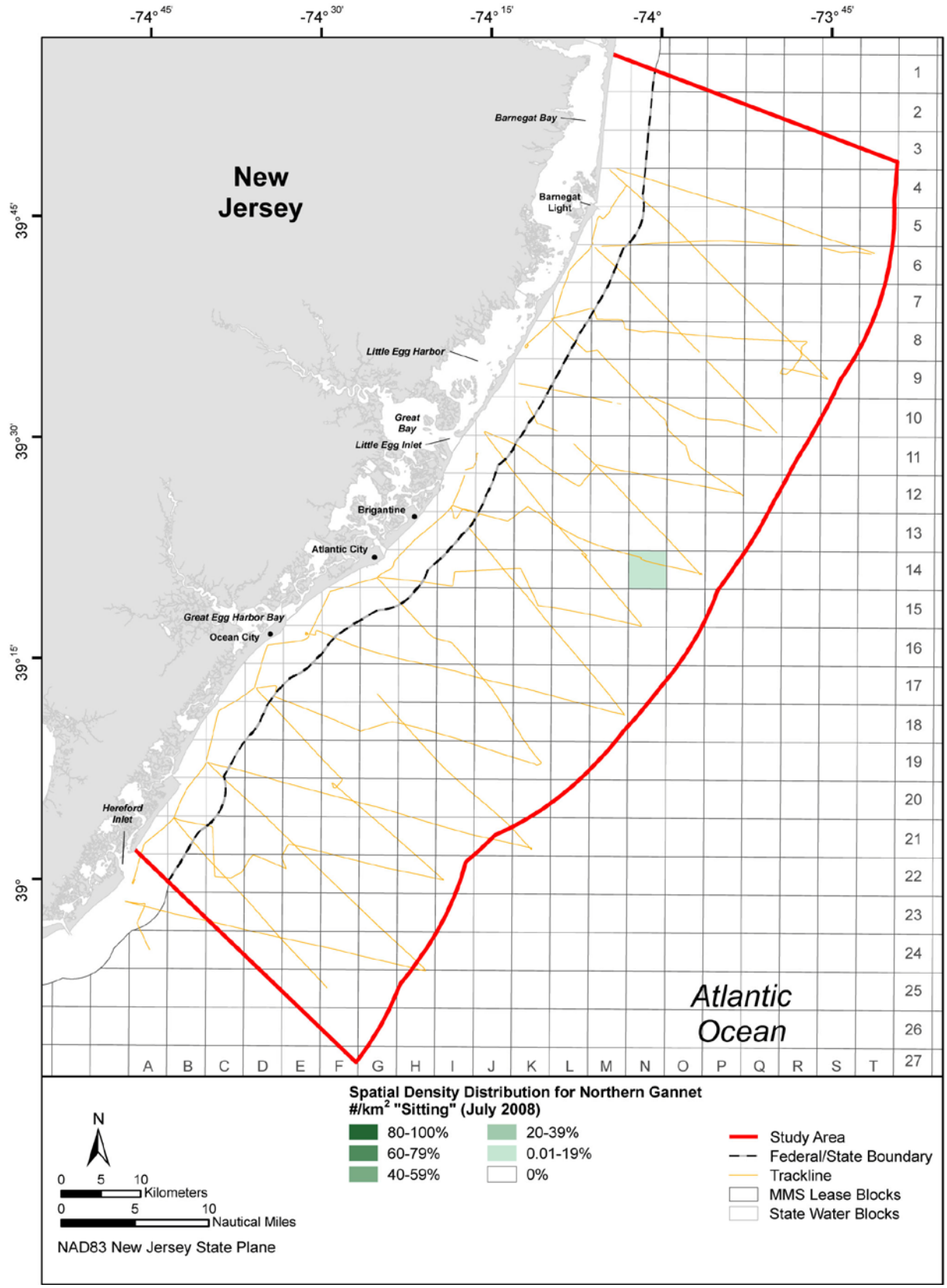

Figure C-326. Percentile abundance of Northern Gannet (sitting), July 2008 (n=1).

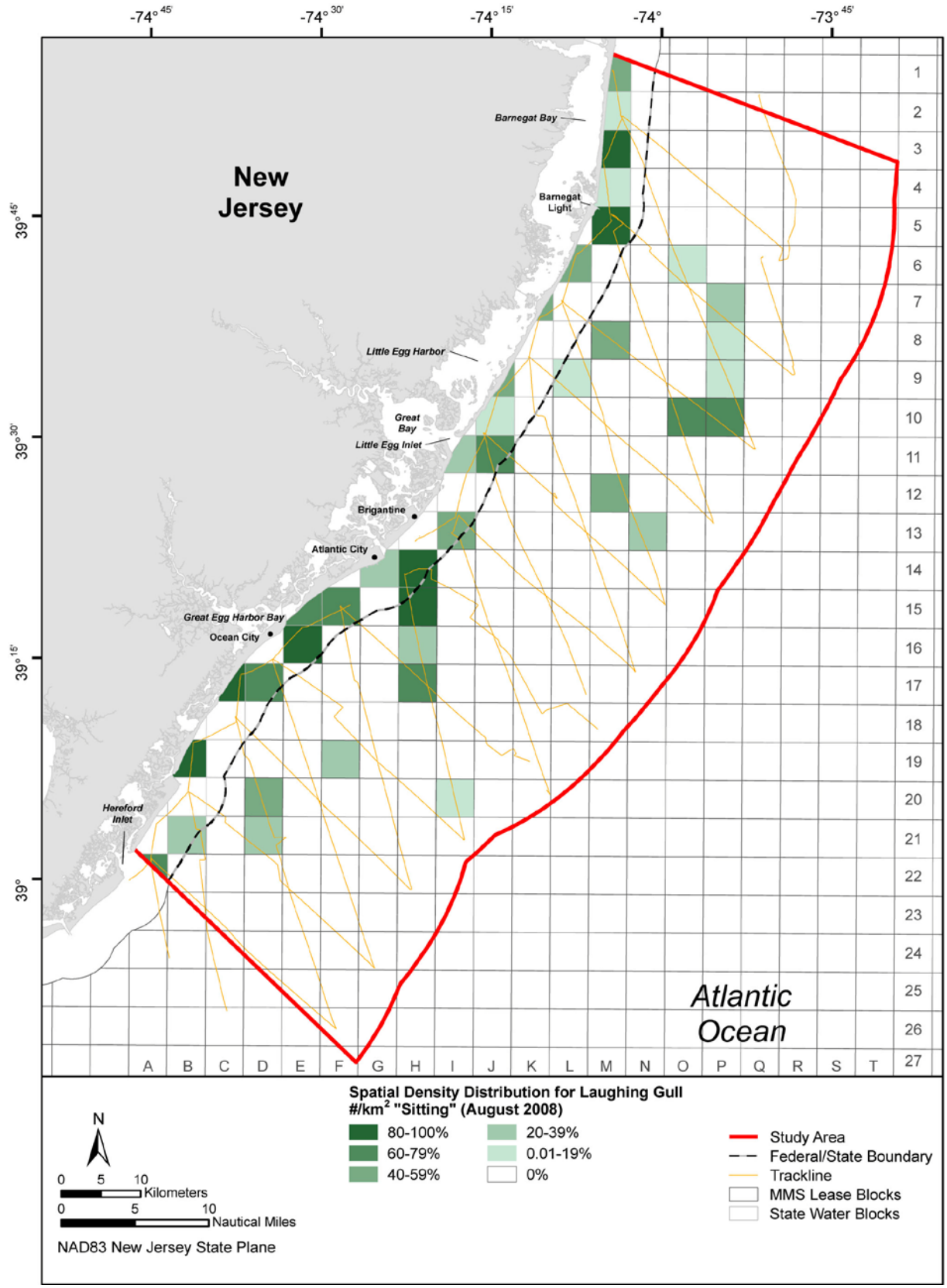

Figure C-327. Percentile abundance of Laughing Gull (sitting), August 2008 (n=343).

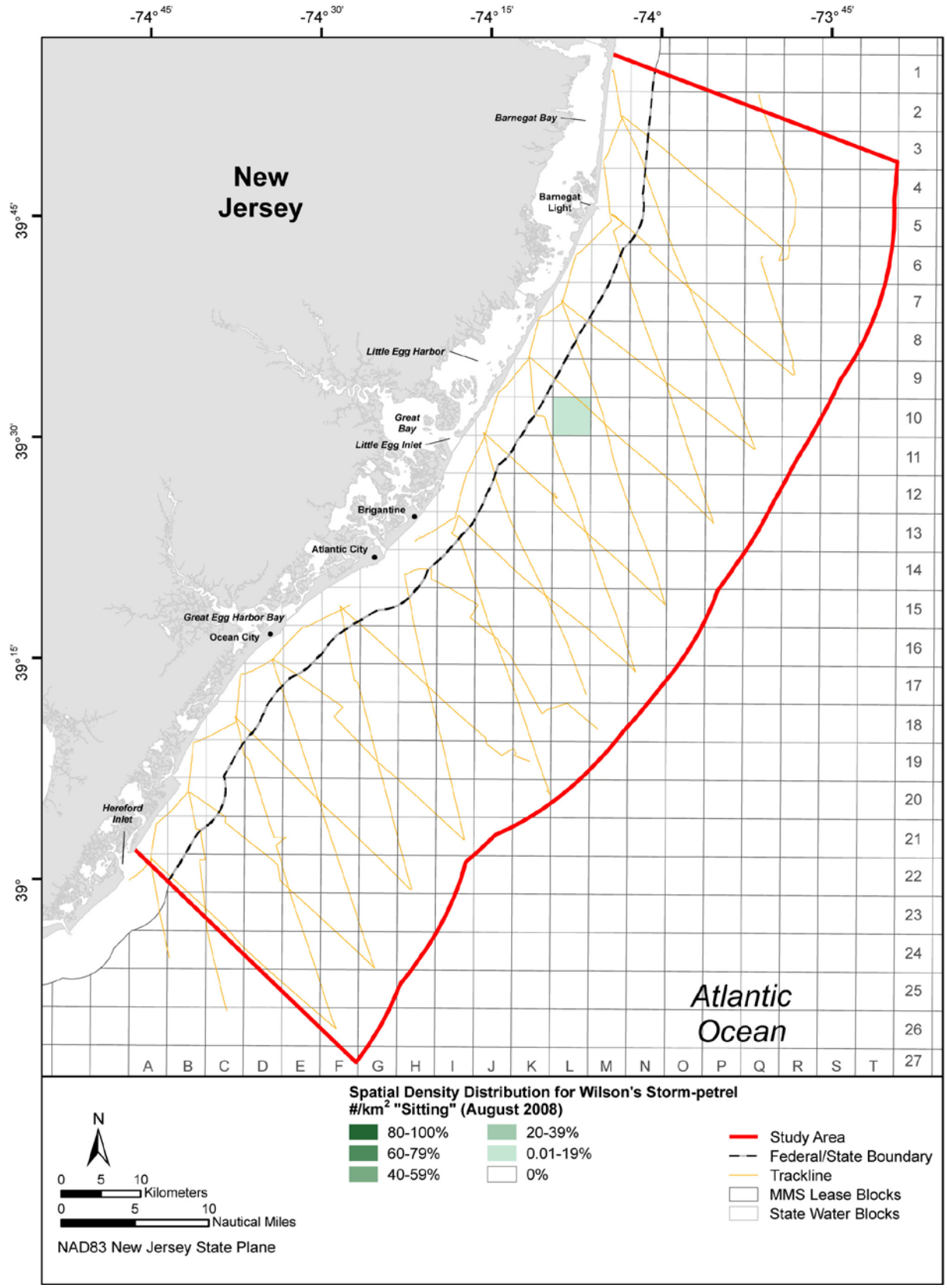

Figure C-328. Percentile abundance of Wilson's Storm-Petrel (sitting), August 2008 (n=191).

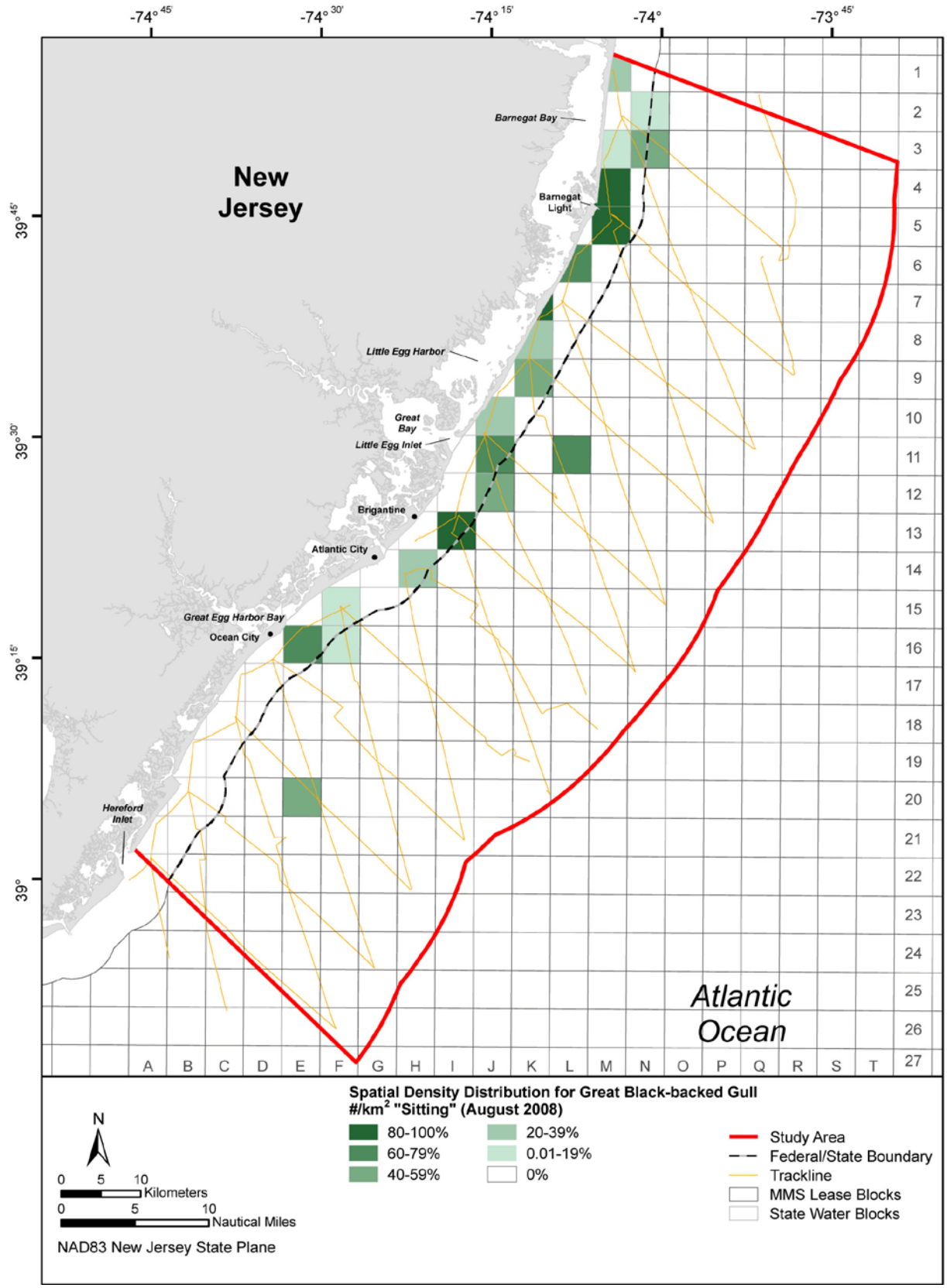

Figure C-329. Percentile abundance of Great Black-backed Gull (sitting), August 2008 (n=57).

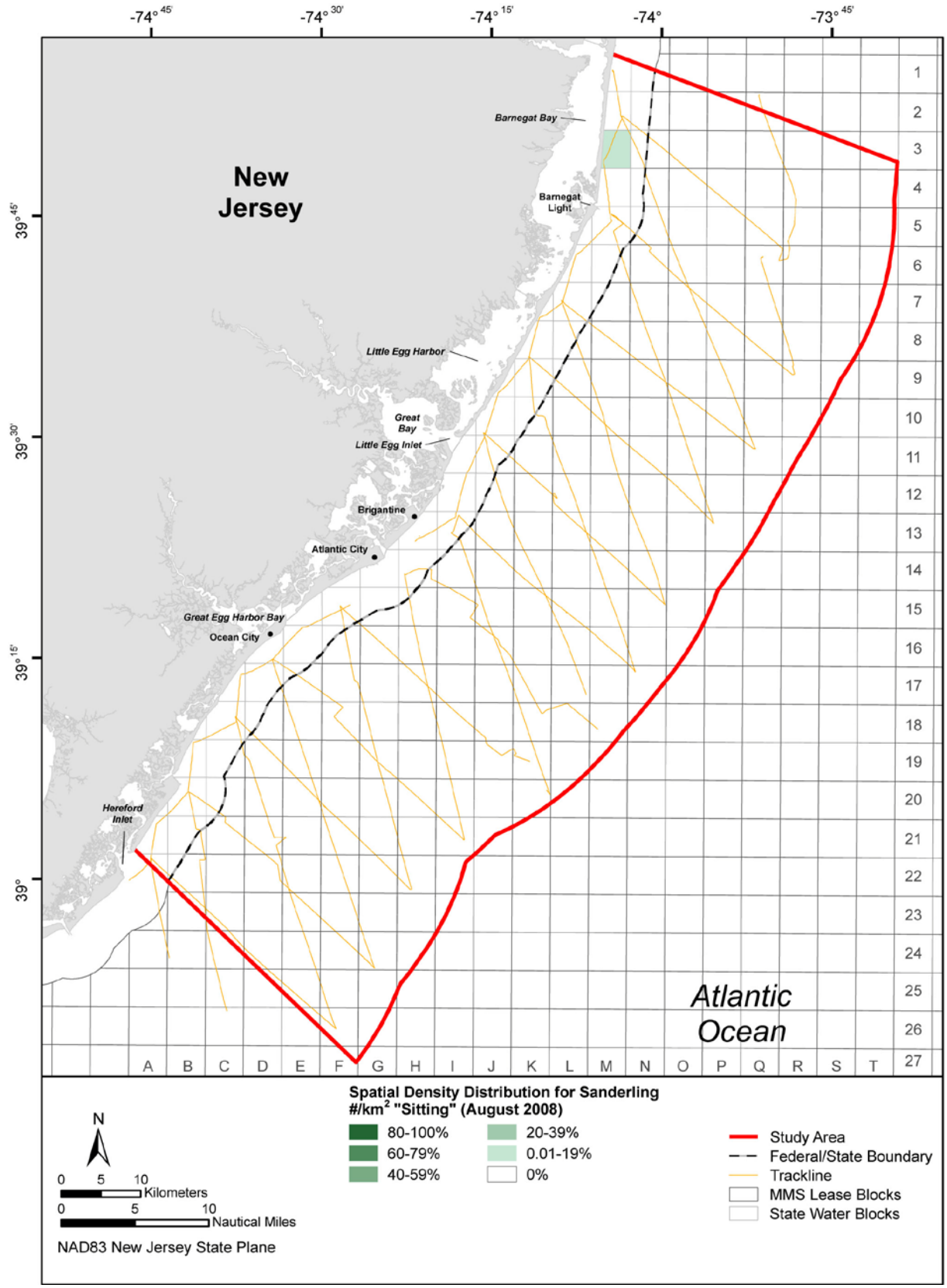

Figure C-330. Percentile abundance of Sanderling (sitting), August 2008 (n=35).

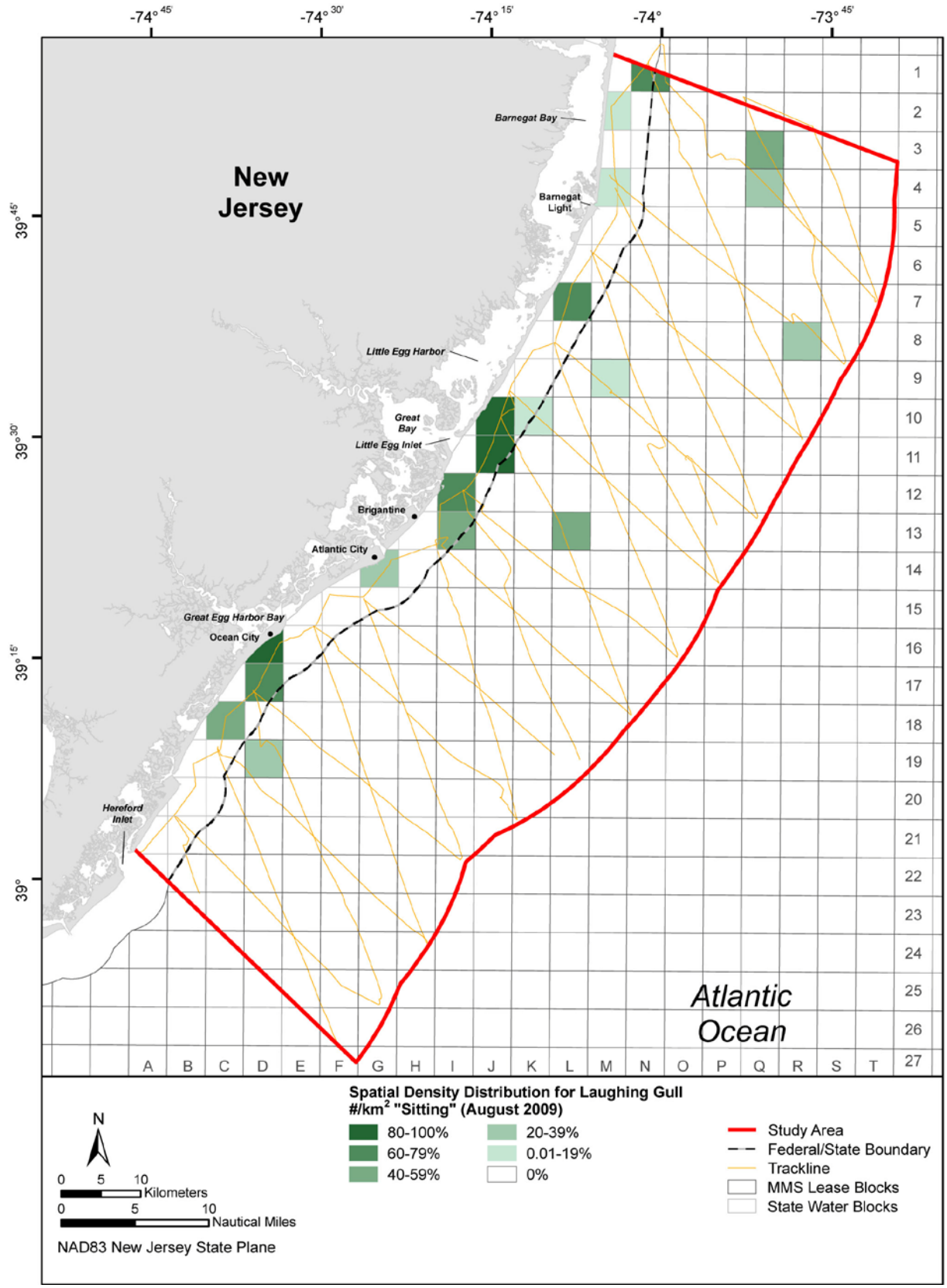

Figure C-331. Percentile abundance of Laughing Gull (sitting), August 2009 (n=148).

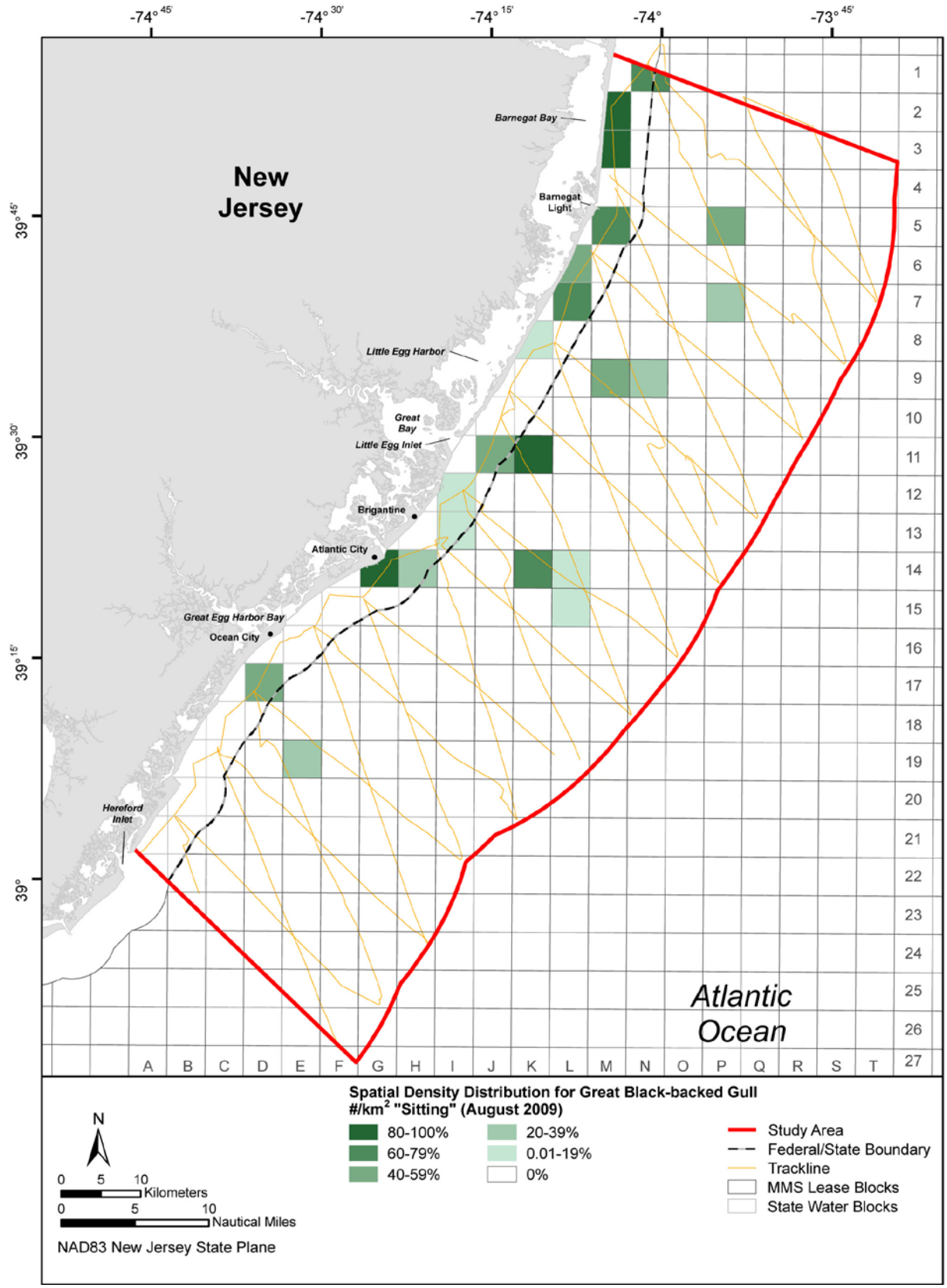

Figure C-332. Percentile abundance of Great Black-backed Gull (sitting), August 2009 (n=50).

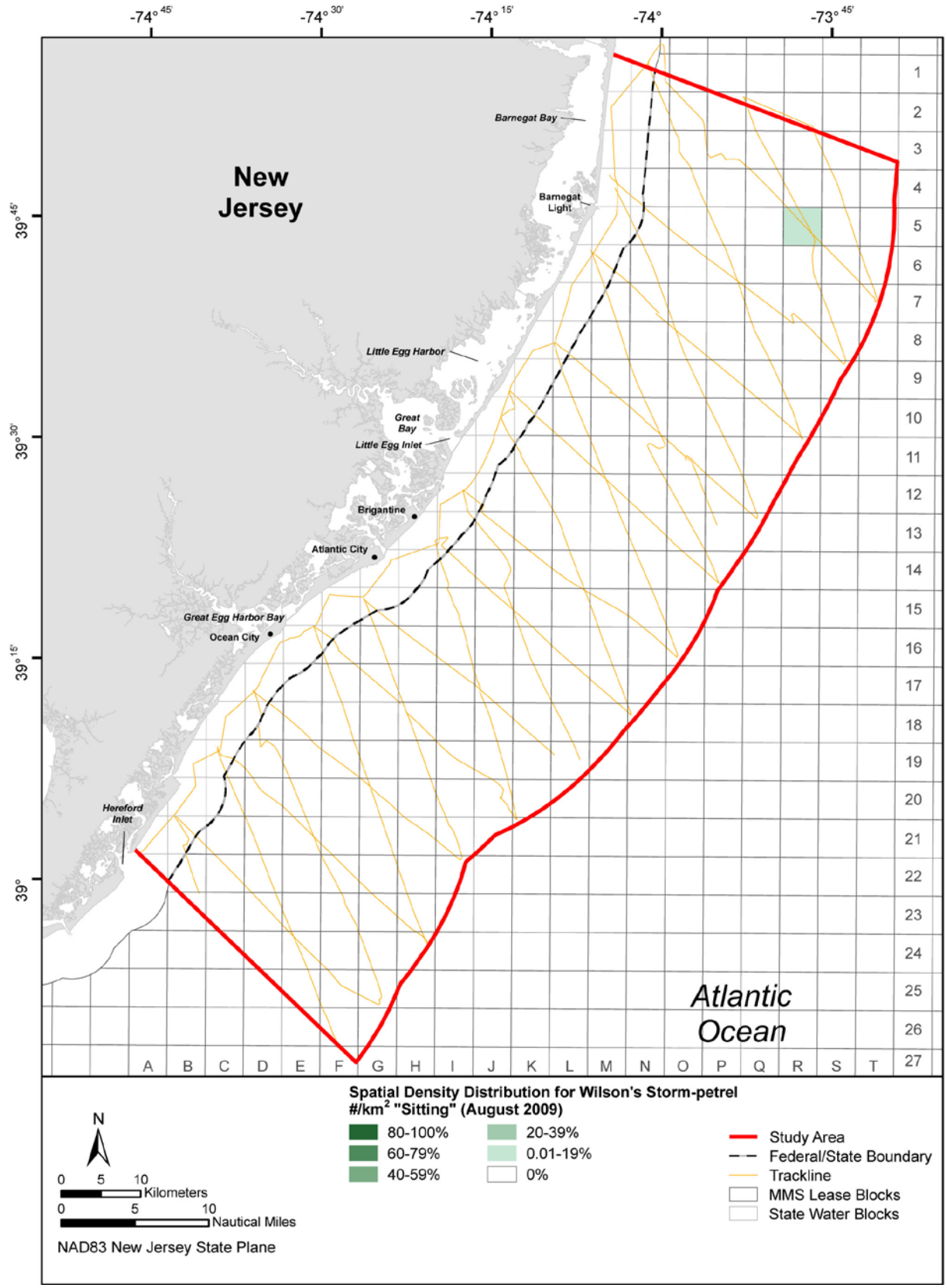

Figure C-333. Percentile abundance of Wilson's Storm-Petrel (sitting), August 2009 (n=6).

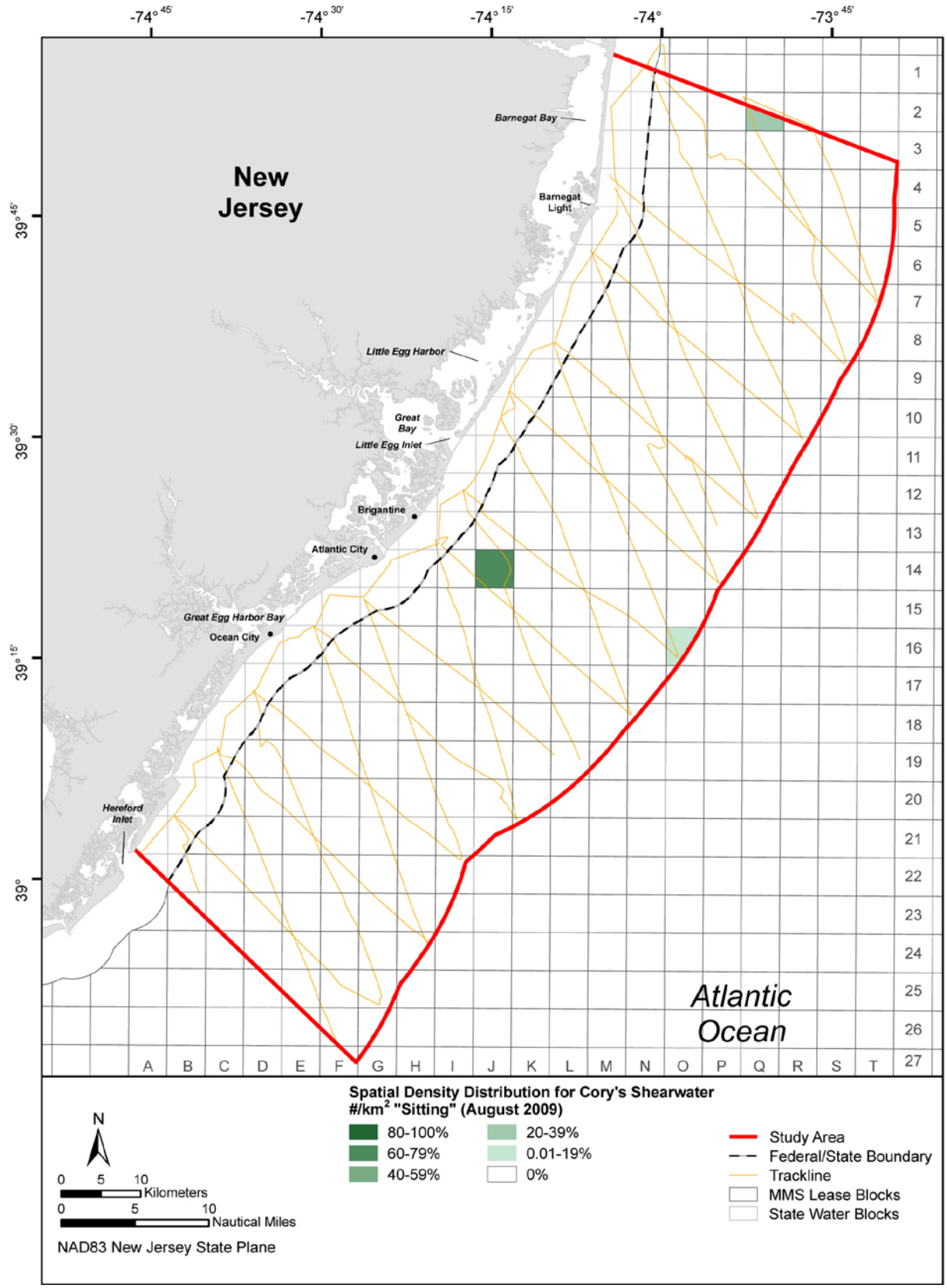

Figure C-334. Percentile abundance of Cory's Shearwater (sitting), August 2009 (n=6).

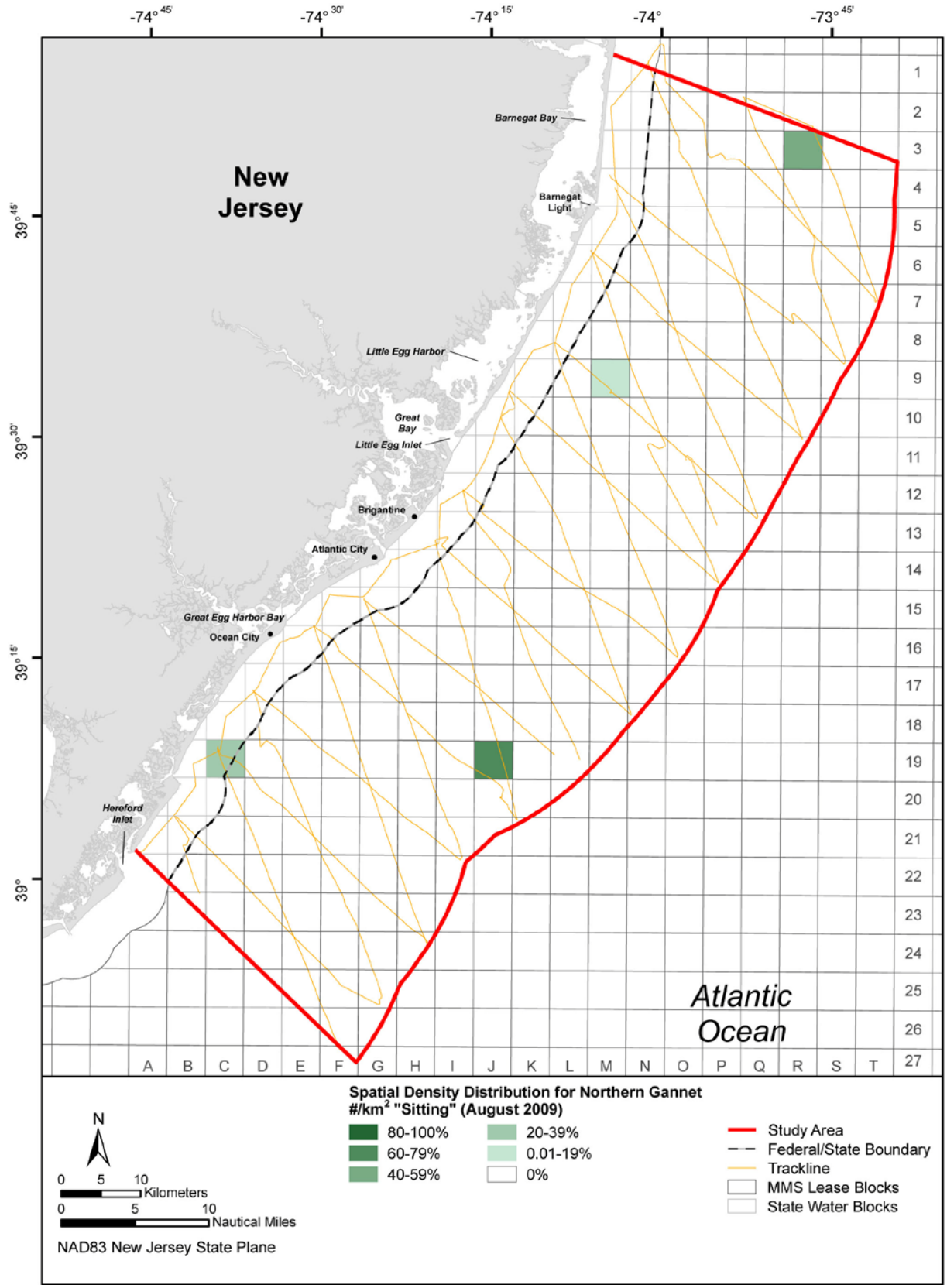

Figure C-335. Percentile abundance of Northern Gannet (sitting), August 2009 (n=5).

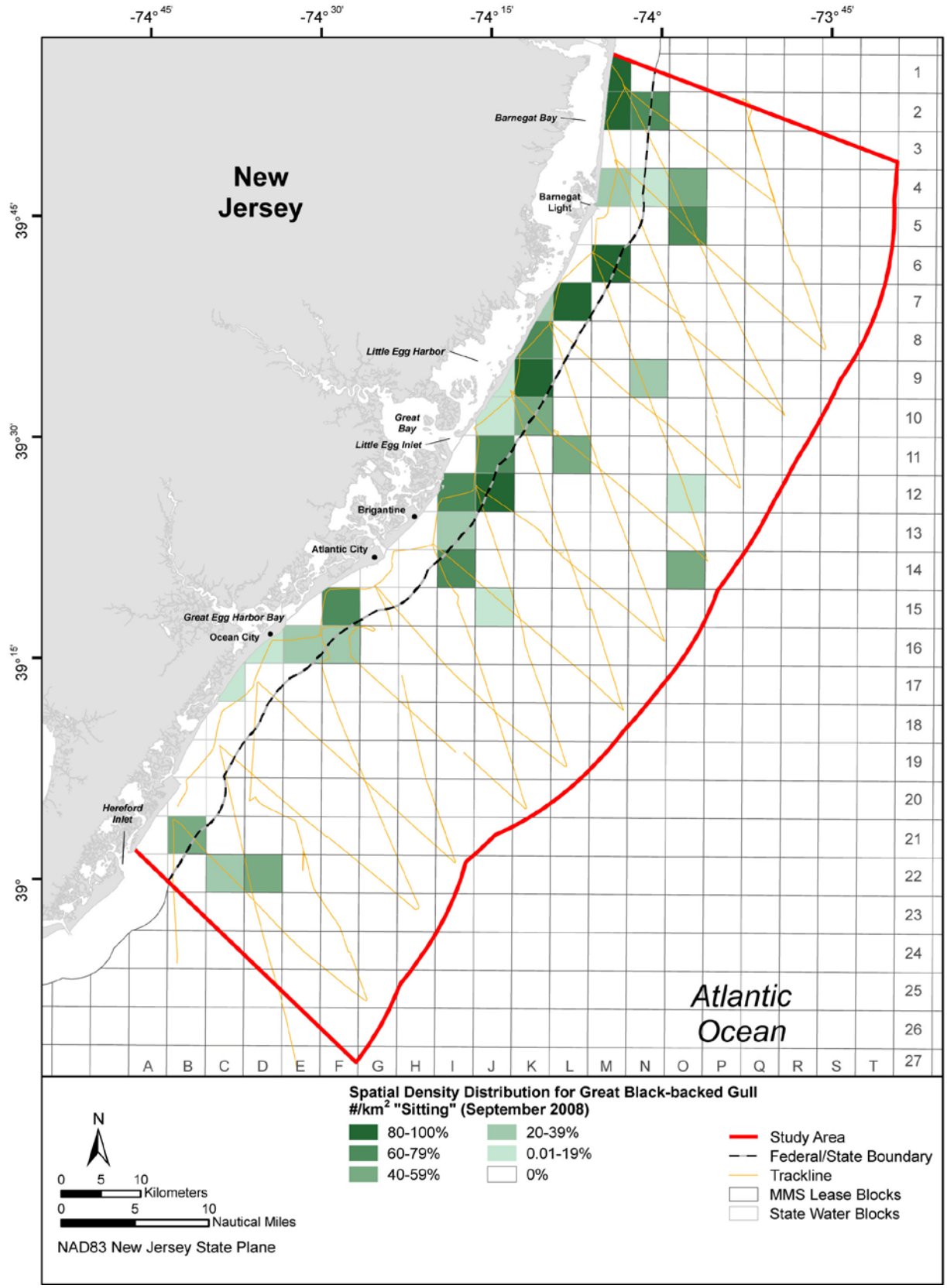

Figure C-336. Percentile abundance of Great Black-backed Gull (sitting), September 2008 (n=125).

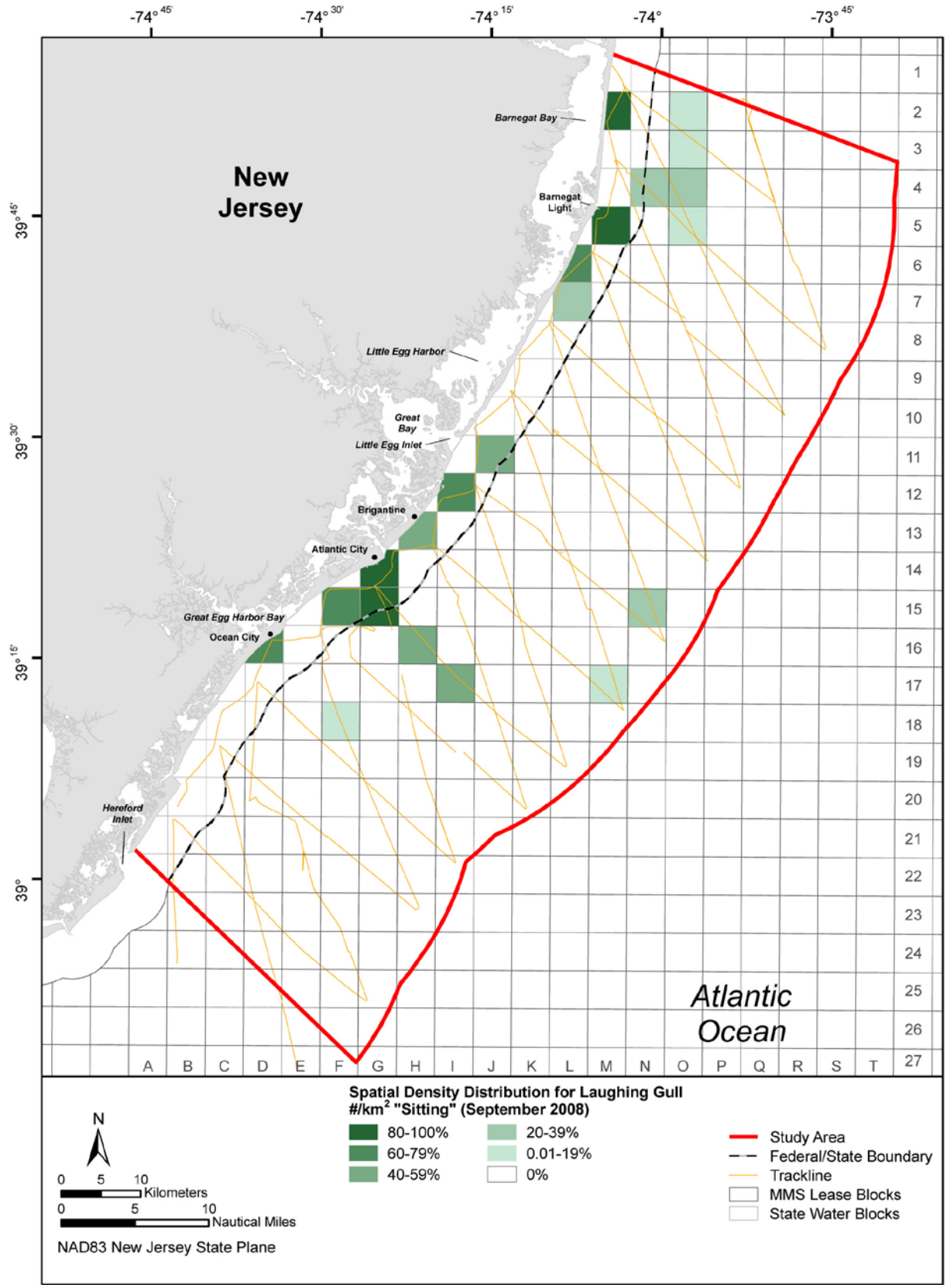

Figure C-337. Percentile abundance of Laughing Gull (sitting), September 2008 (n=81).

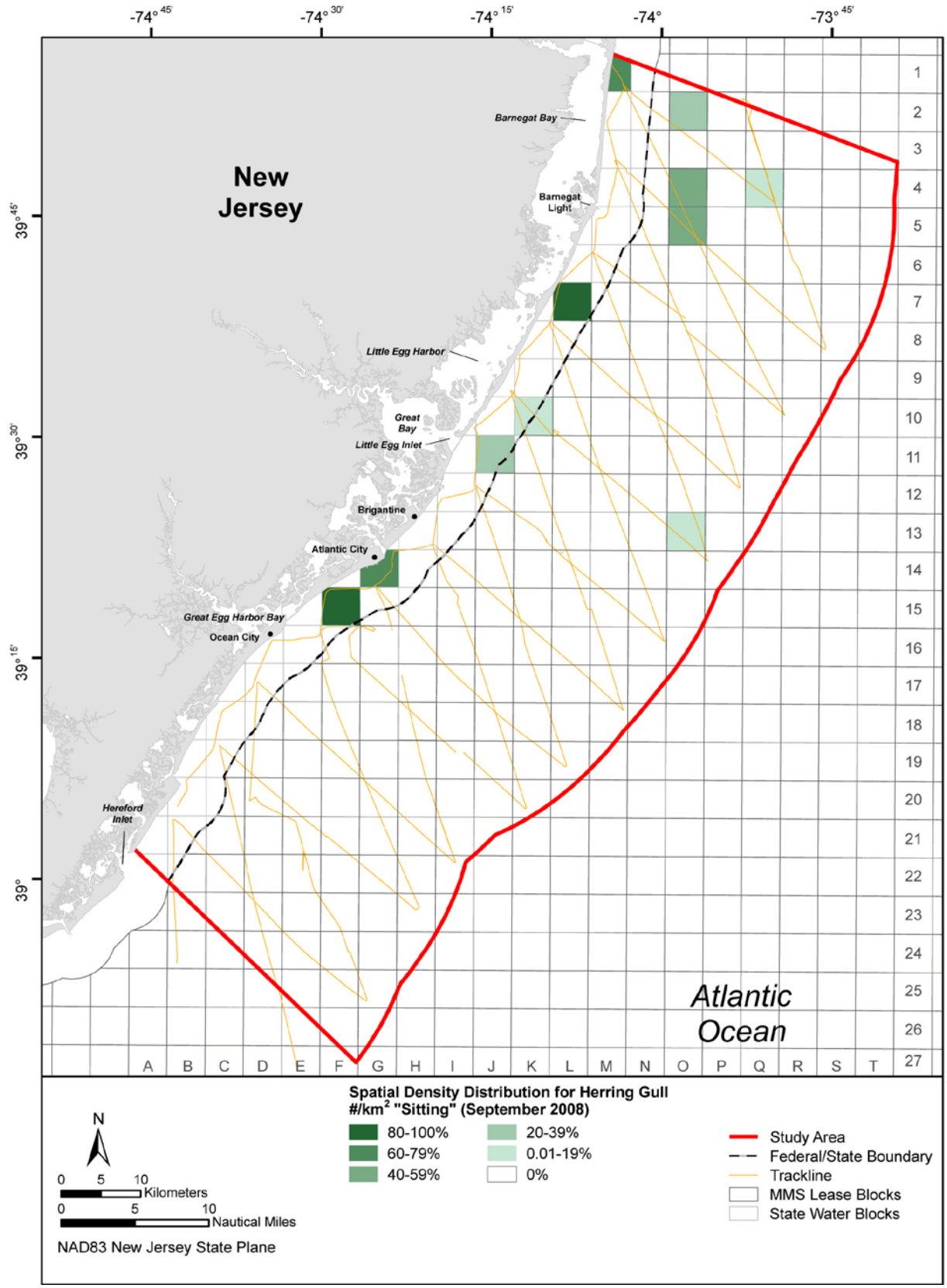

Figure C-338. Percentile abundance of Herring Gull (sitting), September 2008 (n=68).

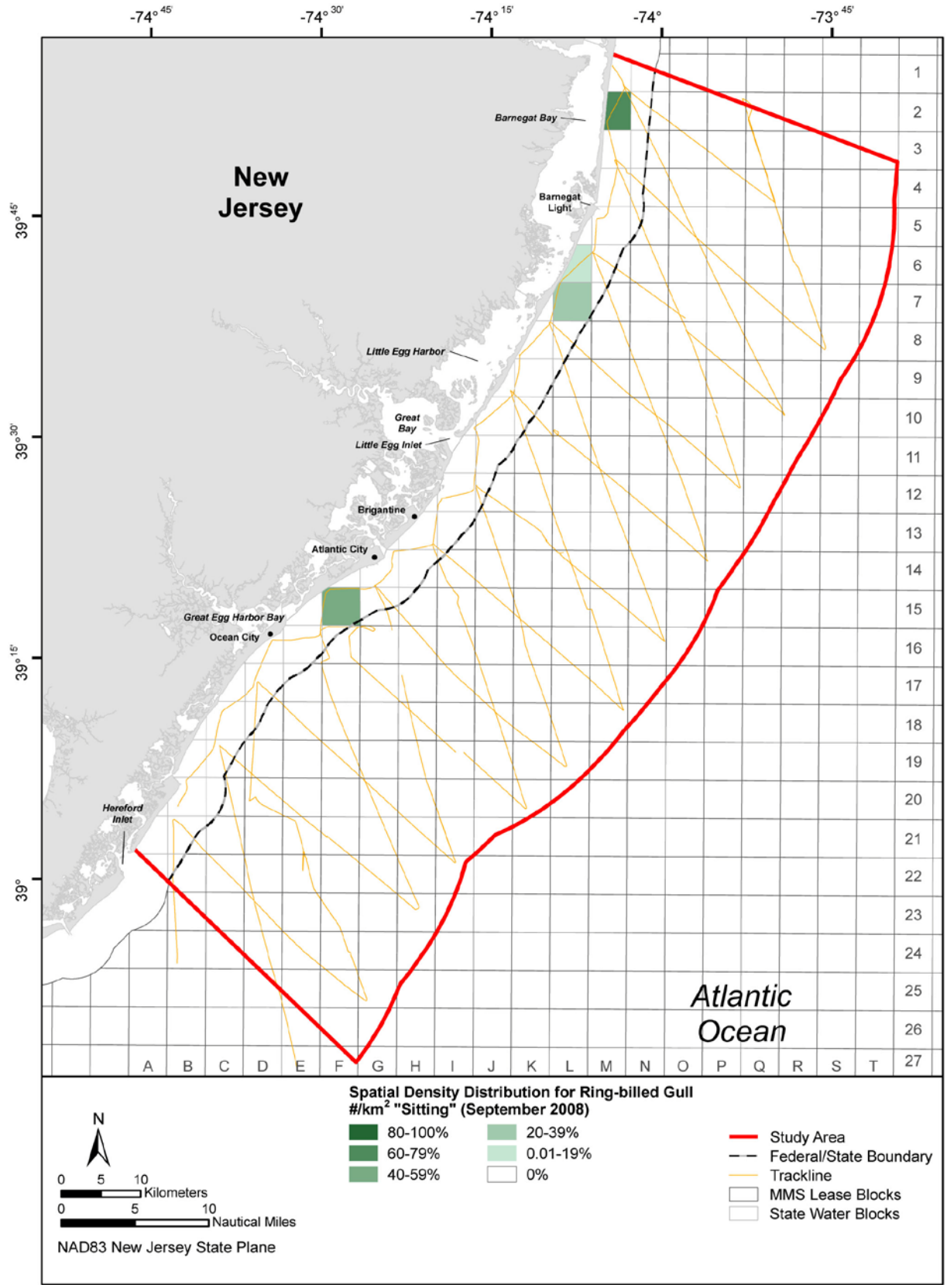

Figure C-339. Percentile abundance of Ring-billed Gull (sitting), September 2008 (n=43).

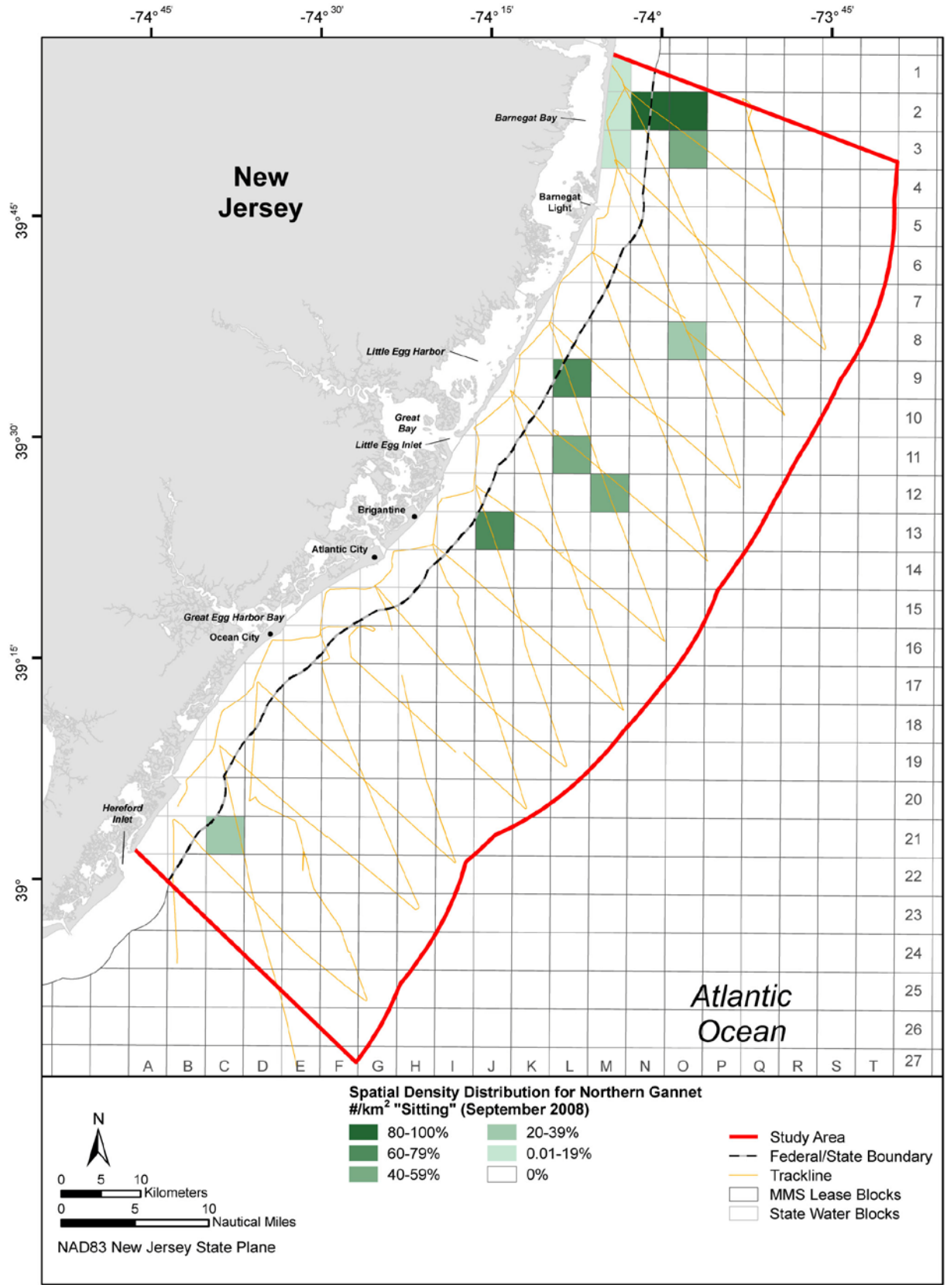

Figure C-340. Percentile abundance of Northern Gannet (sitting), September 2008 (n=19).

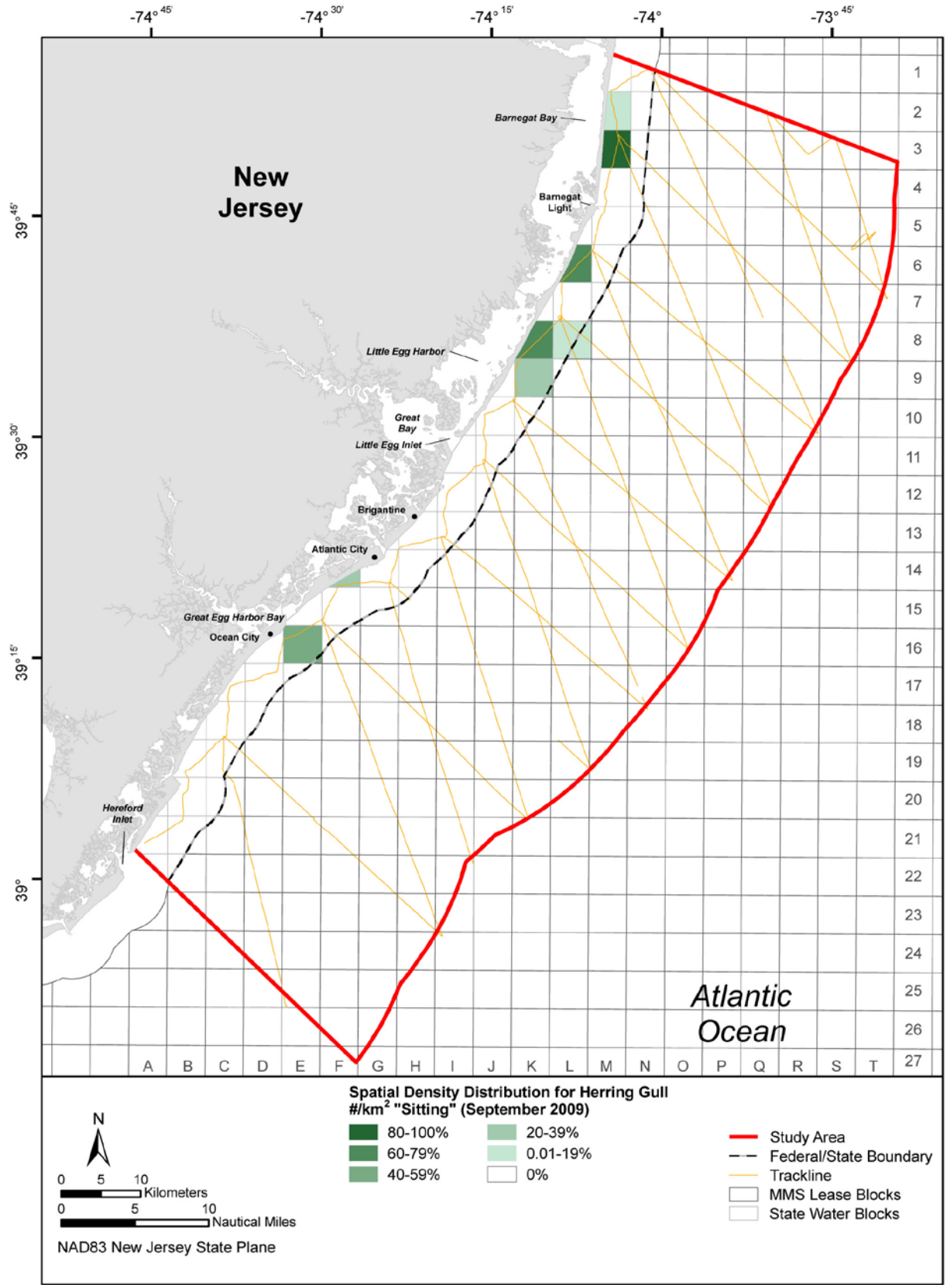

Figure C-341. Percentile abundance of Herring Gull (sitting), September 2009 (n=79).

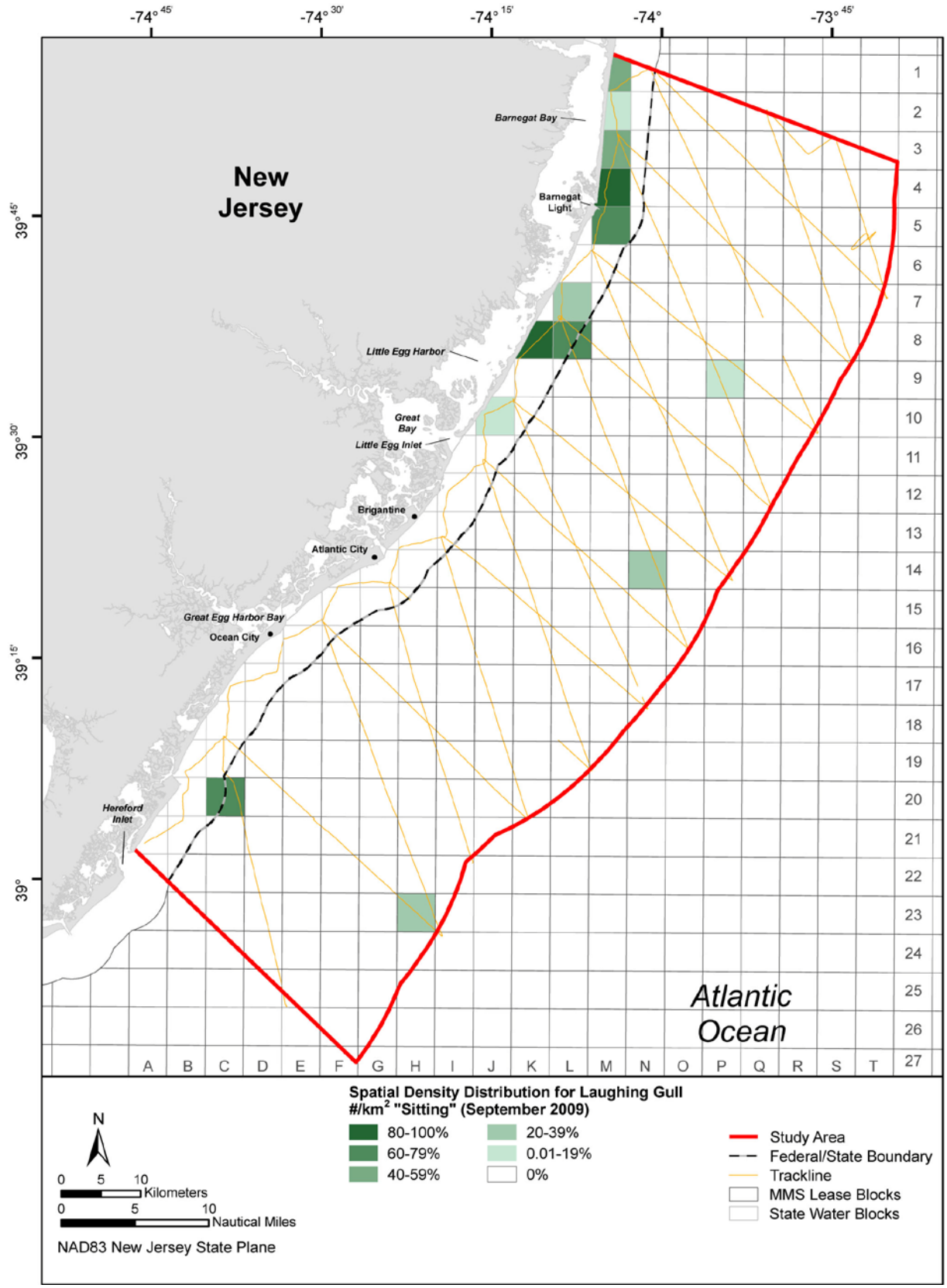

Figure C-342. Percentile abundance of Laughing Gull (sitting), September 2009 (n=72).

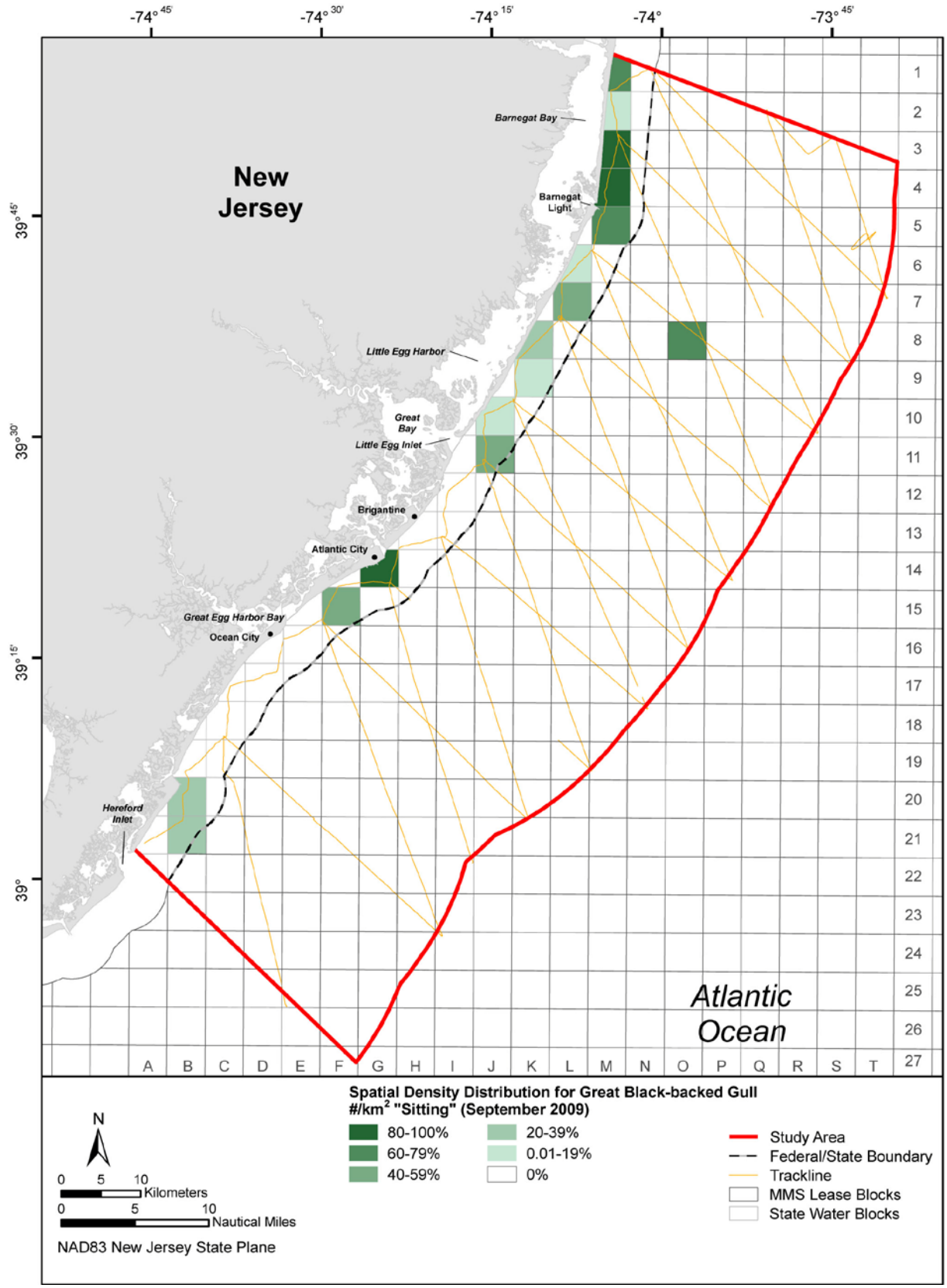

Figure C-343. Percentile abundance of Great Black-backed Gull (sitting), September 2009 (n=62).

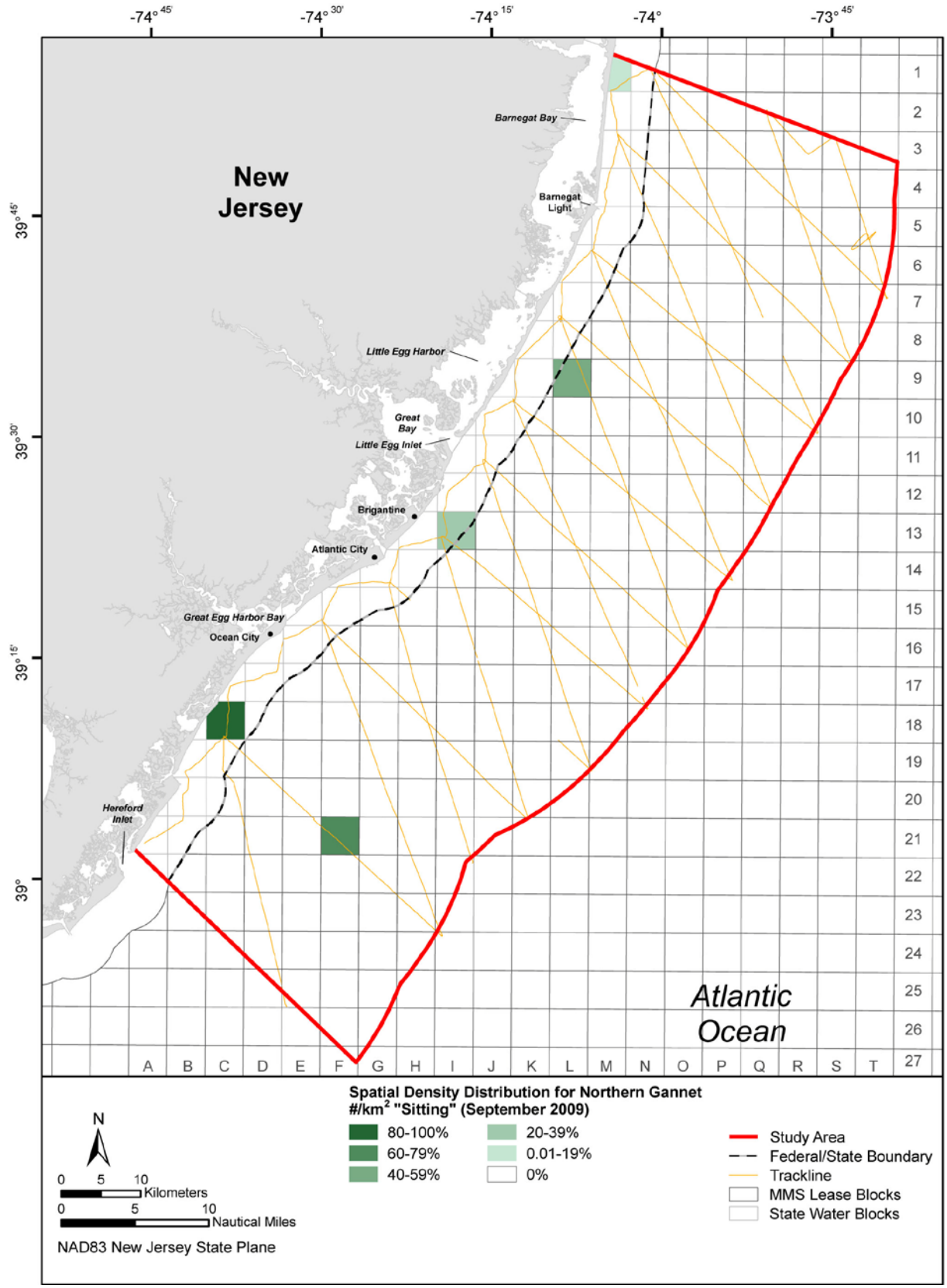

Figure C-344. Percentile abundance of Northern Gannet (sitting), September 2009 (n=7).

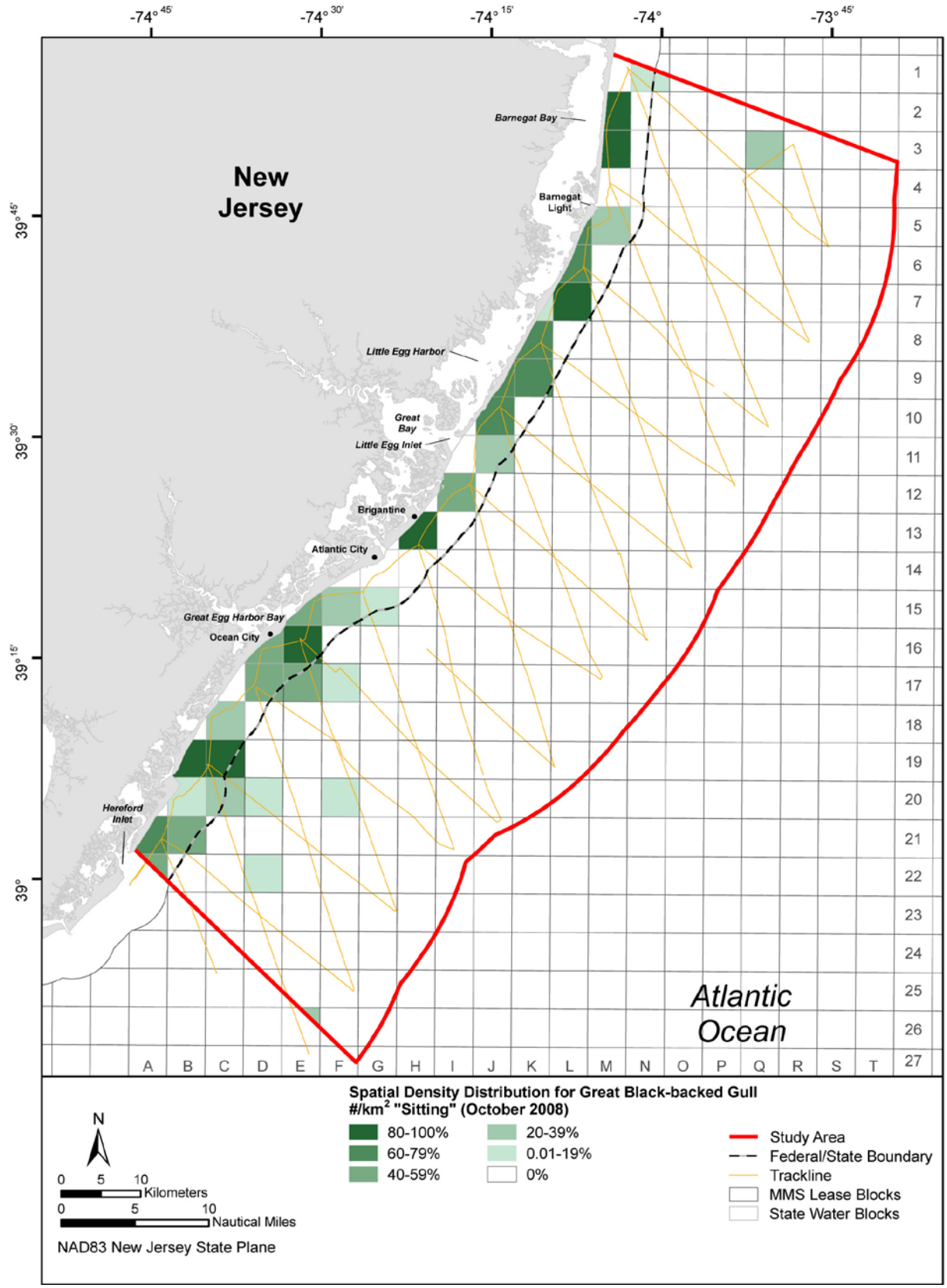

Figure C-345. Percentile abundance of Great Black-backed Gull (sitting), October 2008 (n=421).

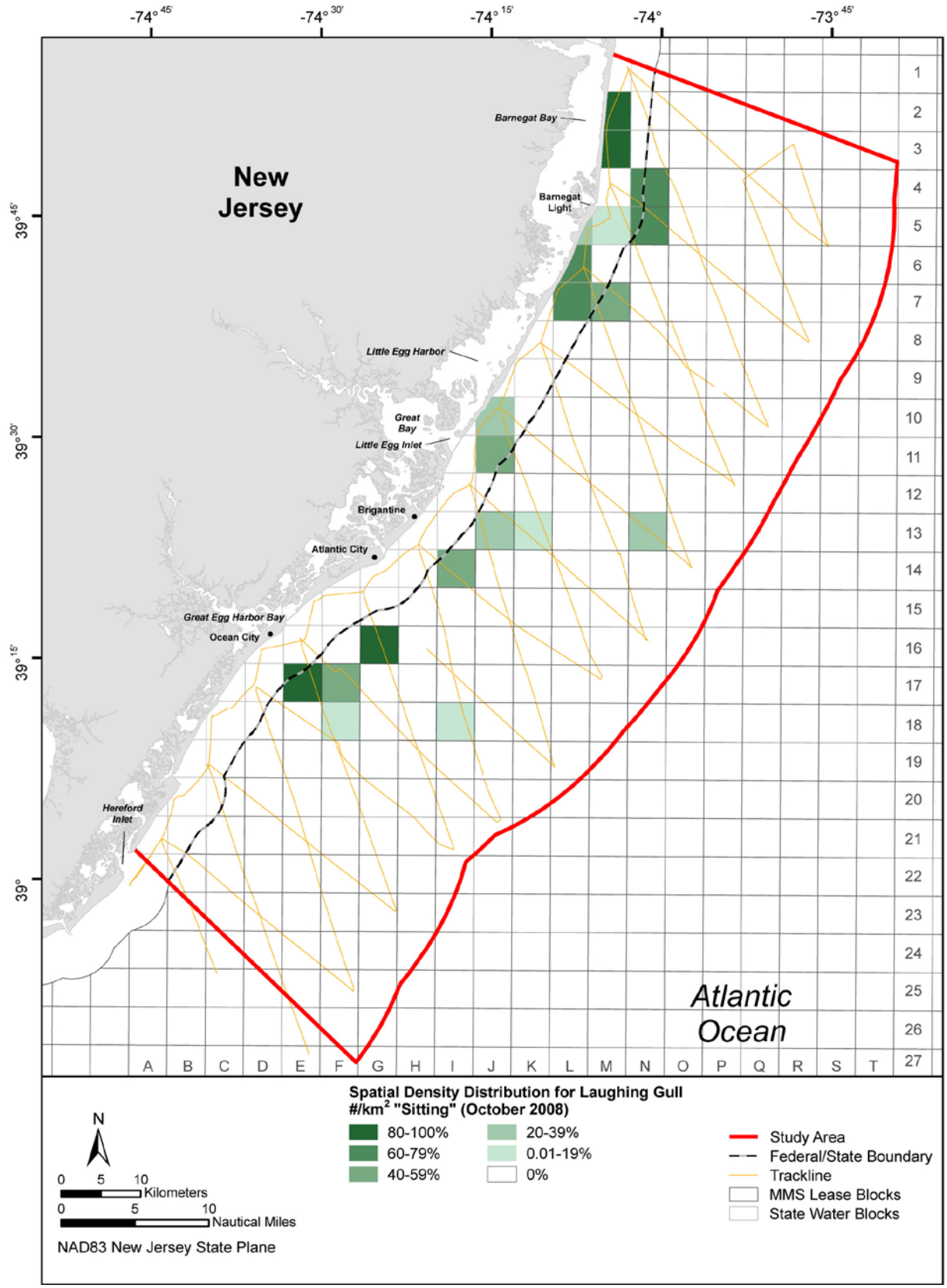

Figure C-346. Percentile abundance of Laughing Gull (sitting), October 2008 (n=196).

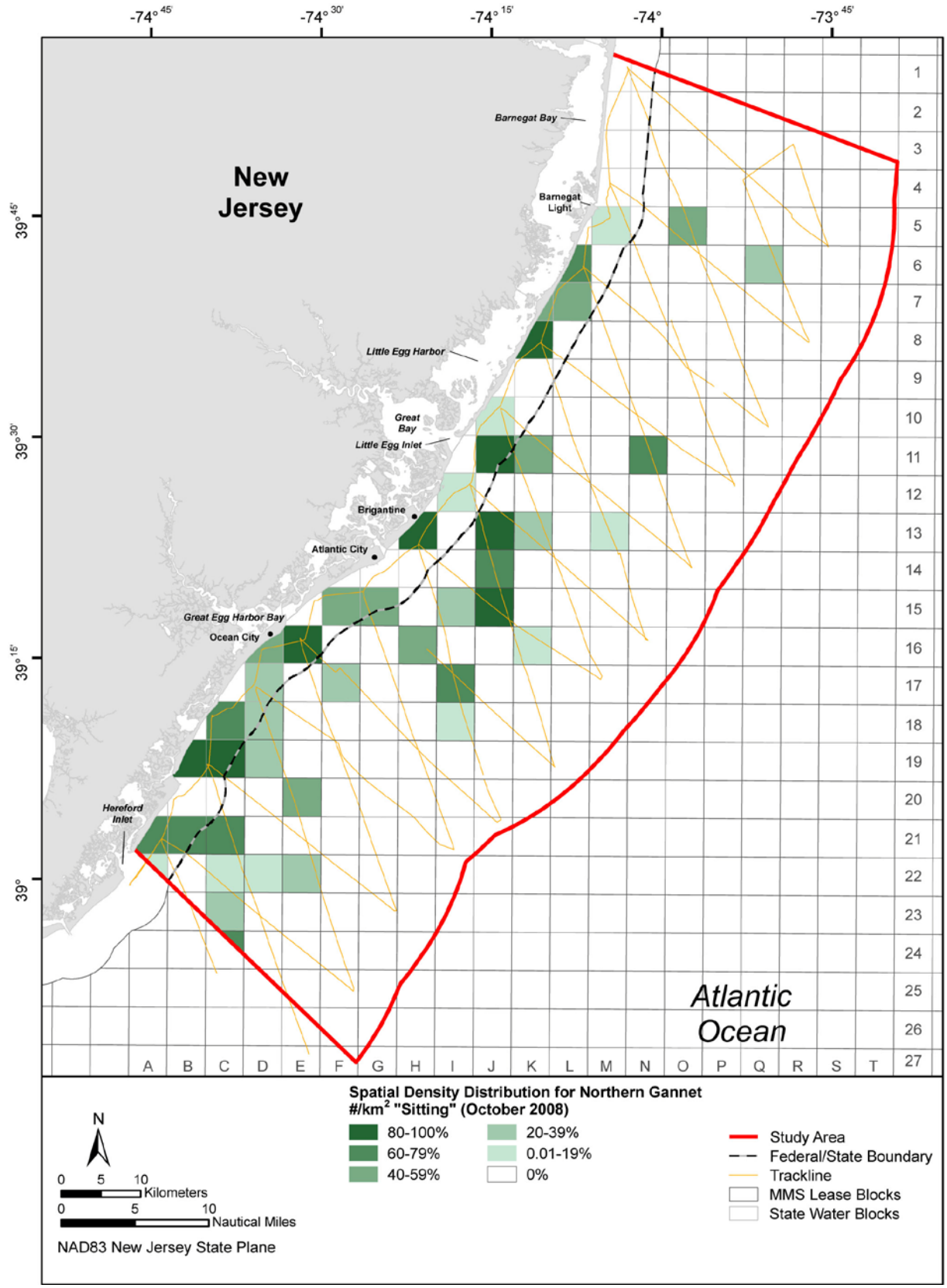

Figure C-347. Percentile abundance of Northern Gannet (sitting), October 2008 (n=136).

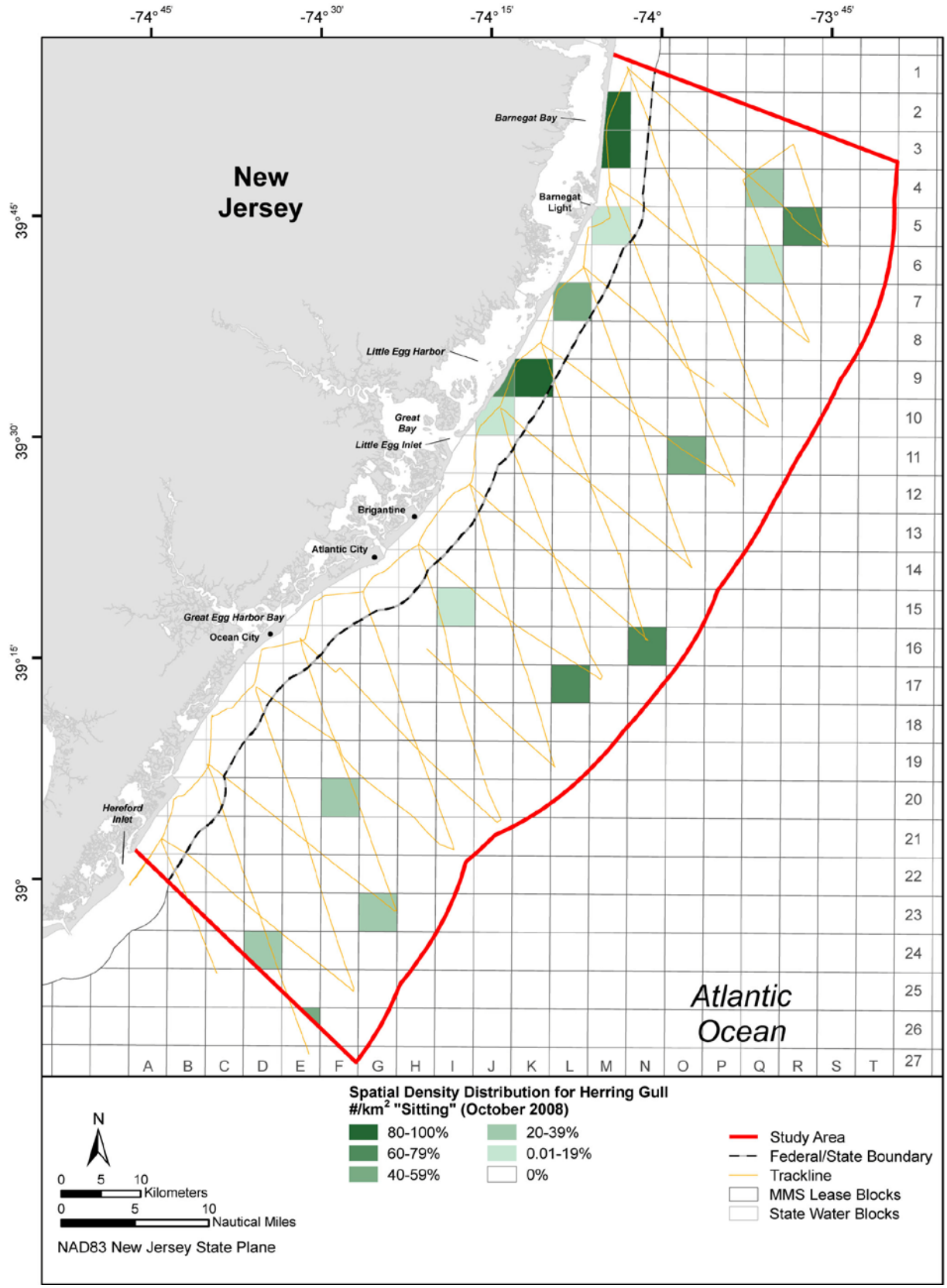

Figure C-348. Percentile abundance of Herring Gull (sitting), October 2008 (n=49).

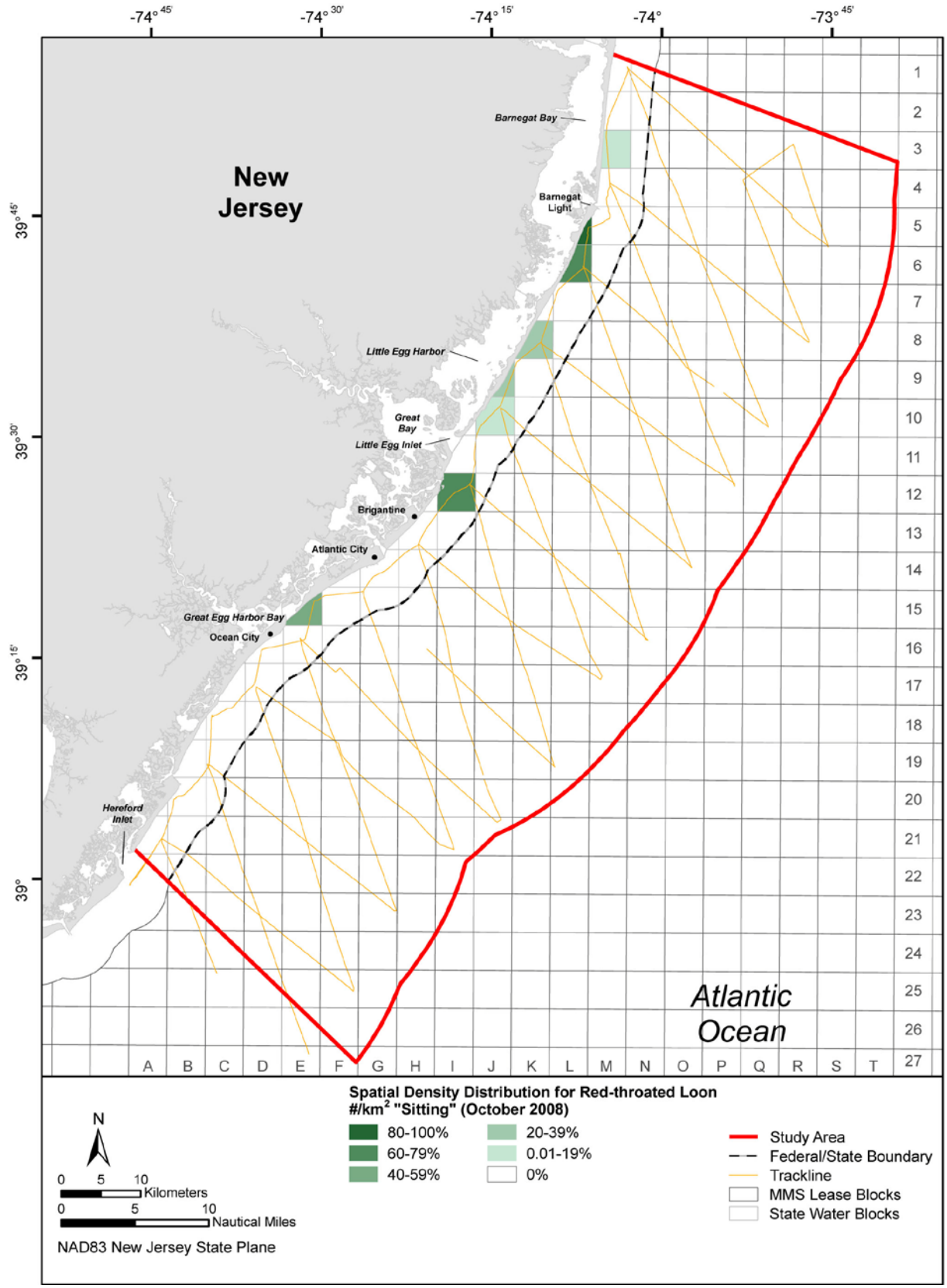

Figure C-349. Percentile abundance of Red-throated Loon (sitting), October 2008 (n=18).

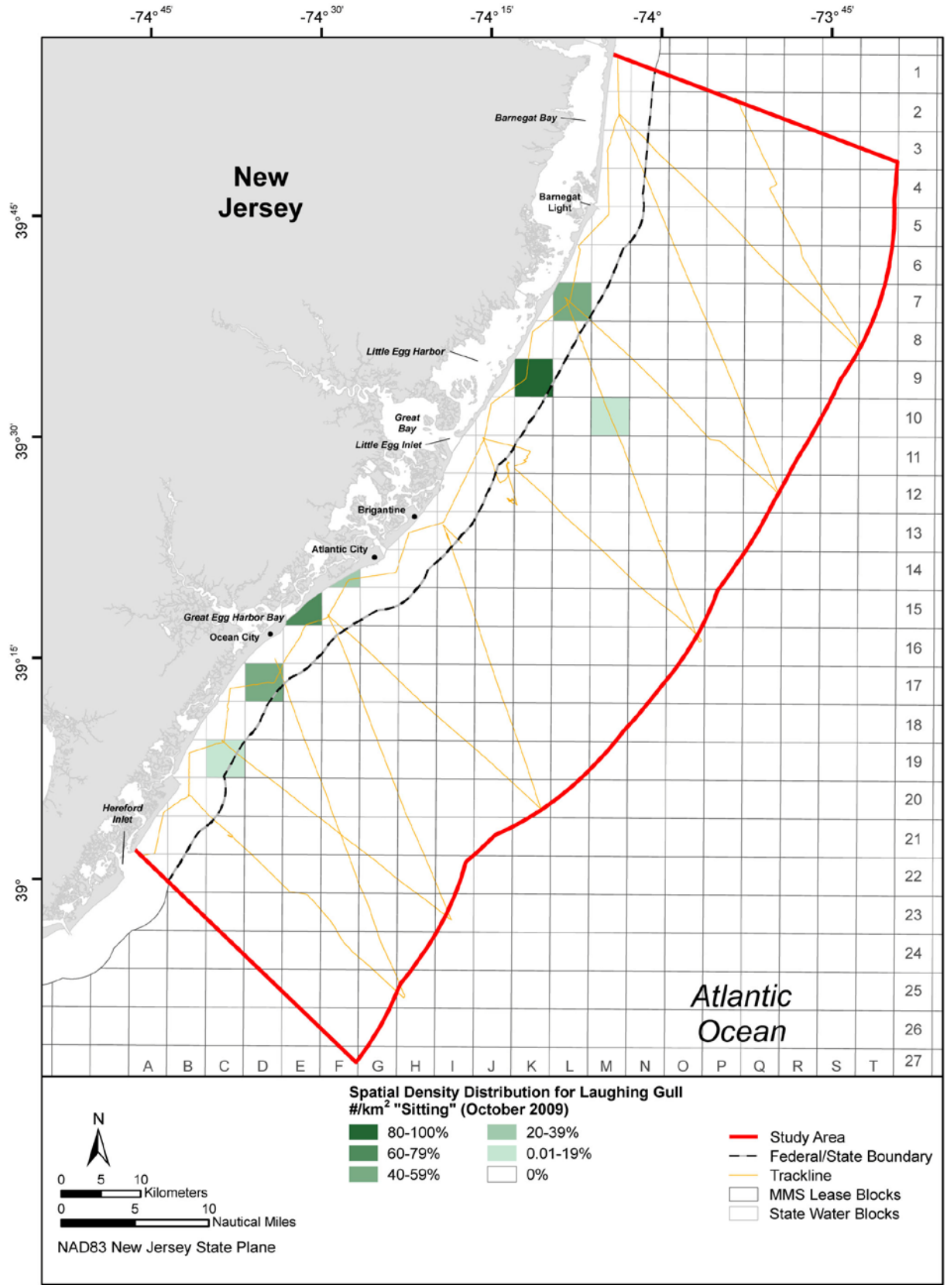

Figure C-350. Percentile abundance of Laughing Gull (sitting), October 2009 (n=317).

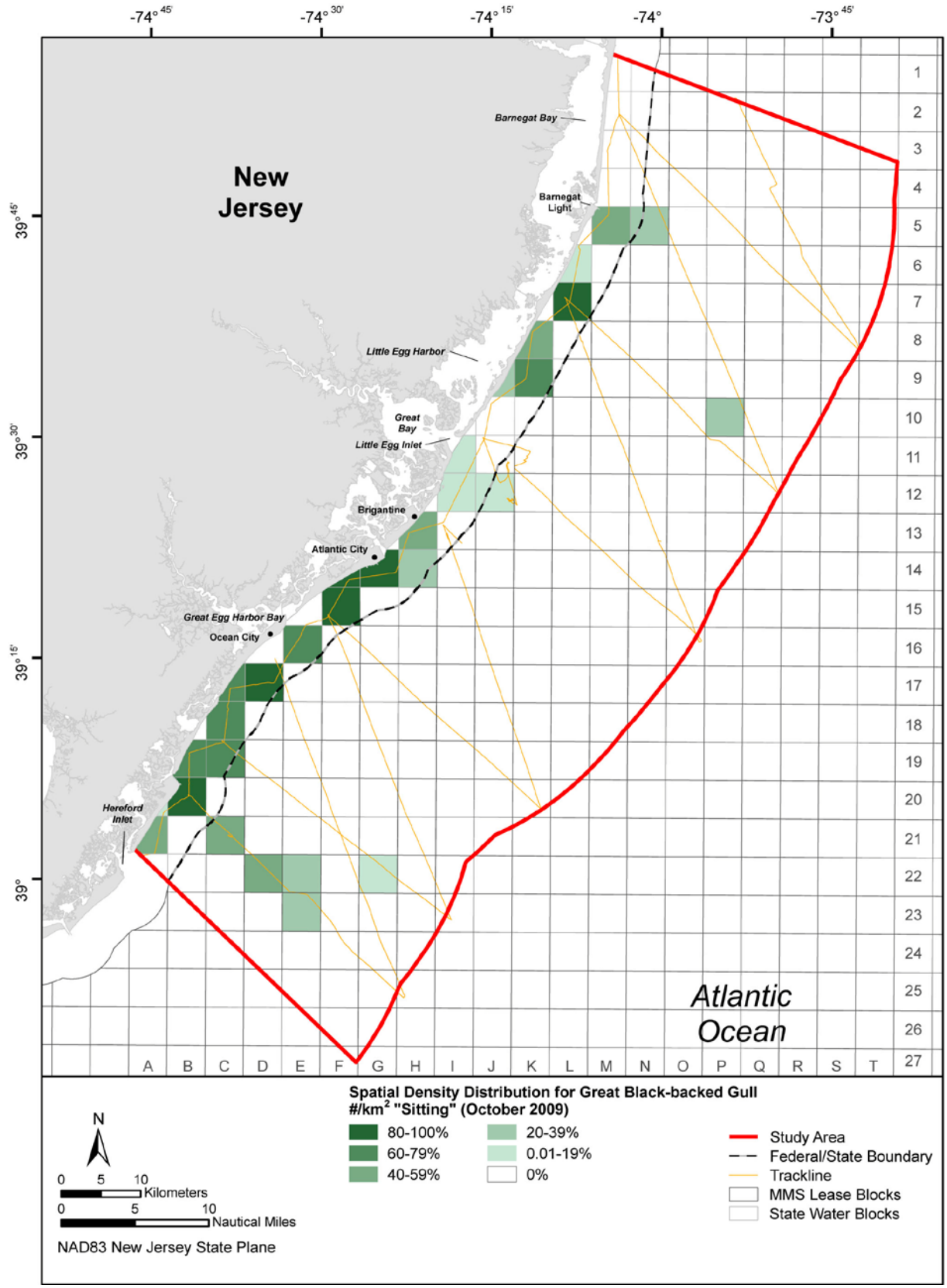

Figure C-351. Percentile abundance of Great Black-backed Gull (sitting), October 2009 (n=136).

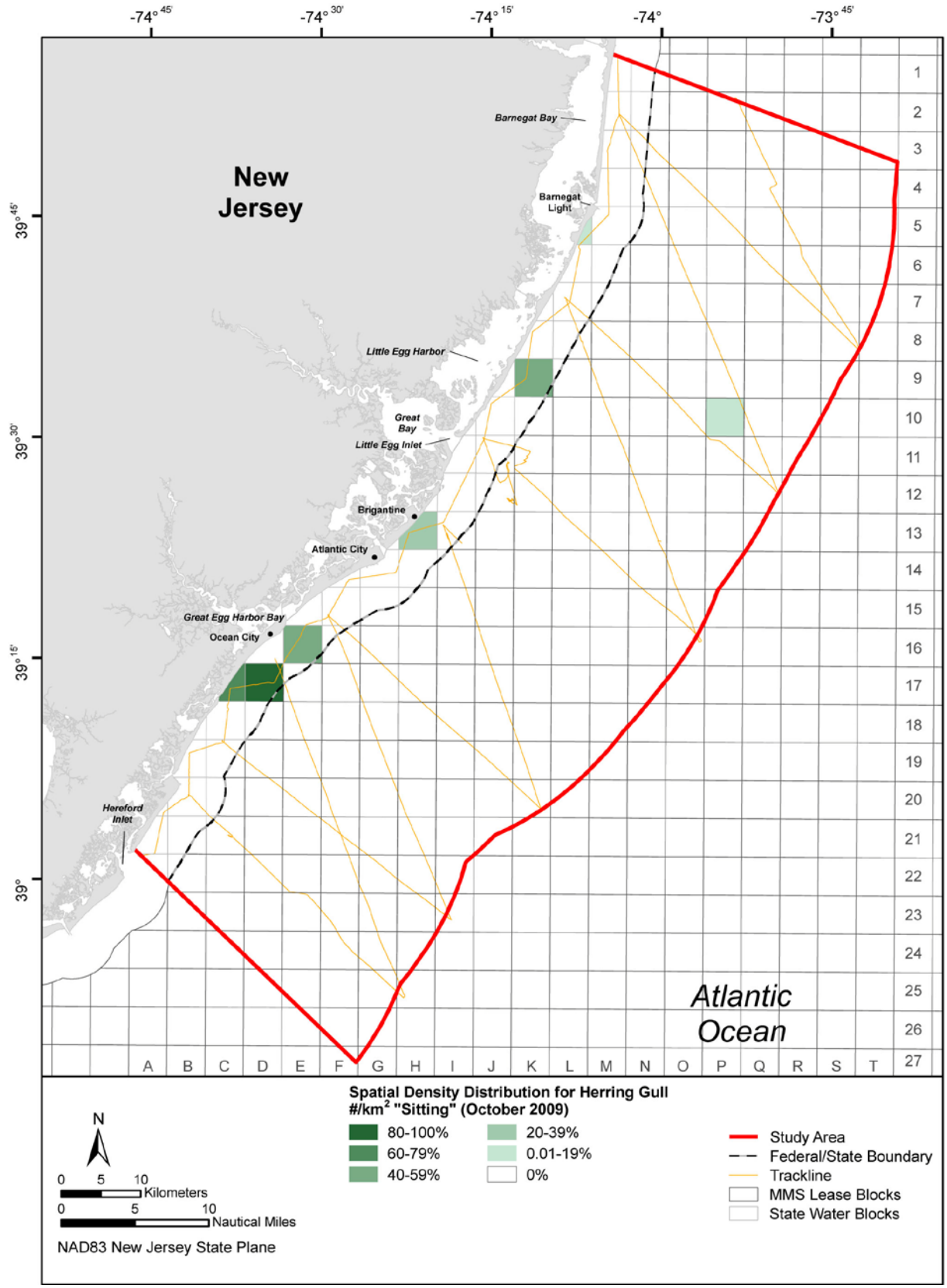

Figure C-352. Percentile abundance of Herring Gull (sitting), October 2009 (n=56).

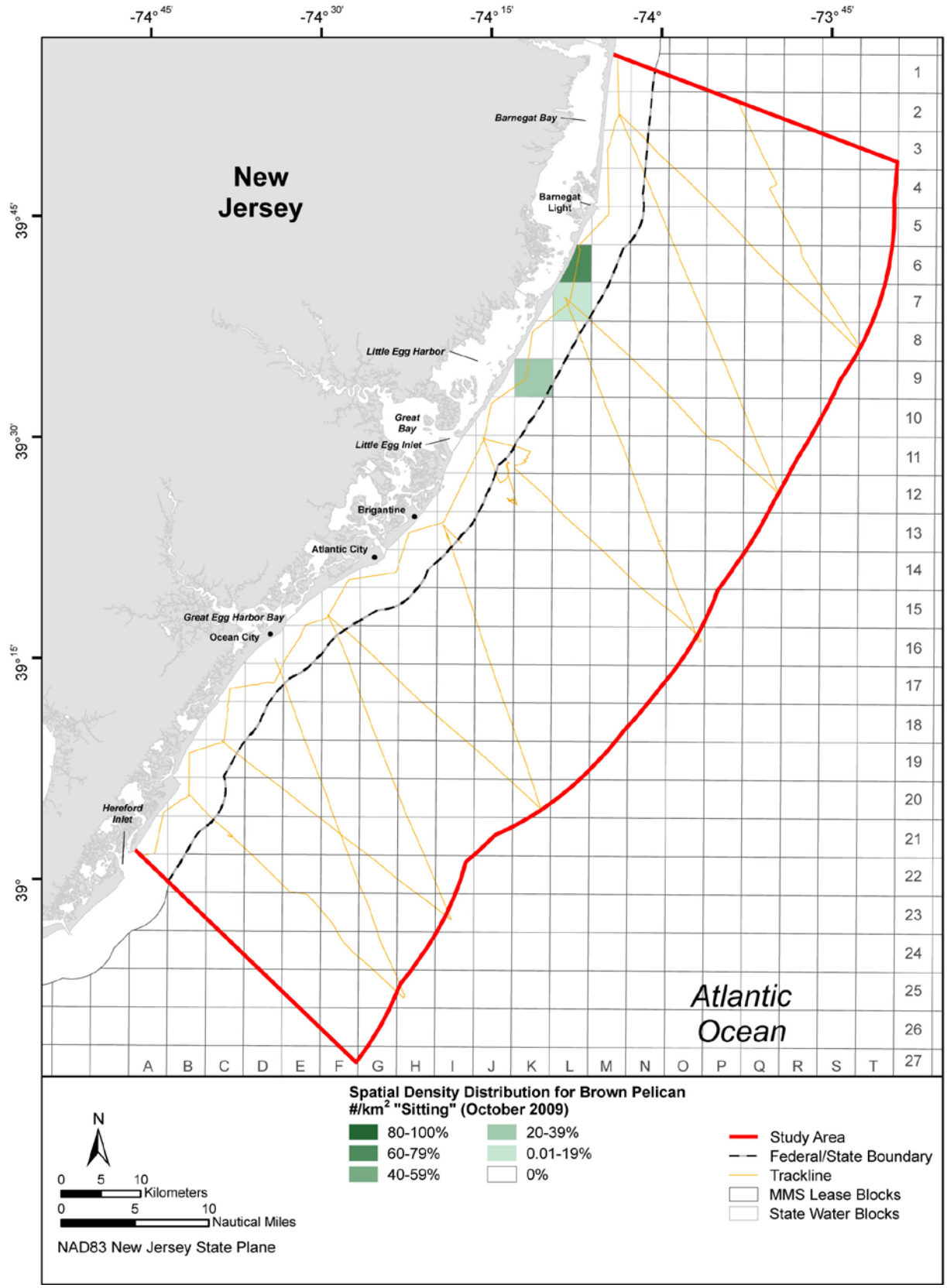

Figure C-353. Percentile abundance of Brown Pelican (sitting), October 2009 (n=24).

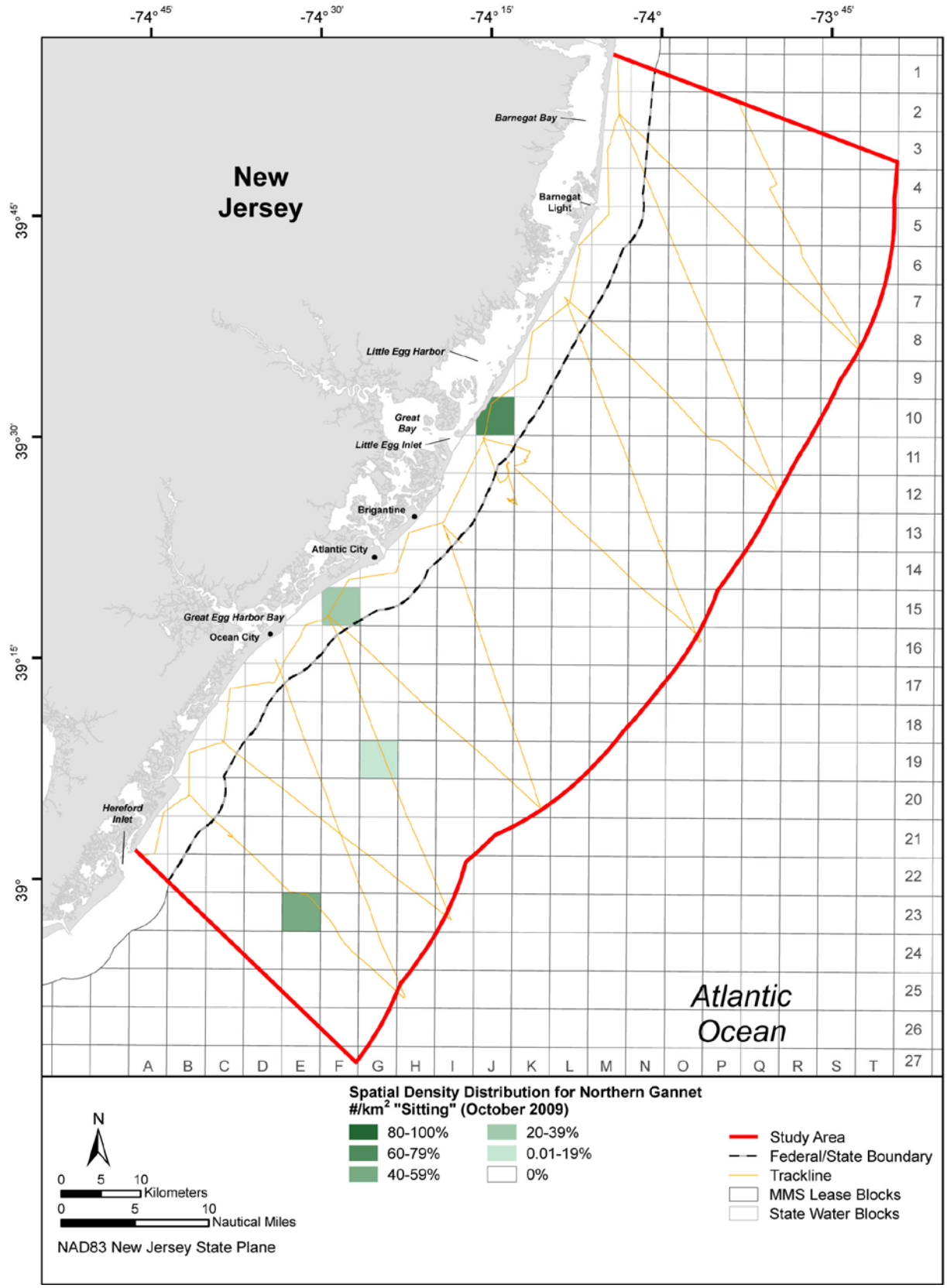

Figure C-354. Percentile abundance of Northern Gannet (sitting), October 2009 (n=5).

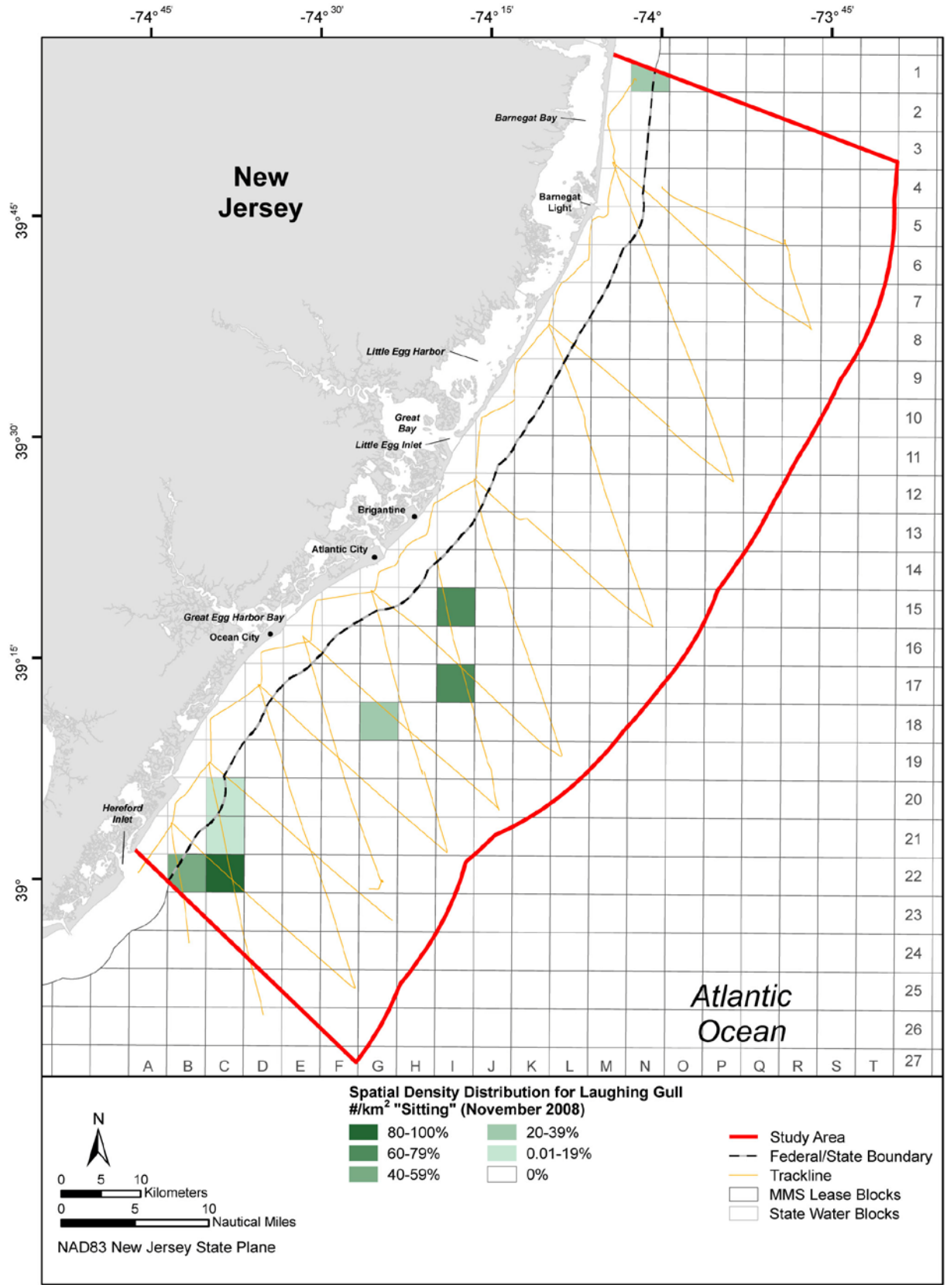

Figure C-355. Percentile abundance of Laughing Gull (sitting), November 2008 (n=813).

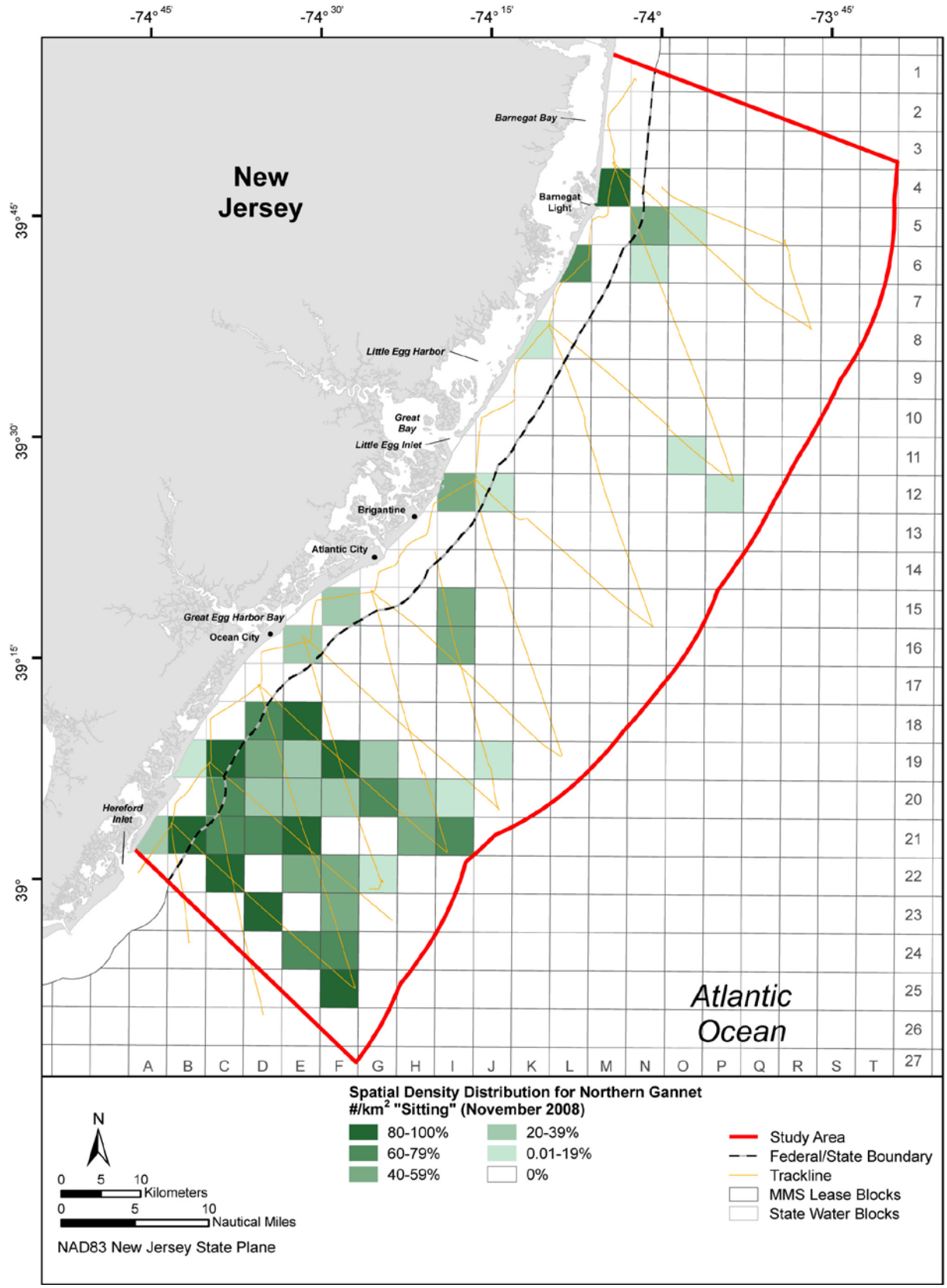

Figure C-356. Percentile abundance of Northern Gannet (sitting), November 2008 (n=535).

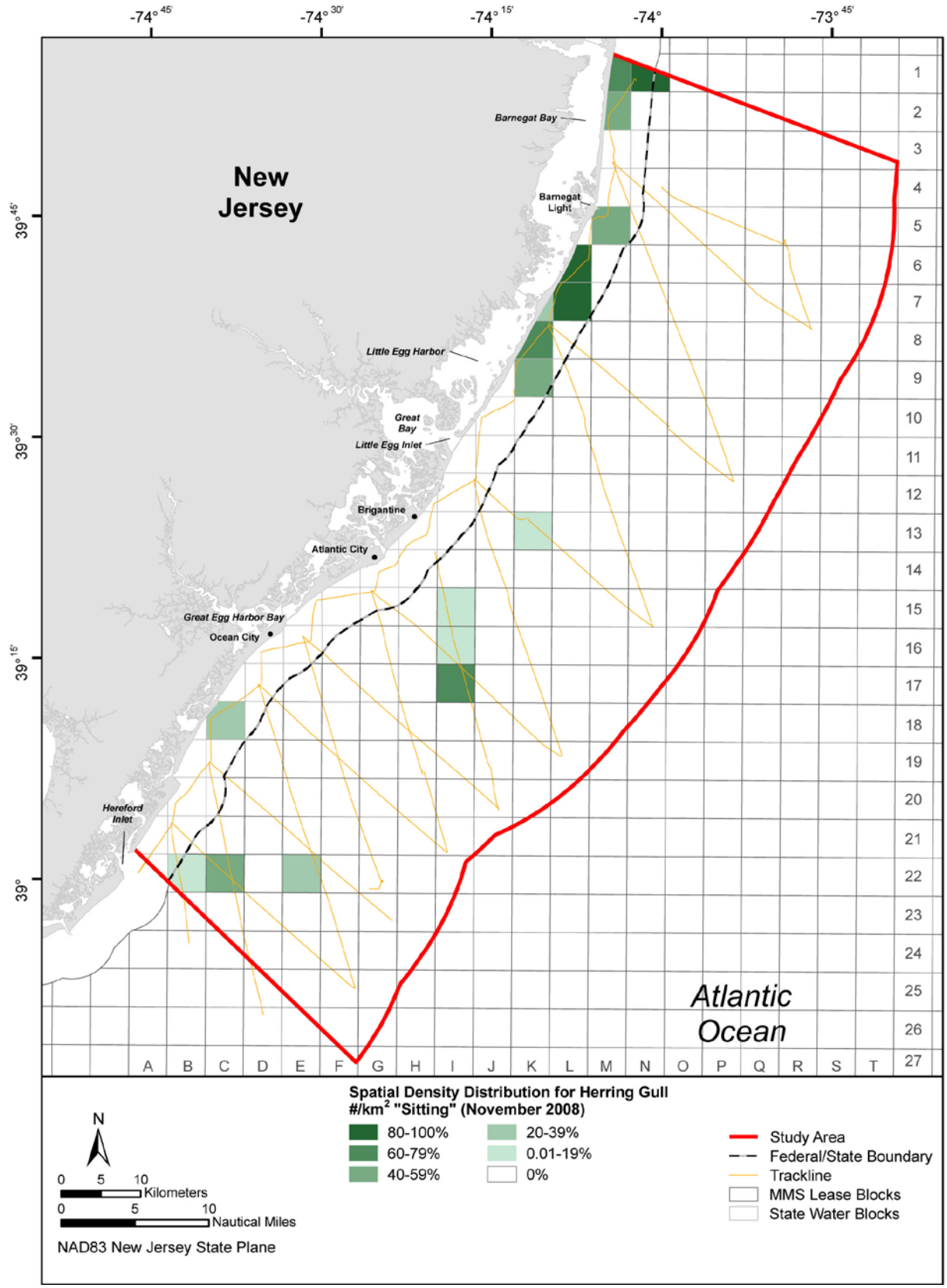

Figure C-357. Percentile abundance of Herring Gull (sitting), November 2008 (n=246).

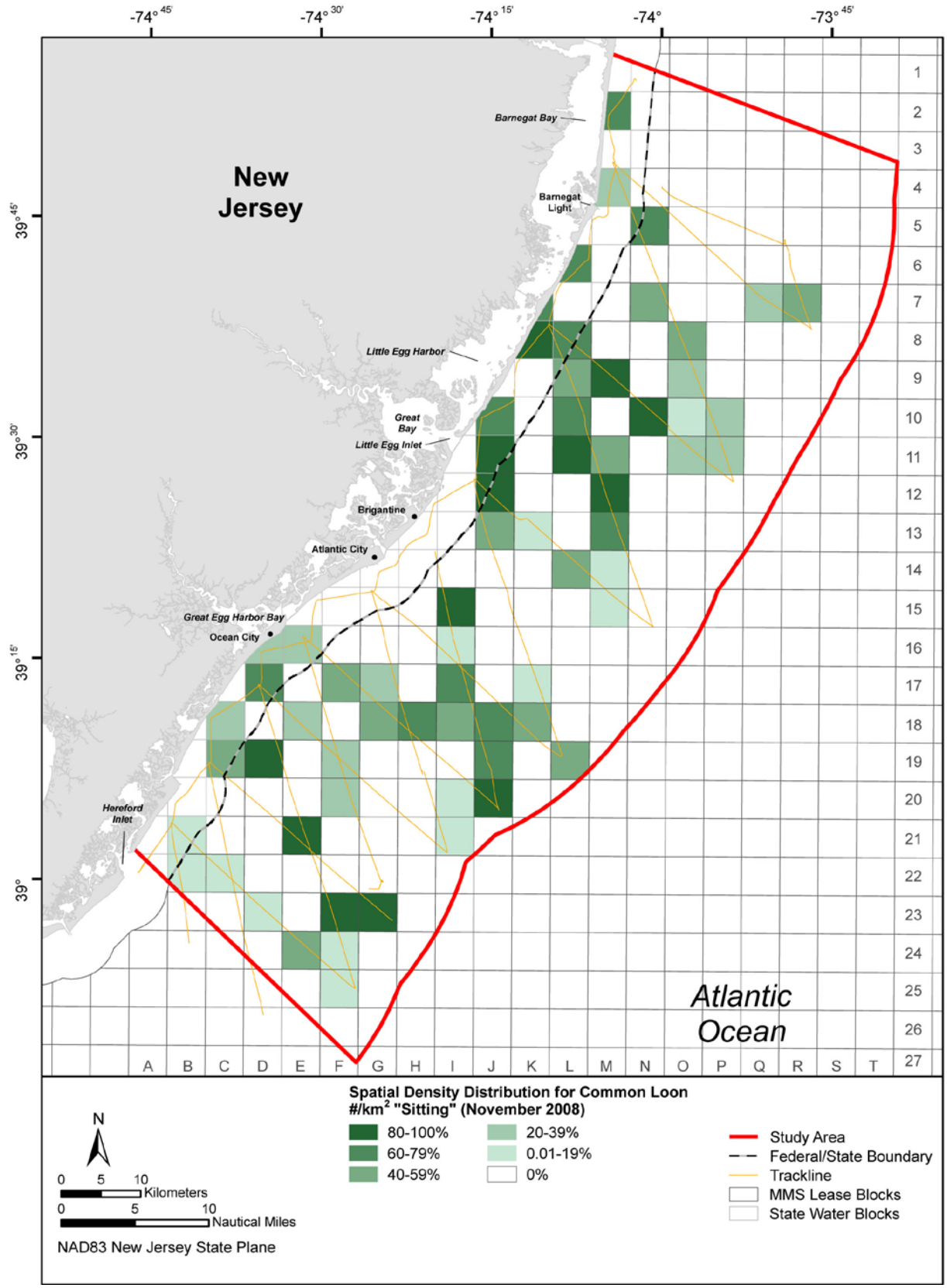

Figure C-358. Percentile abundance of Common Loon (sitting), November 2008 (n=233).

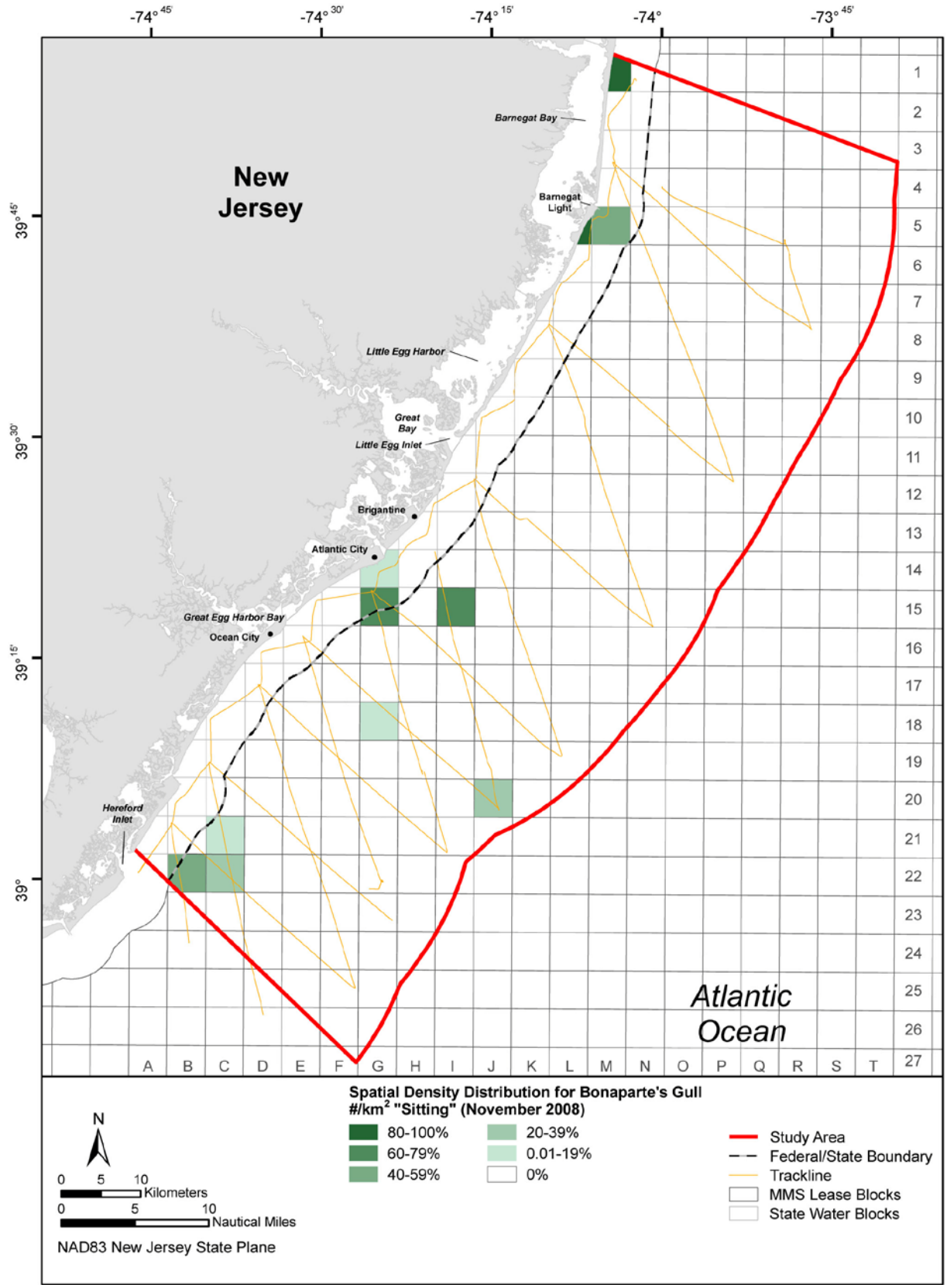

Figure C-359. Percentile abundance of Bonaparte's Gull (sitting), November 2008 (n=217).

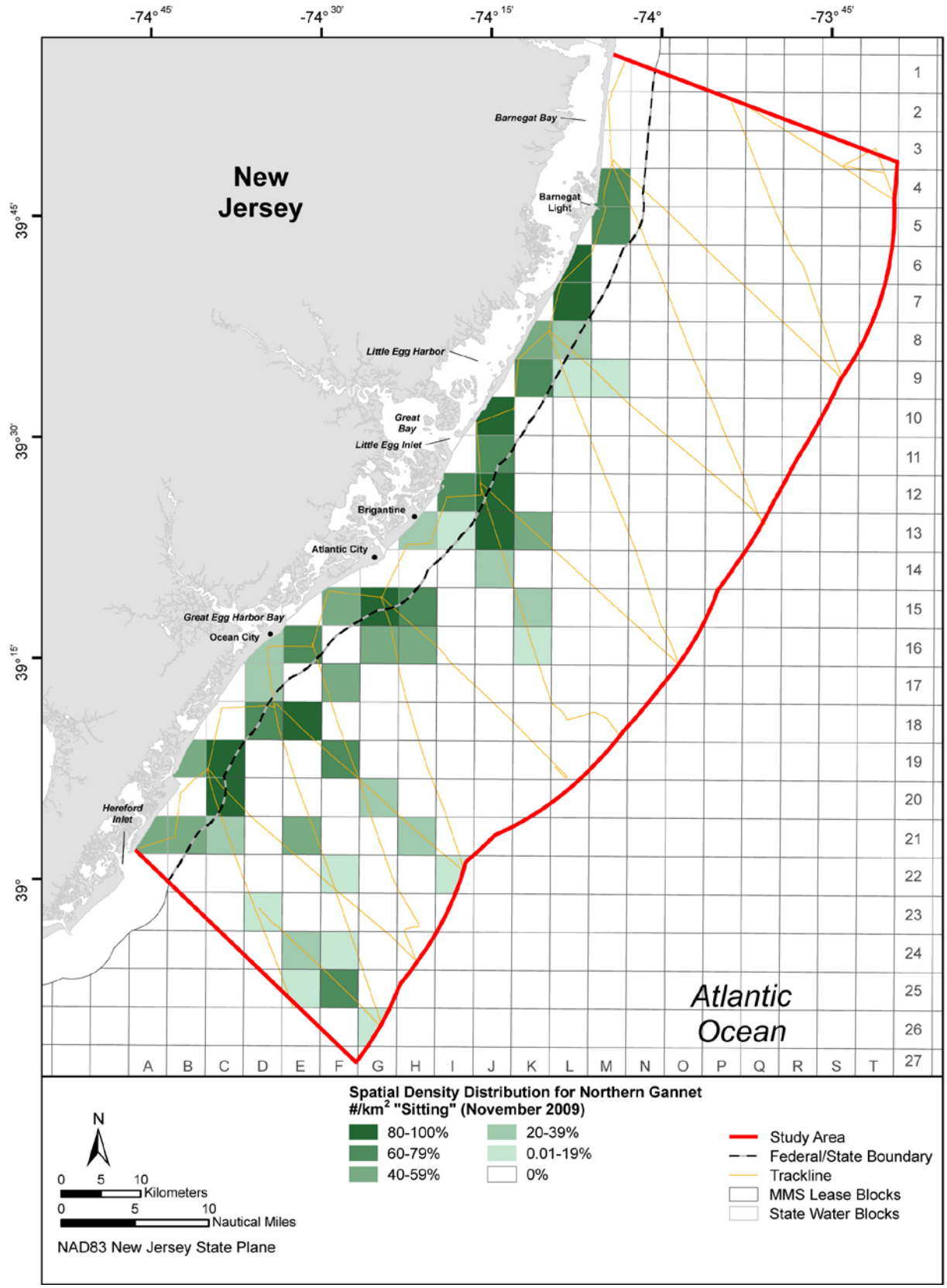

Figure C-360. Percentile abundance of Northern Gannet (sitting), November 2009 (n=984).

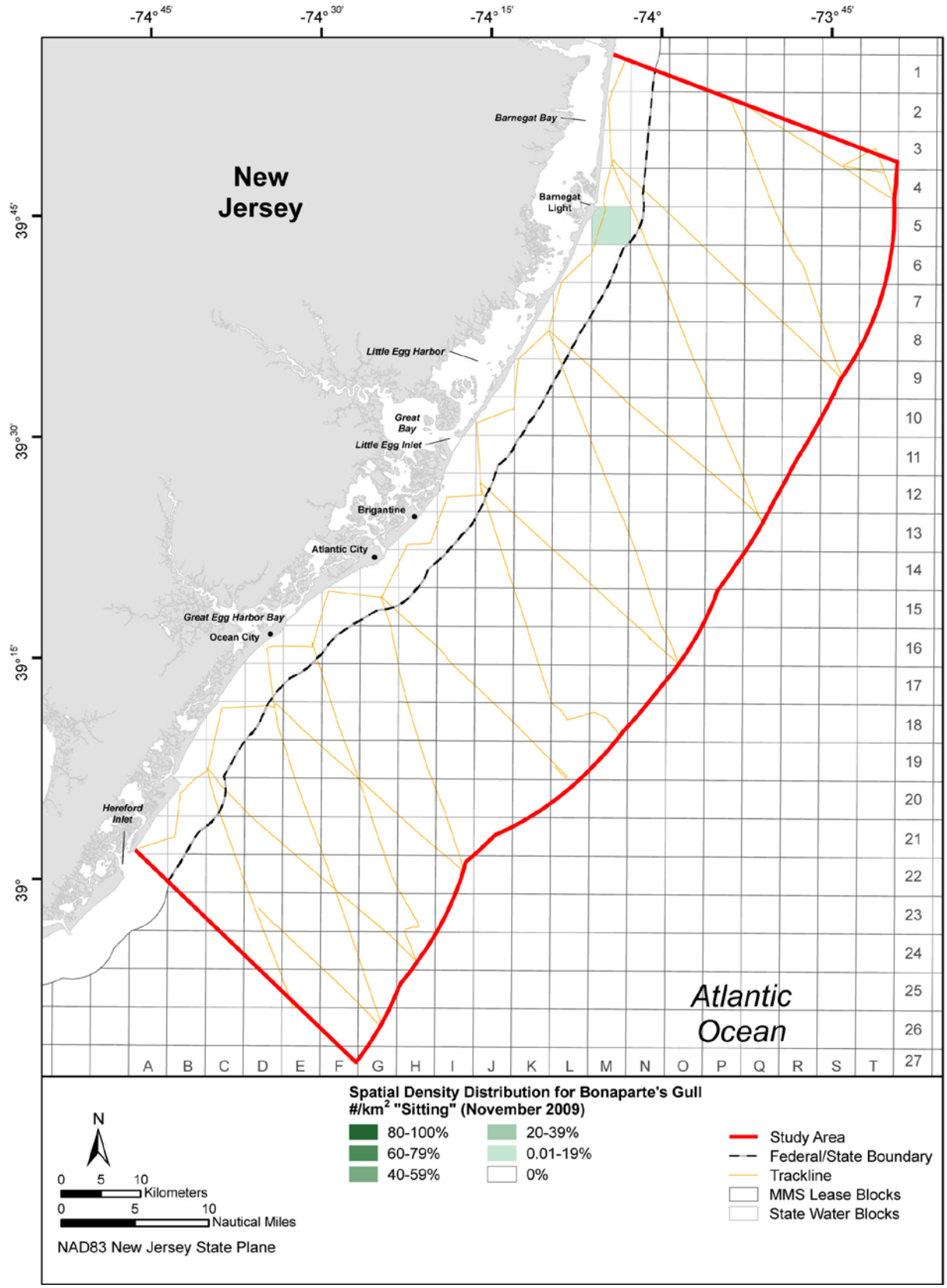

Figure C-361. Percentile abundance of Bonaparte's Gull (sitting), November 2009 (n=213).

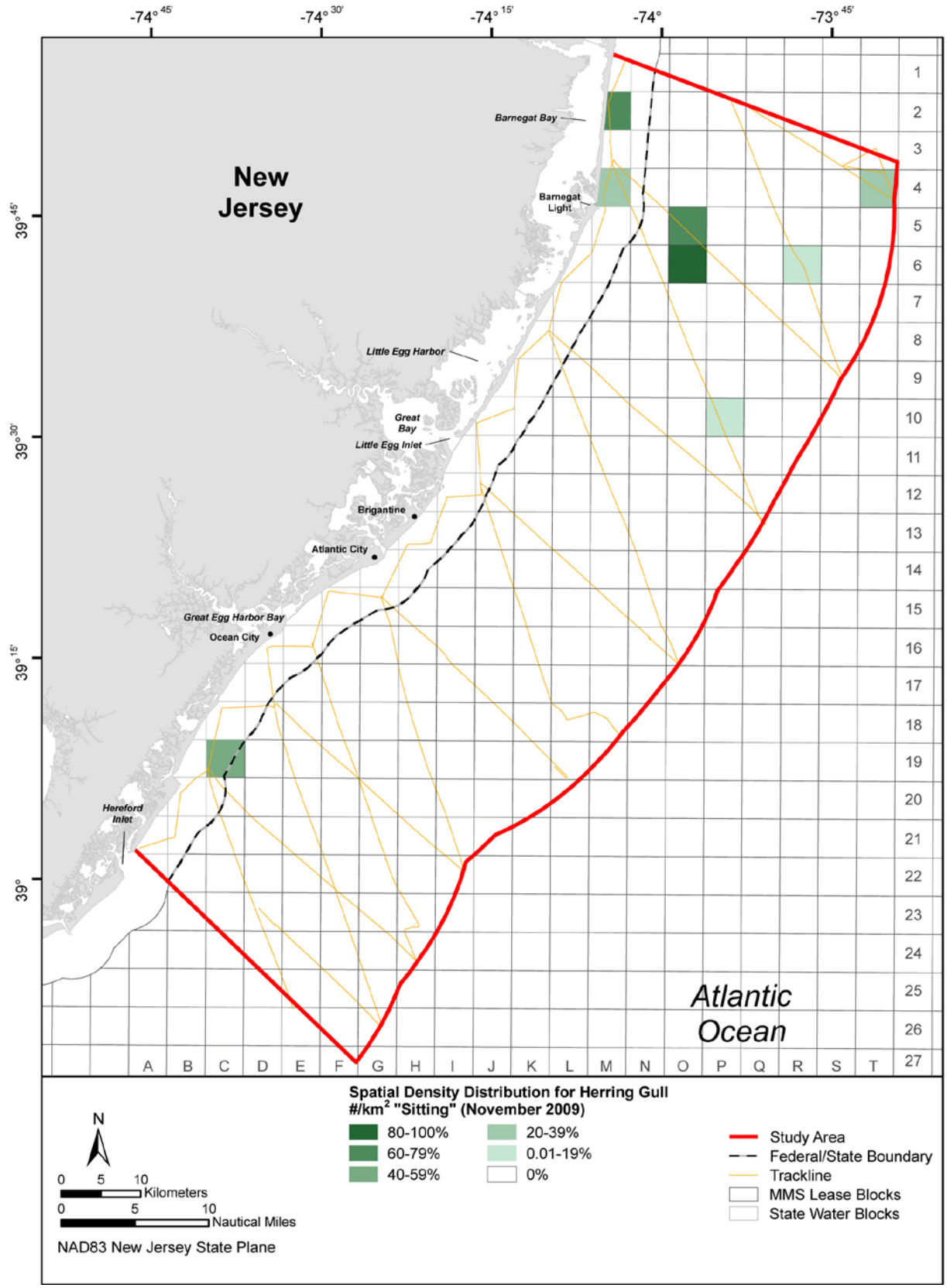

Figure C-362. Percentile abundance of Herring Gull (sitting), November 2009 (n=192).

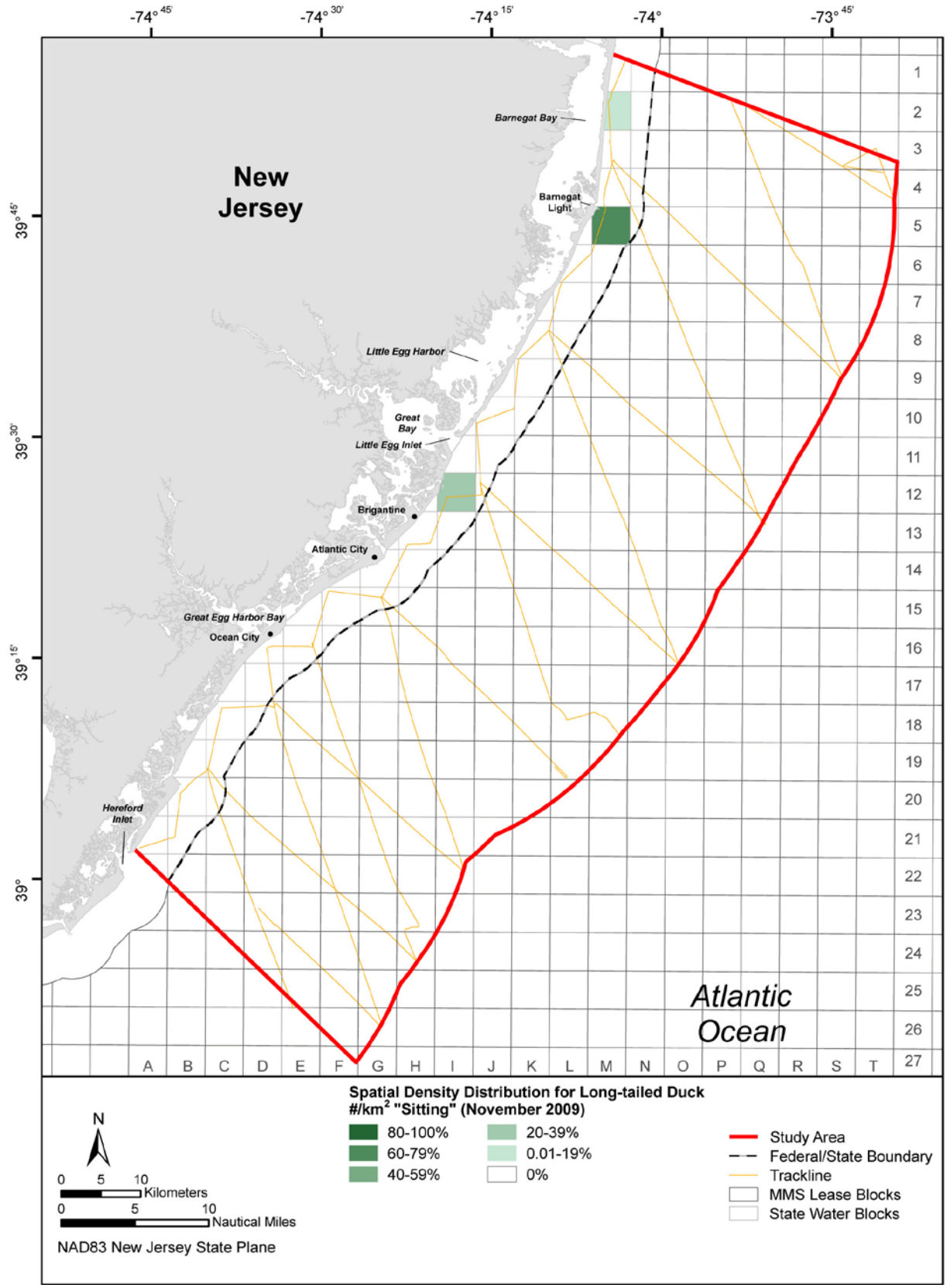

Figure C-363. Percentile abundance of Long-tailed Duck (sitting), November 2009 (n=113).

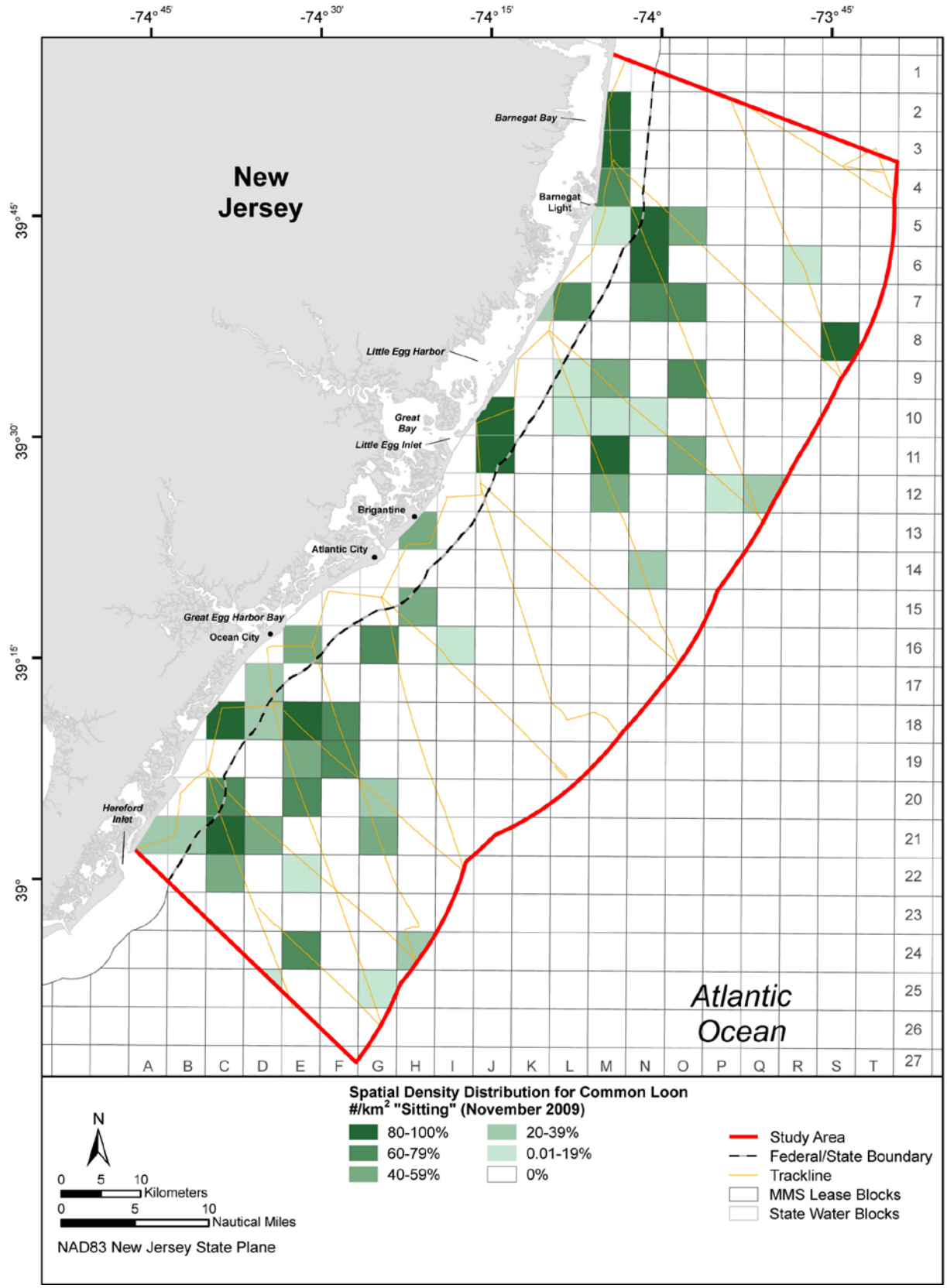

Figure C-364. Percentile abundance of Common Loon (sitting), November 2009 (n=104).

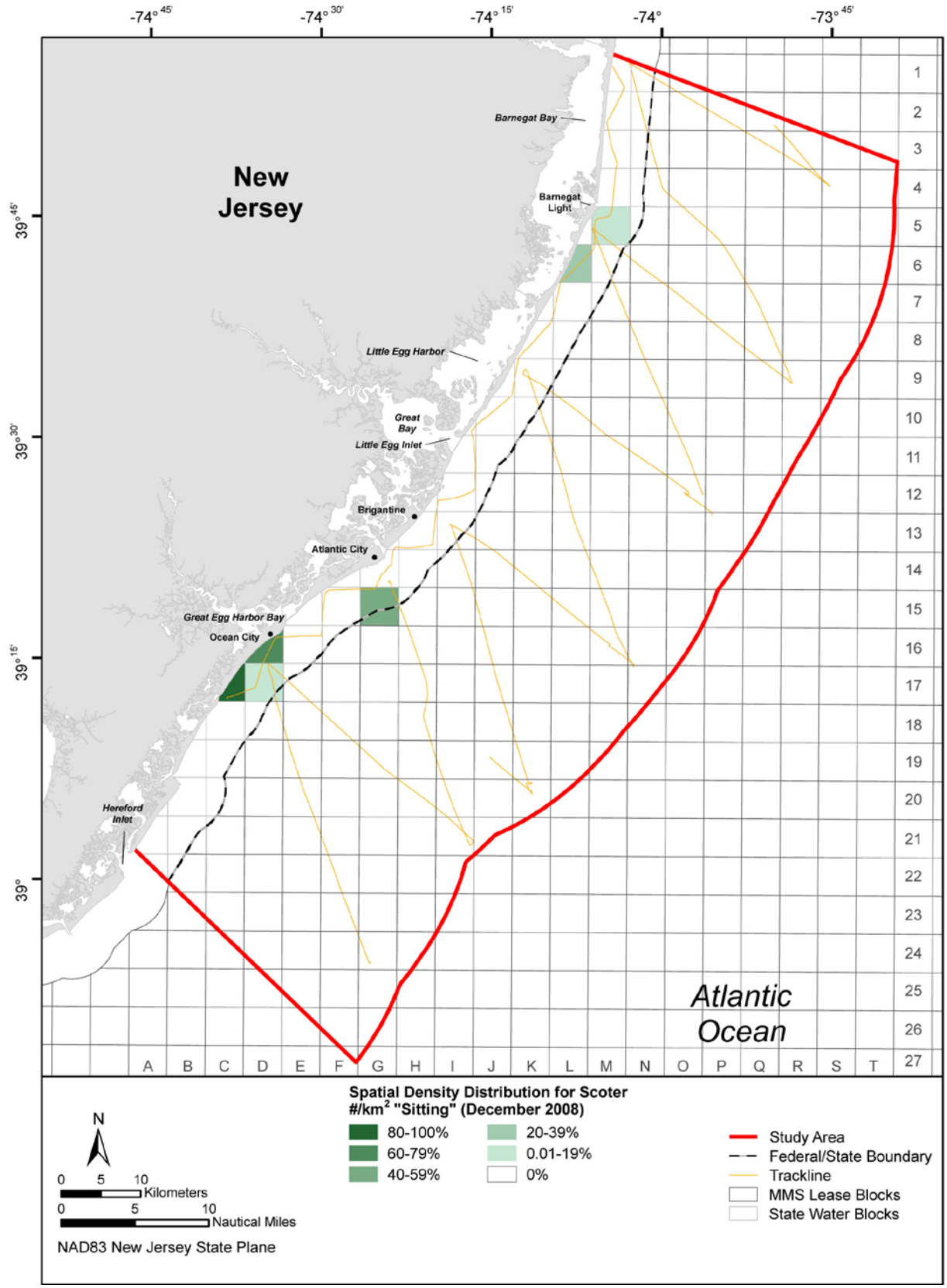

Figure C-365. Percentile abundance of scoters (sitting), December 2008 (n=828).

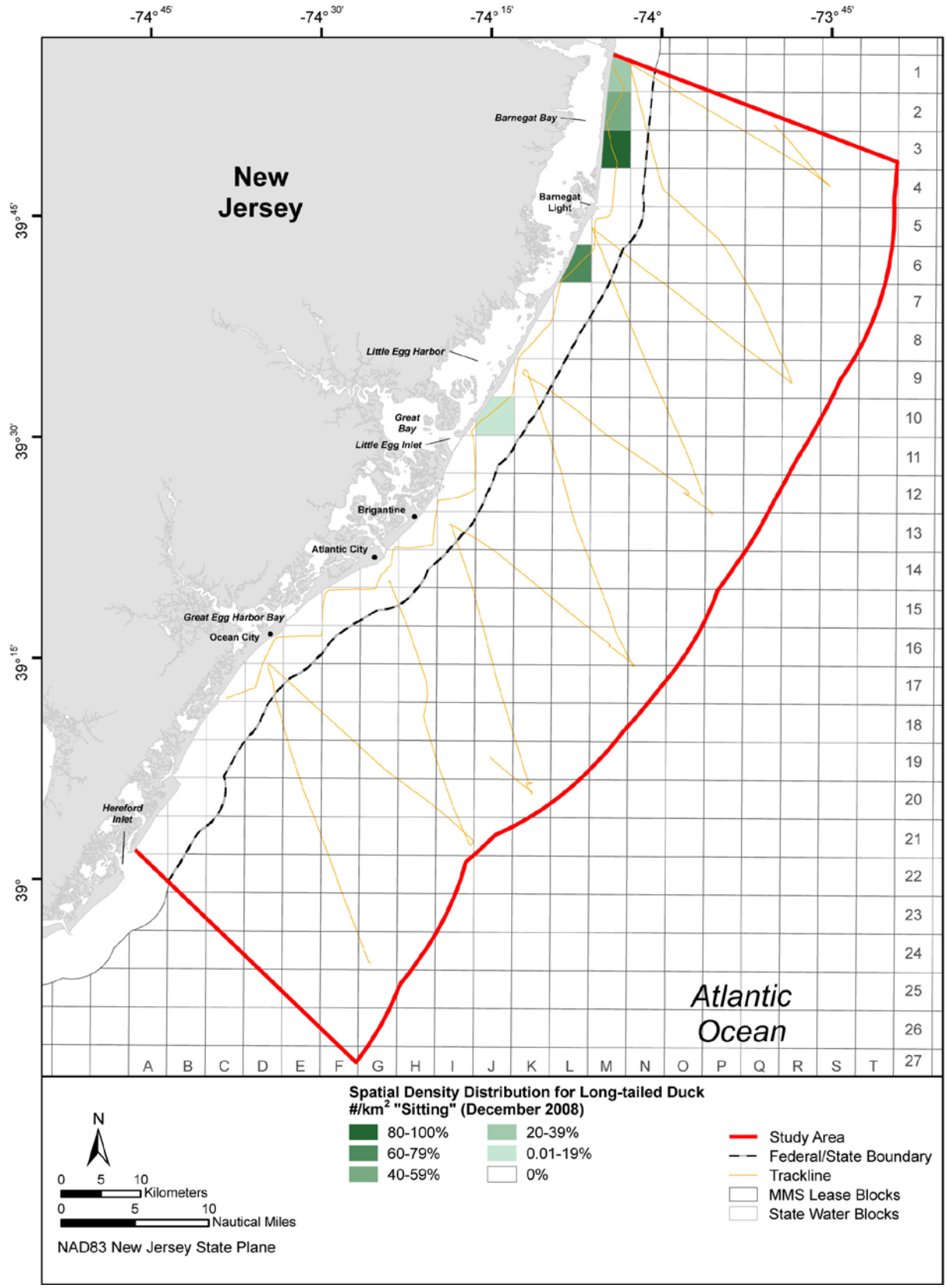

Figure C-366. Percentile abundance of Long-tailed Duck (sitting), December 2008 (n=260).

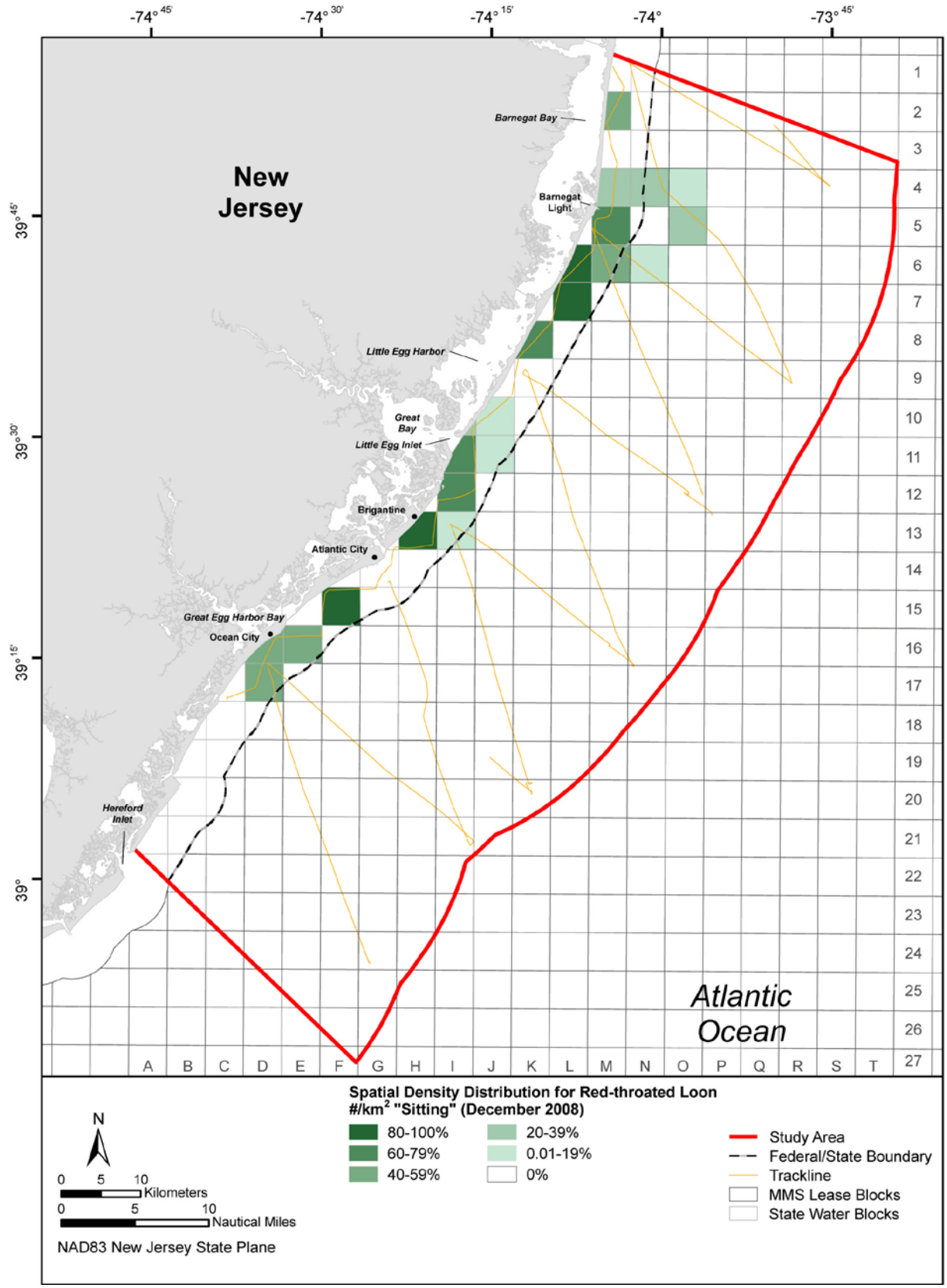

Figure C-367. Percentile abundance of Red-throated Loon (sitting), December 2008 (n=128).

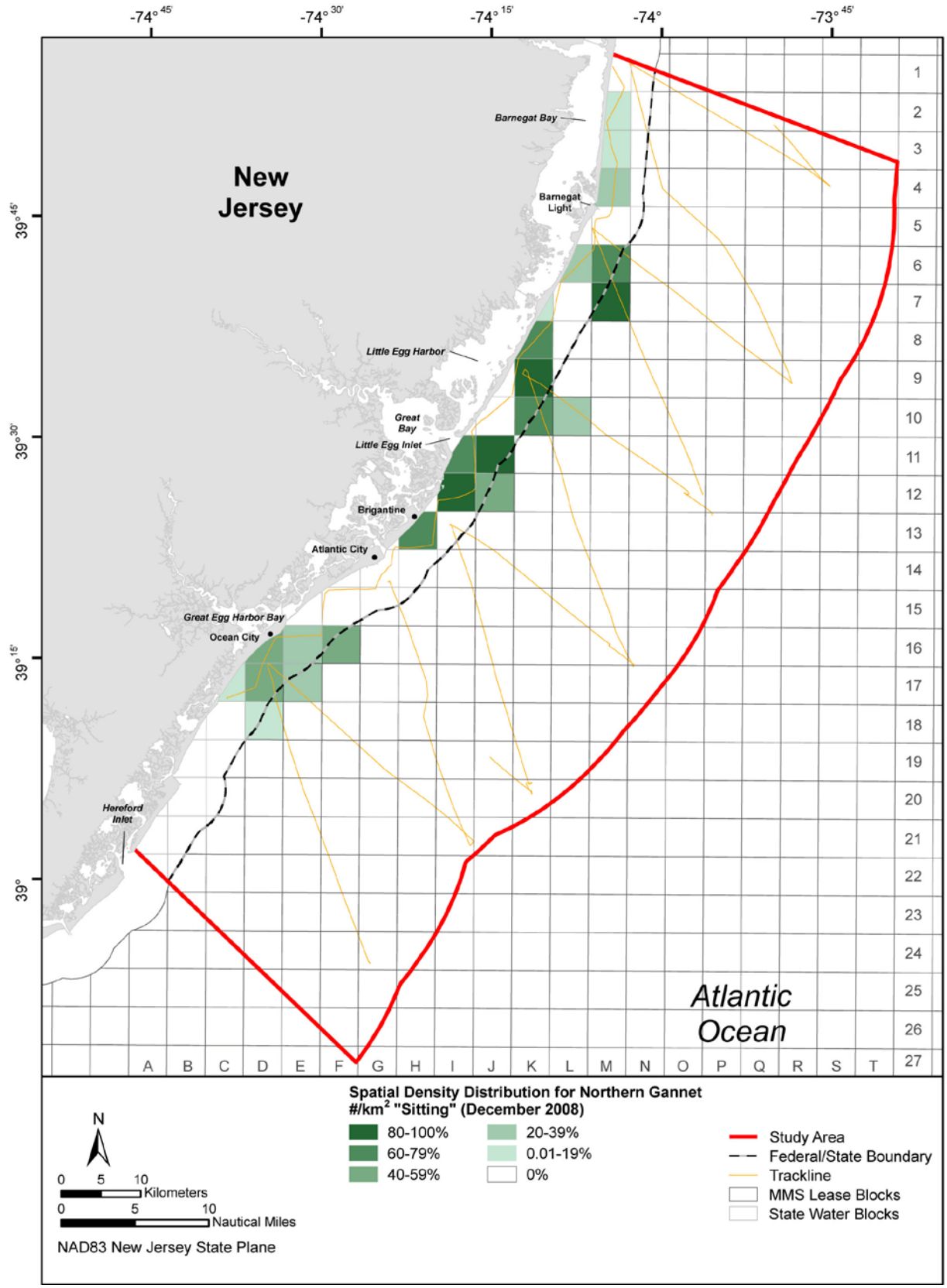

Figure C-368. Percentile abundance of Northern Gannet (sitting), December 2008 (n=104).

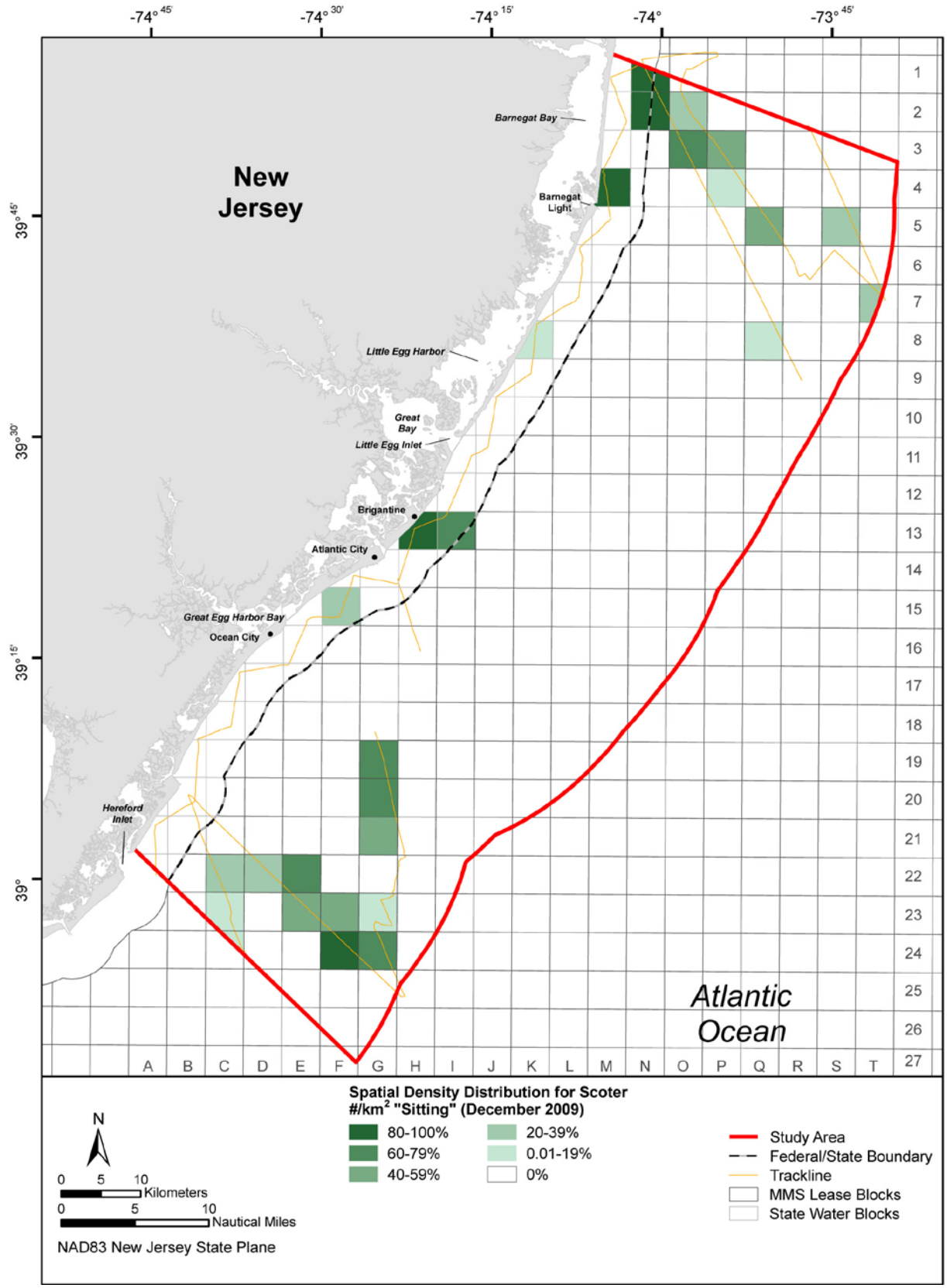

Figure C-369. Percentile abundance of scoters (sitting), December 2009 (n=514).

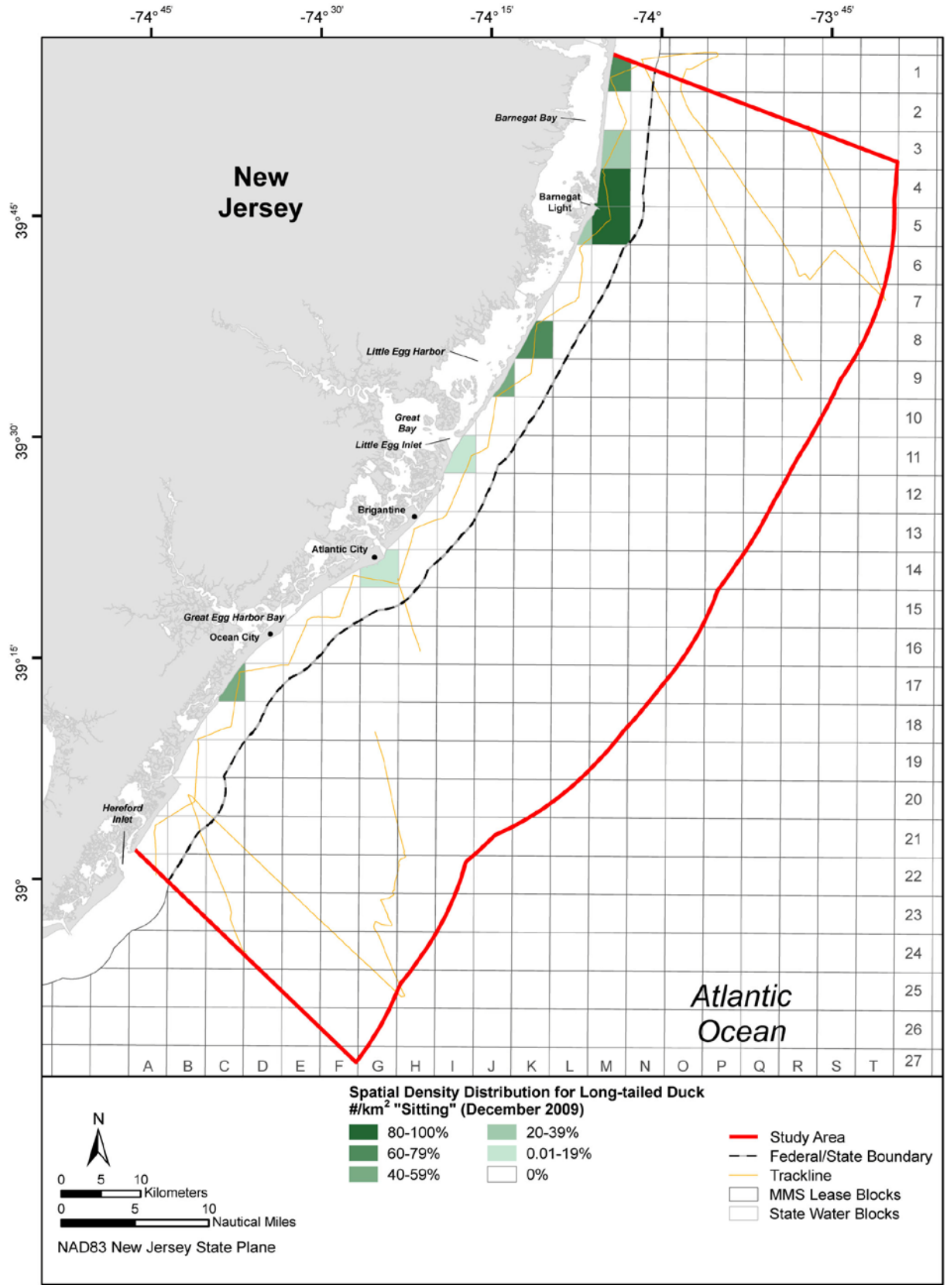

Figure C-370. Percentile abundance of Long-tailed Duck (sitting), December 2009 (n=244).

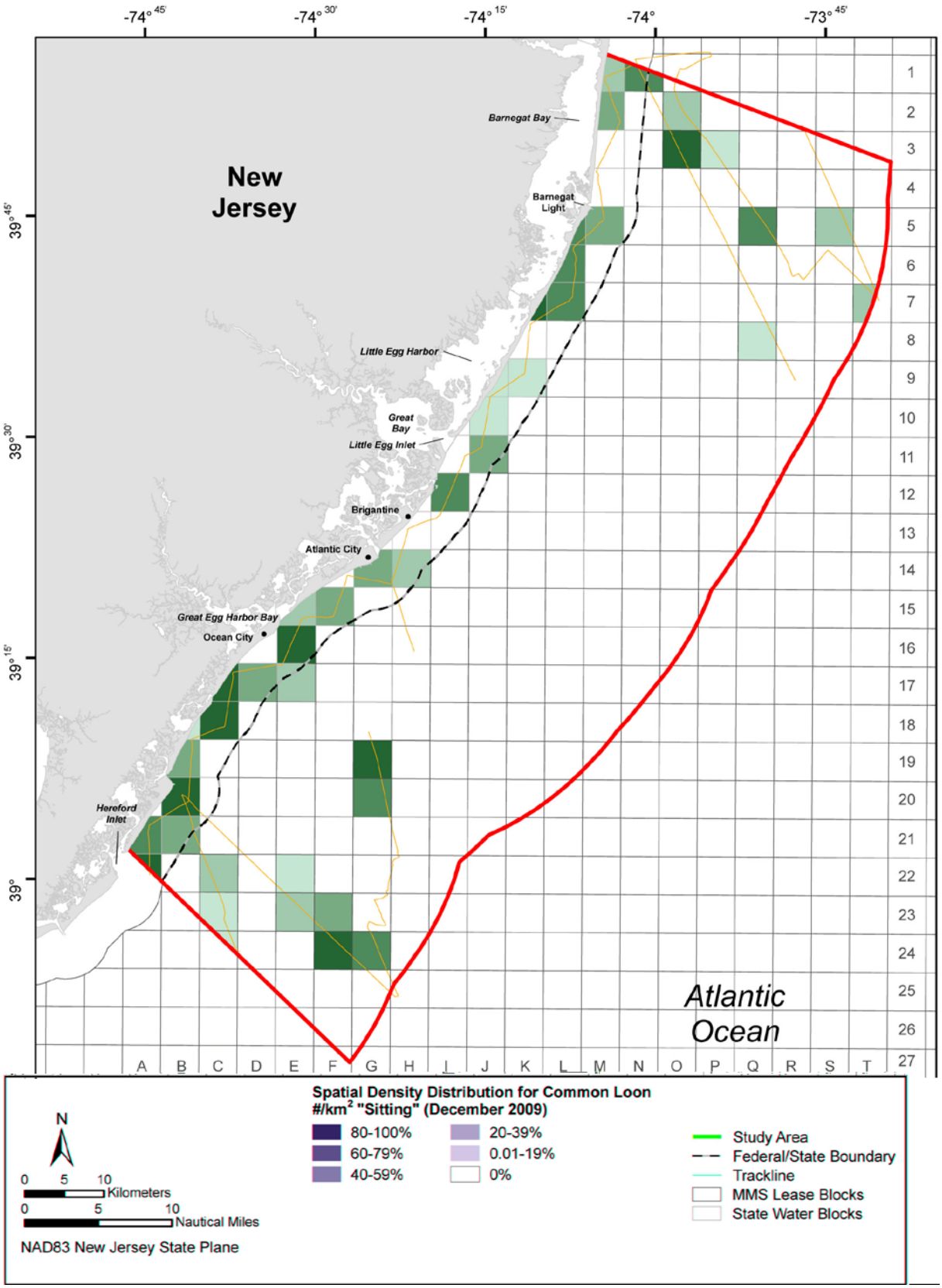

Figure C-371. Percentile abundance of Common Loon (sitting), December 2009 (n=266).

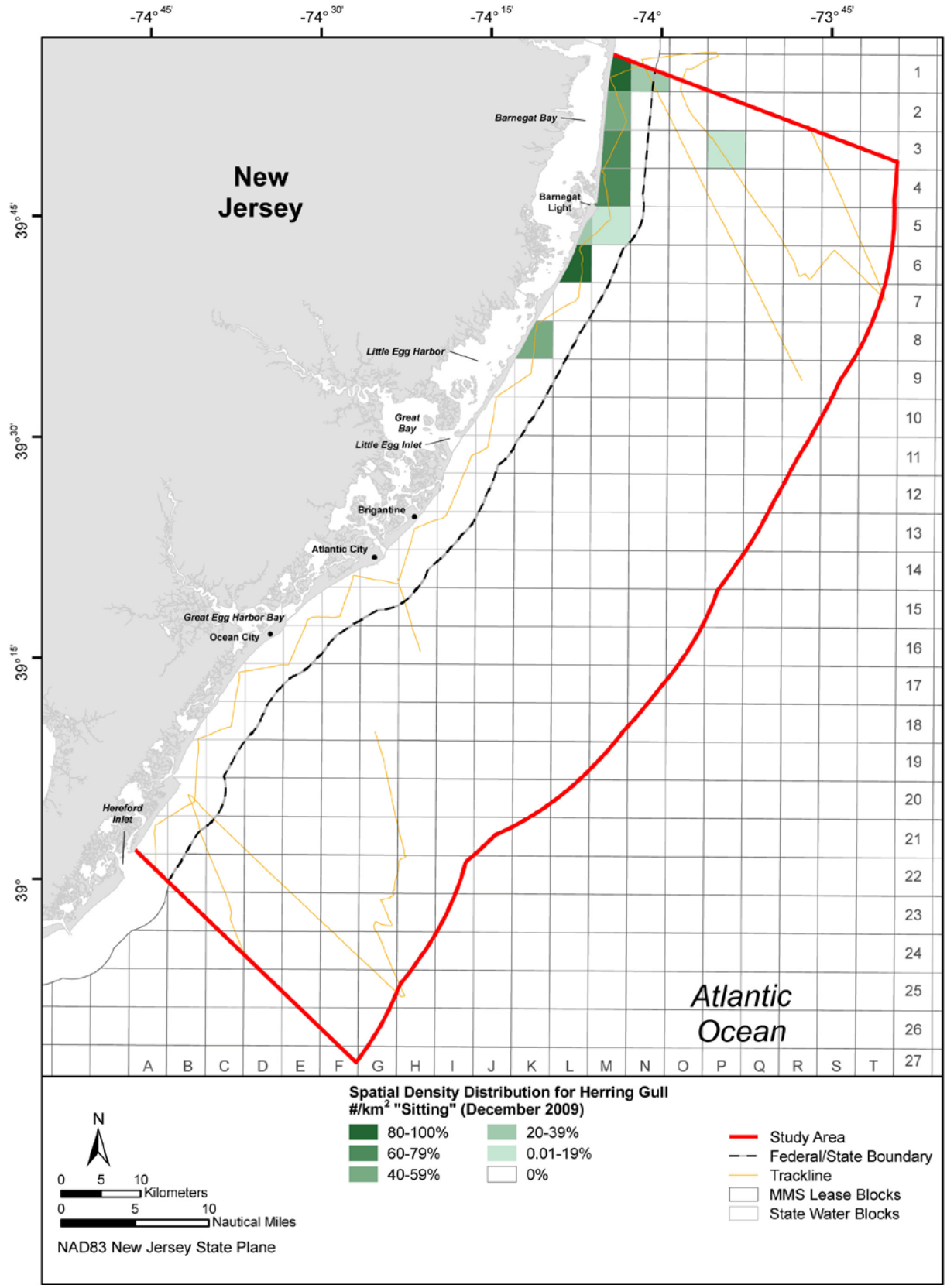

Figure C-372. Percentile abundance of Herring Gull (sitting), December 2009 (n=108).

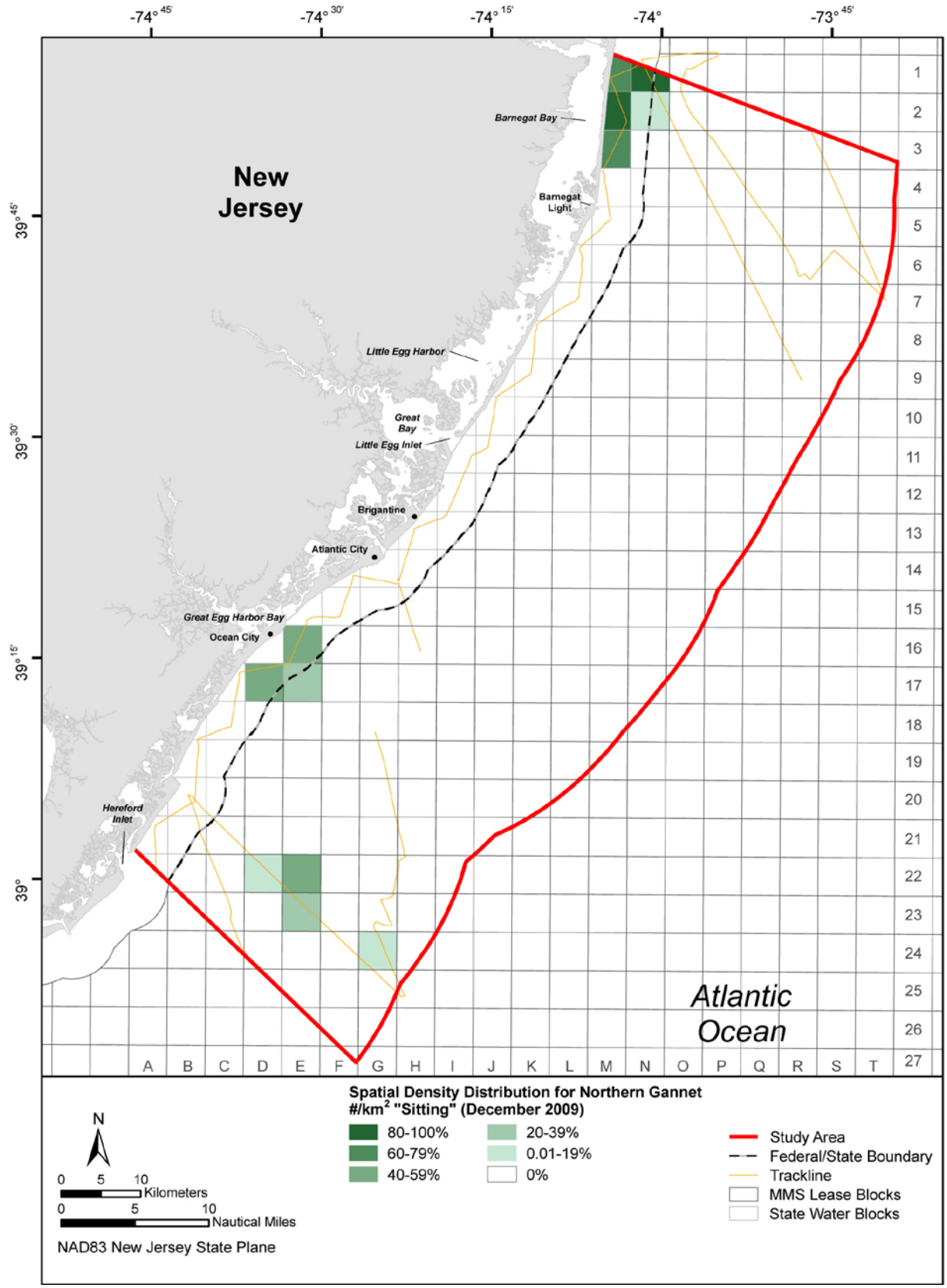

Figure C-373. Percentile abundance of Northern Gannet (sitting), December 2009 (n=95).

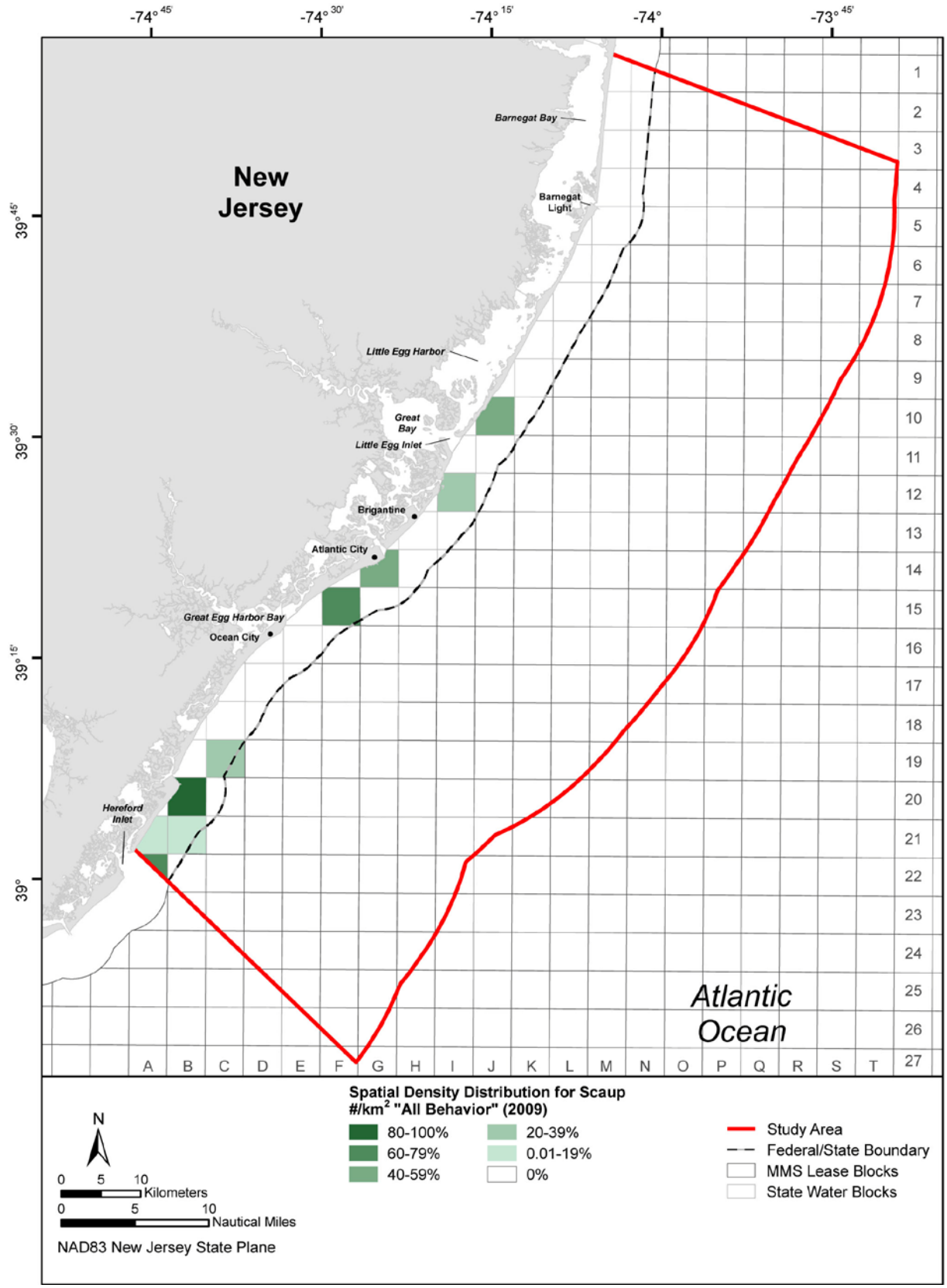

Figure C-374. Percentile abundance of scaup (all behaviors), January-December 2009 (n=2,469).

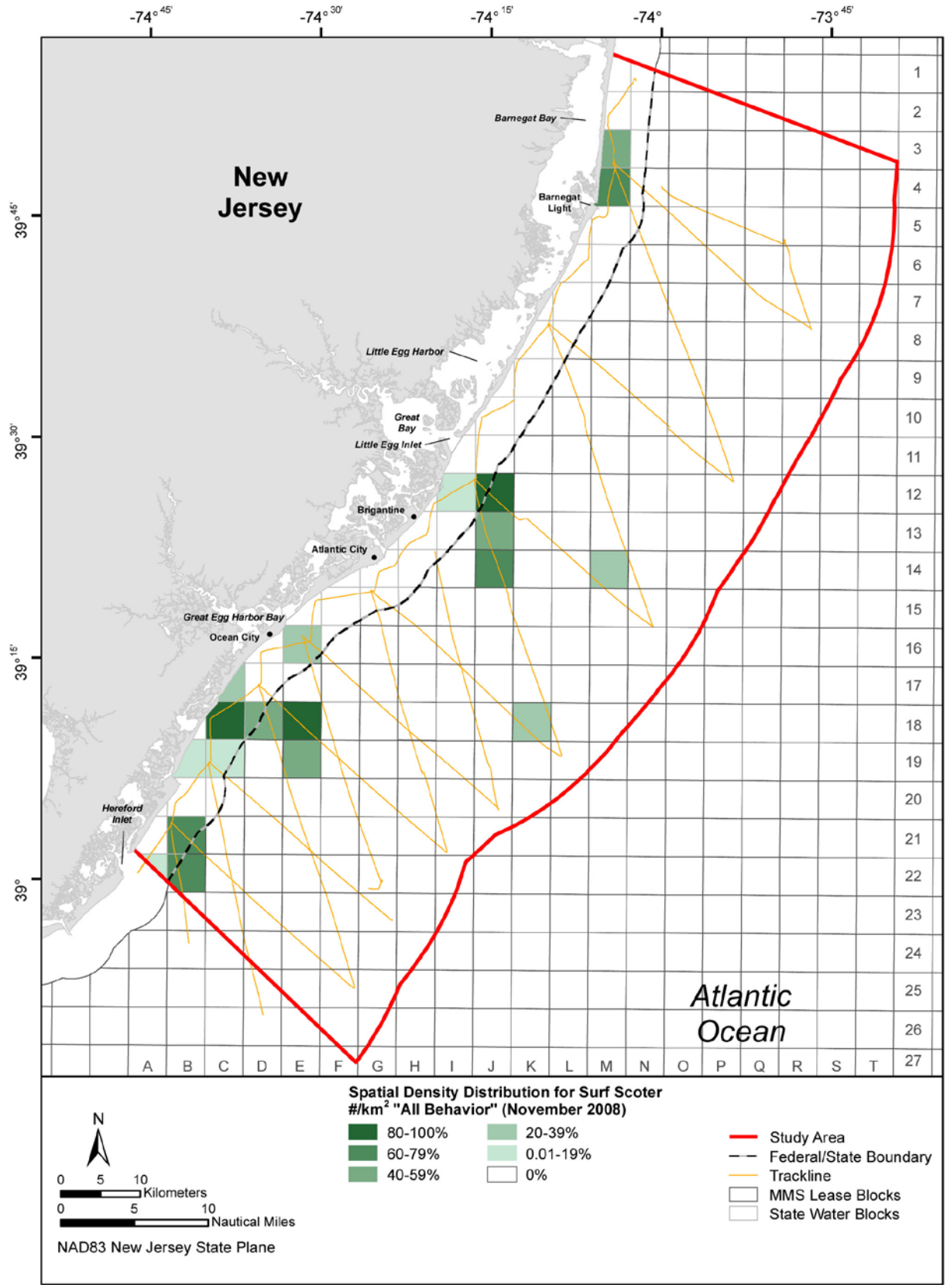

Figure C-375. Percentile abundance of Surf Scoter (all behaviors), November 2008 (n=1,929).

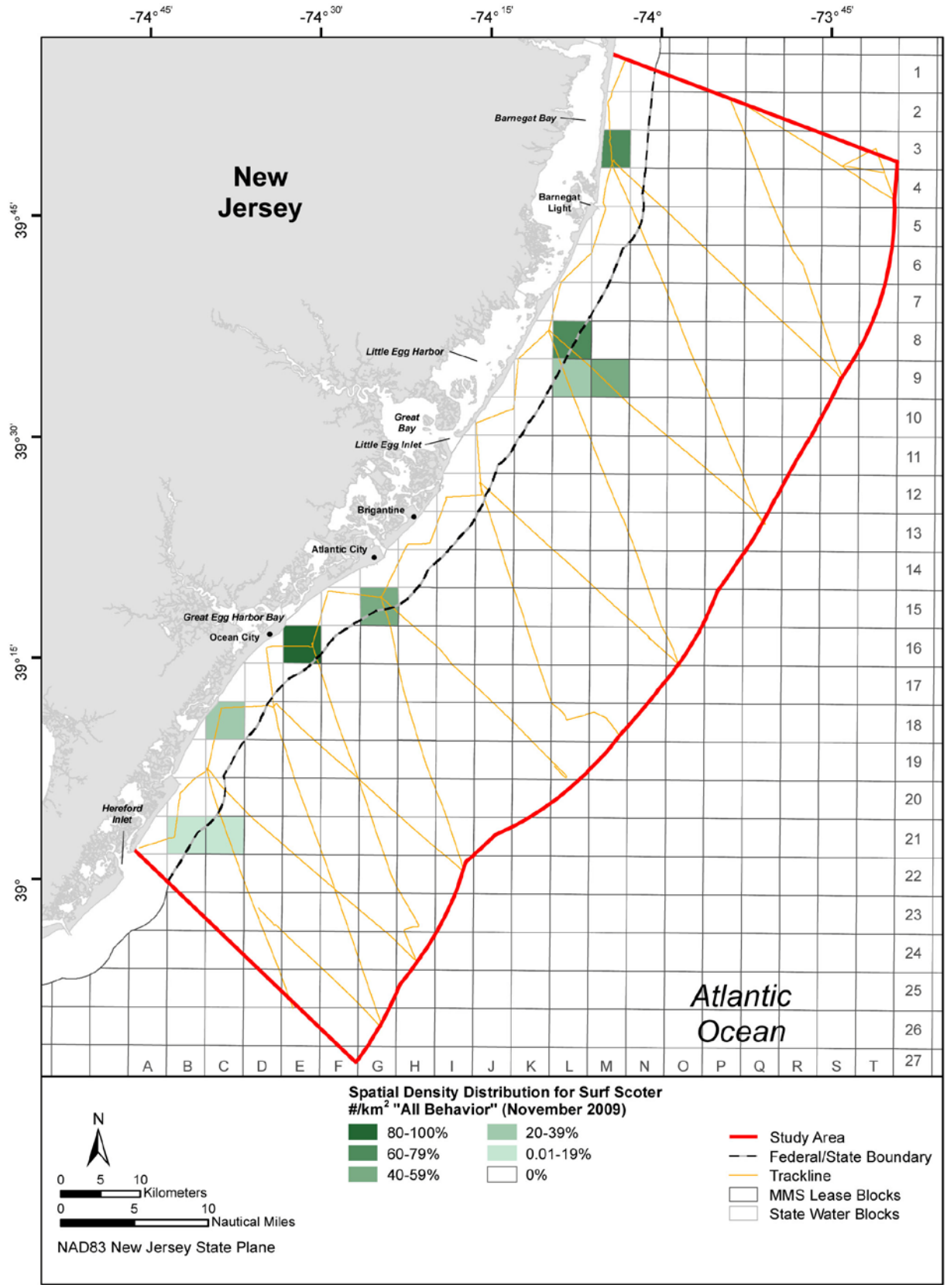

Figure C-376. Percentile abundance of Surf Scoter (all behaviors), November 2009 (n=435).

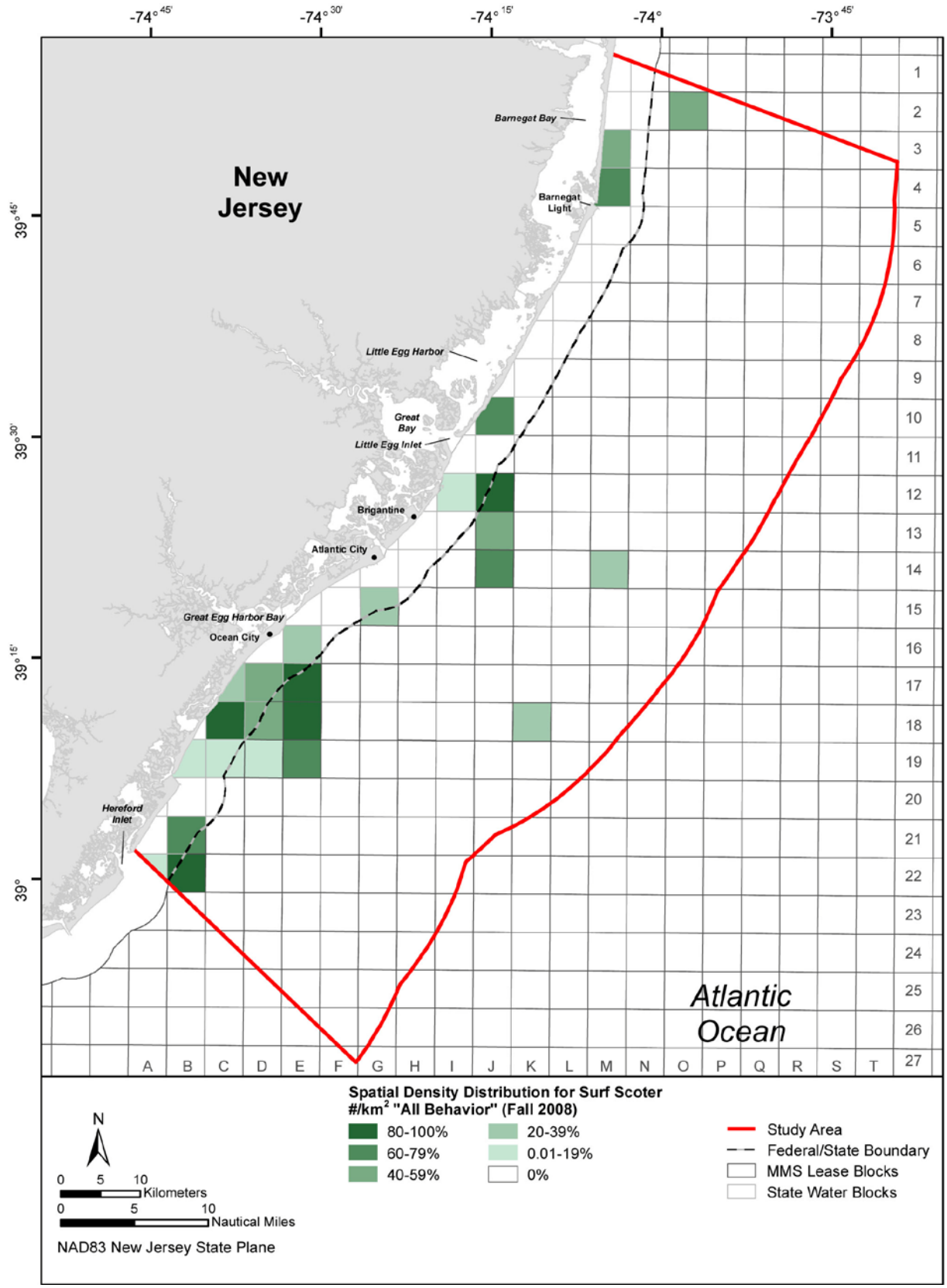

Figure C-377. Percentile abundance of Surf Scoter (all behaviors), Fall 2008 (August-November 2008) (n=200).

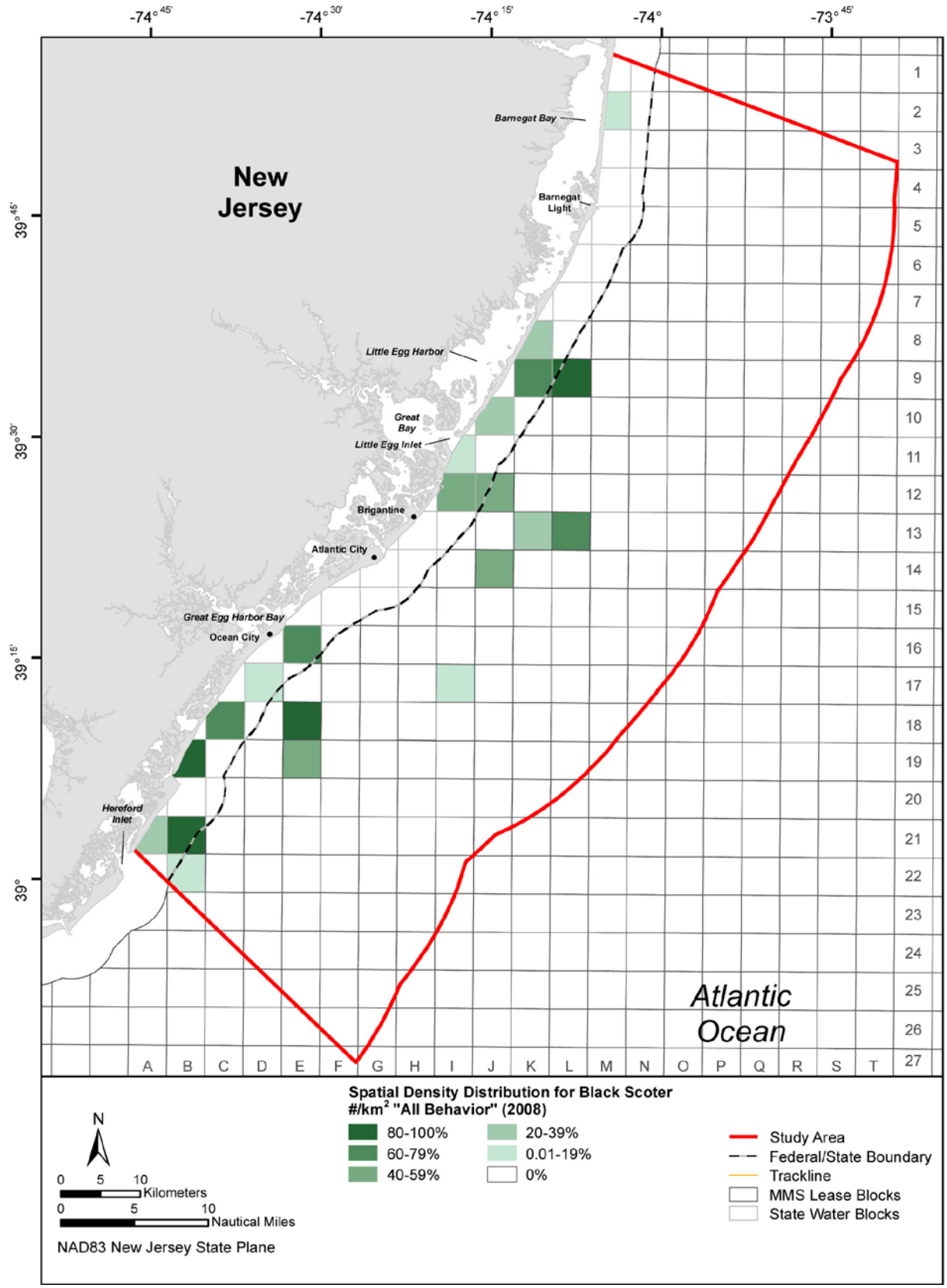

Figure C-378. Percentile abundance of Black Scoter (all behaviors), January-December 2008 (n=2,100).

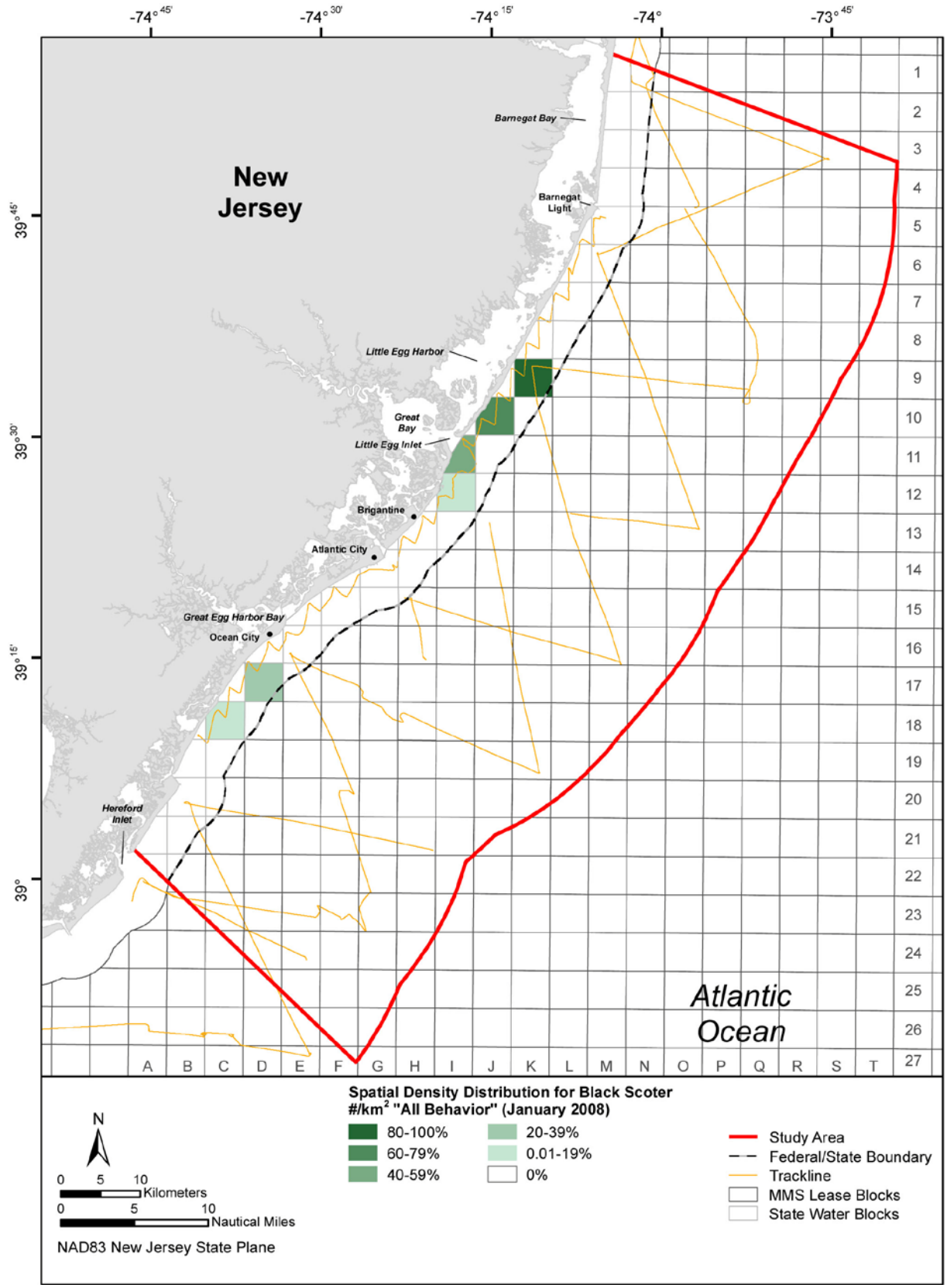

Figure C-379. Percentile abundance of Black Scoter (all behaviors), January 2008 (n=847).

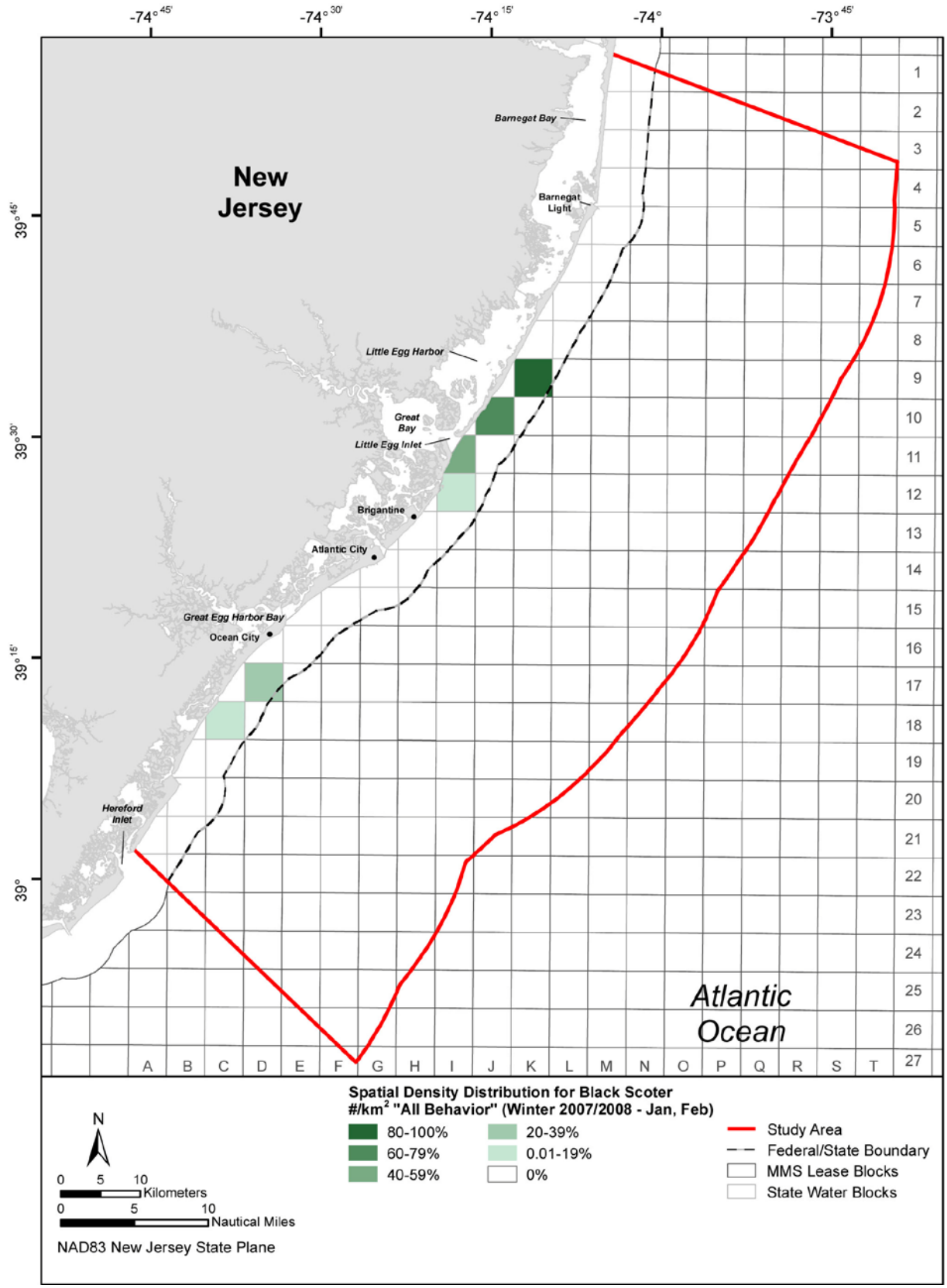

Figure C-380. Percentile abundance of Black Scoter (all behaviors), Winter 2008 (January-February 2008) (n=847).

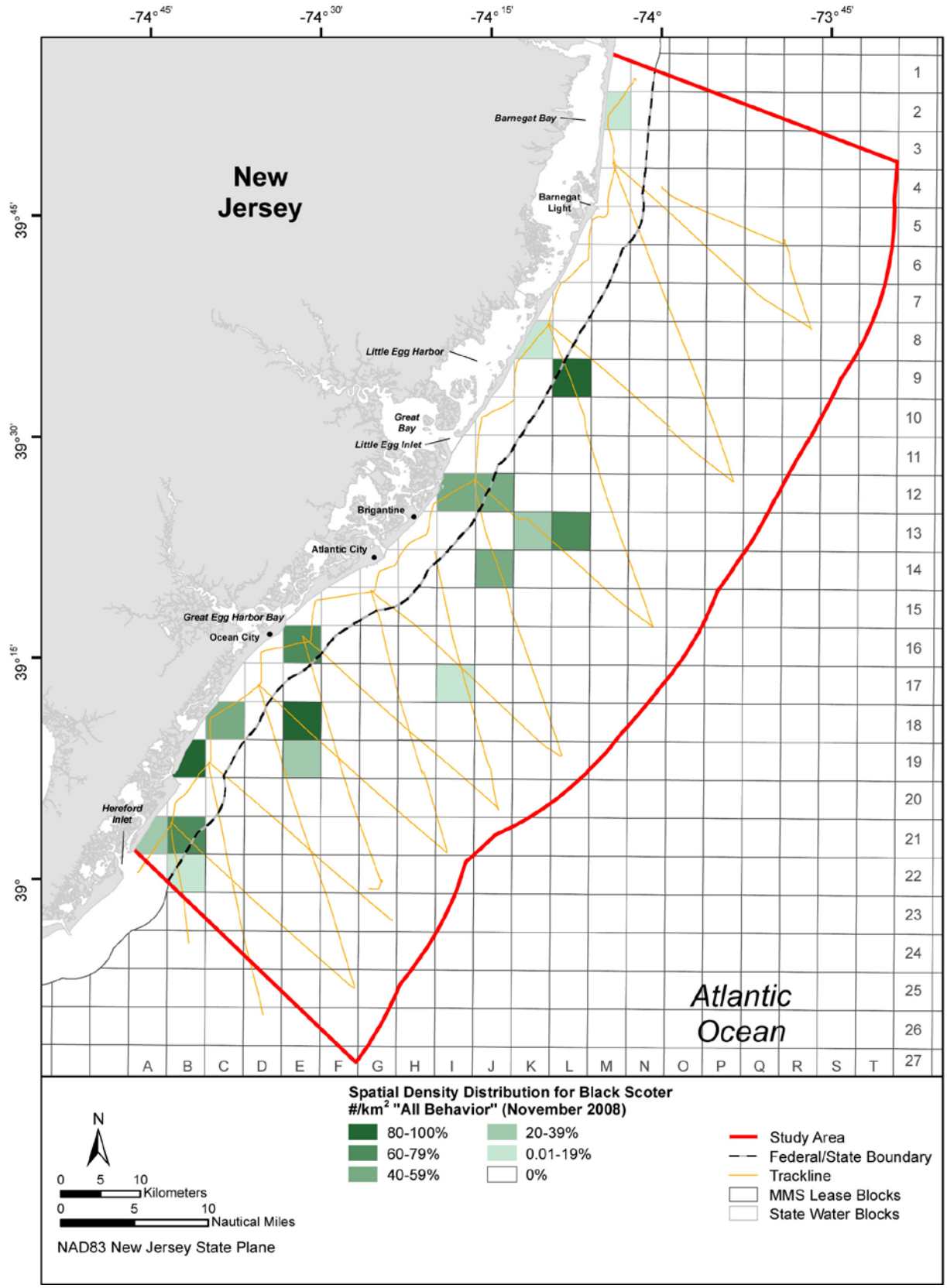

Figure C-381. Percentile abundance of Black Scoter (all behaviors), November 2008 (n=1,113).

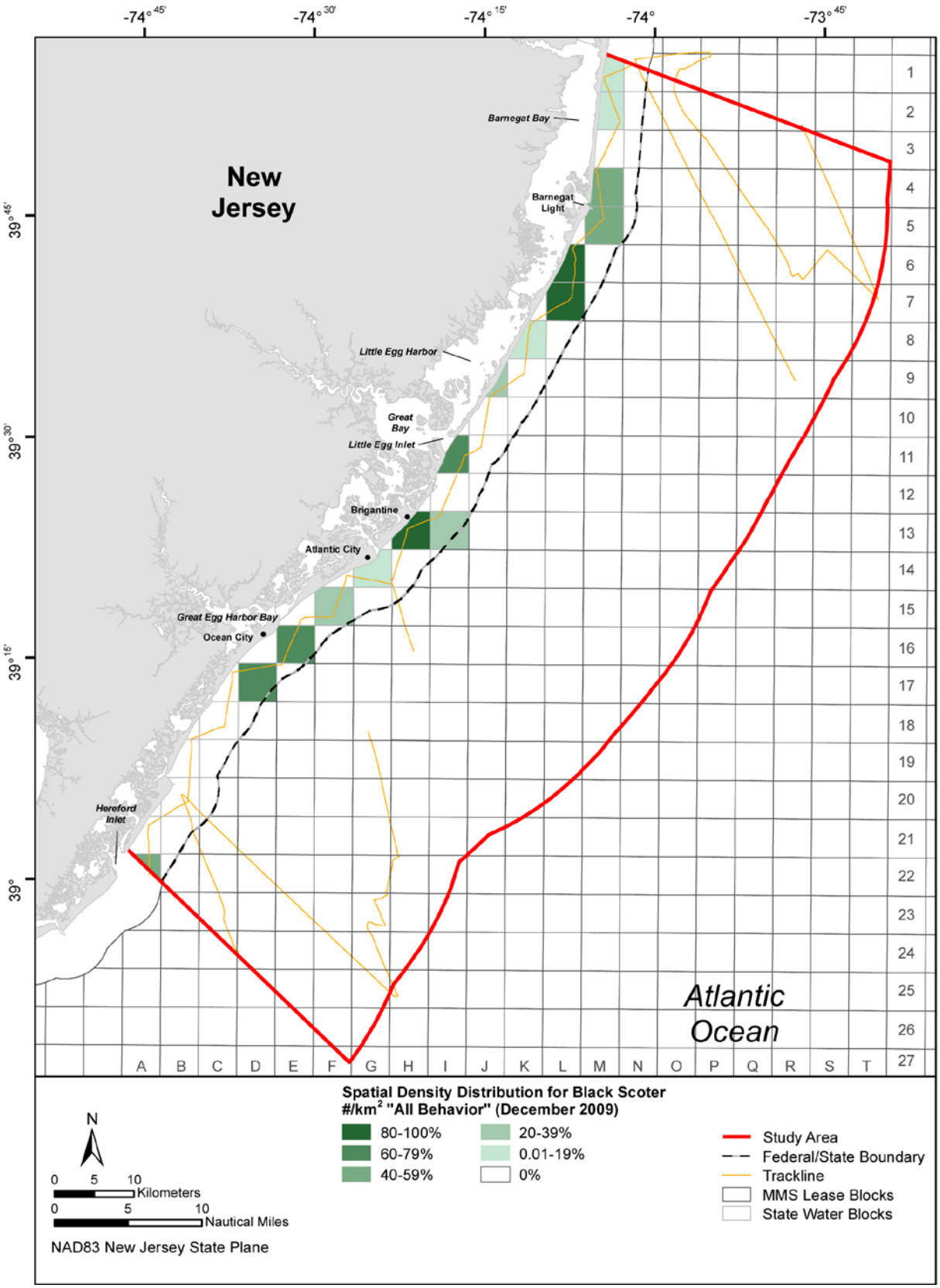

Figure C-382. Percentile abundance of Black Scoter (all behaviors), December 2009 (n=632).

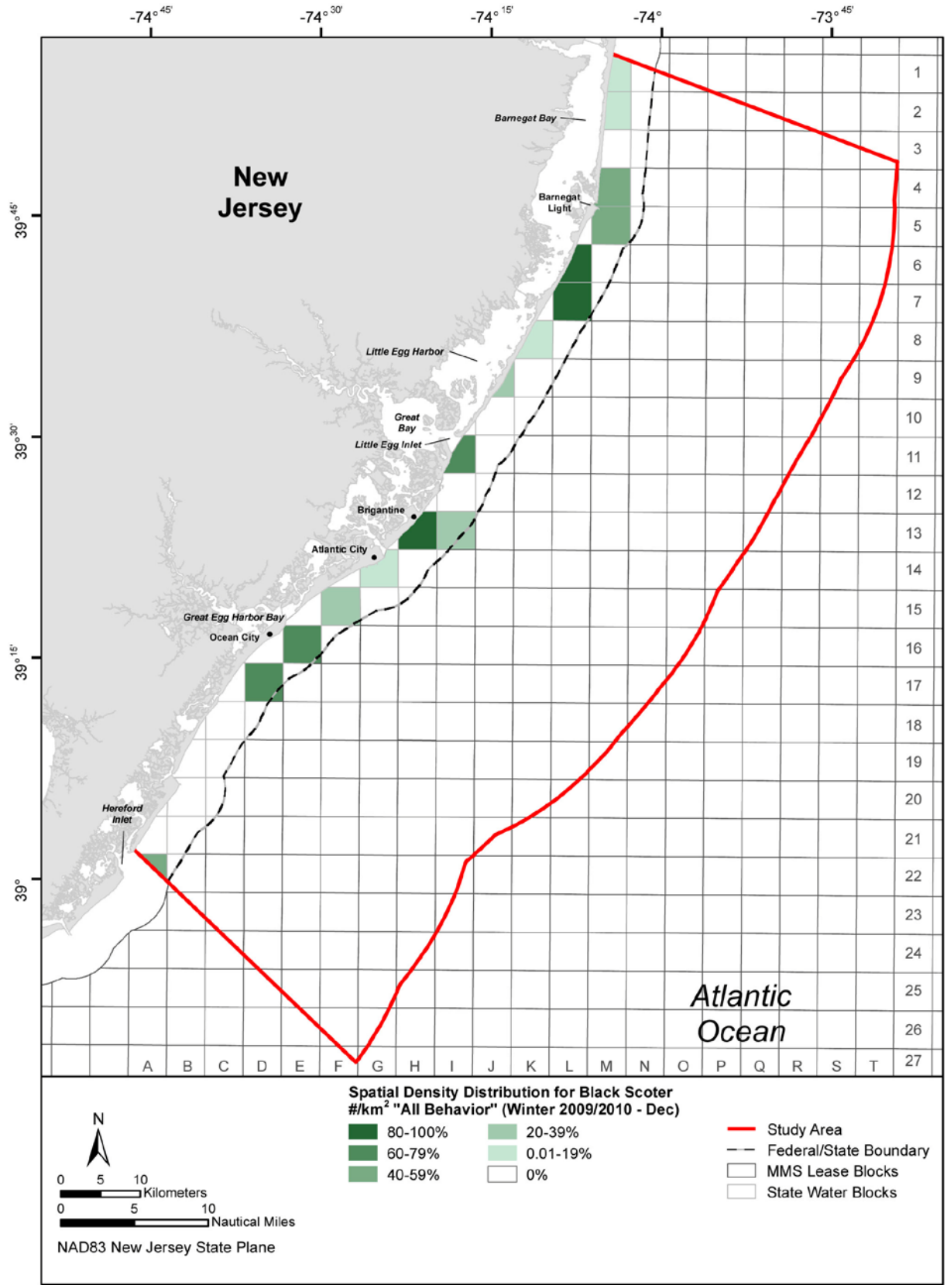

Figure C-383. Percentile abundance of Black Scoter (all behaviors), Winter 2010 (December 2009) (n=632).

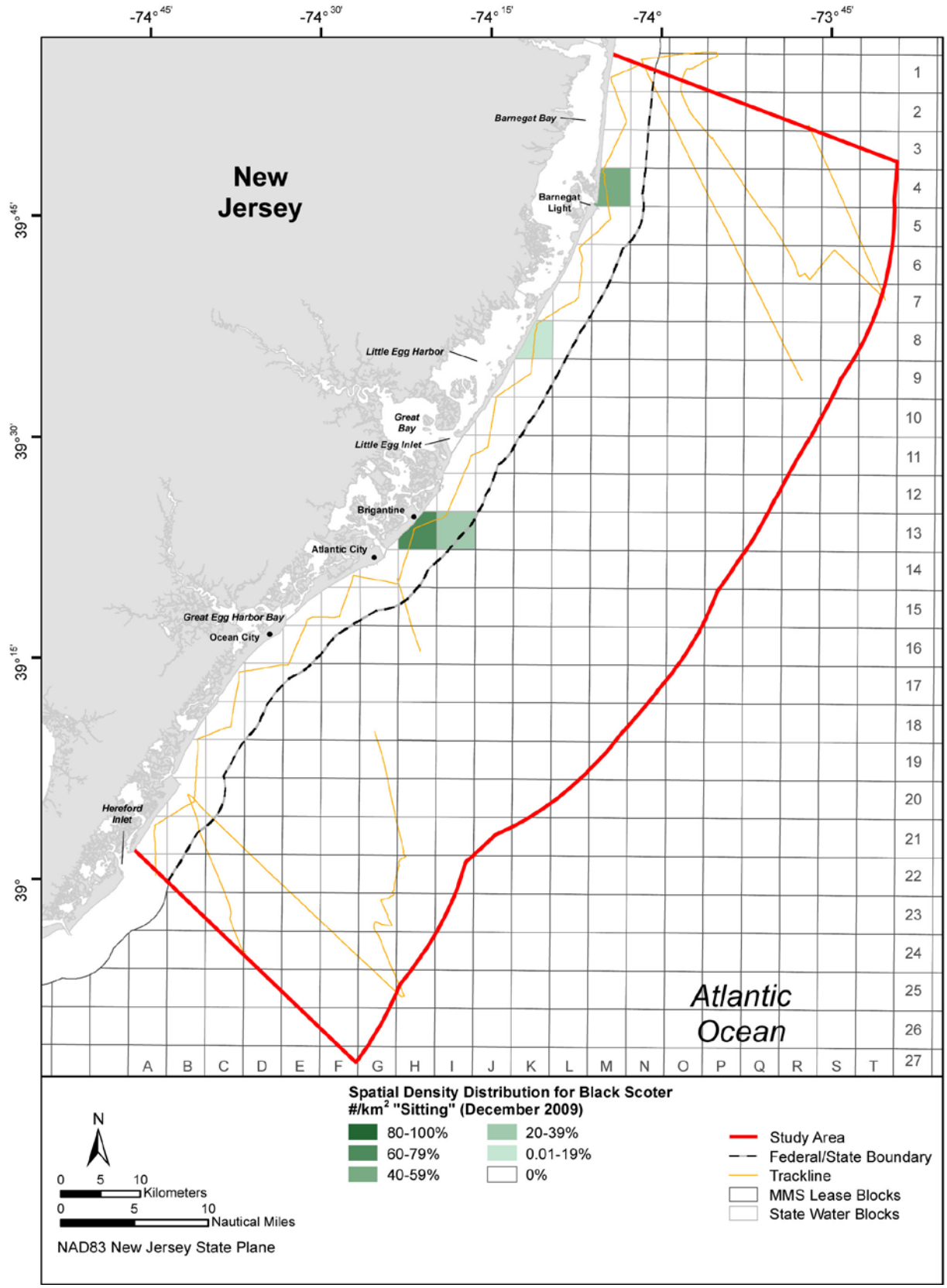

Figure C-384. Percentile abundance of Black Scoter (sitting), December 2009 (n=343).

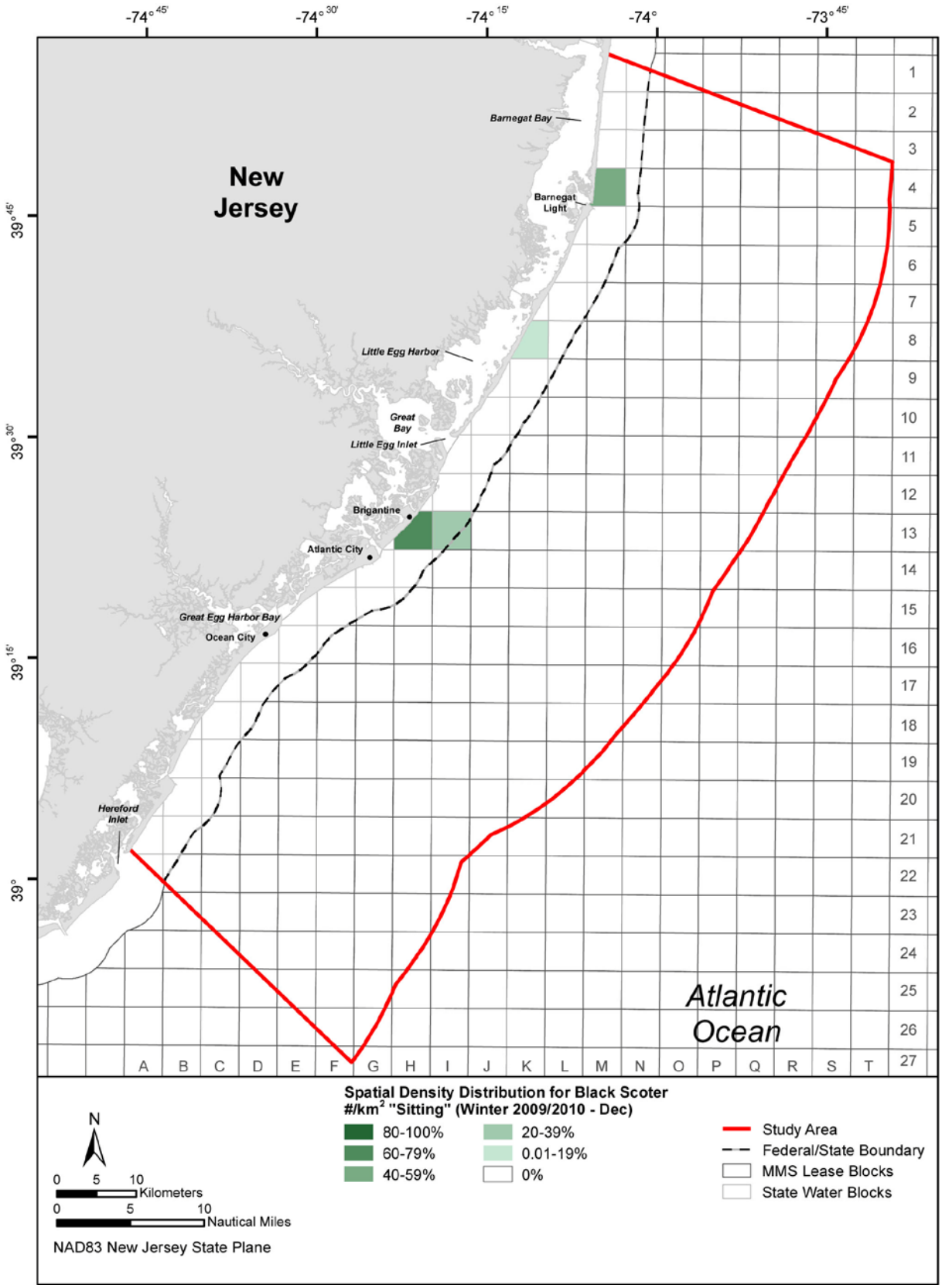

Figure C-385. Percentile abundance of Black Scoter (sitting), Winter 2010 (December 2009) (n=343).

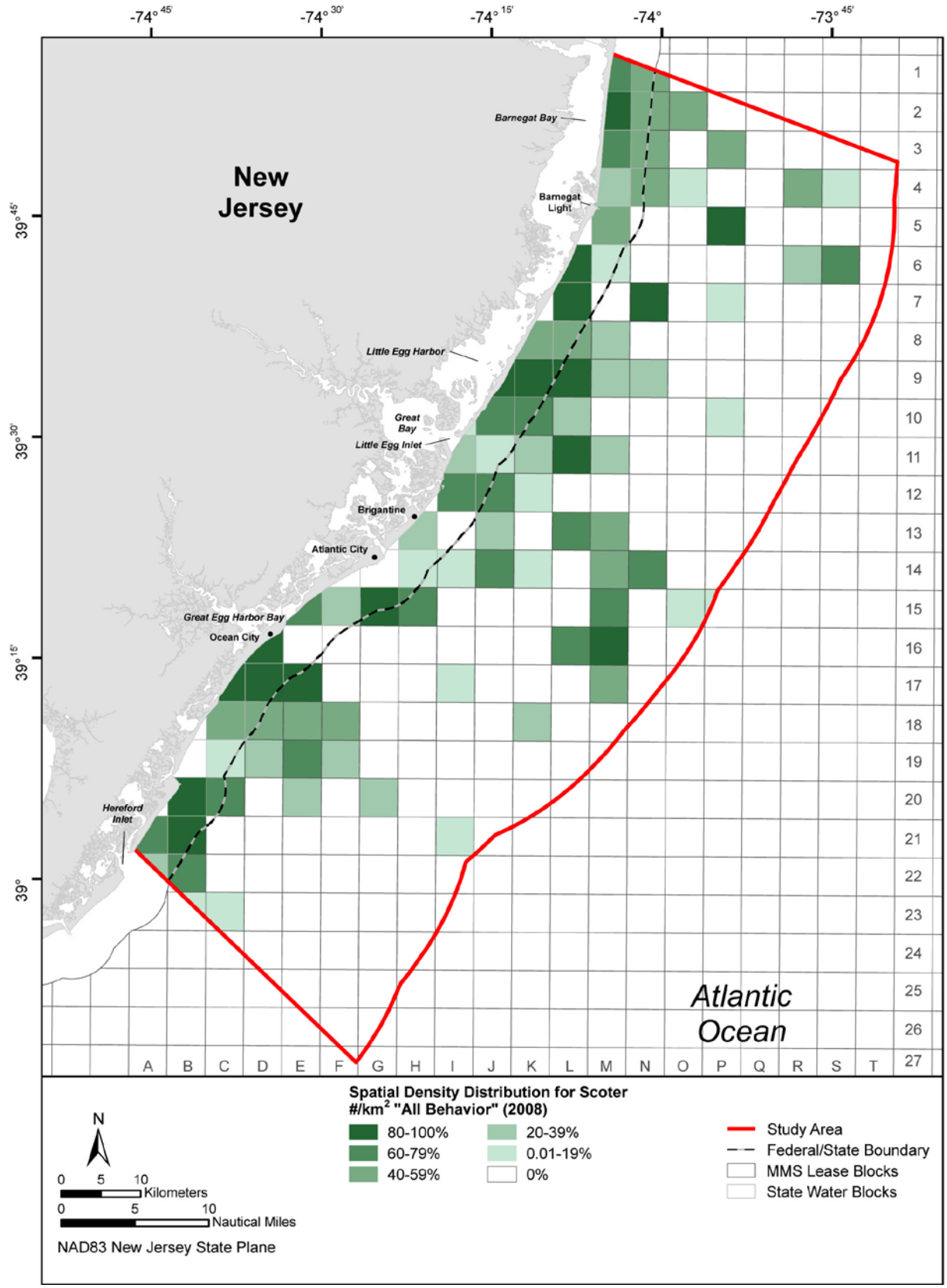

Figure C-386. Percentile abundance of scoters (all behaviors), January-December 2008 (n=8,730).

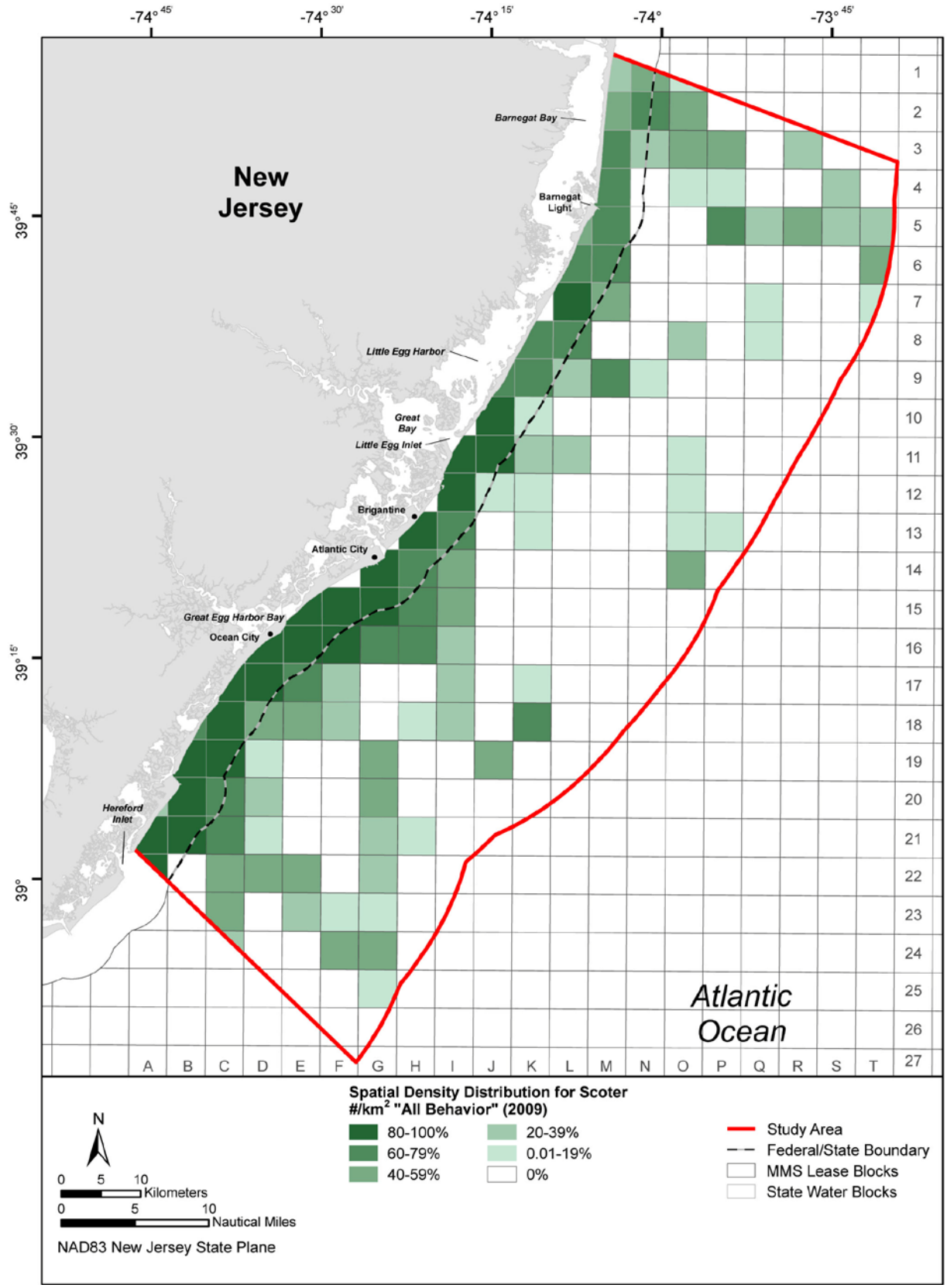

Figure C-387. Percentile abundance of scoters (all behaviors), January-December 2009 (n=7,895).

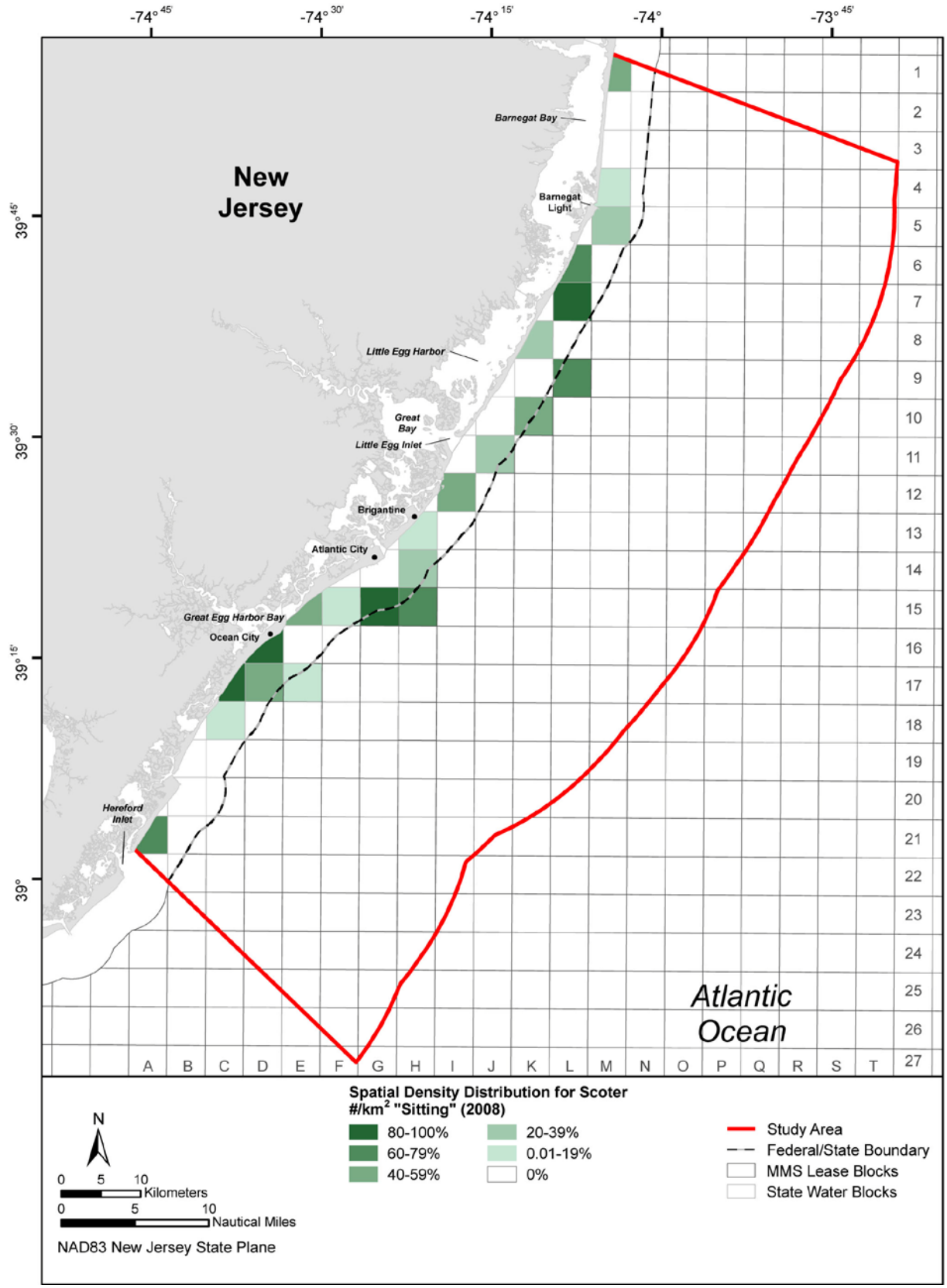

Figure C-388. Percentile abundance of scoters (sitting), January-December 2008 (n=1,558).

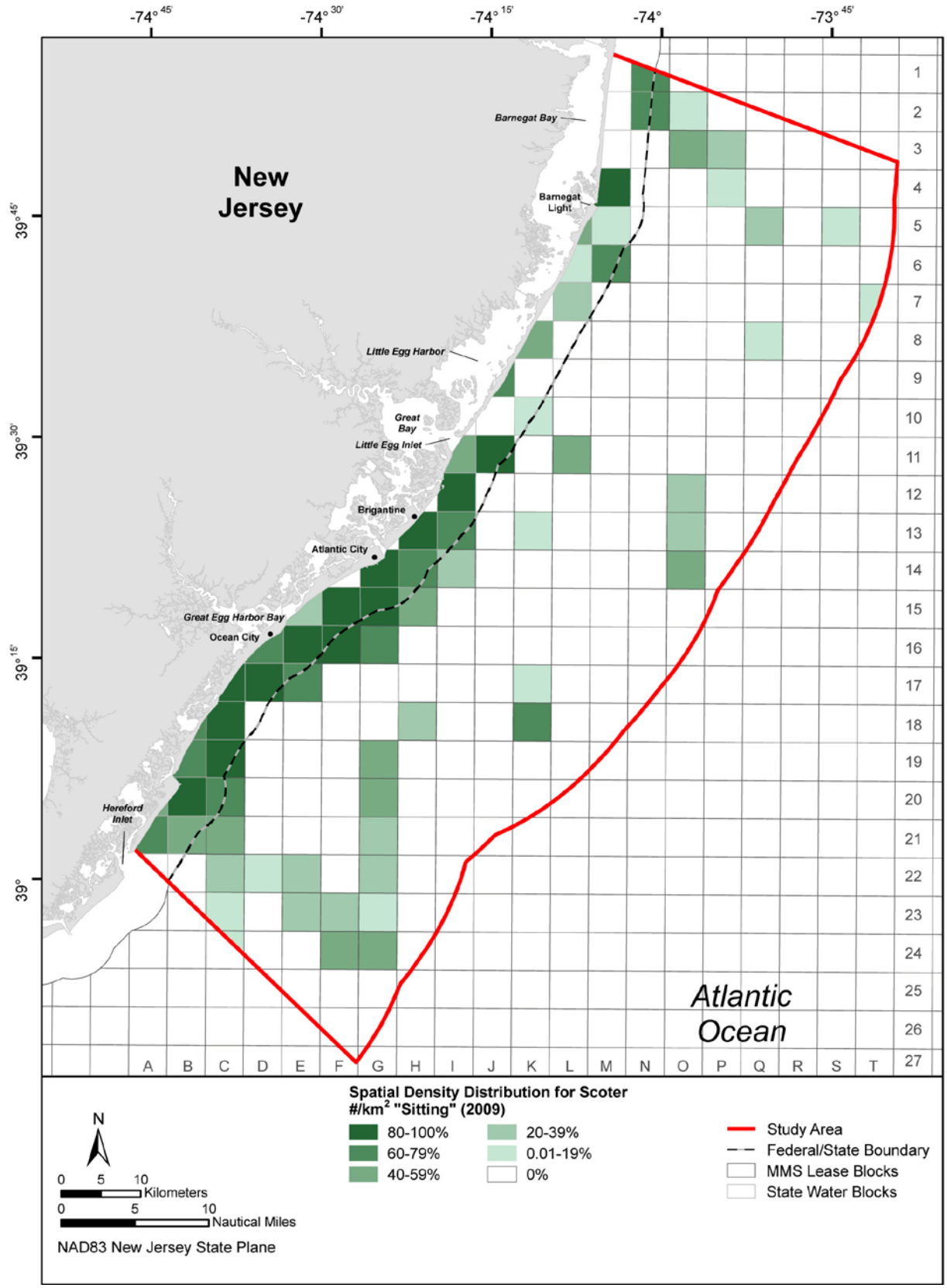

Figure C-389. Percentile abundance of scoters (sitting), January-December 2009 (n=4,209).

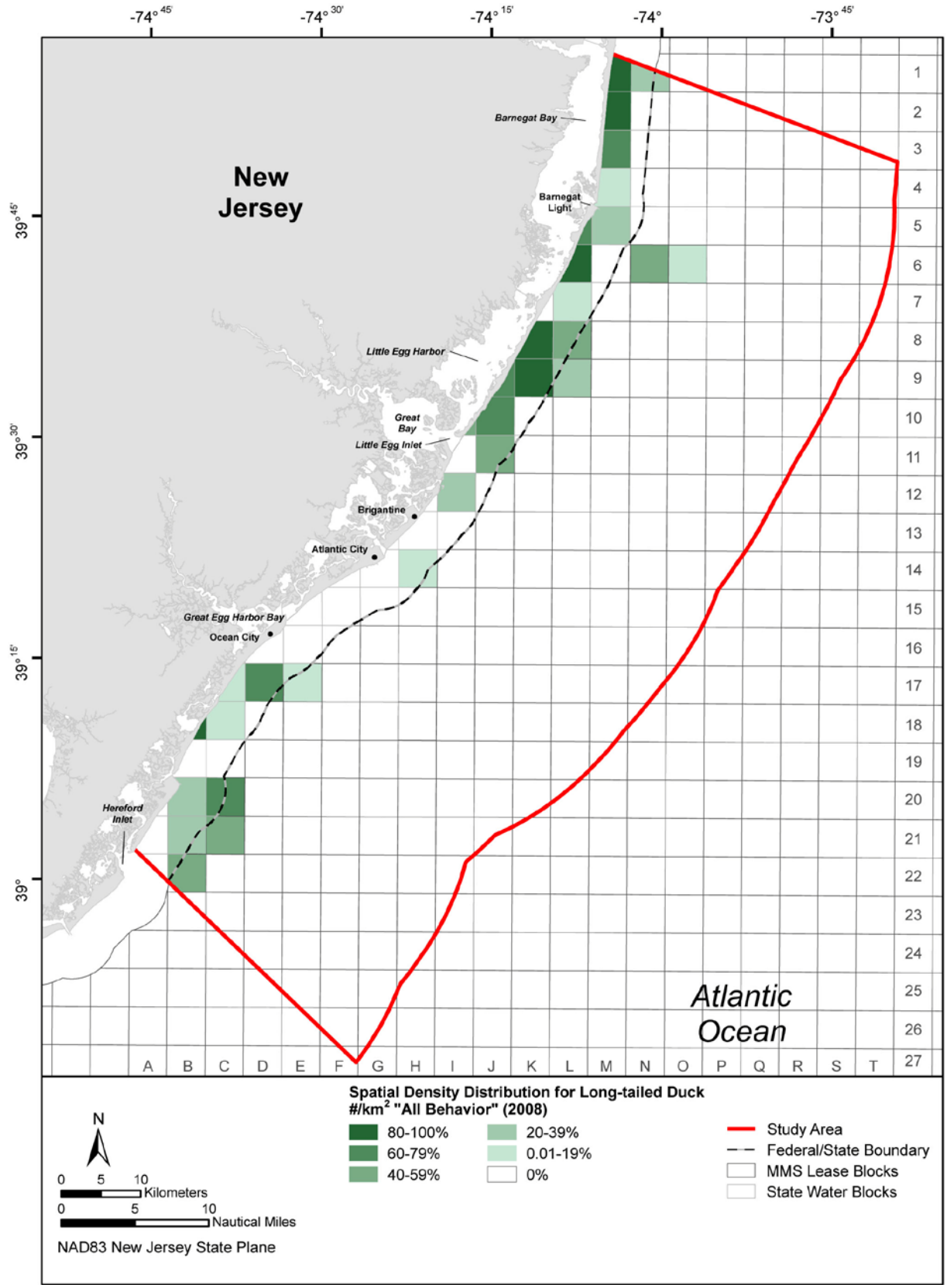

Figure C-390. Percentile abundance of Long-tailed Duck (all behaviors), January-December 2008 (n=703).

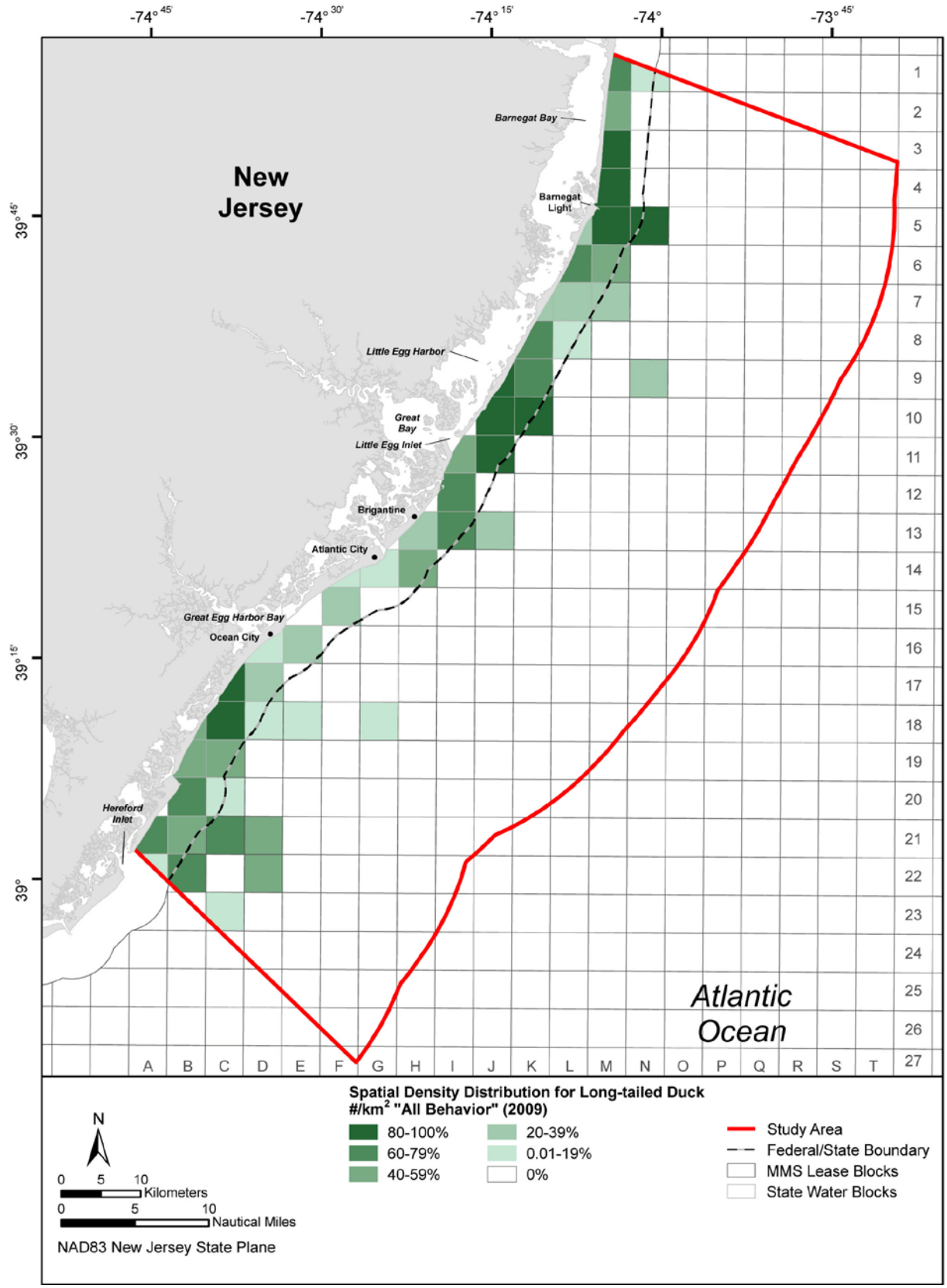

Figure C-391. Percentile abundance of Long-tailed Duck (all behaviors), January-December 2009 (n=3,848).

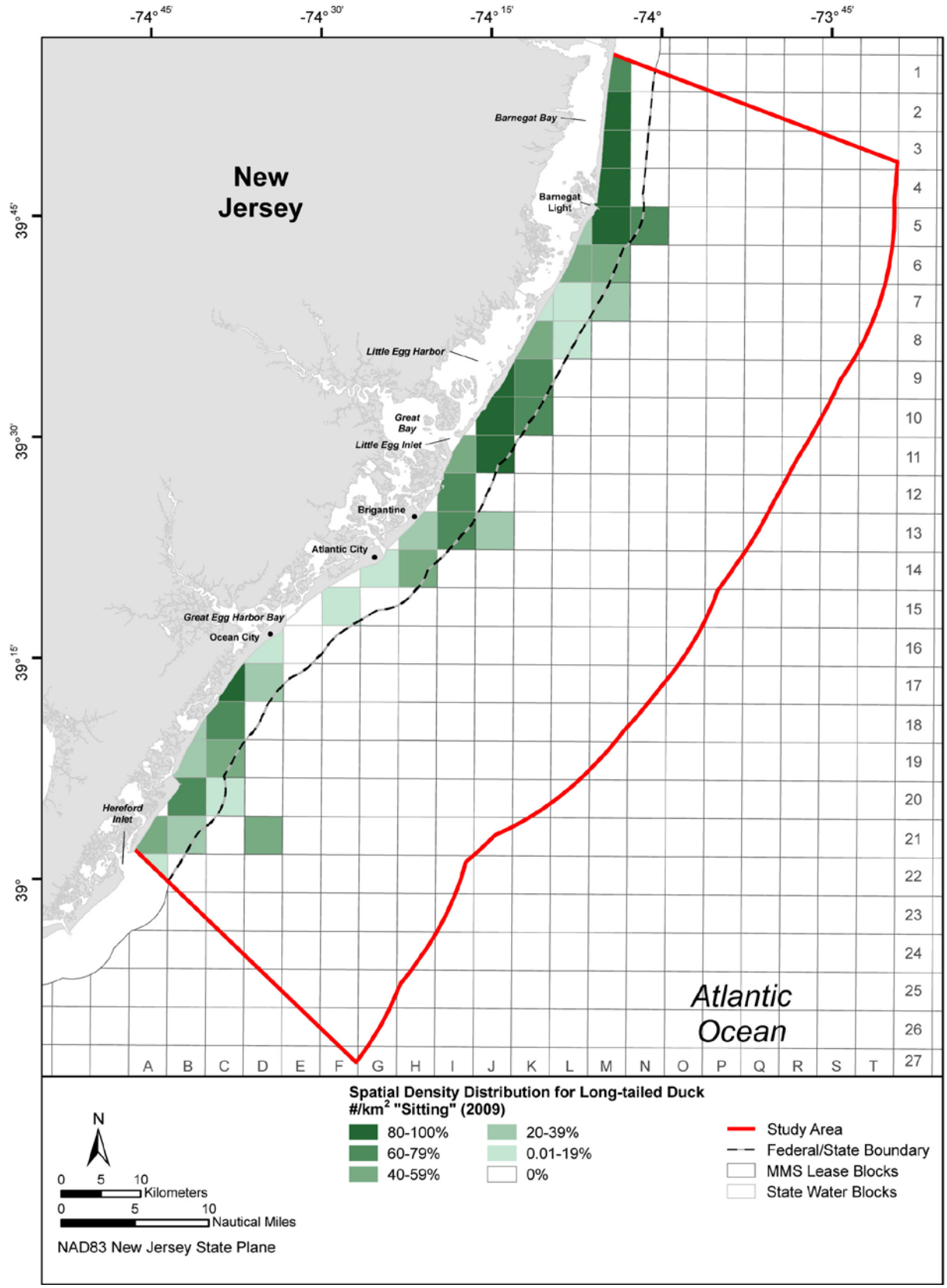

Figure C-392. Percentile abundance of Long-tailed Duck (sitting), January-December 2009 (n=2,828).

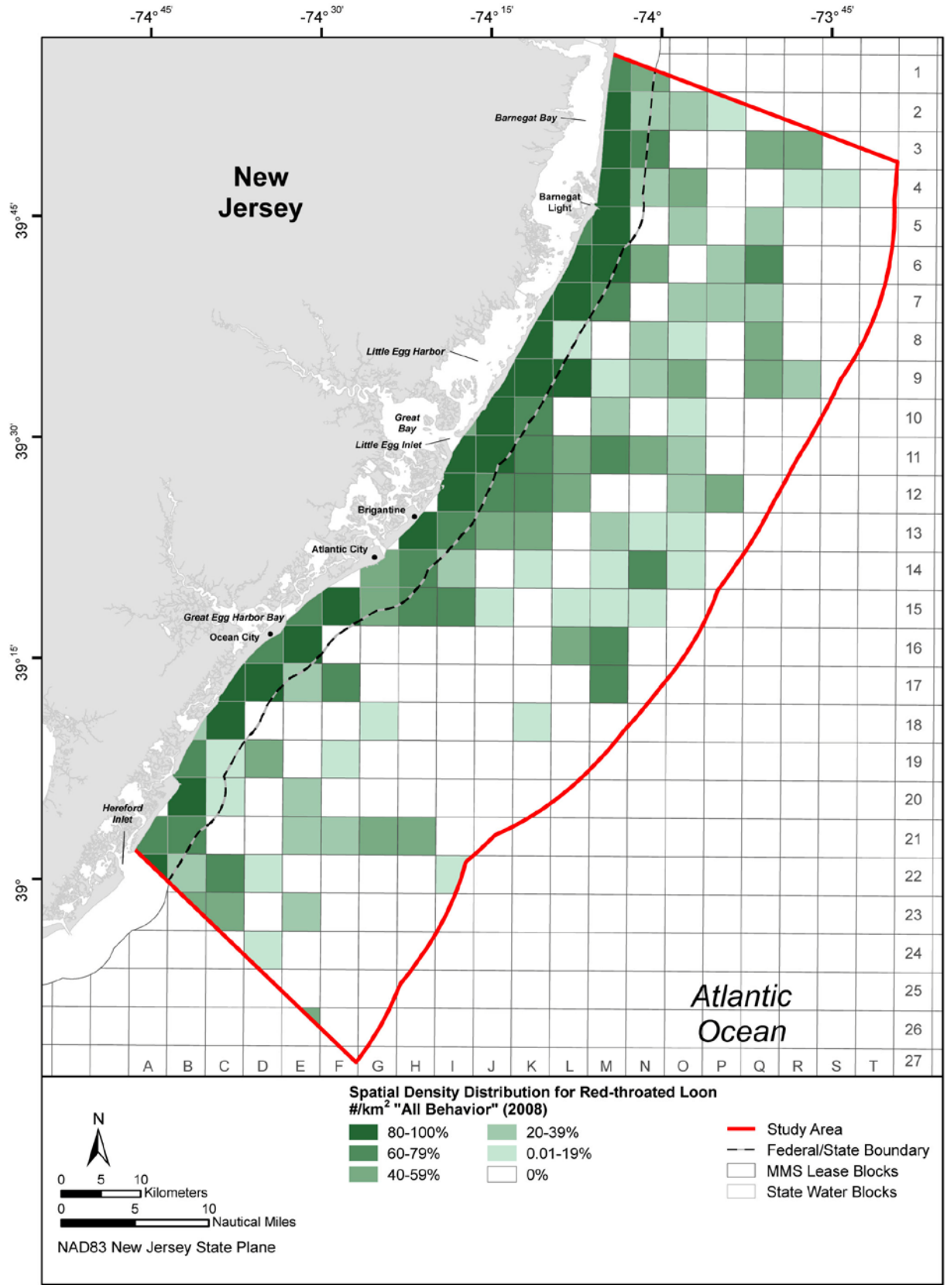

Figure C-393. Percentile abundance of Red-throated Loon (all behaviors), January-December 2008 (n=1,359).

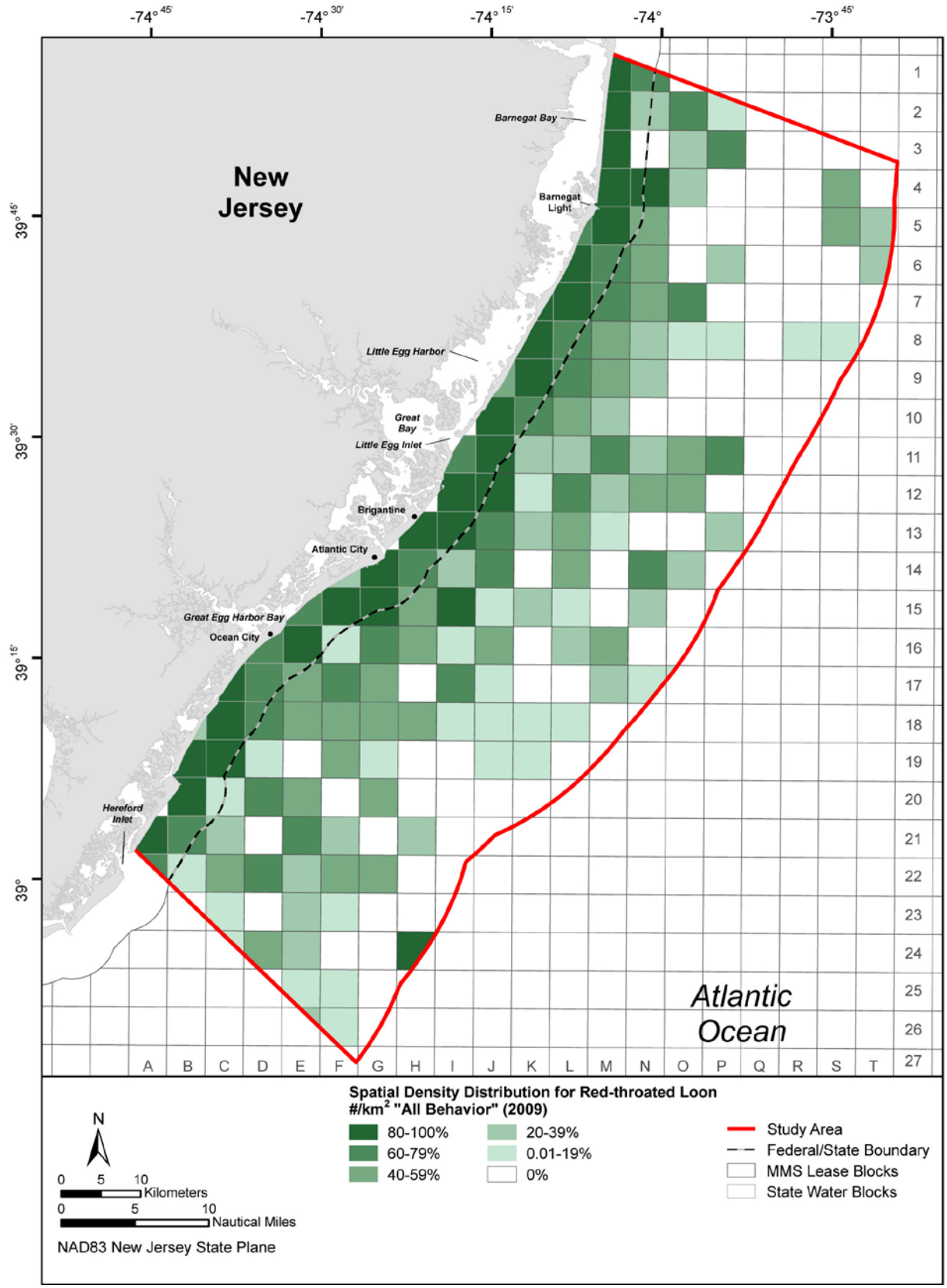

Figure C-394. Percentile abundance of Red-throated Loon (all behaviors), January-December 2009 (n=1,234).

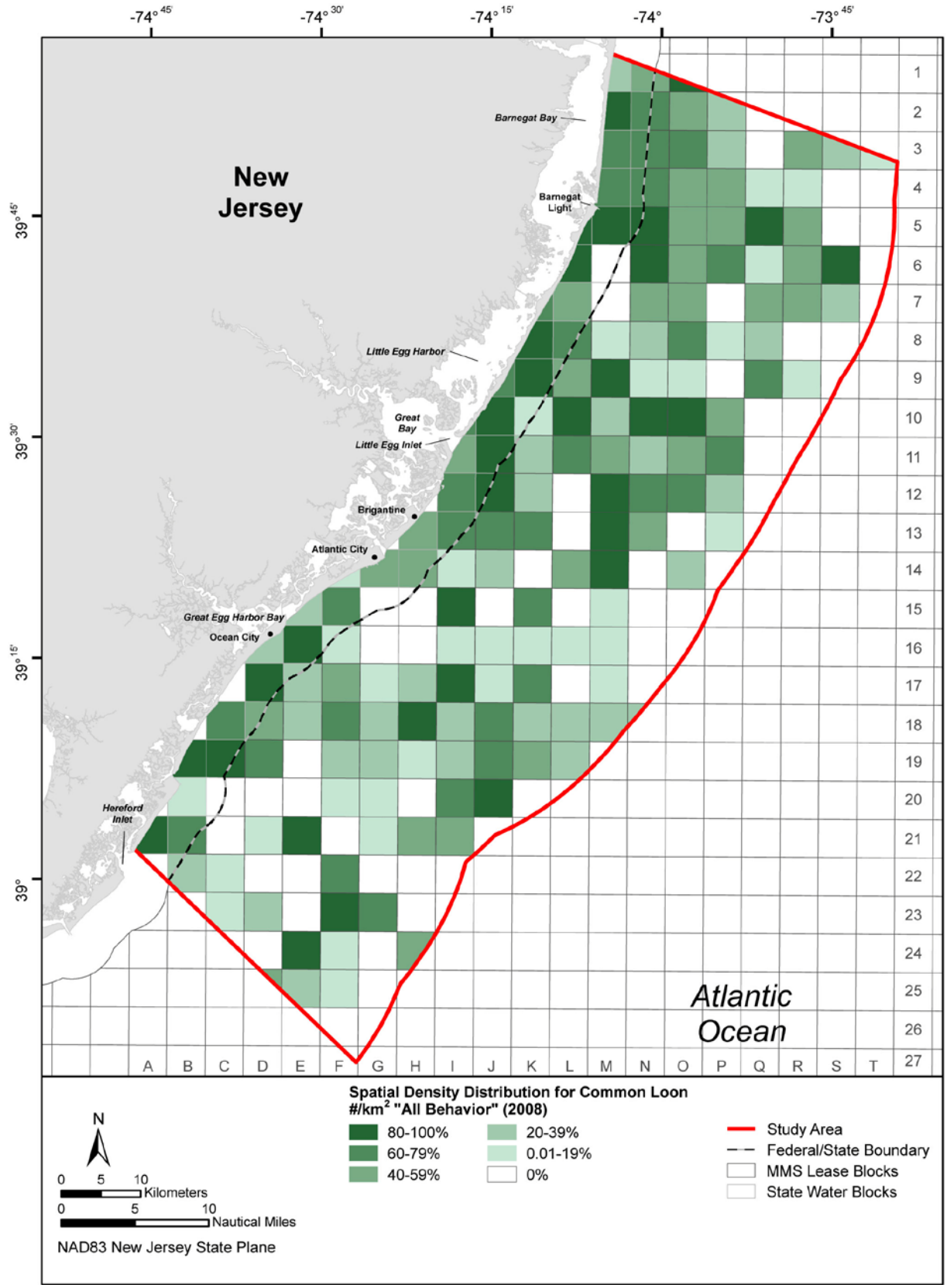

Figure C-395. Percentile abundance of Common Loon (all behaviors), January-December 2008 (n=689).

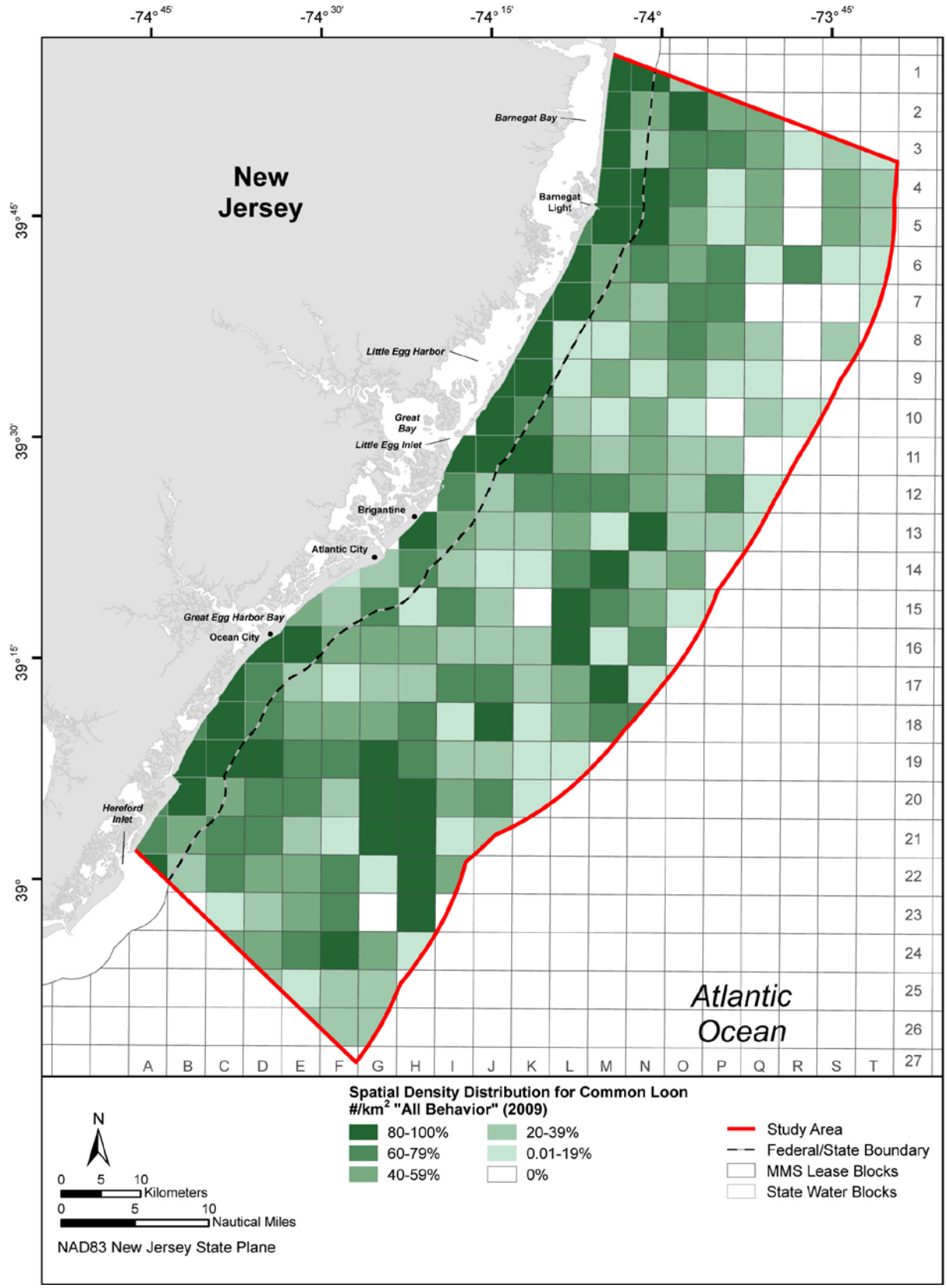

Figure C-396. Percentile abundance of Common Loon (all behaviors), January-December 2009 (n=2,353).

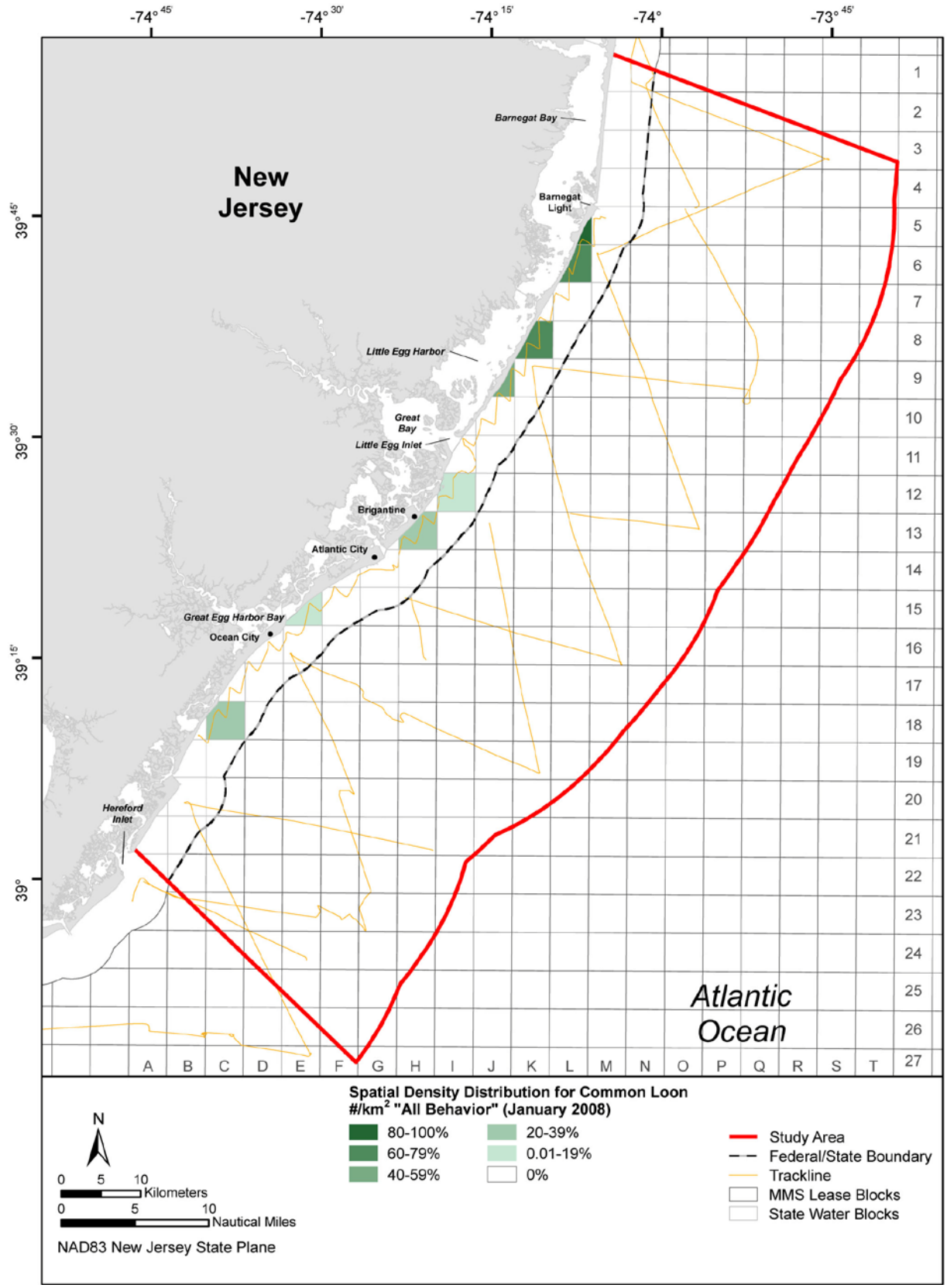

Figure C-397. Percentile abundance of Common Loon (all behaviors), January 2008 (n=22).

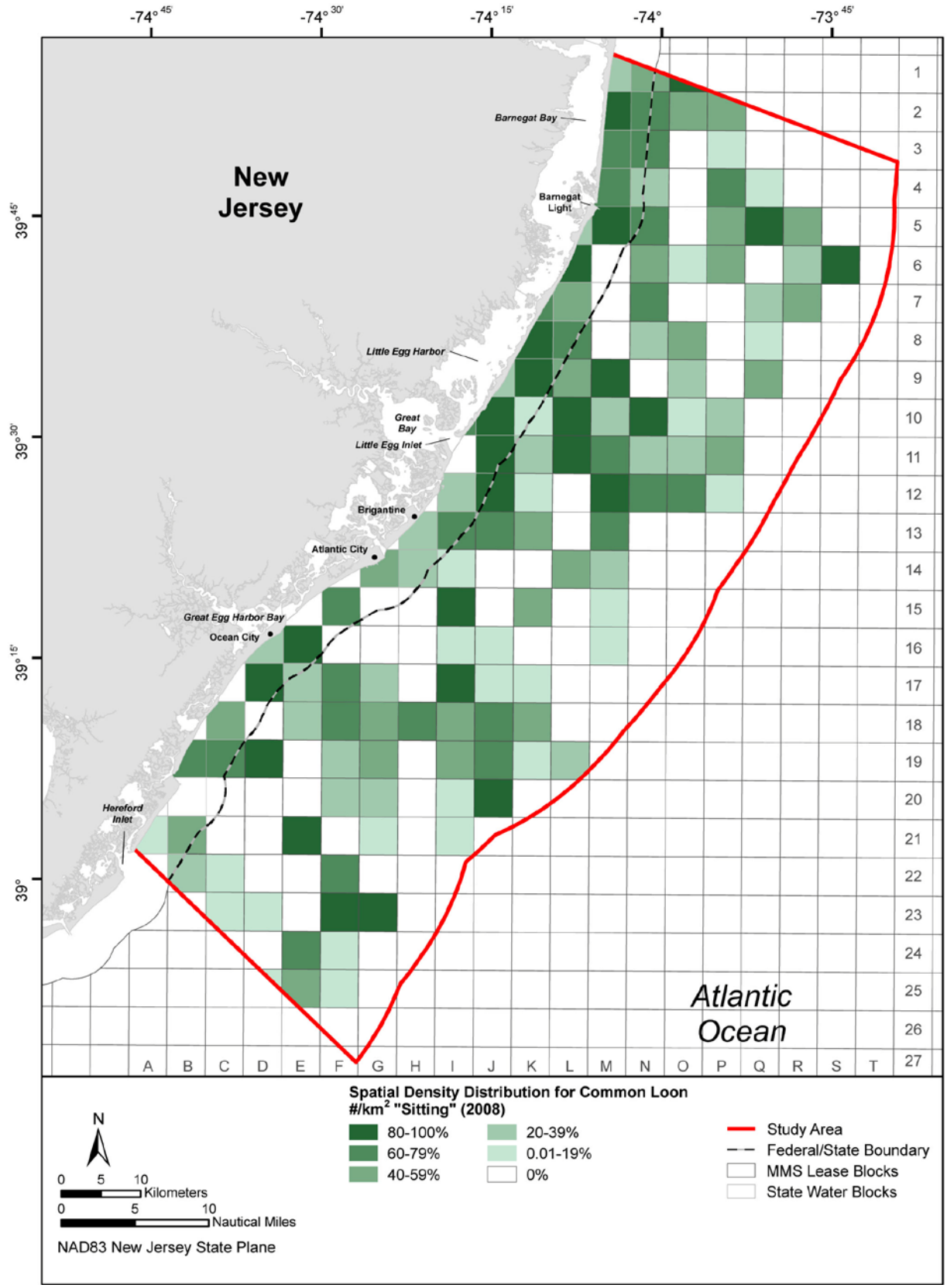

Figure C-398. Percentile abundance of Common Loon (sitting), January-December 2008 (n=444).

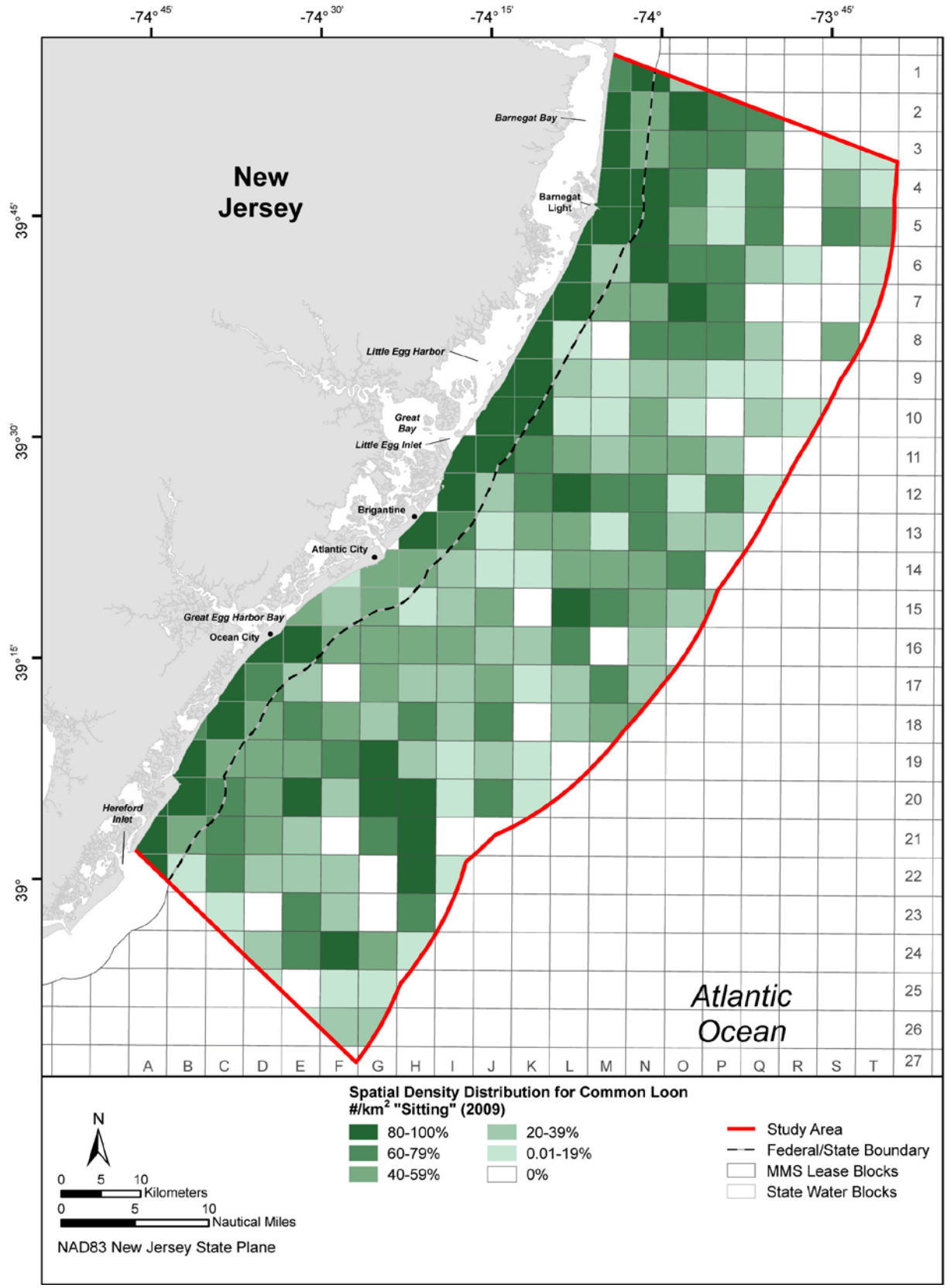

Figure C-399. Percentile abundance of Common Loon (sitting), January-December 2009 (n=1,813).

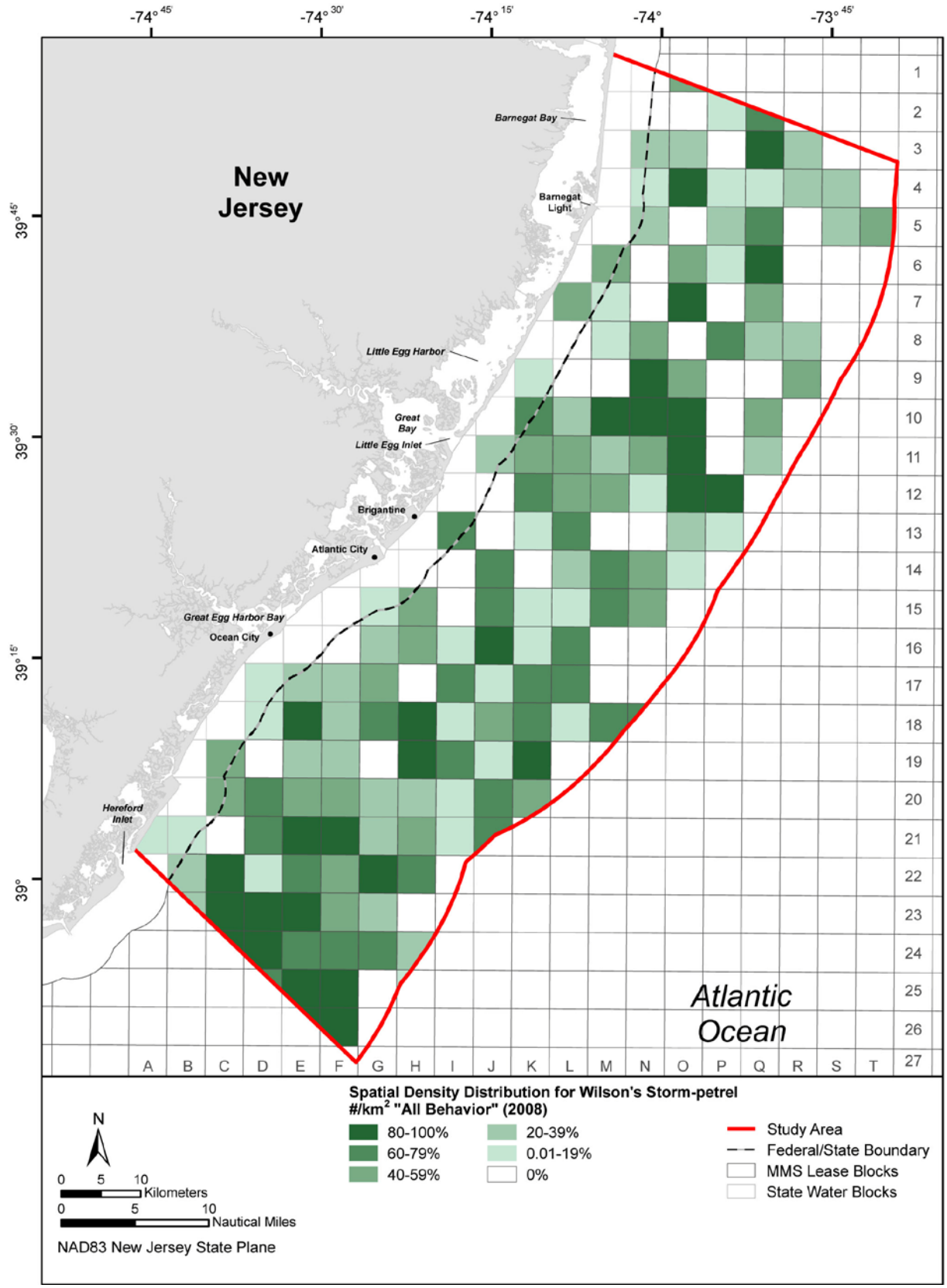

Figure C-400. Percentile abundance of Wilson's Storm-Petrel (all behaviors), January-December 2008 (n=1,656).

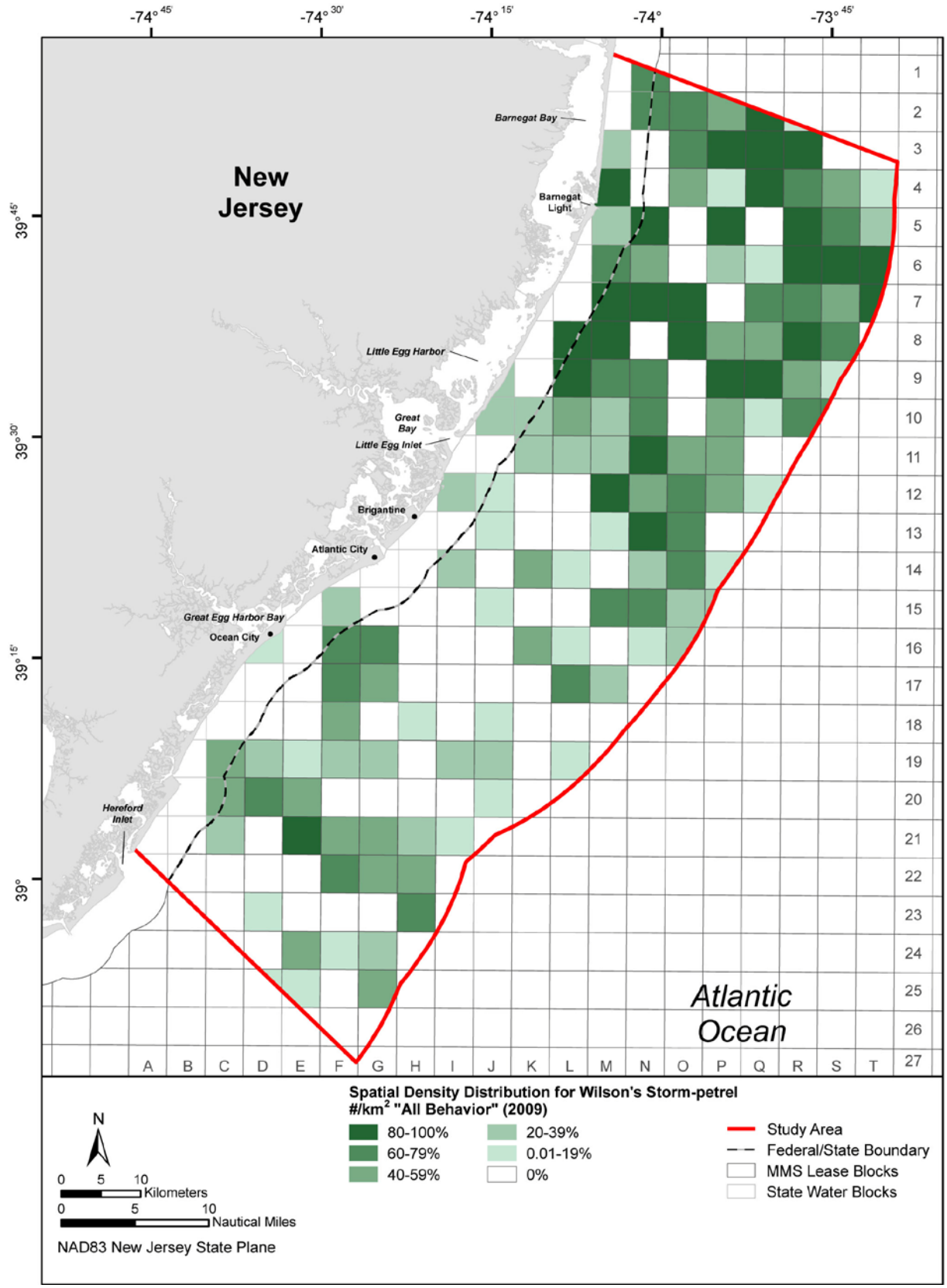

Figure C-401. Percentile abundance of Wilson's Storm-Petrel (all behaviors), January-December 2009 (n=683).

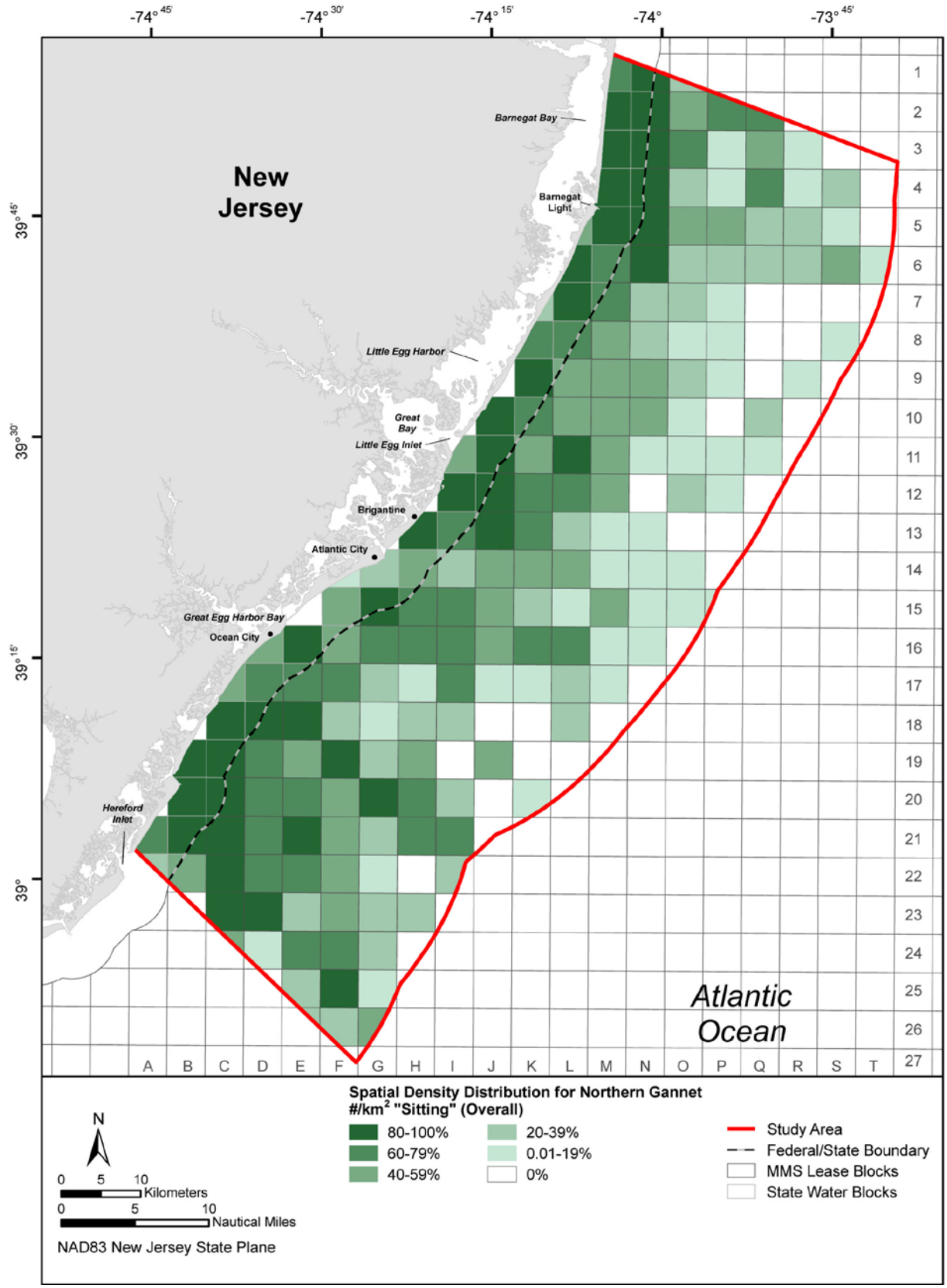

Figure C-402. Percentile abundance of Northern Gannet (sitting), January 2008-December 2009 (n=3,184).

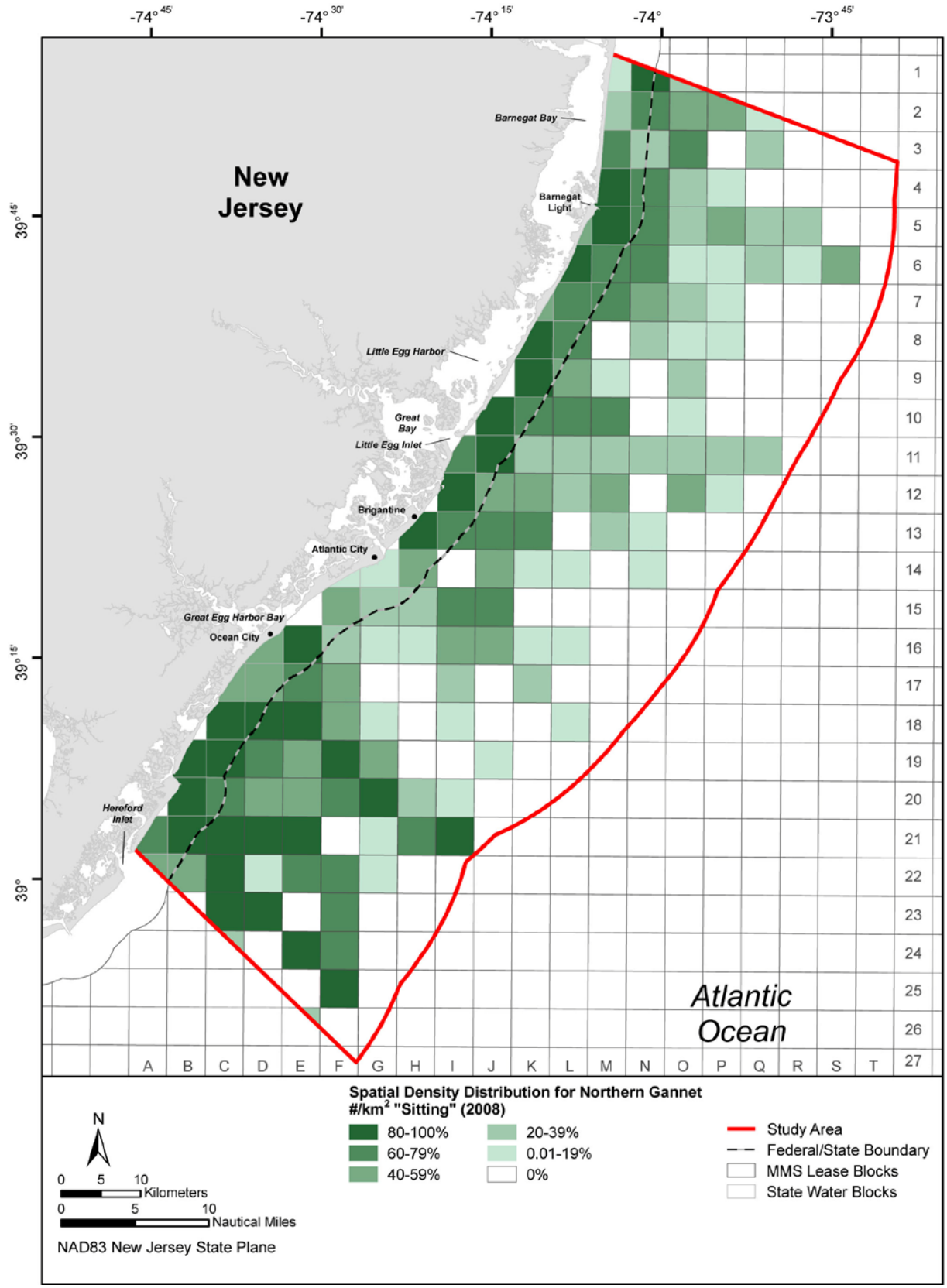

Figure C-403. Percentile abundance of Northern Gannet (sitting), January-December 2008 (n=1,347).

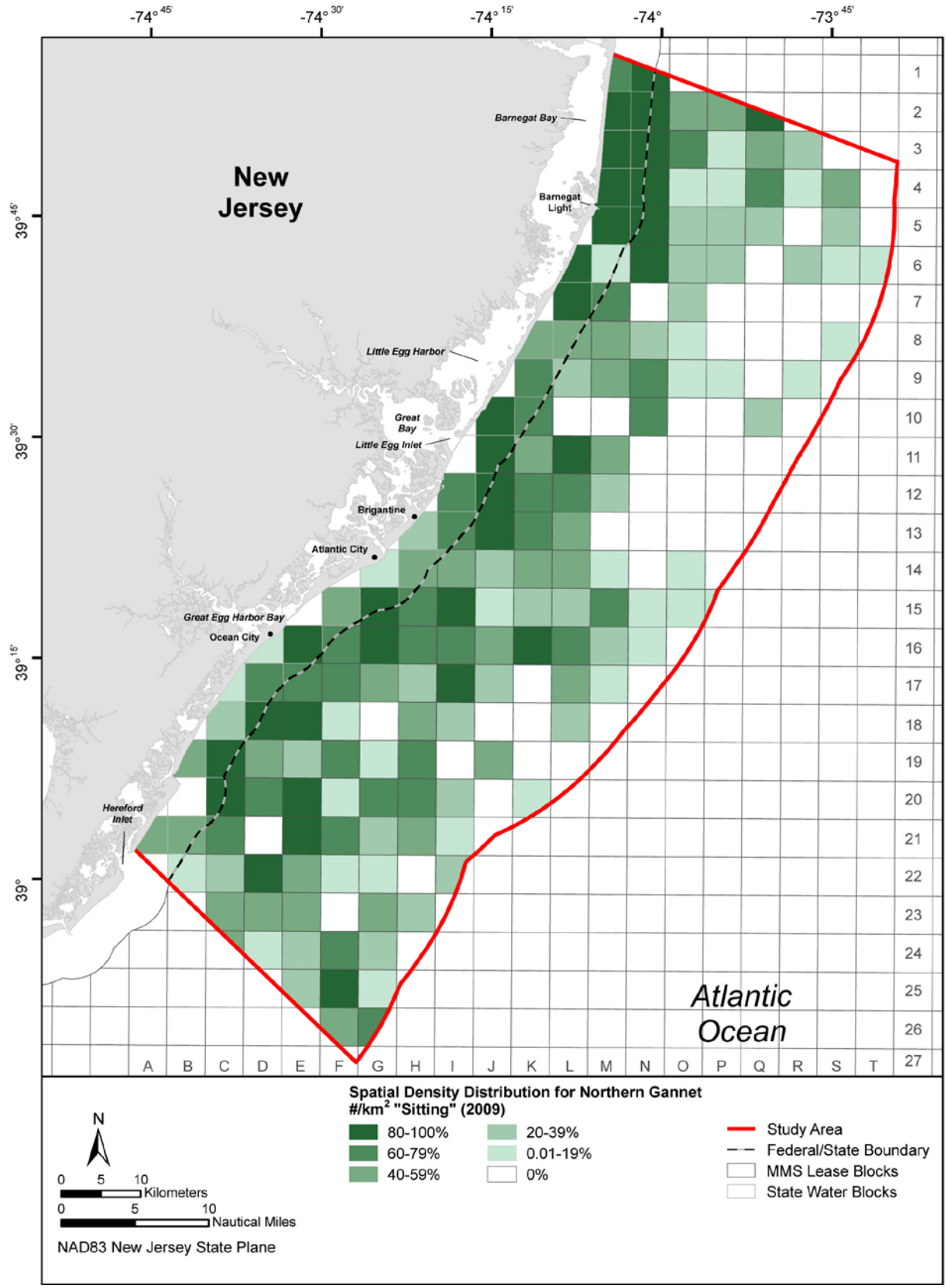

Figure C-404. Percentile abundance of Northern Gannet (sitting), January-December 2009 (n=1,837).

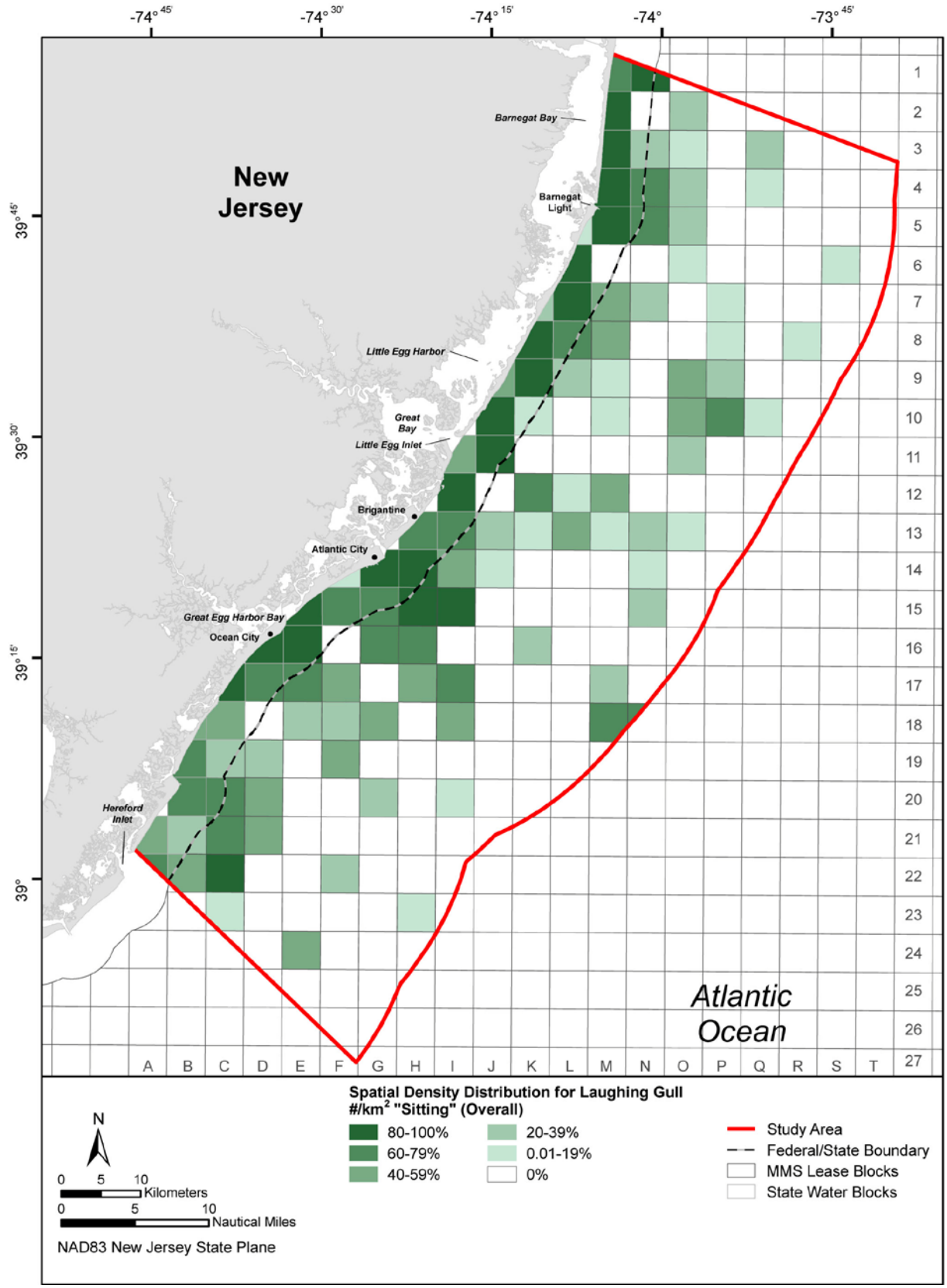

Figure C-405. Percentile abundance of Laughing Gull (sitting), January 2008-December 2009 (n=2,215).

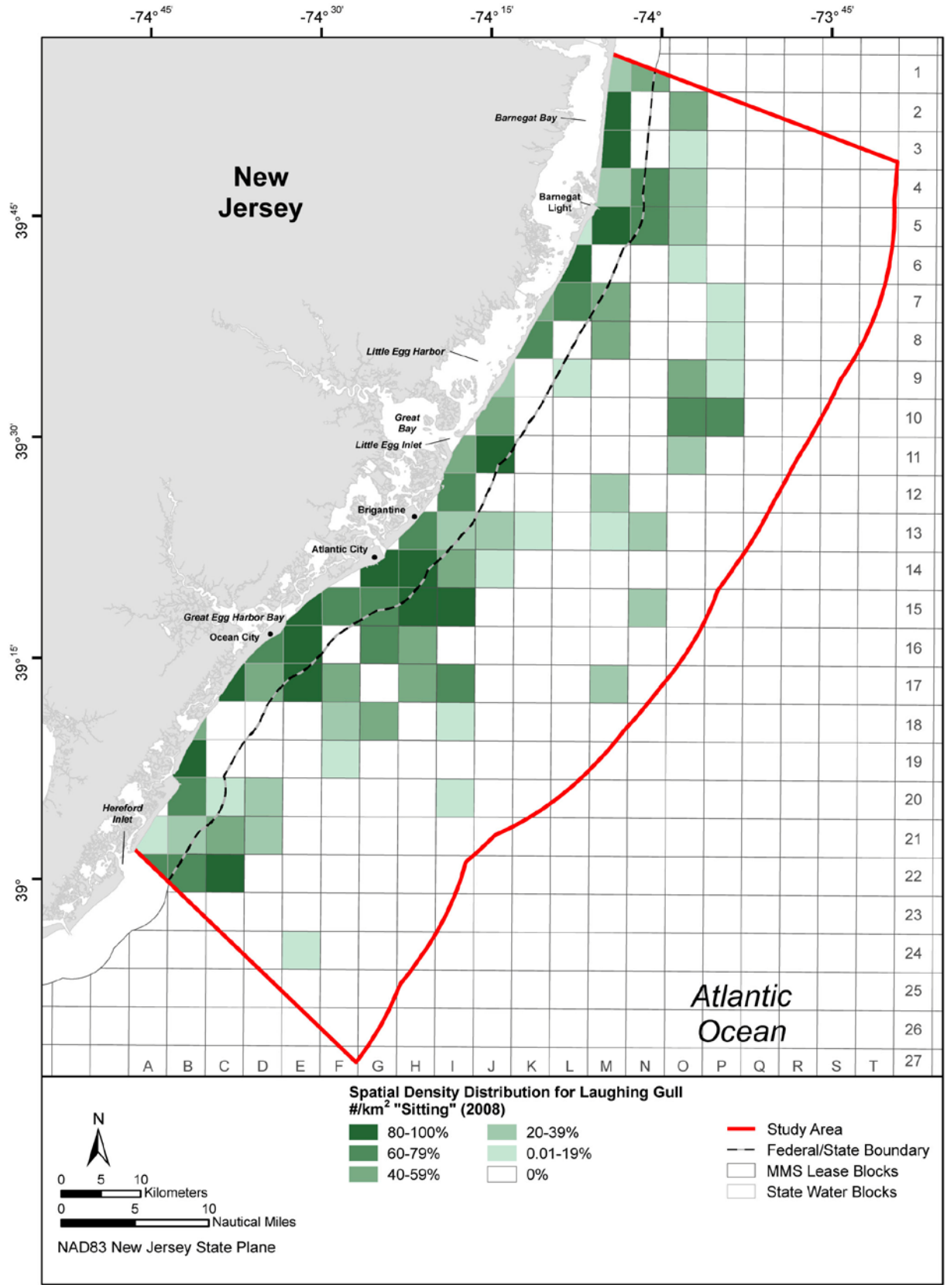

Figure C-406. Percentile abundance of Laughing Gull (sitting), January-December 2008 (n=1,510).

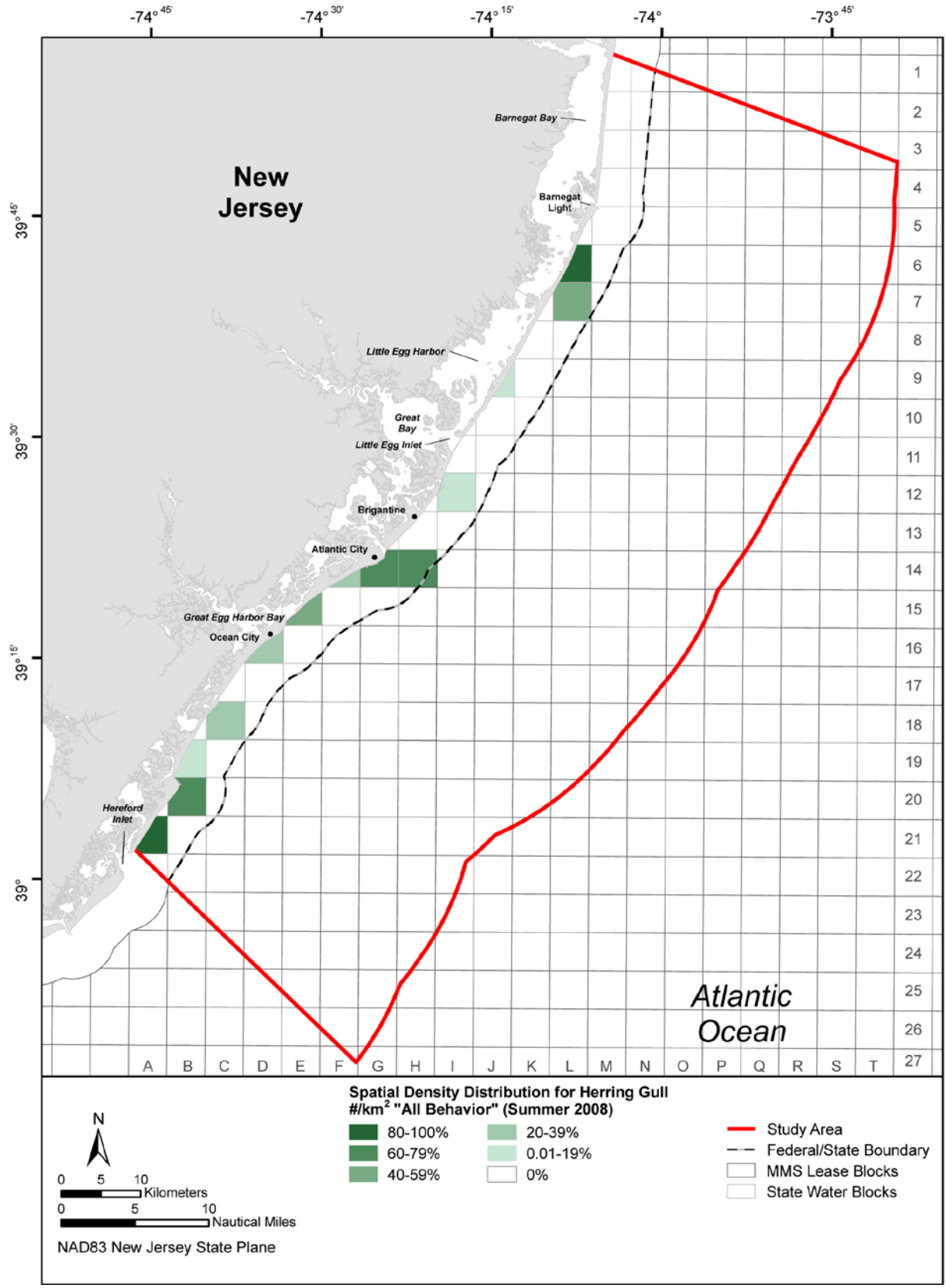

Figure C-407. Percentile abundance of Herring Gull (all behaviors), Summer 2008 (June-July 2008) (n=19).

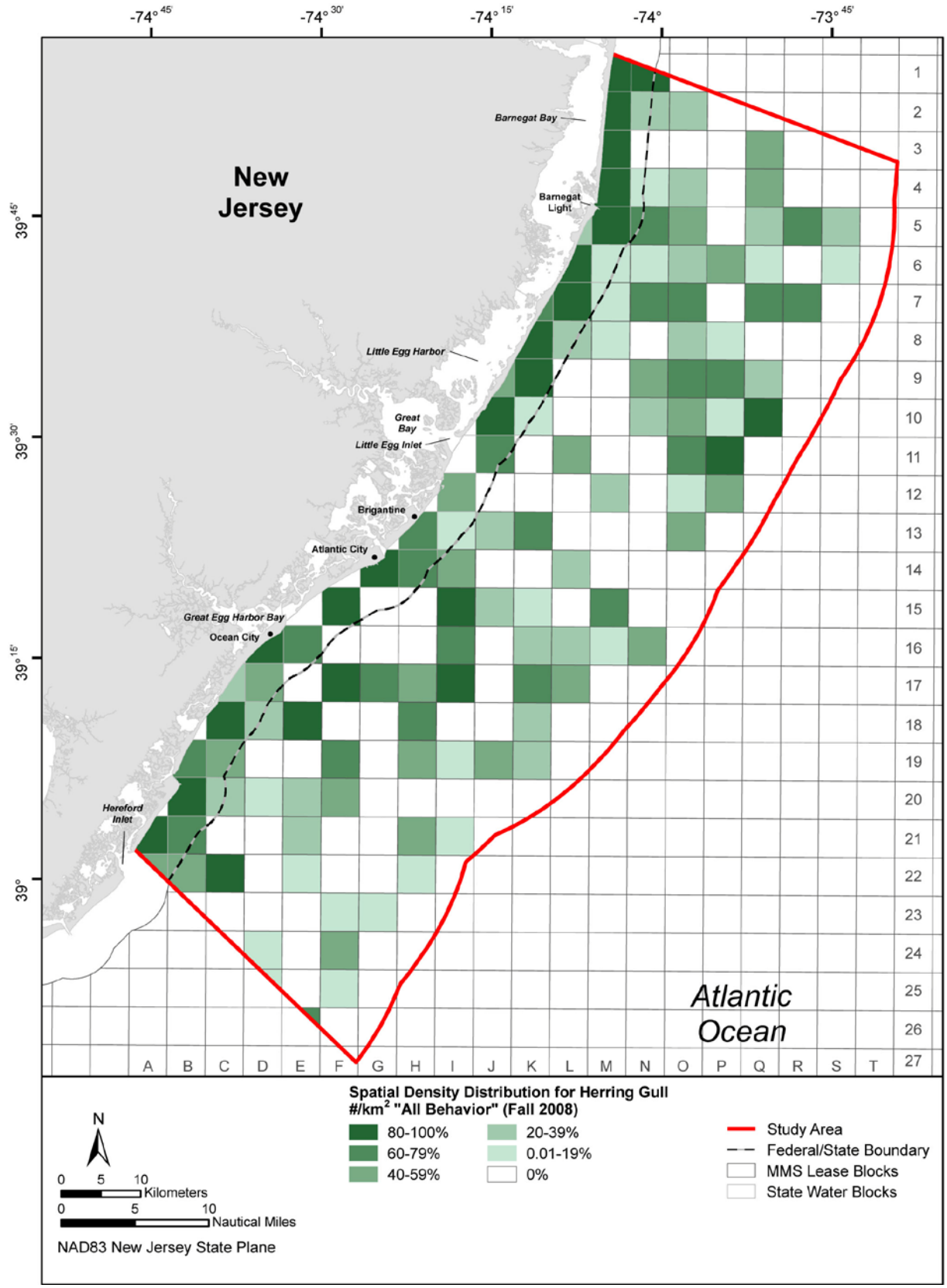

Figure C-408. Percentile abundance of Herring Gull (all behaviors), Fall 2008 (August-November 2008) (n=935).

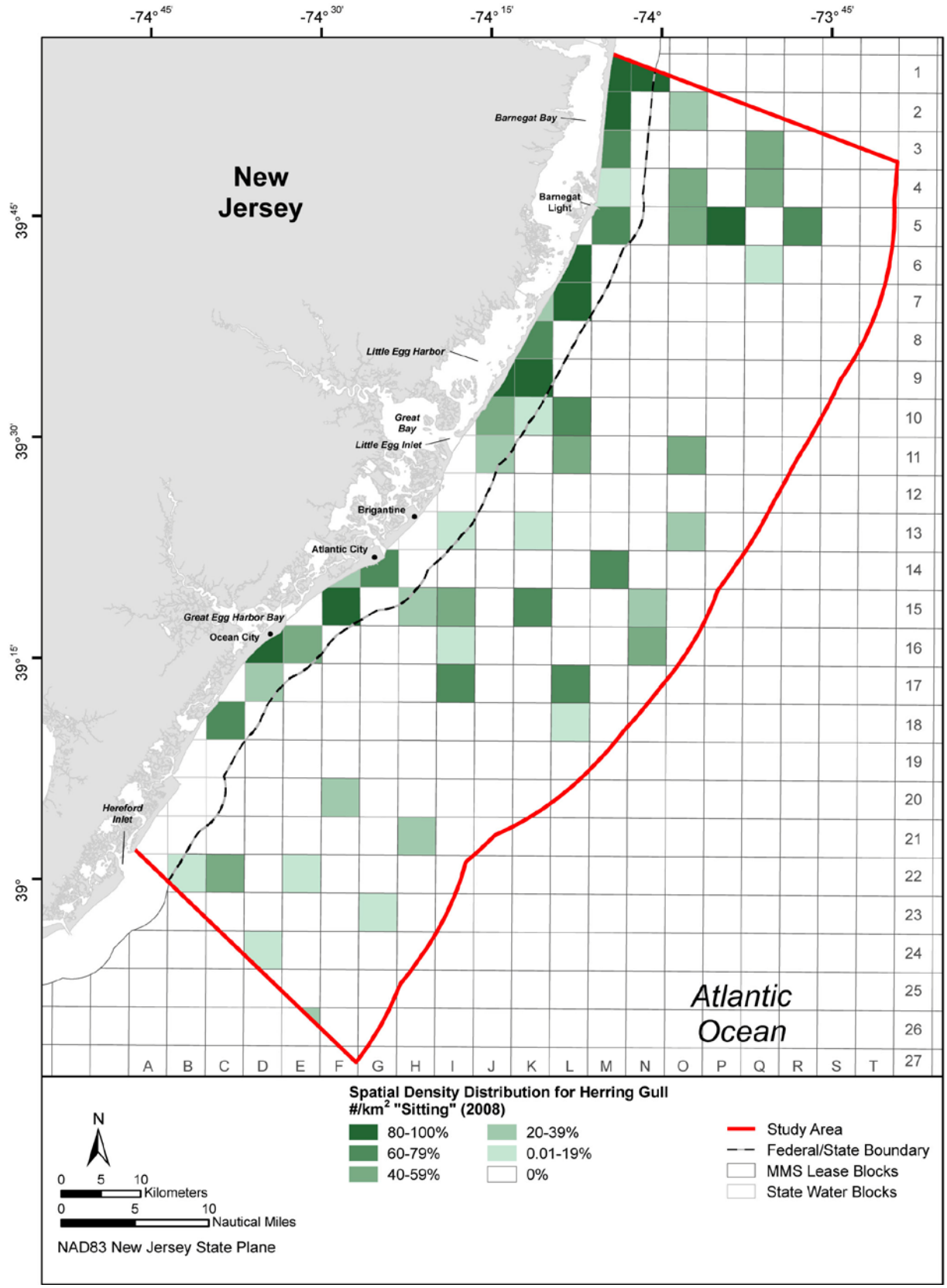

Figure C-409. Percentile abundance of Herring Gull (sitting), January-December 2008 (n=493).

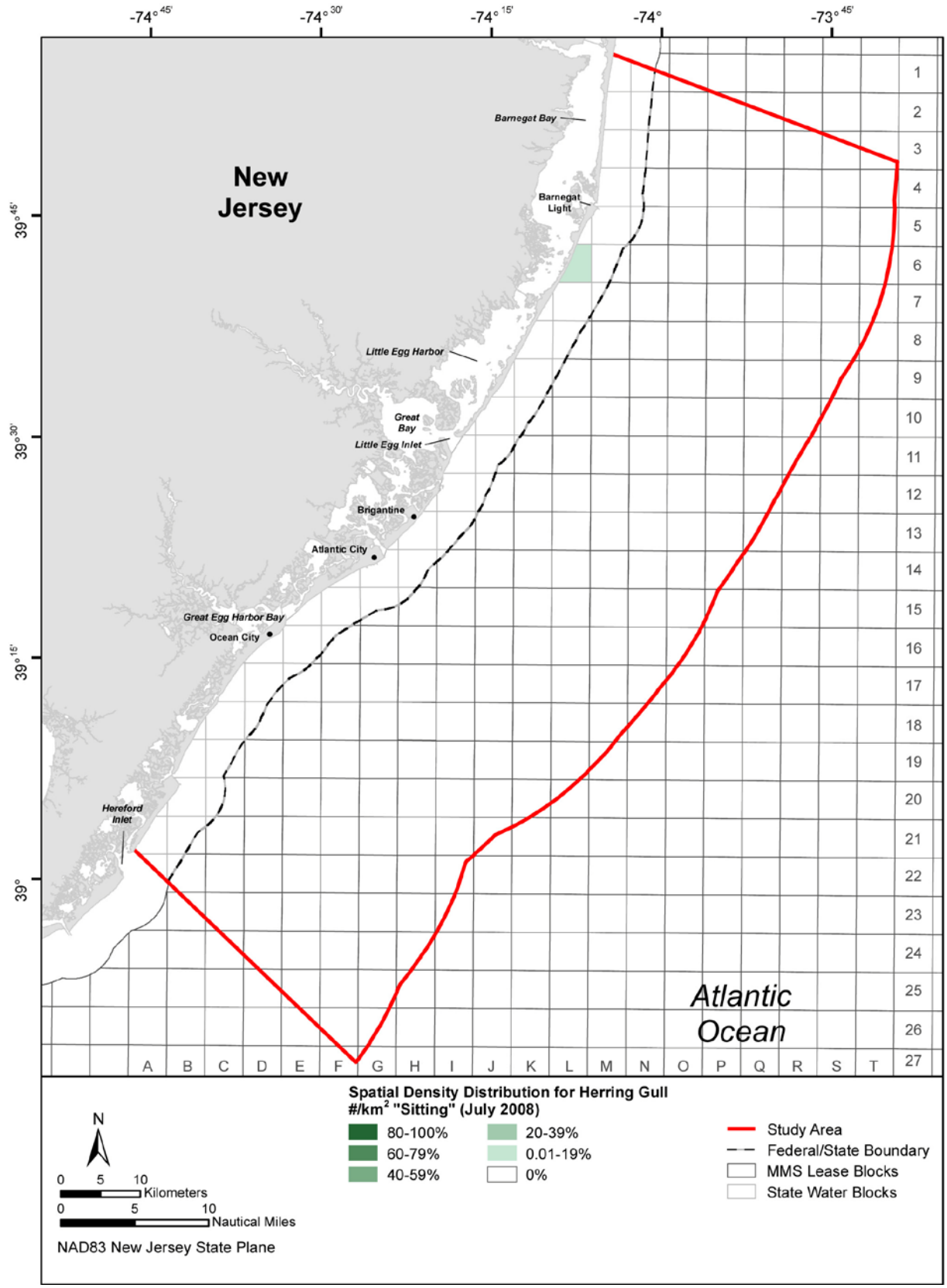

Figure C-410. Percentile abundance of Herring Gull (sitting), July 2008 (n=1).

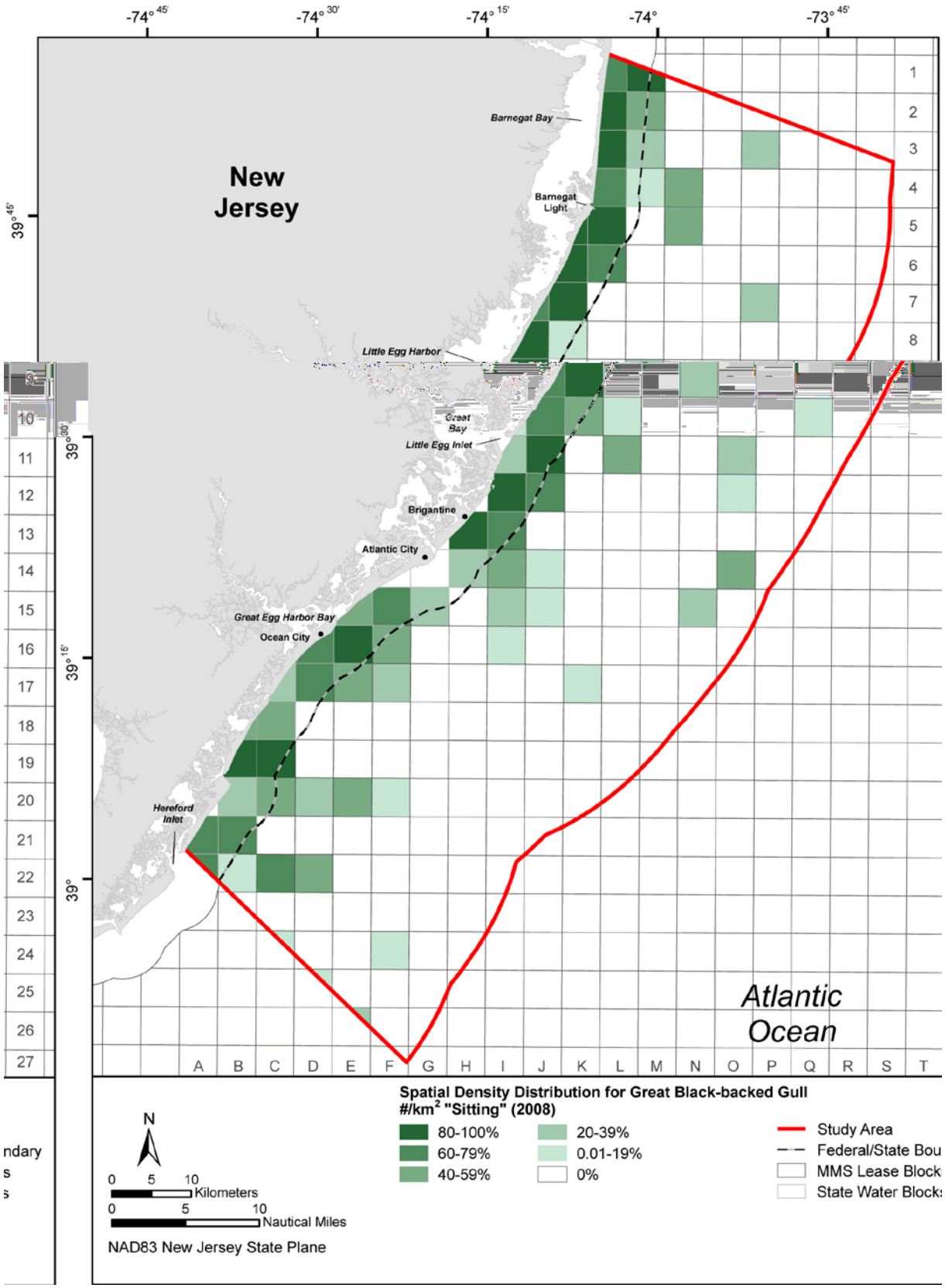

Figure C-411. Percentile abundance of Great Black-backed Gull (sitting), January-December 2008 (n=749).

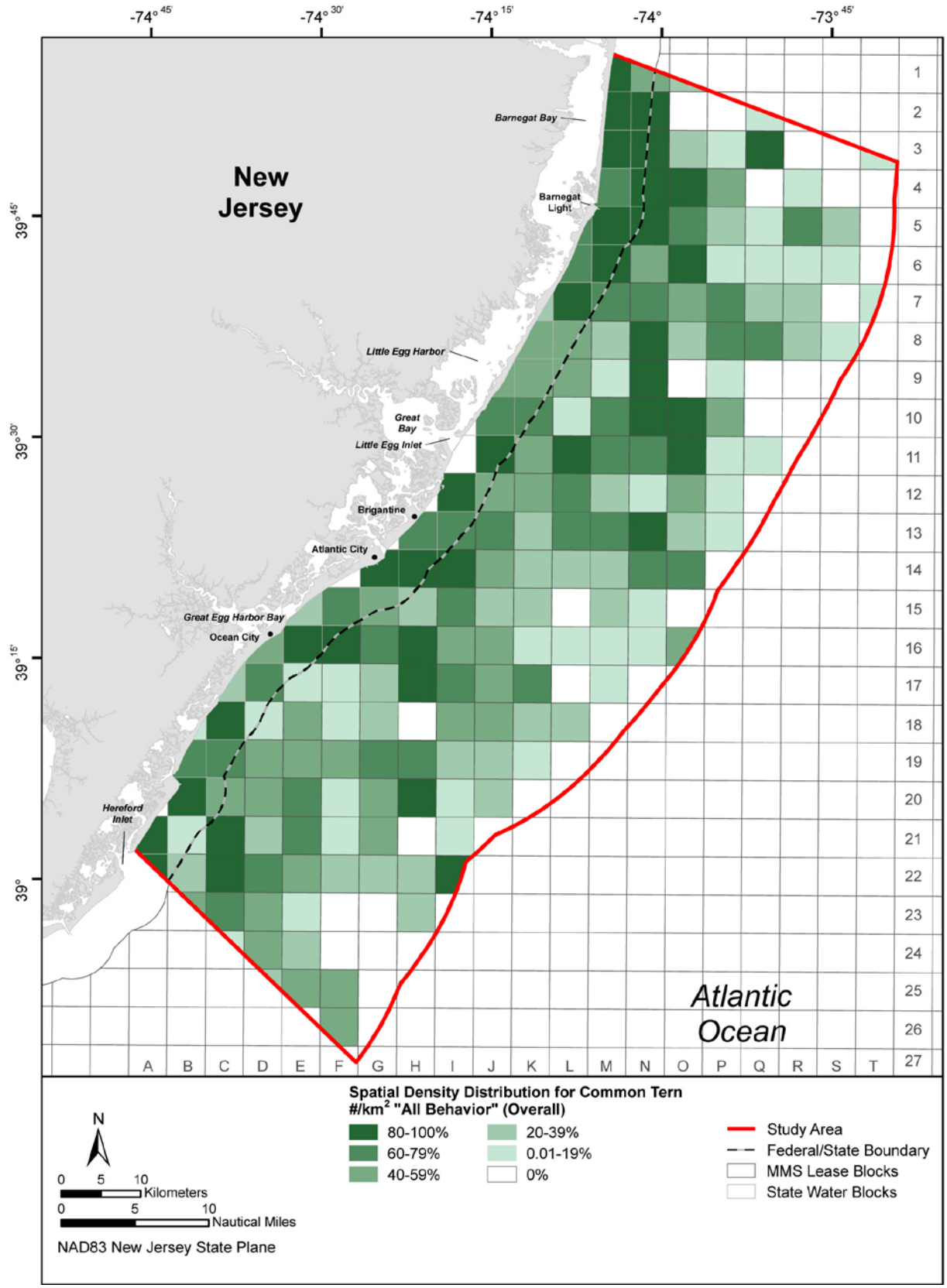

Figure C-412. Percentile abundance of Common Tern (all behaviors), January 2008-December 2009 (n=2,193).

APPENDIX D

AVIAN FLIGHT ALTITUDE HISTOGRAMS

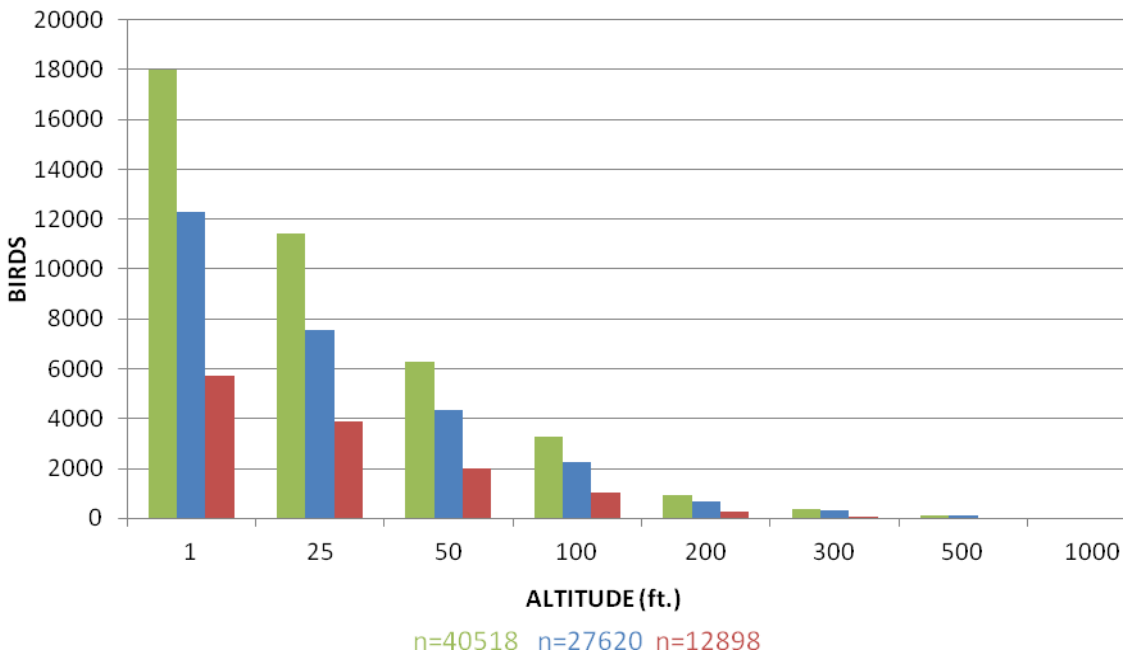

Figure D-1. Altitudinal distribution, all birds, offshore, January 2008-December 2009.

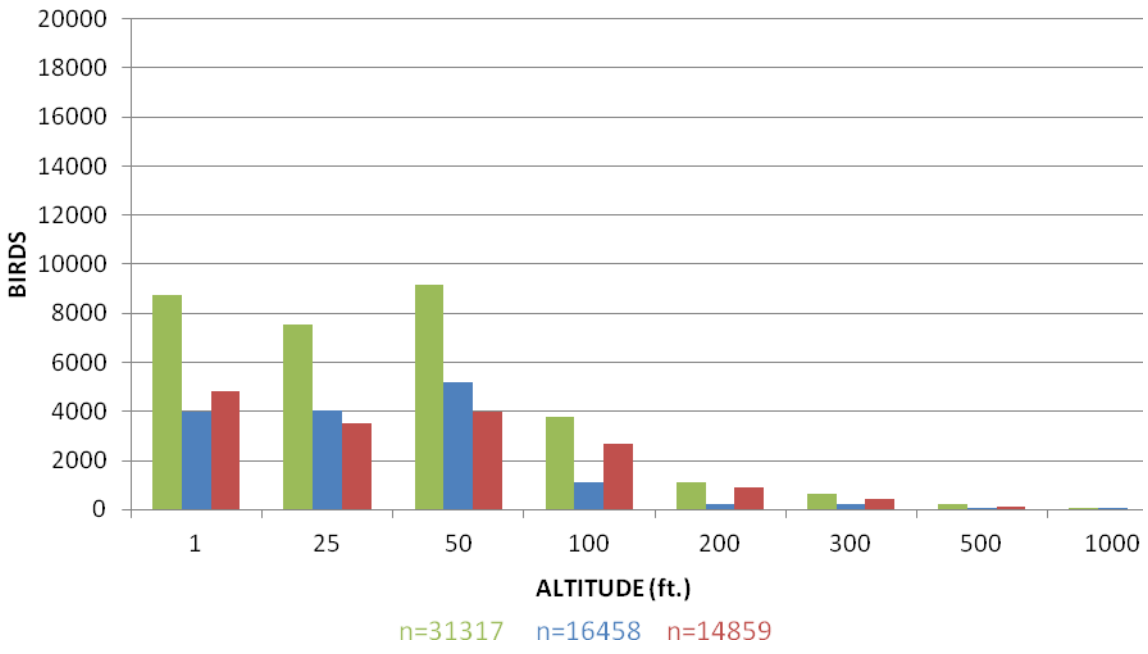

Figure D-2. Altitudinal distribution, all birds, coastal, January 2008-December 2009.

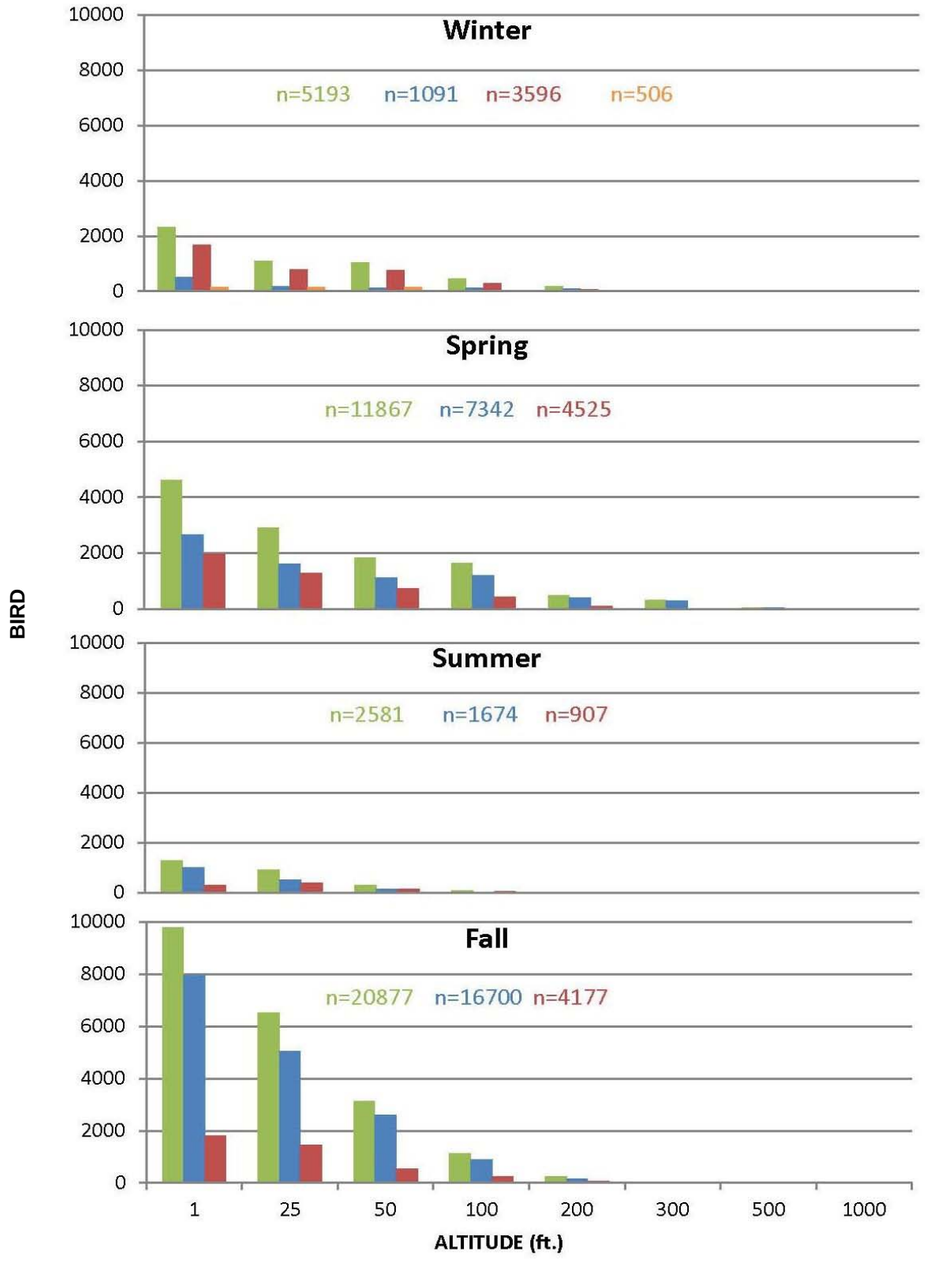

Figure D-3. Altitudinal distribution by season, all birds, offshore, January 2008-December 2009.

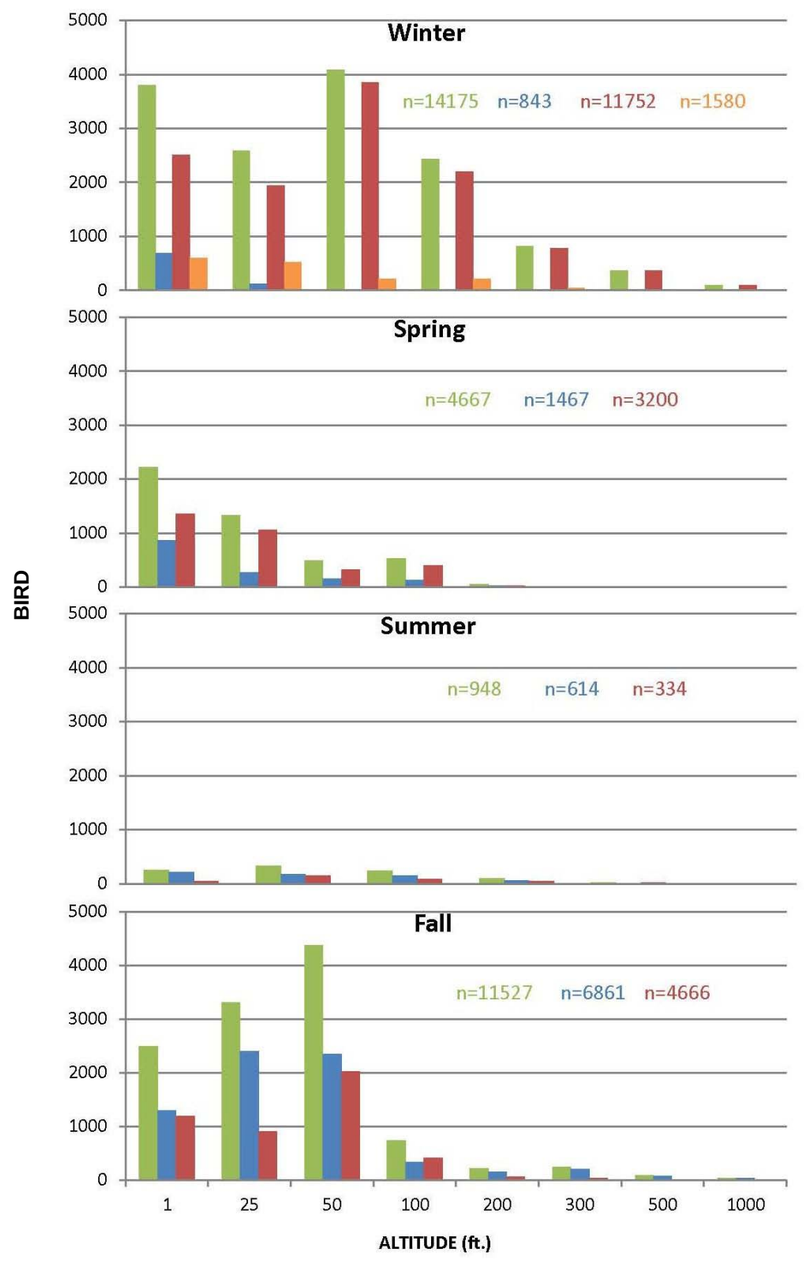

Figure D-4. Altitudinal distribution by season, all birds, coastal, January 2008-December 2009.

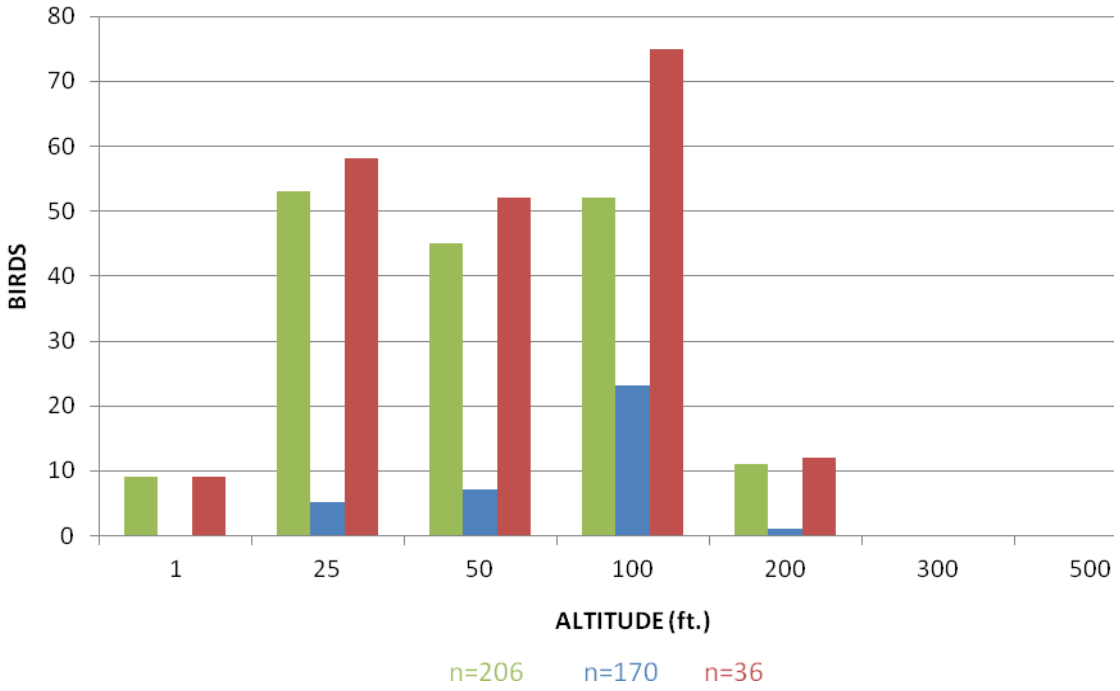

Figure D-5. Altitudinal distribution, dabbling ducks, offshore, January 2008-December 2009.

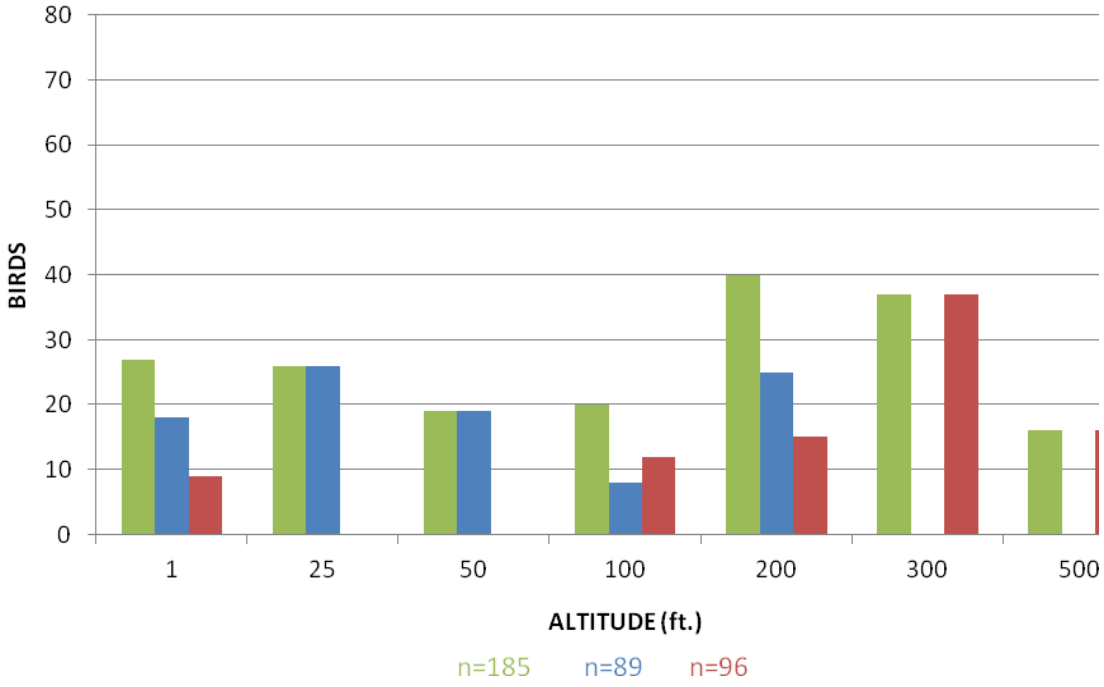

Figure D-6. Altitudinal distribution, dabbling ducks, coastal, January 2008-December 2009.

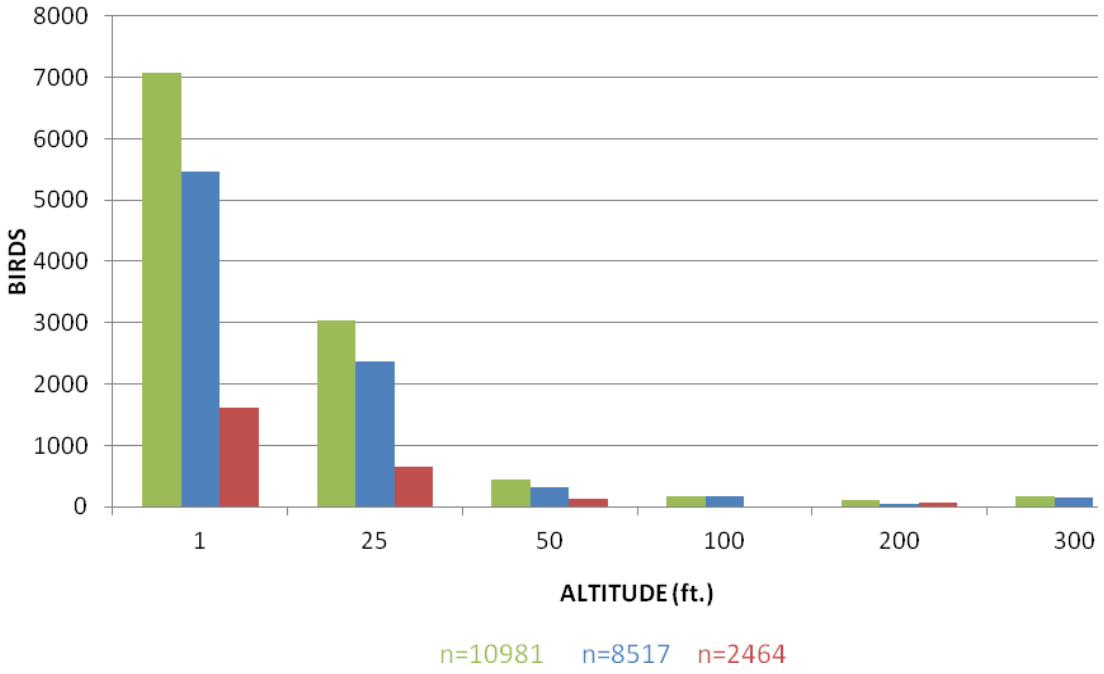

Figure D-7. Altitudinal distribution, scoters, offshore, January 2008-December 2009.

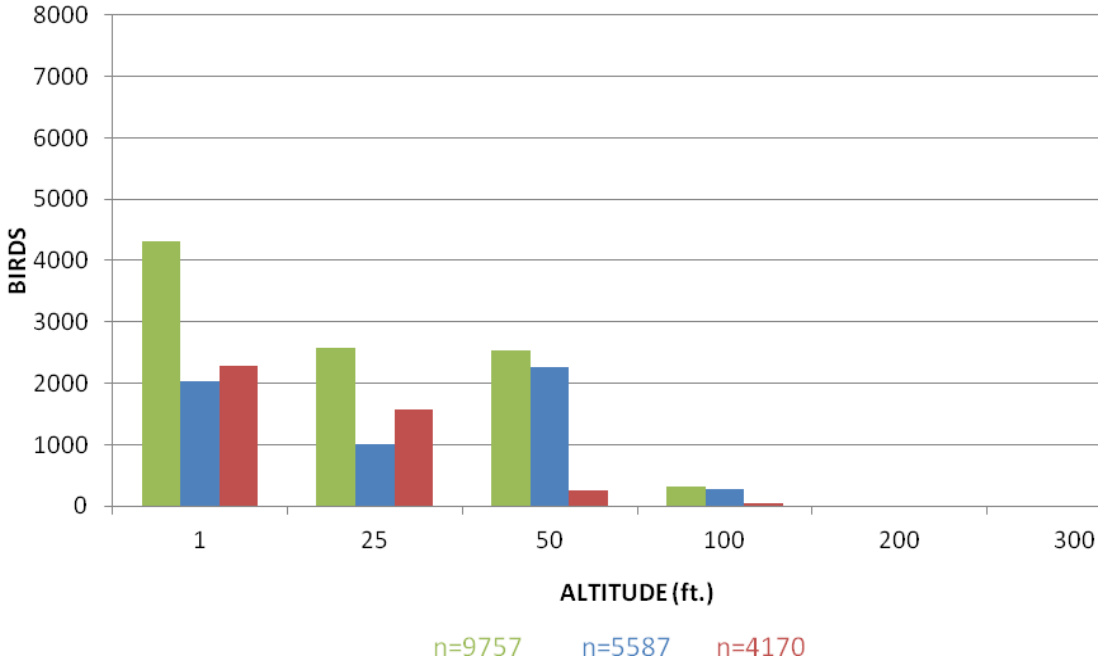

Figure D-8. Altitudinal distribution, scoters, coastal, January 2008-December 2009.

Total **2008** **2009**

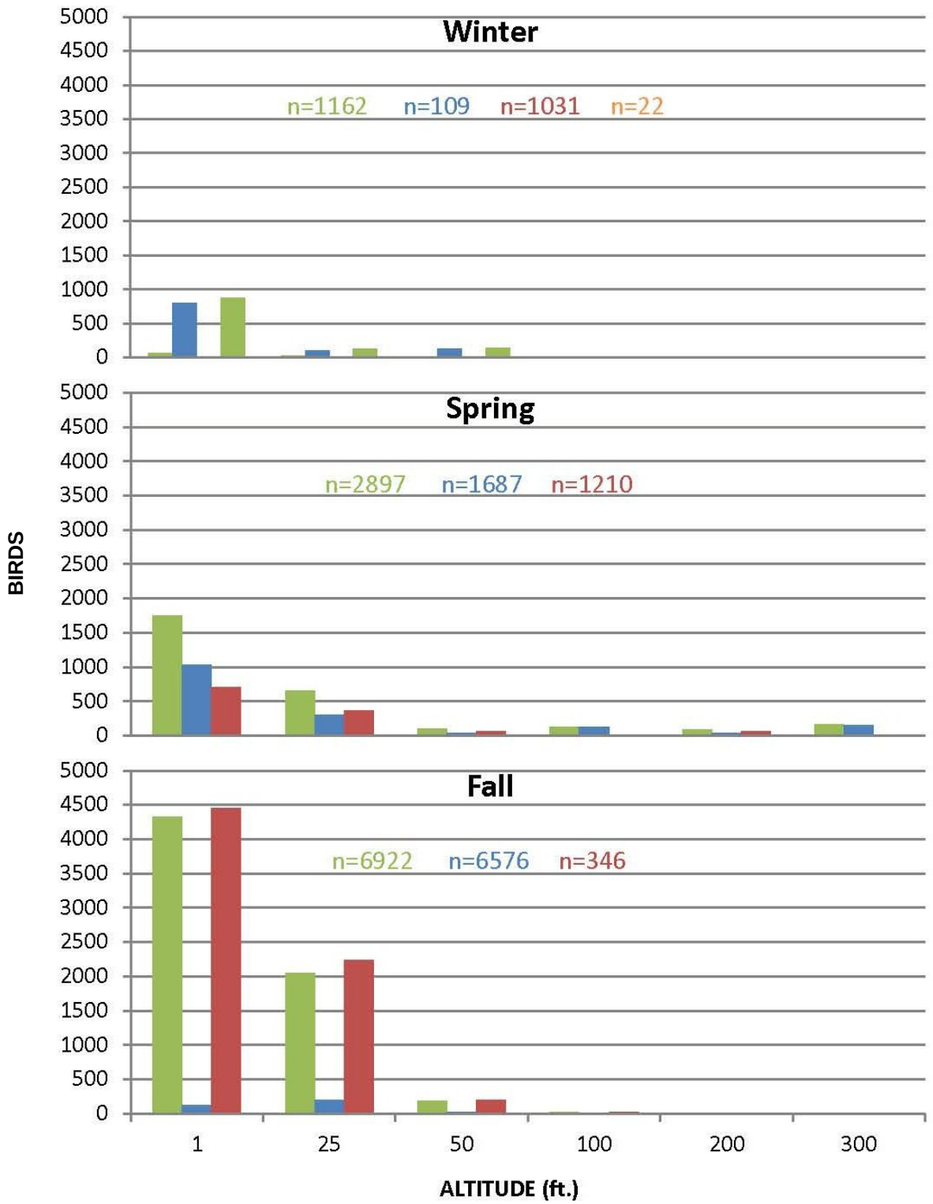

Figure D-9. Altitudinal distribution by season, scoters, offshore, January 2008-December 2009.

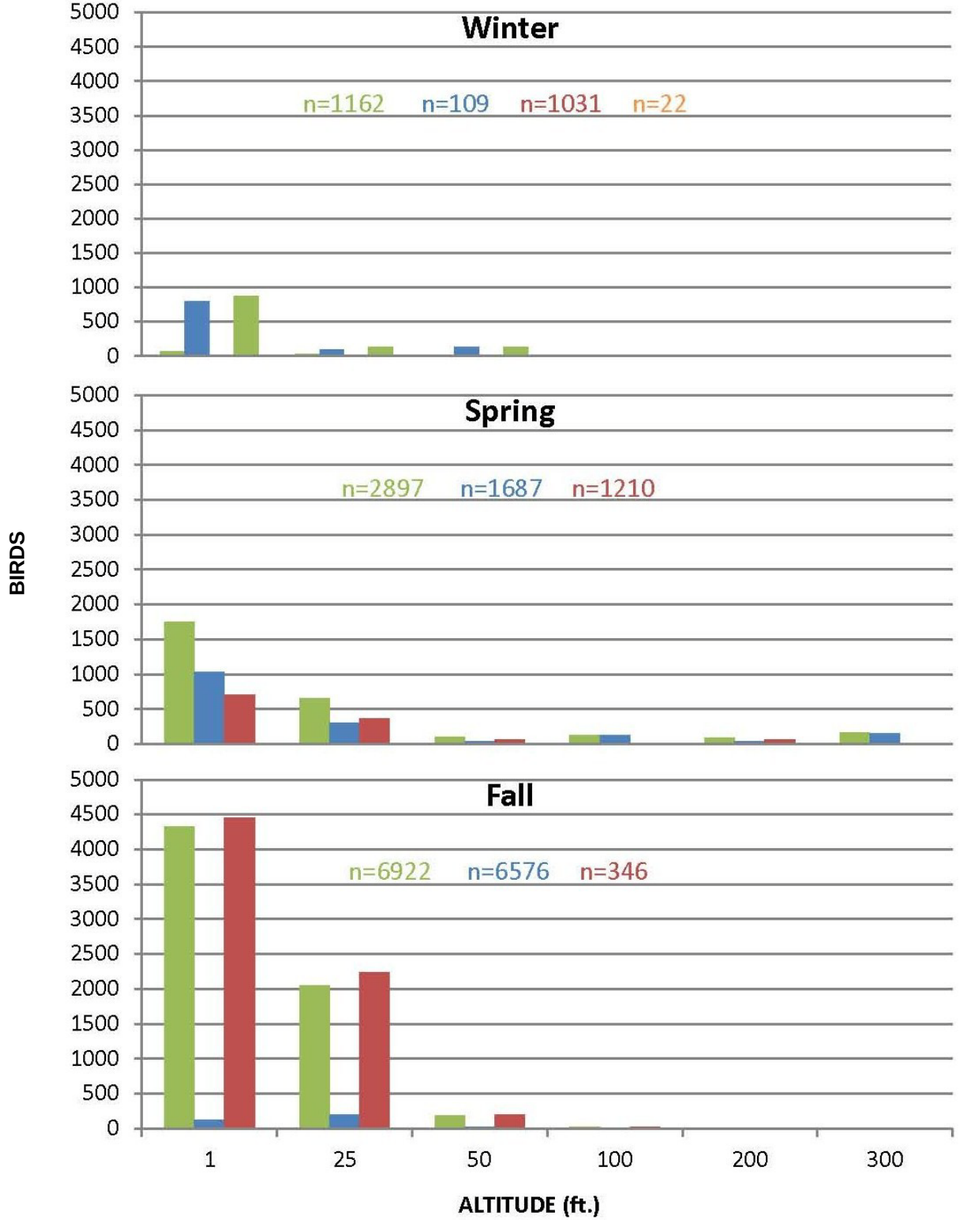

Figure D-10. Altitudinal distribution by season, scoters, coastal, January 2008-December 2009.

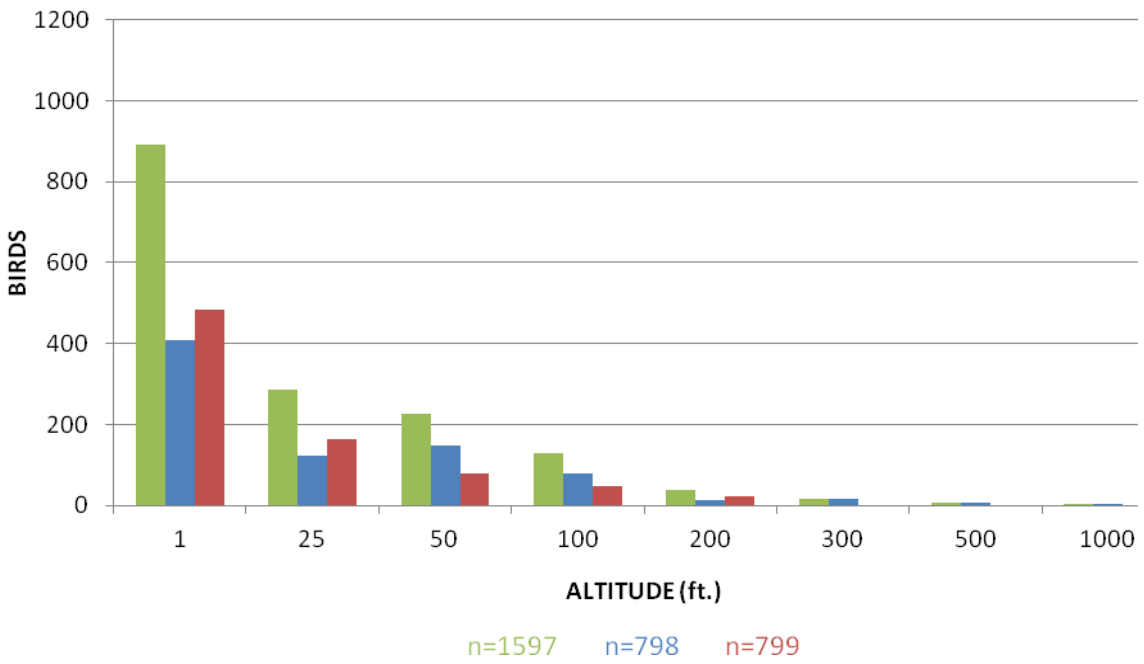

Figure D-11. Altitudinal distribution, Red-throated Loon, offshore, January 2008-December 2009.

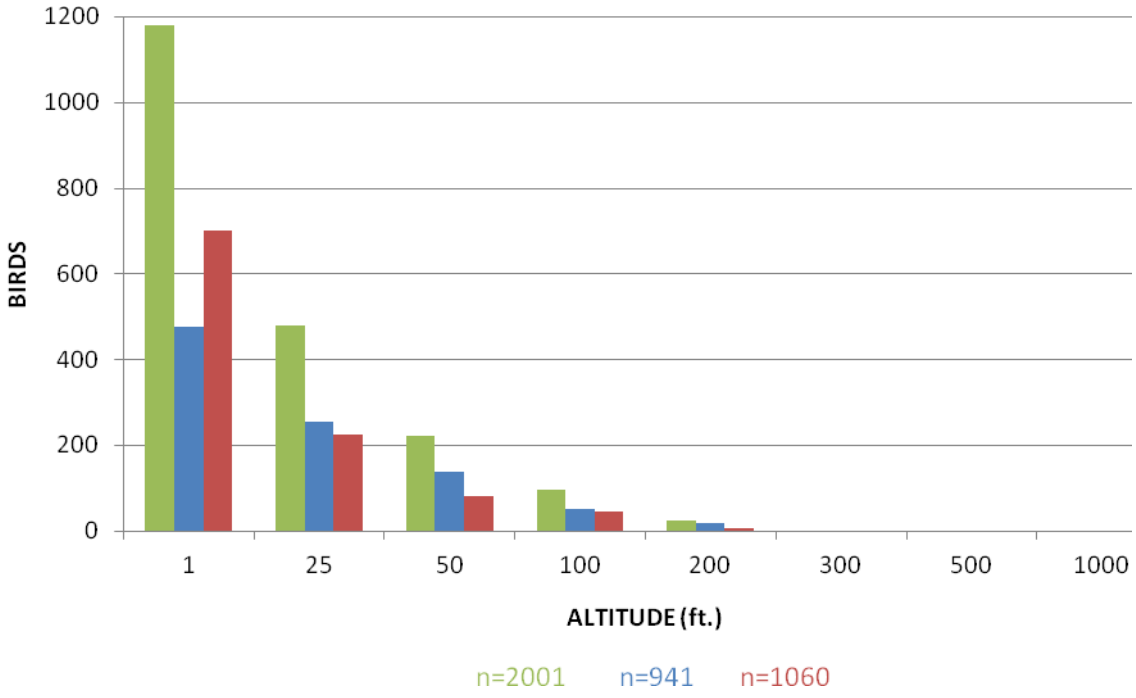

Figure D-12. Altitudinal distribution, Red-throated Loon, coastal, January 2008-December 2009.

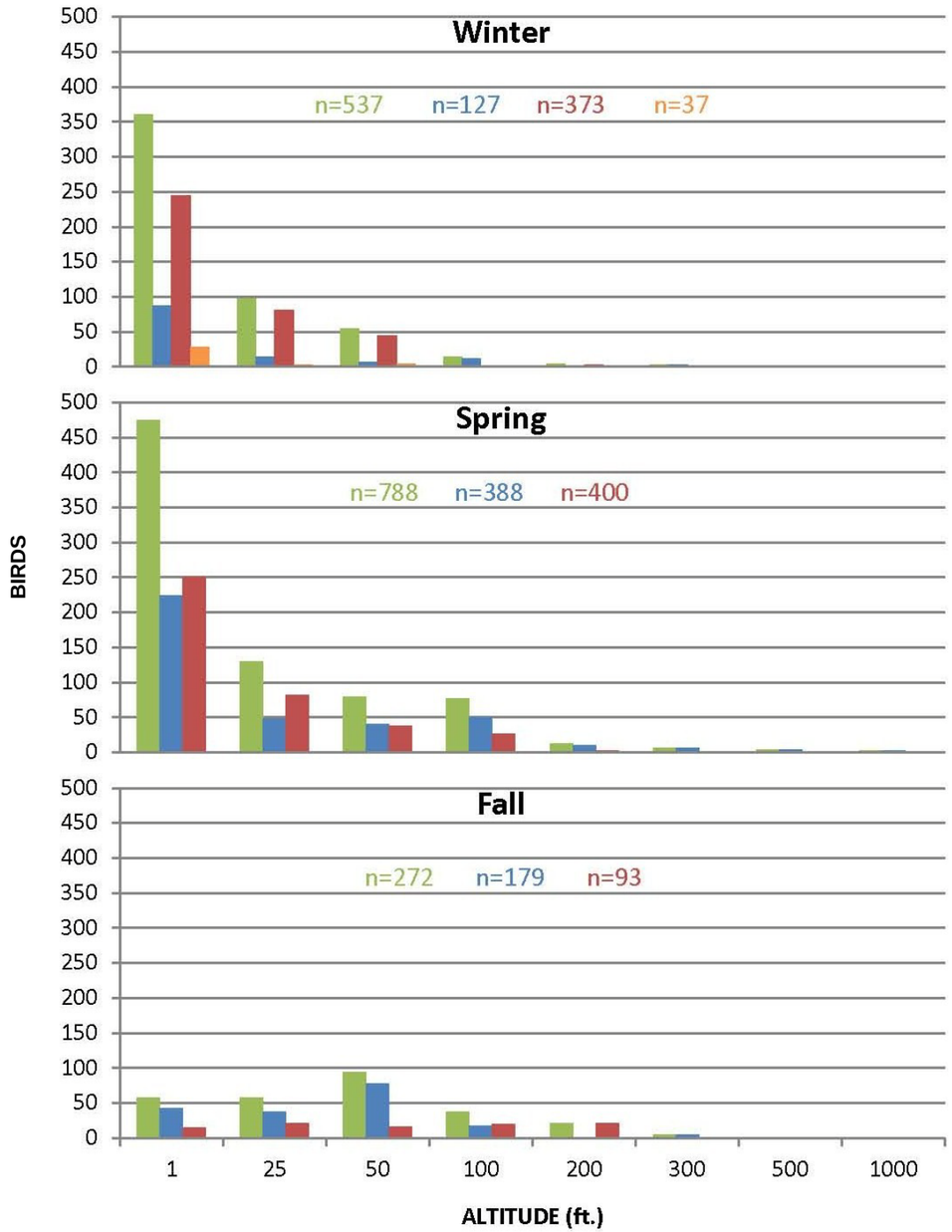

Figure D-13. Altitudinal distribution by season, Red-throated Loon, offshore, January 2008-December 2009.

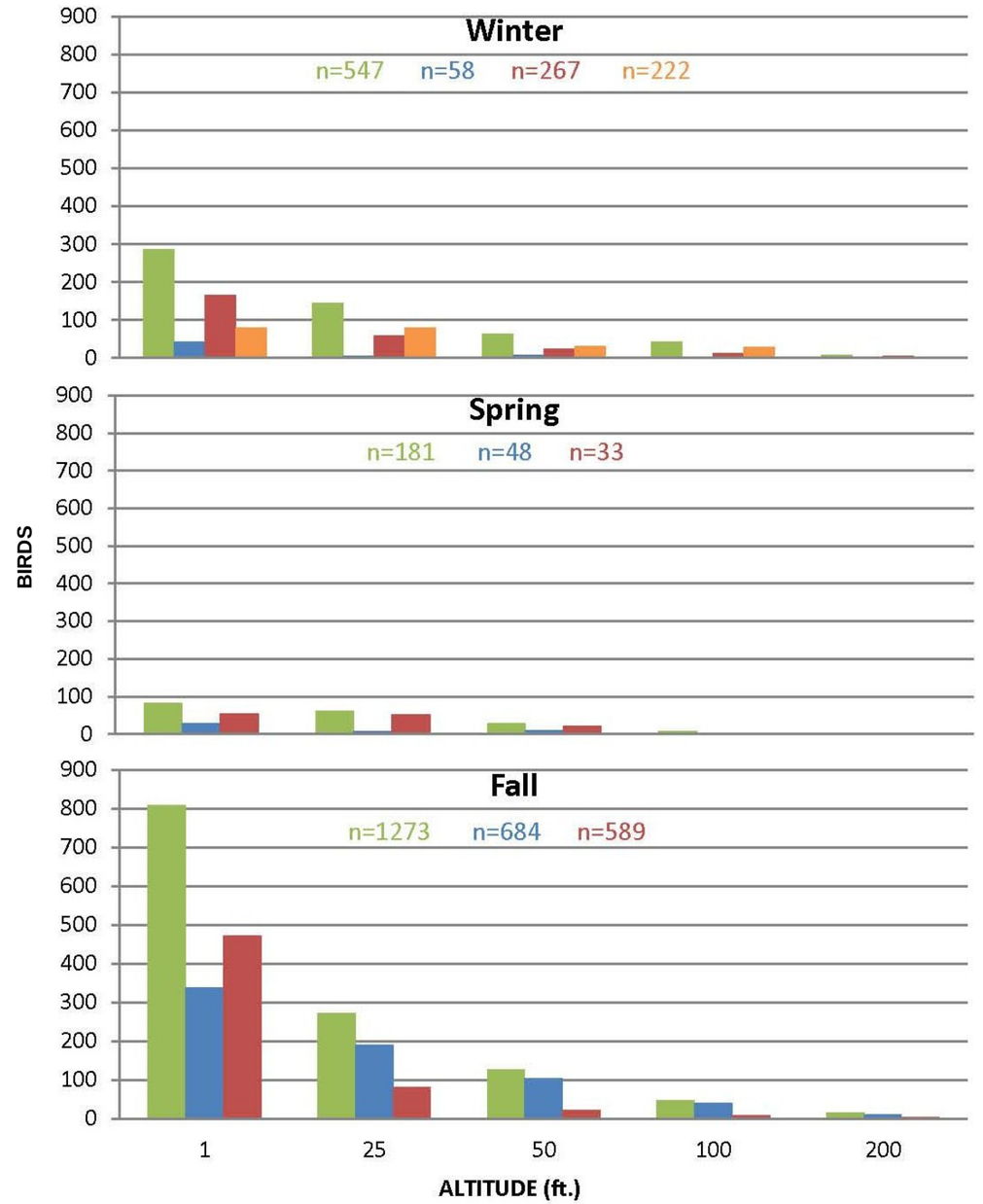

Figure D-14. Altitudinal distribution by season, Red-throated Loon, coastal, January 2008-December 2009.

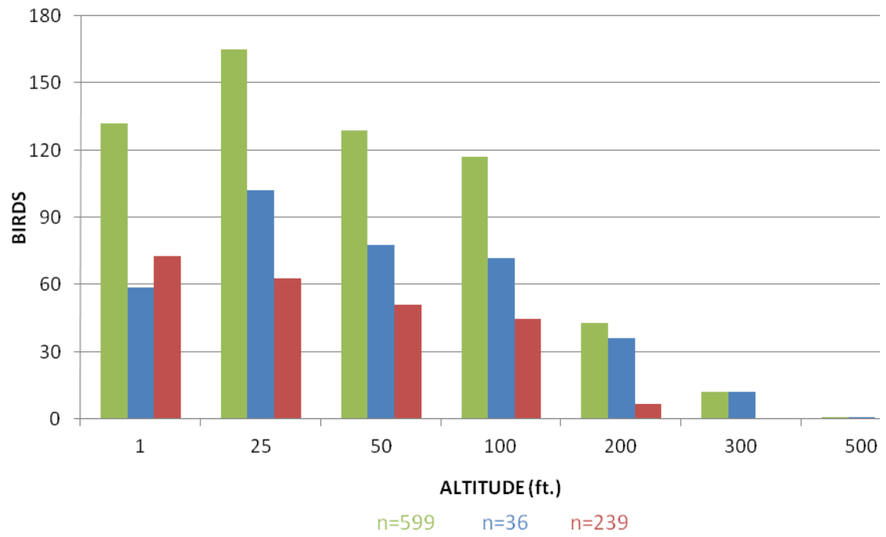

Figure D-15. Altitudinal distribution, Common Loon, offshore, January 2008-December 2009.

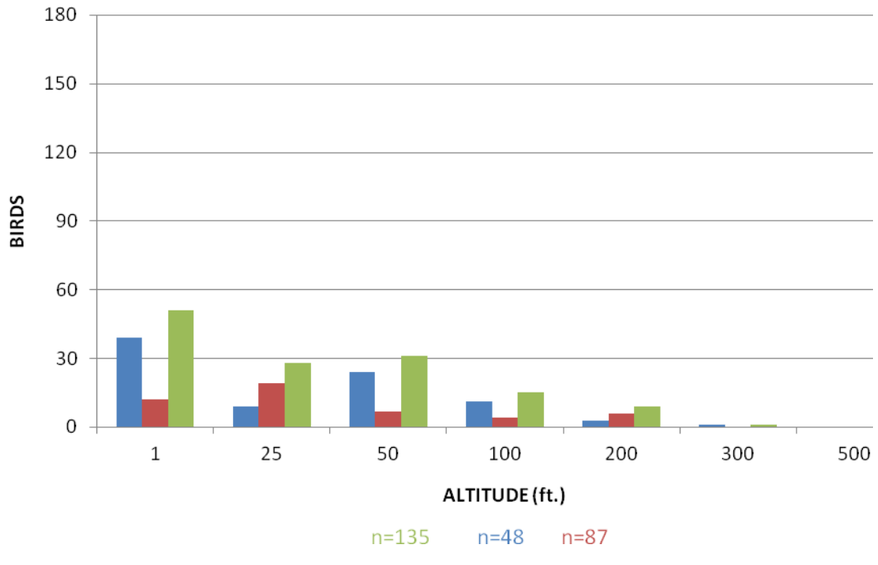

Figure D-16. Altitudinal distribution, Common Loon, coastal, January 2008-December 2009.

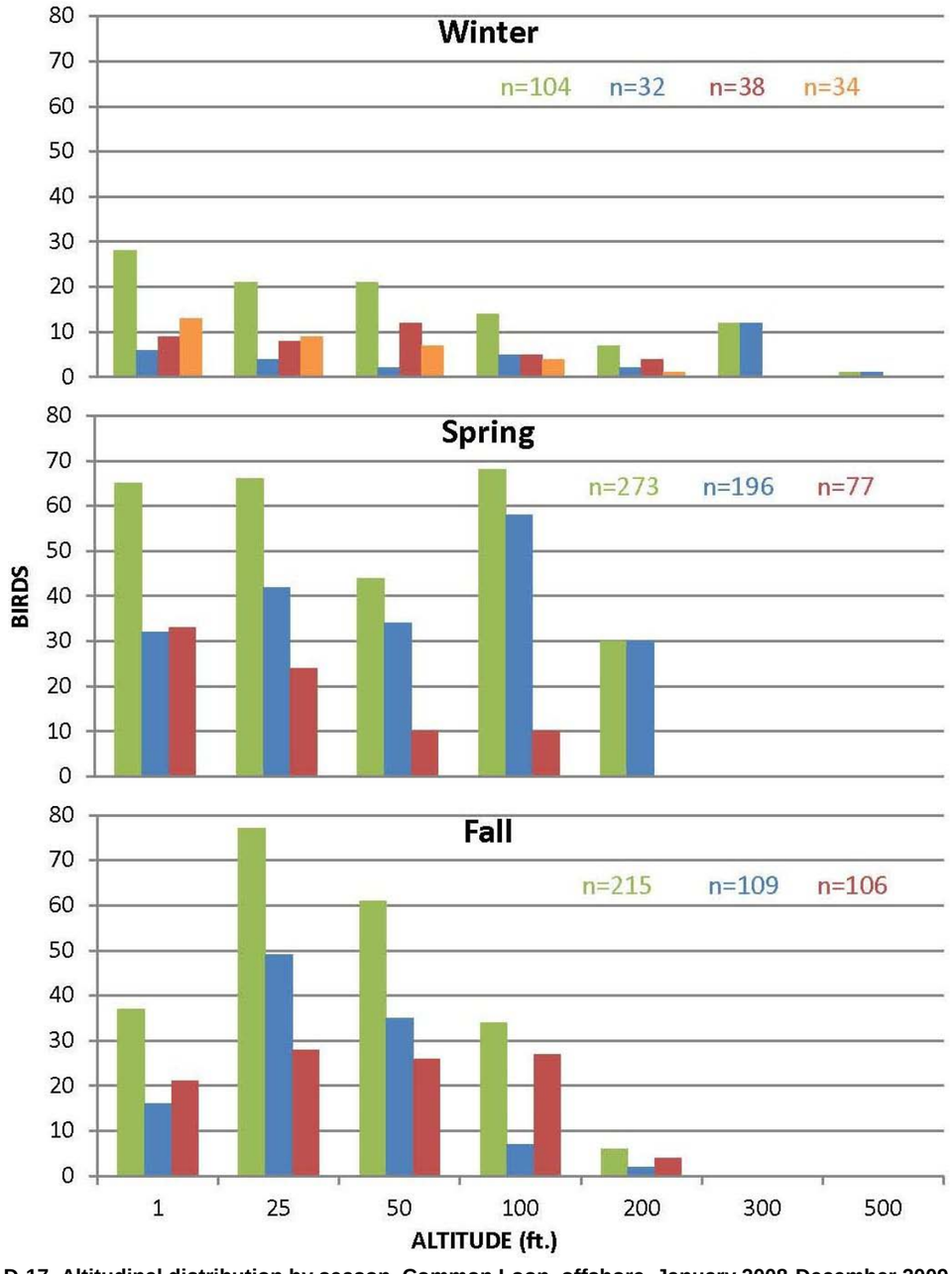

Figure D-17. Altitudinal distribution by season, Common Loon, offshore, January 2008-December 2009.

Total 2008 2009 2008-2009 2009-2010

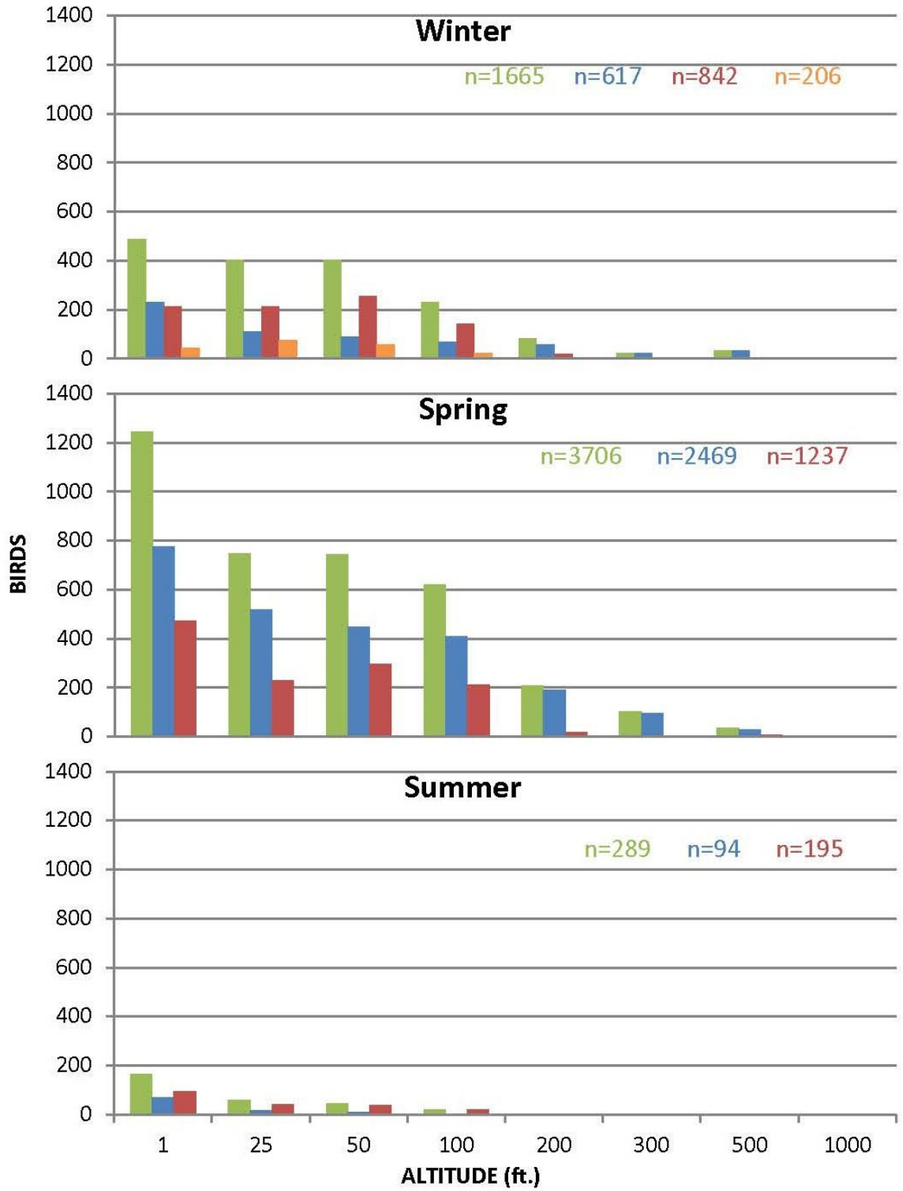

Figure D-18. Altitudinal distribution, Northern Gannet, offshore, Winter through Summer, 2008 and 2009.

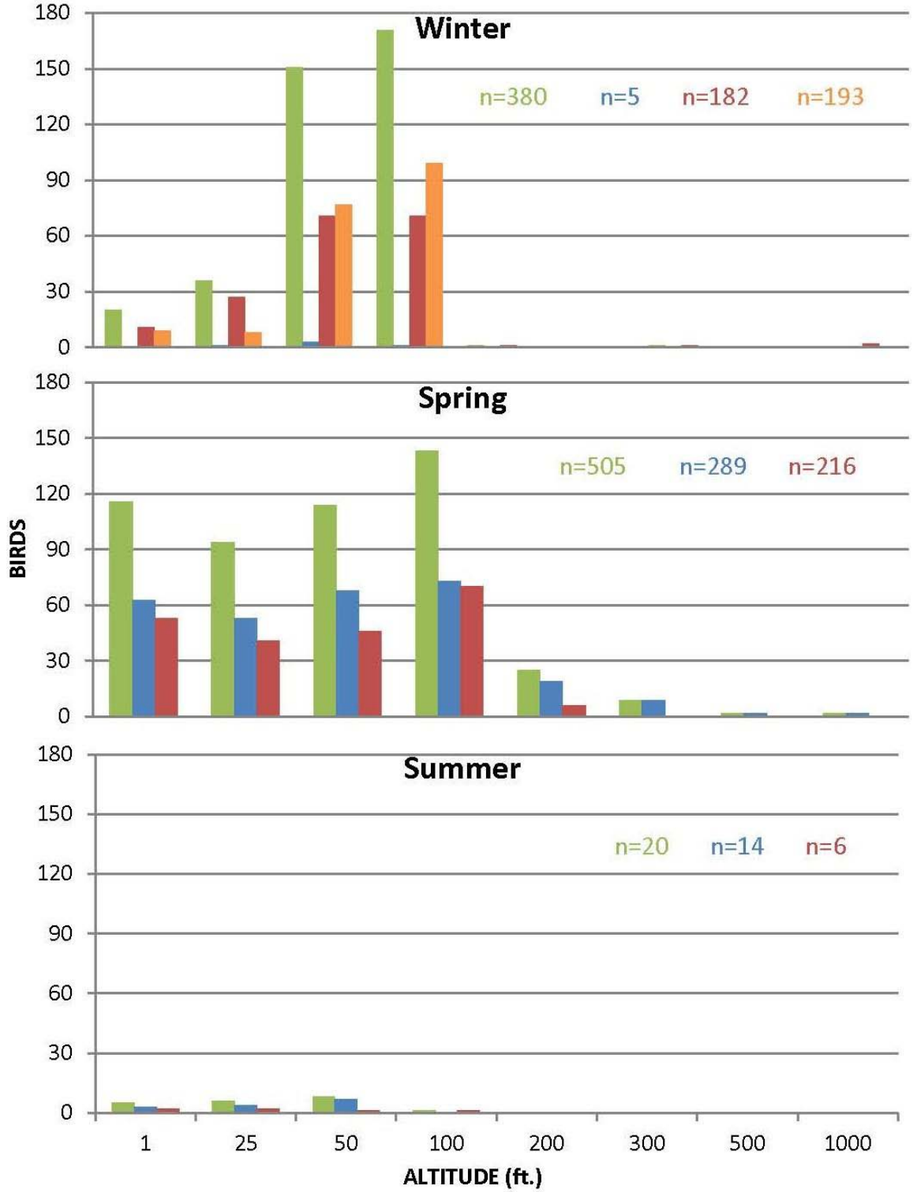

Figure D-19. Altitudinal distribution, Northern Gannet, coastal, Winter through Summer, 2008 and 2009.

Total 2008 2008-2009 2009-2010

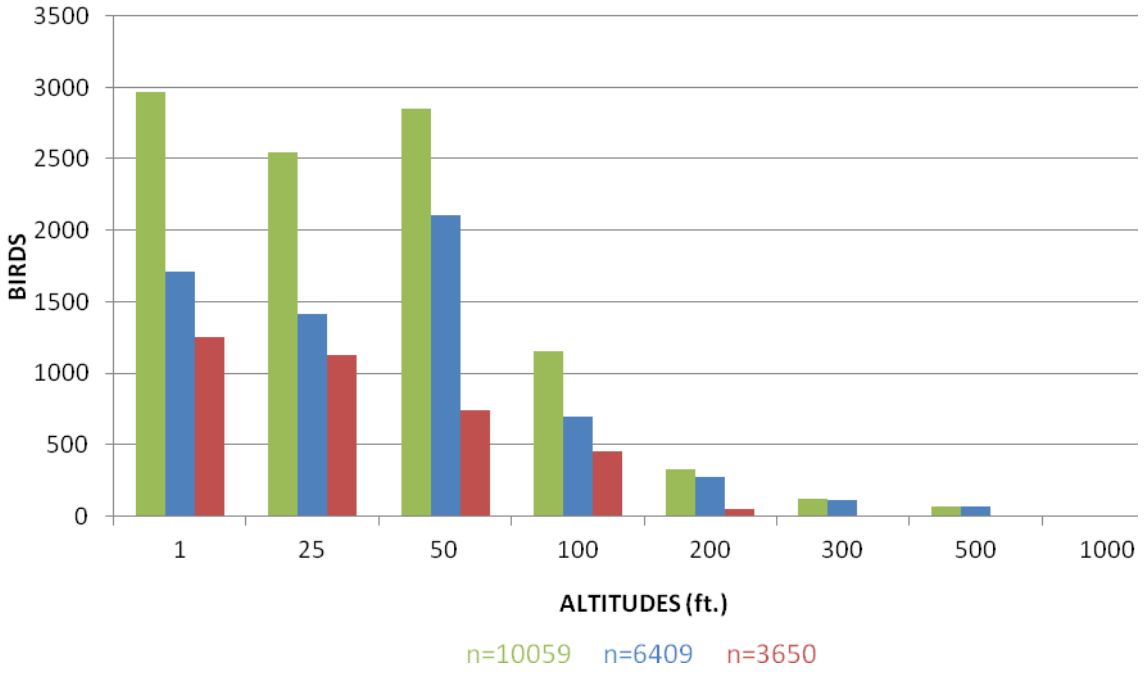

Figure D-20. Altitudinal distribution, Northern Gannet, offshore, January 2008-December 2009.

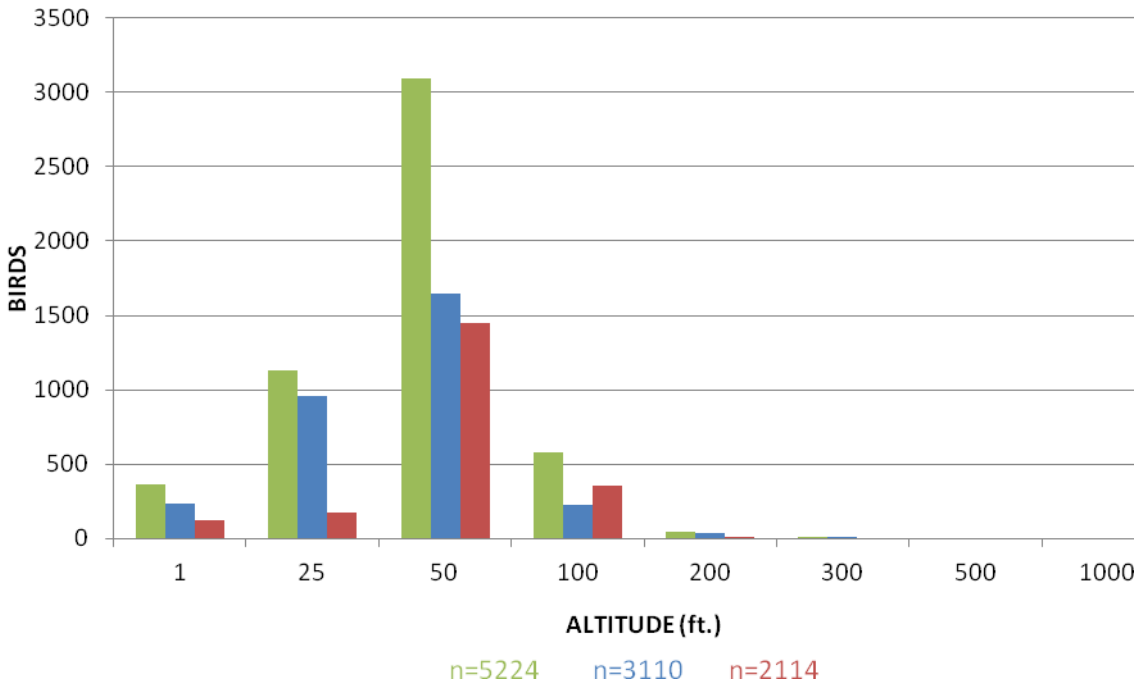

Figure D-21. Altitudinal distribution, Northern Gannet, coastal, January 2008-December 2009.

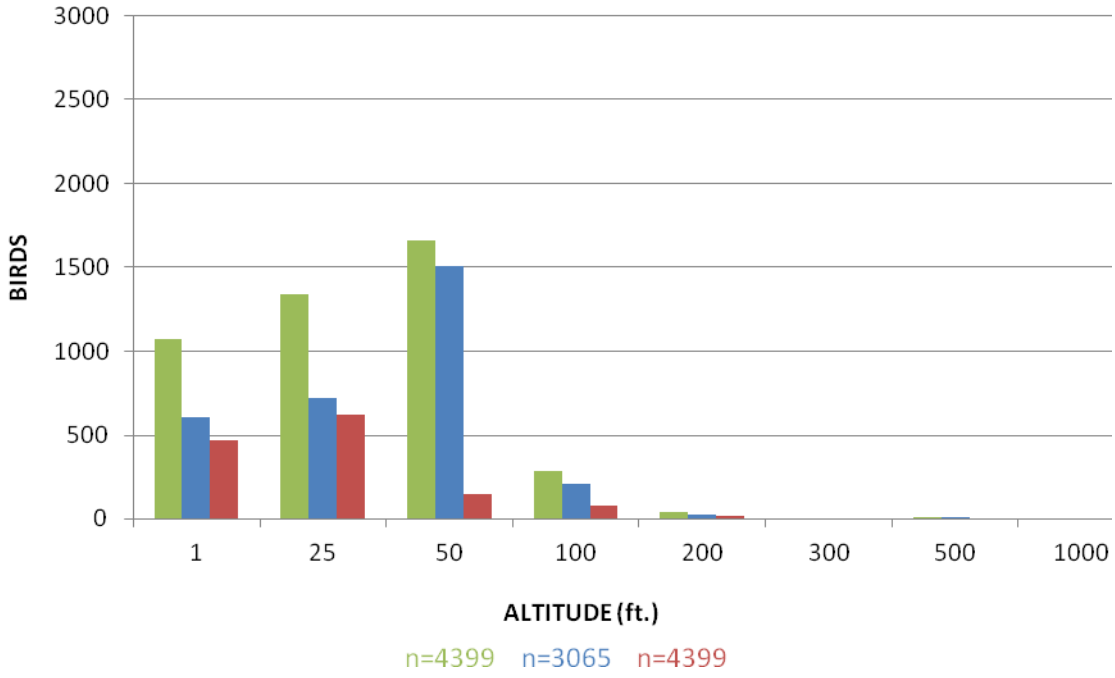

Figure D-22. Altitudinal distribution, Northern Gannet, offshore, Fall, 2008 and 2009.

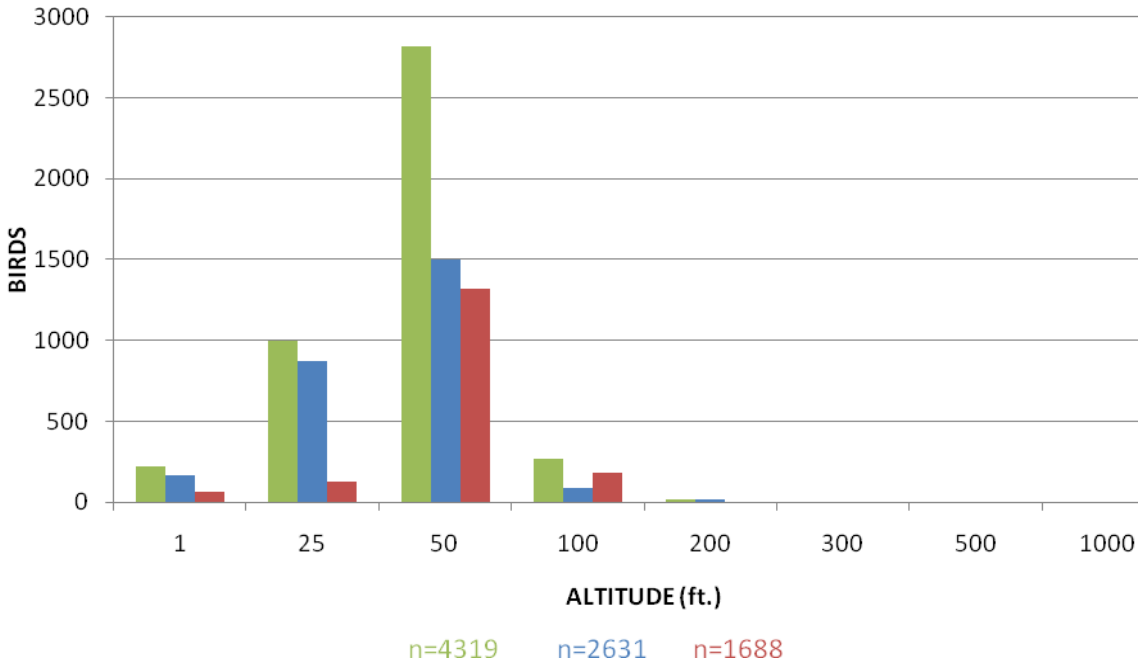

Figure D-23. Altitudinal distribution, Northern Gannet, coastal, Fall, 2008 and 2009.

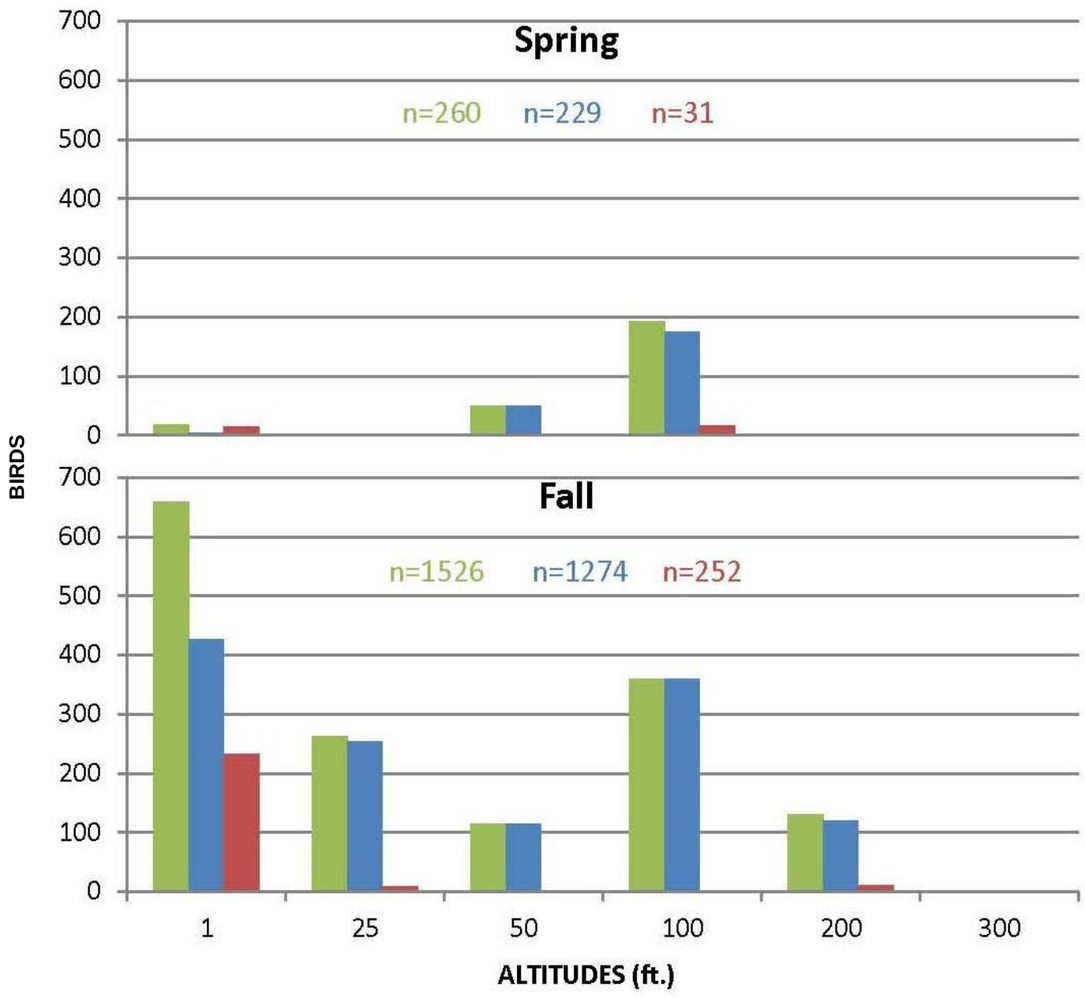

Figure D-24. Altitudinal distribution, Double-crested Cormorant, offshore, Spring and Fall, 2008 and 2009.

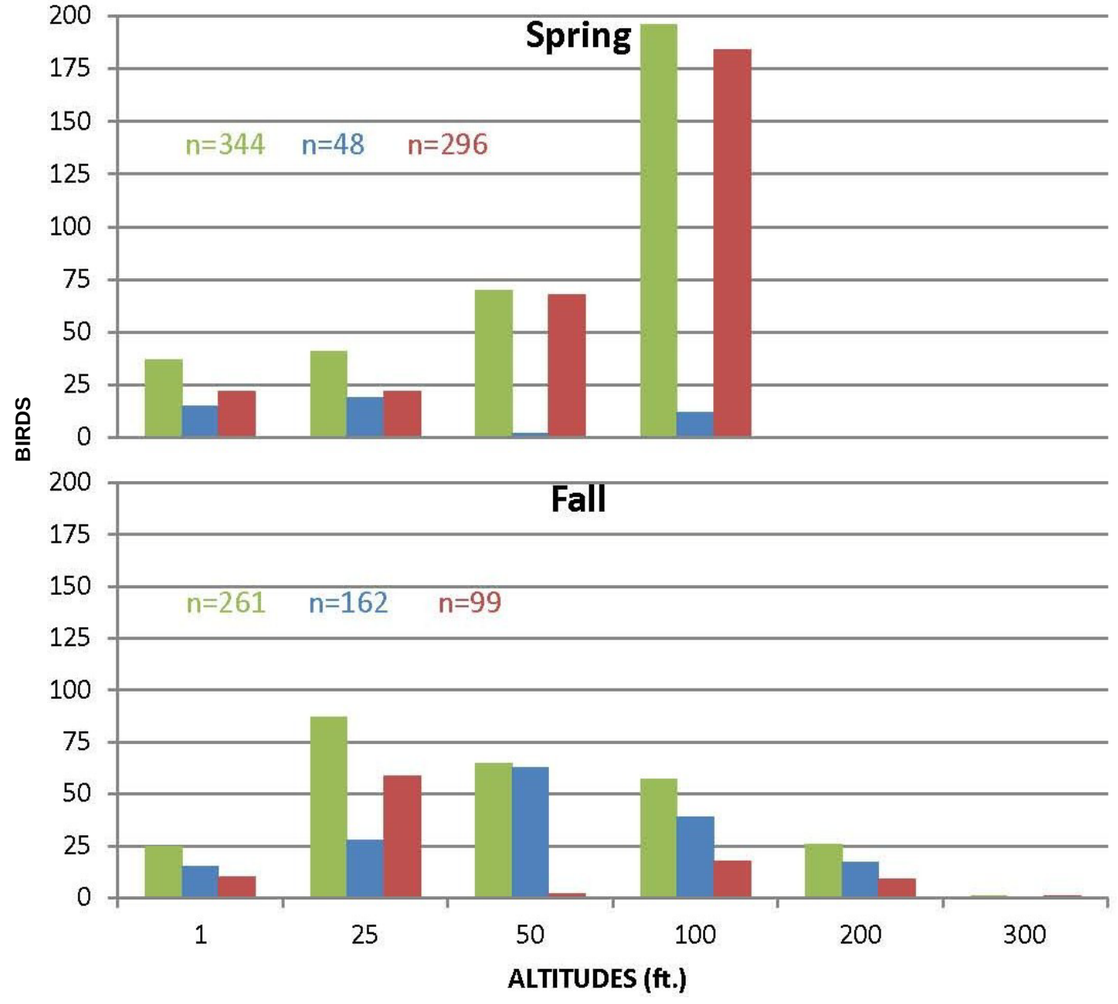

Figure D-25. Altitudinal distribution, Double-crested Cormorant, coastal, Spring and Fall, 2008 and 2009.

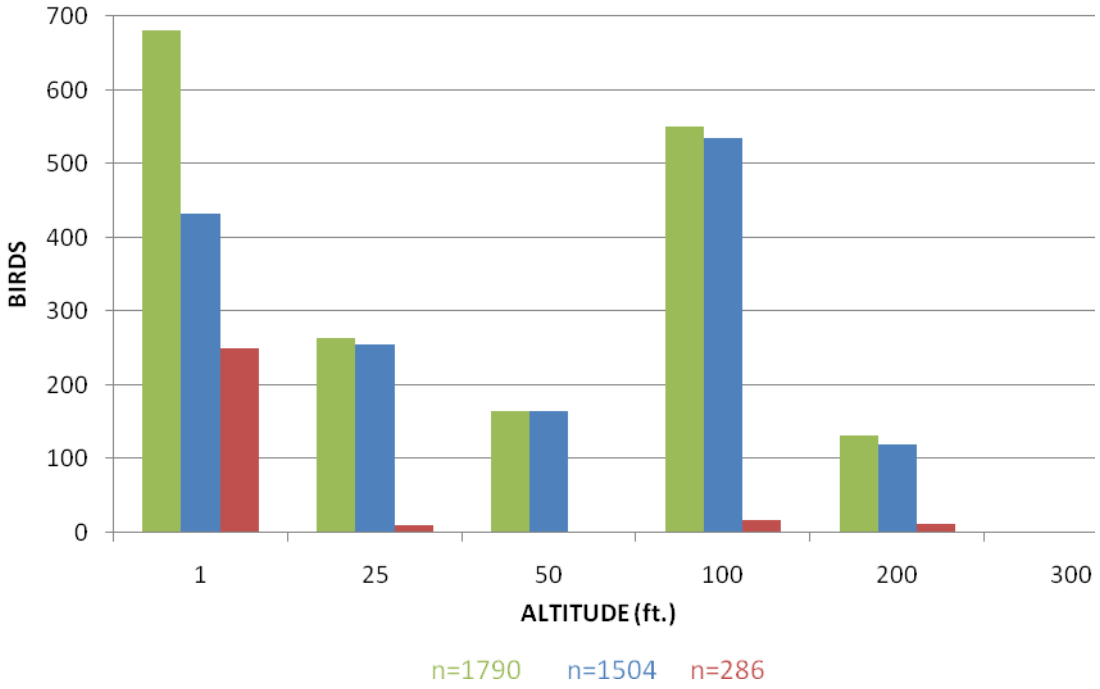

Figure D-26. Altitudinal distribution, Double-crested Cormorant, offshore, January 2008-December 2009.

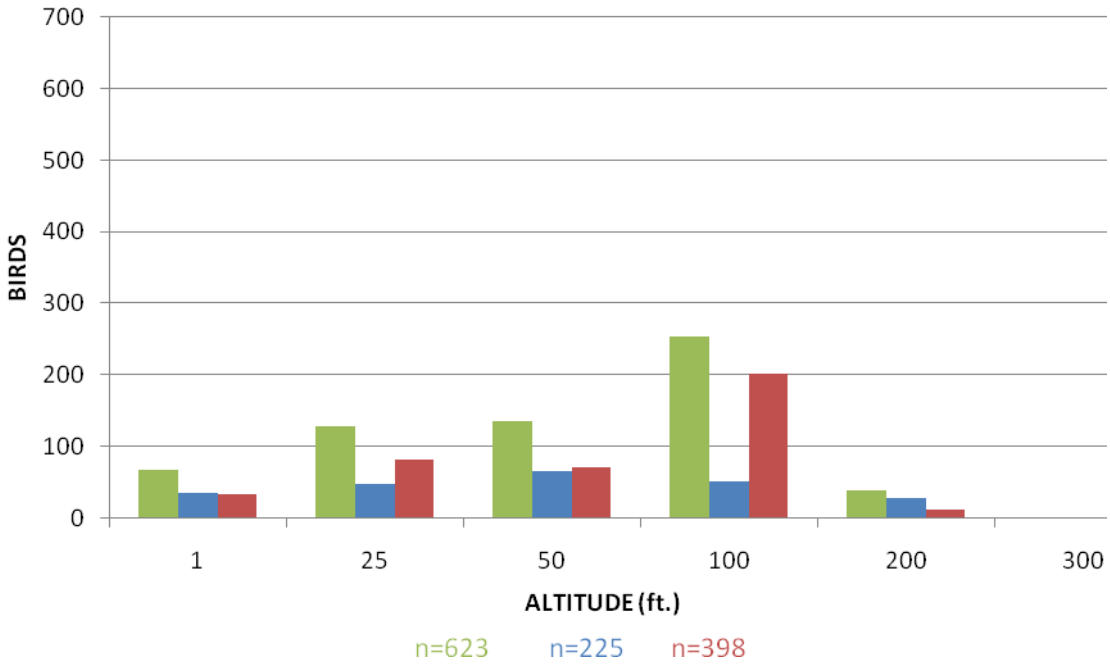

Figure D-27. Altitudinal distribution, Double-crested Cormorant, coastal, January 2008-December 2009.

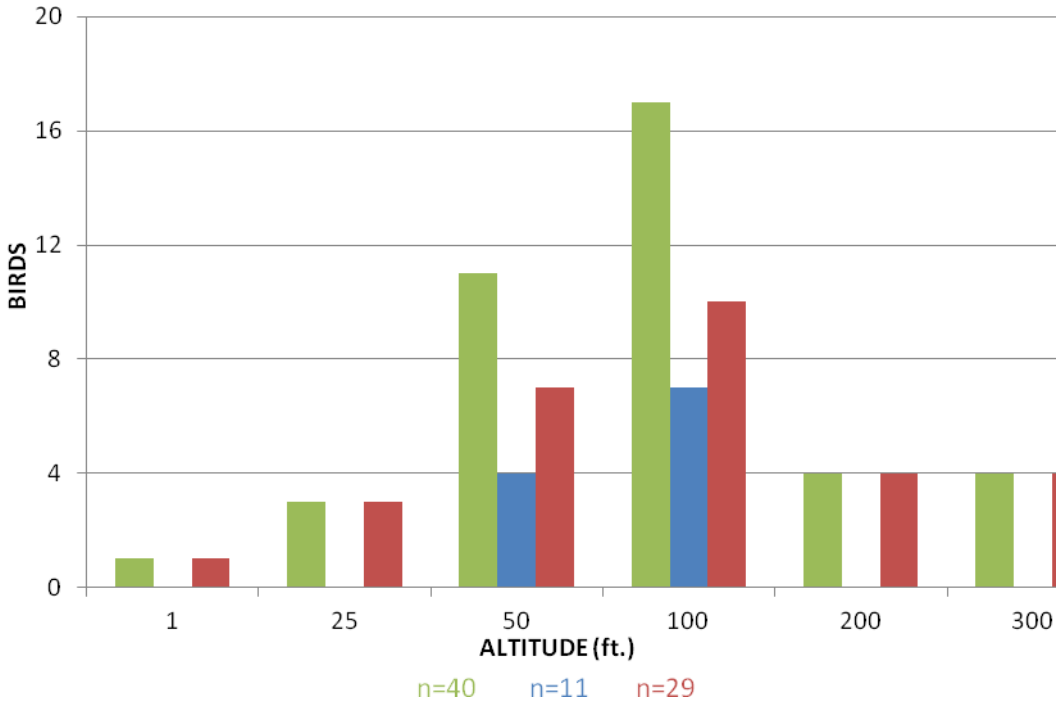

Figure D-28. Altitudinal distribution, Osprey, offshore and coastal, January 2008-December 2009.

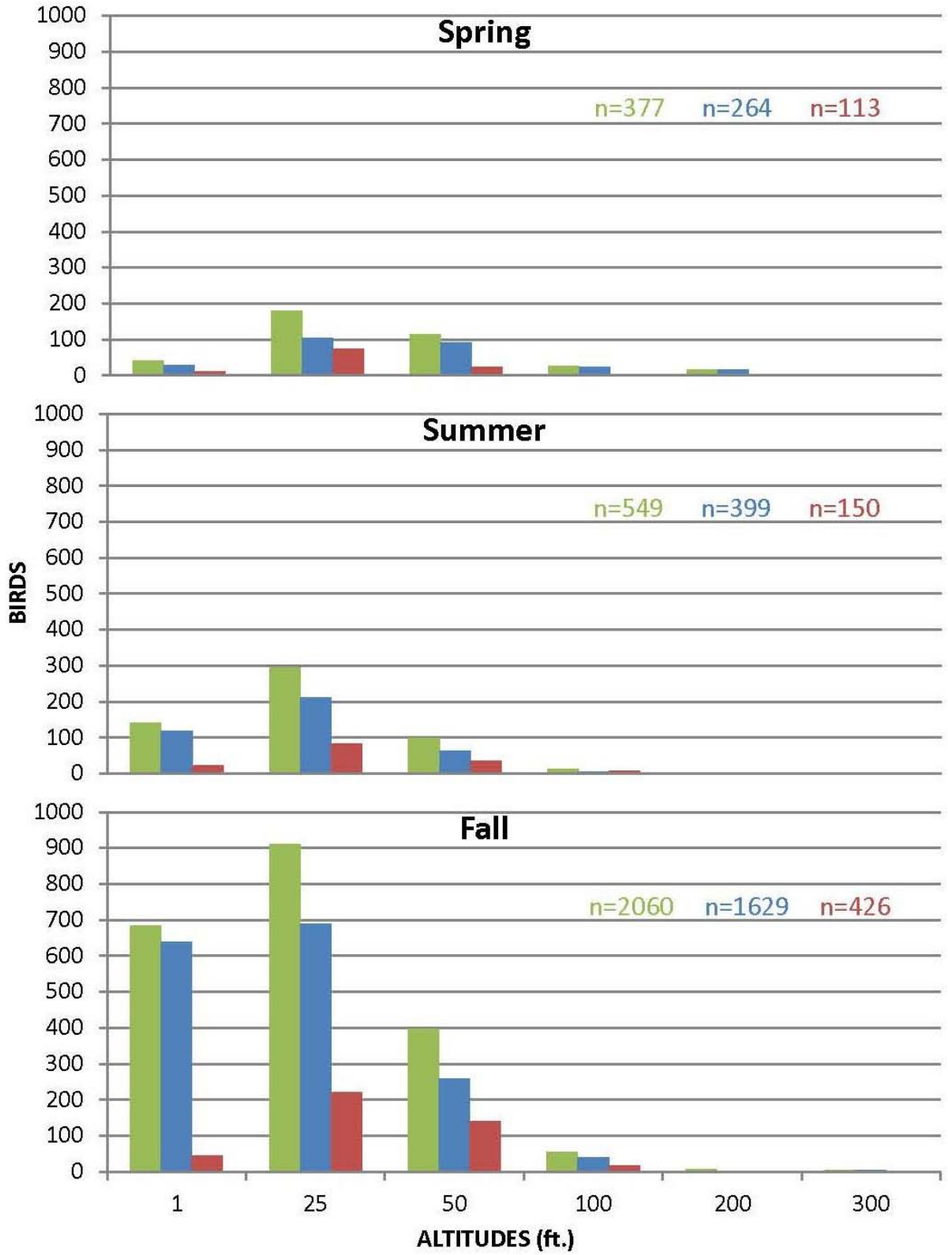

Figure D-29. Altitudinal distribution, Laughing Gull, offshore, Spring through Fall, 2008 and 2009.

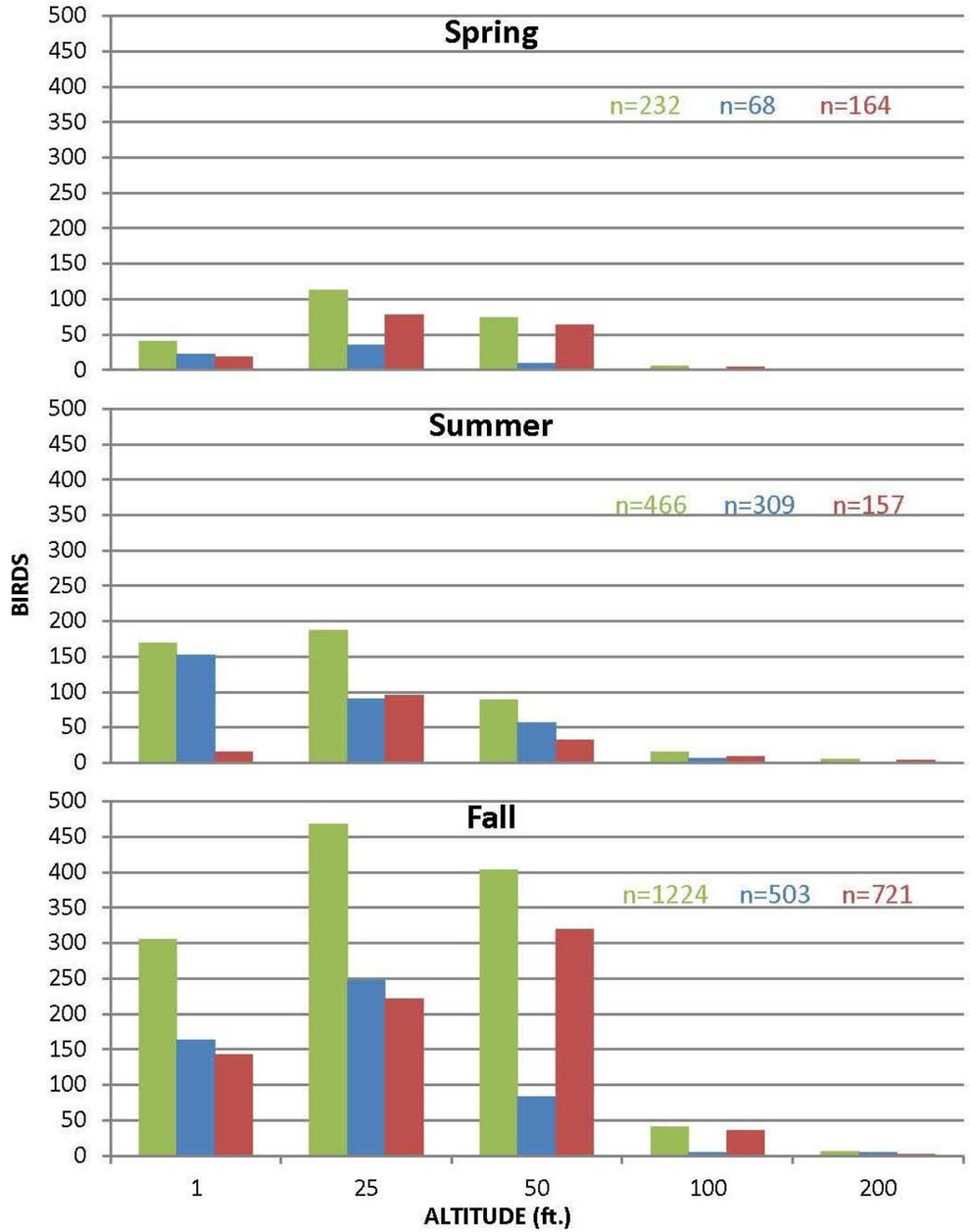

Figure D-30. Altitudinal distribution, Laughing Gull, coastal, Spring through Fall, 2008 and 2009.

Total 2008 2008-2009 2009-2010

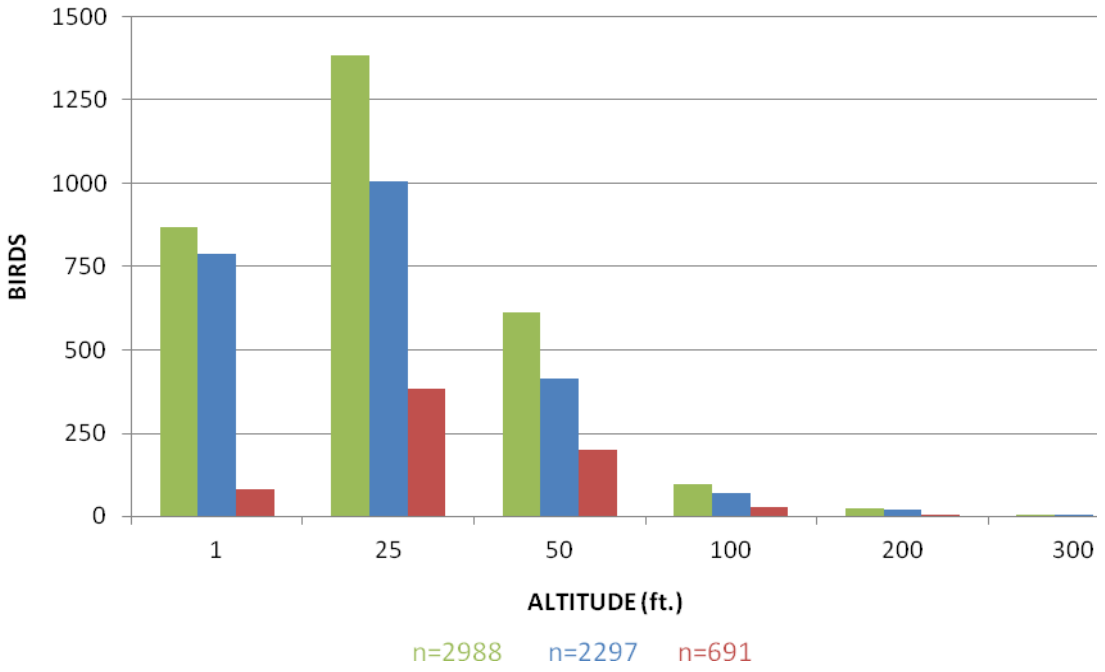

Figure D-31. Altitudinal distribution, Laughing Gull, offshore, January 2008-December 2009.

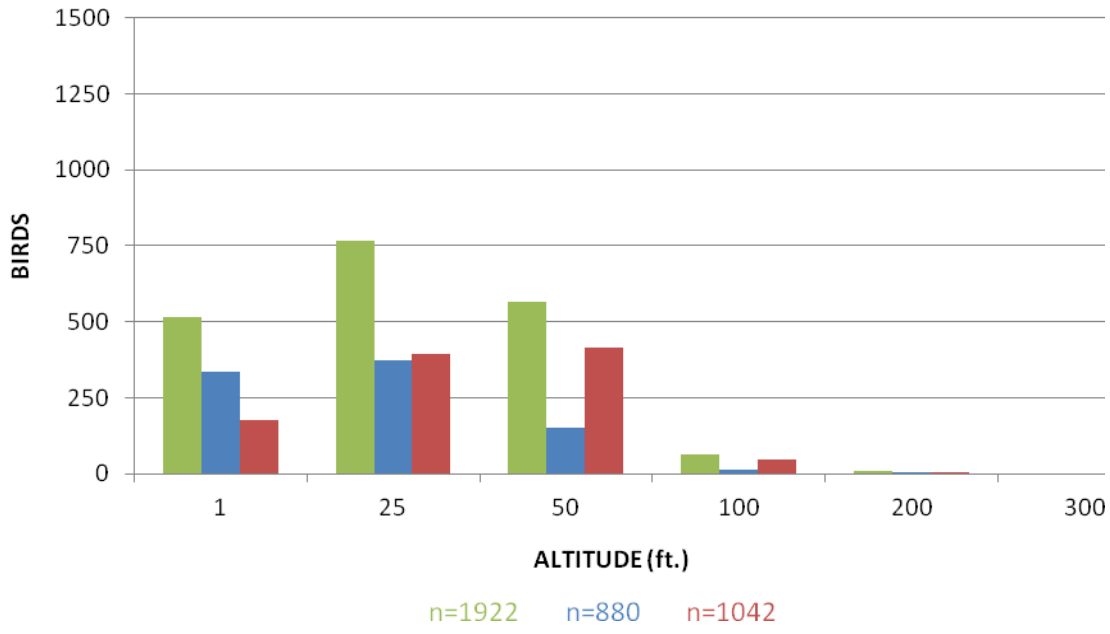

Figure D-32. Altitudinal distribution, Laughing Gull, coastal, January 2008-December 2009.

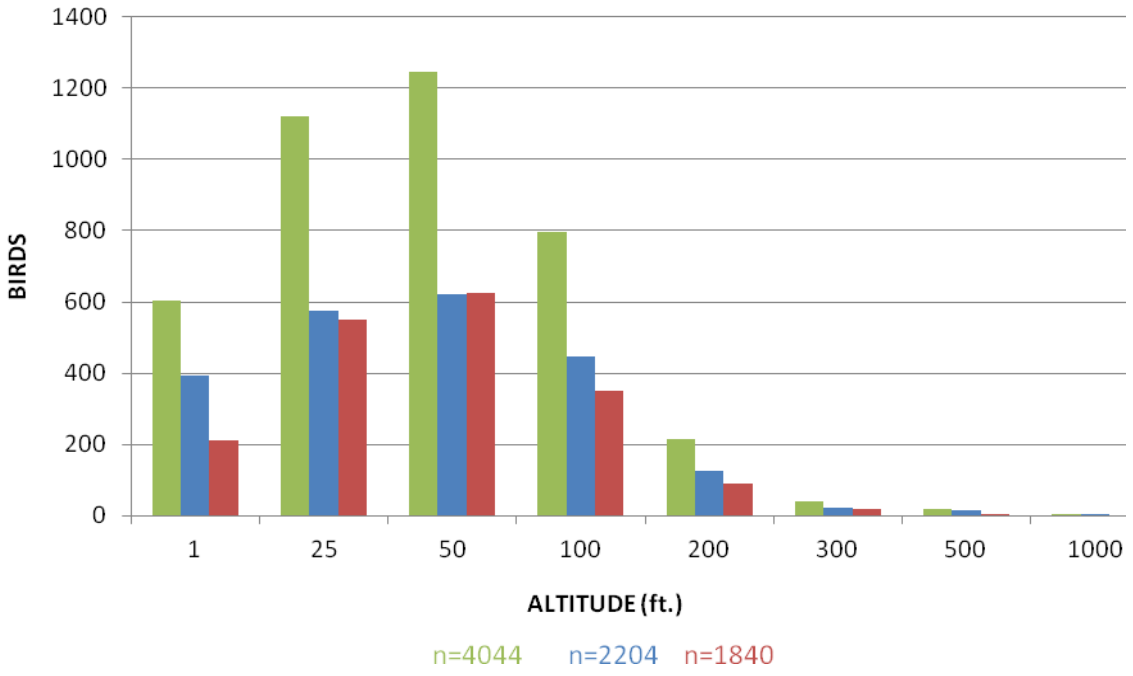

Figure D-33. Altitudinal distribution, large gulls, offshore, January 2008-December 2009.

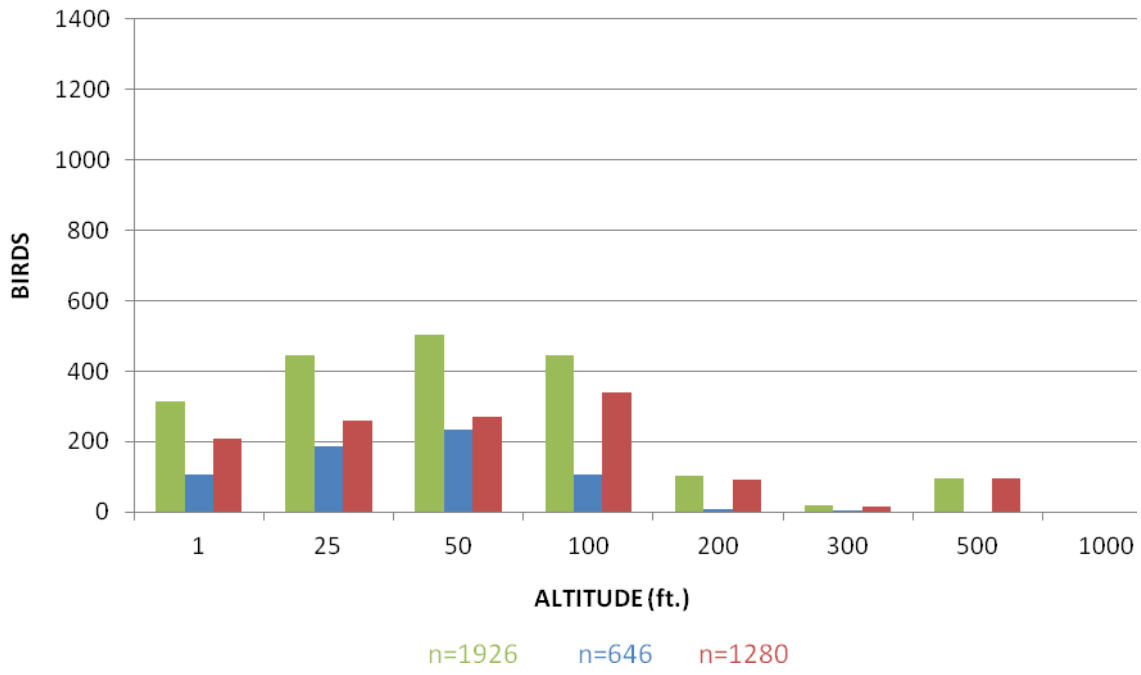

Figure D-34. Altitudinal distribution, large gulls, coastal, January 2008-December 2009.

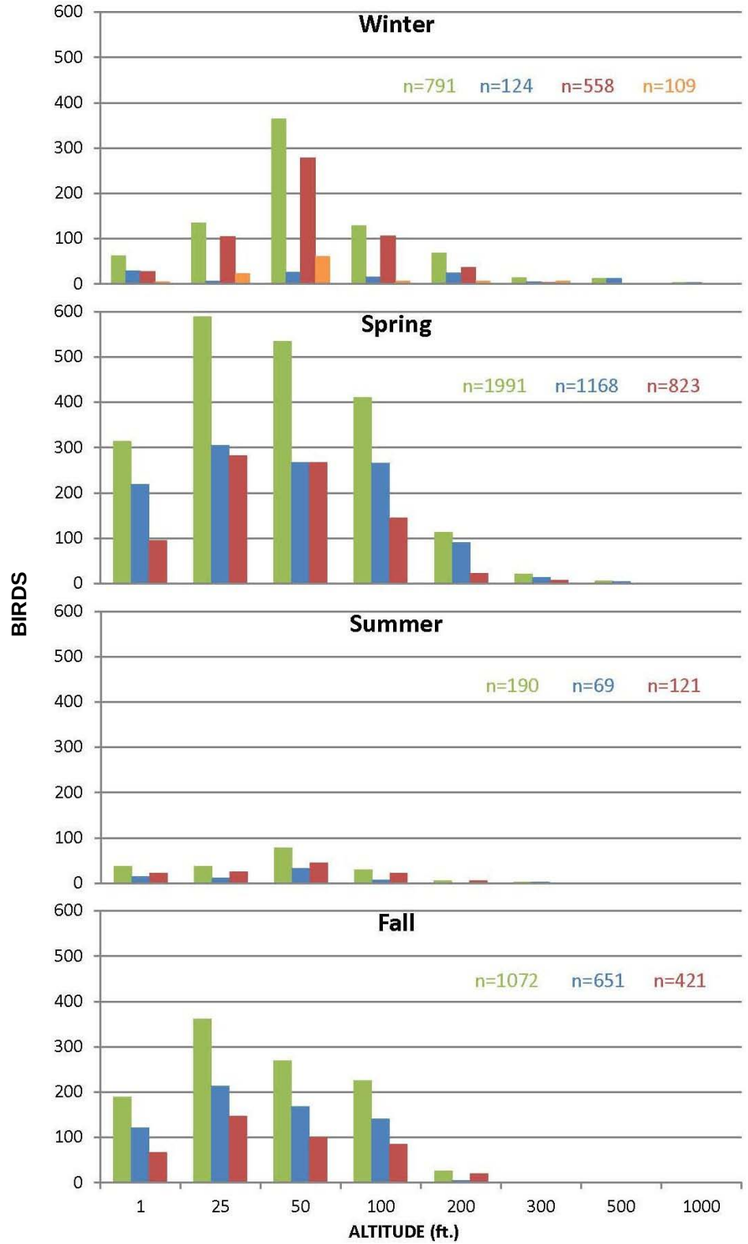

Figure D-35. Altitudinal distribution by season, large gulls, offshore, January 2008-December 2009.

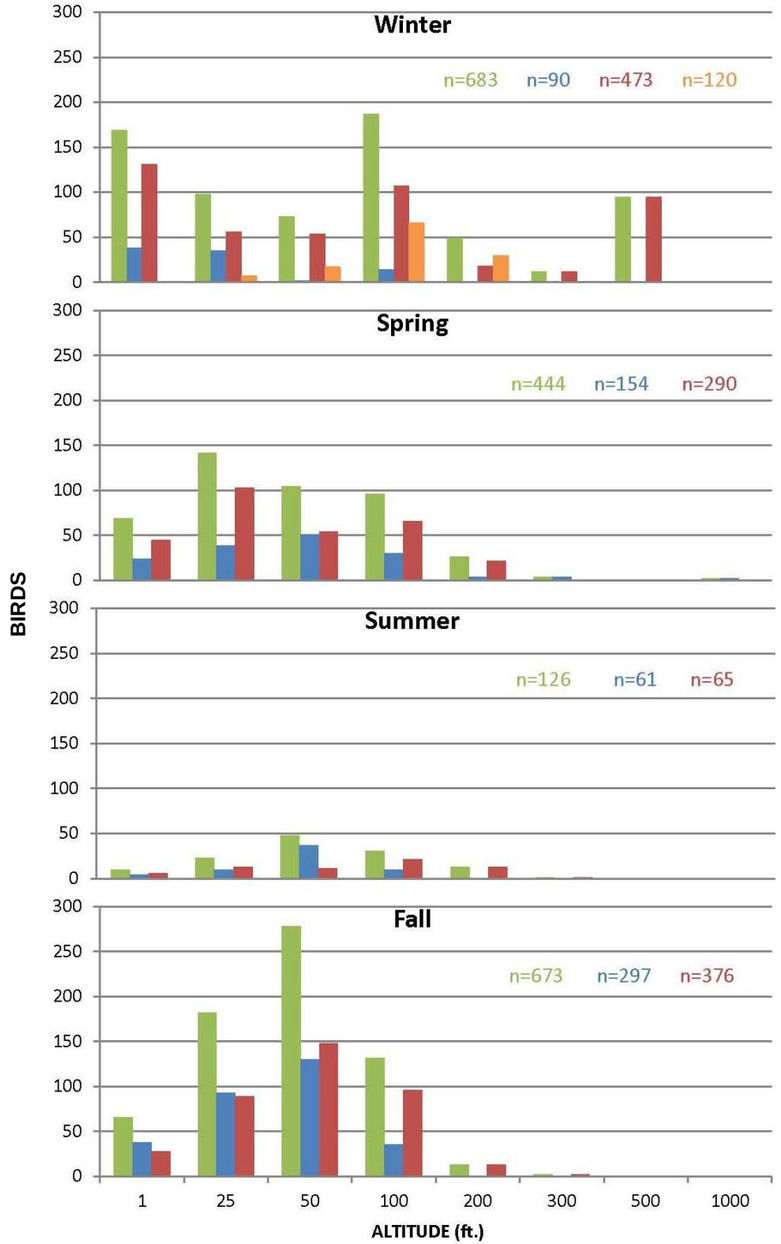

Figure D-36. Altitudinal distribution by season, large gulls, coastal, January 2008-December 2009.

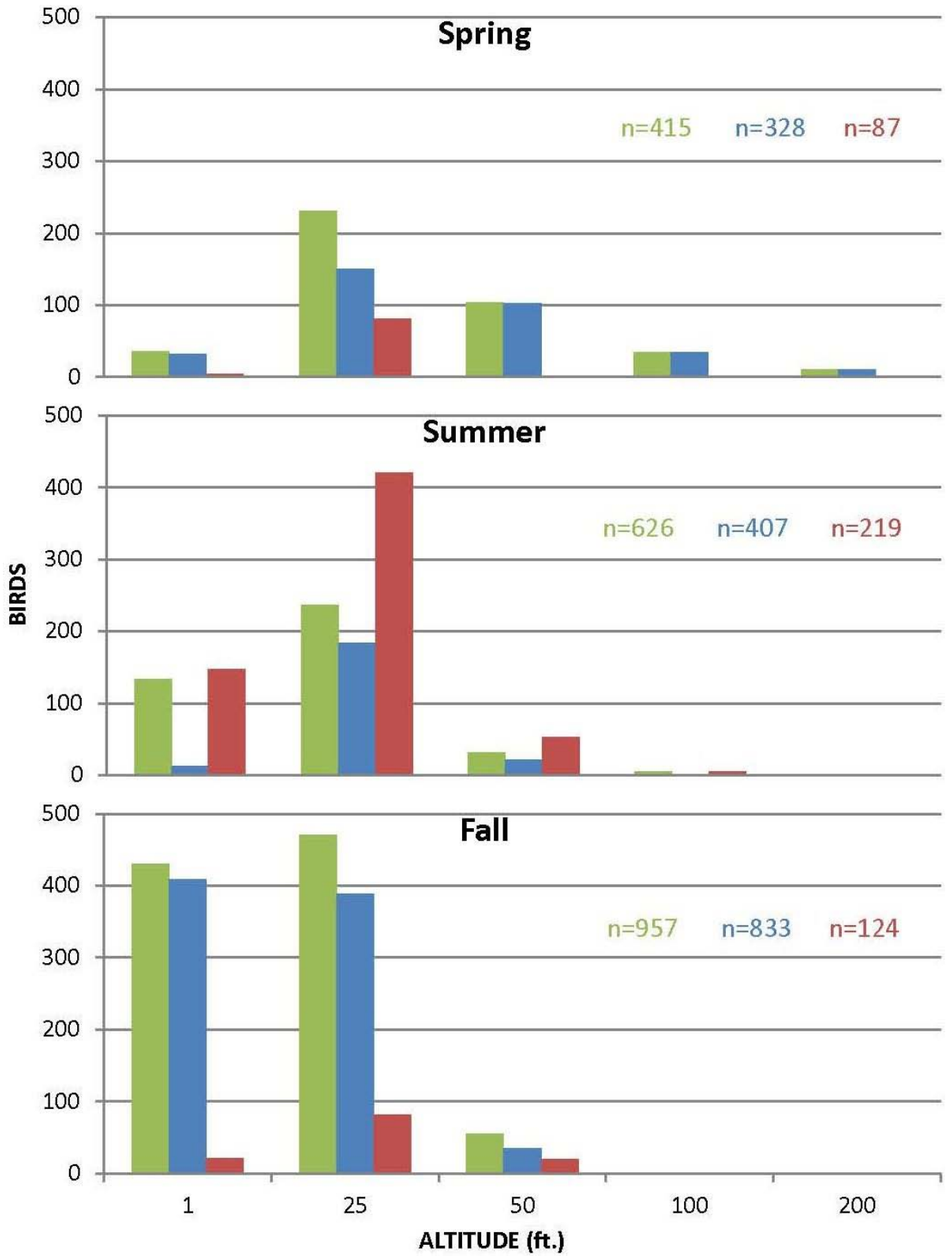

Figure D-37. Altitudinal distribution, Common Tern, offshore, Spring through Fall, 2008 and 2009.

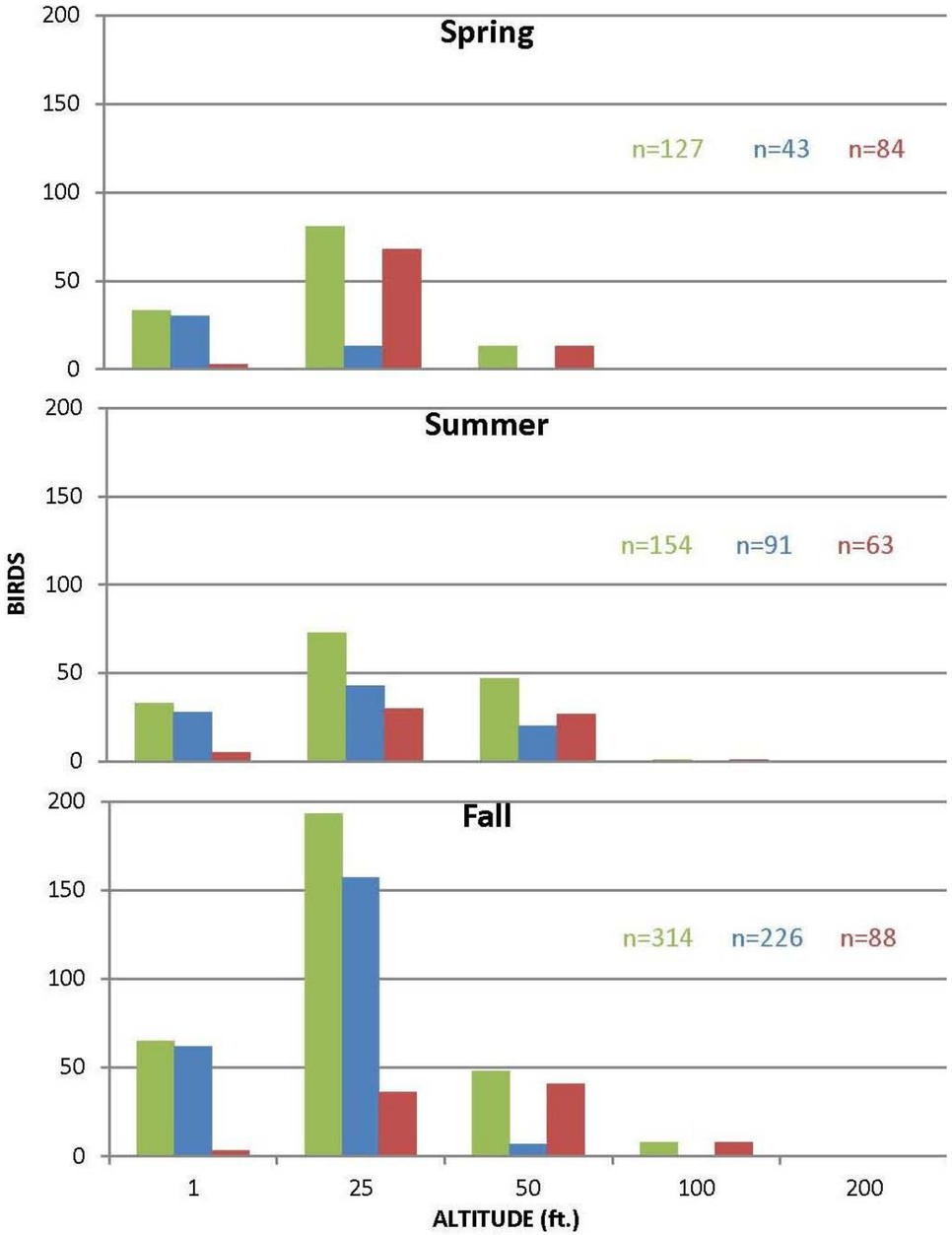

Figure D-38. Altitudinal distribution, Common Tern, coastal, Spring through Fall, 2008 and 2009.

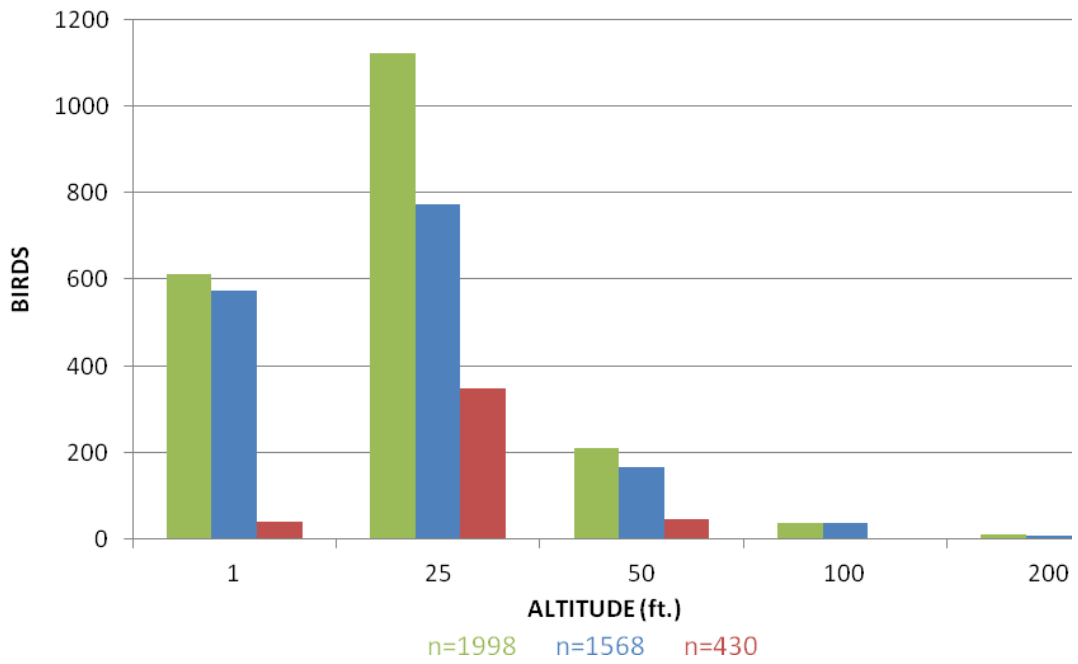

Figure D-39. Altitudinal distribution, Common Tern, offshore, January 2008-December 2009.

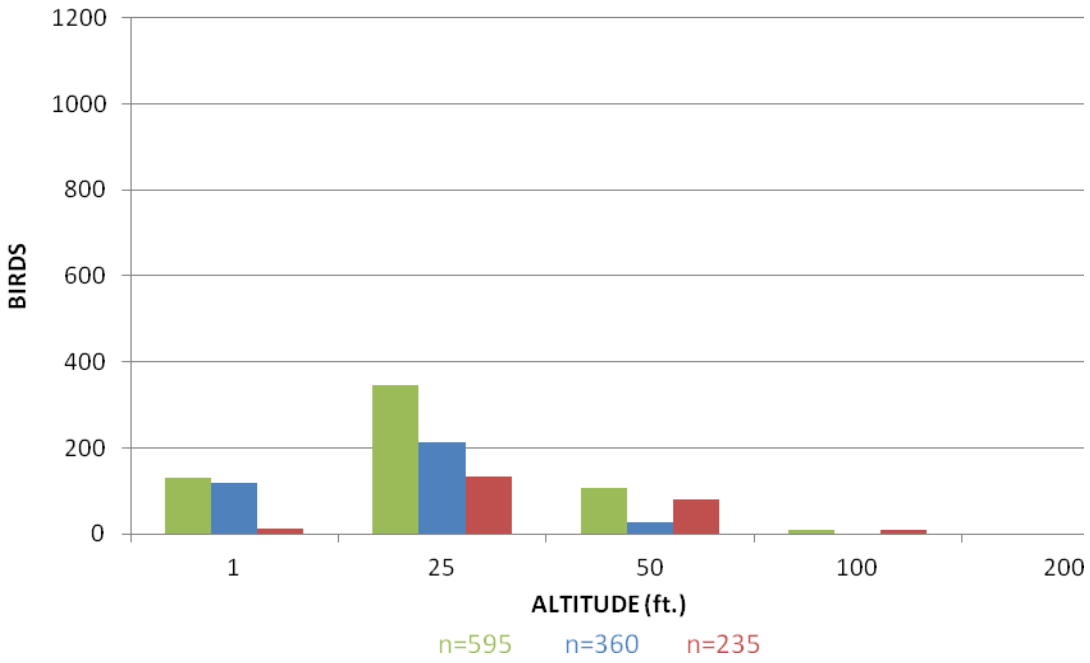

Figure D-40. Altitudinal distribution, Common Tern, coastal, January 2008-December 2009.

APPENDIX E

FLIGHT DIRECTION DATA ANALYSIS

Table E-1a. Frequency distribution of mean flight directions in octants (N, NE, E, SE).

Time Period	Species	Abundance	#Observations	Cluster Size	N					NE					E					SE					Total #Freq (All Octants)
					Center Angle	Low Angle	High Angle	#Freq	%Freq	Center Angle	Low Angle	High Angle	#Freq	%Freq	Center Angle	Low Angle	High Angle	#Freq	%Freq	Center Angle	Low Angle	High Angle	#Freq	%Freq	
Overall	TOTAL	177266	35547	4.99	0	338	23	14820	13.50	45	23	68	15507	14.12	90	68	113	8051	7.33	135	113	158	10170	9.26	**109794**
Jan-08	TOTAL	6500	1212	5.36	0	338	23	201	9.66	45	23	68	217	10.43	90	68	113	253	12.16	135	113	158	570	27.39	**2081**
Feb-08	TOTAL	580	208	2.79	0	338	23	29	8.87	45	23	68	13	3.98	90	68	113	85	25.99	135	113	158	44	13.46	**327**
Mar-08	TOTAL	17569	3068	5.73	0	338	23	1958	21.42	45	23	68	879	9.62	90	68	113	704	7.70	135	113	158	1361	14.89	**9139**
Apr-08	TOTAL	15624	3362	4.65	0	338	23	2116	19.50	45	23	68	4371	40.29	90	68	113	1643	15.14	135	113	158	677	6.24	**10850**
May-08	TOTAL	4446	1901	2.34	0	338	23	613	17.38	45	23	68	730	20.70	90	68	113	404	11.45	135	113	158	278	7.88	**3527**
Jun-08	TOTAL	1964	1198	1.64	0	338	23	84	5.02	45	23	68	182	10.87	90	68	113	185	11.05	135	113	158	240	14.34	**1674**
Jul-08	TOTAL	1957	1061	1.84	0	338	23	107	6.73	45	23	68	184	11.57	90	68	113	192	12.07	135	113	158	292	18.35	**1591**
Aug-08	TOTAL	4255	1457	2.92	0	338	23	1253	36.90	45	23	68	331	9.75	90	68	113	171	5.04	135	113	158	274	8.07	**3396**
Sep-08	TOTAL	2612	1103	2.37	0	338	23	378	17.21	45	23	68	247	11.25	90	68	113	192	8.74	135	113	158	169	7.70	**2196**
Oct-08	TOTAL	11928	1729	6.90	0	338	23	845	8.46	45	23	68	425	4.25	90	68	113	180	1.80	135	113	158	329	3.29	**9994**
Nov-08	TOTAL	27018	2694	10.03	0	338	23	994	4.88	45	23	68	565	2.78	90	68	113	1089	5.35	135	113	158	2081	10.22	**20358**
Dec-08	TOTAL	9672	1150	8.41	0	338	23	251	4.12	45	23	68	188	3.09	90	68	113	136	2.23	135	113	158	827	13.58	**6091**
Jan-09	TOTAL	20306	1618	12.55	0	338	23	1466	15.71	45	23	68	1853	19.86	90	68	113	878	9.41	135	113	158	494	5.29	**9332**
Feb-09	TOTAL	10953	1919	5.71	0	338	23	638	20.53	45	23	68	327	10.52	90	68	113	282	9.07	135	113	158	247	7.95	**3108**
Mar-09	TOTAL	6494	2058	3.16	0	338	23	854	26.75	45	23	68	459	14.38	90	68	113	314	9.83	135	113	158	282	8.83	**3193**
Apr-09	TOTAL	6122	1038	5.90	0	338	23	906	17.13	45	23	68	1919	36.28	90	68	113	364	6.88	135	113	158	721	13.63	**5290**
May-09	TOTAL	3052	1744	1.75	0	338	23	333	16.08	45	23	68	312	15.07	90	68	113	215	10.38	135	113	158	270	13.04	**2071**
Jun-09	TOTAL	1817	1309	1.39	0	338	23	219	15.52	45	23	68	191	13.54	90	68	113	183	12.97	135	113	158	256	18.14	**1411**
Aug-09	TOTAL	1885	1201	1.57	0	338	23	148	9.87	45	23	68	205	13.67	90	68	113	125	8.33	135	113	158	231	15.40	**1500**
Sep-09	TOTAL	1923	814	2.36	0	338	23	171	18.63	45	23	68	114	12.42	90	68	113	57	6.21	135	113	158	133	14.49	**918**
Oct-09	TOTAL	4065	619	6.57	0	338	23	63	2.93	45	23	68	683	31.75	90	68	113	67	3.11	135	113	158	77	3.58	**2151**
Nov-09	TOTAL	10757	1890	5.69	0	338	23	819	12.52	45	23	68	882	13.49	90	68	113	247	3.78	135	113	158	175	2.68	**6539**
Dec-09	TOTAL	5767	1194	4.83	0	338	23	374	12.23	45	23	68	230	7.52	90	68	113	85	2.78	135	113	158	142	4.65	**3057**
Winter2008(DJF)	TOTAL	7080	1420	4.99	0	338	23	230	9.55	45	23	68	230	9.55	90	68	113	338	14.04	135	113	158	614	25.50	**2408**
Spring2008(MAM)	TOTAL	37639	8331	4.52	0	338	23	4687	19.93	45	23	68	5980	25.43	90	68	113	2751	11.70	135	113	158	2316	9.85	**23516**
Summer2008(JJ)	TOTAL	3921	2259	1.74	0	338	23	191	5.85	45	23	68	366	11.21	90	68	113	377	11.55	135	113	158	532	16.29	**3265**
Autumn2008(ASON)	TOTAL	45813	6983	6.56	0	338	23	3470	9.65	45	23	68	1568	4.36	90	68	113	1632	4.54	135	113	158	2853	7.94	**35944**
Winter2009(DJF)	TOTAL	40931	4687	8.73	0	338	23	2355	12.71	45	23	68	2368	12.78	90	68	113	1296	6.99	135	113	158	1568	8.46	**18531**
Spring2009(MAM)	TOTAL	15668	4840	3.24	0	338	23	2093	19.83	45	23	68	2690	25.49	90	68	113	893	8.46	135	113	158	1273	12.06	**10554**
Summer2009(JJ)	TOTAL	1817	1309	1.39	0	338	23	219	15.52	45	23	68	191	13.54	90	68	113	183	12.97	135	113	158	256	18.14	**1411**
Autumn2009(ASON)	TOTAL	18630	4524	4.12	0	338	23	1201	10.81	45	23	68	1884	16.96	90	68	113	496	4.47	135	113	158	616	5.55	**11108**
Winter2010(DJF)	TOTAL	5767	1194	4.83	0	338	23	374	12.23	45	23	68	230	7.52	90	68	113	85	2.78	135	113	158	142	4.65	**3057**
2008	TOTAL	104125	20143	5.17	0	338	23	8829	12.40	45	23	68	8332	11.70	90	68	113	5234	7.35	135	113	158	7142	10.03	**71224**
2009	TOTAL	73141	15404	4.75	0	338	23	5991	15.53	45	23	68	7175	18.60	90	68	113	2817	7.30	135	113	158	3028	7.85	**38570**
Overall	NOGA	34020	9822	3.46	0	338	23	3036	13.28	45	23	68	2223	9.73	90	68	113	1568	6.86	135	113	158	3308	14.47	**22856**
Jan-08	NOGA	898	482	1.86	0	338	23	86	12.41	45	23	68	104	15.01	90	68	113	153	22.08	135	113	158	66	9.52	**693**
Feb-08	NOGA	49	33	1.48	0	338	23	2	5.41	45	23	68	2	5.41	90	68	113	13	35.14	135	113	158	10	27.03	**37**
Mar-08	NOGA	4980	1351	3.69	0	338	23	822	24.55	45	23	68	292	8.72	90	68	113	361	10.78	135	113	158	271	8.09	**3348**
Apr-08	NOGA	3271	1409	2.32	0	338	23	275	13.21	45	23	68	313	15.04	90	68	113	188	9.03	135	113	158	262	12.59	**2081**
May-08	NOGA	858	582	1.47	0	338	23	60	8.53	45	23	68	116	16.50	90	68	113	137	19.49	135	113	158	84	11.95	**703**

Table E-1a (*continued*). Frequency distribution of mean flight directions in octants (N, NE, E, SE).

Time Period	Species	Abundance	#Observations	Cluster Size	N					NE					E					SE					Total #Freq (All Octants)
					Center Angle	Low Angle	High Angle	#Freq	%Freq	Center Angle	Low Angle	High Angle	#Freq	%Freq	Center Angle	Low Angle	High Angle	#Freq	%Freq	Center Angle	Low Angle	High Angle	#Freq	%Freq	
Jun-08	NOGA	270	195	1.38	0	338	23	7	3.59	45	23	68	18	9.23	90	68	113	35	17.95	135	113	158	27	13.85	**195**
Oct-08	NOGA	1692	492	3.44	0	338	23	65	4.71	45	23	68	49	3.55	90	68	113	39	2.83	135	113	158	41	2.97	**1380**
Nov-08	NOGA	9402	1045	9.00	0	338	23	659	10.92	45	23	68	240	3.98	90	68	113	57	0.94	135	113	158	1936	32.07	**6037**
Dec-08	NOGA	470	308	1.53	0	338	23	30	8.75	45	23	68	47	13.70	90	68	113	52	15.16	135	113	158	26	7.58	**343**
Jan-09	NOGA	1849	417	4.43	0	338	23	37	2.17	45	23	68	40	2.34	90	68	113	67	3.93	135	113	158	38	2.23	**1707**
Mar-09	NOGA	840	468	1.79	0	338	23	130	21.52	45	23	68	61	10.10	90	68	113	44	7.28	135	113	158	90	14.90	**604**
Apr-09	NOGA	400	303	1.32	0	338	23	33	10.25	45	23	68	57	17.70	90	68	113	37	11.49	135	113	158	37	11.49	**322**
May-09	NOGA	1077	674	1.60	0	338	23	102	12.52	45	23	68	125	15.34	90	68	113	91	11.17	135	113	158	141	17.30	**815**
Jun-09	NOGA	431	343	1.26	0	338	23	25	10.55	45	23	68	42	17.72	90	68	113	56	23.63	135	113	158	39	16.46	**237**
Nov-09	NOGA	6394	981	6.52	0	338	23	648	18.54	45	23	68	670	19.17	90	68	113	198	5.67	135	113	158	106	3.03	**3495**
Dec-09	NOGA	628	331	1.90	0	338	23	12	2.49	45	23	68	15	3.11	90	68	113	4	0.83	135	113	158	66	13.69	**482**
Winter2008(DJF)	NOGA	947	515	1.84	0	338	23	88	12.05	45	23	68	106	14.52	90	68	113	166	22.74	135	113	158	76	10.41	**730**
Spring2008(MAM)	NOGA	9109	3342	2.73	0	338	23	1157	18.87	45	23	68	721	11.76	90	68	113	686	11.19	135	113	158	617	10.06	**6132**
Summer2008(JJ)	NOGA	312	232	1.34	0	338	23	13	5.80	45	23	68	26	11.61	90	68	113	42	18.75	135	113	158	28	12.50	**224**
Autumn2008(ASON)	NOGA	11217	1631	6.88	0	338	23	737	9.84	45	23	68	291	3.89	90	68	113	103	1.38	135	113	158	1991	26.58	**7490**
Spring2009(MAM)	NOGA	2317	1445	1.60	0	338	23	265	15.22	45	23	68	243	13.96	90	68	113	172	9.88	135	113	158	268	15.39	**1741**
Summer2009(JJ)	NOGA	431	343	1.26	0	338	23	25	10.55	45	23	68	42	17.72	90	68	113	56	23.63	135	113	158	39	16.46	**237**
Autumn2009(ASON)	NOGA	6474	1050	6.17	0	338	23	654	18.44	45	23	68	678	19.11	90	68	113	206	5.81	135	113	158	110	3.10	**3547**
Winter2010(DJF)	NOGA	628	331	1.90	0	338	23	12	2.49	45	23	68	15	3.11	90	68	113	4	0.83	135	113	158	66	13.69	**482**
2008	NOGA	22055	6028	3.66	0	338	23	2025	13.57	45	23	68	1191	7.98	90	68	113	1049	7.03	135	113	158	2738	18.35	**14919**
2009	NOGA	11965	3794	3.15	0	338	23	1011	12.74	45	23	68	1032	13.00	90	68	113	519	6.54	135	113	158	570	7.18	**7937**
Overall	SCDW	13933	364	38.28	0	338	23	348	3.13	45	23	68	1728	15.55	90	68	113	1480	13.32	135	113	158	1736	15.62	**11113**
Mar-08	SCDW	1522	36	42.28	0	338	23	80	5.30	45	23	68	124	8.22	90	68	113	11	0.73	135	113	158	760	50.36	**1509**
Apr-08	SCDW	1885	69	27.32	0	338	23	72	4.80	45	23	68	1058	70.53	90	68	113	296	19.73	135	113	158	38	2.53	**1500**
Nov-08	SCDW	2932	30	97.73	0	338	23	0	0.00	45	23	68	16	0.55	90	68	113	950	32.40	135	113	158	0	0.00	**2932**
Dec-08	SCDW	3025	21	144.05	0	338	23	2	0.14	45	23	68	7	0.48	90	68	113	0	0.00	135	113	158	0	0.00	**1465**
Apr-09	SCDW	1599	36	44.42	0	338	23	66	4.21	45	23	68	242	15.42	90	68	113	130	8.29	135	113	158	650	41.43	**1569**
Dec-09	SCDW	473	16	29.56	0	338	23	18	7.41	45	23	68	9	3.70	90	68	113	25	10.29	135	113	158	10	4.12	**243**
Spring2008(MAM)	SCDW	3407	105	32.45	0	338	23	152	5.05	45	23	68	1182	39.28	90	68	113	307	10.20	135	113	158	798	26.52	**3009**
Autumn2008(ASON)	SCDW	3228	49	65.88	0	338	23	29	0.90	45	23	68	89	2.76	90	68	113	955	29.58	135	113	158	0	0.00	**3228**
Winter2009(DJF)	SCDW	4468	107	41.76	0	338	23	34	1.37	45	23	68	184	7.43	90	68	113	39	1.58	135	113	158	245	9.90	**2476**
Spring2009(MAM)	SCDW	1985	71	27.96	0	338	23	77	4.30	45	23	68	257	14.35	90	68	113	153	8.54	135	113	158	683	38.14	**1791**
Winter2010(DJF)	SCDW	473	16	29.56	0	338	23	18	7.41	45	23	68	9	3.70	90	68	113	25	10.29	135	113	158	10	4.12	**243**
2008	SCDW	9669	178	54.32	0	338	23	183	2.38	45	23	68	1278	16.59	90	68	113	1263	16.39	135	113	158	798	10.36	**7705**
Overall	HERG	13790	3474	3.97	0	338	23	637	13.47	45	23	68	678	14.33	90	68	113	530	11.21	135	113	158	729	15.41	**4730**
Jan-08	HERG	1158	129	8.98	0	338	23	14	6.80	45	23	68	20	9.71	90	68	113	7	3.40	135	113	158	68	33.01	**206**
Feb-08	HERG	61	41	1.49	0	338	23	3	5.00	45	23	68	6	10.00	90	68	113	13	21.67	135	113	158	15	25.00	**60**
Mar-08	HERG	3785	394	9.61	0	338	23	59	8.14	45	23	68	66	9.10	90	68	113	127	17.52	135	113	158	178	24.55	**725**
May-08	HERG	568	249	2.28	0	338	23	56	17.39	45	23	68	28	8.70	90	68	113	64	19.88	135	113	158	37	11.49	**322**
Feb-09	HERG	1710	325	5.26	0	338	23	81	21.49	45	23	68	35	9.28	90	68	113	31	8.22	135	113	158	56	14.85	**377**

Table E-1a (*continued*). Frequency distribution of mean flight directions in octants (N, NE, E, SE).

Time Period	Species	Abundance	#Observations	Cluster Size	N					NE					E					SE					Total #Freq (All Octants)
					Center Angle	Low Angle	High Angle	#Freq	%Freq	Center Angle	Low Angle	High Angle	#Freq	%Freq	Center Angle	Low Angle	High Angle	#Freq	%Freq	Center Angle	Low Angle	High Angle	#Freq	%Freq	
Mar-09	HERG	1037	358	2.90	0	338	23	83	16.60	45	23	68	103	20.60	90	68	113	81	16.20	135	113	158	70	14.00	**500**
Apr-09	HERG	439	138	3.18	0	338	23	38	20.43	45	23	68	33	17.74	90	68	113	15	8.06	135	113	158	14	7.53	**186**
May-09	HERG	261	194	1.35	0	338	23	62	27.68	45	23	68	19	8.48	90	68	113	18	8.04	135	113	158	37	16.52	**224**
Jun-09	HERG	135	90	1.50	0	338	23	45	37.19	45	23	68	12	9.92	90	68	113	7	5.79	135	113	158	17	14.05	**121**
Sep-09	HERG	352	59	5.97	0	338	23	18	33.33	45	23	68	9	16.67	90	68	113	1	1.85	135	113	158	10	18.52	**54**
Oct-09	HERG	237	62	3.82	0	338	23	9	13.04	45	23	68	20	28.99	90	68	113	9	13.04	135	113	158	4	5.80	**69**
Nov-09	HERG	416	149	2.79	0	338	23	22	9.82	45	23	68	53	23.66	90	68	113	13	5.80	135	113	158	34	15.18	**224**
Winter2008(DJF)	HERG	1219	170	7.17	0	338	23	17	6.39	45	23	68	26	9.77	90	68	113	20	7.52	135	113	158	83	31.20	**266**
Spring2008(MAM)	HERG	5024	1016	4.94	0	338	23	164	11.06	45	23	68	208	14.03	90	68	113	276	18.61	135	113	158	273	18.41	**1483**
Spring2009(MAM)	HERG	1737	690	2.52	0	338	23	183	20.11	45	23	68	155	17.03	90	68	113	114	12.53	135	113	158	121	13.30	**910**
Summer2009(JJ)	HERG	135	90	1.50	0	338	23	45	37.19	45	23	68	12	9.92	90	68	113	7	5.79	135	113	158	17	14.05	**121**
Autumn2009(ASON)	HERG	1032	290	3.56	0	338	23	49	13.32	45	23	68	85	23.10	90	68	113	30	8.15	135	113	158	55	14.95	**368**
2008	HERG	7991	1810	4.41	0	338	23	255	10.12	45	23	68	283	11.23	90	68	113	335	13.29	135	113	158	456	18.10	**2520**
2009	HERG	5799	1664	3.49	0	338	23	382	17.29	45	23	68	395	17.87	90	68	113	195	8.82	135	113	158	273	12.35	**2210**
Overall	SUSC	12463	709	17.58	0	338	23	978	14.16	45	23	68	1390	20.12	90	68	113	416	6.02	135	113	158	108	1.56	**6908**
Mar-08	SUSC	2181	71	30.72	0	338	23	493	52.78	45	23	68	69	7.39	90	68	113	0	0.00	135	113	158	13	1.39	**934**
Apr-08	SUSC	3048	142	21.46	0	338	23	148	11.14	45	23	68	794	59.79	90	68	113	229	17.24	135	113	158	20	1.51	**1328**
Nov-08	SUSC	2348	52	45.15	0	338	23	6	0.26	45	23	68	33	1.42	90	68	113	2	0.09	135	113	158	0	0.00	**2318**
Dec-08	SUSC	1029	41	25.10	0	338	23	72	24.66	45	23	68	7	2.40	90	68	113	11	3.77	135	113	158	48	16.44	**292**
Feb-09	SUSC	1165	121	9.63	0	338	23	74	17.37	45	23	68	46	10.80	90	68	113	34	7.98	135	113	158	0	0.00	**426**
Mar-09	SUSC	664	84	7.90	0	338	23	108	43.90	45	23	68	30	12.20	90	68	113	21	8.54	135	113	158	6	2.44	**246**
Apr-09	SUSC	604	48	12.58	0	338	23	39	8.44	45	23	68	316	68.40	90	68	113	69	14.94	135	113	158	0	0.00	**462**
Nov-09	SUSC	435	16	27.19	0	338	23	4	0.92	45	23	68	25	5.75	90	68	113	3	0.69	135	113	158	0	0.00	**435**
Spring2008(MAM)	SUSC	5230	214	24.44	0	338	23	642	28.37	45	23	68	863	38.14	90	68	113	229	10.12	135	113	158	33	1.46	**2263**
Spring2009(MAM)	SUSC	1292	133	9.71	0	338	23	147	20.08	45	23	68	346	47.27	90	68	113	114	15.57	135	113	158	6	0.82	**732**
2008	SUSC	8828	336	26.27	0	338	23	720	14.34	45	23	68	911	18.14	90	68	113	242	4.82	135	113	158	83	1.65	**5021**
Overall	DCCO	10892	394	27.64	0	338	23	1881	17.53	45	23	68	2512	23.41	90	68	113	321	2.99	135	113	158	126	1.17	**10730**
Apr-08	DCCO	1846	64	28.84	0	338	23	986	53.67	45	23	68	623	33.91	90	68	113	166	9.04	135	113	158	0	0.00	**1837**
May-08	DCCO	717	63	11.38	0	338	23	196	29.47	45	23	68	303	45.56	90	68	113	70	10.53	135	113	158	42	6.32	**665**
Sep-08	DCCO	218	15	14.53	0	338	23	15	6.88	45	23	68	26	11.93	90	68	113	50	22.94	135	113	158	0	0.00	**218**
Oct-08	DCCO	4157	99	41.99	0	338	23	12	0.29	45	23	68	1	0.02	90	68	113	16	0.39	135	113	158	79	1.90	**4154**
Apr-09	DCCO	1869	60	31.15	0	338	23	628	34.06	45	23	68	1067	57.86	90	68	113	14	0.76	135	113	158	2	0.11	**1844**
Oct-09	DCCO	931	19	49.00	0	338	23	10	1.08	45	23	68	485	52.32	90	68	113	0	0.00	135	113	158	1	0.11	**927**
Spring2008(MAM)	DCCO	2563	127	20.18	0	338	23	1182	47.24	45	23	68	926	37.01	90	68	113	236	9.43	135	113	158	42	1.68	**2502**
Autumn2008(ASON)	DCCO	5268	130	40.52	0	338	23	27	0.51	45	23	68	27	0.51	90	68	113	66	1.25	135	113	158	79	1.50	**5265**
Spring2009(MAM)	DCCO	1972	83	23.76	0	338	23	662	34.93	45	23	68	1069	56.41	90	68	113	16	0.84	135	113	158	2	0.11	**1895**
Autumn2009(ASON)	DCCO	1053	31	33.97	0	338	23	10	0.96	45	23	68	488	46.97	90	68	113	0	0.00	135	113	158	1	0.10	**1039**
2008	DCCO	7861	275	28.59	0	338	23	1209	15.52	45	23	68	954	12.25	90	68	113	304	3.90	135	113	158	123	1.58	**7790**
Jan-08	BLSC	1369	51	26.84	0	338	23	6	1.02	45	23	68	16	2.72	90	68	113	5	0.85	135	113	158	372	63.16	**589**

Table E-1a (*continued*). Frequency distribution of mean flight directions in octants (N, NE, E, SE).

Time Period	Species	Abundance	#Observations	Cluster Size	N					NE					E					SE					Total #Freq (All Octants)
					Center Angle	Low Angle	High Angle	#Freq	%Freq	Center Angle	Low Angle	High Angle	#Freq	%Freq	Center Angle	Low Angle	High Angle	#Freq	%Freq	Center Angle	Low Angle	High Angle	#Freq	%Freq	
Feb-08	BLSC	187	9	20.78	0	338	23	0	0.00	45	23	68	0	0.00	90	68	113	0	0.00	135	113	158	8	8.70	**92**
Dec-08	BLSC	1642	37	44.38	0	338	23	17	1.26	45	23	68	4	0.30	90	68	113	22	1.64	135	113	158	421	31.32	**1344**
Mar-09	BLSC	634	57	11.12	0	338	23	364	75.99	45	23	68	46	9.60	90	68	113	13	2.71	135	113	158	0	0.00	**479**
Dec-09	BLSC	737	40	18.43	0	338	23	45	11.66	45	23	68	81	20.98	90	68	113	10	2.59	135	113	158	4	1.04	**386**
Winter2008(DJF)	BLSC	1556	60	25.93	0	338	23	6	0.88	45	23	68	16	2.35	90	68	113	5	0.73	135	113	158	380	55.80	**681**
Winter2010(DJF)	BLSC	737	40	18.43	0	338	23	45	11.66	45	23	68	81	20.98	90	68	113	10	2.59	135	113	158	4	1.04	**386**
Jan-08	SCAU	750	1	750.00	0	338	23	8	8.89	45	23	68	26	28.89	90	68	113	31	34.44	135	113	158	0	0.00	**90**
Jan-09	SCAU	4617	32	144.28	0	338	23	704	17.97	45	23	68	1398	35.69	90	68	113	192	4.90	135	113	158	0	0.00	**3917**
Winter2008(DJF)	SCAU	750	1	750.00	0	338	23	8	5.59	45	23	68	28	19.58	90	68	113	76	53.15	135	113	158	0	0.00	**143**
Winter2009(DJF)	SCAU	4617	32	144.28	0	338	23	704	17.97	45	23	68	1398	35.69	90	68	113	192	4.90	135	113	158	0	0.00	**3917**
2009	SCAU	4617	32	144.28	0	338	23	704	17.97	45	23	68	1398	35.69	90	68	113	192	4.90	135	113	158	0	0.00	**3917**
Jan-08	LTDU	603	57	10.58	0	338	23	8	8.89	45	23	68	26	28.89	90	68	113	31	34.44	135	113	158	0	0.00	**90**
Feb-08	LTDU	82	8	10.25	0	338	23	0	0.00	45	23	68	2	3.77	90	68	113	45	84.91	135	113	158	0	0.00	**53**
Feb-09	LTDU	2483	265	9.37	0	338	23	173	24.82	45	23	68	27	3.87	90	68	113	71	10.19	135	113	158	76	10.90	**697**
Mar-09	LTDU	723	87	8.31	0	338	23	35	16.36	45	23	68	34	15.89	90	68	113	14	6.54	135	113	158	6	2.80	**214**
Dec-09	LTDU	441	72	6.13	0	338	23	27	14.44	45	23	68	19	10.16	90	68	113	2	1.07	135	113	158	1	0.53	**187**
Winter2008(DJF)	LTDU	685	65	10.54	0	338	23	8	5.59	45	23	68	28	19.58	90	68	113	76	53.15	135	113	158	0	0.00	**143**
Winter2009(DJF)	LTDU	4152	404	10.28	0	338	23	229	21.71	45	23	68	69	6.54	90	68	113	93	8.82	135	113	158	109	10.33	**1055**
Winter2010(DJF)	LTDU	441	72	6.13	0	338	23	27	14.44	45	23	68	19	10.16	90	68	113	2	1.07	135	113	158	1	0.53	**187**
2009	LTDU	5195	563	9.23	0	338	23	291	19.64	45	23	68	106	7.15	90	68	113	109	7.35	135	113	158	109	7.35	**1482**
Feb-08	COLO	97	62	1.56	0	338	23	0	0.00	45	23	68	0	0.00	90	68	113	0	0.00	135	113	158	1	50.00	**2**
Feb-09	COLO	979	333	2.94	0	338	23	0	0.00	45	23	68	0	0.00	90	68	113	1	20.00	135	113	158	0	0.00	**5**
May-09	COLO	617	352	1.75	0	338	23	6	9.68	45	23	68	37	59.68	90	68	113	10	16.13	135	113	158	4	6.45	**62**
Mar-08	GULG	832	29	28.69	0	338	23	45	27.27	45	23	68	8	4.85	90	68	113	14	8.48	135	113	158	0	0.00	**165**
Jan-09	GULG	1991	17	117.12	0	338	23	0	0.00	45	23	68	0	0.00	90	68	113	0	0.00	135	113	158	0	0.00	**26**
Feb-09	GULG	1362	42	32.43	0	338	23	1	0.60	45	23	68	16	9.52	90	68	113	36	21.43	135	113	158	6	3.57	**168**
Sep-09	GULG	473	14	33.79	0	338	23	5	26.32	45	23	68	2	10.53	90	68	113	0	0.00	135	113	158	0	0.00	**19**
Oct-09	GULG	598	32	18.69	0	338	23	0	0.00	45	23	68	42	53.85	90	68	113	4	5.13	135	113	158	7	8.97	**78**
Nov-09	GULG	875	21	41.67	0	338	23	1	0.23	45	23	68	15	3.49	90	68	113	2	0.47	135	113	158	3	0.70	**430**
Dec-09	GULG	472	16	29.50	0	338	23	2	6.45	45	23	68	0	0.00	90	68	113	0	0.00	135	113	158	14	45.16	**31**
Winter2009(DJF)	GULG	3377	67	50.40	0	338	23	2	0.92	45	23	68	16	7.34	90	68	113	39	17.89	135	113	158	8	3.67	**218**
Autumn2009(ASON)	GULG	1989	72	27.63	0	338	23	6	1.13	45	23	68	59	11.15	90	68	113	6	1.13	135	113	158	12	2.27	**529**
Winter2010(DJF)	GULG	472	16	29.50	0	338	23	2	6.45	45	23	68	0	0.00	90	68	113	0	0.00	135	113	158	14	45.16	**31**
2009	GULG	6129	204	30.04	0	338	23	31	3.05	45	23	68	98	9.64	90	68	113	49	4.82	135	113	158	41	4.03	**1017**
Apr-08	SCOT	1607	50	32.14	0	338	23	159	12.05	45	23	68	766	58.07	90	68	113	239	18.12	135	113	158	123	9.33	**1319**
Dec-08	SCOT	1328	8	166.00	0	338	23	0	0.00	45	23	68	0	0.00	90	68	113	0	0.00	135	113	158	80	6.03	**1326**
Jan-09	SCOT	2811	33	85.18	0	338	23	0	0.00	45	23	68	0	0.00	90	68	113	450	100.00	135	113	158	0	0.00	**450**

Table E-1a (*continued*). Frequency distribution of mean flight directions in octants (N, NE, E, SE).

Time Period	Species	Abundance	#Observations	Cluster Size	N					NE					E					SE					Total #Freq (All Octants)
					Center Angle	Low Angle	High Angle	#Freq	%Freq	Center Angle	Low Angle	High Angle	#Freq	%Freq	Center Angle	Low Angle	High Angle	#Freq	%Freq	Center Angle	Low Angle	High Angle	#Freq	%Freq	
Winter2009(DJF)	SCOT	4943	74	66.80	0	338	23	1	0.06	45	23	68	7	0.39	90	68	113	451	25.27	135	113	158	80	4.48	**1785**
May-08	LAGU	712	237	3.00	0	338	23	91	15.09	45	23	68	100	16.58	90	68	113	36	5.97	135	113	158	19	3.15	**603**
Jun-08	LAGU	531	315	1.69	0	338	23	30	7.13	45	23	68	72	17.10	90	68	113	47	11.16	135	113	158	52	12.35	**421**
Jul-08	LAGU	673	415	1.62	0	338	23	43	7.30	45	23	68	54	9.17	90	68	113	89	15.11	135	113	158	86	14.60	**589**
Aug-08	LAGU	1349	473	2.85	0	338	23	236	23.74	45	23	68	213	21.43	90	68	113	92	9.26	135	113	158	98	9.86	**994**
Sep-08	LAGU	580	334	1.74	0	338	23	80	16.46	45	23	68	112	23.05	90	68	113	45	9.26	135	113	158	57	11.73	**486**
Oct-08	LAGU	1027	298	3.45	0	338	23	86	12.15	45	23	68	48	6.78	90	68	113	41	5.79	135	113	158	36	5.08	**708**
Nov-08	LAGU	1738	199	8.73	0	338	23	127	27.73	45	23	68	12	2.62	90	68	113	20	4.37	135	113	158	55	12.01	**458**
May-09	LAGU	215	151	1.42	0	338	23	46	23.83	45	23	68	43	22.28	90	68	113	14	7.25	135	113	158	18	9.33	**193**
Jun-09	LAGU	466	286	1.63	0	338	23	47	14.29	45	23	68	48	14.59	90	68	113	45	13.68	135	113	158	64	19.45	**329**
Aug-09	LAGU	767	375	2.05	0	338	23	65	12.10	45	23	68	85	15.83	90	68	113	58	10.80	135	113	158	81	15.08	**537**
Sep-09	LAGU	251	180	1.39	0	338	23	37	22.29	45	23	68	13	7.83	90	68	113	8	4.82	135	113	158	30	18.07	**166**
Oct-09	LAGU	1334	170	7.85	0	338	23	16	3.32	45	23	68	80	16.60	90	68	113	20	4.15	135	113	158	27	5.60	**482**
Summer2008(JJ)	LAGU	1204	730	1.65	0	338	23	73	7.23	45	23	68	126	12.48	90	68	113	136	13.47	135	113	158	138	13.66	**1010**
Autumn2008(ASON)	LAGU	4694	1304	3.60	0	338	23	529	19.99	45	23	68	385	14.55	90	68	113	198	7.48	135	113	158	246	9.30	**2646**
Summer2009(JJ)	LAGU	466	286	1.63	0	338	23	47	14.29	45	23	68	48	14.59	90	68	113	45	13.68	135	113	158	64	19.45	**329**
Autumn2009(ASON)	LAGU	2404	757	3.18	0	338	23	127	10.28	45	23	68	181	14.66	90	68	113	91	7.37	135	113	158	138	11.17	**1235**
May-08	GBBG	341	189	1.80	0	338	23	35	18.92	45	23	68	14	7.57	90	68	113	34	18.38	135	113	158	22	11.89	**185**
Jun-08	GBBG	127	97	1.31	0	338	23	11	12.36	45	23	68	14	15.73	90	68	113	21	23.60	135	113	158	15	16.85	**89**
Aug-08	GBBG	147	121	1.21	0	338	23	4	4.82	45	23	68	4	4.82	90	68	113	3	3.61	135	113	158	8	9.64	**83**
Sep-08	GBBG	379	255	1.49	0	338	23	32	13.97	45	23	68	17	7.42	90	68	113	24	10.48	135	113	158	41	17.90	**229**
Jun-09	GBBG	146	119	1.23	0	338	23	27	21.26	45	23	68	20	15.75	90	68	113	13	10.24	135	113	158	25	19.69	**127**
Aug-09	GBBG	169	140	1.21	0	338	23	2	2.04	45	23	68	11	11.22	90	68	113	3	3.06	135	113	158	13	13.27	**98**
Sep-09	GBBG	174	99	1.76	0	338	23	11	15.94	45	23	68	17	24.64	90	68	113	5	7.25	135	113	158	8	11.59	**69**
Oct-09	GBBG	471	212	2.22	0	338	23	18	12.33	45	23	68	15	10.27	90	68	113	9	6.16	135	113	158	28	19.18	**146**
Summer2009(JJ)	GBBG	146	119	1.23	0	338	23	27	21.26	45	23	68	20	15.75	90	68	113	13	10.24	135	113	158	25	19.69	**127**
Jun-08	WISP	400	199	2.01	0	338	23	6	1.50	45	23	68	25	6.25	90	68	113	16	4.00	135	113	158	35	8.75	**400**
Jul-08	WISP	446	251	1.78	0	338	23	28	8.92	45	23	68	51	16.24	90	68	113	48	15.29	135	113	158	71	22.61	**314**
Aug-08	WISP	1251	175	7.15	0	338	23	826	77.92	45	23	68	23	2.17	90	68	113	29	2.74	135	113	158	34	3.21	**1060**
Aug-09	WISP	374	321	1.17	0	338	23	51	13.86	45	23	68	38	10.33	90	68	113	37	10.05	135	113	158	56	15.22	**368**
Sep-09	WISP	281	247	1.14	0	338	23	20	7.52	45	23	68	30	11.28	90	68	113	30	11.28	135	113	158	72	27.07	**266**
Summer2008(JJ)	WISP	846	450	1.88	0	338	23	34	4.76	45	23	68	76	10.64	90	68	113	64	8.96	135	113	158	106	14.85	**714**
Jun-08	COTE	339	195	1.74	0	338	23	8	2.37	45	23	68	24	7.12	90	68	113	33	9.79	135	113	158	61	18.10	**337**
Jul-08	COTE	366	181	2.02	0	338	23	17	5.09	45	23	68	32	9.58	90	68	113	27	8.08	135	113	158	110	32.93	**334**
Aug-08	COTE	798	354	2.25	0	338	23	111	14.32	45	23	68	67	8.65	90	68	113	20	2.58	135	113	158	90	11.61	**775**
Sep-08	COTE	392	133	2.95	0	338	23	107	27.72	45	23	68	38	9.84	90	68	113	45	11.66	135	113	158	21	5.44	**386**
May-09	COTE	175	83	2.11	0	338	23	7	4.09	45	23	68	12	7.02	90	68	113	12	7.02	135	113	158	24	14.04	**171**
Jun-09	COTE	290	202	1.44	0	338	23	33	11.46	45	23	68	26	9.03	90	68	113	25	8.68	135	113	158	65	22.57	**288**

Table E-1a (*continued*). Frequency distribution of mean flight directions in octants (N, NE, E, SE).

Time Period	Species	Abundance	#Observations	Cluster Size	N					NE					E					SE					Total #Freq (All Octants)
					Center Angle	Low Angle	High Angle	#Freq	%Freq	Center Angle	Low Angle	High Angle	#Freq	%Freq	Center Angle	Low Angle	High Angle	#Freq	%Freq	Center Angle	Low Angle	High Angle	#Freq	%Freq	
Aug-09	COTE	129	99	1.30	0	338	23	14	10.85	45	23	68	12	9.30	90	68	113	5	3.88	135	113	158	23	17.83	**129**
Summer2008(JJ)	COTE	705	376	1.88	0	338	23	25	3.73	45	23	68	56	8.35	90	68	113	60	8.94	135	113	158	171	25.48	**671**
Summer2009(JJ)	COTE	290	202	1.44	0	338	23	33	11.46	45	23	68	26	9.03	90	68	113	25	8.68	135	113	158	65	22.57	**288**
Jul-08	COSH	117	44	2.66	0	338	23	2	4.55	45	23	68	7	15.91	90	68	113	7	15.91	135	113	158	13	29.55	**44**
Aug-09	COSH	72	65	1.11	0	338	23	7	10.77	45	23	68	9	13.85	90	68	113	4	6.15	135	113	158	20	30.77	**65**
Summer2008(JJ)	COSH	188	87	2.16	0	338	23	6	6.19	45	23	68	17	17.53	90	68	113	14	14.43	135	113	158	19	19.59	**97**
Jul-08	TESM	72	11	6.55	0	338	23	0	0.00	45	23	68	15	20.83	90	68	113	0	0.00	135	113	158	2	2.78	**72**
Aug-08	PASS	118	58	2.03	0	338	23	20	16.95	45	23	68	2	1.69	90	68	113	1	0.85	135	113	158	0	0.00	**118**
Sep-08	SHSM	200	3	66.67	0	338	23	0	0.00	45	23	68	0	0.00	90	68	113	0	0.00	135	113	158	0	0.00	**200**
Oct-08	SHSM	533	5	106.60	0	338	23	0	0.00	45	23	68	0	0.00	90	68	113	0	0.00	135	113	158	0	0.00	**171**
Oct-08	FOTE	688	81	8.49	0	338	23	5	0.84	45	23	68	52	8.77	90	68	113	34	5.73	135	113	158	96	16.19	**593**
Nov-08	CANG	2548	22	115.82	0	338	23	0	0.00	45	23	68	0	0.00	90	68	113	0	0.00	135	113	158	0	0.00	**2548**
Autumn2008(ASON)	CANG	2637	26	101.42	0	338	23	0	0.00	45	23	68	0	0.00	90	68	113	0	0.00	135	113	158	0	0.00	**2637**
Jan-09	GRSC	1568	9	174.22	0	338	23	2	2.94	45	23	68	15	22.06	90	68	113	0	0.00	135	113	158	0	0.00	**68**
Nov-09	RTLO	892	259	3.44	0	338	23	9	1.13	45	23	68	8	1.00	90	68	113	1	0.13	135	113	158	8	1.00	**799**

Table E-1b. Frequency distribution of mean flight directions in octants (S, SW, W, NW).

Time Period	Species	Abundance	#Observations	Cluster Size	S					SW					W					NW					Total #Freq (All Octants)
					Center Angle	Low Angle	High Angle	#Freq	%Freq	Center Angle	Low Angle	High Angle	#Freq	%Freq	Center Angle	Low Angle	High Angle	#Freq	%Freq	Center Angle	Low Angle	High Angle	#Freq	%Freq	
Overall	TOTAL	177266	35547	4.99	180	158	203	16316	14.86	225	203	248	24761	22.55	270	248	293	12563	11.44	315	293	338	7606	6.93	**109794**
Jan-08	TOTAL	6500	1212	5.36	180	158	203	272	13.07	225	203	248	156	7.50	270	248	293	203	9.75	315	293	338	209	10.04	**2081**
Feb-08	TOTAL	580	208	2.79	180	158	203	24	7.34	225	203	248	4	1.22	270	248	293	20	6.12	315	293	338	108	33.03	**327**
Mar-08	TOTAL	17569	3068	5.73	180	158	203	832	9.10	225	203	248	1407	15.40	270	248	293	1238	13.55	315	293	338	760	8.32	**9139**
Apr-08	TOTAL	15624	3362	4.65	180	158	203	517	4.77	225	203	248	383	3.53	270	248	293	405	3.73	315	293	338	738	6.80	**10850**
May-08	TOTAL	4446	1901	2.34	180	158	203	379	10.75	225	203	248	525	14.89	270	248	293	266	7.54	315	293	338	332	9.41	**3527**
Jun-08	TOTAL	1964	1198	1.64	180	158	203	378	22.58	225	203	248	187	11.17	270	248	293	176	10.51	315	293	338	242	14.46	**1674**
Jul-08	TOTAL	1957	1061	1.84	180	158	203	199	12.51	225	203	248	211	13.26	270	248	293	253	15.90	315	293	338	153	9.62	**1591**
Aug-08	TOTAL	4255	1457	2.92	180	158	203	393	11.57	225	203	248	374	11.01	270	248	293	223	6.57	315	293	338	377	11.10	**3396**
Sep-08	TOTAL	2612	1103	2.37	180	158	203	304	13.84	225	203	248	403	18.35	270	248	293	260	11.84	315	293	338	243	11.07	**2196**
Oct-08	TOTAL	11928	1729	6.90	180	158	203	1351	13.52	225	203	248	3263	32.65	270	248	293	2951	29.53	315	293	338	650	6.50	**9994**
Nov-08	TOTAL	27018	2694	10.03	180	158	203	2500	12.28	225	203	248	10126	49.74	270	248	293	2526	12.41	315	293	338	477	2.34	**20358**
Dec-08	TOTAL	9672	1150	8.41	180	158	203	3361	55.18	225	203	248	808	13.27	270	248	293	324	5.32	315	293	338	196	3.22	**6091**
Jan-09	TOTAL	20306	1618	12.55	180	158	203	1777	19.04	225	203	248	2190	23.47	270	248	293	417	4.47	315	293	338	257	2.75	**9332**
Feb-09	TOTAL	10953	1919	5.71	180	158	203	326	10.49	225	203	248	368	11.84	270	248	293	574	18.47	315	293	338	346	11.13	**3108**
Mar-09	TOTAL	6494	2058	3.16	180	158	203	231	7.23	225	203	248	396	12.40	270	248	293	307	9.61	315	293	338	350	10.96	**3193**
Apr-09	TOTAL	6122	1038	5.90	180	158	203	377	7.13	225	203	248	719	13.59	270	248	293	156	2.95	315	293	338	128	2.42	**5290**
May-09	TOTAL	3052	1744	1.75	180	158	203	271	13.09	225	203	248	185	8.93	270	248	293	144	6.95	315	293	338	341	16.47	**2071**
Jun-09	TOTAL	1817	1309	1.39	180	158	203	119	8.43	225	203	248	136	9.64	270	248	293	128	9.07	315	293	338	179	12.69	**1411**
Aug-09	TOTAL	1885	1201	1.57	180	158	203	148	9.87	225	203	248	203	13.53	270	248	293	151	10.07	315	293	338	289	19.27	**1500**
Sep-09	TOTAL	1923	814	2.36	180	158	203	119	12.96	225	203	248	124	13.51	270	248	293	104	11.33	315	293	338	96	10.46	**918**
Oct-09	TOTAL	4065	619	6.57	180	158	203	254	11.81	225	203	248	555	25.80	270	248	293	251	11.67	315	293	338	201	9.34	**2151**
Nov-09	TOTAL	10757	1890	5.69	180	158	203	1528	23.37	225	203	248	1246	19.05	270	248	293	833	12.74	315	293	338	809	12.37	**6539**
Dec-09	TOTAL	5767	1194	4.83	180	158	203	656	21.46	225	203	248	792	25.91	270	248	293	653	21.36	315	293	338	125	4.09	**3057**
Winter2008(DJF)	TOTAL	7080	1420	4.99	180	158	203	296	12.29	225	203	248	160	6.64	270	248	293	223	9.26	315	293	338	317	13.16	**2408**
Spring2008(MAM)	TOTAL	37639	8331	4.52	180	158	203	1728	7.35	225	203	248	2315	9.84	270	248	293	1909	8.12	315	293	338	1830	7.78	**23516**
Summer2008(JJ)	TOTAL	3921	2259	1.74	180	158	203	577	17.67	225	203	248	398	12.19	270	248	293	429	13.14	315	293	338	395	12.10	**3265**
Autumn2008(ASON)	TOTAL	45813	6983	6.56	180	158	203	4548	12.65	225	203	248	14166	39.41	270	248	293	5960	16.58	315	293	338	1747	4.86	**35944**
Winter2009(DJF)	TOTAL	40931	4687	8.73	180	158	203	5464	29.49	225	203	248	3366	18.16	270	248	293	1315	7.10	315	293	338	799	4.31	**18531**
Spring2009(MAM)	TOTAL	15668	4840	3.24	180	158	203	879	8.33	225	203	248	1300	12.32	270	248	293	607	5.75	315	293	338	819	7.76	**10554**
Summer2009(JJ)	TOTAL	1817	1309	1.39	180	158	203	119	8.43	225	203	248	136	9.64	270	248	293	128	9.07	315	293	338	179	12.69	**1411**
Autumn2009(ASON)	TOTAL	18630	4524	4.12	180	158	203	2049	18.45	225	203	248	2128	19.16	270	248	293	1339	12.05	315	293	338	1395	12.56	**11108**
Winter2010(DJF)	TOTAL	5767	1194	4.83	180	158	203	656	21.46	225	203	248	792	25.91	270	248	293	653	21.36	315	293	338	125	4.09	**3057**
2008	TOTAL	104125	20143	5.17	180	158	203	10510	14.76	225	203	248	17847	25.06	270	248	293	8845	12.42	315	293	338	4485	6.30	**71224**
2009	TOTAL	73141	15404	4.75	180	158	203	5806	15.05	225	203	248	6914	17.93	270	248	293	3718	9.64	315	293	338	3121	8.09	**38570**
Overall	NOGA	34020	9822	3.46	180	158	203	3764	16.47	225	203	248	3812	16.68	270	248	293	2798	12.24	315	293	338	2347	10.27	**22856**
Jan-08	NOGA	898	482	1.86	180	158	203	60	8.66	225	203	248	66	9.52	270	248	293	95	13.71	315	293	338	63	9.09	**693**
Feb-08	NOGA	49	33	1.48	180	158	203	3	8.11	225	203	248	3	8.11	270	248	293	3	8.11	315	293	338	1	2.70	**37**
Mar-08	NOGA	4980	1351	3.69	180	158	203	503	15.02	225	203	248	466	13.92	270	248	293	316	9.44	315	293	338	317	9.47	**3348**
Apr-08	NOGA	3271	1409	2.32	180	158	203	296	14.22	225	203	248	108	5.19	270	248	293	163	7.83	315	293	338	476	22.87	**2081**
May-08	NOGA	858	582	1.47	180	158	203	80	11.38	225	203	248	44	6.26	270	248	293	66	9.39	315	293	338	116	16.50	**703**

Table E-1b (*continued*). Frequency distribution of mean flight directions in octants (S, SW, W, NW).

Time Period	Species	Abundance	#Observations	Cluster Size	S					SW					W					NW					Total #Freq (All Octants)
					Center Angle	Low Angle	High Angle	#Freq	%Freq	Center Angle	Low Angle	High Angle	#Freq	%Freq	Center Angle	Low Angle	High Angle	#Freq	%Freq	Center Angle	Low Angle	High Angle	#Freq	%Freq	
Jun-08	NOGA	270	195	1.38	180	158	203	32	16.41	225	203	248	38	19.49	270	248	293	14	7.18	315	293	338	24	12.31	**195**
Oct-08	NOGA	1692	492	3.44	180	158	203	203	14.71	225	203	248	409	29.64	270	248	293	462	33.48	315	293	338	112	8.12	**1380**
Nov-08	NOGA	9402	1045	9.00	180	158	203	322	5.33	225	203	248	1708	28.29	270	248	293	987	16.35	315	293	338	128	2.12	**6037**
Dec-08	NOGA	470	308	1.53	180	158	203	62	18.08	225	203	248	68	19.83	270	248	293	27	7.87	315	293	338	31	9.04	**343**
Jan-09	NOGA	1849	417	4.43	180	158	203	1291	75.63	225	203	248	112	6.56	270	248	293	68	3.98	315	293	338	54	3.16	**1707**
Mar-09	NOGA	840	468	1.79	180	158	203	41	6.79	225	203	248	87	14.40	270	248	293	75	12.42	315	293	338	76	12.58	**604**
Apr-09	NOGA	400	303	1.32	180	158	203	30	9.32	225	203	248	49	15.22	270	248	293	28	8.70	315	293	338	51	15.84	**322**
May-09	NOGA	1077	674	1.60	180	158	203	110	13.50	225	203	248	82	10.06	270	248	293	41	5.03	315	293	338	123	15.09	**815**
Jun-09	NOGA	431	343	1.26	180	158	203	20	8.44	225	203	248	22	9.28	270	248	293	16	6.75	315	293	338	17	7.17	**237**
Nov-09	NOGA	6394	981	6.52	180	158	203	529	15.14	225	203	248	327	9.36	270	248	293	304	8.70	315	293	338	713	20.40	**3495**
Dec-09	NOGA	628	331	1.90	180	158	203	123	25.52	225	203	248	156	32.37	270	248	293	94	19.50	315	293	338	12	2.49	**482**
Winter2008(DJF)	NOGA	947	515	1.84	180	158	203	63	8.63	225	203	248	69	9.45	270	248	293	98	13.42	315	293	338	64	8.77	**730**
Spring2008(MAM)	NOGA	9109	3342	2.73	180	158	203	879	14.33	225	203	248	618	10.08	270	248	293	545	8.89	315	293	338	909	14.82	**6132**
Summer2008(JJ)	NOGA	312	232	1.34	180	158	203	33	14.73	225	203	248	43	19.20	270	248	293	14	6.25	315	293	338	25	11.16	**224**
Autumn2008(ASON)	NOGA	11217	1631	6.88	180	158	203	542	7.24	225	203	248	2127	28.40	270	248	293	1455	19.43	315	293	338	244	3.26	**7490**
Spring2009(MAM)	NOGA	2317	1445	1.60	180	158	203	181	10.40	225	203	248	218	12.52	270	248	293	144	8.27	315	293	338	250	14.36	**1741**
Summer2009(JJ)	NOGA	431	343	1.26	180	158	203	20	8.44	225	203	248	22	9.28	270	248	293	16	6.75	315	293	338	17	7.17	**237**
Autumn2009(ASON)	NOGA	6474	1050	6.17	180	158	203	537	15.14	225	203	248	333	9.39	270	248	293	313	8.82	315	293	338	716	20.19	**3547**
Winter2010(DJF)	NOGA	628	331	1.90	180	158	203	123	25.52	225	203	248	156	32.37	270	248	293	94	19.50	315	293	338	12	2.49	**482**
2008	NOGA	22055	6028	3.66	180	158	203	1579	10.58	225	203	248	2925	19.61	270	248	293	2139	14.34	315	293	338	1273	8.53	**14919**
2009	NOGA	11965	3794	3.15	180	158	203	2185	27.53	225	203	248	887	11.18	270	248	293	659	8.30	315	293	338	1074	13.53	**7937**
Overall	SCDW	13933	364	38.28	180	158	203	1974	17.76	225	203	248	2967	26.70	270	248	293	692	6.23	315	293	338	188	1.69	**11113**
Mar-08	SCDW	1522	36	42.28	180	158	203	31	2.05	225	203	248	420	27.83	270	248	293	74	4.90	315	293	338	9	0.60	**1509**
Apr-08	SCDW	1885	69	27.32	180	158	203	20	1.33	225	203	248	16	1.07	270	248	293	0	0.00	315	293	338	0	0.00	**1500**
Nov-08	SCDW	2932	30	97.73	180	158	203	173	5.90	225	203	248	1543	52.63	270	248	293	232	7.91	315	293	338	18	0.61	**2932**
Dec-08	SCDW	3025	21	144.05	180	158	203	1283	87.58	225	203	248	168	11.47	270	248	293	0	0.00	315	293	338	5	0.34	**1465**
Apr-09	SCDW	1599	36	44.42	180	158	203	135	8.60	225	203	248	342	21.80	270	248	293	0	0.00	315	293	338	4	0.25	**1569**
Dec-09	SCDW	473	16	29.56	180	158	203	71	29.22	225	203	248	108	44.44	270	248	293	0	0.00	315	293	338	2	0.82	**243**
Spring2008(MAM)	SCDW	3407	105	32.45	180	158	203	51	1.69	225	203	248	436	14.49	270	248	293	74	2.46	315	293	338	9	0.30	**3009**
Autumn2008(ASON)	SCDW	3228	49	65.88	180	158	203	175	5.42	225	203	248	1662	51.49	270	248	293	299	9.26	315	293	338	19	0.59	**3228**
Winter2009(DJF)	SCDW	4468	107	41.76	180	158	203	1465	59.17	225	203	248	244	9.85	270	248	293	164	6.62	315	293	338	101	4.08	**2476**
Spring2009(MAM)	SCDW	1985	71	27.96	180	158	203	187	10.44	225	203	248	395	22.05	270	248	293	22	1.23	315	293	338	17	0.95	**1791**
Winter2010(DJF)	SCDW	473	16	29.56	180	158	203	71	29.22	225	203	248	108	44.44	270	248	293	0	0.00	315	293	338	2	0.82	**243**
2008	SCDW	9669	178	54.32	180	158	203	1509	19.58	225	203	248	2266	29.41	270	248	293	375	4.87	315	293	338	33	0.43	**7705**
Overall	HERG	13790	3474	3.97	180	158	203	477	10.08	225	203	248	485	10.25	270	248	293	494	10.44	315	293	338	700	14.80	**4730**
Jan-08	HERG	1158	129	8.98	180	158	203	7	3.40	225	203	248	11	5.34	270	248	293	39	18.93	315	293	338	40	19.42	**206**
Feb-08	HERG	61	41	1.49	180	158	203	2	3.33	225	203	248	0	0.00	270	248	293	14	23.33	315	293	338	7	11.67	**60**
Mar-08	HERG	3785	394	9.61	180	158	203	39	5.38	225	203	248	37	5.10	270	248	293	73	10.07	315	293	338	146	20.14	**725**
May-08	HERG	568	249	2.28	180	158	203	24	7.45	225	203	248	34	10.56	270	248	293	26	8.07	315	293	338	53	16.46	**322**
Feb-09	HERG	1710	325	5.26	180	158	203	44	11.67	225	203	248	23	6.10	270	248	293	69	18.30	315	293	338	38	10.08	**377**

Table E-1b (*continued*). Frequency distribution of mean flight directions in octants (S, SW, W, NW).

Time Period	Species	Abundance	#Observations	Cluster Size	S					SW					W					NW					Total #Freq (All Octants)
					Center Angle	Low Angle	High Angle	#Freq	%Freq	Center Angle	Low Angle	High Angle	#Freq	%Freq	Center Angle	Low Angle	High Angle	#Freq	%Freq	Center Angle	Low Angle	High Angle	#Freq	%Freq	
Mar-09	HERG	1037	358	2.90	180	158	203	39	7.80	225	203	248	50	10.00	270	248	293	19	3.80	315	293	338	55	11.00	**500**
Apr-09	HERG	439	138	3.18	180	158	203	12	6.45	225	203	248	16	8.60	270	248	293	28	15.05	315	293	338	30	16.13	**186**
May-09	HERG	261	194	1.35	180	158	203	31	13.84	225	203	248	9	4.02	270	248	293	16	7.14	315	293	338	32	14.29	**224**
Jun-09	HERG	135	90	1.50	180	158	203	12	9.92	225	203	248	9	7.44	270	248	293	6	4.96	315	293	338	13	10.74	**121**
Sep-09	HERG	352	59	5.97	180	158	203	4	7.41	225	203	248	2	3.70	270	248	293	7	12.96	315	293	338	3	5.56	**54**
Oct-09	HERG	237	62	3.82	180	158	203	5	7.25	225	203	248	2	2.90	270	248	293	8	11.59	315	293	338	12	17.39	**69**
Nov-09	HERG	416	149	2.79	180	158	203	27	12.05	225	203	248	42	18.75	270	248	293	20	8.93	315	293	338	13	5.80	**224**
Winter2008(DJF)	HERG	1219	170	7.17	180	158	203	9	3.38	225	203	248	11	4.14	270	248	293	53	19.92	315	293	338	47	17.67	**266**
Spring2008(MAM)	HERG	5024	1016	4.94	180	158	203	109	7.35	225	203	248	98	6.61	270	248	293	117	7.89	315	293	338	238	16.05	**1483**
Spring2009(MAM)	HERG	1737	690	2.52	180	158	203	82	9.01	225	203	248	75	8.24	270	248	293	63	6.92	315	293	338	117	12.86	**910**
Summer2009(JJ)	HERG	135	90	1.50	180	158	203	12	9.92	225	203	248	9	7.44	270	248	293	6	4.96	315	293	338	13	10.74	**121**
Autumn2009(ASON)	HERG	1032	290	3.56	180	158	203	38	10.33	225	203	248	47	12.77	270	248	293	36	9.78	315	293	338	28	7.61	**368**
2008	HERG	7991	1810	4.41	180	158	203	233	9.25	225	203	248	237	9.40	270	248	293	268	10.63	315	293	338	453	17.98	**2520**
2009	HERG	5799	1664	3.49	180	158	203	244	11.04	225	203	248	248	11.22	270	248	293	226	10.23	315	293	338	247	11.18	**2210**
Overall	SUSC	12463	709	17.58	180	158	203	704	10.19	225	203	248	2312	33.47	270	248	293	818	11.84	315	293	338	182	2.63	**6908**
Mar-08	SUSC	2181	71	30.72	180	158	203	17	1.82	225	203	248	82	8.78	270	248	293	229	24.52	315	293	338	31	3.32	**934**
Apr-08	SUSC	3048	142	21.46	180	158	203	17	1.28	225	203	248	39	2.94	270	248	293	22	1.66	315	293	338	59	4.44	**1328**
Nov-08	SUSC	2348	52	45.15	180	158	203	203	8.76	225	203	248	1819	78.47	270	248	293	233	10.05	315	293	338	22	0.95	**2318**
Dec-08	SUSC	1029	41	25.10	180	158	203	101	34.59	225	203	248	47	16.10	270	248	293	6	2.05	315	293	338	0	0.00	**292**
Feb-09	SUSC	1165	121	9.63	180	158	203	28	6.57	225	203	248	74	17.37	270	248	293	152	35.68	315	293	338	18	4.23	**426**
Mar-09	SUSC	664	84	7.90	180	158	203	39	15.85	225	203	248	9	3.66	270	248	293	10	4.07	315	293	338	23	9.35	**246**
Apr-09	SUSC	604	48	12.58	180	158	203	19	4.11	225	203	248	15	3.25	270	248	293	4	0.87	315	293	338	0	0.00	**462**
Nov-09	SUSC	435	16	27.19	180	158	203	191	43.91	225	203	248	98	22.53	270	248	293	114	26.21	315	293	338	0	0.00	**435**
Spring2008(MAM)	SUSC	5230	214	24.44	180	158	203	34	1.50	225	203	248	121	5.35	270	248	293	251	11.09	315	293	338	90	3.98	**2263**
Spring2009(MAM)	SUSC	1292	133	9.71	180	158	203	58	7.92	225	203	248	24	3.28	270	248	293	14	1.91	315	293	338	23	3.14	**732**
2008	SUSC	8828	336	26.27	180	158	203	363	7.23	225	203	248	2050	40.83	270	248	293	524	10.44	315	293	338	128	2.55	**5021**
Overall	DCCO	10892	394	27.64	180	158	203	727	6.78	225	203	248	2657	24.76	270	248	293	2233	20.81	315	293	338	273	2.54	**10730**
Apr-08	DCCO	1846	64	28.84	180	158	203	25	1.36	225	203	248	10	0.54	270	248	293	0	0.00	315	293	338	27	1.47	**1837**
May-08	DCCO	717	63	11.38	180	158	203	32	4.81	225	203	248	3	0.45	270	248	293	12	1.80	315	293	338	7	1.05	**665**
Sep-08	DCCO	218	15	14.53	180	158	203	0	0.00	225	203	248	10	4.59	270	248	293	117	53.67	315	293	338	0	0.00	**218**
Oct-08	DCCO	4157	99	41.99	180	158	203	510	12.28	225	203	248	1679	40.42	270	248	293	1673	40.27	315	293	338	184	4.43	**4154**
Apr-09	DCCO	1869	60	31.15	180	158	203	127	6.89	225	203	248	0	0.00	270	248	293	1	0.05	315	293	338	5	0.27	**1844**
Oct-09	DCCO	931	19	49.00	180	158	203	0	0.00	225	203	248	340	36.68	270	248	293	91	9.82	315	293	338	0	0.00	**927**
Spring2008(MAM)	DCCO	2563	127	20.18	180	158	203	57	2.28	225	203	248	13	0.52	270	248	293	12	0.48	315	293	338	34	1.36	**2502**
Autumn2008(ASON)	DCCO	5268	130	40.52	180	158	203	530	10.07	225	203	248	2256	42.85	270	248	293	2051	38.96	315	293	338	229	4.35	**5265**
Spring2009(MAM)	DCCO	1972	83	23.76	180	158	203	127	6.70	225	203	248	5	0.26	270	248	293	6	0.32	315	293	338	8	0.42	**1895**
Autumn2009(ASON)	DCCO	1053	31	33.97	180	158	203	13	1.25	225	203	248	363	34.94	270	248	293	164	15.78	315	293	338	0	0.00	**1039**
2008	DCCO	7861	275	28.59	180	158	203	587	7.54	225	203	248	2285	29.33	270	248	293	2063	26.48	315	293	338	265	3.40	**7790**
Jan-08	BLSC	1369	51	26.84	180	158	203	123	20.88	225	203	248	26	4.41	270	248	293	23	3.90	315	293	338	18	3.06	**589**

Table E-1b (*continued*). Frequency distribution of mean flight directions in octants (S, SW, W, NW).

Time Period	Species	Abundance	#Observations	Cluster Size	S					SW					W					NW					Total #Freq (All Octants)
					Center Angle	Low Angle	High Angle	#Freq	%Freq	Center Angle	Low Angle	High Angle	#Freq	%Freq	Center Angle	Low Angle	High Angle	#Freq	%Freq	Center Angle	Low Angle	High Angle	#Freq	%Freq	
Feb-08	BLSC	187	9	20.78	180	158	203	12	13.04	225	203	248	0	0.00	270	248	293	0	0.00	315	293	338	72	78.26	**92**
Dec-08	BLSC	1642	37	44.38	180	158	203	409	30.43	225	203	248	338	25.15	270	248	293	131	9.75	315	293	338	2	0.15	**1344**
Mar-09	BLSC	634	57	11.12	180	158	203	7	1.46	225	203	248	22	4.59	270	248	293	10	2.09	315	293	338	17	3.55	**479**
Dec-09	BLSC	737	40	18.43	180	158	203	157	40.67	225	203	248	89	23.06	270	248	293	0	0.00	315	293	338	0	0.00	**386**
Winter2008(DJF)	BLSC	1556	60	25.93	180	158	203	135	19.82	225	203	248	26	3.82	270	248	293	23	3.38	315	293	338	90	13.22	**681**
Winter2010(DJF)	BLSC	737	40	18.43	180	158	203	157	40.67	225	203	248	89	23.06	270	248	293	0	0.00	315	293	338	0	0.00	**386**
Jan-08	SCAU	750	1	750.00	180	158	203	5	5.56	225	203	248	6	6.67	270	248	293	7	7.78	315	293	338	7	7.78	**90**
Jan-09	SCAU	4617	32	144.28	180	158	203	82	2.09	225	203	248	1541	39.34	270	248	293	0	0.00	315	293	338	0	0.00	**3917**
Winter2008(DJF)	SCAU	750	1	750.00	180	158	203	9	6.29	225	203	248	6	4.20	270	248	293	7	4.90	315	293	338	9	6.29	**143**
Winter2009(DJF)	SCAU	4617	32	144.28	180	158	203	82	2.09	225	203	248	1541	39.34	270	248	293	0	0.00	315	293	338	0	0.00	**3917**
2009	SCAU	4617	32	144.28	180	158	203	82	2.09	225	203	248	1541	39.34	270	248	293	0	0.00	315	293	338	0	0.00	**3917**
Jan-08	LTDU	603	57	10.58	180	158	203	5	5.56	225	203	248	6	6.67	270	248	293	7	7.78	315	293	338	7	7.78	**90**
Feb-08	LTDU	82	8	10.25	180	158	203	4	7.55	225	203	248	0	0.00	270	248	293	0	0.00	315	293	338	2	3.77	**53**
Feb-09	LTDU	2483	265	9.37	180	158	203	13	1.87	225	203	248	45	6.46	270	248	293	158	22.67	315	293	338	134	19.23	**697**
Mar-09	LTDU	723	87	8.31	180	158	203	3	1.40	225	203	248	64	29.91	270	248	293	32	14.95	315	293	338	26	12.15	**214**
Dec-09	LTDU	441	72	6.13	180	158	203	81	43.32	225	203	248	42	22.46	270	248	293	15	8.02	315	293	338	0	0.00	**187**
Winter2008(DJF)	LTDU	685	65	10.54	180	158	203	9	6.29	225	203	248	6	4.20	270	248	293	7	4.90	315	293	338	9	6.29	**143**
Winter2009(DJF)	LTDU	4152	404	10.28	180	158	203	45	4.27	225	203	248	116	11.00	270	248	293	211	20.00	315	293	338	183	17.35	**1055**
Winter2010(DJF)	LTDU	441	72	6.13	180	158	203	81	43.32	225	203	248	42	22.46	270	248	293	15	8.02	315	293	338	0	0.00	**187**
2009	LTDU	5195	563	9.23	180	158	203	140	9.45	225	203	248	214	14.44	270	248	293	303	20.45	315	293	338	210	14.17	**1482**
Feb-08	COLO	97	62	1.56	180	158	203	0	0.00	225	203	248	0	0.00	270	248	293	1	50.00	315	293	338	0	0.00	**2**
Feb-09	COLO	979	333	2.94	180	158	203	0	0.00	225	203	248	2	40.00	270	248	293	2	40.00	315	293	338	0	0.00	**5**
May-09	COLO	617	352	1.75	180	158	203	2	3.23	225	203	248	0	0.00	270	248	293	2	3.23	315	293	338	1	1.61	**62**
Mar-08	GULG	832	29	28.69	180	158	203	10	6.06	225	203	248	8	4.85	270	248	293	0	0.00	315	293	338	80	48.48	**165**
Jan-09	GULG	1991	17	117.12	180	158	203	7	26.92	225	203	248	4	15.38	270	248	293	15	57.69	315	293	338	0	0.00	**26**
Feb-09	GULG	1362	42	32.43	180	158	203	96	57.14	225	203	248	2	1.19	270	248	293	7	4.17	315	293	338	4	2.38	**168**
Sep-09	GULG	473	14	33.79	180	158	203	11	57.89	225	203	248	0	0.00	270	248	293	0	0.00	315	293	338	1	5.26	**19**
Oct-09	GULG	598	32	18.69	180	158	203	1	1.28	225	203	248	6	7.69	270	248	293	7	8.97	315	293	338	11	14.10	**78**
Nov-09	GULG	875	21	41.67	180	158	203	359	83.49	225	203	248	50	11.63	270	248	293	0	0.00	315	293	338	0	0.00	**430**
Dec-09	GULG	472	16	29.50	180	158	203	4	12.90	225	203	248	4	12.90	270	248	293	1	3.23	315	293	338	6	19.35	**31**
Winter2009(DJF)	GULG	3377	67	50.40	180	158	203	104	47.71	225	203	248	7	3.21	270	248	293	23	10.55	315	293	338	19	8.72	**218**
Autumn2009(ASON)	GULG	1989	72	27.63	180	158	203	371	70.13	225	203	248	56	10.59	270	248	293	7	1.32	315	293	338	12	2.27	**529**
Winter2010(DJF)	GULG	472	16	29.50	180	158	203	4	12.90	225	203	248	4	12.90	270	248	293	1	3.23	315	293	338	6	19.35	**31**
2009	GULG	6129	204	30.04	180	158	203	492	48.38	225	203	248	87	8.55	270	248	293	42	4.13	315	293	338	177	17.40	**1017**
Apr-08	SCOT	1607	50	32.14	180	158	203	7	0.53	225	203	248	25	1.90	270	248	293	0	0.00	315	293	338	0	0.00	**1319**
Dec-08	SCOT	1328	8	166.00	180	158	203	1204	90.80	225	203	248	0	0.00	270	248	293	42	3.17	315	293	338	0	0.00	**1326**
Jan-09	SCOT	2811	33	85.18	180	158	203	0	0.00	225	203	248	0	0.00	270	248	293	0	0.00	315	293	338	0	0.00	**450**

Table E-1b (*continued*). Frequency distribution of mean flight directions in octants (S, SW, W, NW).

Time Period	Species	Abundance	#Observations	Cluster Size	S					SW					W					NW					Total #Freq (All Octants)
					Center Angle	Low Angle	High Angle	#Freq	%Freq	Center Angle	Low Angle	High Angle	#Freq	%Freq	Center Angle	Low Angle	High Angle	#Freq	%Freq	Center Angle	Low Angle	High Angle	#Freq	%Freq	
Winter2009(DJF)	SCOT	4943	74	66.80	180	158	203	1204	67.45	225	203	248	0	0.00	270	248	293	42	2.35	315	293	338	0	0.00	**1785**
May-08	LAGU	712	237	3.00	180	158	203	140	23.22	225	203	248	131	21.72	270	248	293	68	11.28	315	293	338	18	2.99	**603**
Jun-08	LAGU	531	315	1.69	180	158	203	52	12.35	225	203	248	59	14.01	270	248	293	54	12.83	315	293	338	55	13.06	**421**
Jul-08	LAGU	673	415	1.62	180	158	203	58	9.85	225	203	248	45	7.64	270	248	293	145	24.62	315	293	338	69	11.71	**589**
Aug-08	LAGU	1349	473	2.85	180	158	203	81	8.15	225	203	248	102	10.26	270	248	293	59	5.94	315	293	338	113	11.37	**994**
Sep-08	LAGU	580	334	1.74	180	158	203	45	9.26	225	203	248	28	5.76	270	248	293	36	7.41	315	293	338	83	17.08	**486**
Oct-08	LAGU	1027	298	3.45	180	158	203	79	11.16	225	203	248	133	18.79	270	248	293	194	27.40	315	293	338	91	12.85	**708**
Nov-08	LAGU	1738	199	8.73	180	158	203	46	10.04	225	203	248	61	13.32	270	248	293	39	8.52	315	293	338	98	21.40	**458**
May-09	LAGU	215	151	1.42	180	158	203	14	7.25	225	203	248	16	8.29	270	248	293	26	13.47	315	293	338	16	8.29	**193**
Jun-09	LAGU	466	286	1.63	180	158	203	18	5.47	225	203	248	36	10.94	270	248	293	35	10.64	315	293	338	36	10.94	**329**
Aug-09	LAGU	767	375	2.05	180	158	203	39	7.26	225	203	248	26	4.84	270	248	293	67	12.48	315	293	338	116	21.60	**537**
Sep-09	LAGU	251	180	1.39	180	158	203	20	12.05	225	203	248	20	12.05	270	248	293	21	12.65	315	293	338	17	10.24	**166**
Oct-09	LAGU	1334	170	7.85	180	158	203	124	25.73	225	203	248	113	23.44	270	248	293	48	9.96	315	293	338	54	11.20	**482**
Summer2008(JJ)	LAGU	1204	730	1.65	180	158	203	110	10.89	225	203	248	104	10.30	270	248	293	199	19.70	315	293	338	124	12.28	**1010**
Autumn2008(ASON)	LAGU	4694	1304	3.60	180	158	203	251	9.49	225	203	248	324	12.24	270	248	293	328	12.40	315	293	338	385	14.55	**2646**
Summer2009(JJ)	LAGU	466	286	1.63	180	158	203	18	5.47	225	203	248	36	10.94	270	248	293	35	10.64	315	293	338	36	10.94	**329**
Autumn2009(ASON)	LAGU	2404	757	3.18	180	158	203	187	15.14	225	203	248	169	13.68	270	248	293	155	12.55	315	293	338	187	15.14	**1235**
May-08	GBBG	341	189	1.80	180	158	203	18	9.73	225	203	248	19	10.27	270	248	293	21	11.35	315	293	338	22	11.89	**185**
Jun-08	GBBG	127	97	1.31	180	158	203	11	12.36	225	203	248	11	12.36	270	248	293	3	3.37	315	293	338	3	3.37	**89**
Aug-08	GBBG	147	121	1.21	180	158	203	16	19.28	225	203	248	14	16.87	270	248	293	22	26.51	315	293	338	12	14.46	**83**
Sep-08	GBBG	379	255	1.49	180	158	203	38	16.59	225	203	248	23	10.04	270	248	293	22	9.61	315	293	338	32	13.97	**229**
Jun-09	GBBG	146	119	1.23	180	158	203	6	4.72	225	203	248	10	7.87	270	248	293	8	6.30	315	293	338	18	14.17	**127**
Aug-09	GBBG	169	140	1.21	180	158	203	10	10.20	225	203	248	26	26.53	270	248	293	12	12.24	315	293	338	21	21.43	**98**
Sep-09	GBBG	174	99	1.76	180	158	203	3	4.35	225	203	248	7	10.14	270	248	293	13	18.84	315	293	338	5	7.25	**69**
Oct-09	GBBG	471	212	2.22	180	158	203	14	9.59	225	203	248	13	8.90	270	248	293	24	16.44	315	293	338	25	17.12	**146**
Summer2009(JJ)	GBBG	146	119	1.23	180	158	203	6	4.72	225	203	248	10	7.87	270	248	293	8	6.30	315	293	338	18	14.17	**127**
Jun-08	WISP	400	199	2.01	180	158	203	196	49.00	225	203	248	25	6.25	270	248	293	26	6.50	315	293	338	71	17.75	**400**
Jul-08	WISP	446	251	1.78	180	158	203	13	4.14	225	203	248	53	16.88	270	248	293	28	8.92	315	293	338	22	7.01	**314**
Aug-08	WISP	1251	175	7.15	180	158	203	33	3.11	225	203	248	42	3.96	270	248	293	28	2.64	315	293	338	45	4.25	**1060**
Aug-09	WISP	374	321	1.17	180	158	203	44	11.96	225	203	248	56	15.22	270	248	293	35	9.51	315	293	338	51	13.86	**368**
Sep-09	WISP	281	247	1.14	180	158	203	32	12.03	225	203	248	36	13.53	270	248	293	19	7.14	315	293	338	27	10.15	**266**
Summer2008(JJ)	WISP	846	450	1.88	180	158	203	209	29.27	225	203	248	78	10.92	270	248	293	54	7.56	315	293	338	93	13.03	**714**
Jun-08	COTE	339	195	1.74	180	158	203	63	18.69	225	203	248	21	6.23	270	248	293	56	16.62	315	293	338	71	21.07	**337**
Jul-08	COTE	366	181	2.02	180	158	203	35	10.48	225	203	248	24	7.19	270	248	293	53	15.87	315	293	338	36	10.78	**334**
Aug-08	COTE	798	354	2.25	180	158	203	206	26.58	225	203	248	128	16.52	270	248	293	58	7.48	315	293	338	95	12.26	**775**
Sep-08	COTE	392	133	2.95	180	158	203	44	11.40	225	203	248	36	9.33	270	248	293	38	9.84	315	293	338	57	14.77	**386**
May-09	COTE	175	83	2.11	180	158	203	35	20.47	225	203	248	32	18.71	270	248	293	19	11.11	315	293	338	30	17.54	**171**
Jun-09	COTE	290	202	1.44	180	158	203	36	12.50	225	203	248	31	10.76	270	248	293	22	7.64	315	293	338	50	17.36	**288**

Table E-1b (*continued*). Frequency distribution of mean flight directions in octants (S, SW, W, NW).

Time Period	Species	Abundance	#Observations	Cluster Size	S					SW					W					NW					Total #Freq (All Octants)
					Center Angle	Low Angle	High Angle	#Freq	%Freq	Center Angle	Low Angle	High Angle	#Freq	%Freq	Center Angle	Low Angle	High Angle	#Freq	%Freq	Center Angle	Low Angle	High Angle	#Freq	%Freq	
Aug-09	COTE	129	99	1.30	180	158	203	15	11.63	225	203	248	26	20.16	270	248	293	10	7.75	315	293	338	24	18.60	**129**
Summer2008(JJ)	COTE	705	376	1.88	180	158	203	98	14.61	225	203	248	45	6.71	270	248	293	109	16.24	315	293	338	107	15.95	**671**
Summer2009(JJ)	COTE	290	202	1.44	180	158	203	36	12.50	225	203	248	31	10.76	270	248	293	22	7.64	315	293	338	50	17.36	**288**
Jul-08	COSH	117	44	2.66	180	158	203	2	4.55	225	203	248	3	6.82	270	248	293	4	9.09	315	293	338	6	13.64	**44**
Aug-09	COSH	72	65	1.11	180	158	203	12	18.46	225	203	248	5	7.69	270	248	293	4	6.15	315	293	338	4	6.15	**65**
Summer2008(JJ)	COSH	188	87	2.16	180	158	203	7	7.22	225	203	248	8	8.25	270	248	293	7	7.22	315	293	338	19	19.59	**97**
Jul-08	TESM	72	11	6.55	180	158	203	31	43.06	225	203	248	12	16.67	270	248	293	2	2.78	315	293	338	10	13.89	**72**
Aug-08	PASS	118	58	2.03	180	158	203	6	5.08	225	203	248	3	2.54	270	248	293	19	16.10	315	293	338	67	56.78	**118**
Sep-08	SHSM	200	3	66.67	180	158	203	8	4.00	225	203	248	192	96.00	270	248	293	0	0.00	315	293	338	0	0.00	**200**
Oct-08	SHSM	533	5	106.60	180	158	203	0	0.00	225	203	248	161	94.15	270	248	293	10	5.85	315	293	338	0	0.00	**171**
Oct-08	FOTE	688	81	8.49	180	158	203	144	24.28	225	203	248	148	24.96	270	248	293	93	15.68	315	293	338	21	3.54	**593**
Nov-08	CANG	2548	22	115.82	180	158	203	540	21.19	225	203	248	1990	78.10	270	248	293	18	0.71	315	293	338	0	0.00	**2548**
Autumn2008(ASON)	CANG	2637	26	101.42	180	158	203	540	20.48	225	203	248	1993	75.58	270	248	293	98	3.72	315	293	338	6	0.23	**2637**
Jan-09	GRSC	1568	9	174.22	180	158	203	4	5.88	225	203	248	47	69.12	270	248	293	0	0.00	315	293	338	0	0.00	**68**
Nov-09	RTLO	892	259	3.44	180	158	203	249	31.16	225	203	248	434	54.32	270	248	293	75	9.39	315	293	338	15	1.88	**799**

Table E-2. Rayleigh test and Rao spacing test for a uniform circular distribution. Ho: The population has a uniform circular distribution, with no mean direction. Ha: The population has a nonuniform circular distribution, with a mean direction.

Time Period	Species	Abundance	#Observations	Cluster Size	n	CI Level	Zstat	Zcrit	Reject Ho?	Plow	Phigh	Pint	Papprox	ArcLength	Rao U	Rao P
Overall	TOTAL	177266	35547	4.99	109794	0.05	1662.19	2.9957	y	0	0.001	0	0	0.0033	359.9738	0
Jan-08	TOTAL	6500	1212	5.36	2081	0.05	96.85	2.9957	y	0	0.001	0	0	0.1730	358.6160	0
Feb-08	TOTAL	580	208	2.79	327	0.05	11.89	2.9931	y	0	0.001	0	0	1.1009	351.1927	0
Mar-08	TOTAL	17569	3068	5.73	9139	0.05	37.21	2.9957	y	0	0.001	0	0	0.0394	359.6849	0
Apr-08	TOTAL	15624	3362	4.65	10850	0.05	3320.63	2.9957	y	0	0.001	0	0	0.0332	359.7346	0
May-08	TOTAL	4446	1901	2.34	3527	0.05	66.32	2.9957	y	0	0.001	0	0	0.1021	359.1834	0
Jun-08	TOTAL	1964	1198	1.64	1674	0.05	52.39	2.9957	y	0	0.001	0	0	0.2151	358.2796	0
Jul-08	TOTAL	1957	1061	1.84	1591	0.05	27.76	2.9957	y	0	0.001	0	0	0.2263	358.1898	0
Aug-08	TOTAL	4255	1457	2.92	3396	0.05	246.90	2.9957	y	0	0.001	0	0	0.1060	359.1519	0
Sep-08	TOTAL	2612	1103	2.37	2196	0.05	24.34	2.9957	y	0	0.001	0	0	0.1639	358.6885	0
Oct-08	TOTAL	11928	1729	6.90	9994	0.05	3029.05	2.9957	y	0	0.001	0	0	0.0360	359.7118	0
Nov-08	TOTAL	27018	2694	10.03	20358	0.05	6791.84	2.9957	y	0	0.001	0	0	0.0177	359.8585	0
Dec-08	TOTAL	9672	1150	8.41	6091	0.05	2625.06	2.9957	y	0	0.001	0	0	0.0591	359.5272	0
Jan-09	TOTAL	20306	1618	12.55	9332	0.05	71.39	2.9957	y	0	0.001	0	0	0.0386	359.6914	0
Feb-09	TOTAL	10953	1919	5.71	3108	0.05	89.28	2.9957	y	0	0.001	0	0	0.1158	359.0734	0
Mar-09	TOTAL	6494	2058	3.16	3193	0.05	160.39	2.9957	y	0	0.001	0	0	0.1127	359.0980	0
Apr-09	TOTAL	6122	1038	5.90	5290	0.05	585.31	2.9957	y	0	0.001	0	0	0.0681	359.4556	0
May-09	TOTAL	3052	1744	1.75	2071	0.05	25.61	2.9957	y	0	0.001	0	0	0.1738	358.6094	0
Jun-09	TOTAL	1817	1309	1.39	1411	0.05	20.65	2.9957	y	0	0.001	0	0	0.2551	357.9589	0
Aug-09	TOTAL	1885	1201	1.57	1500	0.05	4.07	2.9957	y	0.01	0.02	0.0177	0.0171	0.2400	358.0800	0
Sep-09	TOTAL	1923	814	2.36	918	0.05	1.23	2.9957	n	0.2	0.5	0.3235	0.2918	0.3922	356.8627	0
Oct-09	TOTAL	4065	619	6.57	2151	0.05	15.34	2.9957	y	0	0.001	0	0	0.1674	358.6611	0
Nov-09	TOTAL	10757	1890	5.69	6539	0.05	296.20	2.9957	y	0	0.001	0	0	0.0551	359.5596	0
Dec-09	TOTAL	5767	1194	4.83	3057	0.05	453.70	2.9957	y	0	0.001	0	0	0.1178	359.0579	0
Winter2008(DJF)	TOTAL	7080	1420	4.99	2408	0.05	79.55	2.9957	y	0	0.001	0	0	0.1495	358.8040	0
Spring2008(MAM)	TOTAL	37639	8331	4.52	23516	0.05	1759.61	2.9957	y	0	0.001	0	0	0.0153	359.8775	0
Summer2008(JJ)	TOTAL	3921	2259	1.74	3265	0.05	78.42	2.9957	y	0	0.001	0	0	0.1103	359.1179	0
Autumn2008(ASON)	TOTAL	45813	6983	6.56	35944	0.05	7541.11	2.9957	y	0	0.001	0	0	0.0100	359.9199	0
Winter2009(DJF)	TOTAL	40931	4687	8.73	18531	0.05	1026.87	2.9957	y	0	0.001	0	0	0.0194	359.8446	0
Spring2009(MAM)	TOTAL	15668	4840	3.24	10554	0.05	572.92	2.9957	y	0	0.001	0	0	0.0341	359.7271	0
Summer2009(JJ)	TOTAL	1817	1309	1.39	1411	0.05	20.65	2.9957	y	0	0.001	0	0	0.2551	357.9589	0
Autumn2009(ASON)	TOTAL	18630	4524	4.12	11108	0.05	240.74	2.9957	y	0	0.001	0	0	0.0324	359.7407	0
Winter2010(DJF)	TOTAL	5767	1194	4.83	3057	0.05	453.70	2.9957	y	0	0.001	0	0	0.1178	359.0579	0
2008	TOTAL	104125	20143	5.17	71224	0.05	2490.99	2.9957	y	0	0.001	0	0	0.0051	359.9596	0
2009	TOTAL	73141	15404	4.75	38570	0.05	20.78	2.9957	y	0	0.001	0	0	0.0093	359.9253	0
Overall	NOGA	34020	9822	3.46	22856	0.05	402.92	2.9957	y	0	0.001	0	0	0.0158	359.8740	0
Jan-08	NOGA	898	482	1.86	693	0.05	14.64	2.9957	y	0	0.001	0	0	0.5195	355.8442	0
Feb-08	NOGA	49	33	1.48	37	0.05	8.39	2.9755	y	0	0.001	0	0.0002	9.7297	282.1622	0
Mar-08	NOGA	4980	1351	3.69	3348	0.05	19.25	2.9957	y	0	0.001	0	0	0.1075	359.1398	0
Apr-08	NOGA	3271	1409	2.32	2081	0.05	36.58	2.9957	y	0	0.001	0	0	0.1730	358.6160	0
May-08	NOGA	858	582	1.47	703	0.05	18.10	2.9957	y	0	0.001	0	0	0.5121	355.9033	0

Table E-2 (*continued*). Rayleigh test and Rao spacing test for a uniform circular distribution. Ho: The population has a uniform circular distribution, with no mean direction. Ha: The population has a nonuniform circular distribution, with a mean direction.

Time Period	Species	Abundance	#Observations	Cluster Size	n	CI Level	Zstat	Zcrit	Reject Ho?	Plow	Phigh	Pint	Papprox	ArcLength	Rao U	Rao P
Jun-08	NOGA	270	195	1.38	195	0.05	9.15	2.992	y	0	0.001	0	0.0001	1.8462	345.2308	0
Oct-08	NOGA	1692	492	3.44	1380	0.05	468.73	2.9957	y	0	0.001	0	0	0.2609	357.9130	0
Nov-08	NOGA	9402	1045	9.00	6037	0.05	727.82	2.9957	y	0	0.001	0	0	0.0596	359.5229	0
Dec-08	NOGA	470	308	1.53	343	0.05	5.60	2.9932	y	0.002	0.005	0.004	0.0037	1.0496	351.6035	0
Jan-09	NOGA	1849	417	4.43	1707	0.05	982.66	2.9957	y	0	0.001	0	0	0.2109	358.3128	0
Mar-09	NOGA	840	468	1.79	604	0.05	8.68	2.9957	y	0	0.001	0	0.0002	0.5960	355.2318	0
Apr-09	NOGA	400	303	1.32	322	0.05	1.14	2.9931	n	0.2	0.5	0.354	0.3202	1.1180	351.0559	0
May-09	NOGA	1077	674	1.60	815	0.05	10.76	2.9957	y	0	0.001	0	0	0.4417	356.4663	0
Jun-09	NOGA	431	343	1.26	237	0.05	20.55	2.9924	y	0	0.001	0	0	1.5190	347.8481	0
Nov-09	NOGA	6394	981	6.52	3495	0.05	203.42	2.9957	y	0	0.001	0	0	0.1030	359.1760	0
Dec-09	NOGA	628	331	1.90	482	0.05	176.15	2.9939	y	0	0.001	0	0	0.7469	354.0249	0
Winter2008(DJF)	NOGA	947	515	1.84	730	0.05	16.93	2.9957	y	0	0.001	0	0	0.4932	356.0548	0
Spring2008(MAM)	NOGA	9109	3342	2.73	6132	0.05	50.66	2.9957	y	0	0.001	0	0	0.0587	359.5303	0
Summer2008(JJ)	NOGA	312	232	1.34	224	0.05	6.67	2.9922	y	0.001	0.002	0.0013	0.0012	1.6071	347.1429	0
Autumn2008(ASON)	NOGA	11217	1631	6.88	7490	0.05	997.45	2.9957	y	0	0.001	0	0	0.0481	359.6155	0
Spring2009(MAM)	NOGA	2317	1445	1.60	1741	0.05	6.50	2.9957	y	0.001	0.002	0.0016	0.0015	0.2068	358.3458	0
Summer2009(JJ)	NOGA	431	343	1.26	237	0.05	20.55	2.9924	y	0	0.001	0	0	1.5190	347.8481	0
Autumn2009(ASON)	NOGA	6474	1050	6.17	3547	0.05	199.68	2.9957	y	0	0.001	0	0	0.1015	359.1880	0
Winter2010(DJF)	NOGA	628	331	1.90	482	0.05	176.15	2.9939	y	0	0.001	0	0	0.7469	354.0249	0
2008	NOGA	22055	6028	3.66	14919	0.05	330.92	2.9957	y	0	0.001	0	0	0.0241	359.8070	0
2009	NOGA	11965	3794	3.15	7937	0.05	83.97	2.9957	y	0	0.001	0	0	0.0454	359.6371	0
Overall	SCDW	13933	364	38.28	11113	0.05	1255.23	2.9957	y	0	0.001	0	0	0.0324	359.7408	0
Mar-08	SCDW	1522	36	42.28	1509	0.05	361.10	2.9957	y	0	0.001	0	0	0.2386	358.0915	0
Apr-08	SCDW	1885	69	27.32	1500	0.05	1135.64	2.9957	y	0	0.001	0	0	0.2400	358.5600	0
Nov-08	SCDW	2932	30	97.73	2932	0.05	572.27	2.9957	y	0	0.001	0	0	0.1228	359.2633	0
Dec-08	SCDW	3025	21	144.05	1465	0.05	1330.73	2.9957	y	0	0.001	0	0	0.2457	358.7713	0
Apr-09	SCDW	1599	36	44.42	1569	0.05	396.53	2.9957	y	0	0.001	0	0	0.2294	358.3939	0
Dec-09	SCDW	473	16	29.56	243	0.05	74.49	2.9924	y	0	0.001	0	0	1.4815	349.6296	0
Spring2008(MAM)	SCDW	3407	105	32.45	3009	0.05	579.32	2.9957	y	0	0.001	0	0	0.1196	359.0429	0
Autumn2008(ASON)	SCDW	3228	49	65.88	3228	0.05	548.41	2.9957	y	0	0.001	0	0	0.1115	359.2193	0
Winter2009(DJF)	SCDW	4468	107	41.76	2476	0.05	1003.92	2.9957	y	0	0.001	0	0	0.1454	358.8368	0
Spring2009(MAM)	SCDW	1985	71	27.96	1791	0.05	399.08	2.9957	y	0	0.001	0	0	0.2010	358.3920	0
Winter2010(DJF)	SCDW	473	16	29.56	243	0.05	74.49	2.9924	y	0	0.001	0	0	1.4815	349.6296	0
2008	SCDW	9669	178	54.32	7705	0.05	923.48	2.9957	y	0	0.001	0	0	0.0467	359.6262	0
Overall	HERG	13790	3474	3.97	4730	0.05	23.97	2.9957	y	0	0.001	0	0	0.0761	359.3911	0
Jan-08	HERG	1158	129	8.98	206	0.05	0.37	2.9921	n	0.5	1	0.6073	0.6937	1.7476	346.0194	0
Feb-08	HERG	61	41	1.49	60	0.05	1.32	2.983	n	0.2	0.5	0.2948	0.2674	6.0000	318.0000	0
Mar-08	HERG	3785	394	9.61	725	0.05	13.45	2.9957	y	0	0.001	0	0	0.4966	356.0276	0
May-08	HERG	568	249	2.28	322	0.05	6.31	2.9931	y	0.001	0.002	0.0018	0.0018	1.1180	351.0559	0
Feb-09	HERG	1710	325	5.26	377	0.05	3.59	2.9934	y	0.02	0.05	0.0303	0.0274	0.9549	352.3607	0

Table E-2 (*continued*). Rayleigh test and Rao spacing test for a uniform circular distribution. Ho: The population has a uniform circular distribution, with no mean direction. Ha: The population has a nonuniform circular distribution, with a mean direction.

Time Period	Species	Abundance	#Observations	Cluster Size	n	CI Level	Zstat	Zcrit	Reject Ho?	Plow	Phigh	Pint	Papprox	ArcLength	Rao U	Rao P
Mar-09	HERG	1037	358	2.90	500	0.05	34.28	2.994	y	0	0.001	0	0	0.7200	354.2400	0
Apr-09	HERG	439	138	3.18	186	0.05	13.90	2.992	y	0	0.001	0	0	1.9355	344.5161	0
May-09	HERG	261	194	1.35	224	0.05	6.03	2.9922	y	0.002	0.005	0.0025	0.0023	1.6071	347.1429	0
Jun-09	HERG	135	90	1.50	121	0.05	8.91	2.99	y	0	0.001	0	0.0001	2.9752	336.1983	0
Sep-09	HERG	352	59	5.97	54	0.05	3.91	2.9818	y	0.01	0.02	0.0195	0.0193	6.6667	306.6667	0
Oct-09	HERG	237	62	3.82	69	0.05	8.21	2.9848	y	0	0.001	0	0.0002	5.2174	318.2609	0
Nov-09	HERG	416	149	2.79	224	0.05	1.74	2.9922	n	0.1	0.2	0.1811	0.1755	1.6071	347.1429	0
Winter2008(DJF)	HERG	1219	170	7.17	266	0.05	0.21	2.9927	n	0.5	1	0.658	0.8096	1.3534	349.1729	0
Spring2008(MAM)	HERG	5024	1016	4.94	1483	0.05	53.99	2.9957	y	0	0.001	0	0	0.2428	358.0580	0
Spring2009(MAM)	HERG	1737	690	2.52	910	0.05	39.71	2.9957	y	0	0.001	0	0	0.3956	356.8352	0
Summer2009(JJ)	HERG	135	90	1.50	121	0.05	8.91	2.99	y	0	0.001	0	0.0001	2.9752	336.1983	0
Autumn2009(ASON)	HERG	1032	290	3.56	368	0.05	5.30	2.9933	y	0.002	0.005	0.005	0.0049	0.9783	352.1739	0
2008	HERG	7991	1810	4.41	2520	0.05	5.19	2.9957	y	0.005	0.01	0.0058	0.0056	0.1429	358.8571	0
2009	HERG	5799	1664	3.49	2210	0.05	26.39	2.9957	y	0	0.001	0	0	0.1629	358.6968	0
Overall	SUSC	12463	709	17.58	6908	0.05	192.51	2.9957	y	0	0.001	0	0	0.0521	359.5831	0
Mar-08	SUSC	2181	71	30.72	934	0.05	313.61	2.9957	y	0	0.001	0	0	0.3854	357.3019	0
Apr-08	SUSC	3048	142	21.46	1328	0.05	744.17	2.9957	y	0	0.001	0	0	0.2711	357.8313	0
Nov-08	SUSC	2348	52	45.15	2318	0.05	1882.89	2.9957	y	0	0.001	0	0	0.1553	358.9129	0
Dec-08	SUSC	1029	41	25.10	292	0.05	28.89	2.9929	y	0	0.001	0	0	1.2329	351.3699	0
Feb-09	SUSC	1165	121	9.63	426	0.05	56.75	2.9936	y	0	0.001	0	0	0.8451	354.0845	0
Mar-09	SUSC	664	84	7.90	246	0.05	38.14	2.9925	y	0	0.001	0	0	1.4634	348.2927	0
Apr-09	SUSC	604	48	12.58	462	0.05	284.43	2.9938	y	0	0.001	0	0	0.7792	355.3247	0
Nov-09	SUSC	435	16	27.19	435	0.05	191.69	2.9937	y	0	0.001	0	0	0.8276	355.0345	0
Spring2008(MAM)	SUSC	5230	214	24.44	2263	0.05	702.46	2.9957	y	0	0.001	0	0	0.1591	358.7274	0
Spring2009(MAM)	SUSC	1292	133	9.71	732	0.05	283.74	2.9957	y	0	0.001	0	0	0.4918	356.0656	0
2008	SUSC	8828	336	26.27	5021	0.05	284.04	2.9957	y	0	0.001	0	0	0.0717	359.4264	0
Overall	DCCO	10892	394	27.64	10730	0.05	542.68	2.9957	y	0	0.001	0	0	0.0336	359.7316	0
Apr-08	DCCO	1846	64	28.84	1837	0.05	1271.06	2.9957	y	0	0.001	0	0	0.1960	358.8242	0
May-08	DCCO	717	63	11.38	665	0.05	316.43	2.9957	y	0	0.001	0	0	0.5414	355.6692	0
Sep-08	DCCO	218	15	14.53	218	0.05	17.40	2.9922	y	0	0.001	0	0	1.6514	351.7431	0
Oct-08	DCCO	4157	99	41.99	4154	0.05	2673.66	2.9957	y	0	0.001	0	0	0.0867	359.3067	0
Apr-09	DCCO	1869	60	31.15	1844	0.05	1175.35	2.9957	y	0	0.001	0	0	0.1952	358.6334	0
Oct-09	DCCO	931	19	49.00	927	0.05	13.65	2.9957	y	0	0.001	0	0	0.3883	358.0583	0
Spring2008(MAM)	DCCO	2563	127	20.18	2502	0.05	1551.17	2.9957	y	0	0.001	0	0	0.1439	358.8489	0
Autumn2008(ASON)	DCCO	5268	130	40.52	5265	0.05	3293.72	2.9957	y	0	0.001	0	0	0.0684	359.4530	0
Spring2009(MAM)	DCCO	1972	83	23.76	1895	0.05	1183.63	2.9957	y	0	0.001	0	0	0.1900	358.4802	0
Autumn2009(ASON)	DCCO	1053	31	33.97	1039	0.05	12.30	2.9957	y	0	0.001	0	0	0.3465	357.9211	0
2008	DCCO	7861	275	28.59	7790	0.05	1012.97	2.9957	y	0	0.001	0	0	0.0462	359.6303	0

Table E-2 (*continued*). Rayleigh test and Rao spacing test for a uniform circular distribution. Ho: The population has a uniform circular distribution, with no mean direction. Ha: The population has a nonuniform circular distribution, with a mean direction.

Time Period	Species	Abundance	#Observations	Cluster Size	n	CI Level	Zstat	Zcrit	Reject Ho?	Plow	Phigh	Pint	Papprox	ArcLength	Rao U	Rao P
Jan-08	BLSC	1369	51	26.84	589	0.05	324.11	2.9957	y	0	0.001	0	0	0.6112	355.1104	0
Feb-08	BLSC	187	9	20.78	92	0.05	34.28	2.9872	y	0	0.001	0	0	3.9130	348.2609	0
Dec-08	BLSC	1642	37	44.38	1344	0.05	637.65	2.9957	y	0	0.001	0	0	0.2679	357.8571	0
Mar-09	BLSC	634	57	11.12	479	0.05	311.17	2.9939	y	0	0.001	0	0	0.7516	354.7390	0
Dec-09	BLSC	737	40	18.43	386	0.05	37.74	2.9934	y	0	0.001	0	0	0.9326	354.4041	0
Winter2008(DJF)	BLSC	1556	60	25.93	681	0.05	218.45	2.9957	y	0	0.001	0	0	0.5286	355.7709	0
Winter2010(DJF)	BLSC	737	40	18.43	386	0.05	37.74	2.9934	y	0	0.001	0	0	0.9326	354.4041	0
Jan-08	SCAU	750	1	750.00	90	0.05	17.66	2.987	y	0	0.001	0	0	4.0000	332.0000	0
Jan-09	SCAU	4617	32	144.28	3917	0.05	71.38	2.9957	y	0	0.001	0	0	0.0919	359.5405	0
Winter2008(DJF)	SCAU	750	1	750.00	143	0.05	45.82	2.9901	y	0	0.001	0	0	2.5175	342.3776	0
Winter2009(DJF)	SCAU	4617	32	144.28	3917	0.05	71.38	2.9957	y	0	0.001	0	0	0.0919	359.5405	0
2009	SCAU	4617	32	144.28	3917	0.05	71.38	2.9957	y	0	0.001	0	0	0.0919	359.5405	0
Jan-08	LTDU	603	57	10.58	90	0.05	17.66	2.987	y	0	0.001	0	0	4.0000	332.0000	0
Feb-08	LTDU	82	8	10.25	53	0.05	38.23	2.9816	y	0	0.001	0	0	6.7925	332.8302	0
Feb-09	LTDU	2483	265	9.37	697	0.05	79.28	2.9957	y	0	0.001	0	0	0.5165	355.8680	0
Mar-09	LTDU	723	87	8.31	214	0.05	16.21	2.9921	y	0	0.001	0	0	1.6822	346.5421	0
Dec-09	LTDU	441	72	6.13	187	0.05	31.30	2.992	y	0	0.001	0	0	1.9251	346.5241	0
Winter2008(DJF)	LTDU	685	65	10.54	143	0.05	45.82	2.9901	y	0	0.001	0	0	2.5175	342.3776	0
Winter2009(DJF)	LTDU	4152	404	10.28	1055	0.05	78.37	2.9957	y	0	0.001	0	0	0.3412	357.2701	0
Winter2010(DJF)	LTDU	441	72	6.13	187	0.05	31.30	2.992	y	0	0.001	0	0	1.9251	346.5241	0
2009	LTDU	5195	563	9.23	1482	0.05	93.22	2.9957	y	0	0.001	0	0	0.2429	358.0567	0
Feb-08	COLO	97	62	1.56	2	0.05	0.29	2.865	n	0.5	1	0.6462	0.7866	180.0000	45.0000	0
Feb-09	COLO	979	333	2.94	5	0.05	1.57	2.865	n	0.2	0.5	0.2243	0.2166	72.0000	171.0000	0.0904
May-09	COLO	617	352	1.75	62	0.05	33.92	2.9834	y	0	0.001	0	0	5.8065	319.3548	0
Mar-08	GULG	832	29	28.69	165	0.05	61.80	2.9912	y	0	0.001	0	0	2.1818	346.9091	0
Jan-09	GULG	1991	17	117.12	26	0.05	15.94	2.967	y	0	0.001	0	0	13.8462	318.4615	0
Feb-09	GULG	1362	42	32.43	168	0.05	54.23	2.9914	y	0	0.001	0	0	2.1429	342.8571	0
Sep-09	GULG	473	14	33.79	19	0.05	0.82	2.956	n	0.2	0.5	0.4628	0.4469	18.9474	284.2105	0
Oct-09	GULG	598	32	18.69	78	0.05	14.48	2.986	y	0	0.001	0	0	4.6154	327.6923	0
Nov-09	GULG	875	21	41.67	430	0.05	345.47	2.9936	y	0	0.001	0	0	0.8372	354.9767	0
Dec-09	GULG	472	16	29.50	31	0.05	3.65	2.9715	y	0.02	0.05	0.0267	0.0246	11.6129	290.3226	0
Winter2009(DJF)	GULG	3377	67	50.40	218	0.05	36.38	2.9922	y	0	0.001	0	0	1.6514	346.7890	0
Autumn2009(ASON)	GULG	1989	72	27.63	529	0.05	248.93	2.9957	y	0	0.001	0	0	0.6805	354.5558	0
Winter2010(DJF)	GULG	472	16	29.50	31	0.05	3.65	2.9715	y	0.02	0.05	0.0267	0.0246	11.6129	290.3226	0
2009	GULG	6129	204	30.04	1017	0.05	131.87	2.9957	y	0	0.001	0	0	0.3540	357.1681	0
Apr-08	SCOT	1607	50	32.14	1319	0.05	810.70	2.9957	y	0	0.001	0	0	0.2729	358.3624	0
Dec-08	SCOT	1328	8	166.00	1326	0.05	1198.53	2.9957	y	0	0.001	0	0	0.2715	359.1855	0

Table E-2 (*continued*). Rayleigh test and Rao spacing test for a uniform circular distribution. Ho: The population has a uniform circular distribution, with no mean direction. Ha: The population has a nonuniform circular distribution, with a mean direction.

Time Period	Species	Abundance	#Observations	Cluster Size	n	CI Level	Zstat	Zcrit	Reject Ho?	Plow	Phigh	Pint	Papprox	ArcLength	Rao U	Rao P
Jan-09	SCOT	2811	33	85.18	450	0.05	450.00	2.9937	y	0	0.001	0	0	0.8000	359.2000	0
Winter2009(DJF)	SCOT	4943	74	66.80	1785	0.05	1005.86	2.9957	y	0	0.001	0	0	0.2017	358.7899	0
May-08	LAGU	712	237	3.00	603	0.05	13.20	2.9957	y	0	0.001	0	0	0.5970	355.2239	0
Jun-08	LAGU	531	315	1.69	421	0.05	0.27	2.9936	n	0.5	1	0.6385	0.7626	0.8551	353.1591	0
Jul-08	LAGU	673	415	1.62	589	0.05	3.13	2.9957	y	0.02	0.05	0.0457	0.0438	0.6112	355.1104	0
Aug-08	LAGU	1349	473	2.85	994	0.05	70.18	2.9957	y	0	0.001	0	0	0.3622	357.1026	0
Sep-08	LAGU	580	334	1.74	486	0.05	31.32	2.9939	y	0	0.001	0	0	0.7407	354.0741	0
Oct-08	LAGU	1027	298	3.45	708	0.05	89.98	2.9957	y	0	0.001	0	0	0.5085	355.9322	0
Nov-08	LAGU	1738	199	8.73	458	0.05	28.29	2.9938	y	0	0.001	0	0	0.7860	353.7118	0
May-09	LAGU	215	151	1.42	193	0.05	13.16	2.992	y	0	0.001	0	0	1.8653	345.0777	0
Jun-09	LAGU	466	286	1.63	329	0.05	5.41	2.9931	y	0.002	0.005	0.0046	0.0044	1.0942	351.2462	0
Aug-09	LAGU	767	375	2.05	537	0.05	16.04	2.9957	y	0	0.001	0	0	0.6704	354.6369	0
Sep-09	LAGU	251	180	1.39	166	0.05	0.51	2.9913	n	0.5	1	0.5601	0.6005	2.1687	342.6506	0
Oct-09	LAGU	1334	170	7.85	482	0.05	36.43	2.9939	y	0	0.001	0	0	0.7469	354.0249	0
Summer2008(JJ)	LAGU	1204	730	1.65	1010	0.05	2.37	2.9957	n	0.05	0.1	0.0953	0.0936	0.3564	357.1485	0
Autumn2008(ASON)	LAGU	4694	1304	3.60	2646	0.05	79.44	2.9957	y	0	0.001	0	0	0.1361	358.9116	0
Summer2009(JJ)	LAGU	466	286	1.63	329	0.05	5.41	2.9931	y	0.002	0.005	0.0046	0.0044	1.0942	351.2462	0
Autumn2009(ASON)	LAGU	2404	757	3.18	1235	0.05	6.81	2.9957	y	0.001	0.002	0.0011	0.0011	0.2915	357.6680	0
May-08	GBBG	341	189	1.80	185	0.05	1.46	2.992	n	0.2	0.5	0.2478	0.2315	1.9459	344.4324	0
Jun-08	GBBG	127	97	1.31	89	0.05	9.65	2.9869	y	0	0.001	0	0.0001	4.0449	327.6404	0
Aug-08	GBBG	147	121	1.21	83	0.05	13.24	2.9863	y	0	0.001	0	0	4.3373	325.3012	0
Sep-08	GBBG	379	255	1.49	229	0.05	1.28	2.9923	n	0.2	0.5	0.3086	0.2788	1.5721	347.4236	0
Jun-09	GBBG	146	119	1.23	127	0.05	6.49	2.99	y	0.001	0.002	0.0015	0.0014	2.8346	337.3228	0
Aug-09	GBBG	169	140	1.21	98	0.05	8.22	2.9878	y	0	0.001	0	0.0002	3.6735	330.6122	0
Sep-09	GBBG	174	99	1.76	69	0.05	2.45	2.9848	n	0.05	0.1	0.089	0.0859	5.2174	318.2609	0
Oct-09	GBBG	471	212	2.22	146	0.05	0.97	2.9903	n	0.2	0.5	0.4084	0.378	2.4658	340.2740	0
Summer2009(JJ)	GBBG	146	119	1.23	127	0.05	6.49	2.99	y	0.001	0.002	0.0015	0.0014	2.8346	337.3228	0
Jun-08	WISP	400	199	2.01	400	0.05	70.83	2.9935	y	0	0.001	0	0	0.9000	352.8000	0
Jul-08	WISP	446	251	1.78	314	0.05	10.44	2.9931	y	0	0.001	0	0	1.1465	350.8280	0
Aug-08	WISP	1251	175	7.15	1060	0.05	585.21	2.9957	y	0	0.001	0	0	0.3396	357.2830	0
Aug-09	WISP	374	321	1.17	368	0.05	0.37	2.9933	n	0.5	1	0.6049	0.6884	0.9783	352.1739	0
Sep-09	WISP	281	247	1.14	266	0.05	14.28	2.9927	y	0	0.001	0	0	1.3534	349.1729	0
Summer2008(JJ)	WISP	846	450	1.88	714	0.05	48.69	2.9957	y	0	0.001	0	0	0.5042	355.9664	0
Jun-08	COTE	339	195	1.74	337	0.05	8.54	2.9932	y	0	0.001	0	0.0002	1.0682	351.4540	0
Jul-08	COTE	366	181	2.02	334	0.05	15.58	2.9932	y	0	0.001	0	0	1.0778	351.3772	0
Aug-08	COTE	798	354	2.25	775	0.05	32.63	2.9957	y	0	0.001	0	0	0.4645	356.2839	0
Sep-08	COTE	392	133	2.95	386	0.05	21.68	2.9934	y	0	0.001	0	0	0.9326	352.5389	0
May-09	COTE	175	83	2.11	171	0.05	12.17	2.9915	y	0	0.001	0	0	2.1053	343.1579	0

Table E-2 (*continued*). Rayleigh test and Rao spacing test for a uniform circular distribution. Ho: The population has a uniform circular distribution, with no mean direction. Ha: The population has a nonuniform circular distribution, with a mean direction.

Time Period	Species	Abundance	#Observations	Cluster Size	n	CI Level	Zstat	Zcrit	Reject Ho?	Plow	Phigh	Pint	Papprox	ArcLength	Rao U	Rao P
Jun-09	COTE	290	202	1.44	288	0.05	1.37	2.9929	n	0.2	0.5	0.2778	0.2537	1.2500	350.0000	0
Aug-09	COTE	129	99	1.30	129	0.05	2.69	2.99	n	0.05	0.1	0.0715	0.0674	2.7907	337.6744	0
Summer2008(JJ)	COTE	705	376	1.88	671	0.05	18.21	2.9957	y	0	0.001	0	0	0.5365	355.7079	0
Summer2009(JJ)	COTE	290	202	1.44	288	0.05	1.37	2.9929	n	0.2	0.5	0.2778	0.2537	1.2500	350.0000	0
Jul-08	COSH	117	44	2.66	44	0.05	2.74	2.979	n	0.05	0.1	0.0674	0.0637	8.1818	294.5455	0
Aug-09	COSH	72	65	1.11	65	0.05	5.87	2.984	y	0.002	0.005	0.0028	0.0026	5.5385	315.6923	0
Summer2008(JJ)	COSH	188	87	2.16	97	0.05	2.14	2.9877	n	0.1	0.2	0.1237	0.1178	3.7113	330.3093	0
Jul-08	TESM	72	11	6.55	72	0.05	7.92	2.9854	y	0	0.001	0	0.0003	5.0000	330.0000	0
Aug-08	PASS	118	58	2.03	118	0.05	68.20	2.9898	y	0	0.001	0	0	3.0508	338.6441	0
Sep-08	SHSM	200	3	66.67	200	0.05	195.50	2.992	y	0	0.001	0	0	1.8000	356.4000	0
Oct-08	SHSM	533	5	106.60	171	0.05	165.48	2.9915	y	0	0.001	0	0	2.1053	355.7895	0
Oct-08	FOTE	688	81	8.49	593	0.05	123.12	2.9957	y	0	0.001	0	0	0.6071	355.1433	0
Nov-08	CANG	2548	22	115.82	2548	0.05	2285.08	2.9957	y	0	0.001	0	0	0.1413	359.5761	0
Autumn2008(ASON)	CANG	2637	26	101.42	2637	0.05	2301.01	2.9957	y	0	0.001	0	0	0.1365	359.4539	0
Jan-09	GRSC	1568	9	174.22	68	0.05	16.45	2.9846	y	0	0.001	0	0	5.2941	338.8235	0
Nov-09	RTLO	892	259	3.44	799	0.05	540.84	2.9957	y	0	0.001	0	0	0.4506	356.3955	0

Table E-3. V-test for a uniform circular distribution. Ho: The population has a uniform circular distribution with no mean direction, OR has a nonuniform circular distribution with a mean direction that is different from 223.17 degrees. Ha: The population has a nonuniform circular distribution with a mean direction of 223.17 degrees.

Time Period	Species	Abundance	#Observations	Cluster Size	n	CI Level	ExpAngle	V	u	ucrit	Reject Ho?	Plow	Phigh	Pint	Low Angle	High Angle	CI_low	CI_high	Reject Ho?	CI_low	CI_high
Overall	TOTAL	177266	35547	4.99	109794	0.05	223.17	13509.13	57.66	1.6449	y	0	0.0005	0	135	312	223	223	n	0	180
Jan-08	TOTAL	6500	1212	5.36	2081	0.05	129.10	448.94	13.92	1.6449	y	0	0.0005	0	46	212	118	140	n	0	135
Feb-08	TOTAL	580	208	2.79	327	0.05	24.76	62.35	4.88	1.6449	y	0	0.0005	0	314	95	351	59	y	0	135
Mar-08	TOTAL	17569	3068	5.73	9139	0.05	304.19	583.15	8.63	1.6449	y	0	0.0005	0	225	23	285	323	n	0	135
Apr-08	TOTAL	15624	3362	4.65	10850	0.05	41.98	6002.40	81.49	1.6449	y	0	0.0005	0	313	131	40	44	n	0	45
May-08	TOTAL	4446	1901	2.34	3527	0.05	30.40	483.64	11.52	1.6449	y	0	0.0005	0	309	112	17	44	n	0	135
Jun-08	TOTAL	1964	1198	1.64	1674	0.05	179.22	296.15	10.24	1.6449	y	0	0.0005	0	98	260	164	195	n	0	180
Jul-08	TOTAL	1957	1061	1.84	1591	0.05	175.03	210.17	7.45	1.6449	y	0	0.0005	0	98	252	153	197	n	0	180
Aug-08	TOTAL	4255	1457	2.92	3396	0.05	350.24	915.67	22.22	1.6449	y	0	0.0005	0	264	76	343	357	n	0	90
Sep-08	TOTAL	2612	1103	2.37	2196	0.05	273.97	231.19	6.98	1.6449	y	0	0.0005	0	198	350	251	297	n	0	180
Oct-08	TOTAL	11928	1729	6.90	9994	0.05	245.45	5501.86	77.83	1.6449	y	0	0.0005	0	157	334	244	247	n	0	225
Nov-08	TOTAL	27018	2694	10.03	20358	0.05	216.92	11758.74	116.55	1.6449	y	0	0.0005	0	128	306	216	218	n	0	225
Dec-08	TOTAL	9672	1150	8.41	6091	0.05	182.58	3998.55	72.46	1.6449	y	0	0.0005	0	94	271	181	184	n	0	180
Jan-09	TOTAL	20306	1618	12.55	9332	0.05	151.43	816.21	11.95	1.6449	y	0	0.0005	0	69	234	138	165	n	0	135
Feb-09	TOTAL	10953	1919	5.71	3108	0.05	312.08	526.78	13.36	1.6449	y	0	0.0005	0	229	35	300	324	n	0	180
Mar-09	TOTAL	6494	2058	3.16	3193	0.05	0.28	715.63	17.91	1.6449	y	0	0.0005	0	276	85	352	9	y	0	90
Apr-09	TOTAL	6122	1038	5.90	5290	0.05	57.01	1759.63	34.21	1.6449	y	0	0.0005	0	330	144	53	61	n	0	45
May-09	TOTAL	3052	1744	1.75	2071	0.05	28.70	230.30	7.16	1.6449	y	0	0.0005	0	312	105	6	51	n	0	135
Jun-09	TOTAL	1817	1309	1.39	1411	0.05	60.35	170.69	6.43	1.6449	y	0	0.0005	0	345	136	35	86	n	0	135
Aug-09	TOTAL	1885	1201	1.57	1500	0.05	302.89	78.12	2.85	1.6449	y	0.001	0.0025	0.0022	248	358	227	19	y	0	180
Sep-09	TOTAL	1923	814	2.36	918	0.05	303.92	33.63	1.57	1.6449	n	0.05	0.1	0.0603	72	195	304	304	n	0	135
Oct-09	TOTAL	4065	619	6.57	2151	0.05	265.96	181.62	5.54	1.6449	y	0	0.0005	0	193	339	236	296	n	0	180
Nov-09	TOTAL	10757	1890	5.69	6539	0.05	248.14	1391.71	24.34	1.6449	y	0	0.0005	0	162	334	242	255	n	0	180
Dec-09	TOTAL	5767	1194	4.83	3057	0.05	234.05	1177.70	30.12	1.6449	y	0	0.0005	0	147	321	229	239	n	0	225
Winter2008(DJF)	TOTAL	7080	1420	4.99	2408	0.05	121.17	437.68	12.61	1.6449	y	0	0.0005	0	39	204	109	134	n	0	135
Spring2008(MAM)	TOTAL	37639	8331	4.52	23516	0.05	35.96	6432.65	59.32	1.6449	y	0	0.0005	0	308	124	33	39	n	0	90
Summer2008(JJ)	TOTAL	3921	2259	1.74	3265	0.05	177.48	505.97	12.52	1.6449	y	0	0.0005	0	95	260	165	190	n	0	180
Autumn2008(ASON)	TOTAL	45813	6983	6.56	35944	0.05	229.15	16463.78	122.81	1.6449	y	0	0.0005	0	140	318	228	230	n	0	225
Winter2009(DJF)	TOTAL	40931	4687	8.73	18531	0.05	182.38	4362.12	45.32	1.6449	y	0	0.0005	0	94	270	179	186	n	0	180
Spring2009(MAM)	TOTAL	15668	4840	3.24	10554	0.05	40.28	2458.96	33.85	1.6449	y	0	0.0005	0	313	127	36	45	n	0	90
Summer2009(JJ)	TOTAL	1817	1309	1.39	1411	0.05	60.35	170.69	6.43	1.6449	y	0	0.0005	0	345	136	35	86	n	0	135
Autumn2009(ASON)	TOTAL	18630	4524	4.12	11108	0.05	253.31	1635.25	21.94	1.6449	y	0	0.0005	0	168	339	246	260	n	0	180
Winter2010(DJF)	TOTAL	5767	1194	4.83	3057	0.05	234.05	1177.70	30.12	1.6449	y	0	0.0005	0	147	321	229	239	n	0	225
2008	TOTAL	104125	20143	5.17	71224	0.05	219.43	13319.47	70.58	1.6449	y	0	0.0005	0	131	308	219	220	n	0	180
2009	TOTAL	73141	15404	4.75	38570	0.05	299.10	895.18	6.45	1.6449	y	0	0.0005	0	224	14	274	325	n	0	180
Overall	NOGA	34020	9822	3.46	22856	0.05	213.48	3034.54	28.39	1.6449	y	0	0.0005	0	127	300	208	219	n	0	180
Jan-08	NOGA	898	482	1.86	693	0.05	59.74	100.71	5.41	1.6449	y	0	0.0005	0	347	132	29	90	n	0	135
Feb-08	NOGA	49	33	1.48	37	0.05	117.27	17.61	4.10	1.646	y	0	0.0005	0	51	184	80	155	n	0	135
Mar-08	NOGA	4980	1351	3.69	3348	0.05	334.18	253.83	6.20	1.6449	y	0	0.0005	0	260	49	308	1	y	0	135
Apr-08	NOGA	3271	1409	2.32	2081	0.05	3.87	275.91	8.55	1.6449	y	0	0.0005	0	285	83	345	23	y	0	180
May-08	NOGA	858	582	1.47	703	0.05	61.66	112.80	6.02	1.6449	y	0	0.0005	0	348	136	35	89	n	0	135
Jun-08	NOGA	270	195	1.38	195	0.05	167.72	42.23	4.28	1.645	y	0	0.0005	0	100	235	128	207	n	0	180
Oct-08	NOGA	1692	492	3.44	1380	0.05	244.81	804.26	30.62	1.6449	y	0	0.0005	0	158	332	241	249	n	0	225
Nov-08	NOGA	9402	1045	9.00	6037	0.05	199.21	2096.14	38.15	1.6449	y	0	0.0005	0	112	287	195	203	n	0	180

Table E-3 (*continued*). V-test for a uniform circular distribution. Ho: The population has a uniform circular distribution with no mean direction, OR has a nonuniform circular distribution with a mean direction that is different from 223.17 degrees. Ha: The population has a nonuniform circular distribution with a mean direction of 223.17 degrees.

Time Period	Species	Abundance	#Observations	Cluster Size	n	CI Level	ExpAngle	V	u	ucrit	Reject Ho?	Plow	Phigh	Pint	Low Angle	High Angle	CI_low	CI_high	Reject Ho?	CI_low	CI_high
Dec-08	NOGA	470	308	1.53	343	0.05	171.32	43.82	3.35	1.6449	y	0.0003	0.0005	0.0004	111	232	116	227	n	0	180
Jan-09	NOGA	1849	417	4.43	1707	0.05	182.80	1295.13	44.33	1.6449	y	0	0.0005	0	95	271	180	185	n	0	180
Mar-09	NOGA	840	468	1.79	604	0.05	326.96	72.43	4.17	1.6449	y	0	0.0005	0	260	34	286	8	y	0	135
Apr-09	NOGA	400	303	1.32	322	0.05	14.38	19.16	1.51	1.6449	n	0.05	0.1	0.0686	274	18	14	14	n	0	135
May-09	NOGA	1077	674	1.60	815	0.05	84.07	93.63	4.64	1.6449	y	0	0.0005	0	15	153	48	121	n	0	135
Jun-09	NOGA	431	343	1.26	237	0.05	87.05	69.79	6.41	1.645	y	0	0.0005	0	12	162	63	112	n	0	90
Nov-09	NOGA	6394	981	6.52	3495	0.05	339.69	843.16	20.17	1.6449	y	0	0.0005	0	254	65	332	347	n	0	180
Dec-09	NOGA	628	331	1.90	482	0.05	211.33	291.37	18.77	1.6449	y	0	0.0005	0	126	296	205	218	n	0	225
Winter2008(DJF)	NOGA	947	515	1.84	730	0.05	67.42	111.16	5.82	1.6449	y	0	0.0005	0	354	141	39	96	n	0	135
Spring2008(MAM)	NOGA	9109	3342	2.73	6132	0.05	0.76	557.35	10.07	1.6449	y	0	0.0005	0	280	81	345	17	y	0	135
Summer2008(JJ)	NOGA	312	232	1.34	224	0.05	152.07	38.64	3.65	1.645	y	0	0.0005	0	89	215	103	201	n	0	180
Autumn2008(ASON)	NOGA	11217	1631	6.88	7490	0.05	211.18	2733.28	44.66	1.6449	y	0	0.0005	0	123	299	208	214	n	0	225
Spring2009(MAM)	NOGA	2317	1445	1.60	1741	0.05	33.29	106.41	3.61	1.6449	y	0	0.0005	0	330	96	343	83	y	0	135
Summer2009(JJ)	NOGA	431	343	1.26	237	0.05	87.05	69.79	6.41	1.645	y	0	0.0005	0	12	162	63	112	n	0	90
Autumn2009(ASON)	NOGA	6474	1050	6.17	3547	0.05	339.73	841.57	19.98	1.6449	y	0	0.0005	0	254	65	332	347	n	0	180
Winter2010(DJF)	NOGA	628	331	1.90	482	0.05	211.33	291.37	18.77	1.6449	y	0	0.0005	0	126	296	205	218	n	0	225
2008	NOGA	22055	6028	3.66	14919	0.05	215.18	2221.91	25.73	1.6449	y	0	0.0005	0	129	302	209	221	n	0	180
2009	NOGA	11965	3794	3.15	7937	0.05	208.84	816.37	12.96	1.6449	y	0	0.0005	0	126	292	197	221	n	0	180
Overall	SCDW	13933	364	38.28	11113	0.05	164.37	3734.80	50.10	1.6449	y	0	0.0005	0	76	252	161	167	n	0	180
Mar-08	SCDW	1522	36	42.28	1509	0.05	159.48	738.14	26.87	1.6449	y	0	0.0005	0	73	246	154	165	n	0	135
Apr-08	SCDW	1885	69	27.32	1500	0.05	54.28	1305.15	47.66	1.6449	y	0	0.0005	0	326	142	53	56	n	0	45
Nov-08	SCDW	2932	30	97.73	2932	0.05	196.80	1295.33	33.83	1.6449	y	0	0.0005	0	110	284	193	201	n	45	225
Dec-08	SCDW	3025	21	144.05	1465	0.05	184.82	1396.24	51.59	1.6449	y	0	0.0005	0	97	273	184	186	n	0	180
Apr-09	SCDW	1599	36	44.42	1569	0.05	139.13	788.76	28.16	1.6449	y	0	0.0005	0	52	226	134	144	n	0	135
Dec-09	SCDW	473	16	29.56	243	0.05	197.00	134.54	12.21	1.645	y	0	0.0005	0	115	279	186	208	n	0	180
Spring2008(MAM)	SCDW	3407	105	32.45	3009	0.05	86.94	1320.30	34.04	1.6449	y	0	0.0005	0	360	174	83	91	n	0	90
Autumn2008(ASON)	SCDW	3228	49	65.88	3228	0.05	200.67	1330.49	33.12	1.6449	y	0	0.0005	0	114	288	196	205	n	0	225
Winter2009(DJF)	SCDW	4468	107	41.76	2476	0.05	182.38	1576.58	44.81	1.6449	y	0	0.0005	0	94	270	180	185	n	0	180
Spring2009(MAM)	SCDW	1985	71	27.96	1791	0.05	143.38	845.41	28.25	1.6449	y	0	0.0005	0	57	230	138	148	n	0	135
Winter2010(DJF)	SCDW	473	16	29.56	243	0.05	197.00	134.54	12.21	1.645	y	0	0.0005	0	115	279	186	208	n	0	180
2008	SCDW	9669	178	54.32	7705	0.05	164.11	2667.47	42.98	1.6449	y	0	0.0005	0	76	252	161	168	n	0	180
Overall	HERG	13790	3474	3.97	4730	0.05	34.96	336.75	6.92	1.6449	y	0	0.0005	0	319	111	11	59	n	0	135
Jan-08	HERG	1158	129	8.98	206	0.05	222.21	8.69	0.86	1.645	n	0.1	0.25	0.2053	63	235	222	222	n	0	135
Feb-08	HERG	61	41	1.49	60	0.05	92.66	8.91	1.63	1.645	n	0.05	0.1	0.0525	12	171	93	93	n	0	135
Mar-08	HERG	3785	394	9.61	725	0.05	79.57	98.76	5.19	1.6449	y	0	0.0005	0	8	151	48	112	n	0	135
May-08	HERG	568	249	2.28	322	0.05	29.87	45.06	3.55	1.6449	y	0	0.0005	0	327	92	339	81	y	0	135
Feb-09	HERG	1710	325	5.26	377	0.05	332.87	36.81	2.68	1.6449	y	0.0025	0.005	0.0038	281	25	258	48	y	0	135
Mar-09	HERG	1037	358	2.90	500	0.05	57.23	130.92	8.28	1.6449	y	0	0.0005	0	339	136	38	76	n	0	90
Apr-09	HERG	439	138	3.18	186	0.05	346.01	50.84	5.27	1.645	y	0	0.0005	0	274	58	315	17	y	0	135
May-09	HERG	261	194	1.35	224	0.05	20.05	36.76	3.47	1.645	y	0	0.0005	0	318	82	328	72	y	0	135
Jun-09	HERG	135	90	1.50	121	0.05	10.44	32.84	4.22	1.645	y	0	0.0005	0	303	78	331	50	y	0	90
Sep-09	HERG	352	59	5.97	54	0.05	15.56	14.53	2.80	1.645	y	0.001	0.0025	0.0025	322	70	299	92	y	0	67.5
Oct-09	HERG	237	62	3.82	69	0.05	19.83	23.80	4.05	1.645	y	0	0.0005	0	314	86	339	60	y	0	90

Table E-3 (*continued*). V-test for a uniform circular distribution. Ho: The population has a uniform circular distribution with no mean direction, OR has a nonuniform circular distribution with a mean direction that is different from 223.17 degrees. Ha: The population has a nonuniform circular distribution with a mean direction of 223.17 degrees.

Time Period	Species	Abundance	#Observations	Cluster Size	n	CI Level	ExpAngle	V	u	ucrit	Reject Ho?	Plow	Phigh	Pint	Low Angle	High Angle	CI_low	CI_high	Reject Ho?	CI_low	CI_high
Nov-09	HERG	416	149	2.79	224	0.05	127.68	19.75	1.87	1.645	y	0.025	0.05	0.0324	100	156	128	128	n	0	135
Winter2008(DJF)	HERG	1219	170	7.17	266	0.05	155.91	7.50	0.65	1.645	n	0.25	0.5	0.256	67	238	156	156	n	0	135
Spring2008(MAM)	HERG	5024	1016	4.94	1483	0.05	67.56	282.96	10.39	1.6449	y	0	0.0005	0	347	148	52	83	n	0	135
Spring2009(MAM)	HERG	1737	690	2.52	910	0.05	35.51	190.08	8.91	1.6449	y	0	0.0005	0	316	115	18	53	n	0	135
Summer2009(JJ)	HERG	135	90	1.50	121	0.05	10.44	32.84	4.22	1.645	y	0	0.0005	0	303	78	331	50	y	0	90
Autumn2009(ASON)	HERG	1032	290	3.56	368	0.05	64.83	44.15	3.26	1.6449	y	0.0005	0.001	0.0006	5	124	7	123	n	0	135
2008	HERG	7991	1810	4.41	2520	0.05	62.73	114.36	3.22	1.6449	y	0.0005	0.001	0.0007	3	122	3	122	n	0	135
2009	HERG	5799	1664	3.49	2210	0.05	22.22	241.49	7.26	1.6449	y	0	0.0005	0	305	99	360	45	y	0	135
Overall	SUSC	12463	709	17.58	6908	0.05	253.60	1153.18	19.62	1.6449	y	0	0.0005	0	168	339	246	262	n	0	180
Mar-08	SUSC	2181	71	30.72	934	0.05	332.38	541.20	25.04	1.6449	y	0	0.0005	0	246	59	327	338	n	0	0
Apr-08	SUSC	3048	142	21.46	1328	0.05	45.85	994.11	38.58	1.6449	y	0	0.0005	0	318	133	43	49	n	0	45
Nov-08	SUSC	2348	52	45.15	2318	0.05	226.26	2089.13	61.37	1.6449	y	0	0.0005	0	138	315	225	227	n	0	225
Dec-08	SUSC	1029	41	25.10	292	0.05	173.34	91.84	7.60	1.645	y	0	0.0005	0	96	251	153	194	n	0	180
Feb-09	SUSC	1165	121	9.63	426	0.05	284.50	155.47	10.65	1.6449	y	0	0.0005	0	203	6	270	299	n	0	225
Mar-09	SUSC	664	84	7.90	246	0.05	8.21	96.86	8.73	1.645	y	0	0.0005	0	289	87	351	25	y	0	45
Apr-09	SUSC	604	48	12.58	462	0.05	50.04	362.50	23.85	1.6449	y	0	0.0005	0	324	136	46	54	n	0	45
Nov-09	SUSC	435	16	27.19	435	0.05	214.27	288.76	19.58	1.6449	y	0	0.0005	0	129	299	208	220	n	0	180
Spring2008(MAM)	SUSC	5230	214	24.44	2263	0.05	21.51	1260.77	37.48	1.6449	y	0	0.0005	0	294	109	18	25	n	0	45
Spring2009(MAM)	SUSC	1292	133	9.71	732	0.05	43.84	455.73	23.82	1.6449	y	0	0.0005	0	318	130	39	49	n	0	45
2008	SUSC	8828	336	26.27	5021	0.05	249.58	1194.19	23.83	1.6449	y	0	0.0005	0	164	336	243	256	n	0	225
Overall	DCCO	10892	394	27.64	10730	0.05	298.61	2413.02	32.94	1.6449	y	0	0.0005	0	211	26	294	303	n	0	180
Apr-08	DCCO	1846	64	28.84	1837	0.05	22.32	1528.03	50.42	1.6449	y	0	0.0005	0	294	110	21	24	n	0	0
May-08	DCCO	717	63	11.38	665	0.05	40.00	458.72	25.16	1.6449	y	0	0.0005	0	314	126	35	45	n	0	45
Sep-08	DCCO	218	15	14.53	218	0.05	295.29	61.59	5.90	1.645	y	0	0.0005	0	221	9	268	322	n	0	270
Oct-08	DCCO	4157	99	41.99	4154	0.05	241.11	3332.62	73.13	1.6449	y	0	0.0005	0	152	330	240	242	n	0	225
Apr-09	DCCO	1869	60	31.15	1844	0.05	31.32	1472.17	48.48	1.6449	y	0	0.0005	0	303	119	29	33	n	0	45
Oct-09	DCCO	931	19	49.00	927	0.05	6.25	112.49	5.23	1.6449	y	0	0.0005	0	295	78	334	38	y	0	45
Spring2008(MAM)	DCCO	2563	127	20.18	2502	0.05	26.38	1969.99	55.70	1.6449	y	0	0.0005	0	298	115	25	28	n	0	45
Autumn2008(ASON)	DCCO	5268	130	40.52	5265	0.05	241.72	4164.25	81.16	1.6449	y	0	0.0005	0	153	331	241	243	n	0	225
Spring2009(MAM)	DCCO	1972	83	23.76	1895	0.05	30.41	1497.62	48.65	1.6449	y	0	0.0005	0	302	118	28	32	n	0	45
Autumn2009(ASON)	DCCO	1053	31	33.97	1039	0.05	318.51	113.05	4.96	1.6449	y	0	0.0005	0	248	29	285	352	n	0	225
2008	DCCO	7861	275	28.59	7790	0.05	265.53	2809.01	45.01	1.6449	y	0	0.0005	0	178	353	262	269	n	0	225
Jan-08	BLSC	1369	51	26.84	589	0.05	148.97	436.92	25.46	1.6449	y	0	0.0005	0	63	235	145	153	n	0	135
Feb-08	BLSC	187	9	20.78	92	0.05	306.31	56.16	8.28	1.645	y	0	0.0005	0	228	25	291	322	n	135	315
Dec-08	BLSC	1642	37	44.38	1344	0.05	183.03	925.74	35.71	1.6449	y	0	0.0005	0	96	270	180	186	n	0	180
Mar-09	BLSC	634	57	11.12	479	0.05	1.18	386.07	24.95	1.6449	y	0	0.0005	0	275	87	357	5	y	0	0
Dec-09	BLSC	737	40	18.43	386	0.05	176.59	120.70	8.69	1.6449	y	0	0.0005	0	98	256	159	194	n	0	180
Winter2008(DJF)	BLSC	1556	60	25.93	681	0.05	152.18	385.70	20.90	1.6449	y	0	0.0005	0	67	238	146	158	n	0	135
Winter2010(DJF)	BLSC	737	40	18.43	386	0.05	176.59	120.70	8.69	1.6449	y	0	0.0005	0	98	256	159	194	n	0	180
Jan-08	SCAU	750	1	750.00	90	0.05	56.35	39.87	5.94	1.645	y	0	0.0005	0	342	130	31	81	n	0	90
Jan-09	SCAU	4617	32	144.28	3917	0.05	9.90	528.75	11.95	1.6449	y	0	0.0005	0	288	92	357	23	y	0	45

Table E-3 (*continued*). V-test for a uniform circular distribution. Ho: The population has a uniform circular distribution with no mean direction, OR has a nonuniform circular distribution with a mean direction that is different from 223.17 degrees. Ha: The population has a nonuniform circular distribution with a mean direction of 223.17 degrees.

Time Period	Species	Abundance	#Observations	Cluster Size	n	CI Level	ExpAngle	V	u	ucrit	Reject Ho?	Plow	Phigh	Pint	Low Angle	High Angle	CI_low	CI_high	Reject Ho?	CI_low	CI_high
Winter2008(DJF)	SCAU	750	1	750.00	143	0.05	75.02	80.94	9.57	1.645	y	0	0.0005	0	355	155	61	89	n	0	90
Winter2009(DJF)	SCAU	4617	32	144.28	3917	0.05	9.90	528.75	11.95	1.6449	y	0	0.0005	0	288	92	357	23	y	0	45
2009	SCAU	4617	32	144.28	3917	0.05	9.90	528.75	11.95	1.6449	y	0	0.0005	0	288	92	357	23	y	0	45
Jan-08	LTDU	603	57	10.58	90	0.05	56.35	39.87	5.94	1.645	y	0	0.0005	0	342	130	31	81	n	0	90
Feb-08	LTDU	82	8	10.25	53	0.05	91.49	45.01	8.74	1.645	y	0	0.0005	0	12	171	82	101	n	45	90
Feb-09	LTDU	2483	265	9.37	697	0.05	323.22	235.07	12.59	1.6449	y	0	0.0005	0	241	46	311	335	n	0	180
Mar-09	LTDU	723	87	8.31	214	0.05	295.04	58.89	5.69	1.645	y	0	0.0005	0	222	8	267	323	n	0	225
Dec-09	LTDU	441	72	6.13	187	0.05	201.92	76.50	7.91	1.645	y	0	0.0005	0	124	280	183	221	n	0	180
Winter2008(DJF)	LTDU	685	65	10.54	143	0.05	75.02	80.94	9.57	1.645	y	0	0.0005	0	355	155	61	89	n	0	90
Winter2009(DJF)	LTDU	4152	404	10.28	1055	0.05	314.93	287.55	12.52	1.6449	y	0	0.0005	0	232	37	303	327	n	0	180
Winter2010(DJF)	LTDU	441	72	6.13	187	0.05	201.92	76.50	7.91	1.645	y	0	0.0005	0	124	280	183	221	n	0	180
2009	LTDU	5195	563	9.23	1482	0.05	293.14	371.68	13.65	1.6449	y	0	0.0005	0	210	16	282	304	n	0	180
Feb-08	COLO	97	62	1.56	2	0.05	202.50	0.77	0.77	1.649	n	0.1	0.25	0.2309	228	151	203	203	n	135	202.5
Feb-09	COLO	979	333	2.94	5	0.05	239.64	2.80	1.77	1.649	y	0.025	0.05	0.0399	218	261	240	240	n	90	225
May-09	COLO	617	352	1.75	62	0.05	52.30	45.86	8.24	1.645	y	0	0.0005	0	334	131	39	66	n	0	45
Mar-08	GULG	832	29	28.69	165	0.05	335.07	100.98	11.12	1.645	y	0	0.0005	0	254	57	324	347	n	0	225
Jan-09	GULG	1991	17	117.12	26	0.05	241.13	20.36	5.65	1.646	y	0	0.0005	0	168	314	223	260	n	180	270
Feb-09	GULG	1362	42	32.43	168	0.05	155.02	95.45	10.41	1.645	y	0	0.0005	0	74	236	142	168	n	0	180
Sep-09	GULG	473	14	33.79	19	0.05	169.67	3.94	1.28	1.647	n	0.1	0.25	0.1019	72	195	170	170	n	0	180
Oct-09	GULG	598	32	18.69	78	0.05	35.73	33.61	5.38	1.645	y	0	0.0005	0	324	108	8	64	n	45	45
Nov-09	GULG	875	21	41.67	430	0.05	183.07	385.42	26.29	1.6449	y	0	0.0005	0	97	269	180	186	n	0	180
Dec-09	GULG	472	16	29.50	31	0.05	170.11	10.64	2.70	1.646	y	0.0025	0.005	0.0033	118	223	87	254	n	0	135
Winter2009(DJF)	GULG	3377	67	50.40	218	0.05	170.57	89.06	8.53	1.645	y	0	0.0005	0	92	249	153	188	n	0	180
Autumn2009(ASON)	GULG	1989	72	27.63	529	0.05	179.82	362.88	22.31	1.6449	y	0	0.0005	0	94	266	175	185	n	0	180
Winter2010(DJF)	GULG	472	16	29.50	31	0.05	170.11	10.64	2.70	1.646	y	0.0025	0.005	0.0033	118	223	87	254	n	0	135
2009	GULG	6129	204	30.04	1017	0.05	192.84	366.21	16.24	1.6449	y	0	0.0005	0	109	277	184	202	n	0	180
Apr-08	SCOT	1607	50	32.14	1319	0.05	55.28	1034.06	40.27	1.6449	y	0	0.0005	0	328	143	53	58	n	0	45
Dec-08	SCOT	1328	8	166.00	1326	0.05	179.34	1260.63	48.96	1.6449	y	0	0.0005	0	91	267	178	180	n	135	180
Jan-09	SCOT	2811	33	85.18	450	0.05	90.00	450.00	30.00	1.6449	y	0	0.0005	0	3	177	90	90	n	90	90
Winter2009(DJF)	SCOT	4943	74	66.80	1785	0.05	159.44	1339.91	44.85	1.6449	y	0	0.0005	0	72	247	157	162	n	0	180
May-08	LAGU	712	237	3.00	603	0.05	216.61	89.23	5.14	1.6449	y	0	0.0005	0	145	288	184	249	n	0	180
Jun-08	LAGU	531	315	1.69	421	0.05	179.62	10.69	0.74	1.6449	n	0.1	0.25	0.2347	98	260	180	180	n	0	180
Jul-08	LAGU	673	415	1.62	589	0.05	241.23	42.91	2.50	1.6449	y	0.005	0.01	0.0065	192	290	180	303	n	0	180
Aug-08	LAGU	1349	473	2.85	994	0.05	22.45	264.11	11.85	1.6449	y	0	0.0005	0	300	104	9	36	n	0	90
Sep-08	LAGU	580	334	1.74	486	0.05	23.91	123.37	7.91	1.6449	y	0	0.0005	0	306	102	4	44	n	0	135
Oct-08	LAGU	1027	298	3.45	708	0.05	266.77	252.39	13.41	1.6449	y	0	0.0005	0	184	350	256	278	n	0	225
Nov-08	LAGU	1738	199	8.73	458	0.05	312.40	113.82	7.52	1.6449	y	0	0.0005	0	235	30	291	333	n	0	180
May-09	LAGU	215	151	1.42	193	0.05	9.72	50.40	5.13	1.645	y	0	0.0005	0	298	81	338	41	y	0	90
Jun-09	LAGU	466	286	1.63	329	0.05	65.20	42.17	3.29	1.6449	y	0.0003	0.0005	0.0005	5	125	8	122	n	0	135
Aug-09	LAGU	767	375	2.05	537	0.05	4.93	92.81	5.66	1.6449	y	0	0.0005	0	292	78	336	34	y	0	135

Table E-3 (*continued*). V-test for a uniform circular distribution. Ho: The population has a uniform circular distribution with no mean direction, OR has a nonuniform circular distribution with a mean direction that is different from 223.17 degrees. Ha: The population has a nonuniform circular distribution with a mean direction of 223.17 degrees.

Time Period	Species	Abundance	#Observations	Cluster Size	n	CI Level	ExpAngle	V	u	ucrit	Reject Ho?	Plow	Phigh	Pint	Low Angle	High Angle	CI_low	CI_high	Reject Ho?	CI_low	CI_high
Sep-09	LAGU	251	180	1.39	166	0.05	288.07	9.21	1.01	1.645	n	0.1	0.25	0.1669	69	213	288	288	n	0	135
Oct-09	LAGU	1334	170	7.85	482	0.05	212.11	132.51	8.54	1.6449	y	0	0.0005	0	133	291	194	230	n	0	180
Summer2008(JJ)	LAGU	1204	730	1.65	1010	0.05	230.14	48.91	2.18	1.6449	y	0.01	0.025	0.0161	189	271	192	268	n	0	180
Autumn2008(ASON)	LAGU	4694	1304	3.60	2646	0.05	336.18	458.47	12.60	1.6449	y	0	0.0005	0	254	59	324	349	n	0	135
Summer2009(JJ)	LAGU	466	286	1.63	329	0.05	65.20	42.17	3.29	1.6449	y	0.0003	0.0005	0.0005	5	125	8	122	n	0	135
Autumn2009(ASON)	LAGU	2404	757	3.18	1235	0.05	259.40	91.72	3.69	1.6449	y	0	0.0005	0	196	323	211	308	n	0	180
May-08	GBBG	341	189	1.80	185	0.05	35.10	16.46	1.71	1.645	y	0.025	0.05	0.0447	19	51	35	35	n	0	135
Jun-08	GBBG	127	97	1.31	89	0.05	102.54	29.31	4.39	1.645	y	0	0.0005	0	35	171	66	140	n	0	90
Aug-08	GBBG	147	121	1.21	83	0.05	240.66	33.15	5.15	1.645	y	0	0.0005	0	169	312	211	271	n	0	225
Sep-08	GBBG	379	255	1.49	229	0.05	166.06	17.11	1.60	1.645	n	0.05	0.1	0.0563	274	143	166	166	n	0	180
Jun-09	GBBG	146	119	1.23	127	0.05	36.36	28.71	3.60	1.645	y	0	0.0005	0	334	99	347	85	y	0	135
Aug-09	GBBG	169	140	1.21	98	0.05	242.86	28.39	4.06	1.645	y	0	0.0005	0	177	309	202	284	n	0	225
Sep-09	GBBG	174	99	1.76	69	0.05	5.26	13.00	2.21	1.645	y	0.01	0.025	0.0144	323	47	323	47	y	0	135
Oct-09	GBBG	471	212	2.22	146	0.05	286.03	11.93	1.40	1.645	n	0.05	0.1	0.0843	324	114	286	286	n	0	180
Summer2009(JJ)	GBBG	146	119	1.23	127	0.05	36.36	28.71	3.60	1.645	y	0	0.0005	0	334	99	347	85	y	0	135
Jun-08	WISP	400	199	2.01	400	0.05	192.16	168.32	11.90	1.6449	y	0	0.0005	0	110	274	180	204	n	0	180
Jul-08	WISP	446	251	1.78	314	0.05	111.59	57.25	4.57	1.6449	y	0	0.0005	0	43	180	75	148	n	0	135
Aug-08	WISP	1251	175	7.15	1060	0.05	358.53	787.58	34.21	1.6449	y	0	0.0005	0	271	86	355	2	y	0	0
Aug-09	WISP	374	321	1.17	368	0.05	217.83	11.73	0.86	1.6449	n	0.1	0.25	0.2031	292	132	218	218	n	0	180
Sep-09	WISP	281	247	1.14	266	0.05	141.25	61.63	5.34	1.645	y	0	0.0005	0	69	213	111	172	n	0	135
Summer2008(JJ)	WISP	846	450	1.88	714	0.05	174.53	186.45	9.87	1.6449	y	0	0.0005	0	94	255	159	190	n	0	180
Jun-08	COTE	339	195	1.74	337	0.05	211.39	53.66	4.13	1.6449	y	0	0.0005	0	145	278	170	253	n	0	180
Jul-08	COTE	366	181	2.02	334	0.05	153.68	72.14	5.58	1.6449	y	0	0.0005	0	81	227	125	183	n	0	135
Aug-08	COTE	798	354	2.25	775	0.05	212.17	159.01	8.08	1.6449	y	0	0.0005	0	134	290	193	232	n	0	180
Sep-08	COTE	392	133	2.95	386	0.05	349.26	91.47	6.58	1.6449	y	0	0.0005	0	274	65	325	13	y	0	135
May-09	COTE	175	83	2.11	171	0.05	213.81	45.62	4.93	1.645	y	0	0.0005	0	143	284	181	247	n	0	180
Jun-09	COTE	290	202	1.44	288	0.05	149.57	19.88	1.66	1.645	y	0.025	0.05	0.0491	143	156	150	150	n	0	135
Aug-09	COTE	129	99	1.30	129	0.05	236.85	18.64	2.32	1.645	y	0.01	0.025	0.0101	192	282	187	287	n	0	180
Summer2008(JJ)	COTE	705	376	1.88	671	0.05	177.91	110.55	6.04	1.6449	y	0	0.0005	0	104	252	151	205	n	0	180
Summer2009(JJ)	COTE	290	202	1.44	288	0.05	149.57	19.88	1.66	1.645	y	0.025	0.05	0.0491	143	156	150	150	n	0	135
Jul-08	COSH	117	44	2.66	44	0.05	101.13	10.98	2.34	1.646	y	0.005	0.01	0.0095	56	146	49	154	n	0	135
Aug-09	COSH	72	65	1.11	65	0.05	133.64	19.54	3.43	1.645	y	0	0.0005	0.0001	72	195	82	185	n	0	135
Summer2008(JJ)	COSH	188	87	2.16	97	0.05	68.13	14.40	2.07	1.645	y	0.01	0.025	0.0205	31	105	41	95	n	0	135
Jul-08	TESM	72	11	6.55	72	0.05	193.41	23.87	3.98	1.645	y	0	0.0005	0	128	259	152	235	n	45	180
Aug-08	PASS	118	58	2.03	118	0.05	312.55	89.71	11.68	1.645	y	0	0.0005	0	231	34	304	321	n	0	315
Sep-08	SHSM	200	3	66.67	200	0.05	223.36	197.73	19.77	1.645	y	0	0.0005	0	138	309	222	225	n	180	225
Oct-08	SHSM	533	5	106.60	171	0.05	227.41	168.22	18.19	1.645	y	0	0.0005	0	143	312	226	229	n	225	225

Table E-3 (*continued*). V-test for a uniform circular distribution. Ho: The population has a uniform circular distribution with no mean direction, OR has a nonuniform circular distribution with a mean direction that is different from 223.17 degrees. Ha: The population has a nonuniform circular distribution with a mean direction of 223.17 degrees.

Time Period	Species	Abundance	#Observations	Cluster Size	n	CI Level	ExpAngle	V	u	ucrit	Reject Ho?	Plow	Phigh	Pint	Low Angle	High Angle	CI_low	CI_high	Reject Ho?	CI_low	CI_high
Oct-08	FOTE	688	81	8.49	593	0.05	195.86	270.20	15.69	1.6449	y	0	0.0005	0	112	280	187	205	n	0	180
Nov-08	CANG	2548	22	115.82	2548	0.05	216.20	2412.95	67.60	1.6449	y	0	0.0005	0	128	305	215	217	n	180	225
Autumn2008(ASON)	CANG	2637	26	101.42	2637	0.05	217.85	2463.27	67.84	1.6449	y	0	0.0005	0	129	306	217	219	n	180	225
Jan-09	GRSC	1568	9	174.22	68	0.05	222.58	33.44	5.74	1.645	y	0	0.0005	0	149	296	197	248	n	0	225
Nov-09	RTLO	892	259	3.44	799	0.05	215.33	657.35	32.89	1.6449	y	0	0.0005	0	128	302	213	218	n	0	225

Table E-4. Hodges-Ajne test for a uniform circular distribution. Ho: The population has a uniform circular distribution. Ha: The population has a nonuniform circular distribution.

Time Period	Species	Abundance	#Observations	Cluster Size	m	n	A	P	CI Level	Reject Ho?	Accuracy
Overall	TOTAL	177266	35547	4.99	9999	109794	0.0058	0	0.05	y	-0.0026
Jan-08	TOTAL	6500	1212	5.36	769	2081	0.1320	0	0.05	y	-0.0026
Feb-08	TOTAL	580	208	2.79	92	327	0.1986	0	0.05	y	-0.0026
Mar-08	TOTAL	17569	3068	5.73	3776	9139	0.0946	0	0.05	y	-0.0026
Apr-08	TOTAL	15624	3362	4.65	1982	10850	0.0238	0	0.05	y	-0.0026
May-08	TOTAL	4446	1901	2.34	1448	3527	0.1478	0	0.05	y	-0.0026
Jun-08	TOTAL	1964	1198	1.64	684	1674	0.2100	0	0.05	y	-0.0026
Jul-08	TOTAL	1957	1061	1.84	636	1591	0.1964	0	0.05	y	-0.0026
Aug-08	TOTAL	4255	1457	2.92	1169	3396	0.0865	0	0.05	y	-0.0026
Sep-08	TOTAL	2612	1103	2.37	912	2196	0.1979	0	0.05	y	-0.0026
Oct-08	TOTAL	11928	1729	6.90	1779	9994	0.0244	0	0.05	y	-0.0026
Nov-08	TOTAL	27018	2694	10.03	3125	20358	0.0159	0	0.05	y	-0.0026
Dec-08	TOTAL	9672	1150	8.41	771	6091	0.0269	0	0.05	y	-0.0026
Jan-09	TOTAL	20306	1618	12.55	3993	9332	0.1127	0	0.05	y	-0.0026
Feb-09	TOTAL	10953	1919	5.71	1182	3108	0.1177	0	0.05	y	-0.0026
Mar-09	TOTAL	6494	2058	3.16	1216	3193	0.1166	0	0.05	y	-0.0026
Apr-09	TOTAL	6122	1038	5.90	1380	5290	0.0452	0	0.05	y	-0.0026
May-09	TOTAL	3052	1744	1.75	870	2071	0.2160	0	0.05	y	-0.0026
Jun-09	TOTAL	1817	1309	1.39	562	1411	0.2056	0	0.05	y	-0.0026
Aug-09	TOTAL	1885	1201	1.57	707	1500	0.7074	0.3011	0.05	n	-0.0026
Sep-09	TOTAL	1923	814	2.36	423	918	0.6610	0.2252	0.05	n	-0.0026
Oct-09	TOTAL	4065	619	6.57	890	2151	0.1964	0	0.05	y	-0.0026
Nov-09	TOTAL	10757	1890	5.69	2123	6539	0.0554	0	0.05	y	-0.0026
Dec-09	TOTAL	5767	1194	4.83	814	3057	0.0608	0	0.05	y	-0.0026
Winter2008(DJF)	TOTAL	7080	1420	4.99	930	2408	0.1407	0	0.05	y	-0.0026
Spring2008(MAM)	TOTAL	37639	8331	4.52	7782	23516	0.0303	0	0.05	y	-0.0026
Summer2008(JJ)	TOTAL	3921	2259	1.74	1329	3265	0.1479	0	0.05	y	-0.0026
Autumn2008(ASON)	TOTAL	45813	6983	6.56	8417	35944	0.0156	0	0.05	y	-0.0026
Winter2009(DJF)	TOTAL	40931	4687	8.73	6818	18531	0.0437	0	0.05	y	-0.0026
Spring2009(MAM)	TOTAL	15668	4840	3.24	3605	10554	0.0483	0	0.05	y	-0.0026
Summer2009(JJ)	TOTAL	1817	1309	1.39	562	1411	0.2056	0	0.05	y	-0.0026
Autumn2009(ASON)	TOTAL	18630	4524	4.12	4197	11108	0.0610	0	0.05	y	-0.0026
Winter2010(DJF)	TOTAL	5767	1194	4.83	814	3057	0.0608	0	0.05	y	-0.0026
2008	TOTAL	104125	20143	5.17	9999	71224	0.0082	0	0.05	y	-0.0026
2009	TOTAL	73141	15404	4.75	9999	38570	0.0166	0	0.05	y	-0.0026
Overall	NOGA	34020	9822	3.46	9174	22856	0.0527	0	0.05	y	-0.0026
Jan-08	NOGA	898	482	1.86	284	693	0.3308	0.0001	0.05	y	-0.0026
Feb-08	NOGA	49	33	1.48	37	0.05	8.0000	9	y	0.01	0.02
Mar-08	NOGA	4980	1351	3.69	1427	3348	0.1840	0	0.05	y	-0.0026
Apr-08	NOGA	3271	1409	2.32	829	2081	0.1694	0	0.05	y	-0.0026
May-08	NOGA	858	582	1.47	274	703	0.2687	0	0.05	y	-0.0026
Jun-08	NOGA	270	195	1.38	63	195	0.3179	0	0.05	y	-0.0026
Oct-08	NOGA	1692	492	3.44	194	1380	0.0588	0	0.05	y	-0.0026
Nov-08	NOGA	9402	1045	9.00	1084	6037	0.0315	0	0.05	y	-0.0026
Dec-08	NOGA	470	308	1.53	135	343	0.3985	0.0027	0.05	y	-0.0026
Jan-09	NOGA	1849	417	4.43	182	1707	0.0483	0	0.05	y	-0.0026

Table E-4 (*continued*). Hodges-Ajne test for a uniform circular distribution. Ho: The population has a uniform circular distribution. Ha: The population has a nonuniform circular distribution.

Time Period	Species	Abundance	#Observations	Cluster Size	m	n	A	P	CI Level	Reject Ho?	Accuracy
Mar-09	NOGA	840	468	1.79	236	604	0.2925	0	0.05	y	-0.0026
Apr-09	NOGA	400	303	1.32	144	322	0.8290	0.5023	0.05	n	-0.0026
May-09	NOGA	1077	674	1.60	348	815	0.3768	0.0011	0.05	y	-0.0026
Jun-09	NOGA	431	343	1.26	75	237	0.2780	0	0.05	y	-0.0026
Nov-09	NOGA	6394	981	6.52	1160	3495	0.0790	0	0.05	y	-0.0026
Dec-09	NOGA	628	331	1.90	43	482	0.0871	0	0.05	y	-0.0026
Winter2008(DJF)	NOGA	947	515	1.84	294	730	0.2989	0	0.05	y	-0.0026
Spring2008(MAM)	NOGA	9109	3342	2.73	2659	6132	0.1511	0	0.05	y	-0.0026
Summer2008(JJ)	NOGA	312	232	1.34	78	224	0.3457	0.0002	0.05	y	-0.0026
Autumn2008(ASON)	NOGA	11217	1631	6.88	1375	7490	0.0287	0	0.05	y	-0.0026
Spring2009(MAM)	NOGA	2317	1445	1.60	793	1741	0.4229	0.006	0.05	y	-0.0026
Summer2009(JJ)	NOGA	431	343	1.26	75	237	0.2780	0	0.05	y	-0.0026
Autumn2009(ASON)	NOGA	6474	1050	6.17	1186	3547	0.0796	0	0.05	y	-0.0026
Winter2010(DJF)	NOGA	628	331	1.90	43	482	0.0871	0	0.05	y	-0.0026
2008	NOGA	22055	6028	3.66	5538	14919	0.0499	0	0.05	y	-0.0026
2009	NOGA	11965	3794	3.15	3132	7937	0.0836	0	0.05	y	-0.0026
Overall	SCDW	13933	364	38.28	2956	11113	0.0318	0	0.05	y	-0.0026
Mar-08	SCDW	1522	36	42.28	224	1509	0.0575	0	0.05	y	-0.0026
Apr-08	SCDW	1885	69	27.32	36	1500	0.0426	0	0.05	y	-0.0026
Nov-08	SCDW	2932	30	97.73	266	2932	0.0354	0	0.05	y	-0.0026
Dec-08	SCDW	3025	21	144.05	9	1465	0.0415	0	0.05	y	-0.0026
Apr-09	SCDW	1599	36	44.42	312	1569	0.0658	0	0.05	y	-0.0026
Dec-09	SCDW	473	16	29.56	29	243	0.1324	0	0.05	y	-0.0026
Spring2008(MAM)	SCDW	3407	105	32.45	570	3009	0.0461	0	0.05	y	-0.0026
Autumn2008(ASON)	SCDW	3228	49	65.88	436	3228	0.0379	0	0.05	y	-0.0026
Winter2009(DJF)	SCDW	4468	107	41.76	358	2476	0.0444	0	0.05	y	-0.0026
Spring2009(MAM)	SCDW	1985	71	27.96	373	1791	0.0636	0	0.05	y	-0.0026
Winter2010(DJF)	SCDW	473	16	29.56	29	243	0.1324	0	0.05	y	-0.0026
2008	SCDW	9669	178	54.32	1869	7705	0.0348	0	0.05	y	-0.0026
Overall	HERG	13790	3474	3.97	2156	4730	0.2584	0	0.05	y	-0.0026
Jan-08	HERG	1158	129	8.98	81	206	0.5124	0.0445	0.05	y	-0.0026
Feb-08	HERG	61	41	1.49	23	60	0.8691	0.5632	0.05	n	-0.0026
Mar-08	HERG	3785	394	9.61	295	725	0.3133	0	0.05	y	-0.0026
May-08	HERG	568	249	2.28	121	322	0.3523	0.0003	0.05	y	-0.0026
Feb-09	HERG	1710	325	5.26	154	377	0.4420	0.0103	0.05	y	-0.0026
Mar-09	HERG	1037	358	2.90	163	500	0.2019	0	0.05	y	-0.0026
Apr-09	HERG	439	138	3.18	57	186	0.2975	0	0.05	y	-0.0026
May-09	HERG	261	194	1.35	88	224	0.4898	0.0299	0.05	y	-0.0026
Jun-09	HERG	135	90	1.50	40	121	0.4214	0.0057	0.05	y	-0.0026
Sep-09	HERG	352	59	5.97	16	54	0.5247	0.0541	0.05	n	-0.0026
Oct-09	HERG	237	62	3.82	19	69	0.4209	0.0056	0.05	y	-0.0026
Nov-09	HERG	416	149	2.79	97	224	0.7837	0.429	0.05	n	-0.0026
Winter2008(DJF)	HERG	1219	170	7.17	110	266	0.5569	0.0843	0.05	n	-0.0026
Spring2008(MAM)	HERG	5024	1016	4.94	562	1483	0.1685	0	0.05	y	-0.0026
Spring2009(MAM)	HERG	1737	690	2.52	337	910	0.2008	0	0.05	y	-0.0026

Table E-4 (*continued*). Hodges-Ajne test for a uniform circular distribution. Ho: The population has a uniform circular distribution. Ha: The population has a nonuniform circular distribution.

Time Period	Species	Abundance	#Observations	Cluster Size	m	n	A	P	CI Level	Reject Ho?	Accuracy
Summer2009(JJ)	HERG	135	90	1.50	40	121	0.4214	0.0057	0.05	y	-0.0026
Autumn2009(ASON)	HERG	1032	290	3.56	149	368	0.4305	0.0075	0.05	y	-0.0026
2008	HERG	7991	1810	4.41	1191	2520	0.5714	0.1003	0.05	n	-0.0026
2009	HERG	5799	1664	3.49	960	2210	0.2546	0	0.05	y	-0.0026
Overall	SUSC	12463	709	17.58	2618	6908	0.0781	0	0.05	y	-0.0026
Mar-08	SUSC	2181	71	30.72	99	934	0.0652	0	0.05	y	-0.0026
Apr-08	SUSC	3048	142	21.46	98	1328	0.0506	0	0.05	y	-0.0026
Nov-08	SUSC	2348	52	45.15	41	2318	0.0338	0	0.05	y	-0.0026
Dec-08	SUSC	1029	41	25.10	85	292	0.2200	0	0.05	y	-0.0026
Feb-09	SUSC	1165	121	9.63	108	426	0.1544	0	0.05	y	-0.0026
Mar-09	SUSC	664	84	7.90	64	246	0.2088	0	0.05	y	-0.0026
Apr-09	SUSC	604	48	12.58	38	462	0.0875	0	0.05	y	-0.0026
Nov-09	SUSC	435	16	27.19	32	435	0.0883	0	0.05	y	-0.0026
Spring2008(MAM)	SUSC	5230	214	24.44	417	2263	0.0523	0	0.05	y	-0.0026
Spring2009(MAM)	SUSC	1292	133	9.71	102	732	0.0805	0	0.05	y	-0.0026
2008	SUSC	8828	336	26.27	1599	5021	0.0611	0	0.05	y	-0.0026
Overall	DCCO	10892	394	27.64	3686	10730	0.0485	0	0.05	y	-0.0026
Apr-08	DCCO	1846	64	28.84	35	1837	0.0381	0	0.05	y	-0.0026
May-08	DCCO	717	63	11.38	54	665	0.0727	0	0.05	y	-0.0026
Sep-08	DCCO	218	15	14.53	60	218	0.2367	0	0.05	y	-0.0026
Oct-08	DCCO	4157	99	41.99	108	4154	0.0257	0	0.05	y	-0.0026
Apr-09	DCCO	1869	60	31.15	130	1844	0.0426	0	0.05	y	-0.0026
Oct-09	DCCO	931	19	49.00	341	927	0.1952	0	0.05	y	-0.0026
Spring2008(MAM)	DCCO	2563	127	20.18	116	2502	0.0346	0	0.05	y	-0.0026
Autumn2008(ASON)	DCCO	5268	130	40.52	199	5265	0.0234	0	0.05	y	-0.0026
Spring2009(MAM)	DCCO	1972	83	23.76	140	1895	0.0423	0	0.05	y	-0.0026
Autumn2009(ASON)	DCCO	1053	31	33.97	377	1039	0.1777	0	0.05	y	-0.0026
2008	DCCO	7861	275	28.59	1968	7790	0.0360	0	0.05	y	-0.0026
Jan-08	BLSC	1369	51	26.84	45	589	0.0764	0	0.05	y	-0.0026
Feb-08	BLSC	187	9	20.78	8	92	0.1982	0	0.05	y	-0.0026
Dec-08	BLSC	1642	37	44.38	45	1344	0.0459	0	0.05	y	-0.0026
Mar-09	BLSC	634	57	11.12	39	479	0.0857	0	0.05	y	-0.0026
Dec-09	BLSC	737	40	18.43	126	386	0.2303	0	0.05	y	-0.0026
Winter2008(DJF)	BLSC	1556	60	25.93	117	681	0.0917	0	0.05	y	-0.0026
Winter2010(DJF)	BLSC	737	40	18.43	126	386	0.2303	0	0.05	y	-0.0026
Jan-08	SCAU	750	1	750.00	18	90	0.2760	0	0.05	y	-0.0026
Jan-09	SCAU	4617	32	144.28	1623	3917	0.1465	0	0.05	y	-0.0026
Winter2008(DJF)	SCAU	750	1	750.00	22	143	0.1897	0	0.05	y	-0.0026
Winter2009(DJF)	SCAU	4617	32	144.28	1623	3917	0.1465	0	0.05	y	-0.0026
2009	SCAU	4617	32	144.28	1623	3917	0.1465	0	0.05	y	-0.0026
Jan-08	LTDU	603	57	10.58	18	90	0.2760	0	0.05	y	-0.0026
Feb-08	LTDU	82	8	10.25	2	53	0.2334	0	0.05	y	-0.0026

Table E-4 (*continued*). Hodges-Ajne test for a uniform circular distribution. Ho: The population has a uniform circular distribution. Ha: The population has a nonuniform circular distribution.

Time Period	Species	Abundance	#Observations	Cluster Size	m	n	A	P	CI Level	Reject Ho?	Accuracy
Feb-09	LTDU	2483	265	9.37	187	697	0.1284	0	0.05	y	-0.0026
Mar-09	LTDU	723	87	8.31	57	214	0.2298	0	0.05	y	-0.0026
Dec-09	LTDU	441	72	6.13	48	187	0.2360	0	0.05	y	-0.0026
Winter2008(DJF)	LTDU	685	65	10.54	22	143	0.1897	0	0.05	y	-0.0026
Winter2009(DJF)	LTDU	4152	404	10.28	316	1055	0.1206	0	0.05	y	-0.0026
Winter2010(DJF)	LTDU	441	72	6.13	48	187	0.2360	0	0.05	y	-0.0026
2009	LTDU	5195	563	9.23	464	1482	0.1092	0	0.05	y	-0.0026
Feb-08	COLO	97	62	1.56	2	0.05	0.0000		n	0.2	0.5
Feb-09	COLO	979	333	2.94	5	0.05	1.0000		n	0.5	1
May-09	COLO	617	352	1.75	5	62	0.2379	0	0.05	y	-0.0026
Mar-08	GULG	832	29	28.69	18	165	0.1564	0	0.05	y	-0.0026
Jan-09	GULG	1991	17	117.12	26	0.05	0.0000	5	y	0	0.001
Feb-09	GULG	1362	42	32.43	14	168	0.1454	0	0.05	y	-0.0026
Sep-09	GULG	473	14	33.79	19	0.05	6.0000	3	n	0.5	1
Oct-09	GULG	598	32	18.69	18	78	0.3303	0.0001	0.05	y	-0.0026
Nov-09	GULG	875	21	41.67	16	430	0.0818	0	0.05	y	-0.0026
Dec-09	GULG	472	16	29.50	31	0.05	8.0000	7	n	0.1	0.2
Winter2009(DJF)	GULG	3377	67	50.40	51	218	0.1999	0	0.05	y	-0.0026
Autumn2009(ASON)	GULG	1989	72	27.63	81	529	0.0984	0	0.05	y	-0.0026
Winter2010(DJF)	GULG	472	16	29.50	31	0.05	8.0000	7	n	0.1	0.2
2009	GULG	6129	204	30.04	219	1017	0.0865	0	0.05	y	-0.0026
Apr-08	SCOT	1607	50	32.14	32	1319	0.0455	0	0.05	y	-0.0026
Dec-08	SCOT	1328	8	166.00	0	1326	0.0431	0	0.05	y	-0.0026
Jan-09	SCOT	2811	33	85.18	0	450	0.0740	0	0.05	y	-0.0026
Winter2009(DJF)	SCOT	4943	74	66.80	43	1785	0.0391	0	0.05	y	-0.0026
May-08	LAGU	712	237	3.00	245	603	0.3414	0.0002	0.05	y	-0.0026
Jun-08	LAGU	531	315	1.69	198	421	1.2892	0.9256	0.05	n	-0.0026
Jul-08	LAGU	673	415	1.62	255	589	0.4826	0.026	0.05	y	-0.0026
Aug-08	LAGU	1349	473	2.85	340	994	0.1577	0	0.05	y	-0.0026
Sep-08	LAGU	580	334	1.74	166	486	0.2249	0	0.05	y	-0.0026
Oct-08	LAGU	1027	298	3.45	204	708	0.1393	0	0.05	y	-0.0026
Nov-08	LAGU	1738	199	8.73	133	458	0.1751	0	0.05	y	-0.0026
May-09	LAGU	215	151	1.42	62	193	0.3163	0	0.05	y	-0.0026
Jun-09	LAGU	466	286	1.63	125	329	0.3607	0.0005	0.05	y	-0.0026
Aug-09	LAGU	767	375	2.05	204	537	0.2822	0	0.05	y	-0.0026
Sep-09	LAGU	251	180	1.39	71	166	0.8433	0.5244	0.05	n	-0.0026
Oct-09	LAGU	1334	170	7.85	143	482	0.1759	0	0.05	y	-0.0026
Summer2008(JJ)	LAGU	1204	730	1.65	459	1010	0.5426	0.07	0.05	n	-0.0026
Autumn2008(ASON)	LAGU	4694	1304	3.60	1019	2646	0.1329	0	0.05	y	-0.0026
Summer2009(JJ)	LAGU	466	286	1.63	125	329	0.3607	0.0005	0.05	y	-0.0026
Autumn2009(ASON)	LAGU	2404	757	3.18	537	1235	0.3429	0.0002	0.05	y	-0.0026
May-08	GBBG	341	189	1.80	80	185	0.8546	0.5416	0.05	n	-0.0026

Table E-4 (*continued*). Hodges-Ajne test for a uniform circular distribution. Ho: The population has a uniform circular distribution. Ha: The population has a nonuniform circular distribution.

Time Period	Species	Abundance	#Observations	Cluster Size	m	n	A	P	CI Level	Reject Ho?	Accuracy
Jun-08	GBBG	127	97	1.31	28	89	0.4491	0.0123	0.05	y	-0.0026
Aug-08	GBBG	147	121	1.21	19	83	0.3180	0	0.05	y	-0.0026
Sep-08	GBBG	379	255	1.49	103	229	1.0335	0.7641	0.05	n	-0.0026
Jun-09	GBBG	146	119	1.23	42	127	0.4117	0.0042	0.05	y	-0.0026
Aug-09	GBBG	169	140	1.21	29	98	0.3888	0.0018	0.05	y	-0.0026
Sep-09	GBBG	174	99	1.76	23	69	0.5673	0.0956	0.05	n	-0.0026
Oct-09	GBBG	471	212	2.22	64	146	1.0544	0.7838	0.05	n	-0.0026
Summer2009(JJ)	GBBG	146	119	1.23	42	127	0.4117	0.0042	0.05	y	-0.0026
Jun-08	WISP	400	199	2.01	82	400	0.1331	0	0.05	y	-0.0026
Jul-08	WISP	446	251	1.78	116	314	0.3394	0.0002	0.05	y	-0.0026
Aug-08	WISP	1251	175	7.15	119	1060	0.0622	0	0.05	y	-0.0026
Aug-09	WISP	374	321	1.17	175	368	1.6741	0.9641	0.05	n	-0.0026
Sep-09	WISP	281	247	1.14	96	266	0.3462	0.0002	0.05	y	-0.0026
Summer2008(JJ)	WISP	846	450	1.88	257	714	0.2099	0	0.05	y	-0.0026
Jun-08	COTE	339	195	1.74	126	337	0.3392	0.0002	0.05	y	-0.0026
Jul-08	COTE	366	181	2.02	112	334	0.2610	0	0.05	y	-0.0026
Aug-08	COTE	798	354	2.25	288	775	0.2197	0	0.05	y	-0.0026
Sep-08	COTE	392	133	2.95	139	386	0.2858	0	0.05	y	-0.0026
May-09	COTE	175	83	2.11	55	171	0.3367	0.0001	0.05	y	-0.0026
Jun-09	COTE	290	202	1.44	131	288	1.0253	0.7561	0.05	n	-0.0026
Aug-09	COTE	129	99	1.30	54	129	0.8496	0.534	0.05	n	-0.0026
Summer2008(JJ)	COTE	705	376	1.88	248	671	0.2325	0	0.05	y	-0.0026
Summer2009(JJ)	COTE	290	202	1.44	131	288	1.0253	0.7561	0.05	n	-0.0026
Jul-08	COSH	117	44	2.66	44	0.05	15.0000	12	n	0.2	0.5
Aug-09	COSH	72	65	1.11	20	65	0.5066	0.0404	0.05	y	-0.0026
Summer2008(JJ)	COSH	188	87	2.16	40	97	0.9100	0.621	0.05	n	-0.0026
Jul-08	TESM	72	11	6.55	17	72	0.3508	0.0003	0.05	y	-0.0026
Aug-08	PASS	118	58	2.03	9	118	0.1706	0	0.05	y	-0.0026
Sep-08	SHSM	200	3	66.67	0	200	0.1111	0	0.05	y	-0.0026
Oct-08	SHSM	533	5	106.60	0	171	0.1201	0	0.05	y	-0.0026
Oct-08	FOTE	688	81	8.49	112	593	0.1037	0	0.05	y	-0.0026
Nov-08	CANG	2548	22	115.82	0	2548	0.0311	0	0.05	y	-0.0026
Autumn2008(ASON)	CANG	2637	26	101.42	0	2637	0.0306	0	0.05	y	-0.0026
Jan-09	GRSC	1568	9	174.22	17	68	0.3810	0.0013	0.05	y	-0.0026
Nov-09	RTLO	892	259	3.44	26	799	0.0594	0	0.05	y	-0.0026

Table E-5. Batschelet test for a uniform circular distribution. Ho: The population has a uniform circular distribution, OR has a nonuniform circular distribution that is concentrated around an angle that is different from 223.17 degrees. Ha: The population has a nonuniform circular distribution that is concentrated around an angle of 223.17 degrees.

Time Period	Species	Abundance	#Observations	Cluster Size	Low Angle	Mid Angle	High Angle	Binomial p	mp	#Tails	Run Test	n	CI Level	Stat1	Stat2	Crit1	Crit2	Reject Ho?	Plow	Phigh
Overall	TOTAL	177266	35547	4.99	133	223	313	0.5	63810	2	Randomness	109794	0.05	45984	45984	468	109326	n	0.5	1
Jan-08	TOTAL	6500	1212	5.36	39	129	219	0.5	1312	2	Randomness	2081	0.05	769	769	468	1613	n	0.5	1
Feb-08	TOTAL	580	208	2.79	295	25	115	0.5	235	2	Randomness	327	0.05	92	92	145	182	y	0	0.001
Mar-08	TOTAL	17569	3068	5.73	214	304	34	0.5	5363	2	Randomness	9139	0.05	3776	3776	468	8671	n	0.5	1
Apr-08	TOTAL	15624	3362	4.65	312	42	132	0.5	8868	2	Randomness	10850	0.05	1982	1982	468	10382	n	0.5	1
May-08	TOTAL	4446	1901	2.34	300	30	120	0.5	2079	2	Randomness	3527	0.05	1448	1448	468	3059	n	0.5	1
Jun-08	TOTAL	1964	1198	1.64	89	179	269	0.5	990	2	Randomness	1674	0.05	684	684	468	1206	n	0.5	1
Jul-08	TOTAL	1957	1061	1.84	85	175	265	0.5	894	2	Randomness	1591	0.05	697	697	468	1123	n	0.5	1
Aug-08	TOTAL	4255	1457	2.92	260	350	80	0.5	2184	2	Randomness	3396	0.05	1212	1212	468	2928	n	0.5	1
Sep-08	TOTAL	2612	1103	2.37	184	274	4	0.5	1284	2	Randomness	2196	0.05	912	912	468	1728	n	0.5	1
Oct-08	TOTAL	11928	1729	6.90	155	245	335	0.5	8215	2	Randomness	9994	0.05	1779	1779	468	9526	n	0.5	1
Nov-08	TOTAL	27018	2694	10.03	127	217	307	0.5	17233	2	Randomness	20358	0.05	3125	3125	468	19890	n	0.5	1
Dec-08	TOTAL	9672	1150	8.41	93	183	273	0.5	5320	2	Randomness	6091	0.05	771	771	468	5623	n	0.5	1
Jan-09	TOTAL	20306	1618	12.55	61	151	241	0.5	5339	2	Randomness	9332	0.05	3993	3993	468	8864	n	0.5	1
Feb-09	TOTAL	10953	1919	5.71	222	312	42	0.5	1926	2	Randomness	3108	0.05	1182	1182	468	2640	n	0.5	1
Mar-09	TOTAL	6494	2058	3.16	270	0	90	0.5	1977	2	Randomness	3193	0.05	1216	1216	468	2725	n	0.5	1
Apr-09	TOTAL	6122	1038	5.90	327	57	147	0.5	3910	2	Randomness	5290	0.05	1380	1380	468	4822	n	0.5	1
May-09	TOTAL	3052	1744	1.75	299	29	119	0.5	1201	2	Randomness	2071	0.05	870	870	468	1603	n	0.5	1
Jun-09	TOTAL	1817	1309	1.39	330	60	150	0.5	849	2	Randomness	1411	0.05	562	562	468	943	n	0.5	1
Aug-09	TOTAL	1885	1201	1.57	213	303	33	0.5	791	2	Randomness	1500	0.05	709	709	468	1032	n	0.5	1
Sep-09	TOTAL	1923	814	2.36	214	304	34	0.5	495	2	Randomness	918	0.05	423	423	428	490	y	0.01	0.02
Oct-09	TOTAL	4065	619	6.57	176	266	356	0.5	1261	2	Randomness	2151	0.05	890	890	468	1683	n	0.5	1
Nov-09	TOTAL	10757	1890	5.69	158	248	338	0.5	4416	2	Randomness	6539	0.05	2123	2123	468	6071	n	0.5	1
Dec-09	TOTAL	5767	1194	4.83	144	234	324	0.5	2226	2	Randomness	3057	0.05	831	831	468	2589	n	0.5	1
Winter2008(DJF)	TOTAL	7080	1420	4.99	31	121	211	0.5	1478	2	Randomness	2408	0.05	930	930	468	1940	n	0.5	1
Spring2008(MAM)	TOTAL	37639	8331	4.52	306	36	126	0.5	15248	2	Randomness	23516	0.05	8268	8268	468	23048	n	0.5	1
Summer2008(JJ)	TOTAL	3921	2259	1.74	87	177	267	0.5	1884	2	Randomness	3265	0.05	1381	1381	468	2797	n	0.5	1
Autumn2008(ASON)	TOTAL	45813	6983	6.56	139	229	319	0.5	26421	2	Randomness	35944	0.05	9523	9523	468	35476	n	0.5	1
Winter2009(DJF)	TOTAL	40931	4687	8.73	92	182	272	0.5	11713	2	Randomness	18531	0.05	6818	6818	468	18063	n	0.5	1
Spring2009(MAM)	TOTAL	15668	4840	3.24	310	40	130	0.5	6495	2	Randomness	10554	0.05	4059	4059	468	10086	n	0.5	1
Summer2009(JJ)	TOTAL	1817	1309	1.39	330	60	150	0.5	849	2	Randomness	1411	0.05	562	562	468	943	n	0.5	1
Autumn2009(ASON)	TOTAL	18630	4524	4.12	163	253	343	0.5	6911	2	Randomness	11108	0.05	4197	4197	468	10640	n	0.5	1
Winter2010(DJF)	TOTAL	5767	1194	4.83	144	234	324	0.5	2226	2	Randomness	3057	0.05	831	831	468	2589	n	0.5	1
2008	TOTAL	104125	20143	5.17	129	219	309	0.5	44344	2	Randomness	71224	0.05	26880	26880	468	70756	n	0.5	1
2009	TOTAL	73141	15404	4.75	209	299	29	0.5	19744	2	Randomness	38570	0.05	18826	18826	468	38102	n	0.5	1
Overall	NOGA	34020	9822	3.46	123	213	303	0.5	13682	2	Randomness	22856	0.05	9174	9174	468	22388	n	0.5	1
Jan-08	NOGA	898	482	1.86	330	60	150	0.5	409	2	Randomness	693	0.05	284	284	320	373	y	0	0.001
Feb-08	NOGA	49	33	1.48	27	117	207	0.5	28	2	Randomness	37	0.05	9	9	12	25	y	0.002	0.005
Mar-08	NOGA	4980	1351	3.69	244	334	64	0.5	1747	2	Randomness	3348	0.05	1601	1601	468	2880	n	0.5	1
Apr-08	NOGA	3271	1409	2.32	274	4	94	0.5	1252	2	Randomness	2081	0.05	829	829	468	1613	n	0.5	1
May-08	NOGA	858	582	1.47	332	62	152	0.5	397	2	Randomness	703	0.05	306	306	325	378	y	0.0005	0.001
Jun-08	NOGA	270	195	1.38	78	168	258	0.5	132	2	Randomness	195	0.05	63	63	83	112	y	0	0.001
Oct-08	NOGA	1692	492	3.44	155	245	335	0.5	1186	2	Randomness	1380	0.05	194	194	468	912	y	0	0.001
Nov-08	NOGA	9402	1045	9.00	109	199	289	0.5	4953	2	Randomness	6037	0.05	1084	1084	468	5569	n	0.5	1

Table E-5 (*continued*). Batschelet test for a uniform circular distribution. Ho: The population has a uniform circular distribution, OR has a nonuniform circular distribution that is concentrated around an angle that is different from 223.17 degrees. Ha: The population has a nonuniform circular distribution that is concentrated around an angle of 223.17 degrees.

Time Period	Species	Abundance	#Observations	Cluster Size	Low Angle	Mid Angle	High Angle	Binomial p	mp	#Tails	Run Test	n	CI Level	Stat1	Stat2	Crit1	Crit2	Reject Ho?	Plow	Phigh
Dec-08	NOGA	470	308	1.53	81	171	261	0.5	208	2	Randomness	343	0.05	135	135	152	191	y	0	0.001
Jan-09	NOGA	1849	417	4.43	93	183	273	0.5	1509	2	Randomness	1707	0.05	198	198	468	1239	y	0	0.001
Mar-09	NOGA	840	468	1.79	237	327	57	0.5	342	2	Randomness	604	0.05	262	262	277	327	y	0.001	0.002
Apr-09	NOGA	400	303	1.32	284	14	104	0.5	178	2	Randomness	322	0.05	144	144	142	180	n	0.05	0.1
May-09	NOGA	1077	674	1.60	354	84	174	0.5	459	2	Randomness	815	0.05	356	356	379	436	y	0	0.001
Jun-09	NOGA	431	343	1.26	357	87	177	0.5	162	2	Randomness	237	0.05	75	75	102	135	y	0	0.001
Nov-09	NOGA	6394	981	6.52	250	340	70	0.5	2335	2	Randomness	3495	0.05	1160	1160	468	3027	n	0.5	1
Dec-09	NOGA	628	331	1.90	121	211	301	0.5	439	2	Randomness	482	0.05	43	43	218	264	y	0	0.001
Winter2008(DJF)	NOGA	947	515	1.84	337	67	157	0.5	436	2	Randomness	730	0.05	294	294	338	392	y	0	0.001
Spring2008(MAM)	NOGA	9109	3342	2.73	271	1	91	0.5	3473	2	Randomness	6132	0.05	2659	2659	468	5664	n	0.5	1
Summer2008(JJ)	NOGA	312	232	1.34	62	152	242	0.5	146	2	Randomness	224	0.05	78	78	96	128	y	0	0.001
Autumn2008(ASON)	NOGA	11217	1631	6.88	121	211	301	0.5	6115	2	Randomness	7490	0.05	1375	1375	468	7022	n	0.5	1
Spring2009(MAM)	NOGA	2317	1445	1.60	303	33	123	0.5	930	2	Randomness	1741	0.05	811	811	468	1273	n	0.5	1
Summer2009(JJ)	NOGA	431	343	1.26	357	87	177	0.5	162	2	Randomness	237	0.05	75	75	102	135	y	0	0.001
Autumn2009(ASON)	NOGA	6474	1050	6.17	250	340	70	0.5	2361	2	Randomness	3547	0.05	1186	1186	468	3079	n	0.5	1
Winter2010(DJF)	NOGA	628	331	1.90	121	211	301	0.5	439	2	Randomness	482	0.05	43	43	218	264	y	0	0.001
2008	NOGA	22055	6028	3.66	125	215	305	0.5	9381	2	Randomness	14919	0.05	5538	5538	468	14451	n	0.5	1
2009	NOGA	11965	3794	3.15	119	209	299	0.5	4301	2	Randomness	7937	0.05	3636	3636	468	7469	n	0.5	1
Overall	SCDW	13933	364	38.28	74	164	254	0.5	8157	2	Randomness	11113	0.05	2956	2956	468	10645	n	0.5	1
Mar-08	SCDW	1522	36	42.28	69	159	249	0.5	1222	2	Randomness	1509	0.05	287	287	468	1041	y	0	0.001
Apr-08	SCDW	1885	69	27.32	324	54	144	0.5	1464	2	Randomness	1500	0.05	36	36	468	1032	y	0	0.001
Nov-08	SCDW	2932	30	97.73	107	197	287	0.5	1948	2	Randomness	2932	0.05	984	984	468	2464	n	0.5	1
Dec-08	SCDW	3025	21	144.05	95	185	275	0.5	1451	2	Randomness	1465	0.05	14	14	468	997	y	0	0.001
Apr-09	SCDW	1599	36	44.42	49	139	229	0.5	1257	2	Randomness	1569	0.05	312	312	468	1101	y	0	0.001
Dec-09	SCDW	473	16	29.56	107	197	287	0.5	189	2	Randomness	243	0.05	54	54	105	138	y	0	0.001
Spring2008(MAM)	SCDW	3407	105	32.45	357	87	177	0.5	2439	2	Randomness	3009	0.05	570	570	468	2541	n	0.5	1
Autumn2008(ASON)	SCDW	3228	49	65.88	111	201	291	0.5	2136	2	Randomness	3228	0.05	1092	1092	468	2760	n	0.5	1
Winter2009(DJF)	SCDW	4468	107	41.76	92	182	272	0.5	2118	2	Randomness	2476	0.05	358	358	468	2008	y	0	0.001
Spring2009(MAM)	SCDW	1985	71	27.96	53	143	233	0.5	1418	2	Randomness	1791	0.05	373	373	468	1323	y	0	0.001
Winter2010(DJF)	SCDW	473	16	29.56	107	197	287	0.5	189	2	Randomness	243	0.05	54	54	105	138	y	0	0.001
2008	SCDW	9669	178	54.32	74	164	254	0.5	5836	2	Randomness	7705	0.05	1869	1869	468	7237	n	0.5	1
Overall	HERG	13790	3474	3.97	305	35	125	0.5	2545	2	Randomness	4730	0.05	2185	2185	468	4262	n	0.5	1
Jan-08	HERG	1158	129	8.98	132	222	312	0.5	125	2	Randomness	206	0.05	81	81	88	118	y	0.002	0.005
Feb-08	HERG	61	41	1.49	3	93	183	0.5	36	2	Randomness	60	0.05	24	24	21	39	n	0.1	0.2
Mar-08	HERG	3785	394	9.61	350	80	170	0.5	430	2	Randomness	725	0.05	295	295	335	390	y	0	0.001
May-08	HERG	568	249	2.28	300	30	120	0.5	201	2	Randomness	322	0.05	121	121	142	180	y	0	0.001
Feb-09	HERG	1710	325	5.26	243	333	63	0.5	223	2	Randomness	377	0.05	154	154	168	209	y	0	0.001
Mar-09	HERG	1037	358	2.90	327	57	147	0.5	337	2	Randomness	500	0.05	163	163	227	273	y	0	0.001
Apr-09	HERG	439	138	3.18	256	346	76	0.5	129	2	Randomness	186	0.05	57	57	79	107	y	0	0.001
May-09	HERG	261	194	1.35	290	20	110	0.5	131	2	Randomness	224	0.05	93	93	96	128	y	0.01	0.02
Jun-09	HERG	135	90	1.50	280	10	100	0.5	77	2	Randomness	121	0.05	44	44	49	72	y	0.002	0.005
Sep-09	HERG	352	59	5.97	286	16	106	0.5	31	2	Randomness	54	0.05	23	23	19	35	n	0.2	0.5
Oct-09	HERG	237	62	3.82	290	20	110	0.5	50	2	Randomness	69	0.05	19	19	25	44	y	0	0.001

Table E-5 (*continued*). Batschelet test for a uniform circular distribution. Ho: The population has a uniform circular distribution, OR has a nonuniform circular distribution that is concentrated around an angle that is different from 223.17 degrees. Ha: The population has a nonuniform circular distribution that is concentrated around an angle of 223.17 degrees.

Time Period	Species	Abundance	#Observations	Cluster Size	Low Angle	Mid Angle	High Angle	Binomial p	mp	#Tails	Run Test	n	CI Level	Stat1	Stat2	Crit1	Crit2	Reject Ho?	Plow	Phigh
Nov-09	HERG	416	149	2.79	38	128	218	0.5	127	2	Randomness	224	0.05	97	97	96	128	n	0.05	0.1
Winter2008(DJF)	HERG	1219	170	7.17	66	156	246	0.5	123	2	Randomness	266	0.05	143	143	116	150	n	0.2	0.5
Spring2008(MAM)	HERG	5024	1016	4.94	338	68	158	0.5	921	2	Randomness	1483	0.05	562	562	468	1015	n	0.5	1
Spring2009(MAM)	HERG	1737	690	2.52	306	36	126	0.5	569	2	Randomness	910	0.05	341	341	424	486	y	0	0.001
Summer2009(JJ)	HERG	135	90	1.50	280	10	100	0.5	77	2	Randomness	121	0.05	44	44	49	72	y	0.002	0.005
Autumn2009(ASON)	HERG	1032	290	3.56	335	65	155	0.5	219	2	Randomness	368	0.05	149	149	164	204	y	0	0.001
2008	HERG	7991	1810	4.41	333	63	153	0.5	1329	2	Randomness	2520	0.05	1191	1191	468	2052	n	0.5	1
2009	HERG	5799	1664	3.49	292	22	112	0.5	1219	2	Randomness	2210	0.05	991	991	468	1742	n	0.5	1
Overall	SUSC	12463	709	17.58	164	254	344	0.5	4016	2	Randomness	6908	0.05	2892	2892	468	6440	n	0.5	1
Mar-08	SUSC	2181	71	30.72	242	332	62	0.5	822	2	Randomness	934	0.05	112	112	436	498	y	0	0.001
Apr-08	SUSC	3048	142	21.46	316	46	136	0.5	1191	2	Randomness	1328	0.05	137	137	468	860	y	0	0.001
Nov-08	SUSC	2348	52	45.15	136	226	316	0.5	2277	2	Randomness	2318	0.05	41	41	468	1850	y	0	0.001
Dec-08	SUSC	1029	41	25.10	83	173	263	0.5	207	2	Randomness	292	0.05	85	85	128	164	y	0	0.001
Feb-09	SUSC	1165	121	9.63	195	285	15	0.5	318	2	Randomness	426	0.05	108	108	192	234	y	0	0.001
Mar-09	SUSC	664	84	7.90	278	8	98	0.5	182	2	Randomness	246	0.05	64	64	107	139	y	0	0.001
Apr-09	SUSC	604	48	12.58	320	50	140	0.5	424	2	Randomness	462	0.05	38	38	209	253	y	0	0.001
Nov-09	SUSC	435	16	27.19	124	214	304	0.5	403	2	Randomness	435	0.05	32	32	196	239	y	0	0.001
Spring2008(MAM)	SUSC	5230	214	24.44	292	22	112	0.5	1824	2	Randomness	2263	0.05	439	439	468	1795	y	0	0.001
Spring2009(MAM)	SUSC	1292	133	9.71	314	44	134	0.5	630	2	Randomness	732	0.05	102	102	338	394	y	0	0.001
2008	SUSC	8828	336	26.27	160	250	340	0.5	3065	2	Randomness	5021	0.05	1956	1956	468	4553	n	0.5	1
Overall	DCCO	10892	394	27.64	209	299	29	0.5	7044	2	Randomness	10730	0.05	3686	3686	468	10262	n	0.5	1
Apr-08	DCCO	1846	64	28.84	292	22	112	0.5	1802	2	Randomness	1837	0.05	35	35	468	1369	y	0	0.001
May-08	DCCO	717	63	11.38	310	40	130	0.5	576	2	Randomness	665	0.05	89	89	306	359	y	0	0.001
Sep-08	DCCO	218	15	14.53	205	295	25	0.5	142	2	Randomness	218	0.05	76	76	94	124	y	0	0.001
Oct-08	DCCO	4157	99	41.99	151	241	331	0.5	4046	2	Randomness	4154	0.05	108	108	468	3686	y	0	0.001
Apr-09	DCCO	1869	60	31.15	301	31	121	0.5	1714	2	Randomness	1844	0.05	130	130	468	1376	y	0	0.001
Oct-09	DCCO	931	19	49.00	276	6	96	0.5	495	2	Randomness	927	0.05	432	432	433	494	y	0.02	0.05
Spring2008(MAM)	DCCO	2563	127	20.18	296	26	116	0.5	2378	2	Randomness	2502	0.05	124	124	468	2034	y	0	0.001
Autumn2008(ASON)	DCCO	5268	130	40.52	152	242	332	0.5	5066	2	Randomness	5265	0.05	199	199	468	4797	y	0	0.001
Spring2009(MAM)	DCCO	1972	83	23.76	300	30	120	0.5	1755	2	Randomness	1895	0.05	140	140	468	1427	y	0	0.001
Autumn2009(ASON)	DCCO	1053	31	33.97	229	319	49	0.5	662	2	Randomness	1039	0.05	377	377	468	571	y	0	0.001
2008	DCCO	7861	275	28.59	176	266	356	0.5	5200	2	Randomness	7790	0.05	2590	2590	468	7322	n	0.5	1
Jan-08	BLSC	1369	51	26.84	59	149	239	0.5	526	2	Randomness	589	0.05	63	63	270	319	y	0	0.001
Feb-08	BLSC	187	9	20.78	216	306	36	0.5	72	2	Randomness	92	0.05	20	20	36	56	y	0	0.001
Dec-08	BLSC	1642	37	44.38	93	183	273	0.5	1299	2	Randomness	1344	0.05	45	45	468	876	y	0	0.001
Mar-09	BLSC	634	57	11.12	271	1	91	0.5	440	2	Randomness	479	0.05	39	39	217	262	y	0	0.001
Dec-09	BLSC	737	40	18.43	87	177	267	0.5	260	2	Randomness	386	0.05	126	126	173	213	y	0	0.001
Winter2008(DJF)	BLSC	1556	60	25.93	62	152	242	0.5	546	2	Randomness	681	0.05	135	135	314	367	y	0	0.001
Winter2010(DJF)	BLSC	737	40	18.43	87	177	267	0.5	260	2	Randomness	386	0.05	126	126	173	213	y	0	0.001
Jan-08	SCAU	750	1	750.00	326	56	146	0.5	65	2	Randomness	90	0.05	25	25	35	55	y	0.0005	0.001
Jan-09	SCAU	4617	32	144.28	280	10	100	0.5	2294	2	Randomness	3917	0.05	1623	1623	468	3449	n	0.5	1

Table E-5 (*continued*). Batschelet test for a uniform circular distribution. Ho: The population has a uniform circular distribution, OR has a nonuniform circular distribution that is concentrated around an angle that is different from 223.17 degrees. Ha: The population has a nonuniform circular distribution that is concentrated around an angle of 223.17 degrees.

Time Period	Species	Abundance	#Observations	Cluster Size	Low Angle	Mid Angle	High Angle	Binomial p	mp	#Tails	Run Test	n	CI Level	Stat1	Stat2	Crit1	Crit2	Reject Ho?	Plow	Phigh
Winter2008(DJF)	SCAU	750	1	750.00	345	75	165	0.5	112	2	Randomness	143	0.05	31	31	59	84	y	0	0.001
Winter2009(DJF)	SCAU	4617	32	144.28	280	10	100	0.5	2294	2	Randomness	3917	0.05	1623	1623	468	3449	n	0.5	1
2009	SCAU	4617	32	144.28	280	10	100	0.5	2294	2	Randomness	3917	0.05	1623	1623	468	3449	n	0.5	1
Jan-08	LTDU	603	57	10.58	326	56	146	0.5	65	2	Randomness	90	0.05	25	25	35	55	y	0.0005	0.001
Feb-08	LTDU	82	8	10.25	1	91	181	0.5	51	2	Randomness	53	0.05	2	2	18	35	y	0.0005	0.001
Feb-09	LTDU	2483	265	9.37	233	323	53	0.5	492	2	Randomness	697	0.05	205	205	322	375	y	0	0.001
Mar-09	LTDU	723	87	8.31	205	295	25	0.5	157	2	Randomness	214	0.05	57	57	92	122	y	0	0.001
Dec-09	LTDU	441	72	6.13	112	202	292	0.5	139	2	Randomness	187	0.05	48	48	79	108	y	0	0.001
Winter2008(DJF)	LTDU	685	65	10.54	345	75	165	0.5	112	2	Randomness	143	0.05	31	31	59	84	y	0	0.001
Winter2009(DJF)	LTDU	4152	404	10.28	225	315	45	0.5	739	2	Randomness	1055	0.05	316	316	468	587	y	0	0.001
Winter2010(DJF)	LTDU	441	72	6.13	112	202	292	0.5	139	2	Randomness	187	0.05	48	48	79	108	y	0	0.001
2009	LTDU	5195	563	9.23	203	293	23	0.5	1018	2	Randomness	1482	0.05	464	464	468	1014	y	0.02	0.05
Feb-08	COLO	97	62	1.56	113	203	293	0.5	2	2	Randomness	2	0.05	0	0	0	2	y	0.001	0.002
Feb-09	COLO	979	333	2.94	150	240	330	0.5	4	2	Randomness	5	0.05	1	1	0	5	n	0.2	0.5
May-09	COLO	617	352	1.75	322	52	142	0.5	57	2	Randomness	62	0.05	5	5	22	40	y	0	0.001
Mar-08	GULG	832	29	28.69	245	335	65	0.5	133	2	Randomness	165	0.05	32	32	69	96	y	0	0.001
Jan-09	GULG	1991	17	117.12	151	241	331	0.5	26	2	Randomness	26	0.05	0	0	7	19	y	0.0005	0.001
Feb-09	GULG	1362	42	32.43	65	155	245	0.5	140	2	Randomness	168	0.05	28	28	70	98	y	0	0.001
Sep-09	GULG	473	14	33.79	80	170	260	0.5	11	2	Randomness	19	0.05	8	8	4	15	n	0.5	1
Oct-09	GULG	598	32	18.69	306	36	126	0.5	57	2	Randomness	78	0.05	21	21	29	49	y	0.0005	0.001
Nov-09	GULG	875	21	41.67	93	183	273	0.5	412	2	Randomness	430	0.05	18	18	194	236	y	0	0.001
Dec-09	GULG	472	16	29.50	80	170	260	0.5	22	2	Randomness	31	0.05	9	9	9	22	y	0.02	0.05
Winter2009(DJF)	GULG	3377	67	50.40	81	171	261	0.5	158	2	Randomness	218	0.05	60	60	94	124	y	0	0.001
Autumn2009(ASON)	GULG	1989	72	27.63	90	180	270	0.5	445	2	Randomness	529	0.05	84	84	241	288	y	0	0.001
Winter2010(DJF)	GULG	472	16	29.50	80	170	260	0.5	22	2	Randomness	31	0.05	9	9	9	22	y	0.02	0.05
2009	GULG	6129	204	30.04	103	193	283	0.5	662	2	Randomness	1017	0.05	355	355	468	549	y	0	0.001
Apr-08	SCOT	1607	50	32.14	325	55	145	0.5	1287	2	Randomness	1319	0.05	32	32	468	851	y	0	0.001
Dec-08	SCOT	1328	8	166.00	89	179	269	0.5	1284	2	Randomness	1326	0.05	42	42	468	858	y	0	0.001
Jan-09	SCOT	2811	33	85.18	0	90	180	0.5	450	2	Randomness	450	0.05	0	0	203	247	y	0	0.001
Winter2009(DJF)	SCOT	4943	74	66.80	69	159	249	0.5	1735	2	Randomness	1785	0.05	50	50	468	1317	y	0	0.001
May-08	LAGU	712	237	3.00	127	217	307	0.5	358	2	Randomness	603	0.05	245	245	276	327	y	0	0.001
Jun-08	LAGU	531	315	1.69	90	180	270	0.5	210	2	Randomness	421	0.05	211	211	189	232	n	0.5	1
Jul-08	LAGU	673	415	1.62	151	241	331	0.5	317	2	Randomness	589	0.05	272	272	270	319	n	0.05	0.1
Aug-08	LAGU	1349	473	2.85	292	22	112	0.5	654	2	Randomness	994	0.05	340	340	465	529	y	0	0.001
Sep-08	LAGU	580	334	1.74	294	24	114	0.5	320	2	Randomness	486	0.05	166	166	220	266	y	0	0.001
Oct-08	LAGU	1027	298	3.45	177	267	357	0.5	497	2	Randomness	708	0.05	211	211	327	381	y	0	0.001
Nov-08	LAGU	1738	199	8.73	222	312	42	0.5	325	2	Randomness	458	0.05	133	133	207	251	y	0	0.001
May-09	LAGU	215	151	1.42	280	10	100	0.5	119	2	Randomness	193	0.05	74	74	82	111	y	0.001	0.002
Jun-09	LAGU	466	286	1.63	335	65	155	0.5	204	2	Randomness	329	0.05	125	125	146	183	y	0	0.001
Aug-09	LAGU	767	375	2.05	275	5	95	0.5	324	2	Randomness	537	0.05	213	213	245	292	y	0	0.001

Table E-5 (*continued*). Batschelet test for a uniform circular distribution. Ho: The population has a uniform circular distribution, OR has a nonuniform circular distribution that is concentrated around an angle that is different from 223.17 degrees. Ha: The population has a nonuniform circular distribution that is concentrated around an angle of 223.17 degrees.

Time Period	Species	Abundance	#Observations	Cluster Size	Low Angle	Mid Angle	High Angle	Binomial p	mp	#Tails	Run Test	n	CI Level	Stat1	Stat2	Crit1	Crit2	Reject Ho?	Plow	Phigh
Sep-09	LAGU	251	180	1.39	198	288	18	0.5	95	2	Randomness	166	0.05	71	71	69	97	n	0.05	0.1
Oct-09	LAGU	1334	170	7.85	122	212	302	0.5	312	2	Randomness	482	0.05	170	170	218	264	y	0	0.001
Summer2008(JJ)	LAGU	1204	730	1.65	140	230	320	0.5	537	2	Randomness	1010	0.05	473	473	468	542	n	0.05	0.1
Autumn2008(ASON)	LAGU	4694	1304	3.60	246	336	66	0.5	1627	2	Randomness	2646	0.05	1019	1019	468	2178	n	0.5	1
Summer2009(JJ)	LAGU	466	286	1.63	335	65	155	0.5	204	2	Randomness	329	0.05	125	125	146	183	y	0	0.001
Autumn2009(ASON)	LAGU	2404	757	3.18	169	259	349	0.5	698	2	Randomness	1235	0.05	537	537	468	767	n	0.5	1
May-08	GBBG	341	189	1.80	305	35	125	0.5	105	2	Randomness	185	0.05	80	80	78	107	n	0.05	0.1
Jun-08	GBBG	127	97	1.31	13	103	193	0.5	61	2	Randomness	89	0.05	28	28	34	55	y	0.001	0.002
Aug-08	GBBG	147	121	1.21	151	241	331	0.5	64	2	Randomness	83	0.05	19	19	32	51	y	0	0.001
Sep-08	GBBG	379	255	1.49	76	166	256	0.5	126	2	Randomness	229	0.05	103	103	99	130	n	0.1	0.2
Jun-09	GBBG	146	119	1.23	306	36	126	0.5	78	2	Randomness	127	0.05	49	49	51	76	y	0.01	0.02
Aug-09	GBBG	169	140	1.21	153	243	333	0.5	69	2	Randomness	98	0.05	29	29	38	60	y	0	0.001
Sep-09	GBBG	174	99	1.76	275	5	95	0.5	38	2	Randomness	69	0.05	31	31	25	44	n	0.2	0.5
Oct-09	GBBG	471	212	2.22	196	286	16	0.5	80	2	Randomness	146	0.05	66	66	60	86	n	0.2	0.5
Summer2009(JJ)	GBBG	146	119	1.23	306	36	126	0.5	78	2	Randomness	127	0.05	49	49	51	76	y	0.01	0.02
Jun-08	WISP	400	199	2.01	102	192	282	0.5	282	2	Randomness	400	0.05	118	118	179	221	y	0	0.001
Jul-08	WISP	446	251	1.78	22	112	202	0.5	183	2	Randomness	314	0.05	131	131	139	175	y	0.002	0.005
Aug-08	WISP	1251	175	7.15	269	359	89	0.5	922	2	Randomness	1060	0.05	138	138	468	592	y	0	0.001
Aug-09	WISP	374	321	1.17	128	218	308	0.5	191	2	Randomness	368	0.05	177	177	164	204	n	0.2	0.5
Sep-09	WISP	281	247	1.14	51	141	231	0.5	170	2	Randomness	266	0.05	96	96	116	150	y	0	0.001
Summer2008(JJ)	WISP	846	450	1.88	85	175	265	0.5	457	2	Randomness	714	0.05	257	257	330	384	y	0	0.001
Jun-08	COTE	339	195	1.74	121	211	301	0.5	201	2	Randomness	337	0.05	136	136	150	187	y	0.0005	0.001
Jul-08	COTE	366	181	2.02	64	154	244	0.5	196	2	Randomness	334	0.05	138	138	148	186	y	0.001	0.002
Aug-08	COTE	798	354	2.25	122	212	302	0.5	482	2	Randomness	775	0.05	293	293	359	416	y	0	0.001
Sep-08	COTE	392	133	2.95	259	349	79	0.5	240	2	Randomness	386	0.05	146	146	173	213	y	0	0.001
May-09	COTE	175	83	2.11	124	214	304	0.5	110	2	Randomness	171	0.05	61	61	72	99	y	0	0.001
Jun-09	COTE	290	202	1.44	60	150	240	0.5	157	2	Randomness	288	0.05	131	131	126	162	n	0.1	0.2
Aug-09	COTE	129	99	1.30	147	237	327	0.5	75	2	Randomness	129	0.05	54	54	52	77	n	0.05	0.1
Summer2008(JJ)	COTE	705	376	1.88	88	178	268	0.5	374	2	Randomness	671	0.05	297	297	309	362	y	0.002	0.005
Summer2009(JJ)	COTE	290	202	1.44	60	150	240	0.5	157	2	Randomness	288	0.05	131	131	126	162	n	0.1	0.2
Jul-08	COSH	117	44	2.66	11	101	191	0.5	29	2	Randomness	44	0.05	15	15	15	29	y	0.02	0.05
Aug-09	COSH	72	65	1.11	44	134	224	0.5	45	2	Randomness	65	0.05	20	20	24	41	y	0.002	0.005
Summer2008(JJ)	COSH	188	87	2.16	338	68	158	0.5	56	2	Randomness	97	0.05	41	41	38	59	n	0.1	0.2
Jul-08	TESM	72	11	6.55	103	193	283	0.5	47	2	Randomness	72	0.05	25	25	27	45	y	0.01	0.02
Aug-08	PASS	118	58	2.03	223	313	43	0.5	109	2	Randomness	118	0.05	9	9	47	71	y	0	0.001
Sep-08	SHSM	200	3	66.67	133	223	313	0.5	200	2	Randomness	200	0.05	0	0	85	115	y	0	0.001
Oct-08	SHSM	533	5	106.60	137	227	317	0.5	171	2	Randomness	171	0.05	0	0	72	99	y	0	0.001

Table E-5 (*continued*). Batschelet test for a uniform circular distribution. Ho: The population has a uniform circular distribution, OR has a nonuniform circular distribution that is concentrated around an angle that is different from 223.17 degrees. Ha: The population has a nonuniform circular distribution that is concentrated around an angle of 223.17 degrees.

Time Period	Species	Abundance	#Observations	Cluster Size	Low Angle	Mid Angle	High Angle	Binomial p	mp	#Tails	Run Test	n	CI Level	Stat1	Stat2	Crit1	Crit2	Reject Ho?	Plow	Phigh
Oct-08	FOTE	688	81	8.49	106	196	286	0.5	481	2	Randomness	593	0.05	112	112	272	321	y	0	0.001
Nov-08	CANG	2548	22	115.82	126	216	306	0.5	2548	2	Randomness	2548	0.05	0	0	468	2080	y	0	0.001
Autumn2008(ASON)	CANG	2637	26	101.42	128	218	308	0.5	2631	2	Randomness	2637	0.05	6	6	468	2169	y	0	0.001
Jan-09	GRSC	1568	9	174.22	133	223	313	0.5	51	2	Randomness	68	0.05	17	17	25	43	y	0.0005	0.001
Nov-09	RTLO	892	259	3.44	125	215	305	0.5	766	2	Randomness	799	0.05	33	33	371	428	y	0	0.001

Table E-6. Wilcoxon non-parametric 1-sample (signed-rank) test to assess differences between means (Continuity-corrected). Ho (2-tailed): The 1 sample came from a population with a symmetric distribution around its median (i.e., mean=median). Ha (2-tailed): The 1 sample did NOT come from a population with a symmetric distribution around its median (i.e., mean NOT equal to median).

Time Period	Species	Abundance	# Observations	Cluster Size	# Tails	Run Test	DF	CI Level	ut	sigt	Tm	Tp	Stat	Crit	Reject Ho?	Plow	Phigh	Pint	CI_low	abs(Stat-ut)	CI_high	Accuracy
Overall	TOTAL	177266	35547	4.99	2	Randomness	9999	0.05	2947151015	10484955	3783153522	2377376680	79.73	1.96	y	0	0.001	0	815451996	836002507	856553017	-1
Jan-08	TOTAL	6500	1212	5.36	2	Randomness	9999	0.05	1001793	26954	987449	1341608	0.53	1.96	n	0.5	1	0.5947	-38487	14344	67175	-1
Feb-08	TOTAL	580	208	2.79	2	Randomness	9999	0.05	26319	1692	17166	37452	5.41	1.96	y	0	0.001	0.5201	5837	9153	12468	-1
Mar-08	TOTAL	17569	3068	5.73	2	Randomness	9999	0.05	20419195	252003	19255786	23436286	4.62	1.96	y	0	0.001	0.5353	669482	1163409	1657335	-1
Apr-08	TOTAL	15624	3362	4.65	2	Randomness	9999	0.05	24655835	315279	22782122	45639559	5.94	1.96	y	0	0.001	0.0022	1255765	1873712	2491659	-1
May-08	TOTAL	4446	1901	2.34	2	Randomness	9999	0.05	3091424	59912	3231859	3028550	2.34	1.96	y	0.01	0.02	0.019	23007	140435	257863	-1
Jun-08	TOTAL	1964	1198	1.64	2	Randomness	9999	0.05	665172	19530	784138	689468	6.09	1.96	y	0	0.001	1.7655	80687	118966	157244	-1
Jul-08	TOTAL	1957	1061	1.84	2	Randomness	9999	0.05	623268	18160	735902	550434	6.20	1.96	y	0	0.001	0.194	77040	112634	148227	-1
Aug-08	TOTAL	4255	1457	2.92	2	Randomness	9999	0.05	2876700	57046	2175774	3607039	12.29	1.96	y	0	0.001	0.0617	589116	700926	812736	-1
Sep-08	TOTAL	2612	1103	2.37	2	Randomness	9999	0.05	1182973	29509	1505324	953342	10.92	1.96	y	0	0.001	2.4791	264513	322351	380188	-1
Oct-08	TOTAL	11928	1729	6.90	2	Randomness	9999	0.05	22309900	283371	28731076	26539156	22.66	1.96	y	0	0.001	0.0128	5865769	6421176	6976582	-1
Nov-08	TOTAL	27018	2694	10.03	2	Randomness	9999	0.05	77980630	785269	167469059	91038204	113.96	1.96	y	0	0.001	30.693	87949301	89488428	91027555	-1
Dec-08	TOTAL	9672	1150	8.41	2	Randomness	9999	0.05	6451673	125220	12376062	11826965	47.31	1.96	y	0	0.001	4.9591	5678958	5924389	6169820	-1
Jan-09	TOTAL	20306	1618	12.55	2	Randomness	9999	0.05	21712757	260183	23228288	20441755	5.82	1.96	y	0	0.001	20312.41	1005572	1515531	2025490	-1
Feb-09	TOTAL	10953	1919	5.71	2	Randomness	9999	0.05	2389043	49697	3073617	1811070	13.78	1.96	y	0	0.001	83199619	587168	684574	781980	-1
Mar-09	TOTAL	6494	2058	3.16	2	Randomness	9999	0.05	2524883	51701	1728562	3420114	15.40	1.96	y	0	0.001	2.6729	694987	796321	897654	-1
Apr-09	TOTAL	6122	1038	5.90	2	Randomness	9999	0.05	6076228	108272	4156617	11680318	17.73	1.96	y	0	0.001	10.0527	1707398	1919610	2131822	-1
May-09	TOTAL	3052	1744	1.75	2	Randomness	9999	0.05	1054486	27031	957384	1224758	3.59	1.96	y	0	0.001	0.0004	44121	97102	150082	-1
Jun-09	TOTAL	1817	1309	1.39	2	Randomness	9999	0.05	481635	15176	477292	551771	0.29	1.96	n	0.5	1	0.7747	-25401	4343	34087	-1
Aug-09	TOTAL	1885	1201	1.57	2	Randomness	9999	0.05	557362	16627	623269	513508	3.96	1.96	y	0	0.001	0.9121	33316	65906	98496	-1
Sep-09	TOTAL	1923	814	2.36	2	Randomness	9999	0.05	206455	7967	187521	243212	2.38	1.96	y	0.01	0.02	0.0175	3318	18934	34550	-1
Oct-09	TOTAL	4065	619	6.57	2	Randomness	9999	0.05	1141046	28423	1404482	942380	9.27	1.96	y	0	0.001	3.4525	207726	263436	319145	-1
Nov-09	TOTAL	10757	1890	5.69	2	Randomness	9999	0.05	10107187	151669	11742108	10808579	10.78	1.96	y	0	0.001	0.1502	1337649	1634920	1932191	-1
Dec-09	TOTAL	5767	1194	4.83	2	Randomness	9999	0.05	2180063	48693	3449887	1538294	26.08	1.96	y	0	0.001	2.886	1174385	1269824	1365263	-1
Winter2008(DJF)	TOTAL	7080	1420	4.99	2	Randomness	9999	0.05	1355816	33630	1264607	1824634	2.71	1.96	y	0.005	0.01	0.0068	25293	91208	157123	-1
Spring2008(MAM)	TOTAL	37639	8331	4.52	2	Randomness	9999	0.05	136363755	1040200	111857571	168440691	23.56	1.96	y	0	0.001	11.482	22467391	24506184	26544976	-1
Summer2008(JJ)	TOTAL	3921	2259	1.74	2	Randomness	9999	0.05	2582496	53336	3033096	2465403	8.45	1.96	y	0	0.001	22.0419	346060	450599	555138	-1
Autumn2008(ASON)	TOTAL	45813	6983	6.56	2	Randomness	9999	0.05	272829340	1906091	483132909	263215493	110.33	1.96	y	0	0.001	1.7552	206567630	210303569	214039507	-1
Winter2009(DJF)	TOTAL	40931	4687	8.73	2	Randomness	9999	0.05	78388933	718812	117960250	68678376	55.05	1.96	y	0	0.001	22.4604	38162446	39571317	40980187	-1
Spring2009(MAM)	TOTAL	15668	4840	3.24	2	Randomness	9999	0.05	27649782	312855	21407774	34690133	19.95	1.96	y	0	0.001	367990.4	5628813	6242008	6855203	-1
Summer2009(JJ)	TOTAL	1817	1309	1.39	2	Randomness	9999	0.05	481635	15176	477292	551771	0.29	1.96	n	0.5	1	0.7747	-25401	4343	34087	-1
Autumn2009(ASON)	TOTAL	18630	4524	4.12	2	Randomness	9999	0.05	29799581	336803	35237545	28562066	16.15	1.96	y	0	0.001	1.8243	4777829	5437964	6098099	-1
Winter2010(DJF)	TOTAL	5767	1194	4.83	2	Randomness	9999	0.05	2180063	48693	3449887	1538294	26.08	1.96	y	0	0.001	1.54	1174385	1269824	1365263	-1
2008	TOTAL	104125	20143	5.17	2	Randomness	9999	0.05	1240614698	5478405	1498535315	1093164690	47.08	1.96	y	0	0.001	12.1496	247182944	257920617	268658290	-1
2009	TOTAL	73141	15404	4.75	2	Randomness	9999	0.05	363492007	2182991	513010901	247688556	68.49	1.96	y	0	0.001	796235.4	145240230	149518893	153797556	-1
Overall	NOGA	34020	9822	3.46	2	Randomness	9999	0.05	127062033	995269	155570119	112725408	28.64	1.96	y	0	0.001	0	26557358	28508085	30458812	-1
Jan-08	NOGA	898	482	1.86	2	Randomness	9999	0.05	119130	5228	113028	129654	1.17	1.96	n	0.2	0.5	0.2432	-4145	6102	16348	-1
Feb-08	NOGA	49	33	1.48	2	Randomness	9999	0.05	324	65	422	337	1.50	1.96	n	0.1	0.2	0.1338	-30	97	224	-1
Mar-08	NOGA	4980	1351	3.69	2	Randomness	9999	0.05	2784685	55433	2757229	2885854	0.50	1.96	n	0.5	1	0.6204	-81192	27456	136104	-1
Apr-08	NOGA	3271	1409	2.32	2	Randomness	9999	0.05	1061183	27133	1304961	905316	8.98	1.96	y	0	0.001	0.0174	190597	243778	296959	-1
May-08	NOGA	858	582	1.47	2	Randomness	9999	0.05	121943	5346	105735	145291	3.03	1.96	y	0.002	0.005	0.0024	5729	16208	26686	-1
Jun-08	NOGA	270	195	1.38	2	Randomness	9999	0.05	9291	781	10912	8726	2.08	1.96	y	0.02	0.05	0.0379	90	1621	3151	-1
Oct-08	NOGA	1692	492	3.44	2	Randomness	9999	0.05	434523	14349	481174	555561	3.25	1.96	y	0.001	0.002	0.0012	18528	46651	74774	-1
Nov-08	NOGA	9402	1045	9.00	2	Randomness	9999	0.05	9086850	135209	9467852	8809855	2.82	1.96	y	0.002	0.005	0.0048	115990	381001	646012	-1

Table E-6 (*continued*). Wilcoxon non-parametric 1-sample (signed-rank) test to assess differences between means (Continuity-corrected). Ho (2-tailed): The 1 sample came from a population with a symmetric distribution around its median (i.e., mean=median). Ha (2-tailed): The 1 sample did NOT come from a population with a symmetric distribution around its median (i.e., mean NOT equal to median).

Time Period	Species	Abundance	# Observations	Cluster Size	# Tails	Run Test	DF	CI Level	ut	sigt	Tm	Tp	Stat	Crit	Reject Ho?	Plow	Phigh	Pint	CI_low	abs(Stat-ut)	CI_high	Accuracy
Dec-08	NOGA	470	308	1.53	2	Randomness	9999	0.05	28522	1820	37749	23201	5.07	1.96	y	0	0.001	5078.102	5658	9227	12795	-1
Jan-09	NOGA	1849	417	4.43	2	Randomness	9999	0.05	311896	16729	1114449	1177315	47.97	1.96	y	0	0.001	5199976	769764	802553	835341	-1
Mar-09	NOGA	840	468	1.79	2	Randomness	9999	0.05	89308	4250	80547	106259	2.06	1.96	y	0.02	0.05	0.0393	431	8761	17090	-1
Apr-09	NOGA	400	303	1.32	2	Randomness	9999	0.05	25650	1659	20261	32446	3.25	1.96	y	0.001	0.002	0.0012	2138	5389	8640	-1
May-09	NOGA	1077	674	1.60	2	Randomness	9999	0.05	161255	6667	151125	191406	1.52	1.96	n	0.1	0.2	0.1288	-2938	10129	23196	-1
Jun-09	NOGA	431	343	1.26	2	Randomness	9999	0.05	13304	1041	9670	20129	3.49	1.96	y	0	0.001	0.0004	1592	3633	5674	-1
Nov-09	NOGA	6394	981	6.52	2	Randomness	9999	0.05	2984538	59733	3959186	2290259	16.32	1.96	y	0	0.001	0.6007	857571	974648	1091725	-1
Dec-09	NOGA	628	331	1.90	2	Randomness	9999	0.05	52079	2956	86543	42106	11.66	1.96	y	0	0.001	46.1759	28670	34464	40258	-1
Winter2008(DJF)	NOGA	947	515	1.84	2	Randomness	9999	0.05	131945	5651	126758	142983	0.92	1.96	n	0.2	0.5	0.3588	-5891	5186	16263	-1
Spring2008(MAM)	NOGA	9109	3342	2.73	2	Randomness	9999	0.05	9306563	138617	8266328	10728104	7.50	1.96	y	0	0.001	91.8559	768545	1040235	1311924	-1
Summer2008(JJ)	NOGA	312	232	1.34	2	Randomness	9999	0.05	12320	962	15728	10033	3.54	1.96	y	0	0.001	0.0004	1523	3408	5293	-1
Autumn2008(ASON)	NOGA	11217	1631	6.88	2	Randomness	9999	0.05	12895334	185037	22226417	8090506	50.43	1.96	y	0	0.001	14.0413	8968410	9331083	9693756	-1
Spring2009(MAM)	NOGA	2317	1445	1.60	2	Randomness	9999	0.05	740183	20819	660677	891780	3.82	1.96	y	0	0.001	2943923	38700	79505	120310	-1
Summer2009(JJ)	NOGA	431	343	1.26	2	Randomness	9999	0.05	13304	1041	9670	20129	3.49	1.96	y	0	0.001	0.0004	1592	3633	5674	-1
Autumn2009(ASON)	NOGA	6474	1050	6.17	2	Randomness	9999	0.05	3073963	61047	4078817	2358014	16.46	1.96	y	0	0.001	14.5941	885203	1004854	1124505	-1
Winter2010(DJF)	NOGA	628	331	1.90	2	Randomness	9999	0.05	52079	2956	86543	42106	11.66	1.96	y	0	0.001	24.6407	28670	34464	40258	-1
2008	NOGA	22055	6028	3.66	2	Randomness	9999	0.05	55024165	525741	64645929	47897221	18.30	1.96	y	0	0.001	194.3934	8591312	9621764	10652215	-1
2009	NOGA	11965	3794	3.15	2	Randomness	9999	0.05	14556874	201792	19820538	14069621	26.08	1.96	y	0	0.001	6369884	4868151	5263663	5659175	-1
Overall	SCDW	13933	364	38.28	2	Randomness	9999	0.05	29902808	337254	41703547	22000719	34.99	1.96	y	0	0.001	0	11139721	11800739	12461756	-1
Mar-08	SCDW	1522	36	42.28	2	Randomness	9999	0.05	425058	15408	544895	883581	7.78	1.96	y	0	0.001	0.0192	89637	119837	150036	-1
Apr-08	SCDW	1885	69	27.32	2	Randomness	9999	0.05	282770	12530	649671	1036290	29.28	1.96	y	0	0.001	0.2779	342343	366901	391459	-1
Nov-08	SCDW	2932	30	97.73	2	Randomness	9999	0.05	1554291	42294	3859471	1631503	54.50	1.96	y	0	0.001	0.0194	2222283	2305180	2388076	-1
Dec-08	SCDW	3025	21	144.05	2	Randomness	9999	0.05	125080	6480	836818	1060714	109.84	1.96	y	0	0.001	19.8363	699037	711738	724438	-1
Apr-09	SCDW	1599	36	44.42	2	Randomness	9999	0.05	510045	16999	706725	736515	11.57	1.96	y	0	0.001	160.8437	163361	196680	229998	-1
Dec-09	SCDW	473	16	29.56	2	Randomness	9999	0.05	13545	1063	15112	17090	1.47	1.96	n	0.1	0.2	0.1407	-517	1567	3650	-1
Spring2008(MAM)	SCDW	3407	105	32.45	2	Randomness	9999	0.05	2240634	47789	1944051	2631772	6.21	1.96	y	0	0.001	1.3776	202916	296582	390248	-1
Autumn2008(ASON)	SCDW	3228	49	65.88	2	Randomness	9999	0.05	1914827	48937	4602882	1990678	54.93	1.96	y	0	0.001	0.7019	2592138	2688055	2783971	-1
Winter2009(DJF)	SCDW	4468	107	41.76	2	Randomness	9999	0.05	996341	32005	2079802	2060569	33.85	1.96	y	0	0.001	2874.925	1020732	1083461	1146190	-1
Spring2009(MAM)	SCDW	1985	71	27.96	2	Randomness	9999	0.05	685575	20959	843818	994504	7.55	1.96	y	0	0.001	11775693	117163	158243	199322	-1
Winter2010(DJF)	SCDW	473	16	29.56	2	Randomness	9999	0.05	13545	1063	15112	17090	1.47	1.96	n	0.1	0.2	0.1407	-517	1567	3650	-1
2008	SCDW	9669	178	54.32	2	Randomness	9999	0.05	14274035	194743	20546528	10280133	32.21	1.96	y	0	0.001	1555.147	5890797	6272492	6654187	-1
Overall	HERG	13790	3474	3.97	2	Randomness	9999	0.05	5461365	93219	4698384	6756516	8.18	1.96	y	0	0.001	0	580272	762981	945689	-1
Jan-08	HERG	1158	129	8.98	2	Randomness	9999	0.05	9488	834	6795	16873	3.23	1.96	y	0.001	0.002	0.0012	1058	2693	4327	-1
Feb-08	HERG	61	41	1.49	2	Randomness	9999	0.05	855	134	755	1195	0.74	1.96	n	0.2	0.5	0.457	-163	100	362	0.0000
Mar-08	HERG	3785	394	9.61	2	Randomness	9999	0.05	123622	5568	105574	173532	3.24	1.96	y	0.001	0.002	0.0012	7135	18048	28960	-1
May-08	HERG	568	249	2.28	2	Randomness	9999	0.05	25650	1660	23097	29609	1.54	1.96	n	0.1	0.2	0.1242	-701	2553	5806	-1
Feb-09	HERG	1710	325	5.26	2	Randomness	9999	0.05	34829	2093	31552	41297	1.57	1.96	n	0.1	0.2	0.1175	-826	3276	7378	-1
Mar-09	HERG	1037	358	2.90	2	Randomness	9999	0.05	60965	3200	46812	81760	4.42	1.96	y	0	0.001	10.6917	7881	14153	20424	-1
Apr-09	HERG	439	138	3.18	2	Randomness	9999	0.05	8643	729	7396	10100	1.71	1.96	n	0.05	0.1	0.0871	-182	1247	2675	-1
May-09	HERG	261	194	1.35	2	Randomness	9999	0.05	12249	961	13246	12658	1.04	1.96	n	0.2	0.5	0.2999	-888	997	2881	-1
Jun-09	HERG	135	90	1.50	2	Randomness	9999	0.05	3677	381	3217	4192	1.21	1.96	n	0.2	0.5	0.228	-287	459	1205	-1
Sep-09	HERG	352	59	5.97	2	Randomness	9999	0.05	743	114	491	995	2.21	1.96	y	0.02	0.05	0.0275	28	252	475	-0.3
Oct-09	HERG	237	62	3.82	2	Randomness	9999	0.05	1185	166	840	1621	2.08	1.96	y	0.02	0.05	0.0375	20	345	670	-0.45

Table E-6 (*continued*). Wilcoxon non-parametric 1-sample (signed-rank) test to assess differences between means (Continuity-corrected). Ho (2-tailed): The 1 sample came from a population with a symmetric distribution around its median (i.e., mean=median). Ha (2-tailed): The 1 sample did NOT come from a population with a symmetric distribution around its median (i.e., mean NOT equal to median).

Time Period	Species	Abundance	# Observations	Cluster Size	# Tails	Run Test	DF	CI Level	ut	sigt	Tm	Tp	Stat	Crit	Reject Ho?	Plow	Phigh	Pint	CI_low	abs(Stat-ut)	CI_high	Accuracy
Nov-09	HERG	416	149	2.79	2	Randomness	9999	0.05	12303	958	11961	13835	0.36	1.96	n	0.5	1	0.7215	-1536	342	2219	-1
Winter2008(DJF)	HERG	1219	170	7.17	2	Randomness	9999	0.05	16013	1227	11989	27009	3.28	1.96	y	0.001	0.002	0.001	1618	4024	6429	-1
Spring2008(MAM)	HERG	5024	1016	4.94	2	Randomness	9999	0.05	531493	16353	516029	621758	0.95	1.96	n	0.2	0.5	0.3444	-16588	15463	47514	-1
Spring2009(MAM)	HERG	1737	690	2.52	2	Randomness	9999	0.05	203562	7872	222143	199743	2.36	1.96	y	0.01	0.02	0.0182	3152	18581	34009	-1
Summer2009(JJ)	HERG	135	90	1.50	2	Randomness	9999	0.05	3677	381	3217	4192	1.21	1.96	n	0.2	0.5	0.228	-287	459	1205	-1
Autumn2009(ASON)	HERG	1032	290	3.56	2	Randomness	9999	0.05	33178	2021	34935	34502	0.87	1.96	n	0.2	0.5	0.385	-2205	1756	5717	-1
2008	HERG	7991	1810	4.41	2	Randomness	9999	0.05	1536132	36233	1176307	2104349	9.93	1.96	y	0	0.001	24882.36	288808	359825	430841	-1
2009	HERG	5799	1664	3.49	2	Randomness	9999	0.05	1202877	29760	1175895	1304661	0.91	1.96	n	0.2	0.5	0.3646	-31349	26982	85312	-1
Overall	SUSC	12463	709	17.58	2	Randomness	9999	0.05	11807763	165420	15440516	8671330	21.96	1.96	y	0	0.001	0	3308530	3632753	3956975	-1
Mar-08	SUSC	2181	71	30.72	2	Randomness	9999	0.05	157437	7431	121771	436645	4.80	1.96	y	0	0.001	0.0048	21100	35666	50231	-1
Apr-08	SUSC	3048	142	21.46	2	Randomness	9999	0.05	283421	11918	461099	736972	14.91	1.96	y	0	0.001	0.0695	154318	177678	201038	-1
Nov-08	SUSC	2348	52	45.15	2	Randomness	9999	0.05	516216	22338	2163121	2179891	73.73	1.96	y	0	0.001	0.3099	1603122	1646905	1690687	-1
Dec-08	SUSC	1029	41	25.10	2	Randomness	9999	0.05	18814	1397	34545	13384	11.26	1.96	y	0	0.001	1269.525	12993	15731	18469	-1
Feb-09	SUSC	1165	121	9.63	2	Randomness	9999	0.05	44088	2508	61204	32522	6.82	1.96	y	0	0.001	1.8803	12200	17116	22031	-1
Mar-09	SUSC	664	84	7.90	2	Randomness	9999	0.05	14958	1095	10725	20121	3.87	1.96	y	0	0.001	0.6283	2086	4233	6379	-1
Apr-09	SUSC	604	48	12.58	2	Randomness	9999	0.05	28434	2218	64536	92504	16.28	1.96	y	0	0.001	643.375	31755	36102	40448	-1
Nov-09	SUSC	435	16	27.19	2	Randomness	9999	0.05	38247	2470	31589	81577	2.70	1.96	y	0.005	0.01	0.0071	1817	6658	11498	-1
Spring2008(MAM)	SUSC	5230	214	24.44	2	Randomness	9999	0.05	1094450	29753	1206774	1727758	3.78	1.96	y	0	0.001	367.4237	54009	112324	170638	-1
Spring2009(MAM)	SUSC	1292	133	9.71	2	Randomness	9999	0.05	104124	5296	130150	198159	4.91	1.96	y	0	0.001	0.0727	15646	26026	36406	-1
2008	SUSC	8828	336	26.27	2	Randomness	9999	0.05	5252728	98965	10911371	3798635	57.18	1.96	y	0	0.001	6220.589	5464671	5658643	5852614	-1
Overall	DCCO	10892	394	27.64	2	Randomness	9999	0.05	28653594	320888	39215384	18621060	32.91	1.96	y	0	0.001	0	9932849	10561790	11190730	-1
Apr-08	DCCO	1846	64	28.84	2	Randomness	9999	0.05	600806	20295	486591	1688203	5.63	1.96	y	0	0.001	1.1116	74435	114215	153994	-1
May-08	DCCO	717	63	11.38	2	Randomness	9999	0.05	87695	4611	131610	135891	9.52	1.96	y	0	0.001	0.0096	34878	43915	52952	-1
Sep-08	DCCO	218	15	14.53	2	Randomness	9999	0.05	8484	835	23871	6903	18.42	1.96	y	0	0.001	0.0008	13749	15387	17024	-1
Oct-08	DCCO	4157	99	41.99	2	Randomness	9999	0.05	3609788	74387	3259156	6781139	4.71	1.96	y	0	0.001	0.0512	204832	350631	496430	-1
Apr-09	DCCO	1869	60	31.15	2	Randomness	9999	0.05	565656	19766	1441756	829112	44.32	1.96	y	0	0.001	40.2109	837358	876100	914841	-1
Oct-09	DCCO	931	19	49.00	2	Randomness	9999	0.05	156137	7331	122760	425223	4.55	1.96	y	0	0.001	0.6521	19007	33376	47745	-1
Spring2008(MAM)	DCCO	2563	127	20.18	2	Randomness	9999	0.05	1351026	35401	2362362	1198092	28.57	1.96	y	0	0.001	5.5105	941949	1011336	1080722	-1
Autumn2008(ASON)	DCCO	5268	130	40.52	2	Randomness	9999	0.05	5658425	106003	5444795	10963847	2.02	1.96	y	0.02	0.05	0.0439	5864	213630	421395	-1
Spring2009(MAM)	DCCO	1972	83	23.76	2	Randomness	9999	0.05	612273	20823	1504342	864033	42.84	1.96	y	0	0.001	47102772	851256	892069	932882	-1
Autumn2009(ASON)	DCCO	1053	31	33.97	2	Randomness	9999	0.05	237107	9277	466152	140194	24.69	1.96	y	0	0.001	934.0215	210861	229045	247228	-1
2008	DCCO	7861	275	28.59	2	Randomness	9999	0.05	13867095	195807	21538166	11419534	39.18	1.96	y	0	0.001	99529.43	7287290	7671071	8054851	-1
Jan-08	BLSC	1369	51	26.84	2	Randomness	9999	0.05	52189	3413	83247	159887	9.10	1.96	y	0	0.001	2.3788	24369	31058	37746	-1
Feb-08	BLSC	187	9	20.78	2	Randomness	9999	0.05	825	162	4278	2628	21.26	1.96	y	0	0.001	2.0802	3134	3453	3771	-1
Dec-08	BLSC	1642	37	44.38	2	Randomness	9999	0.05	409998	13646	471414	516271	4.50	1.96	y	0	0.001	79.3453	34671	61416	88161	-1
Mar-09	BLSC	634	57	11.12	2	Randomness	9999	0.05	24265	2036	66430	114960	20.71	1.96	y	0	0.001	2.5132	38174	42165	46155	-1
Dec-09	BLSC	737	40	18.43	2	Randomness	9999	0.05	31144	2092	56535	30559	12.14	1.96	y	0	0.001	11.544	21291	25391	29490	-1
Winter2008(DJF)	BLSC	1556	60	25.93	2	Randomness	9999	0.05	79916	4535	86769	217843	1.51	1.96	n	0.1	0.2	0.1308	-2037	6853	15742	-1
Winter2010(DJF)	BLSC	737	40	18.43	2	Randomness	9999	0.05	31144	2092	56535	30559	12.14	1.96	y	0	0.001	6.1602	21291	25391	29490	-1
Jan-08	SCAU	750	1	750.00	2	Randomness	9999	0.05	1800	241	2165	2426	1.51	1.96	n	0.1	0.2	0.13	-107	365	837	-1
Jan-09	SCAU	4617	32	144.28	2	Randomness	9999	0.05	3347751	69376	2277837	6373467	15.42	1.96	y	0	0.001	81249.63	933938	1069914	1205889	-1

Table E-6 (*continued*). Wilcoxon non-parametric 1-sample (signed-rank) test to assess differences between means (Continuity-corrected). Ho (2-tailed): The 1 sample came from a population with a symmetric distribution around its median (i.e., mean=median). Ha (2-tailed): The 1 sample did NOT come from a population with a symmetric distribution around its median (i.e., mean NOT equal to median).

Time Period	Species	Abundance	# Observations	Cluster Size	# Tails	Run Test	DF	CI Level	ut	sigt	Tm	Tp	Stat	Crit	Reject Ho?	Plow	Phigh	Pint	CI_low	abs(Stat-ut)	CI_high	Accuracy
Winter2008(DJF)	SCAU	750	1	750.00	2	Randomness	9999	0.05	3685	446	6364	6858	6.00	1.96	y	0	0.001	1.4352	1804	2679	3553	-1
Winter2009(DJF)	SCAU	4617	32	144.28	2	Randomness	9999	0.05	3347751	69376	2277837	6373467	15.42	1.96	y	0	0.001	718.7313	933938	1069914	1205889	-1
2009	SCAU	4617	32	144.28	2	Randomness	9999	0.05	3347751	69376	2277837	6373467	15.42	1.96	y	0	0.001	5.8339	933938	1069914	1205889	-1
Jan-08	LTDU	603	57	10.58	2	Randomness	9999	0.05	1800	241	2165	2426	1.51	1.96	n	0.1	0.2	0.13	-107	365	837	-1
Feb-08	LTDU	82	8	10.25	2	Randomness	9999	0.05	198	55	1128	1338	16.94	1.96	y	0	0.001	2.5496	822	930	1037	-0.35
Feb-09	LTDU	2483	265	9.37	2	Randomness	9999	0.05	121581	5272	141085	102259	3.70	1.96	y	0	0.001	0.0002	9170	19504	29837	-1
Mar-09	LTDU	723	87	8.31	2	Randomness	9999	0.05	10463	890	17378	7707	7.77	1.96	y	0	0.001	0.1571	5172	6915	8658	-1
Dec-09	LTDU	441	72	6.13	2	Randomness	9999	0.05	7129	701	11257	9642	5.89	1.96	y	0	0.001	1.5187	2755	4128	5501	-1
Winter2008(DJF)	LTDU	685	65	10.54	2	Randomness	9999	0.05	3685	446	6364	6858	6.00	1.96	y	0	0.001	1.4352	1804	2679	3553	-1
Winter2009(DJF)	LTDU	4152	404	10.28	2	Randomness	9999	0.05	278003	9827	321373	236702	4.41	1.96	y	0	0.001	11499.7	24108	43370	62632	-1
Winter2010(DJF)	LTDU	441	72	6.13	2	Randomness	9999	0.05	7129	701	11257	9642	5.89	1.96	y	0	0.001	1.5187	2755	4128	5501	-1
2009	LTDU	5195	563	9.23	2	Randomness	9999	0.05	544517	16368	614382	494392	4.27	1.96	y	0	0.001	1.4585	37784	69865	101945	-1
Feb-08	COLO	97	62	1.56	2	Randomness	9999	0.05	2	1	2	2	0.47	1.96	n	0.5	1	0.6374	-3	-1	2	-1
Feb-09	COLO	979	333	2.94	2	Randomness	9999	0.05	6	4	8	10	0.43	1.96	n	0.5	1	0.6682	-5	2	8	-1
May-09	COLO	617	352	1.75	2	Randomness	9999	0.05	625	122	976	1680	2.88	1.96	y	0.002	0.005	0.004	112	351	589	-0.1
Mar-08	GULG	832	29	28.69	2	Randomness	9999	0.05	6830	604	9015	4716	3.62	1.96	y	0	0.001	0.0003	1001	2185	3369	-1
Jan-09	GULG	1991	17	117.12	2	Randomness	9999	0.05	116	34	351	120	6.89	1.96	y	0	0.001	1299994	168	235	302	-1
Feb-09	GULG	1362	42	32.43	2	Randomness	9999	0.05	4770	551	12483	6369	14.00	1.96	y	0	0.001	0.4701	6633	7713	8792	-1
Sep-09	GULG	473	14	33.79	2	Randomness	9999	0.05	62	21	177	79	5.34	1.96	y	0	0.001	0.0702	72	115	157	-1
Oct-09	GULG	598	32	18.69	2	Randomness	9999	0.05	1089	180	903	3081	1.03	1.96	n	0.2	0.5	0.3022	-167	186	538	-0.9
Nov-09	GULG	875	21	41.67	2	Randomness	9999	0.05	14023	1345	73365	83920	44.11	1.96	y	0	0.001	9.6115	56705	59342	61979	-1
Dec-09	GULG	472	16	29.50	2	Randomness	9999	0.05	196	48	153	448	0.88	1.96	n	0.2	0.5	0.3797	-52	42	136	-1
Winter2009(DJF)	GULG	3377	67	50.40	2	Randomness	9999	0.05	9206	863	15845	13487	7.69	1.96	y	0	0.001	45998.8	4947	6639	8330	-1
Autumn2009(ASON)	GULG	1989	72	27.63	2	Randomness	9999	0.05	35590	2650	108499	100692	27.52	1.96	y	0	0.001	233.5054	67716	72909	78102	-1
Winter2010(DJF)	GULG	472	16	29.50	2	Randomness	9999	0.05	196	48	153	448	0.88	1.96	n	0.2	0.5	0.3797	-52	42	136	-1
2009	GULG	6129	204	30.04	2	Randomness	9999	0.05	198188	8652	290993	347939	10.73	1.96	y	0	0.001	25479534	75847	92805	109762	-1
Apr-08	SCOT	1607	50	32.14	2	Randomness	9999	0.05	288390	11967	447276	717026	13.28	1.96	y	0	0.001	4.4463	135431	158886	182340	-1
Dec-08	SCOT	1328	8	166.00	2	Randomness	9999	0.05	77196	3537	824970	780241	211.42	1.96	y	0	0.001	317.3814	740842	747774	754706	-1
Jan-09	SCOT	2811	33	85.18	2	Randomness	9999	0.05	0	1378	101475	101475	73.65	1.96	y	0	0.001	324998.5	98774	101475	104175	-1
Winter2009(DJF)	SCOT	4943	74	66.80	2	Randomness	9999	0.05	434298	17025	1529703	789712	64.34	1.96	y	0	0.001	179.6828	1062036	1095405	1128774	-1
May-08	LAGU	712	237	3.00	2	Randomness	9999	0.05	86118	4229	122423	69554	8.58	1.96	y	0	0.001	0.0384	28015	36304	44593	-1
Jun-08	LAGU	531	315	1.69	2	Randomness	9999	0.05	43727	2476	52863	37346	3.69	1.96	y	0	0.001	0.0002	4282	9136	13990	-1
Jul-08	LAGU	673	415	1.62	2	Randomness	9999	0.05	86022	4086	90268	85199	1.04	1.96	n	0.2	0.5	0.2989	-3764	4245	12254	-1
Aug-08	LAGU	1349	473	2.85	2	Randomness	9999	0.05	245119	8974	189734	309059	6.17	1.96	y	0	0.001	0.2469	37794	55384	72974	-1
Sep-08	LAGU	580	334	1.74	2	Randomness	9999	0.05	58344	3076	58266	61729	0.03	1.96	n	0.5	1	0.9797	-5950	78	6106	-1
Oct-08	LAGU	1027	298	3.45	2	Randomness	9999	0.05	121038	5376	155836	104061	6.47	1.96	y	0	0.001	0.0048	24260	34798	45336	-1
Nov-08	LAGU	1738	199	8.73	2	Randomness	9999	0.05	52015	2813	64152	42041	4.31	1.96	y	0	0.001	1.2398	6622	12136	17650	-1
May-09	LAGU	215	151	1.42	2	Randomness	9999	0.05	9308	771	6893	11933	3.13	1.96	y	0.001	0.002	0.0017	904	2415	3925	-1
Jun-09	LAGU	466	286	1.63	2	Randomness	9999	0.05	26103	1710	26404	29962	0.18	1.96	n	0.5	1	0.8605	-3051	301	3652	-1
Aug-09	LAGU	767	375	2.05	2	Randomness	9999	0.05	70566	3572	53859	93916	4.68	1.96	y	0	0.001	3.6485	9707	16707	23707	-1

Table E-6 (*continued*). Wilcoxon non-parametric 1-sample (signed-rank) test to assess differences between means (Continuity-corrected). Ho (2-tailed): The 1 sample came from a population with a symmetric distribution around its median (i.e., mean=median). Ha (2-tailed): The 1 sample did NOT come from a population with a symmetric distribution around its median (i.e., mean NOT equal to median).

Time Period	Species	Abundance	# Observations	Cluster Size	# Tails	Run Test	DF	CI Level	ut	sigt	Tm	Tp	Stat	Crit	Reject Ho?	Plow	Phigh	Pint	CI_low	abs(Stat-ut)	CI_high	Accuracy
Sep-09	LAGU	251	180	1.39	2	Randomness	9999	0.05	6698	613	6255	8072	0.72	1.96	n	0.2	0.5	0.4703	-759	443	1645	-1
Oct-09	LAGU	1334	170	7.85	2	Randomness	9999	0.05	54327	3008	58524	65630	1.40	1.96	n	0.1	0.2	0.163	-1699	4197	10092	-1
Summer2008(JJ)	LAGU	1204	730	1.65	2	Randomness	9999	0.05	252225	9189	282249	234411	3.27	1.96	y	0.001	0.002	0.0011	12013	30024	48034	-1
Autumn2008(ASON)	LAGU	4694	1304	3.60	2	Randomness	9999	0.05	1735800	38981	1497546	2034816	6.11	1.96	y	0	0.001	0.1755	161851	238254	314656	-1
Summer2009(JJ)	LAGU	466	286	1.63	2	Randomness	9999	0.05	26103	1710	26404	29962	0.18	1.96	n	0.5	1	0.8605	-3051	301	3652	-1
Autumn2009(ASON)	LAGU	2404	757	3.18	2	Randomness	9999	0.05	372826	12429	437007	343801	5.16	1.96	y	0	0.001	58.3763	39819	64181	88542	-1
May-08	GBBG	341	189	1.80	2	Randomness	9999	0.05	8476	723	7919	9540	0.77	1.96	n	0.2	0.5	0.4414	-861	557	1975	-1
Jun-08	GBBG	127	97	1.31	2	Randomness	9999	0.05	1887	241	1412	2825	1.97	1.96	y	0.02	0.05	0.0485	3	475	947	-1
Aug-08	GBBG	147	121	1.21	2	Randomness	9999	0.05	1691	217	1999	1592	1.42	1.96	n	0.1	0.2	0.1549	-116	308	732	-1
Sep-08	GBBG	379	255	1.49	2	Randomness	9999	0.05	12797	995	16417	10660	3.64	1.96	y	0	0.001	0.0002	1668	3619	5570	-1
Jun-09	GBBG	146	119	1.23	2	Randomness	9999	0.05	3902	411	4454	3999	1.34	1.96	n	0.1	0.2	0.1797	-254	552	1358	-1
Aug-09	GBBG	169	140	1.21	2	Randomness	9999	0.05	2250	277	3026	2177	2.80	1.96	y	0.005	0.01	0.0052	232	775	1318	-1
Sep-09	GBBG	174	99	1.76	2	Randomness	9999	0.05	1190	165	1161	1291	0.17	1.96	n	0.5	1	0.8631	-295	29	352	-0.45
Oct-09	GBBG	471	212	2.22	2	Randomness	9999	0.05	5313	508	5836	5001	1.03	1.96	n	0.2	0.5	0.3042	-474	522	1518	-1
Summer2009(JJ)	GBBG	146	119	1.23	2	Randomness	9999	0.05	3902	411	4454	3999	1.34	1.96	n	0.1	0.2	0.1797	-254	552	1358	-1
Jun-08	WISP	400	199	2.01	2	Randomness	9999	0.05	30447	2131	42721	56785	5.76	1.96	y	0	0.001	0.0008	8097	12274	16450	-1
Jul-08	WISP	446	251	1.78	2	Randomness	9999	0.05	23450	1588	24268	27744	0.51	1.96	n	0.5	1	0.6067	-2295	818	3930	-1
Aug-08	WISP	1251	175	7.15	2	Randomness	9999	0.05	110390	6372	341551	562330	36.28	1.96	y	0	0.001	0.9874	218673	231161	243649	-1
Aug-09	WISP	374	321	1.17	2	Randomness	9999	0.05	33453	2026	41608	27279	4.02	1.96	y	0	0.001	14.5941	4182	8154	12126	-1
Sep-09	WISP	281	247	1.14	2	Randomness	9999	0.05	16442	1235	15158	22981	1.04	1.96	n	0.2	0.5	0.2989	-1138	1283	3704	-1
Summer2008(JJ)	WISP	846	450	1.88	2	Randomness	9999	0.05	116655	5401	151875	125325	6.52	1.96	y	0	0.001	0.0042	24633	35220	45806	-1
Jun-08	COTE	339	195	1.74	2	Randomness	9999	0.05	27469	1770	24097	34873	1.90	1.96	n	0.05	0.1	0.0568	-98	3372	6841	-1
Jul-08	COTE	366	181	2.02	2	Randomness	9999	0.05	24920	1721	20821	41229	2.38	1.96	y	0.01	0.02	0.0173	725	4099	7472	-1
Aug-08	COTE	798	354	2.25	2	Randomness	9999	0.05	139690	6132	178001	144021	6.25	1.96	y	0	0.001	3.9496	26291	38311	50330	-1
Sep-08	COTE	392	133	2.95	2	Randomness	9999	0.05	37230	2173	36305	38617	0.43	1.96	n	0.5	1	0.6704	-3334	925	5183	-1
May-09	COTE	175	83	2.11	2	Randomness	9999	0.05	7038	640	6336	9000	1.10	1.96	n	0.2	0.5	0.2733	-553	702	1956	-1
Jun-09	COTE	290	202	1.44	2	Randomness	9999	0.05	19736	1399	15538	28223	3.00	1.96	y	0.002	0.005	0.0026	1455	4197	6939	-1
Aug-09	COTE	129	99	1.30	2	Randomness	9999	0.05	4133	421	4285	4220	0.36	1.96	n	0.5	1	0.7179	-673	152	977	-1
Summer2008(JJ)	COTE	705	376	1.88	2	Randomness	9999	0.05	110303	4973	112218	118090	0.39	1.96	n	0.5	1	0.7003	-7833	1915	11662	-1
Summer2009(JJ)	COTE	290	202	1.44	2	Randomness	9999	0.05	19736	1399	15538	28223	3.00	1.96	y	0.002	0.005	0.0026	1455	4197	6939	-1
Jul-08	COSH	117	44	2.66	2	Randomness	9999	0.05	450	84	481	601	0.36	1.96	n	0.5	1	0.7164	-134	31	195	-0.8
Aug-09	COSH	72	65	1.11	2	Randomness	9999	0.05	968	150	1108	1248	0.93	1.96	n	0.2	0.5	0.3509	-154	140	433	-0.25
Summer2008(JJ)	COSH	188	87	2.16	2	Randomness	9999	0.05	2282	275	1943	3000	1.23	1.96	n	0.2	0.5	0.2194	-202	338	878	-1
Jul-08	TESM	72	11	6.55	2	Randomness	9999	0.05	1066	168	1473	1651	2.42	1.96	y	0.01	0.02	0.0154	78	407	735	-0.6
											m											
Aug-08	PASS	118	58	2.03	2	Randomness	9999	0.05	2372	326	7021	2278	14.25	1.96	y	0	0.001	0.6198	4009	4649	5289	-1
Sep-08	SHSM	200	3	66.67	2	Randomness	9999	0.05	786	265	20100	18528	72.88	1.96	y	0	0.001	0.0032	18794	19314	19833	-1
Oct-08	SHSM	533	5	106.60	2	Randomness	9999	0.05	833	133	13041	14706	91.93	1.96	y	0	0.001	3.8366	11948	12208	12468	-1

Table E-6 (*continued*). Wilcoxon non-parametric 1-sample (signed-rank) test to assess differences between means (Continuity-corrected). Ho (2-tailed): The 1 sample came from a population with a symmetric distribution around its median (i.e., mean=median). Ha (2-tailed): The 1 sample did NOT come from a population with a symmetric distribution around its median (i.e., mean NOT equal to median).

Time Period	Species	Abundance	# Observations	Cluster Size	# Tails	Run Test	DF	CI Level	ut	sigt	Tm	Tp	Stat	Crit	Reject Ho?	Plow	Phigh	Pint	CI_low	abs(Stat-ut)	CI_high	Accuracy
Oct-08	FOTE	688	81	8.49	2	Randomness	9999	0.05	82841	4093	83051	103510	0.05	1.96	n	0.5	1	0.9592	-7813	210	8233	-1
Nov-08	CANG	2548	22	115.82	2	Randomness	9999	0.05	633191	27079	3206575	2021896	95.03	1.96	y	0	0.001	0.0775	2520308	2573384	2626460	-1
Autumn2008(ASON)	CANG	2637	26	101.42	2	Randomness	9999	0.05	745591	29621	3235771	2229453	84.07	1.96	y	0	0.001	2.8075	2432123	2490180	2548236	-1
Jan-09	GRSC	1568	9	174.22	2	Randomness	9999	0.05	609	125	2346	1128	13.89	1.96	y	0	0.001	20799905	1492	1737	1981	-0.4
Nov-09	RTLO	892	259	3.44	2	Randomness	9999	0.05	112603	5774	263313	150683	26.10	1.96	y	0	0.001	2.4029	139392	150710	162027	-1

Table E-7. Chi-square (X^2) goodness-of-fit (GOF) test for a uniform circular distribution. Ho: The sample data came from a population with a uniform circular distribution. Ha: The sample data did NOT come from a population with a uniform circular distribution.

Time Period	Species	Abundance	#Observations	Cluster Size	#Tails	DF	CI Level	X2stat	X2crit	Reject Ho?	Plow	Phigh
Overall	TOTAL	177266	35547	4.99	2	7	0.05	15775.42	14.067	y	0	0.001
Jan-08	TOTAL	6500	1212	5.36	2	7	0.05	454.74	14.067	y	0	0.001
Feb-08	TOTAL	580	208	2.79	2	7	0.05	231.46	14.067	y	0	0.001
Mar-08	TOTAL	17569	3068	5.73	2	7	0.05	1134.74	14.067	y	0	0.001
Apr-08	TOTAL	15624	3362	4.65	2	7	0.05	9694.53	14.067	y	0	0.001
May-08	TOTAL	4446	1901	2.34	2	7	0.05	441.05	14.067	y	0	0.001
Jun-08	TOTAL	1964	1198	1.64	2	7	0.05	234.71	14.067	y	0	0.001
Jul-08	TOTAL	1957	1061	1.84	2	7	0.05	113.45	14.067	y	0	0.001
Aug-08	TOTAL	4255	1457	2.92	2	7	0.05	1951.63	14.067	y	0	0.001
Sep-08	TOTAL	2612	1103	2.37	2	7	0.05	174.83	14.067	y	0	0.001
Oct-08	TOTAL	11928	1729	6.90	2	7	0.05	8127.72	14.067	y	0	0.001
Nov-08	TOTAL	27018	2694	10.03	2	7	0.05	27669.44	14.067	y	0	0.001
Dec-08	TOTAL	9672	1150	8.41	2	7	0.05	10843.29	14.067	y	0	0.001
Jan-09	TOTAL	20306	1618	12.55	2	7	0.05	3348.20	14.067	y	0	0.001
Feb-09	TOTAL	10953	1919	5.71	2	7	0.05	355.06	14.067	y	0	0.001
Mar-09	TOTAL	6494	2058	3.16	2	7	0.05	678.08	14.067	y	0	0.001
Apr-09	TOTAL	6122	1038	5.90	2	7	0.05	3565.27	14.067	y	0	0.001
May-09	TOTAL	3052	1744	1.75	2	7	0.05	138.72	14.067	y	0	0.001
Jun-09	TOTAL	1817	1309	1.39	2	7	0.05	88.92	14.067	y	0	0.001
Aug-09	TOTAL	1885	1201	1.57	2	7	0.05	112.53	14.067	y	0	0.001
Sep-09	TOTAL	1923	814	2.36	2	7	0.05	64.52	14.067	y	0	0.001
Oct-09	TOTAL	4065	619	6.57	2	7	0.05	1407.60	14.067	y	0	0.001
Nov-09	TOTAL	10757	1890	5.69	2	7	0.05	1750.94	14.067	y	0	0.001
Dec-09	TOTAL	5767	1194	4.83	2	7	0.05	1443.62	14.067	y	0	0.001
Winter2008(DJF)	TOTAL	7080	1420	4.99	2	7	0.05	450.72	14.067	y	0	0.001
Spring2008(MAM)	TOTAL	37639	8331	4.52	2	7	0.05	5740.21	14.067	y	0	0.001
Summer2008(JJ)	TOTAL	3921	2259	1.74	2	7	0.05	231.45	14.067	y	0	0.001
Autumn2008(ASON)	TOTAL	45813	6983	6.56	2	7	0.05	27540.54	14.067	y	0	0.001
Winter2009(DJF)	TOTAL	40931	4687	8.73	2	7	0.05	6872.73	14.067	y	0	0.001
Spring2009(MAM)	TOTAL	15668	4840	3.24	2	7	0.05	2738.84	14.067	y	0	0.001
Summer2009(JJ)	TOTAL	1817	1309	1.39	2	7	0.05	88.92	14.067	y	0	0.001
Autumn2009(ASON)	TOTAL	18630	4524	4.12	2	7	0.05	1915.45	14.067	y	0	0.001
Winter2010(DJF)	TOTAL	5767	1194	4.83	2	7	0.05	1443.62	14.067	y	0	0.001
2008	TOTAL	104125	20143	5.17	2	7	0.05	13365.59	14.067	y	0	0.001
2009	TOTAL	73141	15404	4.75	2	7	0.05	4894.70	14.067	y	0	0.001
Overall	NOGA	34020	9822	3.46	2	7	0.05	1504.09	14.067	y	0	0.001
Jan-08	NOGA	898	482	1.86	2	7	0.05	79.61	14.067	y	0	0.001
Feb-08	NOGA	49	33	1.48	2	7	0.05	28.95	14.067	y	0	0.001
Mar-08	NOGA	4980	1351	3.69	2	7	0.05	559.34	14.067	y	0	0.001
Apr-08	NOGA	3271	1409	2.32	2	7	0.05	340.94	14.067	y	0	0.001
May-08	NOGA	858	582	1.47	2	7	0.05	82.54	14.067	y	0	0.001
Jun-08	NOGA	270	195	1.38	2	7	0.05	33.39	14.067	y	0	0.001
Oct-08	NOGA	1692	492	3.44	2	7	0.05	1195.69	14.067	y	0	0.001
Nov-08	NOGA	9402	1045	9.00	2	7	0.05	4901.85	14.067	y	0	0.001
Dec-08	NOGA	470	308	1.53	2	7	0.05	45.27	14.067	y	0	0.001

Table E-7 (*continued*). Chi-square (X^2) goodness-of-fit (GOF) test for a uniform circular distribution. Ho: The sample data came from a population with a uniform circular distribution. Ha: The sample data did NOT come from a population with a uniform circular distribution.

Time Period	Species	Abundance	#Observations	Cluster Size	#Tails	DF	CI Level	X2stat	X2crit	Reject Ho?	Plow	Phigh
Jan-09	NOGA	1849	417	4.43	2	7	0.05	6239.89	14.067	y	0	0.001
Mar-09	NOGA	840	468	1.79	2	7	0.05	75.58	14.067	y	0	0.001
Apr-09	NOGA	400	303	1.32	2	7	0.05	19.91	14.067	y	0.005	0.01
May-09	NOGA	1077	674	1.60	2	7	0.05	66.72	14.067	y	0	0.001
Jun-09	NOGA	431	343	1.26	2	7	0.05	49.08	14.067	y	0	0.001
Nov-09	NOGA	6394	981	6.52	2	7	0.05	869.63	14.067	y	0	0.001
Dec-09	NOGA	628	331	1.90	2	7	0.05	400.76	14.067	y	0	0.001
Winter2008(DJF)	NOGA	947	515	1.84	2	7	0.05	89.09	14.067	y	0	0.001
Spring2008(MAM)	NOGA	9109	3342	2.73	2	7	0.05	375.04	14.067	y	0	0.001
Summer2008(JJ)	NOGA	312	232	1.34	2	7	0.05	31.43	14.067	y	0	0.001
Autumn2008(ASON)	NOGA	11217	1631	6.88	2	7	0.05	4896.64	14.067	y	0	0.001
Spring2009(MAM)	NOGA	2317	1445	1.60	2	7	0.05	70.39	14.067	y	0	0.001
Summer2009(JJ)	NOGA	431	343	1.26	2	7	0.05	49.08	14.067	y	0	0.001
Autumn2009(ASON)	NOGA	6474	1050	6.17	2	7	0.05	855.19	14.067	y	0	0.001
Winter2010(DJF)	NOGA	628	331	1.90	2	7	0.05	400.76	14.067	y	0	0.001
2008	NOGA	22055	6028	3.66	2	7	0.05	1897.61	14.067	y	0	0.001
2009	NOGA	11965	3794	3.15	2	7	0.05	1971.18	14.067	y	0	0.001
Overall	SCDW	13933	364	38.28	2	7	0.05	4382.48	14.067	y	0	0.001
Mar-08	SCDW	1522	36	42.28	2	7	0.05	2638.99	14.067	y	0	0.001
Apr-08	SCDW	1885	69	27.32	2	7	0.05	4976.07	14.067	y	0	0.001
Nov-08	SCDW	2932	30	97.73	2	7	0.05	6256.76	14.067	y	0	0.001
Dec-08	SCDW	3025	21	144.05	2	7	0.05	7678.43	14.067	y	0	0.001
Apr-09	SCDW	1599	36	44.42	2	7	0.05	1681.61	14.067	y	0	0.001
Dec-09	SCDW	473	16	29.56	2	7	0.05	344.29	14.067	y	0	0.001
Spring2008(MAM)	SCDW	3407	105	32.45	2	7	0.05	3237.69	14.067	y	0	0.001
Autumn2008(ASON)	SCDW	3228	49	65.88	2	7	0.05	6198.07	14.067	y	0	0.001
Winter2009(DJF)	SCDW	4468	107	41.76	2	7	0.05	5082.69	14.067	y	0	0.001
Spring2009(MAM)	SCDW	1985	71	27.96	2	7	0.05	1575.36	14.067	y	0	0.001
Winter2010(DJF)	SCDW	473	16	29.56	2	7	0.05	344.29	14.067	y	0	0.001
2008	SCDW	9669	178	54.32	2	7	0.05	4185.77	14.067	y	0	0.001
Overall	HERG	13790	3474	3.97	2	7	0.05	131.88	14.067	y	0	0.001
Jan-08	HERG	1158	129	8.98	2	7	0.05	126.43	14.067	y	0	0.001
Feb-08	HERG	61	41	1.49	2	7	0.05	31.73	14.067	y	0	0.001
Mar-08	HERG	3785	394	9.61	2	7	0.05	214.97	14.067	y	0	0.001
May-08	HERG	568	249	2.28	2	7	0.05	40.78	14.067	y	0	0.001
Feb-09	HERG	1710	325	5.26	2	7	0.05	59.14	14.067	y	0	0.001
Mar-09	HERG	1037	358	2.90	2	7	0.05	81.86	14.067	y	0	0.001
Apr-09	HERG	439	138	3.18	2	7	0.05	30.69	14.067	y	0	0.001
May-09	HERG	261	194	1.35	2	7	0.05	69.57	14.067	y	0	0.001
Jun-09	HERG	135	90	1.50	2	7	0.05	73.18	14.067	y	0	0.001
Sep-09	HERG	352	59	5.97	2	7	0.05	32.52	14.067	y	0	0.001
Oct-09	HERG	237	62	3.82	2	7	0.05	25.49	14.067	y	0	0.001
Nov-09	HERG	416	149	2.79	2	7	0.05	50.29	14.067	y	0	0.001
Winter2008(DJF)	HERG	1219	170	7.17	2	7	0.05	139.23	14.067	y	0	0.001

Table E-7 (*continued*). Chi-square (X^2) goodness-of-fit (GOF) test for a uniform circular distribution. Ho: The sample data came from a population with a uniform circular distribution. Ha: The sample data did NOT come from a population with a uniform circular distribution.

Time Period	Species	Abundance	#Observations	Cluster Size	#Tails	DF	CI Level	X2stat	X2crit	Reject Ho?	Plow	Phigh
Spring2008(MAM)	HERG	5024	1016	4.94	2	7	0.05	203.76	14.067	y	0	0.001
Spring2009(MAM)	HERG	1737	690	2.52	2	7	0.05	102.38	14.067	y	0	0.001
Summer2009(JJ)	HERG	135	90	1.50	2	7	0.05	73.18	14.067	y	0	0.001
Autumn2009(ASON)	HERG	1032	290	3.56	2	7	0.05	51.22	14.067	y	0	0.001
2008	HERG	7991	1810	4.41	2	7	0.05	187.19	14.067	y	0	0.001
2009	HERG	5799	1664	3.49	2	7	0.05	134.35	14.067	y	0	0.001
Overall	SUSC	12463	709	17.58	2	7	0.05	4228.67	14.067	y	0	0.001
Mar-08	SUSC	2181	71	30.72	2	7	0.05	1707.49	14.067	y	0	0.001
Apr-08	SUSC	3048	142	21.46	2	7	0.05	2954.87	14.067	y	0	0.001
Nov-08	SUSC	2348	52	45.15	2	7	0.05	9436.52	14.067	y	0	0.001
Dec-08	SUSC	1029	41	25.10	2	7	0.05	258.79	14.067	y	0	0.001
Feb-09	SUSC	1165	121	9.63	2	7	0.05	295.80	14.067	y	0	0.001
Mar-09	SUSC	664	84	7.90	2	7	0.05	250.65	14.067	y	0	0.001
Apr-09	SUSC	604	48	12.58	2	7	0.05	1386.31	14.067	y	0	0.001
Nov-09	SUSC	435	16	27.19	2	7	0.05	663.50	14.067	y	0	0.001
Spring2008(MAM)	SUSC	5230	214	24.44	2	7	0.05	2323.34	14.067	y	0	0.001
Spring2009(MAM)	SUSC	1292	133	9.71	2	7	0.05	1005.95	14.067	y	0	0.001
2008	SUSC	8828	336	26.27	2	7	0.05	4600.99	14.067	y	0	0.001
Overall	DCCO	10892	394	27.64	2	7	0.05	6132.05	14.067	y	0	0.001
Apr-08	DCCO	1846	64	28.84	2	7	0.05	4213.45	14.067	y	0	0.001
May-08	DCCO	717	63	11.38	2	7	0.05	996.53	14.067	y	0	0.001
Sep-08	DCCO	218	15	14.53	2	7	0.05	412.83	14.067	y	0	0.001
Oct-08	DCCO	4157	99	41.99	2	7	0.05	7244.30	14.067	y	0	0.001
Apr-09	DCCO	1869	60	31.15	2	7	0.05	4877.16	14.067	y	0	0.001
Oct-09	DCCO	931	19	49.00	2	7	0.05	2172.95	14.067	y	0	0.001
Spring2008(MAM)	DCCO	2563	127	20.18	2	7	0.05	4905.76	14.067	y	0	0.001
Autumn2008(ASON)	DCCO	5268	130	40.52	2	7	0.05	9385.00	14.067	y	0	0.001
Spring2009(MAM)	DCCO	1972	83	23.76	2	7	0.05	4849.14	14.067	y	0	0.001
Autumn2009(ASON)	DCCO	1053	31	33.97	2	7	0.05	2018.39	14.067	y	0	0.001
2008	DCCO	7861	275	28.59	2	7	0.05	4914.83	14.067	y	0	0.001
Jan-08	BLSC	1369	51	26.84	2	7	0.05	1521.14	14.067	y	0	0.001
Feb-08	BLSC	187	9	20.78	2	7	0.05	376.87	14.067	y	0	0.001
Dec-08	BLSC	1642	37	44.38	2	7	0.05	1493.62	14.067	y	0	0.001
Mar-09	BLSC	634	57	11.12	2	7	0.05	1787.44	14.067	y	0	0.001
Dec-09	BLSC	737	40	18.43	2	7	0.05	469.38	14.067	y	0	0.001
Winter2008(DJF)	BLSC	1556	60	25.93	2	7	0.05	1342.46	14.067	y	0	0.001
Winter2010(DJF)	BLSC	737	40	18.43	2	7	0.05	469.38	14.067	y	0	0.001
Jan-08	SCAU	750	1	750.00	2	7	0.05	75.33	14.067	y	0	0.001
Jan-09	SCAU	4617	32	144.28	2	7	0.05	6025.89	14.067	y	0	0.001
Winter2008(DJF)	SCAU	750	1	750.00	2	7	0.05	241.39	14.067	y	0	0.001
Winter2009(DJF)	SCAU	4617	32	144.28	2	7	0.05	6025.89	14.067	y	0	0.001
2009	SCAU	4617	32	144.28	2	7	0.05	6025.89	14.067	y	0	0.001

Table E-7 (*continued*). Chi-square (X^2) goodness-of-fit (GOF) test for a uniform circular distribution. Ho: The sample data came from a population with a uniform circular distribution. Ha: The sample data did NOT come from a population with a uniform circular distribution.

Time Period	Species	Abundance	#Observations	Cluster Size	#Tails	DF	CI Level	X2stat	X2crit	Reject Ho?	Plow	Phigh
Jan-08	LTDU	603	57	10.58	2	7	0.05	75.33	14.067	y	0	0.001
Feb-08	LTDU	82	8	10.25	2	7	0.05	256.28	14.067	y	0	0.001
Feb-09	LTDU	2483	265	9.37	2	7	0.05	296.85	14.067	y	0	0.001
Mar-09	LTDU	723	87	8.31	2	7	0.05	100.69	14.067	y	0	0.001
Dec-09	LTDU	441	72	6.13	2	7	0.05	225.62	14.067	y	0	0.001
Winter2008(DJF)	LTDU	685	65	10.54	2	7	0.05	241.39	14.067	y	0	0.001
Winter2009(DJF)	LTDU	4152	404	10.28	2	7	0.05	243.37	14.067	y	0	0.001
Winter2010(DJF)	LTDU	441	72	6.13	2	7	0.05	225.62	14.067	y	0	0.001
2009	LTDU	5195	563	9.23	2	7	0.05	250.71	14.067	y	0	0.001
Feb-08	COLO	97	62	1.56	2	7	0.05	6.00	14.067	n	0.5	0.75
Feb-09	COLO	979	333	2.94	2	7	0.05	9.40	14.067	n	0.1	0.25
May-09	COLO	617	352	1.75	2	7	0.05	135.42	14.067	y	0	0.001
Mar-08	GULG	832	29	28.69	2	7	0.05	264.04	14.067	y	0	0.001
Jan-09	GULG	1991	17	117.12	2	7	0.05	63.23	14.067	y	0	0.001
Feb-09	GULG	1362	42	32.43	2	7	0.05	349.81	14.067	y	0	0.001
Sep-09	GULG	473	14	33.79	2	7	0.05	44.58	14.067	y	0	0.001
Oct-09	GULG	598	32	18.69	2	7	0.05	130.82	14.067	y	0	0.001
Nov-09	GULG	875	21	41.67	2	7	0.05	2018.74	14.067	y	0	0.001
Dec-09	GULG	472	16	29.50	2	7	0.05	38.42	14.067	y	0	0.001
Winter2009(DJF)	GULG	3377	67	50.40	2	7	0.05	281.08	14.067	y	0	0.001
Autumn2009(ASON)	GULG	1989	72	27.63	2	7	0.05	1658.78	14.067	y	0	0.001
Winter2010(DJF)	GULG	472	16	29.50	2	7	0.05	38.42	14.067	y	0	0.001
2009	GULG	6129	204	30.04	2	7	0.05	1322.22	14.067	y	0	0.001
Apr-08	SCOT	1607	50	32.14	2	7	0.05	2835.43	14.067	y	0	0.001
Dec-08	SCOT	1328	8	166.00	2	7	0.05	7469.05	14.067	y	0	0.001
Jan-09	SCOT	2811	33	85.18	2	7	0.05	3150.00	14.067	y	0	0.001
Winter2009(DJF)	SCOT	4943	74	66.80	2	7	0.05	5660.29	14.067	y	0	0.001
May-08	LAGU	712	237	3.00	2	7	0.05	214.87	14.067	y	0	0.001
Jun-08	LAGU	531	315	1.69	2	7	0.05	18.39	14.067	y	0.01	0.025
Jul-08	LAGU	673	415	1.62	2	7	0.05	107.19	14.067	y	0	0.001
Aug-08	LAGU	1349	473	2.85	2	7	0.05	232.14	14.067	y	0	0.001
Sep-08	LAGU	580	334	1.74	2	7	0.05	93.62	14.067	y	0	0.001
Oct-08	LAGU	1027	298	3.45	2	7	0.05	224.47	14.067	y	0	0.001
Nov-08	LAGU	1738	199	8.73	2	7	0.05	182.35	14.067	y	0	0.001
May-09	LAGU	215	151	1.42	2	7	0.05	50.27	14.067	y	0	0.001
Jun-09	LAGU	466	286	1.63	2	7	0.05	30.27	14.067	y	0	0.001
Aug-09	LAGU	767	375	2.05	2	7	0.05	81.50	14.067	y	0	0.001
Sep-09	LAGU	251	180	1.39	2	7	0.05	28.31	14.067	y	0	0.001
Oct-09	LAGU	1334	170	7.85	2	7	0.05	200.99	14.067	y	0	0.001
Summer2008(JJ)	LAGU	1204	730	1.65	2	7	0.05	72.28	14.067	y	0	0.001
Autumn2008(ASON)	LAGU	4694	1304	3.60	2	7	0.05	231.01	14.067	y	0	0.001
Summer2009(JJ)	LAGU	466	286	1.63	2	7	0.05	30.27	14.067	y	0	0.001

Table E-7 (*continued*). Chi-square (X^2) goodness-of-fit (GOF) test for a uniform circular distribution. Ho: The sample data came from a population with a uniform circular distribution. Ha: The sample data did NOT come from a population with a uniform circular distribution.

Time Period	Species	Abundance	#Observations	Cluster Size	#Tails	DF	CI Level	X2stat	X2crit	Reject Ho?	Plow	Phigh
Autumn2009(ASON)	LAGU	2404	757	3.18	2	7	0.05	52.38	14.067	y	0	0.001
May-08	GBBG	341	189	1.80	2	7	0.05	16.99	14.067	y	0.01	0.025
Jun-08	GBBG	127	97	1.31	2	7	0.05	22.73	14.067	y	0.001	0.005
Aug-08	GBBG	147	121	1.21	2	7	0.05	31.22	14.067	y	0	0.001
Sep-08	GBBG	379	255	1.49	2	7	0.05	17.32	14.067	y	0.01	0.025
Jun-09	GBBG	146	119	1.23	2	7	0.05	27.14	14.067	y	0	0.001
Aug-09	GBBG	169	140	1.21	2	7	0.05	37.84	14.067	y	0	0.001
Sep-09	GBBG	174	99	1.76	2	7	0.05	18.07	14.067	y	0.01	0.025
Oct-09	GBBG	471	212	2.22	2	7	0.05	17.29	14.067	y	0.01	0.025
Summer2009(JJ)	GBBG	146	119	1.23	2	7	0.05	27.14	14.067	y	0	0.001
Jun-08	WISP	400	199	2.01	2	7	0.05	538.00	14.067	y	0	0.001
Jul-08	WISP	446	251	1.78	2	7	0.05	67.55	14.067	y	0	0.001
Aug-08	WISP	1251	175	7.15	2	7	0.05	4151.05	14.067	y	0	0.001
Aug-09	WISP	374	321	1.17	2	7	0.05	11.30	14.067	n	0.1	0.25
Sep-09	WISP	281	247	1.14	2	7	0.05	58.63	14.067	y	0	0.001
Summer2008(JJ)	WISP	846	450	1.88	2	7	0.05	222.63	14.067	y	0	0.001
Jun-08	COTE	339	195	1.74	2	7	0.05	91.18	14.067	y	0	0.001
Jul-08	COTE	366	181	2.02	2	7	0.05	146.19	14.067	y	0	0.001
Aug-08	COTE	798	354	2.25	2	7	0.05	221.33	14.067	y	0	0.001
Sep-08	COTE	392	133	2.95	2	7	0.05	96.57	14.067	y	0	0.001
May-09	COTE	175	83	2.11	2	7	0.05	35.92	14.067	y	0	0.001
Jun-09	COTE	290	202	1.44	2	7	0.05	41.33	14.067	y	0	0.001
Aug-09	COTE	129	99	1.30	2	7	0.05	24.24	14.067	y	0.001	0.005
Summer2008(JJ)	COTE	705	376	1.88	2	7	0.05	182.19	14.067	y	0	0.001
Summer2009(JJ)	COTE	290	202	1.44	2	7	0.05	41.33	14.067	y	0	0.001
Jul-08	COSH	117	44	2.66	2	7	0.05	17.09	14.067	y	0.01	0.025
Aug-09	COSH	72	65	1.11	2	7	0.05	26.94	14.067	y	0	0.001
Summer2008(JJ)	COSH	188	87	2.16	2	7	0.05	18.88	14.067	y	0.005	0.01
Jul-08	TESM	72	11	6.55	2	7	0.05	87.78	14.067	y	0	0.001
Aug-08	PASS	118	58	2.03	2	7	0.05	241.32	14.067	y	0	0.001
Sep-08	SHSM	200	3	66.67	2	7	0.05	1277.12	14.067	y	0	0.001
Oct-08	SHSM	533	5	106.60	2	7	0.05	1046.36	14.067	y	0	0.001
Oct-08	FOTE	688	81	8.49	2	7	0.05	281.62	14.067	y	0	0.001
Nov-08	CANG	2548	22	115.82	2	7	0.05	10802.15	14.067	y	0	0.001
Autumn2008(ASON)	CANG	2637	26	101.42	2	7	0.05	10327.09	14.067	y	0	0.001
Jan-09	GRSC	1568	9	174.22	2	7	0.05	220.71	14.067	y	0	0.001

Table E-7 (*continued*). Chi-square (X^2) goodness-of-fit (GOF) test for a uniform circular distribution. Ho: The sample data came from a population with a uniform circular distribution. Ha: The sample data did NOT come from a population with a uniform circular distribution.

Time Period	Species	Abundance	#Observations	Cluster Size	#Tails	DF	CI Level	X2stat	X2crit	Reject Ho?	Plow	Phigh
Nov-09	RTLO	892	259	3.44	2	7	0.05	1768.38	14.067	y	0	0.001

Table E-8. Watson 1-sample U^2 non-parametric goodness-of-fit (GOF) test for a uniform circular distribution. Ho: The sample data came from a population with a uniform circular distribution. Ha: The sample data did NOT come from a population with a uniform circular distribution.

Time Period	Species	Abundance	#Observations	Cluster Size	n1	n2	CI Level	ubar	U2	U2crit	Reject Ho?	Plow	Phigh
Overall	TOTAL	177266	35547	4.99	109794	109794	0.05	0.4324	324.72	0.1869	y	0	0.001
Jan-08	TOTAL	6500	1212	5.36	2081	2081	0.05	0.4194	9.57	0.1869	y	0	0.001
Feb-08	TOTAL	580	208	2.79	327	327	0.05	0.4996	2.42	0.1869	y	0	0.001
Mar-08	TOTAL	17569	3068	5.73	9139	9139	0.05	0.4032	19.26	0.1869	y	0	0.001
Apr-08	TOTAL	15624	3362	4.65	10850	10850	0.05	0.2450	211.96	0.1869	y	0	0.001
May-08	TOTAL	4446	1901	2.34	3527	3527	0.05	0.3698	10.49	0.1869	y	0	0.001
Jun-08	TOTAL	1964	1198	1.64	1674	1674	0.05	0.4830	5.66	0.1869	y	0	0.001
Jul-08	TOTAL	1957	1061	1.84	1591	1591	0.05	0.4623	3.90	0.1869	y	0	0.001
Aug-08	TOTAL	4255	1457	2.92	3396	3396	0.05	0.3281	27.17	0.1869	y	0	0.001
Sep-08	TOTAL	2612	1103	2.37	2196	2196	0.05	0.4343	5.06	0.1869	y	0	0.001
Oct-08	TOTAL	11928	1729	6.90	9994	9994	0.05	0.5722	189.37	0.1869	y	0	0.001
Nov-08	TOTAL	27018	2694	10.03	20358	20358	0.05	0.5410	473.09	0.1869	y	0	0.001
Dec-08	TOTAL	9672	1150	8.41	6091	6091	0.05	0.4872	183.66	0.1869	y	0	0.001
Jan-09	TOTAL	20306	1618	12.55	9332	9332	0.05	0.3677	40.77	0.1869	y	0	0.001
Feb-09	TOTAL	10953	1919	5.71	3108	3108	0.05	0.4280	9.60	0.1869	y	0	0.001
Mar-09	TOTAL	6494	2058	3.16	3193	3193	0.05	0.3574	14.88	0.1869	y	0	0.001
Apr-09	TOTAL	6122	1038	5.90	5290	5290	0.05	0.2775	53.34	0.1869	y	0	0.001
May-09	TOTAL	3052	1744	1.75	2071	2071	0.05	0.4112	4.68	0.1869	y	0	0.001
Jun-09	TOTAL	1817	1309	1.39	1411	1411	0.05	0.3988	3.21	0.1869	y	0	0.001
Aug-09	TOTAL	1885	1201	1.57	1500	1500	0.05	0.4737	2.65	0.1869	y	0	0.001
Sep-09	TOTAL	1923	814	2.36	918	918	0.05	0.4111	1.66	0.1869	y	0	0.001
Oct-09	TOTAL	4065	619	6.57	2151	2151	0.05	0.4505	12.45	0.1869	y	0	0.001
Nov-09	TOTAL	10757	1890	5.69	6539	6539	0.05	0.4761	32.49	0.1869	y	0	0.001
Dec-09	TOTAL	5767	1194	4.83	3057	3057	0.05	0.4990	31.98	0.1869	y	0	0.001
Winter2008(DJF)	TOTAL	7080	1420	4.99	2408	2408	0.05	0.4303	9.49	0.1869	y	0	0.001
Spring2008(MAM)	TOTAL	37639	8331	4.52	23516	23516	0.05	0.3252	140.19	0.1869	y	0	0.001
Summer2008(JJ)	TOTAL	3921	2259	1.74	3265	3265	0.05	0.4729	8.83	0.1869	y	0	0.001
Autumn2008(ASON)	TOTAL	45813	6983	6.56	35944	35944	0.05	0.5230	528.05	0.1869	y	0	0.001
Winter2009(DJF)	TOTAL	40931	4687	8.73	18531	18531	0.05	0.4171	114.20	0.1869	y	0	0.001
Spring2009(MAM)	TOTAL	15668	4840	3.24	10554	10554	0.05	0.3279	54.97	0.1869	y	0	0.001
Summer2009(JJ)	TOTAL	1817	1309	1.39	1411	1411	0.05	0.3988	3.21	0.1869	y	0	0.001
Autumn2009(ASON)	TOTAL	18630	4524	4.12	11108	11108	0.05	0.4654	37.32	0.1869	y	0	0.001
Winter2010(DJF)	TOTAL	5767	1194	4.83	3057	3057	0.05	0.4990	31.98	0.1869	y	0	0.001
2008	TOTAL	104125	20143	5.17	71224	71224	0.05	0.4492	285.57	0.1869	y	0	0.001
2009	TOTAL	73141	15404	4.75	38570	38570	0.05	0.4014	88.70	0.1869	y	0	0.001
Overall	NOGA	34020	9822	3.46	22856	22856	0.05	0.4518	56.16	0.1869	y	0	0.001
Jan-08	NOGA	898	482	1.86	693	693	0.05	0.3948	2.02	0.1869	y	0	0.001
Feb-08	NOGA	49	33	1.48	37	37	0.05	0.3716	0.58	0.186	y	0	0.001
Mar-08	NOGA	4980	1351	3.69	3348	3348	0.05	0.3840	8.55	0.1869	y	0	0.001
Apr-08	NOGA	3271	1409	2.32	2081	2081	0.05	0.4510	6.33	0.1869	y	0	0.001
May-08	NOGA	858	582	1.47	703	703	0.05	0.4250	2.14	0.1869	y	0	0.001
Jun-08	NOGA	270	195	1.38	195	195	0.05	0.4737	0.81	0.1869	y	0	0.001
Oct-08	NOGA	1692	492	3.44	1380	1380	0.05	0.6035	28.66	0.1869	y	0	0.001
Nov-08	NOGA	9402	1045	9.00	6037	6037	0.05	0.4723	62.04	0.1869	y	0	0.001
Dec-08	NOGA	470	308	1.53	343	343	0.05	0.4359	0.97	0.1869	y	0	0.001

Table E-8 (*continued*). Watson 1-sample U^2 non-parametric goodness-of-fit (GOF) test for a uniform circular distribution. Ho: The sample data came from a population with a uniform circular distribution. Ha: The sample data did NOT come from a population with a uniform circular distribution.

Time Period	Species	Abundance	#Observations	Cluster Size	n1	n2	CI Level	ubar	U2	U2crit	Reject Ho?	Plow	Phigh
Jan-09	NOGA	1849	417	4.43	1707	1707	0.05	0.4978	79.03	0.1869	y	0	0.001
Mar-09	NOGA	840	468	1.79	604	604	0.05	0.4139	1.55	0.1869	y	0	0.001
Apr-09	NOGA	400	303	1.32	322	322	0.05	0.4394	0.56	0.1869	y	0	0.001
May-09	NOGA	1077	674	1.60	815	815	0.05	0.4121	1.91	0.1869	y	0	0.001
Jun-09	NOGA	431	343	1.26	237	237	0.05	0.3565	1.46	0.1869	y	0	0.001
Nov-09	NOGA	6394	981	6.52	3495	3495	0.05	0.4274	18.42	0.1869	y	0	0.001
Dec-09	NOGA	628	331	1.90	482	482	0.05	0.5552	10.38	0.1869	y	0	0.001
Winter2008(DJF)	NOGA	947	515	1.84	730	730	0.05	0.3937	2.22	0.1869	y	0	0.001
Spring2008(MAM)	NOGA	9109	3342	2.73	6132	6132	0.05	0.4114	12.64	0.1869	y	0	0.001
Summer2008(JJ)	NOGA	312	232	1.34	224	224	0.05	0.4464	0.74	0.1869	y	0	0.001
Autumn2008(ASON)	NOGA	11217	1631	6.88	7490	7490	0.05	0.4958	76.04	0.1869	y	0	0.001
Spring2009(MAM)	NOGA	2317	1445	1.60	1741	1741	0.05	0.4178	2.93	0.1869	y	0	0.001
Summer2009(JJ)	NOGA	431	343	1.26	237	237	0.05	0.3565	1.46	0.1869	y	0	0.001
Autumn2009(ASON)	NOGA	6474	1050	6.17	3547	3547	0.05	0.4272	18.24	0.1869	y	0	0.001
Winter2010(DJF)	NOGA	628	331	1.90	482	482	0.05	0.5552	10.38	0.1869	y	0	0.001
2008	NOGA	22055	6028	3.66	14919	14919	0.05	0.4540	42.73	0.1869	y	0	0.001
2009	NOGA	11965	3794	3.15	7937	7937	0.05	0.4477	26.39	0.1869	y	0	0.001
Overall	SCDW	13933	364	38.28	11113	11113	0.05	0.4285	94.21	0.1869	y	0	0.001
Mar-08	SCDW	1522	36	42.28	1509	1509	0.05	0.4272	29.67	0.1869	y	0	0.001
Apr-08	SCDW	1885	69	27.32	1500	1500	0.05	0.1603	79.49	0.1869	y	0	0.001
Nov-08	SCDW	2932	30	97.73	2932	2932	0.05	0.5048	65.22	0.1869	y	0	0.001
Dec-08	SCDW	3025	21	144.05	1465	1465	0.05	0.5131	102.72	0.1869	y	0	0.001
Apr-09	SCDW	1599	36	44.42	1569	1569	0.05	0.3768	26.95	0.1869	y	0	0.001
Dec-09	SCDW	473	16	29.56	243	243	0.05	0.4769	5.59	0.1869	y	0	0.001
Spring2008(MAM)	SCDW	3407	105	32.45	3009	3009	0.05	0.2942	45.07	0.1869	y	0	0.001
Autumn2008(ASON)	SCDW	3228	49	65.88	3228	3228	0.05	0.5009	65.01	0.1869	y	0	0.001
Winter2009(DJF)	SCDW	4468	107	41.76	2476	2476	0.05	0.4931	75.03	0.1869	y	0	0.001
Spring2009(MAM)	SCDW	1985	71	27.96	1791	1791	0.05	0.3899	26.90	0.1869	y	0	0.001
Winter2010(DJF)	SCDW	473	16	29.56	243	243	0.05	0.4769	5.59	0.1869	y	0	0.001
2008	SCDW	9669	178	54.32	7705	7705	0.05	0.4225	76.09	0.1869	y	0	0.001
Overall	HERG	13790	3474	3.97	4730	4730	0.05	0.4261	7.90	0.1869	y	0	0.001
Jan-08	HERG	1158	129	8.98	206	206	0.05	0.5067	1.05	0.1869	y	0	0.001
Feb-08	HERG	61	41	1.49	60	60	0.05	0.4542	0.36	0.187	y	0.001	0.002
Mar-08	HERG	3785	394	9.61	725	725	0.05	0.4578	3.04	0.1869	y	0	0.001
May-08	HERG	568	249	2.28	322	322	0.05	0.4115	0.90	0.1869	y	0	0.001
Feb-09	HERG	1710	325	5.26	377	377	0.05	0.4098	0.94	0.1869	y	0	0.001
Mar-09	HERG	1037	358	2.90	500	500	0.05	0.3450	2.55	0.1869	y	0	0.001
Apr-09	HERG	439	138	3.18	186	186	0.05	0.4106	1.00	0.1869	y	0	0.001
May-09	HERG	261	194	1.35	224	224	0.05	0.3655	1.02	0.1869	y	0	0.001
Jun-09	HERG	135	90	1.50	121	121	0.05	0.3068	0.99	0.1869	y	0	0.001
Sep-09	HERG	352	59	5.97	54	54	0.05	0.3009	0.42	0.187	y	0	0.001
Oct-09	HERG	237	62	3.82	69	69	0.05	0.3841	0.57	0.187	y	0	0.001
Nov-09	HERG	416	149	2.79	224	224	0.05	0.3962	0.66	0.1869	y	0	0.001
Winter2008(DJF)	HERG	1219	170	7.17	266	266	0.05	0.4948	1.25	0.1869	y	0	0.001

Table E-8 (*continued*). Watson 1-sample U^2 non-parametric goodness-of-fit (GOF) test for a uniform circular distribution. Ho: The sample data came from a population with a uniform circular distribution. Ha: The sample data did NOT come from a population with a uniform circular distribution.

Time Period	Species	Abundance	#Observations	Cluster Size	n1	n2	CI Level	ubar	U2	U2crit	Reject Ho?	Plow	Phigh
Spring2008(MAM)	HERG	5024	1016	4.94	1483	1483	0.05	0.4107	5.49	0.1869	y	0	0.001
Spring2009(MAM)	HERG	1737	690	2.52	910	910	0.05	0.3635	3.46	0.1869	y	0	0.001
Summer2009(JJ)	HERG	135	90	1.50	121	121	0.05	0.3068	0.99	0.1869	y	0	0.001
Autumn2009(ASON)	HERG	1032	290	3.56	368	368	0.05	0.3767	0.99	0.1869	y	0	0.001
2008	HERG	7991	1810	4.41	2520	2520	0.05	0.4572	4.76	0.1869	y	0	0.001
2009	HERG	5799	1664	3.49	2210	2210	0.05	0.3906	4.82	0.1869	y	0	0.001
Overall	SUSC	12463	709	17.58	6908	6908	0.05	0.4181	47.84	0.1869	y	0	0.001
Mar-08	SUSC	2181	71	30.72	934	934	0.05	0.2914	23.30	0.1869	y	0	0.001
Apr-08	SUSC	3048	142	21.46	1328	1328	0.05	0.1995	50.82	0.1869	y	0	0.001
Nov-08	SUSC	2348	52	45.15	2318	2318	0.05	0.6199	138.18	0.1869	y	0	0.001
Dec-08	SUSC	1029	41	25.10	292	292	0.05	0.3630	3.36	0.1869	y	0	0.001
Feb-09	SUSC	1165	121	9.63	426	426	0.05	0.4795	4.65	0.1869	y	0	0.001
Mar-09	SUSC	664	84	7.90	246	246	0.05	0.2602	3.48	0.1869	y	0	0.001
Apr-09	SUSC	604	48	12.58	462	462	0.05	0.1702	21.00	0.1869	y	0	0.001
Nov-09	SUSC	435	16	27.19	435	435	0.05	0.5658	12.33	0.1869	y	0	0.001
Spring2008(MAM)	SUSC	5230	214	24.44	2263	2263	0.05	0.2374	46.85	0.1869	y	0	0.001
Spring2009(MAM)	SUSC	1292	133	9.71	732	732	0.05	0.2030	19.17	0.1869	y	0	0.001
2008	SUSC	8828	336	26.27	5021	5021	0.05	0.4328	49.79	0.1869	y	0	0.001
Overall	DCCO	10892	394	27.64	10730	10730	0.05	0.4081	79.73	0.1869	y	0	0.001
Apr-08	DCCO	1846	64	28.84	1837	1837	0.05	0.0881	81.56	0.1869	y	0	0.001
May-08	DCCO	717	63	11.38	665	665	0.05	0.1566	20.26	0.1869	y	0	0.001
Sep-08	DCCO	218	15	14.53	218	218	0.05	0.5034	3.60	0.1869	y	0	0.001
Oct-08	DCCO	4157	99	41.99	4154	4154	0.05	0.6629	161.96	0.1869	y	0	0.001
Apr-09	DCCO	1869	60	31.15	1844	1844	0.05	0.1118	82.50	0.1869	y	0	0.001
Oct-09	DCCO	931	19	49.00	927	927	0.05	0.3687	16.16	0.1869	y	0	0.001
Spring2008(MAM)	DCCO	2563	127	20.18	2502	2502	0.05	0.1063	98.67	0.1869	y	0	0.001
Autumn2008(ASON)	DCCO	5268	130	40.52	5265	5265	0.05	0.6578	203.15	0.1869	y	0	0.001
Spring2009(MAM)	DCCO	1972	83	23.76	1895	1895	0.05	0.1142	82.82	0.1869	y	0	0.001
Autumn2009(ASON)	DCCO	1053	31	33.97	1039	1039	0.05	0.4021	15.47	0.1869	y	0	0.001
2008	DCCO	7861	275	28.59	7790	7790	0.05	0.4804	84.40	0.1869	y	0	0.001
Jan-08	BLSC	1369	51	26.84	589	589	0.05	0.4304	23.41	0.1869	y	0	0.001
Feb-08	BLSC	187	9	20.78	92	92	0.05	0.7826	3.79	0.187	y	0	0.001
Dec-08	BLSC	1642	37	44.38	1344	1344	0.05	0.5057	37.14	0.1869	y	0	0.001
Mar-09	BLSC	634	57	11.12	479	479	0.05	0.1015	24.09	0.1869	y	0	0.001
Dec-09	BLSC	737	40	18.43	386	386	0.05	0.3841	5.40	0.1869	y	0	0.001
Winter2008(DJF)	BLSC	1556	60	25.93	681	681	0.05	0.4780	18.43	0.1869	y	0	0.001
Winter2010(DJF)	BLSC	737	40	18.43	386	386	0.05	0.3841	5.40	0.1869	y	0	0.001
Jan-08	SCAU	750	1	750.00	90	90	0.05	0.3181	1.33	0.187	y	0	0.001
Jan-09	SCAU	4617	32	144.28	3917	3917	0.05	0.3132	50.03	0.1869	y	0	0.001
Winter2008(DJF)	SCAU	750	1	750.00	143	143	0.05	0.3068	3.53	0.1869	y	0	0.001
Winter2009(DJF)	SCAU	4617	32	144.28	3917	3917	0.05	0.3132	50.03	0.1869	y	0	0.001
2009	SCAU	4617	32	144.28	3917	3917	0.05	0.3132	50.03	0.1869	y	0	0.001

Table E-8 (*continued*). Watson 1-sample U^2 non-parametric goodness-of-fit (GOF) test for a uniform circular distribution. Ho: The sample data came from a population with a uniform circular distribution. Ha: The sample data did NOT come from a population with a uniform circular distribution.

Time Period	Species	Abundance	#Observations	Cluster Size	n1	n2	CI Level	ubar	U2	U2crit	Reject Ho?	Plow	Phigh
Jan-08	LTDU	603	57	10.58	90	90	0.05	0.3181	1.33	0.187	y	0	0.001
Feb-08	LTDU	82	8	10.25	53	53	0.05	0.2877	3.11	0.187	y	0	0.001
Feb-09	LTDU	2483	265	9.37	697	697	0.05	0.4591	5.95	0.1869	y	0	0.001
Mar-09	LTDU	723	87	8.31	214	214	0.05	0.4591	1.58	0.1869	y	0	0.001
Dec-09	LTDU	441	72	6.13	187	187	0.05	0.4345	3.06	0.1869	y	0	0.001
Winter2008(DJF)	LTDU	685	65	10.54	143	143	0.05	0.3068	3.53	0.1869	y	0	0.001
Winter2009(DJF)	LTDU	4152	404	10.28	1055	1055	0.05	0.4608	6.02	0.1869	y	0	0.001
Winter2010(DJF)	LTDU	441	72	6.13	187	187	0.05	0.4345	3.06	0.1869	y	0	0.001
2009	LTDU	5195	563	9.23	1482	1482	0.05	0.4697	7.18	0.1869	y	0	0.001
Feb-08	COLO	97	62	1.56	2	2	0.05	0.5625	0.05	0.187	n	0.5	1
Feb-09	COLO	979	333	2.94	5	5	0.05	0.6000	0.14	0.225	n	0.2	0.5
May-09	COLO	617	352	1.75	62	62	0.05	0.1935	2.30	0.187	y	0	0.001
Mar-08	GULG	832	29	28.69	165	165	0.05	0.5121	4.38	0.1869	y	0	0.001
Jan-09	GULG	1991	17	117.12	26	26	0.05	0.6635	1.04	0.1852	y	0	0.001
Feb-09	GULG	1362	42	32.43	168	168	0.05	0.4241	4.28	0.1869	y	0	0.001
Sep-09	GULG	473	14	33.79	19	19	0.05	0.3487	0.35	0.1845	y	0.001	0.002
Oct-09	GULG	598	32	18.69	78	78	0.05	0.3590	1.40	0.187	y	0	0.001
Nov-09	GULG	875	21	41.67	430	430	0.05	0.4983	26.92	0.1869	y	0	0.001
Dec-09	GULG	472	16	29.50	31	31	0.05	0.5081	0.43	0.186	y	0	0.001
Winter2009(DJF)	GULG	3377	67	50.40	218	218	0.05	0.4817	3.19	0.1869	y	0	0.001
Autumn2009(ASON)	GULG	1989	72	27.63	529	529	0.05	0.4719	20.92	0.1869	y	0	0.001
Winter2010(DJF)	GULG	472	16	29.50	31	31	0.05	0.5081	0.43	0.186	y	0	0.001
2009	GULG	6129	204	30.04	1017	1017	0.05	0.5178	14.37	0.1869	y	0	0.001
Apr-08	SCOT	1607	50	32.14	1319	1319	0.05	0.1674	52.61	0.1869	y	0	0.001
Dec-08	SCOT	1328	8	166.00	1326	1326	0.05	0.5004	94.81	0.1869	y	0	0.001
Jan-09	SCOT	2811	33	85.18	450	450	0.05	0.2500	37.50	0.1869	y	0	0.001
Winter2009(DJF)	SCOT	4943	74	66.80	1785	1785	0.05	0.4354	73.56	0.1869	y	0	0.001
May-08	LAGU	712	237	3.00	603	603	0.05	0.4100	2.92	0.1869	y	0	0.001
Jun-08	LAGU	531	315	1.69	421	421	0.05	0.4555	0.65	0.1869	y	0	0.001
Jul-08	LAGU	673	415	1.62	589	589	0.05	0.4881	1.62	0.1869	y	0	0.001
Aug-08	LAGU	1349	473	2.85	994	994	0.05	0.3358	5.71	0.1869	y	0	0.001
Sep-08	LAGU	580	334	1.74	486	486	0.05	0.3832	2.46	0.1869	y	0	0.001
Oct-08	LAGU	1027	298	3.45	708	708	0.05	0.5332	5.99	0.1869	y	0	0.001
Nov-08	LAGU	1738	199	8.73	458	458	0.05	0.4438	2.96	0.1869	y	0	0.001
May-09	LAGU	215	151	1.42	193	193	0.05	0.3426	1.10	0.1869	y	0	0.001
Jun-09	LAGU	466	286	1.63	329	329	0.05	0.3967	0.81	0.1869	y	0	0.001
Aug-09	LAGU	767	375	2.05	537	537	0.05	0.4525	1.87	0.1869	y	0	0.001
Sep-09	LAGU	251	180	1.39	166	166	0.05	0.4096	0.41	0.1869	y	0.0003	0.0005
Oct-09	LAGU	1334	170	7.85	482	482	0.05	0.5000	3.39	0.1869	y	0	0.001
Summer2008(JJ)	LAGU	1204	730	1.65	1010	1010	0.05	0.4745	1.90	0.1869	y	0	0.001
Autumn2008(ASON)	LAGU	4694	1304	3.60	2646	2646	0.05	0.4160	8.19	0.1869	y	0	0.001
Summer2009(JJ)	LAGU	466	286	1.63	329	329	0.05	0.3967	0.81	0.1869	y	0	0.001

Table E-8 (*continued*). Watson 1-sample U^2 non-parametric goodness-of-fit (GOF) test for a uniform circular distribution. Ho: The sample data came from a population with a uniform circular distribution. Ha: The sample data did NOT come from a population with a uniform circular distribution.

Time Period	Species	Abundance	#Observations	Cluster Size	n1	n2	CI Level	ubar	U2	U2crit	Reject Ho?	Plow	Phigh
Autumn2009(ASON)	LAGU	2404	757	3.18	1235	1235	0.05	0.4665	2.17	0.1869	y	0	0.001
May-08	GBBG	341	189	1.80	185	185	0.05	0.4020	0.38	0.1869	y	0.001	0.002
Jun-08	GBBG	127	97	1.31	89	89	0.05	0.3357	0.65	0.187	y	0	0.001
Aug-08	GBBG	147	121	1.21	83	83	0.05	0.5783	0.84	0.187	y	0	0.001
Sep-08	GBBG	379	255	1.49	229	229	0.05	0.4427	0.48	0.1869	y	0	0.001
Jun-09	GBBG	146	119	1.23	127	127	0.05	0.3632	0.59	0.1869	y	0	0.001
Aug-09	GBBG	169	140	1.21	98	98	0.05	0.5676	0.65	0.187	y	0	0.001
Sep-09	GBBG	174	99	1.76	69	69	0.05	0.3822	0.29	0.187	y	0.005	0.01
Oct-09	GBBG	471	212	2.22	146	146	0.05	0.4769	0.34	0.1869	y	0.002	0.005
Summer2009(JJ)	GBBG	146	119	1.23	127	127	0.05	0.3632	0.59	0.1869	y	0	0.001
Jun-08	WISP	400	199	2.01	400	400	0.05	0.5388	6.57	0.1869	y	0	0.001
Jul-08	WISP	446	251	1.78	314	314	0.05	0.3977	1.19	0.1869	y	0	0.001
Aug-08	WISP	1251	175	7.15	1060	1060	0.05	0.1189	49.79	0.1869	y	0	0.001
Aug-09	WISP	374	321	1.17	368	368	0.05	0.4426	0.56	0.1869	y	0	0.001
Sep-09	WISP	281	247	1.14	266	266	0.05	0.4309	1.26	0.1869	y	0	0.001
Summer2008(JJ)	WISP	846	450	1.88	714	714	0.05	0.4767	4.26	0.1869	y	0	0.001
Jun-08	COTE	339	195	1.74	337	337	0.05	0.5427	1.38	0.1869	y	0	0.001
Jul-08	COTE	366	181	2.02	334	334	0.05	0.4663	1.96	0.1869	y	0	0.001
Aug-08	COTE	798	354	2.25	775	775	0.05	0.4603	3.94	0.1869	y	0	0.001
Sep-08	COTE	392	133	2.95	386	386	0.05	0.3802	1.97	0.1869	y	0	0.001
May-09	COTE	175	83	2.11	171	171	0.05	0.5351	0.93	0.1869	y	0	0.001
Jun-09	COTE	290	202	1.44	288	288	0.05	0.4566	0.70	0.1869	y	0	0.001
Aug-09	COTE	129	99	1.30	129	129	0.05	0.4932	0.40	0.1869	y	0.0003	0.0005
Summer2008(JJ)	COTE	705	376	1.88	671	671	0.05	0.5047	2.83	0.1869	y	0	0.001
Summer2009(JJ)	COTE	290	202	1.44	288	288	0.05	0.4566	0.70	0.1869	y	0	0.001
Jul-08	COSH	117	44	2.66	44	44	0.05	0.4233	0.27	0.1864	y	0.005	0.01
Aug-09	COSH	72	65	1.11	65	65	0.05	0.3885	0.49	0.187	y	0	0.001
Summer2008(JJ)	COSH	188	87	2.16	97	97	0.05	0.4446	0.32	0.187	y	0.002	0.005
Jul-08	TESM	72	11	6.55	72	72	0.05	0.4983	0.94	0.187	y	0	0.001
Aug-08	PASS	118	58	2.03	118	118	0.05	0.6631	4.48	0.1869	y	0	0.001
Sep-08	SHSM	200	3	66.67	200	200	0.05	0.6200	15.83	0.1869	y	0	0.001
Oct-08	SHSM	533	5	106.60	171	171	0.05	0.6323	13.22	0.1869	y	0	0.001
Oct-08	FOTE	688	81	8.49	593	593	0.05	0.5120	7.58	0.1869	y	0	0.001
Nov-08	CANG	2548	22	115.82	2548	2548	0.05	0.5994	163.95	0.1869	y	0	0.001
Autumn2008(ASON)	CANG	2637	26	101.42	2637	2637	0.05	0.6046	162.09	0.1869	y	0	0.001
Jan-09	GRSC	1568	9	174.22	68	68	0.05	0.4890	2.16	0.187	y	0	0.001

Table E-8 (*continued*). Watson 1-sample U^2 non-parametric goodness-of-fit (GOF) test for a uniform circular distribution. Ho: The sample data came from a population with a uniform circular distribution. Ha: The sample data did NOT come from a population with a uniform circular distribution.

Time Period	Species	Abundance	#Observations	Cluster Size	n1	n2	CI Level	ubar	U2	U2crit	Reject Ho?	Plow	Phigh
Nov-09	RTLO	892	259	3.44	799	799	0.05	0.5875	34.71	0.1869	y	0	0.001

Table E-9. Kolmogorov-Smirnov goodness-of-fit (GOF) test for continuous data: Testing for deviations from a UNIFORM distribution. Ho: The sample came from a population with a uniform distribution. Ha: The sample did NOT come from a population with a uniform distribution.

Time Period	Species	Abundance	#Observations	Cluster Size	Status	DF	CI Level	Dstat1	Dstat2	Dstat	Dcrit	Reject Ho?	Plow	Phigh
Overall	TOTAL	177266	35547	4.99	Final Corrected (K-S)	109794	0.05	0.1350	0.1350	0.1350	0.0041	y	0.005	0.01
Jan-08	TOTAL	6500	1212	5.36	Final Corrected (K-S)	2081	0.05	0.1675	0.1676	0.1675	0.0297	y	0	0.001
Feb-08	TOTAL	580	208	2.79	Final Corrected (K-S)	327	0.05	0.1895	0.1884	0.1895	0.0745	y	0	0.001
Mar-08	TOTAL	17569	3068	5.73	Final Corrected (K-S)	9139	0.05	0.2142	0.2142	0.2142	0.0142	y	0	0.001
Apr-08	TOTAL	15624	3362	4.65	Final Corrected (K-S)	10850	0.05	0.4635	0.4636	0.4635	0.0130	y	0	0.001
May-08	TOTAL	4446	1901	2.34	Final Corrected (K-S)	3527	0.05	0.2378	0.2377	0.2378	0.0228	y	0	0.001
Jun-08	TOTAL	1964	1198	1.64	Final Corrected (K-S)	1674	0.05	0.0668	0.0669	0.0669	0.0331	y	0.2	0.5
Jul-08	TOTAL	1957	1061	1.84	Final Corrected (K-S)	1591	0.05	0.0672	0.0667	0.0672	0.0339	y	0.2	0.5
Aug-08	TOTAL	4255	1457	2.92	Final Corrected (K-S)	3396	0.05	0.3689	0.3688	0.3689	0.0233	y	0	0.001
Sep-08	TOTAL	2612	1103	2.37	Final Corrected (K-S)	2196	0.05	0.1721	0.1718	0.1721	0.0289	y	0	0.001
Oct-08	TOTAL	11928	1729	6.90	Final Corrected (K-S)	9994	0.05	0.2583	0.2583	0.2583	0.0136	y	0	0.001
Nov-08	TOTAL	27018	2694	10.03	Final Corrected (K-S)	20358	0.05	0.2164	0.2164	0.2164	0.0095	y	0	0.001
Dec-08	TOTAL	9672	1150	8.41	Final Corrected (K-S)	6091	0.05	0.2104	0.2105	0.2104	0.0174	y	0	0.001
Jan-09	TOTAL	20306	1618	12.55	Final Corrected (K-S)	9332	0.05	0.2134	0.2135	0.2134	0.0140	y	0	0.001
Feb-09	TOTAL	10953	1919	5.71	Final Corrected (K-S)	3108	0.05	0.2052	0.2050	0.2052	0.0243	y	0	0.001
Mar-09	TOTAL	6494	2058	3.16	Final Corrected (K-S)	3193	0.05	0.2682	0.2682	0.2682	0.0240	y	0	0.001
Apr-09	TOTAL	6122	1038	5.90	Final Corrected (K-S)	5290	0.05	0.3911	0.3911	0.3911	0.0186	y	0	0.001
May-09	TOTAL	3052	1744	1.75	Final Corrected (K-S)	2071	0.05	0.1684	0.1683	0.1684	0.0298	y	0	0.001
Jun-09	TOTAL	1817	1309	1.39	Final Corrected (K-S)	1411	0.05	0.1727	0.1728	0.1727	0.0360	y	0	0.001
Aug-09	TOTAL	1885	1201	1.57	Final Corrected (K-S)	1500	0.05	0.0986	0.0981	0.0986	0.0349	y	0.05	0.1
Sep-09	TOTAL	1923	814	2.36	Final Corrected (K-S)	918	0.05	0.1861	0.1854	0.1861	0.0446	y	0	0.001
Oct-09	TOTAL	4065	619	6.57	Final Corrected (K-S)	2151	0.05	0.2038	0.2037	0.2038	0.0292	y	0	0.001
Nov-09	TOTAL	10757	1890	5.69	Final Corrected (K-S)	6539	0.05	0.1252	0.1251	0.1252	0.0168	y	0.01	0.02
Dec-09	TOTAL	5767	1194	4.83	Final Corrected (K-S)	3057	0.05	0.1568	0.1570	0.1570	0.0245	y	0.0003	0.0005
Winter2008(DJF)	TOTAL	7080	1420	4.99	Final Corrected (K-S)	2408	0.05	0.1576	0.1576	0.1576	0.0276	y	0.0003	0.0005
Spring2008(MAM)	TOTAL	37639	8331	4.52	Final Corrected (K-S)	23516	0.05	0.3107	0.3107	0.3107	0.0088	y	0	0.001
Summer2008(JJ)	TOTAL	3921	2259	1.74	Final Corrected (K-S)	3265	0.05	0.0585	0.0582	0.0585	0.0237	y	0.5	1
Autumn2008(ASON)	TOTAL	45813	6983	6.56	Final Corrected (K-S)	35944	0.05	0.1800	0.1800	0.1800	0.0072	y	0	0.001
Winter2009(DJF)	TOTAL	40931	4687	8.73	Final Corrected (K-S)	18531	0.05	0.1716	0.1716	0.1716	0.0100	y	0	0.001
Spring2009(MAM)	TOTAL	15668	4840	3.24	Final Corrected (K-S)	10554	0.05	0.3103	0.3103	0.3103	0.0132	y	0	0.001
Summer2009(JJ)	TOTAL	1817	1309	1.39	Final Corrected (K-S)	1411	0.05	0.1727	0.1728	0.1727	0.0360	y	0	0.001
Autumn2009(ASON)	TOTAL	18630	4524	4.12	Final Corrected (K-S)	11108	0.05	0.1348	0.1348	0.1348	0.0129	y	0.005	0.01
Winter2010(DJF)	TOTAL	5767	1194	4.83	Final Corrected (K-S)	3057	0.05	0.1568	0.1570	0.1570	0.0245	y	0.0003	0.0005
2008	TOTAL	104125	20143	5.17	Final Corrected (K-S)	71224	0.05	0.1240	0.1239	0.1240	0.0051	y	0.01	0.02
2009	TOTAL	73141	15404	4.75	Final Corrected (K-S)	38570	0.05	0.1985	0.1985	0.1985	0.0069	y	0	0.001
Overall	NOGA	34020	9822	3.46	Final Corrected (K-S)	22856	0.05	0.1328	0.1328	0.1328	0.0090	y	0.005	0.01
Jan-08	NOGA	898	482	1.86	Final Corrected (K-S)	693	0.05	0.2085	0.2085	0.2085	0.0513	y	0	0.001
Feb-08	NOGA	49	33	1.48	Final Corrected (K-S)	37	0.05	0.2820	0.2937	0.2937	0.2183	y	0.002	0.005
Mar-08	NOGA	4980	1351	3.69	Final Corrected (K-S)	3348	0.05	0.2454	0.2453	0.2454	0.0234	y	0	0.001
Apr-08	NOGA	3271	1409	2.32	Final Corrected (K-S)	2081	0.05	0.1396	0.1394	0.1396	0.0297	y	0.002	0.005
May-08	NOGA	858	582	1.47	Final Corrected (K-S)	703	0.05	0.1589	0.1587	0.1589	0.0509	y	0	0.001
Jun-08	NOGA	270	195	1.38	Final Corrected (K-S)	195	0.05	0.0867	0.0898	0.0898	0.0961	n	0.1	0.2
Oct-08	NOGA	1692	492	3.44	Final Corrected (K-S)	1380	0.05	0.2881	0.2886	0.2881	0.0364	y	0	0.001
Nov-08	NOGA	9402	1045	9.00	Final Corrected (K-S)	6037	0.05	0.1274	0.1275	0.1275	0.0174	y	0.005	0.01
Dec-08	NOGA	470	308	1.53	Final Corrected (K-S)	343	0.05	0.1142	0.1161	0.1161	0.0727	y	0.02	0.05

Table E-9 (*continued*). Kolmogorov-Smirnov goodness-of-fit (GOF) test for continuous data: Testing for deviations from a UNIFORM distribution. Ho: The sample came from a population with a uniform distribution. Ha: The sample did NOT come from a population with a uniform distribution.

Time Period	Species	Abundance	#Observations	Cluster Size	Status	DF	CI Level	Dstat1	Dstat2	Dstat	Dcrit	Reject Ho?	Plow	Phigh
Jan-09	NOGA	1849	417	4.43	Final Corrected (K-S)	1707	0.05	0.3220	0.3225	0.3220	0.0328	y	0	0.001
Mar-09	NOGA	840	468	1.79	Final Corrected (K-S)	604	0.05	0.2149	0.2139	0.2149	0.0549	y	0	0.001
Apr-09	NOGA	400	303	1.32	Final Corrected (K-S)	322	0.05	0.1358	0.1344	0.1358	0.0750	y	0.002	0.005
May-09	NOGA	1077	674	1.60	Final Corrected (K-S)	815	0.05	0.1353	0.1348	0.1353	0.0473	y	0.005	0.01
Jun-09	NOGA	431	343	1.26	Final Corrected (K-S)	237	0.05	0.2521	0.2536	0.2521	0.0873	y	0	0.001
Nov-09	NOGA	6394	981	6.52	Final Corrected (K-S)	3495	0.05	0.2341	0.2341	0.2341	0.0229	y	0	0.001
Dec-09	NOGA	628	331	1.90	Final Corrected (K-S)	482	0.05	0.2277	0.2290	0.2277	0.0614	y	0	0.001
Winter2008(DJF)	NOGA	947	515	1.84	Final Corrected (K-S)	730	0.05	0.2068	0.2067	0.2068	0.0500	y	0	0.001
Spring2008(MAM)	NOGA	9109	3342	2.73	Final Corrected (K-S)	6132	0.05	0.1887	0.1885	0.1887	0.0173	y	0	0.001
Summer2008(JJ)	NOGA	312	232	1.34	Final Corrected (K-S)	224	0.05	0.1079	0.1108	0.1108	0.0898	y	0.02	0.05
Autumn2008(ASON)	NOGA	11217	1631	6.88	Final Corrected (K-S)	7490	0.05	0.1347	0.1348	0.1348	0.0157	y	0.005	0.01
Spring2009(MAM)	NOGA	2317	1445	1.60	Final Corrected (K-S)	1741	0.05	0.1521	0.1517	0.1521	0.0324	y	0.001	0.002
Summer2009(JJ)	NOGA	431	343	1.26	Final Corrected (K-S)	237	0.05	0.2521	0.2536	0.2521	0.0873	y	0	0.001
Autumn2009(ASON)	NOGA	6474	1050	6.17	Final Corrected (K-S)	3547	0.05	0.2326	0.2325	0.2326	0.0228	y	0	0.001
Winter2010(DJF)	NOGA	628	331	1.90	Final Corrected (K-S)	482	0.05	0.2277	0.2290	0.2277	0.0614	y	0	0.001
2008	NOGA	22055	6028	3.66	Final Corrected (K-S)	14919	0.05	0.1357	0.1357	0.1357	0.0111	y	0.002	0.005
2009	NOGA	11965	3794	3.15	Final Corrected (K-S)	7937	0.05	0.1274	0.1273	0.1274	0.0152	y	0.01	0.02
Overall	SCDW	13933	364	38.28	Final Corrected (K-S)	11113	0.05	0.2064	0.2065	0.2064	0.0129	y	0	0.001
Mar-08	SCDW	1522	36	42.28	Final Corrected (K-S)	1509	0.05	0.2301	0.2307	0.2301	0.0348	y	0	0.001
Apr-08	SCDW	1885	69	27.32	Final Corrected (K-S)	1500	0.05	0.6643	0.6649	0.6643	0.0349	y	0	0.001
Nov-08	SCDW	2932	30	97.73	Final Corrected (K-S)	2932	0.05	0.2001	0.2004	0.2001	0.0250	y	0	0.001
Dec-08	SCDW	3025	21	144.05	Final Corrected (K-S)	1465	0.05	0.4224	0.4231	0.4224	0.0354	y	0	0.001
Apr-09	SCDW	1599	36	44.42	Final Corrected (K-S)	1569	0.05	0.2825	0.2832	0.2825	0.0342	y	0	0.001
Dec-09	SCDW	473	16	29.56	Final Corrected (K-S)	243	0.05	0.2734	0.2774	0.2734	0.0862	y	0	0.001
Spring2008(MAM)	SCDW	3407	105	32.45	Final Corrected (K-S)	3009	0.05	0.3817	0.3819	0.3817	0.0247	y	0	0.001
Autumn2008(ASON)	SCDW	3228	49	65.88	Final Corrected (K-S)	3228	0.05	0.1869	0.1872	0.1869	0.0238	y	0	0.001
Winter2009(DJF)	SCDW	4468	107	41.76	Final Corrected (K-S)	2476	0.05	0.2259	0.2261	0.2259	0.0272	y	0	0.001
Spring2009(MAM)	SCDW	1985	71	27.96	Final Corrected (K-S)	1791	0.05	0.2634	0.2639	0.2634	0.0320	y	0	0.001
Winter2010(DJF)	SCDW	473	16	29.56	Final Corrected (K-S)	243	0.05	0.2734	0.2774	0.2734	0.0862	y	0	0.001
2008	SCDW	9669	178	54.32	Final Corrected (K-S)	7705	0.05	0.2326	0.2328	0.2326	0.0154	y	0	0.001
Overall	HERG	13790	3474	3.97	Final Corrected (K-S)	4730	0.05	0.1351	0.1350	0.1351	0.0197	y	0.005	0.01
Jan-08	HERG	1158	129	8.98	Final Corrected (K-S)	206	0.05	0.1008	0.0997	0.1008	0.0936	y	0.05	0.1
Feb-08	HERG	61	41	1.49	Final Corrected (K-S)	60	0.05	0.1780	0.1816	0.1816	0.1723	y	0.02	0.05
Mar-08	HERG	3785	394	9.61	Final Corrected (K-S)	725	0.05	0.1637	0.1640	0.1637	0.0502	y	0	0.001
May-08	HERG	568	249	2.28	Final Corrected (K-S)	322	0.05	0.1734	0.1722	0.1734	0.0750	y	0	0.001
Feb-09	HERG	1710	325	5.26	Final Corrected (K-S)	377	0.05	0.2143	0.2128	0.2143	0.0694	y	0	0.001
Mar-09	HERG	1037	358	2.90	Final Corrected (K-S)	500	0.05	0.2472	0.2474	0.2472	0.0603	y	0	0.001
Apr-09	HERG	439	138	3.18	Final Corrected (K-S)	186	0.05	0.2368	0.2355	0.2368	0.0984	y	0	0.001
May-09	HERG	261	194	1.35	Final Corrected (K-S)	224	0.05	0.2756	0.2735	0.2756	0.0898	y	0	0.001
Jun-09	HERG	135	90	1.50	Final Corrected (K-S)	121	0.05	0.3689	0.3667	0.3689	0.1220	y	0	0.001
Sep-09	HERG	352	59	5.97	Final Corrected (K-S)	54	0.05	0.3481	0.3477	0.3481	0.1814	y	0	0.001
Oct-09	HERG	237	62	3.82	Final Corrected (K-S)	69	0.05	0.2714	0.2689	0.2714	0.1609	y	0	0.001
Nov-09	HERG	416	149	2.79	Final Corrected (K-S)	224	0.05	0.1905	0.1890	0.1905	0.0898	y	0	0.001
Winter2008(DJF)	HERG	1219	170	7.17	Final Corrected (K-S)	266	0.05	0.1182	0.1186	0.1186	0.0825	y	0.02	0.05

Table E-9 (*continued*). Kolmogorov-Smirnov goodness-of-fit (GOF) test for continuous data: Testing for deviations from a UNIFORM distribution. Ho: The sample came from a population with a uniform distribution. Ha: The sample did NOT come from a population with a uniform distribution.

Time Period	Species	Abundance	#Observations	Cluster Size	Status	DF	CI Level	Dstat1	Dstat2	Dstat	Dcrit	Reject Ho?	Plow	Phigh
Spring2008(MAM)	HERG	5024	1016	4.94	Final Corrected (K-S)	1483	0.05	0.1920	0.1922	0.1920	0.0351	y	0	0.001
Spring2009(MAM)	HERG	1737	690	2.52	Final Corrected (K-S)	910	0.05	0.2282	0.2279	0.2282	0.0448	y	0	0.001
Summer2009(JJ)	HERG	135	90	1.50	Final Corrected (K-S)	121	0.05	0.3689	0.3667	0.3689	0.1220	y	0	0.001
Autumn2009(ASON)	HERG	1032	290	3.56	Final Corrected (K-S)	368	0.05	0.2203	0.2195	0.2203	0.0702	y	0	0.001
2008	HERG	7991	1810	4.41	Final Corrected (K-S)	2520	0.05	0.1012	0.1008	0.1012	0.0270	y	0.05	0.1
2009	HERG	5799	1664	3.49	Final Corrected (K-S)	2210	0.05	0.2086	0.2084	0.2086	0.0288	y	0	0.001
Overall	SUSC	12463	709	17.58	Final Corrected (K-S)	6908	0.05	0.1999	0.1998	0.1999	0.0163	y	0	0.001
Mar-08	SUSC	2181	71	30.72	Final Corrected (K-S)	934	0.05	0.5273	0.5273	0.5273	0.0442	y	0	0.001
Apr-08	SUSC	3048	142	21.46	Final Corrected (K-S)	1328	0.05	0.5954	0.5960	0.5954	0.0371	y	0	0.001
Nov-08	SUSC	2348	52	45.15	Final Corrected (K-S)	2318	0.05	0.4662	0.4666	0.4662	0.0281	y	0	0.001
Dec-08	SUSC	1029	41	25.10	Final Corrected (K-S)	292	0.05	0.2618	0.2651	0.2618	0.0788	y	0	0.001
Feb-09	SUSC	1165	121	9.63	Final Corrected (K-S)	426	0.05	0.1733	0.1718	0.1733	0.0653	y	0	0.001
Mar-09	SUSC	664	84	7.90	Final Corrected (K-S)	246	0.05	0.4372	0.4367	0.4372	0.0857	y	0	0.001
Apr-09	SUSC	604	48	12.58	Final Corrected (K-S)	462	0.05	0.6301	0.6319	0.6301	0.0627	y	0	0.001
Nov-09	SUSC	435	16	27.19	Final Corrected (K-S)	435	0.05	0.3552	0.3571	0.3552	0.0647	y	0	0.001
Spring2008(MAM)	SUSC	5230	214	24.44	Final Corrected (K-S)	2263	0.05	0.5219	0.5220	0.5219	0.0285	y	0	0.001
Spring2009(MAM)	SUSC	1292	133	9.71	Final Corrected (K-S)	732	0.05	0.5424	0.5433	0.5424	0.0499	y	0	0.001
2008	SUSC	8828	336	26.27	Final Corrected (K-S)	5021	0.05	0.1819	0.1818	0.1819	0.0191	y	0	0.001
Overall	DCCO	10892	394	27.64	Final Corrected (K-S)	10730	0.05	0.2665	0.2665	0.2665	0.0131	y	0	0.001
Apr-08	DCCO	1846	64	28.84	Final Corrected (K-S)	1837	0.05	0.7326	0.7330	0.7326	0.0316	y	0	0.001
May-08	DCCO	717	63	11.38	Final Corrected (K-S)	665	0.05	0.6064	0.6071	0.6064	0.0524	y	0	0.001
Sep-08	DCCO	218	15	14.53	Final Corrected (K-S)	218	0.05	0.2531	0.2535	0.2531	0.0910	y	0	0.001
Oct-08	DCCO	4157	99	41.99	Final Corrected (K-S)	4154	0.05	0.4227	0.4229	0.4227	0.0210	y	0	0.001
Apr-09	DCCO	1869	60	31.15	Final Corrected (K-S)	1844	0.05	0.7758	0.7763	0.7758	0.0315	y	0	0.001
Oct-09	DCCO	931	19	49.00	Final Corrected (K-S)	927	0.05	0.3905	0.3906	0.3905	0.0444	y	0	0.001
Spring2008(MAM)	DCCO	2563	127	20.18	Final Corrected (K-S)	2502	0.05	0.6993	0.6996	0.6993	0.0271	y	0	0.001
Autumn2008(ASON)	DCCO	5268	130	40.52	Final Corrected (K-S)	5265	0.05	0.4330	0.4331	0.4330	0.0187	y	0	0.001
Spring2009(MAM)	DCCO	1972	83	23.76	Final Corrected (K-S)	1895	0.05	0.7701	0.7706	0.7701	0.0311	y	0	0.001
Autumn2009(ASON)	DCCO	1053	31	33.97	Final Corrected (K-S)	1039	0.05	0.3360	0.3359	0.3360	0.0420	y	0	0.001
2008	DCCO	7861	275	28.59	Final Corrected (K-S)	7790	0.05	0.1637	0.1637	0.1637	0.0154	y	0	0.001
Jan-08	BLSC	1369	51	26.84	Final Corrected (K-S)	589	0.05	0.3133	0.3146	0.3133	0.0556	y	0	0.001
Feb-08	BLSC	187	9	20.78	Final Corrected (K-S)	92	0.05	0.6421	0.6484	0.6421	0.1396	y	0	0.001
Dec-08	BLSC	1642	37	44.38	Final Corrected (K-S)	1344	0.05	0.2537	0.2544	0.2537	0.0369	y	0	0.001
Mar-09	BLSC	634	57	11.12	Final Corrected (K-S)	479	0.05	0.7583	0.7594	0.7583	0.0616	y	0	0.001
Dec-09	BLSC	737	40	18.43	Final Corrected (K-S)	386	0.05	0.2831	0.2857	0.2831	0.0686	y	0	0.001
Winter2008(DJF)	BLSC	1556	60	25.93	Final Corrected (K-S)	681	0.05	0.2461	0.2475	0.2461	0.0518	y	0	0.001
Winter2010(DJF)	BLSC	737	40	18.43	Final Corrected (K-S)	386	0.05	0.2831	0.2857	0.2831	0.0686	y	0	0.001
Jan-08	SCAU	750	1	750.00	Final Corrected (K-S)	90	0.05	0.4286	0.4334	0.4286	0.1412	y	0	0.001
Jan-09	SCAU	4617	32	144.28	Final Corrected (K-S)	3917	0.05	0.3936	0.3937	0.3936	0.0217	y	0	0.001
Winter2008(DJF)	SCAU	750	1	750.00	Final Corrected (K-S)	143	0.05	0.4921	0.4960	0.4921	0.1123	y	0	0.001
Winter2009(DJF)	SCAU	4617	32	144.28	Final Corrected (K-S)	3917	0.05	0.3936	0.3937	0.3936	0.0217	y	0	0.001
2009	SCAU	4617	32	144.28	Final Corrected (K-S)	3917	0.05	0.3936	0.3937	0.3936	0.0217	y	0	0.001

Table E-9 (*continued*). Kolmogorov-Smirnov goodness-of-fit (GOF) test for continuous data: Testing for deviations from a UNIFORM distribution. Ho: The sample came from a population with a uniform distribution. Ha: The sample did NOT come from a population with a uniform distribution.

Time Period	Species	Abundance	#Observations	Cluster Size	Status	DF	CI Level	Dstat1	Dstat2	Dstat	Dcrit	Reject Ho?	Plow	Phigh
Jan-08	LTDU	603	57	10.58	Final Corrected (K-S)	90	0.05	0.4286	0.4334	0.4286	0.1412	y	0	0.001
Feb-08	LTDU	82	8	10.25	Final Corrected (K-S)	53	0.05	0.5847	0.5989	0.5847	0.1831	y	0	0.001
Feb-09	LTDU	2483	265	9.37	Final Corrected (K-S)	697	0.05	0.2479	0.2471	0.2479	0.0512	y	0	0.001
Mar-09	LTDU	723	87	8.31	Final Corrected (K-S)	214	0.05	0.1781	0.1764	0.1781	0.0918	y	0	0.001
Dec-09	LTDU	441	72	6.13	Final Corrected (K-S)	187	0.05	0.2006	0.2051	0.2006	0.0981	y	0	0.001
Winter2008(DJF)	LTDU	685	65	10.54	Final Corrected (K-S)	143	0.05	0.4921	0.4960	0.4921	0.1123	y	0	0.001
Winter2009(DJF)	LTDU	4152	404	10.28	Final Corrected (K-S)	1055	0.05	0.2169	0.2163	0.2169	0.0416	y	0	0.001
Winter2010(DJF)	LTDU	441	72	6.13	Final Corrected (K-S)	187	0.05	0.2006	0.2051	0.2006	0.0981	y	0	0.001
2009	LTDU	5195	563	9.23	Final Corrected (K-S)	1482	0.05	0.1962	0.1958	0.1962	0.0352	y	0	0.001
Feb-08	COLO	97	62	1.56	Final Corrected (K-S)	2	0.05	0.3810	1.2857	1.2857	0.8419	y	0	0.001
Feb-09	COLO	979	333	2.94	Final Corrected (K-S)	5	0.05	0.4048	0.5714	0.5714	0.5633	y	0.02	0.05
May-09	COLO	617	352	1.75	Final Corrected (K-S)	62	0.05	0.5556	0.5667	0.5556	0.1696	y	0	0.001
Mar-08	GULG	832	29	28.69	Final Corrected (K-S)	165	0.05	0.3451	0.3449	0.3451	0.1044	y	0	0.001
Jan-09	GULG	1991	17	117.12	Final Corrected (K-S)	26	0.05	0.4286	0.4686	0.4286	0.2591	y	0	0.001
Feb-09	GULG	1362	42	32.43	Final Corrected (K-S)	168	0.05	0.3457	0.3507	0.3457	0.1034	y	0	0.001
Sep-09	GULG	473	14	33.79	Final Corrected (K-S)	19	0.05	0.3286	0.3730	0.3730	0.3014	y	0.005	0.01
Oct-09	GULG	598	32	18.69	Final Corrected (K-S)	78	0.05	0.3888	0.3896	0.3888	0.1515	y	0	0.001
Nov-09	GULG	875	21	41.67	Final Corrected (K-S)	430	0.05	0.3798	0.3820	0.3798	0.0650	y	0	0.001
Dec-09	GULG	472	16	29.50	Final Corrected (K-S)	31	0.05	0.2232	0.2524	0.2524	0.2379	y	0.02	0.05
Winter2009(DJF)	GULG	3377	67	50.40	Final Corrected (K-S)	218	0.05	0.2003	0.2028	0.2003	0.0910	y	0	0.001
Autumn2009(ASON)	GULG	1989	72	27.63	Final Corrected (K-S)	529	0.05	0.2852	0.2865	0.2852	0.0587	y	0	0.001
Winter2010(DJF)	GULG	472	16	29.50	Final Corrected (K-S)	31	0.05	0.2232	0.2524	0.2524	0.2379	y	0.02	0.05
2009	GULG	6129	204	30.04	Final Corrected (K-S)	1017	0.05	0.2134	0.2140	0.2134	0.0424	y	0	0.001
Apr-08	SCOT	1607	50	32.14	Final Corrected (K-S)	1319	0.05	0.5961	0.5967	0.5961	0.0373	y	0	0.001
Dec-08	SCOT	1328	8	166.00	Final Corrected (K-S)	1326	0.05	0.3962	0.3969	0.3962	0.0372	y	0	0.001
Jan-09	SCOT	2811	33	85.18	Final Corrected (K-S)	450	0.05	0.7121	0.7143	0.7121	0.0636	y	0	0.001
Winter2009(DJF)	SCOT	4943	74	66.80	Final Corrected (K-S)	1785	0.05	0.4045	0.4050	0.4045	0.0320	y	0	0.001
May-08	LAGU	712	237	3.00	Final Corrected (K-S)	603	0.05	0.1734	0.1728	0.1734	0.0550	y	0	0.001
Jun-08	LAGU	531	315	1.69	Final Corrected (K-S)	421	0.05	0.0988	0.0976	0.0988	0.0657	y	0.05	0.1
Jul-08	LAGU	673	415	1.62	Final Corrected (K-S)	589	0.05	0.0787	0.0782	0.0787	0.0556	y	0.2	0.5
Aug-08	LAGU	1349	473	2.85	Final Corrected (K-S)	994	0.05	0.3084	0.3083	0.3084	0.0429	y	0	0.001
Sep-08	LAGU	580	334	1.74	Final Corrected (K-S)	486	0.05	0.2514	0.2510	0.2514	0.0612	y	0	0.001
Oct-08	LAGU	1027	298	3.45	Final Corrected (K-S)	708	0.05	0.1624	0.1627	0.1624	0.0508	y	0	0.001
Nov-08	LAGU	1738	199	8.73	Final Corrected (K-S)	458	0.05	0.2767	0.2757	0.2767	0.0630	y	0	0.001
May-09	LAGU	215	151	1.42	Final Corrected (K-S)	193	0.05	0.3159	0.3155	0.3159	0.0966	y	0	0.001
Jun-09	LAGU	466	286	1.63	Final Corrected (K-S)	329	0.05	0.1896	0.1903	0.1896	0.0742	y	0	0.001
Aug-09	LAGU	767	375	2.05	Final Corrected (K-S)	537	0.05	0.1360	0.1351	0.1360	0.0582	y	0.002	0.005
Sep-09	LAGU	251	180	1.39	Final Corrected (K-S)	166	0.05	0.2216	0.2182	0.2216	0.1041	y	0	0.001
Oct-09	LAGU	1334	170	7.85	Final Corrected (K-S)	482	0.05	0.1325	0.1334	0.1334	0.0614	y	0.005	0.01
Summer2008(JJ)	LAGU	1204	730	1.65	Final Corrected (K-S)	1010	0.05	0.0722	0.0714	0.0722	0.0425	y	0.2	0.5
Autumn2008(ASON)	LAGU	4694	1304	3.60	Final Corrected (K-S)	2646	0.05	0.2024	0.2023	0.2024	0.0263	y	0	0.001
Summer2009(JJ)	LAGU	466	286	1.63	Final Corrected (K-S)	329	0.05	0.1896	0.1903	0.1896	0.0742	y	0	0.001

Table E-9 (*continued*). Kolmogorov-Smirnov goodness-of-fit (GOF) test for continuous data: Testing for deviations from a UNIFORM distribution. Ho: The sample came from a population with a uniform distribution. Ha: The sample did NOT come from a population with a uniform distribution.

Time Period	Species	Abundance	#Observations	Cluster Size	Status	DF	CI Level	Dstat1	Dstat2	Dstat	Dcrit	Reject Ho?	Plow	Phigh
Autumn2009(ASON)	LAGU	2404	757	3.18	Final Corrected (K-S)	1235	0.05	0.1063	0.1059	0.1063	0.0385	y	0.02	0.05
May-08	GBBG	341	189	1.80	Final Corrected (K-S)	185	0.05	0.1882	0.1848	0.1882	0.0987	y	0	0.001
Jun-08	GBBG	127	97	1.31	Final Corrected (K-S)	89	0.05	0.2492	0.2532	0.2492	0.1419	y	0	0.001
Aug-08	GBBG	147	121	1.21	Final Corrected (K-S)	83	0.05	0.2024	0.2091	0.2091	0.1469	y	0.001	0.002
Sep-08	GBBG	379	255	1.49	Final Corrected (K-S)	229	0.05	0.1391	0.1360	0.1391	0.0888	y	0.002	0.005
Jun-09	GBBG	146	119	1.23	Final Corrected (K-S)	127	0.05	0.2355	0.2381	0.2355	0.1191	y	0	0.001
Aug-09	GBBG	169	140	1.21	Final Corrected (K-S)	98	0.05	0.1775	0.1797	0.1797	0.1354	y	0.002	0.005
Sep-09	GBBG	174	99	1.76	Final Corrected (K-S)	69	0.05	0.2571	0.2542	0.2571	0.1609	y	0	0.001
Oct-09	GBBG	471	212	2.22	Final Corrected (K-S)	146	0.05	0.1224	0.1172	0.1224	0.1112	y	0.02	0.05
Summer2009(JJ)	GBBG	146	119	1.23	Final Corrected (K-S)	127	0.05	0.2355	0.2381	0.2355	0.1191	y	0	0.001
Jun-08	WISP	400	199	2.01	Final Corrected (K-S)	400	0.05	0.2241	0.2256	0.2241	0.0674	y	0	0.001
Jul-08	WISP	446	251	1.78	Final Corrected (K-S)	314	0.05	0.2000	0.2008	0.2000	0.0760	y	0	0.001
Aug-08	WISP	1251	175	7.15	Final Corrected (K-S)	1060	0.05	0.7785	0.7790	0.7785	0.0415	y	0	0.001
Aug-09	WISP	374	321	1.17	Final Corrected (K-S)	368	0.05	0.1382	0.1362	0.1382	0.0702	y	0.002	0.005
Sep-09	WISP	281	247	1.14	Final Corrected (K-S)	266	0.05	0.1407	0.1412	0.1412	0.0825	y	0.002	0.005
Summer2008(JJ)	WISP	846	450	1.88	Final Corrected (K-S)	714	0.05	0.1125	0.1130	0.1130	0.0506	y	0.02	0.05
Jun-08	COTE	339	195	1.74	Final Corrected (K-S)	337	0.05	0.0934	0.0952	0.0952	0.0734	y	0.1	0.2
Jul-08	COTE	366	181	2.02	Final Corrected (K-S)	334	0.05	0.1267	0.1270	0.1270	0.0737	y	0.01	0.02
Aug-08	COTE	798	354	2.25	Final Corrected (K-S)	775	0.05	0.1430	0.1421	0.1430	0.0485	y	0.002	0.005
Sep-08	COTE	392	133	2.95	Final Corrected (K-S)	386	0.05	0.2765	0.2753	0.2765	0.0686	y	0	0.001
May-09	COTE	175	83	2.11	Final Corrected (K-S)	171	0.05	0.1088	0.1109	0.1109	0.1026	y	0.02	0.05
Jun-09	COTE	290	202	1.44	Final Corrected (K-S)	288	0.05	0.1142	0.1115	0.1142	0.0793	y	0.02	0.05
Aug-09	COTE	129	99	1.30	Final Corrected (K-S)	129	0.05	0.1077	0.1016	0.1077	0.1182	n	0.05	0.1
Summer2008(JJ)	COTE	705	376	1.88	Final Corrected (K-S)	671	0.05	0.0759	0.0768	0.0768	0.0521	y	0.2	0.5
Summer2009(JJ)	COTE	290	202	1.44	Final Corrected (K-S)	288	0.05	0.1142	0.1115	0.1142	0.0793	y	0.02	0.05
Jul-08	COSH	117	44	2.66	Final Corrected (K-S)	44	0.05	0.2159	0.2226	0.2226	0.2006	y	0.02	0.05
Aug-09	COSH	72	65	1.11	Final Corrected (K-S)	65	0.05	0.2165	0.2254	0.2254	0.1657	y	0.002	0.005
Summer2008(JJ)	COSH	188	87	2.16	Final Corrected (K-S)	97	0.05	0.1429	0.1443	0.1443	0.1361	y	0.02	0.05
Jul-08	TESM	72	11	6.55	Final Corrected (K-S)	72	0.05	0.1957	0.2032	0.2032	0.1575	y	0.002	0.005
Aug-08	PASS	118	58	2.03	Final Corrected (K-S)	118	0.05	0.4454	0.4493	0.4454	0.1235	y	0	0.001
Sep-08	SHSM	200	3	66.67	Final Corrected (K-S)	200	0.05	0.5316	0.5363	0.5316	0.0949	y	0	0.001
Oct-08	SHSM	533	5	106.60	Final Corrected (K-S)	171	0.05	0.5714	0.5773	0.5714	0.1026	y	0	0.001
Oct-08	FOTE	688	81	8.49	Final Corrected (K-S)	593	0.05	0.1325	0.1337	0.1337	0.0554	y	0.005	0.01
Nov-08	CANG	2548	22	115.82	Final Corrected (K-S)	2548	0.05	0.4286	0.4290	0.4286	0.0268	y	0	0.001
Autumn2008(ASON)	CANG	2637	26	101.42	Final Corrected (K-S)	2637	0.05	0.4286	0.4290	0.4286	0.0264	y	0	0.001
Jan-09	GRSC	1568	9	174.22	Final Corrected (K-S)	68	0.05	0.2712	0.2857	0.2712	0.1620	y	0	0.001

Table E-9 (*continued*). Kolmogorov-Smirnov goodness-of-fit (GOF) test for continuous data: Testing for deviations from a UNIFORM distribution. Ho: The sample came from a population with a uniform distribution. Ha: The sample did NOT come from a population with a uniform distribution.

Time Period	Species	Abundance	#Observations	Cluster Size	Status	DF	CI Level	Dstat1	Dstat2	Dstat	Dcrit	Reject Ho?	Plow	Phigh
Nov-09	RTLO	892	259	3.44	Final Corrected (K-S)	799	0.05	0.3961	0.3972	0.3961	0.0478	y	0	0.001

Table E-10. Kuiper goodness-of-fit (GOF) test for continuous data: Testing for deviations from a UNIFORM distribution. Ho: The sample came from a population with a uniform distribution. Ha: The sample did NOT come from a population with a uniform distribution.

Time Period	Species	Abundance	#Observations	Cluster Size	Status	DF	CI Level	Dstat1	Dstat2	Dstat	Dcrit	Reject Ho?	Plow	Phigh
Overall	TOTAL	177266	35547	4.99	Final Corrected (Kuiper)	109794	0.05	0.1350	0.1350	0.1350	0.0041	y	0.005	0.01
Jan-08	TOTAL	6500	1212	5.36	Final Corrected (Kuiper)	2081	0.05	0.1680	0.1676	0.1680	0.0297	y	0	0.001
Feb-08	TOTAL	580	208	2.79	Final Corrected (Kuiper)	327	0.05	0.2909	0.2892	0.2909	0.0745	y	0	0.001
Mar-08	TOTAL	17569	3068	5.73	Final Corrected (Kuiper)	9139	0.05	0.2143	0.2142	0.2143	0.0142	y	0	0.001
Apr-08	TOTAL	15624	3362	4.65	Final Corrected (Kuiper)	10850	0.05	0.4636	0.4636	0.4636	0.0130	y	0	0.001
May-08	TOTAL	4446	1901	2.34	Final Corrected (Kuiper)	3527	0.05	0.2381	0.2377	0.2381	0.0228	y	0	0.001
Jun-08	TOTAL	1964	1198	1.64	Final Corrected (Kuiper)	1674	0.05	0.0832	0.0837	0.0837	0.0331	y	0.2	0.5
Jul-08	TOTAL	1957	1061	1.84	Final Corrected (Kuiper)	1591	0.05	0.0678	0.0667	0.0678	0.0339	y	0.2	0.5
Aug-08	TOTAL	4255	1457	2.92	Final Corrected (Kuiper)	3396	0.05	0.3691	0.3688	0.3691	0.0233	y	0	0.001
Sep-08	TOTAL	2612	1103	2.37	Final Corrected (Kuiper)	2196	0.05	0.1725	0.1718	0.1725	0.0289	y	0	0.001
Oct-08	TOTAL	11928	1729	6.90	Final Corrected (Kuiper)	9994	0.05	0.3428	0.3428	0.3428	0.0136	y	0	0.001
Nov-08	TOTAL	27018	2694	10.03	Final Corrected (Kuiper)	20358	0.05	0.3545	0.3546	0.3546	0.0095	y	0	0.001
Dec-08	TOTAL	9672	1150	8.41	Final Corrected (Kuiper)	6091	0.05	0.4089	0.4090	0.4090	0.0174	y	0	0.001
Jan-09	TOTAL	20306	1618	12.55	Final Corrected (Kuiper)	9332	0.05	0.2135	0.2135	0.2135	0.0140	y	0	0.001
Feb-09	TOTAL	10953	1919	5.71	Final Corrected (Kuiper)	3108	0.05	0.2157	0.2154	0.2157	0.0243	y	0	0.001
Mar-09	TOTAL	6494	2058	3.16	Final Corrected (Kuiper)	3193	0.05	0.2685	0.2682	0.2685	0.0240	y	0	0.001
Apr-09	TOTAL	6122	1038	5.90	Final Corrected (Kuiper)	5290	0.05	0.3913	0.3911	0.3913	0.0186	y	0	0.001
May-09	TOTAL	3052	1744	1.75	Final Corrected (Kuiper)	2071	0.05	0.1906	0.1901	0.1906	0.0298	y	0	0.001
Jun-09	TOTAL	1817	1309	1.39	Final Corrected (Kuiper)	1411	0.05	0.1734	0.1728	0.1734	0.0360	y	0	0.001
Aug-09	TOTAL	1885	1201	1.57	Final Corrected (Kuiper)	1500	0.05	0.1489	0.1480	0.1489	0.0349	y	0.001	0.002
Sep-09	TOTAL	1923	814	2.36	Final Corrected (Kuiper)	918	0.05	0.1872	0.1854	0.1872	0.0446	y	0	0.001
Oct-09	TOTAL	4065	619	6.57	Final Corrected (Kuiper)	2151	0.05	0.2436	0.2435	0.2436	0.0292	y	0	0.001
Nov-09	TOTAL	10757	1890	5.69	Final Corrected (Kuiper)	6539	0.05	0.2292	0.2291	0.2292	0.0168	y	0	0.001
Dec-09	TOTAL	5767	1194	4.83	Final Corrected (Kuiper)	3057	0.05	0.2791	0.2790	0.2791	0.0245	y	0	0.001
Winter2008(DJF)	TOTAL	7080	1420	4.99	Final Corrected (Kuiper)	2408	0.05	0.1580	0.1576	0.1580	0.0276	y	0.0003	0.0005
Spring2008(MAM)	TOTAL	37639	8331	4.52	Final Corrected (Kuiper)	23516	0.05	0.3108	0.3107	0.3108	0.0088	y	0	0.001
Summer2008(JJ)	TOTAL	3921	2259	1.74	Final Corrected (Kuiper)	3265	0.05	0.0588	0.0582	0.0588	0.0237	y	0.5	1
Autumn2008(ASON)	TOTAL	45813	6983	6.56	Final Corrected (Kuiper)	35944	0.05	0.2765	0.2765	0.2765	0.0072	y	0	0.001
Winter2009(DJF)	TOTAL	40931	4687	8.73	Final Corrected (Kuiper)	18531	0.05	0.1908	0.1908	0.1908	0.0100	y	0	0.001
Spring2009(MAM)	TOTAL	15668	4840	3.24	Final Corrected (Kuiper)	10554	0.05	0.3104	0.3103	0.3104	0.0132	y	0	0.001
Summer2009(JJ)	TOTAL	1817	1309	1.39	Final Corrected (Kuiper)	1411	0.05	0.1734	0.1728	0.1734	0.0360	y	0	0.001
Autumn2009(ASON)	TOTAL	18630	4524	4.12	Final Corrected (Kuiper)	11108	0.05	0.1856	0.1856	0.1856	0.0129	y	0	0.001
Winter2010(DJF)	TOTAL	5767	1194	4.83	Final Corrected (Kuiper)	3057	0.05	0.2791	0.2790	0.2791	0.0245	y	0	0.001
2008	TOTAL	104125	20143	5.17	Final Corrected (Kuiper)	71224	0.05	0.1378	0.1378	0.1378	0.0051	y	0.002	0.005
2009	TOTAL	73141	15404	4.75	Final Corrected (Kuiper)	38570	0.05	0.1985	0.1985	0.1985	0.0069	y	0	0.001
Overall	NOGA	34020	9822	3.46	Final Corrected (Kuiper)	22856	0.05	0.1329	0.1328	0.1329	0.0090	y	0.005	0.01
Jan-08	NOGA	898	482	1.86	Final Corrected (Kuiper)	693	0.05	0.2100	0.2085	0.2100	0.0513	y	0	0.001
Feb-08	NOGA	49	33	1.48	Final Corrected (Kuiper)	37	0.05	0.3195	0.3532	0.3532	0.2183	y	0	0.001
Mar-08	NOGA	4980	1351	3.69	Final Corrected (Kuiper)	3348	0.05	0.2457	0.2453	0.2457	0.0234	y	0	0.001
Apr-08	NOGA	3271	1409	2.32	Final Corrected (Kuiper)	2081	0.05	0.2258	0.2253	0.2258	0.0297	y	0	0.001
May-08	NOGA	858	582	1.47	Final Corrected (Kuiper)	703	0.05	0.1822	0.1811	0.1822	0.0509	y	0	0.001
Jun-08	NOGA	270	195	1.38	Final Corrected (Kuiper)	195	0.05	0.1020	0.1090	0.1090	0.0961	y	0.02	0.05
Oct-08	NOGA	1692	492	3.44	Final Corrected (Kuiper)	1380	0.05	0.3491	0.3503	0.3503	0.0364	y	0	0.001
Nov-08	NOGA	9402	1045	9.00	Final Corrected (Kuiper)	6037	0.05	0.2489	0.2491	0.2491	0.0174	y	0	0.001
Dec-08	NOGA	470	308	1.53	Final Corrected (Kuiper)	343	0.05	0.1171	0.1161	0.1171	0.0727	y	0.02	0.05

Table E-10 (*continued*). Kuiper goodness-of-fit (GOF) test for continuous data: Testing for deviations from a UNIFORM distribution. Ho: The sample came from a population with a uniform distribution. Ha: The sample did NOT come from a population with a uniform distribution.

Time Period	Species	Abundance	#Observations	Cluster Size	Status	DF	CI Level	Dstat1	Dstat2	Dstat	Dcrit	Reject Ho?	Plow	Phigh
Jan-09	NOGA	1849	417	4.43	Final Corrected (Kuiper)	1707	0.05	0.6130	0.6139	0.6139	0.0328	y	0	0.001
Mar-09	NOGA	840	468	1.79	Final Corrected (Kuiper)	604	0.05	0.2165	0.2139	0.2165	0.0549	y	0	0.001
Apr-09	NOGA	400	303	1.32	Final Corrected (Kuiper)	322	0.05	0.1539	0.1504	0.1539	0.0750	y	0.0005	0.001
May-09	NOGA	1077	674	1.60	Final Corrected (Kuiper)	815	0.05	0.1444	0.1430	0.1444	0.0473	y	0.002	0.005
Jun-09	NOGA	431	343	1.26	Final Corrected (Kuiper)	237	0.05	0.2563	0.2536	0.2563	0.0873	y	0	0.001
Nov-09	NOGA	6394	981	6.52	Final Corrected (Kuiper)	3495	0.05	0.2955	0.2953	0.2955	0.0229	y	0	0.001
Dec-09	NOGA	628	331	1.90	Final Corrected (Kuiper)	482	0.05	0.3437	0.3469	0.3469	0.0614	y	0	0.001
Winter2008(DJF)	NOGA	947	515	1.84	Final Corrected (Kuiper)	730	0.05	0.2081	0.2067	0.2081	0.0500	y	0	0.001
Spring2008(MAM)	NOGA	9109	3342	2.73	Final Corrected (Kuiper)	6132	0.05	0.1942	0.1940	0.1942	0.0173	y	0	0.001
Summer2008(JJ)	NOGA	312	232	1.34	Final Corrected (Kuiper)	224	0.05	0.1124	0.1108	0.1124	0.0898	y	0.02	0.05
Autumn2008(ASON)	NOGA	11217	1631	6.88	Final Corrected (Kuiper)	7490	0.05	0.2449	0.2451	0.2451	0.0157	y	0	0.001
Spring2009(MAM)	NOGA	2317	1445	1.60	Final Corrected (Kuiper)	1741	0.05	0.1534	0.1525	0.1534	0.0324	y	0.0005	0.001
Summer2009(JJ)	NOGA	431	343	1.26	Final Corrected (Kuiper)	237	0.05	0.2563	0.2536	0.2563	0.0873	y	0	0.001
Autumn2009(ASON)	NOGA	6474	1050	6.17	Final Corrected (Kuiper)	3547	0.05	0.2918	0.2916	0.2918	0.0228	y	0	0.001
Winter2010(DJF)	NOGA	628	331	1.90	Final Corrected (Kuiper)	482	0.05	0.3437	0.3469	0.3469	0.0614	y	0	0.001
2008	NOGA	22055	6028	3.66	Final Corrected (Kuiper)	14919	0.05	0.1358	0.1357	0.1358	0.0111	y	0.002	0.005
2009	NOGA	11965	3794	3.15	Final Corrected (Kuiper)	7937	0.05	0.1614	0.1613	0.1614	0.0152	y	0	0.001
Overall	SCDW	13933	364	38.28	Final Corrected (Kuiper)	11113	0.05	0.2065	0.2065	0.2065	0.0129	y	0	0.001
Mar-08	SCDW	1522	36	42.28	Final Corrected (Kuiper)	1509	0.05	0.3734	0.3745	0.3745	0.0348	y	0	0.001
Apr-08	SCDW	1885	69	27.32	Final Corrected (Kuiper)	1500	0.05	0.6650	0.6649	0.6650	0.0349	y	0	0.001
Nov-08	SCDW	2932	30	97.73	Final Corrected (Kuiper)	2932	0.05	0.3832	0.3836	0.3836	0.0250	y	0	0.001
Dec-08	SCDW	3025	21	144.05	Final Corrected (Kuiper)	1465	0.05	0.7323	0.7335	0.7335	0.0354	y	0	0.001
Apr-09	SCDW	1599	36	44.42	Final Corrected (Kuiper)	1569	0.05	0.2893	0.2902	0.2902	0.0342	y	0	0.001
Dec-09	SCDW	473	16	29.56	Final Corrected (Kuiper)	243	0.05	0.4479	0.4540	0.4540	0.0862	y	0	0.001
Spring2008(MAM)	SCDW	3407	105	32.45	Final Corrected (Kuiper)	3009	0.05	0.3821	0.3819	0.3821	0.0247	y	0	0.001
Autumn2008(ASON)	SCDW	3228	49	65.88	Final Corrected (Kuiper)	3228	0.05	0.3719	0.3722	0.3722	0.0238	y	0	0.001
Winter2009(DJF)	SCDW	4468	107	41.76	Final Corrected (Kuiper)	2476	0.05	0.4486	0.4491	0.4491	0.0272	y	0	0.001
Spring2009(MAM)	SCDW	1985	71	27.96	Final Corrected (Kuiper)	1791	0.05	0.2773	0.2781	0.2781	0.0320	y	0	0.001
Winter2010(DJF)	SCDW	473	16	29.56	Final Corrected (Kuiper)	243	0.05	0.4479	0.4540	0.4540	0.0862	y	0	0.001
2008	SCDW	9669	178	54.32	Final Corrected (Kuiper)	7705	0.05	0.2328	0.2328	0.2328	0.0154	y	0	0.001
Overall	HERG	13790	3474	3.97	Final Corrected (Kuiper)	4730	0.05	0.1404	0.1402	0.1404	0.0197	y	0.002	0.005
Jan-08	HERG	1158	129	8.98	Final Corrected (Kuiper)	206	0.05	0.1988	0.1979	0.1988	0.0936	y	0	0.001
Feb-08	HERG	61	41	1.49	Final Corrected (Kuiper)	60	0.05	0.2529	0.2518	0.2529	0.1723	y	0.0005	0.001
Mar-08	HERG	3785	394	9.61	Final Corrected (Kuiper)	725	0.05	0.2233	0.2228	0.2233	0.0502	y	0	0.001
May-08	HERG	568	249	2.28	Final Corrected (Kuiper)	322	0.05	0.1977	0.1945	0.1977	0.0750	y	0	0.001
Feb-09	HERG	1710	325	5.26	Final Corrected (Kuiper)	377	0.05	0.2169	0.2128	0.2169	0.0694	y	0	0.001
Mar-09	HERG	1037	358	2.90	Final Corrected (Kuiper)	500	0.05	0.2492	0.2474	0.2492	0.0603	y	0	0.001
Apr-09	HERG	439	138	3.18	Final Corrected (Kuiper)	186	0.05	0.2666	0.2633	0.2666	0.0984	y	0	0.001
May-09	HERG	261	194	1.35	Final Corrected (Kuiper)	224	0.05	0.2800	0.2742	0.2800	0.0898	y	0	0.001
Jun-09	HERG	135	90	1.50	Final Corrected (Kuiper)	121	0.05	0.3770	0.3667	0.3770	0.1220	y	0	0.001
Sep-09	HERG	352	59	5.97	Final Corrected (Kuiper)	54	0.05	0.3662	0.3477	0.3662	0.1814	y	0	0.001
Oct-09	HERG	237	62	3.82	Final Corrected (Kuiper)	69	0.05	0.3143	0.3025	0.3143	0.1609	y	0	0.001
Nov-09	HERG	416	149	2.79	Final Corrected (Kuiper)	224	0.05	0.1949	0.1890	0.1949	0.0898	y	0	0.001
Winter2008(DJF)	HERG	1219	170	7.17	Final Corrected (Kuiper)	266	0.05	0.2108	0.2102	0.2108	0.0825	y	0	0.001

Table E-10 (*continued*). Kuiper goodness-of-fit (GOF) test for continuous data: Testing for deviations from a UNIFORM distribution. Ho: The sample came from a population with a uniform distribution. Ha: The sample did NOT come from a population with a uniform distribution.

Time Period	Species	Abundance	#Observations	Cluster Size	Status	DF	CI Level	Dstat1	Dstat2	Dstat	Dcrit	Reject Ho?	Plow	Phigh
Spring2008(MAM)	HERG	5024	1016	4.94	Final Corrected (Kuiper)	1483	0.05	0.2102	0.2099	0.2102	0.0351	y	0	0.001
Spring2009(MAM)	HERG	1737	690	2.52	Final Corrected (Kuiper)	910	0.05	0.2293	0.2279	0.2293	0.0448	y	0	0.001
Summer2009(JJ)	HERG	135	90	1.50	Final Corrected (Kuiper)	121	0.05	0.3770	0.3667	0.3770	0.1220	y	0	0.001
Autumn2009(ASON)	HERG	1032	290	3.56	Final Corrected (Kuiper)	368	0.05	0.2230	0.2195	0.2230	0.0702	y	0	0.001
2008	HERG	7991	1810	4.41	Final Corrected (Kuiper)	2520	0.05	0.1384	0.1378	0.1384	0.0270	y	0.002	0.005
2009	HERG	5799	1664	3.49	Final Corrected (Kuiper)	2210	0.05	0.2090	0.2084	0.2090	0.0288	y	0	0.001
Overall	SUSC	12463	709	17.58	Final Corrected (Kuiper)	6908	0.05	0.2508	0.2508	0.2508	0.0163	y	0	0.001
Mar-08	SUSC	2181	71	30.72	Final Corrected (Kuiper)	934	0.05	0.5283	0.5273	0.5283	0.0442	y	0	0.001
Apr-08	SUSC	3048	142	21.46	Final Corrected (Kuiper)	1328	0.05	0.5962	0.5960	0.5962	0.0371	y	0	0.001
Nov-08	SUSC	2348	52	45.15	Final Corrected (Kuiper)	2318	0.05	0.6415	0.6422	0.6422	0.0281	y	0	0.001
Dec-08	SUSC	1029	41	25.10	Final Corrected (Kuiper)	292	0.05	0.2652	0.2651	0.2652	0.0788	y	0	0.001
Feb-09	SUSC	1165	121	9.63	Final Corrected (Kuiper)	426	0.05	0.3185	0.3173	0.3185	0.0653	y	0	0.001
Mar-09	SUSC	664	84	7.90	Final Corrected (Kuiper)	246	0.05	0.4413	0.4367	0.4413	0.0857	y	0	0.001
Apr-09	SUSC	604	48	12.58	Final Corrected (Kuiper)	462	0.05	0.6322	0.6319	0.6322	0.0627	y	0	0.001
Nov-09	SUSC	435	16	27.19	Final Corrected (Kuiper)	435	0.05	0.4957	0.5000	0.5000	0.0647	y	0	0.001
Spring2008(MAM)	SUSC	5230	214	24.44	Final Corrected (Kuiper)	2263	0.05	0.5223	0.5220	0.5223	0.0285	y	0	0.001
Spring2009(MAM)	SUSC	1292	133	9.71	Final Corrected (Kuiper)	732	0.05	0.5438	0.5433	0.5438	0.0499	y	0	0.001
2008	SUSC	8828	336	26.27	Final Corrected (Kuiper)	5021	0.05	0.2916	0.2915	0.2916	0.0191	y	0	0.001
Overall	DCCO	10892	394	27.64	Final Corrected (Kuiper)	10730	0.05	0.3192	0.3191	0.3192	0.0131	y	0	0.001
Apr-08	DCCO	1846	64	28.84	Final Corrected (Kuiper)	1837	0.05	0.7331	0.7330	0.7331	0.0316	y	0	0.001
May-08	DCCO	717	63	11.38	Final Corrected (Kuiper)	665	0.05	0.6079	0.6071	0.6079	0.0524	y	0	0.001
Sep-08	DCCO	218	15	14.53	Final Corrected (Kuiper)	218	0.05	0.3914	0.3963	0.3963	0.0910	y	0	0.001
Oct-08	DCCO	4157	99	41.99	Final Corrected (Kuiper)	4154	0.05	0.5210	0.5214	0.5214	0.0210	y	0	0.001
Apr-09	DCCO	1869	60	31.15	Final Corrected (Kuiper)	1844	0.05	0.7764	0.7763	0.7764	0.0315	y	0	0.001
Oct-09	DCCO	931	19	49.00	Final Corrected (Kuiper)	927	0.05	0.4275	0.4275	0.4275	0.0444	y	0	0.001
Spring2008(MAM)	DCCO	2563	127	20.18	Final Corrected (Kuiper)	2502	0.05	0.6997	0.6996	0.6997	0.0271	y	0	0.001
Autumn2008(ASON)	DCCO	5268	130	40.52	Final Corrected (Kuiper)	5265	0.05	0.5322	0.5325	0.5325	0.0187	y	0	0.001
Spring2009(MAM)	DCCO	1972	83	23.76	Final Corrected (Kuiper)	1895	0.05	0.7706	0.7706	0.7706	0.0311	y	0	0.001
Autumn2009(ASON)	DCCO	1053	31	33.97	Final Corrected (Kuiper)	1039	0.05	0.4151	0.4151	0.4151	0.0420	y	0	0.001
2008	DCCO	7861	275	28.59	Final Corrected (Kuiper)	7790	0.05	0.3188	0.3188	0.3188	0.0154	y	0	0.001
Jan-08	BLSC	1369	51	26.84	Final Corrected (Kuiper)	589	0.05	0.5533	0.5561	0.5561	0.0556	y	0	0.001
Feb-08	BLSC	187	9	20.78	Final Corrected (Kuiper)	92	0.05	0.6421	0.6484	0.6484	0.1396	y	0	0.001
Dec-08	BLSC	1642	37	44.38	Final Corrected (Kuiper)	1344	0.05	0.4398	0.4411	0.4411	0.0369	y	0	0.001
Mar-09	BLSC	634	57	11.12	Final Corrected (Kuiper)	479	0.05	0.7604	0.7594	0.7604	0.0616	y	0	0.001
Dec-09	BLSC	737	40	18.43	Final Corrected (Kuiper)	386	0.05	0.3499	0.3532	0.3532	0.0686	y	0	0.001
Winter2008(DJF)	BLSC	1556	60	25.93	Final Corrected (Kuiper)	681	0.05	0.4694	0.4716	0.4716	0.0518	y	0	0.001
Winter2010(DJF)	BLSC	737	40	18.43	Final Corrected (Kuiper)	386	0.05	0.3499	0.3532	0.3532	0.0686	y	0	0.001
Jan-08	SCAU	750	1	750.00	Final Corrected (Kuiper)	90	0.05	0.4396	0.4334	0.4396	0.1412	y	0	0.001
Jan-09	SCAU	4617	32	144.28	Final Corrected (Kuiper)	3917	0.05	0.3939	0.3937	0.3939	0.0217	y	0	0.001
Winter2008(DJF)	SCAU	750	1	750.00	Final Corrected (Kuiper)	143	0.05	0.4990	0.4960	0.4990	0.1123	y	0	0.001
Winter2009(DJF)	SCAU	4617	32	144.28	Final Corrected (Kuiper)	3917	0.05	0.3939	0.3937	0.3939	0.0217	y	0	0.001
2009	SCAU	4617	32	144.28	Final Corrected (Kuiper)	3917	0.05	0.3939	0.3937	0.3939	0.0217	y	0	0.001

Table E-10 (*continued*). Kuiper goodness-of-fit (GOF) test for continuous data: Testing for deviations from a UNIFORM distribution. Ho: The sample came from a population with a uniform distribution. Ha: The sample did NOT come from a population with a uniform distribution.

Time Period	Species	Abundance	#Observations	Cluster Size	Status	DF	CI Level	Dstat1	Dstat2	Dstat	Dcrit	Reject Ho?	Plow	Phigh
Jan-08	LTDU	603	57	10.58	Final Corrected (Kuiper)	90	0.05	0.4396	0.4334	0.4396	0.1412	y	0	0.001
Feb-08	LTDU	82	8	10.25	Final Corrected (Kuiper)	53	0.05	0.6905	0.7225	0.7225	0.1831	y	0	0.001
Feb-09	LTDU	2483	265	9.37	Final Corrected (Kuiper)	697	0.05	0.3819	0.3810	0.3819	0.0512	y	0	0.001
Mar-09	LTDU	723	87	8.31	Final Corrected (Kuiper)	214	0.05	0.3216	0.3206	0.3216	0.0918	y	0	0.001
Dec-09	LTDU	441	72	6.13	Final Corrected (Kuiper)	187	0.05	0.3685	0.3756	0.3756	0.0981	y	0	0.001
Winter2008(DJF)	LTDU	685	65	10.54	Final Corrected (Kuiper)	143	0.05	0.4990	0.4960	0.4990	0.1123	y	0	0.001
Winter2009(DJF)	LTDU	4152	404	10.28	Final Corrected (Kuiper)	1055	0.05	0.3052	0.3044	0.3052	0.0416	y	0	0.001
Winter2010(DJF)	LTDU	441	72	6.13	Final Corrected (Kuiper)	187	0.05	0.3685	0.3756	0.3756	0.0981	y	0	0.001
2009	LTDU	5195	563	9.23	Final Corrected (Kuiper)	1482	0.05	0.2585	0.2581	0.2585	0.0352	y	0	0.001
Feb-08	COLO	97	62	1.56	Final Corrected (Kuiper)	2	0.05	0.3810	1.4286	1.4286	0.8419	y	0	0.001
Feb-09	COLO	979	333	2.94	Final Corrected (Kuiper)	5	0.05	0.4048	0.7143	0.7143	0.5633	y	0.002	0.005
May-09	COLO	617	352	1.75	Final Corrected (Kuiper)	62	0.05	0.5714	0.5667	0.5714	0.1696	y	0	0.001
Mar-08	GULG	832	29	28.69	Final Corrected (Kuiper)	165	0.05	0.6162	0.6132	0.6162	0.1044	y	0	0.001
Jan-09	GULG	1991	17	117.12	Final Corrected (Kuiper)	26	0.05	0.5344	0.6114	0.6114	0.2591	y	0	0.001
Feb-09	GULG	1362	42	32.43	Final Corrected (Kuiper)	168	0.05	0.4252	0.4320	0.4320	0.1034	y	0	0.001
Sep-09	GULG	473	14	33.79	Final Corrected (Kuiper)	19	0.05	0.4071	0.4683	0.4683	0.3014	y	0	0.001
Oct-09	GULG	598	32	18.69	Final Corrected (Kuiper)	78	0.05	0.4014	0.4026	0.4026	0.1515	y	0	0.001
Nov-09	GULG	875	21	41.67	Final Corrected (Kuiper)	430	0.05	0.6901	0.6940	0.6940	0.0650	y	0	0.001
Dec-09	GULG	472	16	29.50	Final Corrected (Kuiper)	31	0.05	0.2946	0.3238	0.3238	0.2379	y	0.002	0.005
Winter2009(DJF)	GULG	3377	67	50.40	Final Corrected (Kuiper)	218	0.05	0.3320	0.3364	0.3364	0.0910	y	0	0.001
Autumn2009(ASON)	GULG	1989	72	27.63	Final Corrected (Kuiper)	529	0.05	0.5571	0.5598	0.5598	0.0587	y	0	0.001
Winter2010(DJF)	GULG	472	16	29.50	Final Corrected (Kuiper)	31	0.05	0.2946	0.3238	0.3238	0.2379	y	0.002	0.005
2009	GULG	6129	204	30.04	Final Corrected (Kuiper)	1017	0.05	0.3404	0.3414	0.3414	0.0424	y	0	0.001
Apr-08	SCOT	1607	50	32.14	Final Corrected (Kuiper)	1319	0.05	0.5969	0.5967	0.5969	0.0373	y	0	0.001
Dec-08	SCOT	1328	8	166.00	Final Corrected (Kuiper)	1326	0.05	0.7645	0.7658	0.7658	0.0372	y	0	0.001
Jan-09	SCOT	2811	33	85.18	Final Corrected (Kuiper)	450	0.05	0.8549	0.8594	0.8594	0.0636	y	0	0.001
Winter2009(DJF)	SCOT	4943	74	66.80	Final Corrected (Kuiper)	1785	0.05	0.5429	0.5440	0.5440	0.0320	y	0	0.001
May-08	LAGU	712	237	3.00	Final Corrected (Kuiper)	603	0.05	0.1947	0.1944	0.1947	0.0550	y	0	0.001
Jun-08	LAGU	531	315	1.69	Final Corrected (Kuiper)	421	0.05	0.1012	0.0976	0.1012	0.0657	y	0.05	0.1
Jul-08	LAGU	673	415	1.62	Final Corrected (Kuiper)	589	0.05	0.1516	0.1497	0.1516	0.0556	y	0.001	0.002
Aug-08	LAGU	1349	473	2.85	Final Corrected (Kuiper)	994	0.05	0.3094	0.3083	0.3094	0.0429	y	0	0.001
Sep-08	LAGU	580	334	1.74	Final Corrected (Kuiper)	486	0.05	0.2810	0.2792	0.2810	0.0612	y	0	0.001
Oct-08	LAGU	1027	298	3.45	Final Corrected (Kuiper)	708	0.05	0.2837	0.2829	0.2837	0.0508	y	0	0.001
Nov-08	LAGU	1738	199	8.73	Final Corrected (Kuiper)	458	0.05	0.3495	0.3473	0.3495	0.0630	y	0	0.001
May-09	LAGU	215	151	1.42	Final Corrected (Kuiper)	193	0.05	0.3211	0.3155	0.3211	0.0966	y	0	0.001
Jun-09	LAGU	466	286	1.63	Final Corrected (Kuiper)	329	0.05	0.1926	0.1903	0.1926	0.0742	y	0	0.001
Aug-09	LAGU	767	375	2.05	Final Corrected (Kuiper)	537	0.05	0.2106	0.2087	0.2106	0.0582	y	0	0.001
Sep-09	LAGU	251	180	1.39	Final Corrected (Kuiper)	166	0.05	0.2275	0.2182	0.2275	0.1041	y	0	0.001
Oct-09	LAGU	1334	170	7.85	Final Corrected (Kuiper)	482	0.05	0.2050	0.2070	0.2070	0.0614	y	0	0.001
Summer2008(JJ)	LAGU	1204	730	1.65	Final Corrected (Kuiper)	1010	0.05	0.1070	0.1058	0.1070	0.0425	y	0.02	0.05
Autumn2008(ASON)	LAGU	4694	1304	3.60	Final Corrected (Kuiper)	2646	0.05	0.2054	0.2050	0.2054	0.0263	y	0	0.001
Summer2009(JJ)	LAGU	466	286	1.63	Final Corrected (Kuiper)	329	0.05	0.1926	0.1903	0.1926	0.0742	y	0	0.001

Table E-10 (*continued*). Kuiper goodness-of-fit (GOF) test for continuous data: Testing for deviations from a UNIFORM distribution. Ho: The sample came from a population with a uniform distribution. Ha: The sample did NOT come from a population with a uniform distribution.

Time Period	Species	Abundance	#Observations	Cluster Size	Status	DF	CI Level	Dstat1	Dstat2	Dstat	Dcrit	Reject Ho?	Plow	Phigh
Autumn2009(ASON)	LAGU	2404	757	3.18	Final Corrected (Kuiper)	1235	0.05	0.1156	0.1146	0.1156	0.0385	y	0.02	0.05
May-08	GBBG	341	189	1.80	Final Corrected (Kuiper)	185	0.05	0.1935	0.1848	0.1935	0.0987	y	0	0.001
Jun-08	GBBG	127	97	1.31	Final Corrected (Kuiper)	89	0.05	0.2603	0.2532	0.2603	0.1419	y	0	0.001
Aug-08	GBBG	147	121	1.21	Final Corrected (Kuiper)	83	0.05	0.2500	0.2456	0.2500	0.1469	y	0	0.001
Sep-08	GBBG	379	255	1.49	Final Corrected (Kuiper)	229	0.05	0.1435	0.1360	0.1435	0.0888	y	0.002	0.005
Jun-09	GBBG	146	119	1.23	Final Corrected (Kuiper)	127	0.05	0.2433	0.2381	0.2433	0.1191	y	0	0.001
Aug-09	GBBG	169	140	1.21	Final Corrected (Kuiper)	98	0.05	0.1977	0.1900	0.1977	0.1354	y	0.0005	0.001
Sep-09	GBBG	174	99	1.76	Final Corrected (Kuiper)	69	0.05	0.2714	0.2542	0.2714	0.1609	y	0	0.001
Oct-09	GBBG	471	212	2.22	Final Corrected (Kuiper)	146	0.05	0.1769	0.1695	0.1769	0.1112	y	0	0.001
Summer2009(JJ)	GBBG	146	119	1.23	Final Corrected (Kuiper)	127	0.05	0.2433	0.2381	0.2433	0.1191	y	0	0.001
Jun-08	WISP	400	199	2.01	Final Corrected (Kuiper)	400	0.05	0.3459	0.3484	0.3484	0.0674	y	0	0.001
Jul-08	WISP	446	251	1.78	Final Corrected (Kuiper)	314	0.05	0.2032	0.2008	0.2032	0.0760	y	0	0.001
Aug-08	WISP	1251	175	7.15	Final Corrected (Kuiper)	1060	0.05	0.7795	0.7790	0.7795	0.0415	y	0	0.001
Aug-09	WISP	374	321	1.17	Final Corrected (Kuiper)	368	0.05	0.1409	0.1362	0.1409	0.0702	y	0.002	0.005
Sep-09	WISP	281	247	1.14	Final Corrected (Kuiper)	266	0.05	0.1445	0.1412	0.1445	0.0825	y	0.002	0.005
Summer2008(JJ)	WISP	846	450	1.88	Final Corrected (Kuiper)	714	0.05	0.1548	0.1561	0.1561	0.0506	y	0.0005	0.001
Jun-08	COTE	339	195	1.74	Final Corrected (Kuiper)	337	0.05	0.1171	0.1161	0.1171	0.0734	y	0.02	0.05
Jul-08	COTE	366	181	2.02	Final Corrected (Kuiper)	334	0.05	0.1855	0.1875	0.1875	0.0737	y	0	0.001
Aug-08	COTE	798	354	2.25	Final Corrected (Kuiper)	775	0.05	0.2005	0.1999	0.2005	0.0485	y	0	0.001
Sep-08	COTE	392	133	2.95	Final Corrected (Kuiper)	386	0.05	0.2835	0.2805	0.2835	0.0686	y	0	0.001
May-09	COTE	175	83	2.11	Final Corrected (Kuiper)	171	0.05	0.1495	0.1462	0.1495	0.1026	y	0.001	0.002
Jun-09	COTE	290	202	1.44	Final Corrected (Kuiper)	288	0.05	0.1478	0.1429	0.1478	0.0793	y	0.001	0.002
Aug-09	COTE	129	99	1.30	Final Corrected (Kuiper)	129	0.05	0.1571	0.1529	0.1571	0.1182	y	0.002	0.005
Summer2008(JJ)	COTE	705	376	1.88	Final Corrected (Kuiper)	671	0.05	0.1146	0.1158	0.1158	0.0521	y	0.02	0.05
Summer2009(JJ)	COTE	290	202	1.44	Final Corrected (Kuiper)	288	0.05	0.1478	0.1429	0.1478	0.0793	y	0.001	0.002
Jul-08	COSH	117	44	2.66	Final Corrected (Kuiper)	44	0.05	0.2381	0.2226	0.2381	0.2006	y	0.01	0.02
Aug-09	COSH	72	65	1.11	Final Corrected (Kuiper)	65	0.05	0.2316	0.2254	0.2316	0.1657	y	0.001	0.002
Summer2008(JJ)	COSH	188	87	2.16	Final Corrected (Kuiper)	97	0.05	0.2041	0.1994	0.2041	0.1361	y	0	0.001
Jul-08	TESM	72	11	6.55	Final Corrected (Kuiper)	72	0.05	0.3033	0.3199	0.3199	0.1575	y	0	0.001
Aug-08	PASS	118	58	2.03	Final Corrected (Kuiper)	118	0.05	0.6134	0.6117	0.6134	0.1235	y	0	0.001
Sep-08	SHSM	200	3	66.67	Final Corrected (Kuiper)	200	0.05	0.8124	0.8220	0.8220	0.0949	y	0	0.001
Oct-08	SHSM	533	5	106.60	Final Corrected (Kuiper)	171	0.05	0.7932	0.8042	0.8042	0.1026	y	0	0.001
Oct-08	FOTE	688	81	8.49	Final Corrected (Kuiper)	593	0.05	0.2383	0.2411	0.2411	0.0554	y	0	0.001
Nov-08	CANG	2548	22	115.82	Final Corrected (Kuiper)	2548	0.05	0.7068	0.7076	0.7076	0.0268	y	0	0.001
Autumn2008(ASON)	CANG	2637	26	101.42	Final Corrected (Kuiper)	2637	0.05	0.6745	0.6752	0.6752	0.0264	y	0	0.001
Jan-09	GRSC	1568	9	174.22	Final Corrected (Kuiper)	68	0.05	0.5383	0.5586	0.5586	0.1620	y	0	0.001

Table E-10 (*continued*). Kuiper goodness-of-fit (GOF) test for continuous data: Testing for deviations from a UNIFORM distribution. Ho: The sample came from a population with a uniform distribution. Ha: The sample did NOT come from a population with a uniform distribution.

Time Period	Species	Abundance	#Observations	Cluster Size	Status	DF	CI Level	Dstat1	Dstat2	Dstat	Dcrit	Reject Ho?	Plow	Phigh
Nov-09	RTLO	892	259	3.44	Final Corrected (Kuiper)	799	0.05	0.5680	0.5702	0.5702	0.0478	y	0	0.001

APPENDIX F

SPECIES ACCOUNTS

References to tables and figures included outside Appendix F can be found in the avian section of the main body of the report (**Volume II: Chapters 2.0, 4.0,** and **8.0**) and in **Appendix C**.

In these accounts, “abundance” and “density” are considered to be different aspects of numbers. The former is an unmodified index of abundance, being presented as the number of birds detected per kilometer of transect per unit time (study, season, month). “Density” is modeled abundance incorporating functions of detection, which vary across species, weather conditions, sea-surface conditions, and observers, among many other possible variables (see **Volume II: Section 8.1**). For maps illustrating monthly distribution and abundance, that month’s trackline is overlaid on the study area, for seasonal, annual, or overall maps, they are not. Thus, it is not possible to determine whether a zero block had no birds or was simply not surveyed.

This appendix is provided in order to summarize details of occurrence – on three scales – and of general ecology of 15 of the commonest species or species groups detected during the study: scaup, scoters, Long-tailed Duck, Red-throated Loon, Common Loon, Cory’s Shearwater, Wilson’s Storm-Petrel, Northern Gannet, Whimbrel, Laughing Gull, Herring Gull, Great Black-backed Gull, Common Tern, Forster’s Tern, and Razorbill. These 15 species/groups account for >89.6% of all birds detected during the course of the project. Just over 87 percent of all birds are represented by a subset of these 15 species/groups that excludes Cory’s Shearwater, Whimbrel, Forster’s Tern, and Razorbill. This set of 11 species/groups accounts for all but three of the species for which at least 1000 individuals were recorded.

The potential rotor-swept zone (hereafter RSZ) is mentioned in a few species accounts. The RSZ is the zone extending from 30.5 m (101 ft) above sea level (ASL) to 213.4 m (700 ft) ASL.

The 15 accounts are presented in taxonomic order:

- Scaup
- Scoters
- Long-tailed Duck
- Red-throated Loon
- Common Loon
- Cory’s Shearwater
- Wilson’s Storm-Petrel
- Northern Gannet
- Whimbrel
- Laughing Gull
- Herring Gull
- Great Black-backed Gull
- Common Tern
- Forster’s Tern
- Razorbill

Species Account for Scaup (*Aythya*) Species

Greater Scaup (*Aythya marila*)
Lesser Scaup (*Aythya affinis*)

Overall Distribution and Ecology

Greater Scaup is the only species of pochard (Tribe Aythyini) with a holarctic distribution. In North America, the species breeds on shallow, vegetated lakes from Alaska to Quebec, in disjunct breeding populations in central and northern Quebec and Labrador, and from James Bay west to interior Alaska (Kessel et al. 2002).

Lesser Scaup is endemic to North America as a breeder and has a more southerly breeding range than does Greater Scaup. Its nesting habitat is primarily on vegetated ponds and lakes in and near boreal forest. Breeding Lesser Scaup range from most of interior Alaska and Canada, west of Labrador, south into the lower 48 states, mainly in North Dakota, Montana, and Wyoming (Austin et al. 1998).

Scaup migration is carried out overland and, to a lesser degree, oversea, and migrating and wintering flocks are segregated largely by sex and age. Greater Scaup depart their breeding grounds from mid-September through late October. Most of the nearctic populations winter to the east of the Mississippi River, including the Great Lakes, and, to a lesser extent on the west coast, tending to be much more numerous in the northern parts of their range. In winter, Greater Scaup often choose bays with fine sand sediments to feed on bivalves and snails (Kessel et al. 2002). Lesser Scaup depart breeding grounds in mid- to late September, although, overall, have earlier occurring fall and spring movements than Greater Scaup. Lesser Scaup have a much greater affinity for freshwater habitats (e.g., lakes, reservoirs, ponds) and their core winter range begins and extends further south than Greater Scaup (Austin et al. 1998). Like many waterfowl, during migration and wintering periods, scaup respond to changes in weather and the freezing of water bodies with facultative movements (Kessel et al. 2002).

New Jersey Occurrence

In the Atlantic Region, >70% of Greater Scaup are thought to winter in the "Long Island Sound Region," which stretches from south of Cape Cod, Massachusetts, to Sandy Hook, New Jersey. Regional Greater Scaup abundance is much lower south of this region, including farther south along the New Jersey coast. By March, Greater Scaup start returning north. Small numbers can be found in New Jersey (mostly first-year birds) in most years into early June (Kessel et al. 2002).

In New Jersey, Lesser Scaup are rarely found in the large, rafting, wintering flocks characteristic of Greater Scaup in the state and the region. Both species may be found in a large variety of aquatic and marine habitats and often occur together (Walsh et al. 1999). In New Jersey's coastal and brackish water habitats, Greater Scaup always outnumbers Lesser Scaup, and usually, this ratio is large.

Summary of Occurrence during the Study

In the northern coastal region of New Jersey, numbers of Greater Scaup can be substantial while numbers of Lesser Scaup are lower unless coastal bays and inland, freshwater habitats freeze. Analysis showed that the majority of scaup were recorded near inlets in the southern half of the study area. **Figure F-1** depicts the distribution of scaup in January 2009. This month's data represented the majority of scaup recorded during the study. The occurrence of scaup flocks at the ocean shoreline of the study area, as supported by the patchy survey data, is not predictable without taking weather patterns into consideration. Very cold weather in the region immediately prior to the January 2009 coastal survey froze freshwater habitats and coastal bays forcing large numbers of scaup to open coastal water.

Scaup abundance (number of birds per km^2) varied greatly during the study while only occurring during five months of surveys. High abundance values of 1.98 and 6.65 birds/km (**Section 2.3.3.3: Table 2-3**) were recorded on the occasions that large flocks of scaup were encountered.

Scaup were the group of birds to occur in greatest abundance (1.091 individuals) within the RSZ. Additionally, 29% of all flying scaup recorded were in the RSZ, the third highest percentage for any group (**Section 2.3.4: Table 2-8**); however, the majority of scaup recorded in the RSZ occurred when bays and inland water bodies froze.

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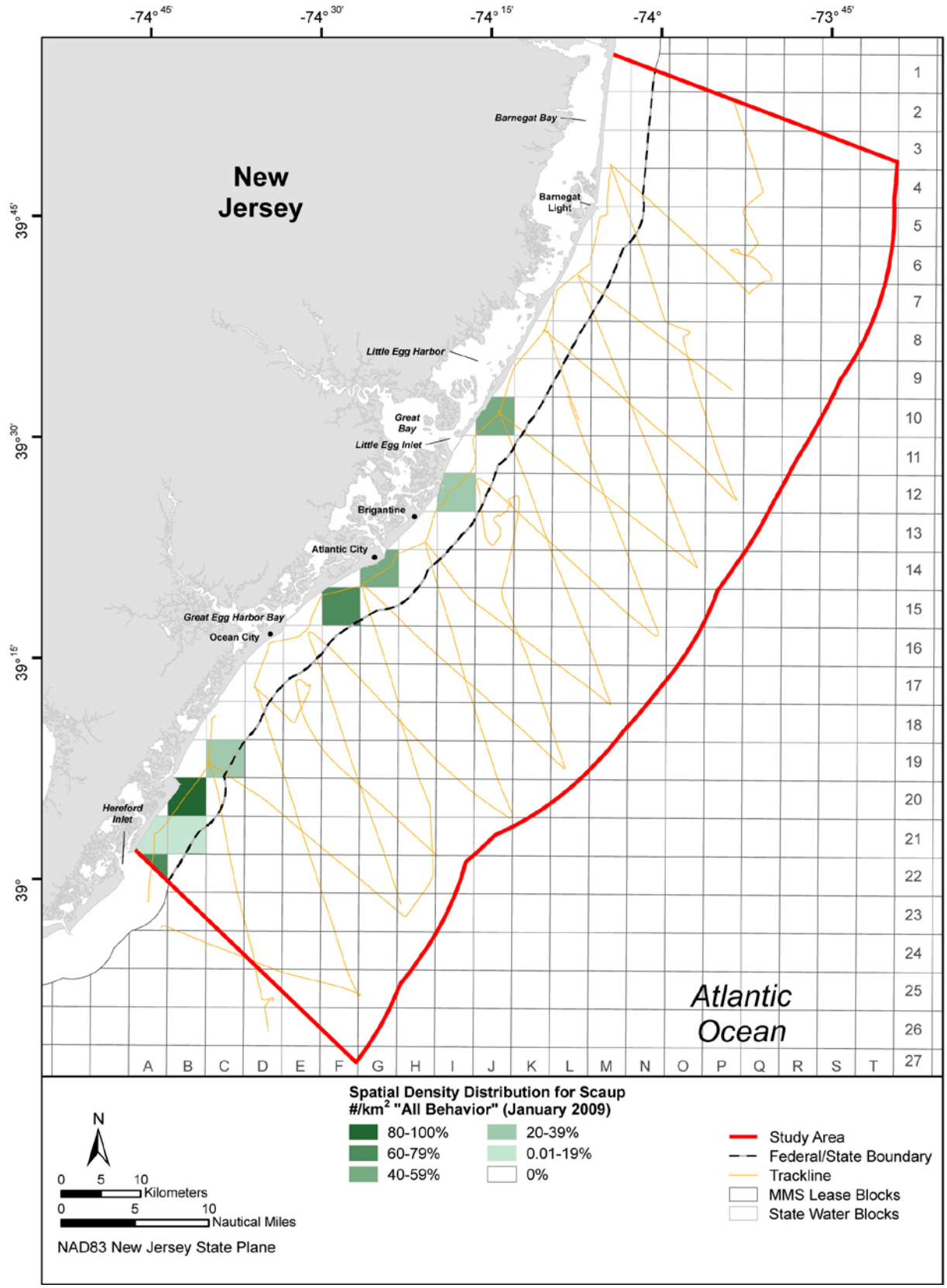

Figure F-1. Percentile abundance of scaup (all behaviors), January 2009 (n=2,469).

Species Account for Scoter (*Melanitta*) Species

Surf Scoter (*Melanitta perspicillata*)
White-winged Scoter (*Melanitta fusca*)
Black Scoter (*Melanitta nigra*)

Overall Distribution and Ecology

Black Scoter

Black Scoter is a holarctic breeder comprised of two subspecies: North American *M. nigra americana*, and Eurasian *M. nigra nigra* (called Common Scoter; Bordage et al. 1995). North America supports two disjunct populations, in western Alaska and northern Quebec, respectively, breeding primarily on small lakes (Bordage et al. 1995). In winter, Black Scoters dive from the water's surface for mollusks in shallow coastal waters and over undersea ledges (Bordage et al. 1995).

Molt migration is a prominent feature of the Black Scoter annual cycle. This is carried out primarily between late June and late August, with males preceding the incubating females, and occurring most prominently in James and Hudson bays in the eastern North American population (Bordage et al. 1995). Birds initiate their southward movement in September through mid-October with the largest numbers seen in Northumberland Strait, eastern Canada, during the second week of October (Mackinnon et al. 1991). Large numbers travel down the eastern coast of the U.S. from late September through late December. Wintering occurs in limited numbers on Lake Erie and Ontario, rarely on the Gulf Coast, and in greatest density in the coastal waters of the Canadian Maritimes down to Florida. Large bays such as Delaware and Chesapeake Bays serve as important winter feeding areas due to their large mollusk populations. Northward movement begins in mid-February and continues through early June, with adults preceding immatures (Bordage et al. 1995).

Surf Scoter

Surf Scoter is endemic to North America, breeding from western Alaska through central Labrador on small lakes. Breeding densities and numbers of Surf Scoters are difficult to ascertain due to the vast breeding range, sparse coverage by observers and aerial surveys, and secretive habits of the incubating and brooding females (Savard et al. 1998). The same problems exist for assessing Black Scoter populations, except for the species' much smaller breeding range. Migration to the wintering areas on both coasts of the U.S. occurs primarily over the ocean. Nocturnal and overland components of migration are poorly understood for all scoters. Winter foraging occurs in shallow coastal waters, with a preference for sandy and rocky tidal and subtidal microhabitats, which relates to a diet of mollusks such as blue mussels (*Mytilus edulis*) and clams.

Post-breeding dispersal and subsequent molt migration is known to occur but is poorly studied for Surf Scoters (Savard et al. 1998), occurring from late June to late August. Surf Scoter southward movements occur from September through late December and the species begins northward movements by mid-February and continues to move up the Atlantic coast, and to an unknown extent, overland, through June (Savard et al. 1998).

White-winged Scoter

White-winged Scoter is holarctic in distribution. The European and west Asian nominate race, called Velvet Scoter, is considered by some to be distinct at the species level from North American *deglandi* and east Siberian *stejnegeri*. The North American population, extending from Alaska through much of Canada west of Quebec, is relatively well-studied. The species nests on freshwater lakes and wetlands and makes surface dives throughout the year to catch food, just as the other scoters (Brown et al. 1997).

Movements of White-winged Scoter follow the same basic framework of the other two scoters, except that they tend to have more-protracted and later-occurring migration periods. The species is also significantly less abundant than the other two in wintering areas of the contiguous United States (Brown et al. 1997).

New Jersey Occurrence

In New Jersey, scoters are present as migrant and wintering species from mid-September through early June. Most birds lingering later into spring (May and June) are immatures. Similar to other areas of the Atlantic Coast, White-winged Scoters arrive later in fall and depart earlier in spring.

Summary of Occurrence during Study

A large percentage of scoters were not identified to species, as it can be difficult to separate these dark winged scoter species (Black scoter, Surf Scoter) in the large, multi-species flocks in which they are typically found in the state. Thus, the following analyses are presented at the generic level.

The overall (cumulative) abundance (number of birds per km^2) and distribution of scoters during the study are presented in **Figure F-2 [overall]**. Differences in occurrence and abundance in the more-offshore regions of the study area were clearly defined from fall 2008 through spring 2009 (**Figures F-3 [fall08]**, through [winter09] **F-5 [spring09]**). Scoters were encountered offshore during migration seasons to a much larger degree than in the winter; these birds were probably migrating, not foraging locally in those areas. Analyses of the group's distribution in spring 2008 (**Figure F-6 [spring08]**) and spring 2009 (**Figure F-5 [2nd ref to spring09]**) confirms this offshore trend of migrating scoters. In winter 2009, a season during which these species should be relatively sedentary, scoters showed a strong coastal affinity (**Figure F-4 [2nd ref to winter09]**. Additional support for this contention is provided by comparing the distribution of all scoters recorded as sitting (thus, either loafing or foraging; **F-7 [sitting overall]**) versus that of all behaviors (thus, including flying birds; **Figure F-2 [2nd ref to overall]**): distribution of the latter was shifted somewhat offshore from that of the former.

Scoters were found in considerable abundance throughout the study area in all seasons except summer (**Section 2.2.3.3: Tables 2-3** through **2-6**). White-winged Scoter is, by far, the least abundant of the trio of species and its totals do not make the "top-10" (**Section 2.2.3.3: Tables 2-3** through **2-6**) in any of the seasons of the study. Surf and Black Scoters, however, are focal duck species from fall through spring in the study area.

Scoters tend to fly at relatively low altitudes and were noted within the RSZ in fairly minimal numbers (<2%).

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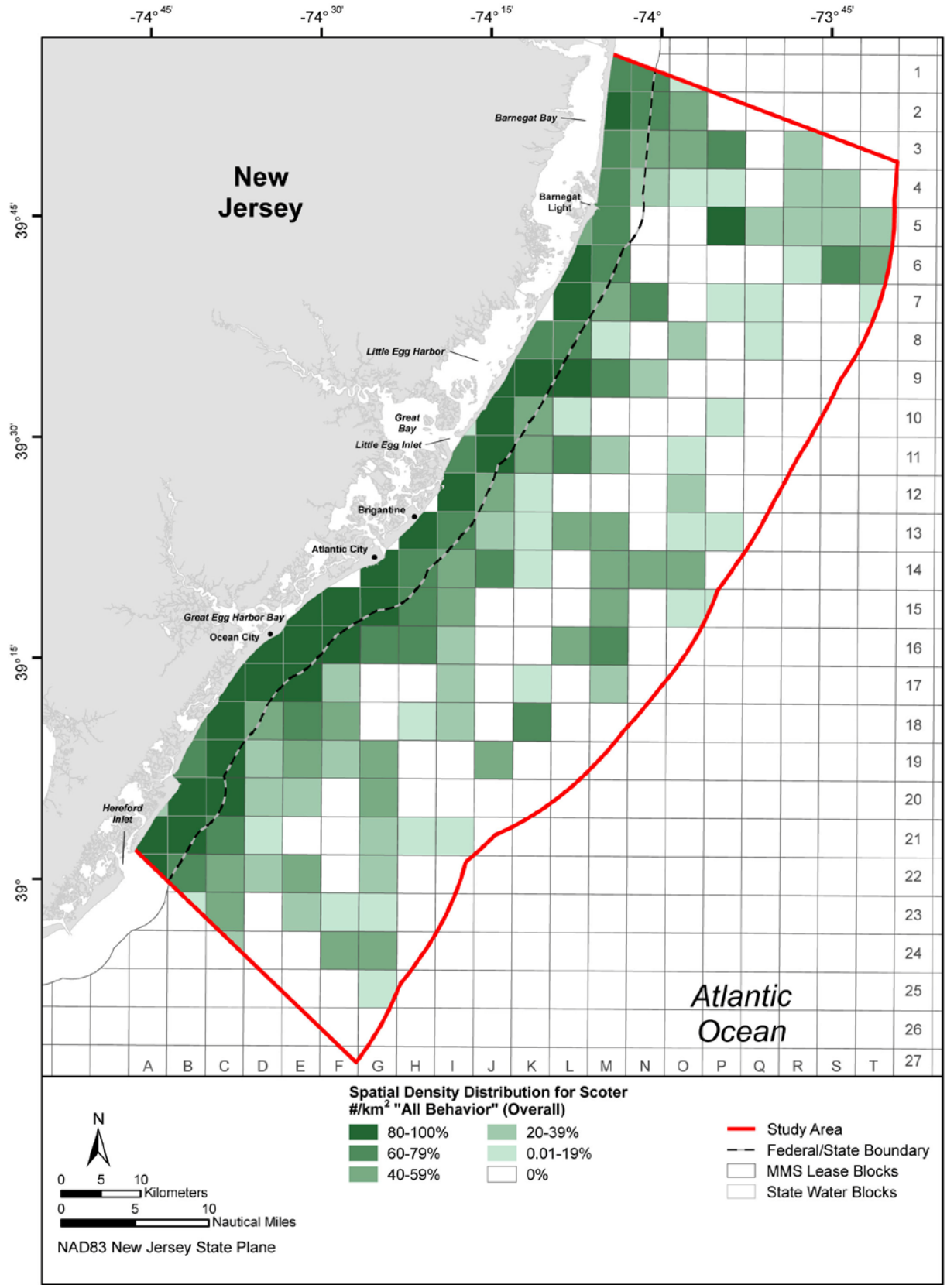

Figure F-2. Percentile abundance of scoters (all behaviors), January 2008-December 2009 (n=17,472).

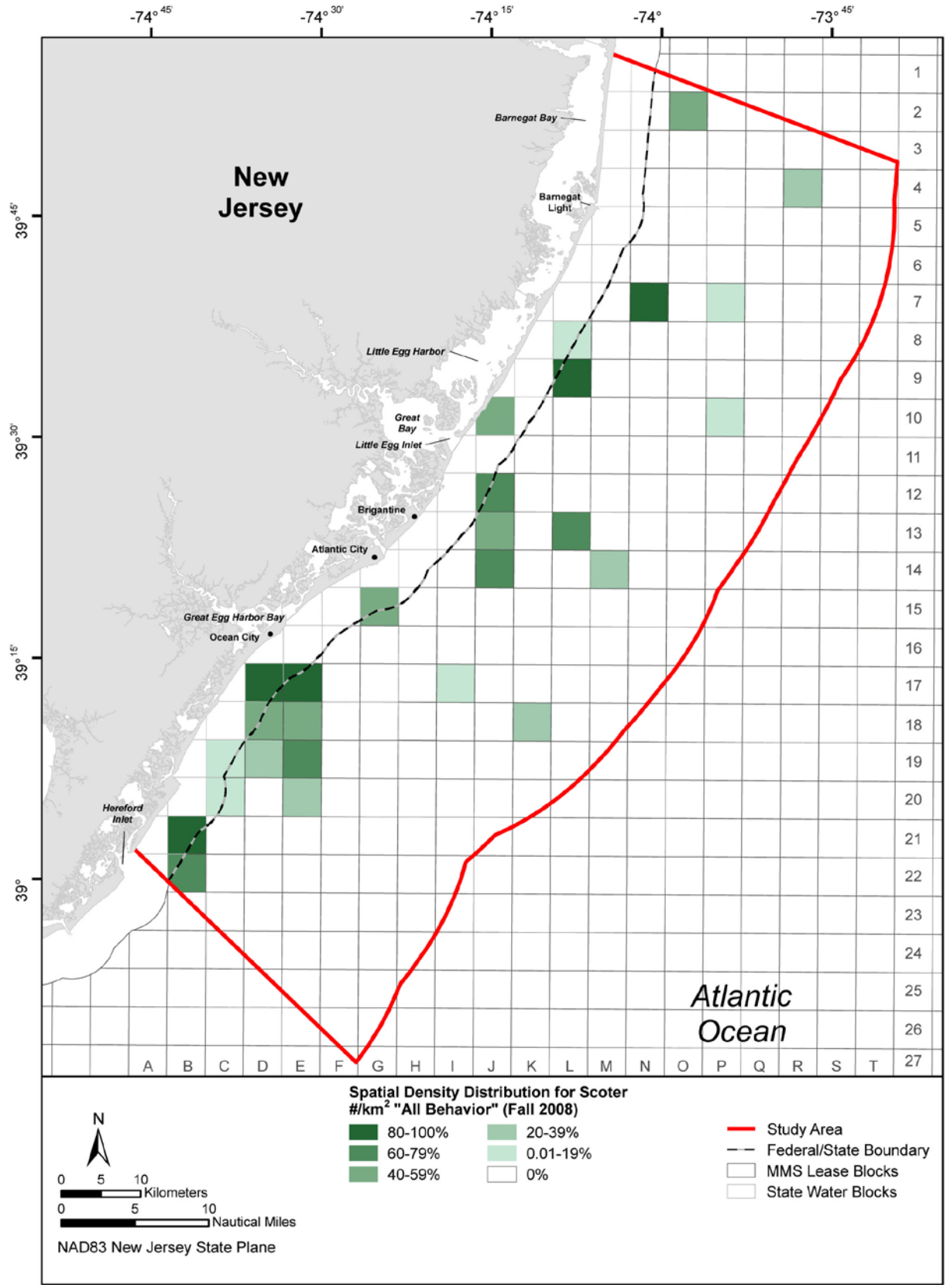

Figure F-3. Percentile abundance of scoters (all behaviors), Fall 2008 (August-November 2008) (n=3,554).

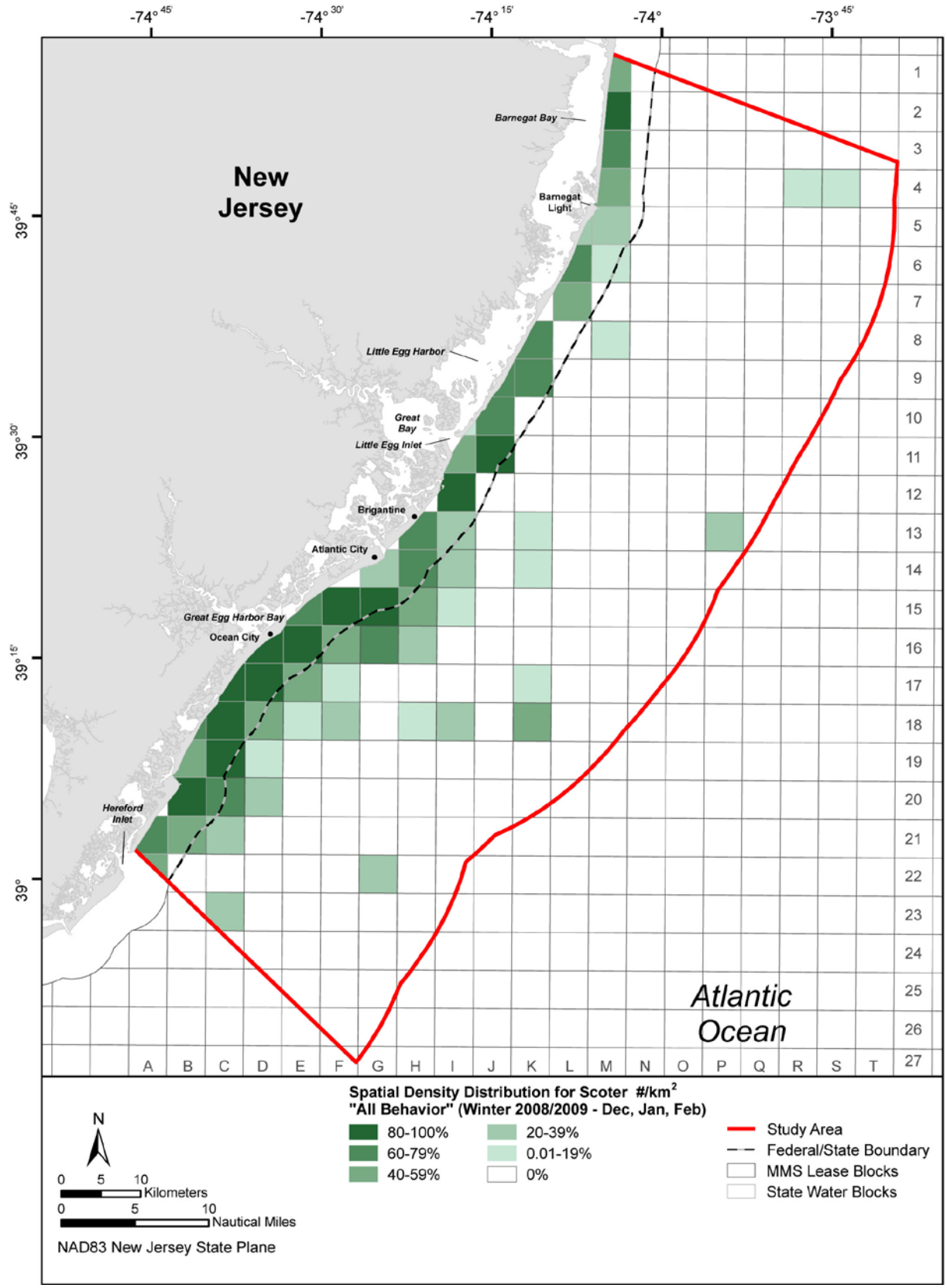

Figure F-4. Percentile abundance of scoters (all behaviors), Winter 2009 (December 2008-February 2009) (n=7,843).

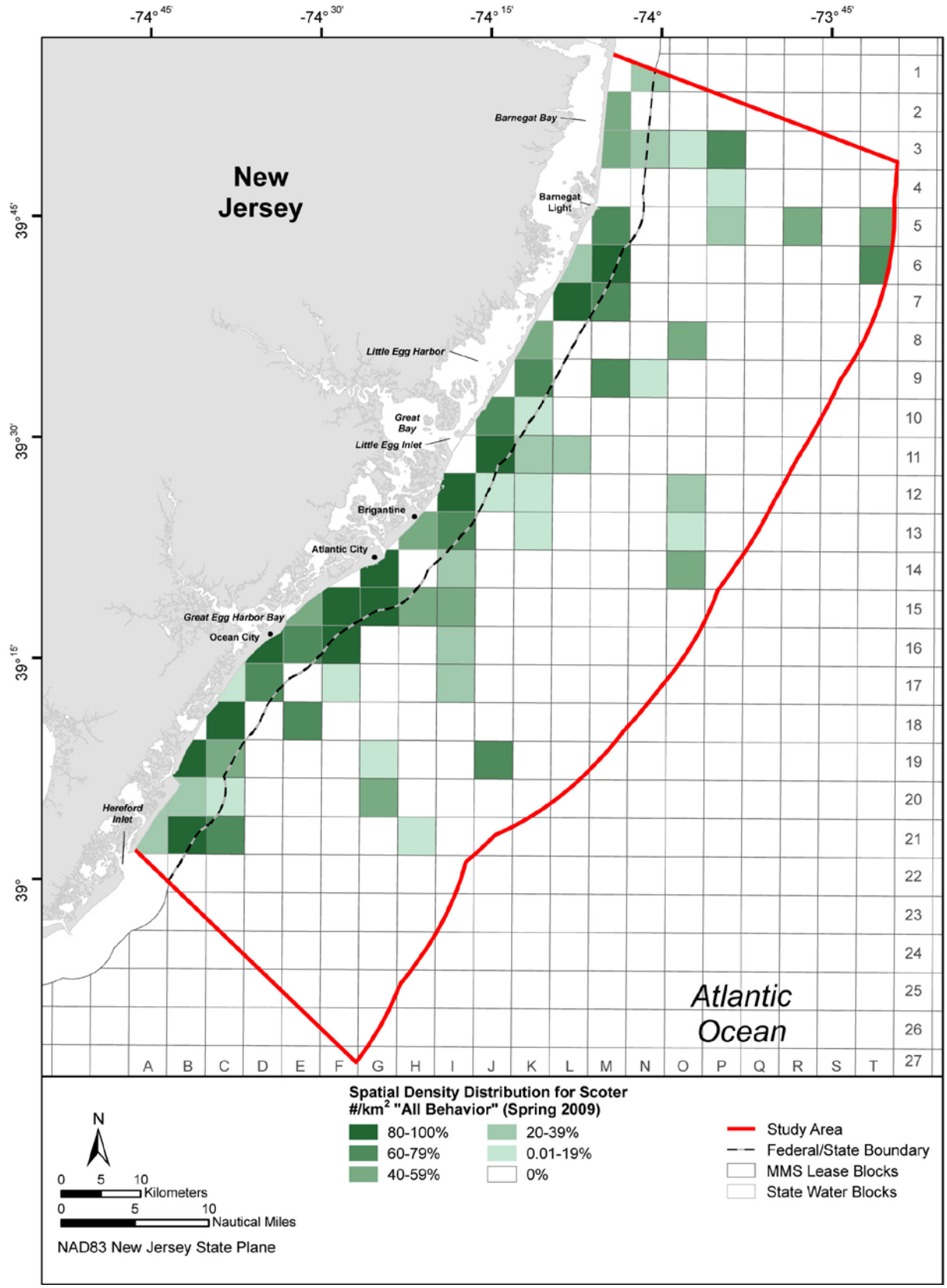

Figure F-5. Percentile abundance of scoters (all behaviors), Spring 2009 (March-May 2009) (n=1,708).

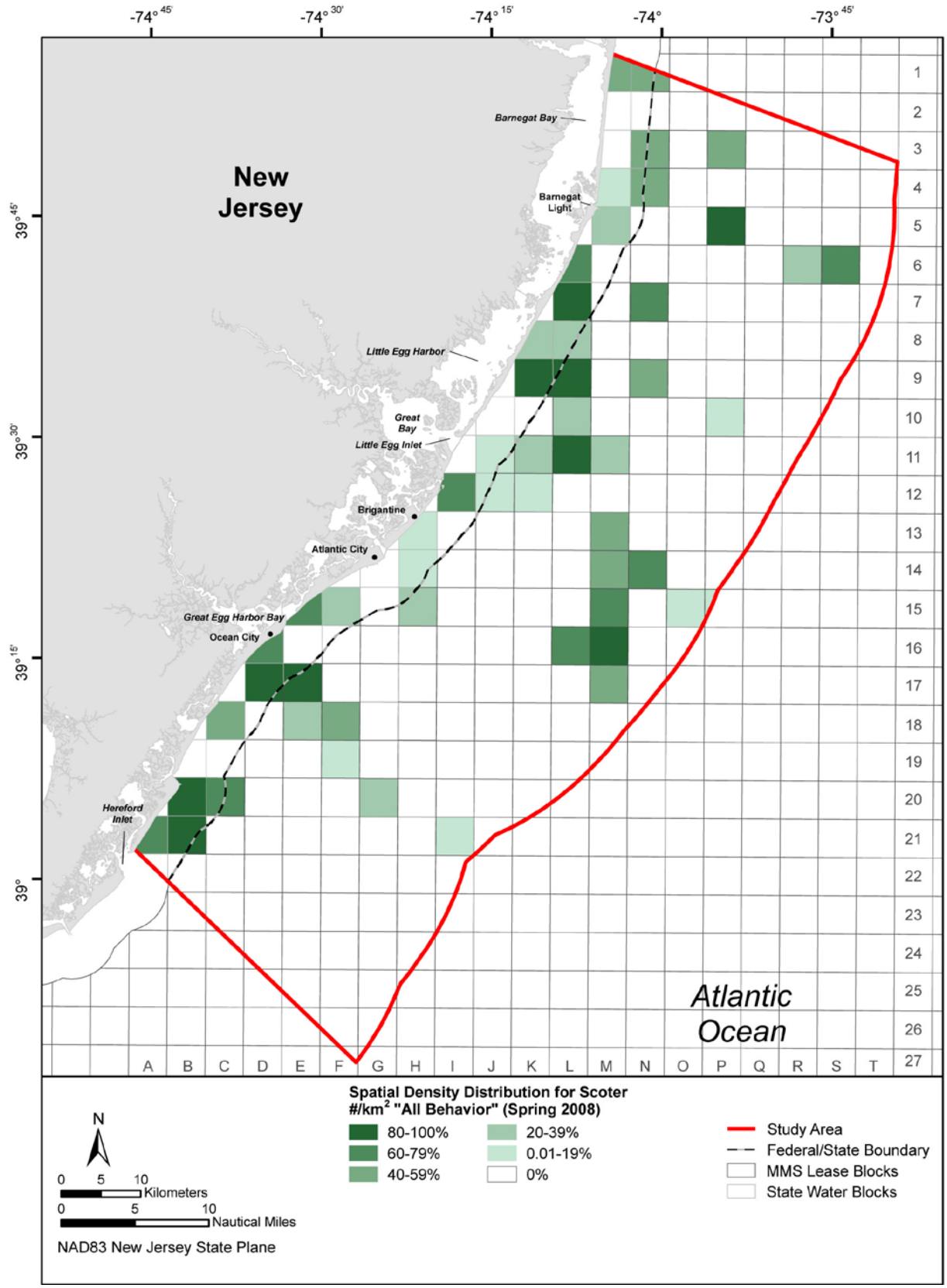

Figure F-6. Percentile abundance of scoters (all behaviors), Spring 2008 (March-May 2008) (n=1,516).

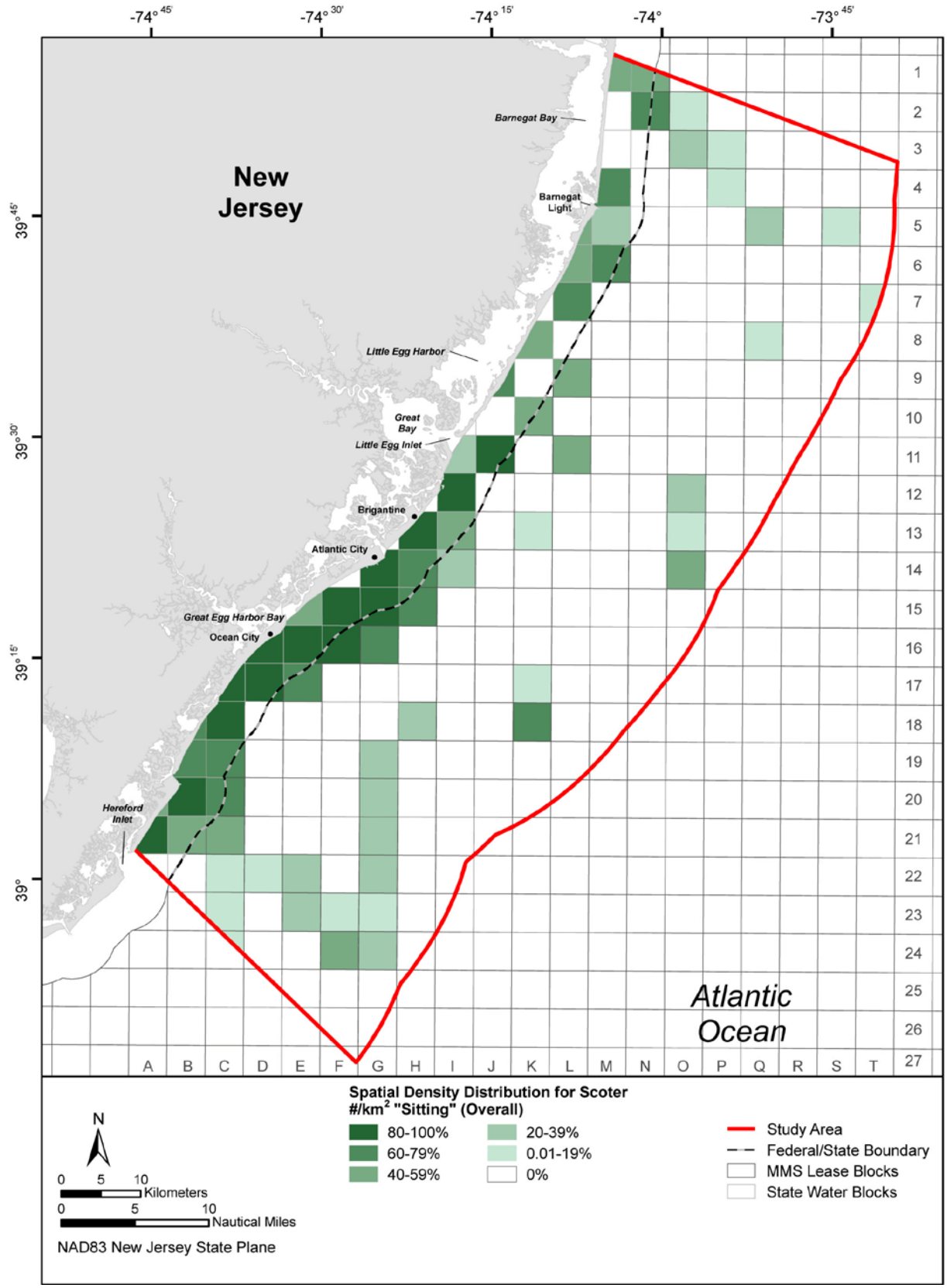

Figure F-7. Percentile abundance of scoters (sitting), January 2008-December 2009 (n=5,767).

Species Account for Long-tailed Duck (*Clangula hyemalis*)

Overall Distribution and Ecology

Long-tailed Duck is a widespread, monotypic duck with a holarctic distribution. Its North American distribution spans the arctic and subarctic regions of Greenland, Canada, and Alaska. Long-tailed Ducks breed in ponds, streams, and other Arctic wetlands. This duck feeds on a varied diet of aquatic insects, crustaceans, fish roe, and vegetation during the breeding season that changes to a diet more focused on crustaceans and bivalves during migration and the winter season. Long-tailed Ducks are apparently the deepest-diving waterfowl with known diving depths up to 66 m (216.5 ft) being reported (Robertson et al. 2002).

Migration of Long-tailed Ducks is somewhat segregated by sex and age with adult males moving before the adult females and immatures. Molt migration and pre-fall migration staging is known to occur but poorly studied. Long-tailed Ducks migrate along the coasts and to a lesser extent, overland, and start to arrive (adult males) along the Atlantic coast in October with numbers peaking in late November and December. Large wintering numbers occur on both coasts, such as >250,000 at Nantucket, Massachusetts, and 700,000 in the Aleutian Islands, Alaska. Wintering Long-tailed Ducks are associated with shoals, sometimes a substantial distance from shore.

New Jersey Occurrence

Nearshore coastal water and offshore shoals make up the predominant habitat for wintering Long-tailed Ducks in New Jersey. Spring migration commences in late February to late March and runs through May, although almost all Long-tailed Ducks have departed New Jersey by late April (Robertson et al. 2002).

Summary of Occurrence during the Study

A summary of the cumulative abundance (number of birds per km^2) of Long-tailed Ducks during the study is presented in **Figure F-8 [overall]**. This same pattern is also seen when viewing just one month of survey effort (e.g., January 2009 [**Figure F-9**] **[jan09]**). Over half (56%) of all Long-tailed Ducks recorded during the study were counted in winter 2009 (**Appendix C: Table C-1**). As predicted by their habitat use outside New Jersey, Long-tailed Ducks were primarily present coastally in the study area, but with some offshore presence in the extensive shoals system in the southern half of the study area. Other species of ducks that are known to specialize on shoals (e.g., scoters) are not as common, however, at these shoals..

Long-tailed Duck abundance was as high as 0.36 birds/km on offshore surveys and 4.49 birds/km on coastal surveys with both highs recorded during winter 2009 (**Table 2-3**). Comparisons between the magnitude of offshore and coastal abundances for Long-tailed Duck in other seasons of the study show similar ratios.

The species was not detected within the RSZ.

Literature Cited

Robertson, G.J. and J.-P.L. Savard. 2002. Long-tailed Duck (*Clangula hyemalis*), The Birds of North America online in A. Poole, Ed. Ithaca: Cornell Lab of Ornithology. Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/651. Accessed 1 January 2010.

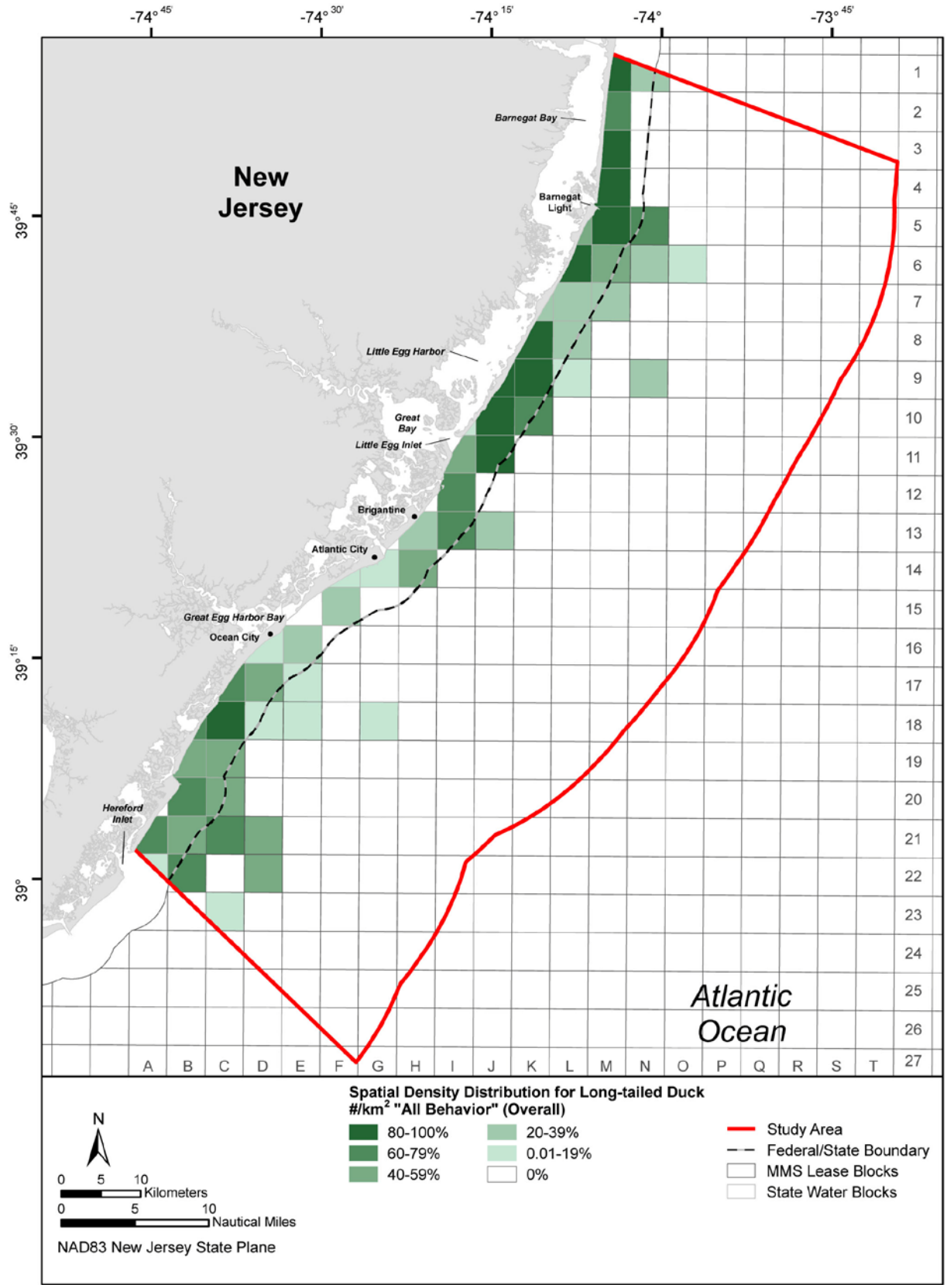

Figure F-8. Percentile abundance of Long-tailed Duck (all behaviors), January 2008-December 2009 (n=4,551).

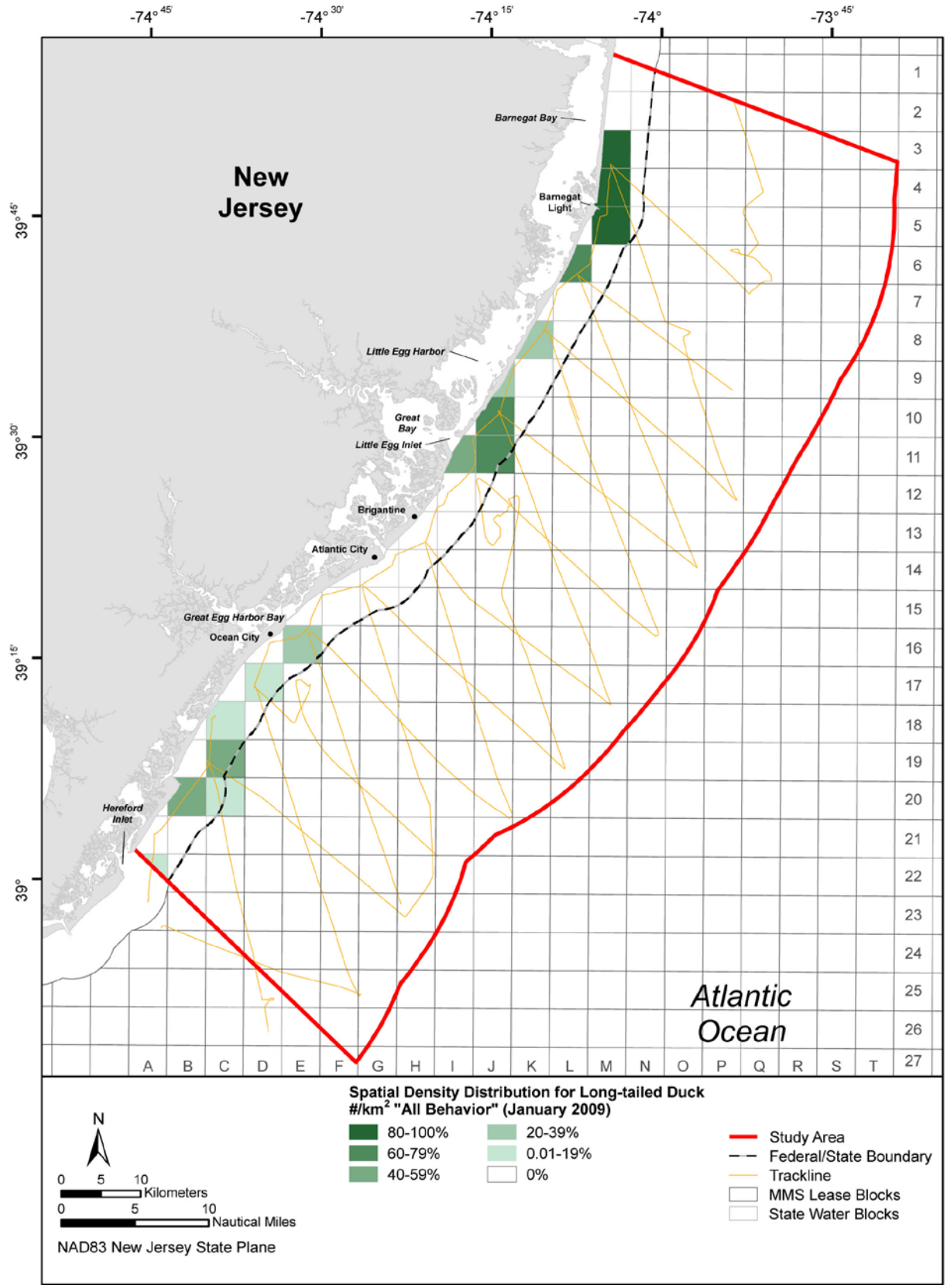

Figure F-9. Percentile abundance of Long-tailed Duck (sitting), January 2009 (n=895).

Species Account for Red-throated Loon (*Gavia stellata*)

Overall Distribution and Ecology

Red-throated Loon is the smallest of the five loon species (McIntyre 1994). Its breeding range is the largest of all the loons', nesting throughout the arctic zone of the northern hemisphere (Terres 1991). In North America, it breeds across Alaska and Canada to Greenland, south to Labrador and Newfoundland on the East Coast (Powers and Cherry 1983; Walsh et al. 1999). The species leaves the Arctic later than does Common Loon (Sherony et al. 2000) and migrates primarily down the Atlantic and Pacific coasts to overwinter in bays and open ocean (Terres 1991; Walsh et al. 1999). A large portion of the Atlantic coast migrants travel through the Great Lakes, especially Lake Ontario (Sherony et al. 2000). Adult Red-throated Loons molt on or near the breeding grounds before departing for winter grounds (Barr et al. 2000), explaining its later departure from breeding grounds and its later occurrence as a migrant in fall. The species often migrates singly, but in areas of high abundance can be seen in fairly large flocks (>50 individuals) on migration (D. Tetlow pers. comm). On the East Coast, the species winters regularly as far south as South Carolina, rarely to the Gulf of Mexico and Florida (Sherony et al. 2000).

New Jersey Occurrence

Red-throated Loons migrate over coastal waters (Powers and Cherry 1983), and occur in greater numbers in fall migration (mid-October through early December) than in spring (March through early May; Walsh et al. 1999). During migration, the species is one of the more abundant species counted at the Avalon Seawatch (Walsh et al. 1999) and Cape May is an important wintering area (Terres 1991). Rowlett (1980) noted that the species is fairly common within 20 km (10.8 NM) of shore and rare beyond 50 km (27 NM).

Summary of Occurrence during the Study

In winter 2008, Red-throated Loons were distributed mostly along the coast, with concentrations near Little Egg Inlet, off Brigantine, and just south of Ocean City (**Figure F-10 [winter08]**). In winter 2009, the species showed a strong coastal presence (**Figure F-11 [winter09]**), especially in the northern portion of the study area, around Barnegat Light. In spring 2008, highest densities were off Great Bay in the middle portion of the study area (**Figure F-12 [spring08]**), but in spring 2009, they were more widely scattered, with a stronger coastal presence in the northern portion, particularly east and south of Barnegat Light (**Figure F-13 [spring09]**).

For fall 2008 and 2009, Red-throated Loons were only observed in November, except for 38 seen during the October 2008 coastal survey. There were many more in fall 2008 than in fall 2009 (**Appendix C: Table C-1**). However, distribution for the species was much more coastal in fall 2008 (**Figure F-14 [fall08]**) than in fall 2009, which showed widely scattered densities, mostly within the southern portion of the study area (**Figure F-15 [fall09]**).

Overall distribution of Red-throated Loon showed a widely scattered presence throughout, but with the highest abundance being coastal (**Figure F-16 [overall]**). There was no apparent correlation of abundance to shoal presence (**Figure 2-7**).

A total of 173 migrating Red-throated Loons were observed during the supplemental sea watch/transect surveys (**Table 4-4**). Although some were observed flying as far as 37.0 km (20 NM) from shore (the width of the study area), 81% (140) were within 3.7 km (2 NM) of the coast.

A total of 3,598 flying Red-throated Loons were observed during the offshore and coastal surveys, and 2% (79) of these individuals were observed flying in the RSZ. When considered separately, 4% (62) of the 1,597 coastal flying Red-throated Loons were within the RSZ compared to 1% (24) of the 2,001 offshore flying loons.

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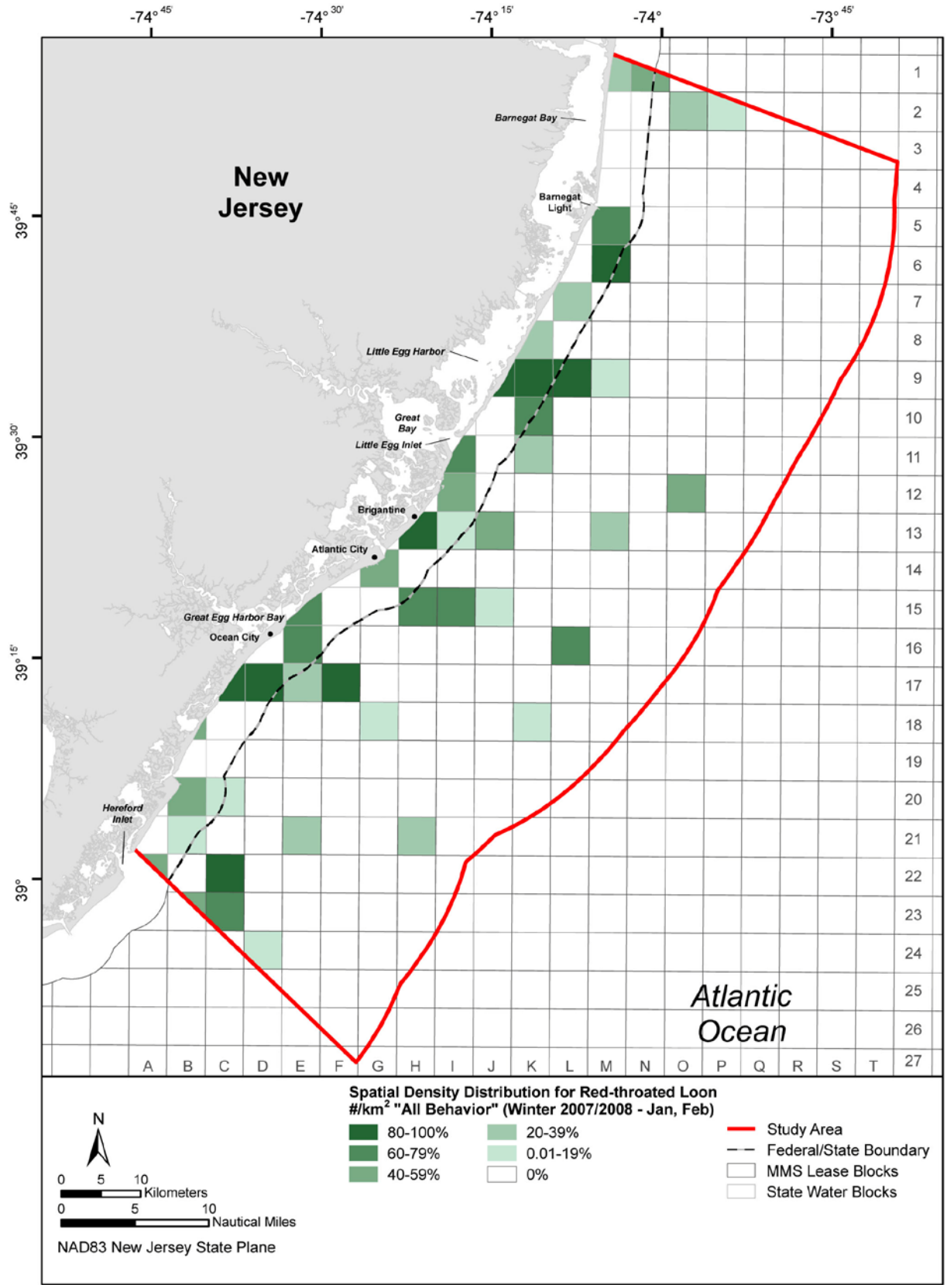

Figure F-10. Percentile abundance of Red-throated Loon (all behaviors), Winter 2008 (January-February 2008) (n=161).

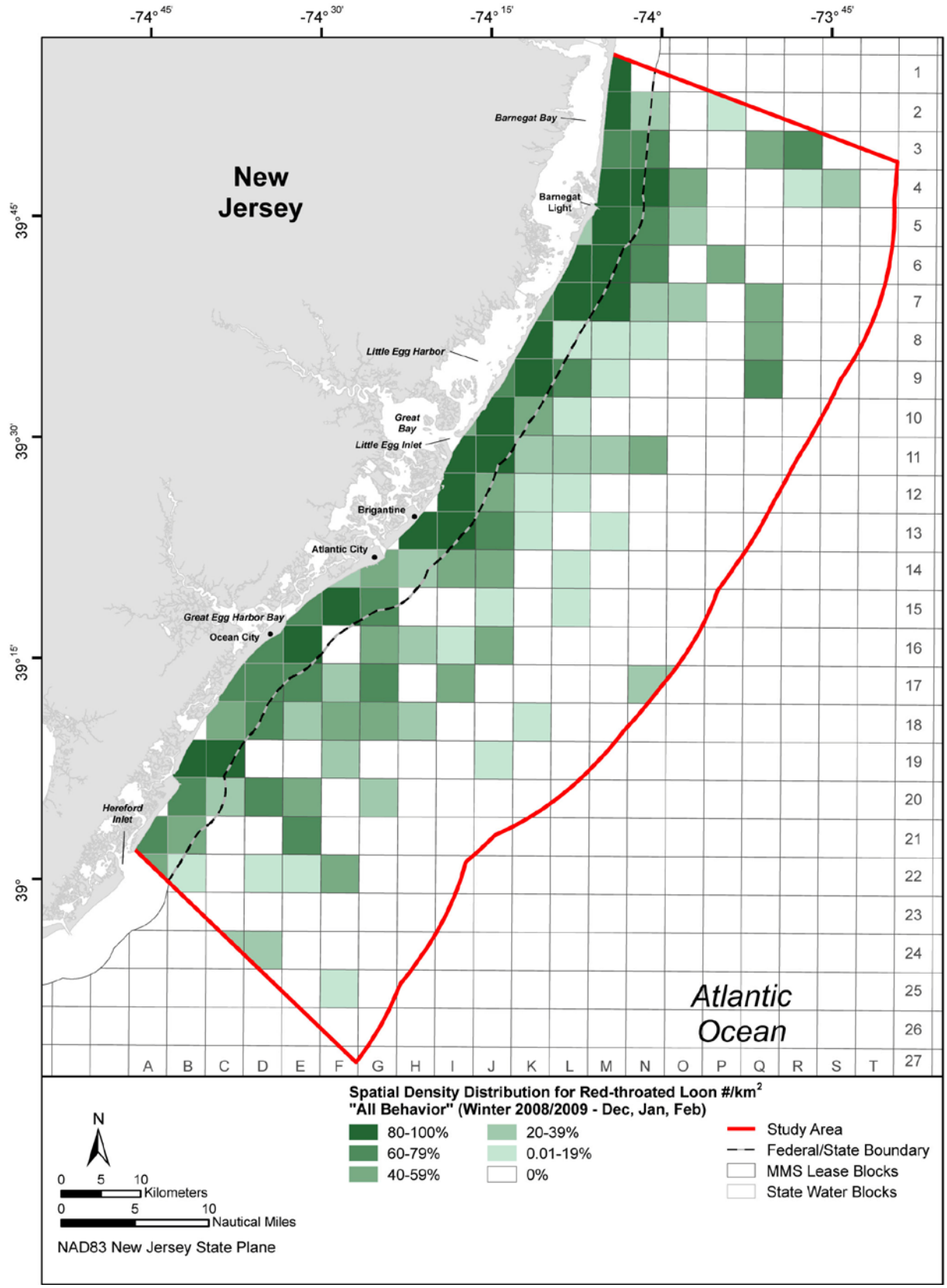

Figure F-11. Percentile abundance of Red-throated Loon (all behaviors), Winter 2009 (December 2008-February 2009) (n=610).

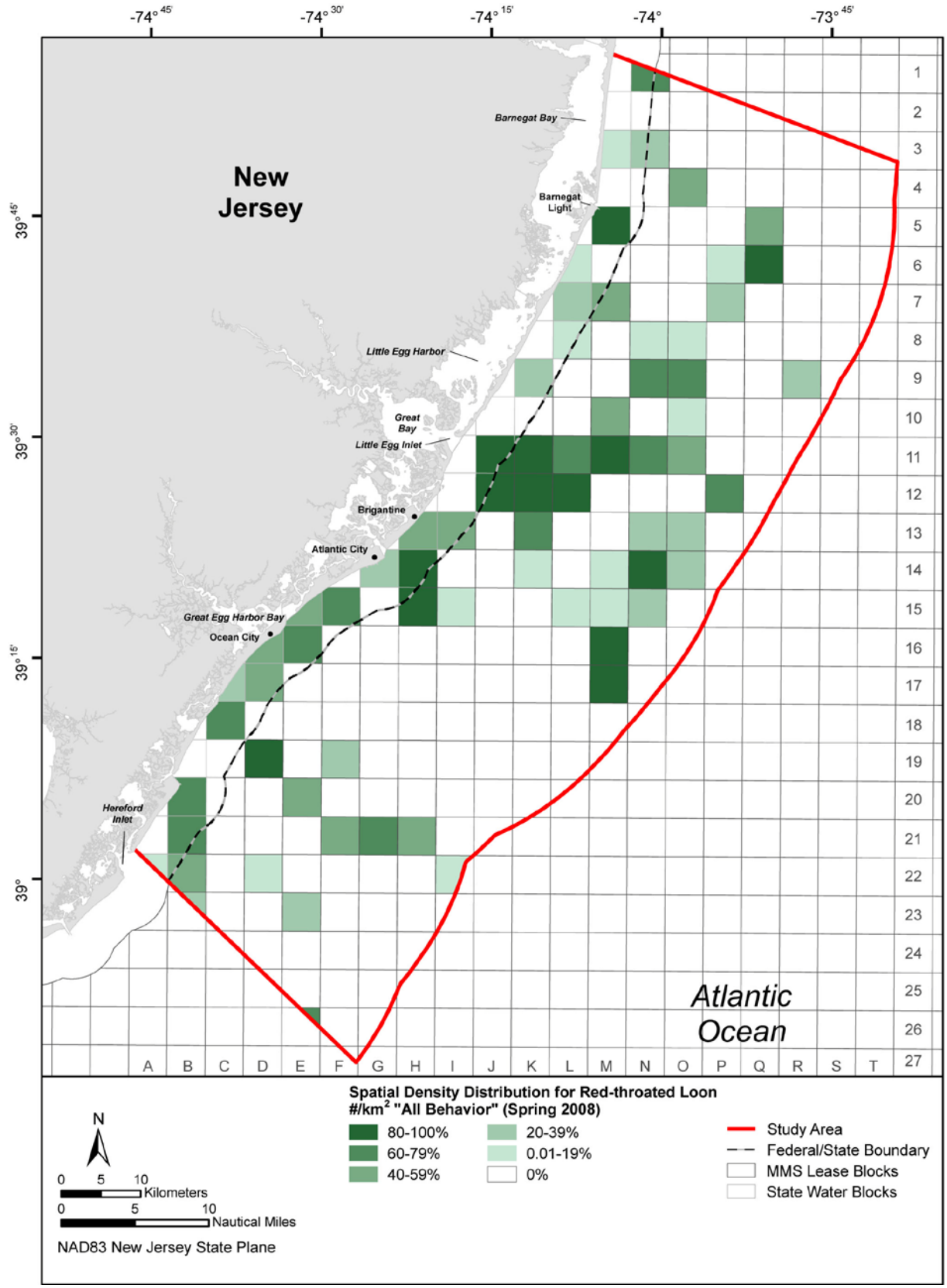

Figure F-12. Percentile abundance of Red-throated Loon (all behaviors), Spring 2008 (March-May 2008) (n=181).

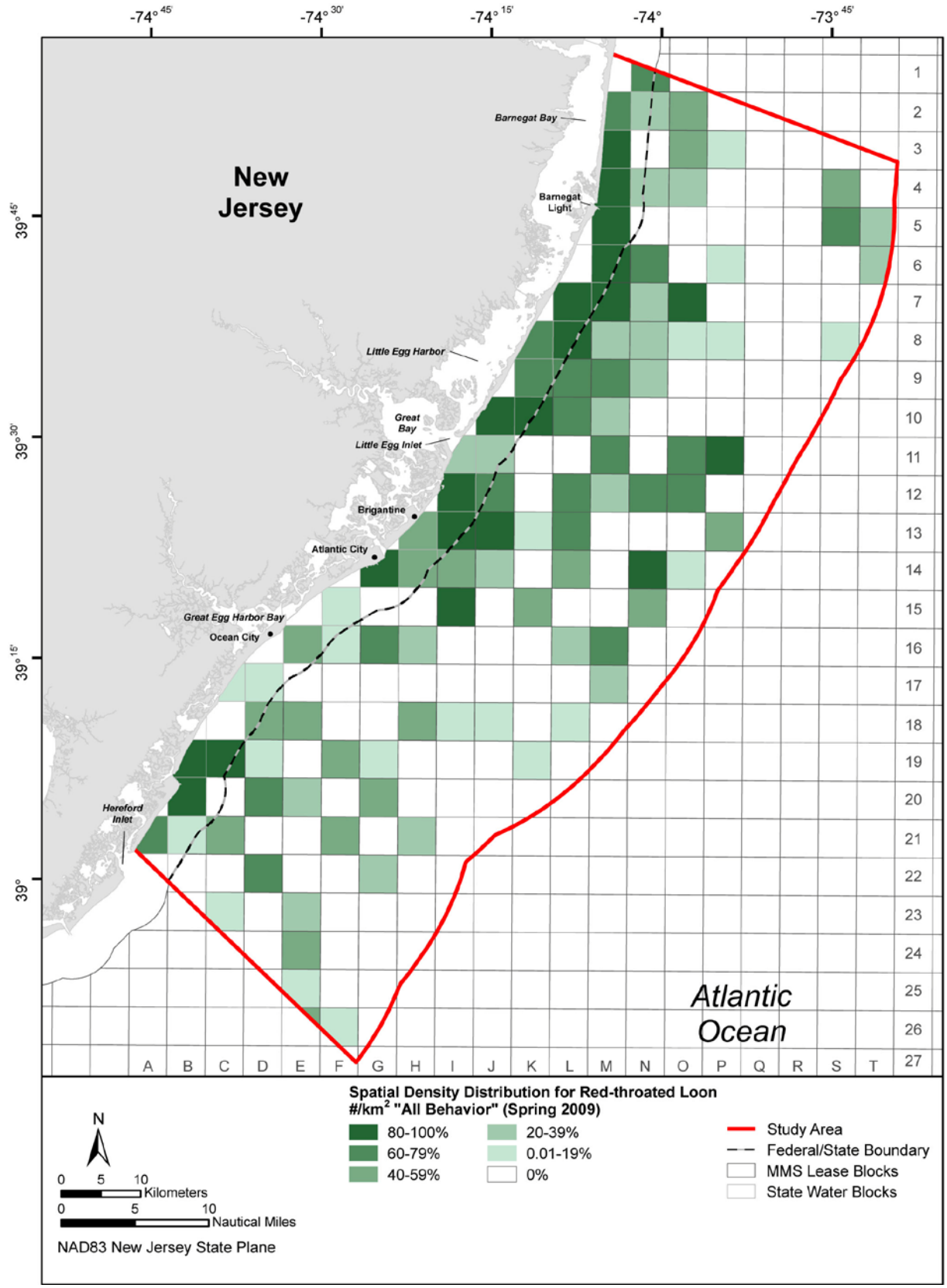

Figure F-13. Percentile abundance of Red-throated Loon (all behaviors), Spring 2009 (March-May 2009) (n=305).

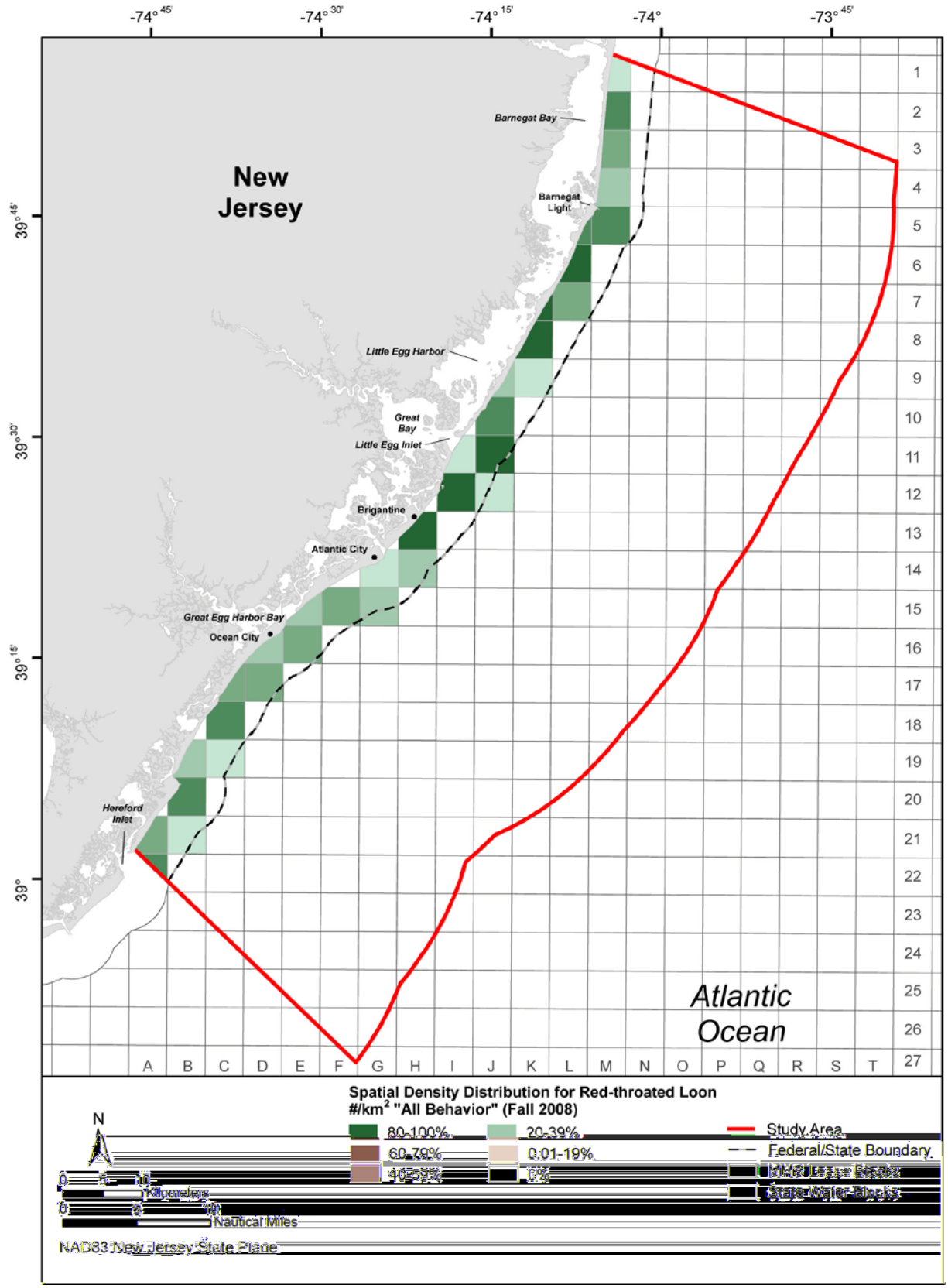

Figure F-14. Percentile abundance of Red-throated Loon (all behaviors), Fall 2008 (August-November 2008) (n=685).

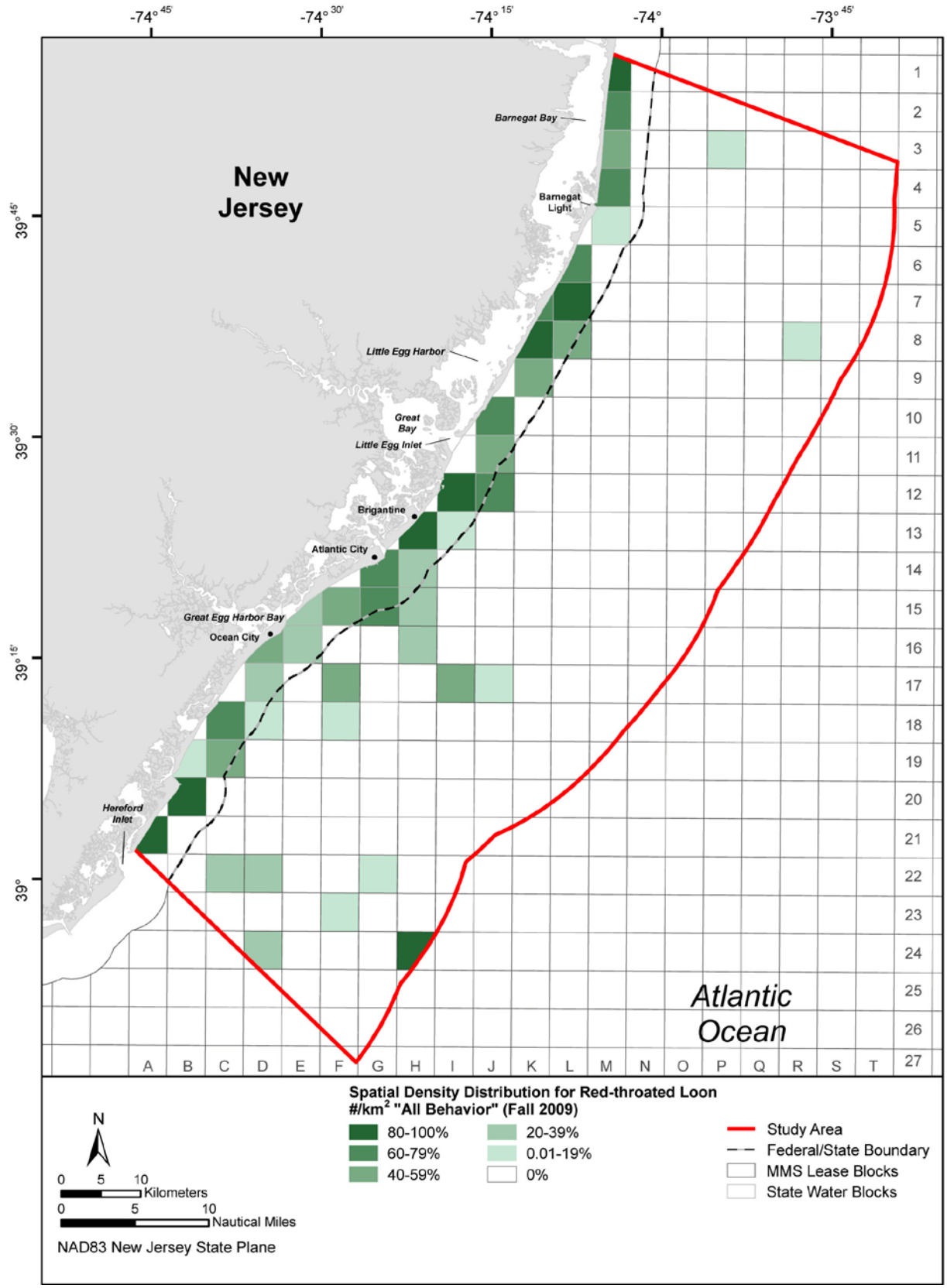

Figure F-15. Percentile abundance of Red-throated Loon (all behaviors), Fall 2009 (August-November 2009) (n=449).

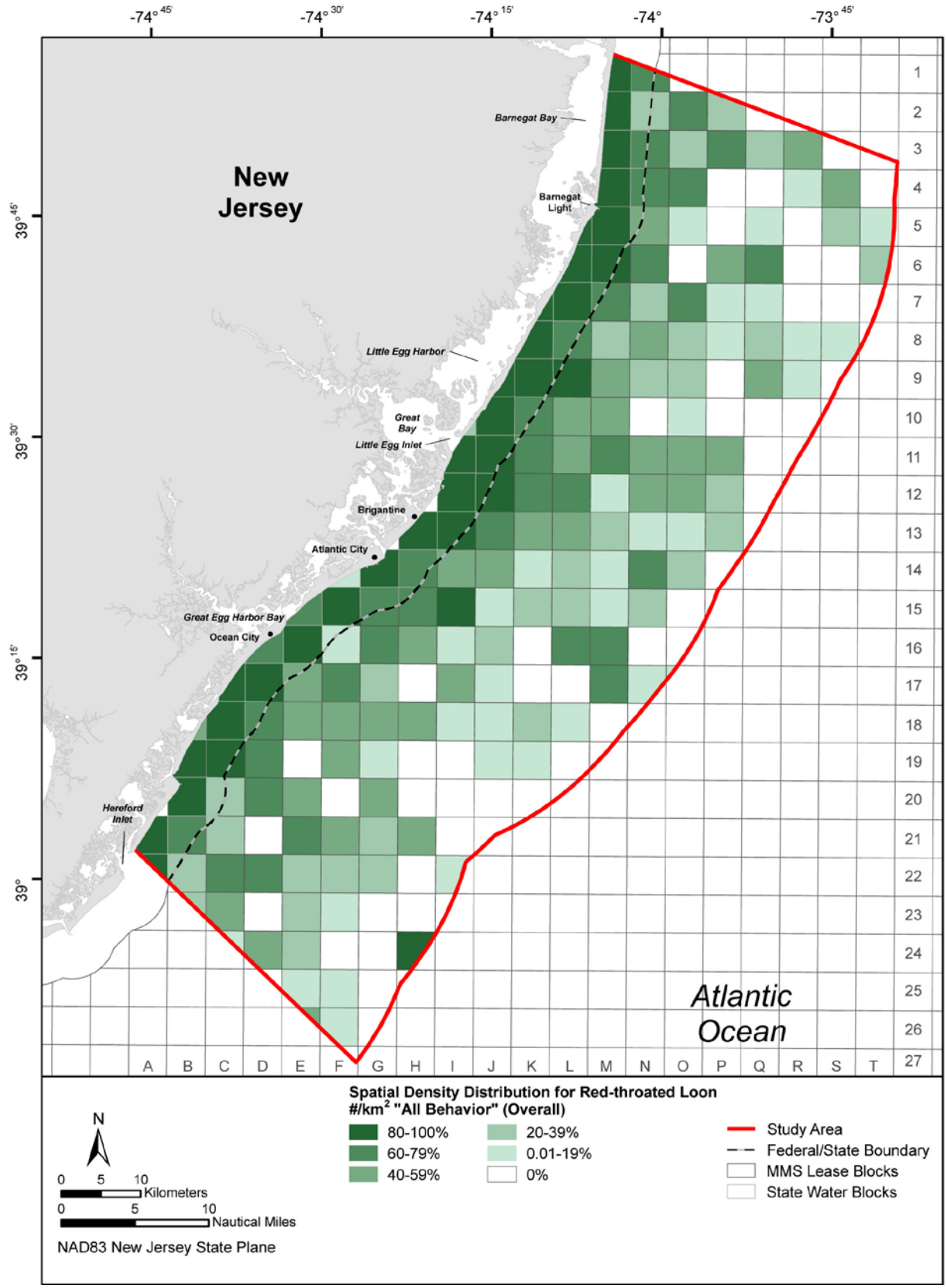

Figure F-16. Percentile abundance of Red-throated Loon (all behaviors), January 2008-December 2009 (n=2,593).

Species Account for Common Loon (*Gavia immer*)

Overall Distribution and Ecology

The Common Loon is a migratory bird inhabiting northern North America, Greenland, and Iceland (Mitro et al. 2008). Common Loon is a long-lived species, possibly living greater than 30 years (Mitro et al. 2008) and able to breed for possibly 20 years or more (Piper et al. 2000). It breeds in freshwater lakes in boreal and arctic habitats and overwinters in marine waters (Powers and Cherry 1983). In North America, its breeding locations range from Alaska across Canada and into the northernmost contiguous United States (Piper et al. 2000; Evers 2007). During the 20th century, loon populations declined due to hunting, human disturbance, and habitat loss (DeSorbo et al. 2008). Populations have recently increased, but New England breeding populations and, especially, those of Atlantic Canada, are affected by mercury bioaccumulation through fish prey (Burgess et al. 2005; Mitro et al. 2008). Evers (2007) noted that the North American adult population consists of 607,000 to 635,000 individuals, with 94% of the breeding population inhabiting Canada. During fall migration (August through November; Walsh et al. 1999) the population increases to between 710,000 and 743,000 individuals, consisting of adults and young (Evers 2007). During the breeding season, loons feed mainly on fish in freshwater lakes; during winter they primarily feed upon marine bottom-dwelling crustaceans (Daub 1989; Grant 1996; Thompson and Price 2006). Loons feed by diving from the surface and have been known to hunt at depths up to 60 m (197 ft; Thompson and Price 2006).

Common Loons remain on freshwater lakes until just before the water freezes (Kenow et al. 2002). Just prior to migration loons gather in assemblages (McIntyre 1978; McIntyre and Barr 1983). While some sources indicate that the species migrates singly (Piper et al. 2000), it is common in small to medium-sized flocks (<50 individuals) at most sites with extensive visible loon migration (e.g., Whitefish Point, Michigan, and Avalon, New Jersey). Loons migrating from the Great Lakes over eastern New York were recorded at a mean altitude of 2.1 km (1.1 NM) above sea level (Kerlinger 1982). The vast majority of Common Loons overwinter in marine waters; approximately 70% of the North American population of Common Loons migrate to the Atlantic coast and Gulf of Mexico, and the remaining 30% migrate to the Pacific coast (Evers 2007). Adult Common Loons do not conduct their wing molt until reaching wintering grounds (Evers 2007). As this molt is synchronous (as it is in all loons), these individuals are flightless for much of the winter. Spring migration occurs from April through early June (Walsh et al. 1999). Powers and Cherry (1983) detected substantial spring and fall migration in offshore waters of the northeast United States. The authors determined that Common Loons migrate shoreward of the 200-m (656.2-ft) isobath following the continental shelf. The mid-Atlantic migration occurs closer to shore and is more condensed compared to migrants northeast of Long Island (Powers and Cherry 1983).

New Jersey Occurrence

Fall migrations to New Jersey occur from August through mid-November, and the spring migration occurs from early April to early June (Walsh et al. 1999). The species is a common migrant at the Avalon Seawatch (Walsh et al. 1999), but is greatly outnumbered there by Red-throated Loon.

Common Loons overwinter off the Atlantic coast as far north as Newfoundland and Labrador and south to the Florida Keys, as well as the Gulf Coast. Evers (2007) found that loons from New York and the remaining New England populations migrate to Long Island Sound and New Jersey, whereas Kenow et al. (2009) found that loons from New York overwintered off Massachusetts, Rhode Island, and southern New Jersey. Loons from Quebec and the Great Lakes area migrate over New York, primarily following the Finger Lakes, and overwinter from the mid-Atlantic to the Gulf of Mexico (Haefele et al. 2005; Evers 2007). Chesapeake Bay is known to contain hundreds of loons (Thompson and Price 2006) from Quebec and Ontario populations (Evers 2007). Loons from the mid-continent, such as western Ontario and Manitoba, also migrate to the mid-Atlantic (Evers 2007). Along the Atlantic Coast large concentrations overwinter off Virginia, Carolinas, and Florida (Grant 1996; Kenow et al. 2002; Evers 2007). Loons primarily overwinter within coastal waters, but also extend offshore, perhaps up to 100 km (54 NM), and are spread out over the continental shelf (Haney 1990; Kenow et al. 2002; Evers 2007). Kenow et al.

(2009) found that radio-marked loons mostly overwintered within 10.5 km (5.7 NM) of shore, in water depths ranging from 3.1 to 19.6 m (10.2 to 64.3 ft).

Summary of Occurrence during the Study

Common Loon was scattered widely throughout the study area during the course of the study (**Figure F-17 [overall]**). In winter 2009, 1,154 Common Loons were observed, with a strong coastal affinity; 457 of these were observed on one coastal survey (25 February 2009). The greatest coastal concentrations (number of birds per km^2) were opposite and north of Great Bay, as well as just off Brigantine and opposite and south of Ocean City (**Figure F-18 [sitting winter09]**). Offshore loon distribution was widely scattered and did not appear correlated with shoal presence (**Section 2.3.3.1: Figure 2-7**), even when considering just "sitting" Common Loons (**Figures F-19 [sitting winter08]**, through [**F-20**; **sitting winter09**], **F-21 [sitting winter10]**), which comprise the vast majority of observations at that season (as the adults are flightless), and when considering all sitting loons (2,762) during the course of the study (**Figure F-22 [sitting overall]**).

Nearly twice as many Common Loons were seen in spring 2009 (897) than in spring 2008 (450). For both years more loons were observed offshore than coastally, with distributions widely scattered within the study area (**Figures F-23 [spring09]** and **F-24 [spring08]**). There were nearly twice as many Common Loons observed in fall 2008 (387) as in fall 2009 (196). In 2008, nearly 100% of the Common Loons were seen in October and November (one was seen in September), compared to 2009, when 99% were seen in November only. Fall 2008 offshore distribution was more widely scattered through the study area than in fall 2009 (**Figures F-25 [fall09]** and **F-26 [fall08]**), which showed a much stronger presence in the southern portion. There did not appear to be a strong coastal presence in either year except for high abundance near Barnegat Bay in fall 2009. These birds were mostly recorded as flying because a low density of sitting birds can be seen in **Figure F-27 "Sitting" Fall 2009**).

A total of 156 migrating Common Loons was observed during the supplemental sea watch/transect surveys (**Section 4.3.3: Table 4-4**) and were observed flying throughout the width of the study area; unlike for all other focus species of the study, Common Loon exhibited a nearly flat distribution of occurrence relative to distance from shore. A total of 734 flying Common Loons were observed in 2008 and 2009 on the offshore and coastal surveys, and 9% (66) of these were observed flying in the RSZ. When considered separately, 7% (10) of the 135 coastal flying Common Loons were within the RSZ compared to 9% (56) of the 599 offshore flying loons.

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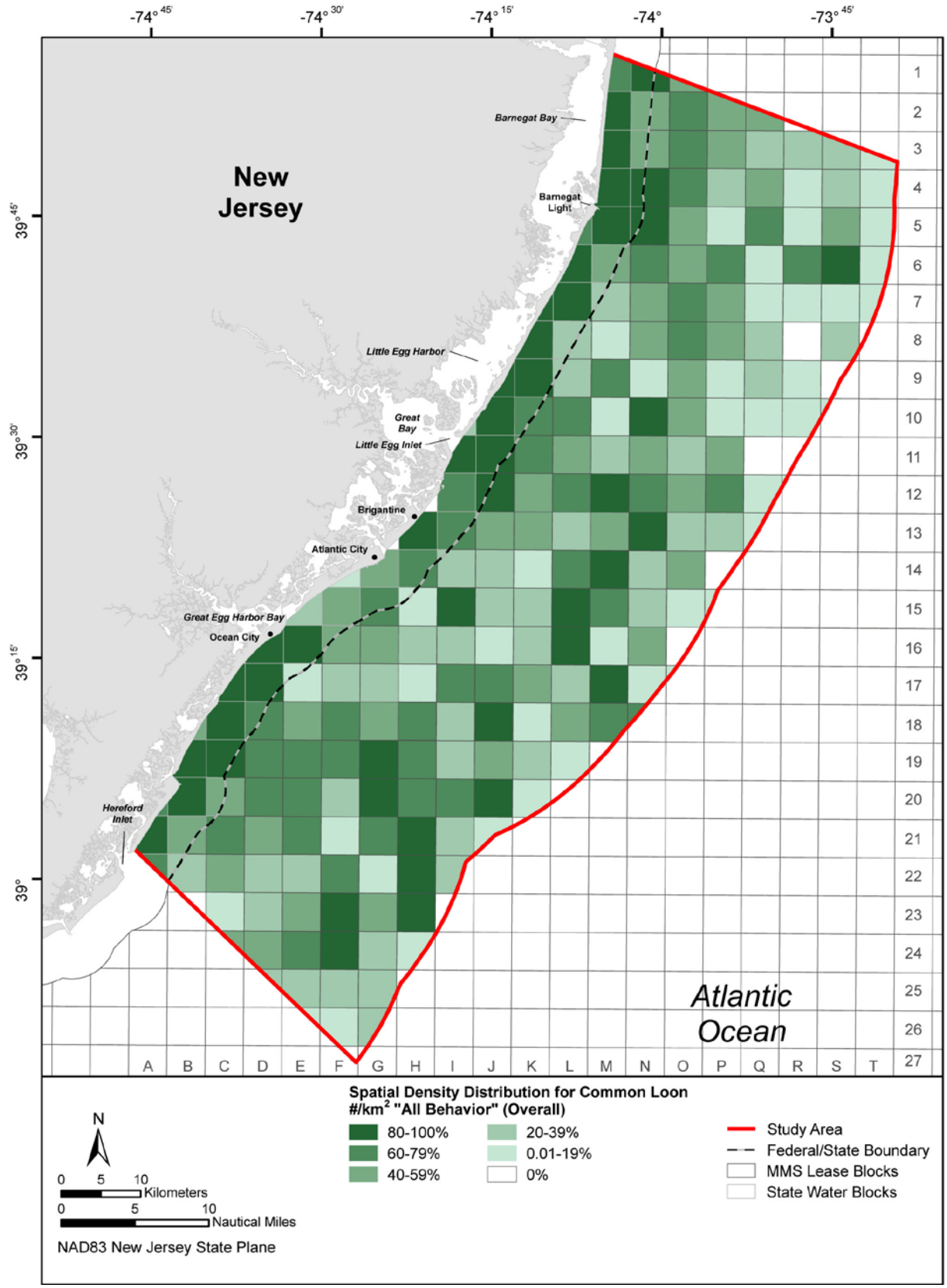

Figure F-17. Percentile abundance of Common Loon (all behaviors), January 2008-December 2009 (n=3,041).

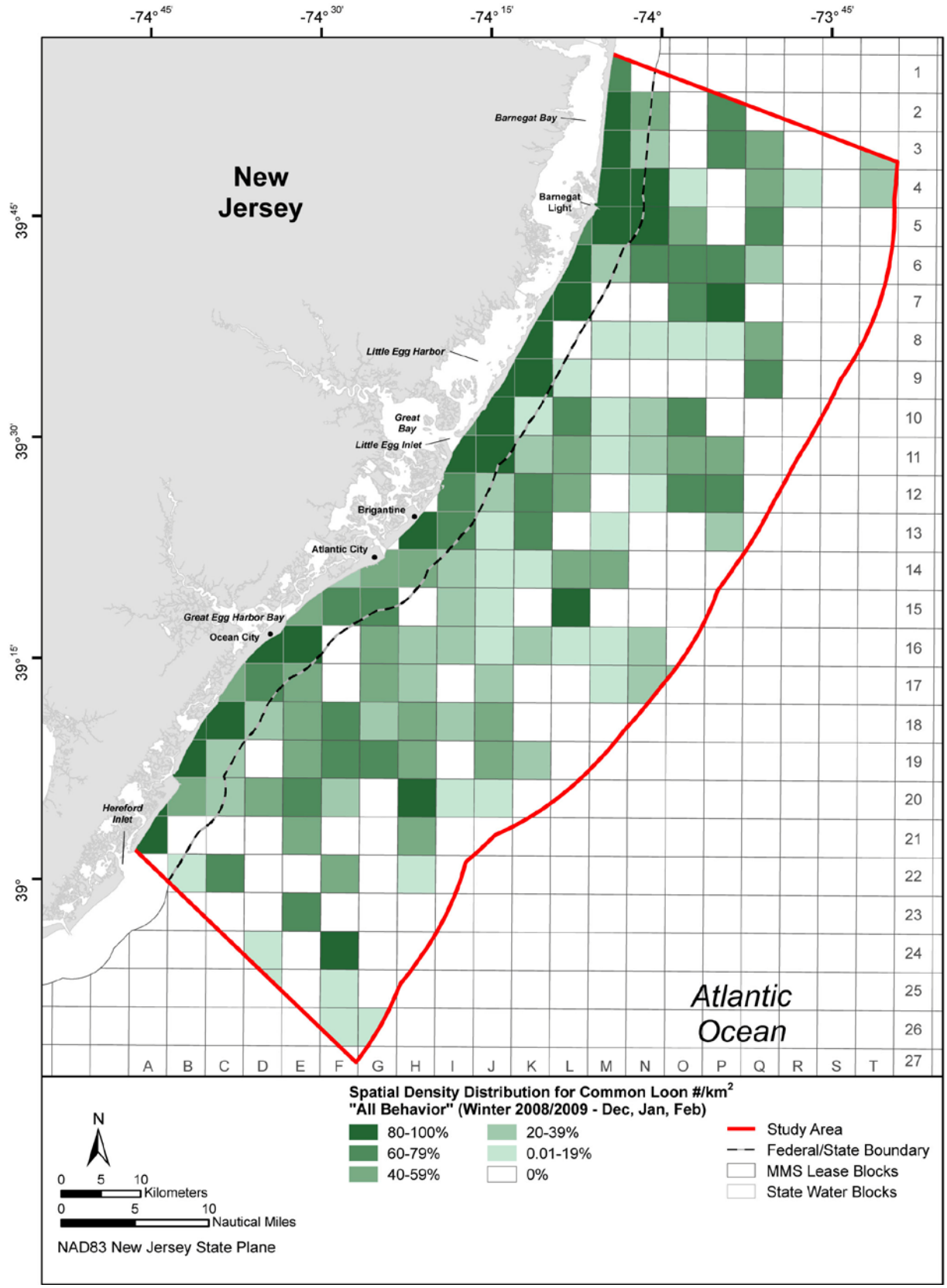

Figure F-18. Percentile abundance of Common Loon (all behaviors), Winter 2009 (December 2008-February 2009) (n=1,148).

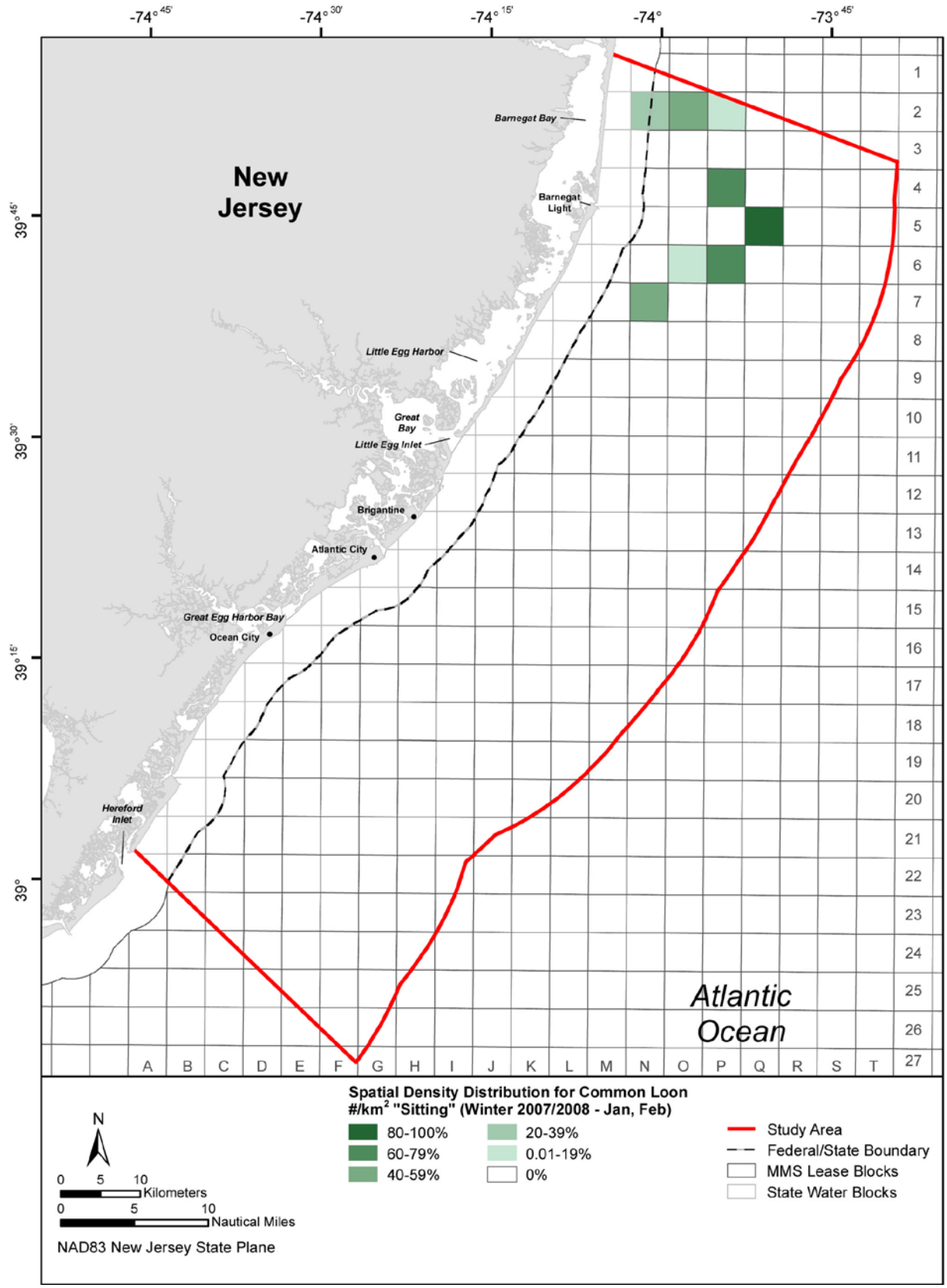

Figure F-19. Percentile abundance of Common Loons (sitting), Winter 2008 (January-February 2008) (n=19).

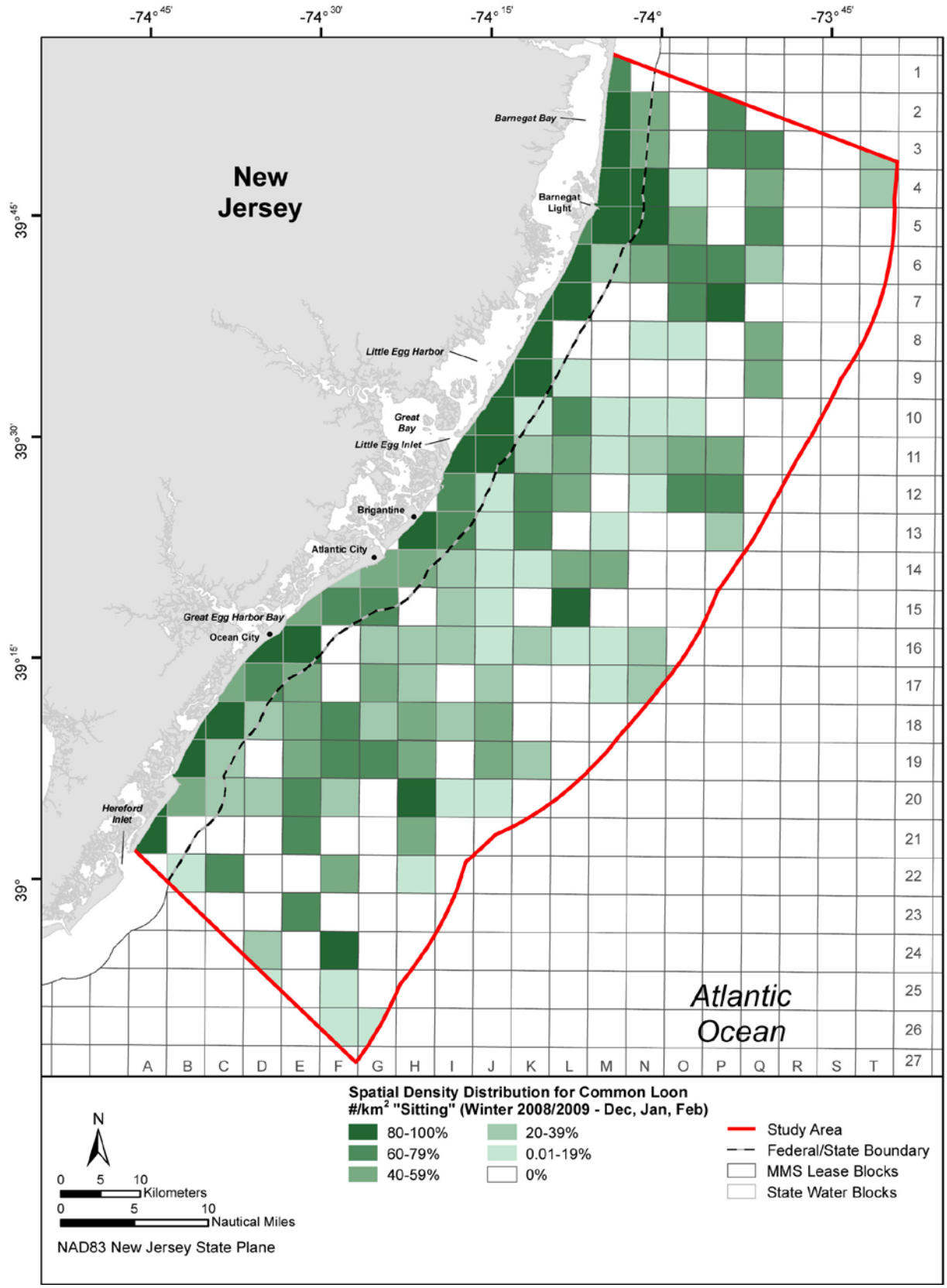

Figure F-20. Percentile abundance of Common Loons (sitting), Winter 2009 (December 2008-February 2009) (n=1,119).

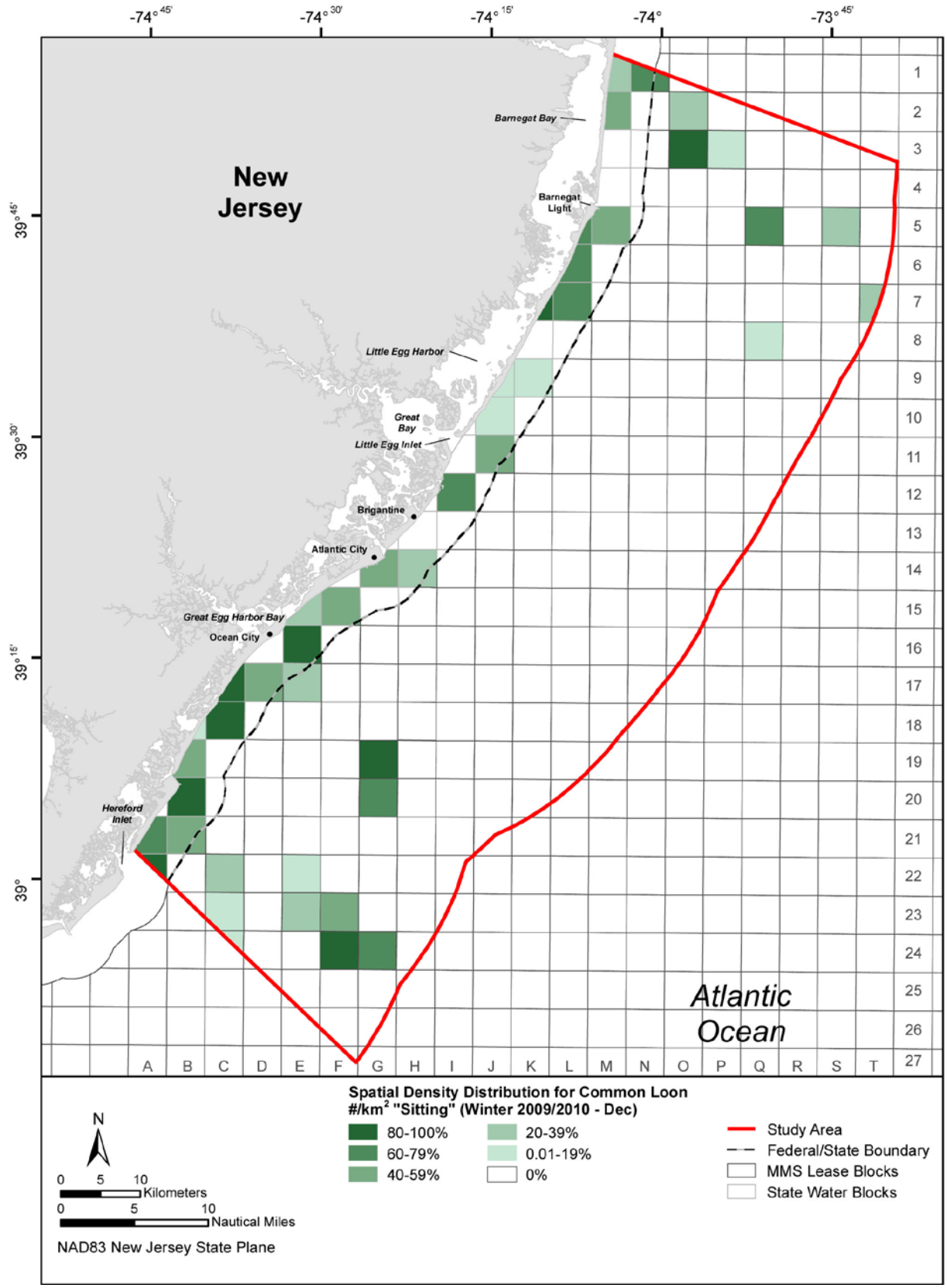

Figure F-21. Percentile abundance of Common Loons (sitting), Winter 2010 (December 2009) (n=226).

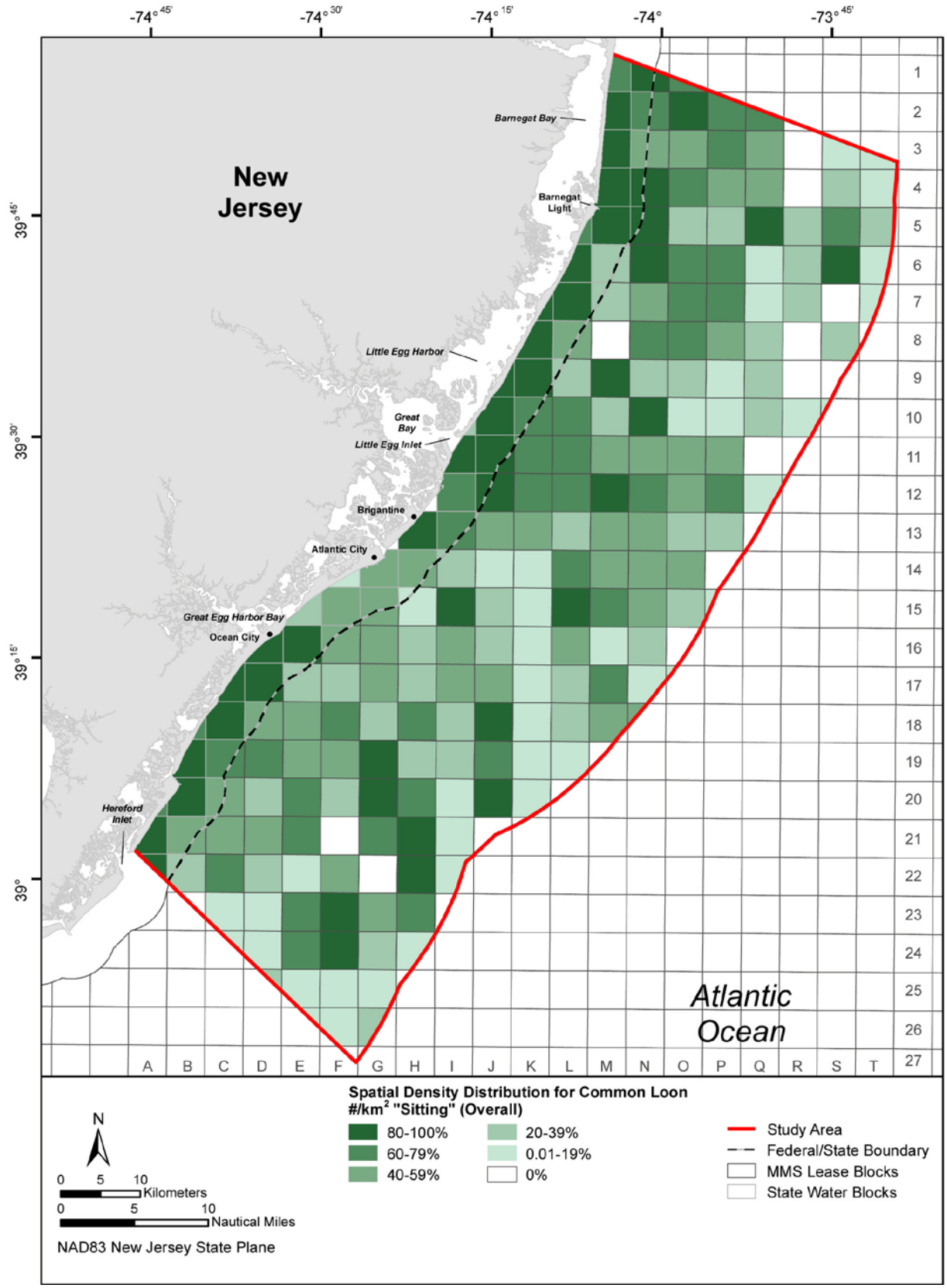

Figure F-22. Percentile abundance of Common Loons (sitting), January 2008-December 2009 (n=2,257).

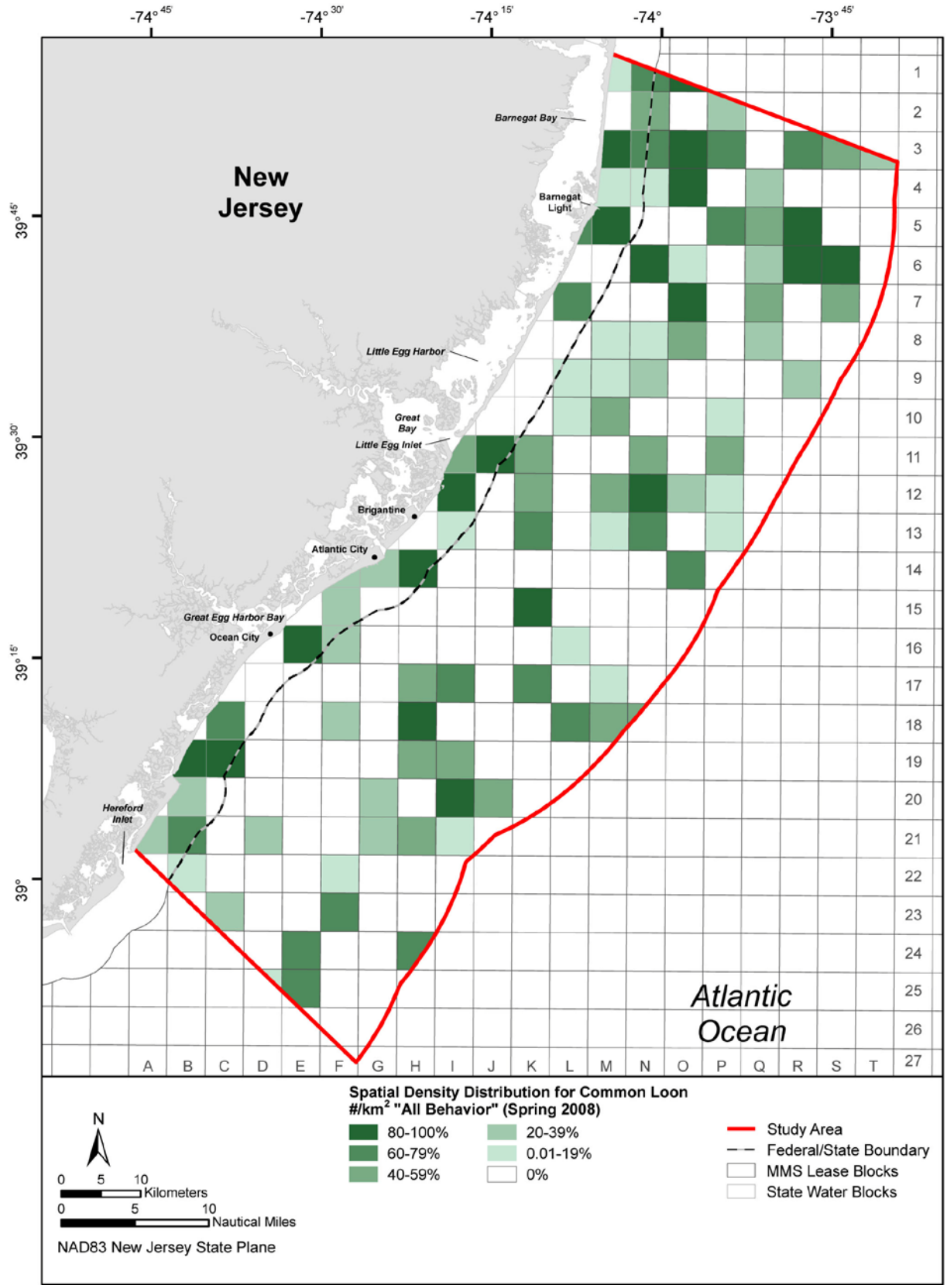

Figure F-23. Percentile abundance of Common Loon (all behaviors), Spring 2008 (March-May 2008) (n=216).

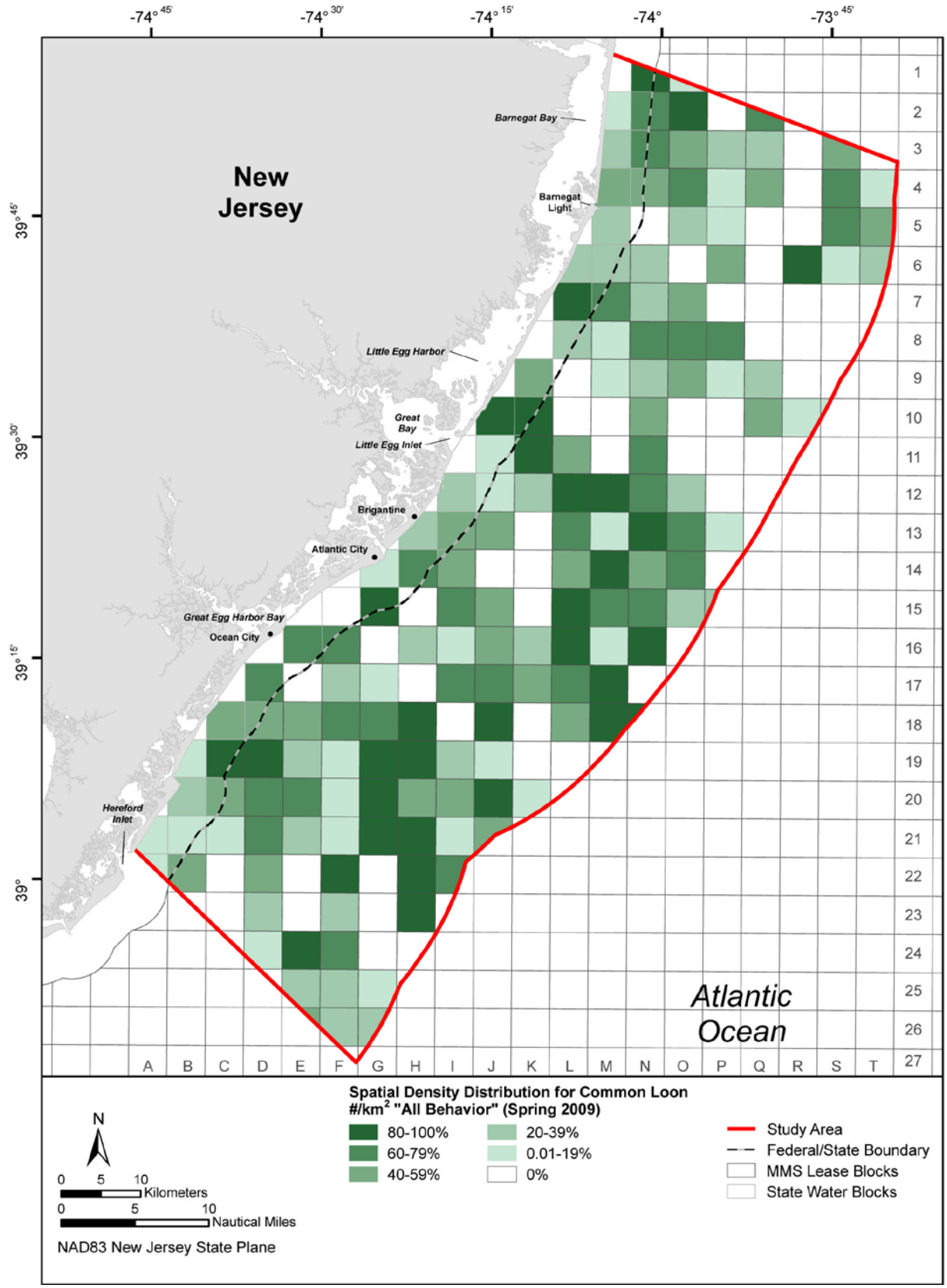

Figure F-24. Percentile abundance of Common Loon (all behaviors), Spring 2009 (March-May 2009) (n=89).

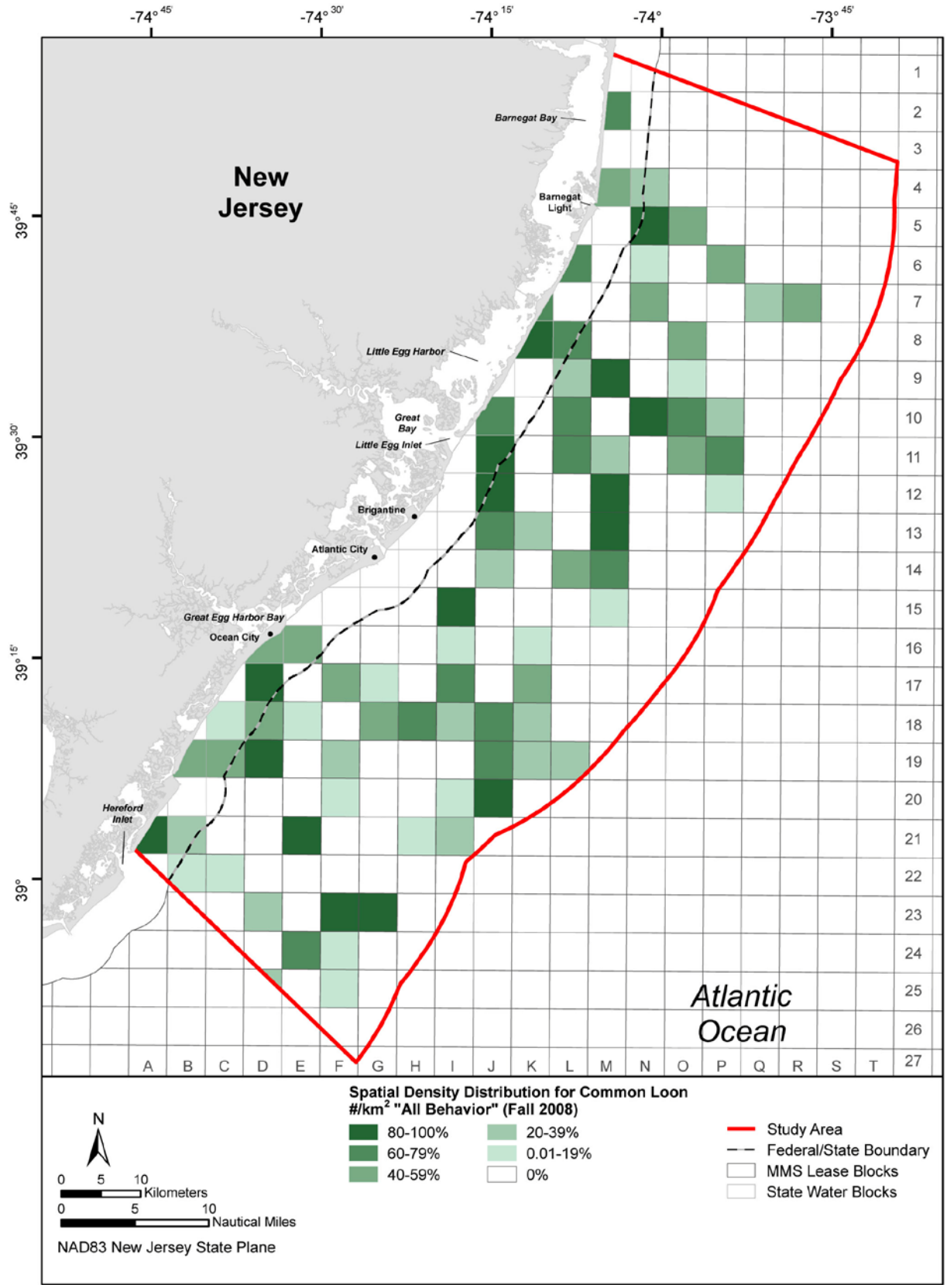

Figure F-25. Percentile abundance of Common Loon (all behaviors), Fall 2008 (August-November 2008) (n=325).

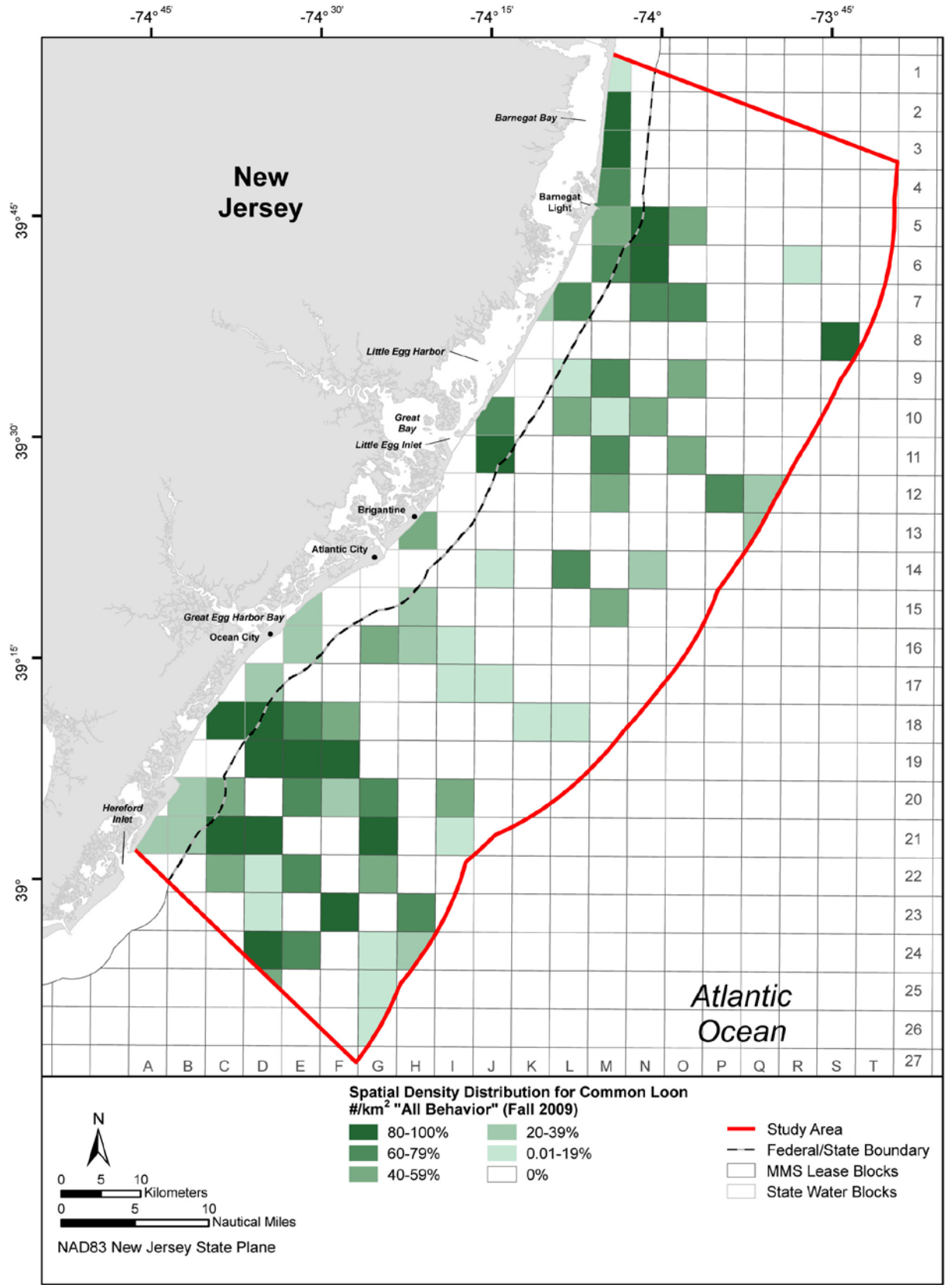

Figure F-26. Percentile abundance of Common Loon (all behaviors), Fall 2009 (August-November 2009) (n=194).

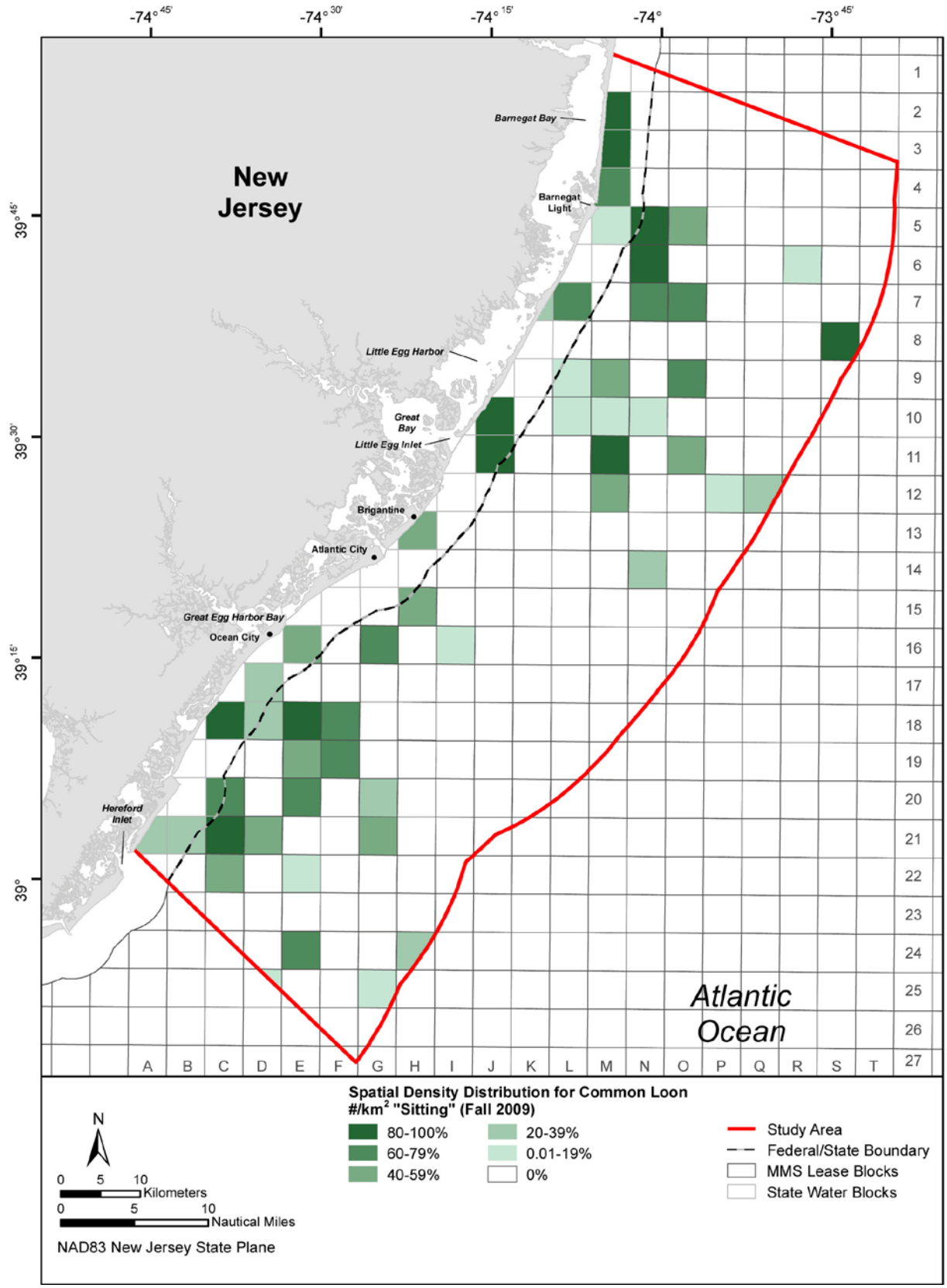

Figure F-27. Percentile abundance of Common Loons (sitting), Fall 2009 (August-November 2009) (n=104).

Species Account for Cory's Shearwater (*Calonectris diomedea*)

Overall Distribution and Ecology

Cory's Shearwater is considered by most authors to consist of two subspecies: *C. d. diomedea* and *C. d. borealis* (Onley and Scofield 2007). *C. d. diomedea* breeds on Mediterranean islands while *C. d. borealis* breeds on islands off the coasts of Portugal and northwestern Africa. Non-breeders of both subspecies are known to disperse to the western Atlantic during summer and fall (Haney and McGillivary 1985). Like other species of the order Procellariiformes, Cory's Shearwater spends most of its life at sea, coming to land only to nest. This species feeds mainly on fish and mollusks captured by skimming along the surface or executing shallow surface-dives (Harrison 1983).

New Jersey Occurrence

Cory's Shearwater is present in New Jersey waters from May to early November. While most common far offshore, this species is often found within 24 km (13 NM) of the coast and is occasionally seen from land (Walsh et al. 1999). There has been no published effort to quantify the occurrence of the species in the state's waters.

Summary of Occurrence during Study

Both *C. d. diomedea* and *C. d. borealis* were recorded, though separation of subspecies from a moving platform proved difficult and was not often possible. Of the individuals that were identified to subspecies, however, the vast majority were *C. d. borealis*.

Cory's Shearwater was recorded in summer and fall of both 2008 and 2009, only on the shipboard offshore surveys, with the highest seasonal abundance occurring in summer 2008 (**Appendix C: Table C-1**). Individuals were recorded as early as June and as late as November.

Comparing this species' abundance (number of birds per km^2) within the study area from one year to the next is complicated by disparities in survey coverage between the two years of the study. Several of the blocks with high densities of Cory's Shearwaters for a month in one year of the study received little or no survey coverage in the same month of the other year, such as in August 2008 and August 2009 (**Figures F-28 [aug08] and F-29 [aug09]**). The fact that no surveys were conducted in July 2009 makes data comparison problematic. Although the lack of surveys during July 2009 makes a summer-to-summer comparison impossible, it is fair to note that this species was found during summer 2009 in unprecedented numbers in New England as far north as the Gulf of Maine[1] (M. Iliff pers. comm., D. Lovitch pers. comm.). This phenomenon was apparent when 47 Cory's Shearwaters were recorded on the August 2009 shipboard offshore surveys, compared to only 14 on the August 2008 surveys.

None of the 183 Cory's Shearwaters recorded in flight exceeded an altitude of 7.6 m (25 ft).

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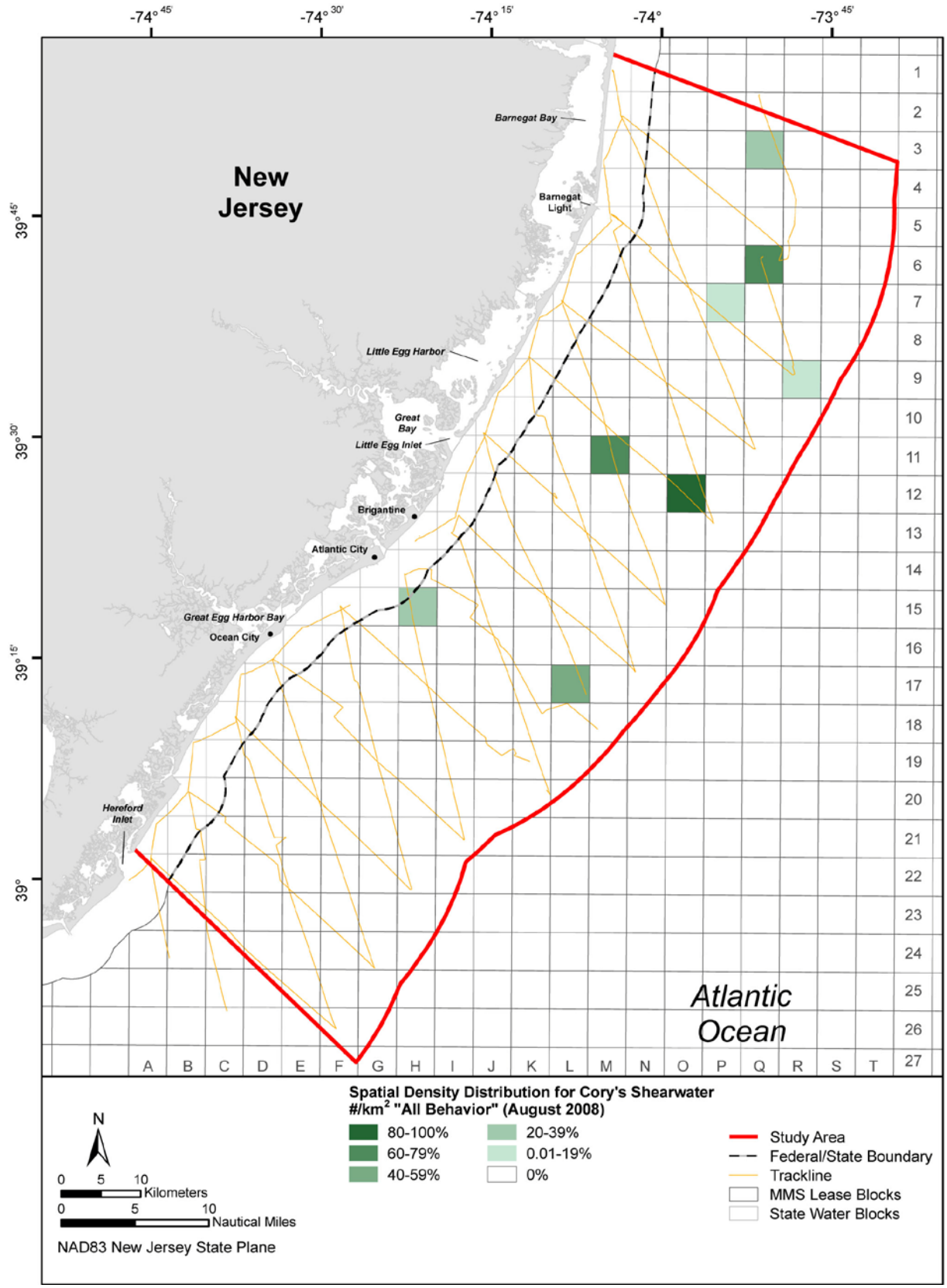

Figure F-28. Percentile abundance of Cory's Shearwater (all behaviors), August 2008 (n=13).

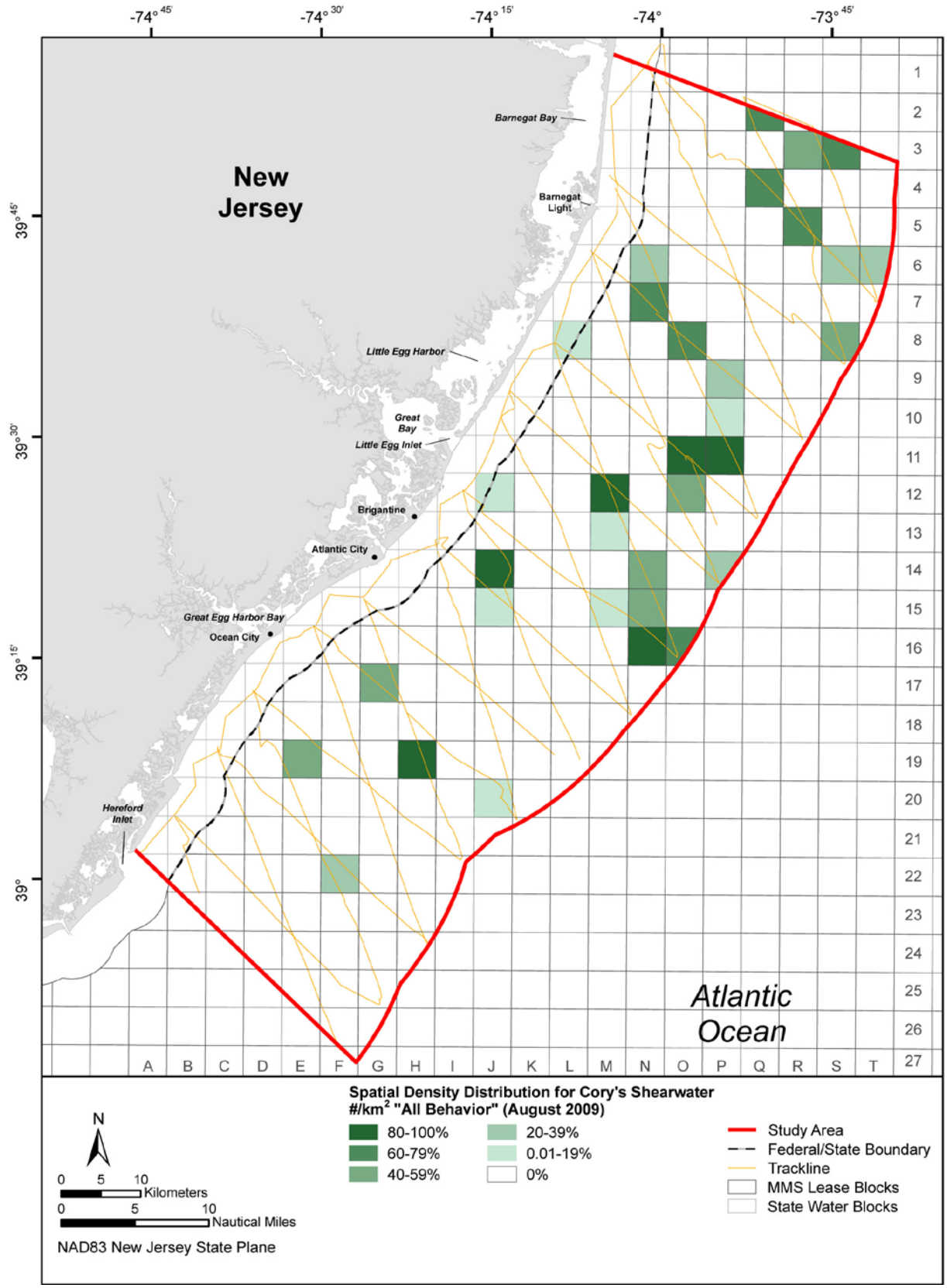

Figure F-29. Percentile abundance of Cory's Shearwater (all behaviors), August 2009 (n=55).

Species Account for Wilson's Storm-Petrel (*Oceanites oceanicus*)

Overall Distribution and Ecology

Wilson's Storm-Petrel is an abundant seabird (Enticott and Tipling 1997; Büßer et al. 2004) with an Antarctic circumpolar breeding range (Copestake and Croxall 1985; Quillfeldt et al. 2005). During the breeding season in the Southern Hemisphere, they feed predominantly upon Antarctic krill (*Euphausia superba*) and migrate north during the austral winter when prey become scarce (Büßer et al. 2004). During the non-breeding season (April to October; Brown 1988), the species is distributed mainly throughout the Atlantic, South Pacific, Indian and Southern Oceans, with small numbers extending north in the eastern Pacific to, at least, California (Sibley 2000) and in the Mediterranean (DoN (Department of the Navy) 2007).

Wilson's Storm-Petrel comes ashore only during the breeding season. This species, as do most members of the Procellariiformes, uses olfaction in foraging (Nevitt 1999; Nevitt et al. 2004). When resting, they may form rafts of tens to hundreds of individuals (Brown 1988). Brown (1988) noted that the species is abundant along the outer edge of the Continental Shelf from Georges Bank to Cape Hatteras, probably due to the topographically-influenced upwellings and convergences of shelf and deeper waters. Wilson's Storm-Petrels also scavenge opportunistically, being known to feed on offal from fishing vessels, as well as on carrion such as dead whales (Payne et al. 1983; DoN [Department of the Navy] 2007).

New Jersey Occurrence

Wilson's Storm-Petrel is distributed off New Jersey in both inshore and offshore waters and can be seen from shore off Cape May Point beginning in May. In the North Atlantic, Wilson's Storm-Petrels begin departing for their breeding grounds in August (Walsh et al. 1999).

Summary of Occurrence during Study

During shipboard offshore surveys in 2008, Wilson's Storm-Petrel numbers were relatively constant in summer, climbed to peak at 1,245 in August, and dropped to just three in September (**Appendix C: Table C-1**); none were seen on coastal surveys. The abundance noted in 2008, both in magnitude and in distribution through the year, is in marked contrast to that of 2009, which had a peak count of only 299 (August), but 247 recorded in September, and 18 during coastal surveys.

In June 2008, Wilson's Storm-Petrels were distributed more uniformly throughout the study area (**Figure F-30 [jun08]**) than they were in June 2009, when there were distinct concentrations in the northern and southern portions of the study area (**Figure F-31 [jun09]**). Note that total summer distributions cannot be compared due to the lack of July 2009 surveys. In August 2008, individuals were distributed more uniformly through the study area, but with a noticeable concentration in the extreme southern area off Hereford Inlet (**Figure F-32 "All Behavior" August 2008**). In contrast, the majority of August 2009 observations occurred in the northern half of the study area, predominantly northward of Brigantine (**Figure F-33 [aug09]**). Fall 2009 (August and September) abundance showed a definite northerly distribution (**Figure F-34**) compared to fall 2008 (essentially August, since only three occurred in September [**Figure F-32 "All Behavior" August 2008**).

Overall, Wilson's Storm-Petrel exhibited a widely scattered presence in the study area, predominantly offshore (**Figure F-35 [overall]**). There did not appear to be any correlation to shoal presence (**Section 2.2.3.1: Figure 2-7**), except for, possibly, within the extreme ends of the study area: in the northern portion off Barnegat Bay and in the southern portion off Hereford Inlet. Although most Wilson's Storm-Petrels were observed flying, none flew within the RSZ (30.5 m to 213.4 m; 100 ft to 700 ft).

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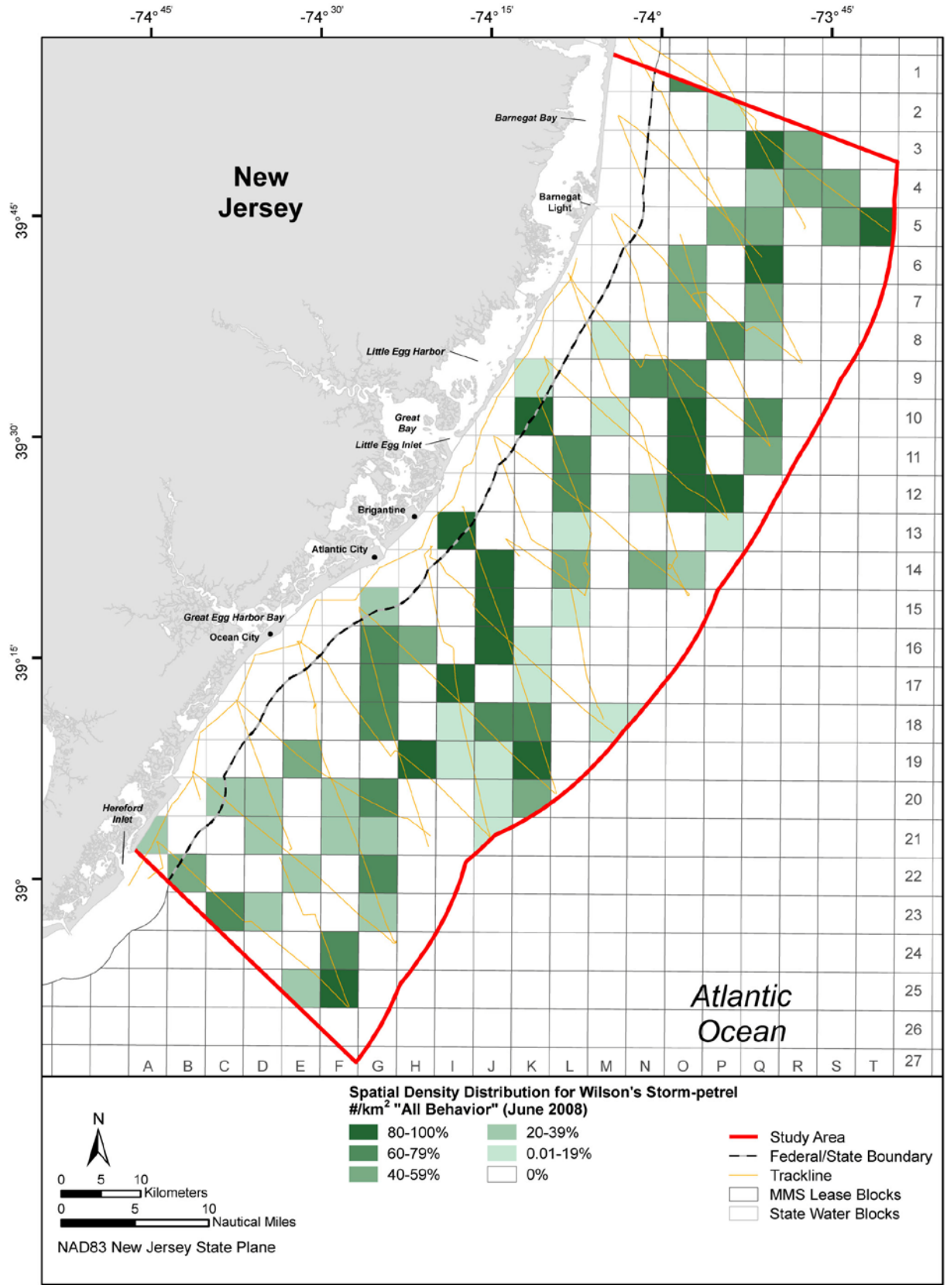

Figure F-30. Percentile abundance of Wilson's Storm-Petrel (all behaviors), June 2008 (n=198).

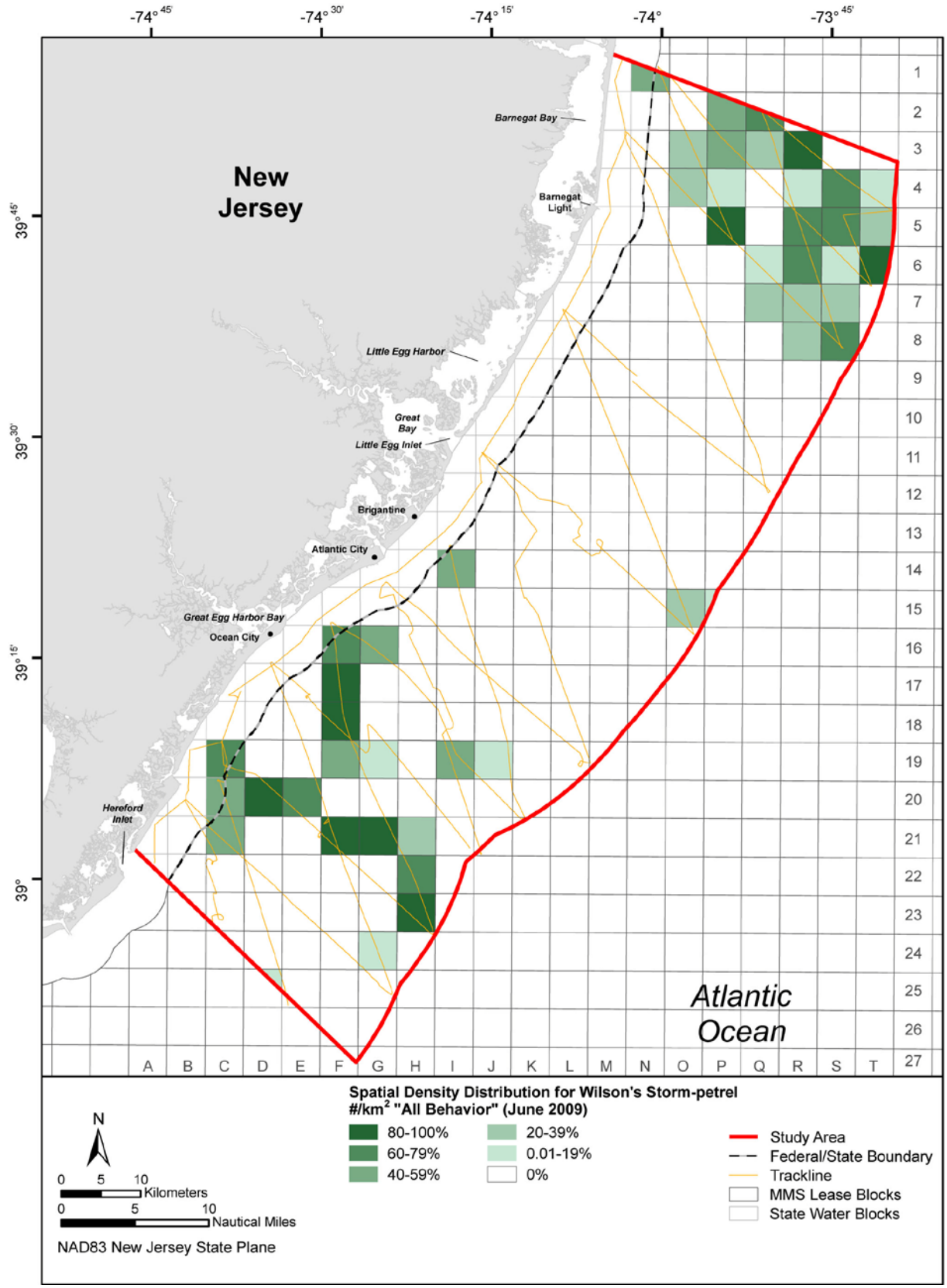

Figure F-31. Percentile abundance of Wilson's Storm-Petrel (all behaviors), June 2009 (n=113).

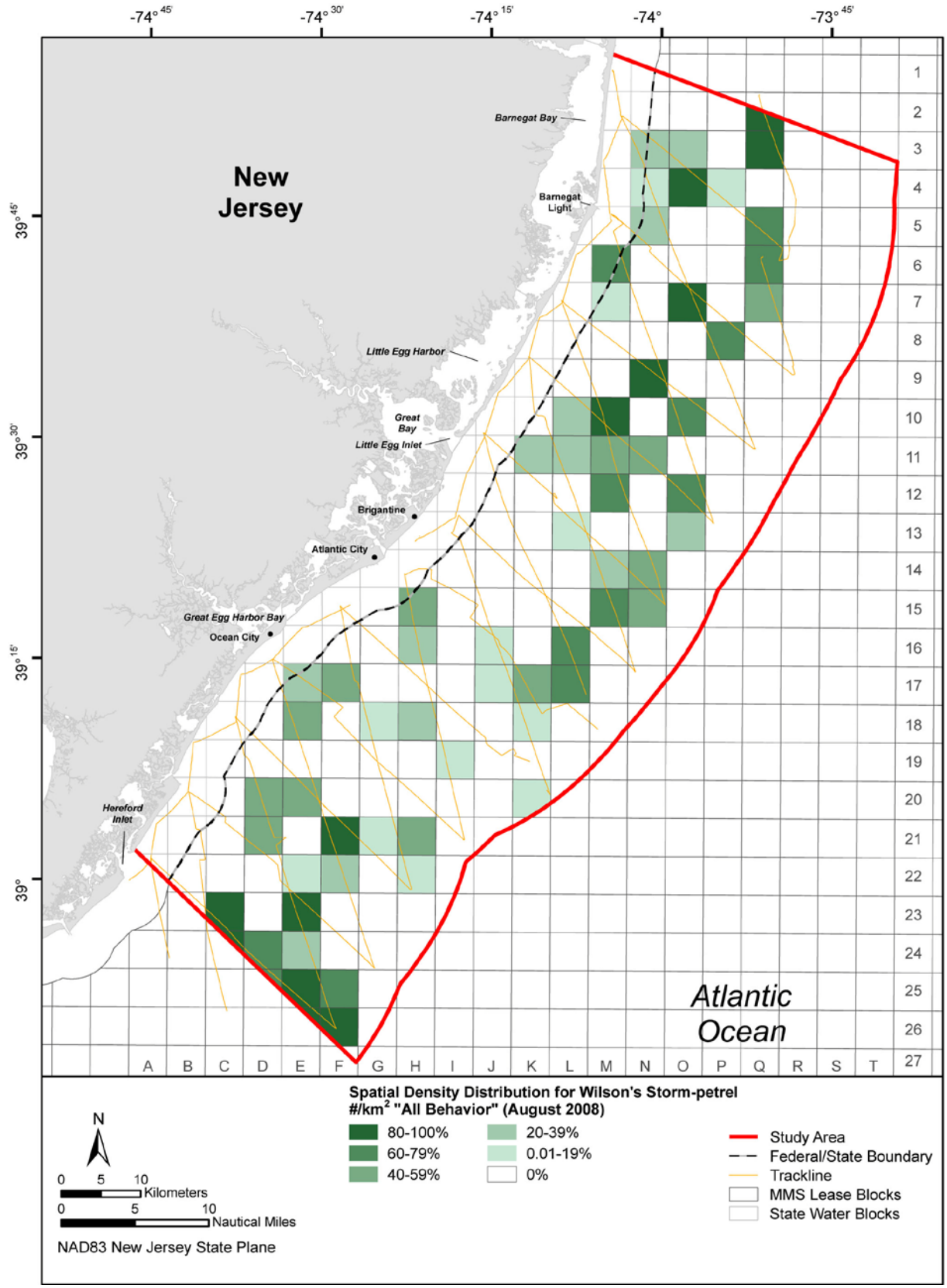

Figure F-32. Percentile abundance of Wilson's Storm-Petrel (all behaviors), August 2008 (n=1,245).

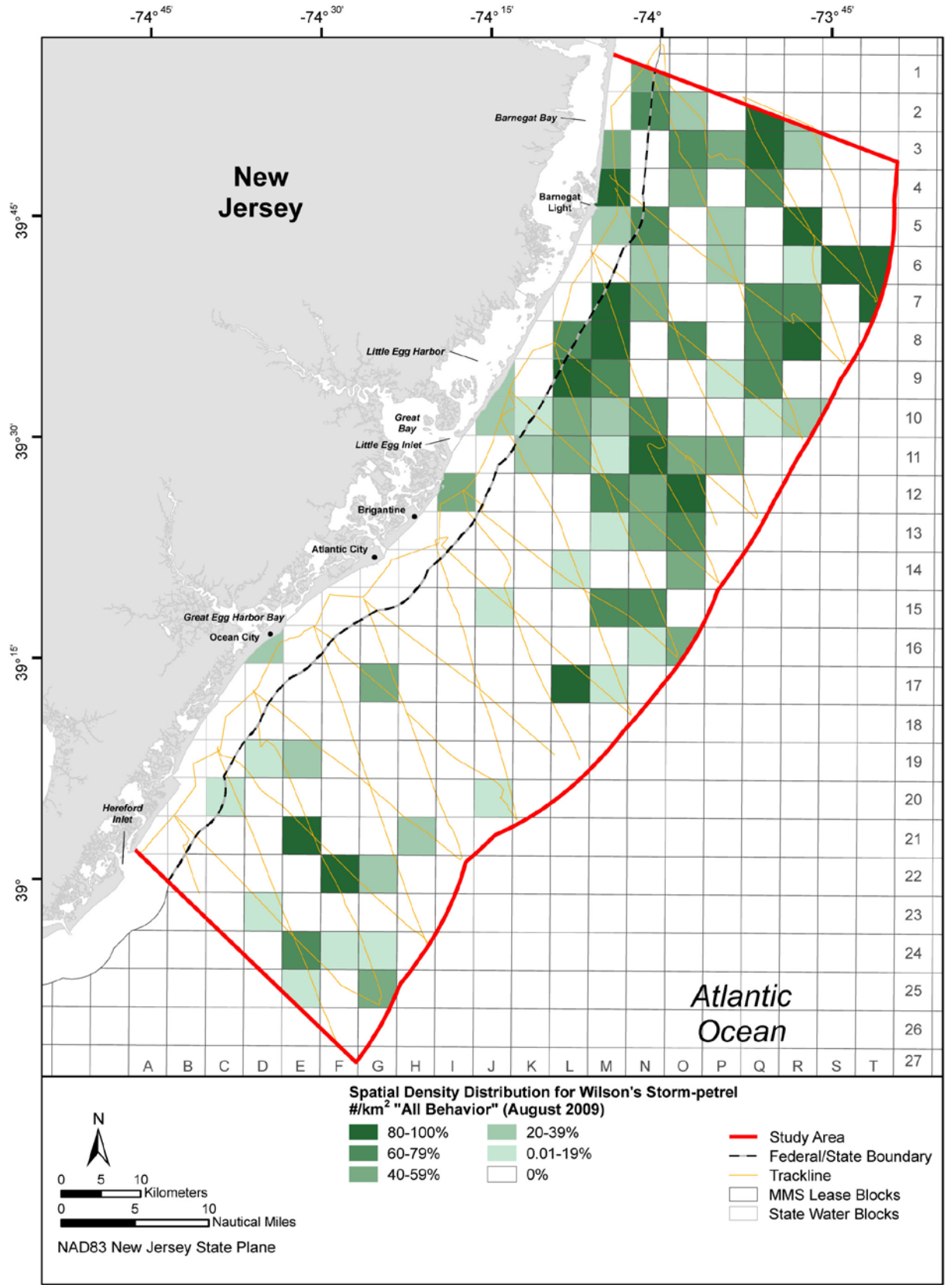

Figure F-33. Percentile abundance of Wilson's Storm-Petrel (all behaviors), August 2009 (n=322).

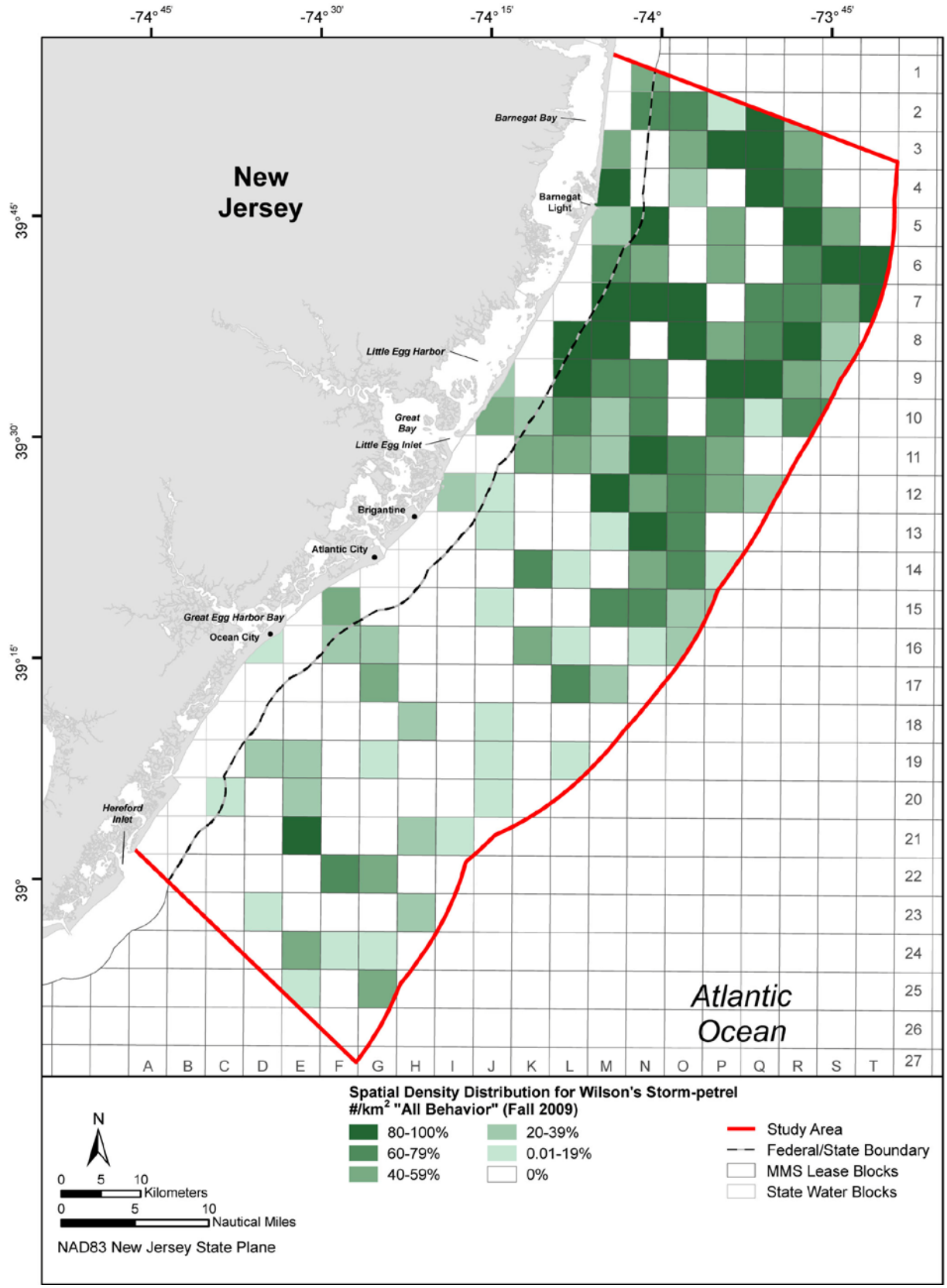

Figure F-34. Percentile abundance of Wilson's Storm-Petrel (all behaviors), Fall 2009 (August-November 2009) (n=570).

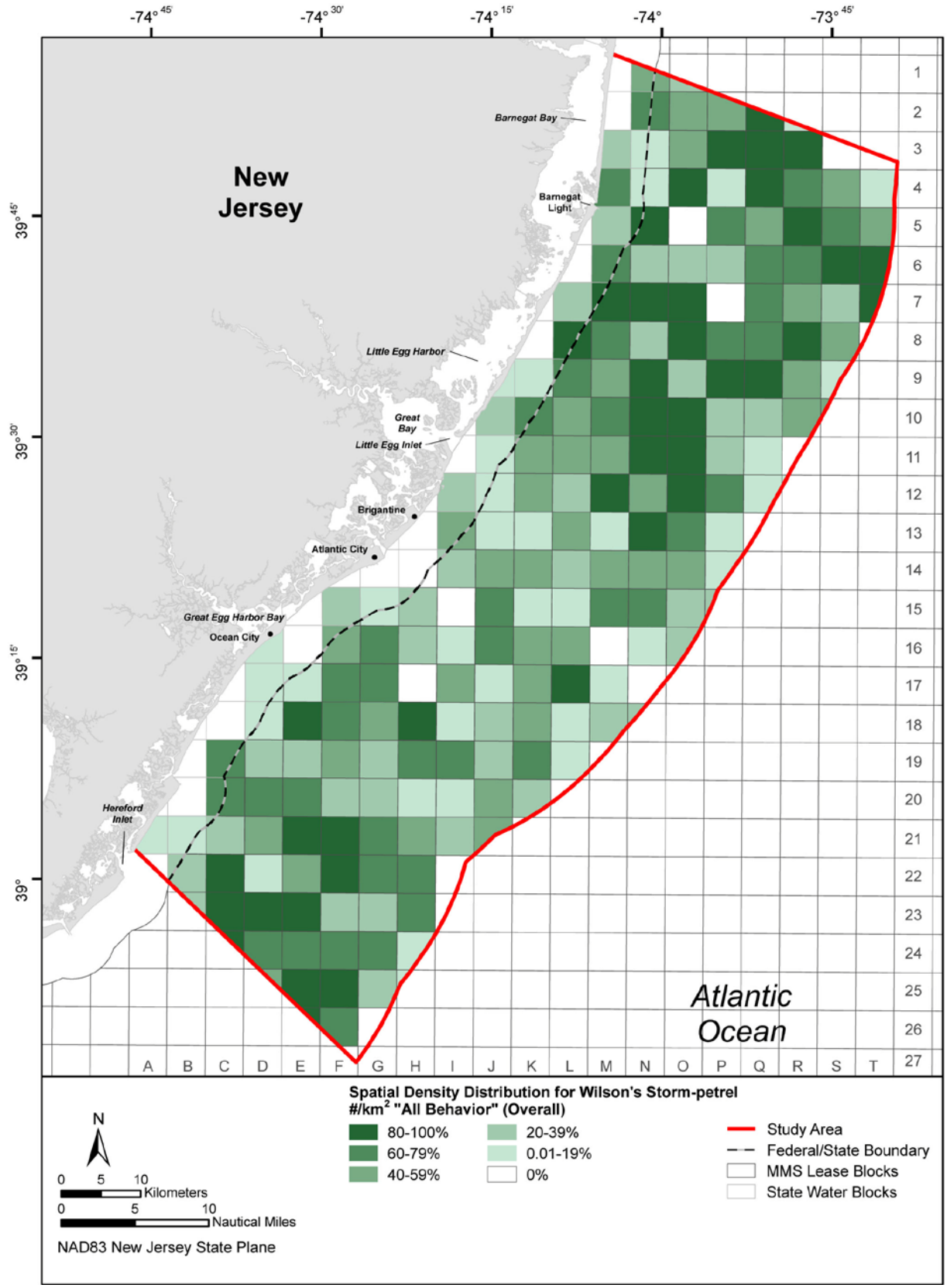

Figure F-35. Percentile abundance of Wilson's Storm-Petrel (all behaviors), January 2008-December 2009 (n=2,339).

Species Account for Northern Gannet (*Morus bassanus*)

Overall distribution and ecology

Northern Gannet is endemic to the North Atlantic, occurring in near-coastal waters on both sides of the Atlantic Ocean south to Florida in the west and to northwest Africa in the east (Mowbray 2002). The species breeds in North America at six major colonies, three each in Quebec and Newfoundland (Mowbray 2002). In the eastern Atlantic, there are at least 32 established colonies and the species occupies 48° of latitude from Norway to France (Mowbray 2002). Birds on both sides of the ocean move south for the winter, with most leaving the breeding range on the western side. The species primarily obtains food by plunge diving from heights up to 40 m (131.2 ft; Mowbray 2002) and diving to depths down to 15 m (49.2 ft; Garthe et al. 2000). Principle prey species include surface-schooling fish, particularly capelin (*Mallotus villosus*), sandlance (*Ammodytes hexapterus*), herring (*Clupea harengus*), and menhaden (*Brevoortia* spp.), and invertebrates such as long-finned squid (*Loligo pealei*; Mowbray 2002). The species is particularly known to exploit such fish when schools are forced to the surface by predatory fish species, such as bluefish (*Pomatomus saltatrix;* Mowbray 2002).

Birds depart breeding grounds and surrounding waters from late September (juveniles) through mid- to late October (adults), with the last birds leaving by early November (Mowbray 2002). Fall migrants appear to be mostly restricted to the continental shelf in the western Atlantic. Winter distribution ranges from just south of the breeding grounds into the Gulf of Mexico (Dunn and Alderfer 2006), with adults remaining closer to the breeding grounds than do younger birds (Mowbray 2002). However, contra Mowbray (2002; and references therein), the vast majority of Northern Gannets wintering in New Jersey waters are adults and even the younger birds present are of older age classes.

Northward movement in spring begins in late February (adults), through early March (subadults), to April (immatures), and continues into early June (Mowbray 2002). Spring migrants seem to be less restricted to the continental shelf, as many are reported well offshore at this season; they may be taking a straighter course from more southerly wintering areas directly to the breeding grounds and avoiding the more sinuous, coast-following track of fall migration. From May through September, Northern Gannets are primarily concentrated around the breeding colonies, with even most non-breeders (of varying age classes) returning north to or near the breeding grounds, as the species is found in northwestern Atlantic Ocean waters south of the breeding range in relatively small numbers (**Appendix C: Table C-1**; Walsh et al. 1999; M. Iliff pers. comm., 15 February 2010; D. Lovitch pers. comm., 15 February 2010.), with a large percentage of those being first-cycle birds (Mowbray 2002).

New Jersey Occurrence

In New Jersey, Northern Gannets utilize primarily coastal-shelf waters, being generally most common within a few miles of land, though with dispersion out to 40 km (21.6 NM) or so from shore (Walsh et al. 1999). Sporadic individuals can be found at farther distances from shore in some seasons. The species is common to abundant in the state during most migration periods (March – May and October – December) and is found in variable densities in winter (Walsh et al. 1999).

Summary of Occurrence during the Study

Northern Gannets occurred in all seasons of the survey period (**Appendix C: Table C-1**). The species was most common within state waters (i.e., within 3 NM of the coast), but with relatively high abundance (number of birds per km^2) farther offshore in the extensive shoals area near the southern boundary of the study area (**Figure F-36** hot spot NOGA overall map, **Appendix M: Figure M-522** overall kernel density NOGA map) and, in 2009, around the shoal in block 42 near the northeastern corner of the study area (**Appendix M: Figure M-504** 2009 kernel density NOGA map). Though Northern Gannets were recorded throughout the study area, in both the northern and southern parts, densities fell off just inshore from the offshore boundary (**Appendix M: Figure M-498** 2008 kernel density NOGA map), matching well with previously observed abundance patterns in the state's marine waters. Distribution in the two years (2008, 2009), although similar in coastal affinity, differed in latitude of concentration of abundance (**Figures F-37**

hot spot NOGA 2008 map and **F-38** hot spot NOGA 2009 map) and density (**Appendix M: Figure M-498** 2008 kernel density NOGA map and **Appendix M: Figure M-504** 2009 kernel density NOGA map), with a northward shift in 2009.

Abundance varied greatly across survey type, with shipboard offshore surveys ranging from 0.10 (per km per season) to 1.54 and small-boat coastal surveys ranging from 0.05 to 3.77 (**Appendix C: Table C-1**). Seasonal offshore and inshore abundance did not vary in concert (**Appendix C: Table C-1**). This lack of concordance was almost certainly due to the facts that the two survey types were never conducted concurrently and that small-scale distribution of the species (as with most) varied from day to day.

Monthly analysis of the distribution of abundance might be useful for examining the transition from what might be termed the static winter distribution of the species to the dynamic distribution of spring migration, as the departure from New Jersey waters is an extended process (see above). However, **Figures F-39** hot spot NOGA Jan08 map and **F-40** hot spot NOGA Apr08 map illustrate the shortcomings of doing so. Although there are interesting differences in apparent distribution between January (winter) and April (spring) of 2008, examination of the tracklines point out that these are largely due to differences in area surveyed in the two months. April shows a concentration of abundance near the shoal in block 42 that was lacking in January, but that area was not surveyed in January.

Abundance on shipboard offshore transects was highest in winter (1.54/km) and spring (1.35) 2008, a time of extraordinary abundance in the study area, particularly in Cape May County (J. Dowdell pers. comm., M. O'Brien pers. comm.). In fact, abundance figures were 2 times or more those of the season of next-highest abundance (0.63 in spring 2009; **Appendix C: Table C-1**). After spring 2008, abundance on these transects varied between 0.35 and 0.63, except for the lowest abundance for the study for this survey type, 0.10 in summer 2008. It seems that winter abundance may not be an indicator of abundance in the following summer.

Abundance on small-boat coastal transects was highest in fall 2008 (3.77/km) and lowest in summer 2009 (0.05). The high abundance in fall 2008 was due to very large numbers of migrating individuals detected on the small-boat coastal survey associated with the November shipboard offshore survey (conducted on 1 December; 6.92) in the peak of fall migration in New Jersey for this species.

Distribution in spring 2009 (**Figure F-41** hot spot NOGA spring09 map) exhibited an offshore shift of abundance from that of the preceding winter (**Figure F-42** hot spot NOGA winter09 map). This difference seems to support the contention that the species may utilize a more direct migration route in spring than in fall (see above). Finally, despite much lower sample sizes, results from summer surveys were effective in illustrating distinctly different distributions across years. In June 2008, most of the 171 individuals were in the northern half of the study area (**Figure F-43** hot spot NOGA jun08 map), while in summer 2009 (**Figure F-44** hot spot NOGA jun09 map), many of the individuals were in Cape May County (southern) waters. Effort was similar in the two Junes, both in distance covered on shipboard offshore transects (887 km in 2008, 782 in 2009) and in distribution (**Figures F-43 [2nd ref to jun08] and F-44 [2nd ref to jun09]**), so the figures represent a real difference in Northern Gannet distribution in those seasons.

Nearly 66% of Northern Gannets in active fall migration were found within 5.6 km (3 NM) of shore and 76% were within 9.3 km (5 NM) of shore (**Section 4.3.3: Figure 4-3**). These data suggest that the annual migrant-waterbird count conducted each fall at Avalon, New Jersey, by the Cape May Bird Observatory is efficacious in documenting and monitoring this phenomenon.

Although this species was found, on a percentage basis, to be rare within the RSZ (**Section 2.3.3.2: Table 2-8**), the sheer number of Northern Gannets present in the study area meant that it was the second most numerous species within the RSZ. The facts that Northern Gannet forages on the wing, takes four to seven years to reach maturity, and lays only one egg per breeding season make it perhaps, the most likely species to be impacted negatively were there to be turbine-related mortalities within the study area.

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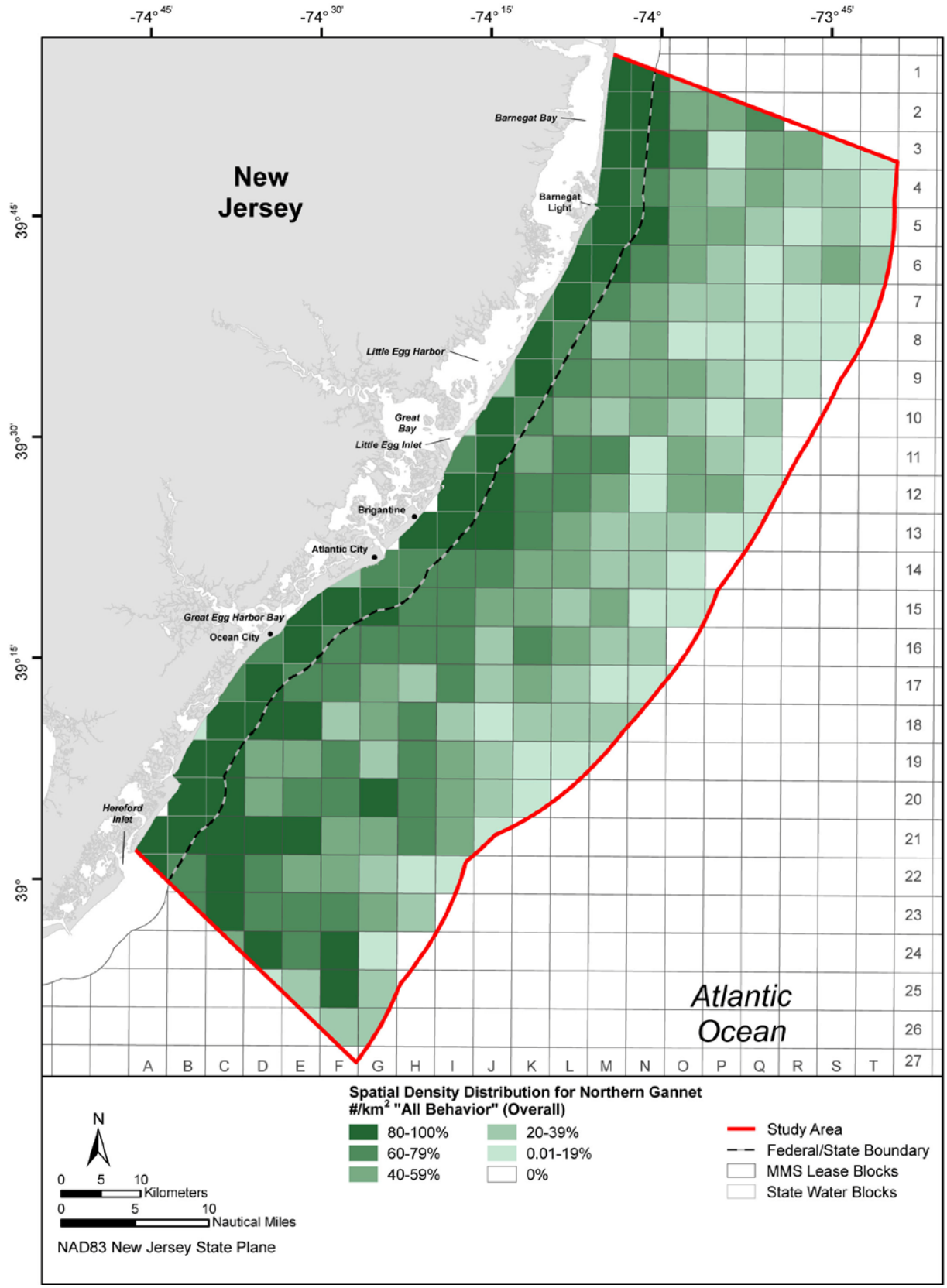

Figure F-36. Percentile abundance of Northern Gannet (all behaviors), January 2008-December 2009 (n=10,539).

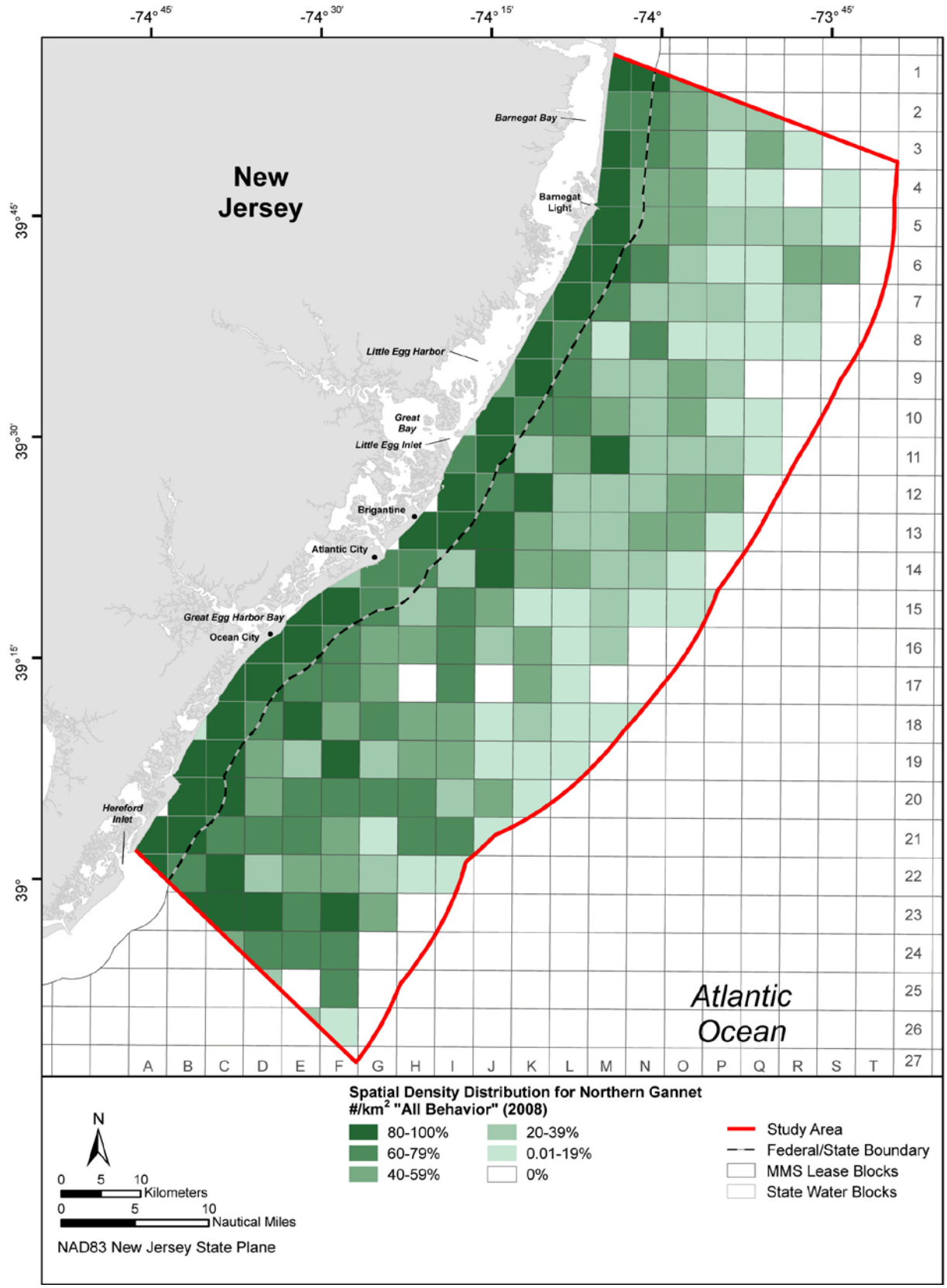

Figure F-37. Percentile abundance of Northern Gannet (all behaviors), January-December 2008 (n=5,557).

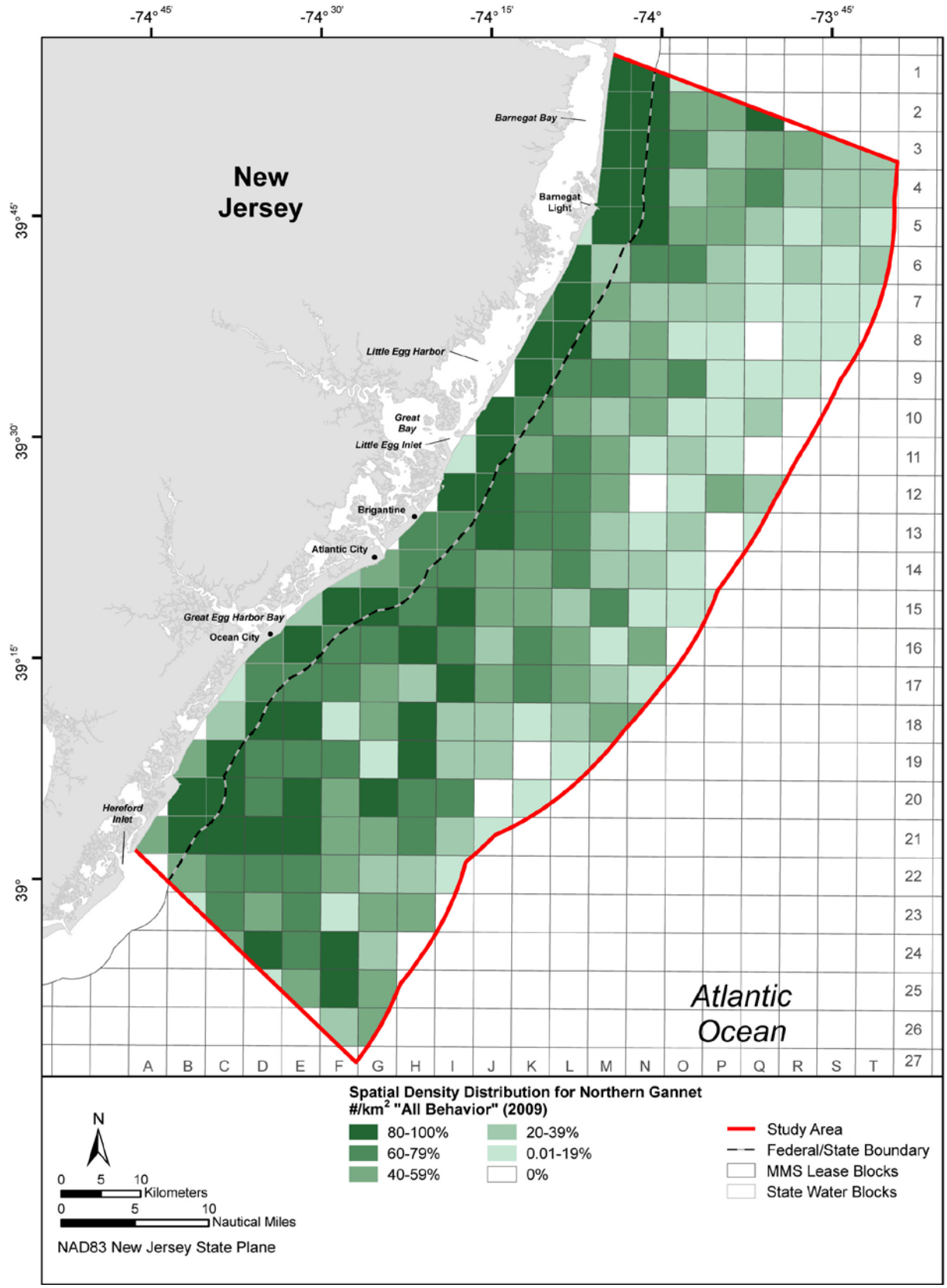

Figure F-38. Percentile abundance of Northern Gannet (all behaviors), January-December 2009 (n=4,982).

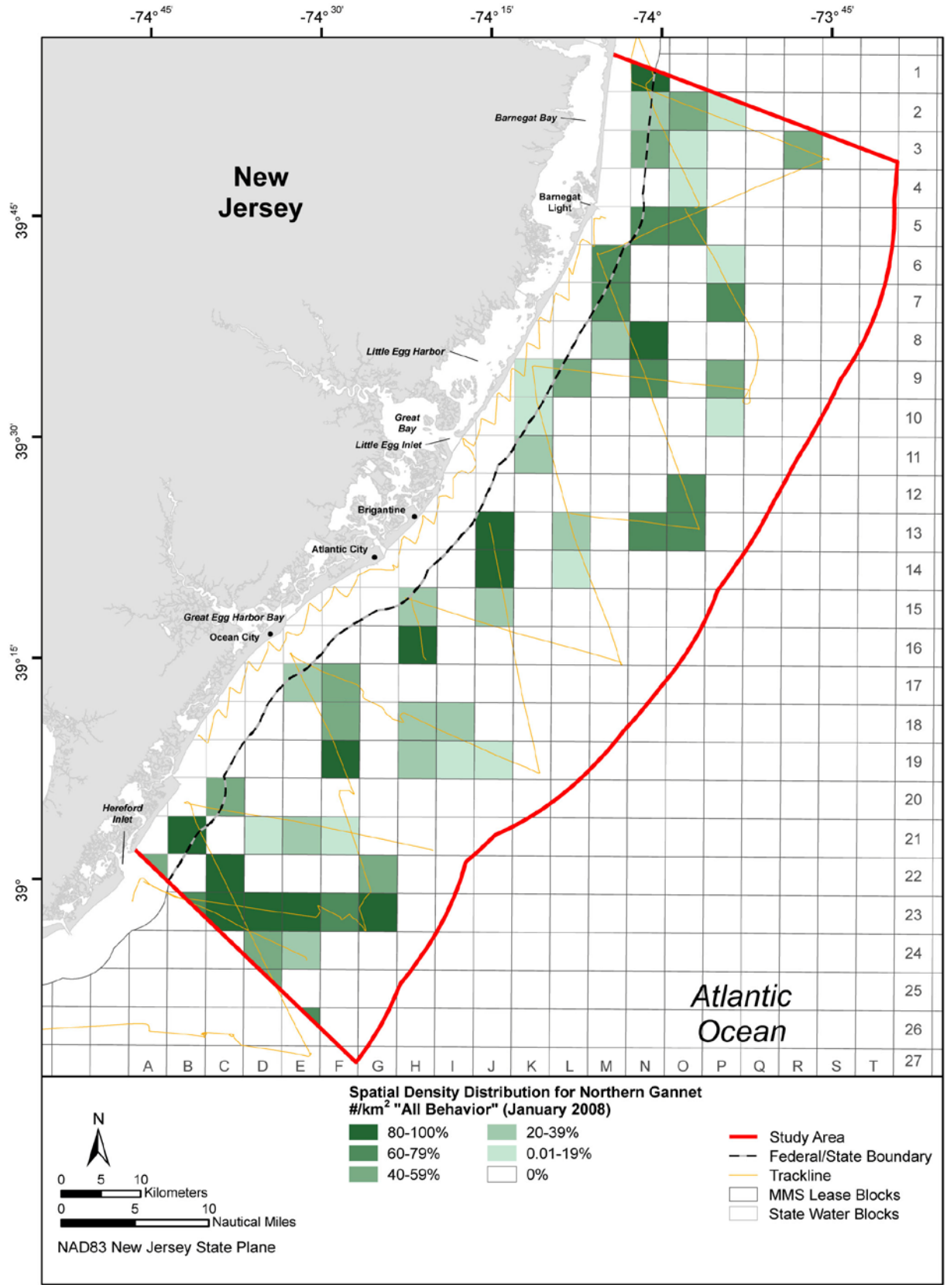

Figure F-39. Percentile abundance of Northern Gannet (all behaviors), January 2008 (n=357).

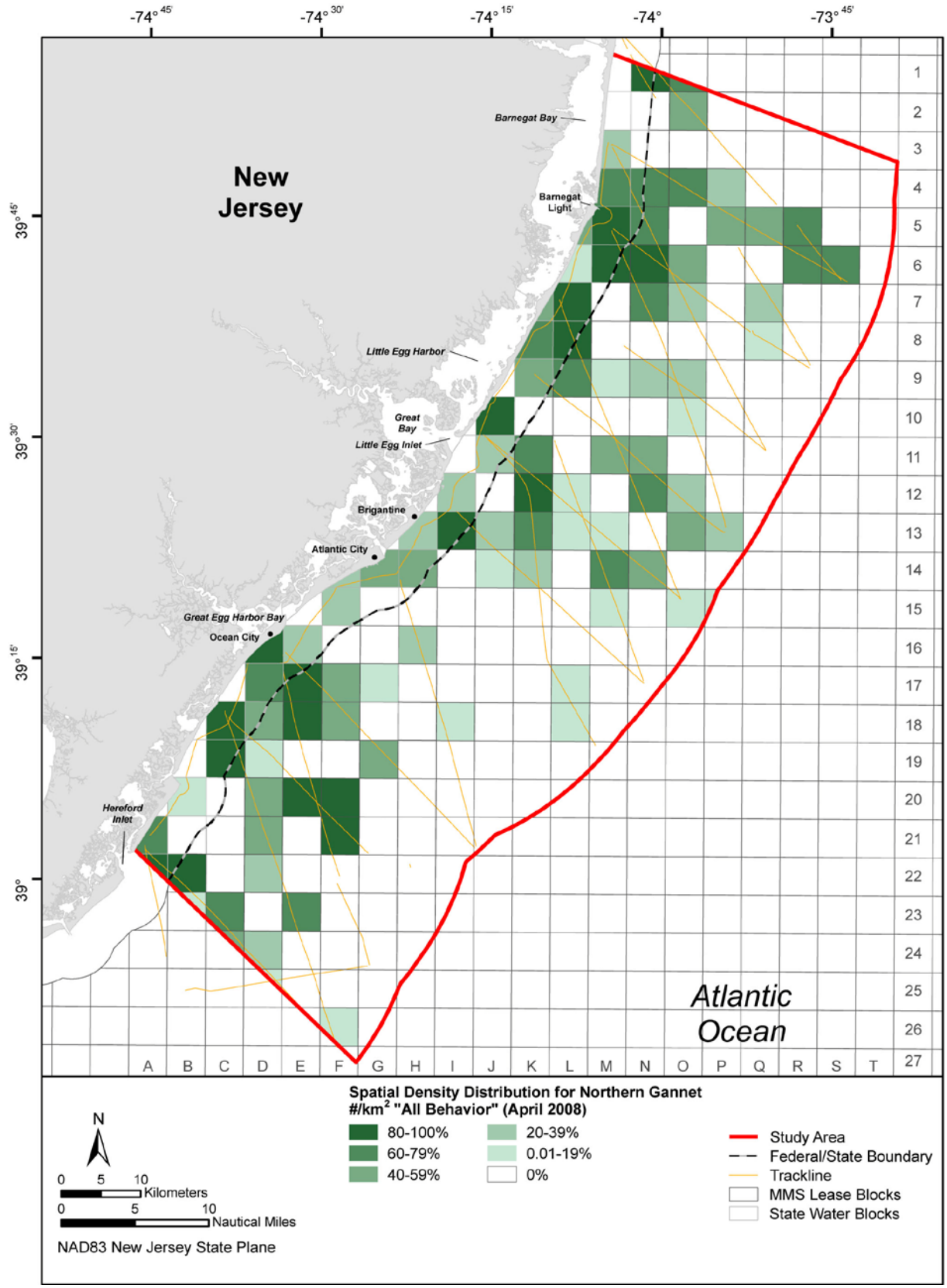

Figure F-40. Percentile abundance of Northern Gannet (all behaviors), April 2008 (n=492).

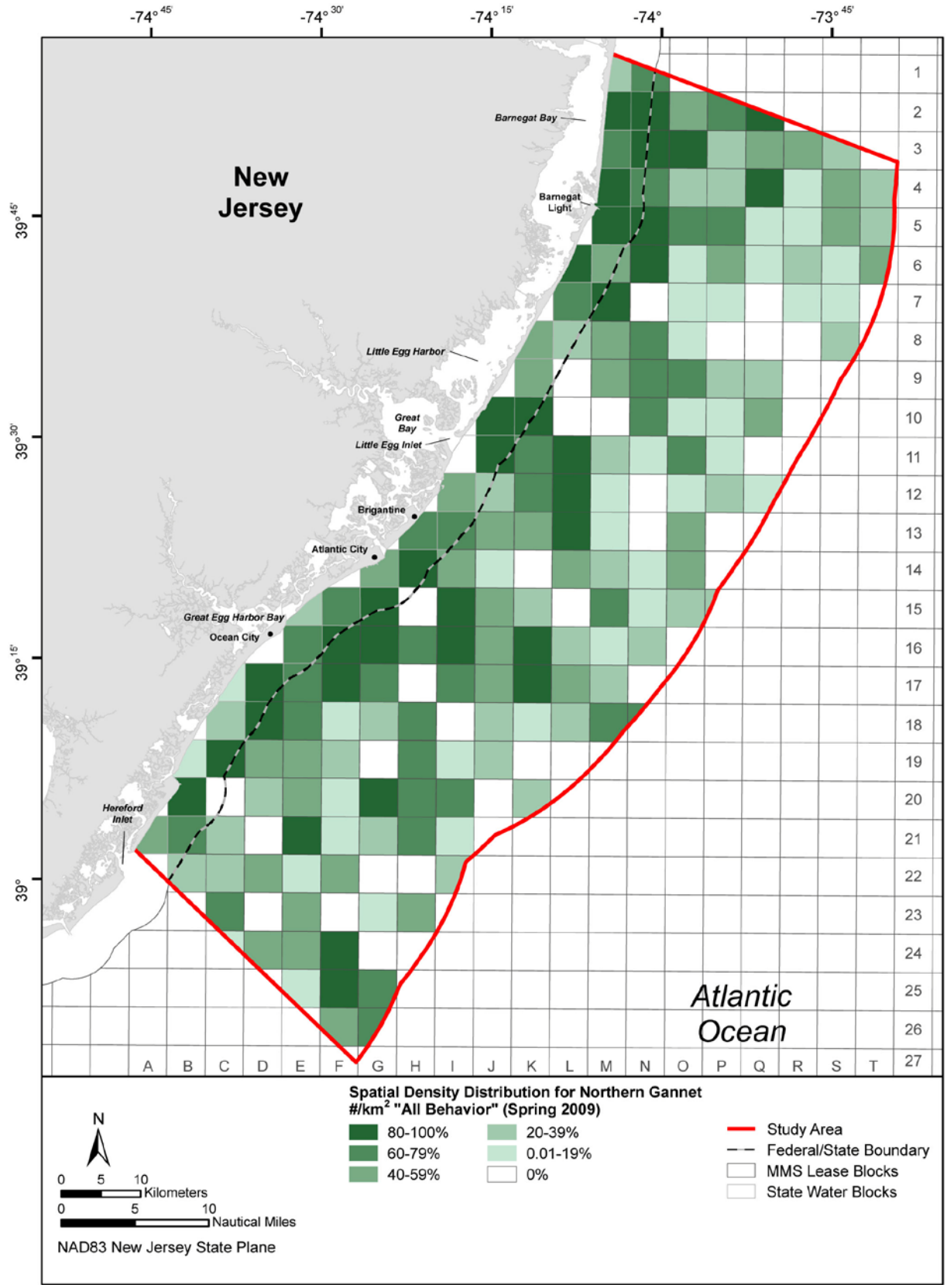

Figure F-41. Percentile abundance of Northern Gannet (all behaviors), Spring 2009 (March-May 2009) (n=1,430).

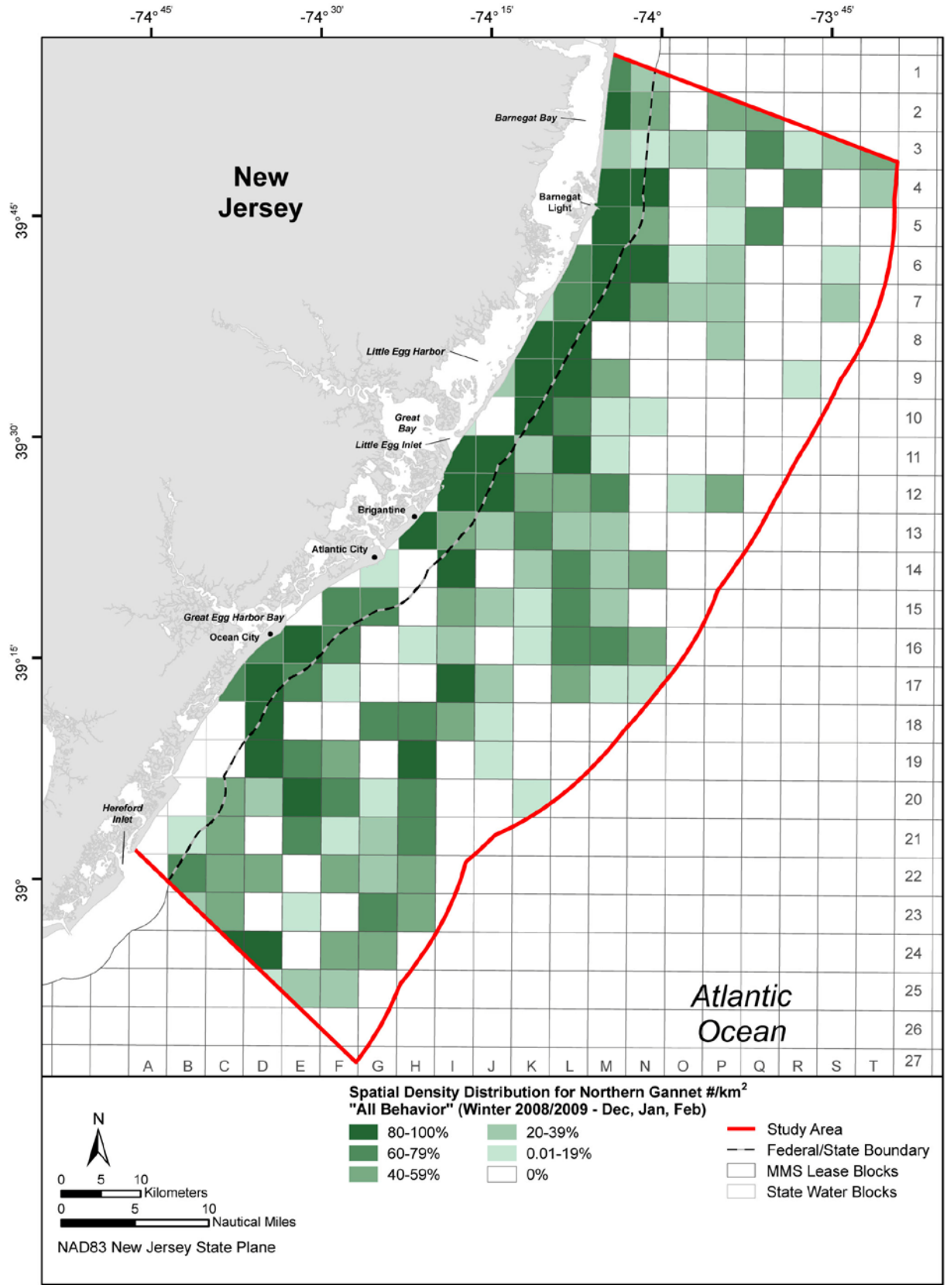

Figure F-42. Percentile abundance of Northern Gannet (all behaviors), Winter 2009 (December 2008-February 2009) (n=913).

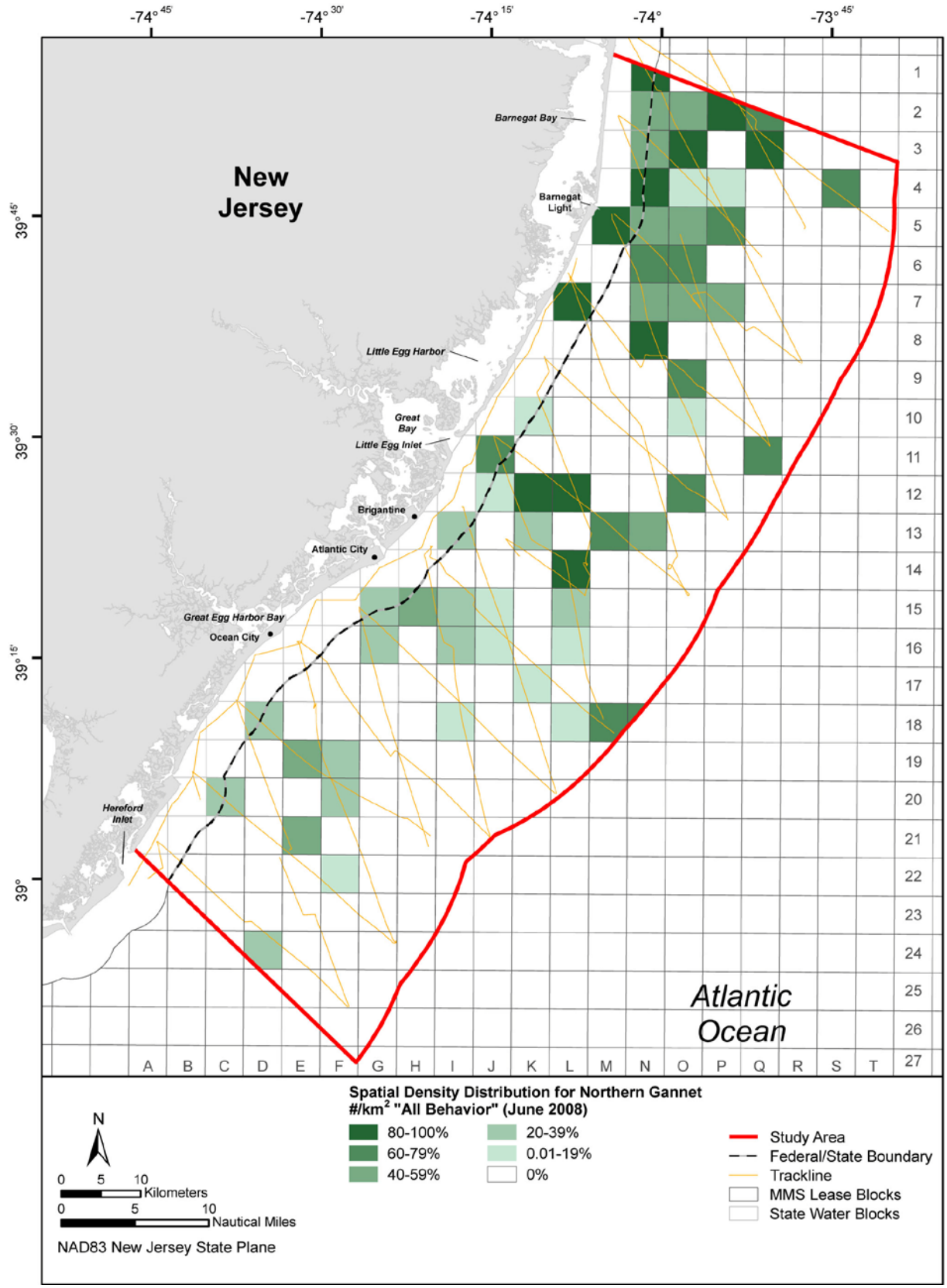

Figure F-43. Percentile abundance of Northern Gannet (all behaviors), June 2008 (n=124).

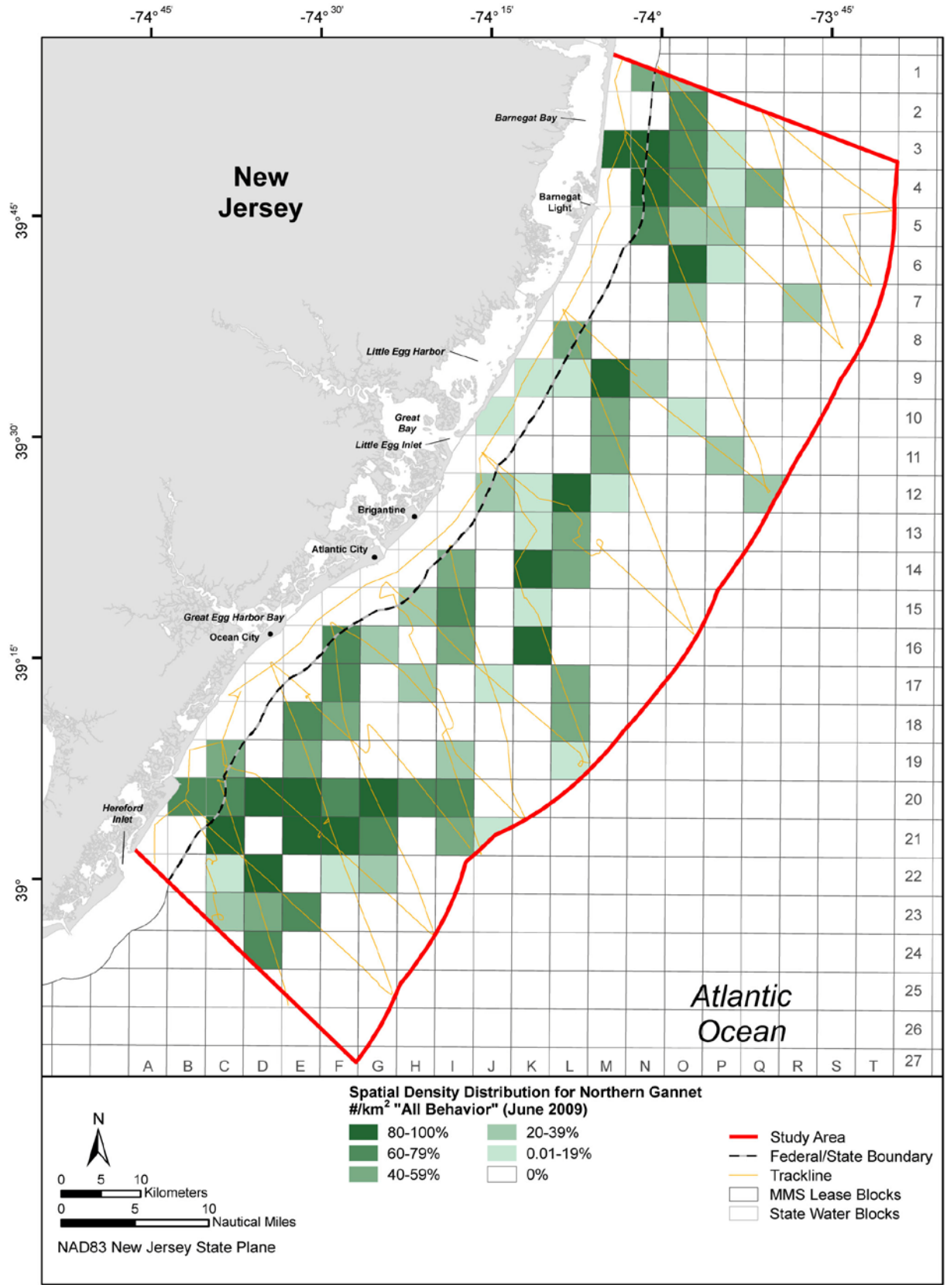

Figure F-44. Percentile abundance of Northern Gannet (all behaviors), June 2009 (n=282).

Species Account for Whimbrel (*Numenius phaeopus*)

Overall Distribution and Ecology

Whimbrel is the only species of curlew occurring in both the Nearctic and Palearctic. Breeding populations of the North American race, *N. p. hudsonicus*, occur in open habitats of subarctic and alpine tundra and taiga of Alaska/Northwest Canada and the west coast of the Hudson Bay (Skeel and Mallory 1996). The entire North American population vacates breeding grounds in mid- to late summer. This species forages on a wide variety of marine invertebrates as well as insects and berries, depending on the availability of these food items (Skeel and Mallory 1996).

Birds depart breeding grounds during summer, with non-breeders moving as early as late June and breeders moving from mid-July to Late August (Handel and Dau 1988). Winter range is vast, with birds occupying Atlantic and Pacific coasts from North Carolina and Vancouver Island, British Columbia, south to Chile and Argentina. Northbound migrants in the eastern U.S. stage along the Gulf of Mexico and Atlantic coasts north to New Jersey from March through April before departing for the Arctic by way of the Great Lakes (Skeel and Mallory 1996).

New Jersey Occurrence

In New Jersey, Whimbrels occur as transients during spring and fall migration. Individuals are often seen foraging in intertidal zones for preferred food items such as small brachyuran crabs. Northbound flocks are seen along Atlantic coast and adjacent tidal marshes most frequently from mid-April to mid-May (Walsh et al. 1999). Southbound individuals may appear in New Jersey as early as June, although peak abundance occurs from mid-July through early September (Walsh et al. 1999).

Summary of Occurrence during the Study

As would be expected with a species so closely tied to the coast, most individuals (49 of 52) were recorded on the small boat coastal survey-all in July 2008 (**Figure F-45**). This total placed Whimbrel ninth in total overall abundance for summer 2008. Although Walsh et al. (1999) states that many Whimbrels migrate far offshore in the fall, only three individuals were recorded on the shipboard offshore surveys.

No individuals of this species were recorded in the RSZ.

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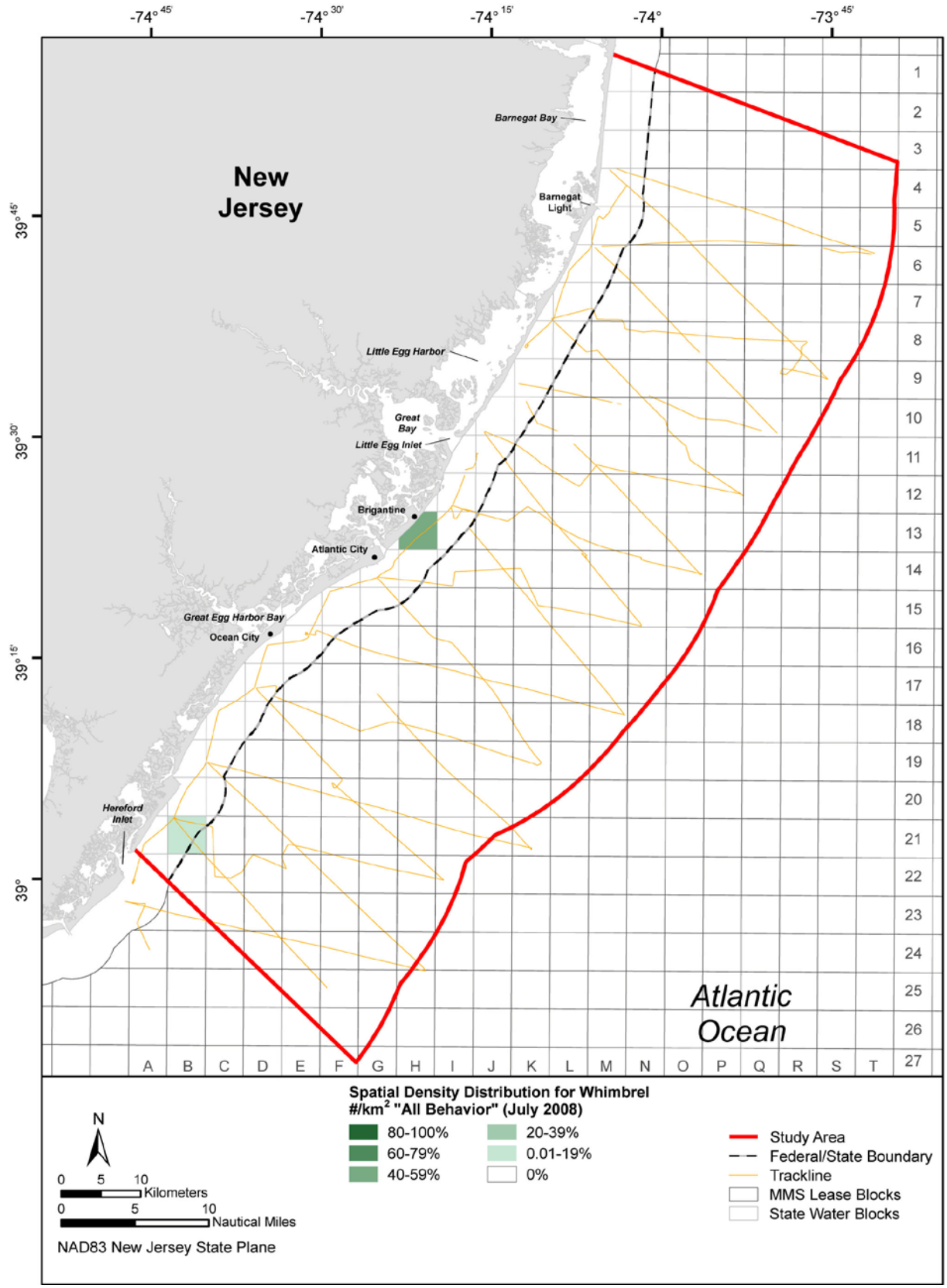

Figure F-45. Percentile abundance of Whimbrel (all behaviors), July 2008 (n=49).

Species Account for Laughing Gull (*Larus marinus*)

Overall Distribution and Ecology

Laughing Gull is a coastal resident of the New World on both coasts, breeding in the United States from Maine south to Florida and through the Gulf of Mexico to southern Texas. It breeds locally in the Greater and Lesser Antilles, in the Yucatan region of Mexico, the Gulf of California, and the Pacific coast of central Mexico (Burger 1996, Dunn and Alderfer 2006). The species' winter range is considerably more extensive, extending from Maryland and central Baja south along both coasts, and through the West Indies, to northern South America (Burger 1996). The species is a widespread vagrant nearly throughout the Americas and in Europe, Hawaii, northern Africa, and Australia (Burger 1996). A New Jersey-banded nestling was recovered in Hawaii in December 1979 when <6 months old (Telfer and Shisler 1981). Laughing Gulls are catholic and opportunistic predators of terrestrial and aquatic invertebrates, fish, eggs, and berries; where available, human refuse is also foraged extensively (Burger 1996).

Adult and juvenile Laughing Gulls disperse from breeding colonies in July, with southward migration beginning in September and extending through December (Belant and Dolbeer 1993). Laughing Gulls from the northeastern United States (including New Jersey) generally winter in Central and South America (Belant and Dolbeer 1993). Wintering adults probably begin leaving wintering areas in February, as migrants begin returning to breeding areas north of the winter grounds in March. Spring migration continues through May (Belant and Dolbeer 1993), with many immatures, which do not breed in their first summer, probably continuing migration into June (inferred from data presented in Belant and Dolbeer 1993). Foraging range data for the species are absent or very limited.

New Jersey Occurrence

Laughing Gull is one of the typical and most common breeding birds of New Jersey's extensive coastal and back-bay salt marshes, with the state hosting a fairly large percentage of the species' U.S. breeding population (Burger 1996). In the state, it breeds along the coast from about Barnegat south to Cape May (Walsh et al. 1999), with breeding adults foraging over extensive areas of marine and estuarine waters, along both the coast and the bayshore, and inland in tilled fields, parking lots, and landfills. Adult Laughing Gulls banded and color-marked at a landfill in Bucks County, Pennsylvania, in April have been noted along the New Jersey coast only days later (C. Dooley pers. comm.), suggesting that individuals make daily commutes across the state to forage, at least in spring. Though abundant in summer and both migration seasons, the species is absent or virtually so in winter, with nearly all individuals having departed before December. The species is among the first breeding species to return in spring, with first arrival, usually in Cape May County, occurring in early March.

Summary of Occurrence during the Study

The species was present throughout the study area, with abundance (number of birds per km^2) concentrated coastally and with a drop-off in abundance near the offshore boundary of the study area (**Figure F-46** hot spot LAGU overall map). Unlike Herring and Great Black-backed Gull, Laughing Gull abundance offshore showed no particular concentration in the north of the study area, rather being nearly uniform in distribution from north to south (**Figure F-46 [2nd ref]**). Interestingly, **Figure F-46 [3rd ref]** shows a concentration of abundance at the shoal area in block 42, the only such concentration beyond 16 km (8.6 NM) or so from shore.

Numbers of Laughing Gulls (and most other offshore-foraging breeding species) were greatly depressed in 2009 relative to 2008 and other years. The distributions of 2009 (**Figure F-47** hot spot LAGU 2009 map) and 2008 (**Figure F-48** hot spot LAGU 2008 map) illustrate this, as the species was less uniform in distribution offshore in 2009 than in 2008. Considering the similar effort conducted during shipboard offshore surveys in the primary period of Laughing Gull occurrence in New Jersey — April through November — in the two years (excluding July, for which there was no 2009 effort: 5,359 km [2,893.7 NM] in 2008 and 4,924 km [2,658.7 NM] in 2009), this illustrated difference is probably real. The cause may well have been the disruption of breeding activities occasioned by the moon high-tide event in early June

2009 that washed out the first nesting attempts of most breeding gulls and terns in the back-bay marshes and coastal islands, at least in Cape May County (D. Freiday pers. comm.). It was hypothesized by many that a large percentage of individuals abandoned nesting attempts for the season and departed the study area well ahead of typical departure dates. Abundance on the shipboard offshore transects in the summers of the two years was identical (0.30/km; **Appendix C: Table C-1**), although there was no July 2009 effort, and distribution in June 2008 and june 2009 was quite similar (**Figures F-49** hot spot LAGU Jun09 map and **F-50** hot spot LAGU Jun08 map). However, August distributions were quite different and were noticeable in both the relevant abundance maps (**Figures F-51** hot spot LAGU Aug09 map and **F-52** hot spot LAGU Aug08 map) and density maps (**Appendix M: Figures M-156** kernel density LAGU aug08 map and **M-221** kernel density LAGU aug09 map, with 2009 exhibiting a much more patchy at-sea distribution, suggesting that considerably smaller numbers were present. Even more interesting is that in August 2008 (**Appendix M: Figure M-156** kernel density LAGU aug08 map), the location of highest density in the study area is in block 194 at Avalon, while the whole coast of Cape May County exhibits low density of the species in August 2009. These various data provide support for the hypothesis.

Abundance differed greatly between the two survey types (**Appendix C: Table C-1**), ranging from 0.25 to 2.24 on the small-boat coastal transects and from 0.06 to 0.89 on the shipboard offshore surveys. As the species has a strong coastal affinity, this is not surprising.

A bit less than 60% of fall-migrant gulls in active migration were found within 5.6 km (3 NM) of shore and around 70% were within 9.3 km (5 NM) of shore (**Section 4.3.3: Table 4-5**). Laughing Gull is a component species of the group, but the distribution of the species was shifted slightly offshore from that of the group as a whole. As analyses were not conducted on individual gull species, that hypothesis has not been tested. Only 3.8% of all flying Laughing Gulls were recorded within the RSZ.

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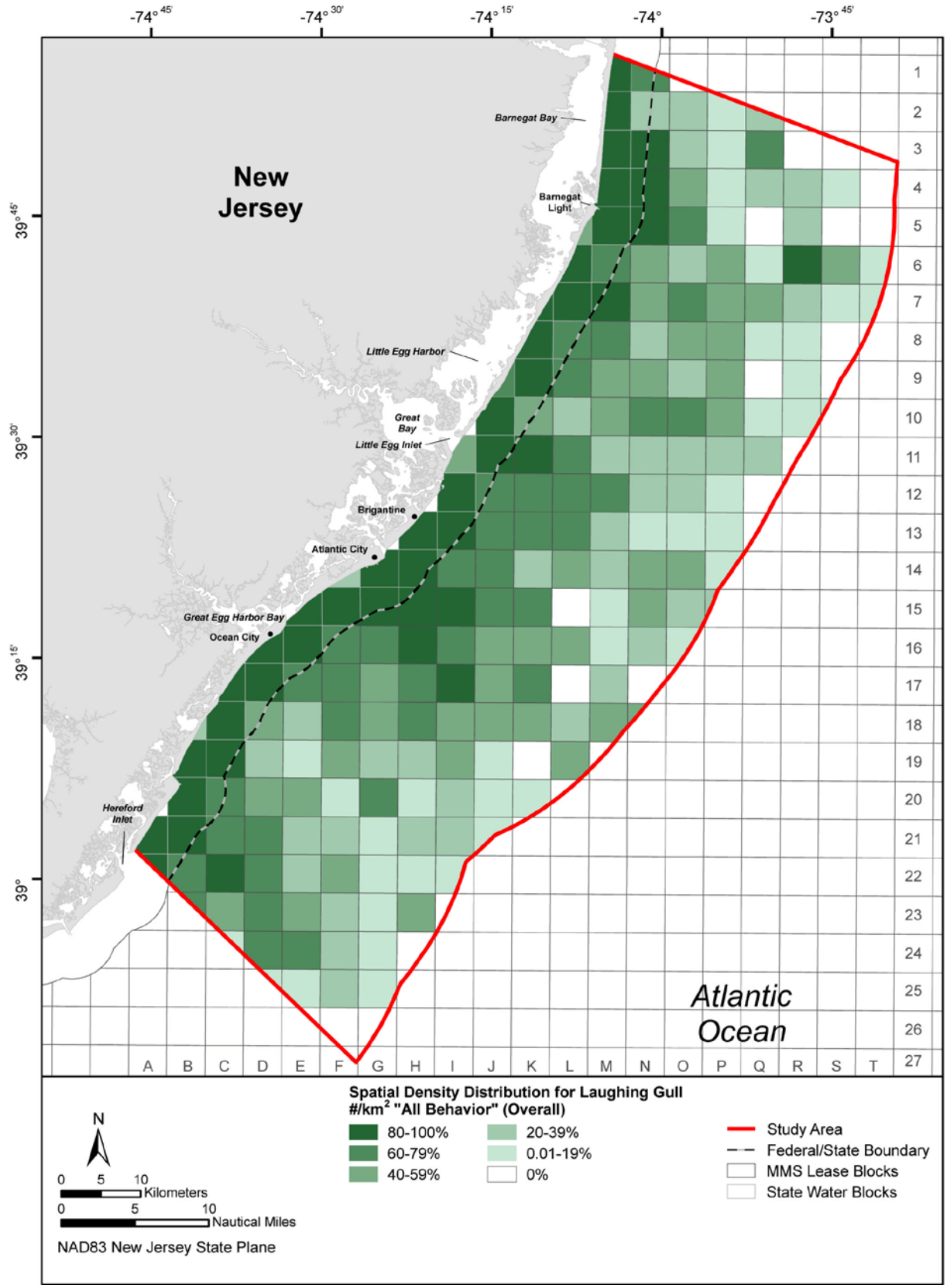

Figure F-46. Percentile abundance of Laughing Gull (all behaviors), January 2008-December 2009 (n=6,668).

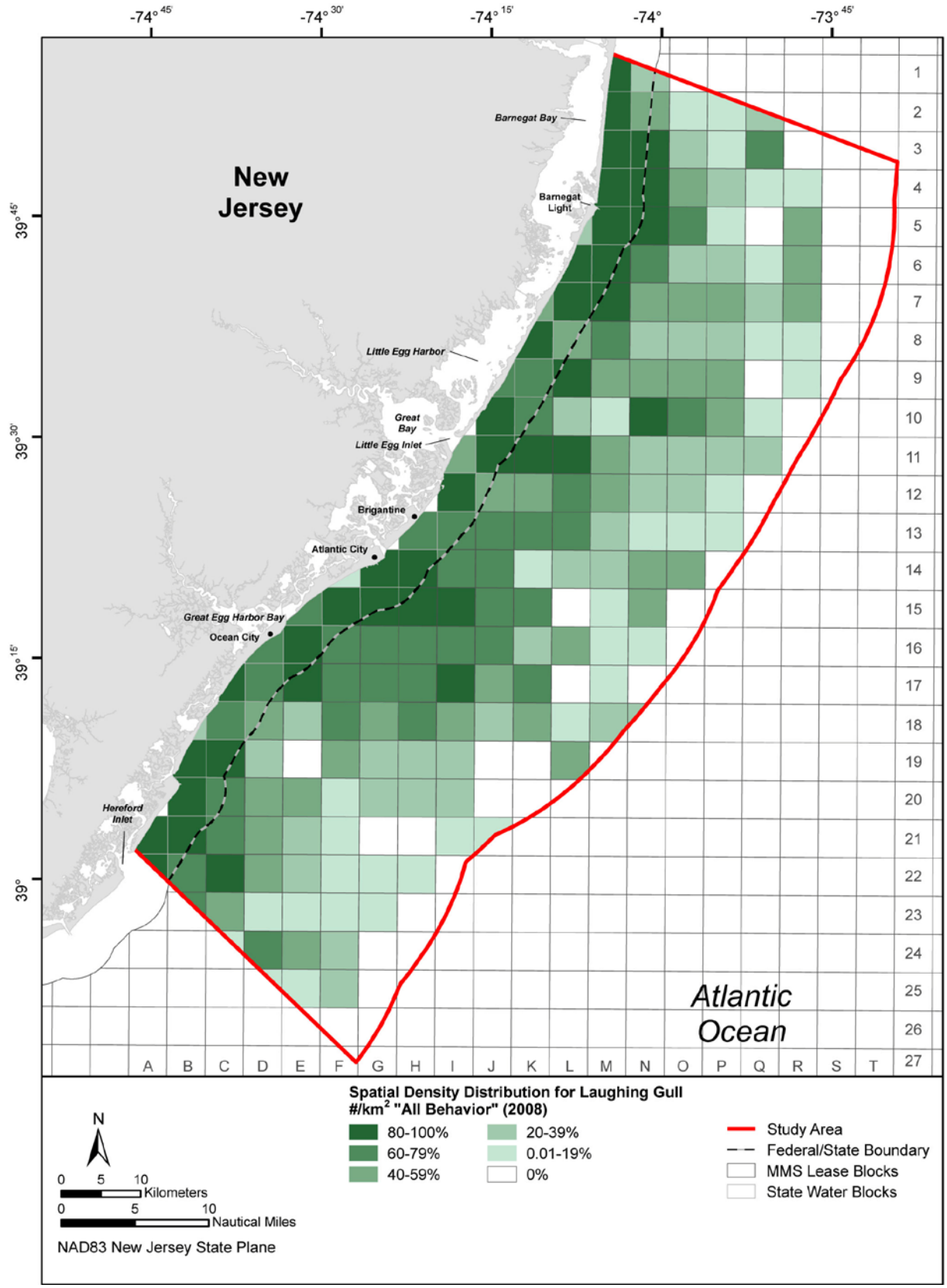

Figure F-47. Percentile abundance of Laughing Gull (all behaviors), January-December 2008 (n=4,461).

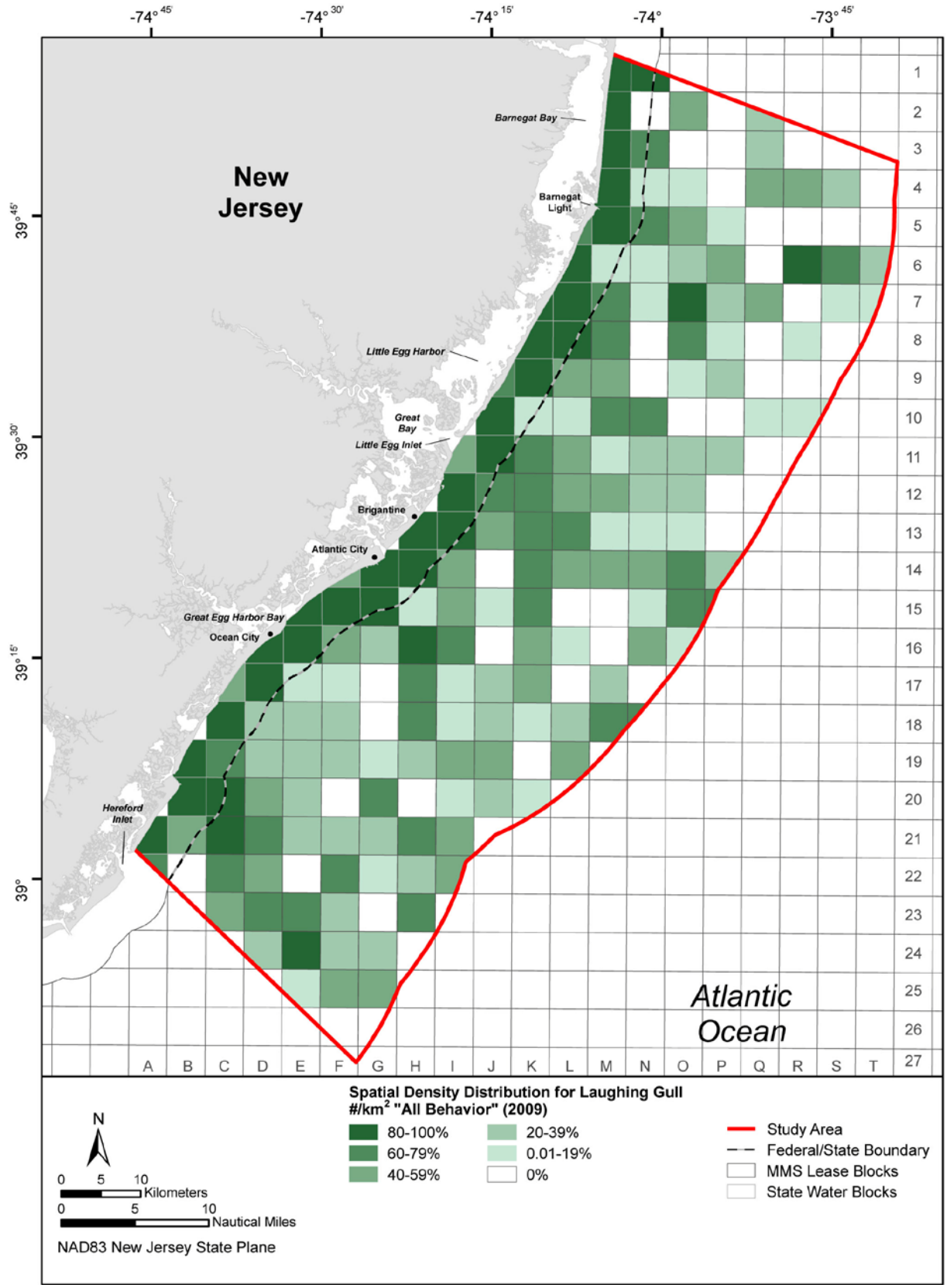

Figure F-48. Percentile abundance of Laughing Gull (all behaviors), January-December 2009 (n=2,207).

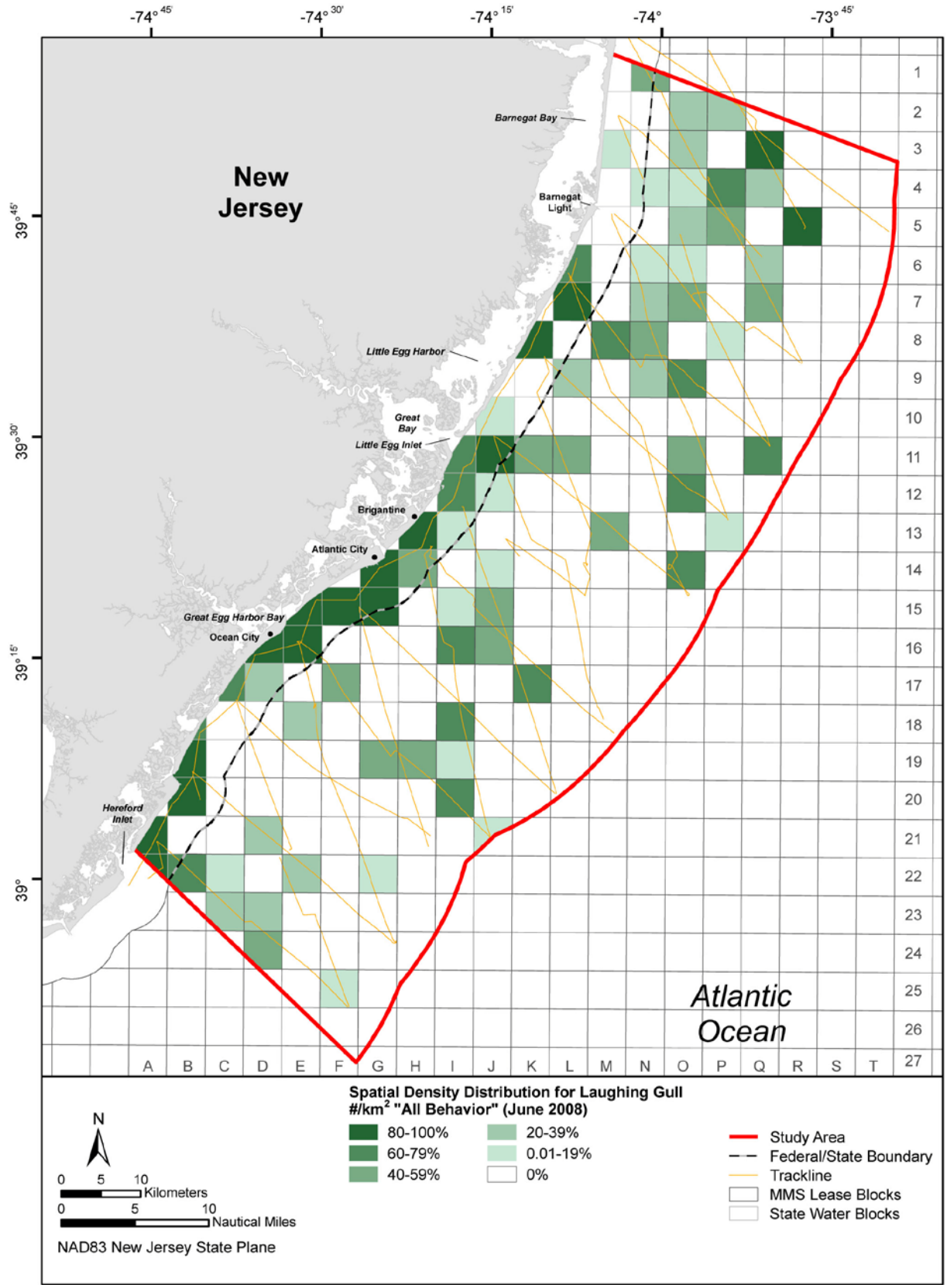

Figure F-49. Percentile abundance of Laughing Gull (all behaviors), June 2008 (n=85).

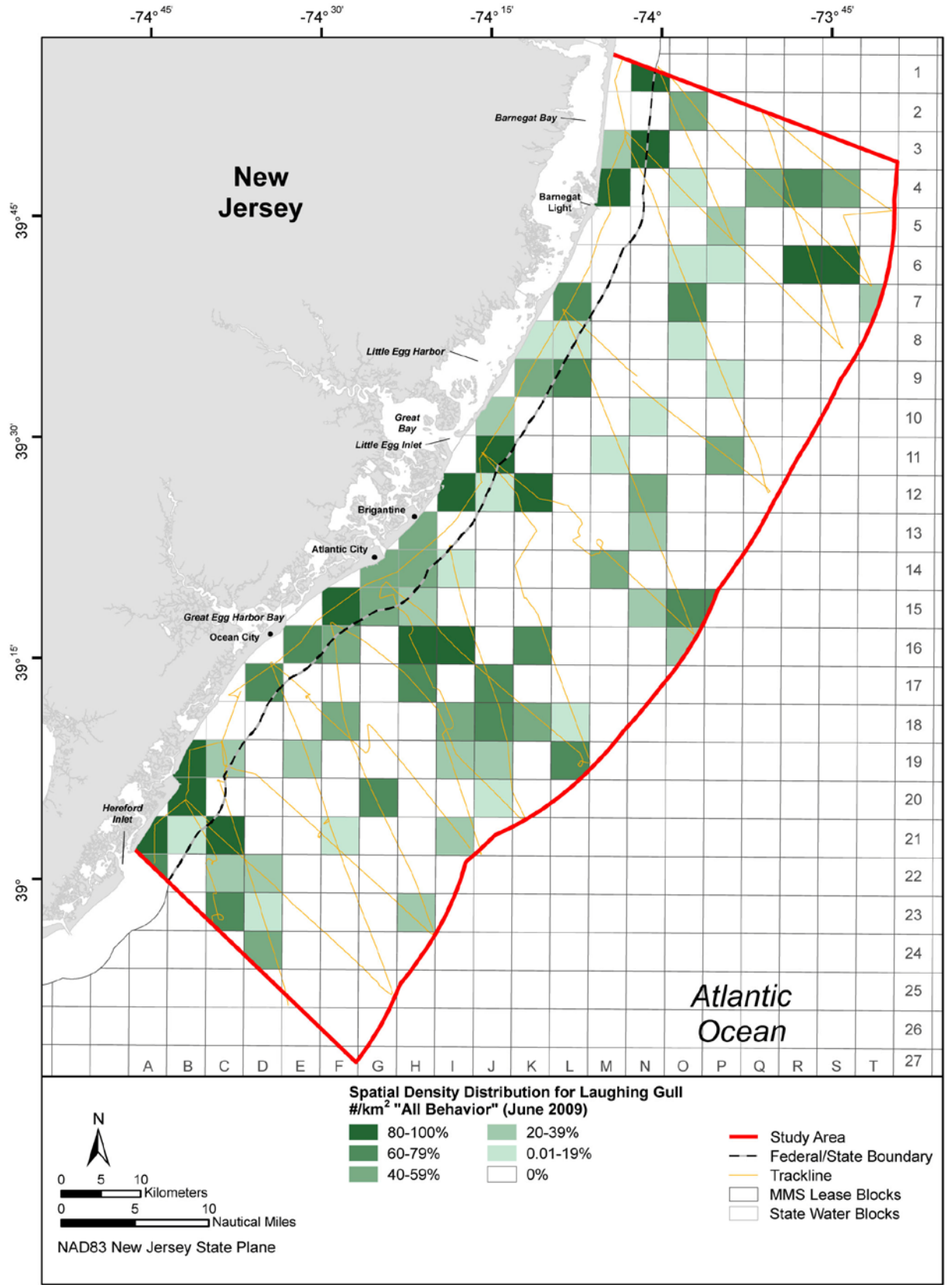

Figure F-50. Percentile abundance of Laughing Gull (all behaviors), June 2009 (n=345).

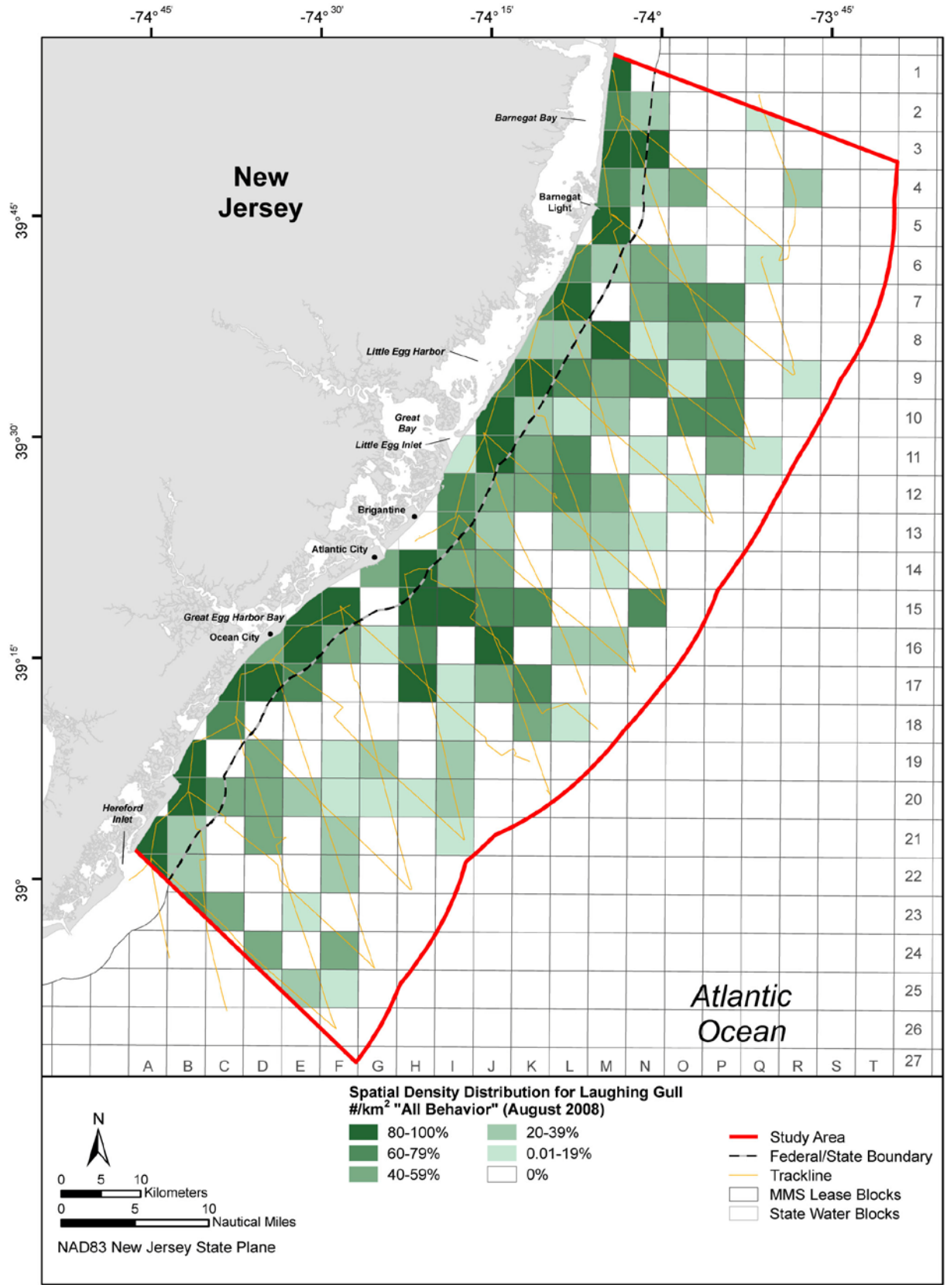

Figure F-51. Percentile abundance of Laughing Gull (all behaviors), August 2008 (n=1,110).

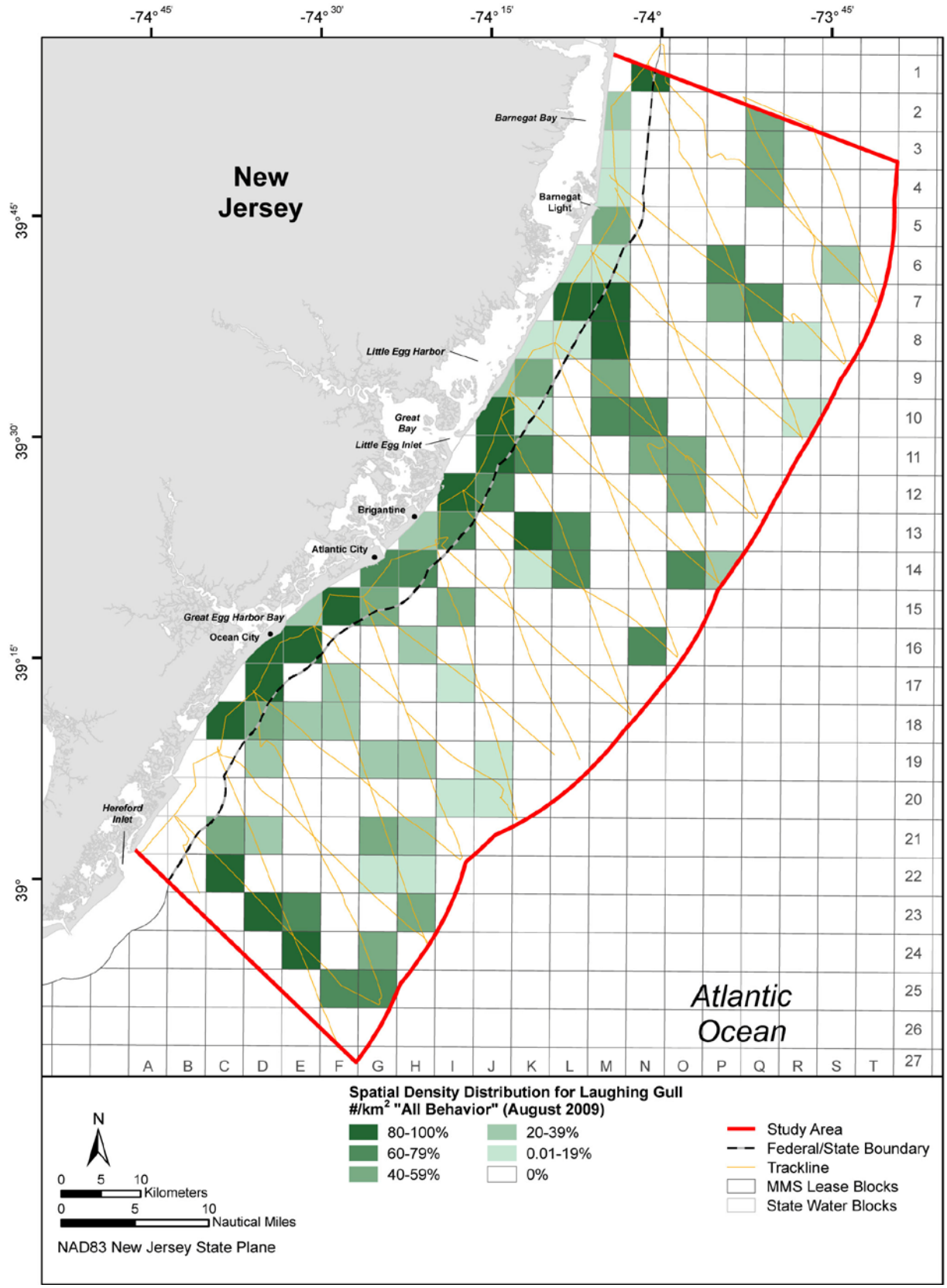

Figure F-52. Percentile abundance of Laughing Gull (all behaviors), August 2009 (n=440).

Species Account for Herring Gull (*Larus argentatus*)

Overall Distribution and Ecology

Herring Gull is a common holarctic breeder of both temperate and arctic regions with a strong coastal affinity, particularly in winter. The North American form, *smithsonianus*, is considered by many (e.g., Crochet et al. 2002, Sangster et al. 2007 and references therein) to comprise a species separate from Old World *argentatus*, though North American authorities (http://www.aou.org/checklist/north/) do not, yet, do so. This subspecies is distributed as a breeder from western Alaska across the tundra and taiga zones of Canada through the Great Lakes to the Maritime provinces and south on the Atlantic coast to South Carolina (National Geographic Society 2002, Pierotti and Good 1994); there is sporadic breeding outside that range (e.g., in Louisiana [Dittman and Cardiff 2005]). The winter range includes a large swath of the continent: both Atlantic and Pacific coasts from Alaska and Newfoundland south through Mexico and much of the interior of the Lower 48 states (Dunn and Alderfer 2006), although the species is rare in the interior away from large bodies of water. The species is an opportunistic generalist predator (particularly of freshwater and marine invertebrates, fish, other birds and their eggs) and scavenger (fish, carrion, human refuse; Pierotti and Good 1994).

The species exhibits differential migration, with immatures and high-latitude-breeding adults being strongly migratory (Howell and Dunn 2007; contra Pierotti and Good 1994 which used only low-latitiude literature sources), but with adults of lower-latitude breeding areas (Great Lakes and Atlantic Coast) typically remaining on or near breeding grounds year-round (Weseloh 1984, Pierotti and Good 1994). The primary autumn migration period for Herring Gull is October – December, although some individuals initiate fall migration earlier (Howell and Dunn 2007). Younger age classes generally precede adults by, on average, a month or more, with this difference primarily due to differing molt strategies of juveniles and older birds (Howell and Dunn 2007). Departure of migrant adults from winter areas probably begins in February; in many areas this departure is masked by the presence of local breeding populations. As spring migration in the species (February to May) progresses, immatures come to predominate. Non-breeding individuals do not generally oversummer in interior North America away from breeding areas, but whether birds from arctic breeding areas oversummer in and near temperate-zone breeding areas is unknown. There is very little known about foraging ranges of individual *smithsonianus* Herring Gulls during breeding and non-breeding season (Pierotti and Good 1994).

New Jersey Occurrence

In New Jersey, Herring Gulls primarily utilize coastal and marine waters, but can be found foraging over recently-tilled fields, at landfills, and at other inland situations nearly throughout the state. While a significant portion of New Jersey-produced immatures may winter south of the state along the coast, resident populations are also swelled by migrants arriving from breeding areas to the north (inferred from Walsh et al. 1999).

Summary of Occurrence during the Study

Herring Gulls were detected on all monthly surveys and the species was among the ten most numerous species in all eight seasons and among the top five most abundant species in five of the eight seasons (**Section 2.3.3.4: Tables 2-3** through **2-6**). The species was present throughout the study area with highest concentration of abundance (number of birds per km^2) coastally and in the northern one-fourth of the study area. In fact, this species was found in nearly all blocks (**Figure F-53** hot spot HERG overall map), being found in more blocks than all other species, other than Northern Gannet. Annual abundance and distribution varied, with 2008 non-coastal distribution of high relative abundance (**Figure F-54** hot spot HERG 2008 map) obviously centered in the north. In 2009, the north also had the majority of blocks of highest relative abundance, but there was also a concentration of abundance in the southeast corner (**Figure F-507** hot spot HERG 2009 map).

Seasonally, abundance varied from 0.02 to 0.39 birds/km on the shipboard offshore transects and from 0.08 to 6.49 on the small-boat coastal surveys (**Appendix C: Table C-1**). Winter and spring 2008 saw the

highest abundance, with highest numbers on the shipboard offshore surveys in the two springs and on the small-boat coastal surveys in the two winters (**Appendix C: Table C-1**).

Slightly less than 60% of fall-migrant gulls in active migration were found within 3 NM (5.56 km) of shore and around 70% were within 5 NM (9.26 km) of shore (**Section 4.3.3: Table 4-5**), and Herring Gull is a component species of the group. It is also a component of the group labeled "large gulls" in the analysis of birds within the RSZ (**Section 2.3.3.2: Table 2.8**) and that group was the species/group of third-highest abundance within the RSZ.

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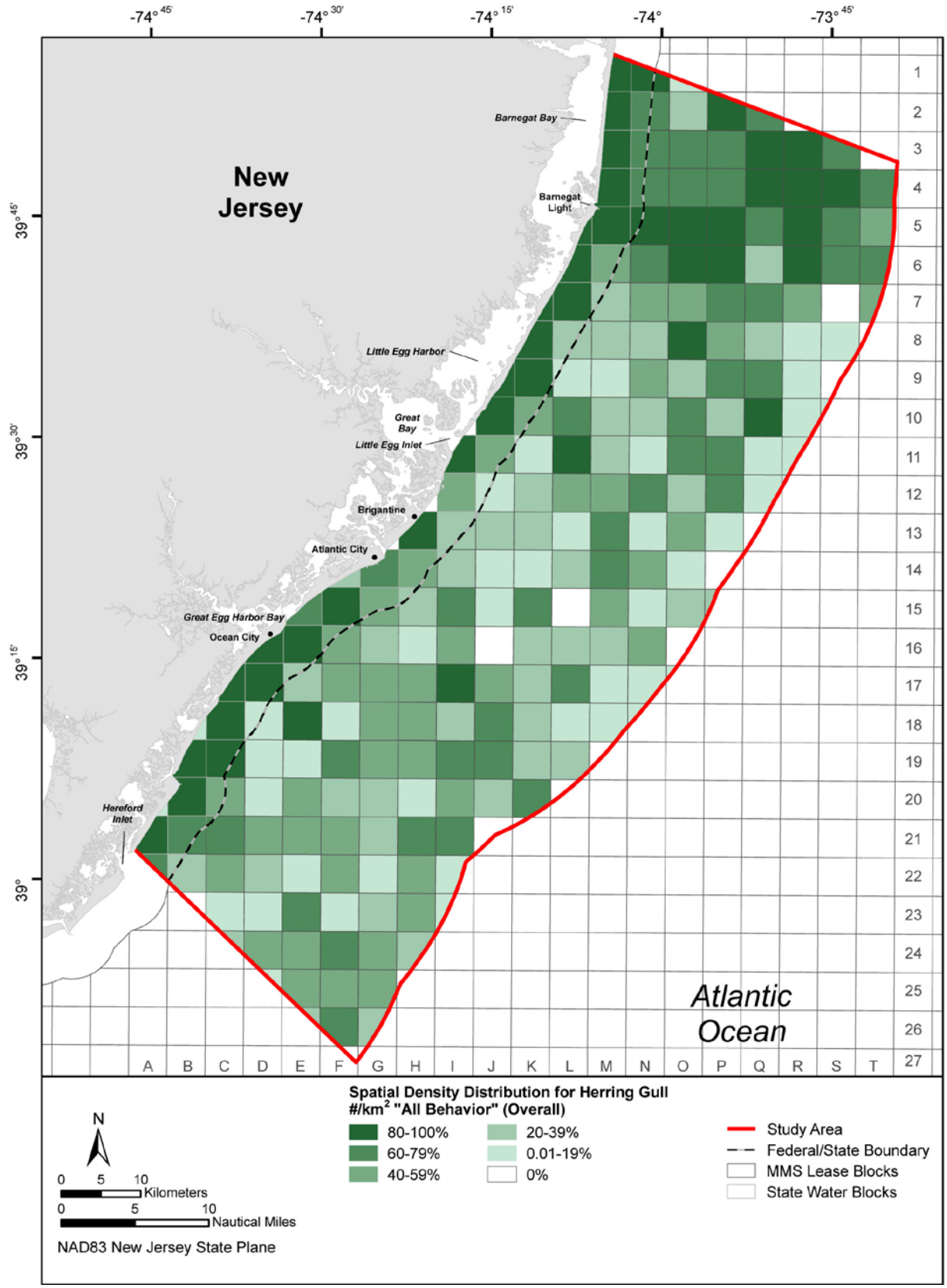

Figure F-53. Percentile abundance of Herring Gull (all behaviors), January 2008-December 2009 (n=4,430).

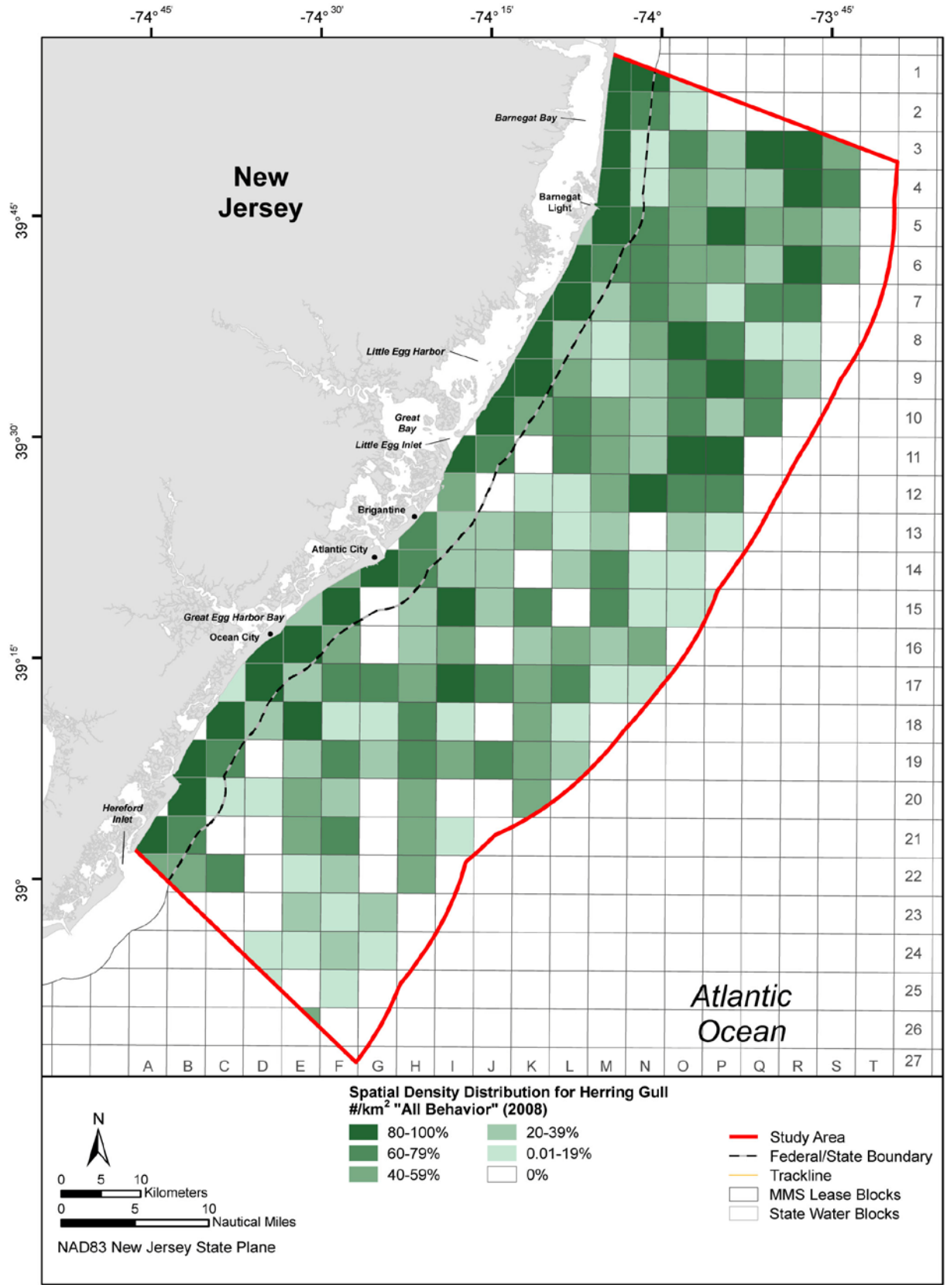

Figure F-54. Percentile abundance of Herring Gull (all behaviors), January-December 2008 (n=1,826).

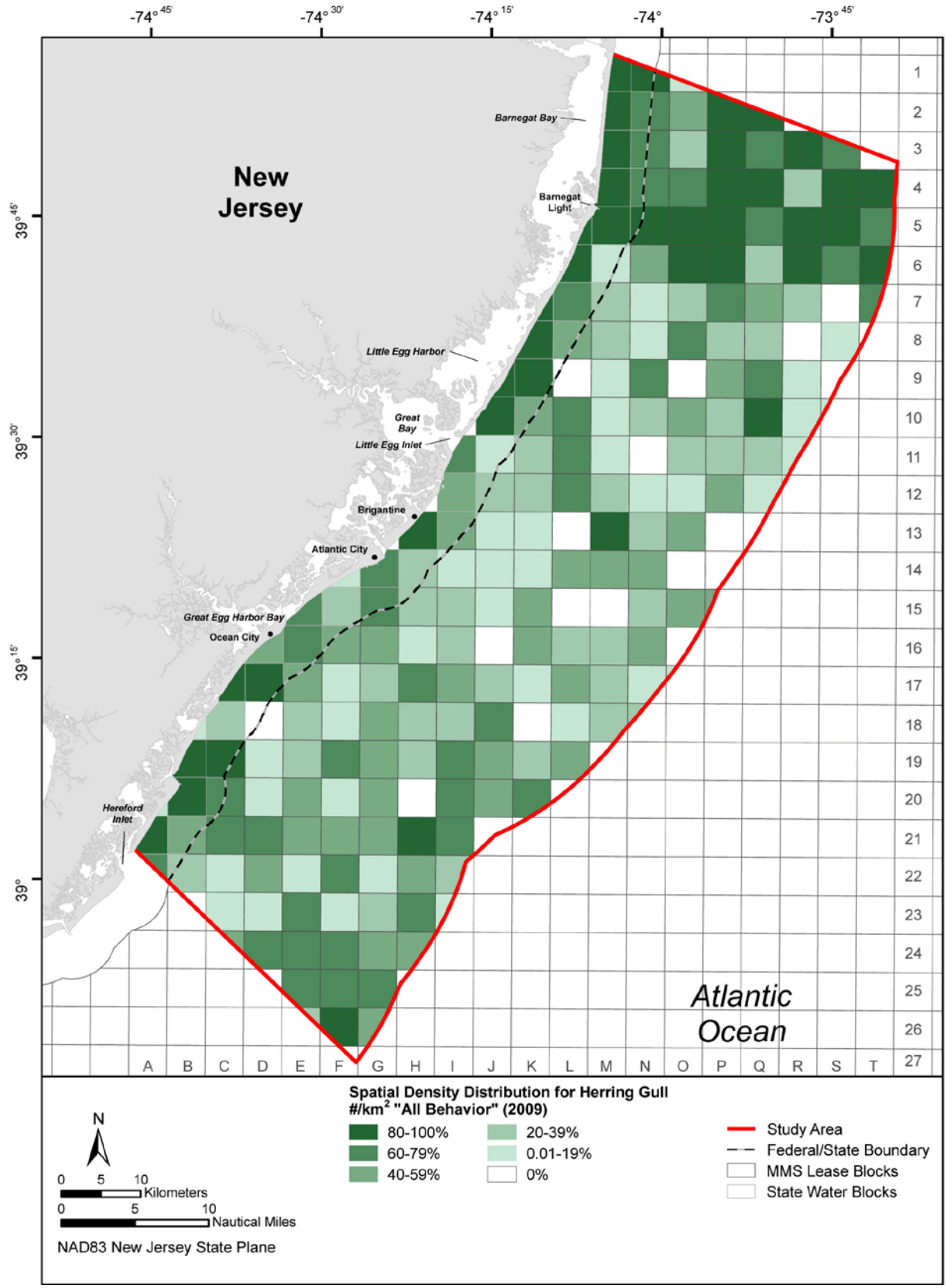

Figure F-55. Percentile abundance of Herring Gull (all behaviors), January-December 2009 (n=2,504).

Species Account for Great Black-backed Gull (*Larus marinus*)

Overall Distribution and Ecology

Great Black-backed Gull is an endemic breeder of the northern Atlantic Ocean, being nearly restricted to coastal areas, though a growing breeding population on the Great Lakes is well away from saltwater. In North America, the species breeds from northeastern Quebec and Labrador south along the coast to Virginia, and with a disjunct population occupying lakes Ontario and Erie (Good 1998, Dunn and Alderfer 2006). Most of the species' breeding range south of New England has been occupied only fairly recently (Good 1998). The winter range includes the Atlantic coast from Newfoundland south through Florida, the eastern Great Lakes, and, in very small numbers, west in the interior to Colorado (Dunn and Alderfer 2006) and coastally to Texas and the West Indies. The species' food habits are similar to those of Herring Gull (Good 1998, Pierotti and Good 1994, Rome and Ellis 2004), but with a higher incidence of live capture of birds (Good 1998), including species as large as (or larger) Lesser Scaup (Mansueti 1961).

Similar to Herring Gull, the species exhibits differential migration, with immatures and high-latitude-breeding adults being strongly migratory, but with adults from the Great Lakes and Newfoundland south typically remaining on or near breeding grounds year-round (Good 1994). Migration periods for Great Black-backed Gulls are probably similar to those of Herring Gull, but little has been published on this facet (among many others) of this species' ecology (Good 1998). There are few data on foraging range of the species, whether during the breeding season or not (but see Good 1998; Daily Time Budget), but the species is well-known as a forager in pelagic waters (see map p. 434, Howell and Dunn 2007), hence the specific epithet *marinus*, though few references specifically note the fact (e.g., Good 1998).

New Jersey Occurrence

Great Black-backed Gulls in New Jersey use similar habitats as do Herring Gulls (Walsh et al. 1999). Athough much less common inland than Herring Gull, their primary occurrence inland is near large landfills (Walsh et al. 1999). While emigration of some portion of New Jersey-produced immatures to the south for winter probably occurs, this may be more than balanced by immigration from breeding areas farther north (Walsh et al. 1999).

Summary of Occurrence during the Study

This species was detected in all monthly survey efforts and was found throughout the study area, though with abundance (number of birds per km^2) concentrated coastally (**Figure F-56** hot spot GBBG overall map). Although among the top five most numerous species in only two seasons (summer 2008 and fall 2009; **Section 2.3.3.1: Tables 2-3** through **2-6**), the species was among the top ten most abundant species in six of the eight seasons, being absent from that list in winter 2009 and spring 2009 (**Section 2.3.3.1: Tables 2-3** through **2-6**). As with Herring Gull, individual Great Black-backed Gulls were noted heading offshore early in the morning, with quite a few birds heading beyond the project-area boundary. The species showed no particular affinity to shoal areas.

Annual distribution of abundance varied markedly, with 2008 abundance (**Figure F-57** hot spot GBBG 2008 map) concentrated much more coastally (with no blocks of highest abundance occurring outside state waters) than the more-even dispersion of abundance in 2009 (with nine of 37 blocks of highest abundance occurring wholly beyond state waters (**Figure F-58** hot spot GBBG 2009 map). Absolute abundance, however, remained very stable, varying from 0.03 to 0.15 birds/km on shipboard offshore transects and from 0.18 to 0.82 birds/km on small-boat coastal transects (**Appendix C: Table C-1**). Highest abundance (0.82 and 0.64) was coastal in fall 2008 and 2009, but offshore was in fall in 2008 (0.15) and in spring in 2009 (0.08; **Appendix C: Table C-1**), although abundance varied little in the latter year (0.06-0.08).

Slightly less than 60% of fall-migrant gulls in active migration were found within 5.6 km (3 NM) of shore and around 70% were within 9.3 km (5 NM) of shore (**Section 4.3.3: Table 4-5**); Great Black-backed Gull is a component species of the group. It is also a component of the group labeled "large gulls" in the

analysis of birds within the RSZ (**Section 2.3.3.2: Table 2.8**) and that group was the species/group of third-highest abundance within the RSZ.

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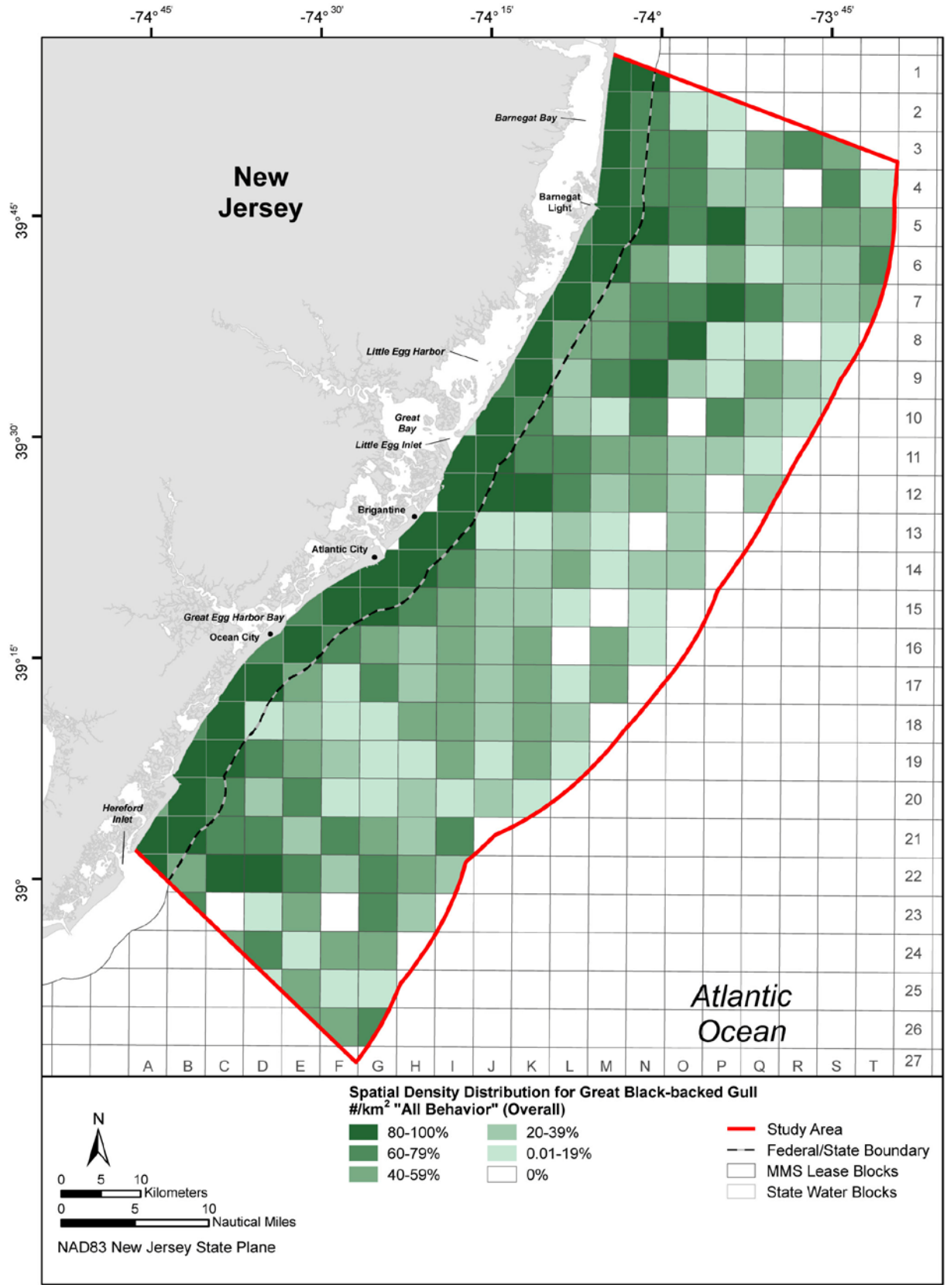

Figure F-56. Percentile abundance of Great Black-backed Gull (all behaviors), January 2008-December 2009 (n=2,163).

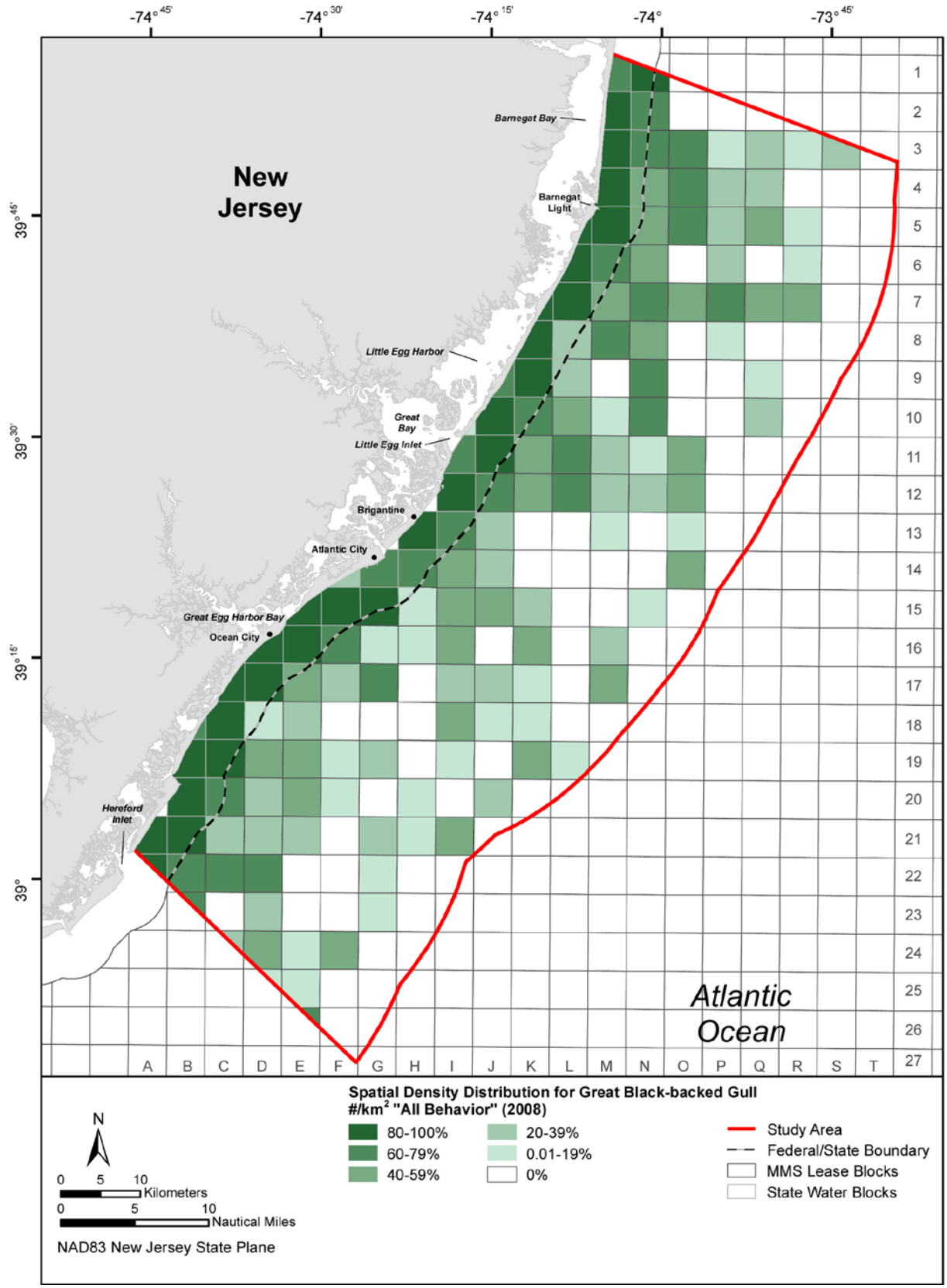

Figure F-57. Percentile abundance of Great Black-backed Gull (all behaviors), January-December 2008 (n=1,132).

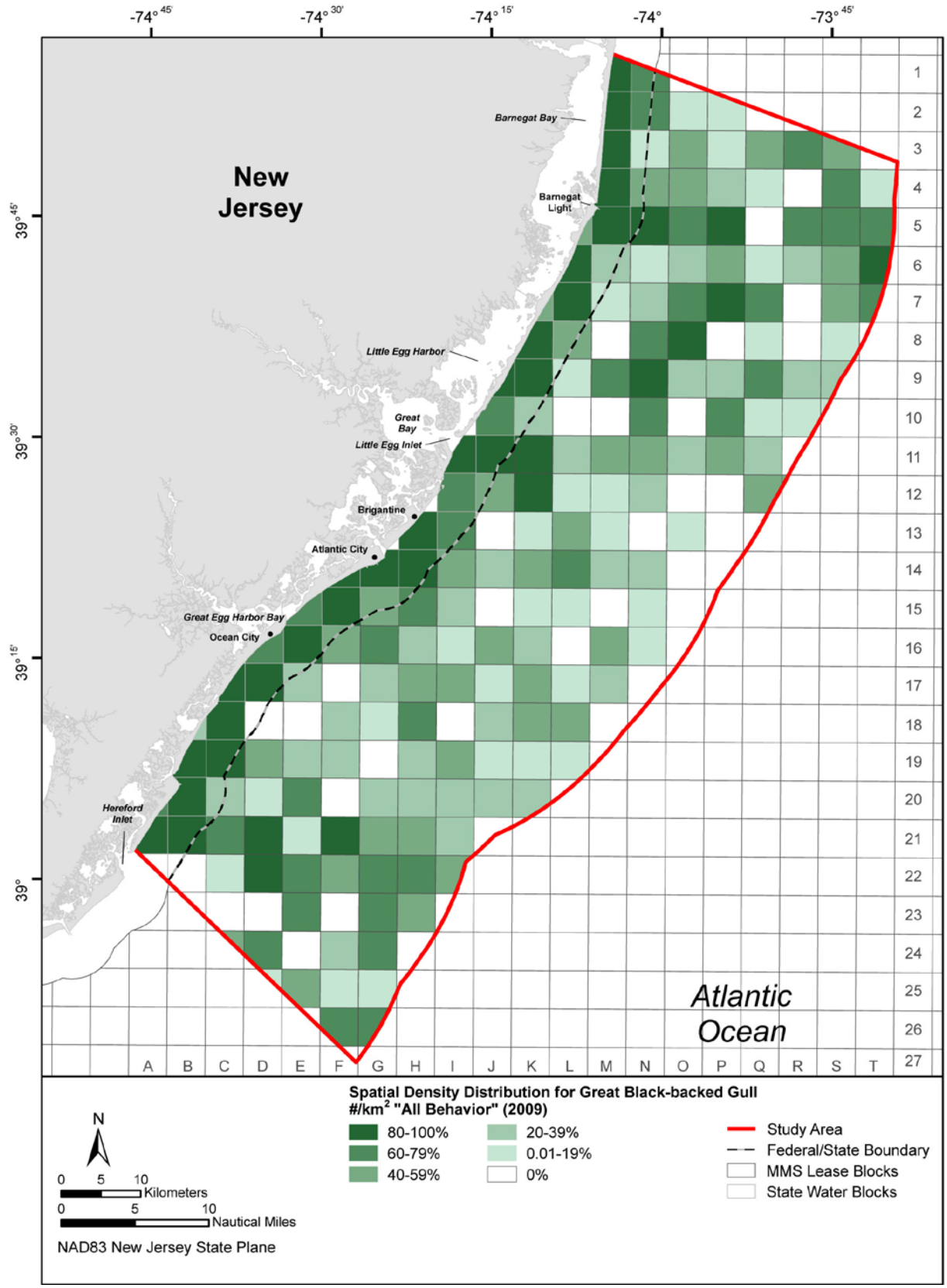

Figure F-58. Percentile abundance of Great Black-backed Gull (all behaviors), January-December 2009 (n=1,031).

Species Account for Common Tern (*Sterna hirundo*)

Overall Distribution and Ecology

Common Tern breeds across the Northern Hemisphere with the subspecies *S. hirundo hirundo* being a widespread breeder in North America. Birds breed inland in colonies from southern Northwest Territory to Montana east to the Canadian Maritime Provinces, with some colonies as far south as the southern Great Lakes. Coastally, the species breeds from eastern Canada south through northern South Carolina, with small numbers breeding along the Gulf Coast of the United States (Nisbet 2002). Most birds winter along the coasts of Central and South America, although very small numbers can be found along the Gulf Coast from Texas to Florida (Dunn and J. Alderfer (eds) 2006). This species feeds on open waters by executing shallow plunge-dives or surface dipping for small fish or crustaceans and also by hawking insects. During the breeding season, Common Terns usually remain near breeding sites, but foraging farther afield as dictated by prey availability. In particular, this species is often found where predatory fish push prey fish to the water's surface (Safina and Burger 1985).

The entire North American population is migratory, with most birds moving during early- to mid-fall and staging in numbers up to the thousands in some areas along the Atlantic coast. Most one-year-olds remain on the wintering grounds, migrating to the breeding grounds with older birds the following May (Nisbet 2002).

New Jersey Occurrence

Common Tern is an abundant migrant and breeder in the state, with large numbers typically present from late April through September (Walsh et al. 1999).

Summary of Occurrence during the Study

This species was detected May through October in both years of the study and in April 2008, with the vast majority of individuals recorded May through September. Common Tern was the third most abundant species recorded each summer and one of the ten most abundant species recorded each fall (**Section 2.3.3.1: Tables 2-3** and **2-4**). Peak abundance of this species for both shipboard offshore (0.68/km) and small boat coastal surveys (1.11/km) occurred in August 2008 (**Appendix C: Table C-2**).

With the lack of surveys in July 2009 the difference between the species' 2008 and 2009 summer distributions is marked (**Figures F-59 and F-60**). This can be explained by the fact that, in July, adults continue foraging to feed growing chicks while the number of birds foraging coastally swells with birds that have already fledged.

Although Common Terns showed an affinity for shoal areas (**Section 2.3.3.1: Figure 2-7**), the species was widely distributed throughout the study area. This would suggest that distribution was tied more to prey availability than to bathymetry.

Only 11 of 2,233 flying Common Terns recorded were in the RSZ.

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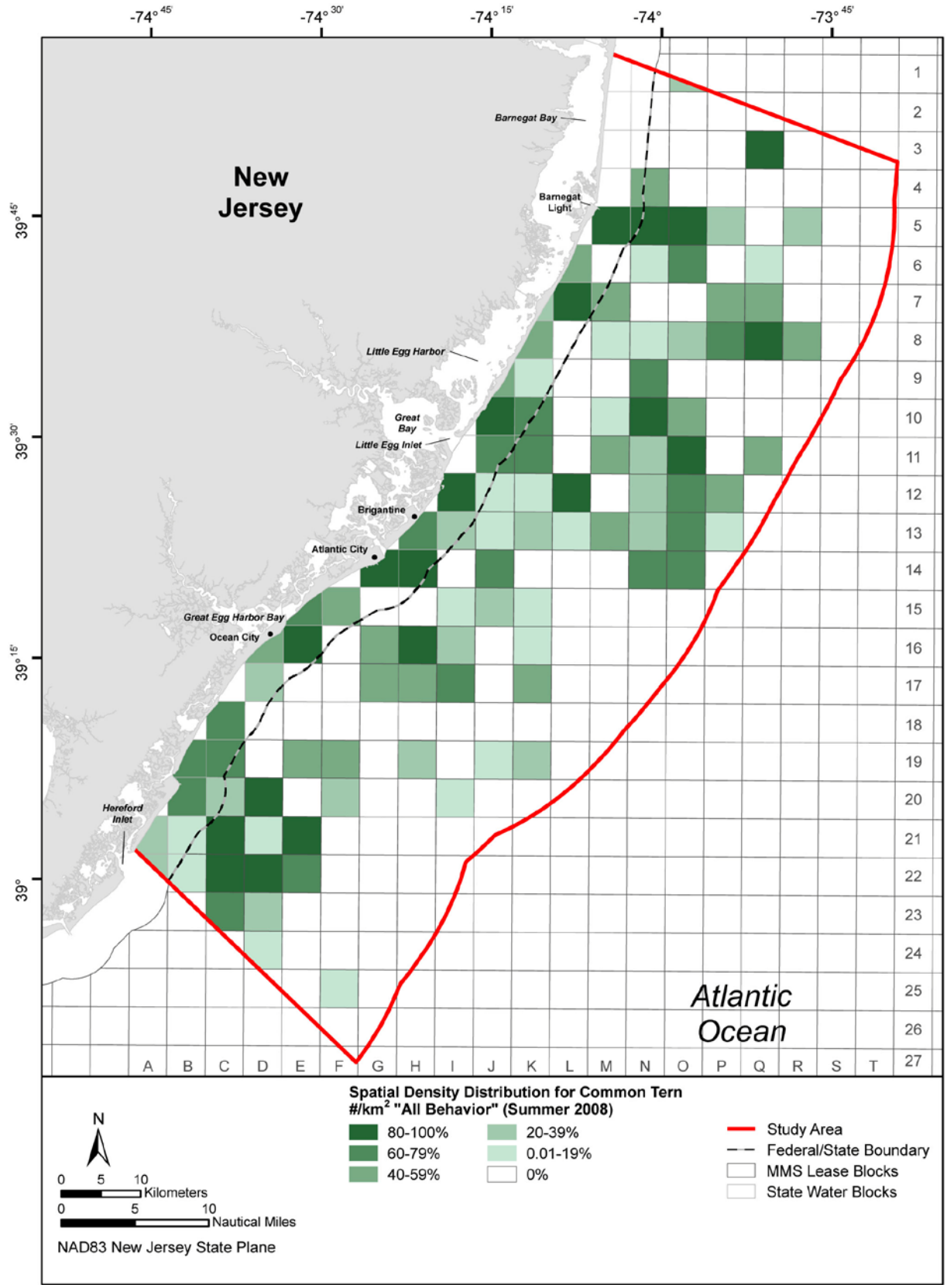

Figure F-59. Percentile abundance of Common Tern (all behaviors), Summer 2008 (n=1,650).

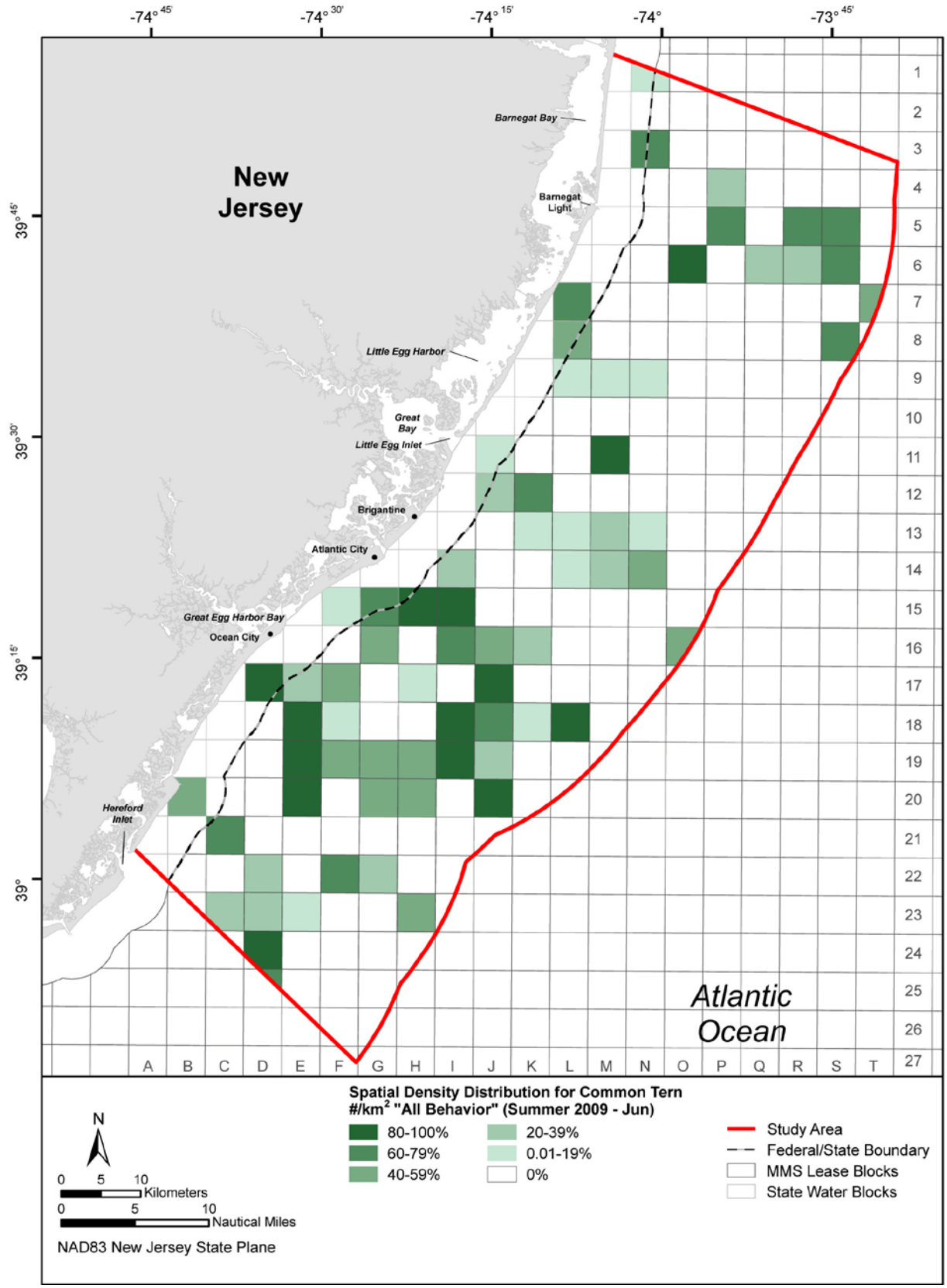

Figure F-60. Percentile abundance of Common Tern (all behaviors), Summer 2009 (n=543).

Species Account for Forster's Tern (*Sterna forsteri*)

Overall Distribution and Ecology

Forster's Tern is the only tern restricted to North America, occurring seasonally in fresh, brackish, and saltwater marshes from southern Canada to Honduras, breeding from southern Manitoba to Tamaulipas, Mexico (Mcnicholl et al. 2001). Northern interior and northernmost coastal breeders vacate their breeding grounds in winter. Coastal winter range extends from northern California to the Pacific Coast of Honduras in the west and from the Atlantic coast of Delaware south to the Yucatan Peninsula in the east. Inland winter range includes the Gulf Coast states and central Mexico. Food is captured by executing shallow plunge dives from the air or from a perch, with birds only occasionally submerging entire body (Salt and Willard 1971). Primary prey includes small fish such as northern anchovy (*Engraulis mordax*) and yellow perch (*Perca flavescens*) and some arthropods (Salt and Willard 1971).

Birds depart northern breeding grounds as early as mid-June and as late as early November (Mcnicholl et al. 2001). Although large numbers of Forster's Terns are often found in southern Delaware as late as December, with smaller numbers into southern New Jersey (Walsh et al. 1999), most of these birds have departed by mid-January. Primary wintering range begins in coastal Virginia. In spring, migrants usually arrive by mid- to late March, with peak migration typically occurring around mid-April (Walsh et al. 1999). Many non-breeders spend their summer in the species' winter range.

New Jersey Occurrence

In New Jersey, Forster's Tern is common during breeding season in freshwater, brackish, and saltwater marshes. This species is also a common spring and fall migrant, with peak fall abundance typically occurring from late October through mid-November (Walsh et al. 1999).

Summary of Occurrence during the Study

This species was recorded each month from April through November of both 2008 and 2009. Since this species has a much stronger affinity for marshes than does its congener, Common Tern, it was detected far less often in the study area. In fact, outside of a handful of migratory flocks offshore, the species' distribution was almost entirely restricted to nearshore waters, illustrated by results from October in 2008 and 2009 (**Figures F-61 and F-62**). Forster's Tern was one of the top ten most abundant species in summers 2008 and 2009, though this was due more to a paucity of locally-breeding waterbird species than it was to an abundance of Forster's Terns (**Section 2.3.3.1: Table 2-3**).

Although this species was recorded only five times during the Fall 2009 shipboard offshore surveys, all in October, the species was recorded every month of the season on the supplemental sawtooth transects. The lack of fall observations is at least partly due to the fact that no shipboard offshore or small boat coastal surveys were conducted between 3 October and 18 November 2009, the time of peak passage for the species through the state.

Only 12 of 1,101 flying Forster's Terns recorded were in the RSZ.

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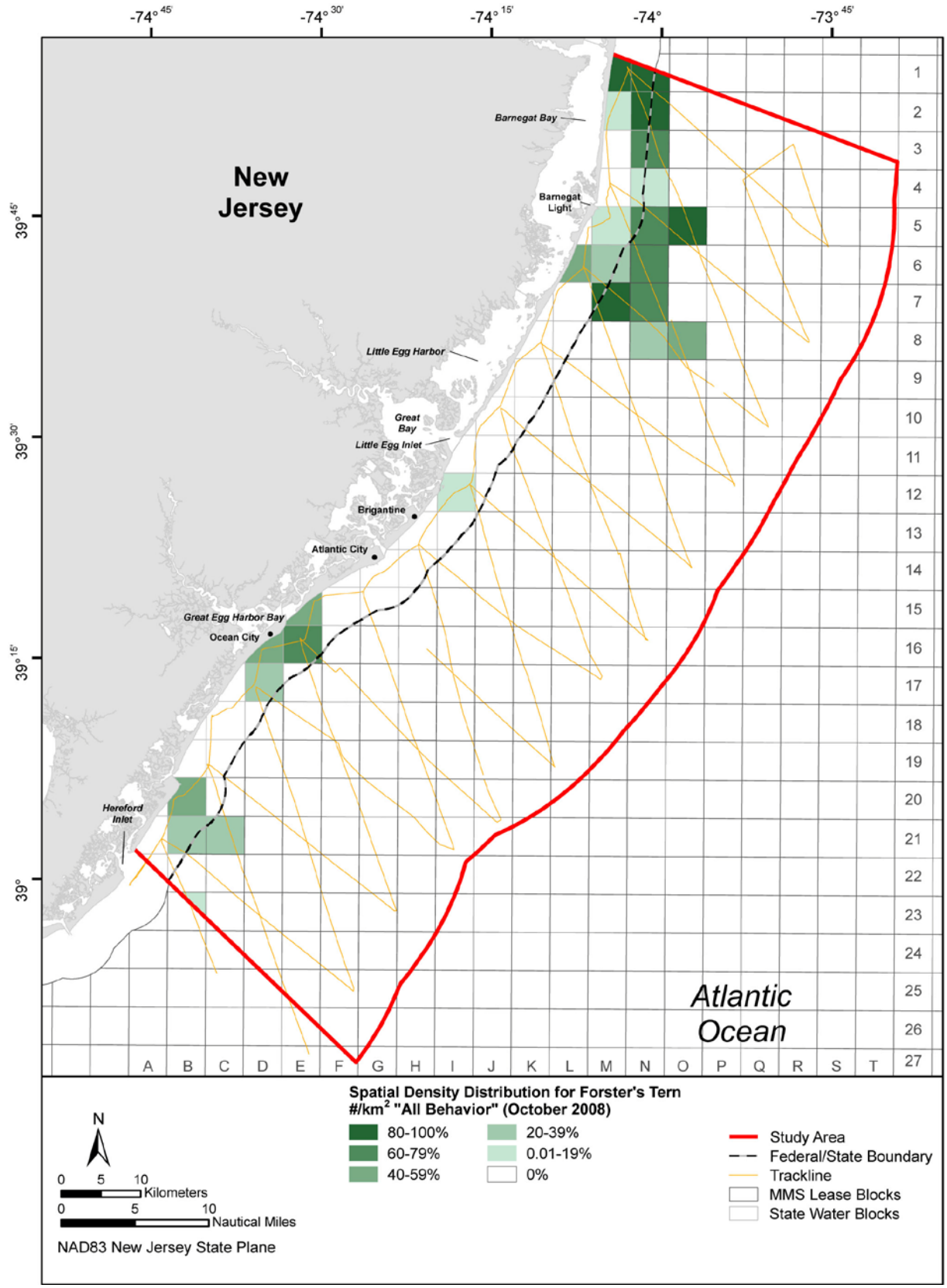

Figure F-61. Percentile abundance of Forster's Tern (all behaviors), October 2008 (n=419).

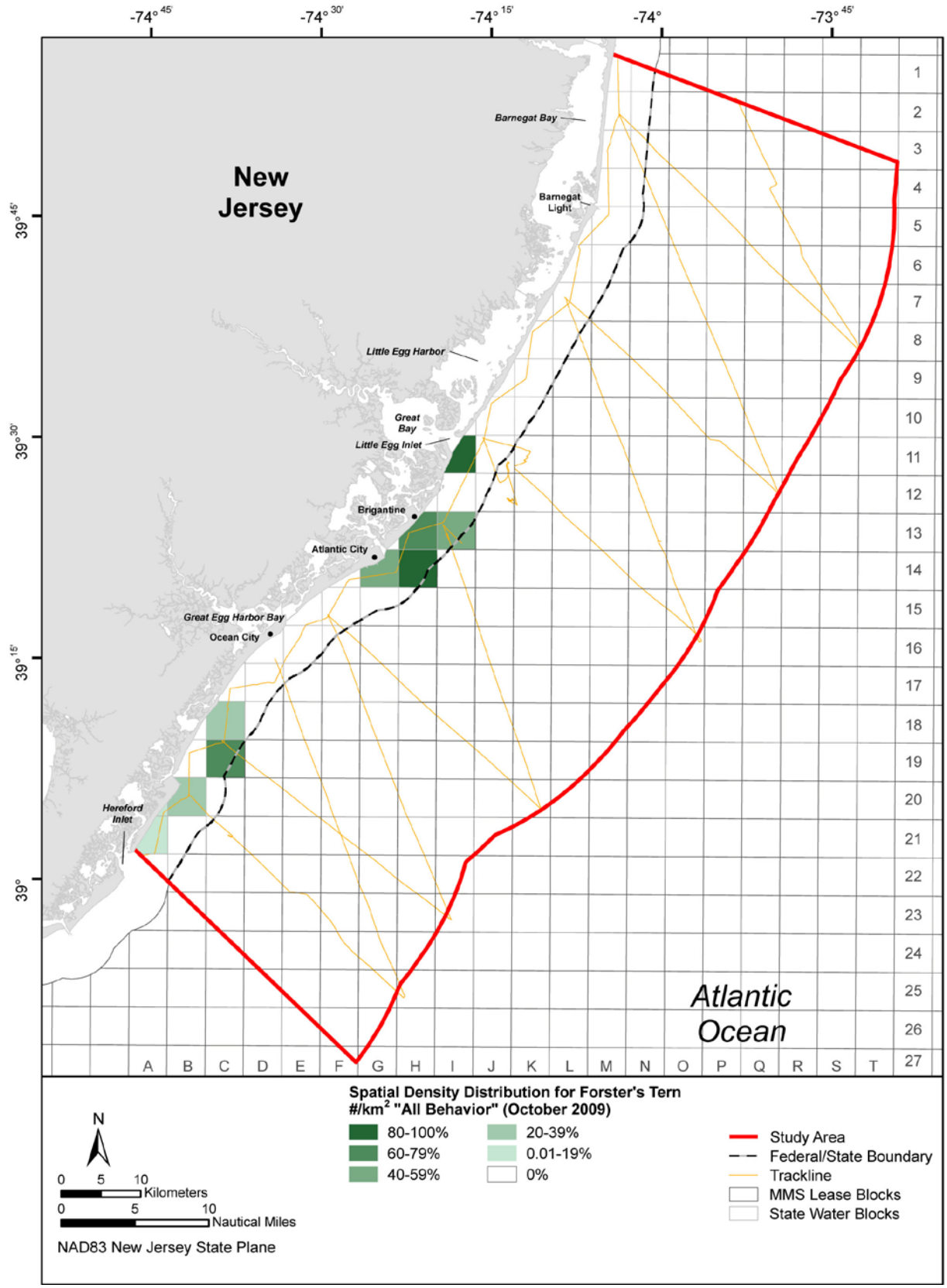

Figure F-62. Percentile abundance of Forster's Tern (all behaviors), October 2009 (n=112).

Species Account for Razorbill (*Alca torda*)

Overall Distribution and Ecology

The Razorbill is a long-lived seabird (one banded chick was re-sighted 33 years later; Lavers et al. 2007) with low productivity and juvenile survivorship and delayed breeding (Lavers et al. 2007; Lavers et al. 2008a,b). In the northern and northeastern Atlantic, Razorbills breed in Iceland, as well as the British Isles (mainly Ireland and Scotland), western Greenland, Norway, Sweden, and Finland (Chapdelaine et al. 2001). In the northwest Atlantic, Razorbills breed primarily in eastern Canada, including Quebec (especially the Gulf of St. Lawrence), Labrador, and Newfoundland, as well as on a few islands off New Brunswick. In the United States, Razorbills breed only on a few Maine islands, which mark the southernmost extent of its breeding range (Chapdelaine et al. 2001). The last breeding population estimate in eastern North America was of 38,000 pairs, with Labrador and Quebec hosting the largest numbers (Chapdelaine et al. 2001). Breeding Razorbills were not seen on Maine islands between the 1890s and the early 1920s (they had historically summered there; Drury 1973). At various times and durations after this period, Razorbills were recorded breeding only on outer Bay of Fundy (i.e., Canadian) islands (Drury 1973). Razorbills apparently re-colonized Maine coastal islands around 1950 (Drury 1974). The North American population declined between 1960 and 1985 and has increased since (Huettmann et al. 2005). During the 1990s, North American Razorbill populations expanded through most of the range (Gaston and Woo 2008). Razorbills are migratory, wintering to the south of the breeding range. Although migratory movements are poorly known, the species is known to travel distances of 250 to 4,130 km (135 and 2,230 NM; Lavers et al. 2007).

Due to their pursuit-diving method of hunting, Razorbills sustain mortality from gillnet entanglement, especially in Newfoundland (Piatt and Nettleship 1985; Tasker et al. 2000; Benjamins et al. 2008). Individuals can dive to depths of at least 120 m (393.7 ft) in search of prey (Piatt and Nettleship 1985), but during the breeding and wintering seasons they are generally recorded as diving to 25 to 40 m (82 to 131.2 ft; Barrett and Furness 1990; Wanless et al. 1990; Skov et al. 2000). Razorbill is reliant on relatively few species of schooling fish, especially clupeids (Herring [*Clupea harengus*] and sprat [*Sprattus sprattus*]), and sand eel (sand lance; *Ammodytes* sp.; (Barrett and Furness 1990; Ouwehand et al. 2004), as well as crustaceans (Paredes et al. 2008). Skov et al. (2000) found that wintering Razorbills in the transition area between the North and Baltic seas were dependent on predictable high-density locations of immature herring (at coarse spatial scales >20 km [10.8 NM]).

New Jersey Occurrence

Razorbill is a federal species of concern for Bird Conservation Region 30 (New England/Mid-Atlantic Coast). Although the outer Bay of Fundy and the Gulf of Maine are important wintering areas in the northwest Atlantic, the species ranges as far south as North Carolina (Walsh et al. 1999). In New Jersey, Razorbill is mostly recorded >8 km (4.3 NM) offshore, though it is the alcid most readily seen from land in the state. Fall migrations to New Jersey occur from late October through January, and the spring migration occurs from late February through mid-March (Walsh et al. 1999).

Summary of Occurrence during the Study

Razorbills were seen throughout the winter months in 2008 and 2009. However, the greatest number occurred in March of the two years, with overall peak of numbers noted during the March 2009 shipboard offshore survey. Detection of these small birds was greatly aided by calm seas encountered during this survey. In that month, Razorbills accounted for 492 of the 528 alcids seen, with an abundance of 0.56 birds/km (**Figure F-63 "All Behavior" Alcids March 2009**). Presence did not appear to be correlated with that of shoals (**Figure 2-7**); rather, their greatest density occurred in the northern half of the study area, especially off Great Bay and Little Egg Inlet (**Figure F-63**). There was little coastal presence; only 17 of the 712 total Razorbills seen were in coastal areas. Of the minority observed flying, none flew within the RSZ.

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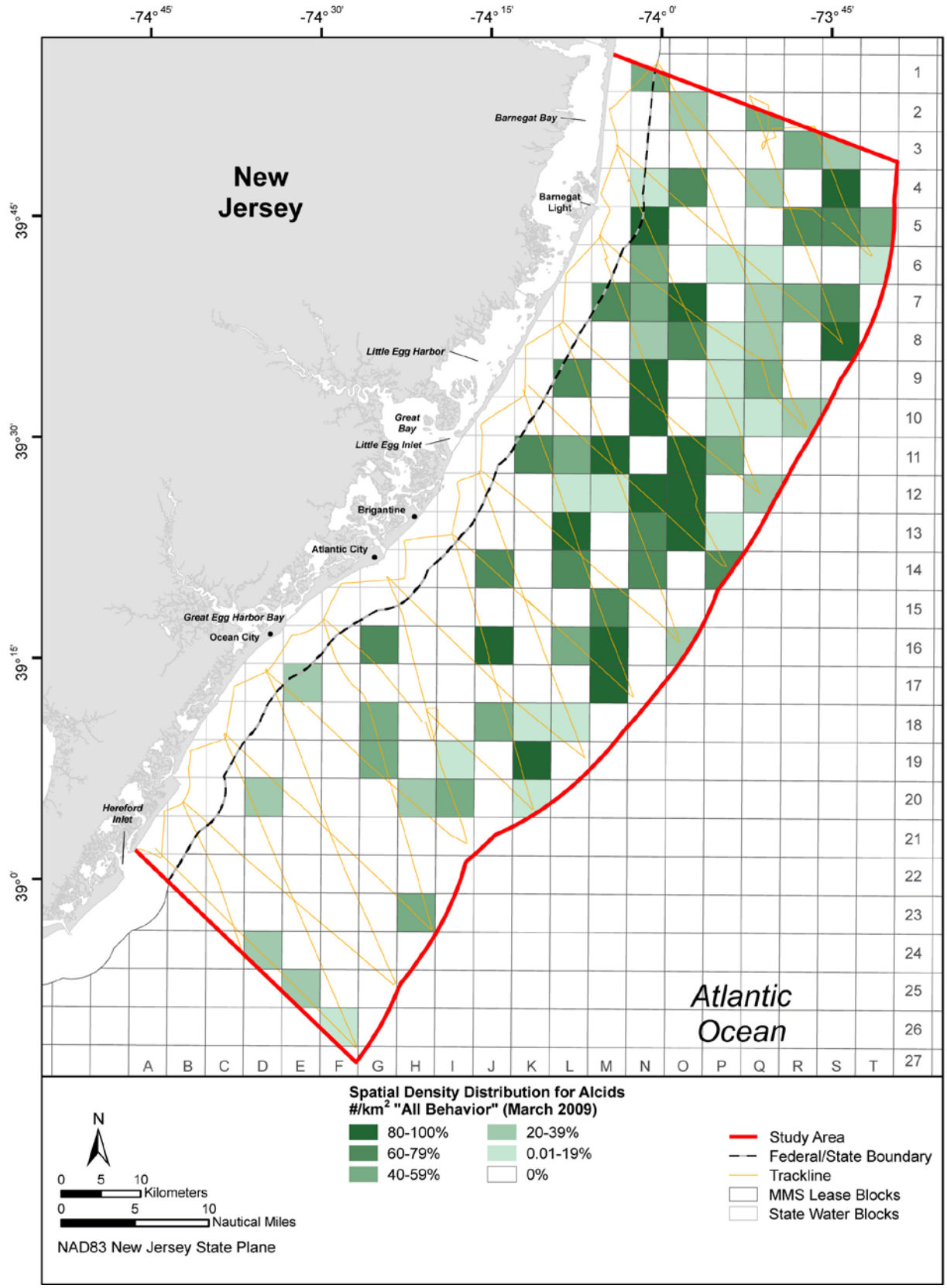

Figure F-63. Percentile abundance of alcids (all behaviors), March 2009 (n=508).

APPENDIX G

AVIAN QUALITY ASSURANCE/CONTROL AND AVIAN OBSERVER EFFICIENCY ANALYSIS

Avian Quality Assurance/Control

Introduction

A Quality Assurance Work Plan (QAWP) was developed to comply with standards set forth in the contract between the New Jersey Department of Environment Protection (NJDEP) Division of Science, Research, & Technology (DSRT) and Geo-Marine, Inc. (GMI) to conduct Ocean/Wind Power Ecological Baseline Studies (EBS) in the coastal and nearshore waters of New Jersey. A copy of the QAWP and Quality Assurance/Quality Control (QA/QC) data for the project can be obtained from NJDEP. A brief summary of avian QA/QC protocols and results is provided along with an analysis of avian observer efficiency.

Quality Assurance/Quality Control Summary

Avian Boat Surveys

Offshore shipboard and small boat coastal avian survey data was checked at the end of the end of each survey day by the senior seabird biologist. If an error(s) were found in the raw electronic data files corrections were made. The file name was changed (QAQC added to file name) and saved (see project database). The avian principal investigator (PI) then conducted a final QA/QC check of the data by randomly selecting 10% of the files for QA/QC.

Monthly error rates were generally low throughout the study for the avian shipboard surveys (**Table 1**). If an error was found, an additional 10% of the survey files were checked until no errors were detected. All files were re-checked in December 2009 when both initially checked files failed QA/QC.

Table 1
QA/QC Results for Avian Shipboard Surveys

Survey Month	No. Data Files	No. of QA/QC Checked Files	No. Fail	No. Pass	Error %
Jan 2008	129	15	1	14	6.67
Feb 2008	58	5	0	5	0.00
Mar 2008	275	28	1	18	3.57
Apr 2008	181	19	4	15	21.05
May 2008	136	14	0	14	0.00
June 2008	81	8	0	8	0.00
July 2008	62	8	1	7	12.50
Aug 2008	65	8	1	7	12.50
Sept 2008	119	13	1	12	7.69
Oct 2008	95	10	1	9	10.00
Nov 2008	50	6	0	6	0.00
Dec 2008	35	4	0	4	0.00
Jan 2009	47	5	0	5	0.00
Feb 2009	74	7	0	7	0.00
Mar 2009	40	4	0	4	0.00
Apr 2009	31	3	0	3	0.00
May 2009	68	8	0	4	0.00
June 2009	52	10	1	10	10.00
Aug 2009	81	8	0	8	0.00
Sept 2009	85	7	0	7	0.00
Oct 2009	39	4	0	4	0.00
Nov 2009	49	5	1	4	20.00
Dec 2009	20	2	2	0	100.00
TOTAL	1,872	201	14	187	7.49

Overall, 10.74% of the data files were checked and the overall failure rate was 7.49%. If a failure was identified the error was corrected in the data file and identified on the QA/QC log. The avian principal investigator then randomly selected and checked another 10% of the data files. This procedure continued until no errors were found. The QA/QC protocol for the small boat coastal survey data was identical to that conducted for the offshore avian ship surveys were similar to the shipboard surveys.

Avian shipboard electronic survey raw data files and QA/QC files were filed with the NJDEP. These files may be requested from NJDEP.

Aerial Surveys

The general QA/QC protocol followed that developed for the avian boat surveys. Each observer played-back voice recorded data and recorded that data. The data was then exchanged and each observer checked a 10% portion of the others. Error rates are not reported for this task since only one avian aerial survey was completed during the study.

Avian Radar

Avian Radar QA/QC was accomplished through detailed data analysis (see **Volume II, Section 5.4**).

Thermal Imaging

QA/QC protocols identified in the QAWP were followed for this task. Upon completion of the thermal imaging data analysis for all seasons a second biologist sampled a subset of the total dataset (15 minutes of each 150 minutes analyzed) for QA/QC purposes. The second biologist randomized the 15-minute samples within each 150-minute time block and conducted checks of recorded tracks and details (e.g. identification, direction, altitude, and size of flock). Upon completion of the QA/QC protocols there were no errors found and final analyses were then completed. If errors would have been recorded the second biologist would determine the cause of the errors and corrected them immediately.

Avian Observer Efficiency

Objective

The objective of this observer efficiency analysis was to calculate observer efficiencies and determine whether bird count observations collected by two independent observers were significantly different from each other over several months of data collection. Observer efficiency error (defined as the percent difference in total bird counts between the two observers) was used as the statistical metric, and was calculated for all months for which adequate observational data were available.

Data Format

The avian observational data consisted of species bird counts and total bird counts recorded by two observers: a primary observer ("Observer") and a QA/QC observer ("Tester"). Species-specific bird counts were summed over the number of species to obtain total bird counts. Bird counts were recorded by species over several survey time periods distributed over one or several days a month, for the given month. Bird count data (collected by the "Observer" and "Tester") were collected on the following dates (the number of survey periods for the given date given in parentheses):

September 2008: 9-13 (1), 9-14 (2), 9-15 (1), and 9-16 (1): n=5
October 2008: 10-14 (2), 10-17 (1): n=3
November 2008: 11-12 (3): n=3
January 2009: 1-12 (2), 1-13 (1): n=3
February 2009: 2-14 (1): n=1
June 2009: 6-2 (2), 6-3 (2), 6-4 (4): n=8
September 2009: 9-20 (1): n=1
October 2009: 10-1 (1): n=1
November 2009: 11-19 (1), 11-22 (1): n=2

For the current analysis (discussed in the Methodology section below), sample size (n) for each month was the cumulative number of survey periods conducted in that month (i.e., summation of the number in parentheses). In the following analysis, only those months with a sample size n>2 were examined. Those months for which n=2 or less were discarded from the analysis due to "insufficient data availability". Thus, the following 5 months were analyzed: September 2008 (n=5), October 2008 (n=3), November 2008 (n=3), January 2009 (n=3), and June 2009 (n=8).

Methodology

A two-sample one-way Analysis of Variance (ANOVA)/Kruskal-Wallis (K-W) analysis was conducted to assess sources of variance and test for significant differences in total bird counts between the two observers ("Observer" and "Tester"). Additional two-sample analyses included the two-sample t-test/Mann-Whitney test and the paired-sample t-test/Wilcoxon test. Tests for significant difference were conducted at the 95% confidence level (CL). These analyses were conducted for each of the above-listed 5 months of adequate avian observer data (n>2): September 2008 (n=5), October 2008 (n=3), November 2008 (n=3), January 2009 (n=3), and June 2009 (n=8). For each month, there were two samples (1=Observer, 2=Tester), with the number of monthly survey periods (= n) being 5, 3, 3, 3, and 8 for these 5 months, respectively. The names of the observer and tester were generally different for observation day (i.e., data point comprising the sample size). The measured attribute was TOTAL bird counts (i.e., summed over the individual species).

In addition, for each of these 5 months, a one-sample t-test/Wilcoxon test was conducted (at the 95% CL) to determine if the difference in total bird counts between the Observer and Tester was significant (i.e., significantly different from 0). Two types of differences were calculated and tested: 1) Difference = Observer bird count – Tester bird count and 2) % Observer Error = 100%*(Observer bird count – Tester bird count)/(Observer bird count)

In addition to the one-way analysis (which was conducted for each of the 5 individual months), a two-way ANOVA/K-W analysis was conducted (at the 95% CL) to test for significant differences in total bird counts among the 5 months (Factor 1), between the two observers (Factor 2), and two-way interactions (Month x Observer). For 5 months of data, there were (5 months)*(two observers) = 10 samples, with sample size n = number of survey periods in the given month.

In addition, separate one-way ANOVA/K-W analyses were conducted (at the 95% CL) to test for significant differences in "Difference" and in "% Observer Error" among the 5 months. The number of samples was equal to the number of months (=5), and sample size n = number of survey periods in the given month.

In initial testing for normality (Kolmogorov-Smirnov test) and homoscedacity (Bartlett test), if it was determined that the given dataset was normal (i.e., conforms to a Gaussian bell-shaped distribution) and homoscedastic (i.e., exhibits homogeneity of variances), then the parametric tests were applied to the samples. These tests include: one-sample t-test, two-sample t-test, paired-sample t-test, and multiple-sample ANOVA. In contrast, if it was determined that the dataset was non-normal or non-homoscedastic after two data transformations (e.g., using logarithmic, arcsine, or square-root transformations), then the non-parametric tests were applied. These tests included: one-sample Wilcoxon test, Mann-Whitney two-sample test, paired-sample Wilcoxon test, and multiple-sample Kruskal-Wallis (K-W) test.

Generally, nonparametric tests were conducted on the RANKS of the attribute data (e.g., sorted from lowest to highest values) rather than on the values themselves. For example, in the K-W test, the total bird counts were ranked from lowest to highest, and an ANOVA-type test was conducted on the RANKS (rather than on the values) of the total bird counts to assess differences among the months of available data (Factor 1), between the 2 observers (Factor 2), and any significance in the 2-way interaction (Month x Observer). In the event that the ANOVA or K-W test detected a significant difference (indicated by rejection of the Null hypothesis H_o of no difference), a subsequent Tukey test examined each pair-wise comparison (i.e., N*(N-1)/2 pairs for N samples) to determine the sources of variance (i.e., which specific sample pairs are significantly different from each other).

In addition to the above analyses, several types of Randomization Tests (which assumes datasets were collected serially/sequentially in space or time) were conducted on "Difference" and "% Observer Error" time-series data, in which the sample size (n) in the time series for each month is equal to the number of survey periods in that month. Two types of randomization tests (with associated null hypotheses H_o) were conducted:

1) **Mean Square Successive Difference Test (MSSDT) (parametric):** assumes normality in the underlying distribution of the data.
    a) Null hypothesis (H_o): Consecutive samples exhibit random variability (i.e., are not serially/sequentially correlated).

2) **Runs-up-and-down Test (nonparametric):** Runs, identified by successive directions of change in the same (either positive or negative) directions are counted in the serial/sequential data and are tested to determine whether the occurrence of these runs is random.
    a) H_o (2-tailed): Successive directions of change in the serial/sequential data occur randomly.
    b) H_o (1-tailed): Successive positive and negative changes in the serial/sequential data are not clustered and do not alternate regularly.

3) **(Optional): Runs-above-and-below-median Test (nonparametric):** Runs, identified by directions of deviation of the data values above or below the sample median, are counted in the serial/sequential data and are tested to determine whether the occurrence of these runs is random.
    a) H_o: The population from which the sample was drawn has a random distribution, with no underlying deterministic trend component.

The null hypothesis (H_o) of these Randomization Tests states that the serial/sequential variability and the occurrence of runs in the given dataset (assumed to be collected serially or sequentially in space or time) are random. Rejection of H_o (at the 95% confidence level CL) suggests that the data exhibit an underlying deterministic trend component. In these cases (i.e., rejection of H_o), linear or quadratic regression analysis is used to model the serial/sequential data and subtract out the modeled trend component from the data, leaving the residuals. The Randomization Tests are then conducted on the residual component only, to determine if the serial/sequential variability in the residuals is random (stationary, with a mean of zero).

Results

Results of the two-sample analyses (one-way ANOVA/K-W test, two-sample t-test/Mann-Whitney test, paired-sample t-test/Wilcoxon test), conducted on the "Observer" and "Tester" total bird counts, and of the one-sample t-test/Wilcoxon test (conducted on "Difference" and "% Observer Error"), for each of the five months, are given in the five month-specific Excel files: 1) ANOVA_obseff_9+2008.xls; (2) ANOVA_obseff_10+2008.xls; 3) ANOVA_obseff_11+2008.xls; 4) ANOVA_obseff_1+2009.xls; and 5) ANOVA_obseff_6+2009.xlsResults of the 1-way ANOVA/K-W tests conducted on "Difference" and "% Observer Error" across the 5 months, and of the 2-way ANOVA/K-W test conducted on total bird counts across the 5 months and between the 2 observers, are given in the Excel file: ANOVA_obseff_total.xls (see Statistics file in Volume II Appendix CD). The results of the observer efficiency analysis are summarized below.

<u>September 2008</u>

For the five samples, the two-sample dataset was determined to be non-normal therefore the non-parametric Mann-Whitney two-sample test, Wilcoxon paired-sample test, Kruskal-Wallis test, Wilcoxon one-sample test, and Runs-Up-and-Down Test were applied. In addition, the Mean Square Successive Difference Test (MSSDT) was conducted to provide a normal approximation.

Mann-Whitney: Results of the two-tailed U test show no significant difference in total bird counts between the two observers (acceptance of H_o: n_1=5, n_2=5, U=13, U_{crit}=23, P=0.9000).

Wilcoxon: Results of the two-tailed test show no significant difference in total bird counts between the two observers (acceptance of H_o: T_m=6.5, T_p=8.5, Crit=-999, P=0.8750.

Kruskal-Wallis: Results of the two-tailed chi-squared (X^2) test show no significant difference in total bird counts between the two observers (acceptance of H_o): DF=1, X^2=0.0109, X^2_{crit}=3.841, P=0.9212 . For N=2 levels, there was 2*(2-1)/2 = 1 pair. A subsequent Tukey test for Rank Means on this one pair confirms this result: H_o is accepted.

All three of these tests confirm each other in accepting H_o, with P values ranging from 0.8750 to 0.9212.

1-sample Wilcoxon (Difference): Results of the two-tailed test show no significant difference in total bird counts between the two observers (acceptance of H_o): T_m=6.0, T_p=12.0, Crit=-999, P=0.8000 (Line 255).

Mean Square Successive Difference Test (MSSDT): Variability in total bird counts exhibits serial/sequential randomness (acceptance of H_o): C = 0.0663, C_{crit} = 0.509, P=0.3764 (Line 317).

Runs-Up-and-Down Test: Variability in total bird counts exhibits serial/sequential randomness (acceptance of H_o): u=3, u_{1crit}=1, u_{2crit}=999, P=0.8000 (Line 343).

Runs-Above-and-Below-Median Test:

One-sample Wilcoxon (% Observer Error): Results of the two-tailed test show no significant difference in total bird counts between the two observers (acceptance of H_o): T_m=8.0, T_p=8.0, Crit=-999, P=1.0000 (Line 395).

Mean Square Successive Difference Test (MSSDT): Variability in total bird counts exhibits serial/sequential randomness (acceptance of H_o): C = 0.0246, C_{crit} = 0.509, P=0.4100 (Line 457).

Runs-Up-and-Down Test: Variability in total bird counts exhibits serial/sequential randomness (acceptance of H_o): u=3, u_{1crit}=1, u_{2crit}=999, P=0.8000 (Line 483).

These 1-sample tests confirm each other in arriving at the same conclusions (acceptance of H_o, serial/sequential randomness) in the analyses of "Difference" and "% Observer Error".

October 2008

For the three samples, the two-sample dataset was determined to be non-normal, therefore the non-parametric Mann-Whitney two-sample test, Wilcoxon paired-sample test, Kruskal-Wallis test, Wilcoxon one-sample test, and Runs-Up-and-Down Test were applied. In addition, the Mean Square Successive Difference Test (MSSDT) was conducted to provide a normal approximation.

Mann-Whitney: Results of the two-tailed U test show no significant difference in total bird counts between the two observers (acceptance of H_o): n_1=3, n_2=3, U=6, U_{crit}=999, P=0.4000.

Wilcoxon: Results of the two-tailed test show no significant difference in total bird counts between the two observers (acceptance of H_o): T_m=0.0, T_p=6.0, Crit=-999, P=0.2000.

Kruskal-Wallis: Results of the two-tailed chi-squared (X^2) test show no significant difference in total bird counts between the two observers (acceptance of H_o): DF=1, X^2=0.4286, X^2_{crit}=3.841, P=0.5187. For N=2 levels, there are 2*(2-1)/2 = 1 pair. A subsequent Tukey test for Rank Means on this one pair confirms this result: H_o is accepted.

All 3 of these tests confirm each other in accepting H_o, with P values ranging from 0.2000 to 0.5187; however, it should be cautioned that the sample size (n=3) for this month is very small, and the results of these analyses may not be as accurate compared to larger sample sizes.

One-sample Wilcoxon (Difference): Results of the two-tailed test show no significant difference in total bird counts between the two observers (acceptance of H_o): T_m=3.0, T_p=6.0, Crit=-999, P=0.6500.

Mean Square Successive Difference Test (MSSDT): Variability in total bird counts exhibits serial/sequential randomness (acceptance of H_o): C = -0.5, C_{crit} = 0.509, P=0.0545 (Line 307).

Runs-Up-and-Down Test: Variability in total bird counts exhibits serial/sequential randomness (acceptance of H_o): u=2, u_{1crit}=1, u_{2crit}=999, P=0.5051 (Line 331).

Runs-Above-and-Below-Median Test:

One-sample Wilcoxon (% Observer Error): Results of the two-tailed test show no significant difference in total bird counts between the two observers (acceptance of H_o): T_m=3.0, T_p=4.0, Crit=-999, P=0.6500.

Mean Square Successive Difference Test (MSSDT): Variability in total bird counts exhibits serial/sequential randomness (acceptance of H_o): C = 0.4868, C_{crit} = 0.509, P=0.0611.

Runs-Up-and-Down Test: Variability in total bird counts exhibits serial/sequential randomness (acceptance of H_o): u=1, u_{1crit}=1, u_{2crit}=999, P=0.3500.

These one-sample tests confirm each other in arriving at the same conclusions (acceptance of H_o, serial/sequential randomness) in the analyses of "Difference" and "% Observer Error".

November 2008

For the three samples, the two-sample dataset was determined to be non-normal, hence the non-parametric Mann-Whitney two-sample test, Wilcoxon paired-sample test, Kruskal-Wallis test, Wilcoxon one-sample test, and Runs-Up-and-Down Test were applied. In addition, the Mean Square Successive Difference Test (MSSDT) was conducted to provide a normal approximation.

Mann-Whitney: Results of the two-tailed U test show no significant difference in total bird counts between the two observers (acceptance of H_o): n_1=3, n_2=3, U=5, U_{crit}=999, P=0.5000.

Wilcoxon: Results of the two-tailed test show no significant difference in total bird counts between the two observers (acceptance of H_o): T_m=3.0, T_p=3.0, Crit=-999, P=0.6500.

Kruskal-Wallis: Results of the two-tailed chi-squared (X^2) test show no significant difference in total bird counts between the two observers (acceptance of H_o): DF=1, X^2=0.0476, X^2_{crit}=3.841, P=0.8449 (Line 154). For N=2 levels, there are 2*(2-1)/2 = 1 pair. A subsequent Tukey test for Rank Means on this one pair confirms this result: H_o is accepted.

All 3 of these tests confirm each other in accepting H_o, with P values ranging from 0.5000 to 0.8449; however, it should be cautioned that the sample size (n=3) for this month is very small, and therefore the results of these analyses may not be as accurate compared to larger sample sizes.

1-sample Wilcoxon (Difference): Results of the two-tailed test show no significant difference in total bird counts between the two observers (acceptance of H_o): T_m=3.0, T_p=6.0, Crit=-999, P=0.6500 (Line 247).

Mean Square Successive Difference Test (MSSDT): Variability in total bird counts exhibits serial/sequential randomness (acceptance of H_o): C = 0.25, C_{crit} = 0.509, P=0.2282.

Runs-Up-and-Down Test: Variability in total bird counts exhibits serial/sequential randomness (acceptance of H_o): u=1.5, u_{1crit}=1, u_{2crit}=999, P=0.6541.

Runs-Above-and-Below-Median Test:

1-sample Wilcoxon (% Observer Error): Results of the two-tailed test show no significant difference in total bird counts between the two observers (acceptance of H_o): T_m=3.0, T_p=4.0, Crit=-999, P=0.6500.

Mean Square Successive Difference Test (MSSDT): Variability in total bird counts exhibits serial/sequential randomness (acceptance of H_o): C = 0.4861, C_{crit} = 0.509, P=0.0615.

Runs-Up-and-Down Test: Variability in total bird counts exhibits serial/sequential randomness (acceptance of H_o): u=1, u_{1crit}=1, u_{2crit}=999, P=0.3500.

These one-sample tests confirm each other in arriving at the same conclusions (acceptance of H_o, serial/sequential randomness) in the analyses of “Difference” and “% Observer Error”.

January 2009

For the three samples, the two-sample dataset was determined to be non-normal, therefore the non-parametric Mann-Whitney 2-sample test, Wilcoxon paired-sample test, Kruskal-Wallis test, Wilcoxon one-sample test, and Runs-Up-and-Down Test were applied. In addition, the Mean Square Successive Difference Test (MSSDT) was conducted to provide a normal approximation.

Mann-Whitney: Results of the two-tailed U test show no significant difference in total bird counts between the two observers (acceptance of H_o): n_1=3, n_2=3, U=4.5, U_{crit}=999, P=0.5500.

Wilcoxon: Results of the two-tailed test show no significant difference in total bird counts between the two observers (acceptance of H_o): T_m=3.0, T_p=4.0, Crit=-999, P=0.6500.

Kruskal-Wallis: Results of the two-tailed chi-squared (X^2) test show no significant difference in total bird counts between the two observers (acceptance of H_o): DF=1, X^2=0.0000, X^2_{crit}=3.841, P=0.9900 (Line 158). For N=2 levels, there are 2*(2-1)/2 = 1 pair. A subsequent Tukey test for Rank Means on this 1 pair confirms this result: H_o is accepted.

All three of these tests confirm each other in accepting H_o, with P values ranging from 0.5500 to 0.9900; however, it should be cautioned that the sample size (n=3) for this month is very small, and therefore, the results of these analyses may not be as accurate compared to larger sample sizes.

One-sample Wilcoxon (Difference): Results of the two-tailed test show no significant difference in total bird counts between the two observers (acceptance of H_o): T_m=3.0, T_p=4.0, Crit=-999, P=0.6500.

Mean Square Successive Difference Test (MSSDT): Variability in total bird counts exhibits serial/sequential randomness (acceptance of H_o): C = 0.1676, C_{crit} = 0.509, P=0.2947.

Runs-Up-and-Down Test: Variability in total bird counts exhibits serial/sequential randomness (acceptance of H_o): u=2, u_{1crit}=1, u_{2crit}=999, P=0.6541.

Runs-Above-and-Below-Median Test:

One-sample Wilcoxon (% Observer Error): Results of the two-tailed test show no significant difference in total bird counts between the two observers (acceptance of H_o): T_m=3.0, T_p=4.0, Crit=-999, P=0.6500.

Mean Square Successive Difference Test (MSSDT): Variability in total bird counts exhibits serial/sequential randomness (acceptance of H_o): C = -0.1125, C_{crit} = 0.509, P=0.3391.

Runs-Up-and-Down Test: Variability in total bird counts exhibits serial/sequential randomness (acceptance of H_o): u=2, u_{1crit}=1, u_{2crit}=999, P=0.6541 (Line 468).

These one-sample tests confirm each other in arriving at the same conclusions (acceptance of H_o, serial/sequential randomness) in the analyses of “Difference” and “% Observer Error”.

<u>June 2009</u>

For the eight samples, the two-sample dataset was determined to be non-normal therefore the non-parametric Mann-Whitney two-sample test, Wilcoxon paired-sample test, Kruskal-Wallis test, Wilcoxon one-sample test, and Runs-Up-and-Down Test were applied. In addition, the Mean Square Successive Difference Test (MSSDT) was conducted to provide a normal approximation.

Mann-Whitney: Results of the two-tailed U test show no significant difference in total bird counts between the two observers (acceptance of H_o): n_1=8, n_2=8, U=35.5, U_{crit}=51, P=0.4375.

Wilcoxon: Results of the two-tailed test show no significant difference in total bird counts between the two observers (acceptance of H_o): T_m=15.0, T_p=31.0, Crit=3.0, P=0.7250.

Kruskal-Wallis: Results of the two-tailed chi-squared (X^2) test show no significant difference in total bird counts between the two observers (acceptance of H_o): DF=1, X^2=0.1375, X^2_{crit}=3.841, P=0.7248. For N=2 levels, there are 2*(2-1)/2 = 1 pair. A subsequent Tukey test for Rank Means on this one pair confirms this result: H_o is accepted.

All three of these tests confirm each other in accepting H_o, with P values ranging from 0.4375 to 0.7248.

One-sample Wilcoxon (Difference): Results of the two-tailed test show no significant difference in total bird counts between the two observers (acceptance of H_o): T_m=15.0, T_p=31.0, Crit=3.0, P=0.7250.

Mean Square Successive Difference Test (MSSDT): Variability in total bird counts exhibits serial/sequential randomness (acceptance of H_o): C = 0.0518, C_{crit} = 0.509, P=0.3881.

Runs-Up-and-Down Test: Variability in total bird counts exhibits serial/sequential randomness (acceptance of H_o): u=4.6667, u_{1crit}=2, u_{2crit}=999, P=1.0000.

Runs-Above-and-Below-Median Test:

One-sample Wilcoxon (% Observer Error): Results of the two-tailed test show no significant difference in total bird counts between the two observers (acceptance of H_o): T_m=15.0, T_p=31.0, Crit=3.0, P=0.7250.

Mean Square Successive Difference Test (MSSDT): Variability in total bird counts exhibits serial/sequential randomness (acceptance of H_o): C = -0.2610, C_{crit} = 0.509, P=0.2193.

Runs-Up-and-Down Test: Variability in total bird counts exhibits serial/sequential randomness (acceptance of H_o): u=4.6667, u_{1crit}=2, u_{2crit}=999, P=1.0000.

These one-sample tests confirm each other in arriving at the same conclusions (acceptance of H_o, serial/sequential randomness) in the analyses of “Difference” and “% Observer Error”.

Summary

Total Bird Counts

From the two-sample one-way analysis for each of the five months, there’s no significant difference in total bird counts between the two observers (“Observer” and “Tester”).

Monthly Difference

One-way ANOVA was run and the five-sample dataset was determined to be non-normal, therefore hence the non-parametric Kruskal-Wallis test was applied. Results of the two-tailed chi-squared (X^2) test show no significant difference in “Difference” (i.e., difference between the 2 observers’ total bird counts) among the five months (acceptance of H_o): DF=4, X^2=2.7512, X^2_{crit}=9.488, P=0.6056. For N=5 levels, there are 5*(5-1)/2 = 10 pairs. A subsequent Tukey test for Rank Means on these 10 pairs confirms this result: H_o is accepted for all 10 pair-wise combinations.

Percent Observer Error

The five-sample dataset was determined to be non-normal therefore the non-parametric Kruskal-Wallis test was applied. Results of the two-tailed chi-squared (X^2) test show no significant difference in “% Observer Error” among the five months (acceptance of H_o): DF=4, X^2=2.6789, X^2_{crit}=9.488, P=0.6182 (Line 157). For N=5 levels, there are 5*(5-1)/2 = 10 pairs. A subsequent Tukey test for Rank Means on these 10 pairs confirms this result: H_o is accepted for all 10 pair-wise combinations.

Between Observer Difference

There was no significant difference in total bird counts (acceptance of H_o): DF1=1, DF2=70, F=1.3814, F_{crit}=3.841, P=0.2437. For N=2 levels, there are 2*(2-1)/2 = 1 pair. A subsequent Tukey test for Rank Means on this pair confirms this result: H_o is accepted.

Month x Observer Interaction

There was no significant difference (acceptance of H_o): DF1=4, DF2=70, F=0.9138, F_{crit}=9.488, P=0.9213 (Line 303). For N=5*2=10 levels, there are 10*(10-1)/2 = 45 pairs. A subsequent Tukey test for Rank Sums on these 45 pairs confirms this result: H_o is accepted for all 45 pair-wise combinations.

Conclusions

The following conclusions can be made. No significant difference exists in:

1) Total bird counts among the five months between the two observers.
2) Difference (i.e., the difference between the two observers' total bird counts) among the five months.
3) Percent Observer Error among the five months.

In addition, no significant interaction between month and observer (i.e., the differences in total bird counts with respect to one factor are independent of the other factor). For example, the sensitivity of total bird counts to changes in month is independent of observer, and likewise, the sensitivity of total bird counts to changes in observer is independent of month. Where there is no significant difference in total bird counts with respect to changes in a given factor or interaction, the Tukey test confirms this result for all pair-wise combinations.

APPENDIX H

INCIDENTAL DATA

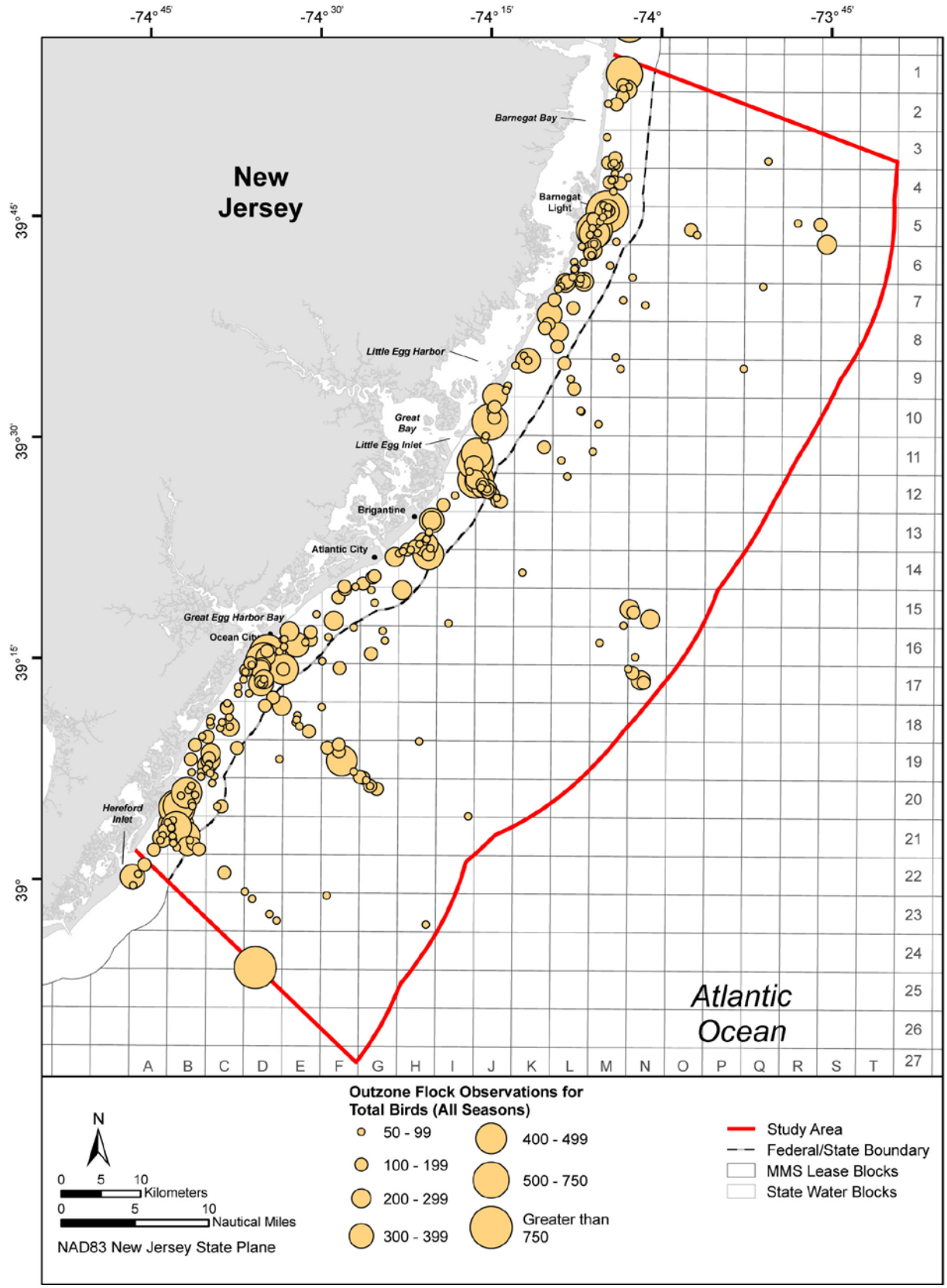

Figure H-1. Out-zone Flock Observations for Total Birds (all seasons; 2008, 2009).

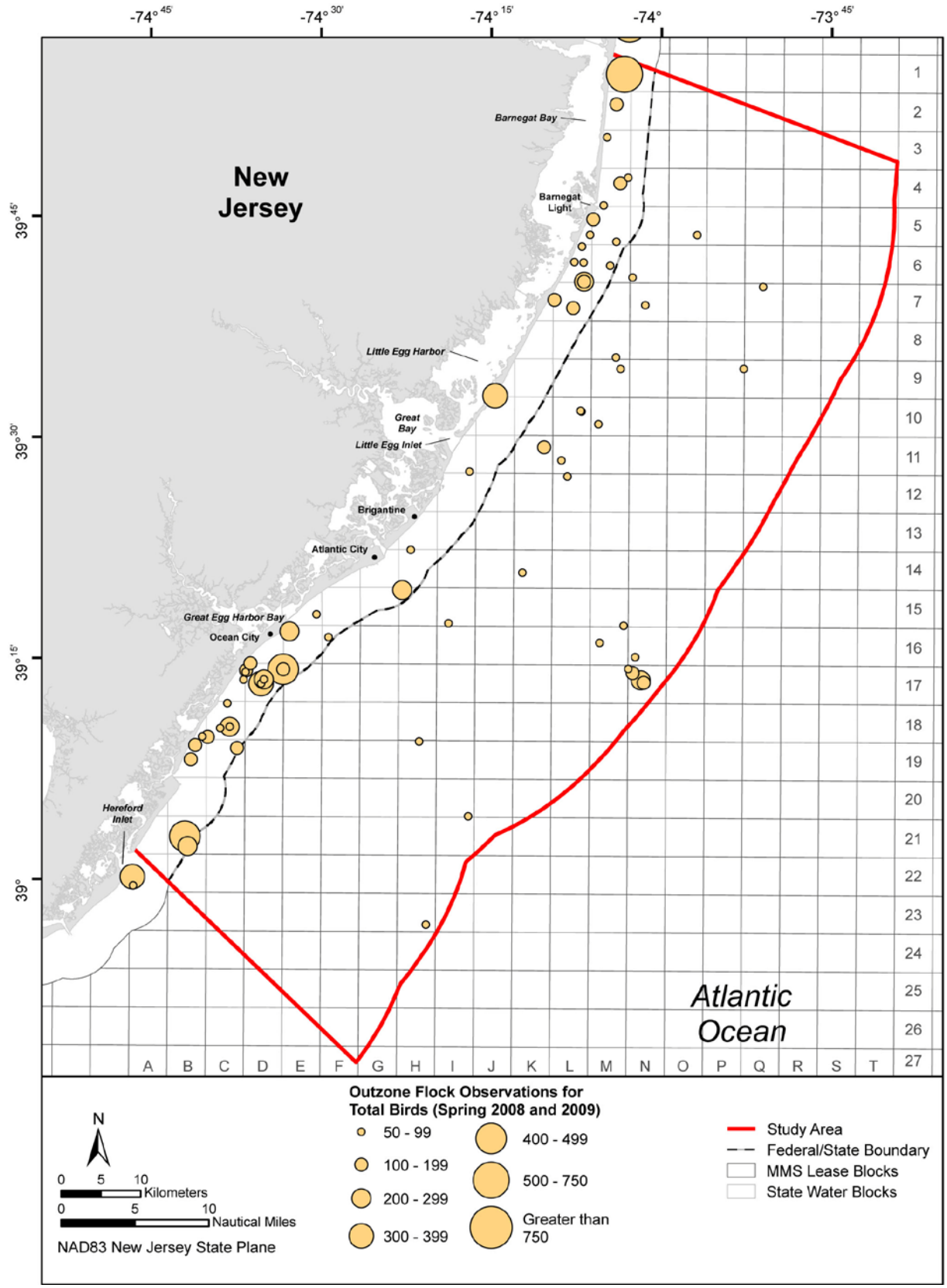

Figure H-2. Out-zone Flock Observations for Total Birds (Spring 2008, 2009).

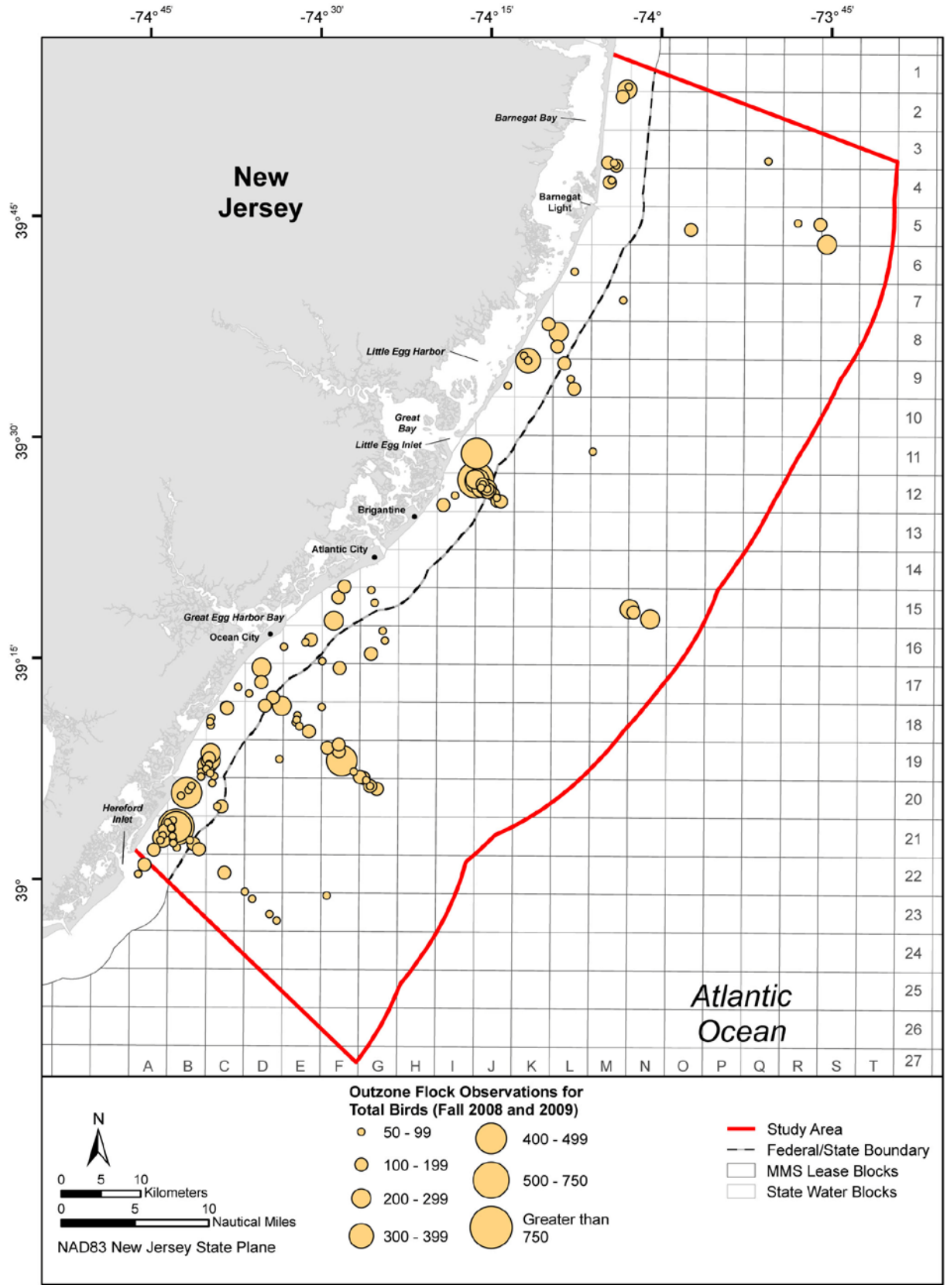

Figure H-3. Out-zone Flock Observations for Total Birds (Fall 2008, 2009).

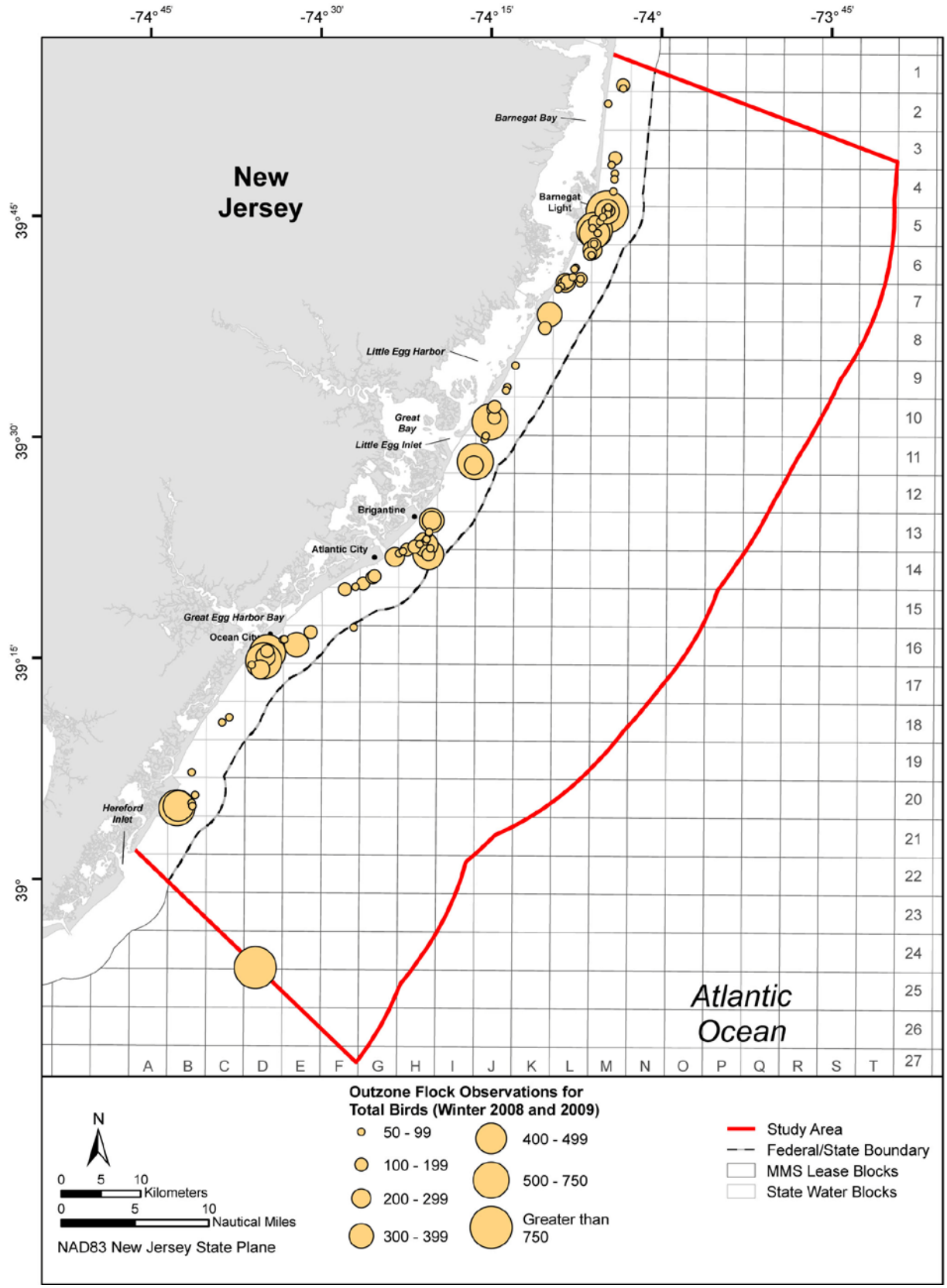

Figure H-4. Out-zone Flock Observations for Total Birds (Winter 2008, 2009).

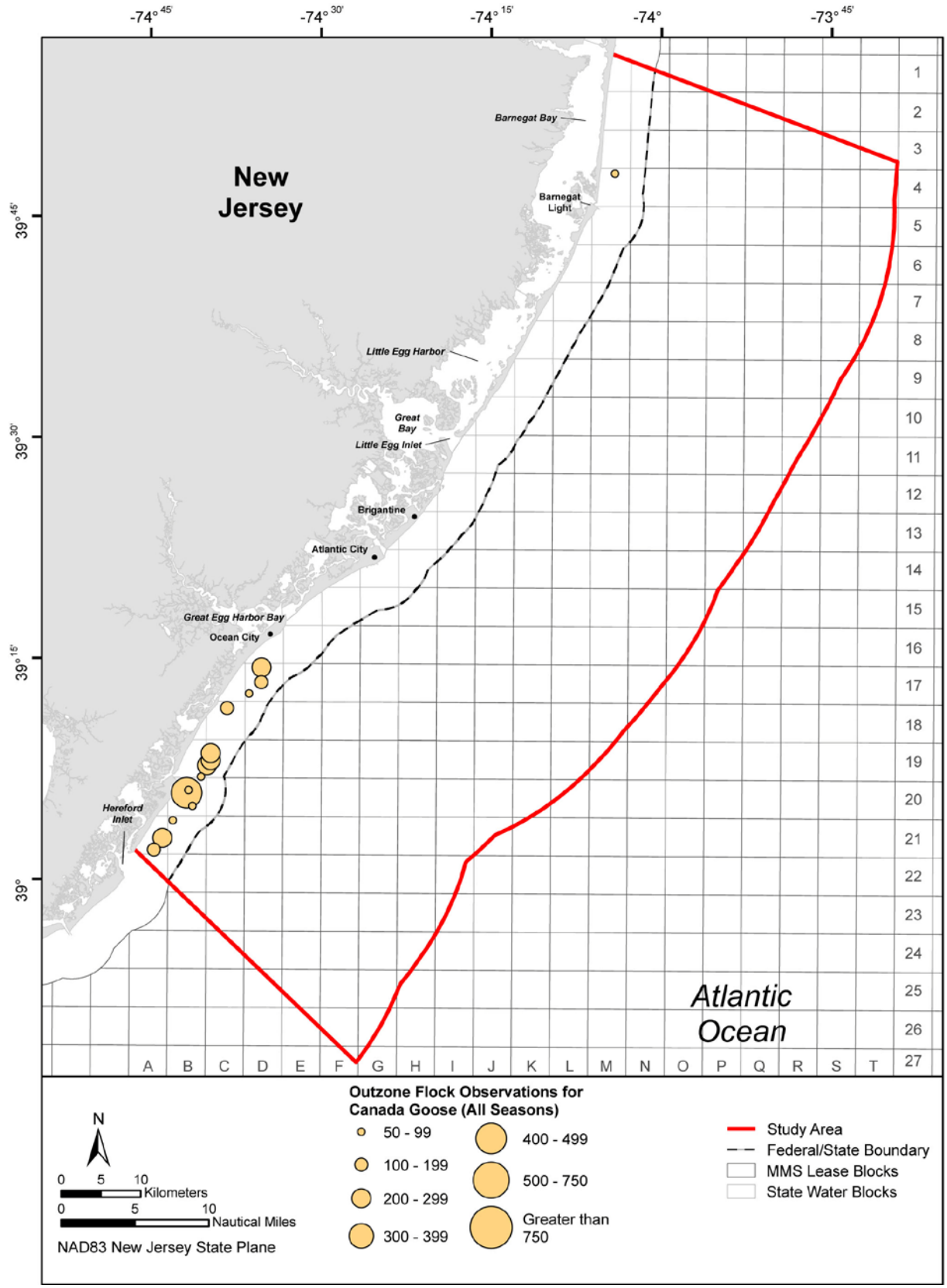

Figure H-5. Out-zone Flock Observations for Canada Goose (all seasons).

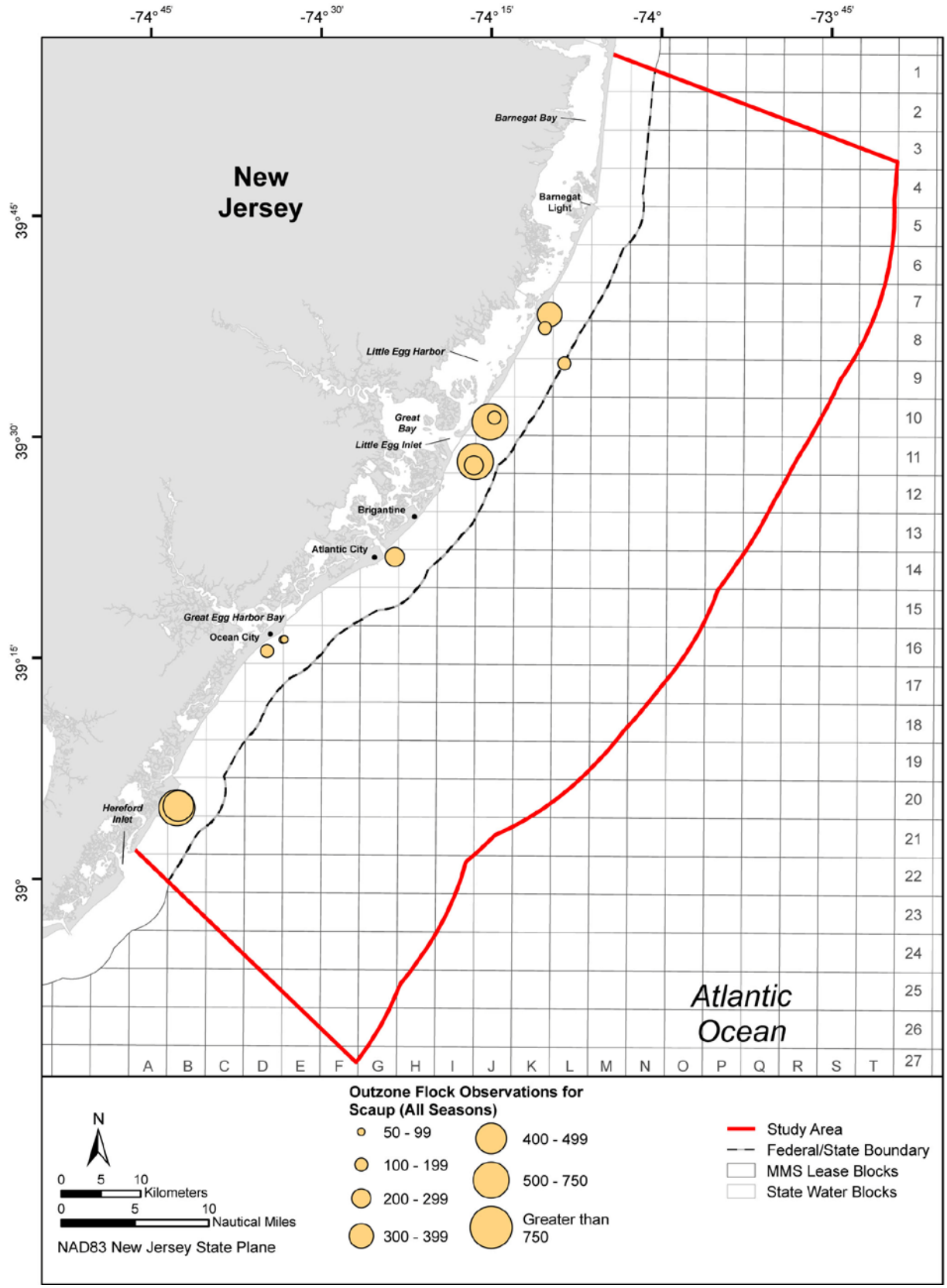

Figure H-6. Out-zone Flock Observations for Scaup (all seasons).

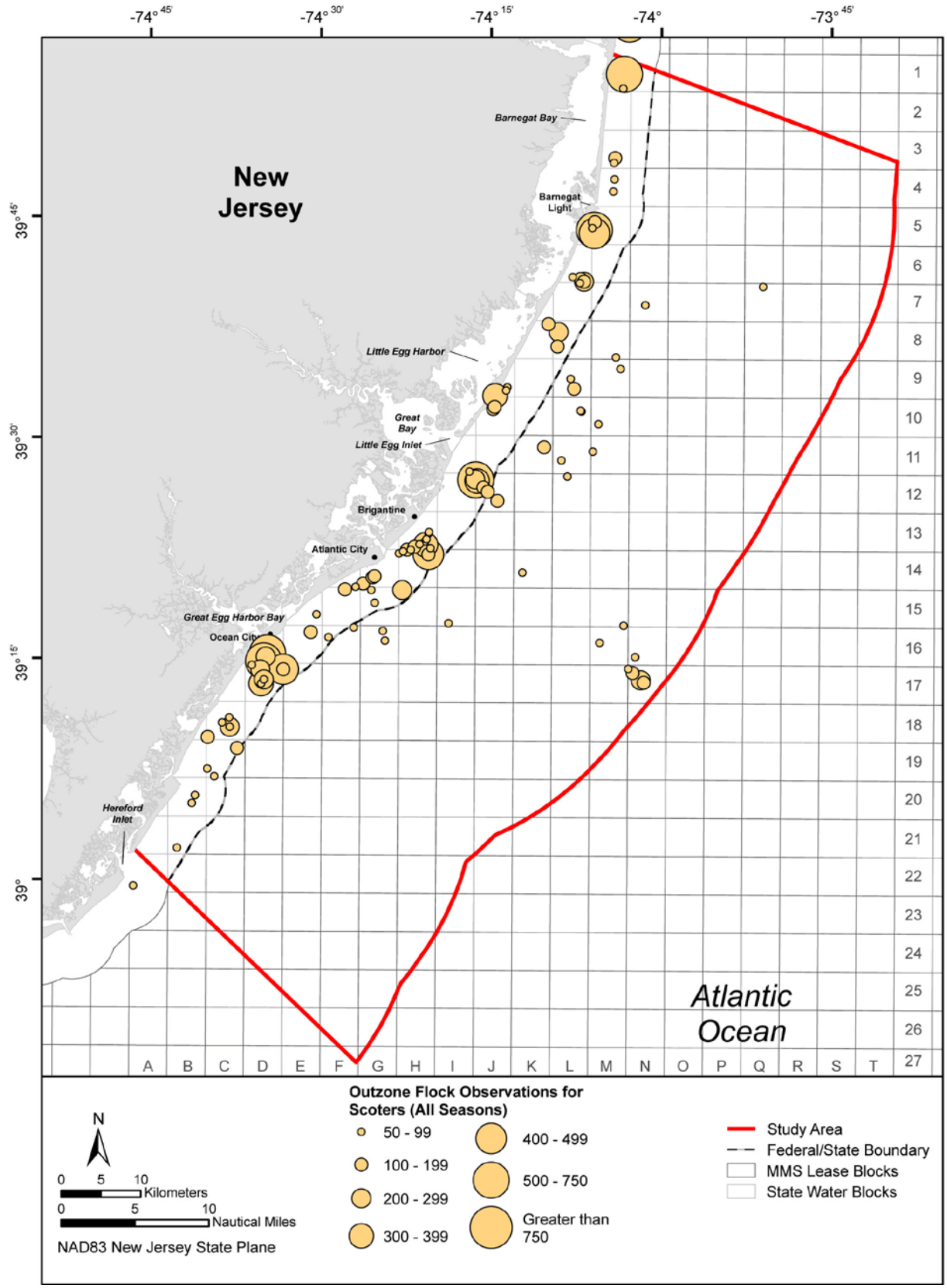

Figure H-7. Out-zone Flock Observations for Scoters (all seasons; 2008, 2009).

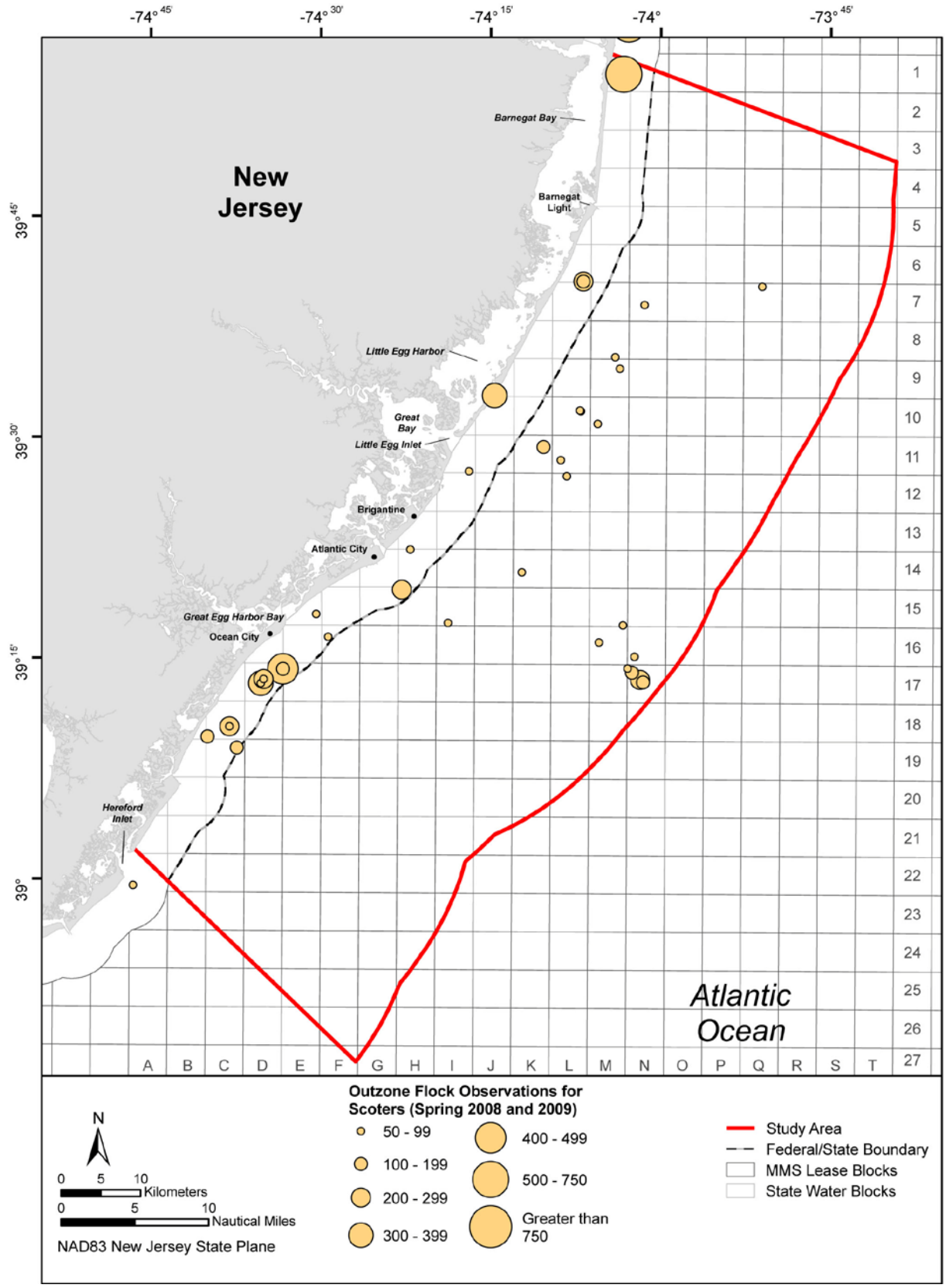

Figure H-8. Out-zone Flock Observations for Scoters (Spring 2008, 2009).

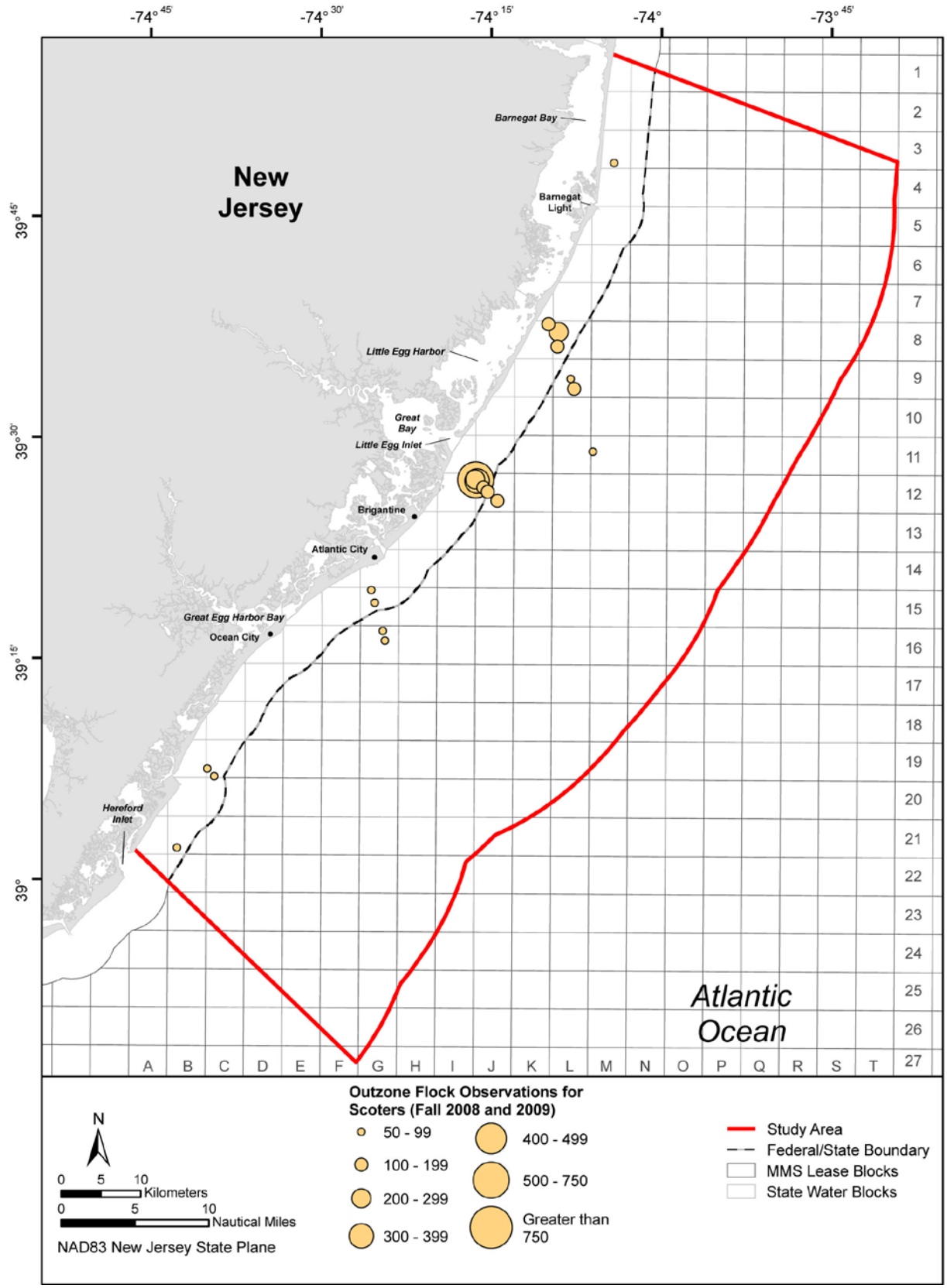

Figure H-9. Out-zone Flock Observations for Scoters (Fall 2008, 2009).

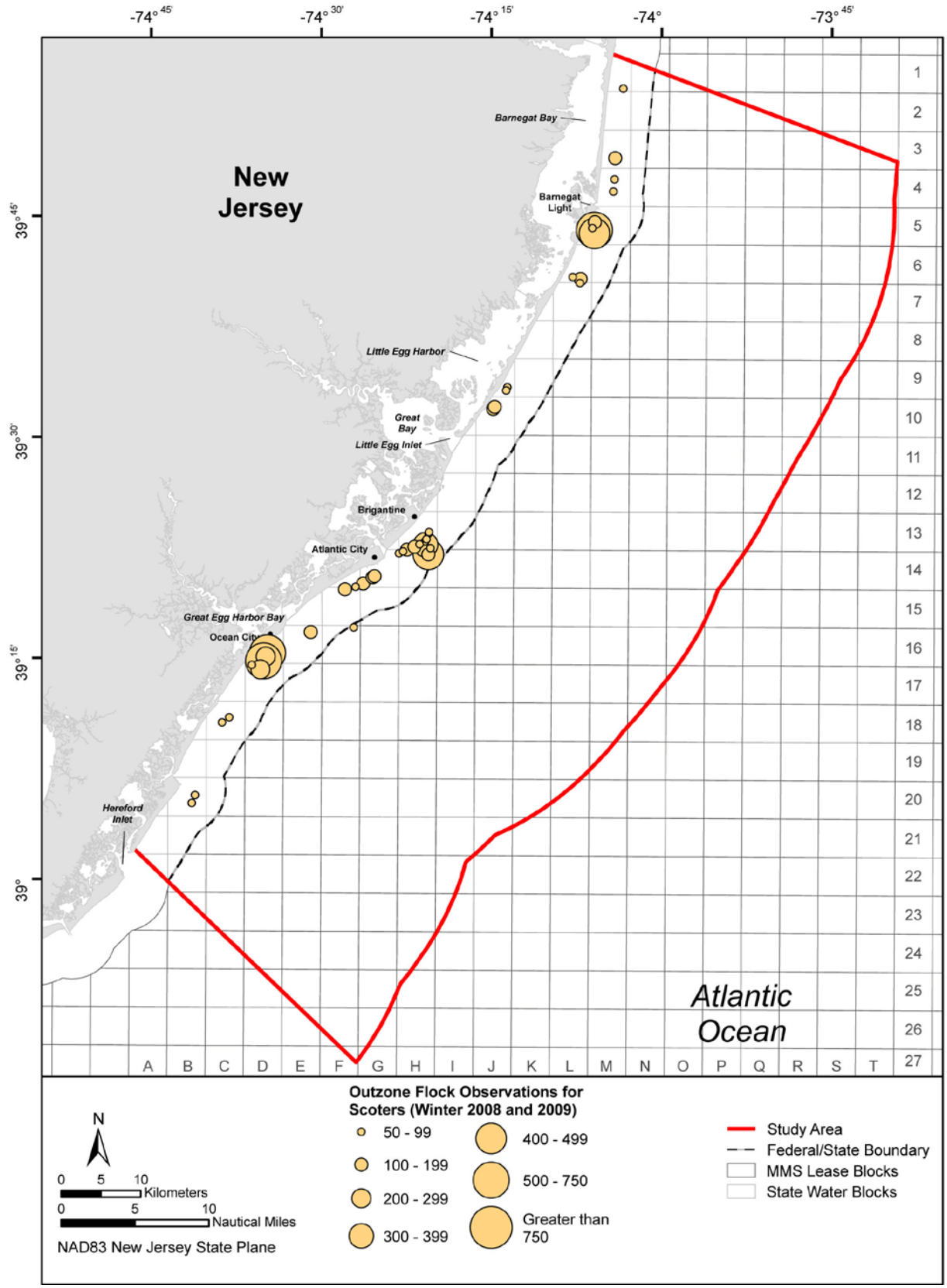

Figure H-10. Out-zone Flock Observations for Scoters (Winter 2008, 2009).

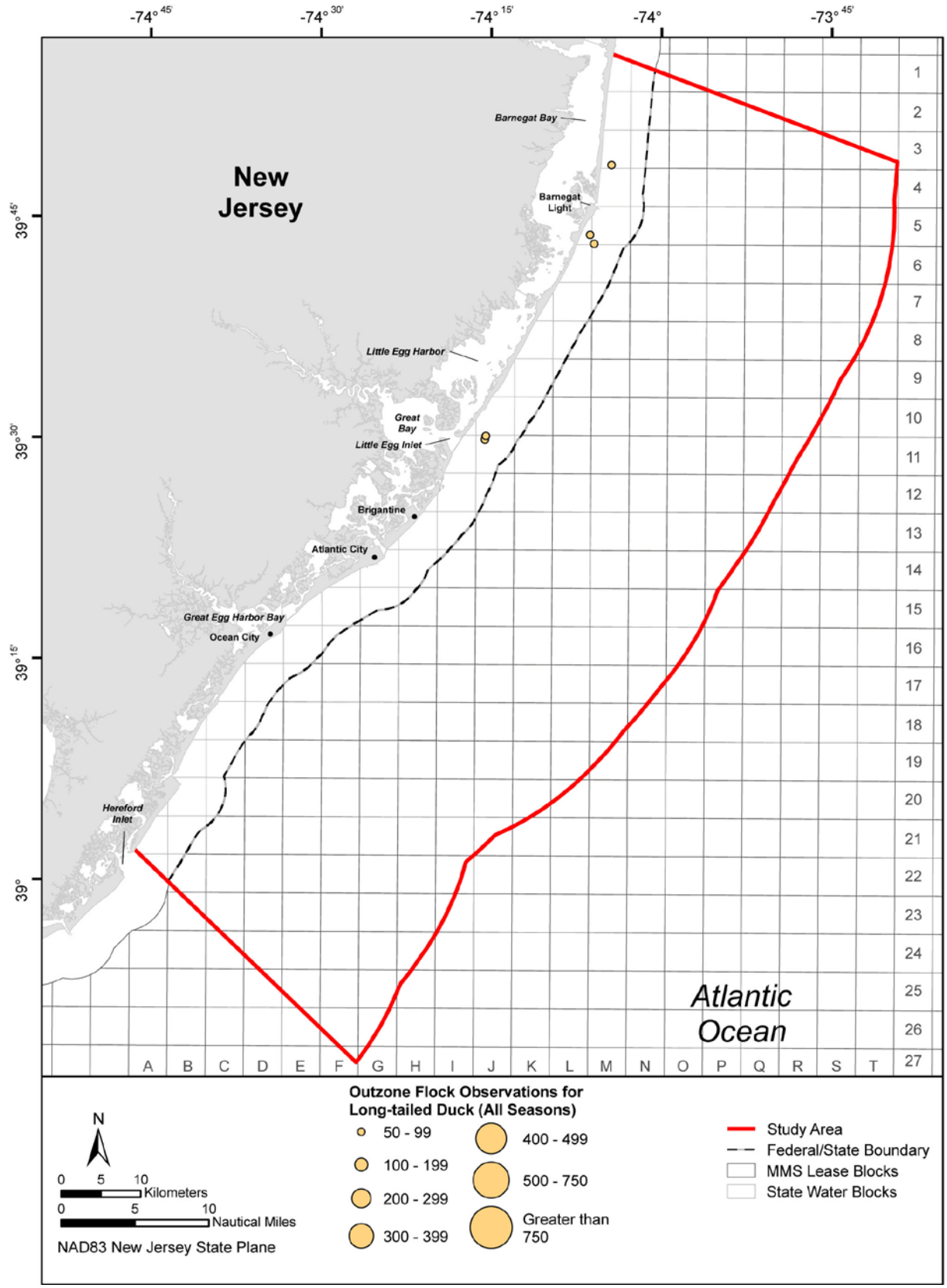

Figure H-11. Out-zone Flock Observations for Long-tailed Duck (all seasons).

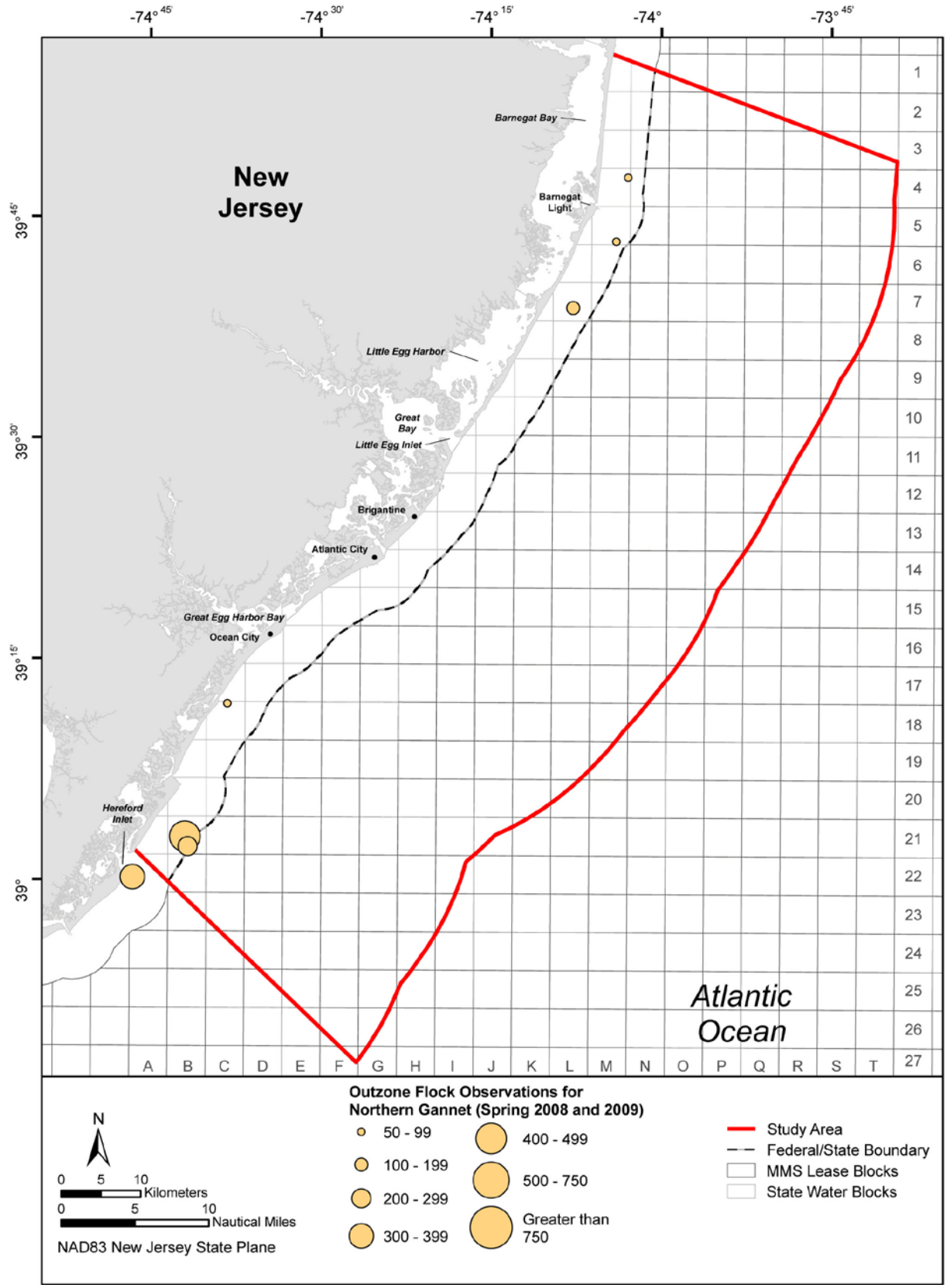

Figure H-12. Out-zone Flock Observations for Northern Gannet (Spring 2008, 2009).

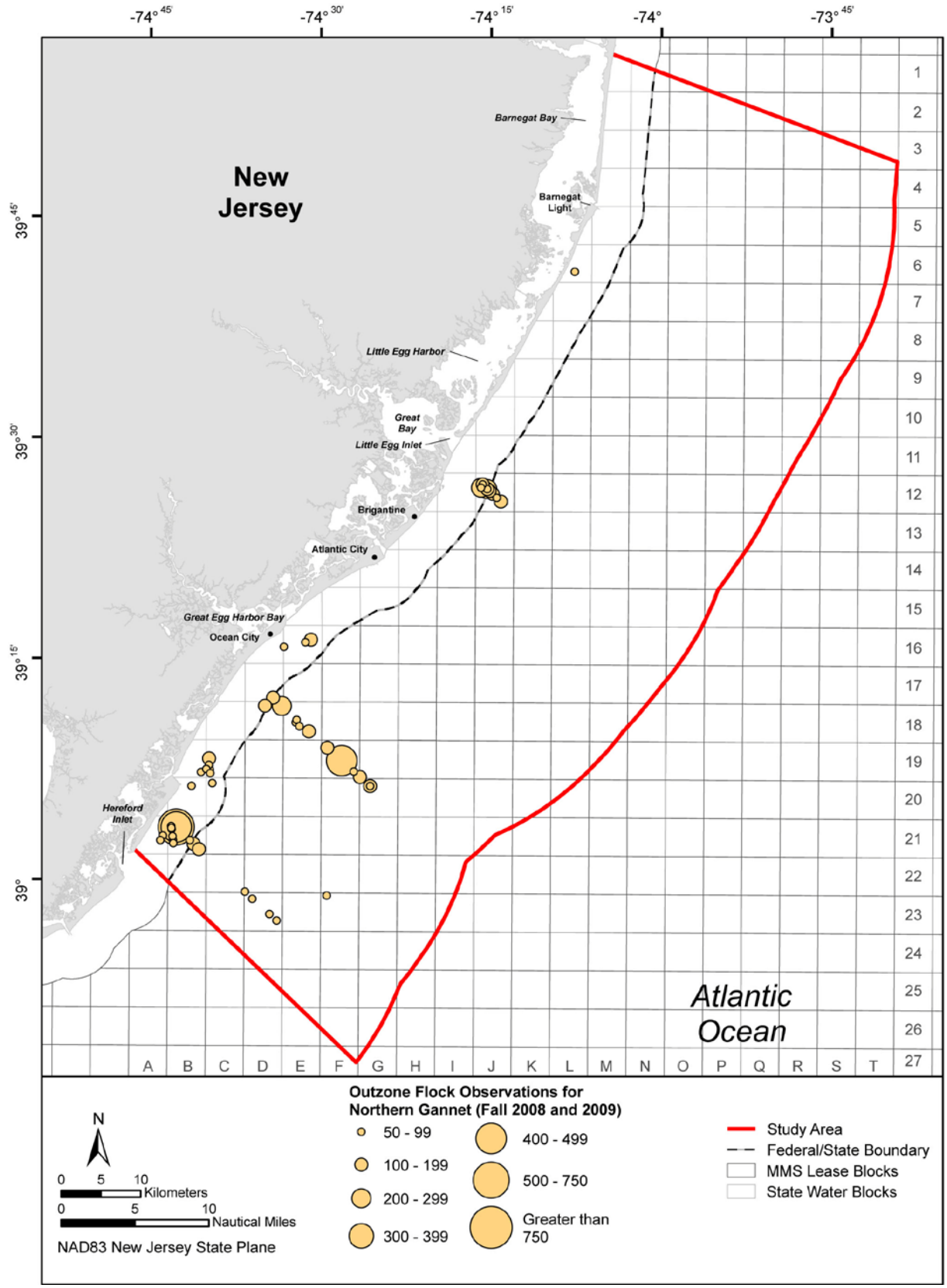

Figure H-13. Out-zone Flock Observations for Northern Gannet (Fall 2008, 2009).

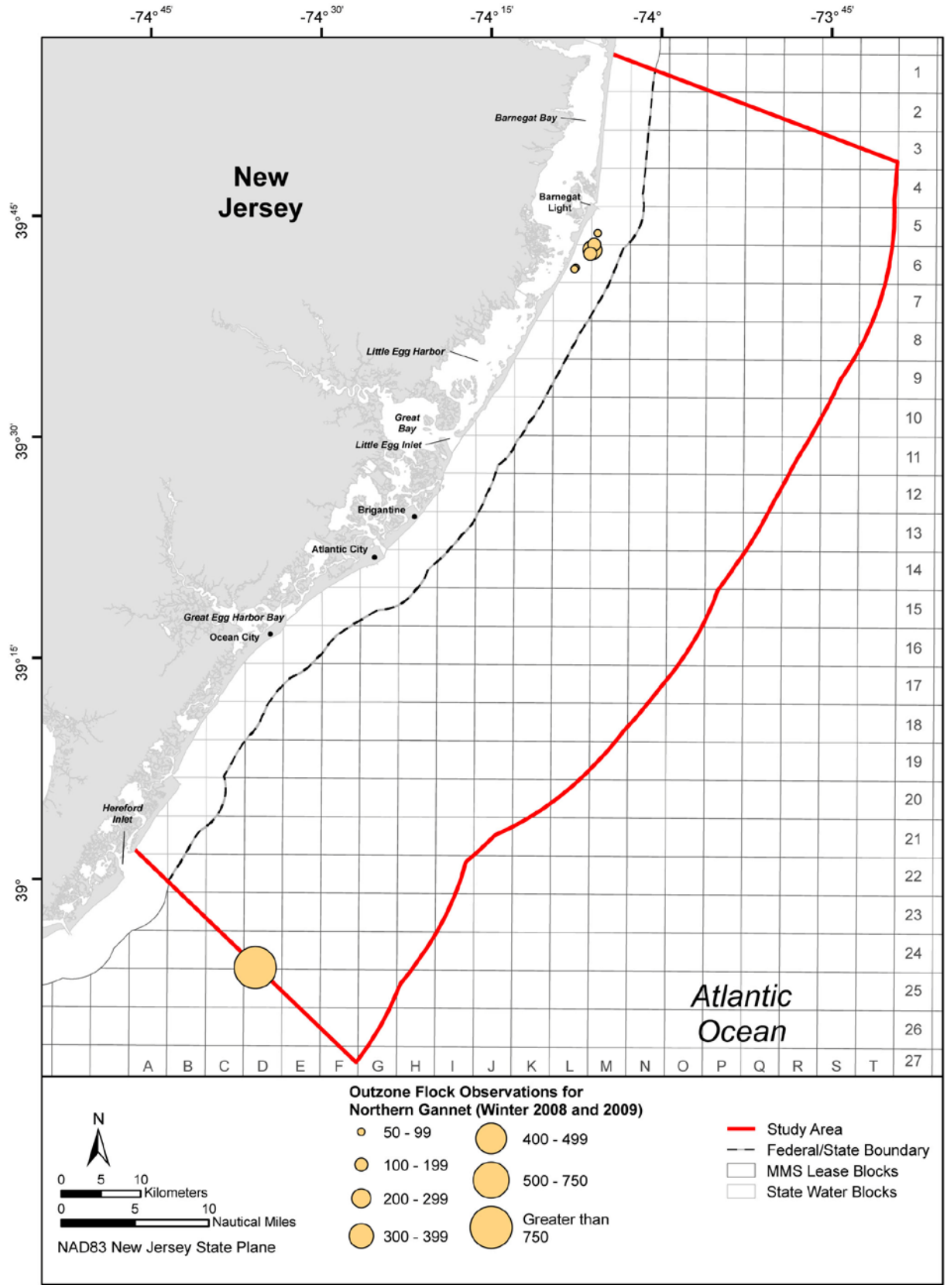

Figure H-14. Out-zone Flock Observations for Northern Gannet (Winter 2008, 2009).

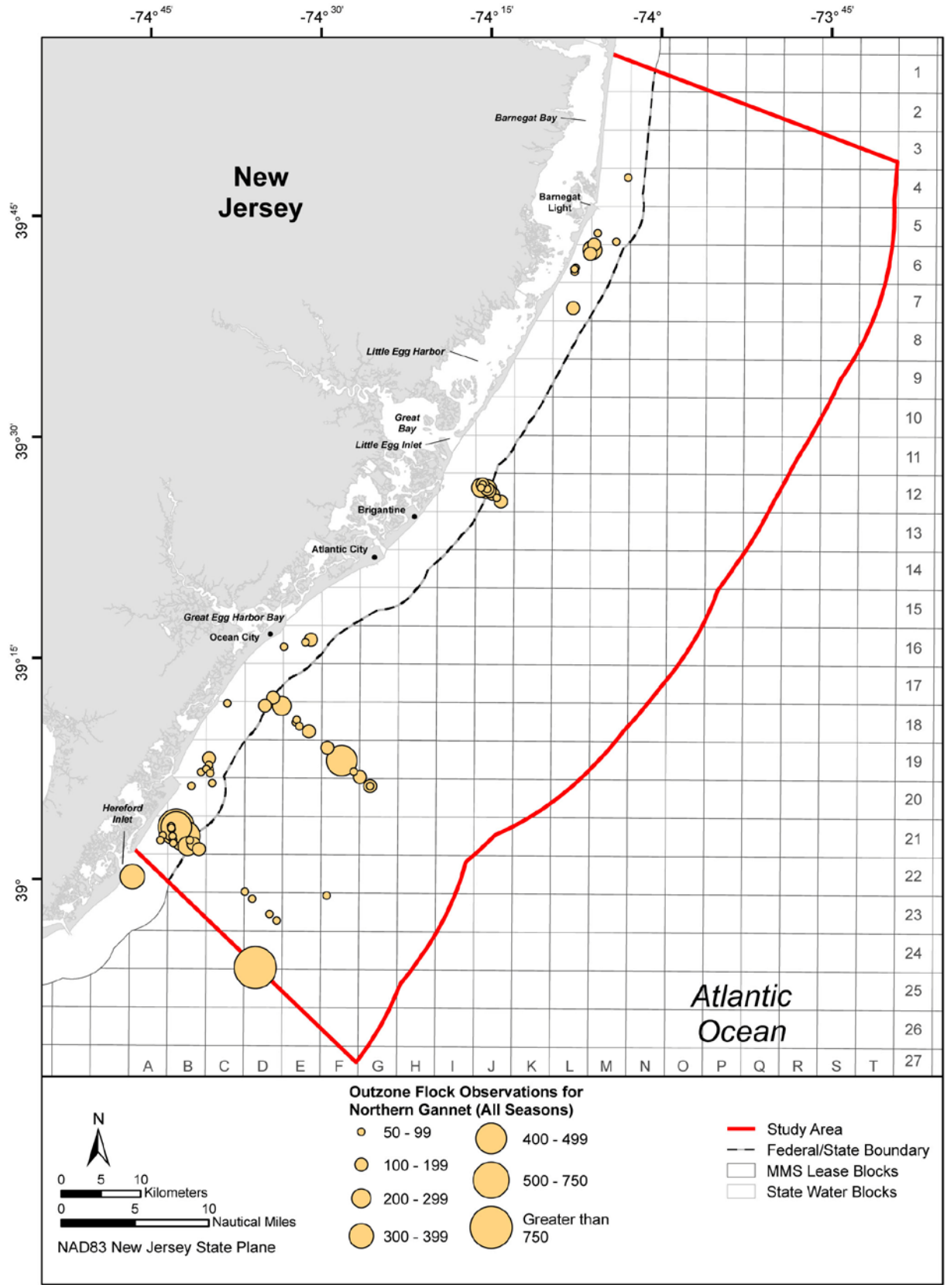

Figure H-15. Out-zone Flock Observations for Northern Gannet (all seasons; 2008, 2009).

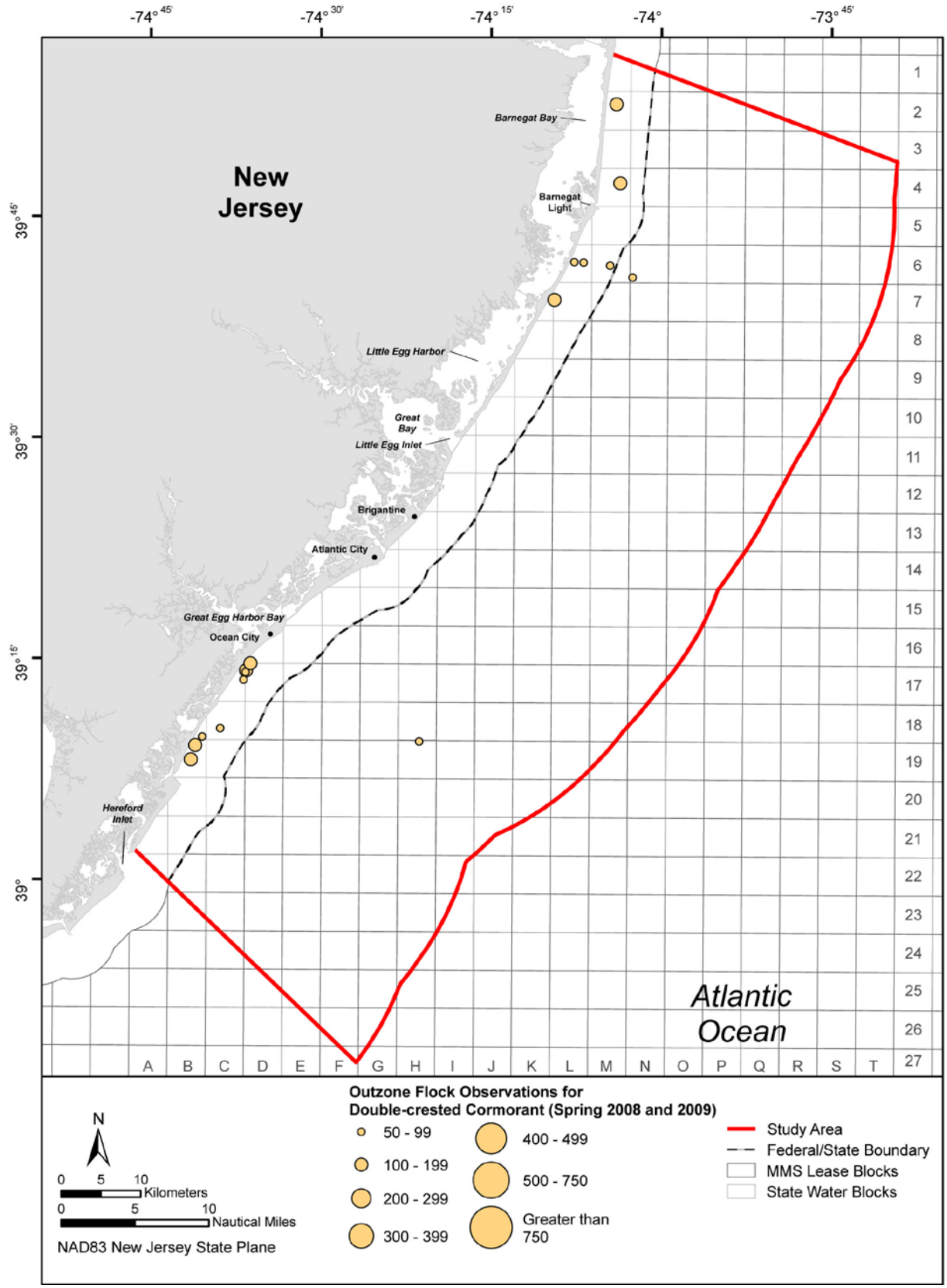

Figure H-16. Out-zone Flock Observations for Double-crested Cormorant (Spring 2008, 2009).

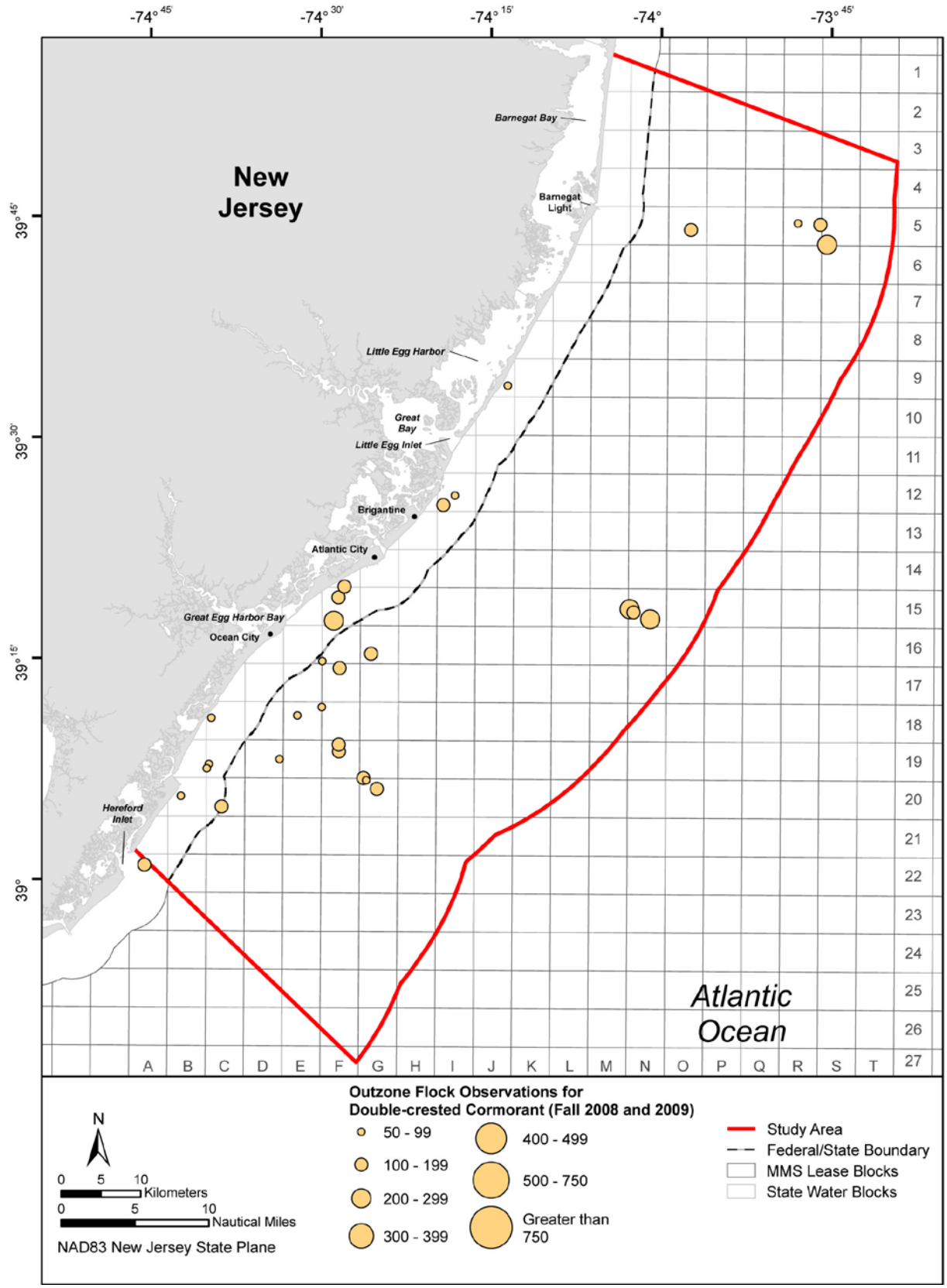

Figure H-17. Out-zone Flock Observations for Double-crested Cormorant (Fall 2008, 2009).

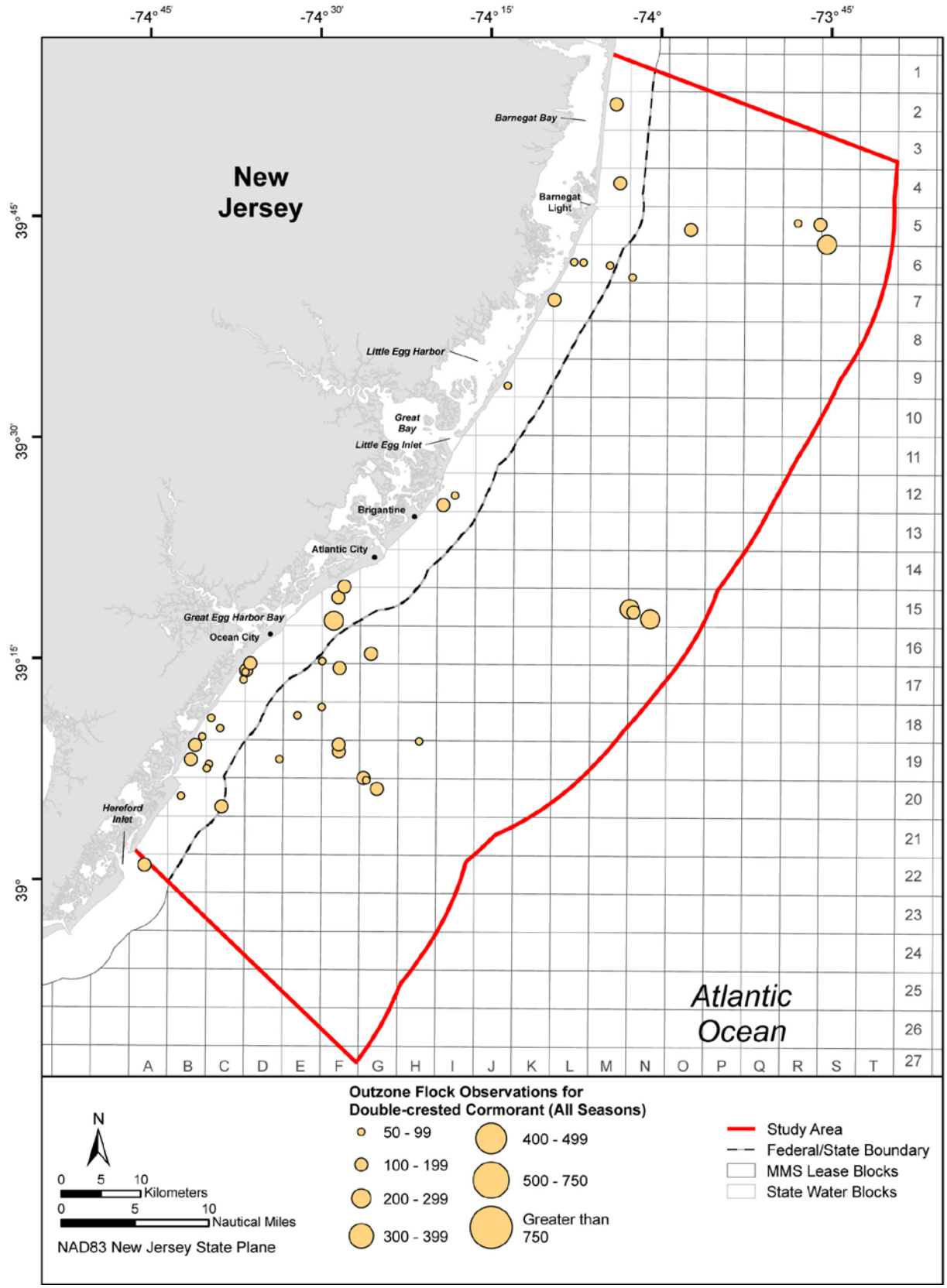

Figure H-18. Out-zone Flock Observations for Double-crested Cormorant (all seasons; 2008, 2009).

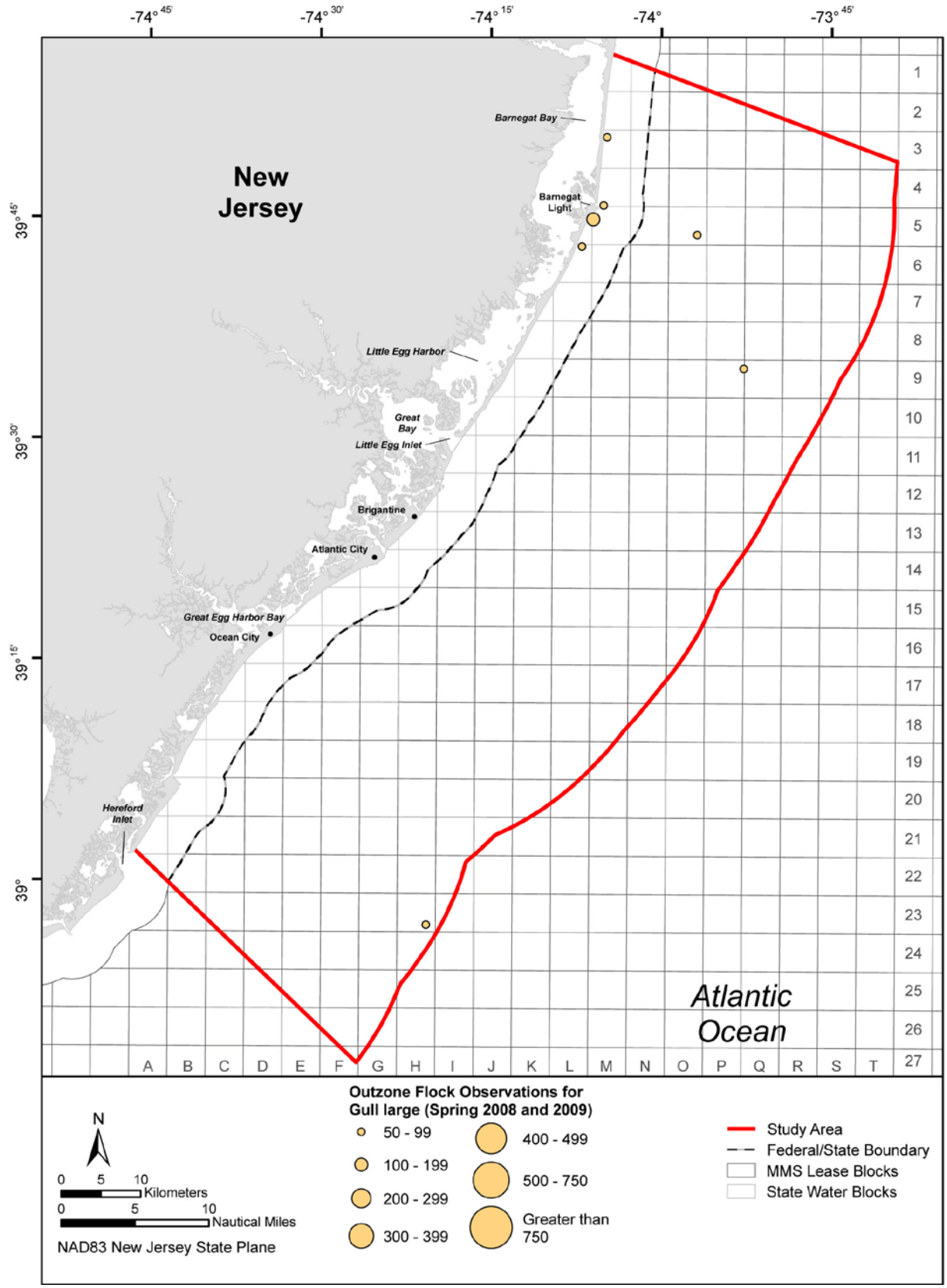

Figure H-19. Out-zone Flock Observations for Large Gulls (Spring 2008, 2009).

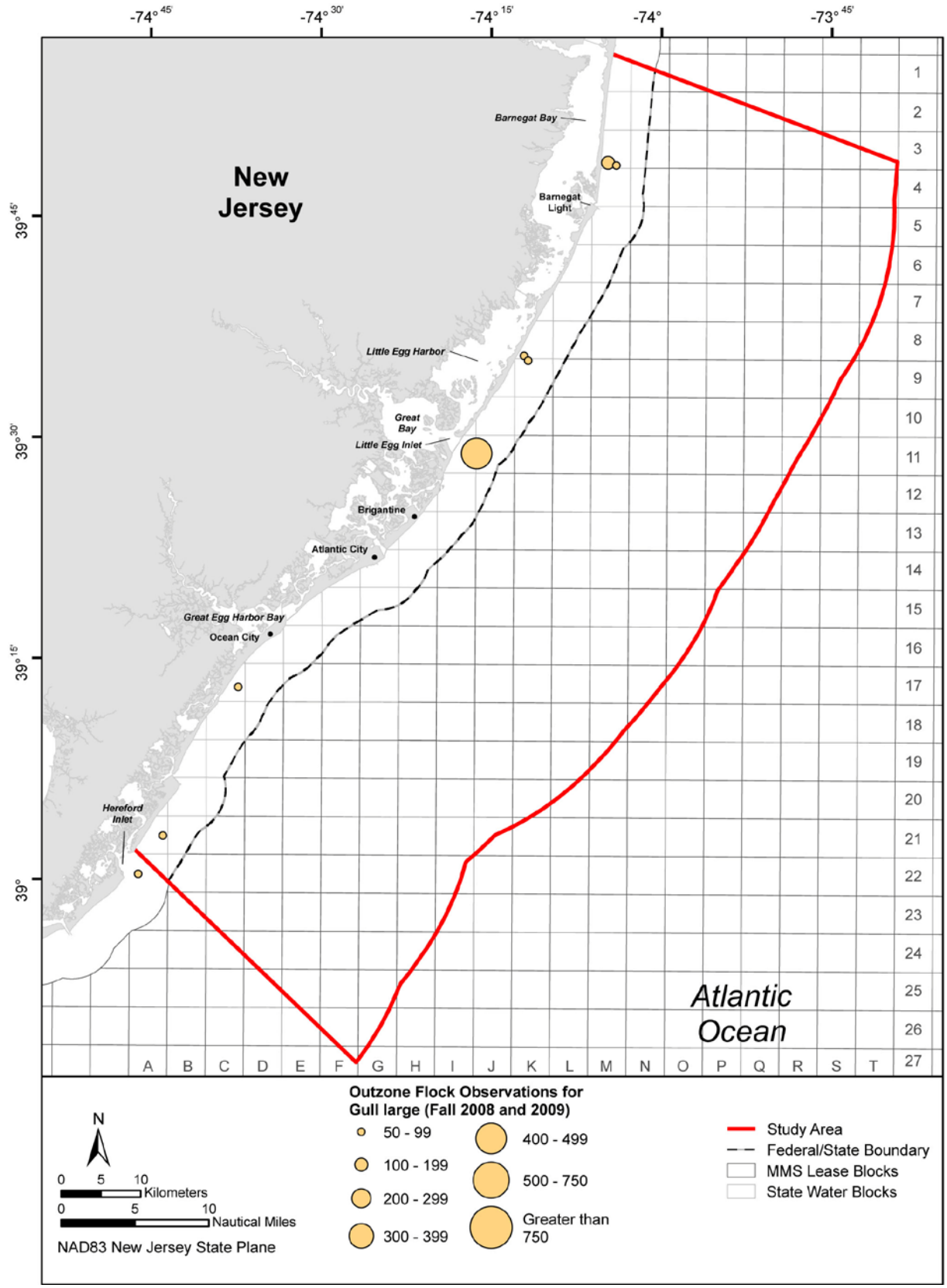

Figure H-20. Out-zone Flock Observations for Large Gulls (Fall 2008, 2009).

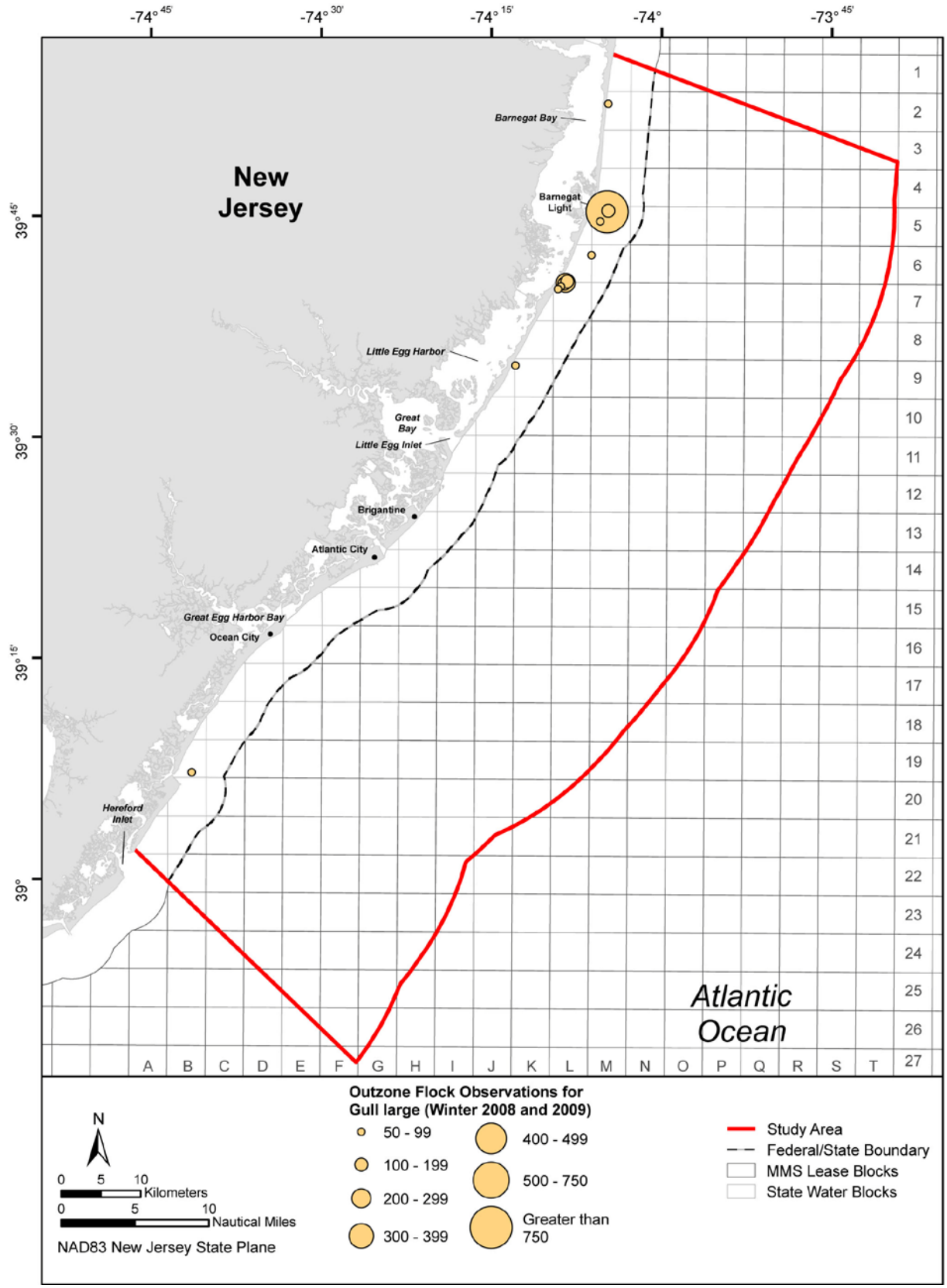

Figure H-21. Out-zone Flock Observations for Large Gulls (Winter 2008, 2009).

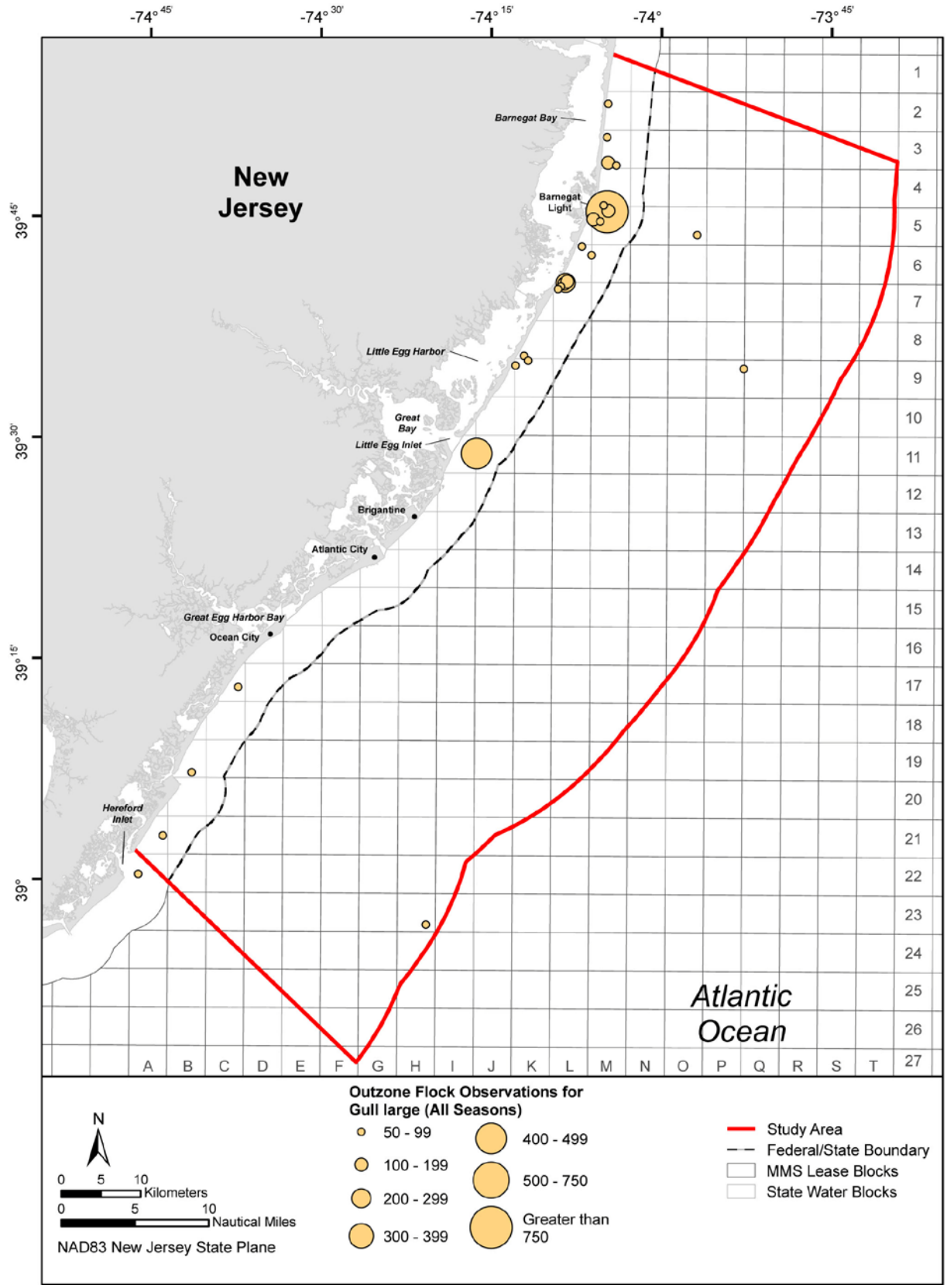

Figure H-22. Out-zone Flock Observations for Large Gulls (all seasons; 2008, 2009).

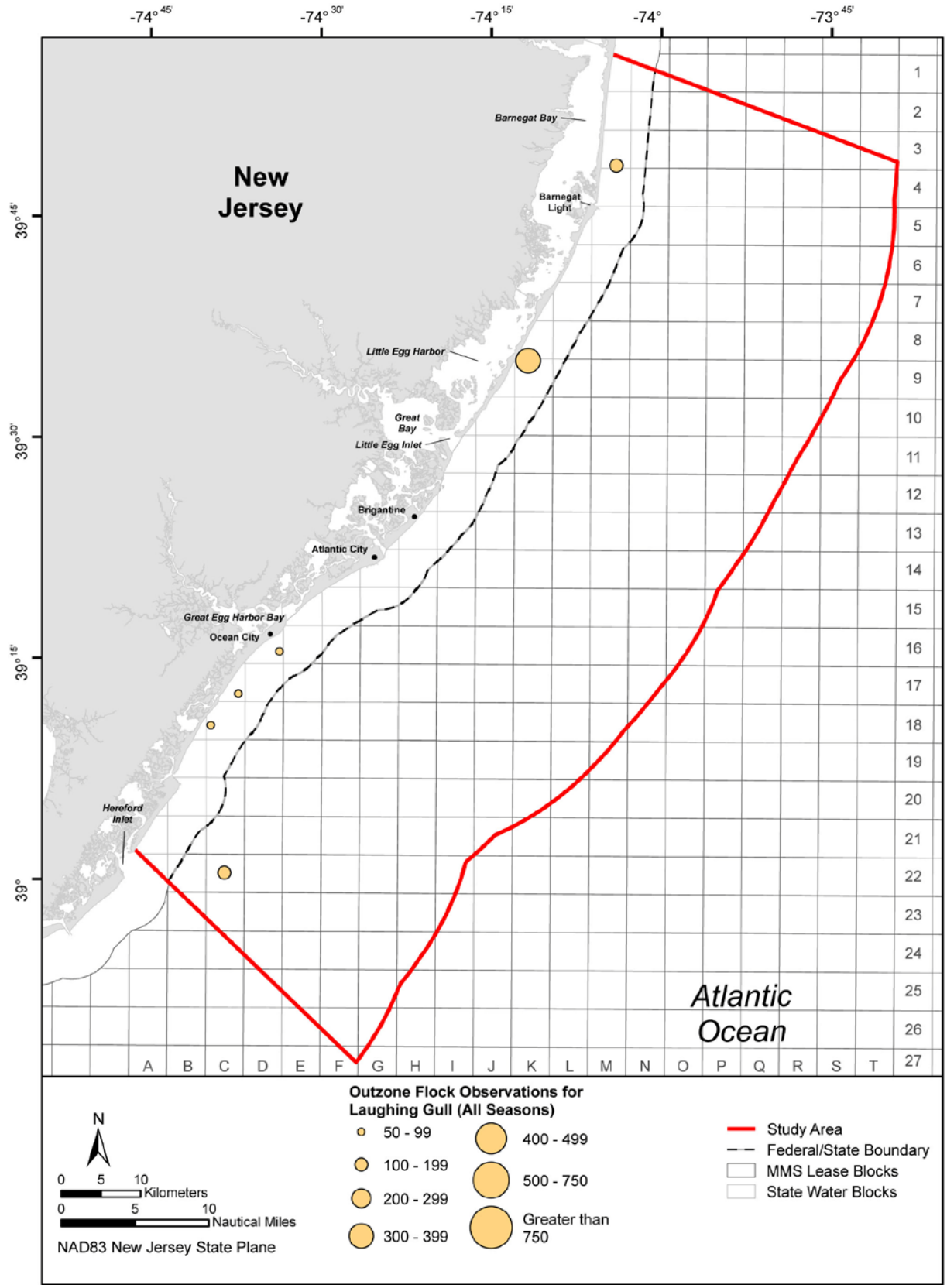

Figure H-23. Out-zone Flock Observations for Laughing Gull (all seasons; 2008, 2009).

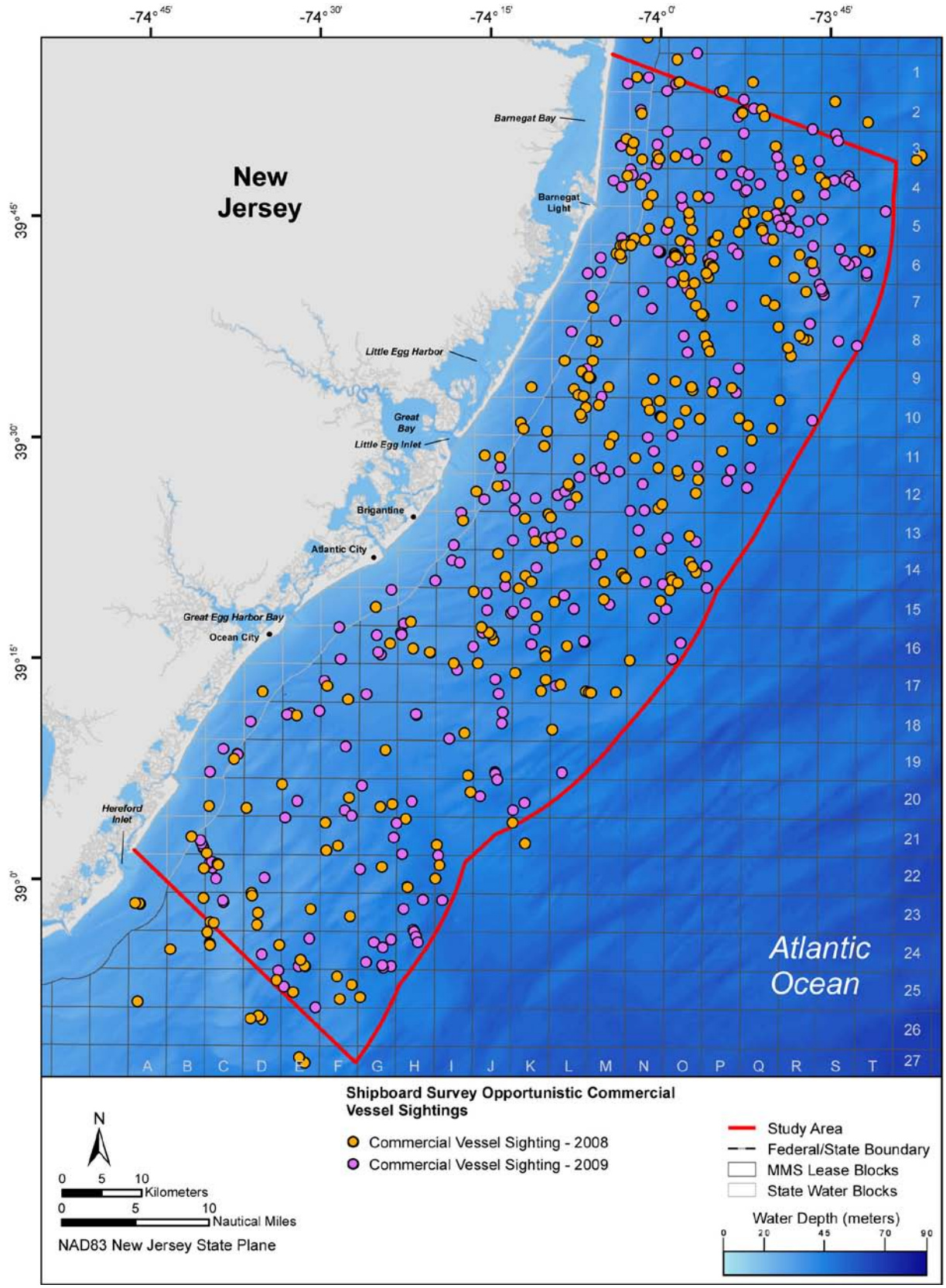

Figure H-24. Marine Mammal Shipboard Opportunistic Commercial Vessel Sightings.

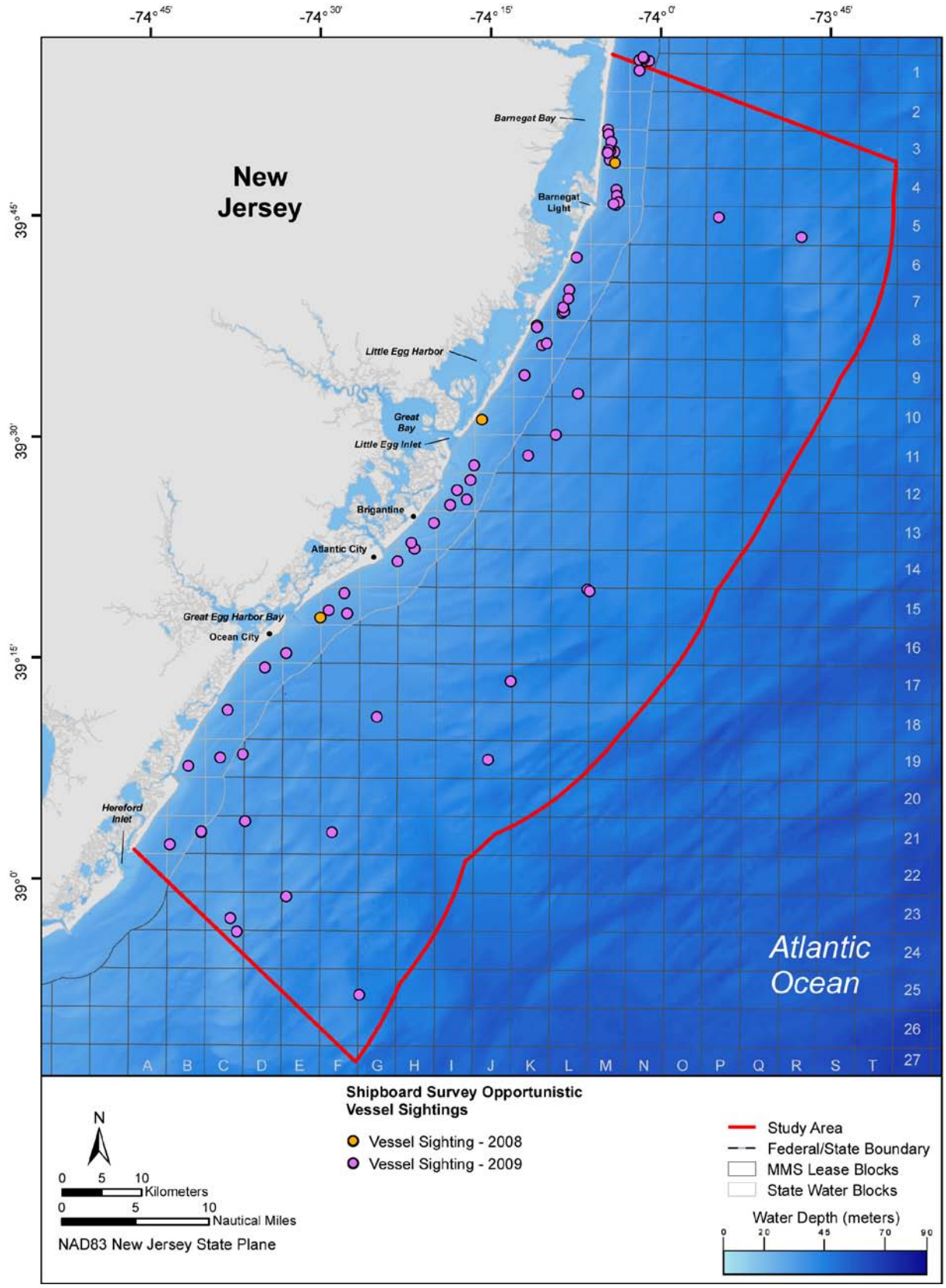

Figure H-25. Avian Shipboard Opportunistic Commercial Vessel Sightings.

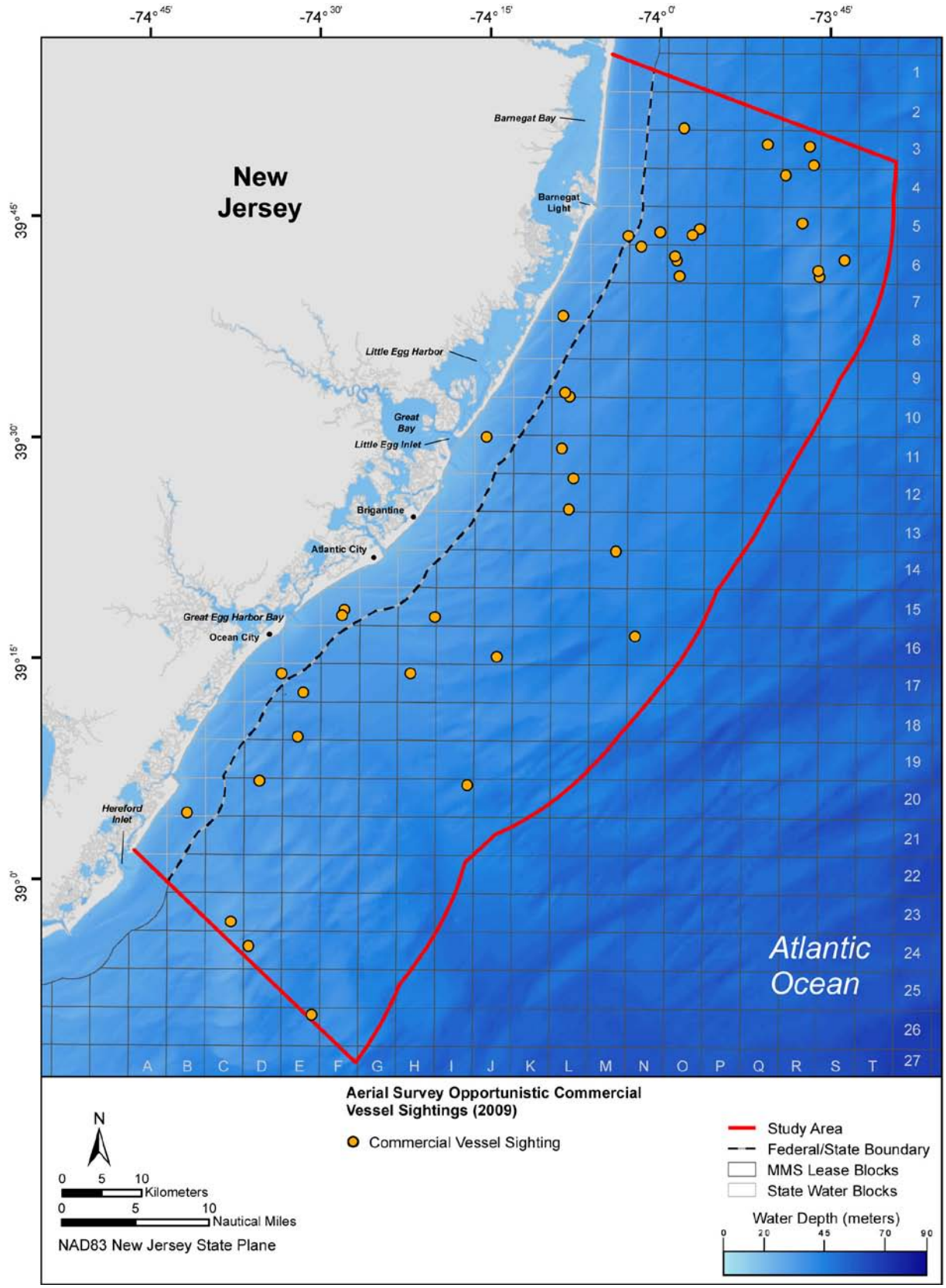

Figure H-26. Marine Mammal Aerial Survey Opportunistic Commercial Vessel Sightings.

APPENDIX I

SUPPLEMENTAL SURVEYS

Recent discussions with the U.S. Fish and Wildlife Service have identified the need for additional avian data to supplement the ongoing baseline studies. Avian data needs include: 1) the identification of avian foraging locations; 2) avian use of fishing locations, and 3) Northern gannet roosting locations. Supplemental avian surveys will be scheduled, when practical, during the final 7 months of the study to collect avian data relating to the identified data needs. The specific goals of the supplemental avian surveys negate use of the collected data in the avian predictive model.

Identification of Avian Foraging Locations

Monthly avian boat surveys of shoal areas will be conducted to determine avian shoal use in the Study Area. Survey methods are discussed below.

Methods

The station count method (Gould and Forsell 1989) will be modified to survey shoal areas. The survey area will consist of two concentric circles with the observer as the center of the circle. The radius of the first circle (A) will range from 0 to 300 meters (m); the radius of the second circle (B) will range from 301 to 600 m.

Shoal area maps will be generated with a geographic information system (GIS) and numbered sequentially from north to south. Shoal size varies greatly in the Study Area; small shoals may require only one station; larger shoals may have numerous stations. All shoal stations will be located a minimum of 1 km apart.

When the boat is on station, the start time, station number, station location global positioning system (GPS) coordinates will be recorded on a field data sheet (**Exhibit 1**). Weather data will be recorded at the beginning, middle, and end of the survey day on the standard weather data sheet currently being used to conduct avian boat surveys for the study. Weather changes will be noted on the data sheet.

Within the survey area (two concentric circles), all birds will be identified and counted during a circular five- (5-) minute survey. Concentrations of out of zone birds (>50 birds) will be recorded on the incidental observations data sheet (**Exhibit 1**). After the modified station count is completed, the observer will record dive altitudes and submersion times of foraging birds (gannets, pelicans, terns) within the survey area for a period of 5 minutes. If time is available, data will be collected for diving ducks and gulls.

This survey sequence will be repeated three (3) times. If bird foraging activity is low (<25 birds), the survey will be terminated and the boat will proceed to the next shoal station. If moderate to high bird foraging activity (>25 birds) is present at the end of the 30-minute period, a second 30-minute survey period will be completed. If time is available, each shoal station will be visited twice daily to document temporal variation in utilization.

Two days of avian boat surveys will be scheduled twice monthly to survey shoal areas. Shoal survey sequence will be reversed during the second monthly survey to document temporal variation in utilization. Shoals throughout the study area will be surveyed.

Avian Use of Fishing Locations

An avian survey will be conducted from a recreational fishing boat to document avian species attracted to fishing boats and to gather data on fishing locations in the Study Area. Survey methods are discussed below.

Methods

Reservations will be made on fishing boat charters to conduct the avian survey. During the trip from the dock to fishing grounds and between fishing grounds the boat often travels well above speeds used to conduct avian transect surveys (10 knots); however, the avian observer will record incidental observations of foraging birds (identity and number) and record location coordinates of the boat at the time of the sighting on the incidental observations data sheet (**Exhibit 1**).

When the fishing boat is anchored on station, the start time, station number, station location GPS coordinates will be recorded on a field data sheet along with the start time (**Exhibit 1**). Weather data will be recorded at the beginning, middle, and end of the survey day on the standard weather data sheet currently being used to conduct avian boat surveys for the study. Weather changes will be noted on the data sheet.

The station count method (Gould and Forsell 1989) will be used to survey the area around the boat. The survey area will consist of two concentric circles with the observer as the center of the circle. The radius of the first circle (A) will range from 0 to 300 m; the radius of the second circle (B) will range from 301 to 600 m.

Within the survey area (two concentric circles), all birds will be identified and counted during a 5-minute circular sweep. After the station count is completed, the observer will record dive altitudes and submersion times of foraging birds (gannets, pelicans, terns) for a period of 5 minutes. If time is available, data will be collected for diving ducks and gulls. This survey sequence will be repeated until the boat leaves for another fishing spot.

An attempt will be made to schedule one to two trips per month during the winter season and one trip per week during the spring/summer season.

Northern Gannet Roosting Locations

The goal of this survey is attempt to identify the night roosting location of Northern gannet. Boats will attempt to be used to follow the gannet evening flight to the roost site(s).

Methods

Data from previous surveys will be reviewed to identify concentration locations of Northern gannets in the study area. When weather permits (Beaufort 1-3), a boat (capable of speeds of up to 20 knots) will attempt to follow the gannets from one concentration area as they leave for the night roosting location. If the boat is successful in locating the roost, the location coordinates of the site will be recorded. Other gannet concentration locations in the Study Area will be visited in an attempt to find additional roosting locations.

EXHIBIT 1

DATA SHEETS

New Jersey Department of Environmental Protection
Ocean/Wind Power Environmental Baseline Studies

Supplemental Avian Survey
Shoals

Date:_______________ Shoal Number:__________ Page:___________

Observer:______________________________________

Location Coordinates:____

Start Time:_____________ End Time:____________

Species Code	Number	Zone	Comments (age, behaviors)

New Jersey Department of Environmental Protection
Ocean/Wind Power Environmental Baseline Studies

Supplemental Avian Survey
Foraging Behavior

Date:______________ **Survey Type: Shoal Fishing Boat** **Page:**__________

Observer:___________________________________

Location Coordinates:____

Start Time:____________ **End Time:**___________

Species Code	Number	Dive Altitude (Feet)	Submersion Time	Comments (age, behaviors)

New Jersey Department of Environmental Protection
Ocean/Wind Power Environmental Baseline Studies

Supplemental Avian Survey
Incidental Observations

Date:_______________ **Page:**___________

Observer:______________________________________

Time	Location Coordinates	Species Code	Number	Direction From Boat	Range

APPENDIX J

AVIAN RADAR DATA

Appendix J-1

Methodology and Results of Radar Dropped Track Analysis

Methods for Dropped Target Analysis

Undetected Track Analysis Method

- Ten, five-minute samples were taken from a calm day.
- Ten, five-minute samples were taken from a windy day.
- Replay was used to watch the filtered data.
- Each track was monitored during the five minute sample period.
- Radar tracks were examined visually. Based on overall heading and speed, the tracks that were dropped and then detected again, were given a Target # to represent a single target comprised of multiple tracks.
- The time the target was undetected to the time it reappeared was given an Undetected Obs. #.
- The amount of Time Undetected between tracks was determined by subtracting the time the target dropped from the time the target was redetected.
- An average Time Undetected was determined by adding up all time undetected between all tracks of a target and divided by the total number of Undetected Observations for all sample periods.

To ensure that dropped target was the same target and not a new target, heading and speed of the target was checked.

Heading and Speed Verification Method

- Two targets from each five-minute period were sampled for heading and speed verification.
- One of the targets selected was the target with the most number of dropped tracks during that period.
- The other target was selected by a random number generator using the =rand between function found in Excel.
- For each track of a target, the heading and speed were recorded.
- The difference in heading was determined by subtracting the heading of where the track stopped from the heading of where the track was redetected.
- An average difference in heading was then determined by adding up all differences in heading for each recounted track and dividing by the total number of tracks observed for the heading and speed verification sample.
- The difference in speed was determined by subtracting the speed of where the track stopped from the speed of where the track was redetected.
- An average difference in speed was then determined by adding up all differences in speed for each recounted track and divided by the total number of tracks observed for the heading and speed verification sample.
- Average difference in heading and speed were analyzed for a windy day, a calm day, and both days combined.

Data Analysis

The data were analyzed and the recount percentage was determined. Recounts are the number of times additional tracks of a single target were counted after the initial track of a target was dropped. This number is the same as the Undetected Obs. #.

- Percent recount was determined by dividing the total number of recounts by the total number of tracks observed during the sample period.
- Percent recounts and average time undetected were determined for the windy day, calm day, and both days combined.

Data Analysis Results

Analysis results are presented on the following page.

The data were analyzed and the recount percentage was determined. Recounts are the number of times additional tracks of a single target were counted after the initial track of a target was dropped. This number is the same as the Undetected Obs. #.

- Percent recount was determined by dividing the total number of recounts by the total number of tracks observed during the sample period.
- Percent recounts and average time undetected were determined for the windy day, calm day, and both days combined.

Table J-1. Results of Dropped Target Analyses.

Sample Period	Tracks Recorded	Recounts	% Recounts	Average Time Undetected (seconds)
Calm Day				
12:00:00-12:05:00 AM	156	34	21.79%	0:00:13
2:00:00-2:05:00 AM	97	39	40.21%	0:00:16
4:00:00-4:04:00 AM	22	8	36.36%	0:00:22
6:00:00-6:05:00 AM	82	25	30.49%	0:00:11
8:00:00-8:05:00 AM	94	25	26.60%	0:00:15
10:00:00-10:05:00 AM	89	26	29.21%	0:00:15
12:00:00-12:05:00 PM	64	22	34.38%	0:00:12
2:00:00-2:05:00 PM	32	3	9.38%	0:00:17
4:00:00-4:05:00 PM	41	4	9.76%	0:00:08
6:00:00-6:05:00 PM	52	10	19.23%	0:00:13
Subtotals	**729 (14.58 per minute)**	**196 (3.92 per minute)**	**26.89%**	**0:00:14**
Windy Day				
12:00:00-12:05:00 AM	49	16	32.65%	0:00:21
2:00:00-2:05:00 AM	13	3	23.08%	0:00:24
4:00:00-4:04:00 AM	7	2	28.57%	0:00:13
6:00:00-6:05:00 AM	18	1	5.56%	0:00:08
8:00:00-8:05:00 AM	13	1	7.69%	0:00:08
10:00:00-10:05:00 AM	15	0	0.00%	0:00:00
12:00:00-12:05:00 PM	5	1	20.00%	0:00:24
2:00:00-2:05:00 PM	21	0	0.00%	0:00:00
4:00:00-4:05:00 PM	48	2	4.17%	0:00:17
6:00:00-6:05:00 PM	47	18	38.30%	0:00:19
Subtotals	**236 (4.72 per minute)**	**44 (0.88 per minute)**	**18.64%**	**0:00:20**
TOTALS	**965 (9.65 per minute)**	**240 (2.4 per minute)**	**24.87%**	**0:00:15**

Appendix J-2

Radar Validation Survey Data

Offshore

Table J-2. Confirmation status of Northern Gannet observations by flight altitude during spring 2008 boat-based VerCat radar offshore validation surveys.

Station #	Distance to Radar (NM)	Altitude (ft AMSL)											
		1-25		26-50		51-75		76-100		101+		Total	
		C	U	C	U	C	U	C	U	C	U	C	U
07	0.50	-	-	1	0	3	0	1	0	-	-	5	0
Subtotal	**0.50**	**-**	**-**	**1**	**0**	**3**	**0**	**1**	**0**	**-**	**-**	**5**	**0**
01	1.00	-	-	-	-	-	-	-	-	1	0	1	0
Subtotal	**1.00**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**0**	**1**	**0**
Total				**1**	**0**	**3**	**0**	**1**	**0**	**1**	**0**	**6**	**0**

NM = nautical miles; ft AMSL = feet above mean sea level; C = Confirmed; U = Unconfirmed

Table J-3. Confirmation status of cormorant observations by flight altitude during spring 2008 boat-based VerCat radar offshore validation surveys.

Grid #	Distance to Radar (NM)	Altitude (ft AMSL)											
		1-25		26-50		51-75		76-100		101+		Total	
		C	U	C	U	C	U	C	U	C	U	C	U
01	1.00	-	-	-	-	-	-	-	-	1	0	1	0
Total										**1**	**0**	**1**	**0**

NM = nautical miles; ft AMSL = feet above mean sea level; C = Confirmed; U = Unconfirmed

Table J-4. Confirmation status of gull observations by flight altitude during spring 2008 boat-based VerCat radar offshore validation surveys.

Grid #	Distance to Radar (NM)	Altitude (ft AMSL)											
		1-25		26-50		51-75		76-100		101+		Total	
		C	U	C	U	C	U	C	U	C	U	C	U
01	1.00	-	-	0	1	-	-	3	0	2	0	5	1
Total				**0**	**1**			**3**	**0**	**2**	**0**	**5**	**1**

NM = nautical miles; ft AMSL = feet above mean sea level; C = Confirmed; U = Unconfirmed

Table J-5. Confirmation status of duck (Anatidae) observations by flight altitude during spring 2008 boat-based TracScan radar offshore validation surveys.

Grid#	Distance to Radar (NM)	Altitude (ft AMSL)											
		1-25		26-50		51-75		76-100		101+		Total	
		C	U	C	U	C	U	C	U	C	U	C	U
07	1.00	1	0	-	-	-	-	-	-	-	-	1	0
19	1.00	0	1	-	-	-	-	-	-	-	-	0	1
Subtotal	**1.00**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**1**
01	2.00	-	-	1	0	0	1	1	0	-	-	2	1
07	2.00	1	1	-	-	-	-	-	-	-	-	1	1
09	2.00	3	0	-	-	-	-	-	-	-	-	3	0
Subtotal	**2.00**	**4**	**1**	**1**	**0**	**0**	**1**	**1**	**0**	**-**	**-**	**6**	**2**
Total		**5**	**2**	**1**	**0**	**0**	**1**	**1**	**0**			**7**	**3**

NM = nautical miles; ft AMSL = feet above mean sea level; C = Confirmed; U = Unconfirmed

Table J-6. Confirmation status of loon observations by flight altitude during spring 2008 TracScan radar boat-based offshore validation surveys.

Grid #	Distance to Radar (NM)	Altitude (ft AMSL)											
		1-25		26-50		51-75		76-100		101+		Total	
		C	U	C	U	C	U	C	U	C	U	C	U
19	1.00	3	0	-	-	1	1	-	-	1	0	5	1
Total		**3**	**0**			**1**	**1**			**1**	**0**	**5**	**1**

NM = nautical miles; ft AMSL = feet above mean sea level; C = Confirmed; U = Unconfirmed

Table J-7. Confirmation status of cormorant observations by flight altitude during spring 2008 boat-based TracScan radar offshore validation surveys.

Grid #	Distance to Radar (NM)	Altitude (ft AMSL)											
		1-25		26-50		51-75		76-100		101+		Total	
		C	U	C	U	C	U	C	U	C	U	C	U
19	1.00	-	-	-	-	2	0	-	-	-	-	2	0
Total						**2**	**0**					**2**	**0**

NM = nautical miles; ft AMSL = feet above mean sea level; C = Confirmed; U = Unconfirmed

Table J-8. Confirmation status of gull observations by flight altitude during spring 2008 boat-based TracScan radar offshore validation surveys.

Station #	Distance to Radar (NM)	Altitude (ft AMSL)											
		1-25		26-50		51-75		76-100		101+		Total	
		C	U	C	U	C	U	C	U	C	U	C	U
07	1.00	-	-	-	-	-	-	-	-	-	-	-	-
19	1.00	3	0	1	0	-	-	-	-	-	-	4	0
Subtotal	**1.00**	**3**	**0**	**1**	**0**	**-**	**-**	**-**	**-**	**-**	**-**	**4**	**0**
23	1.75	3	1	-	-	-	-	-	-	-	-	3	1
01	2.00	-	-	-	-	1	0	-	-	0	2	1	2
07	2.00	0	1	1	0	-	-	-	-	-	-	1	1
19	2.00	-	-	-	-	2	0	-	-	1	0	3	0
Subtotal	**2.00**	**3**	**2**	**1**	**0**	**3**	**0**	**-**	**-**	**1**	**2**	**8**	**4**
Total		**6**	**2**	**2**	**0**	**3**	**0**			**1**	**2**	**12**	**4**

NM = nautical miles; ft AMSL = feet above mean sea level; C = Confirmed; U = Unconfirmed

Table J-9. Offshore radar validation survey data at Station 01, 15 March 2008.

Radar Type	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Qdrt	Range (m)	Heading (cardinal)	Altitude (ft ASL)
TS	2.00	1314	Northern Gannet	2	C	2	200	North	150
TS	2.00	1318	Northern Gannet	2	C	2	150	Northeast	150
TS	2.00	1324	Northern Gannet	1	U	2	300	North	100
TS	2.00	1336	Northern Gannet	1	U	1	500	North	100
TS	2.00	1338	Black Scoter	2	C	2	100	South	100
TS	2.00	1339	Northern Gannet	1	C	1	500	North	100
TS	2.00	1340	Northern Gannet	1	C	1	400	North	100
TS	2.00	1342	Black Scoter	2	C	2	200	South	50
TS	2.00	1348	Herring Gull	2	C	2	150	East	75
TS	2.00	1349	Scoter (unknown)	1	U	1	150	South	75
TS	2.00	1353	Northern Gannet	1	U	1	200	North	100
TS	2.00	1502	Herring Gull	2	U	2	250	North	200
TS	2.00	1512	Gull (unknown)	2	U	2	800	North	150
VC	1.00	1603	Herring Gull	1	C	NA	100	Northeast	100
VC	1.00	1604	Herring Gull	1	C	NA	600	North	100
VC	1.00	1608	Herring Gull	4	U	NA	250	Northeast	50
VC	1.00	1609	Herring Gull	1	C	NA	100	North	125
VC	1.00	1613	Great Black-backed Gull	4	C	NA	25	East	150
VC	1.00	1615	Double-crested Cormorant	18	C	NA	.	North	2,000
VC	1.00	1621	Herring Gull	1	C	NA	350	East	100

NM = nautical mile(s)
No. = number
C/U = Confirmed/Unconfirmed
Qdrt = Observation quadrant
m = meters
ft ASL = feet above sea level
TS = TracScan
VC = VerCat
. = missing data

Table J-10. Offshore radar validation survey data at Station 07, 22 March 2008.

Radar Type	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Qdrt	Range (m)	Heading (cardinal)	Altitude (ft ASL)
TS	2.00	1537	Northern Gannet	1	C	3	725	East	25
TS	2.00	1544	Northern Gannet	1	C	2	500	South	25
TS	2.00	1547	Great Black-backed Gull	1	U	2	725	South	15
TS	2.00	1547	Scoter (unknown)	22	C	1	500	Southwest	25
TS	2.00	1549	Northern Gannet	1	U	3	400	Southeast	10
TS	2.00	155	Northern Gannet	2	C	2	200	Southeast	100
TS	2.00	1557	Northern Gannet	1	C	1	200	Northeast	60
TS	2.00	1559	Northern Gannet	1	C	1	200	East	150
TS	2.00	1602	Northern Gannet	5	U	4	700	Southeast	150
TS	2.00	1606	Scoter (unknown)	5	U	3	500	South	5
TS	2.00	1614	Northern Gannet	1	C	3	800	Northwest	100
TS	2.00	1702	Northern Gannet	1	C	2	500	Southwest	75
TS	2.00	1709	Great Black-backed Gull	1	C	3	700	Southwest	50
TS	2.00	1711	Northern Gannet	1	U	2	100	Northeast	50
TS	2.00	1717	Northern Gannet	1	C	1	200	North	150
TS	2.00	1721	Northern Gannet	1	U	1	200	North	50
TS	2.00	1723	Northern Gannet	1	C	2	700	South	75
TS	1.00	1819	Northern Gannet	1	C	1	200	South	100
TS	1.00	1820	Northern Gannet	1	C	2	150	South	100
TS	1.00	1821	Northern Gannet	1	C	1	100	South	50
TS	1.00	1822	Northern Gannet	1	C	1	100	East	75
TS	1.00	1823	Northern Gannet	1	C	4	200	South	150
TS	1.00	1825	Northern Gannet	1	C	4	400	Northeast	50
TS	1.00	1825	Northern Gannet	1	C	2	100	Southwest	75
TS	1.00	1826	Northern Gannet	1	C	3	200	South	75
TS	1.00	1828	Surf Scoter	7	C	4	100	South	5
TS	1.00	1829	Northern Gannet	1	U	1	750	South	5
TS	1.00	1830	Northern Gannet	1	C	1	250	South	100
TS	1.00	1831	Northern Gannet	3	C	1	100	North	200
TS	1.00	1833	Northern Gannet	1	C	2	100	Northwest	100
TS	1.00	1834	Northern Gannet	1	C	1	100	Northwest	75
TS	1.00	1835	Northern Gannet	1	U	1	100	Northeast	2
TS	1.00	1837	Northern Gannet	1	C	4	50	South	50
VC	0.50	1902	Northern Gannet	1	C	1	100	South	75
VC	0.50	1910	Northern Gannet	1	C	1	25	North	75
VC	0.50	1915	Northern Gannet	1	C	2	75	South	100
VC	0.50	1920	Northern Gannet	1	C	1	300	North	50
VC	0.50	1923	Northern Gannet	1	C	1	100	South	75

NM = nautical mile(s)
No. = number
C/U = Confirmed/Unconfirmed
Qdrt = Observation quadrant
m = meters
ft ASL = feet above sea level
TS = TracScan
VC = VerCat

Table J-11. Offshore radar validation survey data at Station 19, 19 April 2008.

Radar Type	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Qdrt	Range (m)	Heading (cardinal)	Altitude (ft ASL)
TS	2.00	1212	Northern Gannet	1	U	1	50	West	50
TS	2.00	1213	Northern Gannet	4	C	1	300	East	10
TS	2.00	1214	Northern Gannet	1	C	2	200	North	75
TS	2.00	1215	Northern Gannet	1	C	2	200	Northeast	50
TS	2.00	1216	Northern Gannet	1	U	2	250	South	75
TS	2.00	1217	Scoter (unknown)	40	C	1	250	East	15
TS	2.00	1218	Northern Gannet	1	U	2	100	West	75
TS	2.00	1220	Northern Gannet	1	C	2	100	East	160
TS	2.00	1222	Scoter (unknown)	10	C	4	500	East	10
TS	2.00	1229	Gull (unknown)	1	C	1	250	Northeast	150
TS	2.00	1231	Northern Gannet	1	U	1	100	Northeast	75
TS	2.00	1235	Northern Gannet	1	C	2	75	West	75
TS	2.00	1237	Gull (unknown)	1	C	2	100	East	60
TS	2.00	1238	Scoter (unknown)	6	C	1	250	Northeast	2
TS	2.00	1241	Great Black-backed Gull	6	C	4	100	Northeast	75
TS	1.00	1303	Loon (unknown)	1	C	2	100	Northeast	75
TS	1.00	1304	Gull (unknown)	1	C	2	100	East	50
TS	1.00	1305	Northern Gannet	1	C	4	450	West	75
TS	1.00	1306	Cormorant (unknown)	1	C	2	100	Northeast	75
TS	1.00	1308	Herring Gull	1	C	3	200	North	25
TS	1.00	1309	Cormorant (unknown)	1	C	1	400	Northeast	75
TS	1.00	1312	Gull (unknown)	2	C	1	500	East	15
TS	1.00	1313	Gull (unknown)	1	C	2	300	Northeast	20
TS	1.00	1315	Loon (unknown)	1	C	1	400	East	150
TS	1.00	1318	Scoter (unknown)	12	U	4	150	South	5
TS	1.00	1322	Loon (unknown)	1	C	2	50	East	20
TS	1.00	1325	Common Loon	1	C	2	100	East	2
TS	1.00	1327	Northern Gannet	1	C	1	100	North	50
TS	1.00	1328	Common Loon	1	C	4	350	North	10
TS	1.00	1330	Common Loon	1	U	3	35	North	75

NM = nautical mile(s)
No. = number
C/U = Confirmed/Unconfirmed
Qdrt = Observation quadrant
m = meters
ASL = feet above sea level
TS = TracScan

Table J-12. Offshore radar validation survey data at Station 23, 03 May 2008.

Radar Type	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Qdrt	Range (m)	Heading (cardinal)	Altitude (ft ASL)
TS	1.75	1642	Northern Gannet	2	C	.	250	Southwest	5
TS	1.75	1643	Herring Gull	1	C	.	100	Southwest	25
TS	1.75	1647	Herring Gull	1	U	.	100	Northeast	2
TS	1.75	1651	Herring Gull	1	C	.	50	Southwest	25
TS	1.75	1736	Northern Gannet	1	C	.	150	Northeast	50
TS	1.75	1738	Northern Gannet	1	C	.	50	Southeast	20
TS	1.75	1741	Laughing Gull	1	C	.	100	East	25
TS	1.75	1754	Common Tern	1	C	.	175	Southeast	20
TS	1.75	1758	Northern Gannet	1	U	.	200	Southeast	20
TS	3.00	1840	Northern Gannet	1	U	.	30	Northeast	2
TS	3.00	1849	Northern Gannet	1	U	.	150	Southeast	50
TS	3.00	1849	Northern Gannet	2	C	.	150	East	75
TS	3.00	1851	Northern Gannet	1	C	.	150	East	25
TS	3.00	1856	Northern Gannet	1	U	.	50	East	1
TS	3.00	1857	Northern Gannet	2	U	.	15	variable	10
TS	3.00	1901	Northern Gannet	2	U	.	20	diving	10

NM = nautical mile(s)
No. = number
C/U = Confirmed/Unconfirmed
Qdrt = Observation quadrant
m = meters
ft ASL = feet above sea level
TS = TracScan
. = missing data

Table J-13. Radar validation survey data at Grid 16, in the New Jersey Study Area, on 11 May 2009.

Radar Type	Time	Species (Common Name)	No.	C/U	Bearing	Range (m)	Heading (cardinal)	Altitude (ft ASL)
TS	19:12:17	Northern Gannet	1	U	301	1,000	North	50
TS	19:16:55	Double-crested Cormorant	1	C	301	>1,000	North	100
TS	19:19:11	Northern Gannet	1	C	301	>1,000	North	50
TS	19:22:32	Forster's Tern	1	C	301	500	Northwest	25
TS	19:23:44	Laughing Gull	1	U	301	300	Northeast	50
TS	19:30:07	Northern Gannet	1	U	301	>1,000	North	50
TS	19:30:07	Northern Gannet	1	U	301	>1,000	North	50
TS	19:33:10	Northern Gannet	1	U	301	>1,000	North	50
TS	19:36:35	Northern Gannet	1	U	301	500	North	50
TS	19:38:40	Laughing Gull	1	U	301	300	South	25
TS	19:41:00	Laughing Gull	1	U	301	100	Northeast	1 (skimming)
TS	19:41:39	Northern Gannet	1	U	301	1,000	North	25
TS	19:44:05	Laughing Gull	2	U	301	100	Southwest	1 (skimming)
TS	19:44:53	Double-crested Cormorant	1	U	301	1,000	North	25
TS	19:46:03	Northern Gannet	2	U	301	>1,000	North	200
TS	19:48:04	Northern Gannet	1	U	301	>1,000	North	100
TS	19:51:48	Northern Gannet	1	U	301	1,000	North	25
TS	19:52:26	Gull, large (unknown)	1	U	301	>1,000	North	300
TS	19:55:12	Forster's Tern	2	U	301	500	Southwest	25
TS	19:56:50	Laughing Gull	1	U	301	100	Northwest	25
TS	19:58:01	Laughing Gull	1	C	301	>1,000	North	50
TS	19:58:24	Double-crested Cormorant	23	C	301	>1,000	North	100
TS	19:59:54	Double-crested Cormorant	3	C	301	>1,000	North	50
TS	19:59:54	Double-crested Cormorant	1	U	301	500	Northeast	50
TS	20:03:13	Northern Gannet	1	C	301	500	North	50
TS	20:04:02	Northern Gannet	1	C	301	>1,000	North	50
TS	20:05:31	Double-crested Cormorant	1	U	301	>1,000	South	25
TS	20:06:13	Laughing Gull	1	U	301	500	South	1 (skimming)
TS	20:06:13	Laughing Gull	1	C	301	>1,000	North	100
TS	20:07:24	Northern Gannet	1	Missing Frames	301	>1,000	North	50
TS	20:07:55	Northern Gannet	1	U	301	500	North	25

Table J-13 (*continued*). Radar validation survey data at Grid 16, in the New Jersey Study Area, on 11 May 2009.

Radar Type	Time	Species (Common Name)	No.	C/U	Bearing	Range (m)	Heading (cardinal)	Altitude (ft ASL)
TS	20:09:22	Double-crested Cormorant	54	Missing Frames	301	>1,000	North	100
TS	20:10:25	Northern Gannet	1	U	301	500	North	100
TS	21:56:04	Northern Gannet	1	C	340	1,000	South	100
TS	21:57:44	Forster's Tern	1	U	340	>1,000	North	100
TS	21:59:12	Laughing Gull	1	U	340	500	South	1 (skimming)
TS	22:02:26	Double-crested Cormorant	1	U	340	500	North	1 (skimming)
TS	22:05:01	Northern Gannet	1	U	340	200	East	1 (skimming)
TS	22:06:01	Double-crested Cormorant	1	C	340	>1,000	North	50
TS	22:12:57	Forster's Tern	1	U	340	300	North	25
TS	22:14:13	Northern Gannet	1	C	340	>1,000	North	25
TS	22:15:51	Northern Gannet	1	C	340	>1,000	North	100
TS	22:16:39	Northern Gannet	1	U	340	200	South	50
TS	22:18:06	Northern Gannet	1	U	340	1,000	North	1 (skimming)
TS	22:19:12	Northern Gannet	3	C	340	1,000	North	1 (skimming)
TS	22:19:42	Northern Gannet	3	C	340	>1,000	North	100
TS	22:20:14	Northern Gannet	1	C	340	>1,000	North	100
TS	22:20:36	Northern Gannet	1	U	340	>1,000	North	50
TS	22:21:59	Northern Gannet	1	U	340	>1,000	North	100
TS	22:36:33	Northern Gannet	1	Missing Frames	340	500	Northeast	50
TS	22:38:52	Laughing Gull	1	U	340	>1,000	South	50
TS	22:41:17	Laughing Gull	1	Missing Frames	340	>1,000	North	100
TS	22:42:31	Northern Gannet	1	U	340	>1,000	North	100
TS	22:43:04	Gull, large (unknown)	1	Missing Frames	340	>1,000	North	100
TS	22:44:55	Northern Gannet	1	U	340	>1,000	South	1 (skimming)
TS	22:47:47	Northern Gannet	1	Missing Frames	340	>1,000	North	50
TS	22:53:06	Laughing Gull	1	Missing Frames	340	100	Southwest	1 (skimming)

m = meters
ASL = feet above sea level
TS = TracScan
No. = number
C/U = Confirmed/Unconfirmed

Onshore

Table J-14. Confirmation status of tern observations by flight altitude during spring 2008 boat-based TracScan radar onshore validation surveys.

Location	Distance to Radar (NM)	Altitude (ft AMSL)											
		1-25		26-50		51-75		76-100		101+		Total	
		C	U	C	U	C	U	C	U	C	U	C	U
Island Beach State Park	1	-	-	-	-	-	-	1	0	-	-	1	0
North Brigantine Beach	1	-	-	1	0	-	-	-	-	-	-	1	0
Corson's Inlet	1	-	-	1	0	1	0	-	-	-	-	2	0
Total				**2**	**0**	**1**	**0**	**1**	**0**			**4**	**0**

NM = nautical miles; ft AMSL = feet above sea level; C = Confirmed; U = Unconfirmed

Table J-15. Confirmation status of cormorant observations by flight altitude during spring 2008 boat-based TracScan radar onshore validation surveys, spring 2008.

Location	Distance to Radar (NM)	Altitude (ft AMSL)											
		1-25		26-50		51-75		76-100		101+		Total	
		C	U	C	U	C	U	C	U	C	U	C	U
Island Beach State Park	1	-	-	-	-	-	-	-	-	-	-	-	-
North Brigantine Beach	1	-	-	-	-	-	-	-	-	-	-	-	-
Corson's Inlet	1	-	-	-	-	2	0	-	-	-	-	2	0
Total						**2**	**0**					**2**	**0**

NM = nautical miles; ft AMSL = feet above mean sea level; C = Confirmed; U = Unconfirmed

Table J-16. Confirmation status of wader observations by flight altitude during spring 2008 TracScan boat-based radar validation surveys.

Location	Distance to Radar (NM)	Altitude (ft AMSL)											
		1-25		26-50		51-75		76-100		101+		Total	
		C	U	C	U	C	U	C	U	C	U	C	U
Island Beach State Park	1	-	-	-	-	-	-	-	-	-	-	-	-
North Brigantine Beach	1	-	-	-	-	-	-	-	-	-	-	-	-
Corson's Inlet	1	1	0	-	-	3	0	2	0	3	0	9	0
Total		**1**	**0**			**3**	**0**	**2**	**0**	**3**	**0**	**9**	**0**

NM = nautical miles; ft AMSL = feet above sea level; C = Confirmed; U = Unconfirmed

Table J-17. Confirmation status of duck (Anatidae) observations by flight altitude during spring 2008 boat-based TracScan radar validation surveys off Brigantine Beach.

Distance to Radar (NM)	Altitude (ft AMSL)											
	1-25		26-50		51-75		76-100		101+		Total	
	C	U	C	U	C	U	C	U	C	U	C	U
1.67	1	0	-	-	-	-	-	-	-	-	1	0
2.00	-	-	-	-	-	-	-	-	-	-	-	-
2.75	1	2	1	1	-	-	-	-	-	-	2	3
Total	**2**	**2**	**1**	**1**							**3**	**3**

NM = nautical miles; ft AMSL = feet above mean sea level; C = Confirmed; U = Unconfirmed

Table J-18. Confirmation status of cormorant observations by flight altitude during fall 2008 boat-based TracScan radar validation surveys off Brigantine Beach.

Distance to Radar (NM)	Altitude (ft AMSL)											
	1-25		26-50		51-75		76-100		101+		Total	
	C	U	C	U	C	U	C	U	C	U	C	U
1.67	-	-	-	-	-	-	-	-	1	0	1	0
2.00	-	-	-	-	-	-	-	-	3	0	3	0
2.75	-	-	-	-	-	-	-	-	-	-	-	-
Total									**4**	**0**	**4**	**0**

NM = nautical miles; ft AMSL = feet above mean sea level; C = Confirmed; U = Unconfirmed

Table J-19. Onshore radar validation survey data at Island Beach State Park, New Jersey, on 18 May 2008. All radar data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Qdrt	Range (m)	Heading (cardinal)	Altitude (ft ASL)
5/18/2008	1.00	1905	Great Black-blacked Gull	1	C	4	300	South	75
5/18/2008	1.00	1907	Tern (unknown)	1	C	1	100	South	100
5/18/2008	1.00	1908	Great Black-blacked Gull	1	C	4	100	South	75
5/18/2008	1.00	1909	Great Black-blacked Gull	1	C	2	50	South	50
5/18/2008	1.00	1911	Barn Swallow	4	C	2	600	variable	75
5/18/2008	1.00	1914	Great Black-blacked Gull	1	C	3	150	North	125
5/18/2008	1.00	1916	Laughing Gull	1	U	1	50	South	100
5/18/2008	1.00	1918	Gull (unknown)	1	C	4	800	North	150
5/18/2008	1.00	1921	.	.	U	.	400	.	.
5/18/2008	1.00	1924	Herring Gull	1	C	3	400	South	50
5/18/2008	1.00	1928	Osprey	1	U	4	300	West	50

NM = nautical mile(s)
No. = number
C/U = Confirmed/Unconfirmed
Qdrt = Observation quadrant
m = meters
ft ASL = feet above sea level
. = missing data

Table J-20. Onshore radar validation survey data at Brigantine, New Jersey, on 05 June 2008. All radar data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Qdrt	Range (m)	Heading (cardinal)	Altitude (ft ASL)
6/5/2008	1.00	1437	Great Black-backed Gull	1	C	3	240	West	75
6/5/2008	1.00	1439	Laughing Gull	1	C	2	1152	South	100
6/5/2008	1.00	1443	Great Black-backed Gull	1	C	2	467	South	50
6/5/2008	1.00	1445	Great Black-backed Gull	1	C	1	878	East	100
6/5/2008	1.00	1447	Laughing Gull	1	C	4	909	Northwest	50
6/5/2008	1.00	1451	Great Black-backed Gull	1	C	4	137	Southwest	50
6/5/2008	1.00	1453	Great Black-backed Gull	1	C	1	539	South	75
6/5/2008	1.00	1454	Herring Gull	1	C	1	512	South	100
6/5/2008	1.00	1456	Great Black-backed Gull	1	C	1	362	West	35
6/5/2008	1.00	1457	Great Black-backed Gull	1	C	2	253	South	40
6/5/2008	1.00	1458	Tern (unknown)	1	C	4	142	South	45

NM = nautical mile(s)
No. = number
C/U = Confirmed/Unconfirmed
Qdrt = Observation quadrant
m = meters
ft ASL = feet above sea level
. = missing data

Table J-21. Onshore radar validation survey data at Corson's Inlet, New Jersey, on 10 June 2008. All radar data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Qdrt	Range (m)	Heading (cardinal)	Altitude (ft ASL)
6/10/2008	1.00	1452	Great Black-backed Gull	1	C	3	1,211	North	75
6/10/2008	1.00	1455	.	.	U	3	946	North	.
6/10/2008	1.00	1456	Purple Martin	1	C	3	565	South	100
6/10/2008	1.00	1503	Double-crested Cormorant	4	C	3	1,008	East	75
6/10/2008	1.00	1504	Herring Gull	1	C	3	1,244	East	80
6/10/2008	1.00	1505	Gull, large (unknown)	2	C	2	916	East	80
6/10/2008	1.00	1507	Great Black-backed Gull	1	C	3	1,660	East	50
6/10/2008	1.00	1509	Herring Gull	1	C	3	783	North	45
6/10/2008	1.00	1515	Common Tern	1	C	3	1,318	Northeast	75
6/10/2008	1.00	1516	Gull, large (unknown)	2	C	2	1,010	East	80
6/10/2008	1.00	1522	Bat (unknown)	1	C	3	1,111	North	45
6/10/2008	1.00	1549	Herring Gull	1	C	3	3,250	South	60
6/10/2008	1.00	1550	Snowy Egret	1	C	3	2,591	North	25
6/10/2008	1.00	1552	Herring Gull	1	C	3	2,497	North	50
6/10/2008	1.00	1558	Common Tern	1	C	3	2,547	West	35
6/10/2008	1.00	1600	Gull, large (unknown)	1	C	3	2,757	East	70
6/10/2008	1.00	1602	Herring Gull	1	C	3	2,407	Northwest	120
6/10/2008	1.00	1605	Great Egret	1	C	3	2,018	Northeast	100
6/10/2008	1.00	1605	Great Egret	1	C	3	2,355	Northeast	70
6/10/2008	1.00	1607	Herring Gull	5	C	3	2,669	North	40
6/10/2008	1.00	1611	Herring Gull	1	C	3	2,445	Northeast	150
6/10/2008	1.00	1613	Herring Gull	1	C	3	2,590	South	10
6/10/2008	1.00	1614	Herring Gull	1	C	3	3,171	Northwest	100
6/10/2008	1.00	1615	Herring Gull	1	C	3	2,409	Northwest	15
6/10/2008	1.00	1658	Double-crested Cormorant	2	C	4	3,737	West	70
6/10/2008	1.00	1659	Glossy Ibis	1	C	1	2,387	North	150
6/10/2008	1.00	1700	Glossy Ibis	1	C	1	2,414	South	150
6/10/2008	1.00	1704	Glossy Ibis	1	C	1	3,343	North	70
6/10/2008	1.00	1714	Snowy Egret	1	C	1	2,885	Northeast	120
6/10/2008	1.00	1716	Snowy Egret	1	C	1	3,155	West	60
6/10/2008	1.00	1718	Glossy Ibis	1	C	4	2,426	North	100
6/10/2008	1.00	1719	Fish Crow	1	C	1	3,052	East	70
6/10/2008	1.00	1722	Gull, large (unknown)	1	C	4	2,622	Northeast	150

NM = nautical mile(s) m = meters
No. = number ft ASL = feet above sea level
C/U = Confirmed/Unconfirmed. = missing data Qdrt = Observation quadrant

Table J-22. Onshore radar validation survey data at Island Beach State Park, New Jersey, in fall 2008. All radar data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Qdrt	Range (m)	Heading (cardinal)	Altitude (ft ASL)
9/15/2008	1.00	1951	Great Black-backed Gull	1	C	4	100	Northeast	100
9/15/2008	1.00	1954	Great Black-backed Gull	1	C	4	400	South	100
9/15/2008	1.00	1958	Great Black-backed Gull	1	C	3	550	South	200
9/15/2008	1.00	2003	Great Black-backed Gull	1	C	3	345	North	200
9/15/2008	1.00	2012	Great Black-backed Gull	1	C	3	400	South	200
9/15/2008	1.00	2014	Great Black-backed Gull	1	C	4	500	East	125
9/15/2008	1.00	2017	Great Black-backed Gull	1	C	4	25	East	100
9/15/2008	0.03	2125	Great Black-backed Gull	1	C	1	805	East	200
9/15/2008	0.03	2127	Great Black-backed Gull	1	C	1	322	South	150
9/15/2008	0.03	2128	Tern (unknown)	2	C	1	1207	South	150
9/15/2008	0.03	2129	Tern (unknown)	1	C	1	402	South	100
9/15/2008	0.03	2130	Laughing Gull	1	C	1	965	South	150
9/15/2008	0.03	2131	Tern (unknown)	1	C	1	965	North	150
9/15/2008	0.03	2132	Common Tern	1	C	1	402	North	100
9/15/2008	0.03	2134	Caspian Tern	2	C	1	805	South	50
9/15/2008	0.03	2134	Common Tern	10	C	1	402	South	75
9/15/2008	0.03	2137	Great Black-backed Gull	1	C	1	805	North	50
9/15/2008	0.03	2138	Common Tern	2	C	1	644	North	100
9/15/2008	0.03	2140	Forster's Tern	3	C	1	322	North	200
9/15/2008	0.03	2141	Tern, small (unknown)	7	C	1	483	variable	100
9/15/2008	0.03	2143	Great Blue Heron	1	C	1	805	South	300
9/15/2008	0.03	2146	Laughing Gull	1	C	1	483	North	200
9/15/2008	0.03	2146	Tern (unknown)	.	C	1	644	variable	150
9/15/2008	0.03	2148	Gull, large (unknown)	2	C	1	322	South	150
9/15/2008	0.03	2148	Tern (unknown)	1	C	1	322	South	150
9/15/2008	0.03	2149	Laughing Gull	1	C	1	483	South	200
9/15/2008	0.03	2150	Tern (unknown)	7	C	1	1126	South	350
9/15/2008	0.03	2153	Tern (unknown)	1	C	1	322	North	200
9/15/2008	0.03	2154	Osprey	1	C	1	483	North	250
9/15/2008	0.03	2156	Tern (unknown)	2	C	1	483	South	125

Table J-22 (*continued*). Onshore radar validation survey data at Island Beach State Park, New Jersey, in fall 2008. All radar data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Qdrt	Range (m)	Heading (cardinal)	Altitude (ft ASL)
9/15/2008	0.03	2157	Common Tern	3	C	1	322	South	200
9/15/2008	0.03	2158	Gull (unknown)	3	C	1	483	South	200
9/15/2008	0.03	2200	Tern (unknown)	6	C	1	644	South	175
9/15/2008	0.03	2202	Great Black-backed Gull	1	C	1	1126	South	250
9/21/2008	0.03	1853	Gull (unknown)	1	C	1	483	North	100
9/21/2008	0.03	1857	Gull (unknown)	1	C	1	805	North	75
9/21/2008	0.03	1858	Great Black-backed Gull	1	C	1	644	North	150
9/21/2008	0.03	1900	Gull (unknown)	1	C	1	1126	North	150
9/21/2008	0.03	1900	Gull (unknown)	2	C	1	805	South	150
9/21/2008	0.03	1901	Gull (unknown)	1	C	1	644	South	150
9/21/2008	0.03	1902	Great Black-backed Gull	1	C	1	1207	North	300
9/21/2008	0.03	1905	Gull (unknown)	1	C	1	483	South	75
9/21/2008	0.03	1906	Gull (unknown)	1	C	1	805	Southwest	100
9/21/2008	0.03	1908	Gull (unknown)	1	C	1	805	North	110
9/21/2008	0.03	1909	Gull (unknown)	2	C	1	965	North	150
9/21/2008	0.03	1910	Gull (unknown)	1	C	1	1287	Northwest	150
9/21/2008	0.03	1912	Gull (unknown)	1	C	1	965	Northeast	100
9/21/2008	0.03	1913	Gull (unknown)	1	C	1	644	South	100
9/21/2008	0.03	1914	Tern (unknown)	2	C	1	644	North	50
9/21/2008	0.03	1916	Gull (unknown)	1	C	1	1287	Northeast	200
9/21/2008	0.03	1917	Gull (unknown)	1	C	1	1207	Southwest	150
9/21/2008	0.03	1919	Gull (unknown)	1	C	1	644	South	200
9/21/2008	0.03	1921	Gull (unknown)	3	C	1	805	East	110
9/21/2008	0.03	1923	Gull (unknown)	1	C	1	1287	North	100
9/21/2008	0.03	1927	Gull (unknown)	1	C	1	1207	Northeast	200
9/21/2008	0.03	1929	Tern (unknown)	2	C	1	483	.	75
9/21/2008	0.03	1931	Tern (unknown)	1	C	1	805	South	100
10/2/2008	0.03	1727	Herring Gull	1	C	1	322	West	30
10/2/2008	0.03	1730	Gull (unknown)	1	C	1	322	South	100

Table J-22 (*continued*). Onshore radar validation survey data at Island Beach State Park, New Jersey, in fall 2008. All radar data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Qdrt	Range (m)	Heading (cardinal)	Altitude (ft ASL)
10/2/2008	0.03	1732	Gull, small/tern	2	C	1	322	Southeast	120
10/2/2008	0.03	1736	Gull (unknown)	2	C	1	644	North	50
10/2/2008	0.03	1737	Gull (unknown)	1	C	1	644	South	50
10/2/2008	0.03	1740	Gull, small/tern	2	C	1	805	Southeast	50
10/2/2008	0.03	1743	Tern (unknown)	3	C	1	322	South	40
10/2/2008	0.03	1748	Scoter, dark-winged (unknown)	7	C	1	644	East	3
10/2/2008	0.03	1750	Great Black-backed Gull	1	C	1	483	South	25
10/2/2008	0.03	1751	Scoter (unknown)	25	C	1	1609	Southwest	200
10/2/2008	0.03	1751	Northern Gannet	1	C	1	1609	South	125
10/2/2008	0.03	1754	.	4	C	1	1609	South	150
10/2/2008	0.03	1755	Tern (unknown)	25	C	1	1207	South	200
10/2/2008	0.03	1758	Great Black-backed Gull	1	C	1	483	East	50
10/2/2008	0.03	1759	Forster's Tern	1	C	1	965	Northwest	20
10/2/2008	0.03	1801	Gull, large (unknown)	1	C	1	1207	North	50
10/2/2008	0.03	1802	Tern (unknown)	1	C	1	322	North	50
10/2/2008	0.03	1804	.	1	U	1	644	Northeast	.
10/2/2008	0.03	1806	Scoter/Atlantic Brant	13	C	1	1609	South	20
10/2/2008	0.03	1808	Gull, large (unknown)	1	C	1	1207	Northeast	30
10/2/2008	0.03	1809	Gull, large (unknown)	1	C	1	1207	North	200
10/2/2008	0.03	1810	Gull, large (unknown)	3	C	1	1207	North	300
10/2/2008	0.03	1813	Gull, small/tern	3	C	1	1126	South	10
10/2/2008	0.03	1815	Tern (unknown)	8	C	1	483	South	25
10/2/2008	0.03	1818	Gull (unknown)	1	C	1	805	West	30
10/2/2008	0.03	1818	Scoter (unknown)	6	C	1	1609	South	50
10/2/2008	0.03	1820	Northern Gannet	1	C	1	805	South	60
10/2/2008	0.03	1822	Tern (unknown)	6	C	1	483	South	100
10/2/2008	0.03	1823	Great Black-backed Gull	1	C	1	805	North	20
10/2/2008	0.03	1825	Tern (unknown)	6	C	1	483	South	100
10/2/2008	0.03	1826	Northern Gannet	3	C	1	1609	variable	500

Table J-22 (*continued*). Onshore radar validation survey data at Island Beach State Park, New Jersey, in fall 2008. All radar data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Qdrt	Range (m)	Heading (cardinal)	Altitude (ft ASL)
10/2/2008	0.03	1924	Gull, large (unknown)	1	C	1	965	North	50
10/2/2008	0.03	1926	Gull, large (unknown)	1	C	1	1287	North	150
10/2/2008	0.03	1926	Herring Gull	1	C	1	644	South	100
10/2/2008	0.03	1928	Herring Gull	1	C	1	805	North	20
10/2/2008	0.03	1929	Northern Gannet	1	C	1	483	South	100
10/2/2008	0.03	1936	Tern, large (unknown)	1	C	1	644	North	100
10/2/2008	0.03	1937	Gull, large (unknown)	2	C	1	805	North	75
10/2/2008	0.03	1939	Tern (unknown)	1	C	1	483	South	50
10/2/2008	0.03	1942	Northern Gannet	1	C	1	1207	South	50
10/2/2008	0.03	1943	Gull, large (unknown)	1	C	1	1287	North	50
10/2/2008	0.03	1943	Northern Gannet	1	C	1	805	South	10
10/2/2008	0.03	1945	Gull, large (unknown)	1	C	1	1207	North	5
10/2/2008	0.03	1947	Tern (unknown)	5	C	1	1931	North	50
10/2/2008	0.03	1950	Northern Gannet	1	U	1	1287	South	100
10/2/2008	0.03	1952	Northern Gannet	1	C	1	1287	North	50
10/2/2008	0.03	1955	Northern Gannet	1	C	1	1609	South	100
10/2/2008	0.03	1957	Northern Gannet	2	C	1	2735	South	10
10/2/2008	0.03	2000	Tern, large (unknown)	1	C	1	805	North	40
10/2/2008	0.03	2001	Herring Gull	1	C	1	1207	North	25
10/2/2008	0.03	2003	Gull, large (unknown)	1	C	1	402	South	30
10/2/2008	0.03	2003	Gull, large (unknown)	1	C	1	805	South	60
10/2/2008	0.03	2005	Northern Gannet	1	C	1	1126	North	100
10/2/2008	0.03	2007	Great Black-backed Gull	1	C	1	483	North	30
10/2/2008	0.03	2009	Great Black-backed Gull	1	C	1	483	South	30
10/2/2008	0.03	2010	Tern, large (unknown)	1	C	1	965	North	50
10/2/2008	0.03	2013	Gull, small (unknown)	1	C	1	1609	North	20
10/2/2008	0.03	2014	Northern Gannet	1	C	1	1207	South	25
10/2/2008	0.03	2019	Gull (unknown)	3	C	1	1207	North	100
10/2/2008	0.03	2022	Northern Gannet	1	C	1	805	South	150

Table J-22 (*continued*). Onshore radar validation survey data at Island Beach State Park, New Jersey, in fall 2008. All radar data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Qdrt	Range (m)	Heading (cardinal)	Altitude (ft ASL)
10/4/2008	0.03	1758	Gull, large (unknown)	2	C	.	483	South	30
10/4/2008	0.03	1759	Great Black-backed Gull	1	C	.	483	North	20
10/4/2008	0.03	1801	Laughing Gull	1	C	.	1207	East	50
10/4/2008	0.03	1806	Unknown	1	C	.	1609	variable	150
10/4/2008	0.03	1808	Unknown	1	C	.	1609	South	25
10/4/2008	0.03	1809	Herring Gull	1	C	.	1207	South	50
10/4/2008	0.03	1811	Laughing Gull	1	C	.	322	North	30
10/4/2008	0.03	1813	Herring Gull	1	C	.	1207	Southwest	60
10/4/2008	0.03	1814	Unknown, large	1	C	.	2414	North	25
10/4/2008	0.03	1815	Laughing Gull	1	C	.	1207	East	30
10/4/2008	0.03	1817	Laughing Gull	1	C	.	161	South	40
10/4/2008	0.03	1819	Unknown, large	1	C	.	1609	West	30
10/4/2008	0.03	1821	Herring Gull	1	C	.	805	Northeast	30
10/4/2008	0.03	1823	Scoter/Atlantic Brant	8	C	.	1609	Northwest	25
10/4/2008	0.03	1826	Great Black-backed Gull	1	C	.	1207	Southeast	70
10/4/2008	0.03	1829	Laughing Gull	1	C	.	805	South	40
10/4/2008	0.03	1830	Gull, large (unknown)	1	C	.	1207	South	50
10/4/2008	0.03	1834	Unknown	3	C	.	1609	South	20
10/4/2008	0.03	1835	Herring Gull	1	C	.	402	South	40
10/4/2008	0.03	1838	Herring Gull	2	C	.	1609	Southwest	10
10/4/2008	0.03	1840	Gull, large (unknown)	1	C	.	1207	Southwest	15
10/4/2008	0.03	1842	Herring Gull	1	C	.	1207	West	60
10/4/2008	0.03	1843	Gull, large (unknown)	1	C	.	805	East	40
10/4/2008	0.03	1844	Herring Gull	1	C	.	805	South	100
10/4/2008	0.03	1847	Gull, large (unknown)	2	C	.	805	North	40
10/4/2008	0.03	1848	Herring Gull	1	C	.	805	South	30
10/4/2008	0.03	1850	Herring Gull	1	C	.	402	North	30
10/4/2008	0.03	1906	Brown Pelican	1	C	.	644	South	10
10/4/2008	0.03	1909	Double-crested Cormorant	1	C	.	402	North	10

Table J-22 (*continued*). Onshore radar validation survey data at Island Beach State Park, New Jersey, in fall 2008. All radar data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Qdrt	Range (m)	Heading (cardinal)	Altitude (ft ASL)
10/4/2008	0.03	1910	Laughing Gull	1	C	.	322	North	40
10/4/2008	0.03	1912	Herring Gull	1	C	.	805	East	15
10/4/2008	0.03	1913	Herring Gull	1	U	.	402	South	60
10/4/2008	0.03	1914	Great Black-backed Gull	1	C	.	805	Northeast	30
10/4/2008	0.03	1917	Osprey	1	C	.	644	West	200
10/4/2008	0.03	1918	Herring Gull	2	C	.	322	West	100
10/4/2008	0.03	1920	Gull, large (unknown)	1	C	.	1207	Southwest	10
10/4/2008	0.03	1922	Herring Gull	1	C	.	1207	Northwest	40
10/4/2008	0.03	1923	Great Black-backed Gull	1	C	.	483	North	20
10/4/2008	0.03	1925	Great Black-backed Gull	1	C	.	402	Northwest	30
10/4/2008	0.03	1926	Great Black-backed Gull	1	U	.	402	East	40
10/4/2008	0.03	1928	Gull, small (unknown)	1	C	.	805	South	40
10/4/2008	0.03	1929	Great Black-backed Gull	1	C	.	483	North	30
10/4/2008	0.03	1935	Double-crested Cormorant	1	C	.	805	Southwest	40
10/4/2008	0.03	1937	Sanderling	40	U	.	193	North	3
10/4/2008	0.03	1941	Gull, large (unknown)	1	C	.	1207	South	20
10/4/2008	0.03	1942	Herring Gull	1	C	.	805	North	30
10/4/2008	0.03	1943	Herring Gull	1	C	.	805	East	40
10/4/2008	0.03	1944	Herring Gull	1	C	.	1609	East	100
10/4/2008	0.03	1945	Herring Gull	1	C	.	402	Southeast	25
10/4/2008	0.03	1946	Herring Gull	1	C	.	965	Northeast	50
10/4/2008	0.03	1949	Herring Gull	1	C	.	322	North	50
10/4/2008	0.03	1950	Great Black-backed Gull	1	C	.	322	South	25
10/4/2008	0.03	1951	Gull, large (unknown)	1	C	.	1609	South	80
10/4/2008	0.03	1952	Scoter, dark-winged (unknown)	7	C	.	1207	North	3
10/4/2008	0.03	1953	Herring Gull	1	C	.	322	West	100
10/4/2008	0.03	1955	Herring Gull	1	C	.	1207	South	50
10/4/2008	0.03	1956	Herring Gull	1	C	.	402	Southeast	100
10/4/2008	0.03	1957	Herring Gull	1	C	.	805	variable	50

Table J-22 (*continued*). Onshore radar validation survey data at Island Beach State Park, New Jersey, in fall 2008. All radar data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Qdrt	Range (m)	Heading (cardinal)	Altitude (ft ASL)
10/4/2008	0.03	1958	Herring Gull	1	C	.	322	North	100
10/4/2008	0.03	1959	Herring Gull	1	C	.	1207	Southwest	40
10/4/2008	0.03	2000	Gull, large (unknown)	1	C	.	1609	North	50
10/4/2008	0.03	2001	Royal Tern	2	C	.	483	South	20
10/4/2008	0.03	2003	Great Black-backed Gull	1	C	.	965	East	25
10/4/2008	0.03	2004	Royal Tern	1	C	.	483	South	100
10/4/2008	0.03	2005	Great Black-backed Gull	1	C	.	965	East	30
10/4/2008	0.03	2007	Gull (unknown)	1	C	.	1609	North	150
10/4/2008	0.03	2008	Herring Gull	1	C	.	644	North	50
10/4/2008	0.03	2009	Royal Tern	2	C	.	644	South	80
10/4/2008	0.03	2010	Royal Tern	1	C	.	805	South	200
10/4/2008	0.03	2011	Gull, large (unknown)	1	C	.	1207	Southwest	20
10/4/2008	0.03	2012	Great Black-backed Gull	1	C	.	644	West	150
10/4/2008	0.03	2015	Sanderling	6	C	.	1207	South	3
10/4/2008	0.03	2016	Great Black-backed Gull	1	C	.	322	Southwest	40
10/4/2008	0.03	2018	Royal Tern	2	C	.	402	South	40
10/4/2008	0.03	2019	Atlantic Brant	9	C	.	644	South	3
10/4/2008	0.03	2021	Gull, large (unknown)	4	C	.	1609	variable	50
10/4/2008	0.03	2022	Tern, large (unknown)	2	C	.	1609	Southwest	25
10/4/2008	0.03	2024	Great Black-backed Gull	1	C	.	402	South	10
10/4/2008	0.03	2026	Tern, large (unknown)	1	C	.	805	South	75
10/4/2008	0.03	2028	Falcon (unknown)	1	C	.	402	North	100
10/4/2008	0.03	2028	Laughing Gull	2	C	.	402	East	2
10/4/2008	0.03	2033	Tern, large (unknown)	1	C	.	805	South	25
10/4/2008	0.03	2116	Great Black-backed Gull	1	C	.	805	Northeast	50
10/4/2008	0.03	2118	Brown Pelican	1	C	.	805	South	15
10/4/2008	0.03	2119	Herring Gull	1	C	.	1207	South	5
10/4/2008	0.03	2120	Herring Gull	1	C	.	483	Southeast	50
10/4/2008	0.03	2121	Northern Gannet	1	C	.	483	Southeast	2

Table J-22 (*continued*). Onshore radar validation survey data at Island Beach State Park, New Jersey, in fall 2008. All radar data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Qdrt	Range (m)	Heading (cardinal)	Altitude (ft ASL)
10/4/2008	0.03	2121	Northern Gannet	1	U	.	644	South	30
10/4/2008	0.03	2123	Double-crested Cormorant	1	C	.	483	North	30
10/4/2008	0.03	2127	Double-crested Cormorant	1	C	.	483	South	10
10/4/2008	0.03	2129	Double-crested Cormorant	1	C	.	402	South	2
10/4/2008	0.03	2130	Atlantic Brant	1	C	.	805	South	2
10/4/2008	0.03	2133	Brown Pelican	2	C	.	965	West	75
10/4/2008	0.03	2135	Herring Gull	1	C	.	1207	West	50
10/4/2008	0.03	2141	Great Black-backed Gull	3	C	.	1609	Southeast	100
10/4/2008	0.03	2146	Tern, large (unknown)	1	C	.	805	South	150
10/4/2008	0.03	2147	Herring Gull	1	C	.	1207	West	200
10/4/2008	0.03	2151	Unknown	3	C	.	1207	South	1
10/4/2008	0.03	2154	Herring Gull	1	C	.	1207	South	50
10/4/2008	0.03	2155	Laughing Gull	1	C	.	805	South	25
10/4/2008	0.03	2157	Laughing Gull	8	C	.	805	Southwest	150
10/4/2008	0.03	2158	Shorebird, large (unknown)	9	C	.	805	South	2
10/4/2008	0.03	2201	Herring Gull	1	C	.	805	South	40
10/4/2008	0.03	2203	Great Black-backed Gull	4	C	.	965	South	150
10/4/2008	0.03	2204	Gull, small (unknown)	2	C	.	644	South	2
10/4/2008	0.03	2207	Shorebird, large (unknown)	1	C	.	805	South	50
10/4/2008	0.03	2211	Shorebird, large (unknown)	13	C	.	644	South	2
10/4/2008	0.03	2214	Gull, large (unknown)	3	C	.	965	Southwest	80
10/4/2008	0.03	2214	Herring Gull	2	C	.	483	Southwest	75
10/4/2008	0.03	2215	Gull, large (unknown)	2	C	.	805	West	50
10/4/2008	0.03	2218	Unknown, large	25	C	.	1207	South	150
10/4/2008	0.03	2220	Gull, large (unknown)	20	C	.	1609	Southwest	200
10/4/2008	0.03	2223	Gull, large (unknown)	2	C	.	1207	Northwest	250
10/4/2008	0.03	2225	Herring Gull	2	C	.	805	South	250
10/4/2008	0.03	2226	Royal Tern	4	C	.	483	South	100
10/4/2008	0.03	2227	Gull, large (unknown)	1	C	.	965	North	50

Table J-22 (*continued*). Onshore radar validation survey data at Island Beach State Park, New Jersey, in fall 2008. All radar data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Qdrt	Range (m)	Heading (cardinal)	Altitude (ft ASL)
10/4/2008	0.03	2228	Gull, large (unknown)	1	C	.	402	East	30
10/4/2008	0.03	2230	Tern, large (unknown)	2	C	.	805	South	75
10/4/2008	0.03	2231	Gull, large (unknown)	15	C	.	965	Southwest	75
10/4/2008	0.03	2233	Unknown, large	15	C	.	1609	South	75
10/4/2008	0.03	2234	Herring Gull	1	C	.	402	Southwest	200
10/4/2008	0.03	2234	Herring Gull	4	C	.	322	Southwest	100
10/4/2008	0.03	2235	Gull, large (unknown)	3	C	.	805	Southwest	75
10/4/2008	0.03	2236	Tern, large (unknown)	5	C	.	402	South	20
10/4/2008	0.03	2237	Tern, large (unknown)	10	C	.	1207	South	75
10/4/2008	0.03	2240	Unknown	2	C	.	805	South	2
10/4/2008	0.03	2241	Herring Gull	2	C	.	805	West	75
10/5/2008	0.03	1756	Great Blue Heron	15	C	.	.	South	2800

NM = nautical mile(s)
No. = number
C/U = Confirmed/Unconfirmed
Qdrt = Observation quadrant
m = meters
ft ASL = feet above sea level
. = missing data

Table J-23. Onshore radar validation survey data at Sea Isle City, New Jersey, in fall 2008. All radar data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Qdrt	Range (m)	Heading (cardinal)	Altitude (ft ASL)
10/6/2008	0.03	1435	Common Loon	1	C	2	1609	South	20
10/6/2008	0.03	1437	Atlantic Brant	21	C	2	805	South	50
10/6/2008	0.03	1439	Surf Scoter	7	C	2	2414	South	40
10/6/2008	0.03	1447	Duck (unknown)	.	.	2	1931	Southwest	15
10/6/2008	0.03	1453	Green-winged Teal	1	C	1	805	South	5
10/6/2008	0.03	1453	Scoter, dark-winged (unknown)	6	C	1	805	South	5
10/6/2008	0.03	1456	Common Loon	2	C	2	1609	South	40
10/6/2008	0.03	1501	Scoter, dark-winged (unknown)	25	C	2	1207	South	3
10/6/2008	0.03	1501	Green-winged Teal	2	C	2	1207	South	3
10/6/2008	0.03	1505	Double-crested Cormorant	37	C	2	2414	South	50
10/6/2008	0.03	1510	Atlantic Brant	9	C	2	1609	South	150
10/6/2008	0.03	1510	Double-crested Cormorant	2	C	2	1609	South	150
10/6/2008	0.03	1513	Green-winged Teal	38	C	2	1207	South	5
10/6/2008	0.03	1514	Northern Pintail	25	C	2	1931	South	250
10/6/2008	0.03	1514	Northern Shoveler	1	C	2	1931	South	250
10/6/2008	0.03	1520	.	.	U	2	1609	Southeast	.
10/6/2008	0.03	1524	Scoter, dark-winged (unknown)	31	C	2	2574	Southwest	5
10/6/2008	0.03	1529	Scoter, dark-winged (unknown)	26	C	1	3218	South	30
10/6/2008	0.03	1537	Double-crested Cormorant	60	C	2	3218	South	150
10/6/2008	0.03	1538	Scoter, dark-winged (unknown)	57	C	2	2896	South	30
10/6/2008	0.03	1538	Green-winged Teal	1	C	2	2896	South	30
10/6/2008	0.03	1542	Surf Scoter	20	C	2	1207	North	3
10/6/2008	0.03	1555	Northern Pintail	12	C	1	2414	South	70
10/6/2008	0.03	1556	Double-crested Cormorant	68	C	1	3379	South	300
10/6/2008	0.03	1633	Scoter, dark-winged (unknown)	15	C	2	1931	South	4
10/6/2008	0.03	1633	Green-winged Teal	4	C	2	1931	South	4
10/6/2008	0.03	1639	Forster's Tern	5	C	2	1207	North	30
10/6/2008	0.03	1639	Laughing Gull	1	C	2	1207	North	30
10/6/2008	0.03	1642	Double-crested Cormorant	2	C	1	402	South	1000
10/6/2008	0.03	1643	Black Scoter	12	C	2	1207	South	3

Table J-23 (*continued*). Onshore radar validation survey data at Sea Isle City, New Jersey, in fall 2008. All radar data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Qdrt	Range (m)	Heading (cardinal)	Altitude (ft ASL)
10/6/2008	0.03	1644	Black Scoter	19	C	2	2253	South	5
10/6/2008	0.03	1644	Green-winged Teal	1	C	2	2253	South	5
10/6/2008	0.03	1650	American Oystercatcher	11	C	2	1770	South	100
10/6/2008	0.03	1655	Double-crested Cormorant	25	C	2	2816	South	100
10/6/2008	0.03	1656	Double-crested Cormorant	44	C	1	2092	South	150
10/6/2008	0.03	1657	Double-crested Cormorant	17	C	2	2253	South	150
10/6/2008	0.03	1700	Surf Scoter	3	C	1	2414	South	5
10/6/2008	0.03	1702	Northern Pintail	9	C	2	1207	South	1000
10/6/2008	0.03	1707	Double-crested Cormorant	18	C	2	2414	South	200
10/6/2008	0.03	1709	Black Scoter	25	C	1	2414	South	15
10/6/2008	0.03	1714	Northern Pintail	23	C	3	2816	South	1500
10/6/2008	0.03	1715	Double-crested Cormorant	35	C	2	2735	South	300
10/6/2008	0.03	1716	Scaup (unknown)	30	C	2	2816	South	500
10/6/2008	0.03	1719	Double-crested Cormorant	25	C	2	3218	South	1000
10/6/2008	0.03	1724	Scoter, dark-winged (unknown)	11	C	2	2253	South	20
10/6/2008	0.03	1909	Scoter, dark-winged (unknown)	8	C	2	2735	South	20
10/6/2008	0.03	1909	Green-winged Teal	2	C	2	2735	South	20
10/6/2008	0.03	1915	Double-crested Cormorant	44	C	S	3057	Southwest	300
10/6/2008	0.03	1918	Scoter, dark-winged (unknown)	27	C	1	2414	South	30
10/6/2008	0.03	1920	Scoter, dark-winged (unknown)	16	C	1	2253	South	20
10/6/2008	0.03	1924	Double-crested Cormorant	52	C	2	2414	South	300
10/6/2008	0.03	1934	Double-crested Cormorant	120	C	2	4023	South	450
10/6/2008	0.03	1940	Double-crested Cormorant	12	C	1	4023	South	150
10/6/2008	0.03	1944	Surf Scoter	23	C	2	1609	South	2
10/6/2008	0.03	1945	Double-crested Cormorant	17	C	1	1931	Southwest	200
10/6/2008	0.03	1952	Northern Pintail	13	C	1	2414	East	200
10/6/2008	0.03	1956	Scoter, dark-winged (unknown)	24	C	2	3057	South	20
10/6/2008	0.03	1959	Northern Pintail	25	C	2	2735	South	300
10/6/2008	0.03	2011	Double-crested Cormorant	35	C	2	2253	South	20
10/6/2008	0.03	2025	Black Scoter	73	C	1	805	South	5

Table J-23 (*continued*). Onshore radar validation survey data at Sea Isle City, New Jersey, in fall 2008. All radar data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Qdrt	Range (m)	Heading (cardinal)	Altitude (ft ASL)
10/6/2008	0.03	2025	Green-winged Teal	7	C	1	805	South	5
10/7/2008	0.03	1157	Green-winged Teal	7	C	2	1609	South	3
10/7/2008	0.03	1213	Green-winged Teal	14	C	2	2092	Southwest	100
10/7/2008	0.03	1214	Atlantic Brant	17	C	2	965	Northwest	250
10/7/2008	0.03	1217	Surf Scoter	10	C	2	1609	Southwest	20
10/7/2008	0.03	1223	Scoter, dark-winged (unknown)	200	C	2	2558	South	10
10/7/2008	0.03	1230	Scoter, dark-winged (unknown)	55	C	2	2414	Southwest	10
10/7/2008	0.03	1232	Double-crested Cormorant	11	C	2	1931	Southwest	50
10/7/2008	0.03	1235	Double-crested Cormorant	1	C	4	1850	East	200
10/7/2008	0.03	1240	Scoter, dark-winged (unknown)	15	C	2	1754	Southwest	5
10/7/2008	0.03	1245	Common Loon	1	C	2	1770	Southwest	300
10/7/2008	0.03	1249	Double-crested Cormorant	45	C	2	2816	Southwest	750
10/7/2008	0.03	1251	Scoter, dark-winged (unknown)	35	C	2	2993	Southwest	30
10/7/2008	0.03	1253	Scoter, dark-winged (unknown)	130	C	2	2333	South	10
10/7/2008	0.03	1256	Double-crested Cormorant	60	C	2	3717	Southwest	500
10/7/2008	0.03	1257	Double-crested Cormorant	23	C	2	3218	Southwest	500
10/7/2008	0.03	1300	Herring Gull	8	C	2	1931	South	200
10/7/2008	0.03	1313	Double-crested Cormorant	110	C	2	2961	South	500
10/7/2008	0.03	1316	Double-crested Cormorant	140	C	2	2011	Southwest	700
10/7/2008	0.03	1317	Double-crested Cormorant	18	C	2	1545	Southeast	300
10/7/2008	0.03	1319	Green-winged Teal	23	C	2	1561	South	25
10/7/2008	0.03	1323	Double-crested Cormorant	55	C	2	2735	Southwest	300
10/7/2008	0.03	1327	Green-winged Teal	15	C	3	1770	South	10
10/7/2008	0.03	1327	Northern Pintail	5	C	3	1770	South	10
10/7/2008	0.03	1327	Black Scoter	1	C	3	1770	South	10
10/7/2008	0.03	1331	Atlantic Brant	28	C	2	1207	North	5
10/7/2008	0.03	1340	Double-crested Cormorant	95	C	2	2478	East	500
10/7/2008	0.03	1343	Great Blue Heron	3	C	2	2816	South	700
10/7/2008	0.03	1346	Double-crested Cormorant	100	C	2	4312	Southwest	500
10/7/2008	0.03	1350	Double-crested Cormorant	28	C	1	2896	Southwest	300

Table J-23 (*continued*). Onshore radar validation survey data at Sea Isle City, New Jersey, in fall 2008. All radar data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Qdrt	Range (m)	Heading (cardinal)	Altitude (ft ASL)
10/7/2008	0.03	1355	Canada Goose	18	C	1	2671	North	200
10/7/2008	0.03	1357	Scoter, dark-winged (unknown)	60	C	2	2735	Southwest	30
10/7/2008	0.03	1401	Double-crested Cormorant	37	C	2	3765	Northeast	600
10/7/2008	0.03	1405	Scoter (unknown)	6	C	2	3379	North	50
10/7/2008	0.03	1406	Green-winged Teal	10	C	2	1207	Southwest	50
10/7/2008	0.03	1408	Scoter, dark-winged (unknown)	90	C	2	2092	North	5
10/7/2008	0.03	1411	Double-crested Cormorant	95	C	2	2253	Southwest	300
10/7/2008	0.03	1414	Scoter, dark-winged (unknown)	40	C	2	1207	East	5
10/7/2008	0.03	1417	Double-crested Cormorant	110	C	2	3572	Southwest	400
10/7/2008	0.03	1417	Common Loon	4	C	2	3572	Southwest	400
10/7/2008	0.03	1419	Green-winged Teal	5	C	2	1046	East	15
10/7/2008	0.03	1423	Scoter (unknown)	22	C	2	3620	Southwest	25
10/7/2008	0.03	1437	Double-crested Cormorant	31	C	2	1496	North	400
10/7/2008	0.03	1441	Double-crested Cormorant	27	C	2	3862	Southeast	400
10/7/2008	0.03	1444	Scoter, dark-winged (unknown)	130	C	2	2977	West	10
10/7/2008	0.03	1445	Double-crested Cormorant	50	C	2	2735	Southwest	350
10/7/2008	0.03	1448	Common Loon	4	C	2	2864	Southwest	300
10/7/2008	0.03	1451	Double-crested Cormorant	46	C	2	2011	Southwest	400
10/7/2008	0.03	1456	Scoter, dark-winged (unknown)	45	C	2	1786	South	5
10/7/2008	0.03	1458	Scoter, dark-winged (unknown)	30	C	1	2253	Southwest	10
10/7/2008	0.03	1501	Green-winged Teal	13	C	2	2414	West	50
10/7/2008	0.03	1501	Duck (unknown dabbler)	10	C	2	2414	West	50
10/7/2008	0.03	1504	Double-crested Cormorant	30	C	1	1931	South	300
10/7/2008	0.03	1508	Double-crested Cormorant	38	C	2	2832	East	400
10/7/2008	0.03	1510	Northern Pintail	11	C	2	1448	Southwest	80
10/7/2008	0.03	1510	Wood Duck	1	C	2	1448	Southwest	80
10/7/2008	0.03	1510	Green-winged Teal	1	C	2	1448	Southwest	80
10/7/2008	0.03	1510	Mallard	6	C	2	1448	Southwest	80
10/7/2008	0.03	1513	Green-winged Teal	17	C	2	1770	West	8
10/7/2008	0.03	1517	Northern Gannet	1	C	2	2735	East	60

Table J-23 (*continued*). Onshore radar validation survey data at Sea Isle City, New Jersey, in fall 2008. All radar data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Qdrt	Range (m)	Heading (cardinal)	Altitude (ft ASL)
10/7/2008	0.03	1519	American Black Duck	7	C	2	2414	Northeast	8
10/7/2008	0.03	1526	Common Loon	1	C	2	1770	Southeast	20
10/7/2008	0.03	1527	Scoter, dark-winged (unknown)	90	C	2	1931	South	5
10/7/2008	0.03	1531	Scoter, dark-winged (unknown)	29	C	1	3218	Southwest	3
10/7/2008	0.03	1538	Double-crested Cormorant	75	C	2	2574	Southwest	400
10/7/2008	0.03	1541	Black Scoter	11	C	2	3379	West	80
10/7/2008	0.03	1552	Scoter, dark-winged (unknown)	38	C	2	1931	Southwest	7
10/7/2008	0.03	1554	Double-crested Cormorant	38	C	2	4183	Southwest	700
10/7/2008	0.03	1557	Scoter (unknown)	300	C	2	3701	Southwest	15
10/7/2008	0.03	1600	Double-crested Cormorant	2	C	2	2574	Southwest	200
10/7/2008	0.03	1601	Double-crested Cormorant	115	C	2	4666	Southwest	1000
10/7/2008	0.03	1604	Double-crested Cormorant	40	C	1	2735	Southwest	1000
10/7/2008	0.03	1607	Double-crested Cormorant	105	C	2	4344	West	1000
10/7/2008	0.03	1610	Green-winged Teal	1	C	1	2253	Southwest	1000
10/7/2008	0.03	1610	Wood Duck	4	C	1	2253	Southwest	1000
10/7/2008	0.03	1615	Double-crested Cormorant	45	C	2	1931	South	500
10/7/2008	0.03	1620	Scoter, dark-winged (unknown)	210	C	2	3057	South	10
10/7/2008	0.03	1624	Scoter, dark-winged (unknown)	135	C	2	2092	Southwest	8
10/7/2008	0.03	1627	Double-crested Cormorant	57	C	2	2414	South	500
10/7/2008	0.03	1628	Double-crested Cormorant	38	C	1	2092	East	1000
10/7/2008	0.03	1630	Scoter, dark-winged (unknown)	38	C	2	2414	Southwest	7
10/7/2008	0.03	1634	Scoter, dark-winged (unknown)	115	C	2	2414	Southwest	10
10/7/2008	0.03	1639	Double-crested Cormorant	22	C	1	1931	Southwest	300
10/7/2008	0.03	1642	Green-winged Teal	18	C	2	965	Southwest	3
10/7/2008	0.03	1656	Green-winged Teal	11	C	2	965	Southwest	3
10/7/2008	0.03	1659	Scoter (unknown)	225	C	2	3540	Southwest	20
10/7/2008	0.03	1702	Common Loon	1	C	2	2011	West	400
10/7/2008	0.03	1703	Double-crested Cormorant	4	C	1	1931	South	400
10/7/2008	0.03	1709	Common Loon	1	C	1	2574	Northeast	150
10/7/2008	0.03	1719	Double-crested Cormorant	30	C	1	2430	South	400

Table J-23 (*continued*). Onshore radar validation survey data at Sea Isle City, New Jersey, in fall 2008. All radar data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Qdrt	Range (m)	Heading (cardinal)	Altitude (ft ASL)
10/7/2008	0.03	1721	Scoter, dark-winged (unknown)	14	C	2	2478	Southwest	80
10/7/2008	0.03	1726	American Black Duck	2	C	2	949	Southwest	75
10/7/2008	0.03	1729	Double-crested Cormorant	71	C	2	3556	Southwest	250
10/7/2008	0.03	1735	Double-crested Cormorant	80	C	2	3701	Southwest	900
10/7/2008	0.03	1738	Osprey	1	C	2	2446	Northwest	120
10/7/2008	0.03	1740	Common Loon	1	C	2	2414	South	500
10/7/2008	0.03	1742	Double-crested Cormorant	18	C	1	1641	Southeast	800
10/7/2008	0.03	1754	Double-crested Cormorant	18	C	1	2446	West	600
10/7/2008	0.03	1756	Black Scoter	14	C	2	1770	Northeast	5
10/7/2008	0.03	1808	Double-crested Cormorant	78	C	2	2574	West	1000
10/7/2008	0.03	1814	Double-crested Cormorant	35	C	1	3620	West	300
10/16/2008	0.40	1755	Gull, large (unknown)	1	C	.	1609	North	20
10/16/2008	0.40	1800	.	.	U	.	1207	East	.
10/16/2008	0.40	1805	Gull, large (unknown)	1	C	.	805	South	30
10/16/2008	0.40	1813	Great Black-backed Gull	1	C	.	1207	East	60
10/16/2008	0.40	1814	Gull, large (unknown)	1	C	.	805	Southeast	100
10/16/2008	0.40	1816	Gull, large (unknown)	1	C	.	965	South	80
10/16/2008	0.40	1822	Gull, large (unknown)	1	C	.	1207	West	20
10/16/2008	0.40	1826	Great Black-backed Gull	1	C	.	1207	South	50
10/17/2008	0.03	1501	Double-crested Cormorant	130	C	.	2414	South	1000
10/17/2008	0.03	1504	Double-crested Cormorant	13	C	.	1931	South	800
10/17/2008	0.03	1506	Double-crested Cormorant	4	C	.	2414	South	100
10/17/2008	0.03	1508	Double-crested Cormorant	60	C	.	2011	South	1000
10/17/2008	0.03	1512	Double-crested Cormorant	50	C	.	2414	Southwest	1500
10/17/2008	0.03	1519	Double-crested Cormorant	35	C	.	2414	Southwest	1000
10/17/2008	0.03	1524	Unknown, large	80	C	.	2414	South	800
10/17/2008	0.03	1527	Unknown, large	50	C	.	2011	South	100
10/17/2008	0.03	1530	Geese / cormorant	40	C	.	2414	South	2000
10/17/2008	0.03	1534	Geese / cormorant	200	C	.	2896	South	40
10/17/2008	0.40	1756	Double-crested Cormorant	60	C	.	1609	South	100

Table J-23 (*continued*). Onshore radar validation survey data at Sea Isle City, New Jersey, in fall 2008. All radar data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Qdrt	Range (m)	Heading (cardinal)	Altitude (ft ASL)
10/17/2008	0.40	1801	Double-crested Cormorant	8	C	.	1609	South	500
10/17/2008	0.40	1805	Duck (unknown)	12	C	.	965	South	20
10/17/2008	0.40	1806	Double-crested Cormorant	30	C	.	2414	South	500
10/17/2008	0.40	1806	Duck (unknown)	9	U	.	2414	North	550
10/17/2008	0.40	1817	Double-crested Cormorant	50	C	.	1609	South	200
10/17/2008	0.40	1819	Double-crested Cormorant	40	C	.	2414	South	200
10/17/2008	0.40	1820	Scoter (unknown)	90	C	.	1609	South	10
10/17/2008	0.40	1832	Scoter (unknown)	80	C	.	2253	South	40
10/17/2008	0.40	1836	Scoter (unknown)	75	C	.	2414	South	5
10/17/2008	0.40	1839	Cormorant (unknown)	30	C	.	2574	South	1000
10/17/2008	0.40	1840	Cormorant (unknown)	30	U	.	1609	South	50
10/17/2008	0.40	1846	Scoter, dark-winged (unknown)	75	C	.	1609	South	5
10/17/2008	0.40	1851	Cormorant / scoter	50	C	.	3218	South	200
10/17/2008	0.40	1854	Scoter (unknown)	30	C	.	1609	South	25
10/17/2008	0.40	1856	Snow Goose	30	C	.	1207	West	500
10/17/2008	0.40	1901	Cormorant (unknown)	70	C	.	805	Southwest	500
10/17/2008	0.40	1906	Scoter (unknown)	80	C	.	1609	South	20
10/17/2008	0.40	1910	Scoter, dark-winged (unknown)	10	C	.	1207	South	3
10/17/2008	0.40	1910	Duck (unknown)	8	C	.	1207	South	3
10/17/2008	0.40	1915	Cormorant (unknown)	12	C	.	2414	South	1000
10/17/2008	0.40	1918	Scoter (unknown)	100	C	.	2011	South	20
10/17/2008	0.40	1929	Atlantic Brant	20	C	.	1207	South	25
10/17/2008	0.40	1933	Scoter (unknown)	15	C	.	2414	South	50
10/17/2008	0.40	1936	Scoter (unknown)	25	C	.	1609	South	25
10/17/2008	0.40	1942	cormorant / scoter	20	C	.	2414	South	50
10/17/2008	0.40	1947	Scoter (unknown)	75	C	.	1207	South	30
10/17/2008	0.40	1951	Duck (unknown)	20	C	.	805	South	100
10/17/2008	0.03	2039	Cormorant (unknown)	130	C	.	1207	South	400
10/17/2008	0.03	2042	Double-crested Cormorant	130	C	.	1207	South	400
10/17/2008	0.03	2051	Cormorant (unknown)	25	C	.	2011	South	200

Table J-23 (*continued*). Onshore radar validation survey data at Sea Isle City, New Jersey, in fall 2008. All radar data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Qdrt	Range (m)	Heading (cardinal)	Altitude (ft ASL)
10/17/2008	0.03	2057	Cormorant/Atlantic Brant	8	C	.	2011	South	300
10/17/2008	0.03	2103	.	1	U	.	2414	Southwest	40
10/17/2008	0.03	2106	Cormorant (unknown)	90	C	.	1207	South	100
10/17/2008	0.03	2112	Cormorant/Atlantic Brant	40	C	.	1609	South	300
10/17/2008	0.03	2120	Scoter (unknown)	7	C	.	1207	South	5
10/17/2008	0.03	2130	Cormorant/Atlantic Brant	9	C	.	1609	South	60
10/17/2008	0.03	2132	Cormorant/Atlantic Brant	11	C	.	2414	South	10
10/17/2008	0.03	2133	Scoter (unknown)	30	C	.	2011	South	3
10/17/2008	0.03	2138	Unknown, large	40	C	.	1609	Southwest	130
10/17/2008	0.03	2140	Cormorant/Atlantic Brant	26	C	.	1207	South	600
10/17/2008	0.03	2144	Cormorant/Atlantic Brant	8	C	.	2011	South	700
10/17/2008	0.03	2150	Cormorant/Atlantic Brant	10	U	.	1609	South	30
10/21/2008	0.03	1257	Scoter (unknown)	50	C	1	1931	East	30
10/21/2008	0.03	1306	Brown Pelican	10	C	1	724	South	15
10/21/2008	0.03	1310	Northern Gannet	1	C	1	1110	North	75
10/21/2008	0.03	1313	Surf Scoter	16	C	2	2076	Southwest	8
10/21/2008	0.03	1314	Brown Pelican	6	C	2	1062	Southwest	5
10/21/2008	0.03	1320	Brown Pelican	2	C	2	1512	North	5
10/21/2008	0.03	1321	Brown Pelican	2	C	1	2011	North	50
10/21/2008	0.03	1324	Surf Scoter	8	C	2	2027	South	3
10/21/2008	0.03	1325	Northern Gannet	1	C	2	965	East	50
10/21/2008	0.03	1327	Surf Scoter	10	C	2	2510	Northeast	20
10/21/2008	0.03	1331	Scoter, dark-winged (unknown)	12	C	1	2526	Northeast	8
10/21/2008	0.03	1334	Scoter, dark-winged (unknown)	3	C	1	1448	South	8
10/21/2008	0.03	1339	Double-crested Cormorant	175	C	4	2397	Southwest	150
10/21/2008	0.03	1341	Red-throated Loon	4	C	2	1448	Southwest	100
10/21/2008	0.03	1346	Surf Scoter	15	C	2	917	Southwest	8
10/21/2008	0.03	1350	Northern Gannet	8	C	2	1030	South	50
10/21/2008	0.03	1352	Green-winged Teal	7	C	2	1416	South	5
10/21/2008	0.03	1353	Surf Scoter	3	C	2	2494	Northeast	20

Table J-23 (*continued*). Onshore radar validation survey data at Sea Isle City, New Jersey, in fall 2008. All radar data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Qdrt	Range (m)	Heading (cardinal)	Altitude (ft ASL)
10/17/2008	0.03	2054	Cormorant/Atlantic Brant	25	C	.	2011	South	400
10/21/2008	0.03	1402	Great Black-backed Gull	1	C	2	1287	Northeast	150
10/21/2008	0.03	1407	Double-crested Cormorant	5	C	3	1770	South	100
10/21/2008	0.03	1410	Surf Scoter	6	C	2	805	Southwest	5
10/21/2008	0.03	1410	Green-winged Teal	1	C	2	805	Southwest	5
10/21/2008	0.03	1414	Royal Tern	4	C	2	644	South	50
10/21/2008	0.03	1414	Northern Gannet	1	C	2	644	South	50
10/21/2008	0.03	1417	Northern Gannet	1	C	2	1287	West	75
10/21/2008	0.03	1422	Double-crested Cormorant	63	C	3	965	Southwest	75
10/21/2008	0.03	1425	Double-crested Cormorant	17	C	4	2574	South	120
10/21/2008	0.03	1427	Scoter (unknown)	50	C	2	3701	North	5
10/21/2008	0.03	1429	Surf Scoter	16	C	2	805	Northeast	5
10/21/2008	0.03	1431	Surf Scoter	16	C	2	1770	South	5
10/21/2008	0.03	1433	Herring Gull	1	C	2	1126	Northeast	75
10/21/2008	0.03	1436	Surf Scoter	10	C	2	805	Southwest	4
10/21/2008	0.03	1441	Brown Pelican	9	C	1	1046	Northeast	20
10/21/2008	0.03	1445	Surf Scoter	9	C	2	2188	Southwest	5
10/21/2008	0.03	1447	Scoter, dark-winged (unknown)	40	C	1	2735	Northeast	5
10/21/2008	0.03	1451	Scoter, dark-winged (unknown)	15	C	2	3057	Northeast	40
10/21/2008	0.03	1453	Surf Scoter	15	C	2	2735	North	30
10/21/2008	0.03	1455	Scoter, dark-winged (unknown)	16	C	2	2574	Northeast	5
10/21/2008	0.03	1457	Scoter, dark-winged (unknown)	4	C	2	2832	Southwest	5
10/21/2008	0.03	1501	Northern Gannet	1	C	2	1770	North	50
10/21/2008	0.03	1504	Herring Gull	1	C	3	1255	North	100
10/21/2008	0.03	1507	Atlantic Brant	4	C	3	1448	North	50
10/21/2008	0.03	1508	Great Black-backed Gull	1	C	2	1448	Northeast	200
10/21/2008	0.03	1510	Surf Scoter	33	C	1	1609	Southwest	5
10/21/2008	0.03	1512	Great Black-backed Gull	1	C	3	1770	East	100
10/21/2008	0.03	1513	Common Loon	1	C	2	1609	North	5
10/21/2008	0.03	1604	Scoter, dark-winged (unknown)	23	C	2	1142	South	3

Table J-23 (*continued*). Onshore radar validation survey data at Sea Isle City, New Jersey, in fall 2008. All radar data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Qdrt	Range (m)	Heading (cardinal)	Altitude (ft ASL)
10/21/2008	0.03	1605	Sanderling	32	C	1	805	Northwest	8
10/21/2008	0.03	1605	Black-bellied Plover	3	C	1	805	Northwest	8
10/21/2008	0.03	1609	Herring Gull	1	C	3	1014	Southeast	50
10/21/2008	0.03	1610	Green-winged Teal	11	C	2	2414	South	3
10/21/2008	0.03	1612	Surf Scoter	4	C	2	2414	Southwest	5
10/21/2008	0.03	1612	White-winged Scoter	1	C	2	2414	Southwest	5
10/21/2008	0.03	1615	Surf Scoter	11	C	2	1207	South	4
10/21/2008	0.03	1617	Turkey Vulture	1	C	3	402	Southeast	60
10/21/2008	0.03	1621	Red-throated Loon	1	C	1	1046	North	60
10/21/2008	0.03	1631	Northern Pintail	24	C	2	2494	South	30
10/21/2008	0.03	1633	Atlantic Brant	7	U	1	2092	Northeast	35
10/21/2008	0.03	1637	Northern Gannet	1	C	2	2011	South	70
10/21/2008	0.03	1638	Surf Scoter	8	C	2	2896	East	25
10/21/2008	0.03	1642	Scoter, dark-winged (unknown)	48	C	3	2816	Southwest	10
10/21/2008	0.03	1647	Atlantic Brant	35	C	2	2253	South	10
10/21/2008	0.03	1648	Green-winged Teal	6	C	3	1207	South	4
10/21/2008	0.03	1648	Greater Scaup	1	C	3	1207	South	4
10/21/2008	0.03	1653	Common Loon	2	C	3	2414	Northeast	100
10/21/2008	0.03	1701	Surf Scoter	8	C	2	805	Southwest	8
10/21/2008	0.03	1702	Red-throated Loon	1	C	2	1207	South	5
10/21/2008	0.03	1703	Royal Tern	1	C	1	805	South	50
10/21/2008	0.03	1708	Double-crested Cormorant	1	C	4	1496	East	150
10/21/2008	0.03	1709	Scoter, dark-winged (unknown)	40	U	2	2816	South	150
10/21/2008	0.03	1712	Northern Gannet	1	C	1	1722	North	60
10/21/2008	0.03	1714	Great Black-backed Gull	1	C	1	981	South	100
10/21/2008	0.03	1717	Scoter, dark-winged (unknown)	75	C	2	2590	West	30
10/21/2008	0.03	1719	Duck (unknown dabbler)	2	C	1	2430	South	150
10/21/2008	0.03	1725	Scoter, dark-winged (unknown)	34	C	2	2526	Northeast	10
10/21/2008	0.03	1726	Northern Gannet	1	C	2	1110	East	40
10/21/2008	0.03	1730	Atlantic Brant	9	C	4	1271	Northeast	40

Table J-23 (*continued*). Onshore radar validation survey data at Sea Isle City, New Jersey, in fall 2008. All radar data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Qdrt	Range (m)	Heading (cardinal)	Altitude (ft ASL)
10/21/2008	0.03	1732	Royal Tern	1	C	2	1368	South	30
10/21/2008	0.03	1733	Surf Scoter	38	C	2	1593	South	12
10/21/2008	0.03	1733	Black Scoter	5	C	2	1593	South	12
10/21/2008	0.03	1739	Surf Scoter	3	C	1	2381	Southwest	15
10/21/2008	0.03	1744	Northern Gannet	1	C	2	1352	Northeast	50
10/21/2008	0.03	1745	Great Black-backed Gull	1	C	1	1110	West	150
11/16/2008	0.20	2040	.	.	U	S	1400	Northeast	.
11/16/2008	0.20	2043	Northern Gannet	1	C	2	1448	North	30
11/16/2008	0.20	2048	Double-crested Cormorant	24	C	2	644	South	5
11/16/2008	0.20	2050	Scoter, dark-winged (unknown)	3	C	2	1126	South	20
11/16/2008	0.20	2052	Northern Gannet	1	C	2	1287	South	125
11/16/2008	0.20	2054	Northern Gannet	1	U	2	1287	North	5
11/16/2008	0.20	2055	Scoter, dark-winged (unknown)	9	C	2	1126	South	15
11/16/2008	0.20	2101	Black Scoter	2	C	2	644	South	10
11/16/2008	0.20	2102	Northern Gannet	1	C	2	965	South	40
11/16/2008	0.20	2105	Scoter, dark-winged (unknown)	1	C	1	1126	North	12
11/16/2008	0.20	2106	Great Black-backed Gull	1	C	2	644	South	65
11/16/2008	0.20	2110	Laughing Gull	1	C	2	965	South	10

NM = nautical mile(s)
No. = number
C/U = Confirmed/Unconfirmed
Qdrt = Observation quadrant
m = meters
ft ASL = feet above sea level
. = missing data

Table J-24. Onshore radar validation survey data at Brigantine Beach, New Jersey, in fall 2008. All radar data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Qdrt	Range (m)	Heading (cardinal)	Altitude (ft ASL)
10/27/2008	0.10	1321	Black-bellied Plover	14	C	1	3138	East	300
10/27/2008	0.10	1327	American Black Duck	5	C	4	2397	South	250
10/27/2008	0.10	1330	Great Black-backed Gull	1	C	1	1142	East	200
10/27/2008	0.10	1335	American Black Duck	2	C	1	1609	West	150
10/27/2008	0.10	1338	Atlantic Brant	6	C	1	2993	North	10
10/27/2008	0.10	1343	Great Black-backed Gull	1	C	2	1754	South	75
10/27/2008	0.10	1355	Northern Gannet	1	C	2	1577	Northeast	50
10/27/2008	0.10	1404	American Black Duck	12	C	4	3459	West	200
10/27/2008	0.10	1406	Northern Gannet	3	C	2	1400	North	10
10/27/2008	0.10	1410	Double-crested Cormorant	40	U	3	3218	Southeast	100
10/27/2008	0.10	1422	American Black Duck	12	C	4	3218	NW	300
10/27/2008	0.10	1425	Double-crested Cormorant	38	C	4	2011	South	15
10/27/2008	0.10	1428	American Black Duck	5	U	.	2414	NW	100
10/27/2008	0.10	1436	Great Black-backed Gull	1	C	2	1207	NW	5
10/27/2008	0.10	1437	Scoter (unknown)	10	C	1	3218	North	50
10/27/2008	0.10	1440	Double-crested Cormorant	30	C	4	4023	Southwest	200
10/27/2008	0.10	1440	Shorebird (unknown)	750	C	4	3218	East	20
10/27/2008	0.10	1442	American Black Duck	2	C	4	2414	Southwest	160
10/27/2008	0.10	1448	Northern Gannet	1	C	2	1207	NW	50
10/27/2008	0.10	1449	Common Loon	1	C	2	1609	North	20
10/27/2008	0.10	1450	Shorebird (unknown)	400	C	4	3218	East	200
10/27/2008	0.10	1453	Great Black-backed Gull	1	C	1	1931	North	150
10/27/2008	0.10	1457	Double-crested Cormorant	175	C	1	3540	South	150
10/27/2008	0.10	1459	Red-throated Loon	2	C	2	1207	Northeast	150
10/27/2008	0.10	1501	Osprey	1	C	1	1609	South	100
10/27/2008	0.10	1510	American Black Duck	4	C	4	3218	Southwest	200
10/27/2008	0.10	1517	Double-crested Cormorant	9	C	1	805	South	250
10/27/2008	0.10	1523	Double-crested Cormorant	19	C	4	3701	Southwest	100
10/27/2008	0.10	1527	Double-crested Cormorant	700	C	2	1931	South	50
10/27/2008	0.10	1531	Double-crested Cormorant	119	C	1	4023	South	150

Table J-24 (*continued*). Onshore radar validation survey data at Brigantine Beach, New Jersey, in fall 2008. All radar data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Qdrt	Range (m)	Heading (cardinal)	Altitude (ft ASL)
11/7/2008	0.10	1811	Duck (unknown)	50	C	4	2253	variable	150
11/8/2008	0.10	1614	Herring Gull	1	C	4	1931	East	60
11/9/2008	0.10	1405	Great Black-backed Gull	1	C	1	1368	Northeast	50
11/9/2008	0.10	1412	Herring Gull	1	C	1	1207	East	45
11/9/2008	0.10	1414	.	.	U	1	1609	West	.
11/9/2008	0.10	1422	Royal Tern	1	C	2	1609	West	40
11/9/2008	0.10	1424	Herring Gull	1	C	2	965	South	70
11/9/2008	0.10	1427	Ring-billed Gull	1	C	3	1609	West	65
11/9/2008	0.10	1430	Northern Gannet	1	C	1	2414	Northeast	30
11/9/2008	0.10	1435	Great Black-backed Gull	1	C	2	2092	North	80
11/9/2008	0.10	1440	Laughing Gull	1	C	2	805	Northeast	40
11/9/2008	0.10	1444	Raptor (unknown)	1	C	1	1770	NW	90
11/9/2008	0.10	1449	Great Black-backed Gull	1	C	1	1770	North	90
11/9/2008	0.10	1454	Northern Gannet	1	C	1	2092	variable	250
11/9/2008	0.10	1545	Double-crested Cormorant	1	C	1	2414	Northeast	40
11/9/2008	0.10	1552	Northern Gannet	1	C	1	3057	Northeast	40
11/9/2008	0.10	2030	Double-crested Cormorant	3	C	4	3218	Northeast	120
11/9/2008	0.10	2031	Northern Gannet	1	C	2	1931	North	60
11/9/2008	0.10	2034	Northern Gannet	1	C	2	2092	South	40
11/9/2008	0.10	2037	Scoter (unknown)	200	C	4	2735	Northeast	500
11/9/2008	0.10	2039	.	.	U	2	3218	Northeast	.
11/9/2008	0.10	2041	Common Loon	2	C	2	1609	South	60
11/9/2008	0.10	2043	Northern Gannet	2	C	1	1770	North	40
11/9/2008	0.10	2044	Northern Gannet	1	C	1	1609	South	55
11/9/2008	0.10	2047	Northern Gannet	1	C	4	1609	North	55
11/9/2008	0.10	2052	Northern Gannet	1	C	2	2011	South	30
11/9/2008	0.10	2053	Northern Harrier	1	C	4	1207	Northeast	15
11/9/2008	0.10	2056	Laughing Gull	1	C	1	1770	North	45
11/9/2008	0.10	2058	Northern Gannet	1	C	1	1609	Southeast	38
11/9/2008	0.10	2102	Shorebird (unknown)	100	C	1	2414	Northeast	115

Table J-24 (*continued*). Onshore radar validation survey data at Brigantine Beach, New Jersey, in fall 2008. All radar data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Qdrt	Range (m)	Heading (cardinal)	Altitude (ft ASL)
11/9/2008	0.10	2105	Northern Gannet	1	C	2	1609	South	90
11/9/2008	0.10	2109	Great Egret	7	C	1	805	South	120
11/9/2008	0.10	2111	Atlantic Brant	1	C	1	1609	South	40
11/9/2008	0.10	2114	Northern Gannet	1	C	2	2414	Northeast	38
11/9/2008	0.10	2119	Great Egret	2	C	1	1609	South	1000
11/9/2008	0.10	2127	Northern Gannet	1	C	2	1609	Northeast	30
11/9/2008	0.10	2129	Northern Gannet	3	C	1	2092	South	20
11/9/2008	0.10	2131	Northern Gannet	1	C	1	1609	South	20
11/9/2008	0.10	2133	Great Black-backed Gull	1	C	1	2092	North	40
11/9/2008	0.10	2134	Laughing Gull	1	C	1	2092	Northeast	50
11/9/2008	0.10	2137	Northern Gannet	1	C	2	1609	Northeast	40
11/12/2008	0.10	2026	Northern Gannet	1	C	2	1126	Southwest	50
11/12/2008	0.10	2035	Northern Gannet	1	C	2	2253	Southwest	20
11/12/2008	0.10	2037	Northern Gannet	1	C	1	2092	variable	50
11/12/2008	0.10	2039	Northern Gannet	1	C	1	1384	Southwest	60
11/12/2008	0.10	2041	Scoter (unknown)	150	C	2	2414	Southwest	5
11/12/2008	0.10	2043	Northern Gannet	2	C	2	2011	Southwest	55
11/12/2008	0.10	2045	Scoter, dark-winged (unknown)	147	C	2	2011	Southwest	5
11/12/2008	0.10	2045	Loon (unknown)	3	C	2	2011	Southwest	5
11/12/2008	0.10	2047	Herring Gull	1	C	1	1287	Southwest	40
11/12/2008	0.10	2048	Northern Gannet	1	C	2	1448	South	80
11/12/2008	0.10	2050	Northern Gannet	1	C	2	1818	South	50
11/12/2008	0.10	2053	Scoter, dark-winged (unknown)	200	C	2	2253	South	6
11/12/2008	0.10	2054	Herring Gull	1	C	1	1287	Northeast	50
11/12/2008	0.10	2056	Northern Gannet	1	C	1	1287	South	60
11/12/2008	0.10	2057	Northern Gannet	1	C	1	1287	Southwest	40
11/12/2008	0.10	2058	Northern Gannet	1	C	2	1448	Southwest	50
11/12/2008	0.10	2100	Scoter, dark-winged (unknown)	50	C	2	2092	Southwest	10
11/12/2008	0.10	2101	.	.	U	2	2253	Southwest	.
11/12/2008	0.10	2103	.	.	U	2	3041	Southwest	.

Table J-24 (*continued*). Onshore radar validation survey data at Brigantine Beach, New Jersey, in fall 2008. All radar data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Qdrt	Range (m)	Heading (cardinal)	Altitude (ft ASL)
11/12/2008	0.10	2106	Scoter, dark-winged (unknown)	70	C	2	2414	Southwest	5
11/12/2008	0.10	2107	Northern Gannet	1	C	2	1287	Southwest	40
11/12/2008	0.10	2108	.	.	U	1	1834	Southwest	.
11/12/2008	0.10	2114	Northern Gannet	1	C	1	1207	West	25
11/12/2008	0.10	2116	Great Blue Heron	1	C	1	1931	Southwest	60
11/12/2008	0.10	2121	Northern Gannet	2	C	2	1287	Northeast	40
11/12/2008	0.10	2122	Scoter, dark-winged (unknown)	20	C	2	1287	South	5
11/12/2008	0.10	2125	Scoter, dark-winged (unknown)	220	C	2	2816	South	5
11/12/2008	0.10	2132	Northern Gannet	1	C	2	1609	West	65
11/12/2008	0.10	2133	Atlantic Brant	4	C	2	1609	South	250
11/12/2008	0.10	2137	Northern Gannet	1	C	2	1609	Southwest	40
11/12/2008	0.10	2138	Northern Gannet	1	C	1	1609	South	40
11/12/2008	0.10	2140	Northern Gannet	1	C	2	1287	West	45
11/12/2008	0.10	2143	.	.	U	2	1609	South	.
11/12/2008	0.10	2145	.	.	U	1	805	South	.
11/12/2008	0.10	2149	Northern Gannet	1	C	1	1287	North	80
11/12/2008	0.10	2150	.	.	U	2	1609	South	.

NM = nautical mile(s)
No. = number
C/U = Confirmed/Unconfirmed
Qdrt = Observation quadrant
m = meters
ft ASL = feet above sea level
. = missing data

Table J-25. Radar validation survey data taken offshore Brigantine Beach, New Jersey, on 11 November 2008. All radar data are TracScan, and the radar was based onshore.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Qdrt	Range (m)	Heading (cardinal)	Altitude (ft ASL)
11/11/2008	2.75	1459	Northern Gannet	1	C	1	300	West	40
11/11/2008	2.75	1500	Northern Gannet	1	C	1	400	Northwest	40
11/11/2008	2.75	1501	White-winged Scoter	2	U	2	.	South	40
11/11/2008	2.75	1502	Northern Gannet	1	C	4	20	Southwest	30
11/11/2008	2.75	1504	Northern Gannet	1	C	2	500	South	40
11/11/2008	2.75	1505	Northern Gannet	1	C	3	250	West	20
11/11/2008	2.75	1506	Laughing Gull	1	C	3	50	South	35
11/11/2008	2.75	1508	Northern Gannet	1	C	2	600	South	20
11/11/2008	2.75	1509	Northern Gannet	1	C	1	50	South	25
11/11/2008	2.75	1510	Scoter/Atlantic Brant	100	C	3	600	South	15
11/11/2008	2.75	1512	Northern Gannet	2	C	4	300	Southwest	25
11/11/2008	2.75	1514	Scoter (unknown)	65	U	2	350	South	5
11/11/2008	2.75	1517	Northern Gannet	1	C	4	500	Southwest	25
11/11/2008	2.75	1518	Northern Gannet	1	C	4	500	South	25
11/11/2008	2.75	1520	Northern Gannet	2	C	1	10	South	30
11/11/2008	2.75	1521	Scoter (unknown)	60	U	2	300	South	10
11/11/2008	2.75	1522	Northern Gannet	1	C	1	600	Southeast	30
11/11/2008	2.75	1524	Northern Gannet	1	C	4	50	South	20
11/11/2008	2.75	1526	Northern Gannet	1	C	4	400	West	20
11/11/2008	2.75	1527	Northern Gannet	1	C	1	10	East	20
11/11/2008	2.75	1528	Black Scoter	16	C	4	450	South	50
11/11/2008	2.75	1529	Northern Gannet	1	C	1	50	Southwest	25
11/11/2008	2.75	1540	Laughing Gull	1	C	4	50	West	20
11/11/2008	2.75	1541	Northern Gannet	1	C	.	400	South	20
11/11/2008	2.75	1543	Northern Gannet	3	C	1	150	South	35
11/11/2008	2.75	1545	Northern Gannet	2	C	4	100	Southwest	40
11/11/2008	2.75	1546	Northern Gannet	1	C	4	200	West	40
11/11/2008	2.75	1549	Northern Gannet	1	C	2	200	South	30
11/11/2008	2.75	1551	Northern Gannet	1	C	2	400	Southwest	35

Table J-25 (*continued*). Radar validation survey data taken offshore Brigantine Beach, New Jersey, on 11 November 2008. All radar data are TracScan, and the radar was based onshore.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Qdrt	Range (m)	Heading (cardinal)	Altitude (ft ASL)
11/11/2008	2.75	1552	Northern Gannet	1	C	1	900	South	40
11/11/2008	2.75	1554	Northern Gannet	1	C	1	600	West	30
11/11/2008	2.75	1555	Northern Gannet/Herring Gull	1	U	1	300	Northeast	45
11/11/2008	2.75	1556	Northern Gannet	1	C	2	150	Southwest	15
11/11/2008	2.75	1557	Northern Gannet	1	C	2	400	Southeast	20
11/11/2008	2.75	1600	Northern Gannet	1	C	1	400	South	25
11/11/2008	2.75	1602	Northern Gannet	1	C	1	150	Southwest	50
11/11/2008	2.75	1606	Laughing Gull	1	C	1	50	Northeast	25
11/11/2008	2.75	1609	Northern Gannet	1	C	1	400	West	20
11/11/2008	2.75	1610	Northern Gannet	1	C	4	600	West	30
11/11/2008	2.75	1612	Northern Gannet	1	C	2	200	West	40
11/11/2008	1.67	1633	Laughing Gull	1	C	1	250	Northwest	70
11/11/2008	1.67	1635	Laughing Gull	1	C	2	200	Northwest	50
11/11/2008	1.67	1636	Laughing Gull	1	C	4	200	Northeast	40
11/11/2008	1.67	1637	Northern Gannet	1	C	4	600	Southwest	90
11/11/2008	1.67	1639	Northern Gannet	1	C	4	550	South	110
11/11/2008	1.67	1640	Double-crested Cormorant	45	C	1	400	Southwest	300
11/11/2008	1.67	1644	Northern Gannet	1	C	1	600	Southwest	80
11/11/2008	1.67	1644	Northern Gannet	1	C	1	550	Southwest	80
11/11/2008	1.67	1647	Black Scoter	10	C	1	600	Southwest	15
11/11/2008	1.67	1649	Laughing Gull	1	C	2	400	Northeast	20
11/11/2008	1.67	1651	Laughing Gull	1	C	4	250	Northeast	40
11/11/2008	1.67	1654	Northern Gannet	4	C	4	150	South	110
11/11/2008	1.67	1656	Herring Gull	1	C	3	400	West	80
11/11/2008	1.67	1701	Laughing Gull	1	C	4	800	Southwest	8
11/11/2008	1.67	1703	Northern Gannet	1	C	4	600	Southwest	40
11/11/2008	1.67	1704	Northern Gannet	1	C	4	400	West	50
11/11/2008	1.67	1706	Northern Gannet	2	C	1	600	West	45
11/11/2008	1.67	1707	Laughing Gull	1	C	3	150	Southeast	15

Table J-25 (*continued*). Radar validation survey data taken offshore Brigantine Beach, New Jersey, on 11 November 2008. All radar data are TracScan, and the radar was based onshore.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Qdrt	Range (m)	Heading (cardinal)	Altitude (ft ASL)
11/11/2008	1.67	1709	Laughing Gull	1	C	1	50	West	20
11/11/2008	1.67	1710	Northern Gannet	1	C	4	200	Southwest	35
11/11/2008	1.67	1712	Northern Gannet	2	C	2	400	South	60
11/11/2008	1.67	1713	Northern Gannet	1	C	4	20	Southwest	40
11/11/2008	1.67	1715	Northern Gannet	1	C	4	200	West	40
11/11/2008	1.67	1716	Northern Gannet	3	C	4	200	Southwest	60
11/11/2008	1.67	1718	Northern Gannet	1	C	4	500	West	90
11/11/2008	1.67	1720	Northern Gannet	1	C	4	600	Southwest	90
11/11/2008	1.67	1721	Laughing Gull	1	C	4	200	Southwest	40
11/11/2008	1.67	1723	Northern Gannet	1	C	2	250	Southwest	60
11/11/2008	1.67	1725	Herring Gull	1	C	2	500	South	95
11/11/2008	1.67	1727	Laughing Gull	1	C	4	400	Southwest	50
11/11/2008	1.67	1728	Herring Gull	1	C	4	300	West	150
11/11/2008	1.67	1738	Northern Gannet	1	C	4	250	South	50
11/11/2008	1.67	1739	Northern Gannet	1	C	4	350	South	60
11/11/2008	1.67	1740	Herring Gull	1	C	4	200	Southwest	80
11/11/2008	2.00	1759	Northern Gannet	1	C	1	400	South	25
11/11/2008	2.00	1800	Gull, large (unknown)	1	C	1	400	West	35
11/11/2008	2.00	1803	Cormorant (unknown)	70	C	1	400	South	300
11/11/2008	2.00	1805	Cormorant (unknown)	6	C	4	400	Southwest	300
11/11/2008	2.00	1806	Northern Gannet	1	C	3	300	South	55
11/11/2008	2.00	1808	Laughing Gull	1	C	1	50	Southwest	45
11/11/2008	2.00	1809	Northern Gannet	1	C	4	200	Southwest	20
11/11/2008	2.00	1810	Cormorant/Atlantic Brant	3	C	1	600	Southwest	70
11/11/2008	2.00	1812	Gull, large (unknown)	1	C	4	200	Southwest	60
11/11/2008	2.00	1814	Gull, large (unknown)	1	C	2	400	Southwest	30
11/11/2008	2.00	1816	Laughing Gull	1	C	3	200	West	30
11/11/2008	2.00	1817	Northern Gannet	1	C	.	400	West	50
11/11/2008	2.00	1819	Northern Gannet	1	C	4	900	West	80

Table J-25 (*continued*). Radar validation survey data taken offshore Brigantine Beach, New Jersey, on 11 November 2008. All radar data are TracScan, and the radar was based onshore.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Qdrt	Range (m)	Heading (cardinal)	Altitude (ft ASL)
11/11/2008	2.00	1820	Northern Gannet	1	C	4	275	Southwest	60
11/11/2008	2.00	1822	Northern Gannet	1	C	3	300	Southwest	50
11/11/2008	2.00	1823	Northern Gannet	1	C	4	250	West	50
11/11/2008	2.00	1824	Northern Gannet	1	C	3	400	Southwest	40
11/11/2008	2.00	1825	Northern Gannet	4	C	3	250	Southwest	50
11/11/2008	2.00	1827	Northern Gannet	2	C	3	275	South	38
11/11/2008	2.00	1829	Northern Gannet	1	C	4	400	West	45
11/11/2008	2.00	1829	Northern Gannet	1	C	2	400	West	50
11/11/2008	2.00	1831	Northern Gannet	1	C	2	100	West	50
11/11/2008	2.00	1832	Northern Gannet	1	C	3	275	South	30
11/11/2008	2.00	1833	Northern Gannet	2	C	1	400	West	80
11/11/2008	2.00	1836	Northern Gannet	1	C	4	250	South	30
11/11/2008	2.00	1837	Northern Gannet	1	C	4	200	Southwest	15
11/11/2008	2.00	1838	.	.	U	4	400	South	.
11/11/2008	2.00	1839	Northern Gannet	1	C	4	300	Southwest	20
11/11/2008	2.00	1840	Northern Gannet	2	C	4	200	West	60
11/11/2008	2.00	1841	.	.	U	4	400	Southwest	.
11/11/2008	2.00	1842	Laughing Gull	1	C	2	200	West	20
11/11/2008	2.00	1844	Northern Gannet	1	C	4	300	West	30
11/11/2008	2.00	1845	Laughing Gull	1	C	3	50	West	20
11/11/2008	2.00	1852	Double-crested Cormorant	80	C	4	1207	South	700
11/11/2008	2.00	1859	Laughing Gull	1	C	3	400	Southwest	40
11/11/2008	2.00	1900	Laughing Gull	1	C	.	250	Southwest	30

NM = nautical mile(s)
No. = number
C/U = Confirmed/Unconfirmed
Qdrt = Observation quadrant
m = meters
ft ASL = feet above sea level
. = missing data

Table J-26. Onshore radar validation survey data at Island Beach State Park, New Jersey, in fall 2009. All data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Bearing	Range (m)	Heading (cardinal)	Altitude (ft ASL)	Radar Sea Clutter (NM)	Comment
9/17/2009	0.06	15:01:53	Northern Gannet	1	U	78	>1,000	North	100	2.50	
9/17/2009	0.06	15:03:01	Tern, small (unknown)	1	U	78	>1,000	North	50	2.50	
9/17/2009	0.06	15:03:26	Laughing Gull	1	U	78	>1,000	North	100	2.50	
9/17/2009	0.06	15:04:41	Laughing Gull	1	U	78	1,000	North	1 (skimming)	2.50	
9/17/2009	0.06	15:05:16	Royal Tern	2	U	78	1,000	North	100	2.50	
9/17/2009	0.06	15:06:13	Royal Tern	2	U	78	>1,000	North	25	2.50	
9/17/2009	0.06	15:07:16	Forster's Tern	1	U	78	1,000	South	25	2.50	
9/17/2009	0.06	15:08:05	Forster's Tern	1	U	78	1,000	North	25	2.50	
9/17/2009	0.06	15:08:40	Great Black-backed Gull	1	U	78	>1,000	North	100	2.50	
9/17/2009	0.06	15:09:43	Great Black-backed Gull	2	U	78	100	North	50	2.50	
9/17/2009	0.06	15:14:15	Forster's Tern	1	U	78	1,000	South	50	2.50	
9/17/2009	0.06	15:14:15	Great Black-backed Gull	1	U	78	1,000	North	25	2.50	
9/17/2009	0.06	15:14:53	Herring Gull	1	U	78	300	South	25	2.50	
9/17/2009	0.06	15:15:31	Brown Pelican	1	U	78	200	South	200	2.50	
9/17/2009	0.06	15:15:59	Herring Gull	1	U	78	1,000	Northeast	1 (skimming)	2.50	
9/17/2009	0.06	15:16:29	Tern, small (unknown)	1	U	78	>1,000	North	50	2.50	
9/17/2009	0.06	15:17:01	Laughing Gull	1	U	78	>1,000	North	1 (skimming)	2.50	
9/17/2009	0.06	15:17:34	Herring Gull	1	U	78	100	North	25	2.50	
9/17/2009	0.06	15:18:28	Herring Gull	1	U	78	100	Southeast	25	2.50	
9/17/2009	0.06	15:18:51	Royal Tern	2	U	78	1,000	North	50	2.50	
9/17/2009	0.06	15:21:06	Brown Pelican	1	U	78	200	South	200	2.50	
9/17/2009	0.06	15:21:47	Common Tern	1	U	78	1,000	South	25	2.50	
9/17/2009	0.06	15:22:53	Common Tern	2	U	78	500	South	25	2.50	
9/17/2009	0.06	15:24:05	Royal Tern	1	U	78	1,000	North	25	2.50	
9/17/2009	0.06	15:24:05	Herring Gull	1	U	78	1,000	Southeast	1 (skimming)	2.50	
9/17/2009	0.06	15:26:07	Gull, large (unkown)	1	U	78	>1,000	North	50	2.50	
9/17/2009	0.06	15:28:57	Great Black-backed Gull	1	U	78	100	North	25	2.50	
9/17/2009	0.06	15:30:26	Scoter, dark-winged (unknown)	18	U	78	>1,000	South	25	2.50	w/1 AGWT

Table J-26 (*continued*). Onshore radar validation survey data at Island Beach State Park, New Jersey, in fall 2009. All data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Bearing	Range (m)	Heading (cardinal)	Altitude (ft ASL)	Radar Sea Clutter (NM)	Comment
9/17/2009	0.06	15:33:23	Royal Tern	1	U	78	1,000	South	50	2.50	
9/17/2009	0.06	15:33:42	Tern, small (unknown)	3	U	78	1,000	South	50	2.50	
9/17/2009	0.06	15:34:00	Tern, small (unknown)	4	U	78	>1,000	South	50	2.50	
9/17/2009	0.06	15:34:29	Great Black-backed Gull	1	U	78	300	South	100	2.50	
9/17/2009	0.06	15:35:19	Tern, small (unknown)	1	U	78	>1,000	North	50	2.50	
9/17/2009	0.06	15:35:44	Ring-billed Gull	1	U	78	100	South	25	2.50	
9/17/2009	0.06	15:36:46	Great Black-backed Gull	5	U	78	100	North	25	2.50	
9/17/2009	0.06	15:37:57	Great Black-backed Gull	1	U	78	500	South	50	2.50	
9/17/2009	0.06	15:37:57	Tern, small (unknown)	1	U	78	>1,000	South	25	2.50	
9/17/2009	0.06	15:38:49	Tern, small (unknown)	1	U	78	>1,000	South	25	2.50	
9/17/2009	0.06	15:39:05	Tern, small (unknown)	1	U	78	>1,000	South	25	2.50	
9/17/2009	0.06	15:39:34	Tern, small (unknown)	1	U	78	>1,000	North	25	2.50	
9/17/2009	0.06	15:40:16	Great Black-backed Gull	2	U	78	>1,000	North	50	2.50	
9/17/2009	0.06	15:41:29	Gull, large (unkown)	1	U	78	>1,000	North	50	2.50	
9/17/2009	0.06	15:42:31	Herring Gull	1	U	78	100	South	25	2.50	
9/17/2009	0.06	15:43:12	Laughing Gull	1	U	78	>1,000	South	50	2.50	
9/17/2009	0.06	15:43:49	Laughing Gull	1	U	78	1,000	North	25	2.50	
9/17/2009	0.06	15:44:36	Ring-billed Gull	1	U	78	200	South	25	2.50	
9/17/2009	0.06	15:45:33	Ring-billed Gull	1	U	78	100	South	25	2.50	
9/17/2009	0.06	15:46:31	Ring-billed Gull	1	U	78	100	South	25	2.50	
9/17/2009	0.06	15:46:46	Brown Pelican	7	U	78	200	North	25	2.50	
9/17/2009	0.06	15:47:38	Forster's Tern	1	U	78	200	North	25	2.50	
9/17/2009	0.06	15:48:02	Forster's Tern	1	U	78	200	Northeast	25	2.50	
9/17/2009	0.06	15:48:12	Forster's Tern	2	U	78	200	North	25	2.50	
9/17/2009	0.06	15:48:44	Brown Pelican	1	U	78	200	South	25	2.50	
9/17/2009	0.06	15:48:56	Forster's Tern	3	U	78	200	North	25	2.50	
9/17/2009	0.06	15:48:56	Great Black-backed Gull	1	U	78	100	North	25	2.50	

Table J-26 (*continued*). Onshore radar validation survey data at Island Beach State Park, New Jersey, in fall 2009. All data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Bearing	Range (m)	Heading (cardinal)	Altitude (ft ASL)	Radar Sea Clutter (NM)	Comment
9/17/2009	0.06	15:49:31	Brown Pelican	2	U	78	200	North	25	2.50	
9/17/2009	0.06	15:49:52	Forster's Tern	3	U	78	200	North	25	2.50	
9/17/2009	0.06	15:50:33	Tern, small (unknown)	3	U	78	>1,000	South	50	2.50	
9/17/2009	0.06	15:51:15	Brown Pelican	1	U	78	200	North	1 (skimming)	2.50	
9/17/2009	0.06	15:51:48	Brown Pelican	1	U	78	300	North	1 (skimming)	2.50	
9/17/2009	0.06	15:52:20	Gadwall	1	U	78	300	South	25	2.50	
9/17/2009	0.06	15:54:18	Herring Gull	1	U	78	1,000	Southwest	50	2.50	
9/17/2009	0.06	15:54:33	Herring Gull	3	U	78	1,000	Southwest	50	2.50	
9/17/2009	0.06	15:56:39	Brown Pelican	1	U	78	200	South	25	2.50	
9/17/2009	0.06	15:57:26	Forster's Tern	2	U	78	300	North	25	2.50	
9/17/2009	0.06	15:57:36	Brown Pelican	1	U	78	300	South	50	2.50	
9/17/2009	0.06	15:58:12	Brown Pelican	1	U	78	200	North	50	2.50	
9/17/2009	0.06	15:59:07	Brown Pelican	1	U	78	300	Southeast	25	2.50	
9/17/2009	0.06	15:59:24	Ring-billed Gull	1	U	78	300	South	25	2.50	
9/17/2009	0.06	16:02:05	Brown Pelican	1	U	78	200	North	25	2.50	
9/17/2009	0.06	16:02:51	Tern, small (unknown)	1	U	78	1,000	North	25	2.50	
9/17/2009	0.06	16:03:10	Brown Pelican	1	U	78	200	North	25	2.50	
9/17/2009	0.06	16:03:33	Forster's Tern	1	U	78	200	South	50	2.50	
9/17/2009	0.06	16:03:48	Brown Pelican	1	U	78	500	South	50	2.50	
9/17/2009	0.06	16:05:23	Tern, small (unknown)	1	U	78	500	North	25	2.50	
9/17/2009	0.06	16:05:56	Herring Gull	1	U	78	200	South	50	2.50	
9/17/2009	0.06	16:06:30	Laughing Gull	1	U	78	200	South	200	2.50	
9/17/2009	0.06	16:07:38	Tern, small (unknown)	1	U	78	>1,000	North	25	2.50	
9/17/2009	0.06	16:08:32	Herring Gull	2	U	78	100	South	25	2.50	
9/17/2009	0.06	16:09:23	Laughing Gull	1	U	78	1,000	South	50	2.50	
9/17/2009	0.06	16:09:44	Laughing Gull	1	U	78	300	South	25	2.50	
9/17/2009	0.06	16:11:06	Great Black-backed Gull	1	U	78	500	South	50	2.50	

Table J-26 (*continued*). Onshore radar validation survey data at Island Beach State Park, New Jersey, in fall 2009. All data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Bearing	Range (m)	Heading (cardinal)	Altitude (ft ASL)	Radar Sea Clutter (NM)	Comment
9/17/2009	0.06	16:11:32	Brown Pelican	2	U	78	300	North	25	2.50	
9/17/2009	0.06	16:11:57	Herring Gull	1	U	78	200	South	50	2.50	
9/17/2009	0.06	16:13:03	Forster's Tern	1	U	78	200	South	100	2.50	
9/17/2009	0.06	16:14:55	Forster's Tern	1	U	78	300	South	25	2.50	
9/17/2009	0.06	16:15:39	Herring Gull	1	U	78	1,000	North	50	2.50	
9/17/2009	0.06	16:18:52	Forster's Tern	1	U	78	300	North	25	2.50	
9/17/2009	0.06	16:19:08	Forster's Tern	3	U	78	300	North	25	2.50	
9/17/2009	0.06	16:19:54	Tern, small (unknown)	1	U	78	1,000	North	25	2.50	
9/17/2009	0.06	16:21:53	Herring Gull	2	U	78	100	North	25	2.50	
9/17/2009	0.06	16:22:24	Forster's Tern	5	U	78	300	North	1 (skimming)	2.50	
9/17/2009	0.06	16:23:03	Great Black-backed Gull	1	U	78	100	South	25	2.50	
9/17/2009	0.06	16:23:40	Forster's Tern	1	U	78	500	North	25	2.50	
9/17/2009	0.06	16:24:29	Great Black-backed Gull	1	U	78	100	South	100	2.50	
9/17/2009	0.06	16:25:01	Tern, small (unknown)	8	U	78	300	South	25	2.50	
9/17/2009	0.06	16:26:37	Parasitic Jaeger	1	U	78	300	North	1 (skimming)	2.50	
9/17/2009	0.06	17:27:35	Gull, large (unkown)	1	U	78	>1,000	South	100	2.50	
9/17/2009	0.06	17:27:35	Forster's Tern	1	U	78	500	South	100	2.50	
9/17/2009	0.06	17:30:48	Forster's Tern	1	U	78	300	North	25	2.50	
9/17/2009	0.06	17:31:33	Brown Pelican	3	U	78	1,000	North	25	2.50	
9/17/2009	0.06	17:32:49	Laughing Gull	3	U	78	1,000	South	100	2.50	
9/17/2009	0.06	17:33:13	Ring-billed Gull	1	U	78	100	South	25	2.50	
9/17/2009	0.06	17:34:26	Laughing Gull	1	U	78	1,000	North	1 (skimming)	2.50	
9/17/2009	0.06	17:35:23	Tern, small (unknown)	1	U	78	>1,000	South	25	2.50	
9/17/2009	0.06	17:36:33	Common Tern	1	U	78	1,000	South	100	2.50	
9/17/2009	0.06	17:39:09	Royal Tern	1	U	78	1,000	South	25	2.50	
9/17/2009	0.06	17:41:13	Great Black-backed Gull	1	U	78	>1,000	South	100	2.50	
9/17/2009	0.06	17:44:32	Green-winged Teal	2	U	78	300	South	1 (skimming)	2.50	

Table J-26 (*continued*). Onshore radar validation survey data at Island Beach State Park, New Jersey, in fall 2009. All data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Bearing	Range (m)	Heading (cardinal)	Altitude (ft ASL)	Radar Sea Clutter (NM)	Comment
9/17/2009	0.06	17:47:10	Forster's Tern	1	U	78	200	South	25	2.50	
9/17/2009	0.06	17:47:56	American Oystercatcher	4	U	78	100	South	25	2.50	
9/17/2009	0.06	17:48:30	Laughing Gull	1	U	78	300	South	25	2.50	
9/17/2009	0.06	17:50:10	Brown Pelican	5	U	78	300	Northeast	1 (skimming)	2.50	
9/17/2009	0.06	17:51:03	Other	1	U	78	500	South	300	2.50	Plane
9/17/2009	0.06	17:51:54	Common Tern	1	U	78	200	Northeast	25	2.50	
9/17/2009	0.06	17:53:27	Laughing Gull	1	U	78	>1,000	North	25	2.50	
9/17/2009	0.06	17:53:39	Forster's Tern	1	U	78	200	North	25	2.50	
9/17/2009	0.06	17:54:43	Laughing Gull	1	U	78	>1,000	South	25	2.50	
9/17/2009	0.06	17:58:00	Brown Pelican	1	U	78	500	South	50	2.50	
9/17/2009	0.06	18:02:23	Herring Gull	1	U	78	100	South	25	2.50	
9/17/2009	0.06	18:02:23	Common Tern	1	U	78	300	South	25	2.50	
9/17/2009	0.06	18:03:03	Laughing Gull	1	U	78	300	Southeast	25	2.50	
9/17/2009	0.06	18:03:19	Forster's Tern	1	U	78	300	North	25	2.50	
9/17/2009	0.06	18:03:41	Forster's Tern	1	U	78	200	North	25	2.50	
9/17/2009	0.06	18:04:36	Forster's Tern	1	U	78	200	North	25	2.50	
9/17/2009	0.06	18:06:07	Forster's Tern	1	U	78	200	North	25	2.50	
9/17/2009	0.06	18:06:45	Forster's Tern	1	U	78	300	North	25	2.50	
9/17/2009	0.06	18:06:45	Common Tern	1	U	78	300	North	25	2.50	
9/17/2009	0.06	18:11:42	Tern, small (unknown)	3	U	78	1,000	South	50	2.50	
9/17/2009	0.06	18:12:30	Great Black-backed Gull	1	U	78	1,000	North	50	2.50	
9/17/2009	0.06	18:12:51	American Oystercatcher	2	U	78	100	South	25	2.50	
9/17/2009	0.06	18:15:09	Common Tern	1	U	78	300	North	50	2.50	
9/17/2009	0.06	18:16:32	Black-bellied Plover	3	U	78	100	South	50	2.50	
9/17/2009	0.06	18:17:05	Forster's Tern	1	U	78	100	Southeast	25	2.50	
9/17/2009	0.06	18:17:46	Laughing Gull	1	U	78	1,000	South	50	2.50	
9/17/2009	0.06	18:17:58	Brown Pelican	1	U	78	500	South	25	2.50	

Table J-26 (*continued*). Onshore radar validation survey data at Island Beach State Park, New Jersey, in fall 2009. All data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Bearing	Range (m)	Heading (cardinal)	Altitude (ft ASL)	Radar Sea Clutter (NM)	Comment
9/17/2009	0.06	18:18:51	Tern, small (unknown)	1	U	78	>1,000	South	50	2.50	
9/17/2009	0.06	18:19:12	Forster's Tern	1	U	78	200	North	50	2.50	
9/17/2009	0.06	18:19:22	Laughing Gull	1	U	78	1,000	Southeast	50	2.50	
9/17/2009	0.06	18:19:40	Laughing Gull	1	U	78	1,000	Southeast	50	2.50	
9/17/2009	0.06	18:19:52	Forster's Tern	2	U	78	100	North	25	2.50	
9/17/2009	0.06	18:20:36	Forster's Tern	1	U	78	1,000	South	25	2.50	
9/17/2009	0.06	18:20:45	Great Black-backed Gull	1	U	78	100	North	50	2.50	
9/17/2009	0.06	18:21:01	Forster's Tern	1	U	78	100	North	25	2.50	
9/17/2009	0.06	18:21:18	Tern, small (unknown)	1	U	78	200	South	25	2.50	
9/17/2009	0.06	18:22:04	Herring Gull	1	U	78	100	South	50	2.50	
9/17/2009	0.06	18:22:32	Forster's Tern	1	U	78	200	South	25	2.50	
9/17/2009	0.06	18:23:01	Forster's Tern	1	U	78	200	South	25	2.50	
9/17/2009	0.06	18:24:12	Great Black-backed Gull	1	U	78	500	North	1 (skimming)	2.50	
9/17/2009	0.06	18:25:21	Laughing Gull	1	U	78	100	Southeast	25	2.50	
9/17/2009	0.06	18:25:51	Herring Gull	2	U	78	100	South	25	2.50	
9/17/2009	0.06	18:27:29	Great Black-backed Gull	1	U	78	100	South	25	2.50	
9/17/2009	0.06	18:28:13	Forster's Tern	1	U	78	200	North	25	2.50	
9/17/2009	0.06	18:30:18	Brown Pelican	1	U	78	100	South	100	2.50	
9/17/2009	0.06	18:30:35	Brown Pelican	5	U	78	500	North	1 (skimming)	2.50	
9/17/2009	0.06	18:32:38	Laughing Gull	1	U	78	100	South	25	2.50	
9/17/2009	0.06	18:35:02	Tern, small (unknown)	1	U	78	1,000	North	25	2.50	
9/17/2009	0.06	18:37:00	Tern, small (unknown)	1	U	78	1,000	North	25	2.50	
9/17/2009	0.06	18:37:06	Common Tern	1	U	78	200	North	25	2.50	
9/17/2009	0.06	18:37:23	Brown Pelican	5	U	78	1,000	North	25	2.50	
9/17/2009	0.06	18:37:55	Tern, small (unknown)	1	U	78	1,000	North	25	2.50	
9/17/2009	0.06	18:38:53	Great Black-backed Gull	1	U	78	100	South	50	2.50	
9/17/2009	0.06	18:39:08	Common Tern	1	U	78	200	North	25	2.50	

Table J-26 (*continued*). Onshore radar validation survey data at Island Beach State Park, New Jersey, in fall 2009. All data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Bearing	Range (m)	Heading (cardinal)	Altitude (ft ASL)	Radar Sea Clutter (NM)	Comment
9/17/2009	0.06	18:40:46	Laughing Gull	1	U	78	100	South	25	2.50	
9/17/2009	0.06	18:40:46	Laughing Gull	1	U	78	100	South	25	2.50	
9/17/2009	0.06	18:41:48	Laughing Gull	1	U	78	300	North	1 (skimming)	2.50	
9/17/2009	0.06	18:42:15	Laughing Gull	1	U	78	1,000	North	50	2.50	
9/17/2009	0.06	18:42:46	Common Tern	1	U	78	200	South	25	2.50	
9/17/2009	0.06	18:43:07	Great Black-backed Gull	1	U	78	100	South	25	2.50	
9/17/2009	0.06	18:44:36	Peregrine Falcon	1	U	78	200	North	100	2.50	
9/17/2009	0.06	18:50:11	Brown Pelican	1	U	78	200	South	50	2.50	
9/17/2009	0.06	18:51:02	Royal Tern	1	U	78	300	North	100	2.50	
9/17/2009	0.06	18:53:13	Ring-billed Gull	1	U	78	100	North	25	2.50	
9/17/2009	0.06	18:54:02	Forster's Tern	1	U	78	200	North	25	2.50	
9/17/2009	0.06	18:54:30	Forster's Tern	3	U	78	200	North	25	2.50	
9/17/2009	0.06	18:56:15	Forster's Tern	1	U	78	300	South	50	2.50	
9/18/2009	0.06	19:01:21	Tern (unknown)	1	C	90	300	South	25	0.50	
9/18/2009	0.06	19:02:39	Gull, large (unkown)	1	C	90	>1,000	North	25	0.50	
9/18/2009	0.06	19:05:57	Gull (unknown)	1	C	90	500	South	50	0.50	
9/18/2009	0.06	19:06:42	Other	1	C	90	1,000	South	1 (skimming)	0.50	Boat
9/18/2009	0.06	19:07:52	Tern, small (unknown)	1	U	90	100	South	100	0.50	
9/18/2009	0.06	19:09:19	Gull (unknown)	1	U	90	>1,000	North	25	0.50	diving
9/18/2009	0.06	19:11:41	Tern (unknown)	1	U	90	200	Northwest	25	0.50	feeding
9/18/2009	0.06	19:14:26	Ring-billed Gull	1	U	90	200	North	50	0.50	feeding
9/18/2009	0.06	19:18:35	Laughing Gull	1	U	90	200	North	50	0.50	
9/18/2009	0.06	19:19:12	Great Black-backed Gull	1	C	90	1,000	North	100	0.50	
9/18/2009	0.06	19:20:15	Ring-billed Gull	1	C	90	500	North	100	0.50	
9/18/2009	0.06	19:24:02	Other	1	C	90	1,000	South	1 (skimming)	0.50	Boat
9/18/2009	0.06	19:27:19	Brown Pelican	2	C	90	>1,000	North	200	0.50	
9/18/2009	0.06	19:28:32	Gull, large (unkown)	1	C	90	>1,000	North	100	0.50	

Table J-26 (*continued*). Onshore radar validation survey data at Island Beach State Park, New Jersey, in fall 2009. All data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Bearing	Range (m)	Heading (cardinal)	Altitude (ft ASL)	Radar Sea Clutter (NM)	Comment
9/18/2009	0.06	19:31:00	Forster's Tern	1	U	90	200	South	50	0.50	
9/18/2009	0.06	19:57:10	Other	1	U	90	>1,000	South	1 (skimming)	0.50	Boat
9/18/2009	0.06	19:57:51	Herring Gull	1	C	90	500	Northwest	100	0.50	
9/18/2009	0.06	20:04:10	Tern, small (unknown)	1	U	90	100	South	100	0.50	
9/18/2009	0.06	20:05:52	Great Black-backed Gull	1	U	90	1,000	North	25	0.50	
9/18/2009	0.06	20:06:39	Great Black-backed Gull	1	C	90	>1,000	North	50	0.50	
9/18/2009	0.06	20:08:20	Other	1	U	90	1,000	Southeast	1 (skimming)	0.50	Boat
9/18/2009	0.06	20:09:22	Tern, small (unknown)	1	U	90	300	Southwest	50	0.50	
9/18/2009	0.06	20:13:01	Great Black-backed Gull	1	C	90	>1,000	North	25	0.50	
9/18/2009	0.06	20:14:10	Laughing Gull	1	U	90	300	Northwest	50	0.50	
9/18/2009	0.06	20:18:53	Brown Pelican	1	C	90	500	Southwest	100	0.50	
9/18/2009	0.06	20:21:38	Tern, small (unknown)	1	C	90	500	South	25	0.50	feeding
9/18/2009	0.06	20:23:04	Herring Gull	1	C	90	1,000	Northwest	25	0.50	
9/18/2009	0.06	20:23:40	Other	1	U	90	>1,000	South	1 (skimming)	0.50	Boat
9/18/2009	0.06	20:25:13	Gull, large (unkown)	1	U	90	>1,000	North	50	0.50	
9/18/2009	0.06	20:31:46	Forster's Tern	1	U	90	500	Southwest	50	0.50	
9/18/2009	0.06	20:32:34	Forster's Tern	1	U	90	500	Northwest	100	0.50	
9/18/2009	0.06	20:38:00	Forster's Tern	1	C	90	200	Southwest	50	0.50	
9/18/2009	0.06	20:44:13	Laughing Gull	1	U	90	200	Southwest	50	0.50	
9/18/2009	0.06	20:44:56	Forster's Tern	1	C	90	300	South	100	0.50	
9/18/2009	0.06	20:52:20	Forster's Tern	1	U	90	300	North	50	0.50	
9/18/2009	0.06	20:54:09	Great Black-backed Gull	1	C	90	1,000	Northwest	100	0.50	
9/18/2009	0.06	20:57:30	Herring Gull	1	C	90	1,000	Northwest	100	0.50	
9/18/2009	0.06	21:00:41	Laughing Gull	1	C	90	500	South	200	0.50	
9/18/2009	0.06	21:05:51	Laughing Gull	1	U	90	200	South	100	0.50	
9/18/2009	0.06	21:06:23	Laughing Gull	1	C	90	200	Southwest	100	0.50	
9/18/2009	0.06	21:07:14	Forster's Tern	1	U	90	200	South	100	0.50	

Table J-26 (*continued*). Onshore radar validation survey data at Island Beach State Park, New Jersey, in fall 2009. All data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Bearing	Range (m)	Heading (cardinal)	Altitude (ft ASL)	Radar Sea Clutter (NM)	Comment
9/18/2009	0.06	21:07:57	Forster's Tern	1	U	90	200	South	100	0.50	
9/18/2009	0.06	21:13:27	Laughing Gull	1	C	90	500	North	50	0.50	
9/18/2009	0.06	21:15:02	Herring Gull	1	C	90	500	North	25	0.50	
9/18/2009	0.06	21:15:39	Osprey	1	U	90	200	Northwest	200	0.50	
9/18/2009	0.06	21:17:28	Forster's Tern	1	C	90	500	Northwest	300	0.50	
9/18/2009	0.06	21:24:00	Tern, large (unknown)	1	U	90	200	South	100	0.50	
9/18/2009	0.06	21:25:02	Tern, large (unknown)	1	C	90	1,000	Northwest	200	0.50	
9/18/2009	0.06	21:25:39	Laughing Gull	1	U	90	200	Northwest	100	0.50	
9/18/2009	0.06	21:28:49	Herring Gull	1	C	90	500	Southeast	300	0.50	
9/18/2009	0.06	21:33:32	Gull, large (unkown)	1	C	90	>1,000	North	300	0.50	
9/18/2009	0.06	21:35:06	Laughing Gull	1	C	90	500	Northwest	300	0.50	
9/18/2009	0.06	21:36:19	Gull, large (unkown)	1	U	90	>1,000	North	100	0.50	
9/18/2009	0.06	21:40:29	Forster's Tern	1	U	90	300	South	100	0.50	
9/18/2009	0.06	21:41:32	Laughing Gull	1	C	90	300	North	100	0.50	
9/18/2009	0.06	21:42:05	Tern, large (unknown)	1	C	90	1,000	Northwest	25	0.50	
9/18/2009	0.06	21:44:08	Tern, small (unknown)	1	U	90	1,000	Northwest	50	0.50	feeding
9/18/2009	0.06	21:46:17	Laughing Gull	1	C	90	500	Southwest	200	0.50	
9/18/2009	0.06	21:49:23	Forster's Tern	2	C	90	200	South	100	0.50	
9/18/2009	0.06	21:56:07	Forster's Tern	1	U	90	200	North	100	0.50	
9/18/2009	0.06	21:56:45	Tern, large (unknown)	1	U	90	300	Southwest	200	0.50	
9/18/2009	0.06	21:58:31	Laughing Gull	1	C	90	300	South	100	0.50	
9/18/2009	0.06	21:59:59	Gull, large (unkown)	1	U	90	>1,000	North	25	0.50	
9/19/2009	0.06	10:38:37	Tern (unknown)	1	U	90	200	North	50	1.50	
9/19/2009	0.06	10:39:16	Tern (unknown)	1	U	90	200	North	100	1.50	
9/19/2009	0.06	20:40:50	Laughing Gull	1	U	90	200	South	50	1.00	
9/19/2009	0.06	20:42:44	Forster's Tern	1	U	90	200	South	200	1.00	
9/19/2009	0.06	20:44:04	Forster's Tern	1	U	90	300	South	100	1.00	

Table J-26 (*continued*). Onshore radar validation survey data at Island Beach State Park, New Jersey, in fall 2009. All data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Bearing	Range (m)	Heading (cardinal)	Altitude (ft ASL)	Radar Sea Clutter (NM)	Comment
9/19/2009	0.06	20:45:17	Laughing Gull	1	U	90	200	Southeast	100	1.00	
9/19/2009	0.06	20:46:05	Herring Gull	1	U	90	200	Northwest	200	1.00	
9/19/2009	0.06	20:48:10	Laughing Gull	1	U	90	100	South	1000	1.00	
9/19/2009	0.06	20:50:36	Herring Gull	1	C	90	1,000	South	100	1.00	
9/19/2009	0.06	20:51:06	Laughing Gull	1	U	90	200	South	200	1.00	
9/19/2009	0.06	20:52:18	Other	1	C	90	>1,000	Southeast	1 (skimming)	1.00	Boat
9/19/2009	0.06	20:55:45	Other	1	C	90	>1,000	Southeast	1 (skimming)	1.00	Boat
9/19/2009	0.06	20:59:23	Other	1	C	90	300	North	1 (skimming)	1.00	Boat
9/19/2009	0.06	21:04:35	Great Black-backed Gull	1	U	90	>1,000	North	200	1.00	
9/19/2009	0.06	21:06:10	Gull, large (unkown)	1	C	90	>1,000	Northeast	300	1.00	
9/19/2009	0.06	21:10:38	Great Black-backed Gull	1	U	90	100	South	300	1.00	
9/19/2009	0.06	21:11:48	Herring Gull	1	C	90	1,000	South	200	1.00	
9/19/2009	0.06	21:12:21	Brown Pelican	6	U	90	100	Northeast	200	1.00	
9/19/2009	0.06	21:14:04	Laughing Gull	1	U	90	300	South	200	1.00	
9/19/2009	0.06	21:17:56	Herring Gull	1	U	90	100	Northeast	500	1.00	
9/19/2009	0.06	21:20:28	Herring Gull	2	U	90	200	Southeast	100	1.00	
9/19/2009	0.06	21:21:41	Great Black-backed Gull	1	C	90	>1,000	South	300	1.00	
9/19/2009	0.06	21:23:56	Laughing Gull	1	C	90	500	Southwest	200	1.00	
9/19/2009	0.06	21:27:21	Laughing Gull	1	U	90	100	South	200	1.00	
9/19/2009	0.06	21:28:28	Laughing Gull	1	U	90	200	South	100	1.00	
9/19/2009	0.06	21:28:59	Brown Pelican	1	C	90	500	Northeast	100	1.00	
9/19/2009	0.06	21:33:26	Herring Gull	1	C	90	300	North	300	1.00	
9/19/2009	0.06	21:34:53	Gull, large (unkown)	1	C	90	1,000	North	100	1.00	
9/19/2009	0.06	21:40:38	Herring Gull	1	U	90	100	Northeast	100	1.00	
9/19/2009	0.06	21:41:26	Laughing Gull	1	U	90	100	Northeast	200	1.00	
9/19/2009	0.06	21:43:29	Great Black-backed Gull	1	U	90	300	South	1 (skimming)	1.00	
9/19/2009	0.06	21:45:15	Laughing Gull	1	C	90	1,000	South	100	1.00	

Table J-26 (*continued*). Onshore radar validation survey data at Island Beach State Park, New Jersey, in fall 2009. All data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Bearing	Range (m)	Heading (cardinal)	Altitude (ft ASL)	Radar Sea Clutter (NM)	Comment
9/19/2009	0.06	21:45:35	Laughing Gull	1	C	90	1,000	South	100	1.00	
9/19/2009	0.06	21:46:34	Laughing Gull	1	C	90	1,000	South	200	1.00	
9/19/2009	0.06	21:48:36	Gull, large (unkown)	1	C	90	500	South	200	1.00	
9/19/2009	0.06	21:51:56	Herring Gull	1	U	90	300	North	200	1.00	
9/19/2009	0.06	21:56:43	Gull, large (unkown)	1	C	90	1,000	Southeast	200	1.00	
9/19/2009	0.06	21:59:16	Laughing Gull	1	C	90	1,000	Southeast	100	1.00	
9/19/2009	0.06	22:00:45	Other	1	C	90	500	South	1 (skimming)	1.00	Boat
9/19/2009	0.06	22:01:35	Other	1	C	90	1,000	South	1 (skimming)	1.00	Boat
9/19/2009	0.06	22:01:57	Laughing Gull	1	C	90	500	South	200	1.00	
9/19/2009	0.06	22:05:44	Laughing Gull	1	U	90	200	South	100	1.00	
9/19/2009	0.06	22:06:09	Laughing Gull	1	U	90	200	South	100	1.00	
9/19/2009	0.06	22:06:30	Laughing Gull	1	C	90	200	South	300	1.00	
9/19/2009	0.06	22:08:00	Laughing Gull	1	C	90	500	South	300	1.00	
9/19/2009	0.06	22:10:00	Duck (unknown)	12	C	90	1,000	Southeast	100	1.00	Bufflehead maybe
9/19/2009	0.06	22:17:46	Laughing Gull	1	U	90	200	Northeast	100	1.00	
9/19/2009	0.06	22:20:52	Laughing Gull	1	C	90	1,000	South	200	1.00	
9/19/2009	0.06	22:22:01	Laughing Gull	1	C	90	300	South	300	1.00	
9/19/2009	0.06	22:32:54	Laughing Gull	1	C	90	300	North	100	1.00	
9/19/2009	0.06	22:36:45	Laughing Gull	1	C	90	1,000	South	100	1.00	
9/20/2009	0.06	20:08:42	Laughing Gull	1	U	90	100	Southeast	50	0.50	
9/20/2009	0.06	20:12:38	Other	1	U	90	500	South	1 (skimming)	0.50	Boat
9/20/2009	0.06	20:14:03	Other	1	C	90	1,000	South	1 (skimming)	0.50	Boat
9/20/2009	0.06	20:15:14	Laughing Gull	1	U	90	300	South	25	0.50	
9/20/2009	0.06	20:15:48	Laughing Gull	1	U	90	200	Southeast	100	0.50	
9/20/2009	0.06	20:17:22	Tern (unknown)	1	C	90	500	North	200	0.50	
9/20/2009	0.06	20:17:58	Herring Gull	1	C	90	500	North	200	0.50	
9/20/2009	0.06	20:20:09	Forster's Tern	1	U	90	100	Southeast	100	0.50	

Table J-26 (*continued*). Onshore radar validation survey data at Island Beach State Park, New Jersey, in fall 2009. All data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Bearing	Range (m)	Heading (cardinal)	Altitude (ft ASL)	Radar Sea Clutter (NM)	Comment
9/20/2009	0.06	20:21:45	Tern (unknown)	1	C	90	1,000	South	200	0.50	
9/20/2009	0.06	20:24:48	Laughing Gull	1	C	90	1,000	South	200	0.50	
9/20/2009	0.06	20:26:12	Forster's Tern	1	U	90	500	South	100	0.50	
9/20/2009	0.06	20:27:05	Great Black-backed Gull	1	U	90	500	South	1 (skimming)	0.50	
9/20/2009	0.06	20:31:31	Laughing Gull	1	C	90	500	South	25	0.50	
9/20/2009	0.06	20:32:40	Other	1	C	90	1,000	South	1 (skimming)	0.50	Boat
9/20/2009	0.06	20:33:47	Forster's Tern	1	U	90	200	South	200	0.50	
9/20/2009	0.06	20:35:28	Other	1	C	90	>1,000	South	1 (skimming)	0.50	Boat
9/20/2009	0.06	20:46:25	Other	1	C	90	500	Southwest	1 (skimming)	0.50	Boat
9/20/2009	0.06	20:49:51	Cormorant (unknown)	1	C	90	>1,000	Northwest	200	0.50	
9/20/2009	0.06	21:03:46	Other	1	C	90	>1,000	South	1 (skimming)	0.50	Boat
9/20/2009	0.06	21:10:02	Tern (unknown)	1	C	90	>1,000	South	200	0.50	
9/20/2009	0.06	21:16:52	Laughing Gull	1	U	90	300	South	50	0.50	
9/20/2009	0.06	21:18:33	Brown Pelican	1	C	90	500	Northeast	200	0.50	
9/20/2009	0.06	21:20:57	Brown Pelican	1	U	90	100	South	25	0.50	above surfline
9/20/2009	0.06	21:25:58	Laughing Gull	1	U	90	200	North	100	0.50	
9/20/2009	0.06	21:27:23	Laughing Gull	1	U	90	1,000	South	100	0.50	
9/20/2009	0.06	21:35:03	Forster's Tern	1	C	90	1,000	South	100	0.50	
9/20/2009	0.06	21:42:40	Other	1	C	90	1,000	South	1 (skimming)	0.50	Boat
9/20/2009	0.06	21:45:48	Laughing Gull	1	U	90	100	South	50	0.50	
9/20/2009	0.06	21:47:20	Forster's Tern	1	U	90	200	South	25	0.50	
9/20/2009	0.06	21:50:18	Laughing Gull	1	U	90	300	South	25	0.50	
9/20/2009	0.06	21:52:22	Laughing Gull	1	U	90	200	South	25	0.50	
9/20/2009	0.06	21:53:17	Forster's Tern	2	U	90	500	South	50	0.50	
9/20/2009	0.06	21:59:14	Royal Tern	1	U	90	300	South	100	0.50	
9/20/2009	0.06	22:04:05	Great Black-backed Gull	1	U	90	100	Northwest	100	0.50	
9/20/2009	0.06	22:05:40	Laughing Gull	1	U	90	1,000	South	200	0.50	

Table J-26 (*continued*). Onshore radar validation survey data at Island Beach State Park, New Jersey, in fall 2009. All data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Bearing	Range (m)	Heading (cardinal)	Altitude (ft ASL)	Radar Sea Clutter (NM)	Comment
9/20/2009	0.06	22:06:50	Laughing Gull	1	U	90	200	Southeast	200	0.50	
9/20/2009	0.06	22:07:32	Brown Pelican	1	U	90	300	Southeast	1 (skimming)	0.50	
9/21/2009	0.06	14:39:44	Forster's Tern	1	U	90	200	North	100	1.00	
9/21/2009	0.06	14:42:26	Laughing Gull	1	C	90	300	South	50	1.00	
9/21/2009	0.06	14:44:43	Herring Gull	1	U	90	200	North	1 (skimming)	1.00	
9/21/2009	0.06	14:46:27	Brown Pelican	1	U	90	100	South	1 (skimming)	1.00	
9/21/2009	0.06	14:46:49	Laughing Gull	1	C	90	>1,000	Southeast	200	1.00	
9/21/2009	0.06	14:53:15	Gull, large (unkown)	2	C	90	>1,000	Southeast	100	1.00	
9/21/2009	0.06	14:56:50	Laughing Gull	1	C	90	200	South	25	1.00	
9/21/2009	0.06	14:59:17	Laughing Gull	1	C	90	200	Southwest	25	1.00	
9/21/2009	0.06	14:59:59	Laughing Gull	1	C	90	100	Southeast	50	1.00	
9/21/2009	0.06	15:04:45	Tern, large (unknown)	1	U	90	500	North	100	1.00	
9/21/2009	0.06	15:13:07	Herring Gull	1	C	90	>1,000	South	50	1.00	
9/21/2009	0.06	15:15:37	Herring Gull	1	U	90	300	Southeast	100	1.00	
9/21/2009	0.06	15:16:30	Common Tern	1	U	90	300	North	100	1.00	
9/21/2009	0.06	15:17:21	Herring Gull	1	C	90	300	North	25	1.00	
9/21/2009	0.06	15:19:23	Herring Gull	1	U	90	>1,000	Southeast	50	1.00	
9/21/2009	0.06	15:21:58	Brown Pelican	1	U	90	1,000	Northeast	25	1.00	
9/21/2009	0.06	15:24:05	Herring Gull	1	U	90	100	Northeast	25	1.00	
9/21/2009	0.06	15:27:14	Laughing Gull	1	U	90	200	Northeast	1 (skimming)	1.00	
9/21/2009	0.06	15:27:58	Laughing Gull	1	U	90	300	East	1 (skimming)	1.00	
9/21/2009	0.06	15:37:13	Laughing Gull	1	U	90	300	South	50	1.00	
9/21/2009	0.06	15:37:48	Herring Gull	1	U	90	200	Southeast	25	1.00	
9/21/2009	0.06	15:42:30	Herring Gull	1	U	90	200	North	25	1.00	
9/21/2009	0.06	15:42:51	Laughing Gull	1	U	90	200	North	25	1.00	
9/21/2009	0.06	15:45:03	Herring Gull	1	C	90	500	Northwest	50	1.00	
9/21/2009	0.06	15:45:26	Herring Gull	1	U	90	200	North	100	1.00	

Table J-26 (*continued*). Onshore radar validation survey data at Island Beach State Park, New Jersey, in fall 2009. All data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Bearing	Range (m)	Heading (cardinal)	Altitude (ft ASL)	Radar Sea Clutter (NM)	Comment
9/21/2009	0.06	15:53:00	Surf Scoter	1	U	90	200	Southwest	1 (skimming)	1.00	
9/21/2009	0.06	15:53:50	Gull, large (unkown)	1	C	90	>1,000	South	50	1.00	
9/21/2009	0.06	15:54:46	Laughing Gull	1	U	90	1,000	North	100	1.00	
9/21/2009	0.06	15:55:32	Laughing Gull	1	U	90	200	Northeast	1 (skimming)	1.00	
9/21/2009	0.06	15:56:13	Laughing Gull	1	U	90	100	South	25	1.00	
9/21/2009	0.06	16:05:45	Herring Gull	1	U	90	200	North	1 (skimming)	1.00	
9/21/2009	0.06	16:05:45	Laughing Gull	1	U	90	200	South	50	1.00	
9/21/2009	0.06	16:07:28	Royal Tern	1	U	90	200	Southeast	100	1.00	
9/21/2009	0.06	16:12:16	Laughing Gull	1	U	90	300	South	50	1.00	
9/21/2009	0.06	16:15:09	Herring Gull	1	U	90	200	North	1 (skimming)	1.00	
9/25/2009	0.06	18:17:19	Laughing Gull	1	U	90	>1,000	South	1 (skimming)	1.50	
9/25/2009	0.06	18:18:12	Red-throated Loon	1	U	90	>1,000	South	25	1.50	
9/25/2009	0.06	18:24:15	Laughing Gull	1	U	90	300	South	25	1.50	
9/25/2009	0.06	18:25:28	Royal Tern	1	U	90	1,000	South	100	1.50	
9/25/2009	0.06	18:26:10	Laughing Gull	1	U	90	500	South	25	1.50	
9/25/2009	0.06	18:28:31	Laughing Gull	1	U	90	>1,000	South	1 (skimming)	1.50	
9/25/2009	0.06	18:29:59	Scoter, dark-winged (unknown)	4	U	90	500	South	1 (skimming)	1.50	
9/25/2009	0.06	18:31:35	Royal Tern	1	U	90	500	North	100	1.50	
9/25/2009	0.06	18:33:40	Double-crested Cormorant	1	U	90	>1,000	South	100	1.50	
9/25/2009	0.06	18:36:10	Herring Gull	1	U	90	1,000	South	100	1.50	
9/25/2009	0.06	18:37:19	Laughing Gull	1	U	90	500	South	1 (skimming)	1.50	
9/25/2009	0.06	18:38:51	Laughing Gull	1	U	90	>1,000	South	50	1.50	
9/25/2009	0.06	18:39:52	Herring Gull	1	U	90	300	East	100	1.50	
9/25/2009	0.06	18:44:40	Laughing Gull	3	U	90	1,000	South	100	1.50	
9/26/2009	0.90	9:22:29	Brown Pelican	1	U	90	1,000	Southeast	25	1.50	
9/26/2009	0.90	9:23:03	Laughing Gull	1	U	90	500	Southeast	25	1.50	
9/26/2009	0.90	9:23:38	Laughing Gull	1	U	90	500	South	200	1.50	

Table J-26 (*continued*). Onshore radar validation survey data at Island Beach State Park, New Jersey, in fall 2009. All data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Bearing	Range (m)	Heading (cardinal)	Altitude (ft ASL)	Radar Sea Clutter (NM)	Comment
9/26/2009	0.90	9:24:36	Gull, large (unkown)	1	U	90	>1,000	South	50	1.50	
9/26/2009	0.90	9:25:18	Laughing Gull	1	U	90	>1,000	South	25	1.50	
9/26/2009	0.90	9:26:22	Royal Tern	1	U	90	200	Southeast	50	1.50	
9/26/2009	0.90	9:27:16	Royal Tern	1	U	90	200	South	50	1.50	
9/26/2009	0.90	9:28:05	Royal Tern	1	U	90	1,000	South	50	1.50	
9/26/2009	0.90	9:29:28	Great Black-backed Gull	1	U	90	>1,000	South	50	1.50	
9/26/2009	0.90	9:32:23	Gull, large (unkown)	1	U	90	>1,000	South	200	1.50	
9/26/2009	0.90	9:33:39	Gull, large (unkown)	1	U	90	>1,000	South	100	1.50	
9/26/2009	0.90	9:34:57	Gull, large (unkown)	1	U	90	>1,000	South	50	1.50	
9/26/2009	0.90	9:35:21	Laughing Gull	2	U	90	500	South	50	1.50	
9/26/2009	0.90	9:39:07	Gull, large (unkown)	1	U	90	>1,000	South	25	1.50	
9/26/2009	0.90	9:39:35	Laughing Gull	1	U	90	500	South	100	1.50	
9/26/2009	0.90	9:40:20	Laughing Gull	1	U	90	300	North	25	1.50	
9/26/2009	0.90	9:40:59	Royal Tern	1	U	90	300	North	50	1.50	
9/26/2009	0.90	9:44:43	Herring Gull	1	U	90	>1,000	North	50	1.50	
9/26/2009	0.90	9:46:47	Great Black-backed Gull	1	U	90	>1,000	South	50	1.50	
9/26/2009	0.90	9:47:47	Royal Tern	1	U	90	200	South	50	1.50	
9/26/2009	0.90	9:49:14	Gull, large (unkown)	2	U	90	>1,000	South	50	1.50	
9/26/2009	0.90	9:50:17	Black Scoter	5	U	90	500	South	1 (skimming)	1.50	
9/26/2009	0.90	9:51:38	Herring Gull	5	U	90	500	Southeast	100	1.50	
9/26/2009	0.90	9:52:50	Great Black-backed Gull	5	U	90	500	Southwest	100	1.50	
9/26/2009	0.90	9:53:33	Great Black-backed Gull	5	U	90	>1,000	South	100	1.50	
9/26/2009	0.90	9:54:05	American Oystercatcher	5	U	90	100	North	25	1.50	
9/26/2009	0.90	9:55:16	Black Scoter	4	U	90	500	South	1 (skimming)	1.50	
9/26/2009	0.90	9:57:16	Brown Pelican	4	U	90	500	South	50	1.50	
9/26/2009	0.90	10:04:00	Black Scoter	13	U	90	100	South	1 (skimming)	1.50	
9/26/2009	0.90	10:07:11	Laughing Gull	1	U	90	300	South	50	1.50	

Table J-26 (*continued*). Onshore radar validation survey data at Island Beach State Park, New Jersey, in fall 2009. All data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Bearing	Range (m)	Heading (cardinal)	Altitude (ft ASL)	Radar Sea Clutter (NM)	Comment
9/26/2009	0.90	10:07:53	Royal Tern	1	U	90	200	South	25	1.50	
9/26/2009	0.90	10:09:38	Great Black-backed Gull	1	U	90	500	South	100	1.50	
9/26/2009	0.90	10:10:25	Laughing Gull	7	U	90	>1,000	South	50	1.50	
9/26/2009	0.90	10:11:24	Laughing Gull	6	U	90	300	South	25	1.50	
9/26/2009	0.90	10:23:50	Great Black-backed Gull	1	U	90	>1,000	South	25	1.50	
9/26/2009	0.90	10:26:31	Laughing Gull	6	U	90	>1,000	South	100	1.50	
9/26/2009	0.90	10:28:29	Laughing Gull	1	U	90	500	South	100	1.50	
9/26/2009	0.90	10:29:54	Gull, large (unkown)	1	U	90	>1,000	South	50	1.50	
9/26/2009	0.90	10:31:20	Double-crested Cormorant	80	U	90	200	South	1 (skimming)	1.50	
9/26/2009	0.90	10:34:50	Great Black-backed Gull	1	U	90	>1,000	South	25	1.50	
9/26/2009	0.90	10:35:29	Laughing Gull	1	U	90	300	South	50	1.50	
9/26/2009	0.90	10:39:42	Double-crested Cormorant	1	U	90	>1,000	South	25	1.50	
9/26/2009	0.90	10:42:23	Royal Tern	1	U	90	300	South	50	1.50	
9/26/2009	0.90	10:45:03	Laughing Gull	1	U	90	300	South	25	1.50	
9/26/2009	0.90	12:19:14	Laughing Gull	1	U	90	500	South	50	1.50	
9/26/2009	0.90	12:20:13	Royal Tern	1	U	90	200	South	50	1.50	
9/26/2009	0.90	12:24:47	Common Tern	2	U	90	1,000	South	25	1.50	
9/26/2009	0.90	12:25:49	Herring Gull	1	U	90	500	South	25	1.50	
9/26/2009	0.90	12:27:46	Herring Gull	1	U	90	1,000	South	25	1.50	
9/26/2009	0.90	12:29:28	Herring Gull	1	U	90	1,000	North	25	1.50	
9/26/2009	0.90	12:30:24	Laughing Gull	1	U	90	1,000	South	25	1.50	
9/26/2009	0.90	12:32:11	Gull, large (unkown)	1	U	90	>1,000	South	100	1.50	
9/26/2009	0.90	12:34:51	Laughing Gull	7	U	90	>1,000	South	1 (skimming)	1.50	
9/26/2009	0.90	12:35:18	Brown Pelican	1	U	90	500	South	1 (skimming)	1.50	
9/26/2009	0.90	12:36:39	Tern, small (unknown)	10	U	90	500	North	25	1.50	
9/26/2009	0.90	12:38:00	Laughing Gull	1	U	90	1,000	South	50	1.50	
9/26/2009	0.90	12:40:08	Laughing Gull	1	U	90	>1,000	South	50	1.50	

Table J-26 (*continued*). Onshore radar validation survey data at Island Beach State Park, New Jersey, in fall 2009. All data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Bearing	Range (m)	Heading (cardinal)	Altitude (ft ASL)	Radar Sea Clutter (NM)	Comment
9/26/2009	0.90	12:41:51	Herring Gull	1	U	90	500	South	50	1.50	
9/26/2009	0.90	12:43:15	Gull, large (unkown)	1	U	90	1,000	South	25	1.50	
9/26/2009	0.90	12:45:01	Laughing Gull	1	U	90	500	South	50	1.50	
9/26/2009	0.90	12:45:37	Laughing Gull	1	U	90	500	South	25	1.50	
9/26/2009	0.90	12:47:21	Herring Gull	1	U	90	1,000	North	100	1.50	
9/26/2009	0.90	12:48:24	Laughing Gull	3	U	90	500	South	25	1.50	
9/26/2009	0.90	12:49:10	Forster's Tern	1	U	90	500	North	25	1.50	
9/26/2009	0.90	14:43:24	Laughing Gull	1	U	90	>1,000	South	100	1.00	
9/26/2009	0.90	14:45:32	Laughing Gull	1	U	90	500	North	1 (skimming)	1.00	
9/26/2009	0.90	14:46:37	Laughing Gull	1	U	90	300	North	25	1.00	
9/26/2009	0.90	14:46:55	Laughing Gull	1	U	90	100	North	25	1.00	
9/26/2009	0.90	14:47:56	Gull, large (unkown)	1	U	90	>1,000	South	100	1.00	
9/26/2009	0.90	14:49:40	Gull, large (unkown)	1	U	90	>1,000	North	50	1.00	
9/26/2009	0.90	14:50:22	Laughing Gull	1	U	90	1,000	South	100	1.00	
9/26/2009	0.90	14:51:29	Forster's Tern	5	U	90	300	Northeast	25	1.00	
9/26/2009	0.90	14:57:05	Forster's Tern	1	U	90	100	Northeast	25	1.00	
9/26/2009	0.90	14:57:32	Brown Pelican	3	U	90	100	Northeast	25	1.00	
9/26/2009	0.90	14:59:43	Laughing Gull	2	U	90	1,000	North	1 (skimming)	1.00	
9/26/2009	0.90	15:01:06	Laughing Gull	1	U	90	1,000	North	1 (skimming)	1.00	
9/26/2009	0.90	15:01:06	Laughing Gull	1	U	90	1,000	North	1 (skimming)	1.00	
9/26/2009	0.90	15:01:32	Brown Pelican	1	U	90	100	South	25	1.00	
9/26/2009	0.90	15:03:19	Great Black-backed Gull	1	U	90	>1,000	South	50	1.00	
9/26/2009	0.90	15:04:09	Laughing Gull	1	U	90	200	North	25	1.00	
9/26/2009	0.90	15:09:43	Gull, large (unkown)	1	U	90	>1,000	North	25	1.00	
9/26/2009	0.90	15:10:34	Gull, large (unkown)	1	U	90	>1,000	North	25	1.00	
9/26/2009	0.90	15:12:28	Gull, large (unkown)	1	U	90	>1,000	North	25	1.00	
9/26/2009	0.90	15:24:47	Gull, large (unkown)	1	U	90	>1,000	South	25	1.00	

Table J-26 (*continued*). Onshore radar validation survey data at Island Beach State Park, New Jersey, in fall 2009. All data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Bearing	Range (m)	Heading (cardinal)	Altitude (ft ASL)	Radar Sea Clutter (NM)	Comment
9/26/2009	0.90	15:26:17	Gull, large (unkown)	1	U	90	>1,000	North	25	1.00	
9/26/2009	0.90	15:28:38	Laughing Gull	2	U	90	200	North	25	1.00	
9/26/2009	0.90	15:30:50	Forster's Tern	1	U	90	100	North	50	1.00	
9/26/2009	0.90	15:34:43	Forster's Tern	1	U	90	100	North	50	1.00	
9/26/2009	0.90	15:48:22	Laughing Gull	1	U	90	100	Southeast	25	1.00	
9/26/2009	0.90	15:49:13	Laughing Gull	1	U	90	500	South	50	1.00	
9/26/2009	0.90	15:50:17	Gull, large (unkown)	1	U	90	>1,000	North	1 (skimming)	1.00	
9/26/2009	0.90	15:50:45	Great Black-backed Gull	1	U	90	500	South	50	1.00	
9/26/2009	0.90	15:51:41	Laughing Gull	1	U	90	500	North	50	1.00	
9/26/2009	0.90	15:53:12	Scoter, dark-winged (unknown)	8	U	90	1,000	South	1 (skimming)	1.00	
9/26/2009	0.90	15:56:16	Herring Gull	1	U	90	1,000	South	100	1.00	
9/26/2009	0.90	15:59:44	Gull, large (unkown)	1	U	90	>1,000	North	25	1.00	
9/26/2009	0.90	16:00:25	Gull, large (unkown)	1	U	90	>1,000	North	25	1.00	
9/26/2009	0.90	16:00:25	Gull, large (unkown)	1	U	90	>1,000	South	25	1.00	
9/26/2009	0.90	16:10:21	Laughing Gull	1	U	90	500	North	25	1.00	
9/26/2009	0.90	16:14:54	Gull, large (unkown)	1	U	90	>1,000	North	25	1.00	
9/26/2009	0.90	16:18:35	Laughing Gull	1	U	90	1,000	North	25	1.00	
9/26/2009	0.90	16:24:49	Tern, small (unknown)	1	U	90	1,000	North	50	1.00	
9/26/2009	0.90	16:26:16	Laughing Gull	1	U	90	500	North	1 (skimming)	1.00	
9/26/2009	0.90	16:29:06	Laughing Gull	2	U	90	1,000	North	50	1.00	
9/26/2009	0.90	16:29:34	Laughing Gull	1	U	90	1,000	North	25	1.00	
9/26/2009	0.90	16:30:43	Laughing Gull	1	U	90	>1,000	North	25	1.00	
9/26/2009	0.90	16:33:07	Gull, large (unkown)	1	U	90	>1,000	North	25	1.00	
9/26/2009	0.90	16:36:57	Gull, large (unkown)	1	U	90	>1,000	North	1 (skimming)	1.00	
9/26/2009	0.90	16:38:02	Herring Gull	1	U	90	100	South	25	1.00	
9/26/2009	0.90	16:43:08	Gull, large (unkown)	1	U	90	>1,000	North	25	1.00	
9/26/2009	0.90	16:45:48	Brown Pelican	1	U	90	100	North	25	1.00	

Table J-26 (*continued*). Onshore radar validation survey data at Island Beach State Park, New Jersey, in fall 2009. All data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Bearing	Range (m)	Heading (cardinal)	Altitude (ft ASL)	Radar Sea Clutter (NM)	Comment
9/26/2009	0.90	16:46:09	Laughing Gull	1	U	90	200	North	25	1.00	
9/26/2009	0.90	16:46:35	Laughing Gull	2	U	90	200	North	1 (skimming)	1.00	
9/26/2009	0.90	16:53:09	Forster's Tern	125	U	90	300	South	1 (skimming)	1.00	
9/26/2009	0.90	16:57:41	Gull, large (unkown)	1	U	90	>1,000	South	50	1.00	
9/29/2009	0.90	13:50:41	Herring Gull	1	C	90	1,000	North	100	0.50	
9/29/2009	0.90	13:52:40	Laughing Gull	1	C	90	>1,000	North	1 (skimming)	0.50	
9/29/2009	0.90	14:01:40	Laughing Gull	1	U	90	300	South	1 (skimming)	0.50	
9/29/2009	0.90	14:03:42	Gull, large (unkown)	1	C	90	1,000	South	50	0.50	
9/29/2009	0.90	14:05:41	Laughing Gull	1	U	90	200	South	50	0.50	
9/29/2009	0.90	14:06:55	Laughing Gull	1	U	90	300	South	25	0.50	
9/29/2009	0.90	14:09:03	Royal Tern	1	U	90	1,000	North	50	0.50	
9/29/2009	0.90	14:11:14	Laughing Gull	1	C	90	1,000	South	50	0.50	
9/29/2009	0.90	14:13:20	Herring Gull	2	C	90	1,000	South	1 (skimming)	0.50	
9/29/2009	0.90	14:17:35	Great Black-backed Gull	1	U	90	>1,000	South	100	0.50	
9/29/2009	0.90	14:20:54	Laughing Gull	1	C	90	500	North	25	0.50	
9/29/2009	0.90	14:23:30	Laughing Gull	1	U	90	200	North	25	0.50	
9/29/2009	0.90	14:26:46	Herring Gull	1	U	90	500	North	50	0.50	
9/29/2009	0.90	14:29:28	Royal Tern	2	C	90	500	Northwest	25	0.50	
9/29/2009	0.90	14:32:10	Gull, large (unkown)	1	U	90	>1,000	North	25	0.50	
9/29/2009	0.90	14:34:36	Laughing Gull	1	U	90	>1,000	South	1 (skimming)	0.50	
9/29/2009	0.90	14:36:08	Laughing Gull	1	U	90	300	South	25	0.50	
9/29/2009	0.90	14:37:07	Herring Gull	1	C	90	1,000	South	50	0.50	
9/29/2009	0.90	14:46:31	Herring Gull	1	U	90	200	North	50	0.50	
9/29/2009	0.90	14:47:35	Gull, large (unkown)	1	U	90	500	W	100	0.50	
9/29/2009	0.90	14:48:47	Tern, large (unknown)	1	U	90	500	North	100	0.50	feeding
9/29/2009	0.90	14:51:49	Tern, large (unknown)	1	C	90	500	North	100	0.50	
9/29/2009	0.90	14:52:39	Laughing Gull	1	C	90	300	South	50	0.50	

Table J-26 (*continued*). Onshore radar validation survey data at Island Beach State Park, New Jersey, in fall 2009. All data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Bearing	Range (m)	Heading (cardinal)	Altitude (ft ASL)	Radar Sea Clutter (NM)	Comment
9/29/2009	0.90	14:52:39	Laughing Gull	1	U	90	500	South	1 (skimming)	0.50	
9/29/2009	0.90	14:56:06	Laughing Gull	1	U	90	300	South	100	0.50	
9/29/2009	0.90	14:57:25	Tern, large (unknown)	1	C	90	500	North	100	0.50	feeding
9/29/2009	0.90	14:59:04	Tern, large (unknown)	1	C	90	500	South	50	0.50	
9/29/2009	0.90	15:03:44	Laughing Gull	1	U	90	300	South	25	0.50	
9/29/2009	0.90	15:06:35	Herring Gull	1	C	90	500	North	100	0.50	
9/29/2009	0.90	15:08:04	Laughing Gull	1	U	90	200	North	100	0.50	
9/29/2009	0.90	15:10:04	Laughing Gull	1	U	90	200	North	100	0.50	
9/29/2009	0.90	15:11:42	Laughing Gull	1	U	90	300	South	50	0.50	
9/29/2009	0.90	15:12:29	Laughing Gull	1	U	90	200	North	25	0.50	
9/29/2009	0.90	15:19:15	Laughing Gull	2	U	90	300	South	1 (skimming)	0.50	
9/29/2009	0.90	15:23:22	Double-crested Cormorant	2	U	90	300	Southwest	1 (skimming)	0.50	
9/29/2009	0.90	15:27:01	Gull, large (unkown)	1	C	90	1,000	South	200	0.50	
9/29/2009	0.90	15:28:45	Herring Gull	1	U	90	500	North	100	0.50	
9/29/2009	0.90	15:34:40	Laughing Gull	1	U	90	1,000	South	50	0.50	
9/29/2009	0.90	15:41:44	Forster's Tern	5	U	90	200	North	25	0.50	feeding
9/29/2009	0.90	17:51:35	Ring-billed Gull	1	U	90	200	North	1 (skimming)	0.50	
9/29/2009	0.90	17:52:43	Ring-billed Gull	1	U	90	100	North	25	0.50	
9/29/2009	0.90	17:54:58	Herring Gull	1	U	90	100	North	25	0.50	
9/29/2009	0.90	18:01:20	Herring Gull	1	U	90	200	North	1 (skimming)	0.50	
9/29/2009	0.90	18:02:12	Herring Gull	1	U	90	200	North	1 (skimming)	0.50	
9/29/2009	0.90	18:03:33	Tern, large (unknown)	2	U	90	200	South	1 (skimming)	0.50	
9/29/2009	0.90	18:04:43	Laughing Gull	1	U	90	200	North	25	0.50	
9/29/2009	0.90	18:06:53	Tern, large (unknown)	1	U	90	300	North	1 (skimming)	0.50	
9/29/2009	0.90	18:11:25	Great Black-backed Gull	1	U	90	100	North	25	0.50	
9/29/2009	0.90	18:17:13	Royal Tern	2	U	90	100	South	1 (skimming)	0.50	
9/29/2009	0.90	18:19:50	Laughing Gull	2	C	90	>1,000	North	25	0.50	

Table J-26 (*continued*). Onshore radar validation survey data at Island Beach State Park, New Jersey, in fall 2009. All data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Bearing	Range (m)	Heading (cardinal)	Altitude (ft ASL)	Radar Sea Clutter (NM)	Comment
9/29/2009	0.90	18:24:11	Great Black-backed Gull	1	U	90	300	North	25	0.50	
9/29/2009	0.90	18:24:50	Great Black-backed Gull	1	U	90	300	North	25	0.50	
9/29/2009	0.90	18:31:03	Great Black-backed Gull	1	U	90	500	South	1 (skimming)	0.50	
9/29/2009	0.90	18:36:31	Osprey	1	U	90	500	South	100	0.50	
9/29/2009	0.90	18:39:22	Herring Gull	1	U	90	200	South	1 (skimming)	0.50	
9/29/2009	0.90	18:40:10	Great Black-backed Gull	1	U	90	>1,000	Northwest	100	0.50	
9/29/2009	0.90	18:42:22	Great Black-backed Gull	1	U	90	500	Southwest	1 (skimming)	0.50	
9/29/2009	0.90	18:44:21	Laughing Gull	1	U	90	500	Southwest	25	0.50	
9/29/2009	0.90	18:45:18	Royal Tern	3	U	90	>1,000	North	1 (skimming)	0.50	
9/29/2009	0.90	18:48:49	Great Black-backed Gull	1	U	90	200	Southwest	1 (skimming)	0.50	
9/29/2009	0.90	18:49:56	Great Black-backed Gull	1	U	90	>1,000	North	50	0.50	
9/29/2009	0.90	18:51:38	Herring Gull	1	U	90	100	South	1 (skimming)	0.50	
9/29/2009	0.90	18:53:51	Herring Gull	1	U	90	200	South	25	0.50	
9/29/2009	0.90	18:54:35	Herring Gull	1	U	90	200	Southwest	1 (skimming)	0.50	
9/29/2009	0.90	19:03:38	Herring Gull	1	U	90	1,000	Northwest	25	0.50	
9/29/2009	0.90	19:14:46	Great Black-backed Gull	2	U	90	300	Southwest	1 (skimming)	0.50	
9/29/2009	0.90	19:15:44	Great Black-backed Gull	1	U	90	>1,000	South	25	0.50	
9/29/2009	0.90	19:18:42	Herring Gull	1	C	90	500	South	50	0.50	
9/29/2009	0.90	19:21:52	Herring Gull	1	U	90	>1,000	North	25	0.50	
9/29/2009	0.90	19:24:20	Herring Gull	1	C	90	>1,000	North	50	0.50	
9/29/2009	0.90	19:24:54	Royal Tern	1	U	90	1,000	North	25	0.50	
9/29/2009	0.90	19:27:01	Great Black-backed Gull	1	U	90	500	Southwest	1 (skimming)	0.50	
9/29/2009	0.90	19:30:00	Tern, large (unknown)	1	C	90	500	North	50	0.50	
9/29/2009	0.90	19:32:55	Laughing Gull	1	U	90	500	South	1 (skimming)	0.50	
9/29/2009	0.90	20:03:24	Laughing Gull	1	U	90	300	North	1 (skimming)	0.50	
9/29/2009	0.90	20:06:32	Herring Gull	1	U	90	200	North	1 (skimming)	0.50	
9/29/2009	0.90	20:08:38	Laughing Gull	3	U	90	200	North	25	0.50	

Table J-26 (*continued*). Onshore radar validation survey data at Island Beach State Park, New Jersey, in fall 2009. All data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Bearing	Range (m)	Heading (cardinal)	Altitude (ft ASL)	Radar Sea Clutter (NM)	Comment
9/29/2009	0.90	20:10:51	Laughing Gull	1	U	90	200	Southwest	1 (skimming)	0.50	
9/29/2009	0.90	20:11:30	Laughing Gull	1	U	90	200	Southwest	1 (skimming)	0.50	
9/29/2009	0.90	20:12:41	Laughing Gull	1	U	90	200	Southwest	1 (skimming)	0.50	
9/29/2009	0.90	20:13:18	Royal Tern	1	U	90	300	North	50	0.50	
9/29/2009	0.90	20:14:07	Great Black-backed Gull	1	U	90	200	Southwest	1 (skimming)	0.50	
9/29/2009	0.90	20:15:46	Laughing Gull	1	U	90	200	Southwest	1 (skimming)	0.50	
9/29/2009	0.90	20:16:07	Laughing Gull	1	U	90	200	North	1 (skimming)	0.50	
9/29/2009	0.90	20:17:14	Royal Tern	1	C	90	300	North	50	0.50	
9/29/2009	0.90	20:19:07	Laughing Gull	2	U	90	200	North	25	0.50	
9/29/2009	0.90	20:20:09	Laughing Gull	1	U	90	300	North	25	0.50	
9/29/2009	0.90	20:22:16	Laughing Gull	1	U	90	300	North	1 (skimming)	0.50	
9/29/2009	0.90	20:22:46	Laughing Gull	1	U	90	300	North	1 (skimming)	0.50	feeding
9/29/2009	0.90	20:23:17	Great Black-backed Gull	1	C	90	200	North	100	0.50	
9/29/2009	0.90	20:23:39	Laughing Gull	1	U	90	200	North	50	0.50	
9/29/2009	0.90	20:24:07	Royal Tern	1	U	90	500	North	100	0.50	
9/29/2009	0.90	20:25:31	Laughing Gull	1	U	90	200	Northwest	1 (skimming)	0.50	
9/29/2009	0.90	20:28:44	Laughing Gull	1	U	90	200	North	1 (skimming)	0.50	
9/29/2009	0.90	20:29:50	Laughing Gull	1	U	90	200	North	1 (skimming)	0.50	
9/29/2009	0.90	20:30:48	Great Black-backed Gull	1	U	90	300	South	25	0.50	
9/29/2009	0.90	20:32:28	Laughing Gull	1	U	90	200	North	1 (skimming)	0.50	
9/29/2009	0.90	20:39:21	Laughing Gull	1	U	90	500	North	1 (skimming)	0.50	
9/29/2009	0.90	20:41:14	Laughing Gull	1	U	90	300	North	50	0.50	
9/29/2009	0.90	20:43:15	Laughing Gull	2	U	90	300	North	1 (skimming)	0.50	
9/29/2009	0.90	20:45:04	Laughing Gull	1	C	90	200	North	25	0.50	
9/29/2009	0.90	20:45:42	Herring Gull	1	U	90	200	North	1 (skimming)	0.50	
9/29/2009	0.90	20:47:12	Laughing Gull	1	U	90	300	North	1 (skimming)	0.50	
9/29/2009	0.90	20:49:55	Laughing Gull	1	U	90	300	North	1 (skimming)	0.50	

Table J-26*continued*). Onshore radar validation survey data at Island Beach State Park, New Jersey, in fall 2009. All data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Bearing	Range (m)	Heading (cardinal)	Altitude (ft ASL)	Radar Sea Clutter (NM)	Comment
9/29/2009	0.90	20:54:42	Laughing Gull	1	U	90	500	North	1 (skimming)	0.50	
9/29/2009	0.90	20:58:51	Northern Gannet	2	U	90	>1,000	South	100	0.50	
9/29/2009	0.90	21:03:21	Royal Tern	1	U	90	1,000	South	50	0.50	
9/29/2009	0.90	21:07:45	Tern, large (unknown)	2	C	90	500	South	100	0.50	
9/29/2009	0.90	21:10:02	Laughing Gull	1	C	90	500	Northwest	100	0.50	
9/29/2009	0.90	21:10:56	Royal Tern	1	C	90	500	South	100	0.50	
9/29/2009	0.90	21:10:56	Brown Pelican	2	U	90	300	North	100	0.50	
9/29/2009	0.90	21:18:15	Laughing Gull	1	U	90	300	North	1 (skimming)	0.50	
9/29/2009	0.90	21:19:24	Royal Tern	1	U	90	500	South	50	0.50	feeding
9/29/2009	0.90	21:25:05	Brown Pelican	1	U	90	200	North	1 (skimming)	0.50	
9/29/2009	0.90	21:25:48	Laughing Gull	1	U	90	300	North	1 (skimming)	0.50	
9/29/2009	0.90	21:27:57	Ring-billed Gull	1	U	90	100	North	25	0.50	
9/29/2009	0.90	21:29:06	Laughing Gull	1	U	90	300	North	1 (skimming)	0.50	
9/29/2009	0.90	21:31:30	Gull, large (unkown)	1	C	90	1,000	South	100	0.50	
9/29/2009	0.90	21:33:00	Laughing Gull	1	U	90	300	North	1 (skimming)	0.50	
9/29/2009	0.90	21:35:01	Laughing Gull	2	U	90	300	North	1 (skimming)	0.50	
9/29/2009	0.90	21:39:28	Gull, large (unkown)	1	C	90	1,000	Southeast	200	0.50	
9/29/2009	0.90	21:40:51	Brown Pelican	1	U	90	200	South	1 (skimming)	0.50	
9/29/2009	0.90	21:41:44	Laughing Gull	1	U	90	300	South	1 (skimming)	0.50	
9/29/2009	0.90	21:42:48	Great Black-backed Gull	1	U	90	200	South	25	0.50	
9/29/2009	0.90	21:43:56	Laughing Gull	1	U	90	500	South	50	0.50	
9/29/2009	0.90	21:45:32	Laughing Gull	1	U	90	500	South	25	0.50	
9/29/2009	0.90	21:45:40	Laughing Gull	1	U	90	300	South	1 (skimming)	0.50	
9/29/2009	0.90	21:46:22	Laughing Gull	1	U	90	300	Southwest	1 (skimming)	0.50	
9/29/2009	0.90	21:47:27	Brown Pelican	1	U	90	>1,000	South	25	0.50	
9/29/2009	0.90	21:48:07	Royal Tern	1	U	90	300	South	25	0.50	
9/29/2009	0.90	21:49:54	Laughing Gull	1	U	90	500	South	1 (skimming)	0.50	

Table J-26 (*continued*). Onshore radar validation survey data at Island Beach State Park, New Jersey, in fall 2009. All data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Bearing	Range (m)	Heading (cardinal)	Altitude (ft ASL)	Radar Sea Clutter (NM)	Comment
9/29/2009	0.90	21:54:27	Royal Tern	1	C	90	1,000	South	50	0.50	
9/29/2009	0.90	21:57:21	Great Black-backed Gull	1	C	90	>1,000	Southwest	200	0.50	
9/29/2009	0.90	21:58:54	Royal Tern	1	C	90	500	South	100	0.50	
10/2/2009	0.06	14:56:02	Great Black-backed Gull	1	U	90	>1,000	North	25	1.50	
10/2/2009	0.06	15:00:05	Brown Pelican	1	U	90	100	North	1 (skimming)	1.50	
10/2/2009	0.06	15:00:48	Gull/tern (unknown)	2	U	90	>1,000	South	1 (skimming)	1.50	
10/2/2009	0.06	15:03:02	Black Scoter	5	U	90	300	South	1 (skimming)	1.50	
10/2/2009	0.06	15:03:48	Laughing Gull	1	C	90	300	Northeast	50	1.50	
10/2/2009	0.06	15:04:34	Great Black-backed Gull	1	U	90	100	North	100	1.50	
10/2/2009	0.06	15:07:29	Gull, large (unkown)	1	U	90	1,000	South	100	1.50	
10/2/2009	0.06	15:09:27	Gull, large (unkown)	1	U	90	1,000	North	100	1.50	
10/2/2009	0.06	15:11:40	Gull, large (unkown)	1	C	90	>1,000	Northeast	200	1.50	
10/2/2009	0.06	15:13:48	Gull, large (unkown)	1	U	90	1,000	North	50	1.50	
10/2/2009	0.06	15:21:29	Brown Pelican	1	C	90	1,000	North	100	1.50	
10/2/2009	0.06	15:23:33	Gull, large (unkown)	1	C	90	1,000	North	100	1.50	
10/2/2009	0.06	15:25:29	Gull, large (unkown)	1	C	90	>1,000	North	50	1.50	
10/2/2009	0.06	15:25:47	Gull, large (unkown)	1	C	90	>1,000	North	100	1.50	
10/2/2009	0.06	15:26:08	Laughing Gull	1	U	90	500	North	100	1.50	
10/2/2009	0.06	15:26:51	Gull, large (unkown)	1	C	90	>1,000	North	100	1.50	
10/2/2009	0.06	15:27:59	Royal Tern	1	U	90	500	South	50	1.50	
10/2/2009	0.06	15:28:43	Gull, large (unkown)	1	C	90	1,000	North	200	1.50	
10/2/2009	0.06	15:29:28	Gull/tern (unknown)	1	U	90	1,000	Southeast	50	1.50	
10/2/2009	0.06	15:31:57	Gull, large (unkown)	1	U	90	1,000	Southeast	50	1.50	
10/2/2009	0.06	15:33:46	Laughing Gull	2	U	90	300	South	1 (skimming)	1.50	
10/2/2009	0.06	15:34:51	Laughing Gull	1	U	90	500	Southeast	25	1.50	
10/2/2009	0.06	15:44:18	Gull, large (unkown)	1	U	90	500	Northwest	100	1.50	
10/2/2009	0.06	15:48:42	Black Scoter	15	U	90	300	Northwest	1 (skimming)	1.50	

Table J-26 (*continued*). Onshore radar validation survey data at Island Beach State Park, New Jersey, in fall 2009. All data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Bearing	Range (m)	Heading (cardinal)	Altitude (ft ASL)	Radar Sea Clutter (NM)	Comment
10/2/2009	0.06	15:54:02	Red-throated Loon	1	U	90	1,000	South	50	1.50	
10/2/2009	0.06	15:55:04	Red-throated Loon	1	U	90	1,000	South	50	1.50	

NM = nautical mile(s)
No. = number
C/U = Confirmed/Unconfirmed
m = meters
ft ASL = feet above sea level

Table J-27. Onshore radar validation survey data at Brigantine Beach, New Jersey, in fall 2009. All data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Bearing	Range (m)	Heading (cardinal)	Altitude (ft ASL)	Radar Sea Clutter (NM)	Comment
10/6/2009	0.10	17:08:20	Double-crested Cormorant	2	C	90	>1,000	South	100	1.00	
10/6/2009	0.10	17:09:21	Tern, large (unknown)	3	U	90	300	North	50	1.00	
10/6/2009	0.10	17:16:01	Double-crested Cormorant	20	U	90	>1000	South	500	1.00	
10/6/2009	0.10	17:20:35	Laughing Gull	1	U	90	1,000	South	25	1.00	
10/6/2009	0.10	17:21:14	Laughing Gull	1	U	90	300	Southwest	25	1.00	
10/6/2009	0.10	17:23:35	Double-crested Cormorant	50	C	90	>1,000	South	100	1.00	
10/6/2009	0.10	17:26:32	Double-crested Cormorant	25	U	90	>1,000	South	50	1.00	
10/6/2009	0.10	17:29:09	Herring Gull	1	C	90	500	South	50	1.00	
10/6/2009	0.10	17:31:12	Gull, large (unknown)	1	U	90	1,000	Southwest	1 (skimming)	1.00	
10/6/2009	0.10	17:34:13	Gull, large (unknown)	2	C	90	>1,000	North	100	1.00	
10/6/2009	0.10	17:38:51	Great Black-backed Gull	1	U	90	500	North	50	1.00	
10/6/2009	0.10	17:39:42	Royal Tern	1	U	90	300	South	50	1.00	
10/6/2009	0.10	17:41:08	Royal Tern	1	U	90	500	South	25	1.00	
10/6/2009	0.10	17:42:51	Herring Gull	1	U	90	500	Northwest	100	1.00	
10/6/2009	0.10	17:44:18	Royal Tern	1	U	90	300	South	25	1.00	
10/6/2009	0.10	17:46:26	Laughing Gull	1	U	90	500	Northeast	50	1.00	
10/6/2009	0.10	17:52:50	Gull, large (unknown)	1	C	90	1,000	North	25	1.00	
10/6/2009	0.10	17:53:35	Laughing Gull	1	C	90	500	Northeast	50	1.00	
10/6/2009	0.10	17:54:01	Black Scoter	2	C	90	1,000	North	1 (skimming)	1.00	
10/6/2009	0.10	17:56:04	Laughing Gull	1	U	90	300	South	25	1.00	
10/6/2009	0.10	17:57:37	Great Black-backed Gull	1	C	90	>1,000	North	25	1.00	
10/6/2009	0.10	17:59:18	Gull, large (unknown)	1	U	90	>1,000	South	25	1.00	
10/6/2009	0.10	18:00:35	Great Black-backed Gull	1	U	90	>1,000	Northwest	50	1.00	
10/6/2009	0.10	18:01:53	Herring Gull	1	C	90	>1,000	North	100	1.00	
10/6/2009	0.10	18:02:40	Gull, large (unknown)	1	C	90	>1,000	South	50	1.00	
10/6/2009	0.10	18:03:25	Gull, large (unknown)	1	U	90	>1,000	Northwest	50	1.00	
10/6/2009	0.10	18:03:58	Laughing Gull	1	C	90	>1,000	South	25	1.00	
10/6/2009	0.10	18:05:02	Laughing Gull	1	U	90	1,000	South	50	1.00	

Table J-27 (*continued*). Onshore radar validation survey data at Brigantine Beach, New Jersey, in fall 2009. All data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Bearing	Range (m)	Heading (cardinal)	Altitude (ft ASL)	Radar Sea Clutter (NM)	Comment
10/6/2009	0.10	18:06:47	Gull, large (unknown)	1	U	90	1,000	North	100	1.00	
10/6/2009	0.10	18:07:58	Great Black-backed Gull	1	U	90	500	Northwest	100	1.00	
10/6/2009	0.10	18:09:06	Osprey	1	U	90	500	West	25	1.00	
10/6/2009	0.10	18:14:37	Royal Tern	1	U	90	500	North	50	1.00	
10/6/2009	0.10	18:23:40	Great Black-backed Gull	1	U	90	300	South	50	1.00	
10/6/2009	0.10	18:35:36	Great Black-backed Gull	1	U	90	1,000	South	25	1.00	
10/6/2009	0.10	18:39:30	Gull, large (unknown)	1	U	90	>1,000	South	50	1.00	
10/6/2009	0.10	18:40:03	Great Black-backed Gull	1	U	90	500	South	25	1.00	
10/6/2009	0.10	18:40:47	Gull, large (unknown)	1	U	90	1,000	Northwest	25	1.00	
10/6/2009	0.10	18:41:12	Double-crested Cormorant	13	C	90	500	Southeast	1 (skimming)	1.00	
10/6/2009	0.10	18:49:43	Gull, large (unknown)	1	C	90	>1,000	South	100	1.00	
10/6/2009	0.10	18:50:41	Gull, large (unknown)	1	C	90	>1,000	South	100	1.00	
10/6/2009	0.10	18:56:22	Laughing Gull	1	U	90	1,000	South	25	1.00	
10/6/2009	0.10	18:58:43	Royal Tern	1	U	90	300	South	25	1.00	feeding
10/6/2009	0.10	18:59:54	Laughing Gull	1	U	90	1,000	South	50	1.00	
10/8/2009	0.10	17:14:11	Laughing Gull	1	U	121	>1,000	South	25	1.50	
10/8/2009	0.10	17:14:53	Double-crested Cormorant	10	U	121	300	South	200	1.50	
10/8/2009	0.10	17:15:26	Laughing Gull	1	U	121	1,000	Southwest	100	1.50	
10/8/2009	0.10	17:16:12	Great Blue Heron	5	U	121	1,000	Southwest	1 (skimming)	1.50	
10/8/2009	0.10	17:16:38	Laughing Gull	1	C	121	>1,000	South	1 (skimming)	1.50	
10/8/2009	0.10	17:17:54	Herring Gull	1	C	121	200	North	25	1.50	
10/8/2009	0.10	17:18:14	Laughing Gull	2	U	121	>1,000	South	1 (skimming)	1.50	
10/8/2009	0.10	17:18:30	Other	1	U	121	500	South	25	1.50	Monarch butterfly
10/8/2009	0.10	17:19:05	Duck (unknown)	17	U	121	>1,000	South	50	1.50	
10/8/2009	0.10	17:19:42	Herring Gull	3	U	121	100	North	50	1.50	
10/8/2009	0.10	17:20:18	Laughing Gull	1	U	121	1,000	Southwest	1 (skimming)	1.50	
10/8/2009	0.10	17:20:39	Laughing Gull	1	U	121	300	Southwest	50	1.50	
10/8/2009	0.10	17:20:59	Laughing Gull	2	U	121	300	South	1 (skimming)	1.50	

Table J-27 (*continued*). Onshore radar validation survey data at Brigantine Beach, New Jersey, in fall 2009. All data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Bearing	Range (m)	Heading (cardinal)	Altitude (ft ASL)	Radar Sea Clutter (NM)	Comment
10/8/2009	0.10	17:21:14	Herring Gull	1	U	121	200	South	25	1.50	
10/8/2009	0.10	17:22:04	Ring-billed Gull	1	U	121	300	South	1 (skimming)	1.50	
10/8/2009	0.10	17:22:15	Wood Duck	9	U	121	200	South	1 (skimming)	1.50	
10/8/2009	0.10	17:22:41	Double-crested Cormorant	2	U	121	200	North	100	1.50	
10/8/2009	0.10	17:23:27	Forster's Tern	62	U	121	1,000	South	50	1.50	
10/8/2009	0.10	17:24:58	Laughing Gull	1	C	121	500	South	1 (skimming)	1.50	
10/8/2009	0.10	17:26:20	Royal Tern	1	U	121	300	South	50	1.50	
10/8/2009	0.10	17:27:37	Royal Tern	1	U	121	1,000	South	50	1.50	
10/8/2009	0.10	17:28:17	Ring-billed Gull	1	U	121	200	South	50	1.50	
10/8/2009	0.10	17:28:49	Royal Tern	1	U	121	1,000	South	50	1.50	
10/8/2009	0.10	17:29:27	Royal Tern	2	C	121	1,000	South	50	1.50	
10/8/2009	0.10	17:29:38	Great Black-backed Gull	1	U	121	200	South	50	1.50	
10/8/2009	0.10	17:30:05	Royal Tern	1	C	121	1,000	South	50	1.50	
10/8/2009	0.10	17:30:17	Double-crested Cormorant	22	U	121	200	South	300	1.50	
10/8/2009	0.10	17:31:03	Herring Gull	2	U	121	100	South	25	1.50	
10/8/2009	0.10	17:32:10	Northern Pintail	15	C	121	>1,000	Southwest	500	1.50	
10/8/2009	0.10	17:35:52	Caspian Tern	1	U	121	100	South	25	1.50	
10/8/2009	0.10	17:36:35	Surf Scoter	2	C	121	>1,000	South	1 (skimming)	1.50	
10/8/2009	0.10	17:37:16	Caspian Tern	1	U	121	100	South	25	1.50	
10/8/2009	0.10	17:37:31	Northern Gannet	1	U	121	>1,000	South	25	1.50	
10/8/2009	0.10	17:37:31	Laughing Gull	1	U	121	1,000	South	1 (skimming)	1.50	
10/8/2009	0.10	17:38:06	Royal Tern	1	U	121	300	South	50	1.50	
10/8/2009	0.10	17:38:26	Herring Gull	1	U	121	100	South	25	1.50	
10/8/2009	0.10	17:40:52	Laughing Gull	1	C	121	1,000	South	50	1.50	
10/8/2009	0.10	17:40:52	Laughing Gull	3	C	121	>1,000	South	1 (skimming)	1.50	
10/8/2009	0.10	17:42:06	Laughing Gull	1	C	121	>1,000	South	25	1.50	
10/8/2009	0.10	17:42:15	Great Black-backed Gull	1	C	121	>1,000	South	50	1.50	
10/8/2009	0.10	17:42:47	Laughing Gull	1	U	121	>1,000	South	25	1.50	

Table J-27 (*continued*). Onshore radar validation survey data at Brigantine Beach, New Jersey, in fall 2009. All data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Bearing	Range (m)	Heading (cardinal)	Altitude (ft ASL)	Radar Sea Clutter (NM)	Comment
10/8/2009	0.10	17:43:03	Ring-billed Gull	1	U	121	200	South	25	1.50	
10/8/2009	0.10	17:43:54	Herring Gull	1	U	121	100	South	25	1.50	
10/8/2009	0.10	17:44:19	Duck, dabbling (unknown)	11	C	121	>1,000	South	200	1.50	
10/8/2009	0.10	17:45:47	Herring Gull	1	U	121	300	Southwest	1 (skimming)	1.50	
10/8/2009	0.10	17:47:12	Herring Gull	2	U	121	200	South	1 (skimming)	1.50	
10/8/2009	0.10	17:48:59	Black Scoter	1	U	121	>1,000	South	50	1.50	
10/8/2009	0.10	17:49:17	Laughing Gull	2	U	121	>1,000	South	1 (skimming)	1.50	
10/8/2009	0.10	17:50:02	Herring Gull	1	U	121	200	South	1 (skimming)	1.50	
10/8/2009	0.10	17:50:42	Northern Shoveler	5	C	121	>1,000	South	100	1.50	
10/8/2009	0.10	17:52:51	Double-crested Cormorant	38	U	121	>1,000	South	300	1.50	
10/8/2009	0.10	17:52:51	Double-crested Cormorant	5	U	121	300	South	1 (skimming)	1.50	
10/8/2009	0.10	17:54:00	Herring Gull	1	C	121	>1,000	South	25	1.50	
10/8/2009	0.10	17:55:30	Herring Gull	1	C	121	500	South	25	1.50	
10/8/2009	0.10	17:55:30	Herring Gull	1	U	121	>1,000	North	50	1.50	
10/8/2009	0.10	17:56:37	Double-crested Cormorant	37	U	121	200	South	100	1.50	
10/8/2009	0.10	18:00:59	Double-crested Cormorant	230	C	121	>1,000	South	200	1.50	
10/8/2009	0.10	18:01:46	Northern Pintail	12	U	121	1,000	North	200	1.50	
10/8/2009	0.10	18:05:32	Double-crested Cormorant	31	U	121	>1,000	South	200	1.50	
10/8/2009	0.10	18:06:48	Laughing Gull	1	C	121	>1,000	South	50	1.50	
10/8/2009	0.10	18:07:14	Laughing Gull	1	C	121	>1,000	South	50	1.50	
10/8/2009	0.10	18:09:33	Herring Gull	4	U	121	300	South	25	1.50	
10/8/2009	0.10	18:10:04	Herring Gull	1	U	121	200	North	25	1.50	
10/8/2009	0.10	18:11:55	Double-crested Cormorant	70	C	121	500	South	200	1.50	
10/8/2009	0.10	18:12:26	Double-crested Cormorant	28	U	121	500	South	100	1.50	
10/8/2009	0.10	18:18:07	Duck (unknown)	40	C	121	>1,000	South	50	1.50	
10/8/2009	0.10	18:19:44	Duck, dabbling (unknown)	2	C	121	1,000	South	1 (skimming)	1.50	
10/8/2009	0.10	18:20:57	Laughing Gull	1	C	121	1,000	South	50	1.50	
10/8/2009	0.10	18:22:53	Black-bellied Plover	29	U	121	500	South	100	1.50	

Table J-27 (*continued*). Onshore radar validation survey data at Brigantine Beach, New Jersey, in fall 2009. All data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Bearing	Range (m)	Heading (cardinal)	Altitude (ft ASL)	Radar Sea Clutter (NM)	Comment
10/8/2009	0.10	18:23:57	Double-crested Cormorant	76	U	121	300	South	100	1.50	
10/8/2009	0.10	18:24:38	Double-crested Cormorant	2	U	121	200	South	1 (skimming)	1.50	
10/8/2009	0.10	18:28:44	Northern Pintail	3	U	121	500	South	100	1.50	
10/8/2009	0.10	18:30:59	Northern Pintail	25	C	121	1,000	South	200	1.50	
10/8/2009	0.10	18:32:02	Double-crested Cormorant	1	U	121	200	North	500	1.50	
10/8/2009	0.10	18:33:29	Double-crested Cormorant	65	C	121	1,000	South	500	1.50	
10/8/2009	0.10	18:35:15	Northern Pintail	21	U	121	1,000	Northwest	50	1.50	
10/8/2009	0.10	18:37:15	Laughing Gull	21	U	121	1,000	South	25	1.50	
10/8/2009	0.10	18:37:46	Great Black-backed Gull	21	U	121	500	South	50	1.50	
10/8/2009	0.10	18:40:42	Ring-billed Gull	1	U	121	200	South	50	1.50	
10/8/2009	0.10	18:41:47	Royal Tern	1	U	121	200	South	50	1.50	
10/8/2009	0.10	18:46:39	Royal Tern	1	U	121	500	South	50	1.50	
10/8/2009	0.10	18:47:08	Double-crested Cormorant	1	U	121	300	South	50	1.50	
10/8/2009	0.10	18:47:29	Royal Tern	1	C	121	500	South	100	1.50	
10/8/2009	0.10	18:47:29	Canada Goose	3	C	121	>1,000	South	300	1.50	
10/8/2009	0.10	18:51:45	Northern Gannet	1	U	121	>1,000	South	100	1.50	
10/8/2009	0.10	18:52:26	Laughing Gull	1	U	121	300	South	50	1.50	
10/8/2009	0.10	18:53:04	Osprey	1	U	121	200	South	100	1.50	
10/8/2009	0.10	18:53:59	Northern Gannet	1	U	121	>1,000	South	100	1.50	
10/8/2009	0.10	18:54:47	Royal Tern	1	C	121	500	North	50	1.50	
10/8/2009	0.10	18:55:05	Northern Gannet	1	C	121	>1,000	South	50	1.50	
10/8/2009	0.10	18:55:56	Herring Gull	1	U	121	100	South	25	1.50	
10/8/2009	0.10	18:58:53	Laughing Gull	2	U	121	300	South	25	1.50	
10/8/2009	0.10	18:59:16	Brown Pelican	1	U	121	200	North	1 (skimming)	1.50	
10/8/2009	0.10	19:00:03	Northern Gannet	1	U	121	1,000	South	100	1.50	
10/8/2009	0.10	19:00:40	Laughing Gull	6	U	121	1,000	South	1 (skimming)	1.50	
10/8/2009	0.10	19:00:58	Double-crested Cormorant	1	U	121	500	Southeast	1 (skimming)	1.50	
10/8/2009	0.10	19:01:22	Royal Tern	2	U	121	500	South	100	1.50	

Table J-27 (*continued*). Onshore radar validation survey data at Brigantine Beach, New Jersey, in fall 2009. All data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Bearing	Range (m)	Heading (cardinal)	Altitude (ft ASL)	Radar Sea Clutter (NM)	Comment
10/8/2009	0.10	19:02:30	Great Black-backed Gull	1	U	121	300	North	50	1.50	
10/8/2009	0.10	19:03:48	Royal Tern	1	U	121	300	Southwest	50	1.50	
10/8/2009	0.10	19:05:29	Laughing Gull	1	U	121	200	South	50	1.50	
10/9/2009	0.10	20:12:24	Double-crested Cormorant	1	U	121	200	North	100	2.50	
10/9/2009	0.10	20:14:22	Ring-billed Gull	1	U	121	100	North	50	2.50	
10/9/2009	0.10	20:15:07	Herring Gull	1	U	121	100	North	25	2.50	
10/9/2009	0.10	20:15:39	Other	1	U	121	1,000	South	1 (skimming)	2.50	Boat
10/9/2009	0.10	20:16:12	Laughing Gull	1	U	121	200	South	1 (skimming)	2.50	
10/9/2009	0.10	20:16:56	Scoter, dark-winged (unknown)	7	U	121	500	South	1 (skimming)	2.50	
10/9/2009	0.10	20:17:44	Laughing Gull	2	U	121	200	South	1 (skimming)	2.50	
10/9/2009	0.10	20:18:28	Ring-billed Gull	1	U	121	100	North	25	2.50	
10/9/2009	0.10	20:19:05	Caspian Tern	1	U	121	100	South	25	2.50	
10/9/2009	0.10	20:19:52	Great Black-backed Gull	1	U	121	200	North	50	2.50	
10/9/2009	0.10	20:20:58	Gull, large (unknown)	1	U	121	1,000	Northeast	50	2.50	
10/9/2009	0.10	20:23:12	Forster's Tern	4	U	121	200	South	1 (skimming)	2.50	
10/9/2009	0.10	20:24:31	Forster's Tern	1	U	121	200	South	1 (skimming)	2.50	
10/9/2009	0.10	20:26:15	Forster's Tern	5	U	121	200	South	25	2.50	
10/9/2009	0.10	20:26:35	Herring Gull	1	U	121	100	North	50	2.50	
10/9/2009	0.10	20:29:04	Forster's Tern	4	U	121	200	South	25	2.50	
10/9/2009	0.10	20:31:19	Ring-billed Gull	1	U	121	100	North	25	2.50	
10/9/2009	0.10	20:31:49	Laughing Gull	1	U	121	200	South	1 (skimming)	2.50	
10/9/2009	0.10	20:32:11	Royal Tern	2	U	121	100	South	25	2.50	
10/9/2009	0.10	20:32:45	Ring-billed Gull	1	U	121	100	North	25	2.50	
10/9/2009	0.10	20:35:57	Laughing Gull	1	U	121	300	South	1 (skimming)	2.50	
10/9/2009	0.10	20:37:14	Semipalmated Plover	4	U	121	100	Southwest	50	2.50	
10/9/2009	0.10	20:40:47	Herring Gull	1	U	121	200	North	50	2.50	
10/9/2009	0.10	20:45:28	Great Black-backed Gull	1	U	121	100	North	25	2.50	
10/9/2009	0.10	20:47:59	Laughing Gull	1	U	121	200	North	25	2.50	

Table J-27 (*continued*). Onshore radar validation survey data at Brigantine Beach, New Jersey, in fall 2009. All data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Bearing	Range (m)	Heading (cardinal)	Altitude (ft ASL)	Radar Sea Clutter (NM)	Comment
10/9/2009	0.10	20:48:24	Forster's Tern	6	U	121	300	South	25	2.50	
10/9/2009	0.10	20:49:17	Forster's Tern	1	U	121	300	South	25	2.50	
10/9/2009	0.10	20:49:56	Forster's Tern	2	U	121	1,000	South	25	2.50	
10/9/2009	0.10	20:51:23	Forster's Tern	3	U	121	100	South	25	2.50	
10/9/2009	0.10	20:51:36	Forster's Tern	3	U	121	200	South	25	2.50	
10/9/2009	0.10	20:51:59	Forster's Tern	4	U	121	200	South	25	2.50	
10/9/2009	0.10	20:52:28	Forster's Tern	1	U	121	200	South	1 (skimming)	2.50	
10/9/2009	0.10	20:57:19	Laughing Gull	4	U	121	300	South	1 (skimming)	2.50	
10/9/2009	0.10	20:58:27	Ring-billed Gull	1	U	121	100	North	25	2.50	
10/9/2009	0.10	20:59:37	Forster's Tern	4	U	121	300	North	25	2.50	
10/9/2009	0.10	21:01:23	Forster's Tern	2	U	121	300	South	1 (skimming)	2.50	
10/9/2009	0.10	21:03:31	Royal Tern	1	U	121	200	North	50	2.50	
10/9/2009	0.10	21:03:57	Laughing Gull	2	U	121	200	North	1 (skimming)	2.50	
10/9/2009	0.10	21:04:33	Royal Tern	1	U	121	100	South	25	2.50	
10/9/2009	0.10	21:06:37	Laughing Gull	1	U	121	500	Northeast	50	2.50	
10/9/2009	0.10	21:07:28	Herring Gull	1	U	121	100	North	100	2.50	
10/9/2009	0.10	21:09:00	Laughing Gull	1	U	121	200	North	25	2.50	
10/9/2009	0.10	21:11:48	Forster's Tern	3	U	121	1,000	South	25	2.50	
10/9/2009	0.10	21:12:52	Laughing Gull	1	U	121	100	North	25	2.50	
10/9/2009	0.10	21:13:59	Great Black-backed Gull	1	U	121	100	North	25	2.50	
10/9/2009	0.10	21:14:54	Forster's Tern	1	U	121	200	South	25	2.50	
10/9/2009	0.10	21:15:31	Forster's Tern	1	U	121	200	South	25	2.50	
10/9/2009	0.10	21:15:36	Forster's Tern	1	U	121	200	South	25	2.50	
10/9/2009	0.10	21:16:03	Forster's Tern	1	U	121	200	South	1 (skimming)	2.50	
10/9/2009	0.10	21:16:09	Forster's Tern	3	U	121	200	South	25	2.50	
10/9/2009	0.10	21:16:22	Forster's Tern	1	U	121	300	South	25	2.50	
10/9/2009	0.10	21:16:42	Forster's Tern	1	U	121	200	South	25	2.50	
10/9/2009	0.10	21:17:08	Ring-billed Gull	1	U	121	200	North	25	2.50	

Table J-27 (*continued*). Onshore radar validation survey data at Brigantine Beach, New Jersey, in fall 2009. All data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Bearing	Range (m)	Heading (cardinal)	Altitude (ft ASL)	Radar Sea Clutter (NM)	Comment
10/9/2009	0.10	21:18:07	Great Black-backed Gull	1	U	121	300	Northwest	25	2.50	
10/9/2009	0.10	21:19:40	Forster's Tern	2	U	121	1,000	South	25	2.50	
10/9/2009	0.10	21:19:59	Laughing Gull	1	U	121	500	North	25	2.50	
10/9/2009	0.10	21:20:44	Forster's Tern	2	U	121	1,000	South	25	2.50	
10/9/2009	0.10	21:21:12	Forster's Tern	1	U	121	1,000	South	25	2.50	
10/9/2009	0.10	21:21:58	Forster's Tern	2	U	121	1,000	South	25	2.50	
10/9/2009	0.10	21:22:06	Laughing Gull	1	U	121	100	North	25	2.50	
10/9/2009	0.10	21:22:31	Forster's Tern	1	U	121	>1,000	South	25	2.50	
10/9/2009	0.10	21:22:31	Forster's Tern	1	U	121	>1,000	South	50	2.50	
10/9/2009	0.10	21:22:57	Forster's Tern	1	U	121	1,000	South	25	2.50	
10/9/2009	0.10	21:23:15	Herring Gull	1	U	121	100	North	25	2.50	
10/9/2009	0.10	21:24:12	Great Black-backed Gull	1	U	121	500	Southwest	25	2.50	
10/9/2009	0.10	21:24:24	Great Black-backed Gull	1	U	121	100	North	50	2.50	
10/9/2009	0.10	21:24:52	Other	1	U	121	>1,000	South	1 (skimming)	2.50	Boat
10/9/2009	0.10	21:25:46	Laughing Gull	1	U	121	500	South	1 (skimming)	2.50	
10/9/2009	0.10	21:28:25	Laughing Gull	1	U	121	300	South	1 (skimming)	2.50	
10/9/2009	0.10	21:28:57	Laughing Gull	1	U	121	300	South	1 (skimming)	2.50	
10/9/2009	0.10	21:29:11	Laughing Gull	1	U	121	300	South	1 (skimming)	2.50	
10/9/2009	0.10	21:29:20	Laughing Gull	1	U	121	300	South	1 (skimming)	2.50	
10/9/2009	0.10	21:31:22	Herring Gull	1	U	121	100	North	25	2.50	
10/9/2009	0.10	21:34:49	Royal Tern	1	U	121	200	South	50	2.50	
10/9/2009	0.10	21:35:37	Laughing Gull	1	U	121	100	South	25	2.50	
10/9/2009	0.10	21:36:11	Forster's Tern	3	U	121	200	South	25	2.50	
10/9/2009	0.10	21:37:54	Forster's Tern	1	U	121	1,000	South	1 (skimming)	2.50	
10/9/2009	0.10	21:38:14	Forster's Tern	3	U	121	1,000	South	1 (skimming)	2.50	
10/9/2009	0.10	21:38:21	Laughing Gull	1	U	121	200	North	25	2.50	
10/9/2009	0.10	21:38:38	Laughing Gull	1	U	121	300	North	1 (skimming)	2.50	
10/9/2009	0.10	21:39:59	Laughing Gull	1	U	121	500	South	1 (skimming)	2.50	

Table J-27 (*continued*). Onshore radar validation survey data at Brigantine Beach, New Jersey, in fall 2009. All data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Bearing	Range (m)	Heading (cardinal)	Altitude (ft ASL)	Radar Sea Clutter (NM)	Comment
10/9/2009	0.10	21:40:17	Herring Gull	1	U	121	500	South	1 (skimming)	2.50	
10/9/2009	0.10	21:41:47	Laughing Gull	1	U	121	200	South	25	2.50	
10/9/2009	0.10	21:42:25	Forster's Tern	1	U	121	100	South	25	2.50	
10/9/2009	0.10	21:42:36	Forster's Tern	1	U	121	200	South	25	2.50	
10/9/2009	0.10	21:42:49	Forster's Tern	1	U	121	200	South	25	2.50	
10/9/2009	0.10	21:42:54	Great Black-backed Gull	1	U	121	100	Northeast	50	2.50	
10/9/2009	0.10	21:45:00	Herring Gull	3	U	121	100	North	50	2.50	
10/9/2009	0.10	21:45:22	Forster's Tern	13	U	121	500	South	25	2.50	
10/9/2009	0.10	21:45:46	Forster's Tern	3	U	121	300	South	1 (skimming)	2.50	
10/9/2009	0.10	21:45:46	Forster's Tern	1	U	121	500	South	1 (skimming)	2.50	
10/9/2009	0.10	21:47:29	Great Black-backed Gull	1	U	121	100	North	25	2.50	
10/9/2009	0.10	21:49:33	Sanderling	11	U	121	100	South	1 (skimming)	2.50	
10/9/2009	0.10	21:51:37	Laughing Gull	2	U	121	300	South	1 (skimming)	2.50	
10/9/2009	0.10	21:52:24	Great Black-backed Gull	2	U	121	300	Northeast	50	2.50	
10/9/2009	0.10	21:54:24	Great Black-backed Gull	1	U	121	200	South	1 (skimming)	2.50	
10/9/2009	0.10	21:57:55	Caspian Tern	1	U	121	100	South	25	2.50	
10/9/2009	0.10	21:58:17	Laughing Gull	1	U	121	200	South	1 (skimming)	2.50	
10/9/2009	0.10	22:00:05	Laughing Gull	2	U	121	200	South	1 (skimming)	2.50	
10/9/2009	0.10	22:02:02	Royal Tern	1	U	121	300	South	50	2.50	
10/9/2009	0.10	22:02:14	Laughing Gull	2	U	121	200	South	1 (skimming)	2.50	
10/9/2009	0.10	22:03:06	Forster's Tern	2	U	121	1,000	South	25	2.50	
10/9/2009	0.10	22:03:18	Forster's Tern	2	U	121	1,000	South	25	2.50	
10/9/2009	0.10	22:03:48	Forster's Tern	4	U	121	300	South	25	2.50	
10/9/2009	0.10	22:03:59	Laughing Gull	1	U	121	300	South	25	2.50	
10/9/2009	0.10	22:04:09	Forster's Tern	1	U	121	300	South	25	2.50	
10/9/2009	0.10	22:04:21	Laughing Gull	2	U	121	500	South	1 (skimming)	2.50	
10/9/2009	0.10	22:04:40	Forster's Tern	1	U	121	500	South	25	2.50	
10/9/2009	0.10	22:04:54	Forster's Tern	2	U	121	1,000	South	25	2.50	

Table J-27 (*continued*). Onshore radar validation survey data at Brigantine Beach, New Jersey, in fall 2009. All data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Bearing	Range (m)	Heading (cardinal)	Altitude (ft ASL)	Radar Sea Clutter (NM)	Comment
10/9/2009	0.10	22:05:03	Forster's Tern	1	U	121	500	South	25	2.50	
10/9/2009	0.10	22:05:17	Forster's Tern	1	U	121	1,000	South	25	2.50	
10/9/2009	0.10	22:05:48	Forster's Tern	2	U	121	200	South	1 (skimming)	2.50	
10/9/2009	0.10	22:07:14	Laughing Gull	2	U	121	500	South	1 (skimming)	2.50	
10/9/2009	0.10	22:07:32	Herring Gull	1	U	121	100	North	25	2.50	
10/9/2009	0.10	22:08:50	Forster's Tern	1	U	121	1,000	South	25	2.50	
10/9/2009	0.10	22:09:09	Forster's Tern	3	U	121	1,000	South	25	2.50	
10/9/2009	0.10	22:09:20	Forster's Tern	3	U	121	1,000	South	25	2.50	
10/9/2009	0.10	22:09:28	Laughing Gull	2	U	121	500	South	1 (skimming)	2.50	
10/9/2009	0.10	22:10:17	Forster's Tern	2	U	121	1,000	South	25	2.50	
10/9/2009	0.10	22:10:31	Forster's Tern	1	U	121	1,000	South	25	2.50	
10/9/2009	0.10	22:10:51	Forster's Tern	2	U	121	1,000	South	25	2.50	
10/9/2009	0.10	22:11:03	Forster's Tern	1	U	121	>1000	South	25	2.50	
10/9/2009	0.10	22:11:26	Great Black-backed Gull	1	U	121	100	North	25	2.50	
10/9/2009	0.10	22:12:56	Great Black-backed Gull	1	U	121	1,000	South	25	2.50	
10/9/2009	0.10	22:13:16	Laughing Gull	1	U	121	1,000	South	1 (skimming)	2.50	
10/9/2009	0.10	22:16:39	Laughing Gull	1	U	121	300	South	1 (skimming)	2.50	
10/9/2009	0.10	22:16:49	Sanderling	8	U	121	200	North	1 (skimming)	2.50	
10/9/2009	0.10	22:18:59	Peregrine Falcon	1	U	121	300	South	1 (skimming)	2.50	
10/9/2009	0.10	22:20:43	Laughing Gull	1	U	121	200	South	1 (skimming)	2.50	
10/9/2009	0.10	22:21:33	Double-crested Cormorant	1	U	121	200	Northeast	1 (skimming)	2.50	
10/9/2009	0.10	22:22:06	Herring Gull	1	U	121	100	South	25	2.50	
10/9/2009	0.10	22:23:48	Great Black-backed Gull	1	U	121	200	North	25	2.50	
10/9/2009	0.10	22:24:05	Great Black-backed Gull	1	U	121	100	North	25	2.50	
10/9/2009	0.10	22:25:44	Great Black-backed Gull	1	U	121	200	North	50	2.50	
10/9/2009	0.10	22:26:04	Laughing Gull	1	U	121	500	North	1 (skimming)	2.50	
10/9/2009	0.10	22:26:34	Laughing Gull	1	U	121	500	North	1 (skimming)	2.50	
10/9/2009	0.10	22:28:39	Forster's Tern	1	U	121	500	North	25	2.50	

Table J-27 (*continued*). Onshore radar validation survey data at Brigantine Beach, New Jersey, in fall 2009. All data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Bearing	Range (m)	Heading (cardinal)	Altitude (ft ASL)	Radar Sea Clutter (NM)	Comment
10/9/2009	0.10	22:29:12	Great Black-backed Gull	1	U	121	200	North	50	2.50	
10/9/2009	0.10	22:29:12	Great Black-backed Gull	1	U	121	100	North	25	2.50	
10/13/2009	0.10	16:45:23	Scoter, dark-winged (unknown)	27	U	90	>1000	Southeast	1 (skimming)	1.00	
10/13/2009	0.10	16:48:31	Scoter (unknown)	8	C	90	>1000	Southeast	1 (skimming)	1.00	
10/13/2009	0.10	16:51:07	Northern Gannet	1	U	90	500	South	25	1.00	
10/13/2009	0.10	16:52:18	Northern Gannet	1	U	90	500	South	50	1.00	
10/13/2009	0.10	16:55:12	Scoter, dark-winged (unknown)	18	U	90	500	North	1 (skimming)	1.00	
10/13/2009	0.10	16:58:40	Northern Gannet	1	U	90	1,000	Southeast	50	1.00	
10/13/2009	0.10	17:01:11	Northern Gannet	1	U	90	>1000	Southeast	1 (skimming)	1.00	
10/13/2009	0.10	17:04:42	Scoter (unknown)	25	U	90	>1000	North	1 (skimming)	1.00	
10/13/2009	0.10	17:06:39	Northern Gannet	1	U	90	500	North	25	1.00	
10/13/2009	0.10	17:16:39	Scoter, dark-winged (unknown)	15	U	90	>1000	South	1 (skimming)	1.00	
10/13/2009	0.10	17:28:43	Royal Tern	1	U	90	500	Northwest	50	1.00	feeding
10/13/2009	0.10	17:34:40	Northern Gannet	2	U	90	>1000	South	25	1.00	
10/13/2009	0.10	17:35:25	Double-crested Cormorant	2	U	90	500	South	50	1.00	
10/13/2009	0.10	17:41:08	Peregrine Falcon	1	U	90	300	Northwest	1 (skimming)	1.00	
10/13/2009	0.10	17:45:13	Laughing Gull	1	U	90	200	Northwest	1 (skimming)	1.00	
10/13/2009	0.10	17:46:04	Peep (unknown)	100	U	90	300	Northwest	1 (skimming)	1.00	
10/13/2009	0.10	17:57:56	Scoter (unknown)	7	U	90	>1000	South	25	1.00	
10/13/2009	0.10	18:01:37	Scoter (unknown)	110	U	90	>1000	North	1 (skimming)	1.00	
10/13/2009	0.10	18:09:03	Northern Gannet	3	U	90	500	South	1 (skimming)	1.00	
10/13/2009	0.10	18:10:34	Royal Tern	1	U	90	500	South	25	1.00	feeding
10/13/2009	0.10	18:13:49	Northern Gannet	1	U	90	>1000	Southeast	1 (skimming)	1.00	
10/13/2009	0.10	18:14:47	Royal Tern	4	U	90	300	South	1 (skimming)	1.00	
10/13/2009	0.10	18:16:11	Black Scoter	50	U	90	1,000	North	1 (skimming)	1.00	
10/13/2009	0.10	18:21:35	Black Scoter	1	U	90	1,000	North	1 (skimming)	1.00	

Table J-27 (*continued*). Onshore radar validation survey data at Brigantine Beach, New Jersey, in fall 2009. All data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Bearing	Range (m)	Heading (cardinal)	Altitude (ft ASL)	Radar Sea Clutter (NM)	Comment
10/13/2009	0.10	18:23:12	Northern Gannet	1	U	90	1,000	West	1 (skimming)	1.00	
10/13/2009	0.10	18:27:26	Forster's Tern	1	U	90	300	North	1 (skimming)	1.00	
10/13/2009	0.10	18:36:26	Northern Gannet	1	U	90	>1000	South	1 (skimming)	1.00	
10/13/2009	0.10	18:45:14	Royal Tern	1	U	90	>1000	Northwest	25	1.00	
10/13/2009	0.10	18:47:42	Black Scoter	4	U	90	1,000	South	1 (skimming)	1.00	
10/13/2009	0.10	18:54:02	Black Scoter	60	U	90	>1000	Northwest	1 (skimming)	1.00	
10/13/2009	0.10	18:59:20	Northern Gannet	1	U	90	>1000	Southeast	1 (skimming)	1.00	
10/13/2009	0.10	19:06:17	Herring Gull	1	U	90	500	West	50	1.00	
10/13/2009	0.10	19:20:19	Northern Gannet	1	U	90	1,000	Southeast	25	1.00	
10/13/2009	0.10	19:21:50	Northern Gannet	1	U	90	>1000	North	100	1.00	
10/13/2009	0.10	19:36:20	Scoter (unknown)	5	U	90	>1000	North	1 (skimming)	1.00	
10/13/2009	0.10	19:41:15	Scoter, dark-winged (unknown)	2	U	90	>1000	North	1 (skimming)	1.00	
10/13/2009	0.10	19:43:09	Northern Gannet	1	U	90	1,000	Southwest	25	1.00	
10/13/2009	0.10	19:46:15	Laughing Gull	1	U	90	500	Northwest	1 (skimming)	1.00	
10/13/2009	0.10	19:47:53	Northern Gannet	1	U	90	>1000	South	1 (skimming)	1.00	
10/13/2009	0.10	19:48:58	Northern Gannet	1	U	90	>1000	South	1 (skimming)	1.00	
10/13/2009	0.10	19:50:40	Northern Gannet	1	U	90	500	North	1 (skimming)	1.00	
10/13/2009	0.10	19:51:56	Black Scoter	28	C	90	1,000	North	1 (skimming)	1.00	
10/13/2009	0.10	19:53:38	Forster's Tern	4	U	90	500	North	1 (skimming)	1.00	
10/13/2009	0.10	19:54:47	Laughing Gull	1	U	90	300	Southwest	25	1.00	
10/13/2009	0.10	19:57:42	Laughing Gull	1	U	90	500	Northwest	1 (skimming)	1.00	
10/13/2009	0.10	19:59:31	Royal Tern	1	U	90	500	Northwest	50	1.00	
10/13/2009	0.10	20:06:08	Forster's Tern	3	U	90	500	North	1 (skimming)	1.00	
10/13/2009	0.10	20:07:24	Royal Tern	1	U	90	500	Northwest	50	1.00	
10/13/2009	0.10	20:09:52	Northern Gannet	1	U	90	>1000	North	1 (skimming)	1.00	
10/13/2009	0.10	20:12:15	Gull, large (unknown)	1	U	90	500	South	100	1.00	
10/13/2009	0.10	20:17:05	Northern Gannet	1	U	90	>1000	South	1 (skimming)	1.00	
10/13/2009	0.10	20:19:11	Ring-billed Gull	1	U	90	300	North	1 (skimming)	1.00	

Table J-27 (*continued*). Onshore radar validation survey data at Brigantine Beach, New Jersey, in fall 2009. All data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Bearing	Range (m)	Heading (cardinal)	Altitude (ft ASL)	Radar Sea Clutter (NM)	Comment
10/13/2009	0.10	20:21:25	Northern Gannet	1	U	90	500	West	1 (skimming)	1.00	feeding
10/13/2009	0.10	20:22:57	Royal Tern	1	U	90	500	North	25	1.00	
10/14/2009	0.10	11:15:31	Scoter, dark-winged (unknown)	5	U	90	>1000	South	1 (skimming)	2.00	
10/14/2009	0.10	11:15:31	Scoter, dark-winged (unknown)	4	U	90	>1000	South	1 (skimming)	2.00	
10/14/2009	0.10	11:18:16	Black Scoter	7	U	90	500	North	1 (skimming)	2.00	
10/14/2009	0.10	11:20:25	Double-crested Cormorant	2	U	90	300	Southwest	25	2.00	
10/14/2009	0.10	11:23:00	Scoter, dark-winged (unknown)	15	U	90	1,000	North	1 (skimming)	2.00	
10/14/2009	0.10	11:24:19	Scoter, dark-winged (unknown)	30	U	90	>1000	South	1 (skimming)	2.00	
10/14/2009	0.10	11:24:54	Scoter, dark-winged (unknown)	20	U	90	>1000	South	1 (skimming)	2.00	
10/14/2009	0.10	11:26:43	Forster's Tern	10	U	90	500	North	25	2.00	
10/14/2009	0.10	11:29:28	Scoter (unknown)	2	U	90	1,000	South	50	2.00	
10/14/2009	0.10	11:29:55	Scoter (unknown)	15	U	90	>1000	Southeast	1 (skimming)	2.00	
10/14/2009	0.10	11:30:49	Scoter (unknown)	12	U	90	>1000	North	1 (skimming)	2.00	
10/14/2009	0.10	11:31:18	Scoter (unknown)	3	U	90	>1000	North	1 (skimming)	2.00	
10/14/2009	0.10	11:32:52	Northern Gannet	1	U	90	>1000	North	25	2.00	
10/14/2009	0.10	11:33:30	Herring Gull	1	U	90	300	South	25	2.00	
10/14/2009	0.10	11:33:30	Ring-billed Gull	1	U	90	200	South	25	2.00	
10/14/2009	0.10	11:35:47	Herring Gull	3	U	90	200	Southwest	500	2.00	
10/14/2009	0.10	11:36:55	Northern Gannet	1	U	90	>1000	North	25	2.00	
10/14/2009	0.10	11:37:43	Green-winged Teal	5	U	90	1,000	Southwest	1 (skimming)	2.00	
10/14/2009	0.10	11:39:00	Forster's Tern	1	U	90	1,000	North	25	2.00	
10/14/2009	0.10	11:39:51	Double-crested Cormorant	5	U	90	1,000	South	200	2.00	
10/14/2009	0.10	11:41:49	Brown Pelican	1	U	90	1,000	Southwest	50	2.00	
10/14/2009	0.10	11:42:29	Surf Scoter	7	U	90	500	North	1 (skimming)	2.00	
10/14/2009	0.10	11:42:29	Northern Shoveler	1	U	90	500	North	1 (skimming)	2.00	

Table J-27 (*continued*). Onshore radar validation survey data at Brigantine Beach, New Jersey, in fall 2009. All data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Bearing	Range (m)	Heading (cardinal)	Altitude (ft ASL)	Radar Sea Clutter (NM)	Comment
10/14/2009	0.10	11:44:14	Green-winged Teal	2	U	90	>1000	South	25	2.00	
10/14/2009	0.10	11:46:22	Scoter, dark-winged (unknown)	3	U	90	1,000	South	50	2.00	
10/14/2009	0.10	11:50:33	American Black Duck	3	U	90	500	North	50	2.00	
10/14/2009	0.10	11:51:11	Laughing Gull	1	U	90	200	South	25	2.00	
10/14/2009	0.10	11:51:34	Scoter, dark-winged (unknown)	60	U	90	>1000	Southwest	25	2.00	
10/14/2009	0.10	11:51:34	Green-winged Teal	4	U	90	>1000	Southwest	25	2.00	
10/14/2009	0.10	11:53:24	Northern Gannet	2	U	90	>1000	North	100	2.00	
10/14/2009	0.10	11:54:01	Double-crested Cormorant	24	U	90	200	Southwest	300	2.00	
10/14/2009	0.10	11:55:51	Common Loon	1	U	90	>1000	South	1000	2.00	
10/14/2009	0.10	11:56:36	Scoter, dark-winged (unknown)	60	U	90	>1000	South	1 (skimming)	2.00	
10/14/2009	0.10	11:59:17	Northern Gannet	1	C	90	>1000	South	50	2.00	
10/14/2009	0.10	12:00:45	Royal Tern	3	U	90	1,000	Northeast	50	2.00	
10/14/2009	0.10	12:00:45	Northern Gannet	2	U	90	>1000	South	25	2.00	
10/14/2009	0.10	12:04:18	Scoter (unknown)	65	U	90	>1000	South	25	2.00	
10/14/2009	0.10	12:06:38	Northern Gannet	1	U	90	>1000	Southwest	25	2.00	
10/14/2009	0.10	12:07:20	Northern Gannet	1	U	90	1,000	North	100	2.00	
10/14/2009	0.10	12:13:13	Scoter (unknown)	5	U	90	>1000	South	25	2.00	
10/14/2009	0.10	12:14:10	Black-bellied Plover	6	U	90	300	Southwest	50	2.00	
10/14/2009	0.10	12:16:32	Peregrine Falcon	1	U	90	300	North	1 (skimming)	2.00	
10/14/2009	0.10	12:17:28	Northern Gannet	1	U	90	1,000	North	25	2.00	
10/14/2009	0.10	12:19:16	Scoter, dark-winged (unknown)	40	U	90	1,000	North	25	2.00	
10/14/2009	0.10	12:22:08	Other	1	U	90	1,000	North	1 (skimming)	2.00	Boat
10/14/2009	0.10	12:23:37	Common Loon	3	U	90	1,000	South	500	2.00	
10/14/2009	0.10	12:24:04	Double-crested Cormorant	75	U	90	>1000	South	500	2.00	
10/14/2009	0.10	12:29:02	Canada Goose	7	U	90	1,000	North	100	2.00	

Table J-27 (*continued*). Onshore radar validation survey data at Brigantine Beach, New Jersey, in fall 2009. All data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Bearing	Range (m)	Heading (cardinal)	Altitude (ft ASL)	Radar Sea Clutter (NM)	Comment
10/14/2009	0.10	12:31:38	Double-crested Cormorant	40	C	90	>1000	South	100	2.00	
10/14/2009	0.10	12:32:22	Atlantic Brant	10	U	90	1,000	South	50	2.00	
10/14/2009	0.10	12:34:03	Double-crested Cormorant	112	U	90	>1000	South	200	2.00	
10/14/2009	0.10	12:36:21	Scoter, dark-winged (unknown)	20	C	90	>1000	South	100	2.00	
10/14/2009	0.10	12:36:21	Scoter, dark-winged (unknown)	15	C	90	>1000	South	100	2.00	
10/14/2009	0.10	12:39:39	Canada Goose	10	U	90	>1000	North	25	2.00	
10/14/2009	0.10	12:40:16	Double-crested Cormorant	60	U	90	>1000	South	200	2.00	
10/14/2009	0.10	12:43:22	Northern Gannet	3	U	90	1,000	South	25	2.00	
10/14/2009	0.10	12:45:33	Northern Gannet	1	U	90	>1000	South	50	2.00	
10/14/2009	0.10	12:46:00	Tern, small (unknown)	2	U	90	500	North	25	2.00	
10/14/2009	0.10	12:49:21	Duck, dabbling (unknown)	1	U	90	>1000	South	200	2.00	
10/14/2009	0.10	12:53:26	Atlantic Brant	16	U	90	500	North	100	2.00	
10/14/2009	0.10	12:55:34	Common Eider	2	U	90	500	South	50	2.00	
10/14/2009	0.10	12:55:34	Green-winged Teal	1	U	90	500	South	50	2.00	
10/14/2009	0.10	12:57:35	Scoter, dark-winged (unknown)	15	U	90	500	Southwest	25	2.00	
10/14/2009	0.10	12:58:20	Herring Gull	1	U	90	500	North	1 (skimming)	2.00	
10/14/2009	0.10	13:03:19	American Black Duck	5	U	90	300	Southwest	300	2.00	
10/14/2009	0.10	13:06:14	Double-crested Cormorant	27	U	90	1,000	South	300	2.00	
10/14/2009	0.10	13:06:14	Red-throated Loon	1	U	90	1,000	South	300	2.00	
10/14/2009	0.10	13:07:14	Red-throated Loon	1	U	90	>1000	South	25	2.00	
10/14/2009	0.10	13:09:37	Scoter, dark-winged (unknown)	12	U	90	>1000	South	25	2.00	
10/14/2009	0.10	13:10:08	Double-crested Cormorant	7	C	90	>1000	South	100	2.00	
10/14/2009	0.10	13:19:21	Scoter, dark-winged (unknown)	8	C	90	>1000	South	25	2.00	
10/14/2009	0.10	13:20:42	Scoter, dark-winged (unknown)	3	U	90	500	South	25	2.00	

Table J-27 (*continued*). Onshore radar validation survey data at Brigantine Beach, New Jersey, in fall 2009. All data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Bearing	Range (m)	Heading (cardinal)	Altitude (ft ASL)	Radar Sea Clutter (NM)	Comment
10/14/2009	0.10	13:23:20	Surf Scoter	1	U	90	300	North	25	2.00	
10/14/2009	0.10	13:29:48	Double-crested Cormorant	50	C	90	>1000	South	200	2.00	
10/14/2009	0.10	13:31:19	Northern Gannet	1	U	90	>1000	South	50	2.00	
10/14/2009	0.10	13:35:08	Double-crested Cormorant	14	U	90	300	Southwest	300	2.00	
10/14/2009	0.10	13:35:08	Common Loon	1	U	90	300	Southwest	500	2.00	
10/14/2009	0.10	13:36:27	Scoter, dark-winged (unknown)	25	U	90	1,000	South	25	2.00	
10/14/2009	0.10	13:40:37	Double-crested Cormorant	70	U	90	>1000	South	500	2.00	
10/14/2009	0.10	13:43:28	Green-winged Teal	22	U	90	300	South	1 (skimming)	2.00	
10/14/2009	0.10	13:44:53	Common Loon	1	U	90	300	Southwest	200	2.00	
10/14/2009	0.10	13:45:41	Royal Tern	1	U	90	300	Southwest	50	2.00	
10/14/2009	0.10	13:47:45	Surf Scoter	3	U	90	500	North	1 (skimming)	2.00	
10/14/2009	0.10	13:48:10	Green-winged Teal	2	U	90	1,000	North	1 (skimming)	2.00	
10/14/2009	0.10	13:48:35	Green-winged Teal	23	U	90	500	South	1 (skimming)	2.00	
10/14/2009	0.10	13:49:06	Scoter, dark-winged (unknown)	16	C	90	>1000	Southwest	25	2.00	
10/14/2009	0.10	13:50:37	Double-crested Cormorant	11	U	90	500	South	500	2.00	
10/14/2009	0.10	13:52:18	Laughing Gull	1	U	90	1,000	North	25	2.00	
10/14/2009	0.10	13:54:17	Double-crested Cormorant	63	C	90	>1000	South	500	2.00	
10/14/2009	0.10	13:56:21	Green-winged Teal	34	U	90	300	South	1 (skimming)	2.00	
10/14/2009	0.10	14:03:41	Canada Goose	1	U	90	>1,000	South	100	2.00	
10/14/2009	0.10	14:06:35	Royal Tern	1	U	90	500	Southwest	25	2.00	
10/14/2009	0.10	14:09:48	Scoter, dark-winged (unknown)	40	U	90	>1,000	South	25	2.00	
10/14/2009	0.10	14:09:48	Green-winged Teal	7	U	90	>1,000	South	25	2.00	
10/14/2009	0.10	14:12:41	Scoter, dark-winged (unknown)	1	U	90	1,000	North	1 (skimming)	2.00	
10/14/2009	0.10	14:13:42	Scoter, dark-winged (unknown)	55	U	90	>1,000	South	25	2.00	
10/14/2009	0.10	14:13:42	Green-winged Teal	5	U	90	>1,000	South	25	2.00	

Table J-27 (*continued*). Onshore radar validation survey data at Brigantine Beach, New Jersey, in fall 2009. All data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Bearing	Range (m)	Heading (cardinal)	Altitude (ft ASL)	Radar Sea Clutter (NM)	Comment
10/14/2009	0.10	14:18:47	Other	1	U	90	>1,000	Northeast	1 (skimming)	2.00	Boat
10/14/2009	0.10	14:23:47	Ring-billed Gull	1	U	90	200	North	25	2.00	
10/14/2009	0.10	14:28:05	Double-crested Cormorant	27	U	90	500	Southwest	300	2.00	
10/14/2009	0.10	14:33:26	Double-crested Cormorant	23	U	90	>1,000	Southwest	500	2.00	
10/14/2009	0.10	14:34:39	Scoter, dark-winged (unknown)	15	U	90	>1,000	South	50	2.00	
10/14/2009	0.10	14:36:33	Double-crested Cormorant	115	U	90	1,000	Southwest	1000	2.00	
10/14/2009	0.10	14:40:08	Green-winged Teal	12	U	90	500	South	1 (skimming)	2.00	
10/14/2009	0.10	14:40:08	Double-crested Cormorant	25	U	90	1,000	South	500	2.00	
10/14/2009	0.10	14:45:19	Ring-billed Gull	1	U	90	1,000	Southwest	25	2.00	
10/14/2009	0.10	14:46:31	Scoter, dark-winged (unknown)	57	C	90	>1,000	South	25	2.00	
10/14/2009	0.10	14:47:29	Scoter, dark-winged (unknown)	50	U	90	>1,000	South	25	2.00	
10/14/2009	0.10	14:47:29	Black Scoter	27	U	90	500	North	25	2.00	
10/14/2009	0.10	14:52:30	Mallard	6	U	90	500	West	300	2.00	
10/14/2009	0.10	14:53:11	Double-crested Cormorant	33	U	90	1,000	South	500	2.00	
10/14/2009	0.10	14:55:47	Scoter, dark-winged (unknown)	22	U	90	>1,000	Southwest	25	2.00	
10/14/2009	0.10	14:59:38	Other	1	U	90	>1,000	South	1 (skimming)	2.00	Boat
10/14/2009	0.10	15:01:41	Surf Scoter	31	U	90	300	North	1 (skimming)	2.00	
10/14/2009	0.10	15:03:51	Scoter, dark-winged (unknown)	10	U	90	>1,000	North	1 (skimming)	2.00	
10/14/2009	0.10	15:05:08	Herring Gull	14	U	90	300	South	25	2.00	
10/14/2009	0.10	15:06:02	Scoter, dark-winged (unknown)	11	U	90	>1,000	Southwest	50	2.00	
10/14/2009	0.10	15:06:02	Scaup (unknown)	3	U	90	>1,000	Southwest	50	2.00	
10/14/2009	0.10	15:07:17	Northern Gannet	1	U	90	>1,000	North	100	2.00	
10/14/2009	0.10	15:08:09	Royal Tern	1	U	90	>1,000	North	25	2.00	
10/14/2009	0.10	15:10:54	Double-crested Cormorant	24	U	90	1,000	Southeast	1000	2.00	

Table J-27 (*continued*). Onshore radar validation survey data at Brigantine Beach, New Jersey, in fall 2009. All data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Bearing	Range (m)	Heading (cardinal)	Altitude (ft ASL)	Radar Sea Clutter (NM)	Comment
10/19/2009	0.10	18:13:49	Double-crested Cormorant	84	U	121	1,000	South	200	1.00	
10/19/2009	0.10	18:14:52	Herring Gull	2	U	121	300	South	50	1.00	
10/19/2009	0.10	18:15:19	Forster's Tern	5	U	121	100	Southwest	50	1.00	
10/19/2009	0.10	18:18:09	Northern Gannet	1	C	121	>1,000	Southwest	50	1.00	
10/19/2009	0.10	18:18:39	Scoter, dark-winged (unknown)	25	U	121	>1,000	South	1 (skimming)	1.00	
10/19/2009	0.10	18:21:17	Common Loon	1	U	121	500	South	100	1.00	
10/19/2009	0.10	18:21:37	Double-crested Cormorant	19	U	121	200	Southwest	50	1.00	
10/19/2009	0.10	18:22:59	Laughing Gull	1	U	121	300	South	50	1.00	
10/19/2009	0.10	18:23:09	Scoter, dark-winged (unknown)	20	U	121	500	North	1 (skimming)	1.00	
10/19/2009	0.10	18:23:33	Great Egret	12	U	121	1,000	South	100	1.00	
10/19/2009	0.10	18:24:05	Ring-billed Gull	1	U	121	200	Southwest	50	1.00	
10/19/2009	0.10	18:24:31	Common Loon	1	U	121	>1,000	South	1 (skimming)	1.00	
10/19/2009	0.10	18:25:03	Northern Gannet	1	U	121	>1,000	South	1 (skimming)	1.00	
10/19/2009	0.10	18:25:23	Ring-billed Gull	1	U	121	200	South	25	1.00	
10/19/2009	0.10	18:26:04	White-winged Scoter	1	U	121	300	North	1 (skimming)	1.00	
10/19/2009	0.10	18:26:39	Northern Gannet	1	C	121	>1,000	North	50	1.00	
10/19/2009	0.10	18:27:26	Northern Gannet	1	U	121	>1,000	South	1 (skimming)	1.00	
10/19/2009	0.10	18:28:05	Black Scoter	18	U	121	200	North	1 (skimming)	1.00	
10/19/2009	0.10	18:28:23	Laughing Gull	1	U	121	1,000	North	50	1.00	
10/19/2009	0.10	18:28:50	Laughing Gull	1	U	121	1,000	North	50	1.00	
10/19/2009	0.10	18:29:50	Scoter, dark-winged (unknown)	40	C	121	>1,000	South	1 (skimming)	1.00	
10/19/2009	0.10	18:30:58	Northern Gannet	1	C	121	>1,000	South	25	1.00	
10/19/2009	0.10	18:31:41	Northern Gannet	2	U	121	>1,000	South	1 (skimming)	1.00	
10/19/2009	0.10	18:32:24	Northern Gannet	2	U	121	>1,000	North	25	1.00	
10/19/2009	0.10	18:33:34	Herring Gull	1	C	121	>1,000	South	25	1.00	
10/19/2009	0.10	18:34:01	Double-crested Cormorant	1	U	121	200	North	50	1.00	

Table J-27 (*continued*). Onshore radar validation survey data at Brigantine Beach, New Jersey, in fall 2009. All data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Bearing	Range (m)	Heading (cardinal)	Altitude (ft ASL)	Radar Sea Clutter (NM)	Comment
10/19/2009	0.10	18:34:50	Laughing Gull	2	U	121	1,000	North	50	1.00	
10/19/2009	0.10	18:40:37	Herring Gull	1	U	121	500	Northwest	1 (skimming)	1.00	
10/19/2009	0.10	18:40:56	Double-crested Cormorant	125	C	121	>1,000	South	100	1.00	
10/19/2009	0.10	18:42:15	Forster's Tern	3	U	121	500	South	50	1.00	
10/19/2009	0.10	18:43:43	Double-crested Cormorant	26	U	121	1,000	South	100	1.00	
10/19/2009	0.10	18:44:53	Ring-billed Gull	1	U	121	200	South	50	1.00	
10/19/2009	0.10	18:45:44	Black Scoter	3	U	121	300	North	1 (skimming)	1.00	
10/19/2009	0.10	18:47:25	Great Black-backed Gull	1	U	121	300	South	100	1.00	
10/19/2009	0.10	18:49:04	Northern Gannet	2	C	121	>1,000	South	1 (skimming)	1.00	
10/19/2009	0.10	18:50:26	Northern Gannet	2	C	121	>1,000	South	1 (skimming)	1.00	
10/19/2009	0.10	18:50:34	Ring-billed Gull	1	U	121	300	South	50	1.00	
10/19/2009	0.10	18:51:42	Double-crested Cormorant	34	U	121	1,000	South	300	1.00	
10/19/2009	0.10	18:53:32	Common Loon	3	U	121	500	South	300	1.00	
10/19/2009	0.10	18:54:03	Double-crested Cormorant	4	U	121	300	South	200	1.00	
10/19/2009	0.10	18:55:19	Northern Gannet	1	U	121	>1,000	South	100	1.00	
10/19/2009	0.10	18:56:17	Black Scoter	1	U	121	500	South	1 (skimming)	1.00	
10/19/2009	0.10	18:57:05	Double-crested Cormorant	1	U	121	>1,000	South	200	1.00	
10/19/2009	0.10	18:57:58	Ring-billed Gull	1	U	121	100	South	50	1.00	
10/19/2009	0.10	18:58:58	Northern Gannet	1	C	121	>1,000	South	1 (skimming)	1.00	
10/19/2009	0.10	19:01:07	Northern Gannet	1	U	121	>1,000	South	25	1.00	
10/19/2009	0.10	19:01:40	Northern Gannet	2	U	121	>1,000	South	100	1.00	
10/19/2009	0.10	19:02:10	Double-crested Cormorant	85	U	121	300	South	100	1.00	
10/19/2009	0.10	19:03:22	Double-crested Cormorant	140	U	121	200	South	100	1.00	
10/19/2009	0.10	19:03:34	Double-crested Cormorant	65	U	121	200	South	100	1.00	
10/19/2009	0.10	19:03:51	Double-crested Cormorant	38	U	121	100	South	100	1.00	
10/19/2009	0.10	19:04:57	Herring Gull	1	U	121	100	South	50	1.00	
10/19/2009	0.10	19:05:33	Herring Gull	1	U	121	1,000	South	50	1.00	
10/19/2009	0.10	19:05:43	Northern Gannet	1	U	121	>1,000	South	100	1.00	

Table J-27 (*continued*). Onshore radar validation survey data at Brigantine Beach, New Jersey, in fall 2009. All data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Bearing	Range (m)	Heading (cardinal)	Altitude (ft ASL)	Radar Sea Clutter (NM)	Comment
10/19/2009	0.10	19:06:17	Laughing Gull	1	U	121	>1,000	North	50	1.00	
10/19/2009	0.10	19:06:17	Herring Gull	2	C	121	>1,000	South	50	1.00	
10/19/2009	0.10	19:06:44	Great Black-backed Gull	1	U	121	100	South	25	1.00	
10/19/2009	0.10	19:07:38	Northern Gannet	1	U	121	>1,000	South	100	1.00	
10/19/2009	0.10	19:08:00	Northern Gannet	1	C	121	>1,000	South	100	1.00	
10/19/2009	0.10	19:08:56	Forster's Tern	1	U	121	1,000	Southwest	50	1.00	
10/19/2009	0.10	19:10:29	Laughing Gull	1	C	121	>1,000	South	50	1.00	
10/19/2009	0.10	19:11:46	Ring-billed Gull	1	U	121	300	Southwest	50	1.00	
10/19/2009	0.10	19:13:23	Northern Gannet	1	C	121	>1,000	South	25	1.00	
10/19/2009	0.10	19:15:32	Northern Gannet	1	U	121	1,000	South	1 (skimming)	1.00	
10/19/2009	0.10	19:16:23	Northern Gannet	1	U	121	>1,000	South	100	1.00	
10/19/2009	0.10	19:16:45	Northern Gannet	1	U	121	>1,000	South	25	1.00	
10/19/2009	0.10	19:17:19	Northern Gannet	1	U	121	>1,000	Northwest	25	1.00	
10/19/2009	0.10	19:18:07	Great Egret	8	U	121	>1,000	South	100	1.00	
10/19/2009	0.10	19:19:09	Herring Gull	2	U	121	200	South	25	1.00	
10/19/2009	0.10	19:19:26	Northern Gannet	1	U	121	>1,000	South	1 (skimming)	1.00	
10/19/2009	0.10	19:19:37	Northern Gannet	2	U	121	>1,000	South	25	1.00	
10/19/2009	0.10	19:19:44	Double-crested Cormorant	1	U	121	200	Southwest	50	1.00	
10/19/2009	0.10	19:20:19	Northern Gannet	1	U	121	>1,000	Northwest	50	1.00	
10/19/2009	0.10	19:21:41	Surf Scoter	15	C	121	>1,000	South	1 (skimming)	1.00	
10/19/2009	0.10	19:22:26	Northern Gannet	2	C	121	>1,000	South	200	1.00	
10/19/2009	0.10	19:23:00	Northern Gannet	1	U	121	>1,000	South	100	1.00	
10/19/2009	0.10	19:23:12	Forster's Tern	1	U	121	200	South	50	1.00	
10/19/2009	0.10	19:23:21	Double-crested Cormorant	45	U	121	>1,000	South	25	1.00	
10/19/2009	0.10	19:24:24	Northern Gannet	1	C	121	>1,000	South	1 (skimming)	1.00	
10/19/2009	0.10	19:24:50	Laughing Gull	1	C	121	>1,000	North	25	1.00	
10/19/2009	0.10	19:27:09	Northern Gannet	1	U	121	>1,000	South	1 (skimming)	1.00	
10/19/2009	0.10	19:29:38	Northern Gannet	1	C	121	>1,000	South	100	1.00	

Table J-27 (*continued*). Onshore radar validation survey data at Brigantine Beach, New Jersey, in fall 2009. All data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Bearing	Range (m)	Heading (cardinal)	Altitude (ft ASL)	Radar Sea Clutter (NM)	Comment
10/19/2009	0.10	19:29:52	Scoter (unknown)	25	U	121	>1,000	South	50	1.00	
10/19/2009	0.10	19:30:57	Northern Gannet	1	C	121	>1,000	South	100	1.00	
10/19/2009	0.10	19:31:14	Great Black-backed Gull	1	U	121	200	North	50	1.00	
10/19/2009	0.10	19:32:20	Northern Gannet	1	U	121	200	South	100	1.00	
10/19/2009	0.10	19:32:20	Great Black-backed Gull	1	U	121	300	Northwest	200	1.00	
10/19/2009	0.10	19:33:25	Northern Gannet	1	U	121	>1,000	South	100	1.00	
10/19/2009	0.10	19:33:43	Great Black-backed Gull	1	U	121	1,000	Northwest	100	1.00	
10/19/2009	0.10	19:34:03	Scoter, dark-winged (unknown)	33	U	121	>1,000	South	1 (skimming)	1.00	
10/19/2009	0.10	19:35:16	Ring-billed Gull	1	U	121	500	South	100	1.00	
10/19/2009	0.10	19:37:12	Northern Gannet	1	U	121	1,000	Southwest	100	1.00	
10/19/2009	0.10	19:37:59	Great Black-backed Gull	1	U	121	1,000	North	100	1.00	
10/19/2009	0.10	19:38:39	Herring Gull	1	U	121	1,000	South	50	1.00	
10/19/2009	0.10	19:41:02	Northern Gannet	1	U	121	1,000	South	50	1.00	
10/19/2009	0.10	19:41:41	Northern Gannet	1	U	121	1,000	South	50	1.00	
10/19/2009	0.10	19:44:04	Great Black-backed Gull	1	U	121	200	North	100	1.00	
10/19/2009	0.10	19:45:22	Double-crested Cormorant	57	U	121	300	South	100	1.00	
10/19/2009	0.10	19:48:02	Scoter, dark-winged (unknown)	9	C	121	>1,000	South	1 (skimming)	1.00	
10/19/2009	0.10	19:50:19	Forster's Tern	1	C	121	1,000	South	25	1.00	
10/19/2009	0.10	19:50:32	Northern Gannet	2	C	121	1,000	South	1 (skimming)	1.00	
10/19/2009	0.10	19:50:55	Northern Gannet	2	U	121	>1,000	South	1 (skimming)	1.00	
10/19/2009	0.10	19:51:16	Laughing Gull	1	U	121	1,000	North	50	1.00	
10/19/2009	0.10	19:51:16	Great Black-backed Gull	1	U	121	1,000	North	200	1.00	
10/19/2009	0.10	19:51:39	Northern Gannet	1	C	121	>1,000	South	25	1.00	
10/19/2009	0.10	19:51:51	Northern Gannet	1	U	121	>1,000	South	25	1.00	
10/19/2009	0.10	19:51:58	Forster's Tern	5	U	121	500	Northwest	25	1.00	
10/19/2009	0.10	19:52:10	Brown Pelican	3	U	121	300	South	1 (skimming)	1.00	
10/19/2009	0.10	19:52:37	Double-crested Cormorant	170	C	121	1,000	South	100	1.00	

Table J-27 (*continued*). Onshore radar validation survey data at Brigantine Beach, New Jersey, in fall 2009. All data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Bearing	Range (m)	Heading (cardinal)	Altitude (ft ASL)	Radar Sea Clutter (NM)	Comment
10/19/2009	0.10	20:02:24	Northern Gannet	1	C	121	>1,000	South	100	1.00	
10/19/2009	0.10	20:02:44	Northern Gannet	2	U	121	>1,000	South	25	1.00	
10/19/2009	0.10	20:02:56	Northern Gannet	1	U	121	>1,000	South	1 (skimming)	1.00	
10/19/2009	0.10	20:03:54	Northern Gannet	1	C	121	>1,000	Southwest	50	1.00	
10/19/2009	0.10	20:04:12	Brown Pelican	1	U	121	200	North	25	1.00	
10/19/2009	0.10	20:06:05	Laughing Gull	1	C	121	>1,000	South	25	1.00	
10/19/2009	0.10	20:07:20	Herring Gull	1	U	121	100	South	25	1.00	
10/19/2009	0.10	20:08:03	Surf Scoter	110	U	121	1,000	South	1 (skimming)	1.00	
10/19/2009	0.10	20:09:10	Northern Gannet	1	C	121	1,000	South	1 (skimming)	1.00	
10/19/2009	0.10	20:09:26	Laughing Gull	1	U	121	1,000	South	25	1.00	
10/19/2009	0.10	20:10:09	Surf Scoter	1	U	121	>1,000	South	1 (skimming)	1.00	
10/19/2009	0.10	20:11:21	Northern Gannet	1	U	121	>1,000	South	100	1.00	
10/19/2009	0.10	20:11:56	Northern Gannet	1	U	121	>1,000	South	25	1.00	
10/19/2009	0.10	20:12:27	Northern Gannet	1	U	121	>1,000	South	1 (skimming)	1.00	
10/19/2009	0.10	20:12:58	Northern Gannet	1	C	121	>1,000	South	25	1.00	
10/19/2009	0.10	20:13:25	Northern Gannet	2	U	121	>1,000	South	25	1.00	
10/19/2009	0.10	20:14:01	Brown Pelican	3	U	121	300	South	1 (skimming)	1.00	
10/19/2009	0.10	20:15:08	Laughing Gull	7	U	121	200	South	100	1.00	
10/19/2009	0.10	20:15:08	Great Egret	40	C	121	>1,000	South	300	1.00	
10/19/2009	0.10	20:15:54	Great Egret	1	U	121	500	South	100	1.00	
10/19/2009	0.10	20:15:54	Great Egret	1	C	121	1,000	South	200	1.00	
10/19/2009	0.10	20:17:03	Great Egret	8	C	121	500	South	200	1.00	2 SNEG
10/19/2009	0.10	20:17:39	Double-crested Cormorant	6	U	121	200	South	100	1.00	
10/19/2009	0.10	20:19:02	Northern Gannet	2	U	121	1,000	Southwest	25	1.00	
10/19/2009	0.10	20:20:22	Scoter, dark-winged (unknown)	295	U	121	200	North	1 (skimming)	1.00	
10/19/2009	0.10	20:21:00	Scoter, dark-winged (unknown)	100	U	121	200	North	1 (skimming)	1.00	

Table J-27(*continued*). Onshore radar validation survey data at Brigantine Beach, New Jersey, in fall 2009. All data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Bearing	Range (m)	Heading (cardinal)	Altitude (ft ASL)	Radar Sea Clutter (NM)	Comment
10/19/2009	0.10	20:21:15	Scoter, dark-winged (unknown)	20	U	121	300	North	25	1.00	
10/19/2009	0.10	20:23:02	Northern Gannet	1	U	121	>1,000	South	1 (skimming)	1.00	
10/19/2009	0.10	20:23:22	Scoter, dark-winged (unknown)	30	U	121	300	South	50	1.00	
10/19/2009	0.10	20:24:00	Scoter, dark-winged (unknown)	325	U	121	500	South	100	1.00	
10/19/2009	0.10	20:24:23	Scoter, dark-winged (unknown)	85	C	121	>1,000	South	25	1.00	
10/19/2009	0.10	20:25:09	Northern Gannet	1	C	121	>1,000	South	50	1.00	
10/19/2009	0.10	20:26:03	Northern Gannet	2	U	121	>1,000	South	25	1.00	
10/19/2009	0.10	20:26:16	Northern Gannet	2	U	121	1,000	South	1 (skimming)	1.00	
10/19/2009	0.10	20:26:56	Northern Gannet	1	U	121	1,000	South	1 (skimming)	1.00	
10/19/2009	0.10	20:26:56	Northern Gannet	2	U	121	>1,000	South	100	1.00	
10/19/2009	0.10	20:26:56	Northern Gannet	1	C	121	>1,000	North	1 (skimming)	1.00	
10/19/2009	0.10	20:27:46	Laughing Gull	2	C	121	>1,000	North	50	1.00	
10/19/2009	0.10	20:29:08	Northern Gannet	2	U	121	>1,000	South	50	1.00	
10/19/2009	0.10	20:29:15	Surf Scoter	12	C	121	>1,000	South	1 (skimming)	1.00	
10/19/2009	0.10	20:30:19	Black Scoter	3	U	121	200	South	25	1.00	
10/19/2009	0.10	20:31:32	Northern Gannet	1	U	121	>1,000	Southwest	100	1.00	
10/19/2009	0.10	20:31:55	Black Scoter	1	U	121	300	South	25	1.00	
10/19/2009	0.10	20:33:12	Northern Gannet	1	U	121	1,000	South	25	1.00	
10/19/2009	0.10	20:34:32	Scoter, dark-winged (unknown)	3	U	121	>1,000	North	1 (skimming)	1.00	
10/19/2009	0.10	20:35:27	Northern Gannet	1	U	121	1,000	South	25	1.00	
10/19/2009	0.10	20:35:46	Northern Gannet	3	U	121	1,000	South	25	1.00	
10/19/2009	0.10	20:36:12	Northern Gannet	1	U	121	1,000	South	25	1.00	
10/19/2009	0.10	20:36:22	Northern Gannet	2	C	121	1,000	South	1 (skimming)	1.00	
10/19/2009	0.10	20:36:34	Laughing Gull	1	C	121	>1,000	North	50	1.00	
10/19/2009	0.10	20:37:14	Forster's Tern	32	U	121	1,000	North	25	1.00	

Table J-27 (*continued*). Onshore radar validation survey data at Brigantine Beach, New Jersey, in fall 2009. All data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Bearing	Range (m)	Heading (cardinal)	Altitude (ft ASL)	Radar Sea Clutter (NM)	Comment
10/19/2009	0.10	20:37:39	Brown Pelican	2	U	121	300	Southwest	1 (skimming)	1.00	
10/19/2009	0.10	20:38:42	Northern Gannet	1	U	121	500	South	25	1.00	
10/19/2009	0.10	20:39:16	Northern Gannet	1	U	121	1,000	South	1 (skimming)	1.00	
10/19/2009	0.10	20:41:23	Black Scoter	2	U	121	300	South	25	1.00	
10/19/2009	0.10	20:41:54	Scoter, dark-winged (unknown)	13	U	121	300	South	25	1.00	
10/19/2009	0.10	20:42:16	Surf Scoter	1	U	121	300	South	1 (skimming)	1.00	
10/20/2009	0.10	14:50:31	Black Scoter	3	U	90	1,000	Southwest	1 (skimming)	0.50	
10/20/2009	0.10	14:53:00	Black Scoter	65	C	90	1,000	South	1 (skimming)	0.50	
10/20/2009	0.10	14:53:52	Scoter, dark-winged (unknown)	11	C	90	500	North	25	0.50	
10/20/2009	0.10	14:55:16	Laughing Gull	1	U	90	1,000	South	50	0.50	
10/20/2009	0.10	15:00:20	Scoter, dark-winged (unknown)	3	U	90	1,000	South	1 (skimming)	0.50	
10/20/2009	0.10	15:02:02	Black Scoter	9	U	90	500	South	1 (skimming)	0.50	
10/20/2009	0.10	15:05:37	Laughing Gull	1	U	90	300	Northwest	100	0.50	
10/20/2009	0.10	15:08:34	Laughing Gull	1	C	90	>1,000	North	50	0.50	
10/20/2009	0.10	15:12:47	Surf Scoter	3	C	90	500	South	1 (skimming)	0.50	
10/20/2009	0.10	15:14:00	Scoter, dark-winged (unknown)	17	C	90	>1,000	North	50	0.50	
10/20/2009	0.10	15:15:44	Black Scoter	110	U	90	200	South	1 (skimming)	0.50	
10/20/2009	0.10	15:16:57	Black Scoter	30	U	90	300	South	1 (skimming)	0.50	
10/20/2009	0.10	15:18:05	Black Scoter	125	U	90	300	South	25	0.50	
10/20/2009	0.10	15:22:20	Black Scoter	13	C	90	>1,000	Northwest	1 (skimming)	0.50	
10/20/2009	0.10	15:25:01	Black Scoter	10	U	90	300	South	1 (skimming)	0.50	
10/20/2009	0.10	15:28:23	Brown Pelican	1	U	90	300	North	1 (skimming)	0.50	
10/20/2009	0.10	15:29:27	Black Scoter	20	C	90	>1,000	West	25	0.50	
10/20/2009	0.10	15:33:48	Black Scoter	1	U	90	500	Northwest	1 (skimming)	0.50	
10/20/2009	0.10	15:34:21	Tern, large (unknown)	1	C	90	>1,000	North	50	0.50	

Table J-27 (*continued*). Onshore radar validation survey data at Brigantine Beach, New Jersey, in fall 2009. All data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Bearing	Range (m)	Heading (cardinal)	Altitude (ft ASL)	Radar Sea Clutter (NM)	Comment
10/20/2009	0.10	15:38:21	Black Scoter	2	U	90	1,000	North	1 (skimming)	0.50	
10/20/2009	0.10	15:41:08	Black Scoter	7	U	90	300	Northwest	1 (skimming)	0.50	
10/20/2009	0.10	15:41:29	Black Scoter	160	U	90	500	Northwest	25	0.50	
10/20/2009	0.10	15:43:10	Black Scoter	31	U	90	1,000	Southwest	1 (skimming)	0.50	
10/20/2009	0.10	15:44:56	Black Scoter	3	U	90	200	South	1 (skimming)	0.50	
10/20/2009	0.10	15:46:40	Scoter, dark-winged (unknown)	2	U	90	1,000	North	1 (skimming)	0.50	
10/20/2009	0.10	15:47:20	Royal Tern	2	C	90	500	North	50	0.50	
10/20/2009	0.10	15:48:32	Great Black-backed Gull	1	C	90	500	North	25	0.50	
10/20/2009	0.10	15:49:14	Laughing Gull	1	U	90	500	Southwest	25	0.50	
10/20/2009	0.10	15:51:11	Tern, large (unknown)	1	U	90	1,000	North	25	0.50	
10/20/2009	0.10	15:52:13	Black Scoter	18	U	90	1,000	Southwest	1 (skimming)	0.50	
10/20/2009	0.10	15:53:36	Red-throated Loon	1	C	90	>1,000	Northeast	1 (skimming)	0.50	
10/20/2009	0.10	15:54:22	Scoter, dark-winged (unknown)	15	U	90	>1,000	South	1 (skimming)	0.50	
10/20/2009	0.10	15:58:18	Gull, large (unknown)	1	U	90	>1,000	South	1 (skimming)	0.50	
10/20/2009	0.10	16:00:20	Laughing Gull	1	U	90	>1,000	North	25	0.50	
10/20/2009	0.10	16:07:23	Tern, large (unknown)	1	U	90	>1,000	Northeast	100	0.50	
10/20/2009	0.10	16:11:42	Black Scoter	19	U	90	200	South	1 (skimming)	0.50	
10/20/2009	0.10	16:12:21	Black Scoter	14	U	90	200	Northwest	1 (skimming)	0.50	
10/20/2009	0.10	16:15:43	Black Scoter	5	U	90	500	South	1 (skimming)	0.50	
10/20/2009	0.10	16:19:54	Black Scoter	3	U	90	300	Southwest	1 (skimming)	0.50	
10/20/2009	0.10	16:29:30	Black Scoter	25	U	90	300	South	1 (skimming)	0.50	1 WWSC
10/23/2009	0.10	17:03:22	Scoter (unknown)	7	U	90	500	Northwest	1 (skimming)	3.00	
10/23/2009	0.10	17:06:16	Northern Gannet	1	U	90	500	Southeast	25	3.00	
10/23/2009	0.10	17:08:11	Northern Gannet	1	U	90	500	Southeast	50	3.00	
10/23/2009	0.10	17:09:33	Scoter, dark-winged (unknown)	30	U	90	1,000	South	25	3.00	
10/23/2009	0.10	17:12:47	Northern Gannet	1	U	90	1,000	Southeast	25	3.00	

Table J-27 (*continued*). Onshore radar validation survey data at Brigantine Beach, New Jersey, in fall 2009. All data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Bearing	Range (m)	Heading (cardinal)	Altitude (ft ASL)	Radar Sea Clutter (NM)	Comment
10/23/2009	0.10	17:15:31	Double-crested Cormorant	14	U	90	200	Southeast	100	3.00	
10/23/2009	0.10	17:17:46	Northern Gannet	1	U	90	500	Southeast	25	3.00	
10/23/2009	0.10	17:22:54	Northern Gannet	1	U	90	500	Northwest	25	3.00	
10/23/2009	0.10	17:23:46	Scoter (unknown)	4	U	90	1,000	Southeast	50	3.00	
10/23/2009	0.10	17:26:06	Scoter (unknown)	115	U	90	500	Southeast	25	3.00	
10/23/2009	0.10	17:28:30	Northern Gannet	1	U	90	200	Southeast	25	3.00	

NM = nautical mile(s)
No. = number
C/U = Confirmed/Unconfirmed
m = meters
ft ASL = feet above sea level

Table J-28. Boat-based radar validation survey data offshore Brigantine Beach, New Jersey, in fall 2009. Radar is located onshore Brigantine Beach. All data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Bearing	Range (m)	Heading (cardinal)	Altitude (ft ASL)	Radar Sea Clutter (NM)	Comment
10/22/2009	1.50	14:24:22	Northern Gannet	1	U	270	1,000	South	25	1.00	
10/22/2009	1.50	14:29:07	Northern Gannet	1	U	270	100	Northwest	25	1.00	
10/22/2009	1.50	14:31:01	Northern Gannet	1	U	270	100	Southwest	25	1.00	
10/22/2009	1.50	14:32:10	Northern Gannet	1	U	270	100	Southwest	1 (skimming)	1.00	
10/22/2009	1.50	14:35:07	Northern Gannet	1	U	270	100	South	1 (skimming)	1.00	
10/22/2009	1.50	14:35:44	Northern Gannet	1	C	270	500	South	1 (skimming)	1.00	
10/22/2009	1.50	14:36:25	Northern Gannet	1	U	270	300	South	1 (skimming)	1.00	
10/22/2009	1.50	14:39:23	Northern Gannet	1	U	270	200	South	25	1.00	
10/22/2009	1.50	14:40:09	Northern Gannet	2	U	270	200	South	1 (skimming)	1.00	
10/22/2009	1.50	14:40:58	Northern Gannet	1	U	270	300	South	1 (skimming)	1.00	
10/22/2009	1.50	14:42:13	Laughing Gull	1	U	270	100	Southeast	25	1.00	
10/22/2009	1.50	14:43:13	Laughing Gull	1	U	270	100	Northeast	25	1.00	
10/22/2009	1.50	14:43:48	Great Black-backed Gull	1	U	270	300	Northeast	50	1.00	
10/22/2009	1.50	14:44:55	Northern Gannet	1	U	270	100	Southwest	1 (skimming)	1.00	
10/22/2009	1.50	14:47:19	Northern Gannet	1	U	270	100	South	1 (skimming)	1.00	
10/22/2009	1.50	14:50:37	Northern Gannet	1	U	270	300	South	1 (skimming)	1.00	
10/22/2009	1.50	15:01:19	Northern Gannet	1	U	270	100	South	25	1.00	
10/22/2009	1.50	15:02:01	Northern Gannet	3	U	270	300	Southeast	1 (skimming)	1.00	
10/22/2009	1.50	15:03:12	Northern Gannet	1	U	270	100	South	1 (skimming)	1.00	
10/22/2009	1.50	15:03:12	Northern Gannet	1	U	270	200	South	1 (skimming)	1.00	
10/22/2009	1.50	15:03:53	Northern Gannet	2	U	270	100	Southeast	1 (skimming)	1.00	
10/22/2009	1.50	15:05:39	Northern Gannet	2	U	270	100	Southwest	1 (skimming)	1.00	
10/22/2009	1.50	15:05:39	Northern Gannet	1	U	270	200	Southwest	1 (skimming)	1.00	
10/22/2009	1.50	15:06:17	Northern Gannet	5	U	270	100	Southwest	1 (skimming)	1.00	
10/22/2009	1.50	15:09:26	Northern Gannet	1	U	270	100	Southwest	1 (skimming)	1.00	
10/22/2009	1.50	15:09:26	Northern Gannet	1	U	270	100	Northeast	25	1.00	
10/22/2009	1.50	15:11:10	Northern Gannet	2	U	270	500	Southwest	1 (skimming)	1.00	

Table J-28 (*continued*). Boat-based radar validation survey data offshore Brigantine Beach, New Jersey, in fall 2009. Radar is located onshore Brigantine Beach. All data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Bearing	Range (m)	Heading (cardinal)	Altitude (ft ASL)	Radar Sea Clutter (NM)	Comment
10/22/2009	1.50	15:15:17	Northern Gannet	3	U	270	200	South	1 (skimming)	1.00	
10/22/2009	1.50	15:16:32	Northern Gannet	1	U	270	300	Southwest	1 (skimming)	1.00	
10/22/2009	1.50	15:17:33	Northern Gannet	1	U	270	1,000	Southwest	1 (skimming)	1.00	
10/22/2009	1.50	15:21:28	Northern Gannet	2	U	270	1,000	Southwest	1 (skimming)	1.00	
10/22/2009	1.50	15:21:53	Northern Gannet	1	U	270	100	Southwest	1 (skimming)	1.00	
10/22/2009	1.50	15:22:55	Northern Gannet	12	U	270	300	Southwest	25	1.00	
10/22/2009	1.50	15:23:58	Northern Gannet	1	U	270	100	Southwest	1 (skimming)	1.00	
10/22/2009	1.50	15:24:58	Northern Gannet	12	U	270	100	Southwest	25	1.00	1 GBBG
10/22/2009	1.50	15:25:57	Northern Gannet	1	U	270	500	Southwest	1 (skimming)	1.00	
10/22/2009	1.50	15:25:57	Northern Gannet	1	U	270	200	Southwest	1 (skimming)	1.00	
10/22/2009	1.50	15:26:48	Northern Gannet	1	C	270	100	West	25	1.00	
10/22/2009	1.50	15:28:17	Great Black-backed Gull	1	U	270	200	Northeast	25	1.00	
10/22/2009	1.50	15:29:20	Northern Gannet	1	U	270	300	South	1 (skimming)	1.00	
10/22/2009	1.50	15:29:20	Northern Gannet	1	U	270	100	South	1 (skimming)	1.00	
10/22/2009	1.50	15:30:43	Northern Gannet	1	U	270	300	Southwest	1 (skimming)	1.00	
10/22/2009	1.50	15:33:11	Northern Gannet	1	U	270	300	Southwest	25	1.00	
10/22/2009	1.50	15:36:33	Northern Gannet	3	U	270	1,000	South	1 (skimming)	1.00	
10/22/2009	1.50	15:37:19	Northern Gannet	1	C	270	>1,000	South	25	1.00	
10/22/2009	1.50	15:38:29	Laughing Gull	1	U	270	200	Northeast	25	1.00	
10/22/2009	1.50	15:40:35	Northern Gannet	3	U	270	1,000	Southwest	1 (skimming)	1.00	
10/22/2009	1.50	15:42:15	Northern Gannet	1	C	270	>1,000	Southwest	1 (skimming)	1.00	
10/22/2009	1.50	15:43:28	Northern Gannet	1	U	270	200	Southwest	1 (skimming)	1.00	
10/22/2009	1.50	15:44:42	Northern Gannet	1	C	270	500	West	25	1.00	
10/22/2009	1.50	15:51:07	Northern Gannet	1	U	270	200	Southwest	1 (skimming)	1.00	
10/22/2009	1.50	15:51:39	Common Loon	1	U	270	200	Southwest	1 (skimming)	1.00	
10/22/2009	1.50	15:53:26	Northern Gannet	1	U	270	>1,000	North	25	1.00	
10/22/2009	1.50	15:57:08	Northern Gannet	1	U	270	200	Southwest	25	1.00	

Table J-28 (*continued*). Boat-based radar validation survey data offshore Brigantine Beach, New Jersey, in fall 2009. Radar is located onshore Brigantine Beach. All data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Bearing	Range (m)	Heading (cardinal)	Altitude (ft ASL)	Radar Sea Clutter (NM)	Comment
10/22/2009	1.50	15:57:34	Northern Gannet	1	U	270	200	Southwest	25	1.00	
10/22/2009	1.50	15:58:47	Northern Gannet	1	U	270	1,000	South	25	1.00	
10/22/2009	1.50	15:59:10	Northern Gannet	1	U	270	100	Southwest	1 (skimming)	1.00	
10/22/2009	1.50	15:59:48	Northern Gannet	1	U	270	200	Southwest	25	1.00	
10/22/2009	1.50	16:05:20	Northern Gannet	4	U	270	300	South	1 (skimming)	1.00	
10/22/2009	1.50	16:05:54	Northern Gannet	13	C	270	500	Southwest	1 (skimming)	1.00	
10/22/2009	1.50	16:06:31	Northern Gannet	1	U	270	200	Southwest	1 (skimming)	1.00	
10/22/2009	1.50	16:06:50	Northern Gannet	1	U	270	100	Southwest	1 (skimming)	1.00	
10/22/2009	1.50	16:07:21	Northern Gannet	1	U	270	500	South	1 (skimming)	1.00	
10/22/2009	1.50	16:08:28	Northern Gannet	1	C	270	300	Southwest	1 (skimming)	1.00	
10/22/2009	1.50	16:10:02	Northern Gannet	2	U	270	200	Southwest	1 (skimming)	1.00	
10/22/2009	2.00	16:38:01	Northern Gannet	2	U	270	500	Southwest	1 (skimming)	1.00	
10/22/2009	2.00	16:41:29	Tern, large (unknown)	1	U	270	100	Northwest	25	1.00	
10/22/2009	2.00	16:42:38	Northern Gannet	1	U	270	100	Southwest	25	1.00	
10/22/2009	2.00	16:44:17	Northern Gannet	2	U	270	200	South	1 (skimming)	1.00	
10/22/2009	2.00	16:44:49	Northern Gannet	1	U	270	100	Southwest	1 (skimming)	1.00	
10/22/2009	2.00	16:50:14	Northern Gannet	3	U	270	100	Southwest	1 (skimming)	1.00	
10/22/2009	2.00	16:51:17	Northern Gannet	2	U	270	100	Southwest	1 (skimming)	1.00	
10/22/2009	2.00	16:51:57	Northern Gannet	3	U	270	100	Southwest	1 (skimming)	1.00	
10/22/2009	2.00	16:53:04	Northern Gannet	7	U	270	300	Southwest	1 (skimming)	1.00	
10/22/2009	2.00	16:54:05	Northern Gannet	1	U	270	1,000	Southwest	1 (skimming)	1.00	
10/22/2009	2.00	16:56:52	Laughing Gull	1	U	270	100	Northeast	25	1.00	
10/22/2009	2.00	16:58:17	Double-crested Cormorant	1	U	270	500	Southwest	1 (skimming)	1.00	
10/22/2009	2.00	16:59:17	Double-crested Cormorant	1	U	270	500	Southwest	1 (skimming)	1.00	
10/22/2009	2.00	17:03:04	Laughing Gull	1	U	270	100	Northwest	25	1.00	
10/22/2009	2.00	17:03:36	Northern Gannet	1	U	270	100	Southwest	25	1.00	
10/22/2009	2.00	17:05:31	Northern Gannet	1	U	270	100	Southwest	1 (skimming)	1.00	

Table J-28 (*continued*). Boat-based radar validation survey data offshore Brigantine Beach, New Jersey, in fall 2009. Radar is located onshore Brigantine Beach. All data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Bearing	Range (m)	Heading (cardinal)	Altitude (ft ASL)	Radar Sea Clutter (NM)	Comment
10/22/2009	2.00	17:07:25	Northern Gannet	7	U	270	300	Southwest	1 (skimming)	1.00	
10/22/2009	2.00	17:08:22	Northern Gannet	1	U	270	300	Southwest	1 (skimming)	1.00	
10/22/2009	2.00	17:08:32	Northern Gannet	2	U	270	300	Southwest	1 (skimming)	1.00	
10/22/2009	2.00	17:09:03	Northern Gannet	4	U	270	300	Southwest	1 (skimming)	1.00	
10/22/2009	2.00	17:13:23	Northern Gannet	2	U	270	100	Southwest	1 (skimming)	1.00	
10/22/2009	2.00	17:13:59	Northern Gannet	4	U	270	100	Southwest	1 (skimming)	1.00	
10/22/2009	2.00	17:14:35	Northern Gannet	2	U	270	100	Southwest	1 (skimming)	1.00	
10/22/2009	2.00	17:14:54	Northern Gannet	8	U	270	100	South	1 (skimming)	1.00	
10/22/2009	2.00	17:15:56	Northern Gannet	1	U	270	100	Southwest	25	1.00	
10/22/2009	2.00	17:16:46	Northern Gannet	3	U	270	300	Southwest	1 (skimming)	1.00	
10/22/2009	2.00	17:17:08	Northern Gannet	3	U	270	100	Southwest	1 (skimming)	1.00	
10/22/2009	2.00	17:17:47	Northern Gannet	2	U	270	200	Southwest	1 (skimming)	1.00	
10/22/2009	2.00	17:18:28	Northern Gannet	4	U	270	300	West	1 (skimming)	1.00	
10/22/2009	2.00	17:19:08	Great Black-backed Gull	1	U	270	100	Northeast	50	1.00	
10/22/2009	2.00	17:21:15	Northern Gannet	1	U	270	1,000	Southwest	25	1.00	
10/22/2009	2.00	17:23:36	Northern Gannet	1	U	270	1,000	Southwest	1 (skimming)	1.00	
10/22/2009	2.00	17:24:03	Northern Gannet	1	U	270	500	Southwest	1 (skimming)	1.00	
10/22/2009	2.00	17:25:40	Northern Gannet	1	U	270	100	South	1 (skimming)	1.00	
10/22/2009	2.00	17:28:22	Northern Gannet	2	U	270	100	Southwest	1 (skimming)	1.00	
10/22/2009	2.00	17:31:15	Northern Gannet	7	U	270	200	Southwest	1 (skimming)	1.00	
10/22/2009	2.00	17:33:09	Northern Gannet	2	U	270	200	Southwest	1 (skimming)	1.00	
10/22/2009	2.00	17:36:27	Northern Gannet	1	U	270	200	Northwest	25	1.00	
10/22/2009	2.00	17:36:54	Northern Gannet	1	U	270	200	North	25	1.00	
10/22/2009	2.00	17:37:47	Northern Gannet	1	U	270	100	South	1 (skimming)	1.00	
10/22/2009	2.00	17:38:41	Northern Gannet	1	U	270	200	South	1 (skimming)	1.00	
10/22/2009	2.00	17:40:51	Northern Gannet	1	U	270	300	Southwest	1 (skimming)	1.00	
10/22/2009	2.00	17:41:23	Northern Gannet	1	U	270	100	Southwest	1 (skimming)	1.00	

Table J-28 (*continued*). Boat-based radar validation survey data offshore Brigantine Beach, New Jersey, in fall 2009. Radar is located onshore Brigantine Beach. All data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Bearing	Range (m)	Heading (cardinal)	Altitude (ft ASL)	Radar Sea Clutter (NM)	Comment
10/22/2009	2.00	17:42:23	Northern Gannet	1	U	270	300	Southwest	1 (skimming)	1.00	
10/22/2009	2.00	17:46:28	Northern Gannet	1	U	270	100	Southwest	25	1.00	
10/22/2009	2.00	17:46:51	Northern Gannet	1	U	270	100	Southwest	1 (skimming)	1.00	
10/22/2009	2.00	17:47:46	Northern Gannet	1	U	270	300	Southwest	1 (skimming)	1.00	
10/22/2009	2.00	17:48:52	Northern Gannet	1	U	270	500	Southwest	1 (skimming)	1.00	
10/22/2009	2.00	17:50:09	Northern Gannet	2	U	270	100	Southwest	1 (skimming)	1.00	
10/22/2009	2.00	17:50:55	Northern Gannet	1	U	270	200	Southwest	1 (skimming)	1.00	
10/22/2009	2.00	17:52:53	Laughing Gull	1	U	270	100	Northeast	25	1.00	
10/22/2009	2.00	17:56:10	Northern Gannet	1	U	270	100	Southwest	1 (skimming)	1.00	
10/22/2009	2.00	17:58:38	Northern Gannet	1	U	270	1,000	Southwest	25	1.00	
10/22/2009	2.00	17:59:26	Northern Gannet	1	U	270	1,000	Southwest	1 (skimming)	1.00	
10/22/2009	2.00	18:00:28	Northern Gannet	2	U	270	100	Southwest	1 (skimming)	1.00	
10/22/2009	2.00	18:03:34	Northern Gannet	1	U	270	100	Southwest	1 (skimming)	1.00	
10/22/2009	2.00	18:06:09	Northern Gannet	1	U	270	200	Southwest	1 (skimming)	1.00	
10/22/2009	2.00	18:07:04	Northern Gannet	2	U	270	100	Southwest	1 (skimming)	1.00	
10/22/2009	2.00	18:07:39	Laughing Gull	1	U	270	200	West	25	1.00	
10/22/2009	2.00	18:08:15	Northern Gannet	1	U	270	100	Southwest	1 (skimming)	1.00	
10/22/2009	2.00	18:10:46	Herring Gull	1	U	270	100	South	25	1.00	
10/22/2009	2.00	18:12:42	Northern Gannet	3	U	270	100	Southwest	1 (skimming)	1.00	
10/22/2009	2.00	18:13:17	Northern Gannet	1	U	270	200	Southwest	1 (skimming)	1.00	
10/22/2009	2.00	18:15:00	Northern Gannet	3	U	270	100	Southwest	1 (skimming)	1.00	
10/22/2009	2.00	18:15:18	Northern Gannet	2	U	270	300	Southwest	1 (skimming)	1.00	
10/22/2009	2.50	18:35:39	Northern Gannet	1	U	270	500	Southwest	25	1.00	
10/22/2009	2.50	18:35:58	Northern Gannet	3	U	270	100	Southwest	1 (skimming)	1.00	
10/22/2009	2.50	18:37:39	Northern Gannet	1	U	270	1,000	Southwest	25	1.00	
10/22/2009	2.50	18:38:57	Northern Gannet	1	U	270	300	Southwest	1 (skimming)	1.00	
10/22/2009	2.50	18:41:31	Laughing Gull	1	U	270	100	North	25	1.00	

Table J-28 (*continued*). Boat-based radar validation survey data offshore Brigantine Beach, New Jersey, in fall 2009. Radar is located onshore Brigantine Beach. All data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Bearing	Range (m)	Heading (cardinal)	Altitude (ft ASL)	Radar Sea Clutter (NM)	Comment
10/22/2009	2.50	18:43:58	Northern Gannet	5	U	270	1,000	West	1 (skimming)	1.00	
10/22/2009	2.50	18:45:24	Northern Gannet	1	U	270	1,000	Southwest	1 (skimming)	1.00	
10/22/2009	2.50	18:46:30	Northern Gannet	1	U	270	200	Southwest	1 (skimming)	1.00	
10/22/2009	2.50	18:46:44	Laughing Gull	1	U	270	200	Northwest	25	1.00	
10/22/2009	2.50	18:48:30	Northern Gannet	1	U	270	1,000	Southwest	25	1.00	
10/22/2009	2.50	18:51:03	Northern Gannet	9	U	270	500	Southwest	1 (skimming)	1.00	
10/22/2009	2.50	18:51:42	Northern Gannet	12	U	270	100	Southwest	25	1.00	
10/22/2009	2.50	18:56:14	Northern Gannet	1	U	270	1,000	Southwest	1 (skimming)	1.00	
10/22/2009	2.50	18:56:57	Northern Gannet	1	U	270	300	South	1 (skimming)	1.00	
10/22/2009	2.50	18:58:32	Northern Gannet	1	U	270	300	Southwest	25	1.00	
10/22/2009	2.50	18:58:46	Northern Gannet	3	U	270	100	Southwest	1 (skimming)	1.00	
10/22/2009	2.50	19:02:07	Northern Gannet	1	U	270	100	Southwest	1 (skimming)	1.00	
10/22/2009	2.50	19:02:28	Northern Gannet	7	U	270	500	Southwest	1 (skimming)	1.00	
10/22/2009	2.50	19:02:41	Northern Gannet	1	U	270	100	South	25	1.00	
10/22/2009	2.50	19:02:57	Northern Gannet	1	U	270	100	Southwest	1 (skimming)	1.00	
10/22/2009	2.50	19:04:47	Northern Gannet	1	U	270	100	Southwest	25	1.00	
10/22/2009	2.50	19:05:36	Northern Gannet	1	U	270	300	Southwest	1 (skimming)	1.00	
10/22/2009	2.50	19:07:40	Northern Gannet	1	U	270	1,000	West	1 (skimming)	1.00	
10/22/2009	2.50	19:09:24	Northern Gannet	1	U	270	1,000	Southwest	25	1.00	
10/22/2009	2.50	19:10:28	Northern Gannet	1	U	270	200	Southwest	1 (skimming)	1.00	
10/22/2009	2.50	19:11:32	Northern Gannet	5	U	270	300	Southwest	1 (skimming)	1.00	
10/22/2009	2.50	19:12:54	Northern Gannet	1	U	270	200	Southwest	25	1.00	
10/22/2009	2.50	19:13:38	Northern Gannet	1	U	270	1,000	Southwest	25	1.00	
10/22/2009	2.50	19:14:28	Northern Gannet	1	U	270	100	Southwest	25	1.00	
10/22/2009	2.50	19:16:18	Northern Gannet	1	U	270	200	Southwest	25	1.00	
10/22/2009	2.50	19:16:35	Northern Gannet	1	U	270	200	Southwest	1 (skimming)	1.00	
10/22/2009	2.50	19:17:12	Northern Gannet	1	U	270	100	Southwest	25	1.00	

Table J-28 (*continued*). Boat-based radar validation survey data offshore Brigantine Beach, New Jersey, in fall 2009. Radar is located onshore Brigantine Beach. All data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Bearing	Range (m)	Heading (cardinal)	Altitude (ft ASL)	Radar Sea Clutter (NM)	Comment
10/22/2009	2.50	19:18:31	Northern Gannet	1	U	270	300	Southwest	1 (skimming)	1.00	
10/22/2009	2.50	19:18:49	Northern Gannet	1	U	270	200	Southwest	25	1.00	
10/22/2009	2.50	19:20:21	Gull, large (unknown)	1	U	270	300	Northwest	25	1.00	
10/22/2009	2.50	19:23:13	Northern Gannet	2	U	270	200	Southwest	25	1.00	
10/22/2009	2.50	19:25:31	Northern Gannet	1	U	270	1,000	Southwest	25	1.00	
10/22/2009	2.50	19:26:39	Herring Gull	1	U	270	1,000	North	100	1.00	
10/22/2009	2.50	19:31:12	Northern Gannet	1	U	270	100	Southwest	25	1.00	
10/22/2009	2.50	19:31:12	Northern Gannet	1	U	270	100	Southwest	1 (skimming)	1.00	
10/22/2009	2.50	19:31:57	Northern Gannet	1	U	270	200	Southwest	1 (skimming)	1.00	
10/22/2009	2.50	19:32:37	Scoter, dark-winged (unknown)	16	U	270	300	Southwest	1 (skimming)	1.00	
10/22/2009	2.50	19:33:21	Northern Gannet	2	U	270	200	Southwest	25	1.00	
10/22/2009	2.50	19:38:02	Northern Gannet	2	U	270	200	West	25	1.00	
10/22/2009	2.50	19:39:53	Laughing Gull	1	U	270	100	Southwest	1 (skimming)	1.00	
10/22/2009	2.50	19:40:26	Laughing Gull	1	U	270	200	West	25	1.00	
10/22/2009	2.50	19:42:04	Northern Gannet	1	U	270	200	Southwest	25	1.00	
10/22/2009	2.50	19:43:57	Laughing Gull	1	U	270	100	Southwest	1 (skimming)	1.00	
10/22/2009	2.50	19:45:02	Northern Gannet	1	U	270	100	Southwest	25	1.00	
10/22/2009	2.50	19:45:29	Northern Gannet	1	U	270	200	Southwest	25	1.00	
10/22/2009	2.50	19:46:58	Northern Gannet	1	U	270	1,000	Southwest	25	1.00	
10/22/2009	2.50	19:48:05	Northern Gannet	1	U	270	200	Southwest	1 (skimming)	1.00	
10/22/2009	2.50	19:48:33	Northern Gannet	3	U	270	500	Southwest	1 (skimming)	1.00	
10/22/2009	2.50	19:49:06	Northern Gannet	1	U	270	100	Southwest	25	1.00	
10/22/2009	2.50	19:49:28	Northern Gannet	1	U	270	300	Southwest	25	1.00	
10/22/2009	2.50	19:50:39	Northern Gannet	1	U	270	300	North	50	1.00	
10/22/2009	2.50	19:51:50	Northern Gannet	1	U	270	1,000	Southwest	25	1.00	
10/22/2009	2.50	19:52:47	Northern Gannet	1	U	270	100	Southwest	25	1.00	
10/22/2009	2.50	19:56:40	Northern Gannet	1	C	270	>1,000	Southwest	25	1.00	

Table J-28 (*continued*). Boat-based radar validation survey data offshore Brigantine Beach, New Jersey, in fall 2009. Radar is located onshore Brigantine Beach. All data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Bearing	Range (m)	Heading (cardinal)	Altitude (ft ASL)	Radar Sea Clutter (NM)	Comment
10/22/2009	2.50	19:56:49	Northern Gannet	1	U	270	100	Southwest	1 (skimming)	1.00	
10/22/2009	2.50	19:58:38	Northern Gannet	1	U	270	100	West	100	1.00	
10/22/2009	2.50	19:59:15	Northern Gannet	1	U	270	200	Southwest	50	1.00	
10/22/2009	2.50	19:59:46	Northern Gannet	1	U	270	100	Southwest	50	1.00	
10/22/2009	2.50	20:00:31	Northern Gannet	1	U	270	100	South	1 (skimming)	1.00	
10/22/2009	2.50	20:01:14	Northern Gannet	6	U	270	200	South	1 (skimming)	1.00	
10/22/2009	2.50	20:02:13	Northern Gannet	1	U	270	300	Southwest	25	1.00	
10/22/2009	2.50	20:03:42	Northern Gannet	1	U	270	200	Southwest	1 (skimming)	1.00	
10/22/2009	2.50	20:04:46	Northern Gannet	3	U	270	200	Southwest	1 (skimming)	1.00	
10/22/2009	2.50	20:05:08	Northern Gannet	2	U	270	200	Southwest	1 (skimming)	1.00	
10/22/2009	2.50	20:06:35	Northern Gannet	2	U	270	500	Southwest	25	1.00	
10/22/2009	2.50	20:07:53	Northern Gannet	4	U	270	1,000	Southwest	1 (skimming)	1.00	
10/22/2009	2.50	20:08:31	Northern Gannet	1	U	270	100	Southwest	25	1.00	
10/22/2009	2.50	20:10:21	Northern Gannet	1	U	270	100	North	25	1.00	
10/22/2009	2.50	20:10:21	Northern Gannet	1	U	270	100	Southwest	25	1.00	
10/22/2009	2.50	20:11:26	Gull, large (unknown)	1	U	270	500	Southwest	25	1.00	
10/22/2009	2.50	20:12:28	Northern Gannet	1	U	270	100	Northwest	1 (skimming)	1.00	
10/22/2009	2.50	20:13:26	Northern Gannet	1	U	270	100	Southwest	1 (skimming)	1.00	
10/22/2009	2.50	20:13:49	Northern Gannet	6	U	270	200	Southwest	1 (skimming)	1.00	

NM = nautical mile(s)
No. = number
C/U = Confirmed/Unconfirmed
m = meters
ft ASL = feet above sea level

Table J-29. Onshore radar validation survey data at Sea Isle City, New Jersey, in fall 2009. All data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Bearing	Range (m)	Heading (cardinal)	Altitude (ft ASL)	Radar Sea Clutter (NM)	Comment
10/26/2009	0.20	20:35:20	Black Scoter	7	U	120	300	North	1 (skimming)	1.50	
10/26/2009	0.20	20:39:26	Northern Gannet	1	U	120	300	North	50	1.50	
10/26/2009	0.20	20:40:06	Northern Gannet	1	U	120	300	South	50	1.50	
10/26/2009	0.20	20:41:50	Northern Gannet	1	U	120	300	Northeast	50	1.50	
10/26/2009	0.20	20:42:55	Northern Gannet	1	U	120	1,000	North	50	1.50	
10/26/2009	0.20	20:43:34	Northern Gannet	1	U	120	500	North	50	1.50	
10/26/2009	0.20	20:45:01	Royal Tern	2	U	120	300	South	25	1.50	
10/26/2009	0.20	20:46:30	Northern Gannet	1	U	120	500	North	50	1.50	
10/26/2009	0.20	20:47:35	Northern Gannet	1	U	120	500	South	100	1.50	
10/26/2009	0.20	20:48:52	Double-crested Cormorant	6	U	120	100	Southwest	200	1.50	
10/26/2009	0.20	20:50:20	Scoter, dark-winged (unknown)	37	U	120	1,000	South	1 (skimming)	1.50	
10/26/2009	0.20	20:52:00	Tern, large (unknown)	2	U	120	200	South	25	1.50	feeding
10/26/2009	0.20	20:53:01	Tern, large (unknown)	2	U	120	500	North	25	1.50	
10/26/2009	0.20	20:54:07	Northern Gannet	1	U	120	500	Southwest	50	1.50	
10/26/2009	0.20	20:55:16	Northern Gannet	1	U	120	500	Southwest	50	1.50	
10/26/2009	0.20	20:56:33	Northern Gannet	1	U	120	500	Southwest	1 (skimming)	1.50	
10/26/2009	0.20	20:57:34	Northern Gannet	1	U	120	300	Southeast	50	1.50	
10/26/2009	0.20	20:58:52	Northern Gannet	1	U	120	300	South	25	1.50	
10/26/2009	0.20	20:59:57	Northern Gannet	1	U	120	500	Northeast	50	1.50	
10/26/2009	0.20	21:00:23	Northern Gannet	1	U	120	300	Northeast	25	1.50	
10/26/2009	0.20	21:01:48	Northern Gannet	1	U	120	200	South	25	1.50	
10/26/2009	0.20	21:02:39	Northern Gannet	1	U	120	500	North	50	1.50	
10/26/2009	0.20	21:04:24	Northern Gannet	1	U	120	200	Northeast	50	1.50	
10/26/2009	0.20	21:05:20	Northern Gannet	1	U	120	500	South	25	1.50	
10/26/2009	0.20	21:06:15	Northern Gannet	1	U	120	500	South	50	1.50	
10/26/2009	0.20	21:07:04	Scoter, dark-winged (unknown)	90	C	120	>1,000	South	25	1.50	
10/26/2009	0.20	21:08:50	Northern Gannet	1	U	120	300	North	50	1.50	

Table J-29 (*continued*). Onshore radar validation survey data at Sea Isle City, New Jersey, in fall 2009. All data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Bearing	Range (m)	Heading (cardinal)	Altitude (ft ASL)	Radar Sea Clutter (NM)	Comment
10/26/2009	0.20	21:11:00	Northern Gannet	1	U	120	300	Southwest	50	1.50	
10/26/2009	0.20	21:15:01	Royal Tern	1	U	120	200	North	50	1.50	
10/26/2009	0.20	21:16:07	Surf Scoter	1	U	120	100	North	1 (skimming)	1.50	
10/26/2009	0.20	21:17:06	Northern Gannet	1	U	120	300	North	25	1.50	
10/26/2009	0.20	21:18:28	Scoter, dark-winged (unknown)	7	U	120	500	Southwest	25	1.50	
10/26/2009	0.20	21:19:30	Northern Gannet	1	U	120	500	South	25	1.50	
10/26/2009	0.20	21:22:26	Northern Gannet	1	U	120	300	North	1 (skimming)	1.50	
10/26/2009	0.20	21:24:20	Northern Gannet	1	U	120	500	West	25	1.50	
10/26/2009	0.20	21:24:55	Northern Gannet	1	U	120	1,000	South	50	1.50	
10/26/2009	0.20	21:25:16	Northern Gannet	1	U	120	300	Southwest	50	1.50	
10/26/2009	0.20	21:25:56	Northern Gannet	1	U	120	300	North	50	1.50	
10/26/2009	0.20	21:28:31	Royal Tern	1	U	120	300	South	25	1.50	
10/26/2009	0.20	21:29:39	Northern Gannet	1	U	120	500	North	25	1.50	
10/28/2009	0.20	18:11:29	Northern Gannet	1	U	120	200	North	1 (skimming)	1.00	
10/28/2009	0.20	18:16:08	Northern Gannet	1	U	120	300	North	25	1.00	
10/28/2009	0.20	18:19:57	Northern Gannet	1	U	120	200	South	1 (skimming)	1.00	
10/28/2009	0.20	18:23:17	Royal Tern	1	U	120	200	Southwest	25	1.00	
10/28/2009	0.20	18:26:51	Northern Gannet	1	U	120	300	North	25	1.00	
10/28/2009	0.20	18:29:38	Northern Gannet	1	C	120	500	South	25	1.00	
10/28/2009	0.20	18:30:18	Laughing Gull	1	U	120	100	North	50	1.00	
10/28/2009	0.20	18:31:17	Northern Gannet	1	U	120	300	North	25	1.00	
10/28/2009	0.20	18:32:22	Northern Gannet	1	C	120	500	South	25	1.00	
10/28/2009	0.20	18:33:06	Northern Gannet	1	U	120	500	North	50	1.00	
10/28/2009	0.20	18:34:52	Northern Gannet	1	U	120	500	North	25	1.00	
10/28/2009	0.20	18:35:42	Scoter, dark-winged (unknown)	100	C	120	1,000	South	1 (skimming)	1.00	
10/28/2009	0.20	18:40:16	Northern Gannet	1	U	120	300	South	25	1.00	
10/28/2009	0.20	18:40:50	Ring-billed Gull	1	U	120	100	South	1 (skimming)	1.00	

Table J-29 (*continued*). Onshore radar validation survey data at Sea Isle City, New Jersey, in fall 2009. All data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Bearing	Range (m)	Heading (cardinal)	Altitude (ft ASL)	Radar Sea Clutter (NM)	Comment
10/28/2009	0.20	18:43:21	Northern Gannet	1	U	120	500	Northwest	25	1.00	
10/28/2009	0.20	18:45:07	Northern Gannet	1	U	120	300	North	25	1.00	
10/28/2009	0.20	18:48:56	Black Scoter	35	U	120	300	South	1 (skimming)	1.00	
10/28/2009	0.20	18:51:02	Northern Gannet	1	C	120	300	Southwest	50	1.00	
10/28/2009	0.20	18:51:55	Atlantic Brant	7	U	120	300	Southwest	1 (skimming)	1.00	
10/28/2009	0.20	18:53:37	Northern Gannet	1	U	120	500	South	25	1.00	
10/28/2009	0.20	18:54:32	Northern Gannet	1	C	120	300	North	25	1.00	
10/28/2009	0.20	18:55:18	Northern Gannet	2	U	120	500	South	1 (skimming)	1.00	
10/28/2009	0.20	18:56:54	Northern Gannet	3	U	120	300	South	25	1.00	
10/28/2009	0.20	18:57:27	Northern Gannet	1	U	120	300	North	1 (skimming)	1.00	
10/28/2009	0.20	18:57:58	Scoter, dark-winged (unknown)	1	U	120	300	North	50	1.00	
10/28/2009	0.20	19:02:21	Northern Gannet	1	U	120	300	South	25	1.00	
10/28/2009	0.20	19:03:28	Northern Gannet	1	C	120	200	North	50	1.00	
10/28/2009	0.20	19:03:28	Northern Gannet	1	U	120	200	Southwest	25	1.00	
10/28/2009	0.20	19:05:00	Ring-billed Gull	1	U	120	200	Southwest	1 (skimming)	1.00	
10/28/2009	0.20	19:07:15	Black Scoter	7	U	120	200	Southwest	1 (skimming)	1.00	
10/28/2009	0.20	19:08:35	Northern Gannet	1	U	120	300	North	1 (skimming)	1.00	
10/28/2009	0.20	19:10:34	Herring Gull	1	U	120	100	Northwest	25	1.00	
10/28/2009	0.20	19:11:35	Northern Gannet	1	U	120	300	South	1 (skimming)	1.00	
10/28/2009	0.20	19:13:00	Northern Gannet	1	U	120	200	South	1 (skimming)	1.00	
10/28/2009	0.20	19:14:18	Scoter, dark-winged (unknown)	33	U	120	500	South	1 (skimming)	1.00	
10/28/2009	0.20	19:15:41	Northern Gannet	1	U	120	300	North	25	1.00	
10/28/2009	0.20	19:16:31	Scoter, dark-winged (unknown)	65	C	120	1,000	South	25	1.00	
10/28/2009	0.20	19:17:39	Northern Gannet	1	C	120	300	Southwest	50	1.00	
10/28/2009	0.20	19:18:30	Northern Gannet	1	U	120	300	South	25	1.00	
10/28/2009	0.20	19:19:28	Northern Gannet	1	U	120	200	North	25	1.00	

Table J-29 (*continued*). Onshore radar validation survey data at Sea Isle City, New Jersey, in fall 2009. All data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Bearing	Range (m)	Heading (cardinal)	Altitude (ft ASL)	Radar Sea Clutter (NM)	Comment
10/28/2009	0.20	19:19:51	Great Black-backed Gull	1	U	120	100	North	50	1.00	
10/28/2009	0.20	19:20:43	Scoter, dark-winged (unknown)	22	U	120	1,000	South	25	1.00	
10/28/2009	0.20	19:22:21	Northern Gannet	1	U	120	300	South	25	1.00	
10/28/2009	0.20	19:23:54	Northern Gannet	1	U	120	300	Northwest	50	1.00	
10/28/2009	0.20	19:26:16	Northern Gannet	1	U	120	300	South	50	1.00	
10/28/2009	0.20	19:27:32	Northern Gannet	1	U	120	300	South	25	1.00	
10/28/2009	0.20	19:28:15	Northern Gannet	1	U	120	500	South	1 (skimming)	1.00	
10/28/2009	0.20	19:28:41	Northern Gannet	1	C	120	500	North	25	1.00	
10/28/2009	0.20	19:29:57	Black Scoter	75	C	120	1,000	South	1 (skimming)	1.00	
10/28/2009	0.20	19:31:48	Northern Gannet	1	C	120	500	Northwest	50	1.00	
10/28/2009	0.20	19:33:28	Northern Gannet	1	U	120	300	Southwest	25	1.00	
10/28/2009	0.20	19:36:29	Northern Gannet	1	U	120	300	North	25	1.00	
10/28/2009	0.20	19:38:04	Northern Gannet	1	C	120	500	North	50	1.00	
10/28/2009	0.20	19:38:33	Northern Gannet	1	U	120	300	South	50	1.00	
10/28/2009	0.20	19:39:48	Northern Gannet	1	U	120	1,000	South	100	1.00	
10/28/2009	0.20	19:44:43	Northern Gannet	1	U	120	200	North	25	1.00	
10/28/2009	0.20	19:45:10	Northern Gannet	1	U	120	500	North	50	1.00	
10/28/2009	0.20	19:46:12	Northern Gannet	1	U	120	300	South	1 (skimming)	1.00	
10/28/2009	0.20	19:47:29	Scoter, dark-winged (unknown)	75	U	120	>1,000	South	25	1.00	
10/28/2009	0.20	19:48:40	Double-crested Cormorant	1	U	120	200	South	1 (skimming)	1.00	
10/28/2009	0.20	19:50:37	Northern Gannet	1	U	120	300	North	50	1.00	
10/28/2009	0.20	19:51:45	Northern Gannet	1	U	120	300	South	1 (skimming)	1.00	
10/28/2009	0.20	19:53:18	Northern Gannet	1	U	120	300	South	1 (skimming)	1.00	
10/28/2009	0.20	19:53:43	Northern Gannet	1	U	120	300	North	25	1.00	
10/28/2009	0.20	19:54:57	Northern Gannet	1	U	120	300	West	50	1.00	
10/28/2009	0.20	19:56:45	Northern Gannet	1	U	120	500	South	1 (skimming)	1.00	
10/28/2009	0.20	19:57:38	Double-crested Cormorant	2	U	120	500	Southwest	100	1.00	

Table J-29 (*continued*). Onshore radar validation survey data at Sea Isle City, New Jersey, in fall 2009. All data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Bearing	Range (m)	Heading (cardinal)	Altitude (ft ASL)	Radar Sea Clutter (NM)	Comment
10/28/2009	0.20	20:00:41	Double-crested Cormorant	4	C	120	100	West	200	1.00	
10/28/2009	0.20	20:04:49	Northern Gannet	1	U	120	300	Southwest	25	1.00	
10/28/2009	0.20	20:07:54	Northern Gannet	1	U	120	500	North	1 (skimming)	1.00	
10/28/2009	0.20	20:10:45	Brown Pelican	3	C	120	200	Southwest	25	1.00	
10/28/2009	0.20	20:15:39	Northern Gannet	1	C	120	500	North	50	1.00	
10/28/2009	0.20	20:19:12	Northern Gannet	1	U	120	500	North	25	1.00	
10/28/2009	0.20	20:21:13	Northern Gannet	1	U	120	500	North	25	1.00	
10/28/2009	0.20	20:23:02	Double-crested Cormorant	3	U	120	200	North	25	1.00	
10/28/2009	0.20	20:26:15	Northern Gannet	1	C	120	1,000	North	50	1.00	
10/28/2009	0.20	20:27:53	Scoter, dark-winged (unknown)	34	C	120	1,000	South	25	1.00	
10/28/2009	0.20	20:29:06	Royal Tern	1	C	120	500	Southwest	50	1.00	
10/28/2009	0.20	20:31:41	Scoter, dark-winged (unknown)	27	C	120	>1,000	Southwest	25	1.00	
10/28/2009	0.20	20:34:09	Great Black-backed Gull	1	U	120	200	North	1 (skimming)	1.00	
10/28/2009	0.20	20:34:54	Northern Gannet	1	C	120	500	South	25	1.00	
10/28/2009	0.20	20:35:41	Great Black-backed Gull	1	U	120	200	South	1 (skimming)	1.00	
10/28/2009	0.20	20:37:06	Great Black-backed Gull	1	U	120	200	South	25	1.00	
10/28/2009	0.20	20:37:47	Northern Gannet	1	U	120	500	North	25	1.00	
10/28/2009	0.20	20:38:39	Surf Scoter	34	C	120	1,000	South	1 (skimming)	1.00	
10/28/2009	0.20	20:42:22	Northern Gannet	1	U	120	500	North	25	1.00	
10/28/2009	0.20	20:44:18	Northern Gannet	1	U	120	500	North	25	1.00	
10/28/2009	0.20	20:44:38	Northern Gannet	1	C	120	500	South	25	1.00	
10/28/2009	0.20	20:45:40	Northern Gannet	1	C	120	500	Southwest	25	1.00	
10/28/2009	0.20	20:46:07	Northern Gannet	1	U	120	1,000	South	25	1.00	
10/28/2009	0.20	20:46:51	Northern Gannet	1	C	120	1,000	North	50	1.00	
10/28/2009	0.20	20:47:34	Surf Scoter	35	C	120	1,000	South	25	1.00	
10/28/2009	0.20	20:48:43	Northern Gannet	1	U	120	500	Southwest	1 (skimming)	1.00	
10/28/2009	0.20	20:51:06	Northern Gannet	1	U	120	500	South	25	1.00	

Table J-29 (*continued*). Onshore radar validation survey data at Sea Isle City, New Jersey, in fall 2009. All data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Bearing	Range (m)	Heading (cardinal)	Altitude (ft ASL)	Radar Sea Clutter (NM)	Comment
10/28/2009	0.20	20:51:59	Northern Gannet	1	U	120	1,000	North	25	1.00	
10/28/2009	0.20	20:53:03	Great Black-backed Gull	1	U	120	200	North	25	1.00	
10/28/2009	0.20	20:53:59	Northern Gannet	1	C	120	1,000	North	25	1.00	
10/28/2009	0.20	21:12:53	Northern Gannet	1	U	120	1,000	Northwest	25	1.00	
10/28/2009	0.20	21:14:49	Black Scoter	18	C	120	300	Southwest	1 (skimming)	1.00	
10/28/2009	0.20	21:17:23	Common Loon	2	C	120	1,000	Southwest	100	1.00	
10/28/2009	0.20	21:19:14	Gull, large (unknown)	1	U	120	1,000	Northwest	1 (skimming)	1.00	
10/28/2009	0.20	21:21:55	Northern Gannet	1	U	120	1,000	North	25	1.00	
10/28/2009	0.20	21:25:31	Double-crested Cormorant	63	C	120	1,000	South	100	1.00	
10/28/2009	0.20	21:29:53	Northern Gannet	1	C	120	1,000	South	25	1.00	
10/28/2009	0.20	21:31:08	Great Black-backed Gull	1	U	120	100	North	50	1.00	
10/28/2009	0.20	21:31:44	Northern Gannet	1	C	120	1,000	South	25	1.00	
10/28/2009	0.20	21:33:18	Northern Gannet	1	U	120	1,000	South	25	1.00	
10/28/2009	0.20	21:33:48	Great Black-backed Gull	1	U	120	200	North	1 (skimming)	1.00	
10/28/2009	0.20	21:34:55	Great Black-backed Gull	1	U	120	200	North	1 (skimming)	1.00	
10/28/2009	0.20	21:39:49	Northern Gannet	1	U	120	300	North	1 (skimming)	1.00	
10/28/2009	0.20	21:41:47	Northern Gannet	2	U	120	500	North	1 (skimming)	1.00	
10/29/2009	0.20	15:04:31	Double-crested Cormorant	11	U	120	100	South	100	2.50	
10/29/2009	0.20	15:05:35	Scoter, dark-winged (unknown)	63	U	120	1,000	South	1 (skimming)	2.50	
10/29/2009	0.20	15:07:53	Laughing Gull	1	U	120	1,000	South	300	2.50	
10/29/2009	0.20	15:08:45	Red-throated Loon	1	U	120	300	North	1 (skimming)	2.50	
10/29/2009	0.20	15:09:01	Northern Gannet	1	U	120	1,000	South	50	2.50	
10/29/2009	0.20	15:09:20	Northern Gannet	1	U	120	>1,000	South	100	2.50	
10/29/2009	0.20	15:10:25	Scoter, dark-winged (unknown)	45	C	120	>1000	South	25	2.50	
10/29/2009	0.20	15:10:25	Northern Gannet	1	U	120	1,000	North	50	2.50	
10/29/2009	0.20	15:11:01	Northern Gannet	1	U	120	>1,000	South	100	2.50	
10/29/2009	0.20	15:11:01	Northern Gannet	1	U	120	1,000	South	50	2.50	

Table J-29 (*continued*). Onshore radar validation survey data at Sea Isle City, New Jersey, in fall 2009. All data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Bearing	Range (m)	Heading (cardinal)	Altitude (ft ASL)	Radar Sea Clutter (NM)	Comment
10/29/2009	0.20	15:11:01	Northern Gannet	1	U	120	1,000	North	25	2.50	
10/29/2009	0.20	15:11:51	Double-crested Cormorant	82	U	120	1,000	South	25	2.50	
10/29/2009	0.20	15:13:07	Surf Scoter	48	U	120	1,000	South	25	2.50	
10/29/2009	0.20	15:14:16	Scoter, dark-winged (unknown)	16	U	120	500	South	25	2.50	10 BLSC, 6 SUSC
10/29/2009	0.20	15:15:42	Northern Gannet	1	U	120	500	South	50	2.50	
10/29/2009	0.20	15:15:42	Scoter, dark-winged (unknown)	75	U	120	>1,000	South	25	2.50	
10/29/2009	0.20	15:16:46	Double-crested Cormorant	62	U	120	100	South	100	2.50	
10/29/2009	0.20	15:17:15	Surf Scoter	21	U	120	1,000	South	25	2.50	
10/29/2009	0.20	15:17:55	Surf Scoter	75	U	120	1,000	South	1 (skimming)	2.50	1 WODU, 7 AGWT
10/29/2009	0.20	15:19:19	Atlantic Brant	4	U	120	500	South	50	2.50	
10/29/2009	0.20	15:19:19	Scoter, dark-winged (unknown)	25	U	120	>1,000	South	25	2.50	
10/29/2009	0.20	15:20:06	Herring Gull	1	U	120	300	Southeast	100	2.50	
10/29/2009	0.20	15:20:43	Scoter, dark-winged (unknown)	12	U	120	1,000	South	25	2.50	
10/29/2009	0.20	15:22:50	Northern Gannet	2	U	120	1,000	North	25	2.50	
10/29/2009	0.20	15:23:16	Herring Gull	1	U	120	200	South	200	2.50	
10/29/2009	0.20	15:25:00	Atlantic Brant	1	U	120	1,000	South	50	2.50	
10/29/2009	0.20	15:26:31	Northern Gannet	3	U	120	500	North	50	2.50	
10/29/2009	0.20	15:27:36	Surf Scoter	66	U	120	500	South	25	2.50	1 WWSC
10/29/2009	0.20	15:30:00	Double-crested Cormorant	130	U	120	1,000	South	300	2.50	1 GRCO
10/29/2009	0.20	15:31:26	Double-crested Cormorant	86	C	120	>1,000	South	200	2.50	
10/29/2009	0.20	15:33:50	Great Black-backed Gull	1	U	120	200	North	1 (skimming)	2.50	
10/29/2009	0.20	15:34:21	Black Scoter	21	U	120	300	North	1 (skimming)	2.50	
10/29/2009	0.20	15:35:12	Atlantic Brant	2	U	120	1,000	South	50	2.50	
10/29/2009	0.20	15:35:47	Northern Gannet	1	U	120	500	South	50	2.50	
10/29/2009	0.20	15:35:47	Scoter, dark-winged (unknown)	40	U	120	1,000	South	25	2.50	

Table J-29 (*continued*). Onshore radar validation survey data at Sea Isle City, New Jersey, in fall 2009. All data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Bearing	Range (m)	Heading (cardinal)	Altitude (ft ASL)	Radar Sea Clutter (NM)	Comment
10/29/2009	0.20	15:36:59	Northern Gannet	1	U	120	1,000	South	50	2.50	
10/29/2009	0.20	15:36:59	Northern Gannet	1	U	120	>1,000	South	50	2.50	
10/29/2009	0.20	15:37:56	Northern Gannet	1	U	120	>1,000	South	100	2.50	
10/29/2009	0.20	15:38:12	Northern Gannet	1	U	120	>1,000	North	100	2.50	
10/29/2009	0.20	15:38:36	Ring-billed Gull	2	U	120	1,000	South	100	2.50	
10/29/2009	0.20	15:39:24	Scoter, dark-winged (unknown)	87	U	120	1,000	South	25	2.50	1 AGWT
10/29/2009	0.20	15:40:22	Black Scoter	1	U	120	300	North	1 (skimming)	2.50	
10/29/2009	0.20	15:41:42	Red-throated Loon	1	C	120	>1,000	South	200	2.50	
10/29/2009	0.20	15:44:27	Northern Gannet	1	U	120	>1,000	North	100	2.50	
10/29/2009	0.20	15:45:05	Ring-billed Gull	2	U	120	200	South	100	2.50	
10/29/2009	0.20	15:46:03	Double-crested Cormorant	465	U	120	1,000	South	200	2.50	
10/29/2009	0.20	15:48:09	Common Loon	1	U	120	500	South	100	2.50	
10/29/2009	0.20	15:49:06	Black Scoter	28	U	120	500	North	1 (skimming)	2.50	
10/29/2009	0.20	15:50:50	Laughing Gull	1	U	120	300	North	100	2.50	
10/29/2009	0.20	15:51:59	Northern Gannet	1	U	120	1,000	South	100	2.50	
10/29/2009	0.20	15:52:45	Northern Gannet	1	U	120	>1,000	North	50	2.50	
10/29/2009	0.20	15:53:31	Double-crested Cormorant	150	C	120	>1,000	South	300	2.50	
10/29/2009	0.20	15:56:43	Surf Scoter	67	U	120	500	South	1 (skimming)	2.50	
10/29/2009	0.20	15:57:07	Double-crested Cormorant	80	C	120	>1,000	South	200	2.50	
10/29/2009	0.20	15:57:47	Surf Scoter	1	U	120	300	South	1 (skimming)	2.50	
10/29/2009	0.20	15:58:27	Atlantic Brant	12	U	120	300	South	100	2.50	
10/29/2009	0.20	15:59:41	Scaup (unknown)	25	U	120	>1,000	South	25	2.50	
10/29/2009	0.20	16:01:13	Scoter (unknown)	55	U	120	>1,000	South	100	2.50	
10/29/2009	0.20	16:02:16	Scoter (unknown)	220	U	120	>1,000	South	25	2.50	
10/29/2009	0.20	16:02:52	Surf Scoter	30	U	120	500	South	50	2.50	1 TEAL
10/29/2009	0.20	16:04:18	Surf Scoter	75	U	120	500	South	1 (skimming)	2.50	
10/29/2009	0.20	16:04:53	Double-crested Cormorant	315	U	120	1,000	South	200	2.50	
10/29/2009	0.20	16:07:06	Great Black-backed Gull	1	U	120	500	South	200	2.50	

Table J-29 (*continued*). Onshore radar validation survey data at Sea Isle City, New Jersey, in fall 2009. All data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Bearing	Range (m)	Heading (cardinal)	Altitude (ft ASL)	Radar Sea Clutter (NM)	Comment
10/29/2009	0.20	16:08:42	Scoter, dark-winged (unknown)	130	U	120	500	South	25	2.50	
10/29/2009	0.20	16:11:05	Double-crested Cormorant	200	U	120	>1,000	South	200	2.50	
10/29/2009	0.20	16:11:54	Double-crested Cormorant	6	U	120	300	Southwest	100	2.50	
10/29/2009	0.20	16:12:28	Surf Scoter	49	U	120	300	South	25	2.50	
10/29/2009	0.20	16:14:55	Scoter (unknown)	50	U	120	>1,000	South	50	2.50	
10/29/2009	0.20	16:16:34	Surf Scoter	105	U	120	500	South	1 (skimming)	2.50	
10/29/2009	0.20	16:17:15	Scoter, dark-winged (unknown)	9	U	120	1,000	South	25	2.50	
10/29/2009	0.20	16:18:47	Northern Gannet	1	U	120	1,000	North	100	2.50	
10/29/2009	0.20	16:19:39	Herring Gull	1	U	120	100	South	100	2.50	
10/29/2009	0.20	16:20:17	Common Loon	1	U	120	1,000	South	50	2.50	
10/29/2009	0.20	16:21:06	Scaup (unknown)	50	U	120	>1,000	South	100	2.50	
10/29/2009	0.20	16:22:24	Surf Scoter	3	U	120	1,000	South	50	2.50	
10/29/2009	0.20	16:23:19	Scoter, dark-winged (unknown)	150	U	120	>1,000	South	25	2.50	
10/29/2009	0.20	16:24:23	Scoter, dark-winged (unknown)	75	U	120	>1,000	South	25	2.50	
10/29/2009	0.20	16:24:58	Red-throated Loon	6	U	120	>1,000	South	200	2.50	
10/29/2009	0.20	16:25:58	Surf Scoter	17	U	120	1,000	South	300	2.50	
10/29/2009	0.20	16:26:39	Northern Gannet	1	U	120	1,000	North	50	2.50	
10/29/2009	0.20	16:27:23	Northern Gannet	1	U	120	>1,000	North	50	2.50	
10/29/2009	0.20	16:28:03	Scoter (unknown)	70	U	120	>1,000	South	200	2.50	
10/29/2009	0.20	16:28:03	Scoter, dark-winged (unknown)	22	U	120	1,000	South	25	2.50	
10/29/2009	0.20	16:29:15	Scoter, dark-winged (unknown)	65	U	120	>1,000	South	25	2.50	
10/29/2009	0.20	16:30:16	Scoter (unknown)	40	U	120	>1,000	South	1 (skimming)	2.50	
10/29/2009	0.20	16:30:32	Surf Scoter	11	U	120	1,000	South	50	2.50	
10/29/2009	0.20	16:31:08	Black Scoter	40	U	120	500	North	50	2.50	

Table J-29 (*continued*). Onshore radar validation survey data at Sea Isle City, New Jersey, in fall 2009. All data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Bearing	Range (m)	Heading (cardinal)	Altitude (ft ASL)	Radar Sea Clutter (NM)	Comment
10/29/2009	0.20	16:31:42	Duck (unknown)	1	U	120	>1,000	South	25	2.50	
10/29/2009	0.20	16:32:00	Red-throated Loon	1	U	120	>1,000	South	50	2.50	
10/29/2009	0.20	16:32:32	Scoter (unknown)	60	C	120	>1,000	South	50	2.50	
10/29/2009	0.20	16:32:46	Atlantic Brant	4	U	120	200	South	100	2.50	
10/29/2009	0.20	16:33:01	American Oystercatcher	3	U	120	300	South	50	2.50	
10/29/2009	0.20	16:33:27	Surf Scoter	1	U	120	500	South	1 (skimming)	2.50	
10/29/2009	0.20	16:34:41	Common Loon	1	U	120	100	South	100	2.50	
10/29/2009	0.20	16:35:48	Northern Gannet	1	U	120	1,000	North	50	2.50	
10/29/2009	0.20	16:36:15	Northern Gannet	3	U	120	1,000	South	100	2.50	
10/29/2009	0.20	16:36:15	Northern Gannet	2	U	120	500	North	50	2.50	
10/29/2009	0.20	16:37:11	Scoter, dark-winged (unknown)	60	U	120	>1,000	South	1 (skimming)	2.50	
10/29/2009	0.20	16:37:30	Scoter, dark-winged (unknown)	65	U	120	>1,000	South	1 (skimming)	2.50	
10/29/2009	0.20	16:37:50	Northern Gannet	1	U	120	>1,000	South	100	2.50	
10/29/2009	0.20	16:38:22	Surf Scoter	95	U	120	500	South	25	2.50	
10/29/2009	0.20	16:39:58	Black Scoter	22	U	120	300	North	1 (skimming)	2.50	1 AGWT
10/29/2009	0.20	16:40:34	Northern Gannet	2	U	120	>1,000	North	100	2.50	
10/29/2009	0.20	16:41:01	Northern Gannet	2	U	120	>1,000	North	50	2.50	
10/29/2009	0.20	16:41:13	Common Loon	2	U	120	>1,000	South	100	2.50	
10/29/2009	0.20	16:41:13	Common Loon	1	U	120	100	South	100	2.50	
10/29/2009	0.20	16:41:13	Northern Gannet	1	U	120	1,000	South	50	2.50	
10/29/2009	0.20	16:41:13	Scoter, dark-winged (unknown)	180	U	120	500	South	50	2.50	
10/29/2009	0.20	16:41:53	Scoter, dark-winged (unknown)	120	U	120	>1,000	South	50	2.50	
10/29/2009	0.20	16:42:51	Northern Gannet	1	U	120	>1,000	North	50	2.50	
10/29/2009	0.20	16:43:00	Scoter, dark-winged (unknown)	20	U	120	>1,000	South	25	2.50	
10/29/2009	0.20	16:43:58	Northern Gannet	1	U	120	>1,000	South	100	2.50	

Table J-29 (*continued*). Onshore radar validation survey data at Sea Isle City, New Jersey, in fall 2009. All data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Bearing	Range (m)	Heading (cardinal)	Altitude (ft ASL)	Radar Sea Clutter (NM)	Comment
10/29/2009	0.20	16:44:47	Scoter, dark-winged (unknown)	130	U	120	1,000	South	1 (skimming)	2.50	
10/29/2009	0.20	16:44:47	Scoter, dark-winged (unknown)	80	U	120	>1,000	South	25	2.50	
10/29/2009	0.20	16:45:15	Surf Scoter	25	U	120	500	South	50	2.50	
10/29/2009	0.20	16:45:37	Herring Gull	1	U	120	500	South	100	2.50	
10/29/2009	0.20	16:47:04	Atlantic Brant	5	U	120	200	South	50	2.50	
10/29/2009	0.20	16:47:28	Great Black-backed Gull	1	U	120	100	North	100	2.50	
10/29/2009	0.20	16:47:42	Northern Gannet	1	U	120	200	South	50	2.50	
10/29/2009	0.20	16:48:01	Red-breasted Merganser	3	U	120	500	North	100	2.50	
10/29/2009	0.20	16:48:17	Double-crested Cormorant	1	U	120	200	South	25	2.50	
10/29/2009	0.20	16:49:13	Scoter (unknown)	20	U	120	>1,000	South	50	2.50	
10/29/2009	0.20	16:49:41	Black Scoter	55	U	120	500	North	1 (skimming)	2.50	
10/29/2009	0.20	16:50:05	Double-crested Cormorant	195	U	120	200	South	200	2.50	
10/29/2009	0.20	16:50:26	Surf Scoter	110	U	120	500	South	50	2.50	
10/29/2009	0.20	16:50:49	Surf Scoter	8	U	120	>1,000	South	25	2.50	
10/29/2009	0.20	16:52:06	Royal Tern	1	U	120	500	North	25	2.50	
10/29/2009	0.20	16:52:20	Common Loon	1	U	120	1,000	Southwest	200	2.50	
10/29/2009	0.20	16:52:37	Northern Gannet	1	U	120	1,000	South	50	2.50	
10/29/2009	0.20	16:52:46	Scoter (unknown)	70	U	120	>1,000	South	25	2.50	
10/29/2009	0.20	16:53:05	Scoter (unknown)	12	U	120	>1,000	South	50	2.50	
10/29/2009	0.20	16:53:05	Red-throated Loon	3	U	120	1,000	South	100	2.50	
10/29/2009	0.20	16:53:43	Ring-billed Gull	1	U	120	1,000	South	50	2.50	
10/29/2009	0.20	16:53:53	Scoter (unknown)	75	U	120	>1,000	South	50	2.50	
10/29/2009	0.20	16:54:12	Scoter, dark-winged (unknown)	9	U	120	>1,000	South	25	2.50	1 WWSC, 1 AGWT
10/29/2009	0.20	16:54:59	Red-throated Loon	1	U	120	1,000	South	25	2.50	
10/29/2009	0.20	16:55:27	Northern Gannet	1	U	120	>1,000	South	50	2.50	
10/29/2009	0.20	16:55:27	Northern Gannet	2	U	120	300	South	50	2.50	

Table J-29 (*continued*). Onshore radar validation survey data at Sea Isle City, New Jersey, in fall 2009. All data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Bearing	Range (m)	Heading (cardinal)	Altitude (ft ASL)	Radar Sea Clutter (NM)	Comment
10/29/2009	0.20	16:56:28	Duck (unknown)	6	U	120	>1,000	South	100	2.50	
10/29/2009	0.20	16:56:45	Ring-billed Gull	1	U	120	100	South	50	2.50	
10/29/2009	0.20	16:56:53	Black Scoter	15	U	120	1,000	South	100	2.50	1 SUSC
10/29/2009	0.20	16:57:22	Scoter, dark-winged (unknown)	75	U	120	1,000	South	25	2.50	
10/29/2009	0.20	16:58:01	Loon (unknown)	1	U	120	>1,000	South	200	2.50	
10/29/2009	0.20	16:58:18	Surf Scoter	40	U	120	500	South	1 (skimming)	2.50	
10/29/2009	0.20	16:58:53	Atlantic Brant	5	U	120	300	South	50	2.50	
10/29/2009	0.20	16:59:04	Scoter, dark-winged (unknown)	85	U	120	500	South	25	2.50	
10/29/2009	0.20	17:00:20	Red-throated Loon	1	U	120	500	South	100	2.50	
10/29/2009	0.20	17:00:31	Surf Scoter	5	U	120	>1,000	South	50	2.50	
10/29/2009	0.20	17:00:46	Black Scoter	29	U	120	1,000	North	1 (skimming)	2.50	
10/29/2009	0.20	17:01:19	Herring Gull	1	U	120	100	South	50	2.50	
10/29/2009	0.20	17:02:08	Royal Tern	1	U	120	1,000	North	50	2.50	
10/29/2009	0.20	17:02:27	Scoter, dark-winged (unknown)	55	U	120	>1,000	South	50	2.50	
10/29/2009	0.20	17:03:38	Double-crested Cormorant	78	U	120	100	South	100	2.50	
10/29/2009	0.20	17:03:47	Surf Scoter	85	U	120	500	South	25	2.50	
10/29/2009	0.20	17:04:51	Surf Scoter	1	U	120	500	South	25	2.50	
10/29/2009	0.20	17:05:08	Northern Gannet	1	U	120	>1,000	South	50	2.50	
10/29/2009	0.20	17:05:26	Scoter, dark-winged (unknown)	100	C	120	>1,000	South	25	2.50	
10/29/2009	0.20	17:05:52	Common Loon	1	U	120	1,000	South	100	2.50	
10/29/2009	0.20	17:05:52	Common Loon	1	U	120	1,000	Southwest	50	2.50	
10/29/2009	0.20	17:06:44	Common Loon	1	U	120	300	South	50	2.50	
10/29/2009	0.20	17:06:54	Red-throated Loon	1	U	120	>1,000	South	100	2.50	
10/29/2009	0.20	17:07:28	Scoter, dark-winged (unknown)	170	U	120	>1,000	South	50	2.50	
10/29/2009	0.20	17:08:07	Ring-billed Gull	4	U	120	100	Southeast	200	2.50	

Table J-29 (*continued*). Onshore radar validation survey data at Sea Isle City, New Jersey, in fall 2009. All data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Bearing	Range (m)	Heading (cardinal)	Altitude (ft ASL)	Radar Sea Clutter (NM)	Comment
10/29/2009	0.20	17:08:43	Surf Scoter	115	U	120	500	South	1 (skimming)	2.50	
10/29/2009	0.20	17:08:58	Surf Scoter	58	U	120	1,000	South	1 (skimming)	2.50	
10/29/2009	0.20	17:08:58	Red-throated Loon	1	U	120	1,000	South	100	2.50	
10/29/2009	0.20	17:10:06	Surf Scoter	15	U	120	1,000	South	25	2.50	
10/29/2009	0.20	17:10:28	Northern Gannet	1	U	120	>1,000	South	100	2.50	
10/29/2009	0.20	17:10:48	Scoter, dark-winged (unknown)	120	U	120	>1,000	South	25	2.50	
10/29/2009	0.20	17:12:41	Northern Gannet	2	U	120	1,000	South	50	2.50	
10/29/2009	0.20	17:14:08	Surf Scoter	50	U	120	500	South	25	2.50	
10/29/2009	0.20	17:14:25	Scoter, dark-winged (unknown)	60	U	120	1,000	South	25	2.50	
10/29/2009	0.20	17:16:17	Surf Scoter	45	U	120	500	South	25	2.50	5 BLSC
10/29/2009	0.20	17:17:28	Northern Gannet	2	U	120	1,000	South	50	2.50	
10/29/2009	0.20	17:18:16	Northern Gannet	1	U	120	500	South	50	2.50	
10/29/2009	0.20	17:18:36	Scoter, dark-winged (unknown)	140	U	120	1,000	South	25	2.50	
10/29/2009	0.20	17:18:36	Scoter, dark-winged (unknown)	45	U	120	>1,000	South	50	2.50	
10/29/2009	0.20	17:19:28	Surf Scoter	50	U	120	500	South	25	2.50	
10/29/2009	0.20	17:19:59	Surf Scoter	10	U	120	1,000	South	25	2.50	
10/29/2009	0.20	17:20:56	American Black Duck	6	U	120	>1,000	South	100	2.50	
10/29/2009	0.20	17:22:26	Northern Gannet	1	U	120	500	South	100	2.50	
10/29/2009	0.20	17:22:41	Surf Scoter	2	U	120	500	South	25	2.50	
10/29/2009	0.20	17:24:05	Royal Tern	1	U	120	1,000	South	50	2.50	
10/29/2009	0.20	17:25:54	Surf Scoter	50	U	120	1,000	South	25	2.50	
10/29/2009	0.20	17:26:38	Surf Scoter	95	U	120	500	South	25	2.50	
10/29/2009	0.20	17:27:52	Scoter, dark-winged (unknown)	150	U	120	>1,000	South	25	2.50	
10/29/2009	0.20	17:29:40	Surf Scoter	27	U	120	1,000	South	50	2.50	
10/29/2009	0.20	17:30:37	Northern Gannet	1	U	120	>1,000	South	100	2.50	

Table J-29 (*continued*). Onshore radar validation survey data at Sea Isle City, New Jersey, in fall 2009. All data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Bearing	Range (m)	Heading (cardinal)	Altitude (ft ASL)	Radar Sea Clutter (NM)	Comment
10/29/2009	0.20	17:31:29	Northern Gannet	1	U	120	1,000	South	25	2.50	
10/29/2009	0.20	17:32:06	Scoter, dark-winged (unknown)	160	U	120	>1,000	South	50	2.50	
10/29/2009	0.20	17:32:40	Scoter, dark-winged (unknown)	90	U	120	>1,000	South	50	2.50	
10/29/2009	0.20	17:33:11	Scoter, dark-winged (unknown)	105	U	120	>1,000	South	25	2.50	
10/29/2009	0.20	17:34:15	Scoter, dark-winged (unknown)	67	U	120	>1,000	South	25	2.50	
10/29/2009	0.20	17:34:51	Red-breasted Merganser	3	U	120	>1,000	South	25	2.50	
10/29/2009	0.20	17:35:11	Surf Scoter	36	U	120	500	South	25	2.50	
10/29/2009	0.20	17:35:25	Scoter, dark-winged (unknown)	38	U	120	>1,000	South	25	2.50	
10/29/2009	0.20	17:36:25	Surf Scoter	125	U	120	500	South	25	2.50	
10/29/2009	0.20	17:37:12	Scoter, dark-winged (unknown)	110	U	120	>1,000	South	25	2.50	
10/29/2009	0.20	17:37:47	Surf Scoter	28	C	120	>1,000	South	25	2.50	
10/29/2009	0.20	17:38:36	Scoter, dark-winged (unknown)	65	U	120	>1,000	South	25	2.50	
10/29/2009	0.20	17:39:18	Surf Scoter	4	U	120	1,000	South	25	2.50	
10/29/2009	0.20	17:40:09	Atlantic Brant	4	U	120	500	South	50	2.50	
10/29/2009	0.20	17:41:28	Surf Scoter	23	U	120	500	South	1 (skimming)	2.50	
10/29/2009	0.20	17:42:00	Red-throated Loon	23	U	120	>1,000	South	50	2.50	1 COLO
10/29/2009	0.20	17:42:43	Atlantic Brant	14	U	120	300	South	100	2.50	
10/29/2009	0.20	17:43:18	Double-crested Cormorant	11	U	120	500	South	200	2.50	
10/29/2009	0.20	17:43:59	Scoter, dark-winged (unknown)	33	U	120	>1,000	South	50	2.50	
10/29/2009	0.20	17:44:19	Atlantic Brant	5	U	120	500	South	50	2.50	
10/29/2009	0.20	17:45:12	Red-throated Loon	2	U	120	1,000	South	100	2.50	
10/29/2009	0.20	17:45:57	Surf Scoter	65	U	120	1,000	South	25	2.50	
10/29/2009	0.20	17:47:03	Surf Scoter	4	U	120	1,000	South	25	2.50	2 LTDU

Table J-29 (*continued*). Onshore radar validation survey data at Sea Isle City, New Jersey, in fall 2009. All data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Bearing	Range (m)	Heading (cardinal)	Altitude (ft ASL)	Radar Sea Clutter (NM)	Comment
10/29/2009	0.20	17:48:08	Red-throated Loon	11	U	120	>1,000	South	50	2.50	
10/29/2009	0.20	17:48:38	Double-crested Cormorant	4	C	120	>1,000	South	300	2.50	
10/29/2009	0.20	17:49:16	Double-crested Cormorant	115	U	120	300	South	100	2.50	
10/29/2009	0.20	17:49:16	Double-crested Cormorant	70	U	120	200	South	100	2.50	
10/29/2009	0.20	17:49:38	Double-crested Cormorant	100	U	120	300	South	200	2.50	
10/29/2009	0.20	17:50:01	Double-crested Cormorant	47	U	120	300	South	200	2.50	
10/29/2009	0.20	17:50:29	Red-throated Loon	1	U	120	1,000	South	50	2.50	
10/29/2009	0.20	17:50:58	Northern Gannet	1	U	120	200	South	25	2.50	
10/29/2009	0.20	17:51:15	Northern Gannet	1	U	120	500	Southeast	50	2.50	
10/29/2009	0.20	17:51:36	Scoter, dark-winged (unknown)	180	U	120	>1,000	South	50	2.50	
10/29/2009	0.20	17:52:41	Surf Scoter	110	U	120	1,000	South	25	2.50	
10/29/2009	0.20	17:53:18	Ring-billed Gull	1	U	120	300	South	50	2.50	
10/29/2009	0.20	17:54:00	Red-throated Loon	8	U	120	>1,000	South	50	2.50	
10/29/2009	0.20	17:54:31	Red-throated Loon	19	U	120	>1,000	South	50	2.50	
10/29/2009	0.20	17:55:03	Scoter, dark-winged (unknown)	25	U	120	>1,000	South	25	2.50	
10/29/2009	0.20	17:55:56	Surf Scoter	100	U	120	1,000	South	25	2.50	
10/29/2009	0.20	17:56:11	Surf Scoter	48	U	120	>1,000	South	25	2.50	
10/29/2009	0.20	17:56:35	Northern Gannet	1	U	120	1,000	South	50	2.50	
10/29/2009	0.20	17:57:32	Scoter, dark-winged (unknown)	220	U	120	1,000	South	50	2.50	
10/29/2009	0.20	17:57:56	Atlantic Brant	24	U	120	500	South	25	2.50	
10/29/2009	0.20	17:59:03	Atlantic Brant	10	U	120	1,000	South	50	2.50	
10/29/2009	0.20	17:59:41	Surf Scoter	121	U	120	1,000	South	25	2.50	1 WWSC, 10 BLSC
10/29/2009	0.20	18:02:10	Surf Scoter	2	U	120	>1,000	South	50	2.50	
10/29/2009	0.20	18:03:33	Red-throated Loon	26	U	120	>1,000	South	200	2.50	
10/29/2009	0.20	18:04:05	Double-crested Cormorant	215	U	120	500	South	200	2.50	
10/29/2009	0.20	18:04:50	Northern Gannet	1	U	120	>1,000	South	50	2.50	

Table J-29 (*continued*). Onshore radar validation survey data at Sea Isle City, New Jersey, in fall 2009. All data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Bearing	Range (m)	Heading (cardinal)	Altitude (ft ASL)	Radar Sea Clutter (NM)	Comment
10/29/2009	0.20	18:05:44	Red-throated Loon	10	U	120	>1,000	South	100	2.50	
10/29/2009	0.20	18:07:37	Scoter, dark-winged (unknown)	160	U	120	>1,000	South	25	2.50	
10/29/2009	0.20	18:08:10	Black Scoter	1	U	120	1,000	North	1 (skimming)	2.50	
10/29/2009	0.20	18:08:10	Scoter, dark-winged (unknown)	240	U	120	1,000	South	25	2.50	
10/29/2009	0.20	18:09:47	Scoter, dark-winged (unknown)	175	U	120	1,000	South	25	2.50	
10/29/2009	0.20	18:10:26	Surf Scoter	53	U	120	500	South	1 (skimming)	2.50	
10/29/2009	0.20	18:11:07	Scoter, dark-winged (unknown)	19	U	120	1,000	South	50	2.50	
10/29/2009	0.20	18:12:25	Red-throated Loon	1	U	120	300	South	50	2.50	
10/29/2009	0.20	18:12:44	Scoter, dark-winged (unknown)	520	U	120	1,000	South	50	2.50	
10/29/2009	0.20	18:14:09	Atlantic Brant	32	U	120	200	South	25	2.50	
10/29/2009	0.20	18:15:26	Surf Scoter	145	U	120	300	South	25	2.50	
10/29/2009	0.20	18:17:38	Surf Scoter	2	U	120	1,000	South	100	2.50	
10/29/2009	0.20	18:19:28	Herring Gull	1	U	120	300	South	25	2.50	
10/29/2009	0.20	18:19:28	Common Loon	2	U	120	>1,000	South	50	2.50	
10/29/2009	0.20	18:20:12	Loon (unknown)	10	U	120	>1,000	South	50	2.50	
10/29/2009	0.20	18:20:47	Red-throated Loon	11	U	120	500	South	100	2.50	
10/29/2009	0.20	18:22:25	Scoter, dark-winged (unknown)	105	U	120	1,000	South	25	2.50	50/50 BLSC/SUSC
10/29/2009	0.20	18:23:12	Northern Gannet	1	U	120	>1,000	South	100	2.50	
10/29/2009	0.20	18:23:47	Northern Gannet	1	U	120	200	South	1 (skimming)	2.50	
10/29/2009	0.20	18:26:10	Great Black-backed Gull	1	U	120	200	South	200	2.50	
10/29/2009	0.20	18:27:10	Surf Scoter	18	U	120	500	South	25	2.50	
10/29/2009	0.20	18:28:00	White-winged Scoter	2	U	120	1,000	South	25	2.50	
10/29/2009	0.20	18:28:10	Red-throated Loon	6	U	120	1,000	South	100	2.50	
10/29/2009	0.20	18:29:41	Rock Pigeon	2	U	120	100	North	25	2.50	

Table J-29 (*continued*). Onshore radar validation survey data at Sea Isle City, New Jersey, in fall 2009. All data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Bearing	Range (m)	Heading (cardinal)	Altitude (ft ASL)	Radar Sea Clutter (NM)	Comment
10/29/2009	0.20	18:30:25	Scoter, dark-winged (unknown)	80	U	120	1,000	South	25	2.50	2 WWSC
10/29/2009	0.20	18:33:51	White-winged Scoter	2	U	120	1,000	South	25	2.50	
10/29/2009	0.20	18:34:10	Surf Scoter	11	U	120	1,000	South	50	2.50	
10/29/2009	0.20	18:34:26	Ring-billed Gull	1	U	120	100	South	100	2.50	
10/29/2009	0.20	18:35:25	Surf Scoter	25	U	120	200	South	25	2.50	
10/29/2009	0.20	18:35:25	Red-throated Loon	6	U	120	1,000	South	50	2.50	
10/29/2009	0.20	18:36:04	Red-throated Loon	2	U	120	>1,000	South	50	2.50	
10/29/2009	0.20	18:37:03	Red-throated Loon	5	U	120	>1,000	South	50	2.50	
10/29/2009	0.20	18:37:29	Red-throated Loon	5	U	120	1,000	South	100	2.50	
10/29/2009	0.20	18:38:01	Double-crested Cormorant	120	U	120	500	South	300	2.50	
10/29/2009	0.20	18:38:01	Double-crested Cormorant	210	U	120	100	South	300	2.50	
10/29/2009	0.20	18:39:09	Red-throated Loon	3	U	120	500	South	50	2.50	
10/29/2009	0.20	18:39:43	Red-breasted Merganser	5	U	120	100	Southwest	200	2.50	
10/29/2009	0.20	18:40:37	Northern Gannet	1	U	120	1,000	South	50	2.50	
10/29/2009	0.20	18:41:23	Common Loon	1	U	120	>1,000	South	50	2.50	
10/29/2009	0.20	18:41:57	Red-throated Loon	1	U	120	>1,000	South	50	2.50	
10/29/2009	0.20	18:42:26	Surf Scoter	70	U	120	1,000	South	1 (skimming)	2.50	
10/29/2009	0.20	18:42:56	Scoter (unknown)	35	U	120	>1,000	South	25	2.50	
10/29/2009	0.20	18:43:16	Red-throated Loon	2	U	120	1,000	South	50	2.50	
10/29/2009	0.20	18:43:56	Scoter, dark-winged (unknown)	125	U	120	>1,000	South	25	2.50	
10/29/2009	0.20	18:44:12	Scoter, dark-winged (unknown)	45	U	120	>1,000	South	25	2.50	
10/29/2009	0.20	18:46:02	Northern Gannet	1	U	120	1,000	South	50	2.50	
10/29/2009	0.20	18:46:02	Northern Gannet	1	U	120	300	South	50	2.50	
10/29/2009	0.20	18:46:35	Northern Gannet	1	U	120	200	South	50	2.50	
10/29/2009	0.20	18:46:35	Northern Gannet	1	U	120	500	South	50	2.50	

Table J-29 (*continued*). Onshore radar validation survey data at Sea Isle City, New Jersey, in fall 2009. All data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Bearing	Range (m)	Heading (cardinal)	Altitude (ft ASL)	Radar Sea Clutter (NM)	Comment
10/29/2009	0.20	18:46:59	Scoter, dark-winged (unknown)	60	U	120	1,000	South	25	2.50	
10/29/2009	0.20	18:47:41	Northern Gannet	1	U	120	>1,000	South	50	2.50	
10/29/2009	0.20	18:47:54	Northern Gannet	1	U	120	1,000	South	50	2.50	
10/29/2009	0.20	18:48:15	Red-throated Loon	20	U	120	500	South	200	2.50	
10/29/2009	0.20	18:48:27	Herring Gull	1	U	120	200	South	200	2.50	
10/29/2009	0.20	18:48:43	Surf Scoter	15	U	120	1,000	South	25	2.50	
10/29/2009	0.20	18:48:58	Northern Gannet	1	U	120	1,000	South	50	2.50	
10/29/2009	0.20	18:49:18	Duck (unknown)	5	U	120	>1,000	South	100	2.50	
10/29/2009	0.20	18:50:02	Northern Gannet	1	U	120	>1,000	South	100	2.50	
10/29/2009	0.20	18:50:21	Scoter, dark-winged (unknown)	70	U	120	1,000	South	25	2.50	1 AGWT
10/29/2009	0.20	18:50:57	Red-throated Loon	3	U	120	>1,000	South	50	2.50	
10/29/2009	0.20	18:51:06	Red-throated Loon	1	U	120	1,000	South	1 (skimming)	2.50	
10/29/2009	0.20	18:51:06	Northern Gannet	3	U	120	>1,000	South	50	2.50	
10/29/2009	0.20	18:51:35	Red-throated Loon	1	U	120	1,000	South	100	2.50	
10/29/2009	0.20	18:52:17	Northern Gannet	1	U	120	500	South	100	2.50	
10/29/2009	0.20	18:52:36	Red-throated Loon	17	U	120	>1,000	South	100	2.50	
10/29/2009	0.20	18:53:28	Double-crested Cormorant	150	U	120	300	South	300	2.50	
10/29/2009	0.20	18:53:47	Red-throated Loon	8	U	120	1,000	South	200	2.50	
10/29/2009	0.20	18:54:07	Herring Gull	1	U	120	100	South	50	2.50	
10/29/2009	0.20	18:54:17	Red-throated Loon	25	U	120	1,000	South	300	2.50	1 COLO
10/29/2009	0.20	18:54:51	Red-throated Loon	10	U	120	1,000	South	200	2.50	
10/29/2009	0.20	18:55:40	Red-throated Loon	9	U	120	300	South	300	2.50	
10/29/2009	0.20	18:55:56	Peregrine Falcon	1	U	120	200	South	100	2.50	
10/29/2009	0.20	18:56:36	Double-crested Cormorant	235	U	120	300	South	500	2.50	
10/29/2009	0.20	18:56:58	American Oystercatcher	4	U	120	500	South	300	2.50	
10/29/2009	0.20	18:57:29	Common Loon	1	U	120	500	South	50	2.50	
10/29/2009	0.20	18:57:44	Common Loon	1	U	120	300	South	200	2.50	

Table J-29 (*continued*). Onshore radar validation survey data at Sea Isle City, New Jersey, in fall 2009. All data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Bearing	Range (m)	Heading (cardinal)	Altitude (ft ASL)	Radar Sea Clutter (NM)	Comment
10/29/2009	0.20	18:58:48	Surf Scoter	20	U	120	1,000	South	25	2.50	
10/29/2009	0.20	18:59:05	Red-breasted Merganser	1	U	120	1,000	South	25	2.50	
10/29/2009	0.20	18:59:36	Surf Scoter	43	U	120	1,000	South	25	2.50	
10/29/2009	0.20	19:00:25	Double-crested Cormorant	27	U	120	300	South	200	2.50	
10/30/2009	0.20	11:41:05	Northern Gannet	1	U	120	200	East	25	1.50	
10/30/2009	0.20	11:41:55	Northern Gannet	1	U	120	200	South	25	1.50	
10/30/2009	0.20	11:42:19	Scoter, dark-winged (unknown)	90	U	120	1,000	South	25	1.50	
10/30/2009	0.20	11:43:29	Northern Gannet	1	U	120	1,000	South	50	1.50	
10/30/2009	0.20	11:44:56	Scoter (unknown)	38	U	120	1,000	Southwest	25	1.50	11 AGWT
10/30/2009	0.20	11:47:24	Scoter (unknown)	50	U	120	1,000	South	25	1.50	
10/30/2009	0.20	11:48:33	Northern Gannet	1	U	120	500	Southwest	50	1.50	
10/30/2009	0.20	11:49:45	Northern Gannet	1	U	120	300	South	1 (skimming)	1.50	
10/30/2009	0.20	11:50:26	Northern Gannet	1	U	120	300	South	50	1.50	
10/30/2009	0.20	11:51:23	Northern Gannet	1	U	120	200	South	25	1.50	
10/30/2009	0.20	11:51:56	Northern Gannet	1	U	120	200	South	25	1.50	
10/30/2009	0.20	11:53:24	Northern Gannet	1	U	120	500	South	25	1.50	
10/30/2009	0.20	11:54:05	Northern Gannet	1	U	120	200	South	1 (skimming)	1.50	
10/30/2009	0.20	11:54:52	Northern Gannet	1	U	120	500	South	50	1.50	
10/30/2009	0.20	11:55:34	Northern Gannet	1	U	120	200	Southwest	25	1.50	
10/30/2009	0.20	11:56:10	Northern Gannet	1	U	120	200	South	1 (skimming)	1.50	
10/30/2009	0.20	11:58:54	Northern Gannet	1	U	120	200	North	25	1.50	
10/30/2009	0.20	11:59:37	Northern Gannet	1	U	120	300	Northeast	50	1.50	
10/30/2009	0.20	12:00:18	Northern Gannet	1	U	120	200	Southwest	25	1.50	
10/30/2009	0.20	12:01:18	Common Loon	2	U	120	500	South	50	1.50	
10/30/2009	0.20	18:10:13	Northern Gannet	1	U	120	1,000	South	25	2.00	
10/30/2009	0.20	18:11:21	Northern Gannet	1	U	120	1,000	South	25	2.00	
10/30/2009	0.20	18:13:16	Northern Gannet	1	U	120	500	North	50	2.00	
10/30/2009	0.20	18:17:23	Northern Gannet	2	U	120	1,000	South	25	2.00	

Table J-29 (*continued*). Onshore radar validation survey data at Sea Isle City, New Jersey, in fall 2009. All data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Bearing	Range (m)	Heading (cardinal)	Altitude (ft ASL)	Radar Sea Clutter (NM)	Comment
10/30/2009	0.20	18:19:10	Scoter (unknown)	5	U	120	500	Northeast	1 (skimming)	2.00	
10/30/2009	0.20	18:22:33	Northern Gannet	1	U	120	1,000	South	25	2.00	
10/30/2009	0.20	18:24:59	Laughing Gull	1	U	120	500	South	50	2.00	
10/30/2009	0.20	18:26:08	Northern Gannet	1	U	120	500	South	25	2.00	
10/30/2009	0.20	18:29:25	Black Scoter	8	U	120	1,000	North	1 (skimming)	2.00	
10/30/2009	0.20	18:35:16	Northern Gannet	1	U	120	500	Southwest	25	2.00	
10/30/2009	0.20	18:38:04	Black Scoter	10	U	120	1,000	South	25	2.00	
10/30/2009	0.20	18:39:02	Surf Scoter	30	U	120	1,000	North	1 (skimming)	2.00	
10/30/2009	0.20	18:42:08	Northern Gannet	1	U	120	500	North	25	2.00	
10/30/2009	0.20	18:44:28	Ring-billed Gull	2	U	120	500	South	25	2.00	
10/30/2009	0.20	18:46:11	Northern Gannet	1	U	120	1,000	North	25	2.00	
10/30/2009	0.20	18:47:15	Surf Scoter	3	U	120	500	North	1 (skimming)	2.00	
10/30/2009	0.20	18:49:23	Northern Gannet	2	U	120	300	South	25	2.00	
10/30/2009	0.20	18:52:12	Northern Gannet	1	U	120	1,000	South	25	2.00	
10/30/2009	0.20	18:53:08	Northern Gannet	1	C	120	500	South	25	2.00	
10/30/2009	0.20	18:55:05	Northern Gannet	1	U	120	1,000	South	25	2.00	
10/30/2009	0.20	18:55:43	Laughing Gull	1	U	120	200	Southeast	25	2.00	
10/30/2009	0.20	18:58:10	Northern Gannet	1	U	120	500	South	25	2.00	
10/30/2009	0.20	18:59:16	Great Black-backed Gull	1	U	120	100	Southwest	50	2.00	
10/30/2009	0.20	18:59:48	Northern Gannet	1	U	120	1,000	Southwest	50	2.00	
10/30/2009	0.20	19:01:17	Surf Scoter	11	U	120	500	South	1 (skimming)	2.00	3 BLSC
10/30/2009	0.20	19:02:33	Scoter, dark-winged (unknown)	4	U	120	1,000	South	25	2.00	
10/30/2009	0.20	19:05:46	Surf Scoter	12	U	120	1,000	North	1 (skimming)	2.00	
10/30/2009	0.20	19:09:29	Northern Gannet	1	U	120	300	Southwest	25	2.00	
10/30/2009	0.20	19:10:34	Northern Gannet	1	U	120	1,000	South	50	2.00	
10/30/2009	0.20	19:12:02	Northern Gannet	1	U	120	500	Southwest	25	2.00	
10/30/2009	0.20	19:13:16	Scoter, dark-winged (unknown)	7	U	120	1,000	North	25	2.00	

Table J-29 (*continued*). Onshore radar validation survey data at Sea Isle City, New Jersey, in fall 2009. All data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Bearing	Range (m)	Heading (cardinal)	Altitude (ft ASL)	Radar Sea Clutter (NM)	Comment
10/30/2009	0.20	19:14:35	Black Scoter	10	U	120	1,000	South	1 (skimming)	2.00	
10/30/2009	0.20	19:15:17	Northern Gannet	1	U	120	1,000	North	50	2.00	
10/30/2009	0.20	19:17:35	Northern Gannet	1	U	120	1,000	South	100	2.00	
10/30/2009	0.20	19:18:14	Northern Gannet	1	U	120	1,000	South	50	2.00	
10/30/2009	0.20	19:22:13	Northern Gannet	1	U	120	500	South	25	2.00	
10/30/2009	0.20	19:28:59	Northern Gannet	1	U	120	1,000	North	25	2.00	
10/30/2009	0.20	19:29:57	Northern Gannet	1	U	120	1,000	South	25	2.00	
10/30/2009	0.20	19:32:18	Tern, large (unknown)	1	U	120	1,000	North	25	2.00	
10/30/2009	0.20	19:34:25	Northern Gannet	1	U	120	1,000	Southwest	25	2.00	
10/30/2009	0.20	19:36:06	Northern Gannet	1	U	120	1,000	South	25	2.00	
10/30/2009	0.20	19:36:46	Northern Gannet	1	U	120	1,000	Southeast	25	2.00	
10/30/2009	0.20	19:38:31	Surf Scoter	18	U	120	1,000	Southwest	1 (skimming)	2.00	
10/30/2009	0.20	19:39:54	Tern, large (unknown)	2	U	120	500	South	50	2.00	
10/30/2009	0.20	19:42:14	Northern Gannet	1	U	120	1,000	South	25	2.00	
10/30/2009	0.20	19:43:10	Northern Gannet	1	U	120	1,000	North	25	2.00	
10/30/2009	0.20	19:43:44	Northern Gannet	1	U	120	1,000	South	50	2.00	
10/30/2009	0.20	19:44:24	Northern Gannet	1	C	120	>1,000	Northeast	50	2.00	
10/30/2009	0.20	19:46:13	Black Scoter	1	U	120	200	North	1 (skimming)	2.00	
10/30/2009	0.20	19:47:33	Scoter, dark-winged (unknown)	5	U	120	1,000	South	50	2.00	
10/30/2009	0.20	19:49:49	Northern Gannet	1	U	120	500	Northwest	25	2.00	
10/30/2009	0.20	19:52:44	Laughing Gull	1	U	120	200	South	50	2.00	
10/30/2009	0.20	19:53:56	Great Black-backed Gull	1	U	120	200	Southwest	100	2.00	
10/30/2009	0.20	19:55:02	Northern Gannet	1	U	120	1,000	South	50	2.00	
10/30/2009	0.20	19:55:30	Northern Gannet	1	U	120	1,000	South	25	2.00	
10/30/2009	0.20	19:55:49	Great Black-backed Gull	1	U	120	500	South	50	2.00	
10/30/2009	0.20	19:57:54	Northern Gannet	1	U	120	500	South	25	2.00	
10/30/2009	0.20	20:03:31	Northern Gannet	1	C	120	1,000	South	50	2.00	
10/30/2009	0.20	20:03:58	Northern Gannet	2	U	120	1,000	North	25	2.00	

Table J-29 (*continued*). Onshore radar validation survey data at Sea Isle City, New Jersey, in fall 2009. All data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Bearing	Range (m)	Heading (cardinal)	Altitude (ft ASL)	Radar Sea Clutter (NM)	Comment
10/30/2009	0.20	20:04:20	Northern Gannet	1	U	120	1,000	South	25	2.00	
10/30/2009	0.20	20:05:51	Northern Gannet	1	U	120	1,000	South	50	2.00	
10/30/2009	0.20	20:06:03	Scoter, dark-winged (unknown)	14	U	120	1,000	North	25	2.00	
10/30/2009	0.20	20:08:55	Herring Gull	1	U	120	100	Southeast	100	2.00	
10/30/2009	0.20	20:09:32	Ring-billed Gull	2	U	120	100	South	100	2.00	
10/30/2009	0.20	20:12:08	Ring-billed Gull	1	U	120	300	Southeast	25	2.00	
10/30/2009	0.20	20:18:14	Scoter (unknown)	3	U	120	>1,000	South	25	2.00	
10/30/2009	0.20	20:19:50	Northern Gannet	1	U	120	500	Southeast	25	2.00	
10/30/2009	0.20	20:22:29	Northern Gannet	1	U	120	500	Southeast	50	2.00	
10/30/2009	0.20	20:23:11	Northern Gannet	1	U	120	1,000	North	50	2.00	
10/30/2009	0.20	20:24:30	Northern Gannet	1	C	120	1,000	South	25	2.00	
10/30/2009	0.20	20:26:16	Scoter, dark-winged (unknown)	1	U	120	500	Northeast	1 (skimming)	2.00	
10/30/2009	0.20	20:27:36	Northern Gannet	1	U	120	500	South	25	2.00	
10/30/2009	0.20	20:29:04	Northern Gannet	1	U	120	500	South	25	2.00	
10/30/2009	0.20	20:29:25	Laughing Gull	1	U	120	300	Southeast	25	2.00	
10/30/2009	0.20	20:30:44	Northern Gannet	1	U	120	1,000	North	25	2.00	
10/30/2009	0.20	20:33:50	Northern Gannet	1	U	120	500	East	50	2.00	
10/30/2009	0.20	20:35:12	Northern Gannet	1	U	120	500	South	25	2.00	
10/30/2009	0.20	20:37:44	Northern Gannet	1	U	120	1,000	South	25	2.00	
10/30/2009	0.20	20:38:36	Northern Gannet	1	U	120	500	Southeast	50	2.00	
10/30/2009	0.20	20:40:20	Northern Gannet	1	U	120	500	Northeast	25	2.00	
10/30/2009	0.20	20:41:21	Northern Gannet	1	C	120	1,000	South	25	2.00	
10/30/2009	0.20	20:44:24	Northern Gannet	1	U	120	1,000	North	100	2.00	
10/30/2009	0.20	20:46:16	Northern Gannet	1	U	120	1,000	South	25	2.00	
10/30/2009	0.20	20:48:03	Northern Gannet	1	U	120	500	South	25	2.00	
10/30/2009	0.20	20:48:37	Northern Gannet	1	U	120	1,000	North	50	2.00	
10/30/2009	0.20	20:49:04	Northern Gannet	1	U	120	1,000	North	50	2.00	

Table J-29 (*continued*). Onshore radar validation survey data at Sea Isle City, New Jersey, in fall 2009. All data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Bearing	Range (m)	Heading (cardinal)	Altitude (ft ASL)	Radar Sea Clutter (NM)	Comment
10/30/2009	0.20	20:49:48	Northern Gannet	1	U	120	>1,000	South	25	2.00	
10/30/2009	0.20	20:57:41	Northern Gannet	1	U	120	300	Southeast	25	2.00	
10/31/2009	0.20	14:36:56	Northern Gannet	1	C	120	1,000	Northeast	25	1.50	
10/31/2009	0.20	14:37:51	Northern Gannet	1	U	120	500	South	25	1.50	
10/31/2009	0.20	14:38:29	Northern Gannet	1	U	120	1,000	South	25	1.50	
10/31/2009	0.20	14:39:29	Northern Gannet	1	U	120	500	North	50	1.50	
10/31/2009	0.20	14:40:27	Royal Tern	1	U	120	200	South	50	1.50	
10/31/2009	0.20	14:43:15	Northern Gannet	1	U	120	300	North	50	1.50	
10/31/2009	0.20	14:45:00	Northern Gannet	1	U	120	500	Southwest	25	1.50	
10/31/2009	0.20	14:45:20	Northern Gannet	1	U	120	500	South	50	1.50	
10/31/2009	0.20	14:45:56	Northern Gannet	1	C	120	>1,000	North	50	1.50	
10/31/2009	0.20	14:46:37	Northern Gannet	1	U	120	200	Northeast	25	1.50	
10/31/2009	0.20	14:49:43	Northern Gannet	1	U	120	500	North	25	1.50	
10/31/2009	0.20	14:50:39	Northern Gannet	2	U	120	1,000	South	25	1.50	
10/31/2009	0.20	14:51:20	Northern Gannet	1	U	120	1,000	South	50	1.50	
10/31/2009	0.20	14:51:20	Northern Gannet	1	U	120	500	North	25	1.50	
10/31/2009	0.20	14:53:01	Northern Gannet	1	U	120	>1,000	South	25	1.50	
10/31/2009	0.20	14:54:00	Northern Gannet	2	U	120	1,000	South	25	1.50	
10/31/2009	0.20	14:55:24	Northern Gannet	1	U	120	500	North	25	1.50	
10/31/2009	0.20	14:56:08	Northern Gannet	4	U	120	1,000	North	25	1.50	feeding
10/31/2009	0.20	15:04:12	Northern Gannet	1	U	120	300	South	25	1.50	
10/31/2009	0.20	15:04:39	Northern Gannet	1	U	120	>1,000	South	25	1.50	
10/31/2009	0.20	15:04:57	Northern Gannet	1	U	120	500	South	50	1.50	
10/31/2009	0.20	15:05:32	Double-crested Cormorant	1	U	120	300	South	50	1.50	
10/31/2009	0.20	15:07:09	Northern Gannet	1	U	120	500	Northwest	25	1.50	
10/31/2009	0.20	15:08:07	Northern Gannet	1	U	120	1,000	North	25	1.50	
10/31/2009	0.20	15:09:28	Northern Gannet	4	U	120	1,000	North	25	1.50	feeding group
10/31/2009	0.20	15:14:43	Northern Gannet	2	U	120	1,000	North	25	1.50	

Table J-29 (*continued*). Onshore radar validation survey data at Sea Isle City, New Jersey, in fall 2009. All data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Bearing	Range (m)	Heading (cardinal)	Altitude (ft ASL)	Radar Sea Clutter (NM)	Comment
10/31/2009	0.20	15:15:27	Northern Gannet	2	U	120	1,000	North	25	1.50	
11/3/2009	0.20	17:29:42	Scoter, dark-winged (unknown)	190	C	120	1,000	South	25	2.00	
11/3/2009	0.20	17:31:39	Royal Tern	1	U	120	200	Southwest	25	2.00	
11/3/2009	0.20	17:35:24	Scoter, dark-winged (unknown)	130	U	120	1,000	South	25	2.00	
11/3/2009	0.20	17:39:17	Northern Gannet	1	U	120	300	South	1 (skimming)	2.00	
11/3/2009	0.20	17:40:48	Northern Gannet	1	C	120	500	North	25	2.00	
11/3/2009	0.20	17:41:55	Laughing Gull	1	U	120	200	South	25	2.00	
11/3/2009	0.20	17:43:55	Northern Gannet	1	U	120	500	North	25	2.00	
11/3/2009	0.20	17:45:30	Northern Gannet	1	U	120	300	South	1 (skimming)	2.00	
11/3/2009	0.20	17:46:58	Scoter, dark-winged (unknown)	1	U	120	>1,000	South	25	2.00	
11/3/2009	0.20	17:49:14	Northern Gannet	1	U	120	500	South	25	2.00	
11/3/2009	0.20	17:51:11	Northern Gannet	1	U	120	500	South	1 (skimming)	2.00	
11/3/2009	0.20	17:54:20	Northern Gannet	1	U	120	1,000	South	100	2.00	
11/3/2009	0.20	17:55:25	Northern Gannet	3	U	120	500	South	1 (skimming)	2.00	
11/3/2009	0.20	17:56:30	Northern Gannet	1	U	120	1,000	North	100	2.00	
11/3/2009	0.20	17:58:39	Northern Gannet	1	U	120	300	South	1 (skimming)	2.00	
11/3/2009	0.20	17:59:01	Northern Gannet	1	C	120	300	South	50	2.00	
11/3/2009	0.20	18:00:09	Northern Gannet	1	U	120	500	South	1 (skimming)	2.00	
11/3/2009	0.20	18:03:22	Northern Gannet	1	U	120	500	South	1 (skimming)	2.00	
11/3/2009	0.20	18:04:27	Northern Gannet	1	U	120	300	South	1 (skimming)	2.00	
11/3/2009	0.20	18:05:21	Northern Gannet	1	C	120	1,000	South	25	2.00	
11/3/2009	0.20	18:07:21	Northern Gannet	1	U	120	500	Northwest	50	2.00	
11/3/2009	0.20	18:08:32	Scoter, dark-winged (unknown)	85	C	120	1,000	South	25	2.00	
11/3/2009	0.20	18:12:26	Northern Gannet	1	U	120	500	Northwest	25	2.00	
11/3/2009	0.20	18:16:52	Scoter, dark-winged (unknown)	3	C	120	1,000	North	25	2.00	

Table J-29 (*continued*). Onshore radar validation survey data at Sea Isle City, New Jersey, in fall 2009. All data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Bearing	Range (m)	Heading (cardinal)	Altitude (ft ASL)	Radar Sea Clutter (NM)	Comment
11/3/2009	0.20	18:18:43	Northern Gannet	1	U	120	500	South	25	2.00	
11/3/2009	0.20	18:19:51	Northern Gannet	1	U	120	1,000	South	25	2.00	
11/3/2009	0.20	18:20:28	Laughing Gull	3	U	120	300	South	1 (skimming)	2.00	
11/3/2009	0.20	18:21:32	Northern Gannet	1	U	120	500	North	50	2.00	
11/3/2009	0.20	18:17:15	Double-crested Cormorant	20	U	120	300	South	1 (skimming)	2.00	
11/3/2009	0.20	18:25:24	Other	1	C	120	1,000	South	1 (skimming)	2.00	Boat
11/3/2009	0.20	18:28:42	Northern Gannet	1	U	120	500	South	25	2.00	
11/3/2009	0.20	18:29:09	Northern Gannet	1	U	120	1,000	South	25	2.00	
11/3/2009	0.20	18:29:41	Northern Gannet	1	U	120	1,000	South	25	2.00	
11/3/2009	0.20	18:30:01	Northern Gannet	1	U	120	1,000	North	50	2.00	
11/3/2009	0.20	18:31:10	Common Loon	3	U	120	300	South	1 (skimming)	2.00	
11/3/2009	0.20	18:32:52	Northern Gannet	1	U	120	300	South	1 (skimming)	2.00	
11/3/2009	0.20	18:33:29	Northern Gannet	1	U	120	1,000	South	25	2.00	
11/3/2009	0.20	18:37:37	Northern Gannet	1	U	120	1,000	South	25	2.00	
11/3/2009	0.20	18:37:52	Northern Gannet	1	U	120	1,000	South	25	2.00	
11/3/2009	0.20	18:38:12	Double-crested Cormorant	1	U	120	200	North	25	2.00	
11/3/2009	0.20	18:39:40	Northern Gannet	1	U	120	1,000	South	25	2.00	
11/3/2009	0.20	18:41:10	Laughing Gull	1	U	120	100	North	100	2.00	
11/3/2009	0.20	18:43:56	Northern Gannet	1	C	120	1,000	North	50	2.00	
11/3/2009	0.20	18:46:18	Northern Gannet	1	U	120	500	North	100	2.00	
11/3/2009	0.20	18:47:26	Northern Gannet	1	U	120	300	South	50	2.00	
11/3/2009	0.20	18:50:11	Northern Gannet	1	U	120	1,000	South	50	2.00	
11/3/2009	0.20	18:51:09	Northern Gannet	1	U	120	300	Southwest	50	2.00	
11/3/2009	0.20	18:51:58	Surf Scoter	1	U	120	200	North	1 (skimming)	2.00	
11/3/2009	0.20	18:53:04	Scoter (unknown)	25	C	120	1,000	South	25	2.00	
11/3/2009	0.20	18:55:48	Northern Gannet	1	U	120	500	South	1 (skimming)	2.00	
11/3/2009	0.20	19:01:57	Northern Gannet	1	U	120	500	North	50	2.00	
11/3/2009	0.20	19:02:40	Northern Gannet	1	U	120	500	North	25	2.00	

Table J-29 (*continued*). Onshore radar validation survey data at Sea Isle City, New Jersey, in fall 2009. All data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Bearing	Range (m)	Heading (cardinal)	Altitude (ft ASL)	Radar Sea Clutter (NM)	Comment
11/3/2009	0.20	19:03:09	Northern Gannet	1	U	120	300	Southwest	25	2.00	
11/3/2009	0.20	19:06:35	Great Black-backed Gull	1	U	120	200	Southwest	25	2.00	
11/3/2009	0.20	19:07:27	Northern Gannet	1	U	120	300	Northeast	25	2.00	
11/3/2009	0.20	19:08:07	Northern Gannet	1	U	120	1,000	South	25	2.00	
11/3/2009	0.20	19:08:49	Northern Gannet	1	C	120	1,000	Southwest	25	2.00	
11/3/2009	0.20	19:09:56	Northern Gannet	1	U	120	300	Southwest	25	2.00	
11/3/2009	0.20	19:10:35	Northern Gannet	1	U	120	300	Southwest	25	2.00	
11/3/2009	0.20	19:11:03	Northern Gannet	1	U	120	300	South	50	2.00	
11/3/2009	0.20	19:12:24	Northern Gannet	1	U	120	500	South	25	2.00	
11/3/2009	0.20	19:12:54	Black Scoter	7	U	120	500	South	1 (skimming)	2.00	
11/3/2009	0.20	19:16:15	Northern Gannet	1	U	120	1,000	North	50	2.00	
11/3/2009	0.20	19:17:38	Northern Gannet	1	U	120	1,000	South	50	2.00	
11/3/2009	0.20	19:18:09	Northern Gannet	1	C	120	1,000	North	100	2.00	
11/3/2009	0.20	19:19:29	Red-throated Loon	1	U	120	500	South	1 (skimming)	2.00	
11/3/2009	0.20	19:22:14	Northern Gannet	1	U	120	500	South	100	2.00	
11/3/2009	0.20	19:17:55	Northern Gannet	1	U	120	1,000	South	25	2.00	
11/3/2009	0.20	19:24:55	Northern Gannet	1	U	120	1,000	South	50	2.00	
11/3/2009	0.20	19:26:29	Northern Gannet	1	U	120	1,000	South	1 (skimming)	2.00	
11/3/2009	0.20	19:26:45	Northern Gannet	1	U	120	1,000	North	100	2.00	
11/3/2009	0.20	19:27:12	Northern Gannet	1	U	120	300	South	1 (skimming)	2.00	
11/3/2009	0.20	19:27:44	Northern Gannet	1	U	120	300	Northeast	25	2.00	
11/3/2009	0.20	19:28:29	Double-crested Cormorant	33	U	120	200	Southwest	50	2.00	
11/3/2009	0.20	19:29:57	Northern Gannet	1	U	120	500	South	50	2.00	
11/3/2009	0.20	20:08:05	Northern Gannet	1	U	120	1,000	North	50	2.00	
11/3/2009	0.20	20:09:02	Northern Gannet	1	U	120	500	Southwest	1 (skimming)	2.00	
11/3/2009	0.20	20:09:55	Northern Gannet	1	U	120	300	South	1 (skimming)	2.00	
11/3/2009	0.20	20:10:52	Northern Gannet	1	U	120	500	South	50	2.00	
11/3/2009	0.20	20:12:57	Northern Gannet	1	U	120	500	North	100	2.00	

Table J-29 (*continued*). Onshore radar validation survey data at Sea Isle City, New Jersey, in fall 2009. All data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Bearing	Range (m)	Heading (cardinal)	Altitude (ft ASL)	Radar Sea Clutter (NM)	Comment
11/3/2009	0.20	20:16:59	Northern Gannet	1	U	120	1,000	North	50	2.00	
11/3/2009	0.20	20:19:05	Northern Gannet	1	U	120	1,000	North	50	2.00	
11/3/2009	0.20	20:21:19	Northern Gannet	1	U	120	1,000	North	100	2.00	
11/3/2009	0.20	20:22:20	Northern Gannet	1	U	120	1,000	North	50	2.00	
11/3/2009	0.20	20:24:13	Royal Tern	1	U	120	300	South	1 (skimming)	2.00	
11/3/2009	0.20	20:24:57	Red-throated Loon	1	U	120	500	South	1 (skimming)	2.00	
11/3/2009	0.20	20:27:31	Northern Gannet	1	U	120	300	Southwest	50	2.00	
11/3/2009	0.20	20:29:18	Royal Tern	1	U	120	300	Southwest	25	2.00	
11/3/2009	0.20	20:30:32	Northern Gannet	1	U	120	1,000	South	50	2.00	
11/3/2009	0.20	20:31:50	Northern Gannet	1	U	120	1,000	South	25	2.00	
11/3/2009	0.20	20:33:28	Northern Gannet	1	U	120	1,000	South	1 (skimming)	2.00	
11/3/2009	0.20	20:33:59	Northern Gannet	1	U	120	1,000	North	25	2.00	
11/3/2009	0.20	20:37:15	Northern Gannet	1	U	120	300	South	25	2.00	
11/3/2009	0.20	20:38:14	Northern Gannet	1	U	120	1,000	South	50	2.00	
11/3/2009	0.20	20:39:07	Northern Gannet	1	U	120	500	South	25	2.00	
11/3/2009	0.20	20:39:55	Northern Gannet	1	U	120	500	South	25	2.00	
11/3/2009	0.20	20:40:46	Northern Gannet	1	U	120	1,000	North	100	2.00	
11/3/2009	0.20	20:42:30	Northern Gannet	1	C	120	300	North	50	2.00	
11/3/2009	0.20	20:46:01	Northern Gannet	1	U	120	1,000	South	1 (skimming)	2.00	
11/3/2009	0.20	20:48:18	Great Black-backed Gull	1	C	120	200	Northeast	50	2.00	
11/3/2009	0.20	20:50:23	Northern Gannet	1	U	120	1,000	North	50	2.00	
11/3/2009	0.20	20:52:23	Northern Gannet	1	U	120	1,000	North	50	2.00	
11/3/2009	0.20	20:55:12	Northern Gannet	1	U	120	300	Southwest	25	2.00	
11/3/2009	0.20	20:58:24	Northern Gannet	1	U	120	1,000	South	1 (skimming)	2.00	
11/3/2009	0.20	20:59:46	Great Black-backed Gull	1	U	120	200	South	25	2.00	
11/3/2009	0.20	21:00:42	Northern Gannet	1	U	120	300	South	50	2.00	
11/3/2009	0.20	21:02:54	Northern Gannet	1	U	120	500	North	25	2.00	
11/3/2009	0.20	21:03:35	Northern Gannet	1	U	120	1,000	North	50	2.00	

Table J-29 (*continued*). Onshore radar validation survey data at Sea Isle City, New Jersey, in fall 2009. All data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Bearing	Range (m)	Heading (cardinal)	Altitude (ft ASL)	Radar Sea Clutter (NM)	Comment
11/3/2009	0.20	21:05:50	Northern Gannet	1	U	120	1,000	North	50	2.00	
11/3/2009	0.20	21:06:32	Northern Gannet	1	U	120	1,000	North	25	2.00	
11/3/2009	0.20	21:08:41	Northern Gannet	1	C	120	1,000	North	25	2.00	
11/5/2009	0.20	19:50:41	Northern Gannet	1	C	120	1,000	South	100	1.50	
11/5/2009	0.20	19:52:25	Northern Gannet	1	C	120	300	West	50	1.50	
11/5/2009	0.20	19:53:08	Northern Gannet	1	C	120	300	Southwest	25	1.50	
11/5/2009	0.20	19:54:27	Northern Gannet	1	U	120	300	Northwest	25	1.50	
11/5/2009	0.20	19:55:18	Northern Gannet	1	C	120	500	South	50	1.50	
11/5/2009	0.20	19:56:07	Northern Gannet	1	C	120	300	Southwest	25	1.50	
11/5/2009	0.20	20:04:36	Northern Gannet	1	U	120	300	North	1 (skimming)	1.50	
11/5/2009	0.20	20:06:13	Northern Gannet	1	U	120	300	South	50	1.50	
11/5/2009	0.20	20:06:44	Black Scoter	21	U	120	1,000	Northwest	25	1.50	
11/5/2009	0.20	20:08:13	Black Scoter	75	U	120	500	South	25	1.50	
11/5/2009	0.20	20:09:29	Northern Gannet	1	C	120	300	South	25	1.50	
11/5/2009	0.20	20:10:15	Northern Gannet	1	U	120	500	Southwest	25	1.50	
11/5/2009	0.20	20:11:08	Northern Gannet	1	U	120	100	South	25	1.50	
11/5/2009	0.20	20:11:59	Northern Gannet	1	U	120	300	Northeast	25	1.50	
11/5/2009	0.20	20:12:59	Northern Gannet	1	U	120	200	South	25	1.50	
11/5/2009	0.20	20:16:00	Northern Gannet	1	C	120	500	Southwest	50	1.50	
11/5/2009	0.20	20:17:08	Northern Gannet	1	U	120	300	North	100	1.50	
11/5/2009	0.20	20:17:55	Northern Gannet	1	U	120	200	North	25	1.50	
11/5/2009	0.20	20:19:34	Northern Gannet	1	U	120	300	Southwest	50	1.50	
11/5/2009	0.20	20:21:26	Herring Gull	1	U	120	100	South	25	1.50	
11/5/2009	0.20	20:26:43	Northern Gannet	1	C	120	500	North	100	1.50	
11/5/2009	0.20	20:27:26	Northern Gannet	1	C	120	500	Southwest	50	1.50	
11/5/2009	0.20	20:30:03	Northern Gannet	1	U	120	200	Southeast	50	1.50	
11/5/2009	0.20	20:32:50	Ring-billed Gull	1	U	120	100	Northwest	25	1.50	
11/5/2009	0.20	20:33:36	Ring-billed Gull	1	U	120	200	Southwest	50	1.50	

Table J-29 (*continued*). Onshore radar validation survey data at Sea Isle City, New Jersey, in fall 2009. All data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Bearing	Range (m)	Heading (cardinal)	Altitude (ft ASL)	Radar Sea Clutter (NM)	Comment
11/5/2009	0.20	20:34:50	Northern Gannet	1	U	120	300	South	100	1.50	
11/5/2009	0.20	20:36:20	Northern Gannet	1	U	120	200	South	25	1.50	
11/5/2009	0.20	20:37:16	Common Loon	1	U	120	300	South	1 (skimming)	1.50	
11/5/2009	0.20	20:38:21	Northern Gannet	1	U	120	300	South	50	1.50	
11/5/2009	0.20	20:39:09	Northern Gannet	1	U	120	300	Southwest	25	1.50	
11/5/2009	0.20	20:42:10	Northern Gannet	1	C	120	500	South	50	1.50	
11/5/2009	0.20	20:42:59	Northern Gannet	1	C	120	500	South	1 (skimming)	1.50	
11/5/2009	0.20	20:43:48	Northern Gannet	1	U	120	300	Southwest	100	1.50	
11/5/2009	0.20	20:44:51	Northern Gannet	1	U	120	500	Southwest	100	1.50	
11/5/2009	0.20	20:46:15	Royal Tern	1	U	120	300	Southwest	100	1.50	
11/5/2009	0.20	20:50:23	Northern Gannet	1	U	120	500	Northwest	50	1.50	
11/5/2009	0.20	20:51:39	Northern Gannet	1	U	120	500	Southwest	50	1.50	
11/5/2009	0.20	20:52:49	Northern Gannet	1	U	120	1,000	South	50	1.50	
11/5/2009	0.20	20:53:10	Northern Gannet	1	C	120	500	Southwest	50	1.50	
11/5/2009	0.20	20:53:50	Northern Gannet	1	U	120	200	West	25	1.50	
11/5/2009	0.20	20:54:48	Northern Gannet	1	U	120	500	Southwest	25	1.50	
11/5/2009	0.20	20:55:37	Double-crested Cormorant	30	C	120	500	Southwest	25	1.50	
11/5/2009	0.20	20:58:08	Ring-billed Gull	1	U	120	200	South	1 (skimming)	1.50	
11/5/2009	0.20	20:59:13	Northern Gannet	1	U	120	300	Northwest	25	1.50	
11/5/2009	0.20	21:00:33	Northern Gannet	1	U	120	300	Southwest	50	1.50	
11/5/2009	0.20	21:01:10	Northern Gannet	1	C	120	300	South	100	1.50	
11/5/2009	0.20	21:01:39	Northern Gannet	1	U	120	300	Northwest	25	1.50	
11/5/2009	0.20	21:03:35	Northern Gannet	1	U	120	300	South	50	1.50	
11/5/2009	0.20	21:04:48	Northern Gannet	1	U	120	300	West	25	1.50	
11/5/2009	0.20	21:05:42	Northern Gannet	1	U	120	300	North	25	1.50	
11/5/2009	0.20	21:06:25	Red-throated Loon	1	U	120	500	South	1 (skimming)	1.50	
11/5/2009	0.20	21:08:04	Northern Gannet	1	U	120	300	South	50	1.50	
11/5/2009	0.20	21:10:14	Ring-billed Gull	1	U	120	200	South	25	1.50	

Table J-29 (*continued*). Onshore radar validation survey data at Sea Isle City, New Jersey, in fall 2009. All data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Bearing	Range (m)	Heading (cardinal)	Altitude (ft ASL)	Radar Sea Clutter (NM)	Comment
11/5/2009	0.20	21:11:25	Royal Tern	2	U	120	300	South	25	1.50	
11/5/2009	0.20	21:12:53	Northern Gannet	1	C	120	500	Southwest	50	1.50	
11/5/2009	0.20	21:13:56	Northern Gannet	1	C	120	1,000	South	1 (skimming)	1.50	
11/5/2009	0.20	21:16:13	Northern Gannet	1	U	120	1,000	Northwest	50	1.50	
11/5/2009	0.20	21:16:59	Northern Gannet	1	C	120	<1,000	Southwest	50	1.50	
11/6/2009	0.20	19:35:58	Northern Gannet	1	U	120	200	North	1 (skimming)	1.50	
11/6/2009	0.20	19:37:18	Northern Gannet	1	U	120	200	South	25	1.50	
11/6/2009	0.20	19:39:18	Loon (unknown)	1	C	120	>1,000	South	100	1.50	
11/6/2009	0.20	19:41:17	Red-throated Loon	1	U	120	>1,000	Southwest	100	1.50	
11/6/2009	0.20	19:47:26	Black Scoter	4	U	120	1,000	South	50	1.50	
11/6/2009	0.20	19:48:32	Northern Gannet	1	U	120	200	Northwest	100	1.50	
11/6/2009	0.20	19:52:54	American Oystercatcher	2	C	120	300	South	1 (skimming)	1.50	
11/6/2009	0.20	19:55:07	Loon (unknown)	1	U	120	500	South	1 (skimming)	1.50	
11/6/2009	0.20	19:56:40	Northern Gannet	1	U	120	300	North	25	1.50	
11/6/2009	0.20	19:57:48	Northern Gannet	1	C	120	500	North	25	1.50	
11/6/2009	0.20	19:58:51	Northern Gannet	1	U	120	500	North	100	1.50	
11/6/2009	0.20	20:00:02	Northern Gannet	1	U	120	1,000	Northwest	100	1.50	
11/6/2009	0.20	20:00:30	Northern Gannet	1	U	120	1,000	North	25	1.50	
11/6/2009	0.20	20:02:04	Northern Gannet	1	U	120	300	Northwest	50	1.50	
11/6/2009	0.20	20:03:06	Northern Gannet	1	C	120	500	North	50	1.50	
11/6/2009	0.20	20:03:50	Northern Gannet	1	U	120	200	Northwest	1 (skimming)	1.50	
11/6/2009	0.20	20:05:14	Northern Gannet	1	U	120	500	Northwest	50	1.50	
11/6/2009	0.20	20:05:56	Northern Gannet	1	U	120	1,000	North	100	1.50	
11/6/2009	0.20	20:06:13	Double-crested Cormorant	4	U	120	500	Southwest	50	1.50	
11/6/2009	0.20	20:07:04	Northern Gannet	1	U	120	500	North	100	1.50	
11/6/2009	0.20	20:07:50	Herring Gull	1	C	120	300	North	200	1.50	
11/6/2009	0.20	20:08:31	Northern Gannet	1	C	120	>1,000	South	200	1.50	
11/6/2009	0.20	20:09:52	Northern Gannet	1	C	120	>1,000	Southwest	25	1.50	

Table J-29 (*continued*). Onshore radar validation survey data at Sea Isle City, New Jersey, in fall 2009. All data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Bearing	Range (m)	Heading (cardinal)	Altitude (ft ASL)	Radar Sea Clutter (NM)	Comment
11/6/2009	0.20	20:11:11	Northern Gannet	1	U	120	1,000	Northwest	100	1.50	
11/6/2009	0.20	20:11:49	Northern Gannet	1	U	120	1,000	Southwest	50	1.50	
11/6/2009	0.20	20:13:42	Northern Gannet	1	C	120	300	Southwest	25	1.50	
11/6/2009	0.20	20:14:34	Northern Gannet	1	C	120	300	Northwest	25	1.50	
11/6/2009	0.20	20:15:18	Northern Gannet	1	C	120	500	North	100	1.50	
11/6/2009	0.20	20:16:06	Northern Gannet	1	U	120	1,000	Northeast	200	1.50	
11/6/2009	0.20	20:17:08	White-winged Scoter	1	U	120	300	Northwest	25	1.50	
11/6/2009	0.20	20:20:07	Northern Gannet	1	U	120	500	Northwest	25	1.50	
11/6/2009	0.20	20:22:13	Northern Gannet	1	U	120	1,000	Southwest	50	1.50	
11/6/2009	0.20	20:22:40	Herring Gull	1	U	120	100	North	25	1.50	
11/6/2009	0.20	20:24:29	Northern Gannet	1	U	120	1,000	South	50	1.50	
11/6/2009	0.20	20:25:31	Northern Gannet	1	U	120	1,000	Northwest	100	1.50	
11/6/2009	0.20	20:27:23	Northern Gannet	1	U	120	1,000	North	100	1.50	
11/6/2009	0.20	20:28:23	Red-throated Loon	2	U	120	500	Southwest	1 (skimming)	1.50	
11/6/2009	0.20	20:29:52	Northern Gannet	1	U	120	500	West	100	1.50	
11/6/2009	0.20	20:31:16	Northern Gannet	1	U	120	500	North	50	1.50	
11/6/2009	0.20	20:32:16	Herring Gull	3	C	120	500	Southwest	50	1.50	1 NOGA
11/6/2009	0.20	20:33:57	Black Scoter	85	C	120	>1,000	Southwest	25	1.50	
11/6/2009	0.20	20:35:26	Northern Gannet	1	U	120	1,000	North	50	1.50	
11/6/2009	0.20	20:36:07	Herring Gull	1	U	120	100	North	1 (skimming)	1.50	
11/6/2009	0.20	20:37:27	Northern Gannet	1	U	120	1,000	North	100	1.50	
11/6/2009	0.20	20:38:10	Northern Gannet	1	U	120	500	South	100	1.50	
11/6/2009	0.20	20:38:45	Northern Gannet	1	C	120	>1,000	Northeast	50	1.50	
11/6/2009	0.20	20:42:24	Common Loon	1	U	120	500	Southwest	1 (skimming)	1.50	
11/6/2009	0.20	20:43:58	Great Black-backed Gull	1	C	120	500	North	50	1.50	
11/6/2009	0.20	20:44:37	Northern Gannet	1	U	120	500	North	100	1.50	
11/6/2009	0.20	20:45:24	Northern Gannet	1	U	120	500	North	1 (skimming)	1.50	
11/6/2009	0.20	20:47:00	Double-crested Cormorant	1	U	120	200	South	1 (skimming)	1.50	

Table J-29 (*continued*). Onshore radar validation survey data at Sea Isle City, New Jersey, in fall 2009. All data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Bearing	Range (m)	Heading (cardinal)	Altitude (ft ASL)	Radar Sea Clutter (NM)	Comment
11/6/2009	0.20	20:48:43	Northern Gannet	1	U	120	500	Southwest	100	1.50	
11/6/2009	0.20	20:49:37	Royal Tern	1	U	120	300	West	25	1.50	
11/6/2009	0.20	20:50:45	Northern Gannet	1	U	120	500	Southwest	50	1.50	
11/6/2009	0.20	20:53:08	Loon (unknown)	6	U	120	1,000	South	25	1.50	
11/6/2009	0.20	20:54:02	Northern Gannet	1	C	120	300	Southwest	50	1.50	
11/6/2009	0.20	20:54:41	Red-throated Loon	1	U	120	1,000	South	1 (skimming)	1.50	
11/6/2009	0.20	20:55:23	Double-crested Cormorant	4	U	120	500	West	300	1.50	
11/6/2009	0.20	20:57:49	Northern Gannet	1	U	120	1,000	North	50	1.50	
11/6/2009	0.20	20:58:26	Northern Gannet	1	C	120	>1,000	North	25	1.50	
11/6/2009	0.20	20:58:53	Red-throated Loon	1	U	120	500	South	1 (skimming)	1.50	
11/6/2009	0.20	20:59:47	Northern Gannet	1	U	120	500	South	100	1.50	
11/6/2009	0.20	21:05:51	Northern Gannet	1	U	120	1,000	North	100	1.50	
11/6/2009	0.20	21:06:23	Red-throated Loon	1	U	120	500	South	1 (skimming)	1.50	
11/6/2009	0.20	21:08:08	Laughing Gull	3	U	120	300	North	1 (skimming)	1.50	
11/6/2009	0.20	21:09:49	Other	1	U	120	200	South	1 (skimming)	1.50	Boat
11/6/2009	0.20	21:11:05	Double-crested Cormorant	28	C	120	500	South	300	1.50	
11/6/2009	0.20	21:13:31	Northern Gannet	1	U	120	1,000	North	50	1.50	
11/6/2009	0.20	21:14:41	Red-throated Loon	2	U	120	500	South	1 (skimming)	1.50	
11/6/2009	0.20	21:15:41	Northern Gannet	1	U	120	1,000	Northwest	50	1.50	
11/6/2009	0.20	21:16:34	Red-throated Loon	2	U	120	1,000	South	1 (skimming)	1.50	
11/6/2009	0.20	21:17:55	Northern Gannet	1	U	120	1,000	North	100	1.50	
11/6/2009	0.20	21:20:29	Northern Gannet	1	U	120	500	Northeast	100	1.50	
11/6/2009	0.20	21:25:23	Red-throated Loon	1	C	120	500	South	1 (skimming)	1.50	
11/6/2009	0.20	21:26:49	Northern Gannet	1	U	120	1,000	West	100	1.50	
11/6/2009	0.20	21:28:14	Surf Scoter	1	U	120	200	North	1 (skimming)	1.50	
11/6/2009	0.20	21:29:21	Herring Gull	1	U	120	100	South	1 (skimming)	1.50	
11/6/2009	0.20	21:32:30	Black Scoter	1	U	120	500	South	1 (skimming)	1.50	
11/6/2009	0.20	21:34:21	Herring Gull	1	U	120	200	West	25	1.50	

Table J-29 (*continued*). Onshore radar validation survey data at Sea Isle City, New Jersey, in fall 2009. All data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Bearing	Range (m)	Heading (cardinal)	Altitude (ft ASL)	Radar Sea Clutter (NM)	Comment
11/6/2009	0.20	21:37:06	Duck (unknown)	2	C	120	500	South	100	1.50	
11/7/2009	0.20	18:37:57	Northern Gannet	1	U	120	300	South	50	2.00	
11/7/2009	0.20	18:39:54	Northern Gannet	1	U	120	500	South	50	2.00	
11/7/2009	0.20	18:40:33	Northern Gannet	1	U	120	500	South	25	2.00	
11/7/2009	0.20	18:41:01	Northern Gannet	1	U	120	1,000	South	25	2.00	
11/7/2009	0.20	18:42:06	Northern Gannet	1	U	120	300	South	25	2.00	
11/7/2009	0.20	18:42:40	Northern Gannet	1	U	120	500	South	1 (skimming)	2.00	
11/7/2009	0.20	18:43:09	Northern Gannet	1	U	120	200	South	25	2.00	
11/7/2009	0.20	18:49:01	Black Scoter	80	U	120	300	South	1 (skimming)	2.00	
11/7/2009	0.20	18:50:27	Northern Gannet	1	U	120	300	South	50	2.00	
11/7/2009	0.20	18:51:22	Northern Gannet	1	U	120	300	South	50	2.00	
11/7/2009	0.20	18:51:57	Black Scoter	7	C	120	500	South	1 (skimming)	2.00	
11/7/2009	0.20	18:53:24	Northern Gannet	1	U	120	300	South	1 (skimming)	2.00	
11/7/2009	0.20	18:54:22	Northern Gannet	1	U	120	500	South	100	2.00	
11/7/2009	0.20	18:54:58	Northern Gannet	1	U	120	300	South	100	2.00	
11/7/2009	0.20	18:55:25	Northern Gannet	1	U	120	300	Southwest	100	2.00	
11/7/2009	0.20	18:57:01	Northern Gannet	1	U	120	500	Southwest	100	2.00	
11/7/2009	0.20	18:57:52	Northern Gannet	1	U	120	200	Southwest	1 (skimming)	2.00	
11/7/2009	0.20	19:00:23	Northern Gannet	1	U	120	1,000	North	100	2.00	
11/7/2009	0.20	19:01:48	Northern Gannet	1	U	120	1,000	Southwest	100	2.00	
11/7/2009	0.20	19:03:08	Northern Gannet	1	U	120	500	South	1 (skimming)	2.00	
11/7/2009	0.20	19:04:22	Northern Gannet	1	U	120	1,000	South	100	2.00	
11/7/2009	0.20	19:05:05	Ring-billed Gull	1	U	120	200	South	1 (skimming)	2.00	
11/7/2009	0.20	19:06:22	Northern Gannet	1	U	120	500	South	1 (skimming)	2.00	
11/7/2009	0.20	19:07:07	Northern Gannet	1	U	120	200	Southeast	1 (skimming)	2.00	
11/7/2009	0.20	19:11:06	Northern Gannet	1	U	120	500	South	50	2.00	
11/7/2009	0.20	19:11:34	Black Scoter	45	U	120	300	North	1 (skimming)	2.00	
11/7/2009	0.20	19:13:00	Northern Gannet	1	U	120	300	South	25	2.00	

Table J-29 (*continued*). Onshore radar validation survey data at Sea Isle City, New Jersey, in fall 2009. All data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Bearing	Range (m)	Heading (cardinal)	Altitude (ft ASL)	Radar Sea Clutter (NM)	Comment
11/7/2009	0.20	19:14:05	Northern Gannet	1	U	120	500	South	100	2.00	
11/7/2009	0.20	19:15:01	Northern Gannet	1	U	120	300	South	1 (skimming)	2.00	
11/7/2009	0.20	19:15:41	Northern Gannet	2	U	120	300	South	25	2.00	
11/7/2009	0.20	19:18:29	Northern Gannet	1	U	120	500	South	50	2.00	
11/7/2009	0.20	19:21:31	Duck (unknown)	1	U	120	500	South	50	2.00	
11/7/2009	0.20	19:23:29	Northern Gannet	1	U	120	500	South	25	2.00	
11/7/2009	0.20	19:24:12	Northern Gannet	1	U	120	500	South	100	2.00	
11/7/2009	0.20	19:26:05	Northern Gannet	1	U	120	500	South	100	2.00	
11/7/2009	0.20	19:26:32	Northern Gannet	1	U	120	1,000	South	100	2.00	
11/7/2009	0.20	19:27:37	Northern Gannet	1	U	120	300	South	100	2.00	
11/7/2009	0.20	19:28:06	Northern Gannet	1	U	120	300	South	100	2.00	
11/7/2009	0.20	19:28:34	Scoter, dark-winged (unknown)	45	U	120	1,000	Northwest	25	2.00	
11/7/2009	0.20	19:30:07	Northern Gannet	1	U	120	300	South	100	2.00	
11/7/2009	0.20	19:31:09	Northern Gannet	1	U	120	300	South	1 (skimming)	2.00	
11/7/2009	0.20	19:31:29	Northern Gannet	1	U	120	300	South	1 (skimming)	2.00	
11/7/2009	0.20	19:35:24	Red-throated Loon	1	U	120	200	South	1 (skimming)	2.00	
11/7/2009	0.20	19:37:55	Northern Gannet	1	U	120	1,000	South	100	2.00	
11/7/2009	0.20	19:38:19	Duck (unknown)	40	U	120	200	South	1 (skimming)	2.00	
11/7/2009	0.20	19:39:45	Northern Gannet	1	U	120	300	Northwest	50	2.00	
11/7/2009	0.20	19:41:09	Loon (unknown)	1	U	120	300	South	1 (skimming)	2.00	
11/7/2009	0.20	19:42:15	Northern Gannet	1	U	120	500	South	100	2.00	
11/7/2009	0.20	19:44:18	Northern Gannet	1	U	120	500	South	100	2.00	
11/7/2009	0.20	19:45:15	Northern Gannet	1	U	120	300	North	100	2.00	
11/7/2009	0.20	19:46:29	Double-crested Cormorant	1	U	120	200	South	1 (skimming)	2.00	
11/7/2009	0.20	19:47:33	Loon (unknown)	1	U	120	300	South	1 (skimming)	2.00	
11/7/2009	0.20	19:50:07	Northern Gannet	3	U	120	300	South	1 (skimming)	2.00	
11/7/2009	0.20	19:52:32	Northern Gannet	1	U	120	200	South	25	2.00	
11/7/2009	0.20	19:53:27	Northern Gannet	1	U	120	200	Northwest	25	2.00	

Table J-29 (*continued*). Onshore radar validation survey data at Sea Isle City, New Jersey, in fall 2009. All data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Bearing	Range (m)	Heading (cardinal)	Altitude (ft ASL)	Radar Sea Clutter (NM)	Comment
11/7/2009	0.20	19:54:31	Northern Gannet	1	U	120	200	West	25	2.00	
11/7/2009	0.20	19:56:04	Northern Gannet	1	U	120	200	South	50	2.00	
11/7/2009	0.20	19:57:19	Northern Gannet	1	U	120	300	South	50	2.00	
11/7/2009	0.20	19:57:57	Northern Gannet	1	U	120	200	South	50	2.00	
11/7/2009	0.20	19:58:31	Northern Gannet	1	U	120	300	South	1 (skimming)	2.00	
11/7/2009	0.20	19:59:42	Northern Gannet	5	U	120	300	South	1 (skimming)	2.00	
11/7/2009	0.20	20:03:30	Northern Gannet	1	U	120	200	South	1 (skimming)	2.00	
11/7/2009	0.20	20:05:52	Northern Gannet	1	U	120	200	Southwest	25	2.00	
11/7/2009	0.20	20:08:47	Northern Gannet	1	U	120	300	South	100	2.00	
11/7/2009	0.20	20:09:35	Northern Gannet	1	U	120	300	South	100	2.00	
11/7/2009	0.20	20:10:51	Northern Gannet	1	U	120	500	South	200	2.00	
11/7/2009	0.20	20:12:21	Northern Gannet	1	U	120	200	South	1 (skimming)	2.00	
11/7/2009	0.20	20:12:43	Northern Gannet	1	U	120	300	South	100	2.00	
11/7/2009	0.20	20:13:28	Red-throated Loon	5	U	120	300	South	1 (skimming)	2.00	
11/7/2009	0.20	20:15:43	Red-throated Loon	1	U	120	200	South	1 (skimming)	2.00	
11/7/2009	0.20	20:18:37	Northern Gannet	1	U	120	300	South	25	2.00	
11/7/2009	0.20	20:20:46	Red-throated Loon	1	U	120	300	South	1 (skimming)	2.00	
11/7/2009	0.20	20:23:04	Red-throated Loon	1	U	120	300	South	1 (skimming)	2.00	
11/7/2009	0.20	20:25:48	Northern Gannet	1	U	120	300	Northwest	25	2.00	
11/7/2009	0.20	20:26:57	Northern Gannet	1	U	120	1,000	South	50	2.00	
11/7/2009	0.20	20:27:50	Northern Gannet	1	U	120	1,000	North	100	2.00	
11/7/2009	0.20	20:28:46	Northern Gannet	2	U	120	500	South	25	2.00	
11/7/2009	0.20	20:31:04	Northern Gannet	1	U	120	1,000	South	100	2.00	
11/7/2009	0.20	20:32:20	Northern Gannet	1	U	120	300	South	50	2.00	
11/7/2009	0.20	20:34:22	Northern Gannet	1	U	120	500	South	100	2.00	
11/7/2009	0.20	20:35:44	Northern Gannet	1	U	120	500	South	50	2.00	
11/8/2009	0.20	19:14:50	Northern Gannet	2	C	120	500	North	50	1.50	
11/8/2009	0.20	19:15:41	Northern Gannet	1	U	120	500	North	50	1.50	

Table J-29 (*continued*). Onshore radar validation survey data at Sea Isle City, New Jersey, in fall 2009. All data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Bearing	Range (m)	Heading (cardinal)	Altitude (ft ASL)	Radar Sea Clutter (NM)	Comment
11/8/2009	0.20	19:16:27	Northern Gannet	1	C	120	1,000	South	25	1.50	
11/8/2009	0.20	19:17:02	Northern Gannet	1	U	120	500	North	25	1.50	
11/8/2009	0.20	19:17:49	Northern Gannet	1	U	120	200	South	25	1.50	
11/8/2009	0.20	19:18:16	Northern Gannet	1	C	120	1,000	North	25	1.50	
11/8/2009	0.20	19:18:45	Northern Gannet	1	U	120	500	South	25	1.50	
11/8/2009	0.20	19:19:29	Northern Gannet	1	U	120	500	South	25	1.50	
11/8/2009	0.20	19:19:29	Northern Gannet	1	U	120	300	South	25	1.50	
11/8/2009	0.20	19:20:05	Northern Gannet	1	C	120	>1,000	South	100	1.50	
11/8/2009	0.20	19:20:22	Northern Gannet	3	U	120	500	South	50	1.50	
11/8/2009	0.20	19:20:54	Northern Gannet	2	C	120	1,000	South	50	1.50	
11/8/2009	0.20	19:22:05	Northern Gannet	1	C	120	1,000	South	50	1.50	
11/8/2009	0.20	19:23:43	Northern Gannet	1	U	120	200	South	50	1.50	
11/8/2009	0.20	19:24:17	Laughing Gull	3	U	120	500	South	25	1.50	
11/8/2009	0.20	19:28:27	Northern Gannet	1	U	120	1,000	South	50	1.50	
11/8/2009	0.20	19:30:07	Northern Gannet	1	C	120	1,000	North	25	1.50	
11/8/2009	0.20	19:30:56	Northern Gannet	1	U	120	1,000	North	50	1.50	
11/8/2009	0.20	19:33:53	Northern Gannet	1	U	120	500	South	50	1.50	
11/8/2009	0.20	19:34:19	Black Scoter	55	C	120	>1,000	North	25	1.50	
11/8/2009	0.20	19:35:32	Black Scoter	3	C	120	1,000	South	1 (skimming)	1.50	
11/8/2009	0.20	19:36:26	Northern Gannet	1	C	120	500	North	50	1.50	
11/8/2009	0.20	19:37:16	Northern Gannet	1	U	120	300	North	25	1.50	
11/8/2009	0.20	19:37:55	Northern Gannet	2	U	120	1,000	South	100	1.50	
11/8/2009	0.20	19:38:10	Northern Gannet	1	C	120	>1,000	South	25	1.50	
11/8/2009	0.20	19:38:25	Northern Gannet	1	U	120	1,000	South	50	1.50	
11/8/2009	0.20	19:39:01	Northern Gannet	1	U	120	500	South	25	1.50	
11/8/2009	0.20	19:39:18	Northern Gannet	1	U	120	500	North	25	1.50	
11/8/2009	0.20	19:39:35	Herring Gull	1	U	120	500	North	25	1.50	
11/8/2009	0.20	19:40:05	Herring Gull	2	U	120	300	South	25	1.50	

Table J-29 (*continued*). Onshore radar validation survey data at Sea Isle City, New Jersey, in fall 2009. All data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Bearing	Range (m)	Heading (cardinal)	Altitude (ft ASL)	Radar Sea Clutter (NM)	Comment
11/8/2009	0.20	19:41:50	Northern Gannet	1	U	120	1,000	South	25	1.50	
11/8/2009	0.20	19:42:28	Northern Gannet	1	U	120	500	Southeast	25	1.50	
11/8/2009	0.20	19:43:36	Northern Gannet	1	C	120	500	South	100	1.50	
11/8/2009	0.20	19:44:34	Northern Gannet	1	U	120	500	South	25	1.50	
11/8/2009	0.20	19:44:48	Northern Gannet	3	C	120	1,000	South	25	1.50	
11/8/2009	0.20	19:45:18	Northern Gannet	1	U	120	500	South	25	1.50	
11/8/2009	0.20	19:45:46	Northern Gannet	1	U	120	1,000	Southeast	25	1.50	
11/8/2009	0.20	19:46:42	Herring Gull	1	C	120	500	North	25	1.50	
11/8/2009	0.20	19:47:47	Northern Gannet	1	U	120	500	South	1 (skimming)	1.50	
11/8/2009	0.20	19:48:28	Northern Gannet	1	U	120	500	South	50	1.50	
11/8/2009	0.20	19:48:43	Red-throated Loon	1	U	120	500	South	1 (skimming)	1.50	
11/8/2009	0.20	19:49:43	Black Scoter	25	U	120	500	South	25	1.50	
11/8/2009	0.20	19:50:31	Red-throated Loon	1	U	120	500	South	1 (skimming)	1.50	
11/8/2009	0.20	19:51:14	Red-throated Loon	2	U	120	200	South	1 (skimming)	1.50	
11/8/2009	0.20	19:52:00	Northern Gannet	2	C	120	1,000	South	50	1.50	feeding
11/8/2009	0.20	19:52:40	Northern Gannet	2	C	120	1,000	South	50	1.50	
11/8/2009	0.20	19:53:13	Herring Gull	1	U	120	100	North	100	1.50	
11/8/2009	0.20	19:53:36	Northern Gannet	1	U	120	200	South	25	1.50	
11/8/2009	0.20	19:54:41	Northern Gannet	1	C	120	500	South	100	1.50	
11/8/2009	0.20	19:55:12	Lesser Scaup	3	C	120	500	South	25	1.50	
11/8/2009	0.20	19:55:34	Northern Gannet	1	U	120	200	South	50	1.50	
11/8/2009	0.20	19:56:47	Northern Gannet	1	U	120	300	North	50	1.50	
11/8/2009	0.20	19:57:12	Northern Gannet	1	U	120	500	North	50	1.50	
11/8/2009	0.20	19:57:32	Northern Gannet	1	C	120	1,000	North	50	1.50	
11/8/2009	0.20	19:58:08	Northern Gannet	1	C	120	500	South	50	1.50	
11/8/2009	0.20	19:58:29	Northern Gannet	1	C	120	300	South	25	1.50	
11/8/2009	0.20	19:58:51	Northern Gannet	3	C	120	500	South	25	1.50	
11/8/2009	0.20	19:59:23	Red-throated Loon	1	C	120	500	South	1 (skimming)	1.50	

Table J-29 (*continued*). Onshore radar validation survey data at Sea Isle City, New Jersey, in fall 2009. All data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Bearing	Range (m)	Heading (cardinal)	Altitude (ft ASL)	Radar Sea Clutter (NM)	Comment
11/8/2009	0.20	19:59:45	Northern Gannet	1	C	120	>1,000	South	1 (skimming)	1.50	
11/8/2009	0.20	20:00:02	Northern Gannet	1	C	120	500	South	25	1.50	
11/8/2009	0.20	20:00:18	Laughing Gull	1	C	120	1,000	South	25	1.50	
11/8/2009	0.20	20:00:42	Northern Gannet	2	U	120	500	South	25	1.50	
11/9/2009	0.20	16:20:29	Scoter, dark-winged (unknown)	63	U	120	300	South	1 (skimming)	2.00	
11/9/2009	0.20	16:23:30	Scoter, dark-winged (unknown)	67	U	120	200	South	1 (skimming)	2.00	
11/9/2009	0.20	16:24:49	Red-throated Loon	2	U	120	500	South	25	2.00	
11/9/2009	0.20	16:26:29	Gull, large (unknown)	1	C	120	500	South	25	2.00	
11/9/2009	0.20	16:28:44	Red-throated Loon	2	C	120	500	South	25	2.00	
11/9/2009	0.20	16:29:55	Red-throated Loon	3	U	120	300	South	25	2.00	
11/9/2009	0.20	16:30:49	Northern Gannet	1	U	120	300	South	25	2.00	
11/9/2009	0.20	16:33:17	Scoter (unknown)	180	U	120	300	South	25	2.00	
11/9/2009	0.20	16:34:59	Northern Gannet	1	C	120	500	South	25	2.00	
11/9/2009	0.20	16:39:13	Northern Gannet	1	C	120	300	East	25	2.00	
11/9/2009	0.20	16:40:05	Northern Gannet	1	C	120	500	Southwest	25	2.00	
11/9/2009	0.20	16:41:18	Northern Gannet	1	U	120	300	East	1 (skimming)	2.00	
11/9/2009	0.20	16:41:47	Northern Gannet	1	U	120	300	Northeast	25	2.00	feeding
11/9/2009	0.20	16:43:21	Royal Tern	1	U	120	200	South	25	2.00	
11/9/2009	0.20	16:44:08	Northern Gannet	1	U	120	300	Southwest	50	2.00	
11/9/2009	0.20	16:44:50	Northern Gannet	1	C	120	500	Northwest	25	2.00	
11/9/2009	0.20	16:45:27	Northern Gannet	1	U	120	300	North	50	2.00	
11/9/2009	0.20	16:47:26	Northern Gannet	1	C	120	500	North	25	2.00	
11/9/2009	0.20	16:48:26	Double-crested Cormorant	52	C	120	300	Southwest	200	2.00	
11/9/2009	0.20	16:50:17	Double-crested Cormorant	36	U	120	300	Southwest	1 (skimming)	2.00	
11/9/2009	0.20	16:51:43	Scoter, dark-winged (unknown)	35	U	120	300	Southwest	1 (skimming)	2.00	
11/9/2009	0.20	16:53:04	Northern Gannet	1	C	120	500	Southwest	50	2.00	

Table J-29 (*continued*). Onshore radar validation survey data at Sea Isle City, New Jersey, in fall 2009. All data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Bearing	Range (m)	Heading (cardinal)	Altitude (ft ASL)	Radar Sea Clutter (NM)	Comment
11/9/2009	0.20	16:54:19	Double-crested Cormorant	1	U	120	500	Southwest	1 (skimming)	2.00	
11/9/2009	0.20	16:55:08	Red-throated Loon	1	C	120	300	Southwest	1 (skimming)	2.00	
11/9/2009	0.20	16:55:53	Northern Gannet	1	U	120	300	South	1 (skimming)	2.00	
11/9/2009	0.20	16:57:25	Northern Gannet	1	U	120	300	West	25	2.00	
11/9/2009	0.20	16:59:35	Northern Gannet	1	U	120	300	Southwest	25	2.00	
11/9/2009	0.20	17:01:10	Northern Gannet	1	U	120	300	West	25	2.00	
11/9/2009	0.20	17:02:11	Northern Gannet	1	U	120	300	North	25	2.00	
11/9/2009	0.20	17:05:02	Northern Gannet	1	U	120	500	South	50	2.00	
11/9/2009	0.20	17:05:40	Northern Gannet	1	U	120	500	South	50	2.00	
11/9/2009	0.20	17:06:22	Red-throated Loon	1	U	120	300	South	1 (skimming)	2.00	
11/9/2009	0.20	17:07:05	Double-crested Cormorant	19	C	120	500	South	25	2.00	4 DWSC
11/9/2009	0.20	17:08:53	Northern Gannet	1	U	120	300	Northwest	25	2.00	
11/9/2009	0.20	17:10:32	Red-throated Loon	1	U	120	200	South	1 (skimming)	2.00	
11/9/2009	0.20	17:11:33	Red-throated Loon	1	U	120	200	Northwest	1 (skimming)	2.00	
11/9/2009	0.20	17:12:08	Northern Gannet	1	U	120	200	Southeast	25	2.00	
11/9/2009	0.20	17:13:51	Northern Gannet	1	U	120	500	Southwest	25	2.00	
11/9/2009	0.20	17:14:51	Northern Gannet	1	U	120	300	South	50	2.00	
11/9/2009	0.20	17:16:54	Northern Gannet	1	U	120	200	East	25	2.00	
11/9/2009	0.20	17:17:40	Northern Gannet	1	U	120	200	South	25	2.00	
11/9/2009	0.20	17:18:11	Red-throated Loon	4	C	120	500	South	25	2.00	
11/9/2009	0.20	17:19:31	Scoter, dark-winged (unknown)	2	U	120	300	South	1 (skimming)	2.00	
11/9/2009	0.20	17:20:14	Northern Gannet	1	U	120	300	South	25	2.00	
11/9/2009	0.20	17:22:37	Northern Gannet	1	U	120	500	North	25	2.00	
11/9/2009	0.20	17:23:22	Northern Gannet	1	U	120	500	South	25	2.00	
11/9/2009	0.20	17:24:39	Northern Gannet	1	U	120	300	South	25	2.00	
11/9/2009	0.20	17:25:02	Red-throated Loon	1	C	120	300	South	1 (skimming)	2.00	
11/9/2009	0.20	17:27:23	Northern Gannet	1	U	120	500	Southwest	50	2.00	
11/9/2009	0.20	17:28:08	Northern Gannet	1	U	120	500	South	50	2.00	

Table J-29 (*continued*). Onshore radar validation survey data at Sea Isle City, New Jersey, in fall 2009. All data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Bearing	Range (m)	Heading (cardinal)	Altitude (ft ASL)	Radar Sea Clutter (NM)	Comment
11/9/2009	0.20	17:28:41	Black Scoter	4	C	120	300	Southwest	1 (skimming)	2.00	
11/9/2009	0.20	17:29:38	Northern Gannet	1	U	120	300	Northeast	50	2.00	
11/9/2009	0.20	17:30:44	Great Black-backed Gull	1	U	120	100	Southwest	100	2.00	
11/9/2009	0.20	17:34:15	Other	1	U	120	300	West	1 (skimming)	2.00	Boat
11/9/2009	0.20	17:36:33	Red-throated Loon	1	U	120	300	South	1 (skimming)	2.00	
11/9/2009	0.20	17:37:25	Northern Gannet	1	U	120	500	North	25	2.00	
11/9/2009	0.20	17:40:10	Northern Gannet	1	U	120	500	South	25	2.00	
11/9/2009	0.20	17:40:42	Northern Gannet	1	U	120	500	South	1 (skimming)	2.00	
11/9/2009	0.20	17:43:26	Northern Gannet	1	C	120	500	South	25	2.00	
11/9/2009	0.20	17:43:45	Northern Gannet	1	U	120	300	Southwest	25	2.00	
11/9/2009	0.20	17:44:19	Northern Gannet	1	C	120	500	North	50	2.00	
11/9/2009	0.20	17:45:07	Northern Gannet	1	C	120	500	Northwest	25	2.00	
11/9/2009	0.20	17:47:00	Northern Gannet	1	C	120	500	South	25	2.00	
11/9/2009	0.20	17:47:57	Northern Gannet	1	U	120	300	North	50	2.00	
11/9/2009	0.20	17:48:33	Northern Gannet	1	U	120	500	Southeast	25	2.00	
11/9/2009	0.20	17:50:22	Northern Gannet	1	U	120	500	Southwest	50	2.00	
11/9/2009	0.20	17:53:40	Northern Gannet	1	U	120	300	South	50	2.00	
11/9/2009	0.20	17:54:56	Black Scoter	1	U	120	200	South	1 (skimming)	2.00	
11/9/2009	0.20	18:01:13	Northern Gannet	1	U	120	300	East	25	2.00	
11/9/2009	0.20	18:02:05	Northern Gannet	1	U	120	500	South	1 (skimming)	2.00	
11/9/2009	0.20	18:02:43	Northern Gannet	1	U	120	500	South	50	2.00	
11/9/2009	0.20	18:05:31	Northern Gannet	1	U	120	300	South	50	2.00	
11/9/2009	0.20	18:07:27	Northern Gannet	1	U	120	300	Southeast	1 (skimming)	2.00	
11/9/2009	0.20	18:08:10	Northern Gannet	1	C	120	500	South	50	2.00	
11/9/2009	0.20	18:10:28	Northern Gannet	1	C	120	500	South	25	2.00	
11/9/2009	0.20	18:11:02	Northern Gannet	1	U	120	300	South	50	2.00	
11/9/2009	0.20	18:11:34	Northern Gannet	1	C	120	500	Southeast	50	2.00	
11/9/2009	0.20	18:12:51	Northern Gannet	1	U	120	300	Southwest	50	2.00	

Table J-29 (*continued*). Onshore radar validation survey data at Sea Isle City, New Jersey, in fall 2009. All data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Bearing	Range (m)	Heading (cardinal)	Altitude (ft ASL)	Radar Sea Clutter (NM)	Comment
11/9/2009	0.20	18:13:11	Northern Gannet	1	C	120	500	Southwest	50	2.00	
11/9/2009	0.20	18:15:55	Northern Gannet	1	U	120	500	Southeast	25	2.00	
11/9/2009	0.20	18:17:19	Northern Gannet	1	U	120	500	East	25	2.00	
11/9/2009	0.20	18:17:54	Northern Gannet	1	C	120	500	South	50	2.00	
11/9/2009	0.20	18:19:06	Northern Gannet	1	U	120	300	Southeast	25	2.00	
11/9/2009	0.20	18:58:10	Northern Gannet	1	C	120	500	Southwest	50	2.00	
11/9/2009	0.20	18:59:32	Red-throated Loon	15	C	120	500	Southwest	1 (skimming)	2.00	
11/9/2009	0.20	19:01:36	Northern Gannet	1	U	120	300	North	50	1.50	
11/9/2009	0.20	19:02:23	Red-throated Loon	5	C	120	500	Southwest	1 (skimming)	1.50	
11/9/2009	0.20	19:03:08	Northern Gannet	1	U	120	300	South	25	1.50	
11/9/2009	0.20	19:04:38	Northern Gannet	1	C	120	500	South	50	1.50	
11/9/2009	0.20	19:05:08	Northern Gannet	1	C	120	500	Southwest	25	1.50	
11/9/2009	0.20	19:09:44	Northern Gannet	1	U	120	200	Southwest	25	1.50	
11/9/2009	0.20	19:11:13	Northern Gannet	1	C	120	500	South	50	1.50	
11/9/2009	0.20	19:11:51	Northern Gannet	1	C	120	500	South	25	1.50	
11/9/2009	0.20	19:14:10	Northern Gannet	1	C	120	500	South	25	1.50	
11/9/2009	0.20	19:15:08	Northern Gannet	1	U	120	300	Southwest	1 (skimming)	1.50	
11/9/2009	0.20	19:15:58	Northern Gannet	1	C	120	500	Southwest	50	1.50	
11/9/2009	0.20	19:17:00	Northern Gannet	1	C	120	300	South	25	1.50	
11/9/2009	0.20	19:17:28	Northern Gannet	2	U	120	200	Southwest	25	1.50	
11/9/2009	0.20	19:18:10	Northern Gannet	1	C	120	>1,000	South	1 (skimming)	1.50	
11/9/2009	0.20	19:18:33	Northern Gannet	1	C	120	500	Southwest	50	1.50	
11/9/2009	0.20	19:19:50	Northern Gannet	1	C	120	>1,000	Southwest	50	1.50	
11/9/2009	0.20	19:20:17	Northern Gannet	1	C	120	500	South	25	1.50	
11/9/2009	0.20	19:21:46	Northern Gannet	1	U	120	300	South	50	1.50	
11/9/2009	0.20	19:23:27	Northern Gannet	1	U	120	500	South	50	1.50	
11/9/2009	0.20	19:25:55	Northern Gannet	1	U	120	300	South	25	1.50	
11/9/2009	0.20	19:26:43	Northern Gannet	1	C	120	500	South	25	1.50	

Table J-29 (*continued*). Onshore radar validation survey data at Sea Isle City, New Jersey, in fall 2009. All data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Bearing	Range (m)	Heading (cardinal)	Altitude (ft ASL)	Radar Sea Clutter (NM)	Comment
11/9/2009	0.20	19:27:53	Northern Gannet	1	C	120	500	South	25	1.50	
11/9/2009	0.20	19:29:54	Northern Gannet	1	C	120	500	South	50	1.50	
11/9/2009	0.20	19:30:30	Great Black-backed Gull	1	U	120	200	North	25	1.50	
11/9/2009	0.20	19:31:22	Northern Gannet	1	C	120	500	South	25	1.50	
11/9/2009	0.20	19:33:11	Northern Gannet	1	U	120	200	Southwest	25	1.50	
11/9/2009	0.20	19:34:20	Northern Gannet	1	U	120	300	South	1 (skimming)	1.50	
11/9/2009	0.20	19:35:45	Northern Gannet	1	C	120	>1,000	South	50	1.50	
11/9/2009	0.20	19:37:31	Ring-billed Gull	1	U	120	300	South	25	1.50	
11/9/2009	0.20	19:38:10	Northern Gannet	1	C	120	500	South	25	1.50	
11/9/2009	0.20	19:48:19	Northern Gannet	1	U	120	500	South	50	1.50	
11/9/2009	0.20	19:48:44	Northern Gannet	1	U	120	300	South	25	1.50	
11/9/2009	0.20	19:49:46	Northern Gannet	1	U	120	200	South	25	1.50	
11/9/2009	0.20	19:50:39	Northern Gannet	1	U	120	500	South	50	1.50	
11/9/2009	0.20	19:51:52	Northern Gannet	1	U	120	300	South	25	1.50	
11/9/2009	0.20	19:52:49	Northern Gannet	1	U	120	300	South	25	1.50	
11/9/2009	0.20	19:53:34	Northern Gannet	1	C	120	500	South	50	1.50	
11/9/2009	0.20	19:55:09	Northern Gannet	1	C	120	500	South	50	1.50	
11/9/2009	0.20	19:57:24	Herring Gull	1	U	120	200	North	50	1.50	
11/9/2009	0.20	19:59:39	Red-throated Loon	1	U	120	300	South	1 (skimming)	1.50	
11/9/2009	0.20	20:00:51	Herring Gull	1	U	120	200	South	1 (skimming)	1.50	
11/9/2009	0.20	20:03:18	Northern Gannet	1	U	120	300	North	25	1.50	
11/9/2009	0.20	20:03:43	Northern Gannet	1	U	120	200	South	50	1.50	
11/9/2009	0.20	20:04:07	Northern Gannet	1	C	120	500	Southwest	25	1.50	
11/9/2009	0.20	20:04:56	Northern Gannet	1	U	120	500	South	50	1.50	
11/9/2009	0.20	20:05:28	Northern Gannet	1	C	120	300	South	25	1.50	
11/9/2009	0.20	20:05:53	Northern Gannet	1	U	120	300	Southeast	50	1.50	
11/9/2009	0.20	20:07:42	Northern Gannet	2	C	120	500	South	50	1.50	
11/9/2009	0.20	20:08:13	Northern Gannet	1	U	120	200	South	50	1.50	

Table J-29 (*continued*). Onshore radar validation survey data at Sea Isle City, New Jersey, in fall 2009. All data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Bearing	Range (m)	Heading (cardinal)	Altitude (ft ASL)	Radar Sea Clutter (NM)	Comment
11/9/2009	0.20	20:08:32	Great Black-backed Gull	1	U	120	200	North	25	1.50	
11/9/2009	0.20	20:09:52	Red-throated Loon	1	U	120	300	South	1 (skimming)	1.50	
11/9/2009	0.20	20:10:47	Northern Gannet	1	U	120	300	South	50	1.50	
11/9/2009	0.20	20:11:30	Northern Gannet	1	C	120	1,000	South	50	1.50	
11/9/2009	0.20	20:13:04	Northern Gannet	1	C	120	500	South	50	1.50	
11/9/2009	0.20	20:15:13	Northern Gannet	1	C	120	300	South	25	1.50	
11/9/2009	0.20	20:15:58	Northern Gannet	1	C	120	500	South	50	1.50	
11/9/2009	0.20	20:17:34	Northern Gannet	1	U	120	200	North	50	1.50	
11/9/2009	0.20	20:19:00	Northern Gannet	1	C	120	500	North	25	1.50	
11/9/2009	0.20	20:20:31	Red-throated Loon	1	U	120	200	Southwest	1 (skimming)	1.50	
11/9/2009	0.20	20:21:02	Northern Gannet	1	U	120	300	South	50	1.50	
11/9/2009	0.20	20:22:14	Surf Scoter	20	U	120	200	South	1 (skimming)	1.50	
11/9/2009	0.20	20:23:15	Northern Gannet	1	C	120	500	South	25	1.50	
11/9/2009	0.20	20:23:53	Northern Gannet	1	C	120	500	North	25	1.50	
11/9/2009	0.20	20:24:32	Northern Gannet	1	U	120	300	South	50	1.50	
11/9/2009	0.20	20:26:29	Northern Gannet	1	C	120	500	Southwest	25	1.50	
11/9/2009	0.20	20:29:56	Red-throated Loon	1	U	120	300	Southwest	1 (skimming)	1.50	
11/9/2009	0.20	20:30:20	Northern Gannet	1	U	120	200	Southwest	1 (skimming)	1.50	
11/9/2009	0.20	20:31:24	Northern Gannet	1	U	120	500	South	50	1.50	
11/9/2009	0.20	20:31:49	Laughing Gull	1	U	120	100	South	25	1.50	
11/9/2009	0.20	20:33:58	Surf Scoter	7	C	120	500	South	1 (skimming)	1.50	3 BLSC
11/9/2009	0.20	20:36:32	Northern Gannet	1	U	120	500	South	1 (skimming)	1.50	
11/9/2009	0.20	20:39:19	Northern Gannet	2	C	120	500	Southwest	25	1.50	
11/9/2009	0.20	20:40:56	Northern Gannet	2	U	120	500	South	25	1.50	
11/9/2009	0.20	20:41:23	Northern Gannet	1	C	120	500	South	50	1.50	
11/9/2009	0.20	20:42:09	Northern Gannet	3	U	120	300	South	25	1.50	
11/9/2009	0.20	20:43:11	Northern Gannet	1	C	120	500	South	50	1.50	
11/9/2009	0.20	20:43:45	Northern Gannet	1	C	120	500	South	25	1.50	

Table J-29 (*continued*). Onshore radar validation survey data at Sea Isle City, New Jersey, in fall 2009. All data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Bearing	Range (m)	Heading (cardinal)	Altitude (ft ASL)	Radar Sea Clutter (NM)	Comment
11/9/2009	0.20	20:44:17	Laughing Gull	1	U	120	200	Southwest	1 (skimming)	1.50	
11/9/2009	0.20	20:44:38	Gull, large (unknown)	1	U	120	100	Northeast	50	1.50	
11/9/2009	0.20	20:45:46	Red-throated Loon	1	U	120	300	South	1 (skimming)	1.50	
11/9/2009	0.20	20:46:47	Double-crested Cormorant	15	U	120	100	South	1 (skimming)	1.50	
11/9/2009	0.20	20:49:06	Northern Gannet	1	C	120	300	Southwest	25	1.50	
11/9/2009	0.20	20:52:14	Laughing Gull	1	C	120	300	Southwest	1 (skimming)	1.50	
11/9/2009	0.20	20:52:56	Northern Gannet	1	C	120	500	South	100	1.50	
11/9/2009	0.20	20:53:21	Northern Gannet	1	C	120	300	Southwest	25	1.50	
11/9/2009	0.20	20:54:07	Northern Gannet	1	C	120	500	South	100	1.50	
11/9/2009	0.20	20:54:57	Northern Gannet	1	U	120	200	South	50	1.50	
11/9/2009	0.20	20:55:28	Northern Gannet	1	C	120	500	Southwest	25	1.50	
11/9/2009	0.20	20:56:01	Northern Gannet	1	C	120	500	South	50	1.50	
11/9/2009	0.20	20:56:24	Laughing Gull	1	U	120	200	Northeast	50	1.50	
11/9/2009	0.20	20:57:03	Red-throated Loon	1	U	120	200	South	1 (skimming)	1.50	
11/9/2009	0.20	20:58:08	Northern Gannet	1	U	120	200	Southwest	25	1.50	
11/9/2009	0.20	20:58:43	Northern Gannet	1	C	120	500	South	50	1.50	
11/9/2009	0.20	20:59:38	Northern Gannet	1	C	120	500	South	50	1.50	
11/9/2009	0.20	21:00:14	Northern Gannet	1	C	120	500	South	50	1.50	
11/10/2009	0.20	11:29:15	Northern Gannet	1	U	120	200	South	1 (skimming)	2.00	
11/10/2009	0.20	11:32:46	Northern Gannet	1	U	120	300	North	25	2.00	
11/10/2009	0.20	11:33:18	Laughing Gull	1	U	120	100	North	25	2.00	
11/10/2009	0.20	11:34:31	Northern Gannet	1	U	120	300	South	25	2.00	
11/10/2009	0.20	11:35:15	Northern Gannet	1	U	120	300	South	25	2.00	
11/10/2009	0.20	11:35:31	Northern Gannet	1	U	120	300	South	25	2.00	
11/10/2009	0.20	11:35:43	Northern Gannet	1	U	120	200	South	25	2.00	
11/10/2009	0.20	11:35:59	Northern Gannet	1	U	120	300	North	25	2.00	
11/10/2009	0.20	11:36:37	Northern Gannet	1	U	120	300	South	25	2.00	
11/10/2009	0.20	11:37:13	Northern Gannet	2	U	120	300	South	25	2.00	

Table J-29 (*continued*). Onshore radar validation survey data at Sea Isle City, New Jersey, in fall 2009. All data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Bearing	Range (m)	Heading (cardinal)	Altitude (ft ASL)	Radar Sea Clutter (NM)	Comment
11/10/2009	0.20	11:37:48	Northern Gannet	1	U	120	300	South	25	2.00	
11/10/2009	0.20	11:38:21	Northern Gannet	1	U	120	300	South	25	2.00	
11/10/2009	0.20	11:38:36	Northern Gannet	1	U	120	500	South	1 (skimming)	2.00	
11/10/2009	0.20	11:39:06	Red-throated Loon	4	C	120	500	South	1 (skimming)	2.00	
11/10/2009	0.20	11:40:17	Northern Gannet	1	U	120	300	South	25	2.00	
11/10/2009	0.20	11:40:48	Northern Gannet	1	U	120	300	North	25	2.00	
11/10/2009	0.20	11:41:57	Northern Gannet	1	U	120	300	North	25	2.00	
11/10/2009	0.20	11:42:33	Red-throated Loon	1	U	120	300	South	1 (skimming)	2.00	
11/10/2009	0.20	11:43:41	Northern Gannet	1	U	120	300	South	25	2.00	
11/10/2009	0.20	11:44:31	Northern Gannet	1	U	120	300	North	25	2.00	
11/10/2009	0.20	11:45:37	Northern Gannet	1	C	120	500	South	25	2.00	
11/10/2009	0.20	11:46:27	Other	1	U	120	>1,000	North	1 (skimming)	2.00	Boat
11/10/2009	0.20	11:47:59	Northern Gannet	1	U	120	200	South	25	2.00	
11/10/2009	0.20	11:49:09	Northern Gannet	1	U	120	200	Southeast	25	2.00	
11/10/2009	0.20	11:50:35	Northern Gannet	1	U	120	300	South	25	2.00	
11/10/2009	0.20	11:51:54	Northern Gannet	1	U	120	200	South	25	2.00	
11/10/2009	0.20	11:52:15	Northern Gannet	1	U	120	300	South	25	2.00	
11/10/2009	0.20	11:52:54	Northern Gannet	1	U	120	300	Southeast	25	2.00	
11/10/2009	0.20	11:54:03	Northern Gannet	1	U	120	500	North	25	2.00	
11/10/2009	0.20	11:54:58	Northern Gannet	1	U	120	200	South	25	2.00	
11/10/2009	0.20	11:55:37	Northern Gannet	1	U	120	300	South	1 (skimming)	2.00	
11/10/2009	0.20	11:56:04	Northern Gannet	1	U	120	200	Southwest	25	2.00	
11/10/2009	0.20	11:57:06	Northern Gannet	1	U	120	300	Northwest	25	2.00	
11/10/2009	0.20	11:57:43	Northern Gannet	1	C	120	500	South	25	2.00	
11/10/2009	0.20	11:58:16	Northern Gannet	1	U	120	200	East	25	2.00	
11/10/2009	0.20	11:58:57	Northern Gannet	1	U	120	200	North	25	2.00	
11/10/2009	0.20	12:00:07	Northern Gannet	1	U	120	300	South	25	2.00	
11/10/2009	0.20	12:00:31	Northern Gannet	1	C	120	500	South	25	2.00	

Table J-29 (*continued*). Onshore radar validation survey data at Sea Isle City, New Jersey, in fall 2009. All data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Bearing	Range (m)	Heading (cardinal)	Altitude (ft ASL)	Radar Sea Clutter (NM)	Comment
11/10/2009	0.20	12:00:53	Northern Gannet	1	C	120	500	South	50	2.00	
11/10/2009	0.20	12:02:13	Northern Gannet	1	U	120	300	Southwest	50	2.00	
11/10/2009	0.20	12:03:04	Northern Gannet	1	U	120	300	South	1 (skimming)	2.00	
11/10/2009	0.20	12:05:15	Northern Gannet	1	U	120	300	South	25	2.00	
11/10/2009	0.20	12:06:36	Northern Gannet	1	U	120	200	Southwest	25	2.00	
11/10/2009	0.20	12:07:30	Northern Gannet	1	U	120	200	North	25	2.00	
11/10/2009	0.20	12:08:18	Northern Gannet	1	U	120	300	South	50	2.00	
11/10/2009	0.20	12:08:53	Northern Gannet	1	U	120	300	South	50	2.00	
11/10/2009	0.20	12:09:37	Northern Gannet	1	U	120	300	South	50	2.00	
11/10/2009	0.20	12:10:03	Northern Gannet	1	U	120	300	Southeast	25	2.00	
11/10/2009	0.20	12:11:12	Northern Gannet	1	U	120	500	North	25	2.00	
11/10/2009	0.20	12:12:14	Northern Gannet	1	U	120	300	South	1 (skimming)	2.00	
11/10/2009	0.20	12:12:40	Northern Gannet	1	U	120	300	South	50	2.00	
11/10/2009	0.20	12:13:13	Northern Gannet	1	U	120	500	South	50	2.00	
11/10/2009	0.20	12:18:00	Northern Gannet	1	U	120	300	Northeast	25	2.00	
11/10/2009	0.20	12:19:02	Northern Gannet	1	U	120	500	South	50	2.00	
11/10/2009	0.20	12:20:30	Northern Gannet	1	C	120	500	South	50	2.00	
11/10/2009	0.20	12:20:53	Red-throated Loon	1	U	120	300	South	1 (skimming)	2.00	
11/10/2009	0.20	12:21:17	Northern Gannet	1	C	120	500	South	25	2.00	
11/10/2009	0.20	12:21:39	Northern Gannet	1	U	120	300	South	50	2.00	
11/10/2009	0.20	12:22:19	Northern Gannet	1	U	120	300	West	50	2.00	
11/10/2009	0.20	12:23:14	Northern Gannet	1	U	120	300	Southwest	50	2.00	
11/10/2009	0.20	12:24:02	Northern Gannet	1	U	120	200	Southwest	25	2.00	
11/10/2009	0.20	12:24:50	Northern Gannet	1	U	120	300	Southwest	50	2.00	
11/10/2009	0.20	12:25:45	Northern Gannet	1	U	120	300	North	50	2.00	
11/10/2009	0.20	12:26:17	Northern Gannet	1	U	120	300	South	50	2.00	
11/10/2009	0.20	12:27:12	Northern Gannet	1	C	120	500	Northeast	25	2.00	
11/10/2009	0.20	12:27:49	Northern Gannet	1	C	120	500	South	50	2.00	

Table J-29 (*continued*). Onshore radar validation survey data at Sea Isle City, New Jersey, in fall 2009. All data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Bearing	Range (m)	Heading (cardinal)	Altitude (ft ASL)	Radar Sea Clutter (NM)	Comment
11/10/2009	0.20	12:28:18	Northern Gannet	1	C	120	500	South	50	2.00	
11/10/2009	0.20	12:29:49	Northern Gannet	1	U	120	300	North	50	2.00	
11/10/2009	0.20	12:30:21	Northern Gannet	1	U	120	300	North	25	2.00	
11/10/2009	0.20	12:31:48	Northern Gannet	1	U	120	300	South	25	2.00	
11/10/2009	0.20	12:33:34	Red-throated Loon	3	C	120	500	South	1 (skimming)	2.00	
11/10/2009	0.20	12:34:29	Northern Gannet	1	U	120	500	South	1 (skimming)	2.00	
11/10/2009	0.20	12:36:04	Scoter, dark-winged (unknown)	6	U	120	500	North	1 (skimming)	2.00	4 are SUSC
11/10/2009	0.20	12:38:00	Northern Gannet	1	U	120	300	Southwest	1 (skimming)	2.00	
11/10/2009	0.20	12:38:54	Northern Gannet	1	U	120	300	Northeast	50	2.00	
11/10/2009	0.20	12:40:46	Northern Gannet	1	U	120	300	Southwest	50	2.00	
11/10/2009	0.20	12:41:19	Northern Gannet	1	U	120	300	East	50	2.00	
11/10/2009	0.20	12:45:39	Scoter, dark-winged (unknown)	13	U	120	500	East	25	2.00	
11/10/2009	0.20	12:46:53	Northern Gannet	4	U	120	300	South	1 (skimming)	2.00	
11/10/2009	0.20	12:47:28	Red-throated Loon	2	U	120	300	South	1 (skimming)	2.00	
11/10/2009	0.20	12:49:05	Northern Gannet	3	U	120	200	South	1 (skimming)	2.00	
11/10/2009	0.20	12:50:20	Northern Gannet	1	U	120	300	North	25	2.00	
11/10/2009	0.20	12:51:04	Northern Gannet	1	U	120	200	Southeast	1 (skimming)	2.00	
11/10/2009	0.20	12:52:11	Scoter (unknown)	30	U	120	1,000	North	1 (skimming)	2.00	
11/10/2009	0.20	12:53:43	Scoter, dark-winged (unknown)	71	U	120	500	North	1 (skimming)	2.00	
11/10/2009	0.20	12:55:44	Northern Gannet	1	U	120	300	Southeast	25	2.00	
11/10/2009	0.20	12:56:47	Northern Gannet	1	U	120	200	South	25	2.00	
11/10/2009	0.20	12:57:49	Northern Gannet	1	U	120	300	West	25	2.00	
11/10/2009	0.20	12:59:00	Northern Gannet	1	U	120	300	East	50	2.00	
11/10/2009	0.20	14:33:51	Northern Gannet	1	C	120	200	South	25	2.00	
11/10/2009	0.20	14:34:26	Northern Gannet	4	C	120	>1,000	South	50	2.00	
11/10/2009	0.20	14:34:44	Northern Gannet	1	C	120	300	South	50	2.00	

Table J-29 (*continued*). Onshore radar validation survey data at Sea Isle City, New Jersey, in fall 2009. All data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Bearing	Range (m)	Heading (cardinal)	Altitude (ft ASL)	Radar Sea Clutter (NM)	Comment
11/10/2009	0.20	14:35:00	Northern Gannet	1	U	120	300	South	50	2.00	
11/10/2009	0.20	14:35:45	Northern Gannet	8	C	120	>1,000	South	50	2.00	
11/10/2009	0.20	14:37:17	Northern Gannet	2	U	120	500	South	50	2.00	
11/10/2009	0.20	14:40:07	Northern Gannet	2	U	120	500	South	25	2.00	
11/10/2009	0.20	14:40:37	Northern Gannet	7	C	120	500	South	100	2.00	string of noga
11/10/2009	0.20	14:41:37	Northern Gannet	1	C	120	1,000	South	25	2.00	
11/10/2009	0.20	14:48:31	Northern Gannet	1	C	120	500	South	25	2.00	
11/10/2009	0.20	14:48:54	Northern Gannet	1	U	120	500	South	50	2.00	
11/10/2009	0.20	14:49:10	Northern Gannet	2	C	120	1,000	South	25	2.00	
11/10/2009	0.20	14:49:28	Northern Gannet	2	C	120	1,000	South	25	2.00	
11/10/2009	0.20	14:49:55	Northern Gannet	2	U	120	500	South	50	2.00	
11/10/2009	0.20	14:50:36	Northern Gannet	1	U	120	300	South	50	2.00	
11/10/2009	0.20	14:50:36	Northern Gannet	2	C	120	500	South	50	2.00	
11/10/2009	0.20	14:51:28	Northern Gannet	1	C	120	1,000	South	50	2.00	
11/10/2009	0.20	14:53:02	Northern Gannet	1	U	120	300	South	25	2.00	
11/10/2009	0.20	14:53:17	Northern Gannet	1	U	120	500	South	100	2.00	
11/10/2009	0.20	14:53:30	Northern Gannet	1	U	120	1,000	South	25	2.00	
11/10/2009	0.20	14:53:45	Northern Gannet	2	C	120	>1,000	South	50	2.00	
11/10/2009	0.20	14:54:15	Northern Gannet	1	C	120	>1,000	South	50	2.00	
11/10/2009	0.20	14:54:26	Northern Gannet	1	C	120	500	South	50	2.00	
11/10/2009	0.20	14:56:36	Northern Gannet	1	U	120	>1,000	South	50	2.00	
11/10/2009	0.20	14:58:25	Northern Gannet	1	C	120	300	South	50	2.00	
11/10/2009	0.20	14:59:16	Northern Gannet	1	C	120	300	South	25	2.00	
11/10/2009	0.20	15:00:05	Northern Gannet	1	C	120	1,000	South	25	2.00	
11/10/2009	0.20	15:00:57	Northern Gannet	4	C	120	1,000	Southeast	50	2.00	
11/10/2009	0.20	15:01:19	Northern Gannet	1	U	120	100	Southeast	50	2.00	
11/10/2009	0.20	15:02:10	Northern Gannet	1	C	120	300	South	100	2.00	
11/10/2009	0.20	15:02:55	Herring Gull	1	U	120	100	South	100	2.00	

Table J-29 (*continued*). Onshore radar validation survey data at Sea Isle City, New Jersey, in fall 2009. All data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Bearing	Range (m)	Heading (cardinal)	Altitude (ft ASL)	Radar Sea Clutter (NM)	Comment
11/10/2009	0.20	15:03:30	Herring Gull	8	C	120	500	South	50	2.00	
11/10/2009	0.20	15:16:53	Northern Gannet	2	C	120	500	South	25	2.00	
11/10/2009	0.20	15:18:22	Northern Gannet	6	C	120	500	South	1 (skimming)	2.00	
11/10/2009	0.20	15:19:00	Northern Gannet	1	C	120	1,000	South	25	2.00	
11/10/2009	0.20	15:19:28	Northern Gannet	2	U	120	500	South	25	2.00	
11/10/2009	0.20	15:19:45	Northern Gannet	1	C	120	500	South	50	2.00	
11/10/2009	0.20	15:20:15	Northern Gannet	1	C	120	1,000	South	25	2.00	
11/10/2009	0.20	15:20:26	Northern Gannet	2	U	120	500	South	25	2.00	
11/10/2009	0.20	15:21:23	Northern Gannet	1	C	120	1,000	South	50	2.00	
11/10/2009	0.20	15:21:50	Northern Gannet	1	U	120	500	South	25	2.00	
11/10/2009	0.20	15:22:08	Northern Gannet	2	U	120	1,000	South	25	2.00	
11/10/2009	0.20	15:22:43	Northern Gannet	2	C	120	1,000	South	25	2.00	
11/10/2009	0.20	15:25:05	Northern Gannet	5	C	120	1,000	South	50	2.00	
11/10/2009	0.20	15:25:46	Northern Gannet	1	C	120	1,000	South	25	2.00	
11/10/2009	0.20	15:25:57	Northern Gannet	2	C	120	300	South	50	2.00	
11/10/2009	0.20	15:26:53	Northern Gannet	1	C	120	>1,000	South	50	2.00	
11/10/2009	0.20	15:27:04	Northern Gannet	2	C	120	500	South	50	2.00	
11/10/2009	0.20	15:28:15	Northern Gannet	1	C	120	500	South	50	2.00	
11/10/2009	0.20	15:29:04	Northern Gannet	1	C	120	1,000	South	25	2.00	
11/10/2009	0.20	15:29:23	Northern Gannet	1	C	120	500	South	50	2.00	
11/10/2009	0.20	15:30:06	Northern Gannet	1	U	120	300	South	25	2.00	
11/10/2009	0.20	15:30:27	Northern Gannet	2	U	120	300	South	25	2.00	
11/10/2009	0.20	15:30:27	Northern Gannet	2	U	120	500	South	25	2.00	
11/10/2009	0.20	15:30:48	Northern Gannet	1	C	120	500	South	50	2.00	
11/10/2009	0.20	15:31:42	Northern Gannet	1	U	120	100	South	25	2.00	
11/10/2009	0.20	15:32:40	Northern Gannet	2	U	120	200	North	25	2.00	
11/10/2009	0.20	15:33:13	Northern Gannet	3	C	120	500	South	1 (skimming)	2.00	
11/10/2009	0.20	15:33:40	Northern Gannet	1	C	120	500	South	50	2.00	

Table J-29 (*continued*). Onshore radar validation survey data at Sea Isle City, New Jersey, in fall 2009. All data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Bearing	Range (m)	Heading (cardinal)	Altitude (ft ASL)	Radar Sea Clutter (NM)	Comment
11/10/2009	0.20	15:36:00	Northern Gannet	2	U	120	1,000	South	50	2.00	
11/10/2009	0.20	15:36:22	Northern Gannet	1	U	120	100	South	50	2.00	
11/10/2009	0.20	15:36:43	Northern Gannet	1	C	120	300	South	50	2.00	
11/10/2009	0.20	15:36:43	Northern Gannet	1	C	120	1,000	South	50	2.00	
11/10/2009	0.20	15:38:10	Northern Gannet	1	C	120	500	South	25	2.00	
11/10/2009	0.20	15:39:16	Northern Gannet	1	C	120	500	South	50	2.00	
11/10/2009	0.20	15:39:30	Northern Gannet	1	U	120	300	South	25	2.00	
11/10/2009	0.20	15:39:53	Black Scoter	55	U	120	1,000	South	1 (skimming)	2.00	
11/10/2009	0.20	15:41:07	Herring Gull	1	C	120	1,000	South	25	2.00	
11/10/2009	0.20	15:41:44	Herring Gull	1	C	120	1,000	South	50	2.00	
11/10/2009	0.20	15:42:20	Northern Gannet	1	U	120	200	North	50	2.00	
11/10/2009	0.20	15:42:58	Northern Gannet	1	C	120	500	South	50	2.00	
11/10/2009	0.20	15:43:33	Northern Gannet	2	C	120	1,000	South	25	2.00	
11/10/2009	0.20	15:45:48	Northern Gannet	2	U	120	500	South	1 (skimming)	2.00	
11/10/2009	0.20	15:46:49	Northern Gannet	1	C	120	1,000	South	50	2.00	
11/10/2009	0.20	15:47:57	Northern Gannet	1	C	120	1,000	South	25	2.00	
11/10/2009	0.20	15:48:42	Northern Gannet	1	U	120	500	North	25	2.00	
11/10/2009	0.20	15:49:21	Northern Gannet	1	U	120	500	North	25	2.00	
11/10/2009	0.20	15:50:33	Northern Gannet	3	C	120	500	South	50	2.00	
11/10/2009	0.20	15:51:08	Black Scoter	100	C	120	500	South	1 (skimming)	2.00	
11/10/2009	0.20	15:52:57	Northern Gannet	1	C	120	500	South	25	2.00	
11/10/2009	0.20	15:54:23	Northern Gannet	1	C	120	500	South	25	2.00	
11/10/2009	0.20	15:58:11	Northern Gannet	1	C	120	500	South	25	2.00	
11/10/2009	0.20	15:59:42	Northern Gannet	1	C	120	500	South	25	2.00	
11/10/2009	0.20	16:02:24	Northern Gannet	1	C	120	1,000	South	25	2.00	
11/10/2009	0.20	16:02:48	Northern Gannet	1	C	120	300	South	50	2.00	
11/10/2009	0.20	16:04:19	Northern Gannet	1	C	120	500	South	25	2.00	
11/10/2009	0.20	16:06:08	Northern Gannet	2	C	120	1,000	South	25	2.00	

Table J-29 (*continued*). Onshore radar validation survey data at Sea Isle City, New Jersey, in fall 2009. All data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Bearing	Range (m)	Heading (cardinal)	Altitude (ft ASL)	Radar Sea Clutter (NM)	Comment
11/10/2009	0.20	16:07:10	Northern Gannet	3	C	120	>1,000	South	25	2.00	
11/10/2009	0.20	16:09:57	Northern Gannet	1	C	120	1,000	South	25	2.00	
11/10/2009	0.20	16:11:02	Northern Gannet	1	C	120	500	South	50	2.00	
11/10/2009	0.20	16:12:35	Northern Gannet	1	C	120	500	South	50	2.00	
11/10/2009	0.20	16:14:50	Northern Gannet	1	C	120	1,000	South	50	2.00	
11/10/2009	0.20	16:15:15	Northern Gannet	3	C	120	300	South	25	2.00	
11/10/2009	0.20	16:16:52	Common Loon	3	C	120	1,000	South	1 (skimming)	2.00	
11/10/2009	0.20	16:17:53	Northern Gannet	1	U	120	300	South	25	2.00	
11/10/2009	0.20	16:18:30	Black Scoter	1	U	120	200	South	1 (skimming)	2.00	
11/10/2009	0.20	16:19:18	Northern Gannet	1	C	120	500	South	25	2.00	
11/10/2009	0.20	16:21:00	Northern Gannet	1	C	120	300	South	25	2.00	
11/10/2009	0.20	16:21:52	Northern Gannet	1	U	120	200	South	25	2.00	
11/10/2009	0.20	16:22:20	Northern Gannet	2	C	120	300	South	25	2.00	
11/10/2009	0.20	16:24:21	Northern Gannet	1	C	120	1,000	South	50	2.00	
11/10/2009	0.20	16:25:48	Northern Gannet	1	U	120	500	North	25	2.00	
11/10/2009	0.20	16:27:01	Northern Gannet	2	U	120	500	South	100	2.00	
11/10/2009	0.20	16:31:38	Northern Gannet	2	C	120	500	South	50	2.00	
11/10/2009	0.20	16:31:50	Northern Gannet	1	U	120	300	South	50	2.00	
11/10/2009	0.20	16:32:52	Northern Gannet	1	U	120	200	South	50	2.00	
11/10/2009	0.20	16:34:32	Northern Gannet	1	C	120	1,000	South	50	2.00	
11/10/2009	0.20	16:35:58	Northern Gannet	1	C	120	500	South	25	2.00	
11/10/2009	0.20	16:36:35	Northern Gannet	1	C	120	300	South	25	2.00	
11/10/2009	0.20	16:37:43	Double-crested Cormorant	15	C	120	300	South	50	2.00	
11/10/2009	0.20	16:39:42	Northern Gannet	1	C	120	500	South	25	2.00	
11/10/2009	0.20	16:41:20	Northern Gannet	1	C	120	500	South	25	2.00	
11/10/2009	0.20	16:42:22	Northern Gannet	1	C	120	500	South	50	2.00	
11/10/2009	0.20	16:44:50	Northern Gannet	1	C	120	500	South	25	2.00	
11/10/2009	0.20	16:45:19	Herring Gull	1	U	120	100	South	100	2.00	

Table J-29 (*continued*). Onshore radar validation survey data at Sea Isle City, New Jersey, in fall 2009. All data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Bearing	Range (m)	Heading (cardinal)	Altitude (ft ASL)	Radar Sea Clutter (NM)	Comment
11/10/2009	0.20	16:46:22	Northern Gannet	1	C	120	500	South	300	2.00	
11/10/2009	0.20	16:49:18	Northern Gannet	1	C	120	500	South	50	2.00	
11/10/2009	0.20	16:52:23	Northern Gannet	1	C	120	200	South	25	2.00	
11/10/2009	0.20	16:53:17	Black Scoter	13	C	120	500	South	1 (skimming)	2.00	
11/10/2009	0.20	16:54:29	Northern Gannet	1	C	120	500	South	50	2.00	
11/10/2009	0.20	16:59:54	Northern Gannet	1	U	120	500	South	50	2.00	
11/10/2009	0.20	17:00:25	Northern Gannet	2	U	120	500	South	50	2.00	
11/10/2009	0.20	17:01:57	Double-crested Cormorant	51	U	120	300	South	1 (skimming)	2.00	
11/15/2009	0.20	13:38:19	Common Loon	1	U	120	1,000	South	1 (skimming)	0.50	
11/15/2009	0.20	13:40:55	Ring-billed Gull	1	U	120	100	North	50	0.50	
11/15/2009	0.20	13:42:32	Black Scoter	1	U	120	1,000	North	1 (skimming)	0.50	
11/15/2009	0.20	13:45:04	Sanderling	1	U	120	300	North	1 (skimming)	0.50	
11/15/2009	0.20	13:50:47	Black Scoter	11	U	120	300	North	1 (skimming)	0.50	
11/15/2009	0.20	13:54:44	Northern Gannet	1	U	120	1,000	North	100	0.50	
11/15/2009	0.20	13:57:36	Ring-billed Gull	4	U	120	100	North	25	0.50	
11/15/2009	0.20	14:38:27	Yellow-crowned Night-heron	4	U	120	100	North	25	0.50	
11/15/2009	0.20	14:45:10	Herring Gull	1	U	120	1,000	North	25	0.50	
11/15/2009	0.20	14:45:47	Common Loon	2	U	120	1,000	South	25	0.50	
11/15/2009	0.20	14:46:24	Common Loon	1	U	120	500	South	50	0.50	
11/15/2009	0.20	14:50:43	Ring-billed Gull	1	U	120	500	South	50	0.50	
11/15/2009	0.20	14:58:47	White-winged Scoter	7	U	120	300	North	1 (skimming)	0.50	
11/15/2009	0.20	15:05:35	Double-crested Cormorant	3	U	120	500	South	1 (skimming)	0.50	
11/15/2009	0.20	15:07:07	Herring Gull	1	C	120	1,000	North	50	0.50	
11/15/2009	0.20	15:08:33	Herring Gull	1	U	120	1,000	North	50	0.50	
11/15/2009	0.20	18:26:33	Herring Gull	1	U	120	100	Southeast	25	0.50	
11/15/2009	0.20	18:28:12	Herring Gull	1	U	120	100	Southwest	50	0.50	
11/15/2009	0.20	18:29:18	Northern Gannet	8	U	120	500	Southwest	1 (skimming)	0.50	
11/15/2009	0.20	18:33:00	Northern Gannet	2	U	120	500	Southwest	1 (skimming)	0.50	

Table J-29 (*continued*). Onshore radar validation survey data at Sea Isle City, New Jersey, in fall 2009. All data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Bearing	Range (m)	Heading (cardinal)	Altitude (ft ASL)	Radar Sea Clutter (NM)	Comment
11/15/2009	0.20	18:35:44	Scoter, dark-winged (unknown)	1	U	120	200	Northeast	1 (skimming)	0.50	
11/15/2009	0.20	18:37:48	Gull, large (unknown)	1	U	120	500	Northeast	50	0.50	
11/15/2009	0.20	18:39:21	Red-throated Loon	1	U	120	200	North	1 (skimming)	0.50	
11/15/2009	0.20	18:42:16	Northern Gannet	3	U	120	500	South	1 (skimming)	0.50	
11/15/2009	0.20	18:45:03	Other	1	U	120	1,000	North	1 (skimming)	0.50	Boat
11/15/2009	0.20	18:46:43	Northern Gannet	1	U	120	300	Southwest	1 (skimming)	0.50	
11/15/2009	0.20	18:49:49	Northern Gannet	2	U	120	500	Northeast	100	0.50	
11/15/2009	0.20	18:51:13	Double-crested Cormorant	1	C	120	500	Southwest	1 (skimming)	0.50	
11/15/2009	0.20	18:53:12	Northern Gannet	1	U	120	1,000	South	50	0.50	
11/15/2009	0.20	18:54:42	Great Black-backed Gull	1	U	120	200	Southwest	25	0.50	
11/15/2009	0.20	18:57:58	Red-throated Loon	1	U	120	200	North	1 (skimming)	0.50	
11/15/2009	0.20	18:59:08	Northern Gannet	2	U	120	500	South	25	0.50	
11/15/2009	0.20	19:00:01	Northern Gannet	1	U	120	500	South	50	0.50	
11/15/2009	0.20	19:00:44	Herring Gull	1	U	120	200	Southwest	50	0.50	
11/15/2009	0.20	19:01:47	Northern Gannet	1	U	120	300	Southwest	1 (skimming)	0.50	
11/15/2009	0.20	19:03:44	Northern Gannet	1	U	120	500	North	50	0.50	
11/15/2009	0.20	19:04:38	Northern Gannet	1	U	120	500	South	1 (skimming)	0.50	
11/15/2009	0.20	19:05:43	Northern Gannet	2	U	120	500	South	1 (skimming)	0.50	
11/15/2009	0.20	19:06:11	Northern Gannet	2	U	120	500	South	1 (skimming)	0.50	
11/15/2009	0.20	19:06:54	Northern Gannet	1	U	120	300	South	1 (skimming)	0.50	
11/15/2009	0.20	19:08:24	Northern Gannet	1	U	120	300	South	1 (skimming)	0.50	
11/15/2009	0.20	19:09:09	Northern Gannet	1	U	120	500	South	1 (skimming)	0.50	
11/15/2009	0.20	19:09:24	Northern Gannet	1	U	120	300	South	1 (skimming)	0.50	
11/15/2009	0.20	19:09:52	Northern Gannet	1	U	120	300	South	1 (skimming)	0.50	
11/15/2009	0.20	19:10:35	Northern Gannet	1	U	120	300	South	1 (skimming)	0.50	birds are hidden behind the swells
11/15/2009	0.20	19:11:42	Northern Gannet	3	U	120	300	South	1 (skimming)	0.50	
11/15/2009	0.20	19:12:02	Northern Gannet	1	U	120	300	South	1 (skimming)	0.50	

Table J-29 (*continued*). Onshore radar validation survey data at Sea Isle City, New Jersey, in fall 2009. All data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Bearing	Range (m)	Heading (cardinal)	Altitude (ft ASL)	Radar Sea Clutter (NM)	Comment
11/15/2009	0.20	19:12:55	Herring Gull	1	U	120	200	North	50	0.50	
11/15/2009	0.20	19:14:17	Northern Gannet	1	U	120	1,000	South	1 (skimming)	0.50	
11/15/2009	0.20	19:15:08	Northern Gannet	5	U	120	300	South	1 (skimming)	0.50	
11/15/2009	0.20	19:17:38	Northern Gannet	1	U	120	300	South	1 (skimming)	0.50	
11/15/2009	0.20	19:19:45	Northern Gannet	1	U	120	1,000	South	1 (skimming)	0.50	
11/15/2009	0.20	19:20:23	Northern Gannet	1	C	120	>1,000	North	100	0.50	
11/15/2009	0.20	19:22:46	Northern Gannet	4	C	120	>1,000	South	1 (skimming)	0.50	
11/15/2009	0.20	19:24:53	Laughing Gull	1	U	120	200	Southwest	100	0.50	
11/15/2009	0.20	19:25:26	Northern Gannet	1	U	120	300	Southwest	1 (skimming)	0.50	
11/15/2009	0.20	19:26:52	Red-throated Loon	1	U	120	200	North	25	0.50	
11/15/2009	0.20	19:28:07	Red-throated Loon	1	U	120	300	South	1 (skimming)	0.50	
11/15/2009	0.20	19:30:34	Double-crested Cormorant	1	U	120	100	Southwest	1 (skimming)	0.50	in the surf
11/15/2009	0.20	19:31:41	Northern Gannet	1	U	120	1,000	Southwest	200	0.50	
11/15/2009	0.20	19:33:49	Northern Gannet	1	U	120	300	Southwest	1 (skimming)	0.50	
11/15/2009	0.20	19:34:28	Northern Gannet	1	U	120	1,000	North	100	0.50	
11/15/2009	0.20	19:37:21	Northern Gannet	1	U	120	500	South	1 (skimming)	0.50	
11/15/2009	0.20	19:38:15	Gull, large (unknown)	1	U	120	500	North	200	0.50	
11/15/2009	0.20	19:41:33	Northern Gannet	1	U	120	1,000	South	25	0.50	
11/15/2009	0.20	19:42:49	Scoter, dark-winged (unknown)	32	U	120	300	Southwest	25	0.50	
11/15/2009	0.20	19:47:13	Northern Gannet	1	C	120	>1,000	North	100	0.50	
11/15/2009	0.20	19:47:56	Northern Gannet	1	U	120	300	East	25	0.50	
11/15/2009	0.20	19:49:17	Ring-billed Gull	1	U	120	300	Southwest	50	0.50	
11/15/2009	0.20	19:51:42	Herring Gull	1	U	120	200	North	200	0.50	
11/15/2009	0.20	19:58:10	Northern Gannet	1	U	120	500	South	1 (skimming)	0.50	
11/15/2009	0.20	20:00:24	Red-throated Loon	1	C	120	500	Northeast	25	0.50	
11/15/2009	0.20	20:02:00	Northern Gannet	1	C	120	500	North	25	0.50	
11/15/2009	0.20	20:05:38	Surf Scoter	18	U	120	300	Southwest	1 (skimming)	0.50	
11/15/2009	0.20	20:06:53	Northern Gannet	1	U	120	500	South	1 (skimming)	0.50	

Table J-29 (*continued*). Onshore radar validation survey data at Sea Isle City, New Jersey, in fall 2009. All data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Bearing	Range (m)	Heading (cardinal)	Altitude (ft ASL)	Radar Sea Clutter (NM)	Comment
11/15/2009	0.20	20:10:50	Northern Gannet	1	U	120	1,000	North	25	0.50	
11/15/2009	0.20	20:17:33	Northern Gannet	2	C	120	500	Southwest	1 (skimming)	0.50	
11/15/2009	0.20	20:18:27	Northern Gannet	1	C	120	500	North	25	0.50	
11/15/2009	0.20	20:19:52	Double-crested Cormorant	2	U	120	300	South	50	0.50	
11/15/2009	0.20	20:22:54	Gull, large (unknown)	1	U	120	300	Northeast	100	0.50	
11/15/2009	0.20	20:23:40	Black Scoter	8	U	120	300	North	1 (skimming)	0.50	
11/15/2009	0.20	20:25:24	Laughing Gull	1	U	120	300	East	50	0.50	
11/15/2009	0.20	20:26:09	Great Black-backed Gull	1	U	120	200	Southwest	25	0.50	
11/15/2009	0.20	20:27:21	Laughing Gull	1	U	120	300	East	25	0.50	
11/15/2009	0.20	20:28:46	Cormorant (unknown)	8	U	120	1,000	West	500	0.50	
11/15/2009	0.20	20:31:25	Loon (unknown)	1	U	120	300	North	25	0.50	
11/15/2009	0.20	20:33:23	Northern Gannet	1	U	120	500	South	1 (skimming)	0.50	
11/15/2009	0.20	20:36:12	Double-crested Cormorant	1	U	120	300	East	100	0.50	
11/15/2009	0.20	20:36:58	Northern Gannet	1	U	120	>1,000	South	50	0.50	
11/15/2009	0.20	20:41:20	Herring Gull	1	U	120	500	North	25	0.50	
11/15/2009	0.20	20:42:19	Laughing Gull	1	U	120	300	Southeast	100	0.50	
11/15/2009	0.20	20:44:05	Northern Gannet	1	C	120	>1,000	Northeast	25	0.50	
11/15/2009	0.20	20:45:43	Northern Gannet	2	U	120	500	South	25	0.50	
11/15/2009	0.20	20:48:28	Northern Gannet	5	U	120	1,000	South	25	0.50	
11/15/2009	0.20	20:49:18	Herring Gull	1	U	120	200	Northeast	100	0.50	
11/15/2009	0.20	20:50:18	Gull, large (unknown)	1	U	120	300	Northeast	25	0.50	
11/15/2009	0.20	20:52:11	Northern Gannet	2	U	120	500	South	25	0.50	
11/15/2009	0.20	20:54:41	Scoter, dark-winged (unknown)	4	U	120	500	Southwest	25	0.50	
11/15/2009	0.20	20:56:03	Loon (unknown)	5	U	120	500	North	25	0.50	
11/15/2009	0.20	20:58:23	Northern Gannet	2	U	120	1,000	South	1 (skimming)	0.50	
11/15/2009	0.20	21:00:31	Northern Gannet	3	C	120	>1,000	North	25	0.50	
11/15/2009	0.20	21:01:38	Northern Gannet	1	U	120	1,000	East	25	0.50	
11/15/2009	0.20	21:02:03	Other	1	U	120	1,000	S	>1,000	0.50	Helicopter

Table J-29 (*continued*). Onshore radar validation survey data at Sea Isle City, New Jersey, in fall 2009. All data are TracScan.

Date	Dist. (NM)	Time	Species (Common Name)	No.	C/U	Bearing	Range (m)	Heading (cardinal)	Altitude (ft ASL)	Radar Sea Clutter (NM)	Comment
11/15/2009	0.20	21:05:06	Northern Gannet	1	U	120	500	South	1 (skimming)	0.50	
11/15/2009	0.20	21:06:29	Northern Gannet	2	U	120	500	South	1 (skimming)	0.50	
11/15/2009	0.20	21:08:59	Northern Gannet	1	U	120	1,000	North	25	0.50	
11/15/2009	0.20	21:09:59	Northern Gannet	1	U	120	1,000	South	1 (skimming)	0.50	
11/15/2009	0.20	21:10:54	Northern Gannet	1	U	120	1,000	North	25	0.50	
11/15/2009	0.20	21:11:34	Northern Gannet	1	U	120	500	South	25	0.50	
11/15/2009	0.20	21:12:53	Northern Gannet	1	U	120	1,000	North	25	0.50	
11/15/2009	0.20	21:13:23	Herring Gull	1	U	120	500	Southwest	1 (skimming)	0.50	
11/15/2009	0.20	21:14:13	Scoter (unknown)	2	U	120	500	North	1 (skimming)	0.50	
11/15/2009	0.20	21:15:19	Gull, large (unknown)	1	U	120	500	East	200	0.50	
11/15/2009	0.20	21:18:23	Northern Gannet	1	U	120	500	South	1 (skimming)	0.50	
11/15/2009	0.20	21:21:31	Herring Gull	1	U	120	300	North	1 (skimming)	0.50	
11/15/2009	0.20	21:22:26	Great Black-backed Gull	1	U	120	300	West	1 (skimming)	0.50	
11/15/2009	0.20	21:23:54	Ring-billed Gull	1	C	120	500	North	25	0.50	
11/15/2009	0.20	21:26:36	Northern Gannet	1	U	120	500	West	25	0.50	

NM = nautical mile(s)
No. = number
C/U = Confirmed/Unconfirmed
m = meters
ft ASL = feet above sea level

Appendix J-3

Detailed Avian Radar Survey Report

New Jersey Department of Environmental Protection
Baseline Studies

Detailed Avian Radar Survey Results Report

Geo-Marine, Inc.
2201 K Avenue, Suite A2
Plano, Texas 75074

June 2010

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LIST OF ACRONYMS AND ABBREVIATIONS

%	Percent
abt	Adjusted Bird Tracks
Alt	Altitude
AMSL	Above Mean Sea Level
AMTR	Adjusted Migration Traffic Rate
BB	Brigantine Beach
hr	Hour
ft	Foot(Feet)
IBSP	Island Beach State Park
km^3	Cubic Kilometer(s)
kph	Kilometer(s) per Hour
mph	Miler(s) per Hour
MTR	Migration Traffic Rate
N	North
NBB	North Brigantine Beach
NE	Northeast
NW	Northwest
RSZ	Rotor Swept Zone
S	South
SE	Southeast
SIC	Sea Isle City
SW	Southwest

1.0 INTRODUCTION

This report presents a detailed summary of the VerCat and TracScan radar operational hours by sample location and a detailed analysis of VerCat cumulative altitudinal distribution and flux (number of targets per unit of volume per unit of time) below, within, and above the potential rotor swept zone (RSZ); and the VerCat adjusted migration traffic rate (AMTR) and TracScan flux and flux direction data from the offshore and onshore radar surveys. The term "offshore", in general, refers to all areas that are east of the New Jersey coastline. The term, offshore is also used specifically in this section to identify radar sampling locations (grids) in which the radar surveillance coverage does not contact the coastline. The term "nearshore" is used to define radar grids in which the radar surveillance coverage overlaps or is immediately adjacent to the New Jersey coastline.

Summaries of operational hours summaries for each survey location are based on the total number of hours (rounded to the nearest 0.1 hours [hr]) for clear and rain (including mist and fog) weather conditions. The metric "number of bird tracks" is used throughout the data analysis sections of the report. This metric includes both tracks of birds and tracks of migratory bats; however, the vast majority of tracks are thought to be produced by birds.

Cumulative and daily diurnal and nocturnal altitude quartiles are used to report altitudinal distribution of birds because the altitude data are non-normal and could not be normalized. The selected quartile system reports the median bird track altitude, and track altitude at 25 and 75 percent (%) levels. The median value means that 50% of the tracks are above the median value and that 50% are below the median value. Cumulative diurnal and nocturnal VerCat flux data (adjusted bird tracks [abt] per cubic kilometer (km^3) per hour) were also sorted into three altitude bands with reference to the potential RSZ (100 to 700 feet [ft] above mean sea level [AMSL]): (1) below the RSZ (low altitude band, 1 to 99 ft AMSL), (2) within the RSZ (middle altitude, 100 to 700 ft AMSL), and (3) above the RSZ (high altitude band, 701+ ft AMSL). The migration traffic rate (MTR) is a metric that reports movements of birds crossing over a kilometer per hour. This data are reported as the AMTR and are based on adjusted VerCat bird tracks/km/hour. TracScan flux and flux direction are based on abt moving though a surveillance volume of 1 km^3 for each sampling hour at each avian radar offshore sampling location.

2.0 OFFSHORE

2.1 SPRING 2008

2.1.1 Survey Effort

Offshore radar surveys started on 14 March 2008 and concluded on 11 May 2008. The survey effort by weather condition (clear, rain [includes mist and fog]) for each sampling site is presented in **Tables 2-1** and **2-2**. Daily survey effort is listed in **Appendix J-4: Table J-30** and **J-31.**

2.1.2 MARS® Altitudinal Distribution

The cumulative median diurnal flight altitude over all sampling grids and surface wind speed categories during clear weather conditions ranged from 54 to 1,488 ft AMSL, respectively (**Table 2-3; Appendix J-4 Table J-32**). Cumulative nearshore median diurnal altitudes (sample grids 1, 7, 13, and 19) ranged between 54 and 414 ft AMSL. Cumulative nearshore diurnal median flight altitudes early in the spring season (sample grid 1 and 7) were 136 ft AMSL (mostly below the potential RSZ) and lower than those later in the spring season (sample grid 13 and 19) when cumulative median altitudes were mostly within the RSZ. Offshore cumulative diurnal median altitudes (sample grids 26, 23, 17) for all surface wind speed categories ranged from 337 to 1,488 ft AMSL. Most of the cumulative diurnal median altitude quartiles for the offshore grids were within the RSZ. Day-to-day variation in altitude quartiles can be found in **Appendix J-4: Tables J-33** through **J-53.**

Table 2-1. Summary of spring 2008 VerCat offshore survey effort by weather condition.

Sample Grid	Date	Diurnal[1]			Nocturnal[2]			Total Hrs
		Hrs Clear	Hrs Rain[3]	Total Hrs	Hrs Clear	Hrs Rain[3]	Total Hrs	
1	14-21 March	44.3	32.0	76.3	42.7	34.0	76.7	152.9
7	22-27 March	43.7	17.0	61.0	53.5	0.1	53.6	114.6
13	03-13 April	68.0	16.6	84.5	40.2	25.6	65.8	150.3
19	13-19 April	71.6	4.7	76.3	51.5	7.0	58.6	134.9
26	24-30 April	56.1	27.7	83.7	37.6	18.3	55.9	139.6
23	30 April-07 May	89.6	7.7	97.2	57.7	5.6	63.3	160.5
17	07-11 May	21.7	30.7	52.4	23.4	11.9	35.3	87.7

[1] Diurnal occurs from Civil Sunrise to Civil Sunset
[2] Nocturnal occurs from Civil Sunset to Civil Sunrise
[3] Rain includes mist and drizzle
Hrs = Hours

Table 2-2. Summary of spring 2008 TracScan offshore survey effort by weather condition.

Sample Grid	Date	Diurnal[1]			Nocturnal[2]			Total Hrs
		Hrs Clear	Hrs Rain[3]	Total Hrs	Hrs Clear	Hrs Rain[3]	Total Hrs	
1	14-21 March	54.7	31.8	86.5	53.0	34.1	87.2	173.8
7	22-27 March	43.6	20.0	63.6	53.7	0.2	53.8	117.2
13	03-13 April	92.0	36.2	128.2	53.2	43.1	96.0	224.3
19	13-19 April	74.3	4.7	79.0	51.6	7.1	58.7	137.3
26	24-30 April	57.5	28.3	85.9	37.6	18.3	56.0	141.8
23	30 April-07 May	89.7	7.7	97.4	57.9	5.7	63.5	160.6
17	07-11 May	21.8	32.1	53.9	23.3	11.9	35.3	89.3

[1] Diurnal occurs from Civil Sunrise to Civil Sunset
[2] Nocturnal occurs from Civil Sunset to Civil Sunrise
[3] Rain includes mist and drizzle
Hrs = Hours

Table 2-3. Spring 2008 offshore VerCat radar cumulative median altitude (Alt) quartiles (ft AMSL) by sample location and surface wind speed category during clear weather conditions.

Grid	Time	Surface Wind Speed (mph)	25% Alt	Median Alt	75% Alt	Bird Count
1	Diurnal	0-8	46	135	1,953	1,054
		9-15	42	59	1,837	1,836
		16+	42	59	86	1,042
7	Diurnal	0-8	33	55	1,654	1,369
		9-15	45	73	241	1,989
		16+	39	54	84	538

Table 2-3 (*continued*). Spring 2008 offshore VerCat radar cumulative median altitude (Alt) quartiles (ft AMSL) by sample location and surface wind speed category during clear weather conditions.

Grid	Time	Surface Wind Speed (mph)	25% Alt	Median Alt	75% Alt	Bird Count
13	Diurnal	0-8	68	325	586	5,619
		9-15	152	352	555	18,426
		16+	208	414	3,270	932
19	Diurnal	0-8	94	369	693	9,200
		9-15	60	166	416	2,225
		16+	48	65	201	912
26	Diurnal	0-8	254	448	798	2,383
		9-15	391	713	997	6,486
		16+	582	699	935	2,492
23	Diurnal	0-8	405	1,488	2,460	5,354
		9-15	234	379	649	12,698
		16+	230	366	508	3,578
17	Diurnal	0-8	389	582	831	1,845
		9-15	359	801	3,029	3,233
		16+	233	337	582	3,158
1	Nocturnal	0-8	342	1,113	1,994	2,887
		9-15	538	1,917	2,941	2,676
		16+	54	393	1,560	956
7	Nocturnal	0-8	177	443	843	3,487
		9-15	141	328	599	1,317
		16+	168	1,152	1,847	3,416
13	Nocturnal	0-8	250	421	663	17,620
		9-15	248	473	735	18,426
		16+	923	1,553	2,228	1,448
19	Nocturnal	0-8	181	355	594	25,955
		9-15	185	335	541	6,806
		16+	227	440	609	346
26	Nocturnal	0-8	166	348	578	5,037
		9-15	290	472	663	13,030
		16+	400	613	804	32,810
23	Nocturnal	0-8	343	730	1,679	18,827
		9-15	435	828	1,602	25,754
		16+	304	508	740	30,494
17	Nocturnal	0-8	305	558	889	2,533
		9-15	271	493	739	14,342
		16+	305	552	812	20,429

Cumulative median nocturnal flight altitude over all sample grids and surface wind speed categories during clear weather conditions ranged from 328 to 1,917 ft AMSL (**Table 2-3**). Cumulative nearshore median altitudes ranged from 335 to 1,917 ft AMSL. Cumulative nearshore nocturnal median flight altitudes early in the spring season at two of the nearshore sampling grids (1 and 7) were greater (above the RSZ) at some wind speed categories than later in the season at Grid 13 and Grid 19 when most of the cumulative median altitudes were within the RSZ. Cumulative offshore nocturnal flight altitudes ranged from 348 to 828 ft AMSL. Most cumulative nocturnal altitude medians were within the RSZ.

Altitude flux data were analyzed with reference to the potential turbine RSZ (100–700 ft AMSL). VerCat records flight altitudes (behaviors) of biological targets. Within the survey area, Northern Gannets may land on the water and fly up to plunge dive (forage) from varying altitudes many times a day. A gull may fly a short distance and land several times a day. The same flock of birds (e.g., scoters, gulls) may fly through the survey area every day to reach a foraging area and return through the same area on their way to a roosting site. The flux (abt/km^3/hr) was determined for each altitude band. The volume sampled was lowest in the low altitude band (1-99 ft AMSL) and highest in the high altitude band (701-18,228 ft AMSL). A single target may occur in multiple altitude bands, therefore total tracks within each altitude band cannot be used as a measure of bird abundance.

In early spring over the nearshore grids (1, 7, 13, 19) during clear weather conditions for all surface wind speed categories the VerCat cumulative diurnal flux values were concentrated in the low altitude band (**Table 2-4**). Over the offshore grids (26, 23, 17) diurnal flux increased from late April to mid-May. The diurnal flux values were similar within the low altitude and mid-altitude (RSZ) band on Grid 26 and Grid 23. Over Grid 17 diurnal flux was greater in the middle altitude band than the low altitude band.

Table 2-4. Spring 2008 offshore VerCat flux (abt/km^3/hr) by altitude band by surface wind speed category during clear weather conditions.

Grid	Date	Time	VerCat Flux (abt/km^3/hr)/Altitude Band (ft AMSL)								
			Low (1-99)			Middle (100-700)			High (701+)		
			Surface Wind Speed (mph)								
			0-8	9-16	16+	0-8	9-16	16+	0-8	9-16	16+
1	14-21 March	Day	1,204.7	754.4	516.8	19.5	12.3	16.6	3.0	1.0	0.1
7	22-27 March		945.1	700.0	533.9	13.2	63.3	23.4	1.4	0.2	0.0
13	03-13 April		595.2	413.5	243.9	200.3	211.1	218.9	0.9	0.8	1.5
19	13-19 April		693.2	638.2	630.4	222.5	144.4	65.4	1.7	0.4	0.2
26	24-30 April		222.8	39.6	197.5	171.0	279.7	145.0	1.1	5.0	2.4
23	30 April-07 May		269.7	315.8	302.7	169.2	351.9	360.5	5.0	1.8	0.8
17	07-11 May		254.8	335.2	300.9	801.9	312.2	487.9	7.6	6.1	1.8
1	14-21 March	Night	463.9	255.6	272.5	147.2	68.9	18.1	5.9	4.0	0.7
7	22-27 March		355.8	235.7	448.2	214.3	121.7	61.7	1.9	0.6	3.2
13	03-13 April		838.6	856.6	527.6	1,364.9	1,336.5	352.8	6.7	9.1	22.6
19	13-19 April		1,239.2	933.4	160.4	1,065.4	921.6	128.7	4.5	2.3	0.5
26	24-30 April		841.1	609.4	50.8	660.4	1,159.6	434.8	2.5	6.1	4.6
23	30 April-07 May		730.8	566.8	1,015.4	1,035.2	948.5	2,520.3	19.0	22.9	20.6
17	07-11 May		873.2	1,452.2	931.3	2,170.4	2,214.1	2,010.7	24.7	17.2	20.5

The cumulative nearshore nocturnal flux was greater within the low altitude band than the middle altitude band with early in the season at sample grids 1 and 7 (**Table 2-4**). Nearshore nocturnal cumulative flux increased from early spring to mid-spring in the low altitude band and increased sharply in the middle (RSZ) altitude band (grids 13 and 19) in early and mid-April 2008. Over the offshore grids (26, 23, 17), cumulative nocturnal flux increased slightly in the low altitude and mid-altitude bands from mid to late April before increasing throughout the remainder of the study period. By late spring (30 April – 11 May 2008) cumulative nocturnal flux was greater in the mid-altitude (RSZ) band than the low altitude band.

2.1.3 Adjusted Migration Traffic Rate

The cumulative diurnal AMTR for all sample grids in clear weather conditions and for all wind speed categories ranged from 9.3 to 137.0 abt per kilometer per hour (kph; **Table 2-5**). The cumulative nocturnal AMTR ranged from 9.5 to 333.5 abt/kph. Diurnal AMTR over the nearshore grids (1, 7, 13, and 19) ranged from 9.3 to 38.7 abt/kph. Over the offshore grids (26, 23, 17), the cumulative diurnal AMTR ranged 25.4 to 137.0 abt/kph. The nocturnal AMTR over the nearshore grids ranged from 9.5 to 163.9 targets/kph; nocturnal offshore grid AMTR ranged from 62.3 to 333.5 targets/kph.

Table 2-5. Spring 2008 offshore VerCat cumulative AMTR (abt/kph) by surface wind speed category (miles per hour [mph]) during clear weather conditions.

Sample Grid	Date	Time	Cumulative AMTR/Surface Wind Speed		
			0-8	9-16	16+
1	14-21 March	Diurnal	35.9	17.5	9.3
7	22-27 March	Diurnal	23.2	15.7	9.4
13	03-13 April	Diurnal	31.5	28.8	31.1
19	13-19 April	Diurnal	38.7	22.8	14.7
26	24-30 April	Diurnal	137.0	55.5	25.4
23	30 Apr–07 May	Diurnal	44.7	44.2	39.6
17	07-11 May	Diurnal	111.3	67.8	56.0
1	14-21 March	Nocturnal	52.8	32.7	9.5
7	22-27 March	Nocturnal	34.0	16.8	29.3
13	03-13 April	Nocturnal	163.9	172.1	162.9
19	13-19 April	Nocturnal	131.6	102.9	15.1
26	24-30 April	Nocturnal	81.9	137.4	62.3
23	30 Apr–07 May	Nocturnal	191.8	202.0	320.3
17	07-11 May	Nocturnal	333.5	287.9	281.4

The cumulative diurnal AMTR values were similar over the nearshore grids and offshore grids (**Table 2-5**). The peak diurnal AMTR occurred offshore on Grid 26 (137.0 abt/kph) from 24-30 April and on Grid 17 (113.0 abt/kph) from 07-11 May 2008. The cumulative nocturnal AMTR was low early in season but increased dramatically as the season progressed. Peak nocturnal AMTR occurred 30 April-07 May (320.3 abt/kph) and from 07-11 May 2008 (333.5 abt/kph).

The overall, temporal trend was for steadily increasing AMTR values as the spring season progressed over both nearshore and offshore grids. Over the nearshore and offshore grids, the cumulative nocturnal AMTRs were greater than the cumulative diurnal AMTRs. Late April to mid-May appears to be the peak offshore migratory period in spring as the diurnal and nocturnal AMTR increased steadily from late April through mid-May 2008.

2.1.4 TracScan Flux Directions

TracScan cumulative diurnal flux ranged from 0.2 to 14.1 abt/km^3/hr (**Table 2-6**). TracScan cumulative diurnal flux over the nearshore sample grids (1, 7, 13, and 19) ranged from 0.9 to11.5 abt/km^3/hr and from 0.2 to 14.1 abt/km^3/hr over the offshore sample grids (26, 23, and 17). The nocturnal cumulative flux ranged from 0.4 to 9.7 abt/km^3/hr over the nearshore grids and from 0.3 to 7.3 abt/km^3/hr over the offshore grids (**Appendix J-4: Table J-54**).

Diurnal flux values increased from early March to mid-April 2008 over the nearshore grids and flux values over the offshore grids increased from late April though mid-May 2008 (**Table 2-6**). Nearshore nocturnal flux values decreased from early March to early April 2008 before increasing in mid-April 2008. No trend was noted for offshore nocturnal flux values.

Table 2-6. Spring 2008 offshore TracScan flux (abt/km^3/hr) by surface wind speed category during clear weather conditions.

Sample Grid	Date	Time	Total Flux (abt/km^3/hr)/Surface Wind Speed (mph)		
			0-8	9-16	16+
1	14-21 March	Diurnal	7.8	5.1	0.9
7	22-27 March	Diurnal	11.5	6.4	2.4
13	03-13 April	Diurnal	11.3	4.3	1.0
19	13-19 April	Diurnal	10.2	7.6	2.6
26	24-30 April	Diurnal	1.5	1.7	0.2
23	30 Apr–07 May	Diurnal	6.1	3.6	2.4
17	07-11 May	Diurnal	14.1	5.0	3.1
1	14-21 March	Nocturnal	8.1	4.0	-
7	22-27 March	Nocturnal	4.4	2.8	0.6
13	03-13 April	Nocturnal	6.5	2.6	0.4
19	13-19 April	Nocturnal	9.1	9.7	0.5
26	24-30 April	Nocturnal	6.0	4.4	0.3
23	30 Apr–07 May	Nocturnal	5.3	7.3	0.8
17	07-11 May	Nocturnal	6.2	1.3	0.9

Favorable winds for migratory seabirds in spring are from the south and southwest to the north and northeast, respectively because most of the wintering seabirds along the Atlantic coast nest to the north and northeast of the Study Area. An analysis of surface wind directions revealed that winds were favorable only a small percentage of time during the spring of 2008 (**Table 2-7; Appendix J-4: Table J-55**). The percentage of east winds decreased as the season advanced while the percentage of west winds increased.

The dominant diurnal flux and nocturnal flux direction over nearshore and offshore sample grids was to the north and northeast for most sample grids (**Table 2-8**). Overall, the TracScan diurnal and nocturnal flux values were low throughout the season. The low flux values may be the result of the low percentage of time favorable for migration (**Table 2-7**), thereby spreading out migrants throughout the season rather than in a concentrated time period.

Table 2-7. Spring 2008 offshore cumulative surface wind direction percentage (hours)[1] during clear weather conditions (Appendix J-4: see Table J-55 for wind speed data).

Grid	Date	Time	NW, N, NE	SE, S, SW	E	W
1	14-21 March	Diurnal	25	25	42	8
		Nocturnal	18	46	35	1
7	22-27 March	Diurnal	46	17	6	30
		Nocturnal	38	45	8	9
13	03-13 April	Diurnal	35	15	13	34
		Nocturnal	29	21	14	36
19	13-19 April	Diurnal	52	20	1	27
		Nocturnal	50	31	5	3
26	24-30 April	Diurnal	28	27	5	29
		Nocturnal	46	30	6	18
23	30 Apr-07 May	Diurnal	50	19	10	21
		Nocturnal	64	8	11	17
17	07-11 May	Diurnal	41	56	4	0
		Nocturnal	58	33	9	0

[1] rounded to nearest percent

Table 2-8. Spring 2008 offshore cumulative directional flux (abt/km^3/hr) by surface wind speed category (mph) during clear weather conditions.

Grid	Date	Time	Surface Wind Speed[2]	N	NE	E	SE	S	SW	W	NW
1	14-21 Mar.	Diurnal	0-8	1.8	1.8	0.8	0.6	0.7	0.6	0.5	1.0
			9-16	1.0	0.8	0.5	0.7	0.7	0.5	0.4	0.7
			16+	0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.1
		Nocturnal	0-8	2.4	2.1	0.5	0.3	0.4	0.3	0.7	1.5
			9-16	1.0	1.5	0.4	0.2	0.2	0.1	0.2	0.3
			16+	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
7	22-27 Mar.	Diurnal	0-8	1.1	1.8	1.3	0.9	1.3	2.5	1.7	0.9
			9-16	0.6	0.7	0.5	0.4	0.8	1.8	1.1	0.5
			16+	0.4	0.5	0.2	0.2	0.3	0.4	0.3	0.2
		Nocturnal	0-8	0.9	1.8	0.6	0.2	0.1	0.1	0.2	0.5
			9-16	0.2	1.0	0.6	0.1	0.1	0.2	0.2	0.4
			16+	0.1	0.1	0.0	0.0	0.1	0.1	0.1	0.1
13	03-13 Apr.	Diurnal	0-8	1.9	2.6	1.4	1.0	1.0	1.1	1.0	1.3
			9-16	0.7	1.3	0.5	0.3	0.4	0.4	0.3	0.3
			16+	0.2	0.3	0.1	0.1	0.1	0.1	0.1	0.1
		Nocturnal	0-8	1.5	2.4	0.8	0.5	0.3	0.2	0.2	0.5
			9-16	0.6	1.0	0.3	0.2	0.1	0.1	0.1	0.2
			16+	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0

Table 2-8 (*continued*). Spring 2008 offshore cumulative directional flux (abt/km^3/hr) by surface wind speed category (mph) during clear weather conditions.

Grid	Date	Time	Surface Wind Speed[2]	N	NE	E	SE	S	SW	W	NW
19	13-19 Apr.	Diurnal	0-8	2.2	2.5	1.2	0.8	0.8	0.8	0.8	1.2
			9-16	1.2	1.4	0.8	0.6	0.8	1.1	0.8	0.9
			16+	0.2	0.2	0.1	0.2	0.4	0.7	0.4	0.3
		Nocturnal	0-8	2.2	4.5	1.0	0.3	0.2	0.2	0.2	0.5
			9-16	2.2	4.8	1.1	0.3	0.2	0.2	0.2	0.5
			16+	0.0	0.0	0.0	0.1	0.1	0.2	0.0	0.0
26	24-30 Apr.	Diurnal	0-8	0.4	0.4	0.1	0.1	0.1	0.1	0.1	0.2
			9-16	0.5	0.4	0.1	0.1	0.1	0.1	0.1	0.3
			16+	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		Nocturnal	0-8	2.2	2.3	0.3	0.2	0.3	0.1	0.1	0.5
			9-16	1.7	1.0	0.2	0.1	0.2	0.1	0.3	0.8
			16+	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1
23	30 Apr-07 May	Diurnal	0-8	1.3	1.4	0.7	0.5	0.5	0.4	0.5	0.8
			9-16	0.7	0.7	0.5	0.3	0.3	0.3	0.4	0.5
			16+	0.5	0.3	0.1	0.2	0.2	0.3	0.3	0.4
		Nocturnal	0-8	1.5	1.7	0.4	0.3	0.3	0.2	0.3	0.6
			9-16	1.9	2.7	0.6	0.5	0.3	0.2	0.3	0.7
			16+	0.2	0.2	0.1	0.0	0.0	0.0	0.1	0.1
17	07-11 May	Diurnal	0-8	1.6	1.6	1.8	2.4	2.2	1.7	1.3	1.5
			9-16	0.8	0.9	0.7	0.6	0.5	0.4	0.4	0.7
			16+	0.7	0.9	0.4	0.2	0.2	0.1	0.2	0.4
		Nocturnal	0-8	1.4	1.6	0.5	0.4	0.4	0.5	0.6	0.6
			9-16	0.3	0.5	0.2	0.1	0.1	0.0	0.1	0.1
			16+	0.2	0.3	0.1	0.1	0.1	0.0	0.0	0.1

[1] Adjusted bird tracks per cubic kilometer per hour
[2] mph

The period from 22-27 March 2008 was the only time period when the dominant diurnal flux value was not to the north and northeast. During this time period the dominant diurnal flux direction was to the southwest which is the opposite of the expected direction of migratory birds in spring. This south and southwest movement indicates a period of unfavorable wind directions (northwest [NW], north [N], northeast [NE]) for migration. Diurnal winds were northerly (NW, N, NE) 46% of the time and southerly (southeast [SE], south [S], southwest [SW]) 17% of the time from 22-27 March 2008 (**Table 2-7; Appendix J-4: Table J-55**). The diurnal movement to the south and southwest during this time period probably represents a small scale reverse migration.

2.1.5 Discussion

Results for the spring 2008 nearshore and offshore radar sample grids were:

- Most of the offshore cumulative diurnal and nocturnal median altitude quartiles were within the potential RSZ band (100-700 ft AMSL).
- VerCat diurnal and nocturnal flux values at nearshore stations early in the season were concentrated in the low-altitude (1-99 ft AMSL) band. By mid-spring diurnal flux values at nearshore sample grids were similar in the low and middle altitude bands. Cumulative nocturnal

flux values within the middle altitude band increased over both the nearshore and offshore grids and became greater than low altitude flux values by the end of the nearshore and offshore sampling periods.

- Diurnal AMTR increased over the nearshore grids while nocturnal AMTR remained constant over the offshore grids, diurnal AMTR steadily increased; cumulative nocturnal AMTR decreased from Grid 26 to Grid 23 before increasing over Grid 17. Diurnal AMTR was greater than nocturnal AMTR over most grids.
- Peak diurnal AMTRs occurred offshore on Grid 26 (137.0 adt/kph) from 24-30 April and on Grid 17 (113.0 abt/kph) from 07-11 May 2008. Peak nocturnal AMTR occurred 30 April - 07 May (320.3 abt/kph) and from 07-11 May 2008 (333.5 abt/kph) on Grid 26 and Grid 17, respectively.
- The dominant diurnal and nocturnal nearshore and offshore flux directions during most of the survey weeks was from the south and southwest to the north and northeast.

During processing, false bird tracks produced by detections of sea clutter and insects were greatly reduced and inflated bird track numbers resulting from targets that were dropped and then re-tracked with new track identification numbers were eliminated. As identified in radar validation analyses, avian radars do not detect all bird targets because of the limitations in the radar's performance capability, radar operational constraints, and survey conditions.

As discussed in radar validation section, the low percentages of birds detected by the radars at low altitudes were attributable to operational constraints of the radar, operational capabilities of the radar, and the sea clutter conditions during the survey period. The offshore VerCat radar system was affected less by these factors (e.g., sea clutter) because the radar does not transmit toward the water. The TracScan can be affected more if the sea clutter (wave height) was high; however, because of the low percentage of birds tracked at low altitudes the total number of birds reported in the analysis was thought to be lower than what was present. Removal of return from sea clutter also eliminated return from low flying birds because the sea clutter return was usually stronger than the return from individual birds, and rough seas may obscure low flying birds. Day-to-day variation in the percent of undetected birds would be difficult to determine without extensive surveys in all sea clutter conditions under a wide range of migration traffic rates.

VerCat flux calculations for the critical RSZ data were not affected by the above problems, because only bird tracks in the RSZ (100-700 ft AMSL) were used to make the calculation. Median altitude quartiles and AMTR calculations were based on the number of birds detected at all altitudes, therefore these values may be underestimated for the lowest altitudes. Given the radar's capability, operational constraints, and sea state conditions experienced during the study, the data presented are the best available given the existing technology.

2.2 FALL 2008

2.2.1 Survey Effort

Offshore radar surveys started on 30 September 2008 and concluded on 19 October 2008 because of the barge accident. The fall survey effort was limited to Grid 22/23 and Grid 26. Survey effort by weather condition (clear, rain) for each sampling site is presented in **Tables 2-9** and **2-10**. Daily survey effort is listed in **Appendix J-4: Tables J-56** and **J-57.**

Table 2-9. Summary of fall 2008 VerCat offshore survey effort by weather condition.

Sample Grid	Date	Diurnal[1]			Nocturnal[2]			Total Hrs
		Hrs Clear	Hrs Rain[3]	Total Hrs	Hrs Clear	Hrs Rain[3]	Total Hrs	
22/23	30 Sept.-12 Oct.	129.8	7.5	137.2	126.4	11.3	137.7	275.0
26	12-19 Oct.	74.7	9.7	84.4	74.7	8.4	83.1	167.5

[1] Diurnal occurs from Civil Sunrise to Civil Sunset
[2] Nocturnal occurs from Civil Sunset to Civil Sunrise
[3] Rain includes mist and drizzle
Hrs = Hours

Table 2-10. Summary of fall 2008 TracScan offshore survey effort by weather condition.

Sample Grid	Date	Diurnal[1]			Nocturnal[2]			Total Hrs
		Hrs Clear	Hrs Rain[3]	Total Hrs	Hrs Clear	Hrs Rain[3]	Total Hrs	
22/23	30 Sept.-12 Oct.	130.5	9.9	140.4	126.2	12.0	138.1	278.5
26	12-19 Oct.	62.0	3.2	65.2	62.8	8.6	71.4	136.6

[1] Diurnal occurs from Civil Sunrise to Civil Sunset
[2] Nocturnal occurs from Civil Sunset to Civil Sunrise
[3] Rain includes mist and drizzle
Hrs = Hours

2.2.2 MARS® Altitudinal Distribution

The cumulative median diurnal flight altitude for Grid 22/23 and Grid 26 for all wind speed categories during clear weather conditions ranged from 413 to 461 ft AMSL (**Table 2-11**). The cumulative nocturnal median altitude ranged from 421 to 463 ft AMSL. All cumulative diurnal and nocturnal median altitudes were within the RSZ (100-700 ft AMSL). Day-to-day variation in quartile data can be found in **Appendix J-4: Tables J-58** through **J-63**.

The VerCat cumulative diurnal and nocturnal flux were concentrated in the mid-altitude (RSZ) band (**Table 2-12; Appendix J-4: Table J-64**). Nocturnal flux was greater than diurnal flux over both sample grids.

Table 2-11. Fall 2008, offshore cumulative altitude (Alt) quartiles by wind speed category during clear weather conditions.

Grid	Time	Surface Wind Speed (mph)	25% Alt	Median Alt	75% Alt	Bird Count
22/23	Diurnal	0-8	271	419	605	23,251
		9-16	303	456	636	29,456
		16+	296	459	637	11,566
26	Diurnal	0-8	280	413	622	2,769
		9-16	306	457	668	9,154
		16+	244	461	680	9,953
22/23	Nocturnal	0-8	246	421	637	31,884
		9-16	245	434	649	32,293
		16+	250	430	648	18,258
26	Nocturnal	0-8	275	458	726	8,541
		9-16	270	463	711	13,930
		16+	275	455	640	14,507

Table 2-12. Fall 2008 offshore VerCat flux (abt/km^3/hr) by altitude band and surface wind speed category during clear weather conditions.

Grid	Date	Time	VerCat Flux (abt/km^3/hr)/Altitude Band (ft AMSL)								
			Low (1-99)			Middle (100-700)			High (701+)		
			Surface Wind Speed (mph)								
			0-8	9-16	16+	0-8	9-16	16+	0-8	9-16	16+
22/23	30 Sept.-12 Oct.	Diurnal	502.3	301.4	289.2	914.5	849.8	522.7	3.2	3.5	2.0
26	12-19 Oct.	Diurnal	199.7	201.9	369.6	405.3	575.5	343.9	1.5	2.8	2.0
22/23	30 Sept.-12 Oct.	Nocturnal	787.1	674.2	643.1	1,135.1	881.3	990.4	4.8	3.8	4.6
26	12-19 Oct.	Nocturnal	405.5	513.3	419.7	753.1	688.4	743.5	4.7	4.1	3.2

2.2.3 Adjusted Migration Traffic Rate

The diurnal and nocturnal AMTR for the offshore sampling grids ranged from 44.8 to 104.3 abt/kph and from 85 to 134.3 targets/kph, respectively (**Table 2-13**). Cumulative diurnal and nocturnal AMTR were greater over Grid 22/23 than Grid 26. The cumulative nocturnal AMTR was greater than the diurnal AMTR over both sample grids.

Table 2-13. Fall 2008 offshore VerCat cumulative AMTR (abt/kph) by surface wind speed category (mph) and sample location during clear weather conditions.

Grid	Date	Time	Cumulative AMTR/Surface Wind Speed		
			0-8	9-16	16+
22/23	30 Sept.-12 Oct	Diurnal	104.3	96.4	60.1
26	12-19 Oct.	Diurnal	47.3	68.2	44.8
22/23	30 Sept.-12 Oct	Nocturnal	134.3	105.3	115.4
26	12-19 Oct.	Nocturnal	97.2	89.0	85.0

2.2.4 TracScan Flux and Flux Directions

Cumulative diurnal TracScan flux for fall ranged from 0.7 to 3.7abt/km^3/hr and nocturnal TracScan flux ranged from 0.6 to 13.5 abt/km^3/hr (**Table 2-14**). Nocturnal flux was greater than diurnal flux over sample grid 22/23.

Table 2-14. Fall 2008 offshore TracScan flux (abt/km^3/hr) by surface wind speed category during clear weather conditions.

Grid	Date	Time	Total Flux (abt/km^3/hr)/Surface Wind Speed (mph)		
			0-8	9-16	16+
22/23	30 Sept.-12 Oct	Diurnal	3.7	2.6	1.2
26	12-19 Oct.	Diurnal	2.5	1.1	0.7
22/23	30 Sept.-12 Oct	Nocturnal	13.5	11.0	4.1
26	12-19 Oct.	Nocturnal	3.5	3.0	0.6

During the diurnal period in fall 2008 over both sample grids, TracScan flux was similar in all directions (**Table 2-15**) Southbound bird migration was not detected even though favorable (northerly) wind conditions occurred from 32 to 44% of the diurnal hours (**Table 2-16**). Nocturnal flux from 30 September to 12 October 2008 was greater in southerly directions (SE, S, and SW) than other directions indicating the presence of nocturnal southbound bird migrants (winds were favorable 29% of the time). Although the wind direction was favorable for migrant birds 46% of the nocturnal period from 12 to 19 October 2008, no dominant nocturnal flux was detected moving to the south.

Table 2-15. Fall 2008 offshore cumulative directional flux (abt/km^3/hr) by surface wind speed category (mph) during clear weather conditions.

Grid	Date	Time	Surface Wind Speed	N	NE	E	SE	S	SW	W	NW
22/23	30 Sept.-12 Oct.	Diurnal	0-8	0.4	0.4	0.4	0.4	0.4	0.6	0.6	0.5
			9-16	0.3	0.2	0.2	0.3	0.3	0.6	0.5	0.3
			16+	0.2	0.1	0.1	0.1	0.1	0.3	0.2	0.2
		Nocturnal	0-8	1.3	1.2	1.2	1.9	2.9	2.8	1.2	1.1
			9-16	1.1	1.2	0.9	1.3	1.9	2.3	1.1	1.0
			16+	0.4	0.4	0.3	0.5	1.0	0.8	0.4	0.4
26	12-19 Oct.	Diurnal	0-8	0.5	0.3	0.2	0.2	0.2	0.2	0.3	0.6
			9-16	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.2
			16+	0.1	0.1	0.1	0.1	0.1	0.2	0.1	0.1
		Nocturnal	0-8	0.5	0.6	0.4	0.4	0.5	0.5	0.3	0.3
			9-16	0.3	0.2	0.3	0.7	0.7	0.4	0.2	0.2
			16+	0.1	0.0	0.0	0.1	0.1	0.1	0.1	0.0

Table 2-16. Fall 2008 offshore cumulative surface wind direction percentage (hours)[1] during clear weather condition (Appendix J-4; see Table J-65 for wind speed data).

Grid	Date	Time	NW, N, NE	SE, S, SW	E	W
22/23	30 Sept-12 Oct.	Diurnal	32	39	9	20
		Nocturnal	29	37	12	22
26	12-18 October	Diurnal	44	37	11	8
		Nocturnal	46	38	14	2

[1] rounded to nearest percent

2.2.5 Discussion

The fall 2008 radar surveys were limited to two offshore sampling grids in the southern section of the Study Area. The data are limited and insufficient to make any conclusions. The results of the fall study were:

- All cumulative diurnal and nocturnal median altitudes were within the RSZ (100-700 ft AMSL).
- The VerCat cumulative diurnal and nocturnal flux was concentrated in the mid-altitude (RSZ) band.
- Cumulative diurnal and nocturnal AMTR was greater over Grid 22 than Grid 25. The cumulative nocturnal AMTR was greater than the diurnal AMTR over both sample grids.
- Peak diurnal AMTR was 104.3 abt/kph and peak nocturnal AMTR was 134.3 abt/kph and occurred from 30 September through 12 October 2008.
- Directional flux occurred only from 20 September to 12 October 2008. As expected the directional movement was to the south.

2.3 OFFSHORE SPRING 2009

2.3.1 Survey Effort

Survey effort was limited by operational requirements (**Section 5.4.1.2**). Surveys were conducted from 11-13 May 2009. Survey effort by weather condition (clear, rain) for each sampling site is presented in **Table 2-17** and **Table 2-18 (Appendix J-4: Tables J-66** and **J-67).**

Table 2-17. Summary of spring 2009 VerCat offshore survey effort by weather condition.

Sample Grid	Date	Diurnal[1]			Nocturnal[2]			Total Hrs
		Hrs Clear	Hrs Rain[3]	Total Hrs	Hrs Clear	Hrs Rain[3]	Total Hrs	
16	11 May	4.5	0.6	5.1	4.4	0.0	4.4	9.6
	12 May	4.6	0.0	4.6	4.3	0.0	4.3	8.9
22	12 May	3.5	2.3	5.8	4.4	0.0	4.4	10.3
	13 May	6.2	0.5	6.7	4.3	0.0	4.3	11.0

[1] Diurnal occurs from Civil Sunrise to Civil Sunset
[2] Nocturnal occurs from Civil Sunset to Civil Sunrise
[3] Rain includes mist and drizzle
Hrs = Hours

Table 2-18. Summary of spring 2009 TracScan offshore survey effort by weather condition.

Sample Grid	Date	Diurnal[1]			Nocturnal[2]			Total Hrs
		Hrs Clear	Hrs Rain[3]	Total Hrs	Hrs Clear	Hrs Rain[3]	Total Hrs	
16	11 May	5.9	0.7	6.6	4.5	0.0	4.5	11.1
	12 May	4.6	0.0	4.6	4.3	0.0	4.3	8.9
22	12 May	3.5	2.3	5.8	4.5	0.0	4.5	10.3
	13 May	6.2	0.5	6.7	4.3	0.0	4.3	11.0

[1] Diurnal occurs from Civil Sunrise to Civil Sunset
[2] Nocturnal occurs from Civil Sunset to Civil Sunrise
[3] Rain includes mist and drizzle
Hrs = Hours

2.3.2 Altitudinal Distribution

The cumulative median diurnal flight altitude for Grid 16 and Grid 22 for all wind speed categories during clear weather conditions ranged from 48 to 350 ft AMSL (**Table 2-19**). The cumulative median nocturnal flight altitude ranged from 16 to 908 ft AMSL (**Appendix J-4: Tables J-68** through **J-71**).

VerCat diurnal and nocturnal flux values were compared (**Table 2-20**). The sample size was too small to make any comparisons of diurnal and nocturnal data.

Table 2-19. Spring 2009, offshore cumulative altitude (Alt) quartiles by wind speed category during clear weather conditions.

Grid	Time	Surface Wind Speed (mph)	25% Alt	Median Alt	75% Alt	Bird Count
16	Diurnal	0-8	110	350	1230	13
		9-16	92	160	1,141	14
		16+	-	-	-	-
22	Diurnal	0-8	31	48	211	42
		9-16	46	214	224	1
		16+	-	-	-	-
16	Nocturnal	0-8	555	908	1,256	79
		9-16	16	16	19	1
		16+	-	-	-	-
22	Nocturnal	0-8	215	286	338	131
		9-16	85	120	194	15
		16+	-	-	-	-

Table 2-20. Spring 2009, offshore VerCat flux (abt/km^3/hr) by altitude band and surface wind speed category during clear weather conditions.

Grid	Date	Time	VerCat Flux (abt/km^3/hr)/Altitude Band (ft AMSL)								
			Low (1-99)			Middle (100-700)			High (701+)		
			Surface Wind Speed (mph)								
			0-8	9-16	16+	0-8	9-16	16+	0-8	9-16	16+
16	11-12 May	Diurnal	15.9	8.7	-	3.1	1.8	-	0.1	0.0	-
22	12-13 May	Diurnal	34.2	13.3	-	3.9	2.2	-	0.0	0.0	-
16	11-12 May	Nocturnal	17.5	6.1	-	10.6	0.0	-	0.3	0.0	-
22	12-13 May	Nocturnal	22.4	50.8	-	35.9	10.9	-	0.0	0.0	-

2.3.3 Adjusted Migration Traffic Rate

The cumulative diurnal AMTR ranged from 0.4 to 4.3 abt/km/hour and the cumulative nocturnal AMTR ranged from 0.2 to 3.5 abt/km/hour (**Table 2-21**). The sample size was too small to make any comparisons of diurnal and nocturnal data.

2.3.4 TracScan Flux and Flux Direction

Cumulative diurnal and nocturnal TracScan flux for all sample grids ranged from 5.4 to 13.8 abt/km^3/hr and from 4.5 to 6.6 abt/km^3/hr, respectively (**Table 2-22**).The sample size was too small to make any comparisons of diurnal and nocturnal TracScan flux and flux direction data.

Table 2-21. Spring 2009 offshore VerCat cumulative AMTR (abt/kph) by surface wind speed category and sample location during clear weather conditions.

Grid	Date	Time	Cumulative AMTR/Surface Wind Speed (mph)		
			0-8	9-16	16+
16	11-12 May	Diurnal	4.3	2.3	-
22	12-13 May	Diurnal	0.8	0.4	-
16	11-12 May	Nocturnal	2.4	0.2	-
22	12-13 May	Nocturnal	3.5	1.4	-

Table 2-22. Spring 2009 offshore TracScan flux (abt/km^3/hr) by surface wind speed categories during clear weather conditions.

Grid	Date	Time	Total Flux (abt/km^3/hr)/Surface Wind Speed (mph)		
			0-8	9-16	16+
16	11-12 May	Diurnal	13.8	5.4	-
22	12-13 May	Diurnal	5.8	7.8	-
16	11-12 May	Nocturnal	5.8	4.5	-
22	12-13 May	Nocturnal	4.9	6.6	-

The dominant cumulative diurnal movement on 11 May 2009 was from the north and northeast to the south and southwest (**Table 2-23**). A nocturnal movement from the south and southwest to the north and northeast was present on 11-12 and 12-13 May 2009. These movements occurred when the wind directions were generally unfavorable for northbound migrants (north to south: **Table 2-24; Appendix J-4: Table J-72**). On 12-13 May 2009, diurnal movement was nearly uniform in all directions.

Table 2-23. Spring 2009 offshore TracScan cumulative directional flux (abt/km^3/hr) by surface wind speed (mph) categories during clear weather conditions.

Grid	Date	Time	Surface Wind Speed	N	NE	E	SE	S	SW	W	NW
16	11-12 May	Diurnal	0-8	1.6	1.5	1.3	2.0	2.6	2.3	1.3	1.2
			9-16	0.7	0.9	0.7	0.8	0.9	0.1	0.4	0.4
			16+	-	-	-	-	-	-	-	-
		Nocturnal	0-8	1.6	2.0	0.5	0.3	0.3	0.2	0.3	0.7
			9-16	0.8	2.6	0.5	0.2	0.2	0.1	0.1	0.1
			16+	-	-	-	-	-	-	-	-
22	12-13 May	Diurnal	0-8	0.9	0.8	0.5	0.5	0.8	0.8	0.7	0.8
			9-16	1.6	1.7	1.1	0.5	0.6	0.4	0.6	1.2
			16+	-	-	-	-	-	-	-	-
		Nocturnal	0-8	1.5	2.5	0.2	0.1	0.1	0.1	0.1	0.2
			9-16	1.8	3.8	0.3	0.1	0.1	0.1	0.1	0.3
			16+	-	-	-	-	-	-	-	-

Table 2-24. Spring 2009 offshore cumulative surface wind direction percentage (hours)[1] during clear weather conditions (Appendix J-4: see Table J-72 for wind speeds).

Grid	Date	Time	NW, N, NE	SE, S, SW	E	W
16	11-12 May	Diurnal	56	22	21	0
		Nocturnal	45	2	53	0
22	12-13 May	Diurnal	45	31	9	15
		Nocturnal	63	15	11	0

[1] rounded to nearest percent

2.3.5 Discussion

The survey effort was limited to three days and therefore no general trends were identified from the survey results. The data presented for spring 2009 may be used as a qualitative measure of the avian activity for the days that the data were collected.

3.0 ONSHORE RADAR SURVEYS

3.1 SPRING/SUMMER 2008

3.1.1 Survey Effort

Onshore radar surveys started on 15 May 2008 and concluded on 19 June 2008. The survey effort by weather condition (clear, rain) for each onshore sampling site is presented in **Table 3-1** and **Table 3-2**. Daily survey effort is listed in **Appendix J-5: Tables J-73** and **J-74.**

Table 3-1. Summary of spring 2008 VerCat onshore survey effort by weather condition.

Sample Location	Date	Diurnal[1]			Nocturnal[2]			Total Hrs
		Hrs Clear	Hrs Rain[3]	Total Hrs	Hrs Clear	Hrs Rain[3]	Total Hrs	
IBSP	15-23 May	65.8	53.4	119.2	44.9	22.9	67.8	187.0
NBB	29 May - 08 June	137.7	12.6	150.3	68.2	12.7	80.9	231.2
CISP	09–19 June	142.5	17.1	159.6	69.0	11.1	80.1	239.7

[1] Diurnal occurs from Civil Sunrise to Civil Sunset
[2] Nocturnal occurs from Civil Sunset to Civil Sunrise
[3] Rain includes mist and drizzle
CISP = Corson's Inlet State Park
Hrs = Hours
IBSP = Island Beach State Park
NBB = North Brigantine Beach

Table 3-2. Summary of spring 2008 TracScan onshore survey effort by weather condition.

Sample Location	Date	Diurnal[1]			Nocturnal[2]			Total Hrs
		Hrs Clear	Hrs Rain[3]	Total Hrs	Hrs Clear	Hrs Rain[3]	Total Hrs	
IBSP	15-23 May	65.2	53.2	118.4	45.0	22.9	67.9	186.3
NBB	29 May-08 June	137.6	12.5	150.1	68.3	12.7	81.0	231.1
CISP	09-19 June	142.6	17.0	159.9	68.9	11.1	80.0	239.9

[1] Diurnal occurs from Civil Sunrise to Civil Sunset
[2] Nocturnal occurs from Civil Sunset to Civil Sunrise
[3] Rain includes mist and drizzle
CISP = Corson's Inlet State Park
Hrs = Hours
IBSP = Island Beach State Park
NBB = North Brigantine Beach

3.1.2 Altitudinal Distribution

3.1.2.1 Island Beach State Park

The cumulative median diurnal flight altitude for all surface wind speed categories ranged from 112 to 176 ft AMSL; the cumulative median nocturnal flight altitude ranged from 218 to 697 ft AMSL (**Table 3-3**). All of the cumulative diurnal and nocturnal median altitude quartiles were within the middle (RSZ) altitude band. Day-to-day variation in quartile data can be found in **Appendix J-5: Tables J-75 through J-77**.

Table 3-3. Spring 2008, Island Beach State Park, weekly VerCat radar cumulative median altitude (Alt) quartiles (ft AMSL) by surface wind speed category during clear weather conditions.

Date	Time	Surface Wind Speed (mph)	25% Alt	Median Alt	75% Alt	Bird Count
15-18 May	Diurnal	0-8	69	153	653	432
		9-16	55	122	340	464
		16+	-	-	-	-
19-23 May	Diurnal	0-8	62	112	315	887
		9-16	74	176	713	643
		16+	-	-	-	-
15-18 May	Nocturnal	0-8	373	694	1,053	1,748
		9-16	315	697	1,187	257
		16+	-	-	-	-
19-23 May	Nocturnal	0-8	194	393	710	4,724
		9-16	108	218	448	356
		16+	-	-	-	-

The majority of the weekly cumulative diurnal and nocturnal flux values were greater within the low altitude band than within the mid-altitude (RSZ) band (**Table 3-4**). Nocturnal flux values were greater than diurnal flux values within the low altitude and mid-altitude bands during both survey weeks.

Table 3-4. Spring 2008, Island Beach State Park, weekly VerCat flux (abt/km^3/hr) by altitude band and surface wind speed category during clear weather conditions.

Date	Time	VerCat Flux (abt/km^3/hr)/Altitude Band (ft AMSL)								
		Low (1-99)			Middle (100-700)			High (701+)		
		Surface Wind Speed (mph)								
		0-8	9-16	16+	0-8	9-16	16+	0-8	9-16	16+
15-18 May	Diurnal	205.4	303.1	-	37.4	51.7	-	0.3	0.1	-
19-23 May	Diurnal	239.3	231.1	-	38.0	45.7	-	0.2	0.4	-
15-18 May	Nocturnal	228.8	454.6	-	296.0	391.3	-	5.5	7.1	-
19-23 May	Nocturnal	380.3	263.7	-	225.0	97.7	-	1.6	0.3	-

3.1.2.2 North Brigantine Beach

The cumulative median diurnal and nocturnal flight altitude for all surface wind speed categories ranged from 47 to 113 and from 78 to 172 ft AMSL, respectively (**Table 3-5**). The majority of the cumulative median altitudes were within the middle (RSZ) altitude band. Day-to-day variation in quartile data can be found in **Appendix J-5: Table J-78** through **J-80.**

Table 3-5. Spring 2008, North Brigantine Beach, weekly VerCat cumulative altitude (Alt) quartiles by surface wind speed category during clear weather conditions.

Date	Time	Surface Wind Speed (mph)	25% Alt	Median Alt	75% Alt	Bird Count
29 May - 01 June	Diurnal	0-8	55	112	178	1,615
		9-16	22	47	121	548
		16+	-	-	-	-
01 June	Diurnal	0-8	56	113	181	4,089
		9-16	57	111	173	1,940
		16+	-	-	-	-
29 May – 01 June	Nocturnal	0-8	72	143	227	2,744
		9-16	77	172	273	1,683
		16+	-	-	-	-
01-08 June	Nocturnal	0-8	70	139	224	5,895
		9-16	36	78	141	95
		16+	-	-	-	-

The cumulative VerCat diurnal and nocturnal flux values were greater within the low altitude band than within the mid-altitude band (**Table 3-6**). Most nocturnal flux values were greater than diurnal flux values within the low-altitude and middle altitude band during both survey weeks

Table 3-6. Spring 2008, North Brigantine Beach, weekly VerCat flux (abt/km^3/hr) by altitude band and surface wind speed category during clear weather conditions.

Date	Time	VerCat Flux (abt/km^3/hr)/Altitude Band (ft AMSL)								
		Low (1-99)			Middle (100-700)			High (701+)		
		Surface Wind Speed (mph)								
		0-8	9-16	16+	0-8	9-16	16+	0-8	9-16	16+
29 May – 01 June	Diurnal	642.3	286.8	-	133.2	27.7	-	0.0	0.0	-
01-08 June	Diurnal	384.1	376.0	-	81.0	79.5	-	0.0	0.0	-
29 May – 01 June	Nocturnal	900.0	771.0	-	274.6	286.6	-	0.0	0.0	-
01-08 June	Nocturnal	746.2	313.1	-	216.4	51.5	-	0.0	0.0	-

3.1.2.3 Corson's Inlet State Park

The cumulative median diurnal flight altitude for all surface wind speed categories ranged from 75 to 186 ft AMSL; the cumulative median nocturnal flight altitude ranged from 161 to 199 ft AMSL (**Table 3-7**). The majority of the cumulative median diurnal altitude quartiles and all of the nocturnal median altitude quartiles were within the middle (RSZ) altitude band. Day-to-day variation in quartile data can be found in **Appendix J-5: Tables 81** and **82**.

Table 3-7. Spring 2008, Corson's Inlet State Park, weekly VerCat radar cumulative median altitude (Alt) quartiles (ft AMSL) by surface wind speed category during clear weather conditions.

Date	Time	Surface Wind Speed (mph)	25% Alt	Median Alt	75% Alt	Bird Count
09-15 June	Diurnal	0-8	61	132	248	2,312
		9-16	65	142	225	1,007
		16+	85	186	276	147
15-19 June	Diurnal	0-8	77	154	213	879
		9-16	31	76	164	709
		16+	28	75	166	32
09-15 June	Nocturnal	0-8	89	161	237	4,013
		9-16	119	199	240	110
		16+	-	-	-	-
15-19 June	Nocturnal	0-8	93	169	249	3,193
		9-16	63	165	271	80
		16+	-	-	-	-

The cumulative diurnal flux values were greater within the low altitude band than in the mid-altitude band (**Table 3-8**). Cumulative nocturnal flux values were greater within the low altitude band than the mid-altitude band. Cumulative nocturnal flux values were greater than diurnal flux values during both survey weeks.

Table 3-8. Spring 2008, Corson's Inlet State Park, weekly VerCat flux (abt/km^3/hr) by altitude band and surface wind speed category during clear weather conditions.

Date	Time	VerCat Flux (abt/km^3/hr)/Altitude Band (ft AMSL)								
		Low (1-99)			Middle (100-700)			High (701+)		
		Surface Wind Speed (mph)								
		0-8	9-16	16+	0-8	9-16	16+	0-8	9-16	16+
09-15 June	Diurnal	242.6	176.7	256.4	59.7	49.4	93.0	0.0	0.0	0.0
15-19 June	Diurnal	176.4	154.9	107.9	65.7	18.8	11.4	0.0	0.0	0.0
09-15 June	Nocturnal	442.5	176.8	-	164.8	108.2	-	0.0	0.0	-
15-19 June	Nocturnal	482.9	268.5	-	194.7	87.7	-	0.0	0.0	-

3.1.3 Adjusted Migration Traffic Rate

3.1.3.1 Island Beach State Park

The cumulative diurnal AMTR ranged from 6.1 to 7.5 abt/kph while the nocturnal AMTR ranged from 26.9 to 66.2 abt/kph (**Table 3-9**). The nocturnal AMTRs were greater than the diurnal AMTRs. Peak cumulative AMTR occurred at night indicating the passage of spring migrants.

Table 3-9. Spring 2008, Island Beach State Park, weekly VerCat radar cumulative AMTR (abt/kph) by surface wind speed category during clear weather conditions.

Date	Time	Cumulative AMTR/Surface Wind Speed		
		0-8	9-16	16+
15-18 May	Diurnal	6.4	7.3	-
19-23 May	Diurnal	6.1	7.5	-
15-18 May	Nocturnal	48.0	66.2	-
19-23 May	Nocturnal	26.9	60.0	-

3.1.3.2 North Brigantine Beach

The cumulative diurnal AMTR ranged from 5.7 to 17.6 abt/kph and the nocturnal AMTR ranged from 7.1 to 33.0 abt/kph (**Table 3-10**). The majority of the diurnal AMTRs were lower than the nocturnal AMTRs. Peak cumulative AMTR occurred at night.

Corson's Inlet State Park

The cumulative diurnal AMTR ranged from 3.6 to 13.3 abt/kph while the nocturnal AMTR ranged from 10.8 to 21.8 abt/kph (**Table 3-11**). The nocturnal AMTR was greater than the diurnal AMTR during both survey weeks. Peak cumulative AMTR occurred at night.

Table 3-10. Spring 2008, North Brigantine Beach, weekly VerCat radar cumulative AMTR (abt/kph) by surface wind speed category during clear weather conditions.

Date	Time	Cumulative AMTR/Surface Wind Speed		
		0-8	9-16	16+
29 May – 01 June	Diurnal	17.6	5.7	-
01-08 June	Diurnal	10.6	10.7	-
29 May – 01 June	Nocturnal	32.5	33.0	-
01-08 June	Nocturnal	25.5	7.1	-

Table 3-11. Spring 2008 Corson's Inlet State Park, weekly VerCat radar cumulative AMTR (abt/kph) by surface wind speed category during clear weather conditions.

Date	Time	Cumulative AMTR/Surface Wind Speed		
		0-8	9-16	16+
09-15 June	Diurnal	7.9	6.2	10.6
15-19 June	Diurnal	7.9	3.6	13.3
09-15 June	Nocturnal	18.3	11.0	-
15-19 June	Nocturnal	21.8	10.8	-

3.1.4 TracScan Flux and Flux Directions

3.1.4.1 Island Beach State Park

Cumulative diurnal TracScan directional flux ranged from 11.6 to 13.5 abt/km^3/hr; nocturnal TracScan directional flux values ranged from 10.6 to 19.3 abt/km^3/hr (**Table 3-12**). Diurnal directional flux values were similar between weeks. Nocturnal directional flux values were similar to diurnal directional flux values during the first week and greater than diurnal directional flux values during the second week.

Table 3-12. Spring 2008, Island Beach State Park, weekly TracScan flux (abt/km^3/hr) by surface wind speed category during clear weather conditions.

Week	Date	Time	Total Flux (abt/km^3/hr)/Surface Wind Speed (mph)		
			0-8	9-16	16+
1	15-18 May	Diurnal	12.5	11.6	-
2	19-23 May	Diurnal	12.3	13.5	12.4
1	15-18 May	Nocturnal	10.6	13.5	-
2	19-23 May	Nocturnal	18.4	19.3	-

Although diurnal and nocturnal surface winds were not favorable (i.e., directional flow from north to south) for northbound migrants the majority of survey period (**Table 3-13**), the dominant directional flux values during the survey period were from the south and southwest to the north and northeast, respectively (**Table 3-14; Appendix Table J-83**).

Table 3-13. Spring 2008, Island Beach State Park, weekly onshore cumulative surface wind direction percentage (hours)[1] during clear weather conditions (Appendix J-5: see Table J-83 for wind speed data).

Date	Time	NW, N, NE	SE, S, SW	E	W
15-18 May	Diurnal	71	9	0	20
	Nocturnal	45	38	0	17
18-23 May	Diurnal	89	0	4	7
	Nocturnal	100	0	0	0

[1] rounded to nearest percent

Table 3-14. Spring 2008, Island Beach State Park, weekly cumulative directional flux (abt/km^3/hr) by surface wind speed category (mph) during clear weather conditions.

Date	Time	Surface Wind Speed	N	NE	E	SE	S	SW	W	NW
15-18 May	Diurnal	0-8	2.1	3.2	2.0	1.1	1.6	1.2	0.7	0.7
		9-16	3.0	4.3	1.2	0.6	0.9	0.6	0.4	0.7
		16+	-	-	-	-	-	-	-	-
	Nocturnal	0-8	3.4	4.8	0.8	0.2	0.4	0.3	0.2	0.6
		9-16	3.3	7.7	1.4	0.3	0.2	0.1	0.1	0.4
		16+	-	-	-	-	-	-	-	-
18-23 May	Diurnal	0-8	2.0	2.8	1.7	1.0	1.9	1.5	0.6	0.7
		9-16	2.8	3.8	1.7	1.1	1.6	1.1	0.6	0.8
		16+	3.1	3.7	1.2	0.8	1.3	1.0	0.5	0.9
	Nocturnal	0-8	4.8	9.5	2.2	0.4	0.6	0.3	0.1	0.5
		9-16	4.9	10.0	2.5	0.5	0.7	0.2	0.1	0.5
		16+	-	-	-	-	-	-	-	-

3.1.4.2 North Brigantine Beach

Cumulative diurnal TracScan directional flux values ranged from 4.7 to 11.5 abt/km^3/hr. Nocturnal TracScan directional flux values ranged from 2.6 to 9.7 abt/km^3/hr (**Table 3-15**). Diurnal and nocturnal directional flux values were similar between weeks.

During the diurnal and nocturnal periods in spring 2008 the dominant TracScan directional flux was to the north and northeast (**Table 3-16**). Surface winds were favorable for diurnal and nocturnal migration (i.e., from south to north) from 13 to 19% of the time, respectively during the first survey week and from 22 to 48% of the time during the second survey week (**Table 3-17; Appendix J-5: Table J-83**).

Table 3-15. Spring 2008, North Brigantine Beach, weekly TracScan flux (abt/km^3/hr) by surface wind speed category during clear weather conditions.

Week	Date	Time	Total Flux (abt/km^3/hr)/Surface Wind Speed (mph)		
			0-8	9-16	16+
1	29 May – 01 June	Diurnal	11.5	4.7	-
2	01-08 June	Diurnal	9.4	6.2	-
1	29 May – 01 June	Nocturnal	9.7	2.6	-
2	01-08 June	Nocturnal	7.1	4.1	-

Table 3-16. Spring 2008, North Brigantine Beach, weekly cumulative directional flux (abt/km^3/hr) by surface wind speed category (mph) during clear weather conditions.

Date	Time	Surface Wind Speed[2]	N	NE	E	SE	S	SW	W	NW
29 May – 01 June	Diurnal	0-8	1.8	1.7	1.6	1.4	1.1	1.0	1.2	1.6
		9-16	1.2	1.3	0.7	0.3	0.2	0.1	0.1	0.8
		16+	-	-	-	-	-	-	-	-
	Nocturnal	0-8	2.7	1.0	0.5	0.2	0.3	0.3	1.0	3.6
		9-16	0.5	1.2	0.5	0.1	0.1	0.0	0.0	0.2
		16+	-	-	-	-	-	-	-	-
01-08 June	Diurnal	0-8	1.6	1.4	1.0	1.2	1.1	0.9	0.9	1.4
		9-16	1.4	1.3	0.8	0.6	0.5	0.4	0.4	0.9
		16+	-	-	-	-	-	-	-	-
	Nocturnal	0-8	1.3	2.7	1.2	0.3	0.4	0.4	0.3	0.5
		9-16	0.9	1.4	0.7	0.2	0.2	0.2	0.2	0.4
		16+	-	-	-	-	-	-	-	-

Table 3-17. Spring 2008, North Brigantine Beach, weekly onshore cumulative surface wind direction percentage (hours) during clear weather conditions (Appendix J-5: Table J-83 for wind speed data).

Date	Time	NW, N, NE	SE, S, SW	E	W
29 May – 01 June	Diurnal	1	13	86	0
	Nocturnal	0	19	81	0
01-08 June	Diurnal	22	22	53	2
	Nocturnal	17	48	29	6

3.1.4.3 Corson's Inlet State Park

Cumulative diurnal TracScan flux values ranged from 2.5 to 5.8 abt/km^3/hr and nocturnal TracScan flux values ranged from 2.4 to 2.9 abt/km^3/hr (**Table 3-18**). Diurnal and nocturnal flux values were similar between survey weeks.

Table 3-18. Spring 2008, Corson's Inlet State Park, weekly TracScan flux by surface wind speed category during clear weather conditions.

Week	Date	Time	Total Flux (abt/km^3/hr)/Surface Wind Speed (mph)		
			0-8	9-16	16+
1	09-15 June	Diurnal	4.7	3.5	2.5
2	15-19 June	Diurnal	5.8	3.5	2.6
1	09-15 June	Nocturnal	2.8	2.9	-
2	15-19 June	Nocturnal	2.8	2.4	-

Slightly more birds were detected moving to the north and northeast than other directions (**Table 3-19**). Surface wind direction during the first survey week was not favorable for late northbound migrants (i.e., primarily from the north to the south); surface wind direction during the second survey week was favorable for late migrants (i.e., primarily from the south to north (**Table 3-20; Appendix Table J-83**).

Table 3-19. Spring 2008, Corson's Inlet State Park, weekly TracScan cumulative directional flux (abt/km^3/hr) by surface wind speed category by week during clear weather conditions.

Week	Date	Time	Surface Wind Speed[2]	N	NE	E	SE	S	SW	W	NW
1	09-15 June	Diurnal	0-8	0.6	1.2	0.7	0.3	0.4	0.6	0.5	0.4
			9-16	0.5	1.0	0.5	0.2	0.2	0.4	0.3	0.3
			16+	0.2	0.2	0.2	0.2	0.4	0.2	0.4	0.2
		Nocturnal	0-8	0.3	1.0	0.5	0.2	0.2	0.3	0.2	0.1
			9-16	0.4	1.4	0.6	0.1	0.1	0.1	0.1	0.1
			16+	-	-	-	-	-	-	-	-
2	15-19 June	Diurnal	0-8	0.8	1.5	0.8	0.4	0.5	0.7	0.5	0.4
			9-16	0.5	0.8	0.5	0.3	0.4	0.5	0.3	0.3
			16+	0.2	0.4	0.4	0.3	0.4	0.5	0.2	0.1
		Nocturnal	0-8	0.3	0.9	0.4	0.1	0.3	0.5	0.2	0.1
			9-16	0.2	0.6	0.3	0.1	0.4	0.6	0.2	0.1
			16+	-	-	-		-	-		-

Table 3-20. Spring 2008, Corson's Inlet State Park, weekly onshore cumulative surface wind direction percentage (hours)[1] during clear weather conditions (see Appendix J-5: Table J-83 for wind speed data).

Week	Date	Time	NW, N, NE	SE, S, SW	E	W
1	09-15 June	Diurnal	66	25	0	8
		Nocturnal	47	46	2	5
2	15-19 June	Diurnal	36	37	24	3
		Nocturnal	26	44	15	16

[1] rounded to nearest percent

3.1.5 Discussion

The results of the spring/early summer onshore radar survey were:

- The majority of weekly cumulative diurnal and nocturnal median altitude quartiles were within the potential RSZ (middle altitude band: 100-700 ft AMSL).
- At Island Beach State Park (ISBP) and Corson's low altitude and middle altitude (RSZ) band flux values were generally similar. At Brigantine, cumulative diurnal flux values were greater within the low altitude band than within the middle (RSZ) altitude band. This difference may be the result of the different migratory species passing the site or the behavior of resident species at the site. The cumulative nocturnal flux values were greater within the low altitude band than with the middle (RSZ) altitude band at all onshore sites.
- The cumulative diurnal AMTR values were similar between the onshore sites. Nocturnal AMTR values were greater than cumulative diurnal AMTRs indicating that some nocturnal migration was probably still in progress from mid-May into mid-June.
- The cumulative peak diurnal AMTR (17.6 abt/kph) occurred at Brigantine from 29 May-01 June 2008. The cumulative nocturnal AMTR decreased from IBSP to Sea Isle City (SIC) indicating a decline in nocturnal migration. The cumulative peak nocturnal AMTR (66.2 abt/kph) was at ISBP from 15-18 May 2008. Peak AMTR occurred from 15-23 May 2009 (60-66 abt/kph).
- The cumulative diurnal AMTR for all survey sites ranged from 3.6 to 17.6 abt/kph; the cumulative nocturnal AMTR ranged from 7.1-66.2 abt/kph. Most weekly nocturnal AMTRs were greater than weekly diurnal AMTRs.
- Overall, as expected during spring migration, the dominant directions of flux were from the south and southwest to the north and/or northeast, respectively.

3.2 FALL/EARLY WINTER 2008

3.2.1 Survey Effort

Onshore radar surveys started on 13 September 2008 and concluded on 16 November 2008. The survey effort by weather condition (clear, rain, mist, and fog) for each onshore sampling site is presented in **Tables 3-21** and **3-22**. Daily survey effort is listed in **Appendix J-5: Table J-84** and **J-85.**

Table 3-21. Summary of fall 2008 VerCat onshore survey effort by weather condition.

Sample Location	Date	Diurnal[1]			Nocturnal[2]			Total Hrs
		Hrs Clear	Hrs Rain[3]	Total Hrs	Hrs Clear	Hrs Rain[3]	Total Hrs	
IBSP	13 Sept. – 02 October	232.3	26.0	258.3	186.0	35.4	221.4	479.7
SIC	05-26 October	175.0	53.2	228.3	214.9	52.0	266.9	495.1
BB	26 October – 16 November	182.8	17.5	200.3	206.3	17.6	223.9	424.2
SIC	16 November – 15 December	178.2	97.8	276.0	247.2	168.0	415.2	691.2

[1] Diurnal occurs from Civil Sunrise to Civil Sunset
[2] Nocturnal occurs from Civil Sunset to Civil Sunrise
[3] Rain includes mist and drizzle
BB = Brigantine Beach
Hrs = Hours
IBSP = Island Beach State Park
SIC = Sea Isle City

Table 3-22. Summary of fall 2008 TracScan onshore survey effort by weather condition.

Sample Location	Date	Diurnal[1]			Nocturnal[2]			Total Hrs
		Hrs Clear	Hrs Rain[3]	Total Hrs	Hrs Clear	Hrs Rain[3]	Total Hrs	
IBSP	15 Sept. – 02 October	234.1	24.2	258.3	185.9	35.4	221.3	479.6
SIC	05-26 October	148.8	452.1	194.0	186.5	44.6	231.1	425.1
BB	26 October – 16 November	183.9	17.4	201.3	207.0	16.6	223.6	424.9
SIC	16 November-15 December	182.0	101.8	283.8	247.9	178.9	426.8	709.8

[1] Diurnal occurs from Civil Sunrise to Civil Sunset
[2] Nocturnal occurs from Civil Sunset to Civil Sunrise
[3] Rain includes mist and drizzle
BB = Brigantine Beach
Hrs = Hours
IBSP = Island Beach State Park
SIC = Sea Isle City

3.2.2 Altitudinal Distribution

3.2.2.1 Island Beach State Park

The cumulative diurnal and nocturnal median altitude ranged from 28 to 283 and from 149 to 322 ft AMSL, respectively (**Table 3-23**). The majority of diurnal and nocturnal median altitudes were within the middle (RSZ) altitude band. Nocturnal median altitudes were generally greater than diurnal median altitudes. Day-to-day quartile data can be found in **Appendix J-5: Tables J-86** through **J-88**.

Cumulative diurnal flux values were greater in the low altitude band than the middle (RSZ) altitude band during all survey weeks (**Table 3-24**). Cumulative nocturnal VerCat flux values were variable between weeks. Within the low altitude band diurnal flux decreased from the first through third week while nocturnal flux increased from the first to the third survey week. In the middle (RSZ) altitude band, diurnal nocturnal flux decreased during the second survey week before increasing the following week.

Table 3-23. Fall 2008, Island Beach State Park, weekly VerCat radar cumulative median altitude (Alt) quartiles (ft AMSL) by surface wind speed category during clear weather conditions.

Date	Time	Surface Wind Speed (mph)	25% Alt	Median Alt	75% Alt	Bird Count
13 -21 Sept.	Diurnal	0-8	70	141	221	2,388
		9-16	50	114	232	729
		16+	-	-	-	-
21-28 Sept.	Diurnal	0-8	32	158	249	273
		9-16	34	70	147	431
		16+	20	28	85	28
28 Sept.-05 Oct.	Diurnal	0-8	97	197	283	2,907
		9-16	44	132	241	340
		16+	-	-	-	-

Table 3-23 (*continued*). Fall 2008, Island Beach State Park, weekly VerCat radar cumulative median altitude (Alt) quartiles (ft AMSL) by surface wind speed category during clear weather conditions.

Date	Time	Surface Wind Speed (mph)	25% Alt	Median Alt	75% Alt	Bird Count
13 -21 Sept.	Nocturnal	0-8	161	231	313	4,893
		9-16	162	229	304	1,371
		16+	185	256	322	75
21-28 Sept.	Nocturnal	0-8	137	200	275	734
		9-16	130	205	282	439
		16+	33	61	218	12
28 Sept.-05 Oct.	Nocturnal	0-8	104	205	315	4,476
		9-16	39	67	149	174
		16+	-	-	-	-

Table 3-24. Fall 2009, Island Beach State Park, weekly VerCat flux (abt/km^3/hr) by altitude band and surface wind speed category during clear weather conditions.

Date	Time	VerCat Flux (abt/km^3/hr)/Altitude Band (ft AMSL)								
		Low (1-99)			Middle (100-700)			High (701+)		
		Surface Wind Speed (mph)								
		0-8	9-16	16+	0-8	9-16	16+	0-8	9-16	16+
13-21 Sept	Diurnal	237.5	184.3	-	68.7	35.8	-	-	-	-
21-28 Sept	Diurnal	61.7	85.4	24.8	14.1	8.9	1.2	-	-	-
28 Sept.-05 Oct.	Diurnal	170.9	97.4	-	73.9	21.1	-	-	-	-
13-21 Sept	Nocturnal	180.5	125.9	53.0	196.9	145.6	175.2	-	-	-
21-28 Sept	Nocturnal	65.2	43.8	7.6	54.7	29.6	1.2	-	-	-
28 Sept.-05 Oct.	Nocturnal	264.5	275.9	-	126.5	23.9	-	-	-	-

3.2.2.2 Brigantine Beach

The cumulative diurnal and nocturnal median altitude ranged from 9 to 172 and from 42 to 1,105 ft AMSL, respectively (**Table 3-25**). The majority of the diurnal median altitudes were in the low altitude band. In contrast, most of the nocturnal median altitudes were within the middle (RSZ) altitude band. Day-to-day quartile data can be found in **Appendix J-5: Tables J-89** through **J-91**.

Cumulative diurnal flux values were greater within the low altitude band than within the middle (RSZ) altitude band during all survey weeks (**Table 3-26**). Cumulative nocturnal flux values were similar in the low altitude and middle (RSZ) altitude bands. In the low altitude band, the majority of the weekly cumulative diurnal flux values were greater than the weekly cumulative nocturnal flux values. Within the middle (RSZ) altitude band, no definitive trend in cumulative flux values was evident between survey weeks.

Table 3-25. Fall 2008, Brigantine Beach, weekly VerCat radar cumulative median altitude (Alt) quartiles (ft AMSL) by surface wind speed category during clear weather conditions.

Date	Time	Surface Wind Speed (mph)	25% Alt	Median Alt	75% Alt	Bird Count
26 Oct.-02 Nov.	Diurnal	0-8	35	57	135	405
		9-16	62	172	605	465
		16+	46	74	137	70
02-09 Nov.	Diurnal	0-8	27	64	94	252
		9-16	19	53	181	134
		16+	7	9	19	29
09-15 Nov.	Diurnal	0-8	19	27	68	260
		9-16	16	23	52	273
		16+	16	33	107	58
26 Oct.-02 Nov.	Nocturnal	0-8	582	1,105	1,607	1,336
		9-16	243	890	1,685	244
		16+	158	359	831	45
02-09 Nov.	Nocturnal	0-8	35	138	321	74
		9-16	67	188	375	139
		16+	12	42	248	82
09-15 Nov.	Nocturnal	0-8	219	349	464	921
		9-16	190	353	509	733
		16+	25	251	448	68

Table 3-26. Fall 2008, Brigantine Beach, weekly VerCat flux (abt/km^3/hr) by altitude band and surface wind speed category during clear weather conditions.

Date	Time	VerCat Flux (abt/km^3/hr)/Altitude Band (ft AMSL)								
		Low (1-99)			Middle (100-700)			High (701+)		
		Surface Wind Speed (mph)								
		0-8	9-16	16+	0-8	9-16	16+	0-8	9-16	16+
26 Oct.-02 Nov.	Diurnal	133.3	81.9	162.4	6.7	14.3	13.1	-	0.1	0.1
02-09 Nov.	Diurnal	70.4	72.4	169.0	3.7	6.6	-	-	-	-
09-15 Nov.	Diurnal	107.7	129.9	42.8	4.0	4.4	2.2	-	-	-
26 Oct.-02 Nov.	Nocturnal	18.8	19.7	12.6	14.8	11.9	6.5	0.6	0.3	0.1
02-09 Nov.	Nocturnal	9.6	35.7	123.3	1.9	11.3	14.2	-	-	-
09-15 Nov.	Nocturnal	26.9	60.7	38.6	36.9	50.2	8.8	-	0.1	-

3.2.2.3 Sea Isle City

From 05-26 October 2008, the cumulative diurnal median altitude ranged from 24 to 217 ft AMSL and the cumulative nocturnal median altitude ranged from 23 to 344 ft AMSL (**Table 3-27**). The majority of cumulative diurnal altitude medians were in the low altitude band. In contrast, the majority of the cumulative nocturnal altitude medians were within the middle (RSZ) band. Day-to-day quartile data can be found in **Appendix J-5: Tables J-91** through **J-94**.

Table 3-27. Fall 2008, Sea Isle City, weekly VerCat radar cumulative median altitude (Alt) quartiles (ft AMSL) by surface wind speed category during clear weather conditions, 05-26 October 2008.

Date	Time	Surface Wind Speed (mph)	25% Alt	Median Alt	75% Alt	Bird Count
05-12 Oct.	Diurnal	0-8	69	206	300	2,146
		9-16	77	217	324	896
		16+	24	35	61	12
12-19 Oct.	Diurnal	0-8	36	127	244	1,946
		9-16	24	40	166	679
		16+	20	30	56	86
20-26 Oct.	Diurnal	0-8	20	37	69	831
		9-16	21	31	62	271
		16+	17	24	29	53
05-12 Oct.	Nocturnal	0-8	161	258	392	9,661
		9-16	150	245	361	532
		16+	253	344	344	1
12-19 Oct.	Nocturnal	0-8	172	275	395	5,573
		9-16	127	269	397	2,834
		16+	-	-	-	-
20-26 Oct.	Nocturnal	0-8	24	54	255	599
		9-16	21	40	135	123
		16+	17	23	31	164

Weekly diurnal cumulative flux values were greater within the low altitude band than within the middle altitude band (**Table 3-28**). Weekly nocturnal flux values were similar in the low altitude and middle altitude bands. In the low altitude band, the majority of the weekly cumulative diurnal flux values were greater than the weekly cumulative nocturnal flux values. Weekly cumulative nocturnal flux values were greater than weekly cumulative diurnal flux values in the middle (RSZ) altitude band.

Table 3-28. Fall 2008, Sea Isle City, weekly VerCat flux (abt/km^3/hr) by altitude band and surface wind speed category during clear weather conditions.

Date	Time	VerCat Flux (abt/km^3/hr)/Altitude Band (ft AMSL)								
		Low (1-99)			Middle (100-700)			High (701+)		
		Surface Wind Speed (mph)								
		0-8	9-16	16+	0-8	9-16	16+	0-8	9-16	16+
05-12 Oct.	Diurnal	190.7	114.6	96.1	71.3	44.6	3.3	0.0	0.0	0.0
12-19 Oct.	Diurnal	227.4	410.5	578.9	46.5	33.1	19.2	0.0	0.0	0.0
20-26 Oct.	Diurnal	476.7	135.1	13.5	21.9	4.4	0.4	0.0	0.0	0.1
05-12 Oct.	Nocturnal	254.8	112.0	0.0	246.3	91.7	4.4	0.1	0.0	0.0
12-19 Oct.	Nocturnal	177.7	76.6	-	177.7	161.1	-	0.1	0.0	-
20-26 Oct.	Nocturnal	222.2	76.6	17.0	22.7	5.0	0.5	0.0	0.0	0.0

From 15 November through 15 December 2008, the cumulative median altitude ranged from 54 to 256 ft AMSL and the cumulative nocturnal median altitude ranged from 30 to 287 ft AMSL (**Table 3-29**). The majority of the cumulative diurnal median altitudes were within the low altitude band while the cumulative nocturnal median altitudes were nearly split equally between the low altitude band and the middle (RSZ) altitude band.

Table 3-29. Fall 2008, Sea Isle City, weekly VerCat radar cumulative median altitude (Alt) quartiles (ft AMSL) by surface wind speed category during clear weather conditions for weeks 47 through 50.

Date	Time	Surface Wind Speed (mph)	25% Alt	Median Alt	75% Alt	Bird Count
15-23 Nov.	Diurnal	0-8	34	68	206	478
		9-16	40	89	235	243
		16+	37	54	206	5
23-30 Nov.	Diurnal	0-8	37	83	191	247
		9-16	33	93	284	24
		16+	-	-	-	-
30 Nov.-07 Dec.	Diurnal	0-8	52	133	275	234
		9-16	19	80	418	26
		16+	-	-	-	-
07-15 Dec.	Diurnal	0-8	62	136	287	168
		9-16	28	57	199	118
		16+	21	256	4,290	2
15-23 Nov.	Nocturnal	0-8	113	221	369	3,186
		9-16	123	212	484	287
		16+	140	254	472	17
23-30 Nov.	Nocturnal	0-8	149	258	370	1,381
		9-16	22	54	114	10
		16+	-	-	-	-
30 Nov.-07 Dec.	Nocturnal	0-8	184	287	388	1,625
		9-16	24	37	66	26
		16+	44	98	98	1
07-15 Dec.	Nocturnal	0-8	89	182	324	545
		9-16	26	30	90	26
		16+	-	-	-	-

Weekly diurnal cumulative flux values were greater within the low altitude band than within the middle (RSZ) altitude band (**Table 3-30**). The majority of weekly nocturnal flux values were greater in the low altitude band than in the middle altitude (RSZ) band. In the low altitude band, the majority of the weekly cumulative diurnal flux values were greater than the weekly cumulative nocturnal flux values. In the middle (RSZ) altitude band, cumulative nocturnal flux values were greater than cumulative diurnal flux values

Table 3-30. Fall 2008, Sea Isle City, weekly VerCat flux (abt/km^3/hr) by altitude band and surface wind speed category during clear weather conditions.

Date	Time	VerCat Flux (abt/km^3/hr)/Altitude Band (ft AMSL)								
		Low (1-99)			Middle (100-700)			High (701+)		
		Surface Wind Speed (mph)								
		0-8	9-16	16+	0-8	9-16	16+	0-8	9-16	16+
15-23 Nov	Diurnal	150.1	107.5	119.3	14.6	12.8	8.7	0.0	0.0	0.1
23-30 Nov.	Diurnal	51.9	18.8	-	6.7	1.6	-	0.0	0.0	-
30 Nov.-07 Dec.	Diurnal	30.1	14.7	0.0	6.1	1.6	0.0	0.0	0.0	0.0
07-15 Dec.	Diurnal	67.4	37.6	-	15.2	3.4	-	0.0	0.0	-
15-23 Nov.	Nocturnal	191.0	88.0	61.9	108.4	51.0	55.2	0.1	0.2	0.1
23-30 Nov.	Nocturnal	48.8	10.0	-	39.1	0.8	-	0.0	0.0	-
30 Nov.-07 Dec.	Nocturnal	33.1	19.8	26.5	52.2	0.2	0.0	0.0	0.0	0.0
07-15 Dec.	Nocturnal	53.9	22.2	1.0	19.8	1.0	0.0	0.0	0.0	0.0

3.2.3 Migration Traffic Rate

3.2.3.1 Island Beach State Park

The cumulative diurnal AMTR ranged from 0.5 to 8.5 abt/kph and the cumulative nocturnal AMTR ranged from 0.2 to 19.1 abt/kph. (**Table 3-31**). During all three survey weeks the nocturnal AMTR was greater than the diurnal AMTR. The peak cumulative AMTR occurred during the week of 13-21 September 2009.

Table 3-31. Fall 2008, Island Beach State Park, weekly VerCat radar cumulative AMTR (abt/kph) by surface wind speed category during clear weather conditions.

Date	Time	Cumulative AMTR/Surface Wind Speed (mph)		
		0-8	9-16	16+
13-21 September	Diurnal	8.5	5.3	-
21-28 September	Diurnal	2.0	1.9	0.5
28 Sept.-05 Oct.	Diurnal	8.5	3.1	-
13-21 September	Nocturnal	19.1	13.9	16.1
21-28 September	Nocturnal	5.5	3.1	0.2
28 Sept.-05 Oct.	Nocturnal	14.2	5.9	-

3.2.3.2 Brigantine Beach

The cumulative diurnal AMTR ranged from 0.8 to 3.1 abt/kph; the nocturnal AMTR varied from 0.3 to 26.4 abt/kph (**Table 3-32**). The majority of the weekly cumulative nocturnal AMTR values were greater than diurnal values. Peak cumulative AMTR occurred from 26 October to 02 November 2008.

Table 3-32. Fall 2008, Brigantine Beach, weekly VerCat radar cumulative AMTR (abt/kph) by surface wind speed category during clear weather conditions.

Week	Date	Time	Cumulative AMTR/Surface Wind Speed (mph)		
			0-8	9-16	16+
44	26 Oct.-02 Nov.	Diurnal	2.6	2.7	3.1
45	02 Nov.-09 Nov	Diurnal	1.2	1.6	2.5
46	09 Nov.–15 Nov.	Diurnal	1.9	2.3	0.8
44	26 Oct.-02 Nov.	Nocturnal	26.4	2.7	1.0
45	02 Nov.-09 Nov	Nocturnal	0.3	1.5	3.1
46	09 Nov.–15 Nov.	Nocturnal	3.8	5.6	1.4

3.2.3.3 Sea Isle City

From 05 to 26 October 2008, the cumulative diurnal AMTR ranged from 1.6 to 10 abt/kph and the cumulative nocturnal AMTR ranged from 0.4 to 25.0 abt/kph (**Table 3-33**). The majority of the cumulative nocturnal AMTR values were greater than the cumulative diurnal AMTR values. Peak AMTR was recorded from 05 to 12 October 2008.

For the period from 15 November through 16 December 2008, the cumulative diurnal and nocturnal AMTR values ranged from 0.3 to 3.6 abt/kph and from 0.2 to 11.9 abt/kph, respectively (**Table 3-33**). Most of the cumulative nocturnal AMTR values were greater than the cumulative diurnal AMTR values.

Table 3-33. Fall 2008, Sea Isle City, weekly VerCat radar cumulative AMTR by surface wind speed category during clear weather conditions.

Week	Date	Time	Cumulative AMTR/Surface Wind Speed (mph)		
			0-8	9-16	16+
41	05-12 October	Diurnal	8.8	5.5	1.6
42	12-19 October	Diurnal	6.9	8.7	10.0
43	20-26 October	Diurnal	8.8	2.4	2.5
47	15-23 November	Diurnal	3.6	2.7	2.9
48	23-30 November	Diurnal	1.3	0.5	-
49	30 Nov.–07 Dec.	Diurnal	1.0	0.4	-
50	07-15 December	Diurnal	2.3	0.9	0.3
41	05-12 October	Nocturnal	25.0	9.5	0.4
42	12-19 October	Nocturnal	18.2	18.5	-
43	20-26 October	Nocturnal	5.3	2.0	3.1
47	15-23 November	Nocturnal	11.9	6.2	6.0
48	23-30 November	Nocturnal	4.1	0.2	-
49	30 Nov.–07 Dec.	Nocturnal	5.1	0.3	0.4
50	07-15 December	Nocturnal	2.5	0.4	-

3.2.4 TracScan Flux and Flux Directions

3.2.4.1 Island Beach State Park

The cumulative TracScan flux values ranged from 1.0 to 6.2 abt/km^3/hr during the daytime and from 1.2 to 8.6 abt/kph at night (**Table 3-34**). Weekly cumulative flux values at night were greater than weekly cumulative flux values during the night for all sample weeks.

Table 3-34. Fall 2008, Island Beach State Park, weekly TracScan flux by surface wind speed category during clear weather conditions.

Date	Time	Total Flux (abt/km^3/hr)/Surface Wind Speed (mph)		
		0-8	9-16	16+
13-21 September	Diurnal	4.6	2.6	-
21-28 September	Diurnal	3.6	1.9	1.0
28 Sept.-05 Oct.	Diurnal	6.2	3.9	-
13-21 September	Nocturnal	8.6	4.5	-
21-28 September	Nocturnal	7.9	5.2	1.2
28 Sept.-05 Oct.	Nocturnal	7.1	4.6	-

The overall slightly greater diurnal flux moved from the north and northeast to the south and southwest and slightly greater nocturnal flux mover from the south and southwest to the north and northeast (**Table 3-35**). The nocturnal movement to the north may have been gulls leaving a nighttime roost before daylight or returning to a roost site after dark. Winds were not favorable (primarily from the south to the north) for southbound migrants (primarily from the south to the north) from 13-28 September 2008 (**Table 3-36**). Winds were favorable (from the north to the south) 36 to 41% of the time from 29 September through 05 October 2008. A slight diurnal and nocturnal directional flux to the south was evident during the week.

Table 3-35. Fall 2008, Island Beach State Park, weekly TracScan cumulative directional flux (abt/km^3/hr) by surface wind speed (mph) categories during clear weather conditions.

Date	Time	Surface Wind Speed	N	NE	E	SE	S	SW	W	NW
13-21 September	Diurnal	0-8	0.4	0.3	0.4	0.6	1.1	1.0	0.5	0.3
		9-16	0.1	0.0	0.1	0.2	0.7	0.9	0.4	0.2
		16+	-	-	-	-	-	-	-	-
	Nocturnal	0-8	1.6	2.1	0.7	0.6	1.4	1.2	0.5	0.5
		9-16	0.1	0.0	0.0	0.1	1.1	2.2	0.6	0.2
		16+	-	-	-	-	-	--	-	-
21-28 September	Diurnal	0-8	0.5	0.3	0.3	0.3	0.7	0.7	0.5	0.4
		9-16	0.1	0.0	0.0	0.1	0.5	0.6	0.3	0.1
		16+	0.0	0.0	0.0	0.0	0.3	0.4	0.2	0.1
	Nocturnal	0-8	2.1	2.9	0.7	0.3	0.6	0.5	0.3	0.5
		9-16	0.2	0.1	0.0	0.2	1.3	2.5	0.8	0.3
		16+	0.0	0.0	0.0	0.0	0.2	0.6	0.2	0.1

Table 3-35 (*continued*). Fall 2008, Island Beach State Park, weekly TracScan cumulative directional flux (abt/km^3/hr) by surface wind speed (mph) categories during clear weather conditions.

Date	Time	Surface Wind Speed	N	NE	E	SE	S	SW	W	NW
28 Sept.-05 October	Diurnal	0-8	0.8	0.7	0.5	0.6	1.3	1.0	0.6	0.6
		9-16	0.9	0.8	0.4	0.5	0.6	0.3	0.2	0.3
		16+	-	-	-	-	-	-	-	-
	Nocturnal	0-8	1.3	1.5	0.5	0.7	1.6	0.9	0.3	0.4
		9-16	1.6	1.7	0.3	0.2	0.3	0.1	0.1	0.4
		16+	-	-	-	-	-	-	-	-

Table 3-36. Fall 2008, Island Beach State Park, weekly cumulative surface wind direction percentage (hours) [1] during clear weather conditions (Appendix J-5: Table J-95 for wind speed data).

Date	Time	NW, N, NE	SE, S, SW	E	W
15-21 September	Diurnal	6	77	5	12
	Nocturnal	4	76	5	16
21-28 September	Diurnal	8	80	0	13
	Nocturnal	17	49	0	35
28 Sept.-05 Oct.	Diurnal	41	36	21	3
	Nocturnal	36	38	25	0

[1] rounded to nearest percent

3.2.4.2 Brigantine Beach

TracScan diurnal and nocturnal cumulative flux values ranged from 1.8 to 18.2 abt/km^3/hr and from 4.2 to 9.4 abt/km^3/hr, respectively (**Table 3-37**). Cumulative diurnal flux values were greater than cumulative nocturnal flux values.

Table 3-37. Fall 2008, Brigantine Beach, weekly TracScan flux by surface wind speed category during clear weather conditions.

Date	Time	Total Flux (abt/km^3/hr)/Surface Wind Speed (mph)		
		0-8	9-16	16+
02-09 November	Diurnal	17.3	9.5	9.9
09-15 November	Diurnal	12.9	7.4	1.8
15-23 November	Diurnal	18.2	13.4	-
02-09 November	Nocturnal	7.5	4.2	7.9
09-15 November	Nocturnal	9.3	6.6	5.3
15-23 November	Nocturnal	9.4	8.3	-

The dominant diurnal and nocturnal movements (flux), with the exception of the nocturnal period from 09-15 November 2008, were from the north and northeast to the south and southwest (**Table 3-38**). During the week of 02-09 November, a dominant movement to the southwest occurred even though winds were favorable for migration (north to south) only 17% of the time (**Table 3-39**). Diurnal movements to the southwest during the week of 09-15 November and both diurnal and nocturnal movements from 15-23 November 2008 were to the southwest although winds were only favorable (north to south) 23-37% of the time (**Table 3-38**).

Table 3-38. Fall 2008, Brigantine Beach, weekly TracScan cumulative directional flux (abt/km^3/hr) by surface wind speed (mph) categories during clear weather conditions.

Date	Time	Surface Wind Speed	N	NE	E	SE	S	SW	W	NW
02-09 November	Diurnal	0-8	1.7	1.8	1.3	1.3	2.8	4.1	2.7	1.7
		9-16	0.6	0.6	0.6	0.7	2.0	3.0	1.1	0.7
		16+	0.6	0.5	0.6	0.7	2.3	3.2	1.3	0.7
	Nocturnal	0-8	0.7	0.9	0.4	0.5	1.5	2.1	0.9	0.6
		9-16	0.2	0.3	0.2	0.3	1.3	1.3	0.4	0.1
		16+	0.3	0.5	0.4	0.7	2.6	2.8	0.5	0.1
09-15 November	Diurnal	0-8	1.3	1.6	1.3	1.2	2.1	2.7	1.5	1.7
		9-16	1.2	1.5	0.8	0.5	0.8	1.1	0.8	0.9
		16+	0.0	0.0	0.2	0.3	0.3	0.4	0.4	0.1
	Nocturnal	0-8	1.5	1.5	0.8	0.5	0.9	1.2	1.3	1.5
		9-16	0.3	0.3	0.3	0.3	1.6	2.7	0.7	0.3
		16+	0.2	0.2	0.3	0.4	1.5	2.3	0.5	0.2
15-23 November	Diurnal	0-8	1.4	1.6	1.3	1.2	3.4	5.6	2.5	1.2
		9-16	1.2	1.2	0.8	0.8	2.3	3.4	2.1	1.5
		16+	-	-	-	-	-	-	-	-
	Nocturnal	0-8	0.4	0.6	0.4	0.4	1.8	3.9	1.3	0.5
		9-16	0.3	0.3	0.2	0.4	2.4	3.5	0.9	0.3
		16+	-	-	-	--	-	-	-	-

Table 3-39. Fall 2008, Brigantine Beach, weekly cumulative surface wind direction percentage (hours)[1] during clear weather conditions (Appendix J-5: Table J-95 for wind speed data).

Date	Time	NW, N, NE	SE, S, SW	E	W
02-09 November	Diurnal	13	58	29	0
	Nocturnal	17	47	33	3
09-15 November	Diurnal	23	48	16	14
	Nocturnal	34	28	12	26
15-23 November	Diurnal	36	52	11	2
	Nocturnal	37	51	2	0

[1] rounded to nearest percent

3.2.4.3 Sea Isle City

The TracScan diurnal and nocturnal cumulative flux values ranged from 2.3 to 10.1 abt/km^3/hr and from 0.6 to 6.8 abt/km^3/hr, respectively (**Table 3-40**). All of the weekly TracScan diurnal cumulative flux values were greater than the weekly nocturnal cumulative flux values.

Table 3-40. Fall 2008, Sea Isle City, TracScan flux by surface wind speed category during clear weather conditions, weeks 41 to 43.

Date	Time	Total Flux (abt/km^3/hr)/Surface Wind Speed (mph)		
		0-8	9-16	16+
05-12 October	Diurnal	7.4	4.4	2.4
12-19 October	Diurnal	6.0	4.5	2.8
20-26 October	Diurnal	10.1	5.4	2.3
05-12 October	Nocturnal	4.4	4.2	1.9
12-19 October	Nocturnal	4.4	1.9	-
20-26 October	Nocturnal	6.8	2.7	0.6

The dominant diurnal and nocturnal movements (flux) from 05-12 October 2008 were to the south and southwest (**Table 3-41**). During the week of 12-19 October 2008, the dominant direction was to the southwest. No dominant nocturnal direction was present from 12 to 26 October 2008. The surface wind direction (from the south to the north) was unfavorable for southbound migration during all weeks (**Table 3-42**).

Table 3-41. Fall 2008, Sea Isle City, weekly TracScan cumulative directional flux (abt/km^3/hr) by surface wind speed (mph) categories during clear weather conditions.

Date	Time	Surface Wind Speed	N	NE	E	SE	S	SW	W	NW
05-12 October	Diurnal	0-8	0.7	0.8	0.5	0.5	1.1	2.0	1.1	0.6
		9-16	0.4	0.4	0.2	0.2	0.7	1.3	0.7	0.4
		16+	0.5	0.7	0.3	0.1	0.1	0.1	0.2	0.4
	Nocturnal	0-8	0.4	0.6	0.3	0.2	0.6	1.3	0.7	0.3
		9-16	0.5	0.7	0.2	0.1	0.6	1.4	0.4	0.2
		16+	0.5	0.6	0.2	0.1	0.1	0.1	0.2	0.3
12-19 October	Diurnal	0-8	0.7	0.8	0.5	0.4	0.9	1.5	0.8	0.5
		9-16	0.3	0.3	0.2	0.3	0.8	1.7	0.6	0.3
		16+	0.0	0.0	0.1	0.2	0.7	1.5	0.3	0.0
	Nocturnal	0-8	0.8	1.2	0.3	0.2	0.4	0.7	0.4	0.3
		9-16	0.1	0.1	0.0	0.1	0.3	0.7	0.3	0.2
		16+	-	-	`	-	-	-	-	-
20-26 October	Diurnal	0-8	1.0	1.2	1.7	1.6	1.3	1.7	1.0	0.6
		9-16	0.5	0.6	0.5	0.4	0.9	1.4	0.6	0.4
		16+	0.3	0.3	0.1	0.1	0.4	0.6	0.3	0.2
	Nocturnal	0-8	0.8	1.3	0.7	0.5	1.0	1.6	0.5	0.4
		9-16	0.2	0.3	0.2	0.2	0.6	0.9	0.3	0.1
		16+	0.2	0.1	0.0	0.0	0.1	0.1	0.1	0.0

Table 3-42. Fall 2008, Sea Isle City, weekly cumulative surface wind direction percentage (hours)[1] during clear weather conditions, weeks 41 to 43 (see Appendix J-5: Table J-95 for wind speed data).

Week	Date	Time	NW, N, NE	SE, S, SW	E	W
41	05-12 October	Diurnal	33	58	2	6
		Nocturnal	23	53	10	5
42	12-19 October	Diurnal	30	52	15	4
		Nocturnal	39	46	12	3
43	20-26 October	Diurnal	25	57	17	0
		Nocturnal	29	51	16	5

[1] rounded to nearest percent

The TracScan diurnal and nocturnal cumulative flux values ranged from 1.0 to 12.2 abt/km^3/hr and from 0.8 to 11.7 abt/km^3/hr, respectively, from 15 November through 15 December 2008 (**Table 3-43**). Most of the weekly TracScan diurnal cumulative flux values were slightly greater than the weekly nocturnal cumulative flux values.

Table 3-43. Fall 2008, Sea Isle City, Weekly TracScan flux by surface wind speed category during clear weather conditions, weeks 47-50.

Date	Time	Total Flux (abt/km^3/hr)/Surface Wind Speed (mph)		
		0-8	9-16	16+
15-23 November	Diurnal	10.4	8.4	8.0
23-30 November	Diurnal	12.2	4.8	-
30 Nov.–07 Dec.	Diurnal	7.5	2.0	1.9
07-15 December	Diurnal	8.5	2.3	1.0
15-23 November	Nocturnal	11.7	9.7	7.3
23-30 November	Nocturnal	8.2	2.2	-
30 Nov.–07 Dec.	Nocturnal	6.5	1.6	0.8
07-15 December	Nocturnal	8.3	1.9	-

The dominant diurnal and nocturnal directional flux values for the period from 15 November to 16 December 2008 were from the north and northeast to the south and southwest (**Table 3-44**). The surface wind direction was favorable for southbound migrants (i.e., from the north to the south) at least 30% of the time from 15 to 23 November and greater than 50% of the time from 23 November to 15 December (**Table 3-45**).

Table 3-44. Fall 2008, Sea Isle City, Weekly TracScan cumulative directional flux (abt/km^3/hr) by surface wind speed (mph) categories during clear weather conditions.

Date	Time	Surface Wind Speed	N	NE	E	SE	S	SW	W	NW
15-23 November	Diurnal	0-8	0.9	0.8	0.6	0.8	2.2	2.7	1.5	0.9
		9-16	0.7	0.6	0.4	0.5	2.0	2.6	1.0	0.6
		16+	0.5	0.4	0.4	0.5	2.1	2.9	0.8	0.5
	Nocturnal	0-8	0.6	0.5	0.3	0.5	3.7	4.9	0.9	0.3
		9-16	0.3	0.2	0.1	0.4	3.1	4.5	0.8	0.2
		16+	0.0	0.1	0.1	0.2	2.3	3.9	0.7	0.1
23-30 November	Diurnal	0-8	1.4	1.3	0.9	1.0	2.2	2.7	1.5	1.1
		9-16	0.8	0.8	0.4	0.5	0.7	0.6	0.5	0.5
		16+	-	-	-	-	-	-	-	-
	Nocturnal	0-8	0.7	0.6	0.3	0.5	2.1	2.8	0.8	0.4
		9-16	0.4	0.4	0.1	0.1	0.3	0.4	0.2	0.2
		16+	-	-	-	-	-	-	-	-
30 Nov. – 07 Dec.	Diurnal	0-8	0.8	0.7	0.5	0.6	1.7	1.9	0.8	0.5
		9-16	0.5	0.6	0.2	0.1	0.2	0.1	0.1	0.2
		16+	0.3	0.5	0.4	0.2	0.2	0.2	0.1	0.1
	Nocturnal	0-8	0.4	0.3	0.2	0.3	1.9	2.5	0.6	0.3
		9-16	0.4	0.4	0.2	0.1	0.1	0.1	0.1	0.1
		16+	0.1	0.2	0.1	0.1	0.1	0.1	0.0	0.1
07-15 December	Diurnal	0-8	1.1	1.2	0.7	0.6	1.7	1.9	0.7	0.5
		9-16	0.7	0.7	0.4	0.3	0.4	0.4	0.2	0.3
		16+	0.3	0.3	0.1	0.1	0.1	0.0	0.0	0.1
	Nocturnal	0-8	0.6	0.6	0.3	0.3	2.5	3.0	0.7	0.3
		9-16	0.3	0.4	0.2	0.1	0.3	0.3	0.1	0.1
		16+	-	-	-	-	-	-	-	-

Table 3-45. Fall 2008, Sea Isle City, weekly cumulative surface wind direction percentage (hours)[1] during clear weather conditions (see Appendix Table J-95 for wind speed data).

Date	Time	NW, N, NE	SE, S, SW	E	W
15-23 November	Diurnal	36	30	33	0
	Nocturnal	30	27	43	0
23-30 November	Diurnal	79	0	16	4
	Nocturnal	78	6	15	0
30 Nov. – 07 Dec.	Diurnal	68	10	18	4
	Nocturnal	55	15	30	0
07-15 December	Diurnal	61	9	30	0
	Nocturnal	50	6	45	0

[1] rounded to nearest percent

3.2.5 Discussion

The results of the fall/early winter 2008 onshore radar surveys were:

- Most of the cumulative median diurnal altitude quartiles were within the middle (RSZ) altitude band at ISBP in early fall 2008. In contrast, the majority of the cumulative median altitude quartiles were within the low altitude band at Brigantine, SIC, and at IBSP from mid-fall into early winter 2008. Most of the cumulative nocturnal altitude quartiles were within the middle (RSZ) altitude band.
- The majority of the cumulative diurnal flux values were greater within the low altitude band than within the middle (RSZ altitude band. Cumulative nocturnal flux varied at several sites. For most of the survey dates, the cumulative nocturnal flux values at the onshore sites were generally similar between the low and middle (RSZ) altitude bands.
- Cumulative diurnal AMTR values were 10 abt/kph or less and cumulative nocturnal AMTRs were less than 30 abt/kph at all of the onshore sites.
- Peak cumulative AMTR occurred at night at each onshore site (IBSP: 19.1 abt/kph. from 13-21 September; BB: 26.4 abt/kph from 26 October to 02 November; Sea Isle City: 25.0 abt/kph from 05 to 12 October)
- Most weekly nocturnal AMTRs were greater than diurnal AMTRs.
- Overall, as expected during fall migration, the dominant direction of movement during most weeks was from the north and northeast to the south and southwest.

3.3 SPRING 2009

3.3.1 Survey Effort

Onshore radar surveys started on 14 March 2009 and concluded on 02 June 2009. The survey effort by weather condition for each sampling site is presented in **Tables 3-46** and **3-47**. Daily survey effort is listed in **Appendix J-5: Appendix Tables J-96** and **J-97.**

Table 3-46. Summary of spring 2009 VerCat onshore survey effort by sample location.

Sample Location	Date	Diurnal[1]			Nocturnal[2]			Total Hrs
		Hrs Clear	Hrs Rain[3]	Total Hrs	Hrs Clear	Hrs Rain[3]	Total Hrs	
IBSP	14 March – 05 April	212.0	123.0	335.0	189.4	86.7	276.1	611.1
BB	05 April – 05 May	276.1	112.2	388.3	206.6	52.0	258.6	646.9
SIC	07 May – 02 June	333.8	80.3	414.1	181.3	48.7	230.0	644.1

[1] Diurnal occurs from Civil Sunrise to Civil Sunset
[2] Nocturnal occurs from Civil Sunset to Civil Sunrise
[3] Rain includes mist and drizzle
Hrs = Hours
BB = Brigantine Beach
Hrs = Hours
IBSP = Island Beach State Park
SIC = Sea Isle City

Table 3-47. Summary of spring 2009 TracScan onshore survey effort by sample location.

Sample Location	Date	Diurnal[1]			Nocturnal[2]			Total Hrs
		Hrs Clear	Hrs Rain[3]	Total Hrs	Hrs Clear	Hrs Rain[3]	Total Hrs	
IBSP	14 March – 05 April	213.3	117.7	331.0	184.9	80.5	265.4	596.4
BB	05 April – 05 May	265.1	112.3	377.4	208.1	52.1	260.2	637.6
SIC	07 May – 02 June	330.9	80.2	411.1	178.4	48.7	227.1	638.2

[1] Diurnal occurs from Civil Sunrise to Civil Sunset
[2] Nocturnal occurs from Civil Sunset to Civil Sunrise
[3] Rain includes mist and drizzle
BB = Brigantine Beach
Hrs = Hours
IBSP = Island Beach State Park
SIC = Sea Isle City

3.3.2 Altitudinal Distribution

3.3.2.1 Island Beach State Park

Cumulative weekly diurnal median altitudes ranged from 29 to 77 ft AMSL; cumulative weekly nocturnal median altitudes ranged from 68 to 325 ft AMSL (**Table 3-48**). Cumulative diurnal median altitudes were all within the low altitude band. In contrast, most of the cumulative nocturnal median altitudes were within the middle (RSZ) altitude band. Day-to-day quartile data can be found in **Appendix J-5: Table J-98** through **J-100**.

Table 3-48. Spring 2009, Island Beach State Park, weekly VerCat radar cumulative median altitude (Alt) quartiles (ft AMSL) by surface wind speed category during clear weather conditions.

Date	Time	Surface Wind Speed (mph)	25% Alt	Median Alt	75% Alt	Bird Count
14-19 March	Diurnal	0-8	28	40	58	195
		9-16	29	42	61	89
		16+	27	39	86	23
22-29 March	Diurnal	0-8	28	40	83	798
		9-16	28	42	79	306
		16+	-	-	-	-
29 March-05 April	Diurnal	0-8	26	38	118	958
		9-16	28	49	132	998
		16+	21	29	47	161
05-09 April	Diurnal	0-8	32	77	183	588
		9-16	24	34	61	356
		16+	-	-	-	-
14-19 March	Nocturnal	0-8	134	233	354	136
		9-16	204	325	473	180
		16+	-	-	-	-

Table 3-48 (*continued*). Spring 2009, Island Beach State Park, weekly VerCat radar cumulative median altitude (Alt) quartiles (ft AMSL) by surface wind speed category during clear weather conditions.

Date	Time	Surface Wind Speed (mph)	25% Alt	Median Alt	75% Alt	Bird Count
22-29 March	Nocturnal	0-8	88	184	381	622
		9-16	45	68	115	101
		16+	-	-	-	-
29 March-05 April	Nocturnal	0-8	63	108	214	1,636
		9-16	42	78	128	1,149
		16+	60	92	133	32
05-09 April	Nocturnal	0-8	116	247	500	1,302
		9-16	114	294	369	305
		16+	-	-	-	-

The cumulative weekly diurnal flux values and the majority of the weekly cumulative nocturnal flux values were greater within the low altitude band than within the middle altitude band (**Table 3-49**). In the low altitude band, cumulative diurnal flux values were greater than cumulative nocturnal flux values from 14 through 29 March 2009 and from 05 through 09 April 2009. Cumulative nocturnal flux values were greater than cumulative diurnal flux values within the low altitude band from 29 March through 05 April 2009. Within the middle altitude band, the majority of the cumulative weekly nocturnal flux values were greater than the cumulative weekly diurnal flux values.

Table 3-49. Spring 2009, Island Beach State Park, weekly VerCat flux (abt/km^3/hr) by altitude band and surface wind speed category during clear weather conditions.

Date	Time	VerCat Flux (abt/km^3/hr)/Altitude Band (ft AMSL)								
		Low (1-99)			Middle (100-700)			High (701+)		
		Surface Wind Speed (mph)								
		0-8	9-16	16+	0-8	9-16	16+	0-8	9-16	16+
14-19 March	Diurnal	81.2	56.9	57.2	1.9	0.6	2.2	0.0	0.0	0.0
22-29 March	Diurnal	202.7	215.9	-	9.2	8.0	-	0.0	0.0	0.0
29 March-05 April	Diurnal	219.8	277.9	225.8	13.6	21.7	3.9	0.1	0.0	0.0
04-09 April	Diurnal	324.3	220.1	-	38.4	6.6	-	0.0	0.0	0.0
14-19 March	Nocturnal	9.0	10.3	-	5.9	17.7	-	0.0	0.0	0.0
22-29 March	Nocturnal	67.8	99.8	-	23.8	7.1	-	0.0	0.0	0.0
29 March-05 April	Nocturnal	311.9	407.7	755.8	56.4	42.0	95.9	0.1	0.0	0.0
04-09 April	Nocturnal	163.1	65.5		79.0	41.5	-	0.2	0.0	0.0

3.3.2.2 Brigantine Beach

Cumulative weekly diurnal median altitude quartiles ranged from 40 to 270 ft AMSL and cumulative weekly nocturnal median altitude quartiles ranged from 44 to 1,443 ft AMSL (**Table 3-50**). The overall trend throughout the sampling period was for an increase in both diurnal and nocturnal median altitude quartiles. During the daytime, the number of cumulative weekly median quartiles was nearly split equally between the low altitude band and the middle altitude band. During the nighttime, the majority of

cumulative weekly nocturnal altitude quartiles were above the RSZ in the high altitude band. Day-to-day quartile data can be found in **Appendix J-5: Table J-101** through **J-103**.

Table 3-50. Spring 2009, Brigantine Beach, weekly VerCat radar cumulative median altitude (Alt) quartiles (ft AMSL) by surface wind speed category during clear weather conditions.

Date	Time	Surface Wind Speed (mph)	25% Alt	Median Alt	75% Alt	Bird Count
09-12 April	Diurnal	0-8	53	87	397	187
		9-16	46	74	443	62
		16+	57	119	343	119
12-19 April	Diurnal	0-8	26	40	105	1,509
		9-16	33	83	726	1,652
		16+	32	51	259	155
19-26 April	Diurnal	0-8	51	210	777	1,186
		9-16	71	270	688	675
		16+	42	80	359	236
26 April-03 May	Diurnal	0-8	40	69	165	664
		9-16	65	206	804	873
		16+	48	188	1,805	9
03-05 May	Diurnal	0-8	51	81	633	282
		9-16	64	103	1,910	66
		16+	-	-	-	-
09-12 April	Nocturnal	0-8	546	902	1,294	1,350
		9-16	553	849	1,133	869
		16+	129	484	1,030	136
12-19 April	Nocturnal	0-8	245	793	1,303	3,189
		9-16	30	46	71	1,472
		16+	30	44	60	272
19-26 April	Nocturnal	0-8	425	927	1,381	4,425
		9-16	270	898	1,352	225
		16+	35	97	845	25
26 April-03 May	Nocturnal	0-8	740	1,089	1,431	5,059
		9-16	662	1,060	1,411	3,050
		16+	840	1,418	1,728	212
03-05 May	Nocturnal	0-8	1,231	1,443	1,758	102
		9-16	1,141	1,399	1,837	198
		16+	-	-	-	-

Cumulative weekly diurnal flux values were greater within the low altitude band than within the middle altitude band (**Table 3-51**). Cumulative weekly nocturnal flux values were similar within the low and middle altitude bands from 09 through 12 April 2009 and from 26 April through 05 May 2009. From 12 through 26 April 2009 the cumulative weekly flux values were greater within the low altitude band than within the middle altitude band. With the exception of the week of 19 through 26 April 2009, the weekly cumulative diurnal flux values were greater than the cumulative weekly nocturnal flux values within the low altitude band. In the middle altitude band, the majority of the cumulative diurnal flux values were greater than the cumulative nocturnal flux values.

Table 3-51. Spring 2009, Brigantine Beach, weekly VerCat flux (abt/km^3/hr) by altitude band and surface wind speed category during clear weather conditions.

Date	Time	VerCat Flux (abt/km^3/hr)/Altitude Band (ft AMSL)								
		Low (1-99)			Middle (100-700)			High (701+)		
		Surface Wind Speed (mph)								
		0-8	9-16	16+	0-8	9-16	16+	0-8	9-16	16+
09-12 April	Diurnal	106.7	107.9	68.5	11.2	9.3	10.4	0.1	0.1	0.1
12-19 April	Diurnal	505.1	312.7	291.7	22.7	25.8	13.1	0.2	0.4	0.2
19-26 April	Diurnal	145.7	131.5	129.6	23.2	31.2	11.7	0.2	0.3	0.1
26 April–03 May	Diurnal	222.8	104.3	52.2	16.3	19.0	2.9	0.1	0.2	0.1
03-05 May	Diurnal	276.1	117.3	0.0	18.7	5.8	0.0	0.3	0.2	0.0
09-12 April	Nocturnal	75.4	121.3	39.6	76.1	135.8	12.4	2.2	3.8	0.2
12-19 April	Nocturnal	255.7	881.1	651.8	80.1	23.5	8.8	2.1	0.2	0.0
19-26 April	Nocturnal	117.2	50.8	55.7	77.8	29.2	4.6	2.3	0.7	0.1
26 April–03 May	Nocturnal	73.0	73.0	162.4	75.3	84.4	62.7	3.9	3.5	3.9
03-05 May	Nocturnal	13.4	13.0	0.0	5.5	4.2	0.0	1.5	0.8	0.0

3.3.2.3 Sea Isle City

Cumulative weekly diurnal median altitudes ranged from 40 to 179 ft AMSL while the cumulative weekly nocturnal median altitudes ranged from 158 to 312 ft AMSL (**Table 3-52**). The majority of cumulative weekly diurnal median altitudes were within the low altitude band. All of the cumulative weekly nocturnal median altitudes were within the middle (RSZ) altitude band. Day-to-day quartile data can be found in **Appendix J-5: Table J-104 through J-106**.

Table 3-52. Spring 2009, Sea Isle City, weekly VerCat radar cumulative median altitude (Alt) quartiles (ft AMSL) by surface wind speed category during clear weather conditions.

Date	Time	Surface Wind Speed (mph)	25% Alt	Median Alt	75% Alt	Bird Count
6-10 May	Diurnal	0-8	42	89	176	2,215
		9-16	49	105	194	462
		16+	-	-	-	-
10-17 May	Diurnal	0-8	30	46	94	1,569
		9-16	24	40	110	204
		16+	-	-	-	-
17-24 May	Diurnal	0-8	45	94	194	2,119
		9-16	35	70	123	140
		16+	-	-	-	-
24 May-02 June	Diurnal	0-8	64	179	313	3,562
		9-16	24	48	161	232
		16+	-	-	-	-

Table 3-52 (*continued*). Spring 2009, Sea Isle City, weekly VerCat radar cumulative median altitude (Alt) quartiles (ft AMSL) by surface wind speed category during clear weather conditions.

Date	Time	Surface Wind Speed (mph)	25% Alt	Median Alt	75% Alt	Bird Count
6-10 May	Nocturnal	0-8	136	238	377	8,487
		9-16	170	296	392	624
		16+	253	305	374	33
10-17 May	Nocturnal	0-8	129	213	317	7,235
		9-16	198	298	390	1,354
		16+	-	-	-	-
17-24 May	Nocturnal	0-8	186	286	372	6,852
		9-16	231	312	395	1,325
		16+	-	-	-	-
24 May-02 June	Nocturnal	0-8	142	248	364	10,907
		9-16	27	158	297	116
		16+	-	-	-	-

The cumulative weekly diurnal flux values were greater within the low altitude band than within the middle altitude band (**Table 3-53**). With the exception of the week of 17-24 May 2009, the cumulative weekly nocturnal flux values were greater in the low altitude band than within the middle altitude band. Within the low altitude and middle altitude bands the cumulative weekly nocturnal flux vales were greater than cumulative weekly diurnal flux values.

Table 3-53. Spring 2009, Sea Isle City, weekly VerCat flux (abt/km^3/hr) by altitude band and surface wind speed category during clear weather conditions.

Date	Time	VerCat Flux (abt/km^3/hr)/Altitude Band (ft AMSL)								
		Low (1-99)			Middle (100-700)			High (701+)		
		Surface Wind Speed (mph)								
		0-8	9-16	16+	0-8	9-16	16+	0-8	9-16	16+
06-10 May	Diurnal	368.4	261.8	-	54.2	48.3	-	0.0	0.0	-
10-17 May	Diurnal	220.8	103.1	-	11.7	5.8	-	0.0	0.0	-
17-24 May	Diurnal	200.3	103.9	-	30.5	8.9	-	0.0	0.0	-
24 May–02 June	Diurnal	173.3	118.4	-	52.7	10.7	-	0.0	0.0	-
06-10 May	Nocturnal	1,015.9	280.3	-	753.2	211.9	-	0.2	0.1	0.1
10-17 May	Nocturnal	436.1	194.1	-	297.8	256.4	-	0.1	0.1	-
17-24 May	Nocturnal	233.7	165.0	-	302.1	505.0	-	0.0	0.0	-
24 May–02 June	Nocturnal	485.5	177.6	-	361.5	39.0	-	0.0	0.0	-

3.3.3 Adjusted Migration Traffic Rate

3.3.3.1 Island Beach State Park

Cumulative weekly AMTR ranged from 0.9 to 7.7 abt/kph during the daytime and from 0.7 to 17.4 abt/kph during the nighttime (**Table 3-54**). Peak cumulative diurnal occurred from 05-09 April 2009; peak cumulative nocturnal AMTR (17.4 abt/kph) occurred from 29 March through 05 April 2009. Cumulative

weekly nocturnal AMTR was slightly greater from 29 March through 05 April 2009. Otherwise, no trend was evident between diurnal and nocturnal AMTRs.

Table 3-54. Spring 2009, Island Beach State Park, weekly VerCat radar cumulative AMTR (abt/kph) by surface wind speed category during clear weather conditions.

Date	Time	Cumulative AMTR/Surface Wind Speed (mph)		
		0-8	9-16	16+
14-19 March	Diurnal	1.4	0.9	1.0
22-29 March	Diurnal	3.8	3.8	-
29 March–05 April	Diurnal	4.2	5.5	3.7
05-09 April	Diurnal	7.7	3.8	-
14-19 March	Nocturnal	0.7	1.8	-
22-29 March	Nocturnal	3.2	2.0	-
29 March–05 April	Nocturnal	9.1	8.8	17.4
05-09 April	Nocturnal	10.1	4.7	-

3.3.3.2 Brigantine Beach

Cumulative weekly diurnal and nocturnal AMTR ranged from 1.6 to 9.6 abt/kph and from 1.5 to 28.6 abt/kph, respectively (**Table 3-55**). Peak movement during the daytime occurred between 12 and 19 April 2009 (AMTR: 9.6 abt/kph); the peak movement at night occurred from 26 April through 03 May 2009. Cumulative weekly nocturnal AMTRs were greater than cumulative weekly diurnal AMTRs.

Table 3-55. Spring 2009, Brigantine Beach, weekly VerCat radar cumulative AMTR (abt/kph) by surface wind speed category during clear weather conditions.

Date	Time	Cumulative AMTR/Surface Wind Speed (mph)		
		0-8	9-16	16+
9-12 April	Diurnal	2.6	2.5	1.9
12-19 April	Diurnal	9.6	8.5	6.0
19-26 April	Diurnal	4.8	5.3	3.1
26 April–03 May	Diurnal	4.6	3.6	1.6
03-05 May	Diurnal	6.3	3.3	-
9-12 April	Nocturnal	17.9	31.3	2.4
12-19 April	Nocturnal	20.5	15.6	9.9
19-26 April	Nocturnal	19.0	6.5	1.5
26 April–03 May	Nocturnal	27.3	25.4	28.6
03-05 May	Nocturnal	9.3	5.0	-

3.3.3.3 Sea Isle City

The cumulative weekly diurnal AMTR ranged from 2.0 to 9.1 abt/kph; the cumulative weekly nocturnal AMTR ranged from 6 to 76 abt/kph (**Table 3-56**). Peak weekly cumulative diurnal AMTR (9.1abt/kph) and peak weekly nocturnal AMTR (76.0 abt/kph) occurred from 06-10 May 2009. Weekly cumulative nocturnal AMTRs were greater than weekly cumulative weekly diurnal AMTRs.

Table 3-56. Spring 2009, Sea Isle City, weekly VerCat radar cumulative AMTR (abt/kph) by surface wind speed category during clear weather conditions.

Date	Time	Cumulative AMTR/Surface Wind Speed (mph)		
		0-8	9-16	16+
6-10 May	Diurnal	9.1	7.1	-
10-17 May	Diurnal	4.1	2.0	-
17-24 May	Diurnal	5.3	2.2	-
24 May – 02 June	Diurnal	6.9	2.6	-
6-10 May	Nocturnal	76.0	22.6	35.3
10-17 May	Nocturnal	30.1	24.8	-
17-24 May	Nocturnal	29.3	46.2	-
24 May – 02 June	Nocturnal	36.7	6.0	-

3.3.4 Flux Direction

3.3.4.1 Island Beach State Park

The TracScan diurnal and nocturnal cumulative flux values ranged from 5.0 to 24.5 abt/km^3/hr and from 5.9 to 30.8 abt/km^3/hr, respectively (**Table 3-57**). Weekly cumulative diurnal flux values were greater than the weekly nocturnal cumulative flux values from 14-29 March 2009. Weekly cumulative nocturnal flux values were greater than cumulative diurnal flux values from 29 March through 09 April 2009.

Table 3-57. Spring 2009, Island Beach State Park, weekly TracScan flux by surface wind speed category during clear weather conditions.

Date	Time	Total Flux (abt/km^3/hr)/Surface Wind Speed (mph)		
		0-8	9-16	16+
14-22 March	Diurnal	11.1	7.0	5.1
22-29 March	Diurnal	16.9	11.5	-
29 March–05 April	Diurnal	14.7	8.9	5.0
05-09 April	Diurnal	24.5	17.7	-
14-22 March	Nocturnal	5.9	6.0	-
22-29 March	Nocturnal	8.5	6.2	-
29 March–05 April	Nocturnal	16.5	18.7	30.8
05-09 April	Nocturnal	17.2	5.9	-

The overall directional flux pattern from 14-29 March 2009 was for greater cumulative diurnal flux values from the south and southwest to the north and northeast and from the north and northeast to the south and southwest (**Table 3-58**). Since the cumulative diurnal flux values were similar for birds flying north and south the possibility exists that the diurnal flux was comprised of local birds moving to foraging areas in the morning and returning during the diurnal hours to their roosting site. Cumulative nocturnal flux during this period was primarily from the south and southwest to the north, northeast, and east.

Table 3-58. Spring 2009, Island Beach State Park, weekly TracScan cumulative directional flux (abt/km^3/hr) by surface wind speed (mph) categories during clear weather conditions.

Date	Time	Surface Wind Speed	N	NE	E	SE	S	SW	W	NW
14-22 March	Diurnal	0-8	1.7	1.8	1.1	1.1	2.0	1.6	1.0	0.9
		9-16	1.3	1.7	0.6	0.4	0.9	0.8	0.6	0.6
		16+	1.5	2.5	0.4	0.1	0.1	0.1	0.1	0.3
	Nocturnal	0-8	1.9	1.9	0.5	0.3	0.4	0.2	0.2	0.5
		9-16	1.6	2.8	0.4	0.2	0.2	0.2	0.3	0.3
		16+	-	-	-	-	-	-	-	-
22-29 March	Diurnal	0-8	3.3	2.9	1.5	1.6	2.6	1.9	1.3	1.8
		9-16	2.1	2.3	0.8	1.0	2.1	1.6	0.7	0.8
		16+	-	-	-	-	-	-	-	-
	Nocturnal	0-8	2.3	2.4	1.0	0.4	0.5	0.3	0.6	0.9
		9-16	0.7	1.1	1.7	0.9	0.8	0.6	0.2	0.3
		16+	-	-	-	-	-	-	-	-
29 March-05 April	Diurnal	0-8	2.4	1.8	1.0	1.5	3.2	2.1	1.2	1.4
		9-16	1.8	2.0	0.9	1.0	1.5	0.7	0.4	0.6
		16+	0.9	1.3	0.6	0.8	0.8	0.3	0.2	0.2
	Nocturnal	0-8	5.1	5.9	1.4	0.4	0.8	0.5	0.8	1.4
		9-16	5.6	8.0	1.9	0.6	0.8	0.3	0.4	1.1
		16+	10.6	16.0	1.7	0.4	1.0	0.1	0.1	1.0
05-09 April	Diurnal	0-8	4.9	4.3	2.0	2.4	4.1	2.9	1.7	2.3
		9-16	3.8	3.4	1.3	1.9	2.7	1.7	1.3	1.7
		16+	-	-	-	-	-	-	-	-
	Nocturnal	0-8	5.8	8.4	0.9	0.3	0.5	0.2	0.2	0.8
		9-16	1.5	2.1	0.6	0.4	0.5	0.2	0.2	0.3
		16+	-	-	-	-	-	-	-	-

A slightly greater directional movement to the north and northeast was detected during the day and at night during most of the remaining survey weeks. Some of the northward movements occurred even when the surface winds were not favorable for migration (e.g., 05-09 April: **Table 3-59**). The reason for the diurnal directional movement to the south and southwest from 22 March through 09 April 2009 was not identified as winds were generally favorable for northbound migration from 22 March – 05 April 2009 (**Table 3-59**). Weekly cumulative nocturnal flux from the south and southwest to the north and northeast increased during the survey period. Nocturnal surface winds were favorable for northward movement (south to north) 21 to 66% of the time from 14 March through 05 April 2009 (**Table 3-59**). The highest cumulative weekly directional flux to the north and northeast occurred from 05 to 09 April 2009 when the surface wind directions were not favorable for migration (north to south; **Table 3-59**).

Table 3-59. Spring 2009, Island Beach State Park, weekly cumulative surface wind direction percentage (hours) [1] during clear weather conditions (Appendix J-5: see Table J-107 for wind speed data).

Date	Time	NW, N, NE	SE, S, SW	E	W
14-22 March	Diurnal	38	46	0	17
	Nocturnal	62	21	3	15
22-29 March	Diurnal	32	56	2	11
	Nocturnal	30	66	4	0
29 March-05 April	Diurnal	23	48	17	13
	Nocturnal	18	30	40	12
05-09 April	Diurnal	13	6	76	4
	Nocturnal	60	2	38	0

[1] rounded to nearest percent

3.3.4.2 Brigantine Beach

From 09 April through 03 May 2009, the cumulative diurnal and nocturnal flux values ranged from 5.0 to 15.8 abt/km^3/h and from 2.0 to 29.6 abt/km^3/h (**Table 3-60**). During most weeks cumulative diurnal and nocturnal flux values were similar. Weekly cumulative nocturnal flux values were greater than the weekly cumulative diurnal flux values from 26 April through 03 May 2009.

Table 3-60. Spring 2009, Island Beach State Park, weekly TracScan flux by surface wind speed category during clear weather conditions.

Date	Time	Total Flux (abt/km^3/hr)/Surface Wind Speed (mph)		
		0-8	9-16	16+
09-12 April	Diurnal	13.6	13.6	5.6
12-19 April	Diurnal	9.7	11.3	5.2
19-26 April	Diurnal	13.0	15.9	6.6
26 April–03 May	Diurnal	12.2	10.3	5.0
03-05 May	Diurnal	15.8	7.5	-
09-12 April	Nocturnal	10.5	12.1	5.9
12-19 April	Nocturnal	13.3	3.4	4.7
19-26 April	Nocturnal	17.3	11.1	3.6
26 April–03 May	Nocturnal	15.4	16.7	29.6
03-05 May	Nocturnal	3.0	2.0	-

The dominant diurnal and nocturnal directional flux values, with the exception of the nocturnal period from 03-05 May 2009, were from the south and southwest to the north and northeast (**Table 3-61**). Winds were generally favorable for movement to the north during a majority of the season (**Table 3-62**). No definitive directional flux was evident from 03-05 November 2009 when the winds were not favorable for migration (from north to south; **Table 3-61**).

Table 3-61. Spring 2009, Brigantine Beach, weekly TracScan cumulative directional flux (abt/km^3/hr) by surface wind speed (mph) categories during clear weather conditions.

Date	Time	Surface Wind Speed	N	NE	E	SE	S	SW	W	NW
09-12 April	Diurnal	0-8	2.5	3.7	1.4	0.7	1.1	1.5	1.2	1.4
		9-16	2.1	2.9	0.9	0.7	1.6	2.5	1.6	1.3
		16+	0.4	0.8	1.0	0.9	1.1	0.9	0.3	0.2
	Nocturnal	0-8	2.2	5.6	1.0	0.3	0.3	0.2	0.3	0.7
		9-16	2.7	3.5	0.9	0.5	0.8	1.0	1.3	1.4
		16+	0.3	0.8	1.1	1.0	1.1	1.1	0.3	0.2
12-19 April	Diurnal	0-8	1.7	2.9	1.4	0.7	0.8	0.8	0.6	0.8
		9-16	1.7	2.9	1.3	0.9	1.1	1.3	1.1	1.0
		16+	0.5	0.8	0.8	0.8	0.8	0.8	0.4	0.4
	Nocturnal	0-8	3.7	9.2	2.1	0.5	0.5	0.3	0.3	0.8
		9-16	0.2	0.5	0.5	0.5	0.6	0.8	0.3	0.1
		16+	0.3	0.6	0.8	0.7	0.8	0.9	0.3	0.2
19-26 April	Diurnal	0-8	2.3	3.5	2.0	1.2	0.9	0.7	0.9	1.5
		9-16	3.1	4.4	2.0	1.2	1.0	1.0	1.3	2.0
		16+	1.1	1.9	1.0	0.6	0.6	0.5	0.4	0.5
	Nocturnal	0-8	4.1	7.7	1.8	0.6	0.8	0.5	0.5	1.3
		9-16	2.5	3.7	0.9	0.5	0.7	0.6	0.8	1.5
		16+	0.4	0.5	0.3	0.2	0.3	0.5	0.6	0.8
26 April-03 May	Diurnal	0-8	1.9	2.2	1.3	1.1	1.4	1.5	1.3	1.5
		9-16	2.0	2.7	1.3	0.8	0.8	0.7	0.8	1.2
		16+	0.3	0.5	0.3	0.5	0.8	1.2	1.1	0.4
	Nocturnal	0-8	3.6	5.8	1.4	0.7	0.9	0.9	0.8	1.3
		9-16	4.2	4.8	1.0	0.5	0.9	1.2	1.7	2.5
		16+	4.4	2.8	1.4	1.0	3.5	6.5	4.8	5.1
03-05 May	Diurnal	0-8	2.4	3.3	2.0	1.5	1.9	2.0	1.4	1.4
		9-16	0.5	0.4	0.4	0.7	1.6	2.0	1.2	0.6
		16+	-	-	-	-	-	-	-	-
	Nocturnal	0-8	0.2	0.1	0.1	0.4	0.6	0.7	0.5	0.3
		9-16	0.1	0.1	0.1	0.2	0.4	0.6	0.4	0.1
		16+	-	-	-	-	-	-	-	-

Table 3-62. Spring 2008, Brigantine Beach, weekly cumulative surface wind direction percentage (hours)[1] during clear weather conditions (Appendix J-5: see Table J-107 for wind speed data).

Date	Time	NW, N, NE	SE, S, SW	E	W
09-12 April	Diurnal	2	40	20	37
	Nocturnal	25	39	1	35
12-19 April	Diurnal	26	57	6	10
	Nocturnal	24	46	8	23
19-26 April	Diurnal	9	73	17	1
	Nocturnal	9	79	9	3
26 April-03 May	Diurnal	44	43	4	9
	Nocturnal	39	55	2	5
03-05 May	Diurnal	56	24	6	14
	Nocturnal	100	0	0	0

[1] rounded to nearest percent

3.3.4.3 Sea Isle City

TracScan weekly cumulative diurnal flux values ranged from 5.0 to 15.1 abt/km^3/hr and weekly cumulative nocturnal flux values ranged from 3.2 to 23.5 abt/km^3/hr (**Table 3-63**). With the exception of the week of 06-10 May 2009, weekly cumulative nocturnal flux values were greater than cumulative nocturnal flux values.

Table 3-63. Spring 2009, Sea Isle City, TracScan flux by surface wind speed category during clear weather conditions, weeks 41 to 43.

Date	Time	Total Flux (abt/km^3/hr)/Surface Wind Speed (mph)		
		0-8	9-16	16+
06-10 May	Diurnal	15.1	9.2	-
10-17 May	Diurnal	14.3	5.6	-
17-24 May	Diurnal	12.0	8.1	-
24 May – 02 June	Diurnal	11.9	5.0	-
06-10 May	Nocturnal	5.8	3.2	3.6
10-17 May	Nocturnal	16.0	11.9	-
17-24 May	Nocturnal	23.5	22.4	-
24 May – 02 June	Nocturnal	18.9	4.6	-

The dominant diurnal and nocturnal directional flux values were from the south and southwest to the north and northeast during the survey period (**Table 3-64**). Northerly movement occurred even though the dominant surface wind directional flow was from the north to the south from 06-24 May 2009 (**Table 3-65**). Wind direction was slightly more favorable for migration from 24 May - 02 June.

Table 3-64. Spring 2009, Sea Isle City, weekly (wk) TracScan cumulative directional flux (abt/km^3/hr) by surface wind speed (mph) categories during clear weather conditions.

Date	Time	Surface Wind Speed	N	NE	E	SE	S	SW	W	NW
06-10 May	Diurnal	0-8	3.6	4.9	1.4	0.8	1.1	1.1	0.9	1.2
		9-16	2.1	3.2	1.0	0.6	0.8	0.6	0.3	0.5
		16+	-	-	-	-	-		-	-
	Nocturnal	0-8	1.6	3.0	0.6	0.1	0.1	0.1	0.1	0.3
		9-16	0.8	1.1	0.3	0.1	0.2	0.2	0.2	0.3
		16+	1.2	1.9	0.2	0.1	0.0	0.0	0.1	0.2
10-17 May	Diurnal	0-8	3.0	3.6	1.3	1.0	1.3	1.5	1.2	1.5
		9-16	1.5	2.3	0.5	0.3	0.2	0.2	0.2	0.4
		16+	-	-	-	-	-	-	-	-
	Nocturnal	0-8	4.5	6.9	1.2	0.4	0.8	0.9	0.5	0.8
		9-16	3.9	4.7	0.6	0.2	0.6	0.9	0.4	0.7
		16+	-	-	-	-	-	-	-	-
17-24 May	Diurnal	0-8	2.9	3.5	1.2	0.9	0.8	0.7	0.7	1.2
		9-16	2.0	2.9	0.7	0.4	0.5	0.5	0.4	0.7
		16+	-	-	-	-	-	-	-	-
	Nocturnal	0-8	5.5	13.0	17.0	0.5	0.6	0.8	0.5	0.9
		9-16	5.3	14.9	0.8	0.2	0.3	0.2	0.2	0.5
		16+	-	-	-	-	-	-	-	-
24 May-02 June	Diurnal	0-8	2.3	2.5	1.2	1.1	1.3	1.2	1.0	1.3
		9-16	0.8	0.9	0.4	0.5	0.7	0.8	0.4	0.4
		16+	-	-	-	-	-	-	-	-
	Nocturnal	0-8	4.3	7.7	1.7	0.7	1.2	1.4	0.8	1.1
		9-16	0.4	0.6	0.2	0.2	0.9	1.4	0.7	0.3
		16+	-	-	-	-	-	-	-	-

Table 3-65. Spring 2009, Sea Isle City, weekly cumulative surface wind direction percentage (hours)[1] during clear weather conditions, weeks 41 to 43 (Appendix J-5: see Table J-107 for wind speed data).

Date	Time	NW, N, NE	SE, S, SW	E	W
06-10 May	Diurnal	60	13	19	8
	Nocturnal	57	20	19	3
10-17 May	Diurnal	72	9	11	9
	Nocturnal	70	17	13	0
17-24 May	Diurnal	85	4	9	2
	Nocturnal	79	12	9	0
24 May-02 June	Diurnal	36	17	15	32
	Nocturnal	39	38	2	20

[1] rounded to nearest percent

3.3.5 Discussion

The results of the spring/early summer onshore radar survey varied by onshore survey site:

- At IBSP, all of weekly cumulative diurnal median altitude quartiles were within the low altitude band (1-99 ft AMSL) and most of the weekly cumulative nocturnal altitudes were within the middle (RSZ) band (100-700 ft AMSL). At Brigantine Beach (BB), the weekly number of cumulative diurnal median altitudes in the low altitude band and in the middle (RSZ) band was similar. Most of the cumulative nocturnal median altitudes were in the high altitude band (701+ ft AMSL). At SIC, all of the weekly cumulative diurnal median altitudes were within the low altitude band and all of the weekly cumulative nocturnal median altitudes were within the middle (RSZ) band.
- Cumulative weekly diurnal flux values were greater within the low altitude band than within the middle (RSZ) band. Cumulative weekly nocturnal flux values varied at sites and throughout the fall season. Cumulative diurnal flux values were greater within the low altitude band than within the middle (RSZ) altitude band at ISBP from 29 March - 05 April, at Brigantine from 12-19 April 2009, and at SIC on 06-10 May 2009. Cumulative weekly nocturnal flux values within the low and middle altitude bands were similar during the other sampling dates.
- Cumulative diurnal AMTR values were 10 abt/kph or less and cumulative nocturnal AMTRs were less than 80 abt/kph at all of the onshore sites. At each onshore site, peak cumulative AMTR occurred at night (IBSP: 17.4 abt/kph from 29 March – 05 April 2009; BB: 28.6 abt/kph from 26 April - 03 May 2009; SIC: 76.0 abt/kph from 06-10 May 2009.
- The dominant flux movement was from the south and southwest to the north and northeast. Some of these movements occurred even though winds were unfavorable (from north to south) for northerly movement. One small-scale reverse migration was recorded.

3.4 FALL 2009

3.4.1 Survey Effort

Onshore radar surveys started on 15 September 2009 and concluded on 16 November 2009. The survey effort by weather condition (clear, rain [includes mist and fog]) for each sampling site is presented in **Tables 3-66** and **3-67.** Daily survey effort is listed in **Appendix J-5: Table J-108** and **J-109.**

Table 3-66. Summary of fall 2009 VerCat onshore survey effort by sample location.

Sample Location	Date	Diurnal[1]			Nocturnal[2]			Total Hrs
		Hrs Clear	Hrs Rain[3]	Total Hrs	Hrs Clear	Hrs Rain[3]	Total Hrs	
IBSP	15 Sept. – 02 October	166.6	42.6	209.2	161.5	24.5	186.0	395.2
BB	05-26 October	144.6	57.1	201.7	146.2	62.3	208.5	410.2
SIC	26 October – 16 November	165.5	62.6	228.1	174.5	91.5	266.0	494.1

[1] Diurnal occurs from Civil Sunrise to Civil Sunset
[2] Nocturnal occurs from Civil Sunset to Civil Sunrise
[3] Rain includes mist and drizzle
BB = Brigantine Beach
Hrs = Hours
IBSP = Island Beach State Park
SIC = Sea Isle City

Table 3-67. Summary of fall 2009 TracScan onshore survey effort by sample location.

Sample Location	Date	Diurnal[1]			Nocturnal[2]			Total Hrs
		Hrs Clear	Hrs Rain[3]	Total Hrs	Hrs Clear	Hrs Rain[3]	Total Hrs	
IBSP	15 Sept. – 02 October	169.8	44.3	214.1	162.4	24.6	187.0	400.7
BB	05-26 October	180.1	62.3	242.2	165.6	65.7	231.2	473.4
SIC	26 October – 16 November	166.7	65.3	232.0	175.3	91.5	266.8	498.8

[1] Diurnal occurs from Civil Sunrise to Civil Sunset
[2] Nocturnal occurs from Civil Sunset to Civil Sunrise
[3] Rain includes mist and drizzle
BB = Brigantine Beach
Hrs = Hours
IBSP = Island Beach State Park
SIC = Sea Isle City

3.4.2 Altitudinal Distribution

3.4.2.1 Island Beach State Park

Cumulative weekly diurnal median altitudes ranged from 60 to 377 ft AMSL; cumulative weekly nocturnal median altitudes ranged from 121 to 546 ft AMSL (**Table 3-68**). Most of the cumulative weekly diurnal median altitude quartiles and all of the cumulative weekly nocturnal median altitude quartiles were within the middle (RSZ) altitude band. Day-to-day quartile data can be found in **Appendix Table J-110** through **J-112**.

The majority of the cumulative weekly diurnal flux values and all of cumulative weekly nocturnal flux values were greater within the low altitude than within the middle (RSZ) altitude band (**Table 3-69**). Within the low altitude band, the majority of the cumulative weekly nocturnal flux values were greater than cumulative weekly diurnal flux values. Within the middle altitude band, the majority of the cumulative weekly nocturnal flux values were greater than the cumulative weekly diurnal flux values.

Table 3-68. Fall 2009, Island Beach State Park, weekly VerCat radar cumulative median altitude (Alt) quartiles (ft AMSL) by surface wind speed category during clear weather conditions.

Date	Time	Surface Wind Speed (mph)	25% Alt	Median Alt	75% Alt	Bird Count
15-20 Sept.	Diurnal	0-8	83	213	319	2,818
		9-16	192	377	608	386
		16+	48	85	208	33
20-27 Sept.	Diurnal	0-8	116	234	332	4,692
		9-16	147	258	376	2,178
		16+	159	231	310	83
27 Sept.-1 Oct	Diurnal	0-8	46	120	251	1,736
		9-16	31	60	164	175
		16+	24	61	157	54

Table 3-68 (*continued*). Fall 2009, Island Beach State Park, weekly VerCat radar cumulative median altitude (Alt) quartiles (ft AMSL) by surface wind speed category during clear weather conditions.

Date	Time	Surface Wind Speed (mph)	25% Alt	Median Alt	75% Alt	Bird Count
15-20 Sept.	Nocturnal	0-8	170	297	493	8,644
		9-16	-	-	-	-
		16+	215	546	866	184
20-27 Sept.	Nocturnal	0-8	139	238	352	6,906
		9-16	126	218	325	1,630
		16+	-	-	-	-
27 Sept.-1 Oct	Nocturnal	0-8	142	254	371	8,072
		9-16	59	121	222	847
		16+	-	-	-	-

Table 3-69. Fall 2009, Island Beach State Park, weekly VerCat flux (abt/km^3/hr) by altitude band and surface wind speed category during clear weather conditions.

Date	Time	VerCat Flux (abt/km^3/hr)/Altitude Band (ft AMSL)								
		Low (1-99)			Middle (100-700)			High (701+)		
		Surface Wind Speed (mph)								
		0-8	9-16	16+	0-8	9-16	16+	0-8	9-16	16+
15-20 Sept.	Diurnal	350.9	132.0	89.4	122.4	75.1	13.8	0.1	0.4	0.1
20-27 Sept.	Diurnal	286.7	242.4	175.0	143.6	182.0	183.9	0.0	0.2	0.0
27 Sept. -1 Oct.	Diurnal	359.7	115.1	72.6	70.2	9.4	6.1	0.0	0.0	0.0
15-20 Sept.	Nocturnal	401.3	-	44.5	305.9	-	23.9	1.2	-	0.3
20-27 Sept.	Nocturnal	376.8	357.7	-	267.0	219.4	-	0.2	0.1	-
27 Sept. -1 Oct.	Nocturnal	461.9	451.6	-	334.5	94.0	-	0.1	0.0	-

3.4.2.2 Brigantine Beach

Cumulative weekly diurnal median altitude quartiles ranged from 19 to 298 ft AMSL. Cumulative weekly nocturnal median altitude quartiles ranged from 158 to 306 ft AMSL (**Table 3-70**). Most of the cumulative weekly diurnal median altitude quartiles and all of the cumulative weekly nocturnal median altitude quartiles were within the middle (RSZ) altitude band. Day-to-day quartile data can be found in **Appendix J-5: Table J-113 through J-115**.

Cumulative weekly diurnal flux values were greater within the low altitude band than within the middle band (**Table 3-71**). Cumulative weekly nocturnal flux values were generally greater within the low altitude band than within middle altitude band. Within the low altitude band and the middle altitude band, cumulative weekly nocturnal flux values were greater than cumulative weekly diurnal flux values.

Table 3-70. Fall 2009, Brigantine Beach, weekly VerCat radar cumulative median altitude (Alt) quartiles (ft AMSL) by surface wind speed category during clear weather conditions.

Date	Time	Surface Wind Speed (mph)	25% Alt	Median Alt	75% Alt	Bird Count
05-11 October	Diurnal	0-8	61	177	288	1,132
		9-16	46	146	239	1,030
		16+	38	142	231	416
11-18 October	Diurnal	0-8	36	105	219	176
		9-16	82	161	240	525
		16+	10	19	140	153
18-26 October	Diurnal	0-8	140	298	831	3,392
		9-16	64	145	249	1,227
		16+	12	39	183	257
05-11 October	Nocturnal	0-8	155	291	450	11,617
		9-16	79	169	267	2,129
		16+	89	172	232	89
11-18 October	Nocturnal	0-8	92	183	284	1,374
		9-16	93	233	405	765
		16+	103	250	391	428
18-26 October	Nocturnal	0-8	170	306	487	17,409
		9-16	57	158	314	1,100
		16+	68	195	351	539

Table 3-71. Fall 2009, Brigantine Beach, weekly VerCat flux (abt/km^3/hr) by altitude band and surface wind speed category during clear weather conditions.

Date	Time	VerCat Flux (abt/km^3/hr)/Altitude Band (ft AMSL)								
		Low (1-99)			Middle (100-700)			High: (701+)		
		Surface Wind Speed (mph)								
		0-8	9-16	16+	0-8	9-16	16+	0-8	9-16	16+
05-11 October	Diurnal	424.4	307.1	172.3	139.2	75.8	37.0	0.0	0.0	0.0
11-18 October	Diurnal	128.9	250.3	375.8	22.3	87.3	32.8	0.0	0.0	0.0
18-26 October	Diurnal	249.1	222.2	141.4	102.0	63.1	14.0	1.0	0.0	0.0
05-11 October	Nocturnal	1,154.1	472.6	392.7	921.5	163.3	166.0	0.9	0.1	0.0
11-18 October	Nocturnal	644.4	379.9	292.2	281.7	163.2	138.3	0.1	0.1	0.1
18-26 October	Nocturnal	539.2	370.6	268.8	453.6	99.1	88.7	0.9	0.1	0.1

3.4.2.3 Sea Isle City

Cumulative weekly diurnal median altitudes ranged from 26 to 107 ft AMSL while the cumulative weekly nocturnal median altitudes ranged from 28 to 358 ft AMSL (**Table 3-72**). The majority of cumulative weekly diurnal median altitudes were within the low altitude band. Most of the cumulative weekly nocturnal median altitudes were within the middle (RSZ) altitude band. Day-to-day quartile data can be found in **Appendix J-5: Tables J-116** through **J-118**.

Table 3-72. Fall 2009, Sea Isle City, weekly VerCat radar cumulative median altitude (Alt) quartiles (ft AMSL) by surface wind speed category during clear weather conditions.

Date	Time	Surface Wind Speed (mph)	25% Alt	Median Alt	75% Alt	Bird Count
26 Oct.-01 Nov.	Diurnal	0-8	30	58	126	768
		9-16	36	87	166	132
		16+	-	-	-	-
01-08 November	Diurnal	0-8	39	107	205	2,136
		9-16	34	66	203	163
		16+	-	-	-	-
08-16 November	Diurnal	0-8	30	63	161	1,721
		9-16	22	26	30	145
		16+	27	33	39	95
26 Oct.-01 Nov.	Nocturnal	0-8	96	197	320	1,732
		9-16	89	183	304	483
		16+	-	-	-	-
01-08 November	Nocturnal	0-8	172	358	602	12,527
		9-16	65	144	253	101
		16+	-	-	-	-
08-16 November	Nocturnal	0-8	131	248	380	4,961
		9-16	23	28	32	238
		16+	25	31	36	382

The cumulative weekly diurnal and nocturnal flux values were greater within the low altitude band than within the middle altitude band (**Table 3-73**). With the exception of the week of 08-16 November 2009, cumulative weekly nocturnal flux values within the low and middle altitude bands were greater than cumulative weekly diurnal flux values.

Table 3-73. Fall 2009, Sea Isle City, weekly VerCat flux (abt/km^3/hr) by altitude band and surface wind speed category during clear weather conditions.

Date	Time	VerCat Flux (abt/km^3/hr)/Altitude Band (ft AMSL)								
		Low (1-99)			Middle (100-700)			High (701+)		
		Surface Wind Speed (mph)								
		0-8	9-16	16+	0-8	9-16	16+	0-8	9-16	16+
26 Oct.-01 Nov.	Diurnal	184.9	72.2	-	16.5	10.1	-	0.0	0.0	-
01-08 November	Diurnal	247.6	146.4	-	43.4	15.8	-	0.0	0.0	-
08-16 November	Diurnal	291.0	774.2	3,170.4	33.2	0.6	-	0.0	0.0	0.0
26 Oct.-01 Nov.	Nocturnal	243.2	141.4	-	107.5	54.9	-	0.0	0.0	-
01-08 November	Nocturnal	366.2	78.9	-	280.8	19.4	-	1.1	0.0	-
08-16 November	Nocturnal	204.0	1,581.6	2,263.9	132.3	0.0	0.7	0.1	0.0	0.0

3.4.3 Adjusted Migration Traffic Rate

3.4.3.1 Island Beach State Park

Cumulative weekly diurnal AMTRs ranged from 1.5 to 15.2 abt/kph and the cumulative weekly nocturnal AMTRs and from 3.6 to 37.0 abt/kph (**Table 3-74**). The peak weekly cumulative diurnal AMTR was 19.0 abt/kph (20-27 september 2009); the peak nocturnal AMTR was 37 abt/kph (15-20 September 2009). Cumulative weekly nocturnal AMTRs were greater than cumulative weekly diurnal AMTRs.

3.4.3.2 Brigantine Beach

Cumulative weekly diurnal and nocturnal AMTR ranged from 3.2 to 17.4 abt/kph and from 11.4 to 97.1 abt/kph, respectively (**Table 3-75**). The peak weekly cumulative diurnal AMTR was 17.4 abt/kph and the peak weekly nocturnal AMTR was 97.1 abt/kph (05-11 October 2009). Cumulative weekly nocturnal AMTRs were greater than cumulative weekly diurnal AMTRs.

Table 3-74. Fall 2009, Island Beach State Park, weekly VerCat radar cumulative AMTR (abt/kph) by surface wind speed category during clear weather conditions.

Date	Time	Cumulative AMTR/Surface Wind Speed (mph)		
		0-8	9-16	16+
15-20 Sept.	Diurnal	15.2	9.4	2.0
20-27 Sept.	Diurnal	16.1	19.0	17.9
27 Sept. -1 Oct.	Diurnal	10.6	2.4	1.5
15-20 Sept.	Nocturnal	37.0	-	3.6
20-27 Sept.	Nocturnal	27.9	22.9	-
27 Sept. -1 Oct.	Nocturnal	34.8	13.9	-

Table 3-75. Fall 2009, Brigantine Beach, weekly VerCat radar cumulative AMTR (abt/kph) by surface wind speed category during clear weather conditions.

Date	Time	Cumulative AMTR/Surface Wind Speed (mph)		
		0-8	9-16	16+
05-11 October	Diurnal	17.4	10.3	5.4
11-18 October	Diurnal	3.8	10.3	7.8
18-26 October	Diurnal	16.0	8.0	3.2
05-11 October	Nocturnal	97.1	19.5	18.5
11-18 October	Nocturnal	31.9	19.2	15.7
18-26 October	Nocturnal	50.1	13.4	11.4

3.4.3.3 Sea Isle City

The cumulative weekly diurnal AMTR ranged from 1.9 to 46.7 abt/kph; the cumulative weekly nocturnal AMTR ranged from 6.6 to 34.6 abt/kph (**Table 3-76**). The peak weekly diurnal AMTR was 46.7 abt/kph (08-16 November 2009) and the peak weekly nocturnal AMTR was 34.6 abt/kph. Cumulative weekly nocturnal AMTRs were greater than cumulative weekly diurnal AMTRs.

Table 3-76. Fall 2009, Sea Isle City, weekly VerCat radar cumulative AMTR (abt/kph) by surface wind speed category during clear weather conditions.

Date	Time	Cumulative AMTR/Surface Wind Speed (mph)		
		0-8	9-16	16+
26 Oct.-01 Nov.	Diurnal	3.8	1.9	-
01-08 November	Diurnal	6.9	3.5	-
08-16 November	Diurnal	6.5	11.5	46.7
26 Oct.-01 Nov.	Nocturnal	12.5	6.6	-
01-08 November	Nocturnal	34.6	2.8	-
08-16 November	Nocturnal	14.7	23.4	33.5

3.4.4. Flux Direction

3.4.4.1 Island Beach State Park

The TracScan diurnal and nocturnal cumulative flux values ranged from 3.7 to 13.9 abt/km^3/hr and from 5.6 to 27.2 abt/km^3/hr, respectively (**Table 3-77**). Cumulative weekly nocturnal flux values were greater than the weekly diurnal cumulative flux values.

Table 3-77. Fall 2009, Island Beach State Park, weekly TracScan flux by surface wind speed category during clear weather conditions.

Date	Time	Total Flux (abt/km^3/hr)/Surface Wind Speed (mph)		
		0-8	9-16	16+
15-20 Sept.	Diurnal	13.9	7.1	4.4
20-27 Sept.	Diurnal	11.0	7.2	5.9
27 Sept.-02 Oct.	Diurnal	12.2	6.9	3.7
15-20 Sept.	Nocturnal	17.0	-	5.6
20-27 Sept.	Nocturnal	16.5	13.5	-
27 Sept.-02 Oct.	Nocturnal	20.7	27.2	-

For slightly greater diurnal directional flux values, the direction was from the north and northeast to the south and southwest from 15 September through 02 October 2009 (**Table 3-78**). Surface winds were favorable for diurnal southerly movement from 20 to 61% of the time (**Table 3-79**). The same axial direction pattern present at this location in fall 2008 (movement from the south and southwest to the north and northeast and movement from the north and northeast to the south and southwest), was present in fall 2009. This nocturnal movement may have been waterfowl or gulls leaving a nighttime roost before daylight or returning to a roost site after dark. Another explanation is that some reverse migration was occurring in response to southerly winds.

Table 3-78. Fall 2009, Island Beach State Park, weekly TracScan cumulative directional flux (abt/km^3/hr) by surface wind speed (mph) categories during clear weather conditions.

Date	Time	Surface Wind Speed	N	NE	E	SE	S	SW	W	NW
15-20 Sept.	Diurnal	0-8	1.6	1.4	1.3	1.7	2.9	2.5	1.3	1.1
		9-16	0.6	0.5	0.3	0.6	1.5	2.5	0.7	0.4
		16+	0.2	0.1	0.1	0.2	1.1	1.6	0.8	0.4
	Nocturnal	0-8	2.6	3.4	1.3	1.5	3.6	3.0	0.9	0.7
		9-16	-	-	-	-	-	-	-	-
		16+	0.1	0.0	0.0	0.2	1.1	2.3	1.3	0.4
20-27 Sept	Diurnal	0-8	1.6	1.3	0.9	1.0	1.7	1.7	1.4	1.4
		9-16	0.9	0.6	0.3	0.5	1.3	2.0	1.1	0.6
		16+	0.1	0.0	0.1	0.4	1.6	2.9	0.8	0.1
	Nocturnal	0-8	4.2	5.6	1.4	0.8	1.4	1.2	0.8	1.1
		9-16	1.1	0.9	0.3	0.4	1.7	5.1	2.9	1.0
		16+	-	-	-	-	-	-	-	-
27 Sept. – 2 Oct	Diurnal	0-8	1.9	1.8	1.4	1.4	2.0	1.5	1.0	1.2
		9-16	1.5	1.3	0.9	1.0	0.8	0.4	0.3	0.6
		16+	1.2	0.9	0.4	0.2	0.2	0.1	0.2	0.5
	Nocturnal	0-8	3.2	4.4	1.7	2.0	4.5	3.3	0.9	0.8
		9-16	5.5	10.4	4.0	3.1	2.4	0.7	0.2	0.8
		16+	-	-	-	-	-	-	-	-

Table 3-79. Fall 2009, Island Beach State Park, weekly cumulative surface wind direction percentage (hours) [1] during clear weather conditions (Appendix J-5: see Appendix Table J-119 for wind speed data).

Date	Time	NW, N, NE	SE, S, SW	E	W
15-20 Sept.	Diurnal	20	55	17	7
	Nocturnal	21	52	25	2
20-27 Sept.	Diurnal	51	24	3	20
	Nocturnal	61	20	0	19
27 Sept.-2 Oct.	Diurnal	42	13	45	0
	Nocturnal	2	21	76	0

[1] rounded to nearest percent

3.4.4.2 Brigantine Beach

The cumulative weekly diurnal and nocturnal flux values ranged from 4.2 to 21.1 abt/km^3/h and from 0.8 to 12.4 abt/km^3/hr, respectively (**Table 3-80**). The cumulative weekly diurnal flux values were greater than the cumulative weekly nocturnal flux values.

Table 3-80. Fall 2009, Brigantine Beach, weekly TracScan flux by surface wind speed category during clear weather conditions.

Date	Time	Total Flux (abt/km^3/hr)/Surface Wind Speed (mph)		
		0-8	9-16	16+
05-11 October	Diurnal	19.1	8.8	4.2
11-18 October	Diurnal	15.9	10.1	6.5
18-26 October	Diurnal	21.1	12.7	7.3
05-11 October	Nocturnal	2.8	5.8	9.7
11-18 October	Nocturnal	12.4	4.3	6.9
18-26 October	Nocturnal	6.1	0.8	3.4

With the exception of the nocturnal period from 05 through 11 and 18 through 26 October, the dominant diurnal and nocturnal movements were from the north and northeast to the south and southwest (**Table 3-81**). Between 05 and 26 October 2009, southward movements occurred although the surface wind direction was not favorable for southward movement 38 to 74% of the time (**Table 3-82**).

Table 3-81. Fall 2009, Brigantine Beach, weekly TracScan cumulative directional flux (abt/km^3/hr) by surface wind speed (mph) categories during clear weather conditions.

Date	Time	Surface Wind Speed	N	NE	E	SE	S	SW	W	NW
05-11 October	Diurnal	0-8	1.9	2.0	1.5	1.6	3.0	3.8	3.0	2.2
		9-16	1.1	1.3	0.8	0.8	1.5	1.6	0.9	0.8
		16+	0.5	0.5	0.4	0.4	0.9	0.9	0.3	0.3
	Nocturnal	0-8	0.2	0.3	0.4	0.5	0.7	0.5	0.2	0.1
		9-16	0.8	1.2	0.7	0.7	0.9	0.5	0.4	0.5
		16+	0.7	1.4	1.6	2.6	2.4	0.8	0.2	0.1
11-18 October	Diurnal	0-8	1.5	1.5	1.2	1.3	2.8	3.9	2.3	1.4
		9-16	0.6	0.7	0.6	0.8	2.1	3.3	1.6	0.5
		16+	0.4	0.5	0.6	1.0	1.7	1.5	0.5	0.2
	Nocturnal	0-8	0.7	0.8	0.7	0.8	2.9	4.3	1.5	0.6
		9-16	0.2	0.1	0.1	0.2	1.0	1.8	0.7	0.3
		16+	0.1	0.1	0.2	0.4	2.4	3.1	0.6	0.1
18-26 October	Diurnal	0-8	2.9	2.3	1.5	1.6	3.1	3.9	3.0	2.9
		9-16	1.0	1.1	0.9	0.9	2.5	3.6	1.7	0.9
		16+	0.3	0.3	0.5	0.7	1.8	2.3	0.9	0.4
	Nocturnal	0-8	0.7	1.2	0.8	0.7	0.9	0.8	0.5	0.4
		9-16	0.1	0.0	0.0	0.0	0.1	0.2	0.2	0.1
		16+	0.3	0.2	0.1	0.2	0.9	1.0	0.4	0.3

Table 3-82. Fall 2009, Brigantine Beach, weekly cumulative surface wind direction percentage (hours)[1] during clear weather conditions (Appendix J-5: Table J-119 for wind speed data).

Date	Time	NW, N, NE	SE, S, SW	E	W
05-11 October	Diurnal	29	61	10	0
	Nocturnal	32	48	21	0
11-18 October	Diurnal	0	73	10	18
	Nocturnal	17	74	0	8
18-26 October	Diurnal	33	43	13	11
	Nocturnal	27	38	36	0

[1] rounded to nearest percent

3.4.4.3 Sea Isle City

Cumulative weekly diurnal flux values ranged from 2.8 to 16.2 abt/km^3/hr and cumulative weekly nocturnal flux values ranged from 1.7 to 12.0 abt/km^3/hr (**Table 3-83**). With the exception of the week of 26 October through 01 November 2009, cumulative nocturnal flux values were greater than cumulative nocturnal flux values.

Table 3-83. Fall 2009, Sea Isle City, TracScan flux by surface wind speed category during clear weather conditions.

Date	Time	Total Flux (abt/km^3/hr)/Surface Wind Speed (mph)		
		0-8	9-16	16+
26 Oct.-1 Nov.	Diurnal	6.7	3.8	-
1-8 Nov.	Diurnal	16.2	9.6	-
8-16 Nov.	Diurnal	13.4	4.4	2.8
26 Oct.-I Nov.	Nocturnal	9.1	8.6	-
1-8 Nov.	Nocturnal	9.3	5.1	-
8-16 Nov.	Nocturnal	12.0	1.7	2.4

The dominant diurnal and nocturnal movements were from the northeast and north to the southwest and south, respectively (**Table 3-84**). Winds were favorable for southerly movement from 19 to 37% of the time (**Table 3-85**).

Table 3-84. Fall 2009, Sea Isle City, weekly (wk) TracScan cumulative directional flux (abt/km^3/hr) by surface wind speed (mph) categories during clear weather conditions.

Date	Time	Surface Wind Speed	N	NE	E	SE	S	SW	W	NW
26 Oct.-1 Nov.	Diurnal	0-8	0.5	0.5	0.4	0.4	1.1	2.3	1.0	0.5
		9-16	0.6	0.7	0.3	0.2	0.5	0.9	0.4	0.3
		16+	-	-	-	-	-	-	-	-
	Nocturnal	0-8	0.4	0.4	0.2	0.3	1.8	4.4	1.1	0.5
		9-16	0.4	0.4	0.2	0.3	1.8	4.4	0.9	0.2
		16+	-	-	-	-	-	-	-	-
1-8 Nov.	Diurnal	0-8	1.7	1.7	1.2	1.2	2.5	3.8	2.4	1.6
		9-16	0.8	0.9	0.8	0.7	1.8	2.6	1.3	0.7
		16+	-	-	-	-	-	-	-	-
	Nocturnal	0-8	0.5	0.7	0.4	0.5	2.1	3.7	0.9	0.4
		9-16	0.7	1.1	0.5	0.4	0.8	1.1	0.3	0.2
		16+	-	-	-	-	-	-	-	-
8-16 Nov.	Diurnal	0-8	1.2	1.2	1.0	1.2	2.2	3.4	2.0	1.2
		9-16	0.3	0.3	0.3	0.4	0.8	1.4	0.5	0.3
		16+	0.0	0.0	0.0	0.1	0.8	1.4	0.4	0.0
	Nocturnal	0-8	1.0	1.1	0.7	0.7	2.1	3.8	1.6	1.0
		9-16	0.1	0.1	0.1	0.1	0.4	0.7	0.3	0.1
		16+	0.1	0.1	0.1	0.2	0.6	1.0	0.3	0.1

Table 3-85. Fall 2009, Sea Isle City, weekly cumulative surface wind direction percentage (hours)[1] during clear weather conditions (Appendix J-5; see Table J-119 for wind speed data).

Date	Time	NW, N, NE	SE, S, SW	E	W
26 Oct.-1 Nov.	Diurnal	35	47	4	15
	Nocturnal	23	45	0	32
1-8 Nov.	Diurnal	34	46	17	3
	Nocturnal	20	74	5	0
8-16 Nov.	Diurnal	37	51	7	5
	Nocturnal	19	63	17	11

[1] rounded to nearest percent

3.4.5 Discussion

The results of the fall 2009 onshore surveys were:

- The majority of cumulative weekly diurnal and nocturnal median altitude quartiles were within the middle (RSZ) band.
- Most to all of the cumulative weekly diurnal and nocturnal altitude quartiles were greater within the low altitude band than the middle (RSZ) band. The high flux value for the 16+ mph surface wind speed category from 08-16 November 2009 was not expected based on the steady trend in cumulative weekly diurnal flux values prior to this date. The data was replayed on GMI's software

analysis system and examined for possible contaminants that may not have been processed correctly by the radar filters. The examination revealed a large group of birds were present during the time when the surface wind speed was above 16+ mph. The duration of the 16+ mph surface wind was only 22 minutes. The short time duration was responsible for the high diurnal and nocturnal cumulative flux values in the 16+ surface wind speed category.

- Cumulative diurnal AMTR values were <20 abt/kph during the majority of the study. The only exception was during the week of 08-16 November at SIC when the AMTR increased dramatically but only in the 16+ mph wind category. As previously discussed above, this is an accurate representation of the activity that occurred in the 16+ surface wind speed category. Except for peak cumulative nocturnal migration period from 05-11 October 2009, the cumulative weekly nocturnal AMTR was below 50 abt/kph
- Overall, as expected during fall migration, the dominant flux direction during most weeks were from the north and northeast to the south and southwest despite frequent unfavorable winds from the south to the north.

4.0 DISCUSSION

The effects of significant environmental variables on offshore and onshore avian density were determined by conducting statistical analyses. Variables studied include time-of-day and wind speed (see Two Way Density Tests file on Appendix CD). Results of statistical analysis for offshore and onshore radar sites are presented and summarized in this section.

4.1 OFFSHORE

4.1.1 Spring 2008

For the seven locations, the six-sample dataset was determined to be non-normal therefore the non-parametric Kruskal-Wallis test was applied. Between the two time-of-day periods there was a significant difference in avian density (rejection of H_o): DF1=1, DF2=36, F=8.8861, F_{crit}=3.841, P=0.0036. For N=2 levels, there was 2*(2-1)/2 = 1 pair. A subsequent Tukey test for Rank Means on this one pair confirmed that the null hypothesis should be rejected.

Among the three wind speed categories there was no significant difference in avian density (acceptance of H_o): DF1=2, DF2=36, F=0.8467, F_{crit}=5.991, P=0.6662. For N=3 levels, there were 3*(3-1)/2 = 3 pairs. A subsequent Tukey test for Rank Means on these three pairs confirmed that the null hypothesis should not be rejected for all 3 pair-wise combinations.

With respect to time-of-day x wind speed interaction, there was no significant difference (acceptance of H_o): DF1=2, DF2=36, F=0.6872, F_{crit}=5.991, P=0.7154. For N=2*3=6 levels, there were 6*(6-1)/2 = 15 pairs. A subsequent Tukey test for Rank Means on these 15 pairs confirmed this result: H_o was accepted for all 15 pair-wise combinations.

4.1.2 Fall 2008

For two locations, the six-sample dataset was determined to be normal, hence the parametric ANOVA test was applied. Between the two time-of-day periods there was no significant difference in avian density (acceptance of H_o): DF1=1, DF2=6, F=4.089, F_{crit}=5.99, P=0.0930. For N=2 levels, there was 2*(2-1)/2 = 1 pair. A subsequent Tukey test on this one pair confirmed that the null hypothesis should not be rejected.

Among the three wind speeds, there was no significant difference in avian density (acceptance of H_o): DF1=2, DF2=6, F=0.4668, F_{crit}=5.14, P=0.3641. For N=3 levels, there are 3*(3-1)/2 = 3 pairs. A subsequent Tukey test on these 3 pairs confirmed that the null hypothesis should not be rejected for all 3 pair-wise combinations.

With respect to time-of-day x wind speed interaction, there was no significant difference (acceptance of H_o): DF1=2, DF2=6, F=0.6483, F_{crit}=5.14, P=0.3481. For N=2*3=6 levels, there were 6*(6-1)/2 = 15 pairs.

A subsequent Tukey test on these 15 pairs confirmed that the null hypothesis should not be rejected for all 15 pair-wise combinations.

4.1.3 Spring 2009

For the two locations, the six-sample dataset was determined to be non-normal therefore the non-parametric Kruskal-Wallis test was applied. Between the two time-of-day periods there was no significant difference in avian density (acceptance of H_o): DF1=1, DF2=6, F=0.2481, F_{crit}=3.841, P=0.6465. For N=2 levels, there was 2*(2-1)/2 = 1 pair. A subsequent Tukey test for Rank Means on this one pair confirmed that the null hypothesis should not be rejected.

Among the three wind speed categories there was a significant difference in avian density (rejection of H_o): DF1=2, DF2=6, F=7.5677, F_{crit}=5.991, P=0.0234. For N=3 levels, there were 3*(3-1)/2 = 3 pairs. A subsequent Tukey test for Rank Means on these three pairs showed a significant difference in avian density between the "0-8 mph" wind speed range and the ">15 mph" wind speed range. There was no significant difference between the other two pairs (i.e., "0-8 mph" versus "9-15 mph", and "9-15mph" versus ">15 mph").

With respect to time-of-day x wind speed interaction, there was no significant difference (acceptance of H_o): DF1=2, DF2=6, F=0.2895, F_{crit}=5.991, P=0.8677. For N=2*3=6 levels, there were 6*(6-1)/2 = 15 pairs. A subsequent Tukey test for Rank Means on these 15 pairs confirmed that the null hypothesis should not be rejected for all 15 pair-wise combinations.

4.2 ONSHORE

4.2.1 Spring 2008

For the three locations, the six-sample dataset was determined to be non-normal hence the non-parametric Kruskal-Wallis test was applied. Between the two time-of-day periods there was no significant difference in avian density (acceptance of H_o): DF1=1, DF2=12, F=0.0079, F_{crit}=3.841, P=0.9338. For N=2 levels, there was 2*(2-1)/2 = 1 pair. A subsequent Tukey test for Rank Means on this one pair confirmed the result that the null hypothesis should not be rejected.

Among the three wind speed categories there was a significant difference in avian density (rejection of H_o): DF1=2, DF2=12, F=7.3153, F_{crit}=5.991, P=0.0261. For N=3 levels, there were 3*(3-1)/2 = 3 pairs. A subsequent Tukey test for Rank Means on these three pairs showed a significant difference in avian density between the "0-8 mph" wind speed range and the ">15 mph" wind speed range. There was no significant difference between the other 2 pairs (i.e., "0-8 mph" versus "9-15 mph", and "9-15 mph" versus ">15 mph".

With respect to time-of-day x wind speed interaction there was no significant difference (acceptance of H_o): DF1=2, DF2=12, F=2.4148, F_{crit}=5.991, P=0.3146. For N=2*3=6 levels, there were 6*(6-1)/2 = 15 pairs. A subsequent Tukey test for Rank Means on these 15 pairs confirmed the result that the null hypothesis should not be rejected for all 15 pair-wise combinations.

4.2.2 Fall 2008

For the three locations, the six-sample dataset was determined to be non-normal therfore the non-parametric Kruskal-Wallis test was applied. Between the two time-of-day periods there was a significant difference in avian density (rejection of H_o): DF1=1, DF2=12, F=5.8967, F_{crit}=3.841, P=0.0169. For N=2 levels, there was 2*(2-1)/2 = 1 pair. A subsequent Tukey test for Rank Means on this one pair confirmed the result that the null hypothesis should be rejected.

Among three wind speed categories there was no significant difference in avian density (acceptance of H_o): DF1=2, DF2=12, F=3.5205, F_{crit}=5.991, P=0.1888. For N=3 levels, there were 3*(3-1)/2 = 3 pairs. A

subsequent Tukey test for Rank Means on these three pairs confirmed that the null hypothesis should not be rejected for all the pair-wise combinations.

With respect to time-of-day x wind speed interaction, there was no significant difference (acceptance of H_o): DF1=2, DF2=12, F=0.1209, F_{crit}=5.991, P=0.9417. For N=2*3=6 levels, there were 6*(6-1)/2 = 15 pairs. A subsequent Tukey test for Rank Means on these 15 pairs confirmed the result that the null hypothesis should not be rejected for all 15 pair-wise combinations.

4.2.3 Spring 2009

For the three locations, the six-sample dataset was determined to be non-normal therefore the non-parametric Kruskal-Wallis test was applied. Between the two time-of-day periods there was a significant difference in avian density (rejection of H_o): DF1=1, DF2=12, F=11.5575, F_{crit}=3.841, P<0.0001. For N=2 levels, there was 2*(2-1)/2 = 1 pair. A subsequent Tukey test for Rank Means on this one pair confirmed this result that the null hypothesis should be rejected.

Among the three wind speed categories there was no significant difference in avian density (acceptance of H_o): DF1=2, DF2=12, F=1.2982, F_{crit}=5.991, P=0.5271. For N=3 levels, there were 3*(3-1)/2 = 3 pairs. A subsequent Tukey test for Rank Means on these three pairs confirmed that the null hypothesis should not be rejected for all three pair-wise combinations.

With respect to time-of-day x wind speed interaction, there was no significant difference (acceptance of H_o): DF1=2, DF2=12, F=0.7758, F_{crit}=5.991, P=0.6881. For N=2*3=6 levels, there were 6*(6-1)/2 = 15 pairs. A subsequent Tukey test for Rank Means on these 15 pairs confirmed that the null hypothesis should not be rejected for all 15 pair-wise combinations.

4.2.4 Fall 2009

The six-sample dataset was determined to be non-normal therefore the non-parametric Kruskal-Wallis test was applied. Between the two time-of-day periods there was no significant difference in avian density (acceptance of H_o): DF1=1, DF2=12, F=2.3879, F_{crit}=3.841, P=0.1345. For N=2 levels, there was 2*(2-1)/2 = 1 pair. A subsequent Tukey test for Rank Means on this one pair confirmed that the null hypothesis should not be rejected.

Among the three wind speed categories there was a significant difference in avian density (rejection of H_o): DF1=2, DF2=12, F=6.1871, F_{crit}=5.991, P=0.0465. For N=3 levels, there were 3*(3-1)/2 = 3 pairs. A subsequent Tukey test for Rank Means on these three pairs showed a significant difference in avian density between the "0-8 mph" wind speed range and the ">15 mph" wind speed range. There was no significant difference between the other two pairs (i.e., "0-8 mph" versus "9-15 mph", and "9-15 mph" versus ">15 mph").

With respect to time-of-day x wind speed interaction, there was no significant difference (acceptance of H_o): DF1=2, DF2=12, F=1.1735, F_{crit}=5.991, P=0.5655. For N=2*3=6 levels, there were 6*(6-1)/2 = 15 pairs. A subsequent Tukey test for Rank Means on these 15 pairs confirmed this result: H_o was accepted for all 15 pair-wise combinations.

4.3 SUMMARY

In summary, the significant factors (time-of-day, wind speed) contributing to differences in avian density depend on shore type and season. For example, there was no significant difference in avian density between the two time-of-day periods for onshore-spring 2008, onshore-autumn 2009, offshore-autumn 2008, and offshore-spring 2009, whereas there was a significant difference for onshore-autumn 2008, onshore-spring 2009, and offshore-spring 2008.

There was no significant difference in avian density among the three wind speed ranges for onshore-autumn 2008, onshore-spring 2009, offshore-spring 2008, and offshore-autumn 2008, whereas there was a significant difference for onshore-spring 2008, onshore-autumn 2009, and offshore-spring 2009.

For both shore types and all seasons, there was no significant interaction between time-of-day and wind speed (i.e., the differences in avian densities with respect to 1 factor are independent of the other factor). For example, the sensitivity of avian density to changes in diurnal period was independent of wind speed and likewise, the sensitivity of avian density to changes in wind speed was independent of diurnal period. These results were generally confirmed by the Tukey tests. Where there was no significant difference in avian density with respect to changes in a given factor or interaction, the Tukey test confirms this result for all pair-wise combinations. Where there was a significant difference in avian density with respect to changes in a given factor or interaction, the Tukey test identifies at least one pair-wise combination for which a significant difference exists (i.e., identifies the sources of variance among all possible pair-wise combinations).

Appendix J-4

Offshore Radar Data

Table J-30. Spring 2008 offshore VerCat radar daily operational hours by weather condition.

Sample Grid	Date	Diurnal[1]			Nocturnal[2]			Total Hrs
		Hrs Clear	Hrs Rain[3]	Total Hrs	Hrs Clear	Hrs Rain[3]	Total Hrs	
01	3/14/2008				2.0	3.4	*5.4*	**5.4**
	3/15/2008	8.1	3.4	*11.5*	5.2	5.7	*10.9*	**22.4**
	3/16/2008	2.3	10.6	*12.9*	5.7	5.4	*11.1*	**24.0**
	3/17/2008	10.6	2.4	*12.9*	10.5	0.5	*11.1*	**24.0**
	3/18/2008	12.3		*12.3*	6.7	4.3	*11.0*	**23.3**
	3/19/2008		13.0	*13.0*	1.1	9.9	*11.0*	**24.0**
	3/20/2008	2.1	0.6	*2.7*	0.7	4.9	*5.5*	**8.2**
	3/21/2008	9.1	2.0	*11.1*	5.4		*5.4*	**16.4**
	3/22/2008				5.4		*5.4*	**5.4**
07	3/22/2008	5.7	3.2	*8.9*	5.3	0.1	*5.4*	**14.3**
	3/23/2008	13.2		*13.2*	10.8		*10.8*	**24.0**
	3/24/2008	5.8	4.6	*10.4*	10.8		*10.8*	**21.2**
	3/25/2008	10.5	2.8	*13.3*	10.6	0.1	*10.7*	**24.0**
	3/26/2008	6.6	6.8	*13.3*	10.7		*10.7*	**24.0**
	3/27/2008	2.0		*2.0*	5.4		*5.4*	**7.3**
13	4/3/2008	5.3	2.4	*7.8*		5.1	*5.1*	**12.9**
	4/4/2008	11.6	2.1	*13.8*	4.6	5.7	*10.3*	**24.0**
	4/5/2008	13.8		*13.8*	3.7	6.6	*10.2*	**24.0**
	4/6/2008					0.3	*0.3*	**0.3**
	4/7/2008							
	4/8/2008							
	4/9/2008	0.2	5.3	*5.4*		5.0	*5.0*	**10.5**
	4/10/2008	14.0		*14.0*	8.1	2.0	*10.0*	**24.0**
	4/11/2008	13.4		*13.4*	10.0		*10.0*	**23.3**
	4/12/2008	7.4	6.7	*14.1*	9.0	0.9	*9.9*	**24.0**
	4/13/2008	2.4		*2.4*	4.9		*4.9*	**7.4**
19	4/13/2008	0.8	3.9	*4.7*		5.0	*5.0*	**9.7**
	4/14/2008	14.2		*14.2*	7.8	2.1	*9.9*	**24.0**
	4/15/2008	14.1		*14.1*	9.8		*9.8*	**23.9**
	4/16/2008	12.7		*12.7*	9.8		*9.8*	**22.5**
	4/17/2008	13.5	0.8	*14.3*	9.7		*9.7*	**24.0**
	4/18/2008	12.5		*12.5*	9.7		*9.7*	**22.2**
	4/19/2008	3.9		*3.9*	4.8		*4.8*	**8.7**

Table J-30 (*continued*). Spring 2008 offshore VerCat radar daily operational hours by weather condition.

Sample Grid	Date	Diurnal[1]			Nocturnal[2]			Total Hrs
		Hrs Clear	Hrs Rain[3]	Total Hrs	Hrs Clear	Hrs Rain[3]	Total Hrs	
26	4/24/2008	3.7		*3.7*	4.8		*4.8*	**8.5**
	4/25/2008	14.6		*14.6*	9.4		*9.4*	**24.0**
	4/26/2008	14.6		*14.6*	7.9	1.5	*9.4*	**24.0**
	4/27/2008	1.9	12.1	*14.0*	2.8	6.5	*9.3*	**23.3**
26	4/28/2008	2.9	11.8	*14.7*	3.2	6.1	*9.3*	**24.0**
	4/29/2008	11.0	3.7	*14.8*	5.0	4.3	*9.3*	**24.0**
	4/30/2008	7.3		*7.3*	4.5		*4.5*	**11.8**
23	4/30/2008	3.1		*3.1*	4.7		*4.7*	**7.7**
	5/1/2008	11.1	3.7	*14.8*	9.2		*9.2*	**23.9**
	5/2/2008	14.9		*14.9*	9.1		*9.1*	**24.0**
	5/3/2008	14.6		*14.8*	8.4	0.7	*9.1*	**23.9**
	5/4/2008	12.1	2.9	*15.0*	4.6	4.5	*9.0*	**24.0**
	5/5/2008	15.0		*15.0*	9.0		*9.0*	**24.0**
	5/6/2008	14.2	0.9	*15.1*	8.5	0.5	*9.0*	**24.0**
	5/7/2008	4.6		*4.6*	4.4		*4.4*	**9.0**
17	5/7/2008	5.3		*5.3*	4.5		*4.5*	**9.9**
	5/8/2008	4.1	11.0	*15.1*	5.2	3.7	*8.9*	**24.0**
	5/9/2008		15.2	*15.2*	0.8	8.0	*8.8*	**24.0**
	5/10/2008	9.3	4.5	*13.8*	8.6	0.2	*8.8*	**22.6**
	5/11/2008	3.0		*3.0*	4.3		*4.3*	**7.3**

[1] Diurnal occurs from Civil Sunrise to Civil Sunset
[2] Nocturnal occurs from Civil Sunset to Civil Sunrise
[3] Rain includes fog, mist, and drizzle
Hrs = Hours

Table J-31. Spring 2008 offshore TracScan radar daily operational hours by weather condition.

Sample Grid	Date	Diurnal[1]			Nocturnal[2]			Total Hrs
		Hrs Clear	Hrs Rain[3]	Total Hrs	Hrs Clear	Hrs Rain[3]	Total Hrs	
01	3/14/2008				1.5	3.4	*4.9*	**4.9**
	3/15/2008	8.0	3.4	*11.5*	5.2	5.7	*10.9*	**22.4**
	3/16/2008	2.3	10.6	*12.9*	5.7	5.4	*11.1*	**24.0**
	3/17/2008	10.5	2.4	*12.9*	10.5	0.5	*11.1*	**24.0**
	3/18/2008	12.2		*12.2*	6.7	4.3	*11.0*	**23.2**
	3/19/2008		12.6	*12.6*	1.1	9.9	*11.0*	**23.6**
	3/20/2008	10.5	0.8	*11.3*	6.0	4.9	*10.9*	**22.3**
	3/21/2008	11.2	2.0	*13.1*	10.9		*10.9*	**24.0**
	3/22/2008				5.4		*5.4*	**5.4**
07	3/22/2008	5.5	3.2	*8.8*	5.3	0.1	*5.4*	**14.1**
	3/23/2008	13.2		*13.2*	10.8		*10.8*	**24.0**
	3/24/2008	5.8	7.2	*13.0*	10.8		*10.8*	**23.8**
	3/25/2008	10.5	2.8	*13.3*	10.7	0.1	*10.7*	**24.0**
	3/26/2008	6.6	6.8	*13.3*	10.7		*10.7*	**24.0**
	3/27/2008	2.0		*2.0*	5.4		*5.4*	**7.3**
13	4/3/2008	5.5	2.4	*7.9*		5.1	*5.1*	**13.1**
	4/4/2008	11.6	2.1	*13.7*	4.6	5.7	*10.3*	**24.0**
	4/5/2008	13.8		*13.8*	3.7	6.6	*10.2*	**24.0**
	4/6/2008	1.4	12.4	*13.8*	3.8	6.4	*10.2*	**24.0**
	4/7/2008	10.7	1.4	*12.2*	3.9	6.3	*10.1*	**22.3**
	4/8/2008	9.6	4.3	*13.9*	5.1	5.1	*10.1*	**24.0**
	4/9/2008	7.2	6.9	*14.0*	5.0	5.0	*10.1*	**24.1**
	4/10/2008	14.0		*14.0*	8.1	2.0	*10.0*	**24.0**
	4/11/2008	8.4		*8.4*	5.1		*5.1*	**13.4**
	4/12/2008	7.4	6.7	*14.1*	9.0	0.9	*9.9*	**24.0**
	4/13/2008	2.4		*2.4*	4.9		*4.9*	**7.4**
19	4/13/2008		3.9	*3.9*		5.0	*5.0*	**8.8**
	4/14/2008	14.2		*14.2*	7.8	2.1	*9.9*	**24.0**
	4/15/2008	14.1		*14.1*	9.8		*9.8*	**23.9**
	4/16/2008	14.3		*14.3*	9.8		*9.8*	**24.0**
	4/17/2008	13.5	0.8	*14.3*	9.7		*9.7*	**24.0**
	4/18/2008	14.3		*14.3*	9.7		*9.7*	**24.0**
	4/19/2008	3.9		*3.9*	4.8		*4.8*	**8.6**
26	4/24/2008	4.3		*4.3*	4.8		*4.8*	**9.1**
	4/25/2008	14.6		*14.6*	9.4		*9.4*	**24.0**
	4/26/2008	14.6		*14.6*	7.9	1.5	*9.4*	**24.0**
	4/27/2008	1.9	12.8	*14.7*	2.8	6.5	*9.3*	**24.0**

Table J-31 (*continued*). Spring 2008 offshore TracScan radar daily operational hours by weather condition.

Sample Grid	Date	Diurnal[1]			Nocturnal[2]			Total Hrs
		Hrs Clear	Hrs Rain[3]	Total Hrs	Hrs Clear	Hrs Rain[3]	Total Hrs	
26	4/28/2008	2.9	11.8	*14.7*	3.2	6.0	*9.3*	**24.0**
	4/29/2008	11.0	3.7	*14.8*	5.0	4.3	*9.3*	**24.0**
	4/30/2008	8.2		*8.2*	4.5		*4.5*	**12.7**
23	4/30/2008	3.1		*3.1*	4.7		*4.7*	**7.7**
	5/1/2008	11.0	3.7	*14.8*	9.2		*9.2*	**23.9**
	5/2/2008	14.9		*14.9*	9.1		*9.1*	**24.0**
	5/3/2008	14.8		*14.9*	8.4	0.7	*9.1*	**24.0**
	5/4/2008	12.1	2.9	*15.0*	4.6	4.5	*9.0*	**24.0**
	5/5/2008	15.0		*15.0*	9.0		*9.0*	**24.0**
	5/6/2008	14.2	0.9	*15.1*	8.5	0.5	*9.0*	**24.0**
	5/7/2008	4.6		*4.6*	4.4		*4.4*	**9.0**
17	5/7/2008	5.4		*5.4*	4.5		*4.5*	**10.0**
	5/8/2008	4.1	11.0	*15.1*	5.1	3.7	*8.9*	**24.0**
	5/9/2008		15.2	*15.2*	0.8	8.0	*8.8*	**24.0**
	5/10/2008	9.3	5.9	*15.2*	8.6	0.2	*8.8*	**24.0**
	5/11/2008	3.0		*3.0*	4.3		*4.3*	**7.3**

[1] Diurnal occurs from Civil Sunrise to Civil Sunset
[2] Nocturnal occurs from Civil Sunset to Civil Sunrise
[3] Rain includes fog, mist, and drizzle
Hrs = Hours

Table J-32. Spring 2008 offshore VerCat radar cumulative median altitude quartiles (ft AMSL) by sample location and surface wind speed.

Grid	Time	Wind Speed (mph)	25% Alt	Median Alt	75% Alt	Bird Count
1	Diurnal	0-8	46	135	1,953	1,054
		9-15	42	59	1,837	1,836
		16+	42	59	86	1,042
7	Diurnal	0-8	33	55	1,654	1,369
		9-15	45	73	241	1,989
		16+	39	54	84	538
13	Diurnal	0-8	68	325	586	5,619
		9-15	152	352	555	18,426
		16+	208	414	3,270	932
19	Diurnal	0-8	94	369	693	9,200
		9-15	60	166	416	2,225
		16+	48	65	201	912
26	Diurnal	0-8	254	448	798	2,383
		9-15	391	713	997	6,486
		16+	582	699	935	2,492
23	Diurnal	0-8	405	1,488	2,460	5,354
		9-15	234	379	649	12,698
		16+	230	366	508	3,578
17	Diurnal	0-8	389	582	831	1,845
		9-15	359	801	3,029	3,233
		16+	233	337	582	3,158
1	Nocturnal	0-8	342	1,113	1,994	2,887
		9-15	538	1,917	2,941	2,676
		16+	54	393	1,560	956
7	Nocturnal	0-8	177	443	843	3,487
		9-15	141	328	599	1,317
		16+	168	1,152	1,847	3,416
13	Nocturnal	0-8	250	421	663	17,620
		9-15	248	473	735	18,426
		16+	923	1,553	2,228	1,448
19	Nocturnal	0-8	181	355	594	25,955
		9-15	185	335	541	6,806
		16+	227	440	609	346
26	Nocturnal	0-8	166	348	578	5,037
		9-15	290	472	663	13,030
		16+	400	613	804	32,810
23	Nocturnal	0-8	343	730	1,679	18,827
		9-15	435	828	1,602	25,754
		16+	304	508	740	30,494
17	Nocturnal	0-8	305	558	889	2,533
		9-15	271	493	739	14,342
		16+	305	552	812	20,429

Table J-33. Spring 2008 offshore daily VerCat radar altitudinal distribution, Sample Grid 1, winds 0 to 8 mph during clear weather conditions.

Date	Diurnal[1]					Nocturnal[2]				
	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]
3/14/2008						54	248	378	466	23
3/15/2008	39	47	176	343	49	2202	2686	3244	2598	628
3/16/2008	42	65	1463	684	157					
3/17/2008	53	67	93	127	102	58	154	595	586	38
3/18/2008	48	1439	2183	1222	746					
3/19/2008										
3/20/2008										
3/21/2008										
3/22/2008						248	937	1365	916	2198
Total	**46**	**135**	**1953**	**995**	**1054**	**342**	**1113**	**1994**	**1274**	**2887**

Alt = Altitude in feet above mean sea level
[1] Diurnal runs from civil sunrise to civil sunset
[2] Nocturnal runs from civil sunset to civil sunrise
[3] Adjusted bird tracks (ratio 0.363). Bird count numbers added and then rounded to nearest whole number. Some bird count columns may not add to bird count number in total because of rounding.
Cells with normal sized text have at least 40 minutes of observations
Cells with small text have between 10 and 39 minutes of observations
Cells with very small text have less than 10 minutes of observations

Table J-34. Spring 2008 offshore daily VerCat radar altitudinal distribution, Sample Grid 1, winds 9 to 15 mph during clear weather conditions.

Date	Diurnal[1]					Nocturnal[2]				
	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]
3/14/2008						2835	3178	3438	2916	241
3/15/2008	43	67	336	511	82	2389	2752	3268	2774	1031
3/16/2008	36	46	55	83	111					
3/17/2008	45	56	82	241	275	69	556	914	611	30
3/18/2008	42	66	2096	986	1368	1338	1585	1948	1757	441
3/19/2008										
3/20/2008										
3/21/2008						97	255	575	433	520
3/22/2008						156	635	1038	682	416
Total	**42**	**59**	**1837**	**799**	**1836**	**2835**	**3178**	**3438**	**2916**	**241**

Alt = Altitude in feet above mean sea level
[1] Diurnal runs from civil sunrise to civil sunset
[2] Nocturnal runs from civil sunset to civil sunrise
[3] Adjusted bird tracks (ratio 0.363). Bird count numbers added and then rounded to nearest whole number. Some bird count columns may not add to bird count number in total because of rounding.
Cells with normal sized text have at least 40 minutes of observations
Cells with small text have between 10 and 39 minutes of observations
Cells with very small text have less than 10 minutes of observations

Table J-35. Spring 2008 offshore daily VerCat radar altitudinal distribution, Sample Grid 1, winds 16+ mph during clear weather conditions.

Date	Diurnal[1]					Nocturnal[2]				
	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]
3/14/2008										
3/15/2008	42	57	75	505	15	2555	2692	2799	2579	15
3/16/2008	35	185	698	712	2	66	1805	2319	1465	374
3/17/2008	46	58	78	179	331	37	57	111	188	185
3/18/2008	980	1172	1372	1041	78	198	702	885	669	121
3/19/2008						58	291	947	529	174
3/20/2008	35	45	65	105	106	44	78	379	258	84
3/21/2008	40	58	83	110	510	57	66	2936	907	3
3/22/2008										
Total	**42**	**59**	**86**	**208**	**1042**	**54**	**393**	**1560**	**857**	**956**

Alt = Altitude in feet above mean sea level
[1] Diurnal runs from civil sunrise to civil sunset
[2] Nocturnal runs from civil sunset to civil sunrise
[3] Adjusted bird tracks (ratio 0.363). Bird count numbers added and then rounded to nearest whole number. Some bird count columns may not add to bird count number in total because of rounding.
Cells with normal sized text have at least 40 minutes of observations
Cells with small text have between 10 and 39 minutes of observations
Cells with very small text have less than 10 minutes of observations

Table J-36. Spring 2008 offshore daily VerCat radar altitudinal distribution, Sample Grid 7, winds 0 to 8 mph during clear weather conditions.

Date	Diurnal[1]					Nocturnal[2]				
	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]
3/22/2008	36	184	1923	1025	859	56	102	246	390	48
3/23/2008	28	41	55	85	405	152	421	1083	644	264
3/24/2008	28	36	46	37	1	80	159	533	388	336
3/25/2008										
3/26/2008	39	63	74	101	14	197	440	894	569	1888
3/27/2008	716	1921	2098	1581	90	270	521	753	558	951
Total	**33**	**55**	**1654**	**773**	**1369**	**177**	**443**	**843**	**552**	**3487**

Alt = Altitude in feet above mean sea level
[1] Diurnal runs from civil sunrise to civil sunset
[2] Nocturnal runs from civil sunset to civil sunrise
[3] Adjusted bird tracks (ratio 0.363). Bird count numbers added and then rounded to nearest whole number. Some bird count columns may not add to bird count number in total because of rounding.
Cells with normal sized text have at least 40 minutes of observations
Cells with small text have between 10 and 39 minutes of observations
Cells with very small text have less than 10 minutes of observations

Table J-37. Spring 2008 offshore daily VerCat radar altitudinal distribution, Sample Grid 7, winds 9 to 15 mph during clear weather conditions.

Date	Diurnal[1]					Nocturnal[2]				
	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]
3/22/2008	30	43	66	494	137	57	119	320	285	108
3/23/2008	32	45	61	92	311	126	467	1180	666	206
3/24/2008	46	72	100	100	591	74	178	719	459	293
3/25/2008	43	54	71	90	347	47	62	91	216	21
3/26/2008	56	242	528	332	74					
3/27/2008	248	342	686	723	530	285	363	572	452	690
Total	**45**	**73**	**241**	**298**	**1989**	**141**	**328**	**599**	**470**	**1317**

Alt = Altitude in feet above mean sea level
[1] Diurnal runs from civil sunrise to civil sunset
[2] Nocturnal runs from civil sunset to civil sunrise
[3] Adjusted bird tracks (ratio 0.363). Bird count numbers added and then rounded to nearest whole number. Some bird count columns may not add to bird count number in total because of rounding.
Cells with normal sized text have at least 40 minutes of observations
Cells with small text have between 10 and 39 minutes of observations
Cells with very small text have less than 10 minutes of observations

Table J-38. Spring 2008 offshore daily VerCat radar altitudinal distribution, Sample Grid 7, winds 16+ mph during clear weather conditions.

Date	Diurnal[1]					Nocturnal[2]				
	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]
3/22/2008						26	42	66	323	12
3/23/2008	33	46	64	66	233	33	44	57	164	132
3/24/2008										
3/25/2008	39	47	66	170	81	587	1409	1984	1314	2445
3/26/2008	49	70	124	155	224	80	594	1431	814	829
3/27/2008										
Total	**39**	**54**	**84**	**118**	**538**	**168**	**1152**	**1847**	**1145**	**3416**

Alt = Altitude in feet above mean sea level
[1] Diurnal runs from civil sunrise to civil sunset
[2] Nocturnal runs from civil sunset to civil sunrise
[3] Adjusted bird tracks (ratio 0.363). Bird count numbers added and then rounded to nearest whole number. Some bird count columns may not add to bird count number in total because of rounding.
Cells with normal sized text have at least 40 minutes of observations
Cells with small text have between 10 and 39 minutes of observations
Cells with very small text have less than 10 minutes of observations

Table J-39. Spring 2008 offshore daily VerCat radar altitudinal distribution, Sample Grid 13, winds 0 to 8 mph during clear weather conditions.

Date	Diurnal[1]					Nocturnal[2]				
	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]
4/3/2008	41	47	55	75	144					
4/4/2008	49	124	368	215	114	182	318	546	582	1101
4/5/2008	43	83	385	231	343	569	2572	3367	2203	640
4/6/2008										
4/7/2008										
4/8/2008										
4/9/2008										
4/10/2008	202	429	661	465	1160	249	434	705	560	4039
4/11/2008	160	335	591	399	3137	255	408	614	462	8773
4/12/2008	221	474	748	1076	398	245	432	678	527	2895
4/13/2008	45	60	432	283	323	329	1075	1728	1042	172
Total	**68**	**325**	**586**	**431**	**5619**	**250**	**421**	**663**	**572**	**17620**

Alt = Altitude in feet above mean sea level
[1] Diurnal runs from civil sunrise to civil sunset
[2] Nocturnal runs from civil sunset to civil sunrise
[3] Adjusted bird tracks (ratio 0.363). Bird count numbers added and then rounded to nearest whole number. Some bird count columns may not add to bird count number in total because of rounding.
Cells with normal sized text have at least 40 minutes of observations
Cells with small text have between 10 and 39 minutes of observations
Cells with very small text have less than 10 minutes of observations

Table J-40. Spring 2008 offshore daily VerCat radar altitudinal distribution, Sample Grid 13, winds 9 to 15 mph during clear weather conditions.

Date	Diurnal[1]					Nocturnal[2]				
	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]
4/3/2008	1965	2595	3383	2432	554					
4/4/2008	58	165	360	334	204	199	420	788	824	1033
4/5/2008	84	230	345	256	650	178	496	734	699	154
4/6/2008										
4/7/2008										
4/8/2008										
4/9/2008	39	850	891	470	4					
4/10/2008	161	360	538	416	406	183	360	604	477	1746
4/11/2008	195	364	555	402	686	236	444	659	481	4908
4/12/2008	187	366	507	454	2271	297	533	807	599	9753
4/13/2008	40	48	64	120	105	140	335	542	439	839
Total	**152**	**352**	**555**	**630**	**4879**	**248**	**473**	**735**	**562**	**18426**

Alt = Altitude in feet above mean sea level
[1] Diurnal runs from civil sunrise to civil sunset
[2] Nocturnal runs from civil sunset to civil sunrise
[3] Adjusted bird tracks (ratio 0.363). Bird count numbers added and then rounded to nearest whole number. Some bird count columns may not add to bird count number in total because of rounding.
Cells with normal sized text have at least 40 minutes of observations
Cells with small text have between 10 and 39 minutes of observations
Cells with very small text have less than 10 minutes of observations

Table J-41. Spring 2008 offshore daily VerCat radar altitudinal distribution, Sample Grid 13, winds 16+ mph during clear weather conditions.

Date	Diurnal[1]					Nocturnal[2]				
	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]
4/3/2008										
4/4/2008	3648	3910	4115	3373	263					
4/5/2008	189	293	443	672	109					
4/6/2008										
4/7/2008										
4/8/2008										
4/9/2008										
4/10/2008	215	399	574	404	179					
4/11/2008										
4/12/2008	171	289	464	323	381	956	1591	2280	1610	1346
4/13/2008						504	1193	1592	1108	102
Total	**208**	**414**	**3270**	**1239**	**932**	**923**	**1553**	**2228**	**1574**	**1448**

Alt = Altitude in feet above mean sea level
[1] Diurnal runs from civil sunrise to civil sunset
[2] Nocturnal runs from civil sunset to civil sunrise
[3] Adjusted bird tracks (ratio 0.363). Bird count numbers added and then rounded to nearest whole number. Some bird count columns may not add to bird count number in total because of rounding.
Cells with normal sized text have at least 40 minutes of observations
Cells with small text have between 10 and 39 minutes of observations
Cells with very small text have less than 10 minutes of observations

Table J-42. Spring 2008 offshore daily VerCat radar altitudinal distribution, Sample Grid 19, winds 0 to 8 mph during clear weather conditions.

Date	Diurnal[1]					Nocturnal[2]				
	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]
4/13/2008										
4/14/2008	59	87	137	443	498	73	145	212	176	715
4/15/2008	39	51	63	130	159	63	117	254	212	848
4/16/2008	35	46	63	179	901	42	104	225	190	1472
4/17/2008	129	258	428	346	1653	161	298	468	337	5928
4/18/2008	111	289	501	360	2118	183	311	435	339	6773
4/19/2008	407	644	955	681	3872	336	587	835	613	10227
Total	**94**	**369**	**693**	**475**	**9200**	**181**	**355**	**594**	**429**	**25955**

Alt = Altitude in feet above mean sea level
[1] Diurnal runs from civil sunrise to civil sunset
[2] Nocturnal runs from civil sunset to civil sunrise
[3] Adjusted bird tracks (ratio 0.363). Bird count numbers added and then rounded to nearest whole number. Some bird count columns may not add to bird count number in total because of rounding.
Cells with normal sized text have at least 40 minutes of observations
Cells with small text have between 10 and 39 minutes of observations
Cells with very small text have less than 10 minutes of observations

Table J-43. Spring 2008 offshore daily VerCat radar altitudinal distribution, Sample Grid 19, winds 9 to 15 mph during clear weather conditions.

Date	Diurnal[1]					Nocturnal[2]				
	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]
4/13/2008										
4/14/2008	57	89	135	283	721	88	186	241	245	761
4/15/2008	47	56	83	213	258	148	253	449	357	193
4/16/2008	49	316	758	415	124	111	270	533	338	248
4/17/2008	165	294	479	365	376	126	223	455	290	228
4/18/2008	208	347	543	432	745	210	352	523	395	3592
4/19/2008						237	446	700	497	1784
Total	**60**	**166**	**416**	**346**	**2225**	**185**	**335**	**541**	**398**	**6806**

Alt = Altitude in feet above mean sea level
[1] Diurnal runs from civil sunrise to civil sunset
[2] Nocturnal runs from civil sunset to civil sunrise
[3] Adjusted bird tracks (ratio 0.363). Bird count numbers added and then rounded to nearest whole number. Some bird count columns may not add to bird count number in total because of rounding.
Cells with normal sized text have at least 40 minutes of observations
Cells with small text have between 10 and 39 minutes of observations
Cells with very small text have less than 10 minutes of observations

Table J-44. Spring 2008 offshore daily VerCat radar altitudinal distribution, Sample Grid 19, winds 16+ mph during clear weather conditions.

Date	Diurnal[1]					Nocturnal[2]				
	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]
4/13/2008	40									

Table J-45. Spring 2008 offshore daily VerCat radar altitudinal distribution, Sample Grid 26, winds 0 to 8 mph during clear weather conditions.

Date	Diurnal[1]					Nocturnal[2]				
	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]
4/24/2008	181	297	390	315	291	149	270	470	368	1910
4/25/2008	259	460	707	514	1733	181	402	623	451	1611
4/26/2008	478	719	974	734	282	300	478	677	509	123
4/27/2008										
4/28/2008										
4/29/2008						189	409	646	475	1394
4/30/2008	117	332	474	357	78					
Total	**254**	**448**	**708**	**510**	**2383**	**166**	**348**	**578**	**428**	**5037**

Alt = Altitude in feet above mean sea level
[1] Diurnal runs from civil sunrise to civil sunset
[2] Nocturnal runs from civil sunset to civil sunrise
[3] Adjusted bird tracks (ratio 0.363). Bird count numbers added and then rounded to nearest whole number. Some bird count columns may not add to bird count number in total because of rounding.
Cells with normal sized text have at least 40 minutes of observations
Cells with small text have between 10 and 39 minutes of observations
Cells with very small text have less than 10 minutes of observations

Table J-46. Spring 2008 offshore daily VerCat radar altitudinal distribution, Sample Grid 26, winds 9 to 15 mph during clear weather conditions.

Date	Diurnal[1]					Nocturnal[2]				
	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]
4/24/2008	147	255	383	282	477	154	358	619	443	121
4/25/2008	388	576	1081	677	207	274	472	654	490	5818
4/26/2008	521	819	1041	783	4718	329	505	738	548	3981
4/27/2008										
4/28/2008	362	596	928	940	574	386	532	663	558	571
4/29/2008	83	2512	3151	1790	48	287	476	829	717	722
4/30/2008	250	368	498	396	462	268	389	537	410	1822
Total	**391**	**713**	**997**	**737**	**6486**	**290**	**472**	**663**	**512**	**13030**

Alt = Altitude in feet above mean sea level
[1] Diurnal runs from civil sunrise to civil sunset
[2] Nocturnal runs from civil sunset to civil sunrise
[3] Adjusted bird tracks (ratio 0.363). Bird count numbers added and then rounded to nearest whole number. Some bird count columns may not add to bird count number in total because of rounding.
Cells with normal sized text have at least 40 minutes of observations
Cells with small text have between 10 and 39 minutes of observations
Cells with very small text have less than 10 minutes of observations

Table J-47. Spring 2008 offshore daily VerCat radar altitudinal distribution, Sample Grid 26, winds 16+ mph during clear weather conditions.

Date	Diurnal[1]					Nocturnal[2]				
	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]
4/24/2008										
4/25/2008										
4/26/2008	590	683	817	723	1690	395	624	807	631	1360
4/27/2008	665	898	1105	885	635	387	588	803	607	1632
4/28/2008	436	670	988	957	90	517	644	784	643	291
4/29/2008	67	215	411	359	77					
4/30/2008										
Total	**582**	**699**	**935**	**761**	**2492**	**400**	**613**	**804**	**620**	**3280**

Alt = Altitude in feet above mean sea level
[1] Diurnal runs from civil sunrise to civil sunset
[2] Nocturnal runs from civil sunset to civil sunrise
[3] Adjusted bird tracks (ratio 0.363). Bird count numbers added and then rounded to nearest whole number. Some bird count columns may not add to bird count number in total because of rounding.
Cells with normal sized text have at least 40 minutes of observations
Cells with small text have between 10 and 39 minutes of observations
Cells with very small text have less than 10 minutes of observations

Table J-48. Spring 2008 offshore daily VerCat radar altitudinal distribution, Sample Grid 23, winds 0 to 8 mph during clear weather conditions.

Date	Diurnal[1]					Nocturnal[2]				
	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]
4/30/2008	98	682	3088	1289	1					
5/1/2008	657	1986	2923	1914	2179	637	1264	1942	1329	2769
5/2/2008	226	362	507	388	428					
5/3/2008	339	412	432	414	3	410	586	843	629	1068
5/4/2008	148	451	1164	805	548	172	309	512	367	2570
5/5/2008	112	254	1598	791	197	254	403	713	679	4034
5/6/2008	1096	1899	2510	1875	1559	735	1500	2731	2313	5742
5/7/2008	139	625	1908	1196	439	356	961	1922	1287	2645
Total	**405**	**1488**	**2460**	**1566**	**5354**	**343**	**730**	**1679**	**1313**	**18827**

Alt = Altitude in feet above mean sea level
[1] Diurnal runs from civil sunrise to civil sunset
[2] Nocturnal runs from civil sunset to civil sunrise
[3] Adjusted bird tracks (ratio 0.363). Bird count numbers added and then rounded to nearest whole number. Some bird count columns may not add to bird count number in total because of rounding.
Cells with normal sized text have at least 40 minutes of observations
Cells with small text have between 10 and 39 minutes of observations
Cells with very small text have less than 10 minutes of observations

Table J-49. Spring 2008 offshore daily VerCat radar altitudinal distribution, Sample Grid 23, winds 9 to 15 mph during clear weather conditions.

Date	Diurnal[1]					Nocturnal[2]				
	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]
4/30/2008	173	740	1266	814	90	675	1134	1926	1330	3602
5/1/2008	507	2293	3065	2011	157	584	1068	1937	1289	2401
5/2/2008	205	332	479	364	2937					
5/3/2008	254	348	490	402	5139	325	525	761	551	6074
5/4/2008	124	296	755	600	898	178	290	479	352	470
5/5/2008	109	259	653	578	1105	468	929	1757	1548	3346
5/6/2008	479	1080	1732	1199	1709	591	1210	2209	1669	6298
5/7/2008	644	1438	2229	1532	664	395	1011	1837	1227	3574
Total	**234**	**379**	**649**	**612**	**12698**	**435**	**828**	**1602**	**1221**	**25754**

Alt = Altitude in feet above mean sea level
[1] Diurnal runs from civil sunrise to civil sunset
[2] Nocturnal runs from civil sunset to civil sunrise
[3] Adjusted bird tracks (ratio 0.363). Bird count numbers added and then rounded to nearest whole number. Some bird count columns may not add to bird count number in total because of rounding.
Cells with normal sized text have at least 40 minutes of observations
Cells with small text have between 10 and 39 minutes of observations
Cells with very small text have less than 10 minutes of observations

Table J-50. Spring 2008 offshore daily VerCat radar altitudinal distribution, Sample Grid 23, winds 16+ mph during clear weather conditions.

Date	Diurnal[1]					Nocturnal[2]				
	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]
4/30/2008	623	634	634	629	1	525	584	1038	716	1
5/1/2008	339	420	531	666	611	336	522	743	546	7200
5/2/2008	213	348	516	390	1586	290	505	748	538	17576
5/3/2008	260	359	469	382	773	307	500	715	607	5694
5/4/2008										
5/5/2008	57	263	505	331	514					
5/6/2008	244	523	950	749	93	495	965	1447	979	38
5/7/2008										
Total	**230**	**366**	**508**	**436**	**3578**	**304**	**508**	**740**	**553**	**30497**

Alt = Altitude in feet above mean sea level
[1] Diurnal runs from civil sunrise to civil sunset
[2] Nocturnal runs from civil sunset to civil sunrise
[3] Adjusted bird tracks (ratio 0.363). Bird count numbers added and then rounded to nearest whole number. Some bird count columns may not add to bird count number in total because of rounding.
Cells with normal sized text have at least 40 minutes of observations
Cells with small text have between 10 and 39 minutes of observations
Cells with very small text have less than 10 minutes of observations

Table J-51. Spring 2008 offshore Daily VerCat radar altitudinal distribution, Sample Grid 17, winds 0 to 8 mph during clear weather conditions.

Date	Diurnal[1]					Nocturnal[2]				
	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]
5/7/2008										
5/8/2008						296	532	848	727	1550
5/9/2008						326	642	2956	1322	788
5/10/2008	1762	2194	2689	2105	396					
5/11/2008	356	509	658	521	1449	288	484	679	501	200
Total	**389**	**582**	**831**	**861**	**1845**	**305**	**558**	**889**	**895**	**2533**

Alt = Altitude in feet above mean sea level
[1] Diurnal runs from civil sunrise to civil sunset
[2] Nocturnal runs from civil sunset to civil sunrise
[3] Adjusted bird tracks (ratio 0.363). Bird count numbers added and then rounded to nearest whole number. Some bird count columns may not add to bird count number in total because of rounding.
Cells with normal sized text have at least 40 minutes of observations
Cells with small text have between 10 and 39 minutes of observations
Cells with very small text have less than 10 minutes of observations

Table J-52. Spring 2008 offshore Daily VerCat radar altitudinal distribution, Sample Grid 17, winds 9 to 15 mph during clear weather conditions.

Date	Diurnal[1]					Nocturnal[2]				
	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]
5/7/2008	208	329	432	356	77					
5/8/2008						304	546	883	733	2363
5/9/2008										
5/10/2008	385	1977	3146	1764	2915	280	503	734	525	3563
5/11/2008	312	390	520	451	241	258	478	711	497	8424
Total	**359**	**801**	**3029**	**1633**	**3233**	**271**	**493**	**739**	**543**	**14342**

Alt = Altitude in feet above mean sea level
[1] Diurnal runs from civil sunrise to civil sunset
[2] Nocturnal runs from civil sunset to civil sunrise
[3] Adjusted bird tracks (ratio 0.363). Bird count numbers added and then rounded to nearest whole number. Some bird count columns may not add to bird count number in total because of rounding.
Cells with normal sized text have at least 40 minutes of observations
Cells with small text have between 10 and 39 minutes of observations
Cells with very small text have less than 10 minutes of observations

Table J-53. Spring 2008 offshore Daily VerCat radar altitudinal distribution, Sample Grid 17, winds 16+ mph during clear weather conditions.

Date	Diurnal[1]					Nocturnal[2]				
	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]
5/7/2008	158	301	488	364	608	332	600	853	611	7228
5/8/2008	231	350	494	412	2056	304	565	866	685	6724
5/9/2008						274	438	596	451	433
5/10/2008	741	2877	3516	2421	494	282	495	731	517	6060
5/11/2008					608					
Total	**233**	**377**	**582**	**717**	**3158**	**305**	**552**	**812**	**604**	**20429**

Alt = Altitude in feet above mean sea level
[1] Diurnal runs from civil sunrise to civil sunset
[2] Nocturnal runs from civil sunset to civil sunrise
[3] Adjusted bird tracks (ratio 0.363). Bird count numbers added and then rounded to nearest whole number. Some bird count columns may not add to bird count number in total because of rounding.
Cells with normal sized text have at least 40 minutes of observations
Cells with small text have between 10 and 39 minutes of observations
Cells with very small text have less than 10 minutes of observations

Table J-54. Spring 2008 offshore TracScan Radar Cumulative Flux and Flux Direction[1] during clear weather conditions.

Grid	Date	Time	Wind Speed[2]	Total	N	NE	E	SE	S	SW	W	NW
1	14-21 Mar.	Diurnal	0-8	7.8	1.8	1.8	0.8	0.6	0.7	0.6	0.5	1.0
			9-16	5.1	1.0	0.8	0.5	0.7	0.7	0.5	0.4	0.7
			16+	0.9	0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.1
		Nocturnal	0-8	8.1	2.4	2.1	0.5	0.3	0.4	0.3	0.7	1.5
			9-16	4.0	1.0	1.5	0.4	0.2	0.2	0.1	0.2	0.3
			16+	-	-	-	-	-	-	-	-	-
7	22-27 Mar.	Diurnal	0-8	11.5	1.1	1.8	1.3	0.9	1.3	2.5	1.7	0.9
			9-16	6.4	0.6	0.7	0.5	0.4	0.8	1.8	1.1	0.5
			16+	2.4	0.4	0.5	0.2	0.2	0.3	0.4	0.3	0.2
		Nocturnal	0-8	4.4	0.9	1.8	0.6	0.2	0.1	0.1	0.2	0.5
			9-16	2.8	0.2	1.0	0.6	0.1	0.1	0.2	0.2	0.4
			16+	0.6	0.1	0.1	0.0	0.0	0.1	0.1	0.1	0.1
13	3-13 Apr.	Diurnal	0-8	11.3	1.9	2.6	1.4	1.0	1.0	1.1	1.0	1.3
			9-16	4.3	0.7	1.3	0.5	0.3	0.4	0.4	0.3	0.3
			16+	1.0	0.2	0.3	0.1	0.1	0.1	0.1	0.1	0.1
		Nocturnal	0-8	6.5	1.5	2.4	0.8	0.5	0.3	0.2	0.2	0.5
			9-16	2.6	0.6	1.0	0.3	0.2	0.1	0.1	0.1	0.2
			16+	0.4	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0
19	13-19 Apr.	Diurnal	0-8	10.2	2.2	2.5	1.2	0.8	0.8	0.8	0.8	1.2
			9-16	7.6	1.2	1.4	0.8	0.6	0.8	1.1	0.8	0.9
			16+	2.6	0.2	0.2	0.1	0.2	0.4	0.7	0.4	0.3
		Nocturnal	0-8	9.1	2.2	4.5	1.0	0.3	0.2	0.2	0.2	0.5
			9-16	9.7	2.2	4.8	1.1	0.3	0.2	0.2	0.2	0.5
			16+	0.5	0.0	0.0	0.0	0.1	0.1	0.2	0.0	0.0
26	24-30 Apr.	Diurnal	0-8	1.5	0.4	0.4	0.1	0.1	0.1	0.1	0.1	0.2
			9-16	1.7	0.5	0.4	0.1	0.1	0.1	0.1	0.1	0.3
			16+	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		Nocturnal	0-8	6.0	2.2	2.3	0.3	0.2	0.3	0.1	0.1	0.5
			9-16	4.4	1.7	1.0	0.2	0.1	0.2	0.1	0.3	0.8
			16+	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1
23	30 Apr-7 May	Diurnal	0-8	6.1	1.3	1.4	0.7	0.5	0.5	0.4	0.5	0.8
			9-16	3.6	0.7	0.7	0.5	0.3	0.3	0.3	0.4	0.5
			16+	2.4	0.5	0.3	0.1	0.2	0.2	0.3	0.3	0.4
		Nocturnal	0-8	5.3	1.5	1.7	0.4	0.3	0.3	0.2	0.3	0.6
			9-16	7.2	1.9	2.7	0.6	0.5	0.3	0.2	0.3	0.7
			16+	0.8	0.2	0.2	0.1	0.0	0.0	0.0	0.1	0.1
17	7-11 May	Diurnal	0-8	14.1	1.6	1.6	1.8	2.4	2.2	1.7	1.3	1.5
			9-16	5.0	0.8	0.9	0.7	0.6	0.5	0.4	0.4	0.7
			16+	3.1	0.7	0.9	0.4	0.2	0.2	0.1	0.2	0.4
		Nocturnal	0-8	6.2	1.4	1.6	0.5	0.4	0.4	0.5	0.6	0.6
			9-16	1.3	0.3	0.5	0.2	0.1	0.1	0.0	0.1	0.1
			16+	0.9	0.2	0.3	0.1	0.1	0.1	0.0	0.0	0.1

[1] Adjusted bird tracks per cubic kilometer per hour
[2] mph

Table J-55. Spring 2008 offshore cumulative wind direction (by percentage) by wind speed for each sampling site.

Site	Dates	Time/Wind Speed	N	NE	E	SE	S	SW	W	NW
A Grid 01	Mar-14 to Mar-22	**Diurnal**	**13%**	**4%**	**42%**	**7%**	**14%**	**4%**	**8%**	**8%**
		0-8 mph	4%	6%	10%	6%	16%	17%	12%	30%
		9-15 mph	20%	11%	5%	11%	14%	6%	20%	13%
		16+ mph	11%		71%	4%	14%			1%
		Nocturnal	**1%**	**15%**	**35%**	**27%**	**1%**	**18%**	**1%**	**2%**
		0-8 mph		25%	30%	28%	3%	14%		
		9-15 mph		29%	30%	7%	1%	20%	4%	8%
		16+ mph	1%	5%	40%	36%		18%		
B Grid 07	Mar-22 to Mar-27	**Diurnal**	**23%**	**10%**	**6%**		**5%**	**12%**	**30%**	**13%**
		0-8 mph	32%	9%					21%	38%
		9-15 mph	22%	7%			6%	21%	36%	7%
		16+ mph	16%	17%	26%		9%	5%	26%	
		Nocturnal	**12%**	**26%**	**8%**	**5%**	**23%**	**17%**	**9%**	
		0-8 mph	19%	15%	14%	8%	16%	18%	9%	
		9-15 mph	11%	14%	12%	7%	26%	27%	3%	
		16+ mph	6%	44%			26%	10%	14%	
C Grid 13	Apr-03 to Apr-13	**Diurnal**	**6%**	**23%**	**13%**	**5%**	**8%**	**5%**	**34%**	**6%**
		0-8 mph	15%	24%	10%	7%	10%	9%	14%	11%
		9-15 mph	4%	34%	21%	7%	8%	4%	16%	5%
		16+ mph		8%	6%	2%	5%	1%	79%	
		Nocturnal		**27%**	**14%**	**2%**	**13%**	**6%**	**36%**	**2%**
		0-8 mph		38%	19%	1%	9%	19%	8%	7%
		9-15 mph		28%	17%	3%	15%		37%	1%
		16+ mph		3%		2%	13%		83%	
D Grid 19	Apr-13 to Apr-19	**Diurnal**	**19%**	**14%**	**1%**	**2%**	**9%**	**9%**	**27%**	**19%**
		0-8 mph	21%	20%	2%	2%	4%	4%	22%	25%
		9-15 mph	27%	7%		3%	11%	9%	28%	14%
		16+ mph					28%	31%	42%	
		Nocturnal	**19%**	**34%**	**5%**	**6%**	**18%**	**7%**	**3%**	**7%**
		0-8 mph	22%	37%	7%	5%	8%	8%	5%	10%
		9-15 mph	19%	39%	3%	13%	24%	2%		
		16+ mph					88%	12%		
E grid 26	Apr-24 to Apr-30	**Diurnal**	**16%**	**2%**	**5%**	**14%**	**2%**	**11%**	**29%**	**20%**
		0-8 mph	18%	3%			3%	7%	37%	32%
		9-15 mph	25%	4%		10%	4%	18%	16%	23%
		16+ mph	5%		16%	34%		7%	36%	3%

Table J-55 (*continued*). Spring 2008 offshore cumulative wind direction (by percentage) by wind speed for each sampling site.

Site	Dates	Time/Wind Speed	N	NE	E	SE	S	SW	W	NW
E grid 26	Apr-24 to Apr-30	**Nocturnal**	**20%**	**6%**	**6%**	**4%**	**0%**	**26%**	**18%**	**20%**
		0-8 mph	44%	20%	8%	6%	0%	8%	1%	14%
		9-15 mph	15%	1%	8%	5%		30%	6%	34%
		16+ mph	2%					37%	61%	
F Grid 23	Apr-30 to May-07	**Diurnal**	**21%**	**11%**	**10%**	**3%**	**3%**	**13%**	**21%**	**18%**
		0-8 mph	19%	8%	34%	3%	5%	4%	13%	14%
		9-15 mph	22%	13%	4%	4%	3%	19%	17%	19%
		16+ mph	20%	6%				6%	47%	20%
		Nocturnal	**15%**	**48%**	**11%**	**1%**	**2%**	**5%**	**17%**	**1%**
		0-8 mph	12%	49%	20%	2%	7%	4%	4%	2%
		9-15 mph	9%	62%	11%			8%	11%	
		16+ mph	28%	30%				2%	41%	
G Grid 17	May-07 to May-11	**Diurnal**	**23%**	**33%**	**4%**	**3%**	**18%**	**20%**		
		0-8 mph		11%		18%	51%	20%		
		9-15 mph	4%	37%			28%	31%		
		16+ mph	45%	37%	8%			10%		
		Nocturnal	**5%**	**53%**	**9%**	**13%**	**20%**			
		0-8 mph		24%	49%	15%	12%			
		9-15 mph		39%	17%	32%	13%			
		16+ mph	9%	65%			26%			

Table J-56. Fall 2008 VerCat offshore radar daily operational hours by weather condition.

Sample Grid	Date	Diurnal[1]			Nocturnal[2]			Total Hrs
		Hrs Clear	Hrs Rain[3]	Total Hrs	Hrs Clear	Hrs Rain[3]	Total Hrs	
23	9/30/2008		0.3	*0.3*	5.4	0.4	*5.8*	**6.2**
	10/1/2008	9.3	3.1	*12.4*	5.8	5.3	*11.1*	**23.5**
	10/2/2008	12.5		*12.5*	11.0	0.4	*11.4*	**23.9**
	10/3/2008	12.5		*12.5*	11.4		*11.4*	**23.9**
	10/4/2008	12.5		*12.5*	11.5		*11.5*	**24.0**
	10/5/2008	12.3		*12.3*	11.5		*11.5*	**23.8**
	10/6/2008	12.5		*12.5*	11.5		*11.5*	**24.0**
	10/7/2008	12.4		*12.4*	11.6		*11.6*	**24.0**
	10/8/2008	12.2		*12.2*	10.8	0.8	*11.6*	**23.8**
	10/9/2008	4.5	4.2	*8.7*	6.8	4.5	*11.2*	**19.9**
	10/10/2008	12.3		*12.3*	11.7		*11.7*	**24.0**
	10/11/2008	12.3		*12.3*	11.8		*11.8*	**24.0**
	10/12/2008	4.5		*4.5*	5.6		*5.6*	**10.1**
26	10/12/2008	4.5		*4.5*	6.2		*6.2*	**10.6**
	10/13/2008	12.1		*12.1*	11.8		*11.8*	**24.0**
	10/14/2008	12.2		*12.2*	11.9		*11.9*	**24.0**
	10/15/2008	11.1		*11.1*	11.9		*11.9*	**23.0**
	10/16/2008	11.6	0.1	*11.8*	10.6	1.2	*11.8*	**23.6**
	10/17/2008	10.2	1.8	*12.0*	5.1	6.8	*11.9*	**23.9**
	10/18/2008	4.5	7.1	*11.6*	11.6	0.4	*12.0*	**23.6**
	10/19/2008	8.5	0.7	*9.2*	5.7		*5.7*	**14.9**

[1] Diurnal occurs from Civil Sunrise to Civil Sunset
[2] Nocturnal occurs from Civil Sunset to Civil Sunrise
[3] Rain includes fog, mist, and drizzle
Hrs = Hours

Table J-57. Fall 2008 TracScan offshore radar daily operational hours by weather type.

Sample Grid	Date	Diurnal[1]			Nocturnal[2]			Total Hrs
		Hrs Clear	Hrs Rain[3]	Total Hrs	Hrs Clear	Hrs Rain[3]	Total Hrs	
23	9/30/2008	0.1	0.8	*1.0*	5.4	0.4	*5.8*	**6.8**
	10/1/2008	9.3	3.1	*12.3*	5.8	5.5	*11.3*	**23.7**
	10/2/2008	11.9		*11.9*	11.0	0.4	*11.4*	**23.3**
	10/3/2008	12.4		*12.4*	11.4		*11.4*	**23.8**
	10/4/2008	12.5		*12.5*	11.3		*11.3*	**23.8**
	10/5/2008	12.4		*12.4*	11.5		*11.5*	**23.9**
	10/6/2008	12.5		*12.5*	11.5		*11.5*	**24.0**
	10/7/2008	12.4		*12.4*	11.6		*11.6*	**24.0**
	10/8/2008	12.4		*12.4*	10.9	0.8	*11.6*	**24.0**
	10/9/2008	5.6	6.0	*11.6*	6.8	4.9	*11.7*	**23.2**
	10/10/2008	12.3		*12.3*	11.7		*11.7*	**24.0**
	10/11/2008	12.2		*12.2*	11.7		*11.7*	**24.0**
	10/12/2008	4.5		*4.5*	5.6		*5.6*	**10.1**
26	10/12/2008	4.8		*4.8*	6.2		*6.2*	**10.9**
	10/13/2008	12.1		*12.1*	11.8		*11.8*	**23.9**
	10/14/2008	12.1		*12.1*	11.9		*11.9*	**23.9**
	10/15/2008	10.9		*10.9*	11.9		*11.9*	**22.8**
	10/16/2008	11.9	0.1	*12.0*	10.6	1.3	*11.9*	**23.9**
	10/17/2008	10.2	1.8	*12.0*	5.1	6.9	*12.0*	**24.0**
	10/18/2008		1.3	*1.3*	5.3	0.4	*5.7*	**7.0**

[1] Diurnal occurs from Civil Sunrise to Civil Sunset
[2] Nocturnal occurs from Civil Sunset to Civil Sunrise
[3] Rain includes fog, mist, and drizzle
Hrs = Hours

Table J-58. Fall 2008 daily offshore VerCat altitudinal distribution, Sample Grid 23, winds 0 to 8 mph during clear weather conditions.

Date	Diurnal[1]					Nocturnal[2]				
	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]
9/30/2008										
10/1/2008	283	485	692	497	3107	214	386	599	422	2415
10/2/2008	369	456	556	473	678	251	449	644	468	1106
10/3/2008	246	431	645	473	163	195	392	643	423	1441
10/4/2008	251	378	518	396	5244	218	300	421	368	142
10/5/2008	350	555	740	549	5475	291	483	665	488	3744
10/6/2008	271	395	533	409	2619	260	428	612	460	6217
10/7/2008	179	297	411	317	3370	243	379	617	468	2510
10/8/2008	236	407	583	419	248	242	435	657	470	1538
10/9/2008										
10/10/2008	348	483	669	510	1663	261	417	629	484	5699
10/11/2008						213	403	670	487	5562
10/12/2008	333	468	683	523	684	286	431	643	485	1521
Total	**271**	**419**	**605**	**451**	**23251**	**246**	**421**	**637**	**470**	**31884**

Alt = Altitude in feet above mean sea level
[1] Diurnal runs from civil sunrise to civil sunset
[2] Nocturnal runs from civil sunset to civil sunrise
[3] Adjusted bird tracks (ratio 0.363). Bird count numbers added and then rounded to nearest whole number. Some bird count columns may not add to bird count number in total because of rounding.
Cells with normal sized text have at least 40 minutes of observations
Cells with small text have between 10 and 39 minutes of observations
Cells with very small text have less than 10 minutes of observations

Table J-59. Fall 2008 daily Offshore VerCat altitudinal distribution, Sample Grid 23, winds 9 to 15 mph during clear weather conditions.

Date	Diurnal[1]					Nocturnal[2]				
	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]
9/30/2008						176	260	413	342	423
10/1/2008	347	527	734	582	1641	233	413	611	437	926
10/2/2008	325	447	556	445	787	229	428	637	465	918
10/3/2008	401	568	729	567	4838	254	474	661	477	4988
10/4/2008	234	334	431	354	1236	164	345	604	413	3972
10/5/2008	259	451	654	469	1061	328	535	706	524	5311
10/6/2008	297	443	596	459	5886	226	364	520	392	3079
10/7/2008	147	283	435	328	1367	263	407	657	481	1115
10/8/2008	247	408	612	441	972	270	493	721	526	1857
10/9/2008	355	545	738	561	2171	268	487	702	514	3025
10/10/2008	308	453	646	487	4678	277	430	641	477	3828
10/11/2008	299	424	575	453	4528	199	363	583	414	2553
10/12/2008	216	422	560	410	291	303	450	666	538	309
Total	**303**	**456**	**636**	**483**	**29456**	**245**	**434**	**649**	**467**	**32293**

Alt = Altitude in feet above mean sea level
[1] Diurnal runs from civil sunrise to civil sunset
[2] Nocturnal runs from civil sunset to civil sunrise
[3] Adjusted bird tracks (ratio 0.363). Bird count numbers added and then rounded to nearest whole number. Some bird count columns may not add to bird count number in total because of rounding.
Cells with normal sized text have at least 40 minutes of observations
Cells with small text have between 10 and 39 minutes of observations
Cells with very small text have less than 10 minutes of observations

Table J-60. Fall 2008 daily offshore VerCat altitudinal distribution, Sample Grid 23, winds 16+ mph during clear weather conditions.

Date	Diurnal[1]					Nocturnal[2]				
	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]
9/30/2008						299	467	642	489	1017
10/1/2008						219	423	569	425	203
10/2/2008	174	395	579	419	1353	291	471	689	504	3322
10/3/2008	382	553	705	549	3057	338	546	721	541	570
10/4/2008						400	602	796	630	231
10/5/2008	242	372	599	437	209					
10/6/2008						235	435	668	475	5020
10/7/2008	342	469	599	479	1168	230	394	604	438	7234
10/8/2008	485	589	683	563	864	340	413	657	478	534
10/9/2008	312	508	804	561	138	262	365	514	421	132
10/10/2008	262	366	637	437	2271					
10/11/2008	262	406	550	426	2507					
10/12/2008										
Total	**296**	**459**	**637**	**477**	**11566**	**250**	**430**	**648**	**470**	**18258**

Alt = Altitude in feet above mean sea level
[1] Diurnal runs from civil sunrise to civil sunset
[2] Nocturnal runs from civil sunset to civil sunrise
[3] Adjusted bird tracks (ratio 0.363). Bird count numbers added and then rounded to nearest whole number. Some bird count columns may not add to bird count number in total because of rounding.
Cells with normal sized text have at least 40 minutes of observations
Cells with small text have between 10 and 39 minutes of observations
Cells with very small text have less than 10 minutes of observations

Table J-61. Fall 2008 daily offshore VerCat radar altitudinal distribution, Sample Grid 26, winds 0 to 8 mph during clear weather conditions.

Date	Diurnal[1]					Nocturnal[2]				
	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]
10/12/2008	261	370	542	421	870	259	422	695	526	2472
10/13/2008						254	445	715	507	3022
10/14/2008	292	414	652	489	992	310	514	770	561	2966
10/15/2008	301	453	652	485	907	173	471	656	441	83
10/16/2008										
10/17/2008										
10/18/2008										
10/19/2008										
Total	**280**	**413**	**622**	**467**	**2769**	**275**	**458**	**726**	**530**	**8541**

Alt = Altitude in feet above mean sea level
[1] Diurnal runs from civil sunrise to civil sunset
[2] Nocturnal runs from civil sunset to civil sunrise
[3] Adjusted bird tracks (ratio 0.363). Bird count numbers added and then rounded to nearest whole number. Some bird count columns may not add to bird count number in total because of rounding.
Cells with normal sized text have at least 40 minutes of observations
Cells with small text have between 10 and 39 minutes of observations
Cells with very small text have less than 10 minutes of observations

Table J-62. Fall 2008 daily offshore VerCat radar altitudinal distribution, Sample Grid 26, winds 9 to 15 mph during clear weather conditions.

Date	Diurnal[1]					Nocturnal[2]				
	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]
10/12/2008										
10/13/2008	309	465	657	492	3897	290	466	691	510	3261
10/14/2008	329	433	632	498	942	249	468	719	517	1271
10/15/2008	292	419	606	466	2663	304	489	786	571	6766
10/16/2008	293	443	596	454	739	183	379	615	443	2066
10/17/2008	339	794	1521	1149	913					
10/18/2008						183	367	574	395	570
10/19/2008										
Total	**306**	**457**	**668**	**547**	**9154**	**270**	**463**	**711**	**526**	**13930**

Alt = Altitude in feet above mean sea level
[1] Diurnal runs from civil sunrise to civil sunset
[2] Nocturnal runs from civil sunset to civil sunrise
[3] Adjusted bird tracks (ratio 0.363). Bird count numbers added and then rounded to nearest whole number. Some bird count columns may not add to bird count number in total because of rounding.
Cells with normal sized text have at least 40 minutes of observations
Cells with small text have between 10 and 39 minutes of observations
Cells with very small text have less than 10 minutes of observations

Table J-63. Fall 2008 daily offshore VerCat radar altitudinal distribution, Sample Grid 26, winds 16+ mph during clear weather conditions.

Date	Diurnal[1]					Nocturnal[2]				
	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]
10/12/2008										
10/13/2008	341	481	609	485	989					
10/14/2008	316	543	793	557	995	200	418	764	501	1275
10/15/2008	266	372	462	386	743					
10/16/2008	193	333	498	380	1322	307	490	676	508	2493
10/17/2008	271	539	766	597	4234	349	532	709	547	4591
10/18/2008	325	600	747	538	917	228	393	564	416	4651
10/19/2008	53	91	352	254	752	267	405	548	420	1501
Total	**244**	**461**	**680**	**506**	**9953**	**275**	**455**	**640**	**481**	**14507**

Alt = Altitude in feet above mean sea level
[1] Diurnal runs from civil sunrise to civil sunset
[2] Nocturnal runs from civil sunset to civil sunrise
[3] Adjusted bird tracks (ratio 0.363). Bird count numbers added and then rounded to nearest whole number. Some bird count columns may not add to bird count number in total because of rounding.
Cells with normal sized text have at least 40 minutes of observations
Cells with small text have between 10 and 39 minutes of observations
Cells with very small text have less than 10 minutes of observations

Table J-64. Fall 2008 offshore TracScan Flux and Flux Direction[1] during clear weather conditions.

Grid	Date	Time	Wind Speed[2]	Total	N	NE	E	SE	S	SW	W	NW
22	30 Sept.-12 Oct.	Diurnal	0-8	3.7	0.4	0.4	0.4	0.4	0.4	0.6	0.6	0.5
			9-16	2.6	0.3	0.2	0.2	0.3	0.3	0.6	0.5	0.3
			16+	1.2	0.2	0.1	0.1	0.1	0.1	0.3	0.2	0.2
		Nocturnal	0-8	13.5	1.3	1.2	1.2	1.9	2.9	2.8	1.2	1.1
			9-16	11.0	1.1	1.2	0.9	1.3	1.9	2.3	1.1	1.0
			16+	4.1	0.4	0.4	0.3	0.5	1.0	0.8	0.4	0.4
26	12 -19 Oct.	Diurnal	0-8	2.5	0.5	0.3	0.2	0.2	0.2	0.2	0.3	0.6
			9-16	1.1	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.2
			16+	0.7	0.1	0.1	0.1	0.1	0.1	0.2	0.1	0.1
		Nocturnal	0-8	3.5	0.5	0.6	0.4	0.4	0.5	0.5	0.3	0.3
			9-16	3.0	0.3	0.2	0.3	0.7	0.7	0.4	0.2	0.2
			16+	0.6	0.1	0.0	0.0	0.1	0.1	0.1	0.1	0.0

[1] Adjusted bird tracks per cubic kilometer per hour
[2] mph

Table J-65. Fall 2008 offshore cumulative wind direction (by percentage) by wind speed for site.

Site	Dates	Time/Wind Speed	N	NE	E	SE	S	SW	W	NW
A Grid 23	Sep-30 to Oct-12	**Diurnal**	**6%**	**22%**	**9%**	**8%**	**5%**	**26%**	**20%**	**4%**
		0-8 mph	6%	16%	12%	10%	3%	12%	39%	2%
		9-15 mph	5%	21%	11%	10%	6%	34%	6%	6%
		16+ mph	9%	32%	2%	2%	5%	30%	19%	
		Nocturnal	**12%**	**11%**	**13%**	**9%**	**10%**	**18%**	**22%**	**6%**
		0-8 mph	4%	0%	16%	7%	3%	13%	49%	8%
		9-15 mph	16%	12%	18%	7%	17%	17%	7%	7%
		16+ mph	17%	23%	1%	14%	6%	26%	12%	1%
B Grid 26	Oct-12 to Oct-18	**Diurnal**	**18%**	**19%**	**11%**	**14%**	**4%**	**19%**	**8%**	**6%**
		0-8 mph	17%	5%	11%			6%	28%	34%
		9-15 mph	29%	3%	17%	26%	3%	13%	7%	
		16+ mph	9%	39%	6%	9%	7%	29%	1%	
		Nocturnal	**6%**	**31%**	**15%**	**13%**	**6%**	**19%**	**2%**	**9%**
		0-8 mph	15%	17%	20%		6%	4%	7%	31%
		9-15 mph	4%	40%	22%	24%	4%	2%	1%	4%
		16+ mph		28%		6%	9%	56%		

Table J-66. Spring 2009 VerCat offshore radar daily operational hours by weather condition.

Sample Grid	Date	Diurnal[1]			Nocturnal[2]			Total Hrs
		Hrs Clear	Hrs Rain[3]	Total Hrs	Hrs Clear	Hrs Rain[3]	Total Hrs	
16	5/11/2009	4.5	0.6	*5.1*	4.4		*4.4*	**9.6**
	5/12/2009	4.6		*4.6*	4.3		*4.3*	**8.9**
22	5/12/2009	3.5	2.3	*5.8*	4.4		*4.4*	**10.3**
	5/13/2009	6.2	0.5	*6.7*	4.3		*4.3*	**11.0**

[1] Diurnal occurs from Civil Sunrise to Civil Sunset
[2] Nocturnal occurs from Civil Sunset to Civil Sunrise
[3] Rain includes fog, mist, and drizzle
Hrs = Hours

Table J-67. Spring 2009 TracScan offshore radar daily operational hours by weather condition.

Sample Grid	Date	Diurnal[1]			Nocturnal[2]			Total Hrs
		Hrs Clear	Hrs Rain[3]	Total Hrs	Hrs Clear	Hrs Rain[3]	Total Hrs	
16	5/11/2009	5.9	0.7	*6.6*	4.5		*4.5*	**11.1**
	5/12/2009	4.6		*4.6*	4.3		*4.3*	**8.9**
22	5/12/2009	3.5	2.3	*5.8*	4.5		*4.5*	**10.3**
	5/13/2009	6.2	0.5	*6.7*	4.3		*4.3*	**11.0**

[1] Diurnal occurs from Civil Sunrise to Civil Sunset
[2] Nocturnal occurs from Civil Sunset to Civil Sunrise
[3] Rain includes fog, mist, and drizzle
Hrs = Hours

Table J-68. Spring 2009 VerCat altitudinal distribution, Sample Grid 16, winds 0 to 8 mph during clear weather conditions.

Date	Diurnal[1]					Nocturnal[2]				
	25% Alt	Median Alt	75% Alt	Mean Alt	Count	25% Alt	Median Alt	75% Alt	Mean Alt	Count
5/11/2009	21	28	2123	724	1	16	16	19	16	1
5/12/2009	98	160	1141	555	13	760	965	1098	887	1
Total	**92**	**160**	**1141**	**568**	**14**	**16**	**724**	**965**	**452**	**3**

Alt = Altitude in feet above mean sea level
[1] Diurnal runs from civil sunrise to civil sunset
[2] Nocturnal runs from civil sunset to civil sunrise
[3] Adjusted bird tracks (ratio 0.363). Bird count numbers added and then rounded to nearest whole number. Some bird count columns may not add to bird count number in total because of rounding.
Cells with normal sized text have at least 40 minutes of observations
Cells with small text have between 10 and 39 minutes of observations
Cells with very small text have less than 10 minutes of observations

Table J-69. Spring 2009 VerCat altitudinal distribution, Sample Grid 16, winds 9 to 15 mph during clear weather conditions.

Date	Diurnal[1]					Nocturnal[2]				
	25% Alt	Median Alt	75% Alt	Mean Alt	Count	25% Alt	Median Alt	75% Alt	Mean Alt	Count
5/11/2009						614	1025	1401	1704	28
5/12/2009	110	350	1230	665	13	537	847	1157	954	52
Total	**110**	**350**	**1230**	**665**	**13**	**555**	**908**	**1256**	**1216**	**79**

Alt = Altitude in feet above mean sea level
[1] Diurnal runs from civil sunrise to civil sunset
[2] Nocturnal runs from civil sunset to civil sunrise
[3] Adjusted bird tracks (ratio 0.363). Bird count numbers added and then rounded to nearest whole number. Some bird count columns may not add to bird count number in total because of rounding.
Cells with normal sized text have at least 40 minutes of observations
Cells with small text have between 10 and 39 minutes of observations
Cells with very small text have less than 10 minutes of observations

Table J-70. Spring 2009 VerCat altitudinal distribution, Sample Grid 22, winds 0 to 8 mph during clear weather conditions.

Date	Diurnal[1]					Nocturnal[2]				
	25% Alt	Median Alt	75% Alt	Mean Alt	Count	25% Alt	Median Alt	75% Alt	Mean Alt	Count
5/12/2009	22	31	42	46	11	213	296	358	324	64
5/13/2009	36	175	248	155	31	215	273	323	272	68
Total	**31**	**48**	**211**	**126**	**42**	**215**	**286**	**338**	**297**	**131**

Alt = Altitude in feet above mean sea level
[1] Diurnal runs from civil sunrise to civil sunset
[2] Nocturnal runs from civil sunset to civil sunrise
[3] Adjusted bird tracks (ratio 0.363). Bird count numbers added and then rounded to nearest whole number. Some bird count columns may not add to bird count number in total because of rounding.
Cells with normal sized text have at least 40 minutes of observations
Cells with small text have between 10 and 39 minutes of observations
Cells with very small text have less than 10 minutes of observations

Table J-71. Spring 2009 VerCat altitudinal distribution, Sample Grid 22, winds 9 to 15 mph during clear weather conditions.

Date	Diurnal[1]					Nocturnal[2]				
	25% Alt	Median Alt	75% Alt	Mean Alt	Count	25% Alt	Median Alt	75% Alt	Mean Alt	Count
5/12/2009	46	214	224	131	1	85	141	219	152	4
5/13/2009						81	114	180	132	11
Total	**46**	**214**	**224**	**131**	**1**	**85**	**120**	**194**	**137**	**15**

Alt = Altitude in feet above mean sea level
[1] Diurnal runs from civil sunrise to civil sunset
[2] Nocturnal runs from civil sunset to civil sunrise
[3] Adjusted bird tracks (ratio 0.363). Bird count numbers added and then rounded to nearest whole number. Some bird count columns may not add to bird count number in total because of rounding.
Cells with normal sized text have at least 40 minutes of observations
Cells with small text have between 10 and 39 minutes of observations
Cells with very small text have less than 10 minutes of observations

Table J-72. Spring 2009 offshore cumulative wind direction (by percentage) by wind speed for site.

Site	Dates	Time/Wind Speed	N	NE	E	SE	S	SW	W	NW
A Grid 16	May-11 to May-12	**Diurnal**		**56%**	**21%**	**9%**	**10%**	**3%**		
		0-8 mph		25%	20%	29%	26%			
		9-15 mph		71%	22%		2%	5%		
		16+ mph								
		Nocturnal		**45%**	**53%**		**2%**			
		0-8 mph		43%	54%		3%			
		9-15 mph		50%	50%					
		16+ mph								
B Grid 22	May-12 to May-13	**Diurnal**	**21%**		**9%**	**4%**	**17%**	**10%**	**15%**	**24%**
		0-8 mph	20%		9%	4%	18%	11%	16%	21%
		9-15 mph	25%							75%
		16+ mph								
		Nocturnal	**9%**	**57%**	**11%**	**7%**	**8%**	**8%**		
		0-8 mph	12%	50%	10%	9%	10%	10%		
		9-15 mph		83%	17%					
		16+ mph								

Appendix J-5

Onshore Radar Data

Table J-73. Spring 2008 daily VerCat onshore radar daily operational hours by weather condition. (IBSP = Island Beach State Park; NBB = North Brigantine Beach; CISP = Corson's Inlet State Park)

Location	Date	Diurnal[1]			Nocturnal[2]			Total Hrs
		Hrs Clear	Hrs Rain[3]	Total Hrs	Hrs Clear	Hrs Rain[3]	Total Hrs	
IBSP	5/15/2008	3.9		*3.9*	4.0	0.4	*4.4*	**8.3**
	5/16/2008		14.8	*14.8*		8.6	*8.6*	**23.4**
	5/17/2008	13.0	0.5	*13.5*	2.7	5.8	*8.5*	**22.0**
	5/18/2008	6.8	3.1	*9.9*	0.6	3.6	*4.1*	**14.0**
	5/18/2008		5.1	*5.1*	2.7	1.7	*4.4*	**9.5**
	5/19/2008	11.1	4.5	*15.6*	6.7	1.8	*8.5*	**24.0**
	5/20/2008	4.2	11.4	*15.6*	8.4		*8.4*	**24.0**
	5/21/2008	11.7	4.0	*15.6*	7.4	1.0	*8.4*	**24.0**
	5/22/2008	5.2	10.0	*15.2*	8.4		*8.4*	**23.5**
	5/23/2008	10.0		*10.0*	4.1		*4.1*	**14.0**
NBB	5/29/2008	0.2		*0.2*	4.0		*4.0*	**4.2**
	5/30/2008	14.0		*14.0*	8.2		*8.2*	**22.2**
	5/31/2008	10.8	5.1	*15.8*	8.2		*8.2*	**24.0**
	6/1/2008	8.8	1.3	*10.0*	4.0		*4.0*	**14.0**
	6/1/2008	5.4	0.5	*5.9*	4.1		*4.1*	**10.0**
	6/2/2008	15.3		*15.3*	8.1		*8.1*	**23.4**
	6/3/2008	15.9		*15.9*	4.9	3.2	*8.1*	**24.0**
	6/4/2008	11.9	4.1	*15.9*	0.2	7.9	*8.1*	**24.0**
	6/5/2008	14.2	1.6	*15.9*	7.3	0.8	*8.1*	**23.9**
	6/6/2008	15.3		*15.3*	7.9	0.2	*8.1*	**23.4**
	6/7/2008	16.0		*16.0*	7.4	0.7	*8.0*	**24.0**
	6/8/2008	10.0		*10.0*	4.0		*4.0*	**13.9**
CISP	6/9/2008	3.3		*3.3*	4.1		*4.1*	**7.4**
	6/10/2008	16.0		*16.0*	6.8	1.2	*8.0*	**24.0**
	6/11/2008	16.0		*16.0*	8.0		*8.0*	**24.0**
	6/12/2008	16.0		*16.0*	8.0		*8.0*	**24.0**
	6/13/2008	15.1	0.2	*15.3*	7.7	0.3	*8.0*	**23.3**
	6/14/2008	15.7	0.2	*16.0*	5.7	2.3	*8.0*	**24.0**
	6/15/2008	2.8	7.2	*10.0*	1.0	3.0	*4.0*	**14.0**
	6/15/2008	2.4	3.3	*5.6*	4.0		*4.0*	**9.6**
	6/16/2008	13.0	3.0	*16.0*	7.7	0.3	*8.0*	**24.0**
	6/17/2008	14.2	1.9	*16.0*	6.2	1.8	*8.0*	**24.0**
	6/18/2008	14.8	1.2	*16.0*	5.8	2.2	*8.0*	**24.0**
	6/19/2008	13.3		*13.3*	4.0		*4.0*	**17.3**

[1] Diurnal occurs from Civil Sunrise to Civil Sunset
[2] Nocturnal occurs from Civil Sunset to Civil Sunrise
[3] Rain includes fog, mist, and drizzle
Hrs = Hours

Table J-74. Spring 2008 daily VerCat onshore radar daily operational hours by weather condition. (IBSP = Island Beach State Park; BB = Brigantine Beach; CISP = Corson's Inlet State Park)

Location	Date	Diurnal[1]			Nocturnal[2]			Total Hrs
		Hrs Clear	Hrs Rain3	Total Hrs	Hrs Clear	Hrs Rain3	Total Hrs	
IBSP	5/15/2008	2.7		*2.7*	4.0	0.4	*4.4*	**7.1**
	5/16/2008		14.9	*14.9*		8.6	*8.6*	**23.4**
	5/17/2008	13.4	0.5	*13.9*	2.7	5.8	*8.5*	**22.4**
	5/18/2008	6.7	3.1	*9.9*	0.6	3.6	*4.1*	**14.0**
	5/18/2008		5.0	*5.0*	2.7	1.7	*4.4*	**9.3**
	5/19/2008	11.1	4.5	*15.6*	6.7	1.8	*8.5*	**24.0**
	5/20/2008	4.2	11.4	*15.6*	8.4		*8.4*	**24.0**
	5/21/2008	11.7	3.8	*15.5*	7.4	1.0	*8.4*	**23.9**
	5/22/2008	5.2	10.0	*15.2*	8.4		*8.4*	**23.6**
	5/23/2008	10.2		*10.2*	4.1		*4.1*	**14.3**
BB	5/29/2008				4.0		*4.0*	**4.0**
	5/30/2008	14.0		*14.0*	8.2		*8.2*	**22.2**
	5/31/2008	10.8	5.1	*15.8*	8.2		*8.2*	**24.0**
	6/1/2008	8.8	1.3	*10.0*	4.0		*4.0*	**14.0**
	6/1/2008	5.4	0.5	*5.9*	4.1		*4.1*	**10.0**
	6/2/2008	15.3		*15.3*	8.1		*8.1*	**23.4**
	6/3/2008	15.9		*15.9*	4.9	3.2	*8.1*	**24.0**
	6/4/2008	11.9	4.1	*15.9*	0.2	7.8	*8.0*	**24.0**
	6/5/2008	14.3	1.6	*15.9*	7.3	0.8	*8.1*	**24.0**
	6/6/2008	15.3		*15.3*	7.9	0.2	*8.1*	**23.4**
	6/7/2008	16.0		*16.0*	7.3	0.7	*8.0*	**23.9**
	6/8/2008	10.0		*10.0*	4.0		*4.0*	**13.9**
CISP	6/9/2008	3.4		*3.4*	4.1		*4.1*	**7.4**
	6/10/2008	16.0		*16.0*	6.7	1.2	*8.0*	**23.9**
	6/11/2008	16.0		*16.0*	8.0		*8.0*	**24.0**
	6/12/2008	16.0		*16.0*	8.0		*8.0*	**24.0**
	6/13/2008	15.2	0.2	*15.5*	7.7	0.3	*8.0*	**23.5**
	6/14/2008	15.8	0.2	*16.0*	5.7	2.3	*8.0*	**24.0**
	6/15/2008	2.8	7.3	*10.0*	1.0	3.0	*4.0*	**14.0**
	6/15/2008	2.1	3.2	*5.3*	4.0		*4.0*	**9.3**
	6/16/2008	13.0	3.0	*16.0*	7.7	0.3	*8.0*	**24.0**
	6/17/2008	14.2	1.9	*16.0*	6.2	1.8	*8.0*	**24.0**
	6/18/2008	14.8	1.2	*16.0*	5.8	2.2	*8.0*	**24.0**
	6/19/2008	13.3		*13.3*	4.0		*4.0*	**17.3**

[1] Diurnal occurs from Civil Sunrise to Civil Sunset
[2] Nocturnal occurs from Civil Sunset to Civil Sunrise
[3] Rain includes fog, mist, and drizzle
Hrs = Hours

Table J-75. Spring 2008 Island Beach State Park daily onshore VerCat radar altitudinal distribution, winds 0 to 8 mph during clear weather conditions.

Date	Diurnal[1]					Nocturnal[2]				
	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]
5/15/2008	290	635	950	651	88	468	751	1048	770	1089
5/16/2008										
5/17/2008	48	74	121	161	103	274	628	1142	737	541
5/18/2008	76	162	660	448	241	147	327	580	455	118
Total	**69**	**153**	**653**	**421**	**432**	**373**	**694**	**1053**	**739**	**1748**
5/18/2008						208	375	674	474	686
5/19/2008	48	73	119	281	79	192	366	573	424	712
5/20/2008	62	99	324	296	130	243	510	842	580	1457
5/21/2008	73	128	300	385	278	211	429	804	570	1172
5/22/2008	101	391	957	643	147	126	235	427	368	680
5/23/2008	51	89	188	229	254	71	128	206	148	18
Total	**62**	**112**	**315**	**361**	**887**	**194**	**393**	**710**	**507**	**4724**

Alt = Altitude in feet above mean sea level
[1] Diurnal runs from civil sunrise to civil sunset
[2] Nocturnal runs from civil sunset to civil sunrise
[3] Adjusted bird tracks (ratio 0.363). Bird count numbers added and then rounded to nearest whole number. Some bird count columns may not add to bird count number in total because of rounding.
Cells with normal sized text have at least 40 minutes of observations
Cells with small text have between 10 and 39 minutes of observations
Cells with very small text have less than 10 minutes of observations

Table J-76. Spring 2008 Island Beach State Park daily onshore VerCat radar altitudinal distribution, winds 9 to 15 mph during clear weather conditions.

Date	Diurnal[1]					Nocturnal[2]				
	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]
5/15/2008										
5/16/2008										
5/17/2008	57	133	350	352	388	315	697	1187	805	257
5/18/2008	53	87	258	263	77					
Total	**55**	**122**	**340**	**337**	**464**	**315**	**697**	**1187**	**805**	**257**
5/18/2008										
5/19/2008	51	83	146	207	168	101	137	149	148	5
5/20/2008	94	208	891	551	60	208	397	704	499	117
5/21/2008	147	427	984	678	284					
5/22/2008	74	151	680	454	125	90	186	379	314	163
5/23/2008	44	71	99	158	7	65	131	217	171	72
Total	**74**	**176**	**713**	**494**	**643**	**108**	**218**	**448**	**344**	**356**

Alt = Altitude in feet above mean sea level
[1] Diurnal runs from civil sunrise to civil sunset
[2] Nocturnal runs from civil sunset to civil sunrise
[3] Adjusted bird tracks (ratio 0.363). Bird count numbers added and then rounded to nearest whole number. Some bird count columns may not add to bird count number in total because of rounding.
Cells with normal sized text have at least 40 minutes of observations
Cells with small text have between 10 and 39 minutes of observations
Cells with very small text have less than 10 minutes of observations

Table J-77. Spring 2008 Island Beach State Park daily onshore VerCat radar altitudinal distribution, winds 16+ mph during clear weather conditions.

Date	Diurnal[1]					Nocturnal[2]				
	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]
5/15/2008	Not Applicable					Not Applicable				
5/16/2008										
5/17/2008										
5/18/2008										
Total										
5/18/2008						Not Applicable				
5/19/2008	60	92	338	236	10					
5/20/2008										
5/21/2008	172	615	1082	671	33					
5/22/2008										
5/23/2008										
Total	**96**	**395**	**947**	**569**	**44**					

Alt = Altitude in feet above mean sea level
[1] Diurnal runs from civil sunrise to civil sunset
[2] Nocturnal runs from civil sunset to civil sunrise
[3] Adjusted bird tracks (ratio 0.363). Bird count numbers added and then rounded to nearest whole number. Some bird count columns may not add to bird count number in total because of rounding.
Cells with normal sized text have at least 40 minutes of observations
Cells with small text have between 10 and 39 minutes of observations
Cells with very small text have less than 10 minutes of observations

Table J-78. Spring 2008 North Brigantine Beach daily onshore VerCat radar altitudinal distribution, winds 0 to 8 mph during clear weather conditions.

Date	Diurnal[1]					Nocturnal[2]				
	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]
5/29/2008	28	50	140	90	2	92	154	232	174	1249
5/30/2008	70	128	189	138	923	56	125	212	148	662
5/31/2008	38	2762	2991	2011	13	74	170	282	186	387
6/1/2008	39	89	155	111	676	54	113	196	133	448
Total	**55**	**112**	**178**	**142**	**1615**	**72**	**143**	**227**	**163**	**2744**
6/1/2008	44	90	152	117	609	59	121	207	145	665
6/2/2008	76	136	203	153	1376	47	89	159	114	1138
6/3/2008	42	90	155	108	307	47	105	187	126	317
6/4/2008	70	117	181	132	227	109	188	261	192	100
6/5/2008	21	36	93	86	134	50	108	194	132	600
6/6/2008	34	128	222	155	293	113	188	276	199	1292
6/7/2008	73	132	198	141	439	97	161	233	169	1700
6/8/2008	52	93	147	106	703	32	68	120	88	86
Total	**56**	**113**	**181**	**132**	**4089**	**70**	**139**	**224**	**155**	**5895**

Alt = Altitude in feet above mean sea level
[1] Diurnal runs from civil sunrise to civil sunset
[2] Nocturnal runs from civil sunset to civil sunrise
[3] Adjusted bird tracks (ratio 0.363). Bird count numbers added and then rounded to nearest whole number. Some bird count columns may not add to bird count number in total because of rounding.
Cells with normal sized text have at least 40 minutes of observations
Cells with small text have between 10 and 39 minutes of observations
Cells with very small text have less than 10 minutes of observations

Table J-79. Spring 2008 North Brigantine Beach daily onshore VerCat radar altitudinal distribution, winds 9 to 15 mph during clear weather conditions.

Date	Diurnal[1]					Nocturnal[2]				
	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]
5/29/2008										
5/30/2008	19	30	53	46	86	38	115	230	147	235
5/31/2008	21	44	125	80	340	90	178	279	192	1448
6/1/2008	35	83	143	100	122					
Total	**22**	**47**	**121**	**79**	**548**	**77**	**172**	**273**	**186**	**1683**
6/1/2008	30	57	97	96	41	44	97	170	132	64
6/2/2008	59	128	218	146	341					
6/3/2008	37	80	135	92	249	19	43	62	57	11
6/4/2008	28	74	117	89	193					
6/5/2008	97	109	109	103	1					
6/6/2008	99	150	203	163	148	37	134	154	125	5
6/7/2008	74	121	182	132	859					
6/8/2008	52	93	146	102	108	27	46	88	82	15
Total	**57**	**111**	**173**	**125**	**1940**	**36**	**78**	**141**	**115**	**95**

Alt = Altitude in feet above mean sea level
[1] Diurnal runs from civil sunrise to civil sunset
[2] Nocturnal runs from civil sunset to civil sunrise
[3] Adjusted bird tracks (ratio 0.363). Bird count numbers added and then rounded to nearest whole number. Some bird count columns may not add to bird count number in total because of rounding.
Cells with normal sized text have at least 40 minutes of observations
Cells with small text have between 10 and 39 minutes of observations
Cells with very small text have less than 10 minutes of observations

Table J-80. Spring 2008 North Brigantine Beach daily onshore VerCat radar altitudinal distribution, winds 0 to 8 mph during clear weather conditions.

Date	Diurnal[1]					Nocturnal[2]				
	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]
6/9/2008	38	68	126	88	73	83	132	209	155	726
6/10/2008	54	97	158	119	517	99	153	239	175	601
6/11/2008	79	179	303	204	634	81	161	253	177	1220
6/12/2008	79	178	287	199	710	82	172	246	178	631
6/13/2008	28	53	119	96	152	140	197	232	191	370
6/14/2008	28	54	153	107	60	91	163	225	164	324
6/15/2008	81	150	246	171	166	94	155	235	164	143
Total	**61**	**132**	**248**	**168**	**2312**	**89**	**161**	**237**	**173**	**4013**
6/15/2008	24	44	144	101	33	121	196	271	201	958
6/16/2008	123	170	218	171	574	106	174	251	181	1311
6/17/2008	28	63	147	108	50	58	138	230	155	331
6/18/2008	37	106	191	130	166	57	129	206	148	431
6/19/2008	35	92	244	162	56	53	125	234	152	167
Total	**77**	**154**	**213**	**157**	**879**	**93**	**169**	**249**	**179**	**3193**

Alt = Altitude in feet above mean sea level
[1] Diurnal runs from civil sunrise to civil sunset
[2] Nocturnal runs from civil sunset to civil sunrise
[3] Adjusted bird tracks (ratio 0.363). Bird count numbers added and then rounded to nearest whole number. Some bird count columns may not add to bird count number in total because of rounding.
Cells with normal sized text have at least 40 minutes of observations
Cells with small text have between 10 and 39 minutes of observations
Cells with very small text have less than 10 minutes of observations

Table J-81. Spring 2008 Corson's Inlet State Park daily onshore VerCat radar altitudinal distribution, winds 9 to 15 mph during clear weather conditions.

Date	Diurnal[1]					Nocturnal[2]				
	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]
6/9/2008	87	141	212	152	104	97	138	200	148	21
6/10/2008	24	50	115	98	55	86	132	172	131	15
6/11/2008	94	191	311	216	236					
6/12/2008	101	173	232	179	352					
6/13/2008	22	28	44	60	56	151	228	249	204	75
6/14/2008	34	101	176	120	203					
6/15/2008										
Total	**65**	**142**	**225**	**162**	**1007**	**119**	**199**	**240**	**184**	**110**
6/15/2008										
6/16/2008	28	89	166	133	90	127	187	271	199	25
6/17/2008	34	83	164	115	284	46	132	267	166	53
6/18/2008	28	61	137	116	171					
6/19/2008	30	77	178	138	165	36	64	289	134	2
Total	**31**	**76**	**164**	**123**	**709**	**63**	**165**	**271**	**175**	**80**

Alt = Altitude in feet above mean sea level
[1] Diurnal runs from civil sunrise to civil sunset
[2] Nocturnal runs from civil sunset to civil sunrise
[3] Adjusted bird tracks (ratio 0.363). Bird count numbers added and then rounded to nearest whole number. Some bird count columns may not add to bird count number in total because of rounding.
Cells with normal sized text have at least 40 minutes of observations
Cells with small text have between 10 and 39 minutes of observations
Cells with very small text have less than 10 minutes of observations

Table J-82. Spring 2008 Corson's Inlet State Park daily onshore VerCat radar altitudinal distribution, winds 16+ mph during clear weather conditions.

Date	Diurnal[1]					Nocturnal[2]				
	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]
6/9/2008						Not Applicable				
6/10/2008										
6/11/2008	85	186	276	208	147					
6/12/2008										
6/13/2008										
6/14/2008										
6/15/2008										
Total	**85**	**186**	**276**	**208**	**147**					
6/15/2008						Not Applicable				
6/16/2008										
6/17/2008	28	81	166	121	27					
6/18/2008										
6/19/2008	28	73	161	132	5					
Total	**28**	**75**	**166**	**123**	**32**					

Alt = Altitude in feet above mean sea level
[1] Diurnal runs from civil sunrise to civil sunset
[2] Nocturnal runs from civil sunset to civil sunrise
[3] Adjusted bird tracks (ratio 0.363). Bird count numbers added and then rounded to nearest whole number. Some bird count columns may not add to bird count number in total because of rounding.
Cells with normal sized text have at least 40 minutes of observations
Cells with small text have between 10 and 39 minutes of observations
Cells with very small text have less than 10 minutes of observations

Table J-83. Spring 2008 cumulative wind direction (by percentage) by wind speed for site

Site	Dates	Time/Wind Speed	N	NE	E	SE	S	SW	W	NW
A Island Beach State Park\dbs\TS\h-2008wk20	May-15 to May-18	**Diurnal**	**33%**	**19%**			**2%**	**7%**	**21%**	**18%**
		0-8 mph	16%	32%			5%	16%	29%	3%
		9-15 mph	48%	7%					14%	31%
		16+ mph								
		Nocturnal	**6%**	**8%**			**14%**	**24%**	**17%**	**31%**
		0-8 mph	7%	9%			15%	26%	19%	24%
		9-15 mph								100%
		16+ mph								
A Island Beach State Park\dbs\TS\h-2008wk21	May-18 to May-23	**Diurnal**	**51%**	**24%**	**4%**				**7%**	**14%**
		0-8 mph	54%	26%	6%				5%	9%
		9-15 mph	45%	20%	1%				12%	21%
		16+ mph	73%							27%
		Nocturnal	**64%**	**22%**	**0%**				**0%**	**13%**
		0-8 mph	69%	16%					1%	14%
		9-15 mph	34%	56%	3%					7%
		16+ mph								
B Brigantine\dbs\TS\h-2008wk22	May-29 to Jun-01	**Diurnal**		**1%**	**86%**	**8%**	**5%**			
		0-8 mph		1%	76%	16%	6%			
		9-15 mph		1%	95%	1%	4%			
		16+ mph								
		Nocturnal			**81%**	**13%**	**3%**	**3%**		
		0-8 mph			70%	20%	4%	5%		
		9-15 mph			98%	2%				
		16+ mph								

Table J-83 (*continued*). Spring 2008 cumulative wind direction (by percentage) by wind speed for site.

Site	Dates	Time/Wind Speed	N	NE	E	SE	S	SW	W	NW
B Brigantine\dbs\TS\h-2008wk23	Jun-01 to Jun-08	**Diurnal**	**9%**	**9%**	**53%**	**9%**	**7%**	**6%**	**2%**	**4%**
		0-8 mph	13%	11%	38%	13%	10%	5%	3%	7%
		9-15 mph		5%	84%		2%	8%	0%	
		16+ mph								
		Nocturnal	**11%**	**5%**	**29%**	**31%**	**9%**	**8%**	**6%**	**1%**
		0-8 mph	11%	4%	29%	33%	7%	8%	7%	1%
		9-15 mph	14%	19%	19%		49%			
		16+ mph								
C Corson's Inlet\dbs\TS\h-2008wk24	Jun-09 to Jun-15	**Diurnal**	**30%**	**20%**	**0%**	**4%**	**14%**	**7%**	**8%**	**16%**
		0-8 mph	25%	11%	0%	7%	13%	8%	9%	26%
		9-15 mph	41%	38%			10%	6%	5%	
		16+ mph					100%			
		Nocturnal	**10%**	**32%**	**2%**	**22%**	**7%**	**17%**	**5%**	**5%**
		0-8 mph	11%	30%	2%	23%	7%	17%	5%	5%
		9-15 mph		78%		13%		9%		
		16+ mph								
C Corson's Inlet\dbs\TS\h-2008wk25	Jun-15 to Jun-19	**Diurnal**	**28%**	**7%**	**24%**	**37%**	**0%**		**3%**	**1%**
		0-8 mph	42%	9%	21%	17%			7%	4%
		9-15 mph	23%	6%	27%	45%				
		16+ mph				93%	7%			
		Nocturnal	**1%**	**24%**	**15%**	**38%**	**4%**	**2%**	**16%**	**1%**
		0-8 mph	1%	25%	16%	36%	4%	2%	16%	1%
		9-15 mph		13%		88%				
		16+ mph								

Table J-84. Fall 2008 daily VerCat onshore radar daily operational hours by weather condition. (IBSP = Island Beach State Park; BB = Brigantine Beach; SIC = Sea Isle City)

Location	Date	Diurnal[1]			Nocturnal[2]			Total Hrs
		Hrs Clear	Hrs Rain[3]	Total Hrs	Hrs Clear	Hrs Rain[3]	Total Hrs	
IBSP	9/13/2008		1.7	*1.7*				**1.7**
	9/14/2008							
	9/15/2008	6.4		*6.4*	5.5		*5.5*	**11.8**
	9/16/2008	10.4	2.9	*13.3*	10.7		*10.7*	**24.0**
	9/17/2008	13.3		*13.3*	10.7		*10.7*	**24.0**
	9/18/2008	13.2		*13.2*	10.8		*10.8*	**24.0**
	9/19/2008	12.3	0.4	*12.7*	10.8		*10.8*	**23.5**
	9/20/2008	11.0	2.1	*13.2*	10.9		*10.9*	**24.0**
	9/21/2008	8.8		*8.8*	5.3		*5.3*	**14.0**
	9/21/2008	4.0		*4.0*	5.6		*5.6*	**9.7**
	9/22/2008	13.1		*13.1*	10.9		*10.9*	**24.0**
	9/23/2008	13.0		*13.0*	11.0		*11.0*	**24.0**
	9/24/2008	13.0		*13.0*	11.0		*11.0*	**24.0**
	9/25/2008	9.4	2.9	*12.4*	5.3	5.7	*11.1*	**23.4**
	9/26/2008	6.5	6.4	*12.9*	3.7	7.5	*11.1*	**24.0**
	9/27/2008	10.2	2.6	*12.8*	9.5	1.6	*11.2*	**24.0**
	9/28/2008	6.4	1.7	*8.1*	2.2	3.2	*5.4*	**13.5**
	9/28/2008	0.9	3.3	*4.2*	0.6	5.2	*5.8*	**10.0**
	9/29/2008	12.8		*12.8*	8.8	2.4	*11.3*	**24.0**
	9/30/2008	12.7		*12.7*	10.2	1.1	*11.3*	**24.0**
	10/1/2008	11.6	1.1	*12.7*	4.8	6.5	*11.3*	**24.0**
	10/2/2008	11.8		*11.8*	11.0	0.4	*11.4*	**23.2**
	10/3/2008	12.6		*12.6*	11.4		*11.4*	**24.0**
	10/4/2008	11.6	0.8	*12.4*	9.7	1.8	*11.5*	**23.9**
	10/5/2008	7.5		*7.5*	5.5		*5.5*	**13.0**
SIC	10/5/2008				5.2		*5.2*	**5.2**
	10/6/2008	11.3		*11.3*	12.4		*12.4*	**23.7**
	10/7/2008	11.5		*11.5*	12.5		*12.5*	**24.0**
	10/8/2008	11.5		*11.5*	11.6	0.9	*12.5*	**24.0**
	10/9/2008	9.9	0.5	*10.4*	6.8	5.8	*12.6*	**23.0**
	10/10/2008	11.4		*11.4*	12.6		*12.6*	**24.0**
	10/11/2008	11.4		*11.4*	12.7		*12.7*	**24.0**
	10/12/2008	7.9		*7.9*	6.1		*6.1*	**14.0**
	10/12/2008	3.4		*3.4*	6.6		*6.6*	**10.0**
	10/13/2008	11.3		*11.3*	12.7		*12.7*	**24.0**
	10/14/2008	10.4		*10.4*	12.8		*12.8*	**23.2**
	10/15/2008	11.2		*11.2*	12.8		*12.8*	**24.0**
	10/16/2008	10.4	0.8	*11.2*	11.9	0.9	*12.9*	**24.0**

Table J-84 (*continued*). Fall 2008 daily VerCat onshore radar daily operational hours by weather condition. (IBSP = Island Beach State Park; BB = Brigantine Beach; SIC = Sea Isle City)

Location	Date	Diurnal[1]			Nocturnal[2]			Total Hrs
		Hrs Clear	Hrs Rain[3]	Total Hrs	Hrs Clear	Hrs Rain[3]	Total Hrs	
SIC	10/17/2008	10.5	0.6	*11.1*	7.5	5.4	*12.9*	**24.0**
	10/18/2008	5.2	5.5	*10.6*	12.3	0.7	*13.0*	**23.6**
	10/19/2008	4.2		*4.2*	6.2		*6.2*	**10.4**
	10/20/2008	7.2		*7.2*	3.9		*3.9*	**11.1**
	10/21/2008	6.5	2.2	*8.7*	4.2		*4.2*	**12.9**
	10/22/2008	5.6		*5.6*	6.8		*6.8*	**12.4**
	10/23/2008	7.0		*7.0*	6.3		*6.3*	**13.3**
	10/24/2008	6.3		*6.3*	6.9		*6.9*	**13.2**
	10/25/2008	3.0	7.8	*10.8*	9.3	3.9	*13.2*	**24.0**
	10/26/2008	5.9		*5.9*	6.3		*6.3*	**12.3**
BB	10/26/2008	0.8		*0.8*	6.5		*6.5*	**7.2**
	10/27/2008	11.6		*11.6*	9.8	2.6	*12.4*	**24.0**
	10/28/2008		11.5	*11.5*	4.7	7.7	*12.4*	**23.9**
	10/29/2008	8.5	3.0	*11.5*	10.8	1.7	*12.5*	**23.9**
	10/30/2008	11.5		*11.5*	12.5		*12.5*	**24.0**
	10/31/2008	11.2		*11.2*	12.5		*12.5*	**23.7**
	11/1/2008	11.5		*11.5*	12.6		*12.6*	**24.0**
	11/2/2008	8.0		*8.0*	6.0		*6.0*	**14.0**
	11/2/2008	3.4		*3.4*	6.6		*6.6*	**10.0**
	11/3/2008	11.4		*11.4*	12.6		*12.6*	**24.0**
	11/4/2008	8.2	3.1	*11.3*	6.0	6.7	*12.7*	**24.0**
	11/5/2008	3.4	7.7	*11.1*	5.6	7.1	*12.7*	**23.8**
	11/6/2008	2.3	9.0	*11.3*	5.7	7.0	*12.7*	**24.0**
	11/7/2008	10.6		*10.6*	9.5	3.2	*12.8*	**23.3**
	11/8/2008	5.9	5.3	*11.2*	10.2	2.6	*12.8*	**24.0**
	11/9/2008	7.5		*7.5*	5.9	0.2	*6.1*	**13.7**
	11/9/2008	3.3		*3.3*	6.7		*6.7*	**10.0**
	11/10/2008	10.3		*10.3*	12.8		*12.8*	**23.1**
	11/11/2008	11.1		*11.1*	12.9		*12.9*	**24.0**
	11/12/2008	11.1		*11.1*	12.6	0.3	*12.9*	**24.0**
	11/13/2008	3.5	7.4	*10.9*	10.8	2.2	*13.0*	**23.8**
	11/14/2008	9.2	1.9	*11.0*	8.1	4.9	*13.0*	**24.0**
	11/15/2008	6.5	4.5	*11.0*	7.2	5.5	*13.0*	**24.0**
	11/16/2008	4.4		*4.4*	6.2		*6.2*	**10.6**
SIC	11/16/2008	1.5		*1.5*	7.3		*7.3*	**8.7**
	11/17/2008	8.6	1.4	*10.0*	11.1	3.0	*14.0*	**24.0**
	11/18/2008	5.5	4.4	*9.9*	6.5	7.6	*14.1*	**23.9**
	11/19/2008	9.9		*9.9*	14.1		*14.1*	**24.0**

Table J-84 (*continued*). Fall 2008 daily VerCat onshore radar daily operational hours by weather condition. (IBSP = Island Beach State Park; BB = Brigantine Beach; SIC = Sea Isle City)

Location	Date	Diurnal[1]			Nocturnal[2]			Total Hrs
		Hrs Clear	Hrs Rain[3]	Total Hrs	Hrs Clear	Hrs Rain[3]	Total Hrs	
SIC	11/20/2008	9.9		*9.9*	14.1		*14.1*	**24.0**
	11/21/2008	5.1	4.3	*9.4*	3.9	10.2	*14.1*	**23.5**
	11/22/2008		9.8	*9.8*		14.2	*14.2*	**24.0**
	11/23/2008		7.2	*7.2*		6.9	*6.9*	**14.0**
	11/23/2008		2.7	*2.7*		7.3	*7.3*	**10.0**
	11/24/2008	0.6	9.2	*9.8*	3.1	11.1	*14.2*	**24.0**
	11/25/2008	2.7	7.1	*9.8*	7.2	7.1	*14.2*	**24.0**
	11/26/2008	9.6		*9.6*	14.3		*14.3*	**23.9**
	11/27/2008	9.7		*9.7*	14.3		*14.3*	**24.0**
	11/28/2008	9.7		*9.7*	14.3		*14.3*	**24.0**
	11/29/2008	9.7		*9.7*	14.3		*14.3*	**24.0**
	11/30/2008		6.9	*6.9*	0.7	6.3	*7.0*	**13.9**
	11/30/2008	0.1	2.5	*2.6*	0.4	7.0	*7.4*	**10.0**
	12/1/2008	9.6		*9.6*	12.7	1.7	*14.4*	**24.0**
	12/2/2008	7.9	0.4	*8.3*	14.4		*14.4*	**22.7**
	12/3/2008	9.6		*9.6*	14.4		*14.4*	**24.0**
	12/4/2008	8.8		*8.8*	10.9	3.6	*14.4*	**23.2**
	12/5/2008	9.6		*9.6*	12.3	2.2	*14.4*	**24.0**
	12/6/2008	9.2	0.3	*9.6*	7.1	7.4	*14.4*	**24.0**
	12/7/2008		6.9	*6.9*		7.1	*7.1*	**14.0**
	12/7/2008		2.6	*2.6*		7.4	*7.4*	**10.0**
	12/8/2008		9.5	*9.5*		14.5	*14.5*	**24.0**
	12/9/2008		9.5	*9.5*		14.4	*14.4*	**23.9**
	12/10/2008	7.9	1.6	*9.5*	6.0	8.5	*14.5*	**24.0**
	12/11/2008	0.5	9.0	*9.5*	0.3	14.2	*14.5*	**24.0**
	12/12/2008	7.1	2.4	*9.5*	8.4	5.7	*14.4*	**23.8**
	12/13/2008	9.3		*9.3*	14.6		*14.6*	**23.9**
	12/14/2008	9.5		*9.5*	14.6		*14.6*	**24.0**
	12/15/2008	6.7	0.1	*6.8*	6.5	0.7	*7.2*	**14.0**

[1] Diurnal occurs from Civil Sunrise to Civil Sunset
[2] Nocturnal occurs from Civil Sunset to Civil Sunrise
[3] Rain includes fog, mist, and drizzle
Hrs = Hours

Table J-85. Fall 2008 daily TracScan onshore radar daily operational hours by weather condition. (IBSP = Island Beach State Park; BB = Brigantine Beach; SIC = Sea Isle City)

Location	Date	Diurnal[1]			Nocturnal[2]			Total Hrs
		Hrs Clear	Hrs Rain[3]	Total Hrs	Hrs Clear	Hrs Rain[3]	Total Hrs	
IBSP	9/15/2008	7.6		7.6	5.5		5.5	**13.1**
	9/16/2008	10.4	2.9	13.3	10.7		10.7	**24.0**
	9/17/2008	13.3		13.3	10.7		10.7	**24.0**
	9/18/2008	13.2		13.2	10.8		10.8	**24.0**
	9/19/2008	12.3	0.4	12.7	10.8		10.8	**23.5**
	9/20/2008	11.0	2.1	13.2	10.9		10.9	**24.0**
	9/21/2008	8.8		8.8	5.3		5.3	**14.0**
	9/21/2008	4.0		4.0	5.6		5.6	**9.6**
	9/22/2008	13.1		13.1	10.9		10.9	**24.0**
	9/23/2008	13.0		13.0	11.0		11.0	**24.0**
	9/24/2008	13.0		13.0	11.0		11.0	**24.0**
	9/25/2008	9.4	2.9	12.4	5.3	5.7	11.1	**23.4**
	9/26/2008	6.5	6.4	12.9	3.7	7.5	11.1	**24.0**
	9/27/2008	10.2	2.6	12.9	9.5	1.6	11.2	**24.0**
	9/28/2008	6.4	1.7	8.1	2.2	3.2	5.4	**13.5**
	9/28/2008	0.9	3.3	4.2	0.6	5.2	5.8	**10.0**
	9/29/2008	12.8		12.8	8.8	2.4	11.3	**24.0**
	9/30/2008	12.7		12.7	10.2	1.1	11.3	**24.0**
	10/1/2008	11.6	1.1	12.7	4.8	6.5	11.3	**24.0**
	10/2/2008	12.0		12.0	11.0	0.4	11.4	**23.4**
	10/3/2008	12.6		12.6	11.4		11.4	**24.0**
	10/4/2008	11.7	0.8	12.5	9.7	1.8	11.5	**23.9**
	10/5/2008	7.6		7.6	5.5		5.5	**13.1**
SIC	10/5/2008				5.2		*5.2*	**5.2**
	10/6/2008	11.3		*11.3*	12.4		*12.4*	**23.7**
	10/7/2008	11.5		*11.5*	12.5		*12.5*	**24.0**
	10/8/2008	11.5		*11.5*	11.6	0.9	*12.5*	**24.0**
	10/9/2008	9.9	0.5	*10.4*	6.8	5.8	*12.6*	**22.9**
	10/10/2008	11.4		*11.4*	12.6		*12.6*	**24.0**
	10/11/2008	11.4		*11.4*	12.7		*12.7*	**24.0**
	10/12/2008	7.9		*7.9*	6.1		*6.1*	**14.0**
	10/12/2008	3.4		*3.4*	6.6		*6.6*	**10.0**
	10/13/2008	11.3		*11.3*	12.7		*12.7*	**24.0**
	10/14/2008	10.4		*10.4*	12.8		*12.8*	**23.1**
	10/15/2008	11.2		*11.2*	12.8		*12.8*	**24.0**
	10/16/2008	10.4	0.8	*11.2*	11.9	0.9	*12.9*	**24.0**
	10/17/2008	10.5	0.6	*11.1*	7.5	5.4	*12.9*	**24.0**
	10/18/2008	5.0	5.5	*10.5*	12.3	0.7	*12.9*	**23.4**

Table J-85 (*continued*). Fall 2008 daily TracScan onshore radar daily operational hours by weather condition. (IBSP = Island Beach State Park; BB = Brigantine Beach; SIC = Sea Isle City)

Location	Date	Diurnal[1]			Nocturnal[2]			Total Hrs
		Hrs Clear	Hrs Rain[3]	Total Hrs	Hrs Clear	Hrs Rain[3]	Total Hrs	
SIC	10/19/2008	3.4		*3.4*	6.2		*6.2*	**9.6**
	10/20/2008	7.2		*7.2*	3.8		*3.8*	**11.1**
	10/21/2008	7.1	2.2	*9.3*	4.9		*4.9*	**14.3**
	10/22/2008	7.4		*7.4*	6.8		*6.8*	**14.3**
	10/23/2008	7.7		*7.7*	6.3		*6.3*	**13.9**
	10/24/2008	5.1		*5.1*	6.9		*6.9*	**12.0**
	10/25/2008	3.0	7.8	*10.8*	9.3	3.9	*13.2*	**24.0**
	10/26/2008	5.9		*5.9*	6.3		*6.3*	**12.2**
BB	10/26/2008	1.1		*1.1*	6.5		*6.5*	**7.6**
	10/27/2008	11.6		*11.6*	9.8	2.6	*12.4*	**24.0**
	10/28/2008		11.6	*11.6*	4.7	7.7	*12.4*	**24.0**
	10/29/2008	7.6	3.0	*10.6*	10.8	1.7	*12.5*	**23.0**
	10/30/2008	11.5		*11.5*	12.5		*12.5*	**24.0**
	10/31/2008	11.5		*11.5*	12.5		*12.5*	**24.0**
	11/1/2008	11.4		*11.4*	12.6		*12.6*	**24.0**
	11/2/2008	8.0		*8.0*	6.0		*6.0*	**14.0**
	11/2/2008	3.4		*3.4*	6.6		*6.6*	**10.0**
	11/3/2008	1.1		*1.1*	6.0		*6.0*	**7.1**
	11/4/2008							
	11/5/2008		3.5	*3.5*		6.7	*6.7*	**10.2**
	11/6/2008	2.3	9.0	*11.3*	5.7	7.0	*12.7*	**24.0**
	11/7/2008	10.6		*10.6*	9.5	3.2	*12.8*	**23.3**
	11/8/2008	5.9	5.3	*11.2*	10.2	2.6	*12.8*	**24.0**
	11/9/2008	7.9		*7.9*	5.9	0.2	*6.1*	**14.0**
	11/9/2008	3.2		*3.2*	6.7		*6.7*	**9.9**
	11/10/2008	10.4		*10.4*	12.8		*12.8*	**23.2**
	11/11/2008	11.1		*11.1*	12.9		*12.9*	**24.0**
	11/12/2008	10.9		*10.9*	12.6		*12.9*	**23.9**
	11/13/2008	3.6		*11.0*	10.8	0.3	*13.0*	**24.0**
	11/14/2008	9.2	7.4	*11.0*	8.1	2.2	*13.0*	**24.0**
	11/15/2008	6.5	1.9	*11.0*	3.3	4.9	*9.2*	**20.1**
	11/16/2008	3.2	4.5	*3.2*	6.7	5.5	*6.7*	**9.9**
SIC	11/15/2008					3.9	*3.9*	**3.9**
	11/16/2008	1.6	3.8	*5.4*	7.3	6.7	*14.0*	**19.4**
	11/17/2008	8.6	1.4	*10.0*	11.1	3.0	*14.0*	**24.0**
	11/18/2008	5.6	4.4	*10.0*	6.5	7.6	*14.1*	**24.0**
	11/19/2008	9.9		*9.9*	14.1		*14.1*	**24.0**
	11/20/2008	9.9		*9.9*	14.1		*14.1*	**24.0**

Table J-85 (*continued*). Fall 2008 daily TracScan onshore radar daily operational hours by weather condition. (IBSP = Island Beach State Park; BB = Brigantine Beach; SIC = Sea Isle City)

Location	Date	Diurnal[1]			Nocturnal[2]			Total Hrs
		Hrs Clear	Hrs Rain[3]	Total Hrs	Hrs Clear	Hrs Rain[3]	Total Hrs	
SIC	11/21/2008	5.2	4.3	*9.5*	3.9	10.2	*14.1*	**23.6**
	11/22/2008		9.8	*9.8*		14.2	*14.2*	**24.0**
	11/23/2008		7.2	*7.2*		6.9	*6.9*	**14.0**
	11/23/2008		2.7	*2.7*		7.3	*7.3*	**10.0**
	11/24/2008	0.6	9.2	*9.8*	3.1	11.1	*14.2*	**24.0**
	11/25/2008	2.7	7.1	*9.8*	7.2	7.1	*14.2*	**24.0**
	11/26/2008	9.8		*9.8*	14.3		*14.3*	**24.0**
	11/27/2008	9.7		*9.7*	14.3		*14.3*	**24.0**
	11/28/2008	9.7		*9.7*	14.3		*14.3*	**24.0**
	11/29/2008	9.7		*9.7*	14.3		*14.3*	**24.0**
	11/30/2008		7.1	*7.1*	0.7	6.3	*7.0*	**14.0**
	11/30/2008	0.1	2.5	*2.6*	0.4	7.0	*7.4*	**10.0**
	12/1/2008	9.6		*9.6*	12.7	1.7	*14.4*	**24.0**
	12/2/2008	9.3	0.4	*9.6*	14.4		*14.4*	**24.0**
	12/3/2008	9.6		*9.6*	14.4		*14.4*	**24.0**
	12/4/2008	8.8		*8.8*	10.9	3.6	*14.4*	**23.2**
	12/5/2008	9.6		*9.6*	12.3	2.2	*14.4*	**24.0**
	12/6/2008	9.2	0.3	*9.6*	7.1	7.4	*14.5*	**24.0**
	12/7/2008		6.9	*6.9*		7.1	*7.1*	**14.0**
	12/7/2008		2.6	*2.6*		7.4	*7.4*	**10.0**
	12/8/2008		9.5	*9.5*		14.5	*14.5*	**24.0**
	12/9/2008		9.5	*9.5*		14.5	*14.5*	**24.0**
	12/10/2008	7.9	1.6	*9.5*	6.0	8.5	*14.5*	**24.0**
	12/11/2008	0.5	9.0	*9.5*	0.3	14.3	*14.5*	**24.0**
	12/12/2008	7.1	2.4	*9.5*	8.5	5.7	*14.5*	**24.0**
	12/13/2008	9.5		*9.5*	14.6		*14.6*	**24.0**
	12/14/2008	9.5		*9.5*	14.6		*14.6*	**24.0**
	12/15/2008	8.3	0.1	*8.5*	6.5	0.7	*7.2*	**15.7**

[1] Diurnal occurs from Civil Sunrise to Civil Sunset
[2] Nocturnal occurs from Civil Sunset to Civil Sunrise
[3] Rain includes fog, mist, and drizzle
Hrs = Hours

Table J-86. Fall 2008 Island Beach State Park daily onshore VerCat radar altitudinal distribution, winds 0 to 8 mph during clear weather conditions.

Date	Diurnal[1]					Nocturnal[2]				
	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]
9/13/2008										
9/14/2008										
9/15/2008	105	201	296	219	293	149	219	309	238	828
9/16/2008	94	142	205	156	1262	165	236	316	255	1808
9/17/2008	49	152	259	170	366	171	241	328	267	1489
9/18/2008	30	58	169	108	184	141	212	287	224	387
9/19/2008						146	218	241	188	11
9/20/2008	29	45	97	81	83	159	226	302	242	187
9/21/2008	36	126	228	163	199	131	198	264	222	185
Total	**70**	**141**	**221**	**160**	**2388**	**161**	**231**	**313**	**252**	**4893**
9/21/2008	156	229	286	210	123	141	194	265	212	281
9/22/2008	37	178	254	164	29	151	212	286	224	410
9/23/2008	51	199	327	176	3	106	147	294	219	9
9/24/2008						36	63	335	245	2
9/25/2008										
9/26/2008	20	28	36	105	14	19	28	38	65	10
9/27/2008	31	68	171	104	74	34	84	161	120	20
9/28/2008	20	26	40	80	30	38	158	254	157	3
Total	**32**	**158**	**249**	**156**	**273**	**137**	**200**	**275**	**214**	**734**
9/28/2008	142	239	259	194	8	40	214	266	186	11
9/29/2008	124	216	295	216	705	117	228	332	240	1126
9/30/2008	123	197	266	201	739	155	244	336	252	959
10/1/2008	115	203	270	197	242	77	140	235	161	135
10/2/2008	24	46	104	78	30	76	171	360	233	706
10/3/2008	32	146	225	157	74	84	161	260	187	738
10/4/2008	97	198	307	216	719	115	204	304	222	678
10/5/2008	42	150	293	189	390	61	129	220	152	125
Total	**97**	**197**	**283**	**204**	**2907**	**104**	**205**	**315**	**225**	**4476**

Alt = Altitude in feet above mean sea level

[1] Diurnal runs from civil sunrise to civil sunset

[2] Nocturnal runs from civil sunset to civil sunrise

[3] Adjusted bird tracks (ratio 0.363). Bird count numbers added and then rounded to nearest whole number. Some bird count columns may not add to bird count number in total because of rounding.

Cells with normal sized text have at least 40 minutes of observations

Cells with small text have between 10 and 39 minutes of observations

Cells with very small text have less than 10 minutes of observations

Table J-87. Fall 2008 Island Beach State Park daily onshore VerCat radar altitudinal distribution, winds 9 to 15 mph during clear weather conditions.

Date	Diurnal[1]					Nocturnal[2]				
	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]
9/13/2008										
9/14/2008										
9/15/2008	188	250	381	283	28	151	227	318	249	78
9/16/2008						162	230	362	256	97
9/17/2008	109	188	344	211	30					
9/18/2008	48	113	205	139	306	163	230	301	240	562
9/19/2008	39	83	246	183	214	164	230	302	235	609
9/20/2008	66	116	214	149	152	106	174	236	178	25
9/21/2008										
Total	**50**	**114**	**232**	**162**	**729**	**162**	**229**	**304**	**238**	**1371**
9/21/2008										
9/22/2008	57	101	159	129	217	105	194	286	235	93
9/23/2008	30	46	109	94	147	149	211	283	223	314
9/24/2008	24	44	95	94	43	43	111	243	159	30
9/25/2008						53	53	53	53	0
9/26/2008	23	35	78	701	24					
9/27/2008	17	24	32	21	1	24	66	66	45	1
9/28/2008										
Total	**34**	**70**	**147**	**145**	**431**	**130**	**205**	**282**	**221**	**439**
9/28/2008					3					
9/29/2008	285	312	348	330	8					
9/30/2008	143	249	304	219	113	128	200	276	208	12
10/1/2008	125	190	260	197	93	93	106	169	138	4
10/2/2008	24	45	113	98	116	38	63	122	130	150
10/3/2008	41	126	239	157		30	38	42	36	8
10/4/2008					6					
10/5/2008	80	162	297	231	3					
Total	**44**	**132**	**241**	**159**	**340**	**39**	**67**	**149**	**132**	**174**

Alt = Altitude in feet above mean sea level

[1] Diurnal runs from civil sunrise to civil sunset

[2] Nocturnal runs from civil sunset to civil sunrise

[3] Adjusted bird tracks (ratio 0.363). Bird count numbers added and then rounded to nearest whole number. Some bird count columns may not add to bird count number in total because of rounding.

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Cells with very small text have less than 10 minutes of observations

Table J-88. Fall 2008 Island Beach State Park daily onshore VerCat radar altitudinal distribution, winds 16+ mph during clear weather conditions.

Date	Diurnal[1]					Nocturnal[2]				
	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]
9/13/2008	Not Applicable									
9/14/2008										
9/15/2008										
9/16/2008										
9/17/2008										
9/18/2008										
9/19/2008						185	256	322	260	75
9/20/2008										
9/21/2008										
Total						**185**	**256**	**322**	**260**	**75**
9/21/2008										
9/22/2008										
9/23/2008	40	43	55	45	2					
9/24/2008	20	29	51	46	4	29	48	132	95	8
9/25/2008	20	27	102	175	21	42	195	492	229	4
9/26/2008										
9/27/2008										
9/28/2008										
Total	**20**	**28**	**85**	**146**	**28**	**33**	**61**	**218**	**144**	**12**
9/28/2008	Not Applicable					Not Applicable				
9/29/2008										
9/30/2008										
10/1/2008										
10/2/2008										
10/3/2008										
10/4/2008										
10/5/2008										
Total										

Alt = Altitude in feet above mean sea level
[1] Diurnal runs from civil sunrise to civil sunset
[2] Nocturnal runs from civil sunset to civil sunrise
[3] Adjusted bird tracks (ratio 0.363). Bird count numbers added and then rounded to nearest whole number. Some bird count columns may not add to bird count number in total because of rounding.
Cells with normal sized text have at least 40 minutes of observations
Cells with small text have between 10 and 39 minutes of observations
Cells with very small text have less than 10 minutes of observations

Table J-89. Fall 2008 Brigantine Beach daily onshore VerCat radar altitudinal distribution, winds 0 to 8 mph during clear weather conditions.

Date	Diurnal[1]					Nocturnal[2]				
	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]
10/26/2008	51	60	71	59	4	251	726	1338	911	77
10/27/2008	73	224	811	621	32	92	297	767	559	33
10/28/2008						215	295	375	342	4
10/29/2008						190	391	1935	1155	6
10/30/2008	48	133	578	439	8	852	1308	1803	1395	443
10/31/2008	33	57	190	390	146	760	1265	1740	1278	434
11/1/2008	33	51	73	174	214	421	779	1187	888	248
11/2/2008						359	763	1441	1025	91
Total	**35**	**57**	**135**	**292**	**405**	**582**	**1105**	**1607**	**1183**	**1336**
11/2/2008										
11/3/2008	46	71	112	191	76	96	297	646	443	17
11/4/2008	57	73	92	91	78	131	359	1797	722	3
11/5/2008						46	306	388	271	5
11/6/2008										
11/7/2008	10	16	27	35	46	8	52	173	207	13
11/8/2008	8	18	36	23	2	20	42	193	152	22
11/9/2008	22	62	171	117	50	80	188	291	189	15
Total	**27**	**64**	**94**	**115**	**252**	**35**	**138**	**321**	**263**	**74**
11/9/2008	17	30	180	164	30	271	386	483	385	413
11/10/2008						240	343	456	350	248
11/11/2008	16	28	73	96	21	250	407	542	429	73
11/12/2008	22	28	63	73	189	102	227	403	273	114
11/13/2008						104	210	319	218	66
11/14/2008	8	13	29	55	29	7	8	24	55	7
11/15/2008						703	798	2441	1127	1
11/16/2008						2445	2445	2445	2445	0
Total	**19**	**27**	**68**	**83**	**270**	**218**	**349**	**464**	**353**	**921**

Alt = Altitude in feet above mean sea level

[1] Diurnal runs from civil sunrise to civil sunset

[2] Nocturnal runs from civil sunset to civil sunrise

[3] Adjusted bird tracks (ratio 0.363). Bird count numbers added and then rounded to nearest whole number. Some bird count columns may not add to bird count number in total because of rounding.

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Cells with very small text have less than 10 minutes of observations

Table J-90. Fall 2008 Sea Brigantine Beach daily onshore VerCat radar altitudinal distribution, winds 9 to 15 mph during clear weather conditions.

Date	Diurnal[1]					Nocturnal[2]				
	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]
10/26/2008										
10/27/2008	165	448	769	534	107					
10/28/2008						119	243	493	508	11
10/29/2008	53	83	181	292	78	272	1018	1801	1195	131
10/30/2008	40	64	186	375	135	288	1087	1692	1119	83
10/31/2008	30	57	112	251	8					
11/1/2008										
11/2/2008	149	388	688	634	137	204	359	792	856	24
Total	**62**	**172**	**605**	**472**	**465**	**243**	**890**	**1685**	**1106**	**249**
11/2/2008	131	242	519	533	28	163	258	446	332	73
11/3/2008						137	226	450	318	27
11/4/2008										
11/5/2008	65	99	190	163	12	12	44	44	28	1
11/6/2008	8	13	16	16	8	9	19	36	69	29
11/7/2008						7	12	13	15	4
11/8/2008	12	23	50	59	12	11	21	21	16	1
11/9/2008	17	30	102	102	74	73	196	230	162	6
Total	**19**	**53**	**181**	**189**	**134**	**67**	**188**	**375**	**256**	**139**
11/9/2008	30	38	584	167	1					
11/10/2008	15	21	88	82	97	197	342	501	362	421
11/11/2008	16	24	68	88	106	186	353	491	350	309
11/12/2008										
11/13/2008	18	23	31	34	64	32	107	122	120	3
11/14/2008						28	28	28	28	0
11/15/2008	11	22	27	18	3	287	576	945	711	36
11/16/2008	41	57	84	63	3	186	1932	2078	1112	3
Total	**16**	**23**	**52**	**73**	**273**	**190**	**353**	**509**	**375**	**773**

Alt = Altitude in feet above mean sea level

[1] Diurnal runs from civil sunrise to civil sunset

[2] Nocturnal runs from civil sunset to civil sunrise

[3] Adjusted bird tracks (ratio 0.363). Bird count numbers added and then rounded to nearest whole number. Some bird count columns may not add to bird count number in total because of rounding.

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Cells with small text have between 10 and 39 minutes of observations

Cells with very small text have less than 10 minutes of observations

Table J-91. Fall 2008 Sea Brigantine Beach daily onshore VerCat radar altitudinal distribution, winds 16+ mph during clear weather conditions.

Date	Diurnal[1]					Nocturnal[2]				
	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]
10/26/2008										
10/27/2008	58	78	137	141	9	169	359	749	546	27
10/28/2008						153	393	1073	664	13
10/29/2008	1465	1465	1465	1465	0	151	338	809	745	5
10/30/2008	44	73	128	322	59					
10/31/2008										
11/1/2008										
11/2/2008	259	277	633	428	2					
Total	**46**	**74**	**137**	**308**	**70**	**158**	**359**	**831**	**603**	**45**
11/2/2008						149	211	432	311	19
11/3/2008										
11/4/2008										
11/5/2008										
11/6/2008	7	9	19	15	29	9	22	158	130	63
11/7/2008										
11/8/2008										
11/9/2008						149	193	297	213	1
Total	**7**	**9**	**19**	**15**	**29**	**12**	**42**	**248**	**172**	**82**
11/9/2008										
11/10/2008	16	33	259	219	22	205	384	502	365	44
11/11/2008										
11/12/2008										
11/13/2008						12	14	14	26	2
11/14/2008										
11/15/2008	8	20	31	46	15	11	20	26	31	15
11/16/2008	27	49	100	89	21	31	121	403	221	7
Total	**16**	**33**	**107**	**127**	**58**	**25**	**251**	**448**	**268**	**68**

[1] Diurnal runs from civil sunrise to civil sunset
[2] Nocturnal runs from civil sunset to civil sunrise
[3] Adjusted bird tracks (ratio 0.363). Bird count numbers added and then rounded to nearest whole number. Some bird count columns may not add to bird count number in total because of rounding.
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Cells with small text have between 10 and 39 minutes of observations
Cells with very small text have less than 10 minutes of observations

Table J-92. Fall 2008 Sea Isle City State Park daily onshore VerCat radar altitudinal distribution, winds 0 to 8 mph during clear weather conditions.

Date	Diurnal[1]					Nocturnal[2]				
	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]
10/5/2008						146	257	425	295	1832
10/6/2008	100	251	352	239	412	177	277	410	306	2942
10/7/2008	115	213	306	222	1011	165	262	422	317	1989
10/8/2008	21	35	105	80	94	116	205	309	222	379
10/9/2008	33	176	256	160	185	129	239	352	254	317
10/10/2008	158	248	303	231	276	170	254	343	270	1238
10/11/2008	38	141	274	193	64	166	247	348	271	889
10/12/2008	18	28	123	106	104	84	190	334	275	78
Total	**69**	**206**	**300**	**209**	**2146**	**161**	**258**	**392**	**293**	**9661**
10/12/2008	18	32	119	104	33	152	231	308	246	255
10/13/2008	59	133	210	158	609	178	269	381	288	1065
10/14/2008	25	47	290	159	194	150	258	370	269	664
10/15/2008	36	164	293	183	427	168	297	406	303	1191
10/16/2008	28	99	189	128	293	55	166	331	203	191
10/17/2008	39	145	301	215	391	186	319	459	334	1403
10/18/2008						185	256	346	280	806
10/19/2008										
Total	**36**	**127**	**244**	**170**	**1946**	**172**	**275**	**395**	**294**	**5573**
10/20/2008	18	37	69	84	647	27	78	303	179	412
10/21/2008	23	34	41	41	52	32	40	47	84	12
10/22/2008	30	69	93	64	1	38	105	251	167	45
10/23/2008	22	29	48	47	7	94	280	328	267	9
10/24/2008	27	57	119	114	19					
10/25/2008						24	158	571	343	19
10/26/2008	24	41	114	111	105	16	29	41	47	101
Total	**20**	**37**	**69**	**85**	**831**	**24**	**54**	**255**	**161**	**599**
11/16/2008	24	28	603	262	2	88	136	215	178	514
11/17/2008	29	61	242	178	79	110	217	385	262	945
11/18/2008	80	113	124	98	2	182	351	519	424	155
11/19/2008	37	90	366	295	120	153	278	416	317	802
11/20/2008	32	51	129	170	155	118	226	347	255	663
11/21/2008	42	86	209	162	121	90	210	336	236	107
11/22/2008										
11/23/2008										
Total	**34**	**68**	**206**	**201**	**478**	**113**	**221**	**369**	**268**	**3186**
11/23/2008										
11/24/2008						33	77	77	55	1
11/25/2008	52	99	136	333	4	98	179	269	195	167
11/26/2008	28	38	92	103	9	142	247	384	273	160
11/27/2008	40	98	182	148	89	153	270	385	281	420
11/28/2008	32	46	118	154	63	201	294	380	296	422
11/29/2008	41	117	277	201	82	91	212	366	277	189

Table J-92 (*continued*). Fall 2008 Sea Isle City State Park daily onshore VerCat radar altitudinal distribution, winds 0 to 8 mph during clear weather conditions.

Date	Diurnal[1]					Nocturnal[2]				
	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]
11/30/2008						146	220	348	250	22
Total	**37**	**83**	**191**	**168**	**247**	**149**	**258**	**370**	**273**	**1381**
11/30/2008	30	30	30	30	0					
12/1/2008	19	36	47	77	4	19	21	93	42	3
12/2/2008	38	68	194	315	18	236	326	405	327	453
12/3/2008	55	170	303	326	43	201	296	381	293	380
12/4/2008	51	92	146	206	16	42	77	394	709	6
12/5/2008	97	192	319	236	99	157	250	375	281	473
12/6/2008	41	73	135	233	54	162	274	395	292	312
12/7/2008										
Total	**52**	**133**	**275**	**253**	**234**	**184**	**287**	**388**	**300**	**1625**
12/7/2008										
12/8/2008										
12/9/2008										
12/10/2008						22	23	26	22	1
12/11/2008										
12/12/2008	27	30	65	137	3	82	141	275	218	253
12/13/2008	71	153	295	225	148	98	214	356	249	201
12/14/2008	38	65	135	163	16	100	218	360	257	89
12/15/2008	51	70	89	70	1	48	48	48	48	0
Total	**62**	**136**	**287**	**216**	**168**	**89**	**182**	**324**	**235**	**545**

Alt = Altitude in feet above mean sea level

Alt = Altitude in feet above mean sea level

[1] Diurnal runs from civil sunrise to civil sunset

[2] Nocturnal runs from civil sunset to civil sunrise

[3] Adjusted bird tracks (ratio 0.363). Bird count numbers added and then rounded to nearest whole number. Some bird count columns may not add to bird count number in total because of rounding.

Cells with normal sized text have at least 40 minutes of observations

Cells with small text have between 10 and 39 minutes of observations

Cells with very small text have less than 10 minutes of observations

Table J-93. Fall 2008 Sea Isle City State Park daily onshore VerCat radar altitudinal distribution, winds 9 to 15 mph during clear weather conditions.

Date	Diurnal[1]					Nocturnal[2]				
	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]
10/5/2008						127	220	364	260	189
10/6/2008	99	228	339	240	269	203	261	357	310	159
10/7/2008										
10/8/2008	22	34	87	89	91	51	202	287	210	22
10/9/2008	55	157	239	173	31	295	366	371	344	1
10/10/2008	173	264	342	257	403					
10/11/2008	31	132	225	156	91	141	249	368	257	161
10/12/2008	16	24	183	97	11					
Total	**77**	**217**	**324**	**220**	**896**	**150**	**245**	**361**	**272**	**532**
10/12/2008	17	28	94	64	8					
10/13/2008										
10/14/2008						159	270	395	287	443
10/15/2008	28	84	249	141	82	251	352	441	351	282
10/16/2008	80	166	263	180	126	211	327	434	324	785
10/17/2008	35	93	289	185	76	209	331	461	343	261
10/18/2008	24	36	78	99	189	78	218	327	247	804
10/19/2008	19	27	39	56	198	21	30	65	109	260
Total	**24**	**40**	**166**	**116**	**679**	**127**	**269**	**397**	**281**	**2834**
10/20/2008										
10/21/2008	16	26	40	75	44	32	42	83	111	11
10/22/2008	26	52	154	141	47	51	130	293	180	20
10/23/2008	22	41	91	102	95	48	108	239	180	31
10/24/2008	19	24	36	34	78	17	20	34	29	45
10/25/2008						26	43	427	245	16
10/26/2008	20	28	46	45	7					
Total	**21**	**31**	**62**	**84**	**271**	**21**	**40**	**135**	**127**	**123**
11/16/2008	115	128	251	598	2	79	116	174	159	12
11/17/2008	42	137	344	245	36					
11/18/2008	40	91	251	276	54	128	211	484	383	216
11/19/2008	42	102	294	271	80	118	265	527	367	59
11/20/2008	33	55	100	79	26					
11/21/2008	39	73	157	147	46					
11/22/2008										
11/23/2008										
Total	**40**	**89**	**235**	**227**	**243**	**123**	**212**	**484**	**371**	**287**
11/23/2008										
11/24/2008	886	886	886	886	1	54	101	205	369	3
11/25/2008	24	199	964	302	1					
11/26/2008	33	89	276	488	21	61	107	125	109	3
11/27/2008										
11/28/2008						20	22	35	30	4
11/29/2008										

Table J-93 (*continued*). Fall 2008 Sea Isle City State Park daily onshore VerCat radar altitudinal distribution, winds 9 to 15 mph during clear weather conditions.

Date	Diurnal[1]					Nocturnal[2]				
	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]
11/30/2008										
Total	**33**	**93**	**284**	**489**	**24**	**22**	**54**	**114**	**144**	**10**
11/30/2008										
12/1/2008	18	77	392	314	24	20	32	52	128	18
12/2/2008						35	70	78	62	3
12/3/2008										
12/4/2008	34	80	489	281	3	48	55	68	60	5
12/5/2008										
12/6/2008										
12/7/2008										
Total	**19**	**80**	**418**	**311**	**26**	**24**	**37**	**66**	**108**	**26**
12/7/2008										
12/8/2008										
12/9/2008										
12/10/2008	26	41	49	201	8	22	37	56	38	5
12/11/2008	28	28	28	28	0	23	23	23	23	0
12/12/2008	27	41	167	196	72	26	30	117	199	17
12/13/2008	57	175	343	247	24					
12/14/2008	41	95	443	404	12	28	98	211	259	3
12/15/2008	47	85	2023	1296	2	28	28	28	28	0
Total	**28**	**57**	**199**	**244**	**118**	**26**	**30**	**90**	**167**	**26**

Alt = Altitude in feet above mean sea level

Alt = Altitude in feet above mean sea level

[1] Diurnal runs from civil sunrise to civil sunset

[2] Nocturnal runs from civil sunset to civil sunrise

[3] Adjusted bird tracks (ratio 0.363). Bird count numbers added and then rounded to nearest whole number. Some bird count columns may not add to bird count number in total because of rounding.

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Cells with very small text have less than 10 minutes of observations

Table J-94. Fall 2008 Sea Isle City State Park daily onshore VerCat radar altitudinal distribution, winds 16+ mph during clear weather conditions.

Date	Diurnal[1]					Nocturnal[2]				
	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]
10/5/2008										
10/6/2008										
10/7/2008										
10/8/2008	24	35	61	78	12	253	344	344	299	1
10/9/2008										
10/10/2008										
10/11/2008										
10/12/2008										
Total	**24**	**35**	**61**	**78**	**12**	**253**	**344**	**344**	**299**	**1**
10/12/2008						Not Applicable				
10/13/2008										
10/14/2008										
10/15/2008										
10/16/2008										
10/17/2008										
10/18/2008	28	48	215	133	25					
10/19/2008	19	28	42	56	62					
Total	**20**	**30**	**56**	**78**	**86**					
10/20/2008										
10/21/2008	17	17	17	17	0					
10/22/2008	19	24	78	169	5					
10/23/2008										
10/24/2008						17	23	28	24	58
10/25/2008	16	24	29	27	47	17	24	34	44	106
10/26/2008										
Total	**17**	**24**	**29**	**42**	**53**	**17**	**23**	**31**	**37**	**164**
11/16/2008										
11/17/2008										
11/18/2008						140	254	472	345	17
11/19/2008	37	54	206	232	5					
11/20/2008										
11/21/2008										
11/22/2008										
11/23/2008										
Total	**37**	**54**	**206**	**232**	**5**	**140**	**254**	**472**	**345**	**17**
11/23/2008	Not Applicable					Not Applicable				
11/24/2008										
11/25/2008										
11/26/2008										
11/27/2008										
11/28/2008										
11/29/2008										

Table J-94 (*continued*). Fall 2008 Sea Isle City State Park daily onshore VerCat radar altitudinal distribution, winds 16+ mph during clear weather conditions.

Date	Diurnal[1]					Nocturnal[2]				
	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]
11/30/2008	Not Applicable					Not Applicable				
Total										
11/30/2008										
12/1/2008						44	98	98	71	1
12/2/2008										
12/3/2008										
12/4/2008	Not Applicable									
12/5/2008										
12/6/2008										
12/7/2008										
Total						**44**	**98**	**98**	**71**	**1**
12/7/2008						Not Applicable				
12/8/2008										
12/9/2008										
12/10/2008	21	21	21	21	0					
12/11/2008										
12/12/2008										
12/13/2008										
12/14/2008										
12/15/2008	4290	4290	4290	4290	0					
Total	**21**	**4290**	**4290**	**2156**	**1**					

Alt = Altitude in feet above mean sea level

Alt = Altitude in feet above mean sea level

[1] Diurnal runs from civil sunrise to civil sunset

[2] Nocturnal runs from civil sunset to civil sunrise

[3] Adjusted bird tracks (ratio 0.363). Bird count numbers added and then rounded to nearest whole number. Some bird count columns may not add to bird count number in total because of rounding.

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Table J-95. Fall 2008 cumulative wind direction (by percentage) by wind speed for site.

Site	Dates	Time/Wind Speed	N	NE	E	SE	S	SW	W	NW
A Island Beach\TS\h-2008wk38	Sep-15 to Sep-21	**Diurnal**	**4%**	**2%**	**5%**	**11%**	**8%**	**58%**	**12%**	
		0-8 mph	6%	3%	7%	16%	11%	45%	12%	
		9-15 mph			1%	2%		86%	11%	
		16+ mph								
		Nocturnal			**5%**	**19%**	**18%**	**39%**	**16%**	**4%**
		0-8 mph			7%	27%	25%	27%	9%	5%
		9-15 mph					1%	71%	28%	
		16+ mph							100%	
A Island Beach\TS\h-2008wk39	Sep-21 to Sep-28	**Diurnal**	**5%**	**2%**	**0%**		**2%**	**78%**	**13%**	**1%**
		0-8 mph	15%	5%	1%		7%	35%	35%	3%
		9-15 mph						97%	3%	
		16+ mph						100%		
		Nocturnal		**14%**			**4%**	**45%**	**35%**	**3%**
		0-8 mph		34%			9%	34%	15%	8%
		9-15 mph						63%	37%	
		16+ mph						24%	76%	
A Island Beach\TS\h-2008wk40	Sep-28 to Oct-05	**Diurnal**	**20%**	**16%**	**21%**	**18%**	**13%**	**5%**	**3%**	**5%**
		0-8 mph	21%	13%	12%	21%	17%	6%	4%	6%
		9-15 mph	14%	26%	50%	8%	1%			
		16+ mph								
		Nocturnal	**28%**	**8%**	**25%**	**25%**	**13%**			**0%**
		0-8 mph	28%	9%	21%	28%	14%			0%
		9-15 mph	29%	3%	68%					
		16+ mph								

Table J-95 (*continued*). Fall 2008 cumulative wind direction (by percentage) by wind speed for site.

Site	Dates	Time/Wind Speed	N	NE	E	SE	S	SW	W	NW
B Sea Isle City\TS\h-2008wk41	Oct-05 to Oct-12	**Diurnal**	**14%**	**14%**	**2%**	**3%**	**24%**	**31%**	**6%**	**5%**
		0-8 mph	6%	20%	4%	5%	41%	14%	3%	7%
		9-15 mph	22%	7%				59%	10%	2%
		16+ mph	100%							
		Nocturnal	**9%**	**13%**	**10%**	**21%**	**32%**	**9%**	**5%**	**1%**
		0-8 mph	3%	15%	12%	24%	35%	5%	5%	1%
		9-15 mph	46%				9%	42%	3%	
		16+ mph	100%							
B Sea Isle City\TS\h-2008wk42	Oct-12 to Oct-19	**Diurnal**	**12%**	**4%**	**15%**	**6%**	**42%**	**4%**	**4%**	**14%**
		0-8 mph	12%	4%	18%	8%	34%	4%	3%	17%
		9-15 mph	11%	5%	2%		65%	4%	7%	5%
		16+ mph					86%	14%		
		Nocturnal	**16%**	**13%**	**12%**	**10%**	**36%**		**3%**	**10%**
		0-8 mph	14%	20%	18%	15%	17%		2%	14%
		9-15 mph	18%			1%	75%		5%	1%
		16+ mph								
B Sea Isle City\TS\h-2008wk43	Oct-20 to Oct-26	**Diurnal**		**7%**	**17%**	**32%**	**16%**	**9%**		**18%**
		0-8 mph		14%	26%	41%	12%			6%
		9-15 mph		2%	14%	22%	24%	20%		18%
		16+ mph			1%	38%				61%
		Nocturnal	**3%**	**6%**	**16%**	**21%**	**30%**		**5%**	**20%**
		0-8 mph		12%	31%	29%	28%			
		9-15 mph	1%	1%	4%	19%	50%		3%	20%
		16+ mph	11%			7%			18%	65%

Table J-95 (*continued*). Fall 2008 cumulative wind direction (by percentage) by wind speed for site.

Site	Dates	Time/Wind Speed	N	NE	E	SE	S	SW	W	NW
C Brigantine\TS\h-2008wk44	Oct-26 to Nov-02	**Diurnal**	**6%**	**6%**	**29%**	**35%**	**10%**	**13%**		**1%**
		0-8 mph	14%	13%	38%	33%	1%	1%		1%
		9-15 mph		1%	24%	34%	14%	26%		
		16+ mph			8%	46%	42%	4%		
		Nocturnal		**16%**	**33%**	**30%**	**6%**	**11%**	**3%**	**1%**
		0-8 mph		24%	35%	21%	3%	13%	4%	2%
		9-15 mph			29%	57%		14%		
		16+ mph			33%	34%	34%			
C Brigantine\TS\h-2008wk45	Nov-02 to Nov-09	**Diurnal**	**17%**	**5%**	**16%**	**10%**	**18%**	**20%**	**14%**	**1%**
		0-8 mph	4%	6%	18%	12%	32%	6%	21%	1%
		9-15 mph	39%	4%	17%	10%		26%	5%	
		16+ mph						100%		
		Nocturnal	**16%**	**15%**	**12%**	**8%**	**7%**	**13%**	**26%**	**3%**
		0-8 mph	28%	28%	23%	4%	4%		13%	
		9-15 mph	5%	1%		11%	11%	21%	43%	7%
		16+ mph				16%	3%	49%	31%	
C Brigantine\TS\h-2008wk46	Nov-09 to Nov-15	**Diurnal**	**20%**	**7%**	**11%**	**41%**	**11%**	**0%**	**2%**	**9%**
		0-8 mph	20%	11%	22%	18%	20%	1%	4%	5%
		9-15 mph	3%	2%	2%	71%	4%			17%
		16+ mph	62%	6%		33%				
		Nocturnal	**11%**	**15%**	**2%**	**43%**	**17%**	**1%**		**11%**
		0-8 mph	17%	19%	3%	28%	25%	2%		6%
		9-15 mph		3%		81%	6%			9%
		16+ mph	5%	22%		12%				61%

Table J-95 (*continued*). Fall 2008 cumulative wind direction (by percentage) by wind speed for site.

Site	Dates	Time/Wind Speed	N	NE	E	SE	S	SW	W	NW
D Sea Isle City\TS\h-2008wk47	Nov-15 to Nov-23	**Diurnal**	**1%**	**35%**	**33%**	**30%**				**0%**
		0-8 mph	2%	43%	40%	14%				1%
		9-15 mph		22%	24%	53%				
		16+ mph				100%				
		Nocturnal	**1%**	**29%**	**43%**	**26%**	**1%**			
		0-8 mph	1%	32%	51%	14%	1%			
		9-15 mph		10%	2%	88%				
		16+ mph				100%				
D Sea Isle City\TS\h-2008wk48	Nov-23 to Nov-30	**Diurnal**	**12%**	**60%**	**16%**				**4%**	**7%**
		0-8 mph	16%	52%	20%				5%	7%
		9-15 mph		93%						7%
		16+ mph								
		Nocturnal	**31%**	**38%**	**15%**	**5%**	**1%**			**9%**
		0-8 mph	33%	36%	17%	6%	2%			6%
		9-15 mph	11%	50%						39%
		16+ mph								
D Sea Isle City\TS\h-2008wk49	Nov-30 to Dec-07	**Diurnal**	**24%**	**32%**	**18%**	**7%**	**0%**	**3%**	**4%**	**12%**
		0-8 mph	11%	41%	23%	9%	0%	3%	5%	7%
		9-15 mph	66%	1%						32%
		16+ mph	100%							
		Nocturnal	**43%**	**9%**	**30%**	**15%**	**0%**	**0%**		**2%**
		0-8 mph	33%	8%	38%	19%	0%	0%		1%
		9-15 mph	82%	12%						6%
		16+ mph	50%	50%						

Table J-95 (*continued*). Fall 2008 cumulative wind direction (by percentage) by wind speed for site.

Site	Dates	Time/Wind Speed	N	NE	E	SE	S	SW	W	NW
D Sea Isle City\TS\h-2008wk50	Dec-07 to Dec-15	**Diurnal**	**26%**	**1%**	**30%**	**8%**	**1%**			**34%**
		0-8 mph	28%	1%	49%	17%				5%
		9-15 mph	25%	1%	25%	5%	2%			42%
		16+ mph	19%							81%
		Nocturnal	**21%**	**5%**	**45%**	**5%**	**1%**			**24%**
		0-8 mph	19%	7%	55%	6%				13%
		9-15 mph	26%		11%		2%			61%
		16+ mph								

Table J-96. Spring 2009 daily VerCat onshore radar daily operational hours by weather condition. (IBSP = Island Beach State Park; BB = Brigantine Beach; SIC = Sea Isle City)

Location	Date	Diurnal[1]			Nocturnal[2]			Total Hrs
		Hrs Clear	Hrs Rain[3]	Total Hrs	Hrs Clear	Hrs Rain[3]	Total Hrs	
IBSP	3/14/2009	1.2		*1.2*	2.0	3.6	*5.5*	**6.7**
	3/15/2009	0.2	11.9	*12.1*	7.5	3.7	*11.2*	**23.3**
	3/16/2009	12.9		*12.9*	9.0	2.1	*11.1*	**24.0**
	3/17/2009	12.3	0.6	*12.9*	11.1		*11.1*	**24.0**
	3/18/2009	13.0		*13.0*	11.0		*11.0*	**24.0**
	3/19/2009	7.9	5.1	*13.0*	11.0		*11.0*	**24.0**
	3/20/2009		12.9	*12.9*	2.3	8.7	*10.9*	**23.9**
	3/21/2009		12.7	*12.7*		10.8	*10.8*	**23.5**
	3/22/2009		8.5	*8.5*		5.5	*5.5*	**13.9**
	3/22/2009		3.4	*3.4*		5.4	*5.4*	**8.7**
	3/23/2009	6.6	6.7	*13.2*	5.3	5.5	*10.8*	**24.0**
	3/24/2009	12.8		*12.8*	10.8		*10.8*	**23.5**
	3/25/2009	13.3		*13.3*	10.7		*10.7*	**24.0**
	3/26/2009	0.4	12.9	*13.3*	3.5	7.2	*10.7*	**24.0**
	3/27/2009	13.3		*13.3*	9.4	1.2	*10.5*	**23.9**
	3/28/2009	1.6	11.2	*12.8*	4.0	6.6	*10.6*	**23.4**
	3/29/2009	5.0	3.6	*8.7*	0.7	4.6	*5.3*	**14.0**
	3/29/2009	4.6		*4.6*	1.9	3.3	*5.2*	**9.8**
	3/30/2009	12.5		*12.5*	10.5		*10.5*	**23.0**
	3/31/2009	13.6		*13.6*	10.5		*10.5*	**24.0**
	4/1/2009	9.2	4.5	*13.6*	6.1	4.3	*10.4*	**24.0**
	4/2/2009	12.5	1.1	*13.7*	5.2	5.2	*10.4*	**24.0**
	4/3/2009	6.1	7.6	*13.7*	6.9	3.4	*10.3*	**24.0**
	4/4/2009	13.5		*13.5*	10.3		*10.3*	**23.7**
	4/5/2009	8.9		*8.9*	5.1		*5.1*	**14.0**
	4/5/2009	4.9		*4.9*	5.1		*5.1*	**10.0**
	4/6/2009	3.7	10.2	*13.8*	6.2	4.0	*10.2*	**24.0**
	4/7/2009	11.0	2.9	*13.9*	8.4	1.8	*10.1*	**24.0**
	4/8/2009	6.6	7.3	*13.9*	10.1		*10.1*	**24.0**
	4/9/2009	4.7		*4.7*	5.0		*5.0*	**9.7**
BB	3/22/2009	3.0		*3.0*				**3.0**
	3/23/2009	2.3		*2.3*	5.3		*5.3*	**7.7**
	3/24/2009	8.6		*8.6*	5.5		*5.5*	**14.0**
	3/25/2009							
	3/26/2009	2.9		*2.9*	0.7		*0.7*	**3.6**
	4/9/2009	2.7		*2.7*	5.0		*5.0*	**7.7**
	4/10/2009	13.6	0.4	*14.0*	10.0		*10.0*	**24.0**

Table J-96 (*continued*). Spring 2009 daily VerCat onshore radar daily operational hours by weather condition. (IBSP = Island Beach State Park; BB = Brigantine Beach; SIC = Sea Isle City)

Location	Date	Diurnal[1]			Nocturnal[2]			Total Hrs
		Hrs Clear	Hrs Rain[3]	Total Hrs	Hrs Clear	Hrs Rain[3]	Total Hrs	
BB	4/11/2009	3.2	10.0	*13.2*	8.7	1.3	*10.0*	**23.2**
	4/12/2009	9.1		*9.1*	5.0		*5.0*	**14.0**
	4/12/2009	5.0		*5.0*	5.0		*5.0*	**10.0**
	4/13/2009	14.1		*14.1*	7.1	2.8	*9.9*	**24.0**
	4/14/2009		14.0	*14.0*		9.9	*9.9*	**23.8**
	4/15/2009		14.2	*14.2*	3.9	5.9	*9.8*	**24.0**
	4/16/2009	14.2		*14.2*	9.8		*9.8*	**23.9**
	4/17/2009	14.3		*14.3*	9.7		*9.7*	**24.0**
	4/18/2009	11.5	2.8	*14.3*	9.7		*9.7*	**24.0**
	4/19/2009	9.1		*9.1*	4.8		*4.8*	**13.8**
	4/19/2009	5.1		*5.1*	3.7	1.2	*4.9*	**10.0**
	4/20/2009	1.7	12.7	*14.4*	1.6	8.0	*9.6*	**24.0**
	4/21/2009	14.1	0.4	*14.5*	6.1	3.5	*9.5*	**24.0**
	4/22/2009	8.7	5.8	*14.5*	7.0	2.5	*9.5*	**24.0**
	4/23/2009	13.5	0.4	*13.9*	9.5		*9.5*	**23.3**
	4/24/2009	14.6		*14.6*	9.4		*9.4*	**24.0**
	4/25/2009	13.6	1.0	*14.6*	9.4		*9.4*	**24.0**
	4/26/2009	9.4		*9.4*	4.6		*4.6*	**14.0**
	4/26/2009	5.3		*5.3*	4.7		*4.7*	**10.0**
	4/27/2009	14.7		*14.7*	9.3		*9.3*	**24.0**
	4/28/2009	14.6		*14.6*	9.3		*9.3*	**23.8**
	4/29/2009	6.9	7.9	*14.8*	9.2		*9.2*	**24.0**
	4/30/2009	12.0	2.9	*14.8*	9.2		*9.2*	**24.0**
	5/1/2009	7.4	7.4	*14.9*	6.9	2.2	*9.1*	**24.0**
	5/2/2009	9.4	5.6	*14.9*	5.1	4.1	*9.1*	**24.0**
	5/3/2009	0.1	8.9	*9.0*	2.7	1.8	*4.5*	**13.4**
	5/3/2009	0.1	5.3	*5.4*	0.2	4.5	*4.6*	**10.0**
	5/4/2009	2.4	12.6	*15.0*	4.6	4.4	*9.0*	**24.0**
	5/5/2009	9.3		*9.3*	4.4		*4.4*	**13.7**
SIC	5/6/2009	7.6	1.9	*9.5*	1.7	2.8	*4.6*	**14.1**
	5/7/2009	8.9	6.1	*15.1*	6.7	2.2	*8.9*	**24.0**
	5/8/2009	15.0		*15.0*	8.9		*8.9*	**23.9**
	5/9/2009	14.1	1.1	*15.2*	3.6	5.3	*8.9*	**24.0**
	5/10/2009	9.7		*9.7*	4.3		*4.3*	**14.0**
	5/10/2009	5.5		*5.5*	4.5		*4.5*	**10.0**
	5/11/2009	11.1	4.1	*15.2*	8.8		*8.8*	**23.9**
	5/12/2009	11.2	3.9	*15.2*	8.0	0.8	*8.7*	**23.9**
	5/13/2009	14.8		*14.8*	8.7		*8.7*	**23.5**

Table J-96 (*continued*). Spring 2009 daily VerCat onshore radar daily operational hours by weather condition. (IBSP = Island Beach State Park; BB = Brigantine Beach; SIC = Sea Isle City)

Location	Date	Diurnal[1]			Nocturnal[2]			Total Hrs
		Hrs Clear	Hrs Rain[3]	Total Hrs	Hrs Clear	Hrs Rain[3]	Total Hrs	
SIC	5/14/2009	15.3		*15.3*	5.8	2.9	*8.7*	**24.0**
	5/15/2009	12.2	3.2	*15.4*	4.9	3.7	*8.6*	**24.0**
	5/16/2009	15.2		*15.2*	7.8	0.8	*8.6*	**23.8**
	5/17/2009	0.7	9.1	*9.8*	3.7	0.6	*4.2*	**14.0**
	5/17/2009	3.3	2.3	*5.6*	2.4	1.9	*4.4*	**10.0**
	5/18/2009		15.5	*15.5*	2.6	6.0	*8.5*	**24.0**
	5/19/2009	8.6	6.6	*15.2*	4.3	4.2	*8.5*	**23.7**
	5/20/2009	15.5		*15.5*	8.5		*8.5*	**24.0**
	5/21/2009	15.3		*15.3*	8.5		*8.5*	**23.8**
	5/22/2009	15.6		*15.6*	8.4		*8.4*	**24.0**
	5/23/2009	15.6		*15.6*	8.4		*8.4*	**24.0**
	5/24/2009	9.9		*9.9*	4.1		*4.1*	**14.0**
	5/24/2009	5.7		*5.7*	4.3		*4.3*	**10.0**
	5/25/2009	12.4	3.3	*15.7*	8.3	0.1	*8.4*	**24.0**
	5/26/2009	2.9	12.6	*15.5*	2.1	6.2	*8.3*	**23.8**
	5/27/2009	11.9	3.2	*15.1*	7.0	1.3	*8.3*	**23.4**
	5/28/2009	14.0	1.6	*15.6*	4.2	4.1	*8.3*	**23.9**
	5/29/2009	12.7	3.0	*15.6*	3.0	5.2	*8.2*	**23.9**
	5/30/2009	15.8		*15.8*	7.7	0.6	*8.2*	**24.0**
	5/31/2009	13.0	2.9	*15.8*	8.2		*8.2*	**24.0**
	6/1/2009	15.8		*15.8*	8.2		*8.2*	**24.0**
	6/2/2009	5.0		*5.0*	4.0		*4.0*	**9.0**

[1] Diurnal occurs from Civil Sunrise to Civil Sunset
[2] Nocturnal occurs from Civil Sunset to Civil Sunrise
[3] Rain includes fog, mist, and drizzle
Hrs = Hours

Table J-97. Spring 2009 daily TracScan onshore radar daily operational hours by weather condition. (IBSP = Island Beach State Park; BB = Brigantine Beach; SIC = Sea Isle City)

Location	Date	Diurnal[1]			Nocturnal[2]			Total Hrs
		Hrs Clear	Hrs Rain[3]	Total Hrs	Hrs Clear	Hrs Rain[3]	Total Hrs	
IBSP	3/14/2009	0.1		*0.1*				**0.1**
	3/15/2009	0.2	4.4	*4.6*	4.7	0.8	*5.5*	**10.1**
	3/16/2009	12.9		*12.9*	9.0	2.1	*11.1*	**24.0**
	3/17/2009	12.3	0.6	*12.9*	11.1		*11.1*	**24.0**
	3/18/2009	13.0		*13.0*	11.0		*11.0*	**24.0**
	3/19/2009	7.9	5.2	*13.1*	11.0		*11.0*	**24.0**
	3/20/2009		13.1	*13.1*	2.3	8.7	*10.9*	**24.0**
	3/21/2009		13.1	*13.1*		10.9	*10.9*	**24.0**
	3/22/2009		8.5	*8.5*		5.5	*5.5*	**14.0**
	3/22/2009		4.6	*4.6*		5.4	*5.4*	**10.0**
	3/23/2009	6.6	6.7	*13.2*	5.3	5.5	*10.8*	**24.0**
	3/24/2009	13.3		*13.3*	10.8		*10.8*	**24.0**
	3/25/2009	13.3		*13.3*	10.7		*10.7*	**24.0**
	3/26/2009	0.4	13.0	*13.4*	3.5	7.2	*10.7*	**24.0**
	3/27/2009	13.4		*13.4*	9.5	1.2	*10.6*	**24.0**
	3/28/2009	1.6	11.2	*12.9*	4.0	6.6	*10.6*	**23.5**
	3/29/2009	5.0	3.6	*8.7*	0.7	4.6	*5.3*	**14.0**
	3/29/2009	13.5		*4.8*	1.9	3.3	*5.2*	**10.0**
	3/30/2009	13.6		*13.5*	10.5		*10.5*	**24.0**
	3/31/2009	9.2		*13.6*	10.5		*10.5*	**24.0**
	4/1/2009	12.5	4.5	*13.6*	6.1	4.3	*10.4*	**24.0**
	4/2/2009	6.1	1.1	*13.7*	5.2	5.2	*10.4*	**24.0**
	4/3/2009	13.8	7.6	*13.7*	6.9	3.4	*10.3*	**24.0**
	4/4/2009	8.9		*13.8*	10.3		*10.3*	**24.0**
	4/5/2009	13.5		*8.9*	5.1		*5.1*	**14.0**
	4/5/2009	4.9		*4.9*	5.1		*5.1*	**10.0**
	4/6/2009	3.7	10.2	*13.8*	6.2	4.0	*10.2*	**24.0**
	4/7/2009	11.0	2.9	*13.9*	8.4	1.8	*10.1*	**24.0**
	4/8/2009	6.6	7.4	*13.9*	10.1		*10.1*	**24.0**
	4/9/2009	4.7		*4.7*	5.0		*5.0*	**9.7**
BB	3/23/2009	2.0		*2.0*	5.3		*5.3*	**7.3**
	3/24/2009	13.3		*13.3*	10.8		*10.8*	**24.0**
	3/25/2009	10.6		*10.6*	5.4		*5.4*	**16.1**
	3/26/2009	3.0		*3.0*	0.3		*0.3*	**3.3**
	4/5/2009	4.9		*4.9*	5.1		*5.1*	**10.0**
	4/6/2009	3.7	10.2	*13.8*	6.2	4.0	*10.2*	**24.0**

Table J-97 (*continued*). Spring 2009 daily TracScan onshore radar daily operational hours by weather condition. (IBSP = Island Beach State Park; BB = Brigantine Beach; SIC = Sea Isle City)

Location	Date	Diurnal[1]			Nocturnal[2]			Total Hrs
		Hrs Clear	Hrs Rain[3]	Total Hrs	Hrs Clear	Hrs Rain[3]	Total Hrs	
BB	4/7/2009	11.0	2.9	*13.9*	8.4	1.8	*10.1*	**24.0**
	4/8/2009	6.6	7.4	*13.9*	10.1		*10.1*	**24.0**
	4/9/2009	4.7		*4.7*	5.0		*5.0*	**9.7**
	4/12/2009	5.0		*5.0*	5.0		*5.0*	**10.0**
	4/13/2009	14.1		*14.1*	7.1	2.8	*9.9*	**24.0**
	4/14/2009		14.0	*14.0*		9.9	*9.9*	**23.8**
	4/15/2009		14.2	*14.2*	3.9	5.9	*9.8*	**24.0**
	4/16/2009	14.2		*14.2*	9.8		*9.8*	**24.0**
	4/17/2009	14.3		*14.3*	9.7		*9.7*	**24.0**
	4/18/2009	11.5	2.8	*14.3*	9.7		*9.7*	**24.0**
	4/19/2009	9.2		*9.2*	4.8		*4.8*	**14.0**
	4/19/2009	5.1		*5.1*	3.7	1.2	*4.9*	**10.0**
	4/20/2009	1.7	12.7	*14.4*	1.6	8.0	*9.6*	**24.0**
	4/21/2009	14.1	0.4	*14.5*	6.1	3.5	*9.5*	**24.0**
	4/22/2009	8.7	5.8	*14.5*	7.0	2.5	*9.5*	**24.0**
	4/23/2009	13.5	0.4	*13.9*	9.5		*9.5*	**23.4**
	4/24/2009	14.6		*14.6*	9.4		*9.4*	**24.0**
	4/25/2009	13.7	1.0	*14.6*	9.4		*9.4*	**24.0**
	4/26/2009	9.4		*9.4*	4.6		*4.6*	**14.0**
	4/26/2009	5.3		*5.3*	4.7		*4.7*	**10.0**
	4/27/2009	0.7		*0.7*	4.6		*4.6*	**5.3**
	4/28/2009	4.9		*4.9*	4.7		*4.7*	**9.6**
	4/29/2009	6.9	7.9	*14.8*	9.2		*9.2*	**24.0**
	4/30/2009	12.0	2.9	*14.8*	9.2		*9.2*	**24.0**
	5/1/2009	7.4	7.4	*14.9*	6.9	2.2	*9.1*	**24.0**
	5/2/2009	9.4	5.6	*14.9*	5.1	4.1	*9.1*	**24.0**
	5/3/2009	0.1	8.9	*9.0*	2.7	1.8	*4.5*	**13.4**
	5/3/2009	0.1	5.3	*5.4*	0.2	4.5	*4.6*	**10.0**
	5/4/2009	2.4	12.6	*15.0*	4.6	4.4	*9.0*	**24.0**
	5/5/2009	9.3		*9.3*	4.4		*4.4*	**13.7**
SIC	5/6/2009	7.8	1.9	*9.7*	1.7	2.8	*4.6*	**14.3**
	5/7/2009	8.9	6.1	*15.1*	6.7	2.2	*8.9*	**24.0**
	5/8/2009	15.1		*15.1*	8.9		*8.9*	**24.0**
	5/9/2009	14.1	1.1	*15.2*	3.6	5.3	*8.9*	**24.0**
	5/10/2009	9.7		*9.7*	4.3		*4.3*	**14.0**
	5/10/2009	5.5		*5.5*	4.5		*4.5*	**10.0**
	5/11/2009	11.2	4.1	*15.2*	8.8		*8.8*	**24.0**
	5/12/2009	11.3	3.9	*15.3*	8.0	0.8	*8.7*	**24.0**

Table J-97 (*continued*). Spring 2009 daily TracScan onshore radar daily operational hours by weather condition. (IBSP = Island Beach State Park; BB = Brigantine Beach; SIC = Sea Isle City)

Location	Date	Diurnal[1]			Nocturnal[2]			Total Hrs
		Hrs Clear	Hrs Rain[3]	Total Hrs	Hrs Clear	Hrs Rain[3]	Total Hrs	
SIC	5/13/2009	14.8		*14.8*	8.7		*8.7*	**23.5**
	5/14/2009	15.3		*15.3*	5.8	2.9	*8.7*	**24.0**
	5/15/2009	12.1	3.2	*15.4*	4.9	3.7	*8.6*	**24.0**
	5/16/2009	15.4		*15.4*	7.8	0.8	*8.6*	**24.0**
	5/17/2009	0.7	9.1	*9.8*	3.7	0.6	*4.2*	**14.0**
	5/17/2009	3.3	2.3	*5.7*	2.4	1.9	*4.4*	**10.0**
	5/18/2009		15.5	*15.5*	2.6	6.0	*8.5*	**24.0**
	5/19/2009	8.9	6.6	*15.5*	4.3	4.2	*8.5*	**24.0**
	5/20/2009	15.5		*15.5*	8.5		*8.5*	**24.0**
	5/21/2009	15.6		*15.6*	8.5		*8.5*	**24.0**
	5/22/2009	15.6		*15.6*	8.4		*8.4*	**24.0**
	5/23/2009	15.6		*15.6*	8.4		*8.4*	**24.0**
	5/24/2009	9.9		*9.9*	4.1		*4.1*	**14.0**
	5/24/2009	5.8		*5.8*	4.3		*4.3*	**10.0**
	5/25/2009	12.4	3.3	*15.7*	8.3	0.1	*8.4*	**24.0**
	5/26/2009	2.9	12.8	*15.7*	2.1	6.2	*8.3*	**24.0**
	5/27/2009	12.0	3.2	*15.1*	7.0	1.3	*8.3*	**23.4**
	5/28/2009	14.1	1.6	*15.7*	4.2	4.1	*8.3*	**24.0**
	5/29/2009	12.8	3.0	*15.8*	3.0	5.2	*8.2*	**24.0**
	5/30/2009	15.8		*15.8*	7.7	0.6	*8.2*	**24.0**
	5/31/2009	13.0	2.9	*15.8*	8.2		*8.2*	**24.0**
	6/1/2009	15.8		*15.8*	8.2		*8.2*	**24.0**
	6/2/2009				0.8		*0.8*	**0.8**

[1] Diurnal occurs from Civil Sunrise to Civil Sunset
[2] Nocturnal occurs from Civil Sunset to Civil Sunrise
[3] Rain includes fog, mist, and drizzle
Hrs = Hours

Table J-98. Spring 2009 Island Beach State Park daily onshore VerCat radar altitudinal distribution, winds 0 to 8 mph during clear weather conditions.

Date	Diurnal[1]					Nocturnal[2]				
	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]
3/14/2009	44	52	82	64	6	98	214	738	479	3
3/15/2009	43	43	43	43	0	159	237	340	260	12
3/16/2009	28	38	53	42	74	77	139	347	313	9
3/17/2009	28	38	48	84	18	160	287	556	396	33
3/18/2009	30	40	52	52	23	78	132	367	215	22
3/19/2009	29	44	125	96	73	177	247	300	267	54
3/20/2009						62	128	207	147	3
3/21/2009										
3/22/2009										
Total	**28**	**40**	**58**	**68**	**195**	**134**	**233**	**354**	**295**	**136**
3/22/2009										
3/23/2009	30	48	78	114	26	201	201	201	201	0
3/24/2009	27	43	100	122	156	49	65	104	130	77
3/25/2009	27	38	58	69	277	93	157	325	240	152
3/26/2009	23	26	29	30	5	167	312	502	358	257
3/27/2009	29	45	179	119	296	72	121	241	199	128
3/28/2009	23	31	36	32	11	17	20	54	54	4
3/29/2009	22	28	34	39	26	70	291	486	283	3
Total	**28**	**40**	**83**	**98**	**798**	**88**	**184**	**381**	**266**	**622**
3/29/2009	48	180	198	142	5	58	89	139	139	160
3/30/2009	20	26	32	229	6	62	101	163	140	713
3/31/2009	25	34	58	76	257	67	122	267	213	428
4/1/2009	24	31	42	56	150	84	271	521	361	155
4/2/2009	20	29	44	74	153	56	93	158	137	43
4/3/2009						60	123	326	218	121
4/4/2009						44	125	205	130	7
4/5/2009	36	110	195	143	379	39	66	94	70	10
Total	**26**	**38**	**118**	**100**	**950**	**63**	**108**	**214**	**185**	**1636**
4/5/2009	45	135	213	164	363	154	343	607	417	547
4/6/2009	31	48	98	85	55	135	275	449	351	513
4/7/2009	31	39	153	100	10	52	84	312	412	26
4/8/2009	26	101	968	494	25	57	107	190	155	118
4/9/2009	28	37	55	58	135	64	109	206	155	98
Total	**32**	**77**	**183**	**145**	**588**	**116**	**247**	**500**	**347**	**1302**

Alt = Altitude in feet above mean sea level
[1] Diurnal runs from civil sunrise to civil sunset
[2] Nocturnal runs from civil sunset to civil sunrise
[3] Adjusted bird tracks (ratio 0.363). Bird count numbers added and then rounded to nearest whole number. Some bird count columns may not add to bird count number in total because of rounding.
Cells with normal sized text have at least 40 minutes of observations
Cells with small text have between 10 and 39 minutes of observations
Cells with very small text have less than 10 minutes of observations

Table J-99. Spring 2009 Island Beach State Park daily onshore VerCat radar altitudinal distribution, winds 9 to 15 mph during clear weather conditions.

Date	Diurnal[1]					Nocturnal[2]				
	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]
3/14/2009										
3/15/2009										
3/16/2009	49	64	80	151	12	54	372	384	315	2
3/17/2009	28	34	48	39	30	55	64	86	74	8
3/18/2009	28	44	65	69	35	227	396	562	403	85
3/19/2009	27	42	53	54	12	214	299	433	329	86
3/20/2009										
3/21/2009										
3/22/2009										
Total	**29**	**42**	**61**	**67**	**89**	**204**	**325**	**473**	**352**	**180**
3/22/2009										
3/23/2009	27	36	70	115	72	66	144	257	255	32
3/24/2009	29	37	56	72	97	42	59	79	74	67
3/25/2009						41	70	99	126	2
3/26/2009										
3/27/2009										
3/28/2009	21	26	34	30	8					
3/29/2009	30	53	97	82	130					
Total	**28**	**42**	**79**	**85**	**306**	**45**	**68**	**115**	**133**	**101**
3/29/2009	48	154	197	143	122	51	80	112	127	76
3/30/2009	22	29	44	77	196	40	69	114	97	280
3/31/2009						109	274	412	332	25
4/1/2009	23	43	2481	917	12					
4/2/2009										
4/3/2009	47	91	155	108	400	51	93	150	122	353
4/4/2009	24	34	58	164	150	36	69	124	99	326
4/5/2009	25	31	43	52	119	40	66	109	91	89
Total	**28**	**49**	**132**	**118**	**998**	**42**	**78**	**128**	**112**	**1149**
4/5/2009										
4/6/2009	26	36	104	113	24	262	325	389	344	222
4/7/2009	25	36	63	69	206	37	57	114	133	31
4/8/2009	24	31	51	58	127	48	77	168	151	49
4/9/2009						94	133	436	244	3
Total	**24**	**34**	**61**	**68**	**356**	**148**	**294**	**369**	**290**	**305**

Alt = Altitude in feet above mean sea level
[1] Diurnal runs from civil sunrise to civil sunset
[2] Nocturnal runs from civil sunset to civil sunrise
[3] Adjusted bird tracks (ratio 0.363). Bird count numbers added and then rounded to nearest whole number. Some bird count columns may not add to bird count number in total because of rounding.
Cells with normal sized text have at least 40 minutes of observations
Cells with small text have between 10 and 39 minutes of observations
Cells with very small text have less than 10 minutes of observations

Table J-100. Spring 2009 Island Beach State Park daily onshore VerCat radar altitudinal distribution, winds 16+ mph during clear weather conditions.

Date	Diurnal[1]					Nocturnal[2]				
	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]
3/14/2009						Not Applicable				
3/15/2009										
3/16/2009										
3/17/2009										
3/18/2009	27	39	86	140	23					
3/19/2009										
3/20/2009										
3/21/2009										
3/22/2009										
Total	**27**	**39**	**86**	**140**	**23**					
3/22/2009	Not Applicable					Not Applicable				
3/23/2009										
3/24/2009										
3/25/2009										
3/26/2009										
3/27/2009										
3/28/2009										
3/29/2009										
Total										
3/29/2009	27	197	1141	464	3					
3/30/2009	24	33	48	78	16					
3/31/2009										
4/1/2009										
4/2/2009										
4/3/2009	25	36	43	67	5	60	92	133	110	32
4/4/2009	21	29	46	96	138					
4/5/2009										
Total	**21**	**29**	**47**	**100**	**161**	**60**	**92**	**133**	**110**	**32**
4/5/2009	Not Applicable					Not Applicable				
4/6/2009										
4/7/2009										
4/8/2009										
4/9/2009										
Total										

Alt = Altitude in feet above mean sea level
[1] Diurnal runs from civil sunrise to civil sunset
[2] Nocturnal runs from civil sunset to civil sunrise
[3] Adjusted bird tracks (ratio 0.363). Bird count numbers added and then rounded to nearest whole number. Some bird count columns may not add to bird count number in total because of rounding.
Cells with normal sized text have at least 40 minutes of observations
Cells with small text have between 10 and 39 minutes of observations
Cells with very small text have less than 10 minutes of observations

Table J-101. Spring 2009 Brigantine Beach daily onshore VerCat radar altitudinal distribution, winds 0 to 8 mph during clear weather conditions.

Date	Diurnal[1]					Nocturnal[2]				
	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]
3/22/2009	651	1171	1580	1197	6	Not Applicable				
3/23/2009										
3/24/2009										
3/25/2009										
3/26/2009	455	455	455	455	0					
Total	**455**	**1171**	**1580**	**1155**	**7**					
4/9/2009	81	322	1400	1029	21	685	1093	1701	1248	295
4/10/2009	49	81	290	305	167	519	854	1212	910	1055
4/11/2009										
4/12/2009										
Total	**53**	**87**	**397**	**385**	**187**	**546**	**902**	**1294**	**984**	**1350**
4/12/2009										
4/13/2009	90	300	859	736	198	637	1002	1400	1871	71
4/14/2009										
4/15/2009										
4/16/2009	23	32	46	57	913	23	35	626	603	368
4/17/2009	26	64	279	392	248	170	558	1198	751	863
4/18/2009	83	254	658	618	151	402	895	1347	964	1541
4/19/2009						699	1053	1392	1058	347
Total	**26**	**40**	**105**	**257**	**1509**	**245**	**793**	**1303**	**895**	**3189**
4/19/2009										
4/20/2009						30	44	81	282	11
4/21/2009	26	48	373	371	303	753	1141	1440	1115	816
4/22/2009	58	176	760	851	136	156	261	423	386	286
4/23/2009	64	117	350	780	62	147	251	446	438	197
4/24/2009	57	112	649	755	108	564	1155	1675	1173	831
4/25/2009	85	325	911	604	161	605	968	1368	1007	2028
4/26/2009	126	469	866	581	416	156	366	884	686	255
Total	**51**	**210**	**777**	**588**	**1186**	**425**	**927**	**1381**	**972**	**4425**
4/26/2009	55	105	443	459	47	662	1125	1543	1139	933
4/27/2009	67	90	1812	780	5	644	1062	1445	1084	863
4/28/2009	53	128	386	252	9	583	1000	1297	970	322
4/29/2009	30	44	90	263	172	211	959	1141	775	156
4/30/2009	42	65	341	376	103	879	1091	1465	1170	606
5/1/2009	40	69	101	95	16	664	980	1271	989	404
5/2/2009	49	78	162	242	300	822	1160	1417	1119	1136
5/3/2009	96	989	1311	748	12	833	1126	1479	1153	643
Total	**40**	**69**	**165**	**293**	**664**	**740**	**1089**	**1431**	**1097**	**5059**

Table J-101 (*continued*). Spring 2009 Brigantine Beach daily onshore VerCat radar altitudinal distribution, winds 0 to 8 mph during clear weather conditions.

Date	Diurnal[1]					Nocturnal[2]				
	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]
5/3/2009						324	575	731	586	3
5/4/2009	51	208	936	459	6					
5/5/2009	51	81	546	573	276	1249	1456	1783	1534	99
Total	**51**	**81**	**633**	**571**	**282**	**1231**	**1443**	**1758**	**1503**	**102**

Alt = Altitude in feet above mean sea level
[1] Diurnal runs from civil sunrise to civil sunset
[2] Nocturnal runs from civil sunset to civil sunrise
[3] Adjusted bird tracks (ratio 0.363). Bird count numbers added and then rounded to nearest whole number. Some bird count columns may not add to bird count number in total because of rounding.
Cells with normal sized text have at least 40 minutes of observations
Cells with small text have between 10 and 39 minutes of observations
Cells with very small text have less than 10 minutes of observations

Table J-102. Spring 2009 Brigantine Beach daily onshore VerCat radar altitudinal distribution, winds 9 to 15 mph during clear weather conditions.

Date	Diurnal[1]					Nocturnal[2]				
	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]
3/22/2009	340	1454	2355	1385	7	Not Applicable				
3/23/2009										
3/24/2009										
3/25/2009										
3/26/2009										
Total	**340**	**1454**	**2355**	**1385**	**7**					
4/9/2009	53	65	135	104	3	519	793	982	827	17
4/10/2009	44	65	208	279	50	404	756	1068	761	321
4/11/2009	149	902	1436	815	9	628	902	1171	936	533
4/12/2009										
Total	**46**	**74**	**443**	**348**	**62**	**553**	**849**	**1133**	**869**	**869**
4/12/2009	106	238	537	666	11	80	243	562	419	15
4/13/2009	112	525	1256	798	168	101	154	334	265	10
4/14/2009										
4/15/2009						30	44	57	53	581
4/16/2009	24	37	48	50	501	26	39	51	42	616
4/17/2009	21	30	89	171	285					
4/18/2009	261	664	1593	1066	543	913	1214	1425	1174	23
4/19/2009	83	642	1258	782	144	240	494	957	691	228
Total	**33**	**83**	**726**	**549**	**1652**	**30**	**46**	**71**	**170**	**1472**
4/19/2009	122	236	980	1056	9	712	911	1050	807	13
4/20/2009	32	37	42	40	8					
4/21/2009	26	74	348	305	112	53	113	749	1155	5
4/22/2009	26	106	911	914	47					
4/23/2009	106	623	1716	1031	7	170	227	315	309	30
4/24/2009	85	236	591	542	156	1052	1345	1755	1382	105
4/25/2009	142	393	760	554	249	688	918	1091	894	28
4/26/2009	140	420	806	540	86	122	217	466	332	46
Total	**71**	**270**	**688**	**539**	**675**	**270**	**898**	**1352**	**931**	**225**
4/26/2009	48	156	938	752	20					
4/27/2009	74	201	687	644	275	466	1000	1381	988	409
4/28/2009	96	252	626	479	185	423	932	1370	969	563
4/29/2009	51	96	1148	539	38	336	1125	1666	1160	156
4/30/2009	53	281	1125	593	199	829	1009	1265	1017	91
5/1/2009	74	192	510	371	155	751	1101	1418	1102	1831
5/2/2009	24	65	73	54	1					
5/3/2009										
Total	**65**	**206**	**804**	**546**	**873**	**662**	**1060**	**1411**	**1063**	**3050**

Table J-102 (*continued*). Spring 2009 Brigantine Beach daily onshore VerCat radar altitudinal distribution, winds 9 to 15 mph during clear weather conditions.

Date	Diurnal[1]					Nocturnal[2]				
	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]
5/3/2009	3083	3373	3670	2940	5					
5/4/2009	42	71	92	107	20	1036	1329	1739	1419	117
5/5/2009	69	1522	1977	1076	42	1253	1541	1938	1780	81
Total	**64**	**103**	**1910**	**917**	**66**	**1141**	**1399**	**1837**	**1567**	**198**

Alt = Altitude in feet above mean sea level
[1] Diurnal runs from civil sunrise to civil sunset
[2] Nocturnal runs from civil sunset to civil sunrise
[3] Adjusted bird tracks (ratio 0.363). Bird count numbers added and then rounded to nearest whole number. Some bird count columns may not add to bird count number in total because of rounding.
Cells with normal sized text have at least 40 minutes of observations
Cells with small text have between 10 and 39 minutes of observations
Cells with very small text have less than 10 minutes of observations

Table J-103. Spring 2009 Brigantine Beach daily onshore VerCat radar altitudinal distribution, winds 16+ mph during clear weather conditions.

Date	Diurnal[1]					Nocturnal[2]				
	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]
3/22/2009						Not Applicable				
3/23/2009	49	108	151	103	1					
3/24/2009										
3/25/2009										
3/26/2009										
Total	**49**	**108**	**151**	**103**	**1**					
4/9/2009										
4/10/2009										
4/11/2009	30	46	60	174	19	188	644	1116	817	107
4/12/2009	80	162	441	575	100	57	190	318	569	29
Total	**57**	**119**	**343**	**512**	**119**	**129**	**484**	**1030**	**764**	**136**
4/12/2009	97	291	772	605	30	85	211	614	283	3
4/13/2009						74	110	213	154	9
4/14/2009										
4/15/2009						30	44	58	46	214
4/16/2009	26	39	51	50	100	28	37	49	40	45
4/17/2009										
4/18/2009	354	945	1883	1368	24					
4/19/2009	1187	1187	1187	1187	0					
Total	**32**	**51**	**259**	**368**	**155**	**30**	**44**	**60**	**52**	**272**
4/19/2009	71	96	1032	619	21	33	78	1641	818	11
4/20/2009	37	51	73	481	76	30	158	3332	1468	8
4/21/2009	26	377	646	555	23					
4/22/2009										
4/23/2009	57	138	377	440	116	76	160	322	297	6
4/24/2009										
4/25/2009										
4/26/2009										
Total	**42**	**80**	**359**	**480**	**236**	**35**	**97**	**845**	**896**	**25**
4/26/2009										
4/27/2009										
4/28/2009	1276	1276	1276	1276	0					
4/29/2009	48	188	1879	983	9	840	1418	1728	1274	212
4/30/2009										
5/1/2009										
5/2/2009										
5/3/2009										
Total	**48**	**188**	**1805**	**994**	**9**	**840**	**1418**	**1728**	**1274**	**212**

Table J-103 (*continued*). Spring 2009 Brigantine Beach daily onshore VerCat radar altitudinal distribution, winds 16+ mph during clear weather conditions.

Date	Diurnal[1]					Nocturnal[2]				
	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]
5/3/2009	Not Applicable					Not Applicable				
5/4/2009										
5/5/2009										
Total										

Alt = Altitude in feet above mean sea level
[1] Diurnal runs from civil sunrise to civil sunset
[2] Nocturnal runs from civil sunset to civil sunrise
[3] Adjusted bird tracks (ratio 0.363). Bird count numbers added and then rounded to nearest whole number. Some bird count columns may not add to bird count number in total because of rounding.
Cells with normal sized text have at least 40 minutes of observations
Cells with small text have between 10 and 39 minutes of observations
Cells with very small text have less than 10 minutes of observations

Table J-104. Spring 2009 Sea Isle City daily onshore VerCat radar altitudinal distribution, winds 0 to 8 mph during clear weather conditions.

Date	Diurnal[1]					Nocturnal[2]				
	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]
5/6/2009	27	37	101	111	232	109	285	380	293	29
5/7/2009	50	90	165	118	404	129	212	337	251	2528
5/8/2009	36	73	180	143	471	154	266	408	293	5036
5/9/2009	56	113	190	137	1033	104	185	298	211	809
5/10/2009	29	42	86	86	75	42	70	121	90	89
Total	**42**	**89**	**176**	**130**	**2215**	**136**	**238**	**377**	**271**	**8487**
5/10/2009	32	70	157	100	49	49	85	140	118	254
5/11/2009	36	55	107	172	346	115	181	266	209	1533
5/12/2009	32	52	111	114	311	128	209	323	239	1856
5/13/2009	28	39	61	81	257	109	196	350	256	1036
5/14/2009	25	34	56	59	77	311	486	669	474	73
5/15/2009	32	48	100	97	297	202	259	332	276	1201
5/16/2009	24	33	88	102	198	190	264	354	277	692
5/17/2009	38	59	227	131	33	110	186	292	213	593
Total	**30**	**46**	**94**	**114**	**1569**	**129**	**213**	**317**	**241**	**7235**
5/17/2009	26	39	69	61	39	49	92	184	144	113
5/18/2009						40	69	128	103	27
5/19/2009	32	50	91	104	115	244	338	402	326	1085
5/20/2009	36	61	118	116	274	188	285	376	287	1398
5/21/2009	33	52	101	114	174	195	291	372	289	1278
5/22/2009	43	101	224	166	425	196	285	366	286	1757
5/23/2009	69	138	222	162	853	156	221	324	245	675
5/24/2009	49	94	175	141	240	174	285	355	271	522
Total	**45**	**94**	**194**	**145**	**2119**	**186**	**286**	**372**	**285**	**6852**
5/24/2009	48	85	215	149	68	163	272	395	287	1117
5/25/2009	57	174	268	191	514	169	281	397	284	1937
5/26/2009						151	225	299	234	225
5/27/2009	19	28	48	53	96	58	171	303	202	393
5/28/2009	32	48	276	174	61	122	257	361	253	197
5/29/2009	51	173	280	193	340	70	126	279	179	423
5/30/2009	58	134	239	176	709	115	203	306	224	1541
5/31/2009	147	267	405	276	1366	132	233	369	258	2417
6/1/2009	40	82	320	181	239	205	295	380	293	1565
6/2/2009	44	76	158	110	170	161	254	355	266	1096
Total	**64**	**179**	**313**	**211**	**3562**	**142**	**248**	**364**	**261**	**10907**

Alt = Altitude in feet above mean sea level

[1] Diurnal runs from civil sunrise to civil sunset

[2] Nocturnal runs from civil sunset to civil sunrise

[3] Adjusted bird tracks (ratio 0.363). Bird count numbers added and then rounded to nearest whole number. Some bird count columns may not add to bird count number in total because of rounding.

Cells with normal sized text have at least 40 minutes of observations

Cells with small text have between 10 and 39 minutes of observations

Cells with very small text have less than 10 minutes of observations

Table J-105. Spring 2009 Sea Isle City daily onshore VerCat radar altitudinal distribution, winds 9 to 15 mph during clear weather conditions.

Date	Diurnal[1]					Nocturnal[2]				
	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]
5/6/2009	32	85	194	124	14	144	266	376	280	129
5/7/2009	50	88	150	121	106	253	335	411	328	423
5/8/2009										
5/9/2009	92	155	217	176	179	42	62	89	92	22
5/10/2009	32	64	184	142	163	36	57	94	78	52
Total	**49**	**105**	**194**	**150**	**462**	**170**	**296**	**392**	**289**	**624**
5/10/2009	35	80	222	160	81	39	54	79	67	30
5/11/2009	23	30	68	43	6	43	59	83	95	22
5/12/2009										
5/13/2009	16	19	23	19	2					
5/14/2009	23	30	54	101	51	377	510	635	485	112
5/15/2009										
5/16/2009	22	32	75	126	60	205	293	375	293	1144
5/17/2009	51	95	2631	928	3	278	315	386	331	47
Total	**24**	**40**	**110**	**143**	**204**	**198**	**298**	**390**	**302**	**1354**
5/17/2009	30	44	61	130	11					
5/18/2009						23	31	66	197	2
5/19/2009	21	29	46	36	8					
5/20/2009	48	127	316	157	7					
5/21/2009	51	85	119	154	28	294	363	408	352	25
5/22/2009	35	123	235	153	10					
5/23/2009	36	67	107	137	51	230	311	397	319	1183
5/24/2009	31	85	157	137	26	240	320	386	316	117
Total	**35**	**70**	**123**	**136**	**140**	**231**	**312**	**395**	**319**	**1325**
5/24/2009	64	107	256	165	35					
5/25/2009	64	77	100	67	1					
5/26/2009	19	24	30	38	82	18	26	52	45	29
5/27/2009	15	26	34	31	3	19	23	53	69	24
5/28/2009	19	28	46	62	27	196	302	366	277	11
5/29/2009										
5/30/2009	43	117	228	175	29					
5/31/2009	121	166	236	186	46					
6/1/2009	41	60	95	108	9	205	279	359	284	53
6/2/2009										
Total	**24**	**48**	**161**	**109**	**232**	**27**	**158**	**297**	**181**	**116**

Alt = Altitude in feet above mean sea level

[1] Diurnal runs from civil sunrise to civil sunset

[2] Nocturnal runs from civil sunset to civil sunrise

[3] Adjusted bird tracks (ratio 0.363). Bird count numbers added and then rounded to nearest whole number. Some bird count columns may not add to bird count number in total because of rounding.

Cells with normal sized text have at least 40 minutes of observations

Cells with small text have between 10 and 39 minutes of observations

Cells with very small text have less than 10 minutes of observations

Table J-106. Spring 2009 Sea Isle City daily onshore VerCat radar altitudinal distribution, winds 16+ mph during clear weather conditions.

Date	Diurnal[1]					Nocturnal[2]				
	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]
5/6/2009	Not Applicable									
5/7/2009						253	305	374	311	33
5/8/2009										
5/9/2009										
5/10/2009										
Total						**253**	**305**	**374**	**311**	**33**
5/10/2009	Not Applicable					Not Applicable				
5/11/2009										
5/12/2009										
5/13/2009										
5/14/2009										
5/15/2009										
5/16/2009										
5/17/2009										
Total										
5/17/2009	Not Applicable					Not Applicable				
5/18/2009										
5/19/2009										
5/20/2009										
5/21/2009										
5/22/2009										
5/23/2009										
5/24/2009										
Total										
5/24/2009	Not Applicable					Not Applicable				
5/25/2009										
5/26/2009										
5/27/2009										
5/28/2009										
5/29/2009										
5/30/2009										
5/31/2009										
6/1/2009										
6/2/2009										
Total										

Alt = Altitude in feet above mean sea level
[1] Diurnal runs from civil sunrise to civil sunset
[2] Nocturnal runs from civil sunset to civil sunrise
[3] Adjusted bird tracks (ratio 0.363). Bird count numbers added and then rounded to nearest whole number. Some bird count columns may not add to bird count number in total because of rounding.
Cells with normal sized text have at least 40 minutes of observations
Cells with small text have between 10 and 39 minutes of observations
Cells with very small text have less than 10 minutes of observations

Table J-107. Spring 2009 cumulative wind direction (by percentage) by wind speed for site.

Site	Dates	Time/Wind Speed	N	NE	E	SE	S	SW	W	NW
A Island Beach\dbs\TS\h-2009wk12	Mar-14 to Mar-22	**Diurnal**	**8%**	**28%**			**1%**	**45%**	**17%**	**2%**
		0-8 mph	5%	19%				44%	29%	4%
		9-15 mph	8%	30%			2%	56%	4%	
		16+ mph	21%	79%						
		Nocturnal	**2%**	**41%**	**3%**	**2%**		**19%**	**15%**	**19%**
		0-8 mph	3%	39%	4%	2%		1%	20%	29%
		9-15 mph		45%				49%	6%	
		16+ mph								
A Island Beach\dbs\TS\h-2009wk13	Mar-22 to Mar-29	**Diurnal**	**18%**	**6%**	**2%**	**17%**	**21%**	**18%**	**11%**	**8%**
		0-8 mph	22%	1%	2%	11%	15%	22%	16%	11%
		9-15 mph	6%	17%		33%	37%	8%		
		16+ mph								
		Nocturnal	**13%**	**17%**	**4%**	**14%**	**29%**	**23%**	**0%**	
		0-8 mph	16%	21%	5%	16%	18%	25%	0%	
		9-15 mph				9%	76%	15%		
		16+ mph								
A Island Beach\dbs\TS\h-2009wk14	Mar-29 to Apr-05	**Diurnal**	**10%**	**6%**	**17%**	**29%**	**3%**	**16%**	**13%**	**7%**
		0-8 mph	7%		5%	13%	5%	32%	27%	12%
		9-15 mph	15%	12%	19%	50%			0%	4%
		16+ mph	2%	6%	74%	17%				
		Nocturnal	**7%**	**4%**	**40%**	**23%**	**1%**	**6%**	**12%**	**7%**
		0-8 mph	11%	5%	11%	31%	2%	11%	17%	10%
		9-15 mph	1%	1%	79%	13%			4%	2%
		16+ mph			100%					

Table J-107 (*continued*). Spring 2009 cumulative wind direction (by percentage) by wind speed for site.

Site	Dates	Time/Wind Speed	N	NE	E	SE	S	SW	W	NW
A Island Beach\dbs\TS\h-2009wk15	Apr-05 to Apr-09	**Diurnal**	**5%**	**7%**	**76%**	**4%**		**2%**	**4%**	**1%**
		0-8 mph	6%	16%	56%	6%		5%	8%	2%
		9-15 mph	5%		92%	3%				
		16+ mph								
		Nocturnal	**11%**	**40%**	**38%**	**2%**				**9%**
		0-8 mph	17%	53%	20%	2%				8%
		9-15 mph		13%	73%	1%				12%
		16+ mph								
B Brigantine\dbs\TS\h-2009wk13	Mar-23 to Mar-26	**Diurnal**	**13%**	**1%**			**43%**	**4%**	**32%**	**7%**
		0-8 mph	21%	1%			12%	3%	52%	11%
		9-15 mph					67%	17%	8%	8%
		16+ mph					96%	4%		
		Nocturnal		**9%**	**11%**	**9%**	**70%**		**1%**	
		0-8 mph		18%	21%	18%	40%		3%	
		9-15 mph					100%			
		16+ mph					100%			
B Brigantine\dbs\TS\h-2009wk15	Apr-09 to Apr-12	**Diurnal**		**2%**	**20%**	**29%**	**4%**	**7%**	**37%**	**0%**
		0-8 mph		5%	28%	54%	9%	4%		
		9-15 mph			49%	31%		19%		2%
		16+ mph						6%	94%	
		Nocturnal	**13%**		**1%**	**36%**	**2%**	**1%**	**35%**	**12%**
		0-8 mph	10%		1%	74%	5%	0%	2%	7%
		9-15 mph	50%			3%				47%
		16+ mph						2%	96%	2%

Table J-107 (*continued*). Spring 2009 cumulative wind direction (by percentage) by wind speed for site.

Site	Dates	Time/Wind Speed	N	NE	E	SE	S	SW	W	NW
B Brigantine\dbs\TS\h-2009wk16	Apr-12 to Apr-19	**Diurnal**	**17%**	**4%**	**6%**	**39%**	**8%**	**10%**	**10%**	**5%**
		0-8 mph	5%	8%	14%	32%	20%	20%	1%	
		9-15 mph	29%	1%		50%		3%	8%	8%
		16+ mph		4%		4%			75%	17%
		Nocturnal	**4%**		**8%**	**1%**	**16%**	**29%**	**23%**	**20%**
		0-8 mph	1%		14%	2%	27%	43%	7%	7%
		9-15 mph	9%				1%	14%	29%	46%
		16+ mph							93%	7%
B Brigantine\dbs\TS\h-2009wk17	Apr-19 to Apr-26	**Diurnal**	**2%**	**7%**	**17%**	**46%**	**8%**	**19%**	**1%**	**0%**
		0-8 mph	1%	1%	25%	50%	10%	12%	1%	1%
		9-15 mph	1%	4%	11%	67%	6%	8%	1%	
		16+ mph	9%	33%			1%	57%		
		Nocturnal	**7%**	**2%**	**9%**	**30%**	**32%**	**17%**	**3%**	
		0-8 mph			11%	35%	38%	14%	2%	
		9-15 mph	20%	14%		8%	5%	45%	8%	
		16+ mph	83%	6%				11%		
B Brigantine\dbs\TS\h-2009wk18	Apr-26 to May-03	**Diurnal**	**36%**	**3%**	**4%**	**40%**	**2%**	**1%**	**9%**	**4%**
		0-8 mph	35%	6%	8%	25%	3%	1%	15%	7%
		9-15 mph	35%	0%		61%		1%	3%	
		16+ mph	84%			16%				
		Nocturnal	**18%**		**2%**	**51%**	**3%**	**1%**	**5%**	**21%**
		0-8 mph	23%		3%	52%	5%	1%	3%	12%
		9-15 mph	11%			53%			9%	28%
		16+ mph								100%

Table J-107 (*continued*). Spring 2009 cumulative wind direction (by percentage) by wind speed for site.

Site	Dates	Time/Wind Speed	N	NE	E	SE	S	SW	W	NW
B Brigantine\dbs\TS\h-2009wk19	May-03 to May-05	**Diurnal**	**15%**		**6%**	**17%**	**1%**	**6%**	**14%**	**41%**
		0-8 mph	1%		8%	25%	2%	8%	16%	40%
		9-15 mph	47%						9%	43%
		16+ mph								
		Nocturnal	**2%**							**98%**
		0-8 mph	8%							92%
		9-15 mph								100%
		16+ mph								
C Sea Isle City\dbs\TS\h-2009wk19	May-06 to May-10	**Diurnal**	**36%**	**15%**	**19%**	**13%**			**8%**	**9%**
		0-8 mph	43%	13%	19%	5%			9%	11%
		9-15 mph	8%	23%	22%	44%			4%	
		16+ mph								
		Nocturnal	**32%**	**25%**	**19%**	**20%**			**3%**	
		0-8 mph	40%	20%	24%	16%			1%	
		9-15 mph	3%	44%		40%			13%	
		16+ mph		100%						
C Sea Isle City\dbs\TS\h-2009wk20	May-10 to May-17	**Diurnal**	**44%**	**12%**	**11%**	**3%**	**4%**	**2%**	**9%**	**16%**
		0-8 mph	41%	10%	8%	3%	4%	2%	12%	20%
		9-15 mph	55%	22%	20%		2%		1%	
		16+ mph								
		Nocturnal	**24%**	**30%**	**13%**	**6%**	**11%**		**0%**	**16%**
		0-8 mph	23%	25%	15%	7%	10%		0%	19%
		9-15 mph	27%	54%		2%	15%			2%
		16+ mph								

Table J-107 (*continued*). Spring 2009 cumulative wind direction (by percentage) by wind speed for site.

Site	Dates	Time/Wind Speed	N	NE	E	SE	S	SW	W	NW
C Sea Isle City\dbs\TS\h-2009wk21	May-17 to May-24	**Diurnal**	**56%**	**25%**	**9%**		**4%**	**0%**	**2%**	**4%**
		0-8 mph	57%	23%	11%		4%	0%	1%	5%
		9-15 mph	53%	34%			6%		7%	
		16+ mph								
		Nocturnal	**24%**	**55%**	**9%**	**3%**	**9%**			
		0-8 mph	27%	50%	10%	4%	9%			
		9-15 mph		93%			7%			
		16+ mph								
C Sea Isle City\dbs\TS\h-2009wk22	May-24 to Jun-02	**Diurnal**	**24%**	**8%**	**15%**	**3%**	**4%**	**10%**	**32%**	**4%**
		0-8 mph	27%	8%	16%	4%	4%	8%	28%	5%
		9-15 mph	8%	9%	12%			18%	53%	
		16+ mph								
		Nocturnal	**11%**	**28%**	**2%**	**12%**	**11%**	**15%**	**20%**	
		0-8 mph	12%	30%	2%	13%	11%	10%	21%	
		9-15 mph		5%				82%	13%	
		16+ mph								

Table J-108. Fall 2009 daily VerCat onshore radar daily operational hours by weather condition. (IBSP = Island Beach State Park; BB = Brigantine Beach; SIC = Sea Isle City)

Location	Date	Diurnal[1]			Nocturnal[2]			Total Hrs
		Hrs Clear	Hrs Rain[3]	Total Hrs	Hrs Clear	Hrs Rain[3]	Total Hrs	
IBSP	9/15/2009				4.9		*4.9*	**4.9**
	9/16/2009	3.6	8.0	*11.7*	9.8	0.9	*10.7*	**22.3**
	9/17/2009	10.0	3.3	*13.3*	10.2	0.5	*10.7*	**24.0**
	9/18/2009	8.7	2.3	*11.0*	10.5		*10.5*	**21.5**
	9/19/2009	12.7		*12.7*	10.7		*10.7*	**23.4**
	9/20/2009	8.8		*8.8*	5.3		*5.3*	**14.0**
	9/20/2009	4.1		*4.1*	5.6		*5.6*	**9.7**
	9/21/2009	12.9		*12.9*	10.9		*10.9*	**23.8**
	9/22/2009	13.1		*13.1*	10.9		*10.9*	**24.0**
	9/23/2009	5.1	7.9	*13.0*	6.9	4.1	*11.0*	**24.0**
	9/24/2009	12.5	0.5	*13.0*	5.7	5.3	*11.0*	**24.0**
	9/25/2009	12.3		*12.3*	11.1		*11.1*	**23.4**
	9/26/2009	12.9		*12.9*	6.3	4.8	*11.1*	**24.0**
	9/27/2009	1.0	7.7	*8.7*		5.4	*5.4*	**14.0**
	9/27/2009	2.8	1.4	*4.2*	5.8		*5.8*	**10.0**
	9/28/2009	12.5	0.3	*12.8*	7.6	3.6	*11.2*	**24.0**
	9/29/2009	12.4		*12.4*	11.2		*11.2*	**23.6**
	9/30/2009	1.5	11.2	*12.7*	11.3		*11.3*	**24.0**
	10/1/2009	12.7		*12.7*	11.3		*11.3*	**24.0**
	10/2/2009	7.2		*7.2*	5.5		*5.5*	**12.6**
BB	10/5/2009	1.4		*1.4*	6.0		*6.0*	**7.4**
	10/6/2009	11.0		*11.0*	9.3	2.3	*11.5*	**22.5**
	10/7/2009	8.9	3.5	*12.4*	7.3	4.3	*11.6*	**24.0**
	10/8/2009	12.4		*12.4*	11.6		*11.6*	**24.0**
	10/9/2009	9.8	2.6	*12.3*	7.9	3.2	*11.1*	**23.5**
	10/12/2009	0.4		*0.4*				**0.4**
	10/13/2009	7.3		*7.3*	6.2		*6.2*	**13.5**
	10/14/2009	12.2		*12.2*	11.5	0.4	*11.9*	**24.0**
	10/15/2009		12.1	*12.1*	2.1	9.8	*11.9*	**24.0**
	10/16/2009		12.1	*12.1*		11.9	*11.9*	**24.0**
	10/17/2009		12.0	*12.0*	0.1	11.9	*12.0*	**24.0**
	10/18/2009	1.2	6.1	*7.3*		5.7	*5.7*	**13.0**
	10/18/2009	2.7	1.0	*3.7*	6.3		*6.3*	**10.0**
	10/19/2009	11.8		*11.8*	11.9		*11.9*	**23.7**
	10/20/2009	11.9		*11.9*	12.0		*12.0*	**23.9**
	10/21/2009	11.9		*11.9*	12.1		*12.1*	**24.0**
	10/22/2009	11.8		*11.8*	12.2		*12.2*	**24.0**

Table J-108. Fall 2009 daily VerCat onshore radar daily operational hours by weather condition. (IBSP = Island Beach State Park; BB = Brigantine Beach; SIC = Sea Isle City)

Location	Date	Diurnal[1]			Nocturnal[2]			Total Hrs
		Hrs Clear	Hrs Rain[3]	Total Hrs	Hrs Clear	Hrs Rain[3]	Total Hrs	
BB	10/23/2009	10.1	1.5	*11.6*	9.1	3.1	*12.2*	**23.8**
	10/24/2009	5.5	6.3	*11.7*	3.3	9.0	*12.3*	**24.0**
	10/25/2009	11.7		*11.7*	11.7	0.6	*12.3*	**24.0**
	10/26/2009	2.8		*2.8*	5.9		*5.9*	**8.6**
SIC	10/26/2009	3.2		*3.2*	6.5		*6.5*	**9.6**
	10/27/2009	7.3	4.3	*11.6*	1.7	10.7	*12.4*	**24.0**
	10/28/2009	7.0	4.6	*11.6*	6.5	5.9	*12.4*	**24.0**
	10/29/2009	11.6		*11.6*	8.9	3.5	*12.4*	**24.0**
	10/30/2009	11.2		*11.2*	9.1	3.4	*12.5*	**23.7**
	10/31/2009	8.4	3.1	*11.5*	5.5	7.0	*12.5*	**24.0**
	11/1/2009	2.3	5.7	*8.0*		6.0	*6.0*	**14.0**
	11/1/2009	0.2	3.3	*3.4*	4.4	2.2	*6.6*	**10.0**
	11/2/2009	1.6	9.9	*11.4*	8.0	4.6	*12.6*	**24.0**
	11/3/2009	11.0	0.2	*11.2*	12.3		*12.3*	**23.5**
	11/4/2009	11.4		*11.4*	7.5	5.1	*12.7*	**24.0**
	11/5/2009	10.9	0.4	*11.3*	8.1	4.6	*12.7*	**24.0**
	11/6/2009	11.2		*11.2*	12.6		*12.6*	**23.7**
	11/7/2009	11.1		*11.1*	12.8		*12.8*	**23.8**
	11/8/2009	7.3		*7.3*	6.1		*6.1*	**13.4**
	11/8/2009	3.3		*3.3*	6.5		*6.5*	**9.8**
	11/9/2009	11.2		*11.2*	12.8		*12.8*	**24.0**
	11/10/2009	11.2		*11.2*	12.8		*12.8*	**24.0**
	11/11/2009		11.1	*11.1*	2.6	10.3	*12.9*	**24.0**
	11/12/2009		11.0	*11.0*	0.6	12.3	*12.9*	**23.9**
	11/13/2009	0.4	8.4	*8.8*	0.4	12.6	*12.9*	**21.7**
	11/14/2009	10.3	0.7	*11.0*	9.7	3.3	*13.0*	**24.0**
	11/15/2009	11.0		*11.0*	13.0		*13.0*	**24.0**
	11/16/2009	2.9		*2.9*	6.3		*6.3*	**9.1**

[1] Diurnal occurs from Civil Sunrise to Civil Sunset
[2] Nocturnal occurs from Civil Sunset to Civil Sunrise
[3] Rain includes fog, mist, and drizzle
Hrs = Hours

Table J-109. Fall 2009 daily TracScan onshore radar daily operational hours by weather condition. (IBSP = Island Beach State Park; BB = Brigantine Beach; SIC = Sea Isle City)

Location	Date	Diurnal[1]			Nocturnal[2]			Total Hrs
		Hrs Clear	Hrs Rain[3]	Total Hrs	Hrs Clear	Hrs Rain[3]	Total Hrs	
IBSP	9/15/2009				5.4		*5.4*	**5.4**
	9/16/2009	3.7	9.0	*12.7*	9.8	0.9	*10.7*	**23.4**
	9/17/2009	10.0	3.3	*13.3*	10.2	0.5	*10.7*	**24.0**
	9/18/2009	10.3	3.0	*13.3*	10.8		*10.8*	**24.0**
	9/19/2009	13.2		*13.2*	10.8		*10.8*	**24.0**
	9/20/2009	8.8		*8.8*	5.3		*5.3*	**14.0**
	9/20/2009	4.4		*4.4*	5.6		*5.6*	**10.0**
	9/21/2009	13.1		*13.1*	10.9		*10.9*	**24.0**
	9/22/2009	13.1		*13.1*	10.9		*10.9*	**24.0**
	9/23/2009	5.1	7.9	*13.0*	6.9	4.1	*11.0*	**24.0**
	9/24/2009	12.5	0.5	*13.0*	5.7	5.3	*11.0*	**24.0**
	9/25/2009	12.2		*12.2*	11.1		*11.1*	**23.3**
	9/26/2009	12.9		*12.9*	6.3	4.8	*11.1*	**24.0**
	9/27/2009	1.0	7.7	*8.7*		5.4	*5.4*	**14.0**
	9/27/2009	2.8	1.4	*4.2*	5.8		*5.8*	**10.0**
	9/28/2009	12.5	0.3	*12.8*	7.6	3.6	*11.2*	**24.0**
	9/29/2009	12.8		*12.8*	11.2		*11.2*	**24.0**
	9/30/2009	1.5	11.2	*12.7*	11.3		*11.3*	**24.0**
	10/1/2009	12.7		*12.7*	11.3		*11.3*	**24.0**
	10/2/2009	7.2		*7.2*	5.5		*5.5*	**12.6**
BB	10/5/2009	1.4		*1.4*	2.8		*2.8*	**4.3**
	10/6/2009	12.5		*12.5*	9.3	2.3	*11.5*	**24.0**
	10/7/2009	8.9	3.5	*12.4*	7.3	4.3	*11.6*	**24.0**
	10/8/2009	12.4		*12.4*	11.6		*11.6*	**24.0**
	10/9/2009	9.8	2.6	*12.4*	7.0	1.7	*8.7*	**21.0**
	10/10/2009	7.3	5.1	*12.3*	7.3	1.7	*9.0*	**21.3**
	10/11/2009	8.4		*8.4*	2.2		*2.2*	**10.6**
	10/11/2009	3.9		*3.9*	6.1		*6.1*	**10.0**
	10/12/2009	10.0		*10.0*	10.8	1.0	*11.8*	**21.7**
	10/13/2009	11.5		*11.5*	9.5	2.3	*11.8*	**23.3**
	10/14/2009	12.2		*12.2*	11.5	0.4	*11.9*	**24.0**
	10/15/2009		12.1	*12.1*	2.1	9.8	*11.9*	**24.0**
	10/16/2009		12.1	*12.1*		11.9	*11.9*	**24.0**
	10/17/2009		12.0	*12.0*	0.1	11.9	*12.0*	**24.0**
	10/18/2009	1.2	6.1	*7.3*		5.7	*5.7*	**13.1**
	10/18/2009	2.7	1.0	*3.7*	6.3		*6.3*	**10.0**
	10/19/2009	12.0		*12.0*	10.0		*10.0*	**22.0**

Table J-109. Fall 2009 daily TracScan onshore radar daily operational hours by weather condition. (IBSP = Island Beach State Park; BB = Brigantine Beach; SIC = Sea Isle City)

Location	Date	Diurnal[1]			Nocturnal[2]			Total Hrs
		Hrs Clear	Hrs Rain[3]	Total Hrs	Hrs Clear	Hrs Rain[3]	Total Hrs	
BB	10/20/2009	11.9		*11.9*	10.8		*10.8*	**22.7**
	10/21/2009	11.9		*11.9*	12.1		*12.1*	**24.0**
	10/22/2009	11.8		*11.8*	12.2		*12.2*	**24.0**
	10/23/2009	10.3	1.5	*11.8*	9.1	3.1	*12.2*	**24.0**
	10/24/2009	5.5	6.3	*11.7*	3.3	9.0	*12.3*	**24.0**
	10/25/2009	11.7		*11.7*	9.0	0.6	*9.6*	**21.3**
	10/26/2009	2.8		*2.8*	5.2		*5.2*	**8.0**
SIC	10/26/2009	3.2		*3.2*	6.5		*6.5*	**9.6**
	10/27/2009	7.3	4.3	*11.7*	1.7	10.7	*12.4*	**24.0**
	10/28/2009	7.0	4.6	*11.6*	6.5	5.9	*12.4*	**24.0**
	10/29/2009	11.6		*11.6*	8.9	3.5	*12.4*	**24.0**
	10/30/2009	11.5		*11.5*	9.1	3.4	*12.5*	**24.0**
	10/31/2009	8.4	3.1	*11.5*	5.5	7.0	*12.5*	**24.0**
	11/1/2009	2.3	5.7	*8.0*		6.0	*6.0*	**14.0**
	11/1/2009	0.2	3.3	*3.4*	4.4	2.2	*6.6*	**10.0**
	11/2/2009	1.6	9.9	*11.4*	8.0	4.6	*12.6*	**24.0**
	11/3/2009	11.0	0.4	*11.4*	12.6		*12.6*	**24.0**
	11/4/2009	11.4		*11.4*	7.5	5.1	*12.7*	**24.0**
	11/5/2009	10.9	0.4	*11.3*	8.1	4.6	*12.7*	**24.0**
	11/6/2009	11.3		*11.3*	12.7		*12.7*	**24.0**
	11/7/2009	11.3		*11.3*	12.8		*12.8*	**24.0**
	11/8/2009	7.3		*7.3*	6.1		*6.1*	**13.4**
	11/8/2009	3.3		*3.3*	6.7		*6.7*	**10.0**
	11/9/2009	11.2		*11.2*	12.8		*12.8*	**24.0**
	11/10/2009	11.2		*11.2*	12.8		*12.8*	**24.0**
	11/11/2009		11.1	*11.1*	2.6	10.3	*12.9*	**24.0**
	11/12/2009		11.1	*11.1*	0.6	12.3	*12.9*	**24.0**
	11/13/2009	0.4	10.7	*11.1*	0.4	12.6	*12.9*	**24.0**
	11/14/2009	10.4	0.7	*11.0*	9.7	3.3	*13.0*	**24.0**
	11/15/2009	11.0		*11.0*	13.0		*13.0*	**24.0**
	11/16/2009	2.9		*2.9*	6.3		*6.3*	**9.1**

[1] Diurnal occurs from Civil Sunrise to Civil Sunset
[2] Nocturnal occurs from Civil Sunset to Civil Sunrise
[3] Rain includes fog, mist, and drizzle
Hrs = Hours

Table J-110. Fall 2009 Island Beach State Park daily onshore VerCat radar altitudinal distribution, winds 0 to 8 mph during clear weather conditions.

Date	Diurnal[1]					Nocturnal[2]				
	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]
9/15/2009						486	833	1256	925	857
9/16/2009	99	564	1276	780	109	624	1000	1400	1041	1286
9/17/2009	52	118	203	139	177	146	252	363	266	1040
9/18/2009	33	57	110	95	210	97	202	313	229	1315
9/19/2009	124	247	312	244	1192	153	251	356	270	2706
9/20/2009	100	214	344	232	1130	152	252	349	259	1444
Total	**83**	**213**	**319**	**242**	**2818**	**170**	**297**	**493**	**441**	**8644**
9/20/2009	58	230	365	226	206	111	207	323	230	561
9/21/2009	30	65	191	128	532	101	172	260	191	566
9/22/2009	29	89	375	274	242	243	526	925	629	546
9/23/2009	117	206	475	358	46	121	186	255	226	693
9/24/2009	164	255	339	258	3131	158	265	366	272	2236
9/25/2009	180	278	364	279	326	140	237	336	255	2299
9/26/2009	26	50	228	137	199	63	153	315	194	7
9/27/2009	36	139	265	401	10					
Total	**116**	**234**	**332**	**241**	**4692**	**139**	**238**	**352**	**280**	**6906**
9/27/2009	31	73	210	157	53	90	175	252	189	181
9/28/2009	34	58	112	116	94	57	95	170	135	568
9/29/2009	39	72	127	104	62	74	132	228	177	655
9/30/2009	50	143	262	170	79	179	284	392	297	2483
10/1/2009	36	75	169	127	645	170	270	377	281	3168
10/2/2009	85	198	306	211	802	199	305	413	308	1019
Total	**46**	**120**	**251**	**167**	**1736**	**142**	**254**	**371**	**269**	**8072**

Alt = Altitude in feet above mean sea level
[1] Diurnal runs from civil sunrise to civil sunset
[2] Nocturnal runs from civil sunset to civil sunrise
[3] Adjusted bird tracks (ratio 0.363). Bird count numbers added and then rounded to nearest whole number. Some bird count columns may not add to bird count number in total because of rounding.
Cells with normal sized text have at least 40 minutes of observations
Cells with small text have between 10 and 39 minutes of observations
Cells with very small text have less than 10 minutes of observations

Table J-111. Fall 2009 Island Beach State Park daily onshore VerCat radar altitudinal distribution, winds 9 to 15 mph during clear weather conditions.

Date	Diurnal[1]					Nocturnal[2]				
	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]
9/15/2009						Not Applicable				
9/16/2009										
9/17/2009	243	414	653	496	347					
9/18/2009	29	46	80	84	39					
9/19/2009										
9/20/2009										
Total	**192**	**377**	**608**	**454**	**386**					
9/20/2009										
9/21/2009										
9/22/2009										
9/23/2009	114	156	231	199	300	105	155	190	152	100
9/24/2009						133	209	292	231	75
9/25/2009	176	283	393	314	1732	110	216	330	248	896
9/26/2009	24	73	326	181	146	163	246	338	257	559
9/27/2009										
Total	**147**	**258**	**376**	**289**	**2178**	**126**	**218**	**325**	**245**	**1630**
9/27/2009						79	177	248	182	354
9/28/2009	30	59	123	111	37	45	73	114	106	195
9/29/2009	32	60	169	120	138	72	122	212	181	217
9/30/2009						47	96	397	223	81
10/1/2009										
10/2/2009										
Total	**31**	**60**	**164**	**118**	**175**	**59**	**121**	**222**	**168**	**847**

Alt = Altitude in feet above mean sea level
[1] Diurnal runs from civil sunrise to civil sunset
[2] Nocturnal runs from civil sunset to civil sunrise
[3] Adjusted bird tracks (ratio 0.363). Bird count numbers added and then rounded to nearest whole number. Some bird count columns may not add to bird count number in total because of rounding.
Cells with normal sized text have at least 40 minutes of observations
Cells with small text have between 10 and 39 minutes of observations
Cells with very small text have less than 10 minutes of observations

Table J-112. Fall 2009 Island Beach State Park daily onshore VerCat radar altitudinal distribution, winds 16+ mph during clear weather conditions.

Date	Diurnal[1]					Nocturnal[2]				
	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]
9/15/2009										
9/16/2009	32	73	99	104	15	65	115	261	280	29
9/17/2009	58	137	751	461	18	343	617	888	636	155
9/18/2009										
9/19/2009										
9/20/2009										
Total	**48**	**85**	**208**	**298**	**33**	**215**	**546**	**866**	**580**	**184**
9/20/2009						Not Applicable				
9/21/2009										
9/22/2009										
9/23/2009										
9/24/2009										
9/25/2009	159	231	310	263	83					
9/26/2009										
9/27/2009										
Total	**159**	**231**	**310**	**263**	**83**					
9/27/2009						Not Applicable				
9/28/2009	24	61	146	131	52					
9/29/2009	52	196	299	145	1					
9/30/2009										
10/1/2009										
10/2/2009										
Total	**24**	**61**	**157**	**131**	**54**					

Alt = Altitude in feet above mean sea level
[1] Diurnal runs from civil sunrise to civil sunset
[2] Nocturnal runs from civil sunset to civil sunrise
[3] Adjusted bird tracks (ratio 0.363). Bird count numbers added and then rounded to nearest whole number. Some bird count columns may not add to bird count number in total because of rounding.
Cells with normal sized text have at least 40 minutes of observations
Cells with small text have between 10 and 39 minutes of observations
Cells with very small text have less than 10 minutes of observations

Table J-113. Fall 2009 Brigantine Beach daily onshore VerCat radar altitudinal distribution, winds 0 to 8 mph during clear weather conditions.

Date	Diurnal[1]					Nocturnal[2]				
	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]
10/5/2009	23	59	133	91	45	154	298	487	334	3175
10/6/2009	81	204	308	215	847	154	273	387	279	2799
10/7/2009						63	167	303	196	18
10/8/2009	35	128	214	152	240	140	273	461	319	3706
10/9/2009						200	348	496	355	1924
Total	**61**	**177**	**288**	**196**	**1132**	**155**	**291**	**450**	**319**	**11617**
10/12/2009	75	271	409	294	3					
10/13/2009										
10/14/2009	36	105	216	166	174	119	207	308	238	906
10/15/2009						59	127	230	160	469
10/16/2009										
10/17/2009										
10/18/2009										
Total	**36**	**105**	**219**	**168**	**176**	**92**	**183**	**284**	**212**	**1374**
10/18/2009										
10/19/2009	32	77	194	129	73	155	298	453	318	1982
10/20/2009	90	194	312	280	858	206	390	577	470	3613
10/21/2009	254	634	1068	694	1983	207	390	664	580	4059
10/22/2009	12	32	111	82	114	130	229	369	259	2561
10/23/2009	171	244	306	234	156	98	202	293	210	902
10/24/2009										
10/25/2009	60	147	252	179	125	190	296	420	315	2890
10/26/2009	46	125	273	164	82	141	250	377	287	1053
Total	**140**	**298**	**831**	**503**	**3392**	**170**	**306**	**487**	**396**	**17049**

Alt = Altitude in feet above mean sea level
[1] Diurnal runs from civil sunrise to civil sunset
[2] Nocturnal runs from civil sunset to civil sunrise
[3] Adjusted bird tracks (ratio 0.363). Bird count numbers added and then rounded to nearest whole number. Some bird count columns may not add to bird count number in total because of rounding.
Cells with normal sized text have at least 40 minutes of observations
Cells with small text have between 10 and 39 minutes of observations
Cells with very small text have less than 10 minutes of observations

Table J-114. Fall 2009 Brigantine Beach daily onshore VerCat radar altitudinal distribution, winds 9 to 15 mph during clear weather conditions.

Date	Diurnal[1]					Nocturnal[2]				
	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]
10/5/2009	12	19	57	50	10					
10/6/2009	152	291	364	264	107	101	197	325	219	273
10/7/2009	21	38	80	101	23	79	170	273	204	694
10/8/2009	39	137	234	162	581	46	89	241	187	467
10/9/2009	64	143	209	165	309	120	184	258	194	696
Total	**46**	**146**	**239**	**171**	**1030**	**79**	**169**	**267**	**199**	**2129**
10/12/2009										
10/13/2009	103	167	229	169	359	106	264	445	298	368
10/14/2009	47	141	279	180	167	85	228	391	265	356
10/15/2009						65	108	177	137	41
10/16/2009										
10/17/2009										
10/18/2009										
Total	**82**	**161**	**240**	**172**	**525**	**93**	**233**	**405**	**274**	**765**
10/18/2009	7	9	13	15	9	69	185	308	222	410
10/19/2009	46	151	298	214	258	49	146	340	219	471
10/20/2009	457	612	872	653	32					
10/21/2009										
10/22/2009	71	133	196	140	550					
10/23/2009	160	366	403	295	74	32	82	135	200	4
10/24/2009	14	21	48	238	5					
10/25/2009	73	163	267	184	213	58	138	281	198	214
10/26/2009	49	109	236	165	85					
Total	**64**	**145**	**249**	**187**	**1227**	**57**	**158**	**314**	**216**	**1100**

Alt = Altitude in feet above mean sea level

[1] Diurnal runs from civil sunrise to civil sunset

[2] Nocturnal runs from civil sunset to civil sunrise

[3] Adjusted bird tracks (ratio 0.363). Bird count numbers added and then rounded to nearest whole number. Some bird count columns may not add to bird count number in total because of rounding.

Cells with normal sized text have at least 40 minutes of observations

Cells with small text have between 10 and 39 minutes of observations

Cells with very small text have less than 10 minutes of observations

Table J-115. Fall 2009 Brigantine Beach daily onshore VerCat radar altitudinal distribution, winds 16+ mph during clear weather conditions.

Date	Diurnal[1]					Nocturnal[2]				
	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]
10/5/2009										
10/6/2009										
10/7/2009	101	177	239	184	206	89	172	232	179	89
10/8/2009	29	101	238	157	110					
10/9/2009	20	43	183	109	100					
Total	**38**	**142**	**231**	**159**	**416**	**89**	**172**	**232**	**179**	**89**
10/12/2009										
10/13/2009	67	137	194	144	79	121	257	423	287	303
10/14/2009						73	246	346	233	121
10/15/2009										
10/16/2009										
10/17/2009						8	9	16	14	5
10/18/2009	8	10	13	20	74					
Total	**10**	**19**	**140**	**84**	**153**	**103**	**250**	**391**	**269**	**428**
10/18/2009	8	11	14	35	89	78	212	369	255	410
10/19/2009	22	46	236	171	33	54	176	295	205	101
10/20/2009										
10/21/2009										
10/22/2009										
10/23/2009	27	134	238	157	65	37	152	183	128	13
10/24/2009	11	25	31	22	1	16	30	60	51	10
10/25/2009	63	145	276	179	69	64	107	148	129	5
10/26/2009										
Total	**12**	**39**	**183**	**122**	**257**	**68**	**195**	**351**	**238**	**539**

Alt = Altitude in feet above mean sea level
[1] Diurnal runs from civil sunrise to civil sunset
[2] Nocturnal runs from civil sunset to civil sunrise
[3] Adjusted bird tracks (ratio 0.363). Bird count numbers added and then rounded to nearest whole number. Some bird count columns may not add to bird count number in total because of rounding.
Cells with normal sized text have at least 40 minutes of observations
Cells with small text have between 10 and 39 minutes of observations
Cells with very small text have less than 10 minutes of observations

Table J-116. Fall 2009 Sea Isle City daily onshore VerCat radar altitudinal distribution, winds 0 to 8 mph during clear weather conditions.

Date	Diurnal[1]					Nocturnal[2]				
	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]
10/26/2009	37	69	168	139	57	57	105	164	134	78
10/27/2009	24	35	76	60	36	22	35	113	55	3
10/28/2009	74	120	176	130	184	176	316	384	291	302
10/29/2009	25	35	108	94	252	79	180	307	218	624
10/30/2009	28	41	76	70	204	102	193	288	207	720
10/31/2009	36	50	62	48	2	35	52	65	80	5
11/1/2009	40	67	150	125	33					
Total	**30**	**58**	**126**	**99**	**768**	**96**	**197**	**320**	**221**	**1732**
11/1/2009	91	172	301	184	4	179	287	423	324	1477
11/2/2009	36	71	173	115	81	124	217	337	247	1076
11/3/2009	36	98	189	150	256	111	241	414	289	1960
11/4/2009	35	79	171	127	350	93	250	466	301	885
11/5/2009	41	124	218	160	535	87	164	317	245	566
11/6/2009	36	95	245	178	222	181	451	695	462	2777
11/7/2009	34	56	138	114	191	350	554	722	536	3770
11/8/2009	70	142	219	156	498	40	59	129	116	20
Total	**39**	**107**	**205**	**149**	**2136**	**172**	**358**	**602**	**401**	**12527**
11/8/2009	45	142	248	155	129	164	253	370	280	829
11/9/2009	30	38	100	79	215	148	249	364	268	511
11/10/2009	31	42	101	76	347	144	237	366	270	1047
11/11/2009						149	257	338	264	326
11/12/2009										
11/13/2009										
11/14/2009	22	26	30	35	284	35	111	277	162	288
11/15/2009	67	137	208	157	661	134	276	441	331	1608
11/16/2009	51	97	199	146	86	67	229	375	259	354
Total	**30**	**63**	**161**	**110**	**1721**	**131**	**248**	**380**	**284**	**4961**

Alt = Altitude in feet above mean sea level

[1] Diurnal runs from civil sunrise to civil sunset

[2] Nocturnal runs from civil sunset to civil sunrise

[3] Adjusted bird tracks (ratio 0.363). Bird count numbers added and then rounded to nearest whole number. Some bird count columns may not add to bird count number in total because of rounding.

Cells with normal sized text have at least 40 minutes of observations

Cells with small text have between 10 and 39 minutes of observations

Cells with very small text have less than 10 minutes of observations

Table J-117. Fall 2009 Sea Isle City daily onshore VerCat radar altitudinal distribution, winds 9 to 15 mph during clear weather conditions.

Date	Diurnal[1]					Nocturnal[2]				
	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]
10/26/2009	36	48	159	124	21	72	140	241	173	242
10/27/2009	27	33	72	110	21	34	60	79	67	7
10/28/2009	109	155	198	160	76	148	259	350	262	199
10/29/2009						42	164	275	201	31
10/30/2009										
10/31/2009	27	38	55	99	32	54	95	110	171	5
11/1/2009	27	35	59	43	6					
Total	**36**	**87**	**166**	**132**	**155**	**Total**	**89**	**183**	**304**	**483**
11/1/2009	22	33	33	28	1					
11/2/2009						99	190	266	206	64
11/3/2009										
11/4/2009										
11/5/2009						66	116	411	231	10
11/6/2009	38	82	214	156	122					
11/7/2009	29	40	103	120	40	44	63	130	147	26
11/8/2009						57	103	334	234	2
Total	**34**	**66**	**203**	**147**	**163**	**65**	**144**	**253**	**194**	**101**
11/8/2009										
11/9/2009										
11/10/2009										
11/11/2009										
11/12/2009										
11/13/2009						24	30	34	29	15
11/14/2009	22	26	30	27	145	23	28	32	28	224
11/15/2009										
11/16/2009										
Total	**22**	**26**	**30**	**27**	**145**	**23**	**28**	**32**	**28**	**238**

Alt = Altitude in feet above mean sea level
[1] Diurnal runs from civil sunrise to civil sunset
[2] Nocturnal runs from civil sunset to civil sunrise
[3] Adjusted bird tracks (ratio 0.363). Bird count numbers added and then rounded to nearest whole number. Some bird count columns may not add to bird count number in total because of rounding.
Cells with normal sized text have at least 40 minutes of observations
Cells with small text have between 10 and 39 minutes of observations
Cells with very small text have less than 10 minutes of observations

Table J-118. Fall 2009 Sea Isle City daily onshore VerCat radar altitudinal distribution, winds 16+ mph during clear weather conditions.

Date	Diurnal[1]					Nocturnal[2]				
	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]	25% Alt	Median Alt	75% Alt	Mean Alt	Count[3]
10/26/2009	Not Applicable					Not Applicable				
10/27/2009										
10/28/2009										
10/29/2009										
10/30/2009										
10/31/2009										
11/1/2009										
Total										
11/1/2009	Not Applicable					Not Applicable				
11/2/2009										
11/3/2009										
11/4/2009										
11/5/2009										
11/6/2009										
11/7/2009										
11/8/2009										
Total										
11/8/2009										
11/9/2009										
11/10/2009										
11/11/2009										
11/12/2009						28	33	40	35	166
11/13/2009	27	33	39	34	95	26	31	36	31	54
11/14/2009						23	27	32	29	162
11/15/2009										
11/16/2009										
Total	**27**	**33**	**39**	**34**	**95**	**25**	**31**	**36**	**32**	**382**

Alt = Altitude in feet above mean sea level
[1] Diurnal runs from civil sunrise to civil sunset
[2] Nocturnal runs from civil sunset to civil sunrise
[3] Adjusted bird tracks (ratio 0.363). Bird count numbers added and then rounded to nearest whole number. Some bird count columns may not add to bird count number in total because of rounding.
Cells with normal sized text have at least 40 minutes of observations
Cells with small text have between 10 and 39 minutes of observations
Cells with very small text have less than 10 minutes of observations

Table J-119. Fall 2009 cumulative wind direction (by percentage) by wind speed for site.

Site	Dates	Time/Wind Speed	N	NE	E	SE	S	SW	W	NW
A Island Beach\dbs\TS\h-2009wk38	Sep-15 to Sep-20	**Diurnal**	**1%**	**11%**	**17%**	**7%**	**13%**	**35%**	**7%**	**8%**
		0-8 mph	2%	12%	19%	9%	17%	21%	9%	11%
		9-15 mph		9%	14%			77%		
		16+ mph						100%		
		Nocturnal	**2%**	**19%**	**25%**	**6%**	**16%**	**30%**	**2%**	**0%**
		0-8 mph	2%	23%	31%	7%	20%	18%		0%
		9-15 mph								
		16+ mph						89%	11%	
A Island Beach\dbs\TS\h-2009wk39	Sep-20 to Sep-27	**Diurnal**	**28%**	**3%**	**3%**	**5%**	**5%**	**14%**	**20%**	**20%**
		0-8 mph	32%	3%	5%	8%	3%	4%	17%	28%
		9-15 mph	18%	2%			11%	39%	30%	
		16+ mph					20%	80%		
		Nocturnal	**39%**	**17%**		**4%**	**16%**	**0%**	**19%**	**5%**
		0-8 mph	50%	20%		5%	20%		1%	5%
		9-15 mph		8%			1%	1%	84%	5%
		16+ mph								
A Island Beach\dbs\TS\h-2009wk40	Sep-27 to Oct-02	**Diurnal**	**16%**	**18%**	**45%**	**13%**				**8%**
		0-8 mph	2%	24%	40%	21%				13%
		9-15 mph	12%	12%	75%					
		16+ mph	89%	5%	5%					
		Nocturnal		**2%**	**76%**	**19%**	**2%**			
		0-8 mph		3%	70%	25%	3%			
		9-15 mph		2%	98%					
		16+ mph								

Table J-119 (*continued*). Fall 2009 cumulative wind direction (by percentage) by wind speed for site.

Site	Dates	Time/Wind Speed	N	NE	E	SE	S	SW	W	NW
B Brigantine\dbs\TS\h-2009wk41	Oct-05 to Oct-11	**Diurnal**	**14%**	**13%**	**10%**	**53%**	**8%**	**0%**		**2%**
		0-8 mph	12%		11%	62%	10%	0%		5%
		9-15 mph	19%	25%	8%	42%	6%			
		16+ mph	11%	15%	9%	56%	9%			
		Nocturnal	**9%**	**23%**	**21%**	**39%**	**9%**			
		0-8 mph		11%	29%	45%	16%			
		9-15 mph	18%	36%	13%	31%	2%			
		16+ mph	19%			81%				
B Brigantine\dbs\TS\h-2009wk42	Oct-11 to Oct-18	**Diurnal**			**10%**	**30%**	**19%**	**24%**	**18%**	
		0-8 mph			18%	16%	8%	34%	24%	
		9-15 mph			1%	39%	29%	16%	14%	
		16+ mph				66%	34%			
		Nocturnal	**5%**	**0%**		**18%**	**51%**	**5%**	**8%**	**12%**
		0-8 mph	12%	1%		34%	29%	11%	5%	8%
		9-15 mph				7%	59%		14%	20%
		16+ mph				3%	95%	2%		
B Brigantine\dbs\TS\h-2009wk43	Oct-18 to Oct-26	**Diurnal**	**19%**	**14%**	**13%**	**28%**	**12%**	**3%**	**11%**	
		0-8 mph	16%	20%	28%	27%	6%	1%	1%	
		9-15 mph	28%	13%		31%	12%	8%	8%	
		16+ mph	8%			21%	30%		41%	
		Nocturnal	**4%**	**19%**	**36%**	**16%**	**22%**			**4%**
		0-8 mph		26%	51%	10%	13%			
		9-15 mph	8%	1%		44%	37%			10%
		16+ mph	22%	1%		2%	54%			21%

Table J-119 (*continued*). Fall 2009 cumulative wind direction (by percentage) by wind speed for site.

Site	Dates	Time/Wind Speed	N	NE	E	SE	S	SW	W	NW
C Sea Isle City\dbs\TS\h-2009wk44	Oct-26 to Nov-01	**Diurnal**	**11%**	**9%**	**4%**	**3%**	**13%**	**31%**	**15%**	**15%**
		0-8 mph	3%	1%	3%	4%	17%	34%	17%	21%
		9-15 mph	29%	27%	6%	3%	3%	23%	10%	
		16+ mph								
		Nocturnal	**6%**	**8%**			**38%**	**7%**	**32%**	**9%**
		0-8 mph	8%	2%			47%	11%	19%	13%
		9-15 mph	3%	19%			23%		55%	
		16+ mph								
C Sea Isle City\dbs\TS\h-2009wk45	Nov-01 to Nov-08	**Diurnal**	**16%**	**14%**	**17%**	**20%**	**24%**	**2%**	**3%**	**4%**
		0-8 mph	14%	13%	20%	22%	21%	3%	3%	4%
		9-15 mph	25%	19%		10%	46%			
		16+ mph								
		Nocturnal	**2%**	**18%**	**5%**	**45%**	**29%**	**1%**		
		0-8 mph	2%	11%	6%	50%	31%	1%		
		9-15 mph		87%		3%	10%			
		16+ mph								
C Sea Isle City\dbs\TS\h-2009wk46	Nov-08 to Nov-16	**Diurnal**	**16%**	**15%**	**7%**	**11%**	**33%**	**7%**	**5%**	**6%**
		0-8 mph	16%	15%	8%	12%	33%	4%	6%	6%
		9-15 mph					49%	51%		
		16+ mph						100%		
		Nocturnal	**1%**	**18%**	**17%**	**15%**	**40%**	**8%**	**1%**	
		0-8 mph	1%	20%	18%	16%	42%	2%	1%	
		9-15 mph						100%		
		16+ mph						100%		

APPENDIX K

TI-VPR DATA

Table K-1. TI-VPR data for spring 2008 offshore. NTD = no targets detected, CLOUDS = cloudy conditions, LOW = target too low in beam to obtain measurement.

Date	Grid	Time Frame (UTC)	5-min sample	Target start	ID	Count	Altitude	Direction	Comments
2008-03-17	1	11:25 to 13:00	11:35 to 11:40						NTD
2008-03-17	1		11:40 to 11:45						NTD
2008-03-17	1		11:55 to 12:00						NTD
2008-03-17	1		12:10 to 12:15						NTD
2008-03-17	1		12:25 to 12:30						NTD
2008-03-17	1		12:40 to 12:45						NTD
2008-03-17	1		12:55 to 13:00						NTD
2008-03-17	1	20:36 to 22:11	20:36 to 20:41						NTD
2008-03-17	1		20:56 to 21:01						NTD
2008-03-17	1		21:11 to 21:16						NTD
2008-03-17	1		21:31 to 21:36						NTD
2008-03-17	1		21:46 to 21:51						NTD
2008-03-17	1		22:06 to 22:16						NTD
2008-03-19	1	17:24 to 19:24	17:29 to 17:34						CLOUDS
2008-03-19	1		17:44 to 17:49						CLOUDS
2008-03-19	1		17:59 to 18:04						CLOUDS
2008-03-19	1		18:19 to 18:24						CLOUDS
2008-03-19	1		18:34 to 18:39						CLOUDS
2008-03-19	1		18:44 to 18:49						CLOUDS
2008-03-19	1		19:04 to 19:09						CLOUDS
2008-03-19	1		19:09 to 19:14						CLOUDS
2008-03-24	7	1:35 to 3:35	1:45 to 1:50						NTD
2008-03-24	7		1:50 to 1:55	1:52:46	BD	1	1525	55	
2008-03-24	7		2:10 to 2:15						NTD
2008-03-24	7		2:25 to 2:30						NTD
2008-03-24	7		2:40 to 2:45						NTD
2008-03-24	7		3:00 to 3:05						NTD
2008-03-24	7		3:10 to 3:15						NTD
2008-03-24	7		3:30 to 3:35						NTD

Table K-1 (*continued*). TI-VPR data for spring 2008 offshore. NTD = no targets detected, CLOUDS = cloudy conditions, LOW = target too low in beam to obtain measurement.

Date	Grid	Time Frame (UTC)	5-min sample	Target start	ID	Count	Altitude	Direction	Comments
2008-03-24	7	3:44 to 5:40	3:44 to 3:49						NTD
2008-03-24	7		3:59 to 4:04						NTD
2008-03-24	7		4:19 to 4:24						NTD
2008-03-24	7		4:34 to 4:39						NTD
2008-03-24	7		4:49 to 4:54						NTD
2008-03-24	7		5:04 to 5:09	5:06:34	BD	1	925	60	
2008-03-24	7			5:08:02	BD	1	275	20	
2008-03-24	7		5:14 to 5:19	5:15:41	BD	1	1200	65	
2008-03-24	7			5:16:27	I	1		50	
2008-03-24	7		5:34 to 5:39						NTD
2008-03-26	7	1:57 to 3:57	1:57 to 2:02						NTD
2008-03-26	7		2:17 to 2:22						NTD
2008-03-26	7		2:37 to 2:42						NTD
2008-03-26	7		2:52 to 2:57						NTD
2008-03-26	7		3:02 to 3:07						NTD
2008-03-26	7		3:17 to 3:22						NTD
2008-03-26	7		3:32 to 3:37						NTD
2008-03-26	7		3:42 to 3:47						NTD
2008-03-26	7	4:00 to 6:00	4:00 to 4:05						NTD
2008-03-26	7		4:20 to 4:25						NTD
2008-03-26	7		4:35 to 4:40						NTD
2008-03-26	7		4:50 to 4:55						NTD
2008-03-26	7		5:00 to 5:05						NTD
2008-03-26	7		5:25 to 5:30						NTD
2008-03-26	7		5:30 to 5:35						NTD
2008-03-26	7		5:55 to 6:00						NTD
2008-03-26	7	6:21 to 8:21	6:26 to 6:31						NTD
2008-03-26	7		6:46 to 6:51	6:48:12	BD	1	525	45	
2008-03-26	7		6:56 to 7:01						NTD

Table K-1 (*continued*). TI-VPR data for spring 2008 offshore. NTD = no targets detected, CLOUDS = cloudy conditions, LOW = target too low in beam to obtain measurement.

Date	Grid	Time Frame (UTC)	5-min sample	Target start	ID	Count	Altitude	Direction	Comments
2008-03-26	7		7:16 to 7:21						NTD
2008-03-26	7		7:31 to 7:36						NTD
2008-03-26	7		7:36 to 7:41						NTD
2008-03-26	7		8:01 to 8:06						NTD
2008-03-26	7		8:06 to 8:11						NTD
2008-03-26	7	16:53 to 18:53	16:58 to 17:03						NTD
2008-03-26	7		17:13 to 17:18	17:16:19	BD	1	425	60	
2008-03-26	7		17:33 to 17:38						NTD
2008-03-26	7		17:38 to 17:43	17:42:34	BD	1	300	50	
2008-03-26	7		18:03 to 18:08						NTD
2008-03-26	7		18:08 to 18:13						NTD
2008-03-26	7		18:33 to 18:38						NTD
2008-03-26	7		18:48 to 18:53	18:51:43	BD	1	275	0	
2008-03-26	7	19:05 to 21:05	19:15 to 19:20						NTD
2008-03-26	7		19:20 to 19:25						NTD
2008-03-26	7		19:45 to 19:50						NTD
2008-03-26	7		20:00 to 20:05						NTD
2008-03-26	7		20:15 to 20:20						NTD
2008-03-26	7		20:25 to 20:30						NTD
2008-03-26	7		20:35 to 20:40						NTD
2008-03-26	7		20:50 to 20:55						NTD
2008-04-03	13	21:16 to 23:00	21:16 to 21:21						NTD
2008-04-03	13		21:31 to 21:36						NTD
2008-04-03	13		21:56 to 22:01						NTD
2008-04-03	13		22:11 to 22:16						NTD
2008-04-03	13		22:26 to 22:31						NTD
2008-04-03	13		22:31 to 22:36						NTD
2008-04-03	13		22:46 to 22:51						NTD
2008-04-04	13	15:03 to 17:03	15:13 to 15:18						NTD

Table K-1 (*continued*). TI-VPR data for spring 2008 offshore. NTD = no targets detected, CLOUDS = cloudy conditions, LOW = target too low in beam to obtain measurement.

Date	Grid	Time Frame (UTC)	5-min sample	Target start	ID	Count	Altitude	Direction	Comments
2008-04-04	13		15:23 to 15:28						NTD
2008-04-04	13		15:33 to 15:38						NTD
2008-04-04	13		15:53 to 15:58						NTD
2008-04-04	13		16:03 to 16:08						NTD
2008-04-04	13		16:23 to 16:28						NTD
2008-04-04	13		16:33 to 16:38						NTD
2008-04-04	13		16:53 to 16:58						NTD
2008-04-04	13	17:07 to 19:07	17:12 to 17:17						NTD
2008-04-04	13		17:32 to 17:37						NTD
2008-04-04	13		17:47 to 17:52						NTD
2008-04-04	13		17:57 to 18:02						NTD
2008-04-04	13		18:17 to 18:22						NTD
2008-04-04	13		18:22 to 18:27						NTD
2008-04-04	13		18:47 to 18:52						NTD
2008-04-04	13		18:57 to 19:02						NTD
2008-04-04	13	23:04 to 1:04	23:04 to 23:09						NTD
2008-04-04	13		23:29 to 23:34						NTD
2008-04-04	13		23:44 to 23:49						NTD
2008-04-04	13		23:49 to 23:54						NTD
2008-04-04	13		00:04 to 00:09						NTD
2008-04-04	13		00:24 to 00:29						NTD
2008-04-04	13		00:39 to 00:44						NTD
2008-04-04	13		00:49 to 00:54						NTD
2008-04-05	13	1:07 to 3:07	1:12 to 1:17						NTD
2008-04-05	13		1:32 to 1:37						NTD
2008-04-05	13		1:37 to 1:42	1:37:00	I	1			LOW
2008-04-05	13		1:52 to 1:57	1:54:23	I	1		350	LOW
2008-04-05	13		2:12 to 2:17						NTD
2008-04-05	13		2:32 to 2:37						NTD

Table K-1 (*continued*). TI-VPR data for spring 2008 offshore. NTD = no targets detected, CLOUDS = cloudy conditions, LOW = target too low in beam to obtain measurement.

Date	Grid	Time Frame (UTC)	5-min sample	Target start	ID	Count	Altitude	Direction	Comments
2008-04-05	13		2:37 to 2:42						NTD
2008-04-05	13		3:02 to 3:07						NTD
2008-04-06	13	4:04 to 5:19	4:09 to 4:14						NTD
2008-04-06	13		4:24 to 4:29						NTD
2008-04-06	13		4:39 to 4:44						NTD
2008-04-06	13		4:49 to 4:54						NTD
2008-04-06	13		5:09 to 5:14						NTD
2008-04-10	13	12:00 to 14:00	12:10 to 12:15						NTD
2008-04-10	13		12:25 to 12:30						NTD
2008-04-10	13		12:30 to 12:35						NTD
2008-04-10	13		12:50 to 12:55						NTD
2008-04-10	13		13:10 to 13:15						NTD
2008-04-10	13		13:25 to 13:30						NTD
2008-04-10	13		13:35 to 13:40						NTD
2008-04-10	13		13:45 to 13:50						NTD
2008-04-10	13	14:03 to 16:03	14:13 to 14:18						NTD
2008-04-10	13		14:18 to 14:23						NTD
2008-04-10	13		14:33 to 14:38						NTD
2008-04-10	13		14:53 to 14:58						NTD
2008-04-10	13		15:03 to 15:08						NTD
2008-04-10	13		15:23 to 15:28						NTD
2008-04-10	13		15:43 to 15:48						NTD
2008-04-10	13		15:58 to 16:03						NTD
2008-04-10	13	20:10 to 22:10	20:15 to 20:20						NTD
2008-04-10	13		20:30 to 20:35						NTD
2008-04-10	13		20:45 to 20:50						NTD
2008-04-10	13		20:55 to 21:00						NTD
2008-04-10	13		21:20 to 21:25						NTD
2008-04-10	13		21:25 to 21:30						NTD

Table K-1 (*continued*). TI-VPR data for spring 2008 offshore. NTD = no targets detected, CLOUDS = cloudy conditions, LOW = target too low in beam to obtain measurement.

Date	Grid	Time Frame (UTC)	5-min sample	Target start	ID	Count	Altitude	Direction	Comments
2008-04-10	13		21:40 to 21:45						NTD
2008-04-10	13		22:00 to 22:05						NTD
2008-04-10	13	22:13 to 00:13	22:23 to 22:28						NTD
2008-04-10	13		22:28 to 22:33						NTD
2008-04-10	13		22:43 to 22:48						NTD
2008-04-10	13		22:58 to 23:03						NTD
2008-04-10	13		23:23 to 23:28						NTD
2008-04-10	13		23:28 to 23:33						NTD
2008-04-10	13		22:53 to 22:58						NTD
2008-04-11	13		22:58 to 00:03						NTD
2008-04-11	13	9:20 to 11:20	9:30 to 9:35						CLOUDS
2008-04-11	13		9:45 to 9:50						CLOUDS
2008-04-11	13		9:50 to 9:55	9:50:29	BD	1	800	345	
2008-04-11	13			9:50:50	BD	1		80	
2008-04-11	13			9:51:17	BD	1	500	75	
2008-04-11	13			9:51:44	BD	1		215	
2008-04-11	13			9:54:50	BD	1	450	75	
2008-04-11	13			9:54:54	BD	1		295	
2008-04-11	13		10:05 to 10:10						NTD
2008-04-11	13		10:30 to 10:35						NTD
2008-04-11	13		10:35 to 10:40						NTD
2008-04-11	13		11:00 to 11:05						NTD
2008-04-11	13		11:05 to 11:10						NTD
2008-04-12	13	10:41 to 12:41	10:41 to 10:46						NTD
2008-04-12	13		10:56 to 11:01						NTD
2008-04-12	13		11:11 to 11:16						NTD
2008-04-12	13		11:31 to 11:36						NTD
2008-04-12	13		11:46 to 11:51						NTD
2008-04-12	13		12:01 to 12:06	12:01:05	BD	1	250	55	

Table K-1 (*continued*). TI-VPR data for spring 2008 offshore. NTD = no targets detected, CLOUDS = cloudy conditions, LOW = target too low in beam to obtain measurement.

Date	Grid	Time Frame (UTC)	5-min sample	Target start	ID	Count	Altitude	Direction	Comments
2008-04-12	13		12:16 to 12:21						NTD
2008-04-12	13		12:36 to 12:41						NTD
2008-04-12	13	12:44 to 14:44	12:54 to 12:59						CLOUDS
2008-04-12	13		13:04 to 13:09						CLOUDS
2008-04-12	13		13:14 to 13:19						CLOUDS
2008-04-12	13		13:39 to 13:44						CLOUDS
2008-04-12	13		13:49 to 13:54						CLOUDS
2008-04-12	13		14:04 to 14:09						CLOUDS
2008-04-12	13		14:19 to 14:24						CLOUDS
2008-04-12	13		14:29 to 14:34						CLOUDS
2008-04-13	13	1:35 to 2:58	1:40 to 1:45						CLOUDS
2008-04-13	13		2:00 to 2:05						CLOUDS
2008-04-13	13		2:15 to 2:20						CLOUDS
2008-04-13	13		2:25 to 2:30						CLOUDS
2008-04-13	13		2:40 to 2:45						CLOUDS
2008-04-13	13		2:50 to 2:55						CLOUDS
2008-04-14	19	12:00 to 14:00	12:10 to 12:15						NTD
2008-04-14	19		12:20 to 12:25						NTD
2008-04-14	19		12:30 to 12:35						NTD
2008-04-14	19		12:45 to 12:50						NTD
2008-04-14	19		13:10 to 13:15	13:12:39	BD	1	475	170	
2008-04-14	19		13:20 to 13:25						NTD
2008-04-14	19		13:30 to 13:35						NTD
2008-04-14	19		13:50 to 13:55						NTD
2008-04-14	19	14:01 to 16:01	14:01 to 14:06						NTD
2008-04-14	19		14:21 to 14:26						NTD
2008-04-14	19		14:36 to 14:41						NTD
2008-04-14	19		14:56 to 15:01						NTD
2008-04-14	19		15:11 to 15:16						NTD

Table K-1 (*continued*). TI-VPR data for spring 2008 offshore. NTD = no targets detected, CLOUDS = cloudy conditions, LOW = target too low in beam to obtain measurement.

Date	Grid	Time Frame (UTC)	5-min sample	Target start	ID	Count	Altitude	Direction	Comments
2008-04-14	19		15:21 to 15:26						NTD
2008-04-14	19		15:41 to 15:46						NTD
2008-04-14	19		15:55 to 16:01						NTD
2008-04-15	19	00:00 to 02:00	00:10 to 00:15						CLOUDS
2008-04-15	19		00:25 to 00:30						CLOUDS
2008-04-15	19		00:40 to 00:45						CLOUDS
2008-04-15	19		00:50 to 00:55						CLOUDS
2008-04-15	19		01:10 to 01:15						CLOUDS
2008-04-15	19		01:25 to 01:30						CLOUDS
2008-04-15	19		01:40 to 01:45						CLOUDS
2008-04-15	19		01:55 to 02:00						CLOUDS
2008-04-15	19	2:04 to 4:04	2:09 to 2:14						CLOUDS
2008-04-15	19		2:19 to 2:24						CLOUDS
2008-04-15	19		2:44 to 2:49						CLOUDS
2008-04-15	19		2:49 to 2:54						CLOUDS
2008-04-15	19		3:04 to 3:09	3:05:08	BD		200	75	
2008-04-15	19			3:06:12	BD		650	40	
2008-04-15	19		3:29 to 3:34						CLOUDS
2008-04-15	19		3:39 to 3:44						CLOUDS
2008-04-15	19		3:54 to 3:59	3:55:48	I		125	55	
2008-04-15	19	8:00 to 10:00	8:10 to 8:15						CLOUDS
2008-04-15	19		8:25 to 8:30						CLOUDS
2008-04-15	19		8:30 to 8:35						
2008-04-15	19		8:45 to 8:50						
2008-04-15	19		9:10 to 9:15						
2008-04-15	19		9:25 to 9:30						
2008-04-15	19		9:35 to 9:40						
2008-04-15	19		9:50 to 9:55						
2008-04-15	19	10:01 to 12:01	10:01 to 10:06						NTD

Table K-1 (*continued*). TI-VPR data for spring 2008 offshore. NTD = no targets detected, CLOUDS = cloudy conditions, LOW = target too low in beam to obtain measurement.

Date	Grid	Time Frame (UTC)	5-min sample	Target start	ID	Count	Altitude	Direction	Comments
2008-04-15	19		10:21 to 10:26						NTD
2008-04-15	19		10:31 to 10:36						NTD
2008-04-15	19		10:51 to 10:56						NTD
2008-04-15	19		11:11 to 11:16						NTD
2008-04-15	19		11:16 to 11:21						NTD
2008-04-15	19		11:31 to 11:36						NTD
2008-04-15	19		11:51 to 11:56						NTD
2008-04-16	19	4:03 to 6:03	4:08 to 4:13						NTD
2008-04-16	19		4:23 to 4:28						NTD
2008-04-16	19		4:43 to 4:48						NTD
2008-04-16	19		4:48 to 4:53						NTD
2008-04-16	19		5:08 to 5:13	5:08:07	BD	1	275	45	
2008-04-16	19		5:23 to 5:28						NTD
2008-04-16	19		5:43 to 5:48	5:46:50	BT	1	375	45	
2008-04-16	19		5:48 to 5:53						NTD
2008-04-16	19	6:06 to 8:06	6:06 to 6:11						NTD
2008-04-16	19		6:21 to 6:26						NTD
2008-04-16	19		6:41 to 6:46	6:42:22	BD	2	550	80	
2008-04-16	19		7:01 to 7:06						NTD
2008-04-16	19		7:06 to 7:11						NTD
2008-04-16	19		7:21 to 7:26						NTD
2008-04-16	19		7:36 to 7:41						NTD
2008-04-16	19		8:01 to 8:06						NTD
2008-04-16	19	12:00 to 14:00	12:00 to 12:05						NTD
2008-04-16	19		12:20 to 12:25						NTD
2008-04-16	19		12:35 to 12:40						NTD
2008-04-16	19		12:45 to 12:50						NTD
2008-04-16	19		13:00 to 13:05						NTD
2008-04-16	19		13:15 to 13:20						NTD

Table K-1 (*continued*). TI-VPR data for spring 2008 offshore. NTD = no targets detected, CLOUDS = cloudy conditions, LOW = target too low in beam to obtain measurement.

Date	Grid	Time Frame (UTC)	5-min sample	Target start	ID	Count	Altitude	Direction	Comments
2008-04-16	19		13:40 to 13:45						NTD
2008-04-16	19		13:50 to 13:55						NTD
2008-04-16	19	14:05 to 16:05	14:15 to 14:20						NTD
2008-04-16	19		14:20 to 14:25						NTD
2008-04-16	19		14:45 to 14:50						NTD
2008-04-16	19		15:00 to 15:05						NTD
2008-04-16	19		15:10 to 15:15						NTD
2008-04-16	19		15:20 to 15:25						NTD
2008-04-16	19		15:35 to 15:40						NTD
2008-04-16	19		15:50 to 15:55						NTD
2008-04-17	19	8:00 to 10:00	8:10 to 8:15						NTD
2008-04-17	19		8:20 to 8:25						NTD
2008-04-17	19		8:35 to 8:40						NTD
2008-04-17	19		8:45 to 8:50						NTD
2008-04-17	19		9:10 to 9:15						NTD
2008-04-17	19		9:15 to 9:20						NTD
2008-04-17	19		9:40 to 9:45						NTD
2008-04-17	19		9:45 to 9:50						NTD
2008-04-17	19	10:03 to 12:03	10:03 to 10:08						NTD
2008-04-17	19		10:18 to 10:23						NTD
2008-04-17	19		10:33 to 10:38						NTD
2008-04-17	19		10:58 to 11:03						NTD
2008-04-17	19		11:03 to 11:08						NTD
2008-04-17	19		11:18 to 11:23						NTD
2008-04-17	19		11:43 to 11:48						NTD
2008-04-17	19		11:58 to 12:03						NTD
2008-04-17	19		16:10 to 16:15	16:14:58	I	1		90	LOW
2008-04-17	19		16:25 to 16:30						NTD
2008-04-17	19		16:40 to 16:45						NTD

Table K-1 (*continued*). TI-VPR data for spring 2008 offshore. NTD = no targets detected, CLOUDS = cloudy conditions, LOW = target too low in beam to obtain measurement.

Date	Grid	Time Frame (UTC)	5-min sample	Target start	ID	Count	Altitude	Direction	Comments
2008-04-17	19		17:00 to 17:05						NTD
2008-04-17	19		17:10 to 17:15						NTD
2008-04-17	19		17:25 to 17:30						NTD
2008-04-17	19		17:40 to 17:45						NTD
2008-04-17	19		17:55 to 18:00						NTD
2008-04-17	19	18:10 to 20:10	18:15 to 18:20						NTD
2008-04-17	19		18:35 to 18:40						NTD
2008-04-17	19		18:45 to 18:50						NTD
2008-04-17	19		19:00 to 19:05						NTD
2008-04-17	19		19:15 to 19:20	19:18:59	I	1		125	LOW
2008-04-17	19		19:35 to 19:40						NTD
2008-04-17	19		19:50 to 19:55	19:53:16	BD	1		335	LOW
2008-04-17	19		19:55 to 20:00						NTD
2008-04-18	19	12:00 to 14:00	12:10 to 12:15						NTD
2008-04-18	19		12:25 to 12:30	12:28:33	BD	1		30	LOW
2008-04-18	19		12:40 to 12:45						NTD
2008-04-18	19		12:55 to 13:00						NTD
2008-04-18	19		13:05 to 13:10						NTD
2008-04-18	19		13:15 to 13:20						NTD
2008-04-18	19		13:40 to 13:45						NTD
2008-04-18	19		13:50 to 13:55	13:52:26	BD	1		30	LOW
2008-04-18	19	20:00:00 to 22:00:00	2005 to 2010						NTD
2008-04-18	19		2020 to 2025						NTD
2008-04-18	19		2030 to 2035						NTD
2008-04-18	19		2055 to 2100						NTD
2008-04-18	19		2100 to 2105						NTD
2008-04-18	19		2120 to 2125						NTD
2008-04-18	19		2130 to 2135						NTD
2008-04-18	19		2150 to 2155						NTD

Table K-1 (*continued*). TI-VPR data for spring 2008 offshore. NTD = no targets detected, CLOUDS = cloudy conditions, LOW = target too low in beam to obtain measurement.

Date	Grid	Time Frame (UTC)	5-min sample	Target start	ID	Count	Altitude	Direction	Comments
2008-04-18	19	22:03:00 to 00:03:00	2208 to 2213						NTD
2008-04-18	19		2223 to 2228						NTD
2008-04-18	19		2243 to 2248						NTD
2008-04-18	19		2253 to 2258						NTD
2008-04-18	19		2303 to 2308						NTD
2008-04-18	19		2328 to 2333						NTD
2008-04-18	19		2343 to 2348						NTD
2008-04-18	19		2358 to 0003						NTD
2008-04-25	26	12:00:00 to 14:00:00	1210 to 1215						CLOUDS
2008-04-25	26		1220 to 1225						NTD
2008-04-25	26		1235 to 1240						CLOUDS
2008-04-25	26		1255 to 1300						CLOUDS
2008-04-25	26		1310 to 1315						NTD
2008-04-25	26		1320 to 1325						CLOUDS
2008-04-25	26		1340 to 1345						CLOUDS
2008-04-25	26		1355 to 1400						CLOUDS
2008-04-25	26	14:03:00 to 16:03:00	1403 to 1408						CLOUDS
2008-04-25	26		1418 to 1423						CLOUDS
2008-04-25	26		1438 to 1443						CLOUDS
2008-04-25	26		1453 to 1458						CLOUDS
2008-04-25	26		1508 to 1513						CLOUDS
2008-04-25	26		1518 to 1523						CLOUDS
2008-04-25	26		1533 to 1538						CLOUDS
2008-04-25	26		1548 to 1553						CLOUDS
2008-04-25	26	20:10:00 to 22:10:00	2015 to 2020						CLOUDS
2008-04-25	26		2035 to 2040						CLOUDS
2008-04-25	26		2050 to 2055						CLOUDS
2008-04-25	26		2105 to 2110						CLOUDS
2008-04-25	26		2110 to 2115						CLOUDS

Table K-1 (*continued*). TI-VPR data for spring 2008 offshore. NTD = no targets detected, CLOUDS = cloudy conditions, LOW = target too low in beam to obtain measurement.

Date	Grid	Time Frame (UTC)	5-min sample	Target start	ID	Count	Altitude	Direction	Comments
2008-04-25	26		2135 to 2140						CLOUDS
2008-04-25	26		2145 to 2150						CLOUDS
2008-04-25	26		2155 to 2200						CLOUDS
2008-04-25	26	22:13:00 to 00:13:00	2218 to 2223						CLOUDS
2008-04-25	26		2238 to 2243						NTD
2008-04-25	26		2243 to 2248						NTD
2008-04-25	26		2303 to 2308						NTD
2008-04-25	26		2318 to 2323						CLOUDS
2008-04-25	26		2338 to 2343						NTD
2008-04-25	26		2348 to 2353						NTD
2008-04-25	26		0003 to 0008						NTD
2008-04-26	26	16:00:00 to 18:00:00	1600 to 1605						CLOUDS
2008-04-26	26		1620 to 1625						NTD
2008-04-26	26		1635 to 1640						CLOUDS
2008-04-26	26		1650 to 1655						CLOUDS
2008-04-26	26		1705 to 1710						NTD
2008-04-26	26		1720 to 1725						CLOUDS
2008-04-26	26		1735 to 1740						CLOUDS
2008-04-26	26		1750 to 1755						CLOUDS
2008-04-26	26	18:00:03 to 20:04:00	1803 to 1808						CLOUDS
2008-04-26	26		1818 to 1823						CLOUDS
2008-04-26	26		1843 to 1848						CLOUDS
2008-04-26	26		1853 to 1858						CLOUDS
2008-04-26	26		1913 to 1918						CLOUDS
2008-04-26	26		1928 to 1933						CLOUDS
2008-04-26	26		1938 to 1943						CLOUDS
2008-04-26	26		1953 to 1958						CLOUDS
2008-04-27	26	00:02:00 to 02:02:00	0007 to 0012						CLOUDS
2008-04-27	26		0022 to 0027						CLOUDS

Table K-1 (*continued*). TI-VPR data for spring 2008 offshore. NTD = no targets detected, CLOUDS = cloudy conditions, LOW = target too low in beam to obtain measurement.

Date	Grid	Time Frame (UTC)	5-min sample	Target start	ID	Count	Altitude	Direction	Comments
2008-04-27	26		0042 to 0047						CLOUDS
2008-04-27	26		0057 to 0102						CLOUDS
2008-04-27	26		112 to 117						CLOUDS
2008-04-27	26		117 to 122						CLOUDS
2008-04-27	26		142 to 147						CLOUDS
2008-04-27	26		152 to 157						CLOUDS
2008-04-27	26	04:06:00 to 06:06:00	416 to 421						CLOUDS
2008-04-27	26		431 to 436						CLOUDS
2008-04-27	26		436 to 441						CLOUDS
2008-04-27	26		456 to 501						CLOUDS
2008-04-27	26		506 to 511						CLOUDS
2008-04-27	26		521 to 526						CLOUDS
2008-04-27	26		536 to 541						CLOUDS
2008-04-27	26		601 to 606						CLOUDS
2008-04-29	26	20:00:00 to 22:00:00	2010 to 2015						NTD
2008-04-29	26		2025 to 2030						NTD
2008-04-29	26		2030 to 2035						NTD
2008-04-29	26		2045 to 2050						NTD
2008-04-29	26		2100 to 2105						NTD
2008-04-29	26		2120 to 2125						NTD
2008-04-29	26		2135 to 2140						NTD
2008-04-29	26		2155 to 2200						NTD
2008-04-29	26	22:03:00 to 00:05:00	2203 to 2208						NTD
2008-04-29	26		2223 to 2228						NTD
2008-04-29	26		2233 to 2238						NTD
2008-04-29	26		2258 to 2303						NTD
2008-04-29	26		2308 to 2313						NTD
2008-04-29	26		2328 to 2333						NTD
2008-04-29	26		2343 to 2348						NTD

Table K-1 (*continued*). TI-VPR data for spring 2008 offshore. NTD = no targets detected, CLOUDS = cloudy conditions, LOW = target too low in beam to obtain measurement.

Date	Grid	Time Frame (UTC)	5-min sample	Target start	ID	Count	Altitude	Direction	Comments
2008-04-29	26		2358 to 0003						NTD
2008-04-30	26	04:00:00 to 06:00:00	405 to 410	04:05:08	BD	1	175	230	
2008-04-30	26		420 to 425						NTD
2008-04-30	26		435 to 440	04:36:01	BD	1	250	160	
2008-04-30	26			04:36:19	BT	1			LOW
2008-04-30	26		450 to 455	04:51:30	BD	1	230	195	
2008-04-30	26		510 to 515						NTD
2008-04-30	26		515 to 520	05:16:48	I	1		220	LOW
2008-04-30	26		540 to 545						NTD
2008-04-30	26		555 to 600	05:56:00	I	1	125	195	
2008-04-30	26	06:03:00 to 08:03:00	613 to 618	06:13:44	BD	1	750	165	
2008-04-30	26		628 to 633						NTD
2008-04-30	26		633 to 638						CLOUDS
2008-04-30	26		658 to 703						NTD
2008-04-30	26		703 to 708						NTD
2008-04-30	26		718 to 723						NTD
2008-04-30	26		733 to 738						NTD
2008-04-30	26		753 to 758						NTD
2008-04-30	26	12:00:00 to 14:00:00	1205 to 1210						CLOUDS
2008-04-30	26		1220 to 1225						CLOUDS
2008-04-30	26		1235 to 1240						CLOUDS
2008-04-30	26		1245 to 1250						CLOUDS
2008-04-30	26		1305 to 1310						CLOUDS
2008-04-30	26		1320 to 1325						CLOUDS
2008-04-30	26		1340 to 1345						CLOUDS
2008-04-30	26		1355 to 1400						CLOUDS
2008-04-30	26	15:01:00 to 17:01:00	1511 to 1516						CLOUDS
2008-04-30	26		1516 to 1521						CLOUDS
2008-04-30	26		1536 to 1541						NTD

Table K-1 (*continued*). TI-VPR data for spring 2008 offshore. NTD = no targets detected, CLOUDS = cloudy conditions, LOW = target too low in beam to obtain measurement.

Date	Grid	Time Frame (UTC)	5-min sample	Target start	ID	Count	Altitude	Direction	Comments
2008-04-30	26		1556 to 1601						NTD
2008-04-30	26		1606 to 1611						NTD
2008-04-30	26		1621 to 1626						NTD
2008-04-30	26		1636 to 1641						NTD
2008-04-30	26		1646 to 1651						NTD
2008-05-01	23	12:25:00 to 14:27:00	1230 to 1235						NTD
2008-05-01	23		1240 to 1245						NTD
2008-05-01	23		1300 to 1305	13:24:32	BD	1	175	305	
2008-05-01	23		1320 to 1325						NTD
2008-05-01	23		1325 to 1330						NTD
2008-05-01	23		1340 to 1345						NTD
2008-05-01	23		1400 to 1405						NTD
2008-05-01	23		1415 to 1420						NTD
2008-05-01	23	14:41:00 to 16:45:00	1441 to 1446						CLOUDS
2008-05-01	23		1506 to 1511						CLOUDS
2008-05-01	23		1521 to 1526						CLOUDS
2008-05-01	23		1536 to 1541						CLOUDS
2008-05-01	23		1541 to 1546						CLOUDS
2008-05-01	23		1606 to 1611						CLOUDS
2008-05-01	23		1611 to 1616						CLOUDS
2008-05-01	23		1631 to 1636						CLOUDS
2008-05-01	23	20:05:00 to 22:05:00	2010 to 2015						CLOUDS
2008-05-01	23		2020 to 2025						CLOUDS
2008-05-01	23		2035 to 2040						CLOUDS
2008-05-01	23		2050 to 2055						CLOUDS
2008-05-01	23		2110 to 2115						CLOUDS
2008-05-01	23		2130 to 2135						CLOUDS
2008-05-01	23		2135 to 2140						CLOUDS
2008-05-01	23		2155 to 2200						CLOUDS

Table K-1 (*continued*). TI-VPR data for spring 2008 offshore. NTD = no targets detected, CLOUDS = cloudy conditions, LOW = target too low in beam to obtain measurement.

Date	Grid	Time Frame (UTC)	5-min sample	Target start	ID	Count	Altitude	Direction	Comments
2008-05-01	23	22:08:00 to 00:10:00	2208 to 2213						CLOUDS
2008-05-01	23		2228 to 2233						CLOUDS
2008-05-01	23		2243 to 2248						CLOUDS
2008-05-01	23		2258 to 2303						CLOUDS
2008-05-01	23		2313 to 2318						CLOUDS
2008-05-01	23		2323 to 2328						CLOUDS
2008-05-01	23		2343 to 2348						NTD
2008-05-01	23		0003 to 0008						NTD
2008-05-02	23	02:55:00 to 04:55:00	305 to 310	03:06:07	I	1		10	
2008-05-02	23			03:07:06	I	1		10	
2008-05-02	23			03:09:30	I	1		10	
2008-05-02	23			03:09:41	BD	1	850	15	
2008-05-02	23			03:09:42	BD	1	850	15	
2008-05-02	23	10:23:00 to 11:23:00	1023 to 1028						NTD
2008-05-02	23		1048 to 1053						NTD
2008-05-02	23		1103 to 1108	11:03:49	I	1		0	LOW
2008-05-02	23		1108 to 1113						NTD
2008-05-02	23	16:00:00 to 18:00:00	1605 to 1610	16:05:39	I	1		0	
2008-05-02	23		1615 to 1620						NTD
2008-05-02	23		1640 to 1645	16:43:33	I	1		310	LOW
2008-05-02	23		1645 to 1650						NTD
2008-05-02	23		1700 to 1705						NTD
2008-05-02	23		1715 to 1720	17:17:55	I	1		355	LOW
2008-05-02	23		1740 to 1745						NTD
2008-05-02	23		1755 to 1800						NTD
2008-05-02	23	18:03:00 to 20:03:00	1808 to 1813						NTD
2008-05-02	23		1818 to 1823						NTD
2008-05-02	23		1833 to 1838						NTD
2008-05-02	23		1848 to 1853						NTD

Table K-1 (*continued*). TI-VPR data for spring 2008 offshore. NTD = no targets detected, CLOUDS = cloudy conditions, LOW = target too low in beam to obtain measurement.

Date	Grid	Time Frame (UTC)	5-min sample	Target start	ID	Count	Altitude	Direction	Comments
2008-05-02	23		1908 to 1913						NTD
2008-05-02	23		1923 to 1928						NTD
2008-05-02	23		1933 to 1938						NTD
2008-05-02	23		1953 to 1958						NTD
2008-05-03	23	00:00:00 to 02:02:40	0010 to 0015						NTD
2008-05-03	23		0025 to 0030						CLOUDS
2008-05-03	23		0040 to 0045						CLOUDS
2008-05-03	23		0050 to 0055						CLOUDS
2008-05-03	23		100 to 105						FOG
2008-05-03	23		120 to 125						FOG
2008-05-03	23		130 to 135						FOG
2008-05-03	23		150 to 155						FOG
2008-05-03	23	02:05:10 to 04:05:00							CLOUDS
2008-05-04	23	03:00:00 to 04:51:00	300 to 305						CLOUDS
2008-05-04	23		325 to 330						CLOUDS
2008-05-04	23		335 to 340						CLOUDS
2008-05-04	23		345 to 350						CLOUDS
2008-05-04	23		400 to 405						CLOUDS
2008-05-04	23		425 to 430						CLOUDS
2008-05-04	23		440 to 445						CLOUDS
2008-05-04	23		445 to 450						CLOUDS
2008-05-05	23	08:00:00 to 10:00:00	810 to 815						NTD
2008-05-05	23		815 to 820	08:15:21	I	1	175	80	
2008-05-05	23			08:16:33	BD	1	150	245	
2008-05-05	23			08:18:05	BD	1	125	285	
2008-05-05	23		840 to 845						FOG
2008-05-05	23		855 to 900						FOG
2008-05-05	23		910 to 915						NTD
2008-05-05	23		920 to 925						NTD

Table K-1 (*continued*). TI-VPR data for spring 2008 offshore. NTD = no targets detected, CLOUDS = cloudy conditions, LOW = target too low in beam to obtain measurement.

Date	Grid	Time Frame (UTC)	5-min sample	Target start	ID	Count	Altitude	Direction	Comments
2008-05-05	23		935 to 940						NTD
2008-05-05	23		955 to 1000						FOG
2008-05-05	23	10:03:00 to 10:34:00	1003 to 1008						FOG
2008-05-05	23		1025 to 1030						FOG
2008-05-05	23	20:00:00 to 22:00:00	2005 to 2010						CLOUDS
2008-05-05	23		2020 to 2025						CLOUDS
2008-05-05	23		2035 to 2040						CLOUDS
2008-05-05	23		2055 to 2100						CLOUDS
2008-05-05	23		2105 to 2110						CLOUDS
2008-05-05	23		2120 to 2125						NTD
2008-05-05	23		2135 to 2140						NTD
2008-05-05	23		2145 to 2150						NTD
2008-05-05	23	22:03:00 to 00:03:00	2208 to 2213						CLOUDS
2008-05-05	23		2228 to 2233						CLOUDS
2008-05-05	23		2233 to 2238						CLOUDS
2008-05-05	23		2258 to 2303						NTD
2008-05-05	23		2303 to 2308						NTD
2008-05-05	23		2323 to 2328						CLOUDS
2008-05-05	23		2338 to 2343						CLOUDS
2008-05-05	23		2358 to 0003						CLOUDS
2008-05-06	23	04:02:00 to 06:02:00							CLOUDS
2008-05-06	23	06:06:00 to 08:06:00							CLOUDS
2008-05-06	23	14:00:00 to 16:00:00	1405 to 1410	14:09:18	BD	1	250		
2008-05-06	23		1420 to 1425						NTD
2008-05-06	23		1430 to 1435						NTD
2008-05-06	23		1455 to 1500						NTD
2008-05-06	23		1500 to1505						NTD
2008-05-06	23		1520 to 1525	15:21:43	I	1	no		
2008-05-06	23		1535 to 1540						NTD

Table K-1 (*continued*). TI-VPR data for spring 2008 offshore. NTD = no targets detected, CLOUDS = cloudy conditions, LOW = target too low in beam to obtain measurement.

Date	Grid	Time Frame (UTC)	5-min sample	Target start	ID	Count	Altitude	Direction	Comments
2008-05-06	23		1550 to 1555						NTD
2008-05-06	23	16:03:00 to 18:03:00	1608 to 1613						NTD
2008-05-06	23		1618 to 1623	16:18:16	I	1	150		
2008-05-06	23		1633 to 1638						NTD
2008-05-06	23		1653 to 1658	16:57:56	I	1	no		
2008-05-06	23		1703 to 1708						NTD
2008-05-06	23		1728 to 1733						NTD
2008-05-06	23		1743 to 1748						NTD
2008-05-06	23		1753 to 1758						NTD
2008-05-06	23	18:06:00 to 20:26:00	1806 to 1811						NTD
2008-05-06	23		1821 to 1826						NTD
2008-05-06	23		1846 to 1851						NTD
2008-05-06	23		1851 to 1856						NTD
2008-05-06	23		1911 to 1916						CLOUDS
2008-05-06	23		1926 to 1931						CLOUDS
2008-05-06	23		1946 to 1951						NTD
2008-05-06	23		1951 to 1956						NTD
2008-05-06	23	20:09:00 to 22:09:00	2009 to 2014						NTD
2008-05-06	23		2029 to 2034						NTD
2008-05-06	23		2044 to 2049						NTD
2008-05-06	23		2059 to 2104						NTD
2008-05-06	23		2109 to 2114						NTD
2008-05-06	23		2129 to 2134						NTD
2008-05-06	23		2149 to 2154						NTD
2008-05-06	23		2154 to 2159						NTD
2008-05-06	23	22:12:00 to 00:00:00	2222 to 2227	22:25:34	I	1	no		LOW
2008-05-06	23			22:25:47	I	1	no		LOW
2008-05-06	23		2237 to 2242						NTD
2008-05-06	23		2247 to 2252						NTD

Table K-1 (*continued*). TI-VPR data for spring 2008 offshore. NTD = no targets detected, CLOUDS = cloudy conditions, LOW = target too low in beam to obtain measurement.

Date	Grid	Time Frame (UTC)	5-min sample	Target start	ID	Count	Altitude	Direction	Comments
2008-05-06	23		2307 to 2312						NTD
2008-05-06	23		2317 to 2322	23:17:26	BD	1	275		
2008-05-06	23			23:20:00	U	1	no		Faint
2008-05-06	23			23:21:45	I	1	no		
2008-05-06	23		2337 to 2342						NTD
2008-05-06	23		2352 to 2357						NTD
2008-05-07	23	00:03:00 to 02:03:00	00:13 to 00:18						NTD
2008-05-07	23		00:28 to 00:33						NTD
2008-05-07	23		00:38 to 00:43						NTD
2008-05-07	23		00:58 to 01:03						NTD
2008-05-07	23		01:13 to 01:18						NTD
2008-05-07	23		01:28 to 01:33						NTD
2008-05-07	23		01:33 to 01:38	01:35:36	BD	1	400		
2008-05-07	23		01:48 to 01:53	01:49:01	BD	1	400		
2008-05-07	23			01:49:27	BD	1	400		
2008-05-07	23			01:51:50	BD	1	400		
2008-05-07	23	02:06:00 to 04:06:00	2:16 to 2:21	2:16:12	BD	1	475	60	
2008-05-07	23			2:16:45	BD	1	400	60	
2008-05-07	23			2:17:46	BD	1	350	55	
2008-05-07	23			2:19:57	BD	1	550	50	
2008-05-07	23			2:20:49	BD	1	500	70	
2008-05-07	23		2:21 to 2:26	2:21:06	BD	1	450	60	
2008-05-07	23			2:21:36	BD	1	375	65	
2008-05-07	23			2:23:05	BD	1	450	55	
2008-05-07	23			2:23:09	BD	1	575	50	
2008-05-07	23			2:23:22	BD	1	800	60	
2008-05-07	23			2:25:14	BD	1	200	45	
2008-05-07	23			2:25:24	BD	1	500	45	
2008-05-07	23		2:46 to 2:51	2:46:26	I	1		35	

Table K-1 (*continued*). TI-VPR data for spring 2008 offshore. NTD = no targets detected, CLOUDS = cloudy conditions, LOW = target too low in beam to obtain measurement.

Date	Grid	Time Frame (UTC)	5-min sample	Target start	ID	Count	Altitude	Direction	Comments
2008-05-07	23			2:48:25	BD	1	600	60	
2008-05-07	23			2:49:03	I	1		50	
2008-05-07	23			2:49:18	BD	1	650	50	
2008-05-07	23			2:49:28	BD	1	525	65	
2008-05-07	23			2:50:09	BD	1	550	70	
2008-05-07	23		251 to 256	2:51:41	BD	1	450	50	
2008-05-07	23			2:52:07	BD	1	700	65	
2008-05-07	23			2:52:58	BD	1	375	55	
2008-05-07	23			2:53:44	I	1		70	
2008-05-07	23			2:54:04	BD	1	950	75	
2008-05-07	23			2:54:36	I	1		45	
2008-05-07	23			2:54:44	I	1		105	
2008-05-07	23			2:55:10	BD	1	525	50	
2008-05-07	23			2:55:24	BD	1	600	55	
2008-05-07	23			2:55:43	BD	1	400	60	
2008-05-07	23			2:55:45	BD	1	400	65	
2008-05-07	23		3:16 to 3:21	3:17:29	BD	1	475	50	
2008-05-07	23			3:18:07	I	1		45	
2008-05-07	23			3:18:47	I	1		60	
2008-05-07	23			3:20:39	I	1		35	
2008-05-07	23			3:20:42	BD	1	475	50	
2008-05-07	23		3:31 to 3:36	3:31:13	I	1		35	
2008-05-07	23			3:31:39	BD	1	325	25	
2008-05-07	23			3:32:15	BD	1	500	50	
2008-05-07	23			3:32:25	BD	1	450	50	
2008-05-07	23			3:32:30	BD	1	450	85	
2008-05-07	23			3:32:38	I	1		60	
2008-05-07	23			3:32:42	I	1		70	
2008-05-07	23			3:33:20	I	1		90	

Table K-1 (*continued*). TI-VPR data for spring 2008 offshore. NTD = no targets detected, CLOUDS = cloudy conditions, LOW = target too low in beam to obtain measurement.

Date	Grid	Time Frame (UTC)	5-min sample	Target start	ID	Count	Altitude	Direction	Comments
2008-05-07	23		3:36 to 3:41	3:36:59	BD	1	550	35	
2008-05-07	23			3:37:48	BD	1	575	50	
2008-05-07	23			3:37:55	I	2		60	
2008-05-07	23			3:38:26	I	1		100	
2008-05-07	23			3:38:34	I	1		50	
2008-05-07	23			3:39:44	BD	1	525	55	
2008-05-07	23			3:40:41	I	1		50	
2008-05-07	23			3:40:53	BD	1	200	50	
2008-05-07	23		4:01 to 4:06	4:01:14	I	1	100	60	
2008-05-07	23			4:01:22	BD	1	475	65	
2008-05-07	23			4:02:02	I	1		50	
2008-05-07	23			4:02:24	BD	1	350	45	
2008-05-07	23			4:03:01	BD	1	200	70	
2008-05-07	23			4:03:27	BD	1	475	60	
2008-05-07	23			4:04:05	BD	1	500	50	
2008-05-07	23			4:04:15	BD	1	325	45	
2008-05-07	23			4:05:04	BD	1	350	50	
2008-05-07	23			4:05:06	BD	1	1325	50	
2008-05-07	23			4:05:09	I	1		85	
2008-05-07	23			4:05:47	I	1		25	
2008-05-07	23	04:09:00 to 06:09:00	4:09 to 4:14	4:10:08	BD	1	550	70	
2008-05-07	23			4:10:16	BD	1	400	55	
2008-05-07	23			4:10:28	BD	1	250	40	
2008-05-07	23			4:10:47	I	1		40	
2008-05-07	23			4:11:37	I	1		35	
2008-05-07	23			4:12:24	I	1		40	
2008-05-07	23		4:34 to 4:39	4:34:19	BD	1	425	55	
2008-05-07	23			4:35:29	BD	1	425	65	
2008-05-07	23			4:36:13	BD	1	550	60	

Table K-1 (*continued*). TI-VPR data for spring 2008 offshore. NTD = no targets detected, CLOUDS = cloudy conditions, LOW = target too low in beam to obtain measurement.

Date	Grid	Time Frame (UTC)	5-min sample	Target start	ID	Count	Altitude	Direction	Comments
2008-05-07	23			4:36:24	BD	1	475	60	
2008-05-07	23			4:37:06	BD	1	475	60	
2008-05-07	23			4:37:48	BD	1	750	55	
2008-05-07	23			4:38:09	BD	1	300	40	
2008-05-07	23			4:38:49	I	1		30	
2008-05-07	23		4:49 to 4:54	4:49:40	I	1		30	
2008-05-07	23			4:49:59	BT	1	350	var	
2008-05-07	23			4:50:32	I	1		35	
2008-05-07	23			4:50:55	BD	1	525	50	
2008-05-07	23			4:52:27	I	1		35	
2008-05-07	23			4:52:30	BD	1	425	60	
2008-05-07	23			4:53:36	BD	1	550	60	
2008-05-07	23			4:53:52	BD	1	800	100	
2008-05-07	23			4:53:56	BD	1	375	50	
2008-05-07	23		4:59 to 5:04	4:59:09	I	1		45	
2008-05-07	23			5:02:39	I	1		45	
2008-05-07	23			5:02:49	I	1		100	
2008-05-07	23			5:03:15	I	1		40	
2008-05-07	23		5:14 to 5:19	5:15:51	BD	1	500	350	
2008-05-07	23			5:16:16	BD	1	250	50	
2008-05-07	23			5:16:40	I	1		110	
2008-05-07	23			5:17:40	BD	1	250	90	
2008-05-07	23			5:18:42	BD	1	350	85	
2008-05-07	23		5:29 to 5:34	5:29:05	BD	5	300	85	
2008-05-07	23			5:29:50	BD	1	250	40	
2008-05-07	23			5:30:17	BD	1	1225	110	
2008-05-07	23			5:31:34	I/U	1		100	
2008-05-07	23			5:32:55	I	1	175	40	
2008-05-07	23			5:32:58	I	1		45	

Table K-1 (*continued*). TI-VPR data for spring 2008 offshore. NTD = no targets detected, CLOUDS = cloudy conditions, LOW = target too low in beam to obtain measurement.

Date	Grid	Time Frame (UTC)	5-min sample	Target start	ID	Count	Altitude	Direction	Comments
2008-05-07	23			5:33:08	BD	1	500	55	
2008-05-07	23			5:33:47	BD	1	450	60	
2008-05-07	23		5:49 to 5:54	5:49:05	BD	1	575	55	
2008-05-07	23			5:50:16	BD	1	300	55	
2008-05-07	23			5:50:18	BD	1	300	55	
2008-05-07	23			5:50:46	BD	1	400	55	
2008-05-07	23			5:51:02	BD	1	250	70	
2008-05-07	23			5:51:50	BD	1	500	45	
2008-05-07	23			5:51:50	BD	1	300	55	
2008-05-07	23			5:52:26	BD	1	1000	40	
2008-05-07	23			5:53:13	I	1		90	
2008-05-07	23		6:04 to 6:09	6:04:56	BD	1	200	30	
2008-05-07	23			6:05:40	BD	1	175	40	
2008-05-07	23			6:06:42	BD	1	175	35	
2008-05-07	23			6:07:00	I	1	200	25	
2008-05-07	23			6:07:06	BD	1	325	50	
2008-05-07	23			6:07:29	BD	1	1400	25	
2008-05-07	23			6:07:33	BD	1	450	50	
2008-05-07	23			6:08:32	BD	1	425	45	
2008-05-07	23			6:08:52	BD	1	300	90	
2008-05-07	23	06:12:00 to 08:08:00	6:17 to 6:22	6:17:47	BD	1	350	55	
2008-05-07	23			6:17:50	BD	1	325	75	
2008-05-07	23			6:17:50	BD	1	500	55	
2008-05-07	23			6:18:09	BD	1	350	40	
2008-05-07	23			6:18:31	BD	1	275	55	
2008-05-07	23			6:18:44	BD	1	375	40	
2008-05-07	23			6:18:58	BD	1	275	60	
2008-05-07	23			6:19:25	BD	1	250	55	
2008-05-07	23			6:19:31	BT	1	375	155	

Table K-1 (*continued*). TI-VPR data for spring 2008 offshore. NTD = no targets detected, CLOUDS = cloudy conditions, LOW = target too low in beam to obtain measurement.

Date	Grid	Time Frame (UTC)	5-min sample	Target start	ID	Count	Altitude	Direction	Comments
2008-05-07	23			6:20:05	BD	1	275	50	
2008-05-07	23			6:20:22	BD	1	325	40	
2008-05-07	23		6:32 to 6:37	6:32:02	BD	1	600	60	
2008-05-07	23			6:32:06	BD	1	700	55	
2008-05-07	23			6:33:05	BD	1	325	50	
2008-05-07	23			6:33:28	I	1		145	
2008-05-07	23			6:33:33	BD	1	200	55	
2008-05-07	23			6:33:45	BT	1	500	55	
2008-05-07	23			6:33:47	BD	1	350	55	
2008-05-07	23			6:33:52	BD	1	225	45	
2008-05-07	23			6:34:20	BD	1	400	55	
2008-05-07	23			6:34:24	BD	1	750	40	
2008-05-07	23			6:34:40	BD	1	350	55	
2008-05-07	23			6:35:22	BD	1	300	55	
2008-05-07	23			6:35:30	BD	1	575	60	
2008-05-07	23			6:35:39	BD	1	550	55	
2008-05-07	23			6:35:41	BD	1	125	35	
2008-05-07	23			6:36:14	BD	1	200	55	
2008-05-07	23			6:36:32	BD	1	300	60	
2008-05-07	23			6:36:38	BD	1	1100	40	
2008-05-07	23		6:52 to 6:57	6:52:44	BD	1	1300	25	
2008-05-07	23			6:52:51	BD	1	275	60	
2008-05-07	23			6:53:10	BD	1		25	
2008-05-07	23			6:53:26	I	1	100	30	
2008-05-07	23			6:53:40	BD	3	250	40	
2008-05-07	23			6:55:13	BD	1	325	55	
2008-05-07	23			6:56:35	BD	1	175	30	
2008-05-07	23			6:56:41	BD	1	150	60	
2008-05-07	23		6:57 to 7:02	6:57:15	BD	3	400	60	

Table K-1 (*continued*). TI-VPR data for spring 2008 offshore. NTD = no targets detected, CLOUDS = cloudy conditions, LOW = target too low in beam to obtain measurement.

Date	Grid	Time Frame (UTC)	5-min sample	Target start	ID	Count	Altitude	Direction	Comments
2008-05-07	23			6:57:27	BD	1	300	65	
2008-05-07	23			6:58:31	BD	1	250	55	
2008-05-07	23			6:59:13	BD	1	750	65	
2008-05-07	23			6:59:38	I	1		70	
2008-05-07	23			6:59:46	BD	1	300	65	
2008-05-07	23			7:00:03	BD	1	825	40	
2008-05-07	23			7:00:06	BD	1	200	60	
2008-05-07	23			7:00:55	BD	1	250	60	
2008-05-07	23			7:01:05	BD	1	750	55	
2008-05-07	23			7:01:16	BD	1	600	40	
2008-05-07	23			7:01:39	BD	1	175	50	
2008-05-07	23			7:02:00	I	1		70	
2008-05-07	23		7:12 to 7:17	7:12:32	BD	1	300	55	
2008-05-07	23			7:13:12	BD	1	600	60	
2008-05-07	23			7:13:15	BD	1	900	35	
2008-05-07	23			7:13:22	BD	1	350	90	
2008-05-07	23			7:14:33	BD	2	275	50	
2008-05-07	23			7:14:41	BD	1	525	70	
2008-05-07	23			7:14:54	BD	1	325	40	
2008-05-07	23			7:15:28	BD	1	625	40	
2008-05-07	23			7:15:40	BD	1	850	90	
2008-05-07	23			7:15:49	BD	1	925	60	
2008-05-07	23			7:16:27	BD	1	850	25	
2008-05-07	23			7:16:32	BD	1	225	65	
2008-05-07	23			7:16:40	BD	1	500	65	
2008-05-07	23			7:16:43	I	1		40	
2008-05-07	23		7:27 to 7:32	7:27:44	BD	1	200	60	
2008-05-07	23			7:28:06	BD	1	450	55	
2008-05-07	23			7:29:03	I	1		55	

Table K-1 (*continued*). TI-VPR data for spring 2008 offshore. NTD = no targets detected, CLOUDS = cloudy conditions, LOW = target too low in beam to obtain measurement.

Date	Grid	Time Frame (UTC)	5-min sample	Target start	ID	Count	Altitude	Direction	Comments
2008-05-07	23			7:29:14	BD	3	400	50	
2008-05-07	23			7:29:44	BD	1	125	15	
2008-05-07	23			7:30:02	BD	1	300	45	
2008-05-07	23			7:30:40	BD	1	450	65	
2008-05-07	23			7:30:46	I	1		0	
2008-05-07	23			7:30:51	BD	1	200	65	
2008-05-07	23			7:31:23	BD	1	325	55	
2008-05-07	23		7:47 to 7:52	7:47:25	BD	1	450	45	
2008-05-07	23			7:48:40	BD	1	325	50	
2008-05-07	23			7:48:45	BD	1	550	50	
2008-05-07	23			7:49:24	BD	1	475	55	
2008-05-07	23			7:49:50	I	1		30	
2008-05-07	23			7:50:08	BD	1	800	50	
2008-05-07	23			7:51:00	BD	1	275	55	
2008-05-07	23		8:02 to 8:07	8:02:05	BD	1	625	55	
2008-05-07	23			8:03:41	BD	1	250	35	
2008-05-07	23			8:04:11	I	1		55	
2008-05-07	23			8:04:24	BD	1	275	60	
2008-05-07	23			8:06:16	BD	1	275	45	
2008-05-07	23			8:06:50	BD	1	150	40	
2008-05-07	23	08:11:00 to 10:13:00	8:16 to 8:21	8:18:23	BD	1	375	25	
2008-05-07	23			8:18:56	BD	1	325	35	
2008-05-07	23		8:31 to 8:36	8:32:06	BD	1	200	45	
2008-05-07	23			8:35:16	BD	1	175	35	
2008-05-07	23		8:51 to 8:56	8:51:00	I	1		35	
2008-05-07	23			8:53:02	BD	1	175	35	
2008-05-07	23			8:55:31	I	1	175	165	
2008-05-07	23		9:06 to 9:11	9:06:29	BD	1	725	10	
2008-05-07	23			9:08:12	BD	1	250	30	

Table K-1 (*continued*). TI-VPR data for spring 2008 offshore. NTD = no targets detected, CLOUDS = cloudy conditions, LOW = target too low in beam to obtain measurement.

Date	Grid	Time Frame (UTC)	5-min sample	Target start	ID	Count	Altitude	Direction	Comments
2008-05-07	23			9:10:03	I	1		355	
2008-05-07	23			9:10:10	BD	1	150	35	
2008-05-07	23		9:11 to 9:16	9:11:20	I	1		45	
2008-05-07	23			9:11:47	BD	1	675	25	
2008-05-07	23			9:12:59	BD	1	1150	25	
2008-05-07	23			9:13:01	I	1		170	
2008-05-07	23			9:13:27	I	1		355	
2008-05-07	23		9:36 to 9:41						NTD
2008-05-07	23		9:41 to 9:46						NTD
2008-05-07	23		10:06 to 10:11						NTD
2008-05-08	17	16:05:00 to 18:07:00	16:20 to 16:25	16:20:19	I	1		45	
2008-05-08	17		16:30 to 16:35						NTD
2008-05-08	17		16:40 to 16:45						CLOUDS
2008-05-08	17		17:00 to 17:05						CLOUDS
2008-05-08	17		17:10 to 17:15						CLOUDS
2008-05-08	17		17:20 to 17:25						CLOUDS
2008-05-08	17		17:35 to 17:40						CLOUDS
2008-05-08	17		1755 to 1800						CLOUDS
2008-05-08	17	18:10:00 to 20:10:30	18:15 to 18:20						CLOUDS
2008-05-08	17		18:25 to 18:30						CLOUDS
2008-05-08	17		18:45 to 18:50						CLOUDS
2008-05-08	17		19:05 to 19:10						CLOUDS
2008-05-08	17		19:15 to 19:20						CLOUDS
2008-05-08	17		19:35 to 19:40						NTD
2008-05-08	17		19:40 to 19:45						NTD
2008-05-08	17		19:55 to 2:000						NTD
2008-05-09	17	04:00:00 to 05:55:00	4:00 to 4:05						CLOUDS
2008-05-09	17		4:20 to 4:25						CLOUDS
2008-05-09	17		4:40 to 4:45						CLOUDS

Table K-1 (*continued*). TI-VPR data for spring 2008 offshore. NTD = no targets detected, CLOUDS = cloudy conditions, LOW = target too low in beam to obtain measurement.

Date	Grid	Time Frame (UTC)	5-min sample	Target start	ID	Count	Altitude	Direction	Comments
2008-05-09	17		4:55 to 5:00						CLOUDS
2008-05-09	17		5:05 to 5:10						CLOUDS
2008-05-09	17		5:20 to 5:25						CLOUDS
2008-05-09	17		5:35 to 5:40						CLOUDS
2008-05-09	17		5:45 to 5:50						CLOUDS
2008-05-10	17	12:01:00 to 13:57:00	12:06 to 12:11						CLOUDS
2008-05-10	17		12:21 to 12:26						CLOUDS
2008-05-10	17		12:31 to 12:36						CLOUDS
2008-05-10	17		12:51 to 12:56						CLOUDS
2008-05-10	17		13:01 to 13:06						CLOUDS
2008-05-10	17		13:21 to 13:26						CLOUDS
2008-05-10	17		13:41 to 13:46						CLOUDS
2008-05-10	17		13:46 to 13:51						CLOUDS
2008-05-10	17	13:59:58 to 15:58:08	14:00 to 14:05						CLOUDS
2008-05-10	17		14:20 to 14:25						CLOUDS
2008-05-10	17		14:35 to 14:40						CLOUDS
2008-05-10	17		14:55 to 15:00						CLOUDS
2008-05-10	17		15:05 to 15:10						CLOUDS
2008-05-10	17		15:20 to 15:25						CLOUDS
2008-05-10	17		15:30 to 15:35						CLOUDS
2008-05-10	17		15:50 to 15:55						CLOUDS
2008-05-10	17	16:03 to 16:30	16:03 to 16:08						CLOUDS
2008-05-10	17		16:23 to 16:28						CLOUDS
2008-05-10	17	21:44 to 23:46	21:49 to 2154						CLOUDS
2008-05-10	17		22:04 to 22:09						CLOUDS
2008-05-10	17		22:14 to 22:19						CLOUDS
2008-05-10	17		22:34 to 22:39						CLOUDS
2008-05-10	17		22:49 to 22:54						CLOUDS
2008-05-10	17		23:09 to 23:14						CLOUDS

Table K-1 (*continued*). TI-VPR data for spring 2008 offshore. NTD = no targets detected, CLOUDS = cloudy conditions, LOW = target too low in beam to obtain measurement.

Date	Grid	Time Frame (UTC)	5-min sample	Target start	ID	Count	Altitude	Direction	Comments
2008-05-10	17		23:24 to 23:29						CLOUDS
2008-05-10	17		23:34 to 23:39						CLOUDS
2008-05-11	17	00:05 to 02:00	00:15 to 00:20						NTD
2008-05-11	17		00:30 to 00:35						NTD
2008-05-11	17		00:40 to 00:45						NTD
2008-05-11	17		00:50 to 00:55						NTD
2008-05-11	17		1:05 to 1:10						NTD
2008-05-11	17		1:25 to 1:30	01:27:38	I	1		230	
2008-05-11	17		1:35 to 1:40	01:38:26	BD	1	750	65	
2008-05-11	17		1:55 to 02:00	01:57:39	BD	1	400	25	
2008-05-11	17	02:00 to 04:00	2:00 to 2:05	02:03:57	I	1	100	80	
2008-05-11	17		2:20 to 2:25	02:20:10	BD	1	550	85	
2008-05-11	17			02:20:54	BT	1	500	10	
2008-05-11	17		2:40 to 2:45	02:43:34	I	1		60	
2008-05-11	17		2:55 to 3:00						NTD
2008-05-11	17		3:10 to 3:15	03:14:40	I	1		0	
2008-05-11	17		3:15 to 3:20						NTD
2008-05-11	17		3:40 to 3:45	03:40:16	BD	1	700	100	
2008-05-11	17			03:42:27	I	1		95	
2008-05-11	17		3:45 to 3:50	03:45:38	I	1		40	
2008-05-11	17			03:48:05	I	1		55	
2008-05-11	17	04:00 to 06:00	4:00 to 4:05	04:04:15	BD	1	600	70	
2008-05-11	17		4:15 to 4:20	04:15:50	I	1	100	75	
2008-05-11	17			04:18:19	BD	1	400	20	
2008-05-11	17			04:19:25	I	1	100	30	
2008-05-11	17		4:30 to 4:35	04:38:09	I	1		50	LOW
2008-05-11	17		4:50 to 4:55	04:50:21	I	1		20	LOW
2008-05-11	17		5:00 to 5:05						NTD
2008-05-11	17		5:15 to 5:20						NTD

Table K-1 (*continued*). TI-VPR data for spring 2008 offshore. NTD = no targets detected, CLOUDS = cloudy conditions, LOW = target too low in beam to obtain measurement.

Date	Grid	Time Frame (UTC)	5-min sample	Target start	ID	Count	Altitude	Direction	Comments
2008-05-11	17		5:30 to 5:35	05:30:51	BD	1	450	115	
2008-05-11	17			05:34:38	I	1	100	110	
2008-05-11	17		5:45 to 5:50	05:49:29	I	1	100	30	
2008-05-11	17	06:00 to 08:00	6:00 to 6:05	06:02:29	I	1		210	
2008-05-11	17			06:03:54	BD	1	150	0	
2008-05-11	17			06:04:29	BD	1	450	0	
2008-05-11	17			06:04:46	I	1		270	
2008-05-11	17			06:04:50	BD	1	500	240	
2008-05-11	17			06:04:59	I	1		260	
2008-05-11	17		6:15 to 6:20	06:16:09	BD	1	300	220	
2008-05-11	17			06:17:12	BD	1	250	250	
2008-05-11	17			06:17:21	I	1		185	
2008-05-11	17			06:17:39	BD	1	275	30	
2008-05-11	17			06:19:31	I	1		225	
2008-05-11	17		6:30 to 635						NTD
2008-05-11	17		6:45 to 6:50	06:45:01	BD	1	275	355	
2008-05-11	17			06:45:28	I	1	100	255	
2008-05-11	17			06:47:24	I	1	160	230	
2008-05-11	17		7:10 to 7:15	07:12:09	I	1	180	100	
2008-05-11	17		7:15 to 7:20						NTD
2008-05-11	17		7:40 to 7:45	07:44:55	I	1	285	125	
2008-05-11	17		7:45 to 7:50	07:45:10	BD	1	550	305	
2008-05-11	17	08:00 to 10:00	8:00 to 8:05	08:04:52	BD	1	600	60	
2008-05-11	17			08:07:02	I	1	110	200	
2008-05-11	17		8:20 to 8:25	08:25:16	I	1		400	
2008-05-11	17			08:28:00	BT	1		500	
2008-05-11	17		8:30 to 8:35	08:31:23	BD	1	475	270	
2008-05-11	17			08:34:19	BD	1	700	140	

Table K-1 (*continued*). TI-VPR data for spring 2008 offshore. NTD = no targets detected, CLOUDS = cloudy conditions, LOW = target too low in beam to obtain measurement.

Date	Grid	Time Frame (UTC)	5-min sample	Target start	ID	Count	Altitude	Direction	Comments
2008-05-11	17		8:50 to 8:55	08:51:53	I	1	180	200	
2008-05-11	17			08:52:25	BD	1	500	225	
2008-05-11	17			08:52:38	I	1	345	150	
2008-05-11	17			08:53:59	I	1	100		
2008-05-11	17			08:54:29	BD	1	330	250	
2008-05-11	17		9:10 to 9:15	09:11:09	BD	1	250		
2008-05-11	17			09:12:10	I	1	230		
2008-05-11	17			09:12:33	BD	1	325	300	
2008-05-11	17		9:20 to 9:25	09:24:05	BD	1		30	LOW
2008-05-11	17		9:30 to 9:35						NTD
2008-05-11	17		9:45 to 9:50						NTD

Table K-2. TI-VPR data from fall 2008 offshore. NTD = no targets detected, UTV = unable to view, FOG = foggy condition, CLOUDS = cloudy conditions, LOW = target too low in beam.

Date	Grid	Timeframe (UTC)	5-min sample	Target start	ID	Count	Altitude	Direction	Comments
2008-10-01	23	13:46:32 to 15:00:25	13:51 to 1356						FOG
2008-10-01	23		14:06 to 14:11						FOG
2008-10-01	23		14:16 to 14:21						FOG
2008-10-01	23		14:41 to 14:46						FOG
2008-10-01	23	15:58:46 to 17:58:40	16:08 to 16:13						FOG
2008-10-01	23		16:13 to 16:18						FOG
2008-10-01	23		16:28 to 16:33						FOG
2008-10-01	23		16:53 to 16:58						FOG
2008-10-01	23		17:08 to 17:13						FOG
2008-10-01	23		17:23 to 17:28						FOG
2008-10-01	23		17:38 to 17:43						NTD
2008-10-01	23		17:53 to 17:58						FOG
2008-10-01	23	17:58:46 to 19:57:11	18:03 to 18:08						FOG
2008-10-01	23		18:13 to 18:18						NTD
2008-10-01	23		18:33 to 18:38						FOG
2008-10-01	23		18:48 to 18:53						NTD
2008-10-01	23		18:58 to 19:03						FOG
2008-10-01	23		19:18 to 19:23						FOG
2008-10-01	23		19:38 to 19:43						FOG
2008-10-01	23		19:48 to 19:53						FOG
2008-10-01	23	19:58:46 to 21:03:16	20:08 to 20:13						FOG
2008-10-01	23		20:13 to 20:18						FOG
2008-10-01	23		20:33 to 20:38						FOG
2008-10-01	23		20:53 to 20:58						NTD
2008-10-02	23	10:49 to 12:49	10:54 to 10:59	10:54:51	BD	1	575	175	
2008-10-02	23		11:09 to 11:14						NTD
2008-10-02	23		11:19 to 11:24						NTD
2008-10-02	23		11:39 to 11:44	11:42:00	BD	1	300	90	
2008-10-02	23			11:42:00	BD	1	300	140	

Table K-2 (*continued*). TI-VPR data from fall 2008 offshore. NTD = no targets detected, UTV = unable to view, FOG = foggy condition, CLOUDS = cloudy conditions, LOW = target too low in beam.

Date	Grid	Timeframe (UTC)	5-min sample	Target start	ID	Count	Altitude	Direction	Comments
2008-10-02	23		11:49 to 11:54						NTD
2008-10-02	23		12:04 to 12:09						NTD
2008-10-02	23		12:19 to 12:24	12:19:53	BD	1	350	145	
2008-10-02	23			12:22:06	BD	1	575	135	
2008-10-02	23		12:44 to 12:49	12:47:32	BD	1		270	LOW
2008-10-02	23	12:49:07 to 14:49:07	12:54 to 12:59	12:57:49	BD	1		25	LOW
2008-10-02	23		13:14 to 13:19	1:15:00	BD	1	600	75	
2008-10-02	23		13:19 to 13:24						NTD
2008-10-02	23		13:44 to 13:49						CLOUDS
2008-10-02	23		13:55 to 14:00						CLOUDS
2008-10-02	23		14:10 to 14:15						CLOUDS
2008-10-02	23		14:24 to 14:29						CLOUDS
2008-10-02	23		14:39 to14:43						CLOUDS
2008-10-02	23	14:49 to 16:49	14:54 to 14:59						NTD
2008-10-02	23		1514 to 15:19						CLOUDS
2008-10-02	23		1529 to 15:34						CLOUDS
2008-10-02	23		1534 to 1539						NTD
2008-10-02	23		1554 to 1559						CLOUDS
2008-10-02	23		1604 to 1609						CLOUDS
2008-10-02	23		1629 to 1634						CLOUDS
2008-10-02	23		1634 to 1639						NTD
2008-10-02	23	16:49 to 18:49	1649 to 1654						NTD
2008-10-02	23		1704 to 1709						NTD
2008-10-02	23		1724 to 1729						NTD
2008-10-02	23		1744 to1749						NTD
2008-10-02	23		1749 to 1754						CLOUDS
2008-10-02	23		1804 to 1809						NTD
2008-10-02	23		1829 to 1834						NTD
2008-10-02	23		1844 to 1849						NTD

Table K-2 (*continued*). TI-VPR data from fall 2008 offshore. NTD = no targets detected, UTV = unable to view, FOG = foggy condition, CLOUDS = cloudy conditions, LOW = target too low in beam.

Date	Grid	Timeframe (UTC)	5-min sample	Target start	ID	Count	Altitude	Direction	Comments
2008-10-03	23	21:07 to 22:07:20	2107 to 2112						NTD
2008-10-03	23		2122 to 2127						NTD
2008-10-03	23		2142 to 2147						NTD
2008-10-03	23		2157 to 2202	21:58:09	I	1		85	
2008-10-05	23	12:15 to 14:15	1225 to 1230						NTD
2008-10-05	23		1240 to 1245						NTD
2008-10-05	23		1255 to 1300						NTD
2008-10-05	23		1310 to 1315						NTD
2008-10-05	23		1320 to 1325						NTD
2008-10-05	23		1340 to 1345						NTD
2008-10-05	23		1345 to 1350						NTD
2008-10-05	23		1410 to 1415						NTD
2008-10-05	23		1420 to 1425						NTD
2008-10-05	23		1435 to 1440						NTD
2008-10-05	23		1450 to 1455						CLOUDS
2008-10-05	23		1510 to 1515						CLOUDS
2008-10-05	23		1525 to 1530						CLOUDS
2008-10-05	23		1530 to 1535						CLOUDS
2008-10-05	23		1545 to 1550						CLOUDS
2008-10-05	23		1600 to 1605						NTD
2008-10-05	23	16:15 to 18:15	1625 to 1630						NTD
2008-10-05	23		1630 to 1635						NTD
2008-10-05	23		1655 to 1700						NTD
2008-10-05	23		1710 to 1715						CLOUDS
2008-10-05	23		1720 to 1725						CLOUDS
2008-10-05	23		1740 to 1745						CLOUDS
2008-10-05	23		1745 to 1750						CLOUDS
2008-10-05	23		1800 to 1805						CLOUDS
2008-10-05	23	18:15 to 20:15	1825 to 1830						NTD

Table K-2 (*continued*). TI-VPR data from fall 2008 offshore. NTD = no targets detected, UTV = unable to view, FOG = foggy condition, CLOUDS = cloudy conditions, LOW = target too low in beam.

Date	Grid	Timeframe (UTC)	5-min sample	Target start	ID	Count	Altitude	Direction	Comments
2008-10-05	23		1835 to 1840						NTD
2008-10-05	23		1845 to 1850	18:49:13	I	1		300	LOW
2008-10-05	23			18:49:14	I	1		225	LOW
2008-10-05	23		1910 to 1915						NTD
2008-10-05	23		1920 to 1925						NTD
2008-10-05	23		1930 to 1935						NTD
2008-10-05	23		1950 to 1955	19:53:17	I	1		25	LOW
2008-10-05	23		2005 to 2010	20:08:03	I	1		175	
2008-10-06	23	19:26 to 21:26	1931 to 1936	19:31:23	BD	1	250	220	
2008-10-06	23			19:31:43	I	1		270	
2008-10-06	23			19:32:09	BD	1	200	290	
2008-10-06	23			19:32:26	I	1		270	
2008-10-06	23		1946 to 1951	19:46:33	BT	1		200	LOW
2008-10-06	23							195	
2008-10-06	23			19:46:38	BD	1	1150	200	
2008-10-06	23			19:47:22	I	1		165	
2008-10-06	23			19:47:47	I	1		260	
2008-10-06	23			19:47:54	I	1		250	
2008-10-06	23		2001 to 2006	20:01:30	BD	1	475	205	
2008-10-06	23			20:02:35	BT	1	175	variable	
2008-10-06	23			20:02:47	BD	1	400	275	
2008-10-06	23			20:03:24	BD	1		150	
2008-10-06	23			20:03:26	I	1		250	
2008-10-06	23			20:03:56	I	1		170	
2008-10-06	23			20:04:36	I	1		210	
2008-10-06	23			20:04:39	BD	1	175	260	
2008-10-06	23			20:05:09	I	1		210	
2008-10-06	23		2016 to 2021						CLOUDS
2008-10-06	23		2026 to 2031						CLOUDS

Table K-2 (*continued*). TI-VPR data from fall 2008 offshore. NTD = no targets detected, UTV = unable to view, FOG = foggy condition, CLOUDS = cloudy conditions, LOW = target too low in beam.

Date	Grid	Timeframe (UTC)	5-min sample	Target start	ID	Count	Altitude	Direction	Comments
2008-10-06	23		2041 to 2046						NTD
2008-10-06	23		2101 to 2106						CLOUDS
2008-10-06	23		2116 to 2121	21:18:13	I	1		210	
2008-10-06	23			21:19:41	I	1		220	
2008-10-06	23	21:26 to 23:26	2136 to 2141						NTD
2008-10-06	23		2141 to 2146	21:42:00	I	1	275	200	
2008-10-06	23		2206 to 2211						CLOUDS
2008-10-06	23		2216 to 2221						CLOUDS
2008-10-06	23		2231 to 2236						CLOUDS
2008-10-06	23		2246 to 2251						CLOUDS
2008-10-06	23		2256 to 2301						CLOUDS
2008-10-06	23		2321 to 2326						CLOUDS
2008-10-06	23	23:26 to 01:26	2326 to 2331						CLOUDS
2008-10-06	23		2346 to 2351						CLOUDS
2008-10-06	23		0006 to 0011						CLOUDS
2008-10-06	23		0011 to 0016						CLOUDS
2008-10-06	23		0026 to 0031						CLOUDS
2008-10-06	23		0041 to 0046						CLOUDS
2008-10-06	23		101 to 106						CLOUDS
2008-10-06	23		111 to 116						CLOUDS
2008-10-06	23	01:26 to 03:26	131 to 136						CLOUDS
2008-10-06	23		141 to 146						CLOUDS
2008-10-06	23		206 to 211						CLOUDS
2008-10-06	23		216 to 221						CLOUDS
2008-10-06	23		231 to 236						CLOUDS
2008-10-06	23		246 to 251						CLOUDS
2008-10-06	23		301 to 306						CLOUDS
2008-10-06	23		311 to 316						CLOUDS
2008-10-07	23	4:03 to 6:03	4:03:14 to 4:08:14						CLOUDS

Table K-2 (*continued*). TI-VPR data from fall 2008 offshore. NTD = no targets detected, UTV = unable to view, FOG = foggy condition, CLOUDS = cloudy conditions, LOW = target too low in beam.

Date	Grid	Timeframe (UTC)	5-min sample	Target start	ID	Count	Altitude	Direction	Comments
2008-10-07	23		4:23:14 to 4:28:14						CLOUDS
2008-10-07	23		4:43:14 to 4:48:14						CLOUDS
2008-10-07	23		4:53:14 to 4:58:14						CLOUDS
2008-10-07	23		5:13:14 to 5:18:14						CLOUDS
2008-10-07	23		5:23:14 to 5:28:14						CLOUDS
2008-10-07	23		5:38:14 to 5:43:14						CLOUDS
2008-10-07	23		5:53:14 to 5:58:14						CLOUDS
2008-10-07	23	6:03 to 8:03	6:13:14 to 6:18:14						CLOUDS
2008-10-07	23		6:28:14 to 6:33:14	06:28:33	BD	1		200	
2008-10-07	23			06:30:25	I	1		185	
2008-10-07	23			06:30:26	I	1	300	205	
2008-10-07	23			06:31:02	I	1		190	LOW
2008-10-07	23			06:31:48	I	1		190	
2008-10-07	23			06:32:41	BD	1	475	255	
2008-10-07	23		6:33:14 to 6:38:14					270	CLOUDS
2008-10-07	23		6:58:14 to 7:03:14	06:58:19	I	1		225	LOW
2008-10-07	23			06:58:48	BD	1	300	220	
2008-10-07	23			06:59:34	BD	1		270	
2008-10-07	23			07:00:56	I	1	175	195	
2008-10-07	23			07:00:59	BD	1		185	
2008-10-07	23			07:01:02	BD	1		175	
2008-10-07	23			07:01:25	BD	1	300	235	
2008-10-07	23			07:01:36	BD	1	1900	225	
2008-10-07	23			07:01:53	BD	1	600	215	
2008-10-07	23			07:02:17	BD	1	475	225	
2008-10-07	23		7:13:14 to 7:18:14	07:14:28	I	1		205	
2008-10-07	23			07:15:07	I	1		240	
2008-10-07	23		7:28:14 to 7:33:14	07:28:49	BD	7	1175	250	
2008-10-07	23			07:29:13	BD	1	1350	260	

Table K-2 (*continued*). TI-VPR data from fall 2008 offshore. NTD = no targets detected, UTV = unable to view, FOG = foggy condition, CLOUDS = cloudy conditions, LOW = target too low in beam.

Date	Grid	Timeframe (UTC)	5-min sample	Target start	ID	Count	Altitude	Direction	Comments
2008-10-07	23		7:38:14 to 7:43:14	07:38:45	BD	1	575	265	
2008-10-07	23			07:39:47	BD	1	225	240	
2008-10-07	23		7:58:14 to 8:03:14	08:01:32	BD	1	600	190	
2008-10-07	23			08:02:34	BD	1	200	245	
2008-10-07	23			08:02:35	I	1		200	LOW
2008-10-07	23			08:02:36	BD	1		280	LOW
2008-10-07	23	8:03 to 10:03	8:03:14 to 8:08:14	08:04:25	BD	1		230	LOW
2008-10-07	23		8:18:14 to 8:23:14	08:20:15	I	1		195	LOW
2008-10-07	23		8:43:14 to 8:48:14	08:44:20	I	1	175	200	
2008-10-07	23			08:44:47	BD	1	300	175	
2008-10-07	23			08:46:46	BD	1	750	180	
2008-10-07	23		8:58:14 to 9:03:14	09:00:33	BD	1	300	265	
2008-10-07	23			09:01:16	BD	1	450	190	
2008-10-07	23			09:01:35	BD	1	450	245	
2008-10-07	23		9:08:14 to 9:13:14	09:11:26	BD	1	875	210	
2008-10-07	23		9:23:14 to 9:28:14	09:23:18	BD	1	200	240	
2008-10-07	23		9:43:14 to 9:48:14	09:46:06	I	1	200	235	
2008-10-07	23		9:48:14 to 9:53:14						NTD
2008-10-07	23	10:03 to 12:03	10:08:14 to 10:13:14	10:11:28	BD	1		260	LOW
2008-10-07	23			10:11:39	BD	1	875	185	
2008-10-07	23		10:23:14 to 10:28:14	10:23:53	BD	1	900	250	
2008-10-07	23		10:43:14 to 10:48:14	10:43:45	BD	3	525	235	
2008-10-07	23			10:44:23	BD	1	900	265	
2008-10-07	23			10:44:52	BD	1	800	205	
2008-10-07	23			10:46:15	I	1	175	225	
2008-10-07	23		10:48:14 to 10:53:14	10:49:07	BD	1	625	245	
2008-10-07	23		11:08:14 to 11:13:14						NTD
2008-10-07	23		11:18:14 to 11:23:14						NTD
2008-10-07	23		11:38:14 to 11:43:14						NTD

Table K-2 (*continued*). TI-VPR data from fall 2008 offshore. NTD = no targets detected, UTV = unable to view, FOG = foggy condition, CLOUDS = cloudy conditions, LOW = target too low in beam.

Date	Grid	Timeframe (UTC)	5-min sample	Target start	ID	Count	Altitude	Direction	Comments
2008-10-07	23		11:53:14 to 11:58:14	11:54:47	BD	1	850	230	
2008-10-07	23			11:55:16	BD	1		265	
2008-10-08	23	0:05 to 2:05	015 to 020	00:19:02	BD	1		70	
2008-10-08	23		025 to 030						CLOUDS
2008-10-08	23		040 to 045	00:44:10	BD	1	600	150	
2008-10-08	23		055 to 100						NTD
2008-10-08	23		110 to 115	01:10:04	BT	1	250	190	
2008-10-08	23			01:11:14	BD	1	525	65	
2008-10-08	23			01:12:28	I	1		250	
2008-10-08	23			01:13:17	BD	1	625	145	
2008-10-08	23		125 to 130	01:25:50	I	1	250	80	
2008-10-08	23			01:28:17	BD	1	175	220	
2008-10-08	23			01:29:24	BD	1	800	55	
2008-10-08	23		145 to 150	01:49:40	BD	1		110	
2008-10-08	23		150 to 155	01:52:53	BD	1	300	345	
2008-10-08	23	2:05 to 4:05	215 to 220	02:15:15	BD	1		175	
2008-10-08	23			02:16:49	BD	1		205	
2008-10-08	23		230 to 235	02:32:54	BD	1	250	205	
2008-10-08	23			02:33:53	BD	1	325	180	
2008-10-08	23		235 to 240	02:35:44	BD	1		335	
2008-10-08	23		255 to 300	02:59:05	BD	1	825	150	
2008-10-08	23			02:59:55	BD	1	525	70	
2008-10-08	23		305 to 310	03:08:31	I	1		150	
2008-10-08	23		325 to 330						CLOUDS
2008-10-08	23		340 to 345						NTD
2008-10-08	23		400 to 405						NTD
2008-10-08	23			04:02:15	BT	1		310	
2008-10-08	23			04:02:43	BD	1	1200	45	
2008-10-08	23			04:03:05	BD	1		115	

Table K-2 (*continued*). TI-VPR data from fall 2008 offshore. NTD = no targets detected, UTV = unable to view, FOG = foggy condition, CLOUDS = cloudy conditions, LOW = target too low in beam.

Date	Grid	Timeframe (UTC)	5-min sample	Target start	ID	Count	Altitude	Direction	Comments
2008-10-08	23			04:03:41	I	1		125	
2008-10-08	23	4:05 to 6:05	415 to 420	04:19:46	I	1		160	
2008-10-08	23		430 to 435						CLOUDS
2008-10-08	23		445 to 450						CLOUDS
2008-10-08	23		500 to 505	05:01:53	BD	1	950	215	
2008-10-08	23		510 to 515						NTD
2008-10-08	23		525 to 530	05:26:45	I	1		130	LOW
2008-10-08	23			05:27:37	BD	1		205	
2008-10-08	23		545 to 550	05:45:06	BD	1	1400	260	
2008-10-08	23		600 to 605						NTD
2008-10-08	23	6:05 to 8:05	610 to 615						CLOUDS
2008-10-08	23		630 to 635						CLOUDS
2008-10-08	23		645 to 650						NTD
2008-10-08	23		650 to 655						CLOUDS
2008-10-08	23		715 to 720	07:16:14	BD	1	975	70	
2008-10-08	23		730 to 735	07:31:16	BD	1	600	65	
2008-10-08	23		745 to 750						NTD
2008-10-08	23		750 to 755						NTD
2008-10-08	23	20:12 to 22:12	2022 to 2027						NTD
2008-10-08	23		2027 to 2032						NTD
2008-10-08	23		2052 to 2057						NTD
2008-10-08	23		2107 to 2112						NTD
2008-10-08	23		2117 to 2122	21:17:55	BD	1	450	10	
2008-10-08	23		2137 to 2142						NTD
2008-10-08	23		2152 to 2157						CLOUDS
2008-10-08	23		2157 to 2202						CLOUDS
2008-10-08	23	22:12 to 00:12	2222 to 2227						CLOUDS
2008-10-08	23		2232 to 2237						CLOUDS
2008-10-08	23		2252 to 2257						CLOUDS

Table K-2 (*continued*). TI-VPR data from fall 2008 offshore. NTD = no targets detected, UTV = unable to view, FOG = foggy condition, CLOUDS = cloudy conditions, LOW = target too low in beam.

Date	Grid	Timeframe (UTC)	5-min sample	Target start	ID	Count	Altitude	Direction	Comments
2008-10-08	23		2307 to 2312						CLOUDS
2008-10-08	23		2312 to 2317						CLOUDS
2008-10-08	23		2327 to 2332						CLOUDS
2008-10-08	23		2347 to 2352						CLOUDS
2008-10-08	23		0002 to 0007						CLOUDS
2008-10-09	23	0012 to 0212	0017 to 0022						CLOUDS
2008-10-09	23		0027 to 0032						CLOUDS
2008-10-09	23		0047 to 0052						CLOUDS
2008-10-09	23		102 to 107						CLOUDS
2008-10-09	23		112 to 117						CLOUDS
2008-10-09	23		127 to 132						CLOUDS
2008-10-09	23		152 to 157						CLOUDS
2008-10-09	23		207 to 212						CLOUDS
2008-10-09	23	0212 to 0412	217 to 222						CLOUDS
2008-10-09	23		237 to 242						CLOUDS
2008-10-09	23		257 to 302						CLOUDS
2008-10-09	23		307 to 312						CLOUDS
2008-10-09	23		312 to 317						CLOUDS
2008-10-09	23		332 to 337						CLOUDS
2008-10-09	23		347 to 352						CLOUDS
2008-10-09	23		357 to 402						CLOUDS
2008-10-09	23	19:45 to 21:45							
2008-10-09	23		1950 to 1955						CLOUDS
2008-10-09	23		2000 to 2005						CLOUDS
2008-10-09	23		2020 to 2025						CLOUDS
2008-10-09	23		2040 to 2045	20:43:25	I	1		80	LOW
2008-10-09	23		2050 to 2055	20:52:32	I	1		260	LOW
2008-10-09	23		2110 to 2115						CLOUDS
2008-10-09	23		2120 to 2125						CLOUDS

Table K-2 (*continued*). TI-VPR data from fall 2008 offshore. NTD = no targets detected, UTV = unable to view, FOG = foggy condition, CLOUDS = cloudy conditions, LOW = target too low in beam.

Date	Grid	Timeframe (UTC)	5-min sample	Target start	ID	Count	Altitude	Direction	Comments
2008-10-09	23		2130 to 2135	21:34:38	I	1		80	LOW
2008-10-09	23	21:45 to 23:45	2155 to 2200						CLOUDS
2008-10-09	23		2205 to 2210						CLOUDS
2008-10-09	23		2225 to 2230	22:27:41	I	1		80	LOW
2008-10-09	23			22:28:04	I	1		305	LOW
2008-10-09	23		2230 to 2235						CLOUDS
2008-10-09	23		2245 to 2250						CLOUDS
2008-10-09	23		2310 to 2315						CLOUDS
2008-10-09	23		2315 to 2320						CLOUDS
2008-10-09	23		2330 to 2335						CLOUDS
2008-10-10	23	07:10:30 to 09:10:32							
2008-10-10	23		720 to 725	07:20:31	BD	1	175	variable	
2008-10-10	23			07:20:57	BD	1	350	155	
2008-10-10	23			07:21:43	BD	1	825	155	
2008-10-10	23			07:21:56	BD	1	775	170	
2008-10-10	23			07:22:09	BD	1	625	170	
2008-10-10	23			07:22:40	I	1		110	
2008-10-10	23			07:24:15	BD	1	375	220	
2008-10-10	23		735 to 740						CLOUDS
2008-10-10	23		745 to 750						CLOUDS
2008-10-10	23		800 to 805						CLOUDS
2008-10-10	23		820 to 825						CLOUDS
2008-10-10	23		830 to 835	08:32:53	BD	1	350	95	
2008-10-10	23			08:33:38	BD	1		210	LOW
2008-10-10	23		840 to 845						NTD
2008-10-10	23		905 to 910	09:05:02	BD	1	1050	225	
2008-10-10	23			09:08:48	BD	1	900	205	
2008-10-10	23			09:09:57	BD	1		210	LOW
2008-10-10	23	9:10 to 11:10	920 to 925	09:20:10	BD	1	675	215	

Table K-2 (*continued*). TI-VPR data from fall 2008 offshore. NTD = no targets detected, UTV = unable to view, FOG = foggy condition, CLOUDS = cloudy conditions, LOW = target too low in beam.

Date	Grid	Timeframe (UTC)	5-min sample	Target start	ID	Count	Altitude	Direction	Comments
2008-10-10	23			09:23:41	BD	1	750	235	
2008-10-10	23		930 to 935	09:30:24	BD	1	700	210	
2008-10-10	23			09:31:39	BD	1		300	LOW
2008-10-10	23			09:31:53	BD	1	900	240	
2008-10-10	23			09:32:39	BD	1	175	300	
2008-10-10	23			09:34:13	BD	1	725	220	
2008-10-10	23			09:34:58	BD	1	775	235	
2008-10-10	23		945 to 950	09:47:37	BD	1	725	150	
2008-10-10	23			09:49:07	BD	1	150	225	
2008-10-10	23		1005 to 1010	10:08:20	BD	1	200	210	
2008-10-10	23			10:09:26	BD	1	875	250	
2008-10-10	23			10:09:43	BD	1	825	200	
2008-10-10	23		1010 to 1015	10:13:00	BD	1	775	230	
2008-10-10	23		1025 to 1030	10:25:41	BD	1	875	225	
2008-10-10	23			10:26:20	BD	1	375	95	
2008-10-10	23		1040 to 1045	10:40:45	BD	1	775	240	
2008-10-10	23		1100 to 1105						NTD
2008-10-10	23	11:10 to 13:10	1120 to 1125						NTD
2008-10-10	23		1125 to 1130						NTD
2008-10-10	23		1145 to 1150						NTD
2008-10-10	23		1205 to 1210						
2008-10-10	23		1215 to 1220						NTD
2008-10-10	23		1235 to 1240	12:35:27	BD	1	600	220	
2008-10-10	23			12:35:44	BD	1	1000	260	
2008-10-10	23			12:37:45	BD	1	575	225	
2008-10-10	23			12:37:51	BD	1	450	230	
2008-10-10	23		1240 to 1245	12:40:33	BD	5	975	260	
2008-10-10	23			12:42:52	BD	1	400	220	
2008-10-10	23			12:43:25	BD	1	275	220	

Table K-2 (*continued*). TI-VPR data from fall 2008 offshore. NTD = no targets detected, UTV = unable to view, FOG = foggy condition, CLOUDS = cloudy conditions, LOW = target too low in beam.

Date	Grid	Timeframe (UTC)	5-min sample	Target start	ID	Count	Altitude	Direction	Comments
2008-10-10	23			12:44:12	I	1	200	220	
2008-10-10	23		1255 to 1300	12:55:52	BD	1		210	LOW
2008-10-10	23			12:57:17	BD	1	175	215	
2008-10-10	23			12:57:22	BD	1	300	210	
2008-10-10	23								
2008-10-10	23			12:59:17	BD	1		220	LOW
2008-10-10	23			12:59:59	BD	1	300	210	
2008-10-10	23	13:10 to 15:10	1320 to 1325	13:20:05	BD	1	525	225	
2008-10-10	23			13:21:09	BD	1	600	260	
2008-10-10	23			12:23:14	BD	1	575	215	
2008-10-10	23		1335 to 1340	13:35:15	BD	2	200	220	
2008-10-10	23			13:35:51	BD	1	375	225	
2008-10-10	23							235	LOW
2008-10-10	23			13:38:21	BD	1	850	270	
2008-10-10	23			13:38:35	BD	1	250	215	
2008-10-10	23		1345 to 1350						NTD
2008-10-10	23		1355 to 1400	13:57:34	BD	1	1275	220	
2008-10-10	23		1415 to 1420						NTD
2008-10-10	23		1425 to 1430	14:28:24	BD	1		95	LOW
2008-10-10	23		1440 to 1445	14:41:29	BD	1		variable	LOW
2008-10-10	23			14:41:56	BD	1		120	LOW
2008-10-10	23		1505 to 1510	15:05:05	BD	1		215	LOW
2008-10-11	23	6:07 to 08:07	612 to 617	6:13:57	BD	1	675	255	
2008-10-11	23							230	Fast
2008-10-11	23							235	Faint
2008-10-11	23			6:15:25	BD	1	275	220	
2008-10-11	23			6:15:36	I	2	150	200	
2008-10-11	23		622 to 627	6:22:08	BD	1		255	LOW
2008-10-11	23			6:22:13	BD	1	250	260	

Table K-2 (*continued*). TI-VPR data from fall 2008 offshore. NTD = no targets detected, UTV = unable to view, FOG = foggy condition, CLOUDS = cloudy conditions, LOW = target too low in beam.

Date	Grid	Timeframe (UTC)	5-min sample	Target start	ID	Count	Altitude	Direction	Comments
2008-10-11	23		642 to 647	6:43:14	BD	1	275	260	
2008-10-11	23			6:43:18	BD	1	1000	235	
2008-10-11	23			6:44:06	BD	1	1100	260	
2008-10-11	23			6:44:13	BD	1	150	250	
2008-10-11	23		652 to 657	6:54:41	BD	1	175	240	
2008-10-11	23			6:56:43	I	1		245	
2008-10-11	23			6:56:54	BD	1	325	245	
2008-10-11	23		717 to 722	7:17:56	BD	1	500	260	
2008-10-11	23			7:19:01	BD	1	375	120	
2008-10-11	23			7:19:05	BD	1	175	250	
2008-10-11	23			7:19:38	BD	1	350	325	
2008-10-11	23								
2008-10-11	23		722 to 727	7:22:04	BD	1	1225	250	
2008-10-11	23			7:22:32	BD	1	200	260	
2008-10-11	23			7:23:28	BD	1	2.3?	195	
2008-10-11	23			7:23:32	BD	1	450	265	
2008-10-11	23			7:23:40	BD	1	500	180	
2008-10-11	23			7:23:50	BD	1	900	260	
2008-10-11	23			7:24:43	BD	1		305	LOW
2008-10-11	23		737 to 742	7:37:52	BD	1		265	LOW
2008-10-11	23			7:38:42	BD	1	650	245	
2008-10-11	23			7:38:48	BD	1	275	245	
2008-10-11	23			7:40:02	BD	1	575	235	
2008-10-11	23			7:40:35	BD	1	475	255	
2008-10-11	23			7:40:58	BD	1	550	265	
2008-10-11	23							225	
2008-10-11	23			7:41:16	BD	1	1000	220	
2008-10-11	23			7:41:27	BD	1	275	285	
2008-10-11	23		752 to 757	7:52:06	BD	1	150	255	

Table K-2 (*continued*). TI-VPR data from fall 2008 offshore. NTD = no targets detected, UTV = unable to view, FOG = foggy condition, CLOUDS = cloudy conditions, LOW = target too low in beam.

Date	Grid	Timeframe (UTC)	5-min sample	Target start	ID	Count	Altitude	Direction	Comments
2008-10-11	23			7:54:24	BD	1	2		
2008-10-11	23			7:54:52	BD	1	1100	250	
2008-10-11	23			7:55:21	BD	1	600	225	
2008-10-11	23			7:56:09	BD	1		300	LOW
2008-10-11	23			7:56:34	I	1	350	350	
2008-10-11	23			7:56:46	BD	1	650	250	
2008-10-11	23	807 to 907	812 to 817						UTV
2008-10-11	23			8:12:40	BD	1	600	240	
2008-10-11	23			8:14:45	BD	1	850	270	
2008-10-11	23			8:15:51	BD	1		305	LOW
2008-10-11	23			8:16:03	BD	1	525	45	
2008-10-11	23			8:16:09	BD	1	1050	250	
2008-10-11	23			8:16:42	BD	1	750	255	
2008-10-11	23			8:16:45	BD	1	500	250	
2008-10-11	23			8:16:53	BD	1			LOW
2008-10-11	23		832 to 837	8:32:00	I	1	300	225	
2008-10-11	23			8:33:10	I	1	125	225	
2008-10-11	23			8:33:35	BD	1	925	245	
2008-10-11	23			8:33:48	I	1		220	LOW
2008-10-11	23			8:34:26	BD	1	650	270	
2008-10-11	23			8:34:47	BD	1	800	250	
2008-10-11	23			8:34:52	BD	1	175	290	
2008-10-11	23			8:35:56	BD	1	500	255	
2008-10-11	23		847 to 852	8:47:25	BD	1	375	260	
2008-10-11	23			8:48:17	BD	1	575	255	
2008-10-11	23			8:48:34	I	1	125	220	
2008-10-11	23			8:49:19	BD	1	875	65	
2008-10-11	23			8:50:25	BD	1	450	variable	
2008-10-11	23			8:50:27	BD	1	250	240	

Table K-2 (*continued*). TI-VPR data from fall 2008 offshore. NTD = no targets detected, UTV = unable to view, FOG = foggy condition, CLOUDS = cloudy conditions, LOW = target too low in beam.

Date	Grid	Timeframe (UTC)	5-min sample	Target start	ID	Count	Altitude	Direction	Comments
2008-10-11	23			8:51:24	BD	1	300	250	
2008-10-11	23								
2008-10-11	23								
2008-10-11	23			8:56:50	BD	1	250	230	
2008-10-11	23		902 to 907	9:02:07	I	1	125	235	
2008-10-11	23			9:02:49	BD	1	300	255	
2008-10-11	23			9:04:12	I	1		210	
2008-10-11	23			9:04:37	I	1	300		
2008-10-11	23			9:05:05	BD	1	525	260	
2008-10-11	23			9:06:07	BD	1	375	280	
2008-10-11	23	907 to 1007	912 to 917	9:13:07	BD	1	900	250	
2008-10-11	23			9:14:00	BD	1	300	300	
2008-10-11	23			9:14:55	I	1	125	295	
2008-10-11	23			9:15:07	BD	1	900	280	
2008-10-11	23			9:16:04	BD	1	500	250	
2008-10-11	23		932 to 937	9:33:00	BD	1	300	255	
2008-10-11	23			9:35:16	BD	1		290	LOW
2008-10-11	23			9:35:22	BD	1	875	245	
2008-10-11	23			9:36:00	BD	1	550	240	
2008-10-11	23		937 to 942	9:38:05	I	1		240	LOW
2008-10-11	23			9:38:36	BD	1	775	240	
2008-10-11	23		952 to 957	9:53:52	BD	1	750	270	
2008-10-11	23			9:54:38	BD	1	375	280	
2008-10-11	23			9:56:43	BD	1	550	270	
2008-10-11	23	1007 to 1107	1017 to 1022	10:18:50	BD	1	950	270	
2008-10-11	23			10:20:44	BD	1	450	280	
2008-10-11	23		1027 to 1032	10:27:06	BD	1	550	225	
2008-10-11	23			10:27:51	BD	1	750	300	
2008-10-11	23			10:28:26	BD	1	450	280	

Table K-2 (*continued*). TI-VPR data from fall 2008 offshore. NTD = no targets detected, UTV = unable to view, FOG = foggy condition, CLOUDS = cloudy conditions, LOW = target too low in beam.

Date	Grid	Timeframe (UTC)	5-min sample	Target start	ID	Count	Altitude	Direction	Comments
2008-10-11	23			10:29:29	BD	1	650	260	
2008-10-11	23			10:30:06	BD	1	450	220	
2008-10-11	23			10:31:24	BD	1	800	270	
2008-10-11	23			10:31:27	BD	1	800	255	
2008-10-11	23		1037 to 1042	10:37:02	BD	1	300	280	
2008-10-11	23			10:37:03	BD	1	300	280	
2008-10-11	23		1102 to 1107	11:04:03	BD	6	850	270	
2008-10-11	23	1107 to 1207	1107 to 1112	11:08:21	BD	8	1500		
2008-10-11	23			11:09:13	BD	15	1200		
2008-10-11	23			11:09:43	BD	1	900		
2008-10-11	23			11:09:57	BD	6	900		
2008-10-11	23			11:10:03	BD	6	1200		
2008-10-11	23		1122 to 1127	11:23:48	BD	1	900		
2008-10-11	23			11:26:10	BD	12	1200		
2008-10-11	23		1142 to 1147	11:42:38	BD	3	950	270	
2008-10-11	23			11:43:10	BD	1	350	260	
2008-10-11	23			11:44:10	BD	15	650	260	
2008-10-11	23			11:45:14	BD	1	350	250	
2008-10-11	23			11:45:47	BD	1	900	230	
2008-10-11	23			11:46:47	BD	1		260	
2008-10-11	23		1152 to 1157						NTD
2008-10-11	23	1207 to 1307	1217 to 1222	12:17:00	BD	1	350	270	
2008-10-11	23			12:17:16	BD	1	1200		
2008-10-11	23	2 ok		12:19:41	BD	1	275	270	
2008-10-11	23			12:21:09	BD	1		0	
2008-10-11	23		1227 to 1232	12:27:01	BD	1	900		
2008-10-11	23			12:28:49	BD	2	600		
2008-10-11	23			12:28:50	BD	2	900		
2008-10-11	23		1237 to 1242						NTD

Table K-2 (*continued*). TI-VPR data from fall 2008 offshore. NTD = no targets detected, UTV = unable to view, FOG = foggy condition, CLOUDS = cloudy conditions, LOW = target too low in beam.

Date	Grid	Timeframe (UTC)	5-min sample	Target start	ID	Count	Altitude	Direction	Comments
2008-10-11	23		1257 to 1302	12:58:15	BD	1	325	270	
2008-10-11	23			12:59:20	BD	2	500	270	
2008-10-11	23			1:01:09	BD	1		290	
2008-10-11	23								
2008-10-11	23	1307 to 1407	1317 to 1322	13:18:48	BD	1		300	
2008-10-11	23			13:19:49	I	1		240	
2008-10-11	23			13:21:19	BD	1	750	270	
2008-10-11	23			13:21:25	BD	1	750	270	
2008-10-11	23		1327 to 1332	13:27:04	BD	1	1100	300	
2008-10-11	23			13:28:30	BD	1	1050	260	
2008-10-11	23		1347 to 1352						NTD
2008-10-11	23		1402 to 1407	14:02:00	BD	1		0	LOW
2008-10-12	23	12:03:52 to 8:03:52							
2008-10-12	23	1203 to 103	1208 to 1213	12:12:09	I	1			
2008-10-12	23			12:12:42	I	1			
2008-10-12	23		1223 to 1228	12:23:53	I	1		255	
2008-10-12	23			12:27:06	BD	1	275	240	
2008-10-12	23		1233 to 1238	12:33:15	BT	1	1		
2008-10-12	23			12:34:19	BD	1		230	LOW
2008-10-12	23			12:36:45	I	1		235	LOW
2008-10-12	23		1258 to 103						NTD
2008-10-12	23	103 to 203	113 to 118	1:14:28	I	1		270	LOW
2008-10-12	23			1:14:36	BD	1	475	270	
2008-10-12	23			1:16:29	BD	1	425	285	
2008-10-12	23			1:17:53	BD	1	1175	310	
2008-10-12	23		128 to 133	1:31:29	BD	1	1500	245	
2008-10-12	23			1:31:51	BD	1	950	175	
2008-10-12	23		133 to 138	1:34:25	I	1		275	
2008-10-12	23			1:35:09	I	1		270	

Table K-2 (*continued*). TI-VPR data from fall 2008 offshore. NTD = no targets detected, UTV = unable to view, FOG = foggy condition, CLOUDS = cloudy conditions, LOW = target too low in beam.

Date	Grid	Timeframe (UTC)	5-min sample	Target start	ID	Count	Altitude	Direction	Comments
2008-10-12	23			1:37:21	I	1		280	
2008-10-12	23		148 to 153						CLOUDS
2008-10-12	23	203 to 303	208 to 213	2:08:33	BD	1	3		
2008-10-12	23								
2008-10-12	23		223 to 228	2:26:06	BT	1	675	290	
2008-10-12	23		233 to 238	2:34:02	BD	1	6		
2008-10-12	23			2:36:37	BD	1	1		
2008-10-12	23								
2008-10-12	23		248 to 253	2:51:34	I	1			
2008-10-12	23								
2008-10-12	23	303 to 403	303 to 308						NTD
2008-10-12	23		328 to 333	3:50:58	I	1			
2008-10-12	23								
2008-10-12	23								
2008-10-12	23		343 to 348	3:44:48	BT	1	1		
2008-10-12	23			3:45:24	I	1			CLOUDS
2008-10-12	23		358 to 403						
2008-10-12	23	403 to 503	403 to 408	4:04:42	BD	1	600	280	
2008-10-12	23		418 to 423	4:22:40	BD	1	1100	220	
2008-10-12	23		438 to 443					270	
2008-10-12	23			4:40:25	BD	1	600	280	
2008-10-12	23		458 to 503	5:00:37	I	1		295	LOW
2008-10-12	23			5:01:01	I	1		295	LOW
2008-10-12	23			5:02:07	BD	1	275	245	
2008-10-12	23	503 to 603	513 to 518	5:13:13	I	1		310	LOW
2008-10-12	23			5:13:18	I	1		310	LOW
2008-10-12	23		523 to 528	5:26:20	I	1		290	LOW
2008-10-12	23			5:26:31	I	1		295	LOW
2008-10-12	23		543 to 548						NTD

Table K-2 (*continued*). TI-VPR data from fall 2008 offshore. NTD = no targets detected, UTV = unable to view, FOG = foggy condition, CLOUDS = cloudy conditions, LOW = target too low in beam.

Date	Grid	Timeframe (UTC)	5-min sample	Target start	ID	Count	Altitude	Direction	Comments
2008-10-12	23		553 to 558						NTD
2008-10-12	23	603 to 703	608 to 613						NTD
2008-10-12	23		618 to 623	6:18:58	I	1		295	LOW
2008-10-12	23		633 to 638	6:35:38	BD	1	850		
2008-10-12	23			6:36:12	I	1		310	LOW
2008-10-12	23		653 to 658						NTD
2008-10-12	23	703 to 803	708 to 713						NTD
2008-10-12	23		718 to 723	7:20:47	I	1	150	270	
2008-10-12	23		733 to 738						NTD
2008-10-12	23		758 to 803	8:00:57	I	1		230	
2008-10-13	26	802 to 902	8:12:42 to 8:17:42						CLOUDS
2008-10-13	26		8:17:42 to 8:22:42						CLOUDS
2008-10-13	26		8:37:42 to 8:42:42						CLOUDS
2008-10-13	26		8:52:42 to 8:57:42						CLOUDS
2008-10-13	26	902 to 1002	9:07:42 to 9:12:42						CLOUDS
2008-10-13	26		9:17:42 to 9:22:42						CLOUDS
2008-10-13	26		9:37:42 to 9:42:42						CLOUDS
2008-10-13	26		9:47:42 to 9:52:42						CLOUDS
2008-10-13	26	1002 to 1102	10:02:42 to 10:07:42						CLOUDS
2008-10-13	26		10:17:42 to 10:22:42						CLOUDS
2008-10-13	26		10:42:42 to 10:47:42						CLOUDS
2008-10-13	26		10:47:42 to 10:52:42						CLOUDS
2008-10-13	26	1102 to 1202	11:12:42 to 11:17:42						NTD
2008-10-13	26		11:22:42 to 11:27:42						NTD
2008-10-13	26		11:37:42 to 11:42:42						CLOUDS
2008-10-13	26		11:52:42 to 11:57:42						CLOUDS
2008-10-13	26	1202 to 1302	12:12:42 to 12:17:42						CLOUDS
2008-10-13	26		12:17:42 to 12:22:42						CLOUDS
2008-10-13	26		12:32:42 to 12:37:42						CLOUDS

Table K-2 (*continued*). TI-VPR data from fall 2008 offshore. NTD = no targets detected, UTV = unable to view, FOG = foggy condition, CLOUDS = cloudy conditions, LOW = target too low in beam.

Date	Grid	Timeframe (UTC)	5-min sample	Target start	ID	Count	Altitude	Direction	Comments
2008-10-13	26		12:57:42 to 13:02:42						CLOUDS
2008-10-13	26	1302 to 1402	13:12:42 to 13:17:42						CLOUDS
2008-10-13	26		13:22:42 to 13:27:42						CLOUDS
2008-10-13	26		13:32:42 to 13:37:42						CLOUDS
2008-10-13	26		13:57:42 to 14:02:42						CLOUDS
2008-10-13	26	1402 to 1502	14:07:42 to 14:12:42						CLOUDS
2008-10-13	26		14:22:42 to 14:27:42						CLOUDS
2008-10-13	26		14:32:42 to 14:37:42						CLOUDS
2008-10-13	26		14:57:42 to 15:02:42						CLOUDS
2008-10-13	26		15:07:42 to 15:12:42						CLOUDS
2008-10-13	26		15:27:42 to 15:32:42						CLOUDS
2008-10-13	26		15:32:42 to 15:37:42						CLOUDS
2008-10-13	26		15:47:42 to 15:52:42						CLOUDS
2008-10-14	26		4:22:09 to 4:27:09	04:23:42	BD	1	750	215	
2008-10-14	26			04:27:08	BD	1	625	250	
2008-10-14	26	0437 to 0537	4:37:09 to 4:42:09	04:37:09	BD	1	525	245	
2008-10-14	26			04:39:22	BD	1	275	290	
2008-10-14	26			04:39:25	BD	1	600	230	
2008-10-14	26			04:40:53	BD	1	175	240	
2008-10-14	26		4:52:09 to 4:57:09	04:53:07	BD	1	600	240	
2008-10-14	26			04:53:51	BD	1	550	230	
2008-10-14	26			04:54:04	BD	1	625	250	
2008-10-14	26			04:55:02	BD	1	1175	230	
2008-10-14	26			04:56:12	BD	1	750	245	
2008-10-14	26			04:56:34	BD	1	575	255	
2008-10-14	26		5:07:09 to 5:12:09	05:08:02	BD	1	600	270	
2008-10-14	26			05:08:26	BD	1	575	235	
2008-10-14	26			05:09:19	BD	1	600	345	
2008-10-14	26			05:10:29	BD	1	625	210	

Table K-2 (*continued*). TI-VPR data from fall 2008 offshore. NTD = no targets detected, UTV = unable to view, FOG = foggy condition, CLOUDS = cloudy conditions, LOW = target too low in beam.

Date	Grid	Timeframe (UTC)	5-min sample	Target start	ID	Count	Altitude	Direction	Comments
2008-10-14	26			05:10:31	BD	1	625	210	
2008-10-14	26		5:27:09 to 5:32:09	05:27:19	BD	1	975	240	
2008-10-14	26			05:28:01	BD	1	625	250	
2008-10-14	26			05:28:25	BD	1	900	185	
2008-10-14	26			05:28:33	BD	1	850	235	
2008-10-14	26			05:29:17	BD	1	925	245	
2008-10-14	26			05:30:24	BD	1	600	245	
2008-10-14	26			05:30:46	BD	1	900	225	
2008-10-14	26			05:31:19	BD	1	800	`245	
2008-10-14	26	0537 to 0637	05:47:09 to 05:52:09	05:47:35	BD	1	950	250	
2008-10-14	26			05:48:49	BD	1	650	225	
2008-10-14	26			05:50:00	BD	1	300	335	
2008-10-14	26		6:02:09 to 6:07:09	06:02:38	BD	1	325	245	
2008-10-14	26			06:03:05	BD	1	600	240	
2008-10-14	26			06:03:05	BD	1	750	245	
2008-10-14	26			06:03:56	BD	1	850	235	
2008-10-14	26		6:17:09 to 6:22:09	06:21:56	BD	1	1175	185	
2008-10-14	26			06:22:03	BD	1	175	265	
2008-10-14	26		6:27:09 to 6:32:09	06:27:24	BD	1	300	240	
2008-10-14	26			06:28:41	BD	1	900	260	
2008-10-14	26			06:29:44	BD	1	625	245	
2008-10-14	26			06:30:49	BD	1	800	210	
2008-10-14	26	0637 to 0737	06:37:09 to 6:42:09	06:40:33	BD	1	350	220	
2008-10-14	26		7:02:09 to 7:07:09	07:03:23	BD	1	1175	180	
2008-10-14	26			07:03:53	BD	1	300	240	
2008-10-14	26			07:04:25	BD	1	500	220	
2008-10-14	26	0837 to 0937	8:37:09 to 8:42:09	08:39:00	BD	1	800	335	
2008-10-14	26		9:52:09 to 9:57:09	09:52:22	BD	1	450	65	
2008-10-14	26			08:41:56	I	1	150	285	

Table K-2 (*continued*). TI-VPR data from fall 2008 offshore. NTD = no targets detected, UTV = unable to view, FOG = foggy condition, CLOUDS = cloudy conditions, LOW = target too low in beam.

Date	Grid	Timeframe (UTC)	5-min sample	Target start	ID	Count	Altitude	Direction	Comments
2008-10-14	26		09:32:09 to 9:37:09	09:33:39	I	1		305	
2008-10-14	26			09:55:06	I	1		315	LOW
2008-10-14	26			09:55:39	I	1		315	LOW
2008-10-14	26	0337 to 0437	3:47:09 to 3:52:09						CLOUDS
2008-10-14	26		3:52:09 to 3:57:09						CLOUDS
2008-10-14	26		4:12:09 to 4:17:09						CLOUDS
2008-10-14	26		7:07:09 to 7:12:09						NTD
2008-10-14	26		7:27:09 to 7:32:09						CLOUDS
2008-10-14	26	0737 to 0837	7:42:09 to 7:47:09						NTD
2008-10-14	26		8:02:09 to 8:07:09						CLOUDS
2008-10-14	26		8:07:09 to 8:12:09						CLOUDS
2008-10-14	26		8:22:09 to 8:27:09						NTD
2008-10-14	26		9:02:09 to 9:07:09						CLOUDS
2008-10-14	26		09:07:09 to 09:12:09						
2008-10-14	26	0937 to 1037	9:47:09 to 9:52:09						
2008-10-14	26		10:12:09 to 10:17:09						CLOUDS
2008-10-14	26		10:27:09 to 10:32:09						NTD
2008-10-14	26	1037 to 1107	10:47:09 to 10:52:09						CLOUDS
2008-10-14	26		10:57:09 to 11:02:09						CLOUDS
2008-10-14	26		11:17:09 to 11:22:09						CLOUDS
2008-10-14	26		11:32:09 to 11:37:09						NTD
2008-10-15	26	2051 to 2151	20:56:21 to 21:01:21	20:57:01	I	1		310	LOW
2008-10-15	26	2151 to 2251	21:51:21 to 21:56:21	21:55:18	I	1		330	LOW
2008-10-15	26		22:06:21 to 22:11:21	21:10:52	I	1		345	LOW
2008-10-15	26		21:06:21 to 21:11:21						NTD
2008-10-15	26		21:21:22 to 21:26:22						NTD
2008-10-15	26		21:36:21 to 21:41:21						NTD
2008-10-15	26		22:26:21 to 22:31:21						NTD
2008-10-15	26		22:41:21 to 22:46:21						NTD

Table K-2 (*continued*). TI-VPR data from fall 2008 offshore. NTD = no targets detected, UTV = unable to view, FOG = foggy condition, CLOUDS = cloudy conditions, LOW = target too low in beam.

Date	Grid	Timeframe (UTC)	5-min sample	Target start	ID	Count	Altitude	Direction	Comments
2008-10-15	26	2251 to 2351	23:01:21 to 23:06:21						NTD
2008-10-15	26		23:11:21 to 23:16:21						NTD
2008-10-15	26		23:21:21 to 23:26:21						NTD
2008-10-15	26		23:36:21 to 23:41:21						NTD
2008-10-15	26	2351 to 0051	23:51:21 to 23:56:21						NTD
2008-10-16	26		00:11:21 to 00:16:21	00:13:30	BD	9	2100	205	
2008-10-16	26	0051 to 0151	00:56:21 to 01:01:21	00:58:09	BD	1	325	325	
2008-10-16	26		02:26:21 to 02:31:21	02:30:15	BD	1	450	330	
2008-10-16	26		02:36:21 to 02:41:21	02:37:06	BD	1	1500	235	
2008-10-16	26			02:40:12	BD	1	900	115	
2008-10-16	26		03:06:21 to 03:11:21	03:07:24	BD	1	300	270	
2008-10-16	26			03:07:33	BD	1	1775	195	
2008-10-16	26	0351 to 0451	04:01:21 to 04:06:21	04:01:57	BD	1	1750	295	
2008-10-16	26		04:26:21 to 04:31:21	04:26:43	BD	1	150	300	
2008-10-16	26			04:29:58	BD	1	925	140	
2008-10-16	26		04:36:21 to 04:41:21	04:39:06	BD	1	225	330	
2008-10-16	26		01:26:21 to 01:31:21	01:28:03	I	1		315	
2008-10-16	26	0251 to 0351	03:01:21 to 03:06:21	03:01:38	I	1		35	
2008-10-16	26			03:05:28	I	1		0	
2008-10-16	26		03:26:21 to 03:31:21	03:31:06	I	1		30	
2008-10-16	26		03:46:21 to 03:51:21	05:51:01	I	1		10	
2008-10-16	26			04:02:27	I	1		15	
2008-10-16	26			04:29:06	I	1		350	
2008-10-16	26		1625 to 1630	16:29:20	I	1			LOW
2008-10-16	26		1735 to 1740	17:37:58	I	1			
2008-10-16	26	18:00 to 20:00	1805 to 1810	18:08:06	I	1			LOW
2008-10-16	26		00:31:21 to 00:36:21						NTD
2008-10-16	26		00:46:21 to 00:51:21						NTD
2008-10-16	26		01:06:21 to 01:11:21						

Table K-2 (*continued*). TI-VPR data from fall 2008 offshore. NTD = no targets detected, UTV = unable to view, FOG = foggy condition, CLOUDS = cloudy conditions, LOW = target too low in beam.

Date	Grid	Timeframe (UTC)	5-min sample	Target start	ID	Count	Altitude	Direction	Comments
2008-10-16	26		01:46:21 to 01:51:21						
2008-10-16	26	0151 to 0251	01:51:21 to 01:56:21						
2008-10-16	26		02:16:21 to 02:21:21						
2008-10-16	26		04:11:21 to 04:16:21						
2008-10-16	26	16:00 to 18:00	1610 to 1615						NTD
2008-10-16	26		1635 to 1640						CLOUDS
2008-10-16	26		1645 to 1650						NTD
2008-10-16	26		1710 to 1715						NTD
2008-10-16	26		1725 to 1730						NTD
2008-10-16	26		1750 to 1755						NTD
2008-10-16	26		1825 to 1830						NTD
2008-10-16	26		1835 to 1840						NTD
2008-10-16	26		1850 to 1855						NTD
2008-10-16	26		1910 to 1915						NTD
2008-10-16	26		1920 to 1925						NTD
2008-10-16	26		1940 to 1945						NTD
2008-10-16	26		1950 to 1955						CLOUDS
2008-10-16	26	20:00 to 22:00	2000 to 2005						CLOUDS
2008-10-16	26		2025 to 2030						CLOUDS
2008-10-16	26		2035 to 2040						CLOUDS
2008-10-16	26		2050 to 2055						CLOUDS
2008-10-16	26		2100 to 2105						CLOUDS
2008-10-16	26		2120 to 2125						CLOUDS
2008-10-16	26		2135 to 2140						CLOUDS
2008-10-16	26		2150 to 2155						CLOUDS
2008-10-16	26	22:00 to 00:00	2210 to 2215						CLOUDS
2008-10-16	26		2215 to 2220						CLOUDS
2008-10-16	26		2030 to 2035						CLOUDS
2008-10-16	26		2045 to 2050						CLOUDS

Table K-2 (*continued*). TI-VPR data from fall 2008 offshore. NTD = no targets detected, UTV = unable to view, FOG = foggy condition, CLOUDS = cloudy conditions, LOW = target too low in beam.

Date	Grid	Timeframe (UTC)	5-min sample	Target start	ID	Count	Altitude	Direction	Comments
2008-10-16	26		2310 to 2315						CLOUDS
2008-10-16	26		2320 to 2325						CLOUDS
2008-10-16	26		2335 to 2340						CLOUDS
2008-10-16	26		2345 to 2350						CLOUDS
2008-10-17	26	12:05 to 14:05	1205 to 1210						CLOUDS
2008-10-17	26		1220 to 1225						CLOUDS
2008-10-17	26		1240 to 1245						CLOUDS
2008-10-17	26		1250 to 1255						CLOUDS
2008-10-17	26		1305 to 1310						CLOUDS
2008-10-17	26		1325 to 1330						CLOUDS
2008-10-17	26		1335 to 1340						CLOUDS
2008-10-17	26		1355 to 1400						CLOUDS
2008-10-17	26	14:05 to 16:05	1410 to 1415						CLOUDS
2008-10-17	26		1430 to 1435						CLOUDS
2008-10-17	26		1440 to 1445						CLOUDS
2008-10-17	26		1500 to 1505						CLOUDS
2008-10-17	26		1510 to 1515						CLOUDS
2008-10-17	26		1520 to 1525						CLOUDS
2008-10-17	26		1535 to 1540						CLOUDS
2008-10-17	26		1555 to 1600						CLOUDS
2008-10-17	26	16:05 to 18:05	1615 to 1620						CLOUDS
2008-10-17	26		1630 to 1635						CLOUDS
2008-10-17	26		1645 to 1650						CLOUDS
2008-10-17	26		1700 to 1705						CLOUDS
2008-10-17	26		1705 to 1710						CLOUDS
2008-10-17	26		1720 to 1725						CLOUDS
2008-10-17	26		1740 to 1745						CLOUDS
2008-10-17	26		1750 to 1755						CLOUDS
2008-10-17	26	18:05 to 20:05	1815 to 1820						CLOUDS

Table K-2 (*continued*). TI-VPR data from fall 2008 offshore. NTD = no targets detected, UTV = unable to view, FOG = foggy condition, CLOUDS = cloudy conditions, LOW = target too low in beam.

Date	Grid	Timeframe (UTC)	5-min sample	Target start	ID	Count	Altitude	Direction	Comments
2008-10-17	26		1825 to 1830						CLOUDS
2008-10-17	26		1845 to 1850						CLOUDS
2008-10-17	26		1850 to 1855						CLOUDS
2008-10-17	26		1915 to 1920						CLOUDS
2008-10-17	26		1920 to 1925						CLOUDS
2008-10-17	26		1945 to 1950						CLOUDS
2008-10-17	26		1950 to 1955						CLOUDS
2008-10-18	26	7:55 to 9:55	800 to 805						CLOUDS
2008-10-18	26		815 to 820						CLOUDS
2008-10-18	26		825 to 830						CLOUDS
2008-10-18	26		840 to 845						CLOUDS
2008-10-18	26		855 to 900						CLOUDS
2008-10-18	26		910 to 915						CLOUDS
2008-10-18	26		930 to 935						CLOUDS
2008-10-18	26		950 to 955						CLOUDS
2008-10-18	26	9:55 to 11:55	1005 to 1010						CLOUDS
2008-10-18	26		1010 to 1015						CLOUDS
2008-10-18	26		1035 to 1040						CLOUDS
2008-10-18	26		1045 to 1050						CLOUDS
2008-10-18	26		1105 to 1110						CLOUDS
2008-10-18	26		1120 to 1125						CLOUDS
2008-10-18	26		1130 to 1135						CLOUDS
2008-10-18	26		1145 to 1150						CLOUDS
2008-10-18	26	12:51 to 14:51	1256 to 1301						CLOUDS
2008-10-18	26		1311 to 1316						CLOUDS
2008-10-18	26		1326 to 1331						CLOUDS
2008-10-18	26		1336 to 1341						CLOUDS
2008-10-18	26		1351 to 1356						CLOUDS
2008-10-18	26		1406 to 1411						CLOUDS

Table K-2 (*continued*). TI-VPR data from fall 2008 offshore. NTD = no targets detected, UTV = unable to view, FOG = foggy condition, CLOUDS = cloudy conditions, LOW = target too low in beam.

Date	Grid	Timeframe (UTC)	5-min sample	Target start	ID	Count	Altitude	Direction	Comments
2008-10-18	26		1421 to 1426						CLOUDS
2008-10-18	26		1446 to 1451						CLOUDS
2008-10-18	26	14:51 to 15:51	1501 to 1506						CLOUDS
2008-10-18	26		1506 to 1511						CLOUDS
2008-10-18	26		1526 to 1531						CLOUDS
2008-10-18	26		1541 to 1546						CLOUDS
2008-10-19	26		551 to 556	05:55:46	BD	1			LOW
2008-10-19	26		411 to 416	04:12:56	I	1			LOW
2008-10-19	26	5:26 to 7:26	531 to 536	05:34:14	I	1			LOW
2008-10-19	26	3:26 to 5:26	326 to 331						CLOUDS
2008-10-19	26		351 to 356						CLOUDS
2008-10-19	26		356 to 401						CLOUDS
2008-10-19	26		436 to 441						CLOUDS
2008-10-19	26		441 to 446						CLOUDS
2008-10-19	26		506 to 511						CLOUDS
2008-10-19	26		511 to 516						CLOUDS
2008-10-19	26		601 to 606						CLOUDS
2008-10-19	26		616 to 621						CLOUDS
2008-10-19	26		626 to 631						CLOUDS
2008-10-19	26		641 to 646						CLOUDS
2008-10-19	26		706 to 711						CLOUDS
2008-10-19	26		716 to 721						CLOUDS
2008-10-19	26	7:26 to 9:26	736 to 741						CLOUDS
2008-10-19	26		741 to 746						CLOUDS
2008-10-19	26		806 to 811						CLOUDS
2008-10-19	26		811 to 816						CLOUDS
2008-10-19	26		826 to 831						CLOUDS
2008-10-19	26		846 to 851						CLOUDS
2008-10-19	26		856 to 901						CLOUDS

Table K-2 (*continued*). TI-VPR data from fall 2008 offshore. NTD = no targets detected, UTV = unable to view, FOG = foggy condition, CLOUDS = cloudy conditions, LOW = target too low in beam.

Date	Grid	Timeframe (UTC)	5-min sample	Target start	ID	Count	Altitude	Direction	Comments
2008-10-19	26		911 to 916						CLOUDS
2008-10-19	26	9:26 to 11:26	936 to 941						CLOUDS
2008-10-19	26		946 to 951						CLOUDS
2008-10-19	26		956 to 1001						CLOUDS
2008-10-19	26		1016 to 1021						CLOUDS
2008-10-19	26		1031 to 1036						CLOUDS
2008-10-19	26		1041 to 1046						CLOUDS
2008-10-19	26		1056 to 1101						CLOUDS
2008-10-19	26		1111 to 1116						CLOUDS

Table K-3. TI-VPR data from spring 2009 offshore. NTD = no targets detected, CLOUDS = cloudy condition, LOW = target too low in beam.

Date	Location	Timeframe (UTC)	5-min sample	Target start	ID	Count	Altitude	Direction	Comments
2009-05-12	Grid 16	00:10 to 02:10	00:20 to 00:25						NTD
2009-05-12			00:35 to 00:40						NTD
2009-05-12			00:45 to 00:50	00:46:03	BD	1		340	
2009-05-12			1:00 to 1:05						NTD
2009-05-12			1:15 to 1:20						NTD
2009-05-12			1:35 to 1:40						NTD
2009-05-12			1:50 to 1:55	1:50:05	I	1	275	10	
2009-05-12			1:55 to 2:00						NTD
2009-05-12	Grid 16	2:15 to 4:15	2:20 to 2:25	2:23:17	I	1		0	
2009-05-12			2:30 to 2:35	2:33:48	BD	1	400	0	
2009-05-12			2:55 to 3:00	2:55:25	BD	1	400	20	
2009-05-12				2:56:54	BD	1	375	10	
2009-05-12				2:57:19	BD	1	300	20	
2009-05-12				2:57:42	BD	1	275	10	
2009-05-12				2:57:47	BD	1	275	30	
2009-05-12				2:57:57	BD	1	300	10	
2009-05-12				2:58:52	I	1		15	LOW
2009-05-12			3:05 to 3:10	3:05:50	I	1		10	LOW
2009-05-12				3:06:07	BD	1	300	35	
2009-05-12				3:06:43	I	1		40	LOW
2009-05-12				3:06:47	I	1		5	LOW
2009-05-12				3:06:54	BD	1	300	10	
2009-05-12				3:07:15	BD	1	600	30	
2009-05-12			3:15 to 3:20						CLOUDS
2009-05-12			3:30 to 3:35						CLOUDS
2009-05-12			3:45 to 3:50	3:46:13	BD	1	850	10	
2009-05-12				3:49:39	BD	1	650	25	
2009-05-12			4:00 to 4:05	4:00:16	I	1		330	LOW

Table K-3 (*continued*). TI-VPR data from spring 2009 offshore. NTD = no targets detected, CLOUDS = cloudy condition, LOW = target too low in beam.

Date	Location	Timeframe (UTC)	5-min sample	Target start	ID	Count	Altitude	Direction	Comments
2009-05-12	Grid 16	4:20 to 6:20	4:25 to 4:30						NTD
2009-05-12			4:35 to 4:40						NTD
2009-05-12			4:50 to 4:55	4:53:47	I	1		305	LOW
2009-05-12			5:05 to 5:10						NTD
2009-05-12			5:30 to 5:35	5:32:00	I	1	300	215	LOW
2009-05-12			5:40 to 5:45	5:41:41	I	1		310	LOW
2009-05-12				5:42:39	I	1		5	LOW
2009-05-12			5:50 to 5:55						CLOUDS
2009-05-12			6:15 to 6:20						NTD
2009-05-12	Grid 16	6:25 to 8:25	6:35 to 6:40						
2009-05-12			6:45 to 6:50	6:46:57	I	1		355	LOW
2009-05-12				6:49:13	I	1		210	LOW
2009-05-12				6:49:38	I	1		330	LOW
2009-05-12			7:05 to 7:10	7:07:20	I	1		215	LOW
2009-05-12			7:25 to 7:40						NTD
2009-05-12			7:40 to 7:45	7:44:54	I	1		335	LOW
2009-05-12			8:05 to 8:10	8:07:23	I	1		340	LOW
2009-05-12				8:08:38	I	1		290	LOW
2009-05-12			8:20 to 8:25						NTD
2009-05-12	Grid 16	9:50 to 11:50	9:50 to 9:55						CLOUDS
2009-05-12			10:10 to 10:15						CLOUDS
2009-05-12			10:20 to 10:25						CLOUDS
2009-05-12			10:45 to 10:50						CLOUDS
2009-05-12			11:00 to 11:05						NTD
2009-05-12			11:10 to 11:15						NTD
2009-05-12			11:30 to 11:35	11:32:28	I	1		variable	LOW
2009-05-12			11:45 to 11:50						NTD
2009-05-13	Grid 22	00:00 to 2:00	00:10 to 00:15						NTD
2009-05-13			00:20 to 00:25						NTD

Table K-3 (*continued*). TI-VPR data from spring 2009 offshore. NTD = no targets detected, CLOUDS = cloudy condition, LOW = target too low in beam.

Date	Location	Timeframe (UTC)	5-min sample	Target start	ID	Count	Altitude	Direction	Comments
2009-05-13	Grid 22	00:00 to 2:00	00:40 to 00:45						NTD
2009-05-13			00:55 to 1:00						NTD
2009-05-13			1:05 to 1:10						NTD
2009-05-13			1:20 to 1:25						NTD
2009-05-13			1:30 to 1:35						NTD
2009-05-13			1:45 to 1:50						NTD
2009-05-13	Grid 22	2:05 to 3:05	2:10 to 2:15						NTD
2009-05-13			2:30 to 2:35	2:30:31	I	1		20	
2009-05-13				2:32:07	I	1		350	
2009-05-13			2:40 to 2:45	2:41:43	I	1		30	
2009-05-13				2:43:46	BD	1	425	25	
2009-05-13				2:44:14	BD	1	750	40	
2009-05-13			3:00 to 3:05	3:01:16	BD	1	150	20	
2009-05-13			3:15 to 3:20	3:17:27	BD	1	1050	50	
2009-05-13			3:30 to 3:35	3:31:05	BD	1	575	40	
2009-05-13				3:31:16	BD	1	425	30	
2009-05-13			3:45 to 3:50						NTD
2009-05-13			3:55 to 4:00	3:58:16	BD	1	675	10	
2009-05-13	Grid 22	4:10 to 6:10	4:20 to 4:25	4:22:14	BD	1	525	25	
2009-05-13				4:22:30	I	1		315	
2009-05-13				4:22:46	BD	1	300	50	
2009-05-13			4:35 to 4:40	4:37:49	BD	1	300	10	
2009-05-13			4:50 to 4:55						NTD
2009-05-13			5:00 to 5:05	5:02:14	BD	1	275	25	
2009-05-13			5:20 to 5:25	5:22:41	I	1		275	
2009-05-13				5:23:06	BD	1	275	15	
2009-05-13			5:25 to 5:30	5:25:36	BD	1	325	10	
2009-05-13			5:50 to 5:55	5:50:53	I	1		15	
2009-05-13			6:00 to 6:05						NTD

Table K-4. TI-VPR data for fall 2008 Sea Isle City, New Jersey. NTD = no targets detected, CLOUDS = cloudy condition, LOW = target too low in beam.

Date	Timeframe (UTC)	5-min sample	Target start	ID	Count	Altitude	Direction	Comments
2008-12-08	22:00 to 23:00	22:00 to 2205						CLOUDS
2008-12-08		2220 to 2225						CLOUDS
2008-12-08		2235 to 2240						CLOUDS
2008-12-08		2245 to 2250						CLOUDS
2008-12-08	23:00 to 00:00	2310 to 2315						CLOUDS
2008-12-08		2315 to 2320						CLOUDS
2008-12-08		2335 to 2340						CLOUDS
2008-12-08		2355 to 00:00						CLOUDS
2008-12-09	00:00 to 01:00	0005 to 0010						CLOUDS
2008-12-09		0025 to 0030						CLOUDS
2008-12-09		0030 to 0035						CLOUDS
2008-12-09		0055 to 01:00						CLOUDS
2008-12-09	01:00 to 02:00	01:00 to 0105						CLOUDS
2008-12-09		0115 to 0120						CLOUDS
2008-12-09		0130 to 0135						CLOUDS
2008-12-09		0150 to 0155						CLOUDS
2008-12-09	02:00 to 03:00	0205 to 0210						CLOUDS
2008-12-09		0225 to 0230	02:26:39	BD	1	625	190	
2008-12-09		0230 to 0235						CLOUDS
2008-12-09		0255 to 03:00						CLOUDS
2008-12-09	03:00 to 04:00	0310 to 0315						CLOUDS
2008-12-09		0320 to 0325						CLOUDS
2008-12-09		0335 to 0340						CLOUDS
2008-12-09		0345 to 0350						CLOUDS
2008-12-09	04:00 to 05:00	0410 to 0415						CLOUDS
2008-12-09		0415 to 0420						CLOUDS
2008-12-09		0435 to 0440						CLOUDS
2008-12-09		0445 to 0450						CLOUDS
2008-12-09	05:00 to 06:00	05:00 to 0505						CLOUDS

Table K-4 (*continued*). TI-VPR data for fall 2008 Sea Isle City, New Jersey. NTD = no targets detected, CLOUDS = cloudy condition, LOW = target too low in beam.

Date	Timeframe (UTC)	5-min sample	Target start	ID	Count	Altitude	Direction	Comments
2008-12-09		0520 to 0525						CLOUDS
2008-12-09		0540 to 0545						NTD
2008-12-09		0555 to 06:00						NTD
2008-12-09	18:41 to 19:41	1851 to 1856						CLOUDS
2008-12-09		1856 to 1901						CLOUDS
2008-12-09		1916 to 1921						CLOUDS
2008-12-09		1926 to 1931						CLOUDS
2008-12-09	19:41 to 20:41	1946 to 1951						CLOUDS
2008-12-09		1951 to 1956						CLOUDS
2008-12-09		1956 to 2001						CLOUDS
2008-12-09		2021 to 2026						CLOUDS
2008-12-09	21:21 to 23:21	2121 to 2126						CLOUDS
2008-12-09		2141 to 2146						CLOUDS
2008-12-09		2151 to 2156						CLOUDS
2008-12-09		2211 to 2216						CLOUDS
2008-12-09		2226 to 2231						CLOUDS
2008-12-09		2241 to 2246						CLOUDS
2008-12-09		2251 to 2256						CLOUDS
2008-12-09		2311 to 2316						CLOUDS
2008-12-09	23:21 to 01:21	2331 to 2336						CLOUDS
2008-12-09		2341 to 2346						CLOUDS
2008-12-09		2356 to 0001						CLOUDS
2008-12-10		0006 to 0011						CLOUDS
2008-12-10		0026 to 0031						CLOUDS
2008-12-10		0046 to 0051						CLOUDS
2008-12-10		0051 to 0056						CLOUDS
2008-12-10		0106 to 0111						CLOUDS
2008-12-13	02:19 to 03:19	0219 to 0224	02:20:50	BD	4	875	135	
2008-12-13			02:20:50	BD	1	248	210	

Table K-4 (*continued*). TI-VPR data for fall 2008 Sea Isle City, New Jersey. NTD = no targets detected, CLOUDS = cloudy condition, LOW = target too low in beam.

Date	Timeframe (UTC)	5-min sample	Target start	ID	Count	Altitude	Direction	Comments
2008-12-13			02:21:12	BD	1	650	185	
2008-12-13			02:22:05	BD	1	200	170	
2008-12-13			02:22:06	BD	1	1050	175	
2008-12-13			02:23:32	BD	1	500	355	
2008-12-13			02:23:55	BD	1	350	310	
2008-12-13			02:24:18	BD	1	1050	180	
2008-12-13		0244 to 249	02:44:44	BD	1	600	165	
2008-12-13			02:46:02	BD	1	150	285	
2008-12-13			02:47:23	BD	1	2000	155	
2008-12-13			02:47:37	BD	1	950	165	
2008-12-13			02:48:22	BD	1	525	70	
2008-12-13			02:48:48	BD	1	575	170	
2008-12-13		259 to 304	02:59:37	BD	1	1100	185	
2008-12-13			03:00:18	BD	1	150	290	
2008-12-13			03:00:24	BD	1	300	190	
2008-12-13			03:00:44	BD	1	975	155	
2008-12-13			03:00:54	BD	1	150	180	
2008-12-13			03:02:26	BD	1	575	120	
2008-12-13			03:03:40	BD	1	1500	180	
2008-12-13		314 to 319	03:15:18	BD	1	225	180	
2008-12-13			03:17:54	BD	1	300	210	
2008-12-13			03:18:53	I	1	200	100	
2008-12-13	03:19 to 04:19	319 to 324	03:19:52	BD	1	550	185	
2008-12-13			03:20:21	BD	1	275	195	
2008-12-13			03:21:57	BD	1	300	185	
2008-12-13			03:22:06	BD	1	300	135	
2008-12-13			03:22:53	BD	1	475	190	
2008-12-13		339 to 344	03:43:23	BD	1	500	190	
2008-12-13		349 to 344	03:49:27	BD	1	600	180	

Table K-4 (*continued*). TI-VPR data for fall 2008 Sea Isle City, New Jersey. NTD = no targets detected, CLOUDS = cloudy condition, LOW = target too low in beam.

Date	Timeframe (UTC)	5-min sample	Target start	ID	Count	Altitude	Direction	Comments
2008-12-13			03:50:19	BD	1	325	170	
2008-12-13			03:52:10	BD	1	875	80	
2008-12-13		0404 to 0409	04:05:15	BD	1	300	215	
2008-12-13			04:08:05	BD	1	125	220	
2008-12-13			04:08:24	BD	1	275		
2008-12-13	04:19 to 05:19	419 to 424	04:21:51	BD	1	200	280	
2008-12-13			04:22:09	BD	1	450	170	
2008-12-13			04:22:58	BD	1	625	180	
2008-12-13		439 to 444	04:42:15	BD	1		180	
2008-12-13			04:43:25	BD	1	1050	165	
2008-12-13		449 to 454	04:51:19	BD	1	400	195	
2008-12-13			04:51:43	BD	1	650	190	
2008-12-13			04:51:46	BD	1	900	150	
2008-12-13		509 to 514	05:11:30	BD	1		180	
2008-12-13			05:13:22	BD	1	200	355	
2008-12-13			05:13:36	BD	1	500	100	
2008-12-13	05:19 to 06:19	524 to 529	05:25:28	BD	1	400	190	
2008-12-13			05:28:44	BT	1	625	185	
2008-12-13		544 to 549	05:44:39	BD	1	525	210	
2008-12-13		549 to 554	05:49:33	BD	1	575	200	
2008-12-13			05:52:38	BT	1	1550	175	
2008-12-13		614 to 619						NTD
2008-12-13	06:19 to 07:19	619 to 624	06:21:30	BD	1	550	175	
2008-12-13		644 to 649						NTD
2008-12-13		659 to 704	07:01:16	BD	1	450	185	
2008-12-13			07:02:10	BD	1	700	175	
2008-12-13		709 to 714						NTD
2008-12-13	07:19 to 08:19	719 to 724	07:20:16	BD	1	300	195	
2008-12-13			07:20:22	BD	1	700	175	

Table K-4 (*continued*). TI-VPR data for fall 2008 Sea Isle City, New Jersey. NTD = no targets detected, CLOUDS = cloudy condition, LOW = target too low in beam.

Date	Timeframe (UTC)	5-min sample	Target start	ID	Count	Altitude	Direction	Comments
2008-12-13		739 to 744						NTD
2008-12-13		749 to 754						NTD
2008-12-13		814 to 819						NTD
2008-12-13	08:19 to 09:19	824 to 829						NTD
2008-12-13		844 to 849	08:46:15	BD	1	275	170	
2008-12-13		849 to 854	08:49:32	BD	1	625	150	
2008-12-13		904 to 909						NTD
2008-12-13		929 to 934						NTD
2008-12-13		944 to 949						NTD
2008-12-13		949 to 954						NTD
2008-12-13		1004 to 1009						NTD
2008-12-13	12:19 to 13:19	1249 to 1254	12:52:05	BD	8	325	180	
2008-12-13		1314 to 1319						NTD
2008-12-13	13:19 to 14:19	1324 to 1329	13:29:15	BD	1		135	
2008-12-13			13:29:21	BD	1		140	
2008-12-13			13:29:23	BD	1		280	
2008-12-13		1339 to 1344						NTD
2008-12-13		1359 to 1404	14:04:49	BD	2		165	
2008-12-13		1404 to 1409						NTD
2008-12-13	14:19 to 15:19	1419 to 1424	14:21:23	BD	2		70	
2008-12-13		1444 to 1449						NTD
2008-12-13		1509 to 1514	15:10:25	BD	5	1300	215	
2008-12-13		1529 to 1534						NTD
2008-12-13		1534 to 1539						NTD
2008-12-13		1554 to 1559						NTD
2008-12-13		1609 to 1614	16:11:15	BD	1	300	65	
2008-12-13			16:12:22	BD	1	300		
2008-12-13	16:19 to 17:19	1624 to 1629						NTD
2008-12-13		1634 to 1639						NTD

Table K-4 (*continued*). TI-VPR data for fall 2008 Sea Isle City, New Jersey. NTD = no targets detected, CLOUDS = cloudy condition, LOW = target too low in beam.

Date	Timeframe (UTC)	5-min sample	Target start	ID	Count	Altitude	Direction	Comments
2008-12-13		1654 to 1659						NTD
2008-12-13		1709 to 1714						NTD
2008-12-13		1729 to 1734						NTD
2008-12-13		1744 to 1749						NTD
2008-12-13		1754 to 1759						NTD
2008-12-13		1804 to 1809	18:05:21	BD	1		245	
2008-12-13	18:19 to 19:19	1819 to 1824						NTD
2008-12-13		1839 to 1844						NTD
2008-12-13		1859 to 1904						NTD
2008-12-13		1909 to 1914	19:10:56	I	1		135	
2008-12-13		1924 to 1929	19:27:11	BD	1	275	180	
2008-12-13			19:27:12	BD	1	175	175	
2008-12-13		1939 to 1944						NTD
2008-12-13		1949 to 1954	19:51:45	BD	1	200	350	
2008-12-13			19:53:27	BD	1	800	205	
2008-12-13		2004 to 2009	20:08:44	BD	3	575		
2008-12-13	20:19 to 21:19	2024 to 2029	20:23:38	I	1		55	
2008-12-13		2034 to 2039						NTD
2008-12-14	9:21 to 11:21	921 to 926						CLOUDS
2008-12-14		946 to 951						CLOUDS
2008-12-14		951 to 956						CLOUDS
2008-12-14		1006 to 1011						CLOUDS
2008-12-14		1026 to 1031						CLOUDS
2008-12-14		1046 to 1051						CLOUDS
2008-12-14		1051 to 1056						CLOUDS
2008-12-14		1116 to 1121						CLOUDS
2008-12-14	11:21 to 13:21	1131 to 1136						CLOUDS
2008-12-14		1141 to 1146						CLOUDS
2008-12-14		1151 to 1156						CLOUDS

Table K-4 (*continued*). TI-VPR data for fall 2008 Sea Isle City, New Jersey. NTD = no targets detected, CLOUDS = cloudy condition, LOW = target too low in beam.

Date	Timeframe (UTC)	5-min sample	Target start	ID	Count	Altitude	Direction	Comments
2008-12-14		1206 to 1211						CLOUDS
2008-12-14		1226 to 1231						CLOUDS
2008-12-14		1236 to 1241						CLOUDS
2008-12-14		1301 to 1306						CLOUDS
2008-12-14		1306 to 1311						CLOUDS
2008-12-14	13:21 to 15:21	1321 to 1326						CLOUDS
2008-12-14		1346 to 1351						CLOUDS
2008-12-14		1356 to 1401						CLOUDS
2008-12-14		1411 to 1416						NTD
2008-12-14		1426 to 1431						NTD
2008-12-14		1441 to 1446						NTD
2008-12-14		1456 to 1501						NTD
2008-12-14		1506 to 1511						NTD
2008-12-14	15:21 to 17:21	1526 to 1531						NTD
2008-12-14		1536 to 1541						NTD
2008-12-14		1551 to 1556						NTD
2008-12-14		1611 to 1616						NTD
2008-12-14		1631 to 1636						CLOUDS
2008-12-14		1646 to 1651						CLOUDS
2008-12-14		1651 to 1656						CLOUDS
2008-12-14		1706 to 1711						CLOUDS
2008-12-15	5:04 to 7:04	509 to 514						CLOUDS
2008-12-15		519 to 524						CLOUDS
2008-12-15		539 to 544						CLOUDS
2008-12-15		559 to 604						CLOUDS
2008-12-15		604 to 609						CLOUDS
2008-12-15		619 to 624						CLOUDS
2008-12-15		634 to 639						CLOUDS
2008-12-15		659 to 704						CLOUDS

Table K-4 (*continued*). TI-VPR data for fall 2008 Sea Isle City, New Jersey. NTD = no targets detected, CLOUDS = cloudy condition, LOW = target too low in beam.

Date	Timeframe (UTC)	5-min sample	Target start	ID	Count	Altitude	Direction	Comments
2008-12-15	7:04 to 9:04	714 to 719						CLOUDS
2008-12-15		724 to 729						CLOUDS
2008-12-15		734 to 739						CLOUDS
2008-12-15		749 to 754						CLOUDS
2008-12-15		804 to 809						CLOUDS
2008-12-15		819 to 824						CLOUDS
2008-12-15		839 to 844						CLOUDS
2008-12-15		854 to 859						CLOUDS
2008-12-15	9:04 to 11:04	9:04 to 9:09						CLOUDS
2008-12-15		9:19 to 9:24						CLOUDS
2008-12-15		9:34 to 9:39						CLOUDS
2008-12-15		9:54 to 9:59						CLOUDS
2008-12-15		10:14 to 10:19						CLOUDS
2008-12-15		10:29 to 10:34						CLOUDS
2008-12-15		10:39 to 10:44						CLOUDS
2008-12-15		10:59 to 11:04						CLOUDS
2008-12-15	11:04 to 13:04	11:09 to 11:14						CLOUDS
2008-12-15		11:19 to 11:24						CLOUDS
2008-12-15		11:44 to 11:49						CLOUDS
2008-12-15		11:49 to 11:54						CLOUDS
2008-12-15		12:09 to 12:14						CLOUDS
2008-12-15		12:29 to 12:34						CLOUDS
2008-12-15		12:39 to 12:44						CLOUDS
2008-12-15		12:59 to 13:04						CLOUDS

Table K-5. TI-VPR data for spring 2009 Island Beach State Park, New Jersey. NTD = no targets detected, CLOUDS = cloudy condition, LOW = target too low in beam.

Date	Timeframe (UTC)	5-min sample	Target start	ID	Count	Altitude	Direction	Comments
2009-03-21	23:01 to 01:10	23:10 to 23:15						CLOUDS
2009-03-21		23:20 to 23:25						CLOUDS
2009-03-21		23:30 to 23:35						CLOUDS
2009-03-21		23:45 to 23:50						CLOUDS
2009-03-21		00:00 to 00:05						CLOUDS
2009-03-21		00:20 to 00:25						CLOUDS
2009-03-21		00:35 to 00:40						CLOUDS
2009-03-21		00:55 to 1:00						CLOUDS
2009-03-21	1:10 to 3:10	1:19 to 1:24						CLOUDS
2009-03-21		1:34 to 1:39						CLOUDS
2009-03-21		1:49 to 1:54						CLOUDS
2009-03-21		1:54 to 1:59						CLOUDS
2009-03-21		2:09 to 2:14						CLOUDS
2009-03-21		2:29 to 2:34						CLOUDS
2009-03-21		2:44 to 2:49						CLOUDS
2009-03-21		2:59 to 3:04						CLOUDS
2009-03-21	16:00 to 18:00	16:01 to 16:06						NTD
2009-03-21		16:16 to 16:21						NTD
2009-03-21		16:41 to 16:46						NTD
2009-03-21		16:46 to 16:51						NTD
2009-03-21		17:06 to 17:11	17:06:20	I	1		295	
2009-03-21			17:07:57	I	1		200	
2009-03-21			17:10:35	BD	1	1175	110	
2009-03-21			17:10:57	BD	1	2050	50	
2009-03-21		17:26 to 17:31						CLOUDS
2009-03-21		17:41 to 17:46	17:45:00	BD	1	1500	70	
2009-03-21			17:45:18	BD	1	1400	30	
2009-03-21		17:51 to 17:56	17:51:57	I	1		230	
2009-03-21			17:52:44	BD	1	1200	30	

Table K-5 (*continued*). TI-VPR data for spring 2009 Island Beach State Park, New Jersey. NTD = no targets detected, CLOUDS = cloudy condition, LOW = target too low in beam.

Date	Timeframe (UTC)	5-min sample	Target start	ID	Count	Altitude	Direction	Comments
2009-03-21			17:52:47	I	1		270	
2009-03-21			17:53:24	BD	1	1675	340	
2009-03-21			17:54:08	I	1		300	
2009-03-21			17:54:21	I	1		10	
2009-03-21			17:54:22	I	1		variable	
2009-03-21			17:54:42	I	1		variable	
2009-03-21	18:05 to 20:05	18:04:30 to 18:09:30						CLOUDS
2009-03-21		18:24:30 to 18:29:30						CLOUDS
2009-03-21		18:39:30 to 18:44:30	18:41:36	I	1		145	
2009-03-21		18:54:30 to 18:59:30						CLOUDS
2009-03-21		19:09:30 to 19:14:30						CLOUDS
2009-03-21		19:24:30 to 19:29:30						CLOUDS
2009-03-21		19:34:30 to 19:39:30	19:36:38	I	1		5	
2009-03-21			19:37:04	I	1		245	
2009-03-21			19:39:12	BD	1	1750	5	
2009-03-21		19:54:30 to 19:59:30						CLOUDS
2009-03-27	23:45 to 1:45	23:49:30 to 23:54:30						CLOUDS
2009-03-27		00:04:30 to 00:09:30						CLOUDS
2009-03-27		00:19:30 to 00:24:30						CLOUDS
2009-03-27		00:34:30 to 00:39:30						CLOUDS
2009-03-27		00:54:30 to 00:59:30						CLOUDS
2009-03-27		1:09:30 to 1:14:30						CLOUDS
2009-03-27		1:24:30 to 1:29:30						CLOUDS
2009-03-27		1:39:30 to 1:44:30						CLOUDS

Table K-6. TI-VPR data for fall 2009 over Island Beach State Park, Brigantine Beach and Sea Isle City, New Jersey. NTD = no targets detected, CLOUDS = cloudy condition, LOW = target too low in beam.

Date	Location	Timeframe (UTC)	5-min sample	Target start	ID	Count	Altitude	Direction	Comments
2009-09-19	IBSP	23:27 to 00:27	23:32 to 23:37	23:33:07	I	1		0	
2009-09-19	IBSP			23:34:10	I	1	250	235	
2009-09-19	IBSP			23:34:56	I	1		variable	
2009-09-19	IBSP			23:35:11	I	1		10	
2009-09-19	IBSP			23:35:28	I	1	275	variable	
2009-09-19	IBSP		23:52 to 23:57	23:53:48	BD	1	300	240	
2009-09-19	IBSP			23:53:54	I	1		220	
2009-09-19	IBSP			23:54:44	I	1		5	
2009-09-19	IBSP			23:55:32	BD	1	1700	40	
2009-09-19	IBSP			23:56:29	BD	1	1125	25	
2009-09-19	IBSP			23:56:40	I	1		10	
2009-09-19	IBSP			23:56:56	BT	1	625	10	
2009-09-19	IBSP		00:07 to 00:12	00:07:31	BD	1	575	35	
2009-09-19	IBSP			00:07:54	BD	1	650	5	
2009-09-19	IBSP			00:10:52	BD	1	825	0	
2009-09-19	IBSP			00:11:06	I	1		5	
2009-09-19	IBSP			00:11:21	BD	1	300	30	
2009-09-19	IBSP		00:12 to 00:17	00:12:31	BD	1	2175	180	
2009-09-19	IBSP			00:13:18	BD	1	825	350	
2009-09-19	IBSP			00:13:25	I	1		variable	
2009-09-19	IBSP			00:14:42	BD	1	875	125	
2009-09-19	IBSP			00:14:50	BD	1	850	35	
2009-09-19	IBSP			00:15:09	I	1		30	
2009-09-19	IBSP			00:15:54	BD	1	625	350	
2009-09-19	IBSP			00:16:17	I	1		210	
2009-09-19	IBSP	00:33 to 01:33	00:34 to 00:39	00:35:51	I	1		variable	
2009-09-19	IBSP			00:35:57	BD	1	1075	345	
2009-09-19	IBSP			00:36:29	BD	1	500	170	
2009-09-19	IBSP			00:36:46	BD	1	2025	190	

Table K-6 (*continued*). TI-VPR data for fall 2009 over Island Beach State Park, Brigantine Beach and Sea Isle City, New Jersey. NTD = no targets detected, CLOUDS = cloudy condition, LOW = target too low in beam.

Date	Location	Timeframe (UTC)	5-min sample	Target start	ID	Count	Altitude	Direction	Comments
2009-09-19	IBSP			00:37:23	BT	1	1500	35	
2009-09-19	IBSP		00:54 to 00:59	00:54:15	BD	1		190	
2009-09-19	IBSP			00:55:12	BD	1	1200	185	
2009-09-19	IBSP			00:57:33	BD	1	1550	180	
2009-09-19	IBSP		1:09:00 to 1:14:00	1:10:43	BD	1	750	175	
2009-09-19	IBSP			1:10:43	BD	1	950	180	
2009-09-19	IBSP			1:10:46	I	1		15	
2009-09-19	IBSP			1:12:45	BD	1	850	180	
2009-09-19	IBSP			1:13:32	BD	1	525	10	
2009-09-19	IBSP			1:13:50	BD	1	1125	180	
2009-09-19	IBSP			1:13:55	I	1		30	
2009-09-19	IBSP			1:13:56	BD	1	350	195	
2009-09-19	IBSP		1:29:00 to 1:34:00	1:29:08	BD	1	550	200	
2009-09-19	IBSP			1:29:30	BD	1	950	185	
2009-09-19	IBSP			1:29:33	BD	1	950	180	
2009-09-19	IBSP			1:30:20	I	1		20	
2009-09-19	IBSP			1:30:29	I	1		340	
2009-09-19	IBSP			1:31:34	BD	1		160	
2009-09-19	IBSP			1:33:15	BD	1	1875	180	
2009-09-19	IBSP			1:33:40	BD	1	450	180	
2009-09-19	IBSP			1:33:57	BD	1	850	170	
2009-09-19	IBSP	1:39 to 2:39	1:49:30 to 1:54:30	1:51:59	BD	1	500	20	
2009-09-19	IBSP			1:52:25	BD	1	1225	variable	
2009-09-19	IBSP			1:53:41	BD	1	500	variable	
2009-09-19	IBSP			1:54:14	I	1		185	
2009-09-19	IBSP			1:54:24	I	1		55	
2009-09-19	IBSP		1:54:30 to 1:59:30	1:54:39	BD	1	300	190	
2009-09-19	IBSP			1:56:44	I	1		10	
2009-09-19	IBSP			1:56:52	BD	1	1200	175	

Table K-6 (*continued*). TI-VPR data for fall 2009 over Island Beach State Park, Brigantine Beach and Sea Isle City, New Jersey. NTD = no targets detected, CLOUDS = cloudy condition, LOW = target too low in beam.

Date	Location	Timeframe (UTC)	5-min sample	Target start	ID	Count	Altitude	Direction	Comments
2009-09-19	IBSP			1:57:53	BD	1	350	5	
2009-09-19	IBSP			1:58:20	BD	1	325	355	
2009-09-19	IBSP			1:58:21	BD	1	625	180	
2009-09-19	IBSP			1:58:26	I	1		30	
2009-09-19	IBSP			1:59:27	I	1		variable	
2009-09-19	IBSP			1:59:29	BD	1	175	25	
2009-09-19	IBSP		2:14:30 to 2:19:30	2:14:54	BD	1		5	
2009-09-19	IBSP			2:16:19	I	1		345	
2009-09-19	IBSP			2:18:17	BD	1	975	200	
2009-09-19	IBSP		2:29:30 to 2:34:30	2:30:16	BD	1	225	200	
2009-09-19	IBSP			2:31:46	BD	1	250	350	
2009-09-19	IBSP			2:31:58	BD	1	300	5	
2009-09-19	IBSP			2:32:44	BD	1	675	5	
2009-09-19	IBSP			2:33:11	BD	1	875	20	
2009-09-19	IBSP			2:34:09	BD	1	1025	175	
2009-10-20	Brigantine	23:55 to 00:55	0000 to 0005	00:04:09	I	1		0	
2009-10-20	Brigantine		0020 to 0025	00:20:41	BD	1	400	5	
2009-10-20	Brigantine			00:23:34	I	1		10	
2009-10-20	Brigantine			00:24:24	I	1		210	
2009-10-20	Brigantine		0030 to 0035	00:34:17	BD	1	825	205	
2009-10-20	Brigantine			00:34:44	BD	1	350	180	
2009-10-20	Brigantine		0045 to 0050	00:45:28	BD	1		160	
2009-10-20	Brigantine			00:45:33	BD	1	950	335	
2009-10-20	Brigantine			00:46:13	I	1		345	
2009-10-20	Brigantine	00:59 to 1:59	109 to 114	1:10:38	I	1		185	
2009-10-20	Brigantine			1:11:53	I	1		145	
2009-10-20	Brigantine			1:12:31	I	1		variable	
2009-10-20	Brigantine			1:14:04	I	1		110	
2009-10-20	Brigantine			1:14:40	I	1		200	

Table K-6 (*continued*). TI-VPR data for fall 2009 over Island Beach State Park, Brigantine Beach and Sea Isle City, New Jersey. NTD = no targets detected, CLOUDS = cloudy condition, LOW = target too low in beam.

Date	Location	Timeframe (UTC)	5-min sample	Target start	ID	Count	Altitude	Direction	Comments
2009-10-20	Brigantine		114 to 119	1:14:44	I	1		140	
2009-10-20	Brigantine			1:14:45	I	1		0	
2009-10-20	Brigantine			1:15:26	I	1		0	
2009-10-20	Brigantine			1:16:14	I	1		190	
2009-10-20	Brigantine			1:16:29	I	1		200	
2009-10-20	Brigantine			1:17:30	I	1		150	
2009-10-20	Brigantine			1:17:56	I	1		270	
2009-10-20	Brigantine			1:18:26	I	1		190	
2009-10-20	Brigantine			1:18:31	I	1		335	
2009-10-20	Brigantine			1:18:35	BD	1	875	185	
2009-10-20	Brigantine			1:19:11	I	1		5	
2009-10-20	Brigantine		134 to 139	1:35:32	I	1		160	
2009-10-20	Brigantine			1:35:45	BD	1	1150	190	
2009-10-20	Brigantine			1:36:10	I	1		135	
2009-10-20	Brigantine			1:36:43	BD	1	975	155	
2009-10-20	Brigantine			1:36:56	I	1		195	
2009-10-20	Brigantine			1:37:35	I	1		145	
2009-10-20	Brigantine			1:37:55	I	1		345	
2009-10-20	Brigantine			1:38:03	BD	1	300	175	
2009-10-20	Brigantine			1:38:59	I	1		205	
2009-10-20	Brigantine			1:39:08	I	1		190	
2009-10-20	Brigantine			1:39:29	BD	1	1450	25	
2009-10-20	Brigantine			1:39:41	BD	1	1050	20	
2009-10-20	Brigantine		149 to 154	1:49:57	BD	1	925	25	
2009-10-20	Brigantine			1:50:05	I	1		325	
2009-10-20	Brigantine			1:51:19	I	1		340	
2009-10-20	Brigantine			1:51:25	I	1		175	
2009-10-20	Brigantine			1:51:38	I	1		200	
2009-10-20	Brigantine			1:52:23	BD	1	1625	15	

Table K-6 (*continued*). TI-VPR data for fall 2009 over Island Beach State Park, Brigantine Beach and Sea Isle City, New Jersey. NTD = no targets detected, CLOUDS = cloudy condition, LOW = target too low in beam.

Date	Location	Timeframe (UTC)	5-min sample	Target start	ID	Count	Altitude	Direction	Comments
2009-10-20	Brigantine			1:53:21	I	1		200	
2009-10-20	Brigantine			1:53:32	I	1		200	
2009-10-20	Brigantine			1:53:37	I	1		200	
2009-11-03	Sea Isle City	21:30 to 22:23	2130 to 2135	21:30:50	I	5			LOW
2009-11-03	Sea Isle City			21:31:00	I	10			LOW
2009-11-03	Sea Isle City			21:31:22	I	3			LOW
2009-11-03	Sea Isle City		2150 to 2155						CLOUDS
2009-11-03	Sea Isle City		2210 to 2215						CLOUDS
2009-11-03	Sea Isle City		2215 to 2220						CLOUDS
2009-11-03	Sea Isle City	22:46 to 23:46	2246 to 2251						CLOUDS
2009-11-03	Sea Isle City		2306 to 2311						CLOUDS
2009-11-03	Sea Isle City		2326 to 2331	23:26:10	I	1		15	
2009-11-03	Sea Isle City			23:26:47	I	1		200	
2009-11-03	Sea Isle City			23:27:04	I	1		215	
2009-11-03	Sea Isle City			23:27:16	BD	1	350	130	
2009-11-03	Sea Isle City			23:27:43	I	1		10	
2009-11-03	Sea Isle City			23:28:27	I	1		145	
2009-11-03	Sea Isle City			23:28:55	BD	1	600	25	
2009-11-03	Sea Isle City			23:28:56	I	1		30	
2009-11-03	Sea Isle City			23:29:14	BD	1	1150	195	
2009-11-03	Sea Isle City			23:30:15	I	1		0	
2009-11-03	Sea Isle City			23:30:22	I	1		180	
2009-11-03	Sea Isle City		2336 to 2341	23:36:26	BD	1	1450	190	
2009-11-03	Sea Isle City			23:37:16	I	1		205	
2009-11-03	Sea Isle City			23:38:23	BD	1	525	25	
2009-11-03	Sea Isle City			23:38:24	BD	1		200	
2009-11-03	Sea Isle City			23:38:52	I	1		15	
2009-11-03	Sea Isle City			23:38:57	BD	1	1575	170	
2009-11-03	Sea Isle City			23:38:58	I	1		310	

Table K-6 (*continued*). TI-VPR data for fall 2009 over Island Beach State Park, Brigantine Beach and Sea Isle City, New Jersey. NTD = no targets detected, CLOUDS = cloudy condition, LOW = target too low in beam.

Date	Location	Timeframe (UTC)	5-min sample	Target start	ID	Count	Altitude	Direction	Comments
2009-11-03	Sea Isle City			23:39:19	I	1		0	
2009-11-03	Sea Isle City			23:39:26	BD	1	1275	190	
2009-11-03	Sea Isle City			23:39:29	I	1		5	
2009-11-03	Sea Isle City			23:39:46	I	1		150	
2009-11-03	Sea Isle City			23:40:19	BD	1	1275	190	
2009-11-03	Sea Isle City			23:40:43	BD	1	2100	195	
2009-11-03	Sea Isle City			23:41:02	BD	1	900	250	
2009-11-03	Sea Isle City	23:51 to 00:51	2351 to 2356	23:51:38	I	1		90	
2009-11-03	Sea Isle City			23:51:58	I	1		100	
2009-11-03	Sea Isle City			23:52:31	I	1		30	
2009-11-03	Sea Isle City			23:52:51	BD	1	650	185	
2009-11-03	Sea Isle City			23:53:12	I	1		0	
2009-11-03	Sea Isle City			23:53:28	BD	1	1450	190	
2009-11-03	Sea Isle City			23:53:42	BD	1	550	215	
2009-11-03	Sea Isle City			23:54:03	I	1		variable	
2009-11-03	Sea Isle City			23:54:06	I	1		0	
2009-11-03	Sea Isle City			23:54:10	I	1		35	
2009-11-03	Sea Isle City			23:54:12	BT	1	725	230	
2009-11-03	Sea Isle City			23:54:33	I	1		15	
2009-11-03	Sea Isle City			23:54:42	BD	1	1725	210	
2009-11-03	Sea Isle City			23:55:01	BD	1	1125	215	
2009-11-03	Sea Isle City			23:55:31	I	1		5	
2009-11-03	Sea Isle City			23:55:50	I	1		120	
2009-11-03	Sea Isle City			23:55:56	I	1		5	
2009-11-03	Sea Isle City			23:55:57	I	1		270	
2009-11-03	Sea Isle City			23:55:58	I	1		variable	
2009-11-03	Sea Isle City			23:55:59	I	1		195	
2009-11-03	Sea Isle City			23:56:15	I	1		10	
2009-11-03	Sea Isle City		0011 to 0016	00:11:43	I	1		variable	

Table K-6 (*continued*). TI-VPR data for fall 2009 over Island Beach State Park, Brigantine Beach and Sea Isle City, New Jersey. NTD = no targets detected, CLOUDS = cloudy condition, LOW = target too low in beam.

Date	Location	Timeframe (UTC)	5-min sample	Target start	ID	Count	Altitude	Direction	Comments
2009-11-03	Sea Isle City			00:11:53	BD	1	625	205	
2009-11-03	Sea Isle City			00:12:24	BD	1	800	180	
2009-11-03	Sea Isle City			00:12:41	I	1		60	
2009-11-03	Sea Isle City			00:12:50	BD	1	600	130	
2009-11-03	Sea Isle City			00:12:56	I	1		155	
2009-11-03	Sea Isle City			00:12:56	BD	1	2200	185	
2009-11-03	Sea Isle City			00:13:05	BD	1	750	205	
2009-11-03	Sea Isle City			00:13:07	I	1		45	
2009-11-03	Sea Isle City			00:13:16	BD	1	2100	190	
2009-11-03	Sea Isle City			00:13:39	I	1		variable	
2009-11-03	Sea Isle City			00:13:50	BD	1	500	235	
2009-11-03	Sea Isle City			00:13:56	I	1		55	
2009-11-03	Sea Isle City			00:14:13	I	1		5	
2009-11-03	Sea Isle City			00:14:35	BD	1	925	185	
2009-11-03	Sea Isle City			00:14:46	BD	1	950	175	
2009-11-03	Sea Isle City			00:14:54	I	1		355	
2009-11-03	Sea Isle City			00:15:06	BD	1	1675	205	
2009-11-03	Sea Isle City			00:15:52	BD	1	1175	155	
2009-11-03	Sea Isle City			00:15:58	I	1		25	
2009-11-03	Sea Isle City		0021 to 0026	00:21:58	BD	1	1375	185	
2009-11-03	Sea Isle City			00:22:20	I	1		100	
2009-11-03	Sea Isle City			00:24:28	I	1		325	
2009-11-03	Sea Isle City			00:24:47	I	1		350	
2009-11-03	Sea Isle City			00:25:00	BD	1	600	200	
2009-11-03	Sea Isle City			00:25:37	BD	1	800	110	
2009-11-03	Sea Isle City			00:25:45	BD	1	800	200	
2009-11-03	Sea Isle City		0041 to 0046	00:42:00	BD	1		190	
2009-11-03	Sea Isle City			00:42:02	I	1		195	
2009-11-03	Sea Isle City			00:42:12	BD	1	575	200	

Table K-6 (*continued*). TI-VPR data for fall 2009 over Island Beach State Park, Brigantine Beach and Sea Isle City, New Jersey. NTD = no targets detected, CLOUDS = cloudy condition, LOW = target too low in beam.

Date	Location	Timeframe (UTC)	5-min sample	Target start	ID	Count	Altitude	Direction	Comments
2009-11-03	Sea Isle City			00:43:03	I	1		40	
2009-11-03	Sea Isle City			00:43:08	I	1		10	
2009-11-03	Sea Isle City			00:43:08	BD	1	650	135	
2009-11-03	Sea Isle City			00:43:14	BD	1	550	205	
2009-11-03	Sea Isle City			00:43:22	I	1		10	
2009-11-03	Sea Isle City			00:43:37	I	1		190	
2009-11-03	Sea Isle City			00:44:25	I	1		25	
2009-11-03	Sea Isle City			00:44:26	I	1		190	
2009-11-03	Sea Isle City			00:44:53	BD	1		190	
2009-11-03	Sea Isle City			00:44:59	I	1		210	
2009-11-03	Sea Isle City			00:45:01	I	1		5	
2009-11-03	Sea Isle City			00:45:05	I	1		180	
2009-11-03	Sea Isle City			00:45:33	BT	1	250	variable	
2009-11-03	Sea Isle City			00:45:40	BD	1	900	185	
2009-11-03	Sea Isle City			00:45:41	BD	1	175	195	
2009-11-03	Sea Isle City			00:45:42	BD	1	250	195	
2009-11-03	Sea Isle City			00:45:43	BD	1	250	35	
2009-11-03	Sea Isle City			00:45:54	I	1		95	
2009-11-03	Sea Isle City			00:46:13	I	1		160	
2009-11-03	Sea Isle City	00:55 to 1:55							
2009-11-03	Sea Isle City		100 to 105	1:01:12	BD	1	825	135	
2009-11-03	Sea Isle City			1:01:38	BD	1	650	95	
2009-11-03	Sea Isle City			1:01:52	I	1		60	
2009-11-03	Sea Isle City			1:03:41	BD	1	525	190	
2009-11-03	Sea Isle City			1:04:00	BD	1	850	20	
2009-11-03	Sea Isle City			1:04:48	BD	1	925	180	
2009-11-03	Sea Isle City			1:05:09	I	1		5	
2009-11-03	Sea Isle City			1:05:42	I	1		235	
2009-11-03	Sea Isle City		110 to 115	1:11:38	BD	1	1125	195	

Table K-6 (*continued*). TI-VPR data for fall 2009 over Island Beach State Park, Brigantine Beach and Sea Isle City, New Jersey. NTD = no targets detected, CLOUDS = cloudy condition, LOW = target too low in beam.

Date	Location	Timeframe (UTC)	5-min sample	Target start	ID	Count	Altitude	Direction	Comments
2009-11-03	Sea Isle City			1:11:58	I	1		5	
2009-11-03	Sea Isle City			1:12:21	I	1		0	
2009-11-03	Sea Isle City			1:12:53	BD	1	1350	185	
2009-11-03	Sea Isle City			1:14:54	I	1		295	
2009-11-03	Sea Isle City			1:14:57	I	1		15	
2009-11-03	Sea Isle City			1:15:15	BD	1	1350	180	
2009-11-03	Sea Isle City			1:15:38	BD	1	1475	190	
2009-11-03	Sea Isle City		135 to 140	1:35:57	I	1		355	
2009-11-03	Sea Isle City			1:38:15	BD	5	300	125	
2009-11-03	Sea Isle City			1:38:34	BD	1	300	235	
2009-11-03	Sea Isle City			1:38:40	BD	1	825	175	
2009-11-03	Sea Isle City			1:39:11	BD	1	250	20	
2009-11-03	Sea Isle City			1:39:20	I	1		265	
2009-11-03	Sea Isle City			1:40:19	I	1		320	
2009-11-03	Sea Isle City			1:40:29	BD	1	225	225	
2009-11-03	Sea Isle City			1:40:31	BD	1	475	110	
2009-11-03	Sea Isle City		150 to 155	1:51:03	I	1		125	
2009-11-03	Sea Isle City			1:51:55	BD	1	1925	180	
2009-11-03	Sea Isle City			1:52:09	BD	1	275	20	
2009-11-03	Sea Isle City			1:52:10	I	1		340	
2009-11-03	Sea Isle City			1:52:16	I	1		195	
2009-11-03	Sea Isle City			1:52:18	I	1		10	
2009-11-03	Sea Isle City			1:52:35	BD	1	225	15	
2009-11-03	Sea Isle City			1:53:26	BD	1	200	20	
2009-11-03	Sea Isle City			1:54:07	BD	1	200	200	
2009-11-03	Sea Isle City			1:54:23	BD	1	1750	180	
2009-11-03	Sea Isle City			1:54:37	I	1		220	
2009-11-03	Sea Isle City			1:55:06	BD	1	350	215	
2009-11-03	Sea Isle City			1:55:54	I	1		variable	

Table K-6 (*continued*). TI-VPR data for fall 2009 over Island Beach State Park, Brigantine Beach and Sea Isle City, New Jersey. NTD = no targets detected, CLOUDS = cloudy condition, LOW = target too low in beam.

Date	Location	Timeframe (UTC)	5-min sample	Target start	ID	Count	Altitude	Direction	Comments
2009-11-06	Sea Isle City	22:23 to 23:23	2223 to 2228						
2009-11-06	Sea Isle City			22:24:26	I	1		10	
2009-11-06	Sea Isle City								
2009-11-06	Sea Isle City			22:26:56	I	1	200	15	
2009-11-06	Sea Isle City		2248 to 2253	22:50:00	I	1		10	
2009-11-06	Sea Isle City			22:50:35	BD	1	750	235	
2009-11-06	Sea Isle City			22:50:44	BD	1	875	200	
2009-11-06	Sea Isle City			22:50:59	I	1		195	
2009-11-06	Sea Isle City			22:51:30	BD	1	700	190	
2009-11-06	Sea Isle City		2303 to 2308	23:03:57			375		
2009-11-06	Sea Isle City			23:06:29	BD	1	1850	180	
2009-11-06	Sea Isle City			23:07:20	BD	1	700	190	
2009-11-06	Sea Isle City			23:07:36	I	1		205	
2009-11-06	Sea Isle City			23:08:04	BD	1	925	190	
2009-11-06	Sea Isle City		2318 to 2323						
2009-11-06	Sea Isle City			23:19:53	BD	1	850	190	
2009-11-06	Sea Isle City			23:20:06	BD	7	275	205	
2009-11-06	Sea Isle City			23:21:01	BD	1	1125	170	
2009-11-06	Sea Isle City			23:21:39	BD	1	1075	210	
2009-11-06	Sea Isle City			23:22:26	BD	1	2200	195	
2009-11-06	Sea Isle City			23:23:08	BD	1	700	195	
2009-11-06	Sea Isle City	23:28 to 00:28	2333 to 2338						
2009-11-06	Sea Isle City			23:34:43	BD	1	1150	185	
2009-11-06	Sea Isle City			23:35:40	BD	1	1075	205	
2009-11-06	Sea Isle City			23:35:49	I	1		210	
2009-11-06	Sea Isle City			23:36:03	BD	1	925	180	
2009-11-06	Sea Isle City			23:36:37	BD	1	1875	210	
2009-11-06	Sea Isle City			23:37:04	BD	1	1700	150	
2009-11-06	Sea Isle City			23:37:31	BD	1	975	205	

Table K-6 (*continued*). TI-VPR data for fall 2009 over Island Beach State Park, Brigantine Beach and Sea Isle City, New Jersey. NTD = no targets detected, CLOUDS = cloudy condition, LOW = target too low in beam.

Date	Location	Timeframe (UTC)	5-min sample	Target start	ID	Count	Altitude	Direction	Comments
2009-11-06	Sea Isle City			23:37:43	BD	1	325	195	
2009-11-06	Sea Isle City			23:37:43	BD	1	725	195	
2009-11-06	Sea Isle City		2343 to 2348						
2009-11-06	Sea Isle City			23:45:38	BD	1	1800	190	
2009-11-06	Sea Isle City			23:46:48	BD	1	975	210	
2009-11-06	Sea Isle City			23:47:15	I	1		200	
2009-11-06	Sea Isle City			23:47:21	I	1		190	
2009-11-06	Sea Isle City		0008 to 0013						
2009-11-06	Sea Isle City			00:10:20	BD	1	1500	195	
2009-11-06	Sea Isle City			00:10:26	BD	1	900	180	
2009-11-06	Sea Isle City			00:12:09	BD	1	1750	215	
2009-11-06	Sea Isle City			00:12:31	BD	1	750	210	
2009-11-06	Sea Isle City			00:12:48	BD	1	1575	215	
2009-11-06	Sea Isle City			00:13:11	BD	1	600	205	
2009-11-06	Sea Isle City		0013 to 0018	00:13:35	BD	1	675	195	
2009-11-06	Sea Isle City			00:13:36	BD	1	1150	205	
2009-11-06	Sea Isle City			00:15:05	BD	1	1450	190	
2009-11-06	Sea Isle City			00:15:11	BD	1	1425	200	
2009-11-06	Sea Isle City			00:15:42	BD	1	750	205	
2009-11-06	Sea Isle City			00:15:56	BD	1	1050	205	
2009-11-06	Sea Isle City			00:16:11	BD	1	950	210	
2009-11-06	Sea Isle City			00:16:48	BD	1	1375	195	
2009-11-06	Sea Isle City			00:16:52	BD	1	1375	200	
2009-11-06	Sea Isle City			00:17:12	I	1		210	
2009-11-06	Sea Isle City			00:17:46	BD	1	925	195	
2009-11-06	Sea Isle City			00:17:56	BD	1	925	195	
2009-11-06	Sea Isle City	00:34 to 01:34	0039 to 0044	00:40:04	BD	1	375	200	
2009-11-06	Sea Isle City			00:40:10	BD	1	900	205	
2009-11-06	Sea Isle City			00:42:36	BD	1	925	205	

Table K-6 (*continued*). TI-VPR data for fall 2009 over Island Beach State Park, Brigantine Beach and Sea Isle City, New Jersey. NTD = no targets detected, CLOUDS = cloudy condition, LOW = target too low in beam.

Date	Location	Timeframe (UTC)	5-min sample	Target start	ID	Count	Altitude	Direction	Comments
2009-11-06	Sea Isle City			00:42:45	BD	1	675	205	
2009-11-06	Sea Isle City			00:42:47	BD	1	675	200	
2009-11-06	Sea Isle City			00:43:27	BD	1	1425	190	
2009-11-06	Sea Isle City			00:43:27	BD	1	1425	200	
2009-11-06	Sea Isle City		0054 to 0059	00:54:27	BD	1	950	210	
2009-11-06	Sea Isle City			00:54:27	BD	1	1200	175	
2009-11-06	Sea Isle City			00:54:54	I	1		200	
2009-11-06	Sea Isle City			00:56:33	BD	1	1025	205	
2009-11-06	Sea Isle City			00:56:44	BD	1	1450	205	
2009-11-06	Sea Isle City			00:57:10	BD	1	1475	195	
2009-11-06	Sea Isle City			00:58:28	BD	1	650	195	
2009-11-06	Sea Isle City			00:59:17	BD	1		215	
2009-11-06	Sea Isle City		109 to 114	1:09:57	BD	1	1500	205	
2009-11-06	Sea Isle City			1:10:15	BD	1	1250	100	
2009-11-06	Sea Isle City			1:10:19	BD	1	1250	205	
2009-11-06	Sea Isle City			1:10:58	BD	1	600	165	
2009-11-06	Sea Isle City			1:11:47	BD	1	1175	205	
2009-11-06	Sea Isle City			1:13:02	BD	1		215	
2009-11-06	Sea Isle City			1:13:30	BD	1	1750	215	
2009-11-06	Sea Isle City			1:14:08	I	1	0	210	
2009-11-06	Sea Isle City		124 to 129	1:24:29	BD	1	550	210	
2009-11-06	Sea Isle City			1:24:50	BD	1	1350	195	
2009-11-06	Sea Isle City			1:24:55	BD	1	1350	205	
2009-11-06	Sea Isle City			1:24:59	BD	1		195	
2009-11-06	Sea Isle City			1:24:59	BD	1		210	
2009-11-06	Sea Isle City			1:25:02	U	1		210	
2009-11-06	Sea Isle City			1:25:17	I	1		345	
2009-11-06	Sea Isle City			1:25:30	I	1	375	190	
2009-11-06	Sea Isle City			1:26:10	I	1		205	

Table K-6 (*continued*). TI-VPR data for fall 2009 over Island Beach State Park, Brigantine Beach and Sea Isle City, New Jersey. NTD = no targets detected, CLOUDS = cloudy condition, LOW = target too low in beam.

Date	Location	Timeframe (UTC)	5-min sample	Target start	ID	Count	Altitude	Direction	Comments
2009-11-06	Sea Isle City			1:26:17	BD	1	1700	210	
2009-11-06	Sea Isle City			1:26:21	BD	1	1075	205	
2009-11-06	Sea Isle City			1:26:22	I	1		200	
2009-11-06	Sea Isle City			1:26:28	BD	2	875	205	
2009-11-06	Sea Isle City			1:26:28	U	1	1625	210	
2009-11-06	Sea Isle City			1:26:32	BD	1	1625	205	
2009-11-06	Sea Isle City			1:26:46	BD	1	2025	200	
2009-11-06	Sea Isle City			1:26:58	BD	1	1750	205	
2009-11-06	Sea Isle City			1:27:06	BD	1	1675	225	
2009-11-06	Sea Isle City			1:27:16	BD	1	1700	220	
2009-11-06	Sea Isle City			1:28:06	BD	1	2100	230	
2009-11-06	Sea Isle City			1:28:12	BD	1	2100	15	
2009-11-06	Sea Isle City			1:28:24	BD	1		220	
2009-11-06	Sea Isle City			1:28:28	BD	1		220	
2009-11-06	Sea Isle City			1:28:30	BD	1		220	
2009-11-06	Sea Isle City			1:29:14	BD	2	475	240	
2009-11-06	Sea Isle City	01:40 to 02:40	0145 to 0150	1:45:53	BD	1	1750	205	
2009-11-06	Sea Isle City			1:46:02	BD	1	1750	195	
2009-11-06	Sea Isle City			1:46:16	BD	1	2100	210	
2009-11-06	Sea Isle City			1:46:19	BD	1		210	
2009-11-06	Sea Isle City			1:46:38	BD	1	875	190	
2009-11-06	Sea Isle City			1:46:43	BD	1	650	225	
2009-11-06	Sea Isle City			1:48:00	BD	1	1200	205	
2009-11-06	Sea Isle City			1:48:10	BD	1	650	210	
2009-11-06	Sea Isle City			1:48:11	BD	1	675	205	
2009-11-06	Sea Isle City			1:48:15	BD	1	1500	210	
2009-11-06	Sea Isle City			1:48:26	BD	1	950	205	
2009-11-06	Sea Isle City			1:49:13	BD	1	825	195	
2009-11-06	Sea Isle City			1:49:37	BD	2	725	195	

Table K-6 (*continued*). TI-VPR data for fall 2009 over Island Beach State Park, Brigantine Beach and Sea Isle City, New Jersey. NTD = no targets detected, CLOUDS = cloudy condition, LOW = target too low in beam.

Date	Location	Timeframe (UTC)	5-min sample	Target start	ID	Count	Altitude	Direction	Comments
2009-11-06	Sea Isle City			1:50:09	BD	1	1175	20	
2009-11-06	Sea Isle City			1:50:18	BD	1	1625	200	
2009-11-06	Sea Isle City		0155 to 0200	01:55:35	BD	1	1350	210	
2009-11-06	Sea Isle City			01:55:38	BD	1	1925	210	
2009-11-06	Sea Isle City			01:56:33	BD	1	1225	215	
2009-11-06	Sea Isle City			01:56:34	BD	1	775	210	
2009-11-06	Sea Isle City			01:56:38	BD	1	375	210	
2009-11-06	Sea Isle City			01:56:49	BD	1	1575	205	
2009-11-06	Sea Isle City			01:56:51	BD	1	1725	210	
2009-11-06	Sea Isle City			01:57:09	BD	1	775	210	
2009-11-06	Sea Isle City			01:57:10	BD	1	1700	215	
2009-11-06	Sea Isle City			01:57:31	BD	1	1225	210	
2009-11-06	Sea Isle City			01:57:33	BD	1	1225	225	
2009-11-06	Sea Isle City			01:57:36	BD	1	1900	205	
2009-11-06	Sea Isle City			01:58:26	BD	1	1200	160	
2009-11-06	Sea Isle City			01:58:48	BD	1		215	
2009-11-06	Sea Isle City			01:58:51	BD	1		215	
2009-11-06	Sea Isle City			01:58:58	BD	1	1350	225	
2009-11-06	Sea Isle City			01:59:01	BD	1		205	
2009-11-06	Sea Isle City			01:59:02	BD	1	800	215	
2009-11-06	Sea Isle City		0220 to 0225	02:20:38	BD	1	1400	205	
2009-11-06	Sea Isle City			02:20:54	BD	1	1275	215	
2009-11-06	Sea Isle City			02:21:09	BD	1	750	205	
2009-11-06	Sea Isle City			02:21:17	BD	1	1975	215	
2009-11-06	Sea Isle City			02:21:21	BD	1	1500	205	
2009-11-06	Sea Isle City			02:21:25	BD	1	1475	variable	
2009-11-06	Sea Isle City			02:21:25	BD	1	1475	240	
2009-11-06	Sea Isle City			02:21:36	BD	1	1275	205	
2009-11-06	Sea Isle City			02:21:41	BD	1	1325	220	
2009-11-06	Sea Isle City			02:22:00	BD	1	2075	205	

Table K-6 (*continued*). TI-VPR data for fall 2009 over Island Beach State Park, Brigantine Beach and Sea Isle City, New Jersey. NTD = no targets detected, CLOUDS = cloudy condition, LOW = target too low in beam.

Date	Location	Timeframe (UTC)	5-min sample	Target start	ID	Count	Altitude	Direction	Comments
2009-11-06	Sea Isle City			02:22:03	BD	1		230	
2009-11-06	Sea Isle City			02:22:06	BD	1	900	215	
2009-11-06	Sea Isle City			02:22:27	BD	1	1800	205	
2009-11-06	Sea Isle City			02:22:31	BD	1	250	15	
2009-11-06	Sea Isle City			02:22:47	BD	1	1725	190	
2009-11-06	Sea Isle City			02:22:49	BD	1		200	
2009-11-06	Sea Isle City			02:23:18	BD	1	1925	215	
2009-11-06	Sea Isle City			02:23:25	BD	1	1925	205	
2009-11-06	Sea Isle City			02:23:53	BD	1	300	190	
2009-11-06	Sea Isle City			02:24:00	BD	1	1500	220	
2009-11-06	Sea Isle City			02:24:49	BD	1	2025	220	
2009-11-06	Sea Isle City			02:25:02	BD	1	1800	205	
2009-11-06	Sea Isle City			02:25:06	BD	1	1800	205	
2009-11-06	Sea Isle City			02:25:09	BD	1	1800	220	
2009-11-06	Sea Isle City			02:25:26	BD	1	1075	220	
2009-11-06	Sea Isle City		0235 to 0240	02:35:37	BD	1	1325	240	
2009-11-06	Sea Isle City			02:35:46	BD	1	1325	210	
2009-11-06	Sea Isle City			02:36:10	BD	2	1650	210	
2009-11-06	Sea Isle City			02:36:43	BD	1	1675	215	
2009-11-06	Sea Isle City			02:37:13	BD	1		195	
2009-11-06	Sea Isle City			02:37:28	BD	1	2025	215	
2009-11-06	Sea Isle City			02:37:50	BD	1	375	275	
2009-11-06	Sea Isle City			02:37:52	BD	1	1275	210	
2009-11-06	Sea Isle City			02:38:38	BD	1	1425	190	
2009-11-06	Sea Isle City			02:38:40	BD	1	775	205	
2009-11-06	Sea Isle City			02:38:49	BD	1	700	195	
2009-11-06	Sea Isle City			02:38:52	BD	1	1175	200	
2009-11-06	Sea Isle City			02:38:53	BD	1	1575	215	
2009-11-06	Sea Isle City			02:39:21	BD	1	1425	215	
2009-11-06	Sea Isle City			02:39:33	BD	1	300	205	

Table K-6 (*continued*). TI-VPR data for fall 2009 over Island Beach State Park, Brigantine Beach and Sea Isle City, New Jersey. NTD = no targets detected, CLOUDS = cloudy condition, LOW = target too low in beam.

Date	Location	Timeframe (UTC)	5-min sample	Target start	ID	Count	Altitude	Direction	Comments
2009-11-06	Sea Isle City			02:39:40	BD	1	1325	200	
2009-11-06	Sea Isle City			02:40:01	BD	1		180	
2009-11-08	Sea Isle City	20:11 to 21:02	2016 to 2021	20:16:42	I	1		variable	
2009-11-08	Sea Isle City			20:16:47	I	1		variable	
2009-11-08	Sea Isle City			20:17:13	I	1		155	
2009-11-08	Sea Isle City			20:17:20	I	2		variable	
2009-11-08	Sea Isle City			20:17:38	I	1		variable	
2009-11-08	Sea Isle City			20:17:39	I	1		230	
2009-11-08	Sea Isle City			20:17:59	I	1		355	
2009-11-08	Sea Isle City			20:18:12	I	1		variable	
2009-11-08	Sea Isle City			20:18:52	BD	3	1200	205	
2009-11-08	Sea Isle City			20:19:11	I	1		variable	
2009-11-08	Sea Isle City			20:20:32	I	1		variable	
2009-11-08	Sea Isle City			20:20:35	I	1		variable	
2009-11-08	Sea Isle City			20:20:38	I	1		175	
2009-11-08	Sea Isle City			20:20:39	I	1		variable	
2009-11-08	Sea Isle City			20:20:47	I	1		225	
2009-11-08	Sea Isle City		2031 to 2036						NTD
2009-11-08	Sea Isle City		2051 to 2056	20:52:15	I	1		variable	
2009-11-08	Sea Isle City			20:52:42	I	2		variable	
2009-11-08	Sea Isle City			20:53:05	I	1		variable	
2009-11-08	Sea Isle City			20:53:25	I	1		variable	
2009-11-08	Sea Isle City			20:54:34	I	1		300	
2009-11-08	Sea Isle City			20:55:10	I	1		variable	
2009-11-08	Sea Isle City			20:55:30	I	1		310	
2009-11-08	Sea Isle City			20:55:48	I	1		325	
2009-11-08	Sea Isle City			20:56:01	I	1		variable	
2009-11-08	Sea Isle City		2056 to 2101	20:59:22	I	1		20	
2009-11-08	Sea Isle City			21:00:00	I	1		340	
2009-11-08	Sea Isle City			20:00:36	I	1		variable	

Table K-6 (*continued*). TI-VPR data for fall 2009 over Island Beach State Park, Brigantine Beach and Sea Isle City, New Jersey. NTD = no targets detected, CLOUDS = cloudy condition, LOW = target too low in beam.

Date	Location	Timeframe (UTC)	5-min sample	Target start	ID	Count	Altitude	Direction	Comments
2009-11-08	Sea Isle City	23:14 to 00:14	2319 to 2324	21:21:53	BD	1	350	230	
2009-11-08	Sea Isle City			21:23:22	BD	1		300	
2009-11-08	Sea Isle City		2339 to 2344	23:39:23	BD	1	750	350	
2009-11-08	Sea Isle City			23:40:03	BD	1	2200	5	
2009-11-08	Sea Isle City			23:42:30	BD	1	200	15	
2009-11-08	Sea Isle City		2349 to 2354	23:53:12	I	1		350	
2009-11-08	Sea Isle City								
2009-11-08	Sea Isle City		0009 to 0014	00:12:10	I	1		330	
2009-11-08	Sea Isle City			00:13:43	BD	1	250	130	
2009-11-08	Sea Isle City								
2009-11-08	Sea Isle City	00:26 to 01:26	0031 to 0036	00:35:00	I	1		155	
2009-11-08	Sea Isle City			00:35:34	BD	1	375	15	
2009-11-08	Sea Isle City								
2009-11-08	Sea Isle City		0051 to 0056	00:52:01	BD	1	1125	205	
2009-11-08	Sea Isle City			00:52:59	BD	1	700	210	
2009-11-08	Sea Isle City		0056 to 0101	00:56:50	BD	1	1625	180	
2009-11-08	Sea Isle City			00:57:39	BD	1		20	
2009-11-08	Sea Isle City		0121 to 0126						NTD

APPENDIX L

NEXRAD DATA

Appendix L-1

WSR-88D Parameters

Table L-1. WSR-88D characteristics from the National Research Council, 2002.

Parameter/Feature Radar System	Value/Description
Range of observation	
Reflectivity	460km
Velocity	230km
Angular Coverage	
Azimuth	Full circle or sector
Elevation	Operational limits; -1° to +20°
Antenna	
Type	S-Band, center-fed, parabolic dish
Reflector aperture	8.54-m (28-ft) diameter; circular
Beamwidth (one-way, 3 dB)	0.96° at 2.7 GHz; 0.88° at 3.0 GHz
Gain	45.8 dB at 2.85 GHz (midband)
Polarization	Linear horizontal
First side-lobe level	-29 dB
Steerability	360° azimuth; -1° to +45° elevation
Mechanical limits	-1° to +60°
Rotation rate	30° s^{-1} (azimuth and elevation)
Angular acceleration	15° s^{-2} (azimuth and elevation)
Pointing accuracy	±0.2°
Radome	
Type	Fiberglass skin foam sandwich
Diameter	11.89m (39 ft.)
RF Loss (two-way)	0.3 ± 0.06 dB over 2.7–3.0 GHz band
Transmitter	
Type	Master Oscillator Power Amplifier (MOPA)
Frequency range	2.7–3.0 GHz
Peak power output (nominal)	500 kW into antenna
Pulsewidth (nominal)	1.57 µs (short pulse); 4.5 µs (long pulse) ±4%
RF duty cycle (maximum)	0.002
Pulse Repetition Frequency	
Long pulse	322–422 Hz ± 1.7%
Short pulse	322–1282 Hz ± 1.7%
Waveform types	Contiguous and batch
Receiver	
Type	Linear
Tunability (frequency range)	2.7–3.0 GHz
Bandwidth (3 dB)	0.63 MHz (short pulse); 0.22 MHz (long pulse)
Phase control	Selectable
Receiver channels	Linear output I/Q; log output
Dynamic range	95 dB max; 93 dB at 1 dB compression
Minimum detectable signal	-113 dBm
Noise temperature	450 K

Table L-1 (*continued*). WSR-88D characteristics from the National Research Council, 2002.

Parameter/Feature Radar System	Value/Description
Pulse Repetition Frequency	
Intermediate frequency	57.6 MHz
Sampling rate	600 kHz
Signal Processor	
Type	Hardwired/programmable
Parameters derived	Reflectivity; mean radial velocity; Doppler spectral width
Algorithms (respective)	Power averaging; pulse-pair; single-lag correlation
Accuracy (Standard Deviation)	
Reflectivity	<1 dB
Velocity and spectrum width	<1 m s^{-1}
Number of Pulses Averaged	
Reflectivity	6–64
Velocity and spectrum width	40–200
Range Resolution	
Reflectivity	1 km
Velocity and spectrum width	0.25 km
Azimuth Resolution	
Reflectivity	1°
Velocity and spectrum width	1°
Clutter canceller	Digital, infinite impulse response (IIR), 5-pole
Clutter suppression	30–50 dB
Filter notch half-width	0.5–4 m s^{-1}

Appendix L-2

Seasonal Data for Nocturnal Bird Migration

Table L-2. Year-to-year and night-to-night pattern of nocturnal spring bird migration (2005) over the onshore sample areas. Date is the date at beginning of night. Density = mean birds km^{-3} measured by averaging maximum dBZ reflectivity from migrants aloft at 0.5° over the sample areas. ND = no data available, MI=mostly insects aloft, MD = missing data, P = precipitation in SA, V0 = bad velocity, S = strobing in SA, OSA = migration out of sample area, and RM = radar malfunction.

Onshore Spring 2005						
Date	1A		2A		3A	
	Density	Comments	Density	Comments	Density	Comments
15-Mar	0	P	0	P	0	P
16-Mar	0	P, MI	0	P, MI	0	P, MI
17-Mar	0	P, MI	0	P, MI	0	P, MI
18-Mar	0	MI	0	MI	0	MI
19-Mar	0	P	0	P	0	P
20-Mar	0	P	0	P	0	P
21-Mar	0	MI	0	MI	0	MI
22-Mar	23		58		24	
23-Mar	0	P	0	P	0	P
24-Mar	0	MI	0	MI	0	MI
25-Mar	0	P, MI	0	P, MI	0	P, MI
26-Mar	4		5		4	
27-Mar	0	P	0	P	0	P
28-Mar	0	P	0	P	0	P
29-Mar	0	P, MI	0	P, MI	0	P, MI
30-Mar	26		6		40	
31-Mar	0	P	0	P	0	P
1-Apr	0	P	0	P	0	P
2-Apr	0	P	0	P	0	P
3-Apr	0	P, MI	0	P, MI	0	P, MI
4-Apr	0	MI	0	MI	0	MI
5-Apr	46		46		27	
6-Apr	72		11		5	
7-Apr	0	P	0	P	0	P
8-Apr	0	MI, P	0	MI, P	0	MI, P
9-Apr	-	S	-	S	-	S
10-Apr	7		22		12	
11-Apr	12		8		3	
12-Apr	12		6		4	
13-Apr	-	OSA	-	OSA	-	OSA
14-Apr	0	MI	0	MI	0	MI
15-Apr	0	MI	0	MI	0	MI
16-Apr	2		1		2	
17-Apr	-	S	-	S	-	S
18-Apr	0		32		11	
19-Apr	0	P, MI	0	P, MI	0	P, MI
20-Apr	0	P	0	P	0	P
21-Apr	21		5		7	
22-Apr	0	P	58	P	15	P

Table L-2 (*continued*). Year-to-year and night-to-night pattern of nocturnal spring bird migration (2005) over the onshore sample areas. Date is the date at beginning of night. Density = mean birds km^{-3} measured by averaging maximum dBZ reflectivity from migrants aloft at 0.5° over the sample areas. ND = no data available, MI=mostly insects aloft, MD = missing data, P = precipitation in SA, V0 = bad velocity, S = strobing in SA, OSA = migration out of sample area, and RM = radar malfunction.

Onshore Spring 2005						
Date	1A		2A		3A	
	Density	Comments	Density	Comments	Density	Comments
23-Apr	0	P	0	P	0	P
24-Apr	0	P	0	P	0	P
25-Apr	0	P	8	P	5	P
26-Apr	9	P	4	P	4	P
27-Apr	0	P, MI	0	P, MI	0	P, MI
28-Apr	0	P	0	P	0	P
29-Apr	1	P	30	P	9	P
30-Apr	0	P	0	P	0	P
1-May	15		1		2	
2-May	0	P, MI	0	P, MI	0	P, MI
3-May	19		1		49	
4-May	8		68		14	
5-May	7		2		3	
6-May	0	P	0	P	0	P
7-May	12		10		8	
8-May	0	MI	0	MI	0	MI
9-May	95		23		15	
10-May	276		60		28	
11-May	569		119		17	
12-May	0	MI	0	MI	0	MI
13-May	179		101		9	
14-May	-	S	-	S	-	S
15-May	-	S	-	S	-	S
16-May	10		12		14	
17-May	7		31		15	
18-May		S		S		S
19-May	74	P	6	P	8	P
20-May	0	P, MI	0	P, MI	0	P, MI
21-May	0	P	0	P	0	P
22-May	0	P	0	P	0	P
23-May	0	P, MI	0	P, MI	0	P, MI
24-May	0	P	0	P	0	P
25-May	0	P	0	P	0	P
26-May	-	V0	-	V0	-	V0
27-May	-	S	-	S	-	S
28-May	-	V0	-	V0	-	V0
29-May	0	P, MI	0	P, MI	0	P, MI
30-May	0	P, MI	0	P, MI	0	P, MI
31-May	-	S	-	S	-	S

Table L-3. Year-to-year and night-to-night pattern of nocturnal spring bird migration (2005) over the offshore sample areas. Date is the date at beginning of night. Density = mean birds km^{-3} measured by averaging maximum dBZ reflectivity from migrants aloft at 0.5° over the sample areas. ND = no data available, MI=mostly insects aloft, MD = missing data, P = precipitation in SA, V0 = bad velocity, S = strobing in SA, OSA = migration out of sample area, and RM = radar malfunction.

Offshore Spring 2005						
Date	1B		2B		3B	
	Density	Comments	Density	Comments	Density	Comments
15-Mar	0	P	0	P	0	P
16-Mar	0	P, MI	0	P, MI	0	P, MI
17-Mar	0	P, MI	0	P, MI	0	P, MI
18-Mar	0	MI	0	MI	0	MI
19-Mar	0	P	0	P	0	P
20-Mar	0	P	0	P	0	P
21-Mar	0	MI	0	MI	0	MI
22-Mar	9		3		6	
23-Mar	0	P	0	P	0	P
24-Mar	0	MI	0	MI	0	MI
25-Mar	0	P, MI	0	P, MI	0	P, MI
26-Mar	0		0		0	
27-Mar	0	P	0	P	0	P
28-Mar	0	P	0	P	0	P
29-Mar	0	P, MI	0	P, MI	0	P, MI
30-Mar	3		57		5	
31-Mar	0	P	0	P	0	P
1-Apr	0	P	0	P	0	P
2-Apr	0	P	0	P	0	P
3-Apr	0	P, MI	0	P, MI	0	P, MI
4-Apr	0	MI	0	MI	0	MI
5-Apr	32		10		32	
6-Apr	2		3		10	
7-Apr	0	P	0	P	0	P
8-Apr	0	MI, P	0	MI, P	0	MI, P
9-Apr	-	S	-	S	-	S
10-Apr	6		1		1	
11-Apr	0		0		0	
12-Apr	3		1		0	
13-Apr	-	OSA	-	OSA	-	OSA
14-Apr	0	MI	0	MI	0	MI
15-Apr	0	MI	0	MI	0	MI
16-Apr	0		0		0	
17-Apr	-	S	-	S	-	S
18-Apr	2		8		6	
19-Apr	0	P, MI	0	P, MI	0	P, MI
20-Apr	0	P	0	P	0	P
21-Apr	0		0		0	
22-Apr	0	P	6	P	8	P
23-Apr	0	P	0	P	0	P
24-Apr	0	P	0	P	0	P
25-Apr	4	P	2	P	2	P

Table L-3 (*continued*). Year-to-year and night-to-night pattern of nocturnal spring bird migration (2005) over the offshore sample areas. Date is the date at beginning of night. Density = mean birds km^{-3} measured by averaging maximum dBZ reflectivity from migrants aloft at 0.5° over the sample areas. ND = no data available, MI=mostly insects aloft, MD = missing data, P = precipitation in SA, V0 = bad velocity, S = strobing in SA, OSA = migration out of sample area, and RM = radar malfunction.

Offshore Spring 2005						
Date	1B		2B		3B	
	Density	Comments	Density	Comments	Density	Comments
26-Apr	0	P	0	P	0	P
27-Apr	0	P, MI	0	P, MI	0	P, MI
28-Apr	0	P	0	P	0	P
29-Apr	1	P	2	P	5	P
30-Apr	0	P	0	P	0	P
1-May	3		1		1	
2-May	0	P, MI	0	P, MI	0	P, MI
3-May	1		0		1	
4-May	13		3		3	
5-May	3		4		0	
6-May	0	P	0	P	0	P
7-May	3		2		7	
8-May	0	MI	0	MI	0	MI
9-May	3		6		5	
10-May	6		2		3	
11-May	26		10		5	
12-May	0	MI	0	MI	0	MI
13-May	6		2		2	
14-May	-	S	-	S	-	S
15-May	-	S	-	S	-	S
16-May	3		2		4	
17-May	0		0		2	
18-May		S		S		S
19-May	0	P	0	P	0	P
20-May	0	P, MI	0	P, MI	0	P, MI
21-May	0	P	0	P	0	P
22-May	0	P	0	P	0	P
23-May	0	P, MI	0	P, MI	0	P, MI
24-May	0	P	0	P	0	P
25-May	0	P	0	P	0	P
26-May	-	V0	-	V0	-	V0
27-May	-	S	-	S	-	S
28-May	-	V0	-	V0	-	V0
29-May	0	P, MI	0	P, MI	0	P, MI
30-May	0	P, MI	0	P, MI	0	P, MI
31-May	-	S	-	S	-	S

Table L-4. Year-to-year and night-to-night pattern of nocturnal spring bird migration (2006) over the onshore sample areas. Date is the date at beginning of night. Density = mean birds km^{-3} measured by averaging maximum dBZ reflectivity from migrants aloft at 0.5° over the sample areas. ND = no data available, MI=mostly insects aloft, MD = missing data, P = precipitation in SA, V0 = bad velocity, S = strobing in SA, OSA = migration out of sample area, and RM = radar malfunction.

Onshore Spring 2006						
Date	1A		2A		3A	
	Density	Comments	Density	Comments	Density	Comments
15-Mar	-	V0	-	V0	-	V0
16-Mar	-	V0	-	V0	-	V0
17-Mar	-	V0	-	V0	-	V0
18-Mar	-	V0	-	V0	-	V0
19-Mar	-	V0	-	V0	-	V0
20-Mar	-	V0	-	V0	-	V0
21-Mar	-	V0	-	V0	-	V0
22-Mar	-	V0	-	V0	-	V0
23-Mar	-	V0	-	V0	-	V0
24-Mar	-	V0	-	V0	-	V0
25-Mar	0	P	0	P	0	P
26-Mar	0	P, MI	0	P, MI	0	P, MI
27-Mar	28		50		30	
28-Mar	-	S	-	S	-	S
29-Mar	-	V0	-	V0	-	V0
30-Mar	-	V0	-	V0	-	V0
31-Mar	0		9		3	
1-Apr	0	MI	0	MI	0	MI
2-Apr	-	S	-	S	-	S
3-Apr	0	P	0	P	0	P
4-Apr	-	V0	-	V0	-	V0
5-Apr	-	V0	-	V0	-	V0
6-Apr	-	V0	-	V0	-	V0
7-Apr	-	S	-	S	-	S
8-Apr	-	ND	-	ND	-	ND
9-Apr	-	V0	-	V0	-	V0
10-Apr	58		22		49	
11-Apr	-	V0	-	V0	-	V0
12-Apr	0		7		5	
13-Apr	0	MI	0	MI	0	MI
14-Apr	19		12		2	
15-Apr	0	MI	0	MI	0	MI
16-Apr	0	MI	0	MI	0	MI
17-Apr	-	V0	-	V0	-	V0
18-Apr	-	V0	-	V0	-	V0
19-Apr	-	V0	-	V0	-	V0
20-Apr	-	V0	-	V0	-	V0
21-Apr	0	P	0	P	0	P
22-Apr	0	P	0	P	0	P
23-Apr	0	P, MI	0	P, MI	0	P, MI
24-Apr	-	V0	-	V0	-	V0
25-Apr	0	P	0	P	0	P

Table L-4 (*continued*). Year-to-year and night-to-night pattern of nocturnal spring bird migration (2006) over the onshore sample areas. Date is the date at beginning of night. Density = mean birds km^{-3} measured by averaging maximum dBZ reflectivity from migrants aloft at 0.5° over the sample areas. ND = no data available, MI=mostly insects aloft, MD = missing data, P = precipitation in SA, V0 = bad velocity, S = strobing in SA, OSA = migration out of sample area, and RM = radar malfunction.

Onshore Spring 2006						
Date	1A		2A		3A	
	Density	Comments	Density	Comments	Density	Comments
26-Apr	-	V0	-	V0	-	V0
27-Apr	-	V0	-	V0	-	V0
28-Apr	-	V0	-	V0	-	V0
29-Apr	-	V0	-	V0	-	V0
30-Apr	-	V0	-	V0	-	V0
1-May	-	V0	-	V0	-	V0
2-May	-	V0	-	V0	-	V0
3-May	-	V0	-	V0	-	V0
4-May	-	S	-	S	-	S
5-May	67		317		166	
6-May	-	V0	-	V0	-	V0
7-May	-	V0	-	V0	-	V0
8-May	-	V0	-	V0	-	V0
9-May	-	V0	-	V0	-	V0
10-May	-	V0	-	V0	-	V0
11-May	0	P	0	P	0	P
12-May	-	MD	-	MD	-	MD
13-May	0		5		26	
14-May	0	MI, P	0	MI, P	0	MI, P
15-May	0	P	0	P	0	P
16-May	130		47		6	
17-May	0		207		14	
18-May	0	P, MI	0	P, MI	0	P, MI
19-May	9		4		1	
20-May	-	V0	-	V0	-	V0
21-May	-	V0	-	V0	-	V0
22-May	-	V0	-	V0	-	V0
23-May	-	V0	-	V0	-	V0
24-May	-	V0	-	V0	-	V0
25-May	0	P	67	P	36	P
26-May	0	P	0	P	5	P
27-May	0	MI	0	MI	0	MI
28-May	-	S	-	S	-	S
29-May	35		8		6	
30-May	0	P	0	P	0	P
31-May	-	V0	-	V0	-	V0

Table L-5. Year-to-year and night-to-night pattern of nocturnal spring bird migration (2006) over the offshore sample areas. Date is the date at beginning of night. Density = mean birds km^{-3} measured by averaging maximum dBZ reflectivity from migrants aloft at 0.5° over the sample areas. ND = no data available, MI=mostly insects aloft, MD = missing data, P = precipitation in SA, V0 = bad velocity, S = strobing in SA, OSA = migration out of sample area, and RM = radar malfunction.

Offshore Spring 2006						
Date	1B		2B		3B	
	Density	Comments	Density	Comments	Density	Comments
15-Mar	-	V0	-	V0	-	V0
16-Mar	-	V0	-	V0	-	V0
17-Mar	-	V0	-	V0	-	V0
18-Mar	-	V0	-	V0	-	V0
19-Mar	-	V0	-	V0	-	V0
20-Mar	-	V0	-	V0	-	V0
21-Mar	-	V0	-	V0	-	V0
22-Mar	-	V0	-	V0	-	V0
23-Mar	-	V0	-	V0	-	V0
24-Mar	-	V0	-	V0	-	V0
25-Mar	0	P	0	P	0	P
26-Mar	0	P, MI	0	P, MI	0	P, MI
27-Mar	2		2		3	
28-Mar	-	S	-	S	-	S
29-Mar	-	V0	-	V0	-	V0
30-Mar	-	V0	-	V0	-	V0
31-Mar	1		0		0	
1-Apr	0	MI	0	MI	0	MI
2-Apr	-	S	-	S	-	S
3-Apr	0	P	0	P	0	P
4-Apr	-	V0	-	V0	-	V0
5-Apr	-	V0	-	V0	-	V0
6-Apr	-	V0	-	V0	-	V0
7-Apr	-	S	-	S	-	S
8-Apr	-	ND	-	ND	-	ND
9-Apr	-	V0	-	V0	-	V0
10-Apr	10		4		8	
11-Apr	-	V0	-	V0	-	V0
12-Apr	0		1		2	
13-Apr	0	MI	0	MI	0	MI
14-Apr	2		0		0	
15-Apr	0	MI	0	MI	0	MI
16-Apr	0	MI	0	MI	0	MI
17-Apr	-	V0	-	V0	-	V0
18-Apr	-	V0	-	V0	-	V0
19-Apr	-	V0	-	V0	-	V0
20-Apr	-	V0	-	V0	-	V0
21-Apr	0	P	0	P	0	P
22-Apr	0	P	0	P	0	P
23-Apr	0	P, MI	0	P, MI	0	P, MI
24-Apr	-	V0	-	V0	-	V0
25-Apr	0	P	0	P	0	P

Table L-5 (*continued*). Year-to-year and night-to-night pattern of nocturnal spring bird migration (2006) over the offshore sample areas. Date is the date at beginning of night. Density = mean birds km^{-3} measured by averaging maximum dBZ reflectivity from migrants aloft at 0.5° over the sample areas. ND = no data available, MI=mostly insects aloft, MD = missing data, P = precipitation in SA, V0 = bad velocity, S = strobing in SA, OSA = migration out of sample area, and RM = radar malfunction.

Offshore Spring 2006						
Date	1B		2B		3B	
	Density	Comments	Density	Comments	Density	Comments
26-Apr	-	V0	-	V0	-	V0
27-Apr	-	V0	-	V0	-	V0
28-Apr	-	V0	-	V0	-	V0
29-Apr	-	V0	-	V0	-	V0
30-Apr	-	V0	-	V0	-	V0
1-May	-	V0	-	V0	-	V0
2-May	-	V0	-	V0	-	V0
3-May	-	V0	-	V0	-	V0
4-May	-	S	-	S	-	S
5-May	52		78		88	
6-May	-	V0	-	V0	-	V0
7-May	-	V0	-	V0	-	V0
8-May	-	V0	-	V0	-	V0
9-May	-	V0	-	V0	-	V0
10-May	-	V0	-	V0	-	V0
11-May	0	P	0	P	0	P
12-May	-	MD	-	MD	-	MD
13-May	0		2		4	
14-May	0	MI, P	0	MI, P	0	MI, P
15-May	0	P	0	P	0	P
16-May	9		2		3	
17-May	8		2		5	
18-May	0	P, MI	0	P, MI	0	P, MI
19-May	1		0		1	
20-May	-	V0	-	V0	-	V0
21-May	-	V0	-	V0	-	V0
22-May	-	V0	-	V0	-	V0
23-May	-	V0	-	V0	-	V0
24-May	-	V0	-	V0	-	V0
25-May	0	P	1	P	29	P
26-May	0	P	0	P	3	P
27-May	0	MI	0	MI	0	MI
28-May	-	S	-	S	-	S
29-May	2		0		0	
30-May	0	P	0	P	0	P
31-May	-	V0	-	V0	-	V0

Table L-6. Year-to-year and night-to-night pattern of nocturnal spring bird migration (2007) over the onshore sample areas. Date is the date at beginning of night. Density = mean birds km^{-3} measured by averaging maximum dBZ reflectivity from migrants aloft at 0.5° over the sample areas. ND = no data available, MI=mostly insects aloft, MD = missing data, P = precipitation in SA, V0 = bad velocity, S = strobing in SA, OSA = migration out of sample area, and RM = radar malfunction.

Onshore Spring 2007						
Date	1A		2A		3A	
	Density	Comments	Density	Comments	Density	Comments
15-Mar	0	P	0	P	0	P
16-Mar	0	P	0	P	0	P
17-Mar	0	P	0	P	0	P
18-Mar	0	MI	0	MI	0	MI
19-Mar	0	P	0	P	0	P
20-Mar	0	MI	0	MI	0	MI
21-Mar	0	P, MI	0	P, MI	0	P, MI
22-Mar	0	P	0	P	0	P
23-Mar	0	P	0	P	0	P
24-Mar	27		26		5	
25-Mar	21		13		16	
26-Mar	41		341		48	
27-Mar	0	P, MI	0	P, MI	0	P, MI
28-Mar	0	MI	0	MI	0	MI
29-Mar	0	MI	0	MI	0	MI
30-Mar	224		57		43	
31-Mar	11		11		9	
1-Apr	0	P	0	P	0	P
2-Apr	6		7		8	
3-Apr	15		0		1	
4-Apr	0	P, MI	0	P, MI	0	P, MI
5-Apr	0	P	0	P	0	P
6-Apr	0	P	0	P	0	P
7-Apr	0	P	0	P	0	P
8-Apr	0	P, MI	0	P, MI	0	P, MI
9-Apr	0	P, MI	0	P, MI	0	P, MI
10-Apr	29		3		4	
11-Apr	0	P, MI	0	P, MI	0	P, MI
12-Apr	0	P, MI	0	P, MI	0	P, MI
13-Apr	0	MI	0	MI	0	MI
14-Apr	0	P	0	P	0	P
15-Apr	0	P	0	P	0	P
16-Apr	0	P	0	P	0	P
17-Apr	0	P	0	P	0	P
18-Apr	0	P, MI	0	P, MI	0	P, MI
19-Apr	30		7		17	
20-Apr	-	S	-	S	-	S
21-Apr	227		504		54	
22-Apr	-	S	-	S	-	S
23-Apr	29		58		9	
24-Apr	10		7		5	
25-Apr	0	P	0	P	0	P

Table L-6 (*continued*). Year-to-year and night-to-night pattern of nocturnal spring bird migration (2007) over the onshore sample areas. Date is the date at beginning of night. Density = mean birds km^{-3} measured by averaging maximum dBZ reflectivity from migrants aloft at 0.5° over the sample areas. ND = no data available, MI=mostly insects aloft, MD = missing data, P = precipitation in SA, V0 = bad velocity, S = strobing in SA, OSA = migration out of sample area, and RM = radar malfunction.

Onshore Spring 2007						
Date	1A		2A		3A	
	Density	Comments	Density	Comments	Density	Comments
26-Apr	0	P, MI	0	P, MI	0	P, MI
27-Apr	0	P, MI	0	P, MI	0	P, MI
28-Apr	0	P, MI	0	P, MI	0	P, MI
29-Apr	65		82		3	
30-Apr	0	MI	0	MI	0	MI
1-May	345		129		290	
2-May	0	MI	0	MI	0	MI
3-May	62		78		28	
4-May	367		78		28	
5-May	0	P, MI	0	P, MI	0	P, MI
6-May	0	MI	0	MI	0	MI
7-May	-	S	-	S	-	S
8-May	19		10		6	
9-May	35		45		28	
10-May	17		162		31	
11-May	-	V0	-	V0	-	V0
12-May	-	MD	-	MD	-	MD
13-May	-	MD	-	MD	-	MD
14-May	-	V0	-	V0	-	V0
15-May	-	MD	-	MD	-	MD
16-May	0	P	0	P	0	P
17-May	0	P, MI	0	P, MI	0	P, MI
18-May	0	P, MI	0	P, MI	0	P, MI
19-May	0	P	0	P	0	P
20-May	0	P, MI	0	P, MI	0	P, MI
21-May	232		74		36	
22-May	17		21		49	
23-May	21		9		7	
24-May	-	ND	-	ND	-	ND
25-May	-	ND	-	ND	-	ND
26-May	-	ND	-	ND	-	ND
27-May	-	S	-	S	-	S
28-May	18		6		5	
29-May	0		14		7	
30-May	61		10		29	
31-May	41		9		4	

Table L-7. Year-to-year and night-to-night pattern of nocturnal spring bird migration (2007) over the offshore sample areas. Date is the date at beginning of night. Density = mean birds km^{-3} measured by averaging maximum dBZ reflectivity from migrants aloft at 0.5° over the sample areas. ND = no data available, MI=mostly insects aloft, MD = missing data, P = precipitation in SA, V0 = bad velocity, S = strobing in SA, OSA = migration out of sample area, and RM = radar malfunction.

Offshore Spring 2007						
Date	1B		2B		3B	
	Density	Comments	Density	Comments	Density	Comments
15-Mar	0	P	0	P	0	P
16-Mar	0	P	0	P	0	P
17-Mar	0	P	0	P	0	P
18-Mar	0	MI	0	MI	0	MI
19-Mar	0	P	0	P	0	P
20-Mar	0	MI	0	MI	0	MI
21-Mar	0	P, MI	0	P, MI	0	P, MI
22-Mar	0	P	0	P	0	P
23-Mar	0	P	0	P	0	P
24-Mar	3		2		0	
25-Mar	9		0		0	
26-Mar	12		0		3	
27-Mar	0	P, MI	0	P, MI	0	P, MI
28-Mar	0	MI	0	MI	0	MI
29-Mar	0	MI	0	MI	0	MI
30-Mar	22		4		11	
31-Mar	0		0		0	
1-Apr	0	P	0	P	0	P
2-Apr	4		5		6	
3-Apr	1		0		0	
4-Apr	0	P, MI	0	P, MI	0	P, MI
5-Apr	0	P	0	P	0	P
6-Apr	0	P	0	P	0	P
7-Apr	0	P	0	P	0	P
8-Apr	0	P, MI	0	P, MI	0	P, MI
9-Apr	0	P, MI	0	P, MI	0	P, MI
10-Apr	0		0		0	
11-Apr	0	P, MI	0	P, MI	0	P, MI
12-Apr	0	P, MI	0	P, MI	0	P, MI
13-Apr	0	MI	0	MI	0	MI
14-Apr	0	P	0	P	0	P
15-Apr	0	P	0	P	0	P
16-Apr	0	P	0	P	0	P
17-Apr	0	P	0	P	0	P
18-Apr	0	P, MI	0	P, MI	0	P, MI
19-Apr	3		0		0	
20-Apr	-	S	-	S	-	S
21-Apr	103		58		28	
22-Apr	-	S	-	S	-	S
23-Apr	8		3		3	
24-Apr	1		0		2	
25-Apr	0	P	0	P	0	P

Table L-7 (*continued*). Year-to-year and night-to-night pattern of nocturnal spring bird migration (2007) over the offshore sample areas. Date is the date at beginning of night. Density = mean birds km^{-3} measured by averaging maximum dBZ reflectivity from migrants aloft at 0.5° over the sample areas. ND = no data available, MI=mostly insects aloft, MD = missing data, P = precipitation in SA, V0 = bad velocity, S = strobing in SA, OSA = migration out of sample area, and RM = radar malfunction.

Offshore Spring 2007						
Date	1B		2B		3B	
	Density	Comments	Density	Comments	Density	Comments
26-Apr	0	P, MI	0	P, MI	0	P, MI
27-Apr	0	P, MI	0	P, MI	0	P, MI
28-Apr	0	P, MI	0	P, MI	0	P, MI
29-Apr	3		5		0	
30-Apr	0	MI	0	MI	0	MI
1-May	30		18		56	
2-May	0	MI	0	MI	0	MI
3-May	13		2		2	
4-May	24		1		4	
5-May	0	P, MI	0	P, MI	0	P, MI
6-May	0	MI	0	MI	0	MI
7-May	-	S	-	S	-	S
8-May	1		1		0	
9-May	8		6		7	
10-May	2		11		11	
11-May	-	V0	-	V0	-	V0
12-May	-	MD	-	MD	-	MD
13-May	-	MD	-	MD	-	MD
14-May	-	V0	-	V0	-	V0
15-May	-	MD	-	MD	-	MD
16-May	0	P	0	P	0	P
17-May	0	P, MI	0	P, MI	0	P, MI
18-May	0	P, MI	0	P, MI	0	P, MI
19-May	0	P	0	P	0	P
20-May	0	P, MI	0	P, MI	0	P, MI
21-May	3		1		0	
22-May	0		0		0	
23-May	0		1		0	
24-May	-	ND	-	ND	-	ND
25-May	-	ND	-	ND	-	ND
26-May	-	ND	-	ND	-	ND
27-May	-	S	-	S	-	S
28-May	1		0		0	
29-May	3		1		7	
30-May	3		1		2	
31-May	7		0		0	

Table L-8. Year-to-year and night-to-night pattern of nocturnal spring bird migration (2008) over the onshore sample areas. Date is the date at beginning of night. Density = mean birds km^{-3} measured by averaging maximum dBZ reflectivity from migrants aloft at 0.5° over the sample areas. ND = no data available, MI=mostly insects aloft, MD = missing data, P = precipitation in SA, V0 = bad velocity, S = strobing in SA, OSA = migration out of sample area, and RM = radar malfunction.

Onshore Spring 2008						
Date	1A		2A		3A	
	Density	Comments	Density	Comments	Density	Comments
15-Mar	0	P	0	P	0	P
16-Mar	0	P	0	P	0	P
17-Mar	0	P	0	P	0	P
18-Mar	0	P	0	P	0	P
19-Mar	0	P	0	P	0	P
20-Mar	0	P, MI	0	P, MI	0	P, MI
21-Mar	29		16		22	
22-Mar	0	P,MI	0	P,MI	0	P,MI
23-Mar	38		6		16	
24-Mar	0	P, MI	0	P, MI	0	P, MI
25-Mar	22		10		34	
26-Mar	15		9		13	
27-Mar	33		16		5	
28-Mar	0	P	0	P	0	P
29-Mar	0	MI	0	MI	0	MI
30-Mar	-	S	-	S	-	S
31-Mar	0	P	0	P	0	P
1-Apr	15		9		11	
2-Apr	0	MI	0	MI	0	MI
3-Apr	0	P	0	P	0	P
4-Apr	0	P, MI	0	P, MI	0	P, MI
5-Apr	0	P	0	P	0	P
6-Apr	0	MI	0	MI	0	MI
7-Apr	0	P, MI	0	P, MI	0	P, MI
8-Apr	-	S	-	S	-	S
9-Apr	4		5		6	
10-Apr	82		77		40	
11-Apr	37		27		10	
12-Apr	0	P	0	P	0	P
13-Apr	0	P	0	P	0	P
14-Apr	0	MI	0	MI	0	MI
15-Apr	-	S	-	S	-	S
16-Apr	2		7		6	
17-Apr	60		16		9	
18-Apr	92		50		76	
19-Apr	10		4		25	
20-Apr	0	P, MI	0	P, MI	0	P, MI
21-Apr	0	MI	0	MI	0	MI
22-Apr	1		1		0	
23-Apr	164		71		14	
24-Apr	58		40		187	
25-Apr	-	S	-	S	-	S

Table L-8 (*continued*). Year-to-year and night-to-night pattern of nocturnal spring bird migration (2008) over the onshore sample areas. Date is the date at beginning of night. Density = mean birds km^{-3} measured by averaging maximum dBZ reflectivity from migrants aloft at 0.5° over the sample areas. ND = no data available, MI=mostly insects aloft, MD = missing data, P = precipitation in SA, V0 = bad velocity, S = strobing in SA, OSA = migration out of sample area, and RM = radar malfunction.

Onshore Spring 2008						
Date	1A		2A		3A	
	Density	Comments	Density	Comments	Density	Comments
26-Apr	0	P, MI	0	P, MI	0	P, MI
27-Apr	0	P	0	P	0	P
28-Apr	0	P	0	P	0	P
29-Apr	0	MI	0	MI	0	MI
30-Apr	29		68		35	
1-May	0	P	227	P	38	P
2-May	25		39		42	
3-May	0	P	0	P	0	P
4-May	140		37		10	
5-May	133		61		9	
6-May	-	S	-	S	-	S
7-May	372		119		33	
8-May	0	P, MI	0	P, MI	0	P, MI
9-May	0	P	0	P	0	P
10-May	0	MI	0	MI	0	MI
11-May	0	P, MI	0	P, MI	0	P, MI
12-May	0	P	0	P	0	P
13-May	31		11		25	
14-May	-	S	-	S	-	S
15-May	0	P, MI	0	P, MI	0	P, MI
16-May	0	P	0	P	0	P
17-May	116		32		5	
18-May	0	P, MI	0	P, MI	0	P, MI
19-May	0	MI	0	MI	0	MI
20-May	0	P, MI	0	P, MI	0	P, MI
21-May	0	MI	0	MI	0	MI
22-May	0	P, MI	0	P, MI	0	P, MI
23-May	0	MI	0	MI	0	MI
24-May	0	MI	0	MI	0	MI
25-May	215		128		40	
26-May	100		87		9	
27-May	0	P	0	P	0	P
28-May	46		51		7	
29-May	52		29		6	
30-May	65		13		4	
31-May	0	MI	0	MI	0	MI

Table L-9. Year-to-year and night-to-night pattern of nocturnal spring bird migration (2008) over the offshore sample areas. Date is the date at beginning of night. Density = mean birds km^{-3} measured by averaging maximum dBZ reflectivity from migrants aloft at 0.5° over the sample areas. ND = no data available, MI=mostly insects aloft, MD = missing data, P = precipitation in SA, V0 = bad velocity, S = strobing in SA, OSA = migration out of sample area, and RM = radar malfunction.

Offshore Spring 2008						
Date	1B		2B		3B	
	Density	Comments	Density	Comments	Density	Comments
15-Mar	0	P	0	P	0	P
16-Mar	0	P	0	P	0	P
17-Mar	0	P	0	P	0	P
18-Mar	0	P	0	P	0	P
19-Mar	0	P	0	P	0	P
20-Mar	0	P, MI	0	P, MI	0	P, MI
21-Mar	2		2		4	
22-Mar	0	P,MI	0	P,MI	0	P,MI
23-Mar	0		0		1	
24-Mar	0	P, MI	0	P, MI	0	P, MI
25-Mar	4		2		3	
26-Mar	4		2		3	
27-Mar	2		0		2	
28-Mar	0	P	0	P	0	P
29-Mar	0	MI	0	MI	0	MI
30-Mar	-	S	-	S	-	S
31-Mar	0	P	0	P	0	P
1-Apr	3		0		0	
2-Apr	0	MI	0	MI	0	MI
3-Apr	0	P	0	P	0	P
4-Apr	0	P, MI	0	P, MI	0	P, MI
5-Apr	0	P	0	P	0	P
6-Apr	0	MI	0	MI	0	MI
7-Apr	0	P, MI	0	P, MI	0	P, MI
8-Apr	-	S	-	S	-	S
9-Apr	3		0		12	
10-Apr	20		2		1	
11-Apr	2		4		4	
12-Apr	0	P	0	P	0	P
13-Apr	0	P	0	P	0	P
14-Apr	0	MI	0	MI	0	MI
15-Apr	-	S	-	S	-	S
16-Apr	0		0		0	
17-Apr	3		3		0	
18-Apr	4		8		3	
19-Apr	2		1		2	
20-Apr	0	P, MI	0	P, MI	0	P, MI
21-Apr	0	MI	0	MI	0	MI
22-Apr	0		1		0	
23-Apr	3		0		0	
24-Apr	6		1		8	
25-Apr	-	S	-	S	-	S

Table L-9 (*continued*). Year-to-year and night-to-night pattern of nocturnal spring bird migration (2008) over the offshore sample areas. Date is the date at beginning of night. Density = mean birds km^{-3} measured by averaging maximum dBZ reflectivity from migrants aloft at 0.5° over the sample areas. ND = no data available, MI=mostly insects aloft, MD = missing data, P = precipitation in SA, V0 = bad velocity, S = strobing in SA, OSA = migration out of sample area, and RM = radar malfunction.

Offshore Spring 2008						
Date	1B		2B		3B	
	Density	Comments	Density	Comments	Density	Comments
26-Apr	0	P, MI	0	P, MI	0	P, MI
27-Apr	0	P	0	P	0	P
28-Apr	0	P	0	P	0	P
29-Apr	0	MI	0	MI	0	MI
30-Apr	2		2		0	
1-May	0	P	3	P	2	P
2-May	3		4		3	
3-May	0	P	0	P	0	P
4-May	8		1		1	
5-May	3		2		2	
6-May	-	S	-	S	-	S
7-May	13		4		4	
8-May	0	P, MI	0	P, MI	0	P, MI
9-May	0	P	0	P	0	P
10-May	0	MI	0	MI	0	MI
11-May	0	P, MI	0	P, MI	0	P, MI
12-May	0	P	0	P	0	P
13-May	0		0		0	
14-May	-	S	-	S	-	S
15-May	0	P, MI	0	P, MI	0	P, MI
16-May	0	P	0	P	0	P
17-May	10		3		3	
18-May	0	P, MI	0	P, MI	0	P, MI
19-May	0	MI	0	MI	0	MI
20-May	0	P, MI	0	P, MI	0	P, MI
21-May	0	MI	0	MI	0	MI
22-May	0	P, MI	0	P, MI	0	P, MI
23-May	0	MI	0	MI	0	MI
24-May	0	MI	0	MI	0	MI
25-May	15		7		3	
26-May	10		5		3	
27-May	0	P	0	P	0	P
28-May	1		1		7	
29-May	31		0		1	
30-May	2		0		0	
31-May	0	MI	0	MI	0	MI

Table L-10. Year-to-year and night-to-night pattern of nocturnal spring bird migration (2009) over the onshore sample areas. Date is the date at beginning of night. Density = mean birds km^{-3} measured by averaging maximum dBZ reflectivity from migrants aloft at 0.5° over the sample areas. ND = no data available, MI=mostly insects aloft, MD = missing data, P = precipitation in SA, V0 = bad velocity, S = strobing in SA, OSA = migration out of sample area, and RM = radar malfunction.

Onshore Spring 2009						
Date	1A		2A		3A	
	Density	Comments	Density	Comments	Density	Comments
15-Mar	0	P	0	P	0	P
16-Mar	0	P	0	P	0	P
17-Mar	-	S	-	S	-	S
18-Mar	114		66		76	
19-Mar	0	P, MI	0	P, MI	0	P, MI
20-Mar	-	RM	-	RM	-	RM
21-Mar	-	RM	-	RM	-	RM
22-Mar	-	RM	-	RM	-	RM
23-Mar	0	RM, MI	0	RM, MI	0	RM, MI
24-Mar	0	MI	0	MI	0	MI
25-Mar	44		17		57	
26-Mar	0	P	0	P	0	P
27-Mar	0	P	0	P	0	P
28-Mar	0	P	0	P	0	P
29-Mar	0	P, MI	0	P, MI	0	P, MI
30-Mar	0	MI	0	MI	0	MI
31-Mar	17		66		16	
1-Apr	0	P	0	P	0	P
2-Apr	-	OSA	-	OSA	-	OSA
3-Apr	0	P, MI	0	P, MI	0	P, MI
4-Apr	-	RM	-	RM	-	RM
5-Apr	31		27		16	
6-Apr	0	P	0	P	0	P
7-Apr	0	P	0	P	0	P
8-Apr	0	P, MI	0	P, MI	0	P, MI
9-Apr	29		5		8	
10-Apr	0	P, MI	0	P, MI	0	P, MI
11-Apr	0	P, MI	0	P, MI	0	P, MI
12-Apr	-	RM	-	RM	-	RM
13-Apr	0	P	0	P	0	P
14-Apr	0	P	0	P	0	P
15-Apr	0	P, MI	0	P, MI	0	P, MI
16-Apr	14		9		9	
17-Apr	45		30		16	
18-Apr	134		45		9	
19-Apr	0	P	0	P	0	P
20-Apr	0	P	0	P	0	P
21-Apr	0	P, MI	0	P, MI	0	P, MI
22-Apr	0	P,MI	0	P,MI	0	P,MI
23-Apr	0	MI	0	MI	0	MI
24-Apr	187		142		91	
25-Apr	116		67		44	

Table L-10 (*continued*). Year-to-year and night-to-night pattern of nocturnal spring bird migration (2009) over the onshore sample areas. Date is the date at beginning of night. Density = mean birds km^{-3} measured by averaging maximum dBZ reflectivity from migrants aloft at 0.5° over the sample areas. ND = no data available, MI=mostly insects aloft, MD = missing data, P = precipitation in SA, V0 = bad velocity, S = strobing in SA, OSA = migration out of sample area, and RM = radar malfunction.

Onshore Spring 2009						
Date	1A		2A		3A	
	Density	Comments	Density	Comments	Density	Comments
26-Apr	168		45		45	
27-Apr	245		43		19	
28-Apr	0	P, MI	0	P, MI	0	P, MI
29-Apr	-	S	-	S	-	S
30-Apr	11		15		7	
1-May	265		88		6	
2-May	0	P,MI	0	P,MI	0	P,MI
3-May	0	P	0	P	0	P
4-May	0	P, MI	0	P, MI	0	P, MI
5-May	0	P	0	P	0	P
6-May	0	P	0	P	0	P
7-May	-	S	-	S	-	S
8-May	238		121		234	
9-May	0	P, MI	0	P, MI	0	P, MI
10-May	0	MI	0	MI	0	MI
11-May	223		16		8	
12-May	171		71		40	
13-May	-	S	-	S	-	S
14-May	0	P	0	P	0	P
15-May	91		65		15	
16-May	64		25		15	
17-May	0	P	0	P	0	P
18-May	-	ND	-	ND	-	ND
19-May	292		78		20	
20-May	-	S	-	S	-	S
21-May	66		65		25	
22-May	135		83		12	
23-May	105		23		9	
24-May	-	S	-	S	-	S
25-May	0	P, MI	0	P, MI	0	P, MI
26-May	0	P	0	P	0	P
27-May	-	S	-	S	-	S
28-May	0	P	0	P	0	P
29-May	0	P, MI	0	P, MI	0	P, MI
30-May	32		31		11	
31-May	0	MI	0	MI	0	MI

Table L-11. Year-to-year and night-to-night pattern of nocturnal spring bird migration (2009) over the offshore sample areas. Date is the date at beginning of night. Density = mean birds km^{-3} measured by averaging maximum dBZ reflectivity from migrants aloft at 0.5° over the sample areas. ND = no data available, MI=mostly insects aloft, MD = missing data, P = precipitation in SA, V0 = bad velocity, S = strobing in SA, OSA = migration out of sample area, and RM = radar malfunction.

Offshore Spring 2009						
Date	1B		2B		3B	
	Density	Comments	Density	Comments	Density	Comments
15-Mar	0	P	0	P	0	P
16-Mar	0	P	0	P	0	P
17-Mar	-	S	-	S	-	S
18-Mar	6		8		8	
19-Mar	0	P, MI	0	P, MI	0	P, MI
20-Mar	-	RM	-	RM	-	RM
21-Mar	-	RM	-	RM	-	RM
22-Mar	-	RM	-	RM	-	RM
23-Mar	0	RM, MI	0	RM, MI	0	RM, MI
24-Mar	0	MI	0	MI	0	MI
25-Mar	0		0		0	
26-Mar	0	P	0	P	0	P
27-Mar	0	P	0	P	0	P
28-Mar	0	P	0	P	0	P
29-Mar	0	P, MI	0	P, MI	0	P, MI
30-Mar	0	MI	0	MI	0	MI
31-Mar	1		7		5	
1-Apr	0	P	0	P	0	P
2-Apr	-	OSA	-	OSA	-	OSA
3-Apr	0	P, MI	0	P, MI	0	P, MI
4-Apr	-	RM	-	RM	-	RM
5-Apr	7		6		4	
6-Apr	0	P	0	P	0	P
7-Apr	0	P	0	P	0	P
8-Apr	0	P, MI	0	P, MI	0	P, MI
9-Apr	6		2		3	
10-Apr	0	P, MI	0	P, MI	0	P, MI
11-Apr	0	P, MI	0	P, MI	0	P, MI
12-Apr	-	RM	-	RM	-	RM
13-Apr	0	P	0	P	0	P
14-Apr	0	P	0	P	0	P
15-Apr	0	P, MI	0	P, MI	0	P, MI
16-Apr	2		0		0	
17-Apr	8		4		8	
18-Apr	9		1		1	
19-Apr	0	P	0	P	0	P
20-Apr	0	P	0	P	0	P
21-Apr	0	P, MI	0	P, MI	0	P, MI
22-Apr	0	P,MI	0	P,MI	0	P,MI
23-Apr	0	MI	0	MI	0	MI
24-Apr	7		5		12	
25-Apr	21		4		7	

Table L-11 (*continued*). Year-to-year and night-to-night pattern of nocturnal spring bird migration (2009) over the offshore sample areas. Date is the date at beginning of night. Density = mean birds km^{-3} measured by averaging maximum dBZ reflectivity from migrants aloft at 0.5° over the sample areas. ND = no data available, MI=mostly insects aloft, MD = missing data, P = precipitation in SA, V0 = bad velocity, S = strobing in SA, OSA = migration out of sample area, and RM = radar malfunction.

Offshore Spring 2009						
Date	1B		2B		3B	
	Density	Comments	Density	Comments	Density	Comments
26-Apr	24		4		4	
27-Apr	11		4		6	
28-Apr	0	P, MI	0	P, MI	0	P, MI
29-Apr	-	S	-	S	-	S
30-Apr	6		1		5	
1-May	4		2		4	
2-May	0	P,MI	0	P,MI	0	P,MI
3-May	0	P	0	P	0	P
4-May	0	P, MI	0	P, MI	0	P, MI
5-May	0	P	0	P	0	P
6-May	0	P	0	P	0	P
7-May	-	S	-	S	-	S
8-May	17		6		7	
9-May	0	P, MI	0	P, MI	0	P, MI
10-May	0	MI	0	MI	0	MI
11-May	8		3		9	
12-May	11		7		29	
13-May	-	S	-	S	-	S
14-May	0	P	0	P	0	P
15-May	4		4		4	
16-May	9		6		10	
17-May	0	P	0	P	0	P
18-May	-	ND	-	ND	-	ND
19-May	14		6		27	
20-May	-	S	-	S	-	S
21-May	22		7		10	
22-May	13		2		8	
23-May	7		7		5	
24-May	-	S	-	S	-	S
25-May	0	P, MI	0	P, MI	0	P, MI
26-May	0	P	0	P	0	P
27-May	-	S	-	S	-	S
28-May	0	P	0	P	0	P
29-May	0	P, MI	0	P, MI	0	P, MI
30-May	2		1		4	
31-May	0	MI	0	MI	0	MI

Table L-12. Year-to-year and night-to-night pattern of nocturnal fall bird migration (2004) over the onshore sample areas. Date is the date at beginning of night. Density = mean birds km^{-3} measured by averaging maximum dBZ reflectivity from migrants aloft at 0.5° over the sample areas. ND = no data available, MI=mostly insects aloft, MD = missing data, P = precipitation in SA, V0 = bad velocity, S = strobing in SA, OSA = migration out of sample area, and RM = radar malfunction.

Onshore Fall 2004						
Date	1A		2A		3A	
	Density	Comments	Density	Comments	Density	Comments
8/15/04	0	P	0	P	0	P
8/16/04	7		18		12	
8/17/04	0	P, MI	0	P, MI	0	P, MI
8/18/04	0	P, MI	0	P, MI	0	P, MI
8/19/04	0	P, MI	0	P, MI	0	P, MI
8/20/04	-	ND	-	ND	-	ND
8/21/04	-	ND	-	ND	-	ND
8/22/04	29		21		20	
8/23/04	18		14		6	
8/24/04	16		7		25	
8/25/04	-	ND	-	ND	-	ND
8/26/04	0	P, MI	0	P, MI	0	P, MI
8/27/04	0		1		5	
8/28/04	2		15		31	
8/29/04	0		0		0	
8/30/04	0	P, MI	0	P, MI	0	P, MI
8/31/04	41		244		195	
9/1/04	41		53		48	
9/2/04	10		4		13	
9/3/04	7		2		5	
9/4/04	4		35		36	
9/5/04	0	0SA	0	0SA	0	0SA
9/6/04	0	P	0	P	0	P
9/7/04	0	P, MI	0	P, MI	0	P, MI
9/8/04	0	P, MI	0	P, MI	0	P, MI
9/9/04	16		15		12	
9/10/04	466		153		45	
9/11/04	4		23		16	
9/12/04	35		12		4	
9/13/04	12		150		20	
9/14/04	0		0		0	
9/15/04	0		0		0	
9/16/04	23		16		26	
9/17/04	0	P, MI	0	P, MI	0	P, MI
9/18/04	0		77		22	
9/19/04	30		21		19	
9/20/04	26		41		8	
9/21/04	0		9		15	
9/22/04	17		17		13	
9/23/04	13		13		13	
9/24/04	1		5		5	
9/25/04	0	P, MI	0	P, MI	0	P, MI

Table L-12 (*continued*). Year-to-year and night-to-night pattern of nocturnal fall bird migration (2004) over the onshore sample areas. Date is the date at beginning of night. Density = mean birds km^{-3} measured by averaging maximum dBZ reflectivity from migrants aloft at 0.5° over the sample areas. ND = no data available, MI=mostly insects aloft, MD = missing data, P = precipitation in SA, V0 = bad velocity, S = strobing in SA, OSA = migration out of sample area, and RM = radar malfunction.

Onshore Fall 2004						
Date	1A		2A		3A	
	Density	Comments	Density	Comments	Density	Comments
9/26/04	46		112		33	
9/27/04	0	P	0	P	0	P
9/28/04	0	P	0	P	0	P
9/29/04	33		93		31	
9/30/04	-	S	-	S	-	S
10/1/04	21		7		25	
10/2/04	0	P	0	P	0	P
10/3/04	1		130		50	
10/4/04	84		44		10	
10/5/04	528		115		54	
10/6/04	18		5		29	
10/7/04	2		7		8	
10/8/04	-	S	-	S	-	S
10/9/04	0	P, MI	0	P, MI	0	P, MI
10/10/04	169		108		36	
10/11/04	52		116		34	
10/12/04	37		33		37	
10/13/04	0	P	0	P	0	P
10/14/04	0	MI	0	MI	0	MI
10/15/04	0	P, MI	0	P, MI	0	P, MI
10/16/04	16		0		0	
10/17/04	0	P	0	P	0	P
10/18/04	0	P	0	P	0	P
10/19/04	0	P, MI	0	P, MI	0	P, MI
10/20/04	16		4		4	
10/21/04	0	P	0	P	0	P
10/22/04	0	P	0	P	0	P
10/23/04	4		10		4	
10/24/04	13		16		15	
10/25/04	1		58		38	
10/26/04	157		91		64	
10/27/04	18		19		20	
10/28/04	8		7		9	
10/29/04	0	P	0	P	0	P
10/30/04	0	P, MI	0	P, MI	0	P, MI
10/31/04	58		41		4	
11/1/04	0		12		137	
11/2/04	0	P, MI	0	P, MI	0	P, MI
11/3/04	10		26		70	
11/4/04	0	P	0	P	0	P
11/5/04	0	MI	0	MI	0	MI
11/6/04	0	MI	0	MI	0	MI

Table L-12 (*continued*). Year-to-year and night-to-night pattern of nocturnal fall bird migration (2004) over the onshore sample areas. Date is the date at beginning of night. Density = mean birds km^{-3} measured by averaging maximum dBZ reflectivity from migrants aloft at 0.5° over the sample areas. ND = no data available, MI=mostly insects aloft, MD = missing data, P = precipitation in SA, V0 = bad velocity, S = strobing in SA, OSA = migration out of sample area, and RM = radar malfunction.

Onshore Fall 2004						
Date	1A		2A		3A	
	Density	Comments	Density	Comments	Density	Comments
11/7/04	0	MI	0	MI	0	MI
11/8/04	12		42		41	
11/9/04	-	ND	-	ND	-	ND
11/10/04	0	MI	0	MI	0	MI
11/11/04	0	P, MI	0	P, MI	0	P, MI
11/12/04	0	P	0	P	0	P
11/13/04	12		36		72	
11/14/04	5		12		5	
11/15/04	0	MI	0	MI	0	MI

Table L-13. Year-to-year and night-to-night pattern of nocturnal fall bird migration (2004) over the offshore sample areas. Date is the date at beginning of night. Density = mean birds km^{-3} measured by averaging maximum dBZ reflectivity from migrants aloft at 0.5° over the sample areas. ND = no data available, MI=mostly insects aloft, MD = missing data, P = precipitation in SA, V0 = bad velocity, S = strobing in SA, OSA = migration out of sample area, and RM = radar malfunction.

Offshore Fall 2004						
Date	1B		2B		3B	
	Density	Comments	Density	Comments	Density	Comments
8/15/04	0	P	0	P	0	P
8/16/04	3		5		6	
8/17/04	0	P, MI	0	P, MI	0	P, MI
8/18/04	0	P, MI	0	P, MI	0	P, MI
8/19/04	0	P, MI	0	P, MI	0	P, MI
8/20/04	-	ND	-	ND	-	ND
8/21/04	-	ND	-	ND	-	ND
8/22/04	1		3		5	
8/23/04	1		2		4	
8/24/04	4		2		5	
8/25/04	-	ND	-	ND	-	ND
8/26/04	0	P, MI	0	P, MI	0	P, MI
8/27/04	4		2		0	
8/28/04	2		2		4	
8/29/04	0		0		0	
8/30/04	0	P, MI	0	P, MI	0	P, MI
8/31/04	7		29		28	
9/1/04	2		1		6	
9/2/04	1		1		3	
9/3/04	0		2		3	
9/4/04	9		2		6	
9/5/04	0	0SA	0	0SA	0	0SA
9/6/04	0	P	0	P	0	P
9/7/04	0	P, MI	0	P, MI	0	P, MI
9/8/04	0	P, MI	0	P, MI	0	P, MI
9/9/04	2		2		5	
9/10/04	16		7		2	
9/11/04	1		1		3	
9/12/04	1		3		2	
9/13/04	3		2		4	
9/14/04	0		0		0	
9/15/04	0		0		0	
9/16/04	5		3		5	
9/17/04	0	P, MI	0	P, MI	0	P, MI
9/18/04	0		25		4	
9/19/04	8		4		3	
9/20/04	5		3		4	
9/21/04	2		4		16	
9/22/04	2		3		4	
9/23/04	2		2		7	
9/24/04	1		1		3	
9/25/04	0	P, MI	0	P, MI	0	P, MI

Table L-13 (*continued*). Year-to-year and night-to-night pattern of nocturnal fall bird migration (2004) over the offshore sample areas. Date is the date at beginning of night. Density = mean birds km^{-3} measured by averaging maximum dBZ reflectivity from migrants aloft at 0.5° over the sample areas. ND = no data available, MI=mostly insects aloft, MD = missing data, P = precipitation in SA, V0 = bad velocity, S = strobing in SA, OSA = migration out of sample area, and RM = radar malfunction.

Offshore Fall 2004						
Date	1B		2B		3B	
	Density	Comments	Density	Comments	Density	Comments
9/26/04	15		12		6	
9/27/04	0	P	0	P	0	P
9/28/04	0	P	0	P	0	P
9/29/04	8		5		8	
9/30/04	-	S	-	S	-	S
10/1/04	7		4		4	
10/2/04	0	P	0	P	0	P
10/3/04	14		22		22	
10/4/04	0		4		3	
10/5/04	19		23		9	
10/6/04	3		4		4	
10/7/04	2		2		3	
10/8/04	-	S	-	S	-	S
10/9/04	0	P, MI	0	P, MI	0	P, MI
10/10/04	25		10		7	
10/11/04	2		4		4	
10/12/04	2		3		4	
10/13/04	0	P	0	P	0	P
10/14/04	0	MI	0	MI	0	MI
10/15/04	0	P, MI	0	P, MI	0	P, MI
10/16/04	5		0		0	
10/17/04	0	P	0	P	0	P
10/18/04	0	P	0	P	0	P
10/19/04	0	P, MI	0	P, MI	0	P, MI
10/20/04	2		1		21	
10/21/04	0	P	0	P	0	P
10/22/04	0	P	0	P	0	P
10/23/04	0		0		3	
10/24/04	3		4		5	
10/25/04	8		6		2	
10/26/04	52		31		14	
10/27/04	6		2		3	
10/28/04	1		3		3	
10/29/04	0	P	0	P	0	P
10/30/04	0	P, MI	0	P, MI	0	P, MI
10/31/04	6		8		7	
11/1/04	5		31		52	
11/2/04	0	P, MI	0	P, MI	0	P, MI
11/3/04	1		5		8	
11/4/04	0	P	0	P	0	P
11/5/04	0	MI	0	MI	0	MI
11/6/04	0	MI	0	MI	0	MI

Table L-13 (*continued*). Year-to-year and night-to-night pattern of nocturnal fall bird migration (2004) over the offshore sample areas. Date is the date at beginning of night. Density = mean birds km^{-3} measured by averaging maximum dBZ reflectivity from migrants aloft at 0.5° over the sample areas. ND = no data available, MI=mostly insects aloft, MD = missing data, P = precipitation in SA, V0 = bad velocity, S = strobing in SA, OSA = migration out of sample area, and RM = radar malfunction.

Offshore Fall 2004						
Date	1B		2B		3B	
	Density	Comments	Density	Comments	Density	Comments
11/7/04	0	MI	0	MI	0	MI
11/8/04	2		5		3	
11/9/04	-	ND	-	ND	-	ND
11/10/04	0	MI	0	MI	0	MI
11/11/04	0	P, MI	0	P, MI	0	P, MI
11/12/04	0	P	0	P	0	P
11/13/04	0		3		11	
11/14/04	2		3		3	
11/15/04	0	MI	0	MI	0	MI

Table L-14. Year-to-year and night-to-night pattern of nocturnal fall bird migration (2005) over the onshore sample areas. Date is the date at beginning of night. Density = mean birds km^{-3} measured by averaging maximum dBZ reflectivity from migrants aloft at 0.5° over the sample areas. ND = no data available, MI=mostly insects aloft, MD = missing data, P = precipitation in SA, V0 = bad velocity, S = strobing in SA, OSA = migration out of sample area, and RM = radar malfunction.

Onshore Fall 2005						
Date	1A		2A		3A	
	Density	Comments	Density	Comments	Density	Comments
15-Aug	16		4		8	
16-Aug	0	P	0	P	0	P
17-Aug	0	P, S	0	P, S	0	P, S
18-Aug	0	MI, S	0	MI, S	0	MI, S
19-Aug	0	P, MI	0	P, MI	0	P, MI
20-Aug	-	MD	-	MD	-	MD
21-Aug	-	MD	-	MD	-	MD
22-Aug	80		64		54	
23-Aug	-	MD	-	MD	-	MD
24-Aug	81		43		22	
25-Aug	0	MI	0	MI	0	MI
26-Aug	0	P, MI	0	P, MI	0	P, MI
27-Aug	0	P, MI	0	P, MI	0	P, MI
28-Aug	0	MI	0	MI	0	MI
29-Aug	0	P, MI	0	P, MI	0	P, MI
30-Aug	0	P, MI	0	P, MI	0	P, MI
31-Aug	25		64		32	
1-Sep	342		349		132	
2-Sep	-	S	-	S	-	S
3-Sep	225		126		66	
4-Sep	47		38		22	
5-Sep	16		29		45	
6-Sep	9		6		22	
7-Sep	-	S	-	S	-	S
8-Sep	-	S	-	S	-	S
9-Sep	88		173		182	
10-Sep	15		72		122	
11-Sep	1		12		9	
12-Sep	-	S	-	S	-	S
13-Sep	-	S	-	S	-	S
14-Sep	0	P, MI	0	P, MI	0	P, MI
15-Sep	-	S	-	S	-	S
16-Sep	1		7		44	
17-Sep	0	P, MI	0	P, MI	0	P, MI
18-Sep	99		29		7	
19-Sep	-	S	-	S	-	S
20-Sep	51		70		16	
21-Sep	10		17		5	
22-Sep	0	MI	0	MI	0	MI
23-Sep	0	P	24	P	14	P
24-Sep	14		7		18	
25-Sep	0	MI	0	MI	0	MI

Table L-14 (*continued*). Year-to-year and night-to-night pattern of nocturnal fall bird migration (2005) over the onshore sample areas. Date is the date at beginning of night. Density = mean birds km^{-3} measured by averaging maximum dBZ reflectivity from migrants aloft at 0.5° over the sample areas. ND = no data available, MI=mostly insects aloft, MD = missing data, P = precipitation in SA, V0 = bad velocity, S = strobing in SA, OSA = migration out of sample area, and RM = radar malfunction.

Onshore Fall 2005						
Date	1A		2A		3A	
	Density	Comments	Density	Comments	Density	Comments
26-Sep	0	P, MI	0	P, MI	0	P, MI
27-Sep	87		59		37	
28-Sep	0	MI	0	MI	0	MI
29-Sep	23		27		27	
30-Sep	23		32		12	
1-Oct	11		29		8	
2-Oct	-	S	-	S	-	S
3-Oct	-	S	-	S	-	S
4-Oct	22		17		47	
5-Oct	-	S	-	S	-	S
6-Oct	0	P, MI	0	P, MI	0	P, MI
7-Oct	0	P	0	P	0	P
8-Oct	0	P	0	P	0	P
9-Oct	1		15		4	
10-Oct	0	P	0	P	0	P
11-Oct	0	P	0	P	0	P
12-Oct	0	P	0	P	0	P
13-Oct	0	P	0	P	0	P
14-Oct	0	P	0	P	0	P
15-Oct	506		193		46	
16-Oct	20		22		8	
17-Oct	456		361		102	
18-Oct	256		165		6	
19-Oct	0	MI	0	MI	0	MI
20-Oct	705		355		124	
21-Oct	0	P, MI	0	P, MI	0	P, MI
22-Oct	0	P, MI	0	P, MI	0	P, MI
23-Oct	342		152		107	
24-Oct	0	P	0	P	0	P
25-Oct	0	P	0	P	0	P
26-Oct	35		241		72	
27-Oct	23		46		26	
28-Oct	100		325		109	
29-Oct	41		79		58	
30-Oct	15		46		33	
31-Oct	0	MI	0	MI	0	MI
1-Nov	0	P, MI	0	P, MI	0	P, MI
2-Nov	156		347		196	
3-Nov	0	MI	0	MI	0	MI
4-Nov	0	P, MI	0	P, MI	0	P, MI
5-Nov	7		8		13	
6-Nov	0	P, MI	0	P, MI	0	P, MI

Table L-14 (*continued*). Year-to-year and night-to-night pattern of nocturnal fall bird migration (2005) over the onshore sample areas. Date is the date at beginning of night. Density = mean birds km^{-3} measured by averaging maximum dBZ reflectivity from migrants aloft at 0.5° over the sample areas. ND = no data available, MI=mostly insects aloft, MD = missing data, P = precipitation in SA, V0 = bad velocity, S = strobing in SA, OSA = migration out of sample area, and RM = radar malfunction.

Onshore Fall 2005						
Date	1A		2A		3A	
	Density	Comments	Density	Comments	Density	Comments
7-Nov	55		167		90	
8-Nov	30		117		92	
9-Nov	-	MD	-	MD	-	MD
10-Nov	5		12		20	
11-Nov	-	ND	-	ND	-	ND
12-Nov	-	ND	-	ND	-	ND
13-Nov	0	P, MI	0	P, MI	0	P, MI
14-Nov	38		91		40	
15-Nov	0	P, MI	0	P, MI	0	P, MI

Table L-15. Year-to-year and night-to-night pattern of nocturnal fall bird migration (2005) over the offshore sample areas. Date is the date at beginning of night. Density = mean birds km^{-3} measured by averaging maximum dBZ reflectivity from migrants aloft at 0.5° over the sample areas. ND = no data available, MI=mostly insects aloft, MD = missing data, P = precipitation in SA, V0 = bad velocity, S = strobing in SA, OSA = migration out of sample area, and RM = radar malfunction.

Offshore Fall 2005						
Date	1B		2B		3B	
	Density	Comments	Density	Comments	Density	Comments
15-Aug	4		2		13	
16-Aug	0	P	0	P	0	P
17-Aug	0	P, S	0	P, S	0	P, S
18-Aug	0	MI, S	0	MI, S	0	MI, S
19-Aug	0	P, MI	0	P, MI	0	P, MI
20-Aug	-	MD	-	MD	-	MD
21-Aug	-	MD	-	MD	-	MD
22-Aug	19		10		6	
23-Aug	-	MD	-	MD	-	MD
24-Aug	10		11		6	
25-Aug	0	MI	0	MI	0	MI
26-Aug	0	P, MI	0	P, MI	0	P, MI
27-Aug	0	P, MI	0	P, MI	0	P, MI
28-Aug	0	MI	0	MI	0	MI
29-Aug	0	P, MI	0	P, MI	0	P, MI
30-Aug	0	P, MI	0	P, MI	0	P, MI
31-Aug	16		15		14	
1-Sep	31		25		11	
2-Sep	-	S	-	S	-	S
3-Sep	41		10		17	
4-Sep	17		4		6	
5-Sep	6		0		8	
6-Sep	4		1		4	
7-Sep	-	S	-	S	-	S
8-Sep	-	S	-	S	-	S
9-Sep	39		42		7	
10-Sep	18		8		9	
11-Sep	1		3		3	
12-Sep	-	S	-	S	-	S
13-Sep	-	S	-	S	-	S
14-Sep	0	P, MI	0	P, MI	0	P, MI
15-Sep	-	S	-	S	-	S
16-Sep	2		3		5	
17-Sep	0	P, MI	0	P, MI	0	P, MI
18-Sep	7		4		2	
19-Sep	-	S	-	S	-	S
20-Sep	9		19		4	
21-Sep	5		1		2	
22-Sep	0	MI	0	MI	0	MI
23-Sep	0	P	2	P	3	P
24-Sep	2		3		3	
25-Sep	0	MI	0	MI	0	MI

Table L-15 (*continued*). Year-to-year and night-to-night pattern of nocturnal fall bird migration (2005) over the offshore sample areas. Date is the date at beginning of night. Density = mean birds km^{-3} measured by averaging maximum dBZ reflectivity from migrants aloft at 0.5° over the sample areas. ND = no data available, MI=mostly insects aloft, MD = missing data, P = precipitation in SA, V0 = bad velocity, S = strobing in SA, OSA = migration out of sample area, and RM = radar malfunction.

Offshore Fall 2005						
Date	1B		2B		3B	
	Density	Comments	Density	Comments	Density	Comments
26-Sep	0	P, MI	0	P, MI	0	P, MI
27-Sep	18		11		6	
28-Sep	0	MI	0	MI	0	MI
29-Sep	9		5		4	
30-Sep	5		2		3	
1-Oct	5		2		5	
2-Oct	-	S	-	S	-	S
3-Oct	-	S	-	S	-	S
4-Oct	4		3		5	
5-Oct	-	S	-	S	-	S
6-Oct	0	P, MI	0	P, MI	0	P, MI
7-Oct	0	P	0	P	0	P
8-Oct	0	P	0	P	0	P
9-Oct	2		2		4	
10-Oct	0	P	0	P	0	P
11-Oct	0	P	0	P	0	P
12-Oct	0	P	0	P	0	P
13-Oct	0	P	0	P	0	P
14-Oct	0	P	0	P	0	P
15-Oct	73		50		18	
16-Oct	10		9		6	
17-Oct	122		144		50	
18-Oct	9		39		5	
19-Oct	0	MI	0	MI	0	MI
20-Oct	37		18		8	
21-Oct	0	P, MI	0	P, MI	0	P, MI
22-Oct	0	P, MI	0	P, MI	0	P, MI
23-Oct	17		6		7	
24-Oct	0	P	0	P	0	P
25-Oct	0	P	0	P	0	P
26-Oct	12		15		13	
27-Oct	4		4		2	
28-Oct	10		4		10	
29-Oct	10		21		27	
30-Oct	0		14		5	
31-Oct	0	MI	0	MI	0	MI
1-Nov	0	P, MI	0	P, MI	0	P, MI
2-Nov	36		114		83	
3-Nov	0	MI	0	MI	0	MI
4-Nov	0	P, MI	0	P, MI	0	P, MI
5-Nov	1		3		4	
6-Nov	0	P, MI	0	P, MI	0	P, MI

Table L-15 (*continued*). Year-to-year and night-to-night pattern of nocturnal fall bird migration (2005) over the offshore sample areas. Date is the date at beginning of night. Density = mean birds km^{-3} measured by averaging maximum dBZ reflectivity from migrants aloft at 0.5° over the sample areas. ND = no data available, MI=mostly insects aloft, MD = missing data, P = precipitation in SA, V0 = bad velocity, S = strobing in SA, OSA = migration out of sample area, and RM = radar malfunction.

Offshore Fall 2005						
Date	1B		2B		3B	
	Density	Comments	Density	Comments	Density	Comments
7-Nov	15		19		19	
8-Nov	10		5		7	
9-Nov	-	MD	-	MD	-	MD
10-Nov	3		3		4	
11-Nov	-	ND	-	ND	-	ND
12-Nov	-	ND	-	ND	-	ND
13-Nov	0	P, MI	0	P, MI	0	P, MI
14-Nov	6		2		3	
15-Nov	0	P, MI	0	P, MI	0	P, MI

Table L-16. Year-to-year and night-to-night pattern of nocturnal fall bird migration (2006) over the onshore sample areas. Date is the date at beginning of night. Density = mean birds km^{-3} measured by averaging maximum dBZ reflectivity from migrants aloft at 0.5° over the sample areas. ND = no data available, MI=mostly insects aloft, MD = missing data, P = precipitation in SA, V0 = bad velocity, S = strobing in SA, OSA = migration out of sample area, and RM = radar malfunction.

Onshore Fall 2006						
Date	1A		2A		3A	
	Density	Comments	Density	Comments	Density	Comments
15-Aug	-	S	-	S	-	S
16-Aug	-	V0	-	V0	-	V0
17-Aug	-	V0	-	V0	-	V0
18-Aug	-	V0	-	V0	-	V0
19-Aug	0	P, MI	0	P, MI	0	P, MI
20-Aug	23		38		4	
21-Aug	85		116		29	
22-Aug	-	S	-	S	-	S
23-Aug	-	S	-	S	-	S
24-Aug	0	MI	0	MI	0	MI
25-Aug	4		12		6	
26-Aug	0	MI	0	MI	0	MI
27-Aug	0	P	0	P	0	P
28-Aug	3	P IN SA	21	P IN SA	9	P IN SA
29-Aug	0	P, MI	0	P, MI	0	P, MI
30-Aug	-	S	-	S	-	S
31-Aug	-	S	-	S	-	S
1-Sep	0	P, RI	0	P, RI	0	P, RI
2-Sep	0	P, RI	0	P, RI	0	P, RI
3-Sep	-	V0	-	V0	-	V0
4-Sep	-	P	-	P	-	P
5-Sep	0	P	0	P	0	P
6-Sep	-	V0	-	V0	-	V0
7-Sep	-	S	-	S	-	S
8-Sep	-	S	-	S	-	S
9-Sep	-	S	-	S	-	S
10-Sep	49		377		40	
11-Sep	29		14		20	
12-Sep	0	MI	0	MI	0	MI
13-Sep	0	P, MI	0	P, MI	0	P, MI
14-Sep	0	P	0	P	0	P
15-Sep	-	MD	-	MD	-	MD
16-Sep	192		215		152	
17-Sep	-	S	-	S	-	S
18-Sep	4	RWMG	14	RWMG	8	RWMG
19-Sep	88		104		26	
20-Sep	146		55		21	
21-Sep	146		116		37	
22-Sep	0	P, MI	0	P, MI	0	P, MI
23-Sep	0	P, MI	0	P, MI	0	P, MI
24-Sep	0	P	0	P	0	P
25-Sep	-	S	-	S	-	S

Table L-16 (*continued*). Year-to-year and night-to-night pattern of nocturnal fall bird migration (2006) over the onshore sample areas. Date is the date at beginning of night. Density = mean birds km^{-3} measured by averaging maximum dBZ reflectivity from migrants aloft at 0.5° over the sample areas. ND = no data available, MI=mostly insects aloft, MD = missing data, P = precipitation in SA, V0 = bad velocity, S = strobing in SA, OSA = migration out of sample area, and RM = radar malfunction.

Onshore Fall 2006						
Date	1A		2A		3A	
	Density	Comments	Density	Comments	Density	Comments
26-Sep	653		370		81	
27-Sep	-	V0	-	V0	-	V0
28-Sep	0	P, MI	0	P, MI	0	P, MI
29-Sep	73		251		37	
30-Sep	0	P, MI	0	P, MI	0	P, MI
1-Oct	88		117		46	
2-Oct	66		125		99	
3-Oct	-	S	-	S	-	S
4-Oct	0	P, MI	0	P, MI	0	P, MI
5-Oct	81		52		77	
6-Oct	0	P, MI	0	P, MI	0	P, MI
7-Oct	27		6		5	
8-Oct	-	S	-	S	-	S
9-Oct	-	S	-	S	-	S
10-Oct	-	S	-	S	-	S
11-Oct	0	P	0	P	0	P
12-Oct	-	V0, MI	-	V0, MI	-	V0, MI
13-Oct	-	V0, MI	-	V0, MI	-	V0, MI
14-Oct	-	V0	-	V0	-	V0
15-Oct	-	V0	-	V0	-	V0
16-Oct	-	V0	-	V0	-	V0
17-Oct	0	P	0	P	0	P
18-Oct	76		169		42	
19-Oct	0	P, MI	0	P, MI	0	P, MI
20-Oct	0	MI	0	MI	0	MI
21-Oct	12		140		95	
22-Oct	0	P, MI	0	P, MI	0	P, MI
23-Oct	39		37		8	
24-Oct	23		24		11	
25-Oct	52		377		241	
26-Oct	-	MD	-	MD	-	MD
27-Oct	0	P	0	P	0	P
28-Oct	0	P, MI	0	P, MI	0	P, MI
29-Oct	29		21		5	
30-Oct	15		27		5	
31-Oct	0	P, MI	0	P, MI	0	P, MI
1-Nov	-	S	-	S	-	S
2-Nov	412		668		313	
3-Nov	51		92		68	
4-Nov	82		82		116	
5-Nov	28		5		16	
6-Nov	10		12		19	

Table L-16 (*continued*). Year-to-year and night-to-night pattern of nocturnal fall bird migration (2006) over the onshore sample areas. Date is the date at beginning of night. Density = mean birds km^{-3} measured by averaging maximum dBZ reflectivity from migrants aloft at 0.5° over the sample areas. ND = no data available, MI=mostly insects aloft, MD = missing data, P = precipitation in SA, V0 = bad velocity, S = strobing in SA, OSA = migration out of sample area, and RM = radar malfunction.

Onshore Fall 2006						
Date	1A		2A		3A	
	Density	Comments	Density	Comments	Density	Comments
7-Nov	0	P	0	P	0	P
8-Nov	0		101		21	
9-Nov	64		188		137	
10-Nov	-	S	-	S	-	S
11-Nov	0	P, MI	0	P, MI	0	P, MI
12-Nov	0	P	0	P	0	P
13-Nov	0	P	0	P	0	P
14-Nov	0	P, MI	0	P, MI	0	P, MI
15-Nov	0	P, MI	0	P, MI	0	P, MI

Table L-17. Year-to-year and night-to-night pattern of nocturnal fall bird migration (2006) over the offshore sample areas. Date is the date at beginning of night. Density = mean birds km^{-3} measured by averaging maximum dBZ reflectivity from migrants aloft at 0.5° over the sample areas. ND = no data available, MI=mostly insects aloft, MD = missing data, P = precipitation in SA, V0 = bad velocity, S = strobing in SA, OSA = migration out of sample area, and RM = radar malfunction.

Offshore Fall 2006						
Date	1B		2B		3B	
	Density	Comments	Density	Comments	Density	Comments
15-Aug	-	S	-	S	-	S
16-Aug	-	V0	-	V0	-	V0
17-Aug	-	V0	-	V0	-	V0
18-Aug	-	V0	-	V0	-	V0
19-Aug	0	P, MI	0	P, MI	0	P, MI
20-Aug	4		5		2	
21-Aug	3		2		3	
22-Aug	-	S	-	S	-	S
23-Aug	-	S	-	S	-	S
24-Aug	0	MI	0	MI	0	MI
25-Aug	0		1		2	
26-Aug	0	MI	0	MI	0	MI
27-Aug	0	P	0	P	0	P
28-Aug	0	P IN SA	2	P IN SA	2	P IN SA
29-Aug	0	P, MI	0	P, MI	0	P, MI
30-Aug	-	S	-	S	-	S
31-Aug	-	S	-	S	-	S
1-Sep	0	P, RI	0	P, RI	0	P, RI
2-Sep	0	P, RI	0	P, RI	0	P, RI
3-Sep	-	V0	-	V0	-	V0
4-Sep	-	P	-	P	-	P
5-Sep	0	P	0	P	0	P
6-Sep	-	V0	-	V0	-	V0
7-Sep	-	S	-	S	-	S
8-Sep	-	S	-	S	-	S
9-Sep	-	S	-	S	-	S
10-Sep	34		6		4	
11-Sep	3		2		3	
12-Sep	0	MI	0	MI	0	MI
13-Sep	0	P, MI	0	P, MI	0	P, MI
14-Sep	0	P	0	P	0	P
15-Sep	-	MD	-	MD	-	MD
16-Sep	46		9		16	
17-Sep	-	S	-	S	-	S
18-Sep	2	RWMG	0	RWMG	0	RWMG
19-Sep	3		5		4	
20-Sep	26		17		23	
21-Sep	4		3		3	
22-Sep	0	P, MI	0	P, MI	0	P, MI
23-Sep	0	P, MI	0	P, MI	0	P, MI
24-Sep	0	P	0	P	0	P
25-Sep	-	S	-	S	-	S

Table L-17 (*continued*). Year-to-year and night-to-night pattern of nocturnal fall bird migration (2006) over the offshore sample areas. Date is the date at beginning of night. Density = mean birds km^{-3} measured by averaging maximum dBZ reflectivity from migrants aloft at 0.5° over the sample areas. ND = no data available, MI=mostly insects aloft, MD = missing data, P = precipitation in SA, V0 = bad velocity, S = strobing in SA, OSA = migration out of sample area, and RM = radar malfunction.

Offshore Fall 2006						
Date	1B		2B		3B	
	Density	Comments	Density	Comments	Density	Comments
26-Sep	23		12		11	
27-Sep	-	V0	-	V0	-	V0
28-Sep	0	P, MI	0	P, MI	0	P, MI
29-Sep	29		7		5	
30-Sep	0	P, MI	0	P, MI	0	P, MI
1-Oct	17		8		7	
2-Oct	5		33		19	
3-Oct	-	S	-	S	-	S
4-Oct	0	P, MI	0	P, MI	0	P, MI
5-Oct	9		2		6	
6-Oct	0	P, MI	0	P, MI	0	P, MI
7-Oct	9		1		0	
8-Oct	-	S	-	S	-	S
9-Oct	-	S	-	S	-	S
10-Oct	-	S	-	S	-	S
11-Oct	0	P	0	P	0	P
12-Oct	-	V0, MI	-	V0, MI	-	V0, MI
13-Oct	-	V0, MI	-	V0, MI	-	V0, MI
14-Oct	-	V0	-	V0	-	V0
15-Oct	-	V0	-	V0	-	V0
16-Oct	-	V0	-	V0	-	V0
17-Oct	0	P	0	P	0	P
18-Oct	23		19		4	
19-Oct	0	P, MI	0	P, MI	0	P, MI
20-Oct	0	MI	0	MI	0	MI
21-Oct	6		18		13	
22-Oct	0	P, MI	0	P, MI	0	P, MI
23-Oct	3		5		4	
24-Oct	5		6		5	
25-Oct	26		28		104	
26-Oct	-	MD	-	MD	-	MD
27-Oct	0	P	0	P	0	P
28-Oct	0	P, MI	0	P, MI	0	P, MI
29-Oct	14		4		4	
30-Oct	7		4		1	
31-Oct	0	P, MI	0	P, MI	0	P, MI
1-Nov	-	S	-	S	-	S
2-Nov	20		42		19	
3-Nov	6		9		4	
4-Nov	6		4		3	
5-Nov	6		0		0	
6-Nov	0		0		0	

Table L-17 (*continued*). Year-to-year and night-to-night pattern of nocturnal fall bird migration (2006) over the offshore sample areas. Date is the date at beginning of night. Density = mean birds km^{-3} measured by averaging maximum dBZ reflectivity from migrants aloft at 0.5° over the sample areas. ND = no data available, MI=mostly insects aloft, MD = missing data, P = precipitation in SA, V0 = bad velocity, S = strobing in SA, OSA = migration out of sample area, and RM = radar malfunction.

Offshore Fall 2006						
Date	1B		2B		3B	
	Density	Comments	Density	Comments	Density	Comments
7-Nov	0	P	0	P	0	P
8-Nov	0		22		21	
9-Nov	24		32		24	
10-Nov	-	S	-	S	-	S
11-Nov	0	P, MI	0	P, MI	0	P, MI
12-Nov	0	P	0	P	0	P
13-Nov	0	P	0	P	0	P
14-Nov	0	P, MI	0	P, MI	0	P, MI
15-Nov	0	P, MI	0	P, MI	0	P, MI

Table L-18. Year-to-year and night-to-night pattern of nocturnal fall bird migration (2007) over the onshore sample areas. Date is the date at beginning of night. Density = mean birds km^{-3} measured by averaging maximum dBZ reflectivity from migrants aloft at 0.5° over the sample areas. ND = no data available, MI=mostly insects aloft, MD = missing data, P = precipitation in SA, V0 = bad velocity, S = strobing in SA, OSA = migration out of sample area, and RM = radar malfunction.

Onshore Fall 2007						
Date	1A		2A		3A	
	Density	Comments	Density	Comments	Density	Comments
15-Aug	0	P, MI	0	P, MI	0	P, MI
16-Aug	0	P, MI	0	P, MI	0	P, MI
17-Aug	15		32		12	
18-Aug	3		10		4	
19-Aug	0	P	0	P	0	P
20-Aug	0	P	0	P	0	P
21-Aug	0	P, MI	0	P, MI	0	P, MI
22-Aug	0	MI	0	MI	0	MI
23-Aug	8		3		6	
24-Aug	0	MI	0	MI	0	MI
25-Aug	0	P, MI	0	P, MI	0	P, MI
26-Aug	6		0		0	
27-Aug	57		25		35	
28-Aug	-	S	-	S	-	S
29-Aug	-	S	-	S	-	S
30-Aug	-	S	-	S	-	S
31-Aug	29		100		65	
1-Sep	82		51		22	
2-Sep	0	MI	0	MI	0	MI
3-Sep	0	MI	0	MI	0	MI
4-Sep	130		129		65	
5-Sep	53		65		24	
6-Sep	0	MI	0	MI	0	MI
7-Sep	-	S	-	S	-	S
8-Sep	-	S, MI	-	S, MI	-	S, MI
9-Sep	0	P, MI	0	P, MI	0	P, MI
10-Sep	0	P, MI	0	P, MI	0	P, MI
11-Sep	0	P, MI	0	P, MI	0	P, MI
12-Sep	208		277		79	
13-Sep	24		357		19	
14-Sep	0	P	0	P	0	P
15-Sep	176		196		34	
16-Sep	78		14		16	
17-Sep	23		8		6	
18-Sep	10		4		10	
19-Sep	-	MI, S	-	MI, S	-	MI, S
20-Sep	-	S	-	S	-	S
21-Sep	-	S	-	S	-	S
22-Sep	0	MI	0	MI	0	MI
23-Sep	323		225		331	
24-Sep	-	MI, S	-	MI, S	-	MI, S
25-Sep	-	MI, S	-	MI, S	-	MI, S

Table L-18 (*continued*). Year-to-year and night-to-night pattern of nocturnal fall bird migration (2007) over the onshore sample areas. Date is the date at beginning of night. Density = mean birds km^{-3} measured by averaging maximum dBZ reflectivity from migrants aloft at 0.5° over the sample areas. ND = no data available, MI=mostly insects aloft, MD = missing data, P = precipitation in SA, V0 = bad velocity, S = strobing in SA, OSA = migration out of sample area, and RM = radar malfunction.

Onshore Fall 2007						
Date	1A		2A		3A	
	Density	Comments	Density	Comments	Density	Comments
26-Sep	0	P, MI	0	P, MI	0	P, MI
27-Sep	0	P, MI	0	P, MI	0	P, MI
28-Sep	134		196		106	
29-Sep	292		216		161	
30-Sep	15		9		11	
1-Oct	0	MI	0	MI	0	MI
2-Oct	0	MI	0	MI	0	MI
3-Oct	0	MI	0	MI	0	MI
4-Oct	-	S	-	S	-	S
5-Oct	177		66		16	
6-Oct	30		22		29	
7-Oct	35		65		210	
8-Oct	11		17		7	
9-Oct	0	P	0	P	0	P
10-Oct	46		83		85	
11-Oct	0	P, MI	0	P, MI	0	P, MI
12-Oct	65		260		0	
13-Oct	10		30		10	
14-Oct	392		362		71	
15-Oct	-	S	-	S	-	S
16-Oct	-	S	-	S	-	S
17-Oct	0	MI	0	MI	0	MI
18-Oct	0	P, MI	0	P, MI	0	P, MI
19-Oct	0	P	0	P	0	P
20-Oct	43		0		0	
21-Oct	0	MI	0	MI	0	MI
22-Oct	0	P, MI	0	P, MI	0	P, MI
23-Oct	0	P, MI	0	P, MI	0	P, MI
24-Oct	0	P	0	P	0	P
25-Oct	-	MD	-	MD	-	MD
26-Oct	0	P	0	P	0	P
27-Oct	46		15		5	
28-Oct	57		213		142	
29-Oct	-	ND	-	ND	-	ND
30-Oct	35		18		8	
31-Oct	0	MI	0	MI	0	MI
1-Nov	72		80		47	
2-Nov	20		6		5	
3-Nov	46		30		21	
4-Nov	31		19		10	
5-Nov	0	P, MI	0	P, MI	0	P, MI
6-Nov	0	MI	0	MI	0	MI

Table L-18 (*continued*). Year-to-year and night-to-night pattern of nocturnal fall bird migration (2007) over the onshore sample areas. Date is the date at beginning of night. Density = mean birds km^{-3} measured by averaging maximum dBZ reflectivity from migrants aloft at 0.5° over the sample areas. ND = no data available, MI=mostly insects aloft, MD = missing data, P = precipitation in SA, V0 = bad velocity, S = strobing in SA, OSA = migration out of sample area, and RM = radar malfunction.

Onshore Fall 2007						
Date	1A		2A		3A	
	Density	Comments	Density	Comments	Density	Comments
7-Nov	101		121		117	
8-Nov	29		31		21	
9-Nov	0	P	0	P	0	P
10-Nov	92		133		172	
11-Nov	16		23		58	
12-Nov	0	P, MI	0	P, MI	0	P, MI
13-Nov	44		17		28	
14-Nov	0	P, MI	0	P, MI	0	P, MI
15-Nov	0	P, MI	0	P, MI	0	P, MI

Table L-19. Year-to-year and night-to-night pattern of nocturnal fall bird migration (2007) over the offshore sample areas. Date is the date at beginning of night. Density = mean birds km^{-3} measured by averaging maximum dBZ reflectivity from migrants aloft at 0.5° over the sample areas. ND = no data available, MI=mostly insects aloft, MD = missing data, P = precipitation in SA, V0 = bad velocity, S = strobing in SA, OSA = migration out of sample area, and RM = radar malfunction.

Offshore Fall 2007						
Date	1B		2B		3B	
	Density	Comments	Density	Comments	Density	Comments
15-Aug	0	P, MI	0	P, MI	0	P, MI
16-Aug	0	P, MI	0	P, MI	0	P, MI
17-Aug	4		5		3	
18-Aug	3		2		1	
19-Aug	0	P	0	P	0	P
20-Aug	0	P	0	P	0	P
21-Aug	0	P, MI	0	P, MI	0	P, MI
22-Aug	0	MI	0	MI	0	MI
23-Aug	0		0		0	
24-Aug	0	MI	0	MI	0	MI
25-Aug	0	P, MI	0	P, MI	0	P, MI
26-Aug	7		5		5	
27-Aug	5		2		6	
28-Aug	-	S	-	S	-	S
29-Aug	-	S	-	S	-	S
30-Aug	-	S	-	S	-	S
31-Aug	5		19		8	
1-Sep	13		5		3	
2-Sep	0	MI	0	MI	0	MI
3-Sep	0	MI	0	MI	0	MI
4-Sep	21		27		36	
5-Sep	5		3		4	
6-Sep	0	MI	0	MI	0	MI
7-Sep	-	S	-	S	-	S
8-Sep	-	S, MI	-	S, MI	-	S, MI
9-Sep	0	P, MI	0	P, MI	0	P, MI
10-Sep	0	P, MI	0	P, MI	0	P, MI
11-Sep	0	P, MI	0	P, MI	0	P, MI
12-Sep	99		5		4	
13-Sep	4		3		3	
14-Sep	0	P	0	P	0	P
15-Sep	18		9		5	
16-Sep	3		1		3	
17-Sep	3		1		0	
18-Sep	1		1		3	
19-Sep	-	MI, S	-	MI, S	-	MI, S
20-Sep	-	S	-	S	-	S
21-Sep	-	S	-	S	-	S
22-Sep	0	MI	0	MI	0	MI
23-Sep	61		57		26	
24-Sep	-	MI, S	-	MI, S	-	MI, S
25-Sep	-	MI, S	-	MI, S	-	MI, S

Table L-19 (*continued*). Year-to-year and night-to-night pattern of nocturnal fall bird migration (2007) over the offshore sample areas. Date is the date at beginning of night. Density = mean birds km^{-3} measured by averaging maximum dBZ reflectivity from migrants aloft at 0.5° over the sample areas. ND = no data available, MI=mostly insects aloft, MD = missing data, P = precipitation in SA, V0 = bad velocity, S = strobing in SA, OSA = migration out of sample area, and RM = radar malfunction.

Offshore Fall 2007						
Date	1B		2B		3B	
	Density	Comments	Density	Comments	Density	Comments
26-Sep	0	P, MI	0	P, MI	0	P, MI
27-Sep	0	P, MI	0	P, MI	0	P, MI
28-Sep	49		48		39	
29-Sep	67		34		6	
30-Sep	0		0		2	
1-Oct	0	MI	0	MI	0	MI
2-Oct	0	MI	0	MI	0	MI
3-Oct	0	MI	0	MI	0	MI
4-Oct	-	S	-	S	-	S
5-Oct	8		10		5	
6-Oct	7		11		10	
7-Oct	15		65		100	
8-Oct	11		9		4	
9-Oct	0	P	0	P	0	P
10-Oct	10		10		11	
11-Oct	0	P, MI	0	P, MI	0	P, MI
12-Oct	34		15		9	
13-Oct	3		3		4	
14-Oct	43		7		4	
15-Oct	-	S	-	S	-	S
16-Oct	-	S	-	S	-	S
17-Oct	0	MI	0	MI	0	MI
18-Oct	0	P, MI	0	P, MI	0	P, MI
19-Oct	0	P	0	P	0	P
20-Oct	21		9		7	
21-Oct	0	MI	0	MI	0	MI
22-Oct	0	P, MI	0	P, MI	0	P, MI
23-Oct	0	P, MI	0	P, MI	0	P, MI
24-Oct	0	P	0	P	0	P
25-Oct	-	MD	-	MD	-	MD
26-Oct	0	P	0	P	0	P
27-Oct	9		2		5	
28-Oct	19		23		28	
29-Oct	-	ND	-	ND	-	ND
30-Oct	2		0		1	
31-Oct	0	MI	0	MI	0	MI
1-Nov	7		3		4	
2-Nov	3		0		0	
3-Nov	2		7		9	
4-Nov	1		1		2	
5-Nov	0	P, MI	0	P, MI	0	P, MI
6-Nov	0	MI	0	MI	0	MI

Table L-19 (*continued*). Year-to-year and night-to-night pattern of nocturnal fall bird migration (2007) over the offshore sample areas. Date is the date at beginning of night. Density = mean birds km^{-3} measured by averaging maximum dBZ reflectivity from migrants aloft at 0.5° over the sample areas. ND = no data available, MI=mostly insects aloft, MD = missing data, P = precipitation in SA, V0 = bad velocity, S = strobing in SA, OSA = migration out of sample area, and RM = radar malfunction.

Offshore Fall 2007						
Date	1B		2B		3B	
	Density	Comments	Density	Comments	Density	Comments
7-Nov	7		22		14	
8-Nov	2		1		0	
9-Nov	0	P	0	P	0	P
10-Nov	4		6		5	
11-Nov	2		2		3	
12-Nov	0	P, MI	0	P, MI	0	P, MI
13-Nov	5		3		3	
14-Nov	0	P, MI	0	P, MI	0	P, MI
15-Nov	0	P, MI	0	P, MI	0	P, MI

Table L-20. Year-to-year and night-to-night pattern of nocturnal fall bird migration (2008) over the onshore sample areas. Date is the date at beginning of night. Density = mean birds km^{-3} measured by averaging maximum dBZ reflectivity from migrants aloft at 0.5° over the sample areas. ND = no data available, MI=mostly insects aloft, MD = missing data, P = precipitation in SA, V0 = bad velocity, S = strobing in SA, OSA = migration out of sample area, and RM = radar malfunction.

Onshore Fall 2008						
Date	1A		2A		3A	
	Density	Comments	Density	Comments	Density	Comments
15-Aug	53		17		14	
16-Aug	27		22		11	
17-Aug	-	S	-	S	-	S
18-Aug	0	MI	0	MI	0	MI
19-Aug	191		61		14	
20-Aug	33		13		17	
21-Aug	23		12		6	
22-Aug	9		7		8	
23-Aug	0	MI	0	MI	0	MI
24-Aug	0	MI	0	MI	0	MI
25-Aug	196		100		33	
26-Aug	73		58		39	
27-Aug	21		16		45	
28-Aug	-	S	-	S	-	S
29-Aug	0	P	0	P	0	P
30-Aug	214		197		164	
31-Aug	51		56		88	
1-Sep	55		31		33	
2-Sep	-	S	-	S	-	S
3-Sep	-	S	-	S	-	S
4-Sep	0	P, MI	0	P, MI	0	P, MI
5-Sep	0	P	0	P	0	P
6-Sep	-	P, MI	-	P, MI	-	P, MI
7-Sep	78		74		60	
8-Sep	0	MI	0	MI	0	MI
9-Sep	0	P	0	P	0	P
10-Sep	84		66		81	
11-Sep	9		28		13	
12-Sep	-	MD	-	MD	-	MD
13-Sep	-	ND	-	ND	-	ND
14-Sep	0	MI	0	MI	0	MI
15-Sep	-	S	-	S	-	S
16-Sep	0		70		42	
17-Sep	36		30		13	
18-Sep	129		39		18	
19-Sep	30		6		7	
20-Sep	23		17		18	
21-Sep	-	S	-	S	-	S
22-Sep	21		5		11	
23-Sep	-	MD	-	MD	-	MD
24-Sep	-	S	-	S	-	S
25-Sep	0	P	0	P	0	P

Table L-20 (*continued*). Year-to-year and night-to-night pattern of nocturnal fall bird migration (2008) over the onshore sample areas. Date is the date at beginning of night. Density = mean birds km^{-3} measured by averaging maximum dBZ reflectivity from migrants aloft at 0.5° over the sample areas. ND = no data available, MI=mostly insects aloft, MD = missing data, P = precipitation in SA, V0 = bad velocity, S = strobing in SA, OSA = migration out of sample area, and RM = radar malfunction.

Onshore Fall 2008						
Date	1A		2A		3A	
	Density	Comments	Density	Comments	Density	Comments
26-Sep	0	P, MI	0	P, MI	0	P, MI
27-Sep	0	P, MI	0	P, MI	0	P, MI
28-Sep	31		12		5	
29-Sep	-	S	-	S	-	S
30-Sep	0	P, MI	0	P, MI	0	P, MI
1-Oct	-	S	-	S	-	S
2-Oct	132		78		167	
3-Oct	267		77		24	
4-Oct	0	MI	0	MI	0	MI
5-Oct	121		129		73	
6-Oct	196		81		37	
7-Oct	-	S	-	S	-	S
8-Oct	0	P, MI	0	P, MI	0	P, MI
9-Oct	-	S	-	S	-	S
10-Oct	-	S	-	S	-	S
11-Oct	-	S	-	S	-	S
12-Oct	198		290		121	
13-Oct	-	S	-	S	-	S
14-Oct	-	S	-	S	-	S
15-Oct	268		99		60	
16-Oct	144		213		81	
17-Oct	81	P	44	P	21	P
18-Oct	47		7		5	
19-Oct	23		6		8	
20-Oct	0	MI	0	MI	0	MI
21-Oct	0	MI	0	MI	0	MI
22-Oct	-	V0	-	V0	-	V0
23-Oct	62		18		22	
24-Oct	0	P	0	P	0	P
25-Oct	0	P	0	P	0	P
26-Oct	0	MI	0	MI	0	MI
27-Oct	0	P	0	P	0	P
28-Oct	0	P	0	P	0	P
29-Oct	0	P	0	P	0	P
30-Oct	209		103		105	
31-Oct	0	MI	0	MI	0	MI
1-Nov	147		98		105	
2-Nov	8		5		9	
3-Nov	0	MI	0	MI	0	MI
4-Nov	0	P	0	P	0	P
5-Nov	0	P	0	P	0	P
6-Nov	0	P, MI	0	P, MI	0	P, MI

Table L-20 (*continued*). Year-to-year and night-to-night pattern of nocturnal fall bird migration (2008) over the onshore sample areas. Date is the date at beginning of night. Density = mean birds km^{-3} measured by averaging maximum dBZ reflectivity from migrants aloft at 0.5° over the sample areas. ND = no data available, MI=mostly insects aloft, MD = missing data, P = precipitation in SA, V0 = bad velocity, S = strobing in SA, OSA = migration out of sample area, and RM = radar malfunction.

Onshore Fall 2008						
Date	1A		2A		3A	
	Density	Comments	Density	Comments	Density	Comments
7-Nov	0	MI	0	MI	0	MI
8-Nov	0	P, MI	0	P, MI	0	P, MI
9-Nov	101		121		80	
10-Nov	78		78		30	
11-Nov	56		50		44	
12-Nov	16		23		16	
13-Nov	0	P	0	P	0	P
14-Nov	0	P	0	P	0	P
15-Nov	0	P	0	P	0	P

Table L-21. Year-to-year and night-to-night pattern of nocturnal fall bird migration (2008) over the offshore sample areas. Date is the date at beginning of night. Density = mean birds km^{-3} measured by averaging maximum dBZ reflectivity from migrants aloft at 0.5° over the sample areas. ND = no data available, MI=mostly insects aloft, MD = missing data, P = precipitation in SA, V0 = bad velocity, S = strobing in SA, OSA = migration out of sample area, and RM = radar malfunction.

Offshore Fall 2008						
Date	1B		2B		3B	
	Density	Comments	Density	Comments	Density	Comments
15-Aug	3		3		5	
16-Aug	8		4		5	
17-Aug	-	S	-	S	-	S
18-Aug	0	MI	0	MI	0	MI
19-Aug	25		16		17	
20-Aug	5		7		8	
21-Aug	9		4		0	
22-Aug	2		0		0	
23-Aug	0	MI	0	MI	0	MI
24-Aug	0	MI	0	MI	0	MI
25-Aug	40		9		9	
26-Aug	41		9		9	
27-Aug	4		8		6	
28-Aug	-	S	-	S	-	S
29-Aug	0	P	0	P	0	P
30-Aug	22		31		71	
31-Aug	11		6		8	
1-Sep	16		6		5	
2-Sep	-	S	-	S	-	S
3-Sep	-	S	-	S	-	S
4-Sep	0	P, MI	0	P, MI	0	P, MI
5-Sep	0	P	0	P	0	P
6-Sep		P, MI		P, MI		P, MI
7-Sep	16		9		13	
8-Sep	0	MI	0	MI	0	MI
9-Sep	0	P	0	P	0	P
10-Sep	21		9		11	
11-Sep	6		6		9	
12-Sep	-	MD	-	MD	-	MD
13-Sep	-	ND	-	ND	-	ND
14-Sep	0	MI	0	MI	0	MI
15-Sep	-	S	-	S	-	S
16-Sep	19		7		8	
17-Sep	8		3		3	
18-Sep	23		4		5	
19-Sep	1		6		0	
20-Sep	2		10		9	
21-Sep	-	S	-	S	-	S
22-Sep	9		4		3	
23-Sep	-	MD	-	MD	-	MD
24-Sep	-	S	-	S	-	S
25-Sep	0	P	0	P	0	P

Table L-21 (*continued*). Year-to-year and night-to-night pattern of nocturnal fall bird migration (2008) over the offshore sample areas. Date is the date at beginning of night. Density = mean birds km^{-3} measured by averaging maximum dBZ reflectivity from migrants aloft at 0.5° over the sample areas. ND = no data available, MI=mostly insects aloft, MD = missing data, P = precipitation in SA, V0 = bad velocity, S = strobing in SA, OSA = migration out of sample area, and RM = radar malfunction.

Offshore Fall 2008						
Date	1B		2B		3B	
	Density	Comments	Density	Comments	Density	Comments
26-Sep	0	P, MI	0	P, MI	0	P, MI
27-Sep	0	P, MI	0	P, MI	0	P, MI
28-Sep	6		3		5	
29-Sep	-	S	-	S	-	S
30-Sep	0	P, MI	0	P, MI	0	P, MI
1-Oct	-	S	-	S	-	S
2-Oct	26		3		7	
3-Oct	13		3		21	
4-Oct	0	MI	0	MI	0	MI
5-Oct	10		9		5	
6-Oct	28		9		5	
7-Oct	-	S	-	S	-	S
8-Oct	0	P, MI	0	P, MI	0	P, MI
9-Oct	-	S	-	S	-	S
10-Oct	-	S	-	S	-	S
11-Oct	-	S	-	S	-	S
12-Oct	13		44		22	
13-Oct	-	S	-	S	-	S
14-Oct	-	S	-	S	-	S
15-Oct	9		9		15	
16-Oct	48		15		5	
17-Oct	45	P	4	P	7	P
18-Oct	4		2		3	
19-Oct	5		2		4	
20-Oct	0	MI	0	MI	0	MI
21-Oct	0	MI	0	MI	0	MI
22-Oct	-	V0	-	V0	-	V0
23-Oct	4		5		4	
24-Oct	0	P	0	P	0	P
25-Oct	0	P	0	P	0	P
26-Oct	0	MI	0	MI	0	MI
27-Oct	0	P	0	P	0	P
28-Oct	0	P	0	P	0	P
29-Oct	0	P	0	P	0	P
30-Oct	27		34		36	
31-Oct	0	MI	0	MI	0	MI
1-Nov	11		5		5	
2-Nov	0		0		0	
3-Nov	0	MI	0	MI	0	MI
4-Nov	0	P	0	P	0	P
5-Nov	0	P	0	P	0	P
6-Nov	0	P, MI	0	P, MI	0	P, MI

Table L-21 (*continued*). Year-to-year and night-to-night pattern of nocturnal fall bird migration (2008) over the offshore sample areas. Date is the date at beginning of night. Density = mean birds km^{-3} measured by averaging maximum dBZ reflectivity from migrants aloft at 0.5° over the sample areas. ND = no data available, MI=mostly insects aloft, MD = missing data, P = precipitation in SA, V0 = bad velocity, S = strobing in SA, OSA = migration out of sample area, and RM = radar malfunction.

Offshore Fall 2008						
Date	1B		2B		3B	
	Density	Comments	Density	Comments	Density	Comments
7-Nov	0	MI	0	MI	0	MI
8-Nov	0	P, MI	0	P, MI	0	P, MI
9-Nov	11		3		4	
10-Nov	8		11		17	
11-Nov	5		6		3	
12-Nov	1		0		0	
13-Nov	0	P	0	P	0	P
14-Nov	0	P	0	P	0	P
15-Nov	0	P	0	P	0	P

Appendix L-3

Hourly Data for Nocturnal Bird Migration

Table L-22. Hour-to-hour patterns of migration density (expressed as percentage of peak density) over sample area for a subsample of nights showing migration for Spring (2005-2009). Time is in Universal Time Coordinate (UTC). Note: Date is for beginning of night. SE= standard error, SD = standard deviation, SV = sample variance.

Date	Spring Sample Area 1A										
	Time (UTC)										
	22:00	23:00	0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00
3/30/2005	1%	9%	100%	17%	39%	30%	37%	45%	58%	49%	61%
4/5/2005	2%	0%	6%	100%	8%	0%	0%	0%	0%	0%	29%
4/18/2005	0%	79%	100%	0%	0%	0%	0%	0%	0%	0%	0%
5/10/2005	0%	1%	4%	17%	28%	100%	0%	0%	50%	27%	27%
5/31/2005	1%	1%	15%	100%	89%	29%	39%	68%	55%	30%	4%
3/27/2006	39%	8%	31%	38%	51%	100%	58%	76%	70%	75%	51%
4/10/2006	0%	0%	11%	37%	25%	18%	62%	29%	85%	100%	66%
5/5/2006	0%	1%	0%	0%	0%	0%	0%	0%	100%	47%	6%
5/17/2006	0%	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%
4/23/2007	0%	0%	0%	16%	11%	79%	100%	0%	15%	10%	5%
5/13/2008	0%	0%	1%	7%	10%	16%	0%	0%	52%	100%	77%
5/25/2008	0%	0%	32%	79%	0%	0%	74%	34%	49%	100%	25%
3/18/2009	0%	7%	38%	20%	39%	100%	93%	85%	90%	51%	26%
4/24/2009	1%	1%	11%	21%	100%	54%	76%	85%	84%	70%	30%
4/26/2009	0%	1%	15%	22%	26%	48%	75%	78%	100%	78%	36%
4/27/2009	0%	3%	11%	18%	48%	81%	88%	100%	55%	34%	20%
5/12/2009	6%	3%	14%	86%	46%	24%	97%	100%	77%	27%	13%

Table L-22 (*continued*). Hour-to-hour patterns of migration density (expressed as percentage of peak density) over sample area for a subsample of nights showing migration for Spring (2005-2009). Time is in Universal Time Coordinate (UTC). Note: Date is for beginning of night. SE= standard error, SD = standard deviation, SV = sample variance.

Date	Spring Sample Area 1A										
	Time (UTC)										
	22:00	23:00	0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00
Mean	3%	13%	23%	34%	31%	40%	47%	41%	55%	47%	28%
SE	2%	7%	8%	8%	7%	9%	10%	10%	8%	9%	6%
Median	0	1	11	20	26	29	58	34	55	47	26
Mode	0	#N/A	0	0	0	0	0	0	0	0	0
SD	9	29	31	35	30	39	40	40	34	35	24
SV	90	856	973	1220	901	1492	1579	1635	1155	1250	562
Kurtosis	16	6	3	0	1	-1	-2	-2	-1	-1	0
Skewness	4	3	2	1	1	1	0	0	-1	0	1
Range	39	100	100	100	100	100	100	100	100	100	77
Minimum	0	0	0	0	0	0	0	0	0	0	0
Maximum	39	100	100	100	100	100	100	100	100	100	77
Sum	51	215	389	579	521	678	799	699	939	797	476
Count	17	17	17	17	17	17	17	17	17	17	17

Table L-23. Hour-to-hour patterns of migration density (expressed as percentage of peak density) over sample area for a subsample of nights showing migration for Spring (2005-2009). Time is in Universal Time Coordinate (UTC). Note: Date is for beginning of night. SE= standard error, SD = standard deviation, SV = sample variance.

Date	Spring Sample Area 2A										
	Time (UTC)										
	22:00	23:00	0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00
3/30/2005	0%	55%	97%	61%	45%	53%	77%	77%	89%	100%	86%
4/5/2005	9%	1%	8%	21%	46%	85%	100%	91%	100%	67%	29%
4/18/2005	0%	0%	39%	59%	87%	94%	100%	61%	93%	59%	32%
5/10/2005	1%	0%	5%	6%	17%	100%	62%	27%	18%	17%	27%
5/31/2005	5%	0%	6%	48%	24%	34%	100%	68%	27%	16%	8%
3/27/2006	6%	2%	13%	69%	100%	81%	74%	58%	53%	22%	18%
4/10/2006	0%	0%	11%	12%	25%	28%	24%	15%	12%	100%	61%
5/5/2006	0%	0%	9%	23%	0%	44%	100%	45%	39%	0%	4%
5/17/2006	0%	0%	5%	33%	35%	95%	33%	37%	100%	14%	13%
4/23/2007	0%	0%	3%	17%	35%	75%	100%	55%	13%	9%	1%
5/13/2008	0%	0%	3%	14%	44%	100%	96%	62%	79%	92%	89%
5/25/2008	0%	1%	4%	100%	83%	65%	23%	11%	14%	15%	8%
3/18/2009	0%	1%	9%	20%	38%	100%	58%	68%	55%	26%	12%
4/24/2009	0%	0%	4%	18%	43%	46%	100%	84%	58%	25%	10%
4/26/2009	0%	2%	17%	18%	79%	92%	100%	96%	84%	63%	23%
4/27/2009	0%	10%	7%	24%	85%	74%	100%	71%	44%	19%	9%
5/12/2009	0%	38%	20%	39%	31%	100%	71%	46%	46%	61%	68%

Table L-23 (*continued*). Hour-to-hour patterns of migration density (expressed as percentage of peak density) over sample area for a subsample of nights showing migration for Spring (2005-2009). Time is in Universal Time Coordinate (UTC). Note: Date is for beginning of night. SE= standard error, SD = standard deviation, SV = sample variance.

Date	Spring Sample Area 2A										
	Time (UTC)										
	22:00	23:00	0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00
Mean	1%	6%	15%	34%	48%	75%	77%	57%	54%	41%	29%
SE	1%	4%	6%	6%	7%	6%	7%	6%	8%	8%	7%
Median	0	0	8	23	43	81	96	61	53	25	18
Mode	0	0	#N/A	#N/A	#N/A	100	100	#N/A	#N/A	#N/A	#N/A
SD	3	15	23	25	29	25	28	25	32	34	29
SV	7	238	526	638	815	620	806	609	999	1128	829
Kurtosis	4	7	11	1	-1	-1	0	0	-1	-1	0
Skewness	2	3	3	1	0	-1	-1	0	0	1	1
Range	9	55	95	94	100	72	77	85	88	100	88
Minimum	0	0	3	6	0	28	23	11	12	0	1
Maximum	9	55	97	100	100	100	100	96	100	100	89
Sum	21	109	260	580	818	1268	1317	972	923	705	498
Count	17	17	17	17	17	17	17	17	17	17	17

Table L-24. Hour-to-hour patterns of migration density (expressed as percentage of peak density) over sample area for a subsample of nights showing migration for Spring (2005-2009). Time is in Universal Time Coordinate (UTC). Note: Date is for beginning of night. SE= standard error, SD = standard deviation, SV = sample variance.

Date	Spring Sample Area 3A										
	Time (UTC)										
	22:00	23:00	0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00
3/30/2005	2%	6%	10%	17%	20%	37%	59%	100%	81%	60%	36%
4/5/2005	0%	0%	41%	72%	61%	71%	87%	91%	100%	61%	37%
4/18/2005	0%	0%	59%	100%	98%	69%	33%	22%	28%	39%	25%
5/10/2005	0%	0%	12%	15%	97%	100%	40%	32%	22%	21%	14%
5/31/2005	79%	26%	26%	97%	70%	100%	38%	21%	18%	12%	11%
3/27/2006	22%	2%	52%	100%	44%	40%	63%	84%	71%	59%	58%
4/10/2006	0%	0%	51%	44%	39%	31%	100%	30%	32%	47%	7%
5/5/2006	0%	0%	9%	14%	25%	29%	100%	17%	11%	4%	0%
5/17/2006	0%	0%	28%	48%	41%	55%	100%	65%	39%	47%	16%
4/23/2007	0%	0%	45%	100%	77%	78%	58%	22%	21%	0%	0%
5/13/2008	0%	0%	17%	45%	100%	88%	58%	57%	57%	19%	10%
5/25/2008	0%	12%	29%	100%	83%	34%	26%	24%	22%	12%	8%
3/18/2009	0%	9%	45%	41%	61%	100%	48%	36%	20%	8%	5%
4/24/2009	0%	0%	30%	97%	78%	81%	100%	91%	48%	9%	4%
4/26/2009	0%	21%	40%	31%	100%	69%	73%	98%	84%	75%	6%
4/27/2009	0%	0%	25%	91%	88%	81%	100%	52%	30%	18%	16%
5/12/2009	0%	0%	59%	91%	50%	42%	44%	30%	100%	48%	26%

Table L-24 (*continued*). Hour-to-hour patterns of migration density (expressed as percentage of peak density) over sample area for a subsample of nights showing migration for Spring (2005-2009). Time is in Universal Time Coordinate (UTC). Note: Date is for beginning of night. SE= standard error, SD = standard deviation, SV = sample variance.

Date	Spring Sample Area 3A										
	Time (UTC)										
	22:00	23:00	0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00
Mean	6%	4%	34%	65%	67%	65%	66%	51%	46%	32%	16%
SE	5%	2%	4%	8%	6%	6%	6%	7%	7%	6%	4%
Median	0	0	30	72	70	69	59	36	32	21	11
Mode	0	0	#N/A	100	#N/A	#N/A	100	#N/A	#N/A	#N/A	0
SD	19	8	17	34	26	25	27	31	30	24	16
SV	380	64	276	1163	702	649	709	943	906	570	242
Kurtosis	14	3	-1	-2	-1	-1	-2	-1	-1	-1	2
Skewness	4	2	0	0	0	0	0	1	1	0	1
Range	79	26	51	86	80	71	74	83	89	75	58
Minimum	0	0	9	14	20	29	26	17	11	0	0
Maximum	79	26	59	100	100	100	100	100	100	75	58
Sum	103	76	577	1104	1132	1107	1128	873	783	536	279
Count	17	17	17	17	17	17	17	17	17	17	17

Table L-25. Hour-to-hour patterns of migration density (expressed as percentage of peak density) over sample area for a subsample of nights showing migration for Spring (2005-2009). Time is in Universal Time Coordinate (UTC). Note: Date is for beginning of night. SE= standard error, SD = standard deviation, SV = sample variance.

Date	Spring Sample Area 1B										
	Time (UTC)										
	22:00	23:00	0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00
3/30/2005	0%	0%	0%	0%	0%	42%	77%	74%	100%	84%	94%
4/5/2005	0%	2%	3%	4%	20%	22%	77%	50%	38%	100%	85%
4/18/2005	40%	32%	94%	42%	21%	56%	72%	76%	0%	37%	100%
5/10/2005	0%	0%	0%	11%	49%	59%	100%	66%	29%	25%	25%
5/31/2005	0%	0%	0%	0%	73%	84%	66%	51%	100%	49%	0%
3/27/2006	0%	0%	100%	40%	32%	42%	30%	28%	32%	36%	30%
4/10/2006	0%	0%	17%	15%	61%	33%	100%	23%	32%	39%	64%
5/5/2006	0%	0%	0%	14%	9%	6%	100%	0%	0%	0%	3%
5/17/2006	0%	0%	0%	100%	78%	47%	37%	17%	13%	41%	41%
4/23/2007	0%	0%	0%	33%	70%	82%	100%	61%	17%	11%	7%
5/13/2008	0%	0%	3%	0%	7%	27%	58%	54%	44%	38%	100%
5/25/2008	0%	5%	6%	100%	37%	69%	36%	12%	22%	18%	15%
3/18/2009	0%	0%	0%	71%	46%	85%	100%	36%	28%	7%	88%
4/24/2009	41%	10%	16%	27%	61%	68%	89%	89%	100%	85%	26%
4/26/2009	4%	45%	14%	100%	47%	53%	42%	19%	44%	17%	13%
4/27/2009	0%	21%	35%	20%	64%	39%	41%	100%	85%	26%	16%
5/12/2009	0%	0%	16%	100%	66%	18%	13%	15%	24%	7%	8%

Table L-25 (*continued*). Hour-to-hour patterns of migration density (expressed as percentage of peak density) over sample area for a subsample of nights showing migration for Spring (2005-2009). Time is in Universal Time Coordinate (UTC). Note: Date is for beginning of night. SE= standard error, SD = standard deviation, SV = sample variance.

Date	Spring Sample Area 1B										
	Time (UTC)										
	22:00	23:00	0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00
Mean	5%	7%	18%	40%	44%	49%	67%	45%	42%	37%	42%
SE	3%	3%	8%	9%	6%	6%	7%	7%	8%	7%	9%
Median	0	0	3	27	47	47	72	50	32	36	26
Mode	0	0	0	0	#N/A	#N/A	100	#N/A	100	#N/A	#N/A
SD	13	13	31	39	25	24	29	30	34	29	37
SV	178	180	982	1510	622	560	853	872	1143	842	1404
Kurtosis	5	4	4	-1	-1	-1	-1	-1	0	0	-1
Skewness	3	2	2	1	0	0	0	0	1	1	1
Range	41	45	100	100	78	78	87	100	100	100	100
Minimum	0	0	0	0	0	6	13	0	0	0	0
Maximum	41	45	100	100	78	85	100	100	100	100	100
Sum	85	116	304	678	740	831	1137	771	707	621	715
Count	17	17	17	17	17	17	17	17	17	17	17

Table L-26. Hour-to-hour patterns of migration density (expressed as percentage of peak density) over sample area for a subsample of nights showing migration for Spring (2005-2009). Time is in Universal Time Coordinate (UTC). Note: Date is for beginning of night. SE= standard error, SD = standard deviation, SV = sample variance.

Date	Spring Sample Area 1B										
	Time (UTC)										
	22:00	23:00	0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00
3/30/2005	0%	0%	0%	0%	87%	51%	60%	58%	67%	100%	92%
4/5/2005	0%	0%	0%	14%	18%	50%	76%	71%	100%	94%	45%
4/18/2005	0%	0%	0%	19%	23%	28%	44%	86%	84%	100%	92%
5/10/2005	0%	0%	0%	0%	62%	72%	100%	55%	82%	54%	72%
5/31/2005	0%	0%	0%	0%	99%	0%	85%	100%	46%	53%	0%
3/27/2006	0%	0%	0%	64%	100%	63%	29%	87%	92%	50%	54%
4/10/2006	0%	0%	0%	0%	0%	60%	60%	100%	34%	23%	49%
5/5/2006	0%	0%	0%	0%	4%	11%	100%	20%	5%	0%	0%
5/17/2006	0%	0%	0%	0%	59%	0%	0%	0%	100%	0%	0%
4/23/2007	0%	0%	100%	10%	12%	15%	17%	0%	7%	7%	0%
5/13/2008	0%	0%	0%	0%	34%	77%	65%	100%	26%	32%	47%
5/25/2008	0%	0%	0%	15%	86%	100%	70%	27%	43%	33%	17%
3/18/2009	0%	0%	0%	30%	0%	100%	67%	0%	16%	0%	0%
4/24/2009	15%	22%	20%	38%	81%	92%	100%	73%	47%	52%	71%
4/26/2009	0%	0%	0%	91%	55%	95%	84%	100%	83%	68%	52%
4/27/2009	0%	0%	0%	100%	73%	50%	59%	67%	55%	46%	27%
5/12/2009	0%	0%	0%	0%	12%	0%	18%	42%	100%	28%	42%

Table L-26 (*continued*). Hour-to-hour patterns of migration density (expressed as percentage of peak density) over sample area for a subsample of nights showing migration for Spring (2005-2009). Time is in Universal Time Coordinate (UTC). Note: Date is for beginning of night. SE= standard error, SD = standard deviation, SV = sample variance.

Date	Spring Sample Area 1B										
	Time (UTC)										
	22:00	23:00	0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00
Mean	1%	1%	7%	22%	47%	51%	61%	58%	58%	43%	39%
SE	1%	1%	6%	8%	9%	9%	7%	9%	8%	8%	8%
Median	0	0	0	10	55	51	65	67	55	46	45
Mode	0	0	0	0	0	0	100	100	100	0	0
SD	4	5	24	33	36	36	31	37	33	33	32
SV	14	29	597	1065	1325	1314	931	1371	1098	1107	1032
Kurtosis	17	17	15	1	-2	-1	-1	-1	-1	-1	-1
Skewness	4	4	4	2	0	0	-1	0	0	0	0
Range	15	22	100	100	100	100	100	100	95	100	92
Minimum	0	0	0	0	0	0	0	0	5	0	0
Maximum	15	22	100	100	100	100	100	100	100	100	92
Sum	15	22	120	379	805	866	1034	987	988	738	658
Count	17	17	17	17	17	17	17	17	17	17	17

Table L-27. Hour-to-hour patterns of migration density (expressed as percentage of peak density) over sample area for a subsample of nights showing migration for Spring (2005-2009). Time is in Universal Time Coordinate (UTC). Note: Date is for beginning of night. SE= standard error, SD = standard deviation, SV = sample variance.

Date	Spring Sample Area 3B										
	Time (UTC)										
	22:00	23:00	0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00
3/30/2005	0%	0%	0%	37%	51%	66%	59%	99%	100%	90%	59%
4/5/2005	0%	0%	5%	11%	13%	17%	20%	26%	33%	100%	16%
4/18/2005	0%	0%	0%	0%	48%	44%	39%	32%	37%	100%	34%
5/10/2005	0%	0%	50%	0%	67%	100%	70%	60%	66%	70%	0%
5/31/2005	0%	0%	0%	100%	22%	20%	16%	16%	0%	25%	0%
3/27/2006	0%	0%	82%	100%	73%	56%	59%	50%	67%	82%	64%
4/10/2006	0%	0%	0%	0%	15%	16%	21%	100%	4%	9%	9%
5/5/2006	0%	0%	0%	0%	12%	12%	100%	4%	0%	0%	0%
5/17/2006	0%	0%	0%	0%	45%	0%	0%	100%	99%	70%	0%
4/23/2007	0%	0%	0%	100%	80%	83%	79%	79%	0%	0%	0%
5/13/2008	0%	0%	0%	0%	100%	77%	56%	41%	24%	58%	34%
5/25/2008	0%	0%	0%	0%	84%	67%	68%	100%	0%	0%	40%
3/18/2009	0%	0%	15%	7%	6%	6%	6%	4%	2%	100%	0%
4/24/2009	0%	0%	22%	62%	100%	83%	91%	50%	22%	18%	27%
4/26/2009	0%	0%	0%	0%	100%	98%	64%	78%	78%	47%	36%
4/27/2009	0%	0%	0%	76%	81%	79%	100%	79%	78%	55%	87%
5/12/2009	0%	0%	0%	0%	0%	10%	0%	0%	0%	100%	14%

Table L-27 (*continued*). Hour-to-hour patterns of migration density (expressed as percentage of peak density) over sample area for a subsample of nights showing migration for Spring (2005-2009). Time is in Universal Time Coordinate (UTC). Note: Date is for beginning of night. SE= standard error, SD = standard deviation, SV = sample variance.

Date	Spring Sample Area 3B										
	Time (UTC)										
	22:00	23:00	0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00
Mean	0%	0%	10%	29%	53%	49%	50%	54%	36%	54%	25%
SE	0%	0%	5%	10%	9%	9%	8%	9%	9%	9%	6%
Median	0	0	0	0	51	56	59	50	24	58	16
Mode	0	0	0	0	100	#N/A	100	#N/A	0	0	0
SD	0	0	23	41	36	35	34	36	37	39	27
SV	0	0	508	1676	1277	1239	1165	1313	1399	1499	707
Kurtosis	N/A	N/A	7	-1	-2	-2	-1	-1	-1	-2	0
Skewness	N/A	N/A	3	1	0	0	0	0	1	0	1
Range	0	0	82	100	100	100	100	100	100	100	87
Minimum	0	0	0	0	0	0	0	0	0	0	0
Maximum	0	0	82	100	100	100	100	100	100	100	87
Sum	0	0	174	492	897	832	848	919	611	924	421
Count	17	17	17	17	17	17	17	17	17	17	17

Table L-28. Hour-to-hour patterns of migration density (expressed as percentage of peak density) over sample area for a subsample of nights showing migration for fall (2004-2008). Time is in Universal Time Coordinate (UTC). Note: Date is for beginning of night. SE= standard error, SD = standard deviation, SV = sample variance.

Date	Fall Sample Area 1A										
	Time (UTC)										
	22:00	23:00	0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00
8/24/2004	0%	84%	84%	30%	97%	100%	70%	21%	28%	12%	18%
9/10/2004	0%	2%	9%	15%	50%	0%	100%	33%	9%	7%	4%
10/5/2004	0%	12%	18%	13%	16%	39%	100%	61%	20%	24%	15%
8/22/2005	3%	3%	27%	29%	53%	0%	100%	33%	59%	28%	26%
9/1/2005	1%	1%	16%	23%	43%	79%	100%	0%	64%	43%	29%
9/3/2005	1%	2%	28%	27%	51%	100%	31%	77%	31%	32%	20%
9/9/2005	3%	3%	13%	70%	69%	0%	32%	100%	72%	33%	32%
10/15/2005	7%	82%	65%	82%	100%	71%	53%	61%	59%	21%	7%
11/14/2005	15%	50%	35%	74%	100%	62%	19%	5%	3%	4%	3%
9/10/2006	0%	1%	3%	33%	46%	0%	0%	100%	68%	33%	16%
11/3/2006	3%	8%	40%	48%	70%	68%	48%	45%	100%	33%	19%
11/4/2006	14%	4%	14%	94%	32%	100%	22%	32%	40%	16%	20%
11/9/2006	15%	88%	23%	67%	89%	41%	19%	19%	35%	82%	100%
8/27/2007	0%	3%	13%	23%	89%	100%	69%	58%	32%	44%	20%
9/15/2007	1%	7%	66%	100%	90%	76%	46%	35%	33%	72%	23%
9/29/2007	0%	0%	0%	4%	8%	21%	0%	0%	100%	35%	22%
10/7/2007	4%	15%	15%	29%	28%	35%	59%	70%	88%	100%	69%
10/14/2007	1%	13%	26%	81%	91%	39%	32%	0%	100%	0%	24%
10/27/2007	0%	6%	45%	100%	34%	2%	18%	5%	22%	11%	12%
8/25/2008	0%	59%	13%	34%	68%	96%	95%	82%	100%	48%	26%
9/10/2008	9%	24%	62%	70%	93%	83%	100%	97%	36%	14%	15%

Table L-28 (*continued*). Hour-to-hour patterns of migration density (expressed as percentage of peak density) over sample area for a subsample of nights showing migration for fall (2004-2008). Time is in Universal Time Coordinate (UTC). Note: Date is for beginning of night. SE= standard error, SD = standard deviation, SV = sample variance.

Date	Fall Sample Area 1A										
	Time (UTC)										
	22:00	23:00	0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00
9/18/2008	0%	19%	25%	100%	63%	50%	36%	26%	11%	10%	10%
10/6/2008	6%	29%	32%	48%	100%	60%	59%	63%	53%	38%	29%
11/9/2008	5%	19%	31%	39%	95%	64%	41%	47%	81%	100%	66%
Mean	4%	22%	29%	51%	66%	54%	52%	44%	52%	35%	26%
SE	1%	6%	4%	6%	6%	7%	7%	7%	6%	6%	5%
Median	1	10	26	43	69	61	47	40	46	32	20
Mode	0	#N/A	#N/A	100	100	100	100	0	100	#N/A	#N/A
SD	5	28	22	31	29	36	33	32	31	28	22
SV	0	8	5	9	8	13	11	11	10	8	5
Kurtosis	95	91	57	-129	-107	-118	-113	-100	-117	80	502
Skewness	144	149	105	31	-41	-28	24	24	26	118	218
Range	15	87	84	96	92	100	100	100	97	100	97
Minimum	0	0	0	4	8	0	0	0	3	0	3
Maximum	15	88	84	100	100	100	100	100	100	100	100
Sum	88	535	703	1232	1576	1286	1250	1068	1246	839	624
Count	24	24	24	24	24	24	24	24	24	24	24

Table L-29. Hour-to-hour patterns of migration density (expressed as percentage of peak density) over sample area for a subsample of nights showing migration for fall (2004-2008). Time is in Universal Time Coordinate (UTC). Note: Date is for beginning of night. SE= standard error, SD = standard deviation, SV = sample variance.

Date	Fall Sample Area 2A										
	Time (UTC)										
	22:00	23:00	0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00
8/24/2004	0%	0%	54%	45%	58%	78%	80%	100%	0%	0%	0%
9/10/2004	0%	2%	21%	23%	32%	50%	98%	100%	27%	13%	10%
10/5/2004	0%	24%	33%	34%	49%	81%	100%	67%	48%	30%	12%
8/22/2005	1%	1%	34%	100%	96%	63%	56%	91%	79%	54%	36%
9/1/2005	0%	1%	17%	22%	22%	33%	61%	100%	88%	63%	34%
9/3/2005	1%	2%	48%	51%	43%	73%	100%	74%	54%	34%	33%
9/9/2005	5%	1%	22%	27%	30%	49%	100%	91%	58%	0%	0%
10/15/2005	2%	44%	67%	100%	85%	53%	30%	23%	17%	10%	4%
11/14/2005	2%	8%	11%	18%	88%	100%	39%	7%	3%	4%	0%
9/10/2006	0%	14%	58%	58%	68%	71%	100%	62%	25%	22%	18%
11/3/2006	7%	13%	27%	61%	74%	100%	89%	75%	58%	53%	23%
11/4/2006	5%	19%	20%	25%	53%	88%	100%	64%	40%	15%	6%
11/9/2006	12%	18%	56%	100%	68%	26%	10%	10%	13%	22%	40%
8/27/2007	0%	12%	41%	88%	100%	92%	59%	57%	51%	36%	21%
9/15/2007	1%	7%	30%	41%	32%	61%	80%	60%	63%	100%	65%
9/29/2007	0%	17%	28%	19%	18%	33%	49%	100%	99%	79%	21%
10/7/2007	2%	3%	2%	5%	39%	100%	74%	64%	59%	78%	27%
10/14/2007	0%	7%	16%	20%	28%	34%	44%	59%	100%	92%	57%
10/27/2007	0%	0%	0%	90%	0%	100%	52%	27%	38%	32%	34%
8/25/2008	4%	5%	12%	44%	42%	92%	95%	80%	100%	93%	43%
9/10/2008	16%	9%	80%	100%	100%	98%	73%	95%	62%	27%	12%

Table L-29 (*continued*). Hour-to-hour patterns of migration density (expressed as percentage of peak density) over sample area for a subsample of nights showing migration for fall (2004-2008). Time is in Universal Time Coordinate (UTC). Note: Date is for beginning of night. SE= standard error, SD = standard deviation, SV = sample variance.

Date	Fall Sample Area 2A										
	Time (UTC)										
	22:00	23:00	0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00
9/18/2008	0%	16%	86%	100%	46%	38%	34%	29%	23%	14%	12%
10/6/2008	38%	41%	48%	65%	84%	81%	82%	100%	68%	36%	15%
11/9/2008	14%	16%	18%	24%	56%	85%	80%	100%	59%	32%	43%
Mean	5%	12%	35%	53%	55%	70%	70%	68%	51%	39%	24%
SE	2%	2%	5%	7%	6%	5%	5%	6%	6%	6%	4%
Median	1	8	29	45	51	76	77	71	56	32	21
Mode	0	0	#N/A	100	100	100	100	100	#N/A	0	0
SD	8	12	23	33	28	25	26	30	29	31	18
SV	72	140	538	1066	777	630	698	907	868	936	321
Kurtosis	10	2	0	-1	-1	-1	-1	-1	-1	-1	0
Skewness	3	2	1	0	0	0	-1	-1	0	1	1
Range	38	44	86	95	100	74	90	93	100	100	65
Minimum	0	0	0	5	0	26	10	7	0	0	0
Maximum	38	44	86	100	100	100	100	100	100	100	65
Sum	110	279	828	1260	1311	1679	1686	1635	1231	939	565
Count	24	24	24	24	24	24	24	24	24	24	24

Table L-30. Hour-to-hour patterns of migration density (expressed as percentage of peak density) over sample area for a subsample of nights showing migration for fall (2004-2008). Time is in Universal Time Coordinate (UTC). Note: Date is for beginning of night. SE= standard error, SD = standard deviation, SV = sample variance.

Date	Fall Sample Area 3A										
	Time (UTC)										
	22:00	23:00	0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00
8/24/2004	0%	6%	11%	33%	60%	61%	61%	98%	100%	99%	37%
9/10/2004	0%	10%	78%	71%	52%	55%	47%	100%	84%	31%	24%
10/5/2004	0%	61%	62%	31%	43%	62%	100%	46%	49%	28%	13%
8/22/2005	8%	6%	92%	100%	79%	79%	79%	63%	68%	54%	40%
9/1/2005	2%	6%	52%	45%	46%	50%	60%	81%	100%	93%	73%
9/3/2005	4%	6%	96%	96%	0%	83%	91%	100%	62%	50%	35%
9/9/2005	1%	6%	14%	16%	16%	19%	50%	100%	37%	43%	23%
10/15/2005	4%	38%	50%	72%	100%	59%	28%	17%	22%	12%	7%
11/14/2005	12%	32%	98%	80%	94%	85%	100%	14%	9%	5%	0%
9/10/2006	0%	20%	94%	100%	81%	81%	77%	95%	57%	16%	16%
11/3/2006	65%	64%	63%	93%	100%	71%	68%	59%	44%	37%	30%
11/4/2006	66%	65%	100%	80%	76%	81%	76%	62%	39%	20%	11%
11/9/2006	64%	80%	100%	62%	27%	14%	13%	6%	6%	8%	11%
8/27/2007	0%	6%	92%	100%	87%	75%	67%	42%	35%	35%	26%
9/15/2007	0%	13%	70%	84%	82%	59%	66%	97%	80%	100%	98%
9/29/2007	0%	54%	95%	84%	36%	35%	54%	100%	51%	73%	46%
10/7/2007	0%	4%	5%	7%	16%	55%	100%	99%	52%	34%	26%
10/14/2007	3%	29%	56%	43%	61%	60%	55%	74%	100%	66%	51%
10/27/2007	63%	0%	0%	0%	0%	100%	80%	53%	51%	55%	69%
8/25/2008	0%	0%	32%	98%	58%	64%	95%	95%	100%	63%	31%
9/10/2008	6%	6%	80%	81%	100%	73%	64%	65%	57%	37%	27%

Table L-30 (*continued*). Hour-to-hour patterns of migration density (expressed as percentage of peak density) over sample area for a subsample of nights showing migration for fall (2004-2008). Time is in Universal Time Coordinate (UTC). Note: Date is for beginning of night. SE= standard error, SD = standard deviation, SV = sample variance.

Date	Fall Sample Area 3A										
	Time (UTC)										
	22:00	23:00	0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00
9/18/2008	0%	33%	100%	80%	60%	49%	59%	53%	40%	25%	17%
10/6/2008	13%	47%	85%	49%	61%	98%	100%	82%	60%	51%	33%
11/9/2008	47%	55%	100%	56%	38%	37%	42%	82%	28%	17%	5%
Mean	15%	27%	68%	65%	57%	63%	68%	70%	55%	44%	31%
SE	5%	5%	7%	6%	6%	4%	5%	6%	6%	6%	5%
Median	3	16	79	76	60	61	67	78	52	37	26
Mode	0	0	100	100	0	#N/A	100	100	100	#N/A	#N/A
SD	25	25	33	31	31	22	23	29	28	28	23
SV	6	6	11	9	10	5	5	9	8	8	5
Kurtosis	54	-95	-52	-54	-80	18	1	-26	-54	-25	196
Skewness	152	67	-88	-72	-34	-50	-40	-81	19	68	131
Range	66	80	100	100	100	86	87	94	94	95	98
Minimum	0	0	0	0	0	14	13	6	6	5	0
Maximum	66	80	100	100	100	100	100	100	100	100	98
Sum	358	646	1624	1562	1372	1505	1632	1683	1331	1051	749
Count	24	24	24	24	24	24	24	24	24	24	24

Table L-31. Hour-to-hour patterns of migration density (expressed as percentage of peak density) over sample area for a subsample of nights showing migration for fall (2004-2008). Time is in Universal Time Coordinate (UTC). Note: Date is for beginning of night. SE= standard error, SD = standard deviation, SV = sample variance.

Date	Fall Sample Area 1B										
	Time (UTC)										
	22:00	23:00	0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00
8/24/2004	0%	0%	0%	0%	96%	93%	100%	77%	46%	55%	80%
9/10/2004	0%	1%	5%	12%	17%	84%	100%	30%	6%	4%	3%
10/5/2004	0%	3%	9%	14%	22%	47%	49%	0%	100%	57%	29%
8/22/2005	4%	4%	7%	51%	70%	82%	100%	94%	75%	43%	19%
9/1/2005	2%	1%	6%	38%	66%	90%	0%	47%	100%	49%	26%
9/3/2005	2%	2%	4%	11%	52%	100%	72%	66%	48%	31%	16%
9/9/2005	7%	2%	5%	12%	41%	66%	100%	99%	70%	27%	17%
10/15/2005	1%	45%	100%	82%	70%	71%	54%	30%	33%	11%	6%
11/14/2005	0%	8%	35%	100%	92%	40%	31%	25%	17%	14%	0%
9/10/2006	0%	0%	2%	2%	23%	100%	93%	35%	23%	19%	15%
11/3/2006	0%	0%	23%	16%	34%	100%	95%	95%	21%	69%	0%
11/4/2006	0%	0%	0%	8%	100%	19%	0%	61%	33%	65%	22%
11/9/2006	0%	6%	27%	58%	93%	44%	19%	33%	48%	100%	71%
8/27/2007	0%	0%	30%	40%	98%	69%	100%	80%	79%	72%	44%
9/15/2007	11%	4%	35%	78%	80%	70%	100%	0%	0%	82%	21%
9/29/2007	0%	0%	5%	5%	8%	17%	100%	0%	65%	9%	4%
10/7/2007	3%	0%	0%	11%	100%	0%	0%	47%	80%	43%	29%
10/14/2007	1%	3%	4%	15%	30%	54%	62%	100%	86%	48%	26%
10/27/2007	0%	23%	100%	92%	66%	47%	28%	24%	9%	15%	92%
8/25/2008	13%	25%	26%	11%	44%	100%	17%	15%	25%	28%	28%
9/10/2008	26%	13%	21%	30%	41%	48%	100%	55%	25%	11%	8%

Table L-31 (*continued*). Hour-to-hour patterns of migration density (expressed as percentage of peak density) over sample area for a subsample of nights showing migration for fall (2004-2008). Time is in Universal Time Coordinate (UTC). Note: Date is for beginning of night. SE= standard error, SD = standard deviation, SV = sample variance.

Date	Fall Sample Area 1B										
	Time (UTC)										
	22:00	23:00	0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00
9/18/2008	0%	30%	100%	25%	35%	71%	43%	26%	17%	20%	22%
10/6/2008	6%	8%	26%	47%	100%	67%	78%	74%	49%	28%	20%
11/9/2008	24%	10%	16%	53%	100%	55%	69%	39%	43%	9%	17%
Mean	4%	8%	24%	34%	61%	64%	63%	48%	46%	38%	26%
SE	2%	2%	6%	6%	6%	6%	8%	7%	6%	5%	5%
Median	0	3	12	21	66	68	70	43	44	30	20
Mode	0	0	0	#N/A	100	100	100	0	100	#N/A	0
SD	7	12	31	30	31	28	37	32	30	26	24
SV	54	133	984	903	980	775	1395	1024	897	694	578
Kurtosis	4	4	2	0	-1	0	-1	-1	-1	0	2
Skewness	2	2	2	1	0	-1	0	0	0	1	2
Range	26	45	100	100	92	100	100	100	100	96	92
Minimum	0	0	0	0	8	0	0	0	0	4	0
Maximum	26	45	100	100	100	100	100	100	100	100	92
Sum	101	188	586	811	1476	1535	1509	1153	1099	910	616
Count	24	24	24	24	24	24	24	24	24	24	24

Table L-32. Hour-to-hour patterns of migration density (expressed as percentage of peak density) over sample area for a subsample of nights showing migration for fall (2004-2008). Time is in Universal Time Coordinate (UTC). Note: Date is for beginning of night. SE= standard error, SD = standard deviation, SV = sample variance.

Date	Fall Sample Area 2B										
	Time (UTC)										
	22:00	23:00	0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00
8/24/2004	0%	0%	0%	56%	83%	78%	72%	35%	100%	71%	0%
9/10/2004	0%	32%	51%	97%	68%	83%	100%	100%	50%	43%	41%
10/5/2004	0%	28%	31%	24%	29%	43%	62%	100%	68%	36%	14%
8/22/2005	15%	20%	12%	44%	37%	26%	33%	100%	74%	28%	5%
9/1/2005	4%	5%	12%	26%	22%	42%	80%	100%	94%	55%	36%
9/3/2005	8%	9%	15%	40%	35%	66%	100%	88%	100%	68%	69%
9/9/2005	8%	3%	5%	10%	14%	22%	91%	100%	75%	43%	0%
10/15/2005	2%	40%	73%	88%	100%	61%	34%	19%	14%	9%	37%
11/14/2005	0%	45%	100%	91%	97%	91%	69%	57%	0%	89%	25%
9/10/2006	0%	0%	39%	38%	48%	64%	100%	48%	42%	33%	11%
11/3/2006	0%	0%	15%	86%	24%	37%	66%	73%	100%	83%	35%
11/4/2006	0%	0%	0%	42%	34%	79%	100%	78%	89%	27%	29%
11/9/2006	0%	8%	35%	52%	100%	32%	12%	16%	12%	15%	14%
8/27/2007	0%	46%	44%	100%	98%	95%	66%	79%	53%	39%	61%
9/15/2007	0%	0%	37%	100%	98%	61%	65%	100%	99%	89%	71%
9/29/2007	0%	0%	7%	9%	12%	23%	33%	100%	31%	23%	11%
10/7/2007	0%	0%	1%	2%	21%	77%	100%	95%	85%	79%	19%
10/14/2007	0%	24%	25%	33%	45%	70%	95%	100%	101%	68%	54%
10/27/2007	0%	47%	100%	97%	90%	53%	72%	44%	45%	22%	0%
8/25/2008	53%	0%	54%	100%	50%	62%	57%	46%	47%	56%	26%
9/10/2008	45%	0%	39%	98%	100%	91%	75%	67%	63%	61%	37%

Table L-32 (*continued*). Hour-to-hour patterns of migration density (expressed as percentage of peak density) over sample area for a subsample of nights showing migration for fall (2004-2008). Time is in Universal Time Coordinate (UTC). Note: Date is for beginning of night. SE= standard error, SD = standard deviation, SV = sample variance.

Date	Fall Sample Area 2B										
	Time (UTC)										
	22:00	23:00	0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00
9/18/2008	0%	32%	83%	61%	67%	90%	70%	100%	69%	51%	69%
10/6/2008	0%	35%	34%	33%	63%	100%	80%	67%	38%	17%	13%
11/9/2008	11%	24%	100%	24%	30%	33%	29%	0%	19%	19%	24%
Mean	6%	17%	38%	56%	57%	62%	69%	71%	61%	47%	29%
SE	3%	4%	7%	7%	6%	5%	5%	6%	6%	5%	5%
Median	0	8	34	48	49	63	71	78	65	43	26
Mode	0	0	0	100	100	#N/A	100	100	100	#N/A	0
SD	14	18	32	34	32	24	26	31	32	25	22
SV	192	313	1053	1146	1002	598	658	985	1002	614	501
Kurtosis	7	-1	0	-2	-2	-1	0	0	-1	-1	-1
Skewness	3	1	1	0	0	0	-1	-1	0	0	1
Range	53	47	100	98	88	78	88	100	101	80	71
Minimum	0	0	0	2	12	22	12	0	0	9	0
Maximum	53	47	100	100	100	100	100	100	101	89	71
Sum	145	398	912	1352	1365	1479	1662	1710	1467	1127	702
Count	24	24	24	24	24	24	24	24	24	24	24

Table L-33. Hour-to-hour patterns of migration density (expressed as percentage of peak density) over sample area for a subsample of nights showing migration for fall (2004-2008). Time is in Universal Time Coordinate (UTC). Note: Date is for beginning of night. SE= standard error, SD = standard deviation, SV = sample variance.

Date	Fall Sample Area 3B										
	Time (UTC)										
	22:00	23:00	0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00
8/24/2004	0%	0%	0%	48%	60%	45%	56%	66%	100%	73%	28%
9/10/2004	0%	49%	100%	85%	95%	84%	72%	78%	73%	68%	75%
10/5/2004	0%	97%	76%	47%	51%	77%	100%	45%	43%	57%	36%
8/22/2005	0%	0%	51%	61%	61%	74%	73%	68%	51%	89%	100%
9/1/2005	16%	20%	21%	66%	66%	62%	87%	100%	93%	63%	28%
9/3/2005	21%	0%	40%	49%	61%	57%	70%	100%	46%	27%	28%
9/9/2005	31%	33%	37%	60%	66%	100%	87%	79%	64%	70%	85%
10/15/2005	18%	27%	72%	85%	93%	100%	27%	20%	21%	21%	13%
11/14/2005	0%	0%	77%	91%	84%	100%	88%	0%	0%	0%	0%
9/10/2006	0%	0%	0%	0%	73%	100%	100%	82%	68%	66%	0%
11/3/2006	0%	0%	86%	83%	100%	80%	93%	93%	64%	57%	35%
11/4/2006	27%	37%	100%	91%	83%	42%	22%	11%	10%	12%	14%
11/9/2006	0%	0%	36%	56%	58%	75%	76%	100%	78%	96%	58%
8/27/2007	0%	0%	44%	82%	100%	72%	35%	53%	41%	23%	0%
9/15/2007	0%	0%	57%	100%	61%	63%	43%	52%	56%	57%	55%
9/29/2007	0%	0%	40%	50%	55%	78%	84%	100%	56%	52%	61%
10/7/2007	0%	0%	2%	3%	10%	52%	66%	100%	85%	61%	58%
10/14/2007	0%	73%	50%	40%	58%	57%	84%	100%	66%	53%	42%
10/27/2007	0%	100%	48%	34%	49%	49%	44%	0%	0%	0%	0%
8/25/2008	0%	0%	57%	100%	76%	42%	50%	57%	46%	57%	56%
9/10/2008	0%	0%	30%	79%	88%	100%	70%	53%	30%	26%	0%

Table L-33 (*continued*). Hour-to-hour patterns of migration density (expressed as percentage of peak density) over sample area for a subsample of nights showing migration for fall (2004-2008). Time is in Universal Time Coordinate (UTC). Note: Date is for beginning of night. SE= standard error, SD = standard deviation, SV = sample variance.

Date	Fall Sample Area 3B										
	Time (UTC)										
	22:00	23:00	0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00
9/18/2008	0%	36%	88%	100%	49%	55%	46%	40%	51%	33%	28%
10/6/2008	0%	63%	100%	59%	68%	83%	93%	78%	53%	35%	31%
11/9/2008	69%	100%	91%	94%	65%	42%	49%	35%	18%	0%	0%
Mean	8%	26%	54%	65%	68%	70%	67%	63%	51%	46%	35%
SE	3%	7%	6%	6%	4%	4%	5%	7%	6%	6%	6%
Median	0	0	51	63	65	73	71	67	52	55	29
Mode	0	0	0	100	100	100	#N/A	100	0	0	0
SD	16	36	31	28	20	20	23	33	27	27	29
SV	267	1268	979	797	408	413	539	1076	737	756	848
Kurtosis	8	0	-1	0	2	-1	-1	-1	0	-1	0
Skewness	3	1	0	-1	-1	0	0	-1	0	0	1
Range	69	100	100	100	90	58	78	100	100	96	100
Minimum	0	0	0	0	10	42	22	0	0	0	0
Maximum	69	100	100	100	100	100	100	100	100	96	100
Sum	183	635	1306	1562	1628	1689	1616	1510	1215	1097	830
Count	24	24	24	24	24	24	24	24	24	24	24

Appendix L-4

Weather and Nocturnal Bird Migration Data

Table L-34. Number of nights with overcast and ceiling at or below 1000 ft. during spring 2005 (15 March - 31 May). Weather conditions on these nights are also indicated. Time 1 is when conditions began and time 2 is when conditions ended. Sample area density (mean birds km^{-3}) entry based on maximum mean dBZ measures within the sample areas.

Spring 2005	Time 1	Time 2	Sky Cover[a]	Ceiling	Weather	Mean Birds km-3 [b]					
						1A	2A	3A	1B	2B	3B
20-21 March	19:00	1:00	ovc	200-600	light rain, mist	0	0	0	0	0	0
23-24 March	19:00	4:00	ovc	600-900	light rain, mist	0	0	0	0	0	0
27-28 March	1:00	4:00	ovc	200-800	moderate rain, light rain	0	0	0	0	0	0
28-29 March	19:00	4:00	ovc	100-300	light rain, mist, fog	0	0	0	0	0	0
31 March-1 April	4:00	4:00	ovc	400		0	0	0	0	0	0
1-2 April	22:00	4:00	ovc	100-300	light rain, mist	0	0	0	0	0	0
2-3 April	19:00	22:00	ovc	100-500	mist	0	0	0	0	0	0
22-23 April	22:00	1:00	ovc, bkn	400-600		0	58	15	0	6	8
23-24 April	22:00	1:00	ovc	200		0	0	0	0	0	0
30 April-1 May	19:00	19:00	ovc	500		0	0	0	0	0	0
6-7 May	1:00	1:00	ovc	800	light rain	0	0	0	0	0	0
10-11 May	19:00	4:00	ovc	100-700	mist	276	60	28	6	2	3
15-16 May	1:00	1:00	ovc	200		S	S	S	S	S	S
20-21 May	19:00	22:00	ovc	500-900	light rain, mist	0	0	0	0	0	0

[a] Sky Cover is the amount of the sky obscured. CLR or SKC = 0, FEW = 1/8-2/8, SCT = 3/8-4/8, BKN = 5/8-7/8, OVC = 8/8, W = Vertical Visibility = 8/8.
[b] Peak mean value for evening; measured in birds km^{-3}; V0 = bad radial velocity data, ND= no data, P=Precipitation, MI=mostly insects, OSA = Out of Sample Area, S=strobing.

Table L-35. Number of nights with overcast and ceiling at or below 1000 ft. during spring 2006 (15 March - 31 May). Weather conditions on these nights are also indicated. Time 1 is when conditions began and time 2 is when conditions ended. Sample area density (mean birds km^{-3}) entry based on maximum mean dBZ measures within the sample areas.

Spring 2006	Time 1	Time 2	Sky Cover[a]	Ceiling	Weather	Birds km-3 [b]					
						1A	2A	3A	1B	2B	3B
25-26 March	4:00	4:00	ovc	600		0	0	0	0	0	0
28-29 March	4:00	4:00	vv	100	mist	S	S	S	S	S	S
3-4 April	19:00	19:00	ovc	300	mist	0	0	0	0	0	0
21-22 April	4:00	4:00	ovc	600	moderate rain, mist	0	0	0	0	0	0
22-23 April	22:00	4:00	ovc	200-400	light rain, mist	0	0	0	0	0	0
11-12 May	19:00	19:00	ovc	600	light rain, mist	0	0	0	0	0	0
	1:00	1:00	ovc	600	moderate rain, mist	0	0	0	0	0	0
13-14 May	22:00	4:00	ovc	500-700		0	5	26	0	2	4
14-15 May	1:00	1:00	ovc	800		0	0	0	0	0	0
15-16 May	1:00	1:00	ovc	500	mist	0	0	0	0	0	0
28-29 May	4:00	4:00	ovc	100	mist	S	S	S	S	S	S
31 May-1 June	19:00	4:00	ovc, bkn	100-300	mist	V0	V0	V0	V0	V0	V0

[a] Sky Cover is the amount of the sky obscured. CLR or SKC = 0, FEW = 1/8-2/8, SCT = 3/8-4/8, BKN = 5/8-7/8, OVC = 8/8, W = Vertical Visibility = 8/8.
[b] Peak mean value for evening; measured in birds km^{-3}; V0 = bad radial velocity data, ND= no data, P=Precipitation, MI=mostly insects, OSA = Out of Sample Area, S=strobing.

Table L-36. Number of nights with overcast and ceiling at or below 1000 ft. during spring 2007 (15 March - 31 May). Weather conditions on these nights are also indicated. Time 1 is when conditions began and time 2 is when conditions ended. Sample area density (mean birds km^{-3}) entry based on maximum mean dBZ measures within the sample areas.

Spring 2007	Time 1	Time 2	Sky Cover[a]	Ceiling	Weather	Birds km-3 [b]					
						1A	2A	3A	1B	2B	3B
15-16 March	1:00	1:00	ovc	1000	moderate rain	0	0	0	0	0	0
16-17 March	22:00	1:00	ovc	700-900	light snow, freezing rain, mist	0	0	0	0	0	0
23-24 March	1:00	4:00	ovc	200	light rain, mist	0	0	0	0	0	0
1-2 April	19:00	4:00	ovc	100-1000	mist, fog	0	0	0	0	0	0
2-3 April	19:00	4:00	vv, ovc	100	mist, fog	6	7	8	4	5	6
3-4 April	19:00	4:00	ovc	600-800		15	0	1	1	0	0
15-16 April	19:00	22:00	ovc	100-700	heavy rain, light rain, mist	0	0	0	0	0	0
26-27 April	22:00	4:00	ovc	200-600	mist	0	0	0	0	0	0
27-28 April	19:00	1:00	ovc	300-500	mist	0	0	0	0	0	0
8-9 May	22:00	4:00	ovc	100-200	mist	19	10	6	1	1	0
9-10 May	19:00	4:00	sct, ovc	100-300	mist	35	45	28	8	6	7
10-11 May	4:00	4:00	ovc	100	mist	17	162	31	2	11	11
12-13 May	1:00	1:00	ovc	1000	light rain	MD	MD	MD	MD	MD	MD
17-18 May	1:00	1:00	ovc	900		0	0	0	0	0	0

[a] Sky Cover is the amount of the sky obscured. CLR or SKC = 0, FEW = 1/8-2/8, SCT = 3/8-4/8, BKN = 5/8-7/8, OVC = 8/8, W = Vertical Visibility = 8/8.
[b] Peak mean value for evening; measured in birds km^{-3}; V0 = bad radial velocity data, ND= no data, P=Precipitation, MI=mostly insects, OSA = Out of Sample Area, S=strobing.

Table L-37. Number of nights with overcast and ceiling at or below 1000 ft. during spring 2008 (15 March - 31 May). Weather conditions on these nights are also indicated. Time 1 is when conditions began and time 2 is when conditions ended. Sample area density (mean birds km^{-3}) entry based on maximum mean dBZ measures within the sample areas.

Spring 2008	Time 1	Time 2	Sky Cover[a]	Ceiling	Weather	Birds km-3 [b]					
						1A	2A	3A	1B	2B	3B
3-4 April	4:00	4:00	ovc	200	moderate rain, mist	0	0	0	0	0	0
7-8 April	19:00	4:00	ovc	600-1000	mist	0	0	0	0	0	0
8-9 April	19:00	4:00	ovc	200-400	mist	S	S	S	S	S	S
9-10 April	19:00	22:00	ovc	400-600	mist	4	5	6	3	0	12
	4:00	4:00	ovc	100	mist	4	5	6	3	0	12
11-12 April	19:00	22:00	ovc	200	mist	37	27	10	2	4	4
19-20 April	22:00	22:00	ovc	500		10	4	25	2	1	2
20-21 April	4:00	4:00	ovc	500		0	0	0	0	0	0
27-28 April	1:00	4:00	ovc	300-500	light rain, mist	0	0	0	0	0	0
28-29 April	22:00	22:00	ovc	600		0	0	0	0	0	0
2-3 May	19:00	4:00	bkn, ovc	100-500	mist	25	39	42	3	4	3
3-4 May	19:00	22:00	ovc	100	mist	0	0	0	0	0	0
	4:00	4:00	ovc	100	mist	0	0	0	0	0	0
4-5 May	4:00	4:00	ovc	200	mist	140	37	10	8	1	1
16-17 May	19:00	19:00	ovc	200	mist	0	0	0	0	0	0
31 May-1 June	19:00	19:00	ovc	400	mist	0	0	0	0	0	0

[a] Sky Cover is the amount of the sky obscured. CLR or SKC = 0, FEW = 1/8-2/8, SCT = 3/8-4/8, BKN = 5/8-7/8, OVC = 8/8, W = Vertical Visibility = 8/8.
[b] Peak mean value for evening; measured in birds km^{-3}; V0 = bad radial velocity data, ND= no data, P=Precipitation, MI=mostly insects, OSA = Out of Sample Area, S=strobing.

Table L-38. Number of nights with overcast and ceiling at or below 1000 ft. during spring 2009 (15 March - 31 May). Weather conditions on these nights are also indicated. Time 1 is when conditions began and time 2 is when conditions ended. Sample area density (mean birds km^{-3}) entry based on maximum mean dBZ measures within the sample areas.

Spring 2009	Time 1	Time 2	Sky Cover[a]	Ceiling	Weather	Birds km-3 [b]					
						1A	2A	3A	1B	2B	3B
15-16 March	19:00	19:00	ovc	800		0	0	0	0	0	0
16-17 March	1:00	4:00	ovc	700-900		0	0	0	0	0	0
26-27 March	19:00	4:00	ovc, few	200-1000	light rain, mist	0	0	0	0	0	0
27-28 March	4:00	4:00	ovc	400	light rain, mist	0	0	0	0	0	0
28-29 March	19:00	4:00	ovc	200-400	moderate rain, mist	0	0	0	0	0	0
2-3 April	19:00	19:00	ovc	200	fog	OSA	OSA	OSA	OSA	OSA	OSA
10-11 April	1:00	4:00	ovc	100-200	mist	0	0	0	0	0	0
13-14 April	4:00	4:00	ovc	300	moderate rain, mist	0	0	0	0	0	0
14-15 April	19:00	4:00	ovc	500	light rain, mist	0	0	0	0	0	0
20-21 April	19:00	19:00	ovc	200	mist	0	0	0	0	0	0
	1:00	4:00	ovc	100-200	mist	0	0	0	0	0	0
21-22 April	19:00	19:00	ovc	300	mist	0	0	0	0	0	0
24-25 April	1:00	1:00	bkn	600		187	142	91	7	5	12
30 April-1 May	19:00	1:00	ovc	200	mist	11	15	7	6	1	5
3-4 May	19:00	4:00	ovc	400-600	moderate rain, light rain, mist	0	0	0	0	0	0
4-5 May	19:00	4:00	ovc	200-400	mist	0	0	0	0	0	0
5-6 May	22:00	4:00	ovc	300-800	heavy rain, moderate rain, mist	0	0	0	0	0	0
7-8 May	4:00	4:00	vv	700	fog	S	S	S	S	S	S
12-13 May	4:00	4:00	vv	100	fog	171	71	40	11	7	29
14-15 May	4:00	4:00	ovc	900		0	0	0	0	0	0
15-16 May	19:00	4:00	ovc, vv	100-300	mist, fog	91	65	15	4	4	4

Table L-38 (*continued*). Number of nights with overcast and ceiling at or below 1000 ft. during spring 2009 (15 March - 31 May). Weather conditions on these nights are also indicated. Time 1 is when conditions began and time 2 is when conditions ended. Sample area density (mean birds km^{-3}) entry based on maximum mean dBZ measures within the sample areas.

Spring 2009	Time 1	Time 2	Sky Cover[a]	Ceiling	Weather	Birds km-3 [b]					
						1A	2A	3A	1B	2B	3B
16-17 May	22:00	1:00	ovc, bkn	500		64	25	15	9	6	10
25-26 May	1:00	1:00	ovc	300	mist	0	0	0	0	0	0
26-27 May	1:00	4:00	ovc	300-700	mist	0	0	0	0	0	0
27-28 May	19:00	4:00	bkn, ovc	200-600	light rain, mist, fog	P	P	P	P	P	P
28-29 May	19:00	4:00	ovc	200	light rain, mist, fog	0	0	0	0	0	0
29-30 May	19:00	22:00	ovc, bkn	200-400	light thunderstorm, mist	0	0	0	0	0	0

[a] Sky Cover is the amount of the sky obscured. CLR or SKC = 0, FEW = 1/8-2/8, SCT = 3/8-4/8, BKN = 5/8-7/8, OVC = 8/8, W = Vertical Visibility = 8/8.
[b] Peak mean value for evening; measured in birds km^{-3}; V0 = bad radial velocity data, ND= no data, P=Precipitation, MI=mostly insects, OSA = Out of Sample Area, S=strobing.

Table L-39. Number of nights with overcast and ceiling at or below 1000 ft. during fall 2004 (15 August – 15 November). Weather conditions on these nights are also indicated. Time 1 is when conditions began and time 2 is when conditions ended. Sample area density (mean birds km^{-3}) entry based on maximum mean dBZ measures within the sample areas.

Fall 2004	Time 1	Time 2	Sky Cover[a]	Ceiling	Weather	Birds km-3 [b]					
						1A	2A	3A	1B	2B	3B
16 - 17 Aug	4:00	4:00	vv	100	fog	7	18	12	3	5	6
29-30 Aug	4:00	4:00	ovc	700		0	0	0	0	0	0
6-7 Sep	4:00	4:00	ovc	400	mist	0	0	0	0	0	0
7-8 Sep	22:00	4:00	ovc	400-700	rain, mist	0	0	0	0	0	0
15-16 Sep	22:00	4:00	ovc	100-700	mist	0	0	0	0	0	0
17-18 Sep	19:00	19:00	ovc	800		0	0	0	0	0	0
23-24 Sep	4:00	4:00	ovc	800	mist	13	13	13	2	2	7
26-27 Sep	4:00	4:00	ovc	100	mist	46	112	33	15	12	6
27-28 Sep	1:00	4:00	ovc	200	light rain, mist	0	0	0	0	0	0
28-29 Sep	19:00	19:00	ovc	700	light rain	33	0	0	0	0	0
30 Sep - 1 Oct	22:00	22:00	vv	100	fog	S	S	S	S	S	S
2-3 Oct	1:00	1:00	ovc	100	mist	0	0	0	0	0	0
19-20 Oct	19:00	4:00	ovc	500-900	light rain	0	0	0	0	0	0
29-30 Oct	1:00	4:00	ovc	500-700	rain	0	0	0	0	0	0
30-31 Oct	19:00	22:00	vv, ovc	100-300	mist	0	0	0	0	0	0
2-3 Nov	19:00	19:00	bkn	1000		0	0	0	0	0	0
4-5 Nov	19:00	22:00	ovc	200-400	light rain	0	0	0	0	0	0
12-13 Nov	19:00	4:00	ovc	700-900	light rain, rain	0	0	0	0	0	0

[a] Sky Cover is the amount of the sky obscured. CLR or SKC = 0, FEW = 1/8-2/8, SCT = 3/8-4/8, BKN = 5/8-7/8, OVC = 8/8, W = Vertical Visibility = 8/8.
[b] Peak mean value for evening; measured in birds km^{-3}; V0 = bad radial velocity data, ND= no data, P=Precipitation, MI=mostly insects, OSA = Out of Sample Area, S=strobing.

Table L-40. Number of nights with overcast and ceiling at or below 1000 ft. during fall 2005 (15 August – 15 November). Weather conditions on these nights are also indicated. Time 1 is when conditions began and time 2 is when conditions ended. Sample area density (mean birds km^{-3}) entry based on maximum mean dBZ measures within the sample areas.

Fall 2005	Time 1	Time 2	Sky Cover[a]	Ceiling	Weather	Birds km-3 [b]					
						1A	2A	3A	1B	2B	3B
30-31 Aug	1:00	1:00	ovc	1000		0	0	0	0	0	0
14-15 Sep	19:00	4:00	ovc	500-900		0	0	0	0	0	0
15-16 Sep	22:00	4:00	bkn, ovc	500-900	mist	S	S	S	S	S	S
16-17 Sep	19:00	19:00	bkn	500		1	7	44	2	3	5
	1:00	4:00	ovc	200-300	light rain	1	7	44	2	3	5
3-4 Oct	22:00	22:00	ovc	100		P	P	P	P	P	P
	4:00	4:00	ovc	900		P	P	P	P	P	P
4-5 Oct	22:00	22:00	vv	100		22	17	47	4	3	5
5-6 Oct	22:00	1:00	ovc	800-1000		S	S	S	S	S	S
6-7 Oct	19:00	19:00	ovc	100	mist	0	0	0	0	0	0
7-8 Oct	19:00	4:00	ovc	700-900	light rain	0	0	0	0	0	0
8-9 Oct	19:00	4:00	ovc	300-700	mist	0	0	0	0	0	0
9-10 Oct	19:00	4:00	ovc	200-500	mist	1	15	4	2	2	4
10-11 Oct	19:00	4:00	ovc	400-600	light rain	0	0	0	0	0	0
11-12 Oct	19:00	1:00	ovc	500-700	mist	0	0	0	0	0	0
12-13 Oct	19:00	4:00	ovc	400-900	rain, light rain, mist	0	0	0	0	0	0
13-14 Oct	19:00	22:00	ovc	800-900	light rain, mist	0	0	0	0	0	0
13-14 Oct	4:00	4:00	ovc	900		0	0	0	0	0	0
14-15 Oct	19:00	4:00	ovc	600-1000	mist	0	0	0	0	0	0
21-22 Oct	22:00	22:00	ovc	500	mist	0	0	0	0	0	0
25-26 Oct	19:00	1:00	ovc	600-700	mist	0	0	0	0	0	0
5-6 Nov	4:00	4:00	vv	100	fog	7	8	13	1	3	4

[a] Sky Cover is the amount of the sky obscured. CLR or SKC = 0, FEW = 1/8-2/8, SCT = 3/8-4/8, BKN = 5/8-7/8, OVC = 8/8, W = Vertical Visibility = 8/8.
[b] Peak mean value for evening; measured in birds km^{-3}; V0 = bad radial velocity data, ND= no data, P=Precipitation, MI=mostly insects, OSA = Out of Sample Area, S=strobing.

Table L-41. Number of nights with overcast and ceiling at or below 1000 ft. during fall 2006 (15 August – 15 November). Weather conditions on these nights are also indicated. Time 1 is when conditions began and time 2 is when conditions ended. Sample area density (mean birds km^{-3}) entry based on maximum mean dBZ measures within the sample areas.

Fall 2006	Time 1	Time 2	Sky Cover[a]	Ceiling	Weather	Birds km-3 [b]					
						1A	2A	3A	1B	2B	3B
15-16 Aug	1:00	1:00	vv	100	fog	S	S	S	S	S	S
16-17 Aug	1:00	1:00	few	100	mist	V0	V0	V0	V0	V0	V0
23-24 Aug	4:00	4:00	ovc	100	mist	S	S	S	S	S	S
25-26 Aug	1:00	1:00	bkn	1000		4	12	6	0	1	2
27-28 Aug	22:00	22:00	ovc	900	mist	0	0	0	0	0	0
29-30 Aug	19:00	4:00	ovc	200-500	light rain, mist	0	0	0	0	0	0
1-2 Sep	4:00	4:00	ovc	800	light rain, mist	0	0	0	0	0	0
5-6 Sep	22:00	22:00	ovc	1000	mist	0	0	0	0	0	0
	4:00	4:00	ovc	500	mist	0	0	0	0	0	0
6-7 Sep	1:00	4:00	vv, ovc	100	fog, mist	V0	V0	V0	V0	V0	V0
9-10 Sep	4:00	4:00	sct	100	mist	S	S	S	S	S	S
14-15 Sep	1:00	4:00	ovc	1000	heavy rain, mist	0	0	0	0	0	0
15-16 Sep	1:00	4:00	ovc	400-1000	mist	MD	MD	MD	MD	MD	MD
17-18 Sep	4:00	4:00	few	100	mist	S	S	S	S	S	S
10-11 Oct	22:00	1:00	vv, ovc	100-900	fog	S	S	S	S	S	S
11-12 Oct	19:00	22:00	ovc	200	light rain, mist	0	0	0	0	0	0
17-18 Oct	1:00	4:00	ovc	400-700		0	0	0	0	0	0
27-28 Oct	1:00	1:00	ovc	900	rain, mist	0	0	0	0	0	0
7-8 Nov	19:00	22:00	ovc	200	rain, mist	0	0	0	0	0	0
8-9 Nov	22:00	6:00	ovc	200-600	light rain, mist	0	101	21	0	22	21
11-12 Nov	4:00	4:00	ovc	300	mist	0	0	0	0	0	0
12-13 Nov	4:00	4:00	ovc	800	light rain, mist	0	0	0	0	0	0

Table L-41 (*continued*). Number of nights with overcast and ceiling at or below 1000 ft. during fall 2006 (15 August – 15 November). Weather conditions on these nights are also indicated. Time 1 is when conditions began and time 2 is when conditions ended. Sample area density (mean birds km^{-3}) entry based on maximum mean dBZ measures within the sample areas.

Fall 2006	Time 1	Time 2	Sky Cover[a]	Ceiling	Weather	Birds km-3 [b]					
						1A	2A	3A	1B	2B	3B
13-14 Nov	19:00	1:00	ovc	300-700	light rain, mist	0	0	0	0	0	0
14-15 Nov	1:00	1:00	ovc	400	mist	0	0	0	0	0	0
15-16 Nov	19:00	1:00	vv, ovc	100	fog	0	0	0	0	0	0

[a] Sky Cover is the amount of the sky obscured. CLR or SKC = 0, FEW = 1/8-2/8, SCT = 3/8-4/8, BKN = 5/8-7/8, OVC = 8/8, W = Vertical Visibility = 8/8.
[b] Peak mean value for evening; measured in birds km^{-3}; V0 = bad radial velocity data, ND= no data, P=Precipitation, MI=mostly insects, OSA = Out of Sample Area, S=strobing.

Table L-42. Number of nights with overcast and ceiling at or below 1000 ft. during fall 2007 (15 August – 15 November). Weather conditions on these nights are also indicated. Time 1 is when conditions began and time 2 is when conditions ended. Sample area density (mean birds km^{-3}) entry based on maximum mean dBZ measures within the sample areas.

Fall 2007	Time 1	Time 2	Sky Cover[a]	Ceiling	Weather	Birds km-3 [b]					
						1A	2A	3A	1B	2B	3B
19-20 Aug	22:00	1:00	ovc	400		0	0	0	0	0	0
20-21 Aug	22:00	22:00	ovc	1000		0	0	0	0	0	0
	4:00	4:00	ovc	700	light rain, mist	0	0	0	0	0	0
21-22 Aug	19:00	22:00	ovc	500-700	mist	0	0	0	0	0	0
	4:00	4:00	ovc	500	mist	0	0	0	0	0	0
22-23 Aug	19:00	4:00	ovc	100-500	mist	0	0	0	0	0	0
23-24 Aug	22:00	4:00	vv	100	fog	8	3	6	0	0	0
9-10 Sep	19:00	22:00	bkn, sct	500-700		0	0	0	0	0	0
	4:00	4:00	ovc	300		0	0	0	0	0	0
21-22 Sep	1:00	4:00	ovc	300-500	mist	S	S	S	S	S	S
26-27 Sep	4:00	4:00	few	300	mist	0	0	0	0	0	0
27-28 Sep	4:00	4:00	ovc	400		0	0	0	0	0	0
2-3 Oct	22:00	4:00	ovc	100-800	mist	0	0	0	0	0	0
3-4 Oct	19:00	19:00	sct	700		0	0	0	0	0	0
	1:00	4:00	ovc	300		0	0	0	0	0	0
4-5 Oct	19:00	4:00	ovc	100-300	mist	S	S	S	S	S	S
5-6 Oct	22:00	4:00	ovc, vv	100-300	mist, fog	177	66	16	8	10	5
7-8 Oct	19:00	22:00	ovc	900		35	65	210	15	65	100
9-10 Oct	19:00	1:00	ovc	400-800	thunderstorm, light thunderdstorm, light rain, mist	0	0	0	0	0	0
16-17 Oct	1:00	1:00	sct	100	mist	S	S	S	S	S	S
18-19 Oct	1:00	4:00	ovc	700-900		0	0	0	0	0	0

Table L-42 (*continued*). Number of nights with overcast and ceiling at or below 1000 ft. during fall 2007 (15 August – 15 November). Weather conditions on these nights are also indicated. Time 1 is when conditions began and time 2 is when conditions ended. Sample area density (mean birds km^{-3}) entry based on maximum mean dBZ measures within the sample areas.

Fall 2007	Time 1	Time 2	Sky Cover[a]	Ceiling	Weather	Birds km-3 [b]					
						1A	2A	3A	1B	2B	3B
19-20 Oct	19:00	22:00	ovc	200-800		0	0	0	0	0	0
24-25 Oct	19:00	4:00	ovc	600-900	rain, light rain, mist	0	0	0	0	0	0
26-27 Oct	19:00	22:00	ovc	200	mist	0	0	0	0	0	0
13-14 Nov	22:00	4:00	sct, ovc, few	100-700	shallow fog, mist	44	17	24	5	3	3

[a] Sky Cover is the amount of the sky obscured. CLR or SKC = 0, FEW = 1/8-2/8, SCT = 3/8-4/8, BKN = 5/8-7/8, OVC = 8/8, W = Vertical Visibility = 8/8.
[b] Peak mean value for evening; measured in birds km^{-3}; V0 = bad radial velocity data, ND= no data, P=Precipitation, MI=mostly insects, OSA = Out of Sample Area, S=strobing.

Table L-43. Number of nights with overcast and ceiling at or below 1000 ft. during fall 2008 (15 August – 15 November). Weather conditions on these nights are also indicated. Time 1 is when conditions began and time 2 is when conditions ended. Sample area density (mean birds km^{-3}) entry based on maximum mean dBZ measures within the sample areas.

Fall 2008	Time 1	Time 2	Sky Cover[a]	Ceiling	Weather	Birds km-3 [b]					
						1A	2A	3A	1B	2B	3B
5-6 Sep	22:00	4:00	ovc	400-600	light rain, mist	0	0	0	0	0	0
12-13 Sep	1:00	1:00	lvc	500	light rain, mist	MD	MD	MD	MD	MD	MD
20-21 Sep	4:00	4:00	ovc	1000	fog	23	17	18	2	10	9
25-26 Sep	1:00	1:00	ovc	800	light rain	0	0	0	0	0	0
26-27 Sep	19:00	1:00	ovc	200-400	mist	0	0	0	0	0	0
27-28 Sep	1:00	1:00	ovc	400		0	0	0	0	0	0
28-29 Sep	22:00	22:00	ovc	900	light rain, mist	31	12	5	6	3	5
30 Sep - 1 Oct	4:00	4:00	ovc	200	fog	0	0	0	0	0	0
5-6 Oct	1:00	1:00	ovc	500	fog	121	129	73	10	9	5
13-14 Oct	4:00	4:00	ovc	700	mist	S	S	S	S	S	S
15-16 Oct	4:00	4:00	ovc	200	mist	268	99	60	9	9	15
3-4 Nov	22:00	22:00	few	100	mist	0	0	0	0	0	0
5-6 Nov	22:00	1:00	ovc	800-1000	light rain, mist	0	0	0	0	0	0
6-7 Nov	19:00	4:00	ovc	400-1000	light rain, mist	0	0	0	0	0	0
7-8 Nov	19:00	4:00	ovc	300-800	mist	0	0	0	0	0	0
8-9 Nov	22:00	22:00	ovc	200	mist	0	0	0	0	0	0
13-14 Nov	19:00	4:00	ovc	100-500	mist	0	0	0	0	0	0
14-15 Nov	19:00	4:00	ovc, vv	100-300	rain, light rain, fog, mist	0	0	0	0	0	0
15-16 Nov	19:00	19:00	ovc	700	mist	0	0	0	0	0	0

[a] Sky Cover is the amount of the sky obscured. CLR or SKC = 0, FEW = 1/8-2/8, SCT = 3/8-4/8, BKN = 5/8-7/8, OVC = 8/8, W = Vertical Visibility = 8/8.
[b] Peak mean value for evening; measured in birds km^{-3}; V0 = bad radial velocity data, ND= no data, P=Precipitation, MI=mostly insects, OSA = Out of Sample Area, S=strobing.

APPENDIX M

AVIAN PREDICTIVE MODEL

Table M-1. Avian variables and spatial covariates used in modeling avian density (km^{-2}) and distribution.

Bird Variable	
Total birds	
Total birds 'Fall'	
Total birds 'Spring'	
Total birds 'Summer'	
Total birds 'Winter'	
Total sitting birds	
Total sitting birds 'Fall'	
Total sitting birds 'Spring'	
Total sitting birds 'Summer'	
Total sitting birds 'Winter'	
Northern Gannet	
Scoter Species	
Long-tailed Duck	
Common Loon	
Red-throated Loon	
Herring Gull	
Laughing Gull	
Common Tern	
Wilson's Storm Petrel	
Cory Shearwater	
Spatial Covariate	**Units**
Depth	Meters
Slope	Degrees
Distance from shoreline 'DistShore'	Feet
Distance to nearest shoal 'DistShoal'	Feet
Longitude	Decimal degrees
Latitude	Decimal degrees

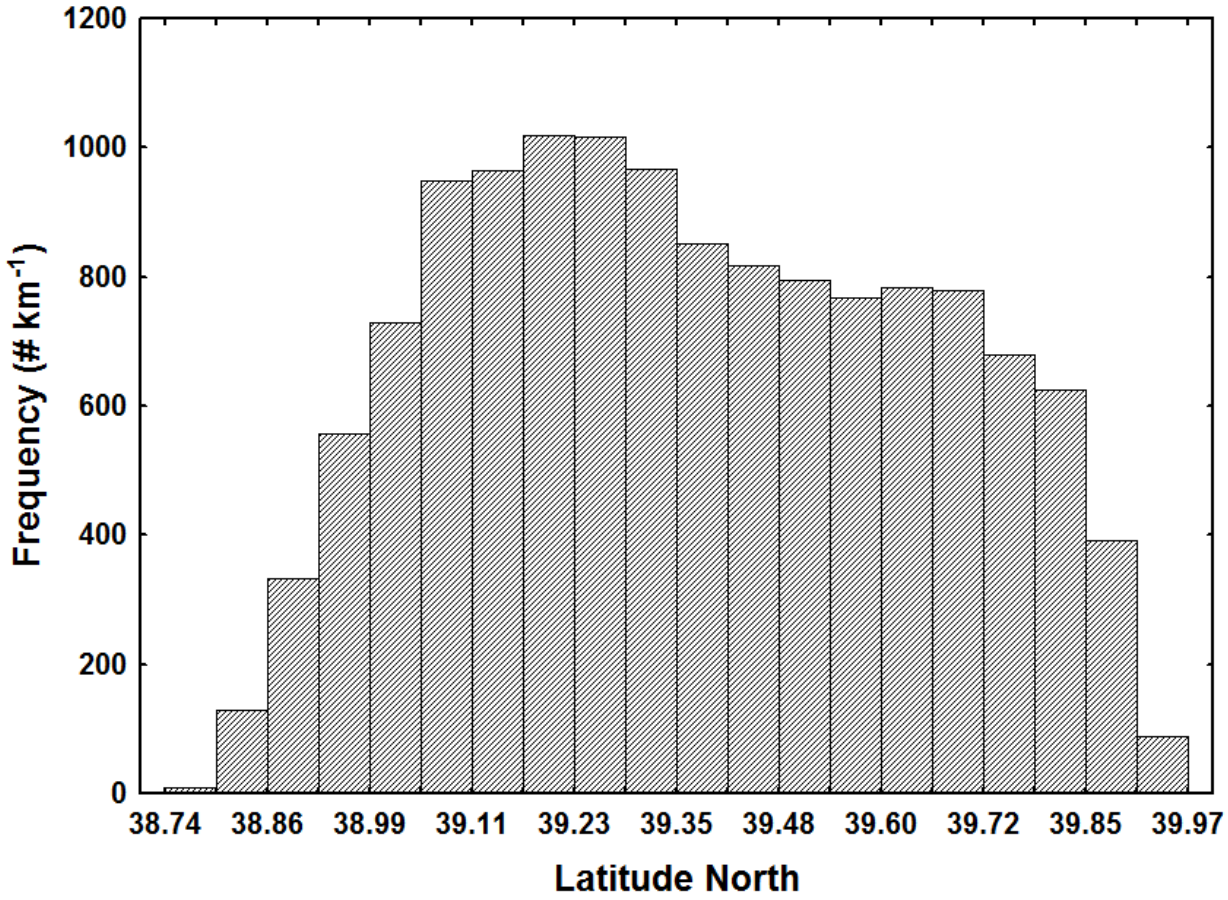

Figure M-1. Frequency distribution (km) of sampling effort for avian density and latitude.

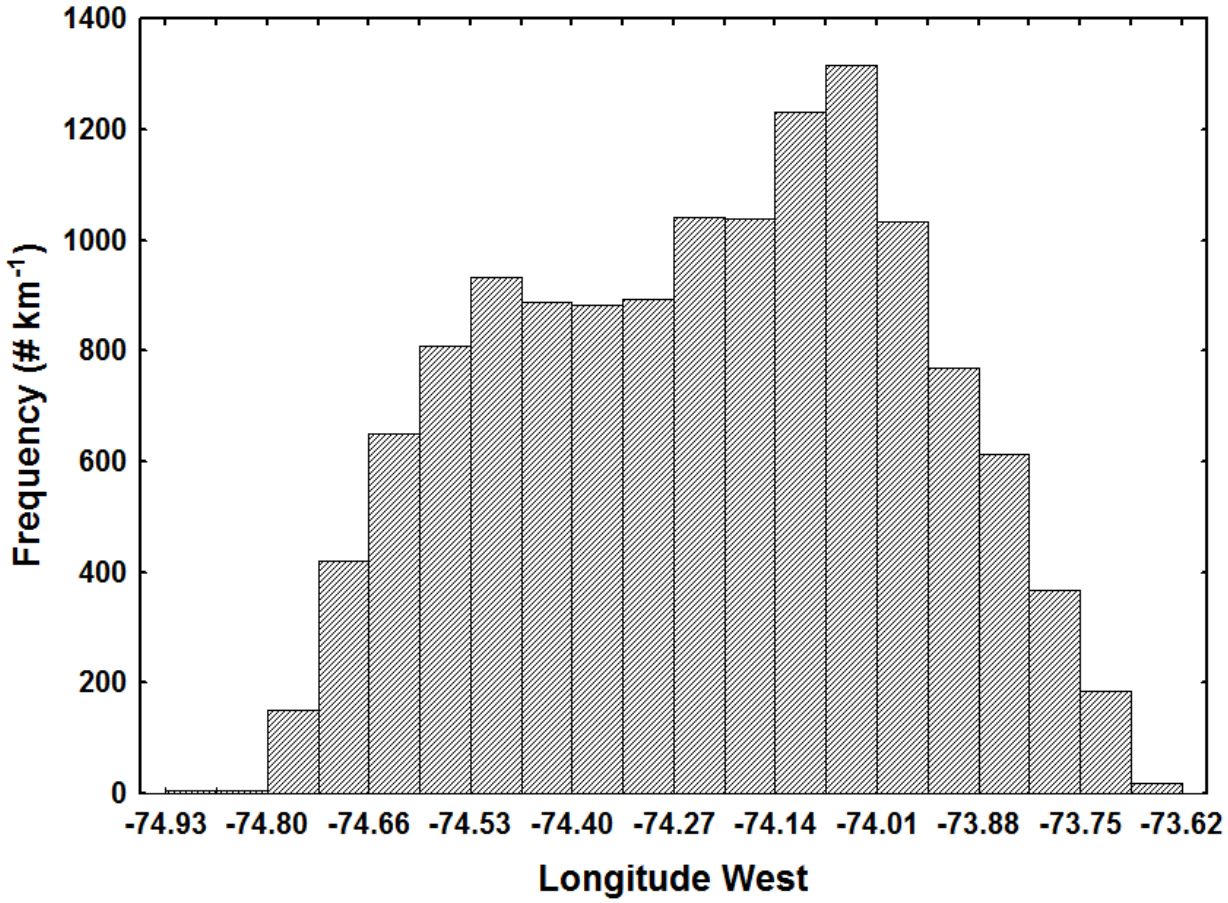

Figure M-2. Frequency distribution (km) of total sampling effort for avian density and longitude.

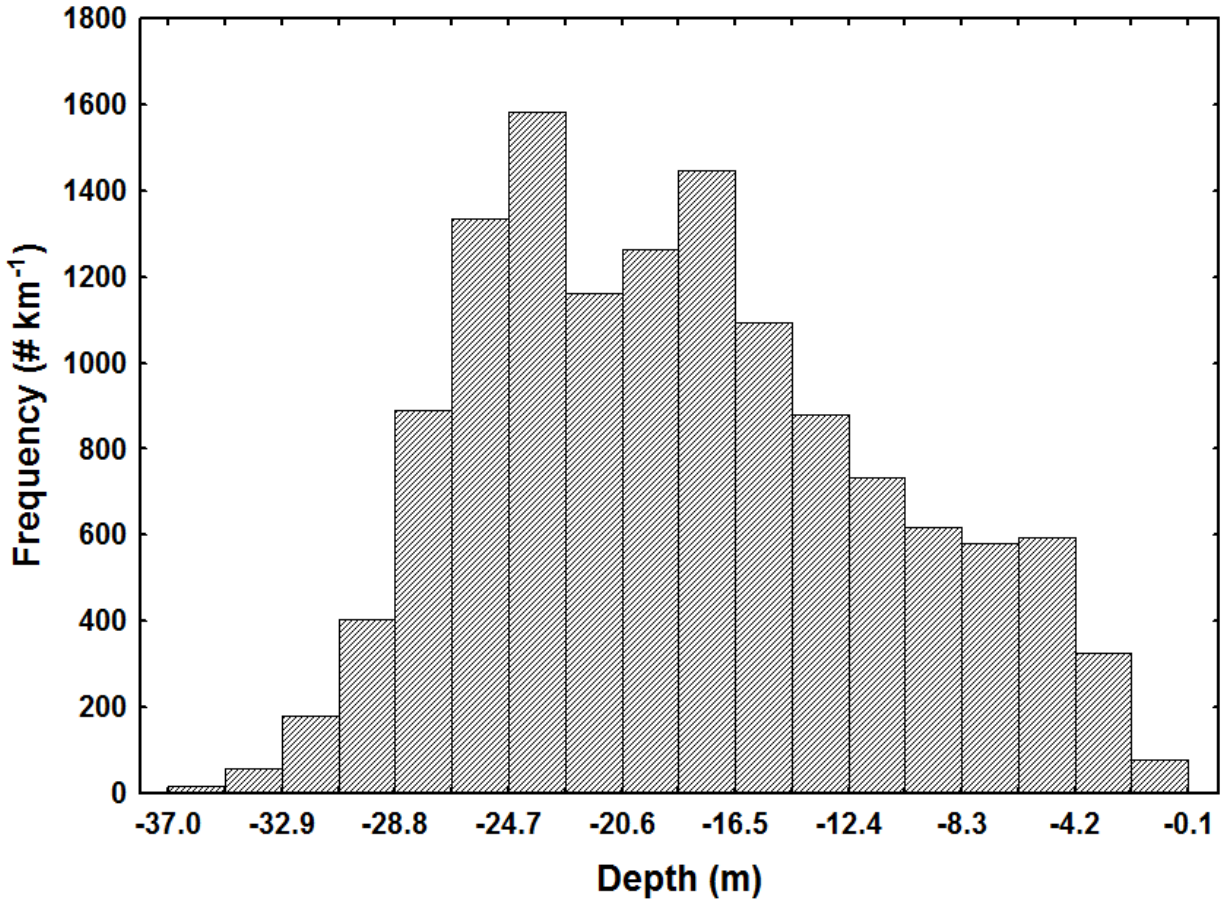

Figure M-3. Frequency distribution (km) of total sampling effort for avian density and depth.

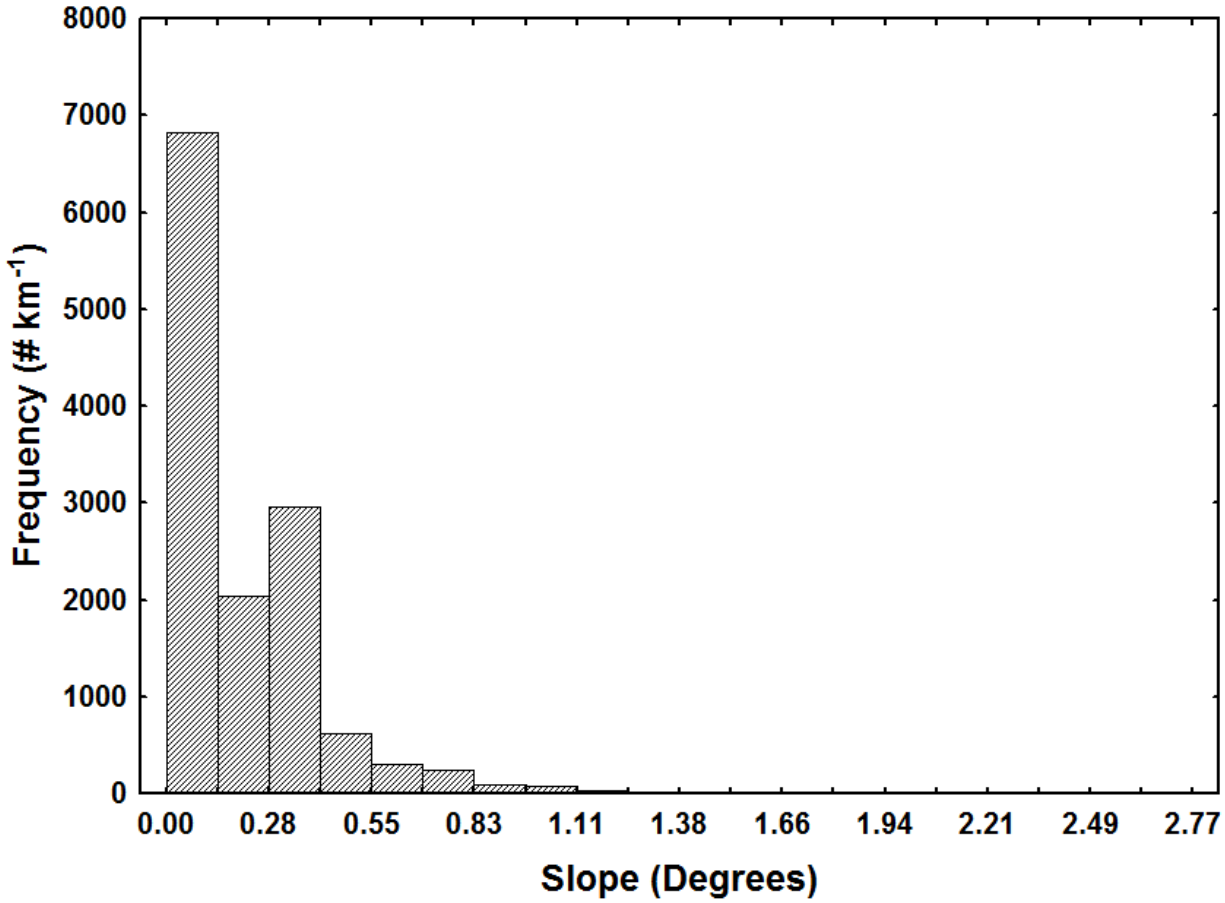

Figure M-4. Frequency distribution (km) of total sampling effort for avian density and slope.

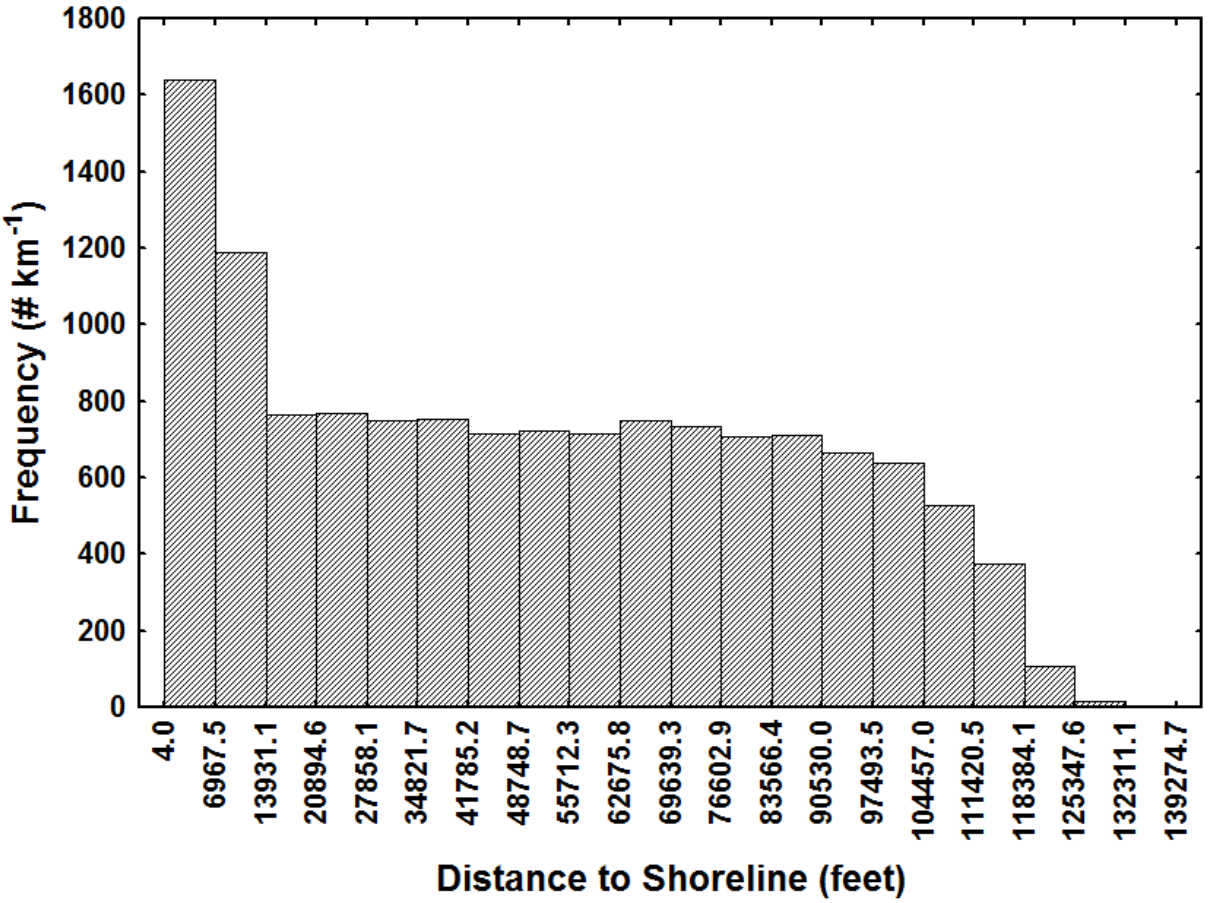

Figure M-5. Frequency distribution (km) of total sampling effort for avian density and distance to shoreline.

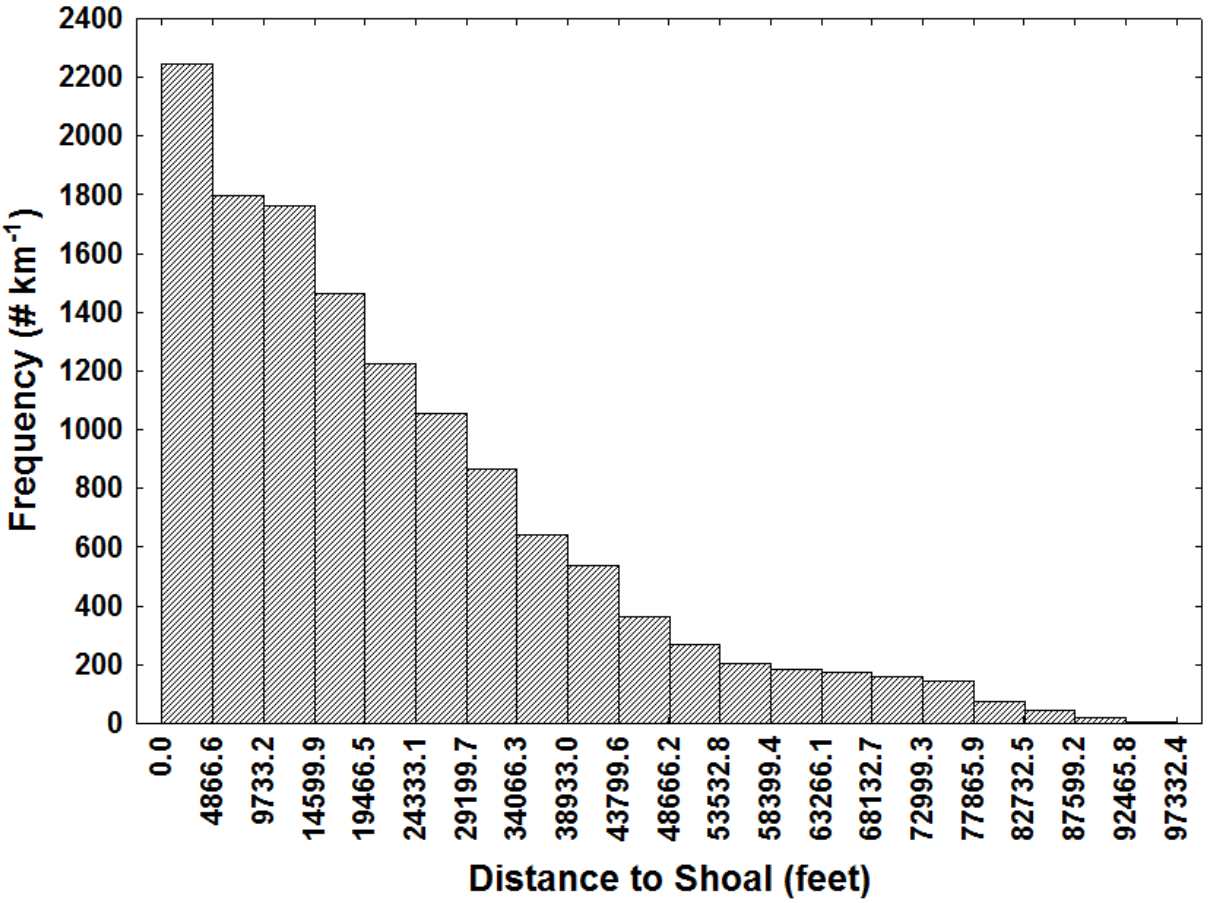

Figure M-6. Frequency distribution (km) of total sampling effort for avian density and distance to nearest shoal.

Table M-2. General summary of effect of spatial covariates on bird density based on GAM results: (a) description of effect and (b) covariate effect on bird density.

Covariate	Effect on bird density		
	+	-	+/-
Depth	Density increases in shallower water	Density increases in deeper water	Effect on density is curvilinear
Slope	Density increases with slope	Density decreases with slope	Effect on density is curvilinear
DistShore	Density increases with distance from shoreline	Density is decreases with distance from shoreline	Effect on density is curvilinear
DistShoal	Density increases with distance to nearest shoal	Density decreases with distance from nearest shoal	Effect on density is curvilinear
Longitude	Density increase indicates more bird in the eastern portion of the survey area	Density decrease indicates more birds in the western portion of the survey area	Effect on density is curvilinear
Latitude	Density increase indicates more birds in the northern portion of the study area	Density increase indicates more birds in the southern portion of the survey area	Effect on density is curvilinear

Table M-3. General summary of effect of spatial covariates on bird density based on GAM results (b) covariate effect on bird density.

Bird Variable	Depth	Slope	DistShore	DistShoal	Longitude	Latitude
Total birds	+		-		+	-
Total birds 'Fall'	+		-		+	-
Total birds 'Spring'	-		-		-	
Total birds 'Summer'	+/-		-	+/-	+	-
Total birds 'Winter'	+	-	-		+	-
Total sitting birds	+	-				
Total sitting birds 'Fall'	+	+	-			+/-
Total sitting birds 'Spring'	-	+/-			-	+
Total sitting birds 'Summer'	+/-		+/-	+/-	+/-	
Total sitting birds 'Winter'	+		-			
Northern Gannet	-		-	+	+	-
Scoter Species			+/-	+	-	+
Long-tailed Duck		+/-	-		+	-
Common Loon	-				-	
Red-throated Loon			+/-	+	-	
Herring Gull	+		+	+	-	+
Laughing Gull	+		-		+	-
Common Tern			-	+/-	+	-
Wilson's Storm Petrel			+		-	+
Cory Shearwater	-		+/-	+/-	+/-	

Table M-4. Spatial regression model results for spatial covariates and total bird density (All Years and Seasons).

Spatial Regression Model:
Spatial lag model – Maximum Likelihood Estimation
N=5801, R^2=0.26, Log likelihood=-21598.9, Akaike info criterion=43213.7
Global Moran's I = 0.3551, p<0.002

Variable	Coefficient	Std.Error	z-value	Probability
Spatial lag	0.484	0.014	34.867	**0.0000**
Constant	-50.341	361.643	-0.139	0.8890
Depth	0.358	0.041	8.685	**0.0000**
Slope	-0.105	0.483	-0.218	0.8275
DistShore	3.283e-005	1.60e-005	2.047	**0.0406**
DistShoal	1.206e-005	7.73e-006	1.561	0.1185
Longitude	0.082	3.327	0.024	0.9801
Latitude	1.600	2.927	0.546	0.5846

Table M-5. GAM results for spatial covariates and total bird density (All Years and Seasons).

Generalized Additive Models:
Initial Model Summary: Significance of smoothed terms

Variable	Df	Npar Df	Npar F	Pr(F)
Depth	**1**	**3**	**10.279**	**9.288e-07 *** **
Slope	**1**	**3**	**1.343**	**0.2584**
DistShore	**1**	**3**	**47.335**	**<2.2e-16 *** **
DistShoal	**1**	**3**	**1.612**	**0.1844**
Lon	**1**	**3**	**52.442**	**<2.2e-16 *** **
Lat	**1**	**3**	**12.629**	**3.030e-08 *** **

AIC: 185949.7

Stepwise-selected Model Summary: Significance of smoothed terms

Variable	Df	Npar Df	Npar F	Pr(F)
Depth	**1**	**3**	**10.189**	**1.058e-06 *** **
DistShore	**1**	**3**	**56.903**	**<2.2e-16 *** **
Lon	**1**	**3**	**54.741**	**<2.2e-16 *** **
Lat	**1**	**3**	**11.694**	**1.186e-07 *** **

AIC: 185943.4

Significant codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
Df=degrees of freedom, NparDf=nonparametric degrees of freedom, NparF=nonparametric F value, Pr(F)=probability value.

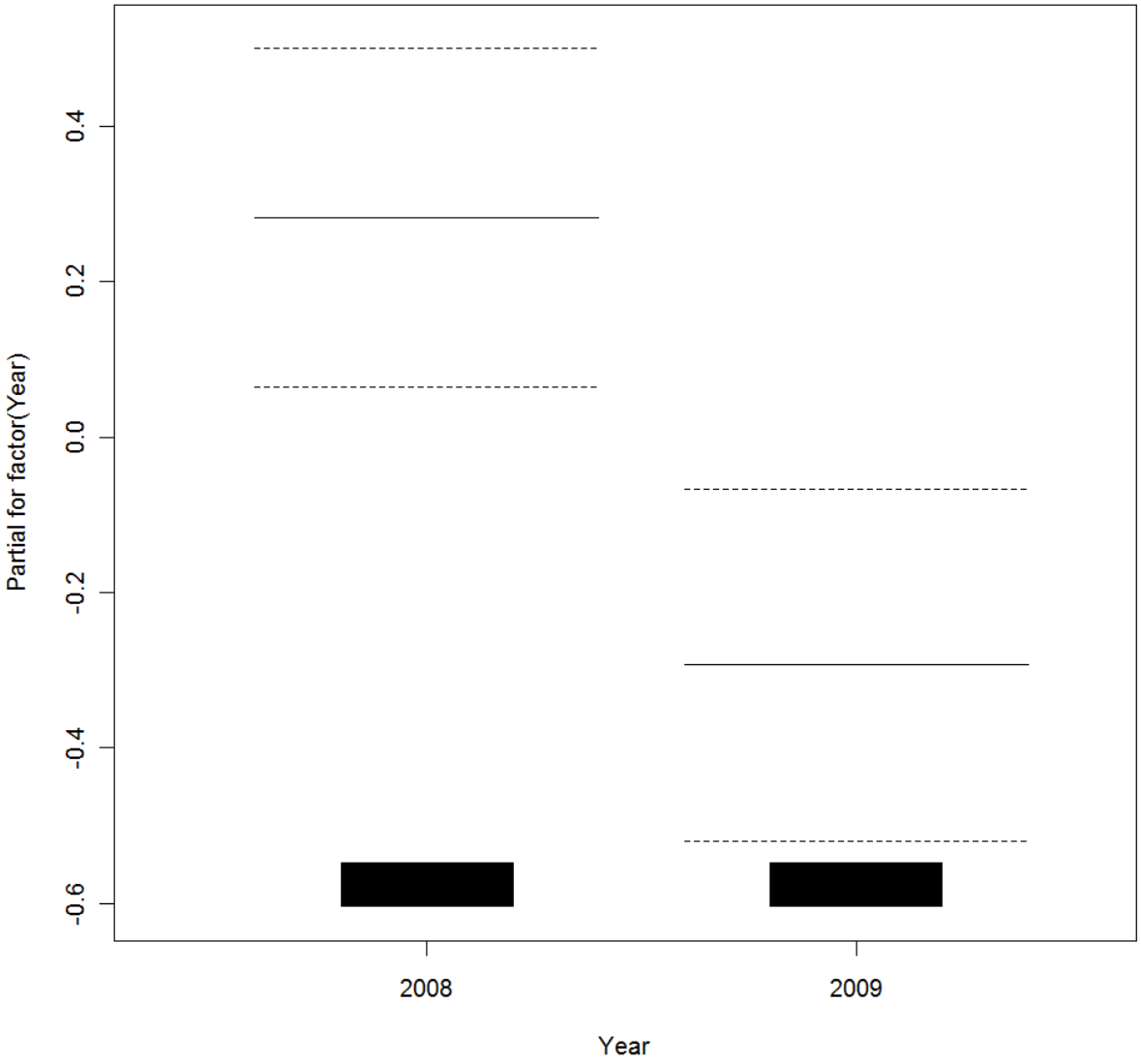

Figure M-7. Result of GAM regression for the effect of year on total bird density. Broken lines represent 95% confidence intervals around the covariate main effect.

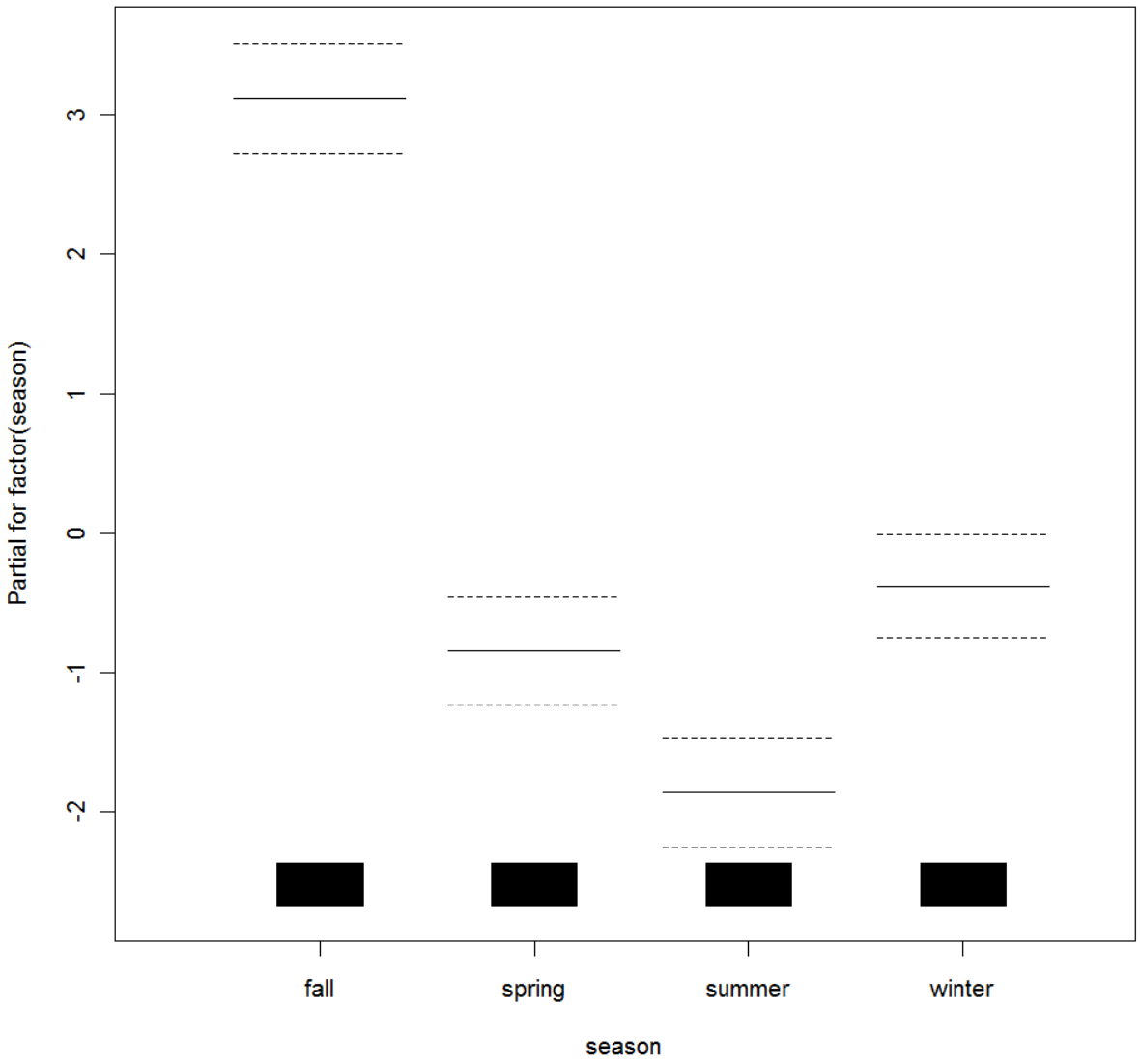

Figure M-8. Result of GAM regression for the effect of season on total bird density. Broken lines represent 95% confidence intervals around the covariate main effect.

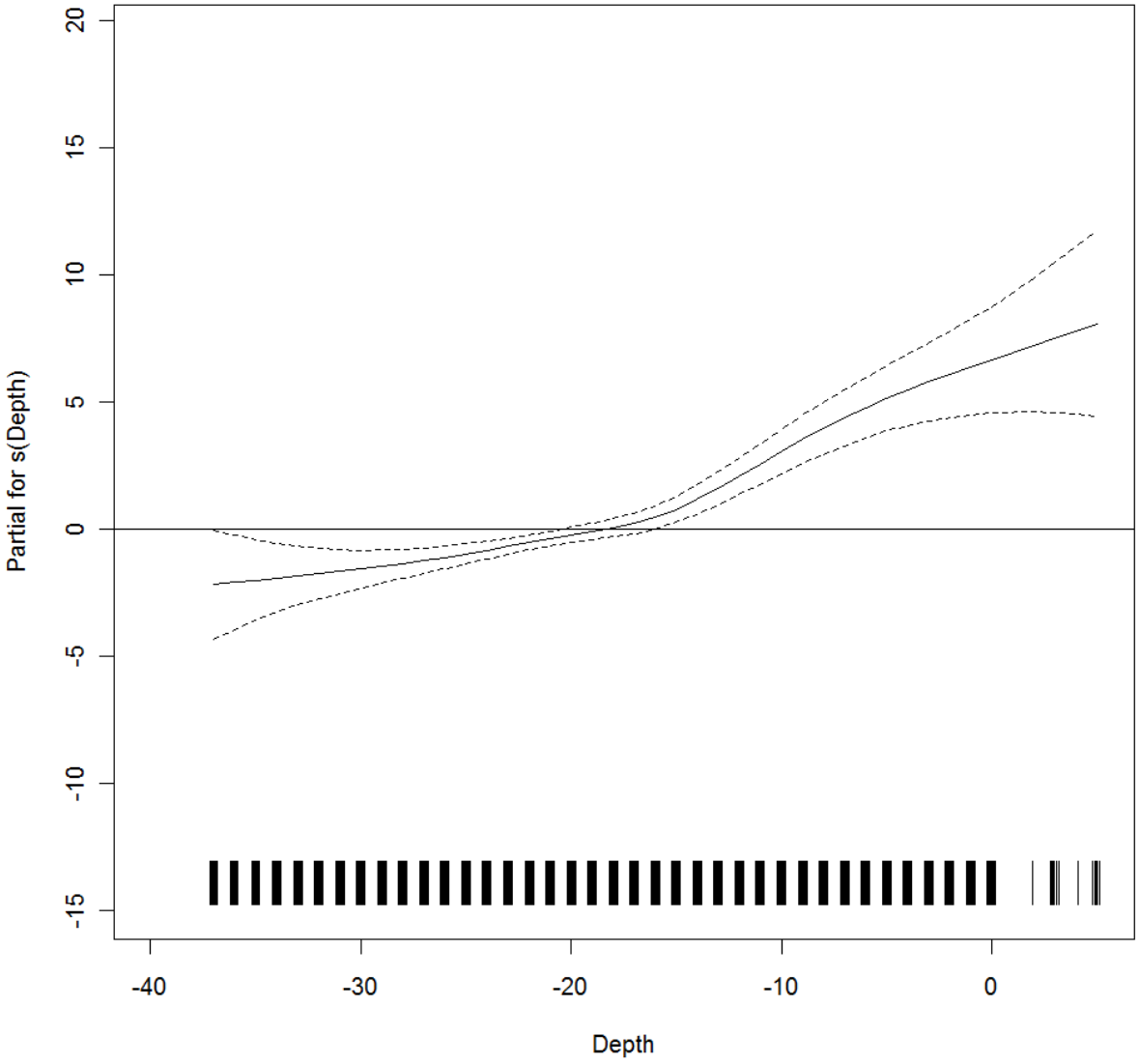

Figure M-9. Result of GAM regression for the effect of depth (m) on total bird density. Broken lines represent 95% confidence intervals around the covariate main effect.

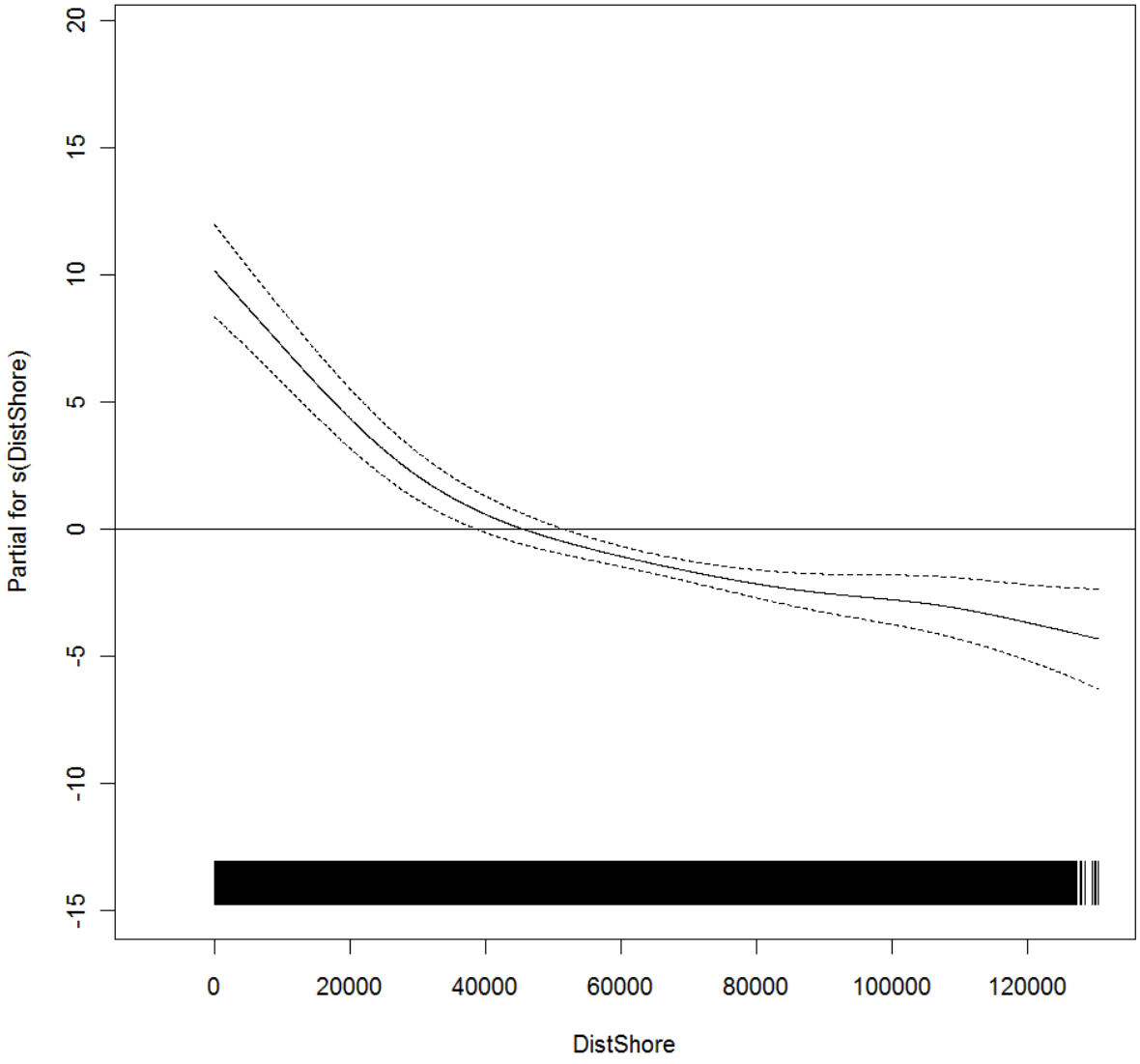

Figure M-10. Result of GAM regression for the effect of distance from shoreline 'DistShore' (feet) on total bird density. Broken lines represent 95% confidence intervals around the covariate main effect.

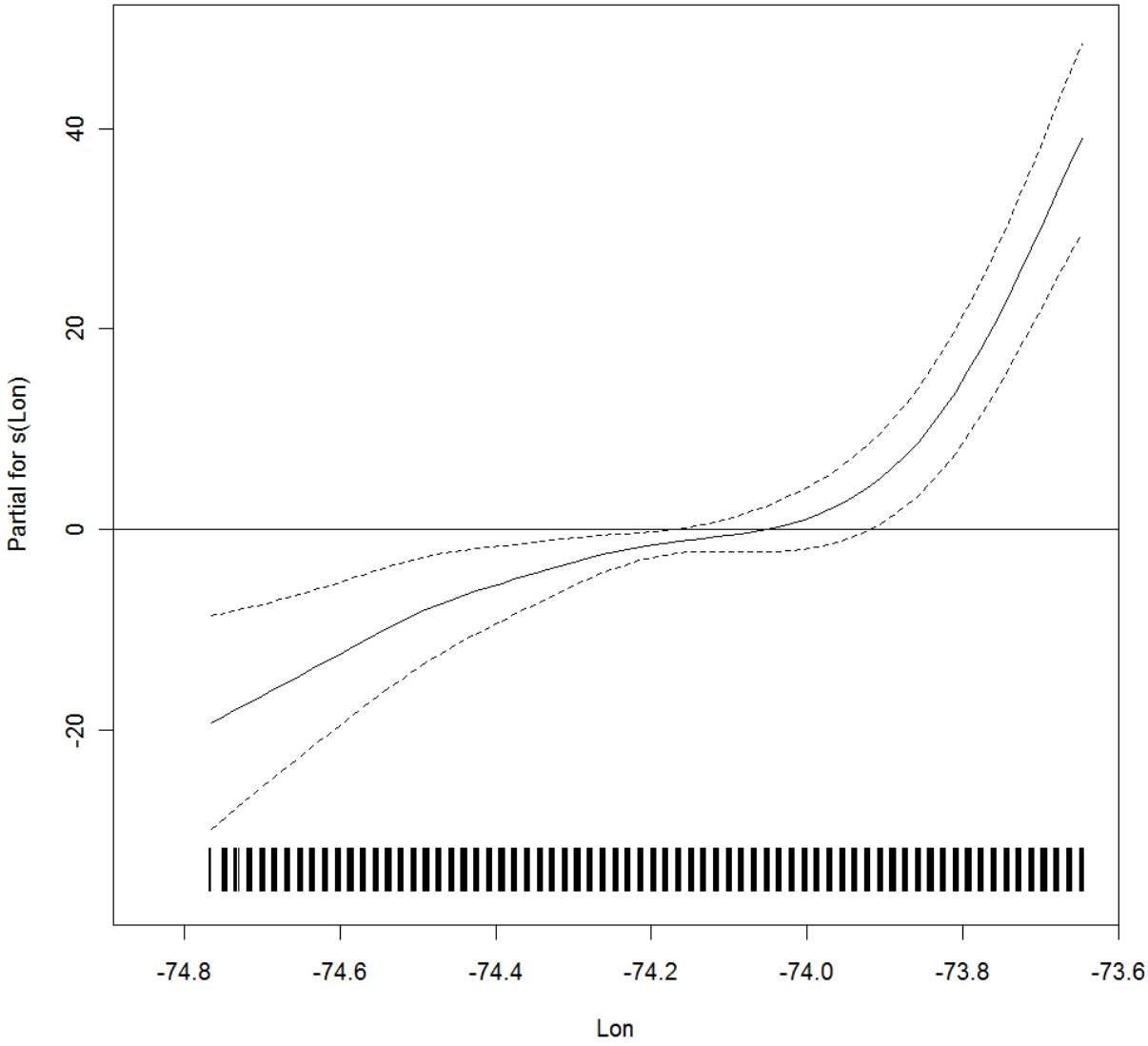

Figure M-11. Result of GAM regression for the effect of longitude 'Lon' on total bird density. Broken lines represent 95% confidence intervals around the covariate main effect.

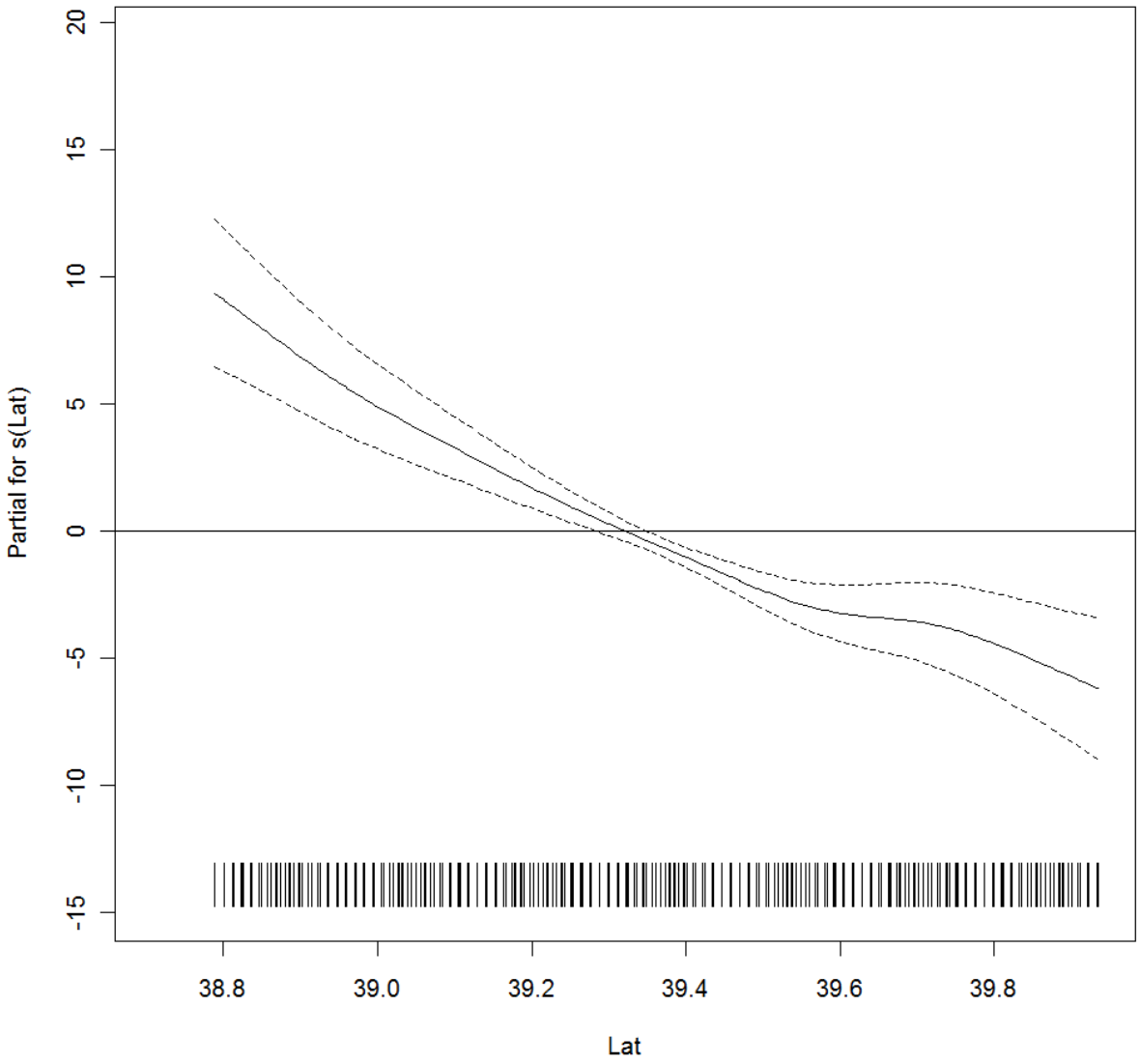

Figure M-12. Result of GAM regression for the effect of latitude 'Lat' on total bird density. Broken lines represent 95% confidence intervals around the covariate main effect.

Table M-6. General summary of effect of spatial covariates on bird density based on GAM results (b) covariate effect on bird density.

Spatial Regression Model:
Spatial lag model – Maximum Likelihood Estimation
N=2698, R^2=0.26, Log likelihood=-8539.02, Akaike info criterion=17094
Global Moran's I = 0.4432 , p=0.001

Variable	Coefficient	Std.Error	z-value	Probability
Spatial lag	0.352	0.014	24.992	**0.0000**
Constant	155.046	296.591	0.523	0.6011
Depth	0.206	0.034	6.096	**0.0000**
Slope	0.459	0.458	1.001	0.3165
DistShore	9.600e-005	1.29e-005	0.743	0.4574
DistShoal	-9.372e-005	6.45e-006	-1.452	0.1463
Longitude	2.159	2.736	0.789	0.4300
Latitude	0.257	2.386	0.107	0.9143

Table M-7. GAM results for spatial covariates and total bird density (Fall 2007).

Generalized Additive Models:
Initial Model Summary: Significance of smoothed terms

Variable	Df	Npar Df	Npar F	Pr(F)
Depth	**1**	**3**	**4.598**	**0.003226 ****
Slope	**1**	**3**	**1.841**	**0.137401**
DistShore	**1**	**3**	**23.305**	**5.551e-15 *****
DistShoal	**1**	**3**	**2.026**	**0.107997**
Lon	**1**	**3**	**51.836**	**<2.2e-16 *****
Lat	**1**	**3**	**13.945**	**4.693e-09 *****

AIC: 50994.79

Stepwise-selected Model Summary: Significance of smoothed terms

Variable	Df	Npar Df	Npar F	Pr(F)
Depth	**1**	**3**	**4.713**	**0.002746 ****
DistShore	**1**	**3**	**26.823**	**<2.2e-16 *****
Lon	**1**	**3**	**55.426**	**<2.2e-16 *****
Lat	**1**	**3**	**13.764**	**6.113e-09 *****

AIC: 50989.94

Significant codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
Df=degrees of freedom, NparDf=nonparametric degrees of freedom, NparF=nonparametric F value, Pr(F)=probability value.

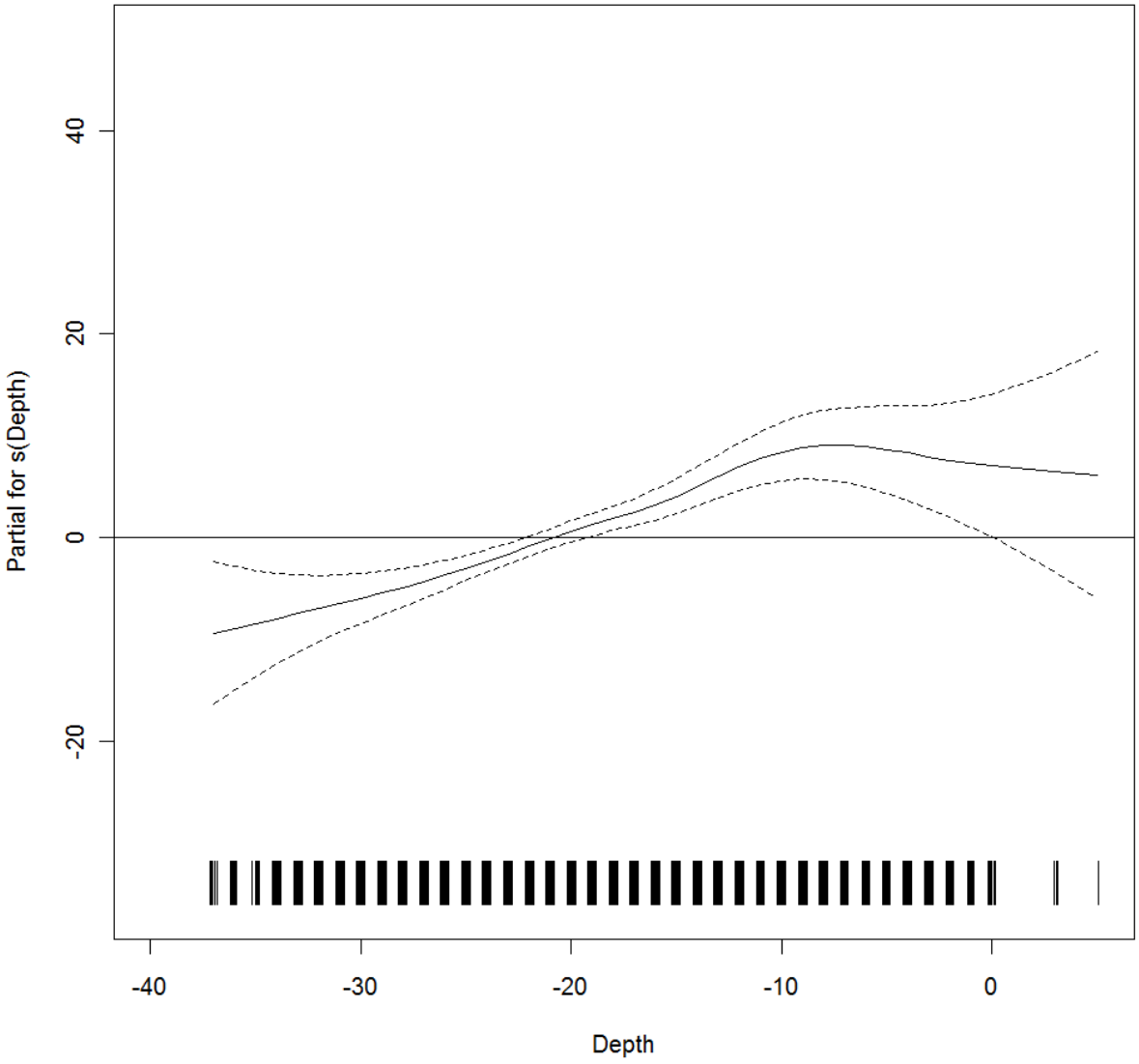

Figure M-13. Result of GAM regression for the effect of depth (m) on total bird density in fall. Broken lines represent 95% confidence intervals around the covariate main effect.

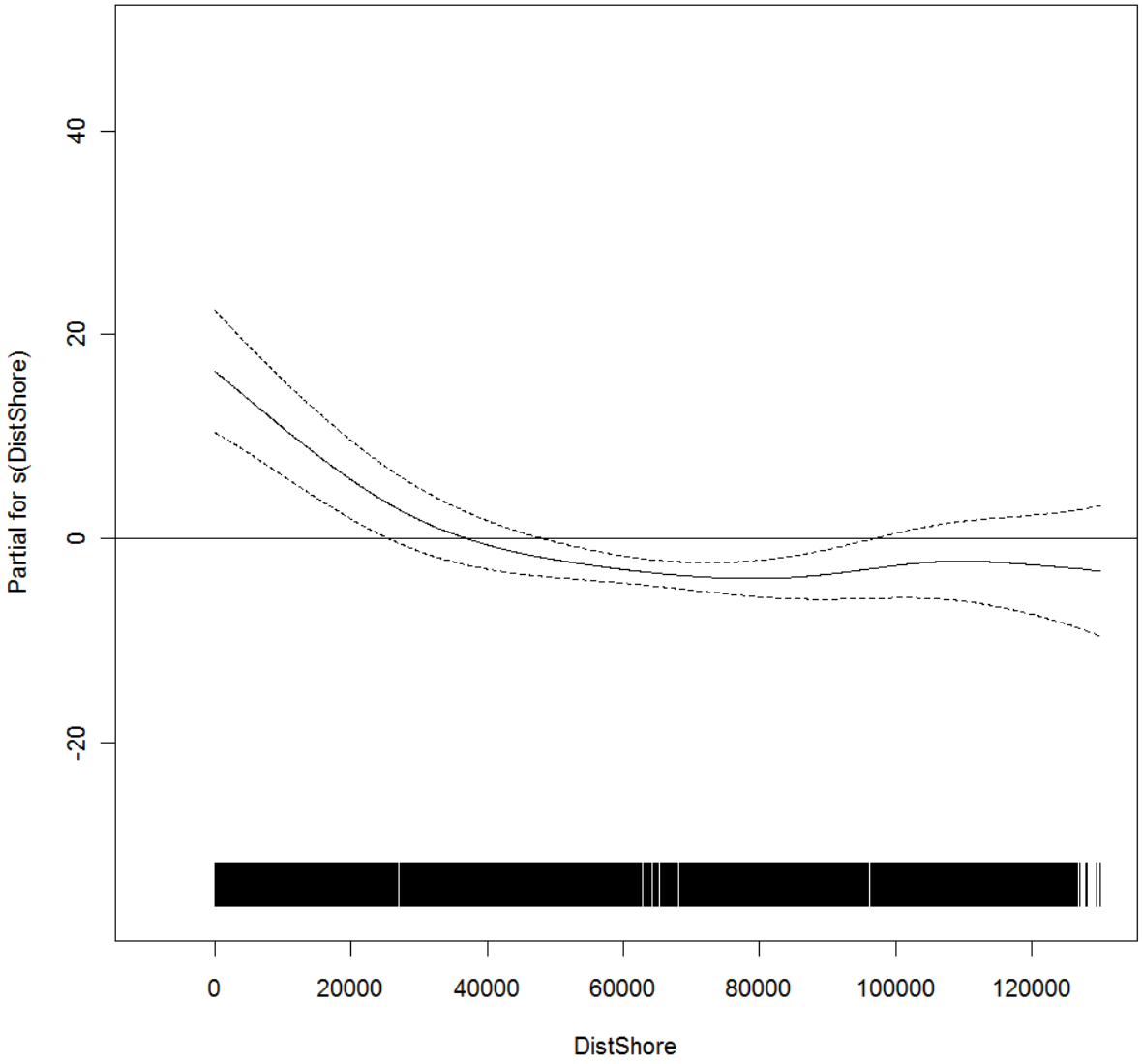

Figure M-14. Result of GAM regression for the effect of distance to shoreline 'DistShore' (feet) on total bird density in fall. Broken lines represent 95% confidence intervals around the covariate main effect.

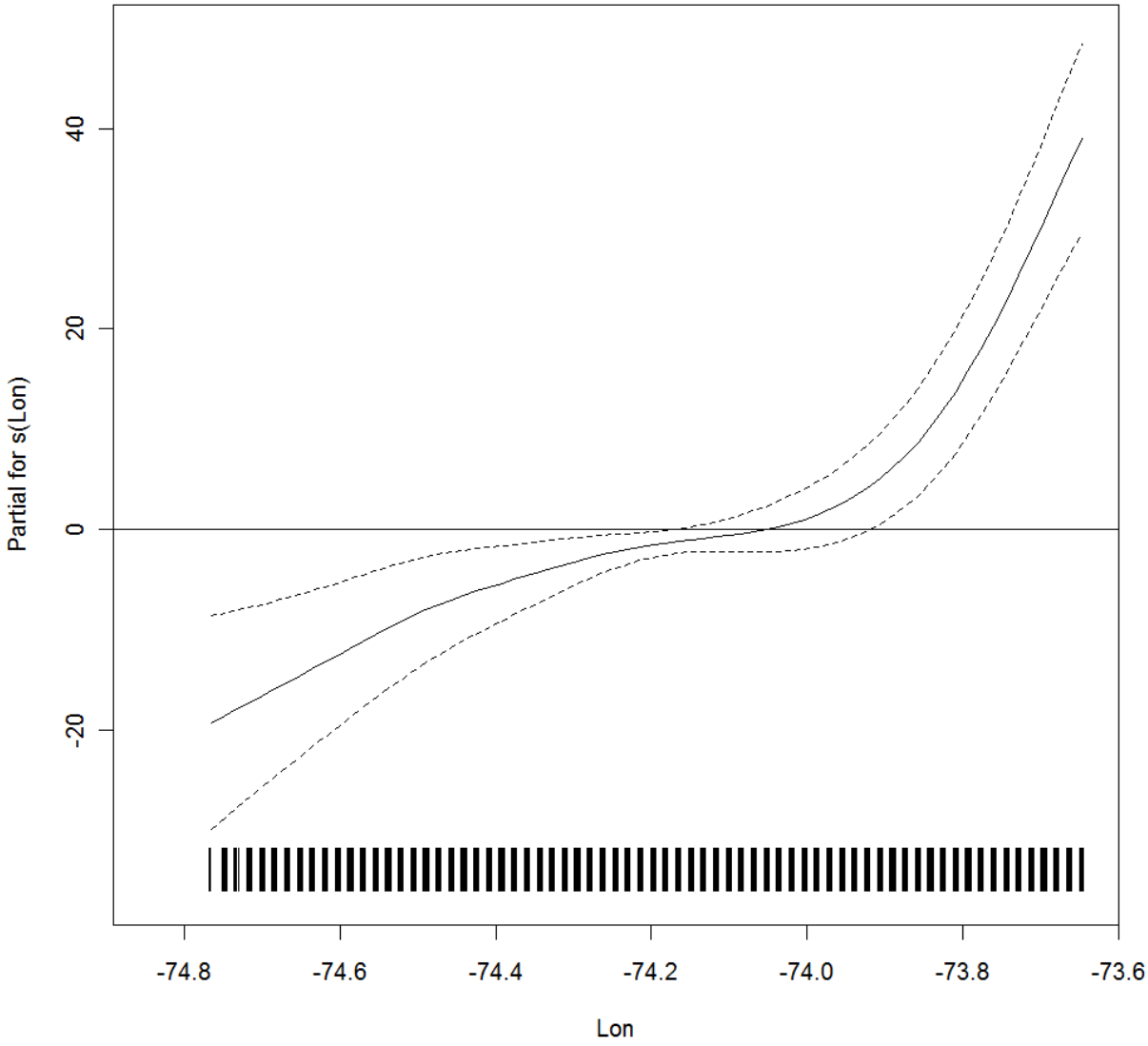

Figure M-15. Result of GAM regression for the effect longitude 'Lon' on total bird density in fall. Broken lines represent 95% confidence intervals around the covariate main effect.

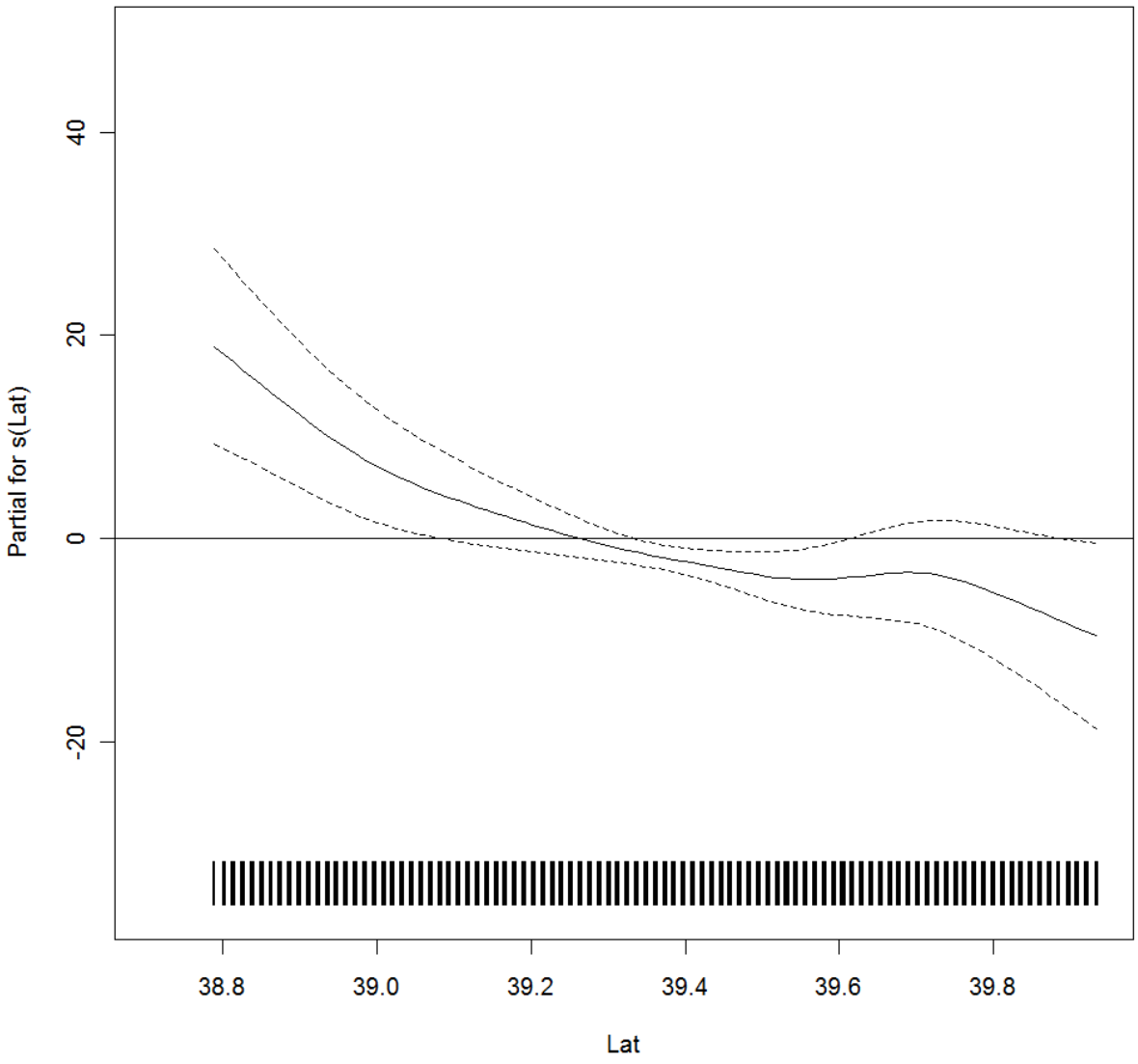

Figure M-16. Result of GAM regression for the effect of latitude 'Lat' on total bird density in fall. Broken lines represent 95% confidence intervals around the covariate main effect.

Table M-8. Spatial regression model results for spatial covariates and total bird density (Spring 2008).

Spatial Regression Model:
Spatial lag model – Maximum Likelihood Estimation
N=5801, R^2=0.18, Log likelihood=-5597.2, Akaike info criterion=11210.4
Global Moran's I = 0.3478, p<0.01

Variable	Coefficient	Std.Error	z-value	Probability
Spatial lag	0.291	0.015	19.674	**0.0000**
Constant	-234.069	101.154	-2.314	**0.0207**
Depth	-0.004	0.011	-0.316	0.7518
Slope	0.075	0.156	0.484	0.6286
DistShore	-3.051e-007	4.40e-006	-0.069	0.9447
DistShoal	4.013e-006	2.19e-006	1.852	0.0679
Longitude	-2.226	0.933	-2.386	**0.0170**
Latitude	1.762	0.814	2.165	**0.0304**

Table M-9. GAM results for spatial covariates and total bird density (Spring 2008).

Generalized Additive Models:
Initial Model Summary: Significance of smoothed terms

Variable	Df	Npar Df	Npar F	Pr(F)
Depth	**1**	**3**	**18.936**	**3.271e-12 *** **
Slope	**1**	**3**	**1.303**	**0.271706**
DistShore	**1**	**3**	**55.652**	**<2.2e-16 *** **
DistShoal	**1**	**3**	**0.485**	**0.692923**
Lon	**1**	**3**	**11.096**	**2.937e-07 *** **
Lat	**1**	**3**	**5.687**	**0.000695 *** **

AIC: 38246.47

Stepwise-selected Model Summary: Significance of smoothed terms

Variable	Df	Npar Df	Npar F	Pr(F)
Depth	**1**	**3**	**20.686**	**2.544e-13 *** **
DistShore	**1**	**3**	**61.784**	**<2.2e-16 *** **
Lon	**1**	**3**	**11.857**	**9.743e-08 *** **
Lat	**1**	**3**	**5.594**	**0.000792 *** **

AIC: 38235.87

Significant codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
Df=degrees of freedom, NparDf=nonparametric degrees of freedom, NparF=nonparametric F value, Pr(F)=probability value.

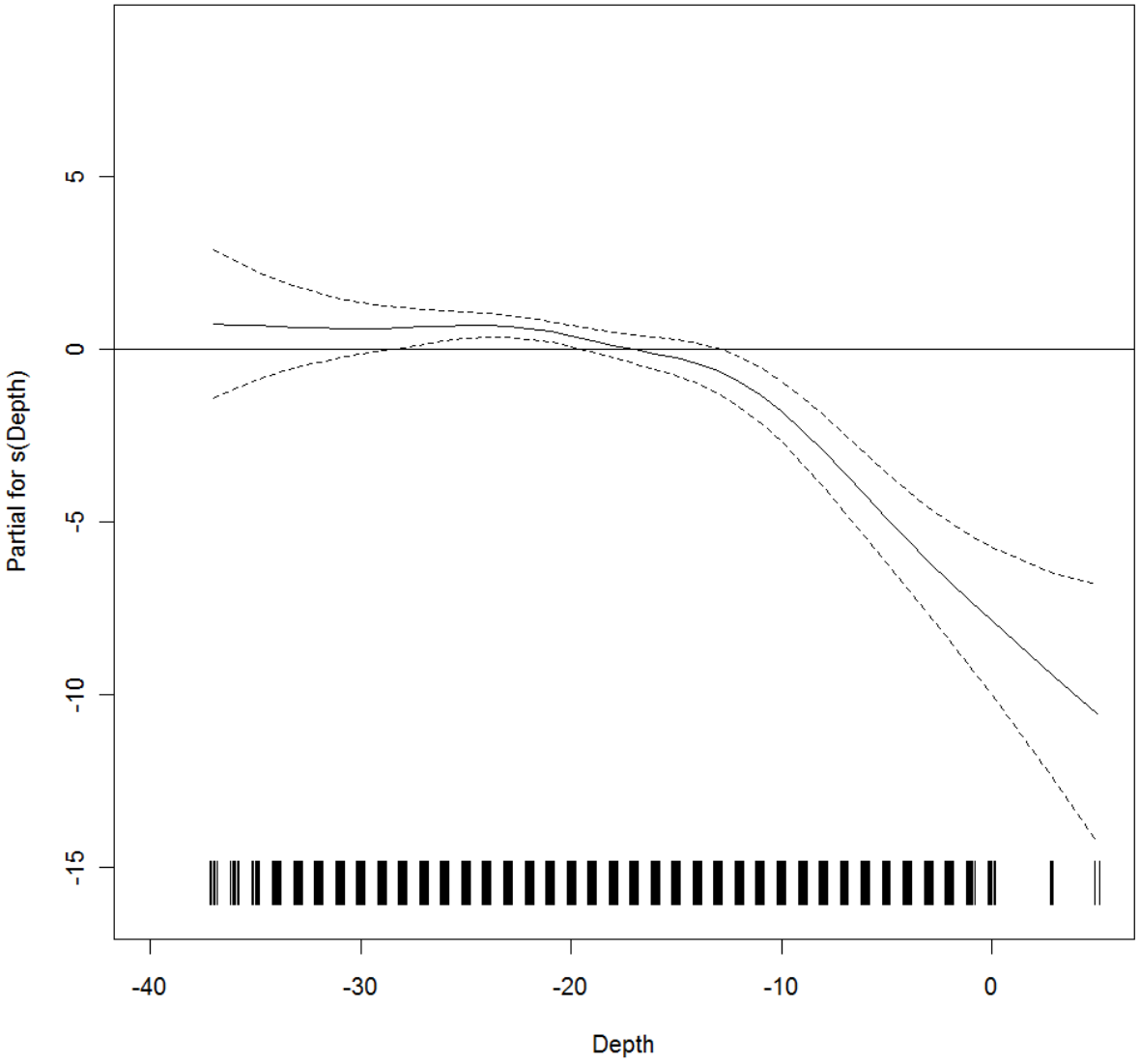

Figure M-17. Result of GAM regression for the effect of depth (m) on total bird density in spring. Broken lines represent 95% confidence intervals around the covariate main effect.

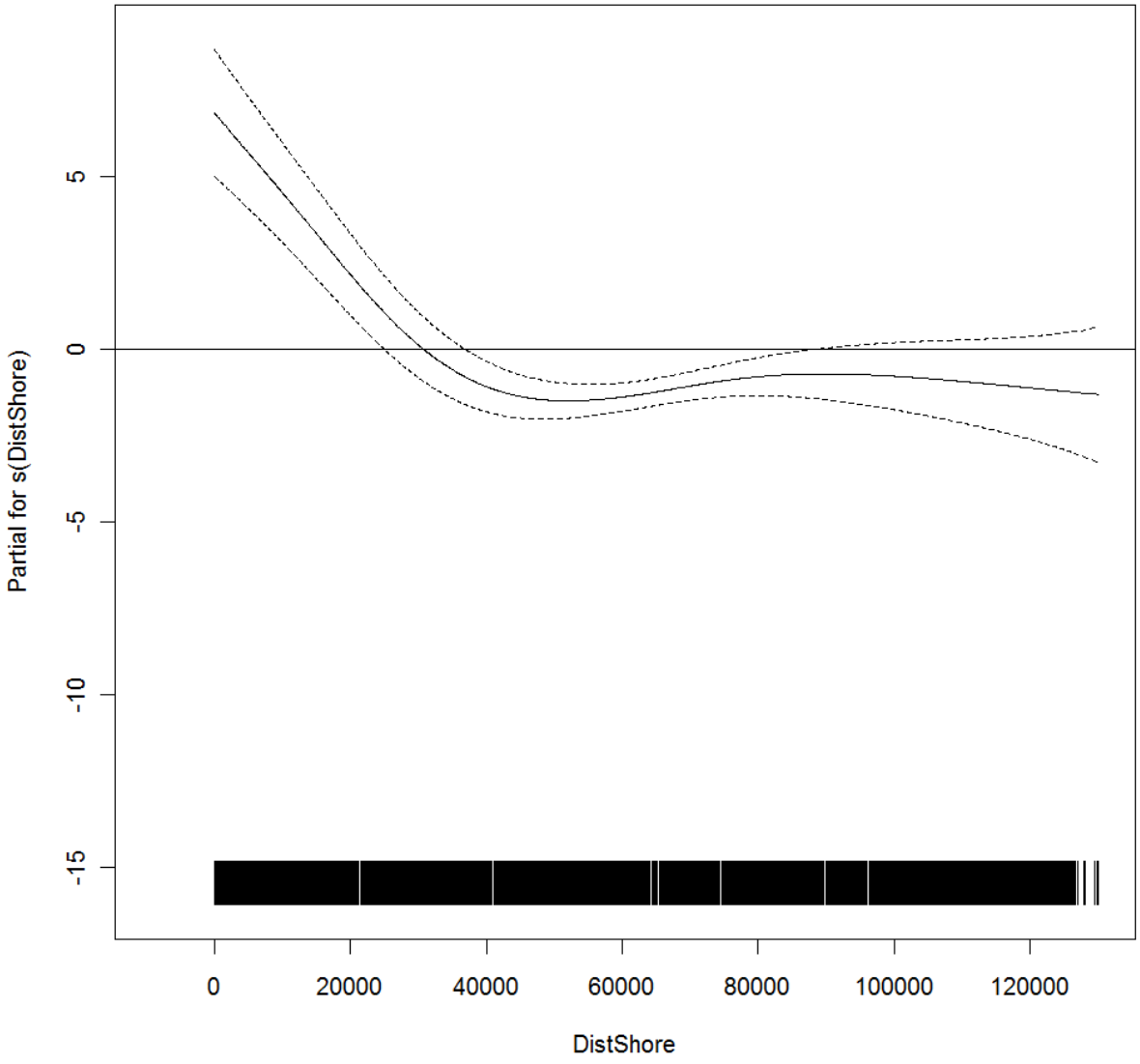

Figure M-18. Result of GAM regression for the effect of distance to shoreline 'DistShore' (feet) on total bird density in spring. Broken lines represent 95% confidence intervals around the covariate main effect.

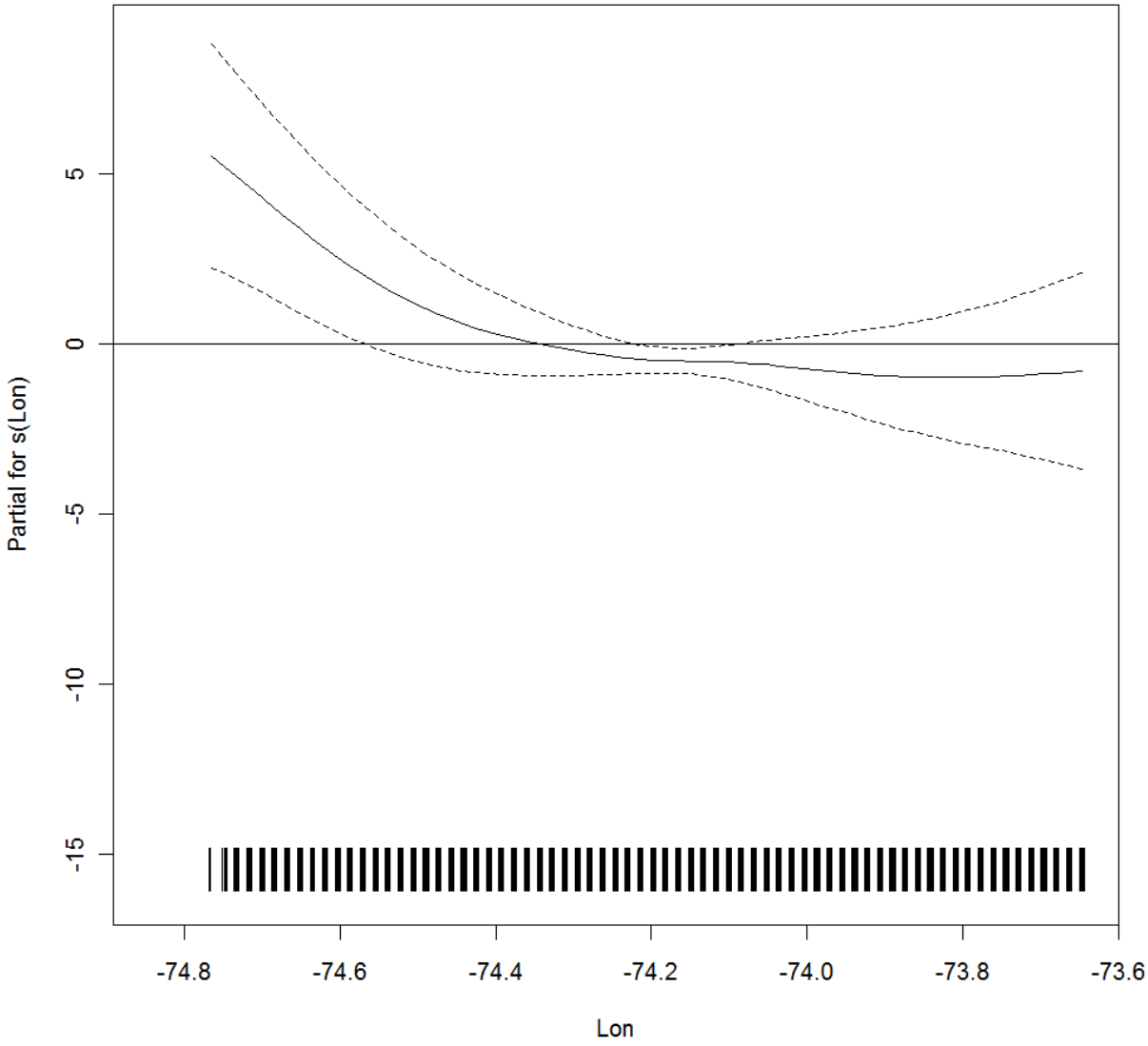

Figure M-19. Partial GAM fit for the effect of longitude 'Lon' on total bird density in spring. Broken lines represent 95% confidence intervals around the covariate main effect.

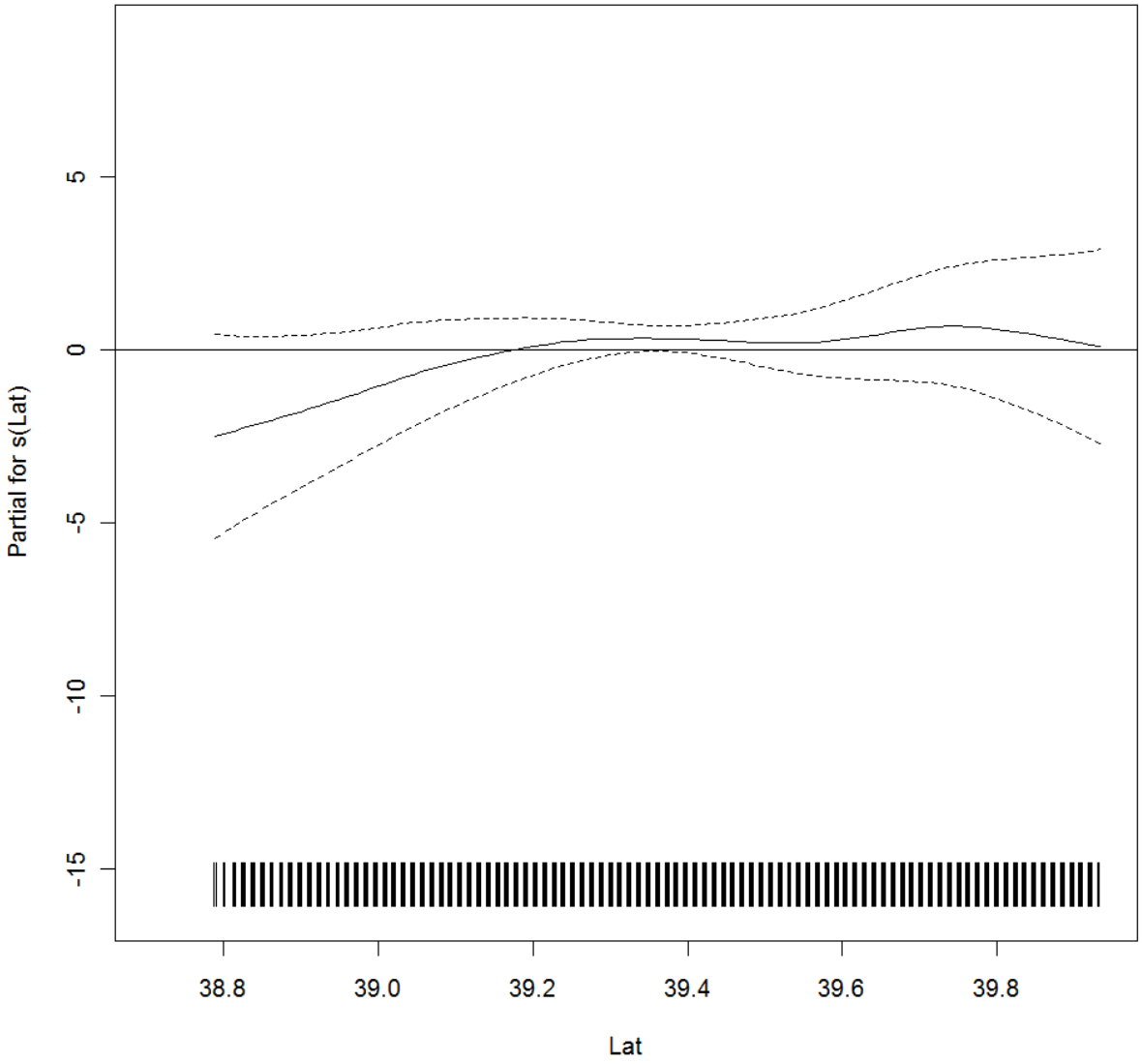

Figure M-20. Result of GAM regression for the effect of latitude 'Lat' on total bird density in spring. Broken lines represent 95% confidence intervals around the covariate main effect.

Table M-10. Spatial regression model results for spatial covariates and total bird density (Summer 2008).

Spatial Regression Model:

Spatial lag model – Maximum Likelihood Estimation
N=2698, R^2=0.38, Log likelihood=-1849.7, Akaike info criterion=3715.5
Global Moran's I = 0.5909, p<0.001

Variable	Coefficient	Std.Error	z-value	Probability
Spatial lag	0.452	0.012	35.627	**0.0000**
Constant	-43.675	24.116	-1.811	0.0701
Depth	0.010	0.003	3.703	**0.0002**
Slope	0.006	0.0372	0.167	0.8667
DistShore	2.083e-006	1.05e-006	1.982	**0.0474**
DistShoal	8.573e-007	5.24e-007	1.635	0.1020
Longitude	-0.373	0.222	-1.677	0.0935
Latitude	0.415	0.194	2.141	**0.0322**

Table M-11. GAM results for spatial covariates and total bird density (Summer 2008).

Generalized Additive Models:

Initial Model Summary: Significance of smoothed terms

Variable	Df	Npar Df	Npar F	Pr(F)
Depth	**1**	**3**	**40.008**	**<2.2e-16 *** **
Slope	**1**	**3**	**1.204**	**0.3066889**
DistShore	**1**	**3**	**12.791**	**2.515e-08 *** **
DistShoal	**1**	**3**	**29.624**	**<2.2e-16 *** **
Lon	**1**	**3**	**58.349**	**<2.2e-16 *** **
Lat	**1**	**3**	**6.559**	**0.0002012 *** **

AIC: 25174.46

Stepwise-selected Model Summary: Significance of smoothed terms

Variable	Df	Npar Df	Npar F	Pr(F)
Depth	**1**	**3**	**39.248**	**<2.2e-16 *** **
DistShore	**1**	**3**	**12.816**	**2.426e-08 *** **
DistShoal	**1**	**3**	**29.165**	**<2.2e-16 *** **
Lon	**1**	**3**	**59.672**	**<2.2e-16 *** **
Lat	**1**	**3**	**6.396**	**0.0002540 *** **

AIC: 25171.39

Significant codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
Df=degrees of freedom, NparDf=nonparametric degrees of freedom, NparF=nonparametric F value, Pr(F)=probability value.

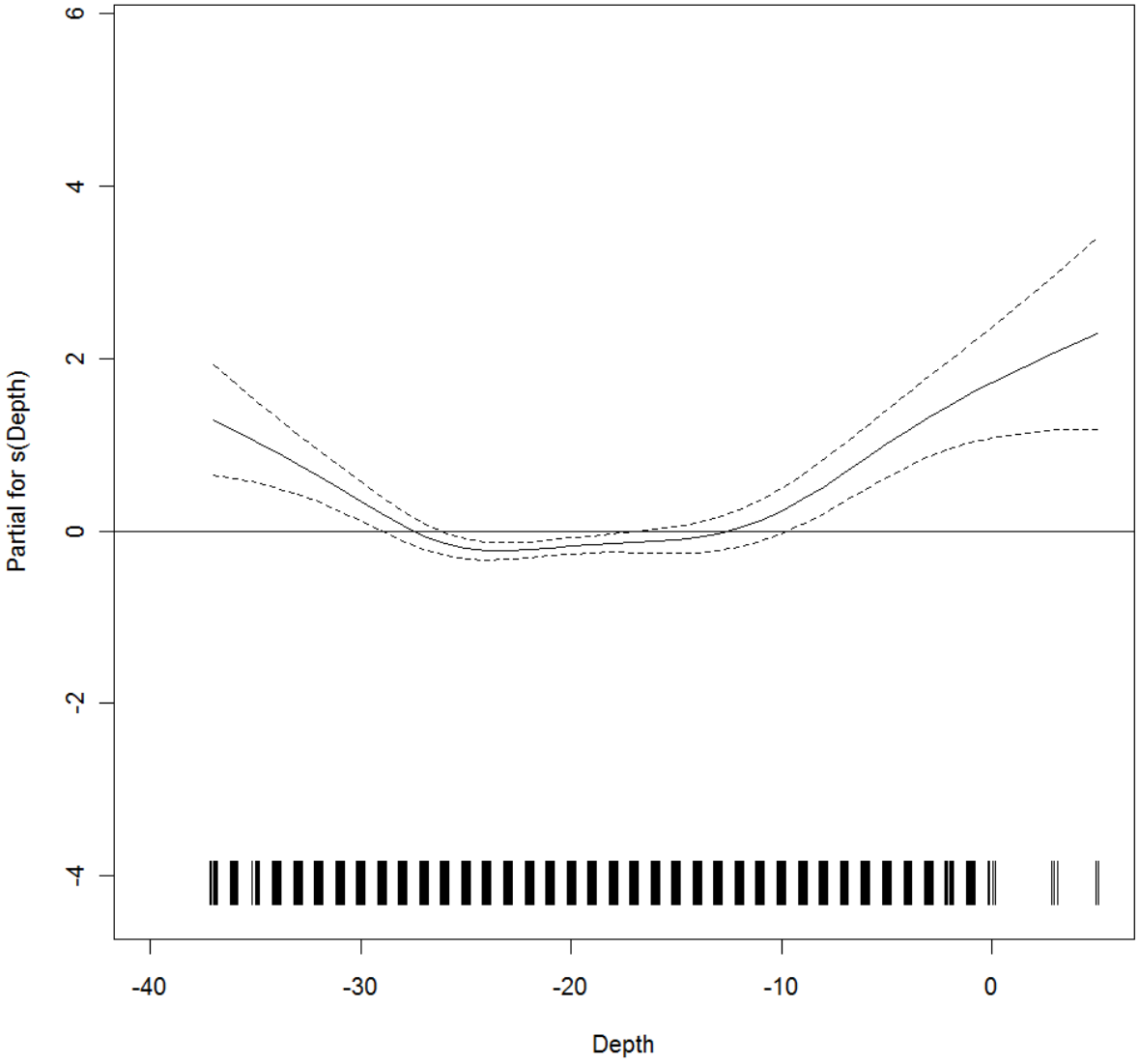

Figure M-21. Result of GAM regression for the effect of depth (m) on total bird density in summer. Broken lines represent 95% confidence intervals around the covariate main effect.

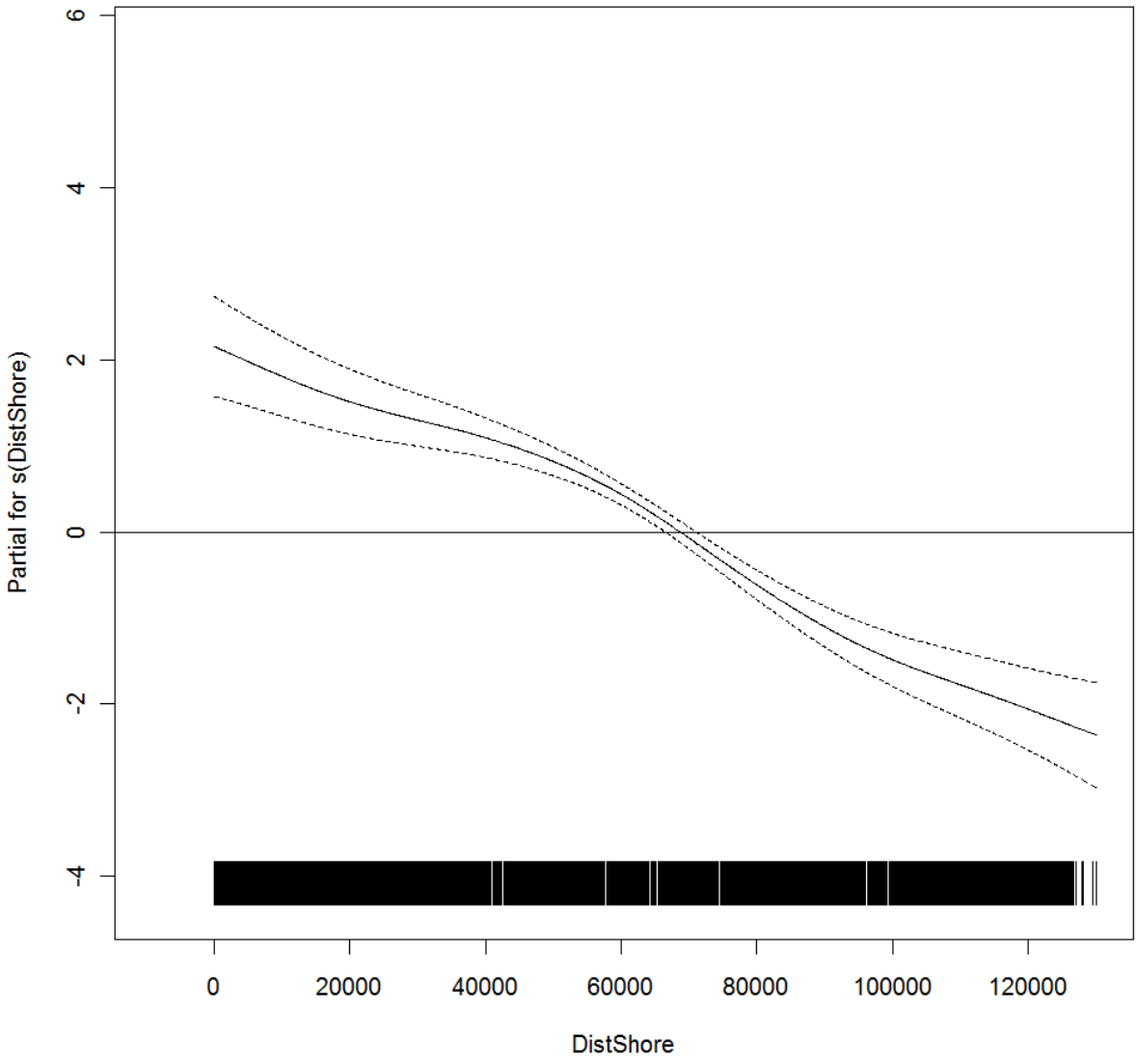

Figure M-22. Result of GAM regression for the effect of distance to shoreline 'DistShore' (feet) on total bird density in summer. Broken lines represent 95% confidence intervals around the covariate main effect.

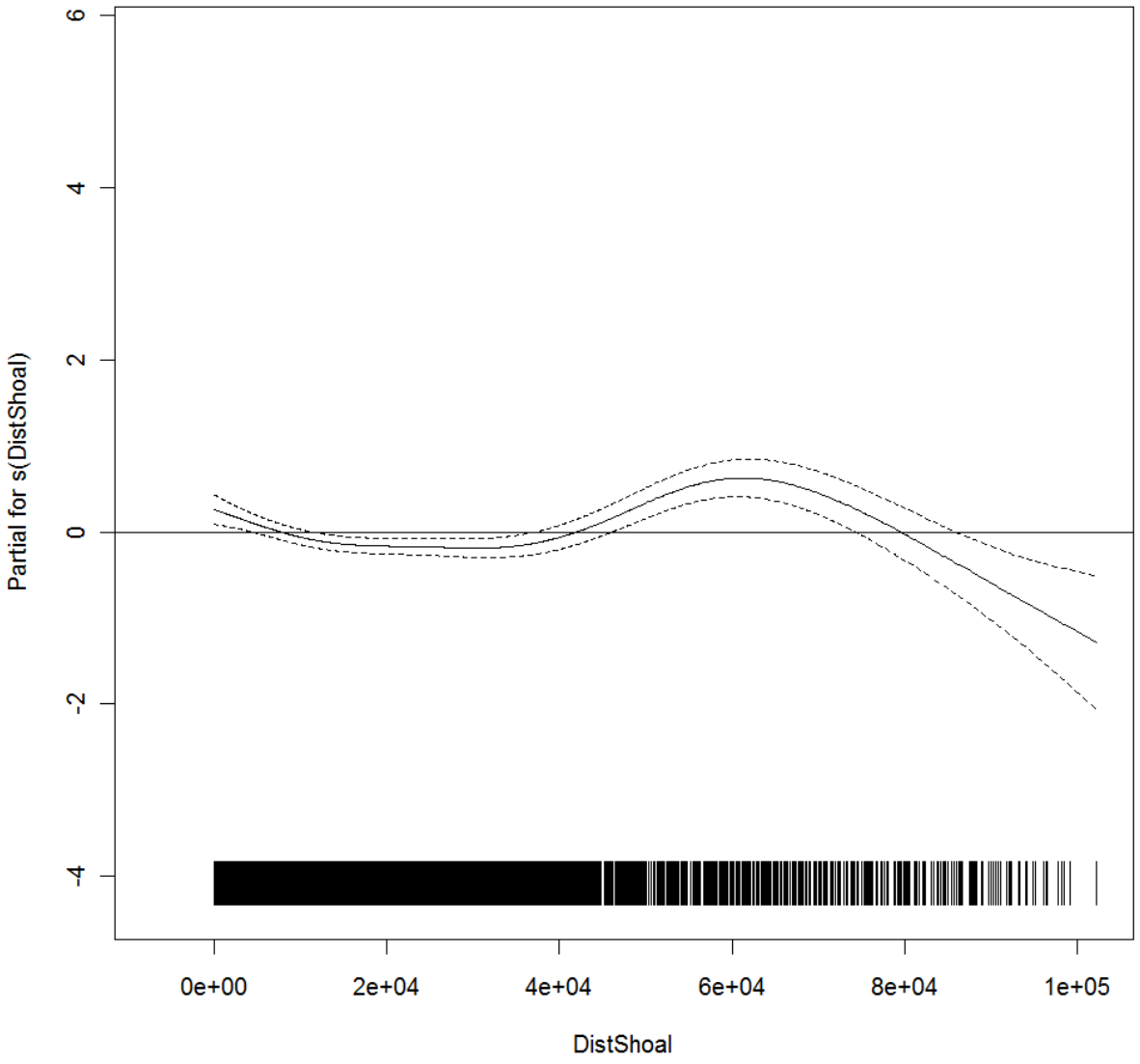

Figure M-23. Result of GAM regression for the effect of distance to nearest shoal 'DistShoal' (feet) on total bird density in summer. Broken lines represent 95% confidence intervals around the covariate main effect.

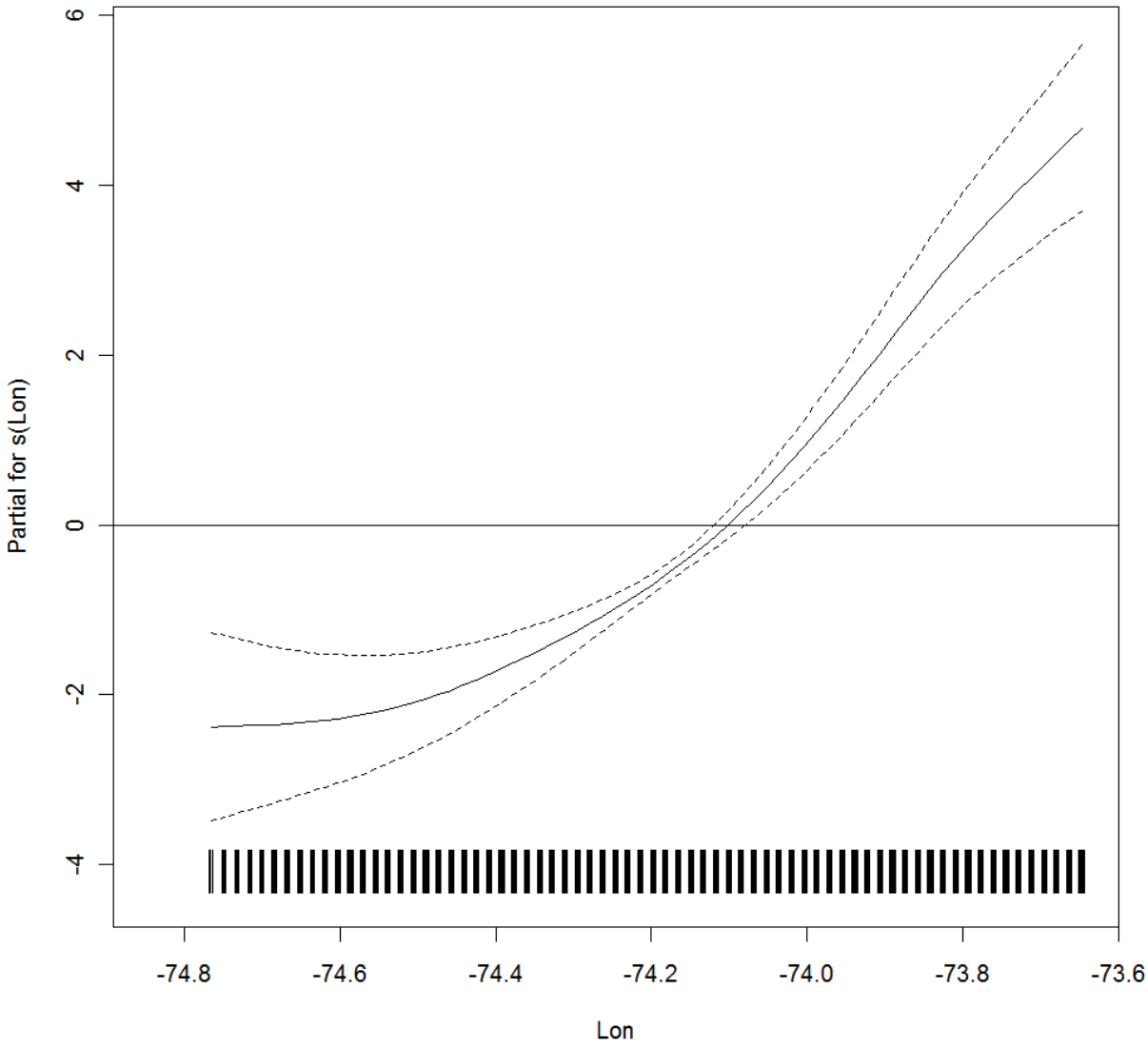

Figure M-24. Result of GAM regression for the effect of longitude 'Lon' on total bird density in summer. Broken lines represent 95% confidence intervals around the covariate main effect.

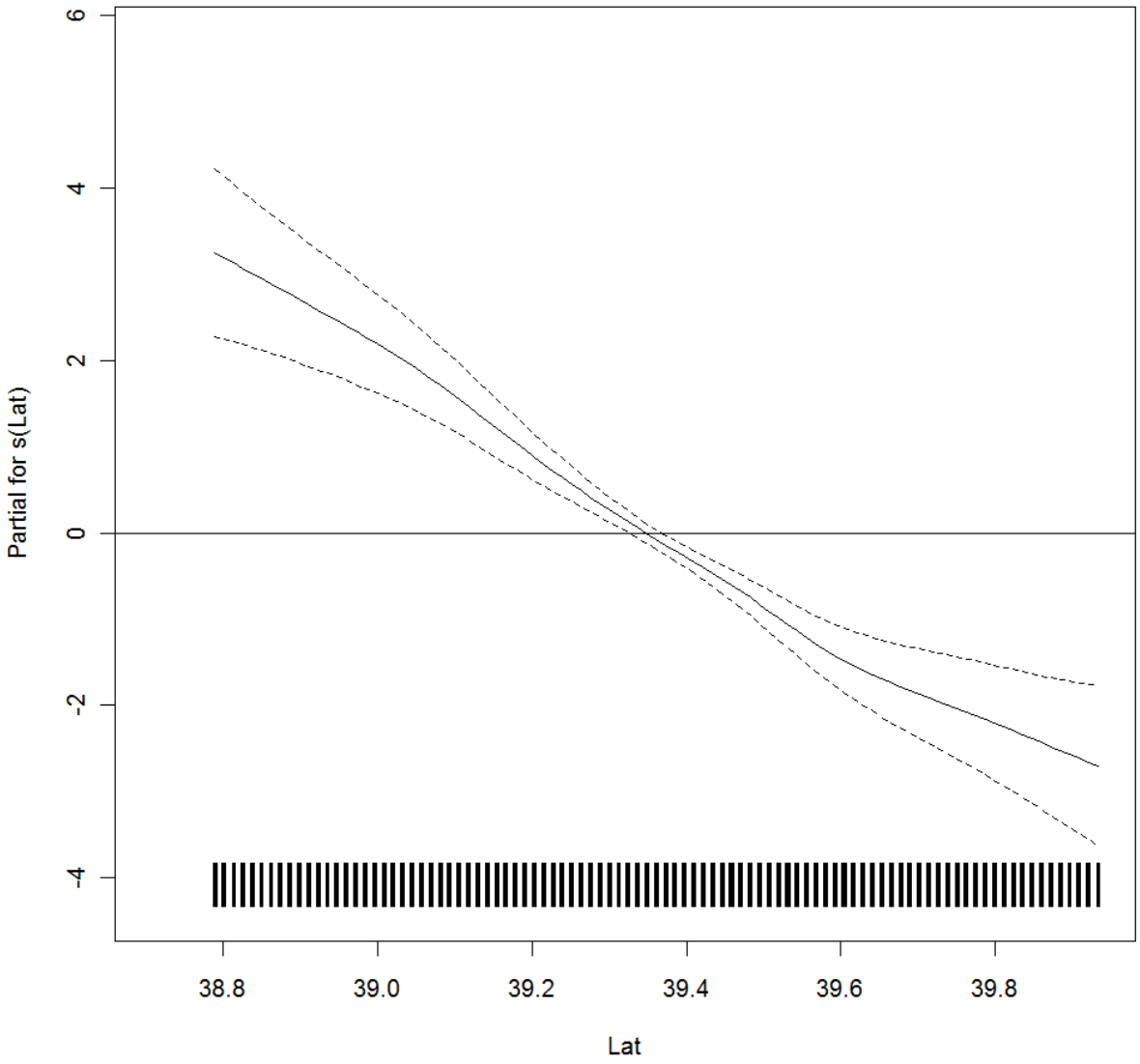

Figure M-25. Result of GAM regression for the effect of latitude 'Lat' on total bird density in summer. Broken lines represent 95% confidence intervals around the covariate main effect.

Table M-12. Spatial regression model results for spatial covariates and total bird density (Winter 2008).

Spatial Regression Model:

Spatial lag model – Maximum Likelihood Estimation
N=5801, R^2=0.20, Log likelihood=-18223.8, Akaike info criterion=36463.6
Global Moran's I = 0.3050 , p<0.01

Variable	Coefficient	Std.Error	z-value	Probability
Spatial lag	0.397	0.015	26.164	**0.0000**
Constant	-36.638	204.441	-0.179	0.8577
Depth	0.2116	0.023	9.068	**0.0000**
Slope	-0.149	0.273	-0.547	0.5843
DistShore	1.292e-005	9.06e-006	1.426	0.1538
DistShoal	1.382e-005	4.37e-006	3.157	**0.0015**
Longitude	-0.267	1.881	-0.142	0.8867
Latitude	0.524	1.655	0.316	0.7515

Table M-13. GAM results for spatial covariates and total bird density (Winter 2008).

Generalized Additive Models:

Initial Model Summary: Significance of smoothed terms

Variable	Df	Npar Df	Npar F	Pr(F)
Depth	**1**	**3**	**79.008**	**<2.2e-16 *** **
Slope	**1**	**3**	**1.935**	**0.121627**
DistShore	**1**	**3**	**10.603**	**5.986e-07 *** **
DistShoal	**1**	**3**	**3.818**	**0.009562 ** **
Lon	**1**	**3**	**7.382**	**6.205e-05 *** **
Lat	**1**	**3**	**7.370**	**6.303e-05 *** **

AIC: 47552.72

Stepwise-selected Model Summary: Significance of smoothed terms

Variable	Df	Npar Df	Npar F	Pr(F)
Depth	**1**	**3**	**79.008**	**<2.2e-16 *** **
Slope	**1**	**3**	**1.935**	**0.121627**
DistShore	**1**	**3**	**10.603**	**5.986e-07 *** **
DistShoal	**1**	**3**	**3.818**	**0.009562 ** **
Lon	**1**	**3**	**7.382**	**6.205e-05 *** **
Lat	**1**	**3**	**7.370**	**6.303e-05 *** **

AIC: 47552.72

Significant codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
Df=degrees of freedom, NparDf=nonparametric degrees of freedom, NparF=nonparametric F value, Pr(F)=probability value.

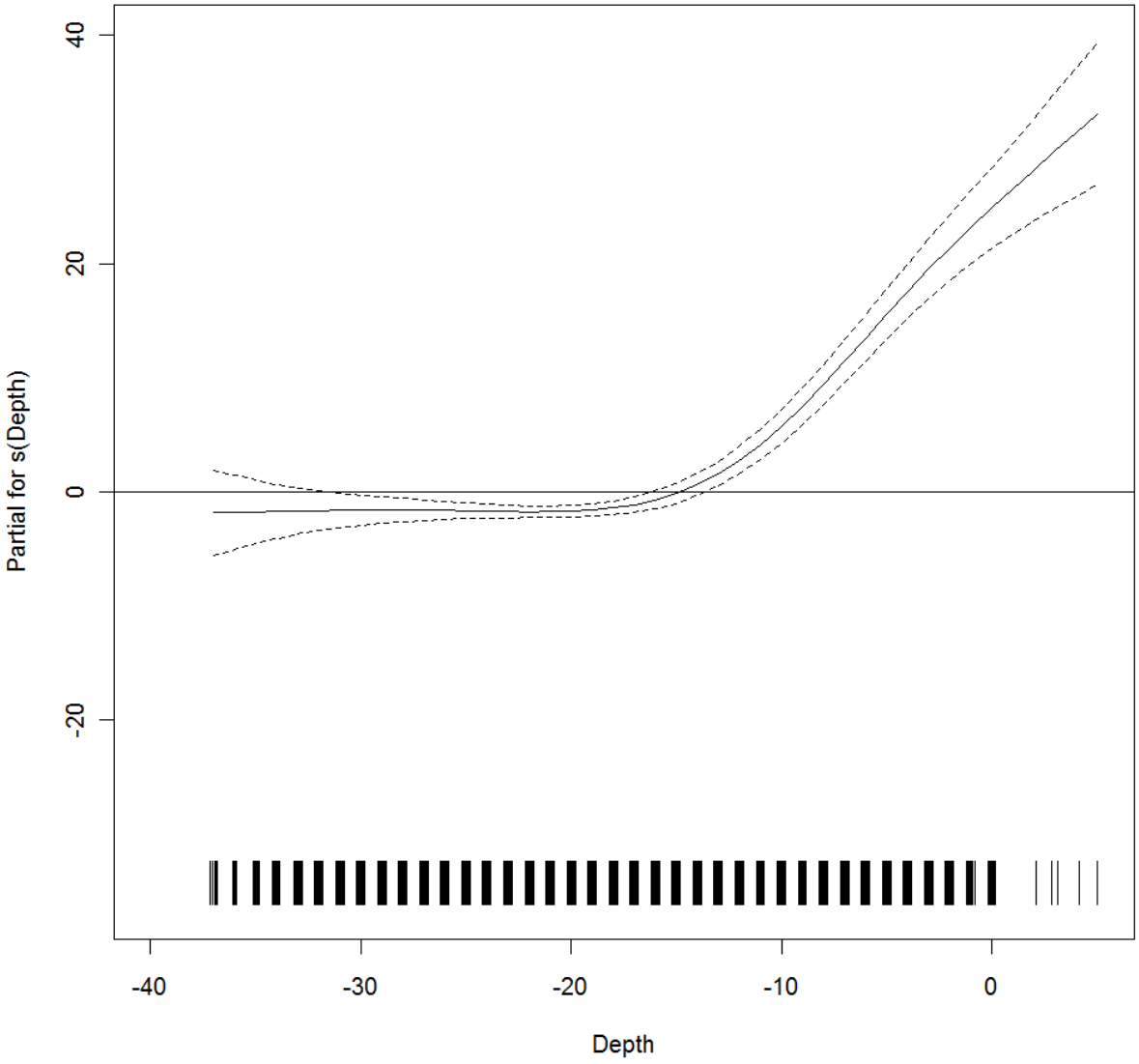

Figure M-26. Result of GAM regression for the effect of depth (m) on total bird density in winter. Broken lines represent 95% confidence intervals around the covariate main effect.

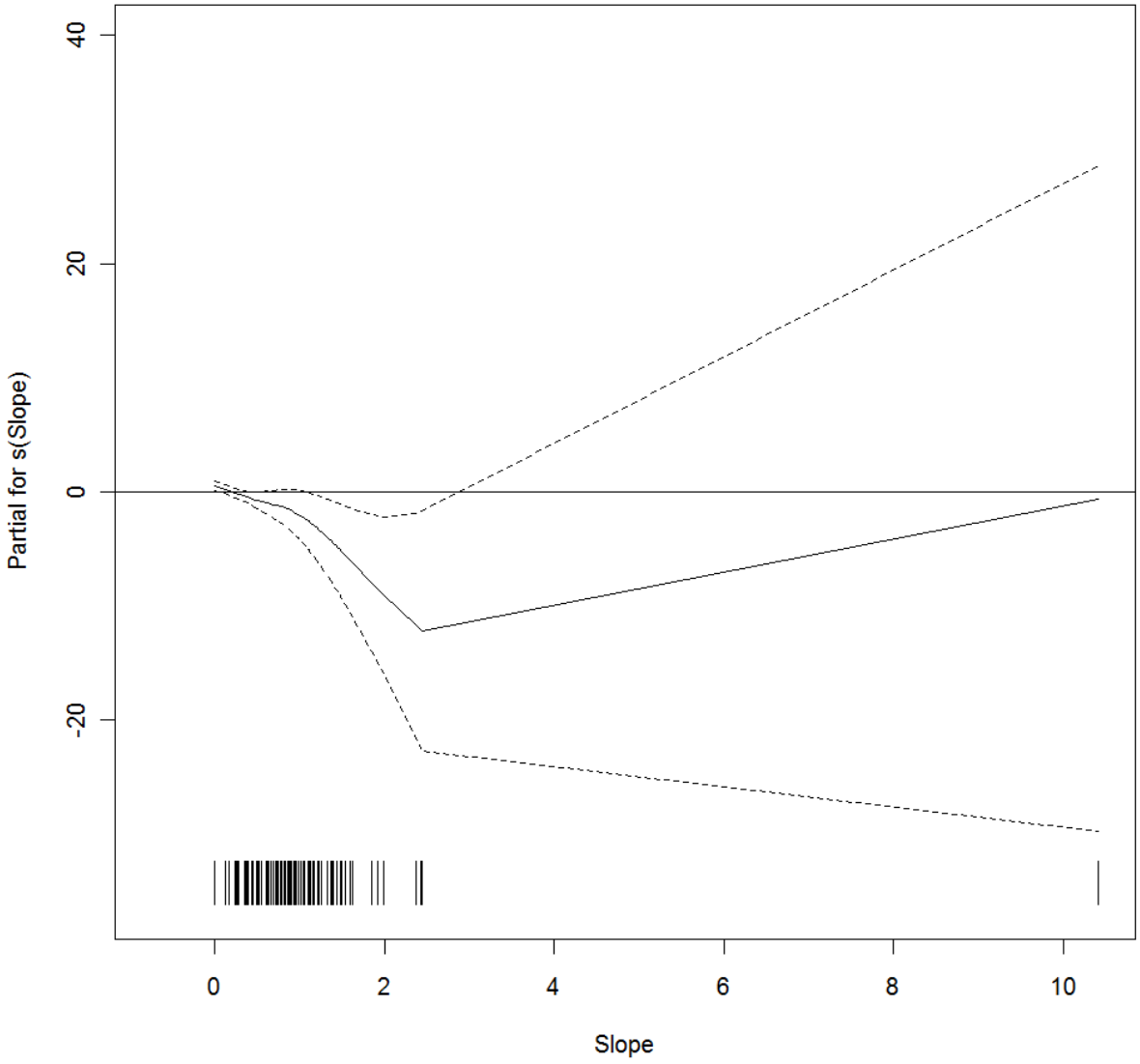

Figure M-27. Result of GAM regression for the effect of slope (degrees) on total bird density in winter. Broken lines represent 95% confidence intervals around the covariate main effect.

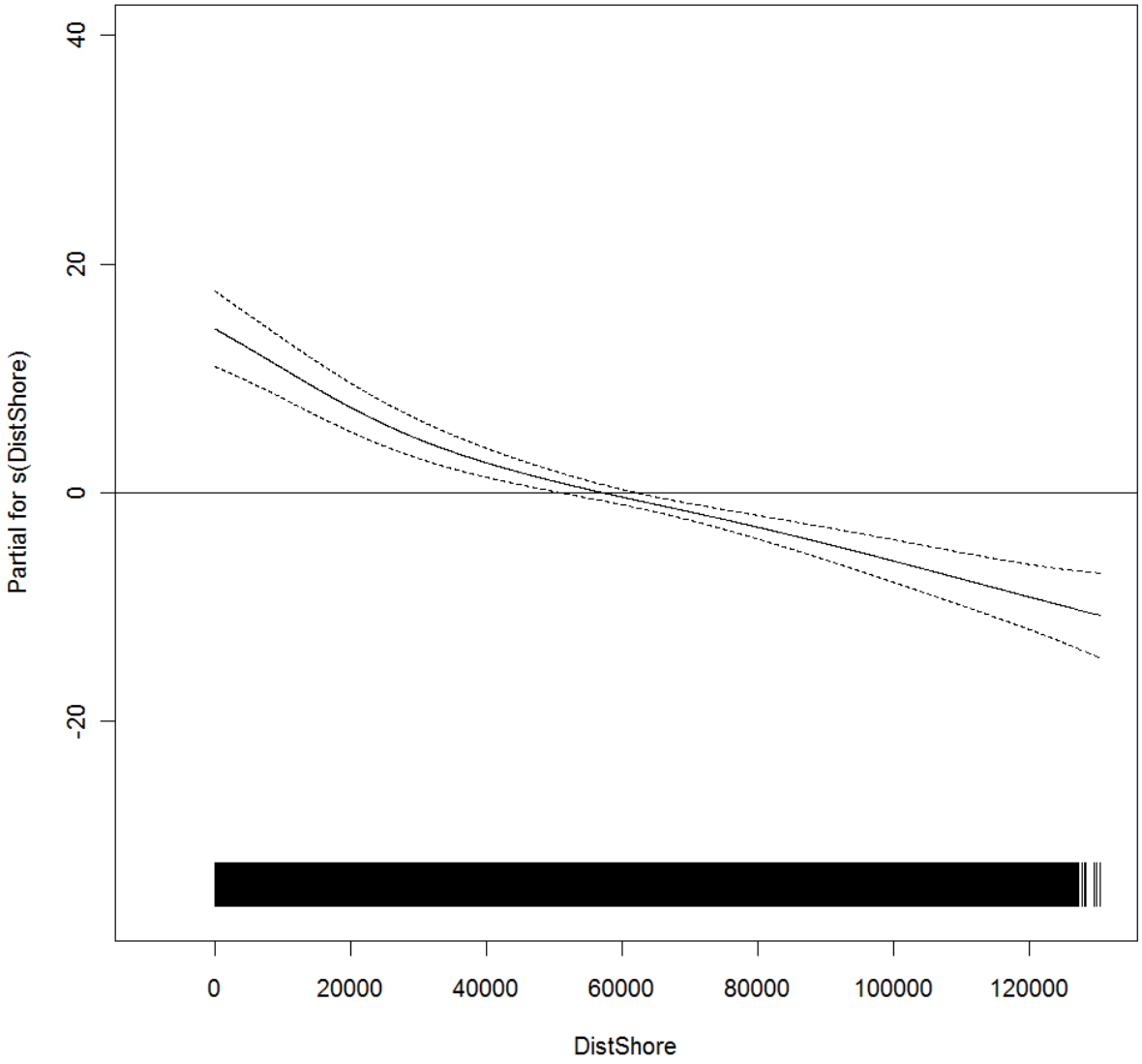

Figure M-28. Result of GAM regression for the effect of distance to shoreline 'DistShore' (feet) on total bird density in winter. Broken lines represent 95% confidence intervals around the covariate main effect.

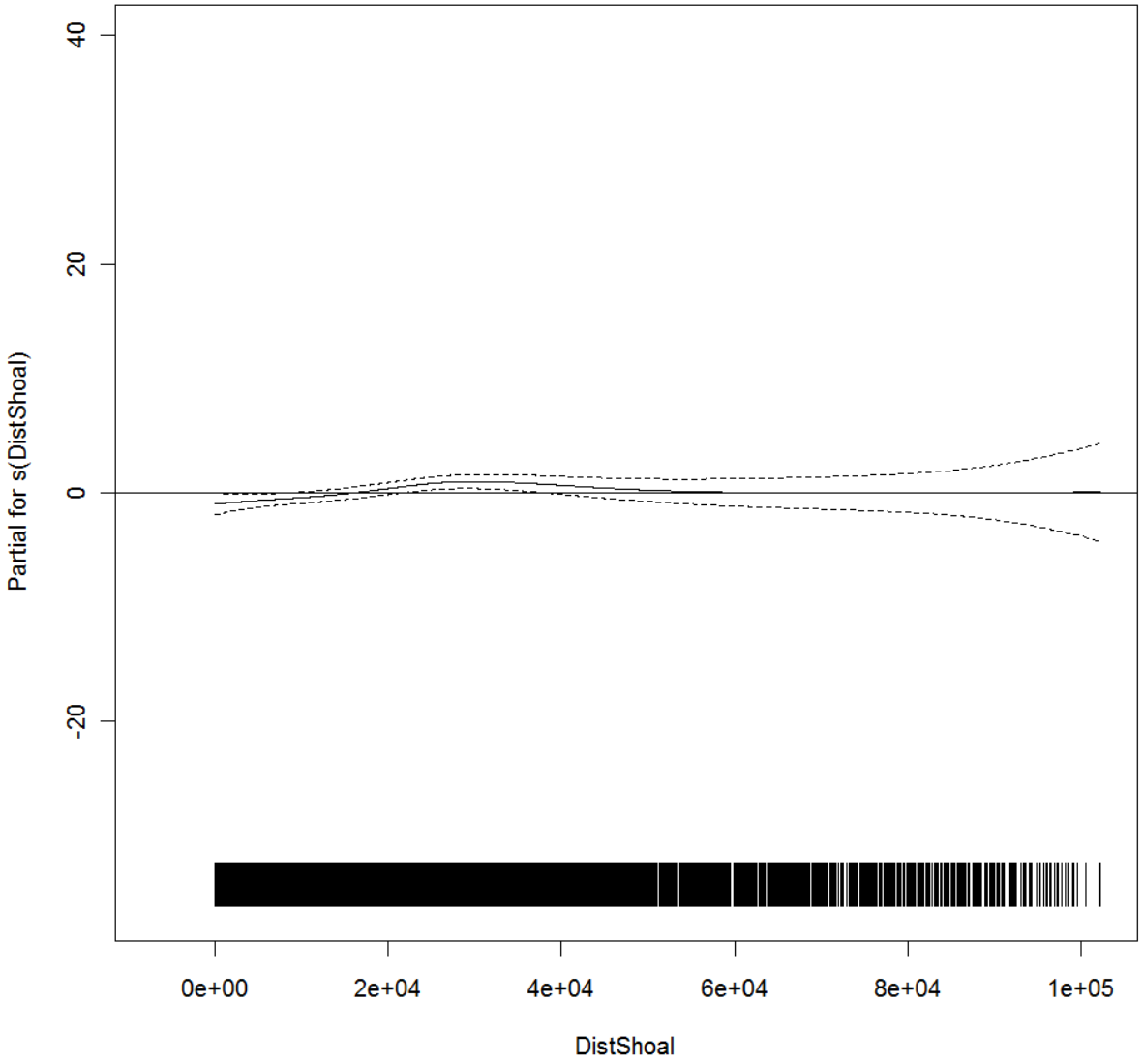

Figure M-29. Result of GAM regression for the effect of distance to nearest shoal 'DistShoal' (feet) on total bird density in winter. Broken lines represent 95% confidence intervals around the covariate main effect.

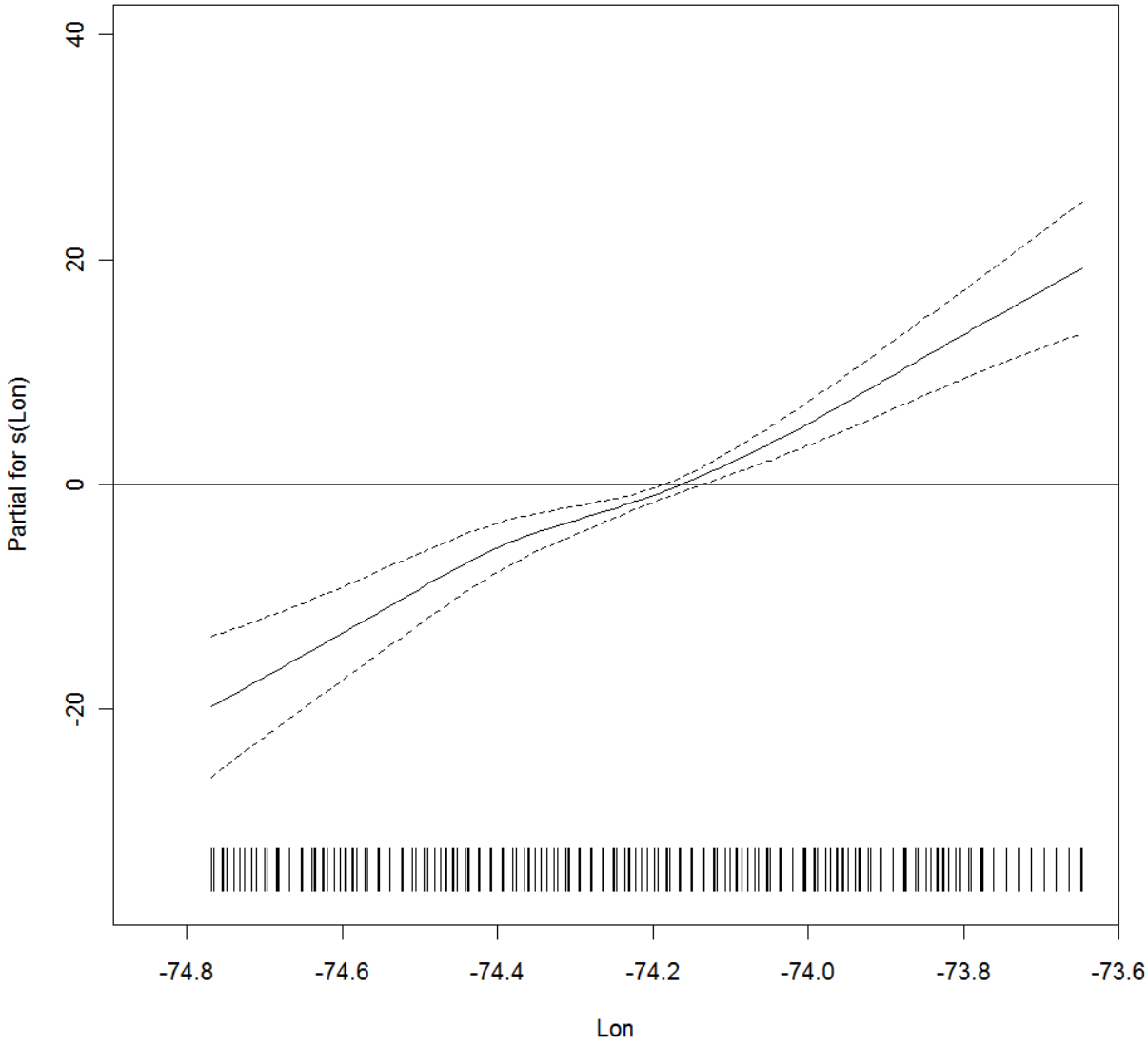

Figure M-30. Result of GAM regression for the effect of longitude 'Lon' on total bird density in winter. Broken lines represent 95% confidence intervals around the covariate main effect.

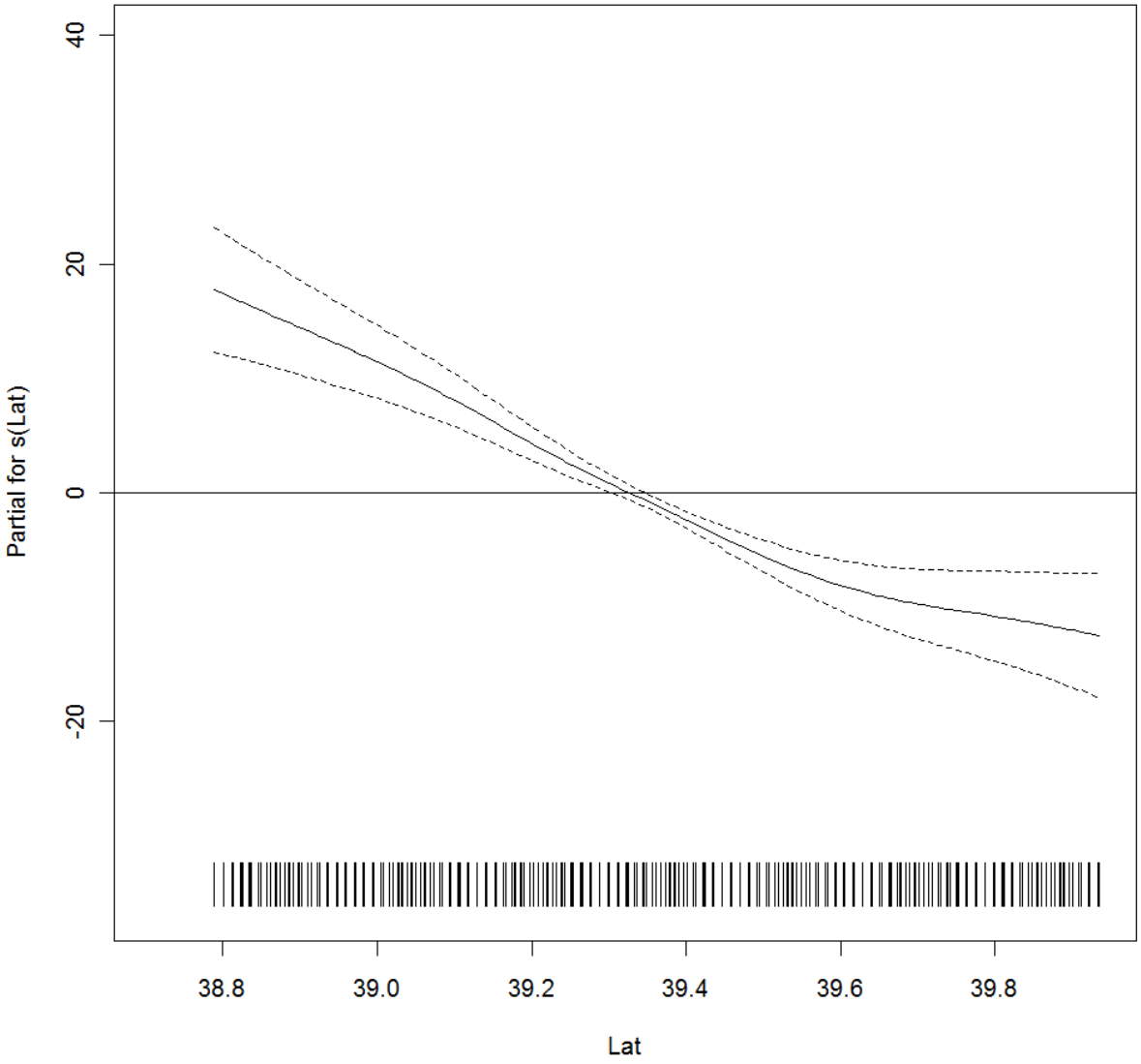

Figure M-31. Result of GAM regression for the effect of latitude 'Lat' on total bird density in winter. Broken lines represent 95% confidence intervals around the covariate main effect.

Table M-14. Spatial regression model results for spatial covariates and total sitting bird density (All Years and Seasons).

Spatial Regression Model:
Spatial lag model – Maximum Likelihood Estimation
N=5801, R^2=0.11, Log likelihood=-12753.9, Akaike info criterion=25523.8
Global Moran's I = 0.1917 p=0.01

Variable	Coefficient	Std.Error	z-value	Probability
Spatial lag	0.228	0.017	13.257	**0.0000**
Constant	-17.928	80.779	-0.222	0.8243
Depth	0.075	0.009	8.2.5	**0.0000**
Slope	0.185	0.107	1.717	0.0859
DistShore	1.119e-006	3.58e-006	0.312	0.7545
DistShoal	4.828e-006	1.72e-006	2.795	**0.0052**
Longitude	-0.117	0.743	-0.157	0.8748
Latitude	0.279	0.654	0.428	0.6685

Table M-15. GAM results for spatial covariates and total sitting bird density (All Years and Seasons).

Generalized Additive Models:
Initial Model Summary: Significance of smoothed terms

Variable	Df	Npar Df	Npar F	Pr(F)
Depth	**1**	**3**	**25.5103**	**2.220e-16 *** **
Slope	**1**	**3**	**0.9705**	**0.40550**
DistShore	**1**	**3**	**25.1876**	**3.331e-16 *** **
DistShoal	**1**	**3**	**0.7907**	**0.49887**
Lon	**1**	**3**	**1.2451**	**0.29154**
Lat	**1**	**3**	**2.4278**	**0.06342 .**

AIC: 147131.0

Stepwise-selected Model Summary: Significance of smoothed terms

Variable	Df	Npar Df	Npar F	Pr(F)
Depth	**1**	**3**	**25.572**	**<2e-16 *** **
DistShore	**1**	**3**	**32.809**	**<2e-16 *** **
Lat	**1**	**3**	**2.077**	**0.1010**

AIC: 147118.3

Significant codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
Df=degrees of freedom, NparDf=nonparametric degrees of freedom, NparF=nonparametric F value, Pr(F)=probability value.

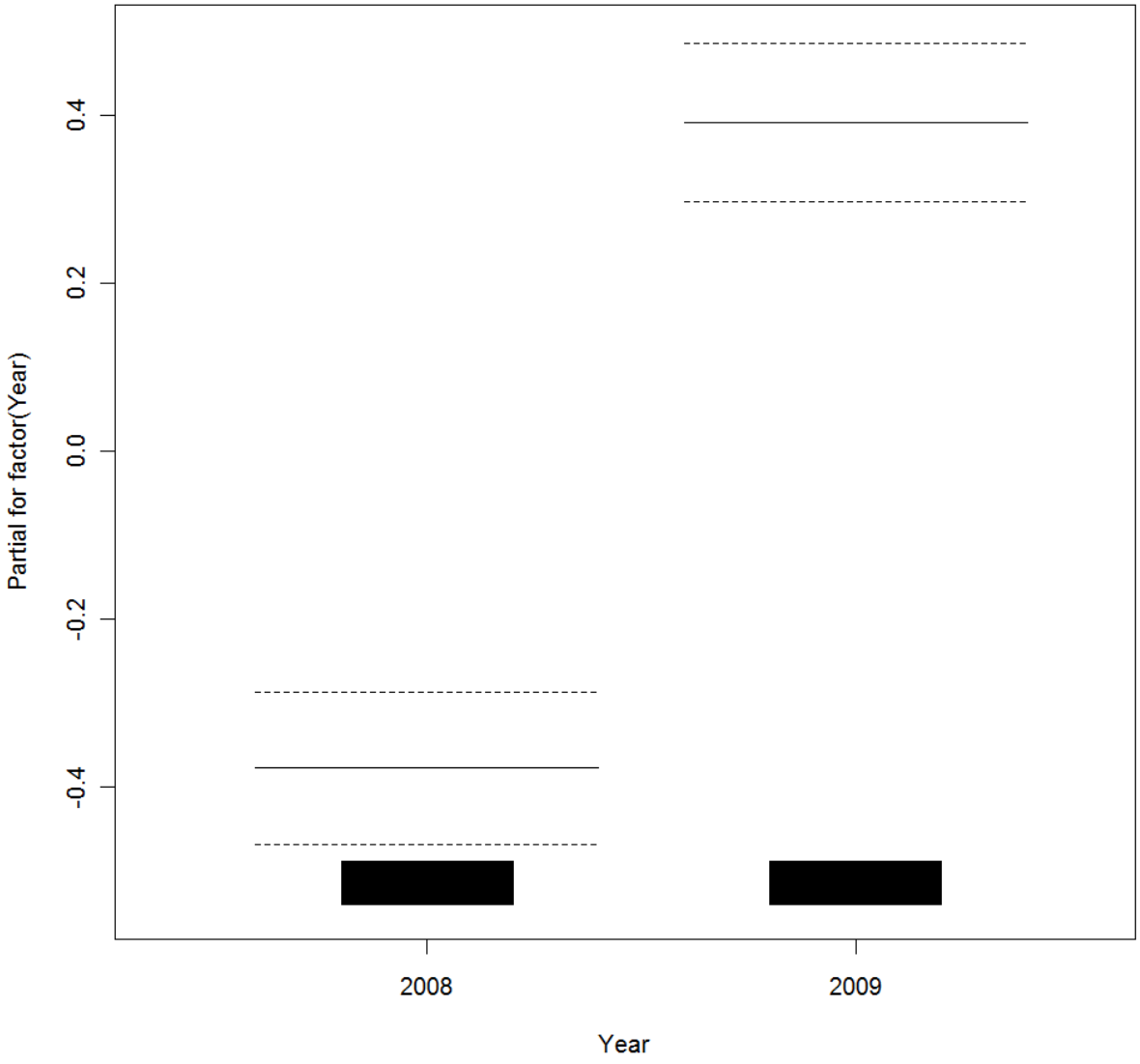

Figure M-32. Result of GAM regression for the effect of year on total sitting bird density. Broken lines represent 95% confidence intervals around the covariate main effect.

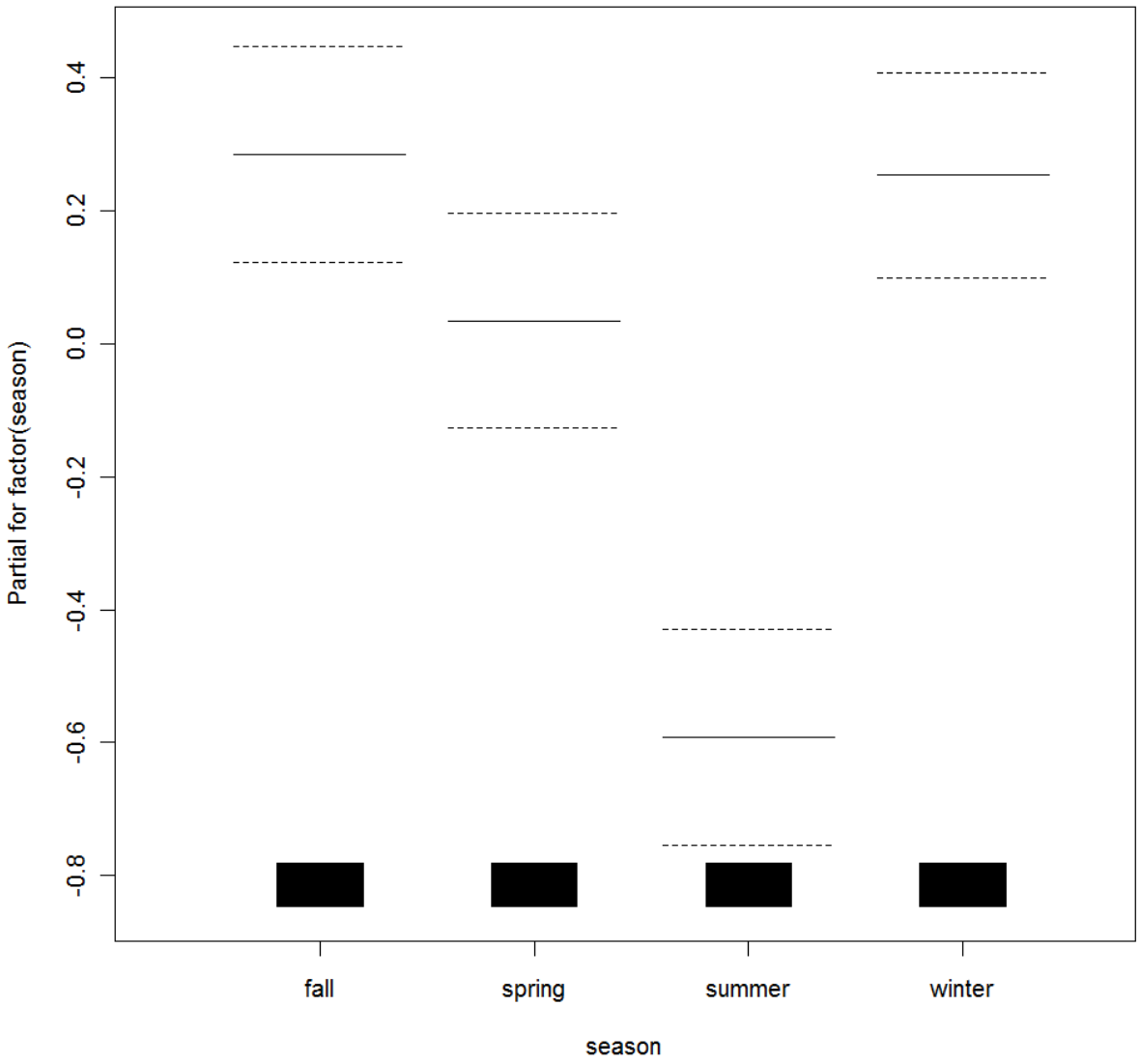

Figure M-33. Result of GAM regression for the effect of season on total sitting bird density. Broken lines represent 95% confidence intervals around the covariate main effect.

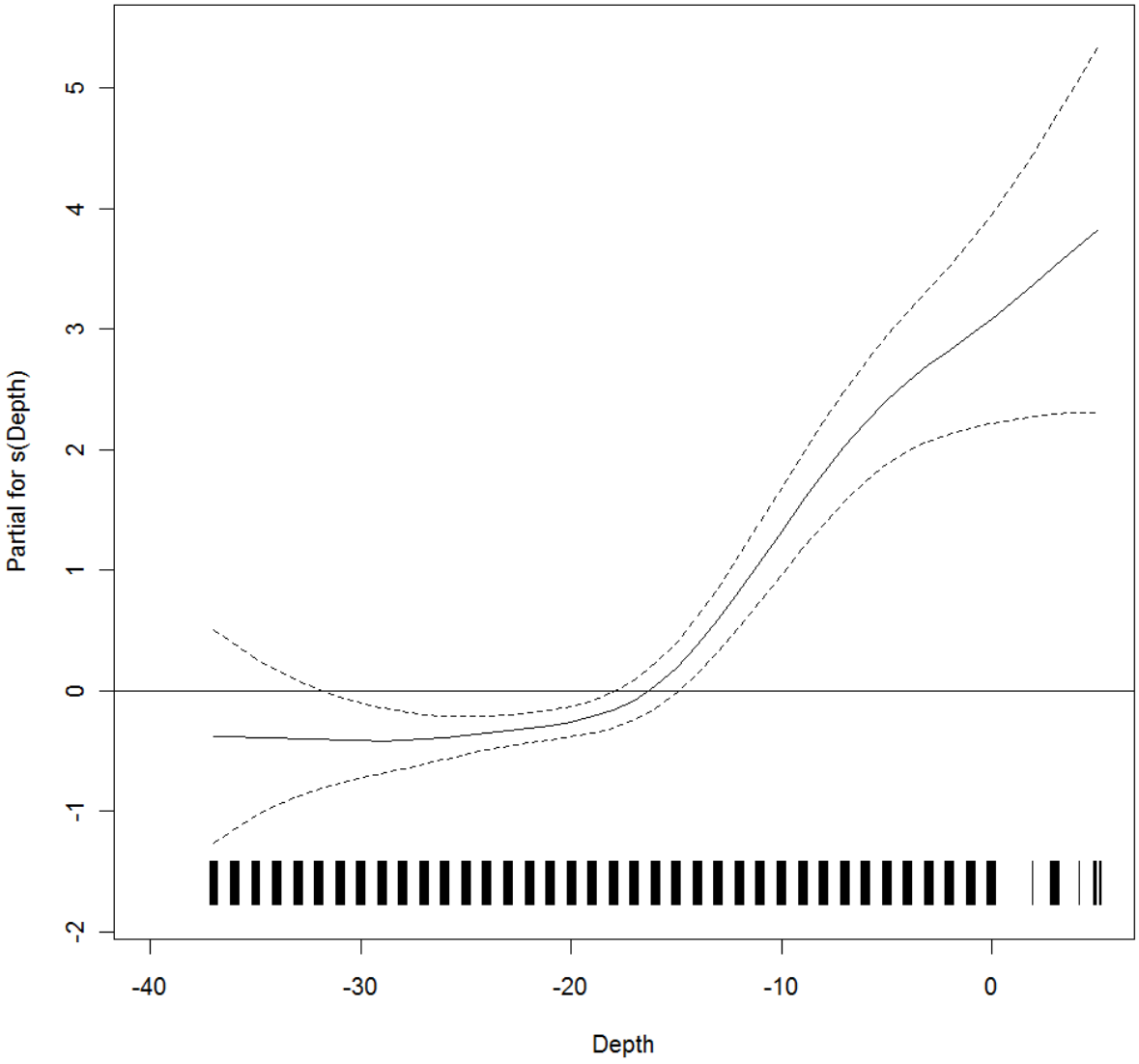

Figure M-34. Result of GAM regression for the effect of depth (m) on total sitting bird density. Broken lines represent 95% confidence intervals around the covariate main effect.

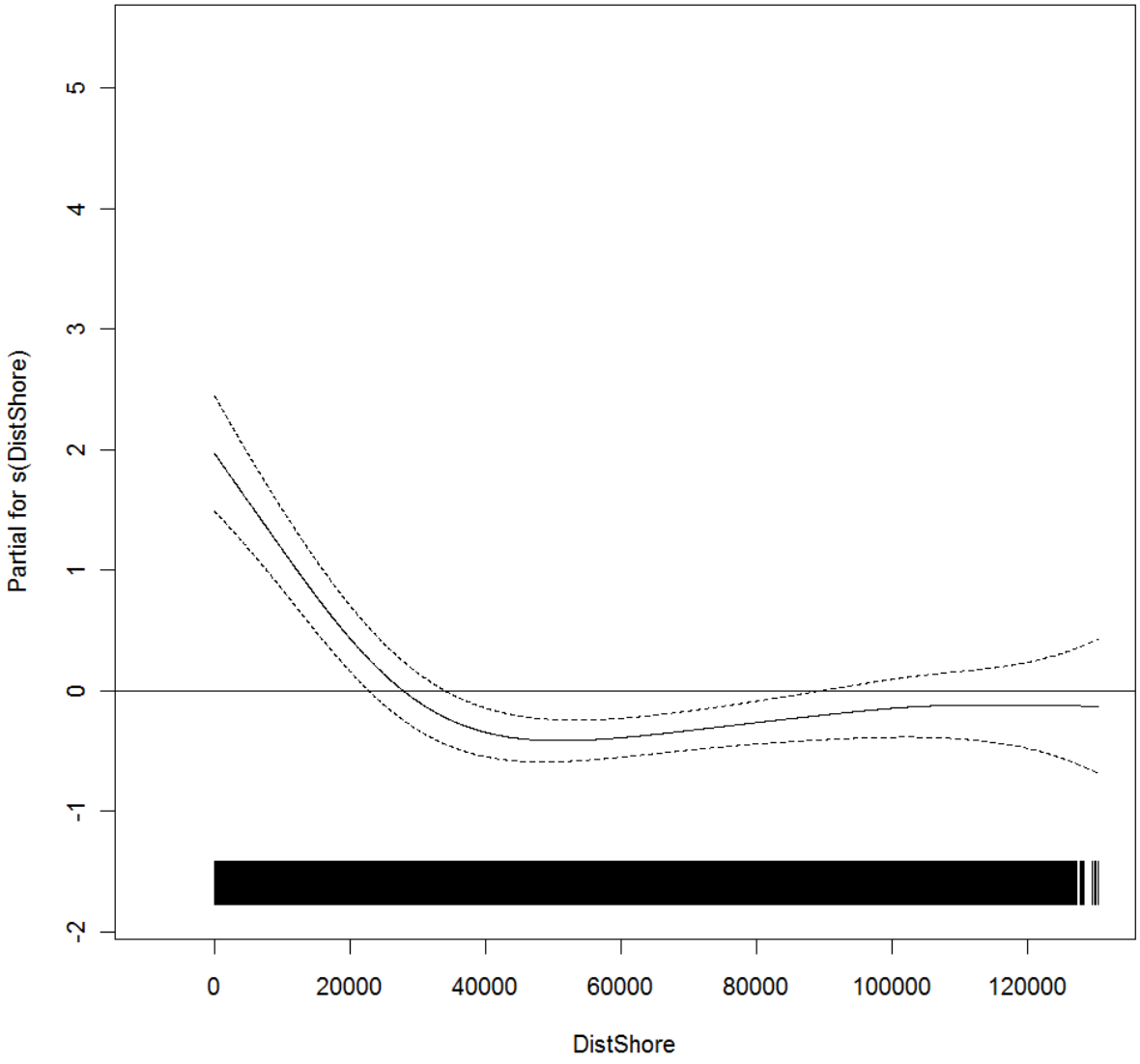

Figure M-35. Result of GAM regression for the effect of distance to shoreline 'DistShore' (feet) on total sitting bird density. Broken lines represent 95% confidence intervals around the covariate main effect.

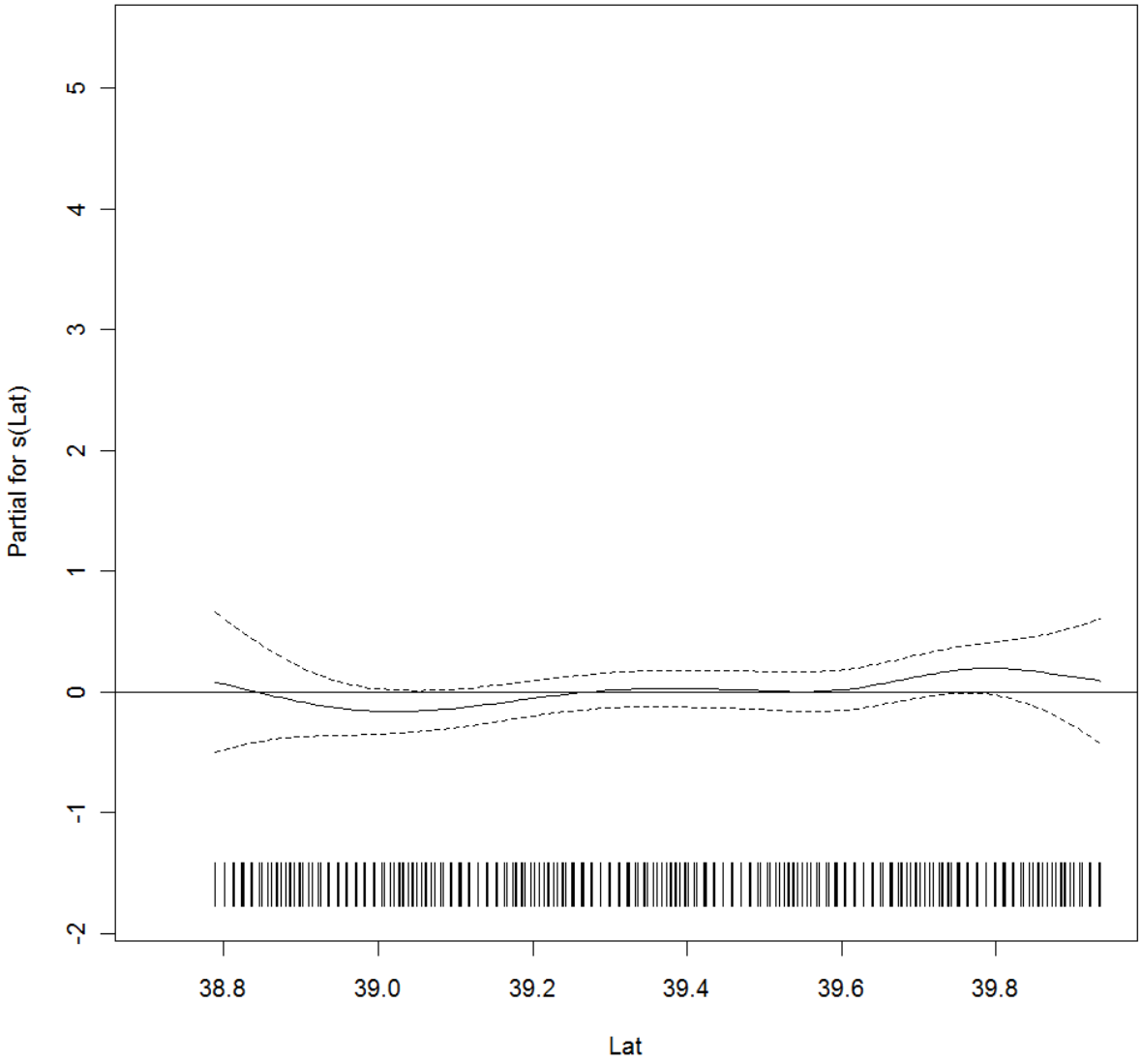

Figure M-36. Result of GAM regression for the effect of latitude on total sitting bird density. Broken lines represent 95% confidence intervals around the covariate main effect.

Table M-16. Spatial regression model results for spatial covariates and total sitting bird density (Fall 2008).

Spatial Regression Model:
Spatial lag model – Maximum Likelihood Estimation
N=2698, R^2=0.16, Log likelihood=-8492, Akaike info criterion=17000
Global Moran's I = 0.3441, p<0.001

Variable	Coefficient	Std.Error	z-value	Probability
Spatial lag	0.208	0.015	13.569	**0.0000**
Constant	-384.360	299.696	-1.282	0.1996
Depth	0.262	0.034	7.624	**0.0000**
Slope	1.399	0.463	3.020	**0.0025**
DistShore	2.409e-005	1.30e-005	1.845	0.0649
DistShoal	1.850e-005	6.52e-006	2.838	**0.0045**
Longitude	-3.075	2.764	-1.112	0.2658
Latitude	4.071	2.412	1.688	0.0914

Table M-17. GAM results for spatial covariates and total sitting bird density (Fall 2008).

Generalized Additive Models:
Initial Model Summary: Significance of smoothed terms

Variable	Df	Npar Df	Npar F	Pr(F)
Depth	**1**	**3**	**18.4953**	**6.218e-12 *** **
Slope	**1**	**3**	**4.0239**	**0.0071823 ** **
DistShore	**1**	**3**	**12.7792**	**2.557e-08 *** **
DistShoal	**1**	**3**	**2.6217**	**0.0489895 * **
Lon	**1**	**3**	**10.7664**	**4.733e-07 *** **
Lat	**1**	**3**	**5.7146**	**0.0006682 *** **

AIC: 37716.8

Stepwise-selected Model Summary: Significance of smoothed terms

Variable	Df	Npar Df	Npar F	Pr(F)
Depth	**1**	**3**	**18.4953**	**6.218e-12 *** **
Slope	**1**	**3**	**4.0239**	**0.0071823 ** **
DistShore	**1**	**3**	**12.7792**	**2.557e-08 *** **
DistShoal	**1**	**3**	**2.6217**	**0.0489895 * **
Lon	**1**	**3**	**10.7664**	**4.733e-07 *** **
Lat	**1**	**3**	**5.7146**	**0.0006682 *** **

AIC: 37716.8

Significant codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
Df=degrees of freedom, NparDf=nonparametric degrees of freedom, NparF=nonparametric F value, Pr(F)=probability value.

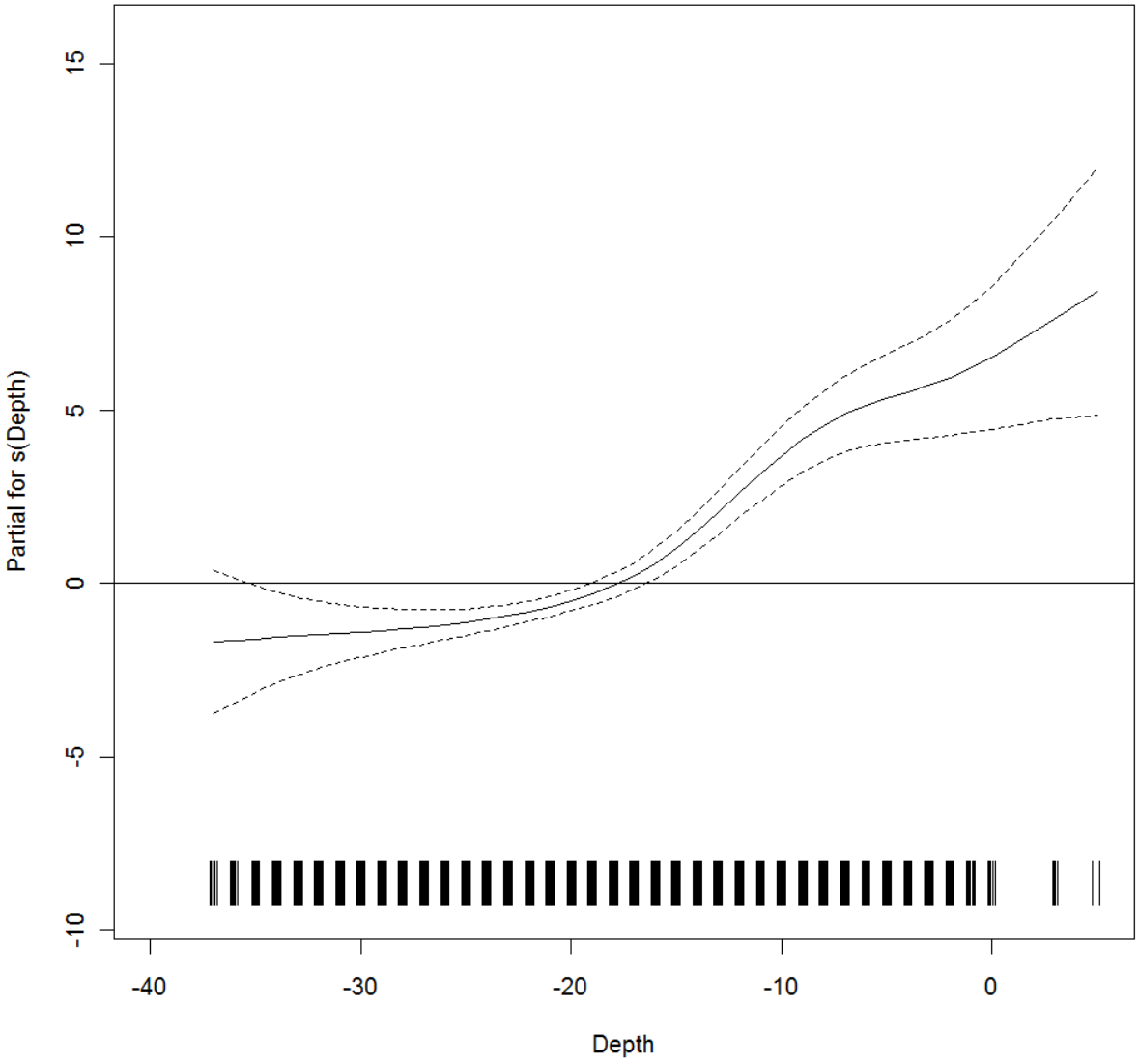

Figure M-37. Result of GAM regression for the effect of depth (m) on total sitting bird density in fall. Broken lines represent 95% confidence intervals around the covariate main effect.

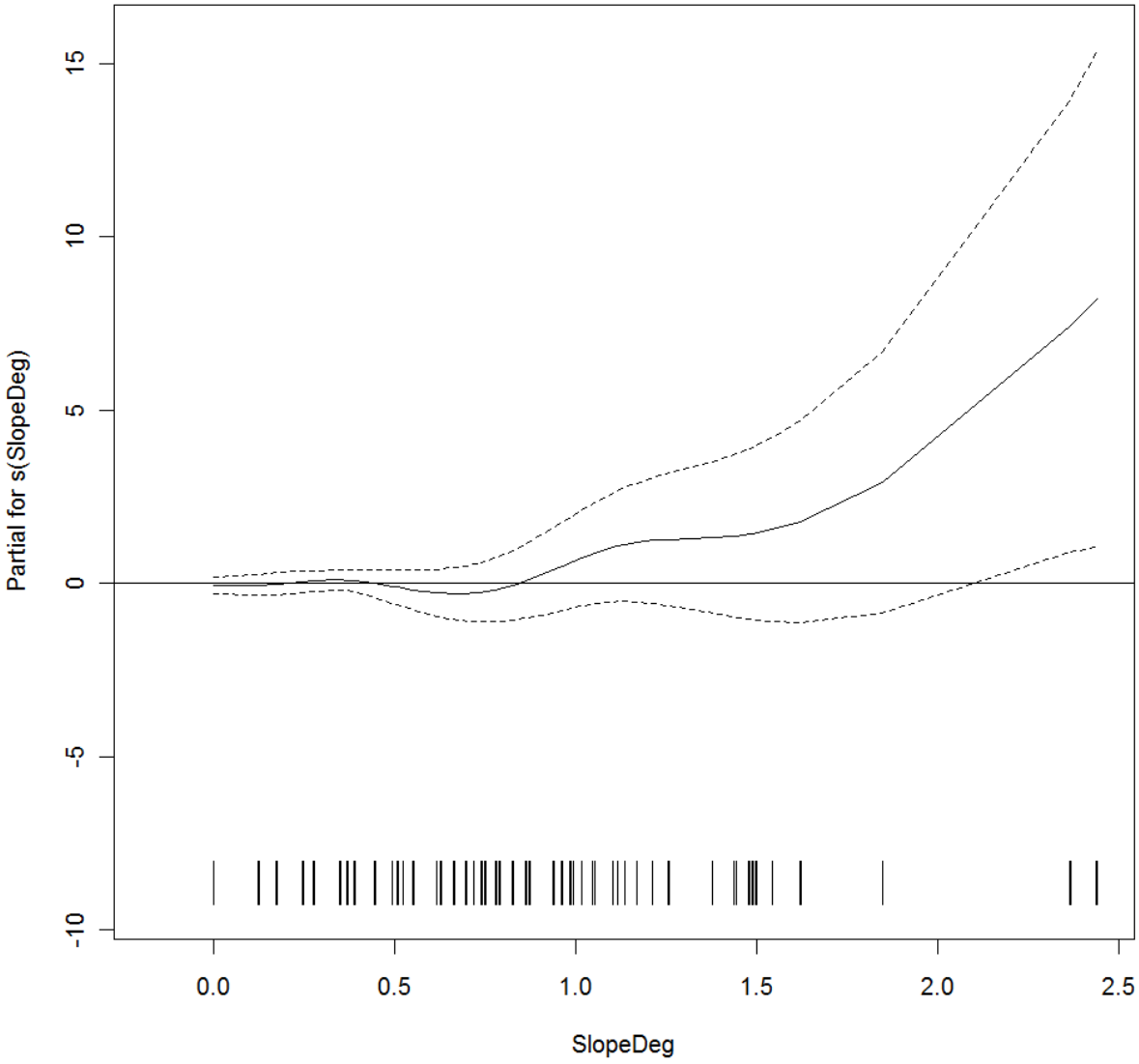

Figure M-38. Result of GAM regression for the effect of slope 'SlopeDeg' (degrees) on total sitting bird density in fall. Broken lines represent 95% confidence intervals around the covariate main effect.

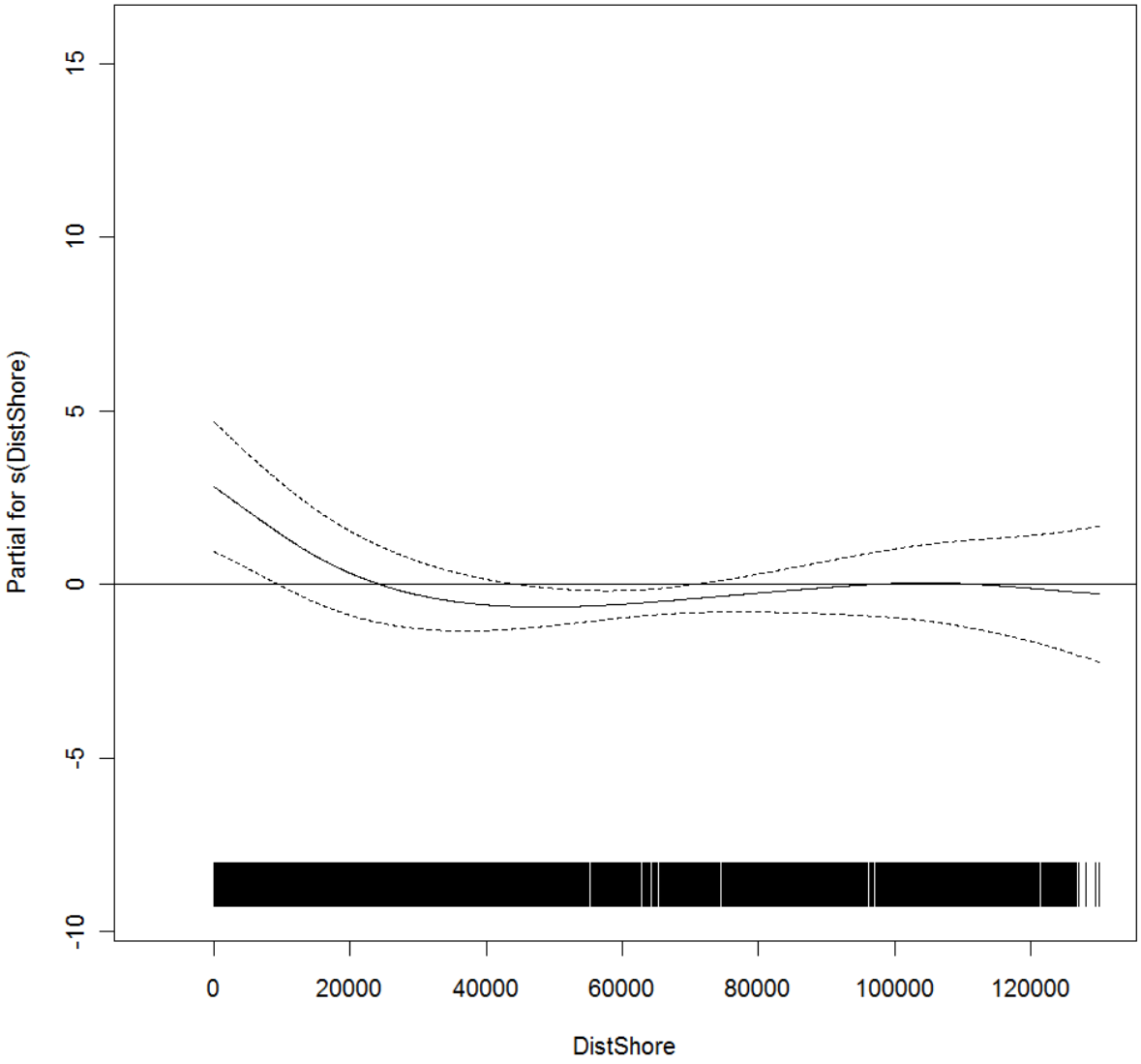

Figure M-39. Result of GAM regression for the effect of distance to shoreline 'DistShore' (feet) on total sitting bird density in fall. Broken lines represent 95% confidence intervals around the covariate main effect.

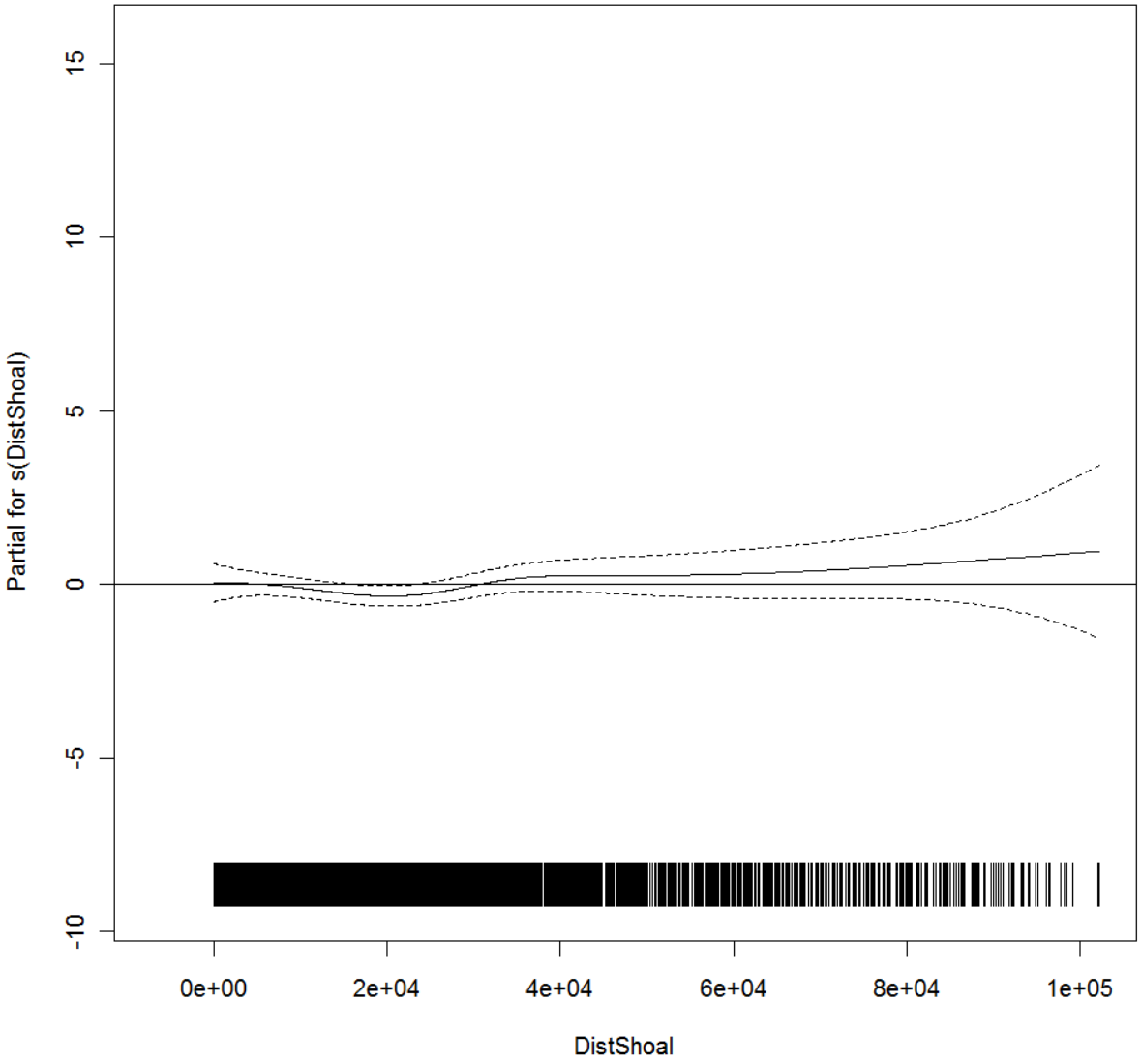

Figure M-40. Result of GAM regression for the effect of distance to nearest shoal 'DistShoal' (feet) on total sitting bird density in fall. Broken lines represent 2-SE around the covariate main effect.

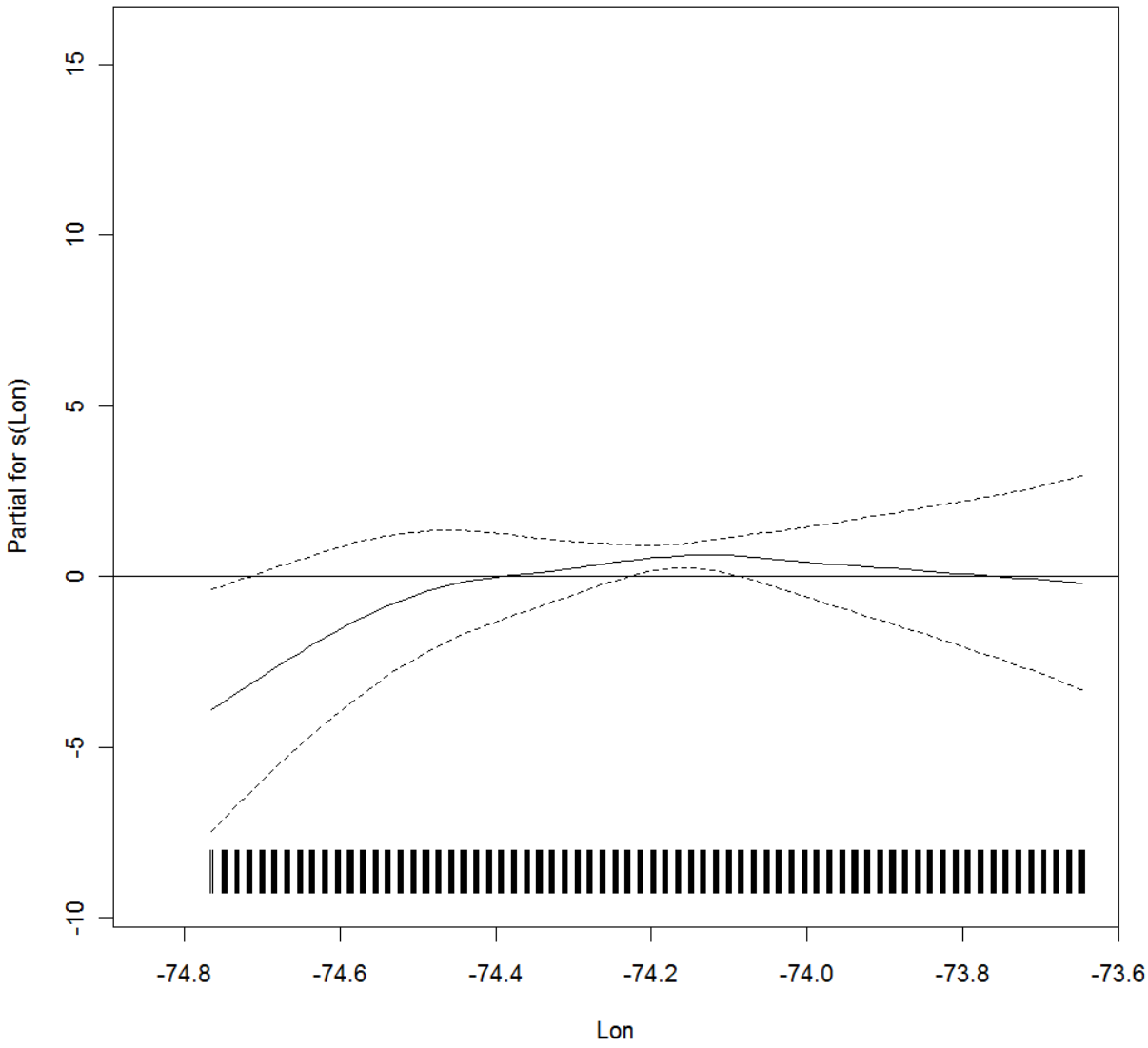

Figure M-41. Result of GAM regression for the effect of longitude 'Lon' on total sitting bird density in fall. Broken lines represent 95% confidence intervals around the covariate main effect.

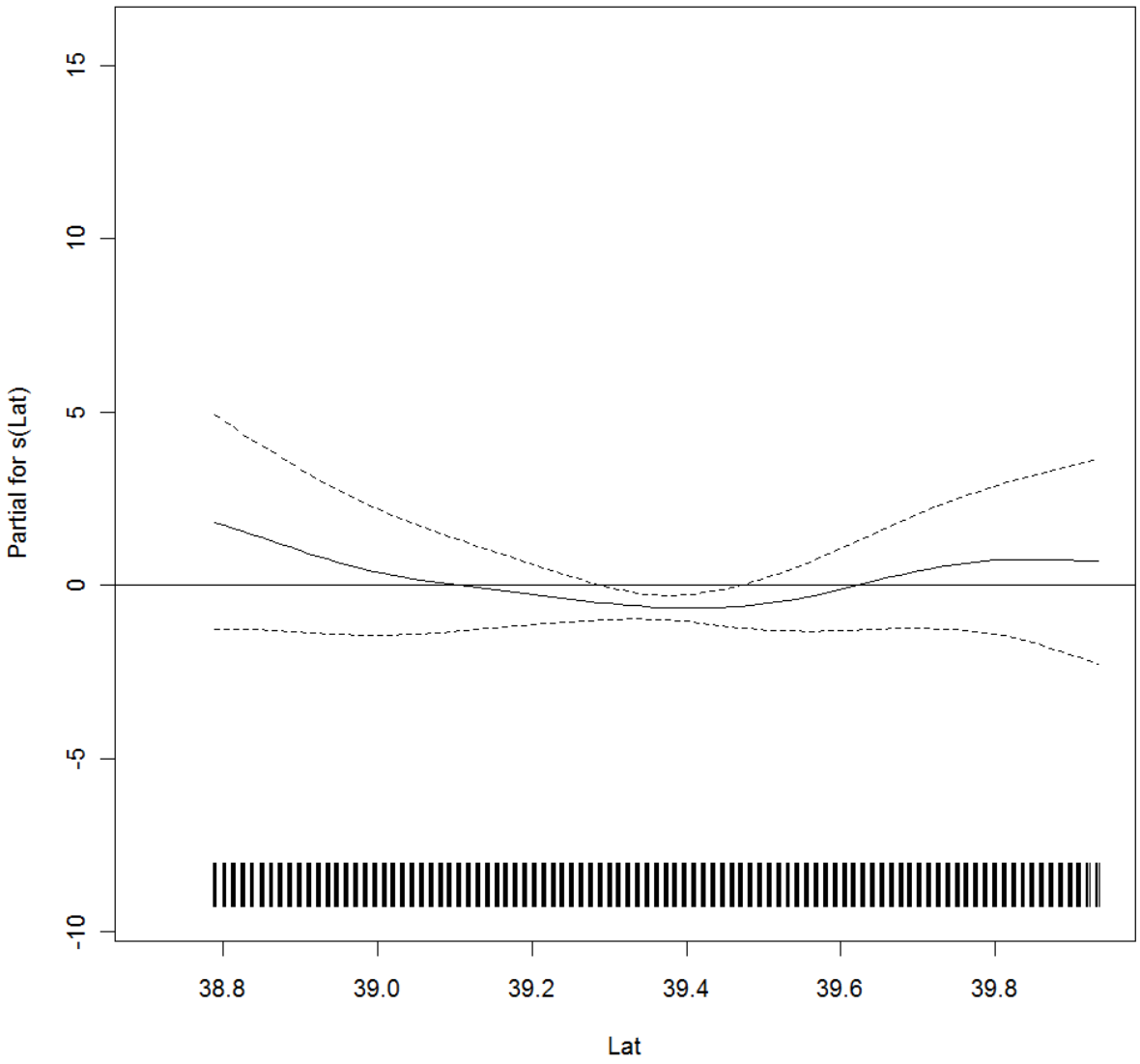

Figure M-42. Result of GAM regression for the effect of latitude 'Lat' on total sitting bird density in fall. Broken lines represent 95% confidence intervals around the covariate main effect.

Table M-18. Spatial regression model results for spatial covariates and total sitting bird density (Spring 2009).

Spatial Regression Model:
Spatial lag model – Maximum Likelihood Estimation
N=2698, R^2=0.03, Log likelihood=--7860.8, Akaike info criterion=15737.6
Global Moran's I = 0.0930, p>0.05

Variable	Coefficient	Std.Error	z-value	Probability
Spatial lag	0.079	0.016	4.930	**0.0000**
Constant	-500.530	240.171	-2.084	**0.0371**
Depth	0.009	0.027	0.337	0.7356
Slope	0.105	0.371	0.283	0.7769
DistShore	5.303e-005	1.04e-005	0.507	0.6121
DistShoal	1.666e-005	5.22e-006	3.188	**0.0014**
Longitude	-4.761	2.215	-2.149	**0.0316**
Latitude	3.749	1.932	1.940	0.0523

Table M-19. GAM results for spatial covariates and total bird density (Spring 2009).

Generalized Additive Models:
Initial Model Summary: Significance of smoothed terms

Variable	Df	Npar Df	Npar F	Pr(F)
Depth	**1**	**3**	**7.9301**	**2.833e-05 *** **
Slope	**1**	**3**	**0.7434**	**0.526056**
DistShore	**1**	**3**	**17.5067**	**2.623e-11 *** **
DistShoal	**1**	**3**	**0.9229**	**0.428759**
Lon	**1**	**3**	**4.0670**	**0.006764 ** **
Lat	**1**	**3**	**3.2390**	**0.021206 * **

AIC: 35187.03

Stepwise-selected Model Summary: Significance of smoothed terms

Variable	Df	Npar Df	Npar F	Pr(F)
Depth	**1**	**3**	**7.7680**	**3.574e-05 *** **
DistShore	**1**	**3**	**23.2811**	**5.773e-15 *** **
Lon	**1**	**3**	**4.8168**	**0.002371 ** **
Lat	**1**	**3**	**3.8986**	**0.008546 ** **

AIC: 35176.48

Significant codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
Df=degrees of freedom, NparDf=nonparametric degrees of freedom, NparF=nonparametric F value, Pr(F)=probability value.

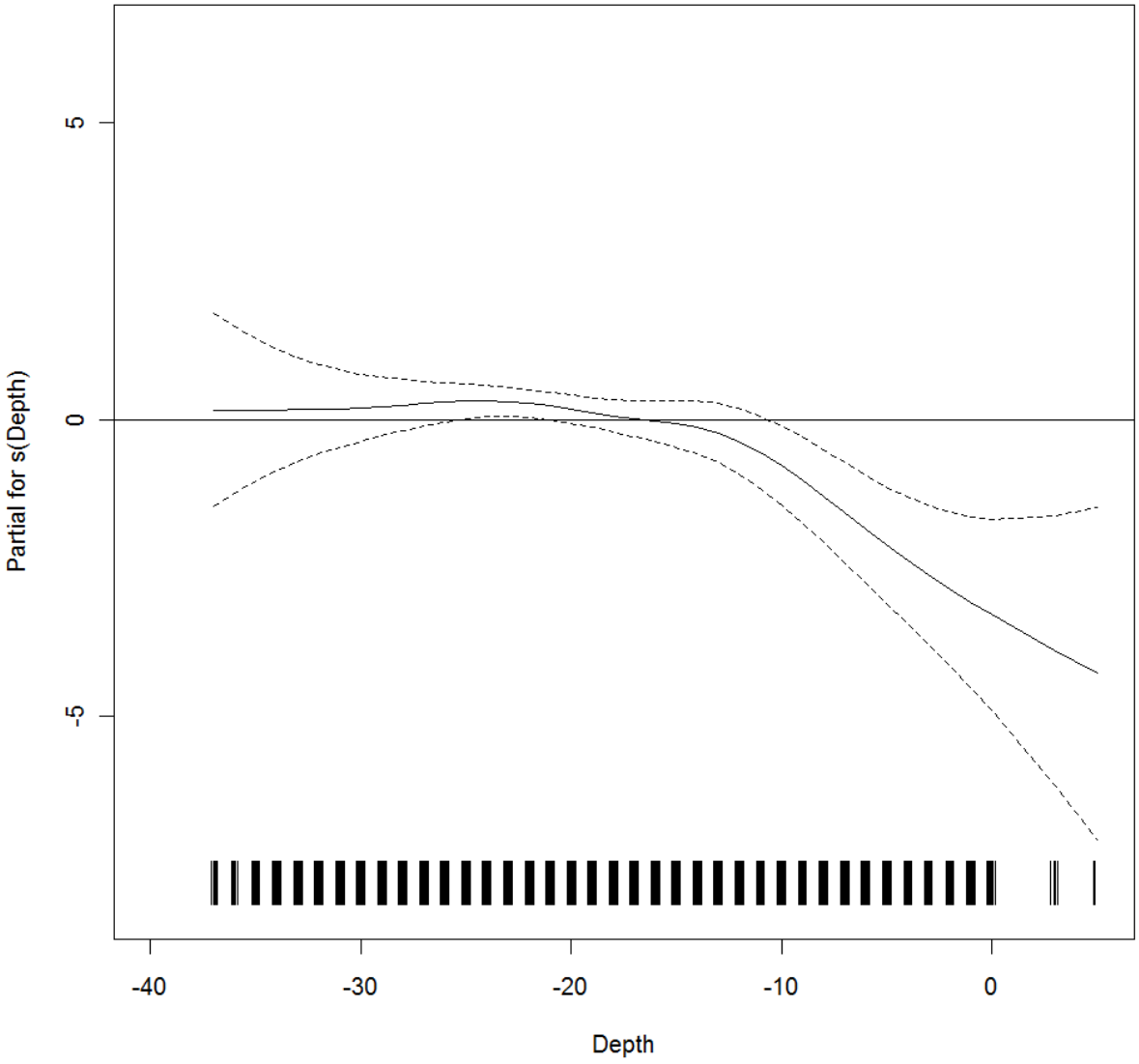

Figure M-43. Result of GAM regression for the effect of depth (m) on total sitting bird density in spring. Broken lines represent 95% confidence intervals around the covariate main effect.

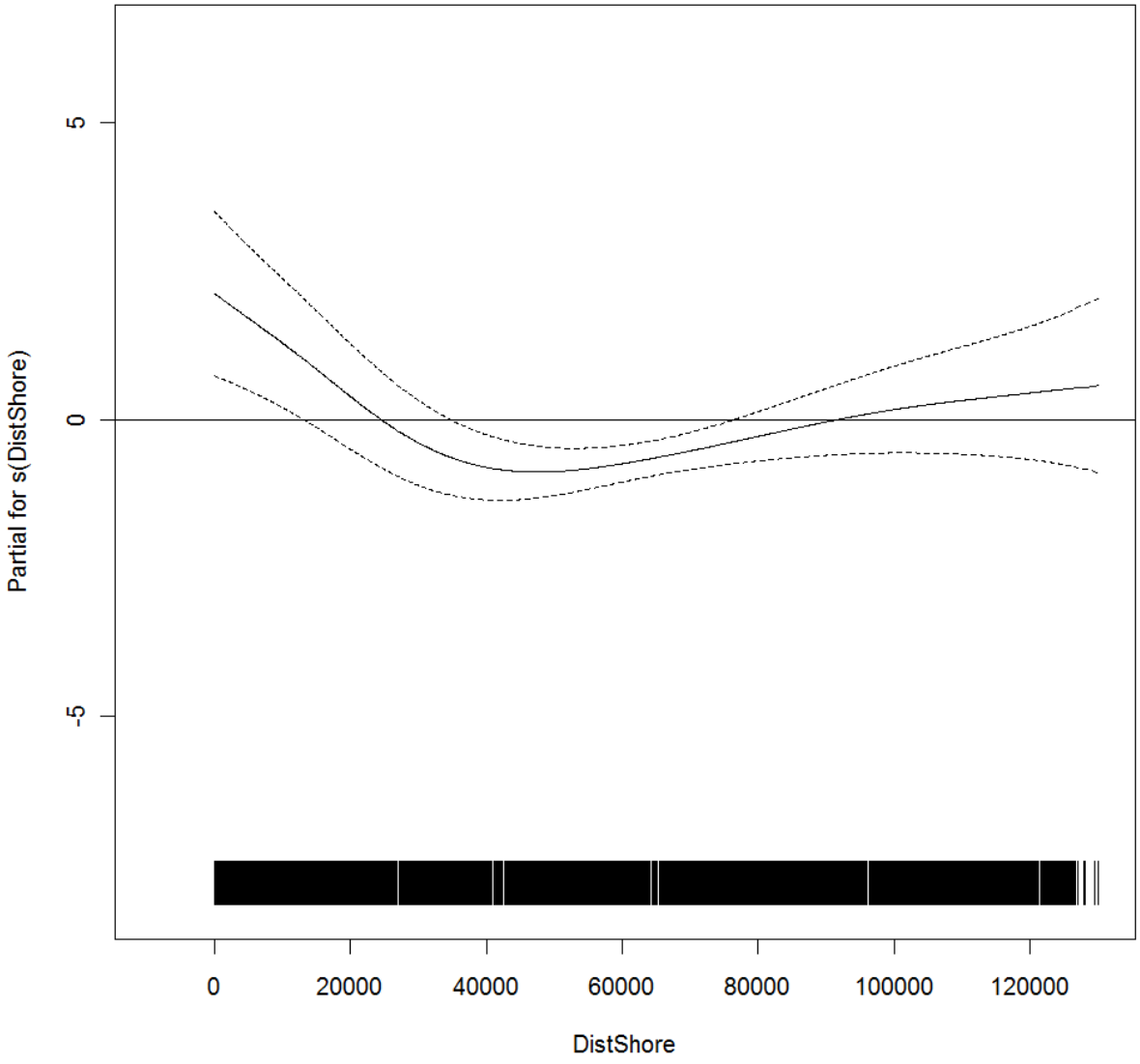

Figure M-44. Result of GAM regression for the effect of distance to shoreline 'DistShore' (feet) on total sitting bird density in spring. Broken lines represent 95% confidence intervals around the covariate main effect.

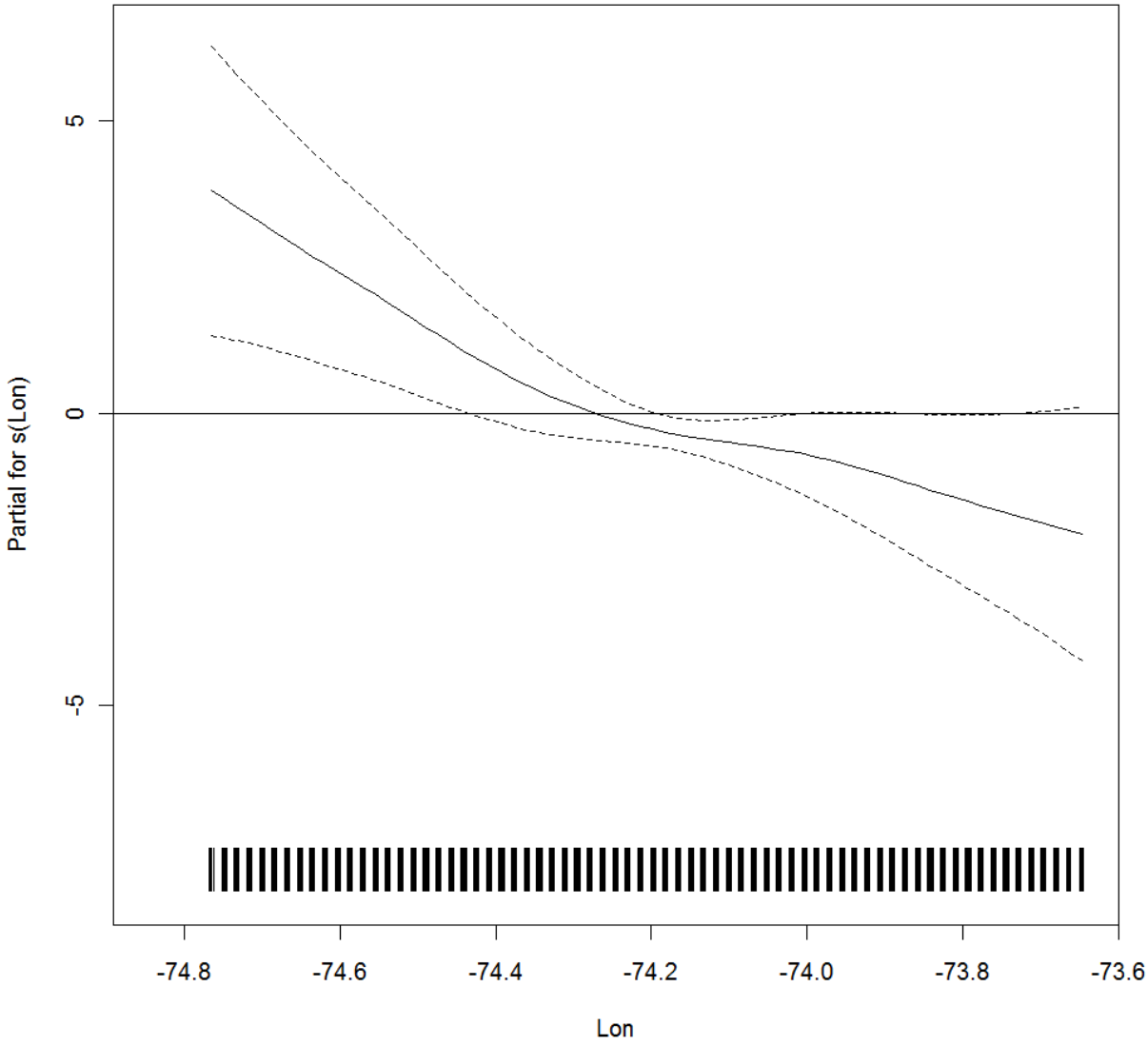

Figure M-45. Result of GAM regression for the effect of longitude 'Lon' on total sitting bird density in spring. Broken lines represent 95% confidence intervals around the covariate main effect.

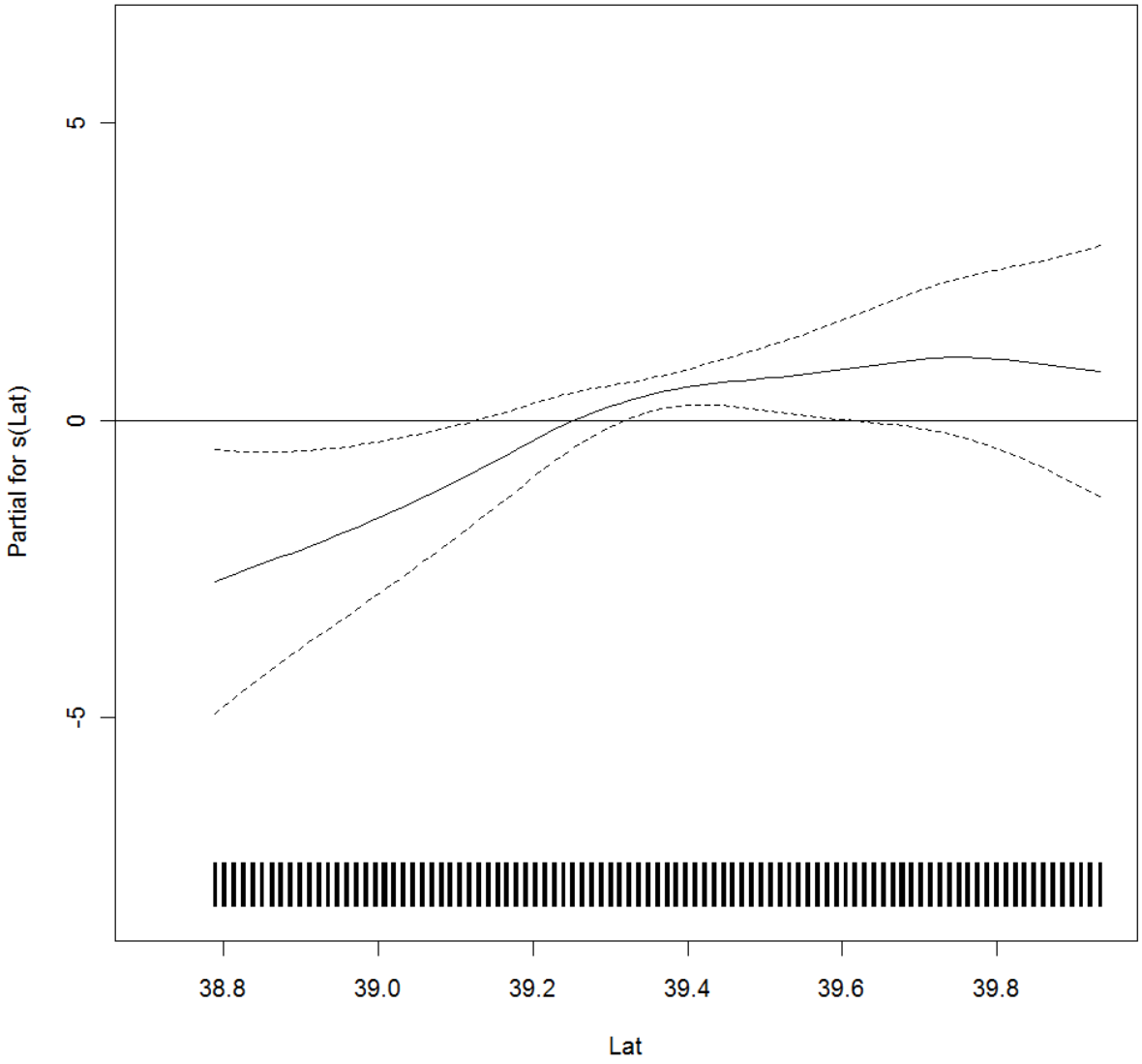

Figure M-46. Result of GAM regression for the effect of latitude 'Lat' on total sitting bird density in spring. Broken lines represent 95% confidence intervals around the covariate main effect.

Table M-20. Spatial regression model results for spatial covariates and total sitting bird density (Summer 2009).

Spatial Regression Model:
Spatial lag model – Maximum Likelihood Estimation
N=2698, R^2=0.74, Log likelihood=-1816.3, Akaike info criterion=3648.6
Global Moran's I = 0.8485, p=0.001

Variable	Coefficient	Std.Error	z-value	Probability
Spatial lag	0.693	0.008	84.917	**0.0000**
Constant	-23.812	20.879	-1.140	0.2540
Depth	0.0006	0.002	0.254	0.7991
Slope	-0.022	0.032	-0.686	0.4927
DistShore	5.018e-007	9.09e-007	0.552	0.5811
DistShoal	1.851e-006	4.56e-007	4.059	**0.0000**
Longitude	-0.205	0.192	-1.067	0.2855
Latitude	0.218	0.168	1.298	0.1940

Table M-21. GAM results for spatial covariates and total sitting bird density (Summer 2009).

Generalized Additive Models:
Initial Model Summary: Significance of smoothed terms

Variable	Df	Npar Df	Npar F	Pr(F)
Depth	**1**	**3**	**31.750**	**<2.2e-16 *** **
Slope	**1**	**3**	**0.167**	**0.919**
DistShore	**1**	**3**	**23.109**	**7.327e-15 *** **
DistShoal	**1**	**3**	**56.796**	**<2.2e-16 *** **
Lon	**1**	**3**	**27.273**	**<2.2e-16 *** **
Lat	**1**	**3**	**25.540**	**2.220e-16 *** **

AIC: 15858.14

Stepwise-selected Model Summary: Significance of smoothed terms

Variable	Df	Npar Df	Npar F	Pr(F)
Depth	**1**	**3**	**31.719**	**<2.2e-16 *** **
DistShore	**1**	**3**	**23.082**	**7.66e-15 *** **
DistShoal	**1**	**3**	**56.636**	**<2.2e-16 *** **
Lon	**1**	**3**	**27.387**	**<2.2e-16 *** **
Lat	**1**	**3**	**25.717**	**<2.2e-16 *** **

AIC: 15851.04

Significant codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
Df=degrees of freedom, NparDf=nonparametric degrees of freedom, NparF=nonparametric F value, Pr(F)=probability value.

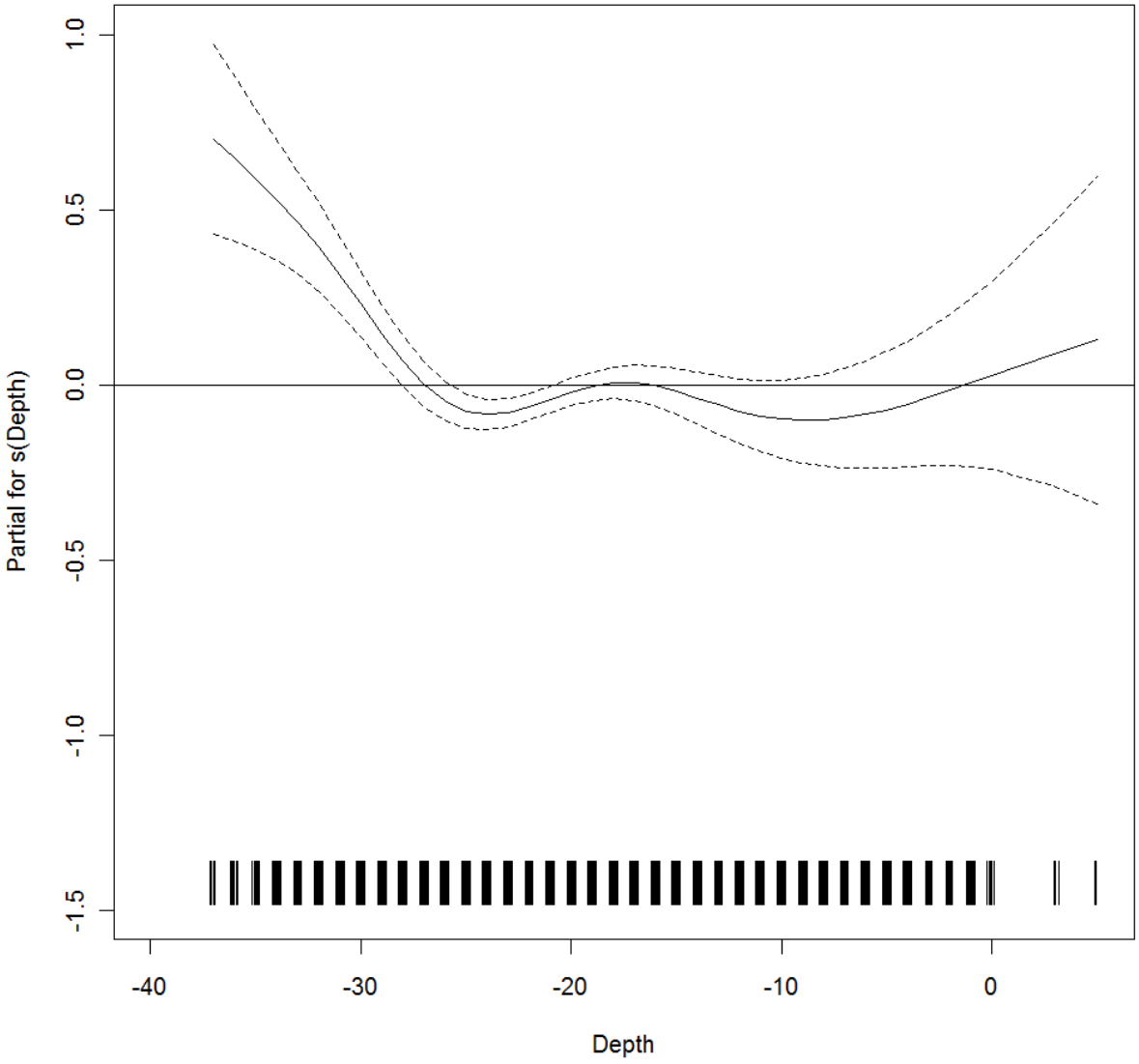

Figure M-47. Result of GAM regression for the effect of depth (m) on total sitting bird density in summer. Broken lines represent 95% confidence intervals around the covariate main effect.

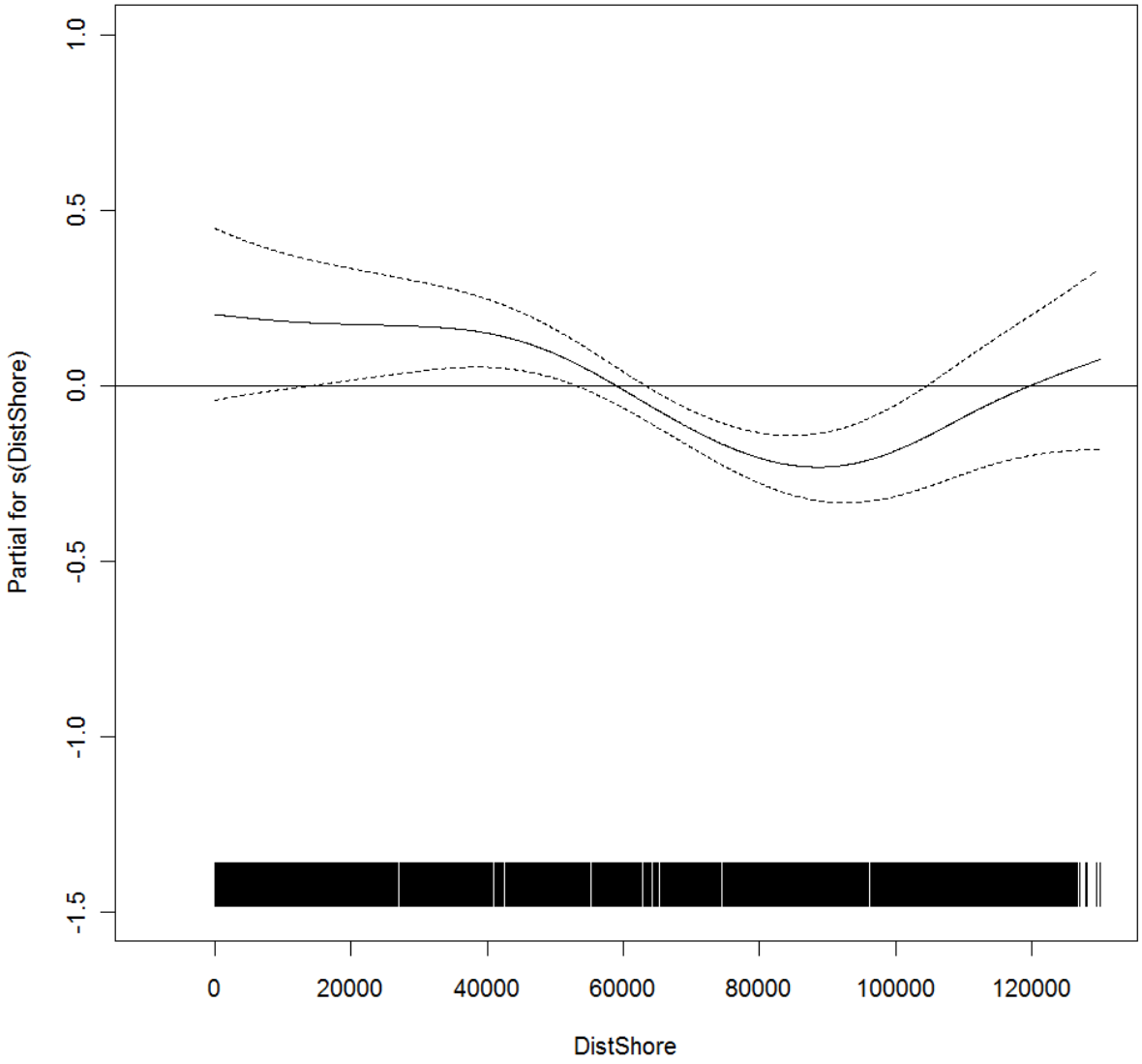

Figure M-48. Result of GAM regression for the effect of distance to shoreline 'DistShore' (feet) on total sitting bird density in summer. Broken lines represent 95% confidence intervals around the covariate main effect.

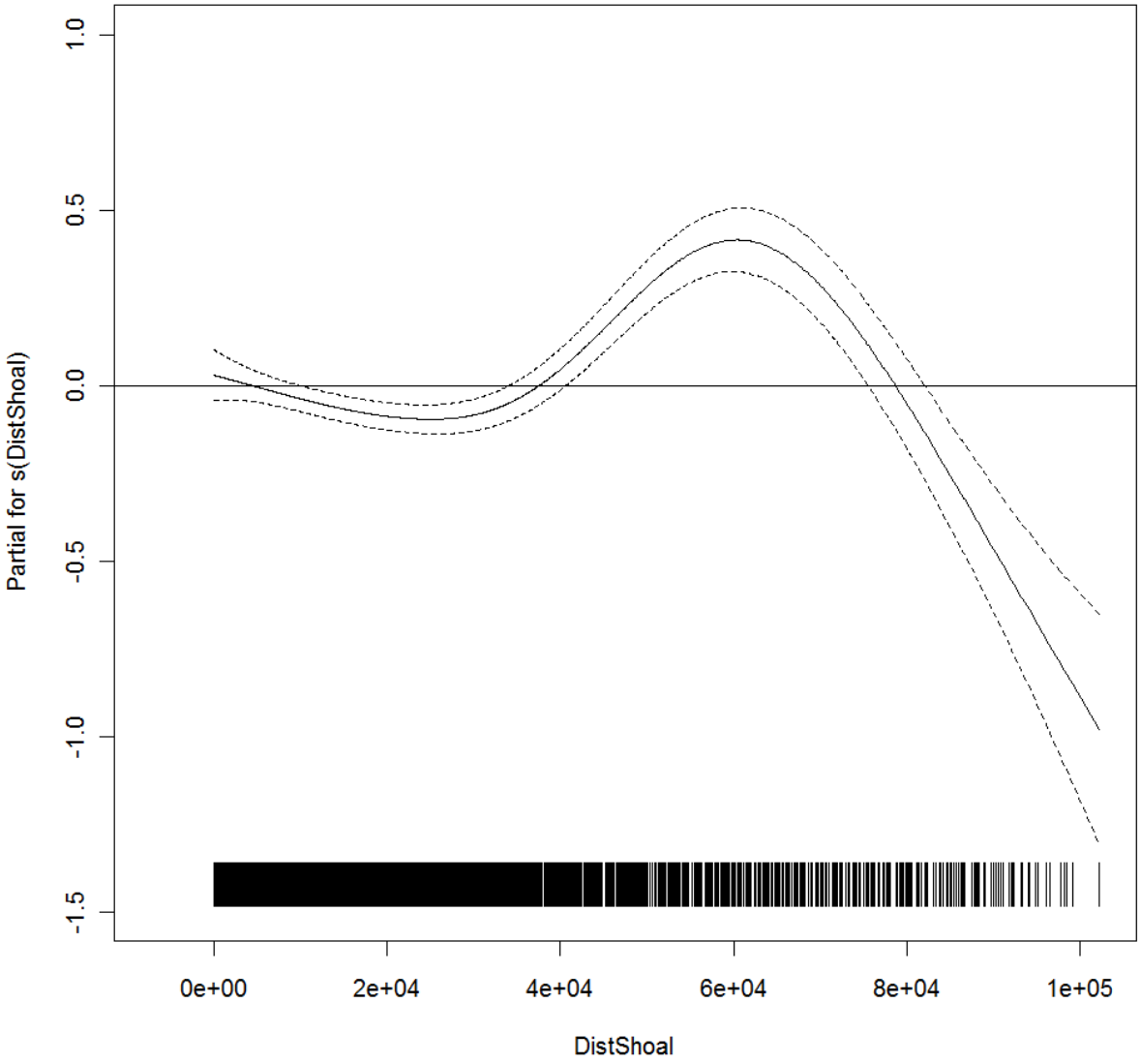

Figure M-49. Result of GAM regression for the effect of distance to nearest shoal 'DistShoal' (feet) on total sitting bird density in summer. Broken lines represent 95% confidence intervals around the covariate main effect.

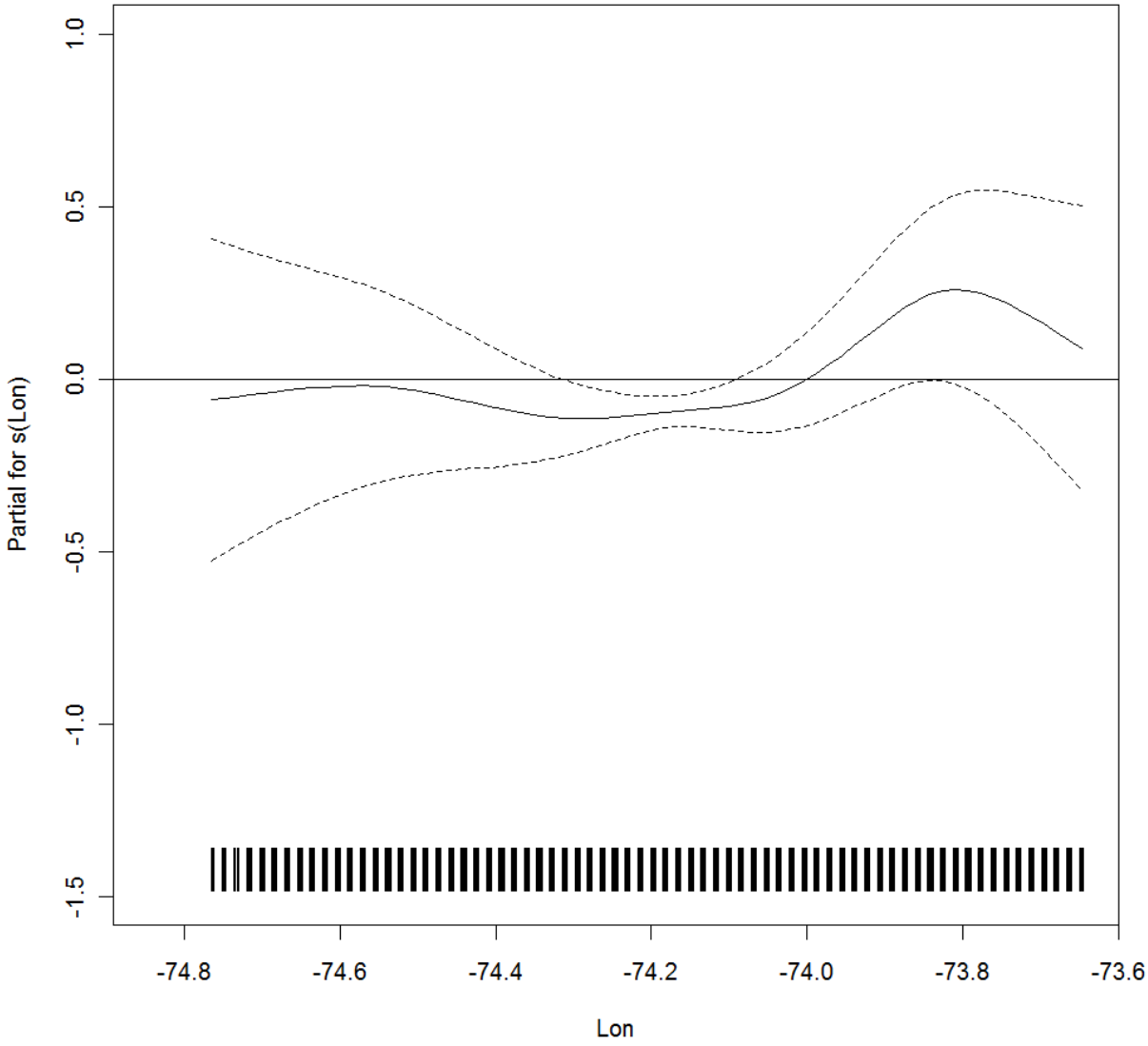

Figure M-50. Result of GAM regression for the effect of longitude 'Lon' on total sitting bird density in summer. Broken lines represent 95% confidence intervals around the covariate main effect.

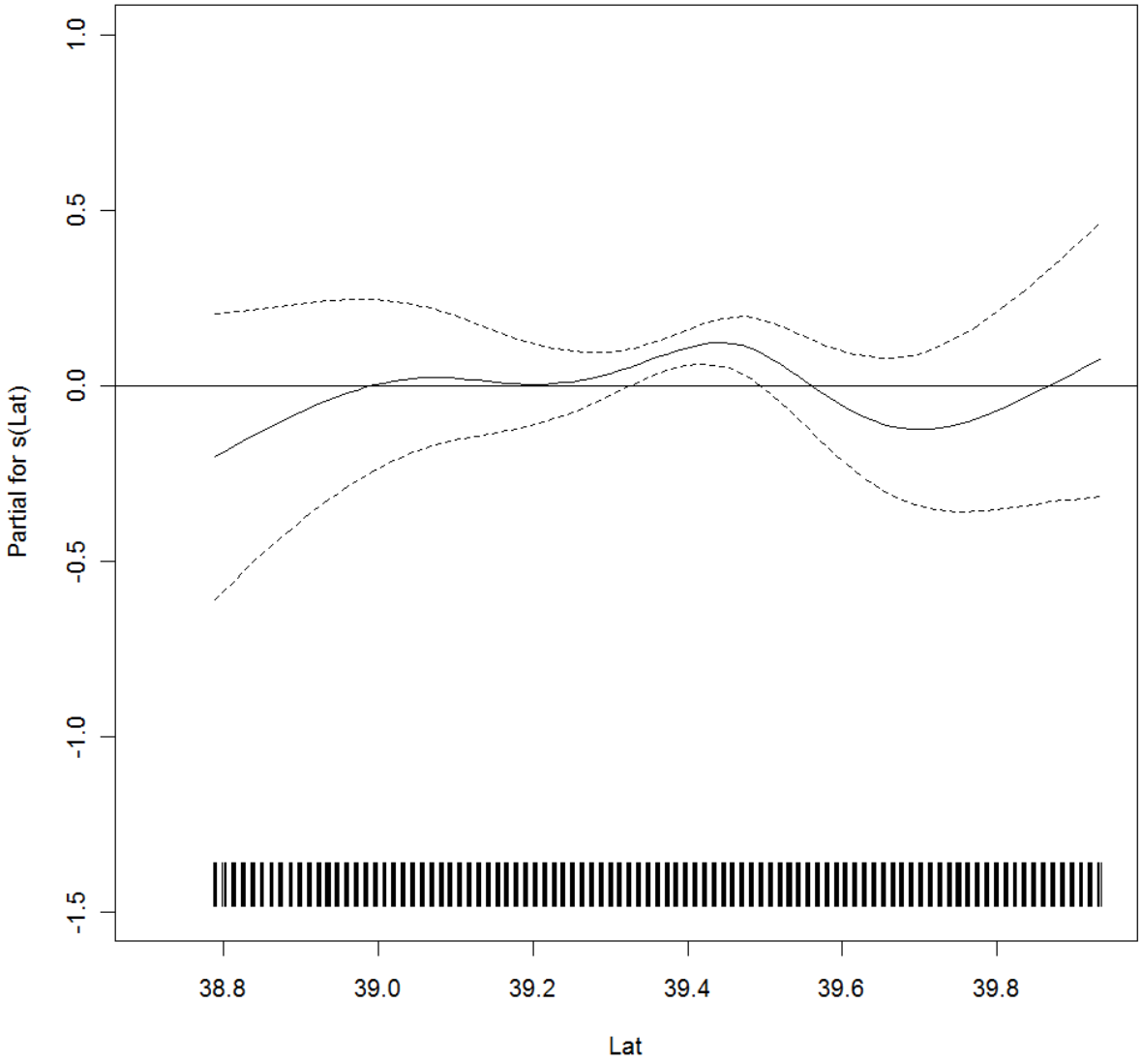

Figure M-51. Result of GAM regression for the effect of latitude 'Lat' on total sitting bird density in summer. Broken lines represent 95% confidence intervals around the covariate main effect.

Table M-22. Spatial regression model results for spatial covariates and total sitting bird density (Winter 2009).

Spatial Regression Model:
Spatial lag model – Maximum Likelihood Estimation
N=5801, R^2=0.04, Log likelihood=-20879, Akaike info criterion=41774.9
Global Moran's I =0.0814 , p=0.05

Variable	Coefficient	Std.Error	z-value	Probability
Spatial lag	0.079	0.018	4.293	**0.0000**
Constant	61.164	329.700	0.185	0.8528
Depth	0.306	0.037	8.201	**0.0000**
Slope	0.618	0.440	1.406	0.1596
DistShore	1.044e-005	1.46e-005	0.714	0.4750
DistShoal	1.710e-005	7.04e-006	0.256	**0.0152**
Longitude	0.777	3.033	0.256	0.7976
Latitude	0.067	2.668	0.025	0.9797

Table M-23. GAM results for spatial covariates and total sitting bird density (Winter 2009).

Generalized Additive Models:
Initial Model Summary: Significance of smoothed terms

Variable	Df	Npar Df	Npar F	Pr(F)
Depth	**1**	**3**	**34.963**	**<2.2e-16 *** **
Slope	**1**	**3**	**0.902**	**0.439344**
DistShore	**1**	**3**	**4.106**	**0.006405 ** **
DistShoal	**1**	**3**	**1.836**	**0.138318**
Lon	**1**	**3**	**1.399**	**0.240955**
Lat	**1**	**3**	**1.621**	**0.182263**

AIC: 41654.16

Stepwise-selected Model Summary: Significance of smoothed terms

Variable	Df	Npar Df	Npar F	Pr(F)
Depth	**1**	**3**	**39.182**	**<2.2e-16 *** **
DistShore	**1**	**3**	**5.693**	**0.0006886 *** **

AIC: 41639.45

Significant codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
Df=degrees of freedom, NparDf=nonparametric degrees of freedom, NparF=nonparametric F value, Pr(F)=probability value.

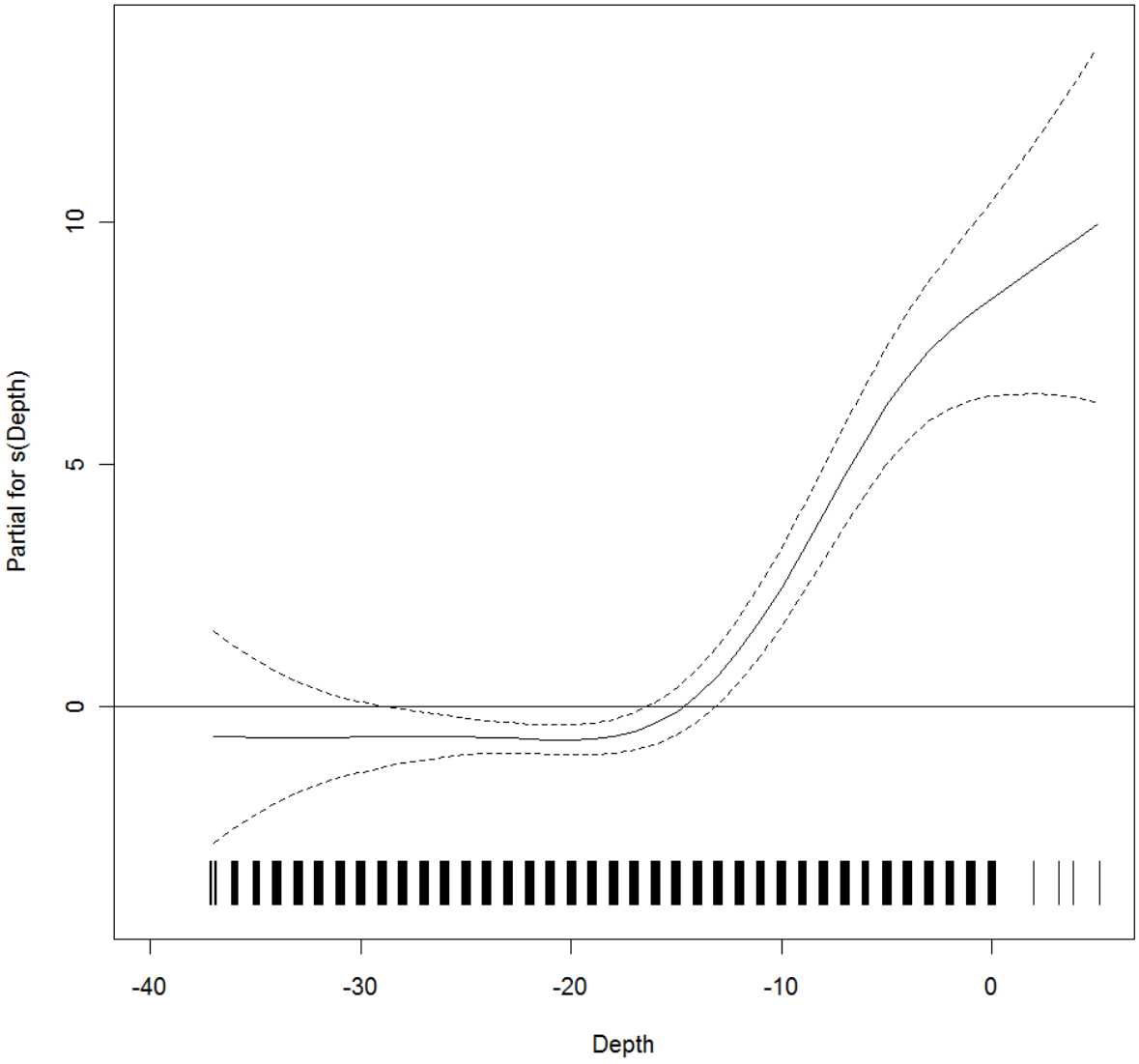

Figure M-52. Result of GAM regression for the effect of depth (m) on total sitting bird density in winter. Broken lines represent 95% confidence intervals around the covariate main effect.

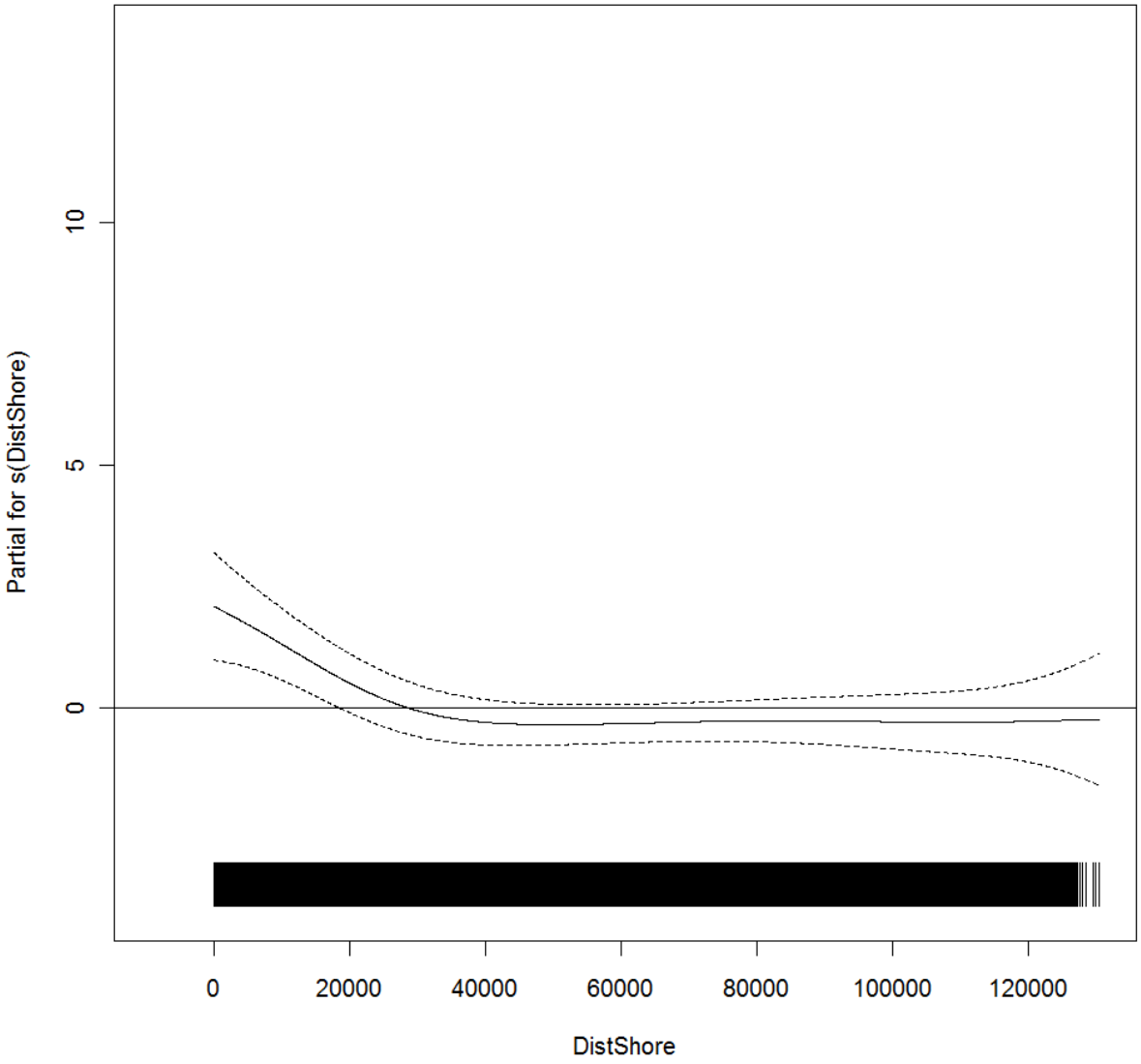

Figure M-53. Result of GAM regression for the effect of distance to shoreline 'DistShore' (feet) on total sitting bird density in winter. Broken lines represent 95% confidence intervals around the covariate main effect.

Table M-24. Spatial regression model results for spatial covariates and Northern Gannet density.

Spatial Regression Model:
Spatial lag model – Maximum Likelihood Estimation
N=5801, R^2=0.18, Log likelihood=--9934.5, Akaike info criterion=19885.1
Global Moran's I =0.2919, p<0.01

Variable	Coefficient	Std.Error	z-value	Probability
Spatial lag	0.461	0.015	27.816	**0.0000**
Constant	-14.314	48.868	-0.293	0.7695
Depth	0.008	0.005	1.461	0.1437
Slope	-0.077	0.065	-1.191	0.2335
DistShore	-6.054e-007	2.16e-006	-0.279	0.7798
DistShoal	-1.084e-006	1.04e-006	-1.038	0.2989
Longitude	-0.301	0.449	-0.669	0.5031
Latitude	-0.189	0.395	-0.478	0.6324

Table M-25. GAM results for spatial covariates and Northern Gannet density.

Generalized Additive Models:
Initial Model Summary: Significance of smoothed terms

Variable	Df	Npar Df	Npar F	Pr(F)
Depth	**1**	**3**	**9.2416**	**4.182e-06 *** **
Slope	**1**	**3**	**1.3047**	**0.270930**
DistShore	**1**	**3**	**28.4740**	**<2.2e-16 *** **
DistShoal	**1**	**3**	**8.7484**	**8.542e-06 *** **
Lon	**1**	**3**	**4.7337**	**0.002650 ** **
Lat	**1**	**3**	**5.3968**	**0.001039 ** **

AIC: 121675.9

Stepwise-selected Model Summary: Significance of smoothed terms

Variable	Df	Npar Df	Npar F	Pr(F)
Depth	**1**	**3**	**9.8997**	**1.612e-06 *** **
DistShore	**1**	**3**	**28.7835**	**<2.2e-16 *** **
DistShoal	**1**	**3**	**8.3031**	**1.625e-05 *** **
Lon	**1**	**3**	**4.9773**	**0.001880 ** **
Lat	**1**	**3**	**4.9867**	**0.001855 ** **

AIC: 121673.5

Significant codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
Df=degrees of freedom, NparDf=nonparametric degrees of freedom, NparF=nonparametric F value, Pr(F)=probability value.

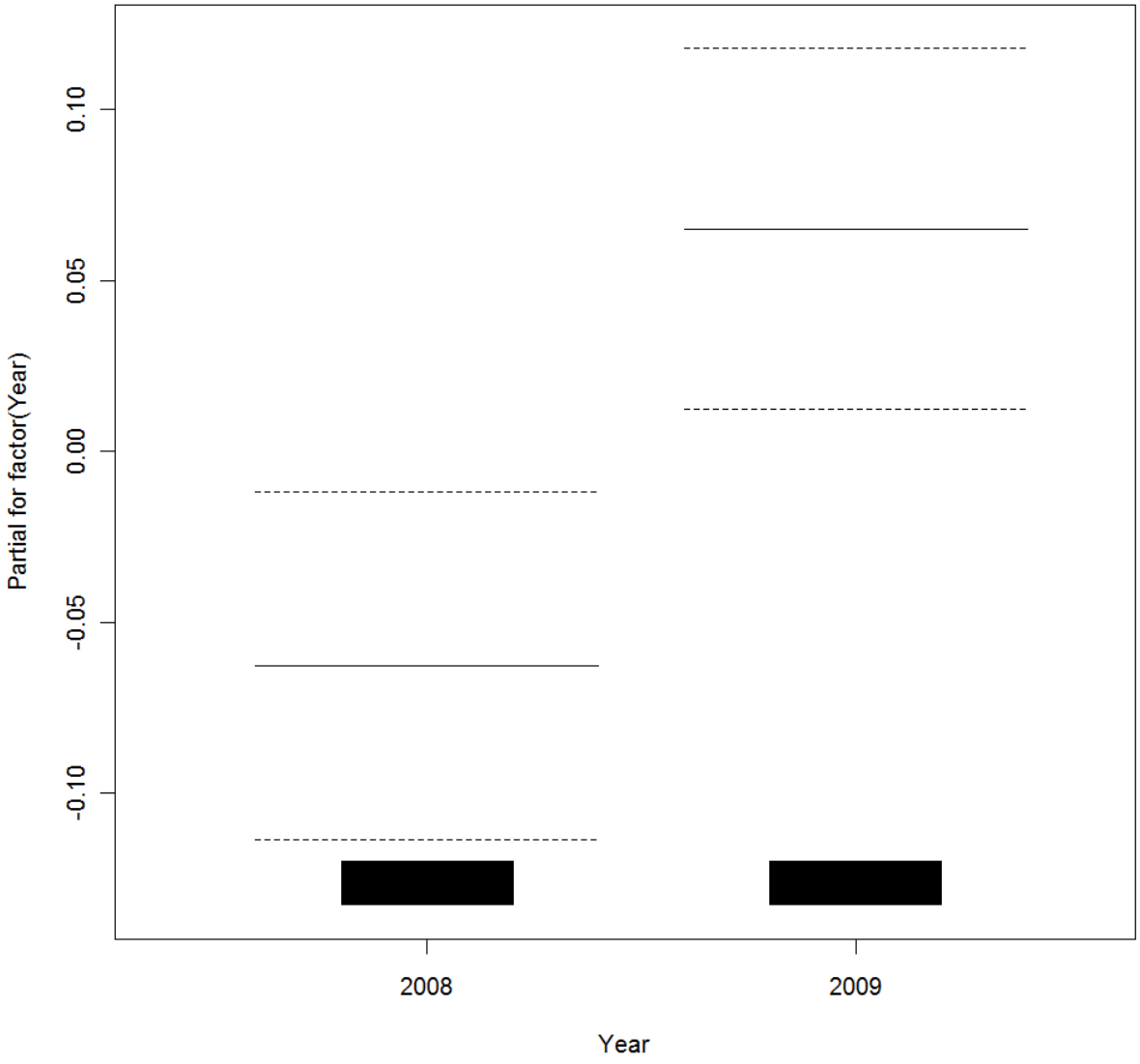

Figure M-54. Result of GAM regression for the effect of year on Northern Gannet density. Broken lines represent 95% confidence intervals around the covariate main effect.

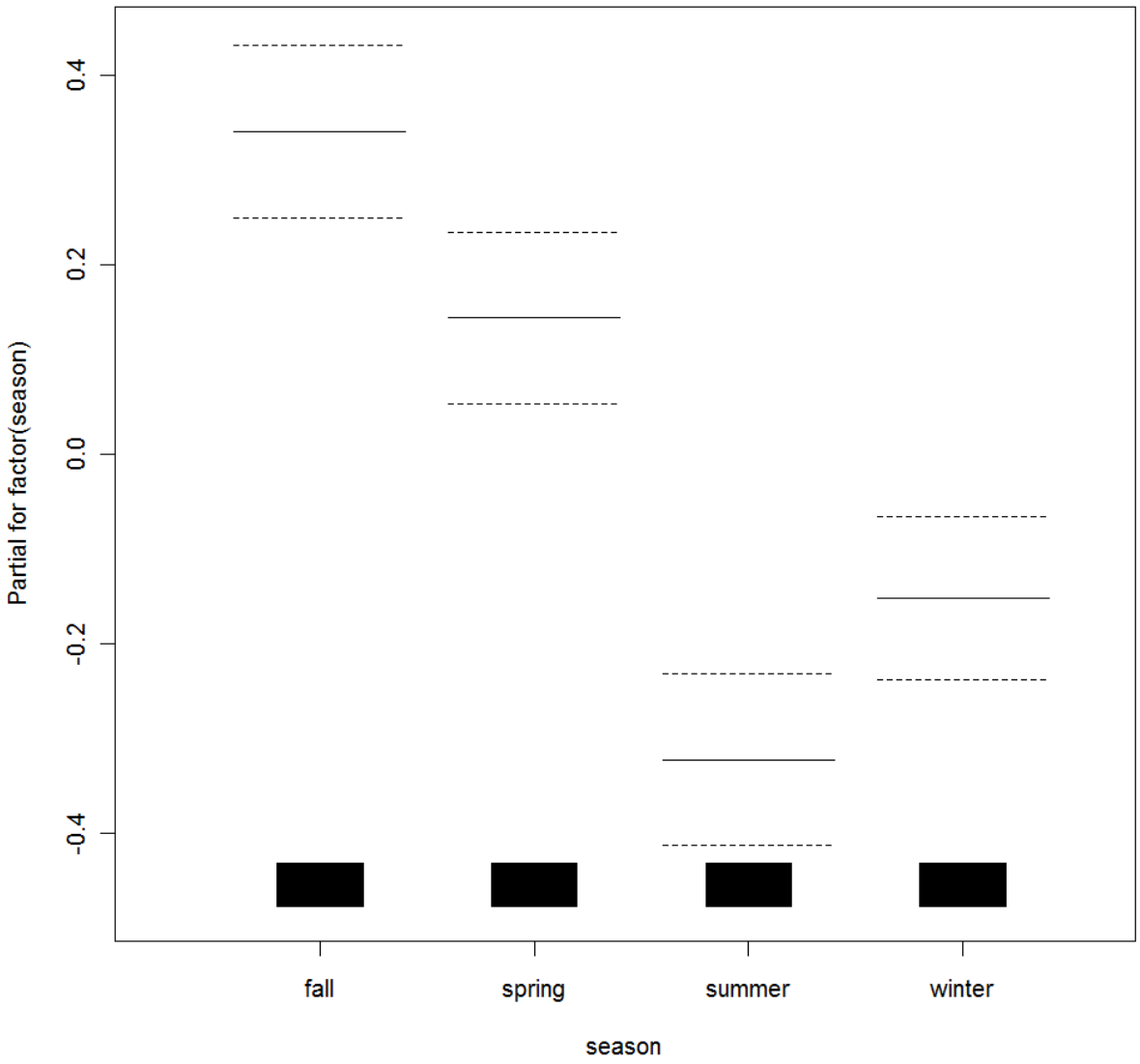

Figure M-55. Result of GAM regression for the effect of season on Northern Gannet density. Broken lines represent 95% confidence intervals around the covariate main effect.

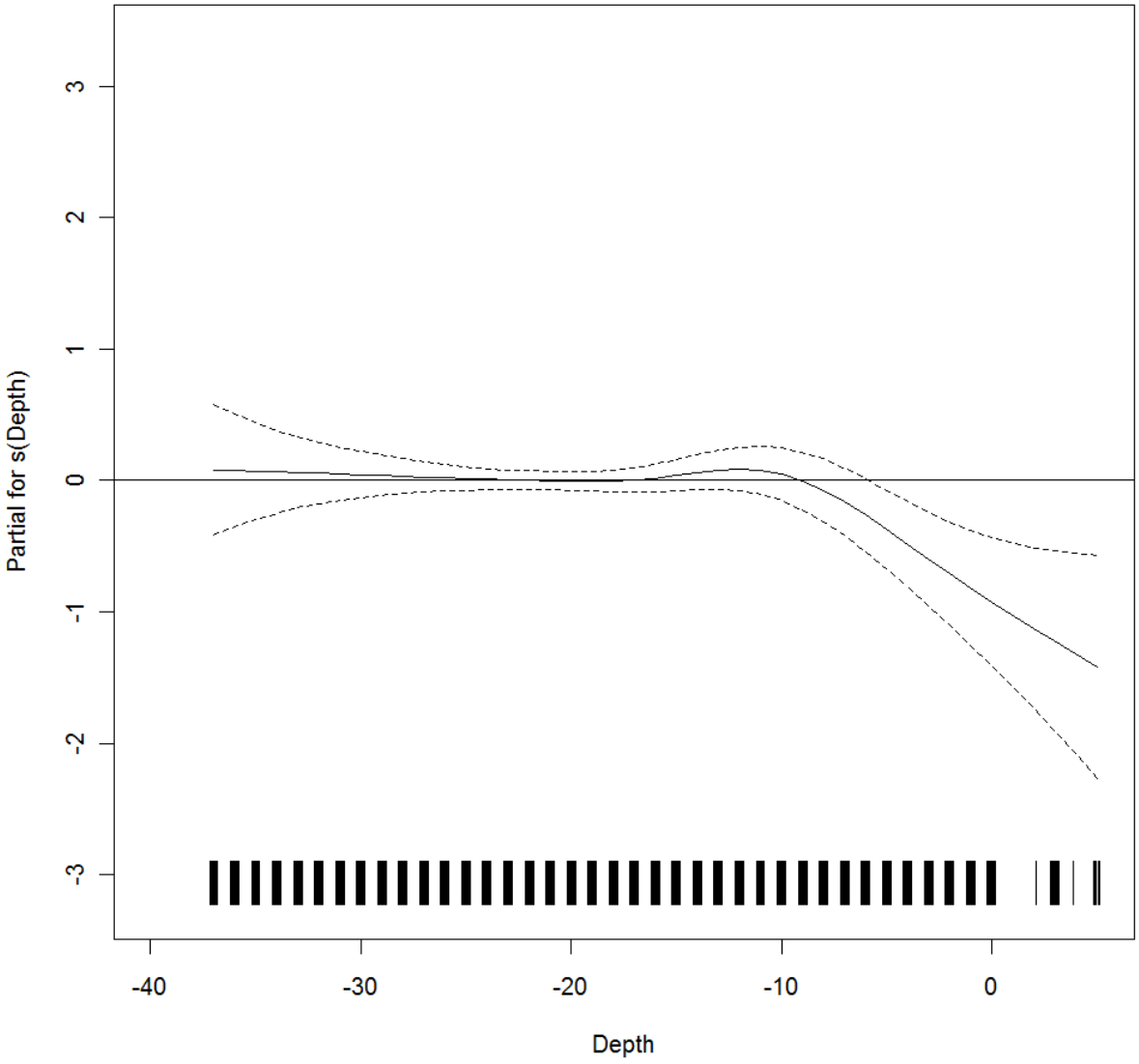

Figure M-56. Result of GAM regression for the effect of depth (m) on Northern Gannet density. Broken lines represent 95% confidence intervals around the covariate main effect.

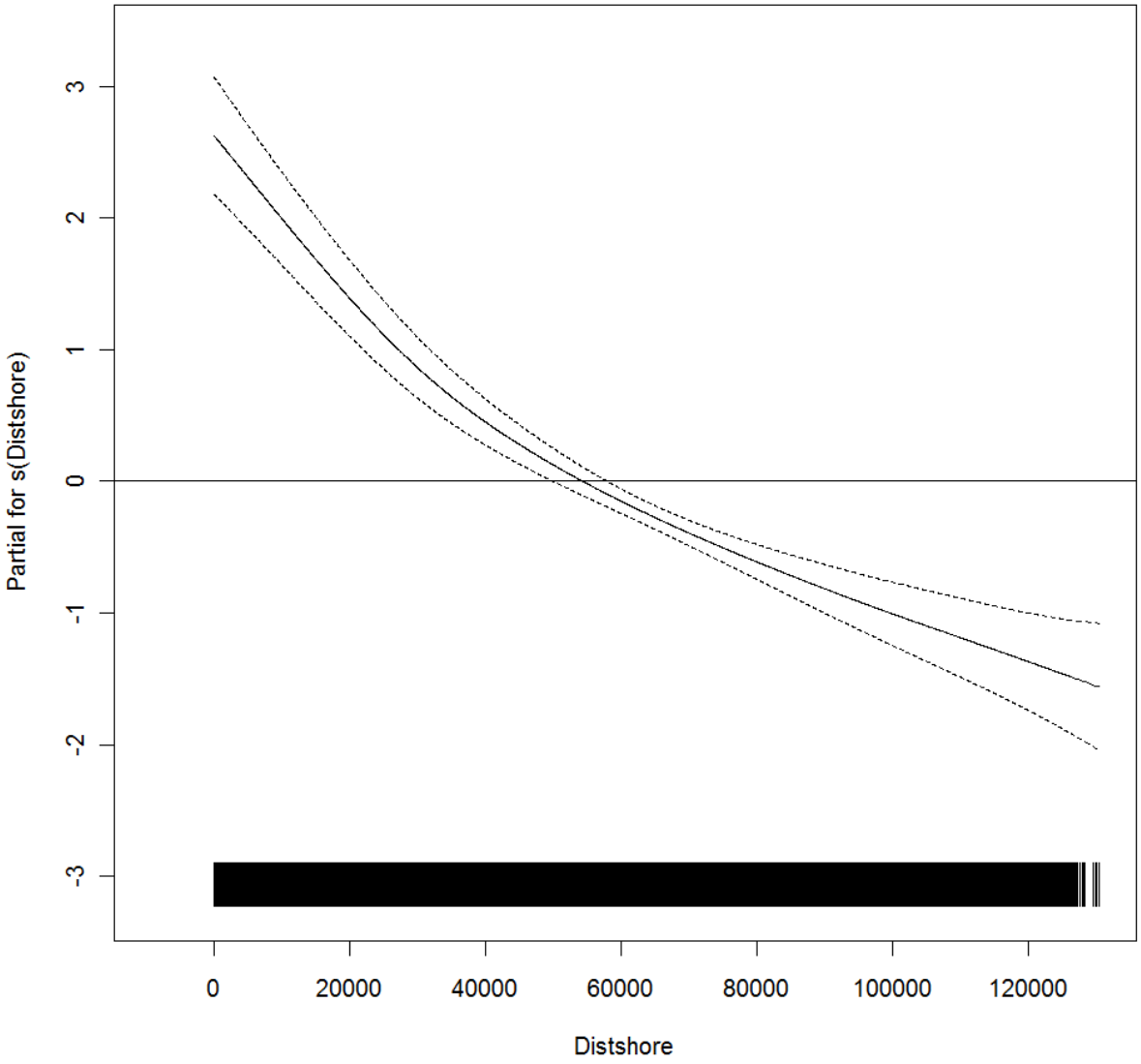

Figure M-57. Result of GAM regression for the effect of distance to shoreline 'DistShore' (feet) on Northern Gannet density. Broken lines represent 95% confidence intervals around the covariate main effect.

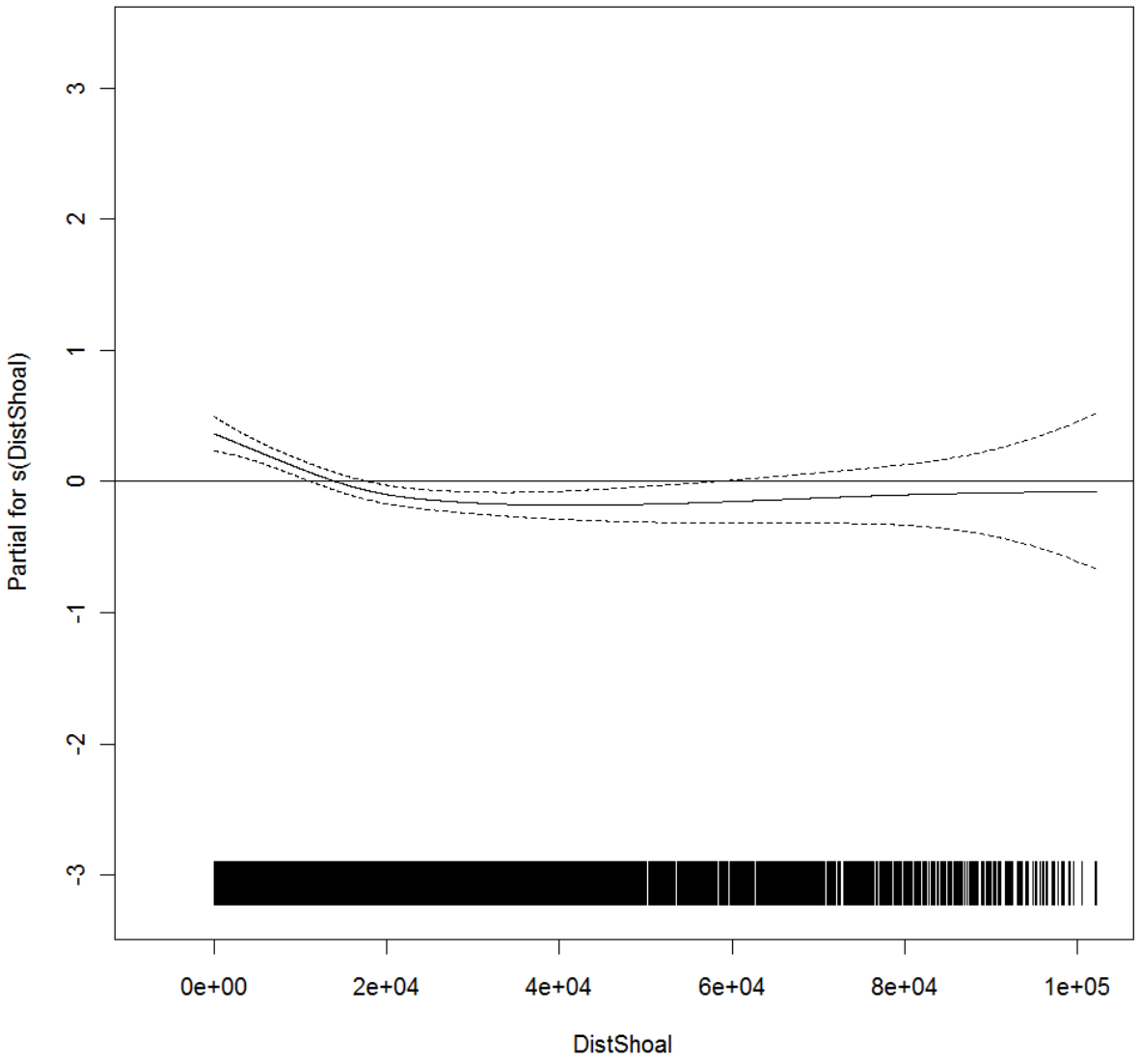

Figure M-58. Result of GAM regression for the effect of distance to nearest shoal 'DistShoal' (feet) on Northern Gannet density. Broken lines represent 95% confidence intervals around the covariate main effect.

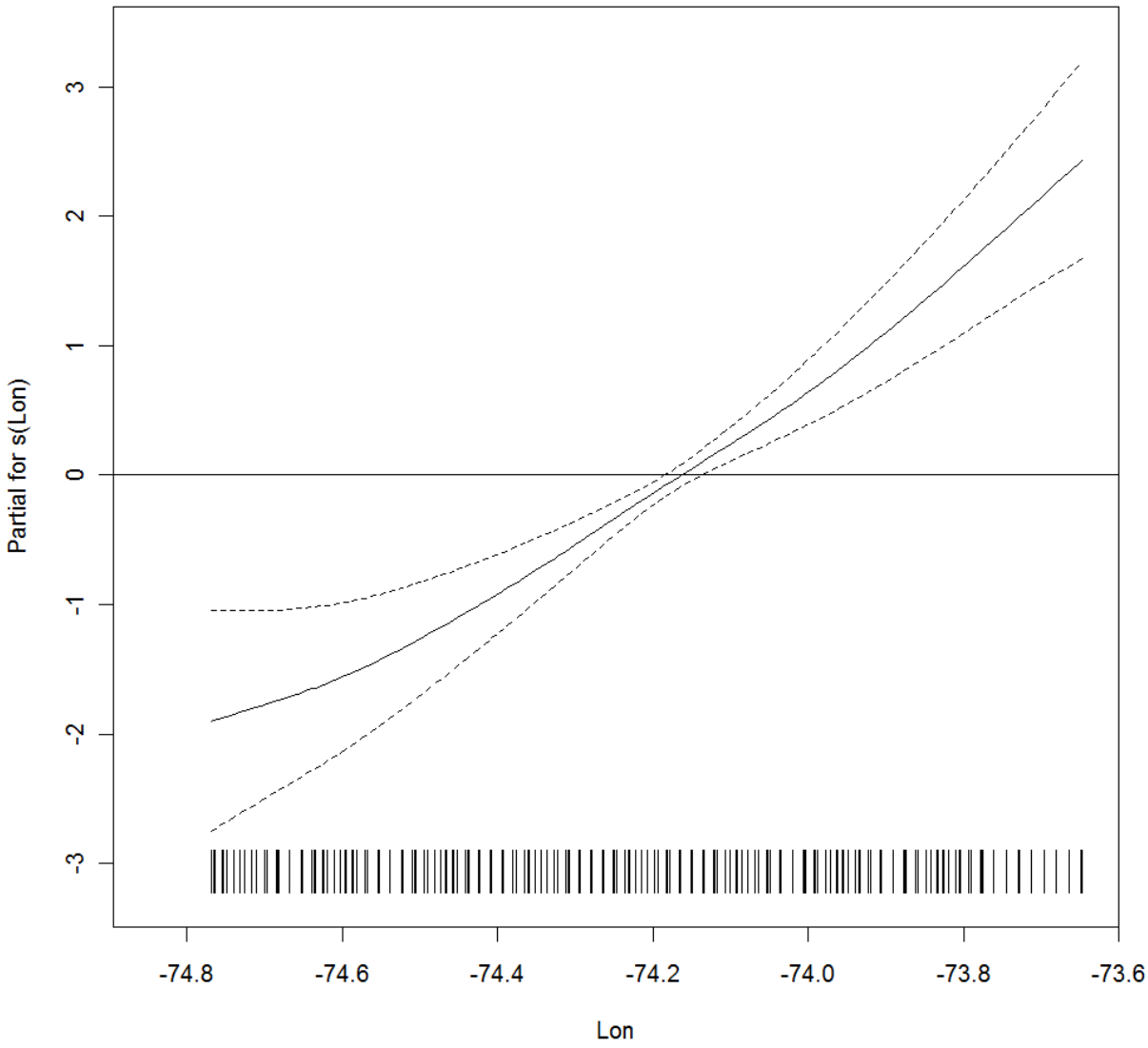

Figure M-59. Result of GAM regression for the effect of longitude 'Lon' on Northern Gannet density. Broken lines represent 95% confidence intervals around the covariate main effect.

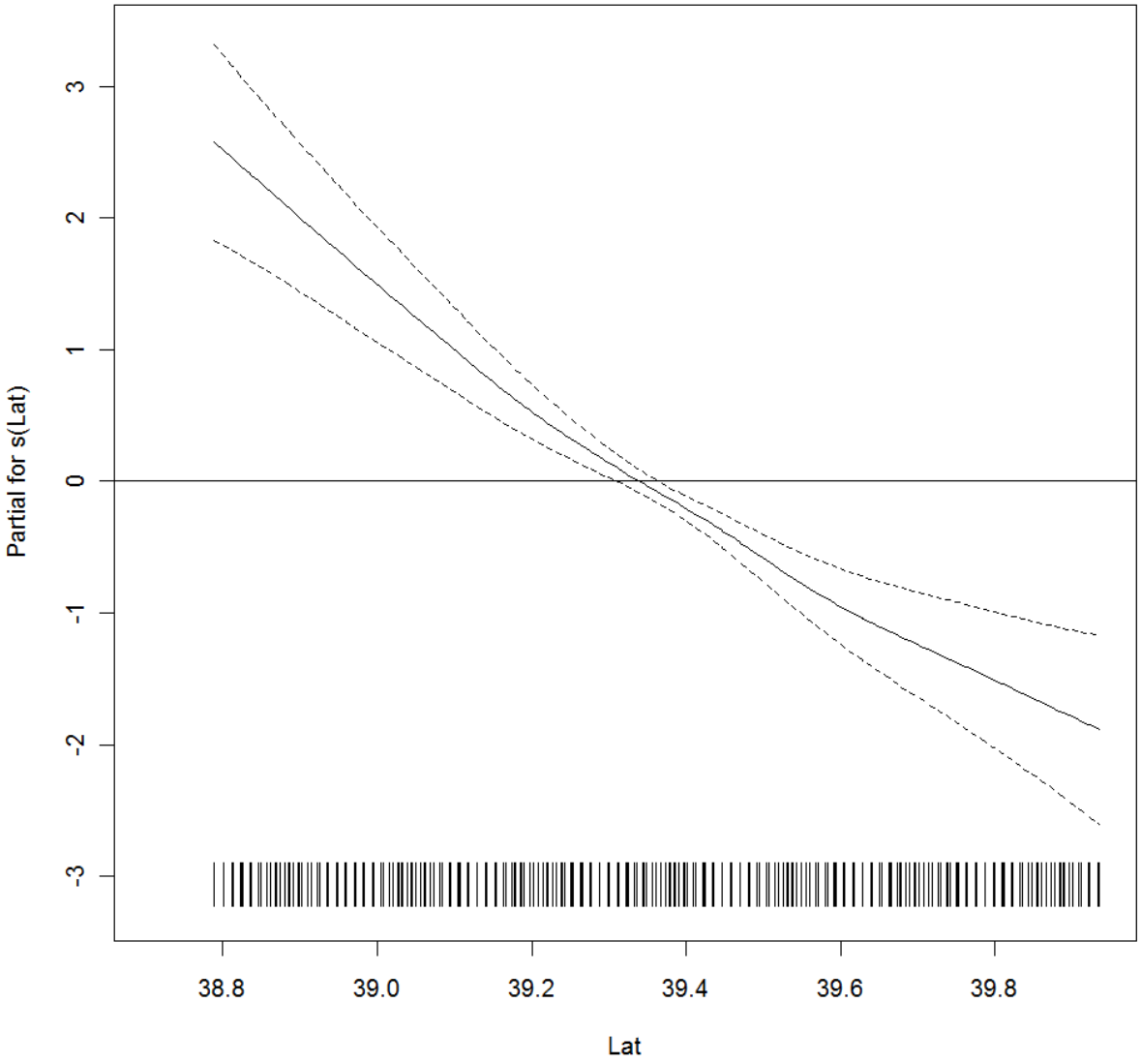

Figure M-60. Result of GAM regression for the effect of latitude 'Lat' on Northern Gannet density. Broken lines represent 95% confidence intervals around the covariate main effect.

Table M-26. Spatial regression model results for spatial covariates and Scoter species density.

Spatial Regression Model:
Spatial lag model – Maximum Likelihood Estimation
N=2698, R^2=0.24, Log likelihood=--8105.7, Akaike info criterion=16227.4
Global Moran's I = 0.442, P<0.01

Variable	Coefficient	Std.Error	z-value	Probability
Spatial lag	0.326	0.014	22.609	**0.0000**
Constant	510.054	254.389	2.005	**0.0449**
Depth	0.052	0.029	1.799	0.0720
Slope	0.168	0.393	0.429	0.6678
DistShore	-3.30e-005	1.10e-005	-2.975	**0.0029**
DistShoal	-4.24e-006	5.53e-006	-0.768	0.4424
Longitude	4.668	2.346	1.989	**0.0466**
Latitude	-4.058	2.047	-1.982	**0.0474**

Table M-27. GAM results for spatial covariates and Scoter Species density.

Generalized Additive Models:
Initial Model Summary: Significance of smoothed terms

Variable	Df	Npar Df	Npar F	Pr(F)
Depth	**1**	**3**	**11.4947**	**1.601e-07 *** **
Slope	**1**	**3**	**2.6774**	**0.045388 * **
DistShore	**1**	**3**	**19.4143**	**1.482e-12 *** **
DistShoal	**1**	**3**	**1.3095**	**0.269346**
Lon	**1**	**3**	**4.2464**	**0.005248 ** **
Lat	**1**	**3**	**14.7683**	**1.345e-09 *** **

AIC: 103550.4

Stepwise-selected Model Summary: Significance of smoothed terms

Variable	Df	Npar Df	Npar F	Pr(F)
Depth	**1**	**3**	**11.7245**	**1.146e-07 *** **
DistShore	**1**	**3**	**20.0326**	**5.975e-13 *** **
DistShoal	**1**	**3**	**1.1814**	**0.315114**
Lon	**1**	**3**	**3.9303**	**0.008151 ** **
Lat	**1**	**3**	**15.2041**	**7.109e-10 *** **

AIC: 103550.3

Significant codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
Df=degrees of freedom, NparDf=nonparametric degrees of freedom, NparF=nonparametric F value, Pr(F)=probability value.

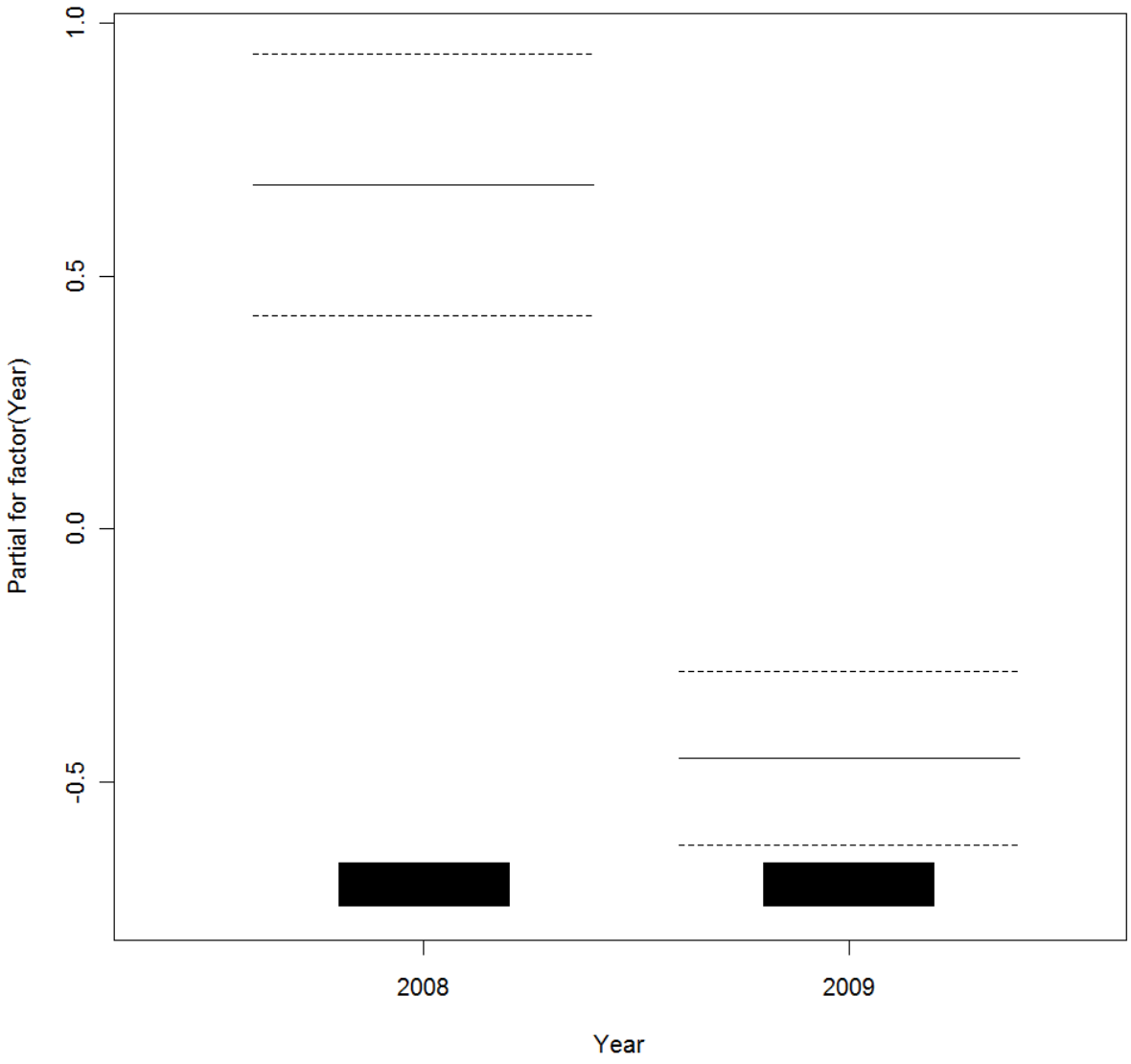

Figure M-61. Result of GAM regression for the effect of year on Scoter species density. Broken lines represent 95% confidence intervals around the covariate main effect.

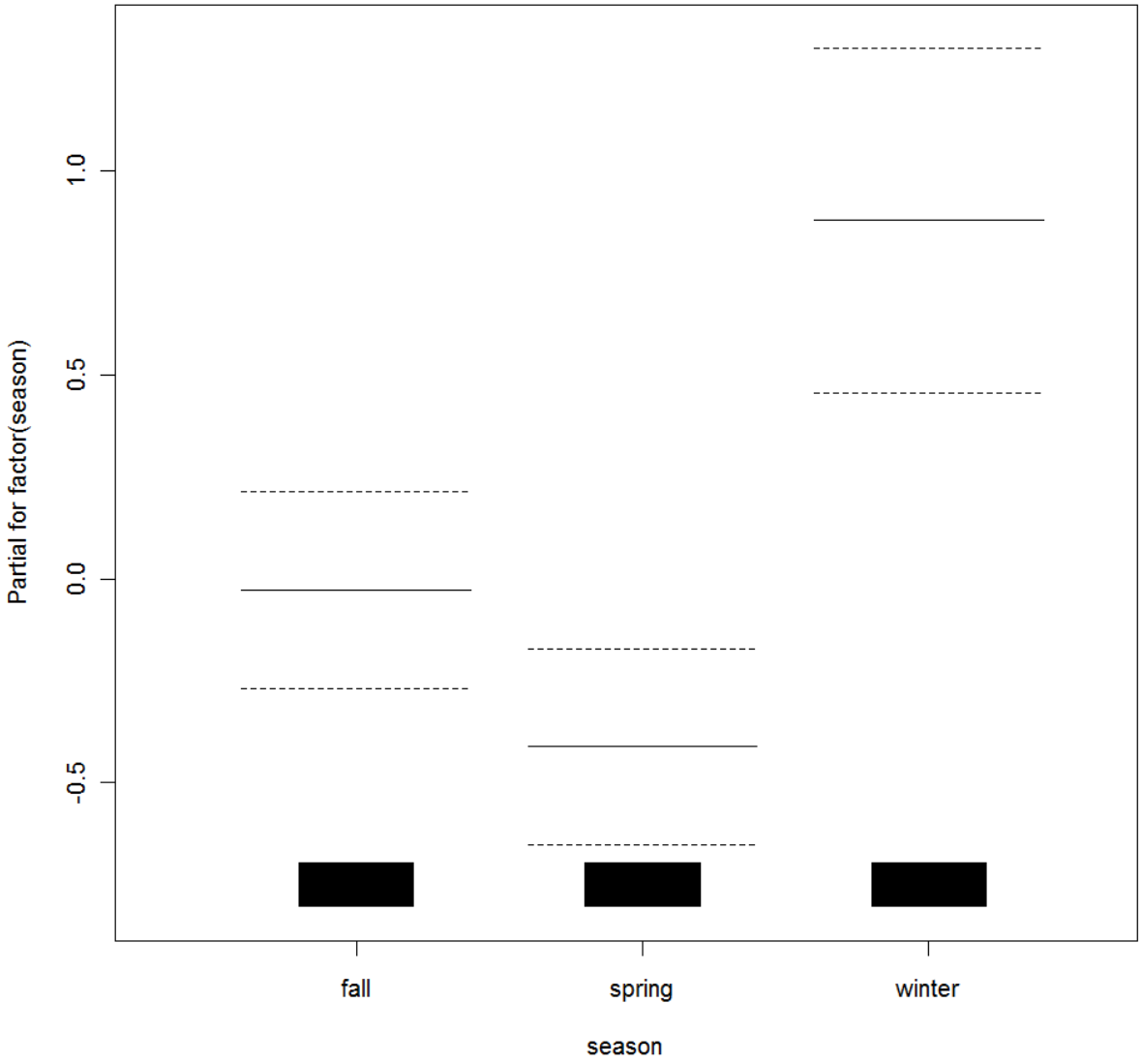

Figure M-62. Result of GAM regression for the effect of season on Scoter species density. Broken lines represent 95% confidence intervals around the covariate main effect.

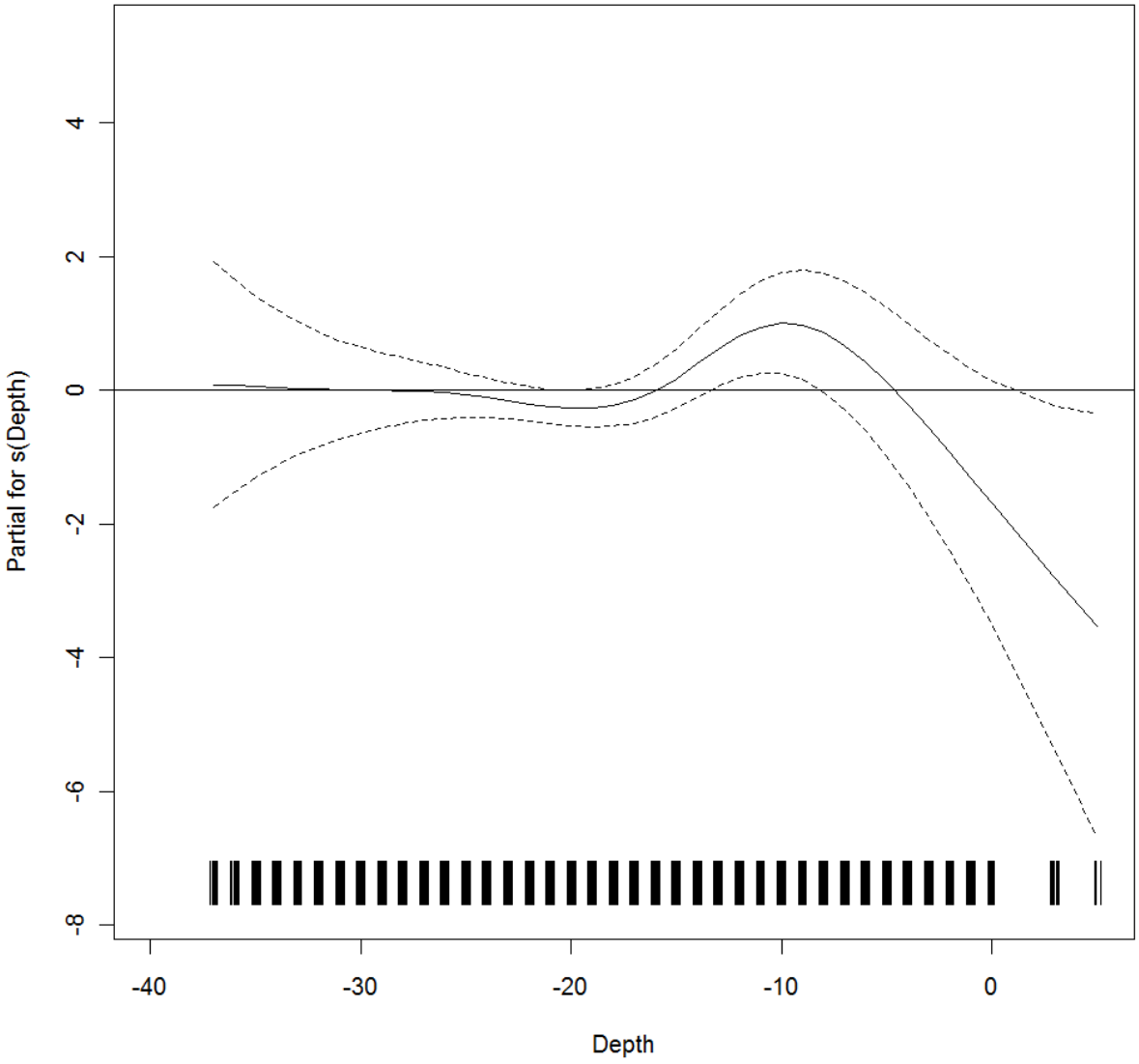

Figure M-63. Result of GAM regression for the effect of depth (m) on Scoter species density. Broken lines represent 95% confidence intervals around the covariate main effect.

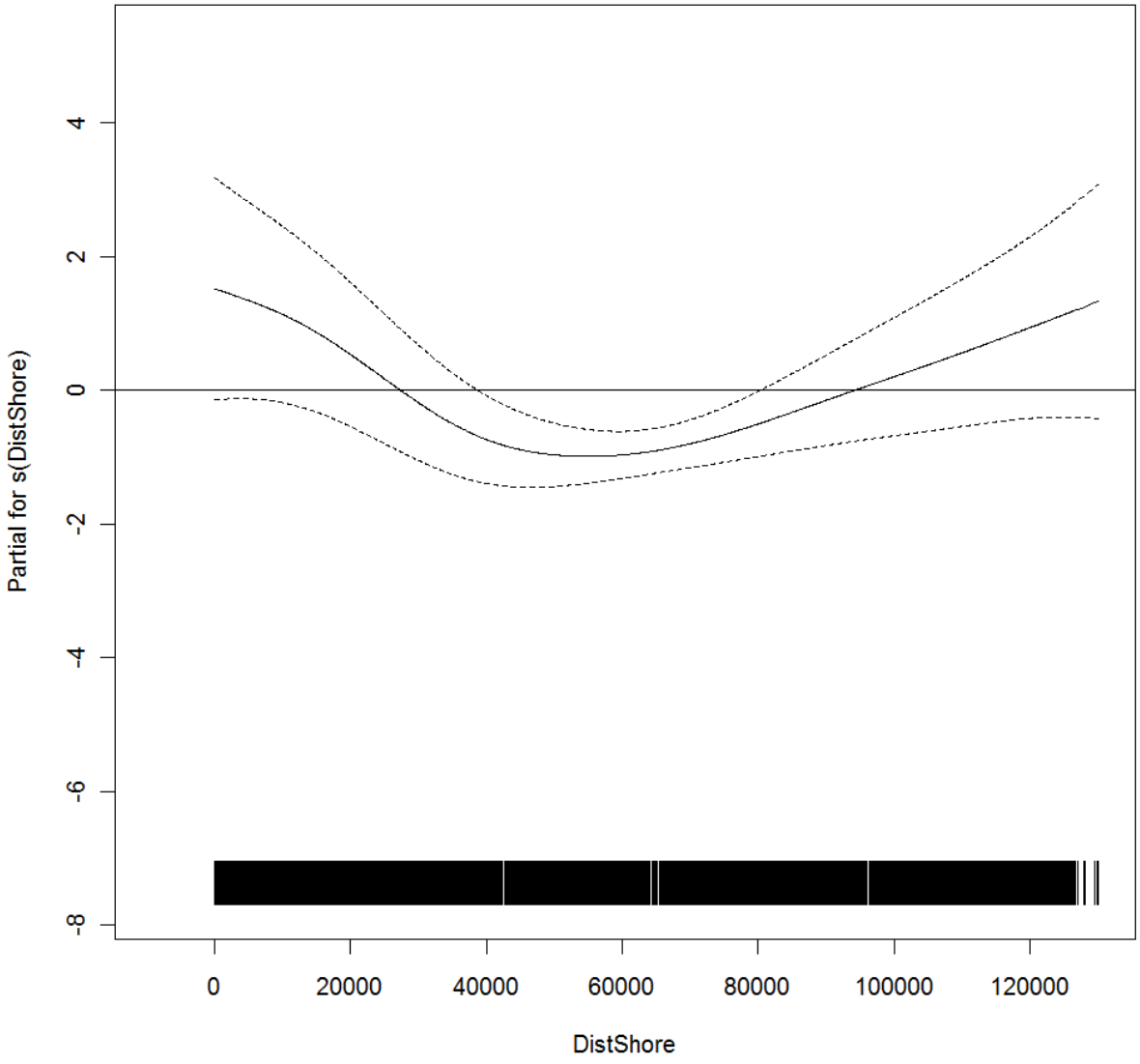

Figure M-64. Result of GAM regression for the effect of distance to shoreline 'DistShore' (feet) on Scoter species density. Broken lines represent 95% confidence intervals around the covariate main effect.

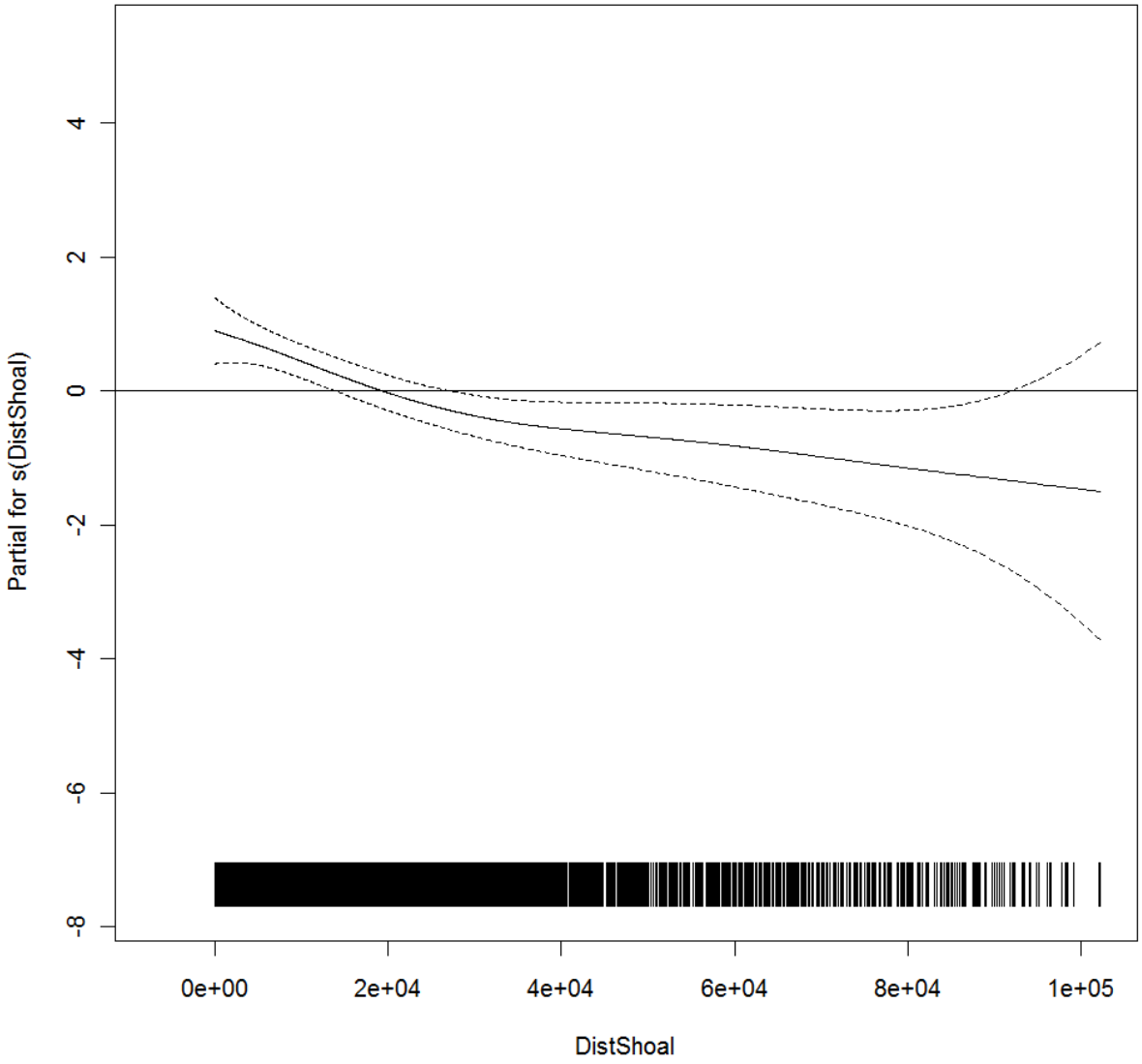

Figure M-65. Result of GAM regression for the effect of distance to shoal 'DistShoal' (feet) on Scoter species density. Broken lines represent 95% confidence intervals around the covariate main effect.

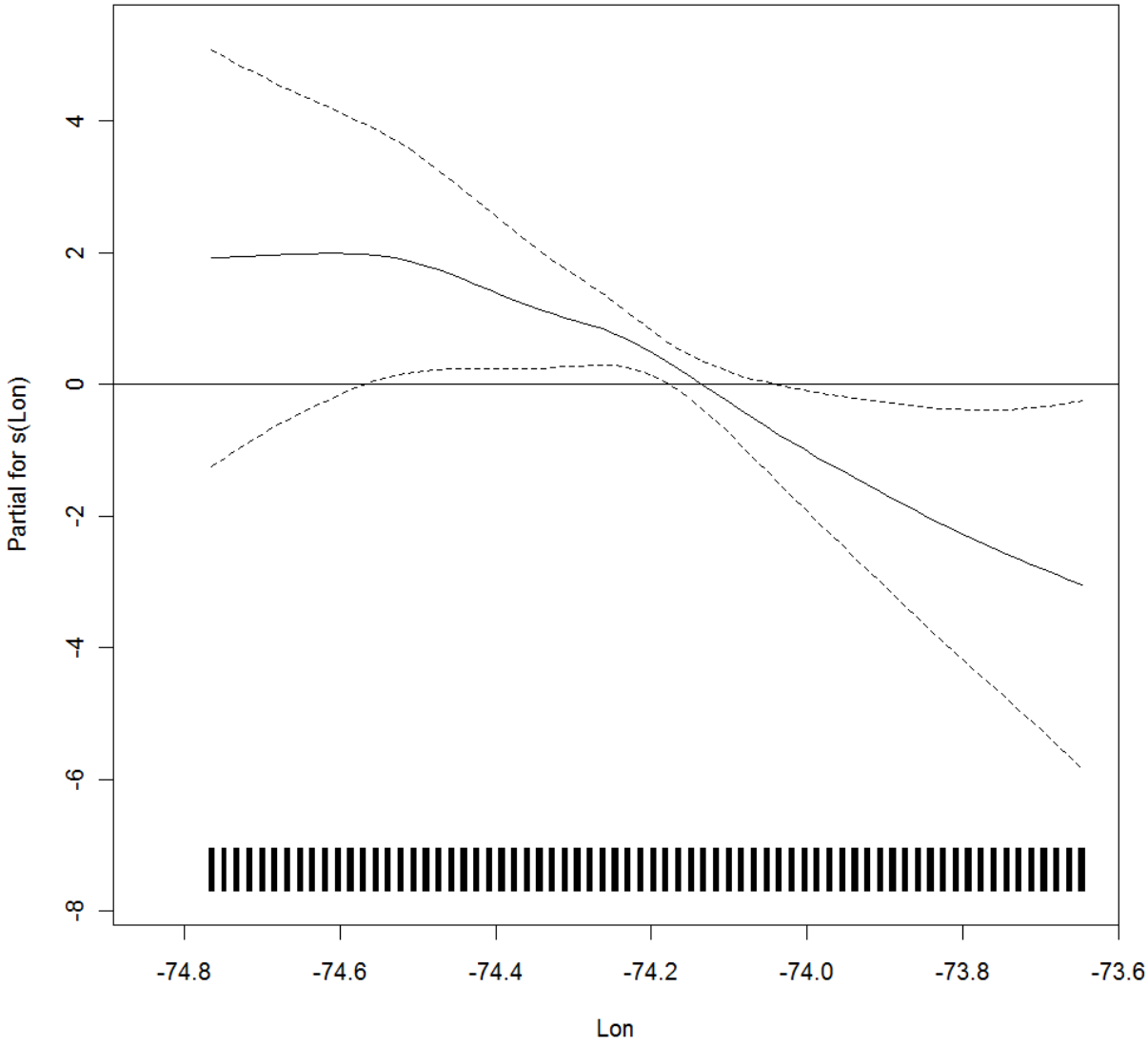

Figure M-66. Result of GAM regression for the effect of longitude 'Lon' on Scoter species density. Broken lines represent 95% confidence intervals around the covariate main effect.

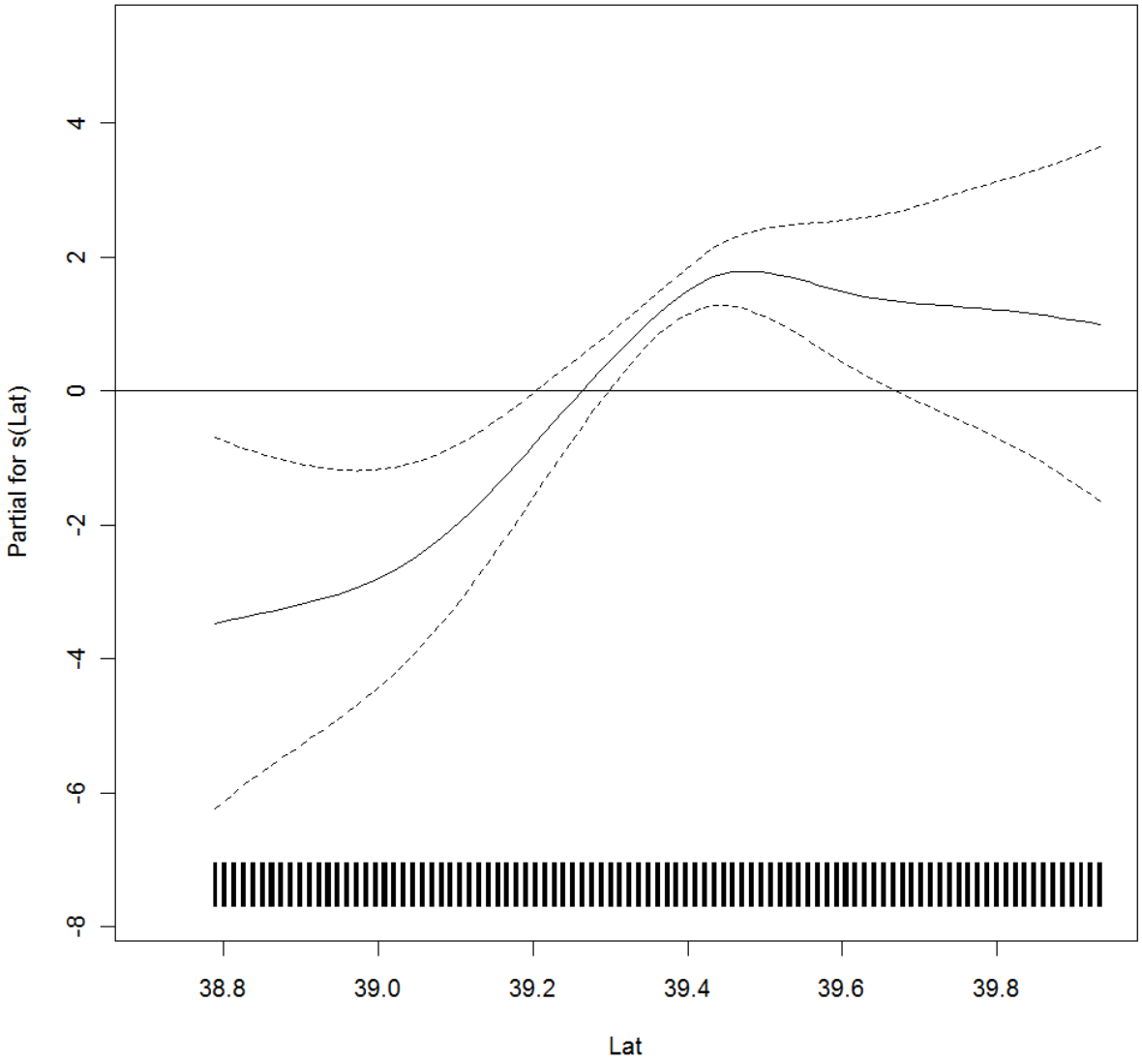

Figure M-67. Result of GAM regression for the effect of latitude 'Lat' on Scoter species density. Broken lines represent 95% confidence intervals around the covariate main effect.

Table M-28. Spatial regression model results for spatial covariates and Long-tailed Duck density.

Spatial Regression Model:
Spatial lag model – Maximum Likelihood Estimation
N=5801, R^2=0.16, Log likelihood=-12845.3, Akaike info criterion=25706.6
Global Moran's I = 0.2541, p<0.01

Variable	Coefficient	Std.Error	z-value	Probability
Spatial lag	0.365	0.015	23.377	**0.0000**
Constant	-62.355	81.181	-0.768	0.4424
Depth	0.044	0.009	4.836	**0.0000**
Slope	0.625	0.108	5.764	**0.0000**
DistShore	1.070e-006	3.59e-006	0.297	0.7661
DistShoal	5.391e-006	1.73e-006	3.104	**0.0001**
Longitude	-0.459	0.747	-0.615	0.5385
Latitude	0.738	0.657	1.123	0.2612

Table M-29. GAM results for spatial covariates and Long-tailed Duck density.

Generalized Additive Models:
Initial Model Summary: Significance of smoothed terms

Variable	Df	Npar Df	Npar F	Pr(F)
Depth	**1**	**3**	**3.500**	**0.014792 ***
Slope	**1**	**3**	**15.670**	**3.675e-10 *****
DistShore	**1**	**3**	**32.865**	**<2.2e-16 *****
DistShoal	**1**	**3**	**4.562**	**0.003383 ** **
Lon	**1**	**3**	**5.334**	**0.001140 ** **
Lat	**1**	**3**	**36.148**	**<2.2e-16 *****

AIC: 43281.23

Stepwise-selected Model Summary: Significance of smoothed terms

Variable	Df	Npar Df	Npar F	Pr(F)
SlopeDeg	**1**	**3**	**16.530**	**1.045e-10 *****
DistShore	**1**	**3**	**55.484**	**<2.2e-16 *****
DistShoal	**1**	**3**	**5.402**	**0.001036 ** **
Lon	**1**	**3**	**5.226**	**0.001328 ** **
Lat	**1**	**3**	**36.032**	**<2.2e-16 *****

AIC: 43279.01

Significant codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
Df=degrees of freedom, NparDf=nonparametric degrees of freedom, NparF=nonparametric F value, Pr(F)=probability value.

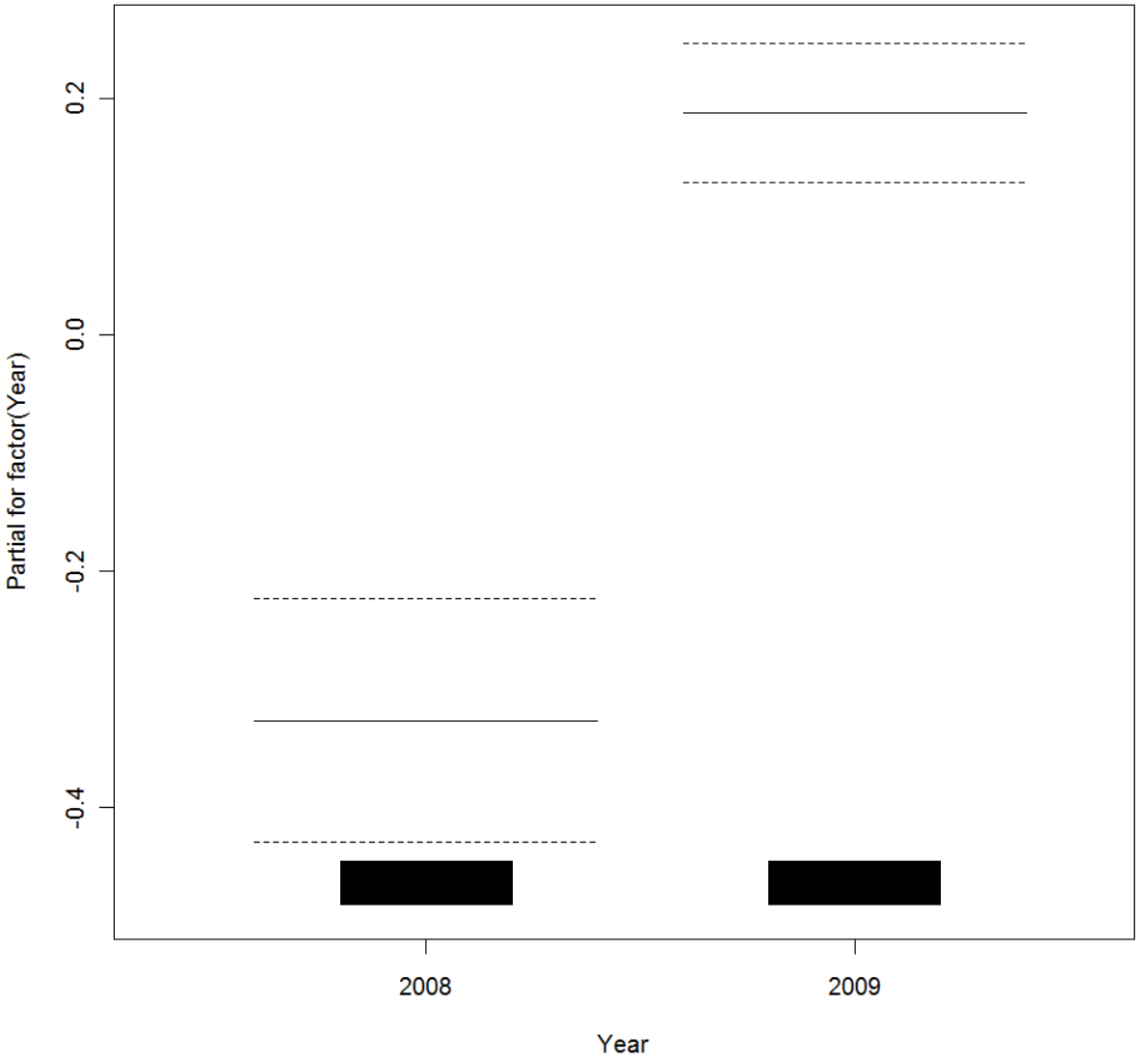

Figure M-68. Result of GAM regression for the effect of year on Long-tailed Duck density. Broken lines represent 95% confidence intervals around the covariate main effect.

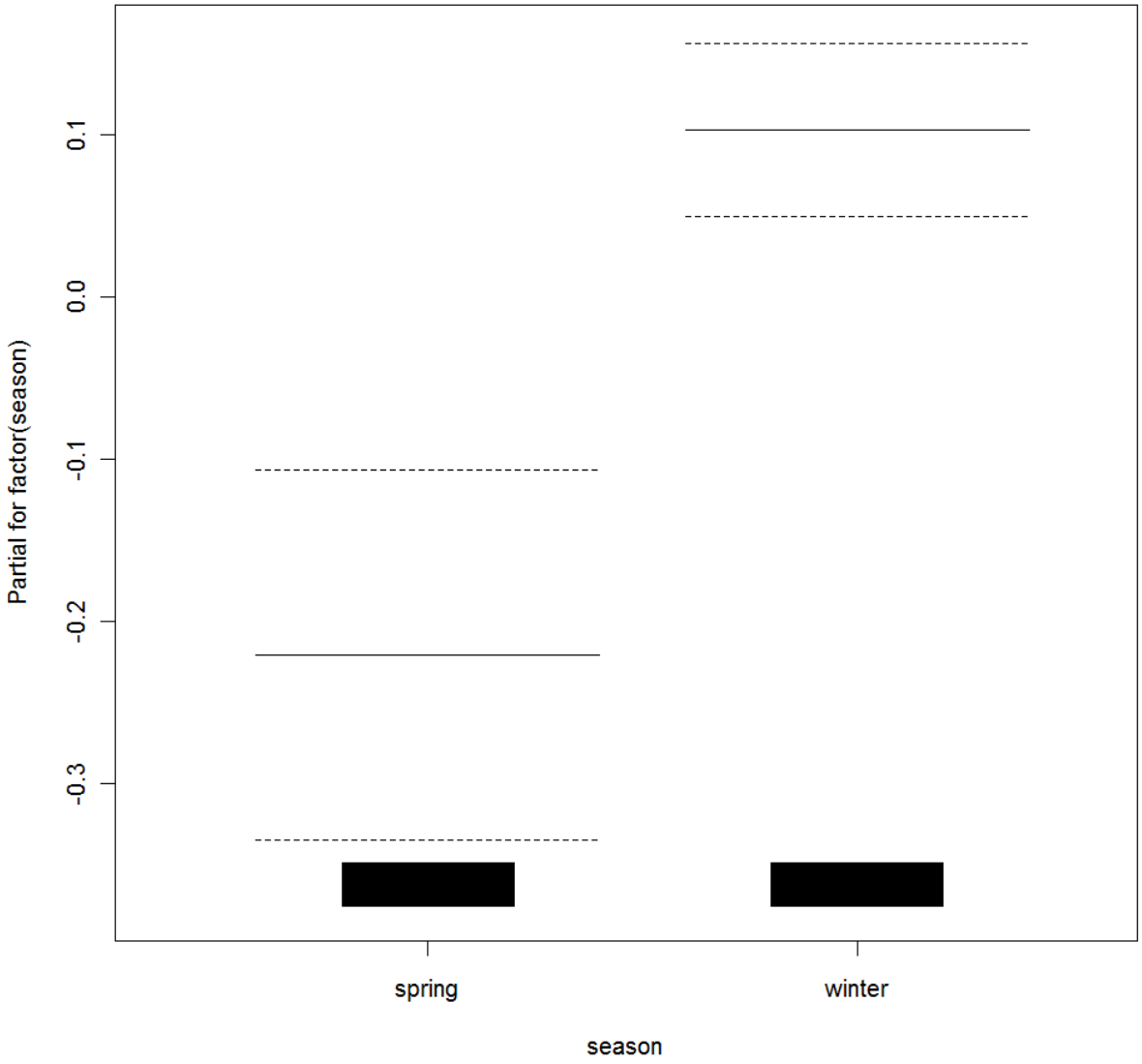

Figure M-69. Result of GAM regression for the effect of season on Long-tailed Duck density. Broken lines represent 95% confidence intervals around the covariate main effect.

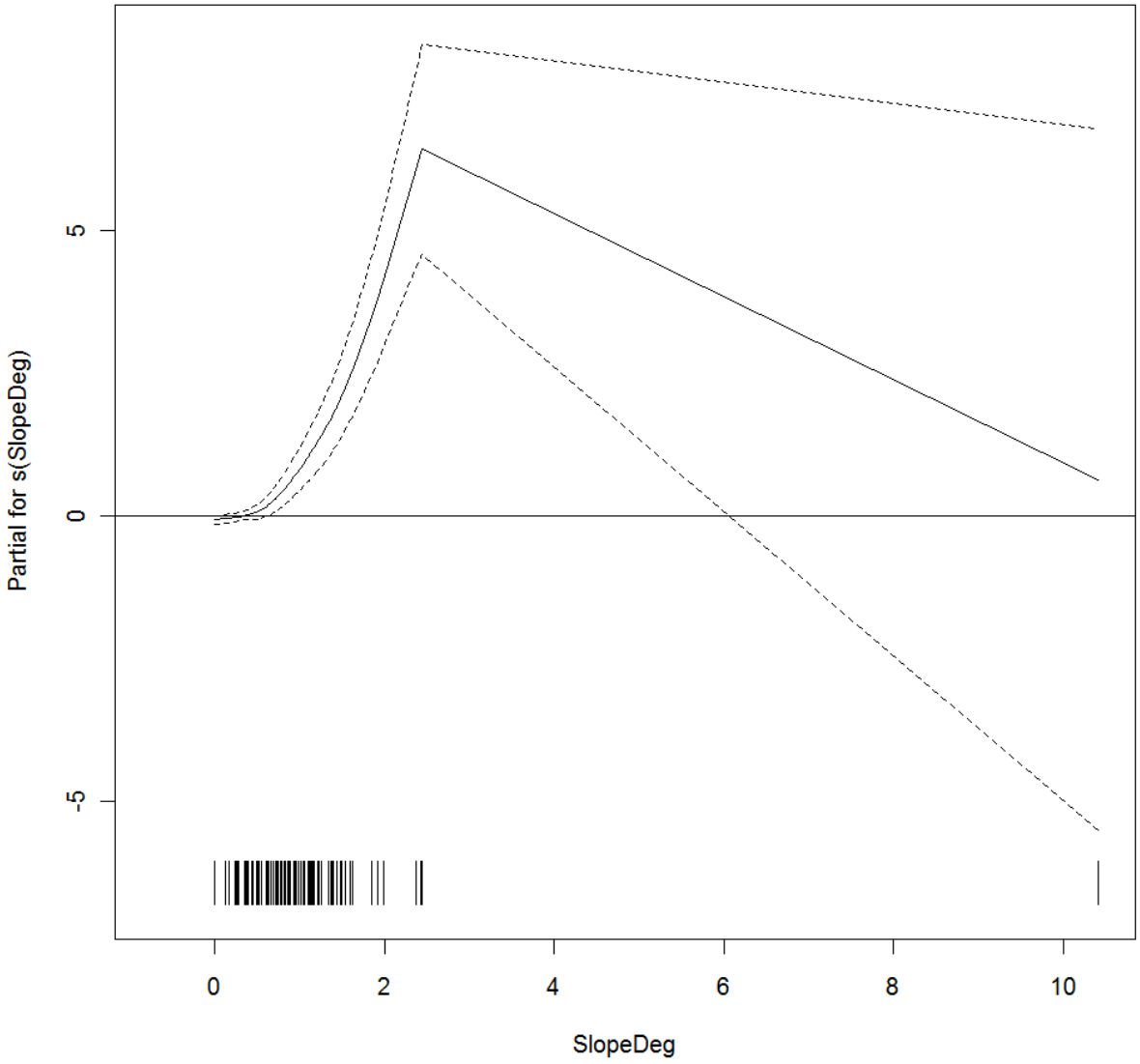

Figure M-70. Result of GAM regression for the effect of slope (degrees) on Long-tailed Duck density. Broken lines represent 95% confidence intervals around the covariate main effect.

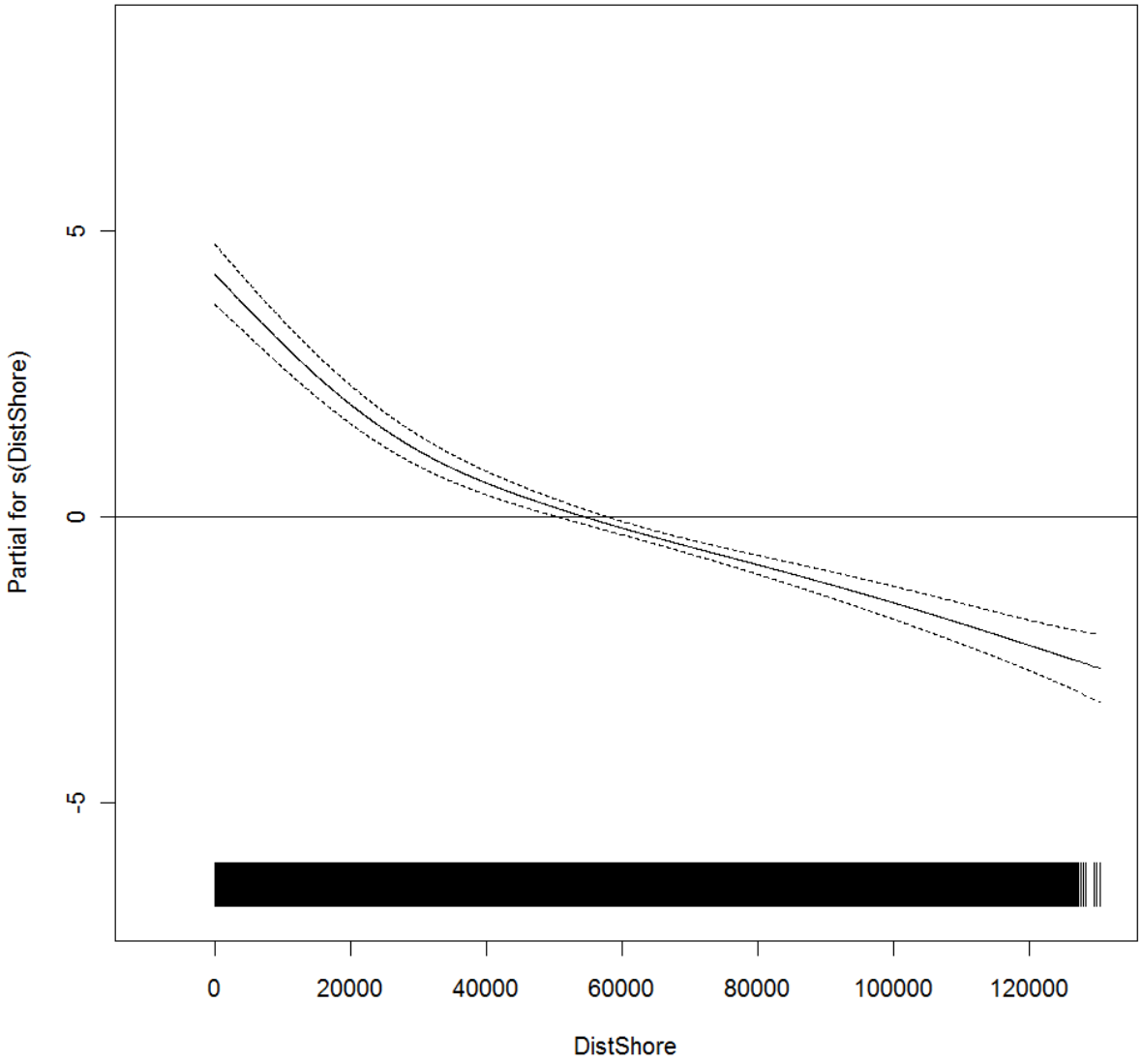

Figure M-71. Result of GAM regression for the effect of distance to shoreline 'DistShore' (feet) on Long-tailed Duck density. Broken lines represent 95% confidence intervals around the covariate main effect.

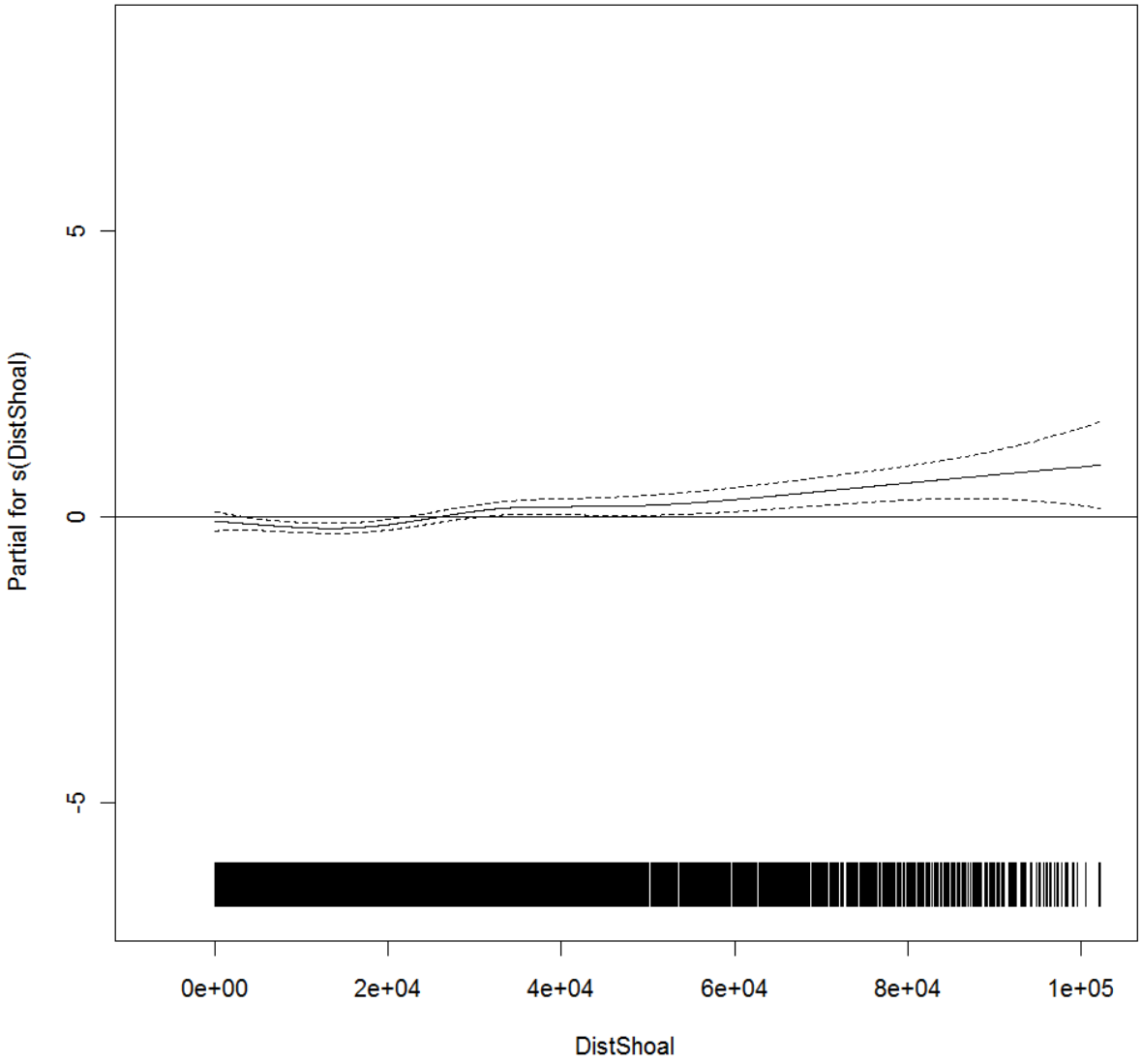

Figure M-72. Result of GAM regression for the effect of distance to nearest shoal 'DistShoal' (feet) on Long-tailed Duck density. Broken lines represent 95% confidence intervals around the covariate main effect.

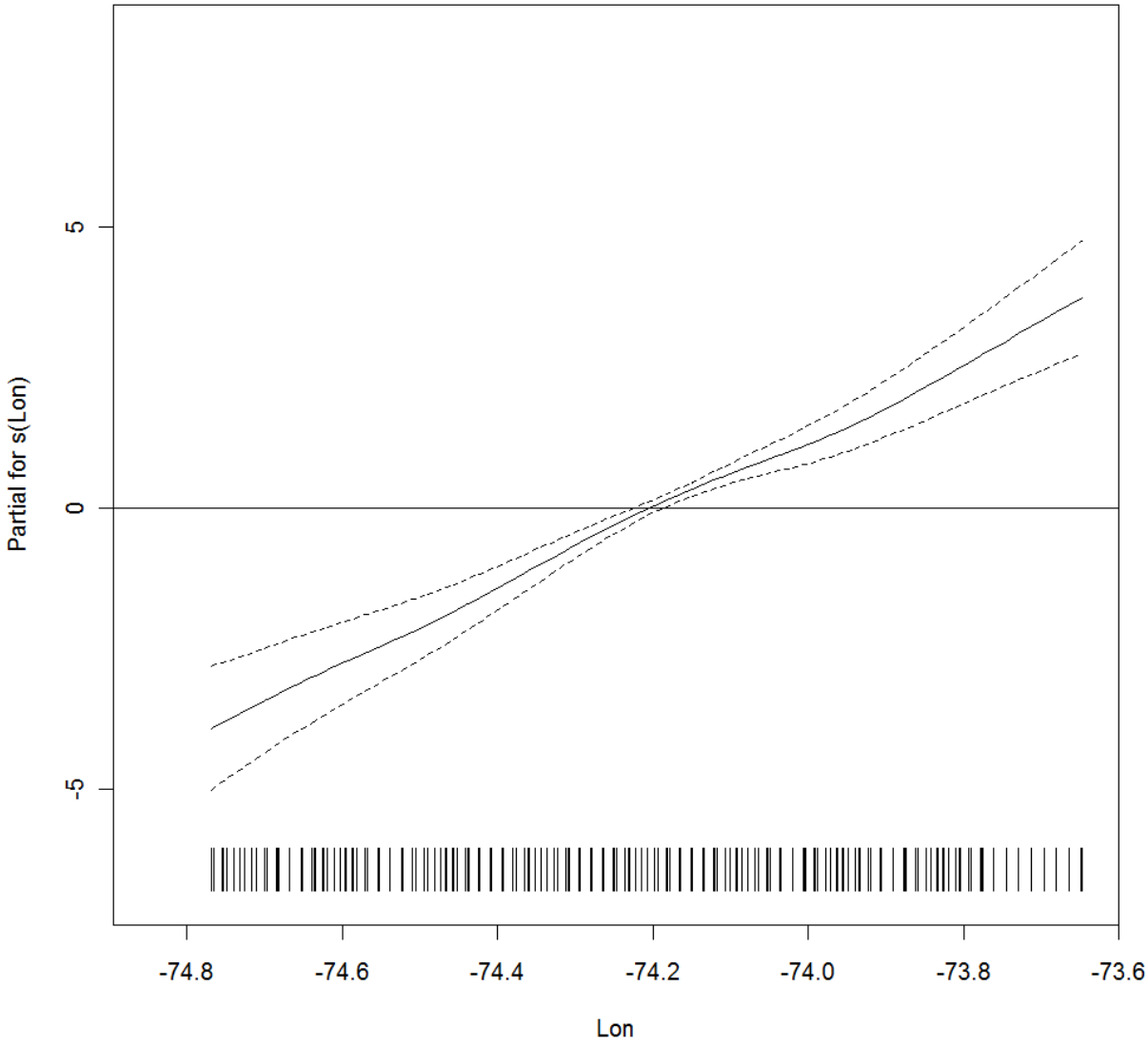

Figure M-73. Result of GAM regression for the effect of longitude 'Lon' on Long-tailed Duck density. Broken lines represent 95% confidence intervals around the covariate main effect.

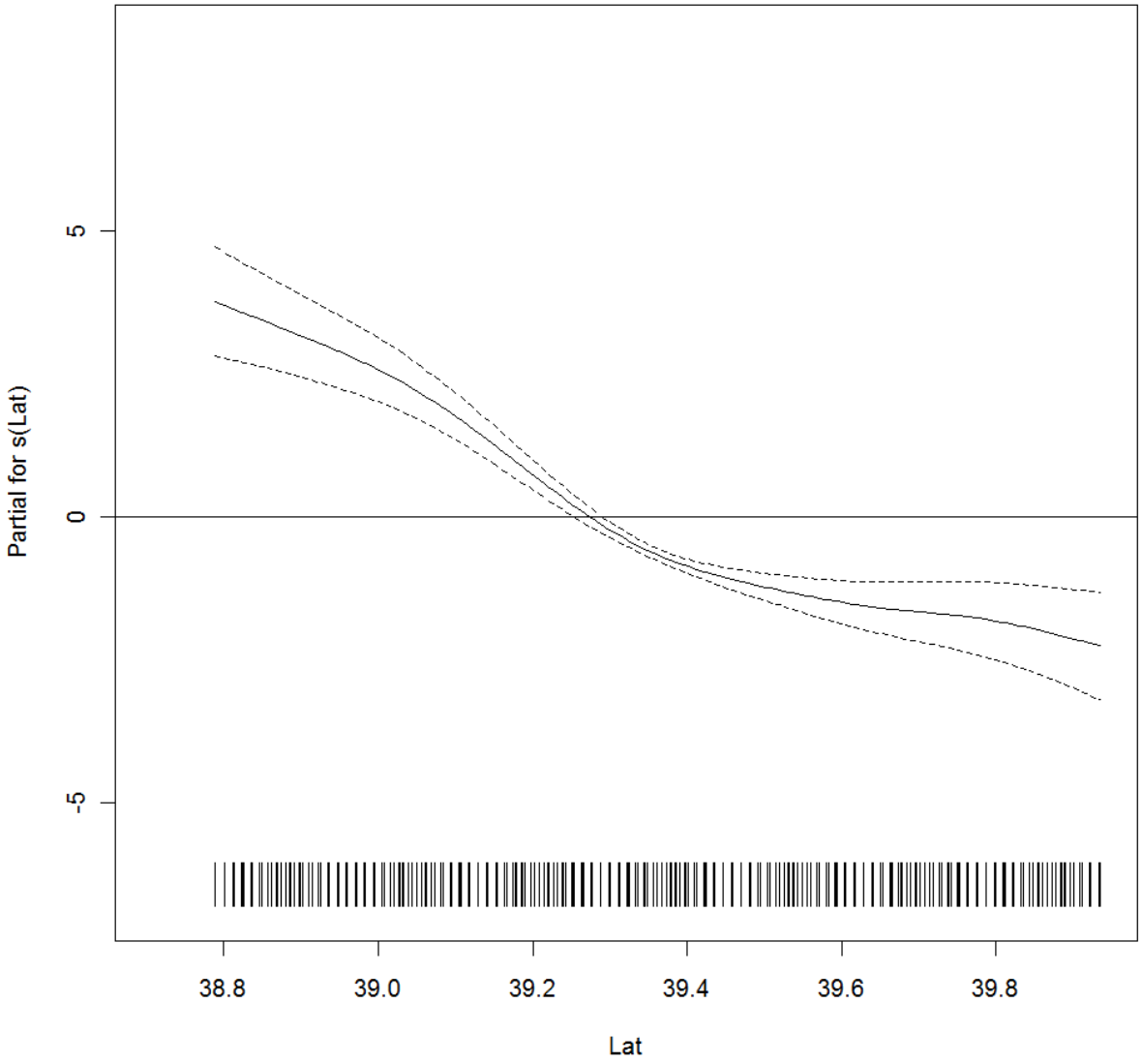

Figure M-74. Result of GAM regression for the effect of latitude 'Lat' on Long-tailed Duck density. Broken lines represent 95% confidence intervals around the covariate main effect.

Table M-30. Spatial regression model results for spatial covariates and Common Loon density.

Spatial Regression Model:
Spatial lag model – Maximum Likelihood Estimation
N=5801, R^2=0.26, Log likelihood=-21598.9, Akaike info criterion=43213.7
Global Moran's I = 0.5019, p<0.001

Variable	Coefficient	Std.Error	z-value	Probability
Spatial lag	0.323	0.014	22.366	**0.0000**
Constant	-78.456	83.385	-0.941	0.3467
Depth	0.019	0.009	1.974	**0.0483**
Slope	0.033	0.128	0.255	0.7982
DistShore	3.928e-006	3.63e-006	1.081	0.2795
DistShoal	2.310e-006	1.81e-006	1.274	0.2026
Longitude	-0.764	0.769	-0.993	0.3208
Latitude	0.562	0.671	0.837	0.4024

Table M-31. GAM results for spatial covariates and Common Loon density.

Generalized Additive Models:
Initial Model Summary: Significance of smoothed terms

Variable	Df	Npar Df	Npar F	Pr(F)
Depth	**1**	**3**	**17.7831**	**1.684e-11 *****
Slope	**1**	**3**	**0.8505**	**0.4661**
DistShore	**1**	**3**	**1.0752**	**0.3582**
DistShoal	**1**	**3**	**1.1327**	**0.3343**
Lon	**1**	**3**	**21.7775**	**4.829e-14 *****
Lat	**1**	**3**	**1.1541**	**0.3258**

AIC: 40914.78

Stepwise-selected Model Summary: Significance of smoothed terms

Variable	Df	Npar Df	Npar F	Pr(F)
Depth	**1**	**3**	**19.468**	**1.431e-12 *****
Lon	**1**	**3**	**23.050**	**7.438e-15 *****

AIC: 40893.3

Significant codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
Df=degrees of freedom, NparDf=nonparametric degrees of freedom, NparF=nonparametric F value, Pr(F)=probability value.

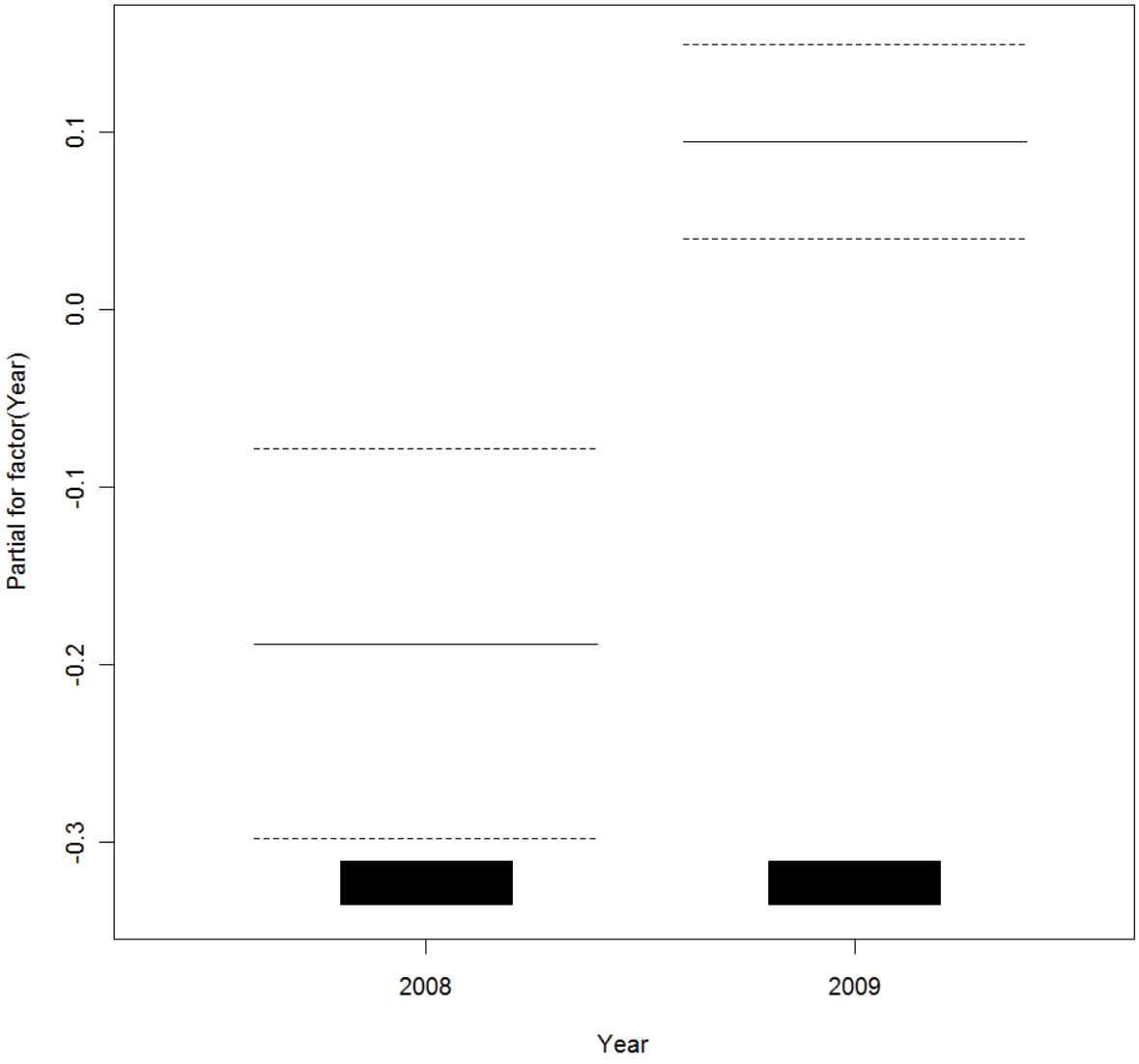

Figure M-75. Result of GAM regression for the effect of year on Common Loon density. Broken lines represent 95% confidence intervals around the covariate main effect.

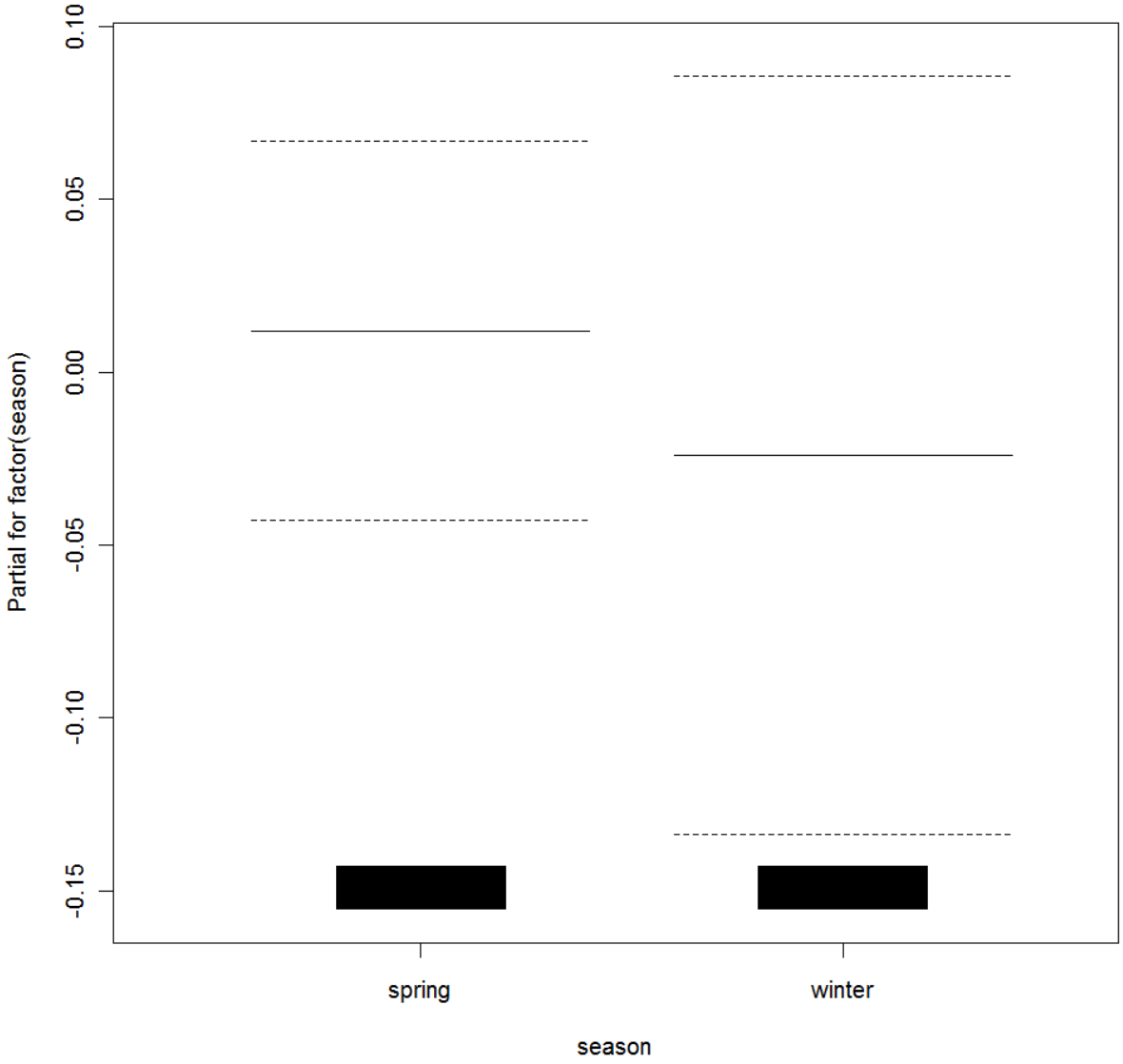

Figure M-76. Result of GAM regression for the effect of season on Common Loon density. Broken lines represent 95% confidence intervals around the covariate main effect.

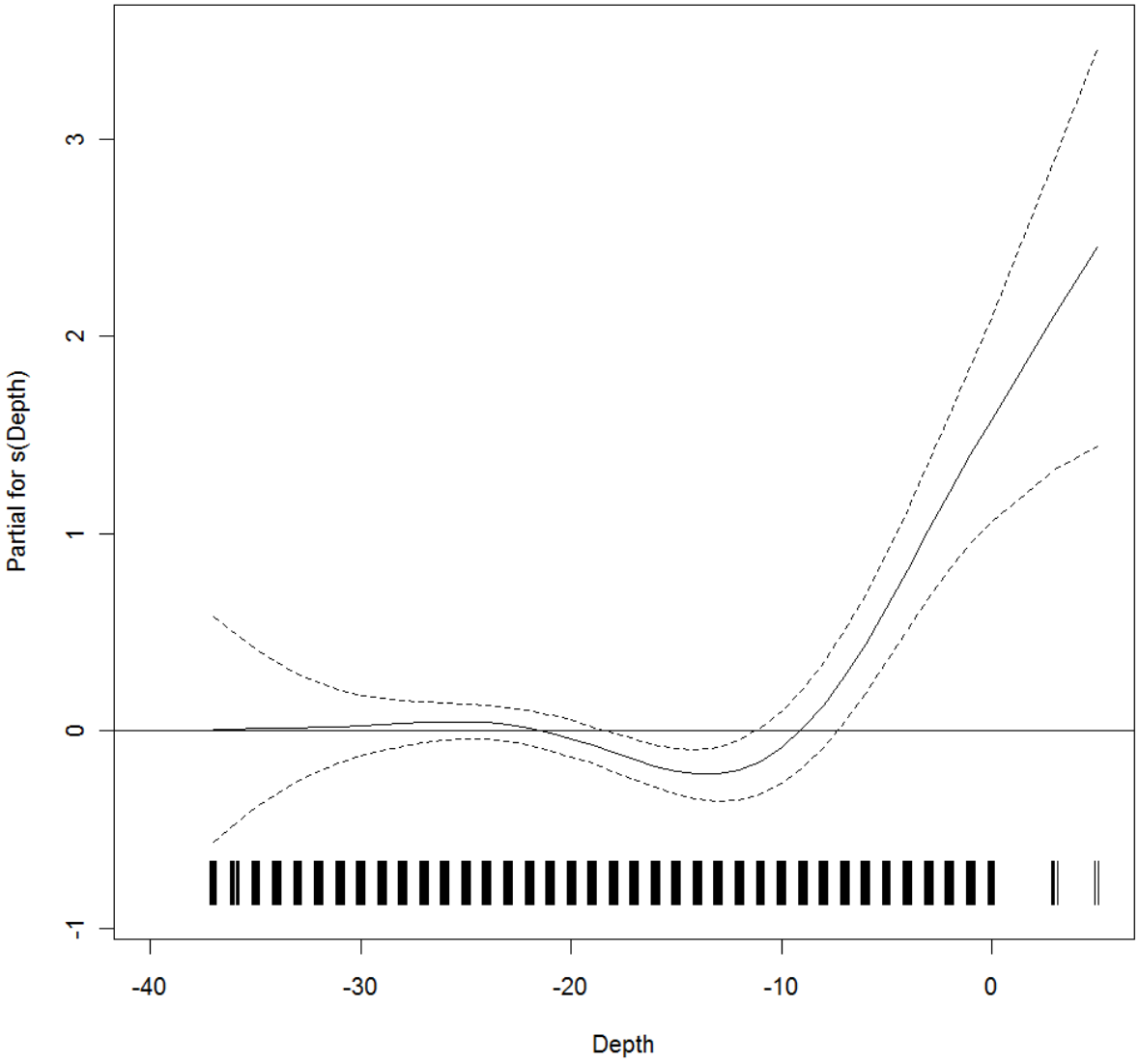

Figure M-77. Result of GAM regression for the effect of depth (m) on Common Loon density. Broken lines represent 95% confidence intervals around the covariate main effect.

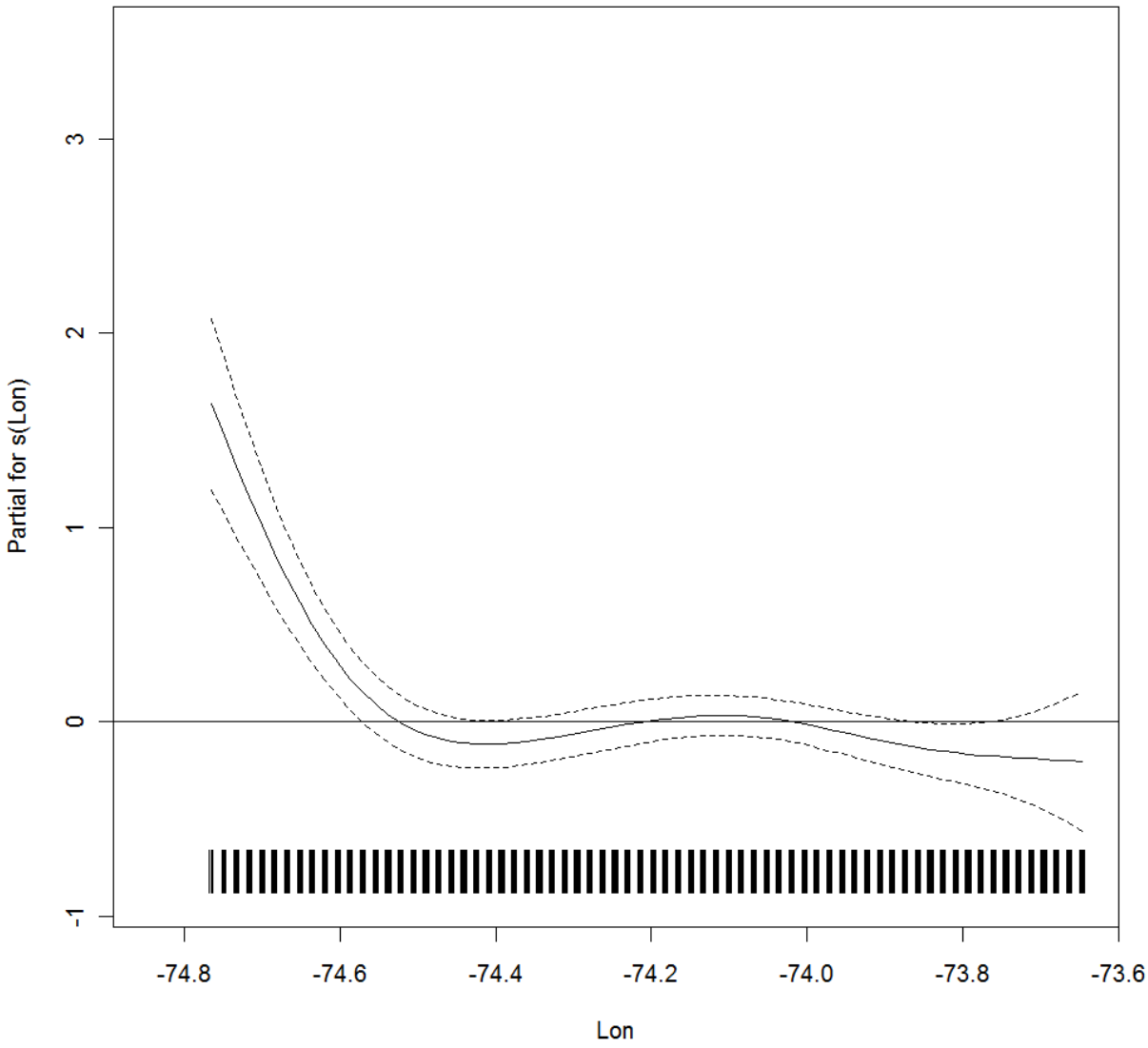

Figure M-78. Result of GAM regression for the effect of longitude 'Lon' on Common Loon density. Broken lines represent 95% confidence intervals around the covariate main effect.

Table M-32. Spatial regression model results for spatial covariates and Red-throated Loon density.

Spatial Regression Model:
Spatial lag model – Maximum Likelihood Estimation
N=5801, R^2=0.24, Log likelihood=-3180.3, Akaike info criterion=6376.7
Global Moran's I = 0.3661, p<0.01

Variable	Coefficient	Std.Error	z-value	Probability
Spatial lag	0.488	0.014	35.175	**0.0000**
Constant	51.416	15.169	3.389	**0.0007**
Depth	0.002	0.001	1.474	0.1404
Slope	0.007	0.020	0.368	0.7122
DistShore	-2.857e-006	6.74e-007	-4.237	**0.0000**
DistShoal	5.808e-005	3.23e-007	1.799	0.0720
Longitude	0.451	0.139	3.234	**0.0012**
Latitude	-0.448	0.123	-3.645	**0.0002**

Table M-33. GAM results for spatial covariates and Red-throated Loon density.

Generalized Additive Models:
Initial Model Summary: Significance of smoothed terms

Variable	Df	Npar Df	Npar F	Pr(F)
Depth	**1**	**3**	**9.0647**	**5.522e-06 *****
Slope	**1**	**3**	**0.4888**	**0.6901**
DistShore	**1**	**3**	**24.1903**	**1.443e-15 *****
DistShoal	**1**	**3**	**11.1855**	**2.575e-07 *****
Lon	**1**	**3**	**11.9006**	**9.121e-08 *****
Lat	**1**	**3**	**11.7306**	**1.167e-07 *****

AIC: 7196.876

Stepwise-selected Model Summary: Significance of smoothed terms

Variable	Df	Npar Df	Npar F	Pr(F)
Depth	**1**	**3**	**9.2028**	**4.525e-06 *****
DistShore	**1**	**3**	**23.9182**	**2.220e-15 *****
DistShoal	**1**	**3**	**11.2523**	**2.337e-07 *****
Lon	**1**	**3**	**12.0605**	**7.232e-08 *****
Lat	**1**	**3**	**12.0513**	**7.325e-08 *****

AIC: 7190.376

Significant codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
Df=degrees of freedom, NparDf=nonparametric degrees of freedom, NparF=nonparametric F value, Pr(F)=probability value.

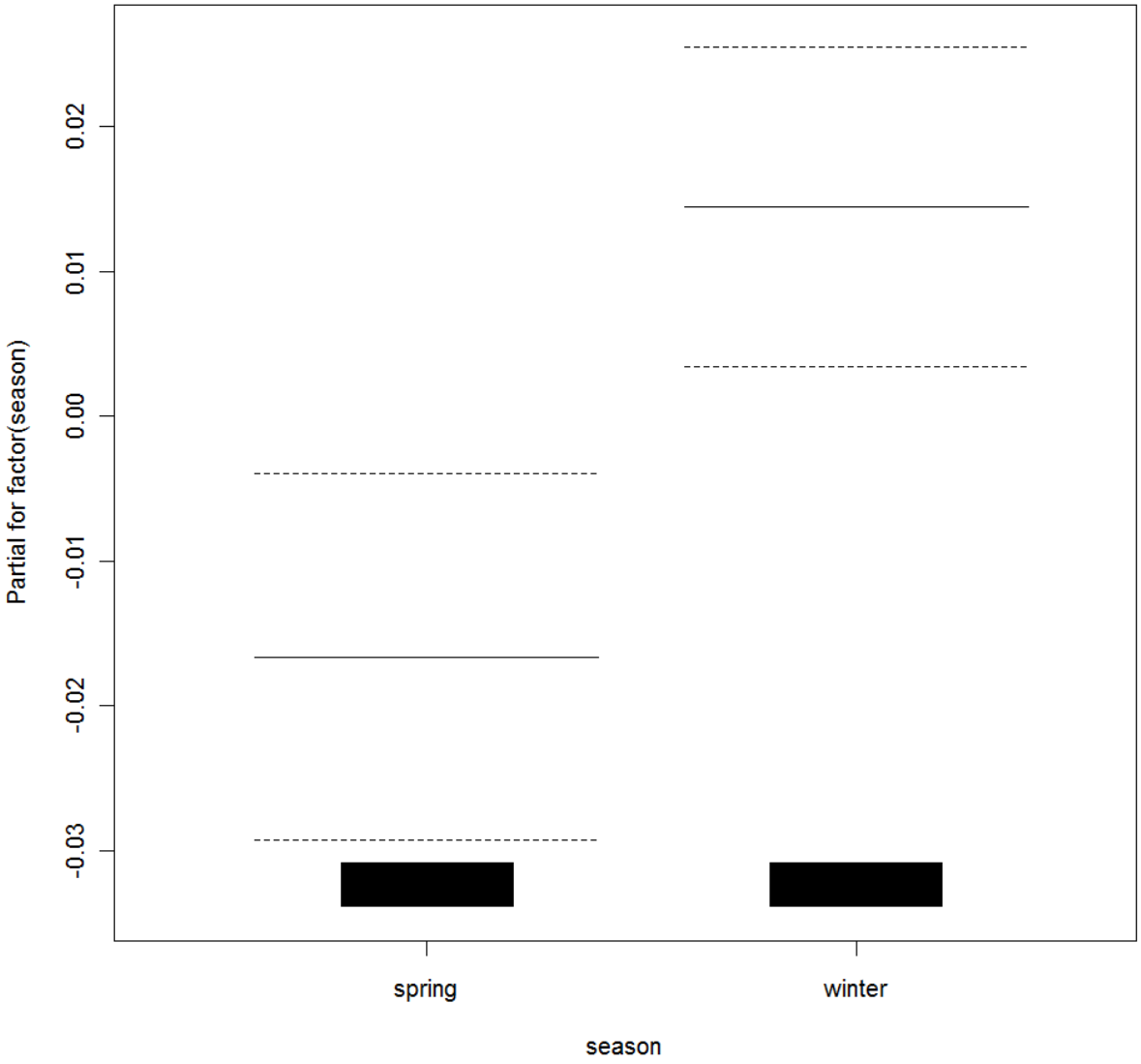

Figure M-79. Result of GAM regression for the effect of season on Red-throated Loon density. Broken lines represent 95% confidence intervals around the covariate main effect.

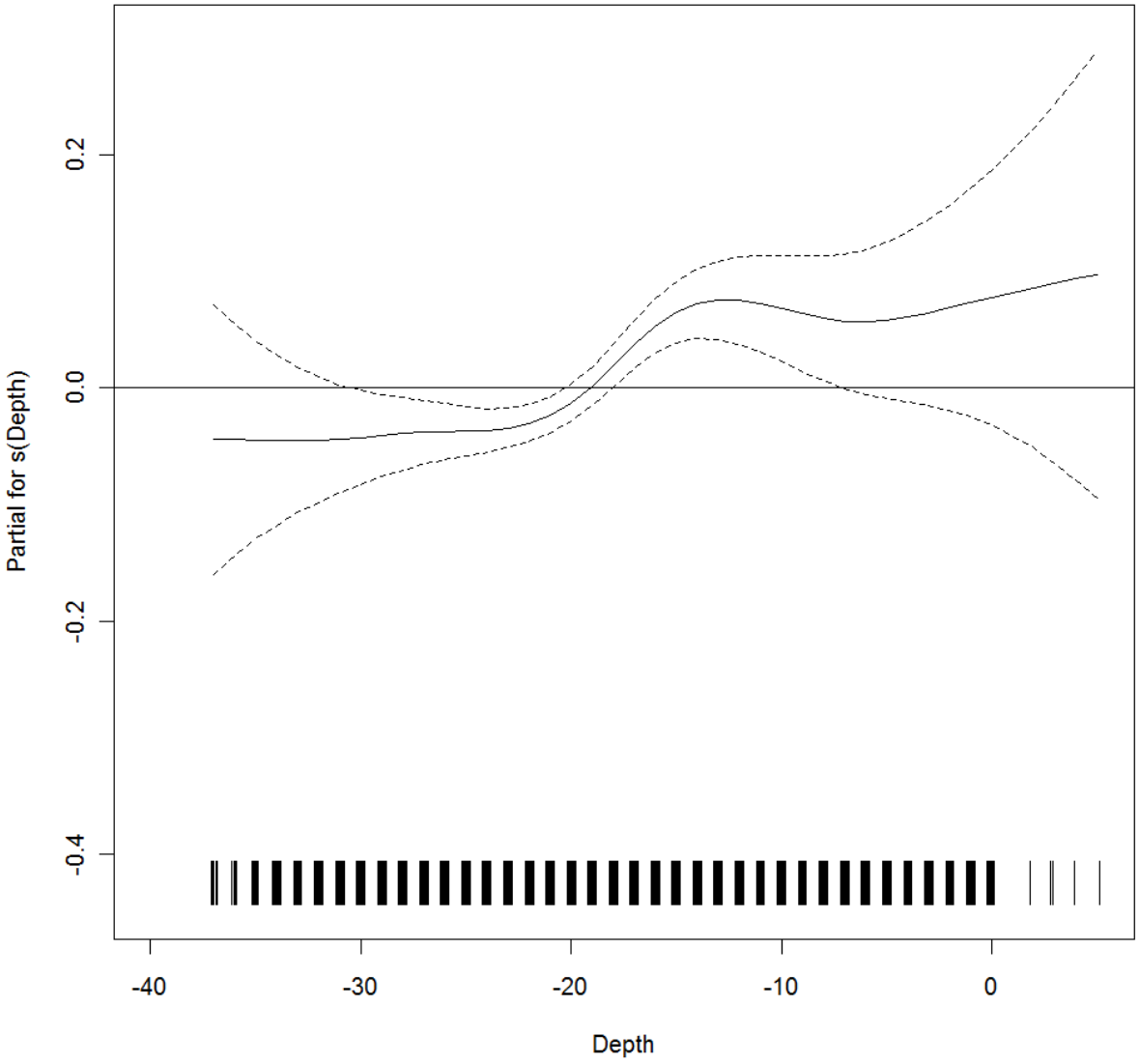

Figure M-80. Result of GAM regression for the effect of depth (m) on Red-throated Loon density. Broken lines represent 95% confidence intervals around the covariate main effect.

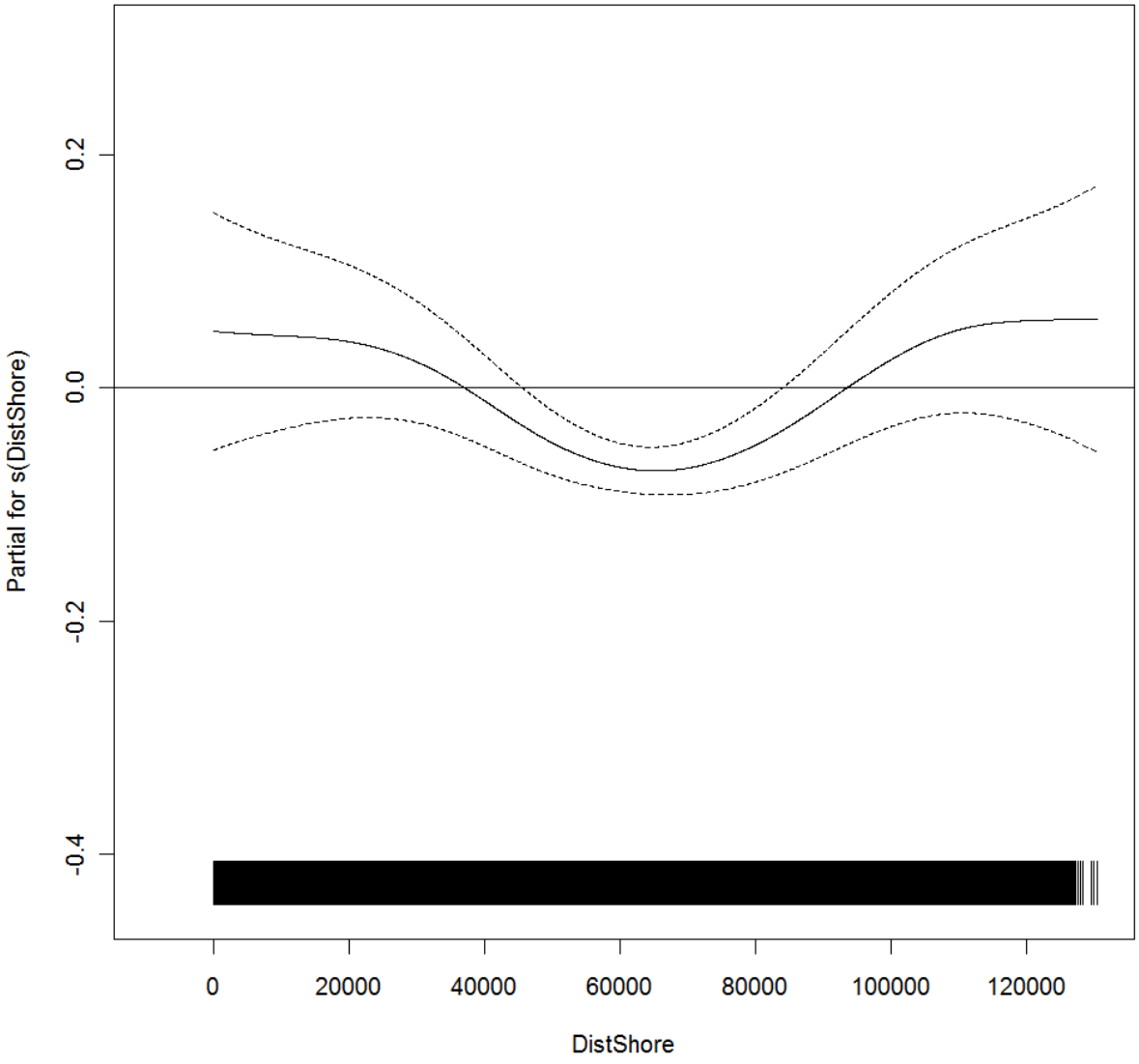

Figure M-81. Result of GAM regression for the effect of distance to shoreline 'DistShore' (feet) on Red-throated Loon density. Broken lines represent 95% confidence intervals around the covariate main effect.

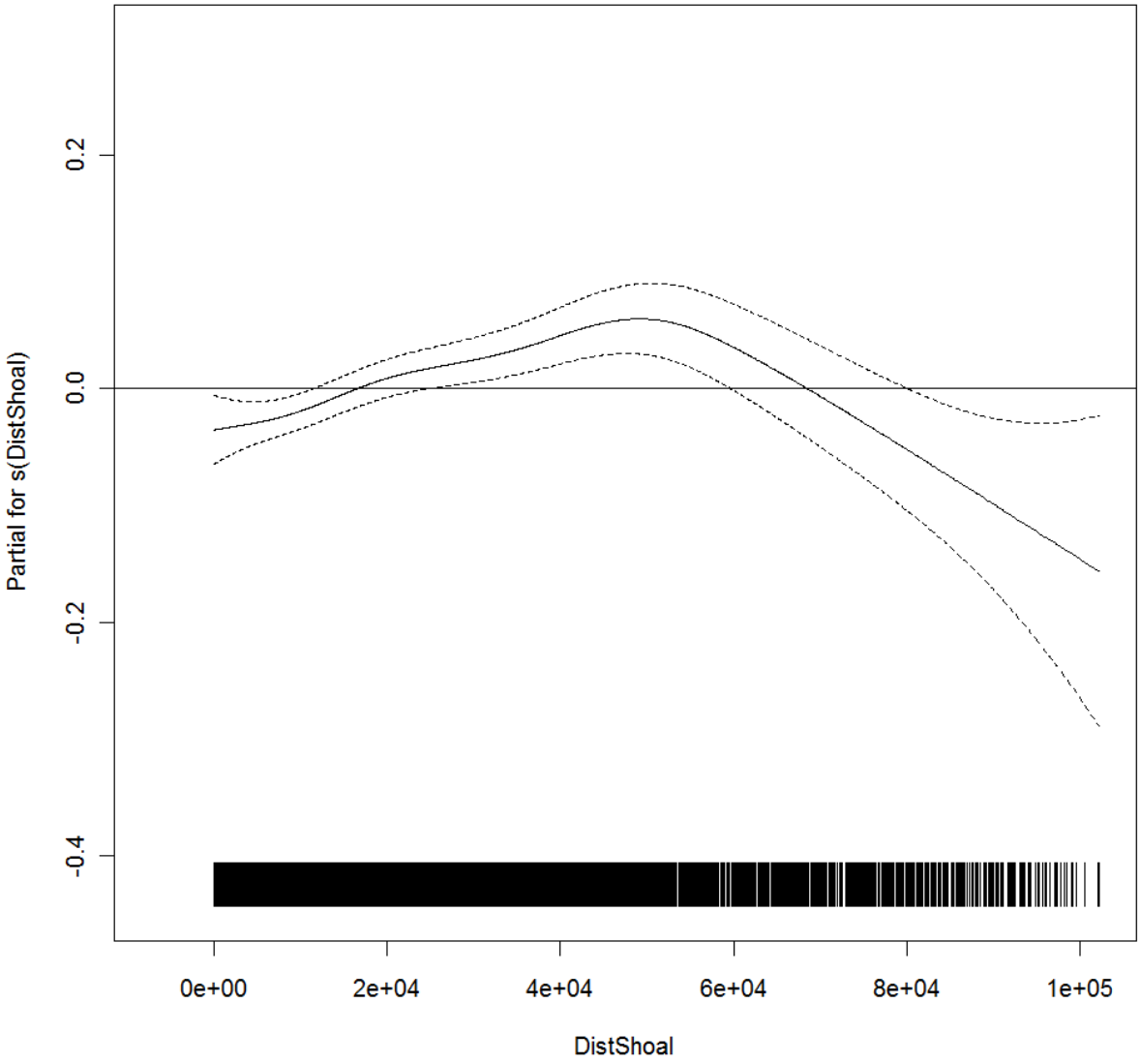

Figure M-82. Result of GAM regression for the effect of distance to nearest shoal 'DistShoal' (feet) on Red-throated Loon density. Broken lines represent 95% confidence intervals around the covariate main effect.

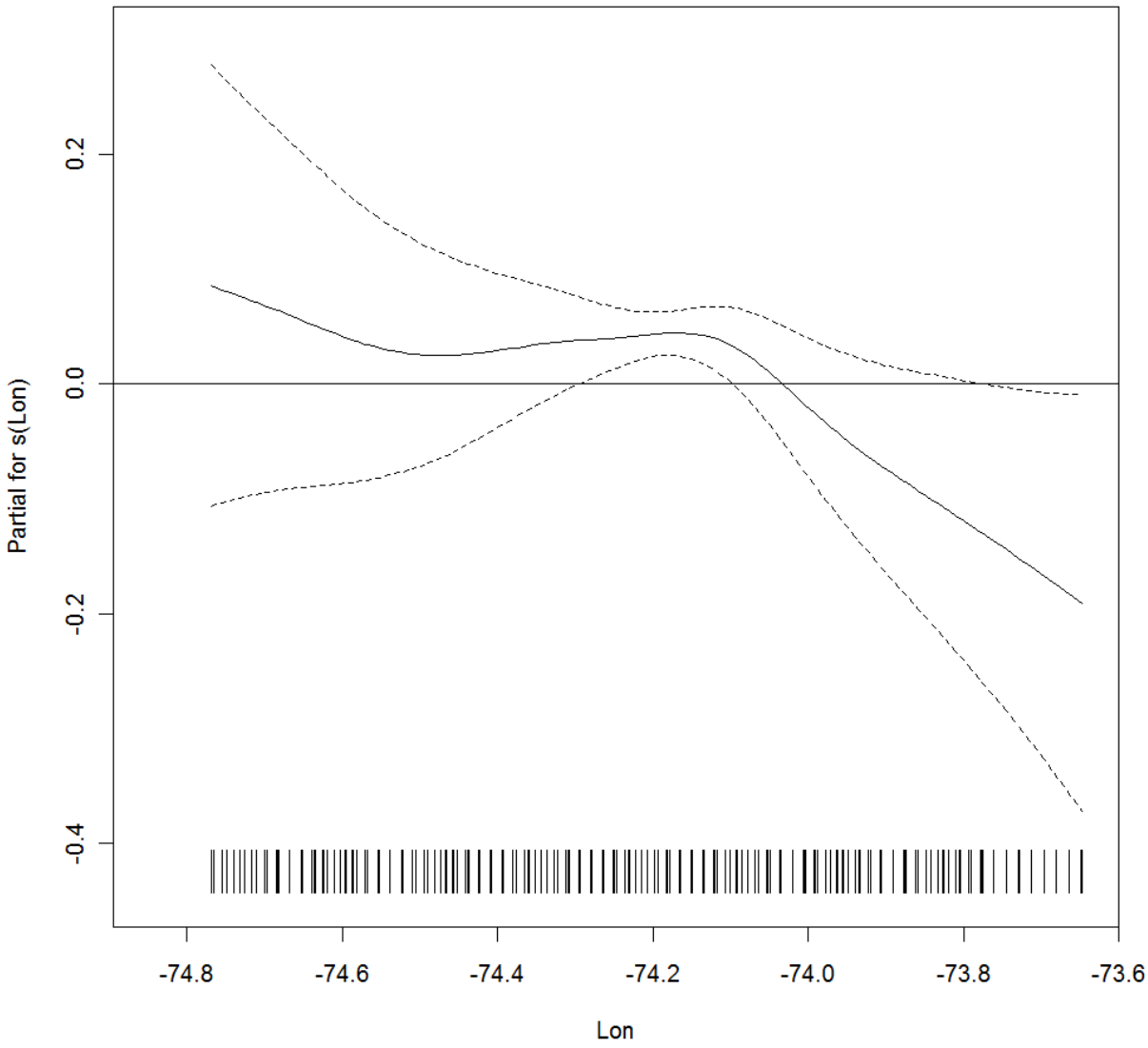

Figure M-83. Result of GAM regression for the effect of longitude 'Lon' on Red-throated Loon density. Broken lines represent 95% confidence intervals around the covariate main effect.

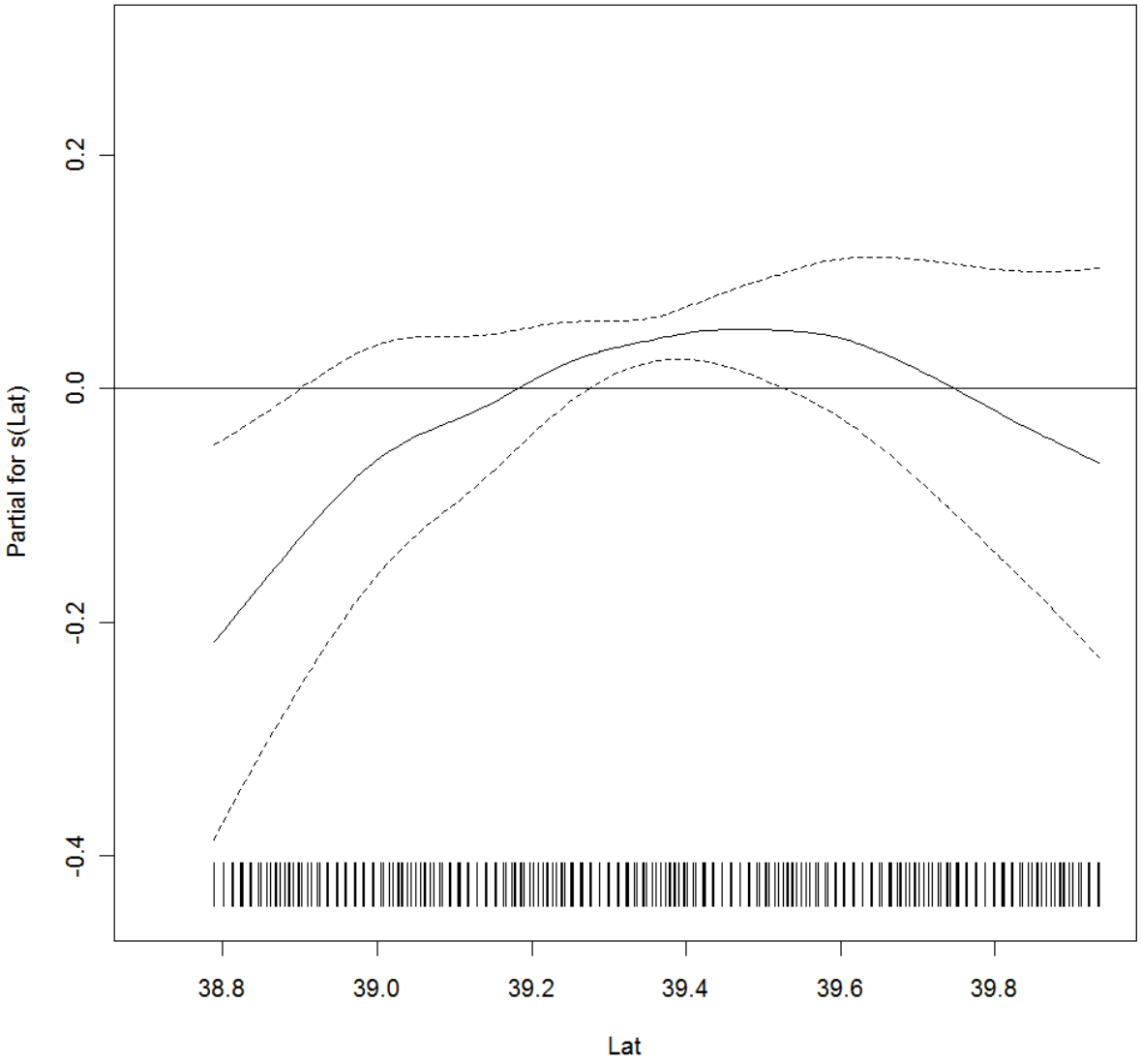

Figure M-84. Result of GAM regression for the effect of latitude 'Lat' on Red-throated Loon density. Broken lines represent 95% confidence intervals around the covariate main effect.

Table M-34. Spatial regression model results for spatial covariates and Herring Gull density.

Spatial Regression Model:
Spatial lag model – Maximum Likelihood Estimation
N=5801, R^2=0.10, Log likelihood=-10888, Akaike info criterion=21845.3
Global Moran's I =0.1894, p=0.02

Variable	Coefficient	Std.Error	z-value	Probability
Spatial lag	0.287	0.017	17.285	**0.0000**
Constant	-261.685	58.6222	-4.463	**0.0000**
Depth	0.052	0.006	7.793	**0.0000**
Slope	0.191	0.078	2.455	**0.0141**
DistShore	1.456e-005	2.60e-006	5.594	**0.0000**
DistShoal	5.369e-006	1.25e-007	4.292	**0.0000**
Longitude	-2.298	0.539	-4.262	**0.0000**
Latitude	2.319	0.474	4.884	**0.0000**

Table M-35. GAM results for spatial covariates and Herring Gull density.

Generalized Additive Models:
Initial Model Summary: Significance of smoothed terms

Variable	Df	Npar Df	Npar F	Pr(F)
Depth	**1**	**3**	**57.723**	**<2.2e-16 *** **
Slope)	**1**	**3**	**4.705**	**0.002762 ** **
DistShore	**1**	**3**	**10.293**	**9.164e-07 *** **
DistShoal	**1**	**3**	**2.829**	**0.036995 * **
Lon	**1**	**3**	**7.256**	**7.354e-05 *** **
Lat	**1**	**3**	**12.992**	**1.801e-08 *** **

AIC: 54615.99

Stepwise-selected Model Summary: Significance of smoothed terms

Variable	Df	Npar Df	Npar F	Pr(F)
Depth	**1**	**3**	**57.723**	**<2.2e-16 *** **
Slope)	**1**	**3**	**4.705**	**0.002762 ** **
DistShore	**1**	**3**	**10.293**	**9.164e-07 *** **
DistShoal	**1**	**3**	**2.829**	**0.036995 * **
Lon	**1**	**3**	**7.256**	**7.354e-05 *** **
Lat	**1**	**3**	**12.992**	**1.801e-08 *** **

AIC: 54615.99

Significant codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
Df=degrees of freedom, NparDf=nonparametric degrees of freedom, NparF=nonparametric F value, Pr(F)=probability value.

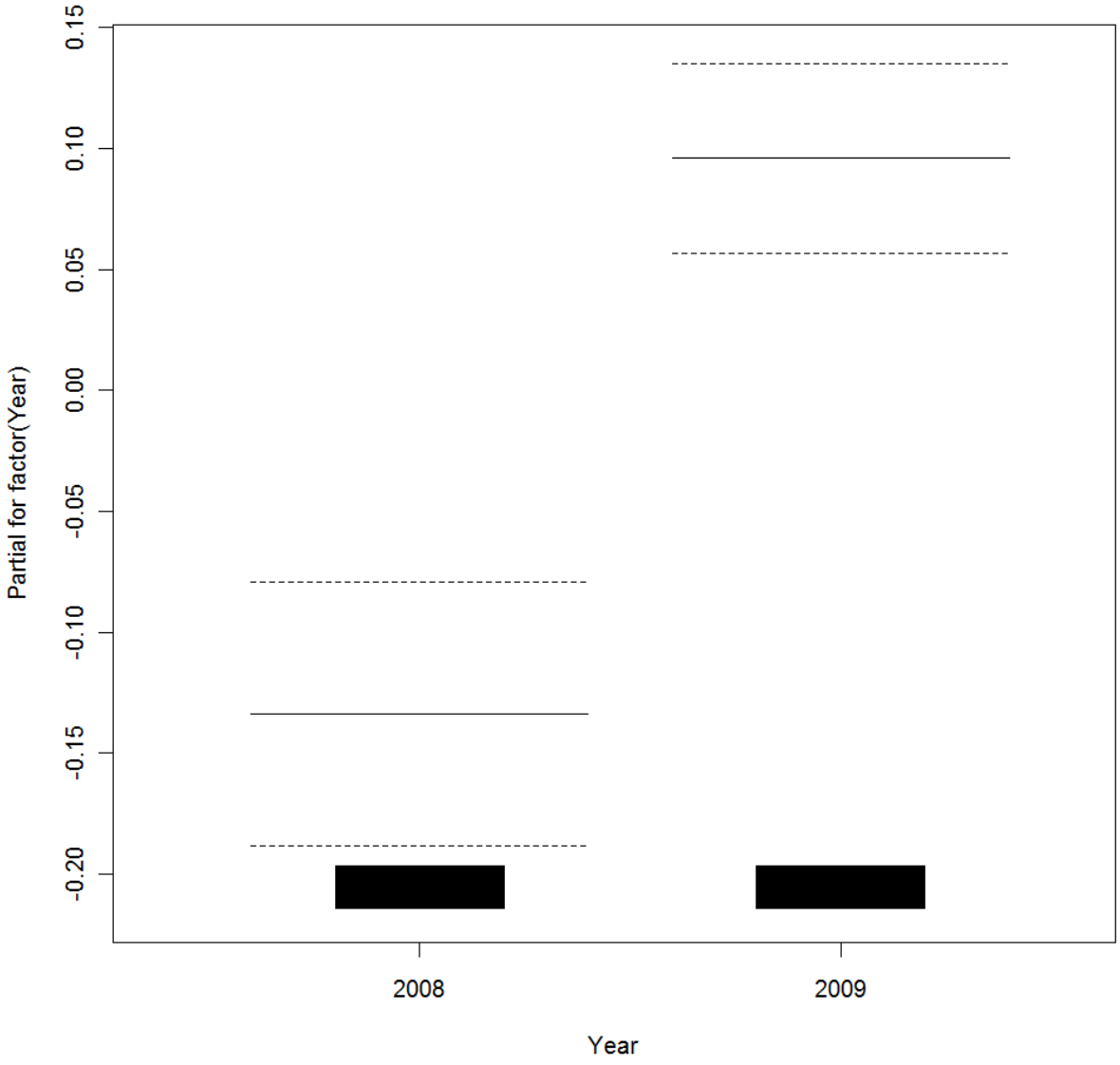

Figure M-85. Result of GAM regression for the effect of year on Herring Gull density. Broken lines represent 95% confidence intervals around the covariate main effect.

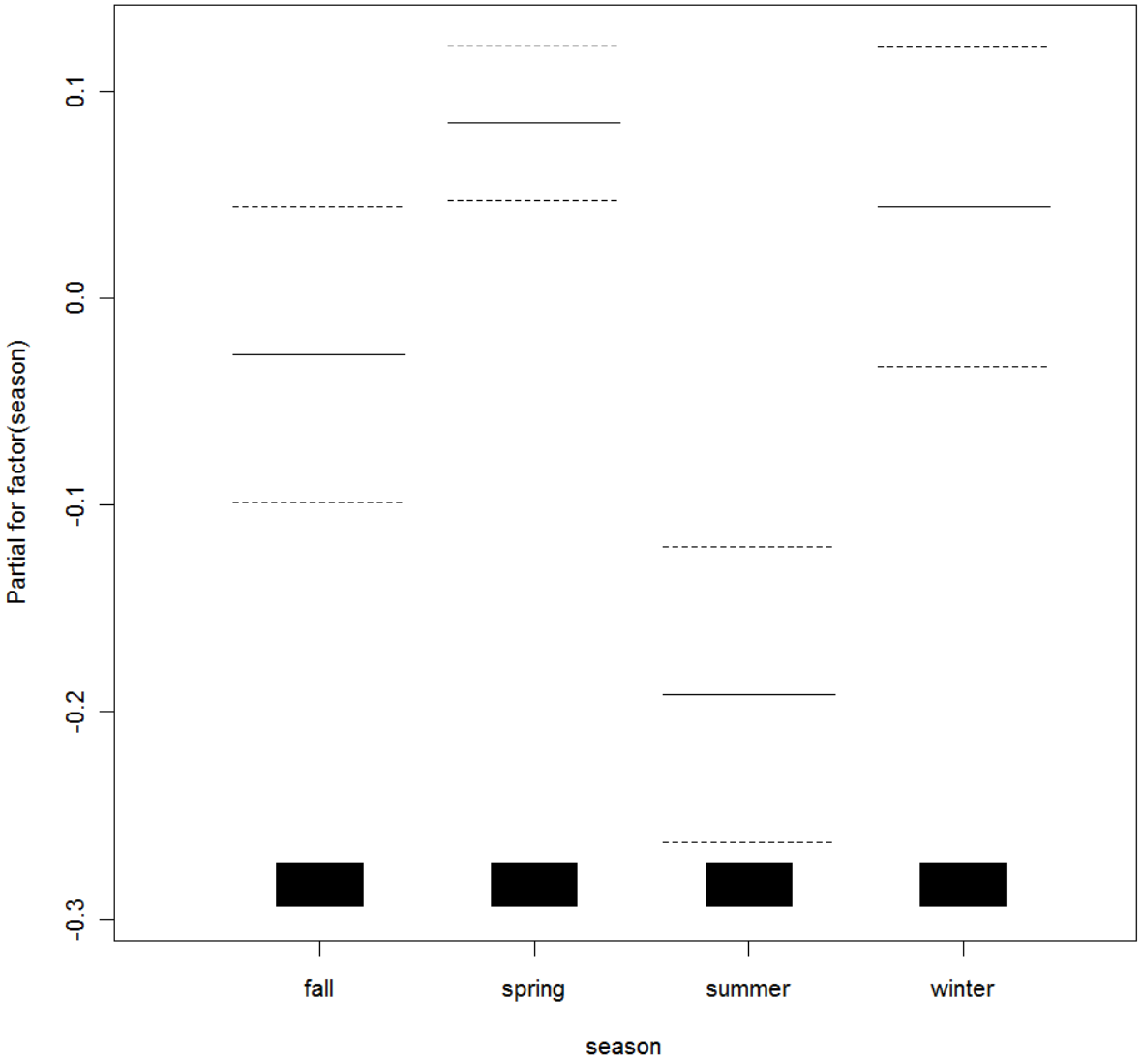

Figure M-86. Result of GAM regression for the effect of season on Herring Gull density. Broken lines represent 95% confidence intervals around the covariate main effect.

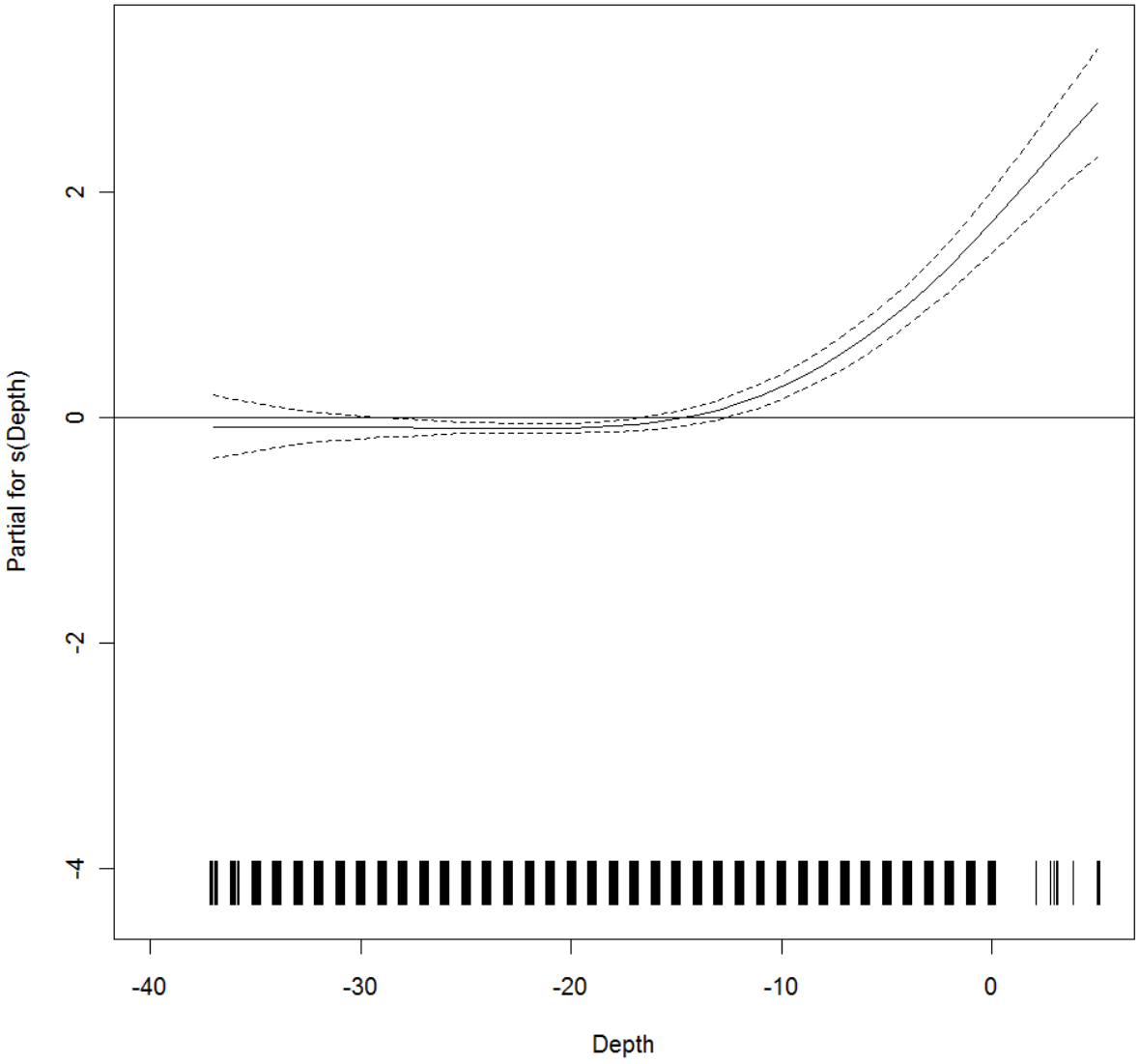

Figure M-87. Result of GAM regression for the effect of depth (m) on Herring Gull density. Broken lines represent 95% confidence intervals around the covariate main effect.

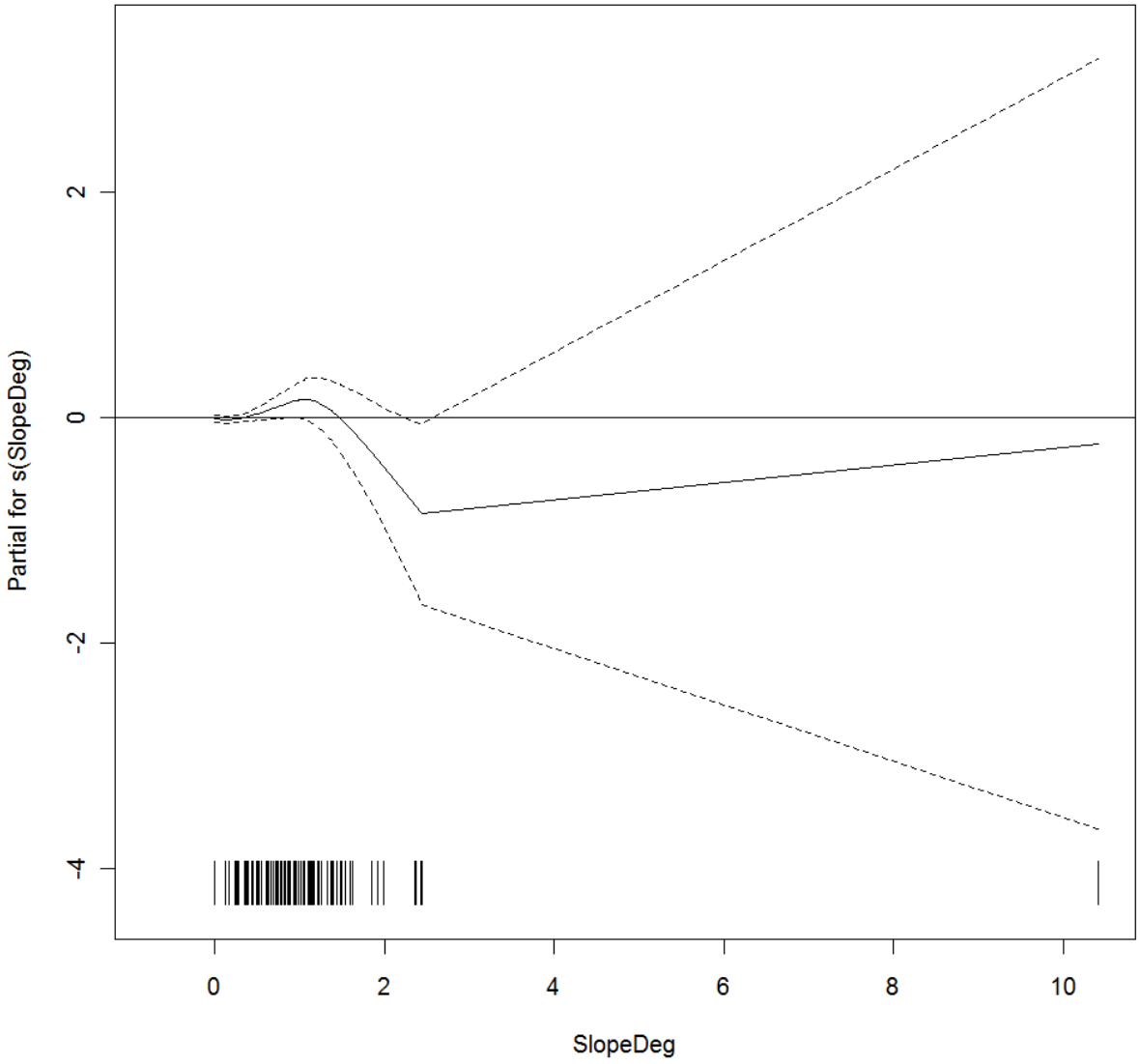

Figure M-88. Result of GAM regression for the effect of slope 'SlopeDeg' (degrees) on Herring Gull density. Broken lines represent 95% confidence intervals around the covariate main effect.

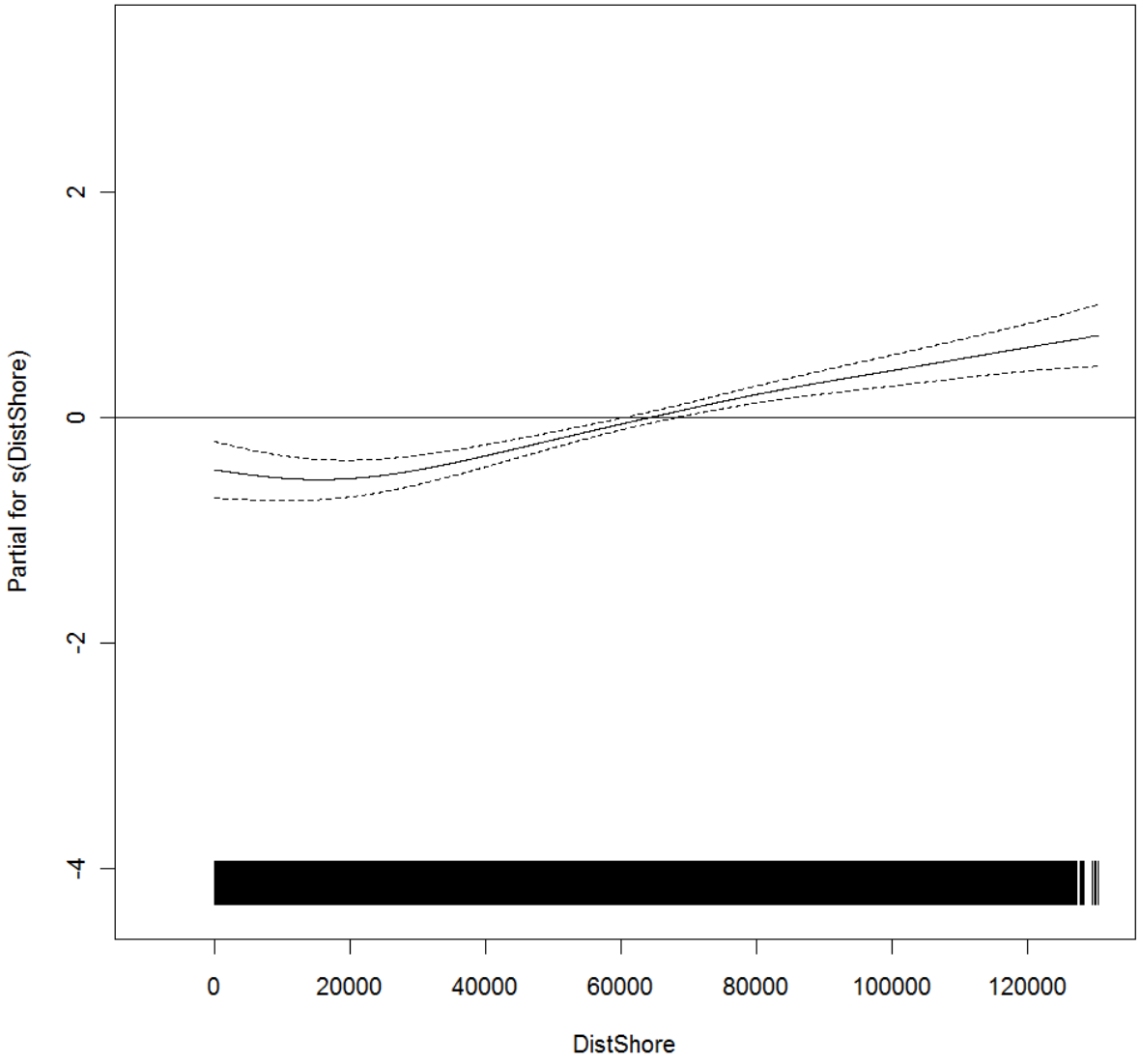

Figure M-89. Result of GAM regression for the effect of distance to shoreline 'DistShore' (feet) on Herring Gull density. Broken lines represent 95% confidence intervals around the covariate main effect.

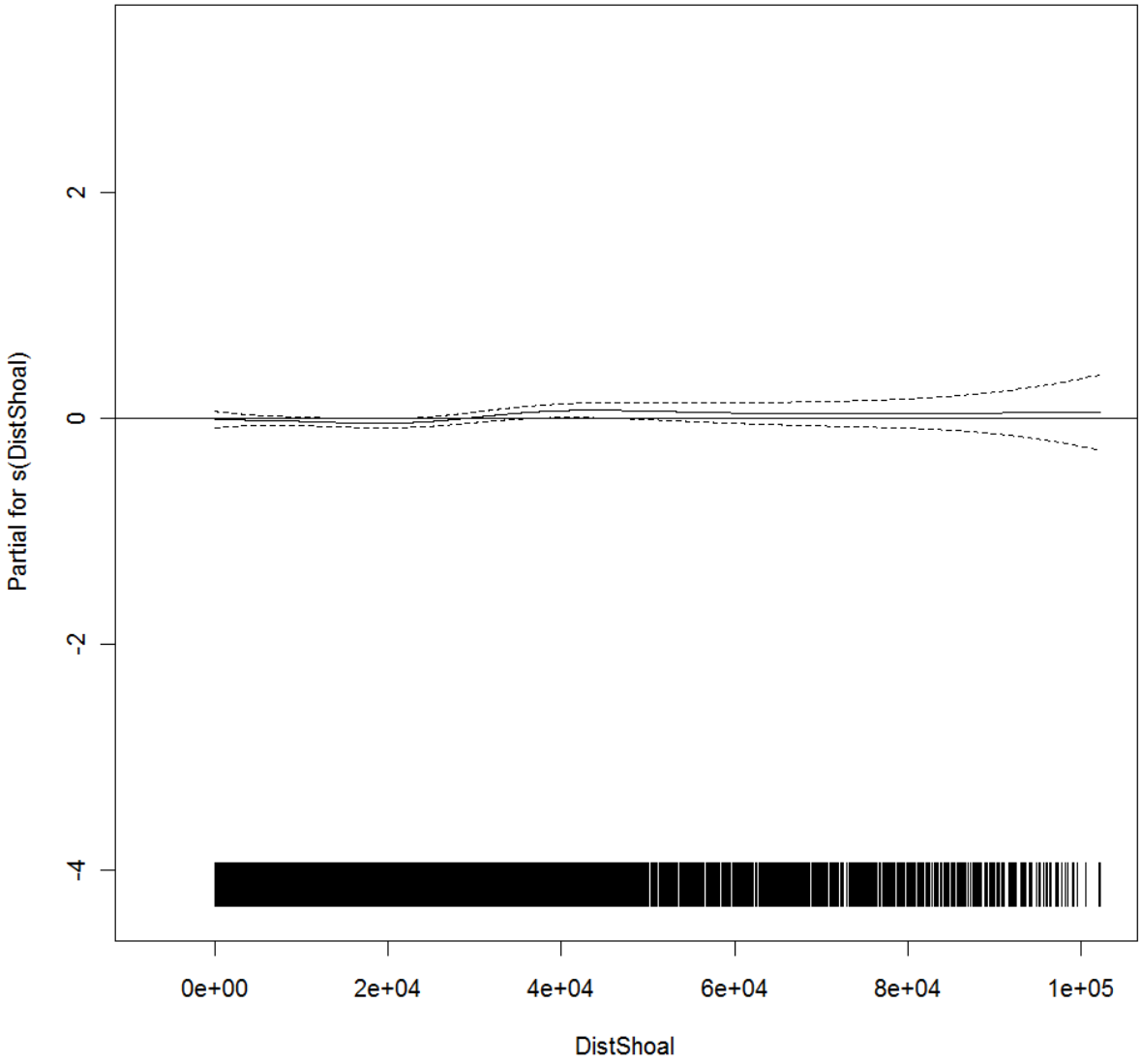

Figure M-90. Result of GAM regression for the effect of distance to nearest shoal 'DistShoal' (feet) on Herring Gull density. Broken lines represent 95% confidence intervals around the covariate main effect.

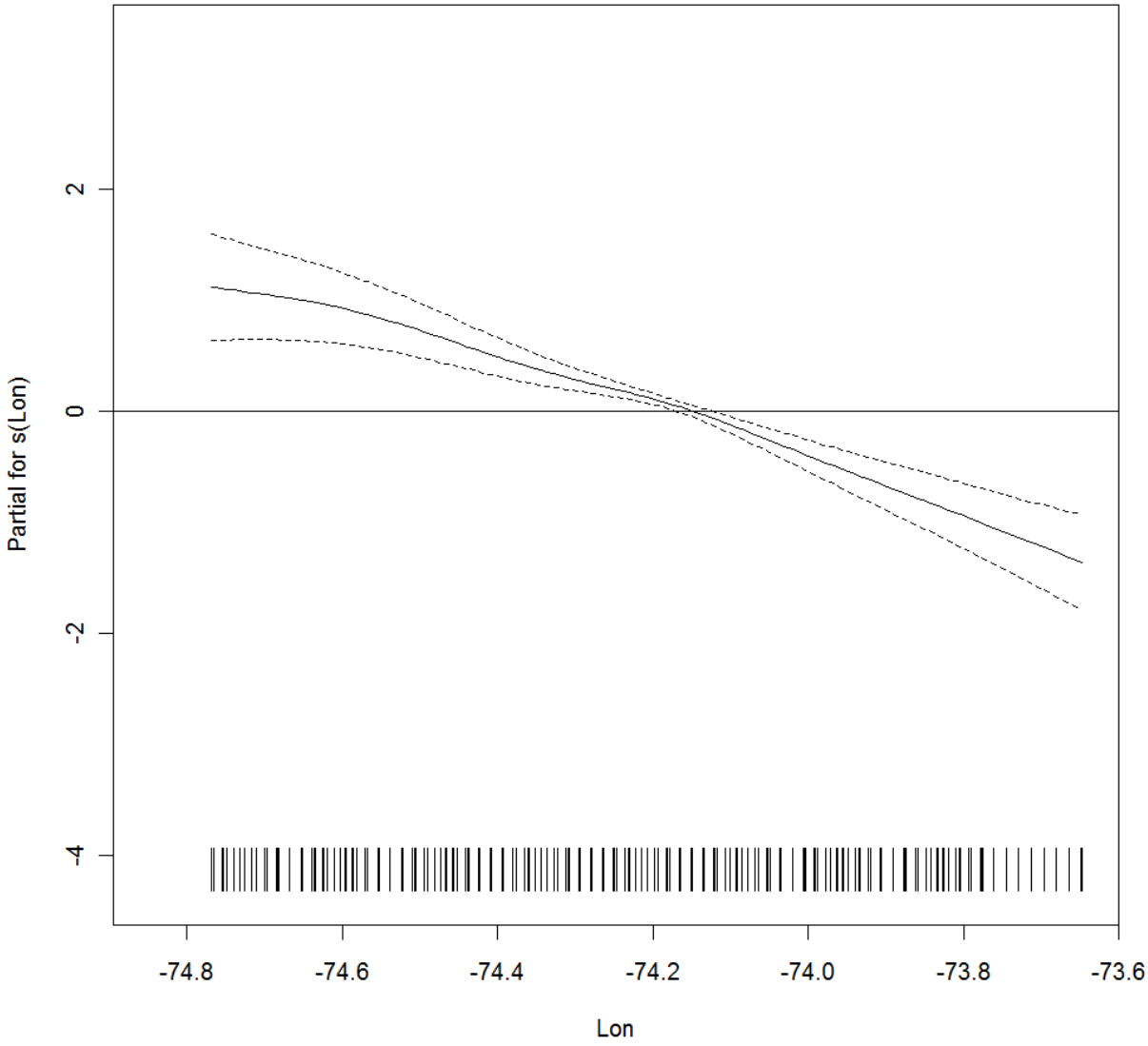

Figure M-91. Result of GAM regression for the effect of longitude 'Lon' on Herring Gull density. Broken lines represent 95% confidence intervals around the covariate main effect.

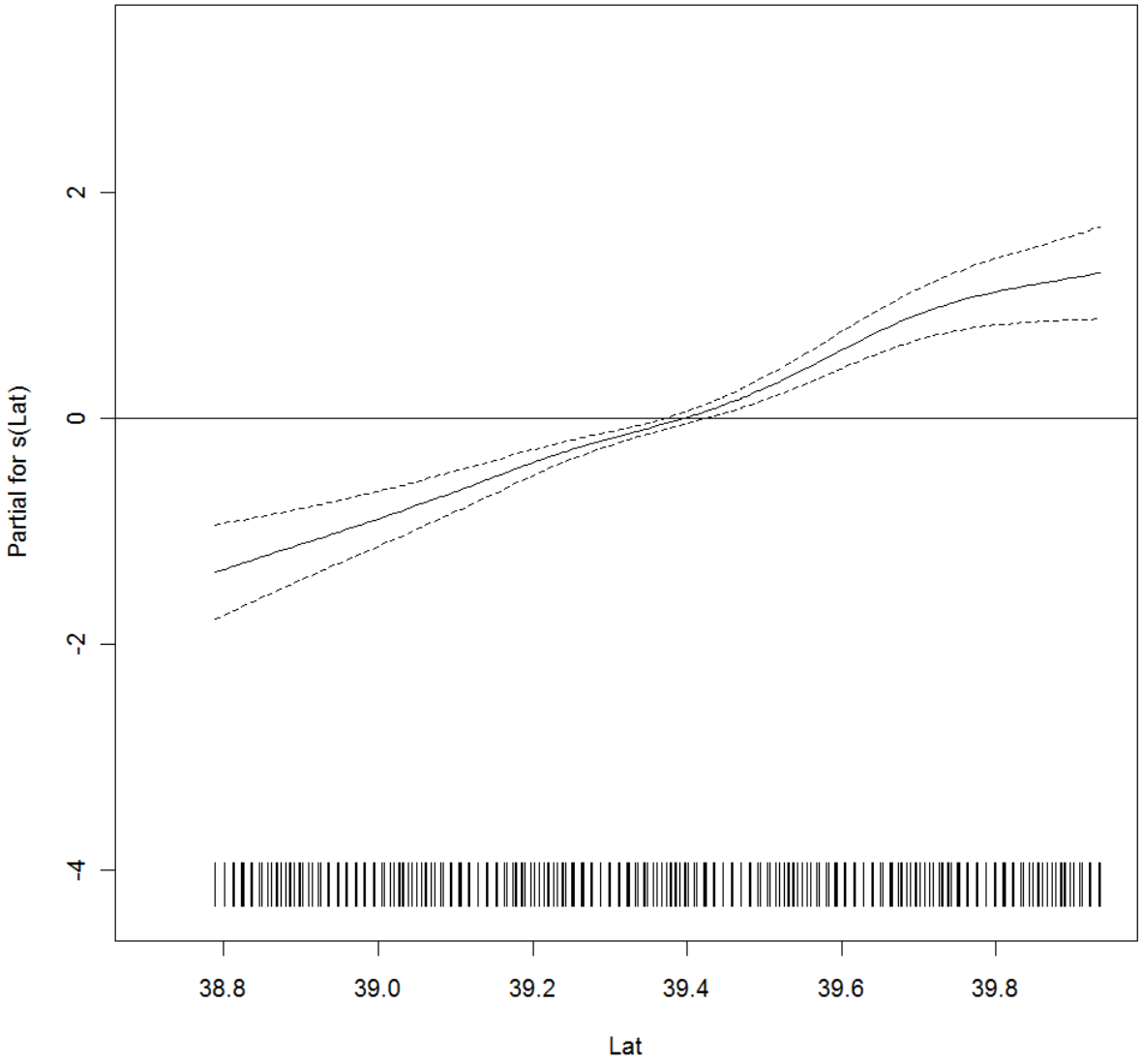

Figure M-92. Result of GAM regression for the effect of latitude 'Lat' on Herring Gull density. Broken lines represent 95% confidence intervals around the covariate main effect.

Table M-36. Spatial regression model results for spatial covariates and Laughing Gull density.

Spatial Regression Model:
Spatial lag model – Maximum Likelihood Estimation
N=2698, R^2=0.26, Log likelihood=-4943, Akaike info criterion=9902.01
Global Moran's I = 0.4330, p<0.01

Variable	Coefficient	Std.Error	z-value	Probability
Spatial lag	0.274	0.015	18.538	**0.0000**
Constant	-86.456	79.555	-1.087	0.2771
Depth	0.066	0.009	7.254	**0.0000**
Slope	0.218	0.123	1.775	0.0757
DistShore	1.132e-006	3.46e-006	0.327	0.7438
DistShoal	6.907e-006	1.73e-006	3.984	**0.0000**
Longitude	-0.731	0.734	-0.996	0.3193
Latitude	0.858	0.640	1.341	0.1797

Table M-37. GAM results for spatial covariates and Laughing Gull density.

Generalized Additive Models:
Initial Model Summary: Significance of smoothed terms

Variable	Df	Npar Df	Npar F	Pr(F)
Depth	**1**	**3**	**13.474**	**9.005e-09 *** **
Slope	**1**	**3**	**1.886**	**0.129614**
DistShore	**1**	**3**	**59.661**	**<2.2e-16 *** **
DistShoal	**1**	**3**	**0.203**	**0.894372**
Lon	**1**	**3**	**2.121**	**0.095309 .**
Lat	**1**	**3**	**4.119**	**0.006275 ****

AIC: 55298.11

Stepwise-selected Model Summary: Significance of smoothed terms

Variable	Df	Npar Df	Npar F	Pr(F)
Depth	**1**	**3**	**13.322**	**1.123e-08 *** **
DistShore	**1**	**3**	**70.757**	**<2.2e-16 *** **
Lon	**1**	**3**	**2.358**	**0.06963 .**
Lat	**1**	**3**	**2.965**	**0.03074 ***

AIC: 55290.13

Significant codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
Df=degrees of freedom, NparDf=nonparametric degrees of freedom, NparF=nonparametric F value, Pr(F)=probability value.

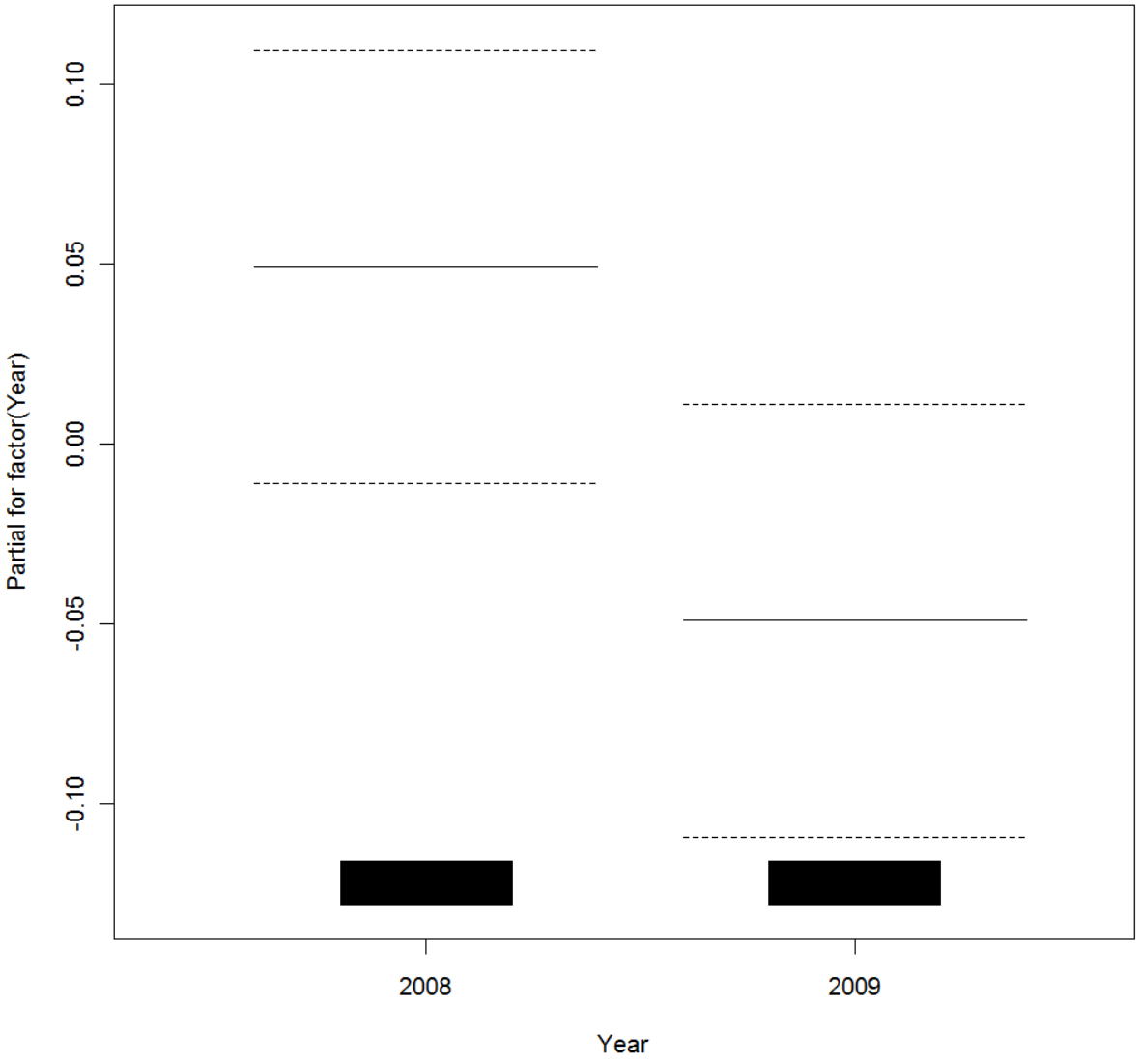

Figure M-93. Result of GAM regression for the effect of year on Laughing Gull density. Broken lines represent 95% confidence intervals around the covariate main effect.

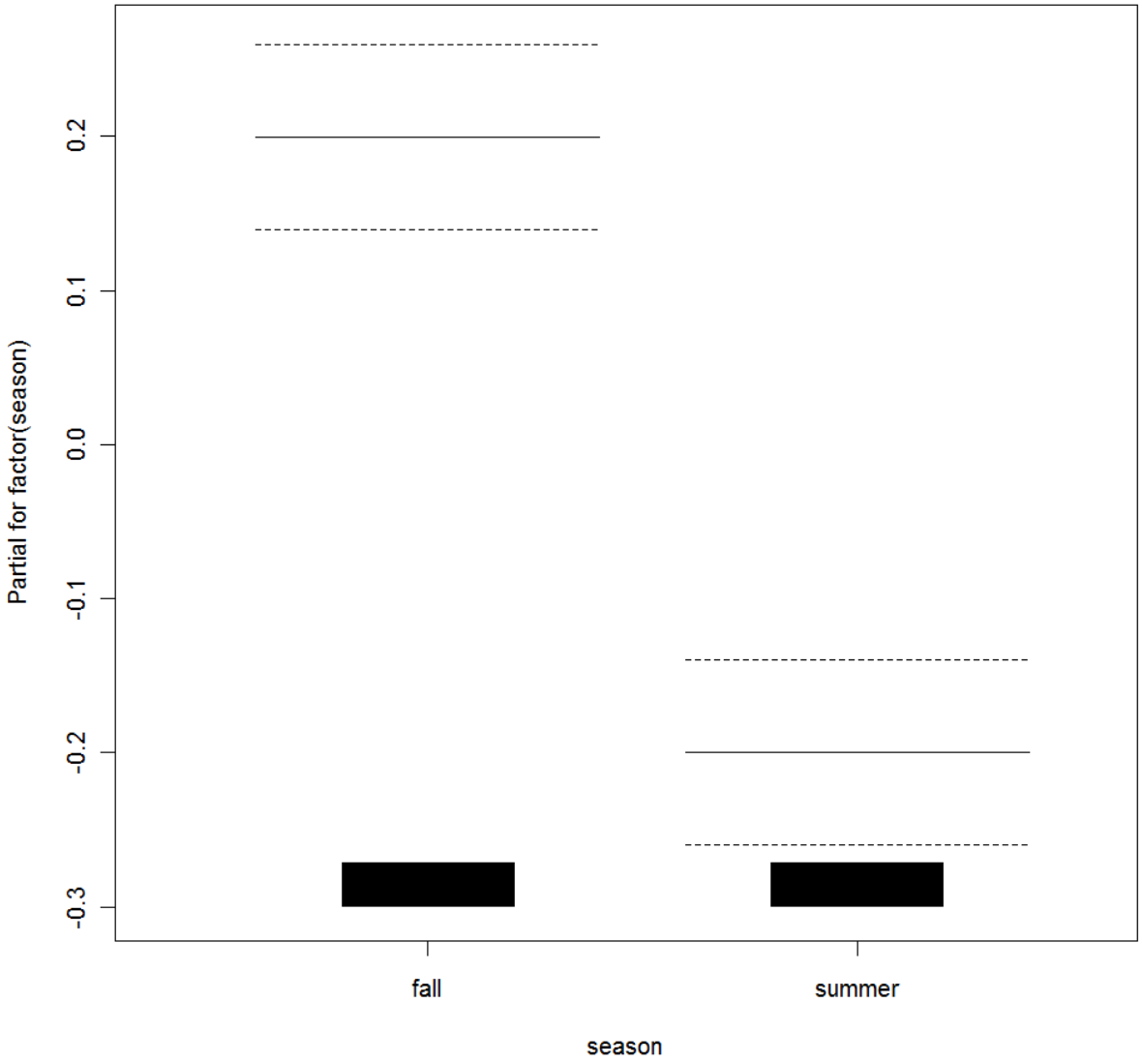

Figure M-94. Result of GAM regression for the effect of season on Laughing Gull density. Broken lines represent 95% confidence intervals around the covariate main effect.

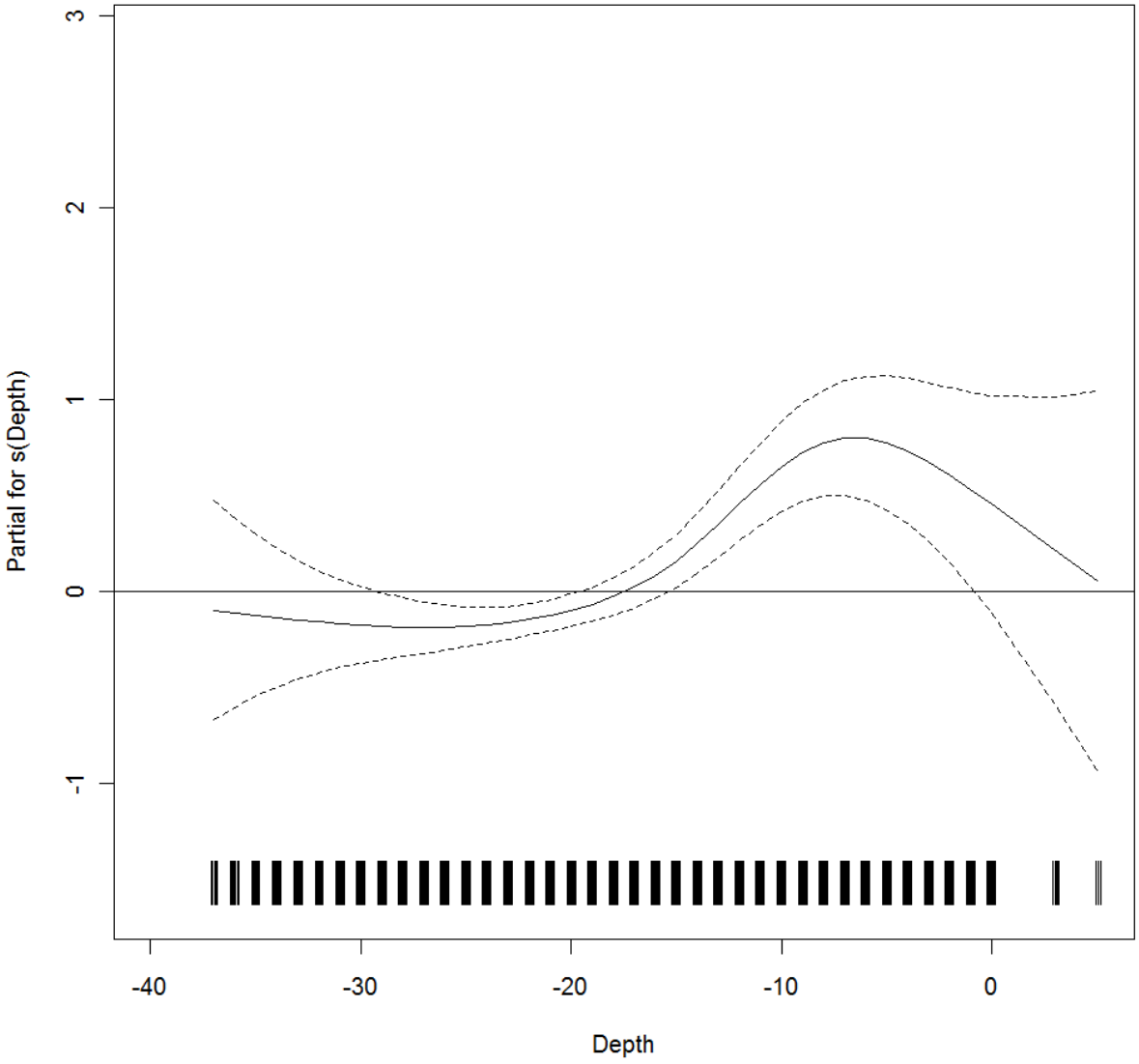

Figure M-95. Result of GAM regression for the effect of depth (m) on Laughing Gull density. Broken lines represent 95% confidence intervals around the covariate main effect.

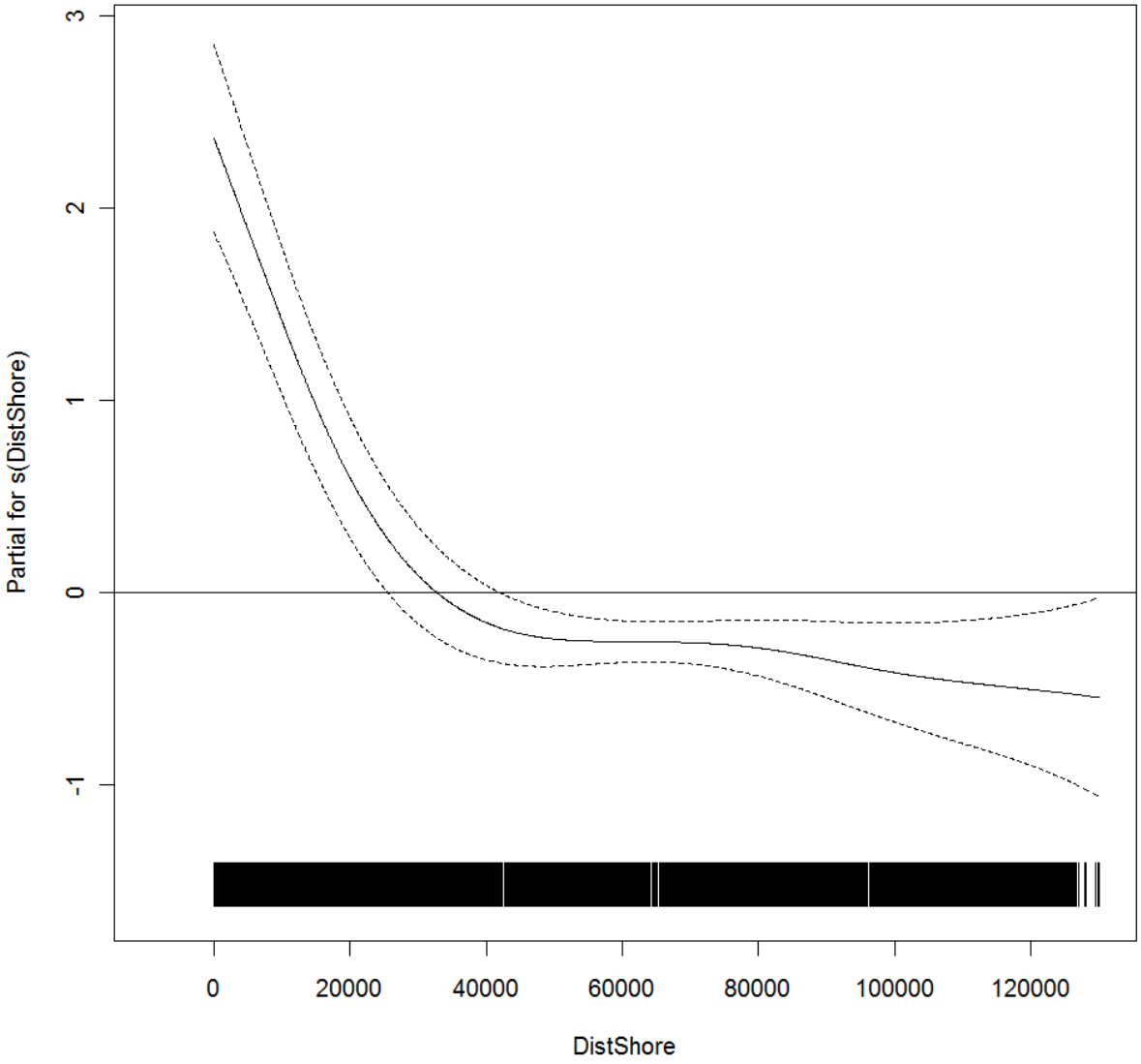

Figure M-96. Result of GAM regression for the effect of distance to shoreline 'DistShore' (feet) on Laughing Gull density. Broken lines represent 95% confidence intervals around the covariate main effect.

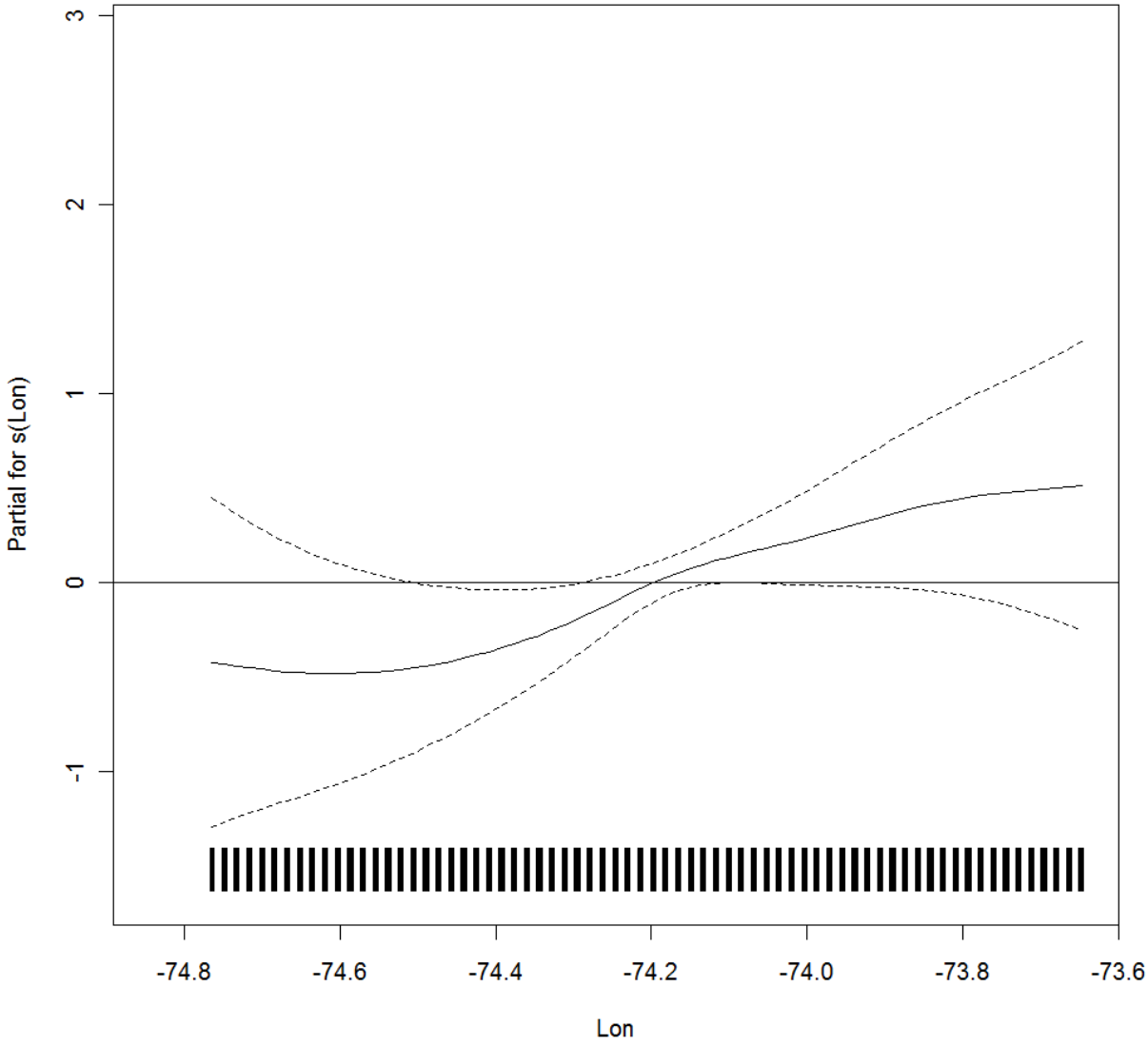

Figure M-97. Result of GAM regression for the effect of longitude 'Lon' on Laughing Gull density. Broken lines represent 95% confidence intervals around the covariate main effect.

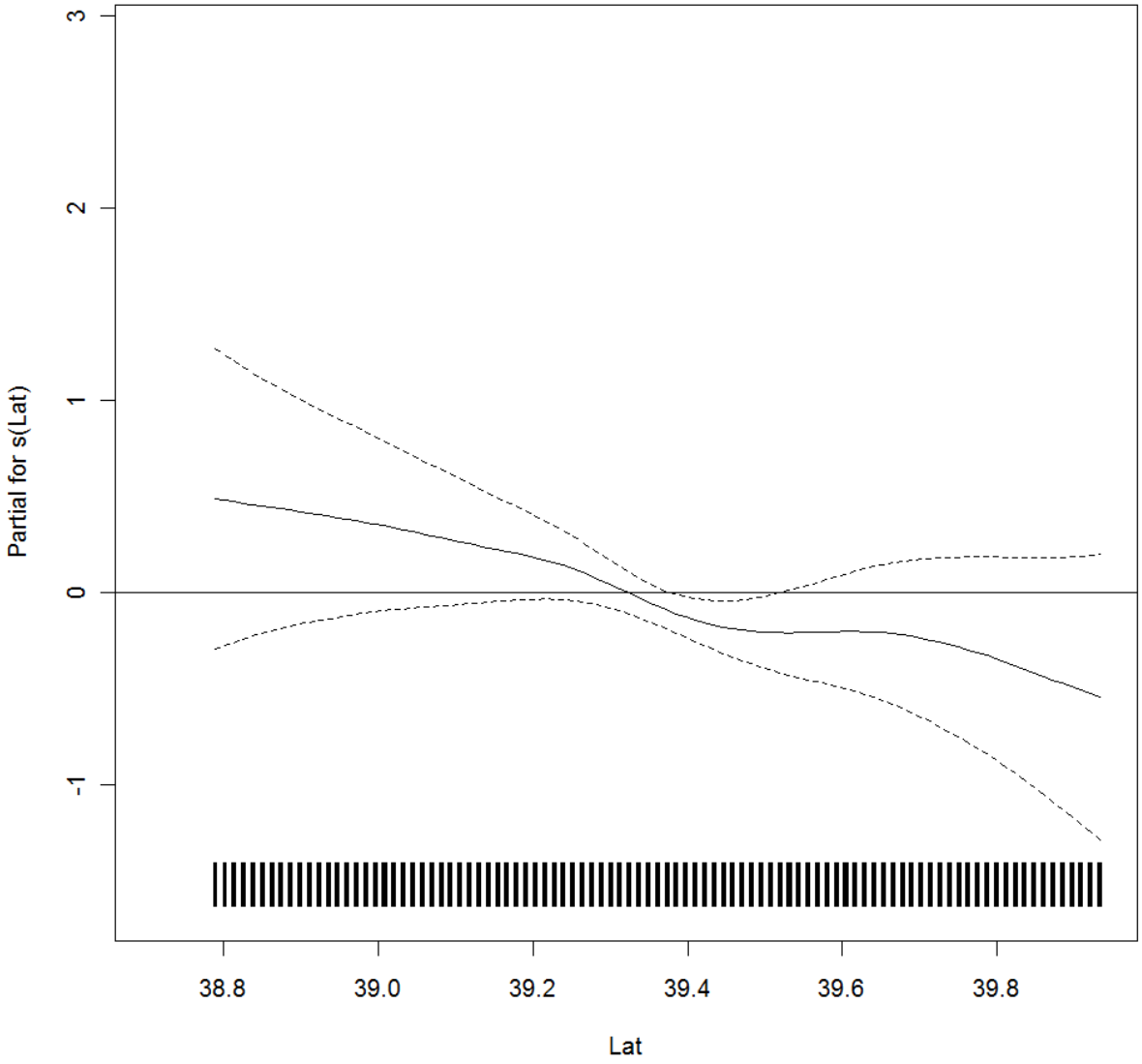

Figure M-98. Result of GAM regression for the effect of longitude 'Lon' on Laughing Gull density. Broken lines represent 95% confidence intervals around the covariate main effect.

Table M-38. Spatial regression model results for spatial covariates and Common Tern density.

Spatial Regression Model:
Spatial lag model – Maximum Likelihood Estimation
N=5801, R^2=0.26, Log likelihood=-21598.9, Akaike info criterion=43213.7
Global Moran's I = 0.6509, p<0.01

Variable	Coefficient	Std.Error	z-value	Probability
Spatial lag	0.486	0.012	39.787	**0.0000**
Constant	66.764	30.541	2.186	**0.0288**
Depth	-0.003	0.003	-0.996	0.3191
Slope	-0.011	0.047	-0.246	0.8052
DistShore	-4.460e-006	1.33e-006	-3.34	**0.0008**
DistShoal	8.371e-007	6.63e-007	1.262	0.2069
Longitude	0.595	0.282	2.114	**0.0345**
Latitude	-0.564	0.246	-2.296	**0.0216**

Table M-39. GAM results for spatial covariates and Common Tern density.

Generalized Additive Models:
Initial Model Summary: Significance of smoothed terms

Variable	Df	Npar Df	Npar F	Pr(F)
Depth	**1**	**3**	**2.2368**	**0.08186 .**
Slope	**1**	**3**	**0.1468**	**0.93177**
DistShore	**1**	**3**	**17.5106**	**2.608e-11 *****
DistShoal	**1**	**3**	**16.4905**	**1.153e-10 *****
Lon	**1**	**3**	**3.2307**	**0.02145 ***
Lat	**1**	**3**	**7.5600**	**4.812e-05 *****

AIC: 16163.86

Stepwise-selected Model Summary: Significance of smoothed terms

Variable	Df	Npar Df	Npar F	Pr(F)
DistShore	**1**	**3**	**18.6341**	**5.065e-12 *****
DistShoal	**1**	**3**	**14.7024**	**1.559e-09 *****
Lon	**1**	**3**	**2.9838**	**0.03003 ***
Lat	**1**	**3**	**7.3061**	**6.920e-05 *****

AIC: 16155.27

Significant codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
Df=degrees of freedom, NparDf=nonparametric degrees of freedom, NparF=nonparametric F value, Pr(F)=probability value.

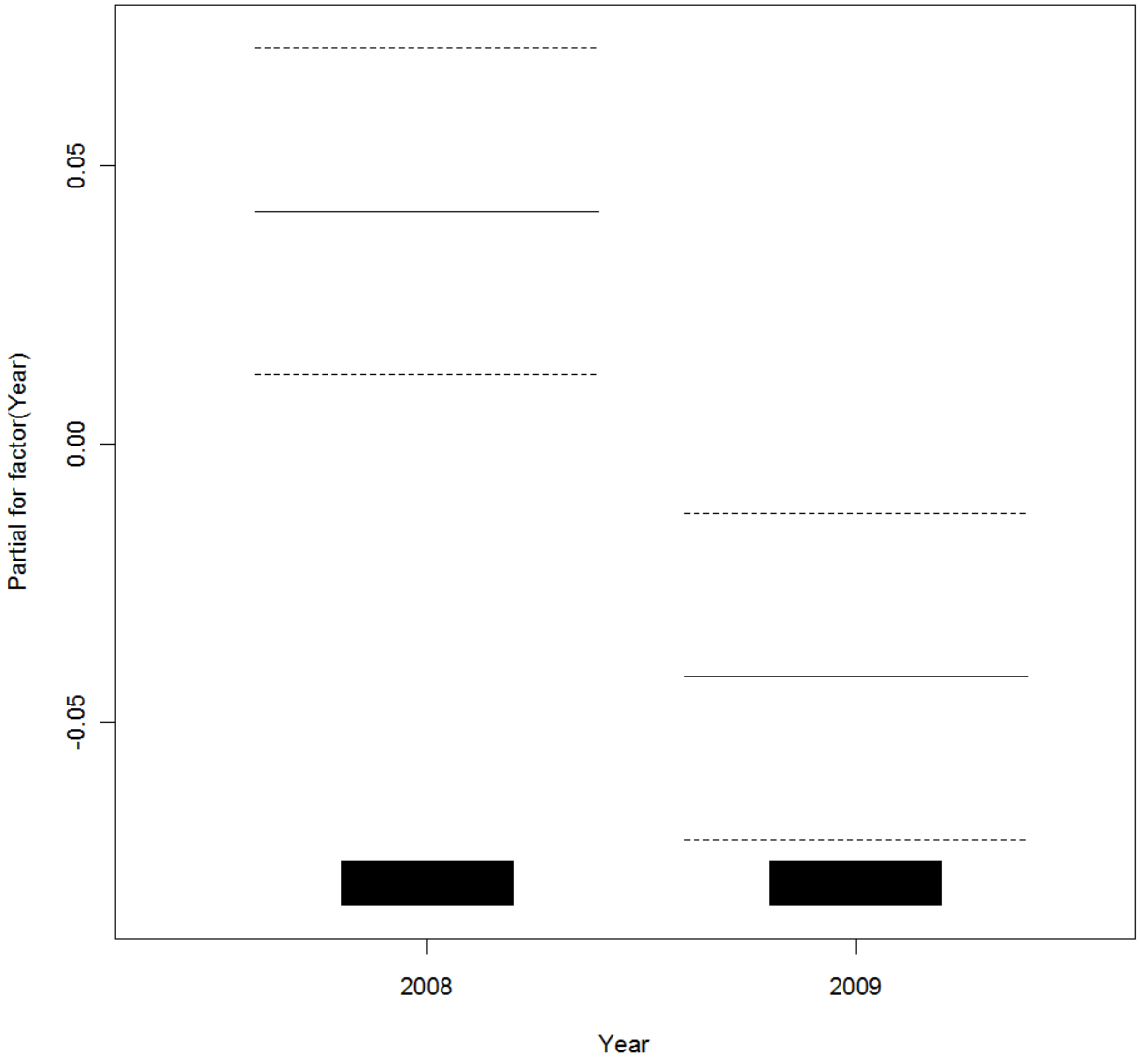

Figure M-99. Result of GAM regression for the effect of year on Common Tern density. Broken lines represent 95% confidence intervals around the covariate main effect.

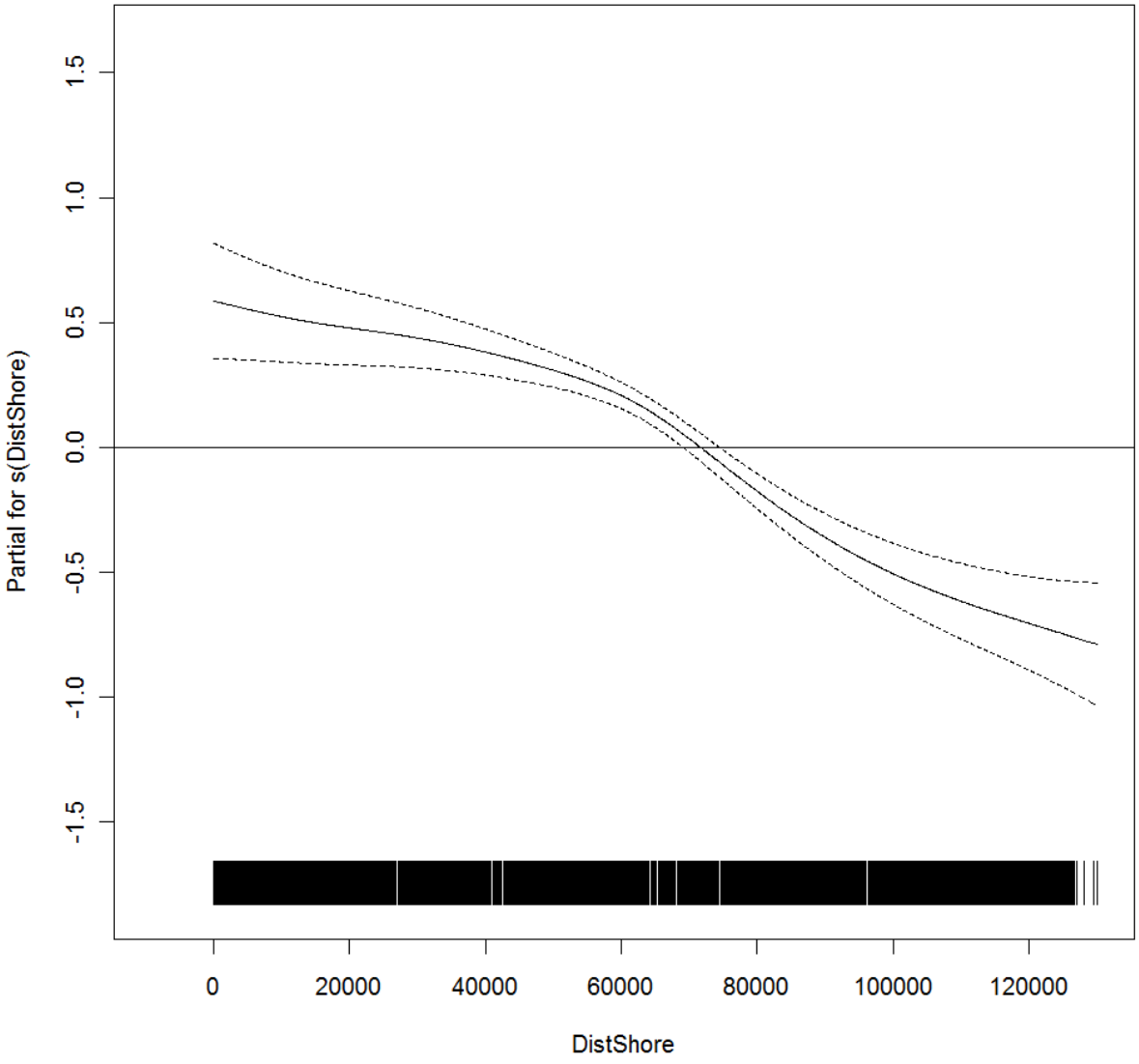

Figure M-100. Result of GAM regression for the effect of distance to shoreline 'DistShore' (feet) on Common Tern density. Broken lines represent 95% confidence intervals around the covariate main effect.

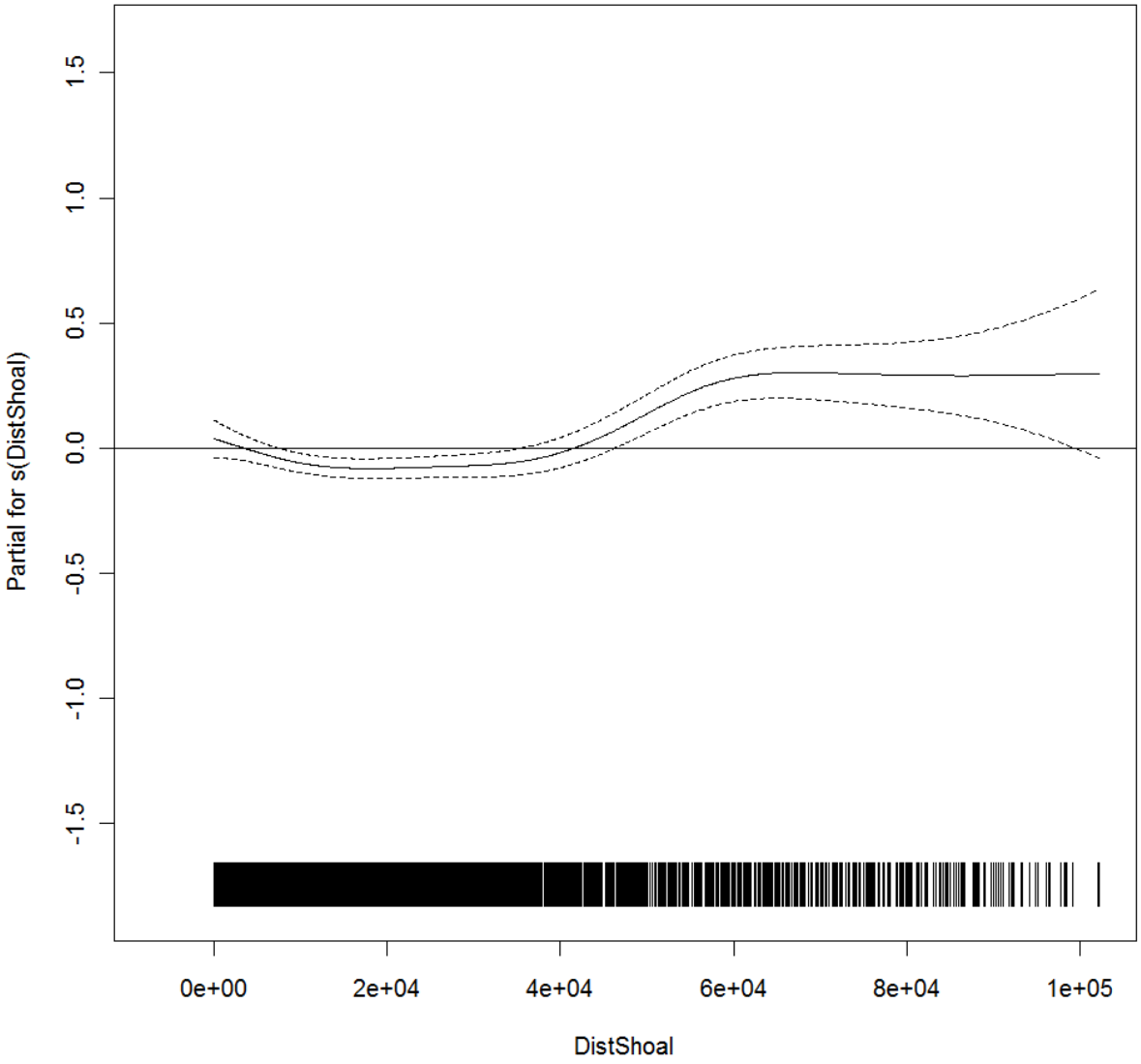

Figure M-101. Result of GAM regression for the effect of distance to nearest shoal 'DistShoal' (feet) on Common Tern density. Broken lines represent 95% confidence intervals around the covariate main effect.

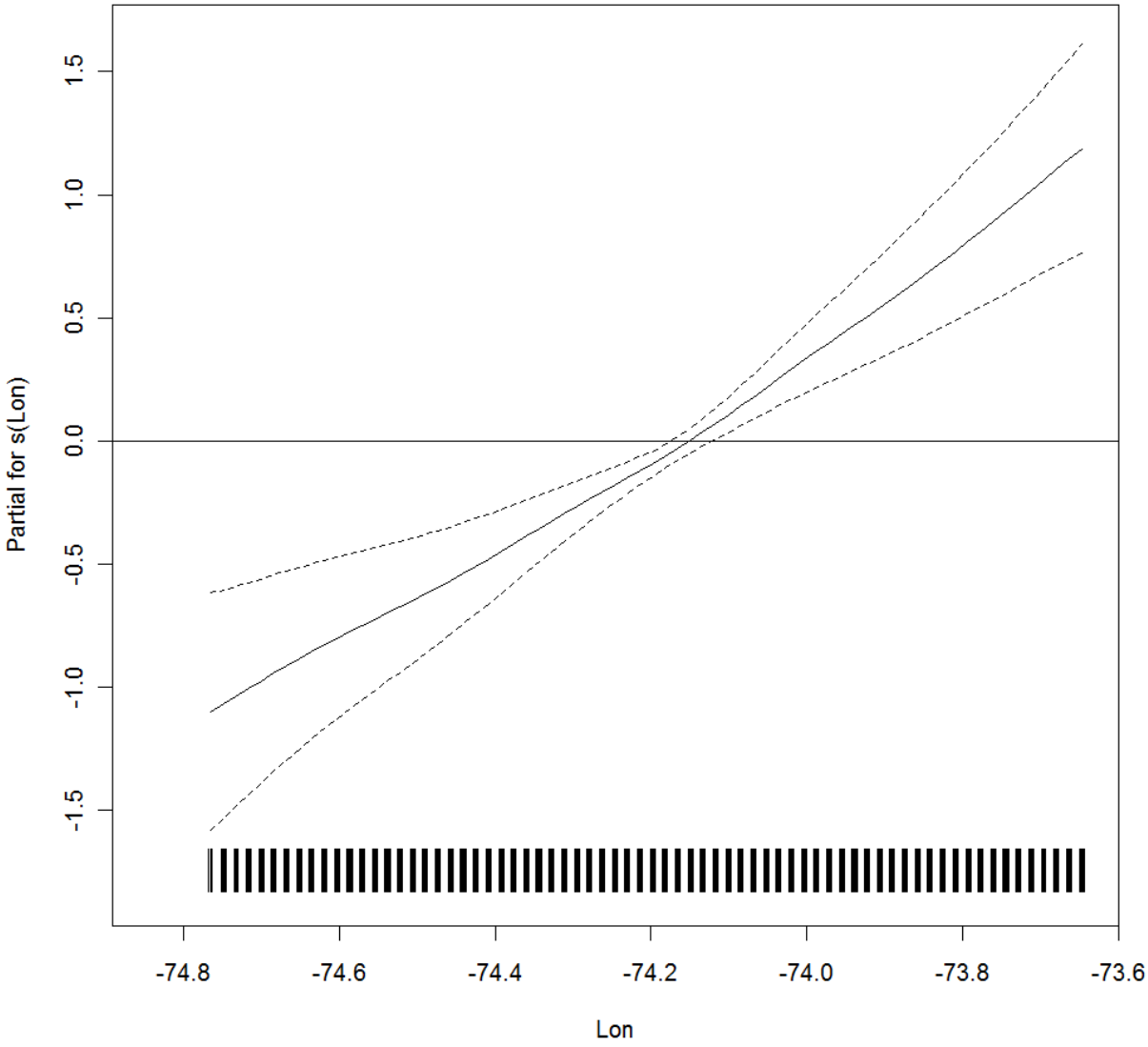

Figure M-102. Result of GAM regression for the effect of longitude 'Lon' on Common Tern density. Broken lines represent 95% confidence intervals around the covariate main effect.

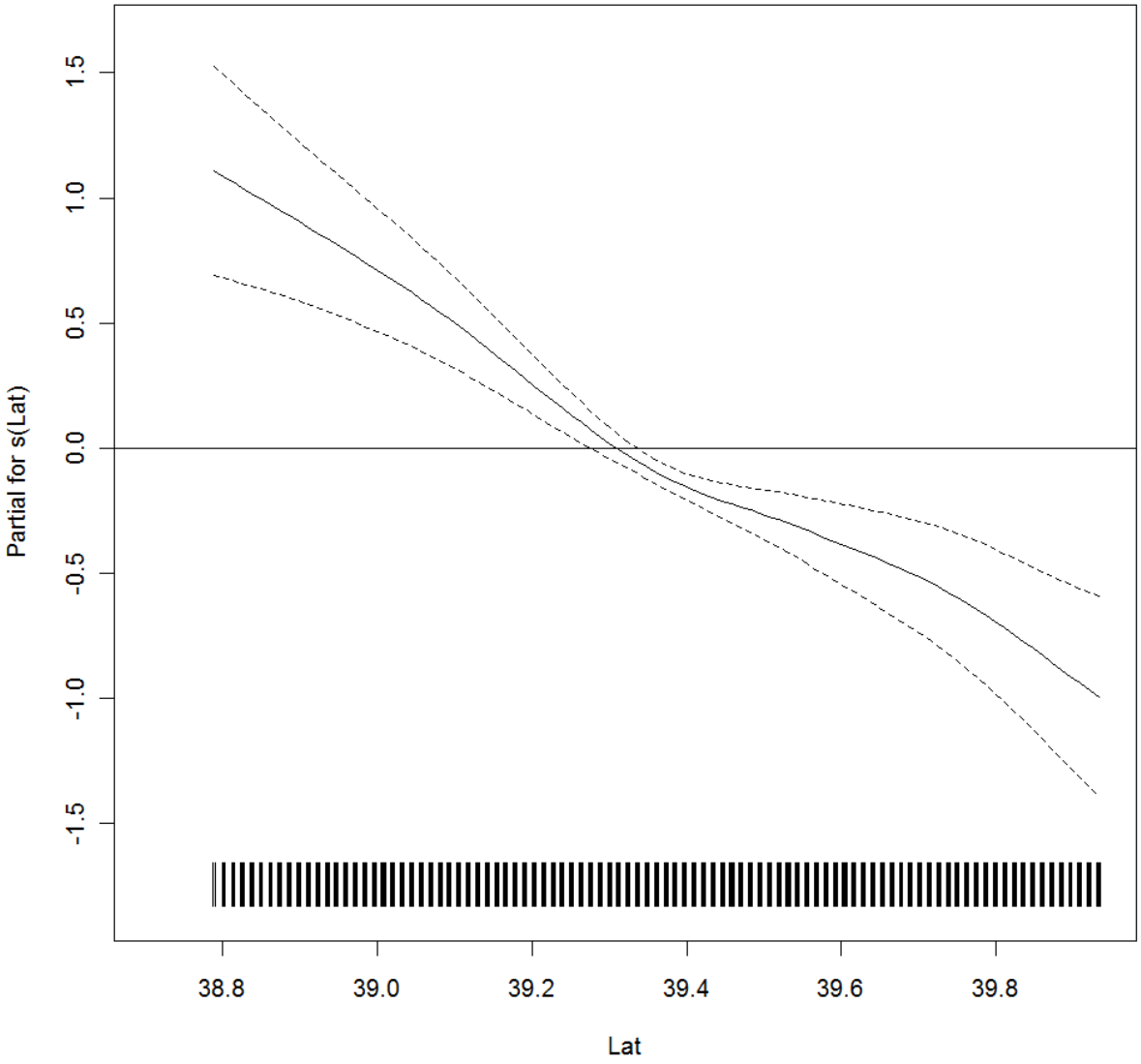

Figure M-103. Result of GAM regression for the effect of latitude 'Lat' on Common Tern density. Broken lines represent 95% confidence intervals around the covariate main effect.

Table M-40. Spatial regression model and for spatial covariates and Wilson's Storm Petrel density.

Spatial Regression Model:
Spatial lag model – Maximum Likelihood Estimation
N=2698, R^2=0.34, Log likelihood=--955.5, Akaike info criterion=1926.9
Global Moran's I = 0.5655, p<0.001

Variable	Coefficient	Std.Error	z-value	Probability
Spatial lag	0.484	0.014	34.867	**0.0000**
Constant	-50.341	361.643	-0.139	0.8890
Depth	0.358	0.041	8.685	**0.0000**
Slope	-0.105	0.483	-0.218	0.8275
DistShore	3.283e-005	1.60e-005	2.047	**0.0406**
DistShoal	1.206e-005	7.73e-006	1.561	0.1185
Longitude	0.082	3.327	0.024	0.9801
Latitude	1.600	2.927	0.546	0.5846

Table M-41. GAM results for spatial covariates and Wilson's Storm Petrel density.

Generalized Additive Models:
Initial Model Summary: Significance of smoothed terms

Variable	Df	Npar Df	Npar F	Pr(F)
Depth	**1**	**3**	**12.028**	**7.621e-08 *** **
Slope	**1**	**3**	**0.579**	**0.6289290**
DistShore	**1**	**3**	**49.334**	**<2.2e-16 *** **
DistShoal	**1**	**3**	**5.558**	**0.0008342 *** **
Lon	**1**	**3**	**24.911**	**5.551e-16 *** **
Lat	**1**	**3**	**13.520**	**8.706e-09 *** **

AIC: 8646.79

Stepwise-selected Model Summary: Significance of smoothed terms

Variable	Df	Npar Df	Npar F	Pr(F)
Depth	**1**	**3**	**11.624**	**1.369e-07 *** **
DistShore	**1**	**3**	**51.030**	**<2.2e-16 *** **
DistShoal	**1**	**3**	**5.477**	**0.0009347 *** **
Lon	**1**	**3**	**24.774**	**6.661e-16 *** **
Lat	**1**	**3**	**12.715**	**2.807e-08 *** **

AIC: 8643.084

Significant codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
Df=degrees of freedom, NparDf=nonparametric degrees of freedom, NparF=nonparametric F value, Pr(F)=probability value.

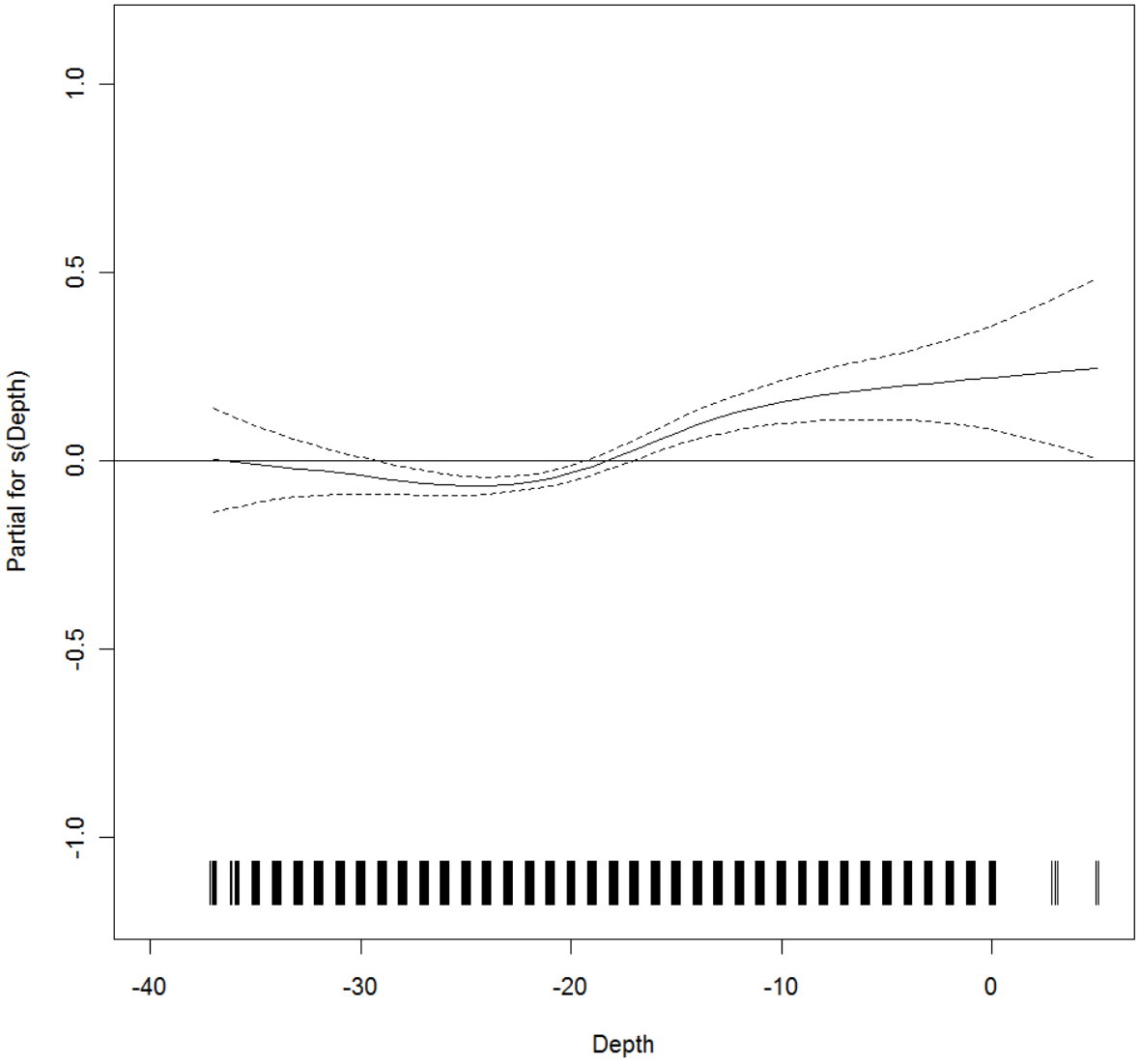

Figure M-104. Result of GAM regression for the effect of depth (m) on Wilson's Storm Petrel density. Broken lines represent 95% confidence intervals around the covariate main effect.

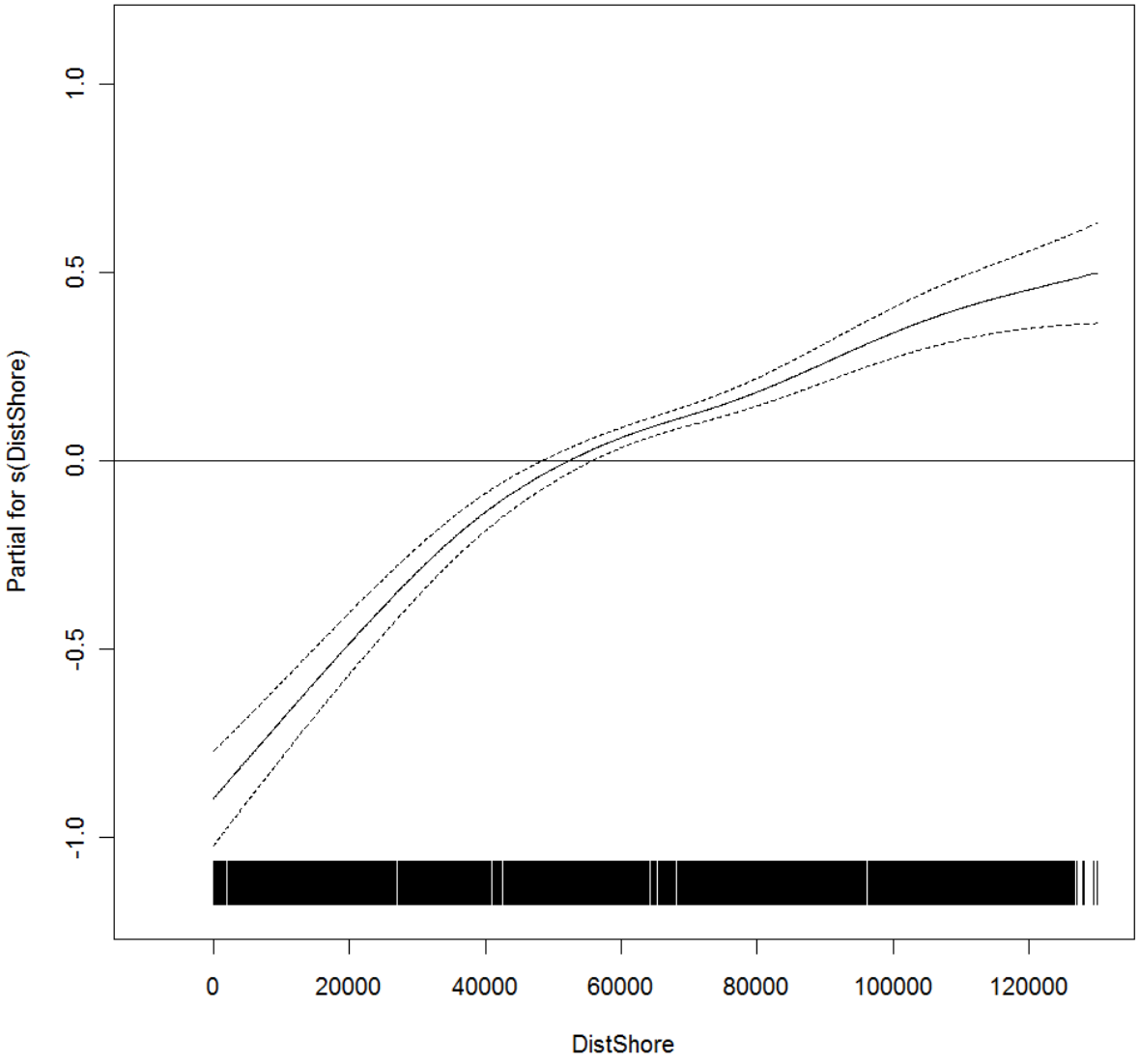

Figure M-105. Result of GAM regression for the effect of distance to shoreline 'DistShore' (feet) on Wilson's Storm Petrel density. Broken lines represent 95% confidence intervals around the covariate main effect.

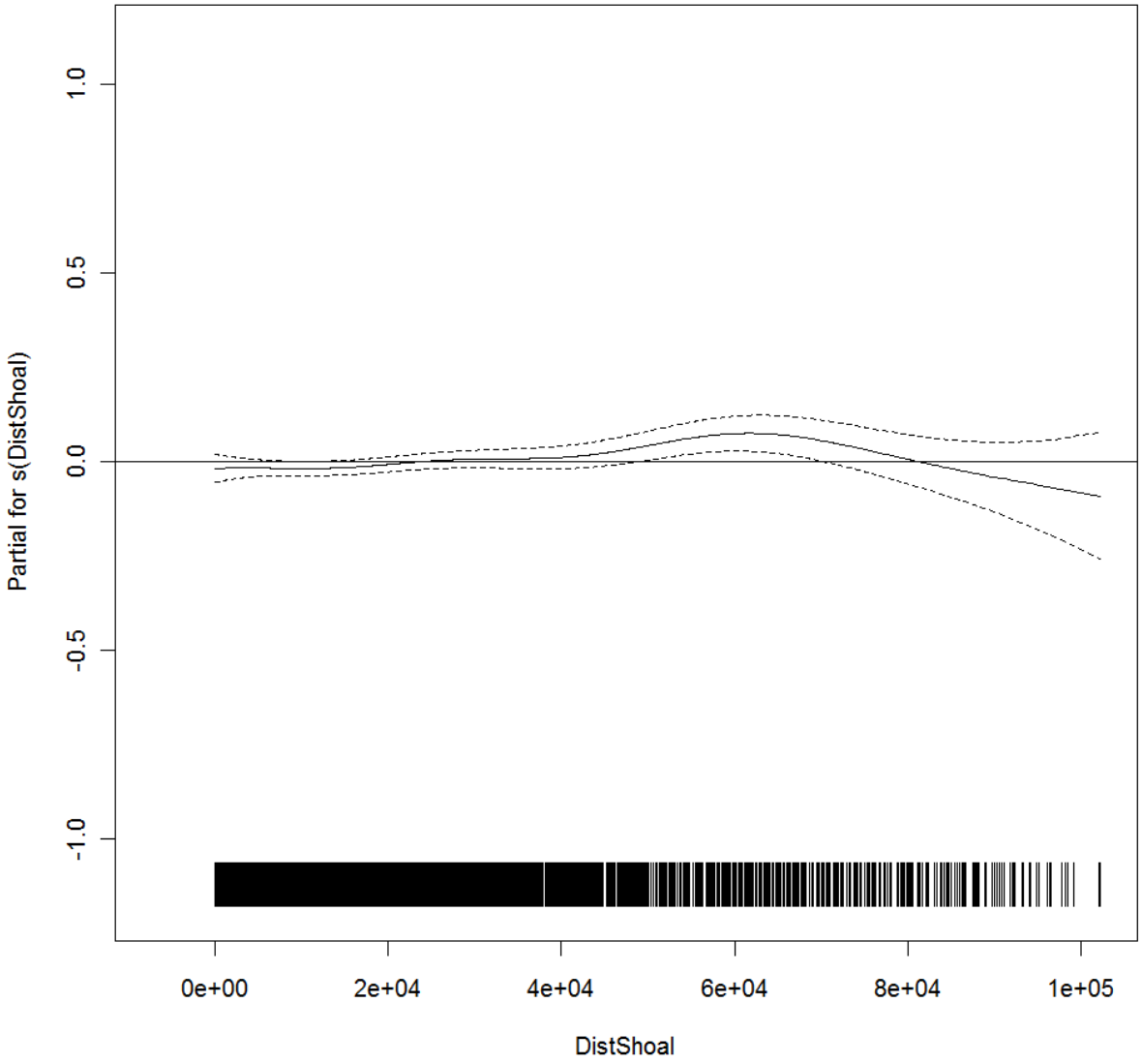

Figure M-106. Result of GAM regression for the effect of distance to nearest shoal 'DistShoal' (feet) on Wilson's Storm Petrel density. Broken lines represent 95% confidence intervals around the covariate main effect.

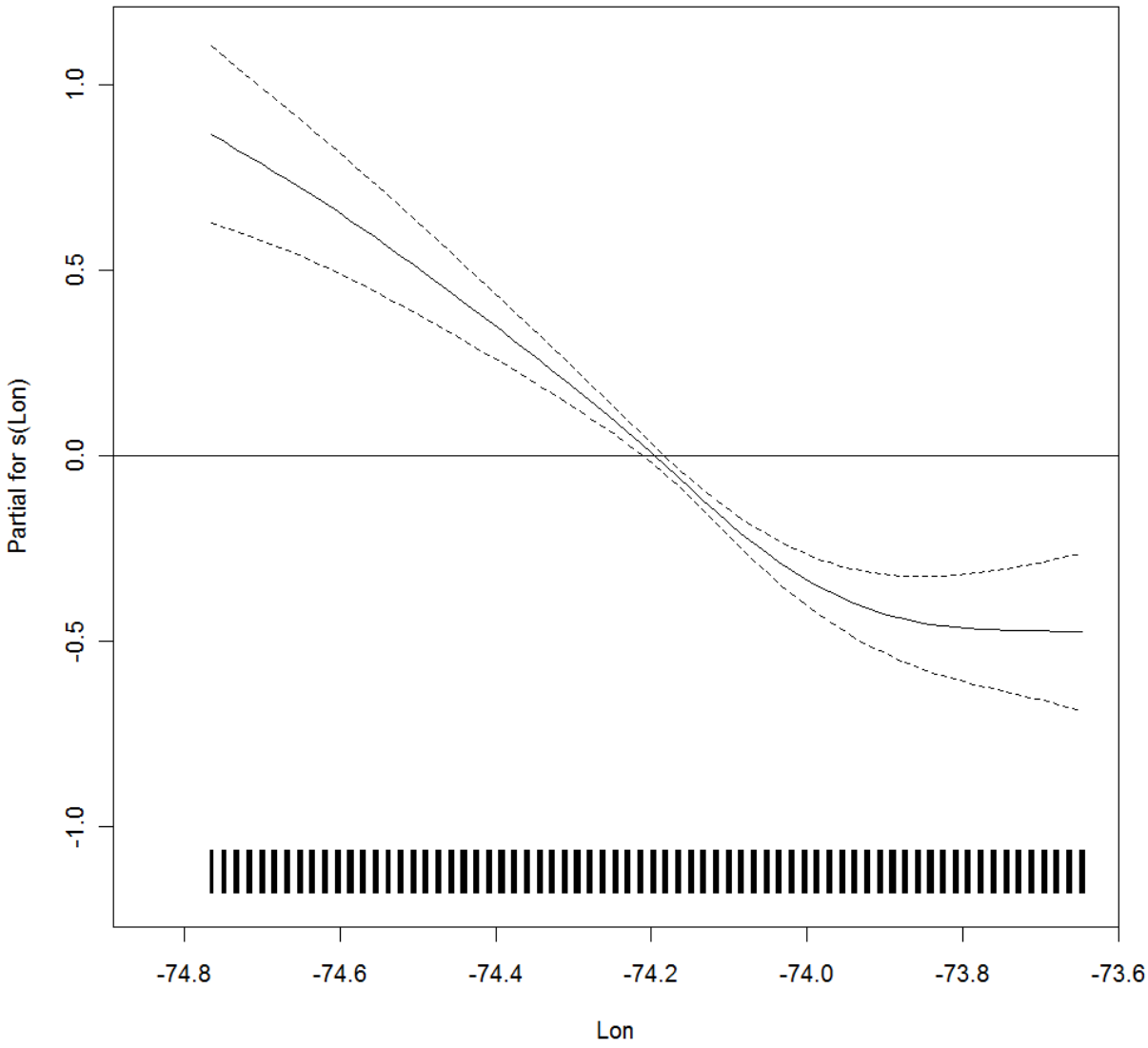

Figure M-107. Result of GAM regression for the effect of longitude 'Lon' on Wilson's Storm Petrel density. Broken lines represent 95% confidence intervals around the covariate main effect.

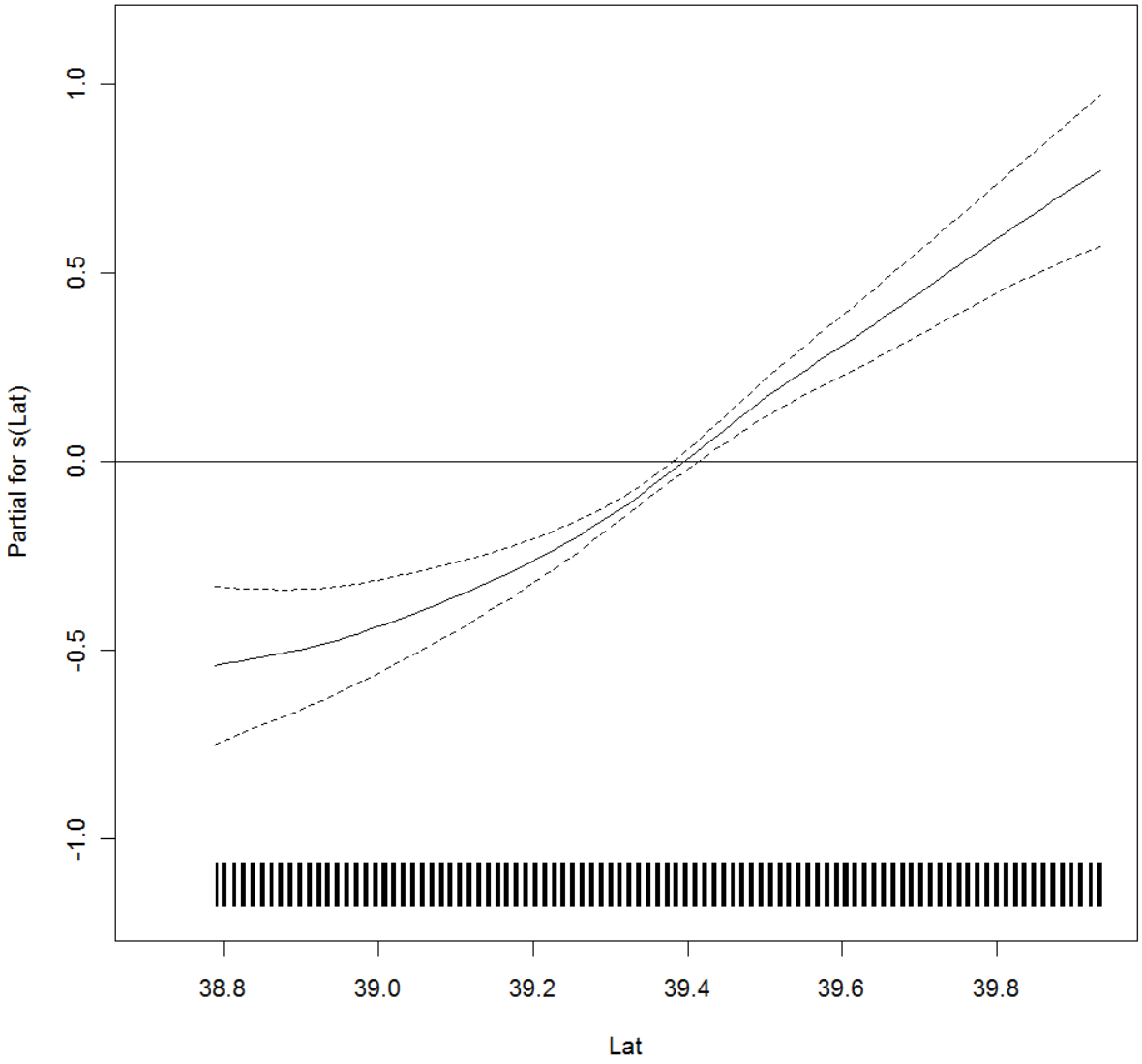

Figure M-108. Result of GAM regression for the effect of latitude 'Lat' on Wilson's Storm Petrel density. Broken lines represent 95% confidence intervals around the covariate main effect.

Table M-42. Spatial regression model results for spatial covariates and Cory Shearwater density.

Spatial Regression Model:
Spatial lag model – Maximum Likelihood Estimation
N=2698, R^2=0.81, Log likelihood=--3293.8, Akaike info criterion=6603.6
Global Moran's I = 0.885, p<0.01

Variable	Coefficient	Std.Error	z-value	Probability
Spatial lag	0.733	0.007	101.435	**0.0000**
Constant	-10.07	34.844	-0.289	0.7725
Depth	0.001	0.003	0.313	0.7535
Slope	0.002	0.053	0.034	0.9725
DistShore	2.308e-006	1.52e-006	1.519	0.1286
DistShoal	2.719e-006	7.60e-006	3.574	**0.0003**
Longitude	-0.046	0.321	-0.144	0.8852
Latitude	0.165	0.280	0.589	0.5553

Table M-43. GAM results for spatial covariates and Cory Shearwater density.

Generalized Additive Models:
Initial Model Summary: Significance of smoothed terms

Variable	Df	Npar Df	Npar F	Pr(F)
Depth	**1**	**3**	**33.361**	**<2.2e-16 *** **
Slope	**1**	**3**	**0.699**	**0.5523**
DistShore	**1**	**3**	**29.958**	**<2.2e-16 *** **
DistShoal	**1**	**3**	**91.968**	**<2.2e-16 *** **
Lon	**1**	**3**	**60.769**	**<2.2e-16 *** **
Lat	**1**	**3**	**24.109**	**2.109e-15 *** **

AIC: 8974.697

Stepwise-selected Model Summary: Significance of smoothed terms

Variable	Df	Npar Df	Npar F	Pr(F)
Depth	**1**	**3**	**33.569**	**<2.2e-16 *** **
DistShore	**1**	**3**	**29.944**	**<2.2e-16 *** **
DistShoal	**1**	**3**	**92.268**	**<2.2e-16 *** **
Lon	**1**	**3**	**60.422**	**<2.2e-16 *** **
Lat	**1**	**3**	**23.885**	**2.998e-15 *** **

AIC: 8969.383

Significant codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
Df=degrees of freedom, NparDf=nonparametric degrees of freedom, NparF=nonparametric F value, Pr(F)=probability value.

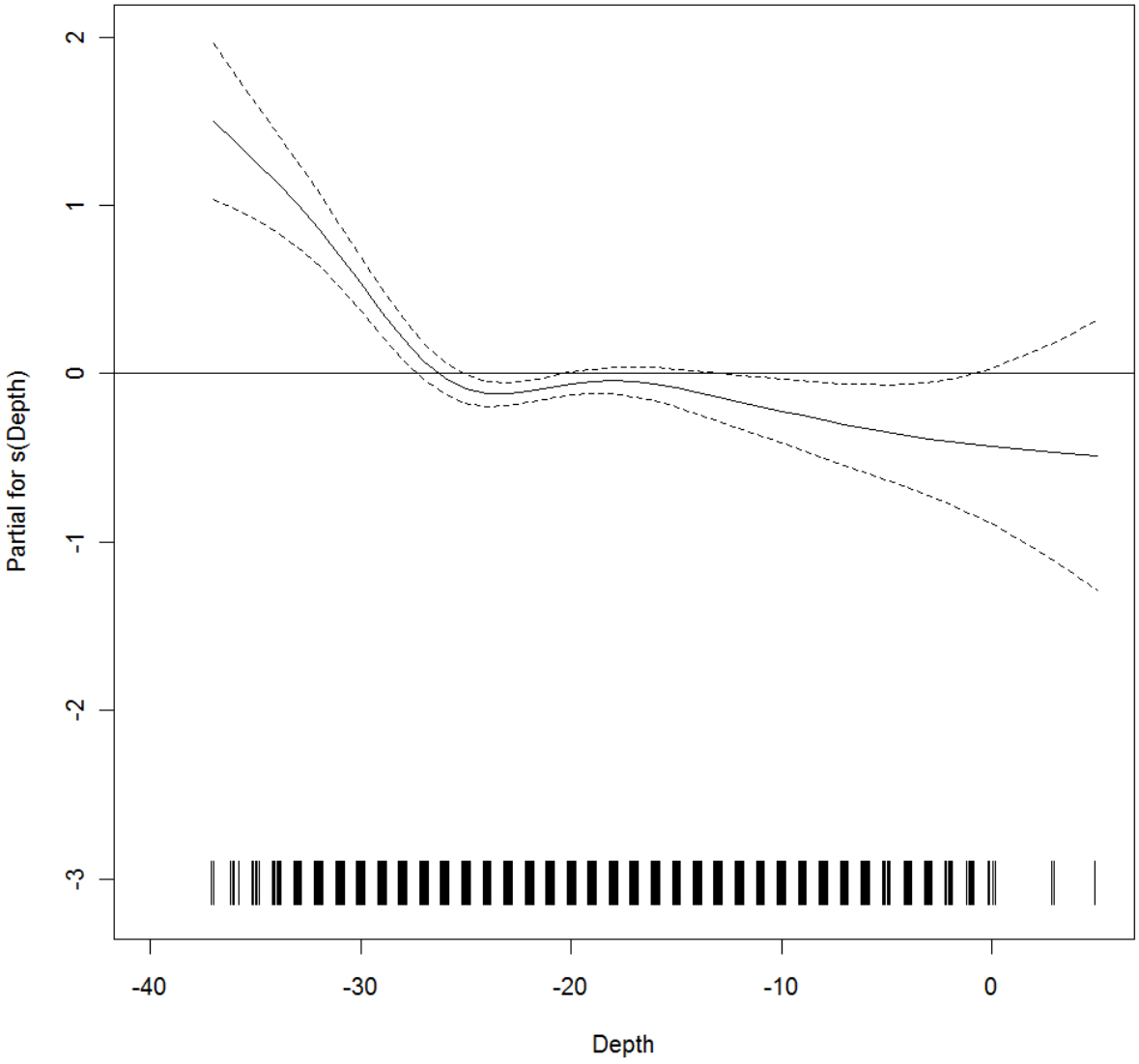

Figure M-109. Result of GAM regression for the effect of depth (m) on Cory Shearwater density. Broken lines represent 95% confidence intervals around the covariate main effect.

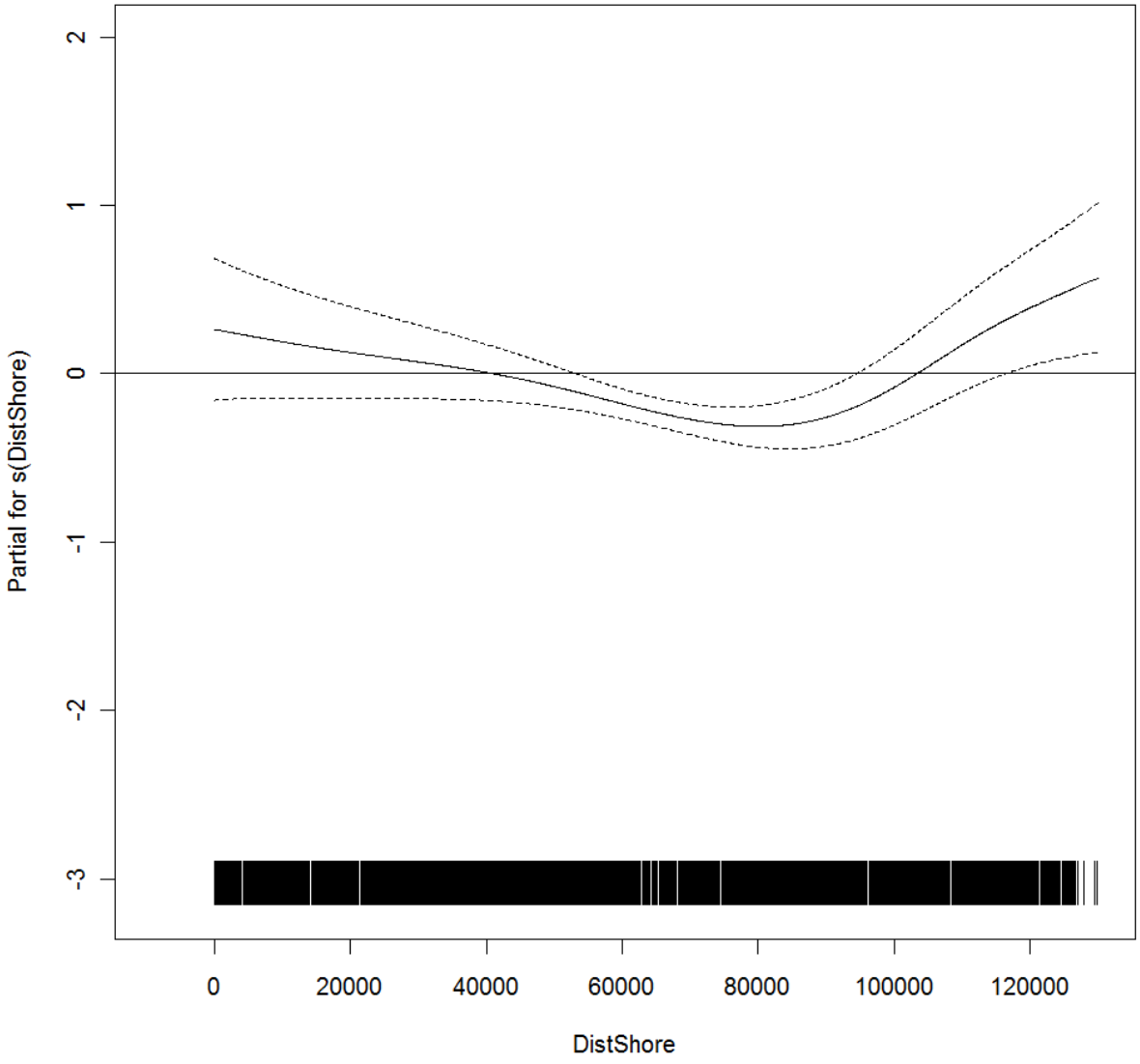

Figure M-110. Result of GAM regression for the effect of distance to shoreline 'DistShore' (feet) on Cory Shearwater density. Broken lines represent 95% confidence intervals around the covariate main effect.

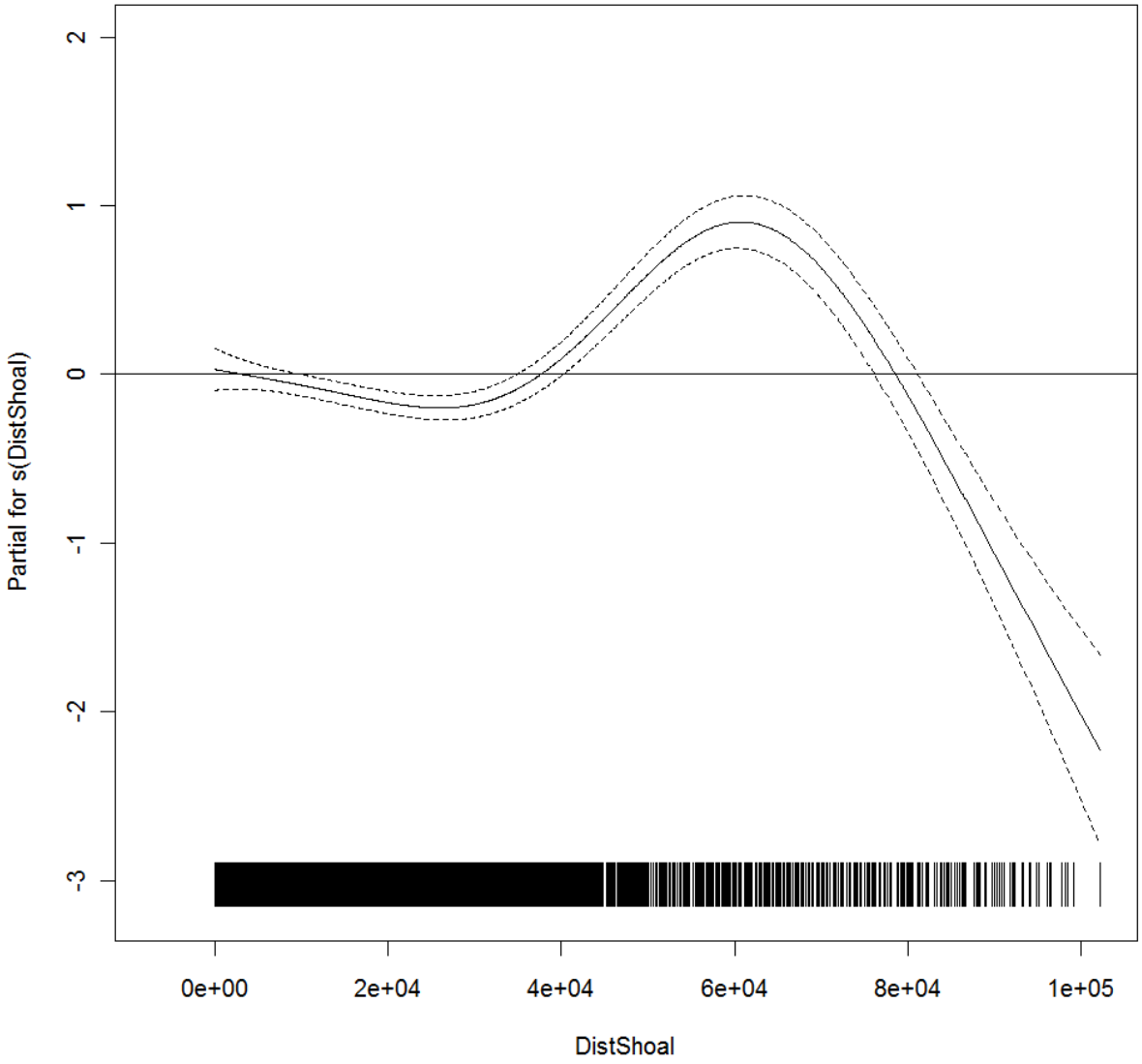

Figure M-111. Result of GAM regression fit for the effect of distance to nearest shoal 'DistShoal' (feet) on Cory Shearwater density. Broken lines represent 95% confidence intervals around the covariate main effect.

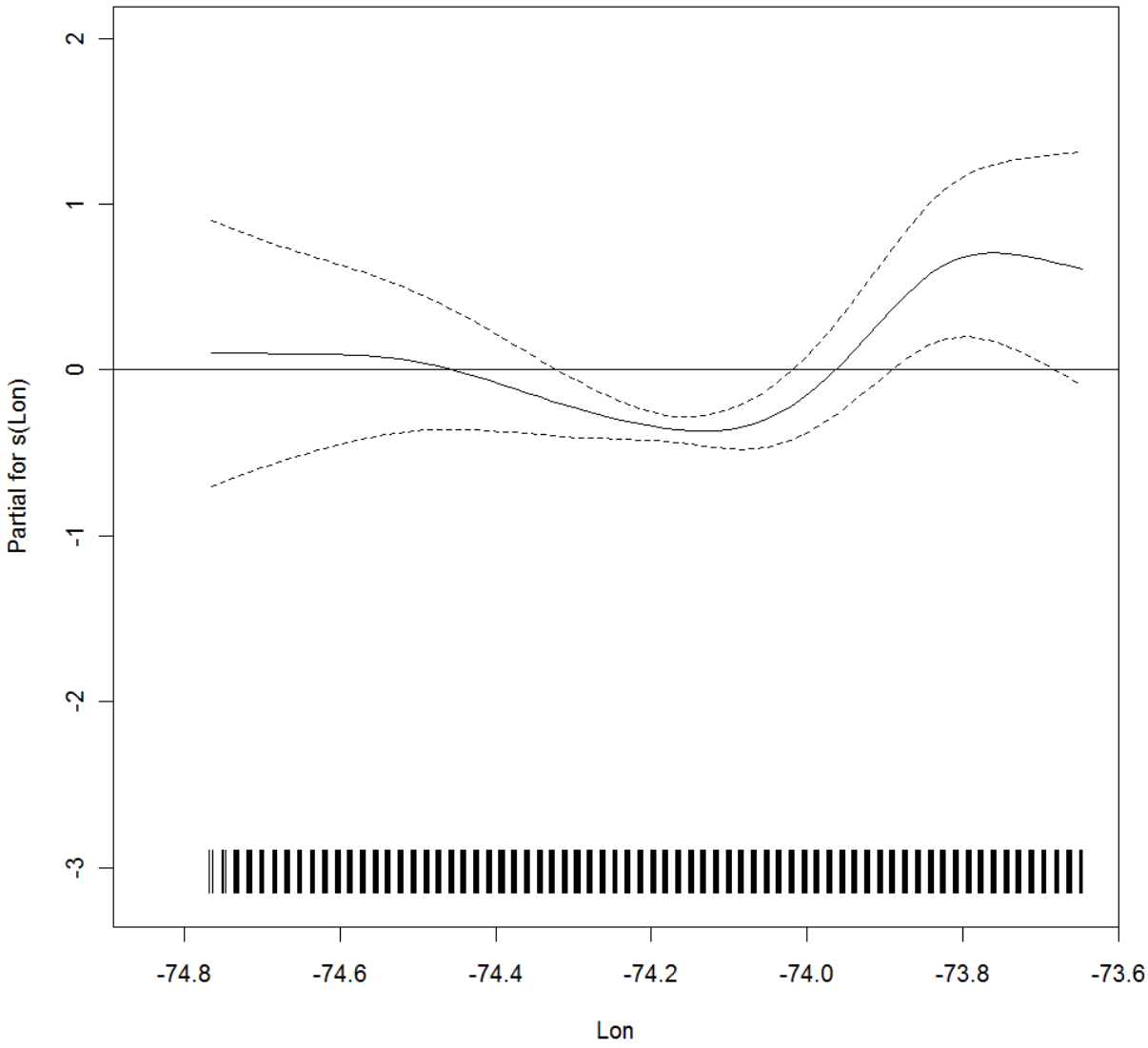

Figure M-112. Result of GAM regression for the effect of longitude 'Lon' on Cory Shearwater density. Broken lines represent 95% confidence intervals around the covariate main effect.

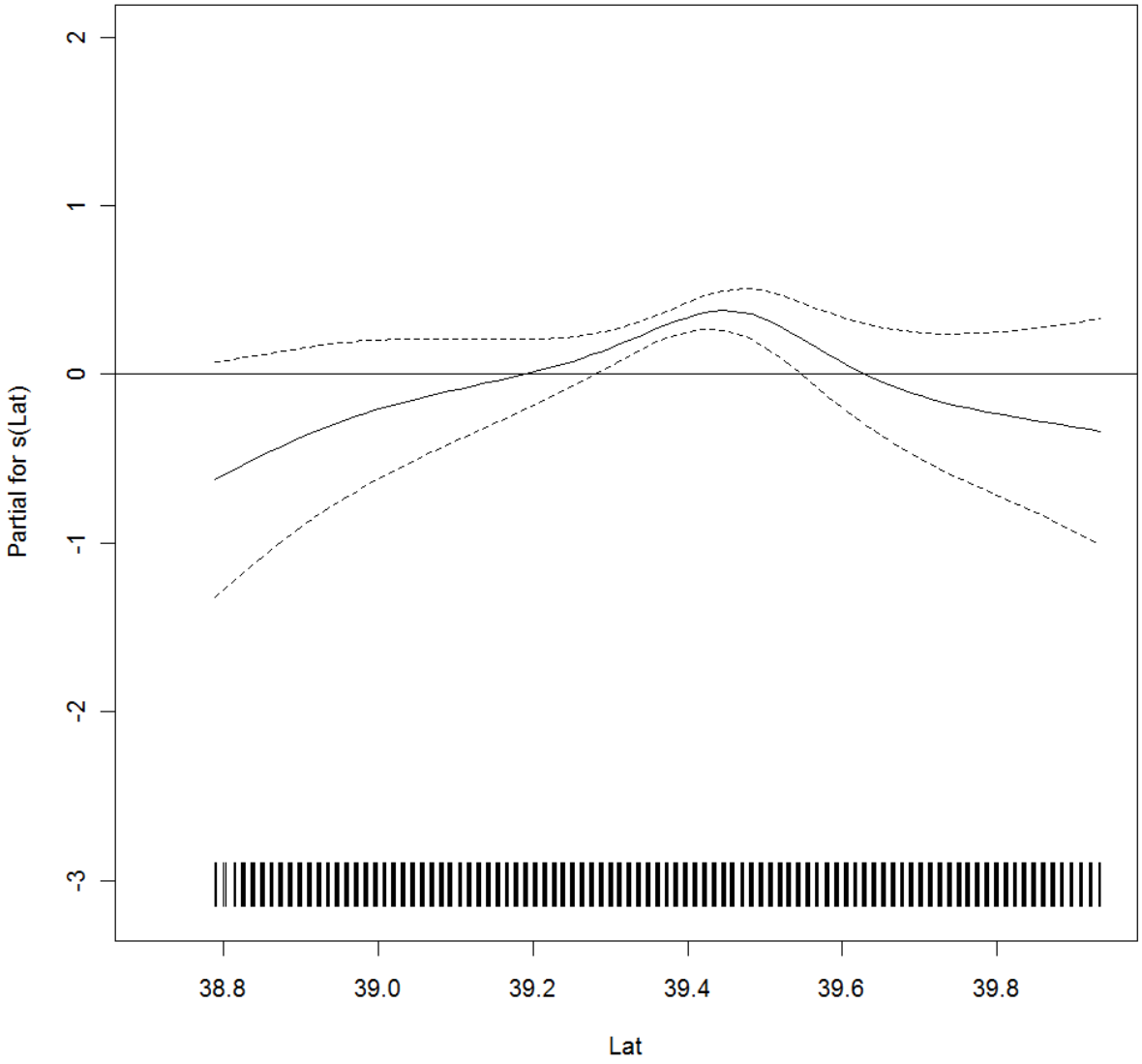

Figure M-113. Result of GAM regression for the effect of latitude 'Lat' on Cory Shearwater density. Broken lines represent 95% confidence intervals around the covariate main effect.

Table M-44. Summary of top 5 most abundant species for each time period and bird behavior, for use in Hotspot analysis.

Behavior	Time	Species	#Observations	Abundance	ClusterSize	h
alltypes	Jan-08	SCOTER	27	912	33.7778	0.5595
alltypes	Jan-08	HERG	21	367	17.4761	0.5595
alltypes	Jan-08	NOGA	141	357	2.5319	0.5595
alltypes	Jan-08	LTDU	25	245	9.8000	0.5595
alltypes	Jan-08	RTLO	90	160	1.7778	0.5595
alltypes	Jan-08	All Species	394	2435	6.1802	0.5595
alltypes	Feb-08	LTDU	5	48	9.6000	0.2260
alltypes	Feb-08	SCOTER	3	38	12.6667	0.2260
alltypes	Feb-08	COLO	14	20	1.4286	0.2260
alltypes	Feb-08	GULLS	10	11	1.1000	0.2260
alltypes	Feb-08	NOGA	9	9	1.0000	0.2260
alltypes	Feb-08	All Species	45	130	2.8889	0.2260
alltypes	Mar-08	NOGA	114	682	5.9825	0.5210
alltypes	Mar-08	SCOTER	27	301	11.1481	0.5210
alltypes	Mar-08	HERG	44	169	3.8409	0.5210
alltypes	Mar-08	LTDU	21	80	3.8095	0.5210
alltypes	Mar-08	RTLO	44	74	1.6818	0.5210
alltypes	Mar-08	All Species	303	1457	4.8086	0.5210
alltypes	Apr-08	SCOTER	54	1215	22.5000	0.5308
alltypes	Apr-08	NOGA	219	492	2.2466	0.5308
alltypes	Apr-08	BOGU	32	109	3.4062	0.5308
alltypes	Apr-08	RTLO	61	107	1.7541	0.5308
alltypes	Apr-08	HERG	74	102	1.3784	0.5308
alltypes	Apr-08	All Species	538	2183	4.0576	0.5308
alltypes	May-08	NOGA	97	228	2.3505	0.5777
alltypes	May-08	SCOTER	1	140	140.0000	0.5777

Table M-44 (*continued*). Summary of top 5 most abundant species for each time period and bird behavior, for use in Hotspot analysis.

Behavior	Time	Species	#Observations	Abundance	ClusterSize	h
alltypes	May-08	COTE	36	94	2.6111	0.5777
alltypes	May-08	LAGU	43	85	1.9767	0.5777
alltypes	May-08	HERG	65	83	1.2769	0.5777
alltypes	May-08	All Species	375	853	2.2747	0.5777
alltypes	Jun-08	LAGU	146	332	2.2740	0.5247
alltypes	Jun-08	COTE	106	212	2.0000	0.5247
alltypes	Jun-08	WISP	125	198	1.5840	0.5247
alltypes	Jun-08	NOGA	85	124	1.4588	0.5247
alltypes	Jun-08	COSH	26	51	1.9615	0.5247
alltypes	Jun-08	All Species	539	1004	1.8627	0.5247
alltypes	Jul-08	LAGU	168	405	2.4107	0.4623
alltypes	Jul-08	COTE	90	273	3.0333	0.4623
alltypes	Jul-08	WISP	118	213	1.8051	0.4623
alltypes	Jul-08	WHIM	2	49	24.5001	0.4623
alltypes	Jul-08	COSH	25	36	1.4400	0.4623
alltypes	Jul-08	All Species	460	1062	2.3087	0.4623
alltypes	Aug-08	WISP	124	1245	10.0403	0.5041
alltypes	Aug-08	LAGU	269	1110	4.1264	0.5041
alltypes	Aug-08	COTE	232	716	3.0862	0.5041
alltypes	Aug-08	GBBG	78	131	1.6795	0.5041
alltypes	Aug-08	TESM	9	78	8.6667	0.5041
alltypes	Aug-08	All Species	804	3486	4.3358	0.5041
alltypes	Sep-08	LAGU	204	415	2.0343	0.5127
alltypes	Sep-08	COTE	62	355	5.7258	0.5127
alltypes	Sep-08	GBBG	145	301	2.0759	0.5127
alltypes	Sep-08	HERG	67	172	2.5672	0.5127

Table M-44 (*continued*). Summary of top 5 most abundant species for each time period and bird behavior, for use in Hotspot analysis.

Behavior	Time	Species	#Observations	Abundance	ClusterSize	h
alltypes	Sep-08	TESM	12	73	6.0833	0.5127
alltypes	Sep-08	All Species	574	1553	2.7056	0.5127
alltypes	Oct-08	DCCO	23	1004	43.6520	0.5161
alltypes	Oct-08	NOGA	193	813	4.2124	0.5161
alltypes	Oct-08	LAGU	138	777	5.6304	0.5161
alltypes	Oct-08	FOTE	38	419	11.0263	0.5161
alltypes	Oct-08	GBBG	100	262	2.6200	0.5161
alltypes	Oct-08	All Species	715	3841	5.3720	0.5161
alltypes	Nov-08	SCOTER	34	3353	98.6174	0.4985
alltypes	Nov-08	NOGA	286	2380	8.3217	0.4985
alltypes	Nov-08	LAGU	96	1337	13.9271	0.4985
alltypes	Nov-08	RTLO	80	646	8.0750	0.4985
alltypes	Nov-08	BOGU	43	643	14.9535	0.4985
alltypes	Nov-08	All Species	946	9847	10.4091	0.4985
alltypes	Dec-08	SCOTER	53	3557	67.1131	0.4515
alltypes	Dec-08	NOGA	126	369	2.9286	0.4515
alltypes	Dec-08	RTLO	121	332	2.7438	0.4515
alltypes	Dec-08	LTDU	17	330	19.4117	0.4515
alltypes	Dec-08	BOGU	48	187	3.8958	0.4515
alltypes	Dec-08	All Species	565	5248	9.2885	0.4515
alltypes	Jan-09	SCAUP	19	2469	129.9467	0.4739
alltypes	Jan-09	SCOTER	81	2459	30.3580	0.4739
alltypes	Jan-09	LTDU	48	895	18.6458	0.4739
alltypes	Jan-09	NOGA	163	421	2.5828	0.4739
alltypes	Jan-09	COLO	150	314	2.0933	0.4739
alltypes	Jan-09	All Species	732	7326	10.0082	0.4739

Table M-44 (*continued*). Summary of top 5 most abundant species for each time period and bird behavior, for use in Hotspot analysis.

Behavior	Time	Species	#Observations	Abundance	ClusterSize	h
alltypes	Feb-09	SCOTER	119	1827	15.3529	0.5238
alltypes	Feb-09	LTDU	121	1756	14.5124	0.5238
alltypes	Feb-09	COLO	169	728	4.3077	0.5238
alltypes	Feb-09	HERG	168	592	3.5238	0.5238
alltypes	Feb-09	RTLO	86	134	1.5581	0.5238
alltypes	Feb-09	All Species	876	5321	6.0742	0.5238
alltypes	Mar-09	SCOTER	93	1375	14.7849	0.5214
alltypes	Mar-09	LTDU	46	659	14.3261	0.5214
alltypes	Mar-09	NOGA	225	534	2.3733	0.5214
alltypes	Mar-09	ALCIDS	130	508	3.9077	0.5214
alltypes	Mar-09	HERG	197	462	2.3452	0.5214
alltypes	Mar-09	All Species	1052	4241	4.0314	0.5214
alltypes	Apr-09	SCOTER	38	291	7.6579	0.4821
alltypes	Apr-09	NOGA	88	151	1.7159	0.4821
alltypes	Apr-09	HERG	56	85	1.5179	0.4821
alltypes	Apr-09	COLO	46	58	1.2609	0.4821
alltypes	Apr-09	RTLO	32	49	1.5312	0.4821
alltypes	Apr-09	All Species	336	793	2.3601	0.4821
alltypes	May-09	NOGA	260	745	2.8654	0.5235
alltypes	May-09	COLO	203	508	2.5025	0.5235
alltypes	May-09	HERG	136	237	1.7426	0.5235
alltypes	May-09	LAGU	101	198	1.9604	0.5235
alltypes	May-09	COTE	54	169	3.1296	0.5235
alltypes	May-09	All Species	890	2184	2.4539	0.5235
alltypes	Jun-09	LAGU	145	345	2.3793	0.5187
alltypes	Jun-09	NOGA	147	282	1.9184	0.5187

Table M-44 (*continued*). Summary of top 5 most abundant species for each time period and bird behavior, for use in Hotspot analysis.

Behavior	Time	Species	#Observations	Abundance	ClusterSize	h
alltypes	Jun-09	COTE	108	201	1.8611	0.5187
alltypes	Jun-09	WISP	72	113	1.5694	0.5187
alltypes	Jun-09	HERG	65	86	1.3231	0.5187
alltypes	Jun-09	All Species	636	1164	1.8302	0.5187
alltypes	Aug-09	LAGU	152	440	2.8947	0.5294
alltypes	Aug-09	WISP	167	322	1.9281	0.5294
alltypes	Aug-09	GBBG	70	111	1.5857	0.5294
alltypes	Aug-09	COTE	73	105	1.4384	0.5294
alltypes	Aug-09	COSH	40	55	1.3750	0.5294
alltypes	Aug-09	All Species	569	1151	2.0228	0.5294
alltypes	Sep-09	WISP	150	248	1.6533	0.5092
alltypes	Sep-09	LAGU	110	213	1.9364	0.5092
alltypes	Sep-09	HERG	36	120	3.3333	0.5092
alltypes	Sep-09	GBBG	58	116	2.0000	0.5092
alltypes	Sep-09	COTE	30	68	2.2667	0.5092
alltypes	Sep-09	All Species	443	865	1.9526	0.5092
alltypes	Oct-09	LAGU	78	848	10.8718	0.5123
alltypes	Oct-09	GBBG	96	235	2.4479	0.5123
alltypes	Oct-09	HERG	38	126	3.3158	0.5123
alltypes	Oct-09	FOTE	13	112	8.6154	0.5123
alltypes	Oct-09	BRPE	8	37	4.6250	0.5123
alltypes	Oct-09	All Species	254	1390	5.4724	0.5123
alltypes	Nov-09	NOGA	283	2358	8.3322	0.5289
alltypes	Nov-09	SCOTER	21	637	30.3332	0.5289
alltypes	Nov-09	RTLO	100	449	4.4900	0.5289
alltypes	Nov-09	HERG	102	383	3.7549	0.5289

Table M-44 (*continued*). Summary of top 5 most abundant species for each time period and bird behavior, for use in Hotspot analysis.

Behavior	Time	Species	#Observations	Abundance	ClusterSize	h
alltypes	Nov-09	BOGU	4	228	57.0000	0.5289
alltypes	Nov-09	All Species	787	4750	6.0356	0.5289
alltypes	Dec-09	SCOTER	147	1264	8.5986	0.5610
alltypes	Dec-09	LTDU	34	392	11.5294	0.5610
alltypes	Dec-09	NOGA	106	322	3.0377	0.5610
alltypes	Dec-09	COLO	102	260	2.5490	0.5610
alltypes	Dec-09	HERG	53	243	4.5849	0.5610
alltypes	Dec-09	All Species	553	2743	4.9602	0.5610
alltypes	Winter2008(DJF)	SCOTER	30	950	31.6667	0.5579
alltypes	Winter2008(DJF)	HERG	21	367	17.4761	0.5595
alltypes	Winter2008(DJF)	NOGA	150	366	2.4400	0.5579
alltypes	Winter2008(DJF)	LTDU	30	293	9.7666	0.5579
alltypes	Winter2008(DJF)	RTLO	91	161	1.7692	0.5579
alltypes	Winter2008(DJF)	All Species	439	2565	5.8428	0.5579
alltypes	Spring2008(MAM)	SCOTER	82	1656	20.1951	0.5596
alltypes	Spring2008(MAM)	NOGA	430	1402	3.2605	0.5595
alltypes	Spring2008(MAM)	HERG	183	354	1.9344	0.5595
alltypes	Spring2008(MAM)	COLO	146	216	1.4795	0.5595
alltypes	Spring2008(MAM)	RTLO	105	181	1.7238	0.5275
alltypes	Spring2008(MAM)	All Species	1216	4493	3.6949	0.5596
alltypes	Summer2008(JJ)	LAGU	314	737	2.3471	0.5124
alltypes	Summer2008(JJ)	COTE	196	485	2.4745	0.5124
alltypes	Summer2008(JJ)	WISP	243	411	1.6914	0.5124
alltypes	Summer2008(JJ)	NOGA	98	138	1.4082	0.5124
alltypes	Summer2008(JJ)	COSH	51	87	1.7059	0.5124
alltypes	Summer2008(JJ)	All Species	999	2066	2.0681	0.5124

Table M-44 (*continued*). Summary of top 5 most abundant species for each time period and bird behavior, for use in Hotspot analysis.

Behavior	Time	Species	#Observations	Abundance	ClusterSize	h
alltypes	Autumn2008(ASON)	LAGU	707	3639	5.1471	0.4988
alltypes	Autumn2008(ASON)	SCOTER	47	3554	75.6169	0.5044
alltypes	Autumn2008(ASON)	NOGA	541	3282	6.0665	0.4988
alltypes	Autumn2008(ASON)	WISP	124	1245	10.0403	0.5041
alltypes	Autumn2008(ASON)	COTE	294	1071	3.6429	0.5091
alltypes	Autumn2008(ASON)	All Species	3039	18727	6.1622	0.4989
alltypes	Winter2009(DJF)	SCOTER	253	7843	31.0000	0.5057
alltypes	Winter2009(DJF)	LTDU	186	2981	16.0269	0.5057
alltypes	Winter2009(DJF)	SCAUP	19	2469	129.9467	0.4739
alltypes	Winter2009(DJF)	COLO	397	1148	2.8917	0.5057
alltypes	Winter2009(DJF)	NOGA	376	913	2.4282	0.5057
alltypes	Winter2009(DJF)	All Species	2173	17895	8.2352	0.5057
alltypes	Spring2009(MAM)	SCOTER	133	1708	12.8421	0.5098
alltypes	Spring2009(MAM)	NOGA	573	1430	2.4956	0.5098
alltypes	Spring2009(MAM)	COLO	400	839	2.0975	0.5098
alltypes	Spring2009(MAM)	HERG	389	784	2.0154	0.5098
alltypes	Spring2009(MAM)	LTDU	46	659	14.3261	0.5214
alltypes	Spring2009(MAM)	All Species	2278	7218	3.1686	0.5098
alltypes	Summer2009(JJ)	LAGU	145	345	2.3793	0.5187
alltypes	Summer2009(JJ)	NOGA	147	282	1.9184	0.5187
alltypes	Summer2009(JJ)	COTE	108	201	1.8611	0.5187
alltypes	Summer2009(JJ)	WISP	72	113	1.5694	0.5187
alltypes	Summer2009(JJ)	HERG	65	86	1.3231	0.5187
alltypes	Summer2009(JJ)	All Species	636	1164	1.8302	0.5187
alltypes	Autumn2009(ASON)	NOGA	322	2404	7.4658	0.5096
alltypes	Autumn2009(ASON)	LAGU	356	1542	4.3315	0.5096

Table M-44 (*continued*). Summary of top 5 most abundant species for each time period and bird behavior, for use in Hotspot analysis.

Behavior	Time	Species	#Observations	Abundance	ClusterSize	h
alltypes	Autumn2009(ASON)	HERG	182	641	3.5220	0.5096
alltypes	Autumn2009(ASON)	SCOTER	21	637	30.3332	0.5289
alltypes	Autumn2009(ASON)	WISP	317	570	1.7981	0.5172
alltypes	Autumn2009(ASON)	All Species	2053	8156	3.9727	0.5096
alltypes	Winter2010(DJF)	SCOTER	147	1264	8.5986	0.5610
alltypes	Winter2010(DJF)	LTDU	34	392	11.5294	0.5610
alltypes	Winter2010(DJF)	NOGA	106	322	3.0377	0.5610
alltypes	Winter2010(DJF)	COLO	102	260	2.5490	0.5610
alltypes	Winter2010(DJF)	HERG	53	243	4.5849	0.5610
alltypes	Winter2010(DJF)	All Species	553	2743	4.9602	0.5610
alltypes	2008	SCOTER	212	9717	45.8349	0.5618
alltypes	2008	NOGA	1345	5557	4.1316	0.5526
alltypes	2008	LAGU	1064	4461	4.1927	0.5342
alltypes	2008	HERG	588	1826	3.1054	0.5527
alltypes	2008	WISP	367	1656	4.5123	0.5118
alltypes	2008	All Species	6258	33099	5.2891	0.5527
alltypes	2009	SCOTER	501	7895	15.7585	0.5023
alltypes	2009	NOGA	1398	4982	3.5637	0.4975
alltypes	2009	LTDU	264	3848	14.5758	0.5064
alltypes	2009	HERG	944	2504	2.6525	0.4975
alltypes	2009	SCAUP	19	2469	129.9467	0.4739
alltypes	2009	All Species	7128	31928	4.4792	0.4975
alltypes	Overall	SCOTER	713	17612	24.7013	0.5503
alltypes	Overall	NOGA	2743	10539	3.8421	0.5433
alltypes	Overall	LAGU	1694	6668	3.9362	0.5241
alltypes	Overall	LTDU	332	4551	13.7078	0.5361

Table M-44 (*continued*). Summary of top 5 most abundant species for each time period and bird behavior, for use in Hotspot analysis.

Behavior	Time	Species	#Observations	Abundance	ClusterSize	h
alltypes	Overall	HERG	1532	4330	2.8264	0.5433
alltypes	Overall	All Species	13386	65027	4.8578	0.5434
sitting	Jan-08	NOGA	25	88	3.5200	0.5595
sitting	Jan-08	SCOTER	4	31	7.7500	0.5595
sitting	Jan-08	RTLO	22	30	1.3636	0.5595
sitting	Jan-08	LTDU	3	10	3.3333	0.5595
sitting	Jan-08	BOGU	2	5	2.5000	0.5595
sitting	Jan-08	All Species	61	170	2.7869	0.5595
sitting	Feb-08	COLO	13	19	1.4615	0.2260
sitting	Feb-08	SCOTER	1	17	16.9984	0.2260
sitting	Feb-08	NOGA	2	2	1.0000	0.2260
sitting	Feb-08	GULLS	1	2	1.9998	0.2260
sitting	Feb-08	ALCIDS	1	1	1.0000	0.2260
sitting	Feb-08	All Species	18	41	2.2778	0.2260
sitting	Mar-08	NOGA	30	193	6.4333	0.5210
sitting	Mar-08	HERG	13	79	6.0769	0.5210
sitting	Mar-08	COLO	25	54	2.1600	0.5210
sitting	Mar-08	SAND	1	35	34.9966	0.5210
sitting	Mar-08	GBBG	7	20	2.8572	0.5210
sitting	Mar-08	All Species	93	424	4.5591	0.5210
sitting	Apr-08	SCOTER	12	664	55.3333	0.5308
sitting	Apr-08	NOGA	89	185	2.0786	0.5308
sitting	Apr-08	BOGU	7	52	7.4286	0.5308
sitting	Apr-08	COLO	33	48	1.4545	0.5308
sitting	Apr-08	RTLO	16	23	1.4375	0.5308
sitting	Apr-08	All Species	169	997	5.8994	0.5308

Table M-44 (*continued*). Summary of top 5 most abundant species for each time period and bird behavior, for use in Hotspot analysis.

Behavior	Time	Species	#Observations	Abundance	ClusterSize	h
sitting	May-08	NOGA	2	4	2.0000	0.5777
sitting	May-08	LAGU	3	4	1.3333	0.5777
sitting	May-08	TERN	3	4	1.3333	0.5777
sitting	May-08	HERG	2	2	1.0000	0.5777
sitting	May-08	GBBG	2	2	1.0000	0.5777
sitting	May-08	All Species	14	18	1.2857	0.5777
sitting	Jun-08	LAGU	21	62	2.9524	0.5247
sitting	Jun-08	NOGA	45	55	1.2222	0.5247
sitting	Jun-08	COSH	2	18	9.0001	0.5247
sitting	Jun-08	GBBG	6	11	1.8333	0.5247
sitting	Jun-08	COTE	2	3	1.5000	0.5247
sitting	Jun-08	All Species	77	150	1.9480	0.5247
sitting	Jul-08	LAGU	4	11	2.7500	0.4623
sitting	Jul-08	WISP	5	5	1.0000	0.4623
sitting	Jul-08	GBBG	3	3	1.0000	0.4623
sitting	Jul-08	COTE	1	1	1.0000	0.4623
sitting	Jul-08	NOGA	1	1	1.0000	0.4623
sitting	Jul-08	All Species	15	22	1.4667	0.4623
sitting	Aug-08	LAGU	45	343	7.6222	0.5041
sitting	Aug-08	WISP	2	191	95.5000	0.5041
sitting	Aug-08	TESM	1	63	62.9938	0.5041
sitting	Aug-08	GBBG	33	57	1.7273	0.5041
sitting	Aug-08	SAND	1	35	34.9966	0.5041
sitting	Aug-08	All Species	105	737	7.0190	0.5041
sitting	Sep-08	GBBG	57	125	2.1930	0.5127
sitting	Sep-08	LAGU	29	81	2.7931	0.5127

Table M-44 (*continued*). Summary of top 5 most abundant species for each time period and bird behavior, for use in Hotspot analysis.

Behavior	Time	Species	#Observations	Abundance	ClusterSize	h
sitting	Sep-08	HERG	13	68	5.2308	0.5127
sitting	Sep-08	RBGU	4	43	10.7500	0.5127
sitting	Sep-08	NOGA	16	19	1.1875	0.5127
sitting	Sep-08	All Species	122	342	2.8033	0.5127
sitting	Oct-08	GBBG	68	421	6.1912	0.5161
sitting	Oct-08	LAGU	27	196	7.2592	0.5161
sitting	Oct-08	NOGA	59	136	2.3051	0.5161
sitting	Oct-08	HERG	19	49	2.5789	0.5161
sitting	Oct-08	RTLO	11	18	1.6364	0.5161
sitting	Oct-08	All Species	195	840	4.3077	0.5161
sitting	Nov-08	LAGU	13	813	62.5385	0.4985
sitting	Nov-08	NOGA	98	535	5.4592	0.4985
sitting	Nov-08	HERG	20	246	12.2999	0.4985
sitting	Nov-08	COLO	113	233	2.0619	0.4985
sitting	Nov-08	BOGU	12	217	18.0833	0.4985
sitting	Nov-08	All Species	331	2299	6.9456	0.4985
sitting	Dec-08	SCOTER	9	828	92.0000	0.4515
sitting	Dec-08	LTDU	7	260	37.1429	0.4515
sitting	Dec-08	RBME	1	135	134.9865	0.4515
sitting	Dec-08	RTLO	52	128	2.4615	0.4515
sitting	Dec-08	NOGA	41	104	2.5366	0.4515
sitting	Dec-08	All Species	213	1676	7.8685	0.4515
sitting	Jan-09	SCOTER	50	1891	37.8199	0.4739
sitting	Jan-09	SCAUP	1	1500	1499.8501	0.4739
sitting	Jan-09	LTDU	31	753	24.2902	0.4739
sitting	Jan-09	COLO	144	306	2.1250	0.4739

Table M-44 (*continued*). Summary of top 5 most abundant species for each time period and bird behavior, for use in Hotspot analysis.

Behavior	Time	Species	#Observations	Abundance	ClusterSize	h
sitting	Jan-09	RBME	2	179	89.5000	0.4739
sitting	Jan-09	All Species	328	4844	14.7683	0.4739
sitting	Feb-09	LTDU	87	1237	14.2184	0.5238
sitting	Feb-09	SCOTER	66	1139	17.2576	0.5238
sitting	Feb-09	COLO	168	723	4.3036	0.5238
sitting	Feb-09	HERG	43	385	8.9535	0.5238
sitting	Feb-09	RTLO	38	63	1.6579	0.5238
sitting	Feb-09	All Species	478	3649	7.6339	0.5238
sitting	Mar-09	SCOTER	36	636	17.6666	0.5214
sitting	Mar-09	LTDU	25	481	19.2399	0.5214
sitting	Mar-09	ALCIDS	93	419	4.5054	0.5214
sitting	Mar-09	COLO	150	264	1.7600	0.5214
sitting	Mar-09	NOGA	75	151	2.0133	0.5214
sitting	Mar-09	All Species	454	2232	4.9163	0.5214
sitting	Apr-09	COLO	37	45	1.2162	0.4821
sitting	Apr-09	SCOTER	7	29	4.1429	0.4821
sitting	Apr-09	NOGA	21	27	1.2857	0.4821
sitting	Apr-09	BOGU	6	24	4.0000	0.4821
sitting	Apr-09	DCCO	2	16	8.0001	0.4821
sitting	Apr-09	All Species	85	154	1.8118	0.4821
sitting	May-09	NOGA	134	321	2.3955	0.5235
sitting	May-09	COLO	74	129	1.7432	0.5235
sitting	May-09	HERG	48	85	1.7708	0.5235
sitting	May-09	LAGU	36	56	1.5556	0.5235
sitting	May-09	GBBG	12	22	1.8333	0.5235
sitting	May-09	All Species	324	658	2.0309	0.5235

Table M-44 (*continued*). Summary of top 5 most abundant species for each time period and bird behavior, for use in Hotspot analysis.

Behavior	Time	Species	#Observations	Abundance	ClusterSize	h
sitting	Jun-09	NOGA	83	143	1.7229	0.5187
sitting	Jun-09	LAGU	16	24	1.5000	0.5187
sitting	Jun-09	COLO	13	16	1.2308	0.5187
sitting	Jun-09	GBBG	6	10	1.6667	0.5187
sitting	Jun-09	HERG	4	8	2.0000	0.5187
sitting	Jun-09	All Species	124	204	1.6452	0.5187
sitting	Aug-09	LAGU	26	148	5.6923	0.5294
sitting	Aug-09	GBBG	33	50	1.5151	0.5294
sitting	Aug-09	WISP	2	6	3.0000	0.5294
sitting	Aug-09	COSH	3	6	2.0000	0.5294
sitting	Aug-09	NOGA	5	5	1.0000	0.5294
sitting	Aug-09	All Species	73	223	3.0548	0.5294
sitting	Sep-09*	HERG	11	79	7.1818	0.5092
sitting	Sep-09	LAGU	19	72	3.7895	0.5092
sitting	Sep-09	GBBG	23	62	2.6956	0.5092
sitting	Sep-09	NOGA	6	7	1.1667	0.5092
sitting	Sep-09	All Species	59	220	3.7288	0.5092
sitting	Oct-09	LAGU	13	317	24.3846	0.5123
sitting	Oct-09	GBBG	52	136	2.6154	0.5123
sitting	Oct-09	HERG	10	56	5.6000	0.5123
sitting	Oct-09	BRPE	3	24	8.0000	0.5123
sitting	Oct-09	NOGA	4	5	1.2500	0.5123
sitting	Oct-09	All Species	83	539	6.4940	0.5123
sitting	Nov-09	NOGA	112	984	8.7857	0.5289
sitting	Nov-09	BOGU	2	213	106.5000	0.5289
sitting	Nov-09	HERG	14	192	13.7143	0.5289

Table M-44 (*continued*). Summary of top 5 most abundant species for each time period and bird behavior, for use in Hotspot analysis.

Behavior	Time	Species	#Observations	Abundance	ClusterSize	h
sitting	Nov-09	LTDU	4	113	28.2500	0.5289
sitting	Nov-09	COLO	80	104	1.3000	0.5289
sitting	Nov-09	All Species	258	1718	6.6589	0.5289
sitting	Dec-09	SCOTER	51	514	10.0784	0.5610
sitting	Dec-09	LTDU	19	244	12.8420	0.5610
sitting	Dec-09	COLO	83	226	2.7229	0.5610
sitting	Dec-09	HERG	15	108	7.2000	0.5610
sitting	Dec-09	NOGA	25	95	3.8000	0.5610
sitting	Dec-09	All Species	228	1251	5.4868	0.5610
sitting	Winter2008(DJF)	NOGA	27	90	3.3333	0.5579
sitting	Winter2008(DJF)	SCOTER	5	48	9.6000	0.5579
sitting	Winter2008(DJF)	RTLO	22	30	1.3636	0.5579
sitting	Winter2008(DJF)	COLO	13	19	1.4615	0.5579
sitting	Winter2008(DJF)	LTDU	3	10	3.3333	0.5579
sitting	Winter2008(DJF)	All Species	79	211	2.6709	0.5579
sitting	Spring2008(MAM)	SCOTER	17	682	40.1174	0.5595
sitting	Spring2008(MAM)	NOGA	121	382	3.1570	0.5595
sitting	Spring2008(MAM)	COLO	58	102	1.7586	0.5595
sitting	Spring2008(MAM)	HERG	18	96	5.3333	0.5595
sitting	Spring2008(MAM)	BOGU	7	52	7.4286	0.5308
sitting	Spring2008(MAM)	All Species	276	1439	5.2138	0.5595
sitting	Summer2008(JJ)	LAGU	25	73	2.9200	0.5124
sitting	Summer2008(JJ)	NOGA	46	56	1.2174	0.5124
sitting	Summer2008(JJ)	COSH	2	18	9.0001	0.5124
sitting	Summer2008(JJ)	GBBG	9	14	1.5556	0.5124
sitting	Summer2008(JJ)	WISP	5	5	1.0000	0.5124

Table M-44 (*continued*). Summary of top 5 most abundant species for each time period and bird behavior, for use in Hotspot analysis.

Behavior	Time	Species	#Observations	Abundance	ClusterSize	h
sitting	Summer2008(JJ)	All Species	92	172	1.8696	0.5124
sitting	Autumn2008(ASON)	LAGU	114	1433	12.5702	0.4988
sitting	Autumn2008(ASON)	NOGA	189	715	3.7831	0.4988
sitting	Autumn2008(ASON)	GBBG	193	690	3.5751	0.4988
sitting	Autumn2008(ASON)	HERG	54	365	6.7592	0.4988
sitting	Autumn2008(ASON)	COLO	113	233	2.0619	0.4985
sitting	Autumn2008(ASON)	All Species	753	4218	5.6016	0.4988
sitting	Winter2009(DJF)	SCOTER	125	3858	30.8640	0.5057
sitting	Winter2009(DJF)	LTDU	125	2250	18.0000	0.5057
sitting	Winter2009(DJF)	SCAUP	1	1500	1499.8501	0.4739
sitting	Winter2009(DJF)	COLO	380	1119	2.9447	0.5057
sitting	Winter2009(DJF)	HERG	60	441	7.3500	0.5057
sitting	Winter2009(DJF)	All Species	1019	10169	9.9794	0.5057
sitting	Spring2009(MAM)	SCOTER	43	665	15.4651	0.5098
sitting	Spring2009(MAM)	NOGA	230	499	2.1696	0.5098
sitting	Spring2009(MAM)	LTDU	25	481	19.2399	0.5214
sitting	Spring2009(MAM)	COLO	261	438	1.6782	0.5098
sitting	Spring2009(MAM)	ALCIDS	93	419	4.5054	0.5214
sitting	Spring2009(MAM)	All Species	863	3044	3.5272	0.5098
sitting	Summer2009(JJ)	NOGA	83	143	1.7229	0.5187
sitting	Summer2009(JJ)	LAGU	16	24	1.5000	0.5187
sitting	Summer2009(JJ)	COLO	13	16	1.2308	0.5187
sitting	Summer2009(JJ)	GBBG	6	10	1.6667	0.5187
sitting	Summer2009(JJ)	HERG	4	8	2.0000	0.5187
sitting	Summer2009(JJ)	All Species	124	204	1.6452	0.5187

Table M-44 (*continued*). Summary of top 5 most abundant species for each time period and bird behavior, for use in Hotspot analysis.

Behavior	Time	Species	#Observations	Abundance	ClusterSize	h
sitting	Autumn2009(ASON)	NOGA	127	1001	7.8819	0.5096
sitting	Autumn2009(ASON)	LAGU	60	539	8.9833	0.5096
sitting	Autumn2009(ASON)	HERG	37	332	8.9729	0.5096
sitting	Autumn2009(ASON)	GBBG	119	276	2.3193	0.5096
sitting	Autumn2009(ASON)	BOGU	2	213	106.5000	0.5289
sitting	Autumn2009(ASON)	All Species	473	2700	5.7082	0.5096
sitting	Winter2010(DJF)	SCOTER	51	514	10.0784	0.5610
sitting	Winter2010(DJF)	LTDU	19	244	12.8420	0.5610
sitting	Winter2010(DJF)	COLO	83	226	2.7229	0.5610
sitting	Winter2010(DJF)	HERG	15	108	7.2000	0.5610
sitting	Winter2010(DJF)	NOGA	25	95	3.8000	0.5610
sitting	Winter2010(DJF)	All Species	228	1251	5.4868	0.5610
sitting	2008	SCOTER	31	1558	50.2579	0.5312
sitting	2008	LAGU	142	1510	10.6338	0.5342
sitting	2008	NOGA	424	1347	3.1769	0.5526
sitting	2008	GBBG	226	749	3.3142	0.5526
sitting	2008	HERG	80	493	6.1625	0.5526
sitting	2008	All Species	1413	7716	5.4607	0.5526
sitting	2009	SCOTER	210	4209	20.0429	0.5023
sitting	2009	LTDU	166	2828	17.0361	0.5064
sitting	2009	NOGA	517	1837	3.5532	0.4975
sitting	2009	COLO	749	1813	2.4206	0.5007
sitting	2009	SCAUP	1	1500	1499.8501	0.4739
sitting	2009	All Species	2494	15692	6.2919	0.4975
sitting	Overall	SCOTER	241	5767	23.9295	0.5291
sitting	Overall	NOGA	941	3184	3.3836	0.5433

Table M-44 (*continued*). Summary of top 5 most abundant species for each time period and bird behavior, for use in Hotspot analysis.

Behavior	Time	Species	#Observations	Abundance	ClusterSize	h
sitting	Overall	LTDU	179	3111	17.3799	0.5361
sitting	Overall	COLO	1001	2257	2.2547	0.5506
sitting	Overall	LAGU	258	2215	8.5853	0.5241
sitting	Overall	All Species	3907	23408	5.9913	0.5433

Area: 4775 km^2
Note: Only 4 species observed for this month (September 2009)

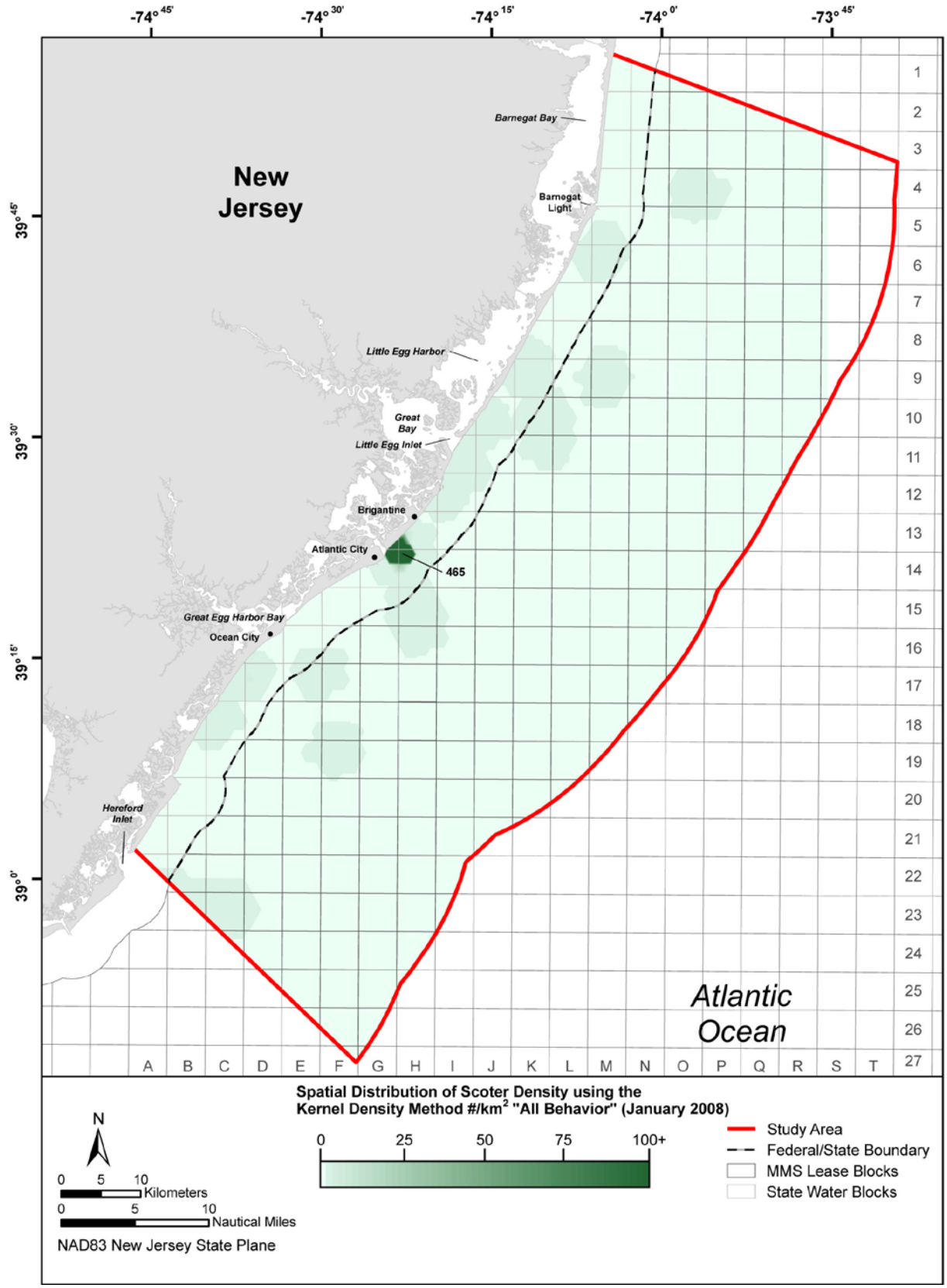

Figure M-114. Spatial distribution of scoter density (#/km^2) in the Study Area for all behaviors using the kernel density method (January 2008).

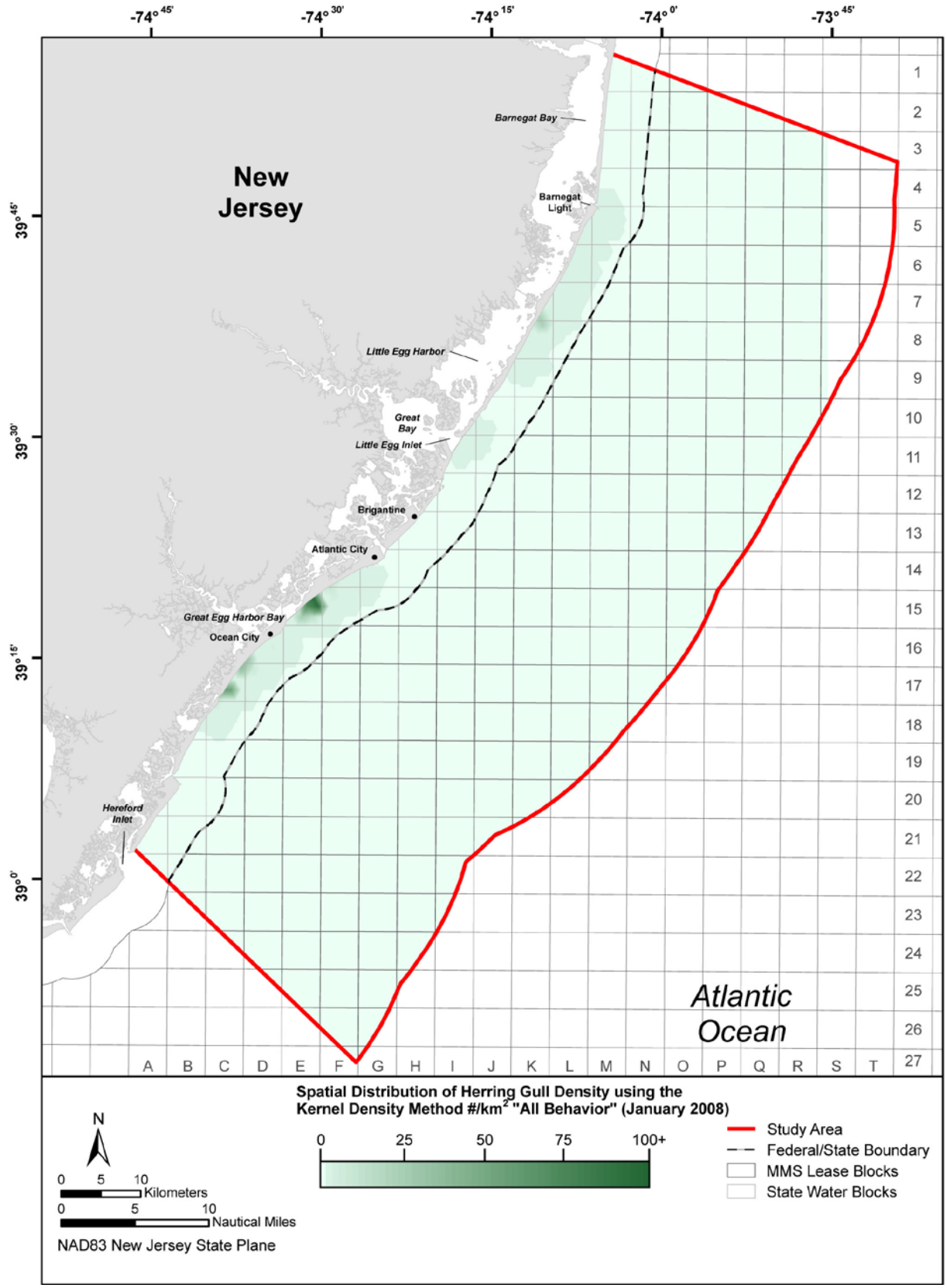

Figure M-115. Spatial distribution of Herring Gull density (#/km^2) in the Study Area for all behaviors using the kernel density method (January 2008).

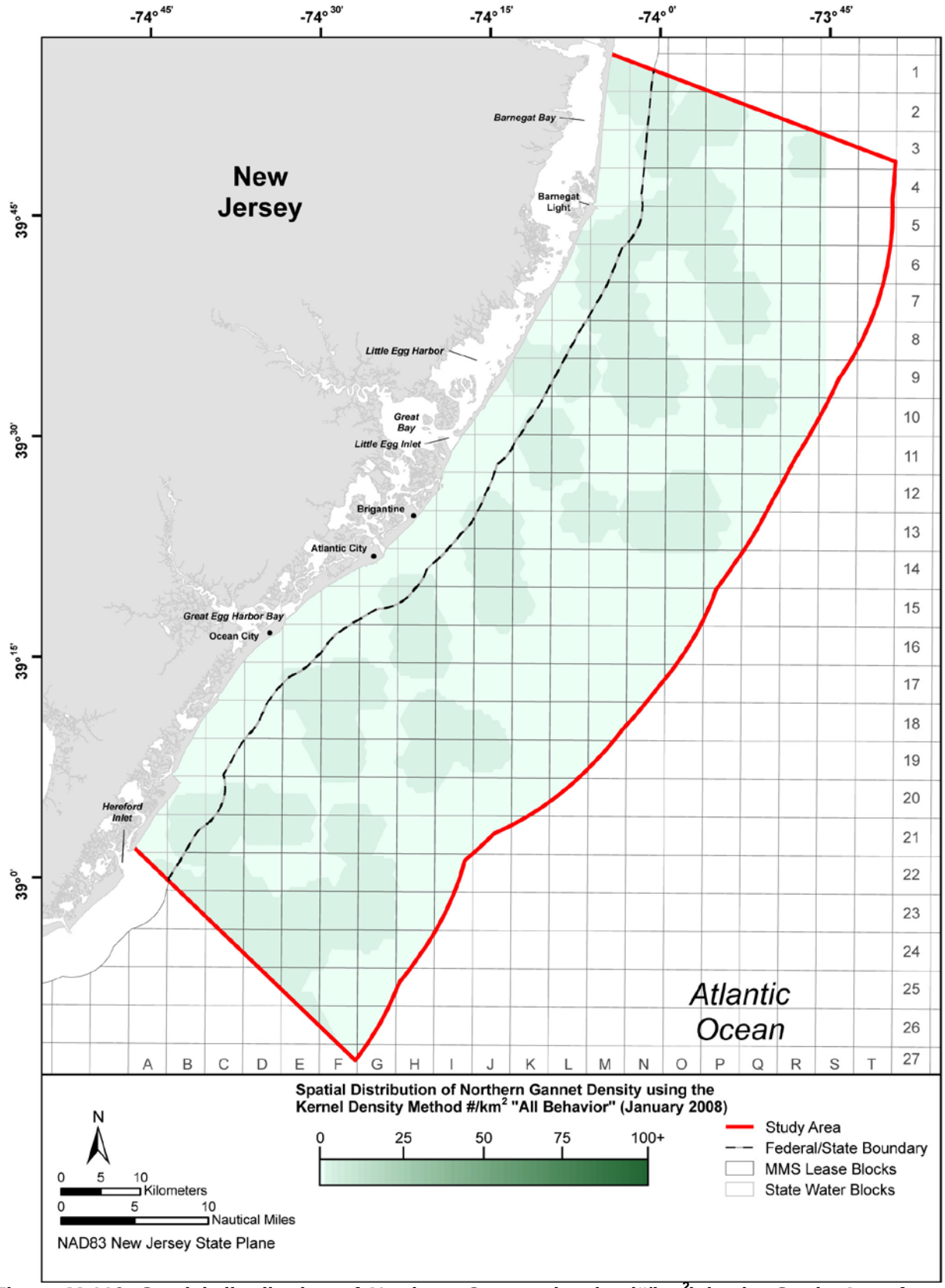

Figure M-116. Spatial distribution of Northern Gannet density (#/km^2) in the Study Area for all behaviors using the kernel density method (January 2008).

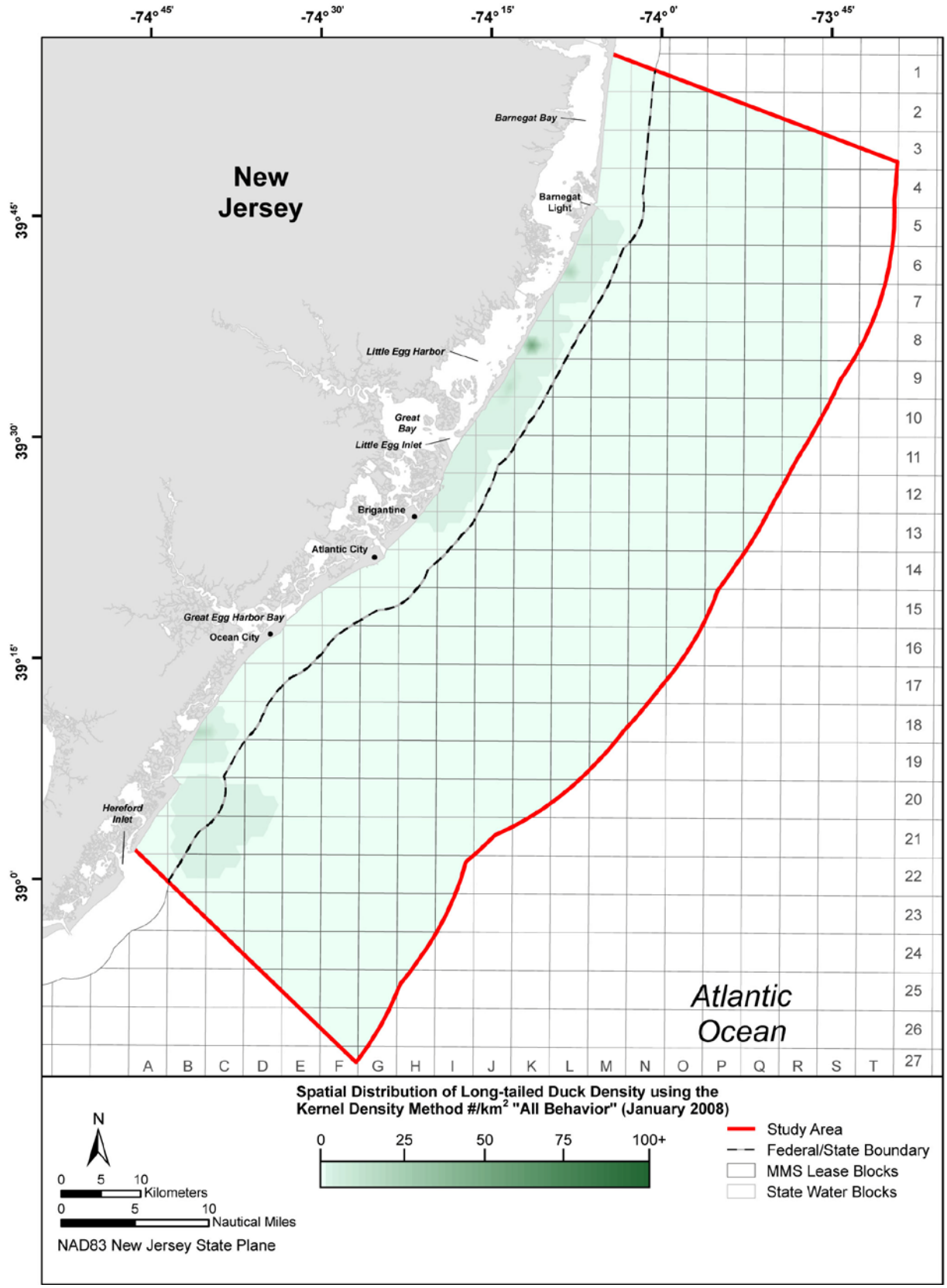

Figure M-117. Spatial distribution of Long-tailed Duck density (#/km^2) in the Study Area for all behaviors using the kernel density method (January 2008).

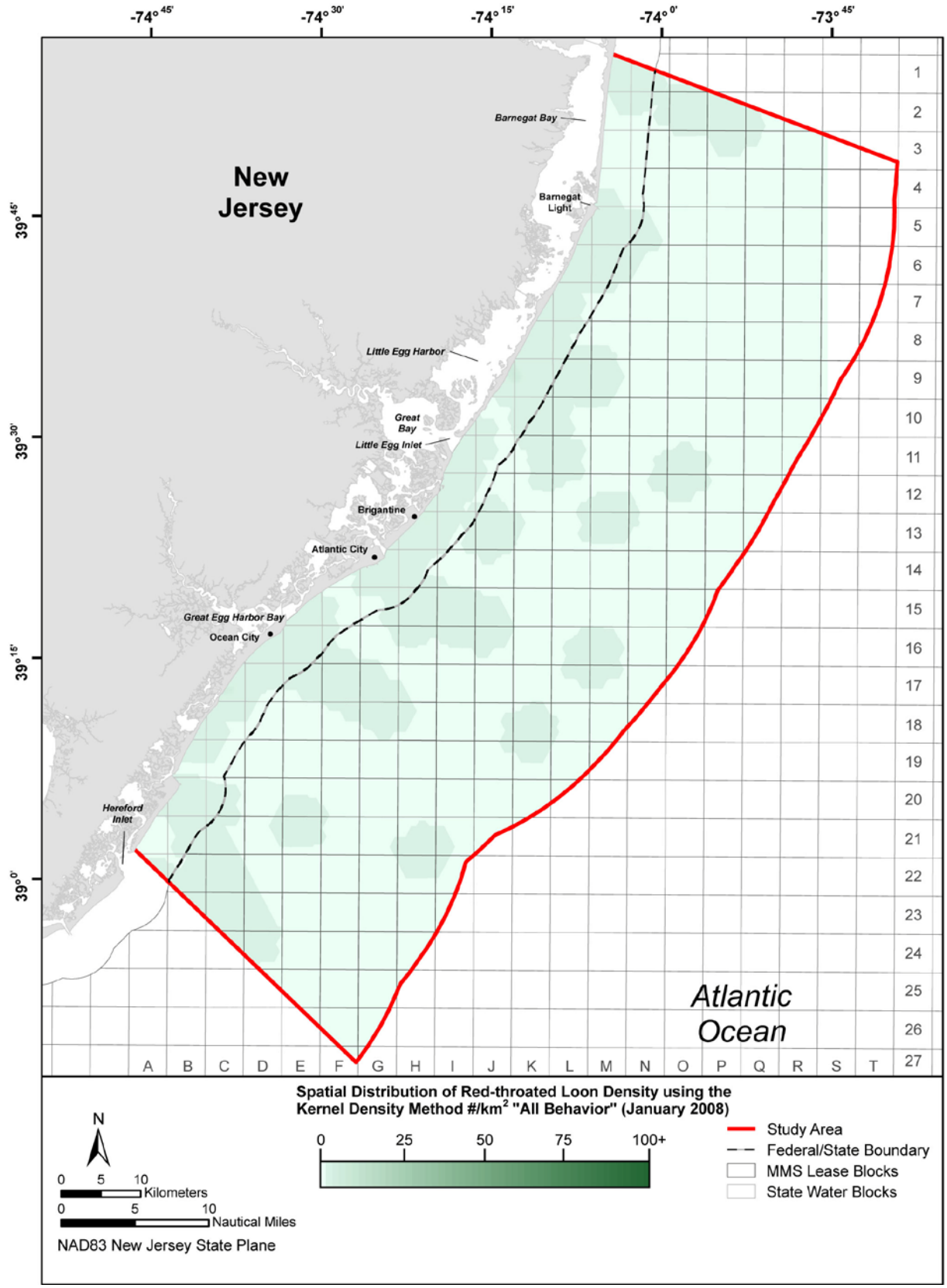

Figure M-118. Spatial distribution of Red-throated Loon density (#/km^2) in the Study Area for all behaviors using the kernel density method (January 2008).

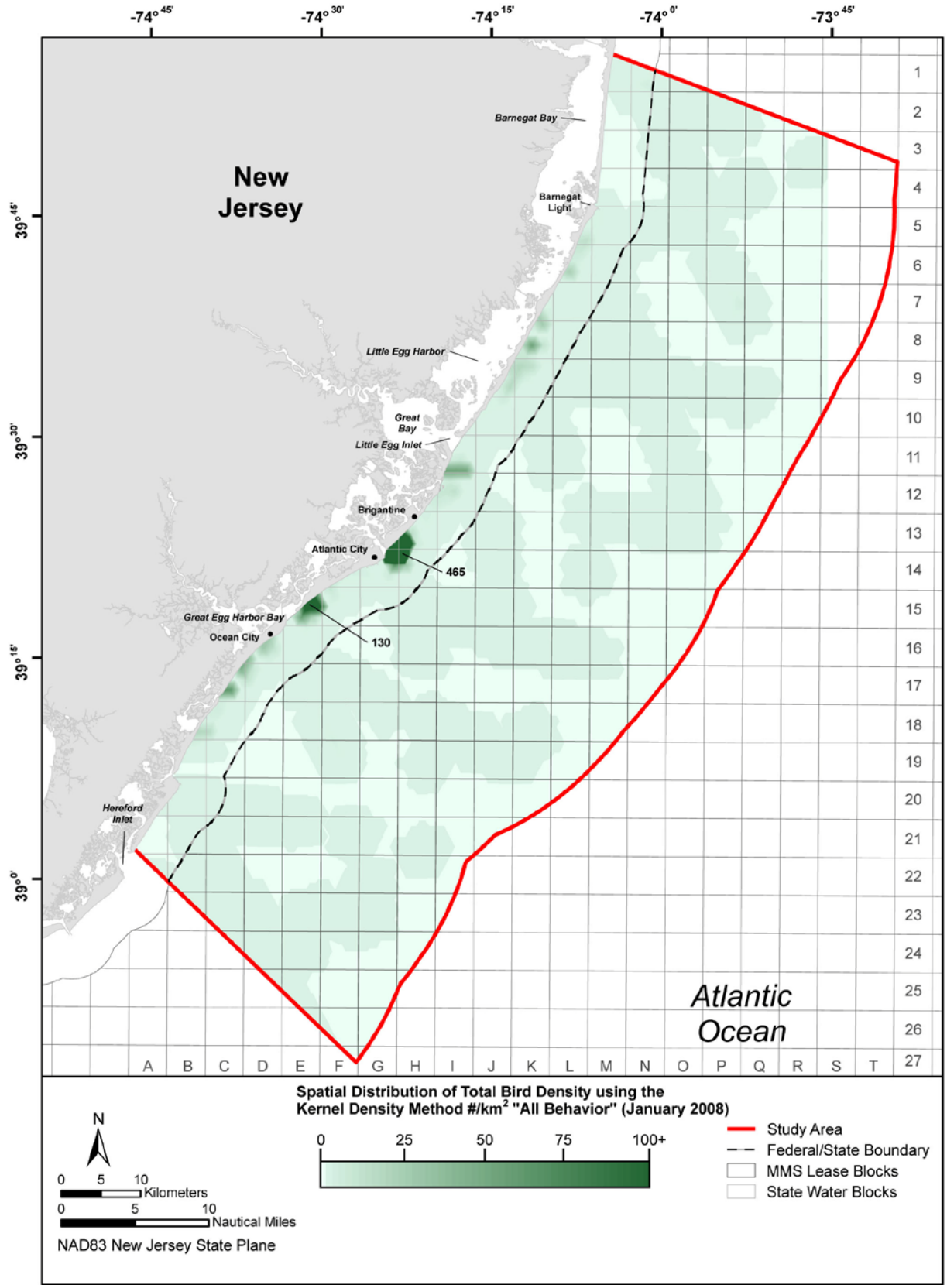

Figure M-119. Spatial distribution of total bird density (#/km^2) in the Study Area for all behaviors using the kernel density method (January 2008).

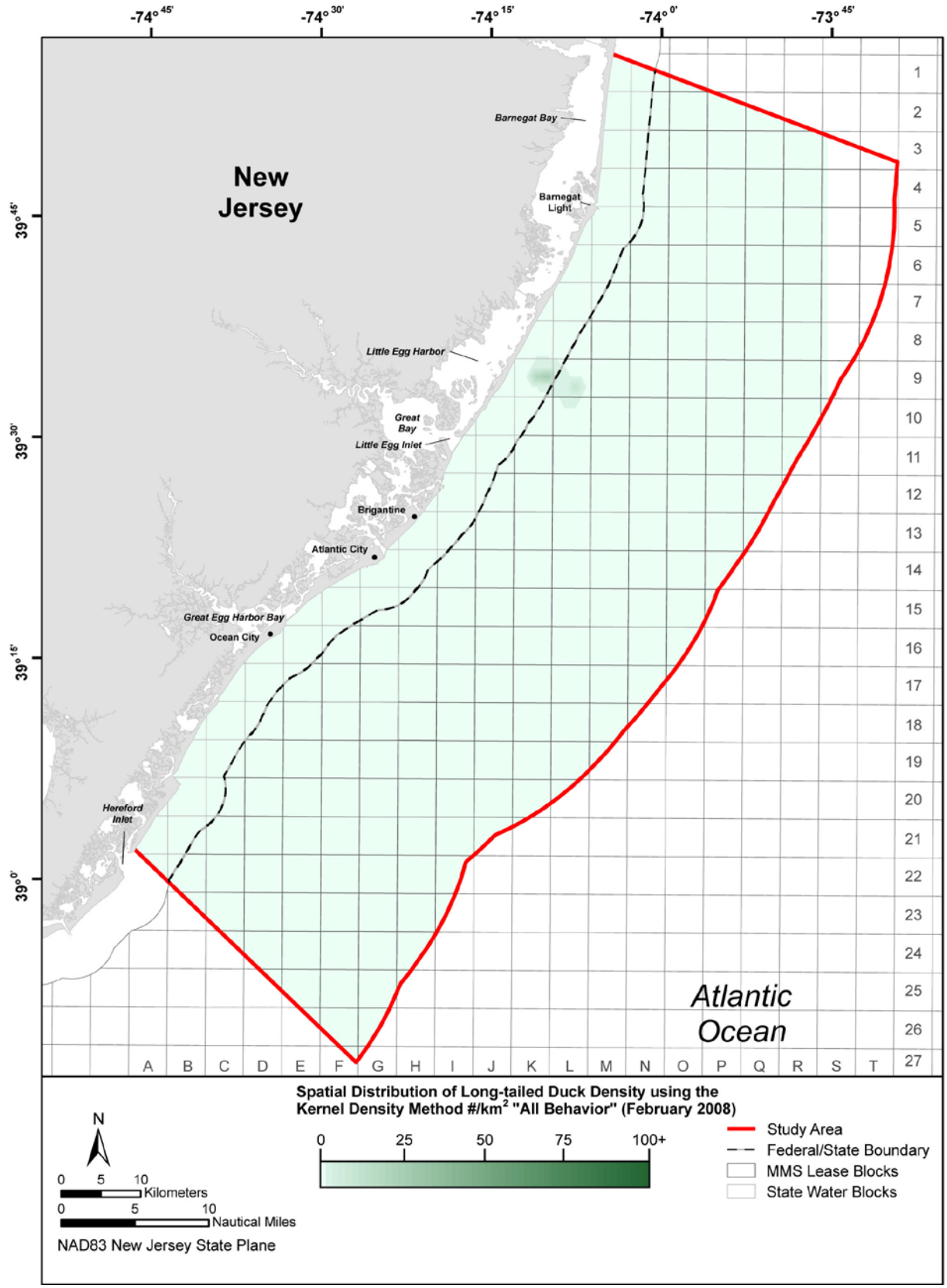

Figure M-120. Spatial distribution of Long-tailed Duck density (#/km^2) in the Study Area for all behaviors using the kernel density method (February 2008).

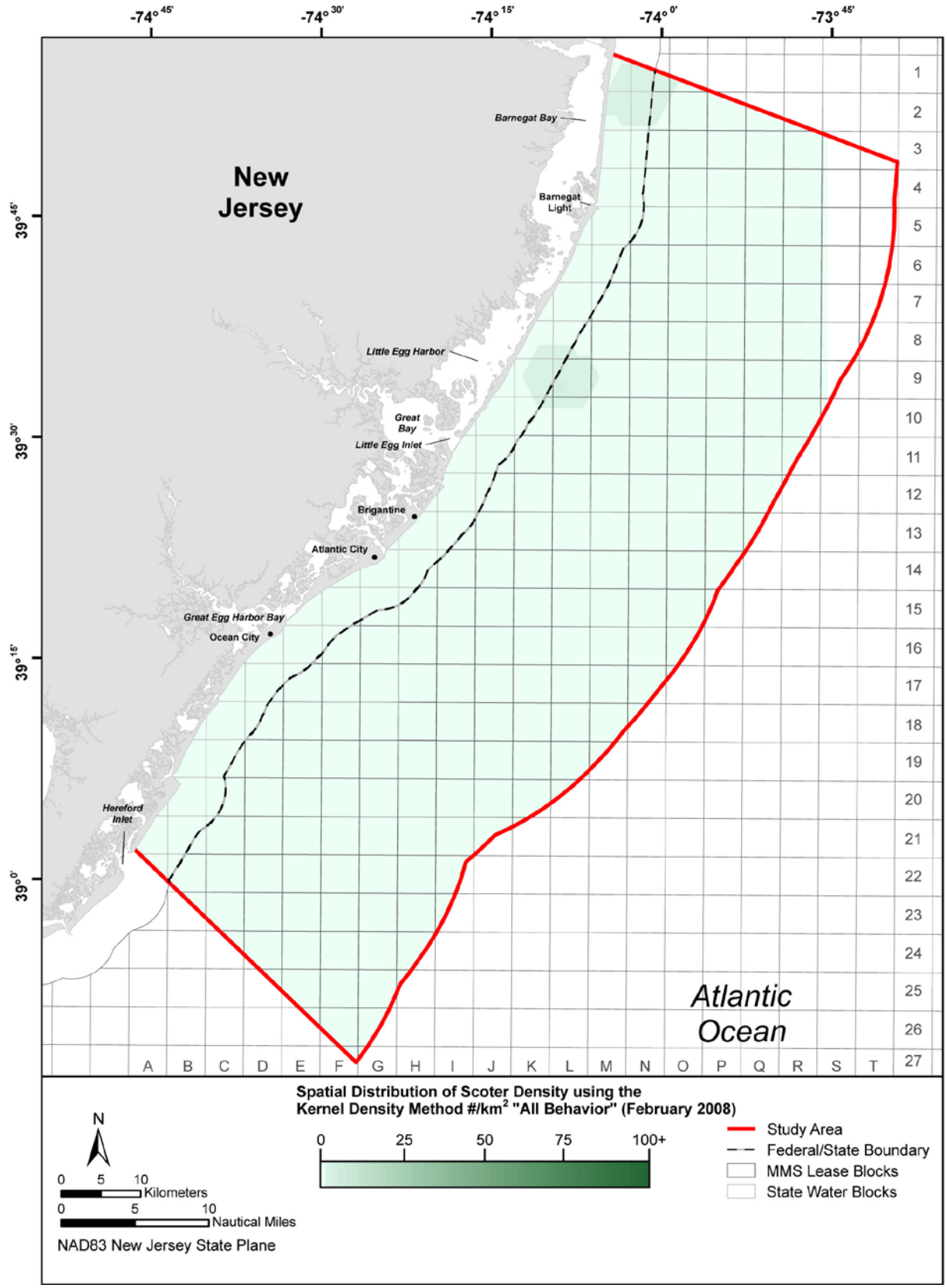

Figure M-121. Spatial distribution of scoter density (#/km^2) in the Study Area for all behaviors using the kernel density method (February 2008).

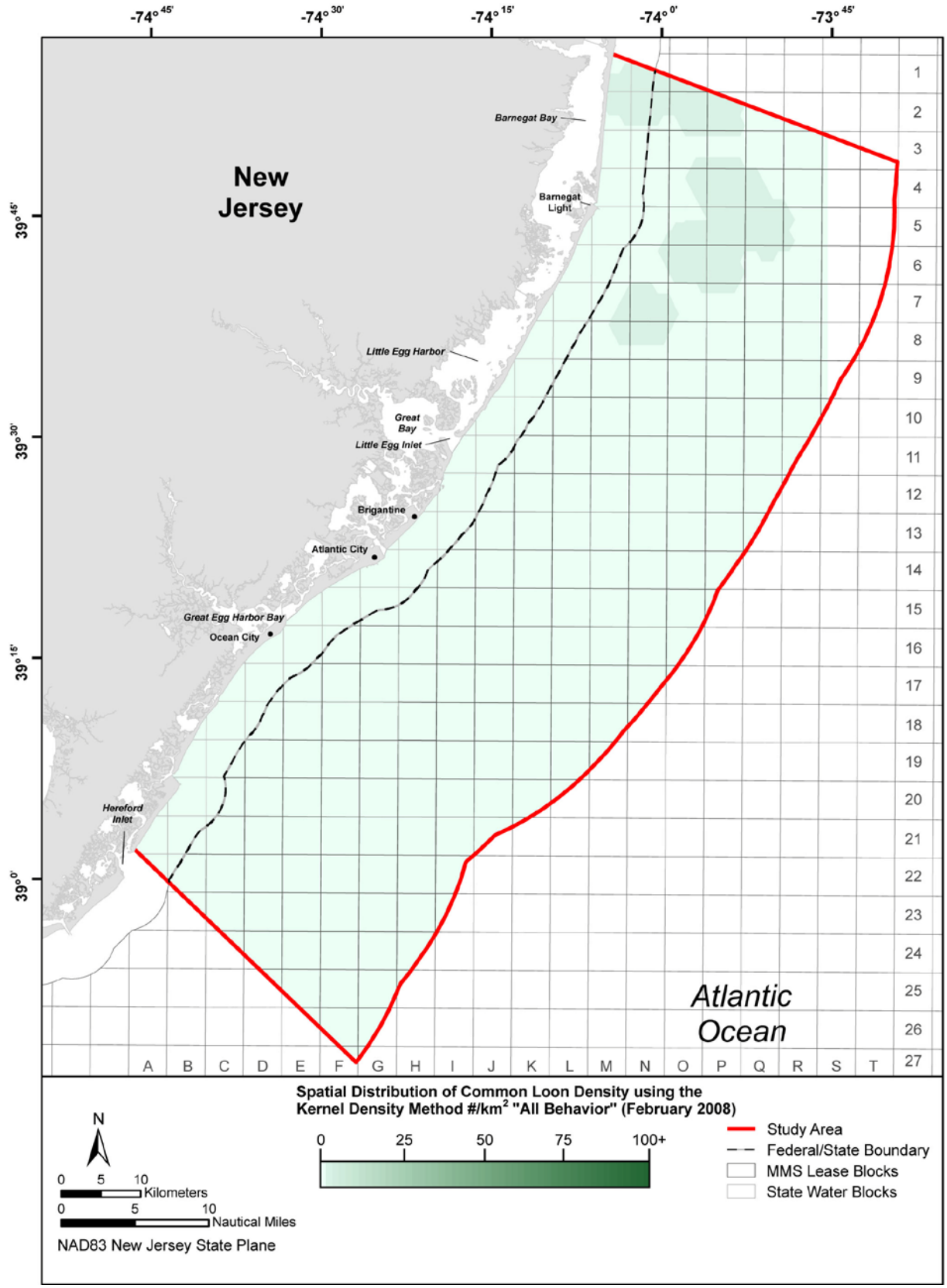

Figure M-122. Spatial distribution of Common Loon density (#/km^2) in the Study Area for all behaviors using the kernel density method (February 2008).

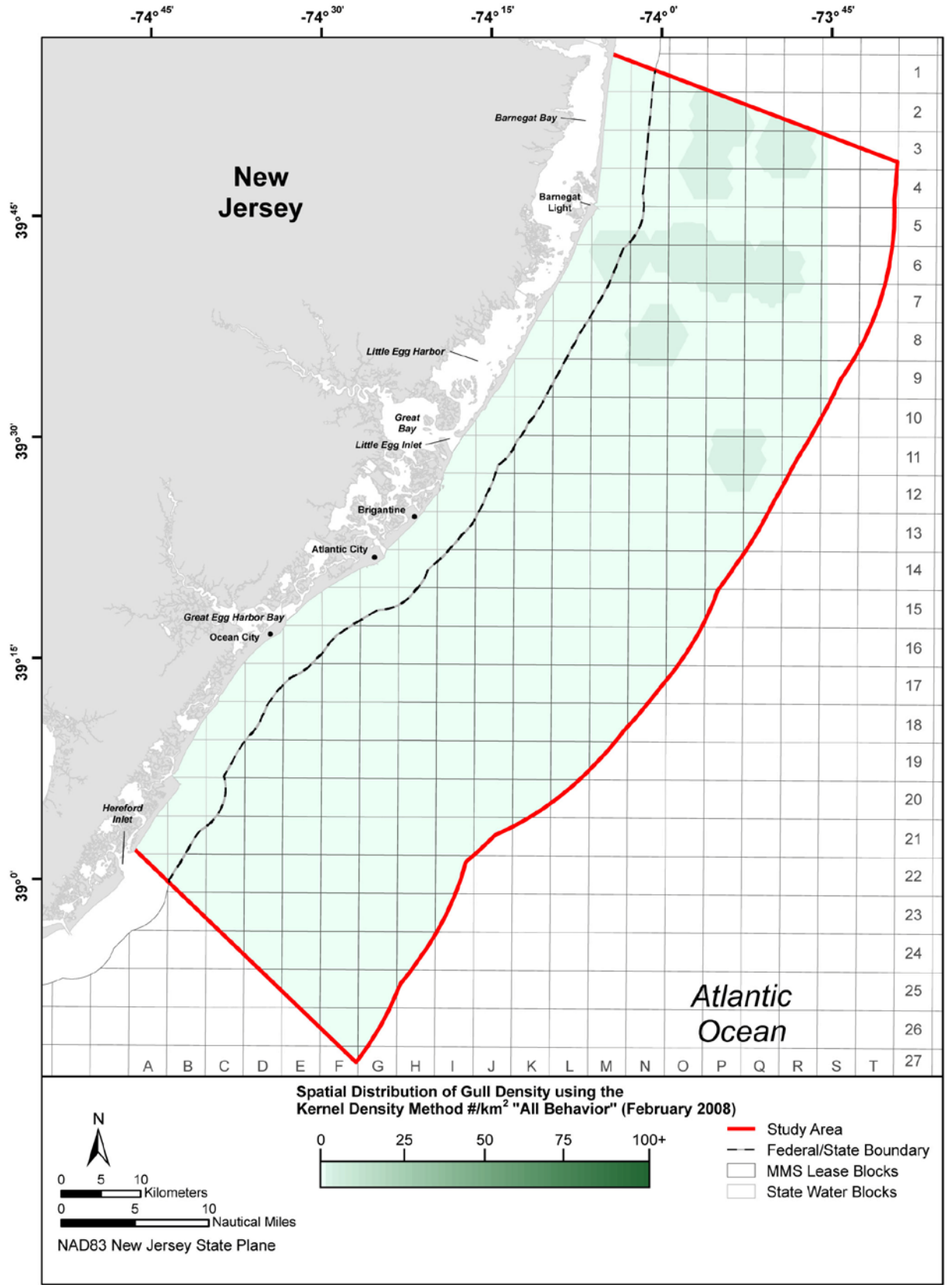

Figure M-123. Spatial distribution of gull density (#/km^2) in the Study Area for all behaviors using the kernel density method (February 2008).

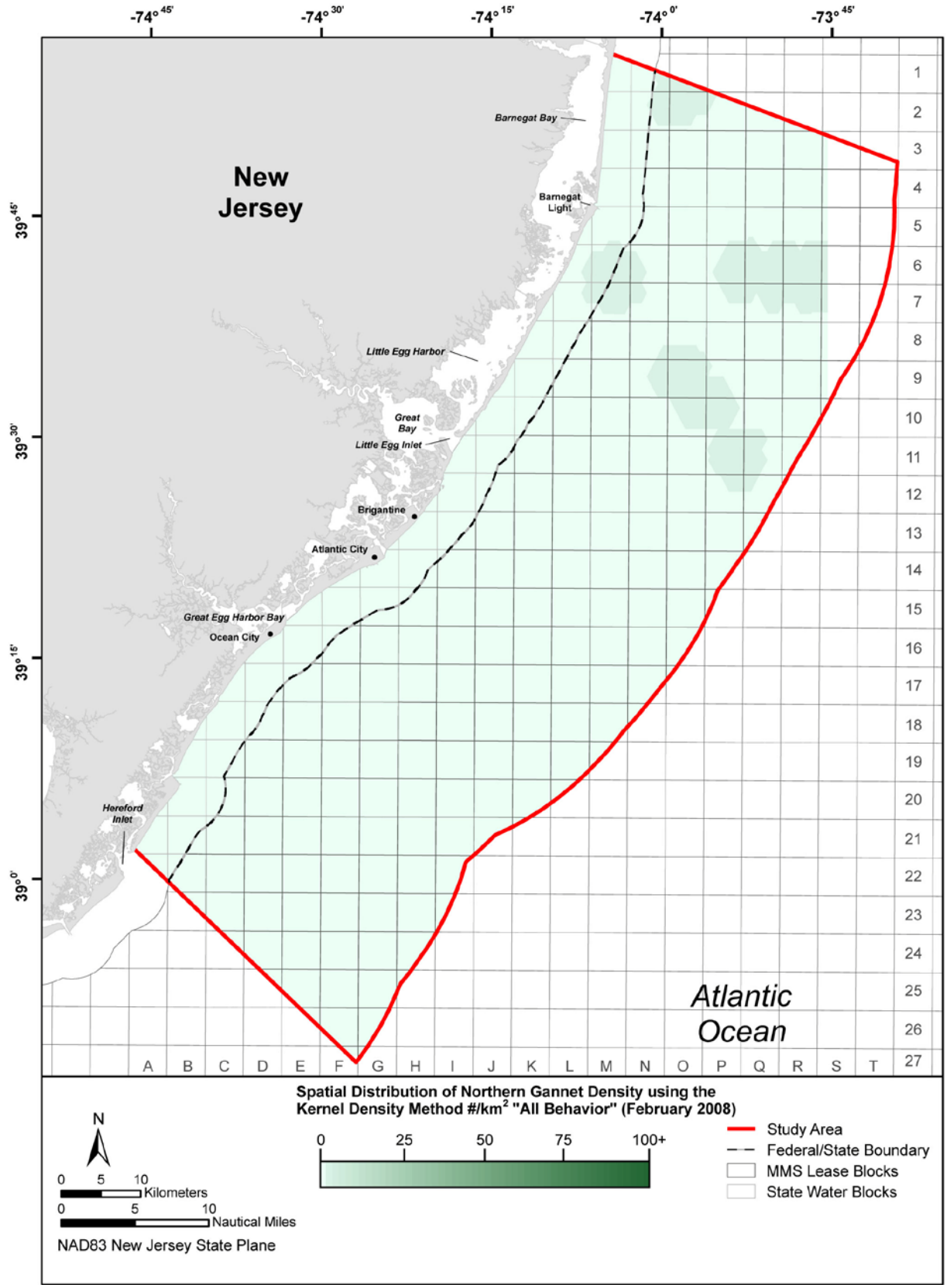

Figure M-124. Spatial distribution of Northern Gannet density (#/km^2) in the Study Area for all behaviors using the kernel density method (February 2008).

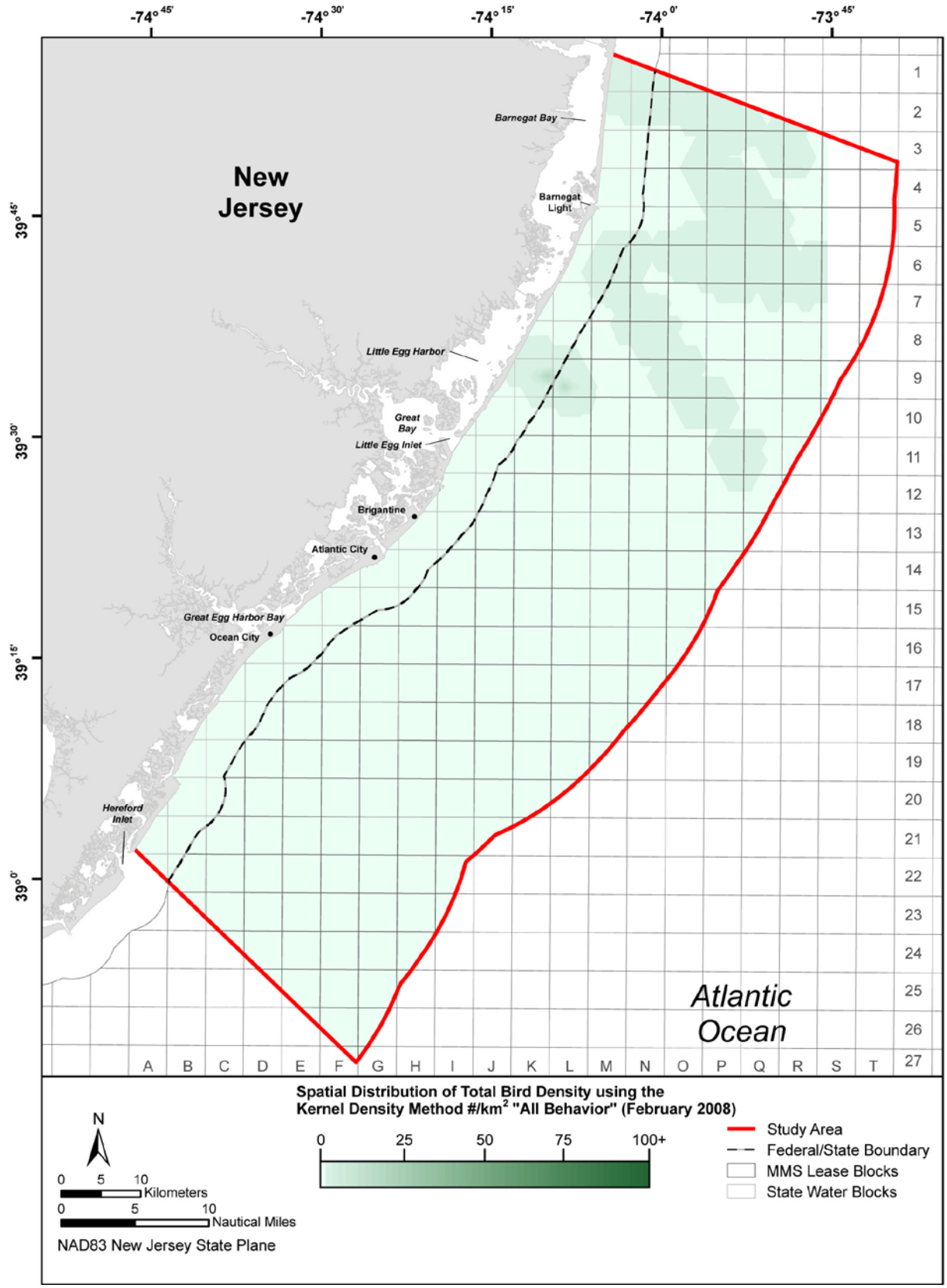

Figure M-125. Spatial distribution of total bird density (#/km^2) in the Study Area for all behaviors using the kernel density method (February 2008).

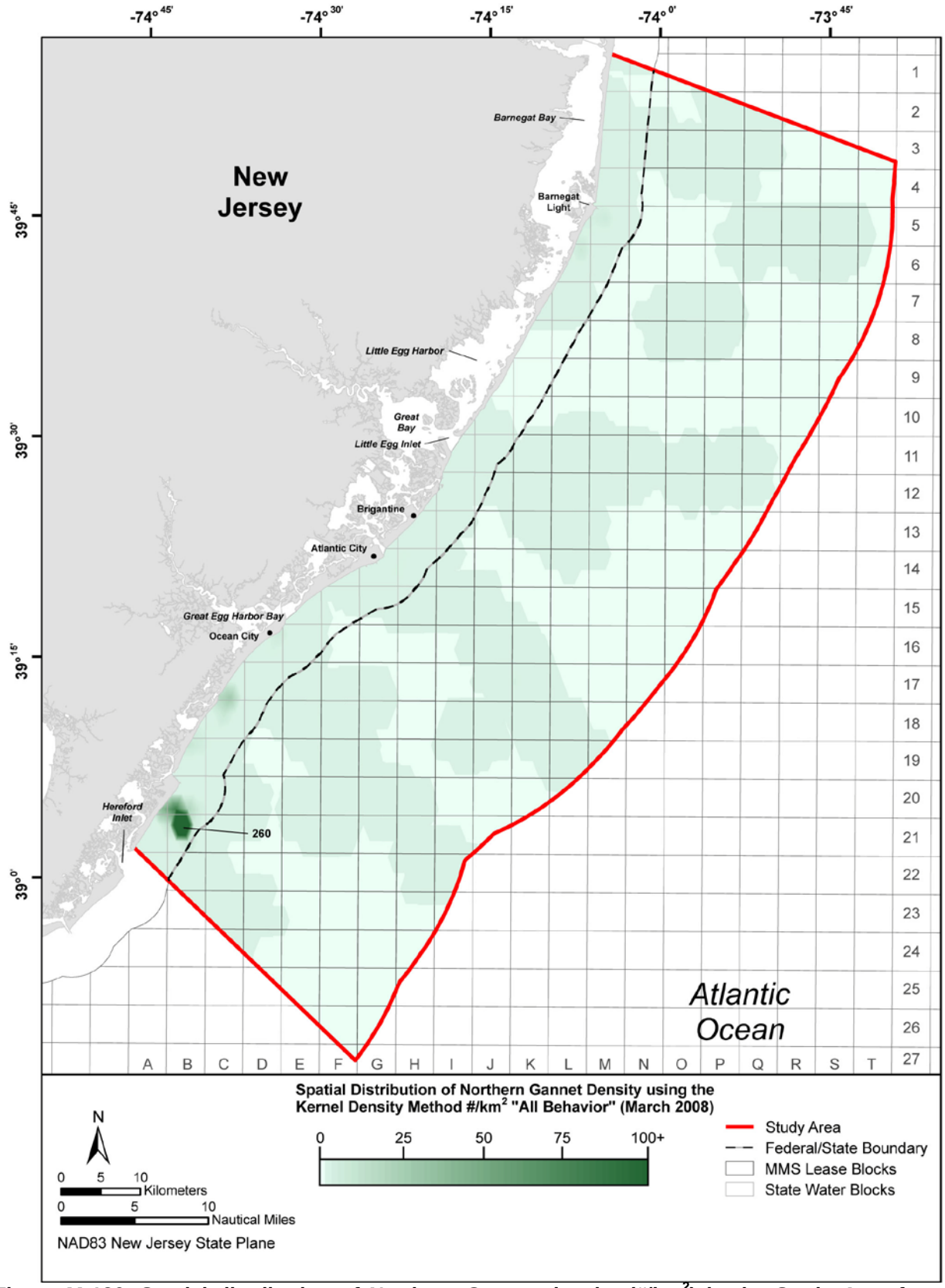

Figure M-126. Spatial distribution of Northern Gannet density (#/km^2) in the Study Area for all behaviors using the kernel density method (March 2008).

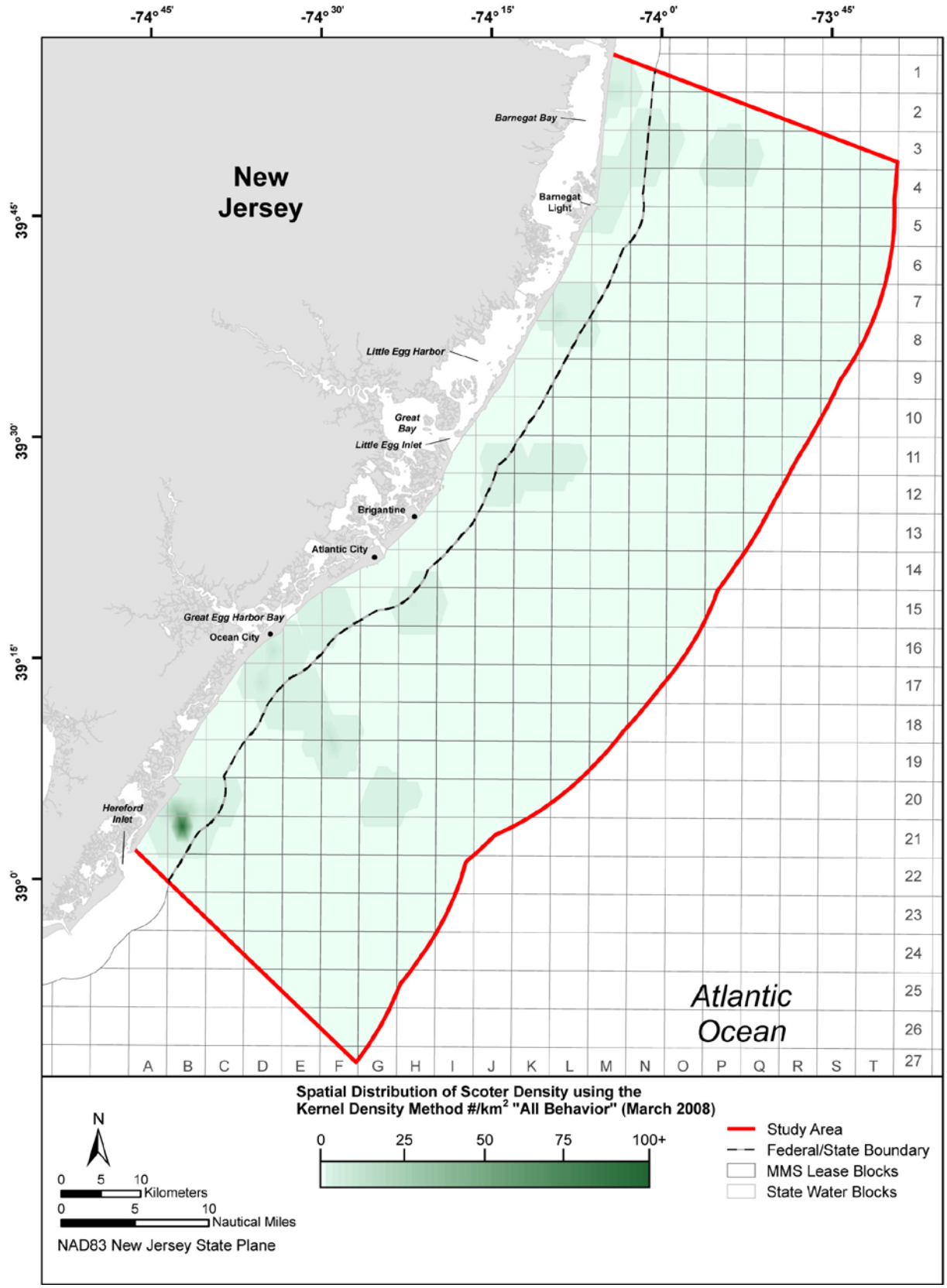

Figure M-127. Spatial distribution of scoter density (#/km^2) in the Study Area for all behaviors using the kernel density method (March 2008).

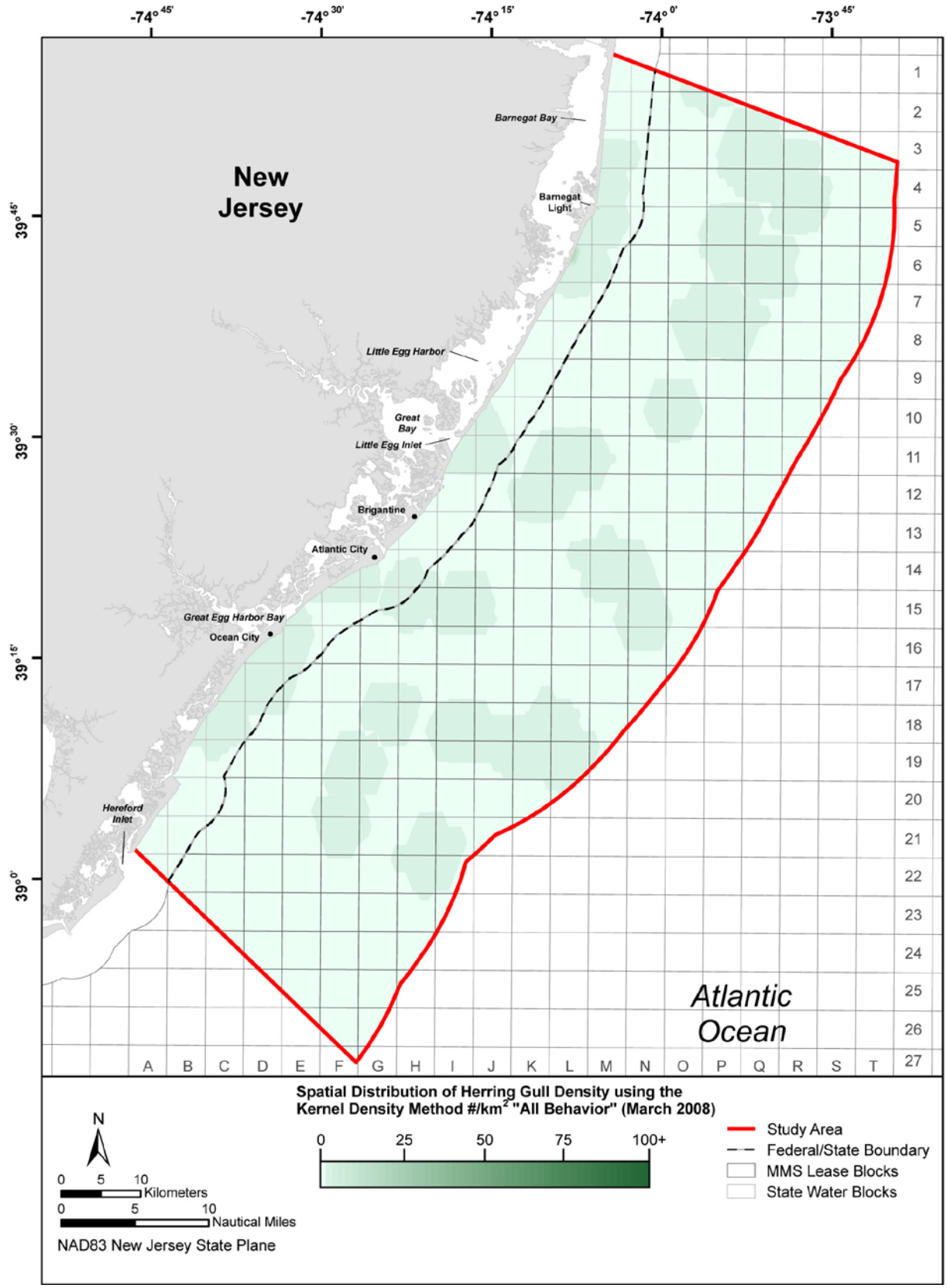

Figure M-128. Spatial distribution of Herring Gull density (#/km^2) in the Study Area for all behaviors using the kernel density method (March 2008).

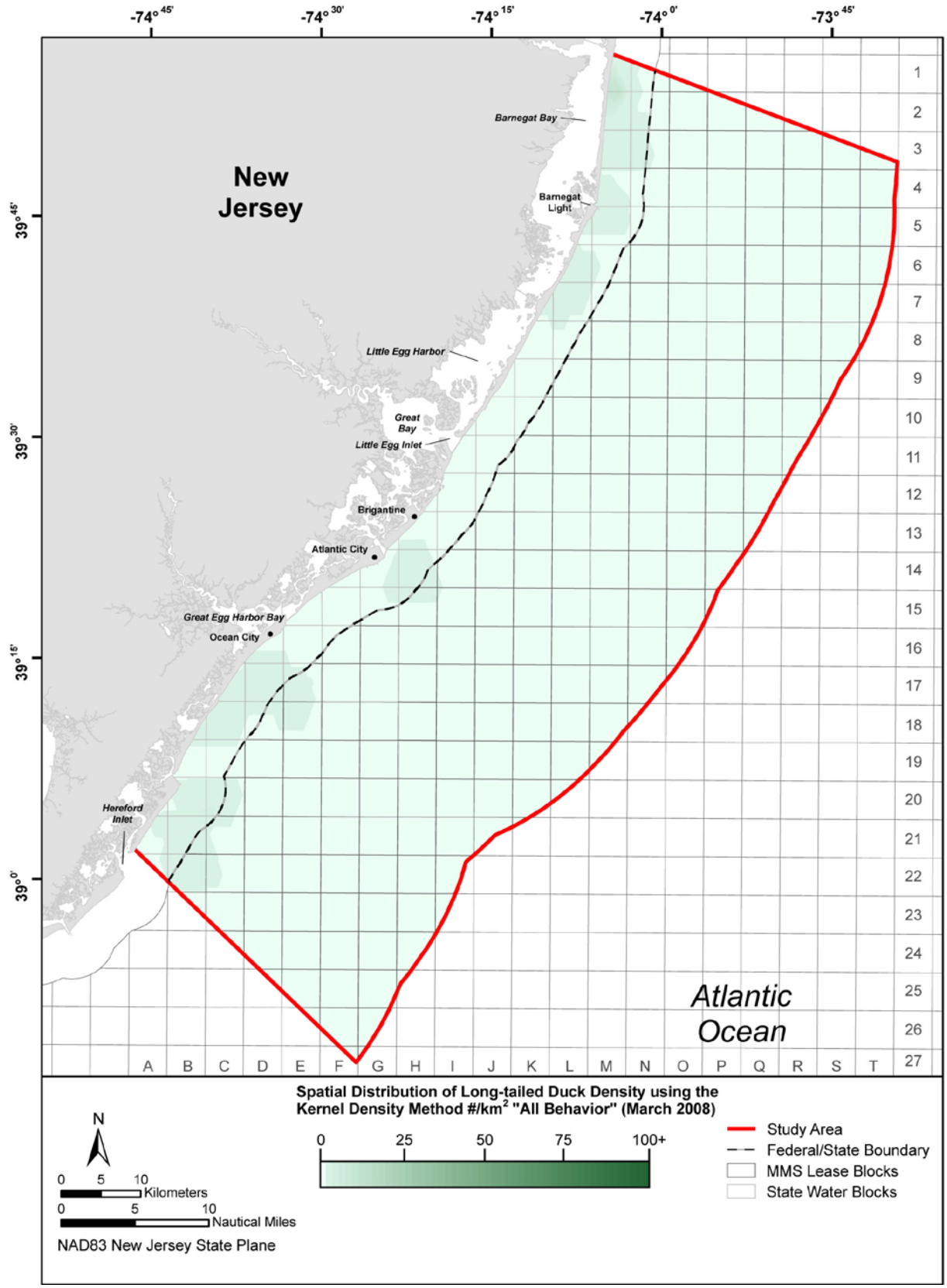

Figure M-129. Spatial distribution of Long-tailed Duck density (#/km^2) in the Study Area for all behaviors using the kernel density method (March 2008).

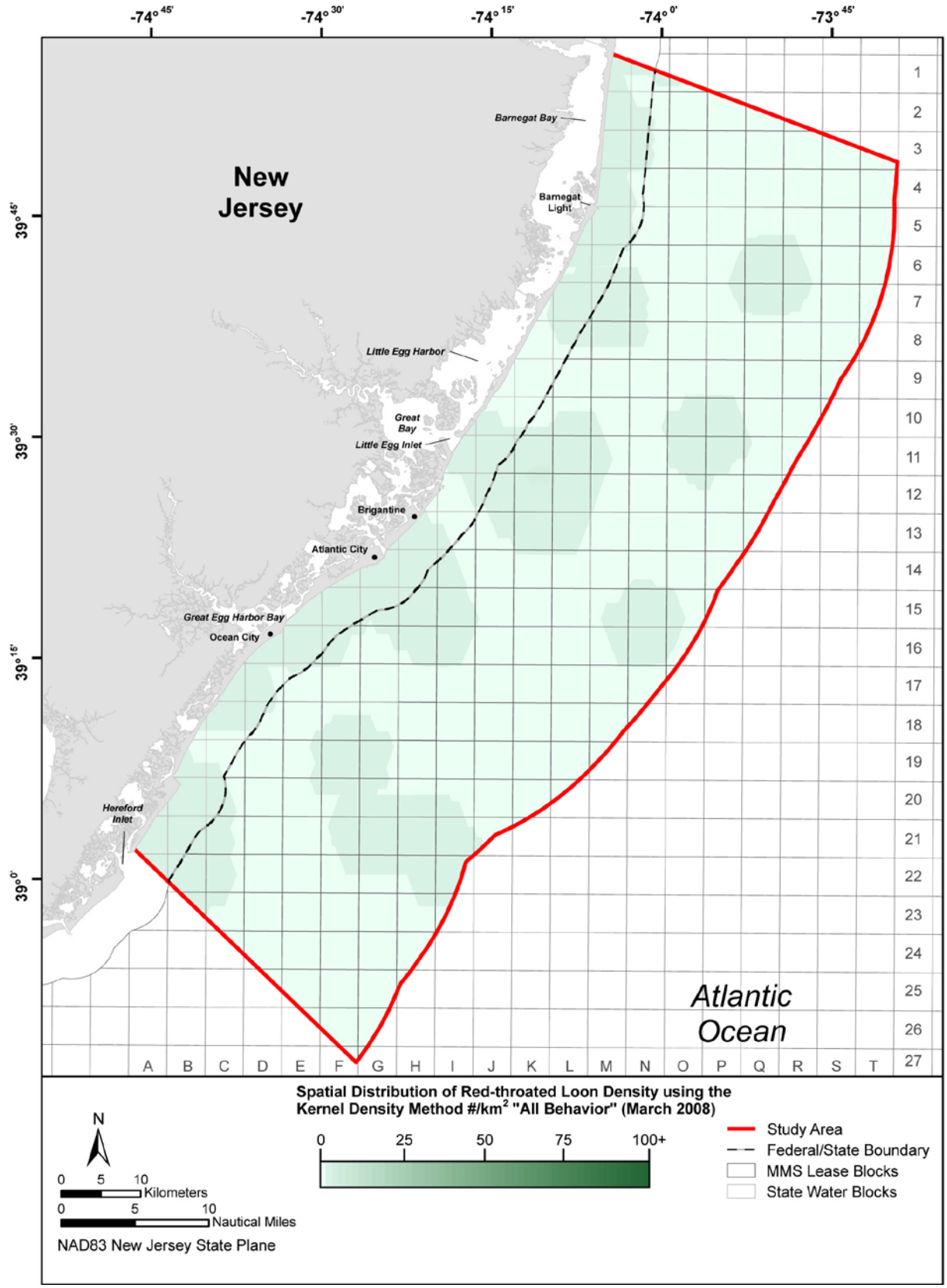

Figure M-130. Spatial distribution of Red-throated Loon density (#/km^2) in the Study Area for all behaviors using the kernel density method (March 2008).

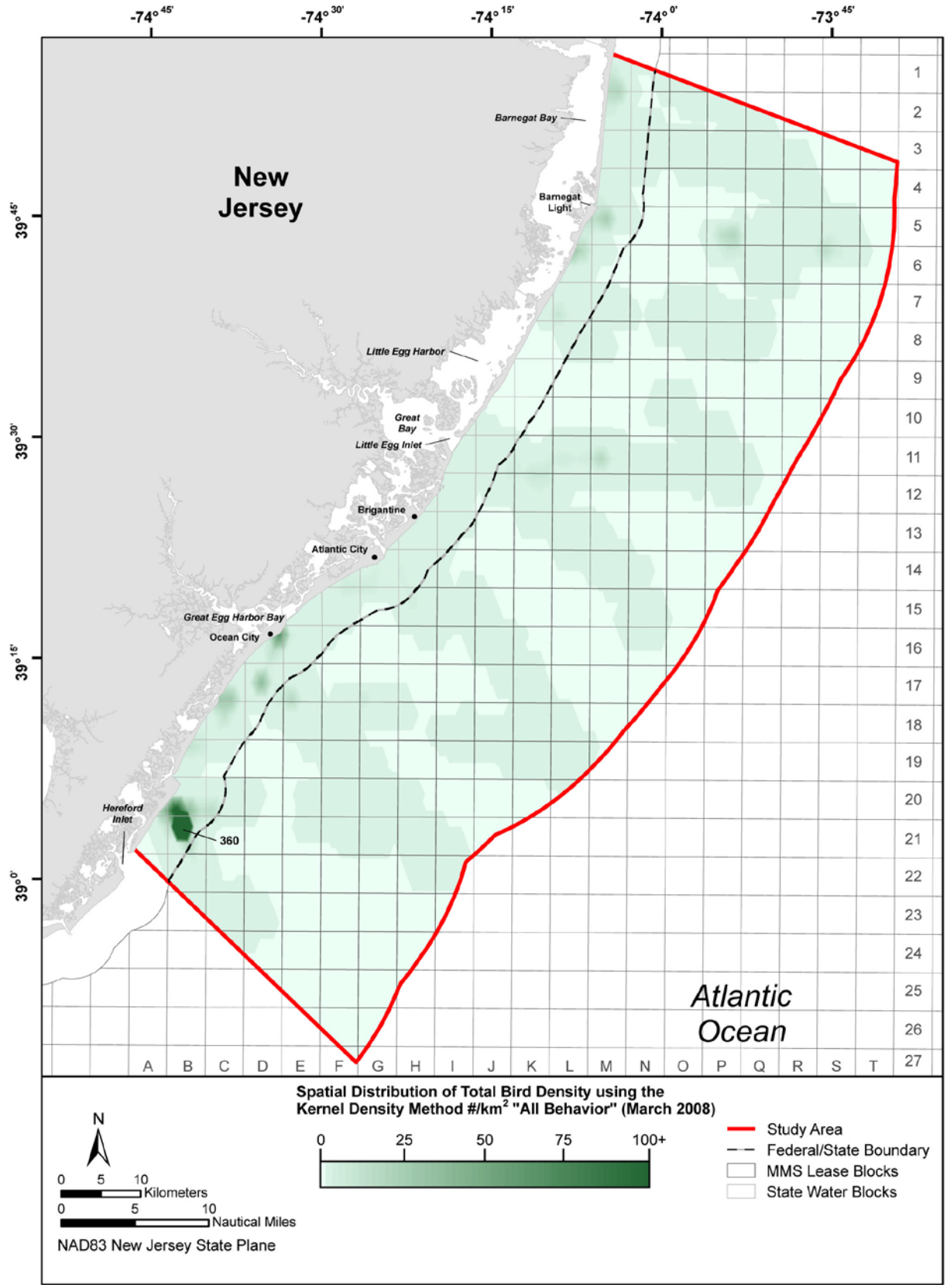

Figure M-131. Spatial distribution of total bird density (#/km^2) in the Study Area for all behaviors using the kernel density method (March 2008).

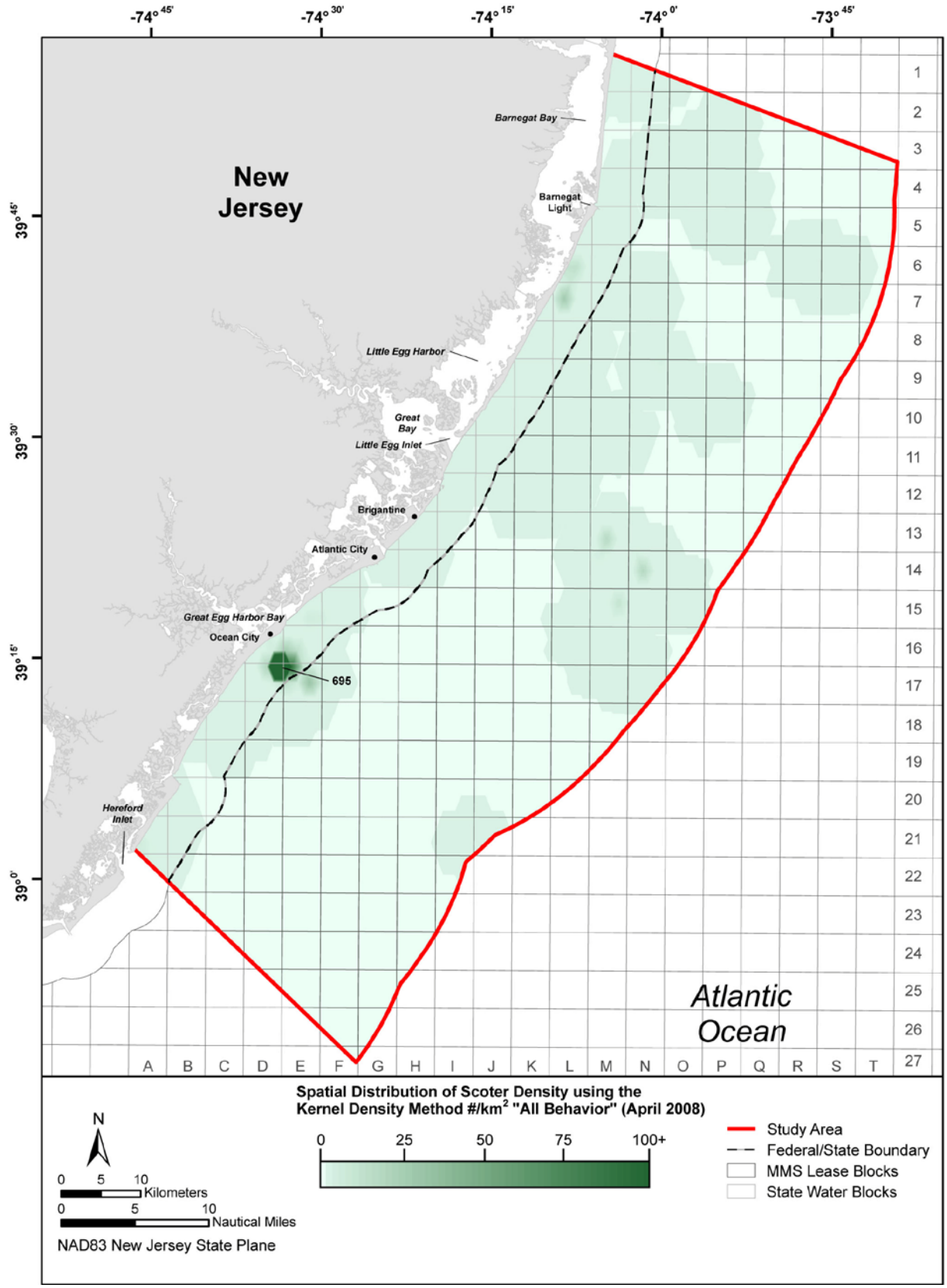

Figure M-132. Spatial distribution of scoter density (#/km^2) in the Study Area for all behaviors using the kernel density method (April 2008).

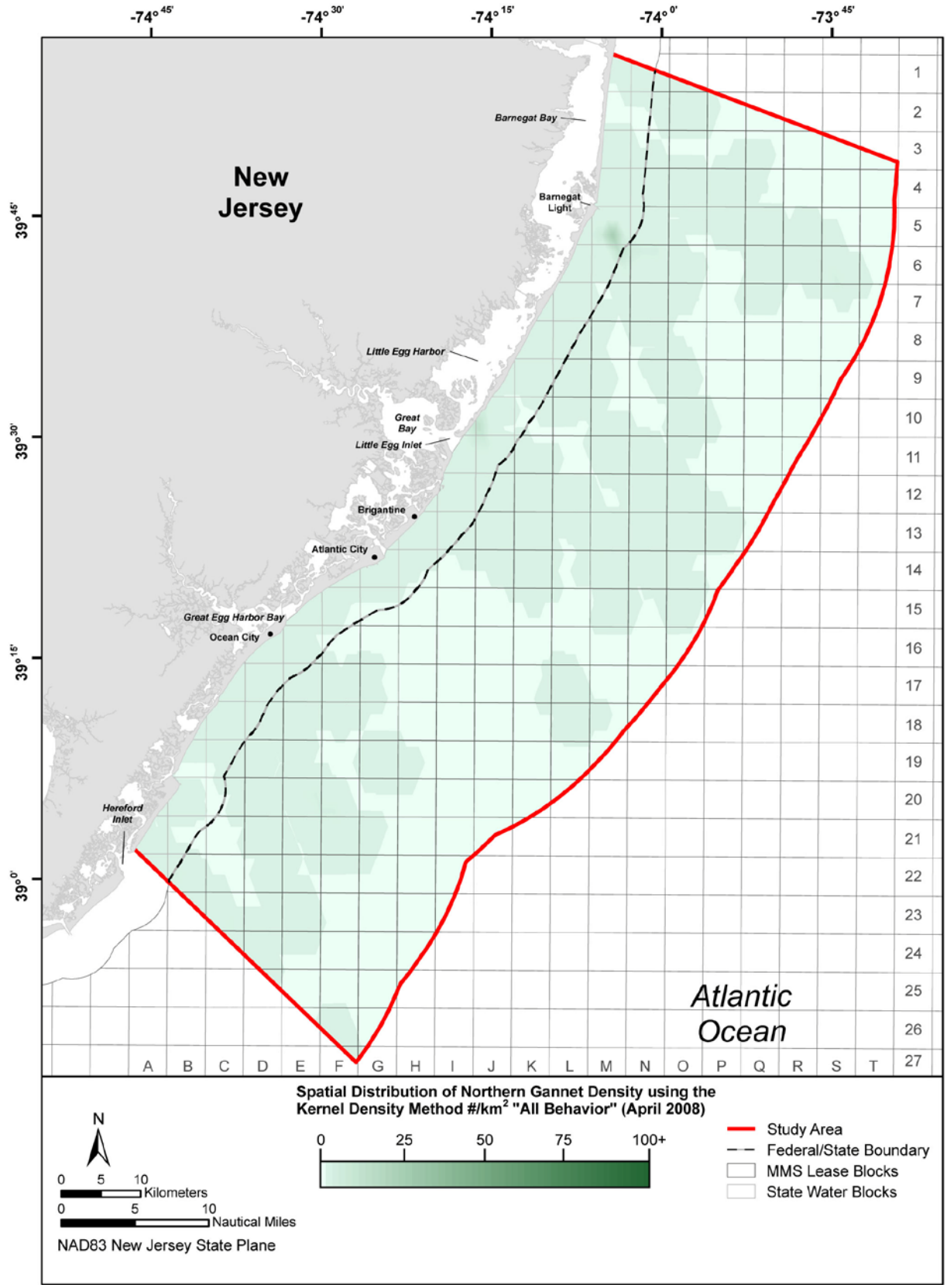

Figure M-133. Spatial distribution of Northern Gannet density (#/km^2) in the Study Area for all behaviors using the kernel density method (April 2008).

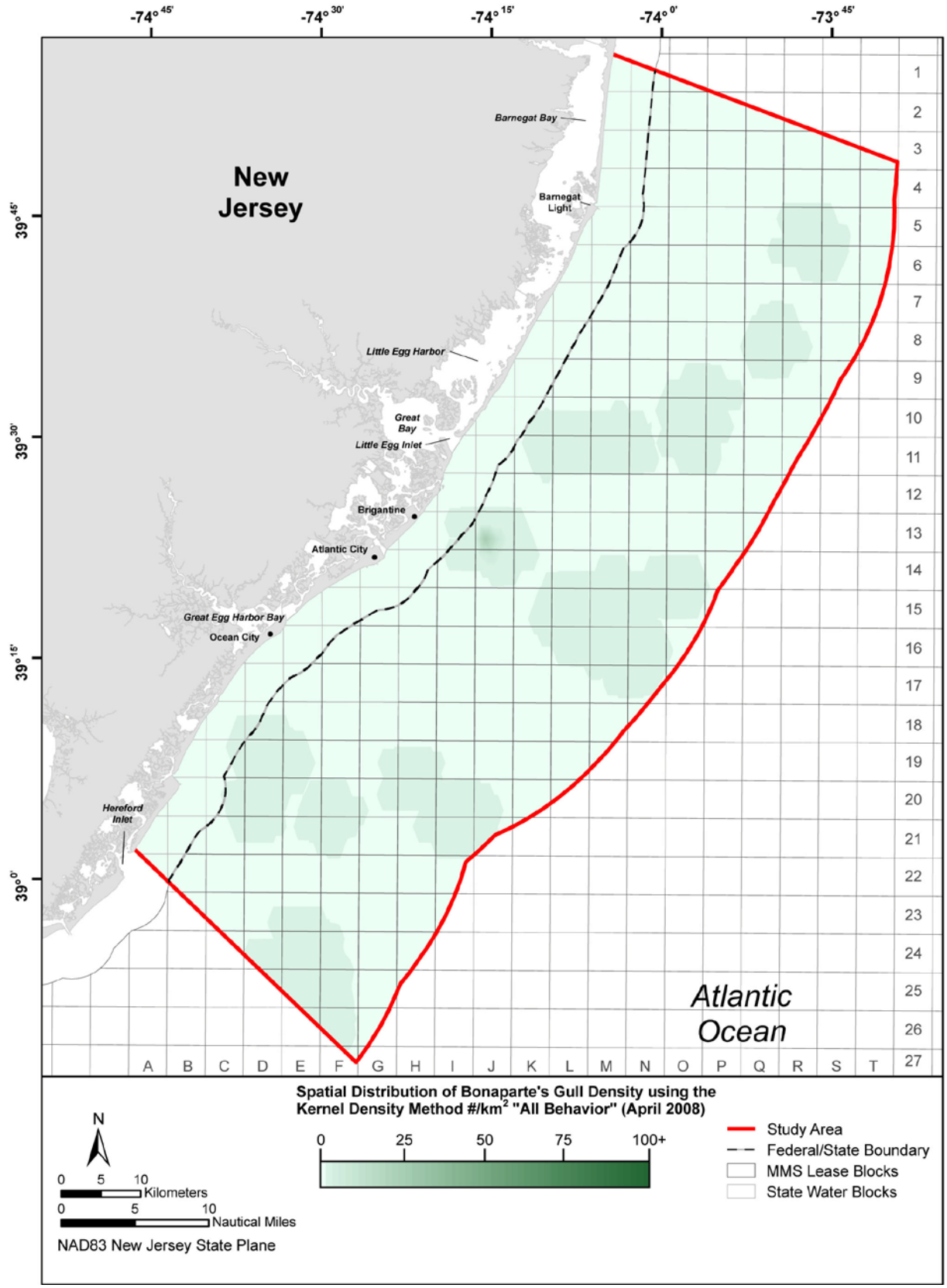

Figure M-134. Spatial distribution of Bonaparte's Gull density (#/km^2) in the Study Area for all behaviors using the kernel density method (April 2008).

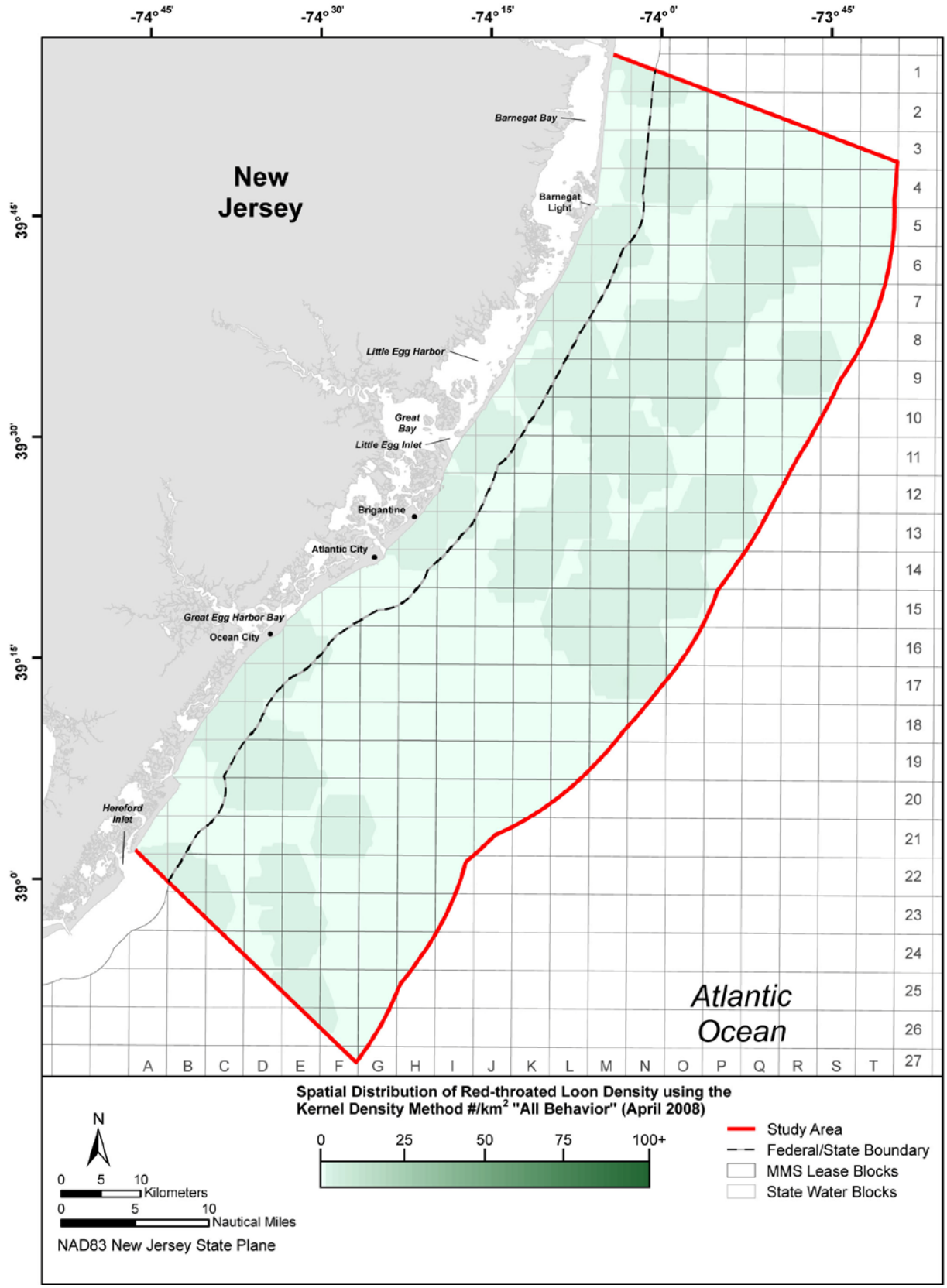

Figure M-135. Spatial distribution of Red-throated Loon density (#/km^2) in the Study Area for all behaviors using the kernel density method (April 2008).

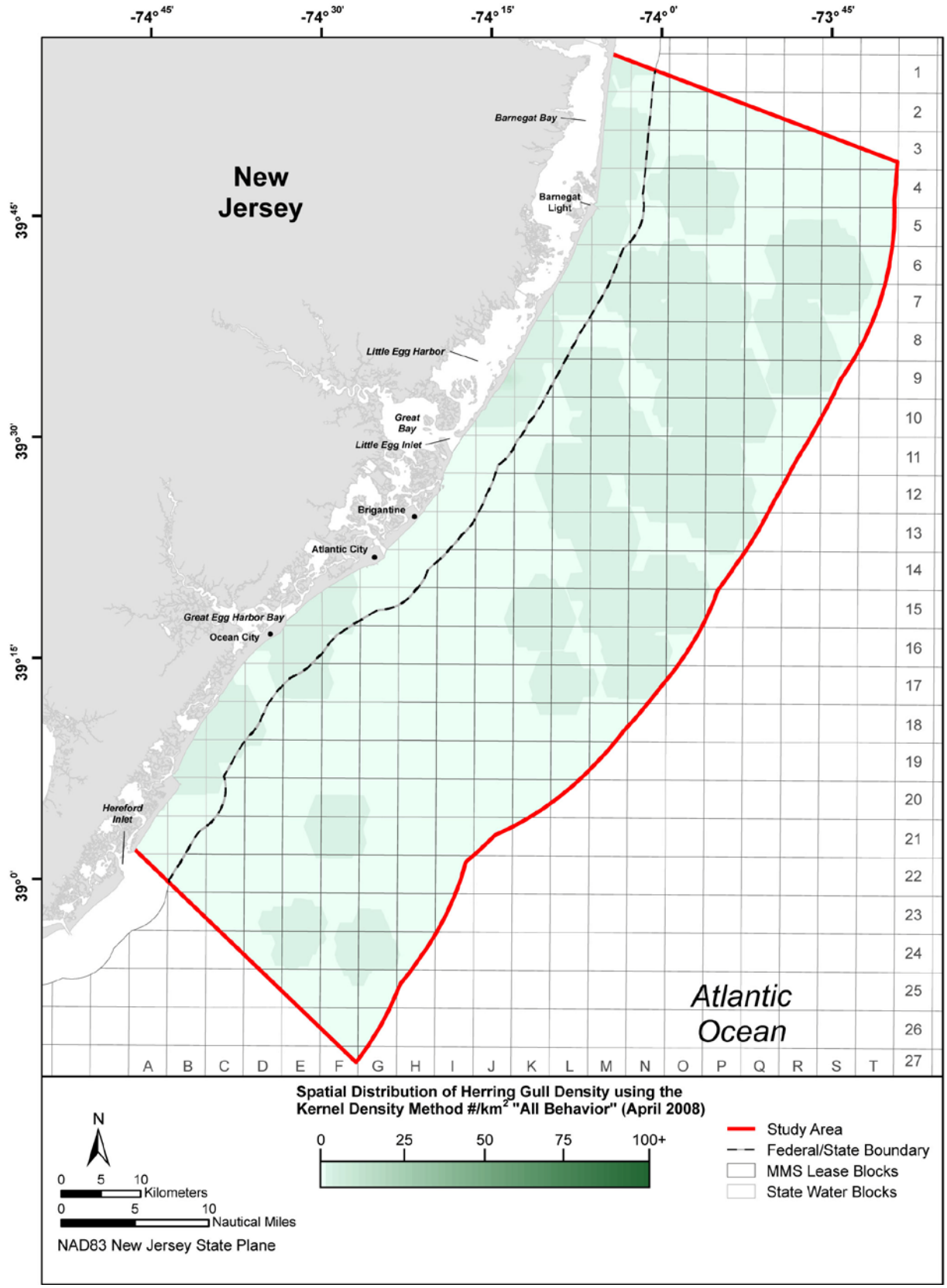

Figure M-136. Spatial distribution of Herring Gull density (#/km^2) in the Study Area for all behaviors using the kernel density method (April 2008).

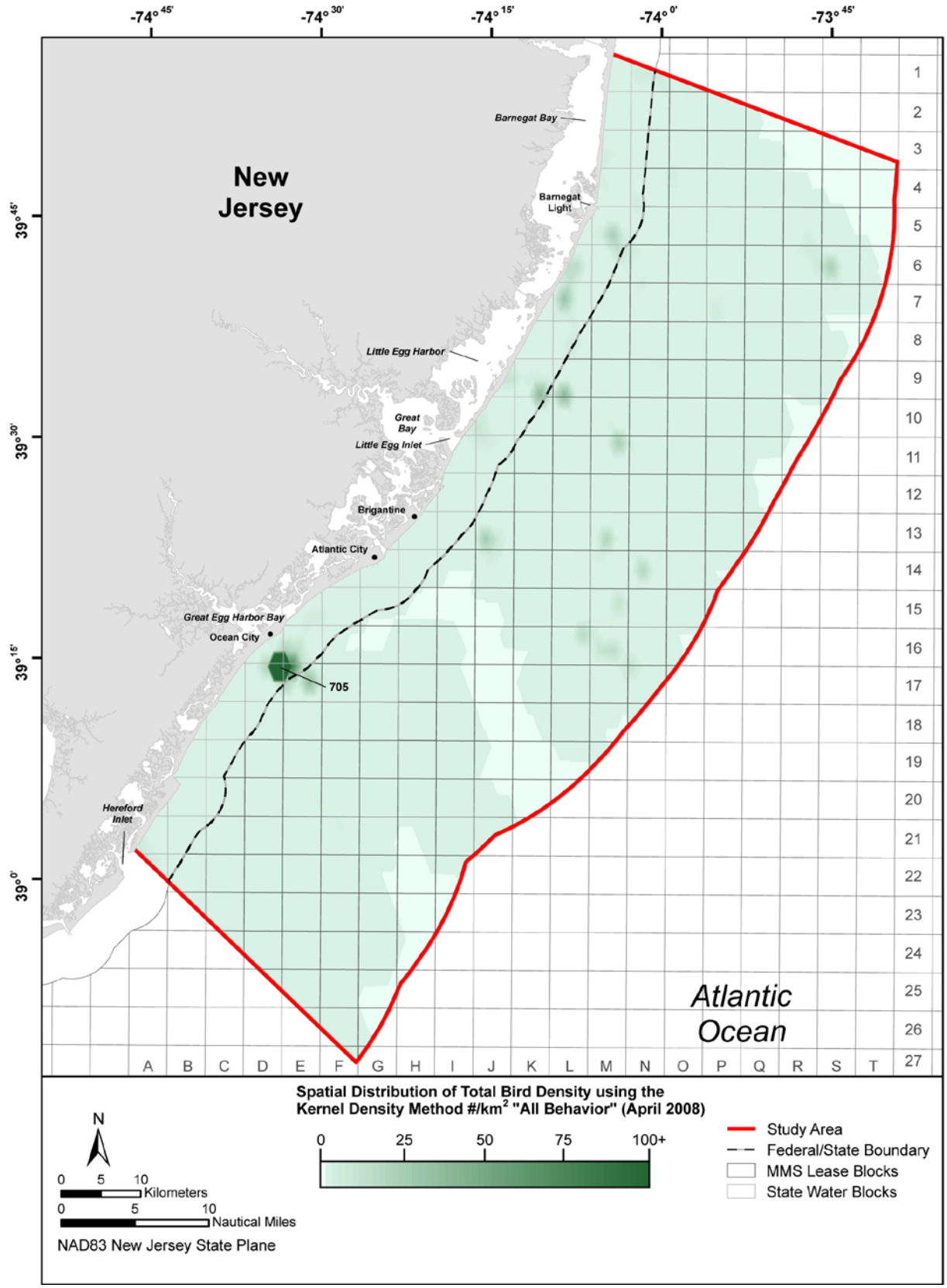

Figure M-137. Spatial distribution of total bird density (#/km^2) in the Study Area for all behaviors using the kernel density method (April 2008).

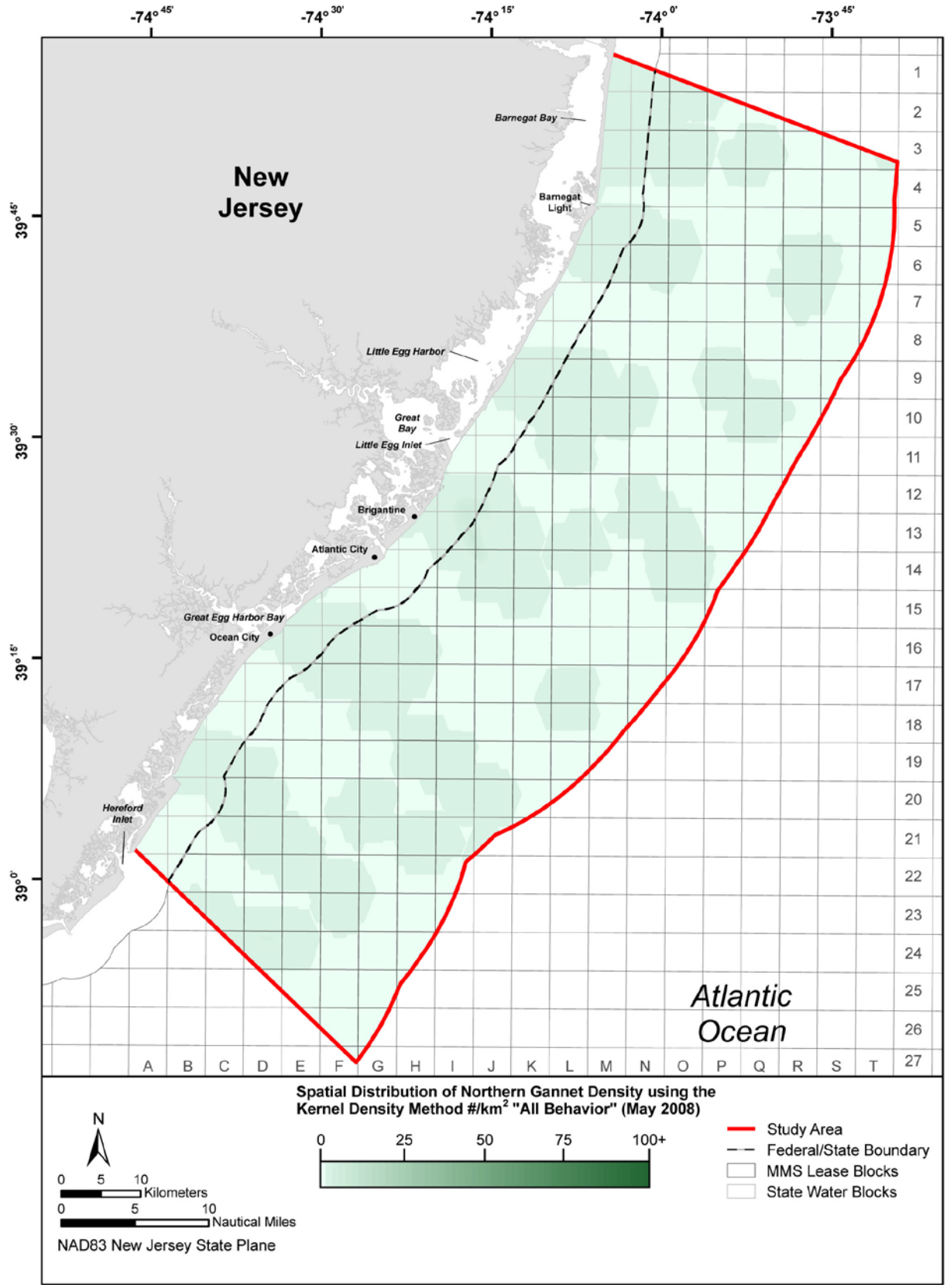

Figure M-138. Spatial distribution of Northern Gannet density (#/km^2) in the Study Area for all behaviors using the kernel density method (May 2008).

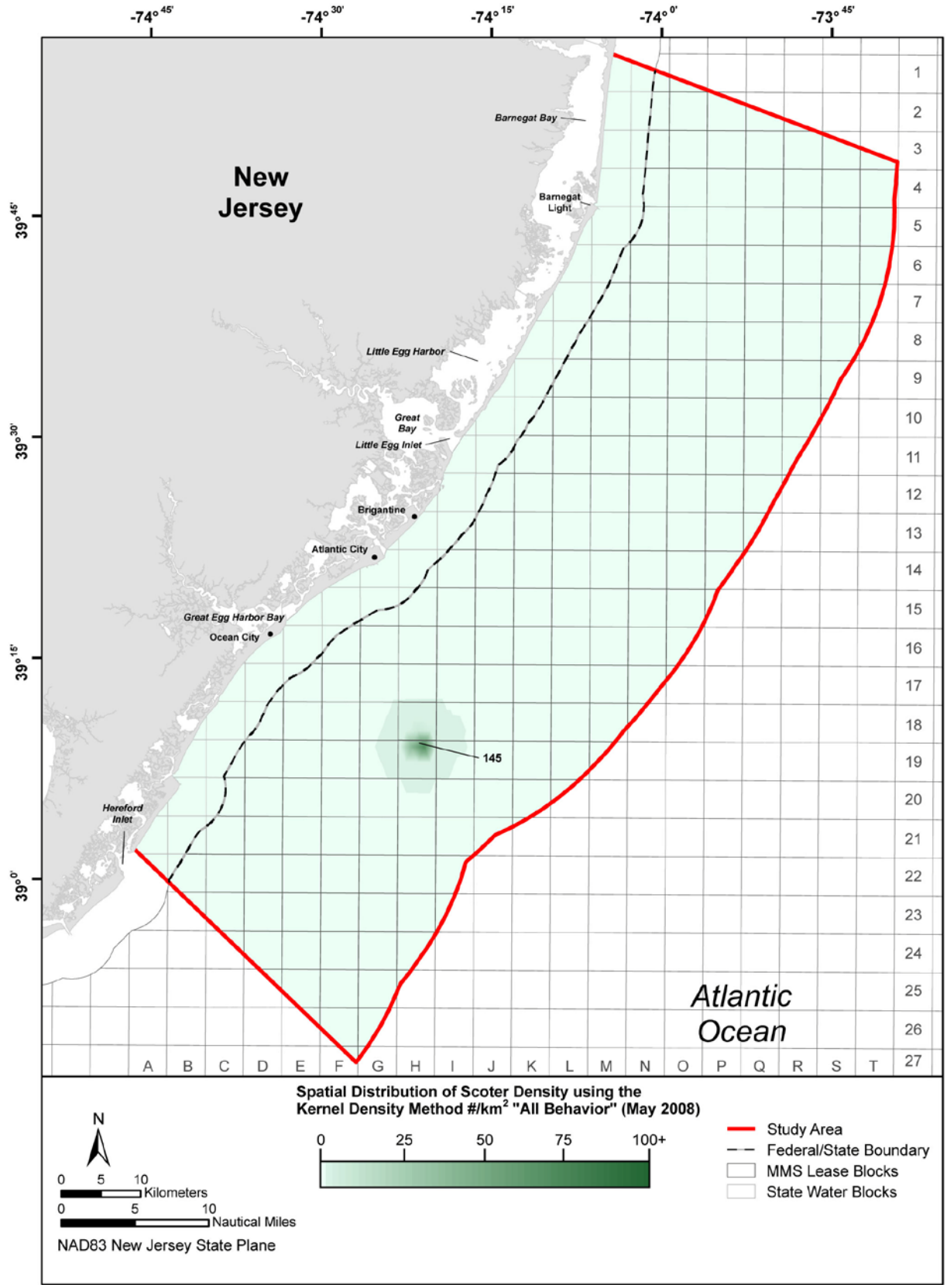

Figure M-139. Spatial distribution of scoter density (#/km^2) in the Study Area for all behaviors using the kernel density method (May 2008).

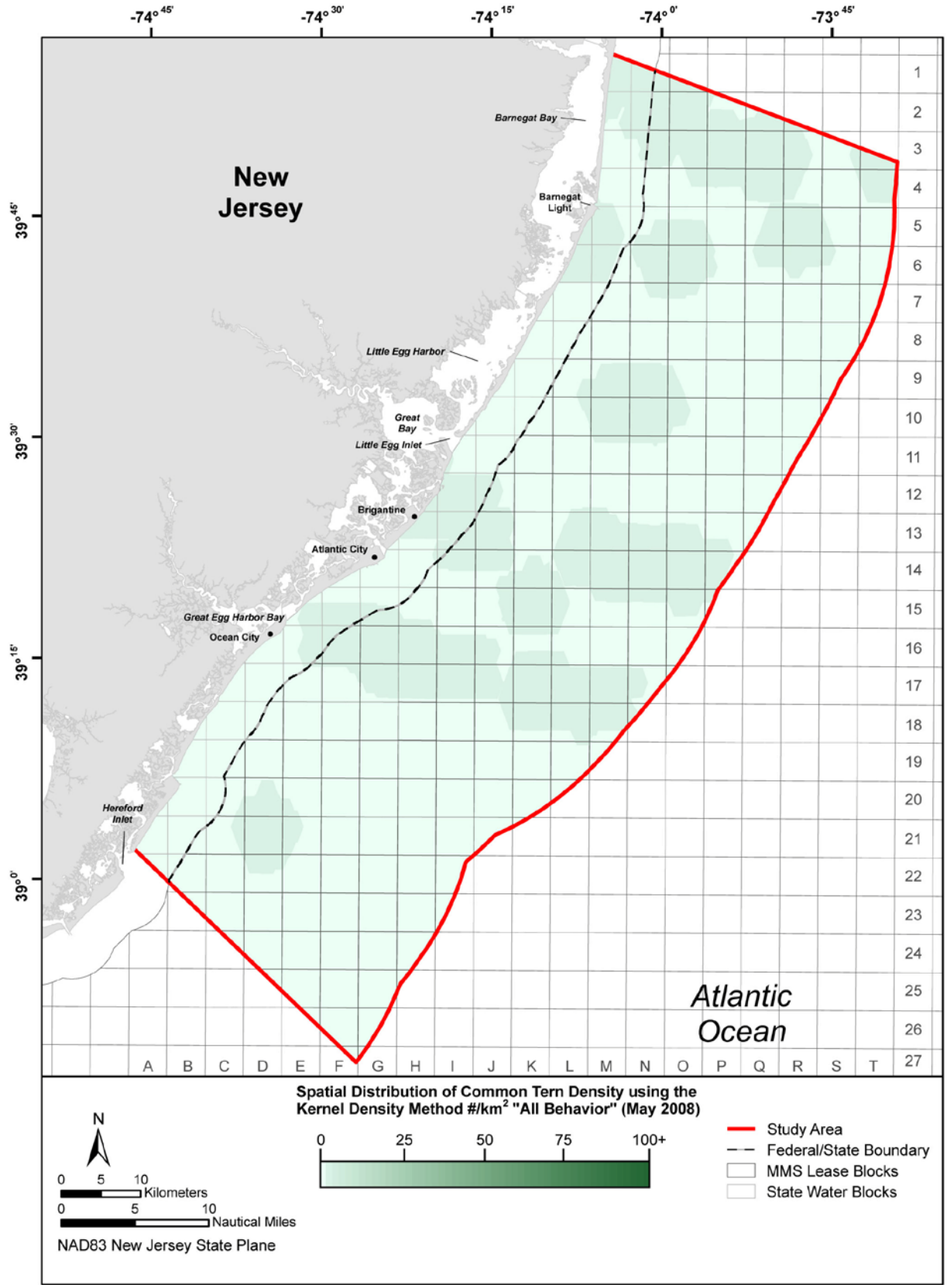

Figure M-140. Spatial distribution of Common Tern density (#/km^2) in the Study Area for all behaviors using the kernel density method (May 2008).

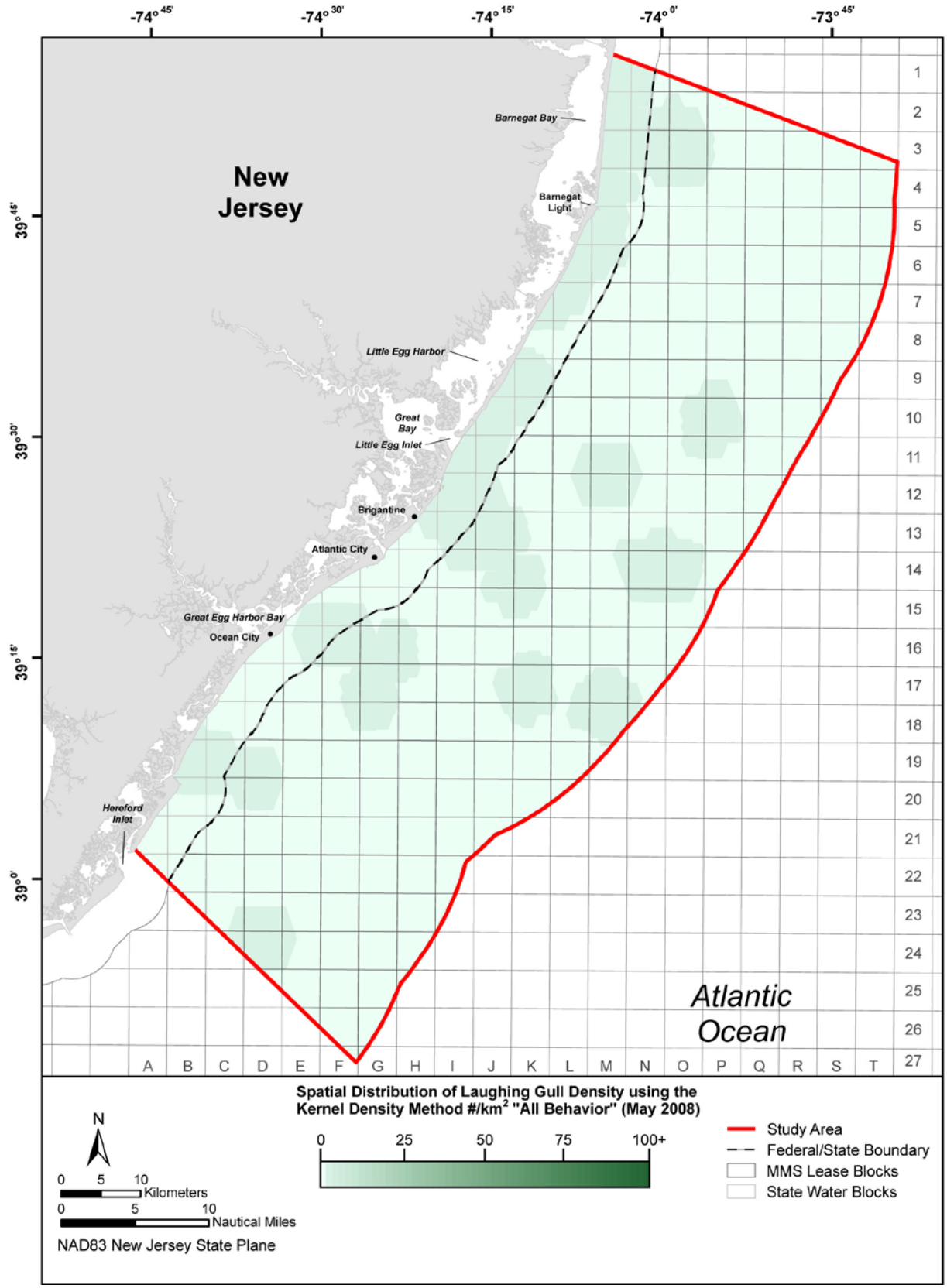

Figure M-141. Spatial distribution of Laughing Gull density (#/km^2) in the Study Area for all behaviors using the kernel density method (May 2008).

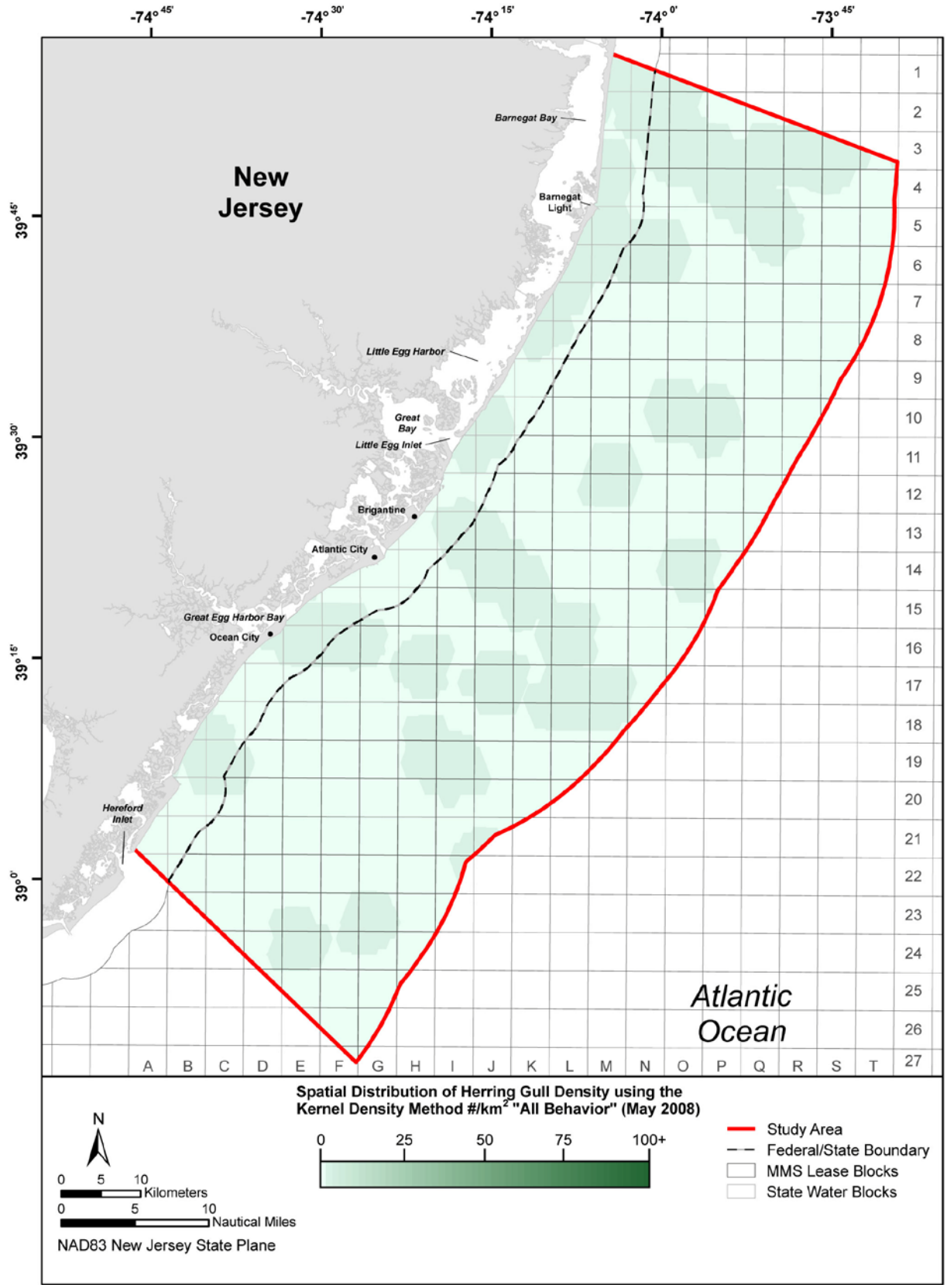

Figure M-142. Spatial distribution of Herring Gull density (#/km^2) in the Study Area for all behaviors using the kernel density method (May 2008).

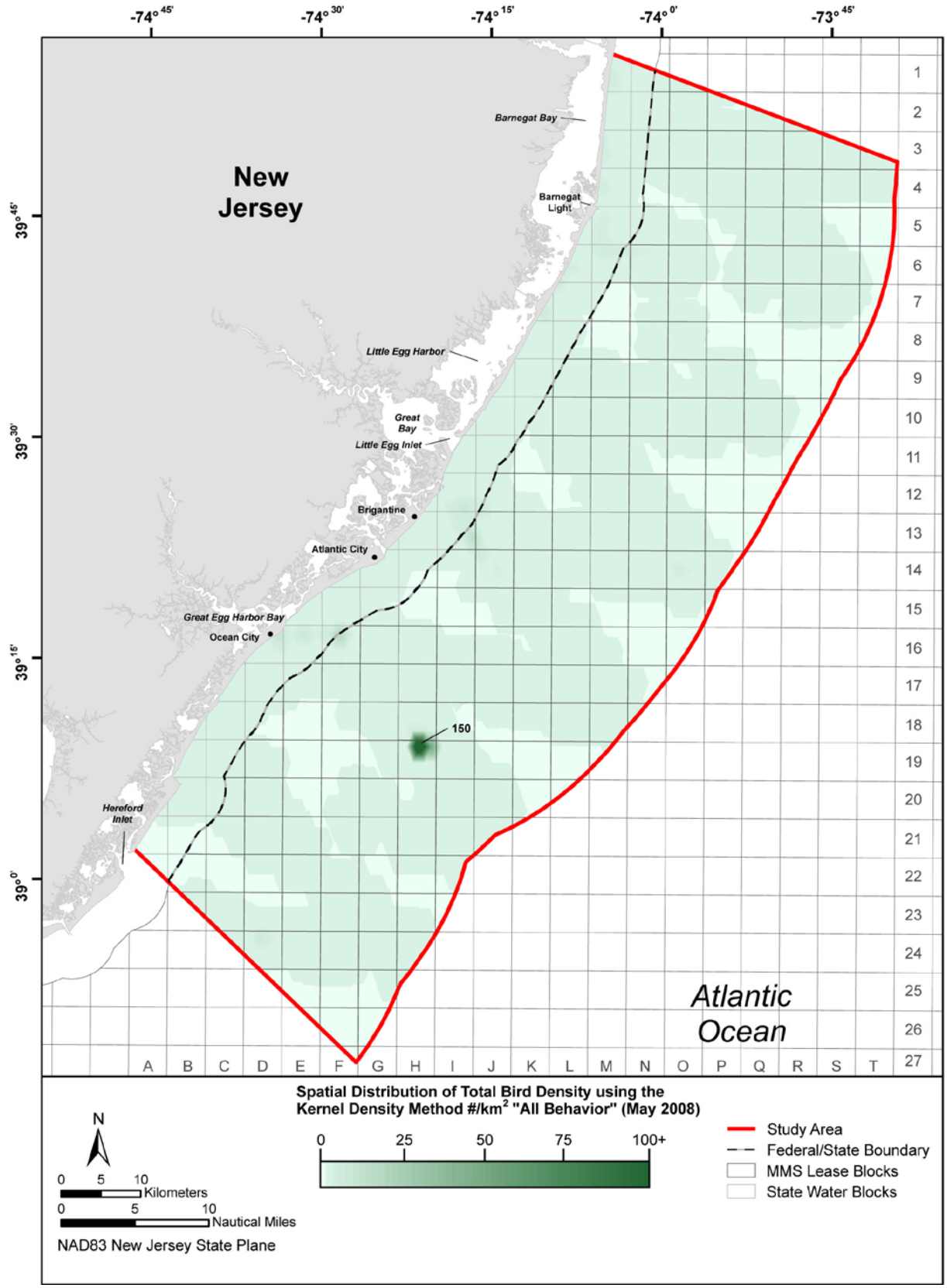

Figure M-143. Spatial distribution of total bird density (#/km^2) in the Study Area for all behaviors using the kernel density method (May 2008).

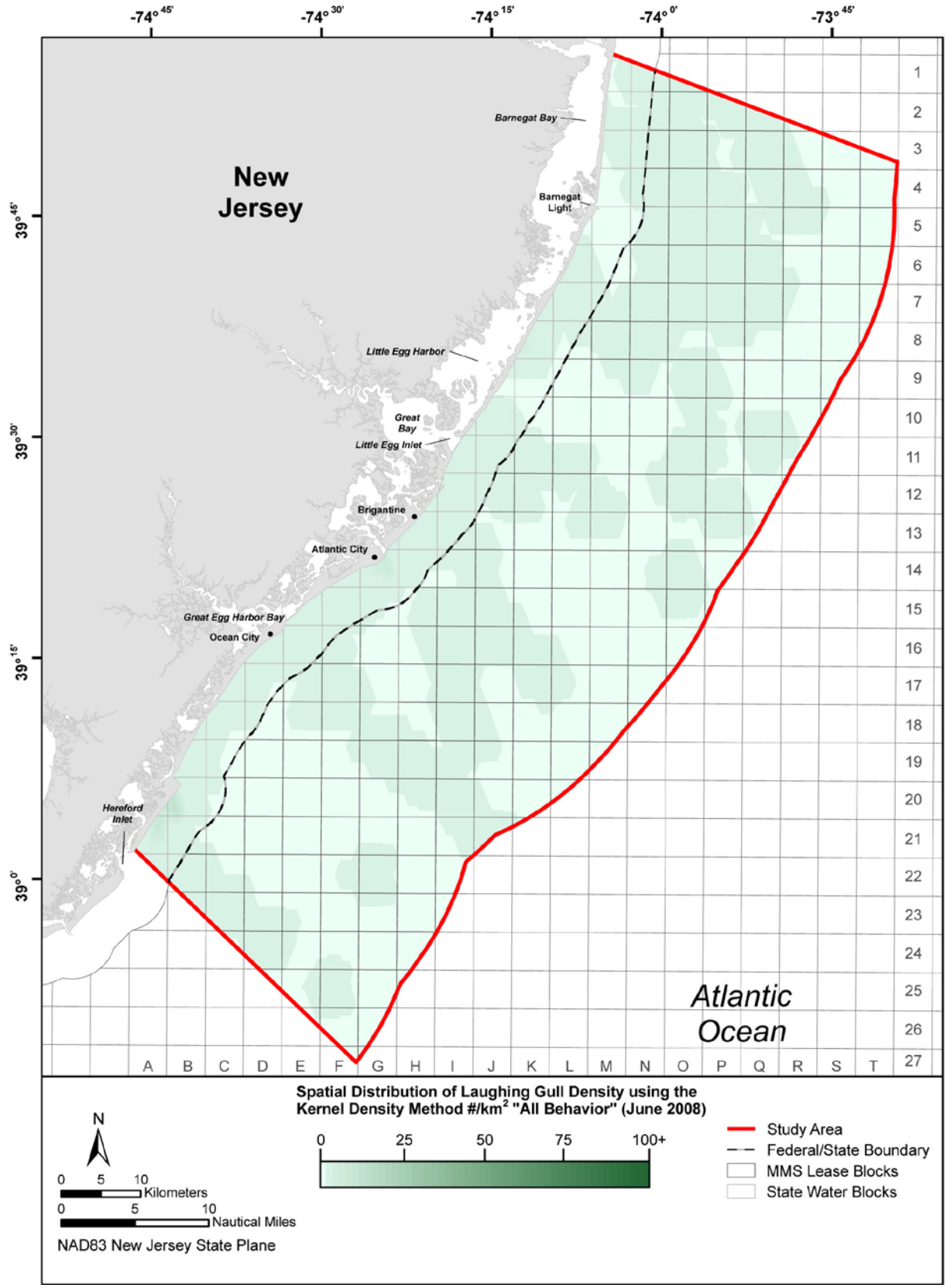

Figure M-144. Spatial distribution of Laughing Gull density (#/km^2) in the Study Area for all behaviors using the kernel density method (June 2008).

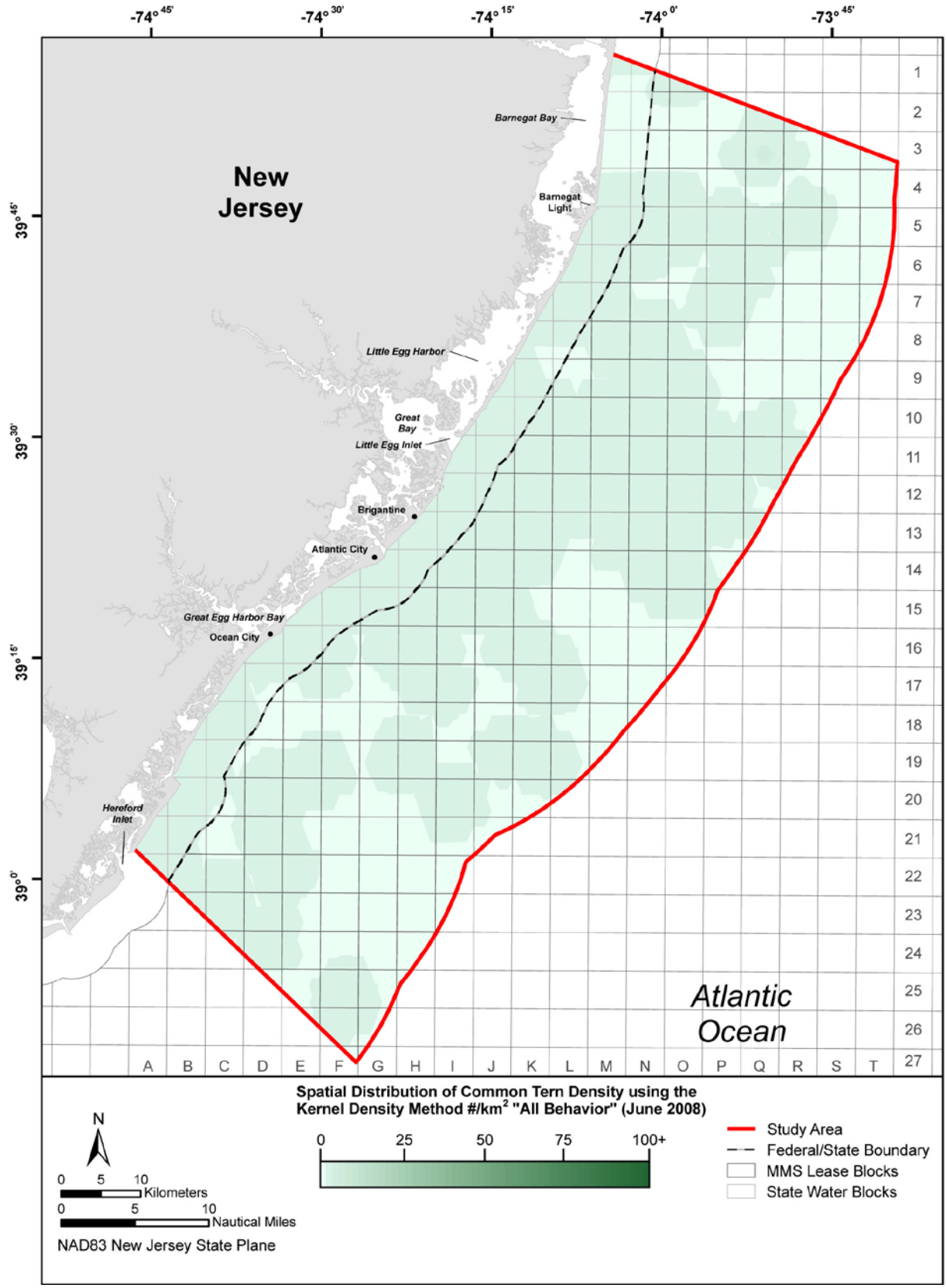

Figure M-145. Spatial distribution of Common Tern density (#/km^2) in the Study Area for all behaviors using the kernel density method (June 2008).

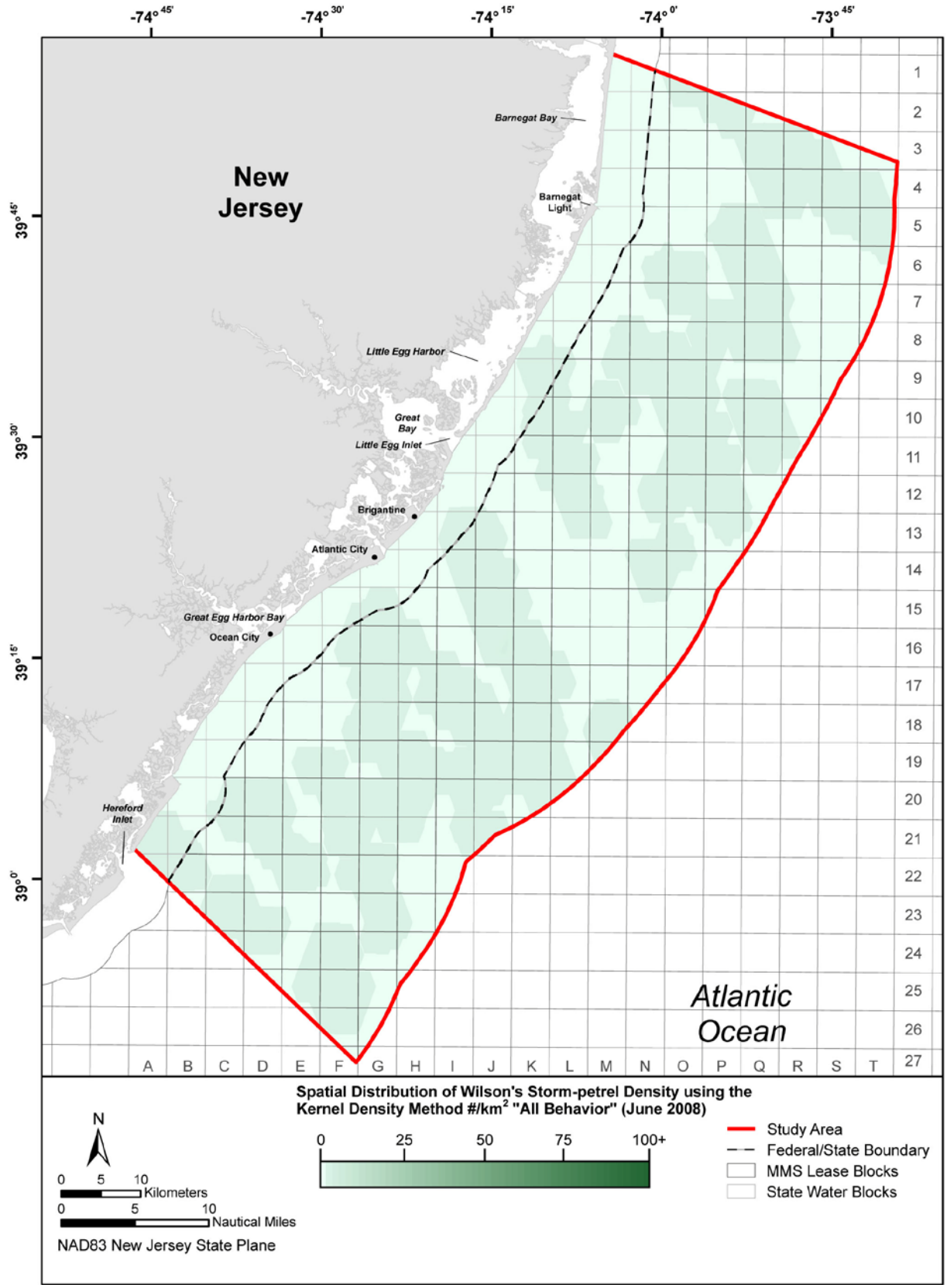

Figure M-146. Spatial distribution of Wilson's Storm-Petrel density (#/km^2) in the Study Area for all behaviors using the kernel density method (June 2008).

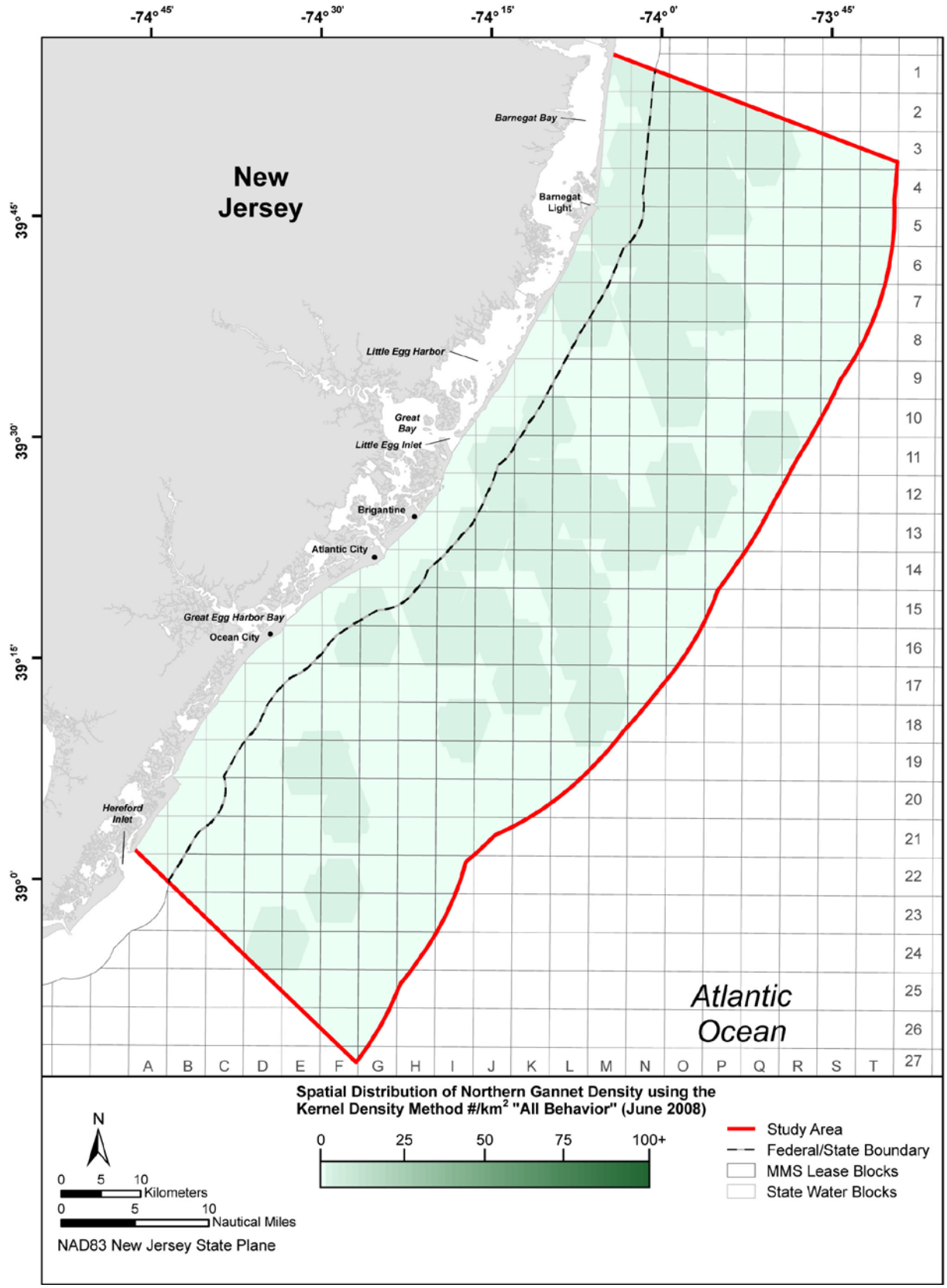

Figure M-147. Spatial distribution of Northern Gannet density (#/km^2) in the Study Area for all behaviors using the kernel density method (June 2008).

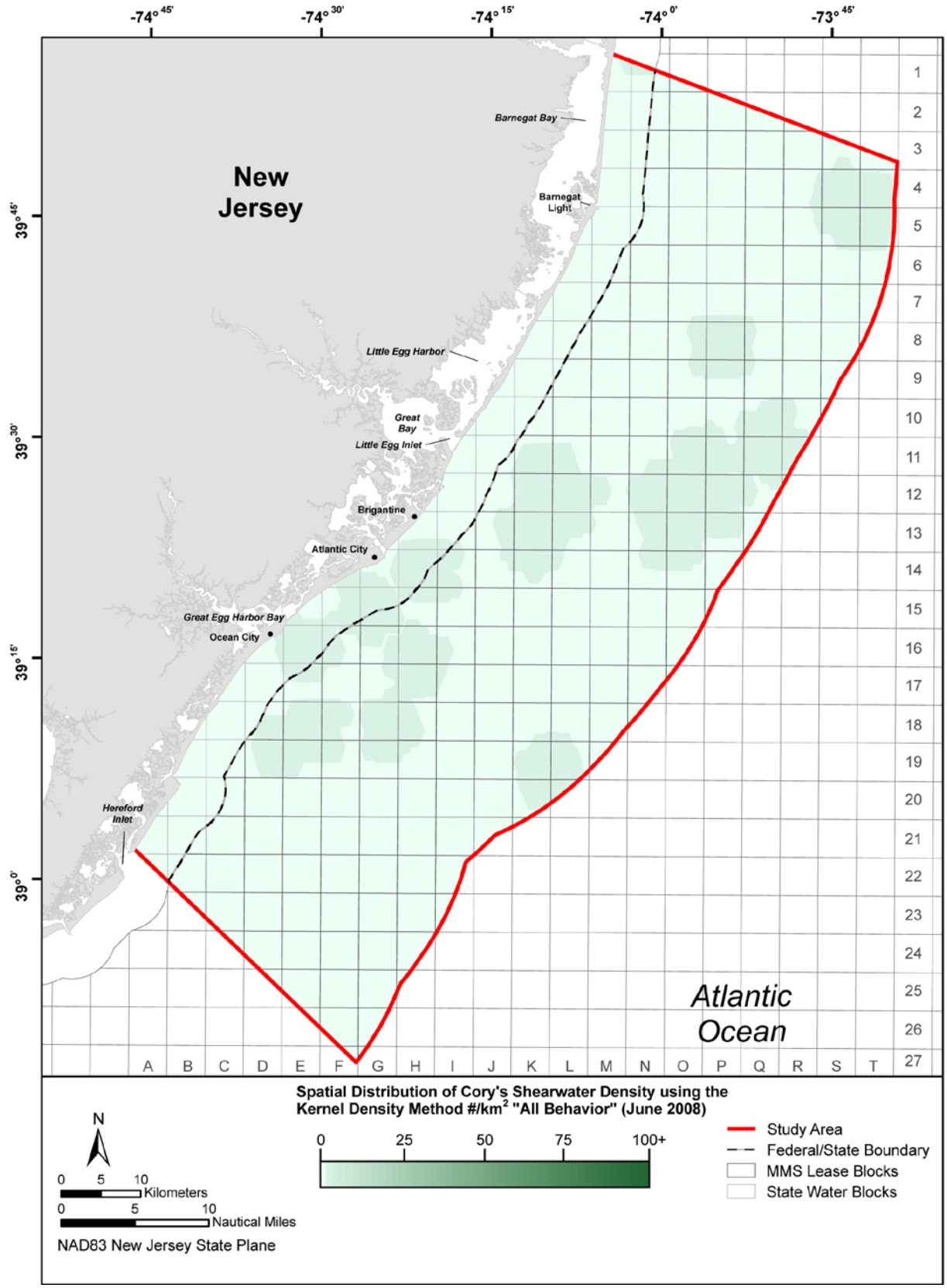

Figure M-148. Spatial distribution of Cory's Shearwater density (#/km^2) in the Study Area for all behaviors using the kernel density method (June 2008).

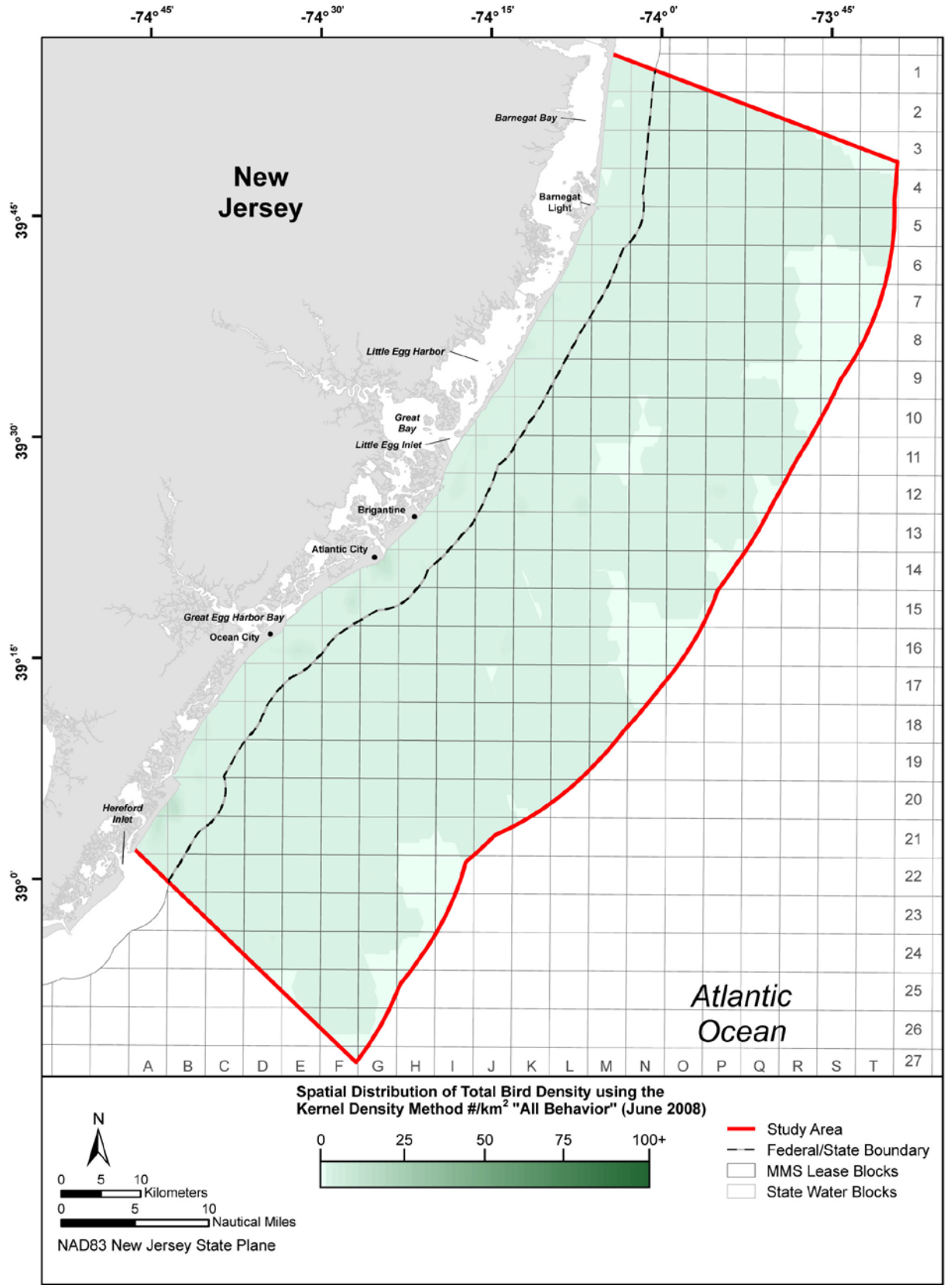

Figure M-149. Spatial distribution of total bird density (#/km^2) in the Study Area for all behaviors using the kernel density method (June 2008).

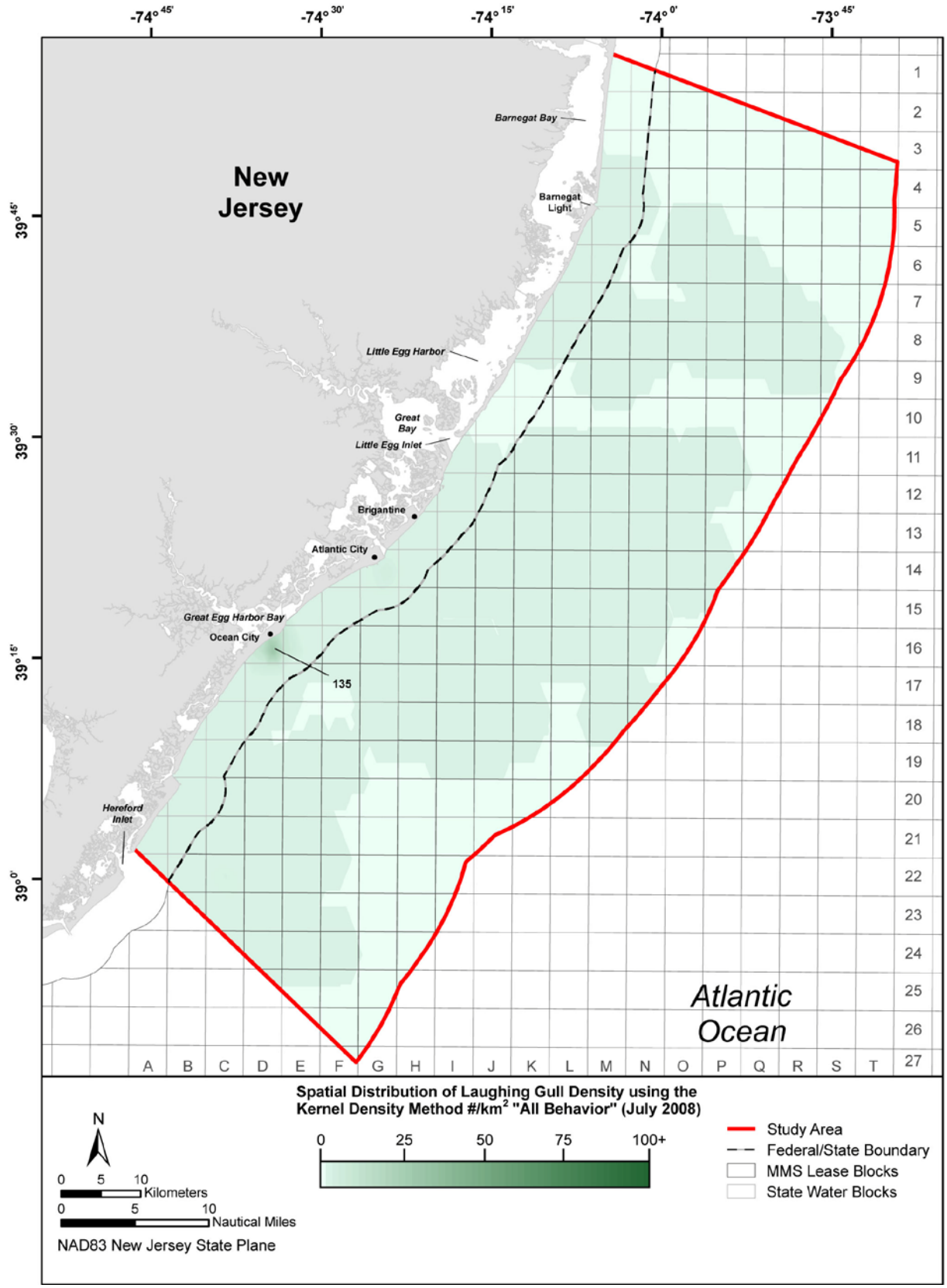

Figure M-150. Spatial distribution of Laughing Gull density (#/km^2) in the Study Area for all behaviors using the kernel density method (July 2008).

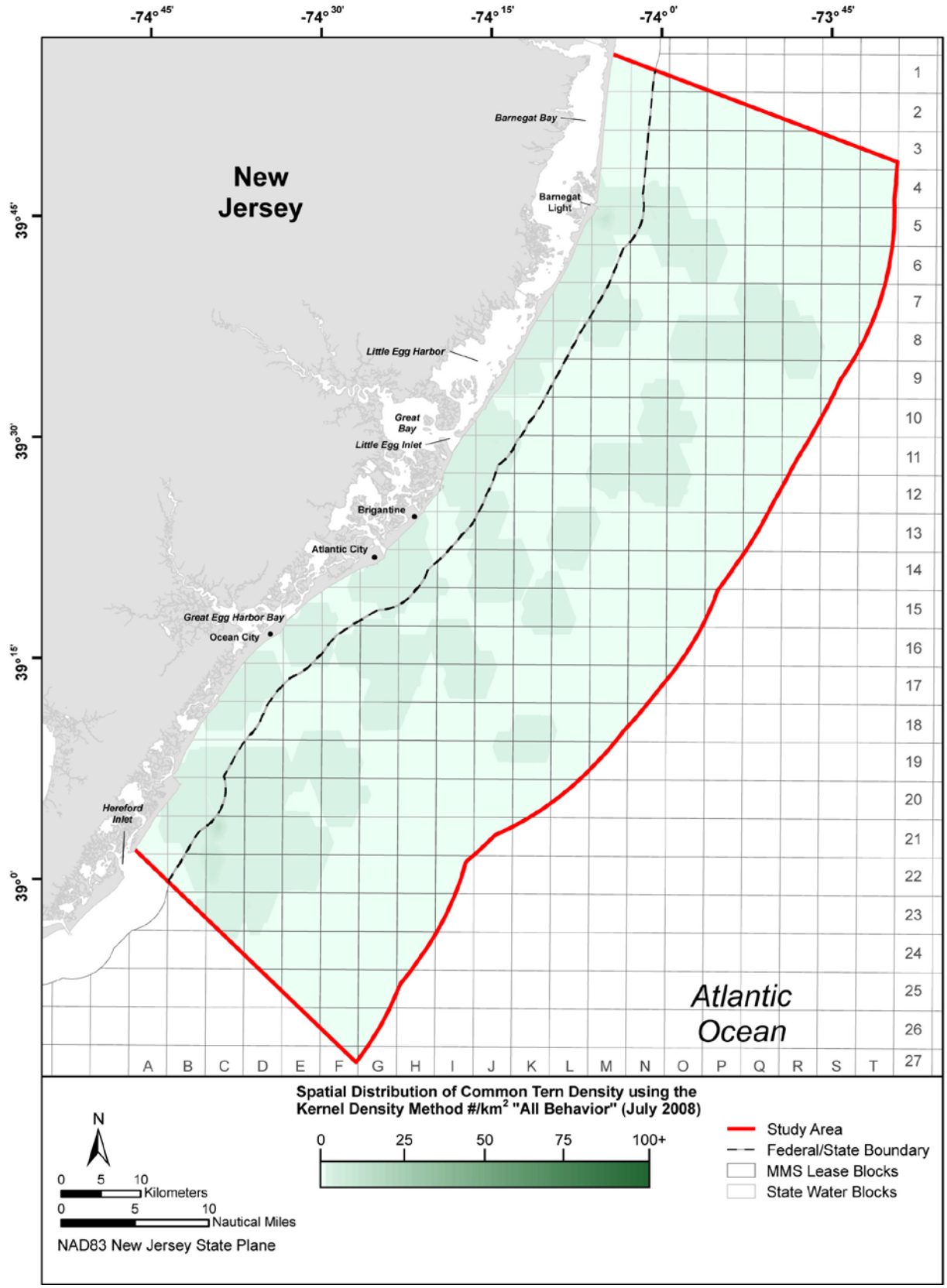

Figure M-151. Spatial distribution of Common Tern density (#/km^2) in the Study Area for all behaviors using the kernel density method (July 2008).

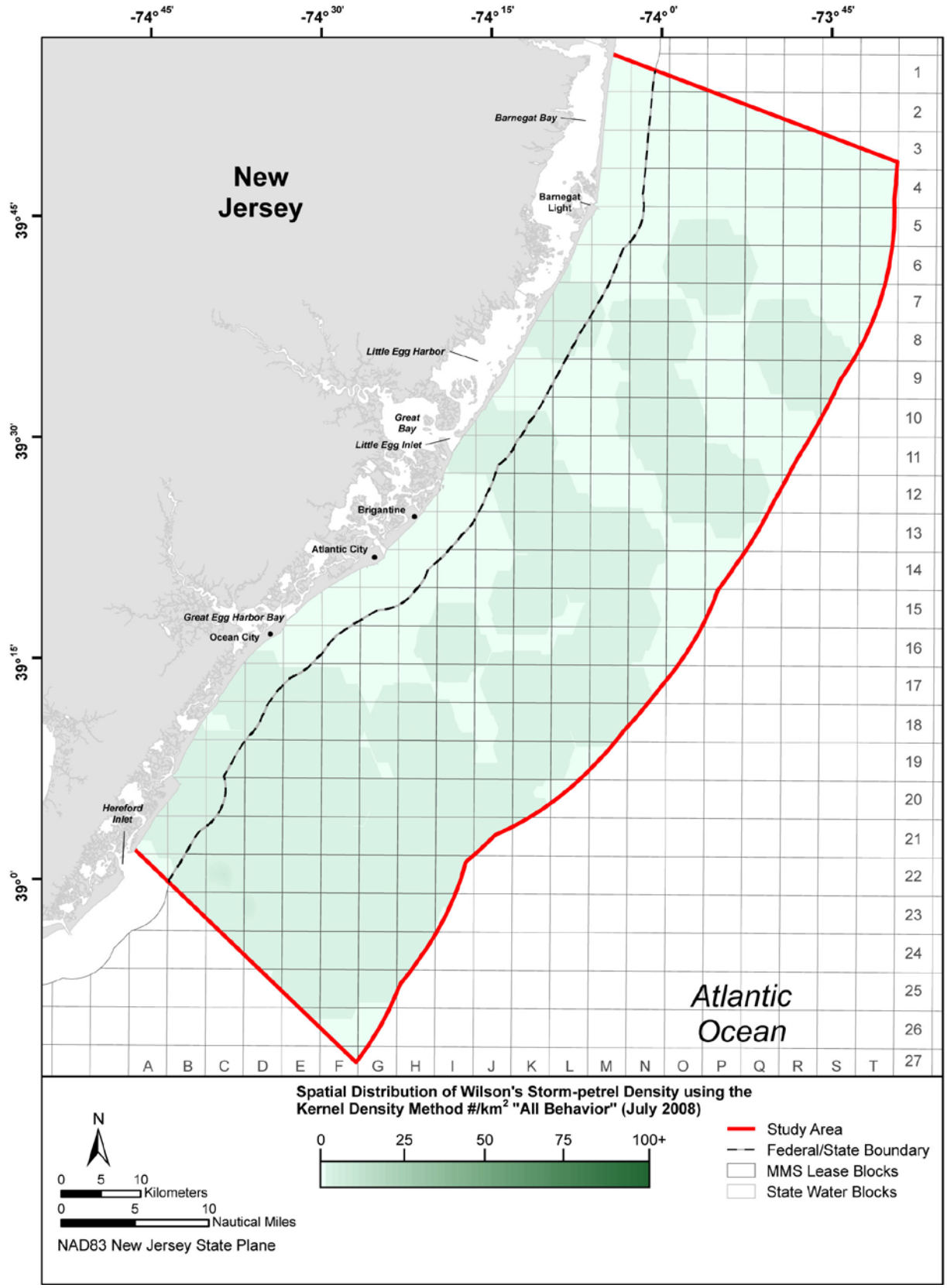

Figure M-152. Spatial distribution of Wilson's Storm-Petrel density (#/km^2) in the Study Area for all behaviors using the kernel density method (July 2008).

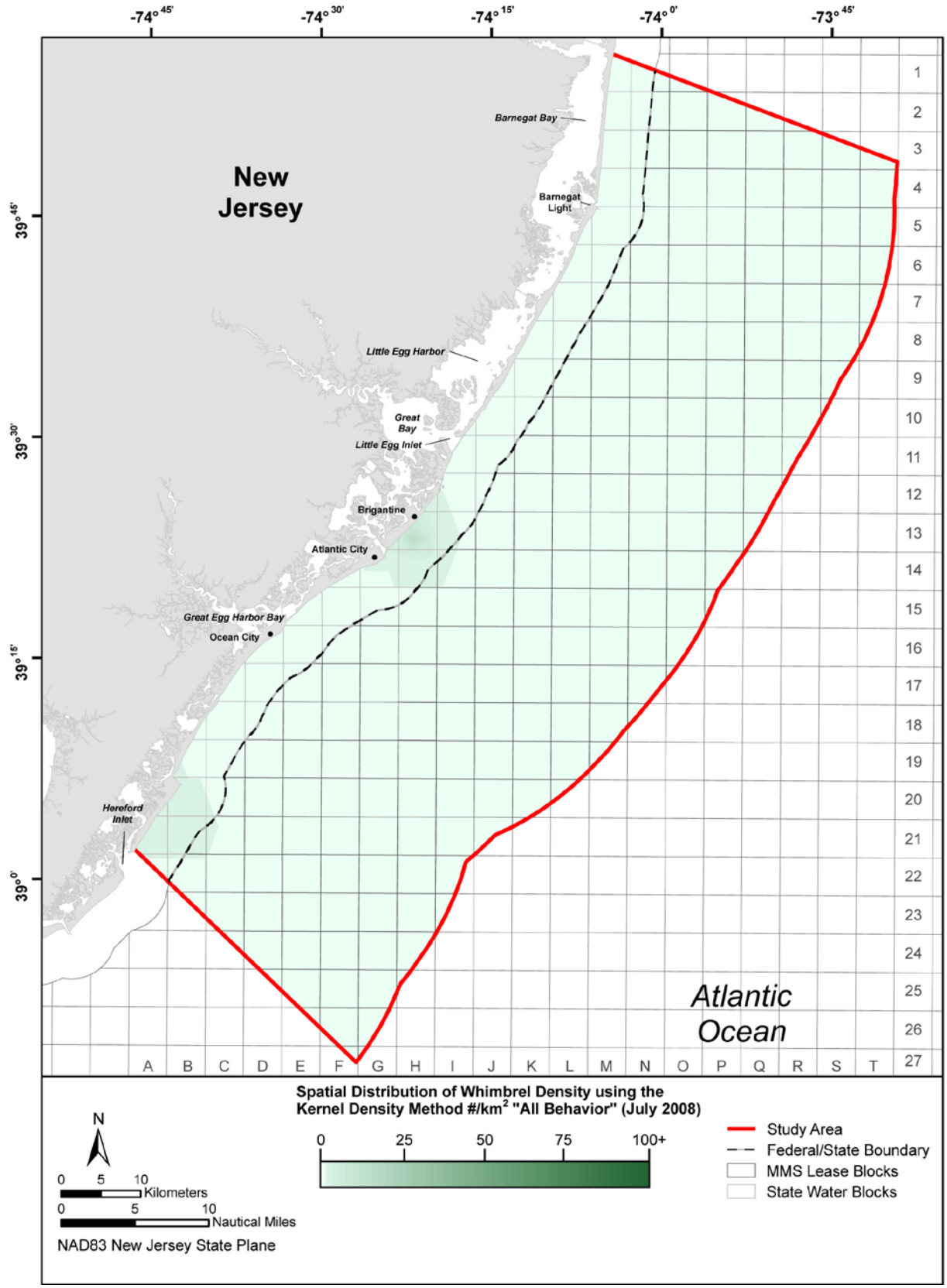

Figure M-153. Spatial distribution of Whimbrel density (#/km^2) in the Study Area for all behaviors using the kernel density method (July 2008).

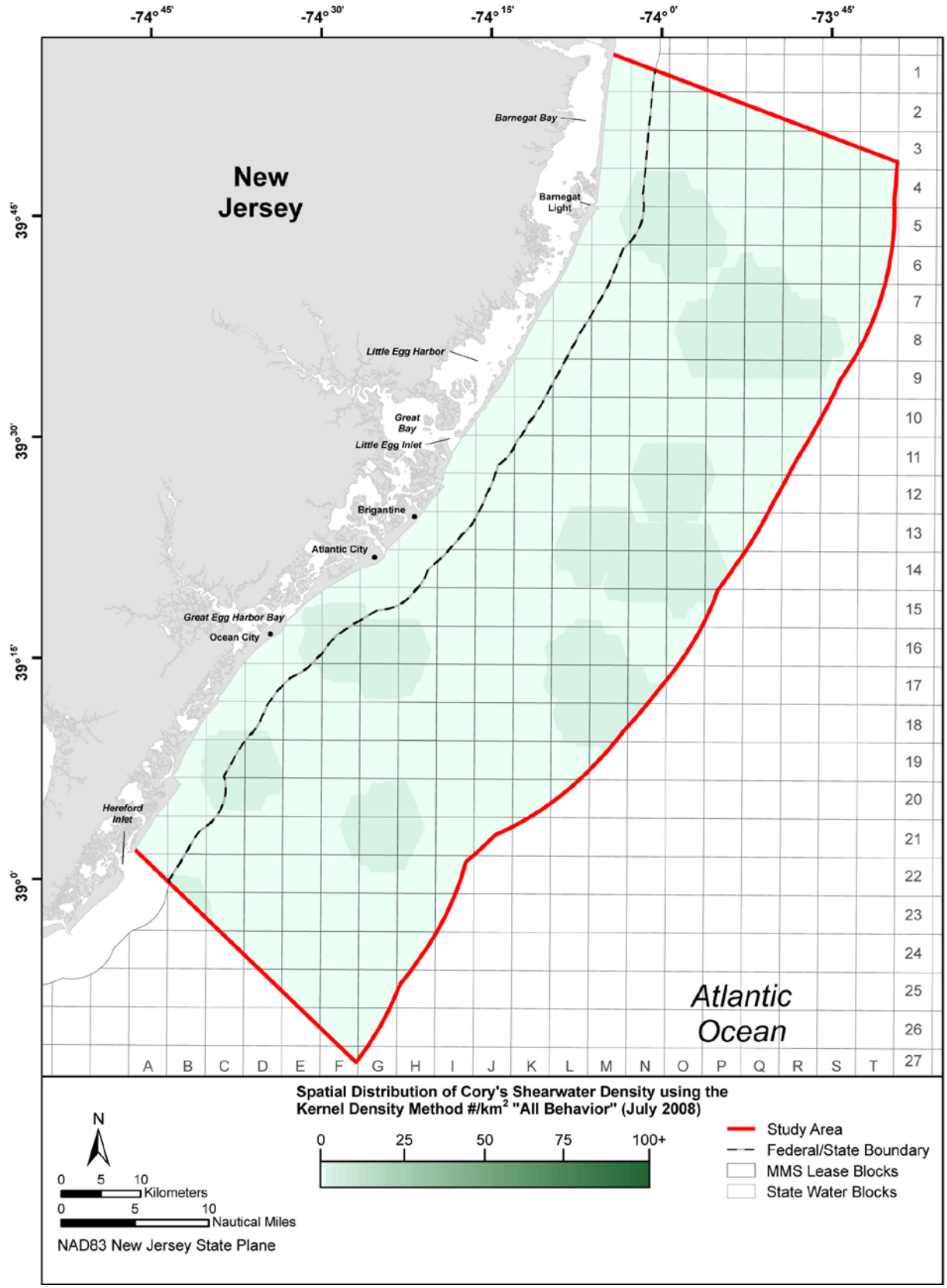

Figure M-154. Spatial distribution of Cory's Shearwater density (#/km^2) in the Study Area for all behaviors using the kernel density method (July 2008).

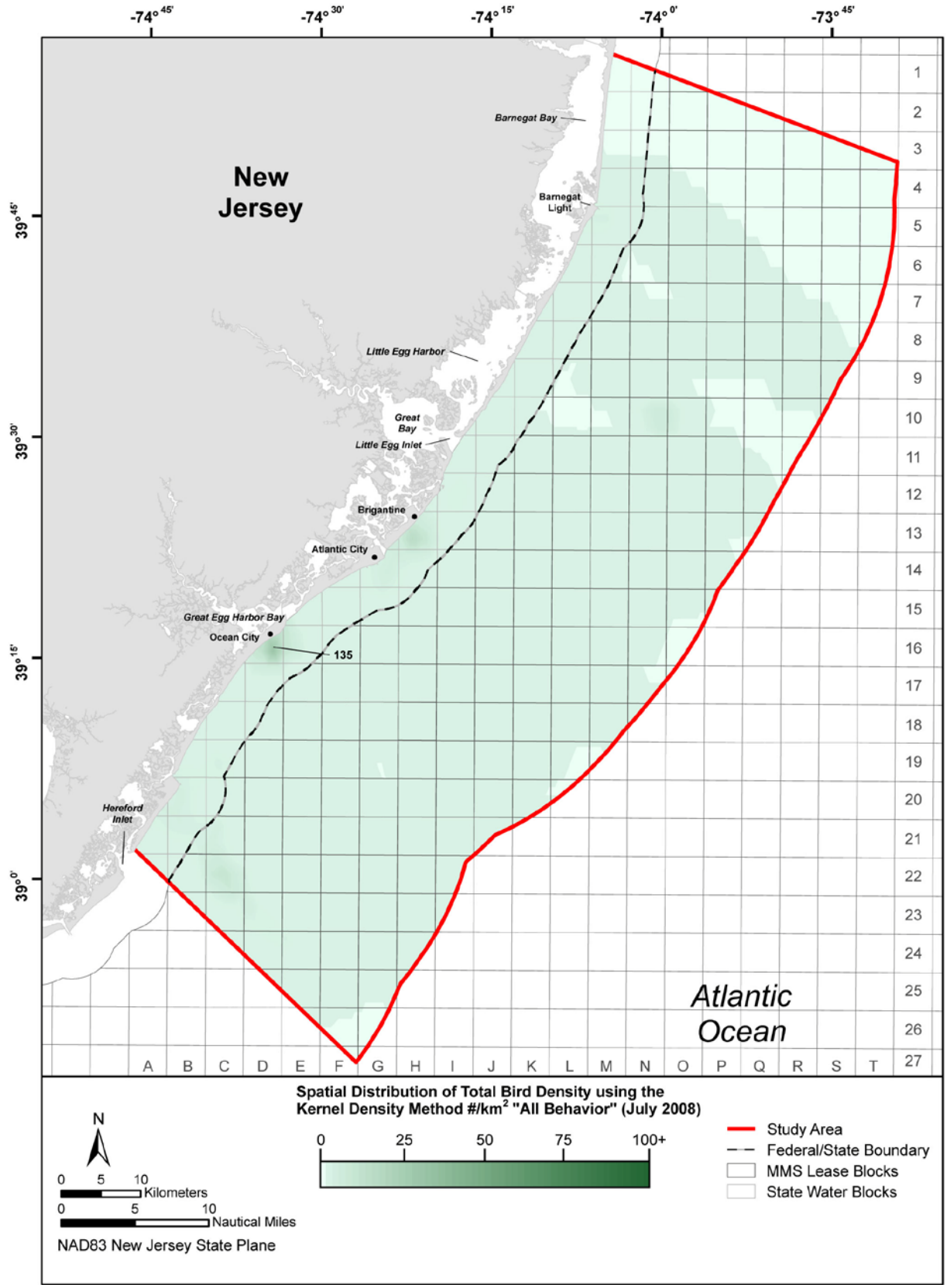

Figure M-155. Spatial distribution of total bird density (#/km^2) in the Study Area for all behaviors using the kernel density method (July 2008).

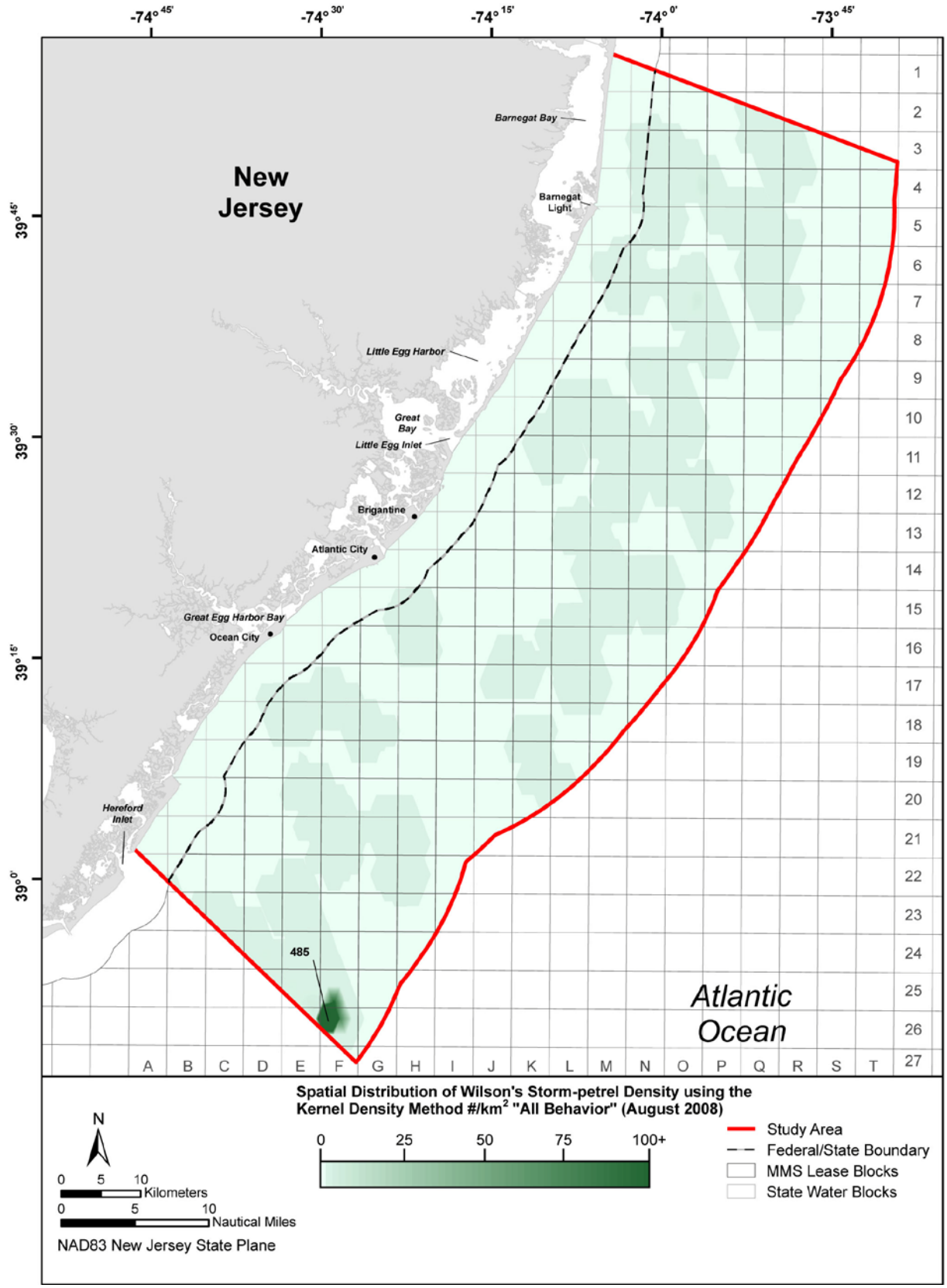

Figure M-156. Spatial distribution of Wilson's Storm-Petrel density (#/km^2) in the Study Area for all behaviors using the kernel density method (August 2008).

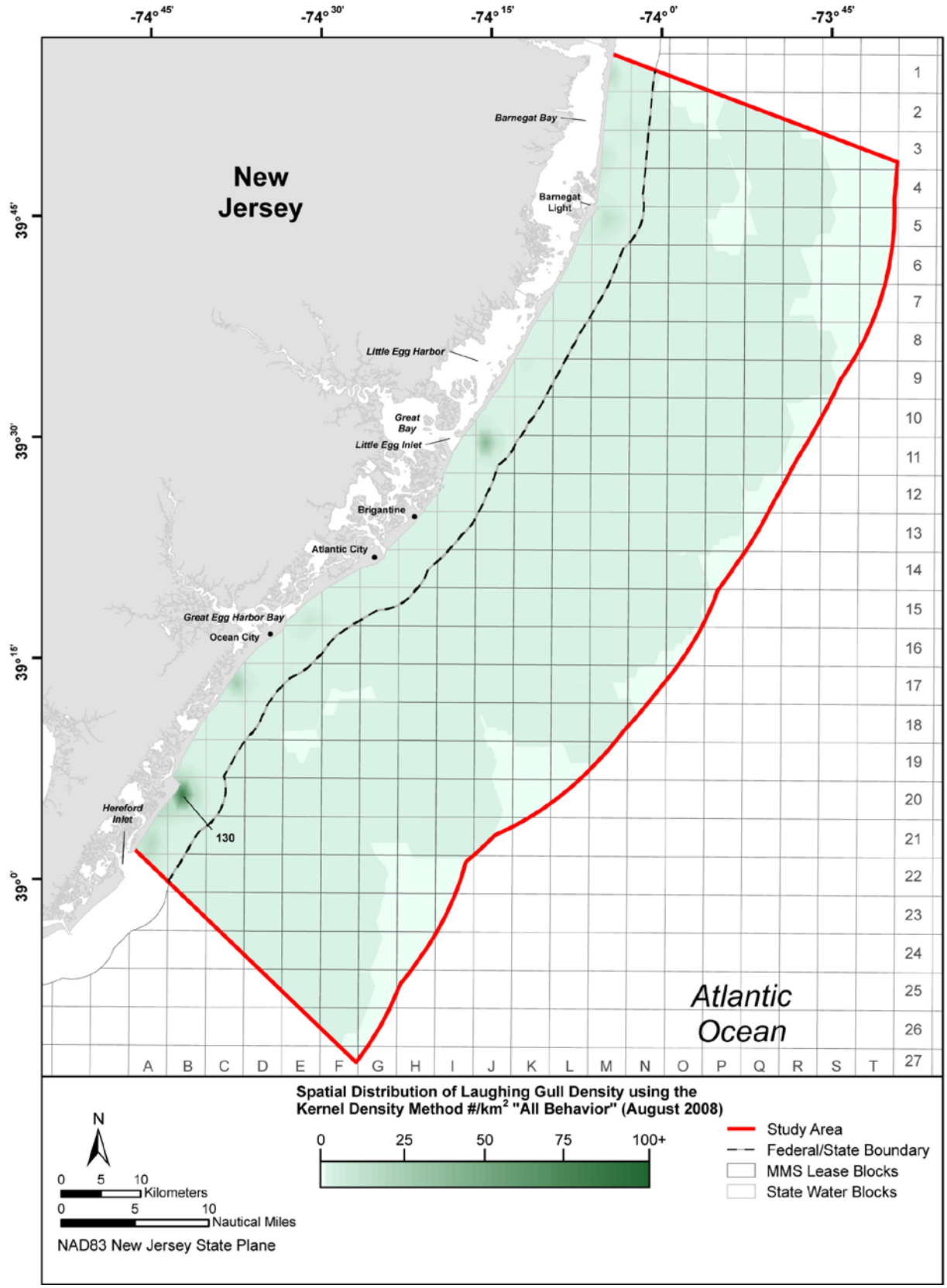

Figure M-157. Spatial distribution of Laughing Gull density (#/km^2) in the Study Area for all behaviors using the kernel density method (August 2008).

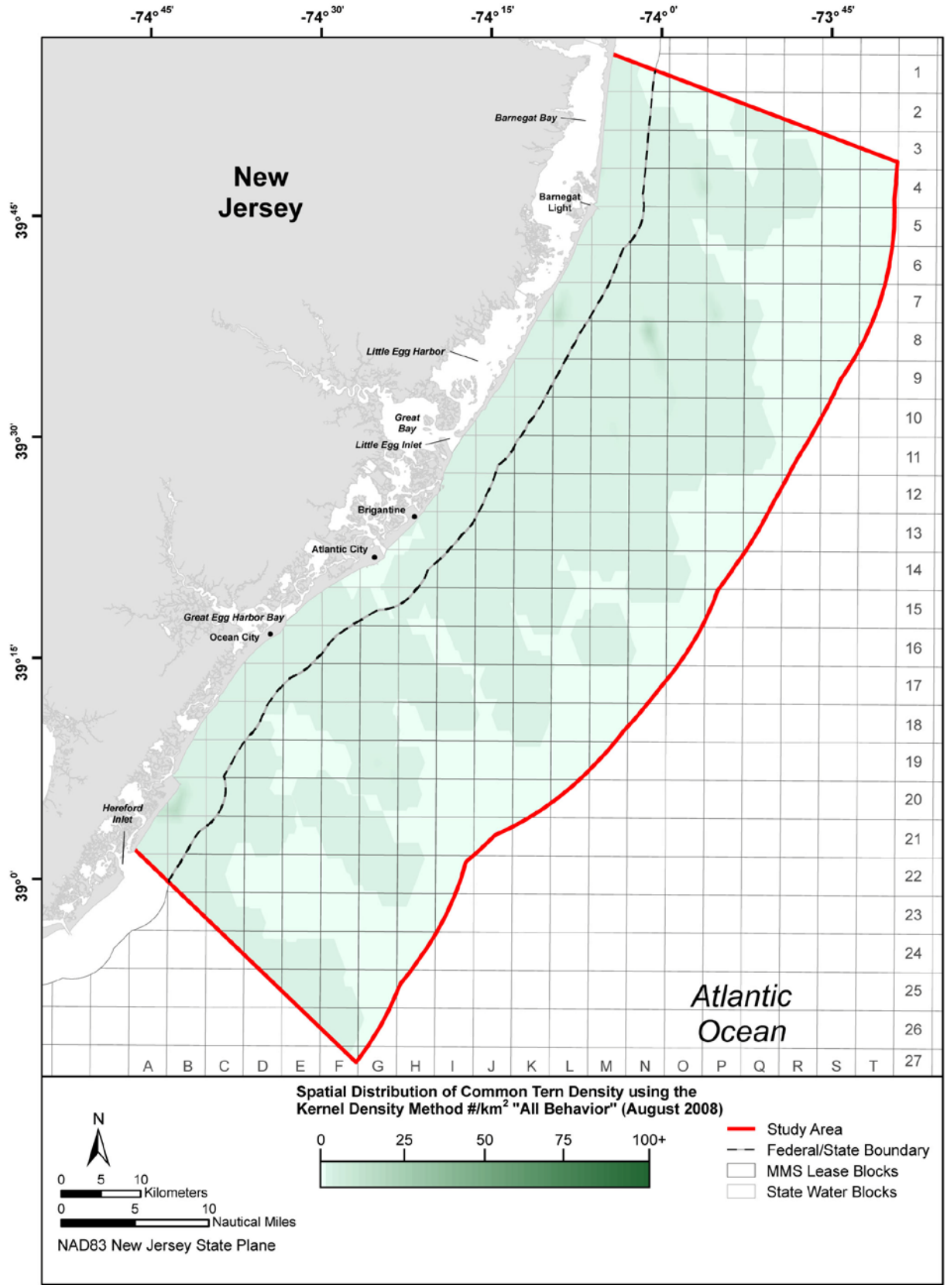

Figure M-158. Spatial distribution of Common Tern density (#/km^2) in the Study Area for all behaviors using the kernel density method (August 2008).

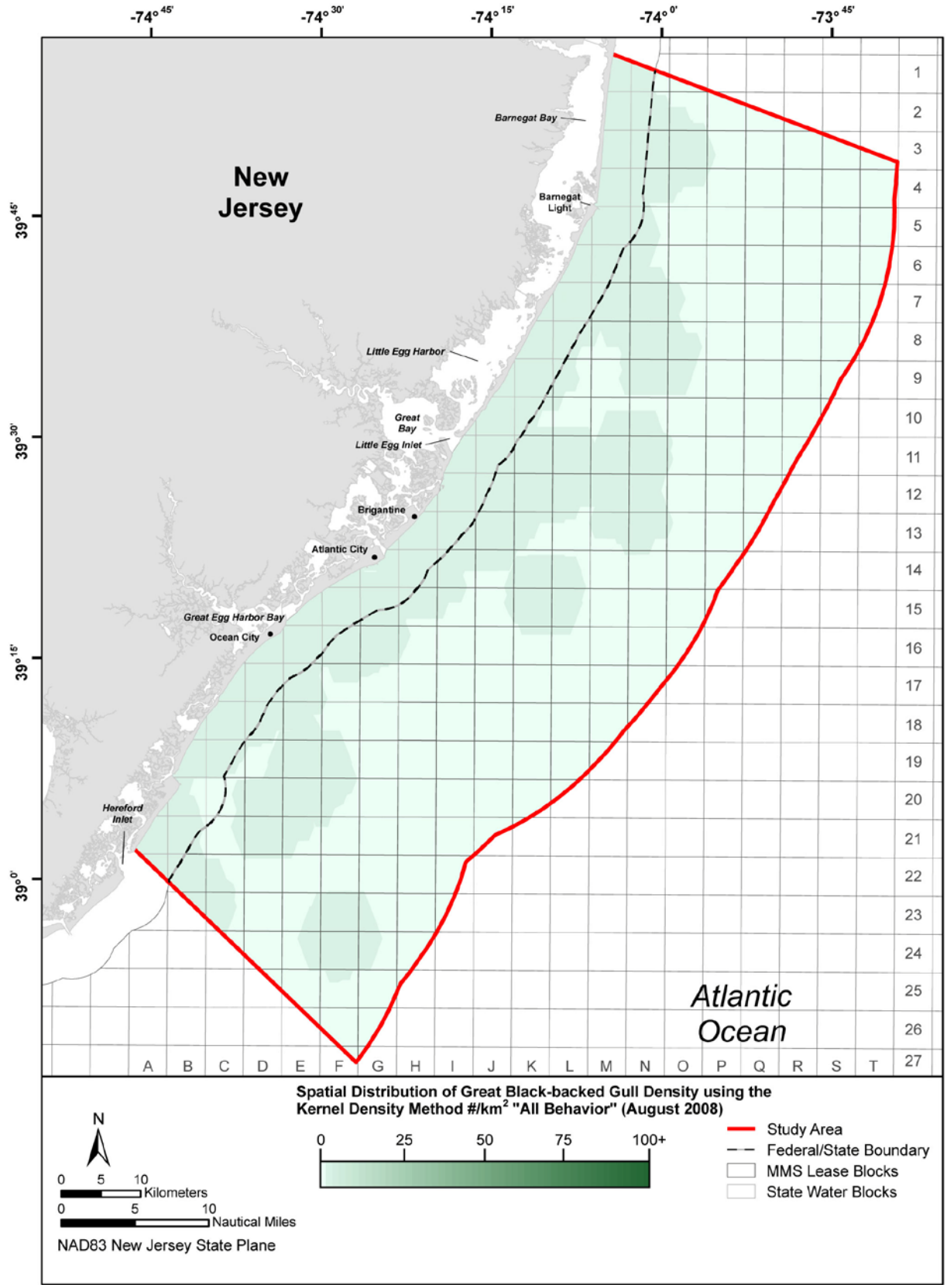

Figure M-159. Spatial distribution of Great Black-backed Gull density (#/km^2) in the Study Area for all behaviors using the kernel density method (August 2008).

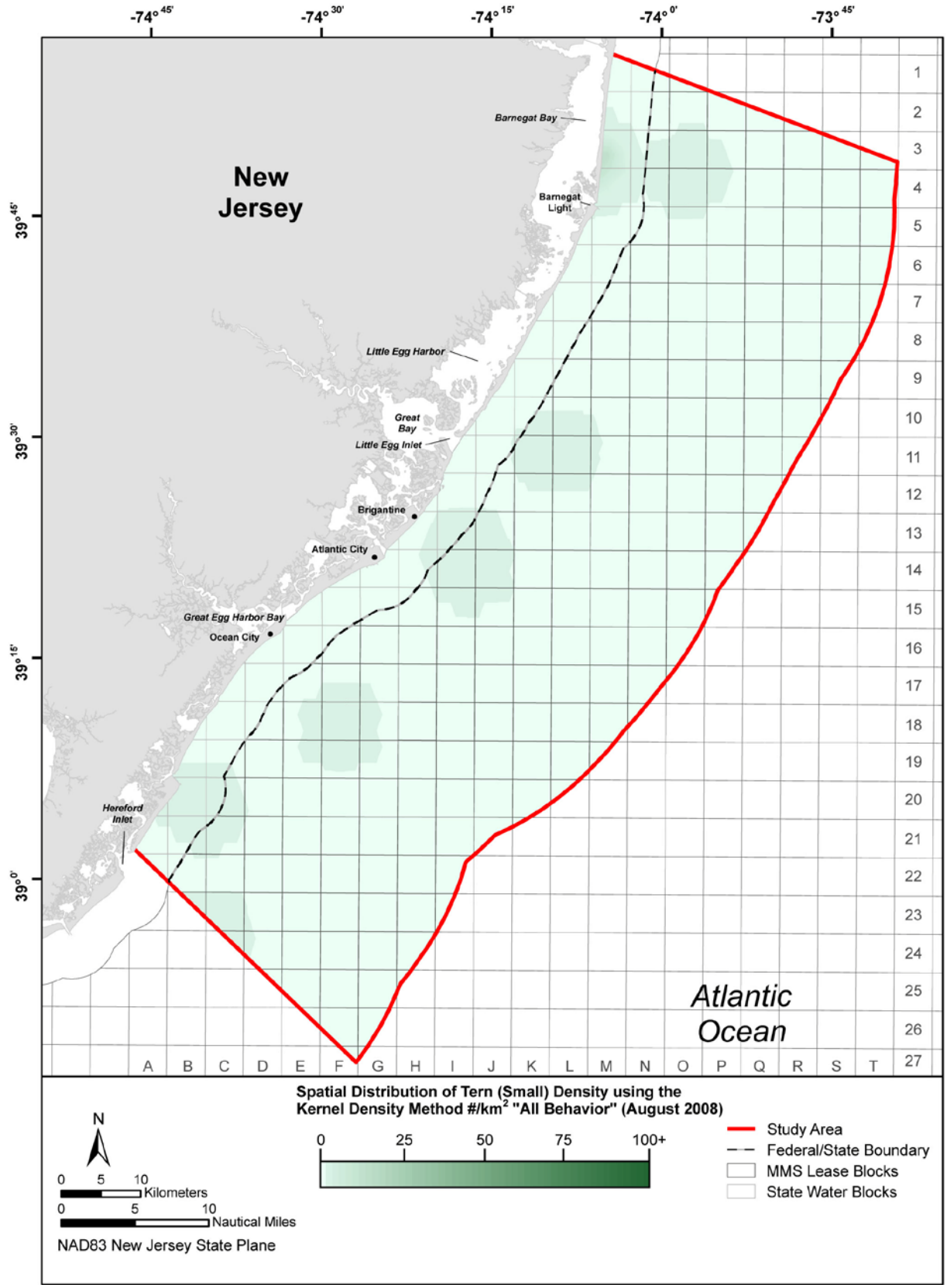

Figure M-160. Spatial distribution of small tern density (#/km^2) in the Study Area for all behaviors using the kernel density method (August 2008).

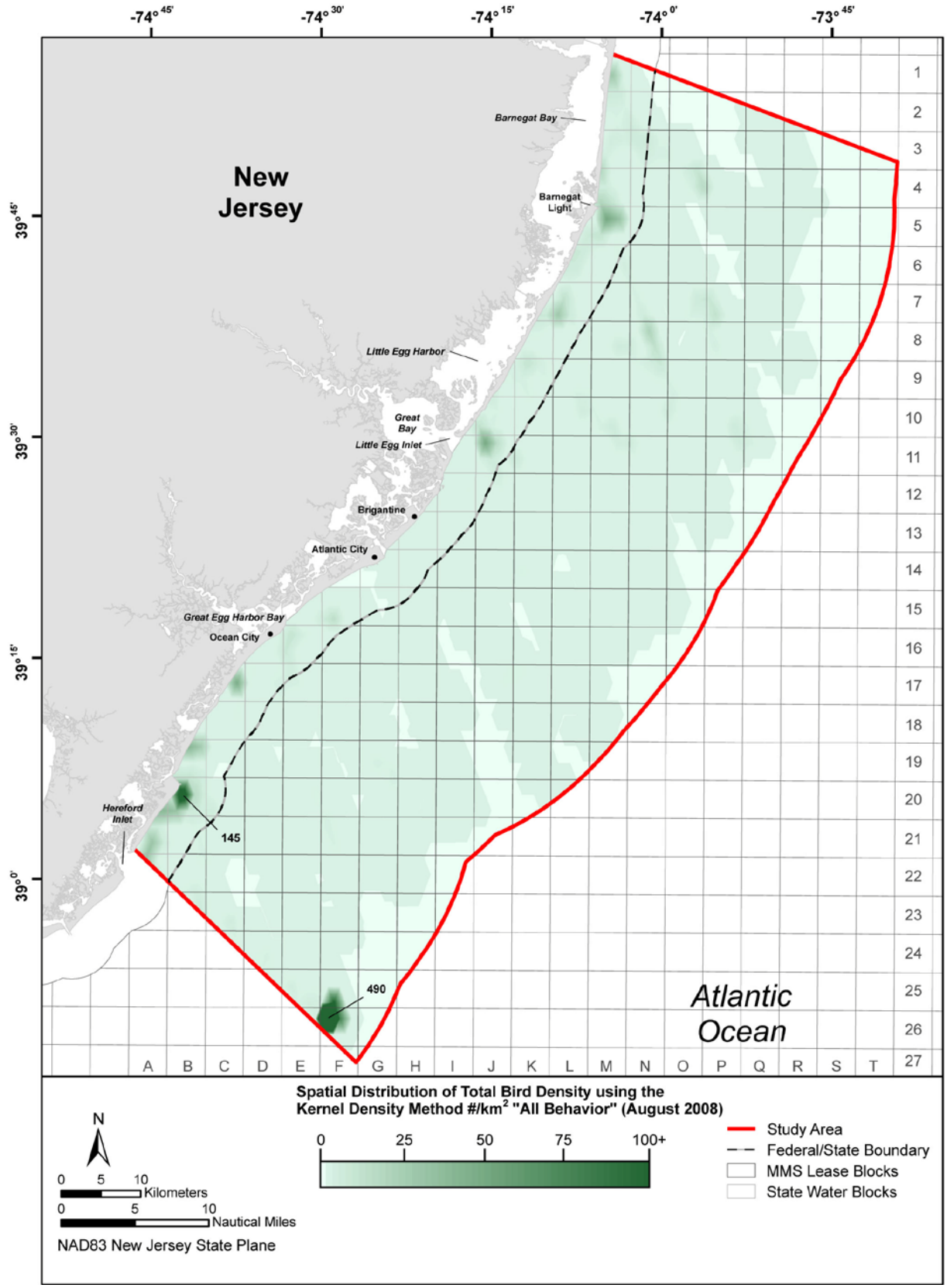

Figure M-161. Spatial distribution of total bird density (#/km^2) in the Study Area for all behaviors using the kernel density method (August 2008).

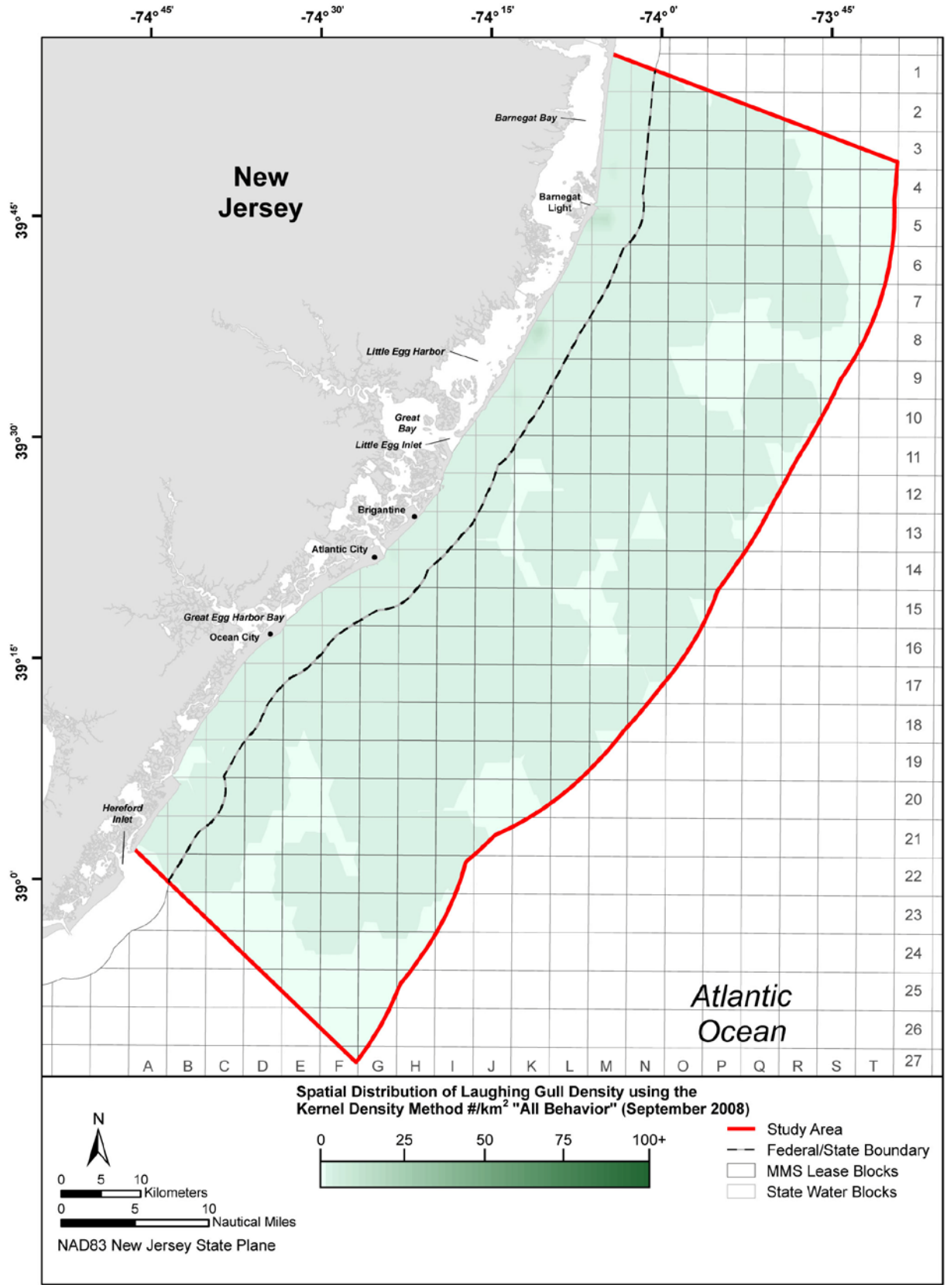

Figure M-162. Spatial distribution of Laughing Gull density (#/km^2) in the Study Area for all behaviors using the kernel density method (September 2008).

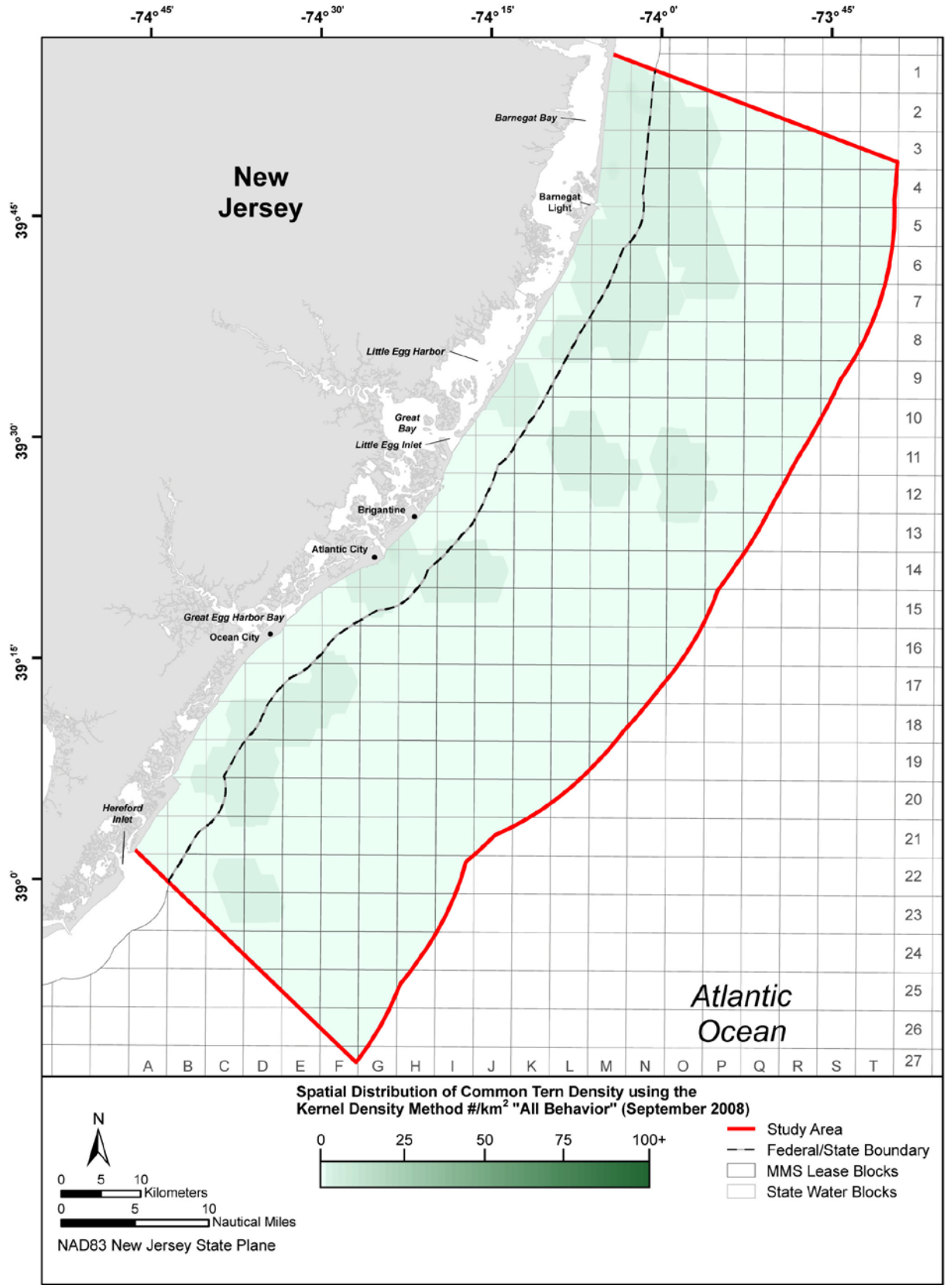

Figure M-163. Spatial distribution of Common Tern density (#/km^2) in the Study Area for all behaviors using the kernel density method (September 2008).

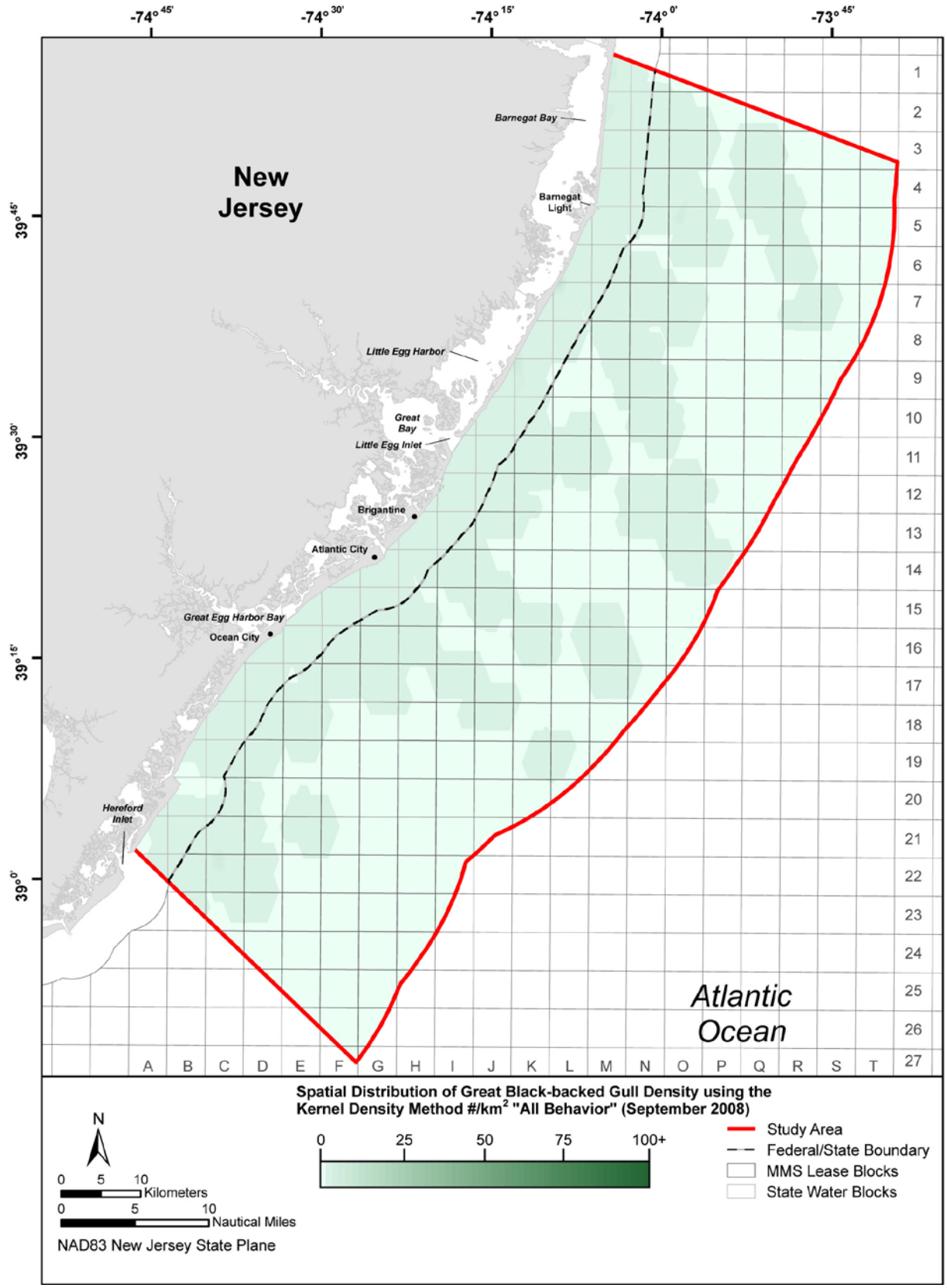

Figure M-164. Spatial distribution of Great Black-backed Gull density (#/km^2) in the Study Area for all behaviors using the kernel density method (September 2008).

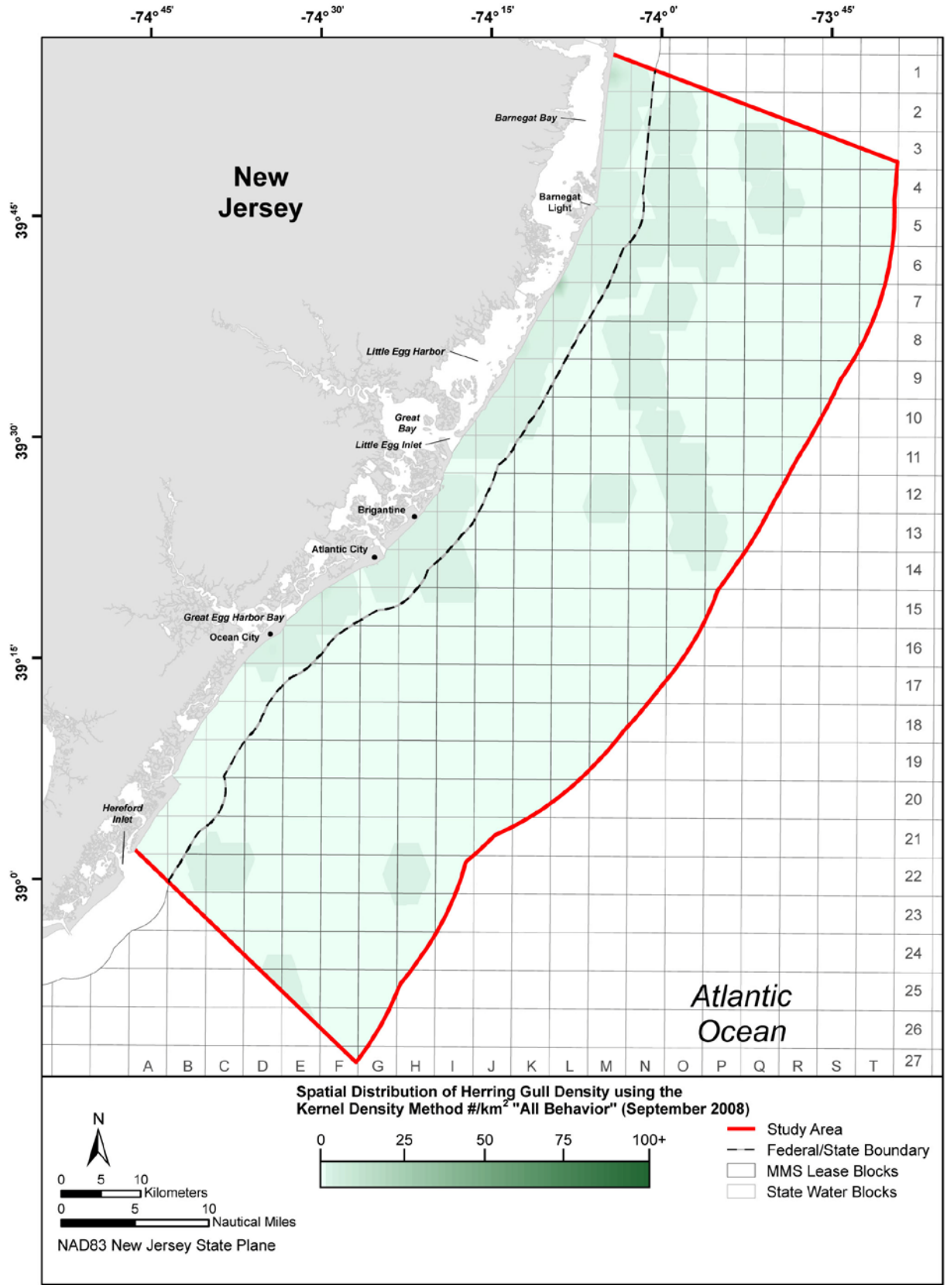

Figure M-165. Spatial distribution of Herring Gull density (#/km^2) in the Study Area for all behaviors using the kernel density method (September 2008).

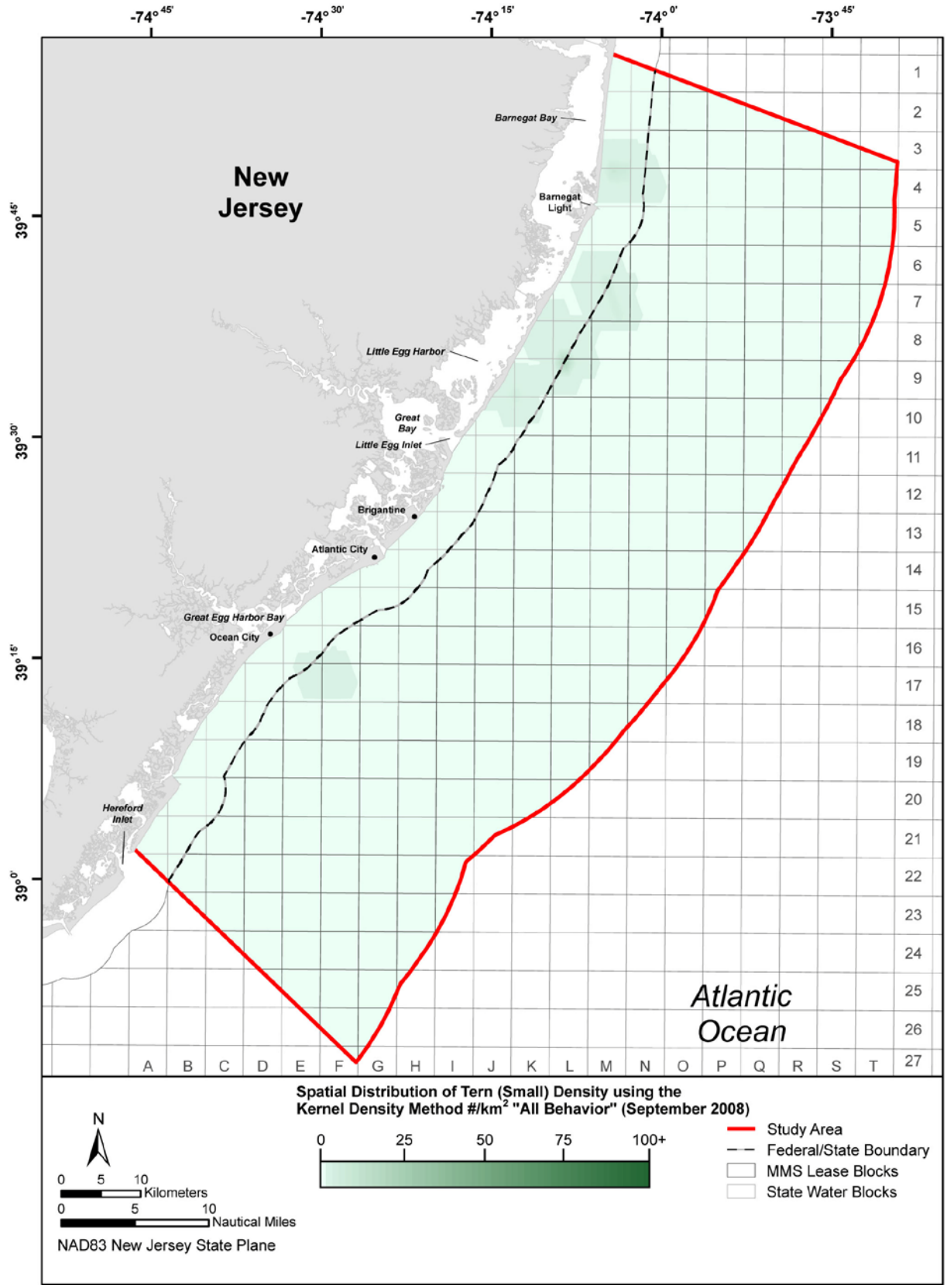

Figure M-166. Spatial distribution of small tern density (#/km^2) in the Study Area for all behaviors using the kernel density method (September 2008).

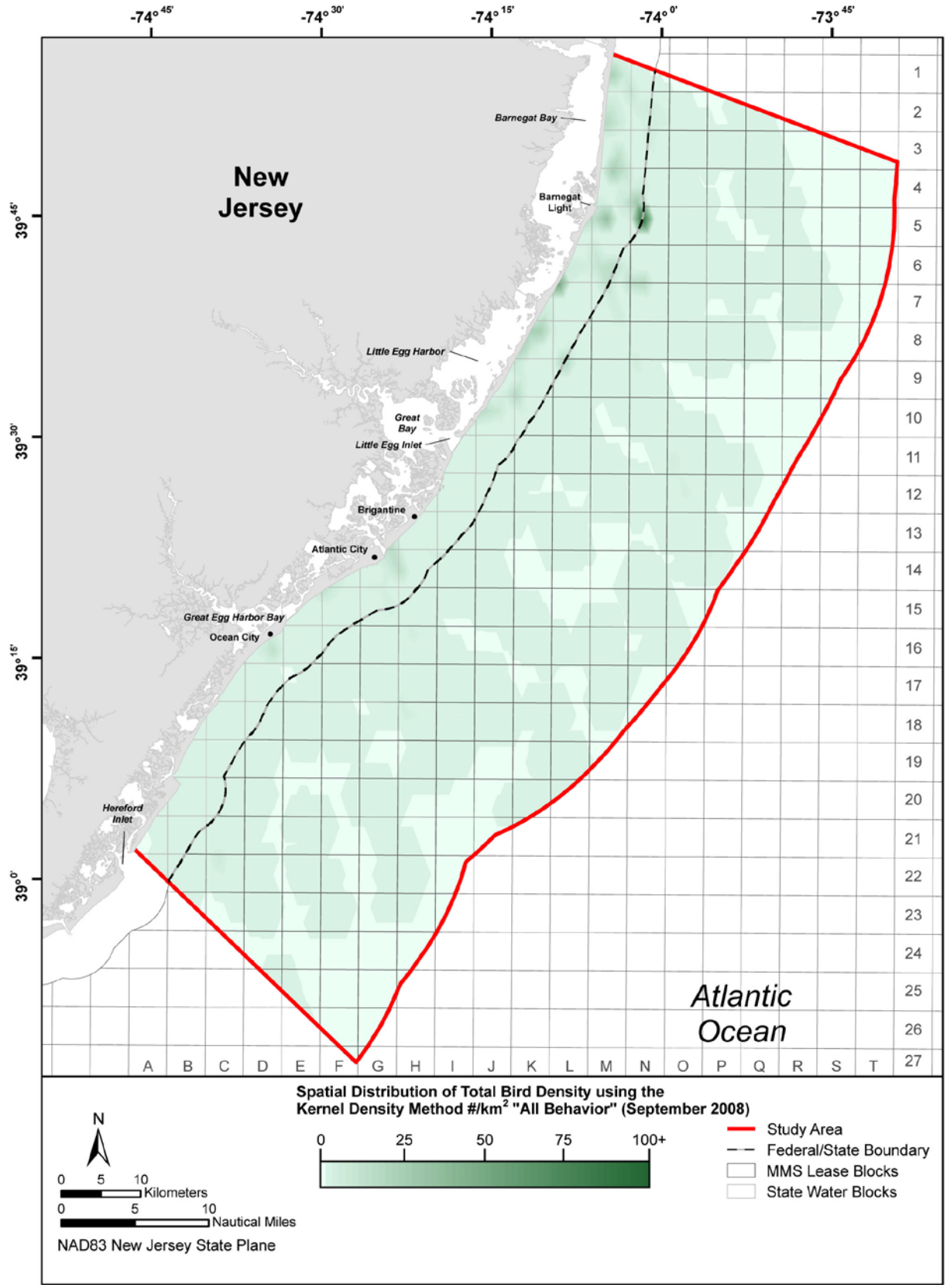

Figure M-167. Spatial distribution of total bird density (#/km^2) in the Study Area for all behaviors using the kernel density method (September 2008).

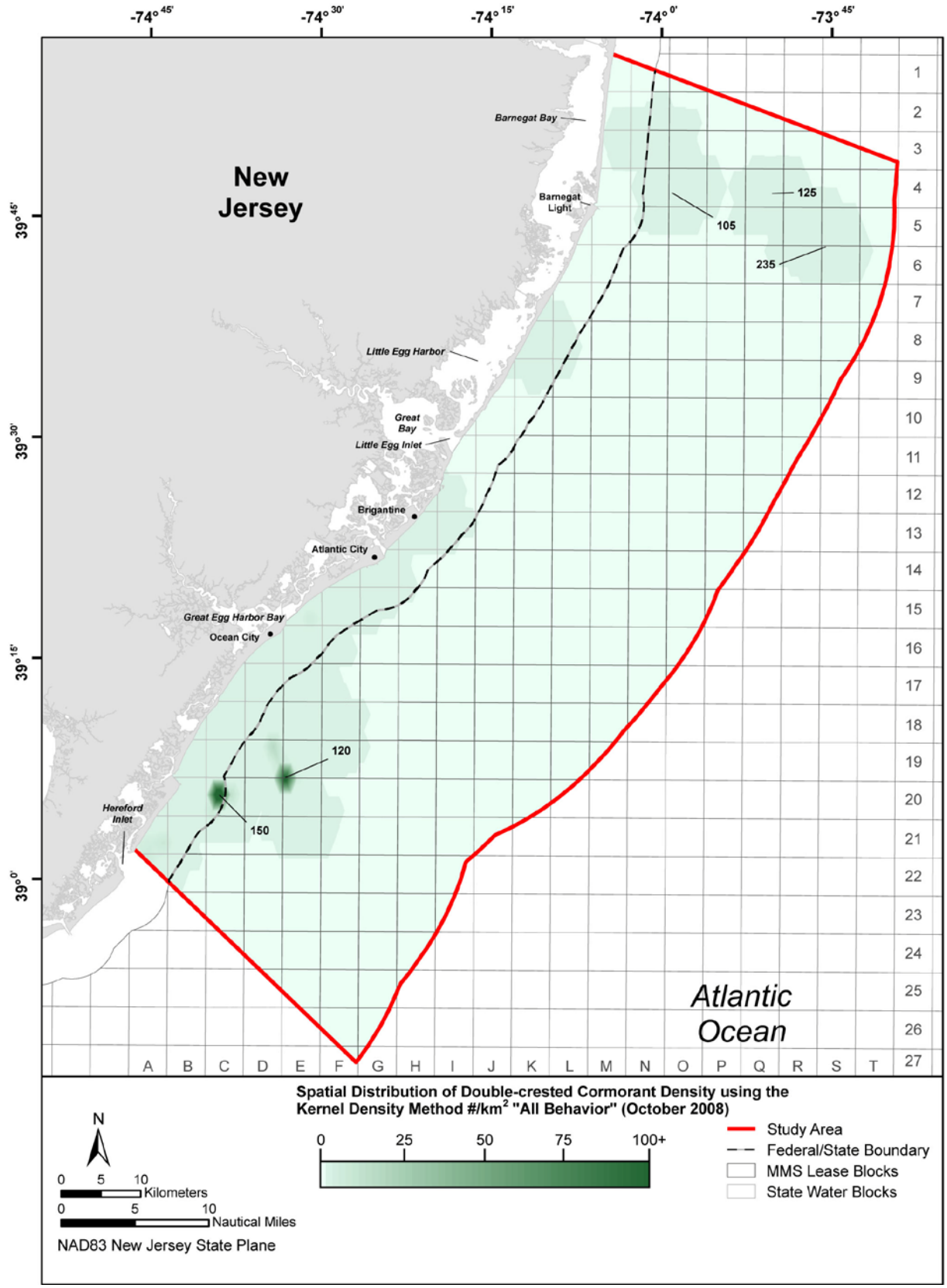

Figure M-168. Spatial distribution of Double-crested Cormorant density (#/km^2) in the Study Area for all behaviors using the kernel density method (October 2008).

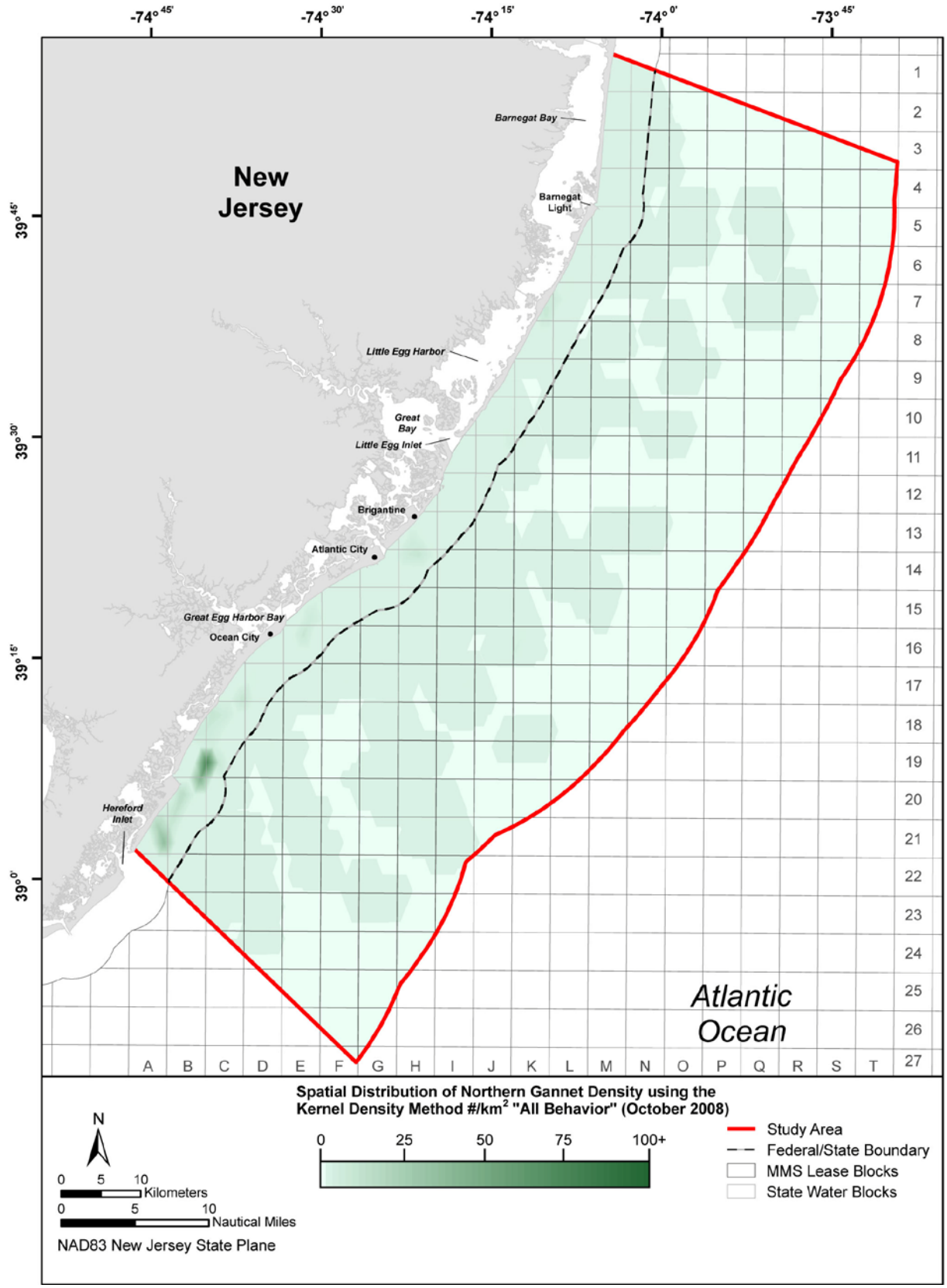

Figure M-169. Spatial distribution of Northern Gannet density (#/km^2) in the Study Area for all behaviors using the kernel density method (October 2008).

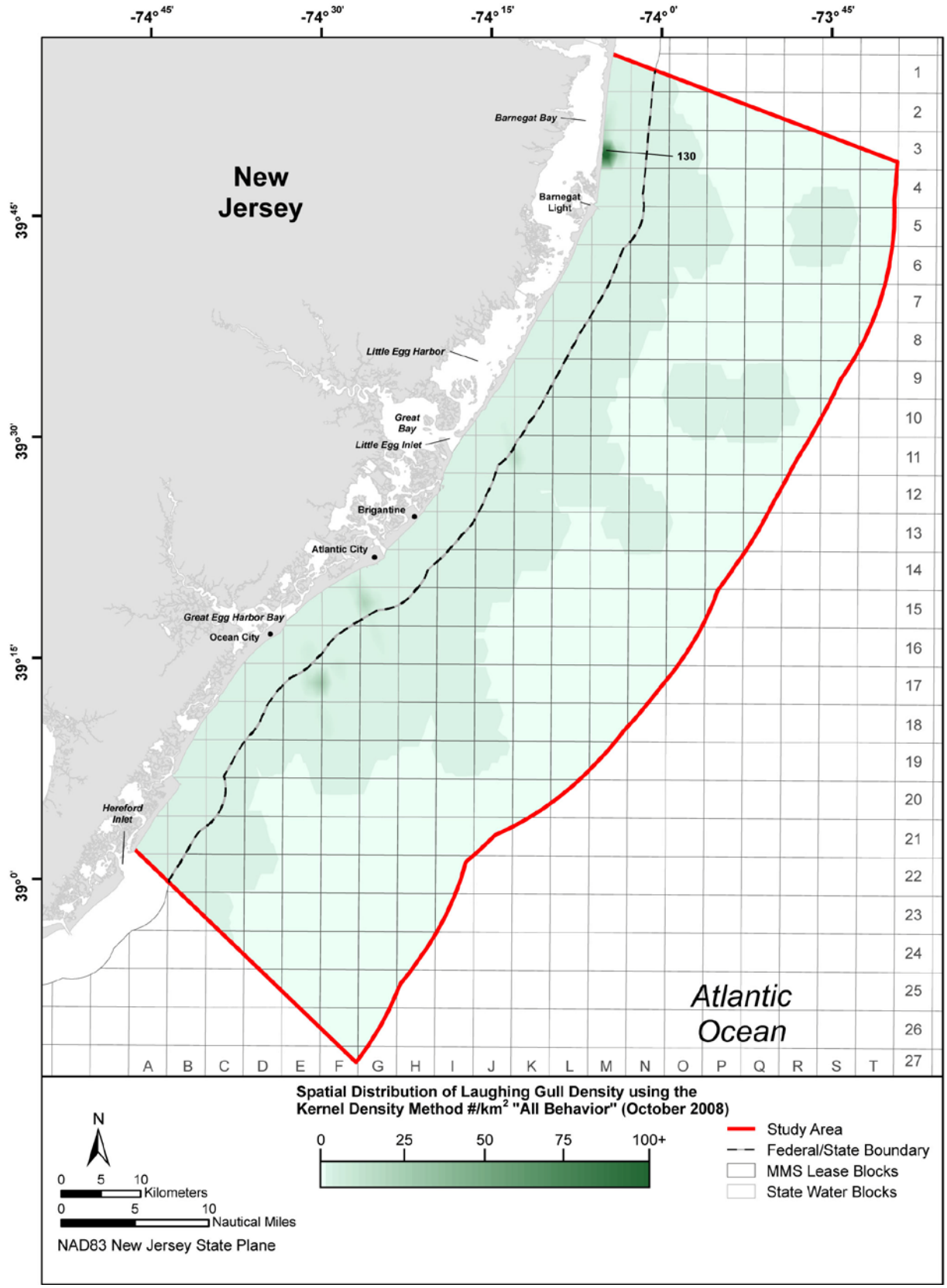

Figure M-170. Spatial distribution of Laughing Gull density (#/km^2) in the Study Area for all behaviors using the kernel density method (October 2008).

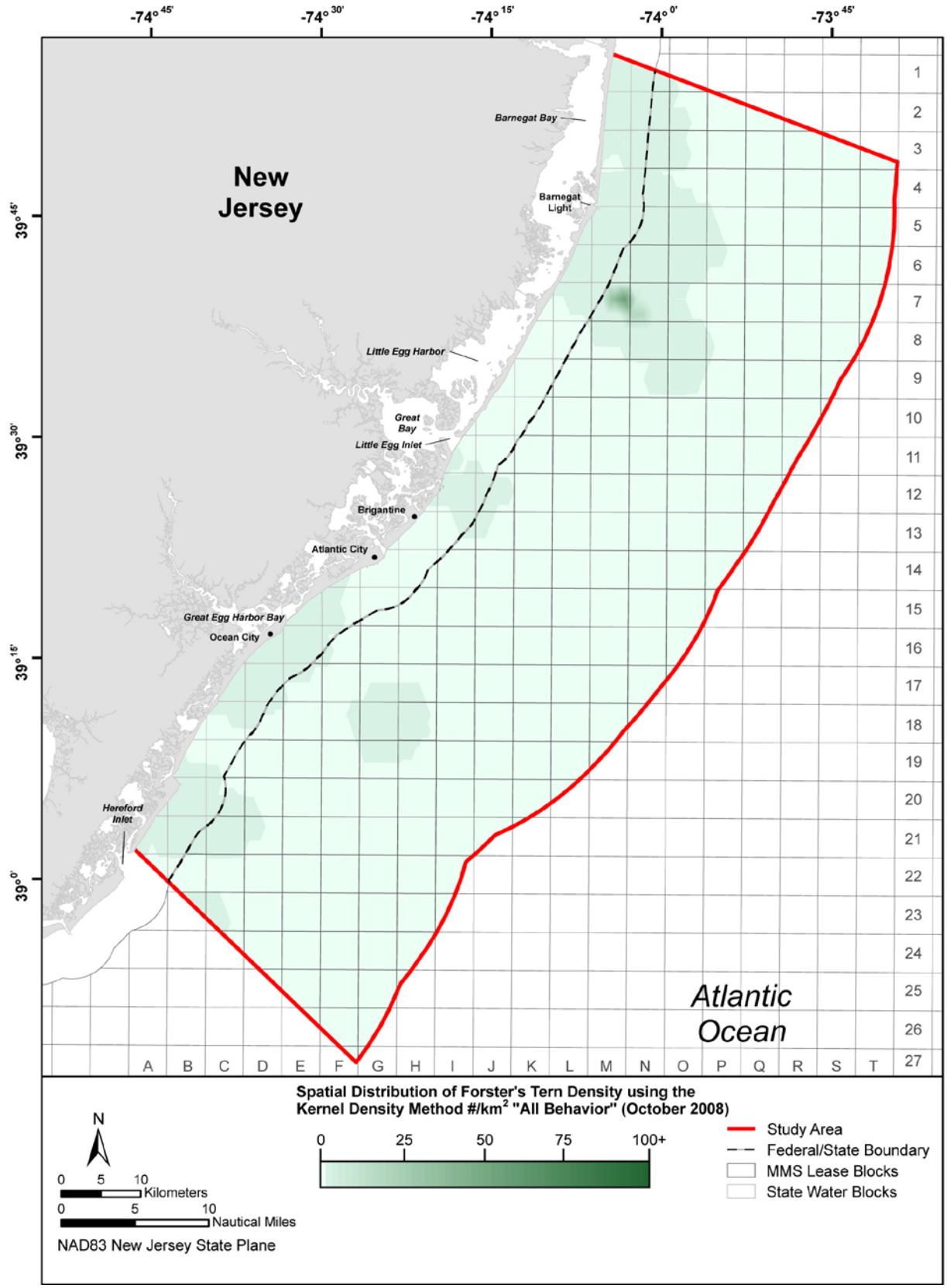

Figure M-171. Spatial distribution of Forster's Tern density (#/km^2) in the Study Area for all behaviors using the kernel density method (October 2008).

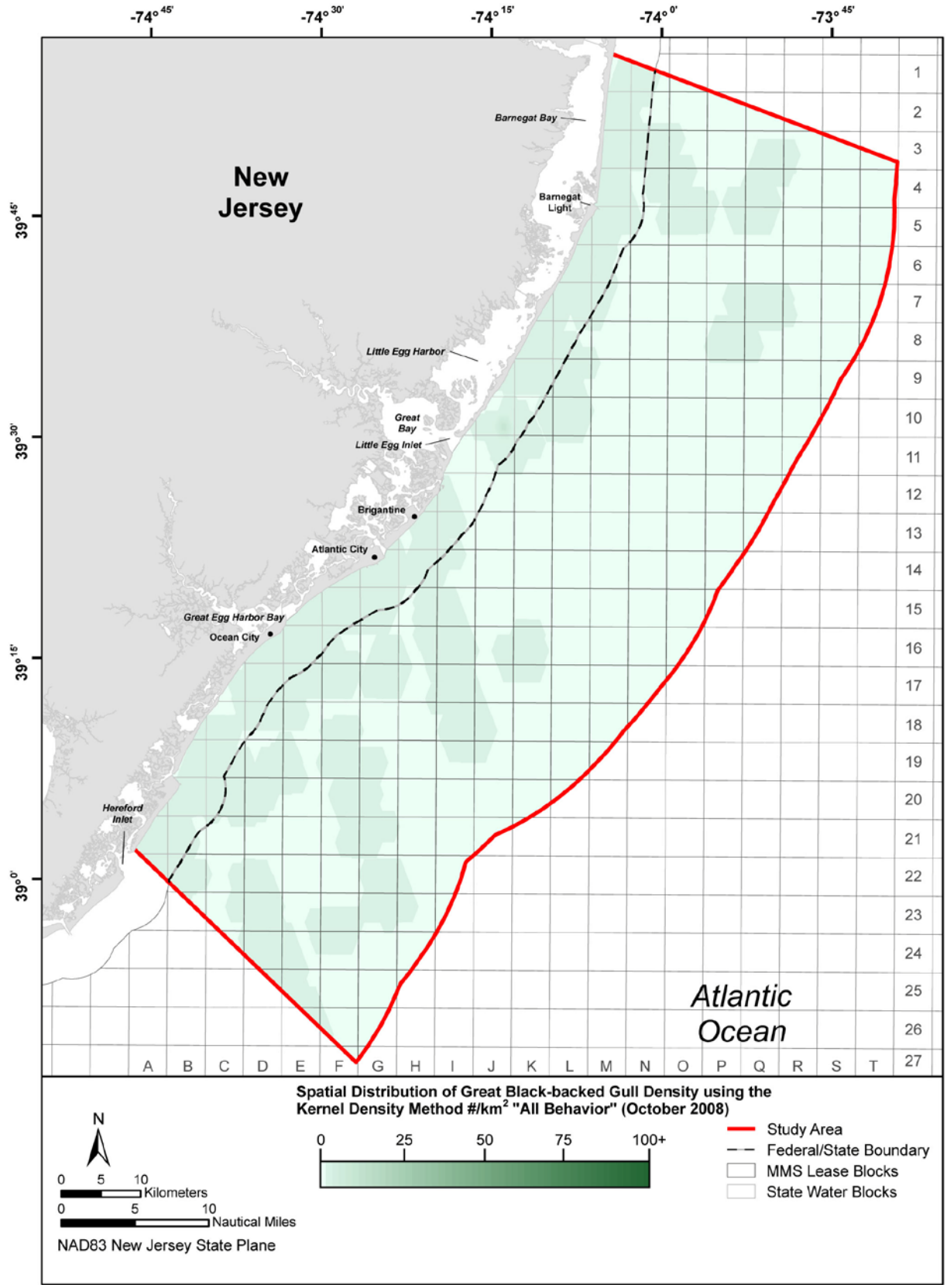

Figure M-172. Spatial distribution of Great Black-backed Gull density (#/km^2) in the Study Area for all behaviors using the kernel density method (October 2008).

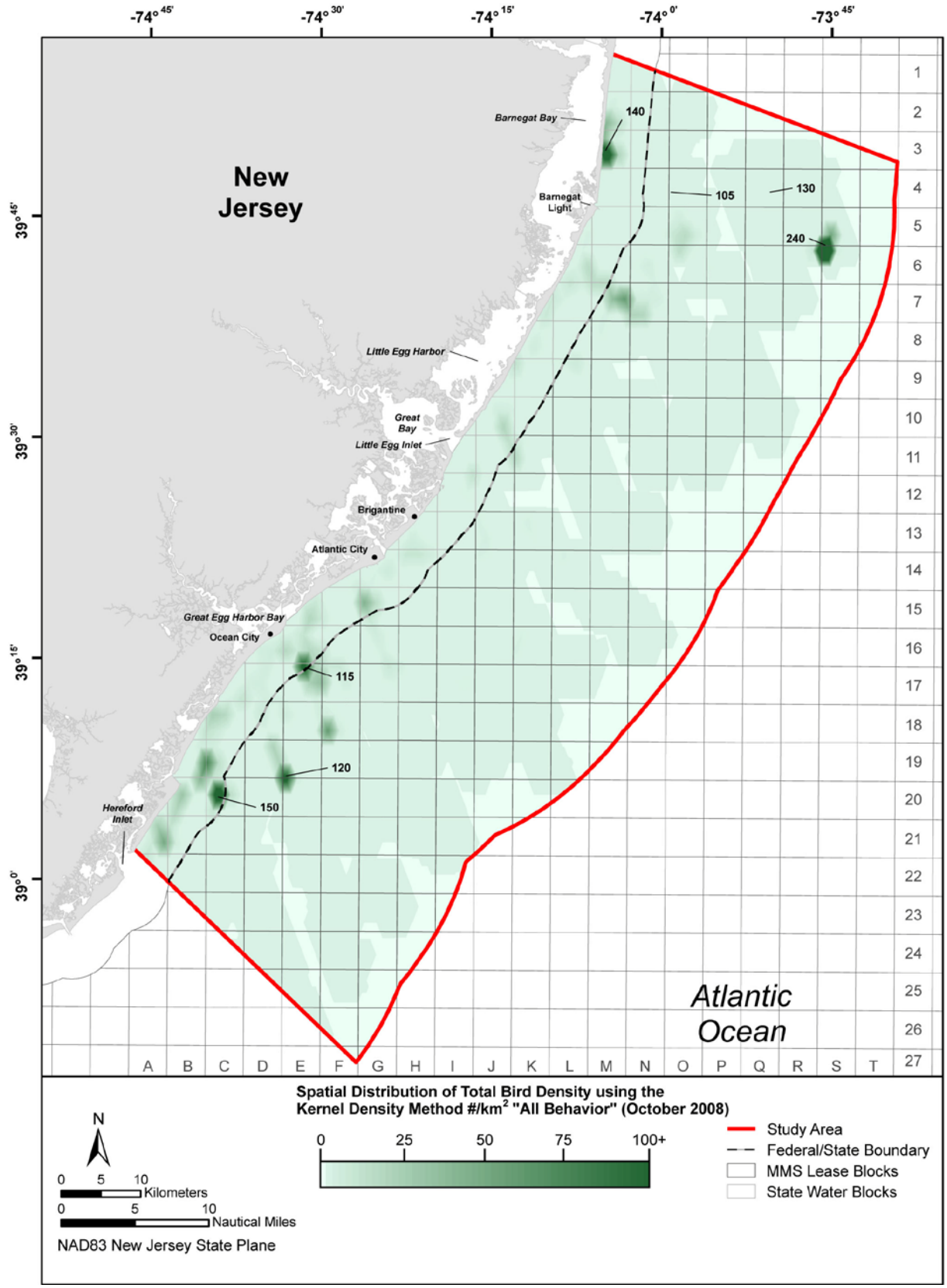

Figure M-173. Spatial distribution of total bird density (#/km^2) in the Study Area for all behaviors using the kernel density method (October 2008).

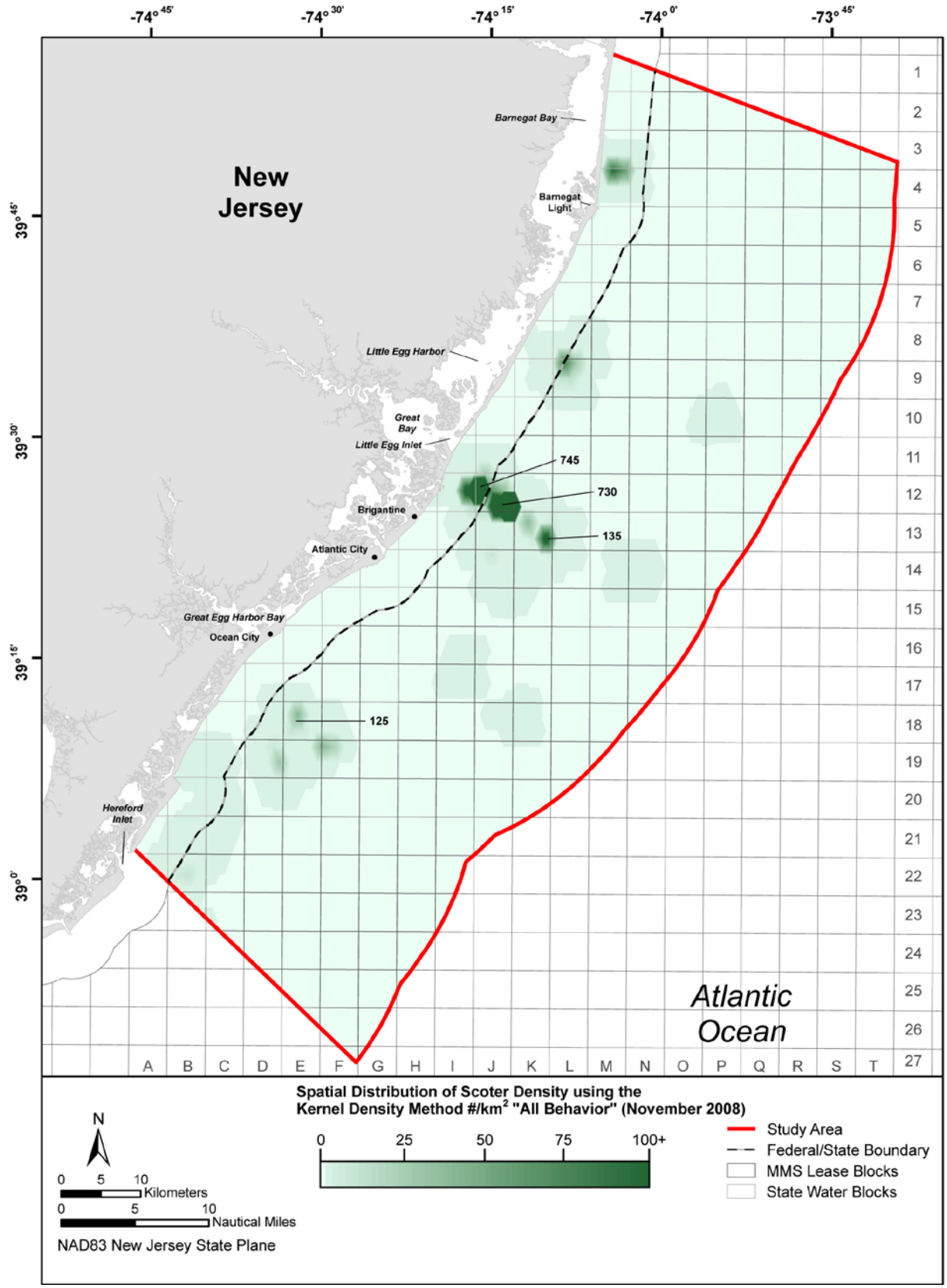

Figure M-174. Spatial distribution of scoter density (#/km^2) in the Study Area for all behaviors using the kernel density method (November 2008).

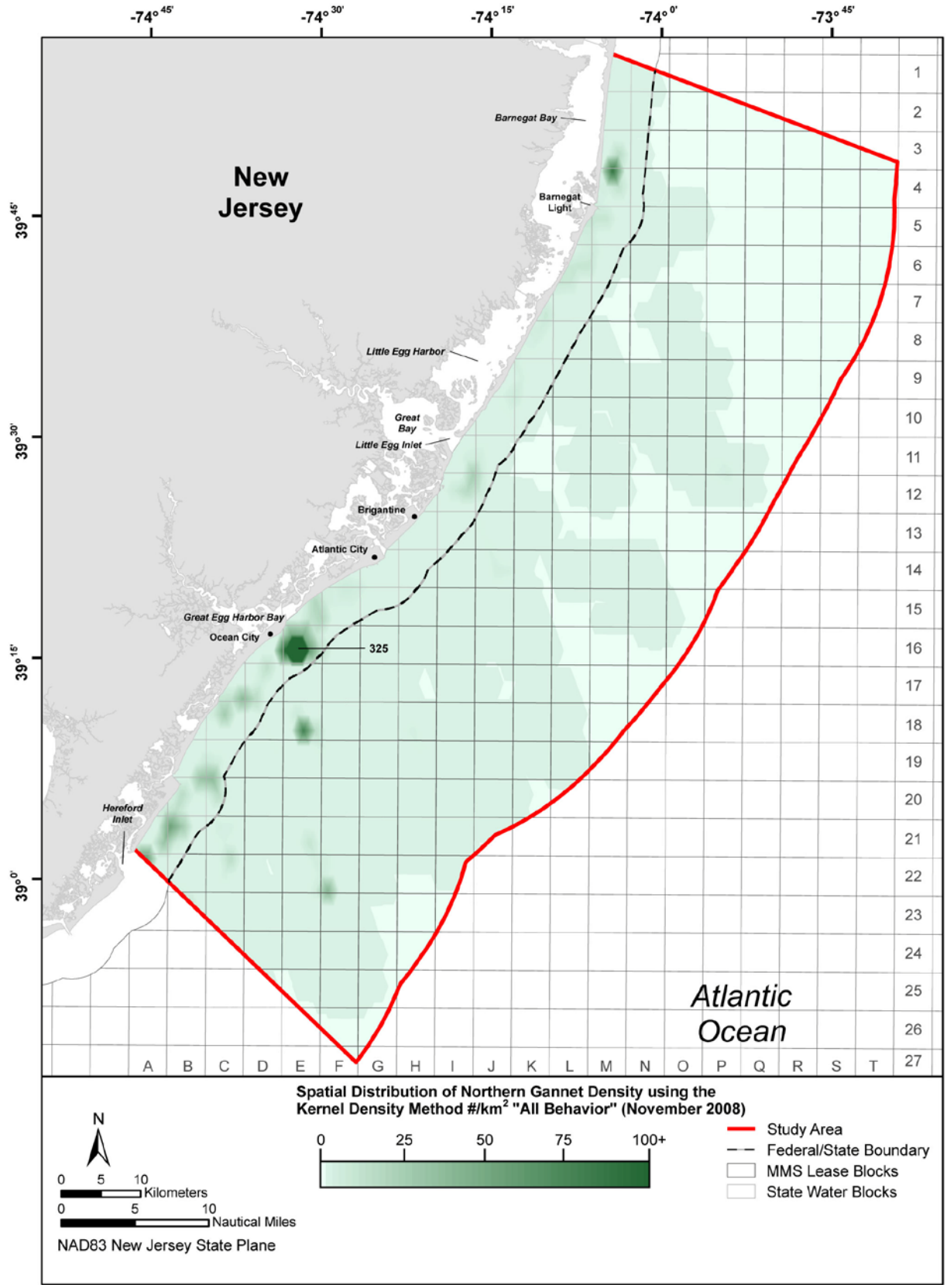

Figure M-175. Spatial distribution of Northern Gannet density (#/km^2) in the Study Area for all behaviors using the kernel density method (November 2008).

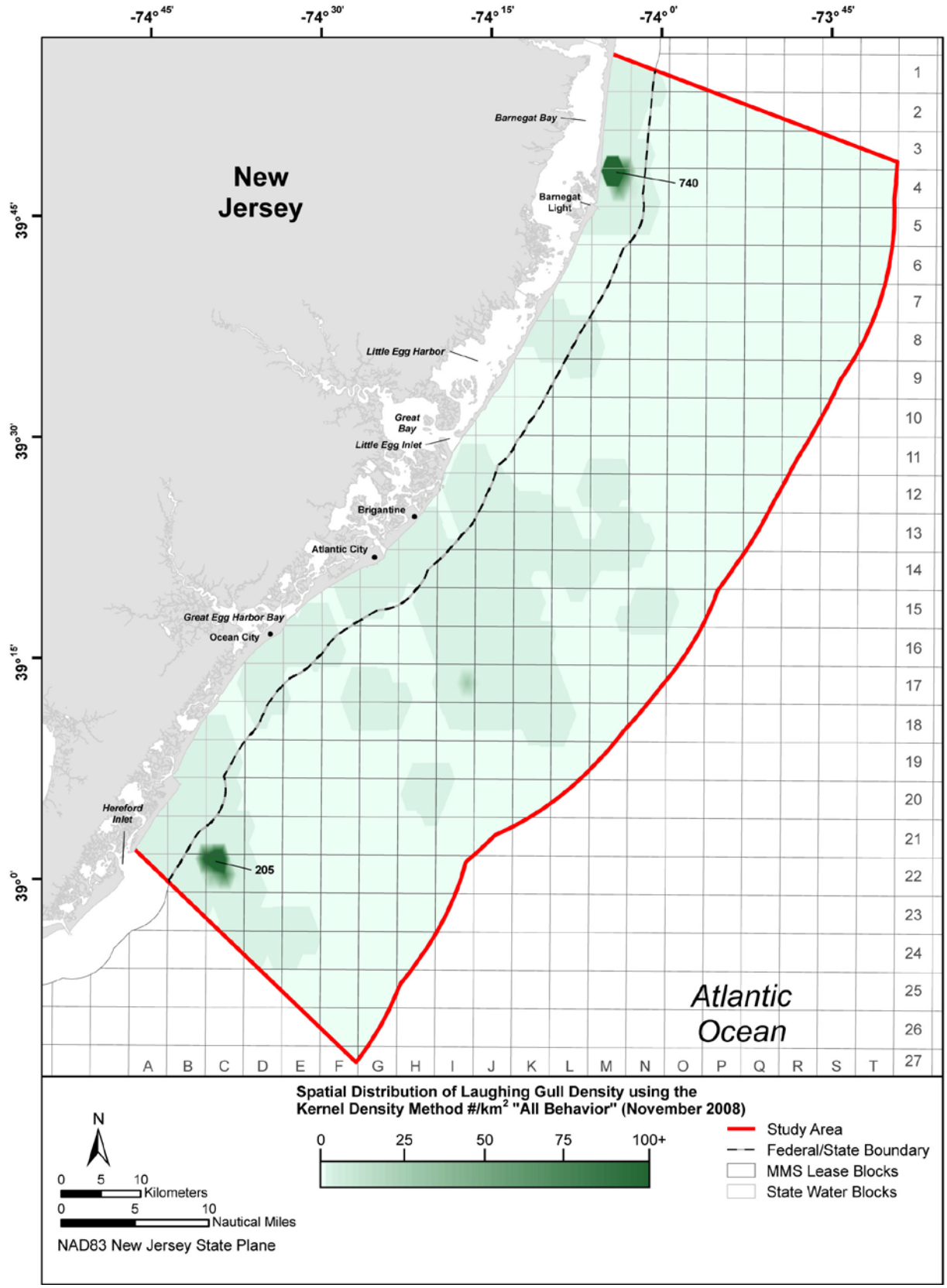

Figure M-176. Spatial distribution of Laughing Gull density (#/km^2) in the Study Area for all behaviors using the kernel density method (November 2008).

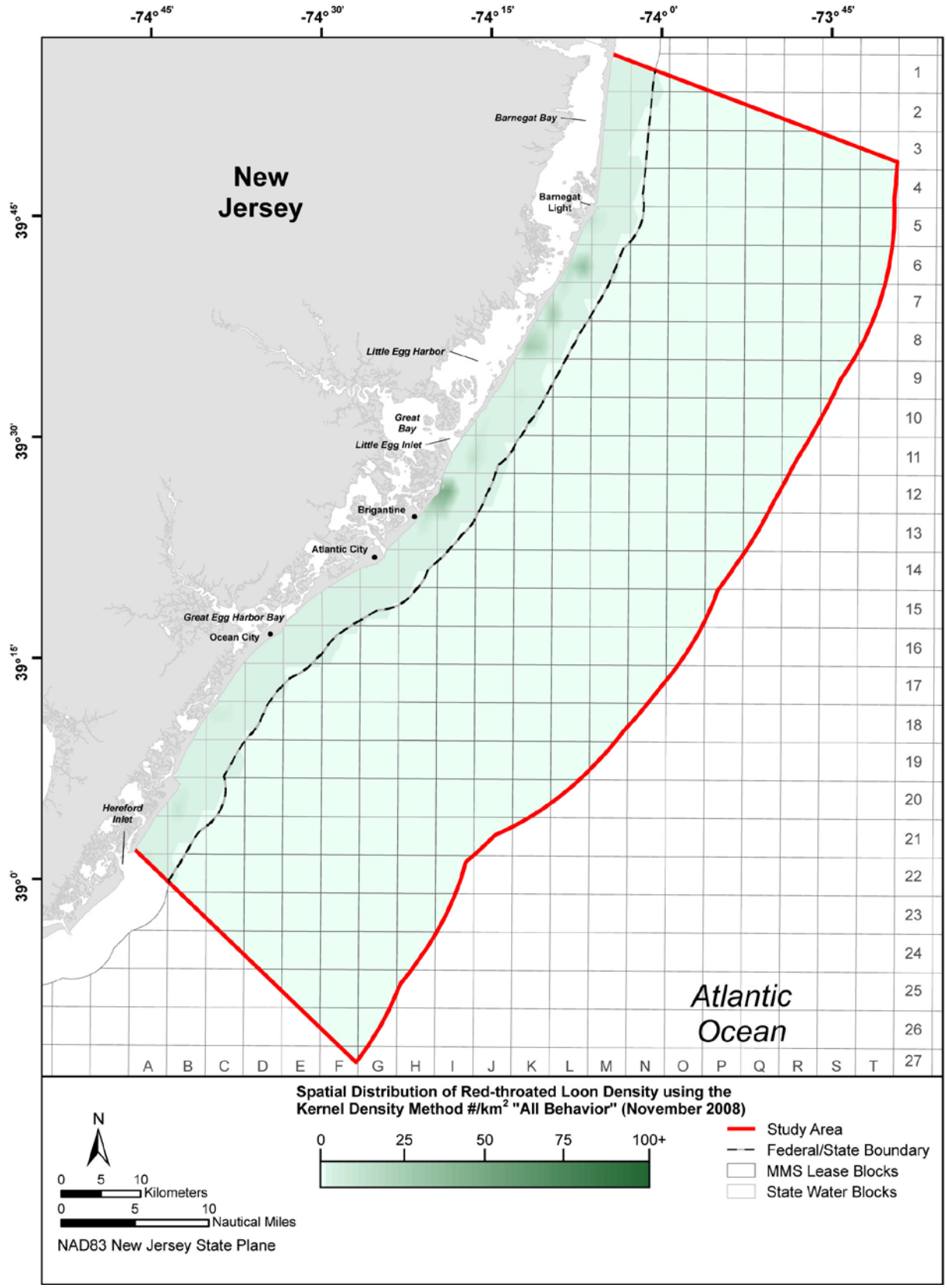

Figure M-177. Spatial distribution of Red-throated Loon density (#/km^2) in the Study Area for all behaviors using the kernel density method (November 2008).

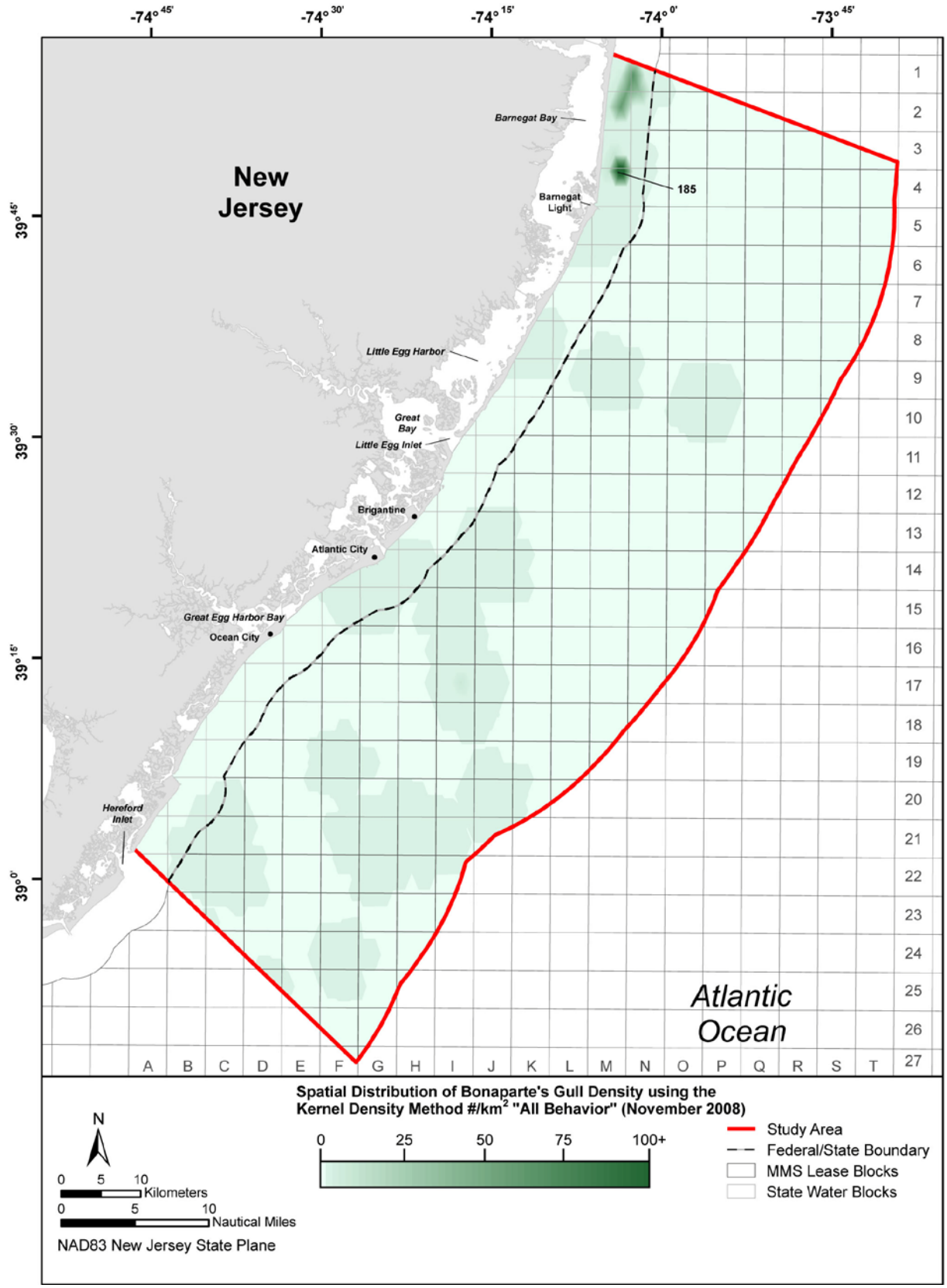

Figure M-178. Spatial distribution of Bonaparte's Gull density (#/km^2) in the Study Area for all behaviors using the kernel density method (November 2008).

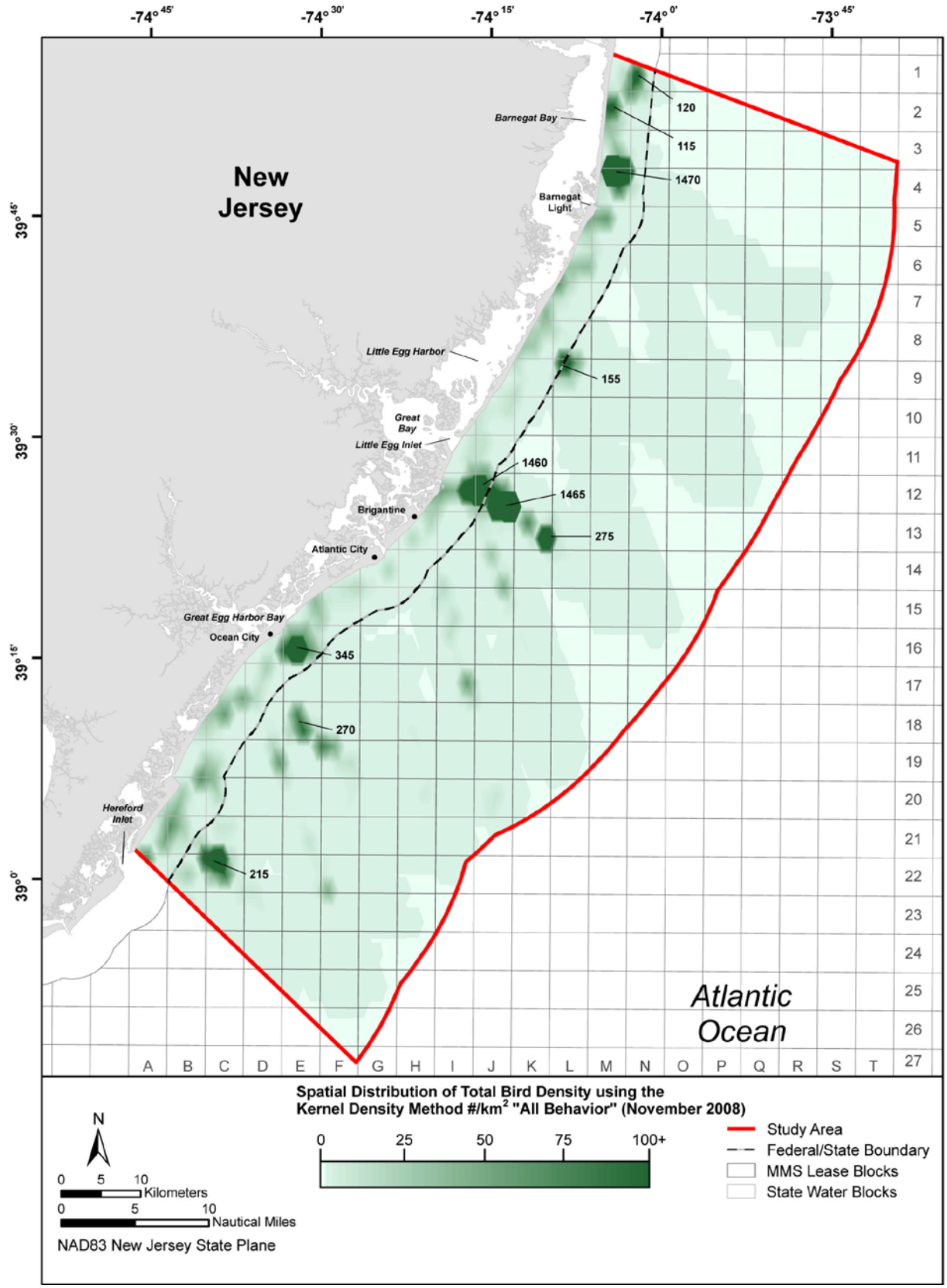

Figure M-179. Spatial distribution of total bird density (#/km^2) in the Study Area for all behaviors using the kernel density method (November 2008).

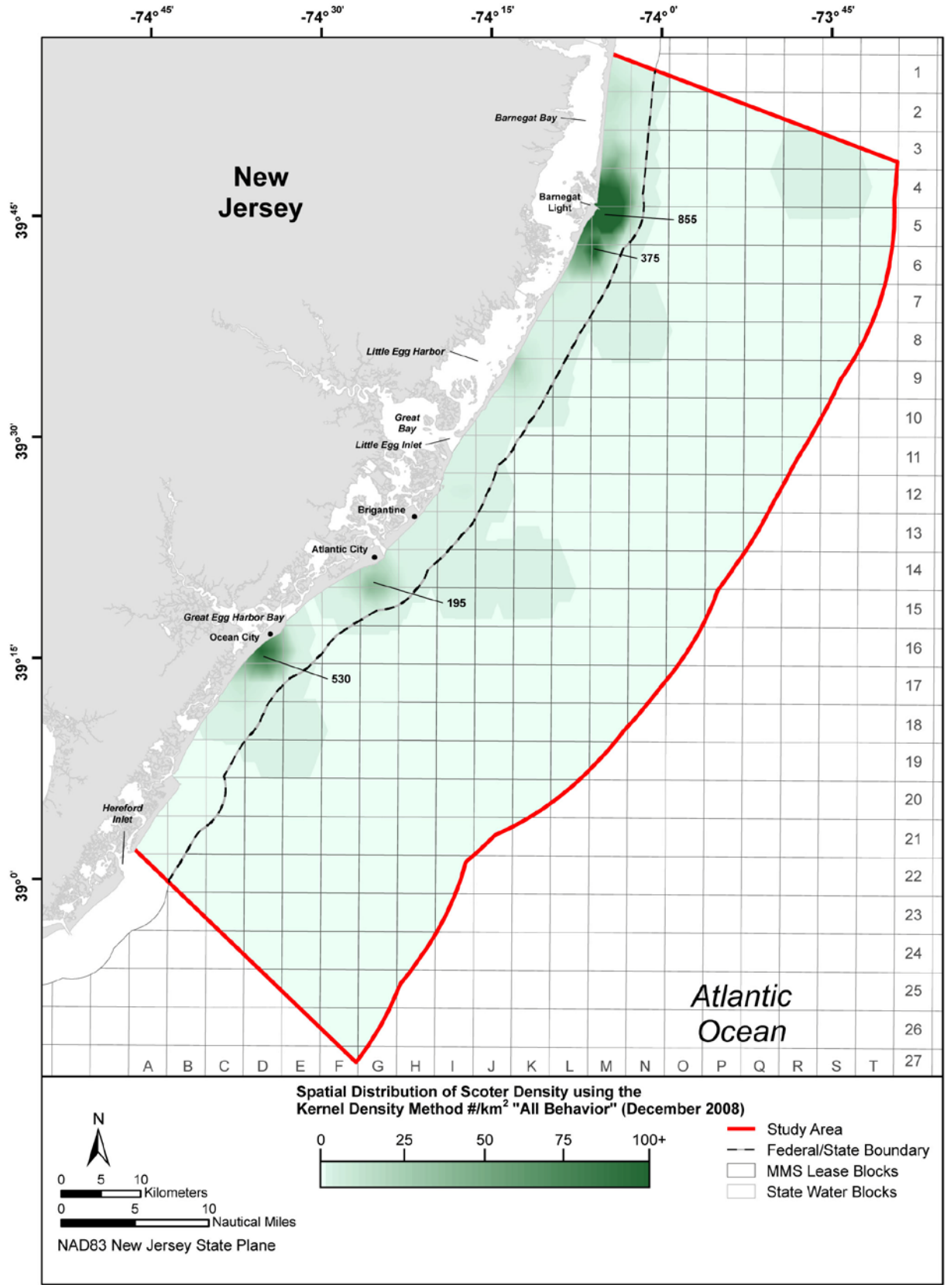

Figure M-180. Spatial distribution of scoter density (#/km^2) in the Study Area for all behaviors using the kernel density method (December 2008).

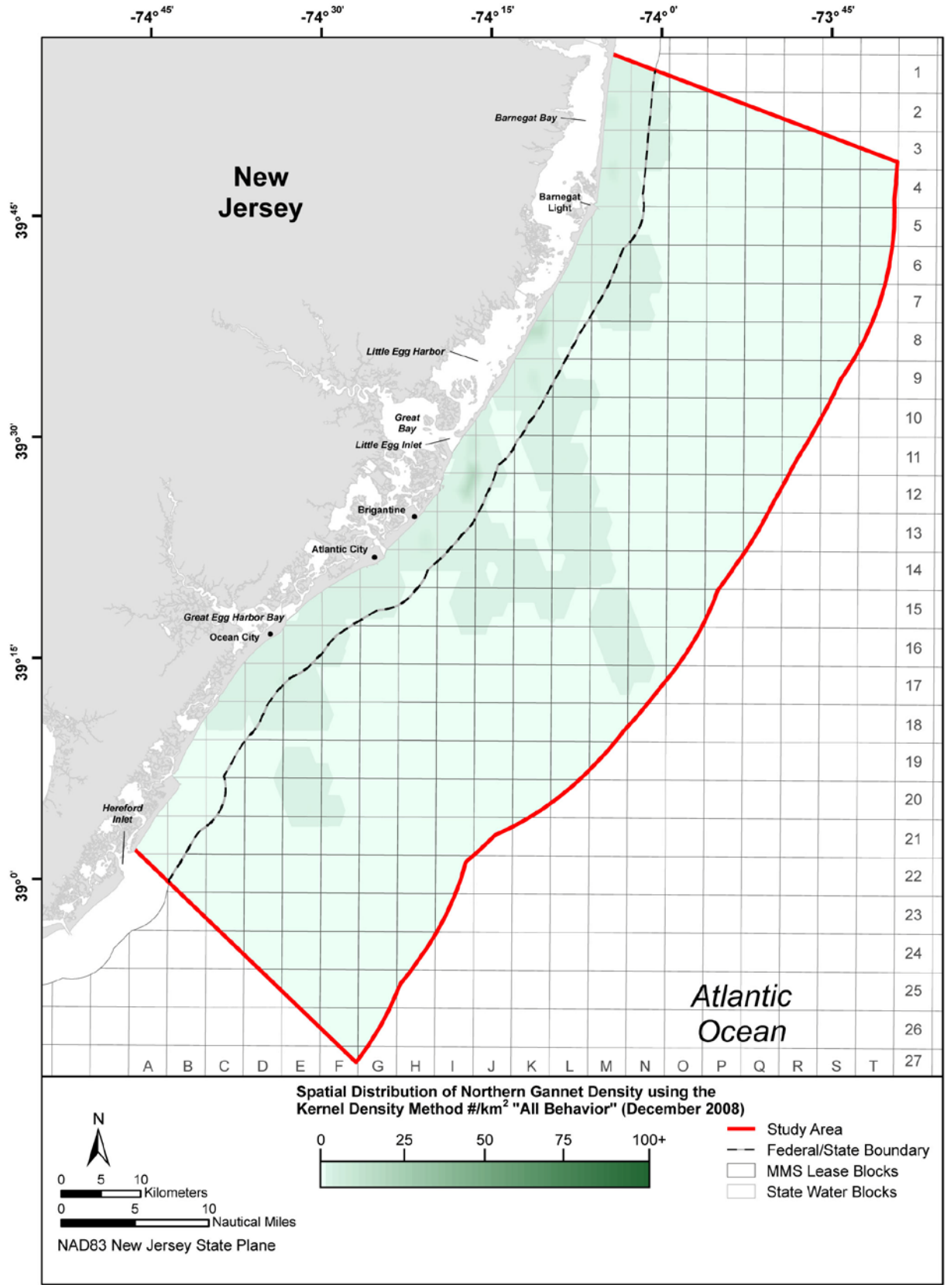

Figure M-181. Spatial distribution of Northern Gannet density (#/km^2) in the Study Area for all behaviors using the kernel density method (December 2008).

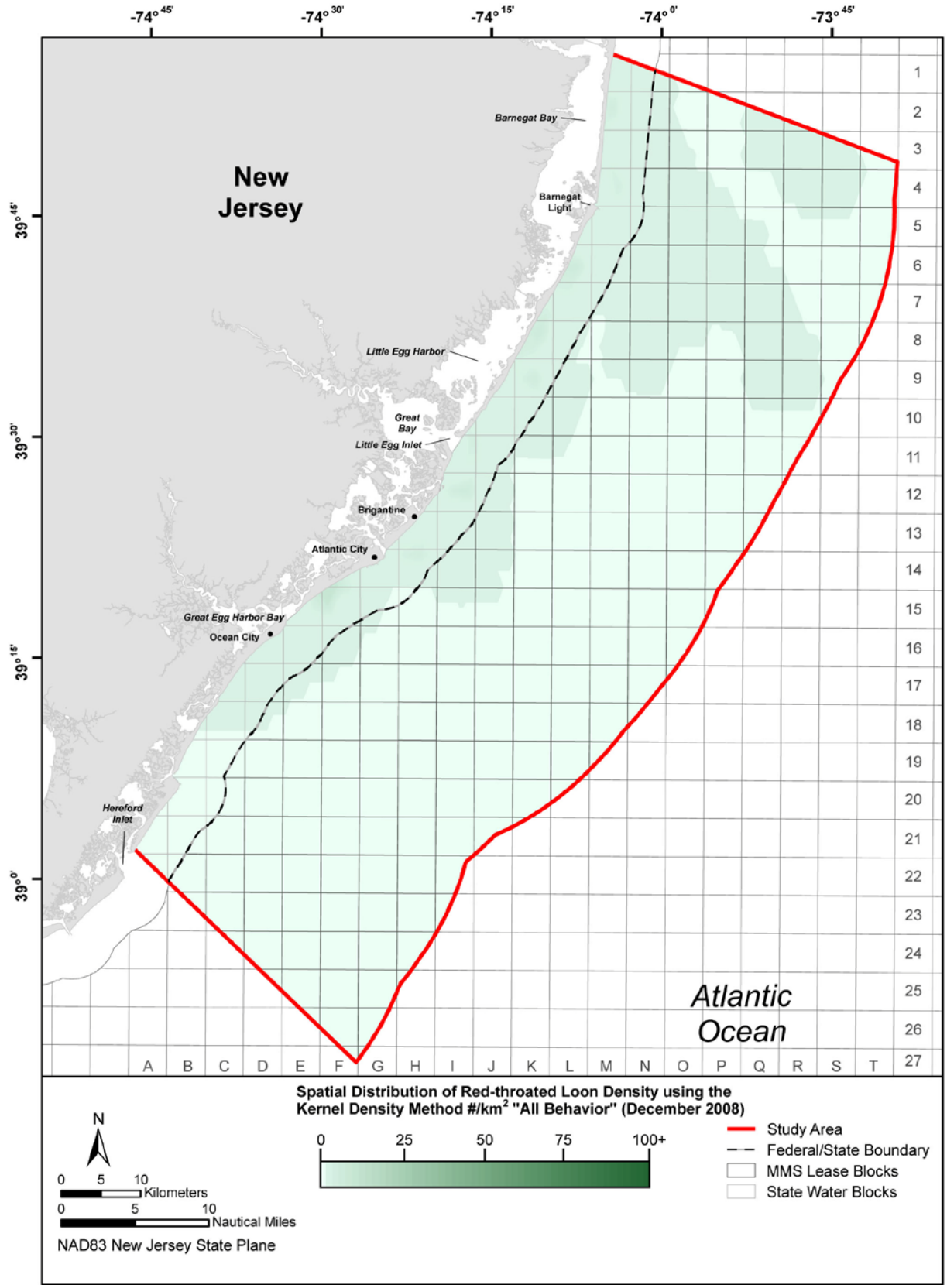

Figure M-182. Spatial distribution of Red-throated Loon density (#/km^2) in the Study Area for all behaviors using the kernel density method (December 2008).

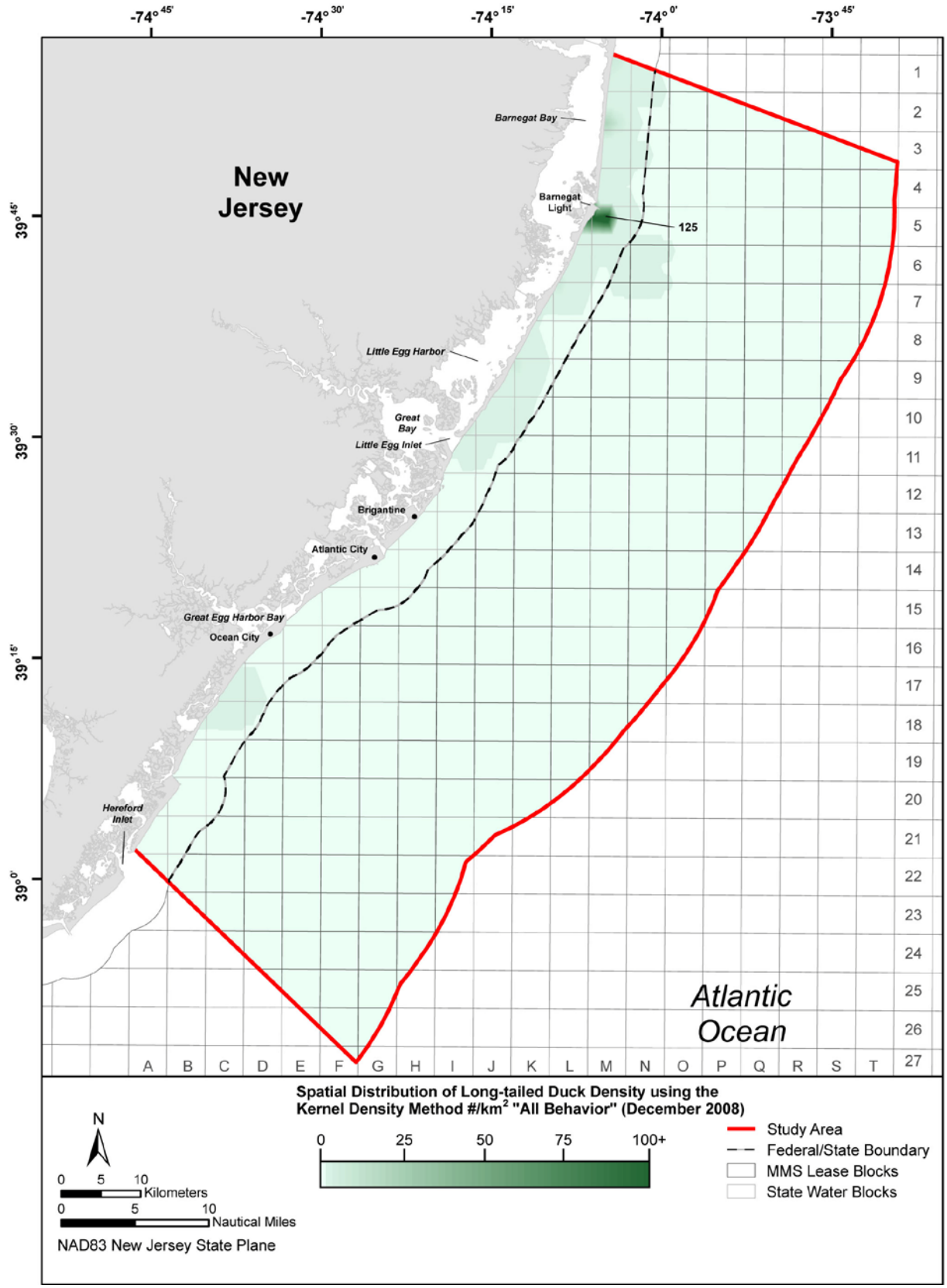

Figure M-183. Spatial distribution of Long-tailed Duck density (#/km^2) in the Study Area for all behaviors using the kernel density method (December 2008).

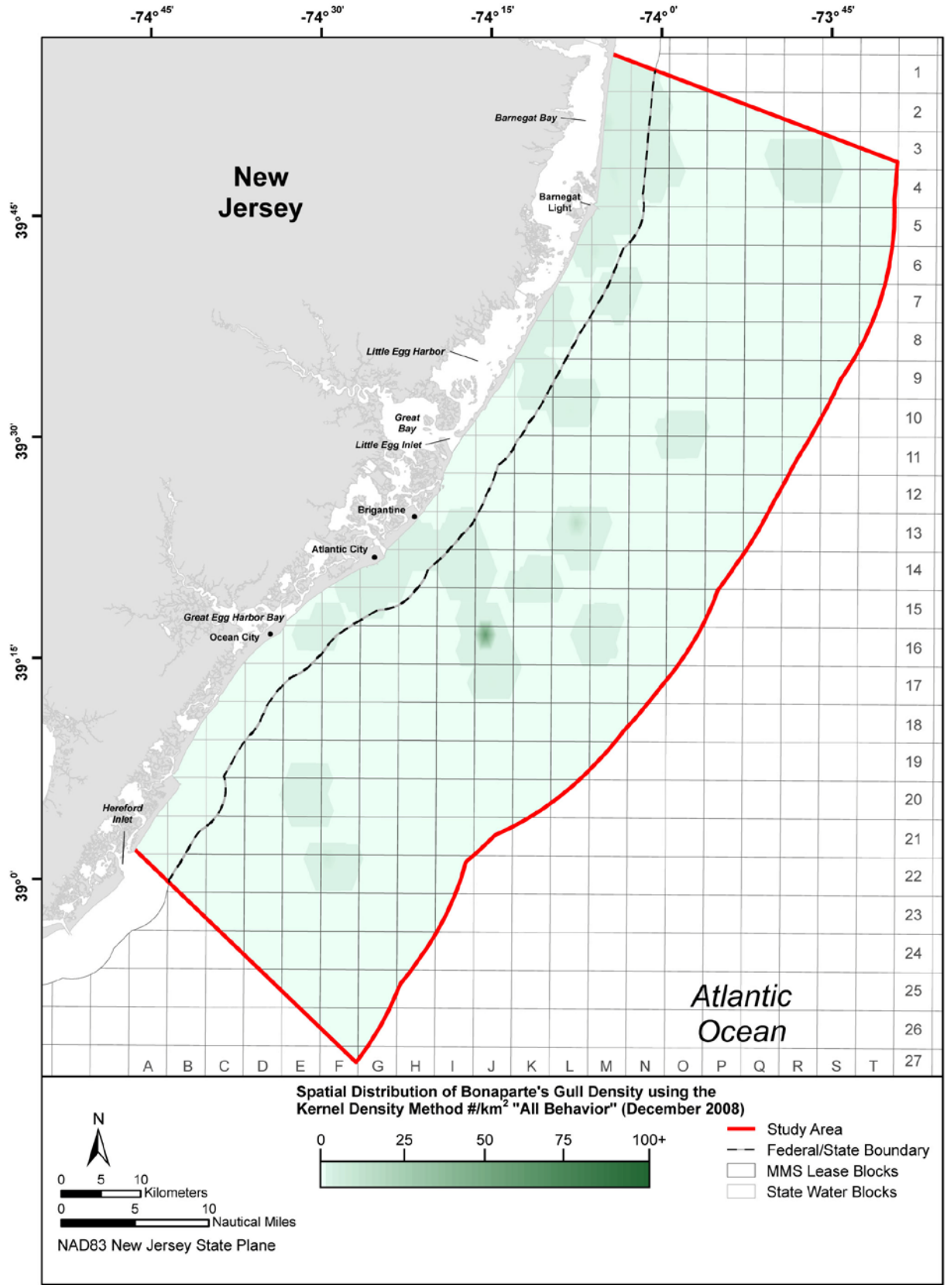

Figure M-184. Spatial distribution of Bonaparte's Gull density (#/km^2) in the Study Area for all behaviors using the kernel density method (December 2008).

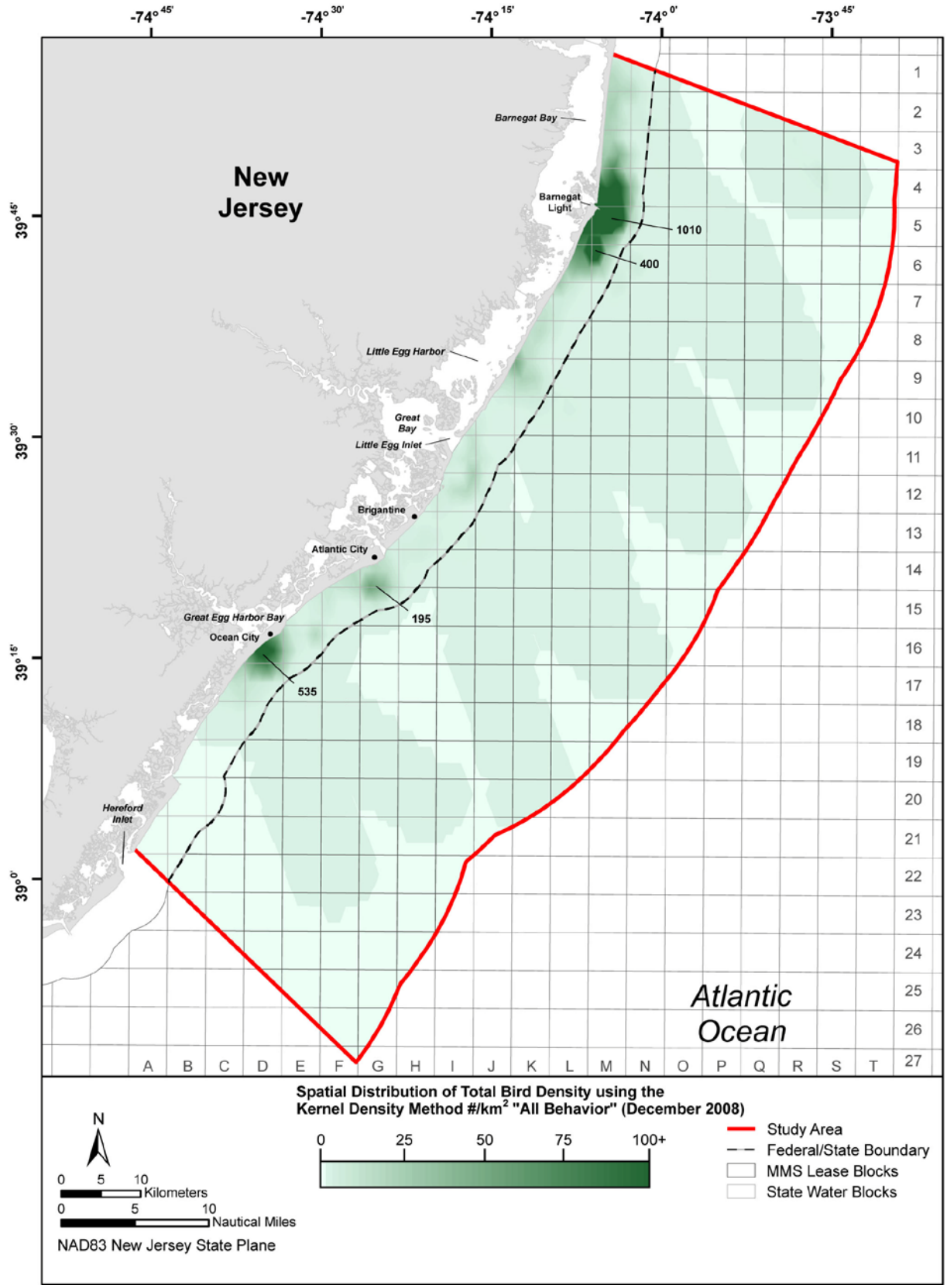

Figure M-185. Spatial distribution of total bird density (#/km^2) in the Study Area for all behaviors using the kernel density method (December 2008).

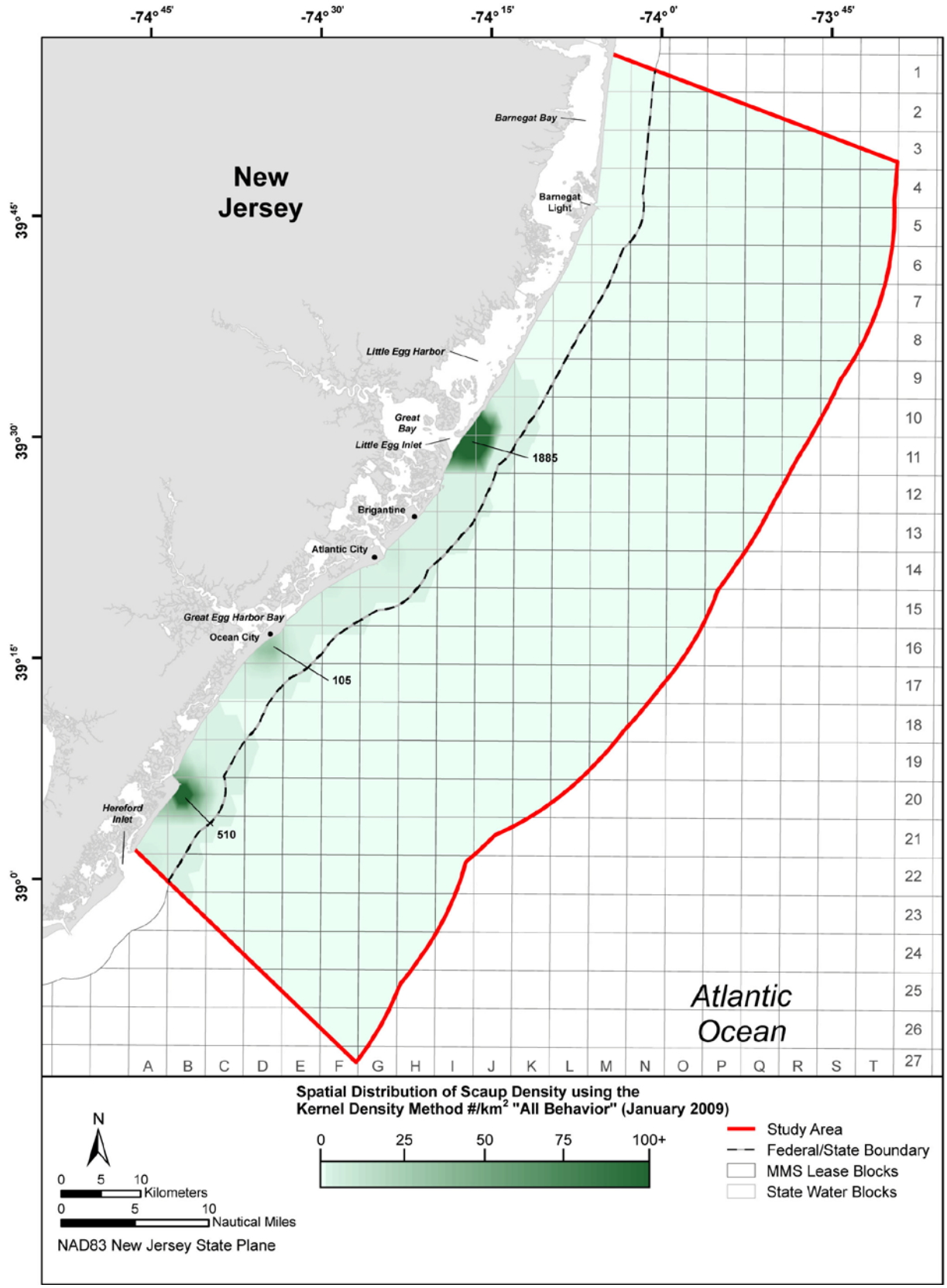

Figure M-186. Spatial distribution of scaup density (#/km^2) in the Study Area for all behaviors using the kernel density method (January 2009).

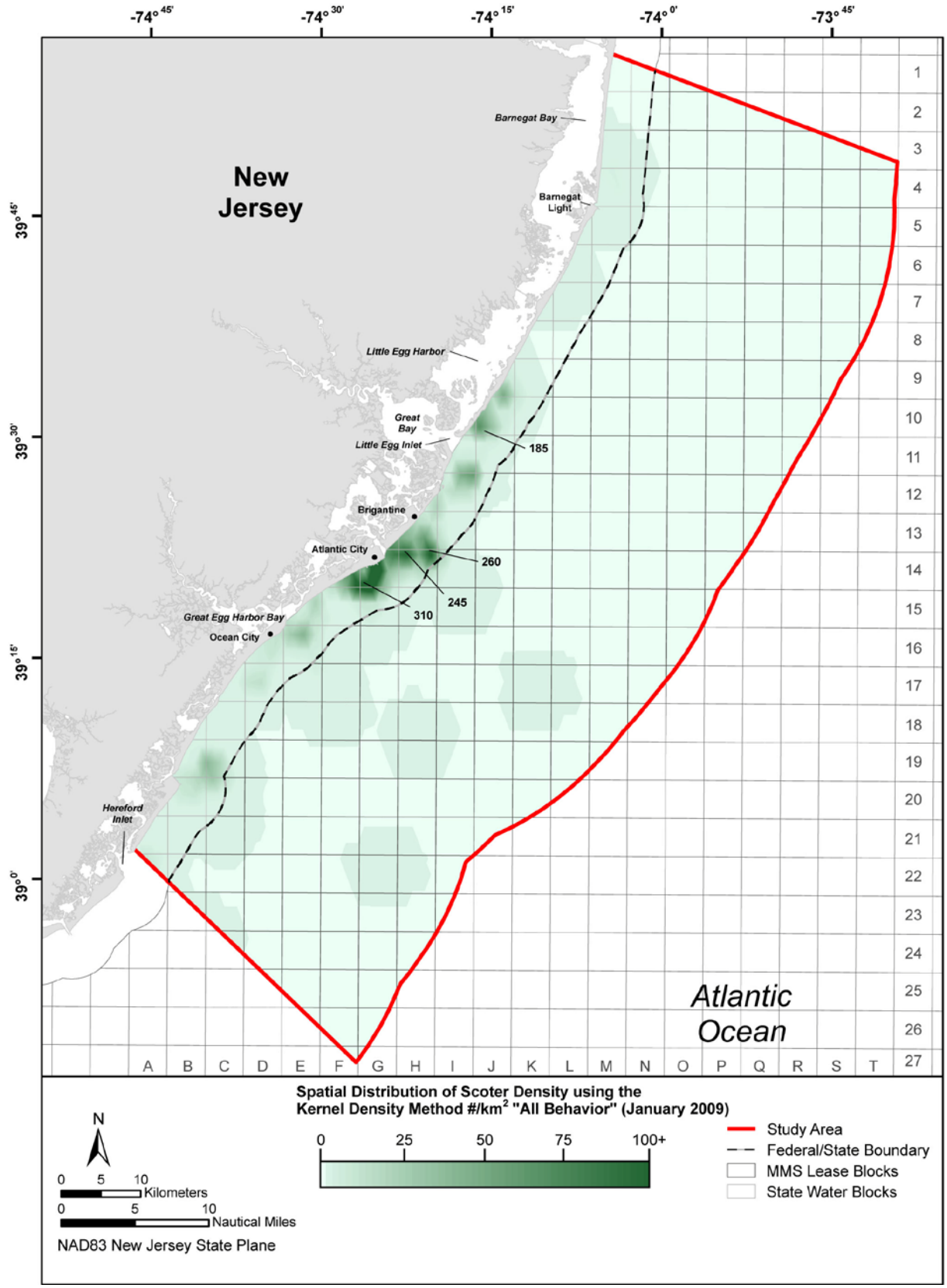

Figure M-187. Spatial distribution of scoter density (#/km^2) in the Study Area for all behaviors using the kernel density method (January 2009).

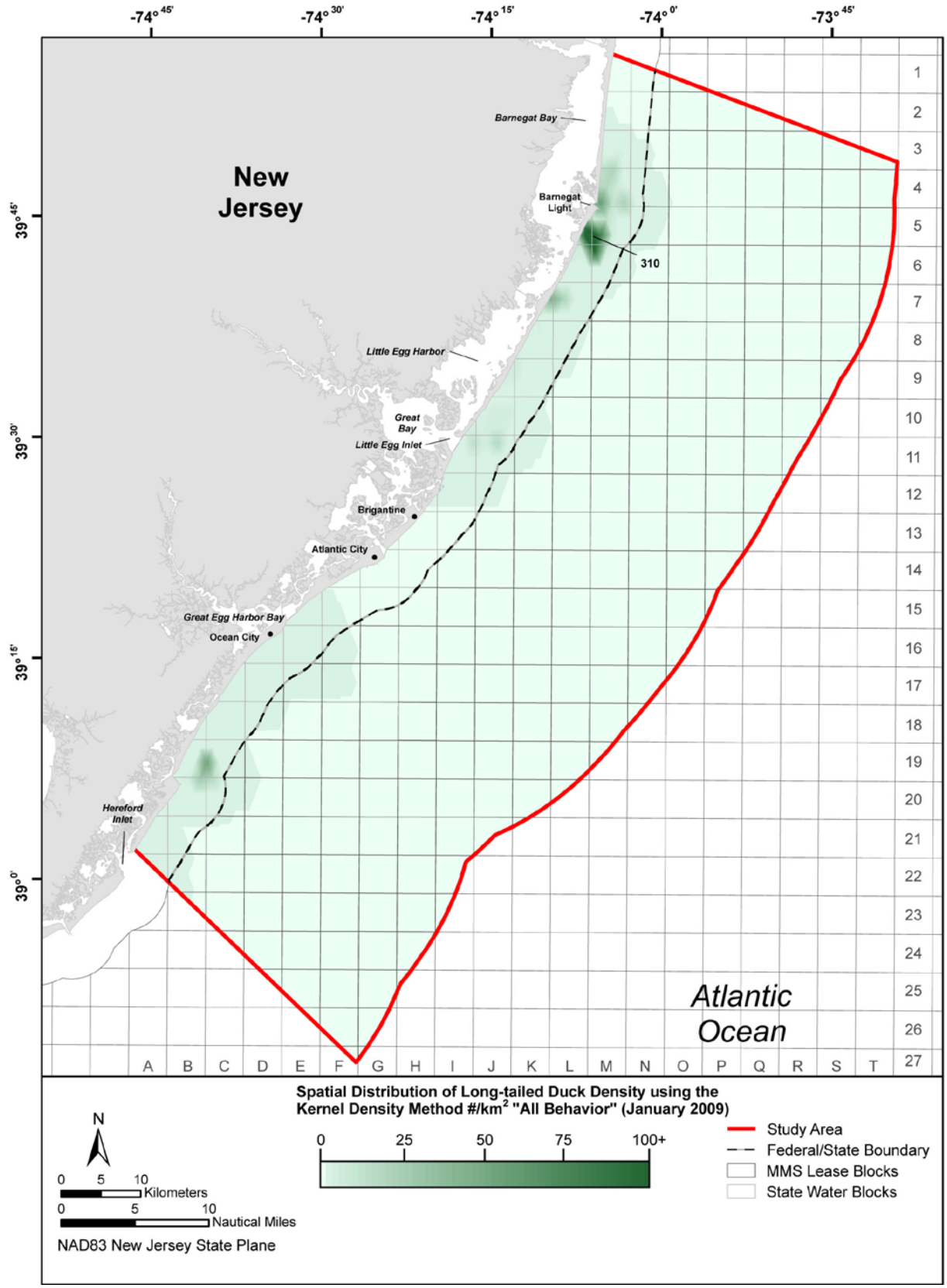

Figure M-188. Spatial distribution of Long-tailed Duck density (#/km^2) in the Study Area for all behaviors using the kernel density method (January 2009).

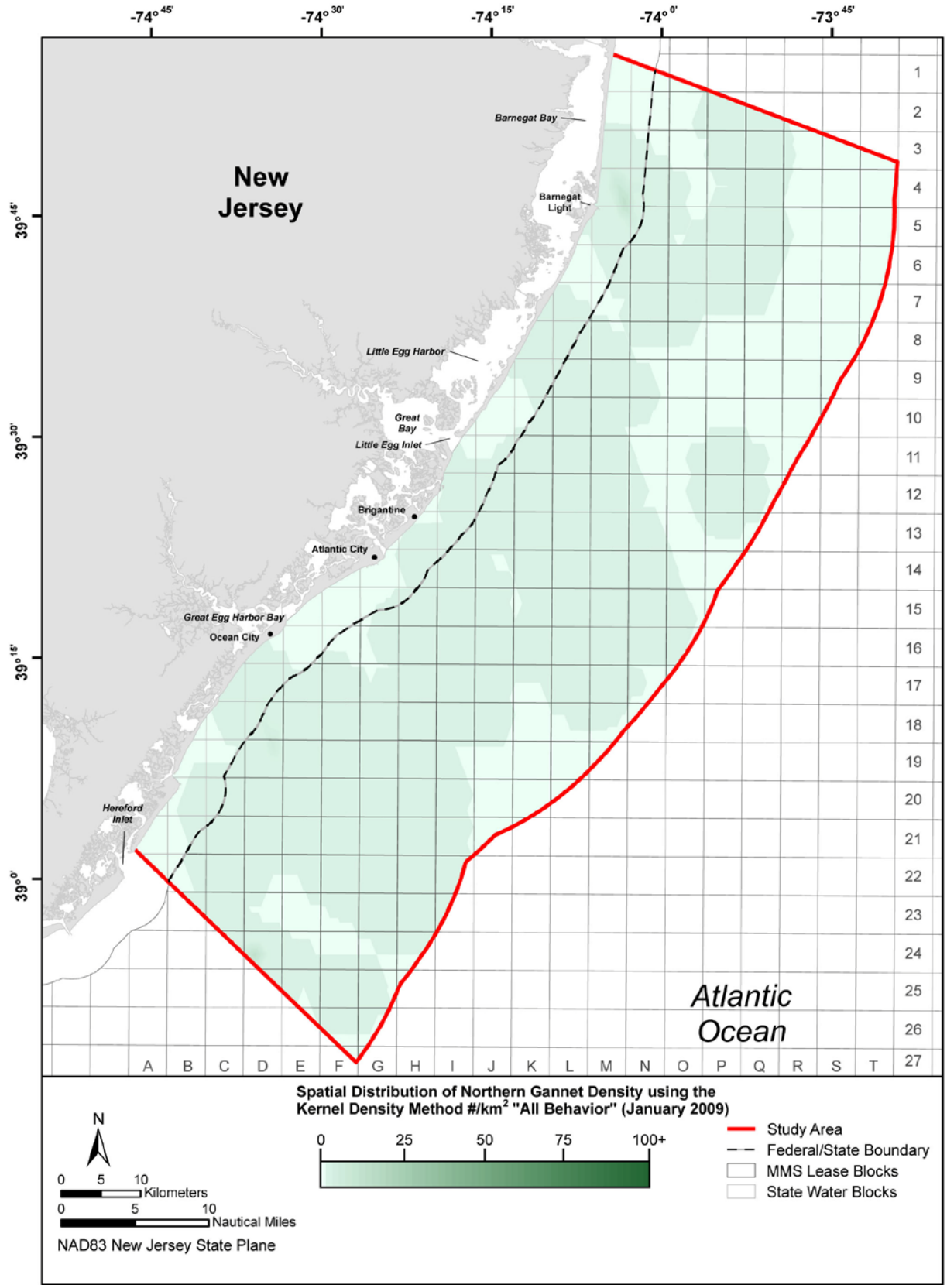

Figure M-189. Spatial distribution of Northern Gannet density (#/km^2) in the Study Area for all behaviors using the kernel density method (January 2009).

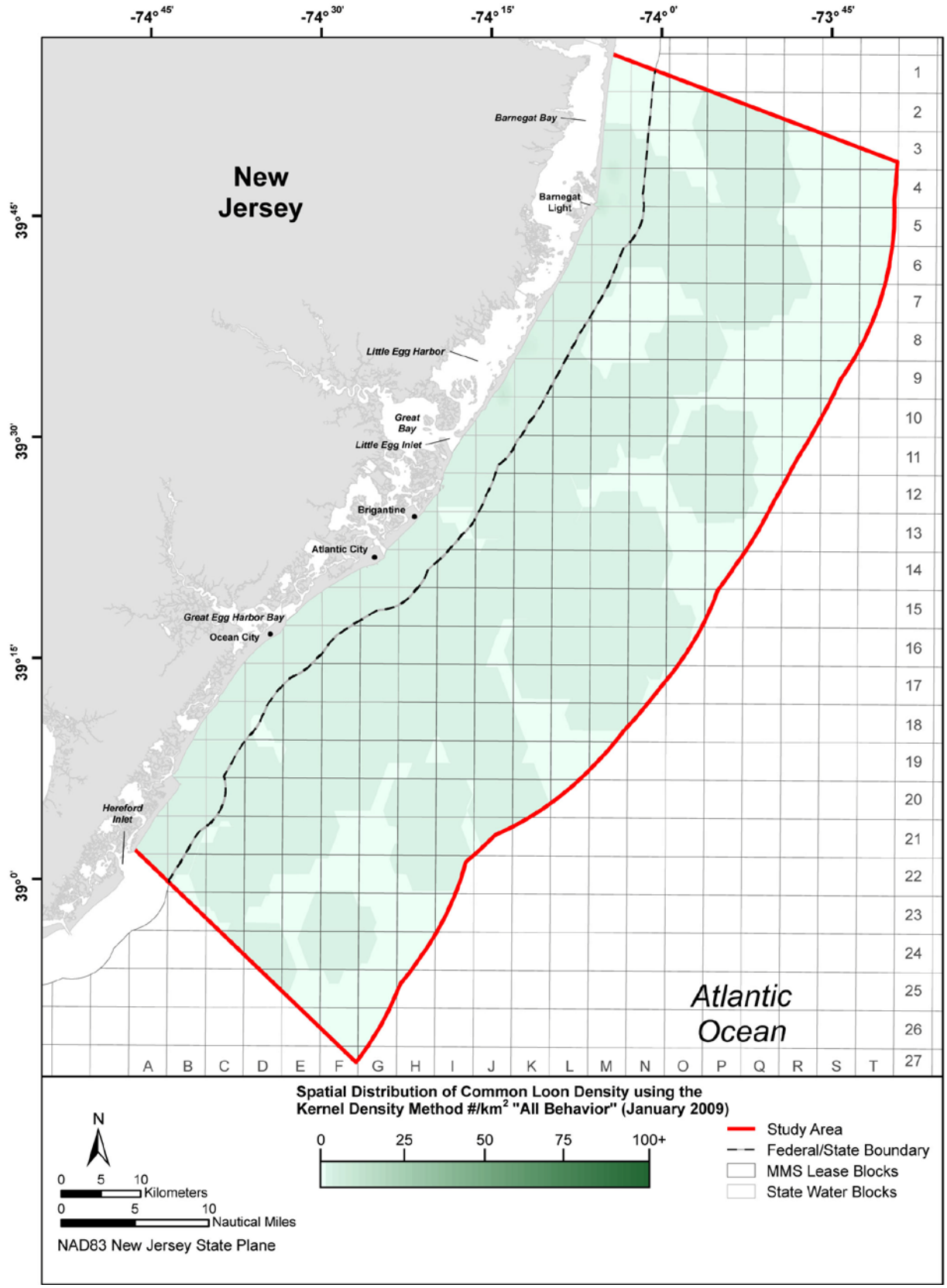

Figure M-190. Spatial distribution of Common Loon density (#/km^2) in the Study Area for all behaviors using the kernel density method (January 2009).

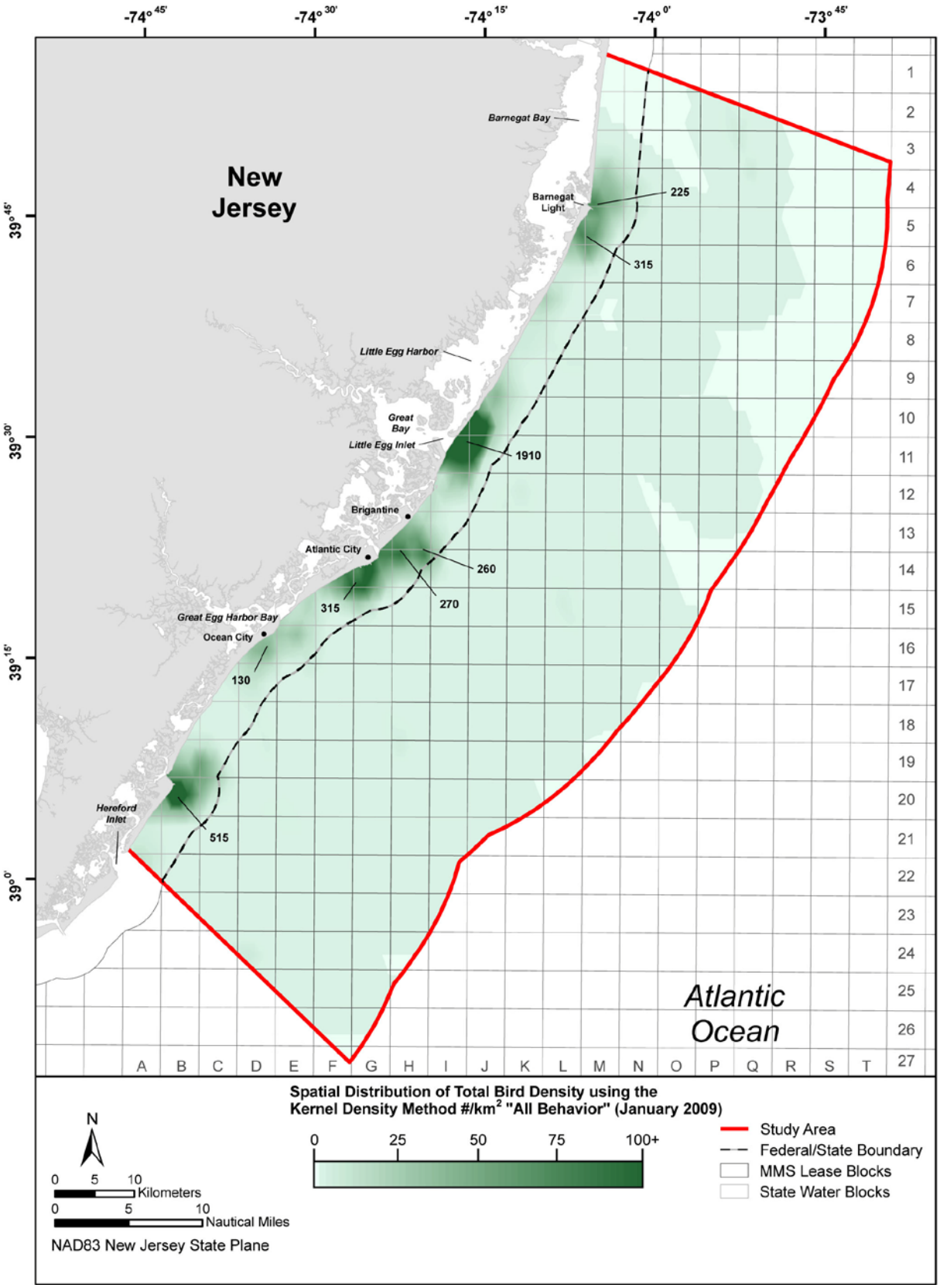

Figure M-191. Spatial distribution of total bird density (#/km^2) in the Study Area for all behaviors using the kernel density method (January 2009).

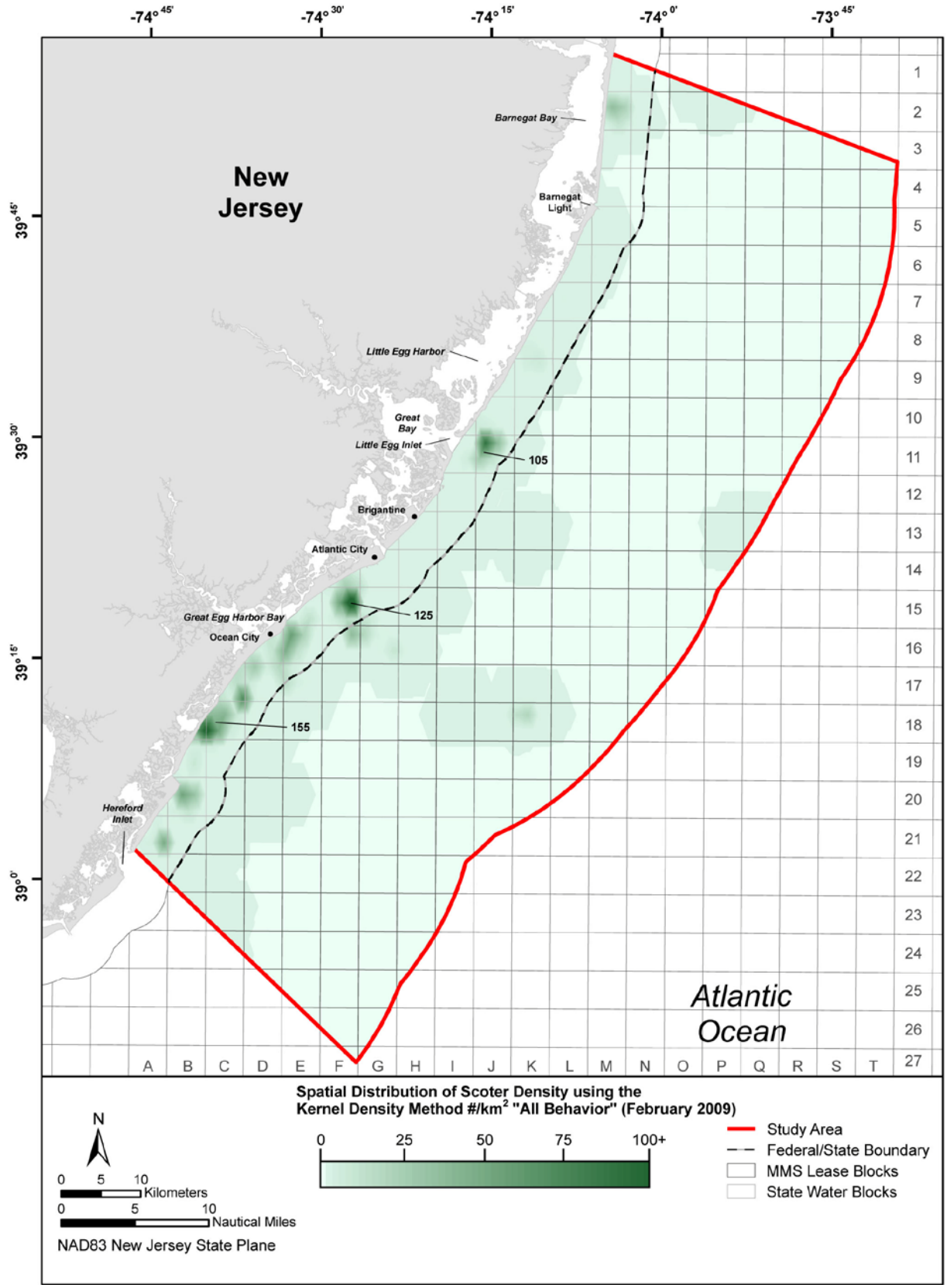

Figure M-192. Spatial distribution of scoter density (#/km^2) in the Study Area for all behaviors using the kernel density method (February 2009).

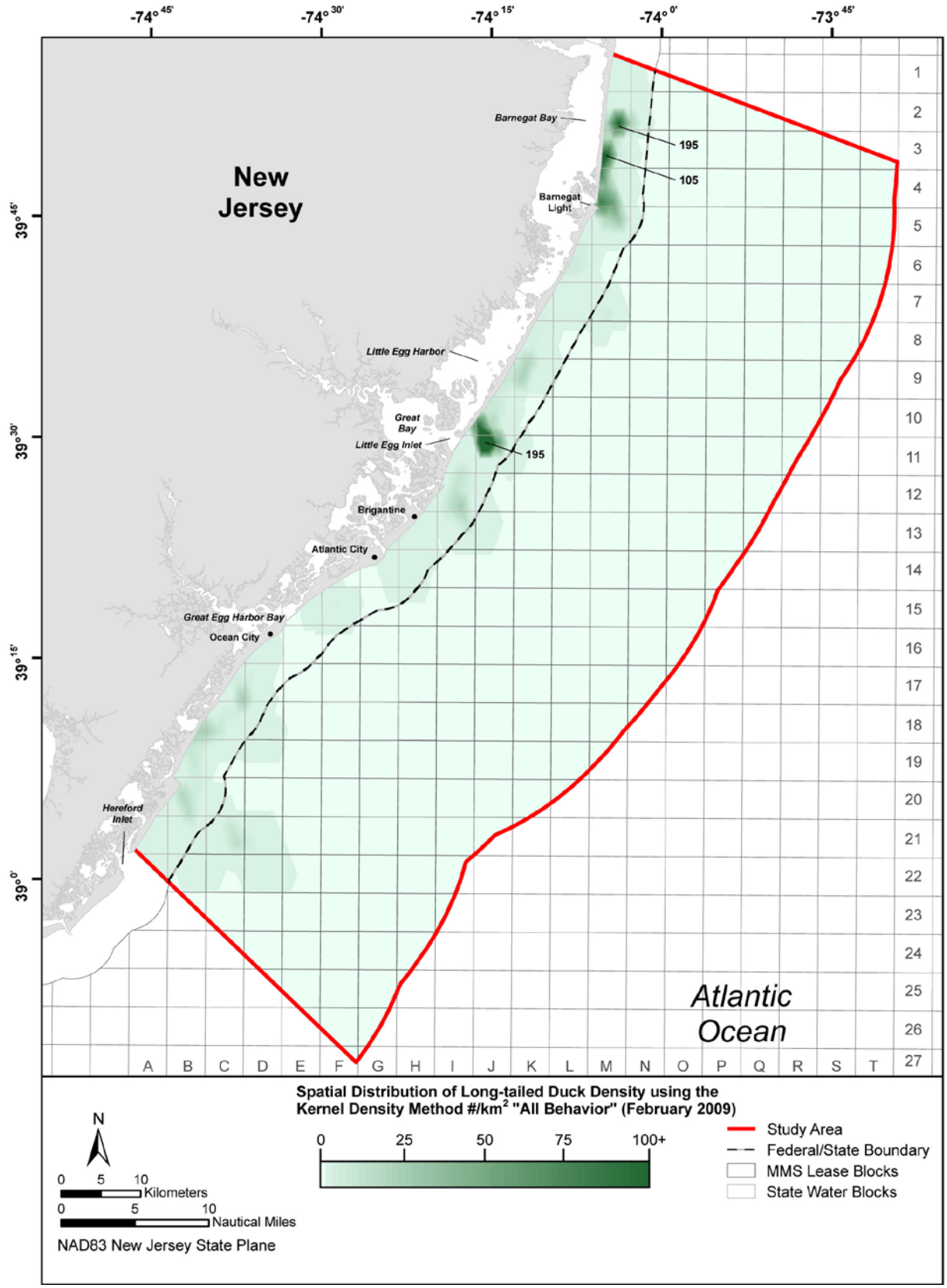

Figure M-193. Spatial distribution of Long-tailed Duck density (#/km^2) in the Study Area for all behaviors using the kernel density method (February 2009).

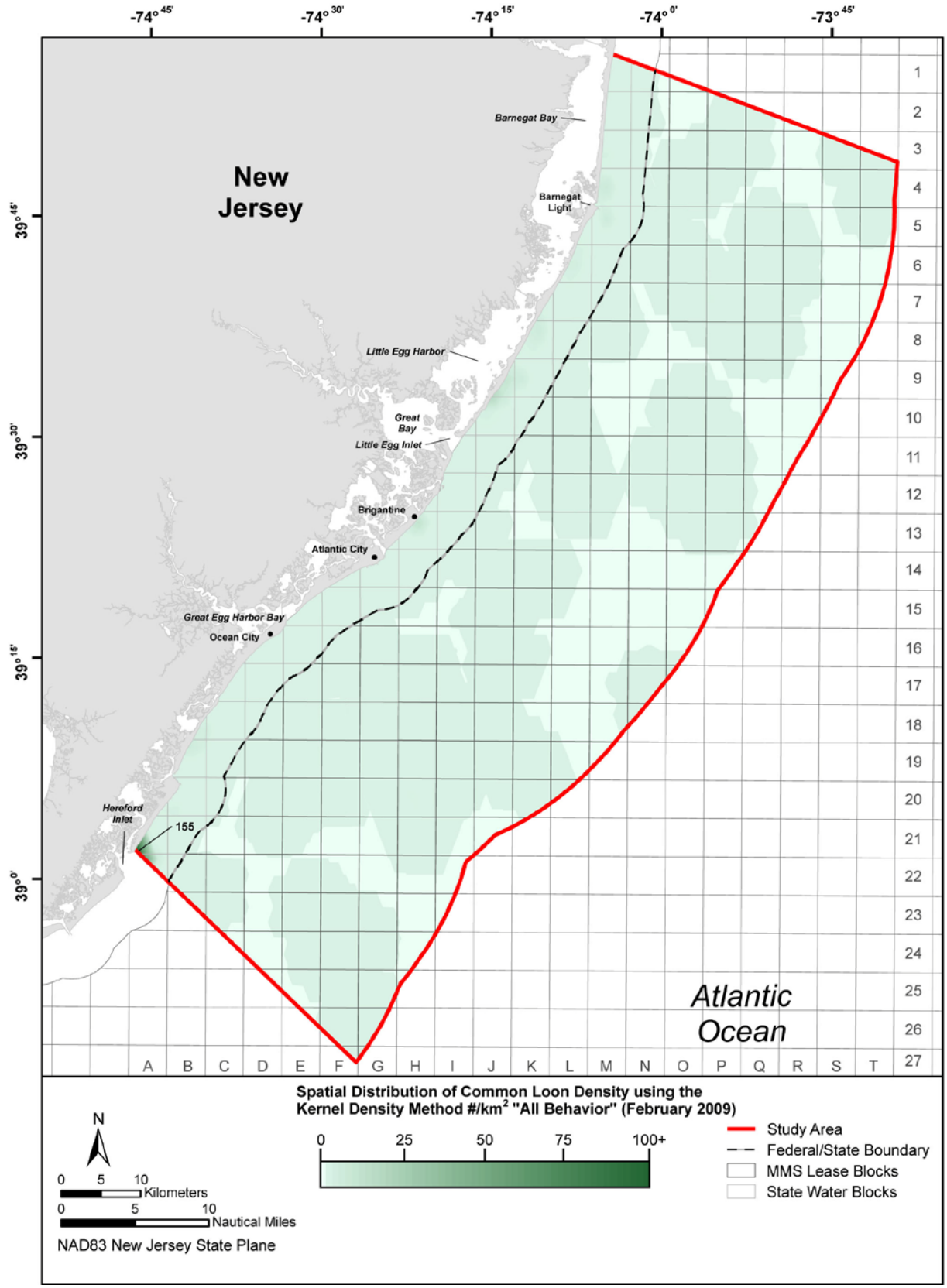

Figure M-194. Spatial distribution of Common Loon density (#/km^2) in the Study Area for all behaviors using the kernel density method (February 2009).

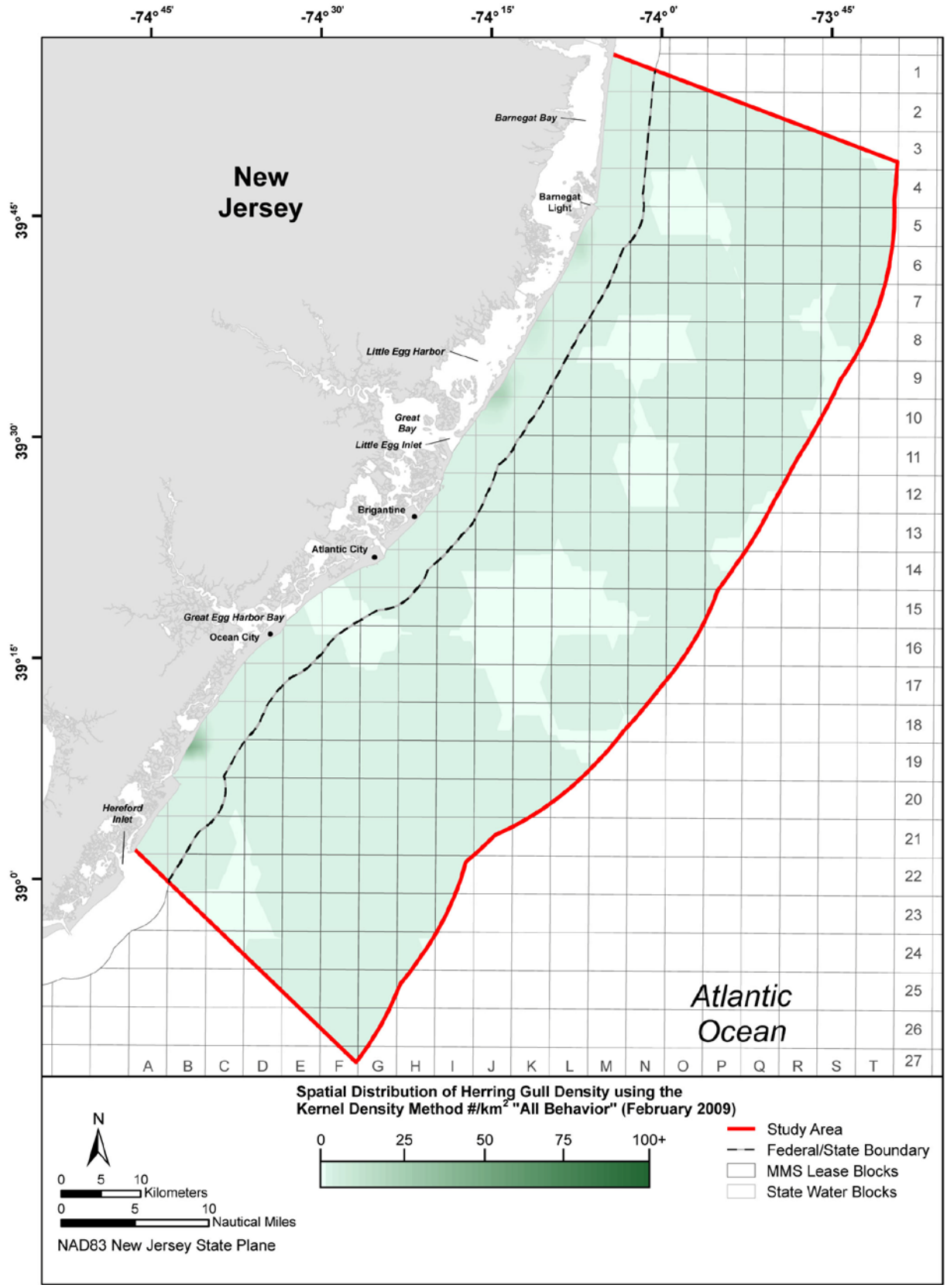

Figure M-195. Spatial distribution of Herring Gull density (#/km^2) in the Study Area for all behaviors using the kernel density method (February 2009).

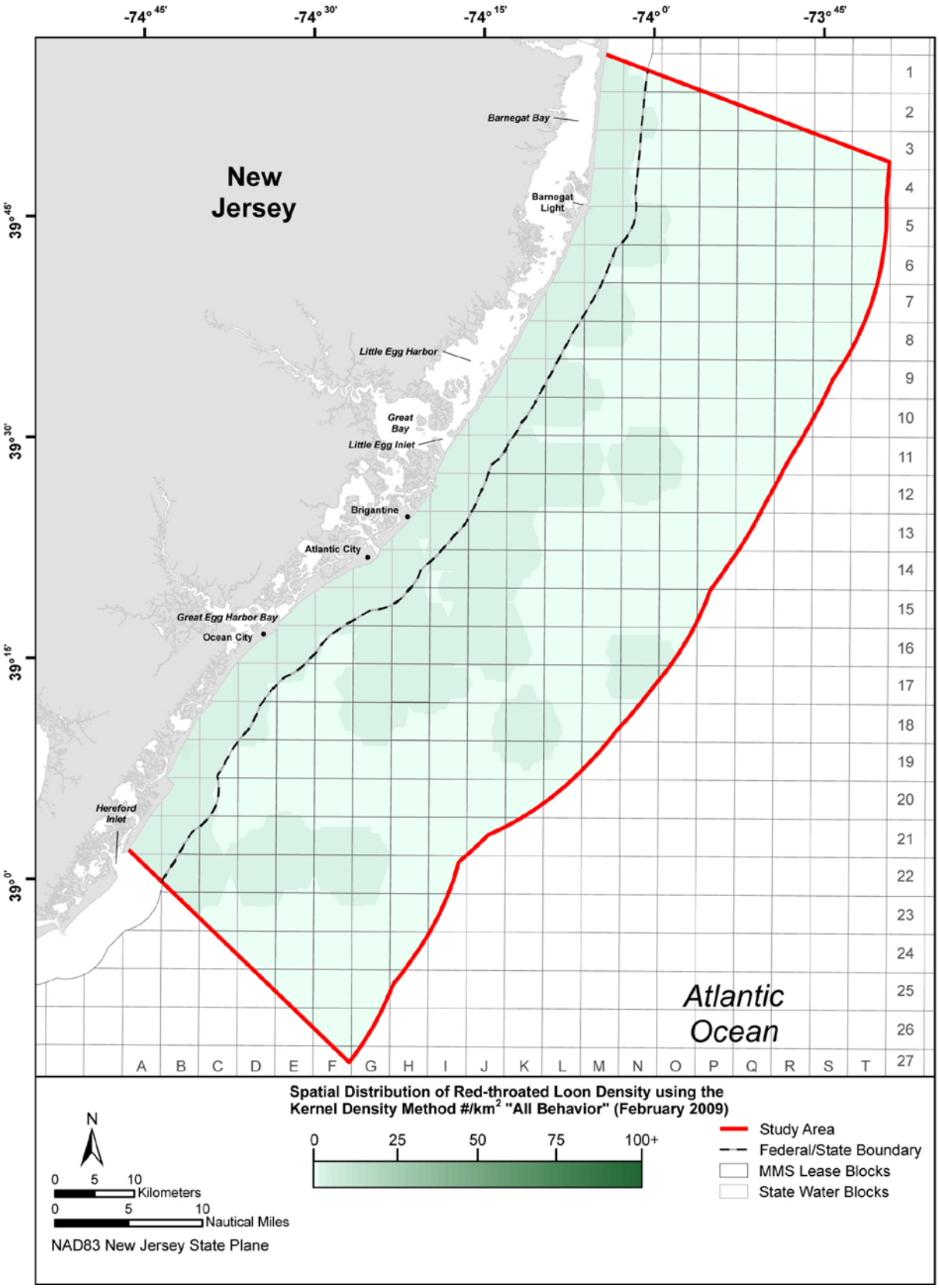

Figure M-196. Spatial distribution of Red-throated Loon density (#/km^2) in the Study Area for all behaviors using the kernel density method (February 2009).

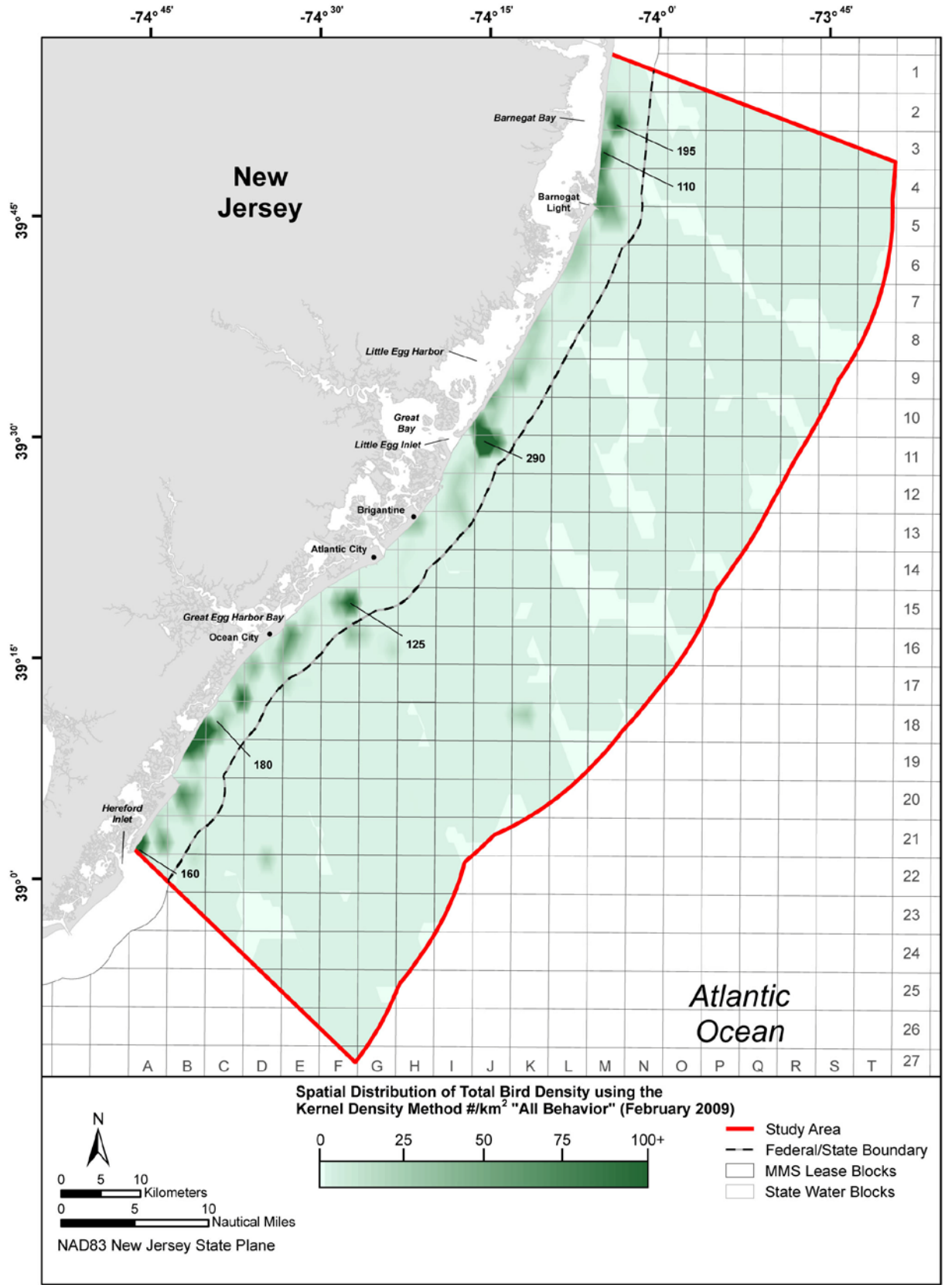

Figure M-197. Spatial distribution of total bird density (#/km^2) in the Study Area for all behaviors using the kernel density method (February 2009).

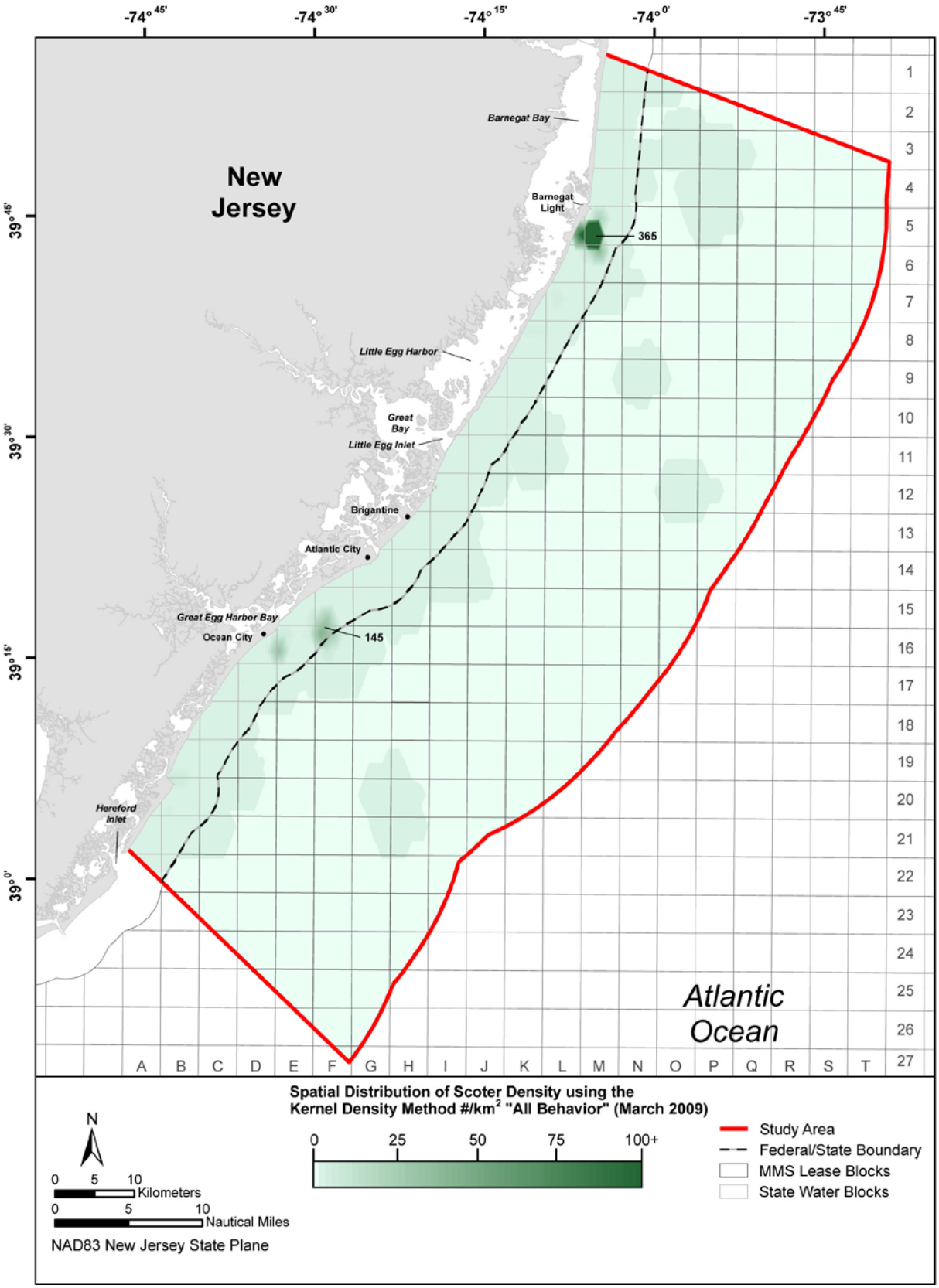

Figure M-198. Spatial distribution of scoter density (#/km^2) in the Study Area for all behaviors using the kernel density method (March 2009).

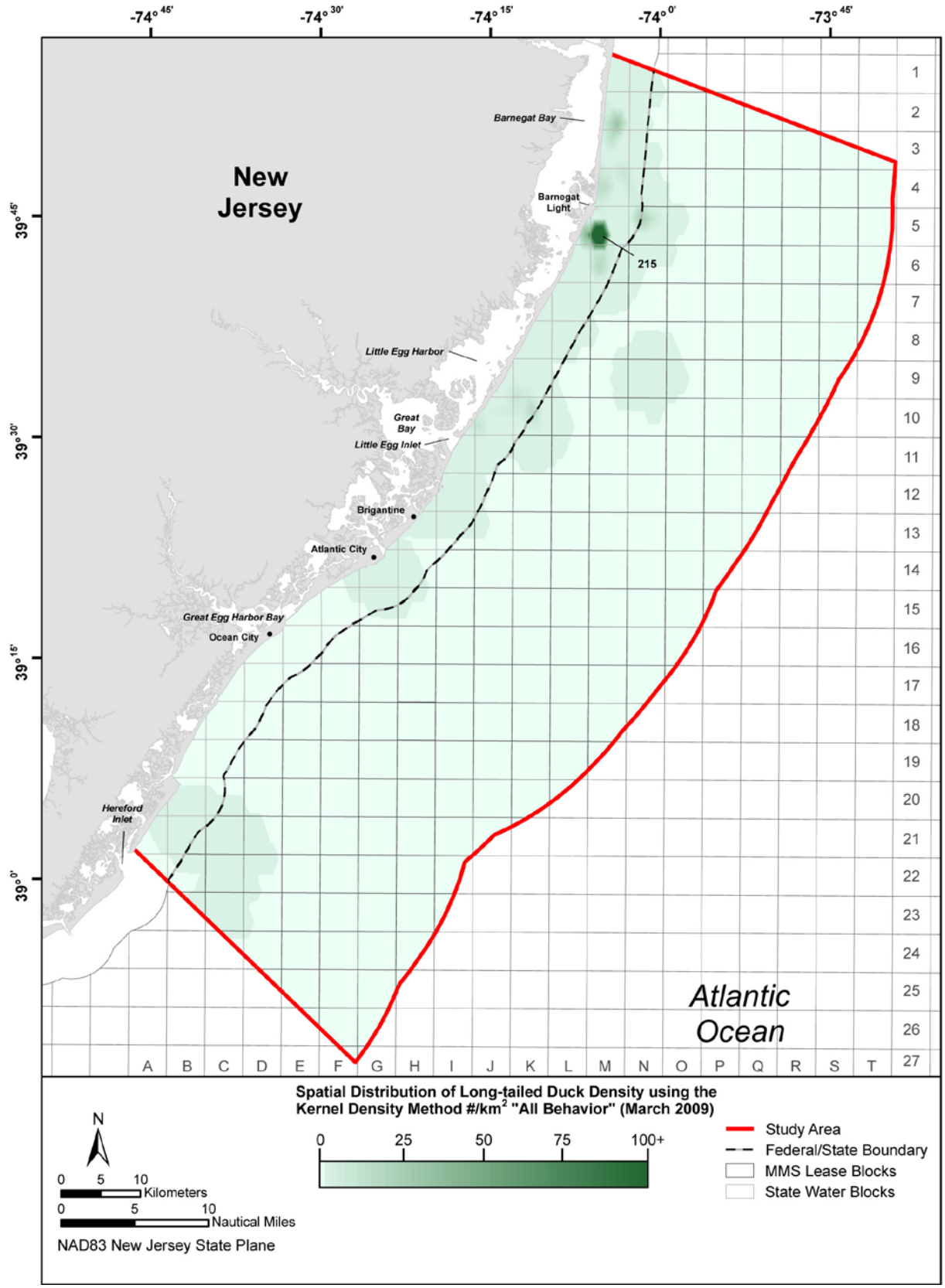

Figure M-199. Spatial distribution of Long-tailed Duck density (#/km^2) in the Study Area for all behaviors using the kernel density method (March 2009).

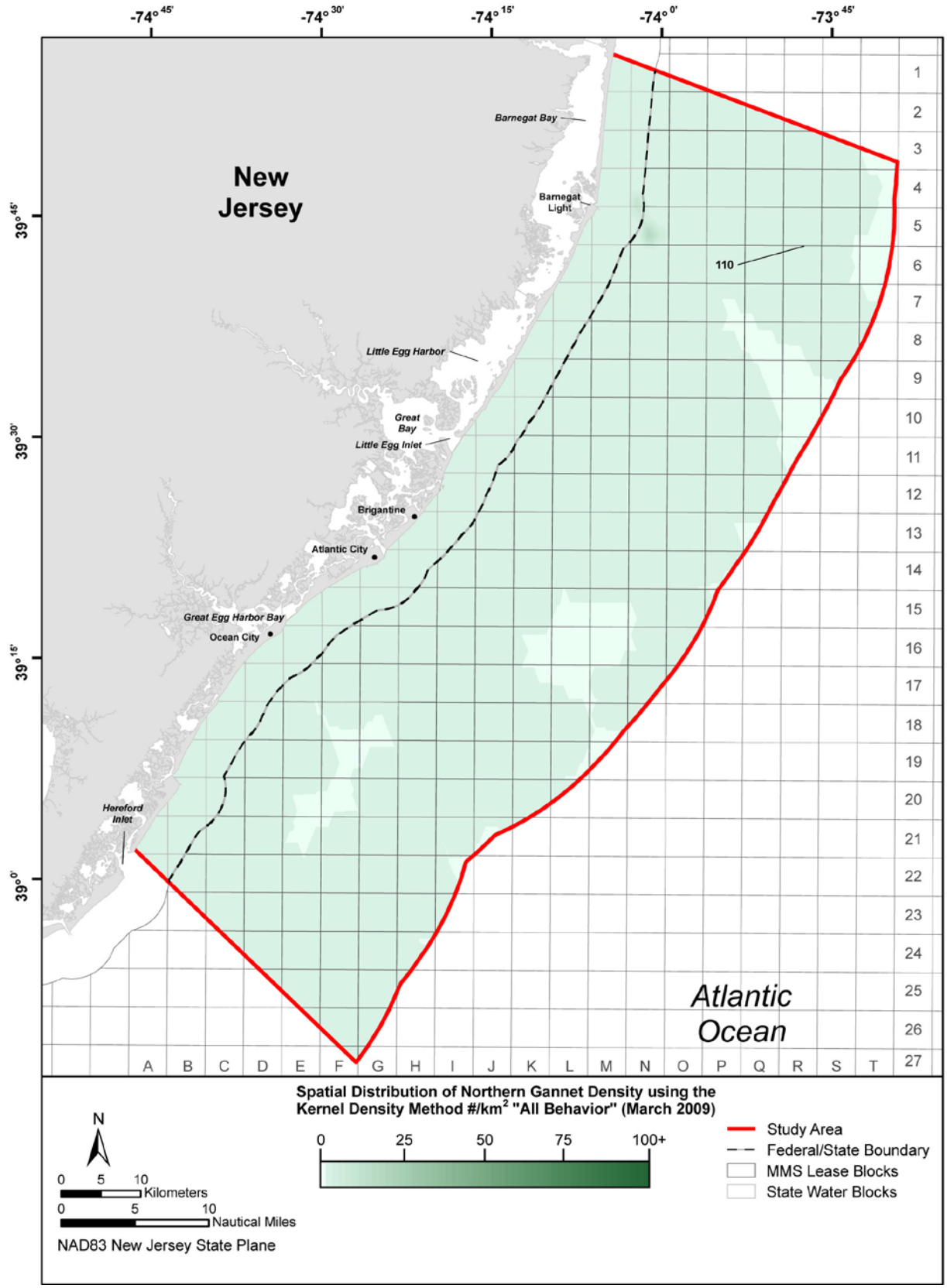

Figure M-200. Spatial distribution of Northern Gannet density (#/km^2) in the Study Area for all behaviors using the kernel density method (March 2009).

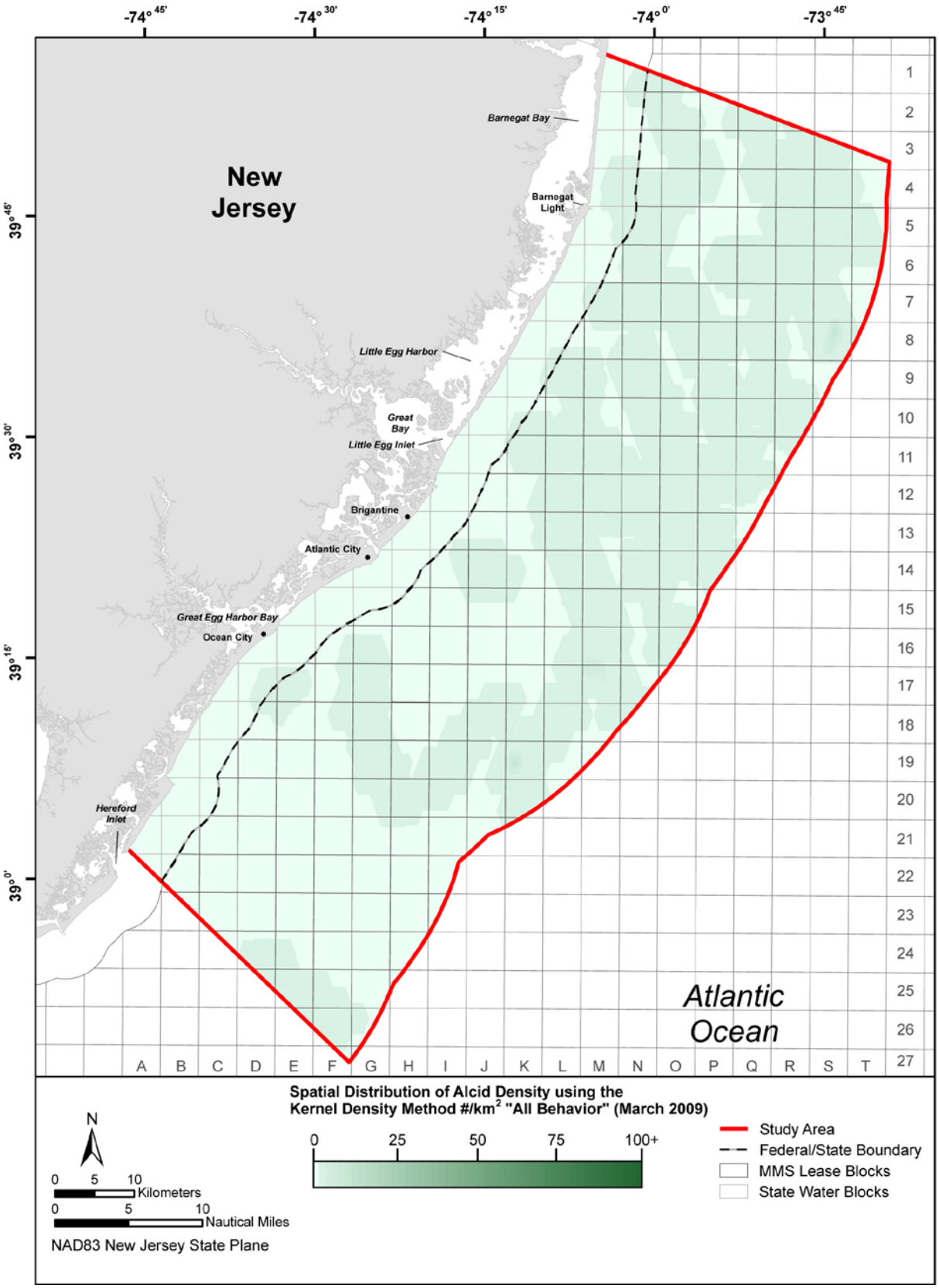

Figure M-201. Spatial distribution of alcid density (#/km^2) in the Study Area for all behaviors using the kernel density method (March 2009).

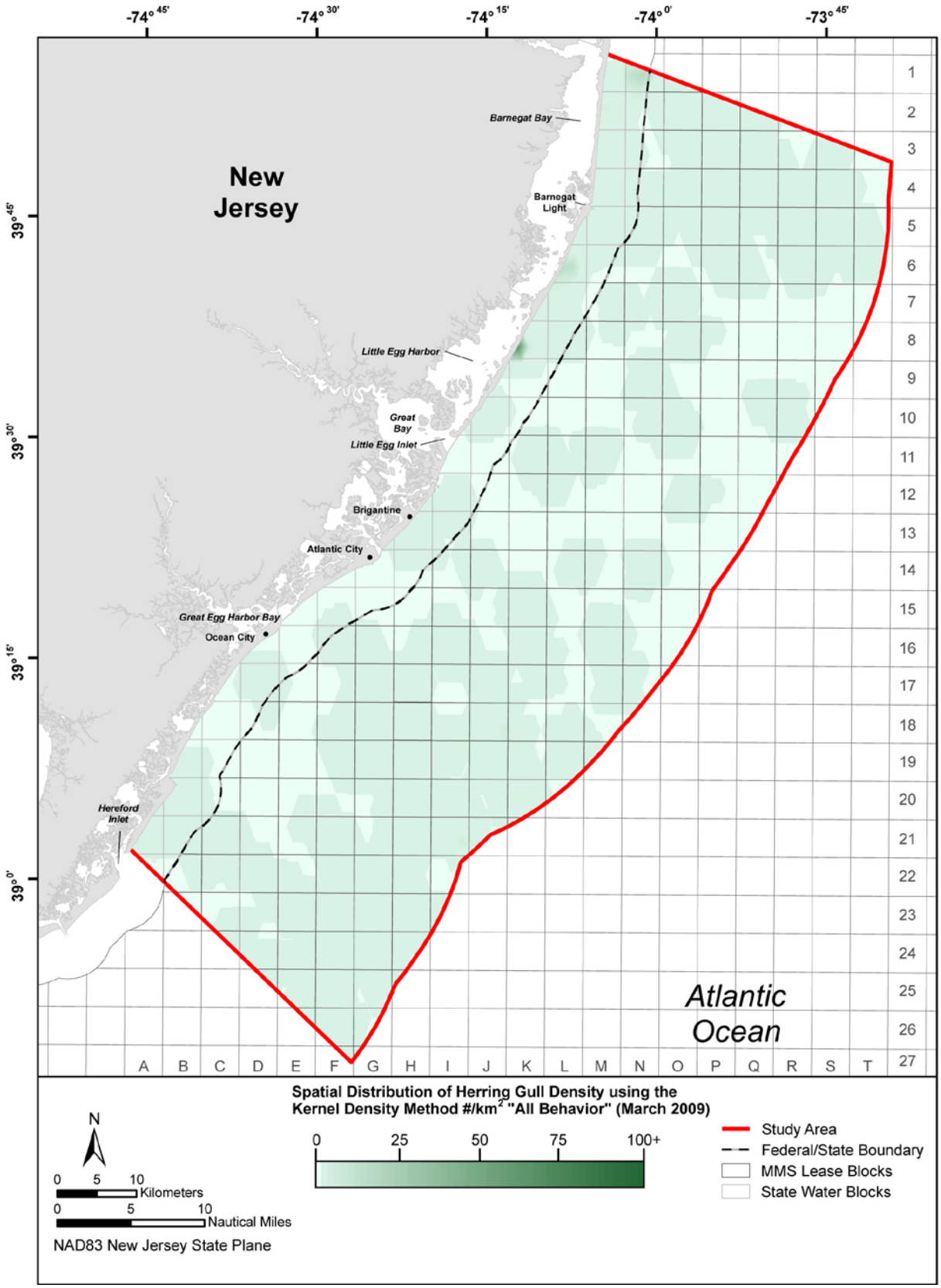

Figure M-202. Spatial distribution of Herring Gull density (#/km^2) in the Study Area for all behaviors using the kernel density method (March 2009).

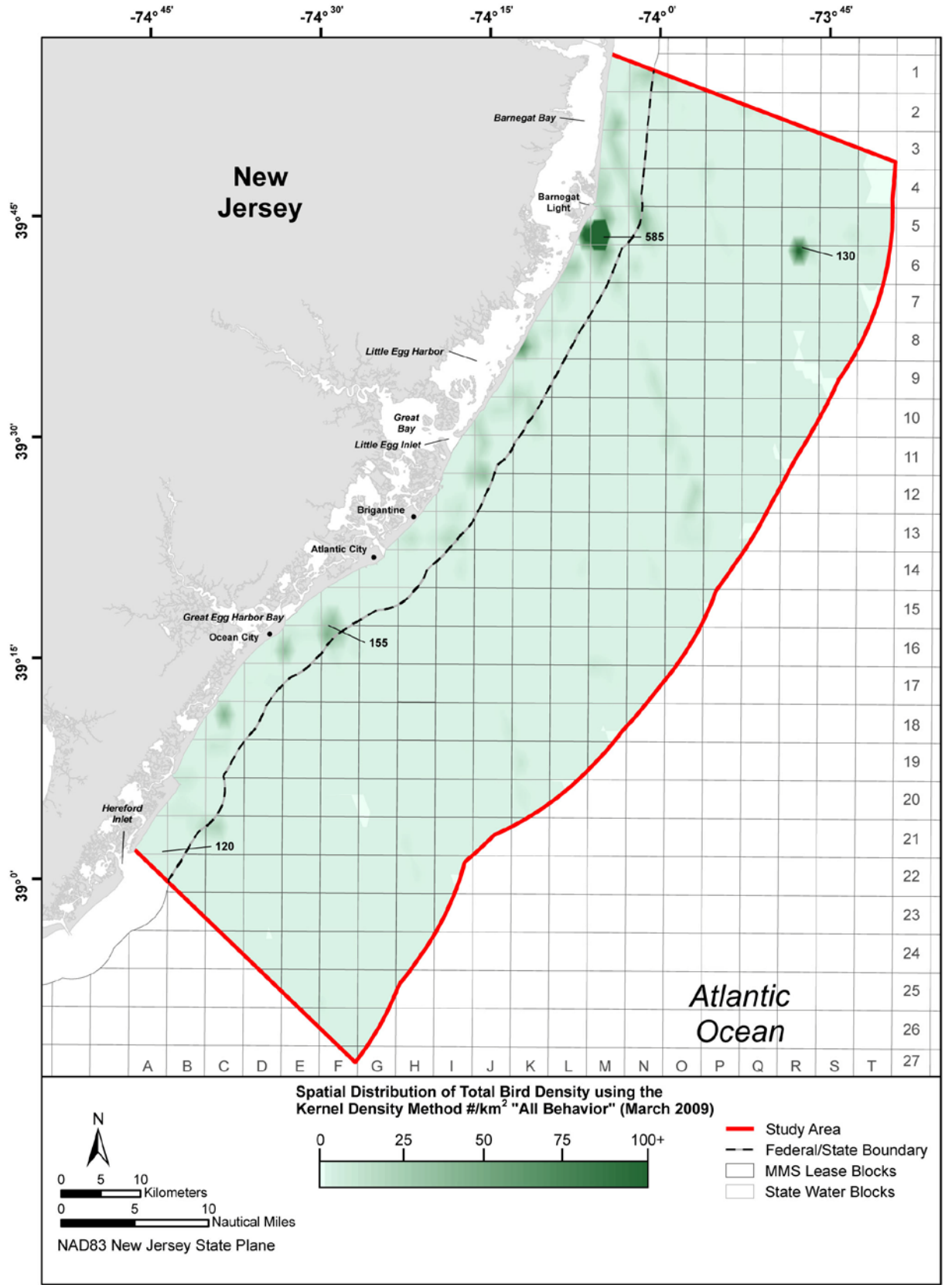

Figure M-203. Spatial distribution of total bird density (#/km^2) in the Study Area for all behaviors using the kernel density method (March 2009).

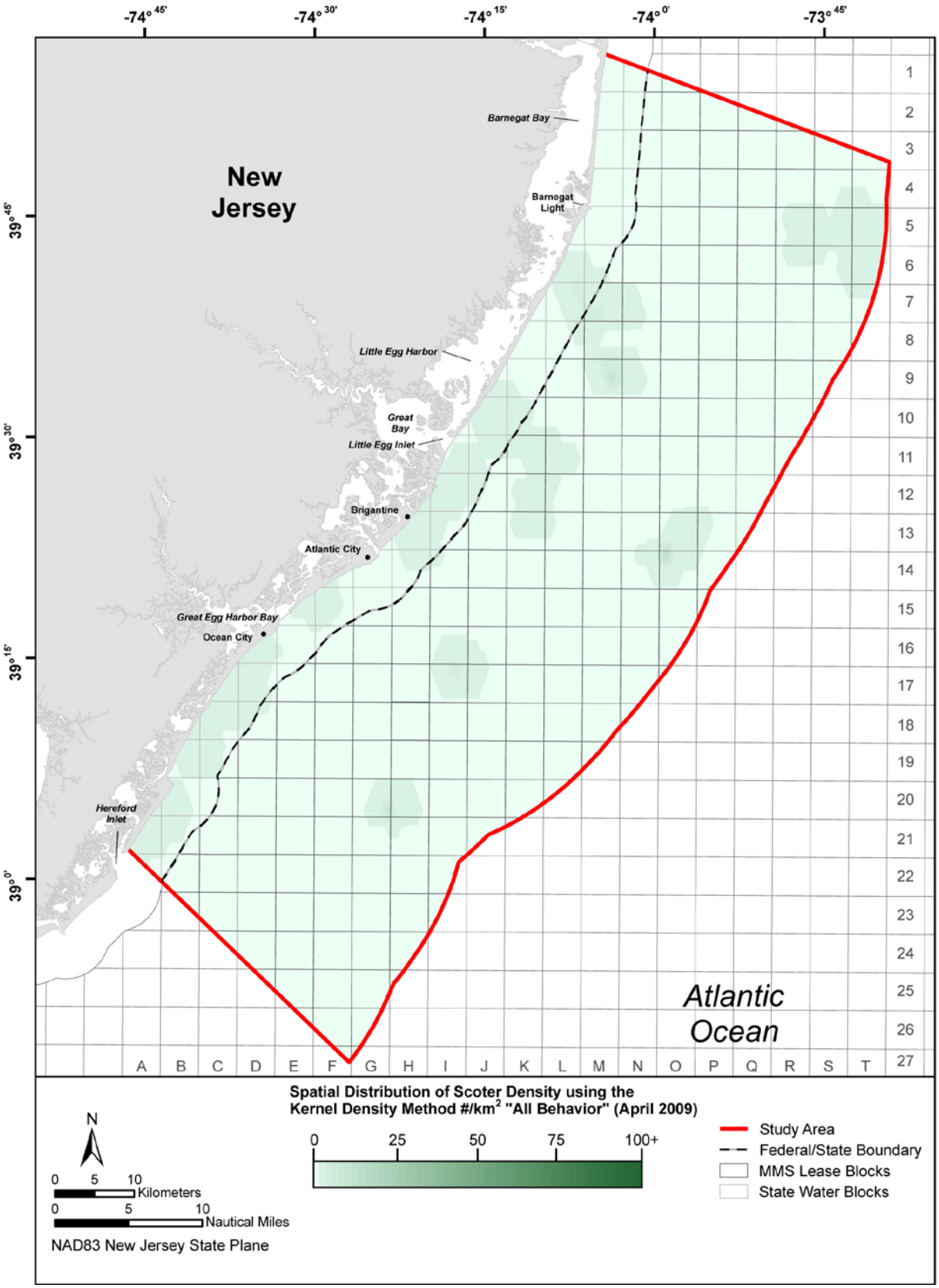

Figure M-204. Spatial distribution of scoter density (#/km^2) in the Study Area for all behaviors using the kernel density method (April 2009).

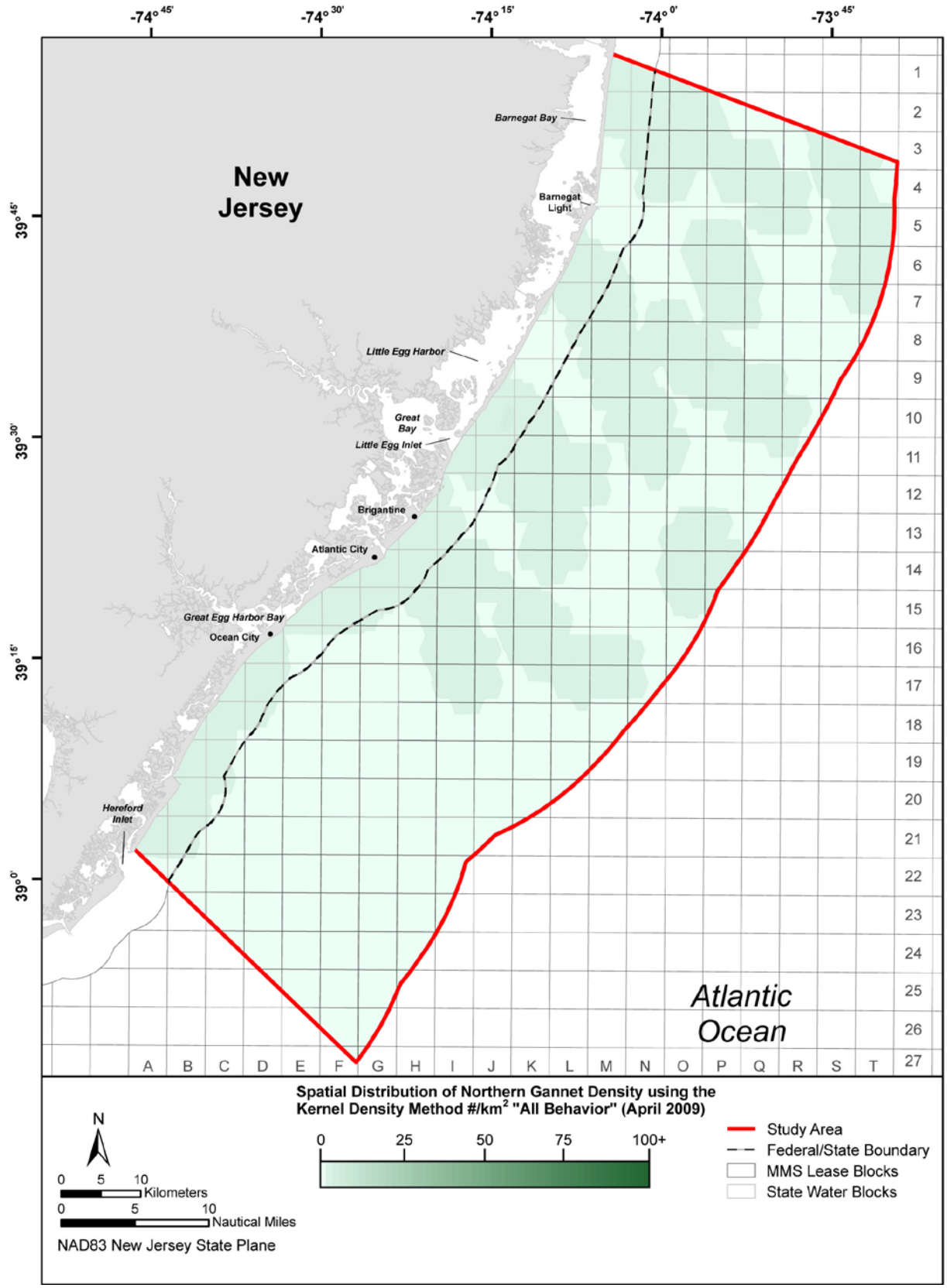

Figure M-205. Spatial distribution of Northern Gannet density (#/km^2) in the Study Area for all behaviors using the kernel density method (April 2009).

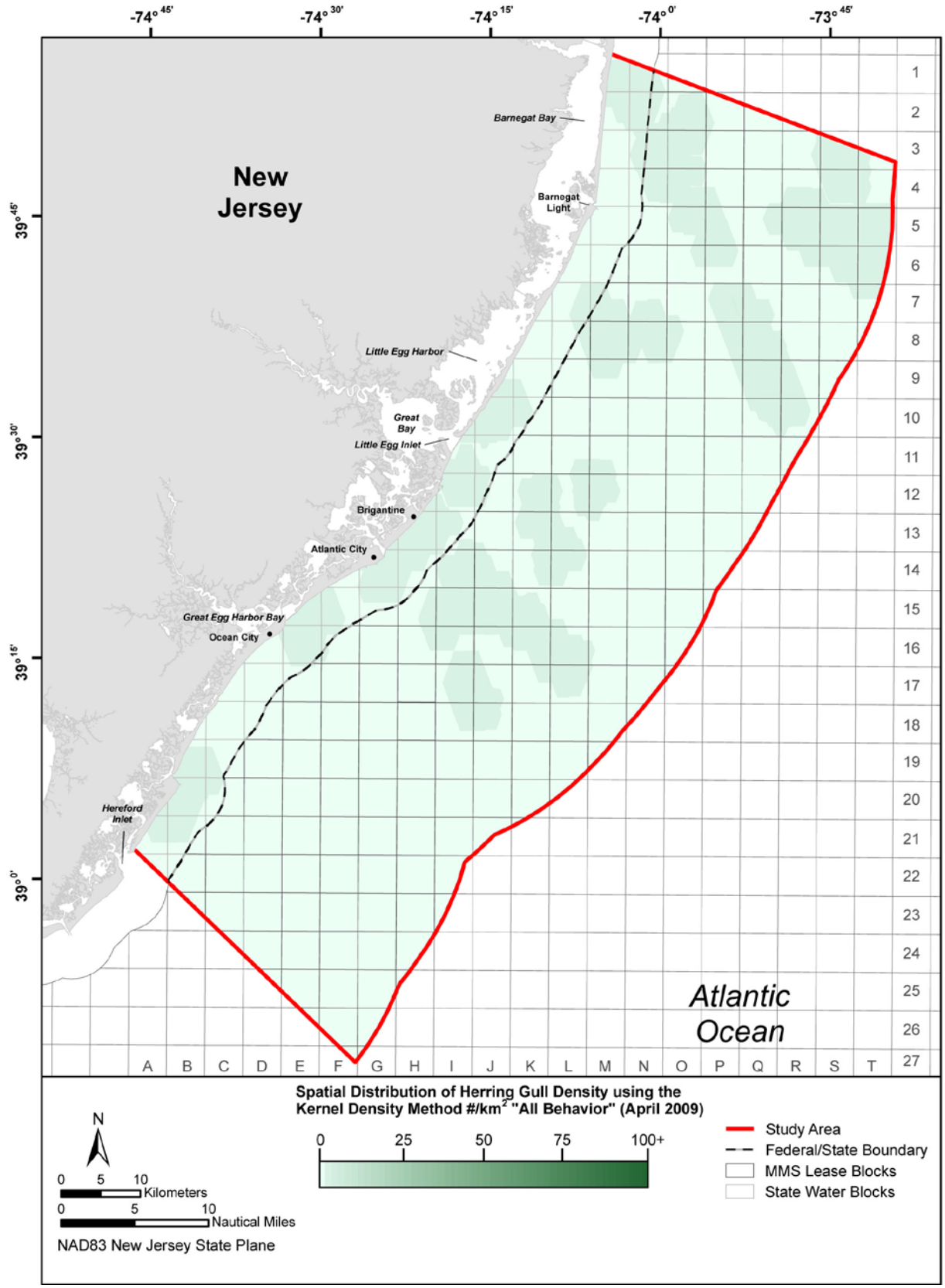

Figure M-206. Spatial distribution of Herring Gull density (#/km^2) in the Study Area for all behaviors using the kernel density method (April 2009).

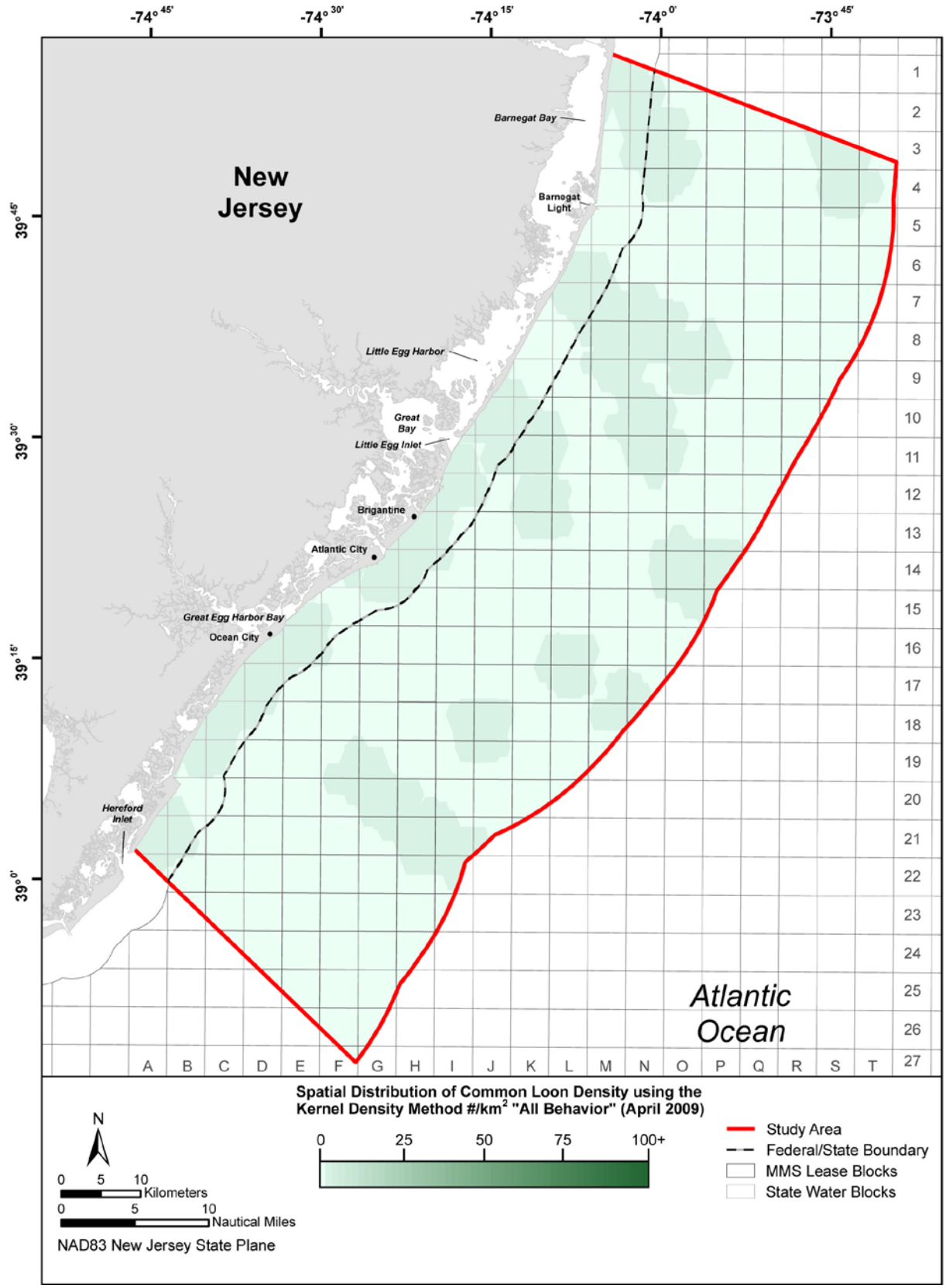

Figure M-207. Spatial distribution of Common Loon density (#/km^2) in the Study Area for all behaviors using the kernel density method (April 2009).

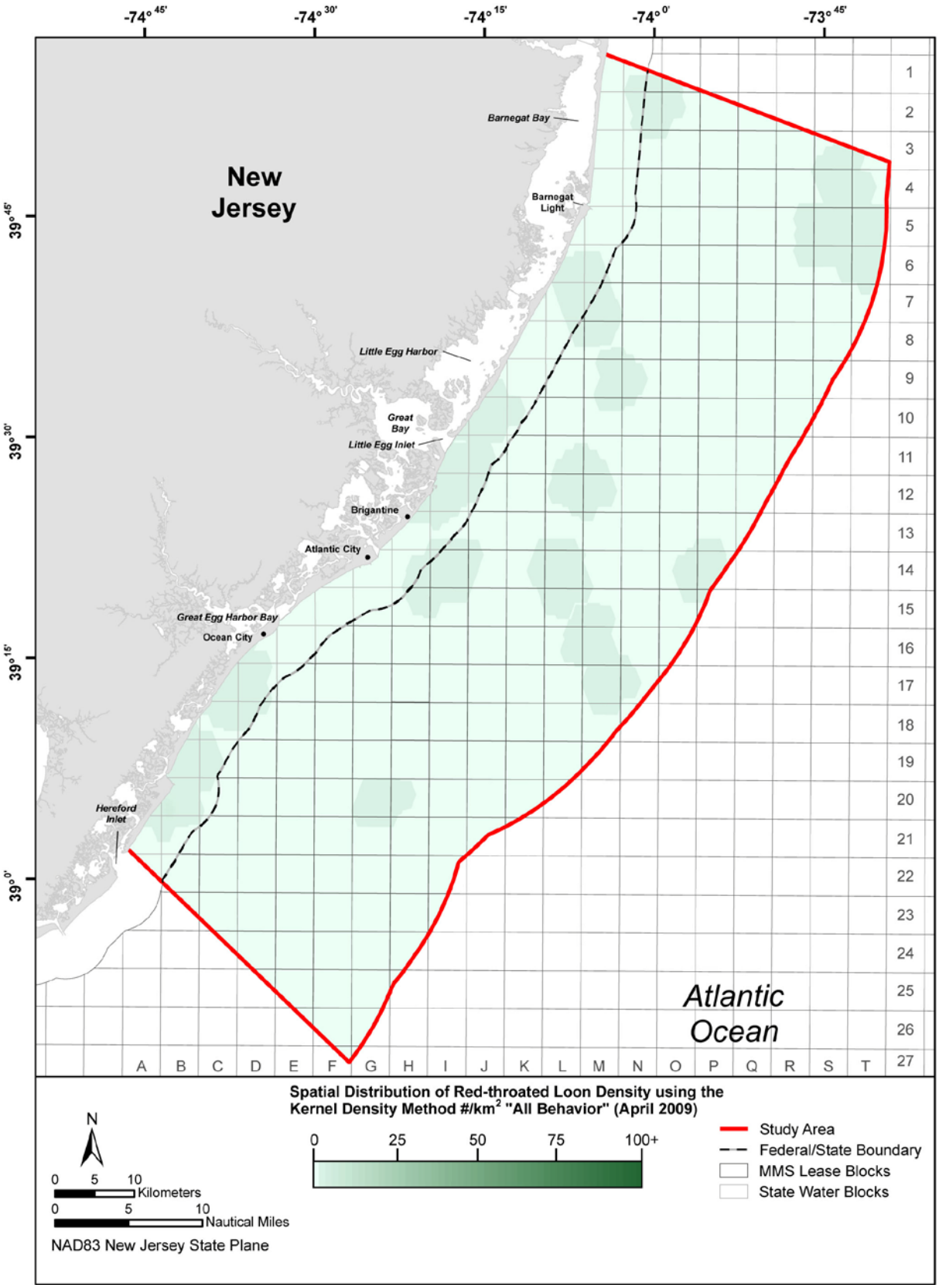

Figure M-208. Spatial distribution of Red-throated Loon density (#/km^2) in the Study Area for all behaviors using the kernel density method (April 2009).

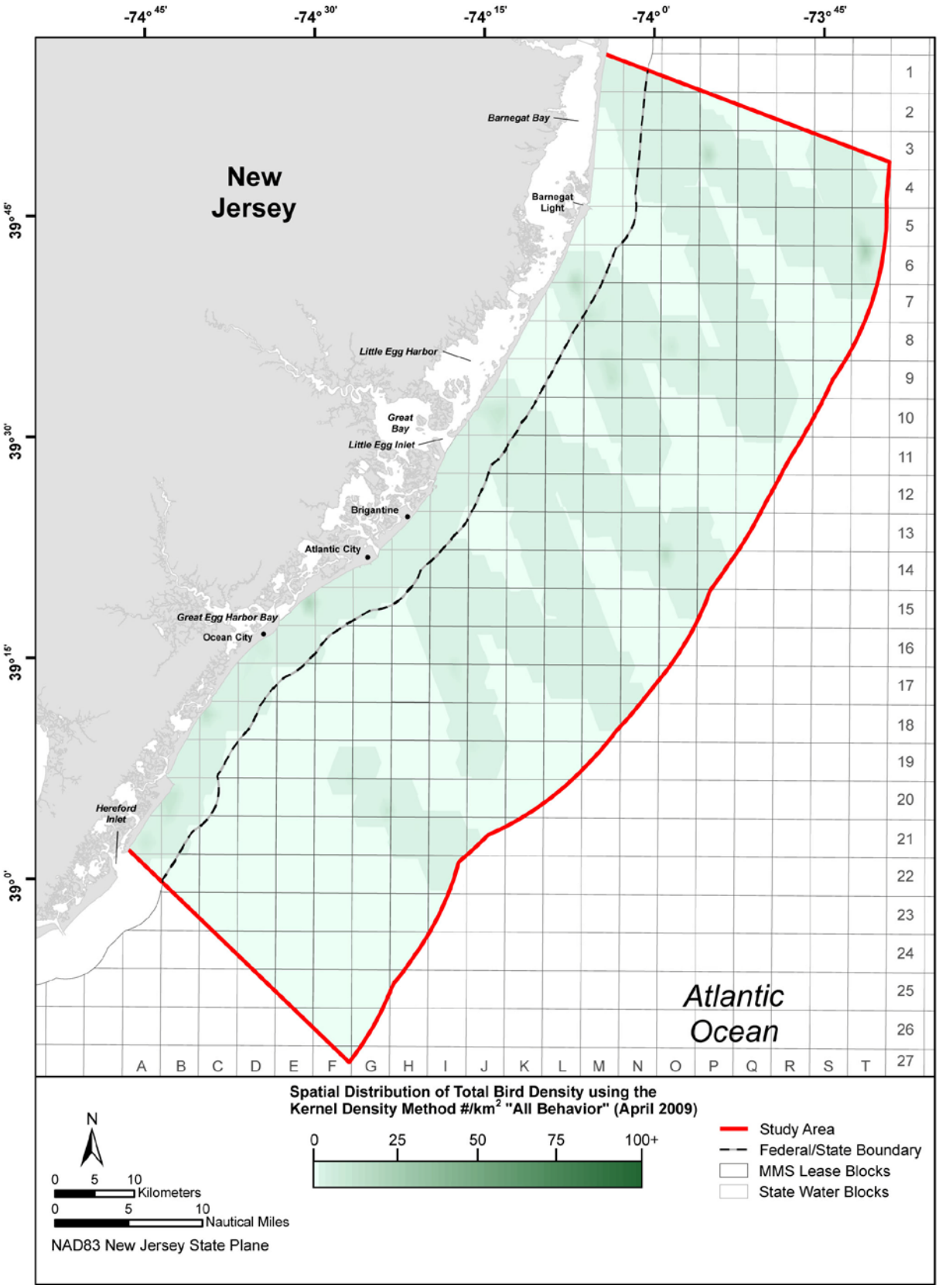

Figure M-209. Spatial distribution of total bird density (#/km^2) in the Study Area for all behaviors using the kernel density method (April 2009).

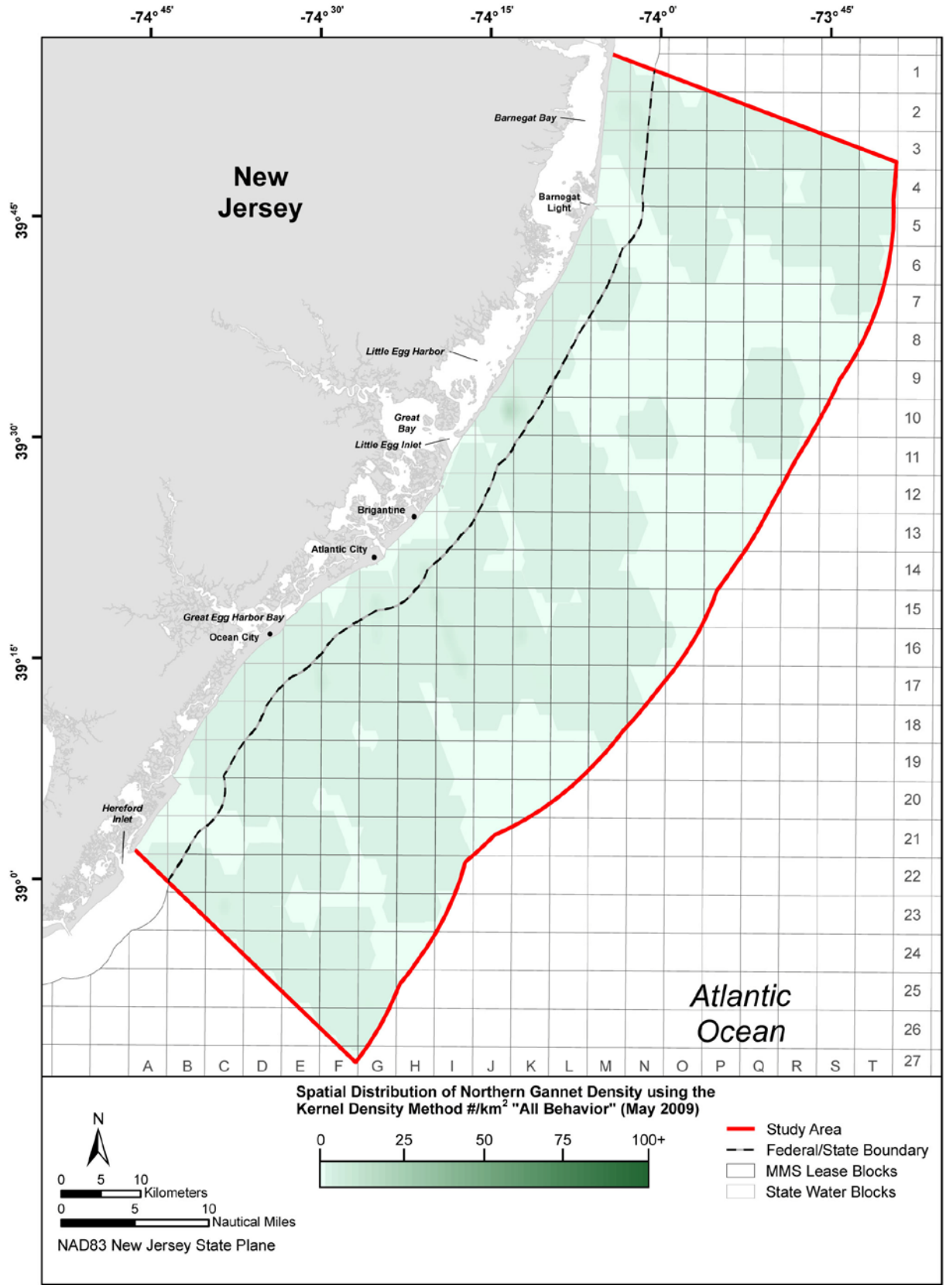

Figure M-210. Spatial distribution of Northern Gannet density (#/km^2) in the Study Area for all behaviors using the kernel density method (May 2009).

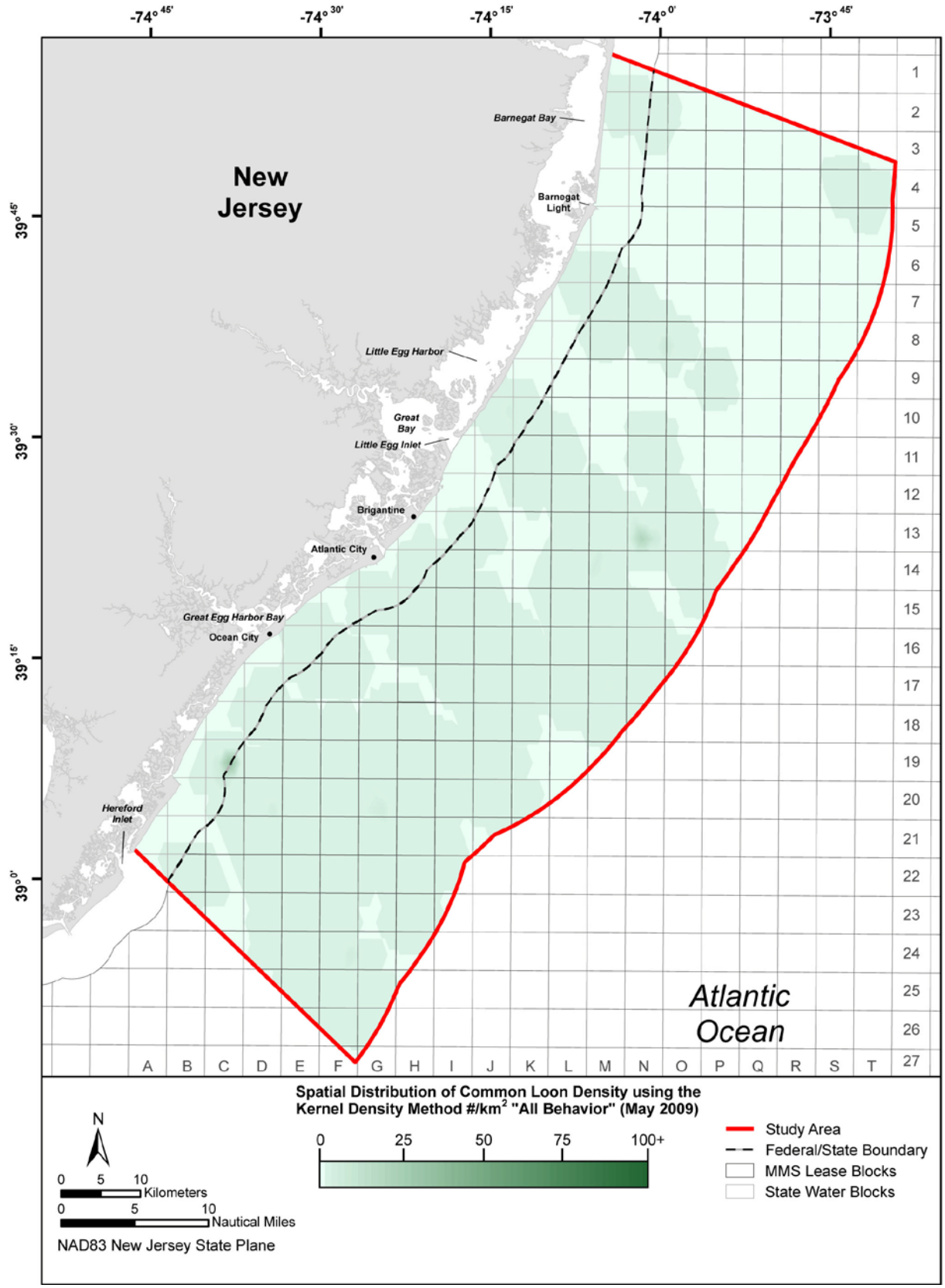

Figure M-211. Spatial distribution of Common Loon density (#/km^2) in the Study Area for all behaviors using the kernel density method (May 2009).

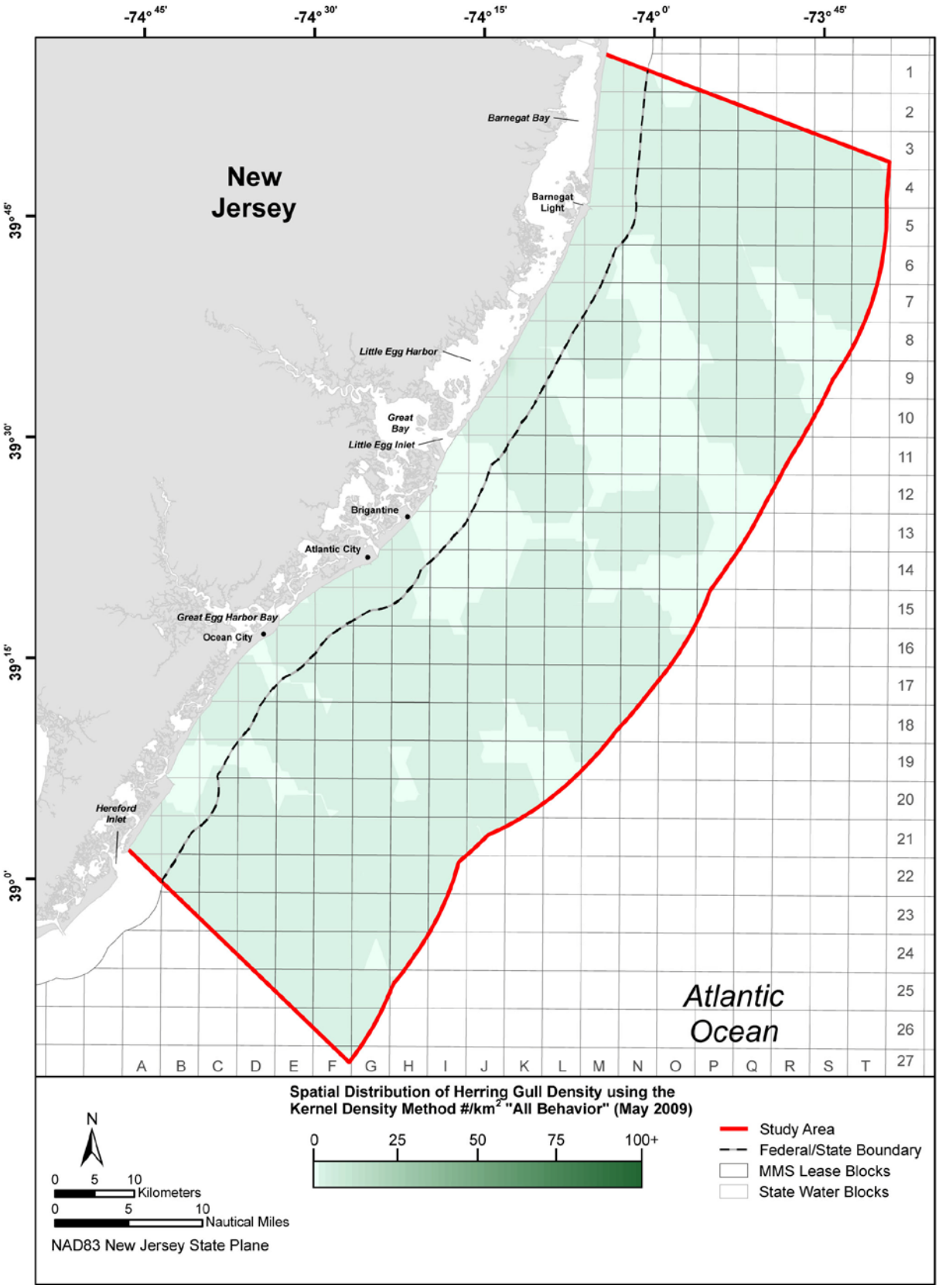

Figure M-212. Spatial distribution of Herring Gull density (#/km^2) in the Study Area for all behaviors using the kernel density method (May 2009).

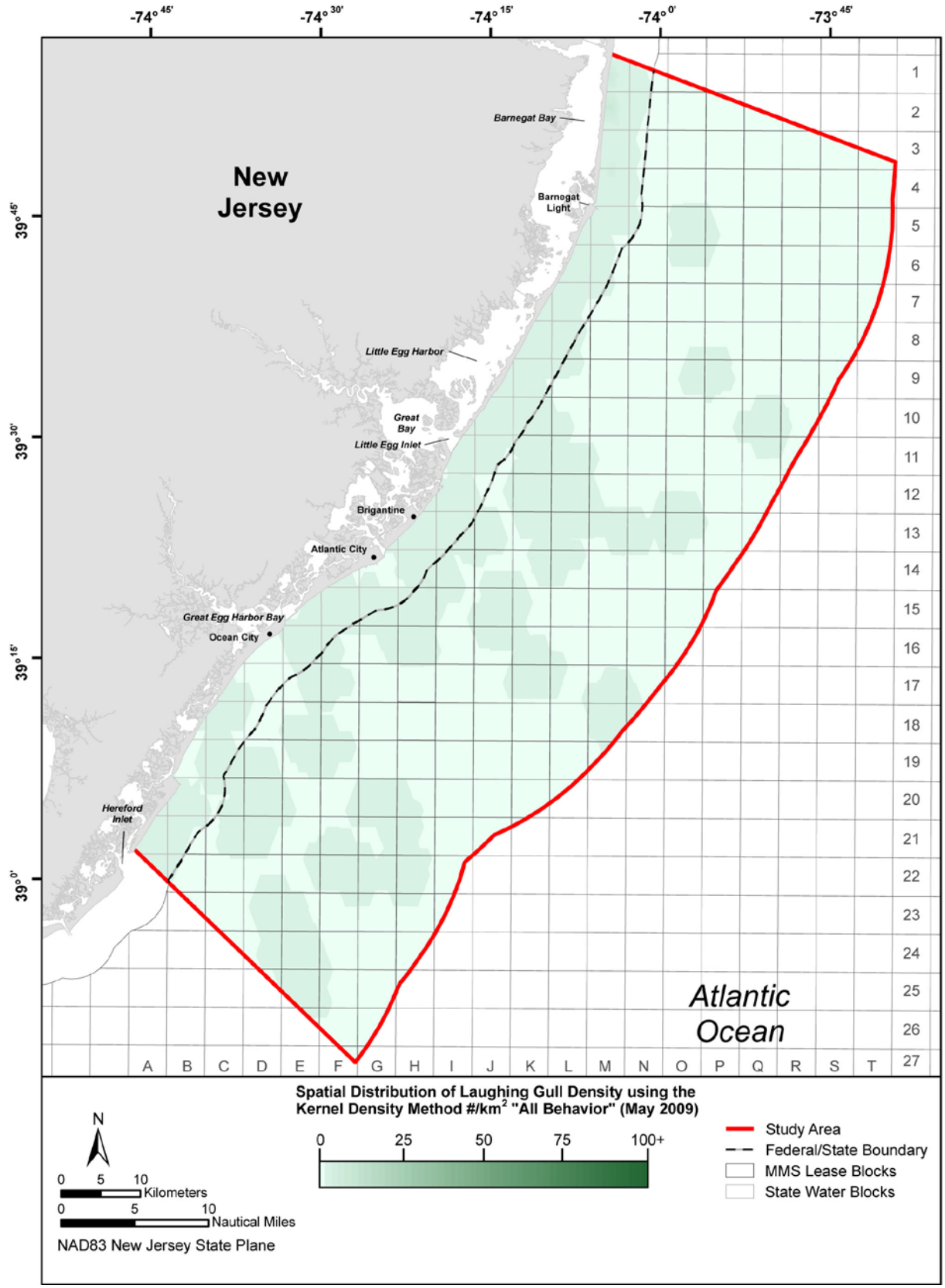

Figure M-213. Spatial distribution of Laughing Gull density (#/km^2) in the Study Area for all behaviors using the kernel density method (May 2009).

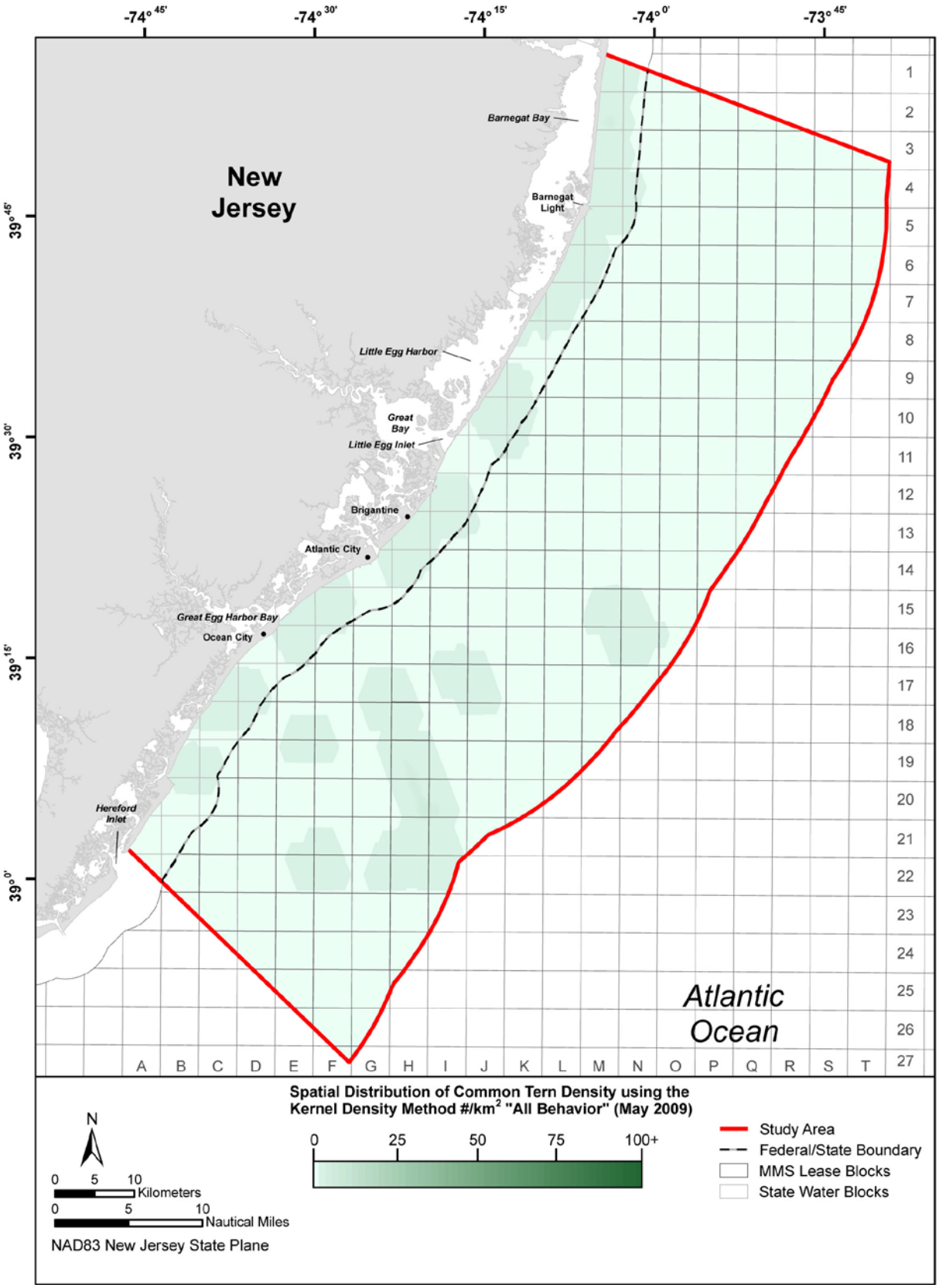

Figure M-214. Spatial distribution of Common Tern density (#/km^2) in the Study Area for all behaviors using the kernel density method (May 2009).

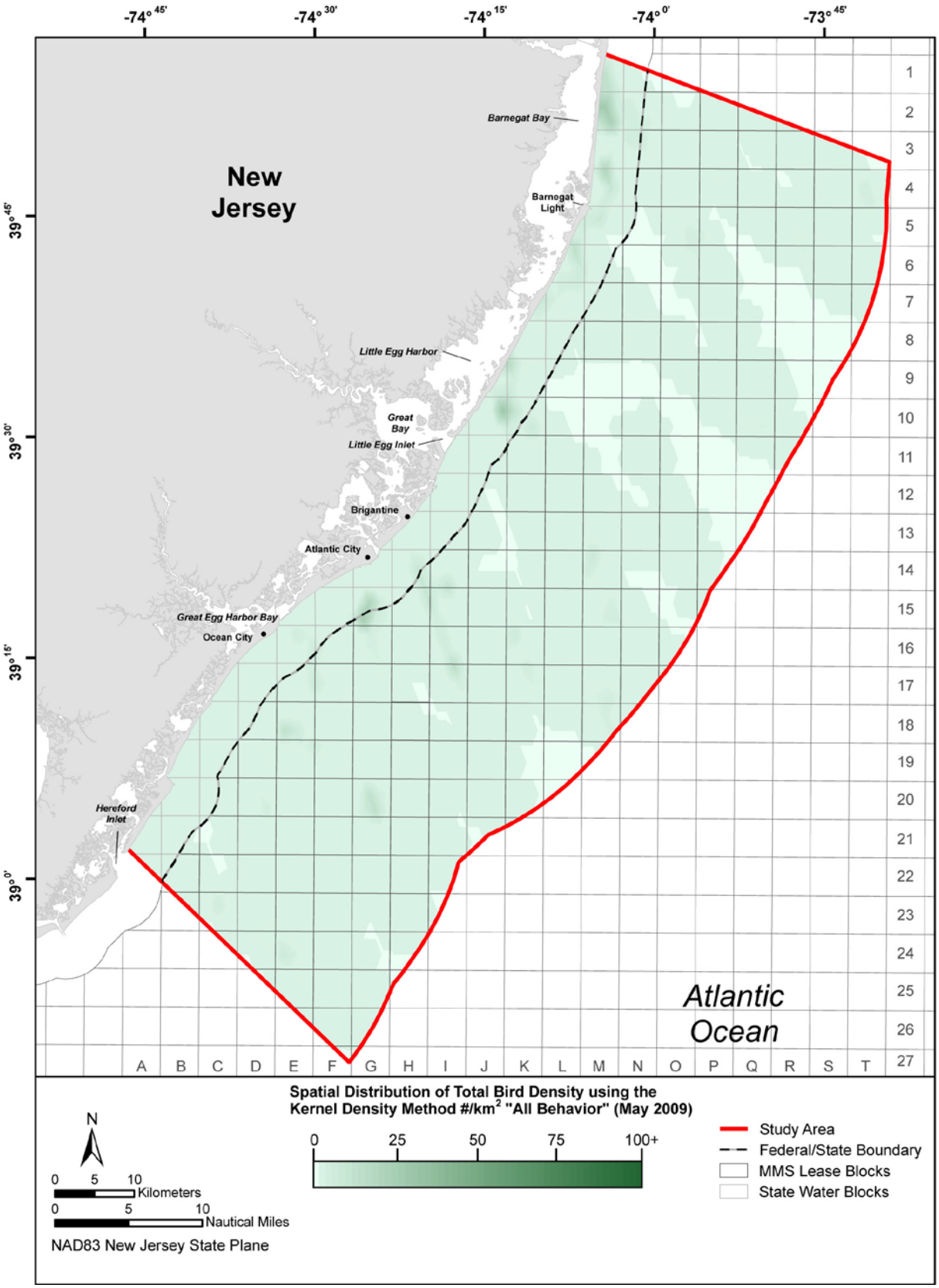

Figure M-215. Spatial distribution of total bird density (#/km^2) in the Study Area for all behaviors using the kernel density method (May 2009).

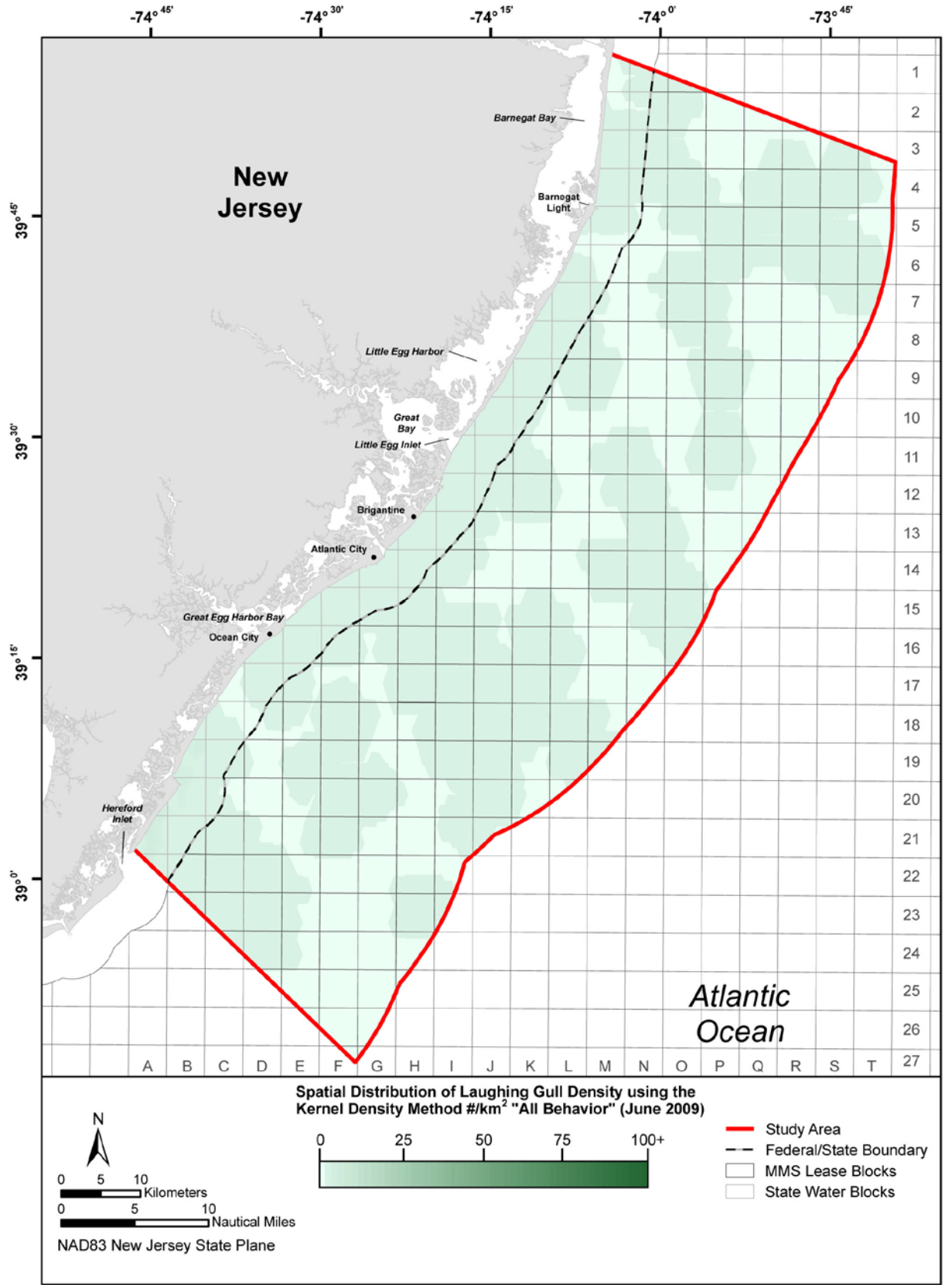

Figure M-216. Spatial distribution of Laughing Gull density (#/km^2) in the Study Area for all behaviors using the kernel density method (June 2009).

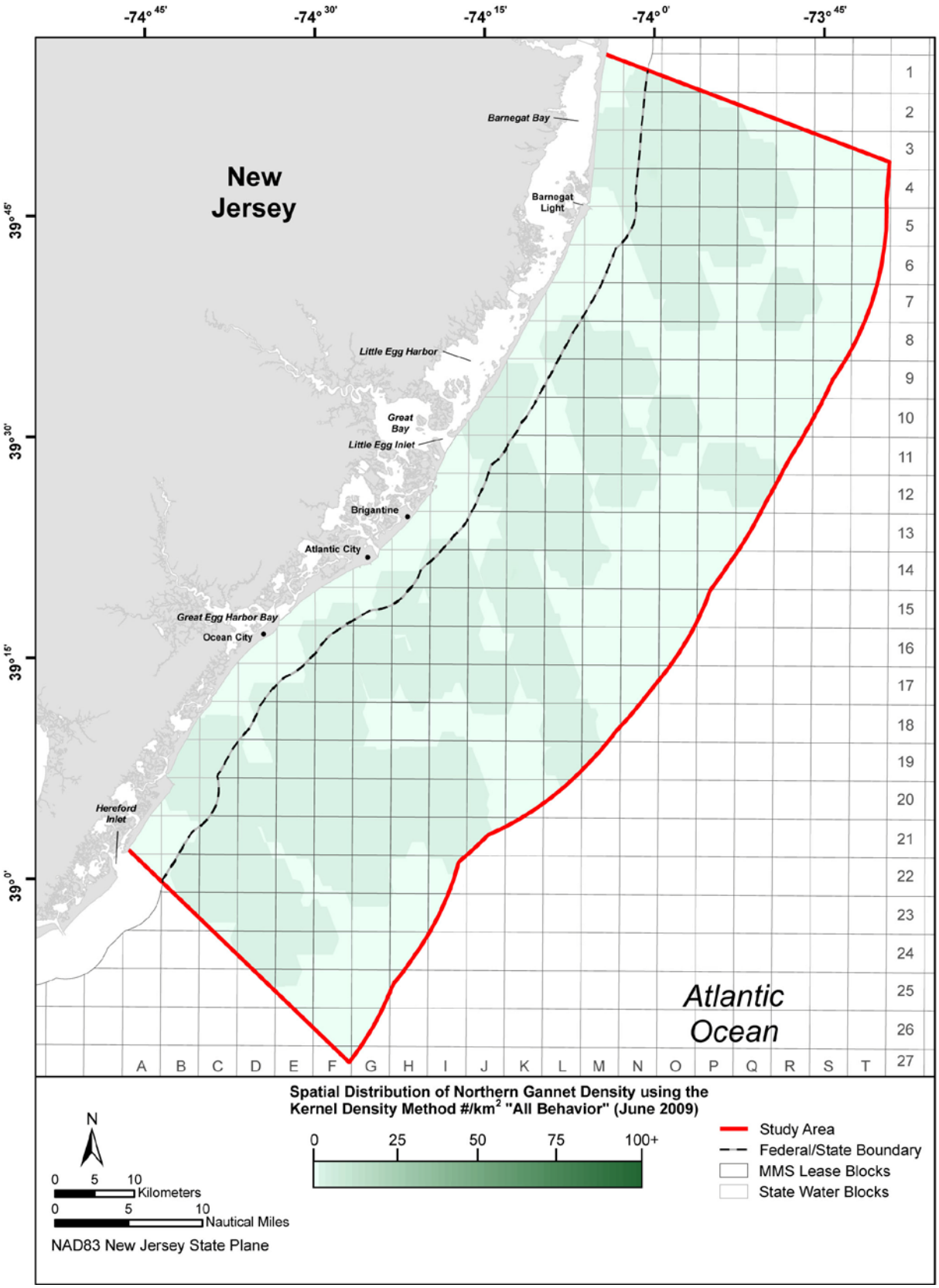

Figure M-217. Spatial distribution of Northern Gannet density (#/km^2) in the Study Area for all behaviors using the kernel density method (June 2009).

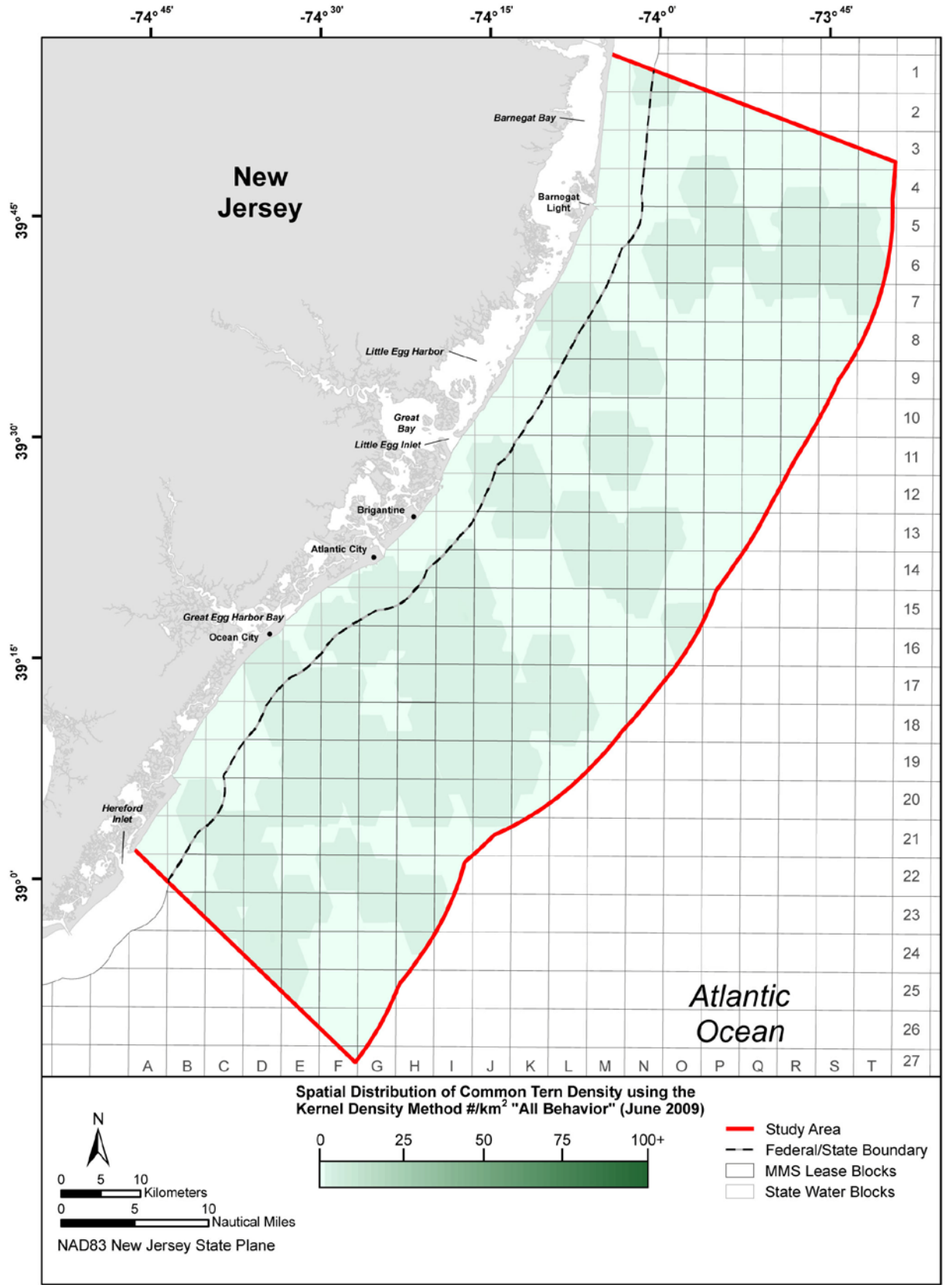

Figure M-218. Spatial distribution of Common Tern density (#/km^2) in the Study Area for all behaviors using the kernel density method (June 2009).

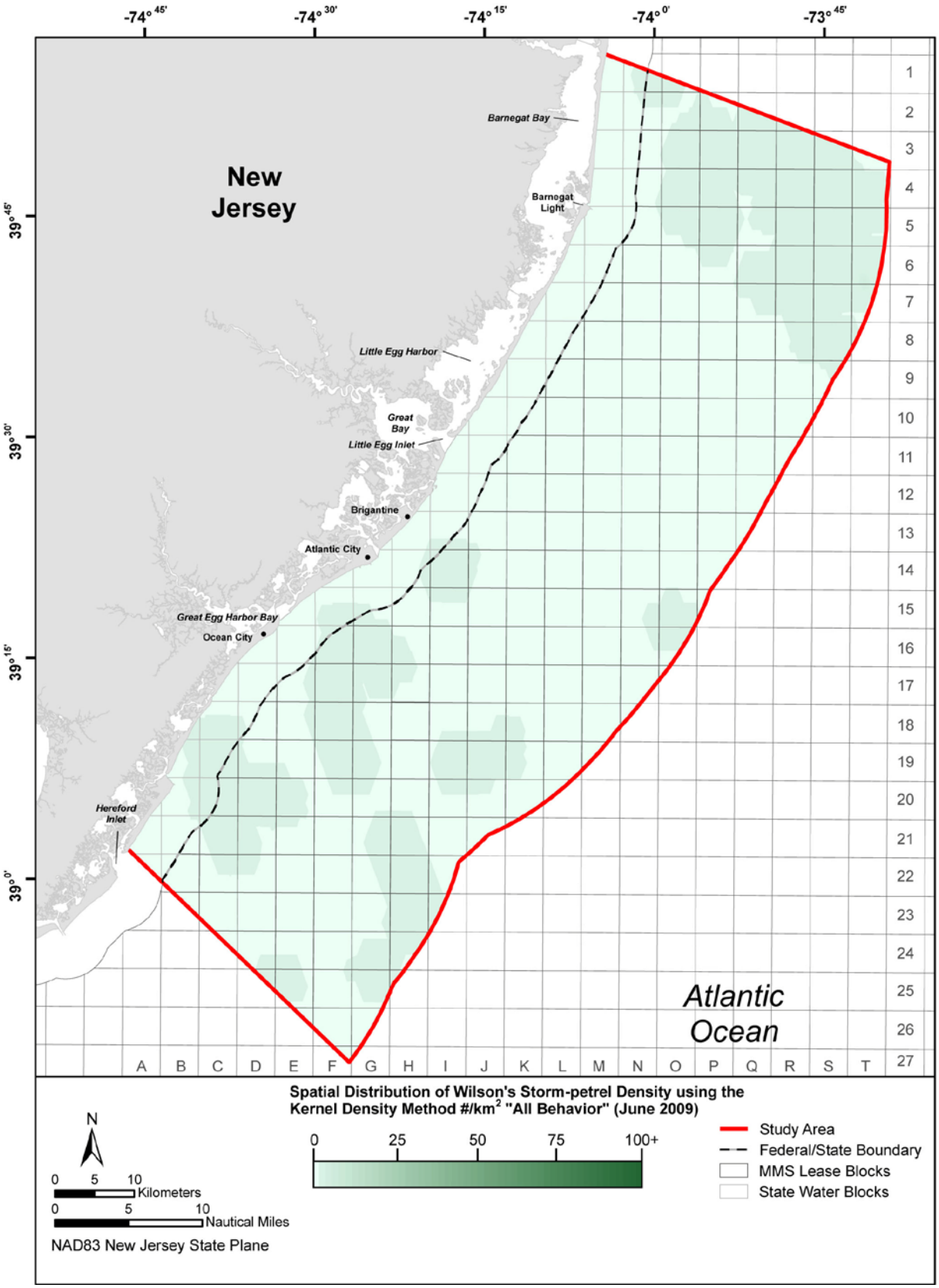

Figure M-219. Spatial distribution of Wilson's Storm-Petrel density (#/km^2) in the Study Area for all behaviors using the kernel density method (June 2009).

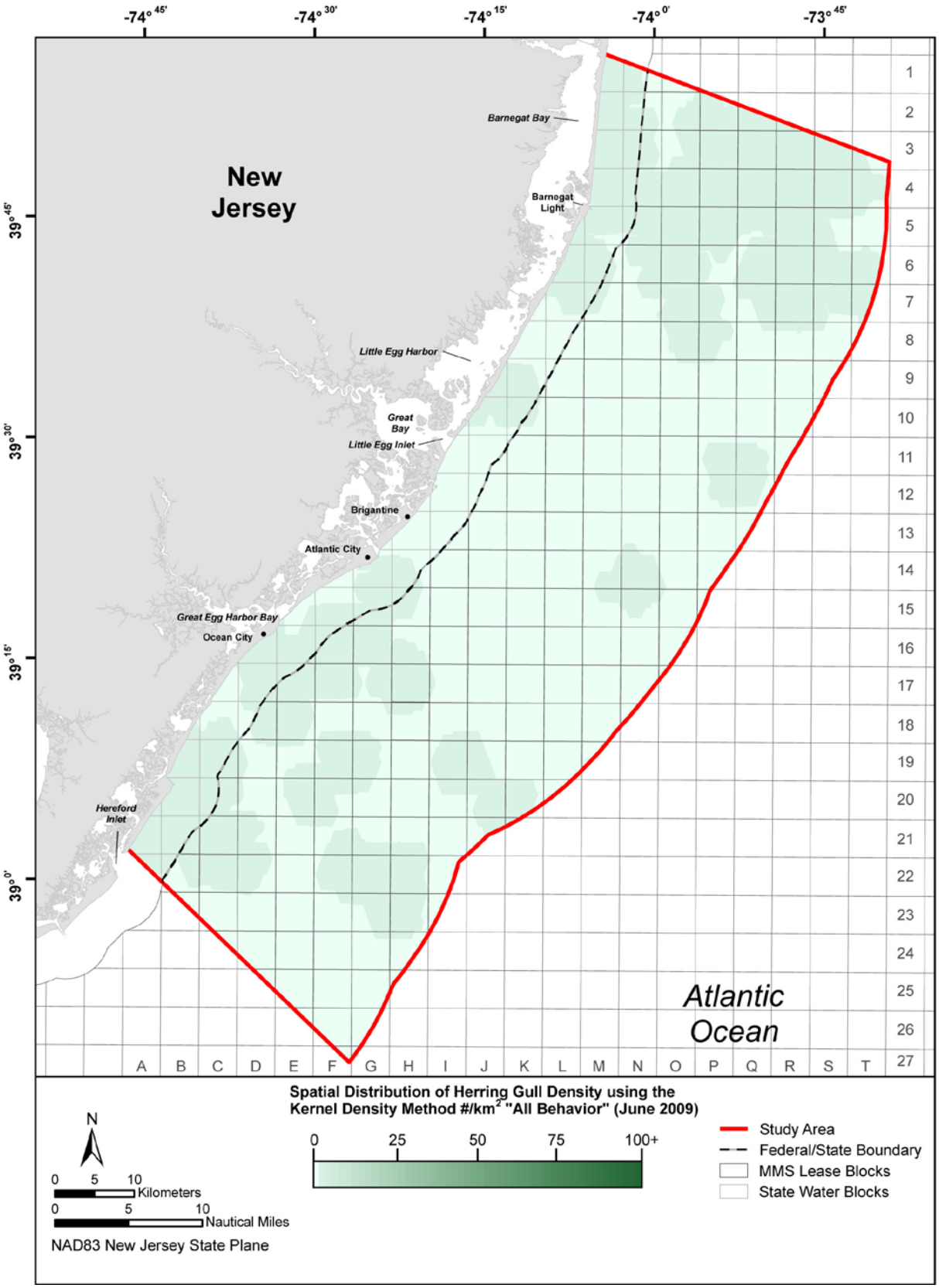

Figure M-220. Spatial distribution of Herring Gull density (#/km^2) in the Study Area for all behaviors using the kernel density method (June 2009).

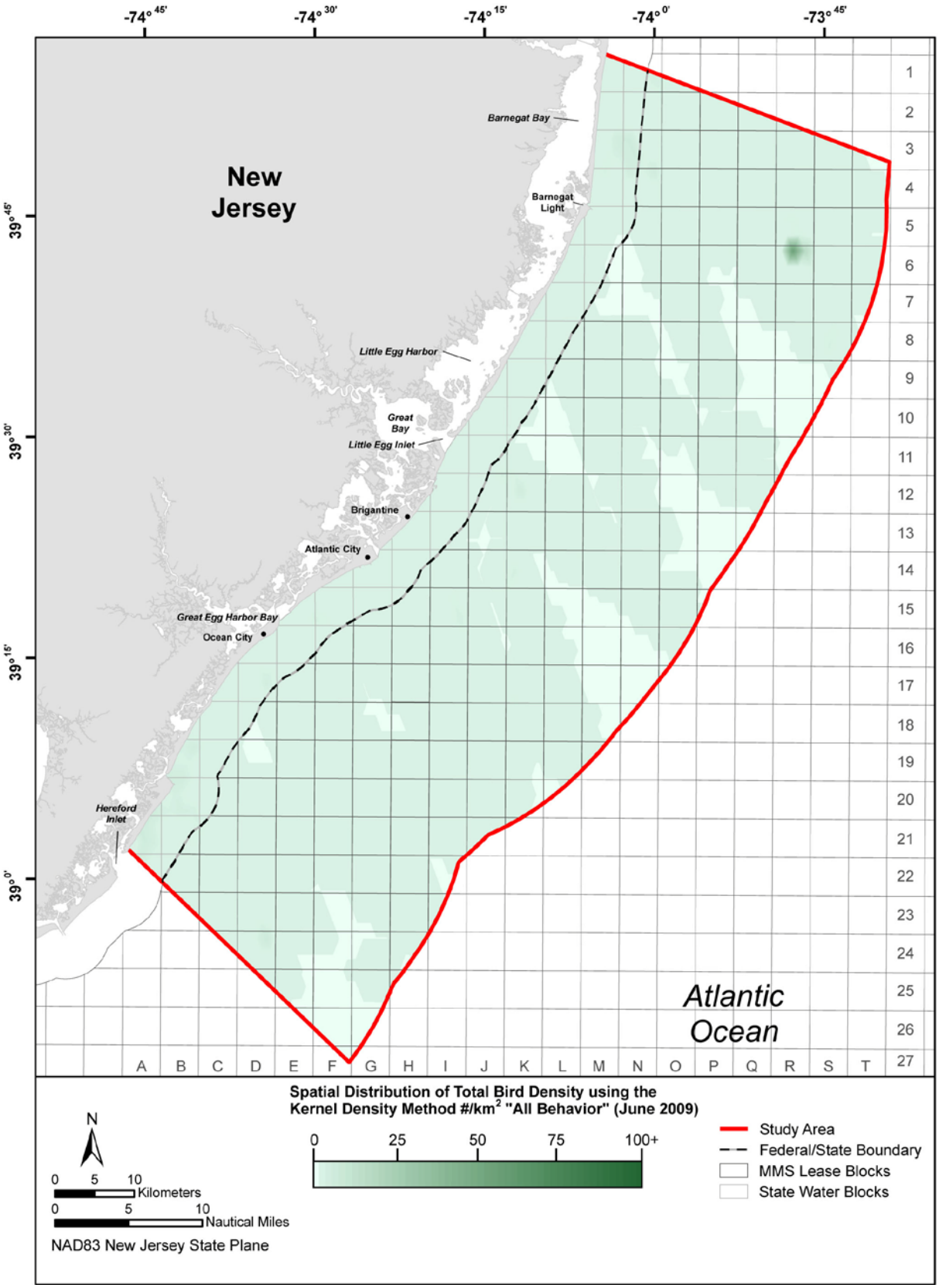

Figure M-221. Spatial distribution of total bird density (#/km^2) in the Study Area for all behaviors using the kernel density method (June 2009).

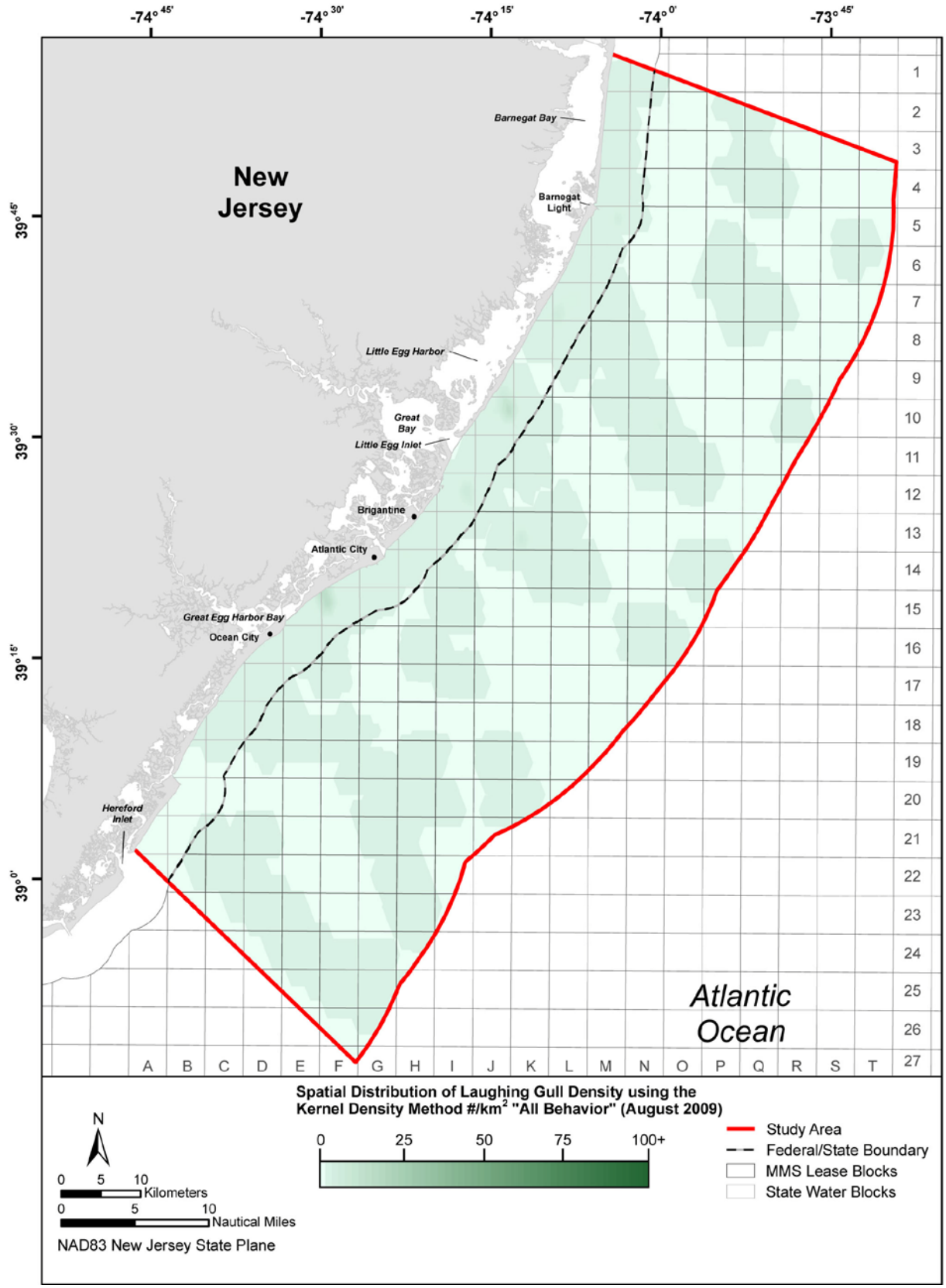

Figure M-222. Spatial distribution of Laughing Gull density (#/km^2) in the Study Area for all behaviors using the kernel density method (August 2009).

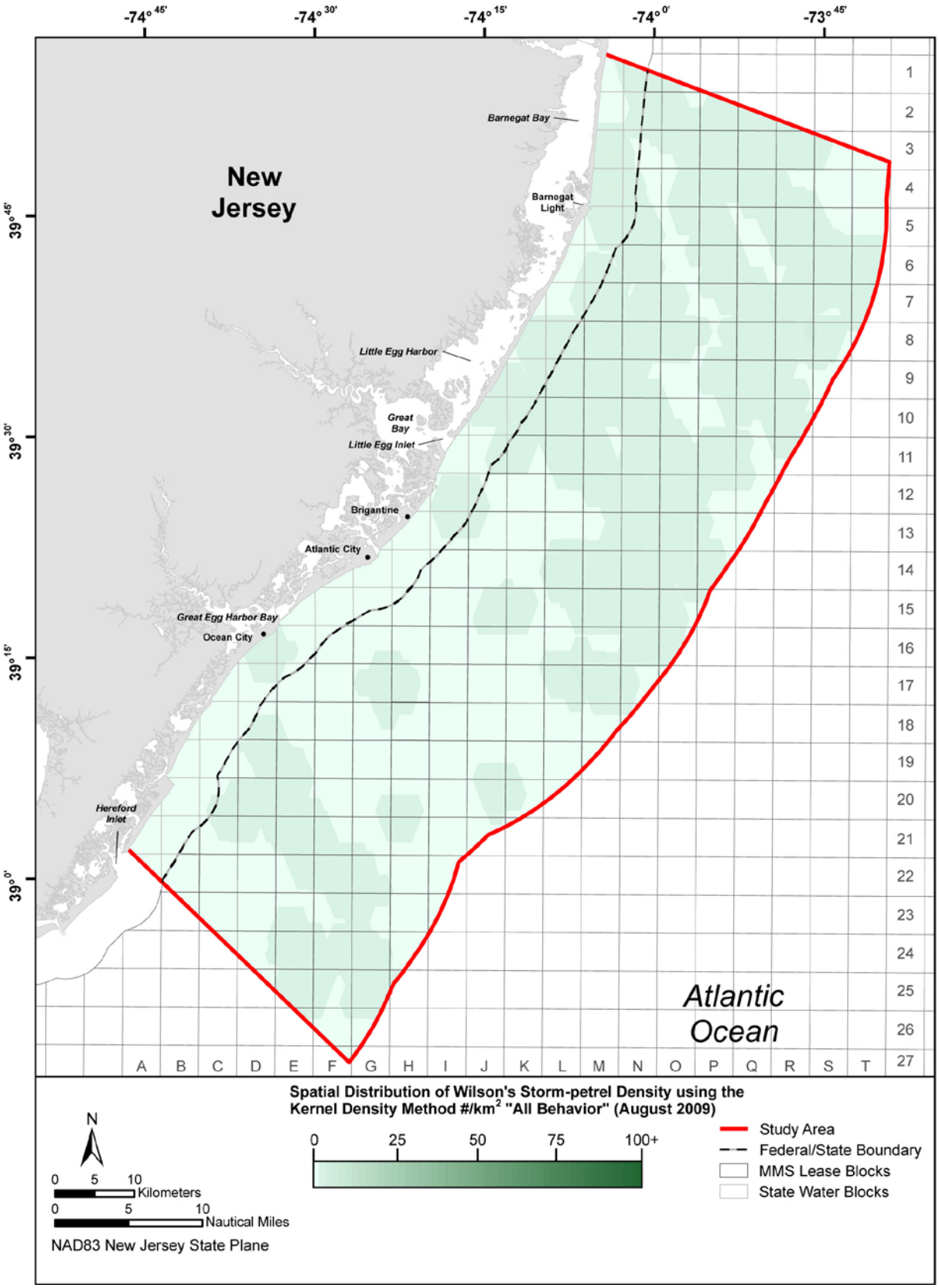

Figure M-223. Spatial distribution of Wilson's Storm-Petrel density (#/km^2) in the Study Area for all behaviors using the kernel density method (August 2009).

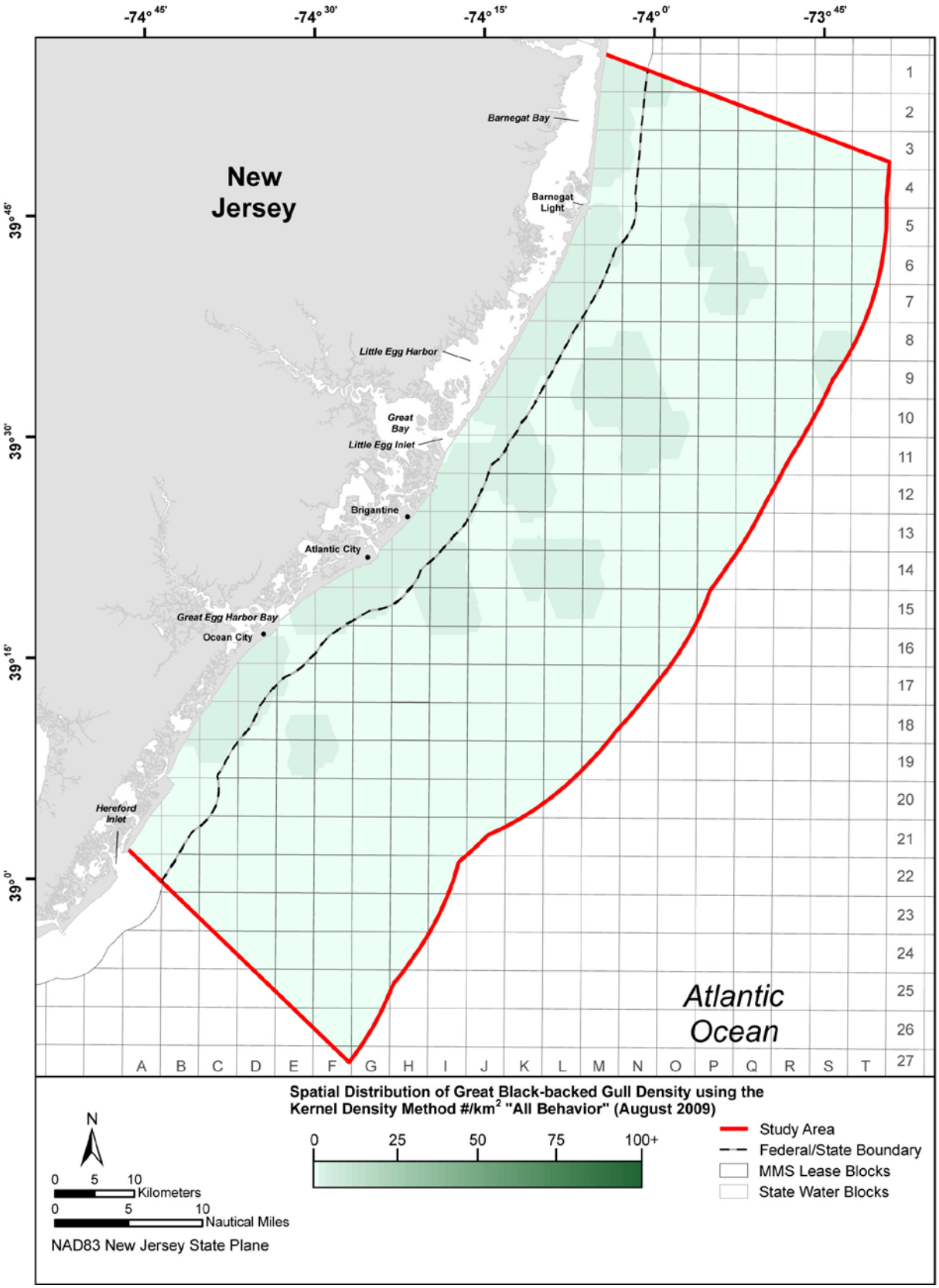

Figure M-224. Spatial distribution of Great Black-backed Gull density (#/km^2) in the Study Area for all behaviors using the kernel density method (August 2009).

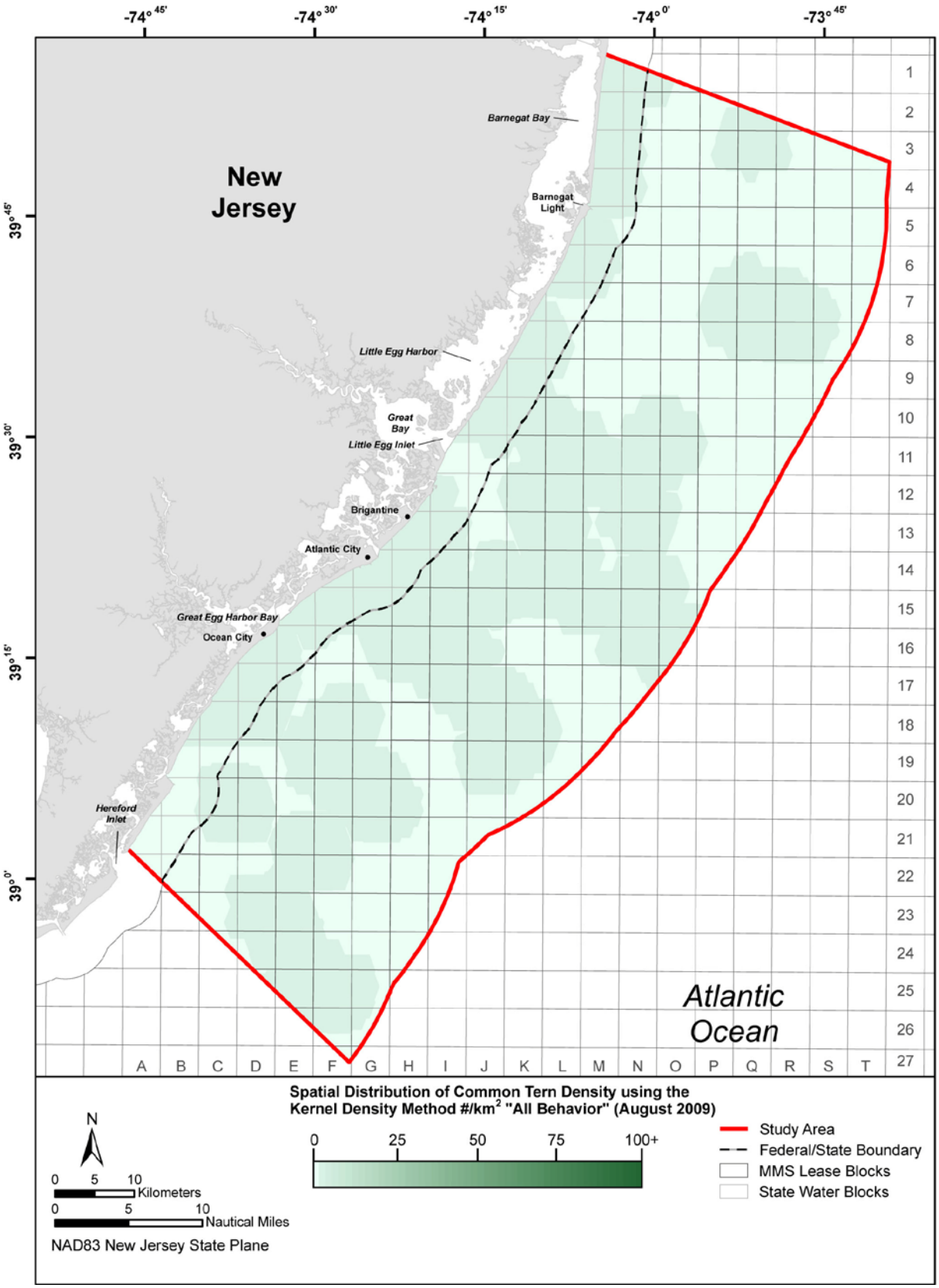

Figure M-225. Spatial distribution of Common Tern density (#/km^2) in the Study Area for all behaviors using the kernel density method (August 2009).

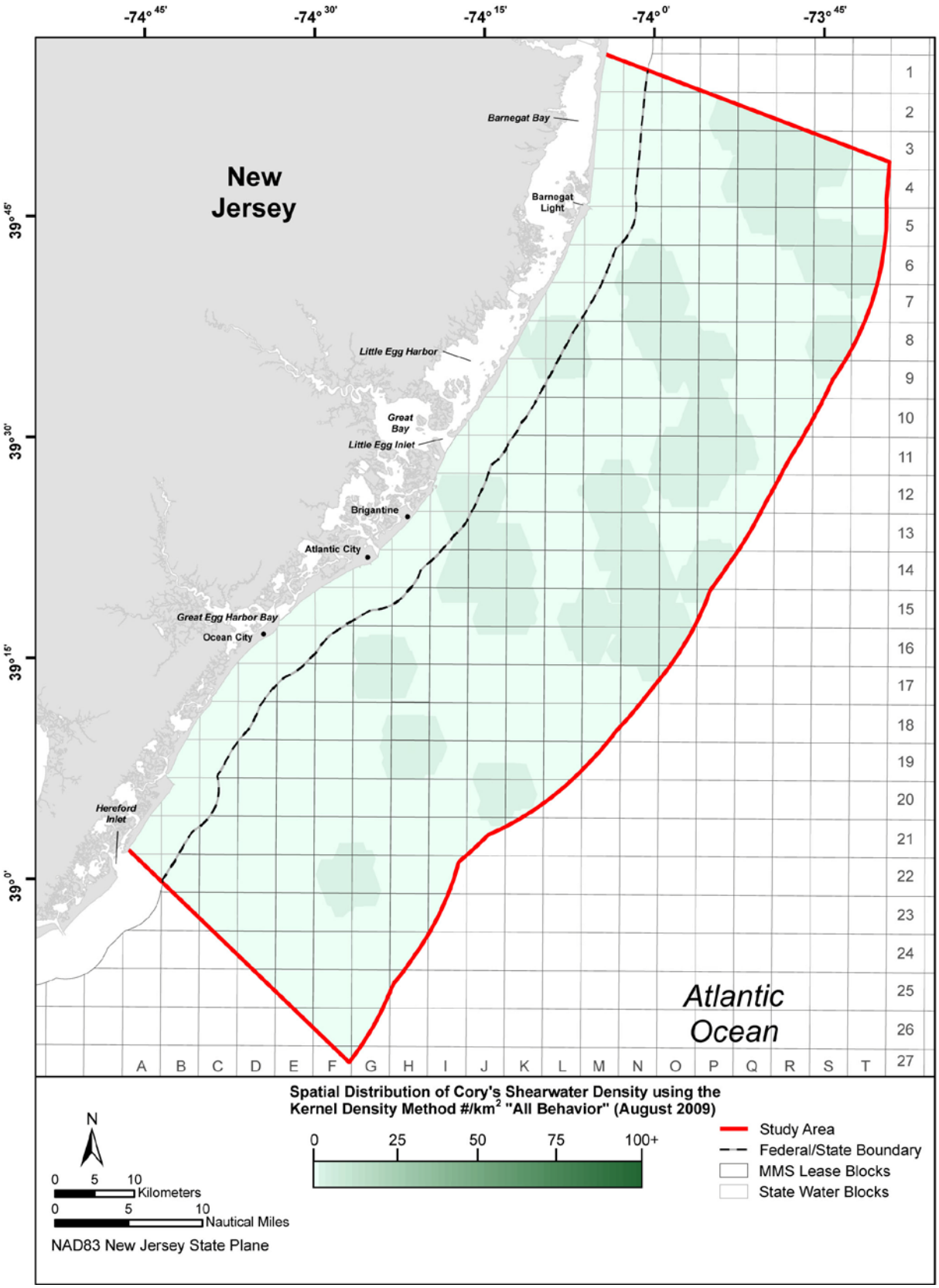

Figure M-226. Spatial distribution of Cory's Shearwater density (#/km^2) in the Study Area for all behaviors using the kernel density method (August 2009).

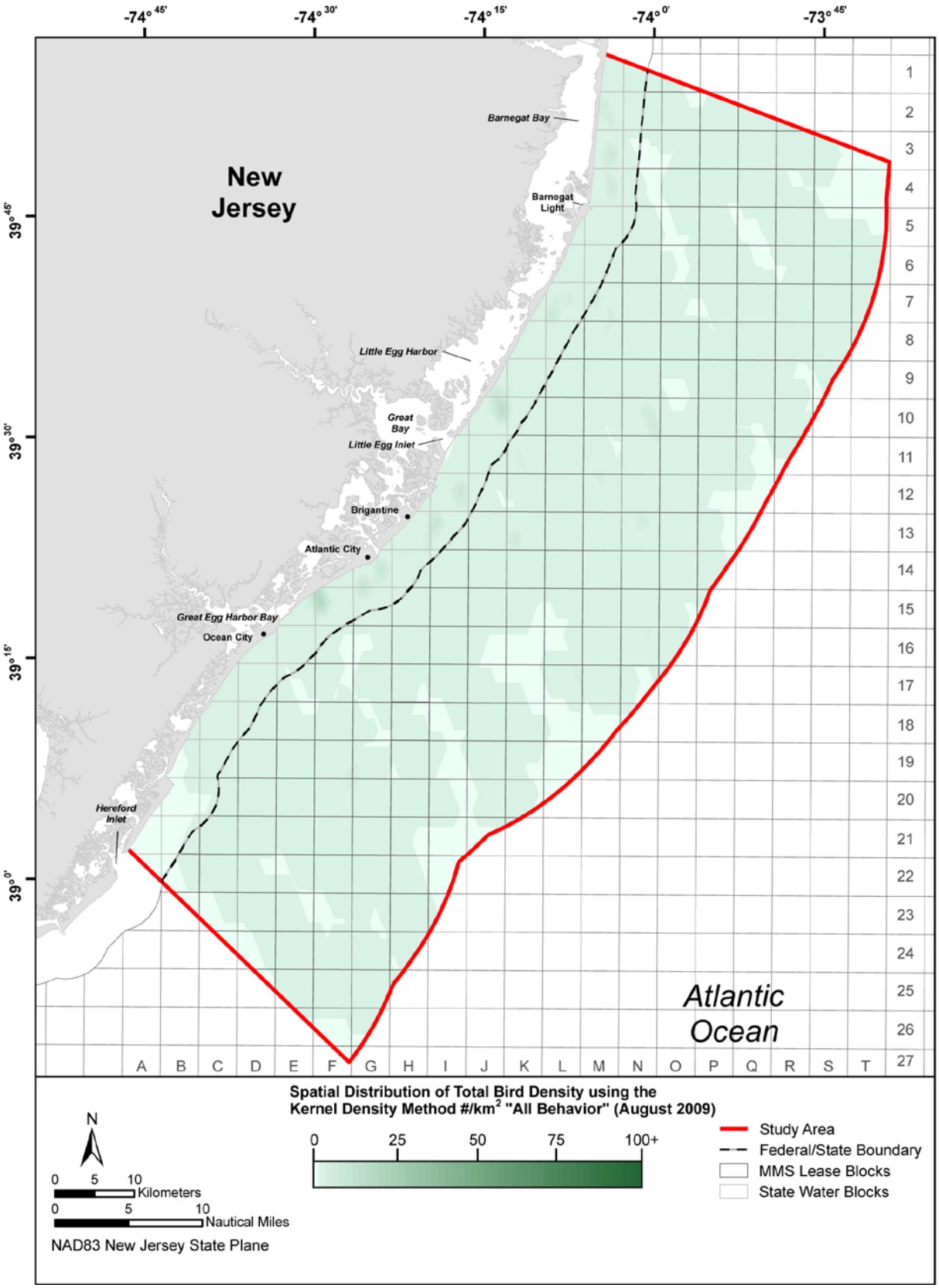

Figure M-227. Spatial distribution of total bird density (#/km^2) in the Study Area for all behaviors using the kernel density method (August 2009).

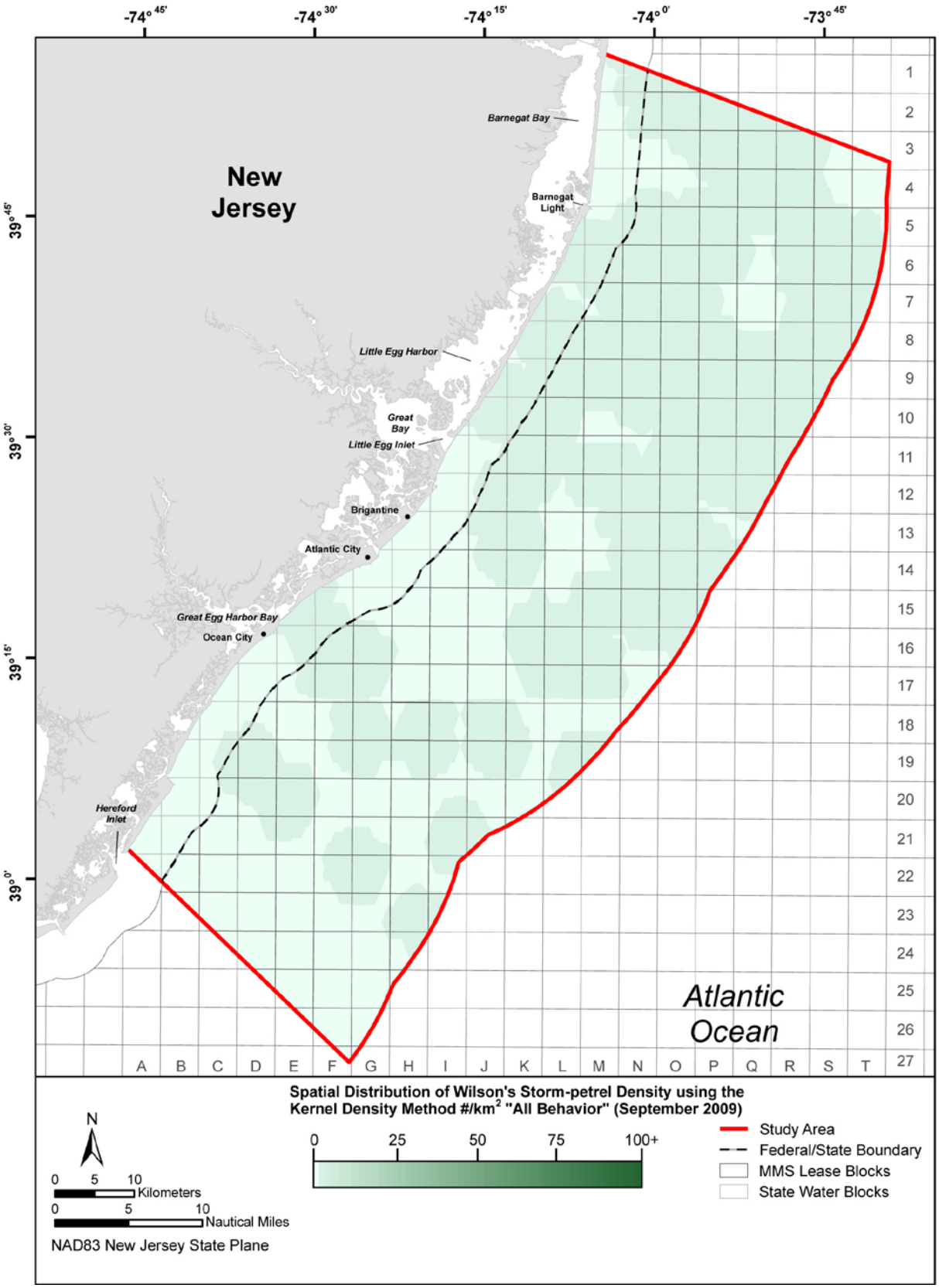

Figure M-228. Spatial distribution of Wilson's Storm-Petrel density (#/km^2) in the Study Area for all behaviors using the kernel density method (September 2009).

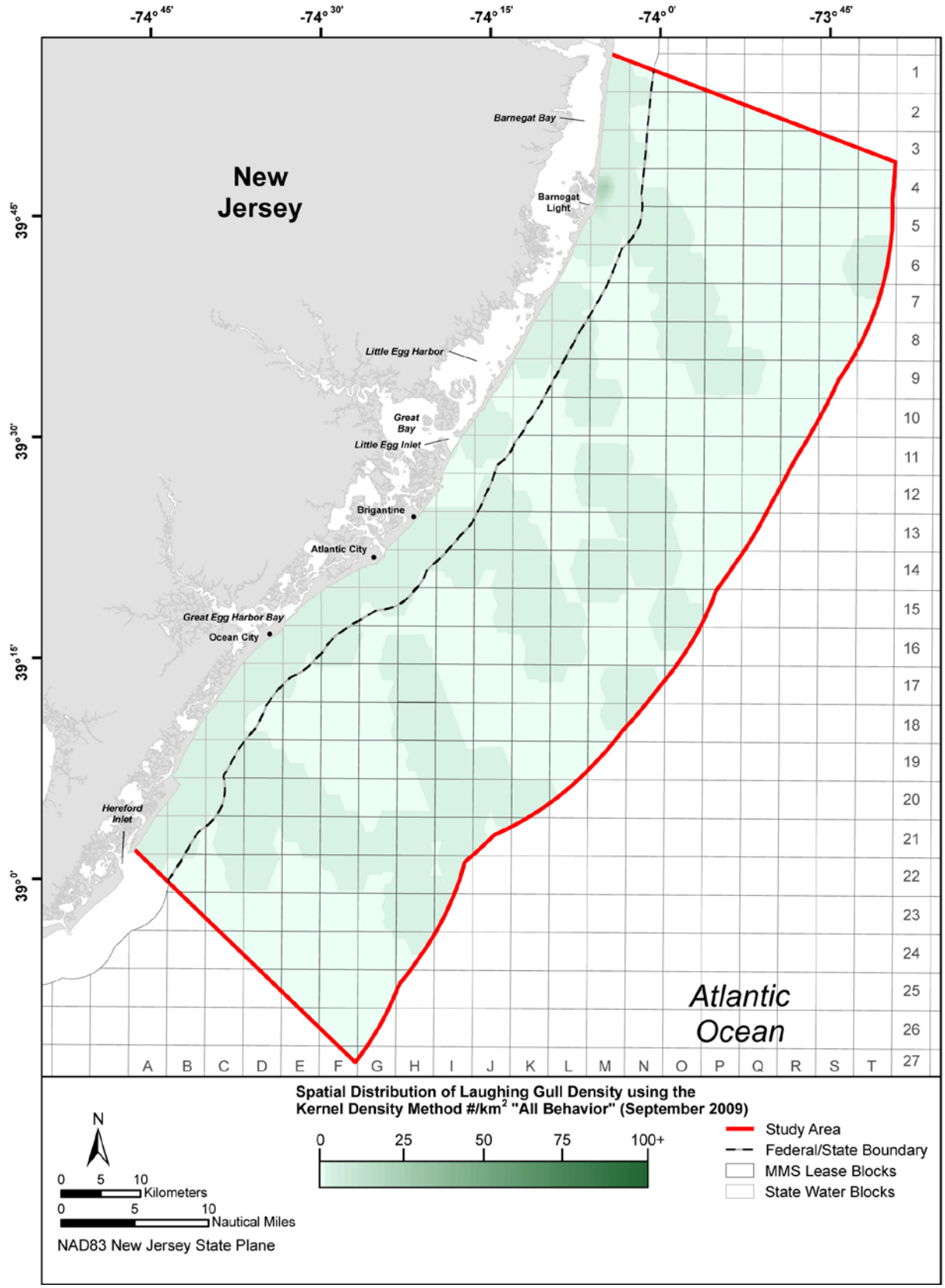

Figure M-229. Spatial distribution of Laughing Gull density (#/km^2) in the Study Area for all behaviors using the kernel density method (September 2009).

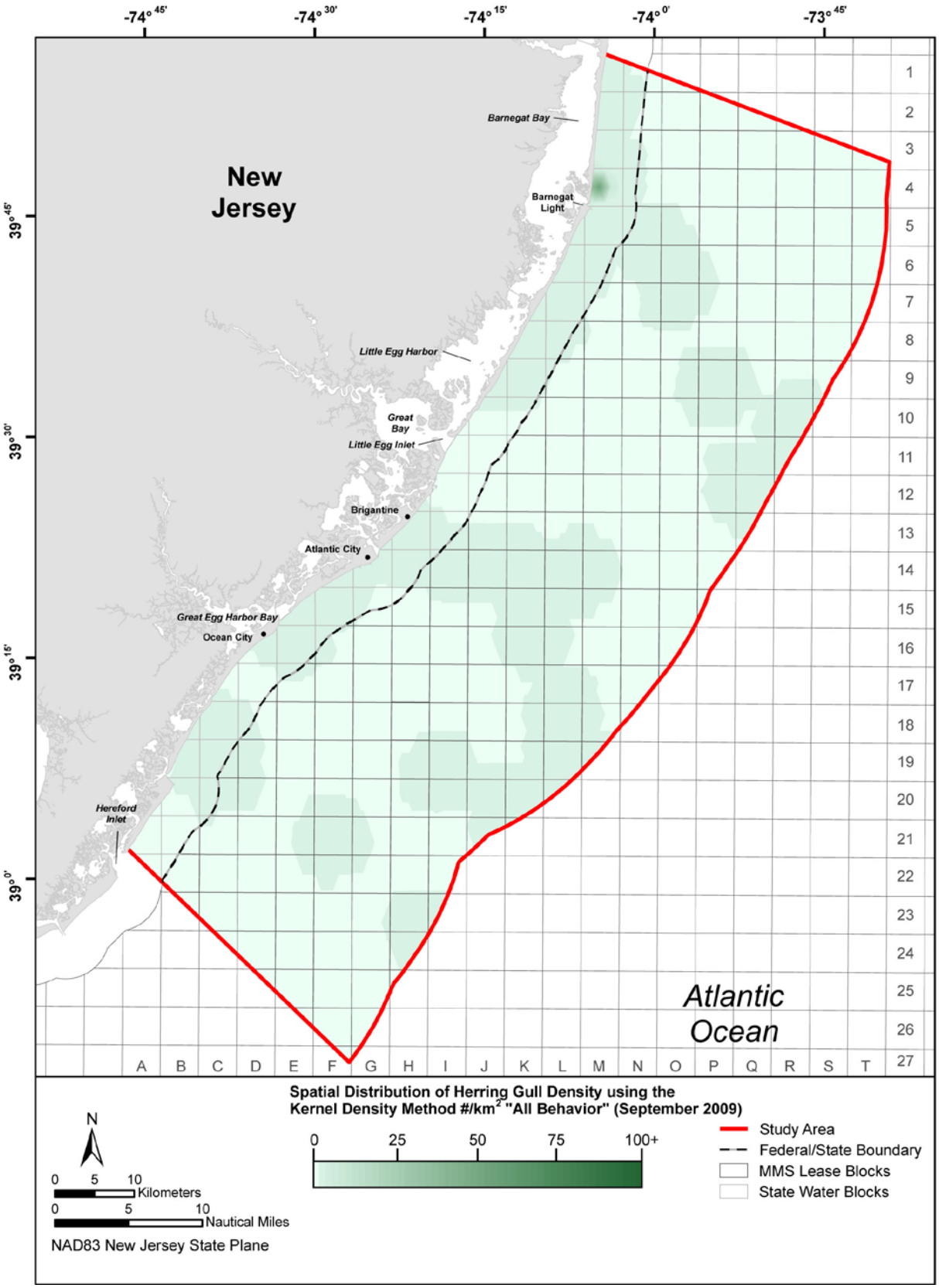

Figure M-230. Spatial distribution of Herring Gull density (#/km^2) in the Study Area for all behaviors using the kernel density method (September 2009).

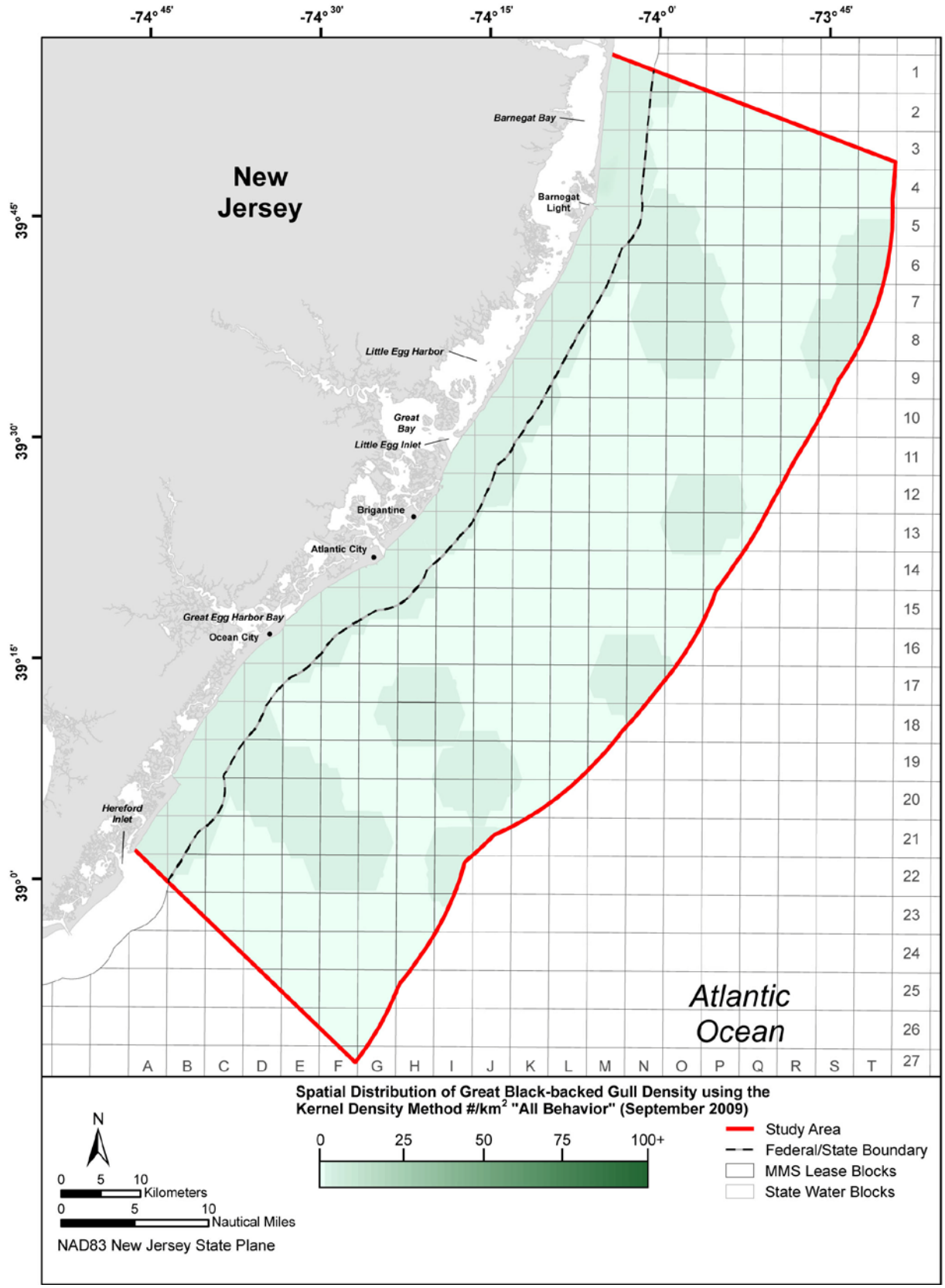

Figure M-231. Spatial distribution of Great Black-backed Gull density (#/km^2) in the Study Area for all behaviors using the kernel density method (September 2009).

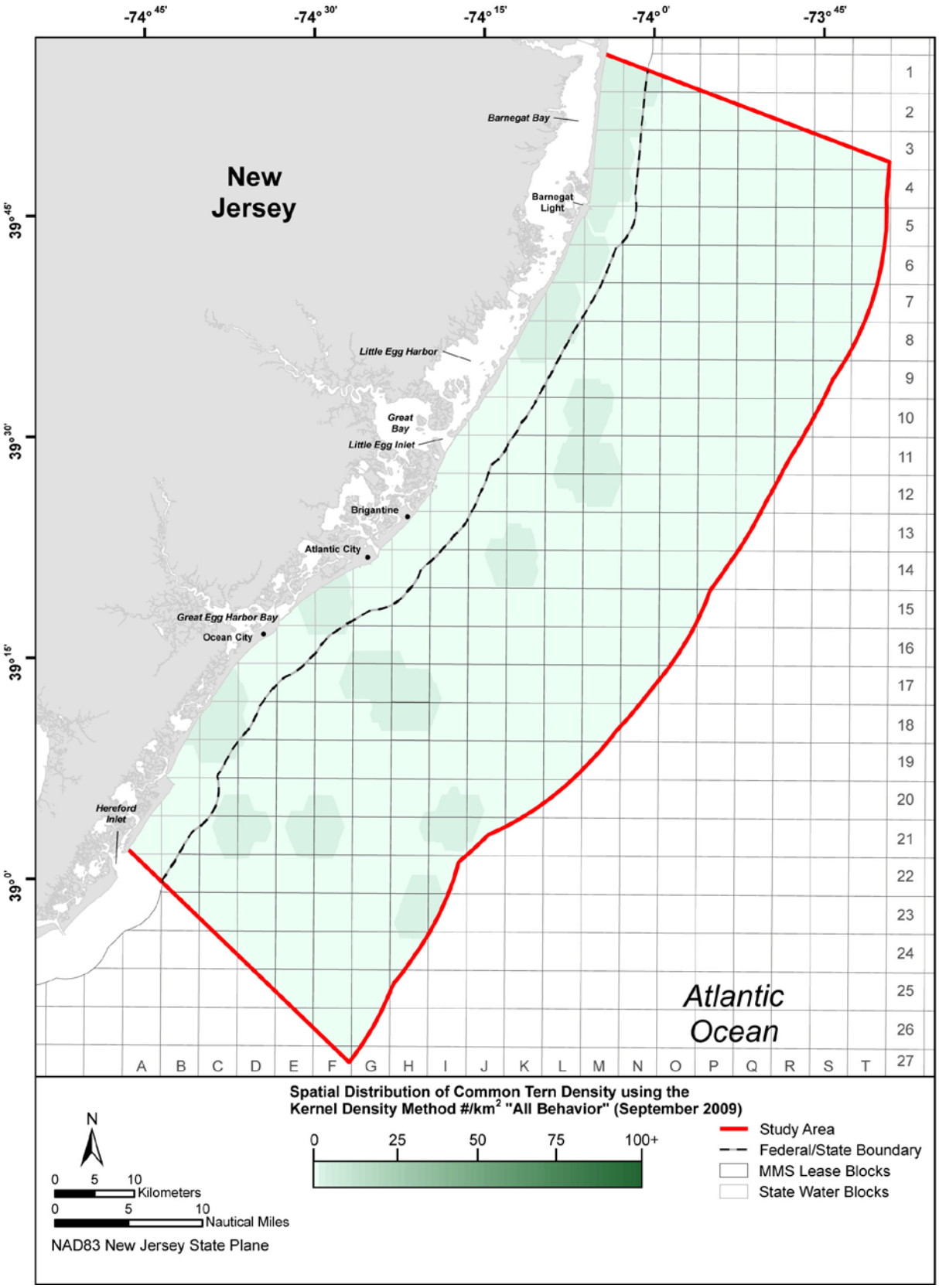

Figure M-232. Spatial distribution of Common Tern density (#/km^2) in the Study Area for all behaviors using the kernel density method (September 2009).

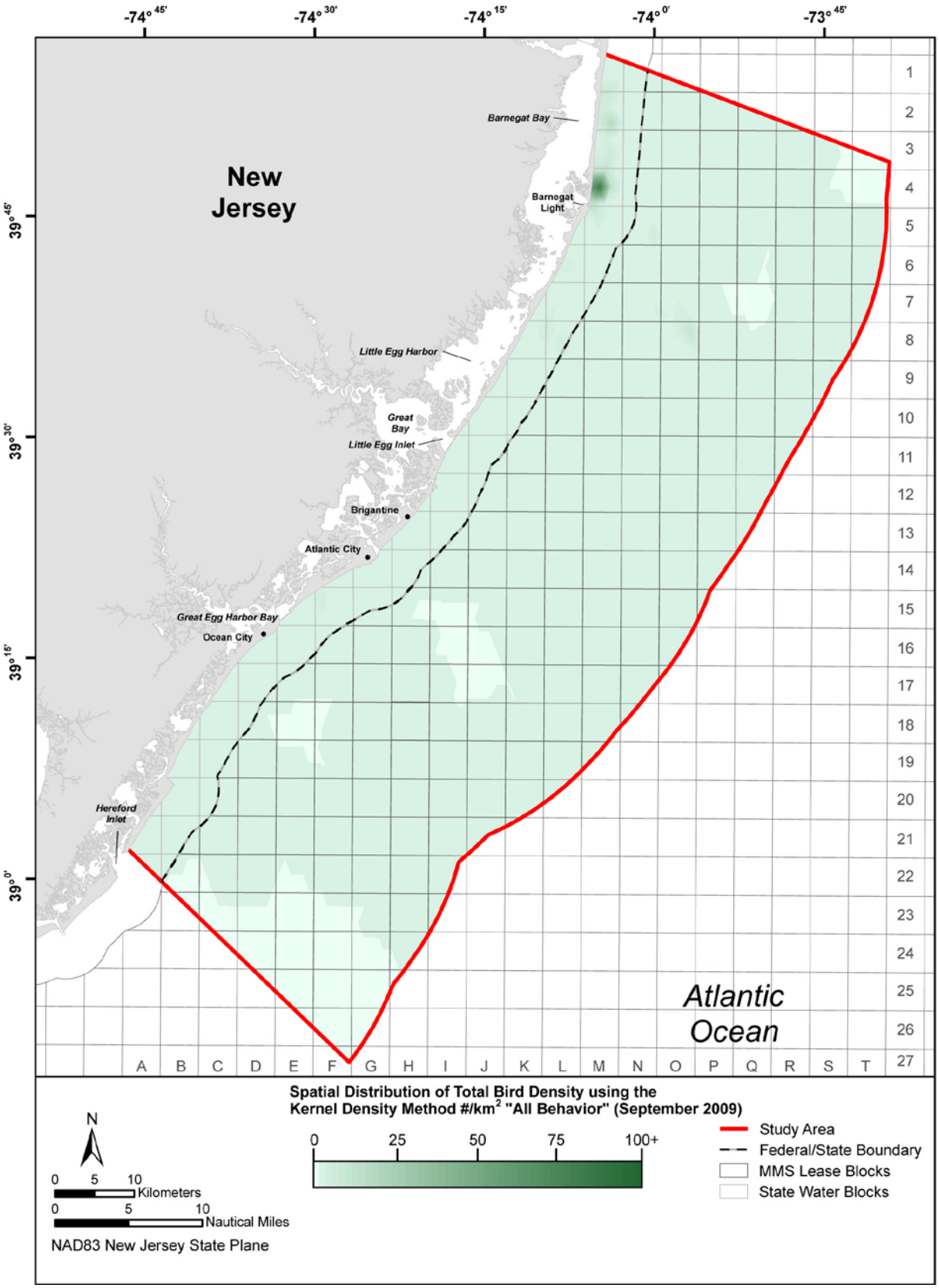

Figure M-233. Spatial distribution of total bird density (#/km^2) in the Study Area for all behaviors using the kernel density method (September 2009).

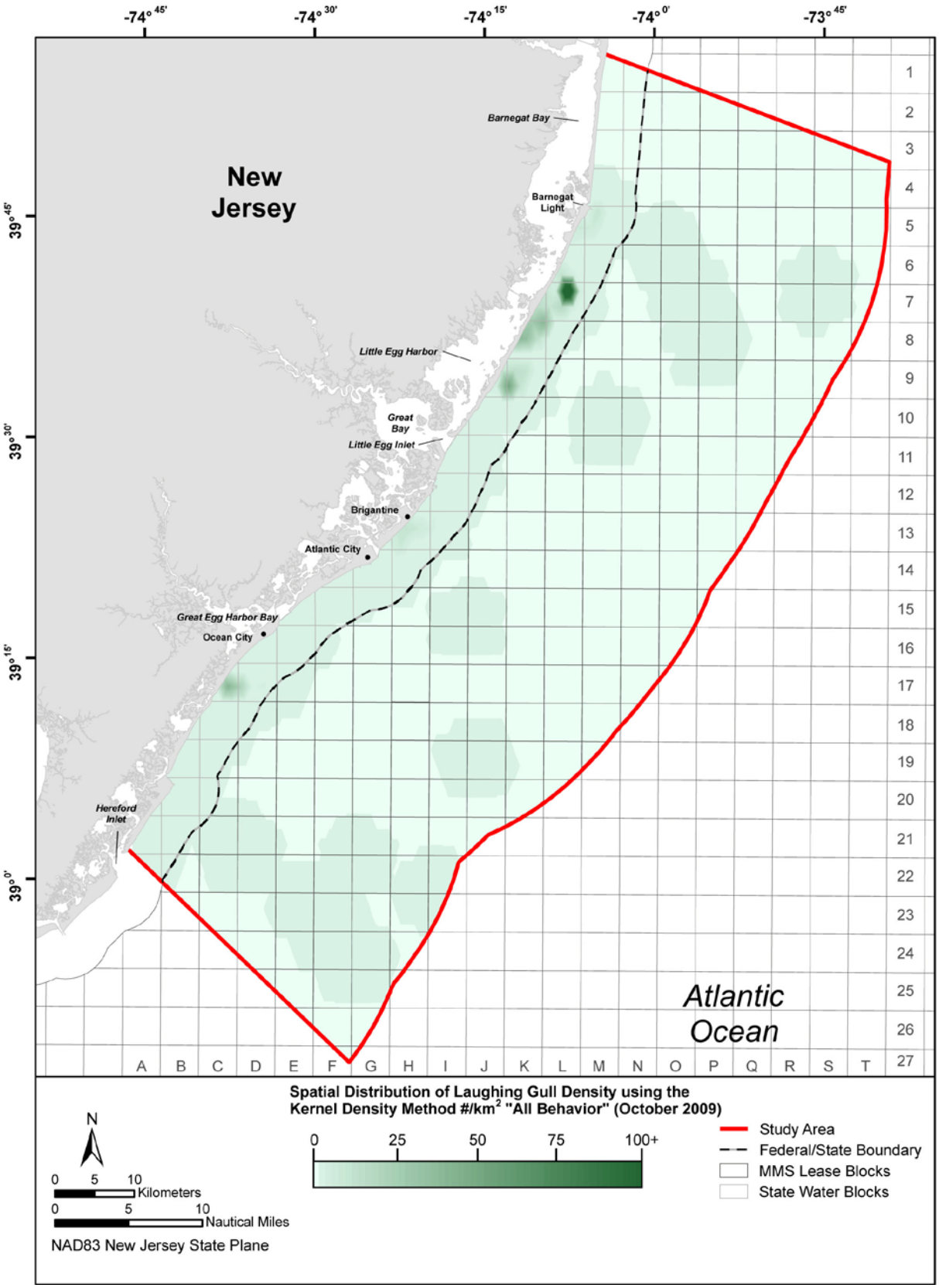

Figure M-234. Spatial distribution of Laughing Gull density (#/km^2) in the Study Area for all behaviors using the kernel density method (October 2009).

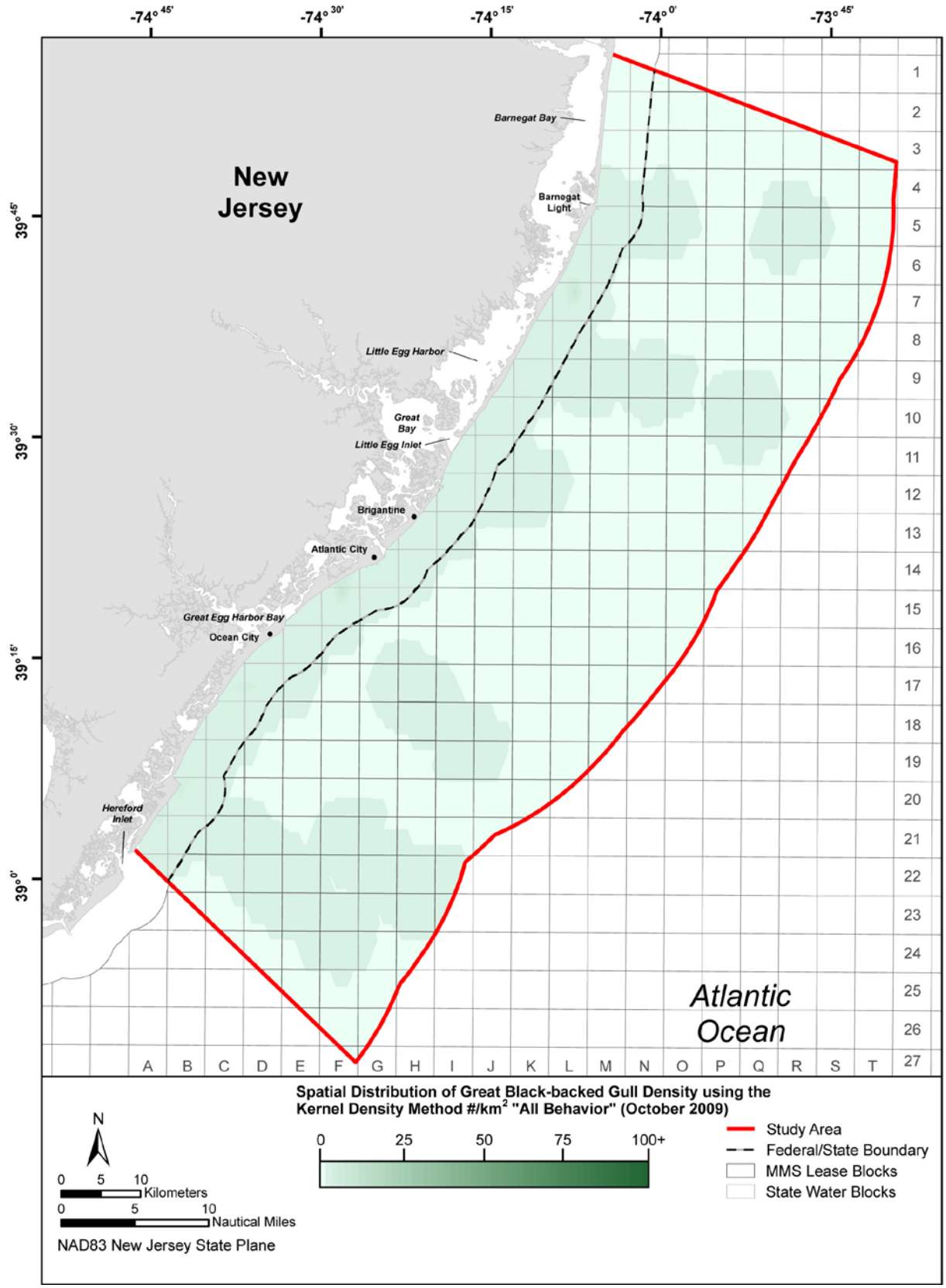

Figure M-235. Spatial distribution of Great Black-backed Gull density (#/km^2) in the Study Area for all behaviors using the kernel density method (October 2009).

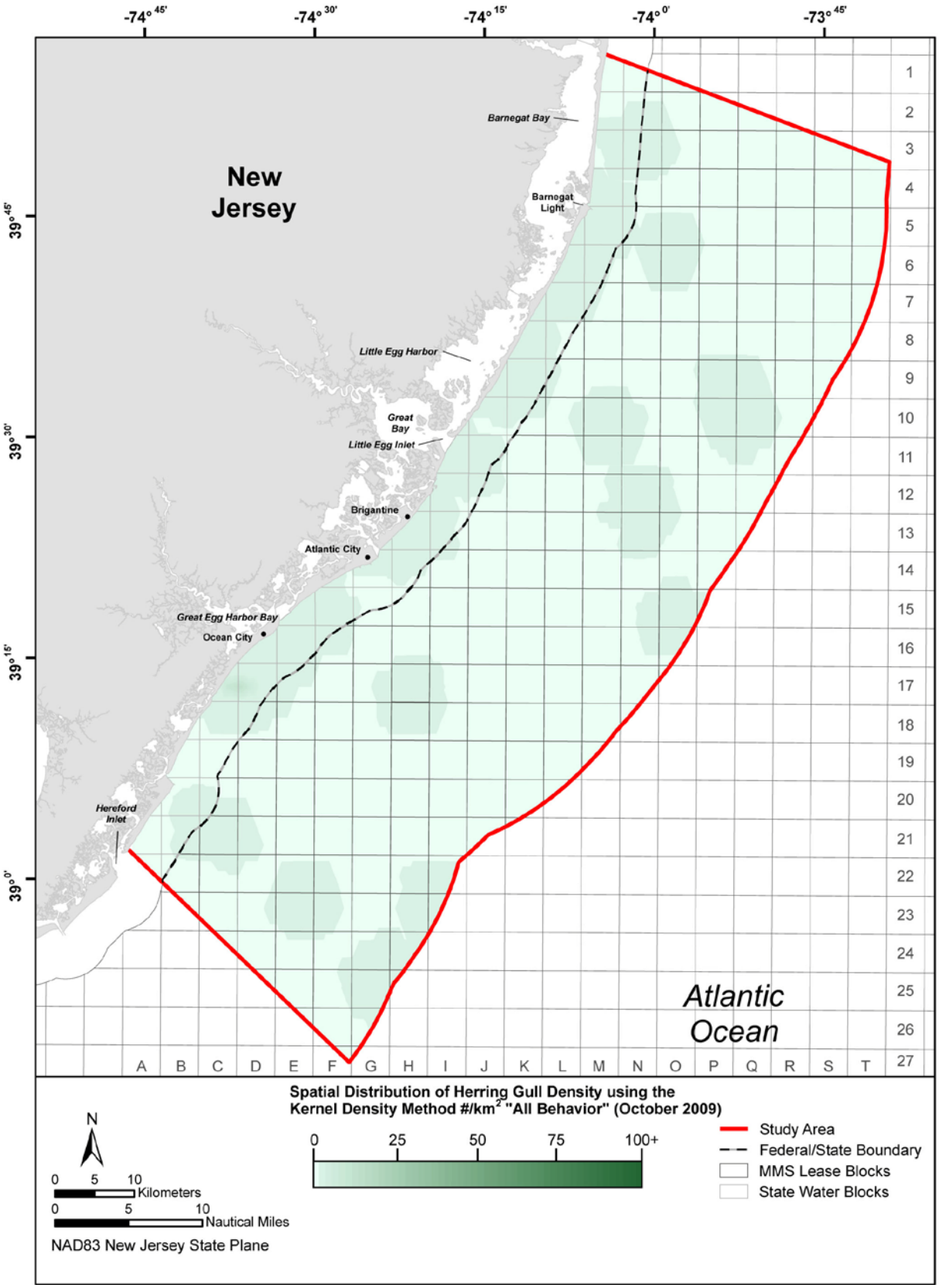

Figure M-236. Spatial distribution of Herring Gull density (#/km^2) in the Study Area for all behaviors using the kernel density method (October 2009).

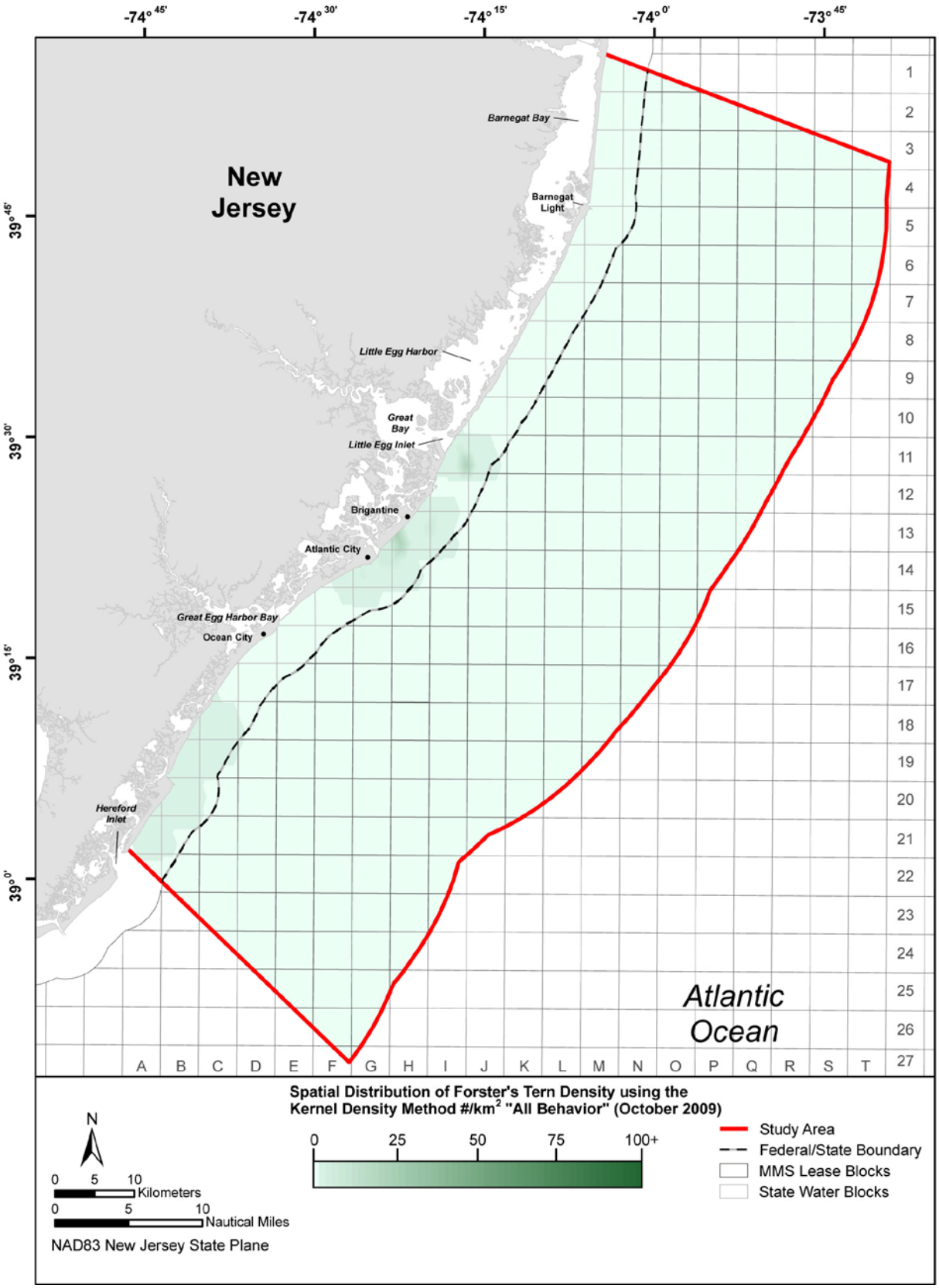

Figure M-237. Spatial distribution of Forster's Tern density (#/km^2) in the Study Area for all behaviors using the kernel density method (October 2009).

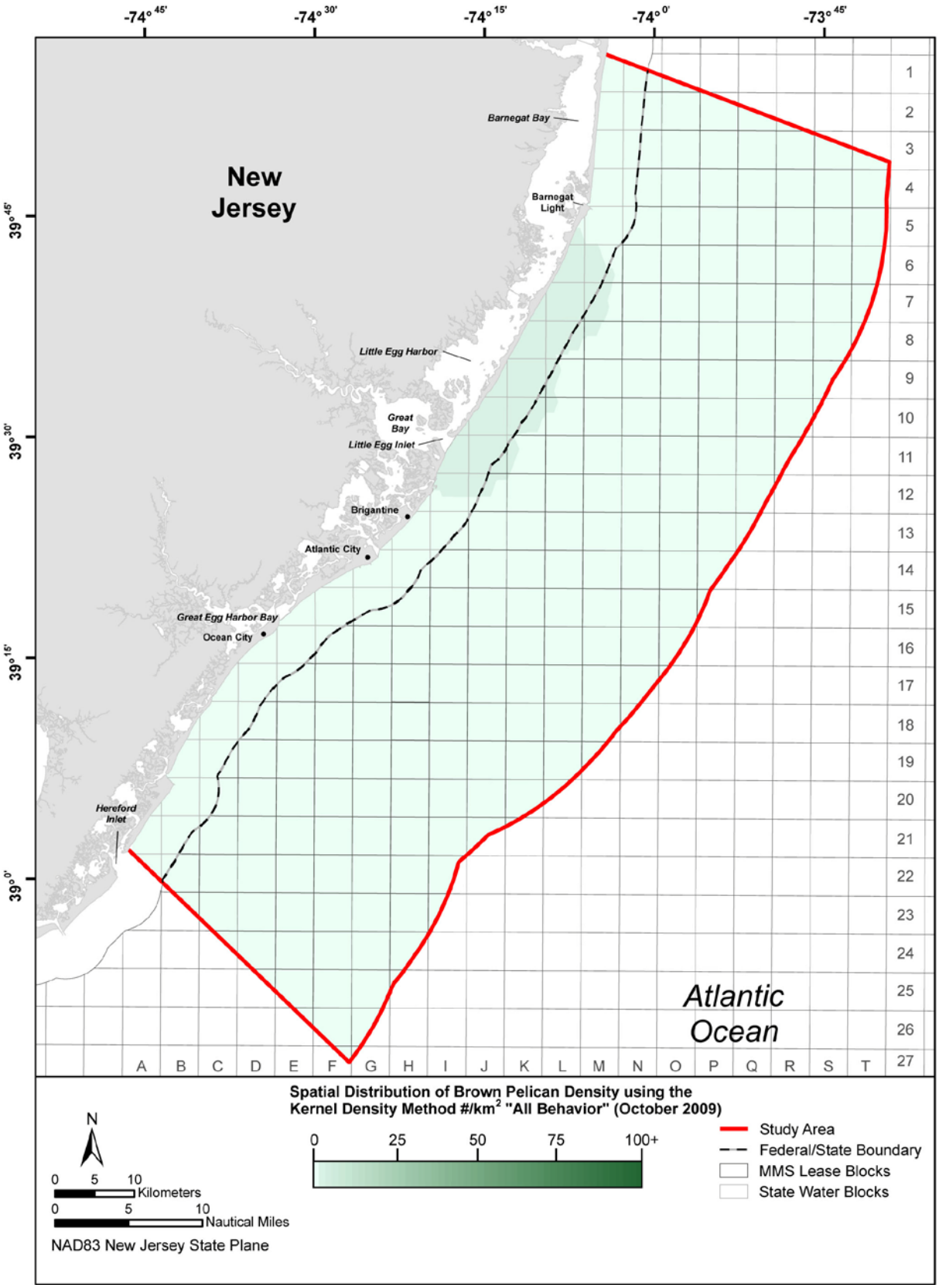

Figure M-238. Spatial distribution of Brown Pelican density (#/km^2) in the Study Area for all behaviors using the kernel density method (October 2009).

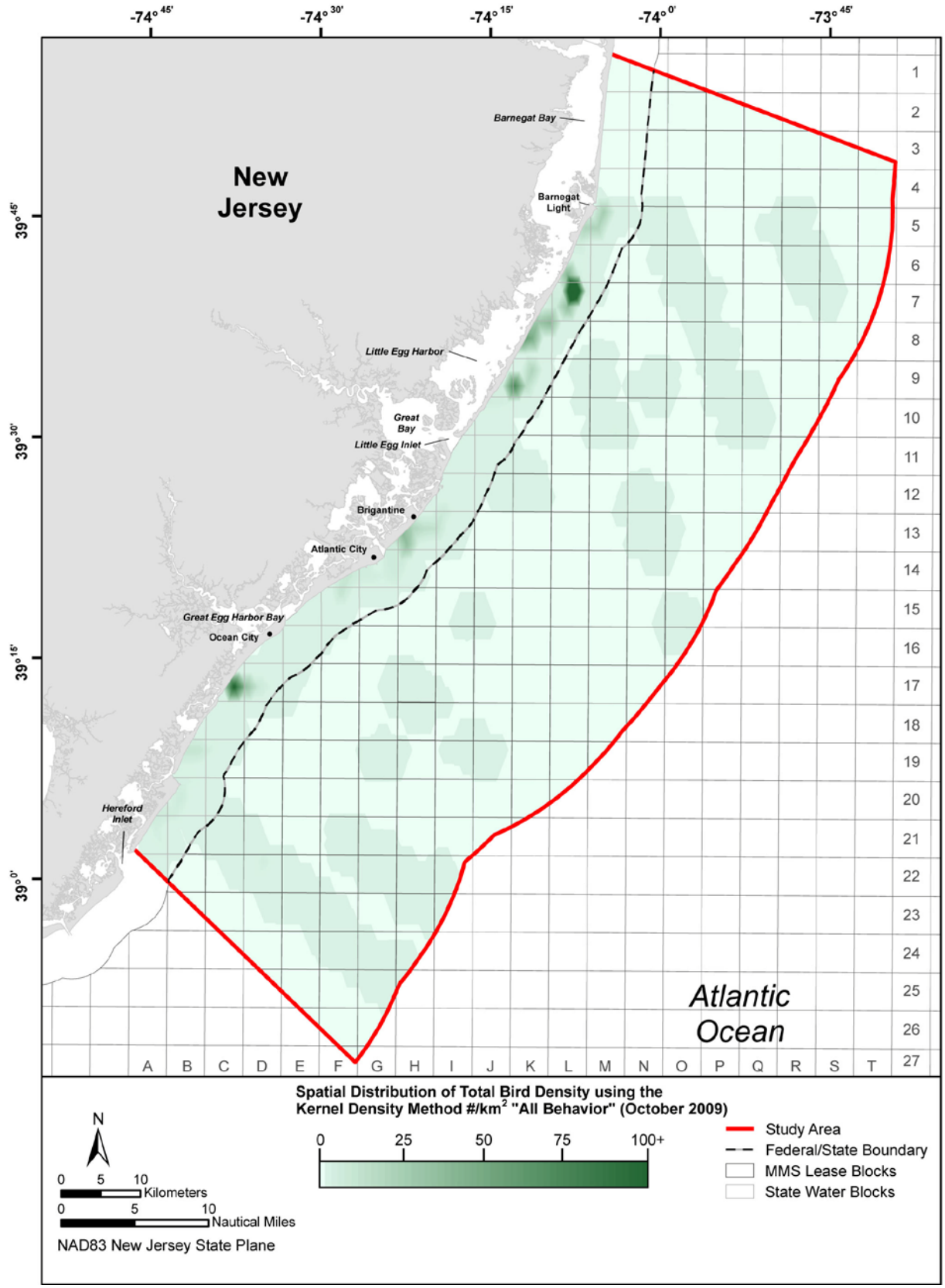

Figure M-239. Spatial distribution of total bird density (#/km^2) in the Study Area for all behaviors using the kernel density method (October 2009).

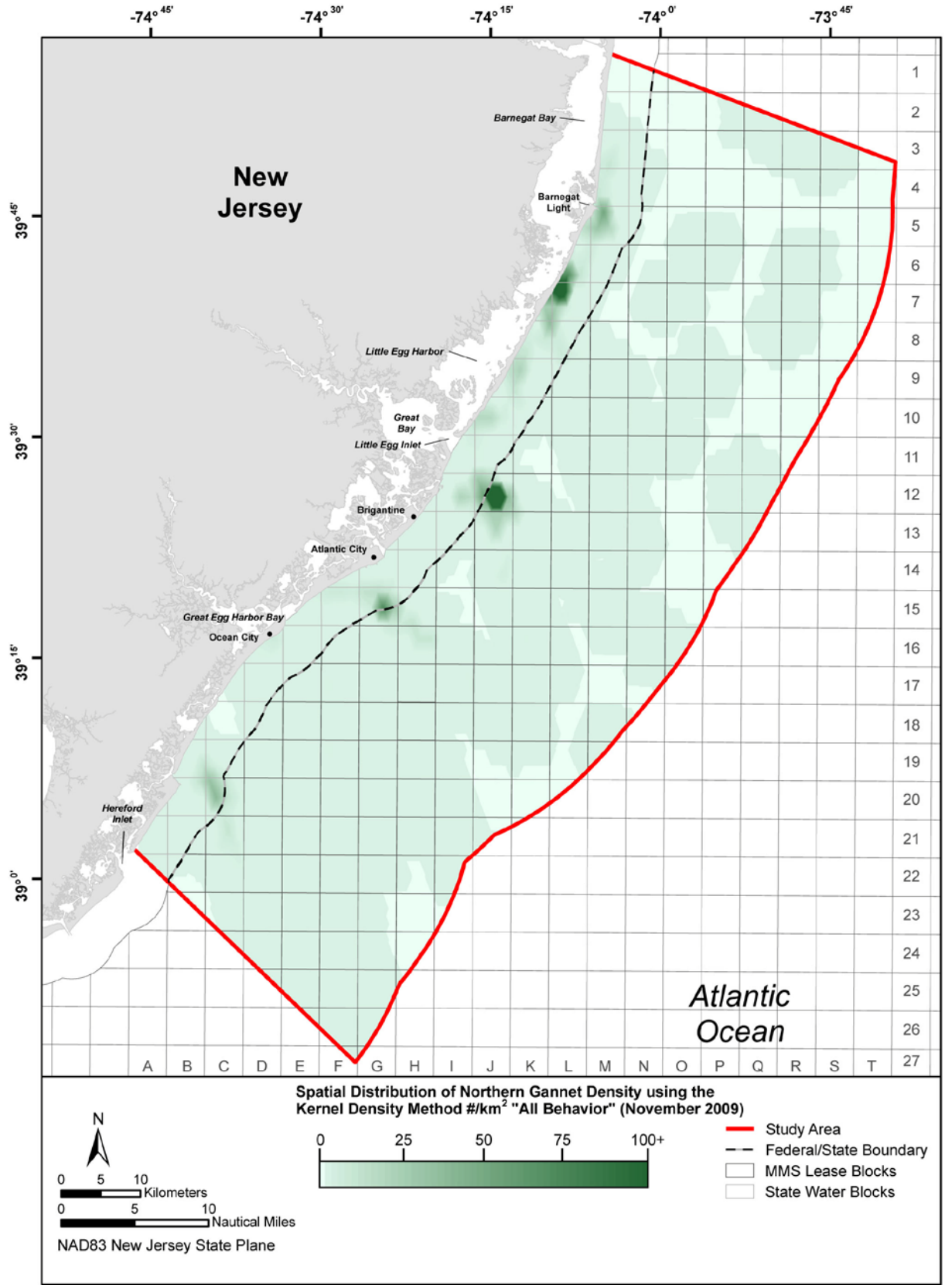

Figure M-240. Spatial distribution of Northern Gannet density (#/km^2) in the Study Area for all behaviors using the kernel density method (November 2009).

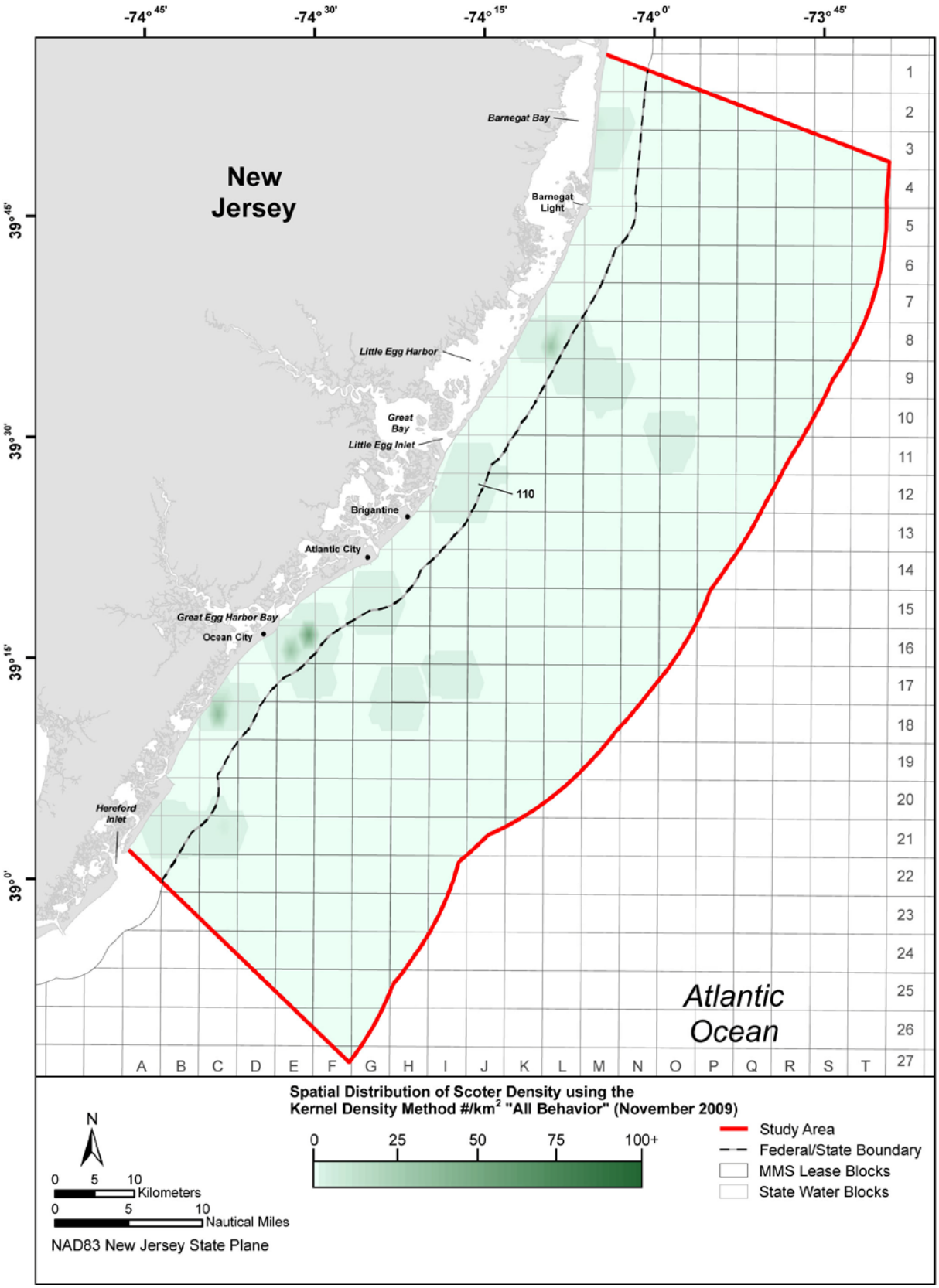

Figure M-241. Spatial distribution of scoter density (#/km^2) in the Study Area for all behaviors using the kernel density method (November 2009).

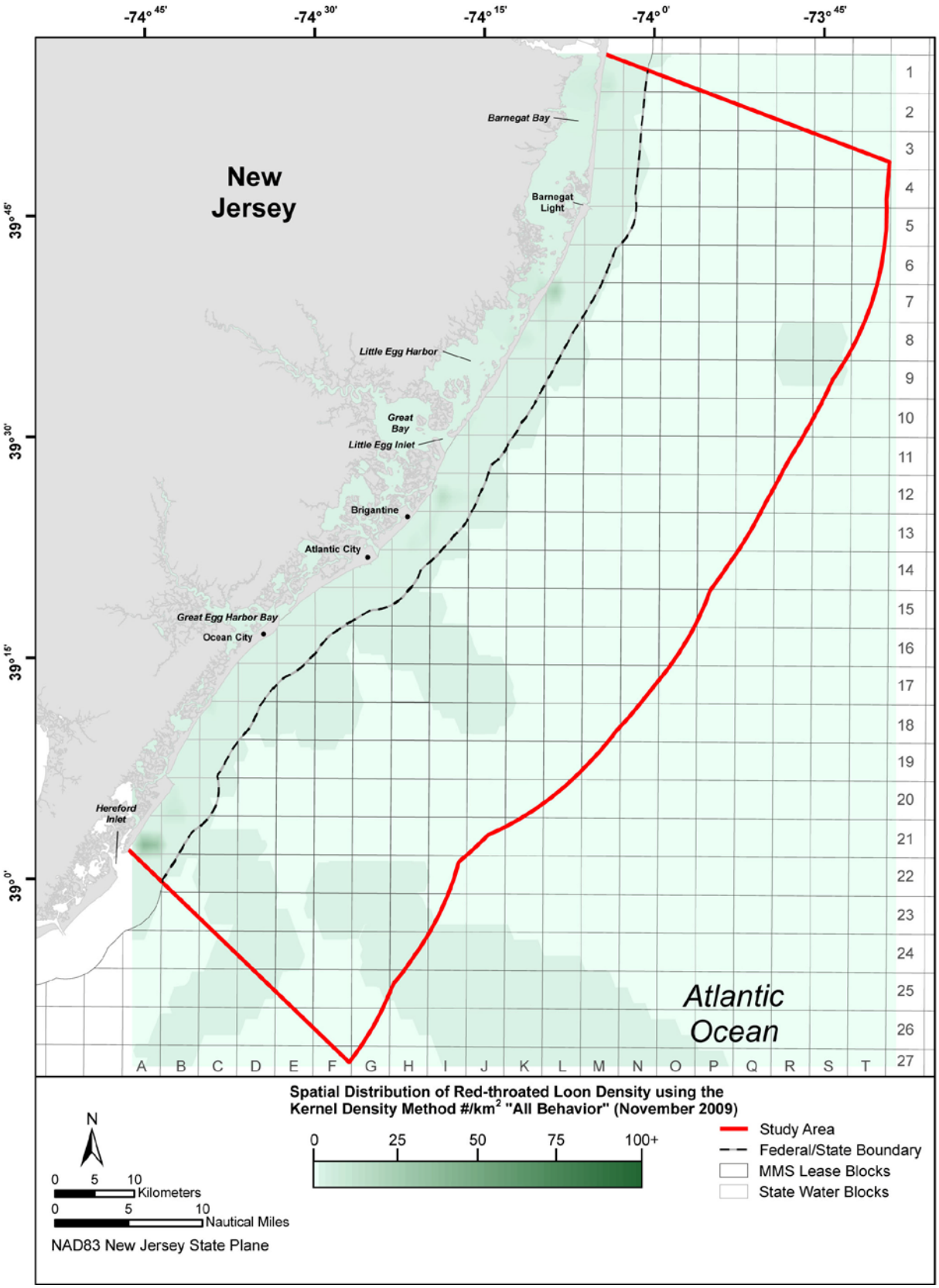

Figure M-242. Spatial distribution of Red-throated Loon density (#/km^2) in the Study Area for all behaviors using the kernel density method (November 2009).

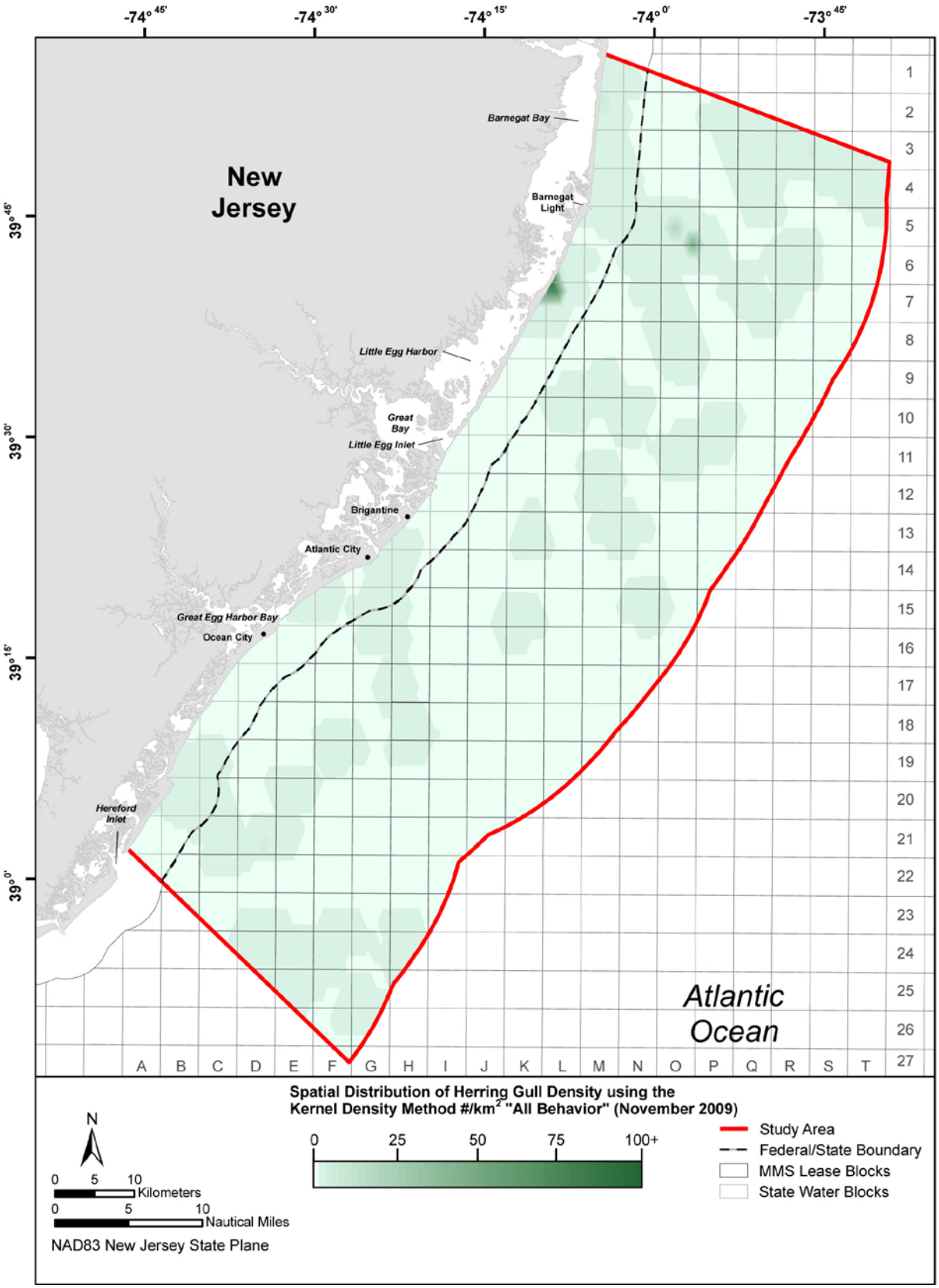

Figure M-243. Spatial distribution of Herring Gull density (#/km^2) in the Study Area for all behaviors using the kernel density method (November 2009).

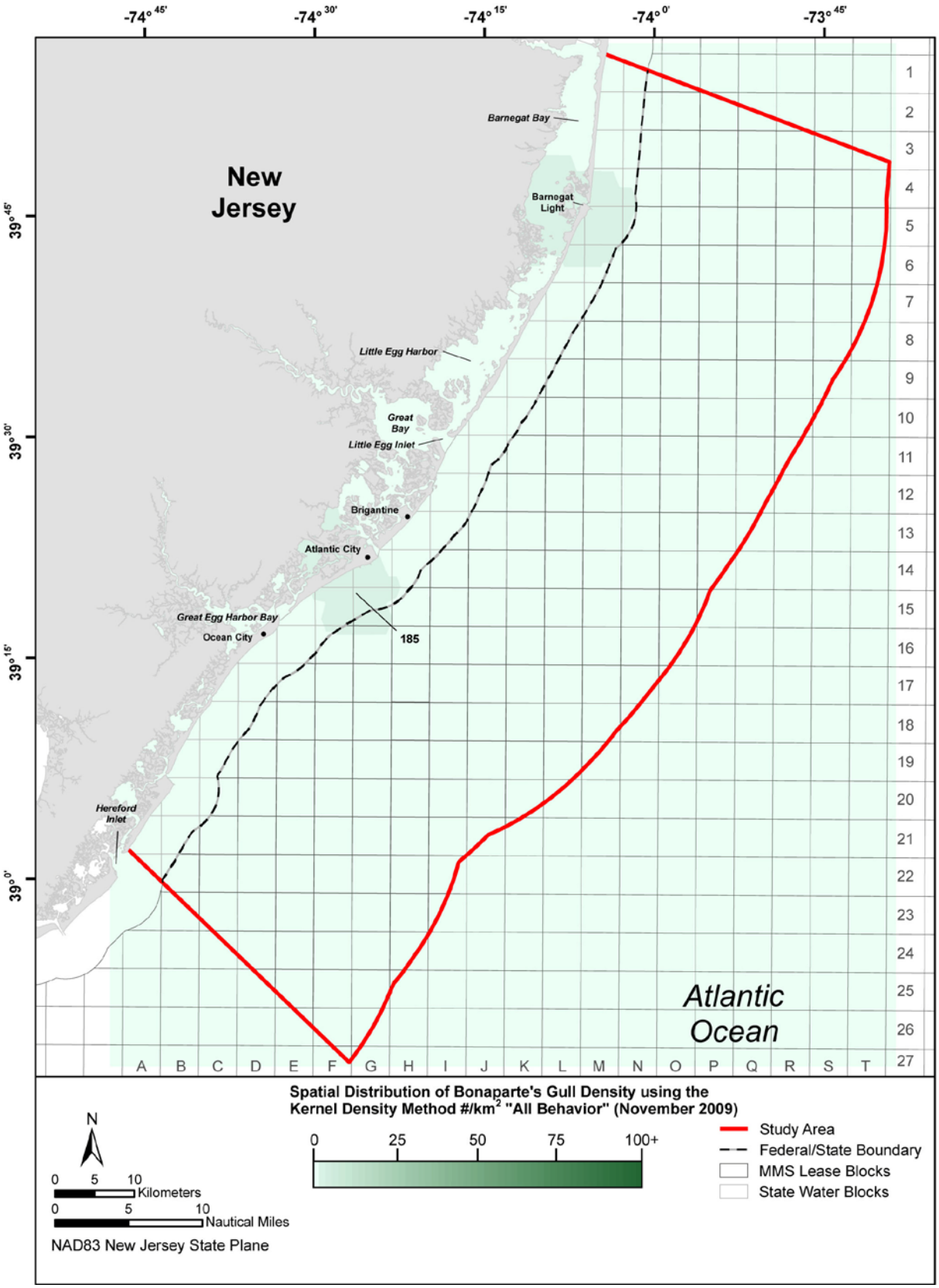

Figure M-244. Spatial distribution of Bonaparte's Gull density (#/km^2) in the Study Area for all behaviors using the kernel density method (November 2009).

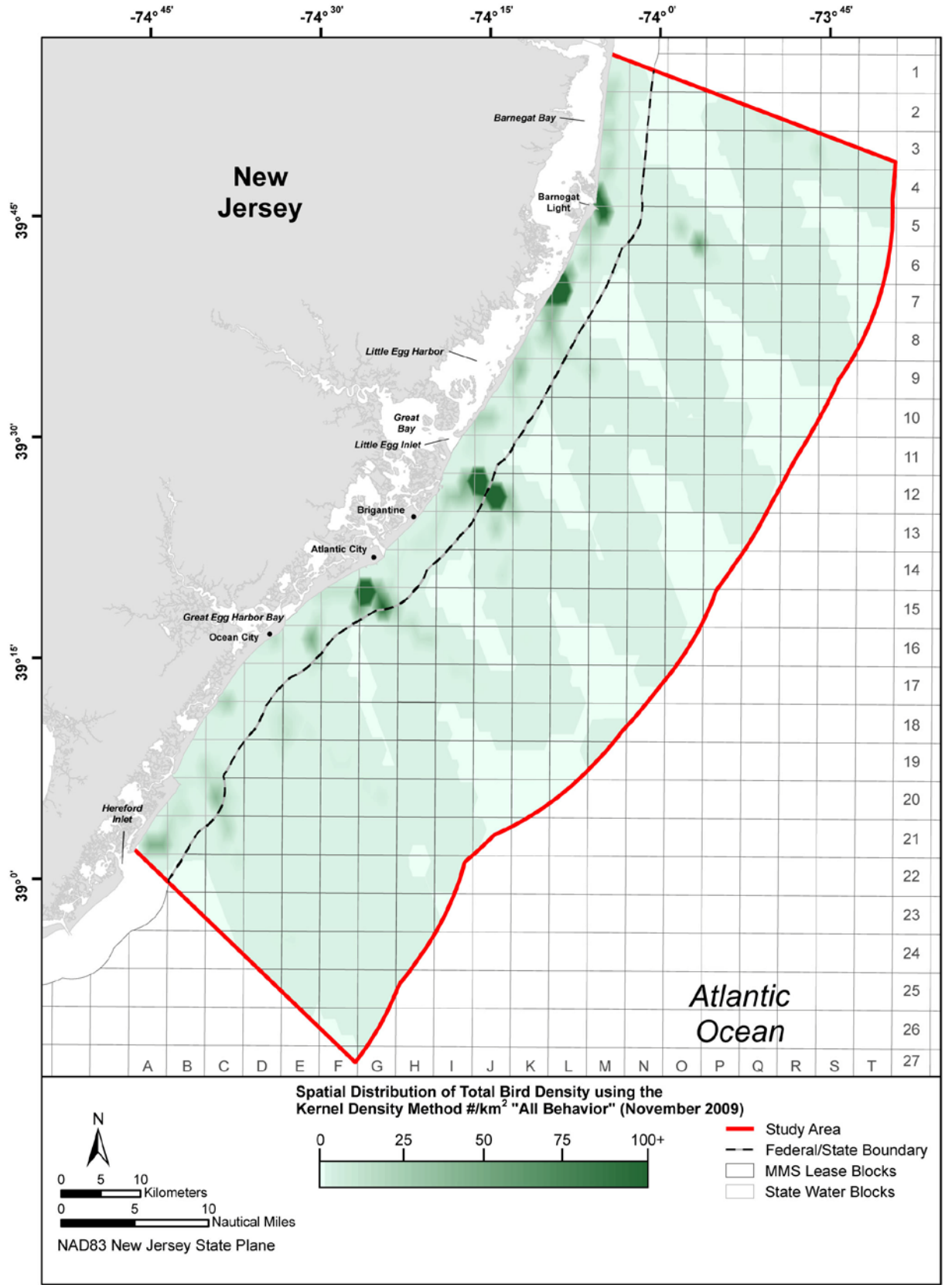

Figure M-245. Spatial distribution of total bird density (#/km^2) in the Study Area for all behaviors using the kernel density method (November 2009).

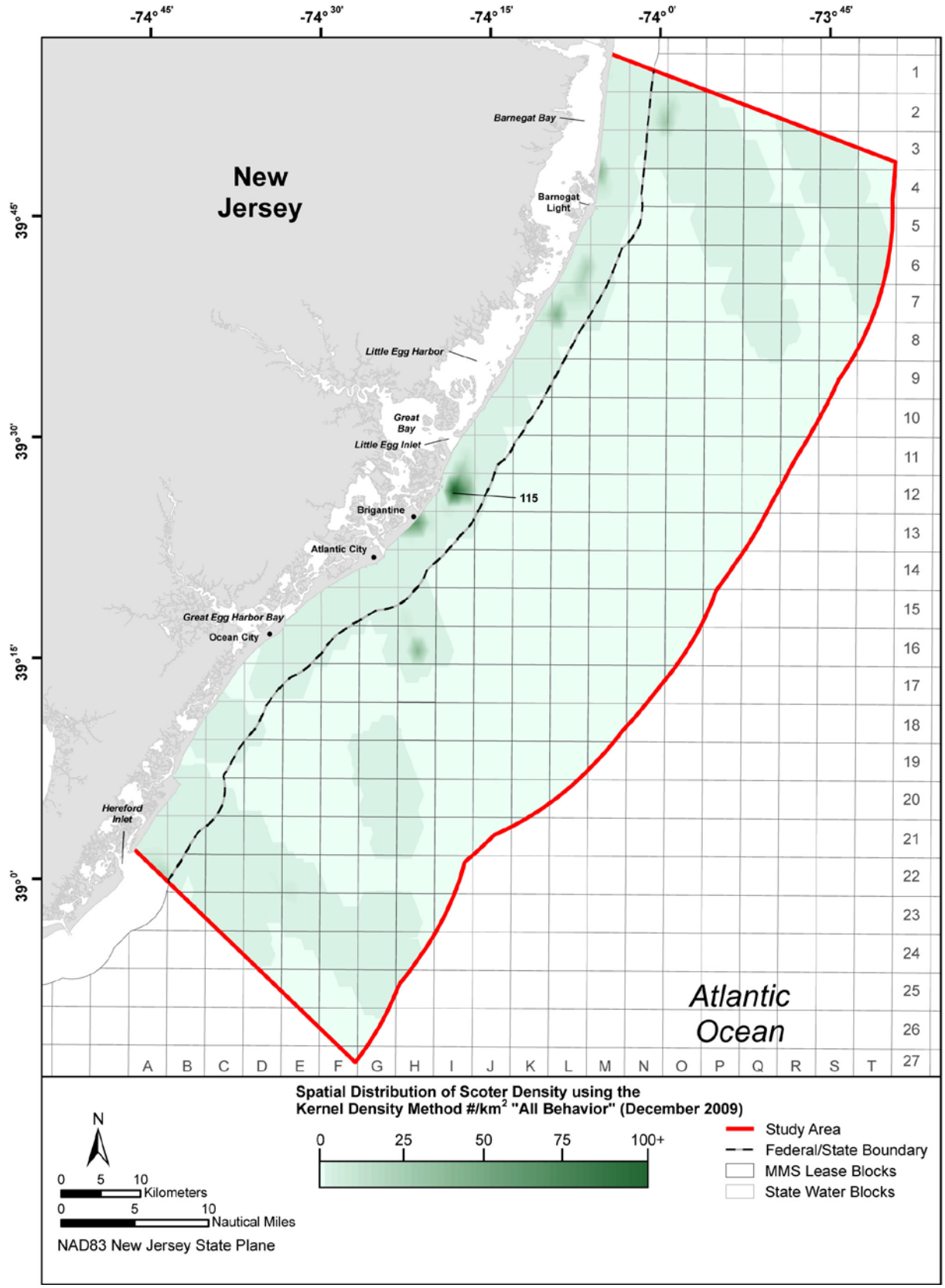

Figure M-246. Spatial distribution of scoter density (#/km^2) in the Study Area for all behaviors using the kernel density method (December 2009).

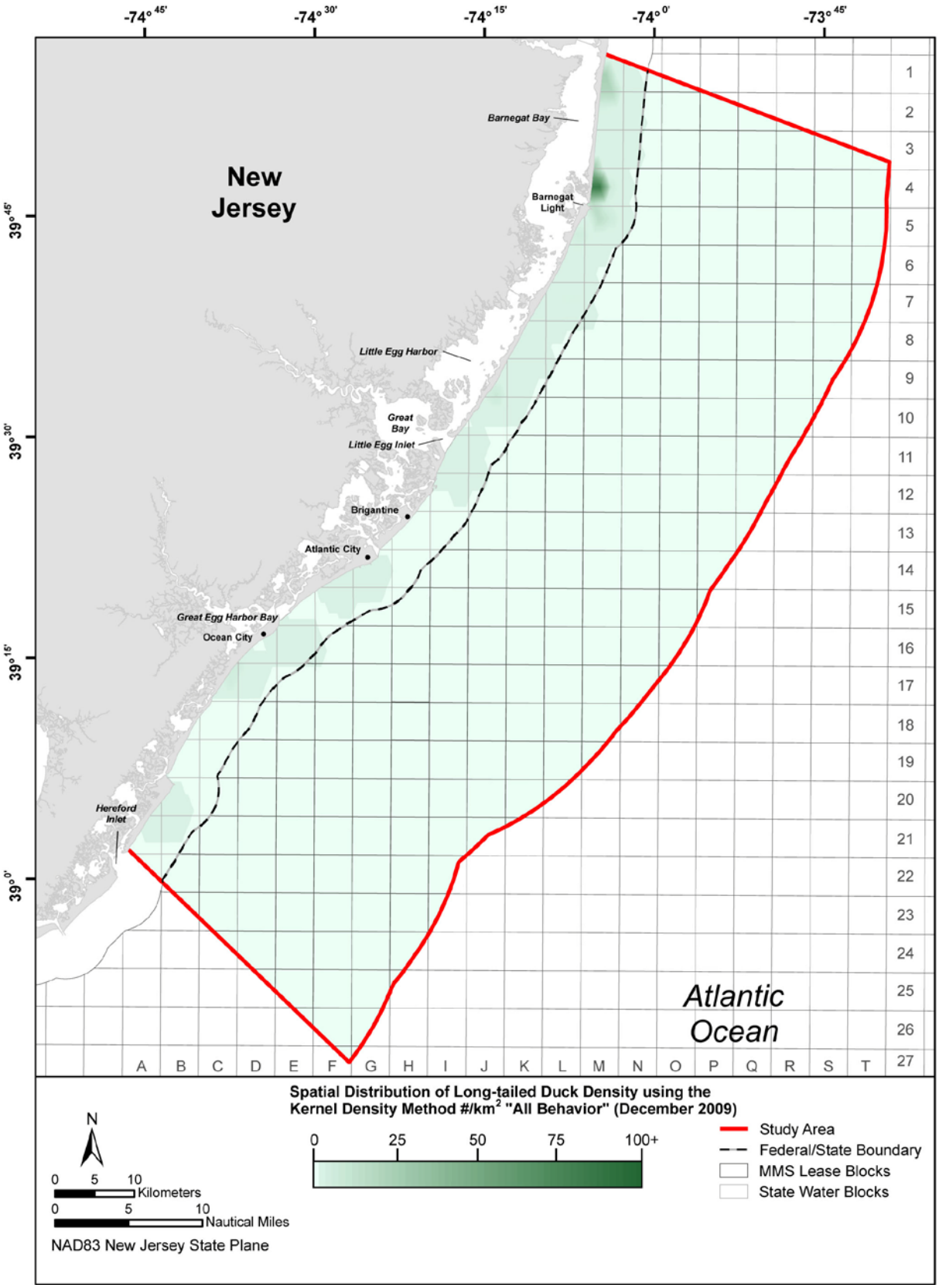

Figure M-247. Spatial distribution of Long-tailed Duck density (#/km^2) in the Study Area for all behaviors using the kernel density method (December 2009).

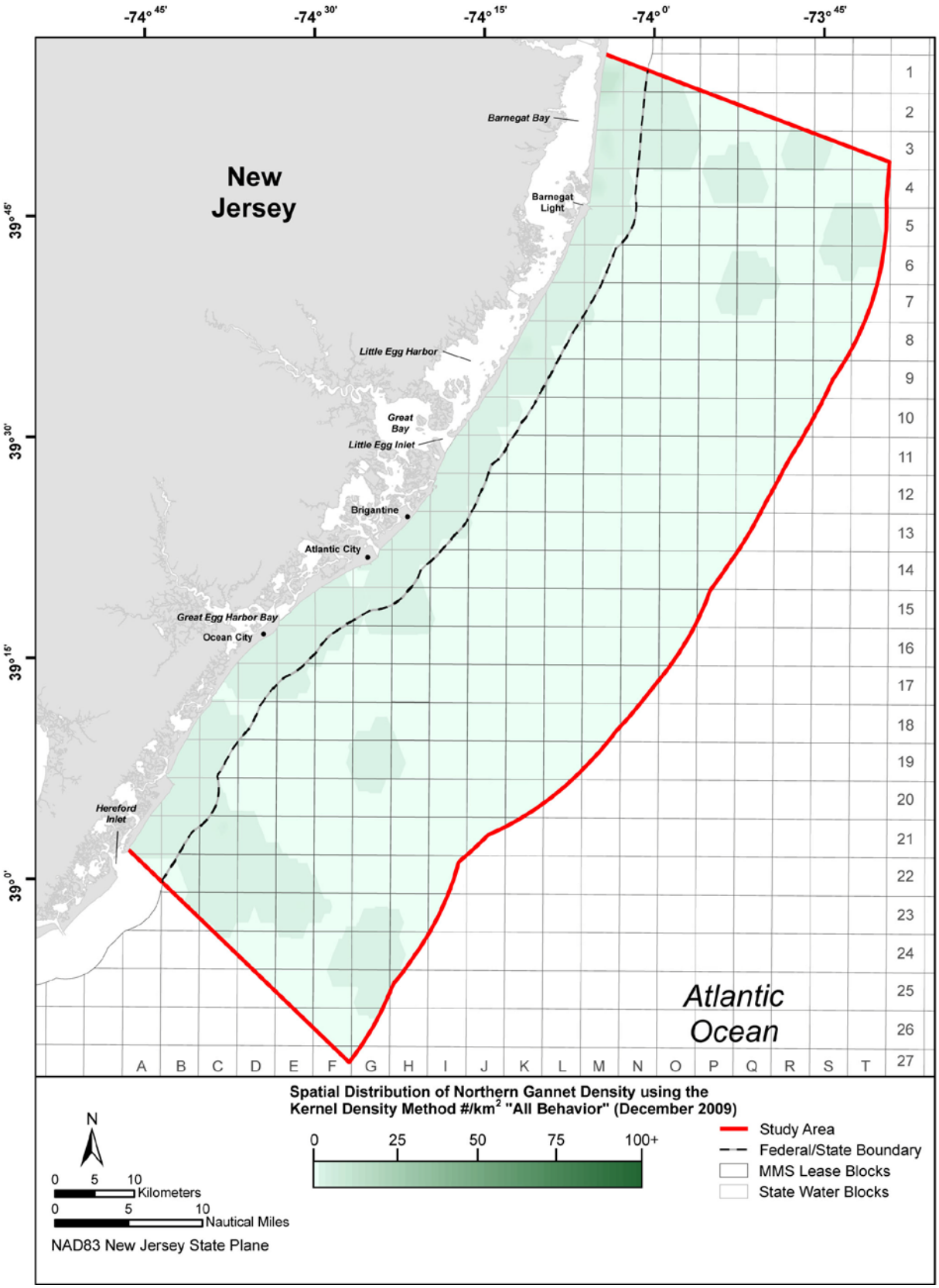

Figure M-248. Spatial distribution of Northern Gannet density (#/km^2) in the Study Area for all behaviors using the kernel density method (December 2009).

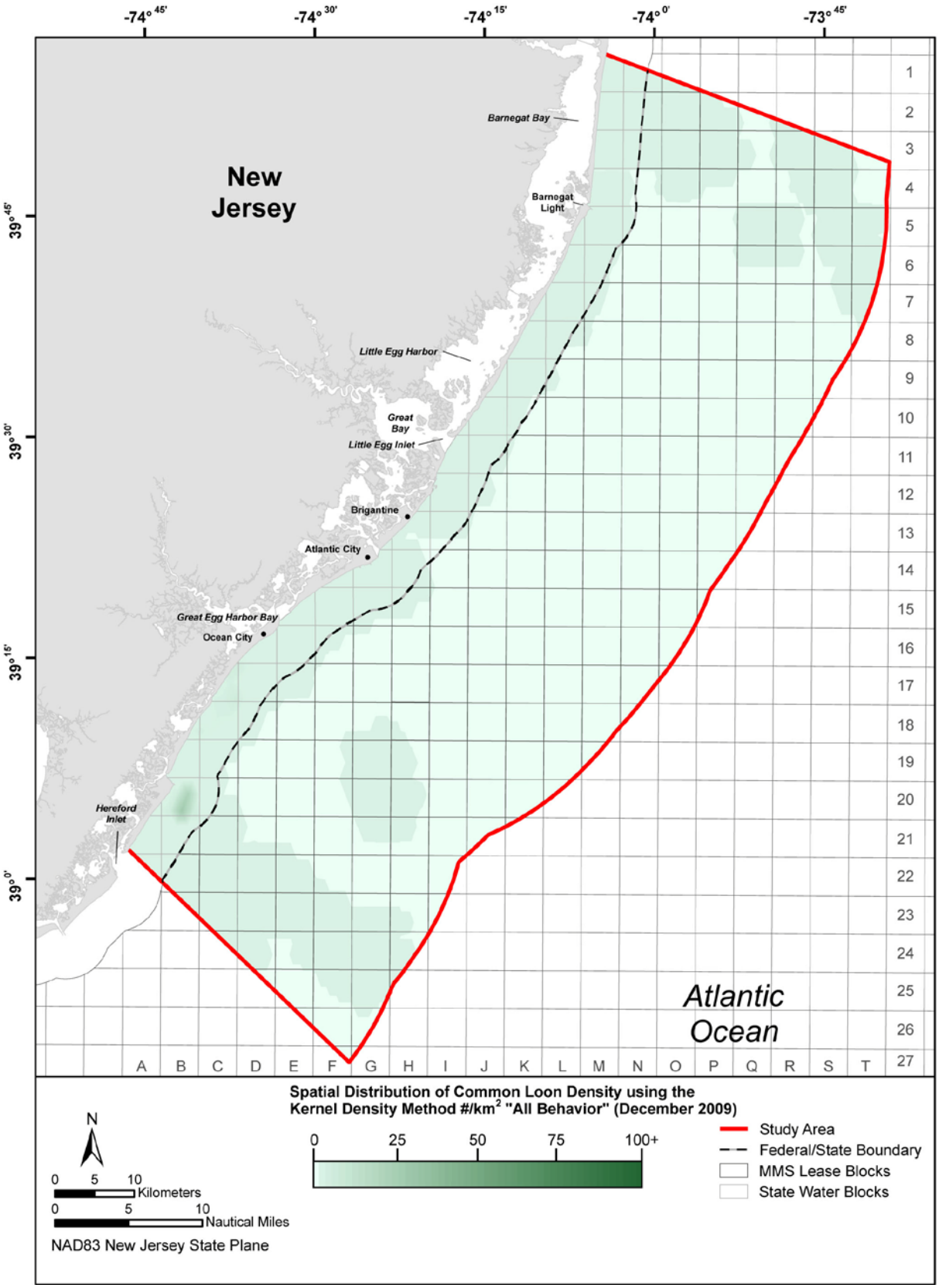

Figure M-249. Spatial distribution of Common Loon density (#/km^2) in the Study Area for all behaviors using the kernel density method (December 2009).

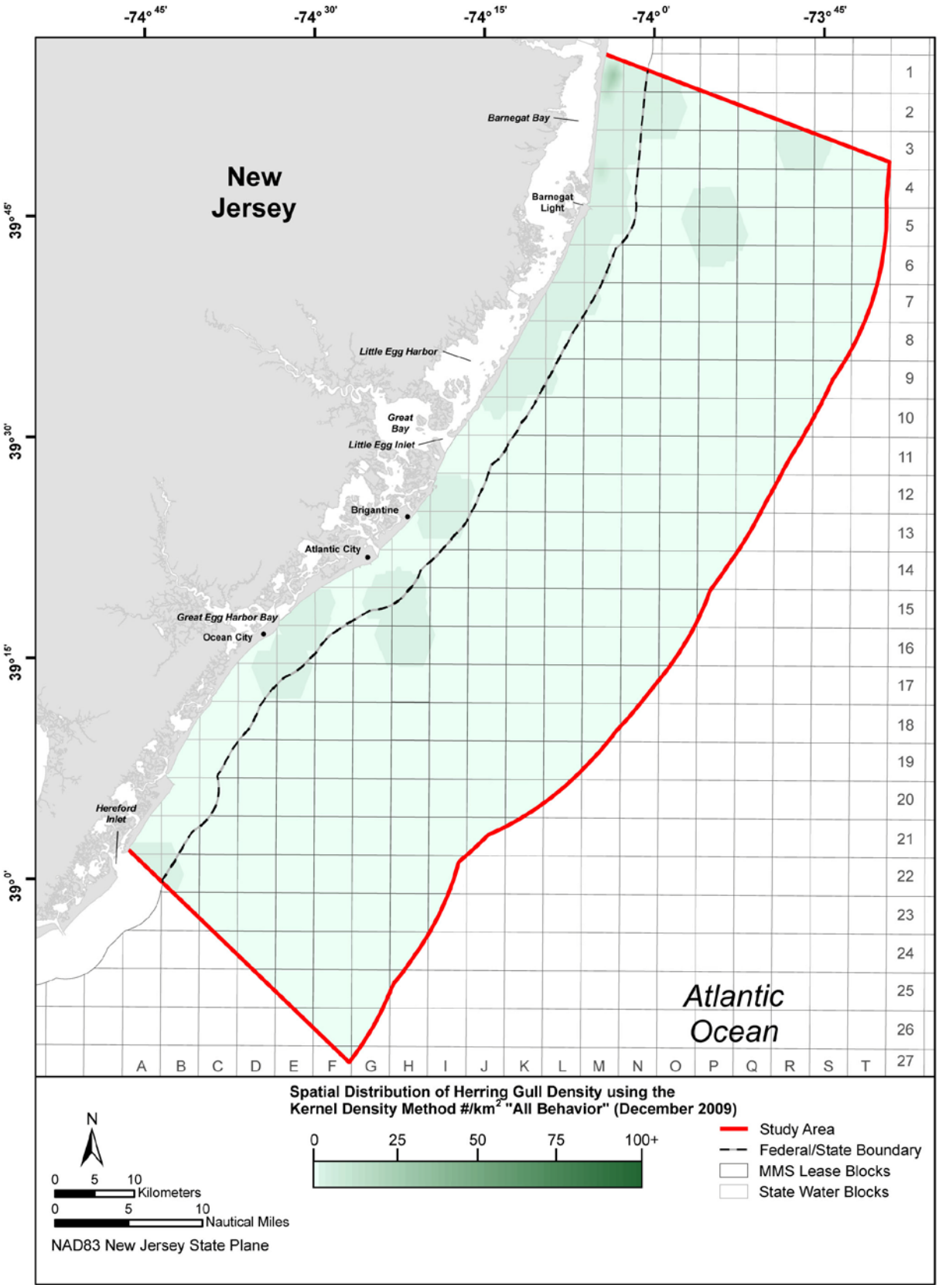

Figure M-250. Spatial distribution of Herring Gull density (#/km^2) in the Study Area for all behaviors using the kernel density method (December 2009).

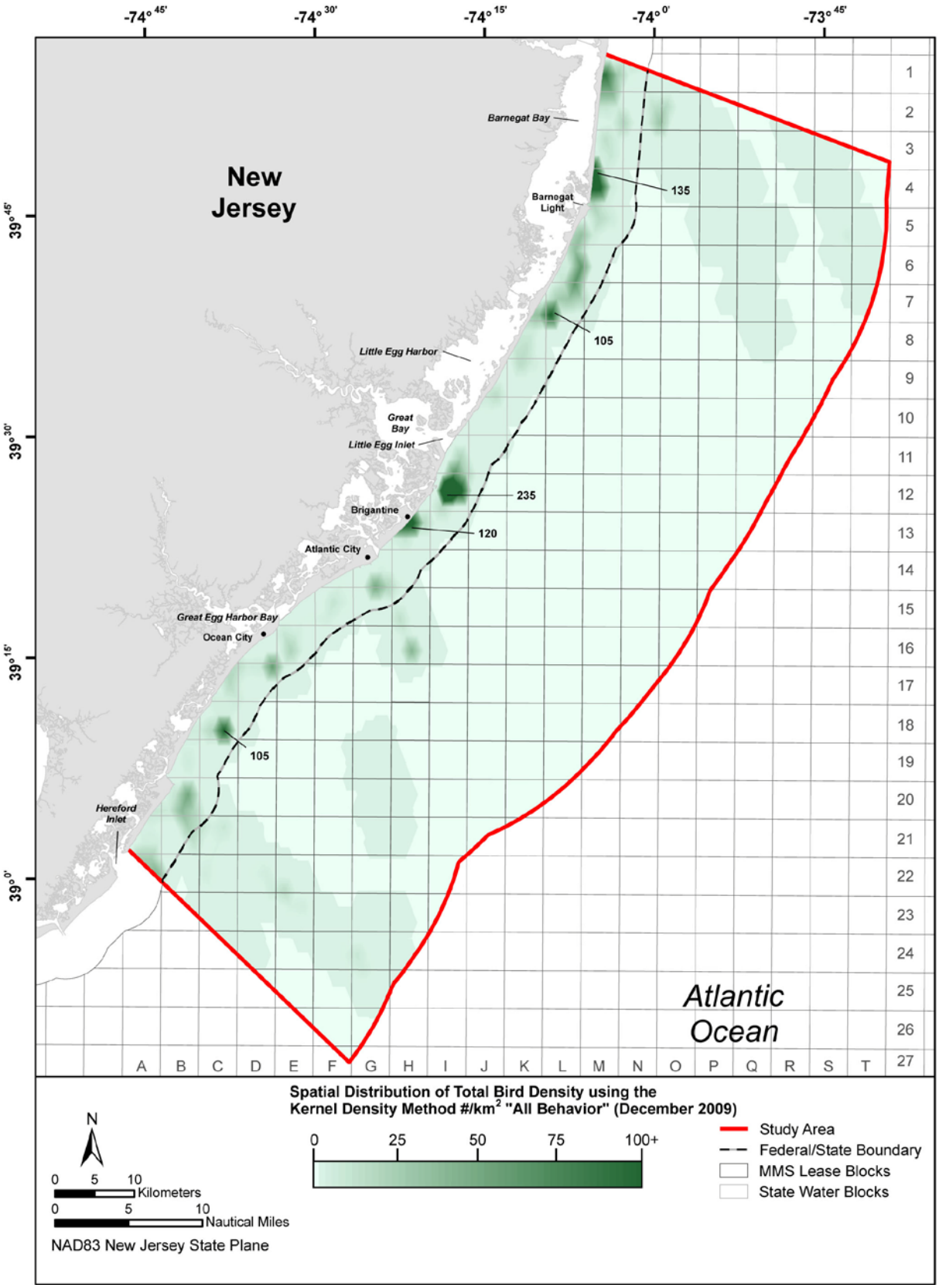

Figure M-251. Spatial distribution of total bird density (#/km^2) in the Study Area for all behaviors using the kernel density method (December 2009).

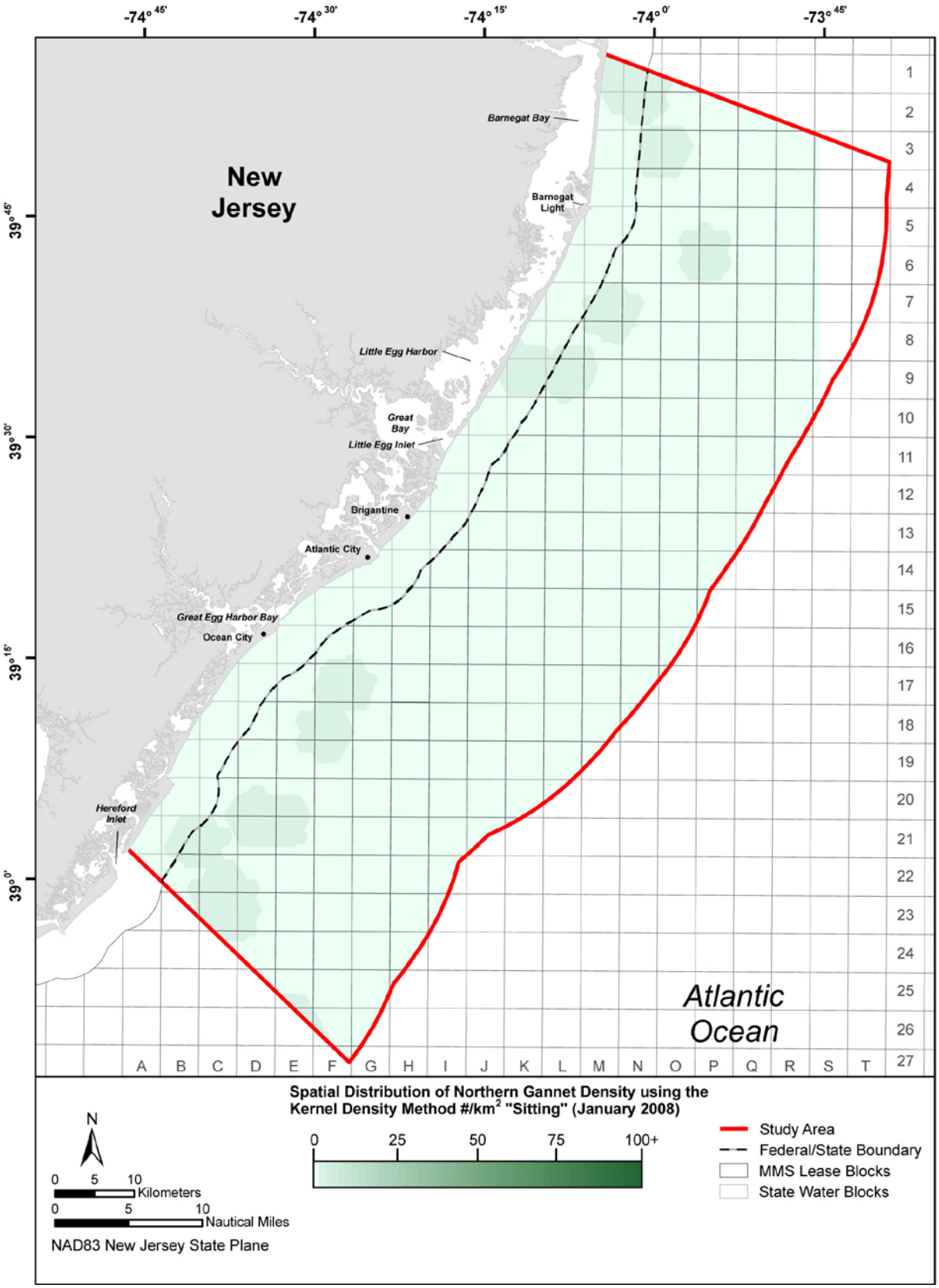

Figure M-252. Spatial distribution of Northern Gannet density (#/km^2) in the Study Area for sitting birds using the kernel density method (January 2008).

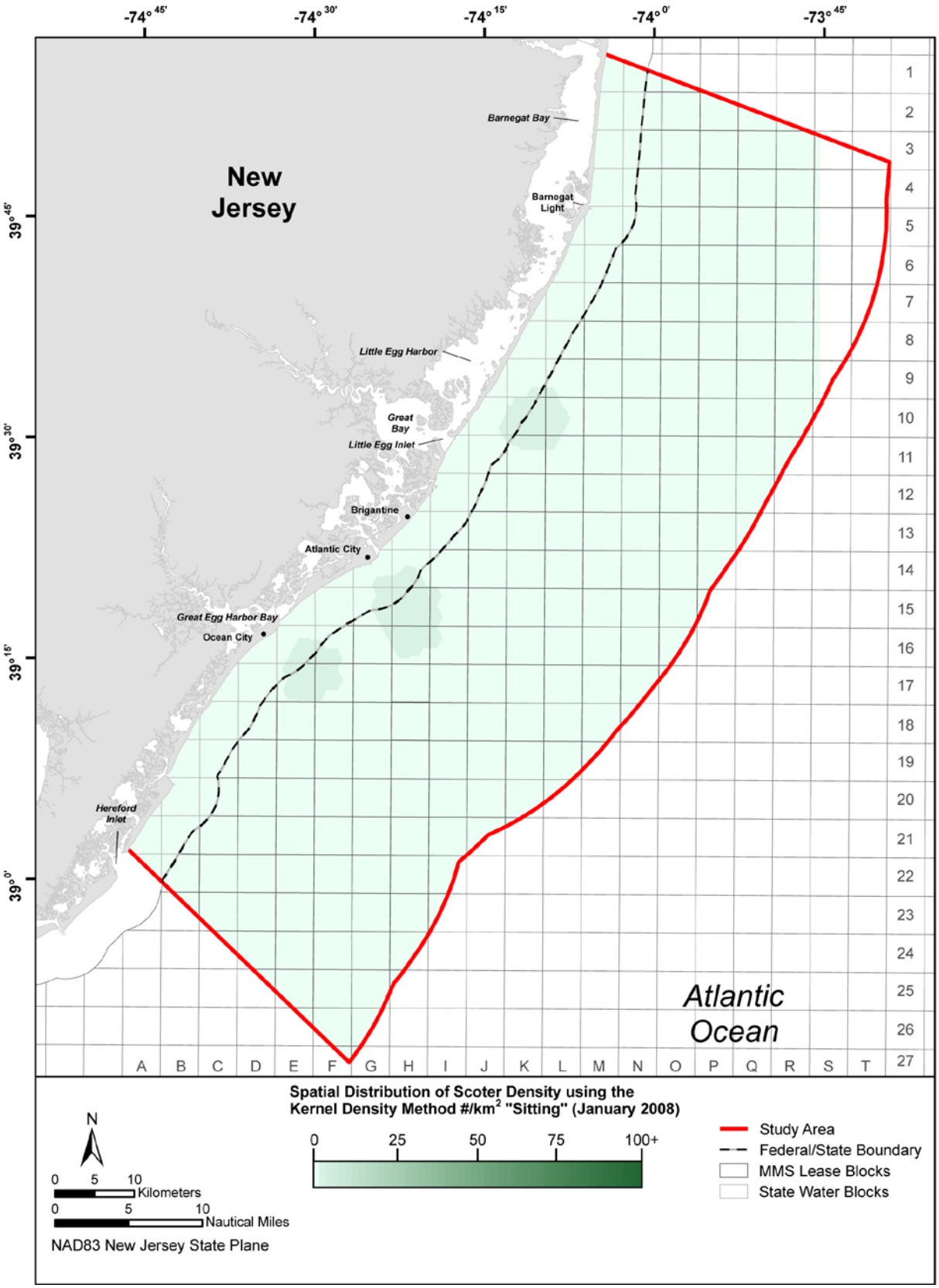

Figure M-253. Spatial distribution of scoter density (#/km^2) in the Study Area for sitting birds using the kernel density method (January 2008).

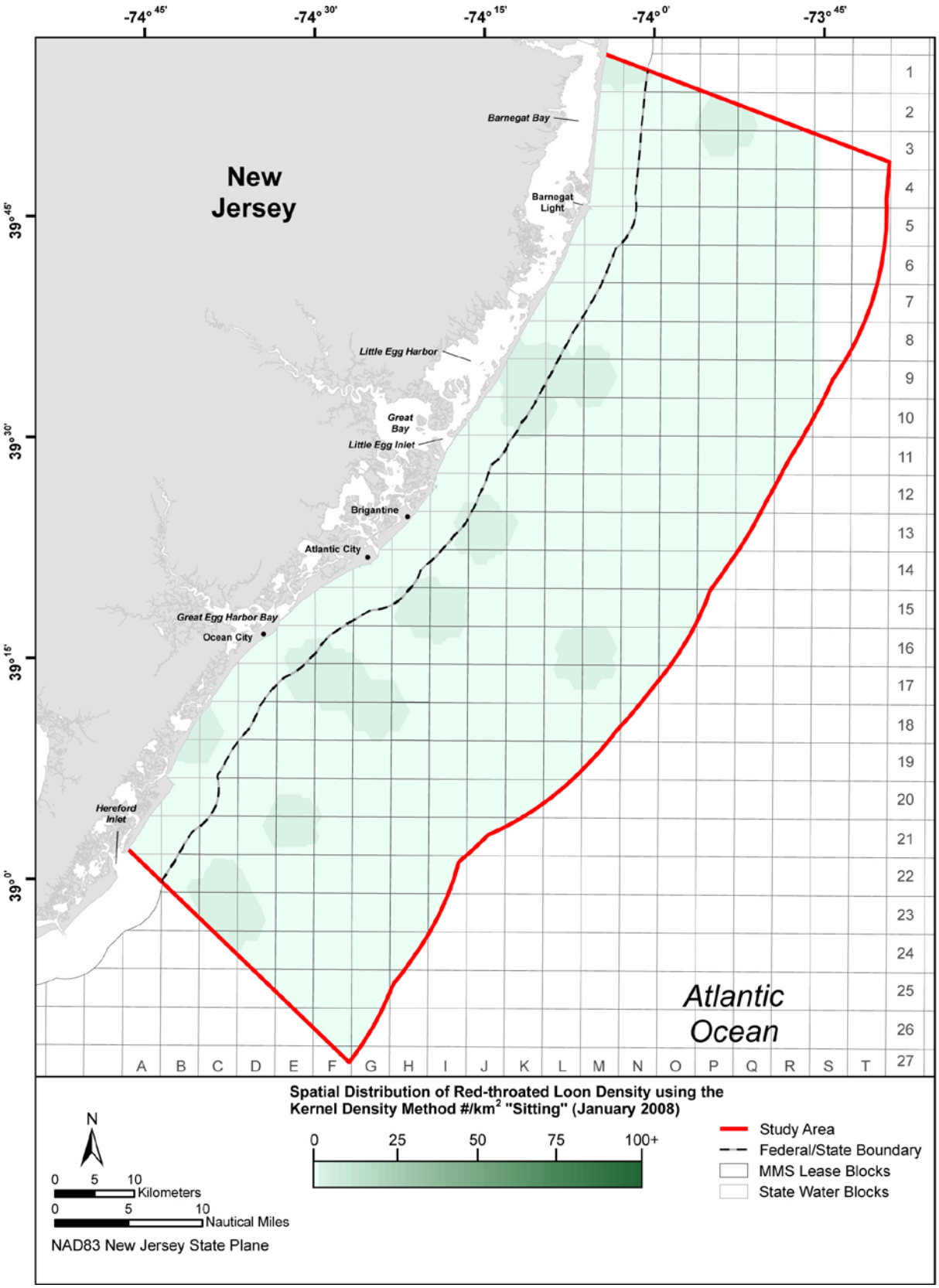

Figure M-254. Spatial distribution of Red-throated Loon density (#/km^2) in the Study Area for sitting birds using the kernel density method (January 2008).

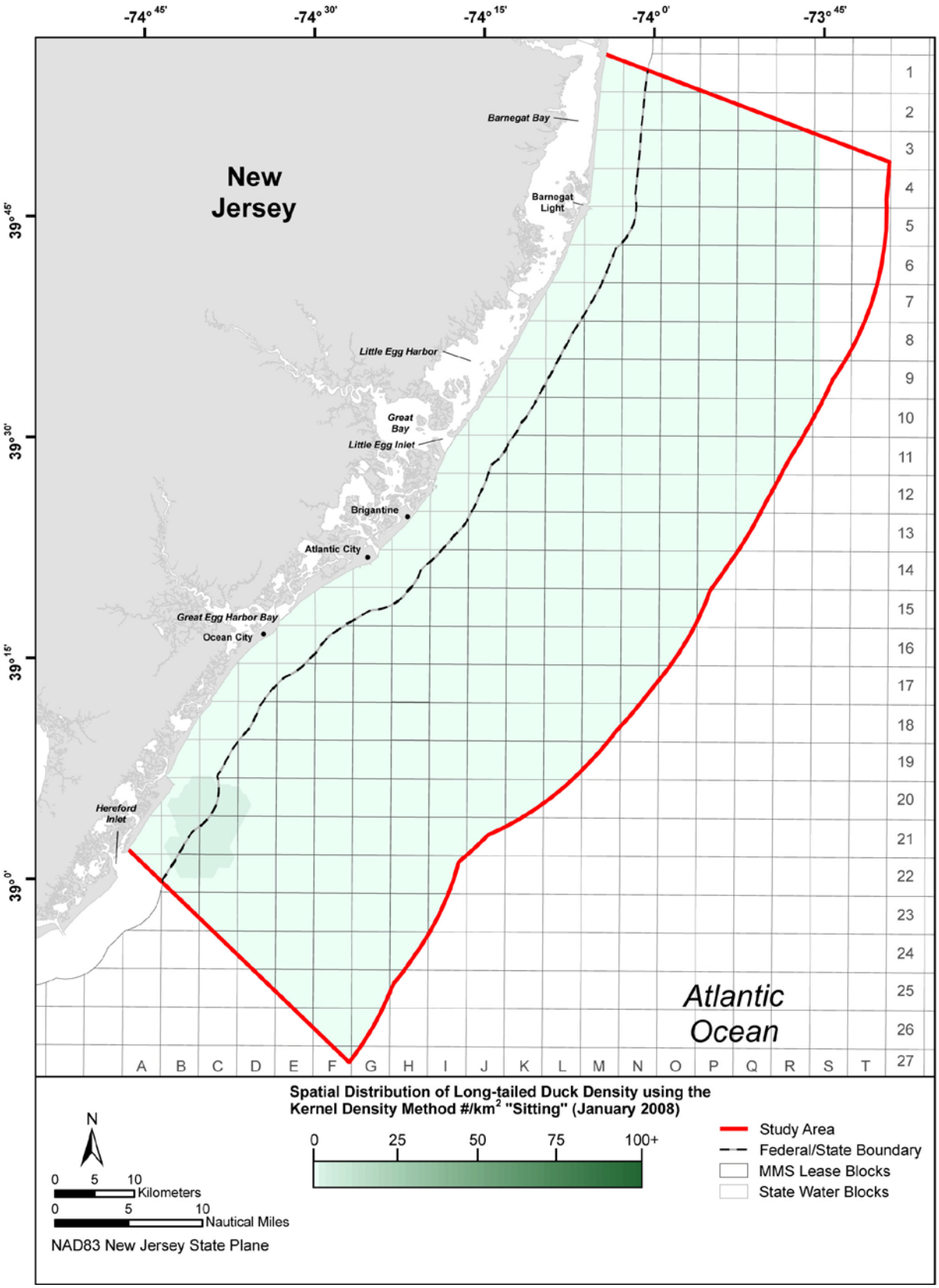

Figure M-255. Spatial distribution of Long-tailed Duck density (#/km^2) in the Study Area for sitting birds using the kernel density method (January 2008).

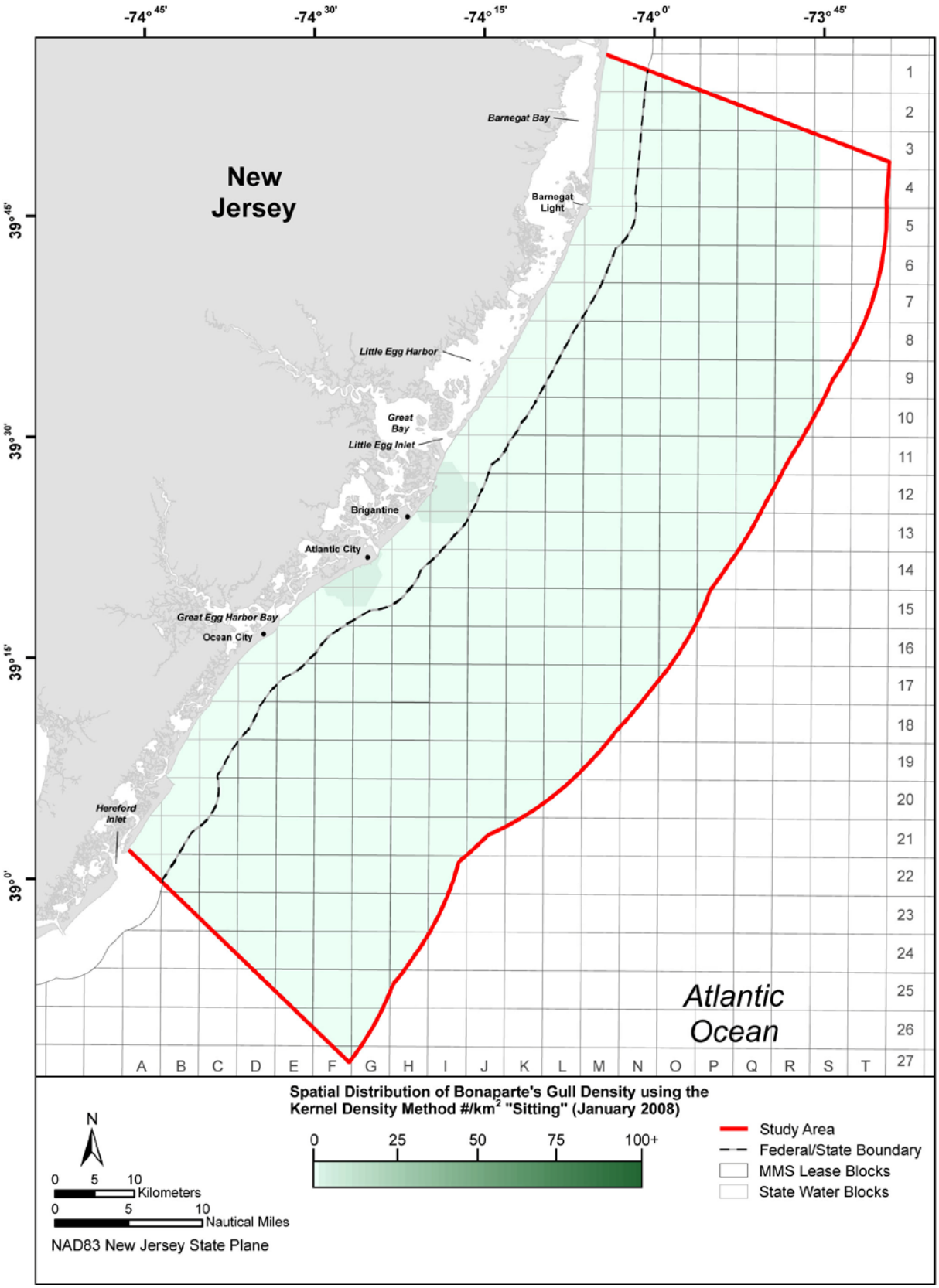

Figure M-256. Spatial distribution of Bonaparte's Gull density (#/km^2) in the Study Area for sitting birds using the kernel density method (January 2008).

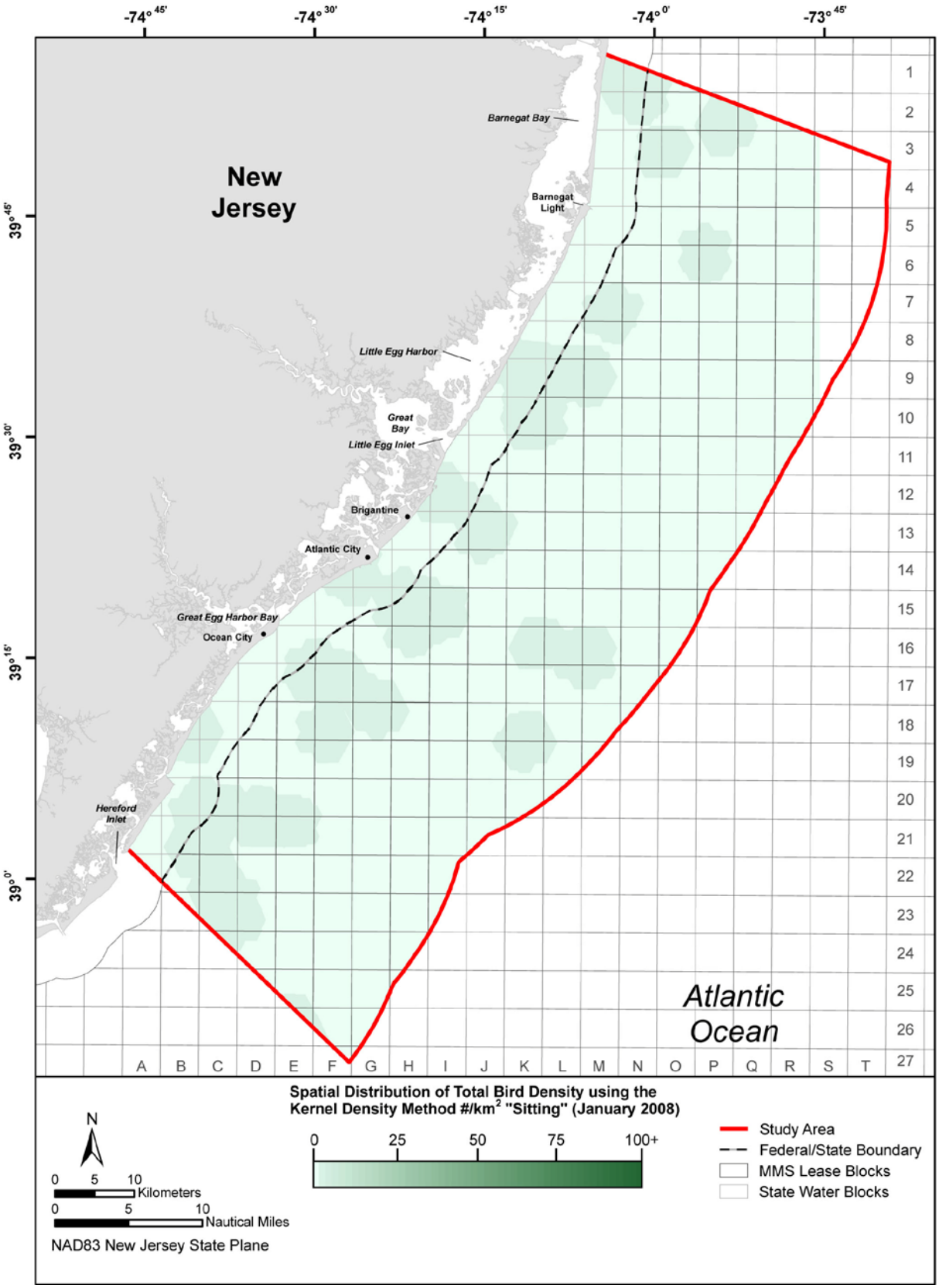

Figure M-257. Spatial distribution of total bird density (#/km^2) in the Study Area for sitting birds using the kernel density method (January 2008).

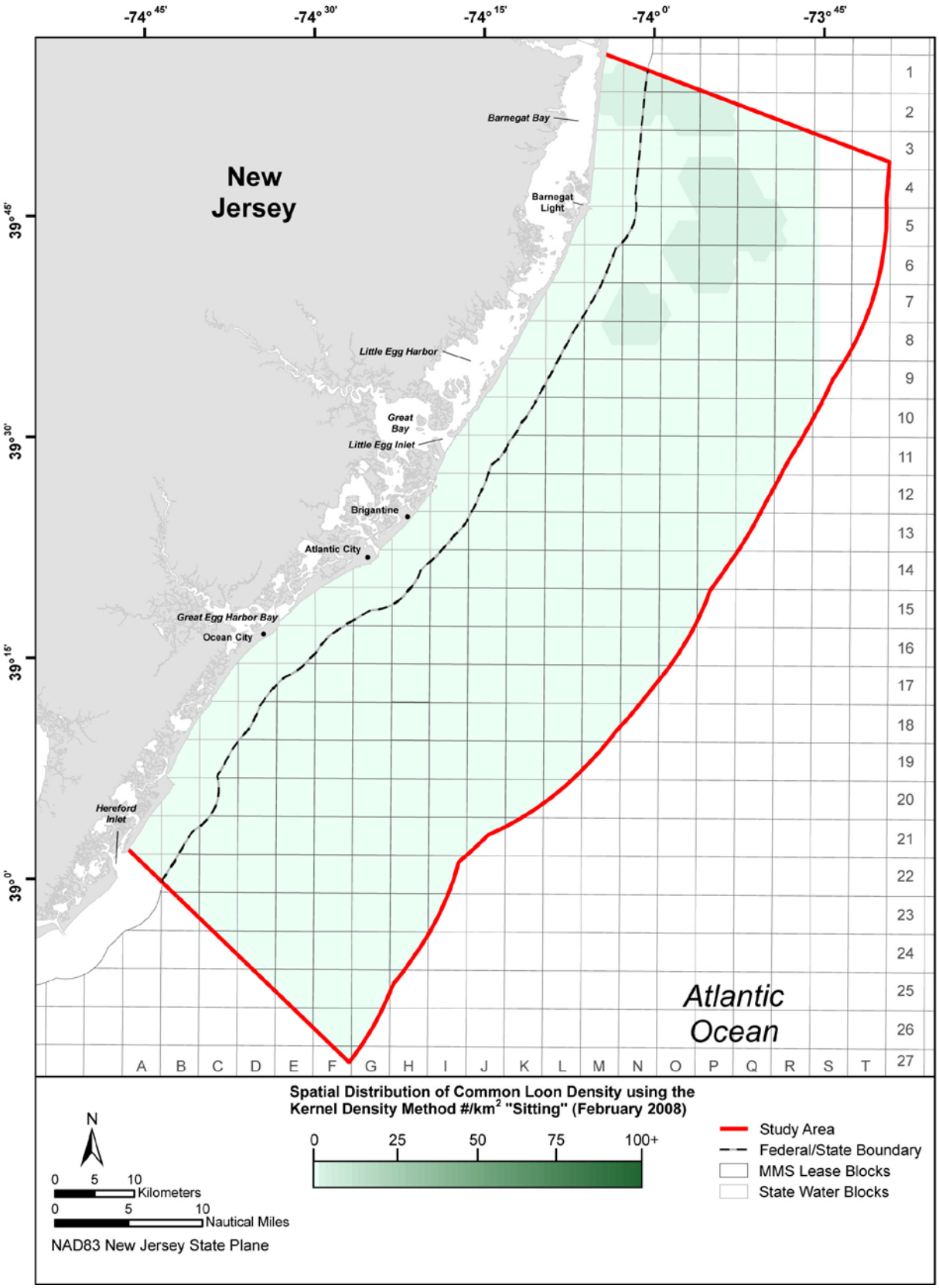

Figure M-258. Spatial distribution of Common Loon density (#/km^2) in the Study Area for sitting birds using the kernel density method (February 2008).

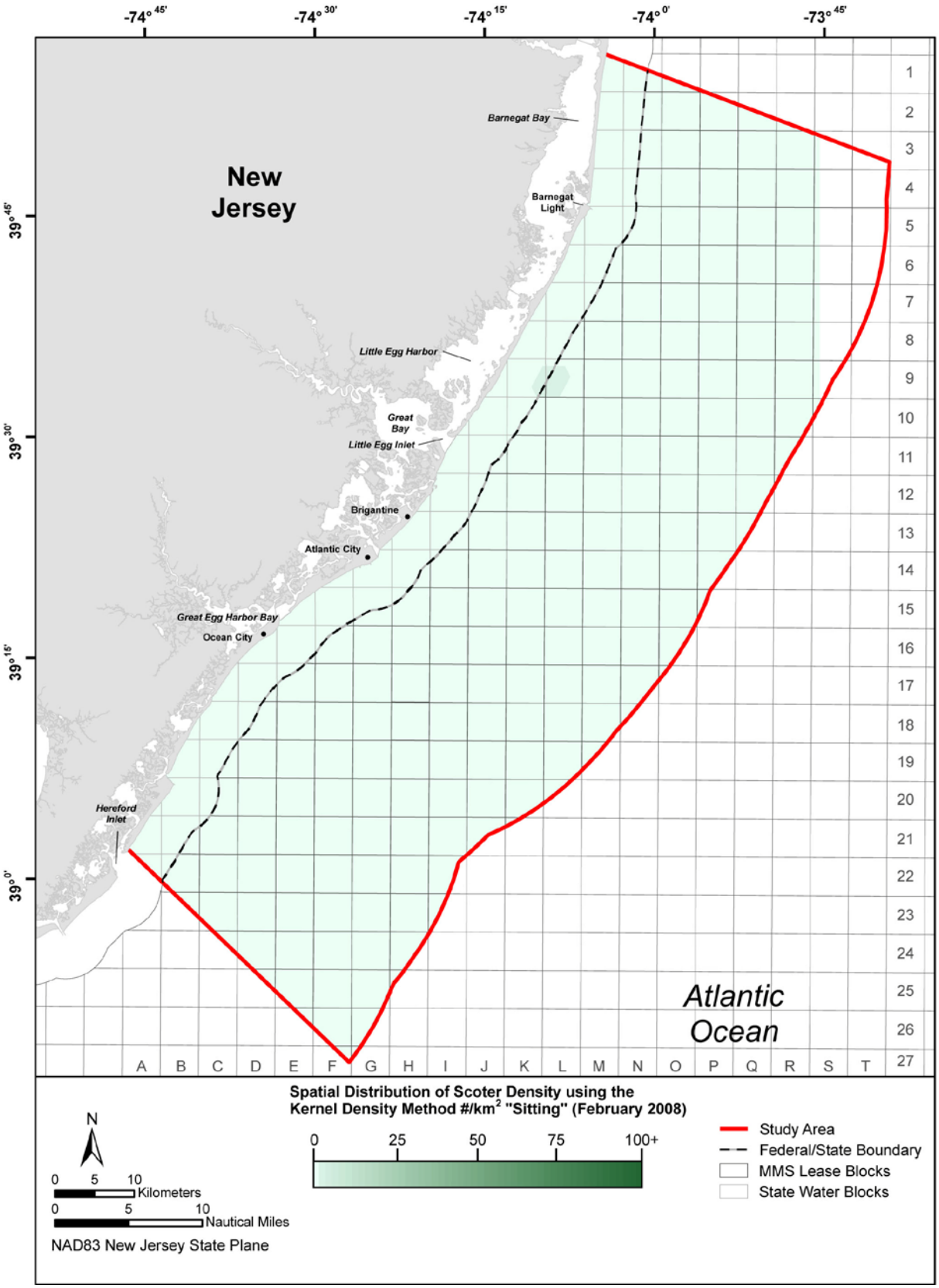

Figure M-259. Spatial distribution of scoter density (#/km^2) in the Study Area for sitting birds using the kernel density method (February 2008).

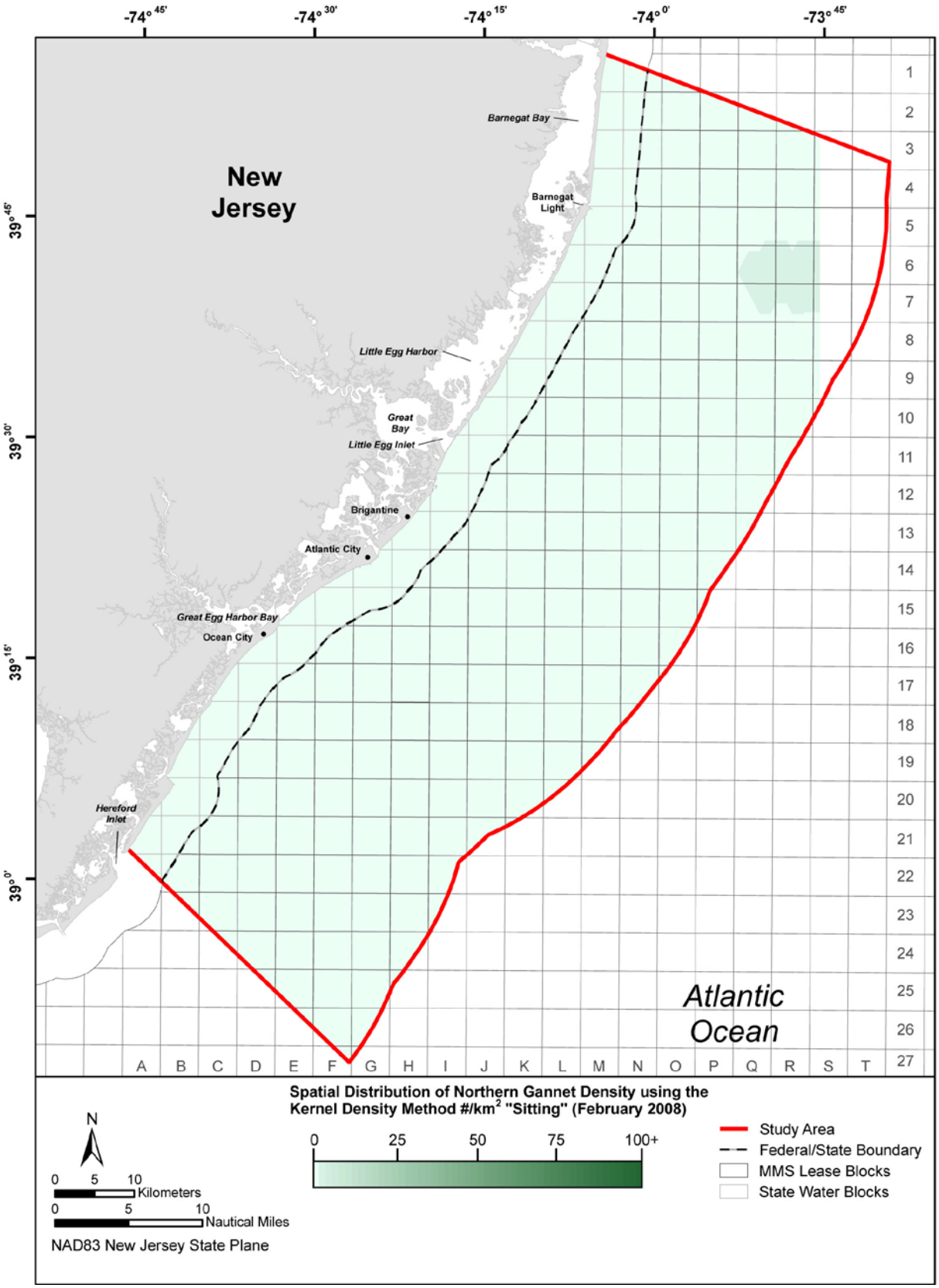

Figure M-260. Spatial distribution of Northern Gannet density (#/km^2) in the Study Area for sitting birds using the kernel density method (February 2008).

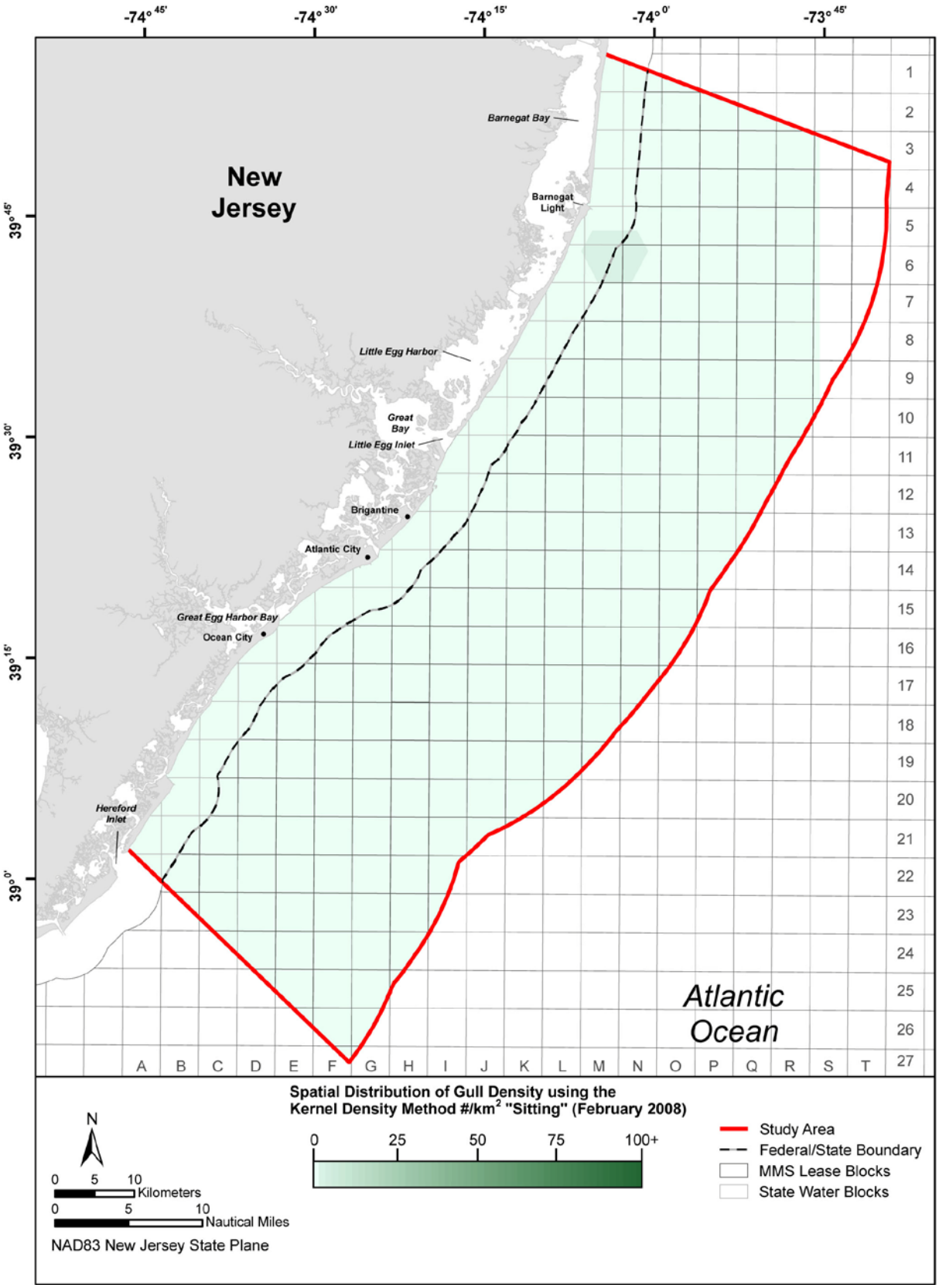

Figure M-261. Spatial distribution of gull density (#/km^2) in the Study Area for sitting birds using the kernel density method (February 2008).

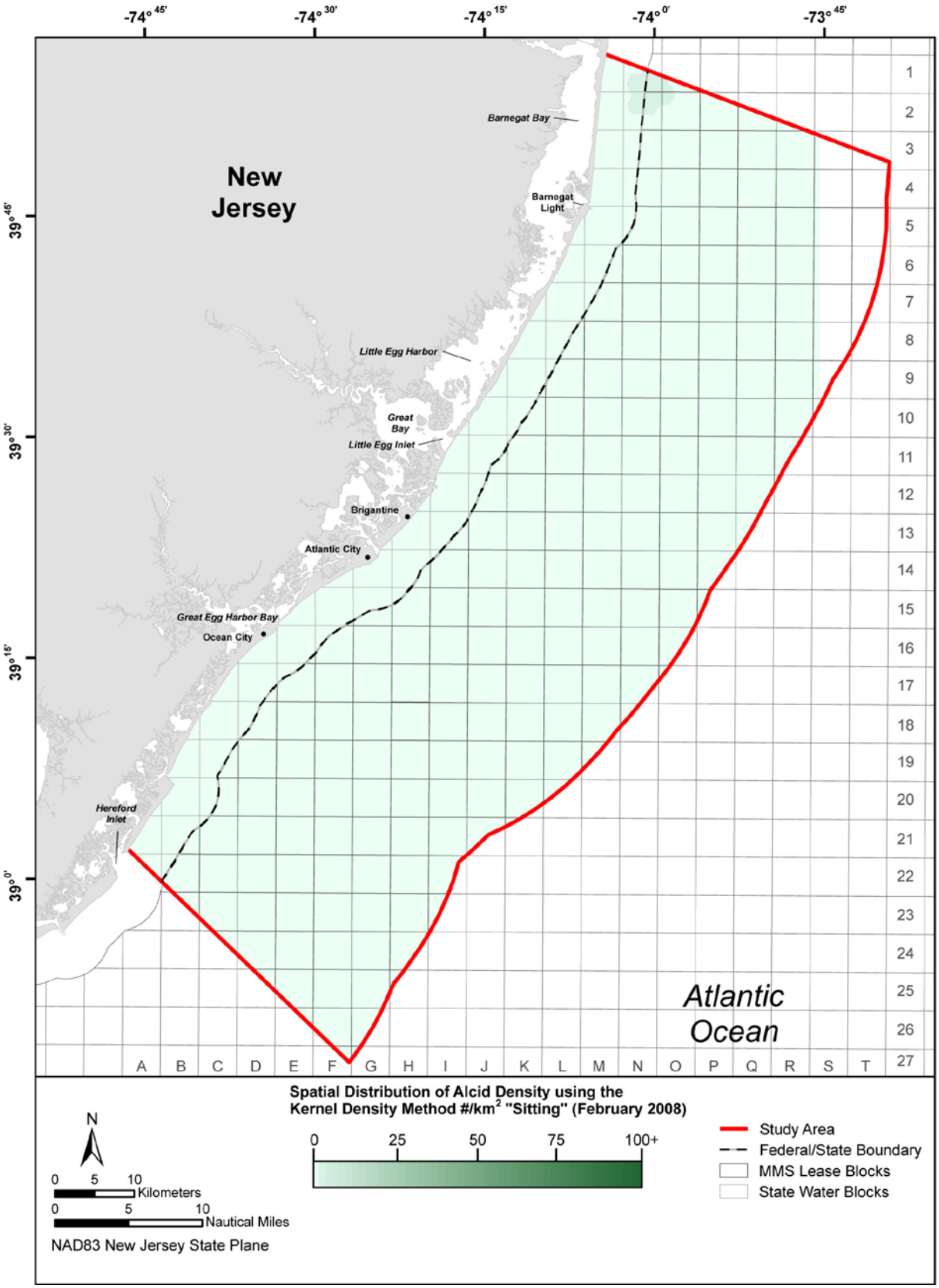

Figure M-262. Spatial distribution of alcid density (#/km^2) in the Study Area for sitting birds using the kernel density method (February 2008).

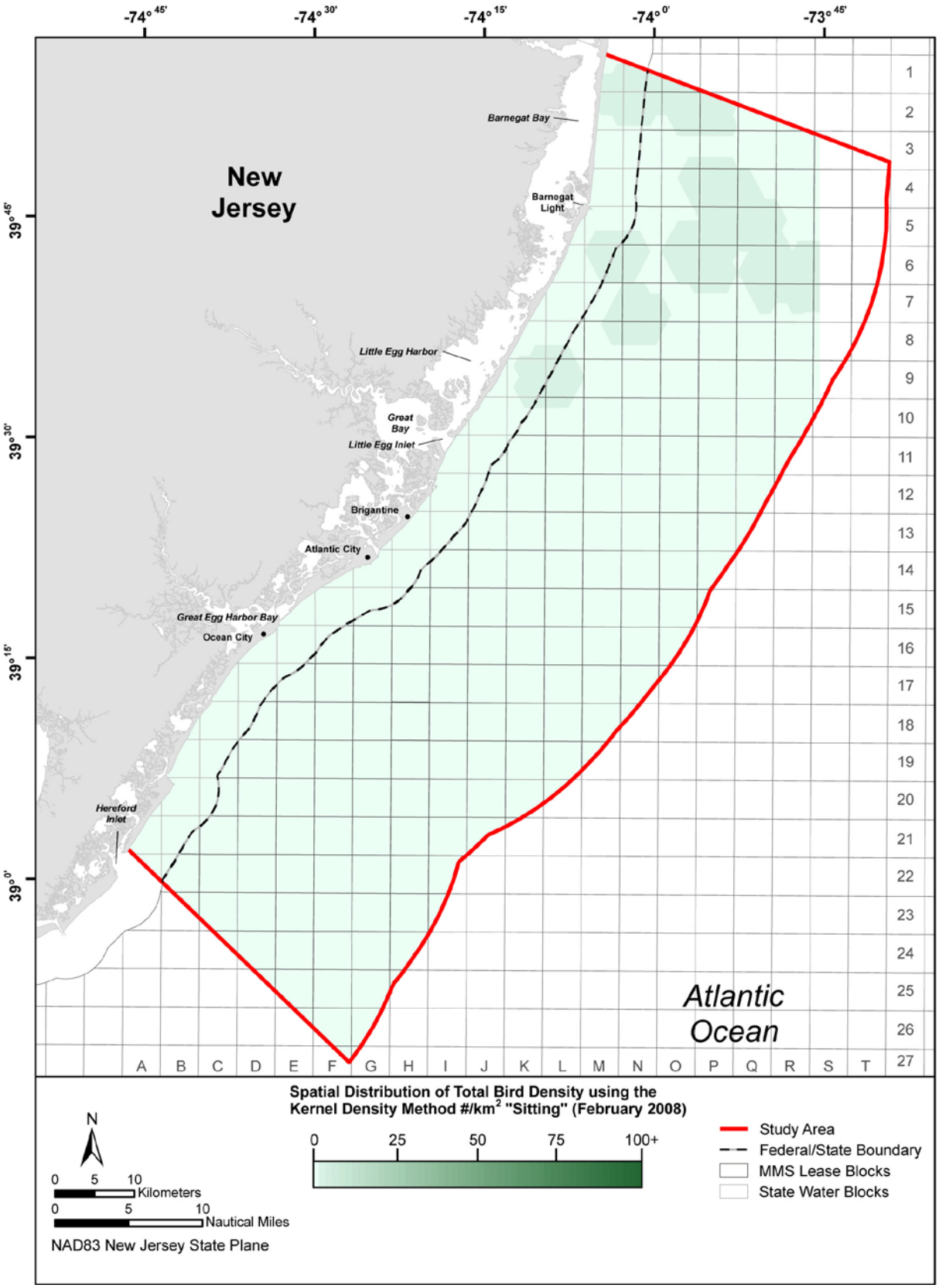

Figure M-263. Spatial distribution of total bird density (#/km^2) in the Study Area for sitting birds using the kernel density method (February 2008).

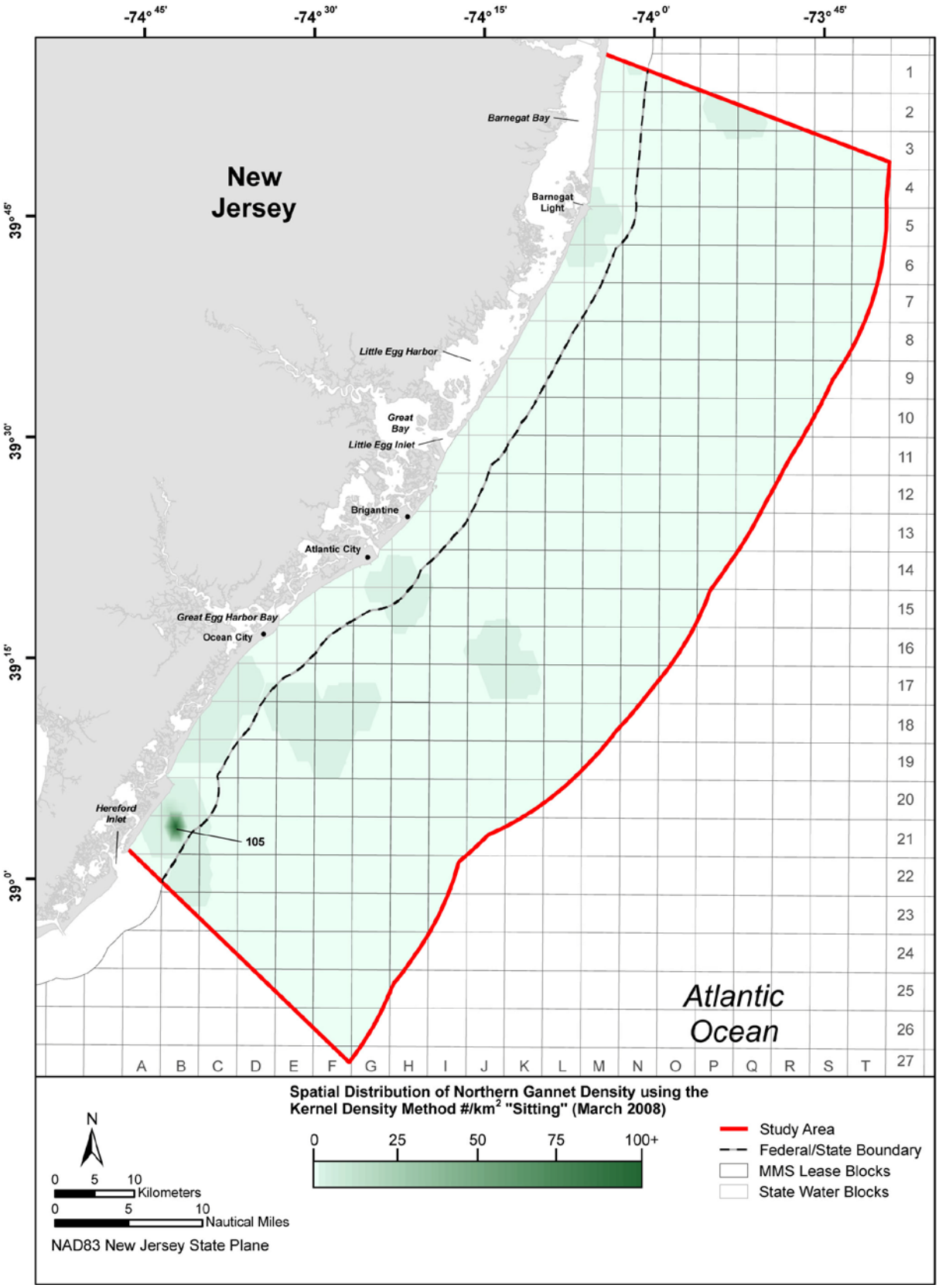

Figure M-264. Spatial distribution of Northern Gannet density (#/km^2) in the Study Area for sitting birds using the kernel density method (March 2008).

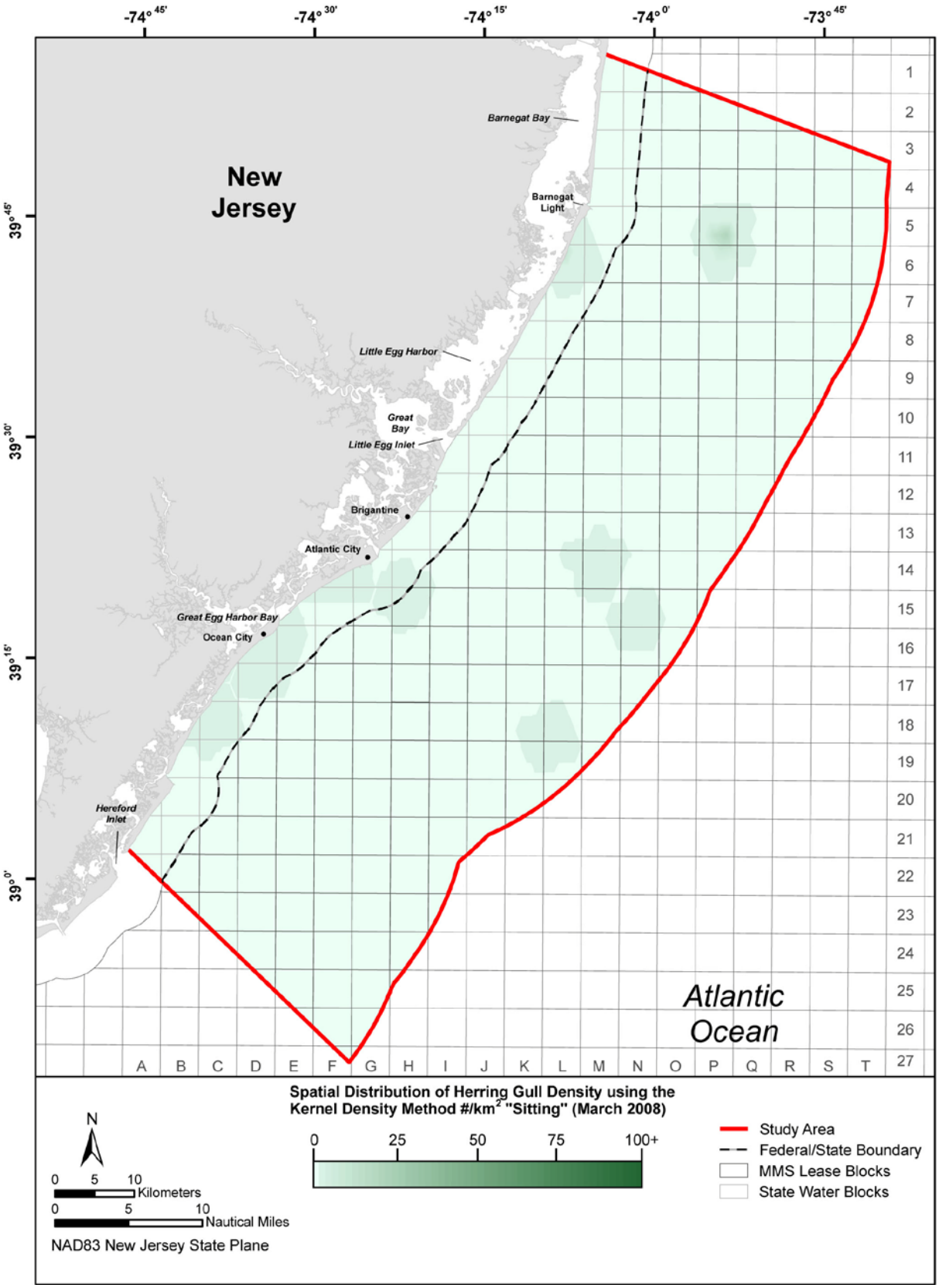

Figure M-265. Spatial distribution of Herring Gull density (#/km^2) in the Study Area for sitting birds using the kernel density method (March 2008).

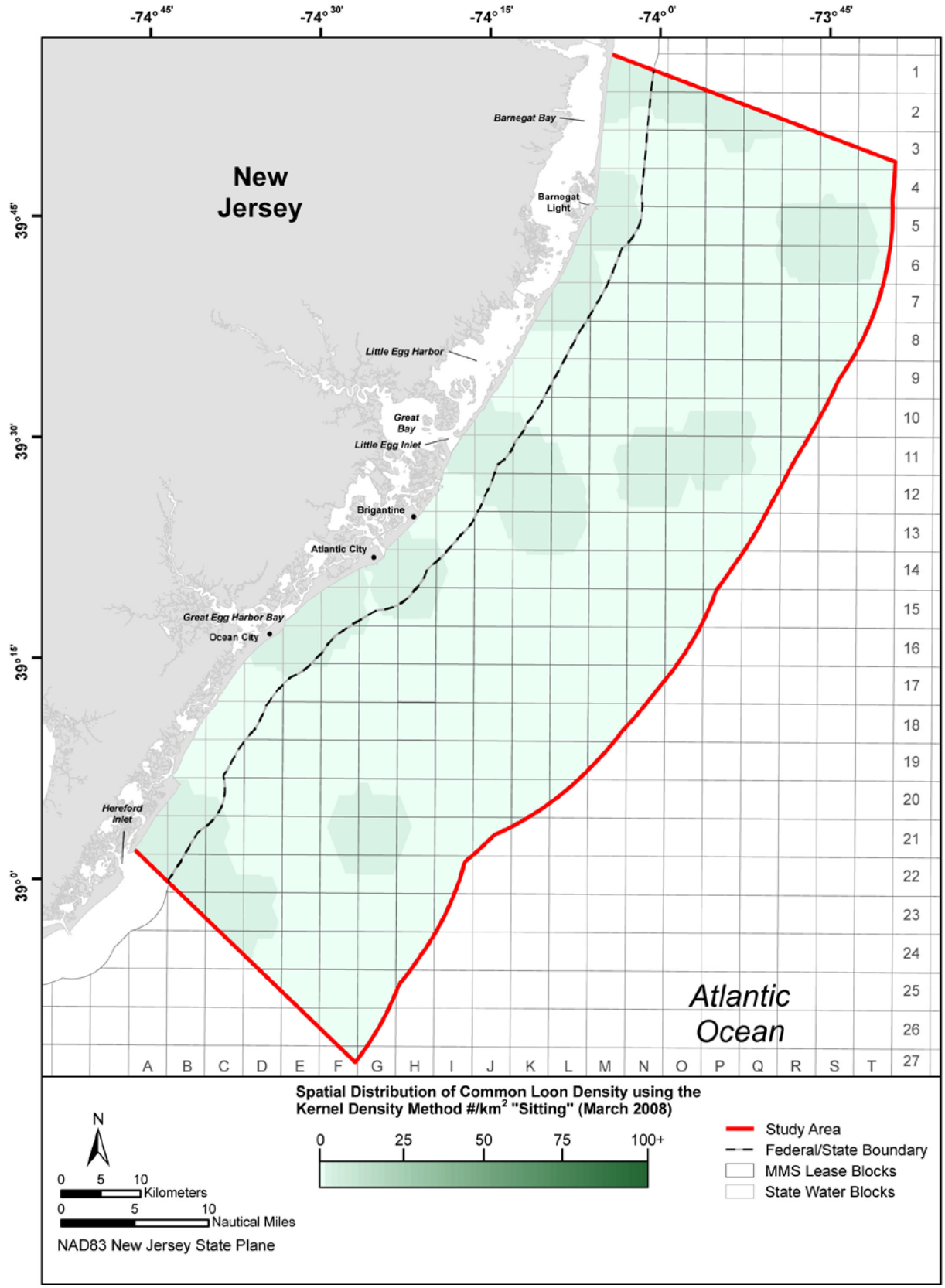

Figure M-266. Spatial distribution of Common Loon density (#/km^2) in the Study Area for sitting birds using the kernel density method (March 2008).

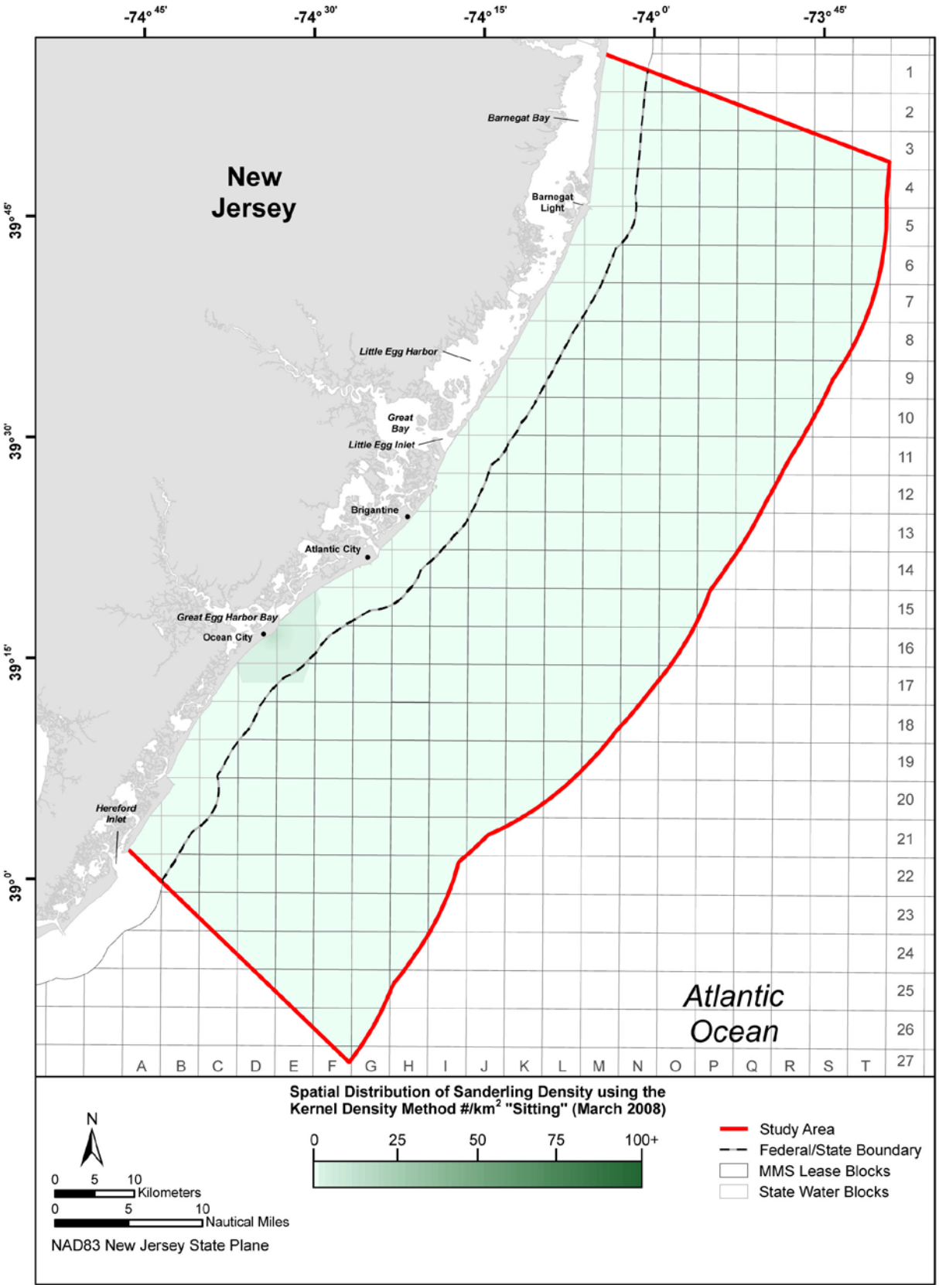

Figure M-267. Spatial distribution of Sanderling density (#/km^2) in the Study Area for sitting birds using the kernel density method (March 2008).

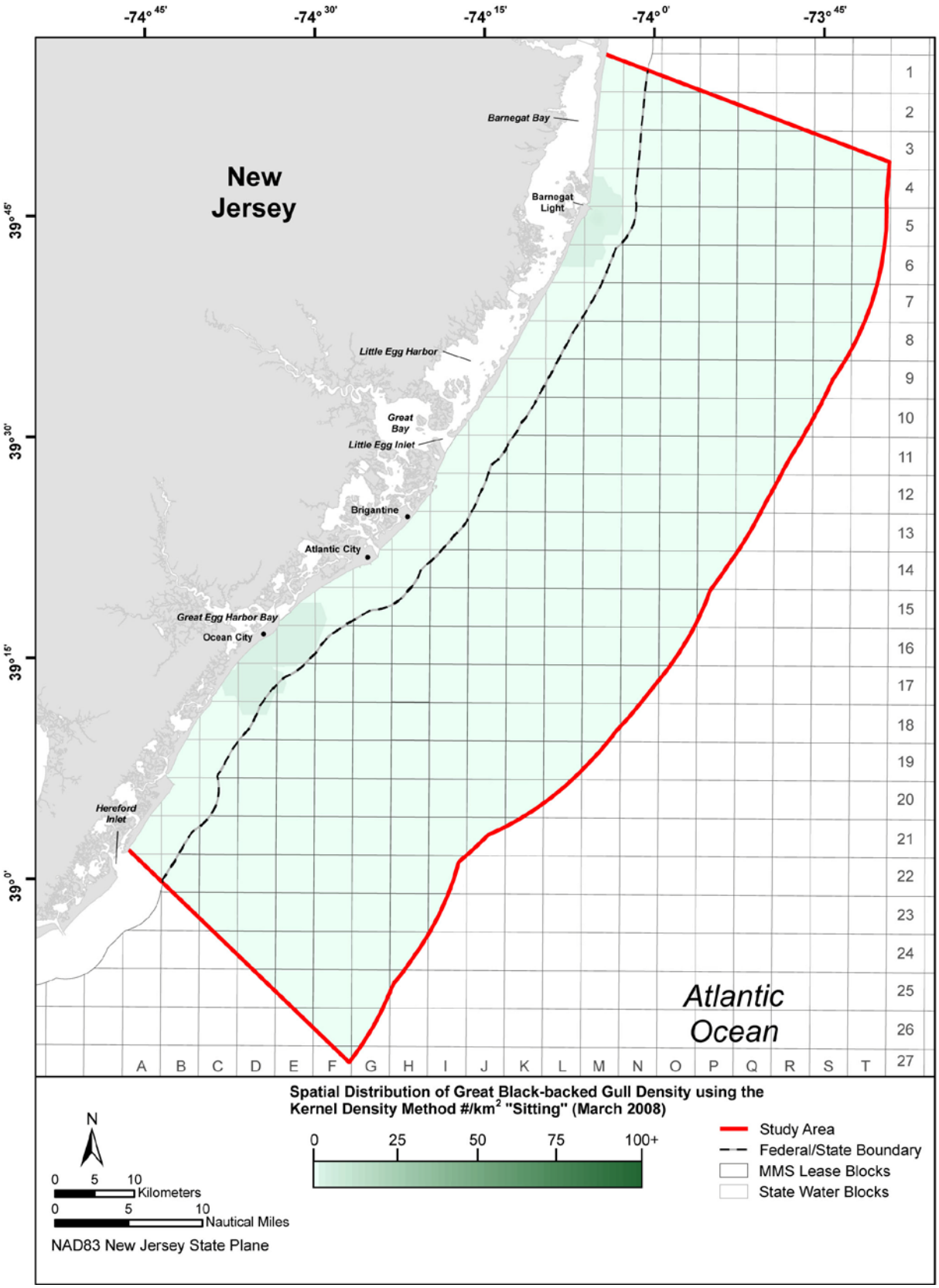

Figure M-268. Spatial distribution of Great Black-backed Gull density (#/km^2) in the Study Area for sitting birds using the kernel density method (March 2008).

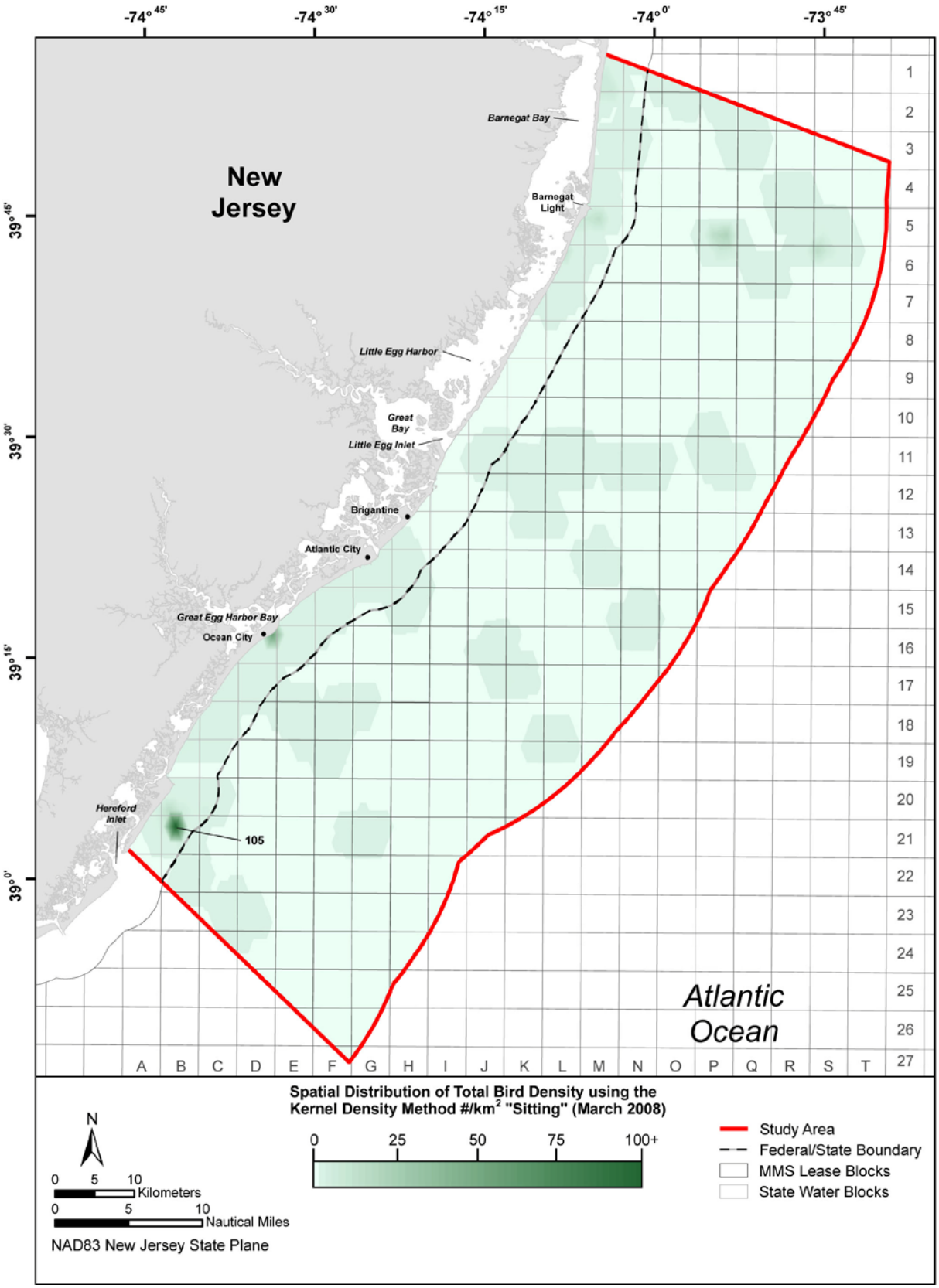

Figure M-269. Spatial distribution of total bird density (#/km^2) in the Study Area for sitting birds using the kernel density method (March 2008).

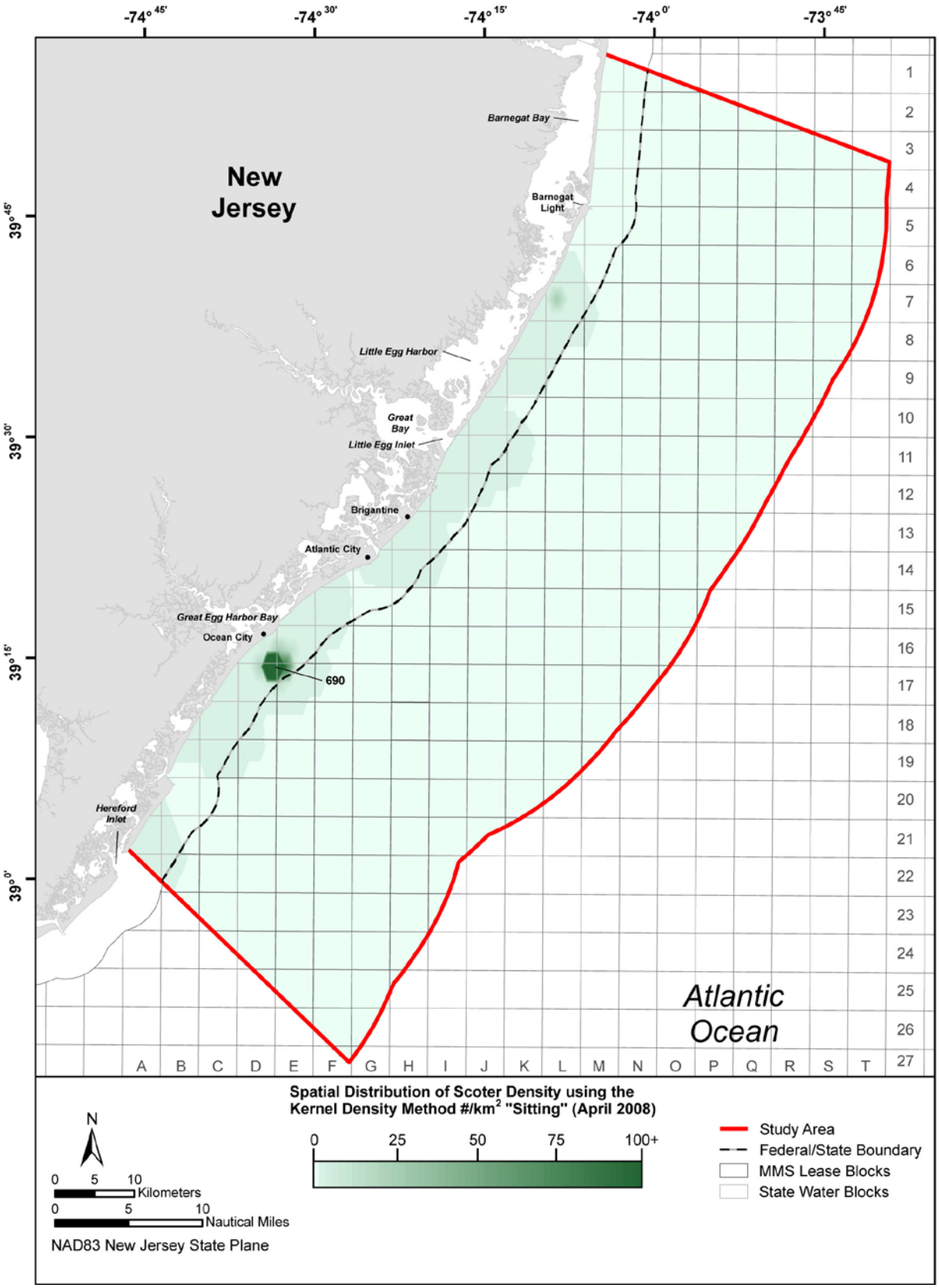

Figure M-270. Spatial distribution of scoter density (#/km^2) in the Study Area for sitting birds using the kernel density method (April 2008).

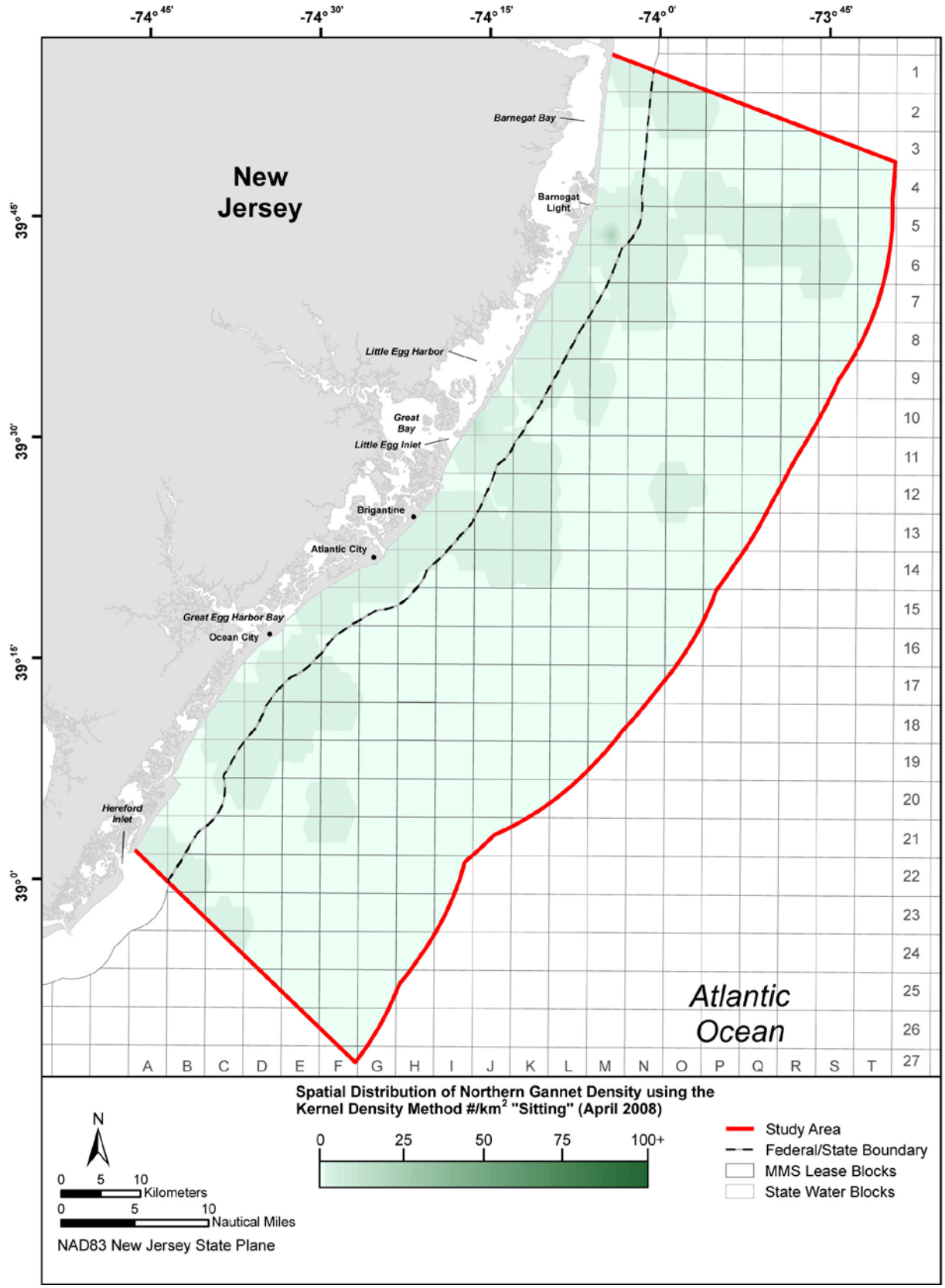

Figure M-271. Spatial distribution of Northern Gannet density (#/km^2) in the Study Area for sitting birds using the kernel density method (April 2008).

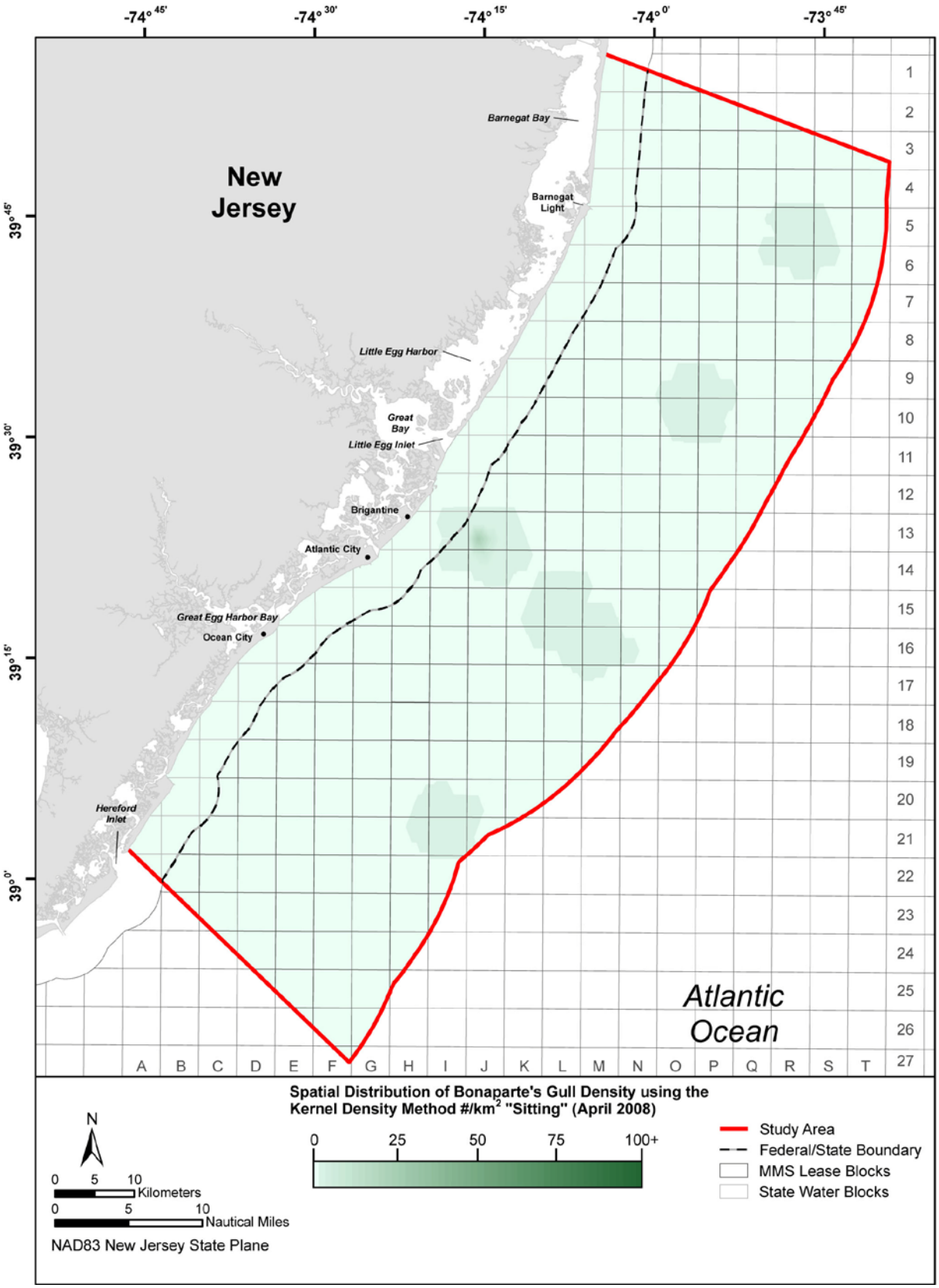

Figure M-272. Spatial distribution of Bonaparte's Gull density (#/km^2) in the Study Area for sitting birds using the kernel density method (April 2008).

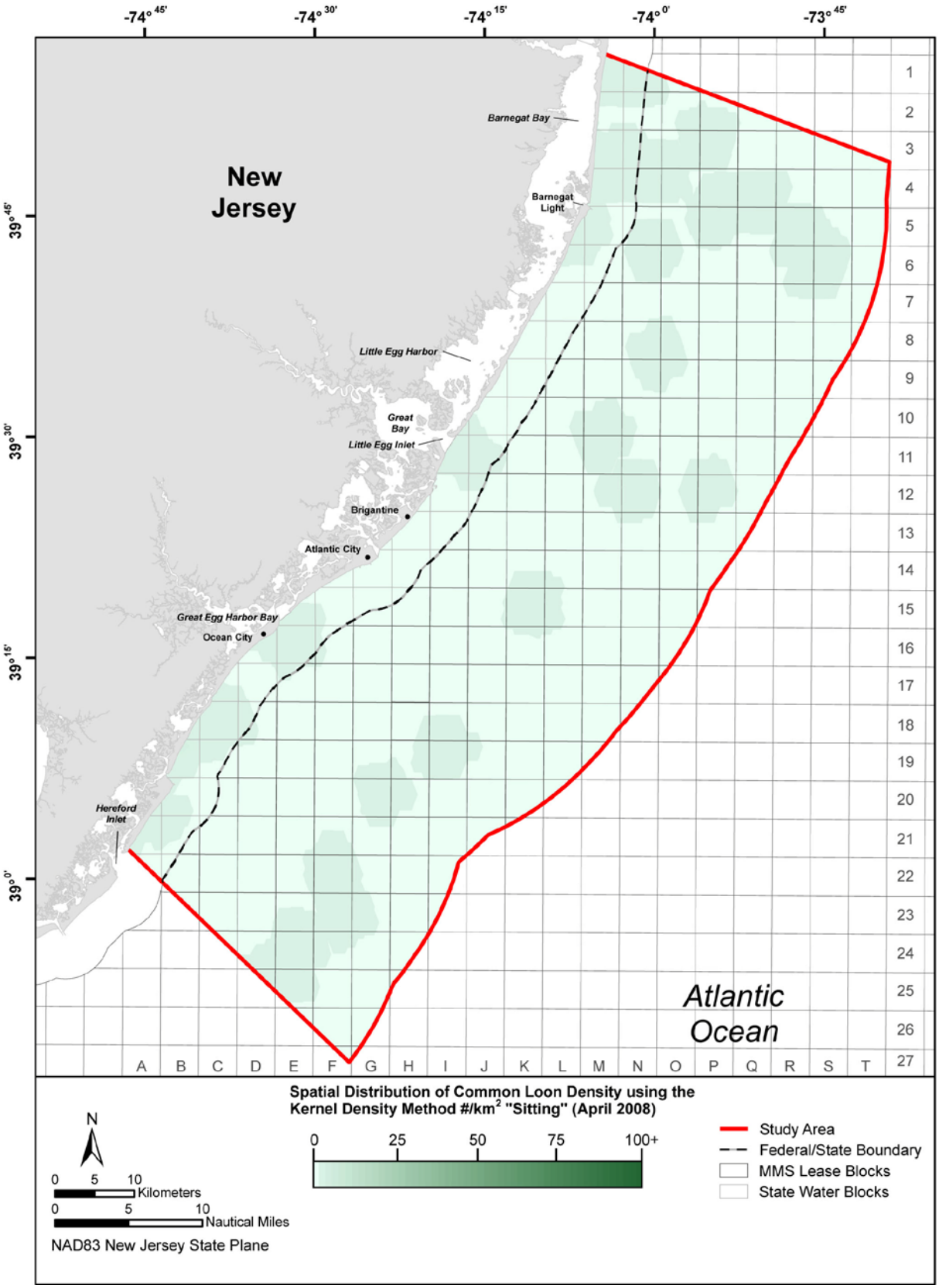

Figure M-273. Spatial distribution of Common Loon density (#/km^2) in the Study Area for sitting birds using the kernel density method (April 2008).

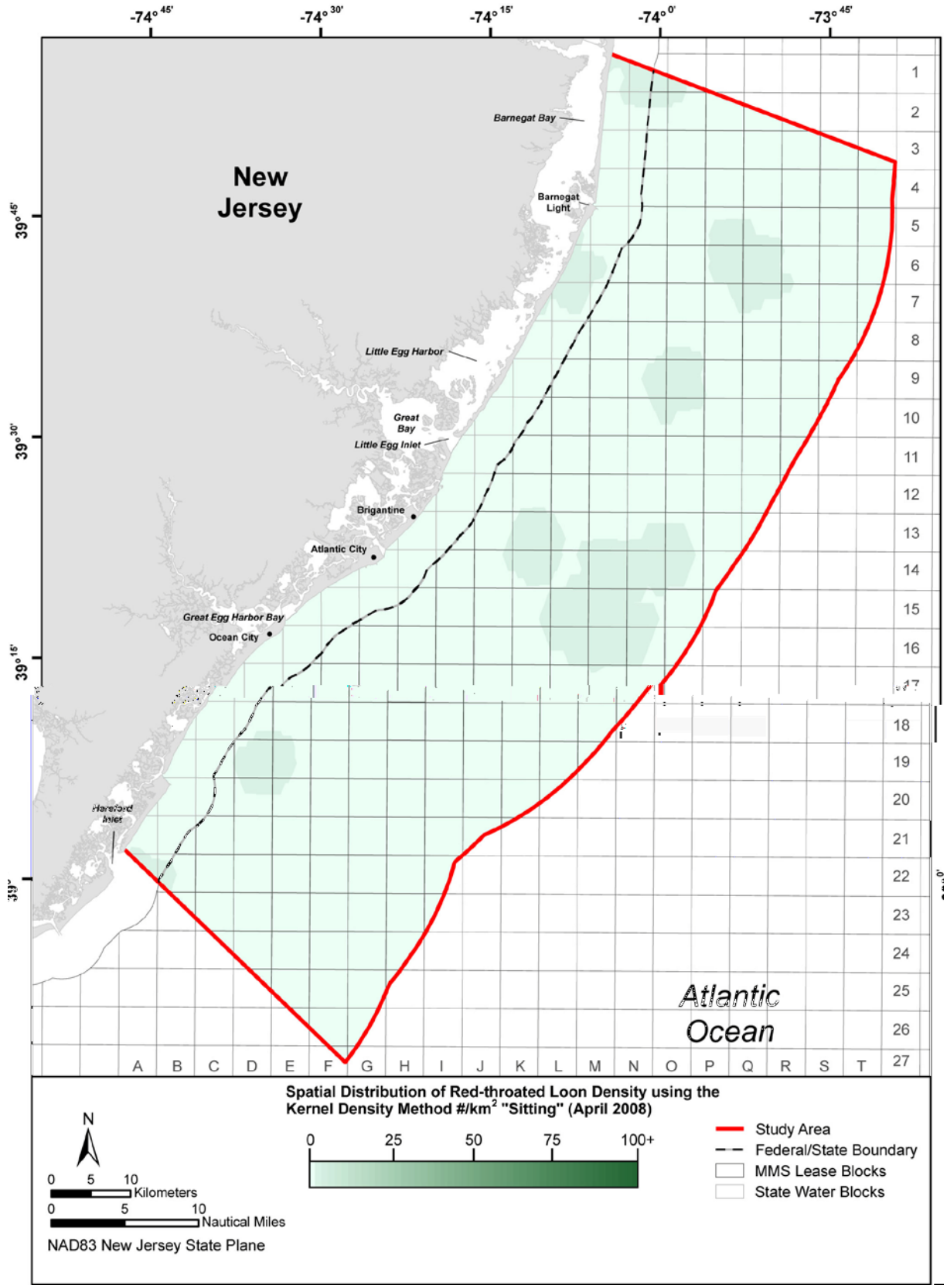

Figure M-274. Spatial distribution of Red-throated Loon density (#/km^2) in the Study Area for sitting birds using the kernel density method (April 2008).

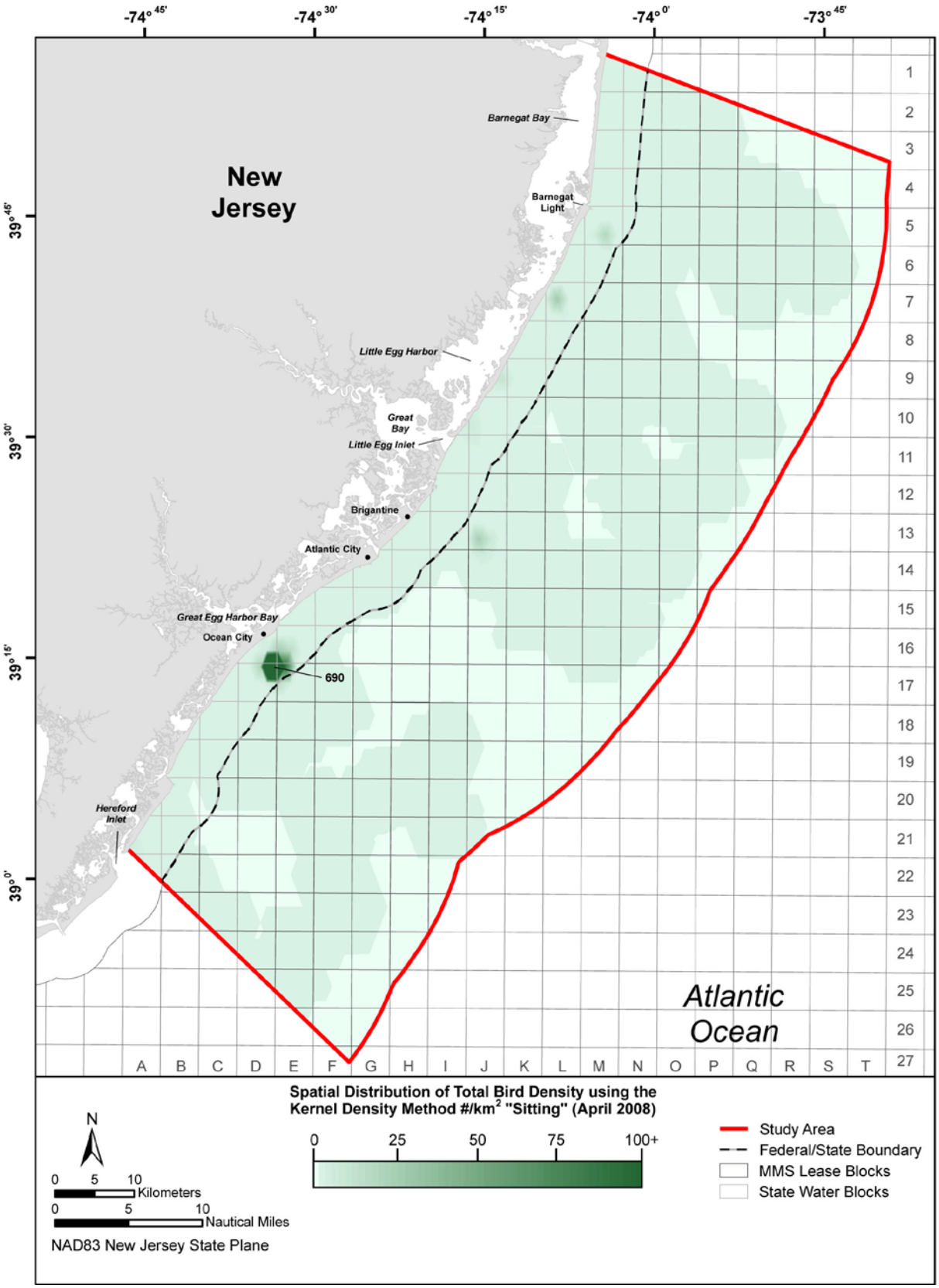

Figure M-275. Spatial distribution of total bird density (#/km^2) in the Study Area for sitting birds using the kernel density method (April 2008).

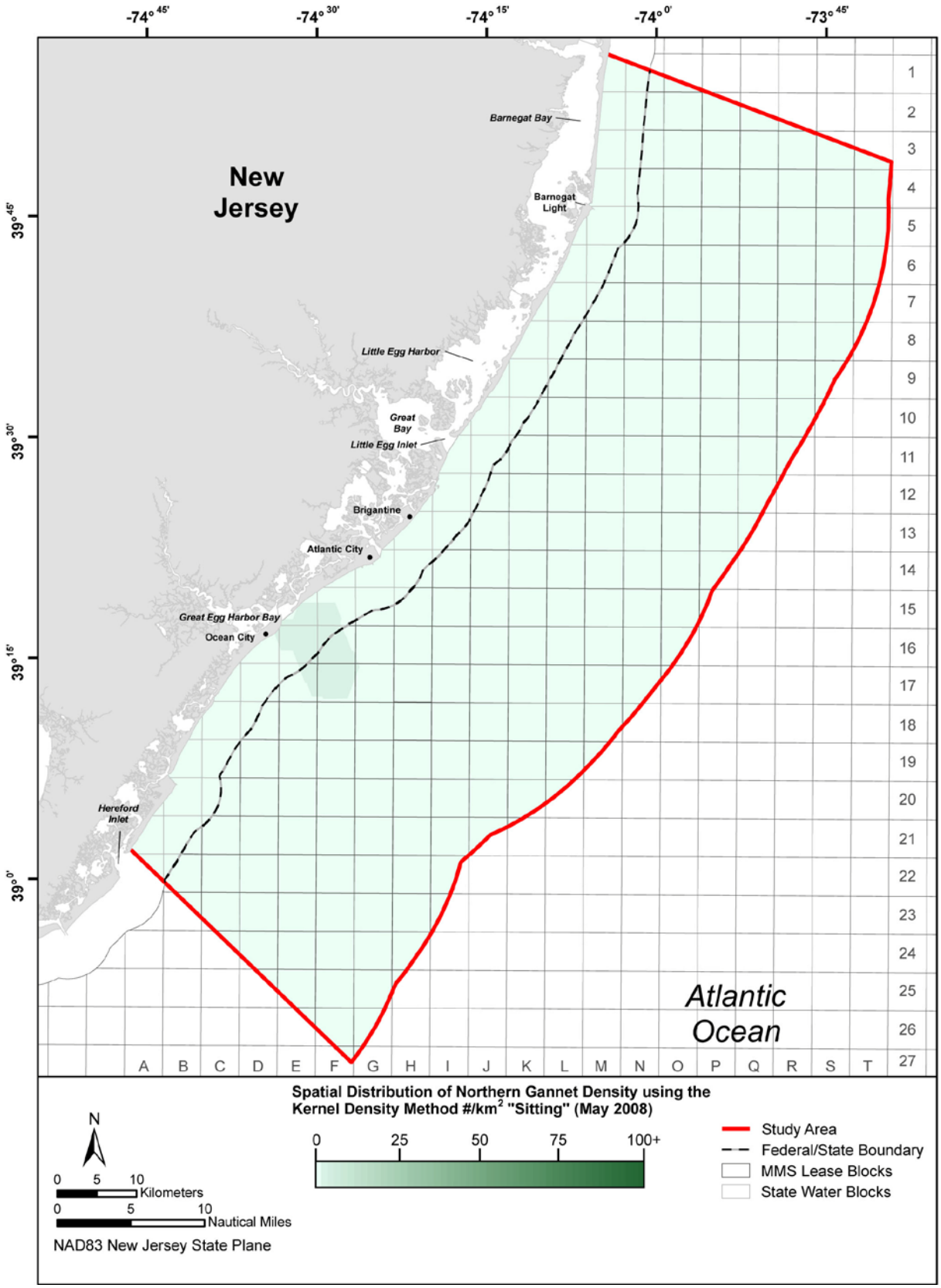

Figure M-276. Spatial distribution of Northern Gannet density (#/km^2) in the Study Area for sitting birds using the kernel density method (May 2008).

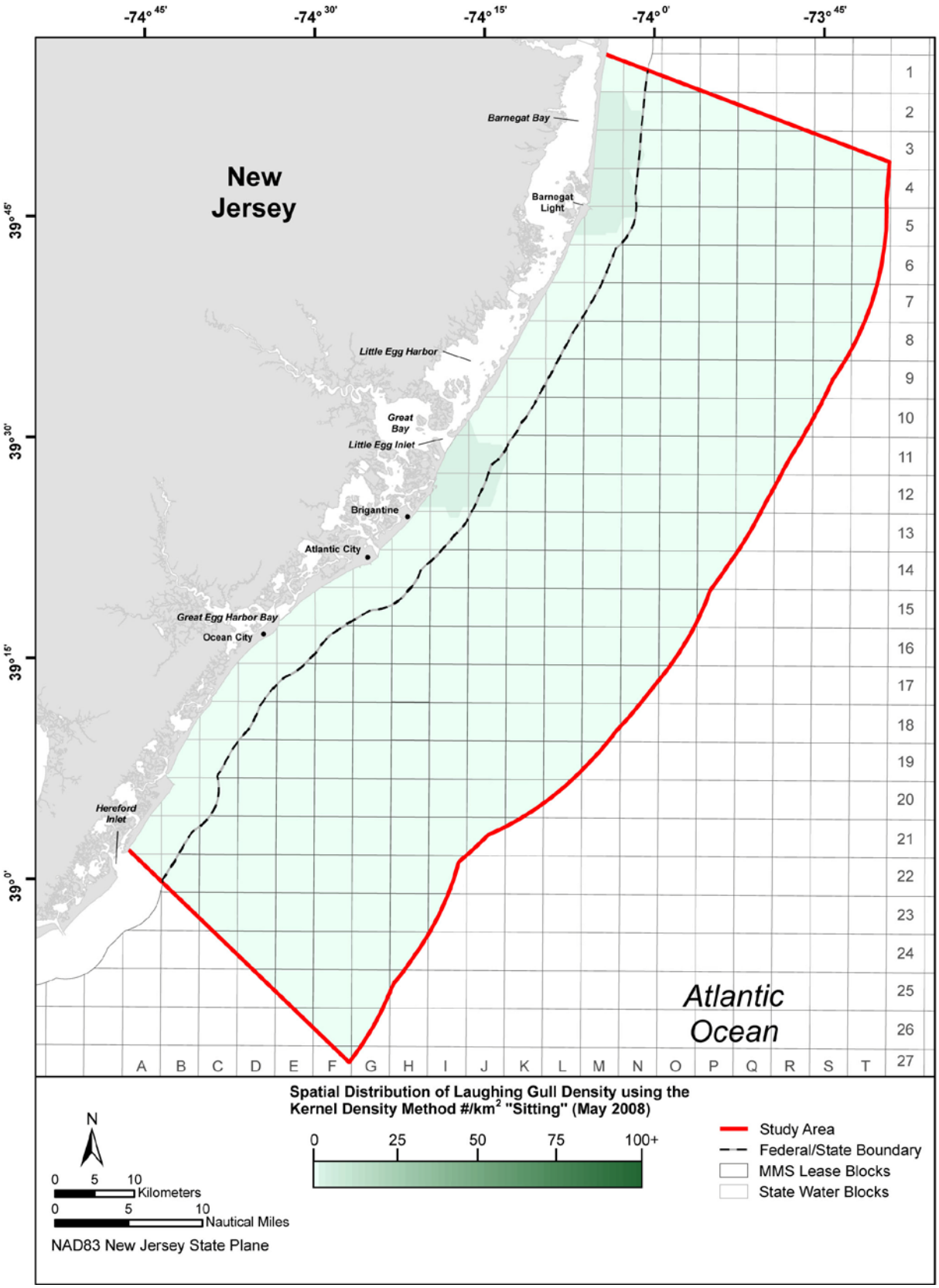

Figure M-277. Spatial distribution of Laughing Gull density (#/km^2) in the Study Area for sitting birds using the kernel density method (May 2008).

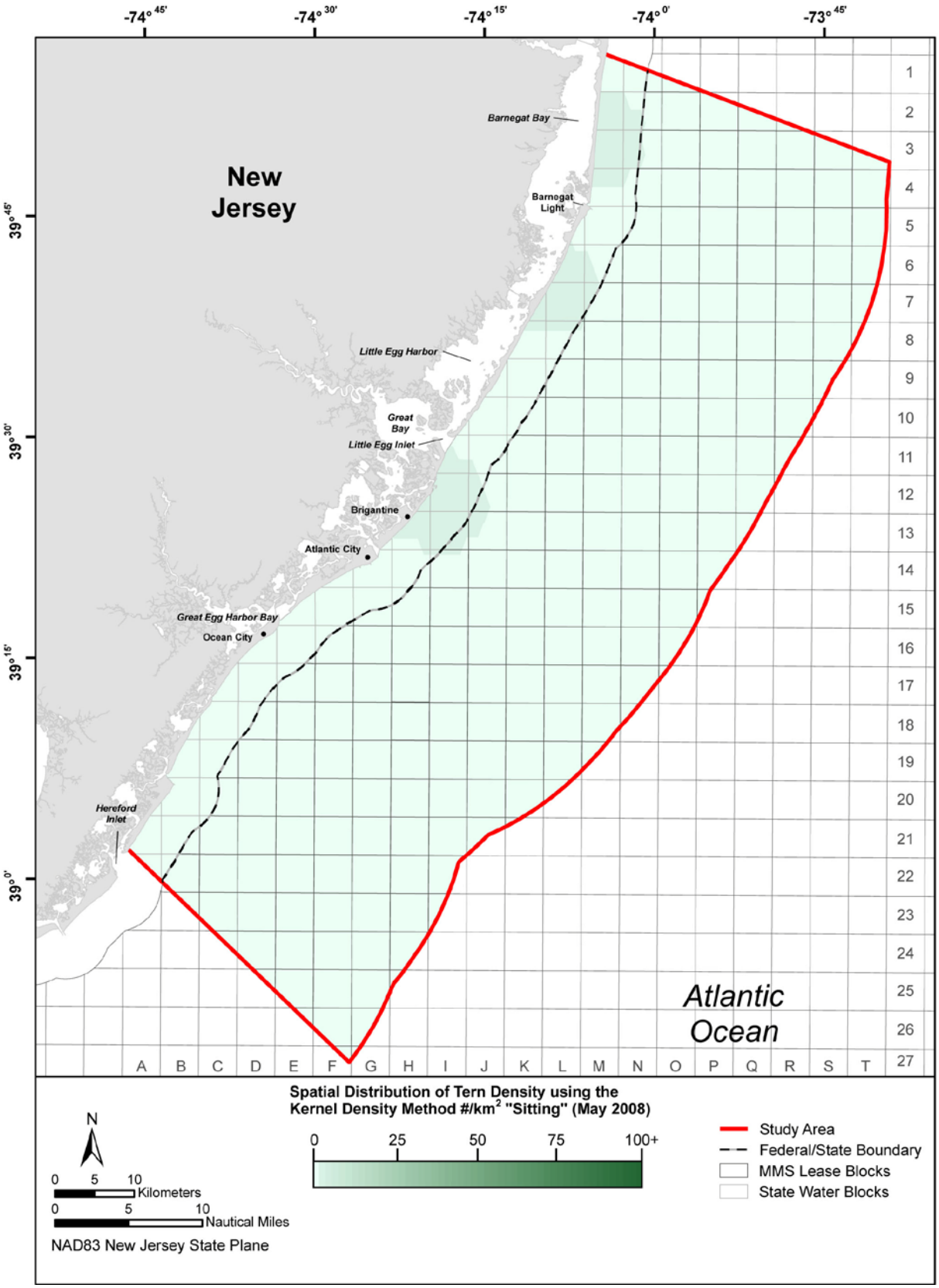

Figure M-278. Spatial distribution of tern density (#/km^2) in the Study Area for sitting birds using the kernel density method (May 2008).

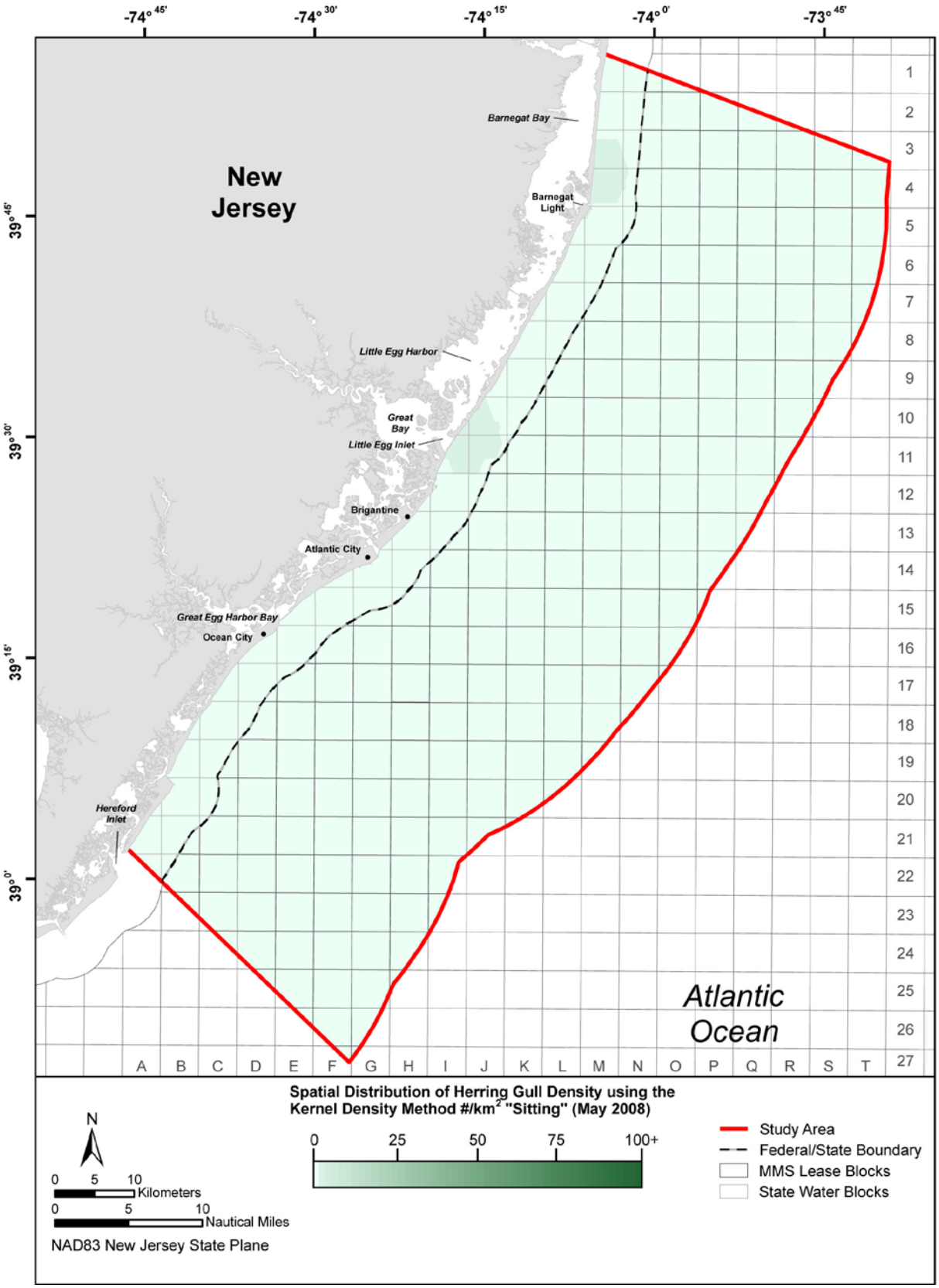

Figure M-279. Spatial distribution of Herring Gull density (#/km^2) in the Study Area for sitting birds using the kernel density method (May 2008).

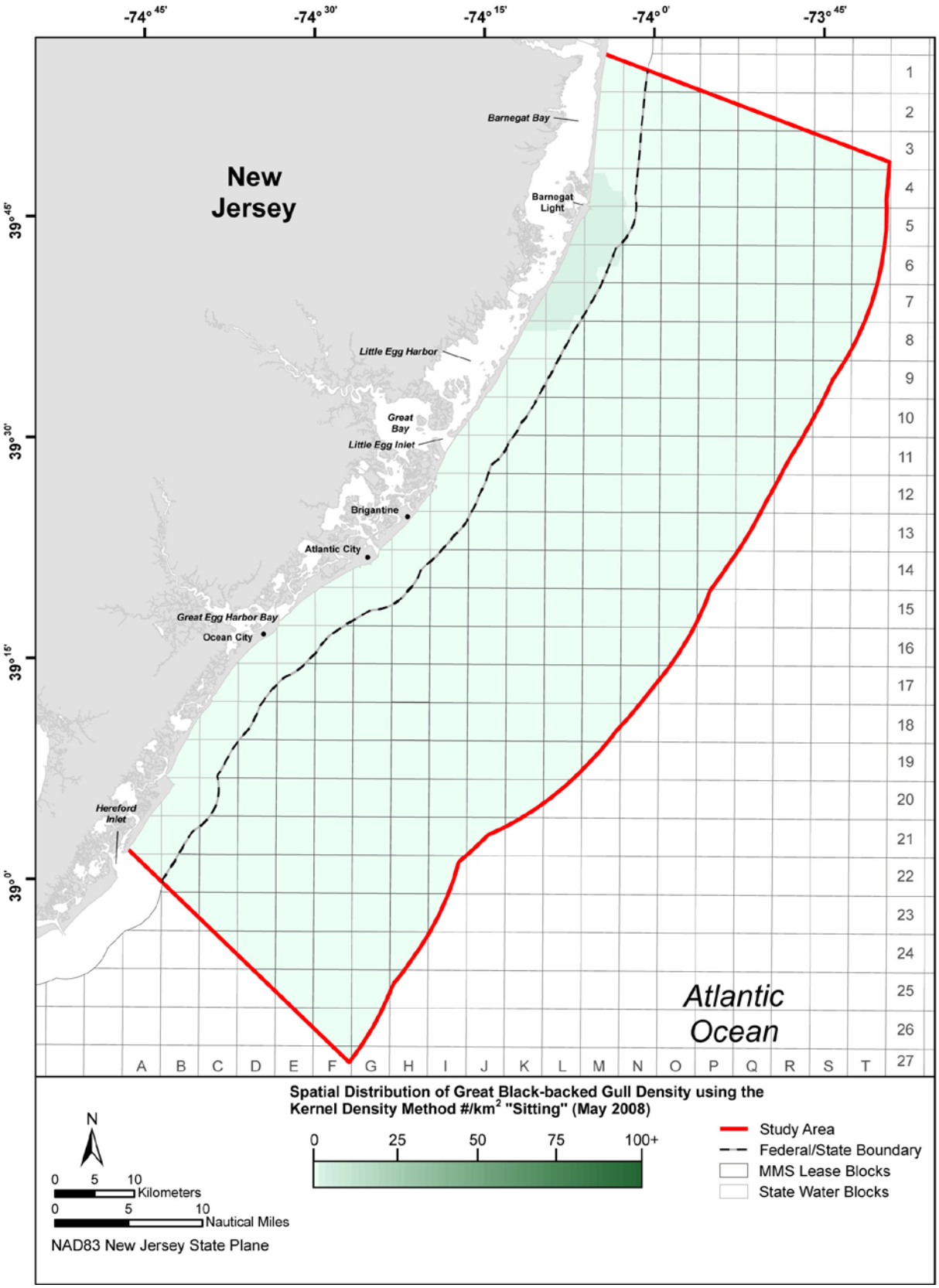

Figure M-280. Spatial distribution of Great Black-backed Gull density (#/km^2) in the Study Area for sitting birds using the kernel density method (May 2008).

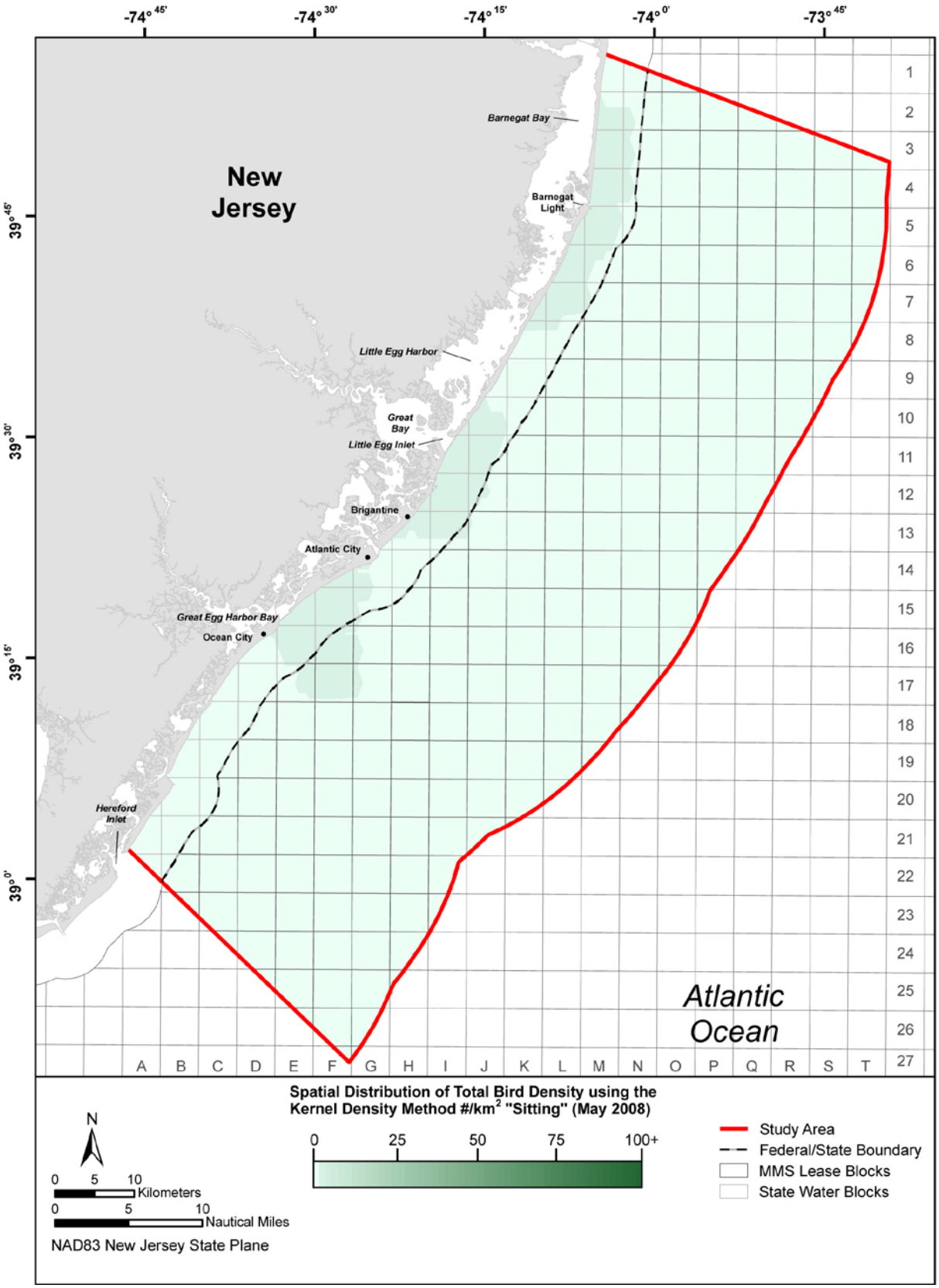

Figure M-281. Spatial distribution of total bird density (#/km^2) in the Study Area for sitting birds using the kernel density method (May 2008).

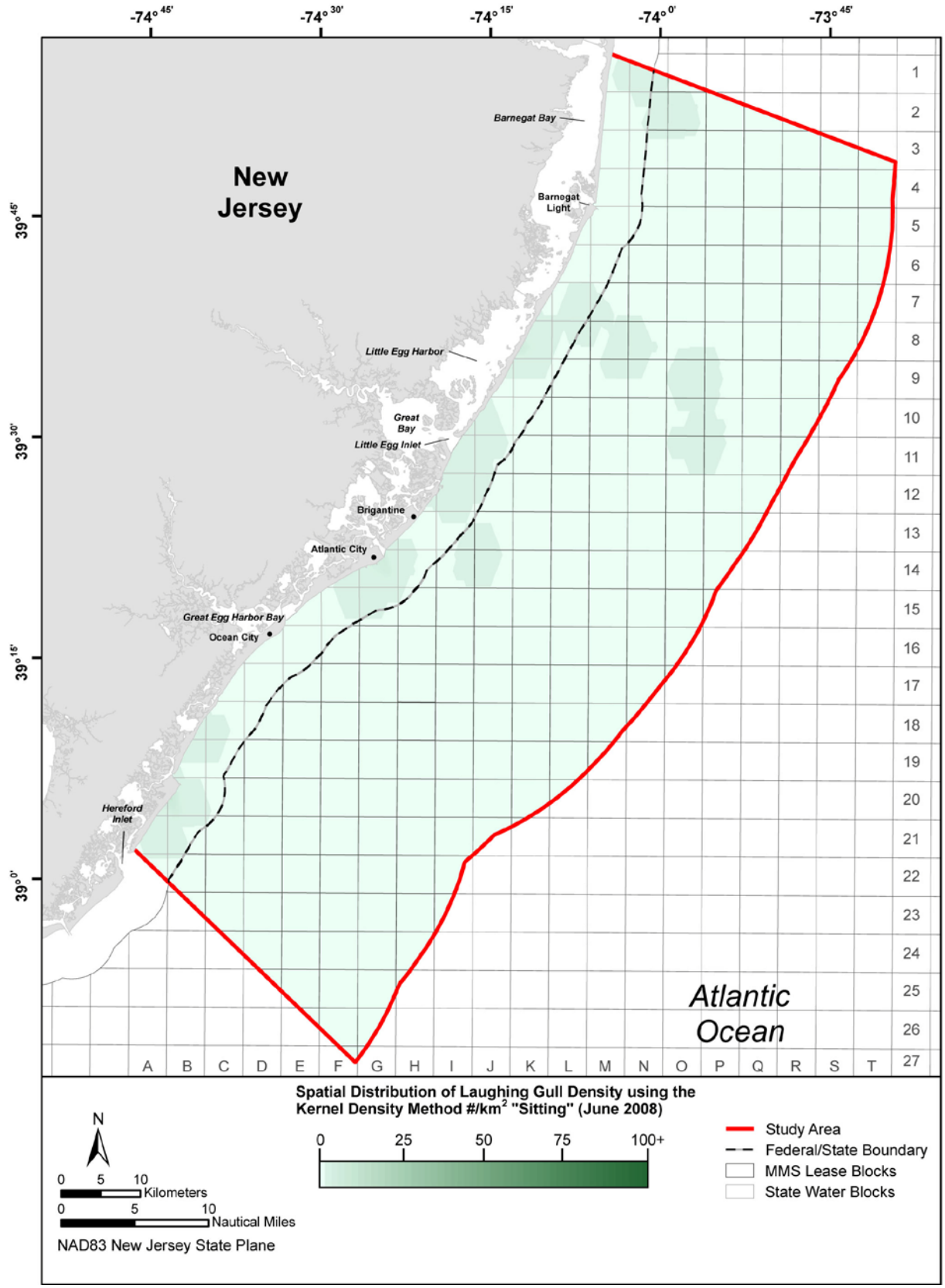

Figure M-282. Spatial distribution of Laughing Gull density (#/km^2) in the Study Area for sitting birds using the kernel density method (June 2008).

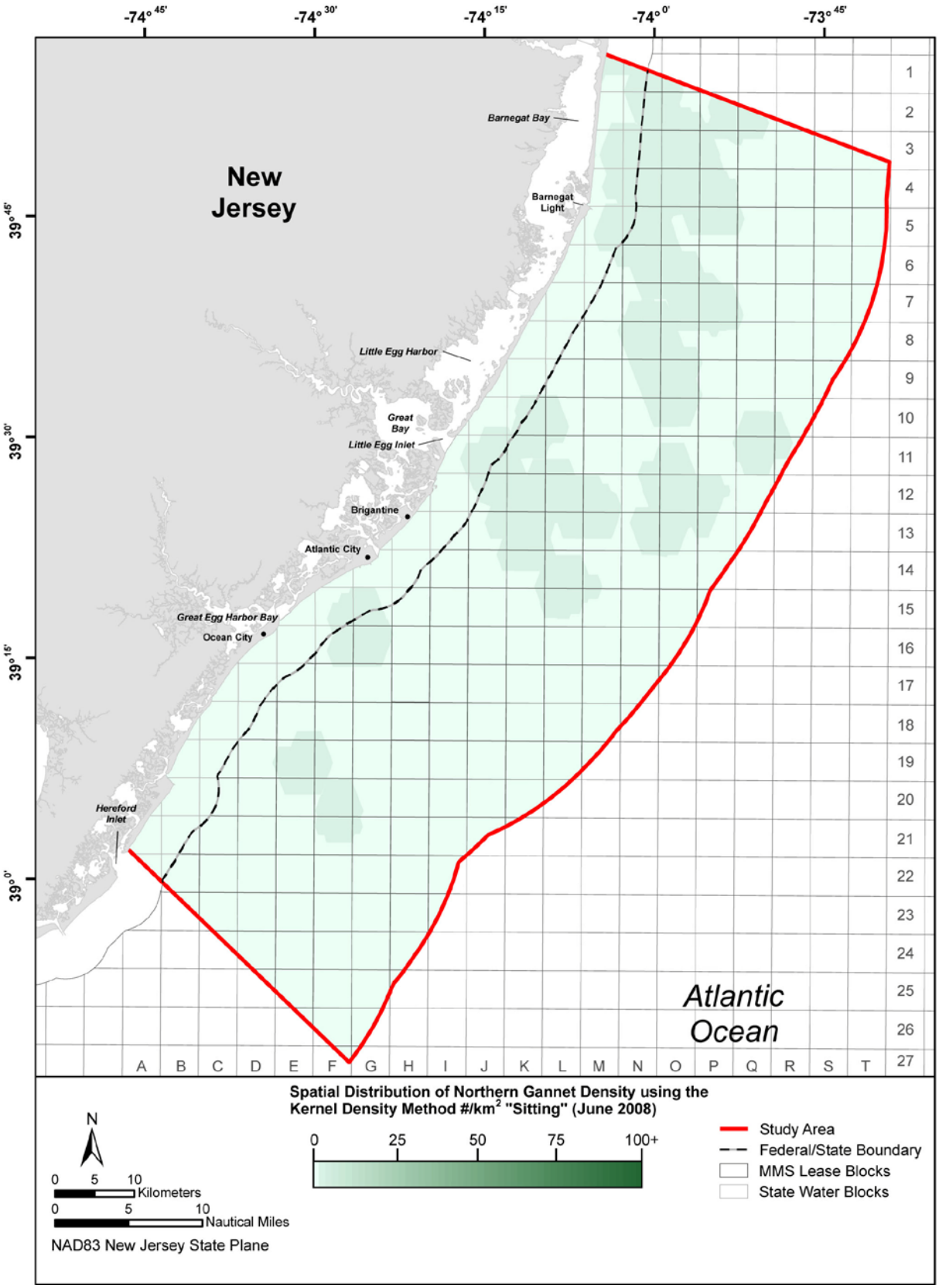

Figure M-283. Spatial distribution of Northern Gannet density (#/km^2) in the Study Area for sitting birds using the kernel density method (June 2008).

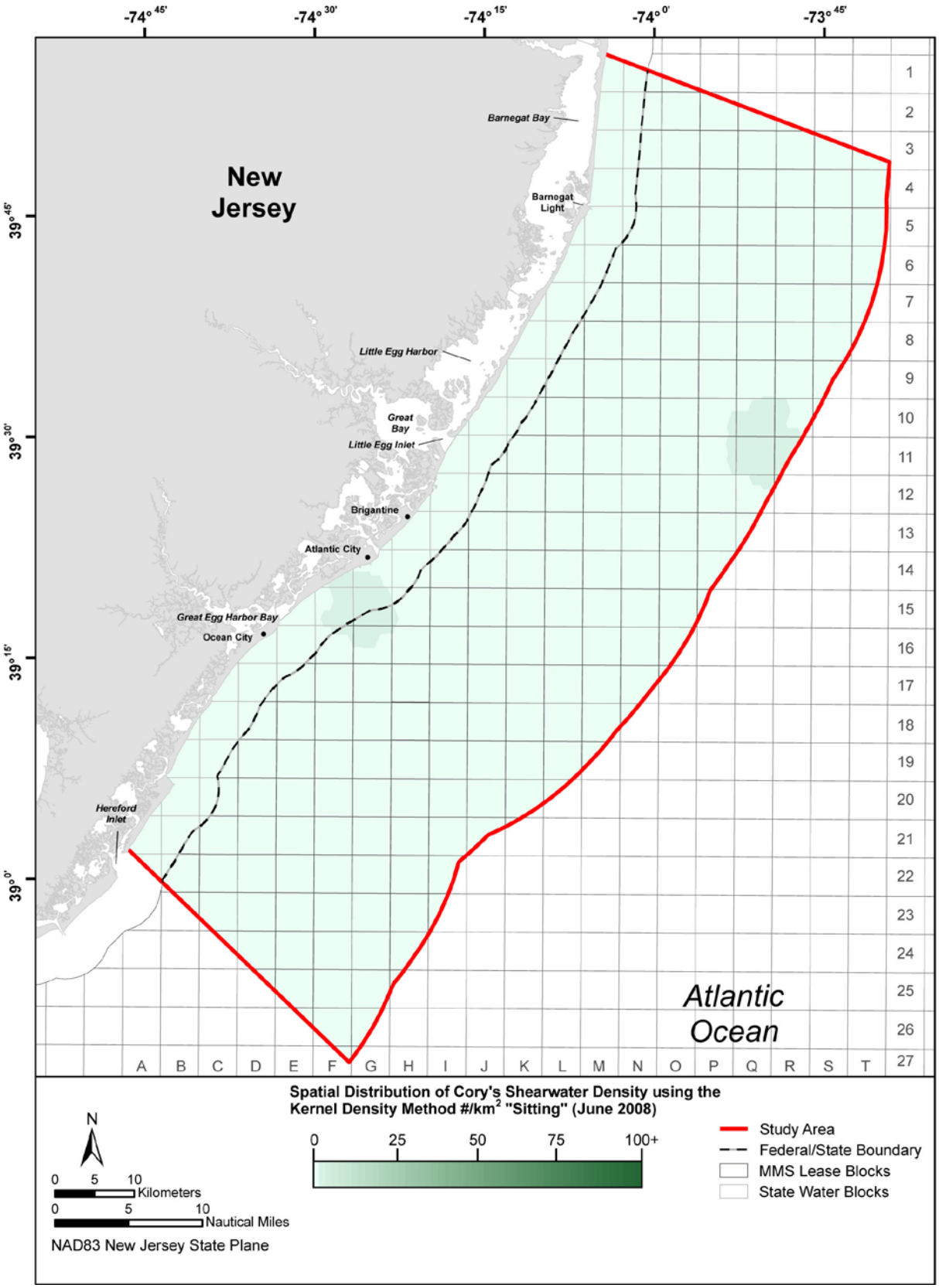

Figure M-284. Spatial distribution of Cory's Shearwater density (#/km^2) in the Study Area for sitting birds using the kernel density method (June 2008).

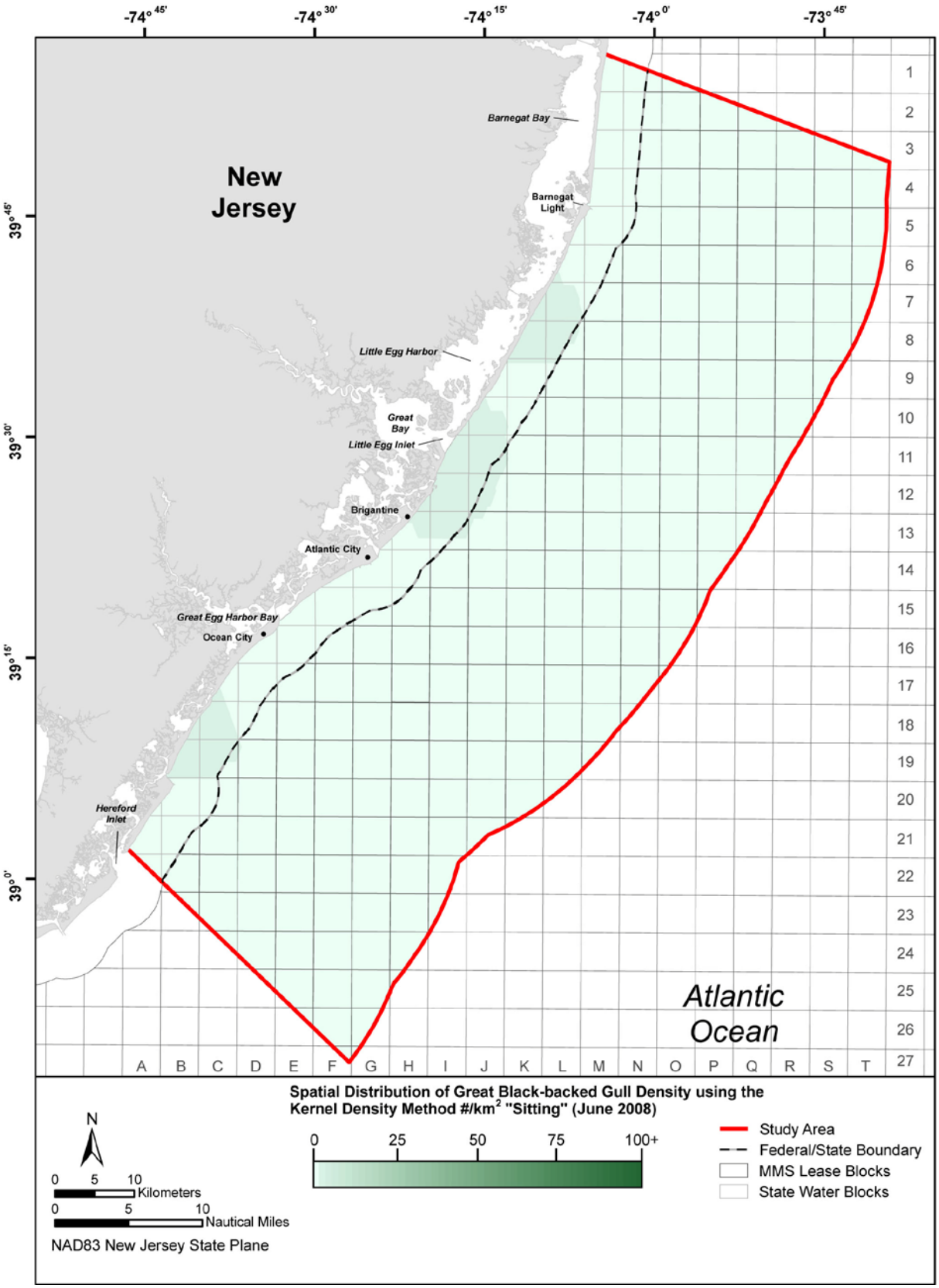

Figure M-285. Spatial distribution of Great Black-backed Gull density (#/km^2) in the Study Area for sitting birds using the kernel density method (June 2008).

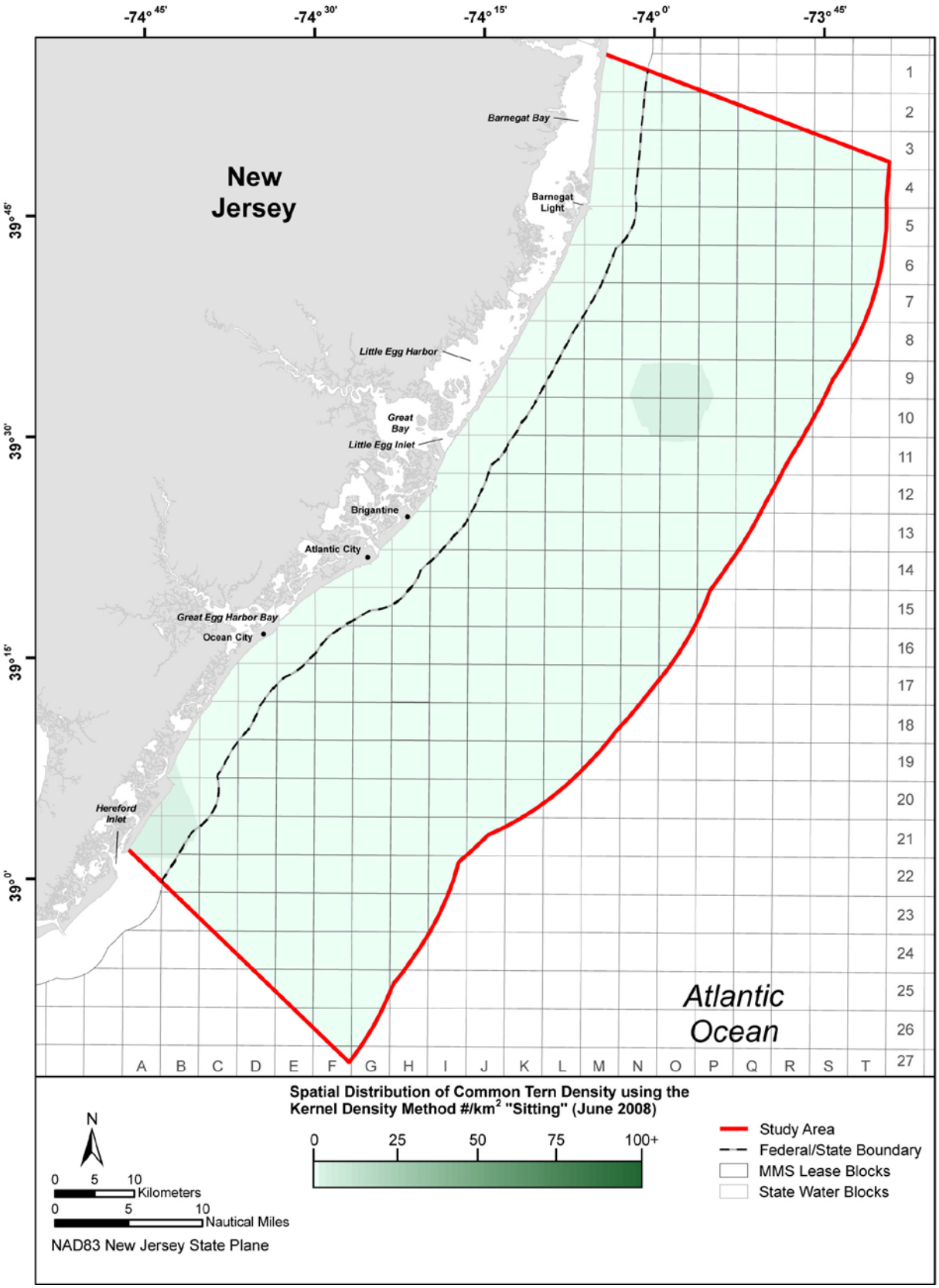

Figure M-286. Spatial distribution of Common Tern density (#/km^2) in the Study Area for sitting birds using the kernel density method (June 2008).

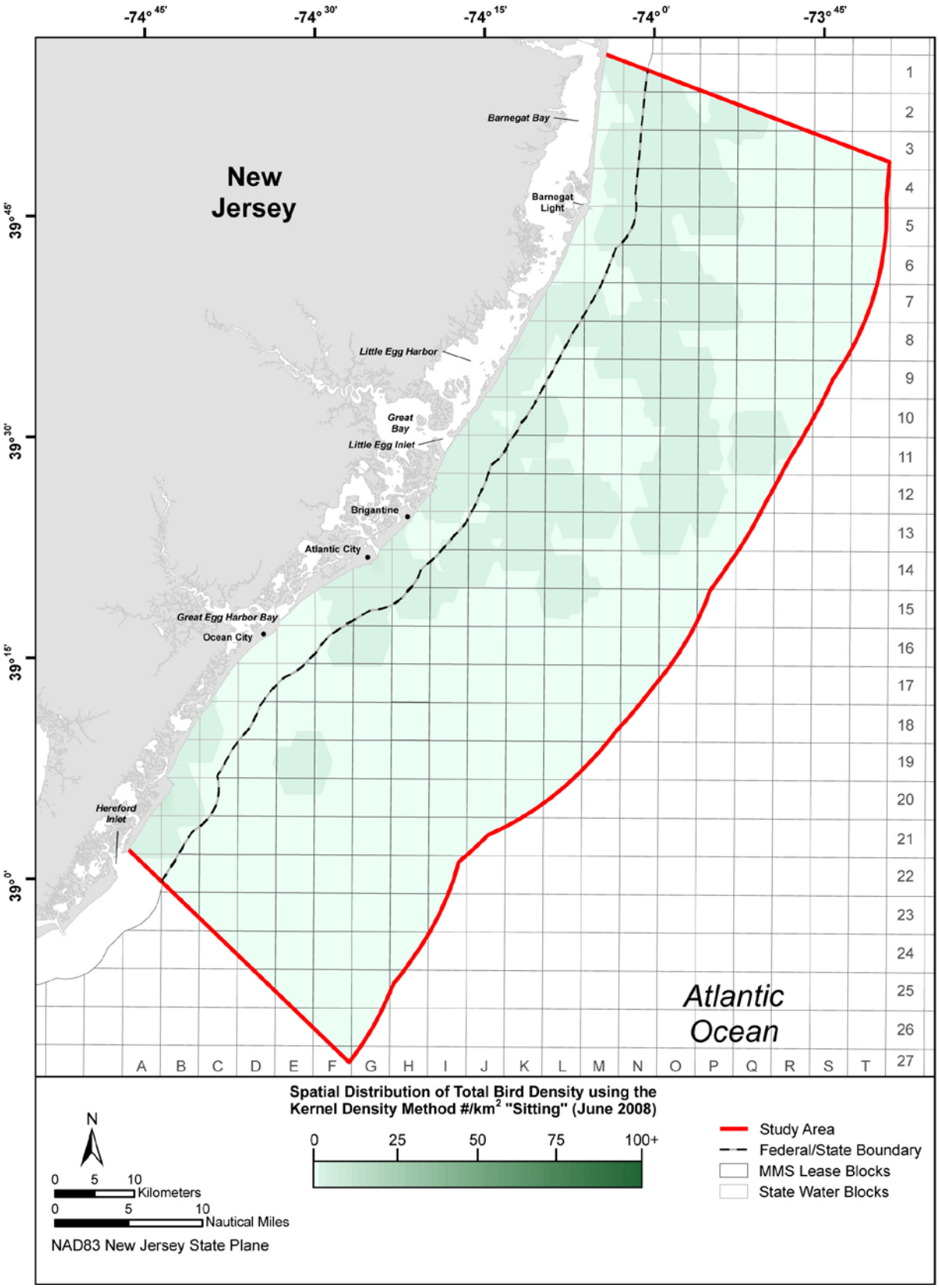

Figure M-287. Spatial distribution of total bird density (#/km^2) in the Study Area for sitting birds using the kernel density method (June 2008).

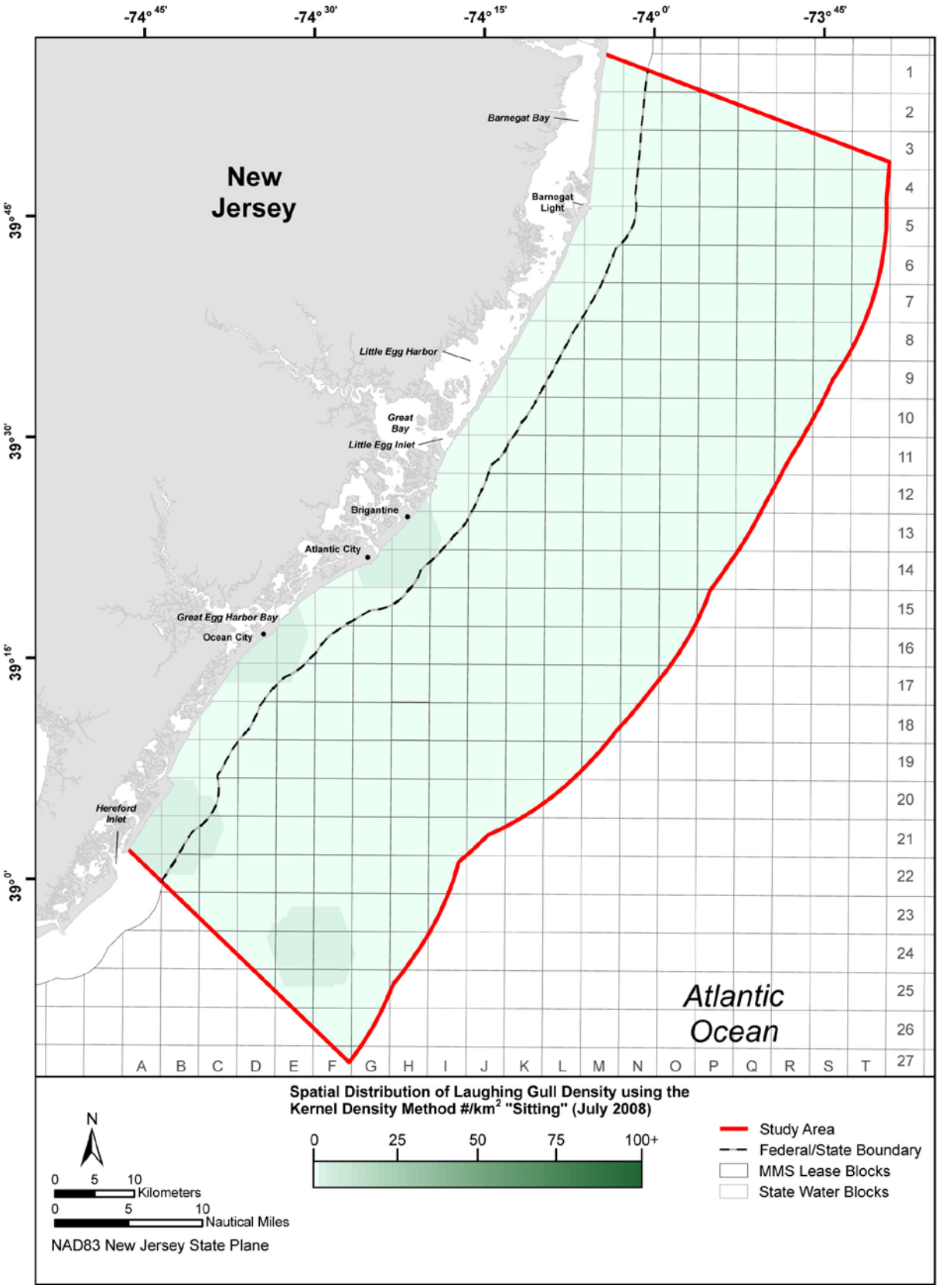

Figure M-288. Spatial distribution of Laughing Gull density (#/km^2) in the Study Area for sitting birds using the kernel density method (July 2008).

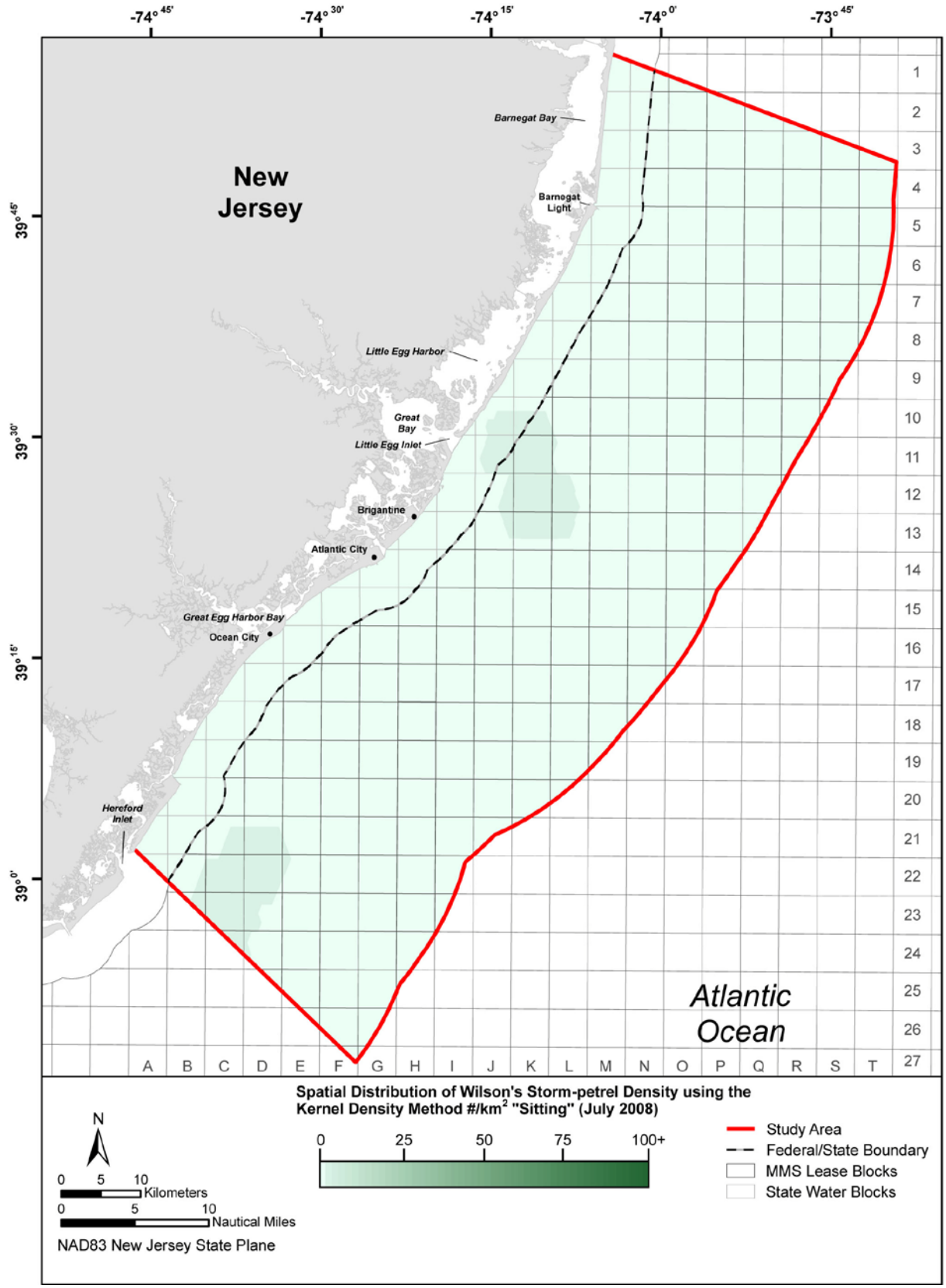

Figure M-289. Spatial distribution of Wilson's Storm-Petrel density (#/km^2) in the Study Area for sitting birds using the kernel density method (July 2008).

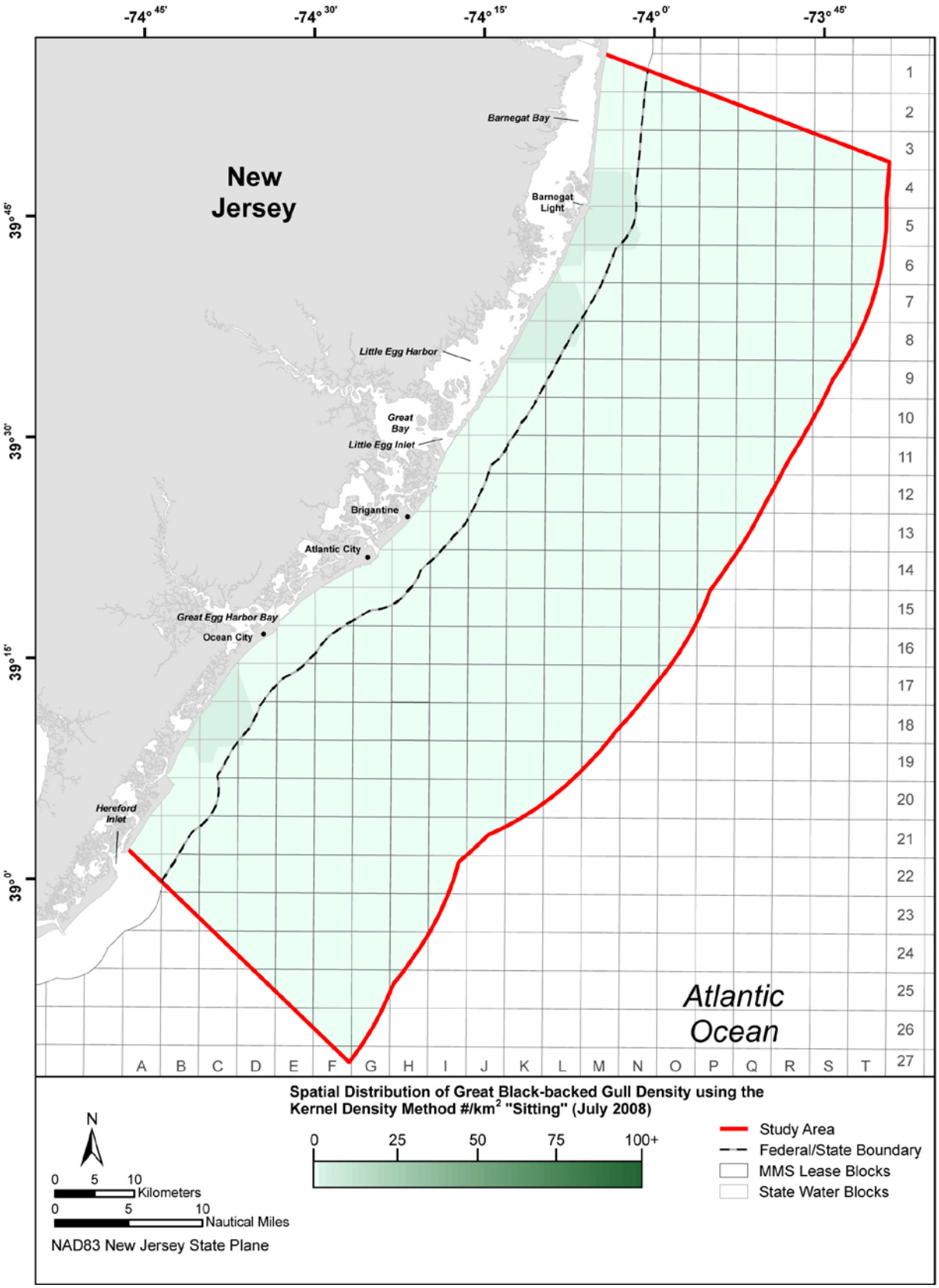

Figure M-290. Spatial distribution of Great Black-backed Gull density (#/km^2) in the Study Area for sitting birds using the kernel density method (July 2008).

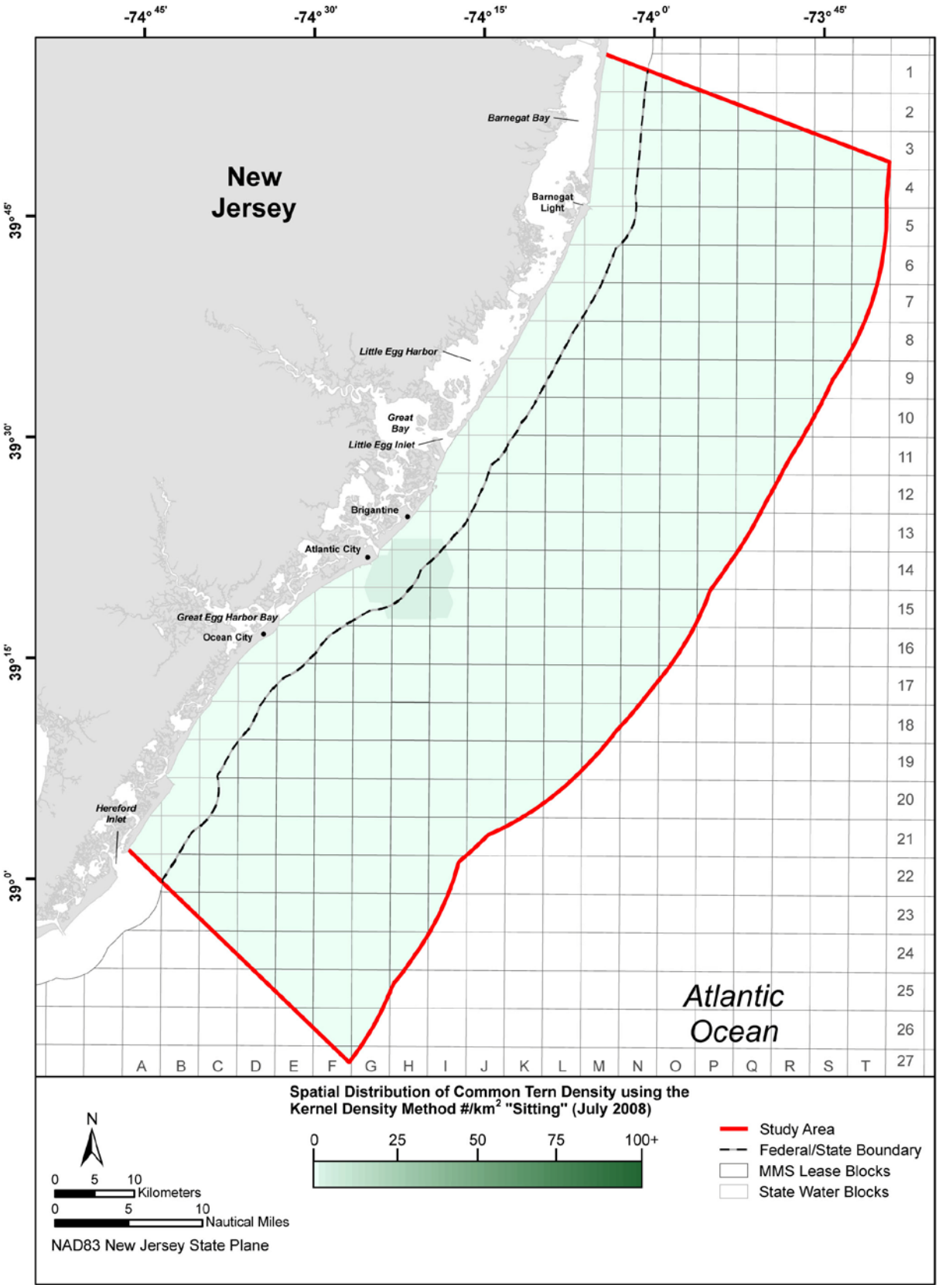

Figure M-291. Spatial distribution of Common Tern density (#/km^2) in the Study Area for sitting birds using the kernel density method (July 2008).

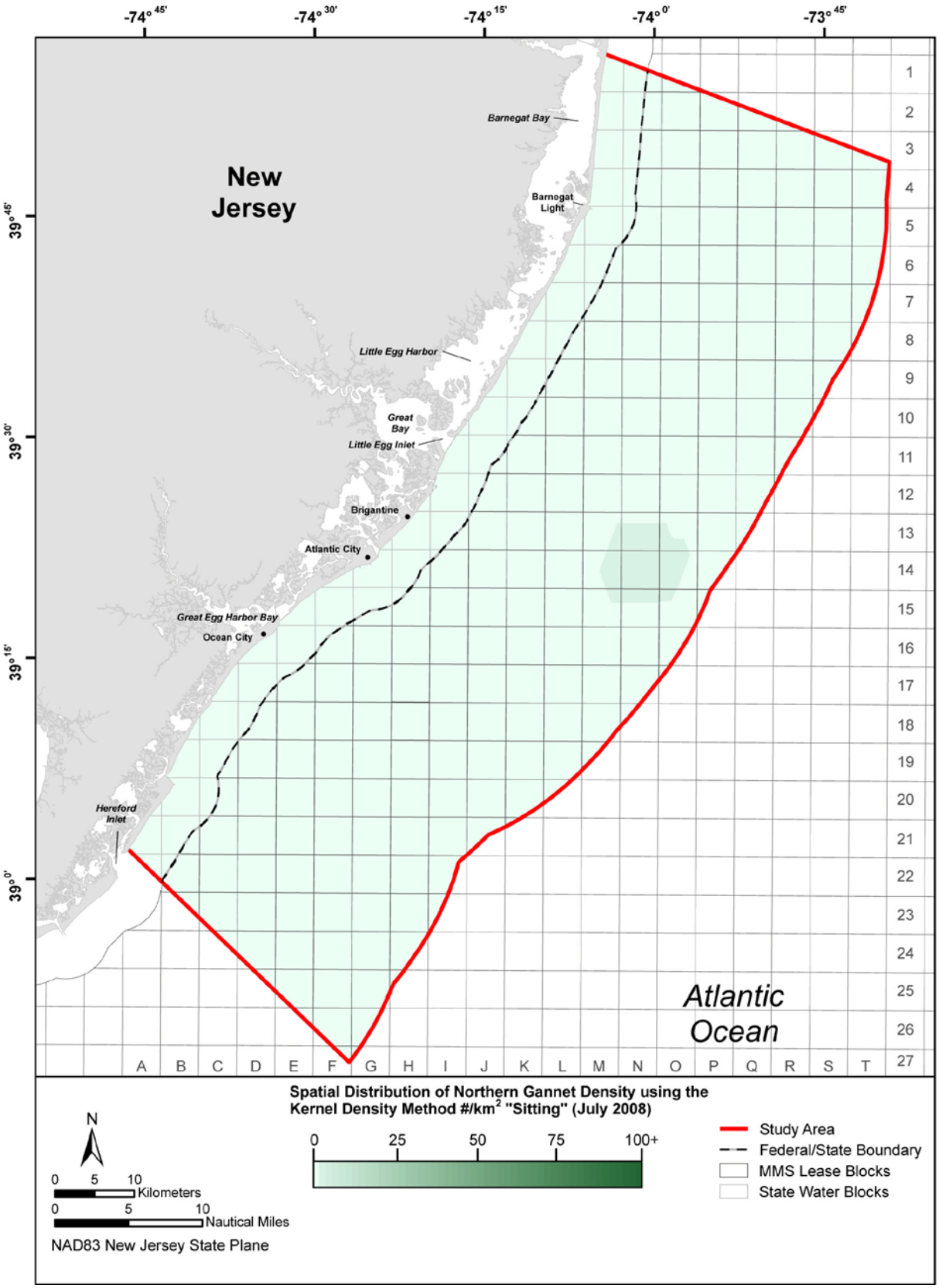

Figure M-292. Spatial distribution of Northern Gannet density (#/km^2) in the Study Area for sitting birds using the kernel density method (July 2008).

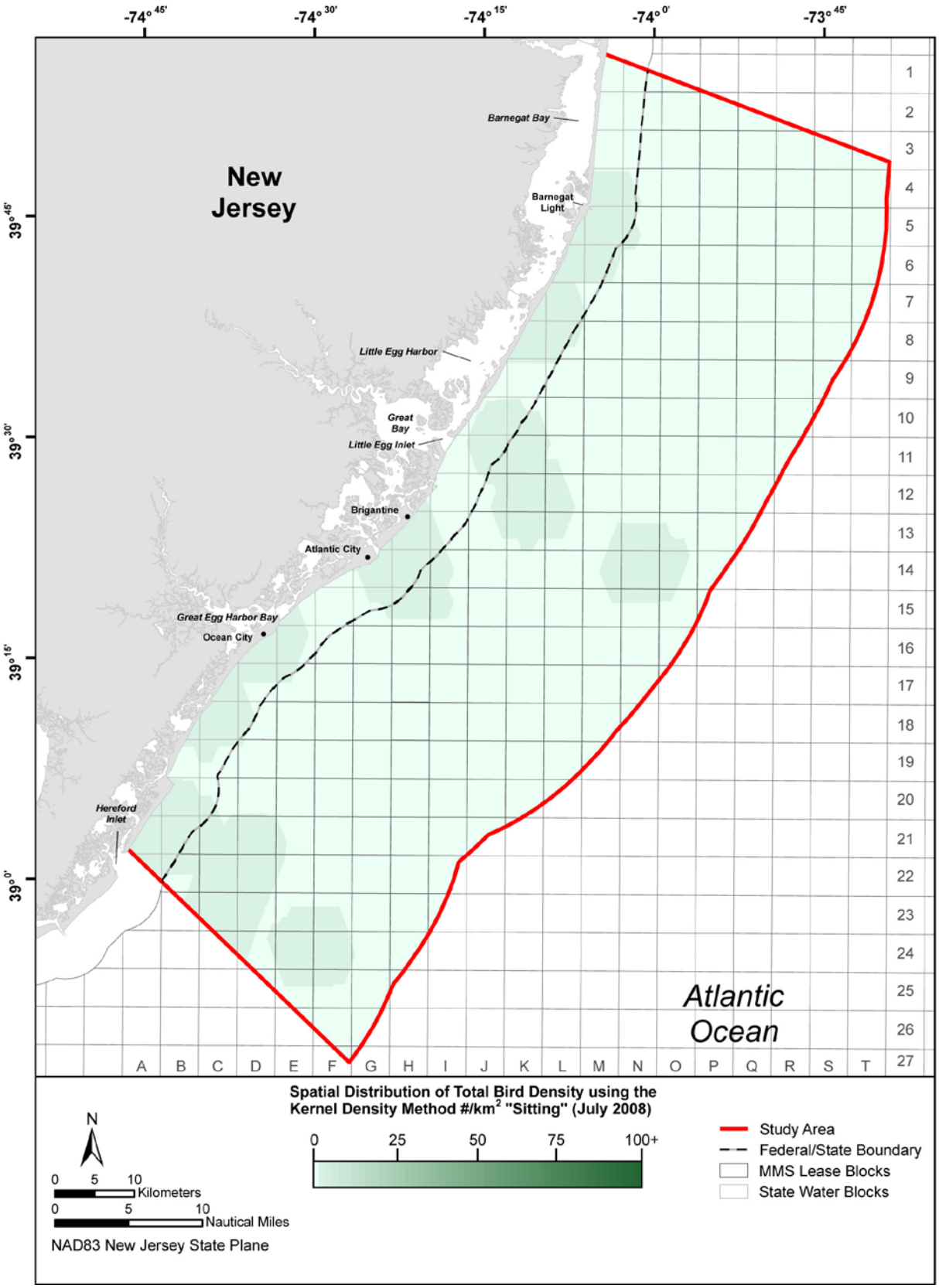

Figure M-293. Spatial distribution of total bird density (#/km^2) in the Study Area for sitting birds using the kernel density method (July 2008).

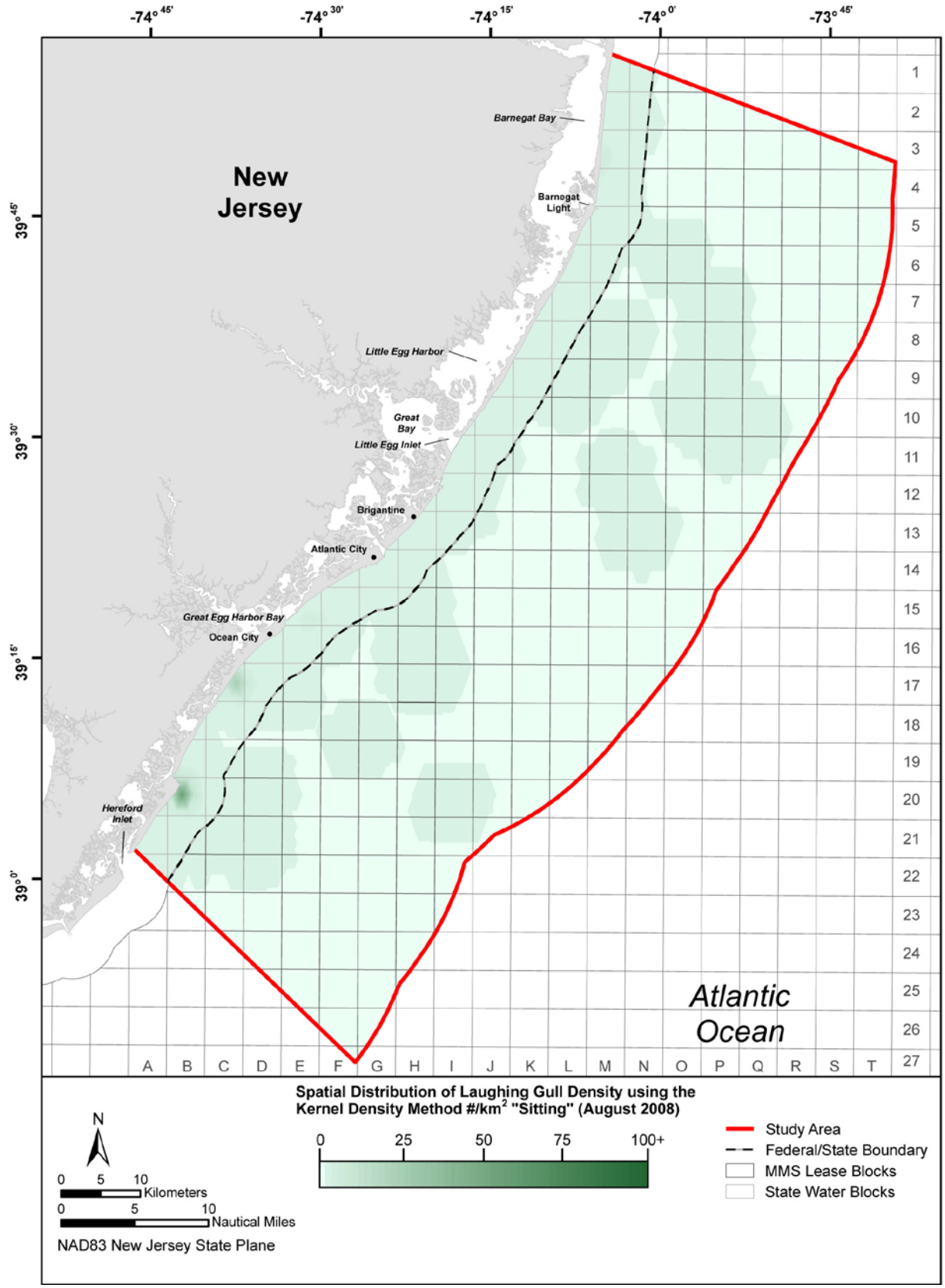

Figure M-294. Spatial distribution of Laughing Gull density (#/km^2) in the Study Area for sitting birds using the kernel density method (August 2008).

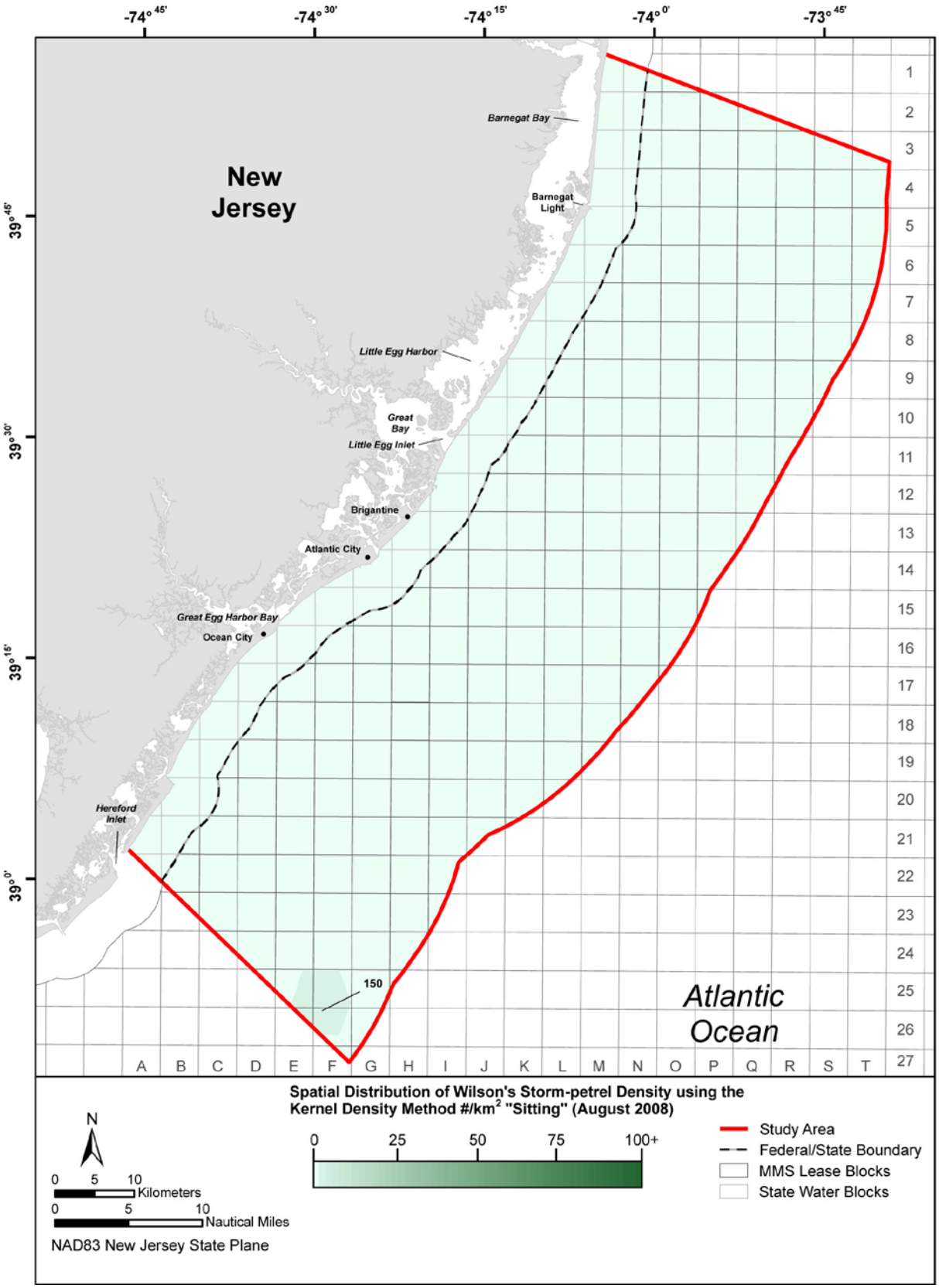

Figure M-295. Spatial distribution of Wilson's Storm-Petrel density (#/km^2) in the Study Area for sitting birds using the kernel density method (August 2008).

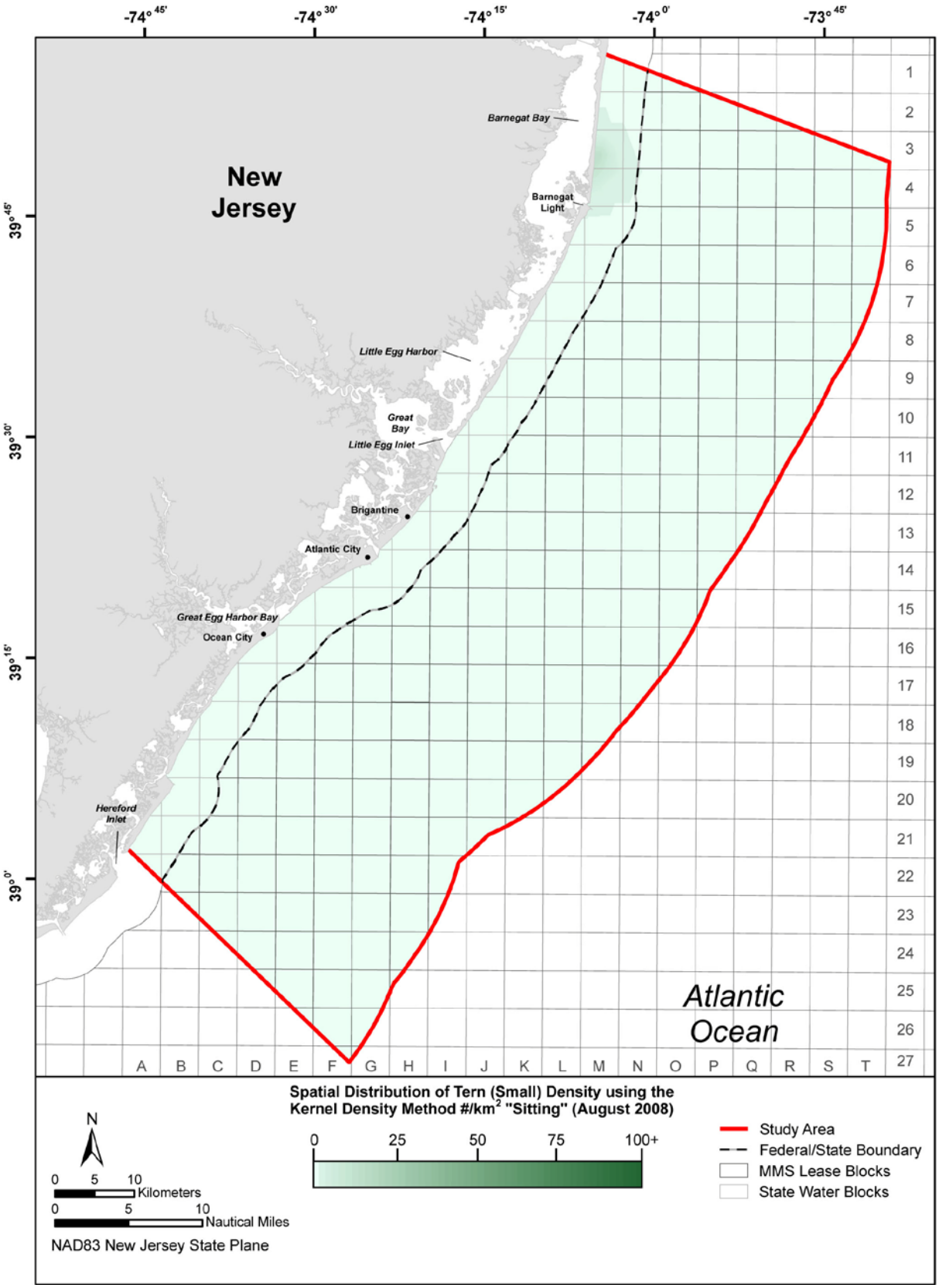

Figure M-296. Spatial distribution of small tern density (#/km^2) in the Study Area for sitting birds using the kernel density method (August 2008).

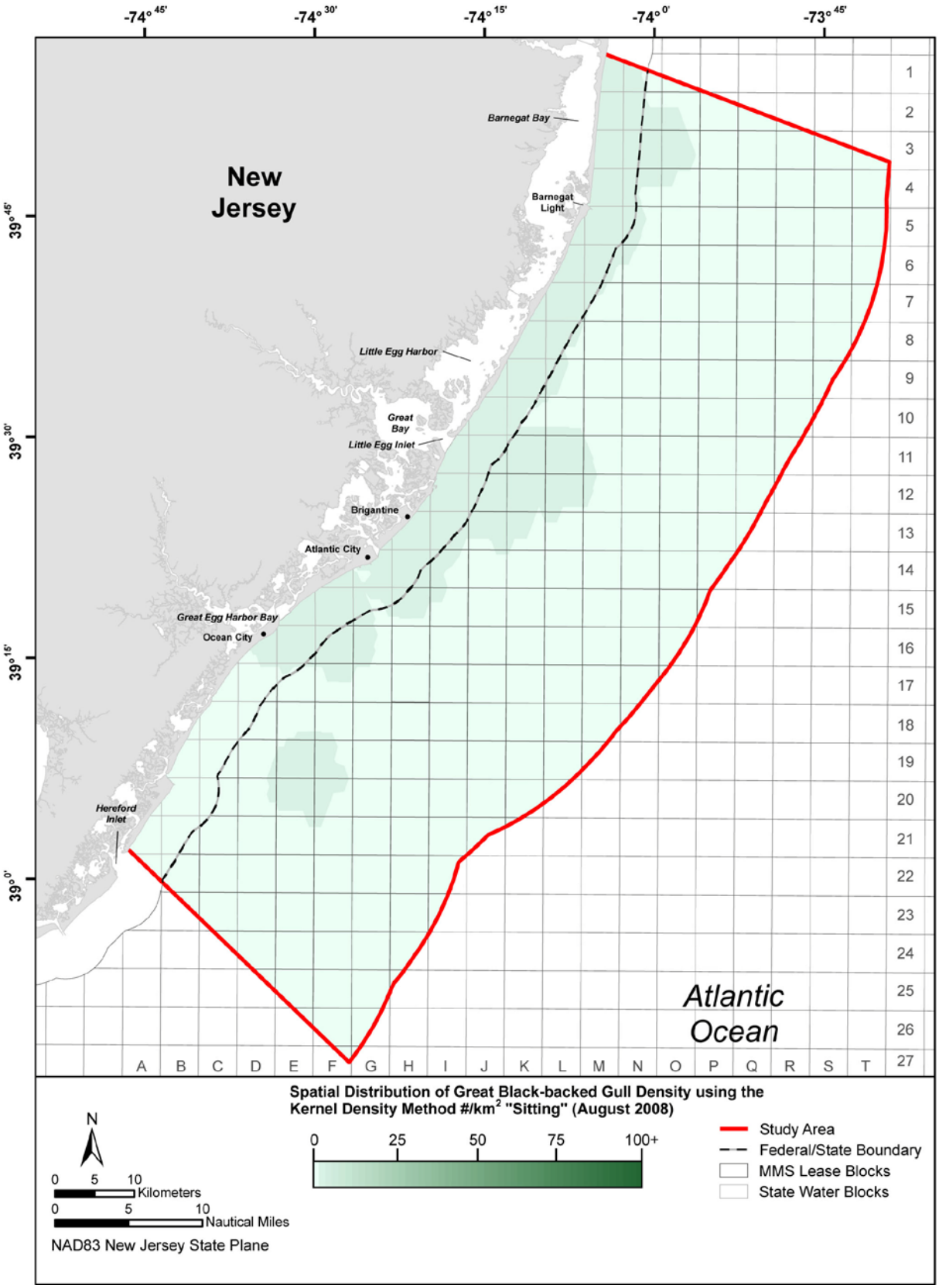

Figure M-297. Spatial distribution of Great Black-backed Gull density (#/km^2) in the Study Area for sitting birds using the kernel density method (August 2008).

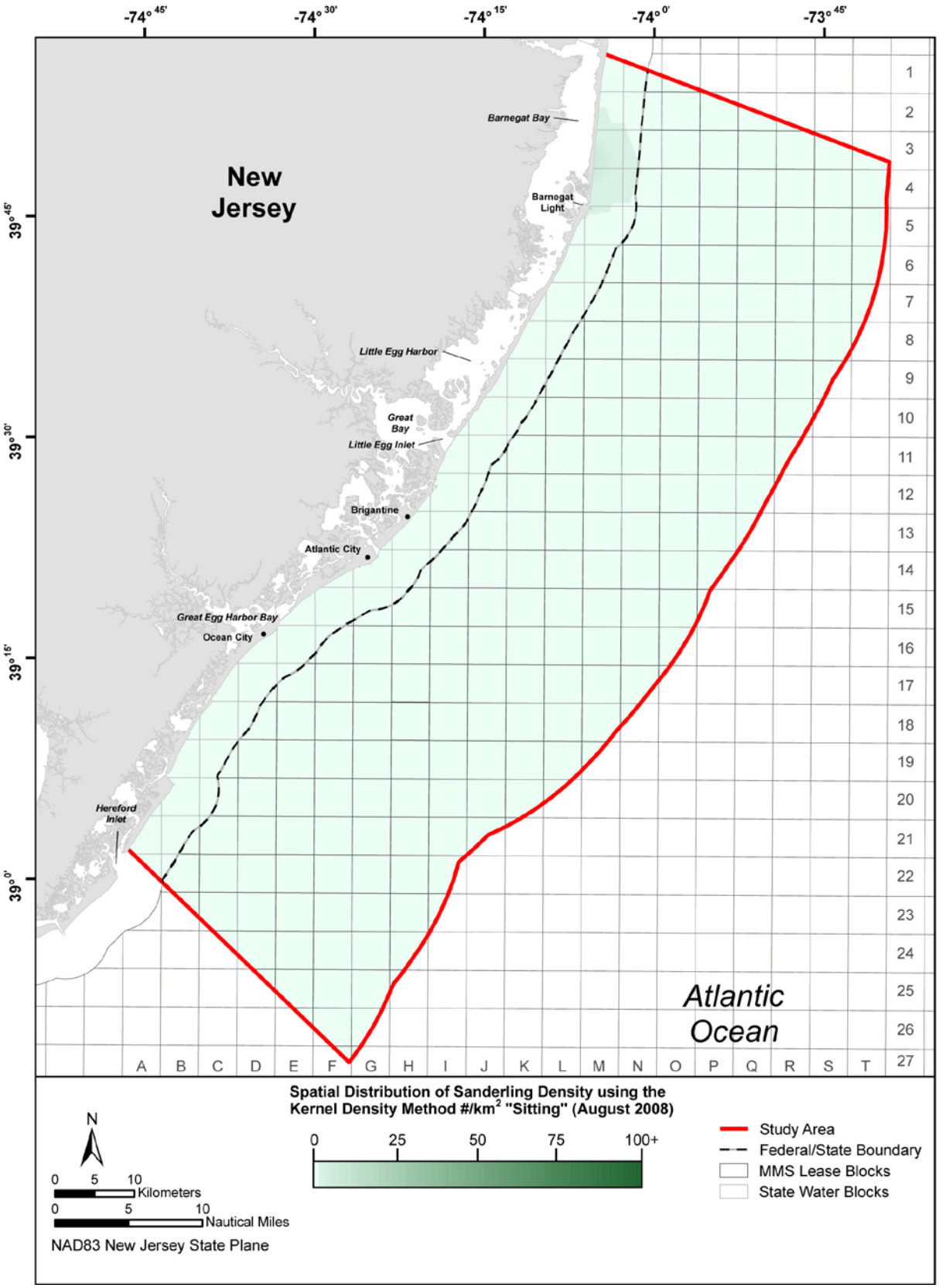

Figure M-298. Spatial distribution of Sanderling density (#/km^2) in the Study Area for sitting birds using the kernel density method (August 2008).

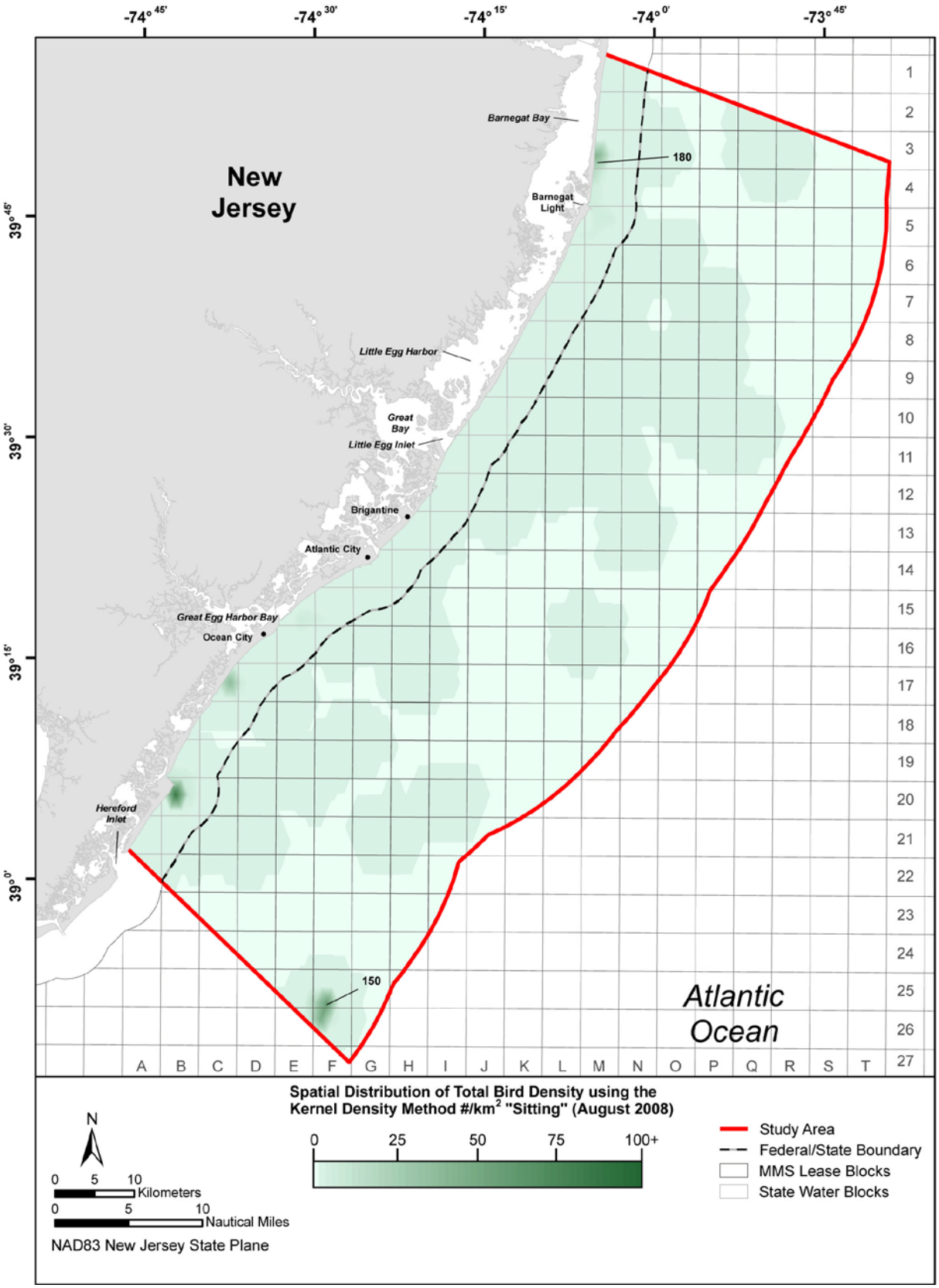

Figure M-299. Spatial distribution of total bird density (#/km^2) in the Study Area for sitting birds using the kernel density method (August 2008).

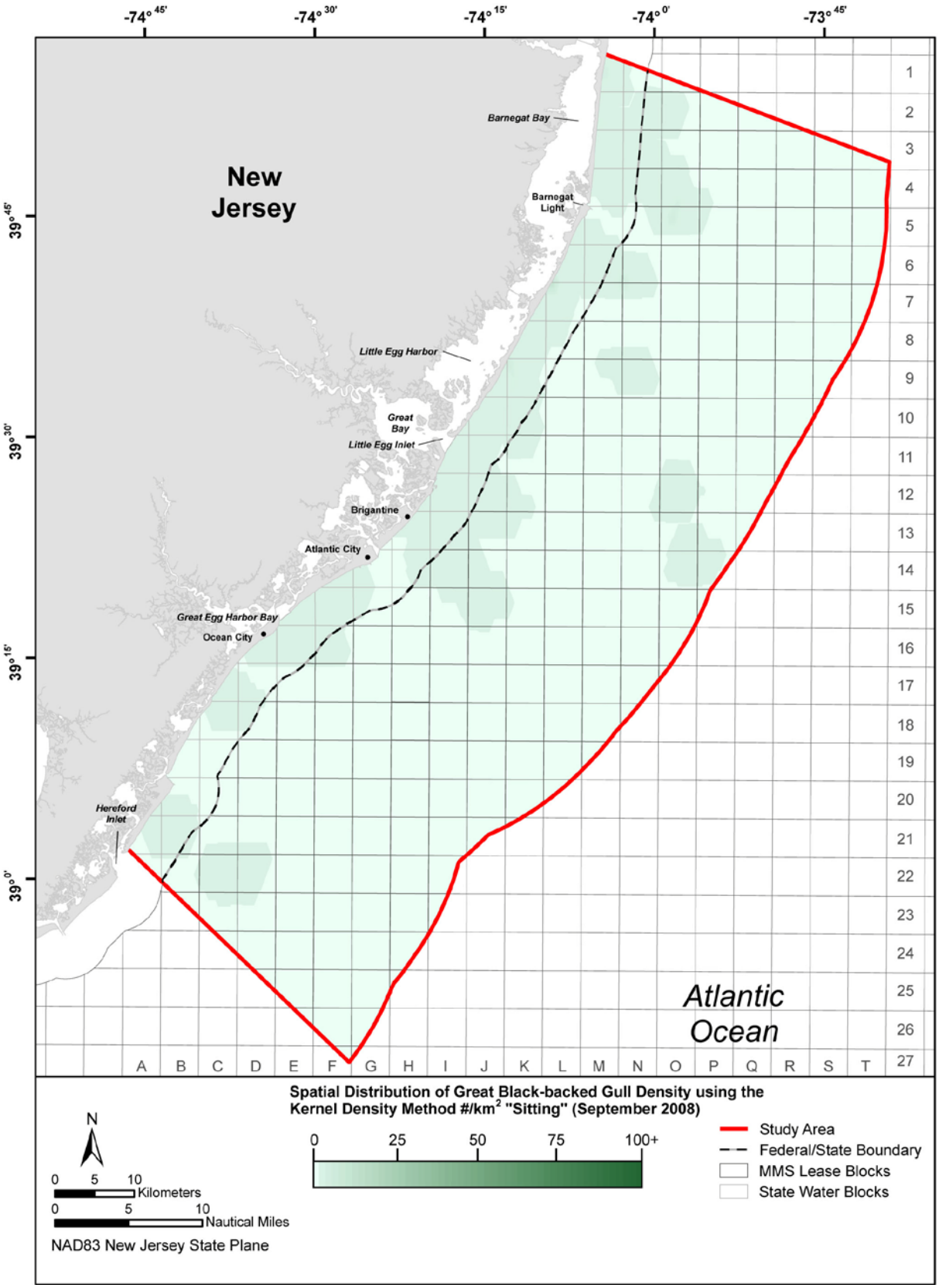

Figure M-300. Spatial distribution of Great Black-backed Gull density (#/km^2) in the Study Area for sitting birds using the kernel density method (September 2008).

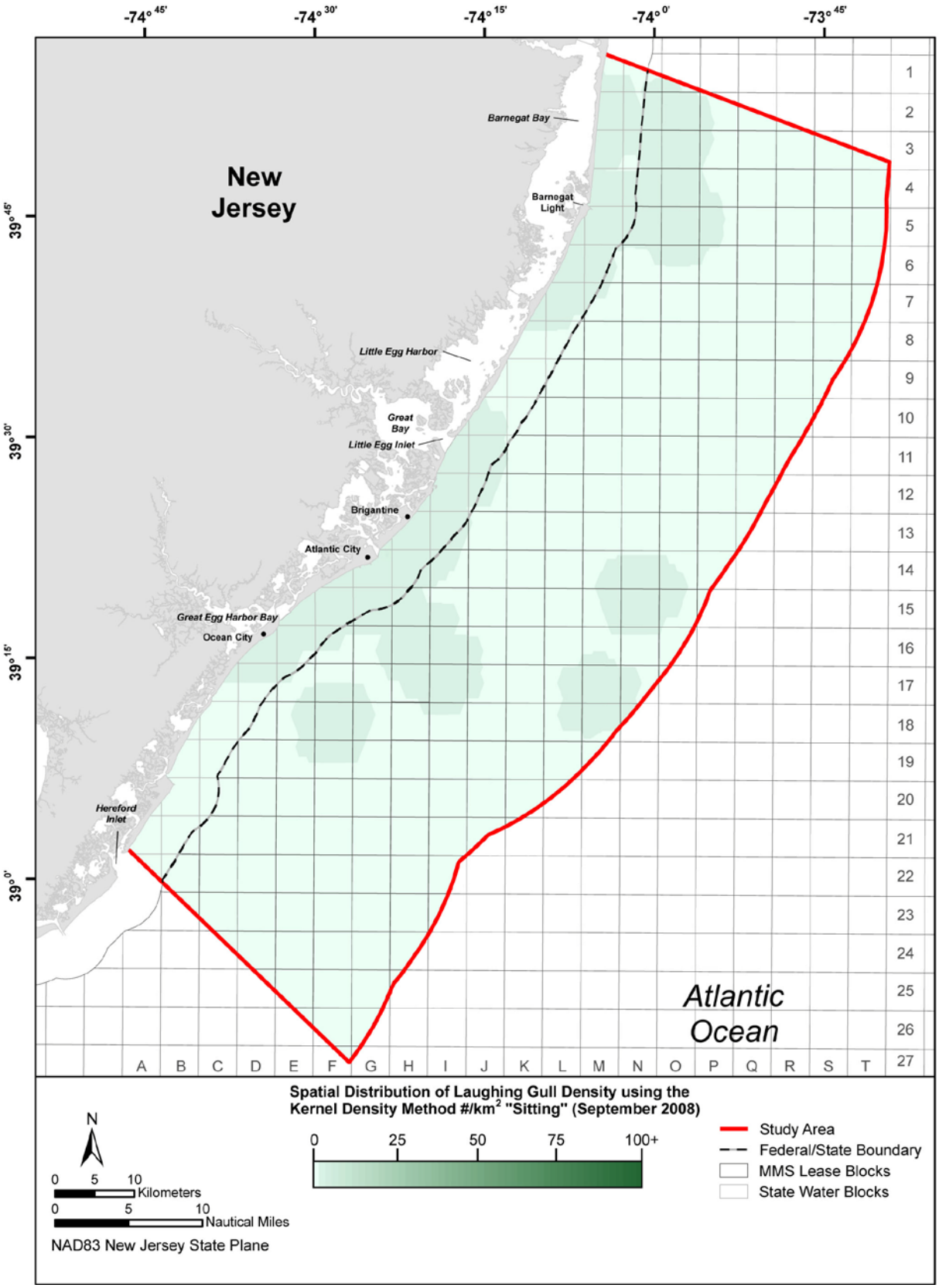

Figure M-301. Spatial distribution of Laughing Gull density (#/km^2) in the Study Area for sitting birds using the kernel density method (September 2008).

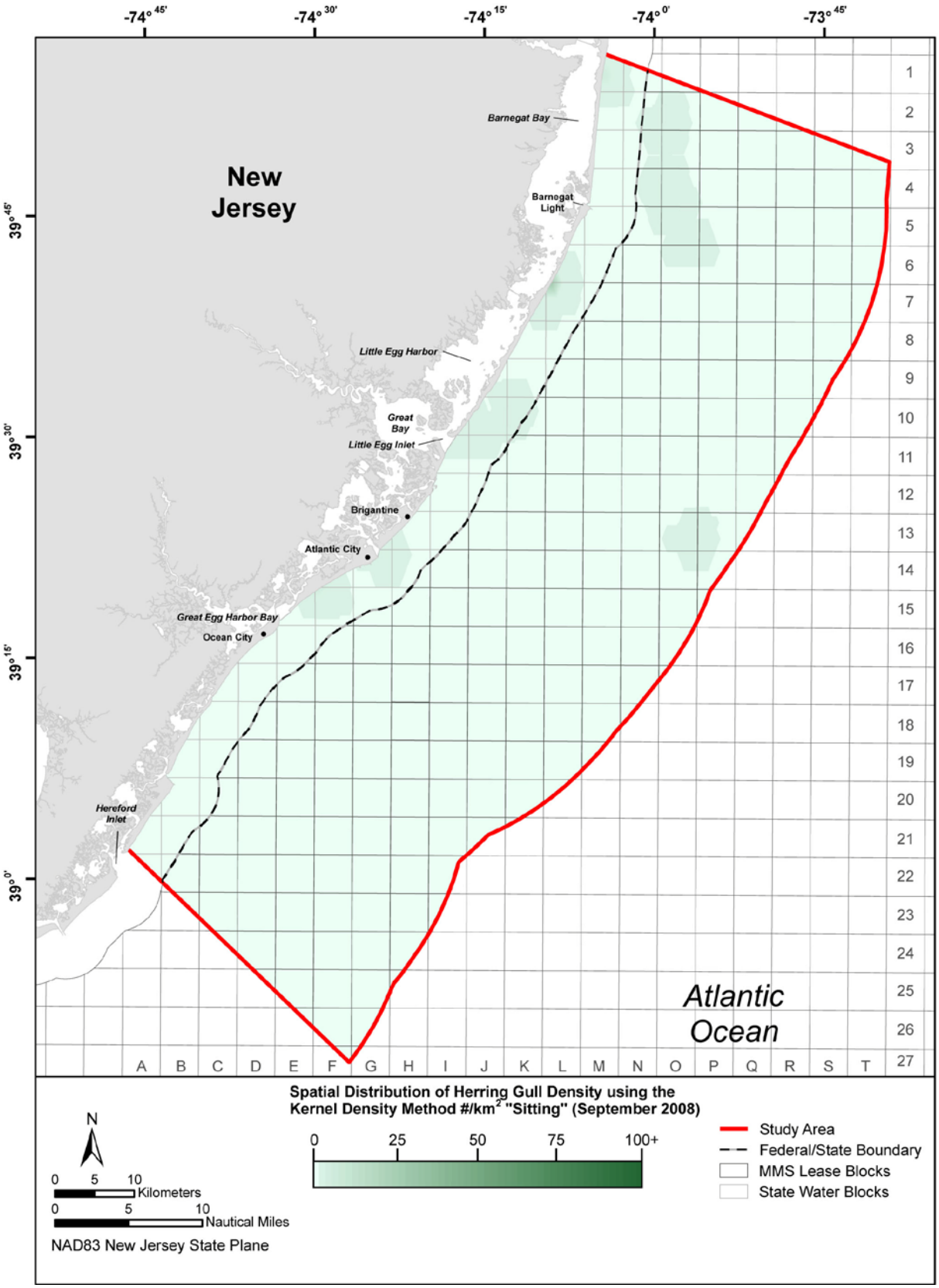

Figure M-302. Spatial distribution of Herring Gull density (#/km^2) in the Study Area for sitting birds using the kernel density method (September 2008).

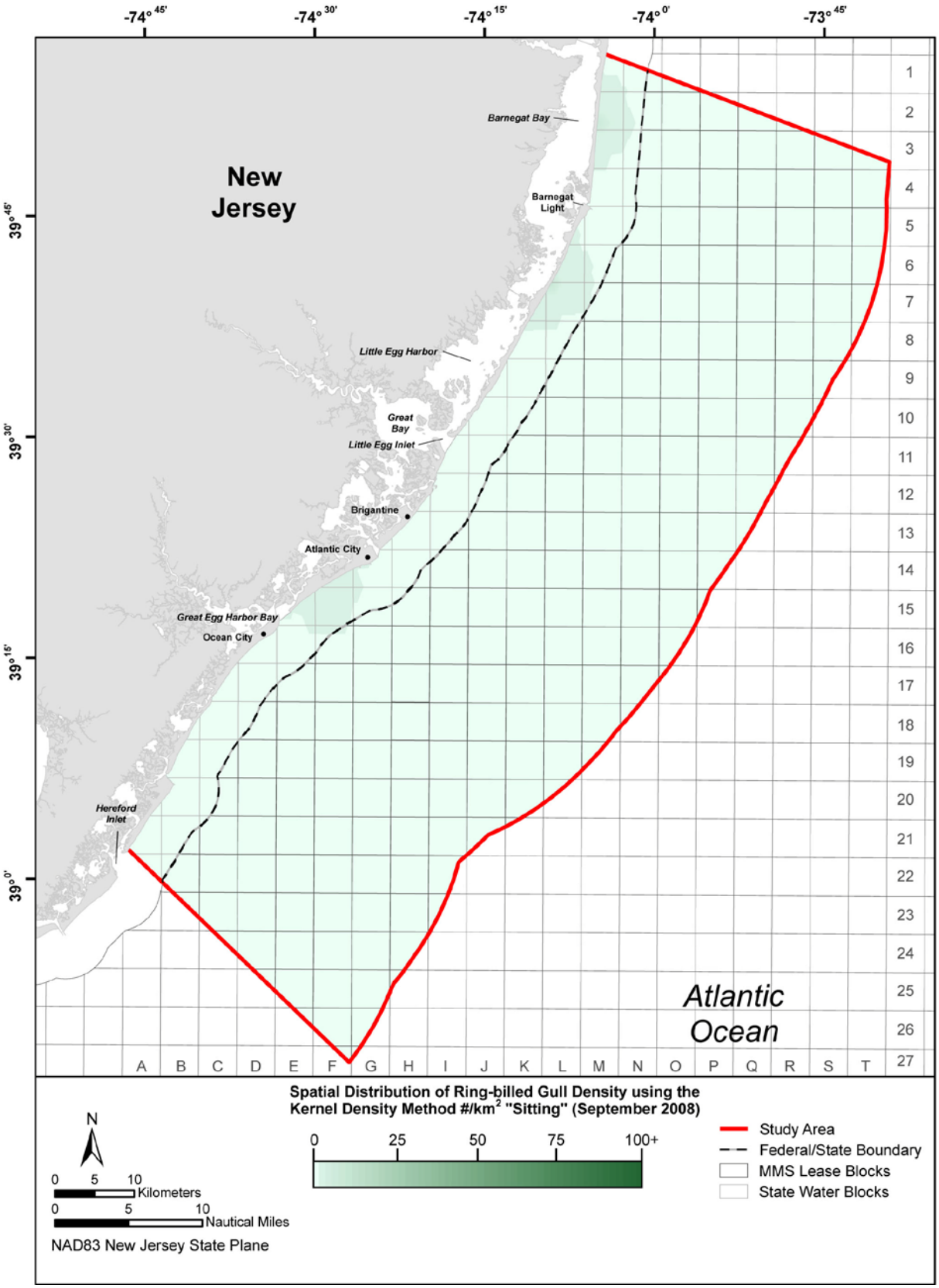

Figure M-303. Spatial distribution of Ring-billed Gull density (#/km^2) in the Study Area for sitting birds using the kernel density method (September 2008).

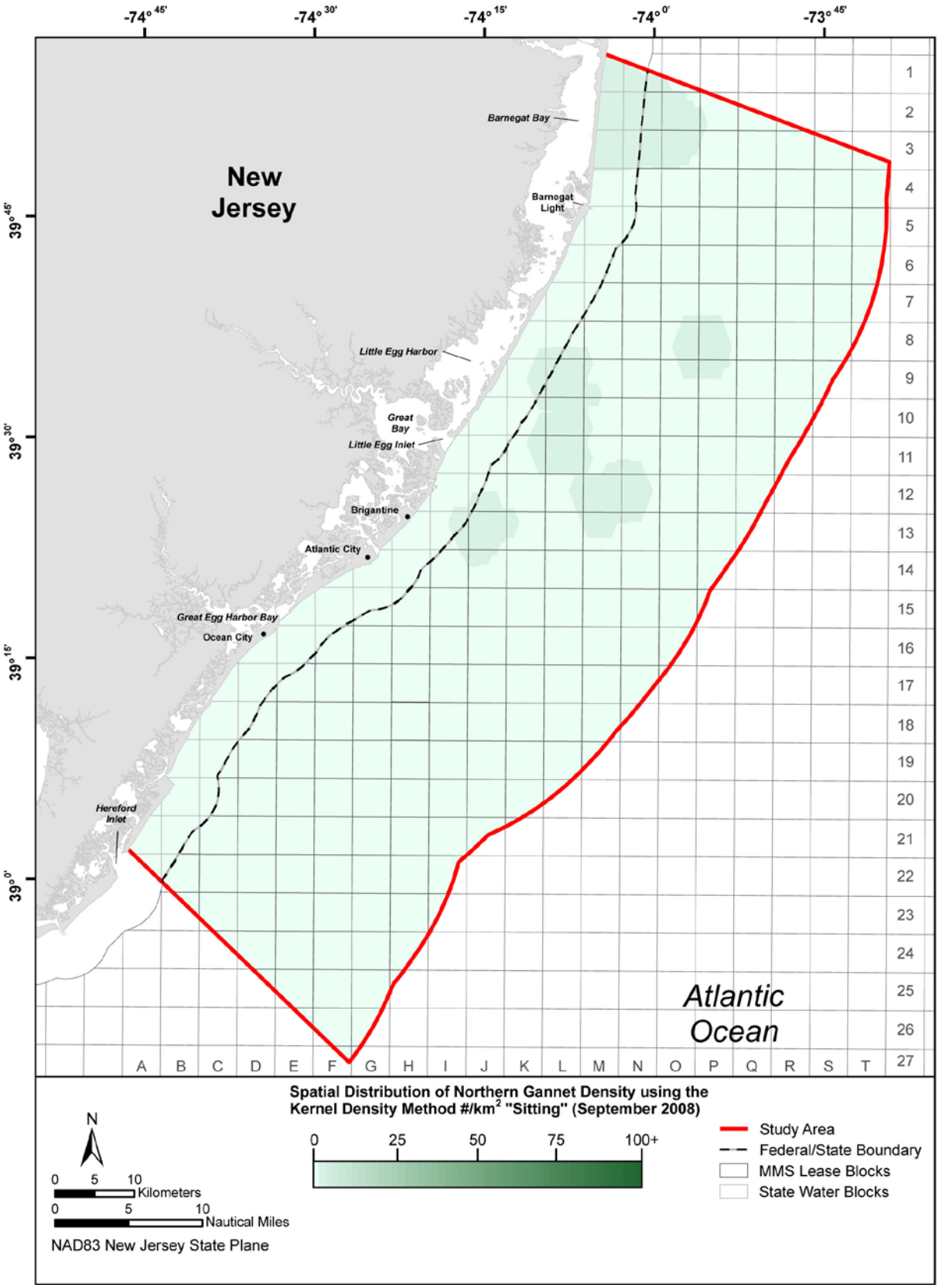

Figure M-304. Spatial distribution of Northern Gannet density (#/km^2) in the Study Area for sitting birds using the kernel density method (September 2008).

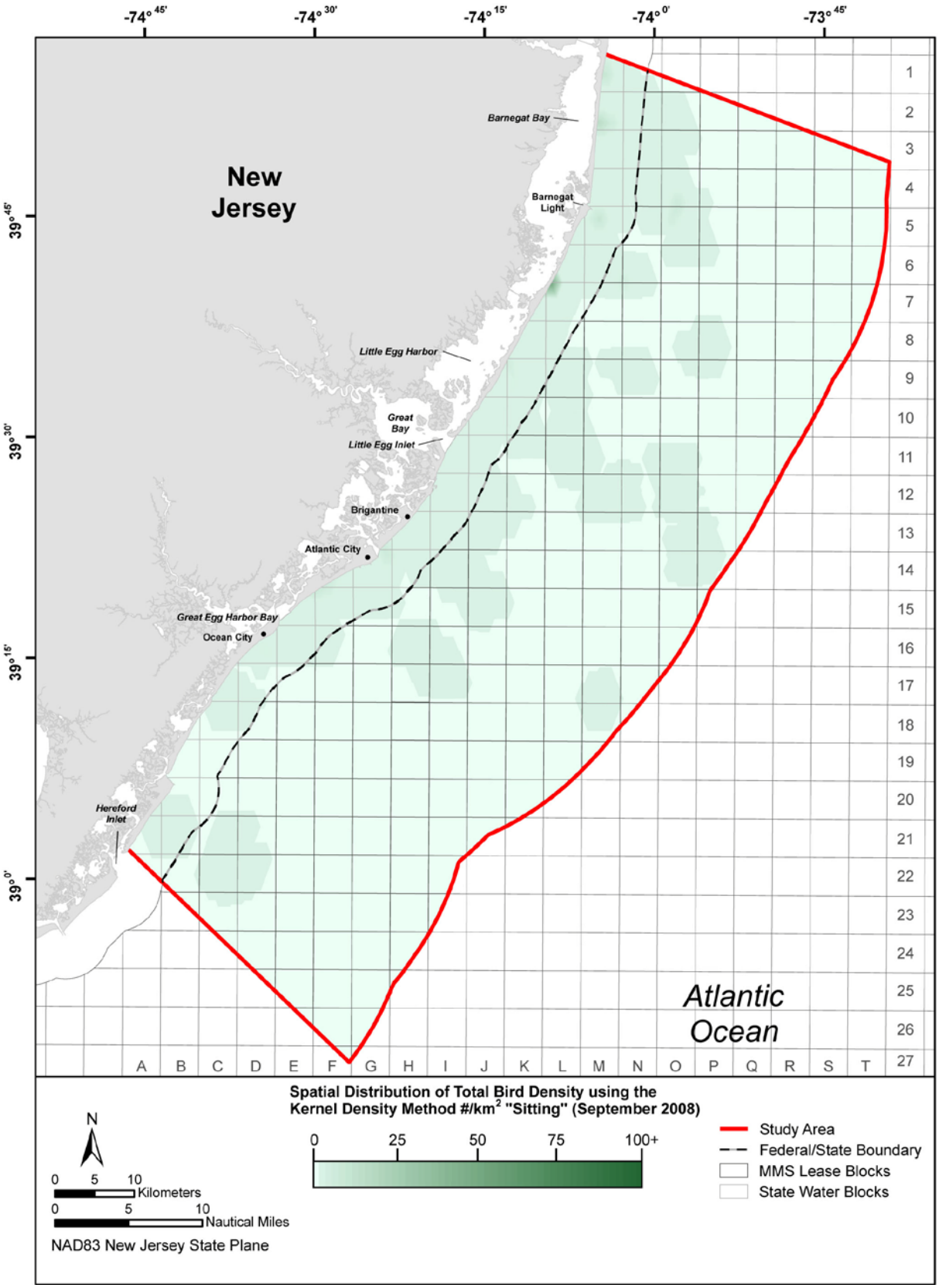

Figure M-305. Spatial distribution of total bird density (#/km^2) in the Study Area for sitting birds using the kernel density method (September 2008).

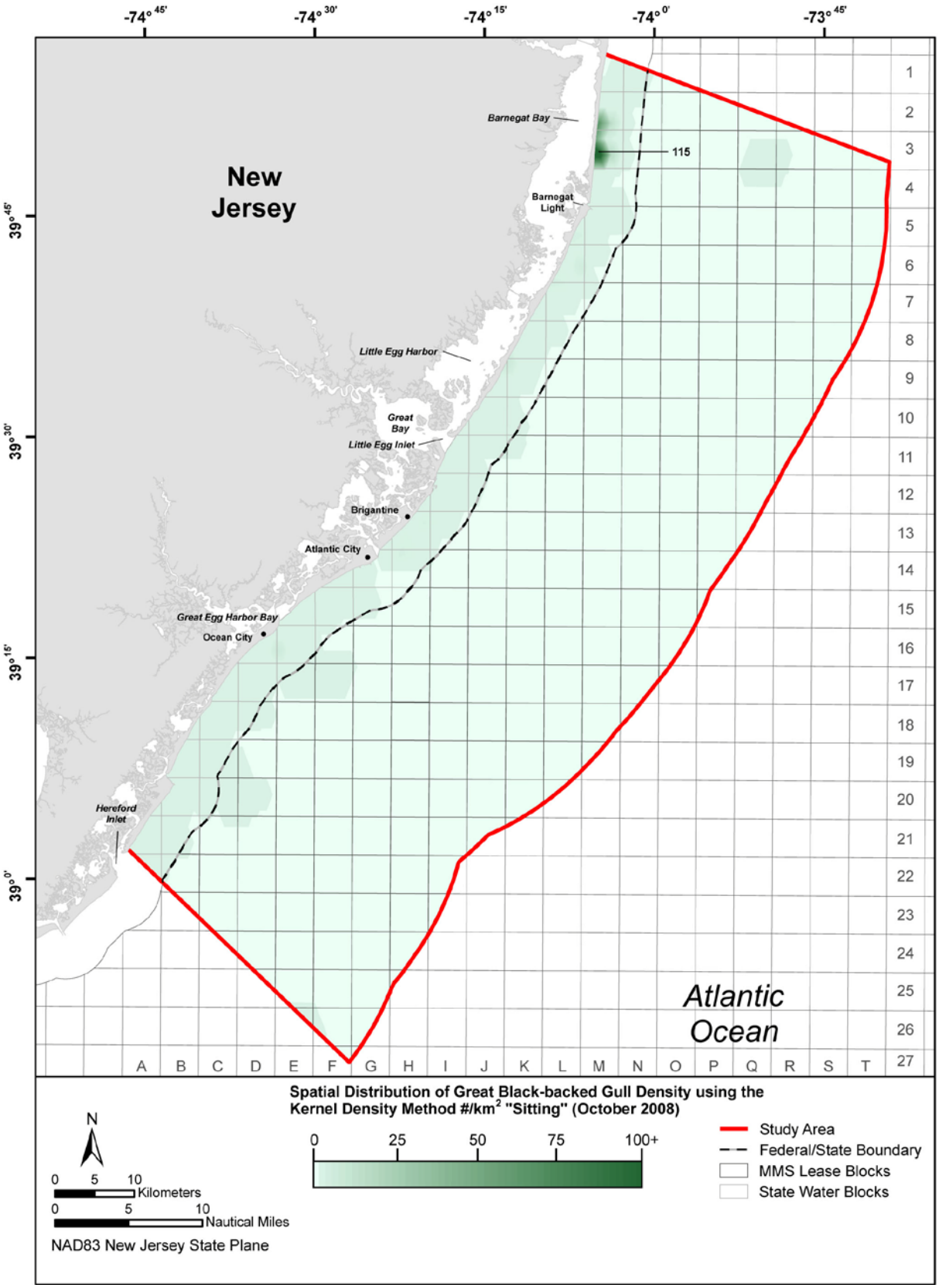

Figure M-306. Spatial distribution of Great Black-backed Gull density (#/km^2) in the Study Area for sitting birds using the kernel density method (October 2008).

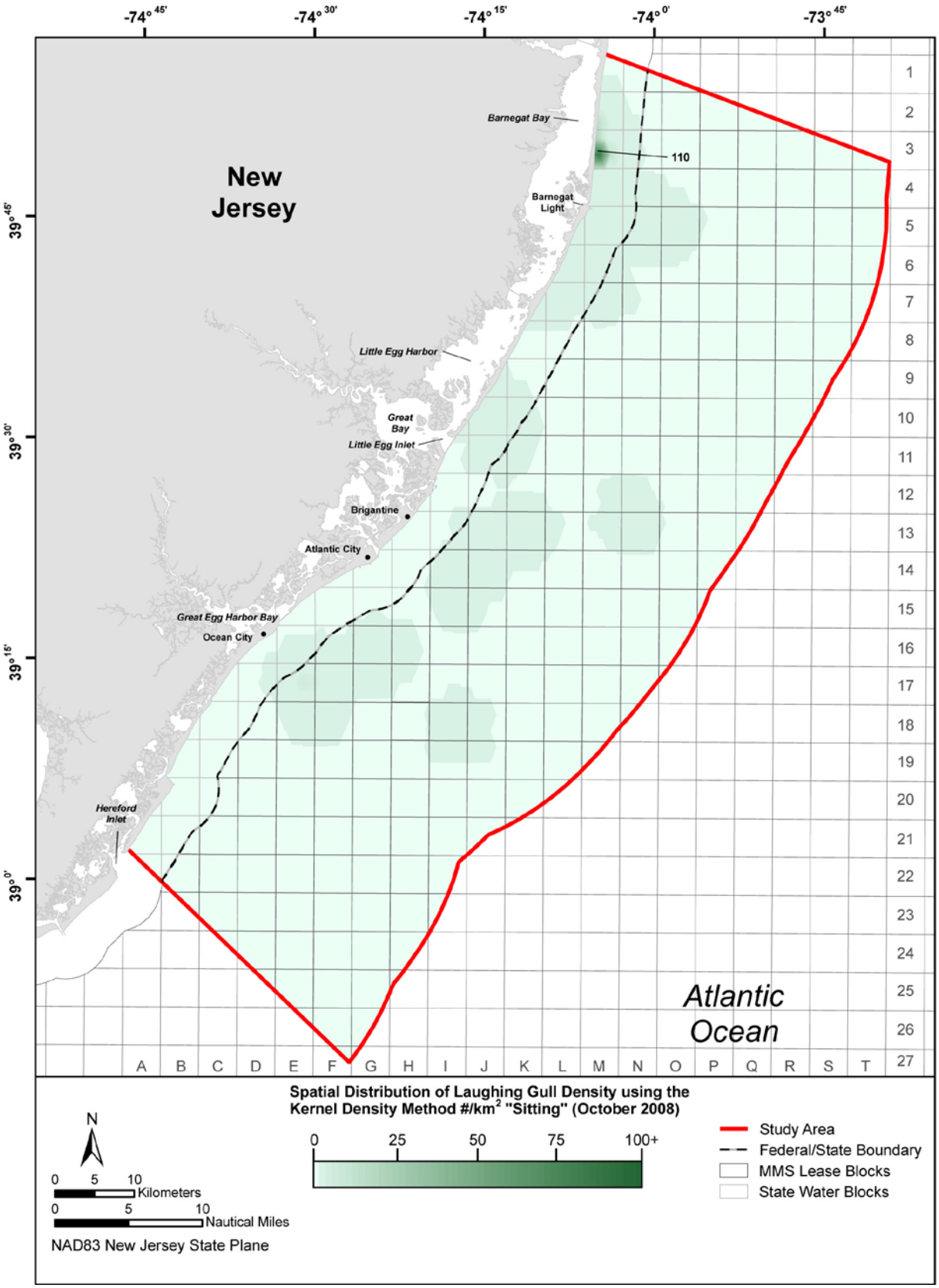

Figure M-307. Spatial distribution of Laughing Gull density (#/km^2) in the Study Area for sitting birds using the kernel density method (October 2008).

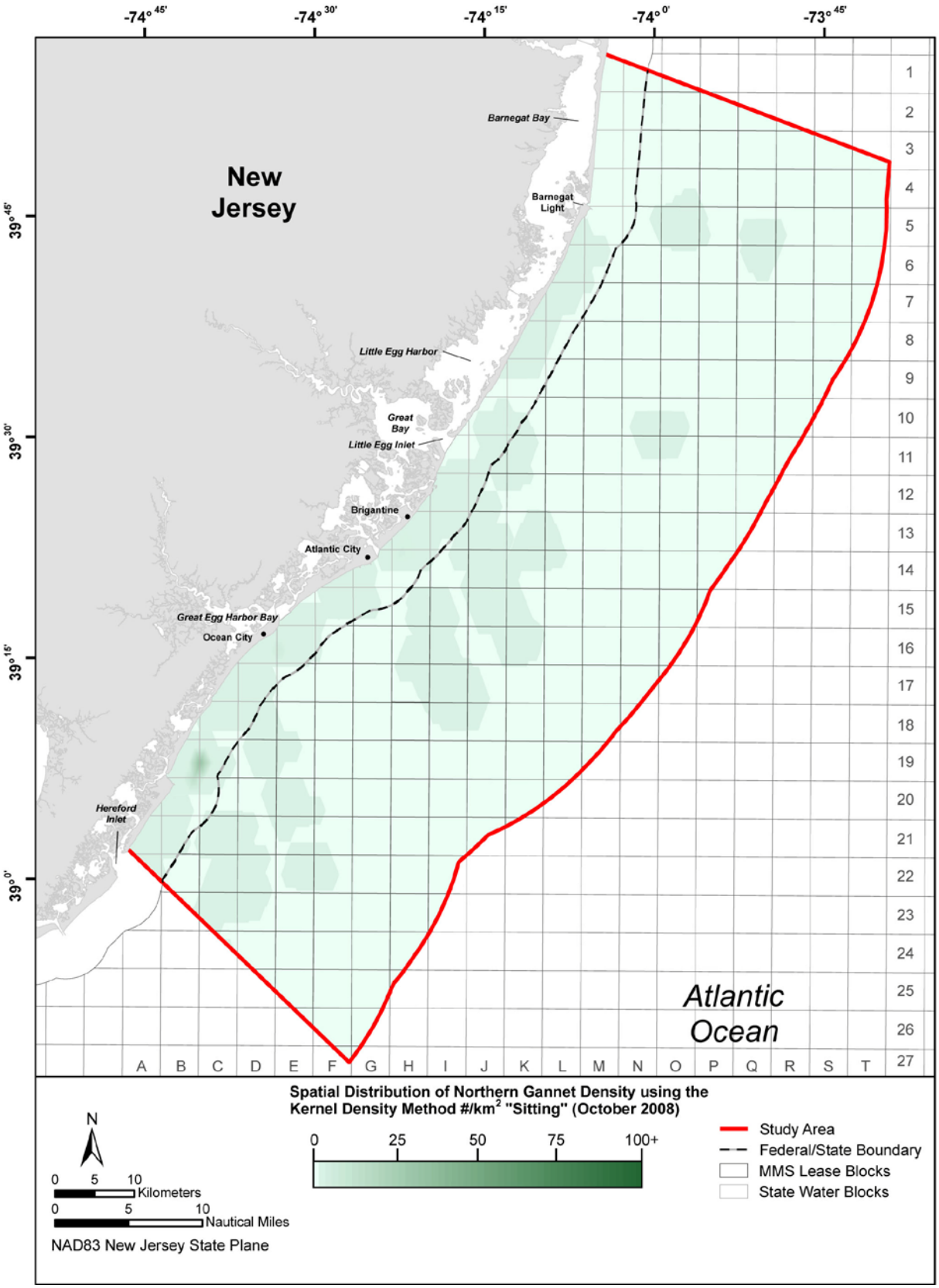

Figure M-308. Spatial distribution of Northern Gannet density (#/km^2) in the Study Area for sitting birds using the kernel density method (October 2008).

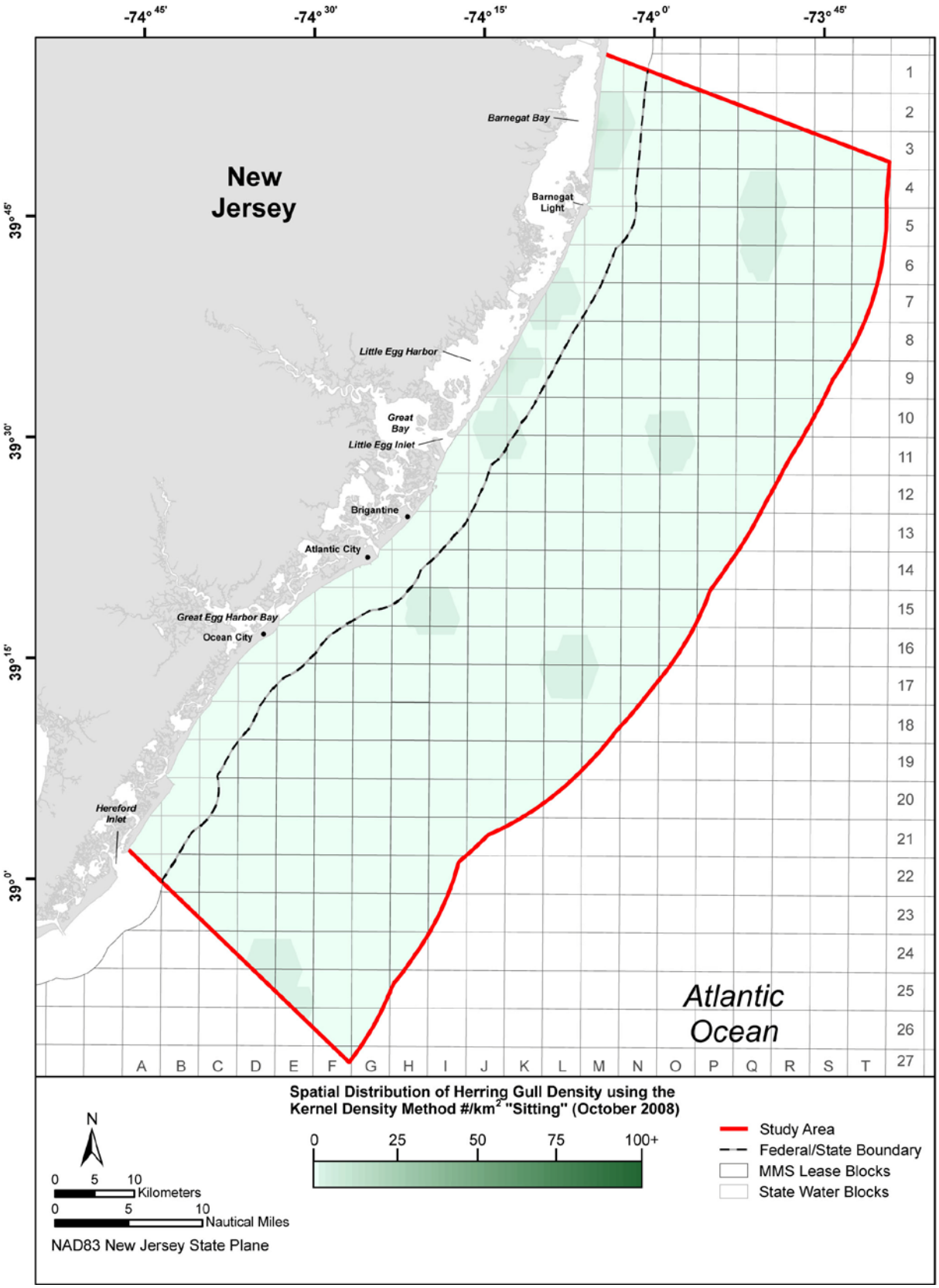

Figure M-309. Spatial distribution of Herring Gull density (#/km^2) in the Study Area for sitting birds using the kernel density method (October 2008).

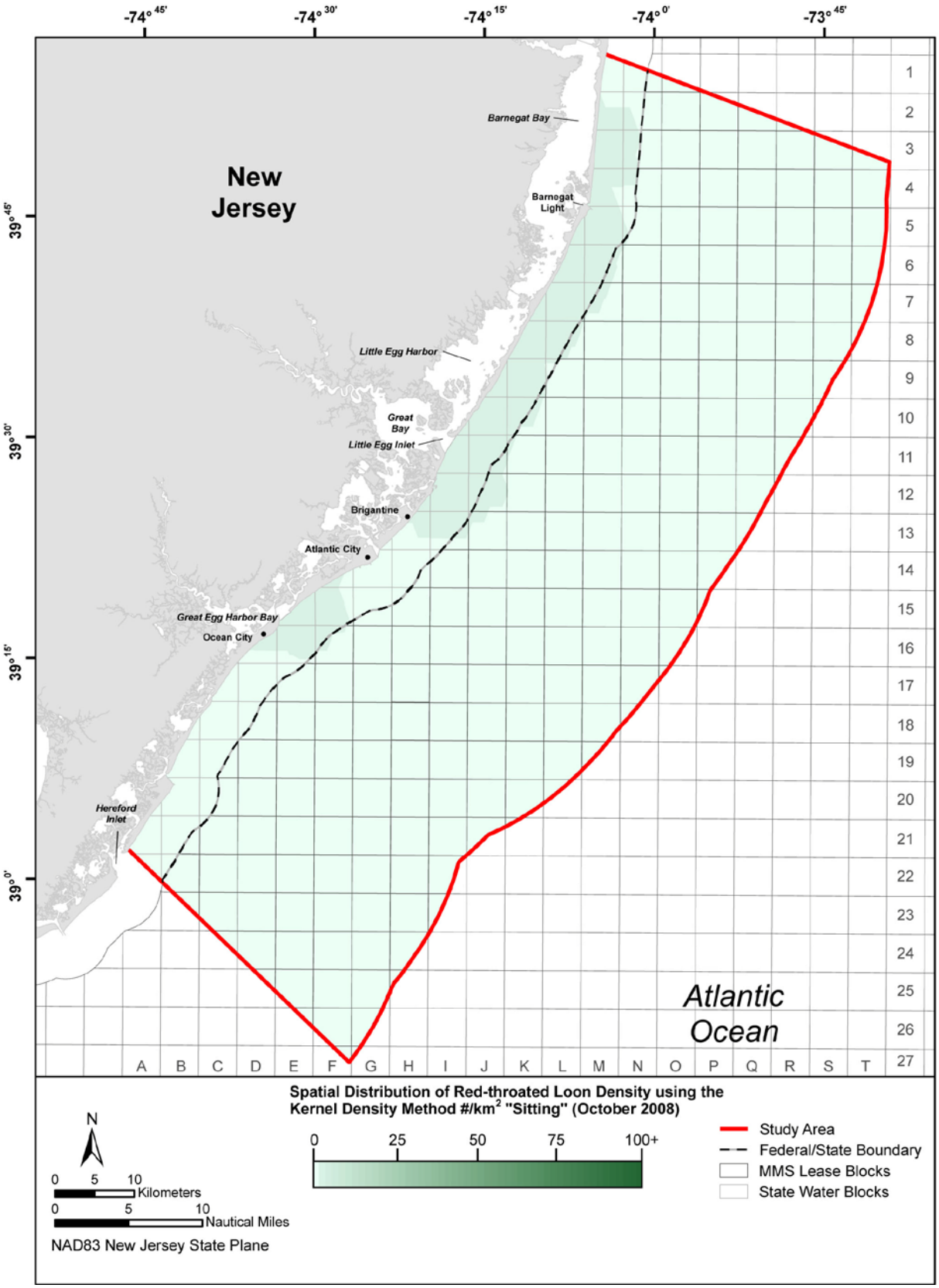

Figure M-310. Spatial distribution of Red-throated Loon density (#/km^2) in the Study Area for sitting birds using the kernel density method (October 2008).

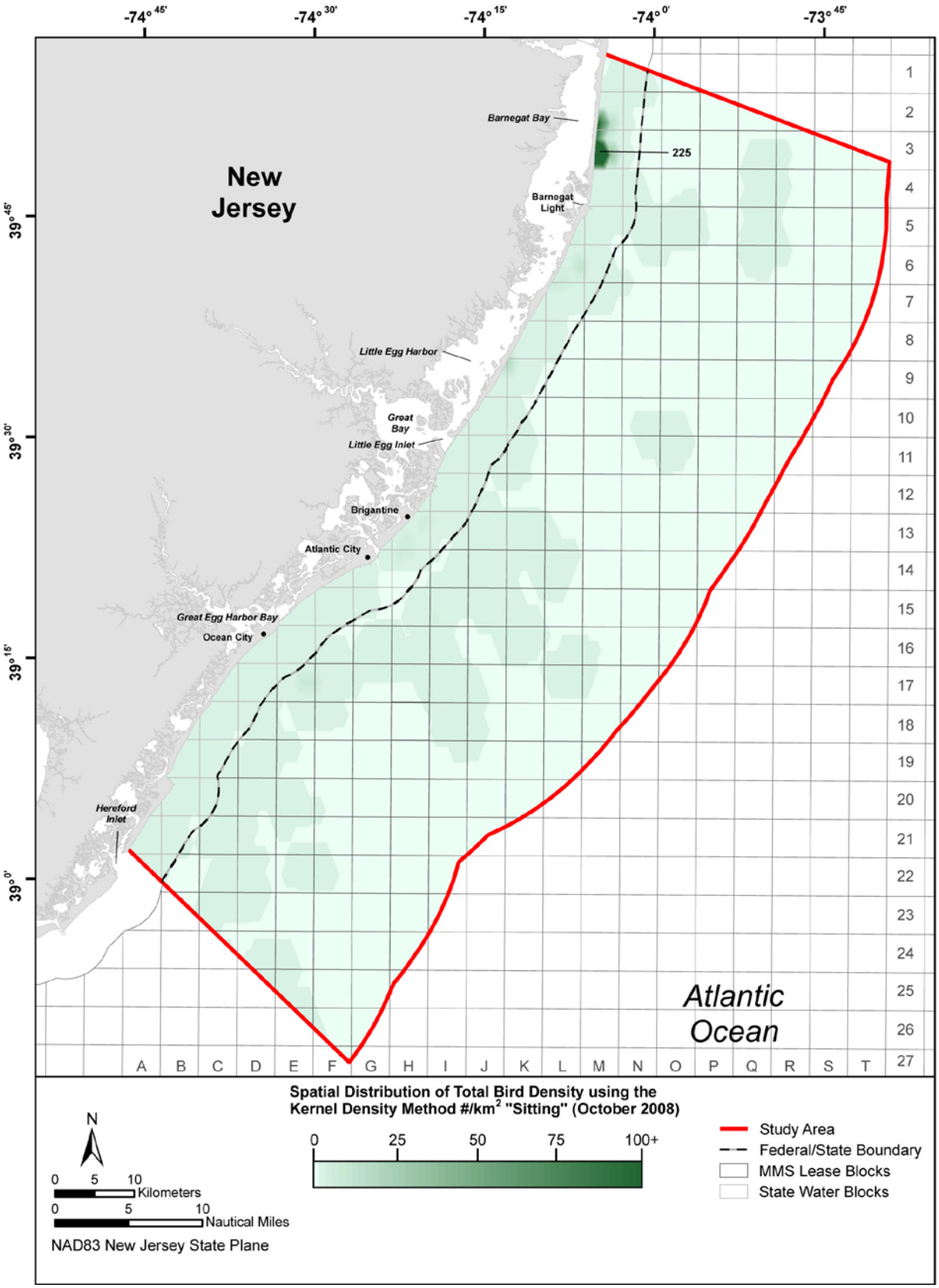

Figure M-311. Spatial distribution of total bird density (#/km^2) in the Study Area for sitting birds using the kernel density method (October 2008).

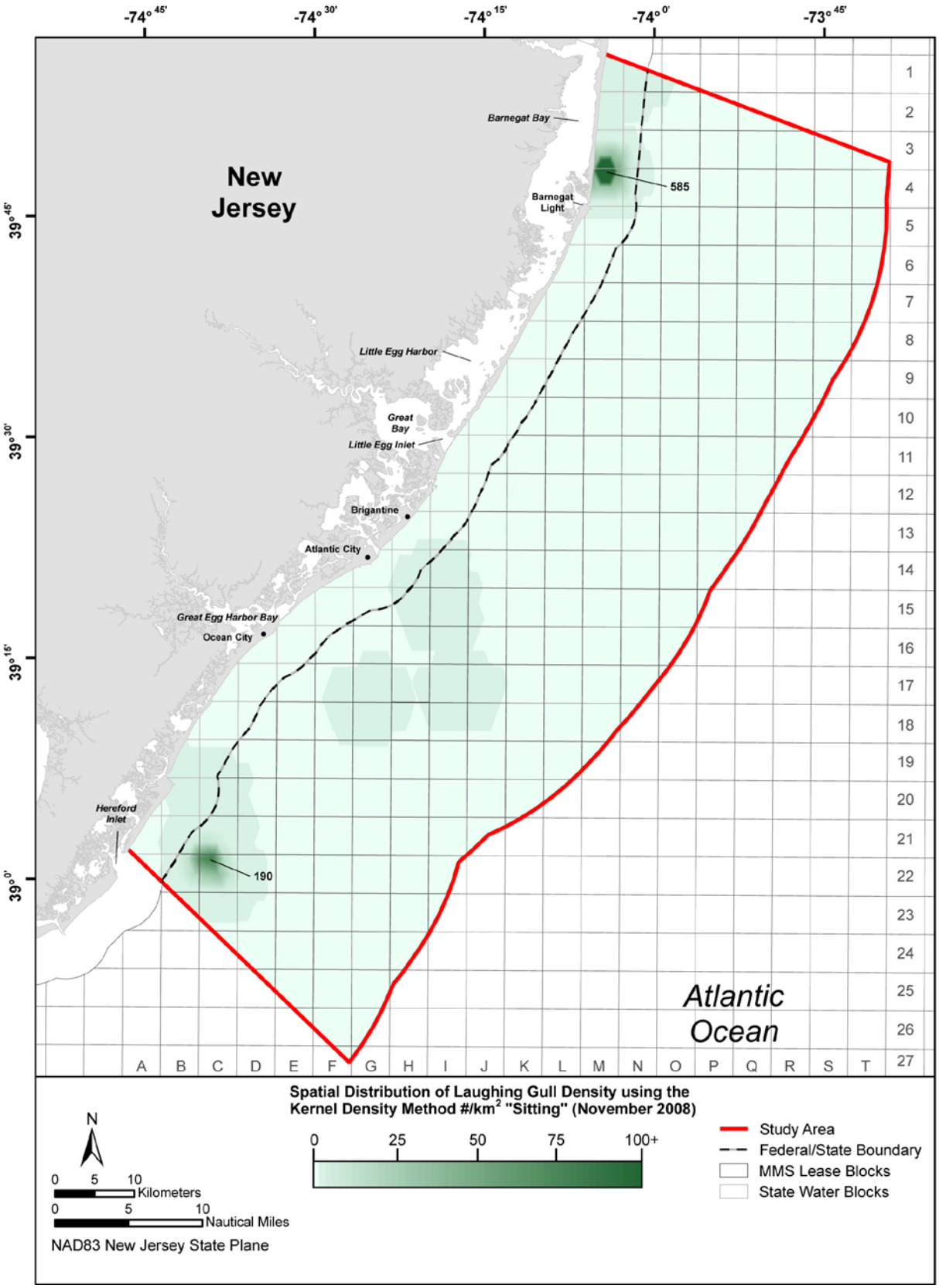

Figure M-312. Spatial distribution of Laughing Gull density (#/km^2) in the Study Area for sitting birds using the kernel density method (November 2008).

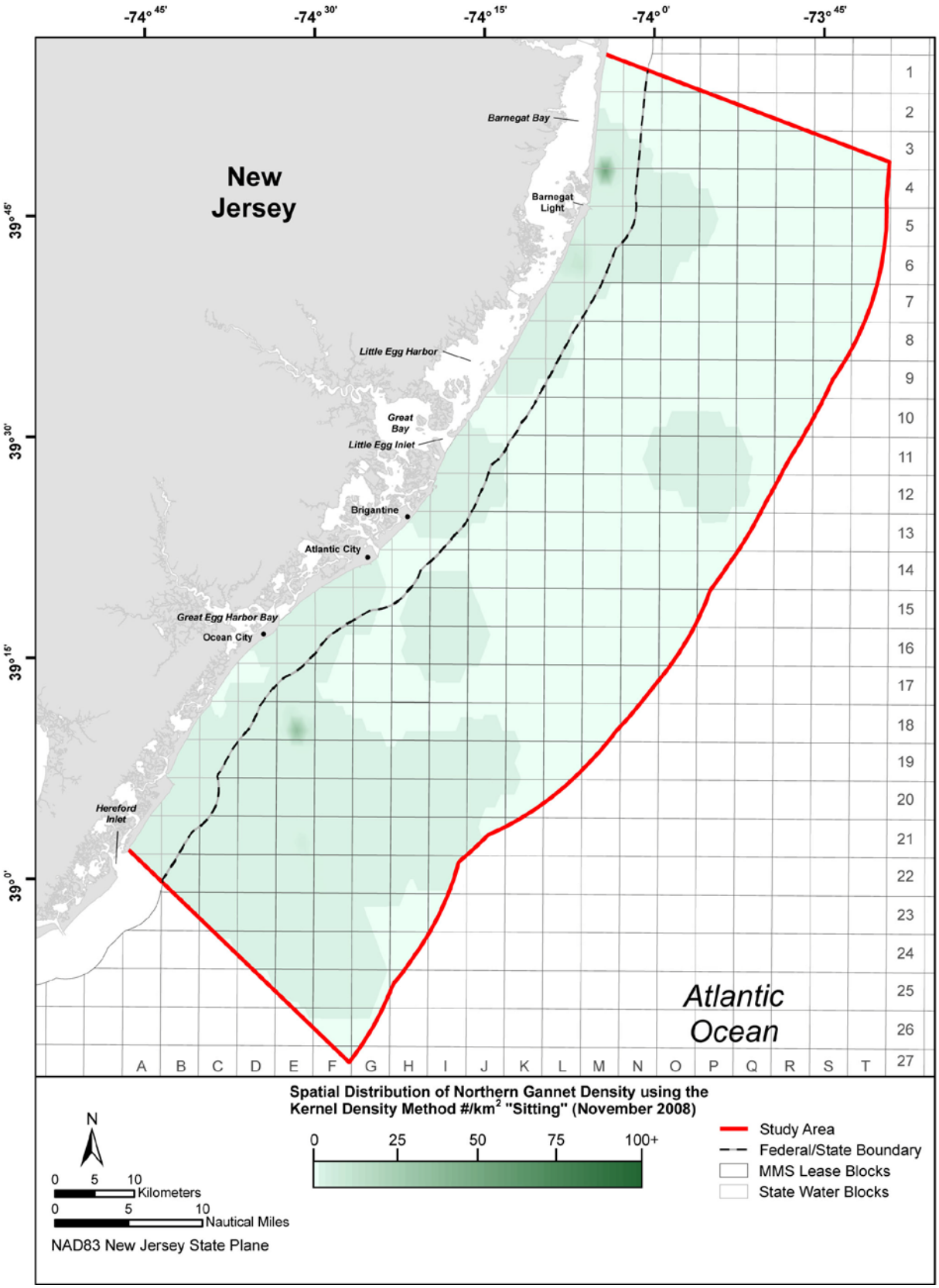

Figure M-313. Spatial distribution of Northern Gannet density (#/km^2) in the Study Area for sitting birds using the kernel density method (November 2008).

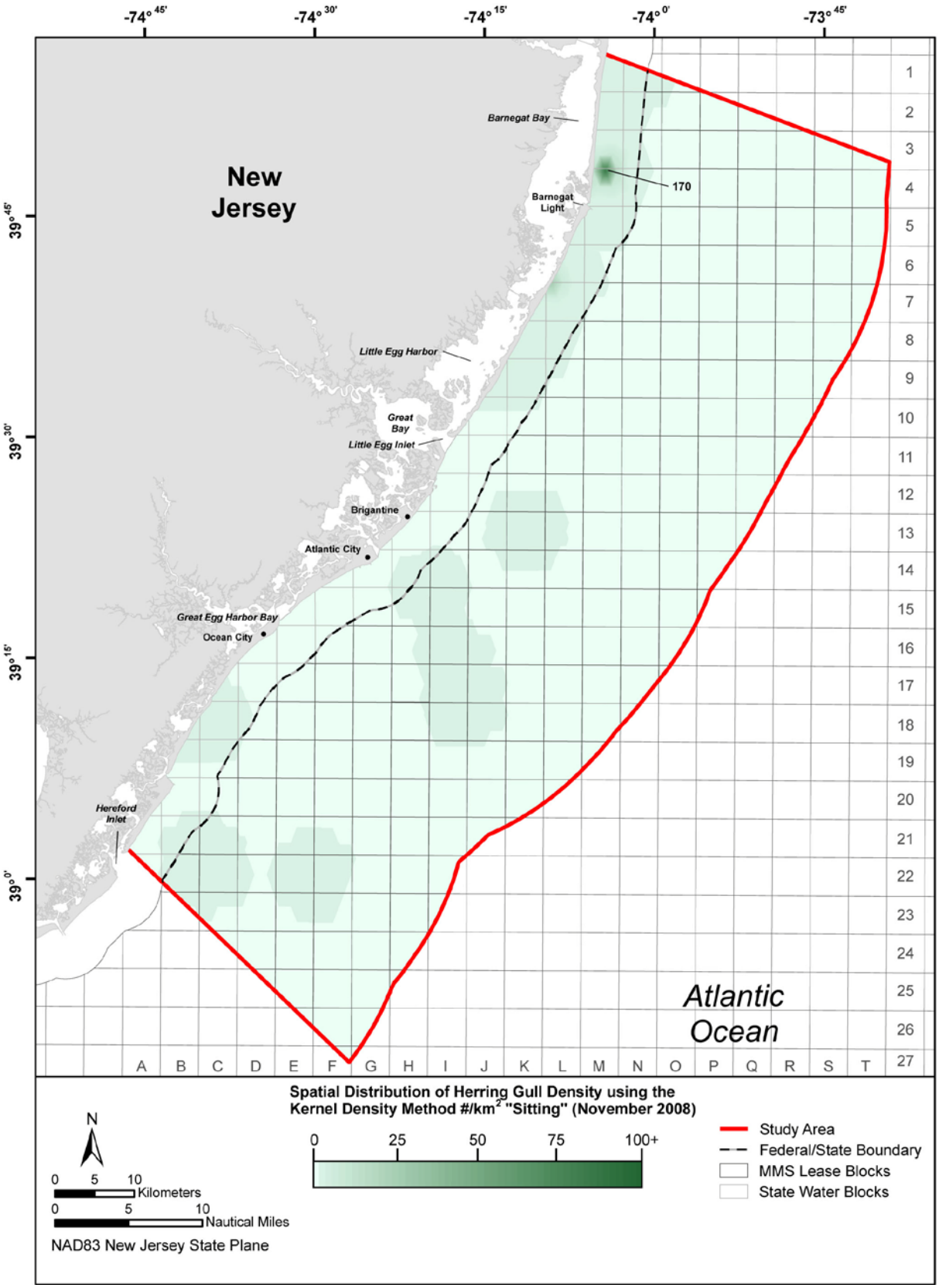

Figure M-314. Spatial distribution of Herring Gull density (#/km^2) in the Study Area for sitting birds using the kernel density method (November 2008).

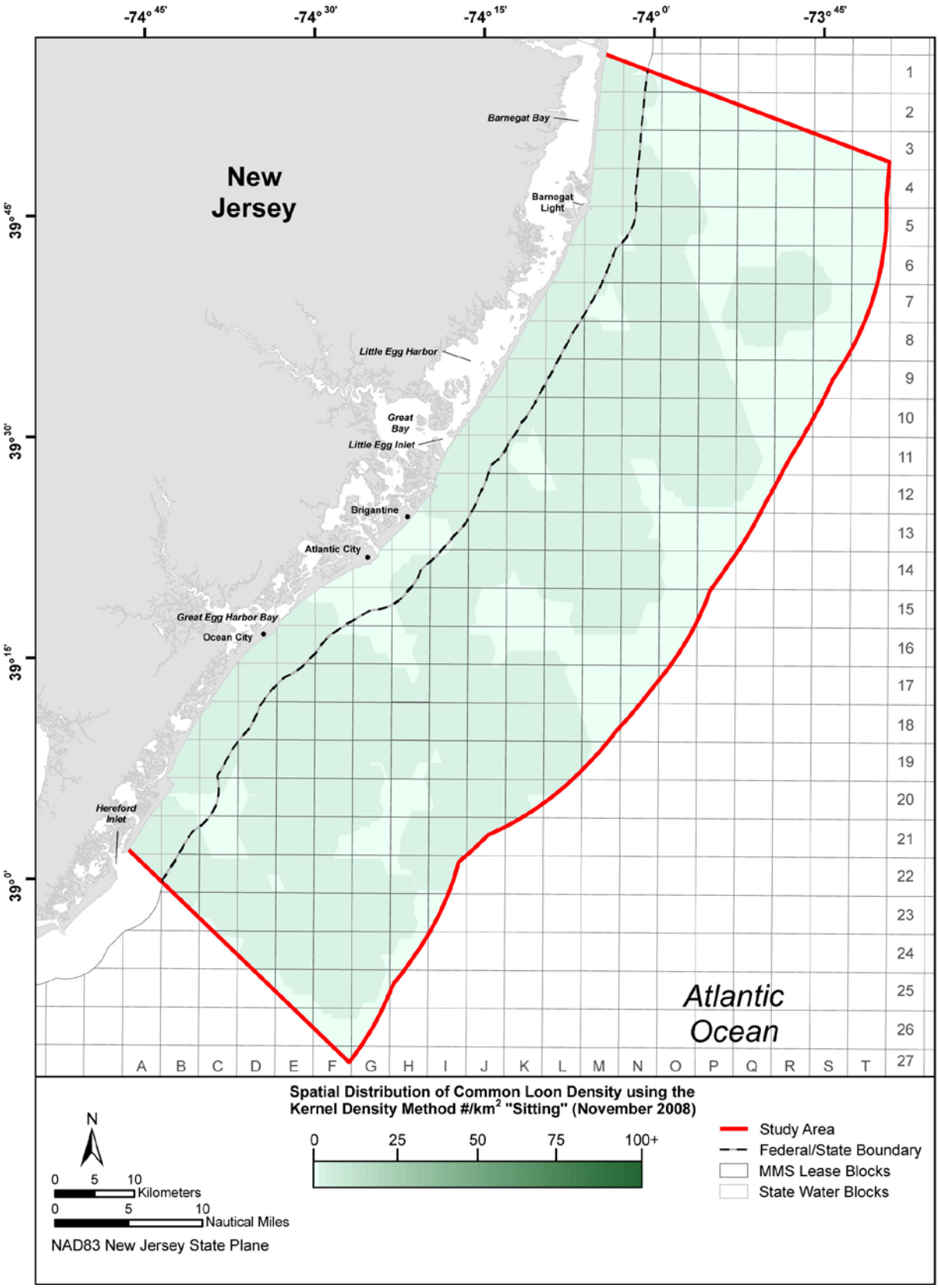

Figure M-315. Spatial distribution of Common Loon density (#/km^2) in the Study Area for sitting birds using the kernel density method (November 2008).

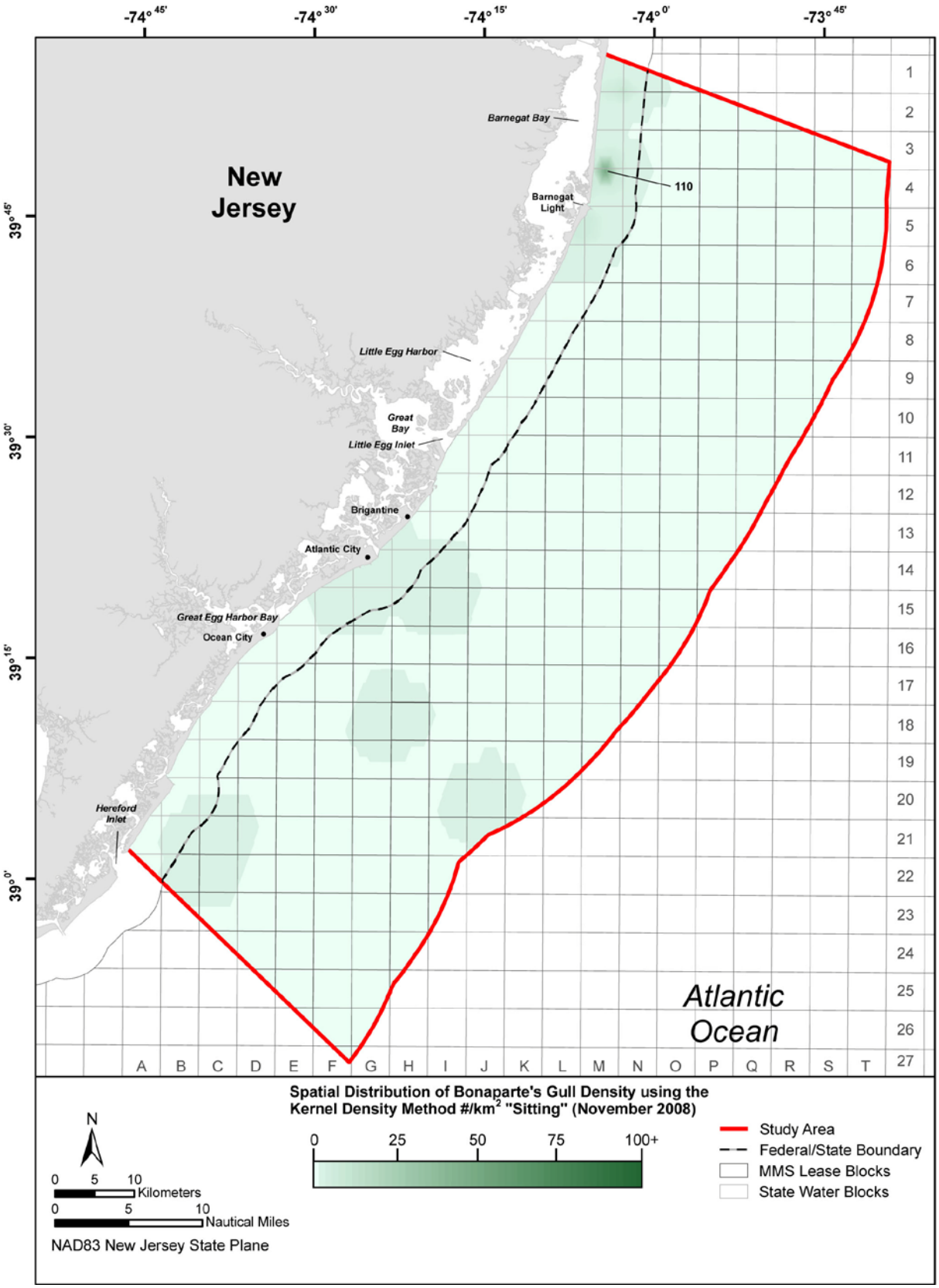

Figure M-316. Spatial distribution of Bonaparte's Gull density (#/km^2) in the Study Area for sitting birds using the kernel density method (November 2008).

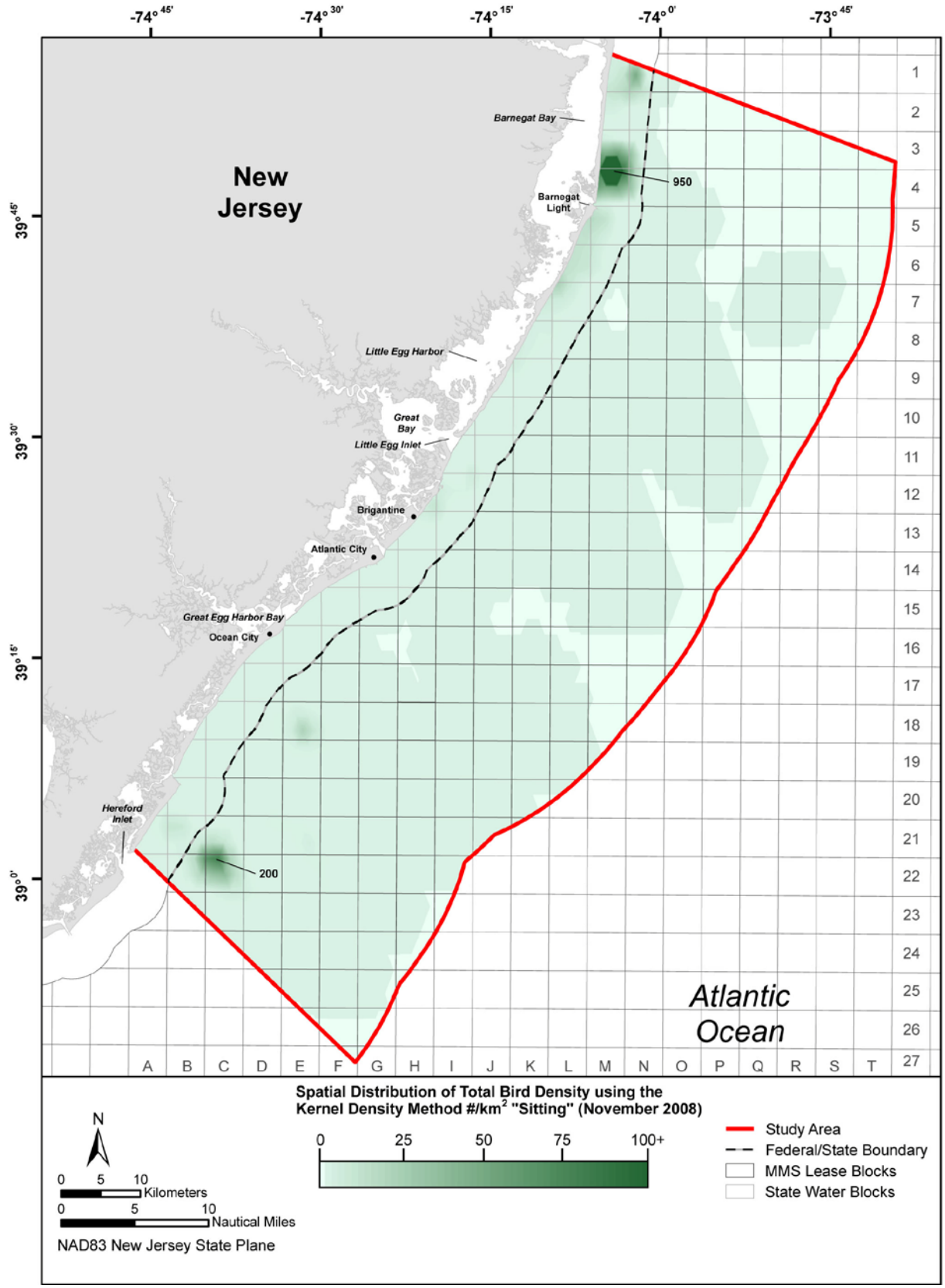

Figure M-317. Spatial distribution of total bird density (#/km^2) in the Study Area for sitting birds using the kernel density method (November 2008).

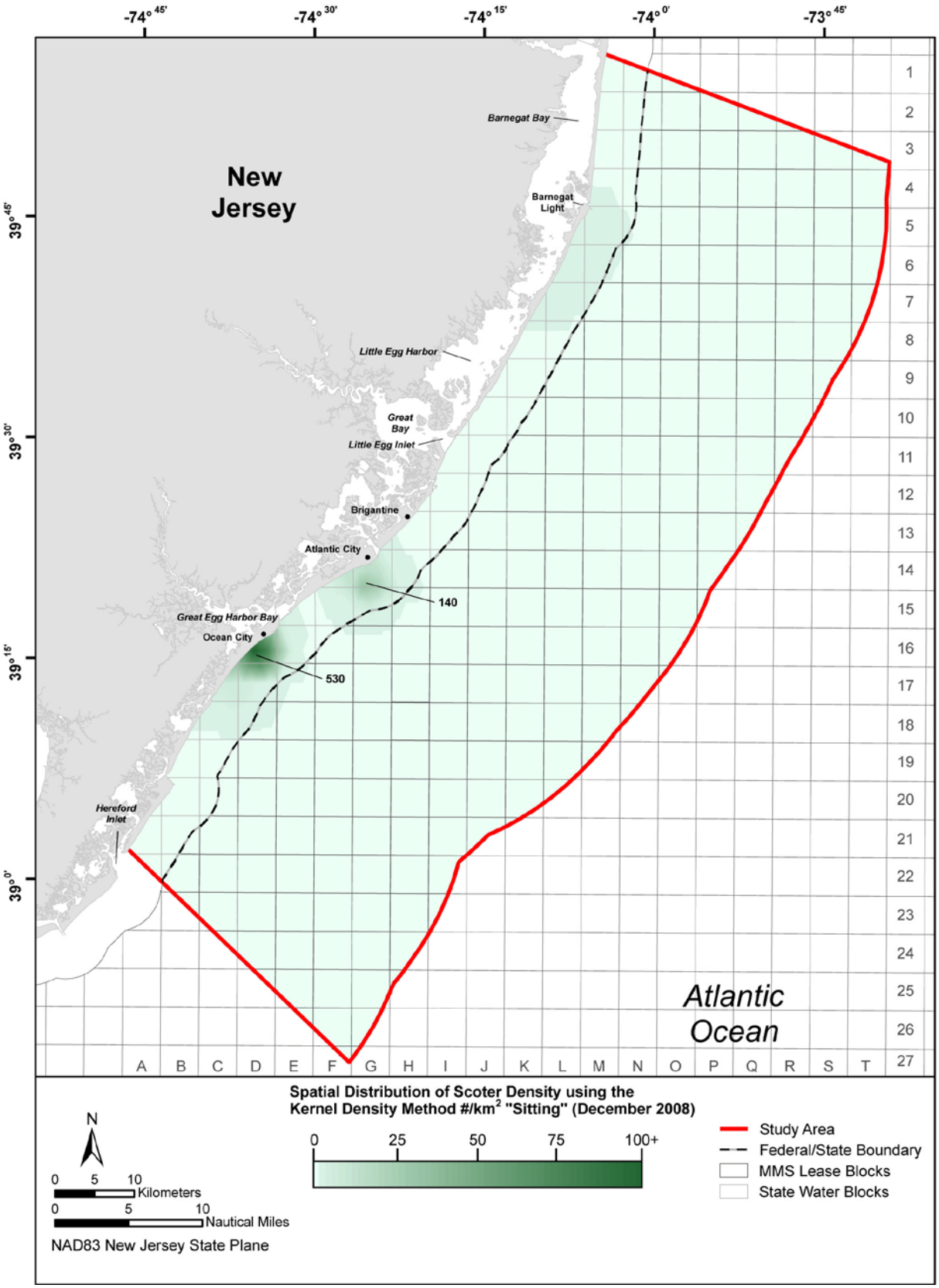

Figure M-318. Spatial distribution of scoter density (#/km^2) in the Study Area for sitting birds using the kernel density method (December 2008).

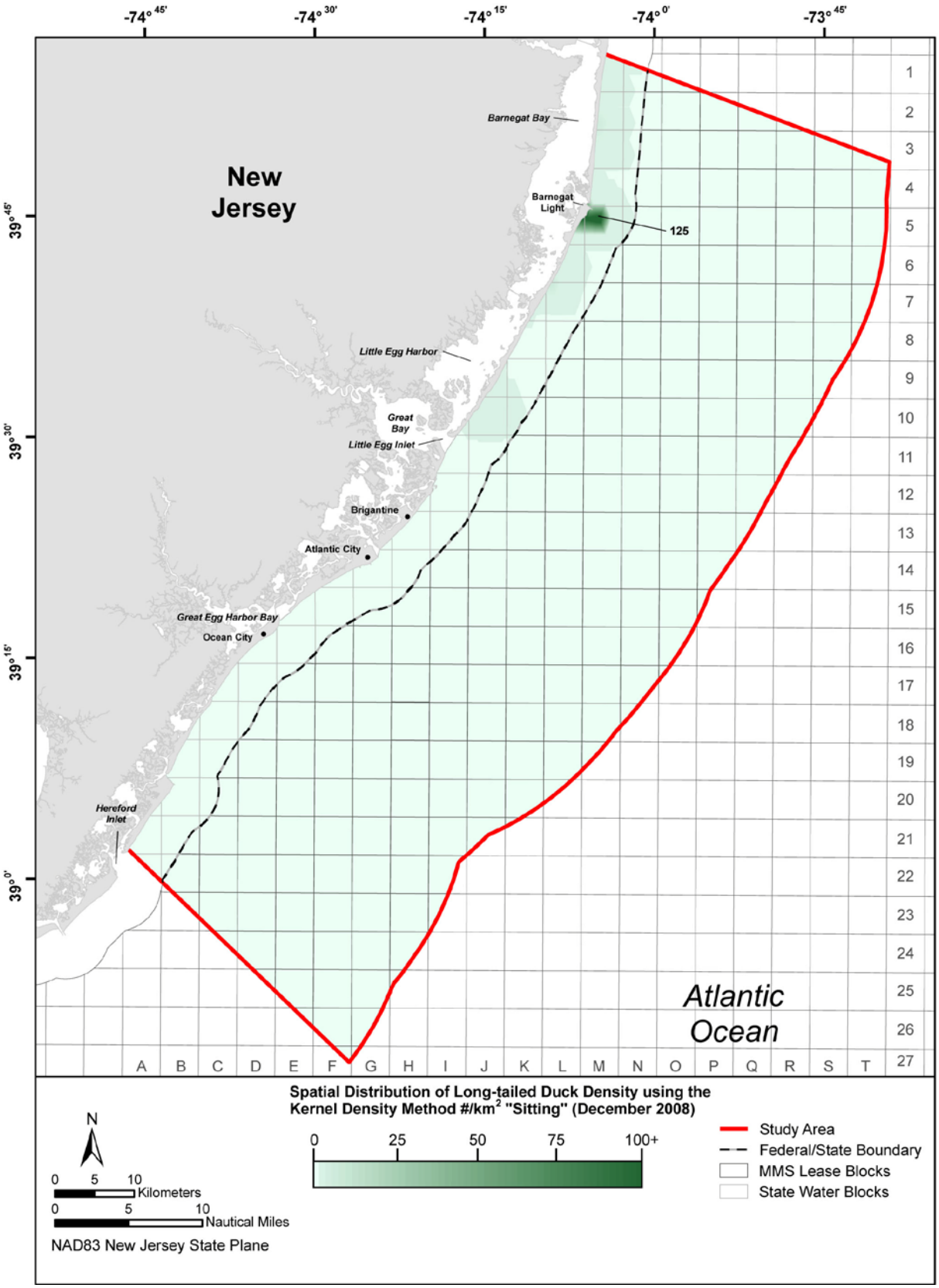

Figure M-319. Spatial distribution of Long-tailed Duck density (#/km^2) in the Study Area for sitting birds using the kernel density method (December 2008).

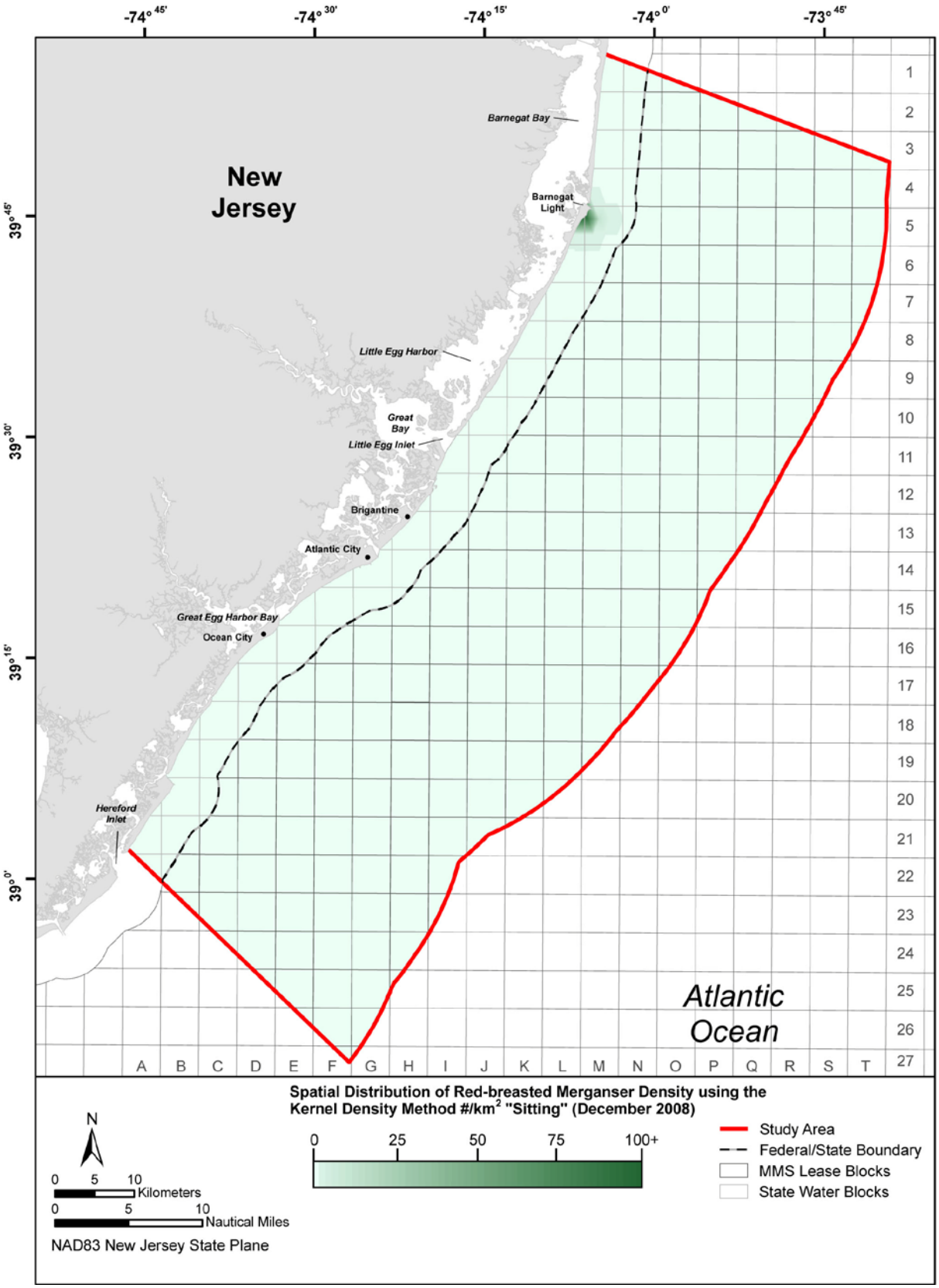

Figure M-320. Spatial distribution of Red-breasted Merganser density (#/km^2) in the Study Area for sitting birds using the kernel density method (December 2008).

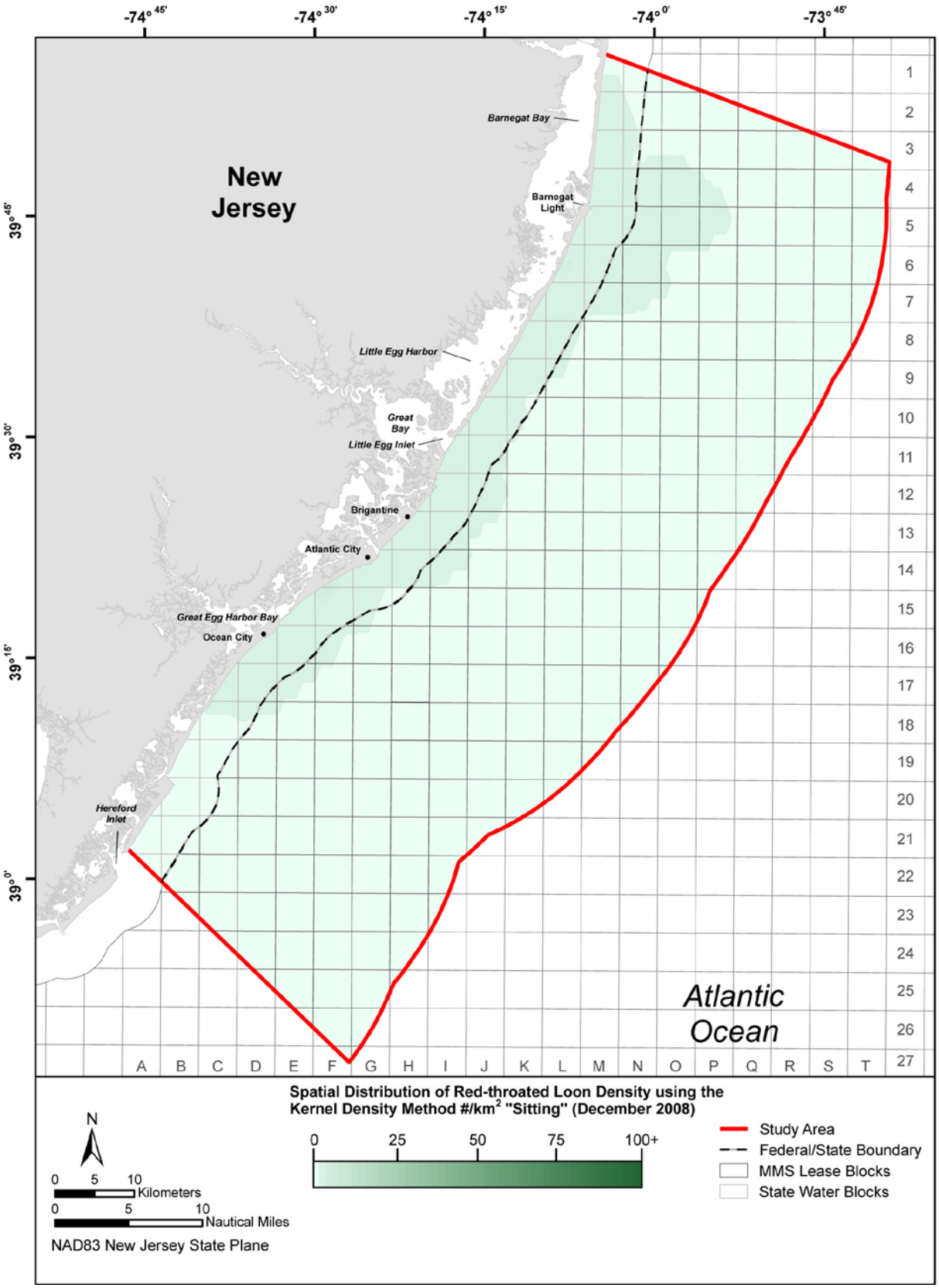

Figure M-321. Spatial distribution of Red-throated Loon density (#/km^2) in the Study Area for sitting birds using the kernel density method (December 2008).

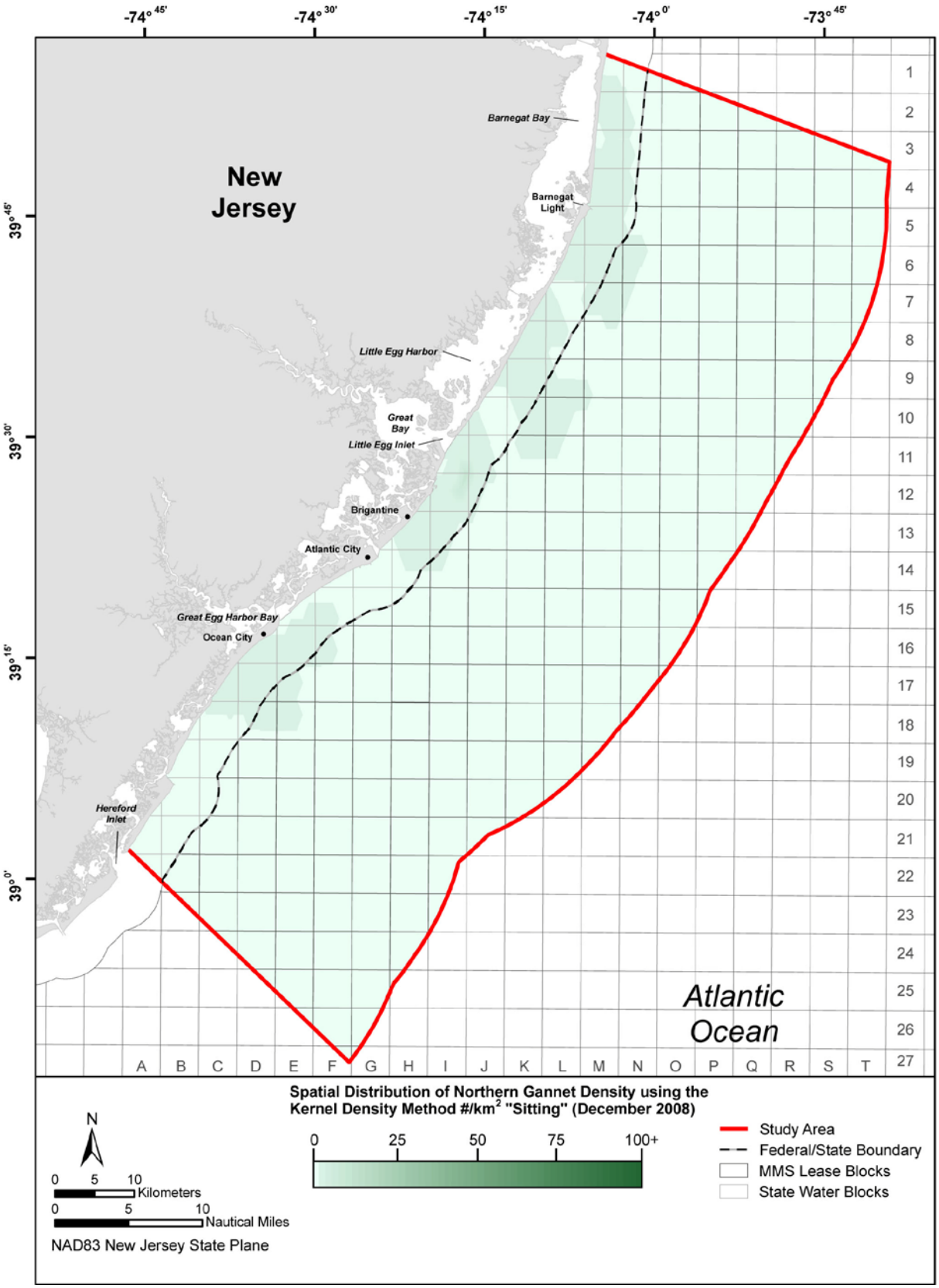

Figure M-322. Spatial distribution of Northern Gannet density (#/km^2) in the Study Area for sitting birds using the kernel density method (December 2008).

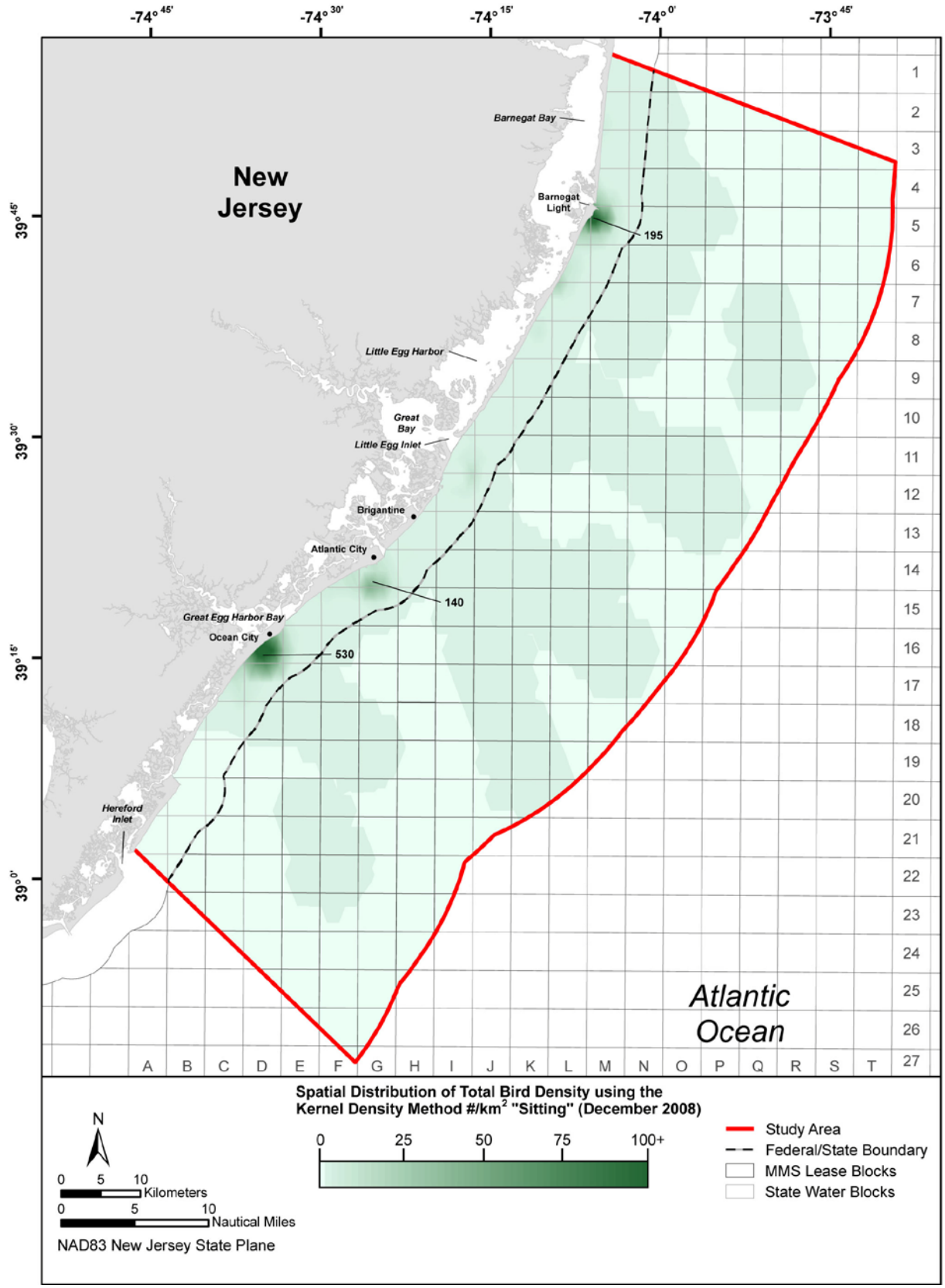

Figure M-323. Spatial distribution of total bird density (#/km^2) in the Study Area for sitting birds using the kernel density method (December 2008).

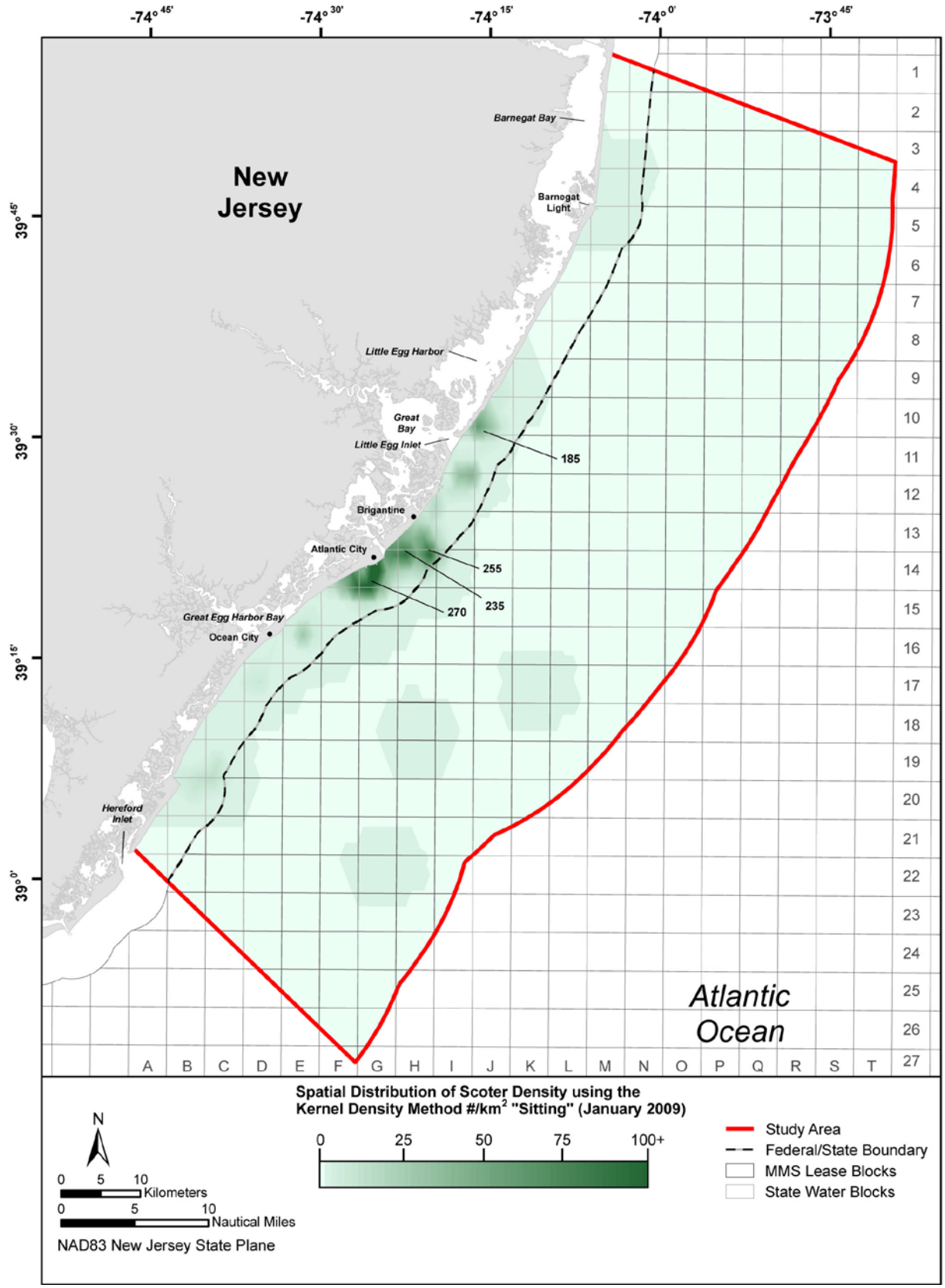

Figure M-324. Spatial distribution of scoter density (#/km^2) in the Study Area for sitting birds using the kernel density method (January 2009).

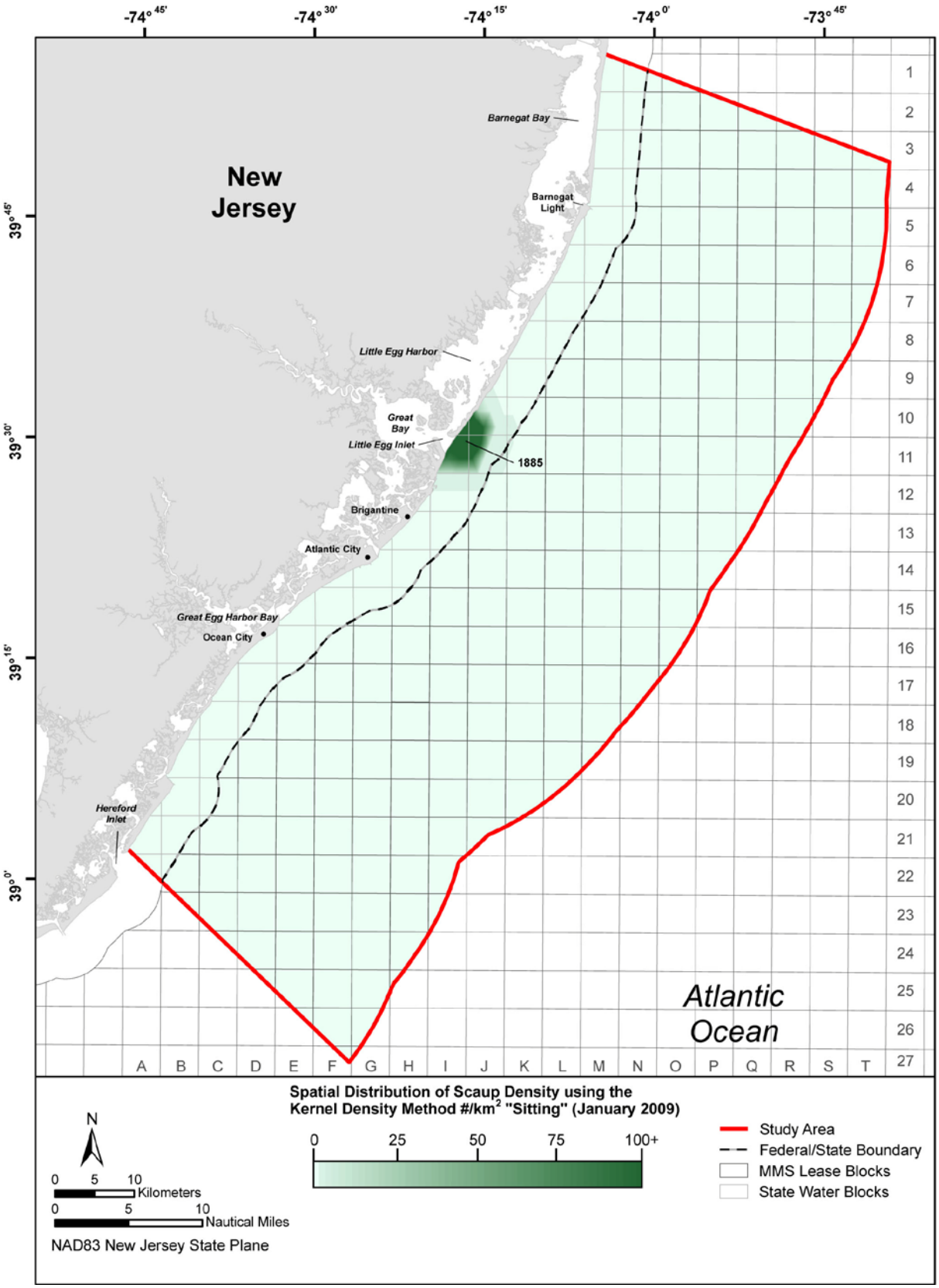

Figure M-325. Spatial distribution of scaup density (#/km^2) in the Study Area for sitting birds using the kernel density method (January 2009).

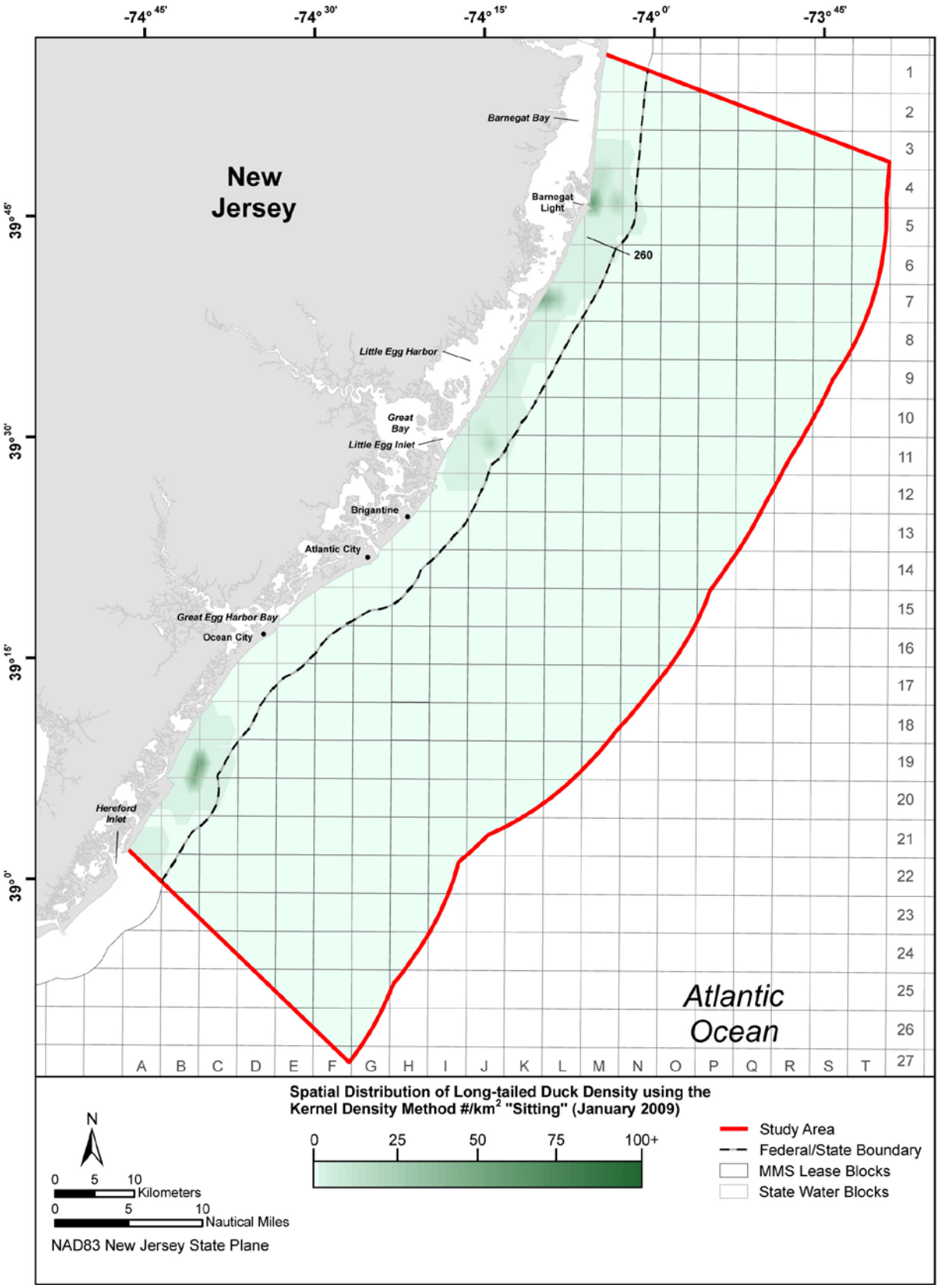

Figure M-326. Spatial distribution of Long-tailed Duck density (#/km^2) in the Study Area for sitting birds using the kernel density method (January 2009).

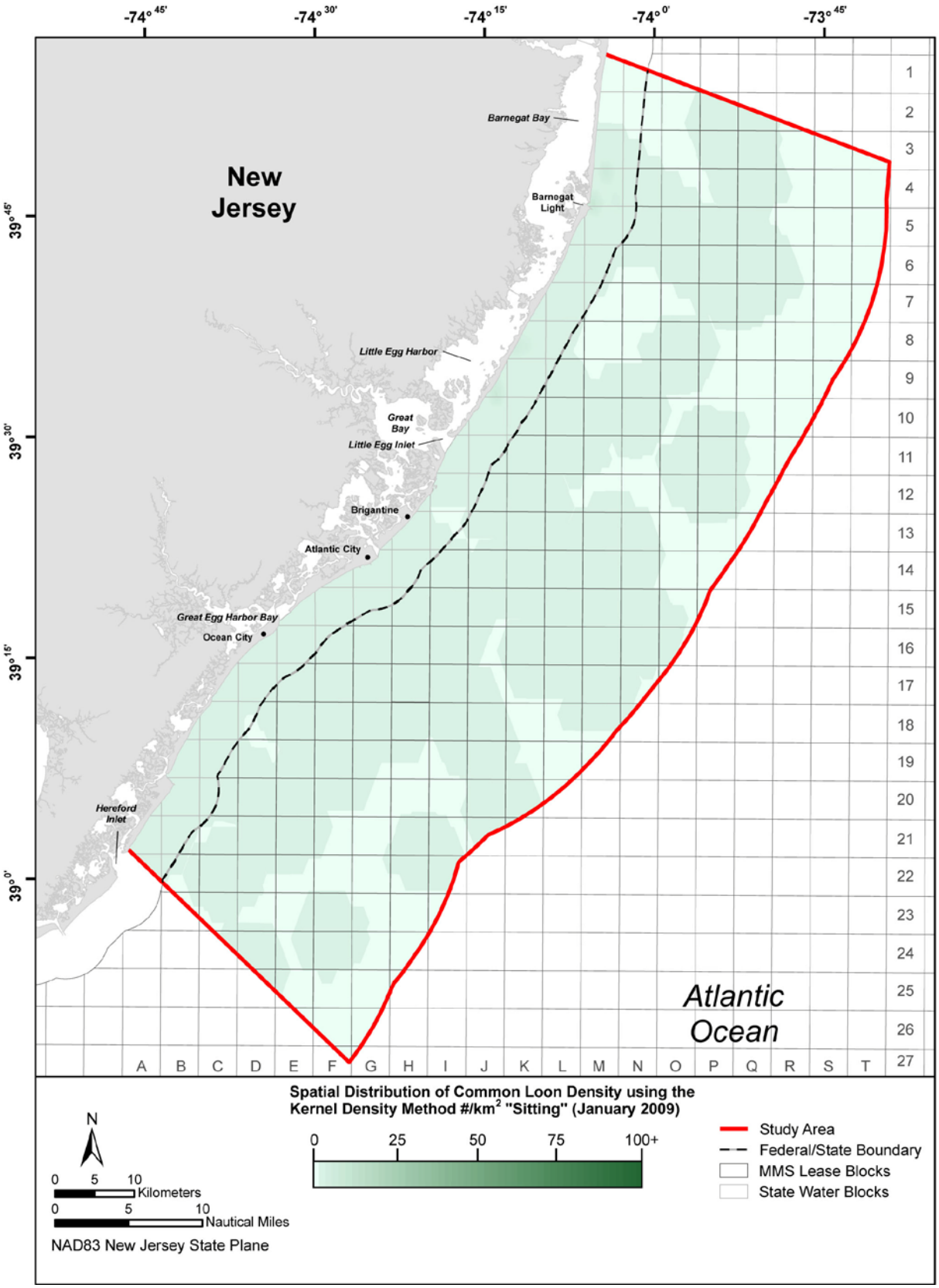

Figure M-327. Spatial distribution of Common Loon density (#/km^2) in the Study Area for sitting birds using the kernel density method (January 2009).

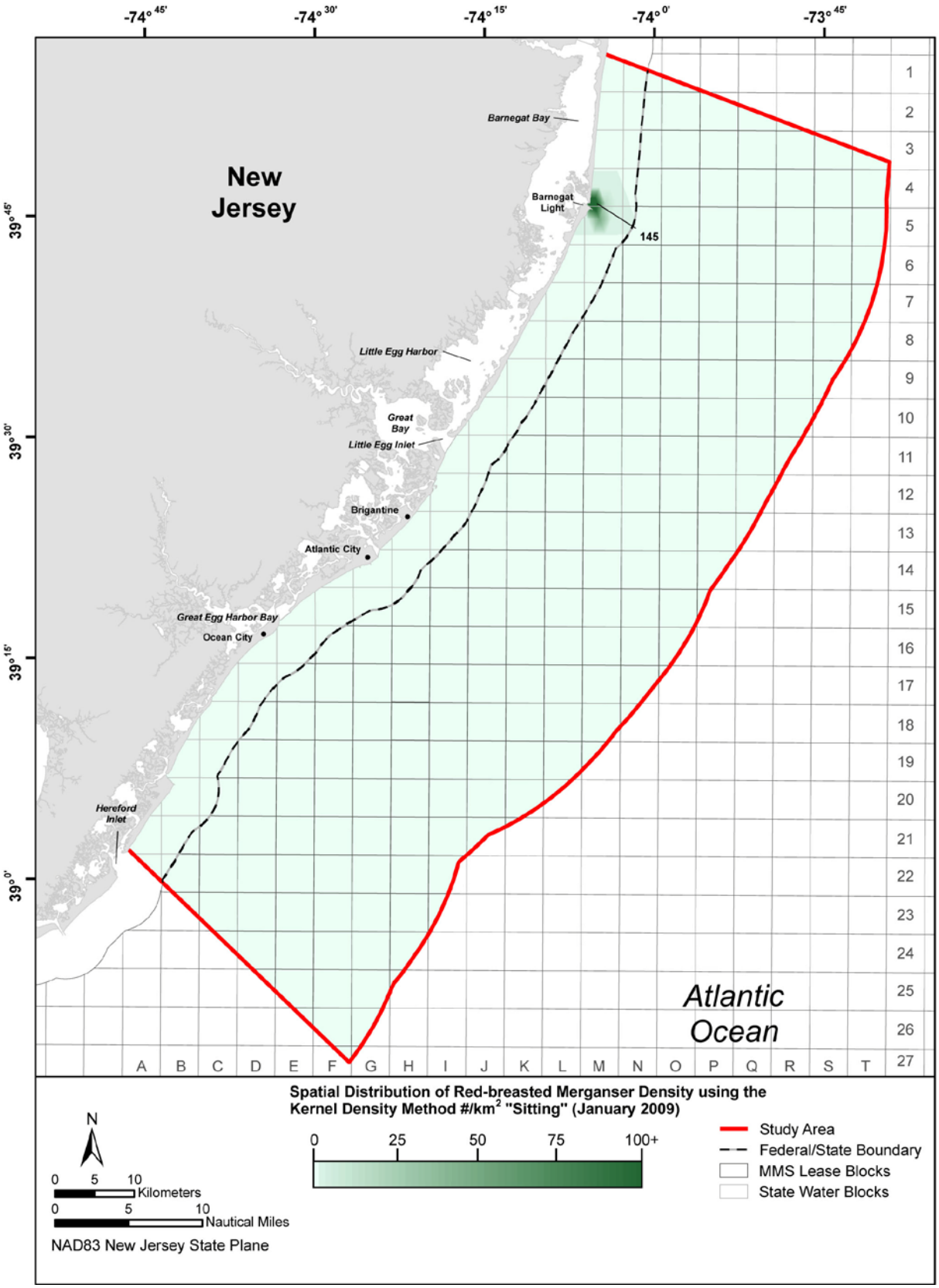

Figure M-328. Spatial distribution of Red-breasted Merganser density (#/km^2) in the Study Area for sitting birds using the kernel density method (January 2009).

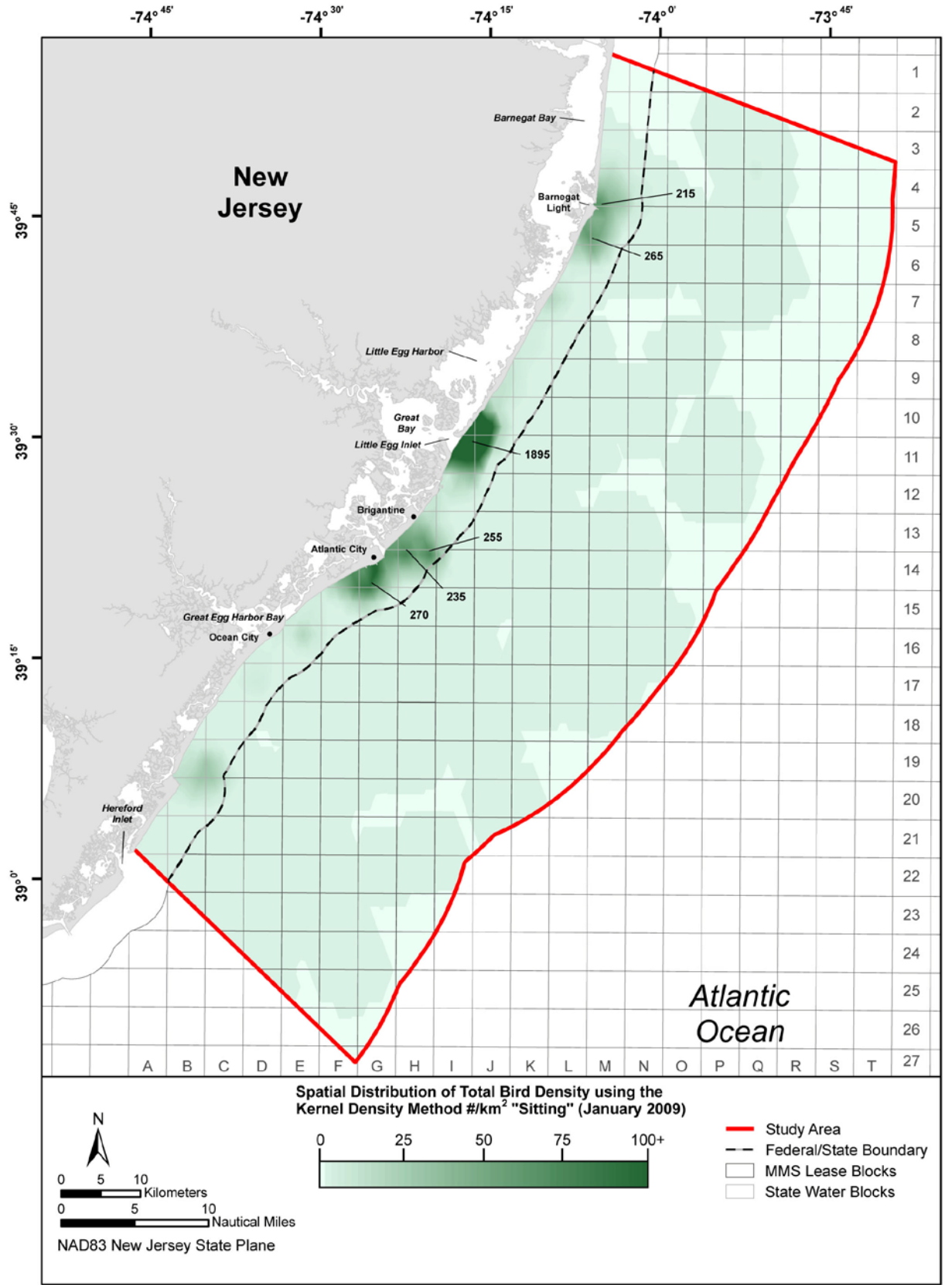

Figure M-329. Spatial distribution of total bird density (#/km^2) in the Study Area for sitting birds using the kernel density method (January 2009).

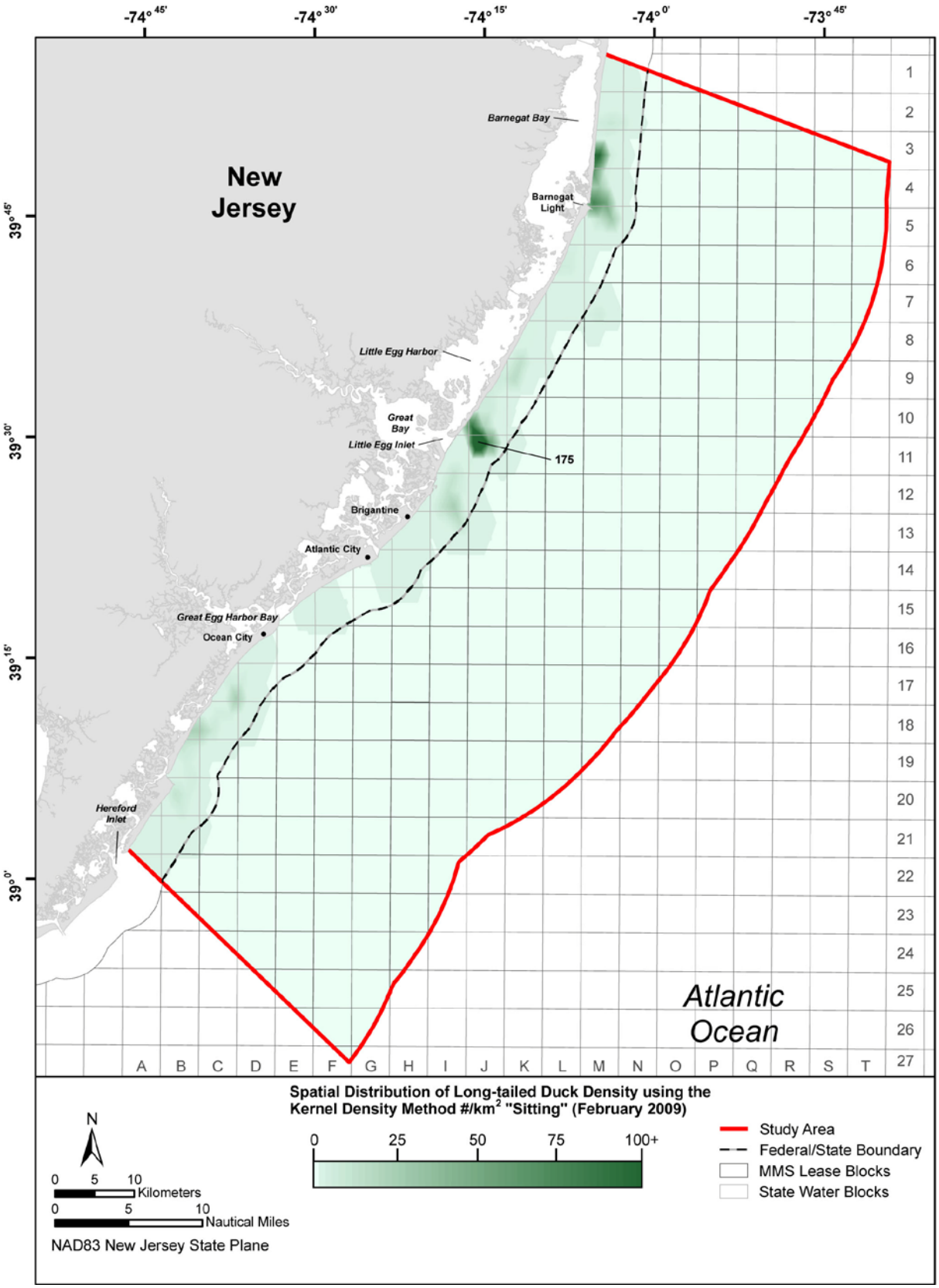

Figure M-330. Spatial distribution of Long-tailed Duck density (#/km^2) in the Study Area for sitting birds using the kernel density method (February 2009).

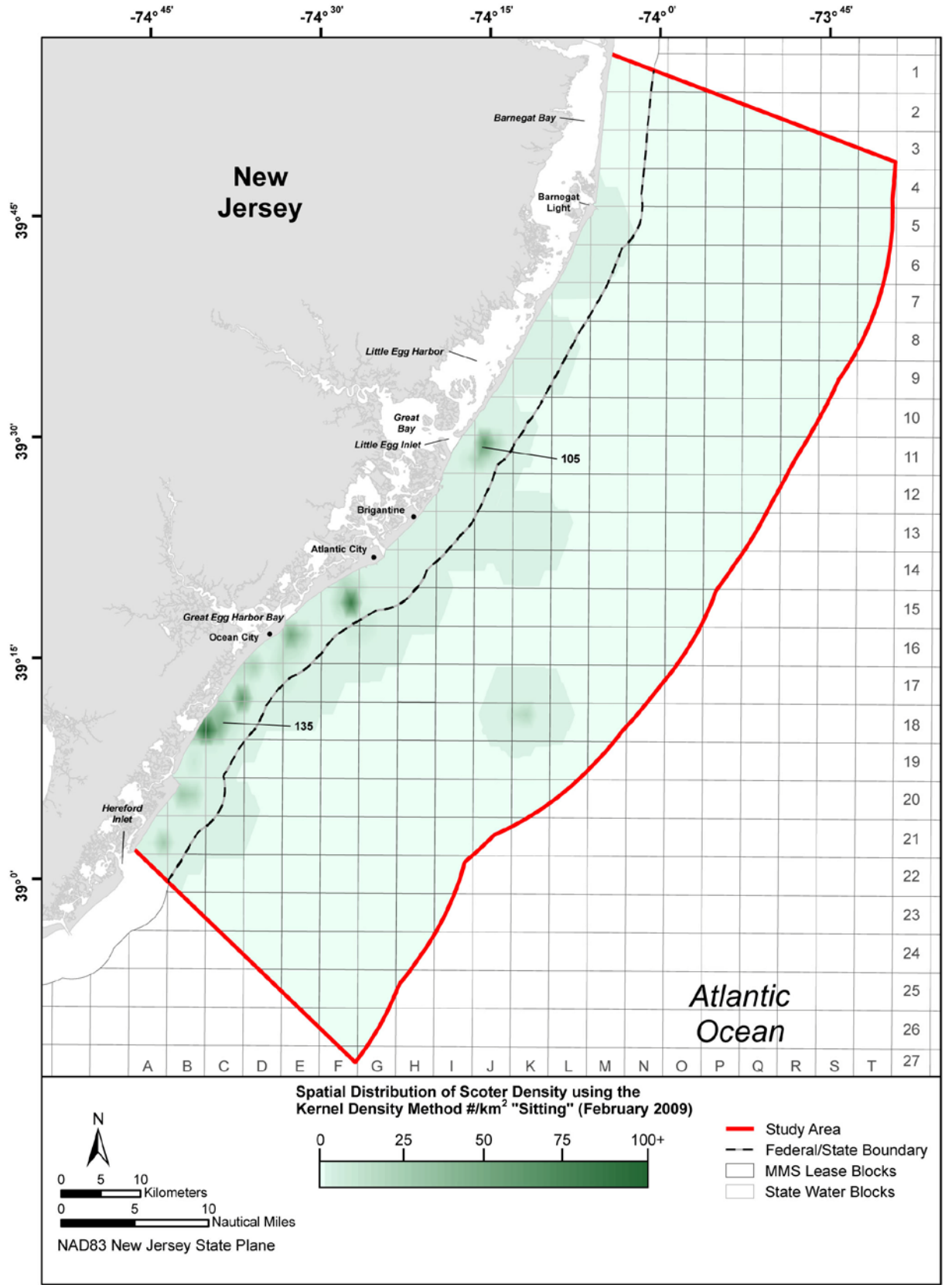

Figure M-331. Spatial distribution of scoter density (#/km^2) in the Study Area for sitting birds using the kernel density method (February 2009).

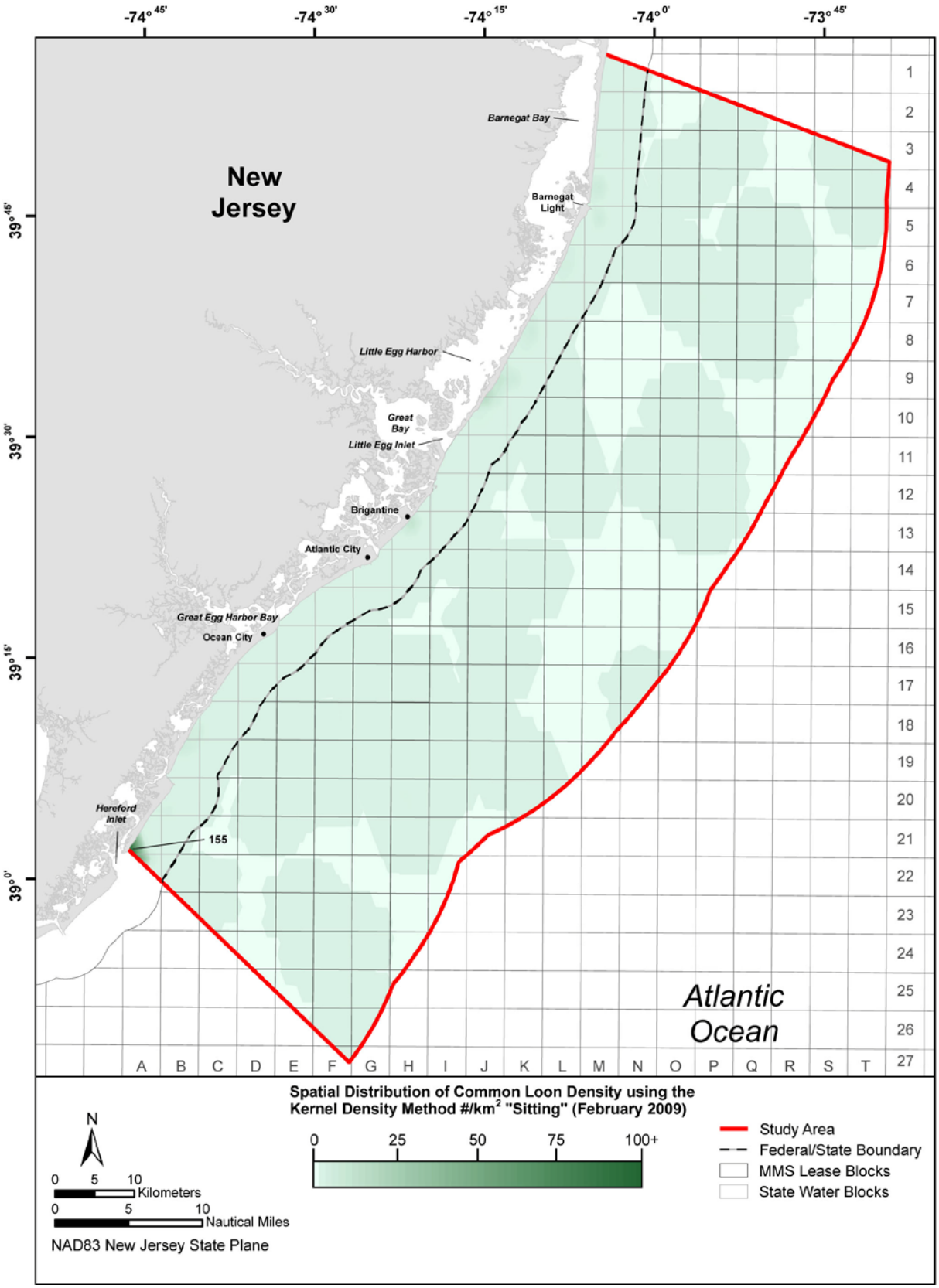

Figure M-332. Spatial distribution of Common Loon density (#/km^2) in the Study Area for sitting birds using the kernel density method (February 2009).

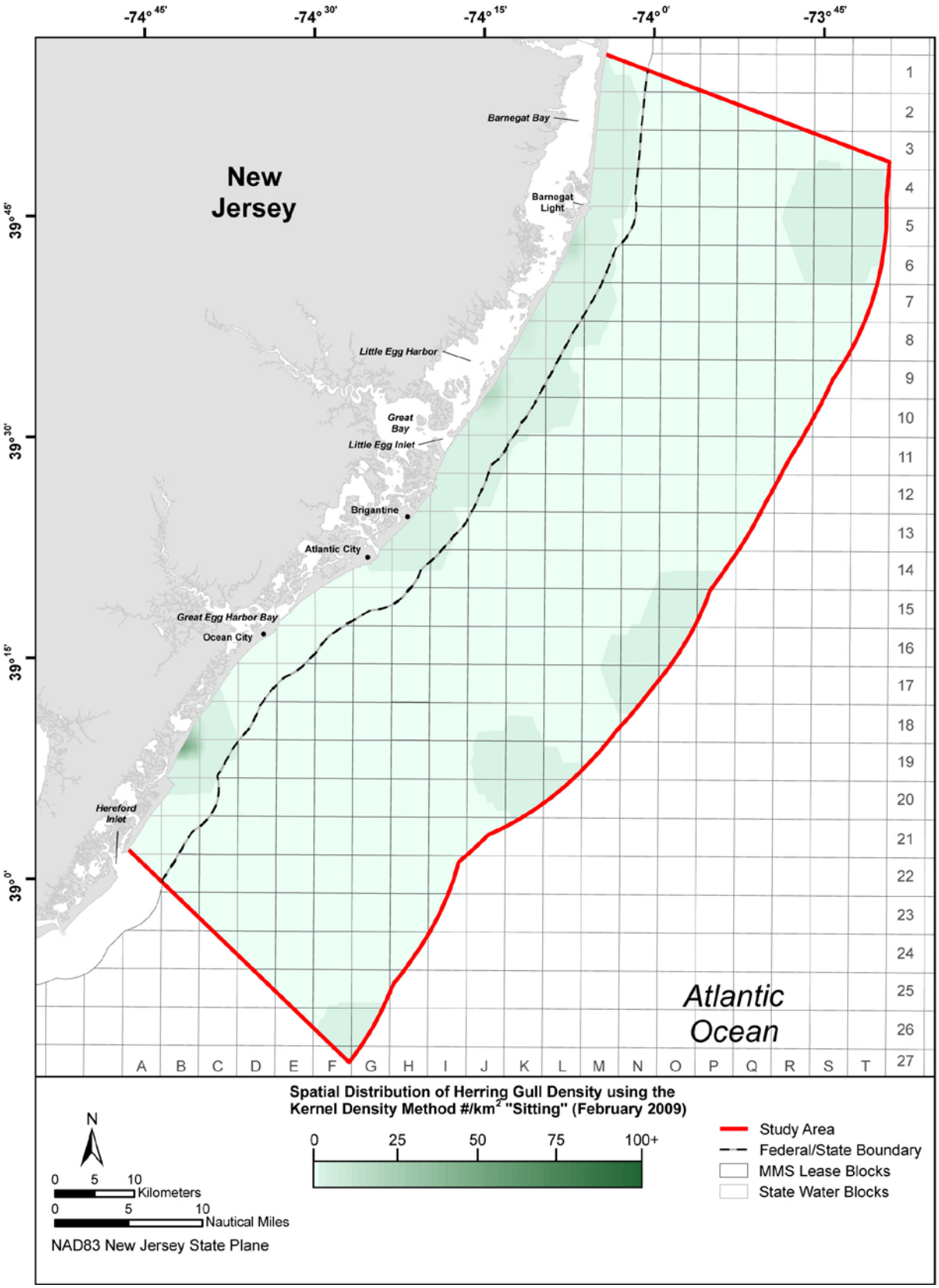

Figure M-333. Spatial distribution of Herring Gull density (#/km^2) in the Study Area for sitting birds using the kernel density method (February 2009).

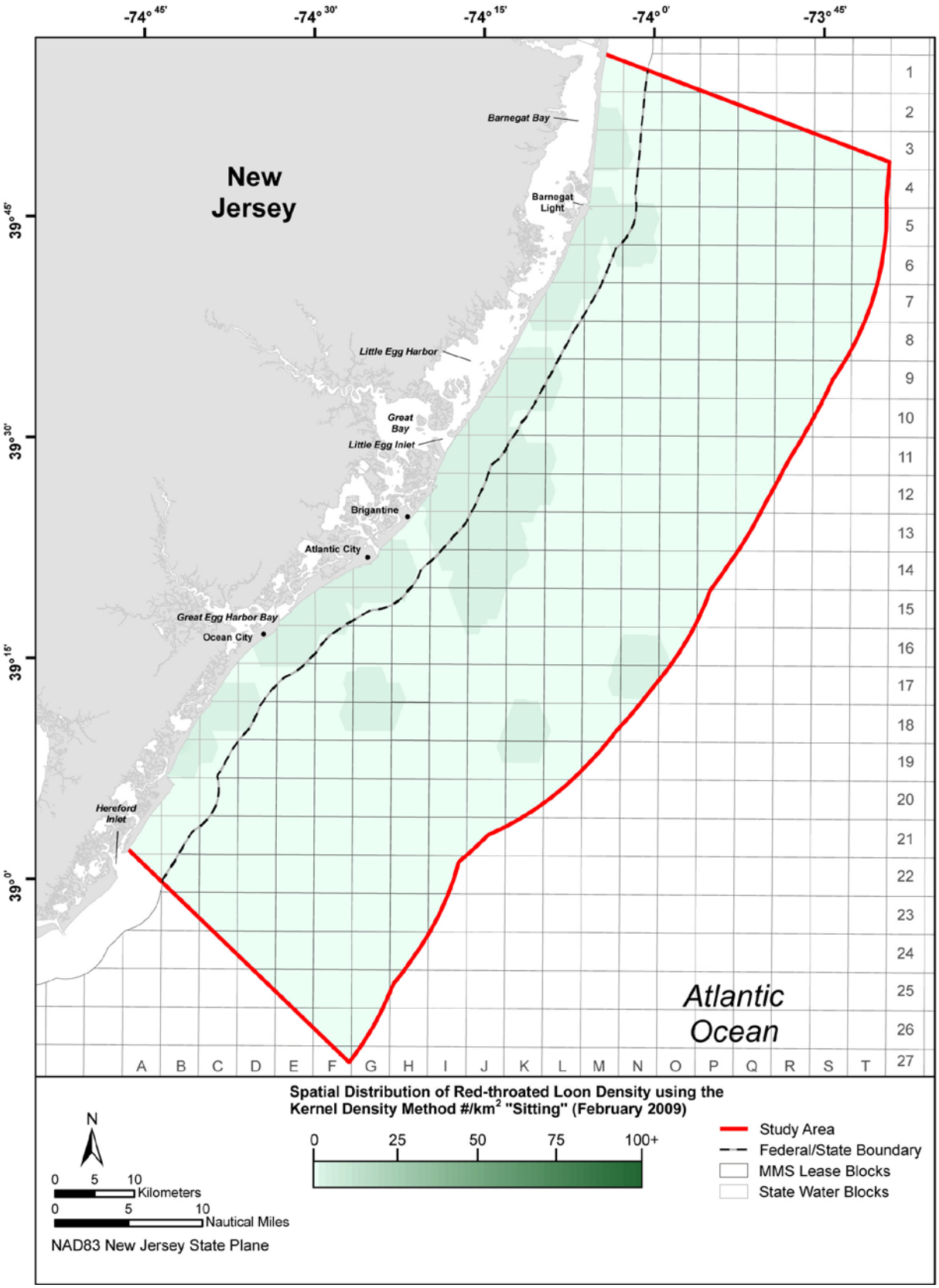

Figure M-334. Spatial distribution of Red-throated Loon density (#/km^2) in the Study Area for sitting birds using the kernel density method (February 2009).

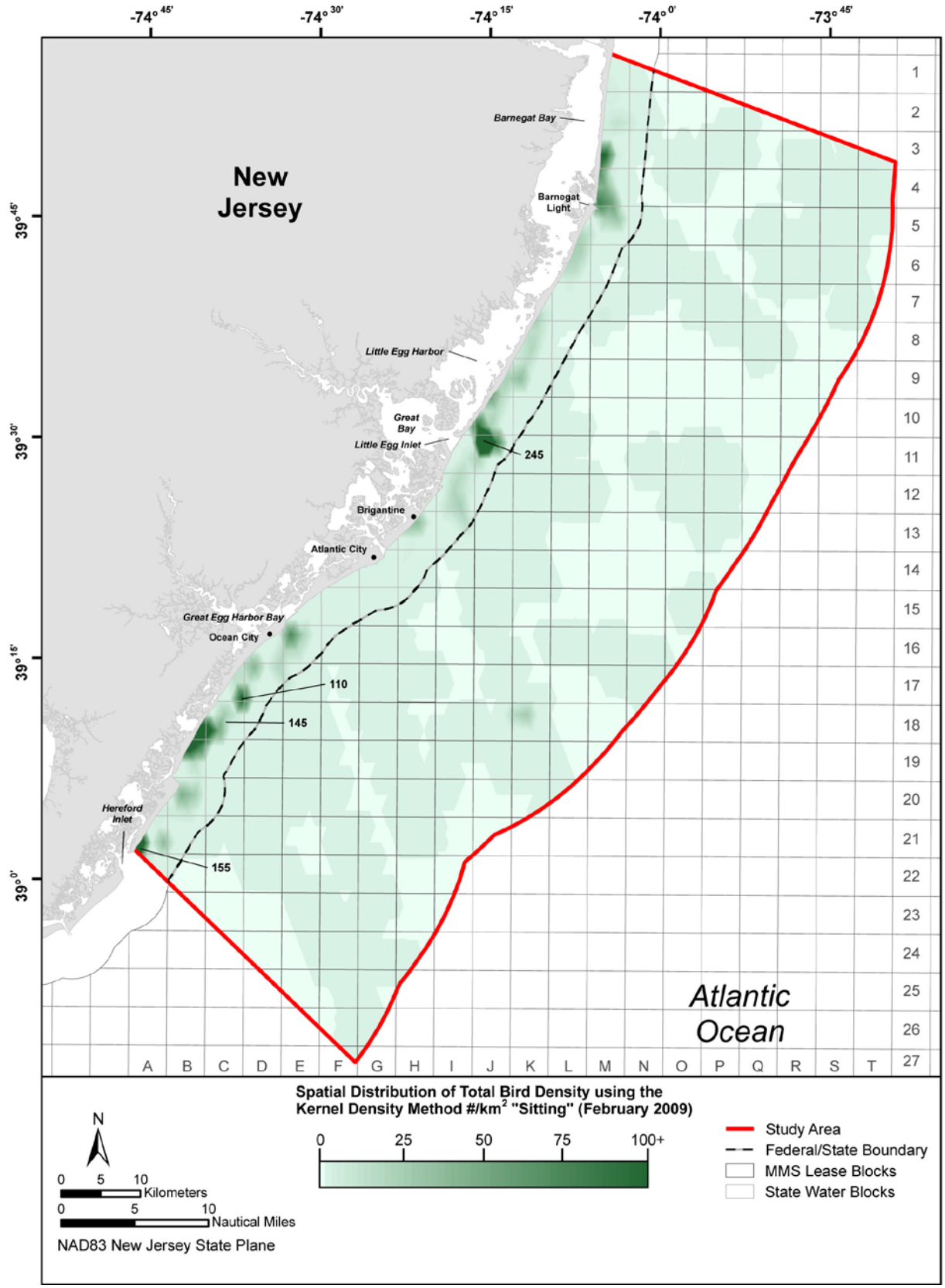

Figure M-335. Spatial distribution of total bird density (#/km^2) in the Study Area for sitting birds using the kernel density method (February 2009).

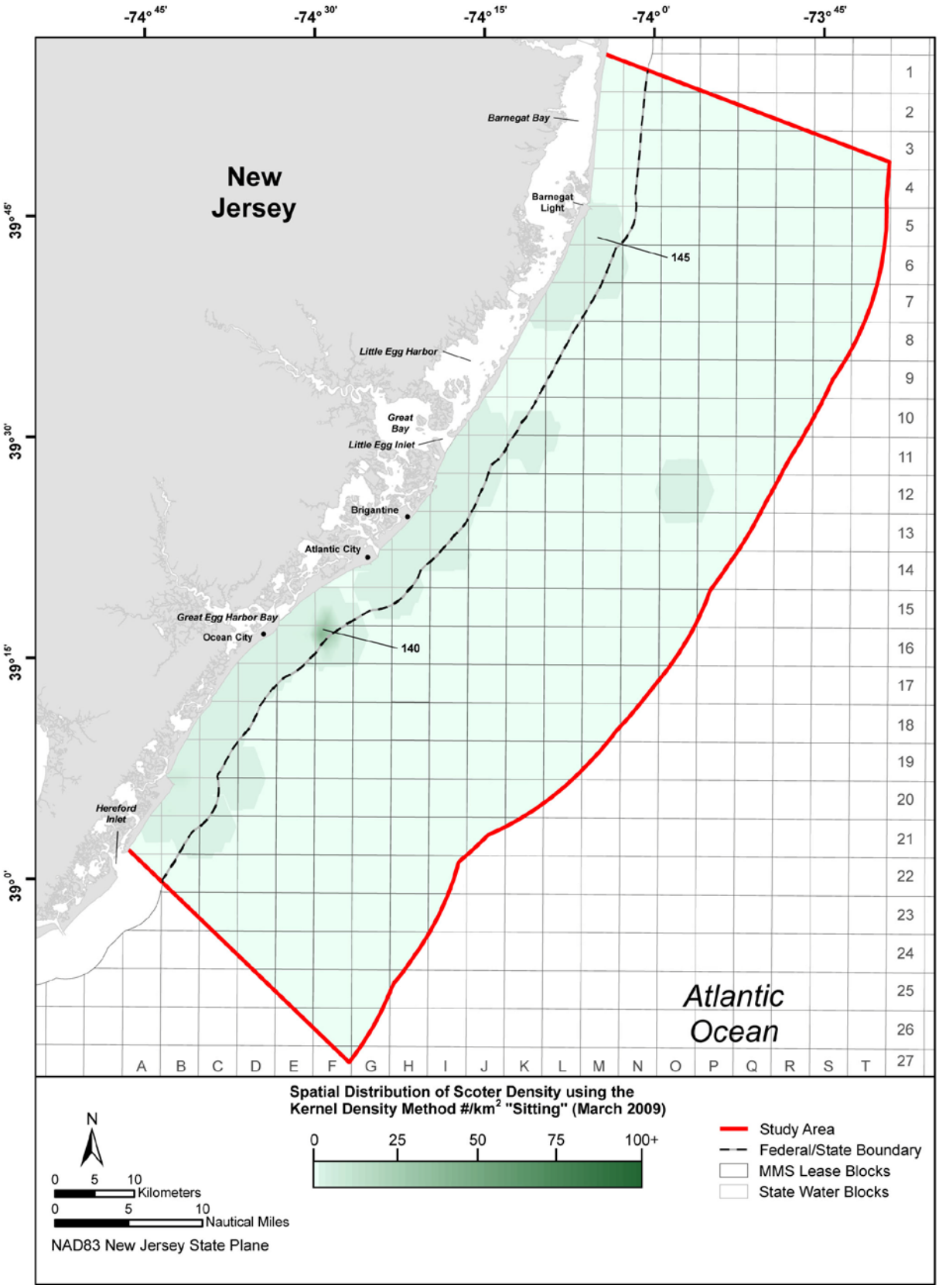

Figure M-336. Spatial distribution of scoter density (#/km^2) in the Study Area for sitting birds using the kernel density method (March 2009).

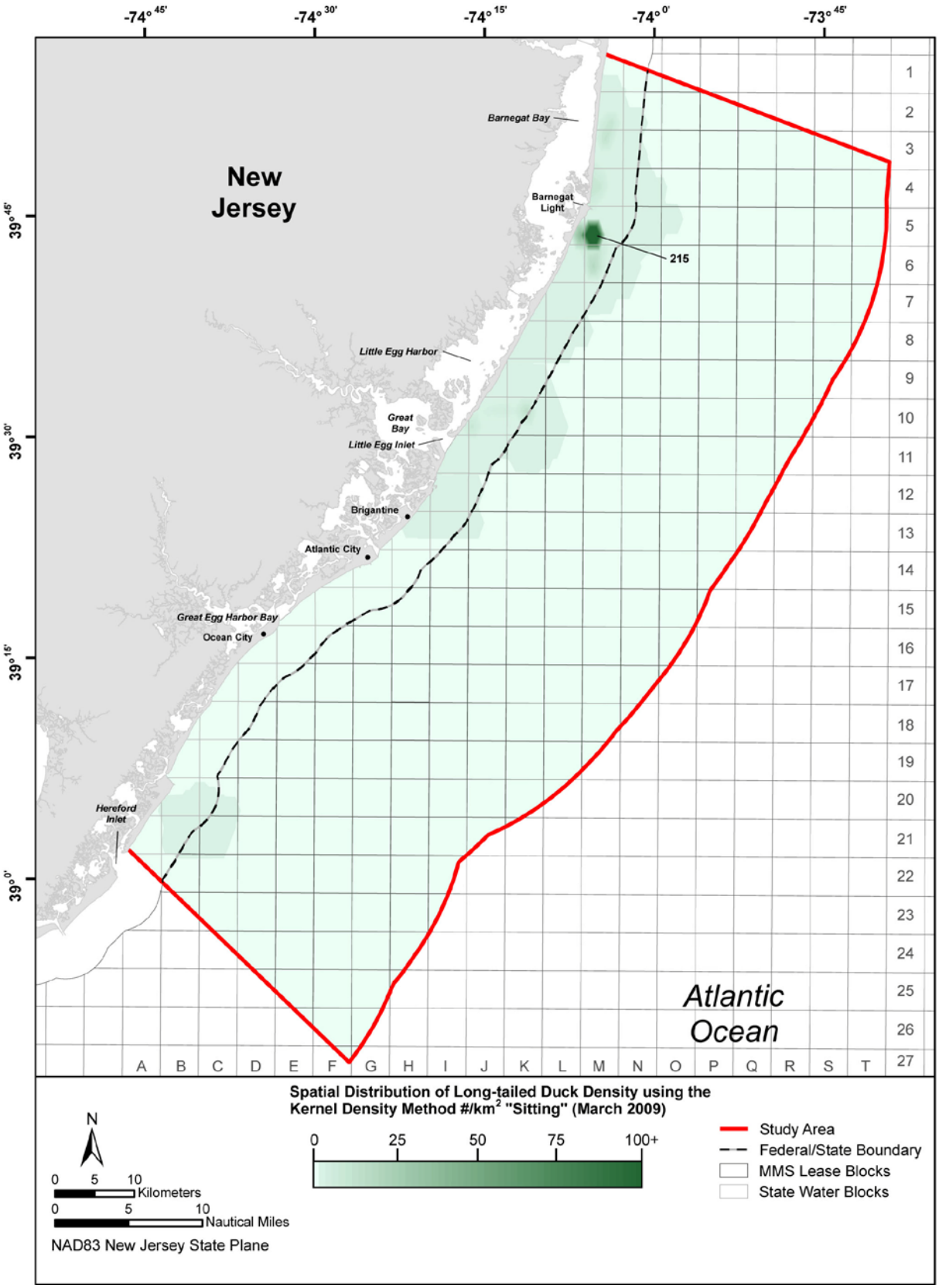

Figure M-337. Spatial distribution of Long-tailed Duck density (#/km^2) in the Study Area for sitting birds using the kernel density method (March 2009).

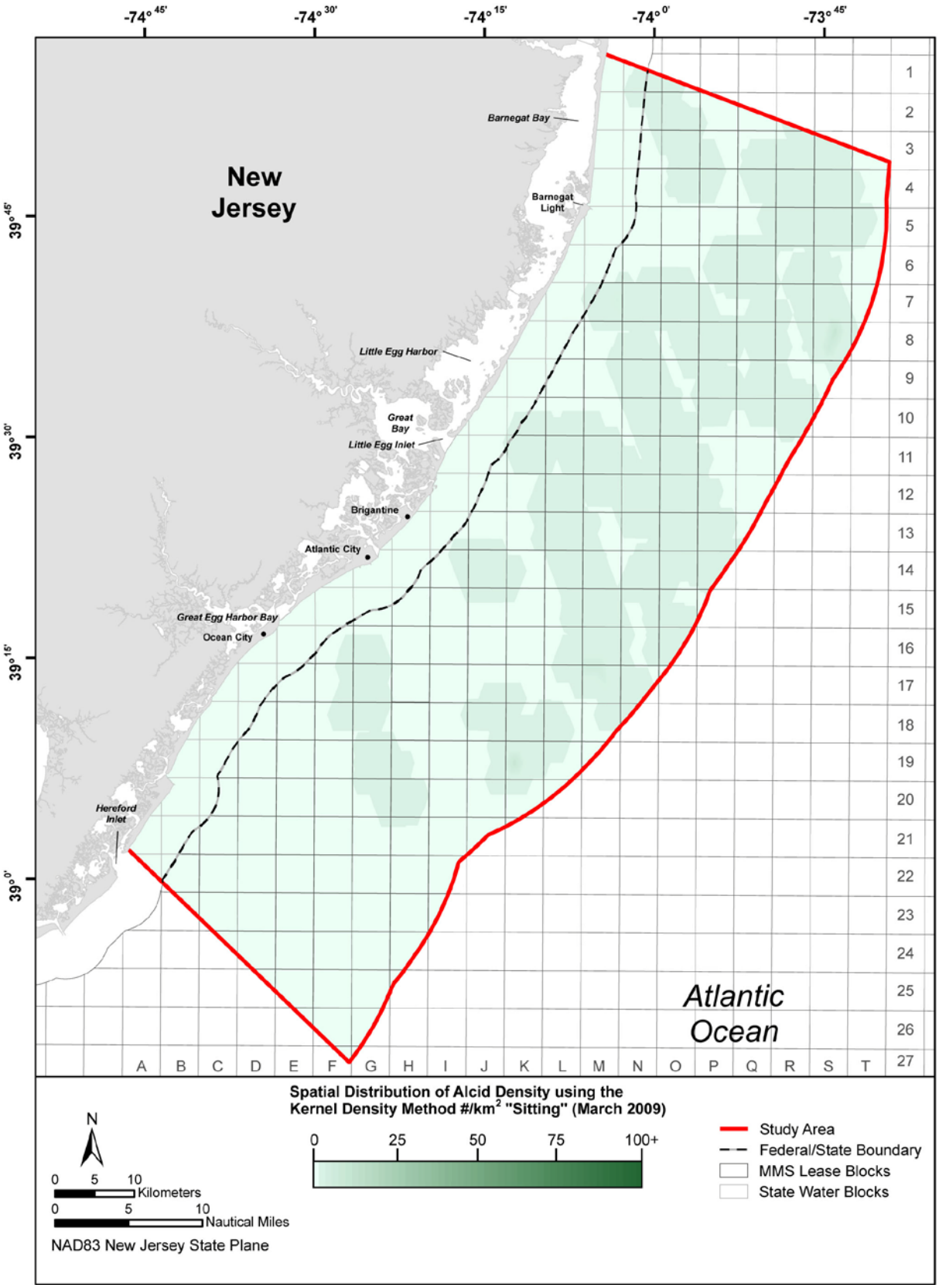

Figure M-338. Spatial distribution of alcid density (#/km^2) in the Study Area for sitting birds using the kernel density method (March 2009).

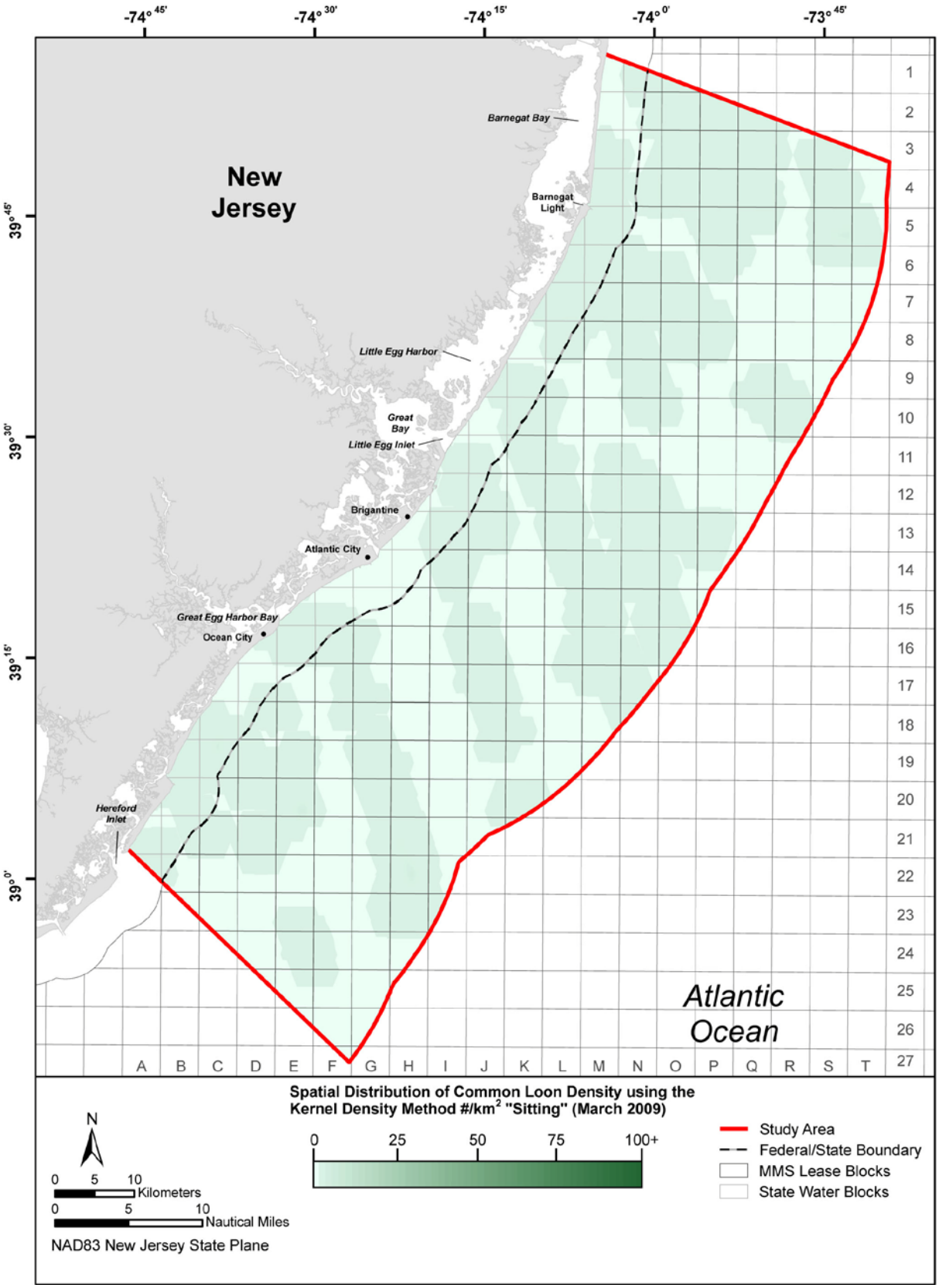

Figure M-339. Spatial distribution of Common Loon density (#/km^2) in the Study Area for sitting birds using the kernel density method (March 2009).

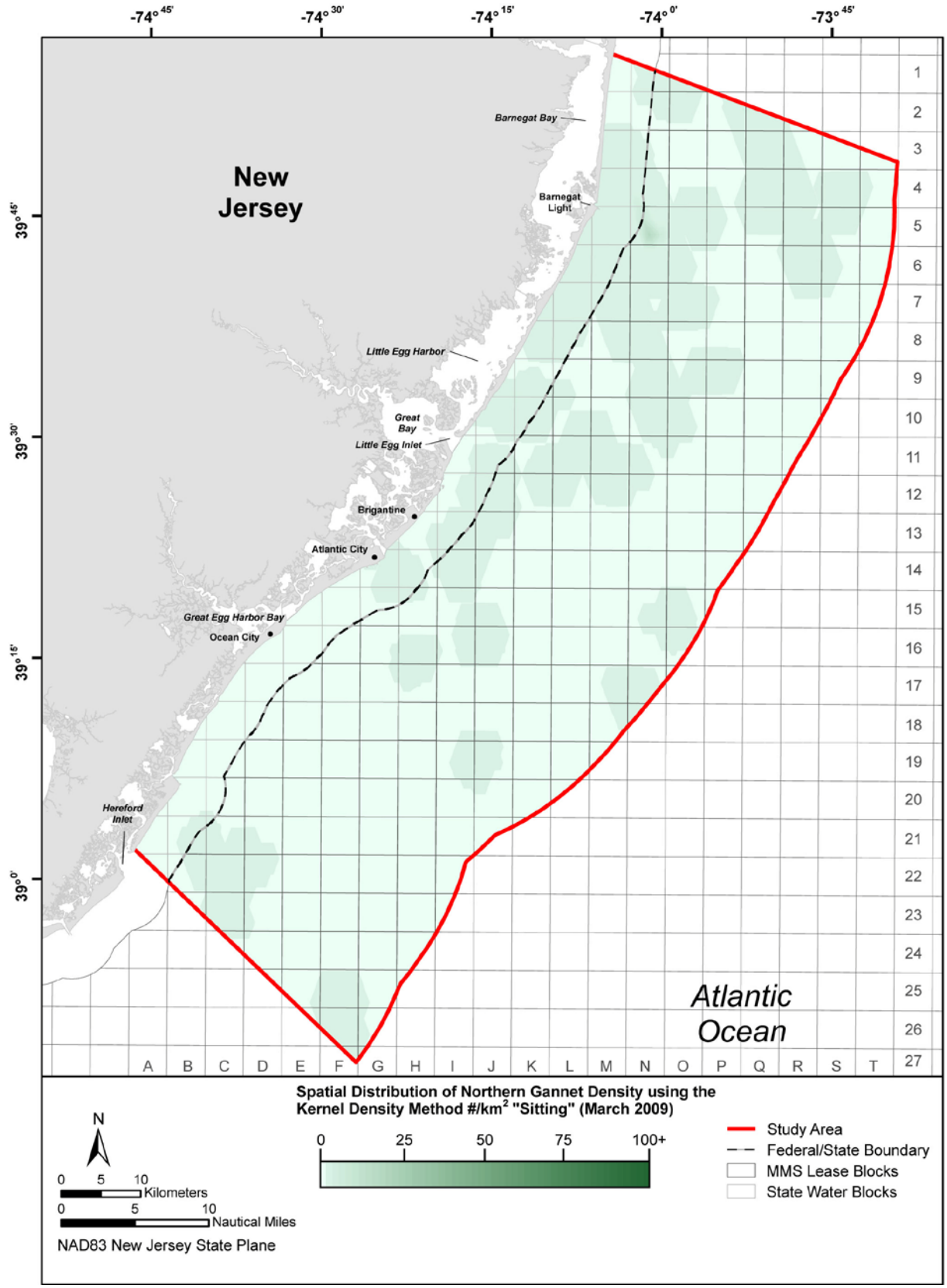

Figure M-340. Spatial distribution of Northern Gannet density (#/km^2) in the Study Area for sitting birds using the kernel density method (March 2009).

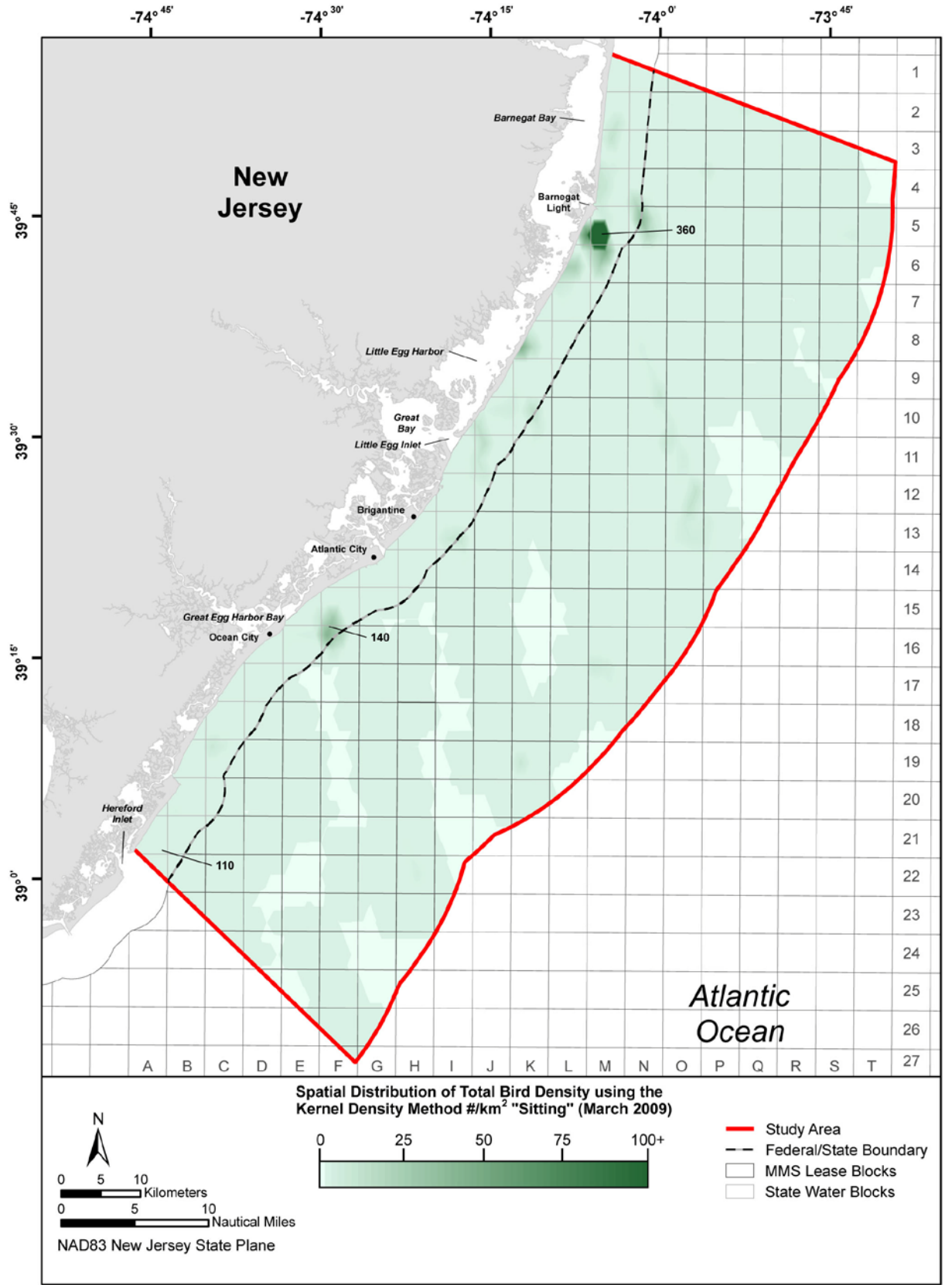

Figure M-341. Spatial distribution of total bird density (#/km^2) in the Study Area for sitting birds using the kernel density method (March 2009).

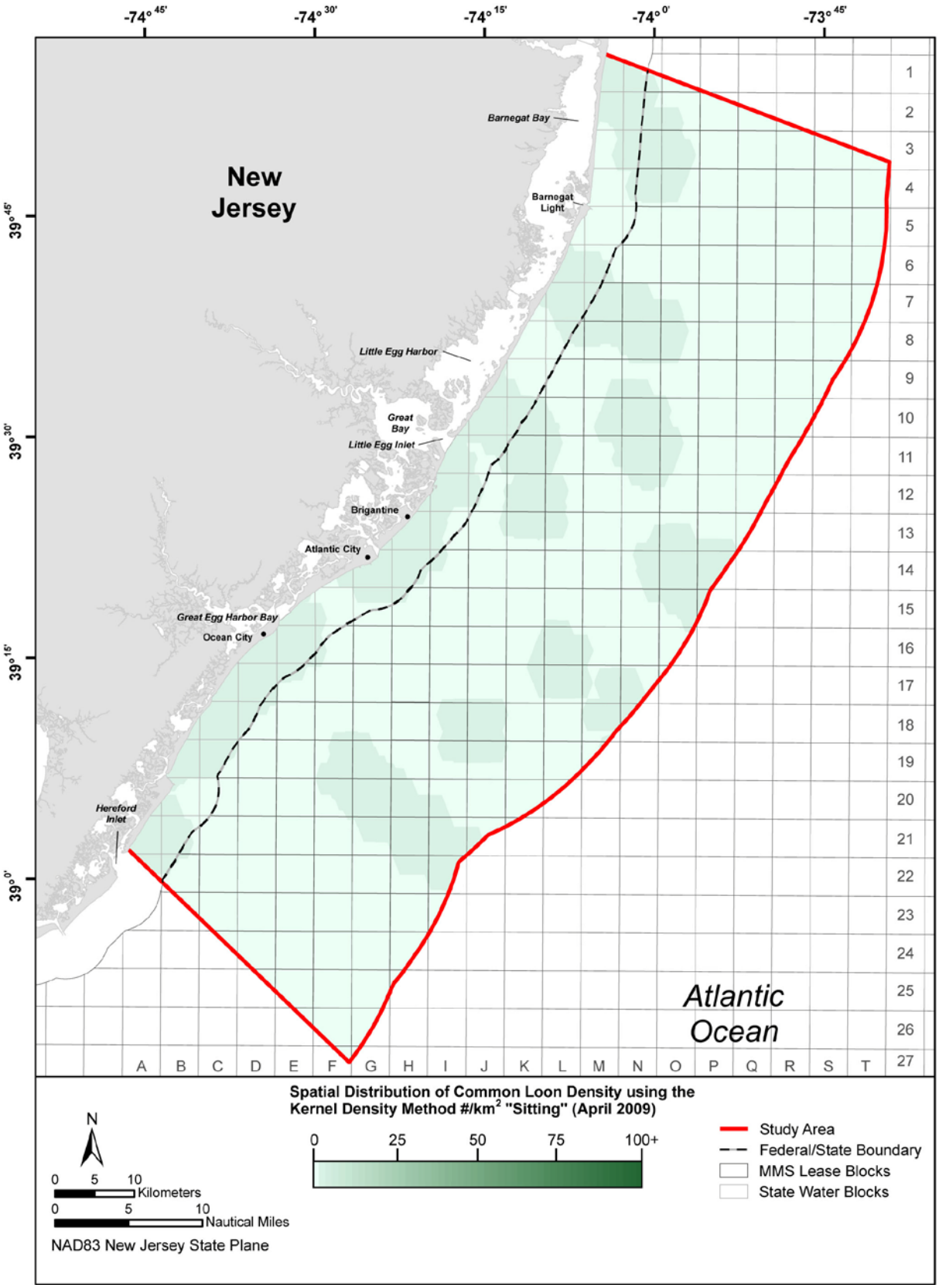

Figure M-342. Spatial distribution of Common Loon density (#/km^2) in the Study Area for sitting birds using the kernel density method (April 2009).

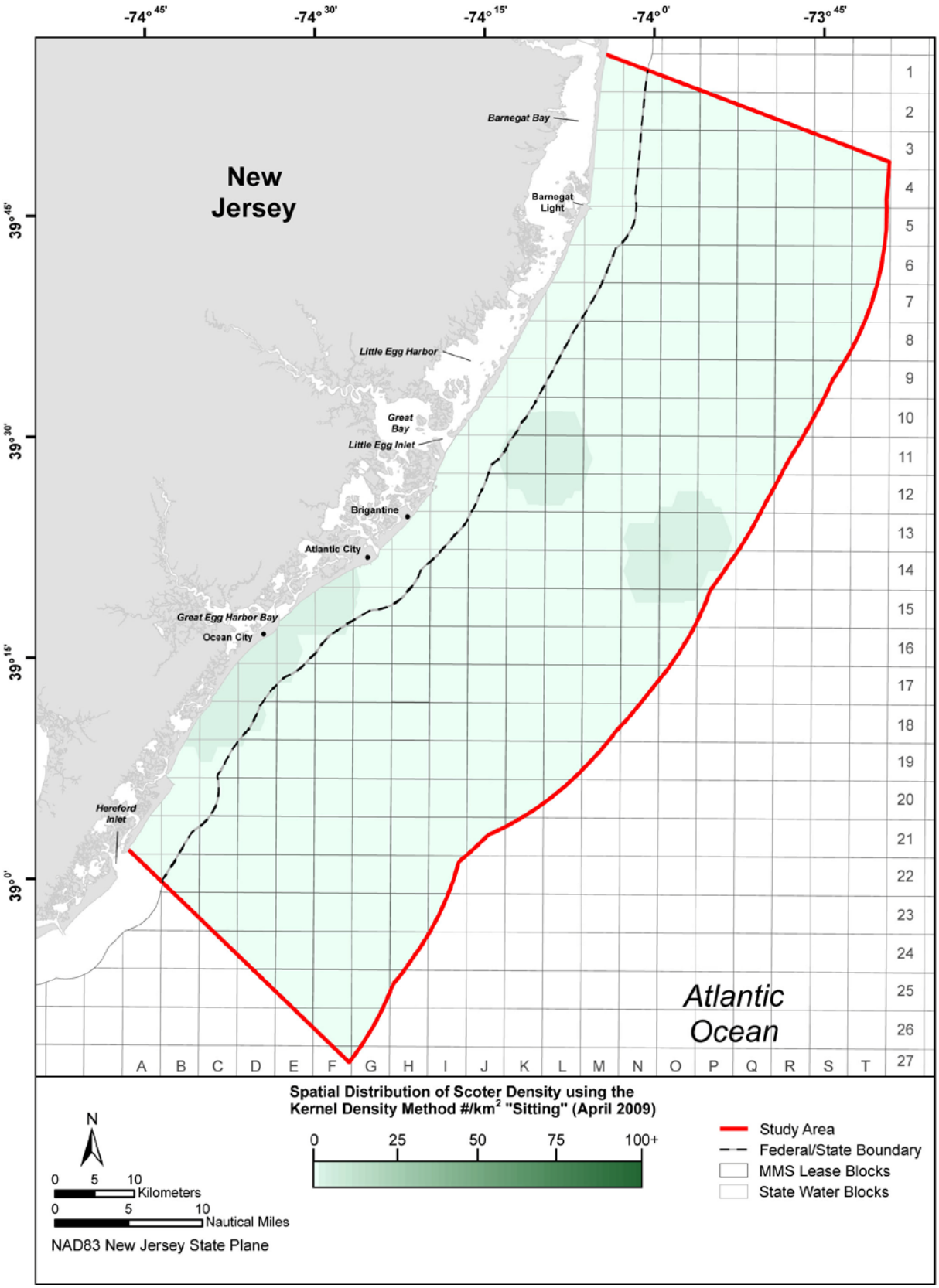

Figure M-343. Spatial distribution of scoter density (#/km^2) in the Study Area for sitting birds using the kernel density method (April 2009).

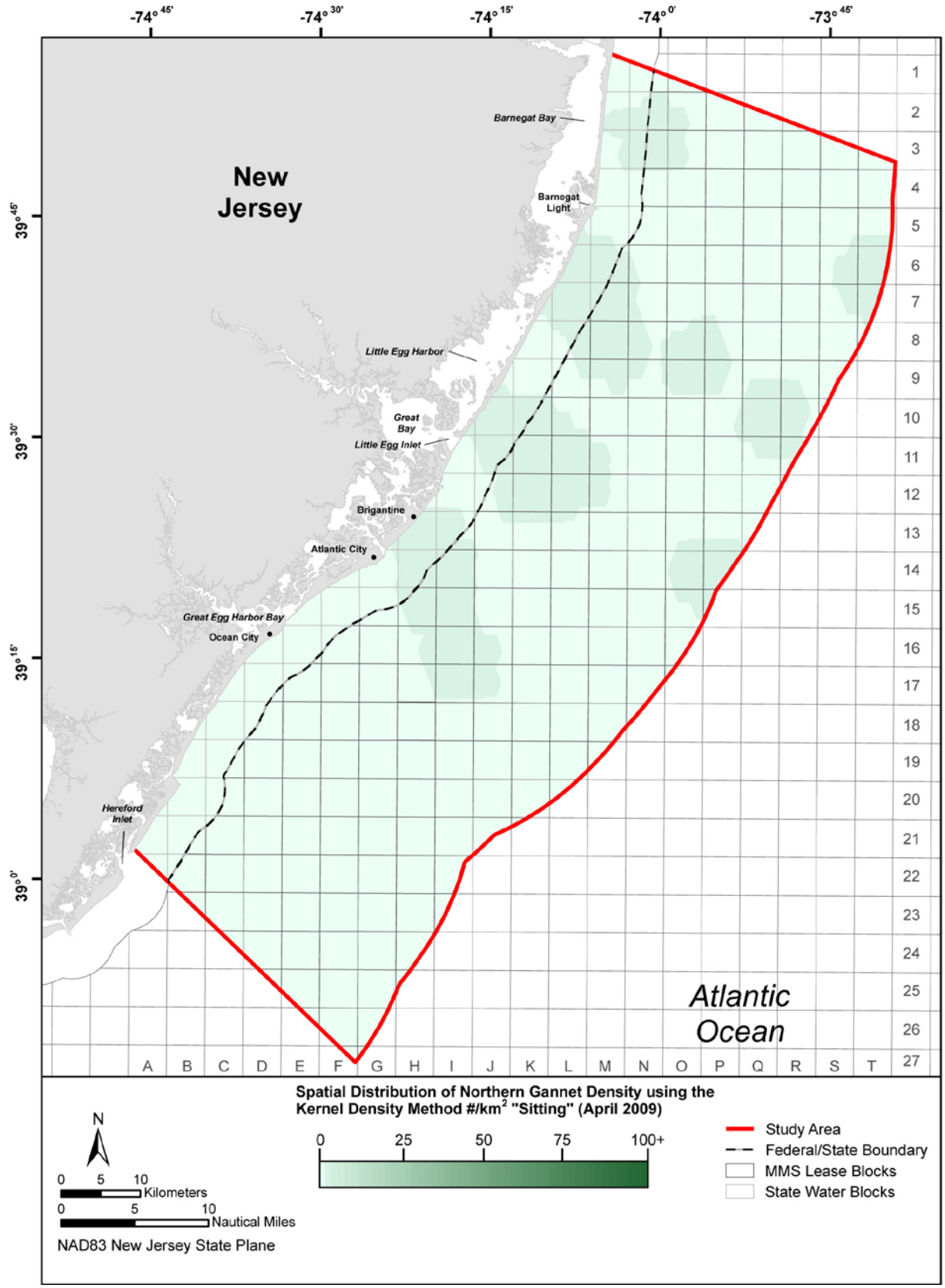

Figure M-344. Spatial distribution of Northern Gannet density (#/km^2) in the Study Area for sitting birds using the kernel density method (April 2009).

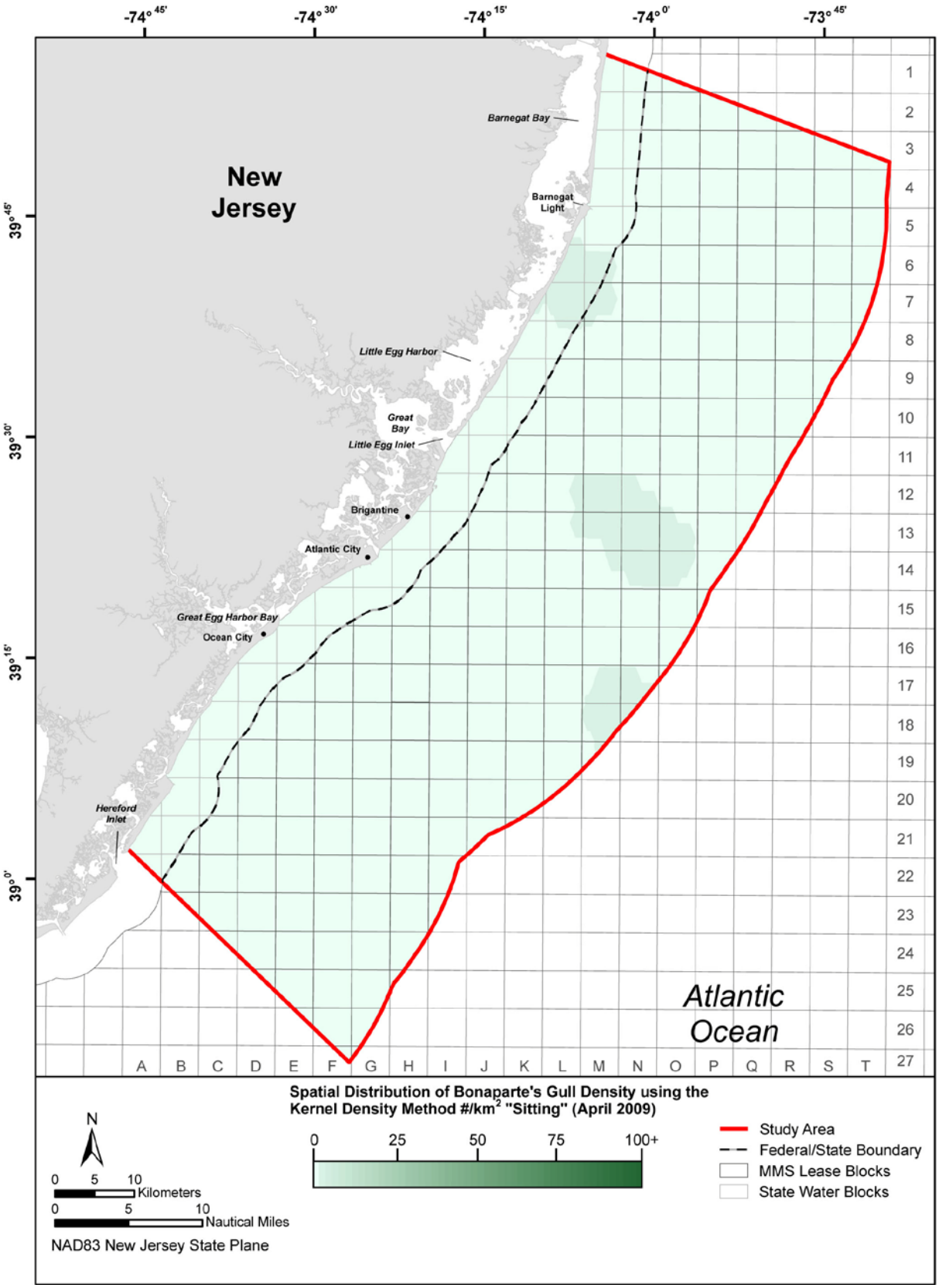

Figure M-345. Spatial distribution of Bonaparte's Gull density (#/km^2) in the Study Area for sitting birds using the kernel density method (April 2009).

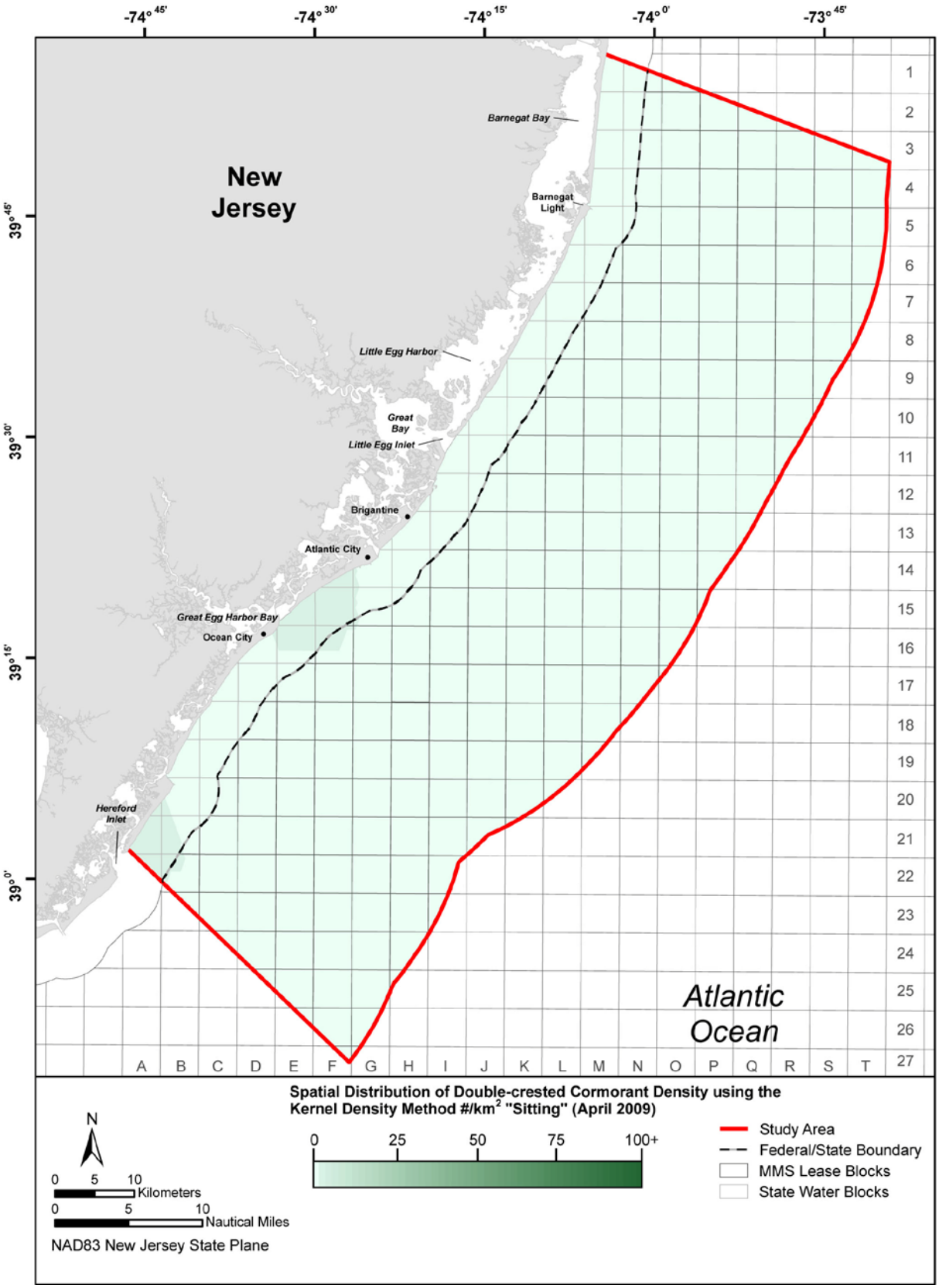

Figure M-346. Spatial distribution of Double-crested Cormorant density (#/km^2) in the Study Area for sitting birds using the kernel density method (April 2009).

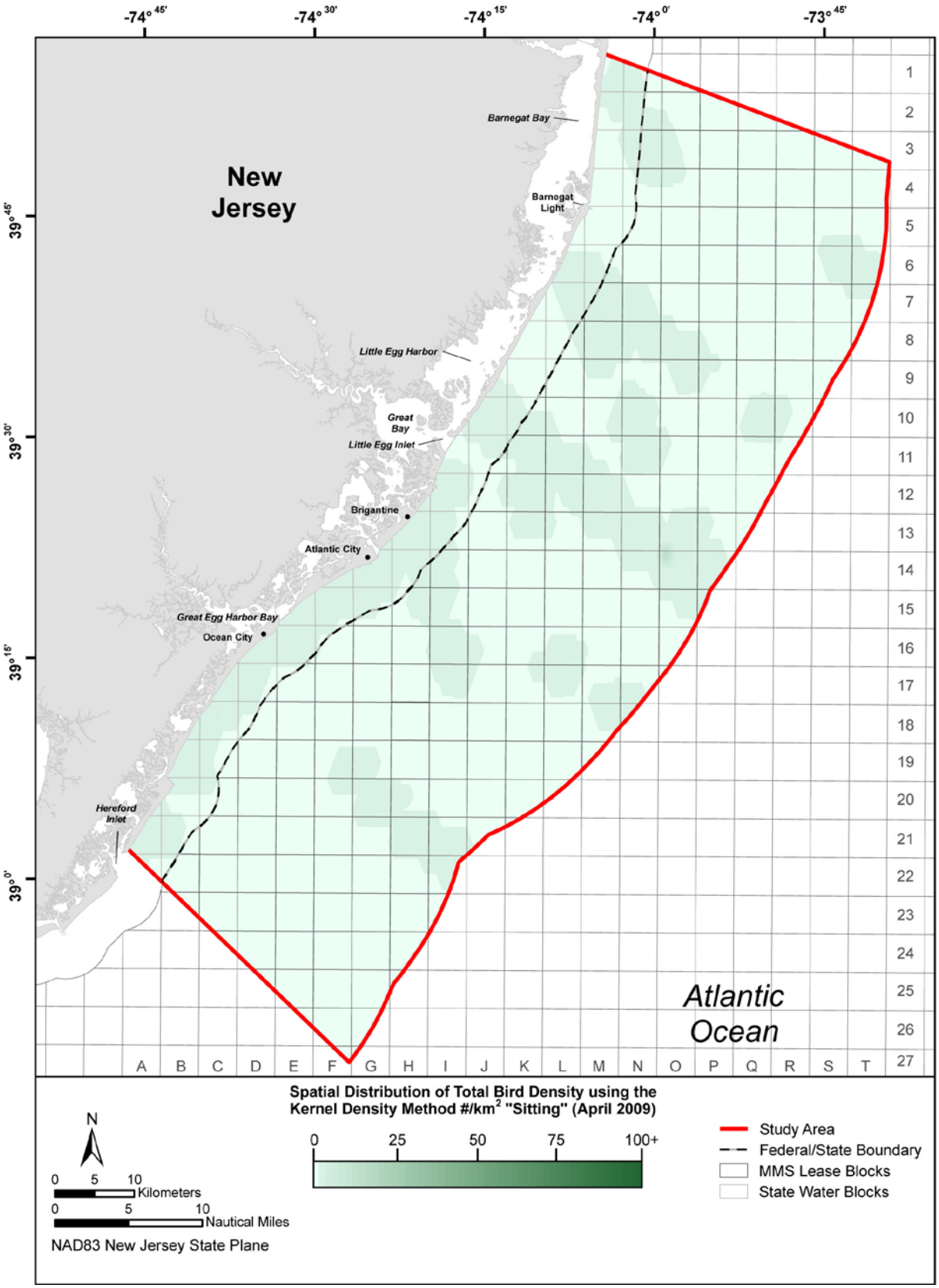

Figure M-347. Spatial distribution of total bird density (#/km^2) in the Study Area for sitting birds using the kernel density method (April 2009).

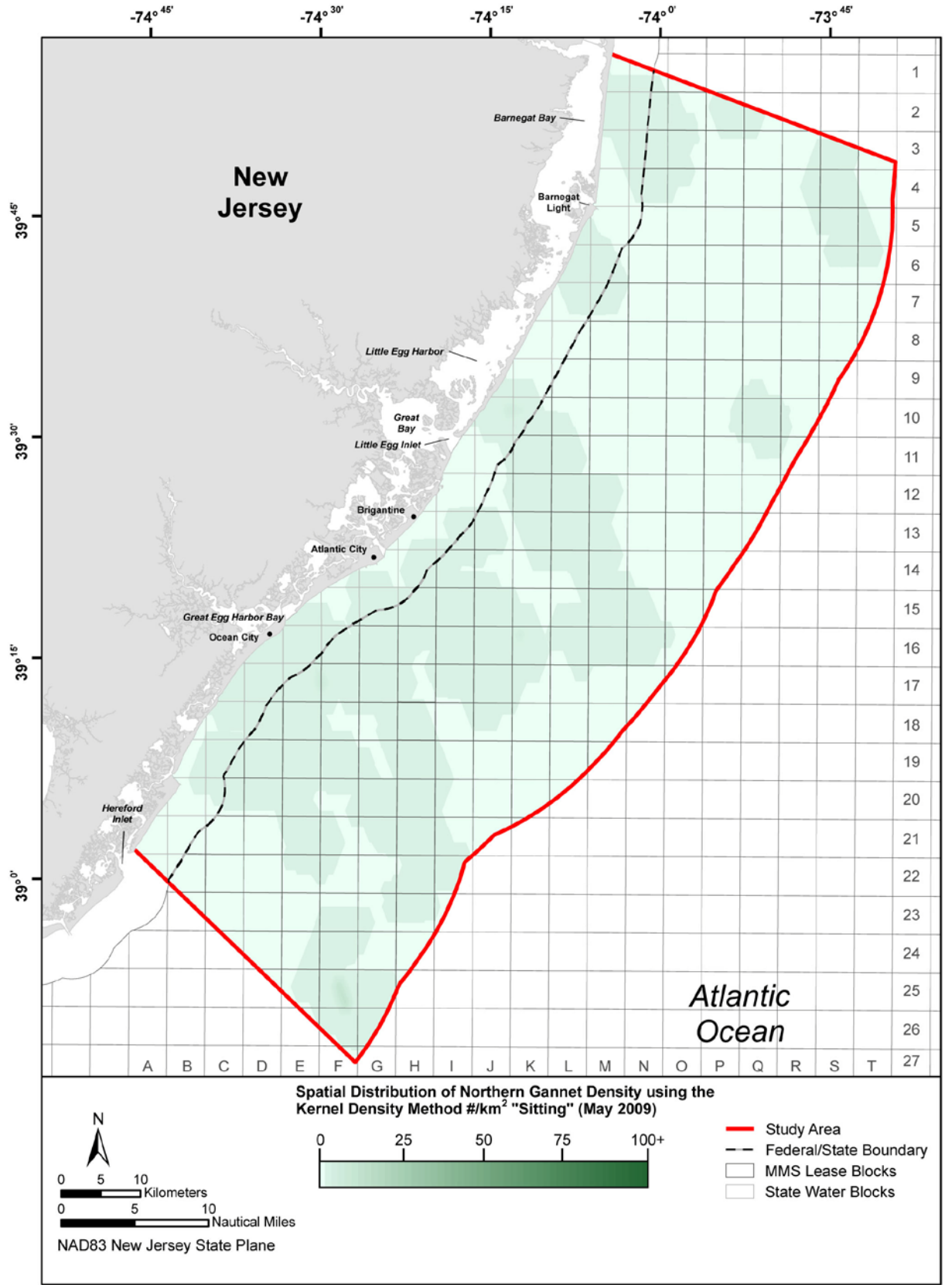

Figure M-348. Spatial distribution of Northern Gannet density (#/km^2) in the Study Area for sitting birds using the kernel density method (May 2009).

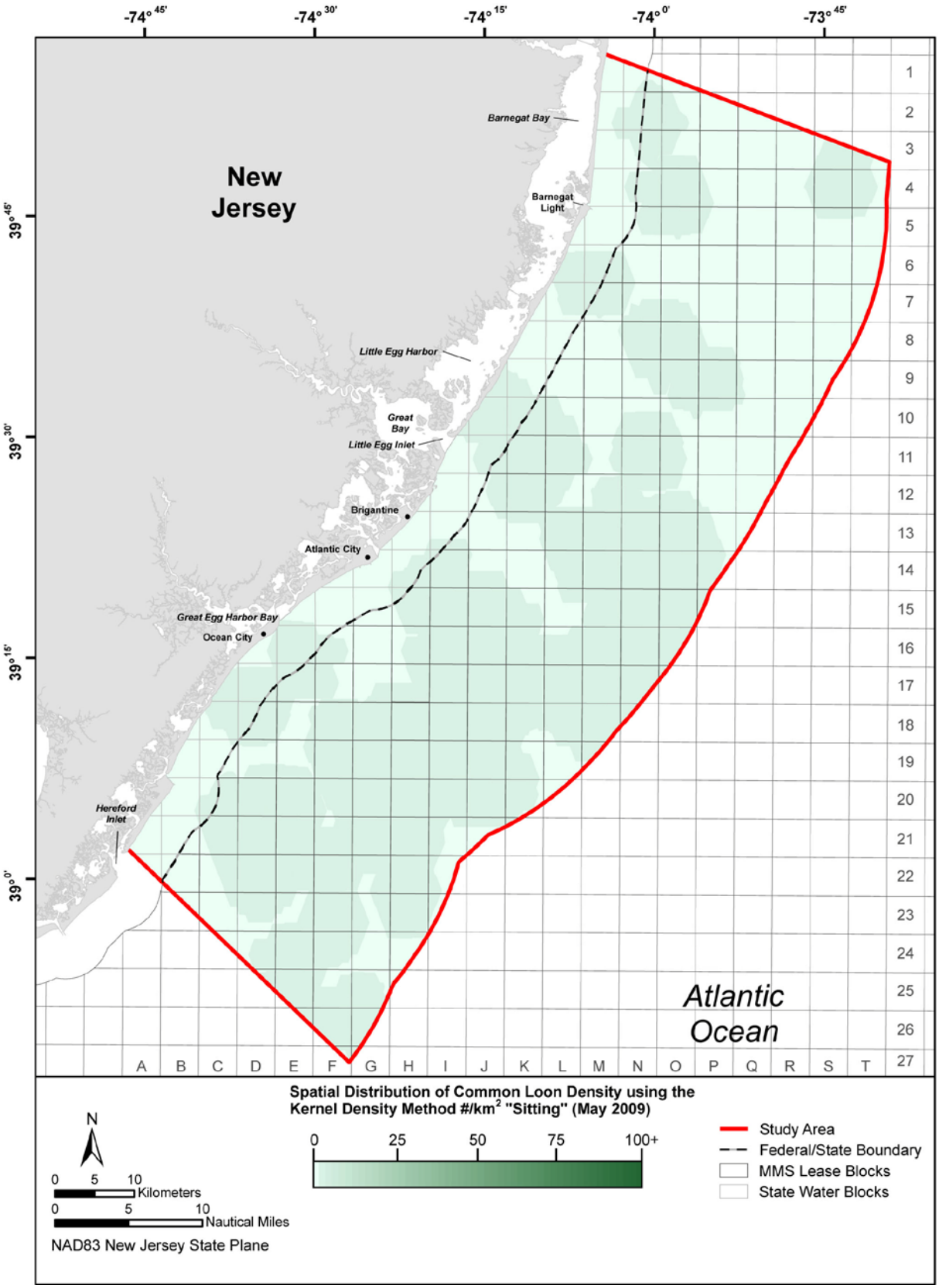

Figure M-349. Spatial distribution of Common Loon density (#/km^2) in the Study Area for sitting birds using the kernel density method (May 2009).

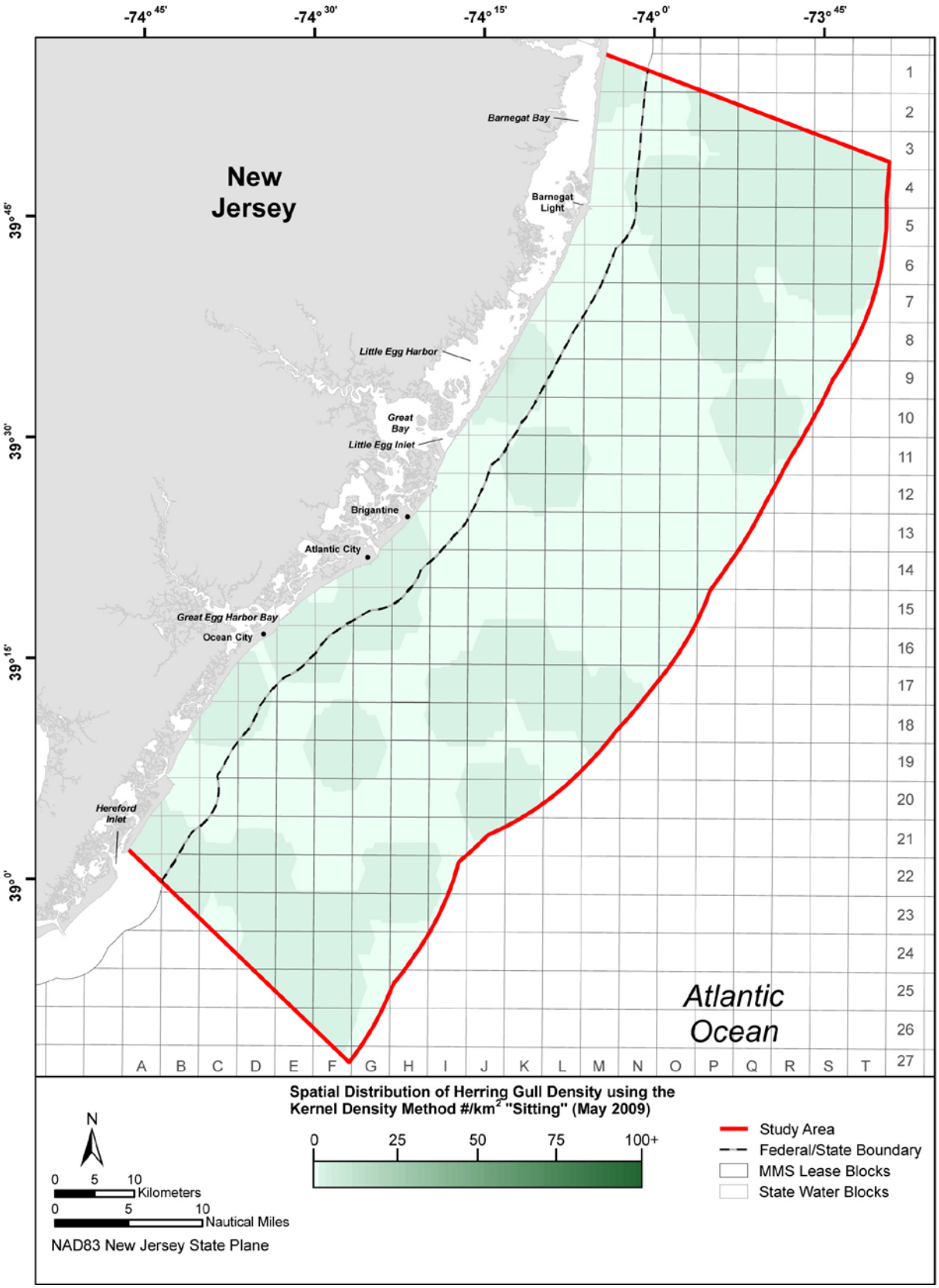

Figure M-350. Spatial distribution of Herring Gull density (#/km^2) in the Study Area for sitting birds using the kernel density method (May 2009).

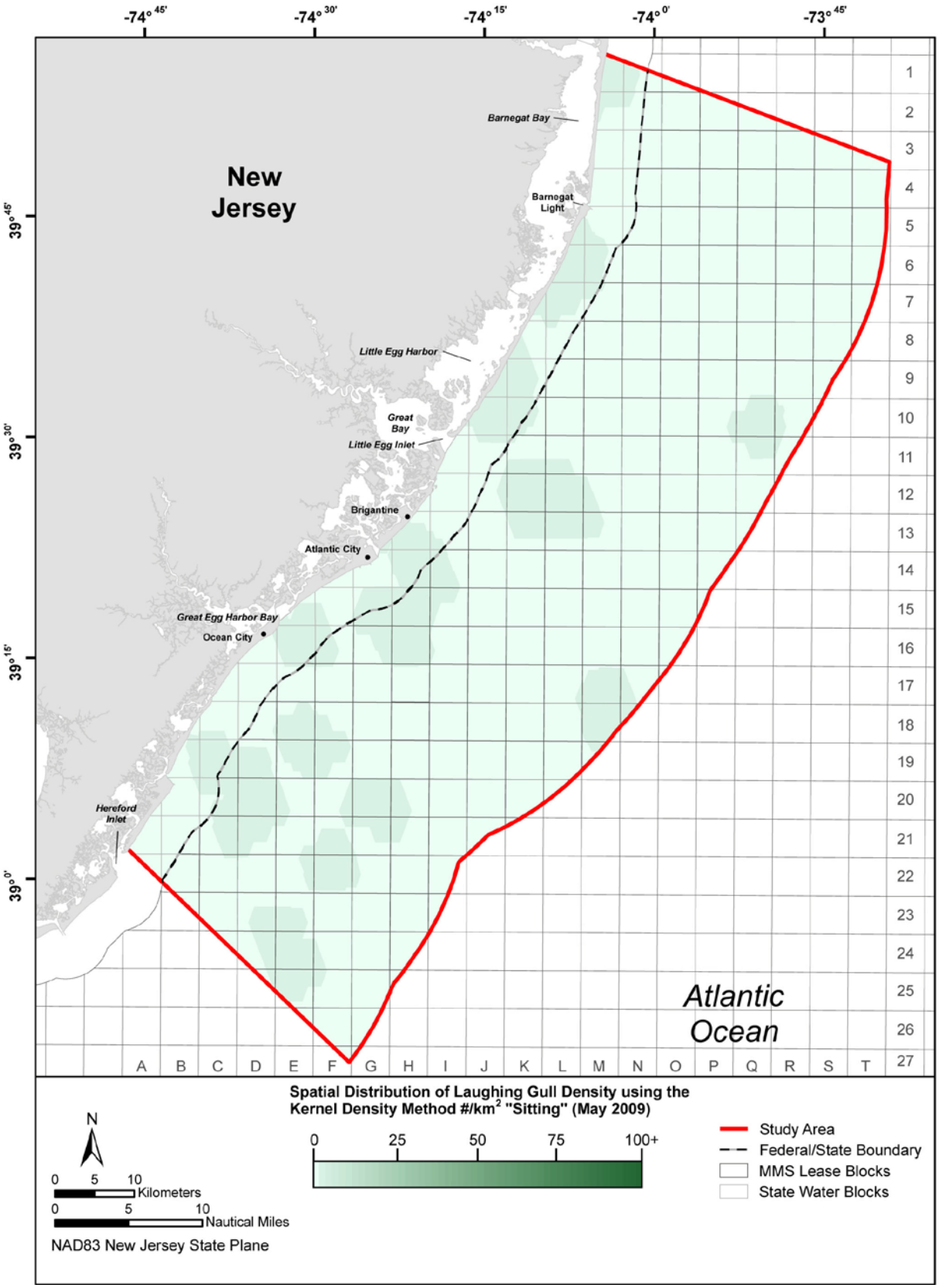

Figure M-351. Spatial distribution of Laughing Gull density (#/km^2) in the Study Area for sitting birds using the kernel density method (May 2009).

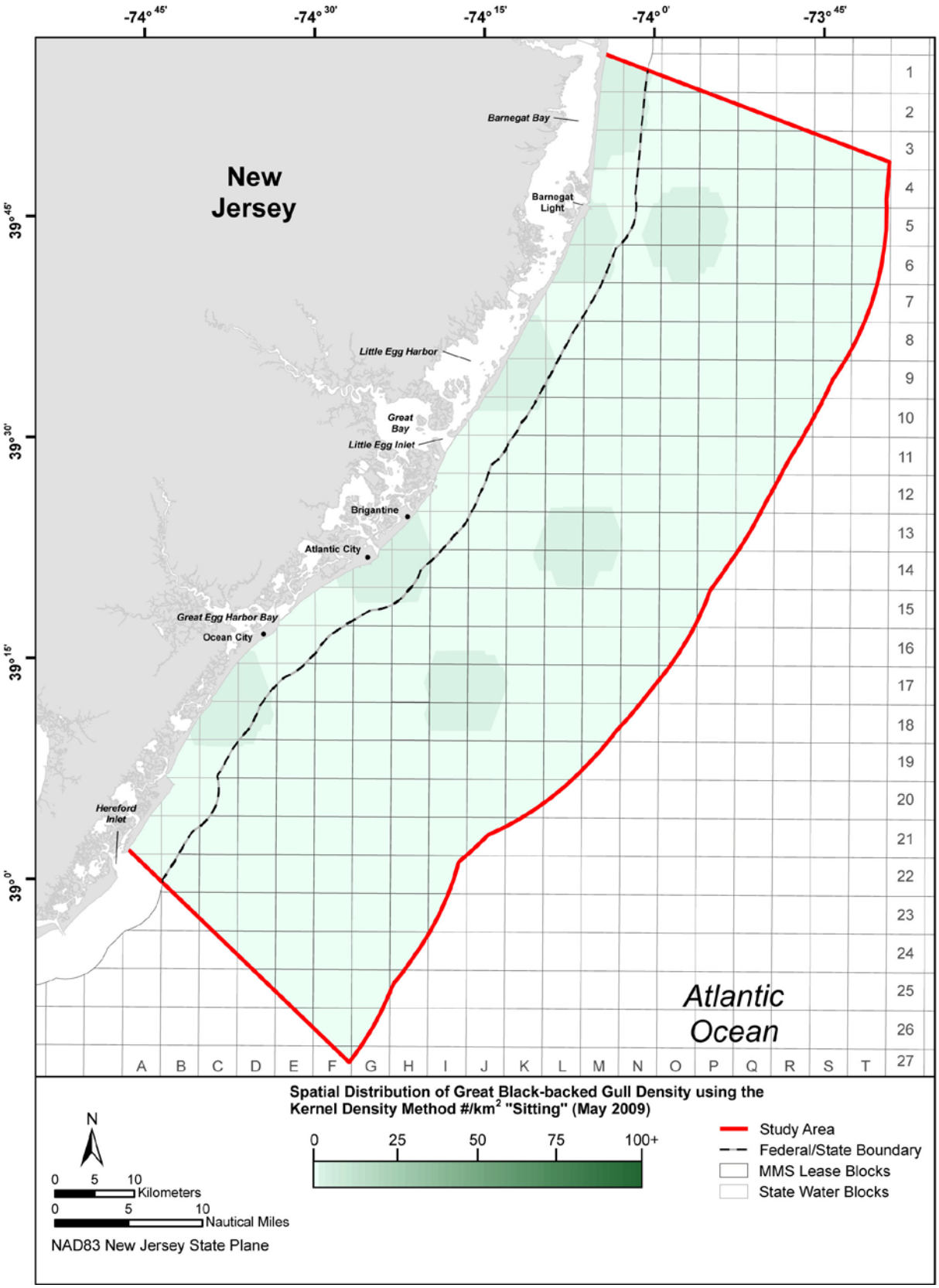

Figure M-352. Spatial distribution of Great Black-backed Gull density (#/km^2) in the Study Area for sitting birds using the kernel density method (May 2009).

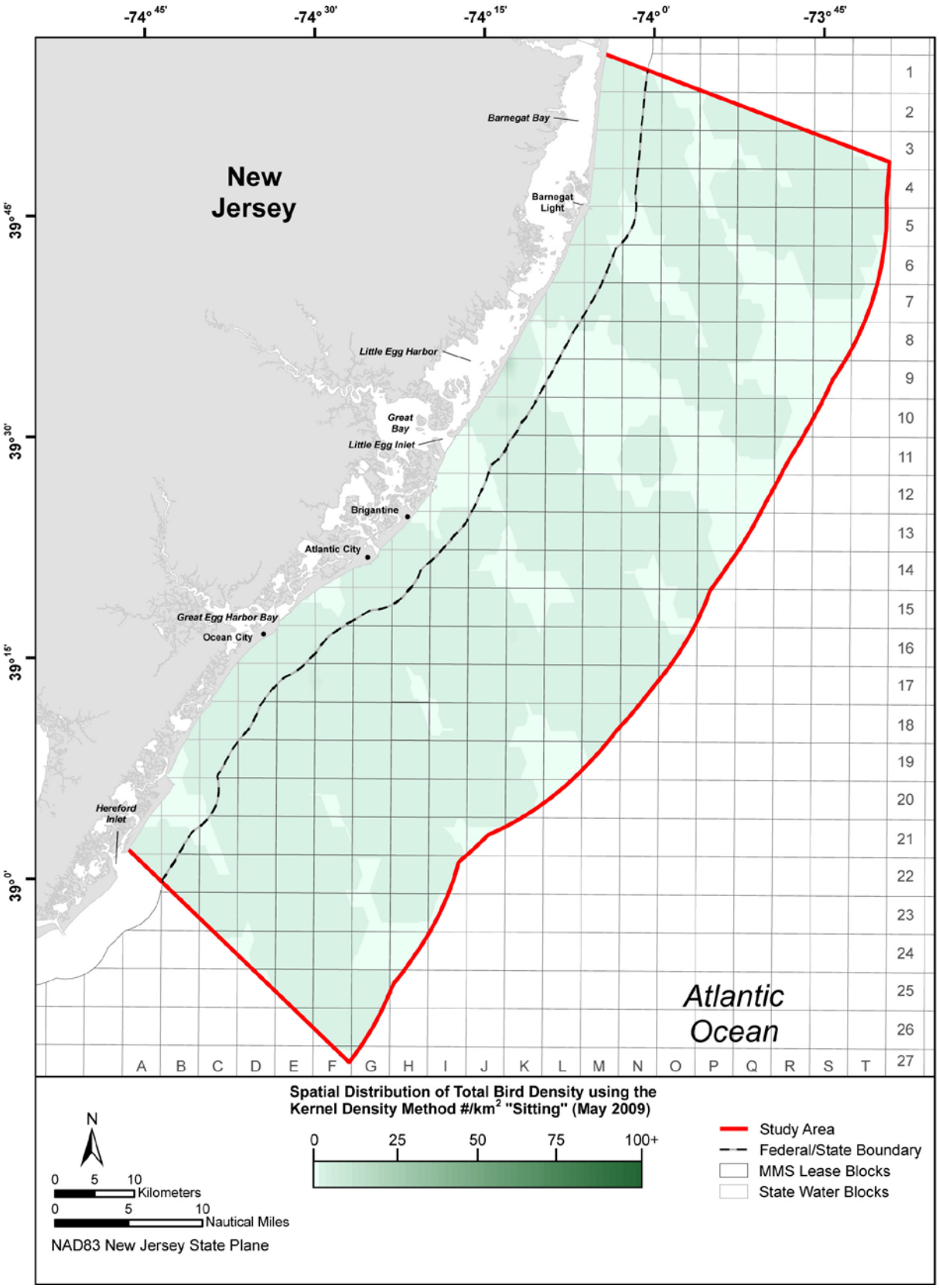

Figure M-353. Spatial distribution of total bird density (#/km^2) in the Study Area for sitting birds using the kernel density method (May 2009).

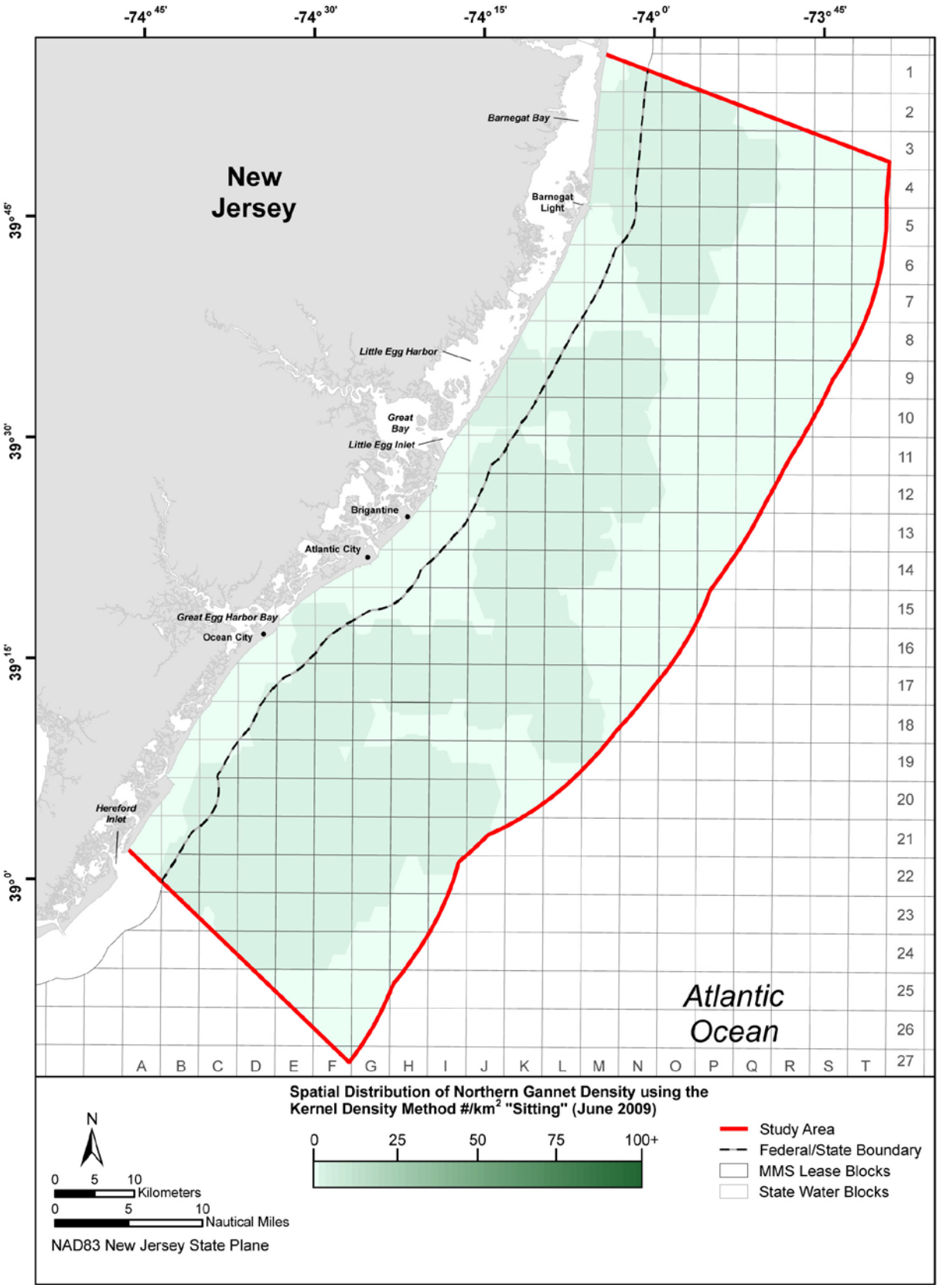

Figure M-354. Spatial distribution of Northern Gannet density (#/km^2) in the Study Area for sitting birds using the kernel density method (June 2009).

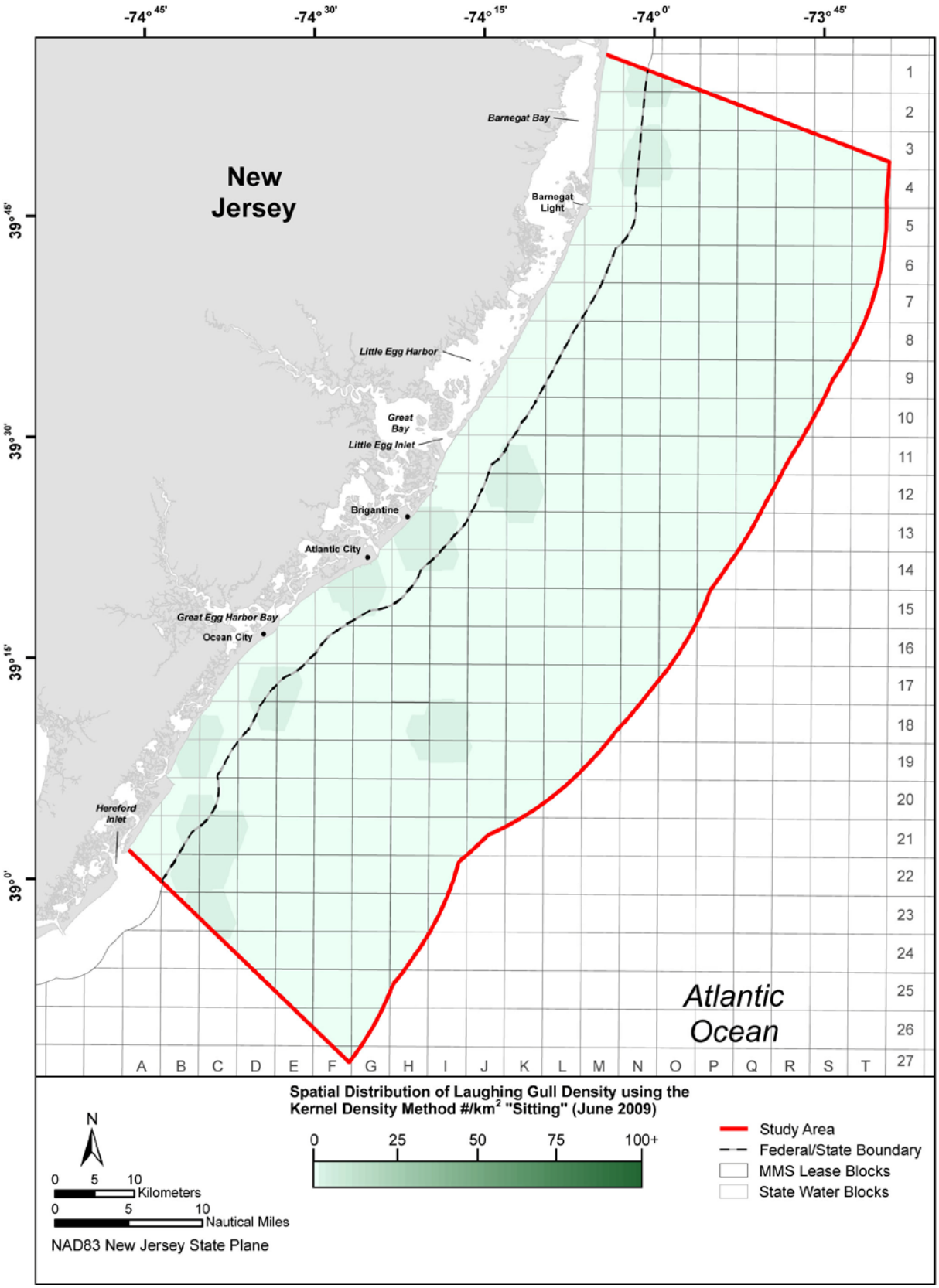

Figure M-355. Spatial distribution of Laughing Gull density (#/km^2) in the Study Area for sitting birds using the kernel density method (June 2009).

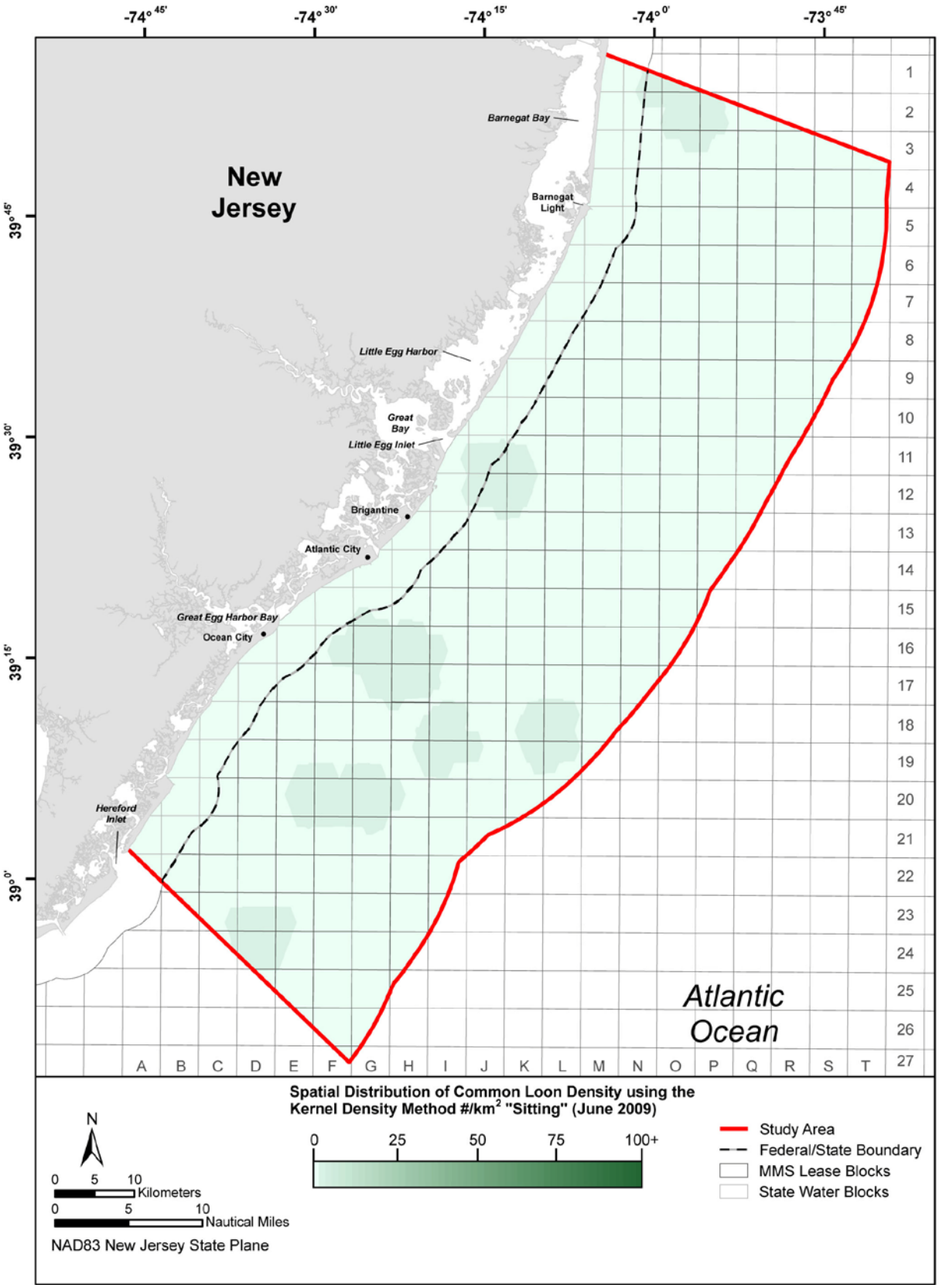

Figure M-356. Spatial distribution of Common Loon density (#/km^2) in the Study Area for sitting birds using the kernel density method (June 2009).

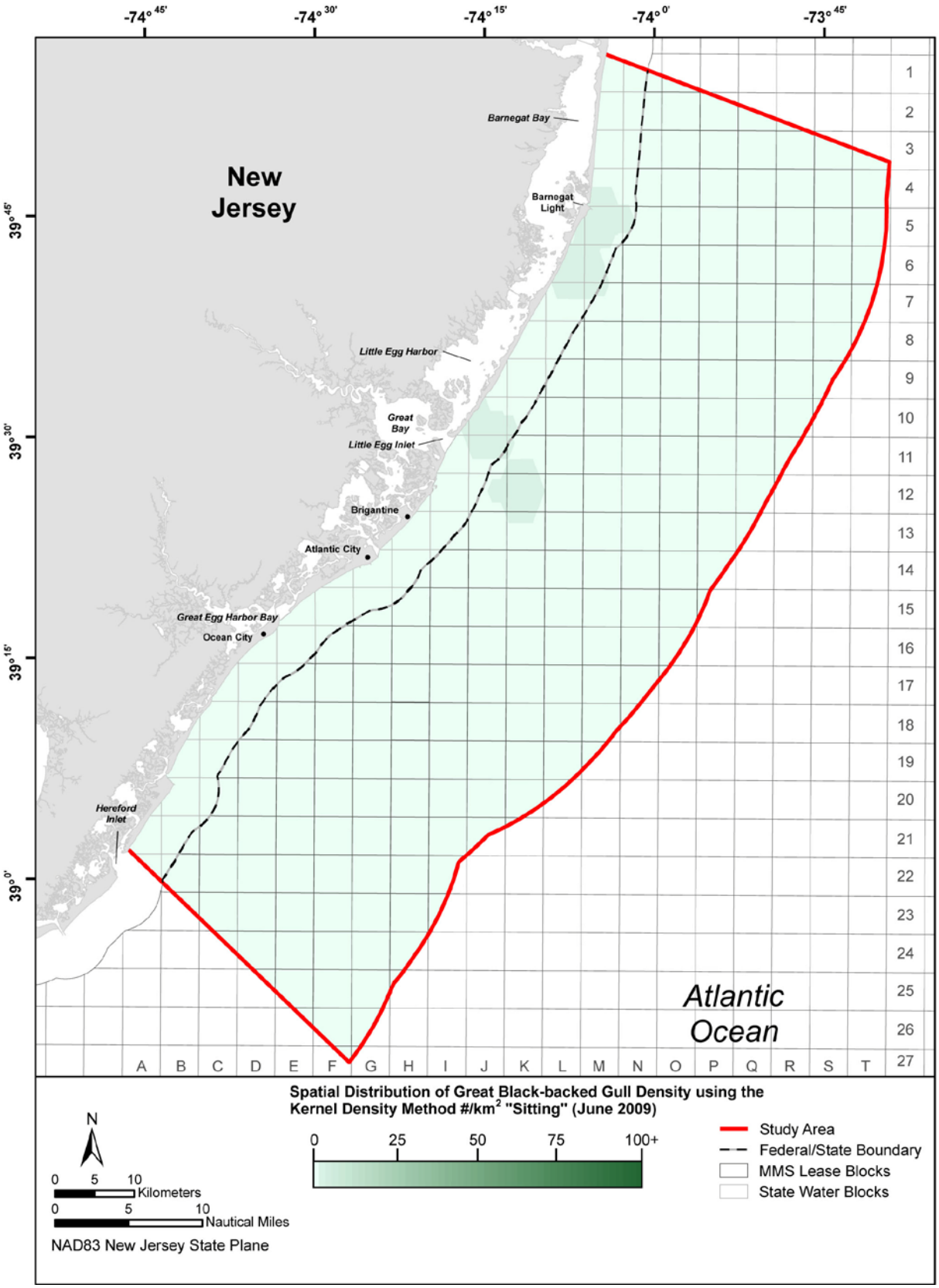

Figure M-357. Spatial distribution of Great Black-backed Gull density (#/km^2) in the Study Area for sitting birds using the kernel density method (June 2009).

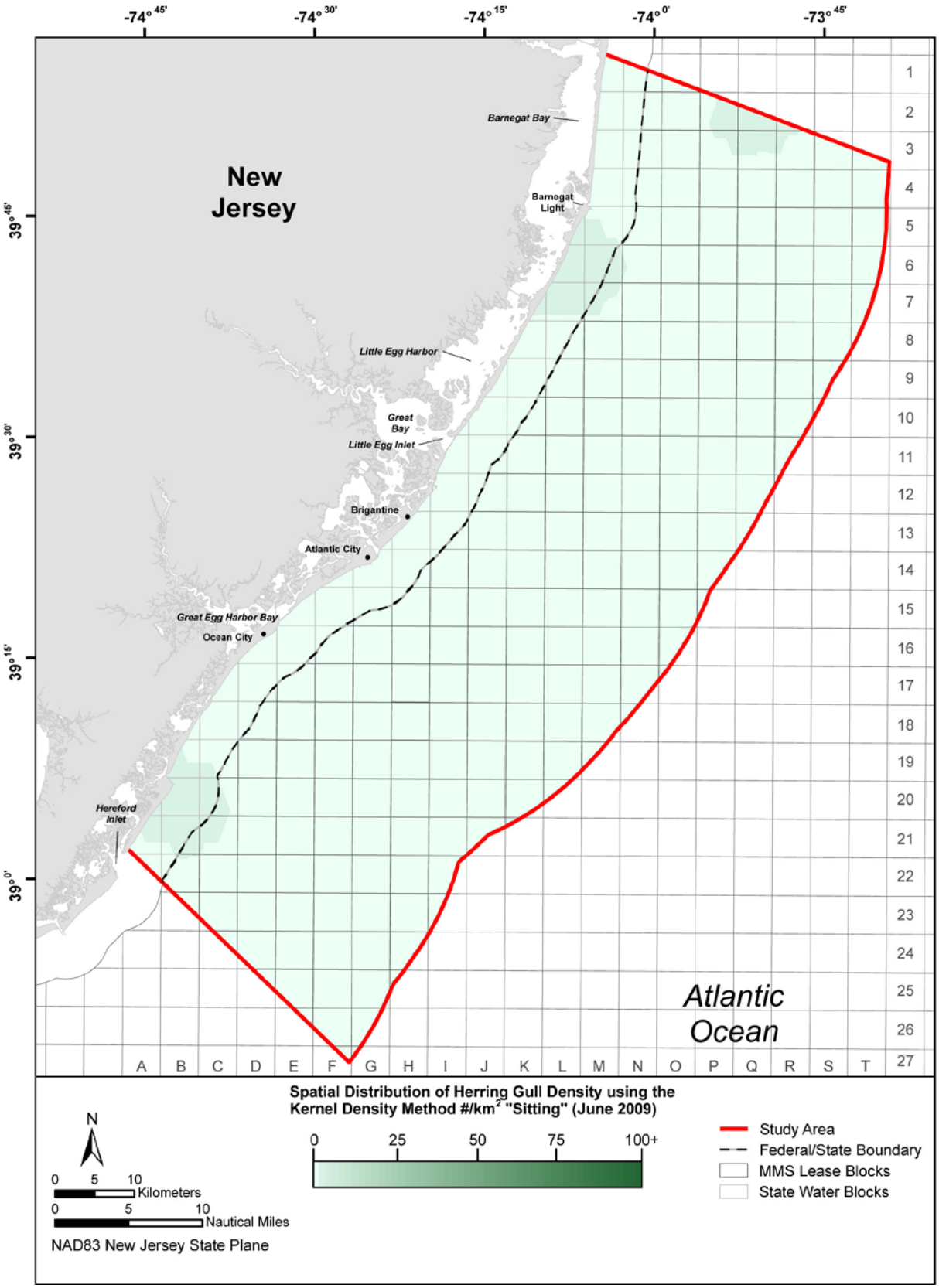

Figure M-358. Spatial distribution of Herring Gull density (#/km^2) in the Study Area for sitting birds using the kernel density method (June 2009).

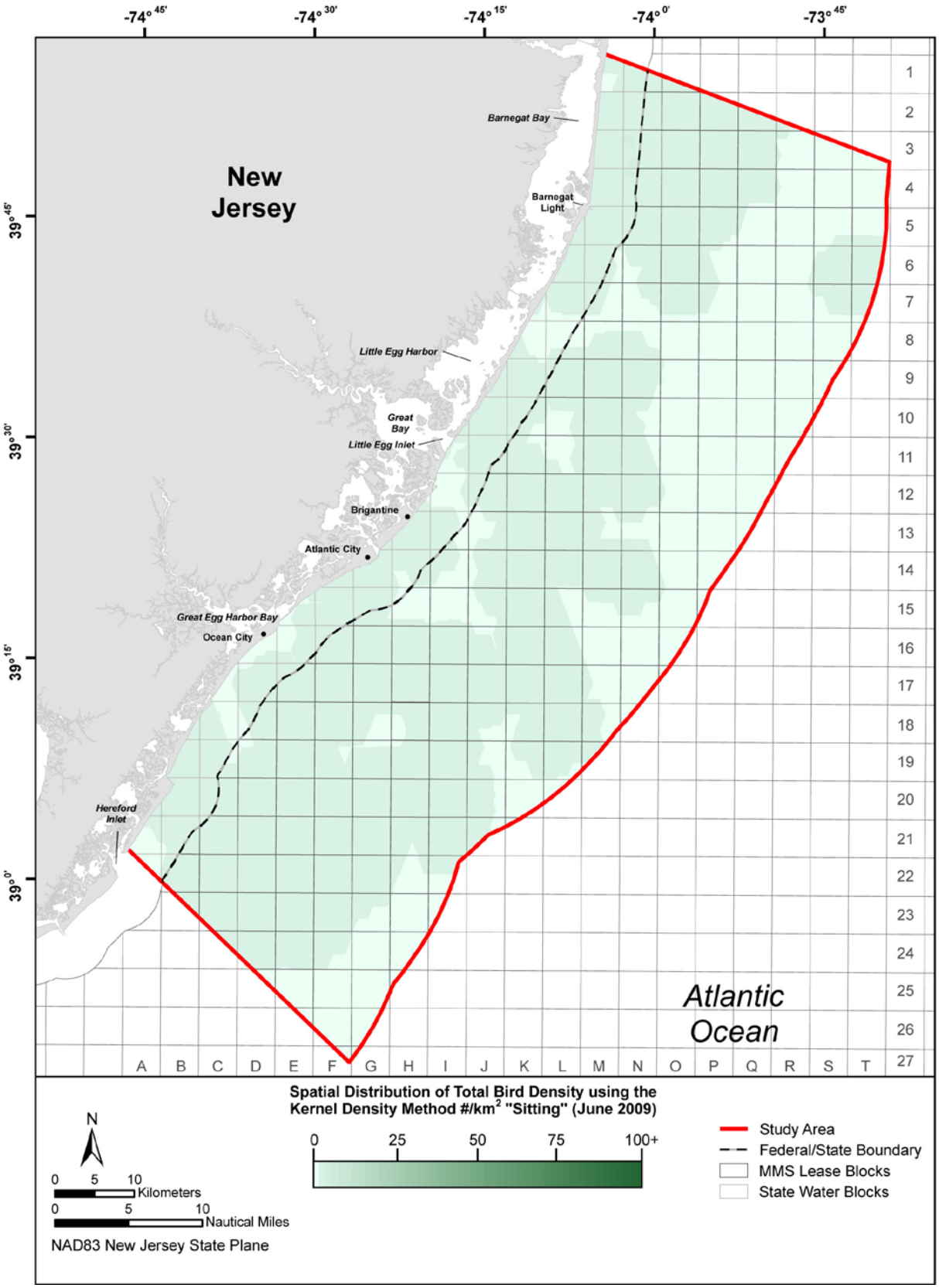

Figure M-359. Spatial distribution of total bird density (#/km^2) in the Study Area for sitting birds using the kernel density method (June 2009).

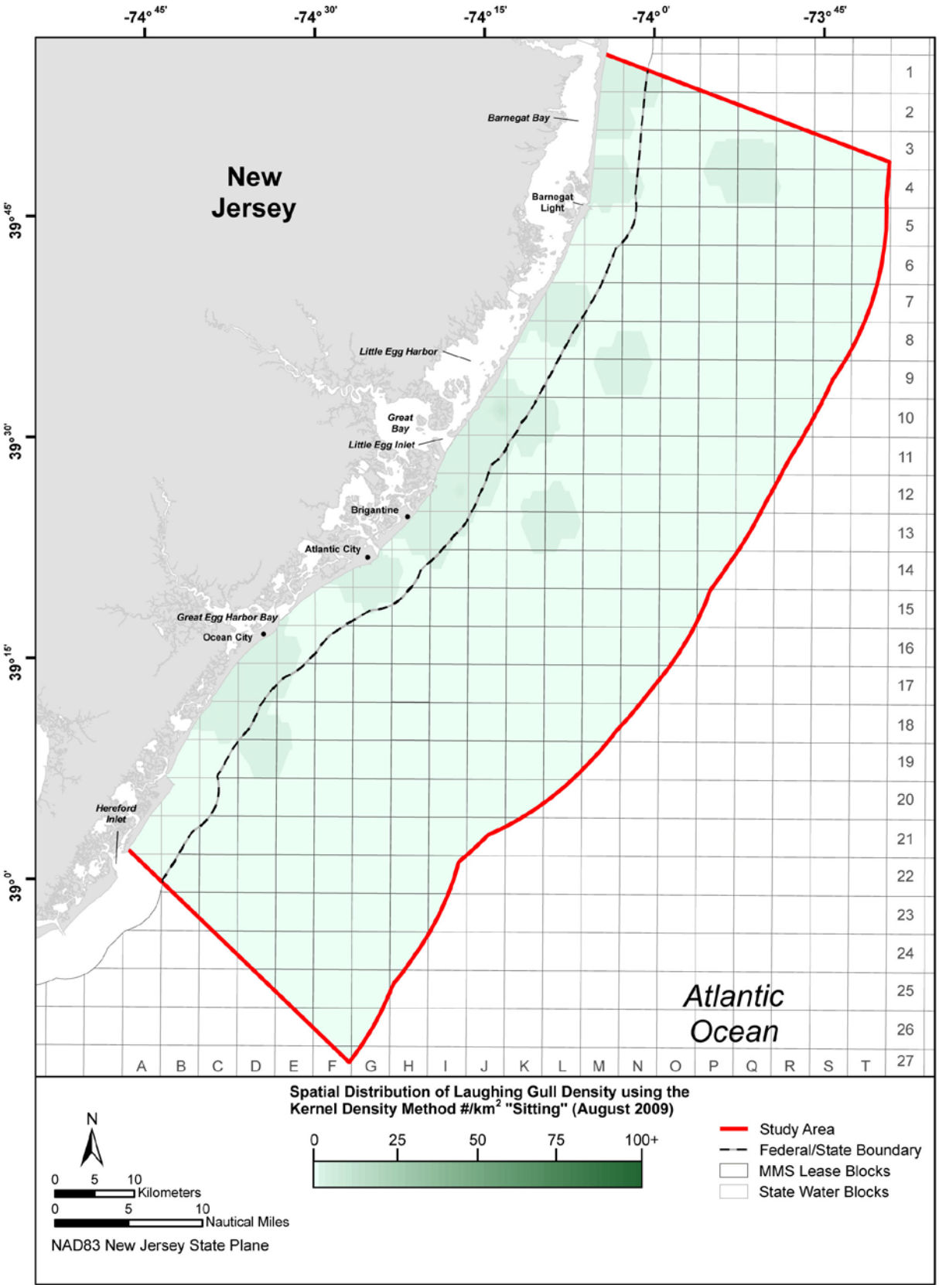

Figure M-360. Spatial distribution of Laughing Gull density (#/km^2) in the Study Area for sitting birds using the kernel density method (August 2009).

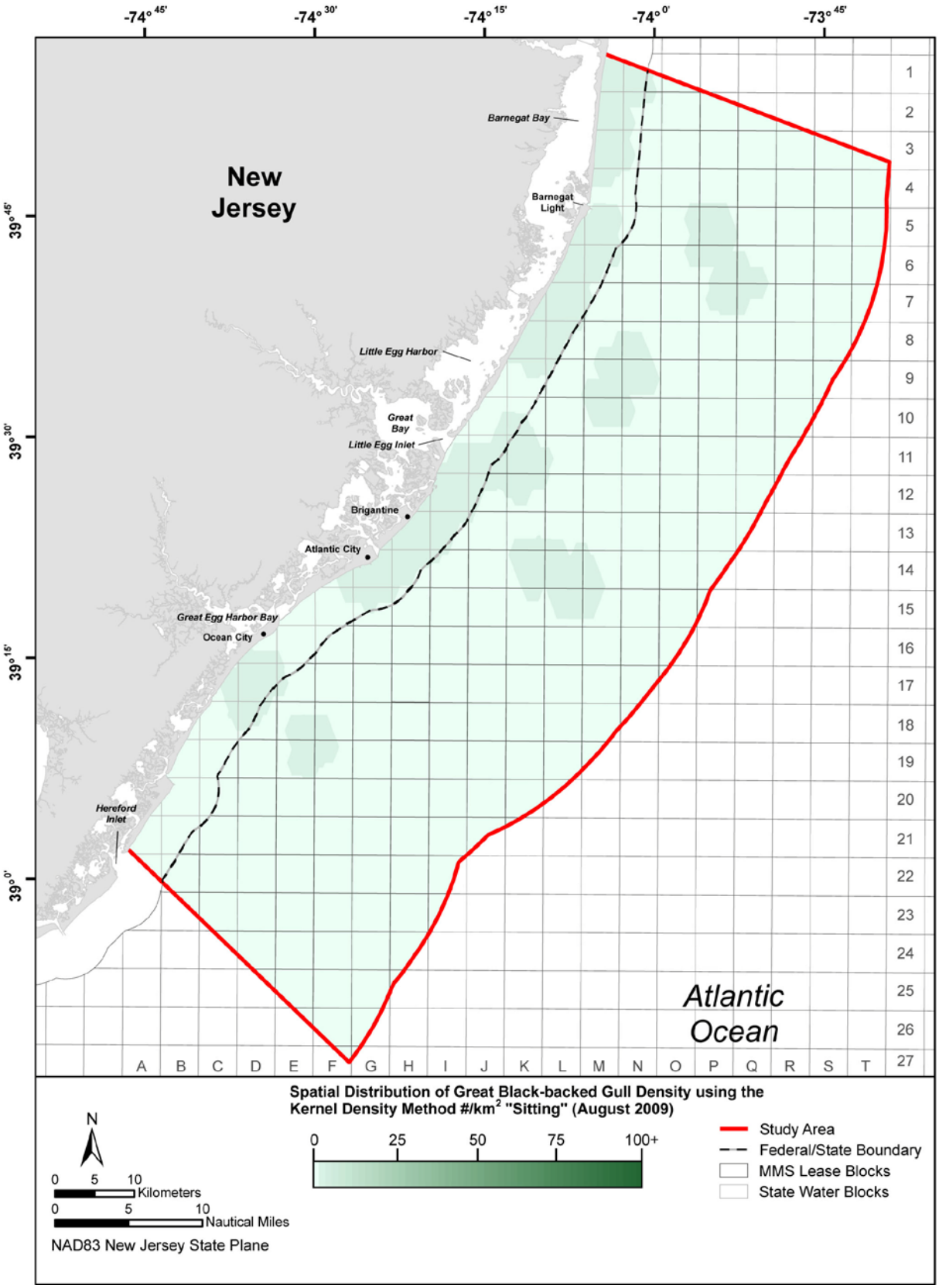

Figure M-361. Spatial distribution of Great Black-backed Gull density (#/km^2) in the Study Area for sitting birds using the kernel density method (August 2009).

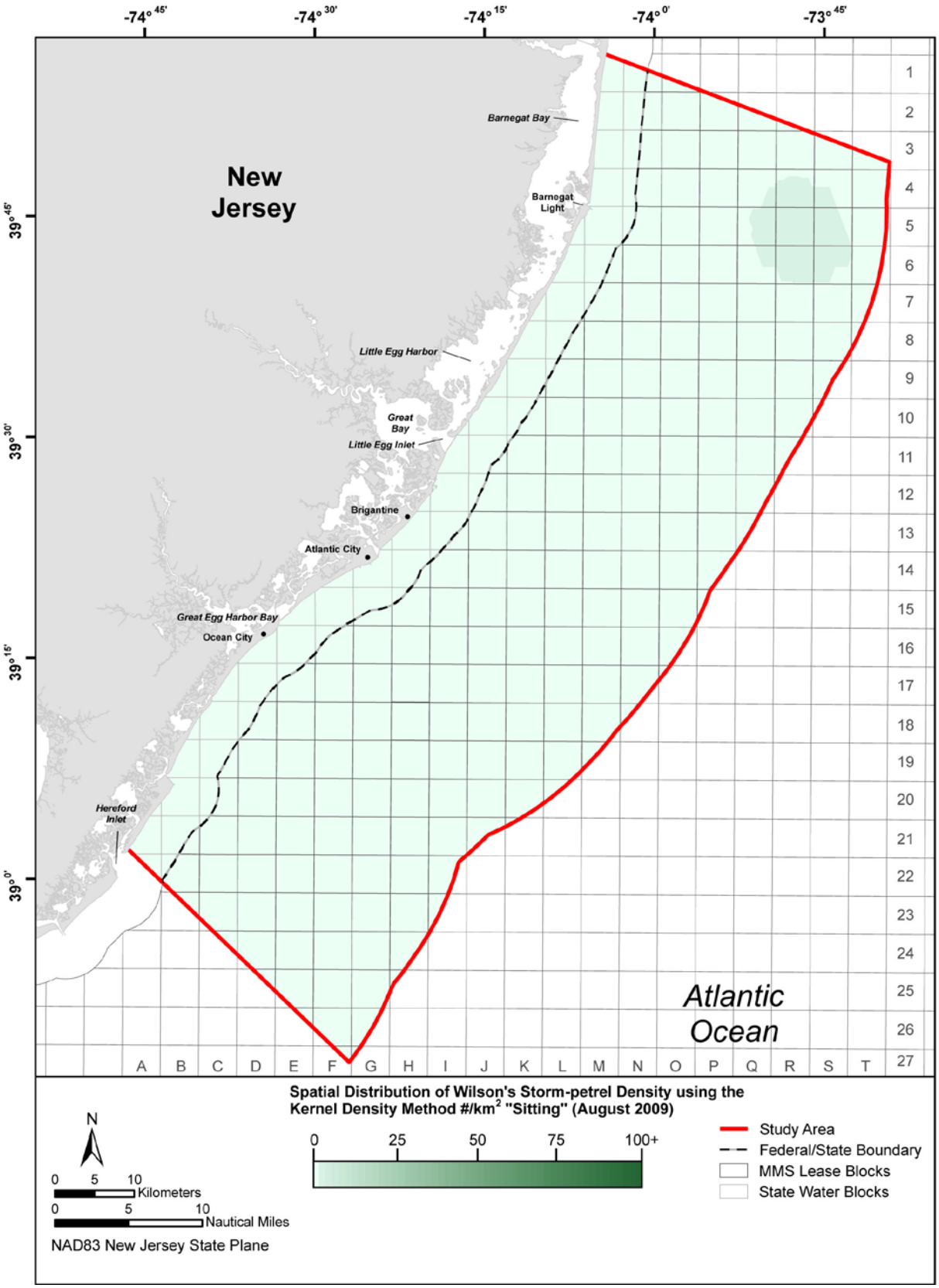

Figure M-362. Spatial distribution of Wilson's Storm-Petrel density (#/km^2) in the Study Area for sitting birds using the kernel density method (August 2009).

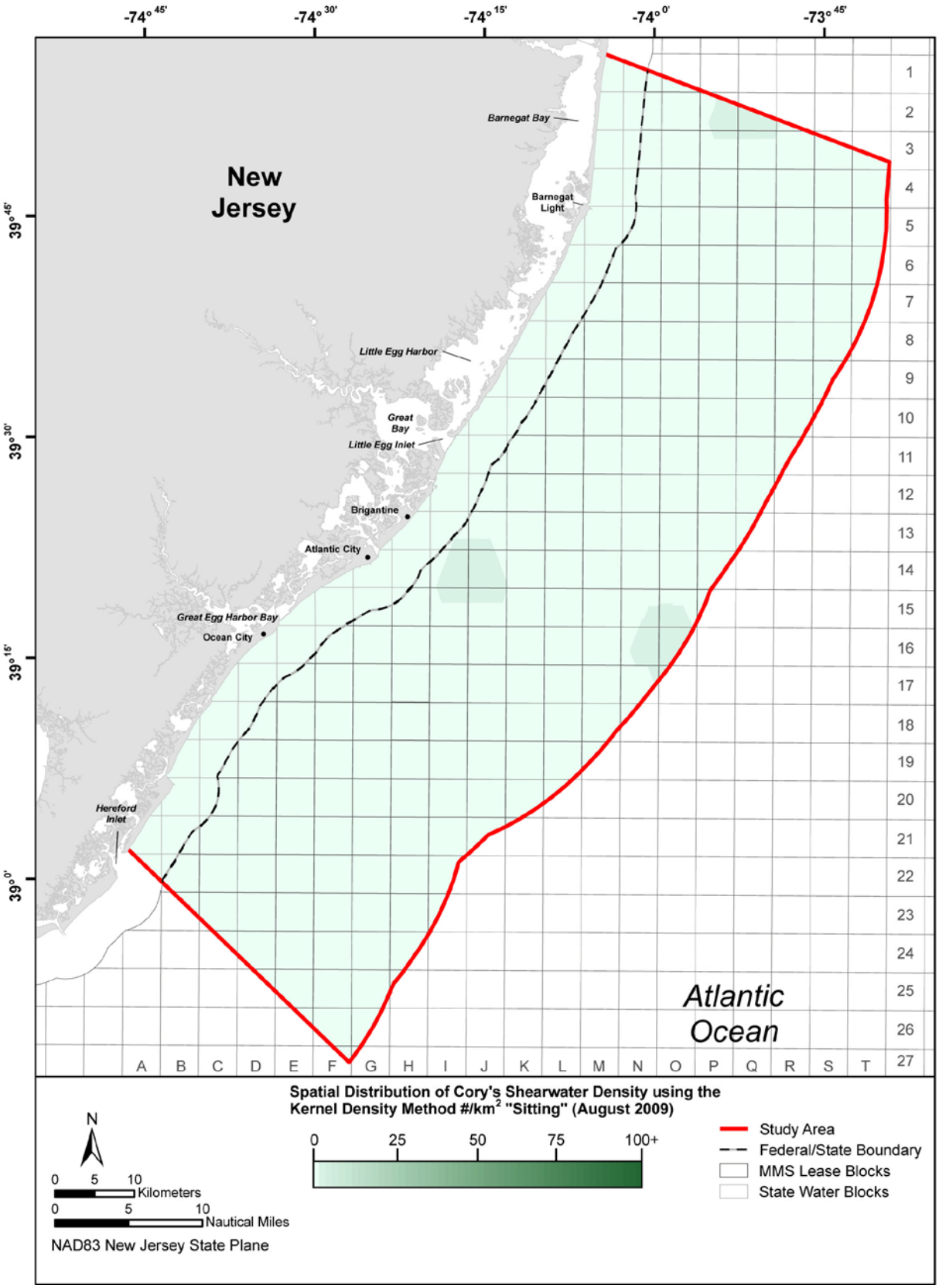

Figure M-363. Spatial distribution of Cory's Shearwater density (#/km^2) in the Study Area for sitting birds using the kernel density method (August 2009).

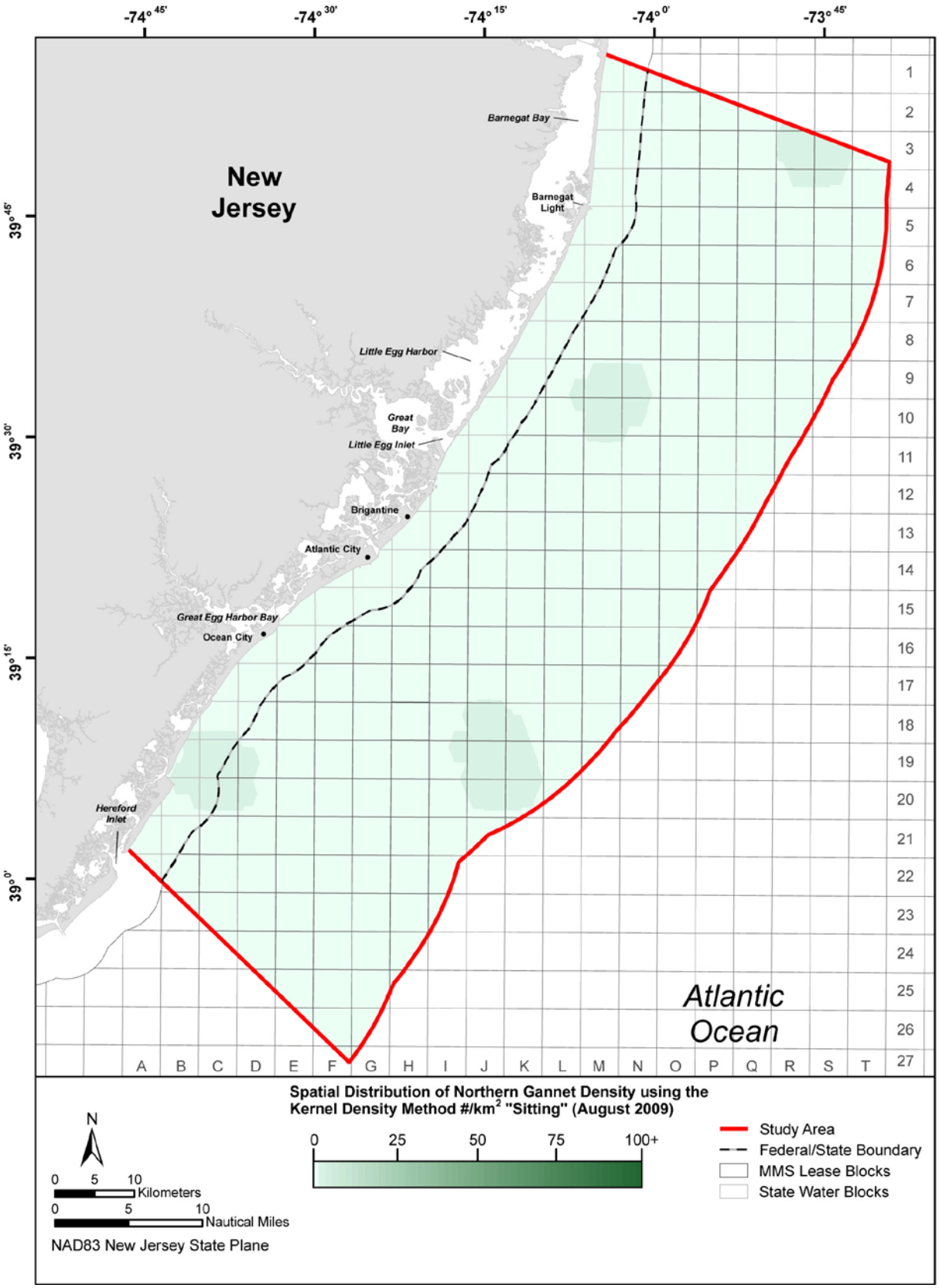

Figure M-364. Spatial distribution of Northern Gannet density (#/km^2) in the Study Area for sitting birds using the kernel density method (August 2009).

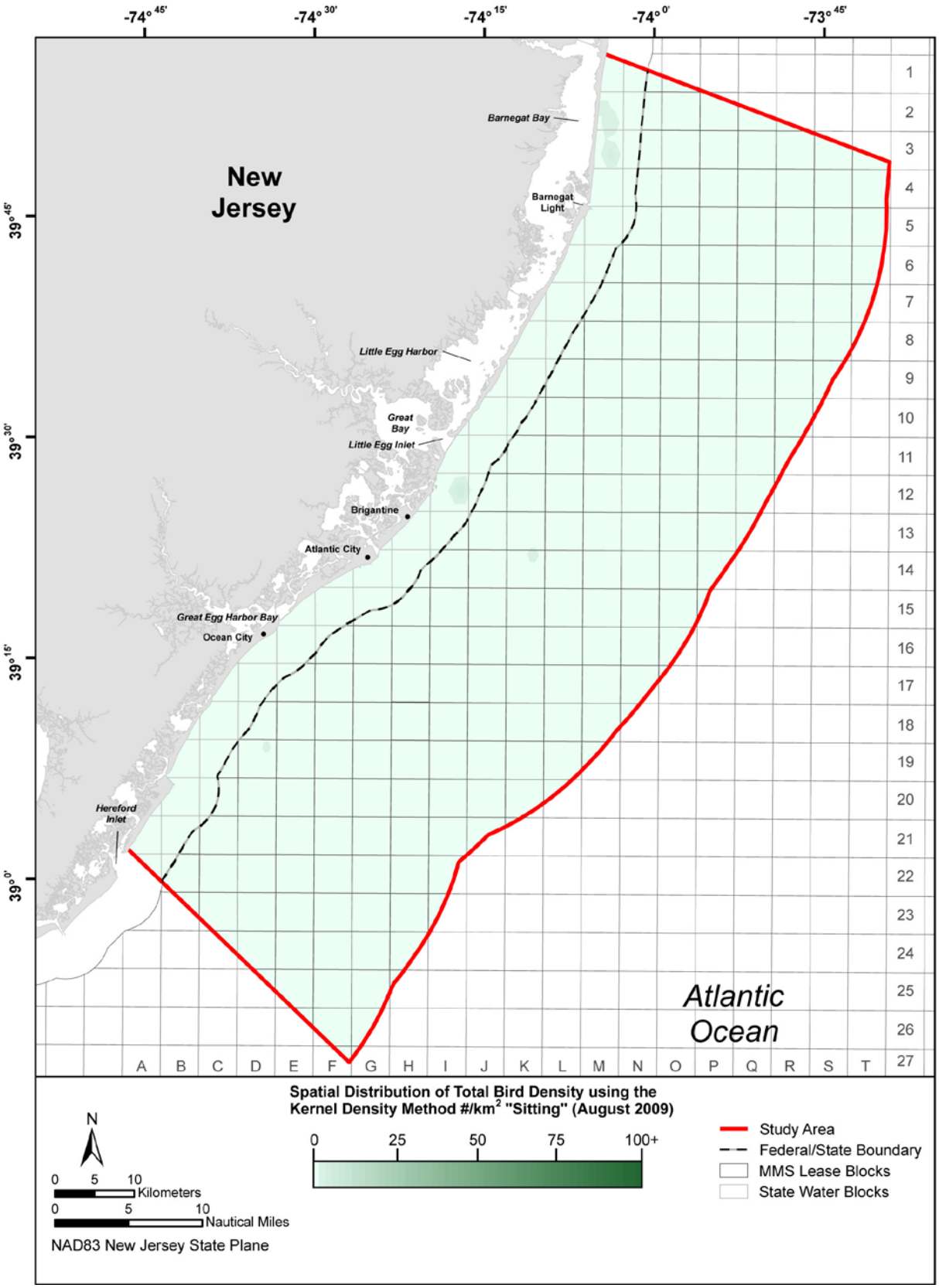

Figure M-365. Spatial distribution of total bird density (#/km^2) in the Study Area for sitting birds using the kernel density method (August 2009).

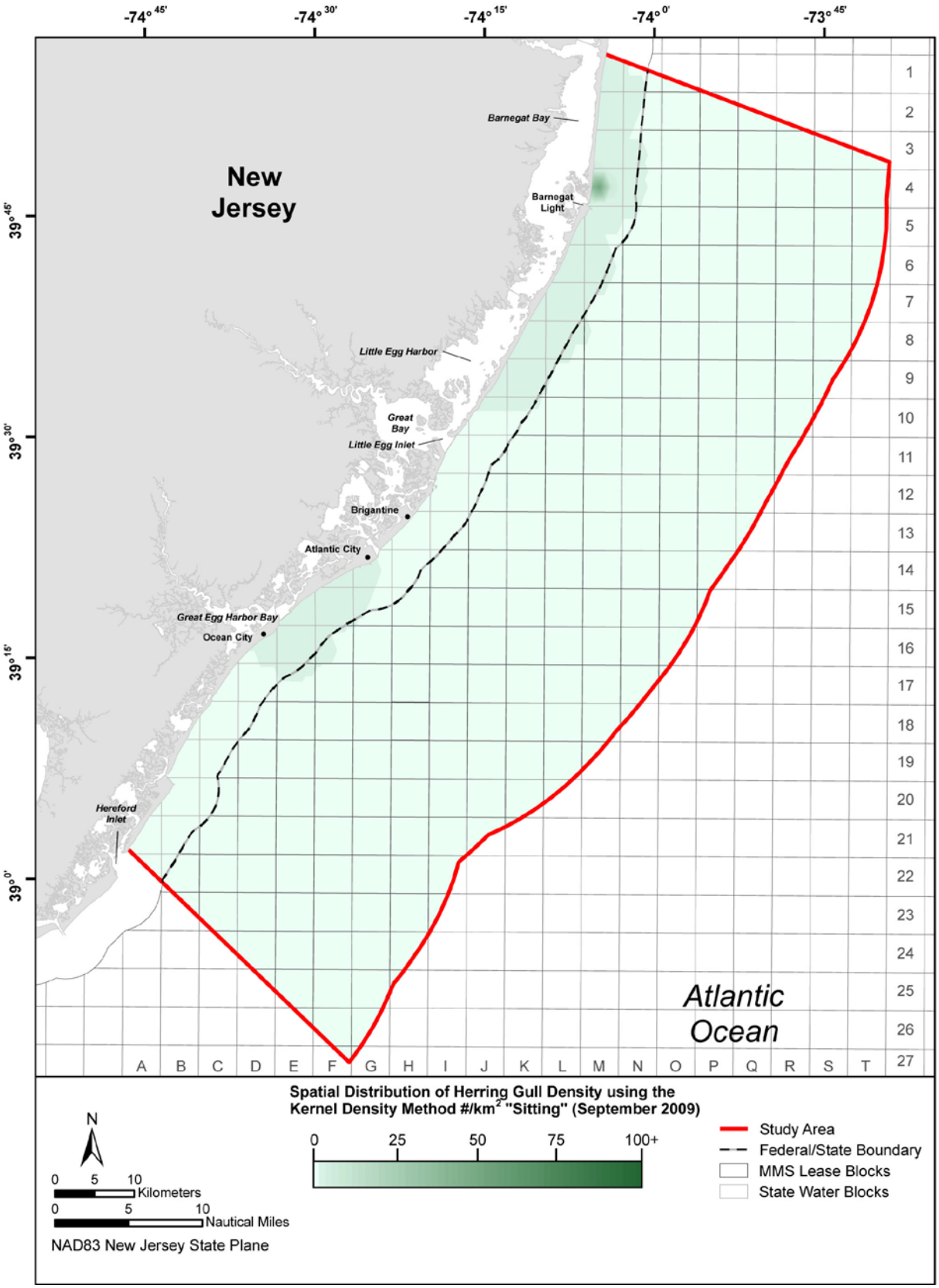

Figure M-366. Spatial distribution of Herring Gull density (#/km^2) in the Study Area for sitting birds using the kernel density method (September 2009).

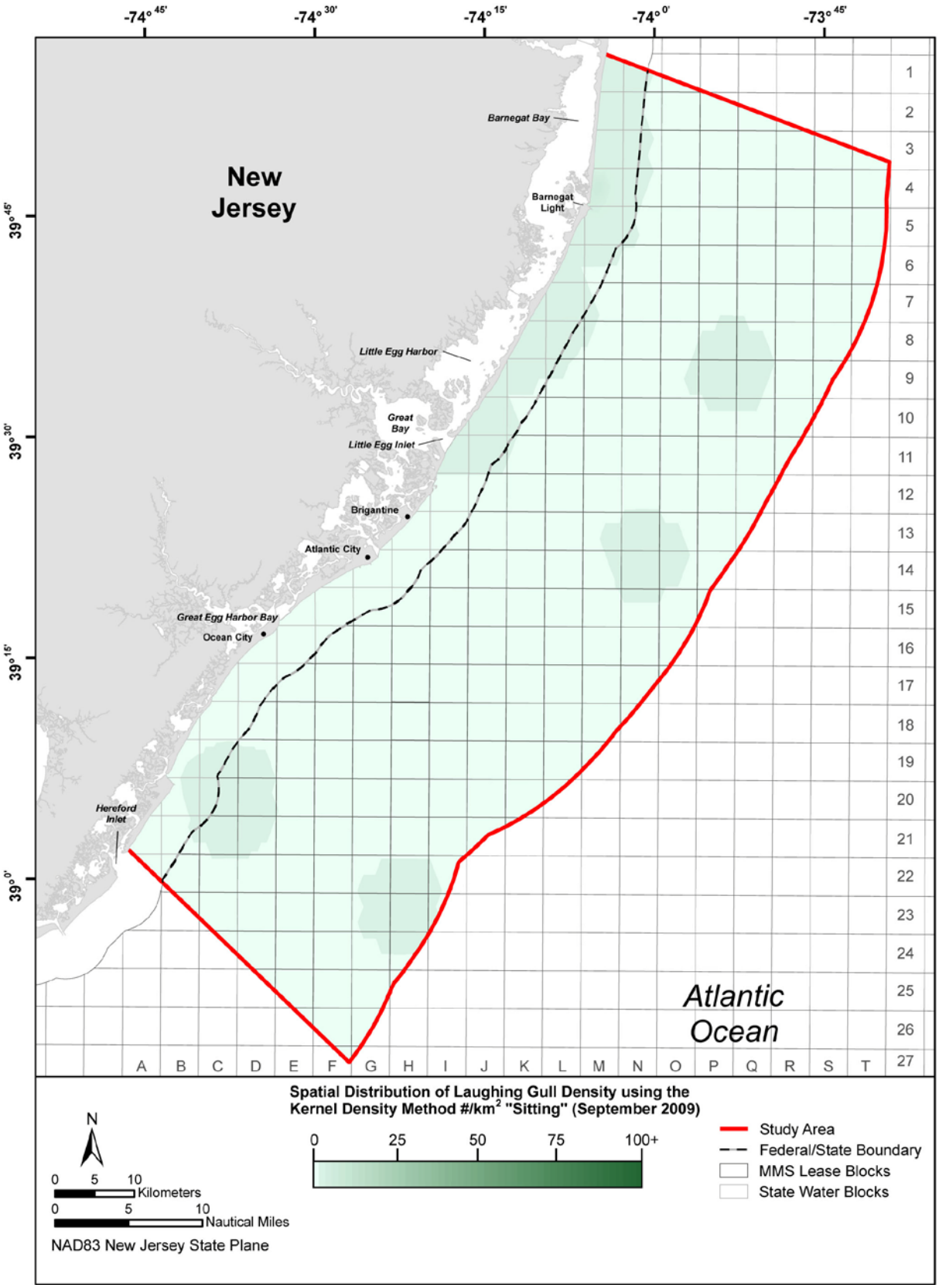

Figure M-367. Spatial distribution of Laughing Gull density (#/km^2) in the Study Area for sitting birds using the kernel density method (September 2009).

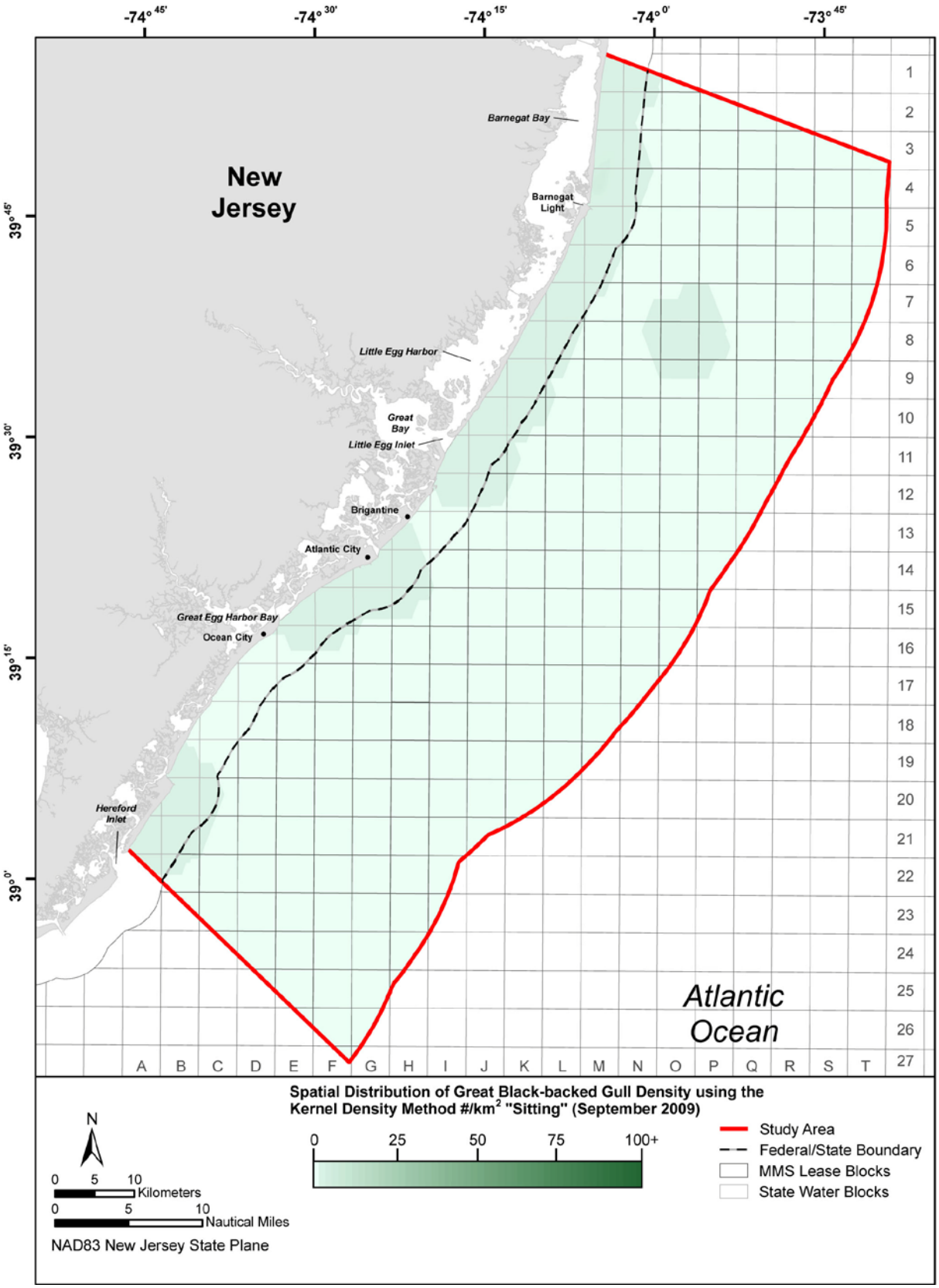

Figure M-368. Spatial distribution of Great Black-backed Gull density (#/km^2) in the Study Area for sitting birds using the kernel density method (September 2009).

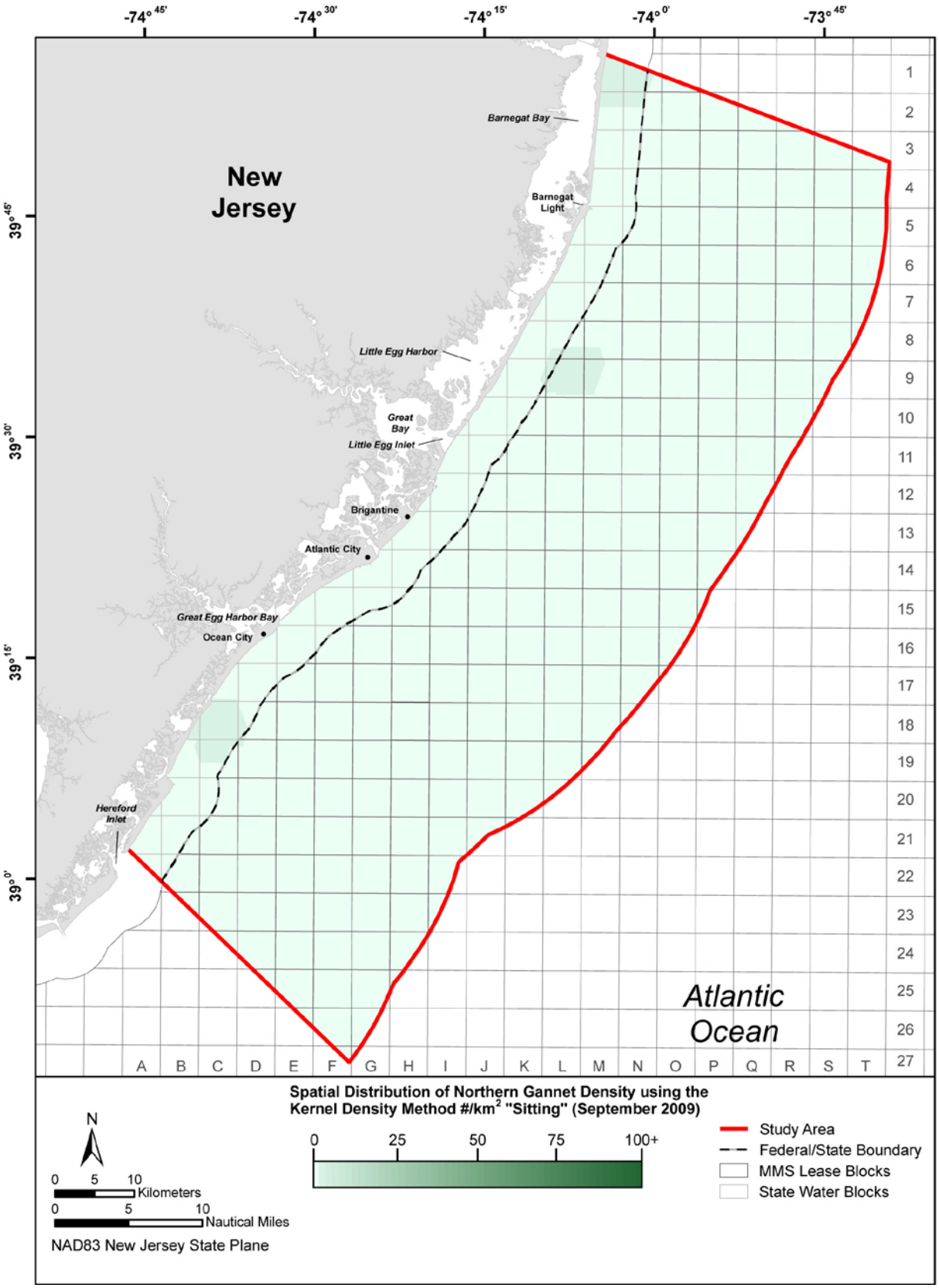

Figure M-369. Spatial distribution of Northern Gannet density (#/km^2) in the Study Area for sitting birds using the kernel density method (September 2009).

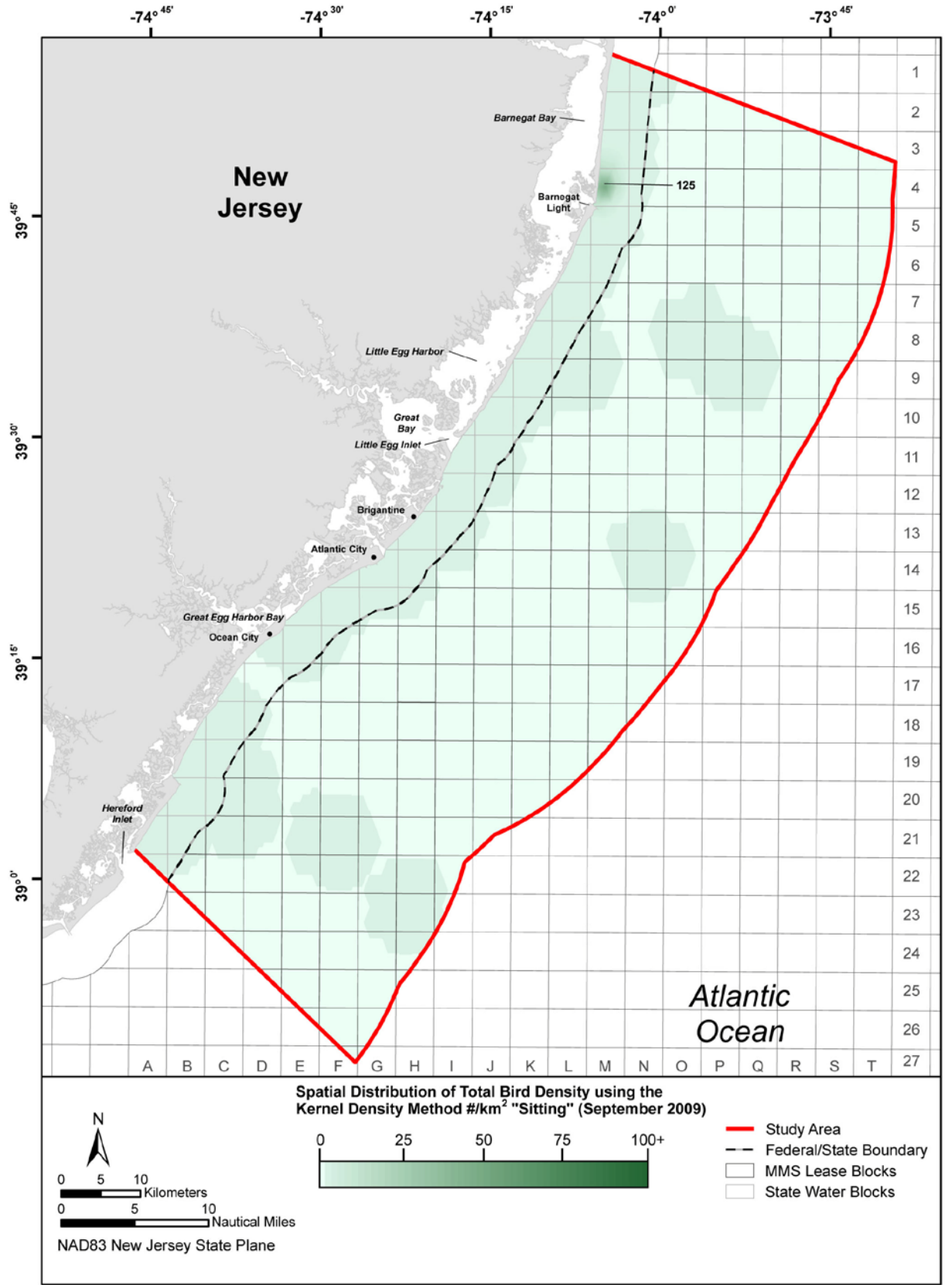

Figure M-370. Spatial distribution of total bird density (#/km^2) in the Study Area for sitting birds using the kernel density method (September 2009).

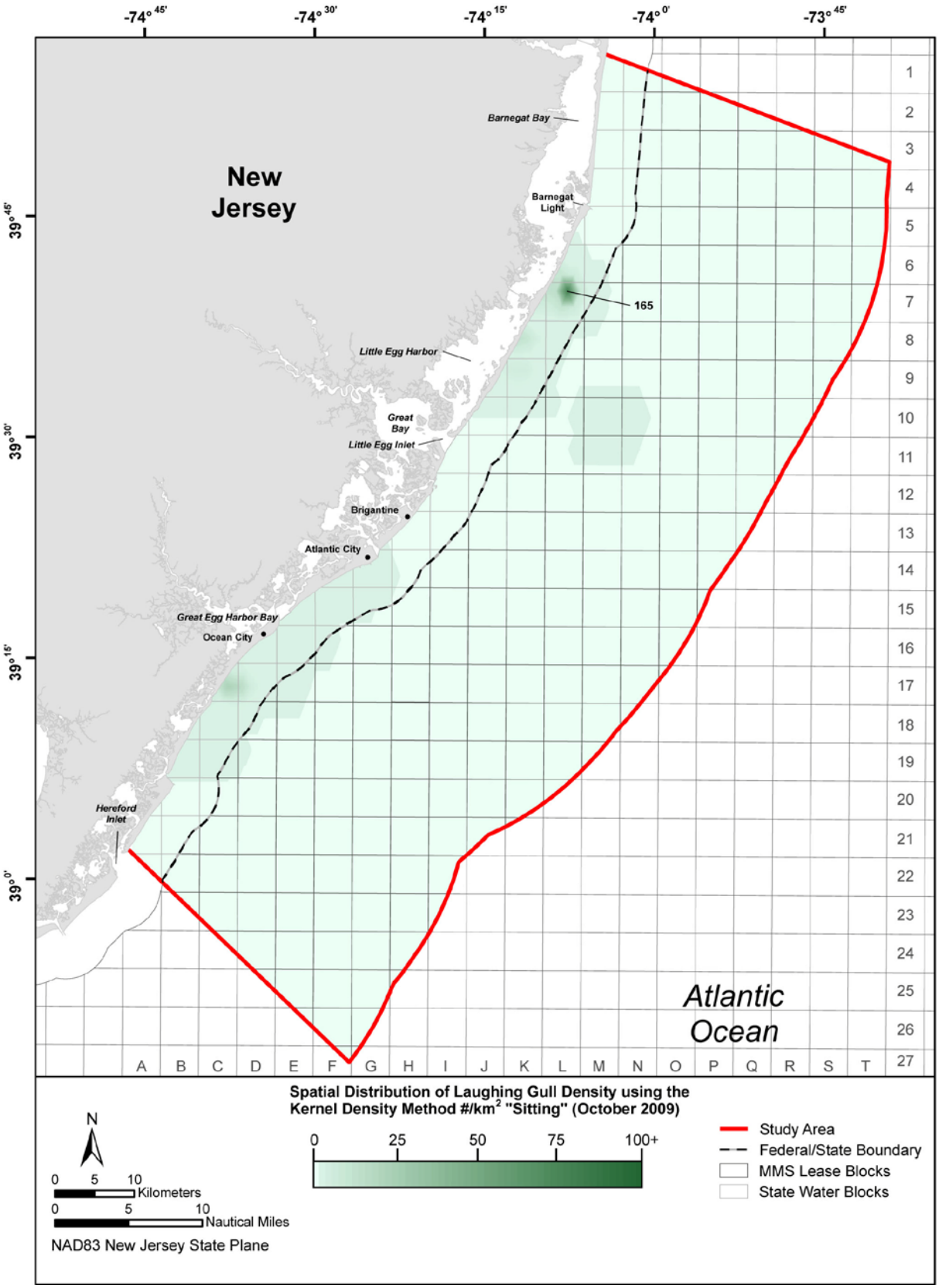

Figure M-371. Spatial distribution of Laughing Gull density (#/km^2) in the Study Area for sitting birds using the kernel density method (October 2009).

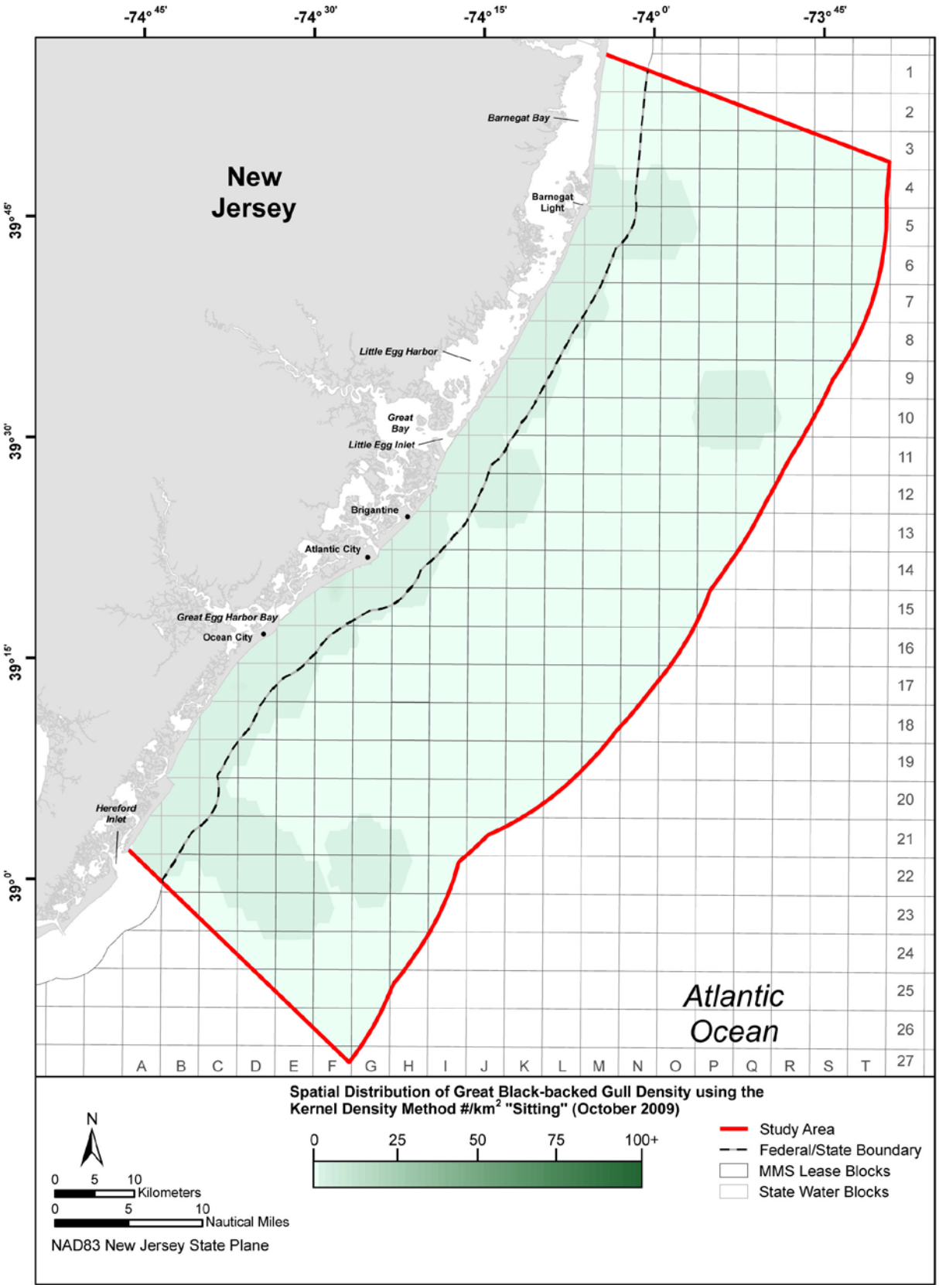

Figure M-372. Spatial distribution of Great Black-backed Gull density (#/km^2) in the Study Area for sitting birds using the kernel density method (October 2009).

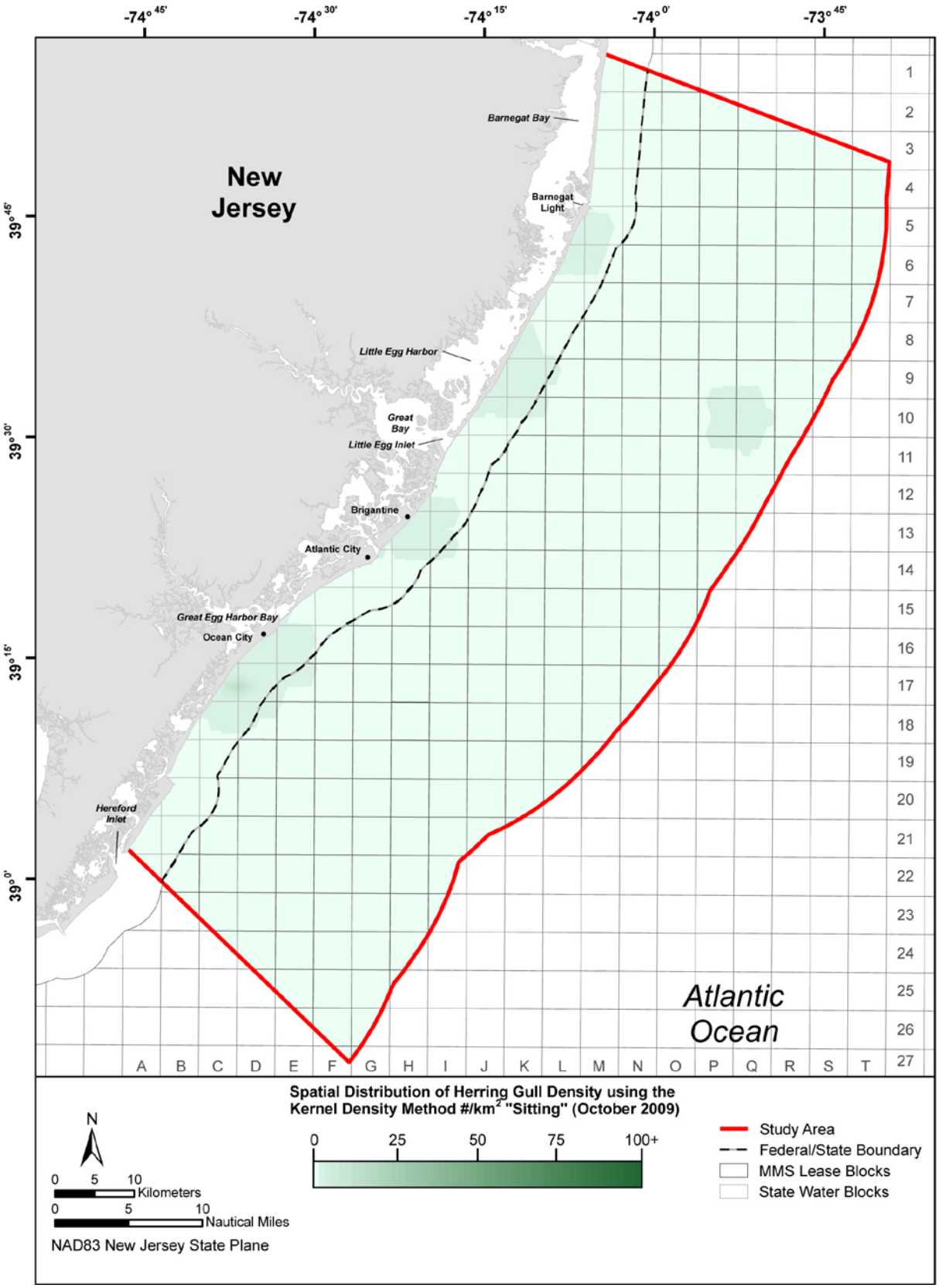

Figure M-373. Spatial distribution of Herring Gull density (#/km^2) in the Study Area for sitting birds using the kernel density method (October 2009).

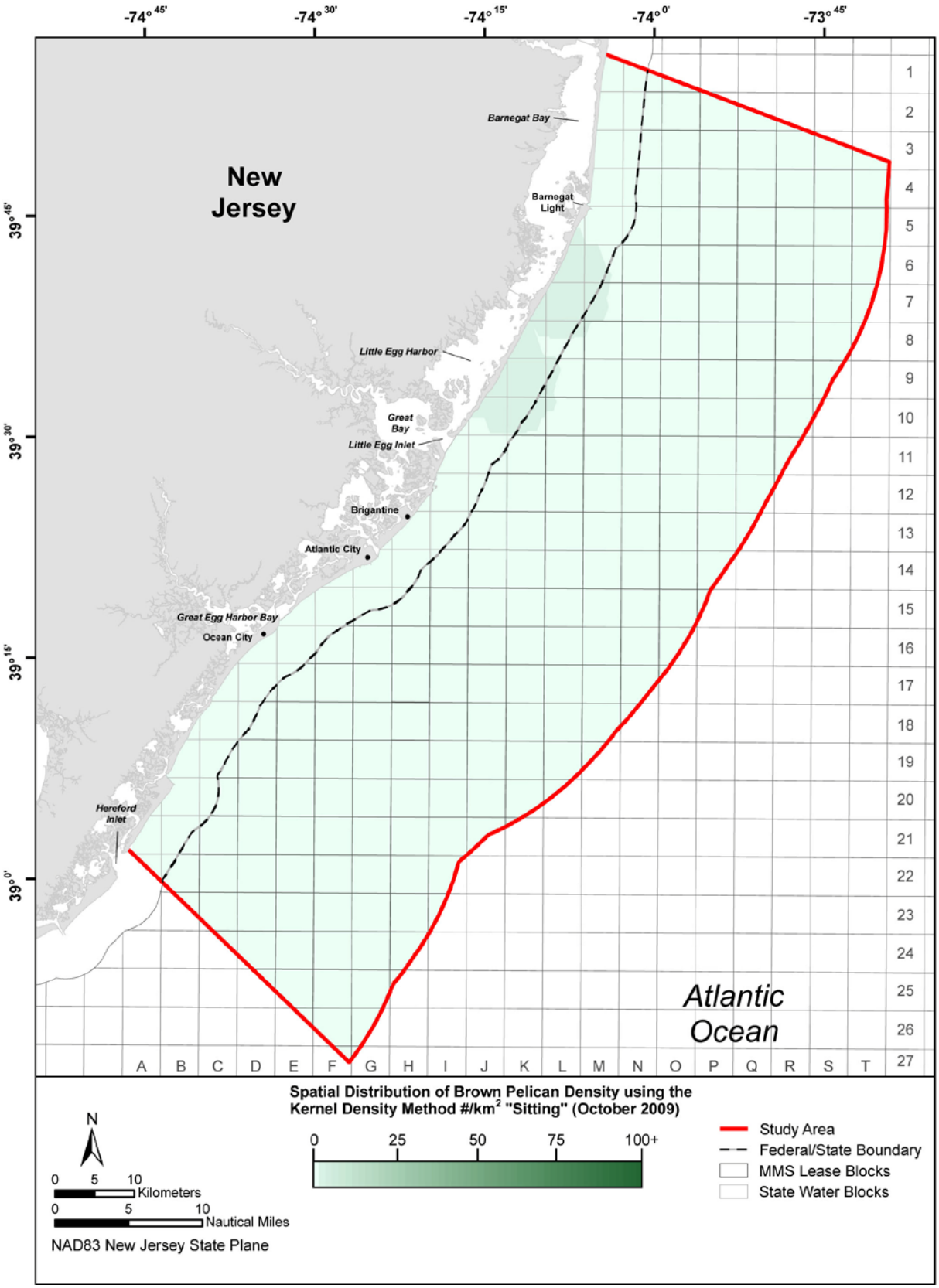

Figure M-374. Spatial distribution of Brown Pelican density (#/km^2) in the Study Area for sitting birds using the kernel density method (October 2009).

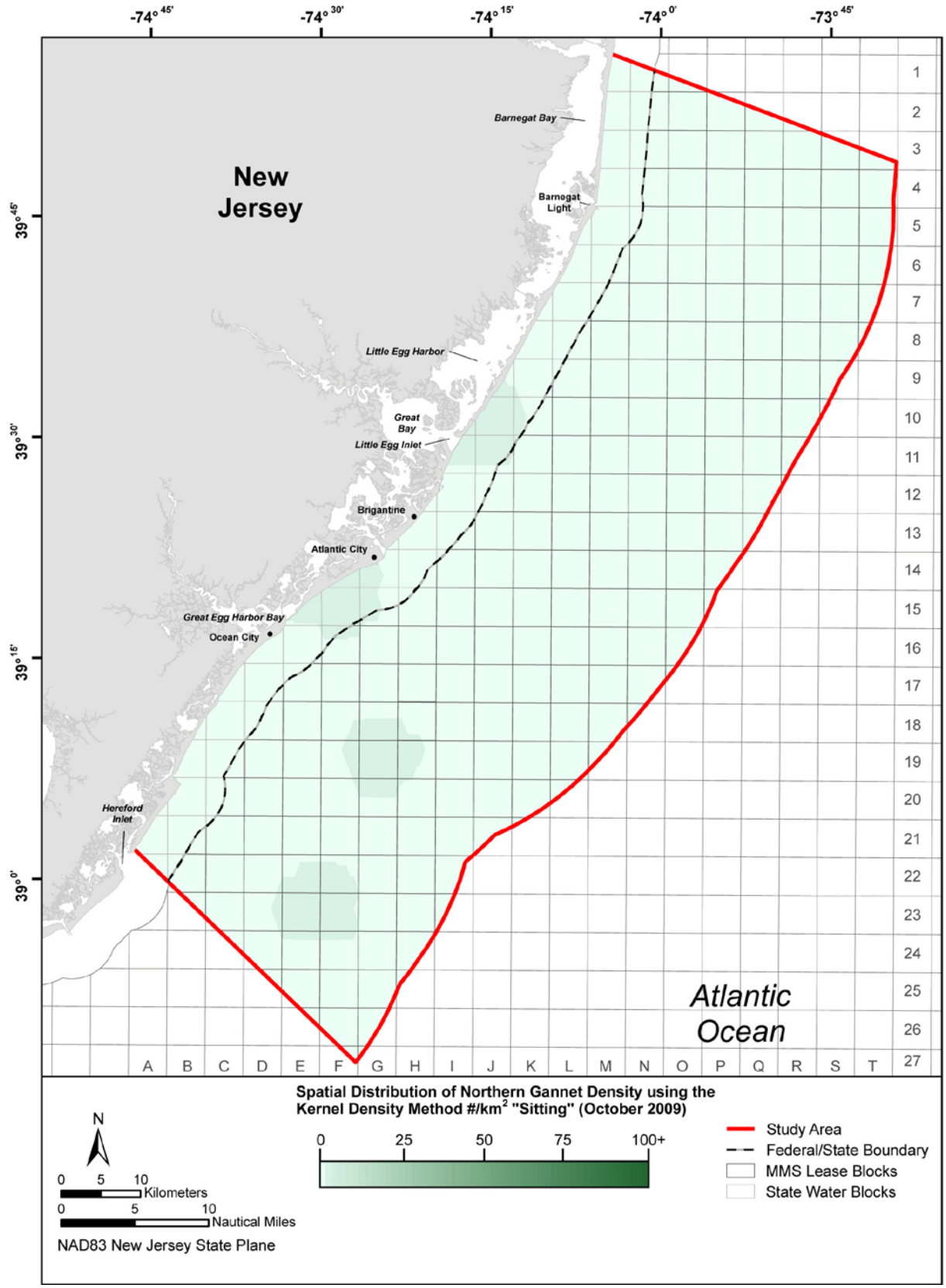

Figure M-375. Spatial distribution of Northern Gannet density (#/km^2) in the Study Area for sitting birds using the kernel density method (October 2009).

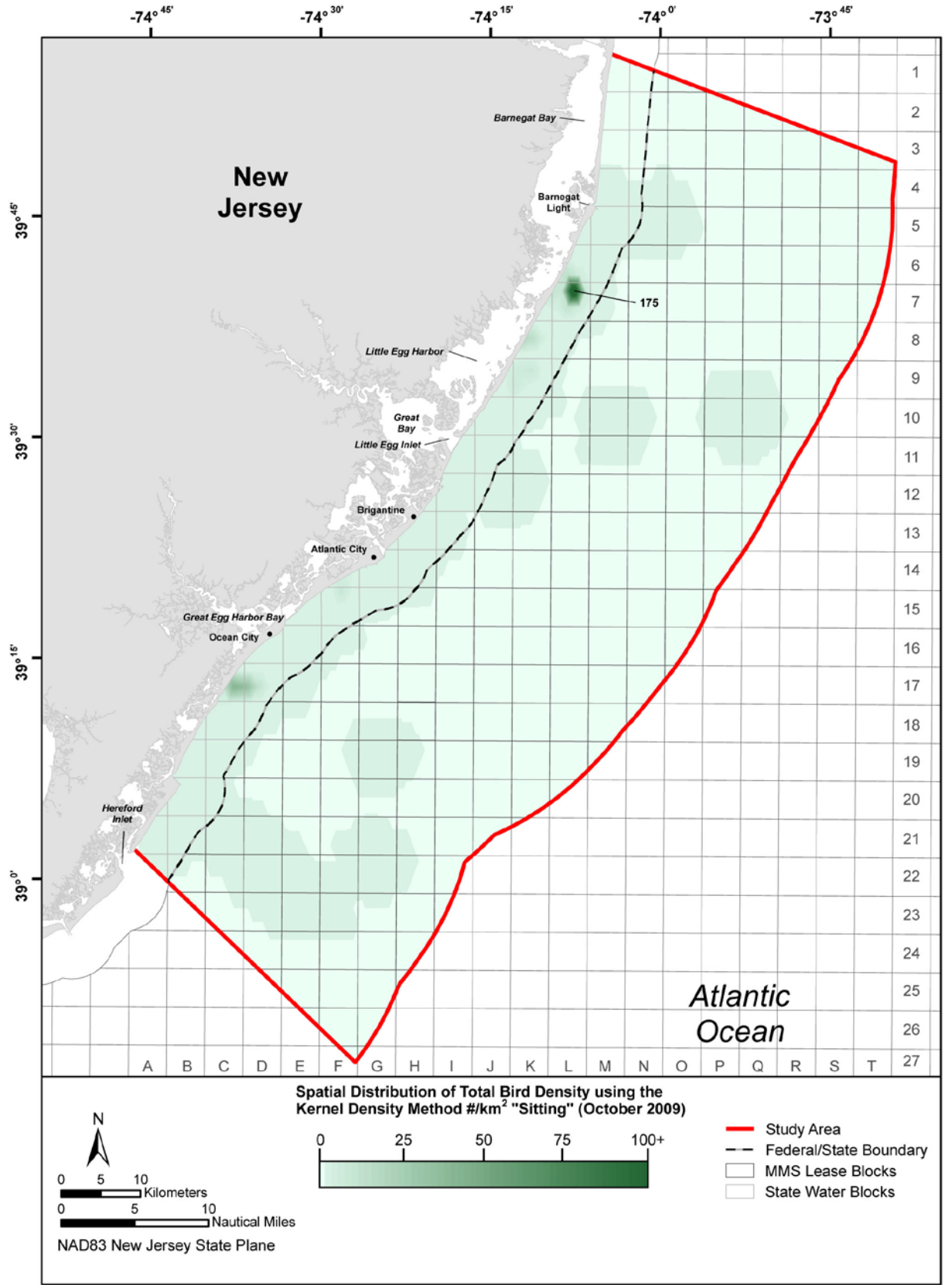

Figure M-376. Spatial distribution of total bird density (#/km^2) in the Study Area for sitting birds using the kernel density method (October 2009).

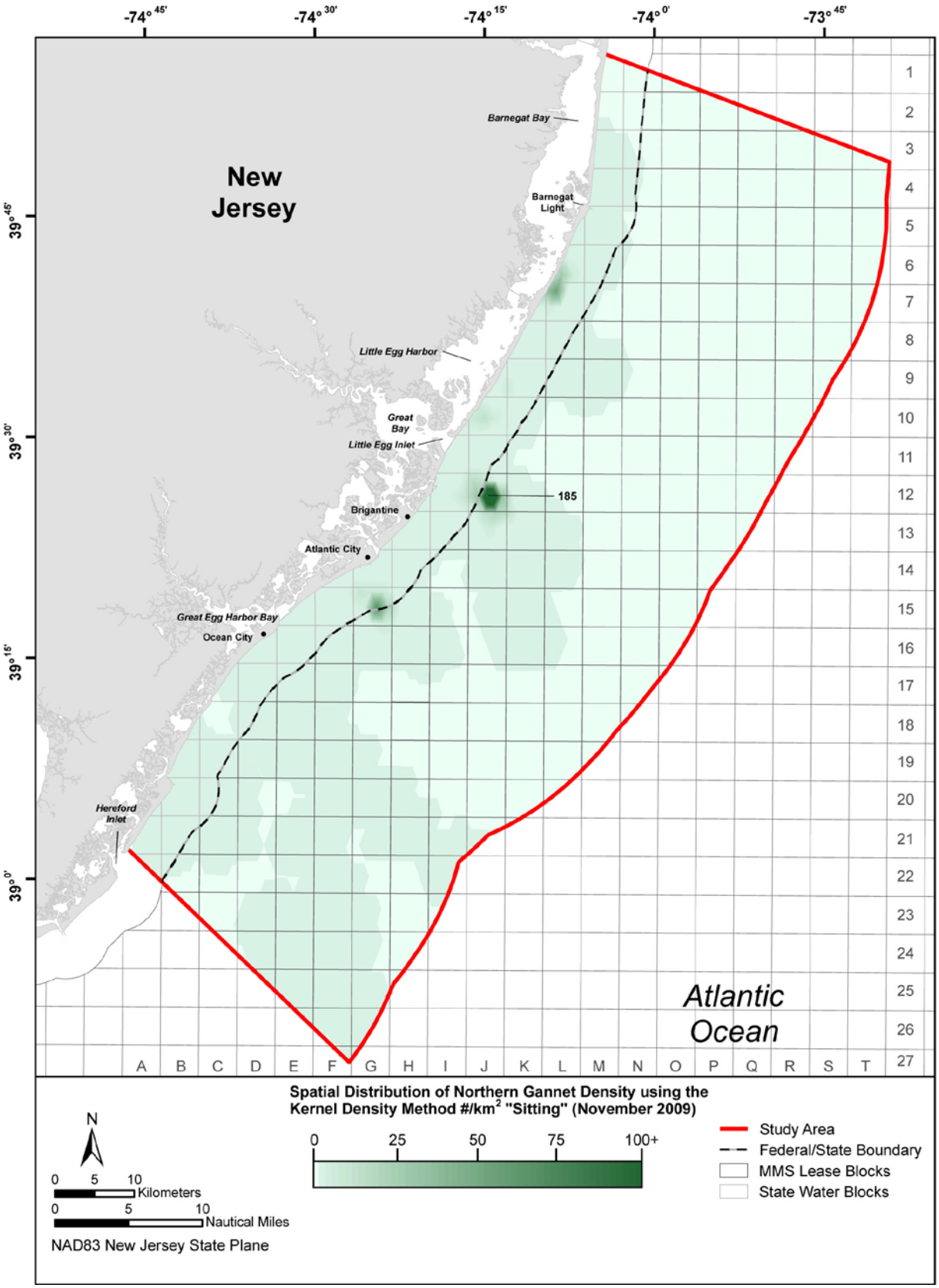

Figure M-377. Spatial distribution of Northern Gannet density (#/km^2) in the Study Area for sitting birds using the kernel density method (November 2009).

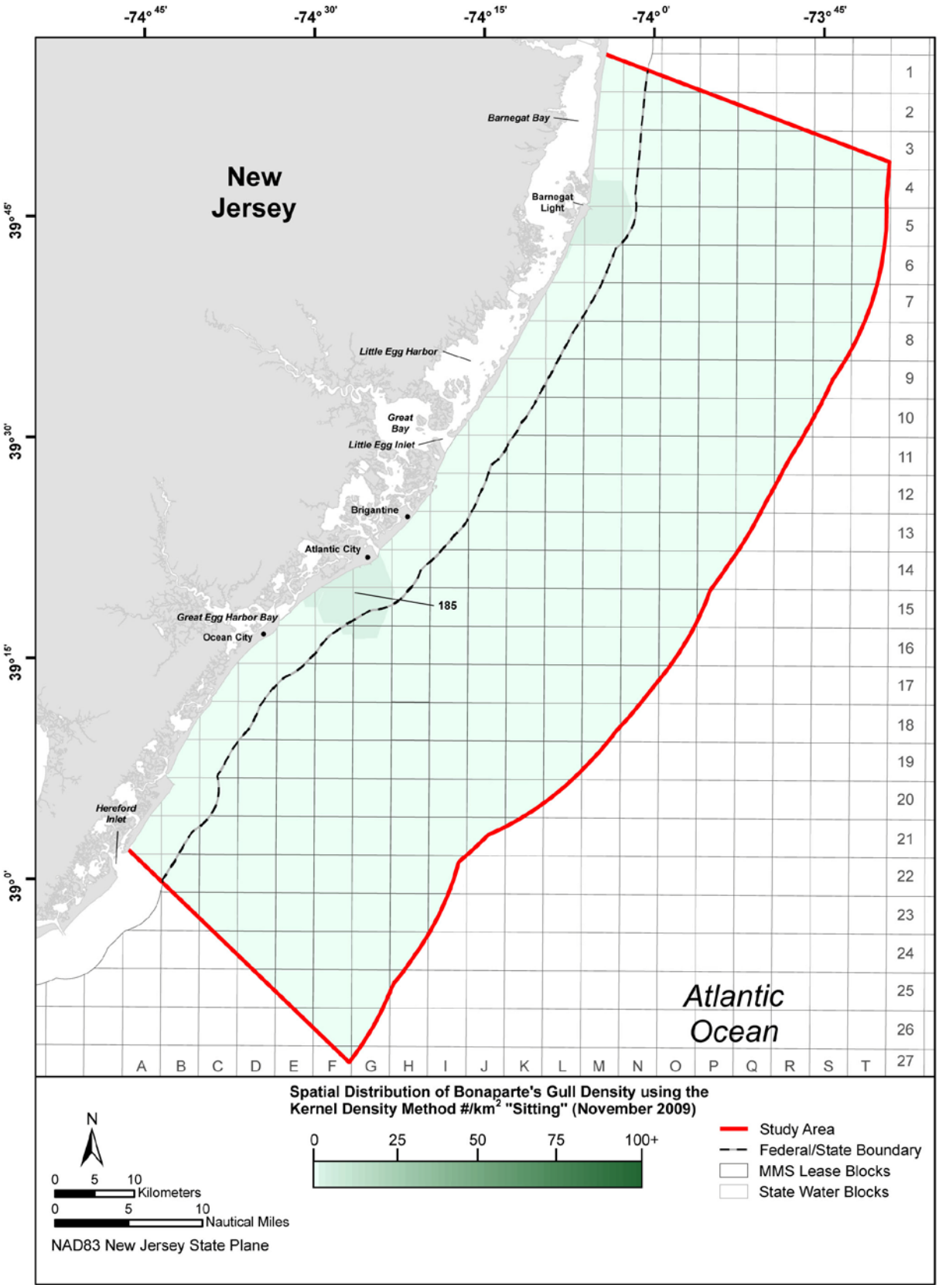

Figure M-378. Spatial distribution of Bonaparte's Gull density (#/km^2) in the Study Area for sitting birds using the kernel density method (November 2009).

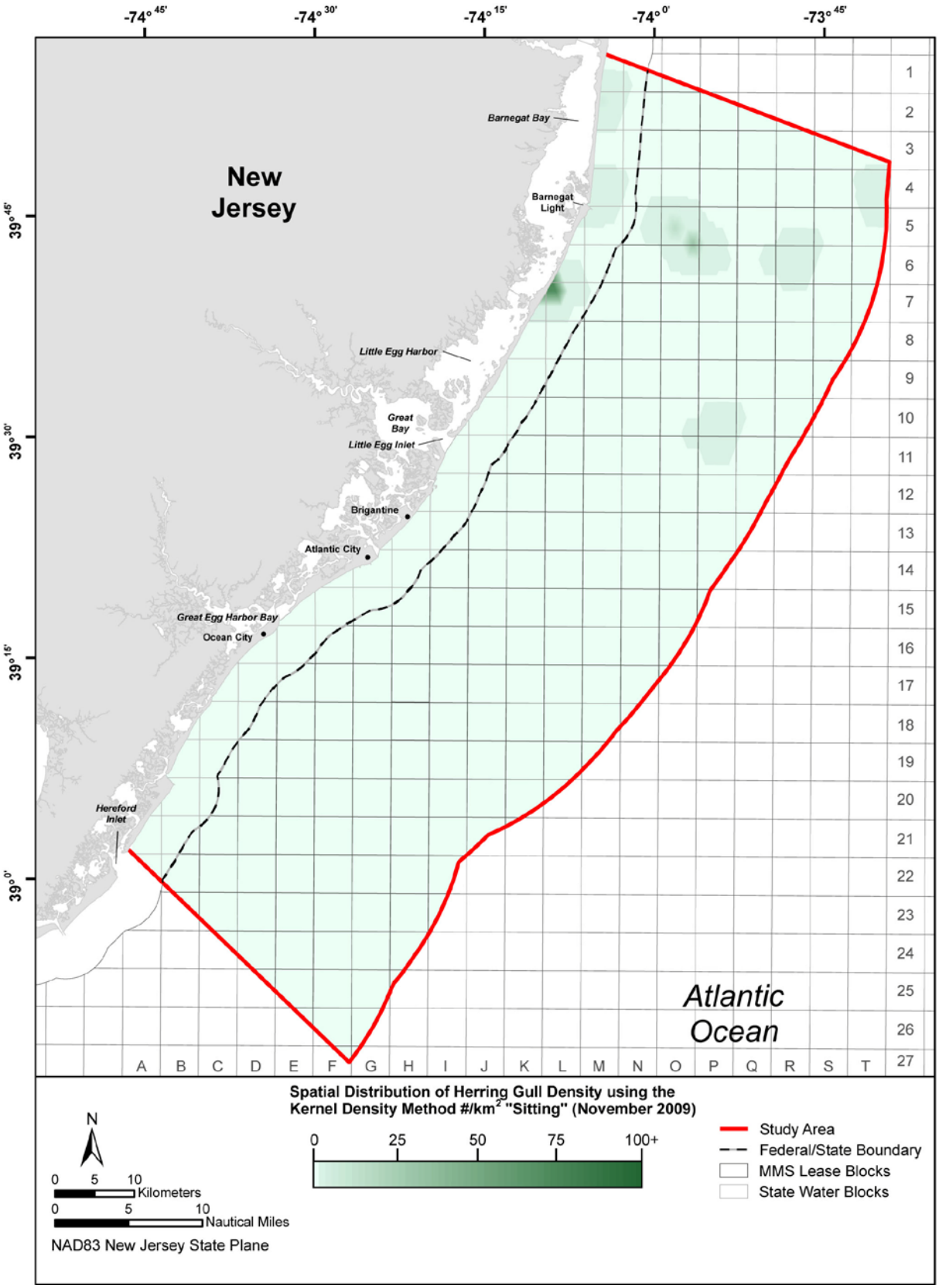

Figure M-379. Spatial distribution of Herring Gull density (#/km^2) in the Study Area for sitting birds using the kernel density method (November 2009).

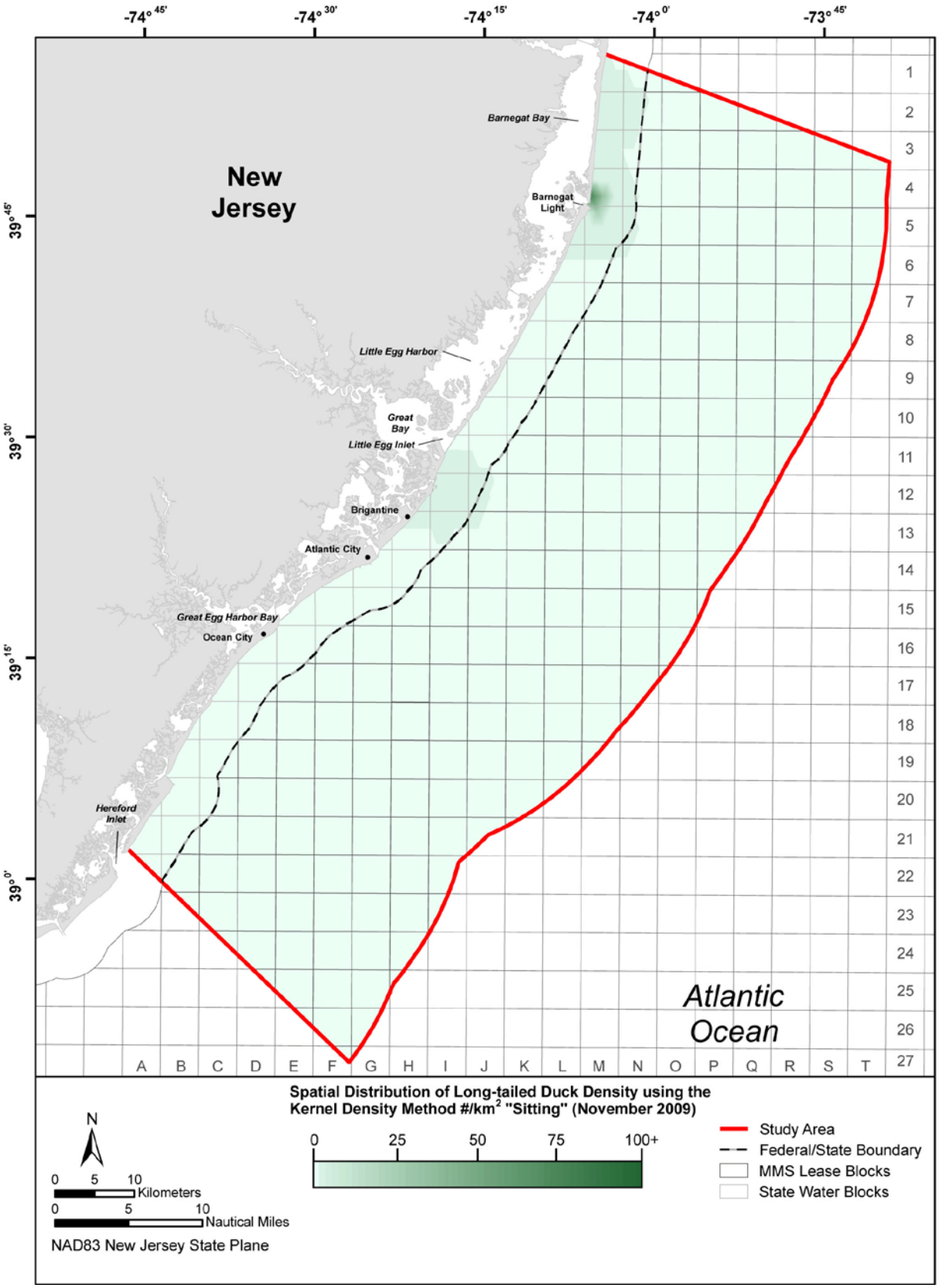

Figure M-380. Spatial distribution of Long-tailed Duck density (#/km^2) in the Study Area for sitting birds using the kernel density method (November 2009).

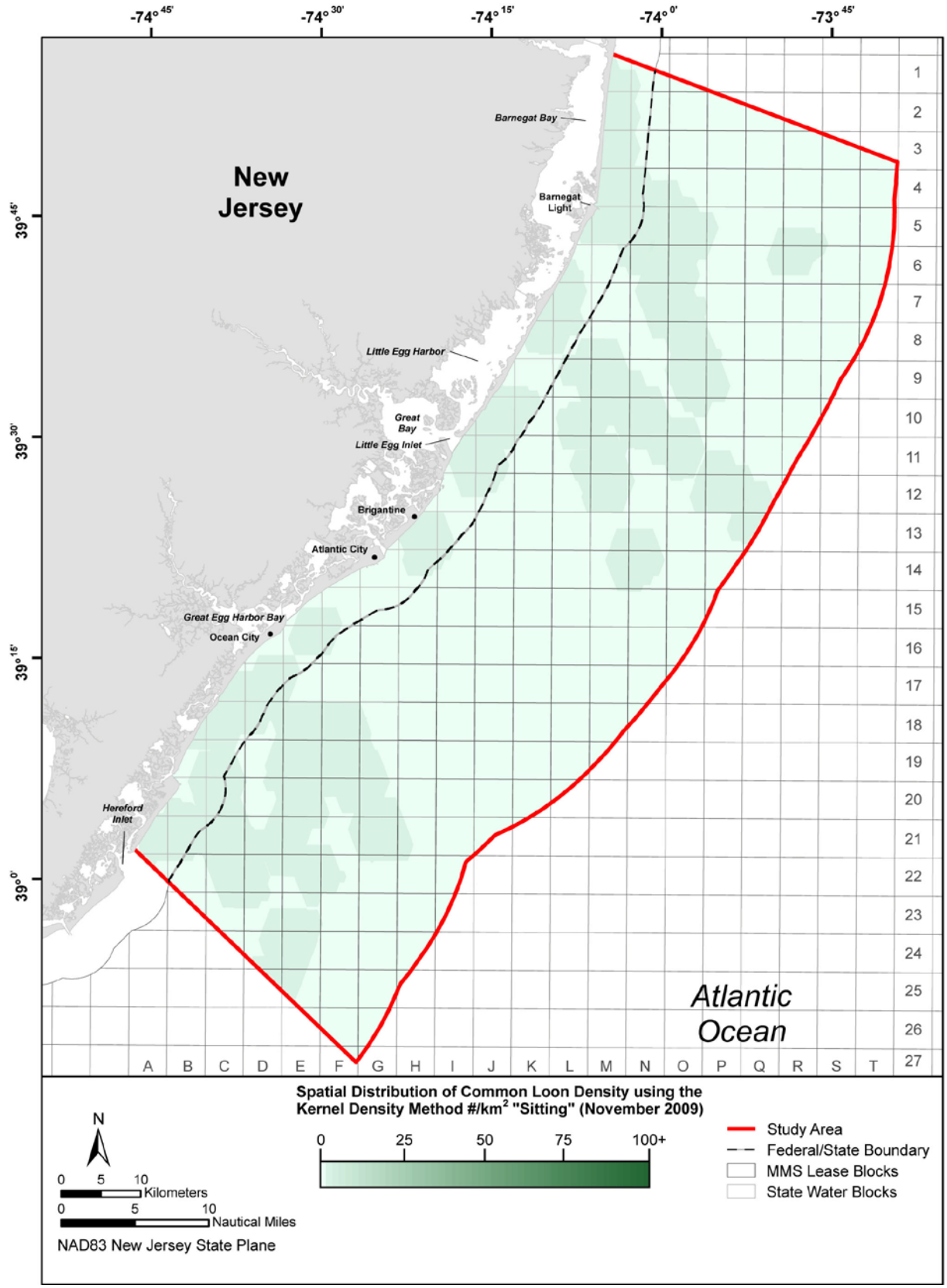

Figure M-381. Spatial distribution of Common Loon density (#/km^2) in the Study Area for sitting birds using the kernel density method (November 2009).

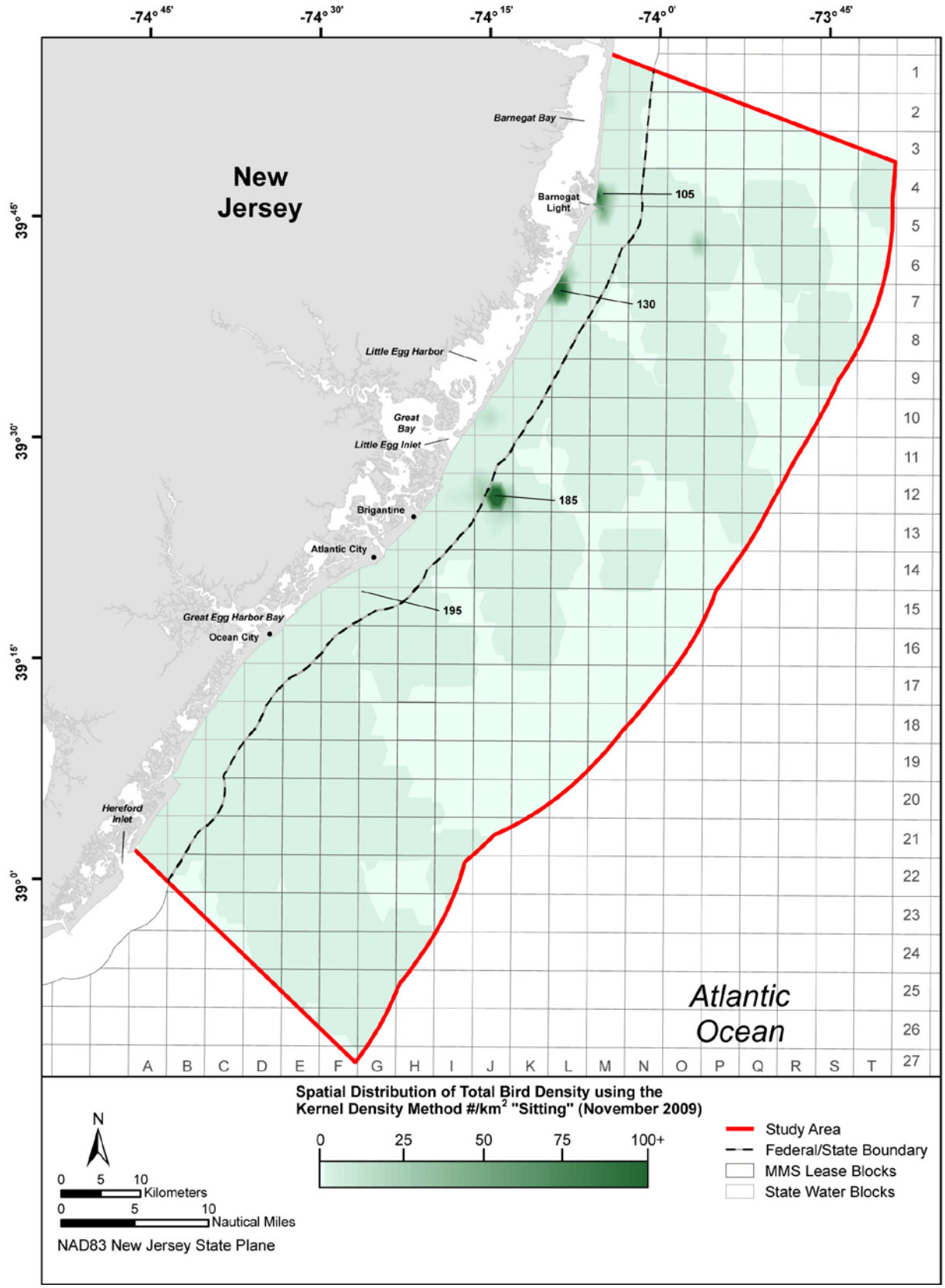

Figure M-382. Spatial distribution of total bird density (#/km^2) in the Study Area for sitting birds using the kernel density method (November 2009).

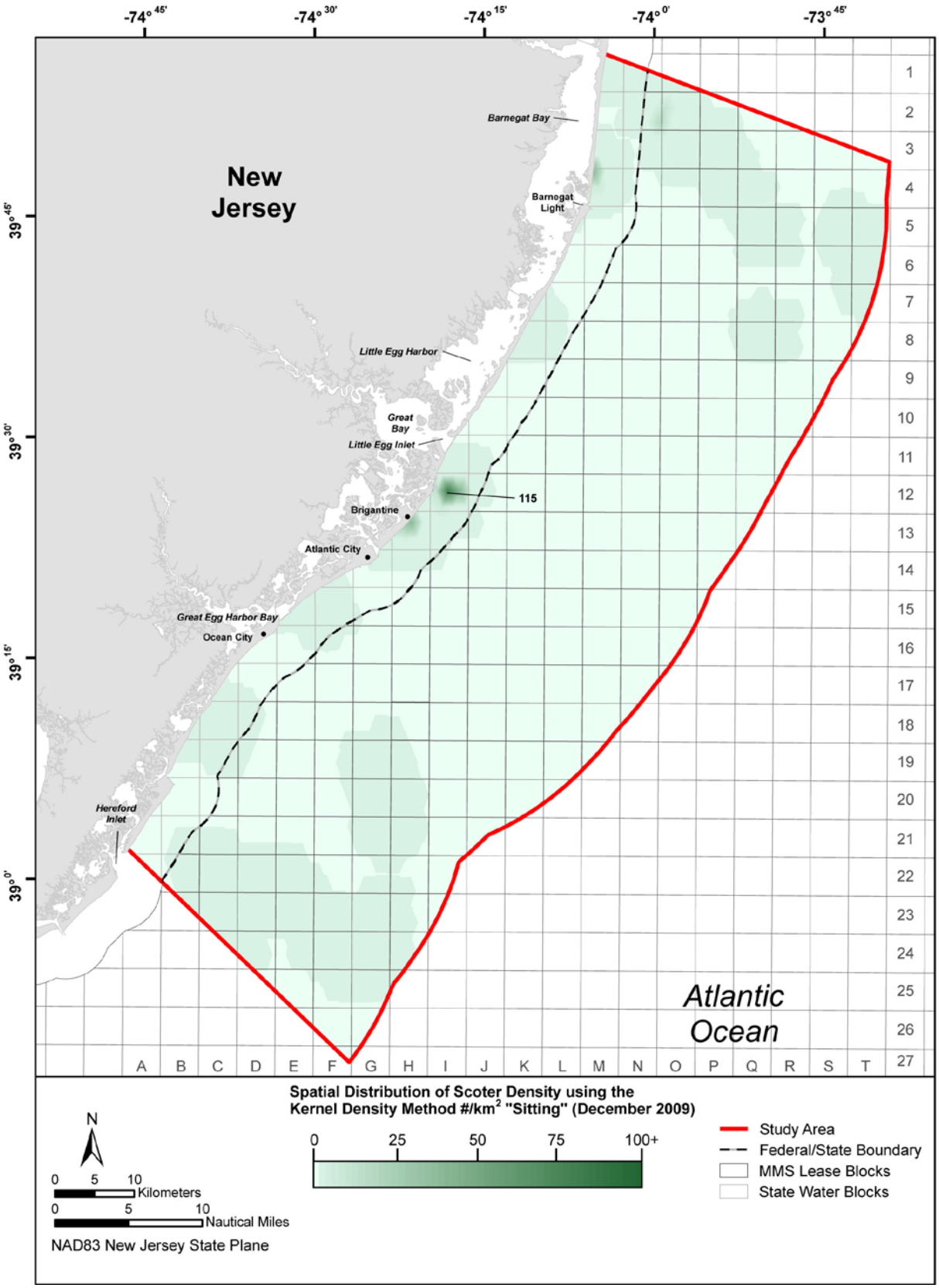

Figure M-383. Spatial distribution of scoter density (#/km^2) in the Study Area for sitting birds using the kernel density method (December 2009).

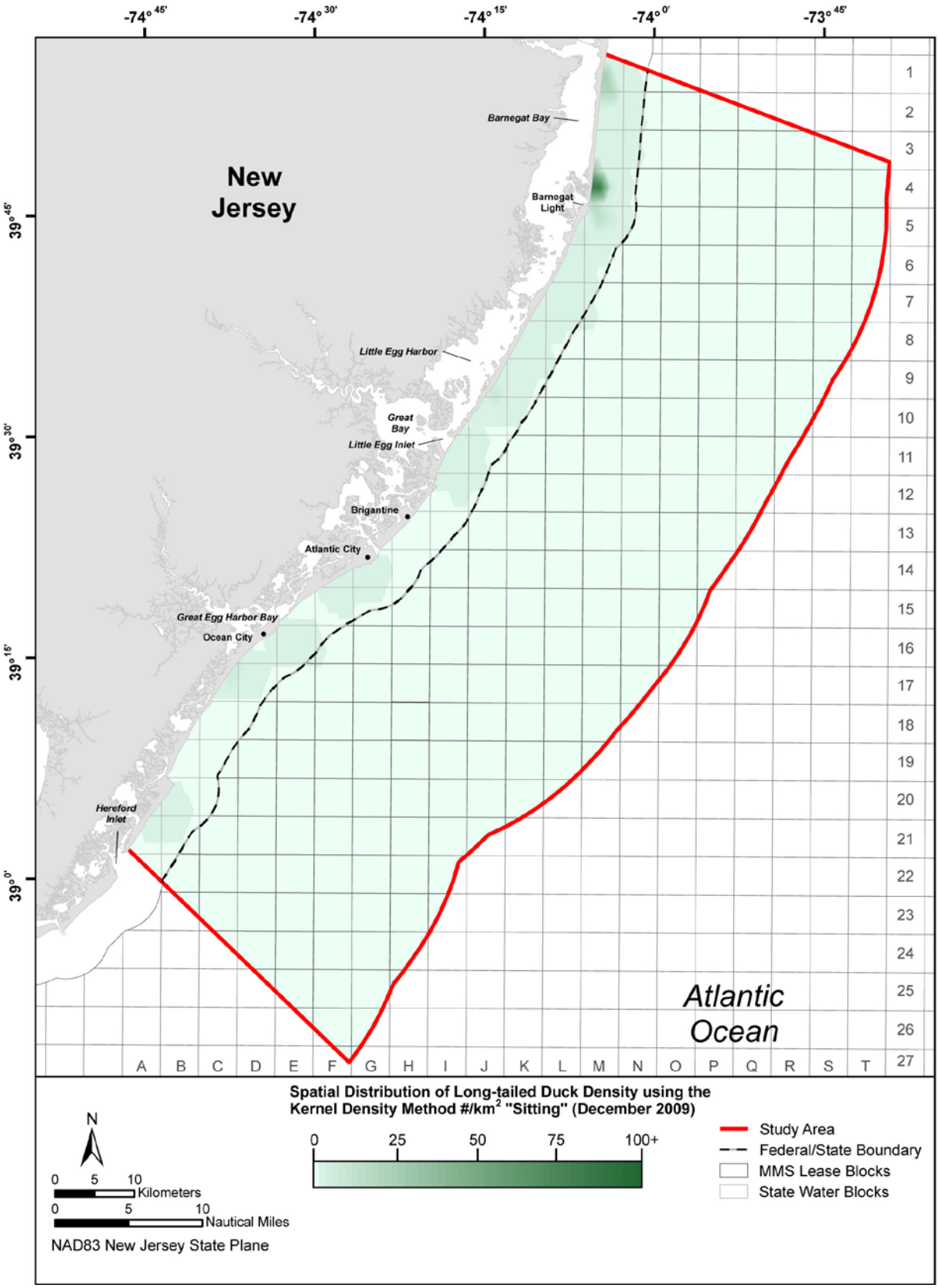

Figure M-384. Spatial distribution of Long-tailed Duck density (#/km^2) in the Study Area for sitting birds using the kernel density method (December 2009).

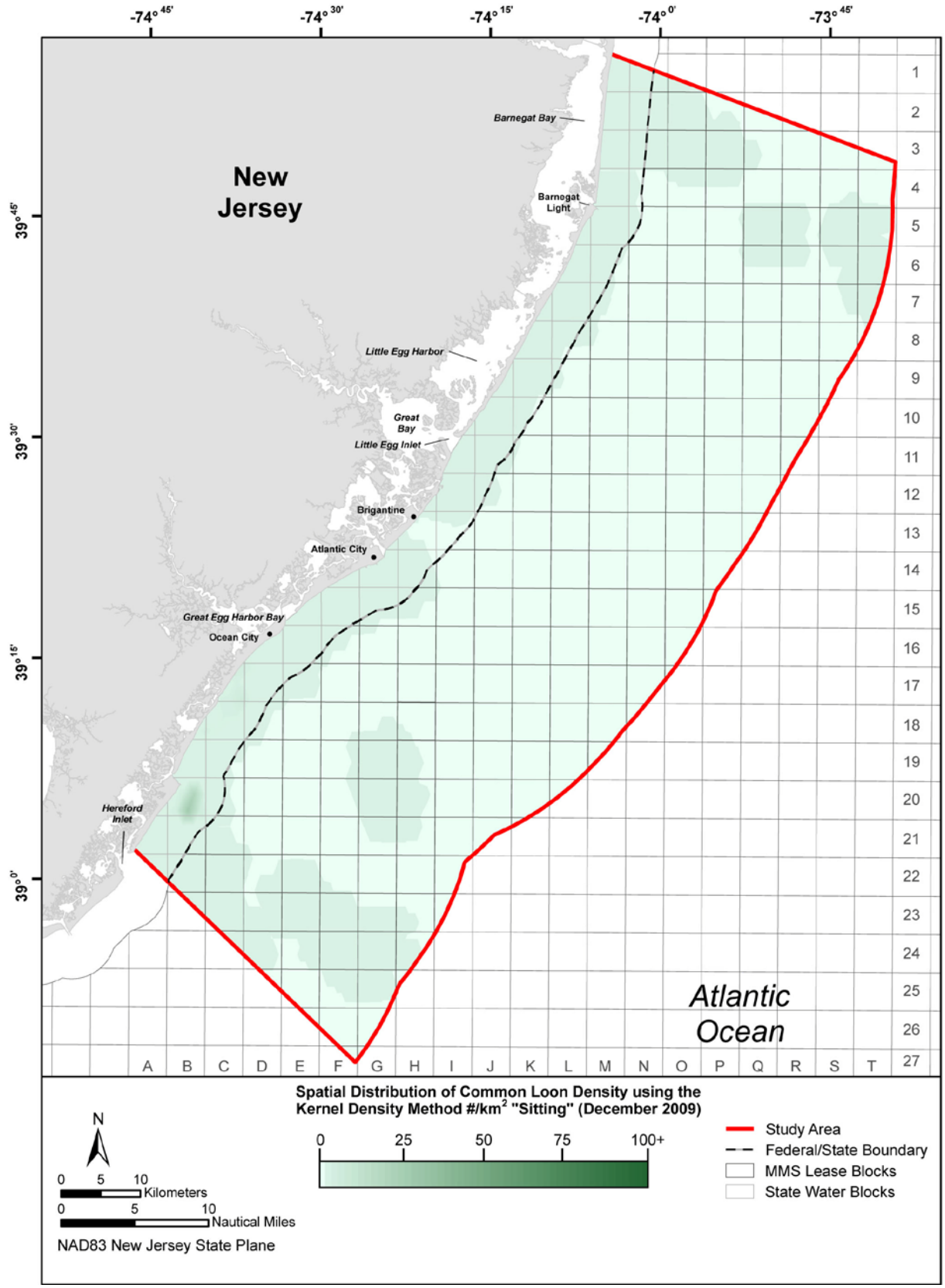

Figure M-385. Spatial distribution of Common Loon density (#/km^2) in the Study Area for sitting birds using the kernel density method (December 2009).

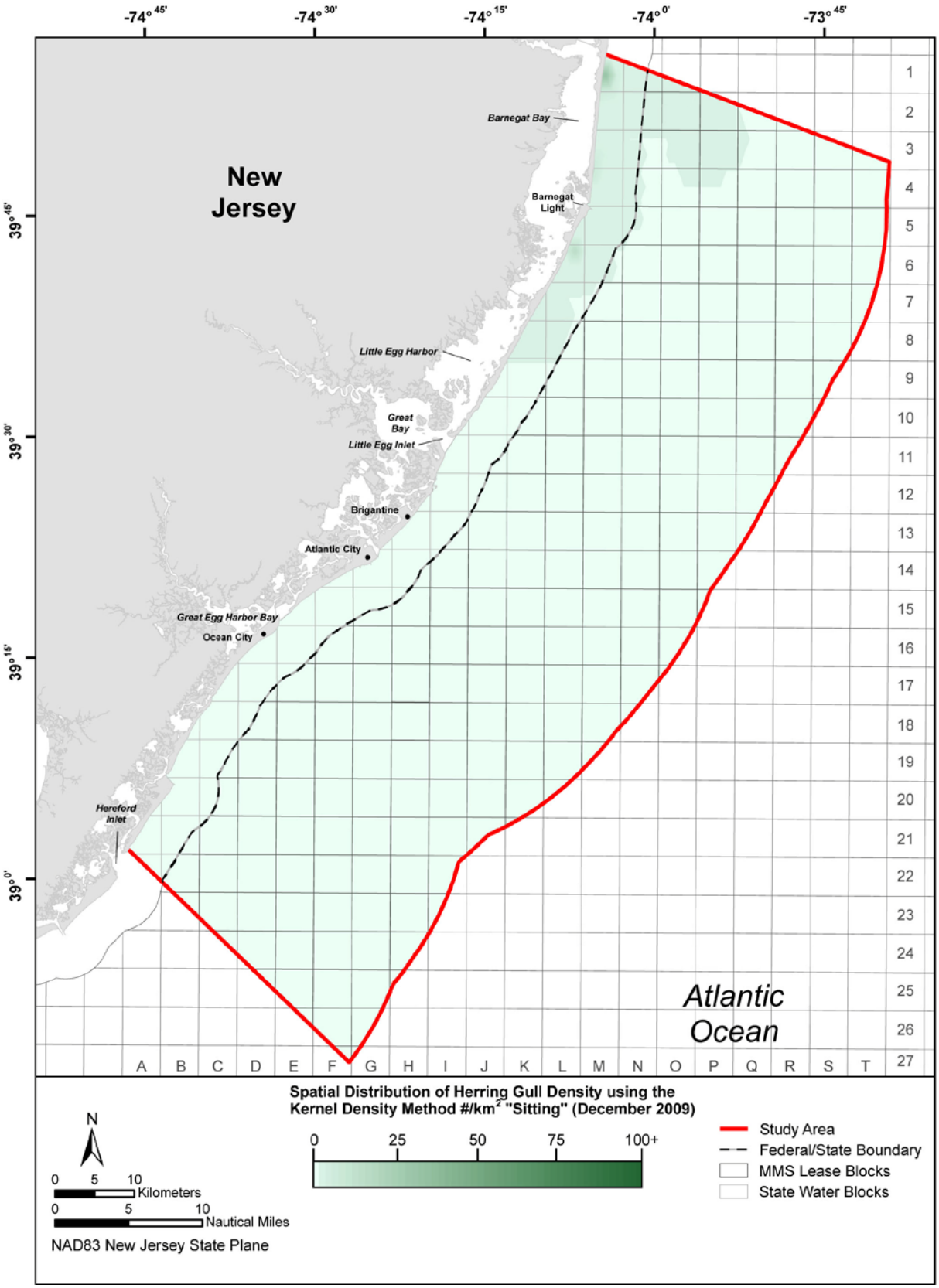

Figure M-386. Spatial distribution of Herring Gull density (#/km^2) in the Study Area for sitting birds using the kernel density method (December 2009).

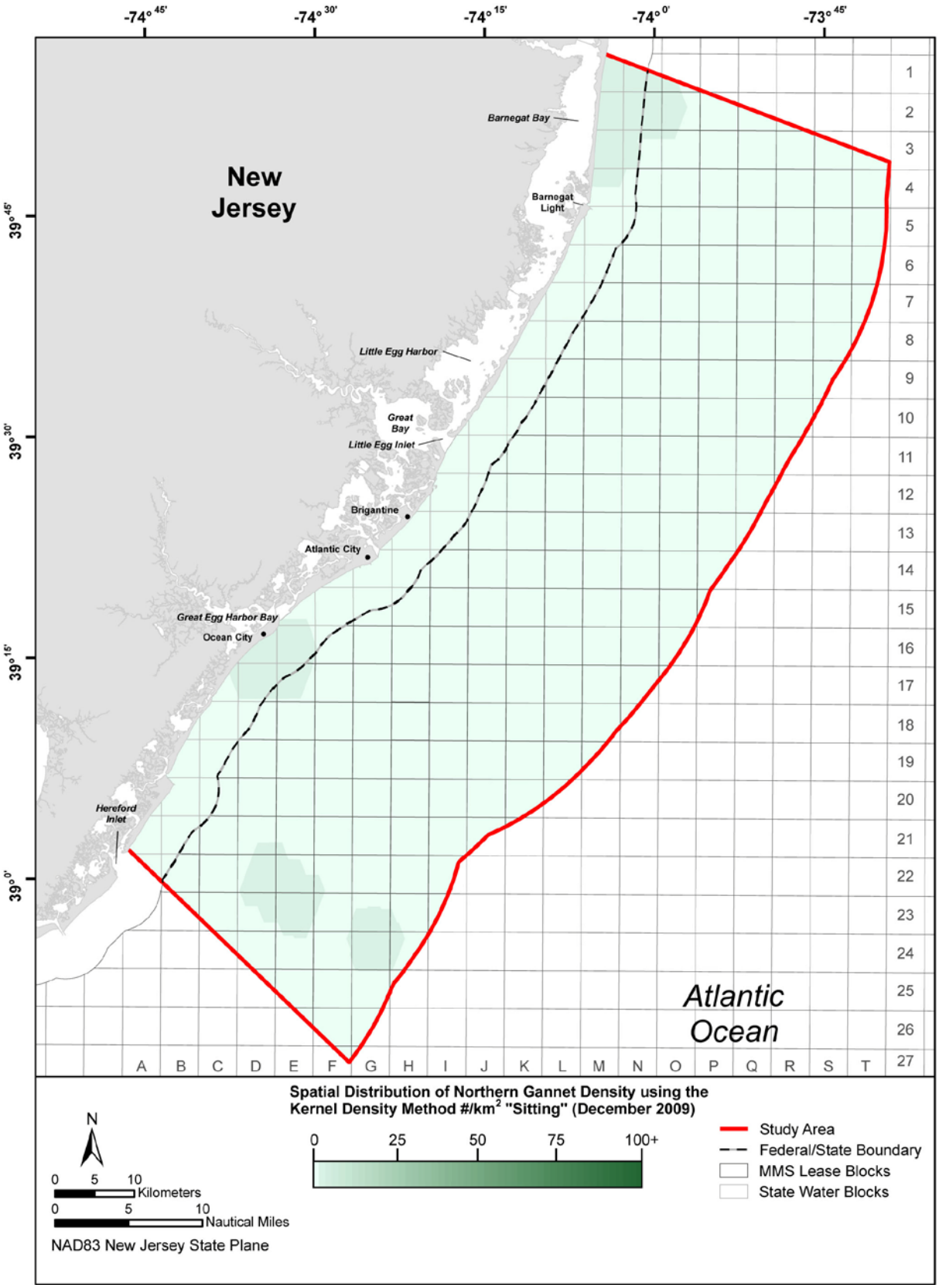

Figure M-387. Spatial distribution of Northern Gannet density (#/km^2) in the Study Area for sitting birds using the kernel density method (December 2009).

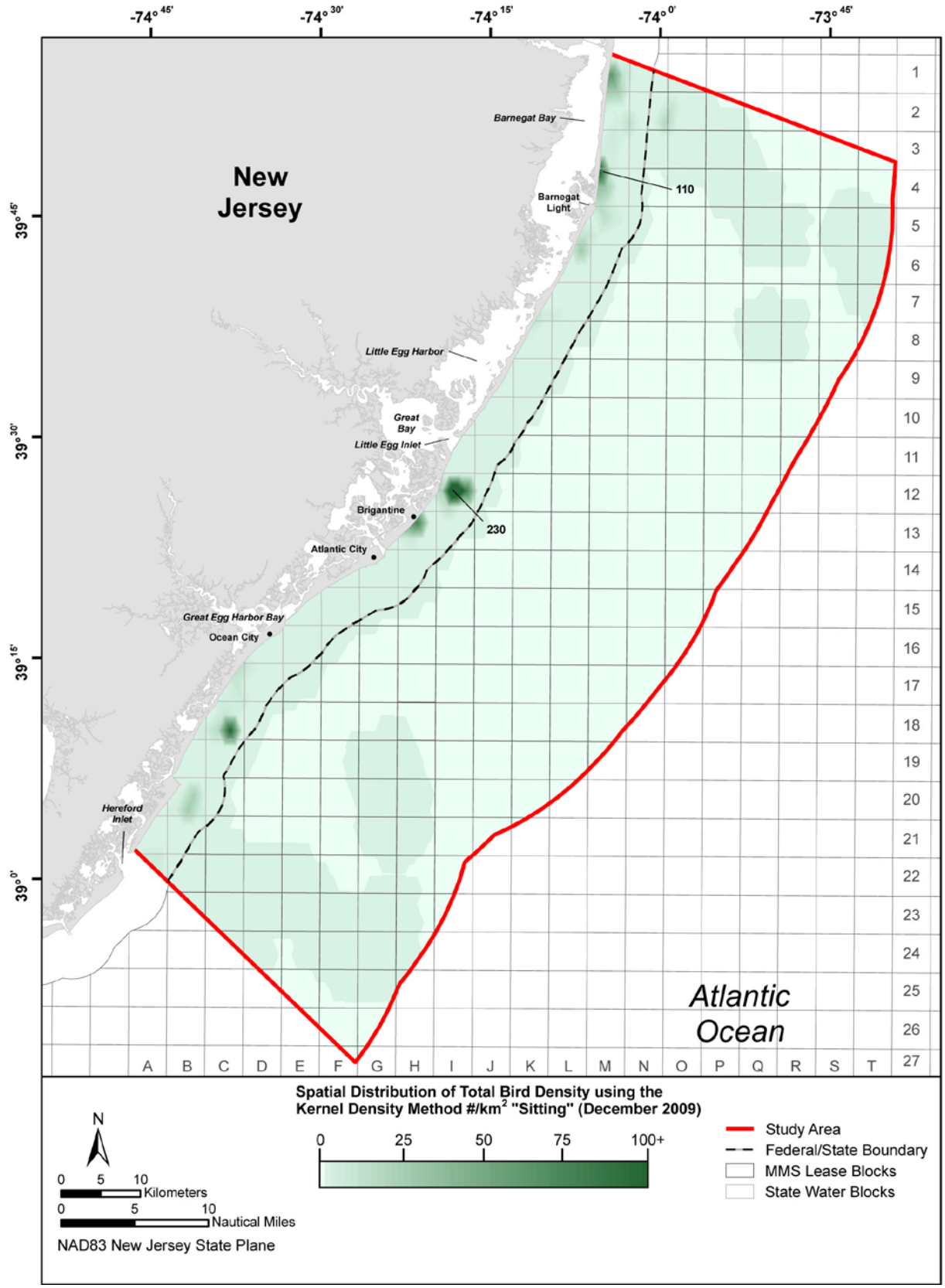

Figure M-388. Spatial distribution of total bird density (#/km^2) in the Study Area for sitting birds using the kernel density method (December 2009).

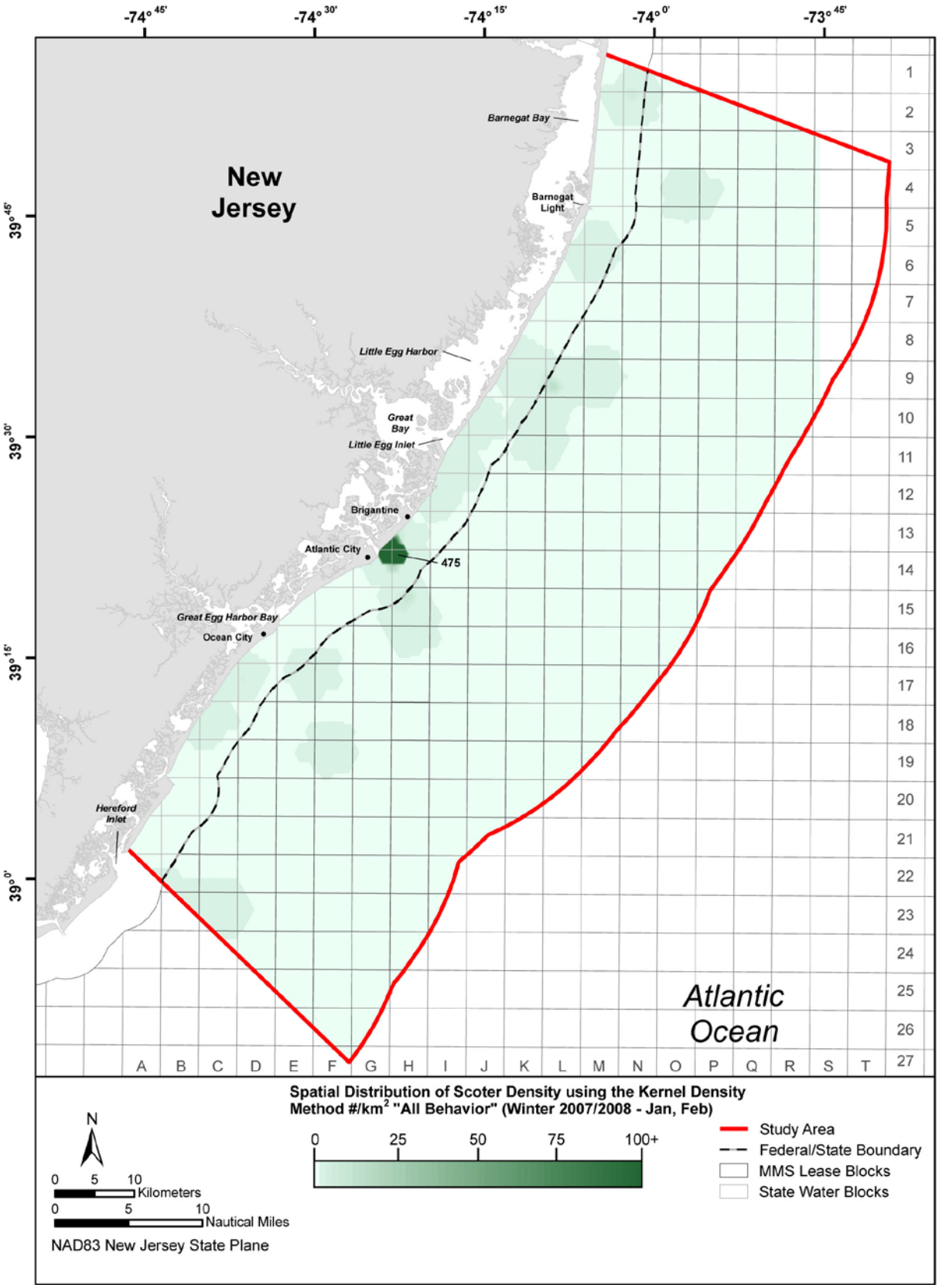

Figure M-389. Spatial distribution of scoter density (#/km^2) in the Study Area for all behaviors using the kernel density method (Winter 2008).

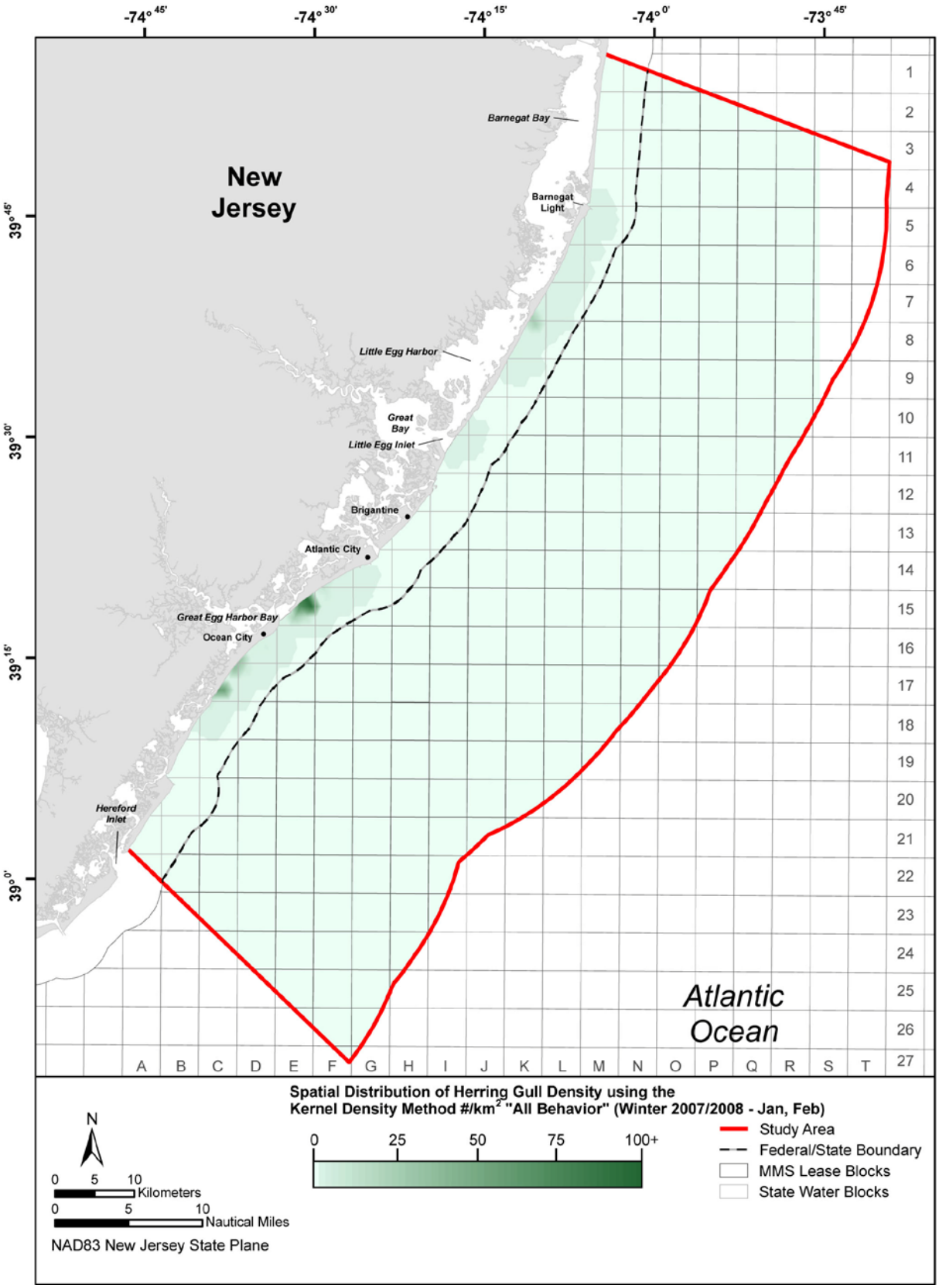

Figure M-390. Spatial distribution of Herring Gull density (#/km^2) in the Study Area for all behaviors using the kernel density method (Winter 2008).

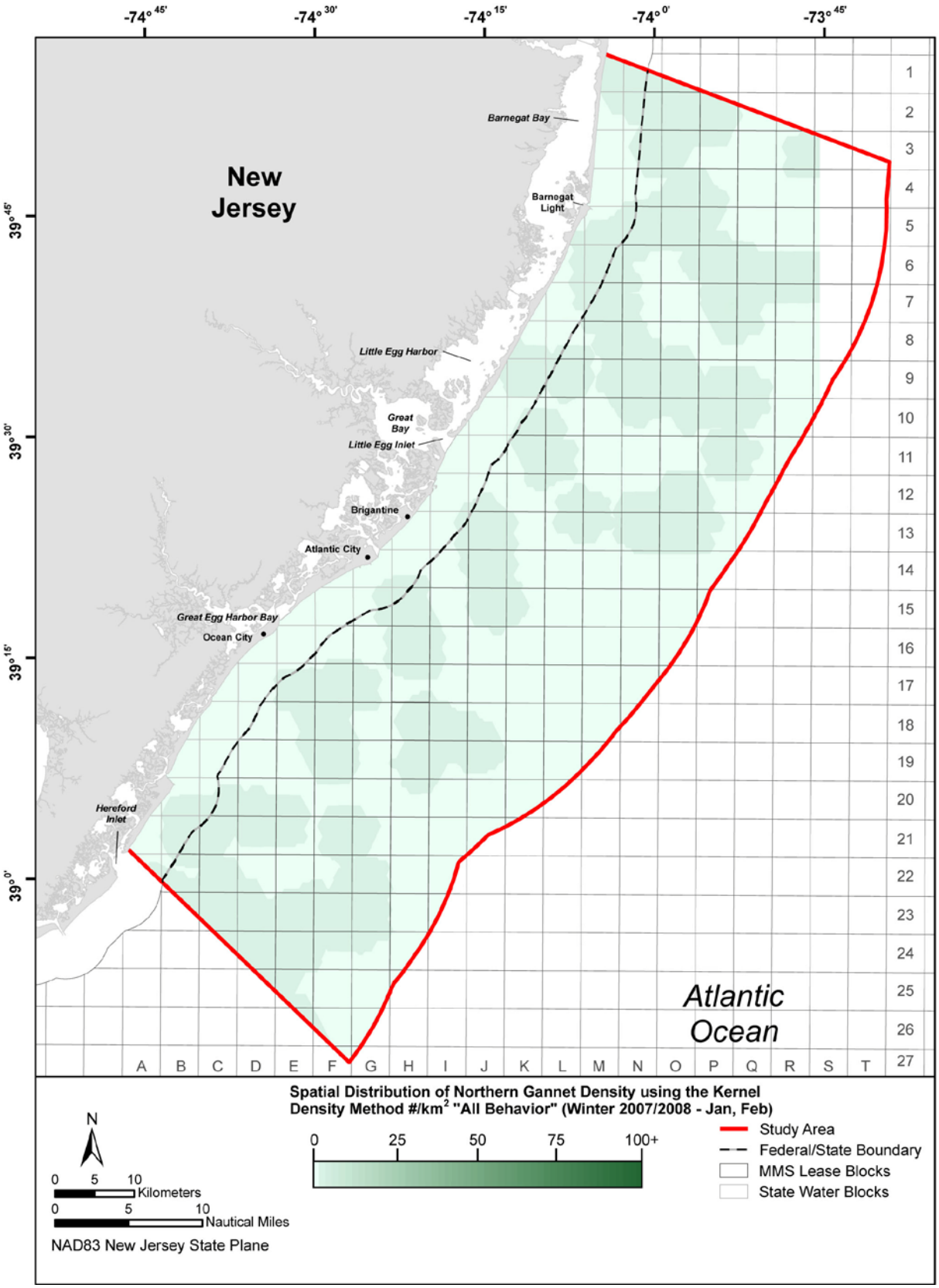

Figure M-391. Spatial distribution of Northern Gannet density (#/km^2) in the Study Area for all behaviors using the kernel density method (Winter 2008).

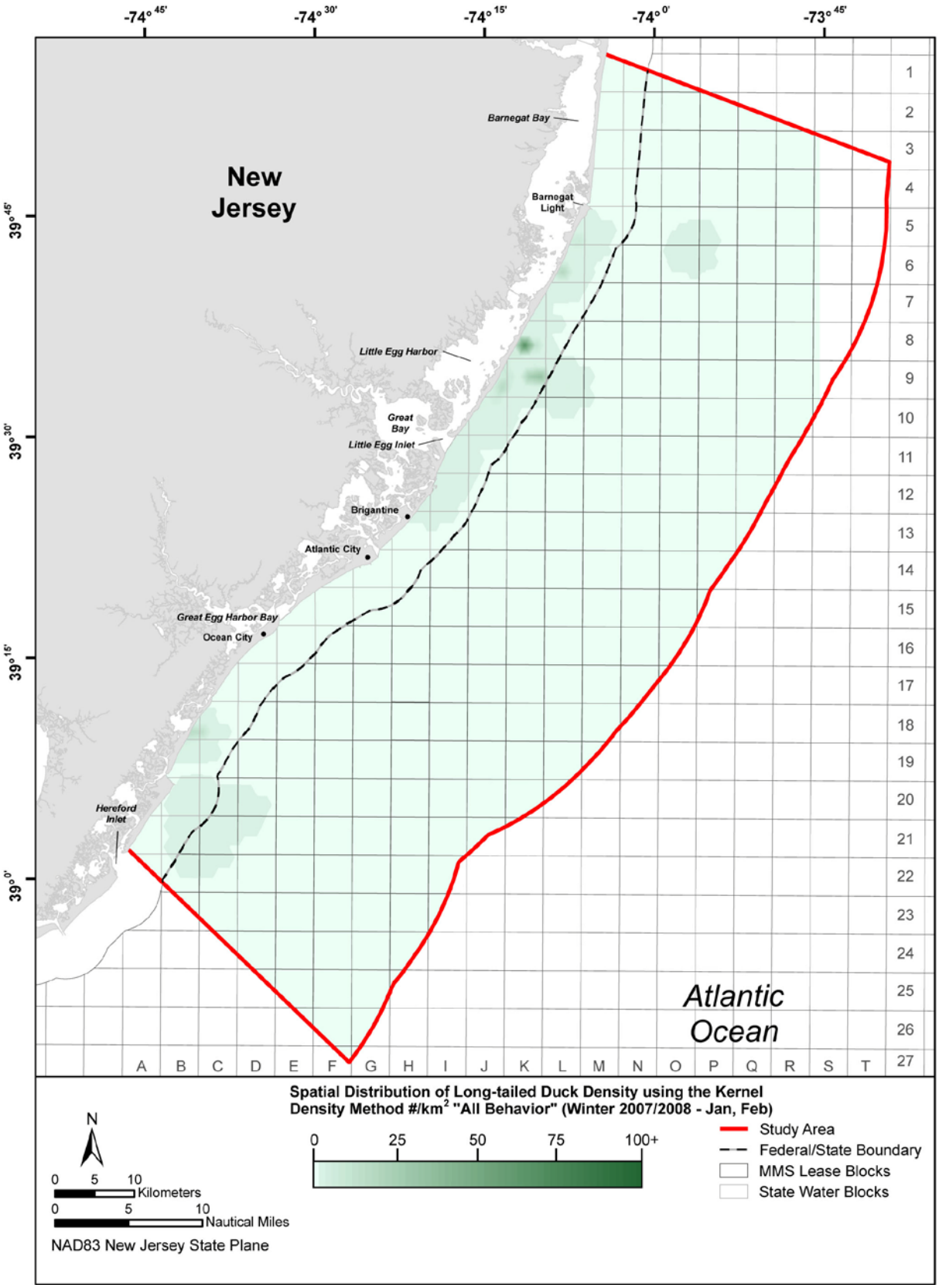

Figure M-392. Spatial distribution of Long-tailed Duck density (#/km^2) in the Study Area for all behaviors using the kernel density method (Winter 2008).

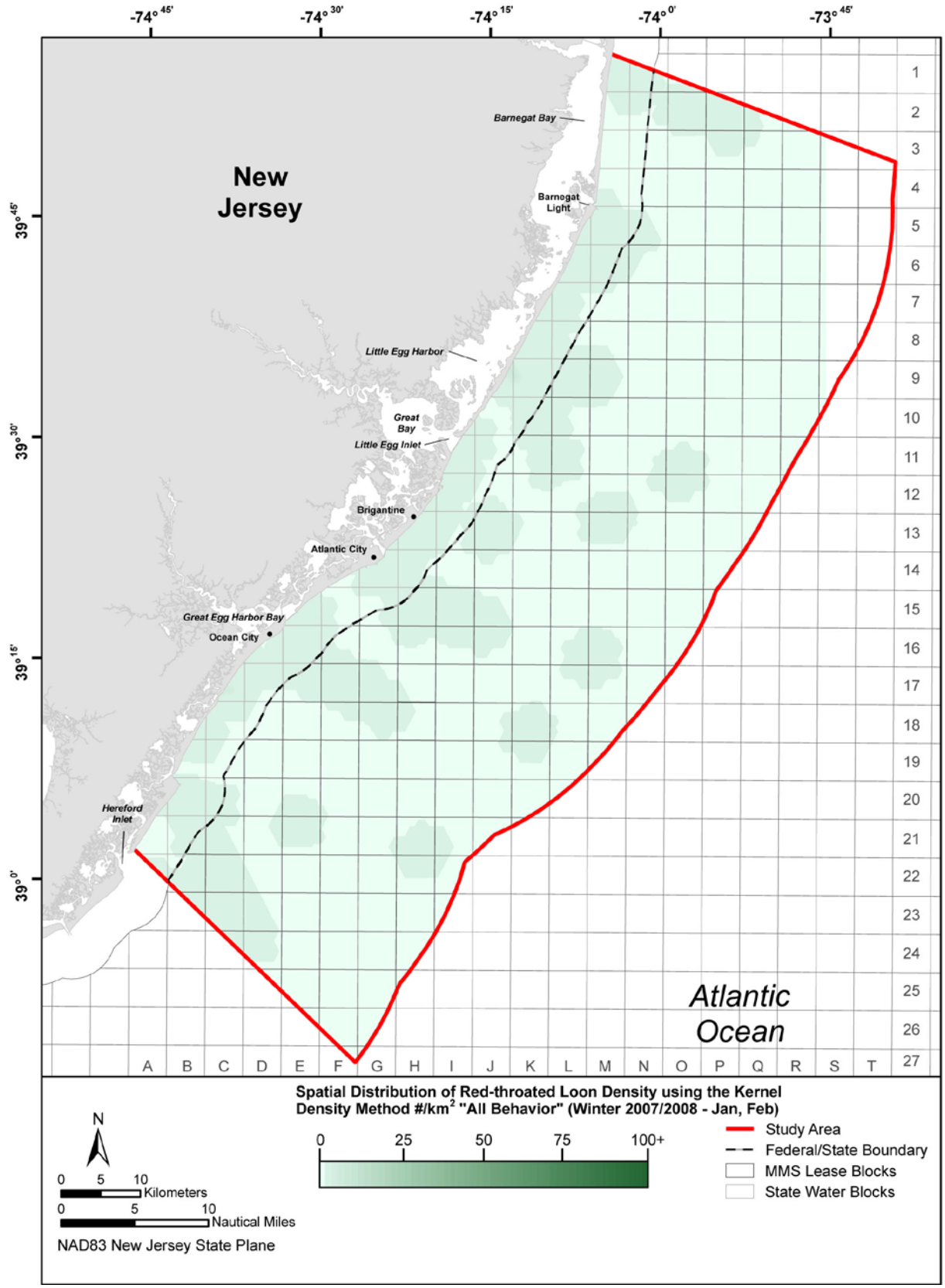

Figure M-393. Spatial distribution of Red-throated Loon density (#/km^2) in the Study Area for all behaviors using the kernel density method (Winter 2008).

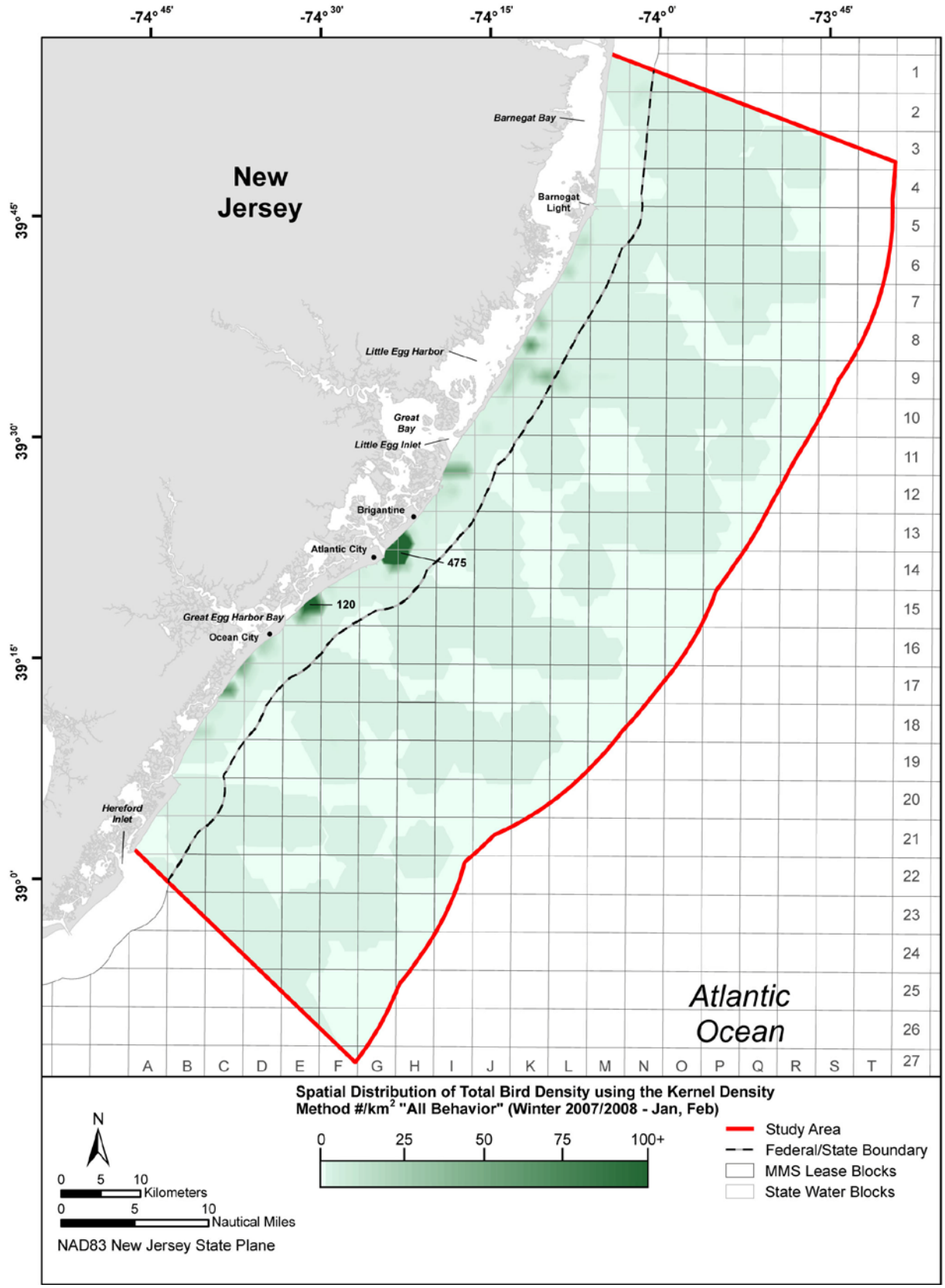

Figure M-394. Spatial distribution of total bird density (#/km^2) in the Study Area for all behaviors using the kernel density method (Winter 2008).

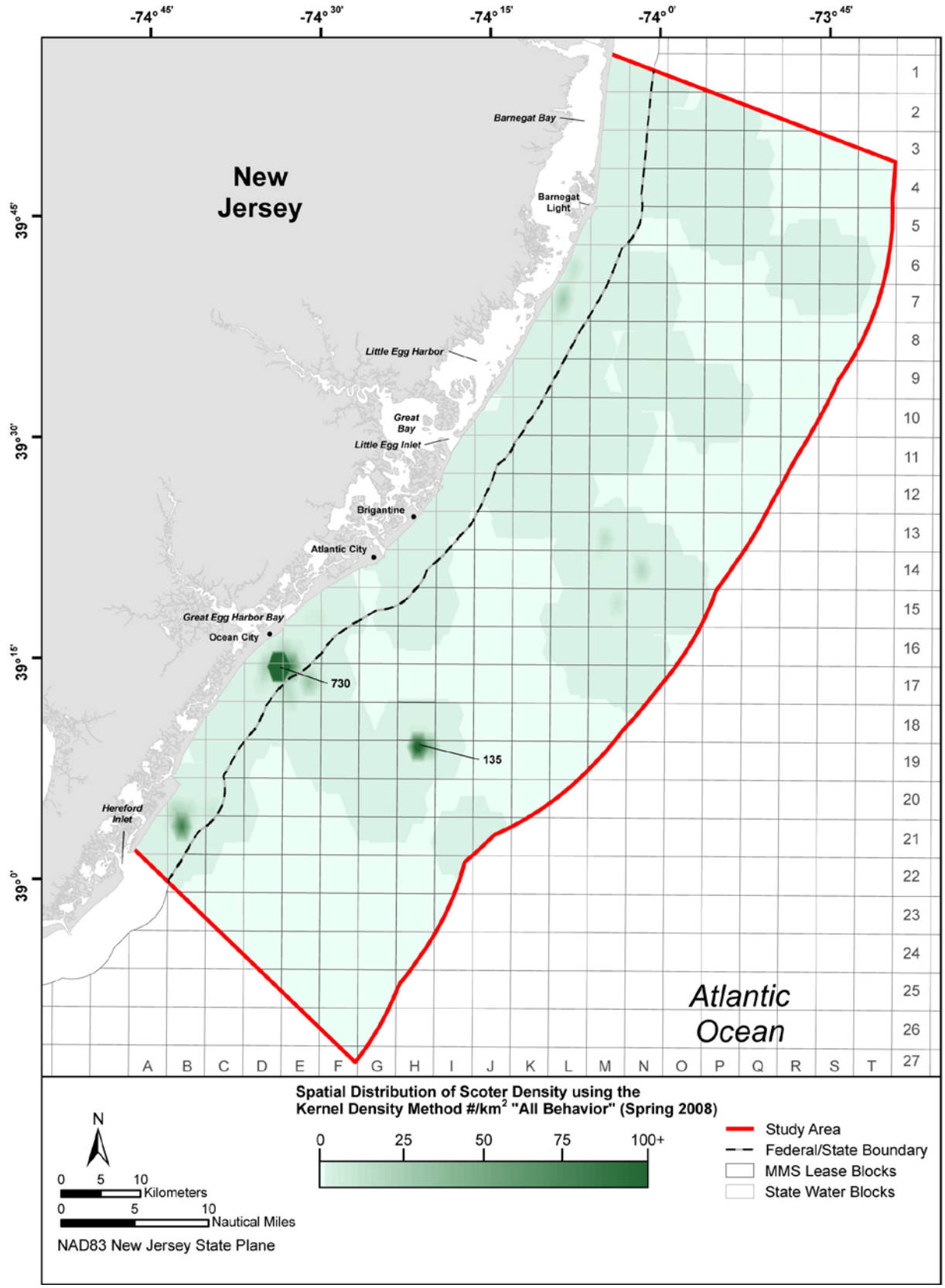

Figure M-395. Spatial distribution of scoter density (#/km^2) in the Study Area for all behaviors using the kernel density method (Spring 2008).

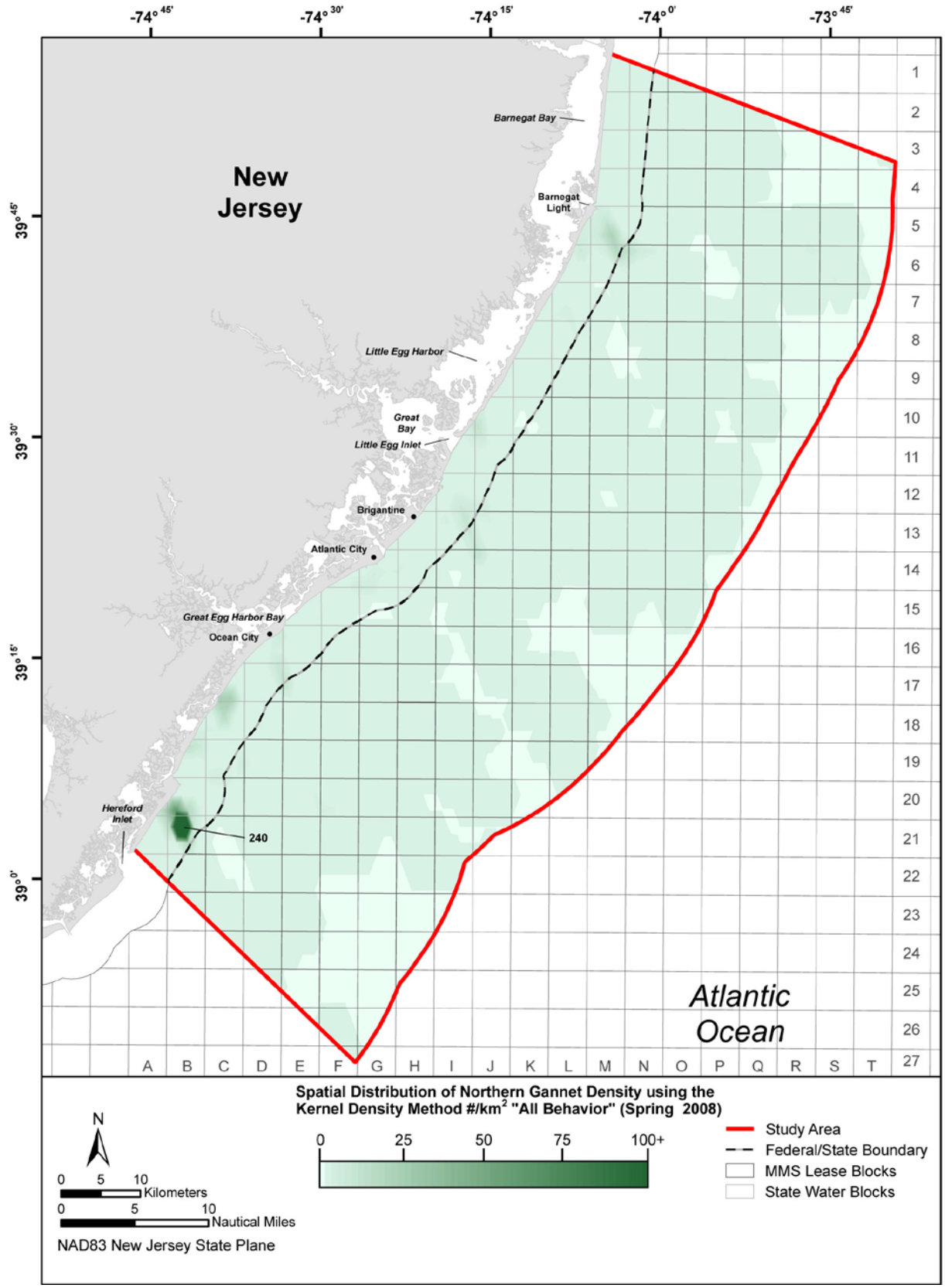

Figure M-396. Spatial distribution of Northern Gannet density (#/km^2) in the Study Area for all behaviors using the kernel density method (Spring 2008).

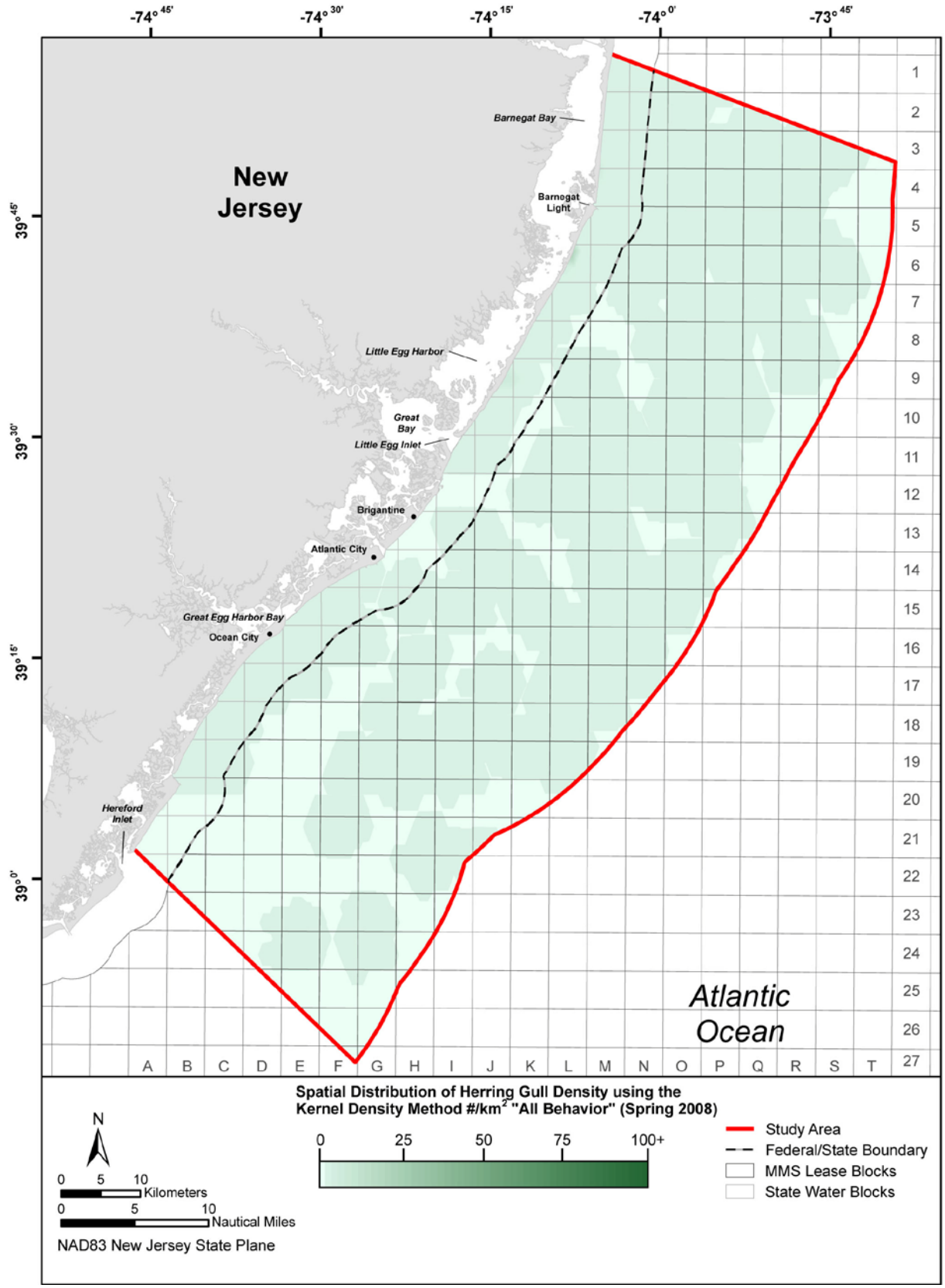

Figure M-397. Spatial distribution of Herring Gull density (#/km^2) in the Study Area for all behaviors using the kernel density method (Spring 2008).

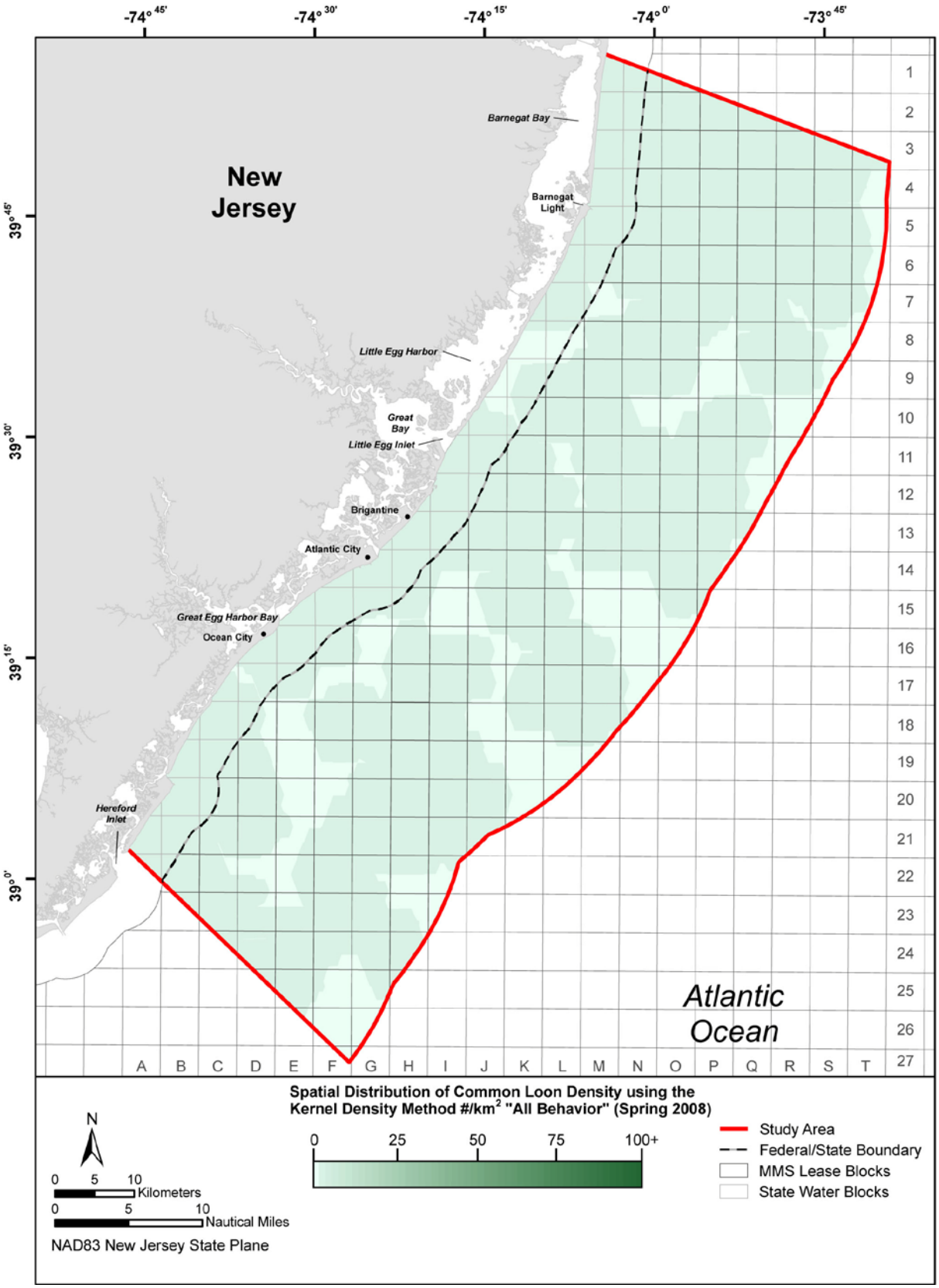

Figure M-398. Spatial distribution of Common Loon density (#/km^2) in the Study Area for all behaviors using the kernel density method (Spring 2008).

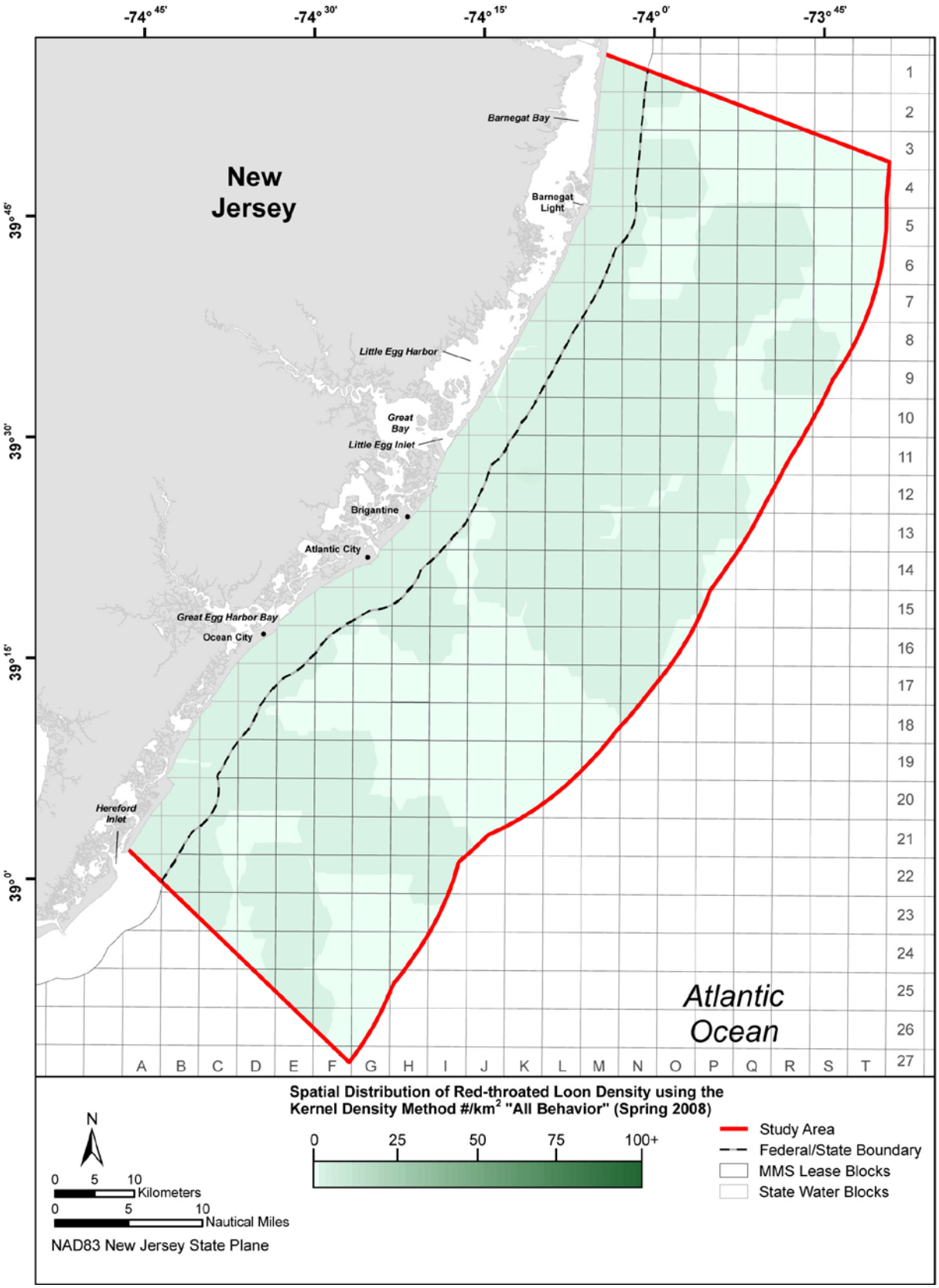

Figure M-399. Spatial distribution of Red-throated Loon density (#/km^2) in the Study Area for all behaviors using the kernel density method (Spring 2008).

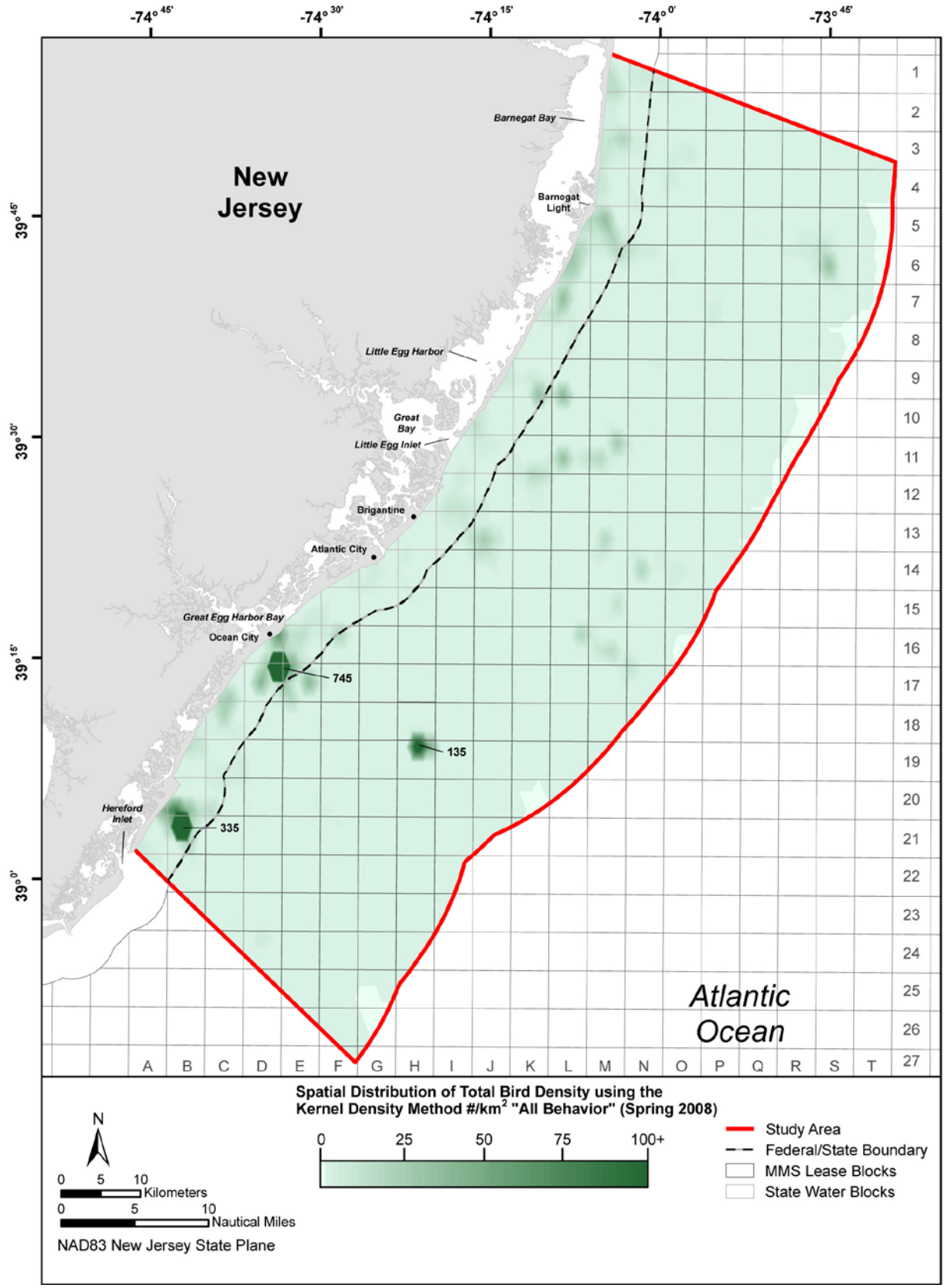

Figure M-400. Spatial distribution of total bird density (#/km^2) in the Study Area for all behaviors using the kernel density method (Spring 2008).

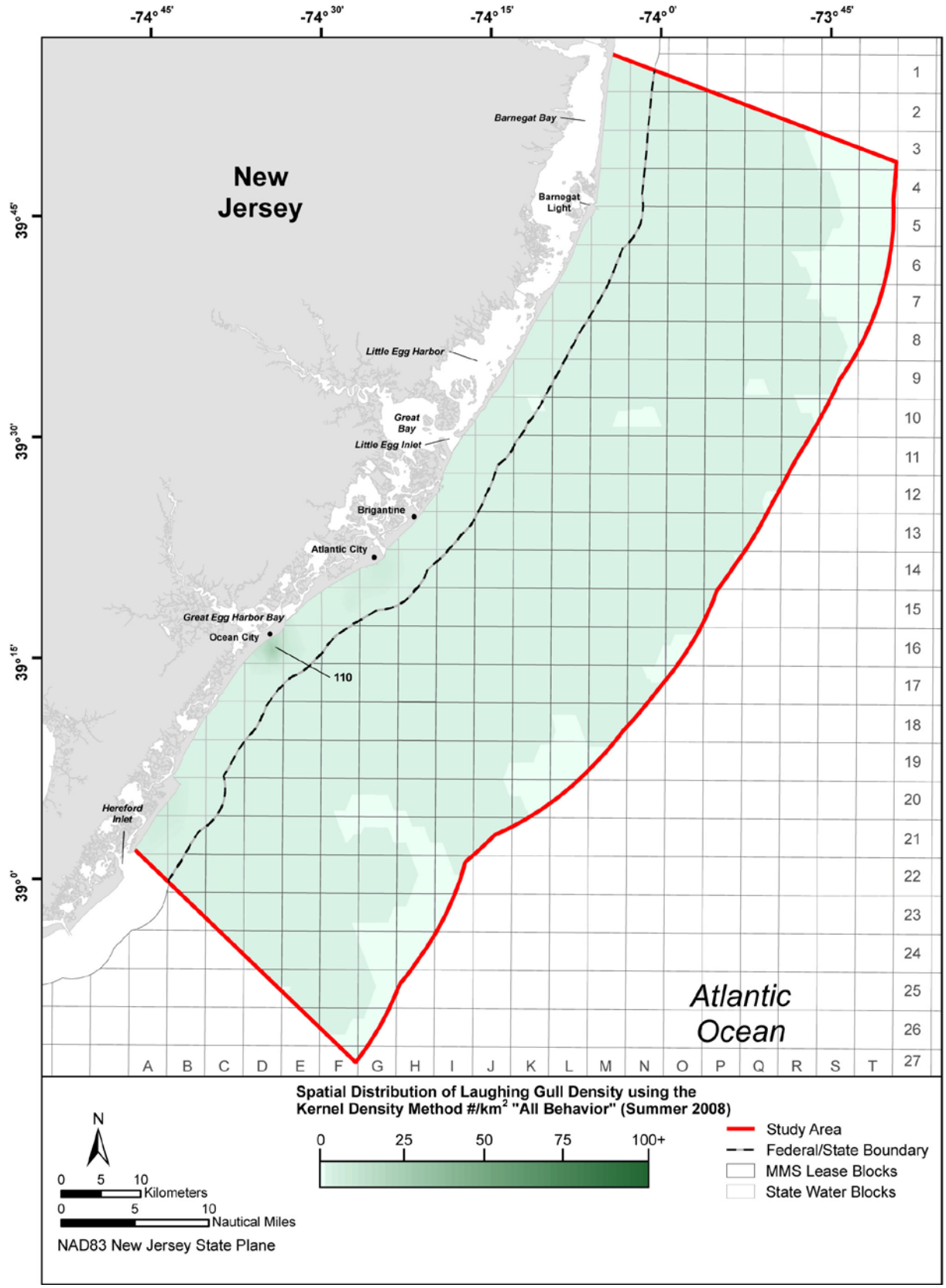

Figure M-401. Spatial distribution of Laughing Gull density (#/km^2) in the Study Area for all behaviors using the kernel density method (Summer 2008).

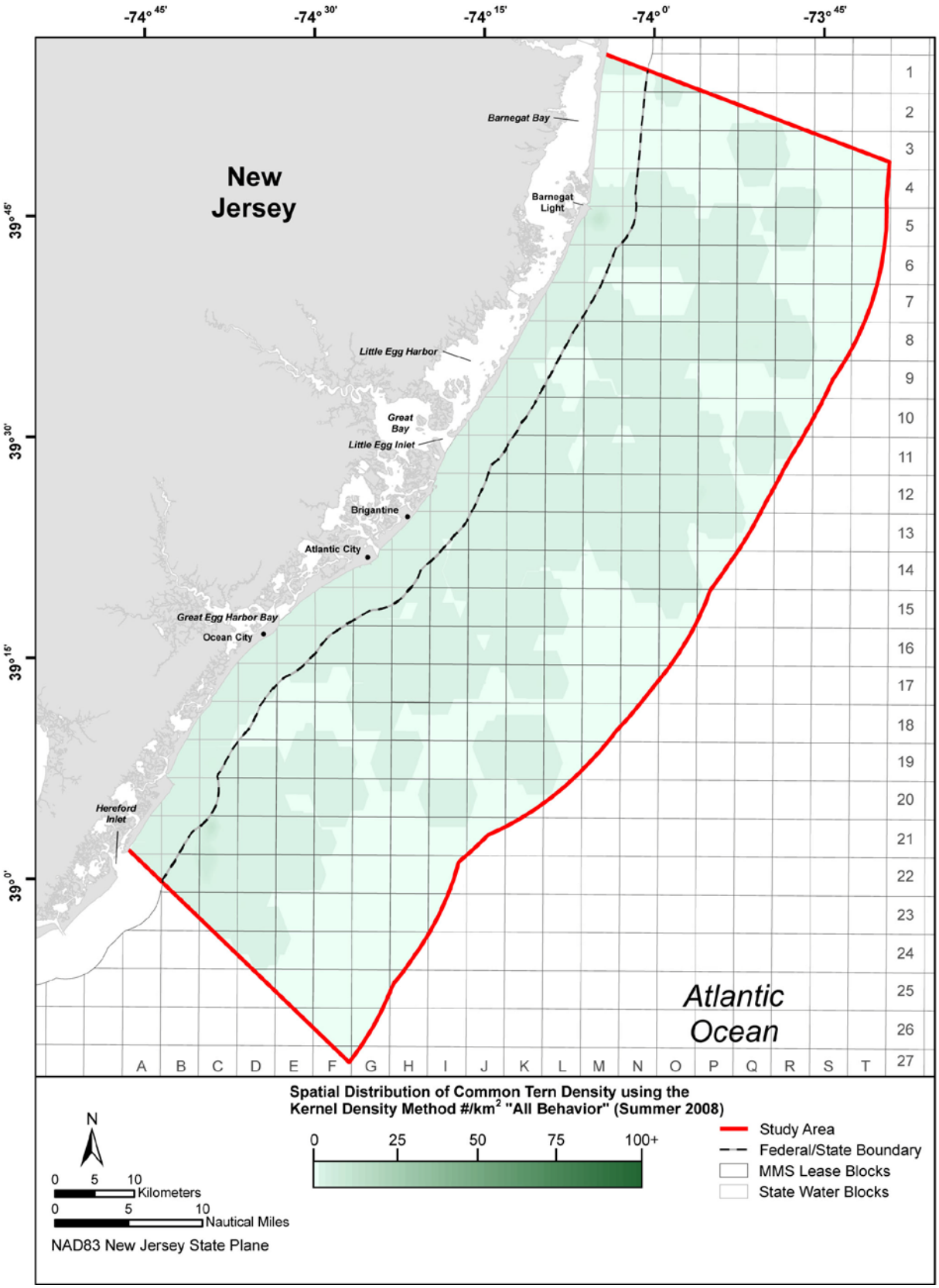

Figure M-402. Spatial distribution of Common Tern density (#/km^2) in the Study Area for all behaviors using the kernel density method (Summer 2008).

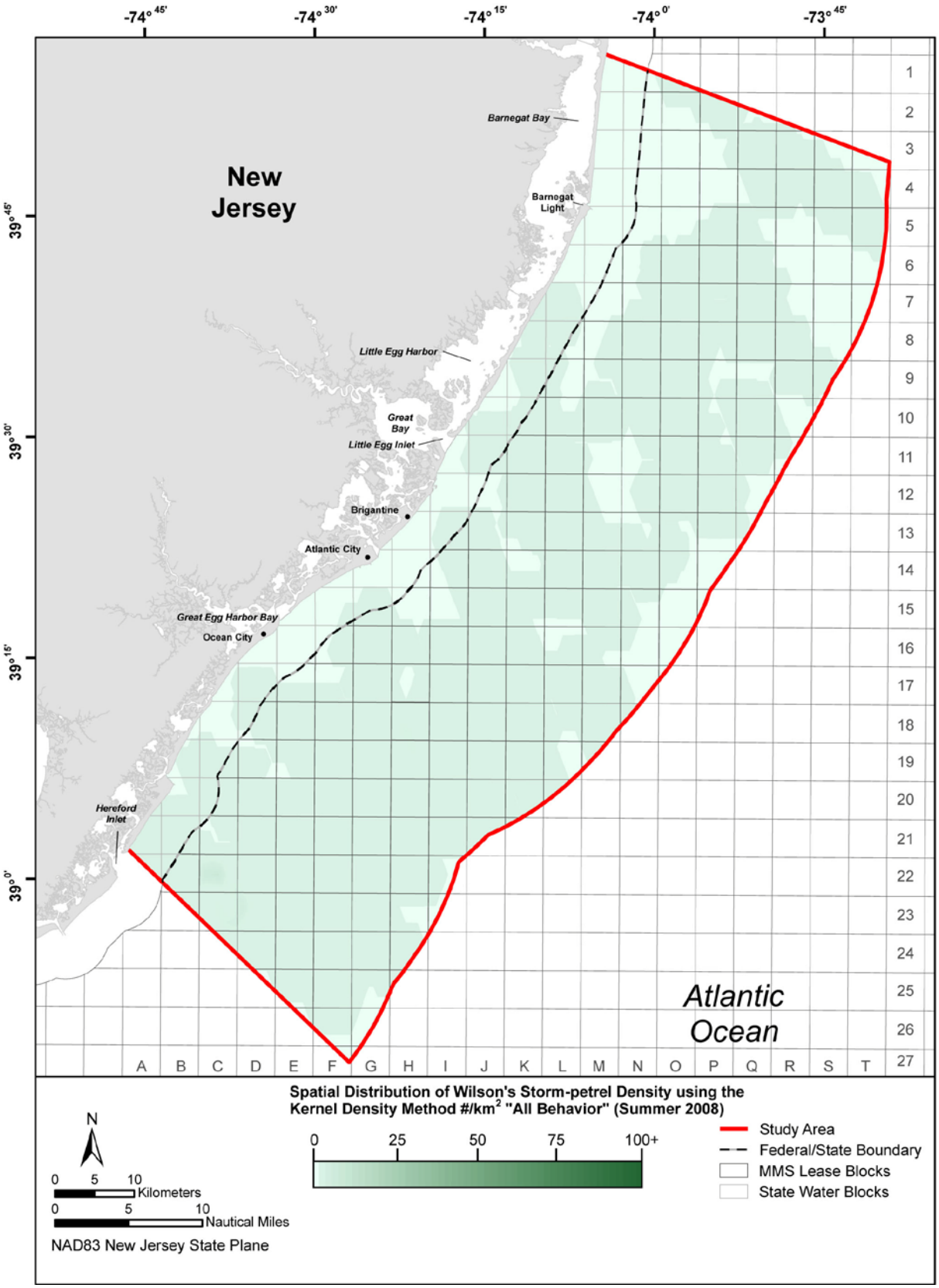

Figure M-403. Spatial distribution of Wilson's Storm-Petrel density (#/km^2) in the Study Area for all behaviors using the kernel density method (Summer 2008).

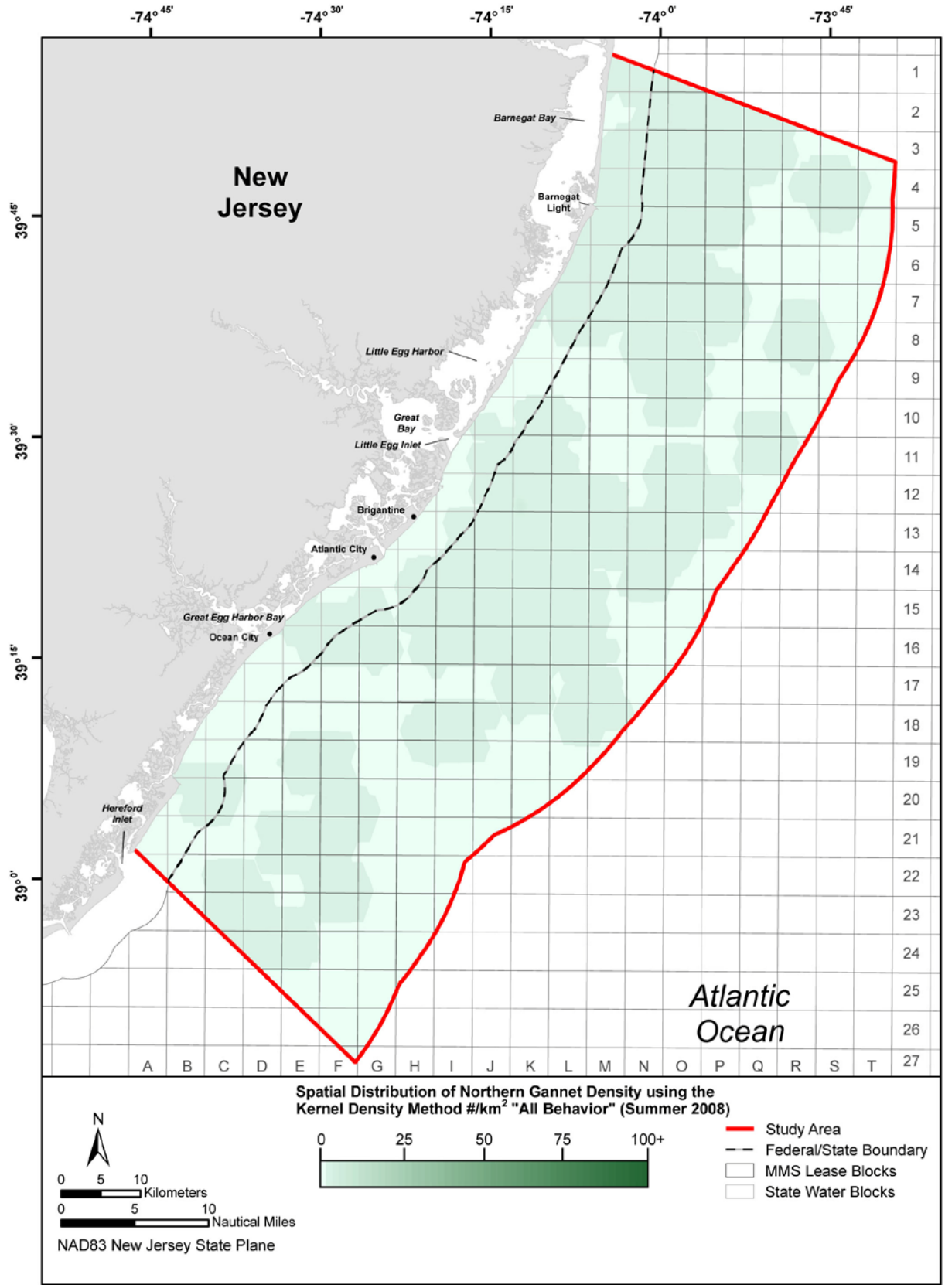

Figure M-404. Spatial distribution of Northern Gannet density (#/km^2) in the Study Area for all behaviors using the kernel density method (Summer 2008).

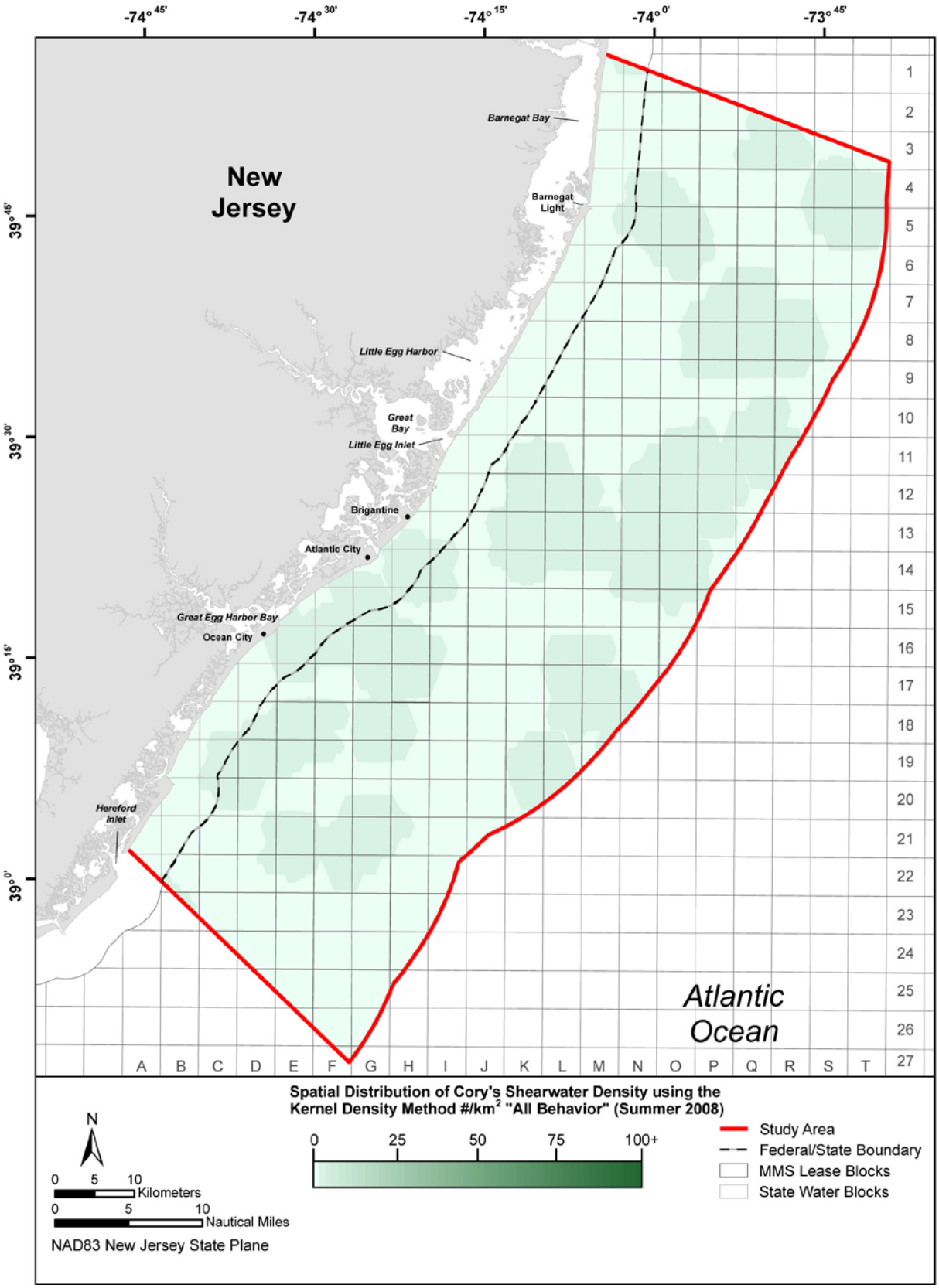

Figure M-405. Spatial distribution of Cory's Shearwater density (#/km^2) in the Study Area for all behaviors using the kernel density method (Summer 2008).

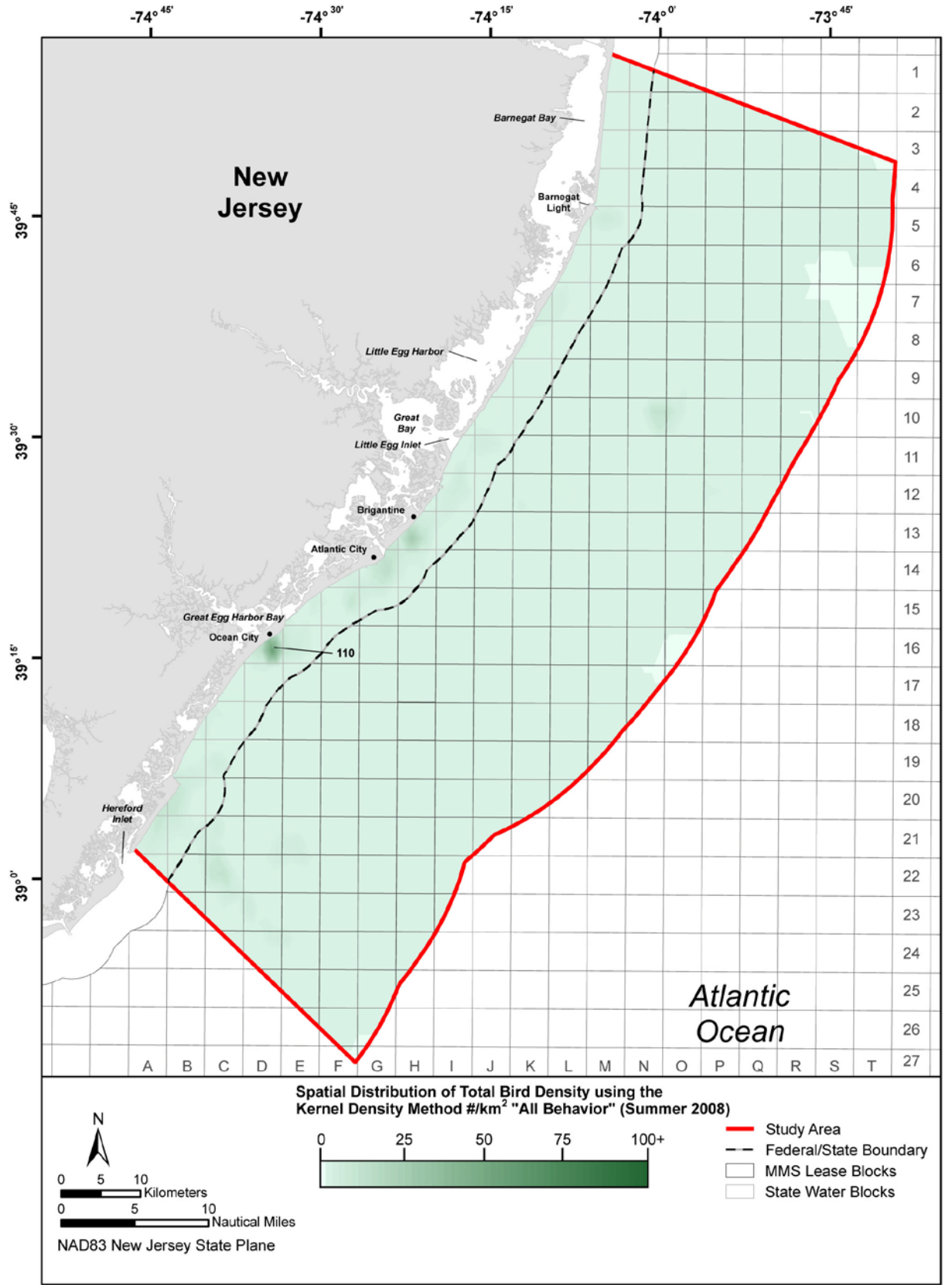

Figure M-406. Spatial distribution of total bird density (#/km^2) in the Study Area for all behaviors using the kernel density method (Summer 2008).

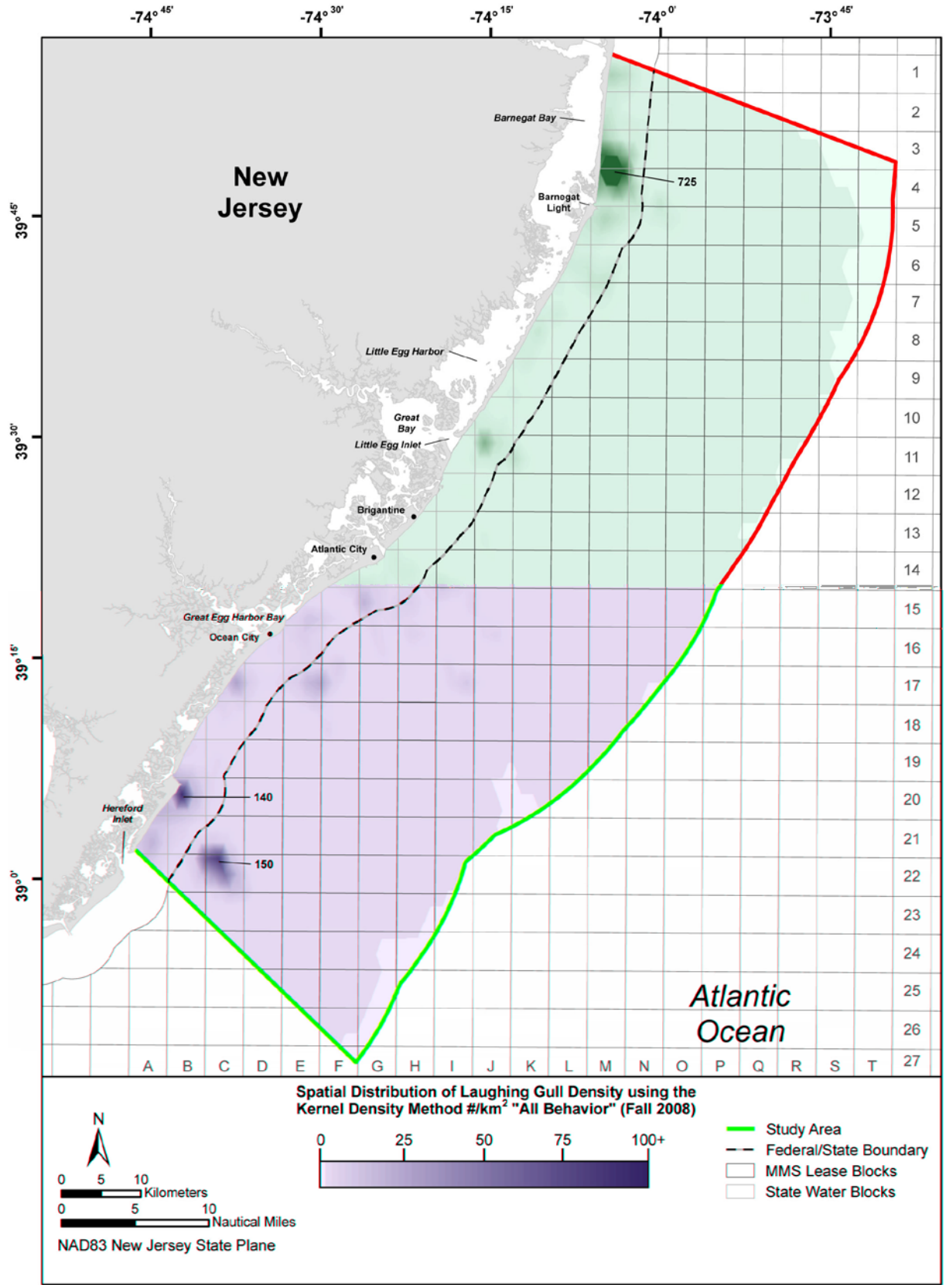

Figure M-407. Spatial distribution of Laughing Gull density (#/km^2) in the Study Area for all behaviors using the kernel density method (Fall 2008).

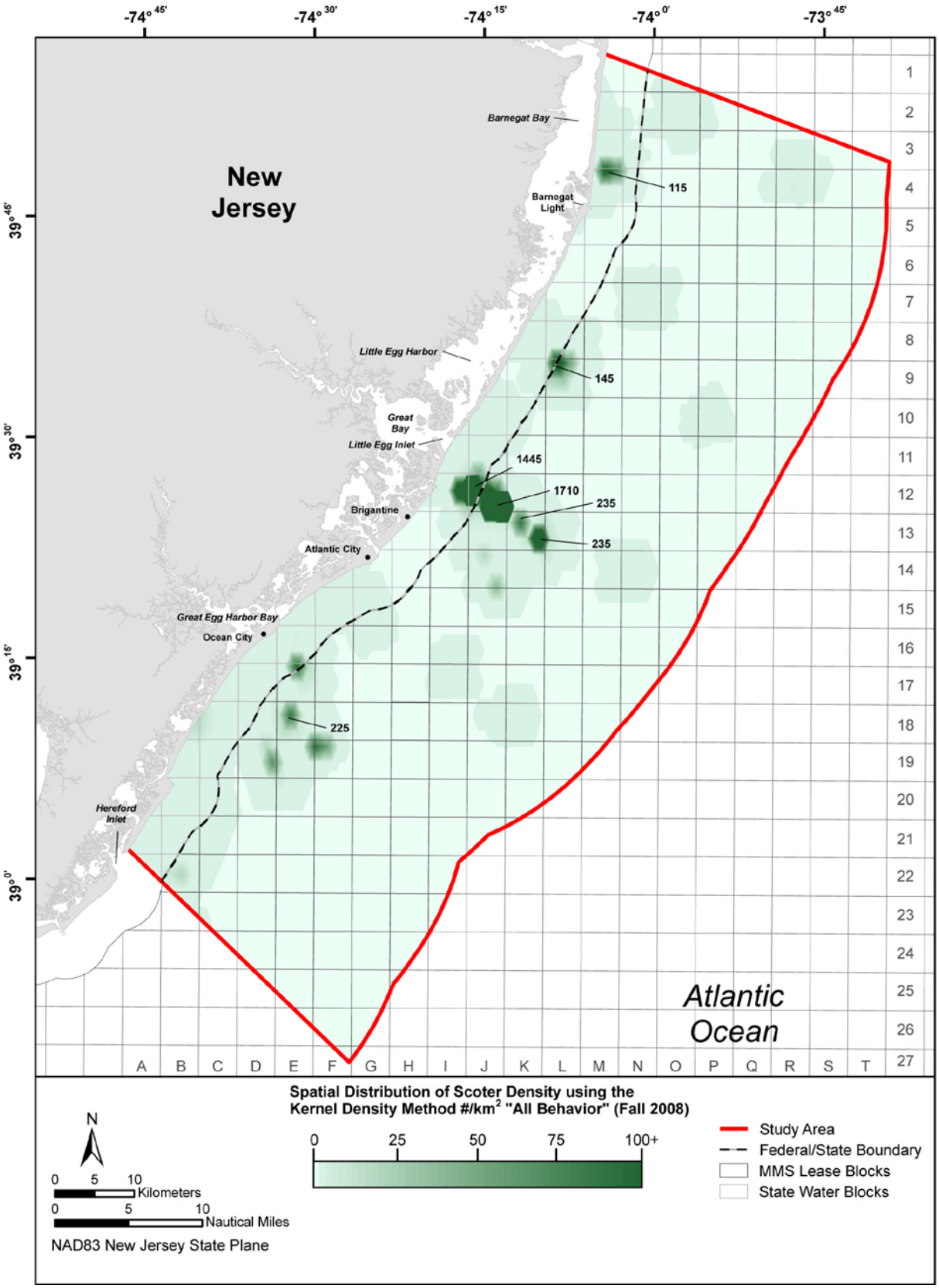

Figure M-408. Spatial distribution of scoter density (#/km^2) in the Study Area for all behaviors using the kernel density method (Fall 2008).

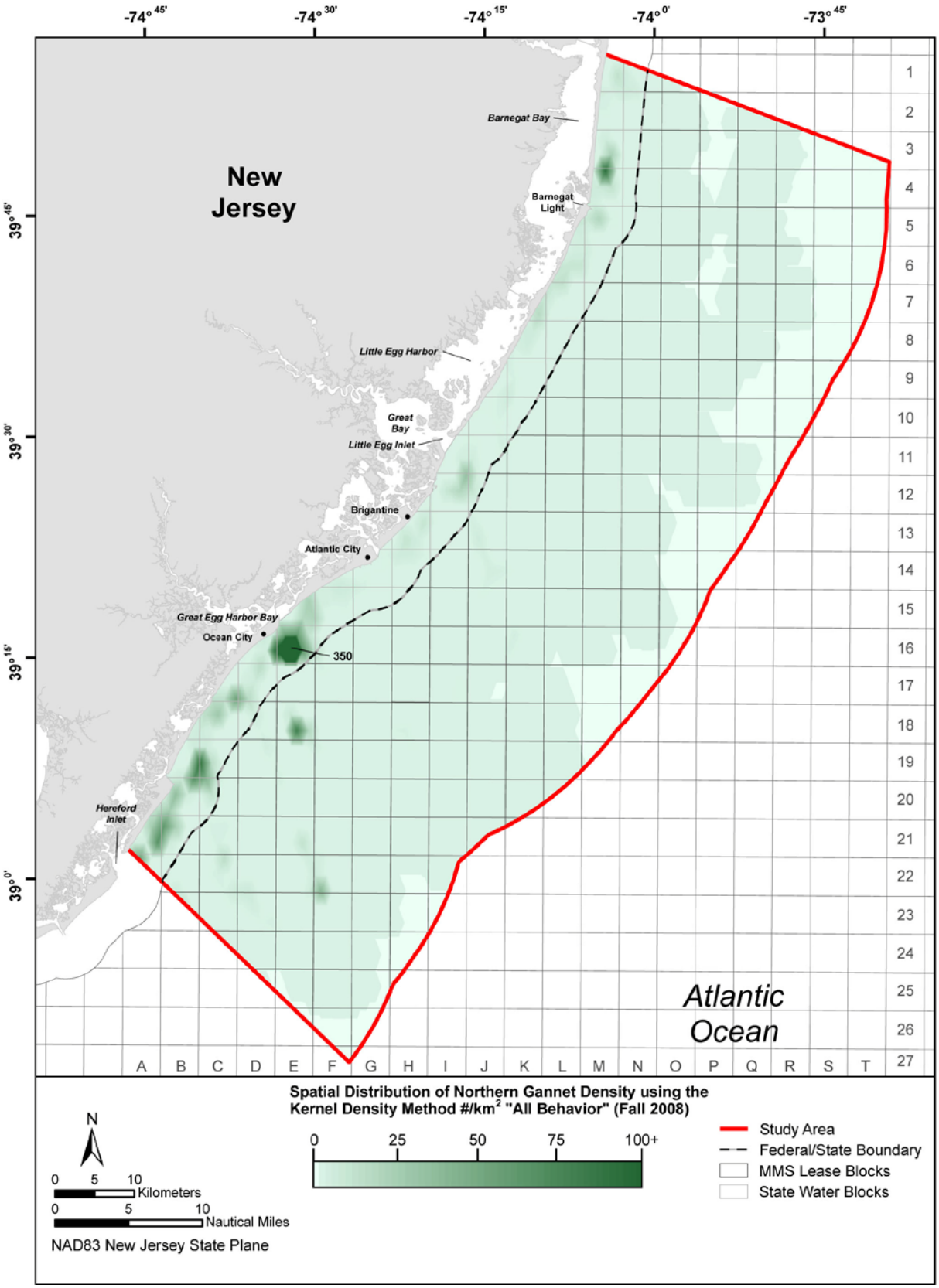

Figure M-409. Spatial distribution of Northern Gannet density (#/km^2) in the Study Area for all behaviors using the kernel density method (Fall 2008).

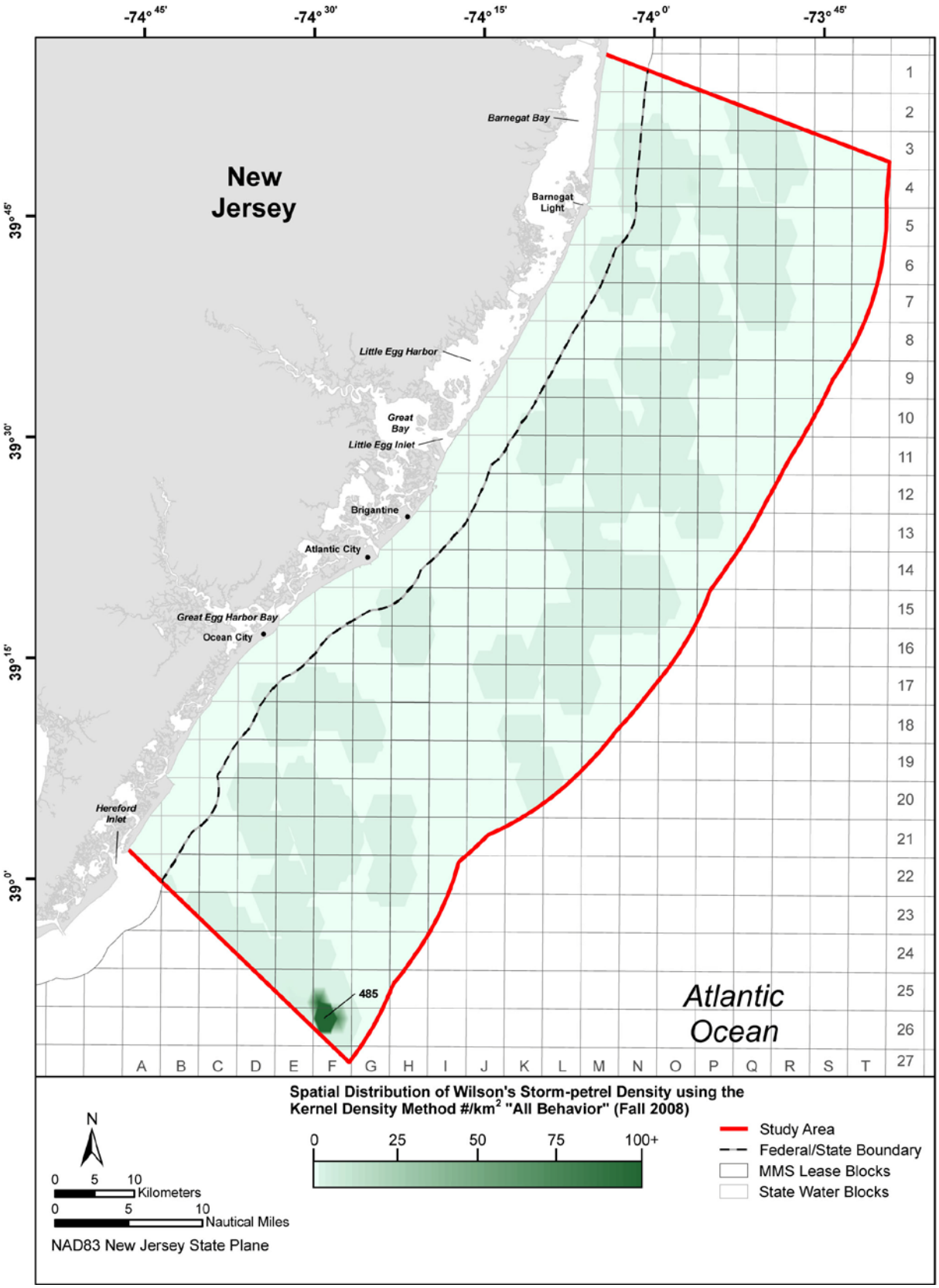

Figure M-410. Spatial distribution of Wilson's Storm-Petrel density (#/km^2) in the Study Area for all behaviors using the kernel density method (Fall 2008).

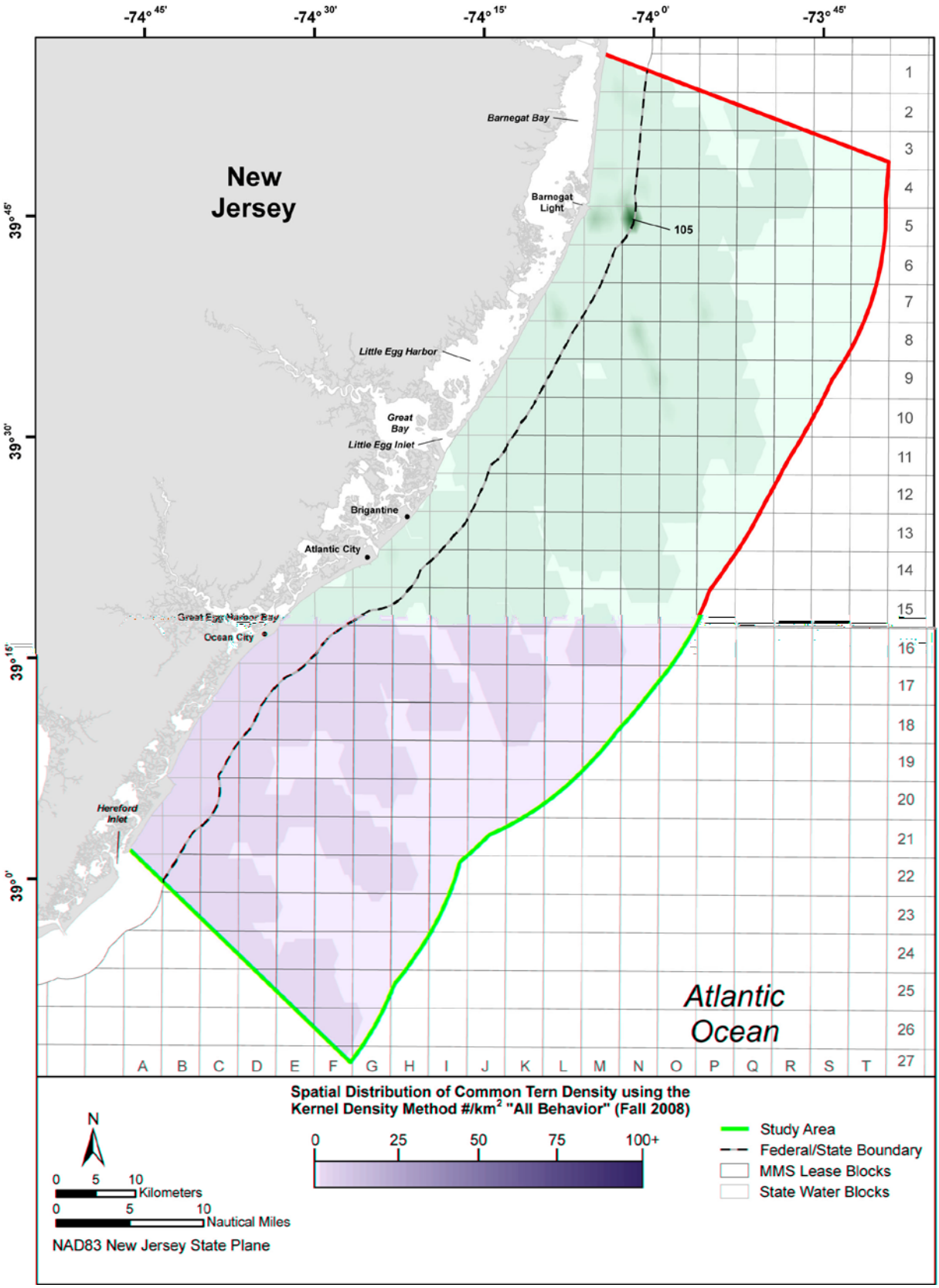

Figure M-411. Spatial distribution of Common Tern density (#/km^2) in the Study Area for all behaviors using the kernel density method (Fall 2008).

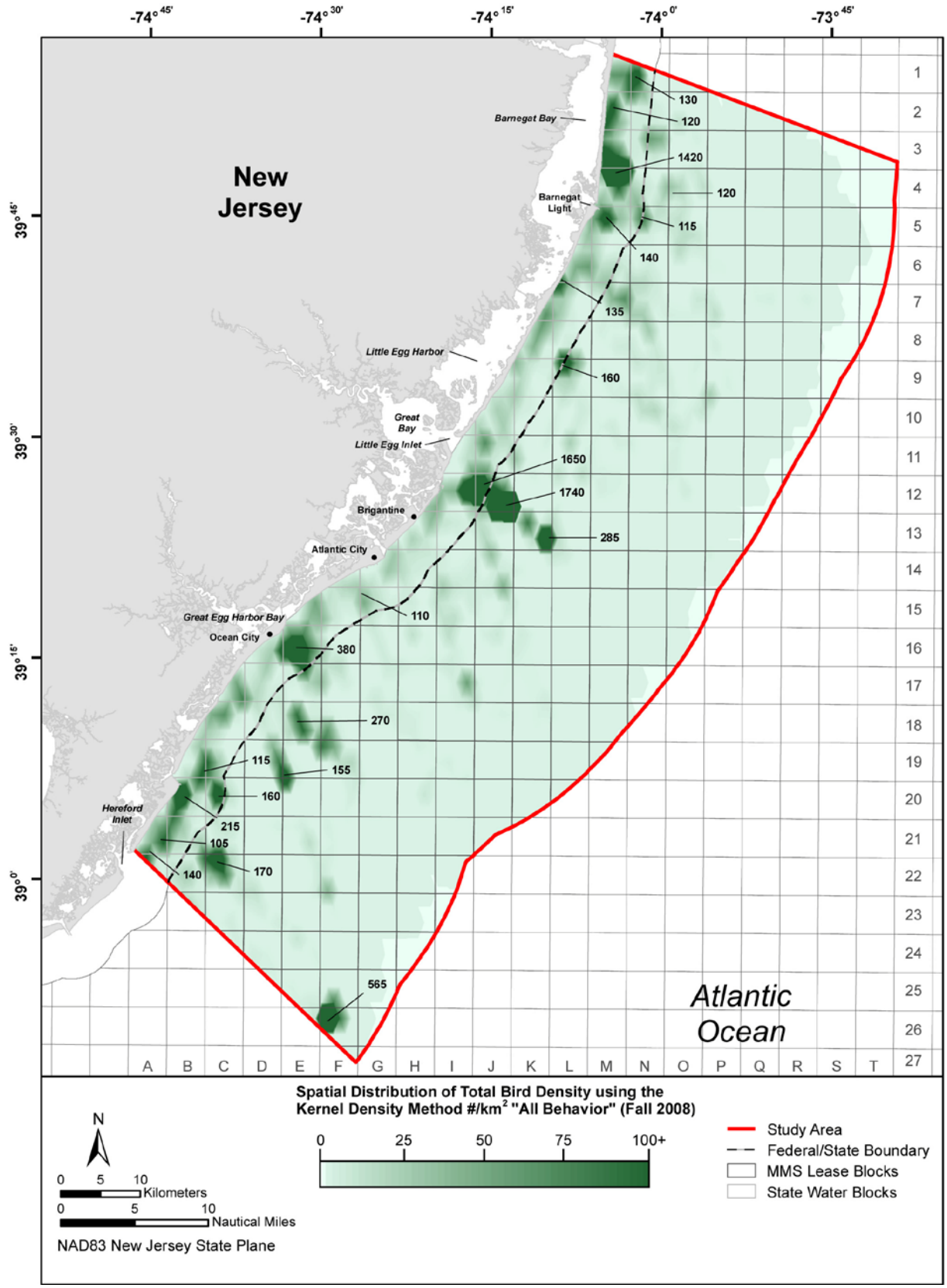

Figure M-412. Spatial distribution of total bird density (#/km^2) in the Study Area for all behaviors using the kernel density method (Fall 2008).

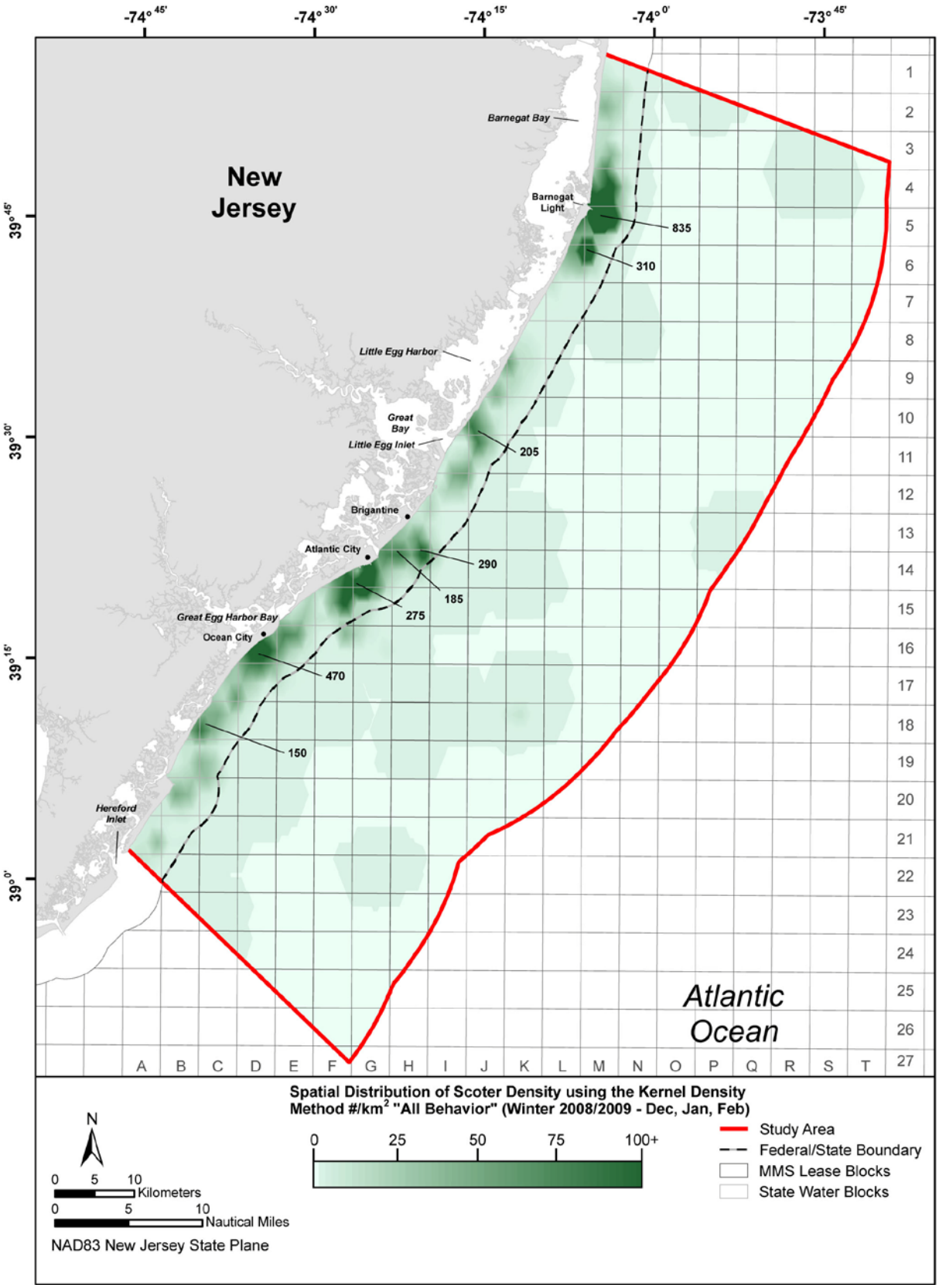

Figure M-413. Spatial distribution of scoter density (#/km^2) in the Study Area for all behaviors using the kernel density method (Winter 2008/2009).

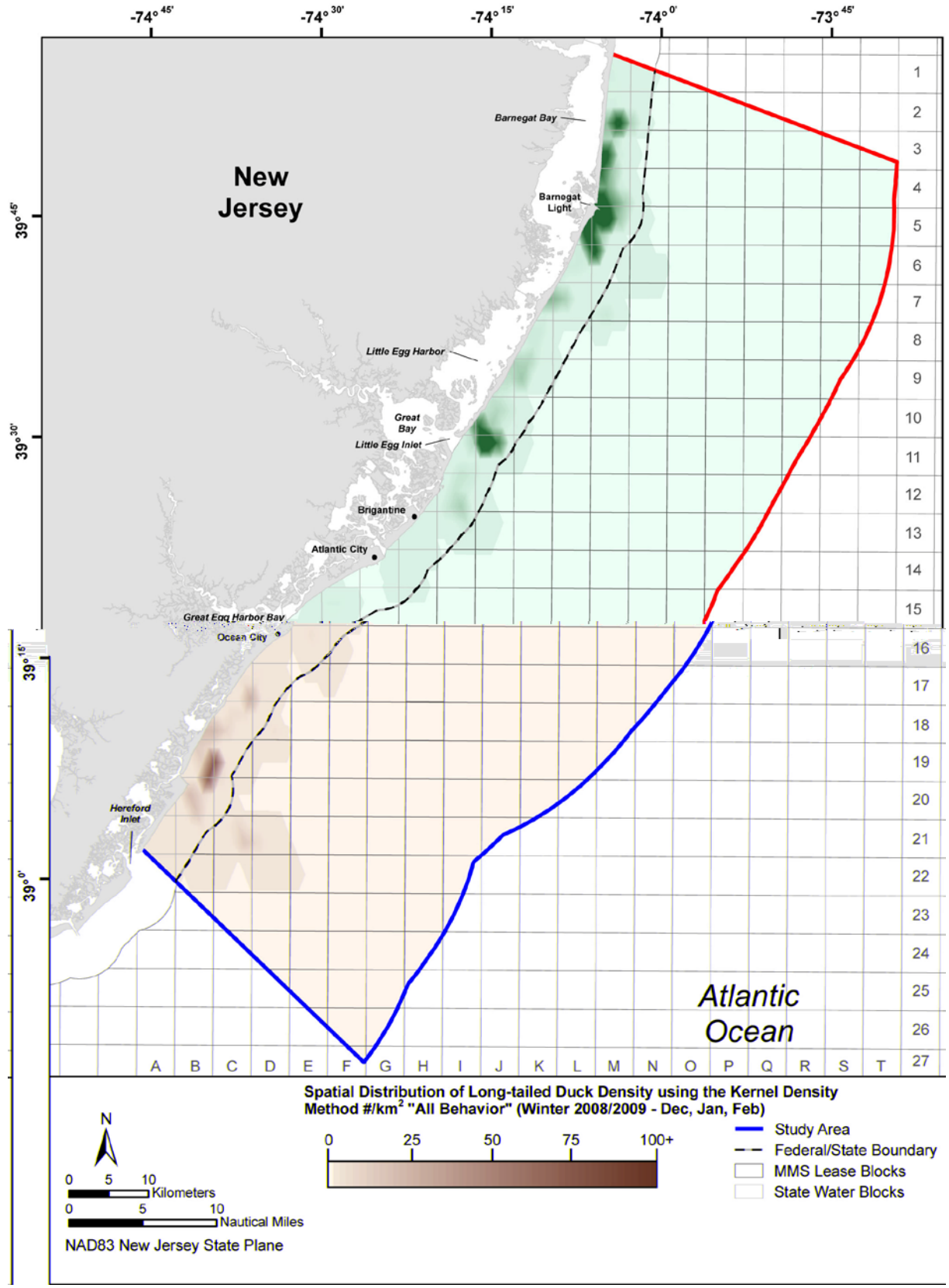

Figure M-414. Spatial distribution of Long-tailed Duck density (#/km^2) in the Study Area for all behaviors using the kernel density method (Winter 2008/2009).

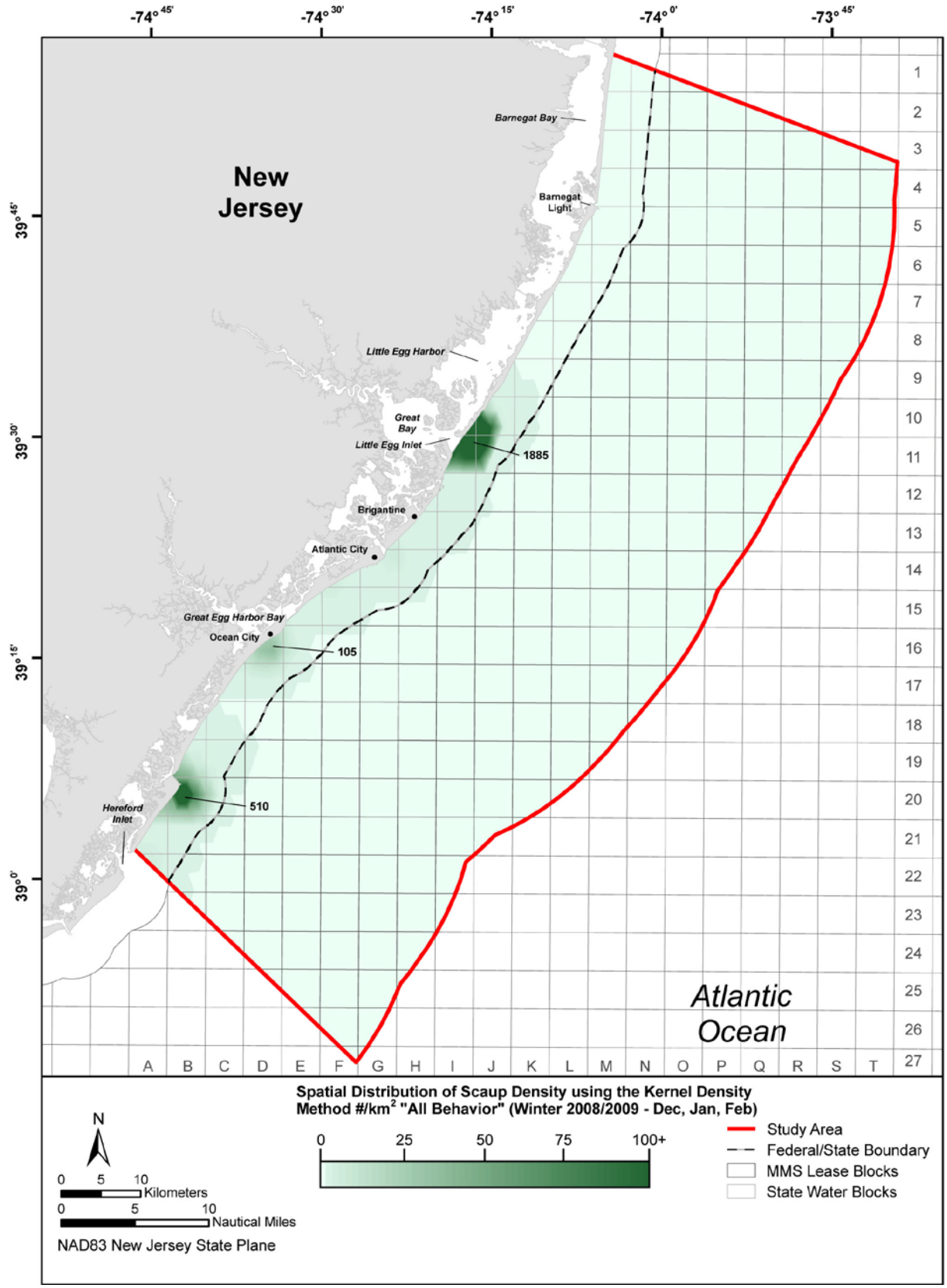

Figure M-415. Spatial distribution of scaup density (#/km^2) in the Study Area for all behaviors using the kernel density method (Winter 2008/2009).

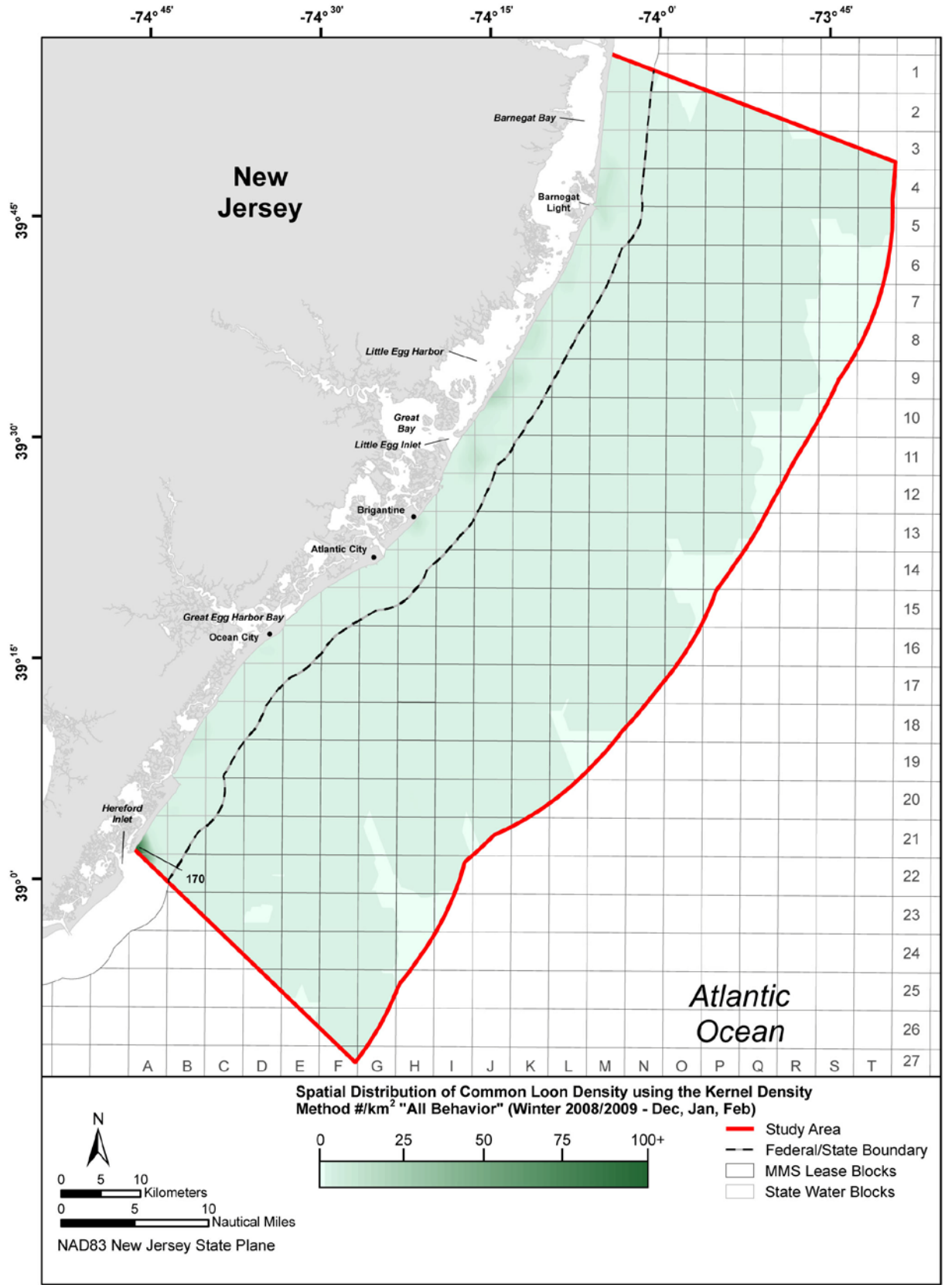

Figure M-416. Spatial distribution of Common Loon density (#/km^2) in the Study Area for all behaviors using the kernel density method (Winter 2008/2009).

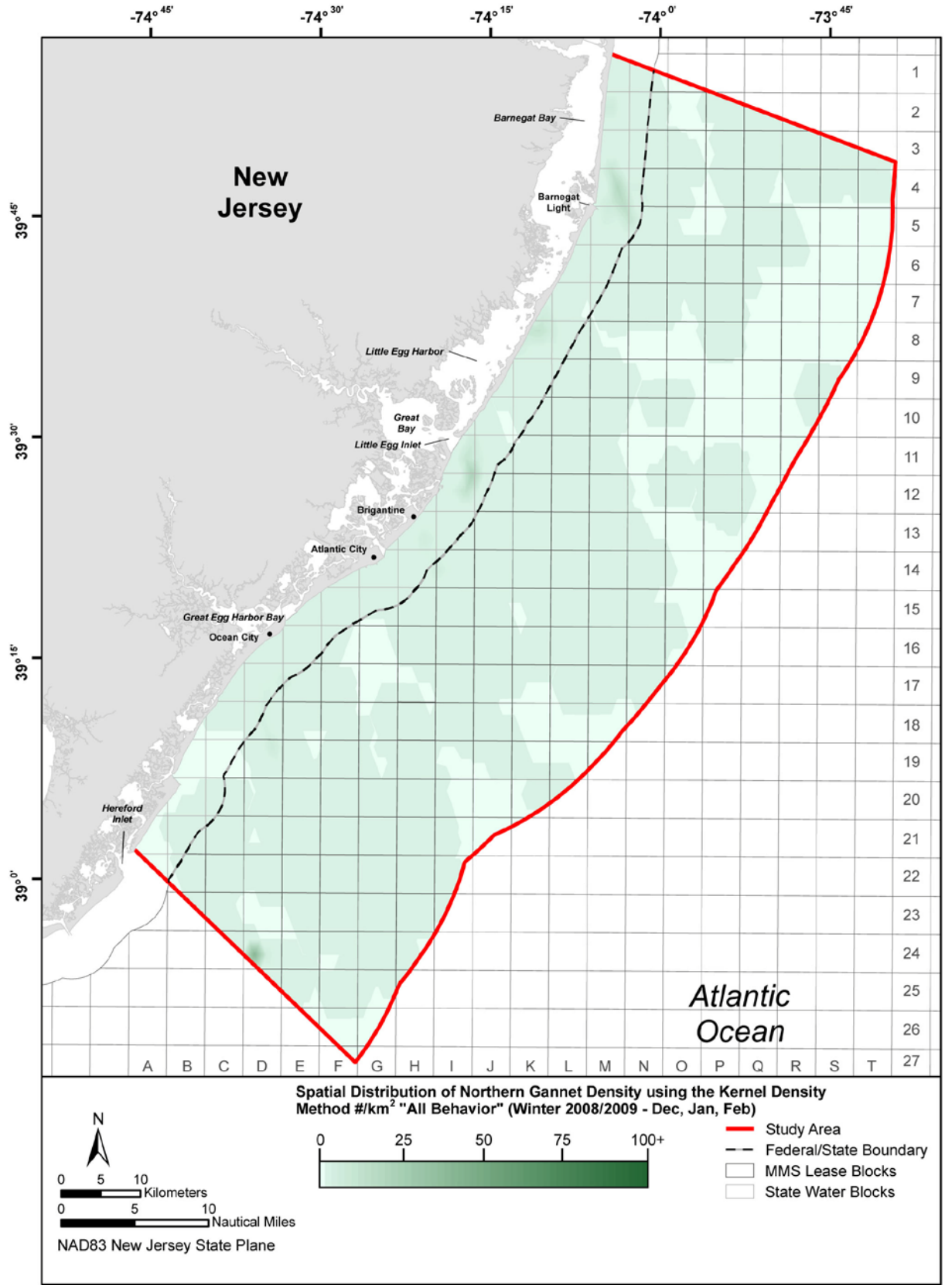

Figure M-417. Spatial distribution of Northern Gannet density (#/km^2) in the Study Area for all behaviors using the kernel density method (Winter 2008/2009).

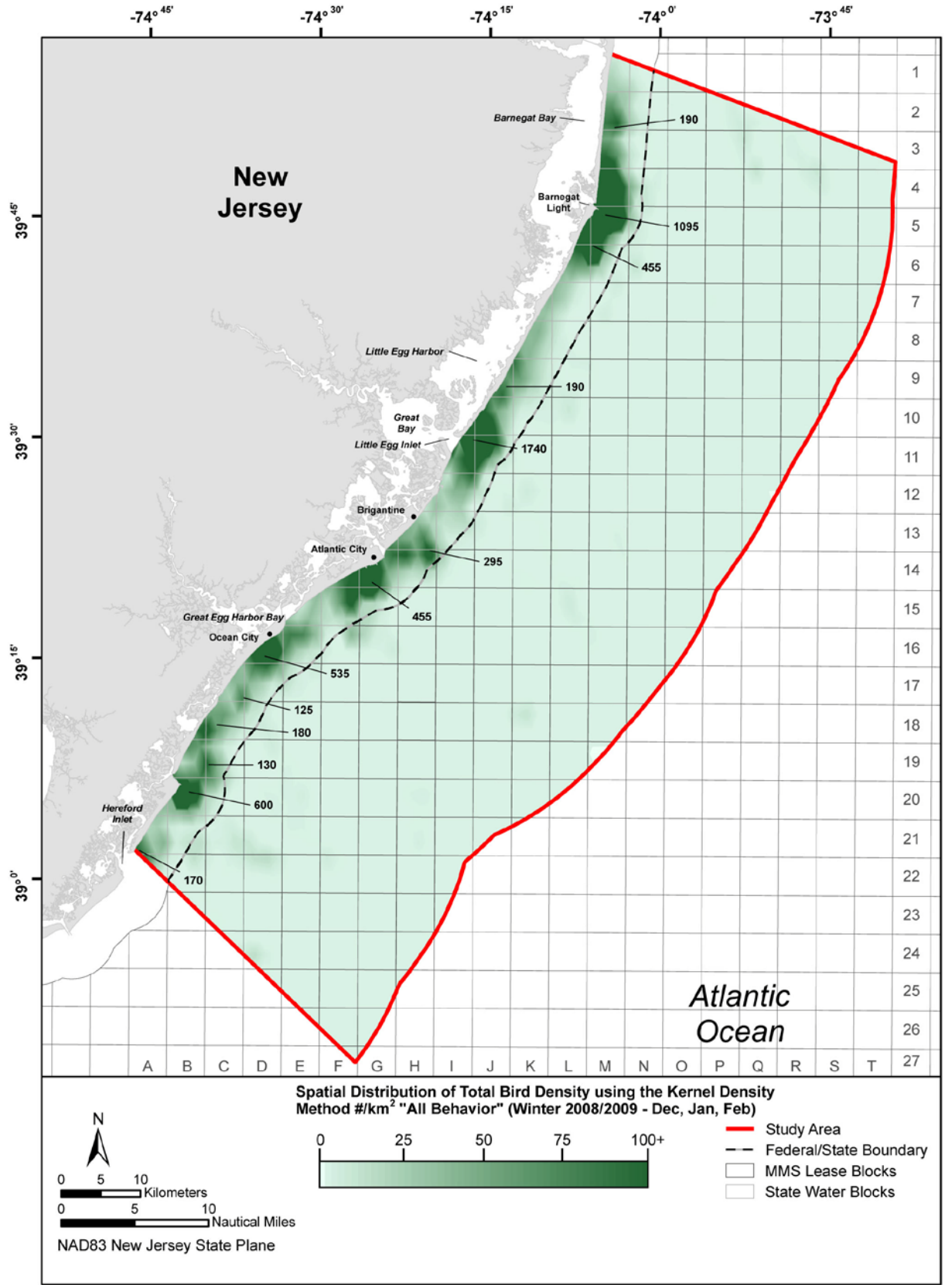

Figure M-418. Spatial distribution of total bird density (#/km^2) in the Study Area for all behaviors using the kernel density method (Winter 2008/2009).

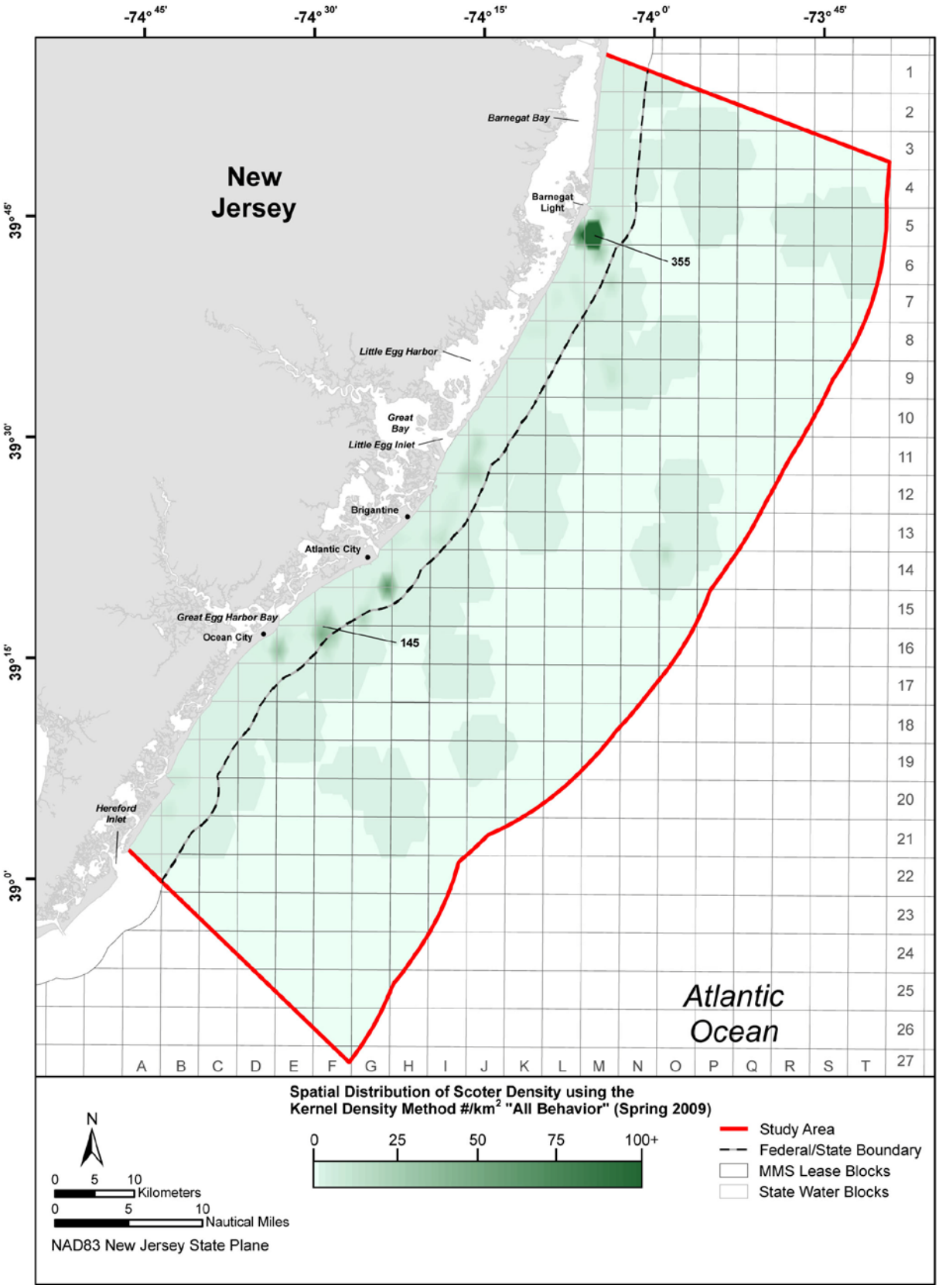

Figure M-419. Spatial distribution of scoter density (#/km^2) in the Study Area for all behaviors using the kernel density method (Spring 2009).

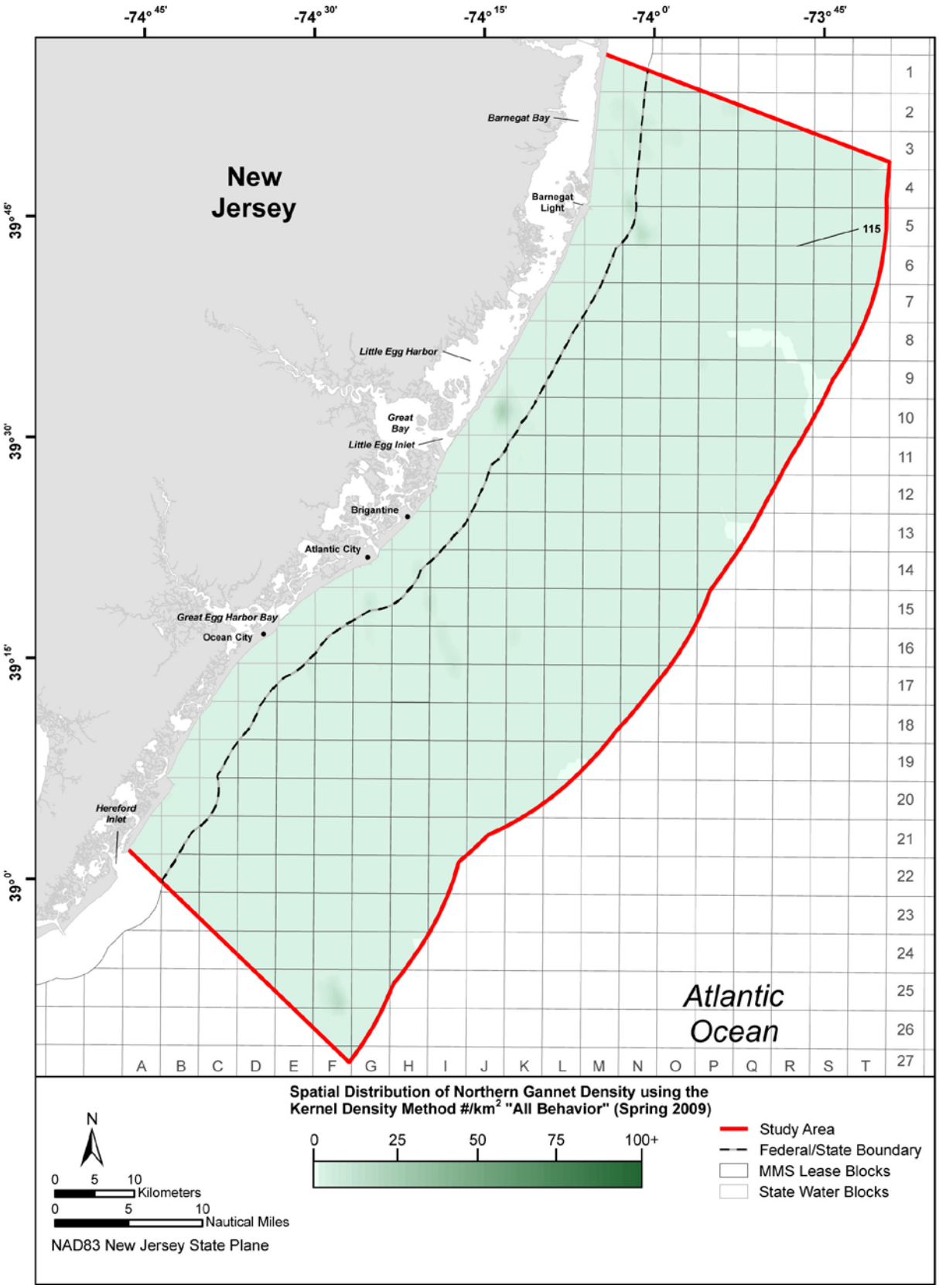

Figure M-420. Spatial distribution of Northern Gannet density (#/km^2) in the Study Area for all behaviors using the kernel density method (Spring 2009).

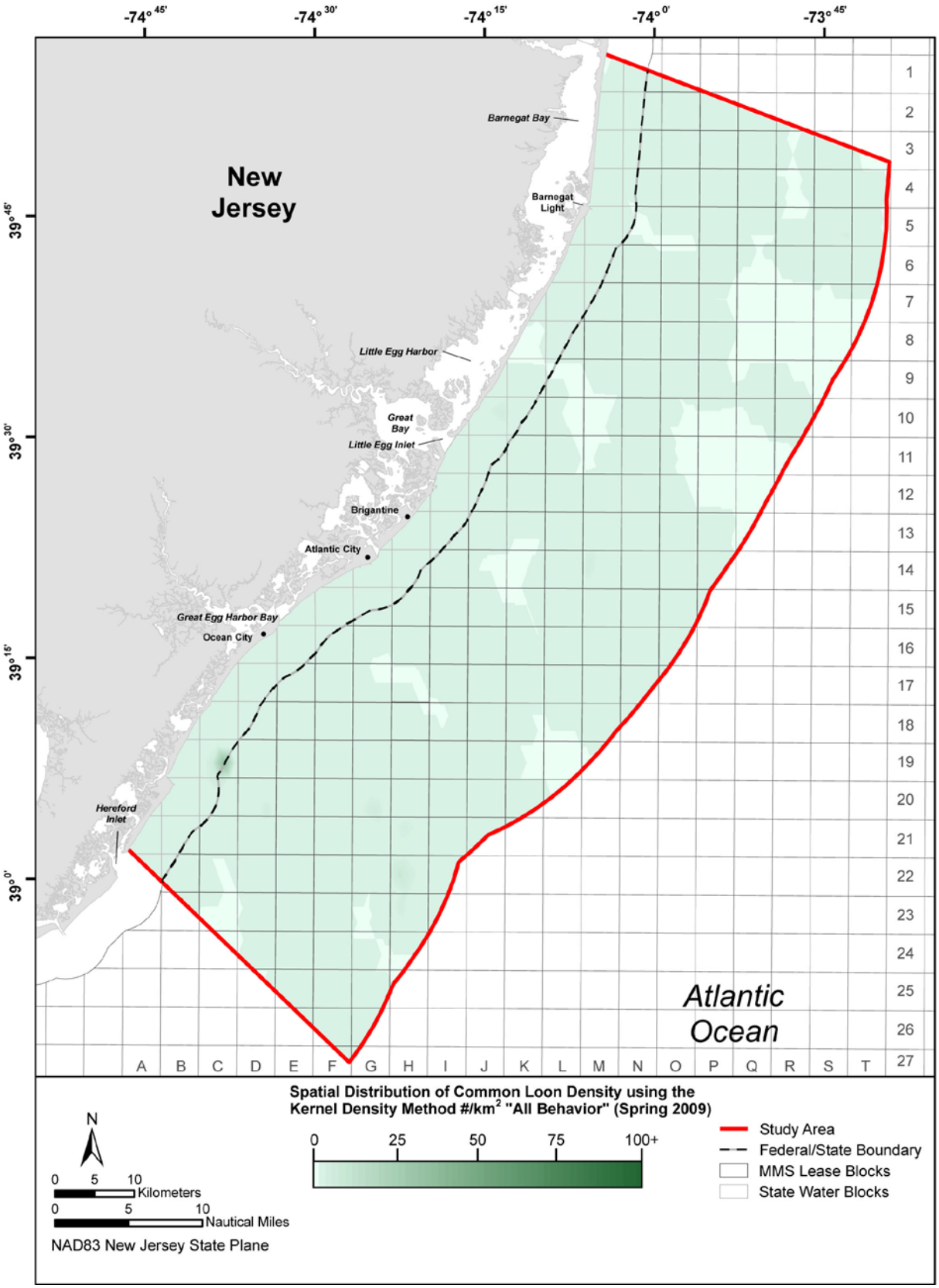

Figure M-421. Spatial distribution of Common Loon density (#/km^2) in the Study Area for all behaviors using the kernel density method (Spring 2009).

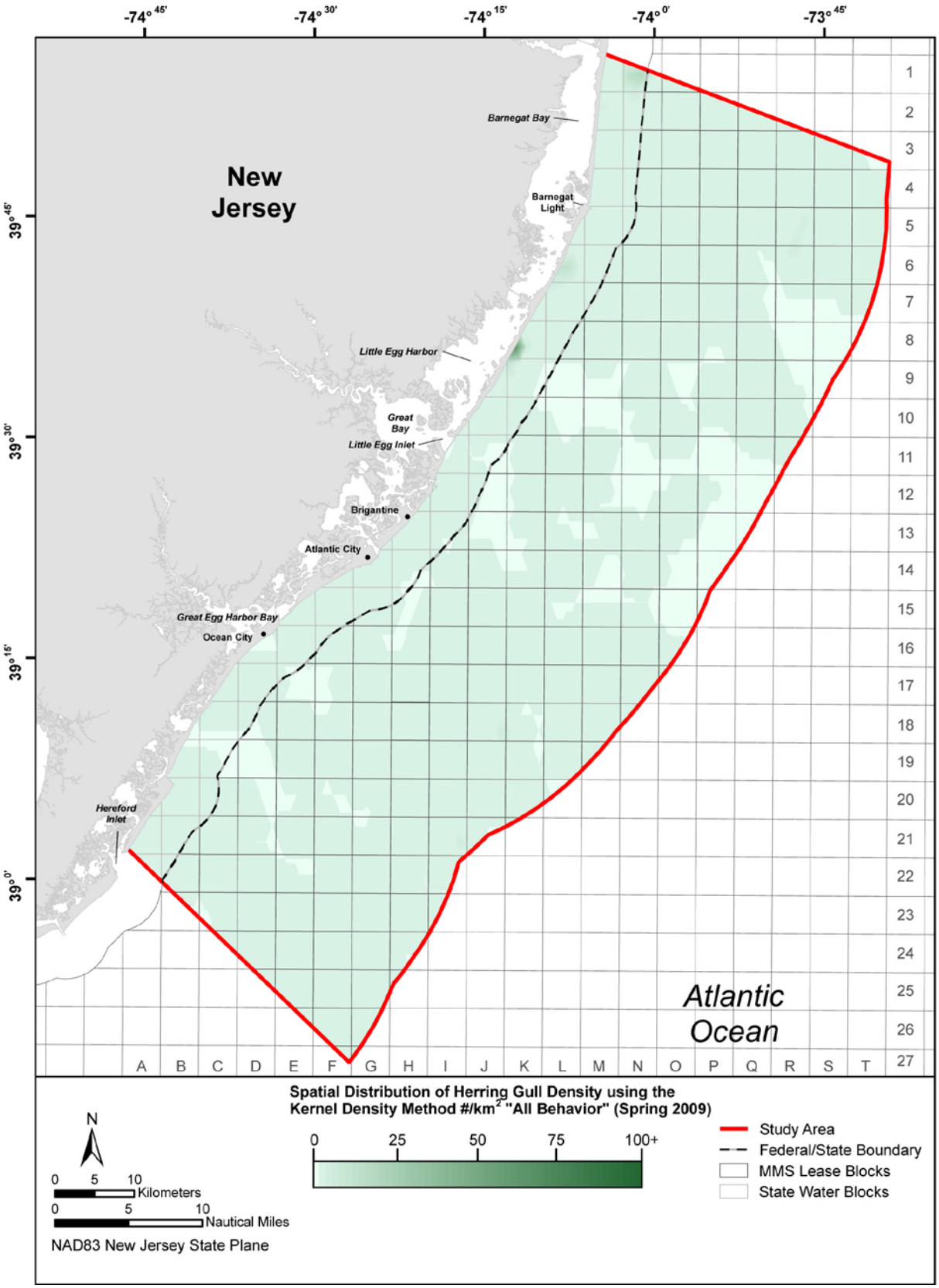

Figure M-422. Spatial distribution of Herring Gull density (#/km^2) in the Study Area for all behaviors using the kernel density method (Spring 2009).

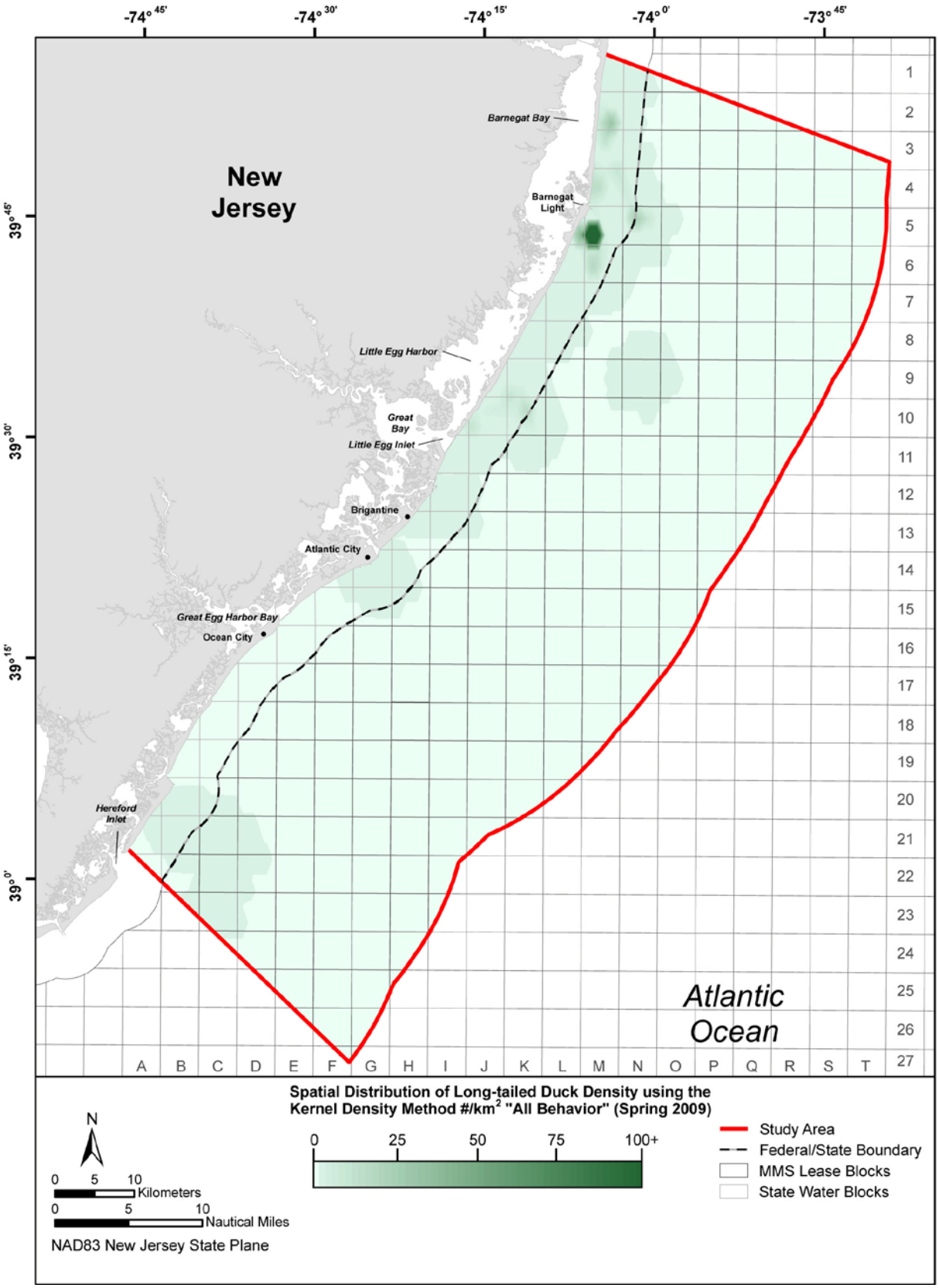

Figure M-423. Spatial distribution of Long-tailed Duck density (#/km^2) in the Study Area for all behaviors using the kernel density method (Spring 2009).

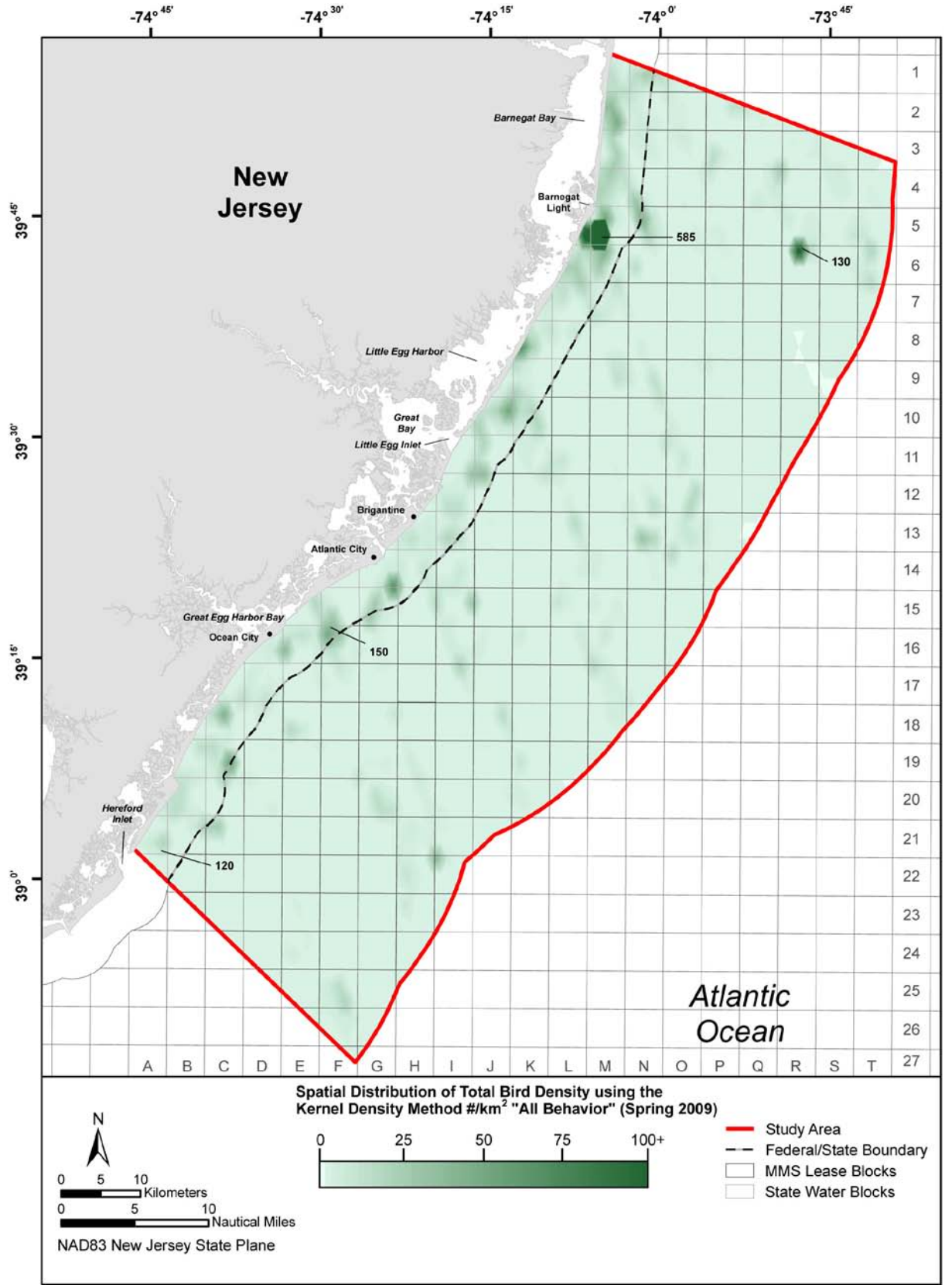

Figure M-424. Spatial distribution of total bird density (#/km^2) in the Study Area for all behaviors using the kernel density method (Spring 2009).

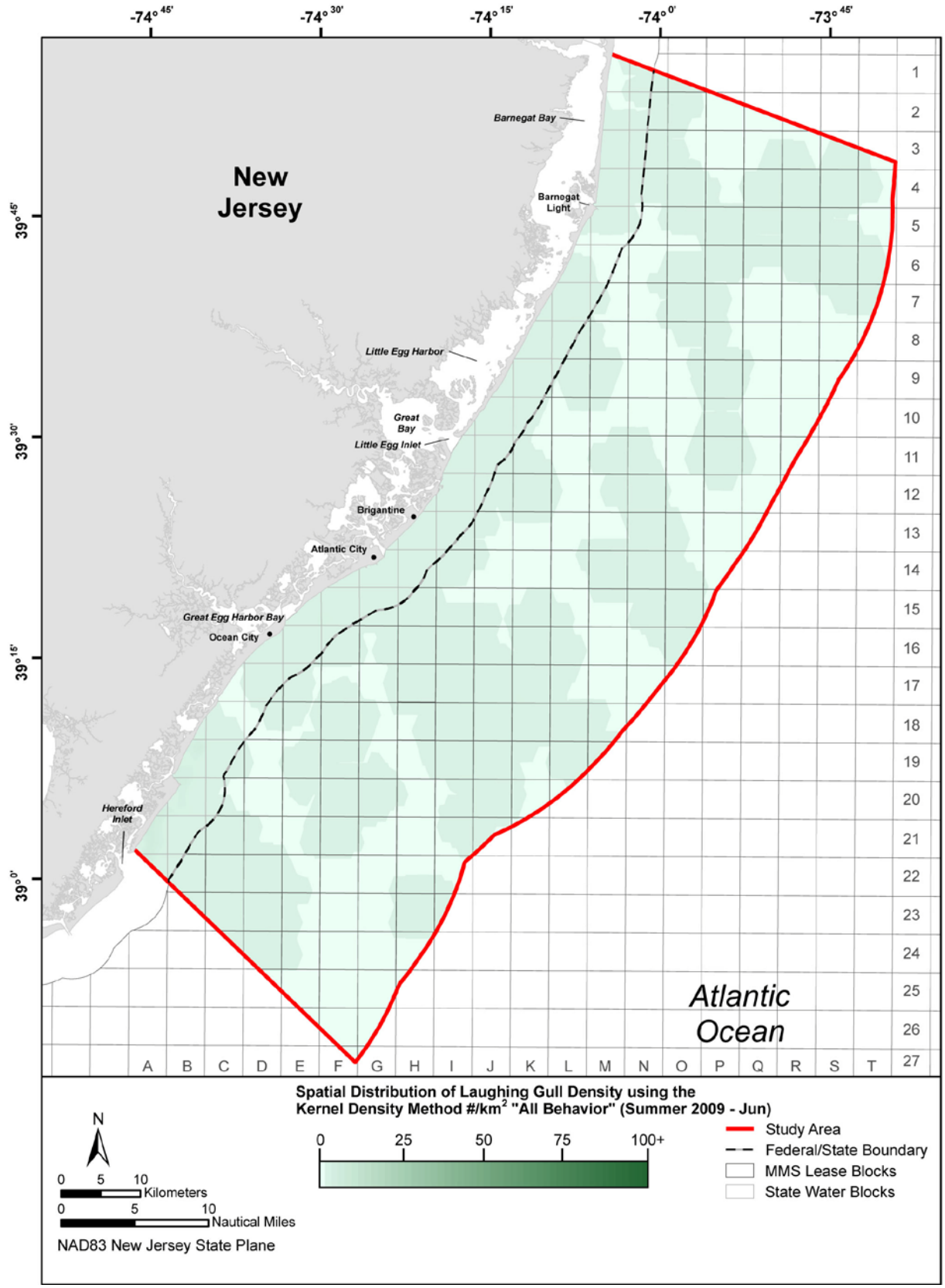

Figure M-425. Spatial distribution of Laughing Gull density (#/km^2) in the Study Area for all behaviors using the kernel density method (Summer 2009).

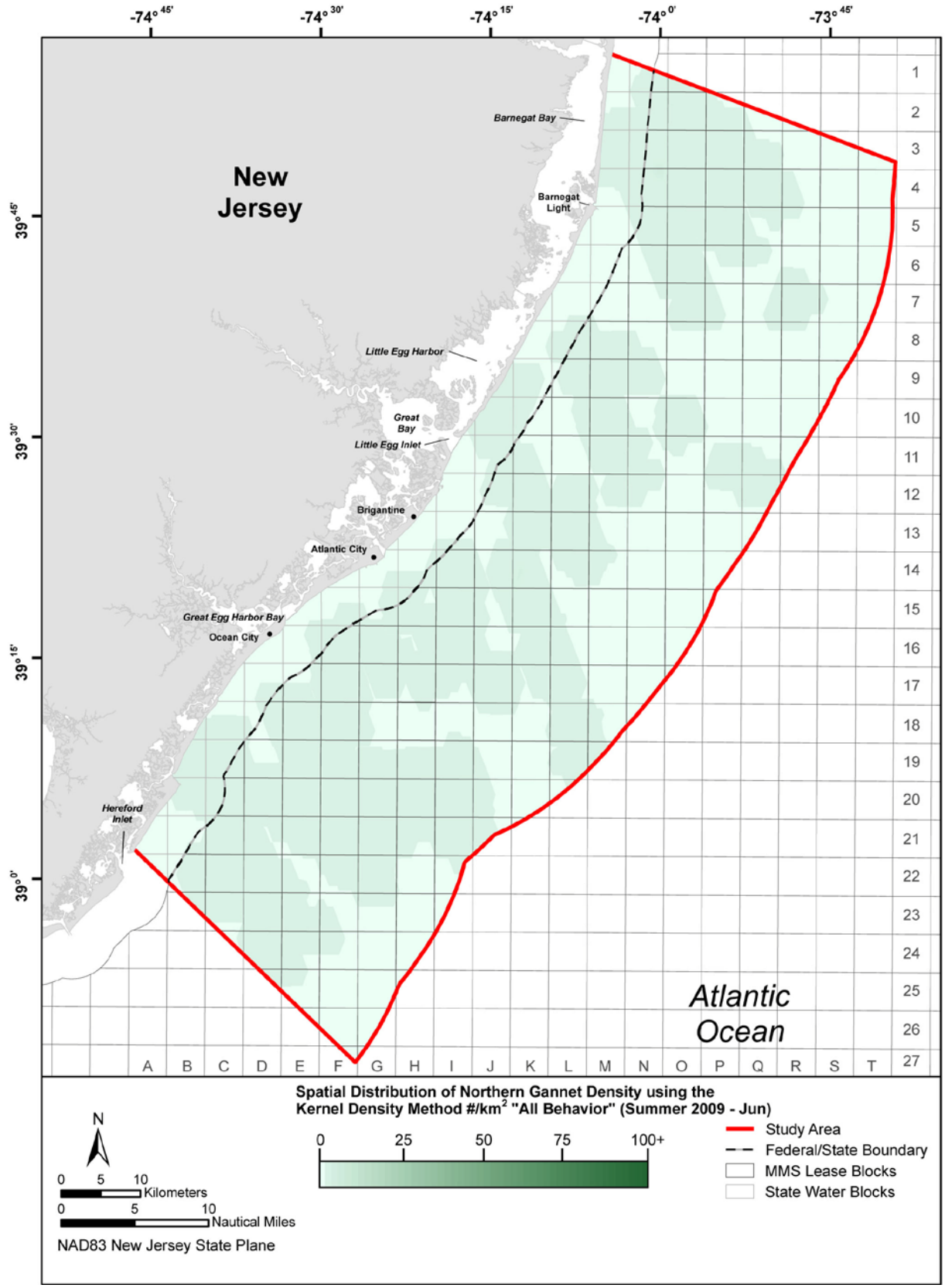

Figure M-426. Spatial distribution of Northern Gannet density (#/km^2) in the Study Area for all behaviors using the kernel density method (Summer 2009).

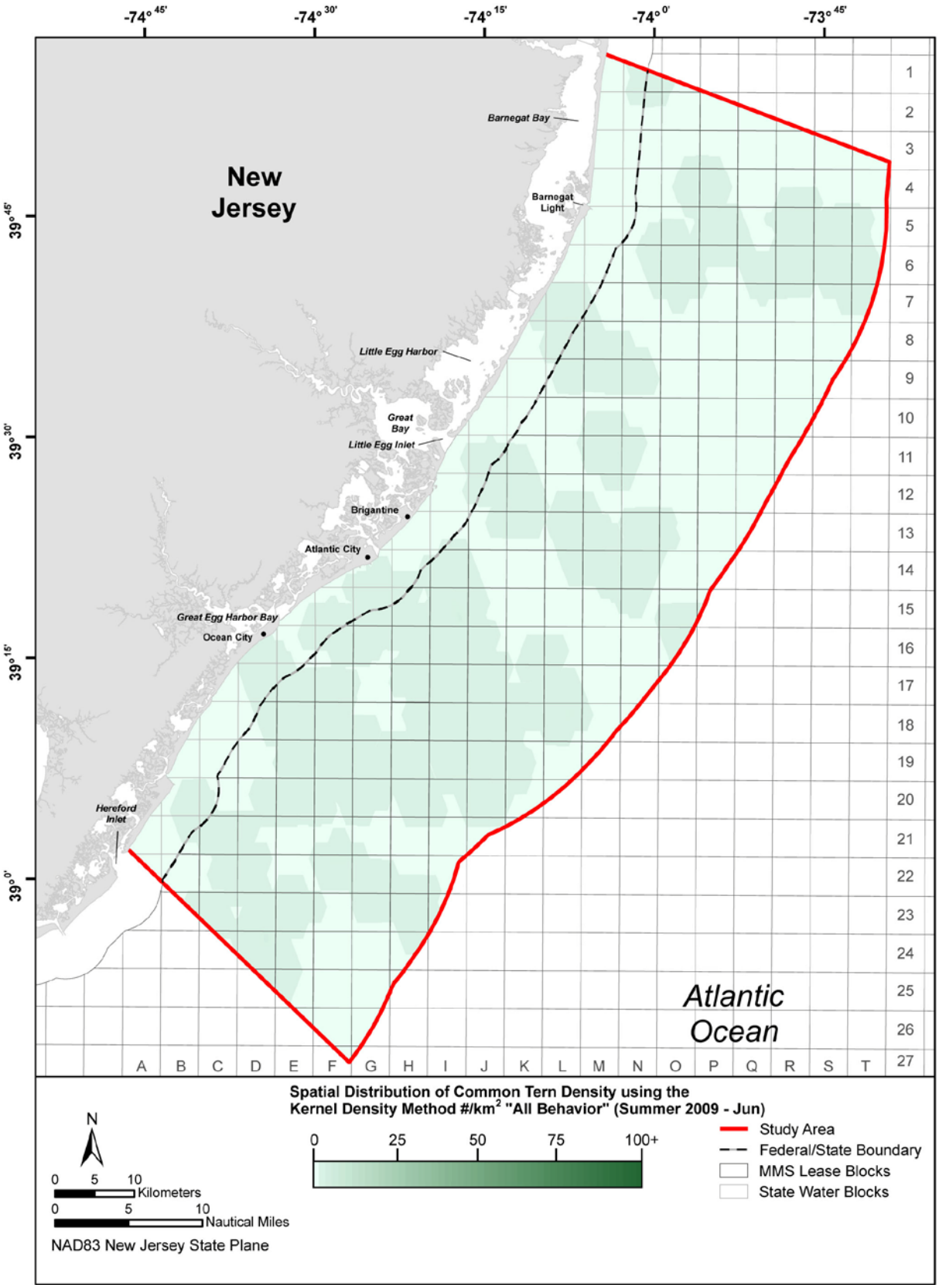

Figure M-427. Spatial distribution of Common Tern density (#/km^2) in the Study Area for all behaviors using the kernel density method (Summer 2009).

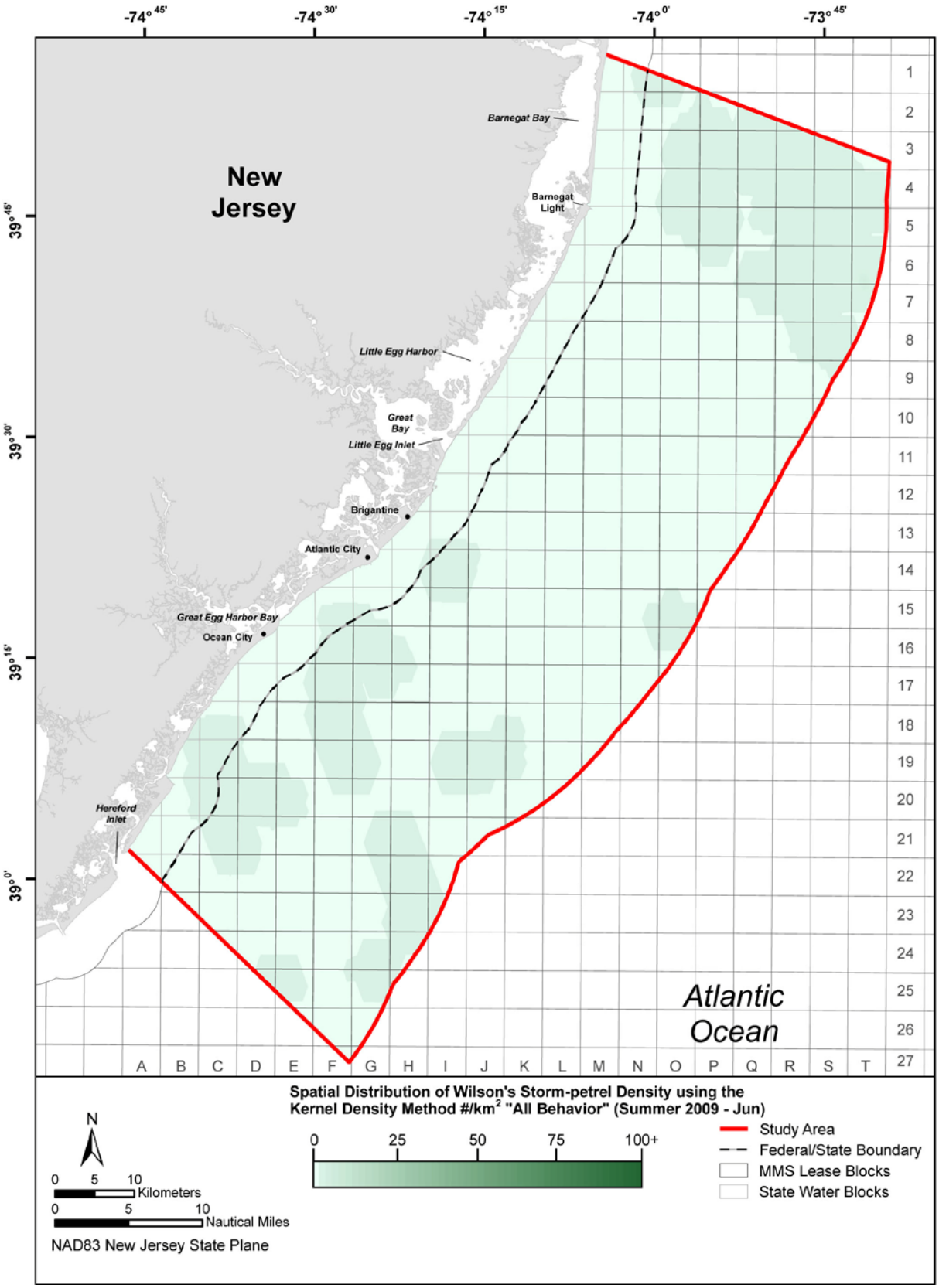

Figure M-428. Spatial distribution of Wilson's Storm-Petrel density (#/km^2) in the Study Area for all behaviors using the kernel density method (Summer 2009).

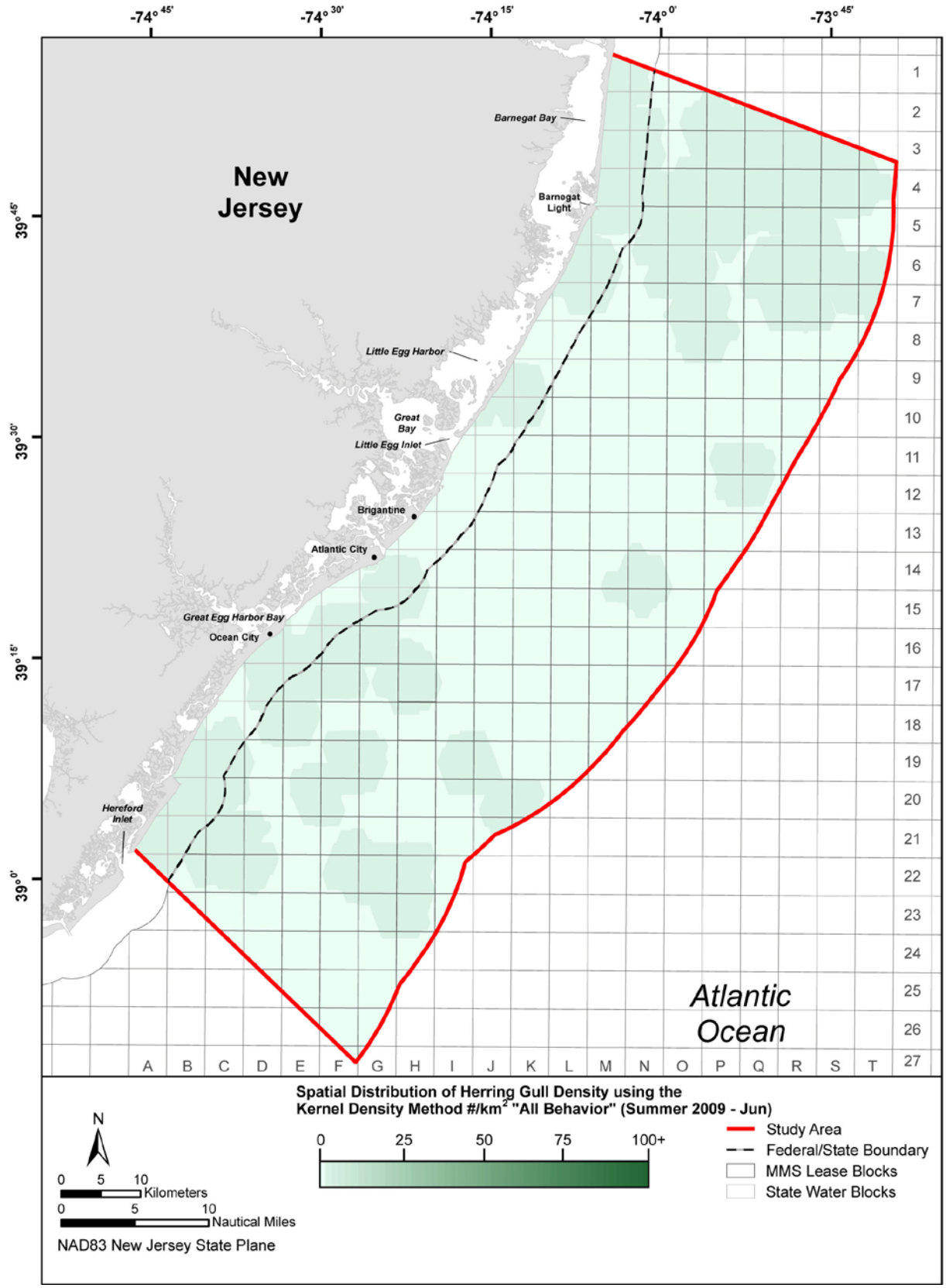

Figure M-429. Spatial distribution of Herring Gull density (#/km^2) in the Study Area for all behaviors using the kernel density method (Summer 2009).

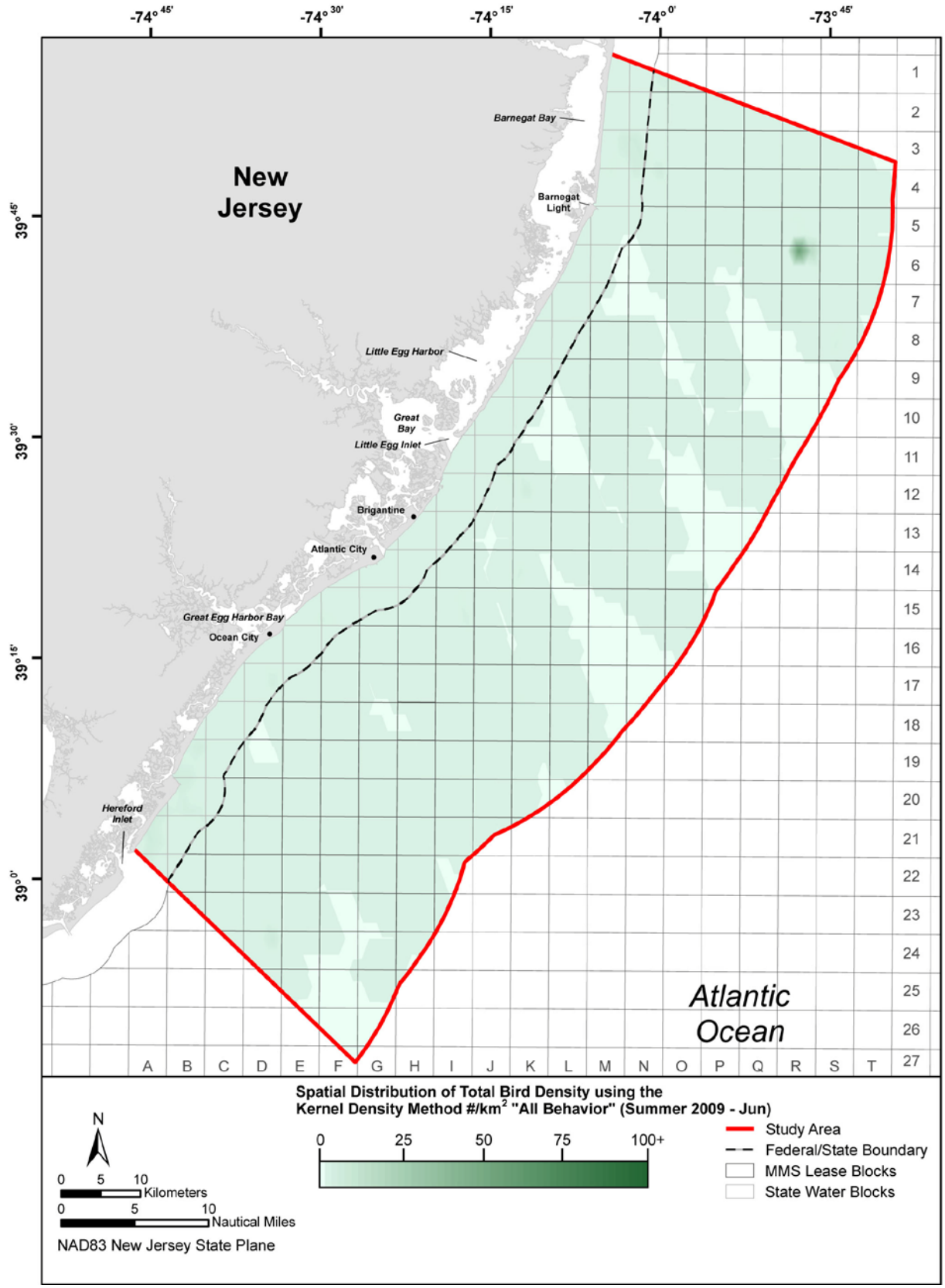

Figure M-430. Spatial distribution of total bird density (#/km^2) in the Study Area for all behaviors using the kernel density method (Summer 2009).

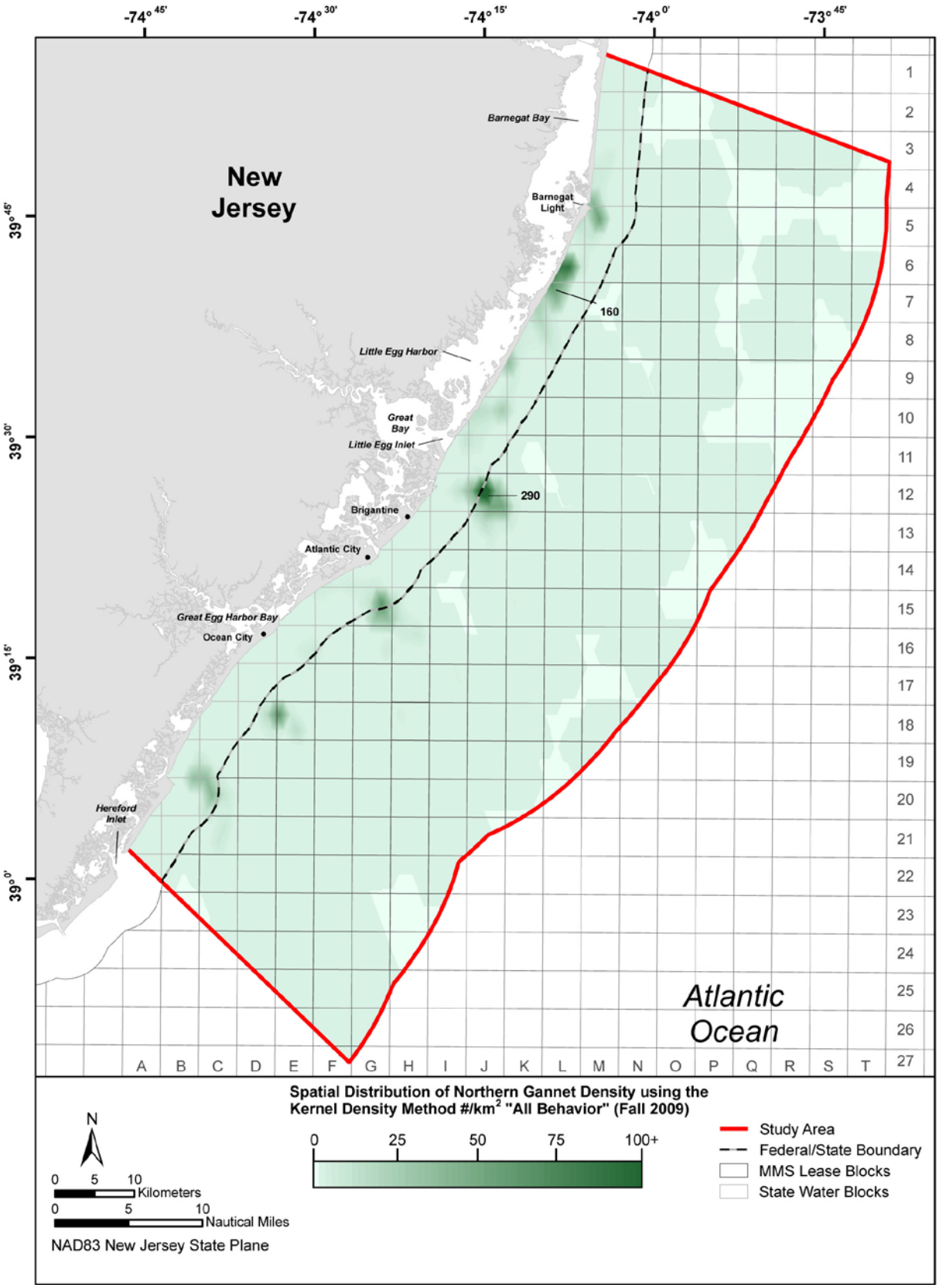

Figure M-431. Spatial distribution of Northern Gannet density (#/km^2) in the Study Area for all behaviors using the kernel density method (Fall 2009).

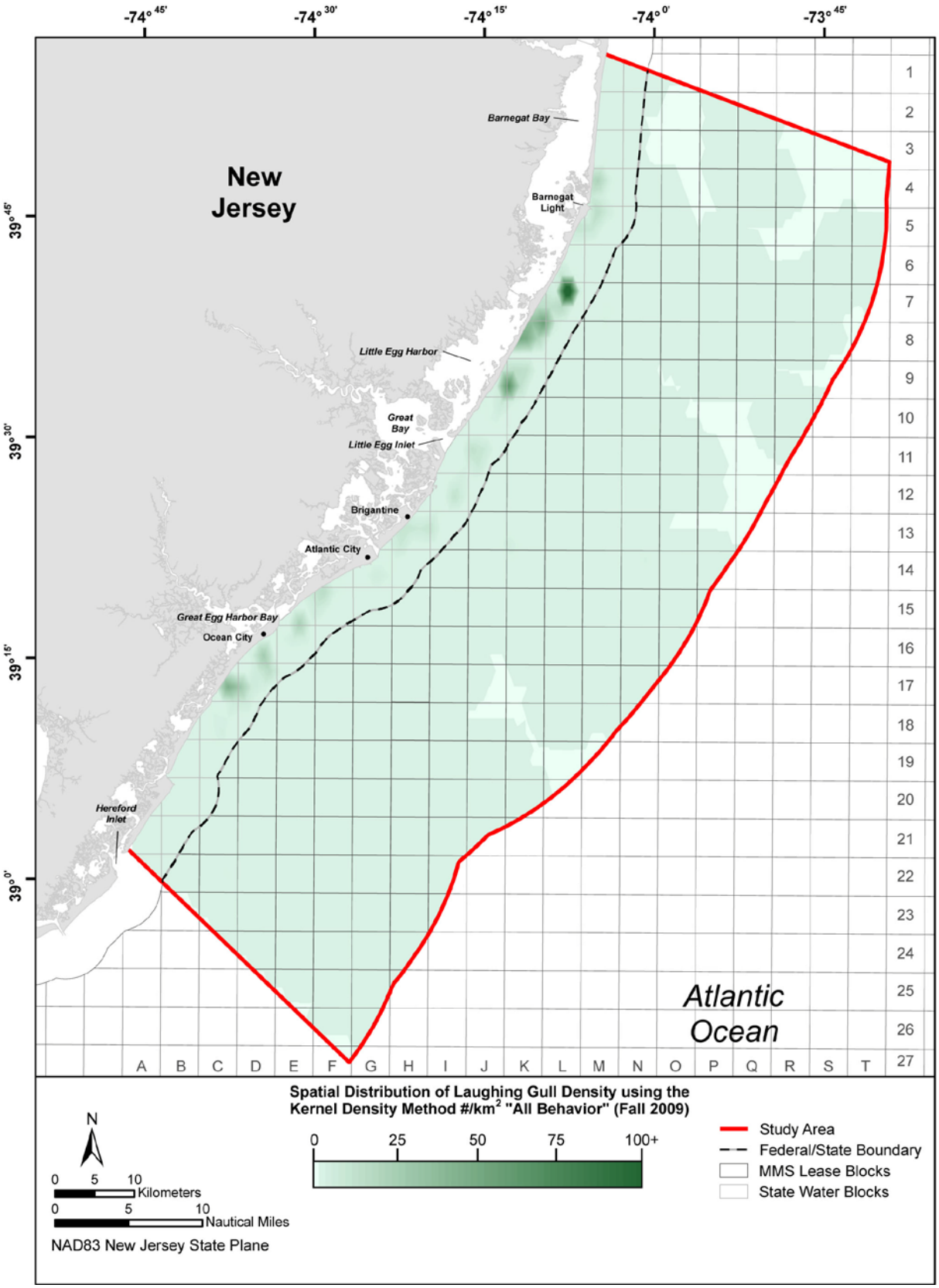

Figure M-432. Spatial distribution of Laughing Gull density (#/km^2) in the Study Area for all behaviors using the kernel density method (Fall 2009).

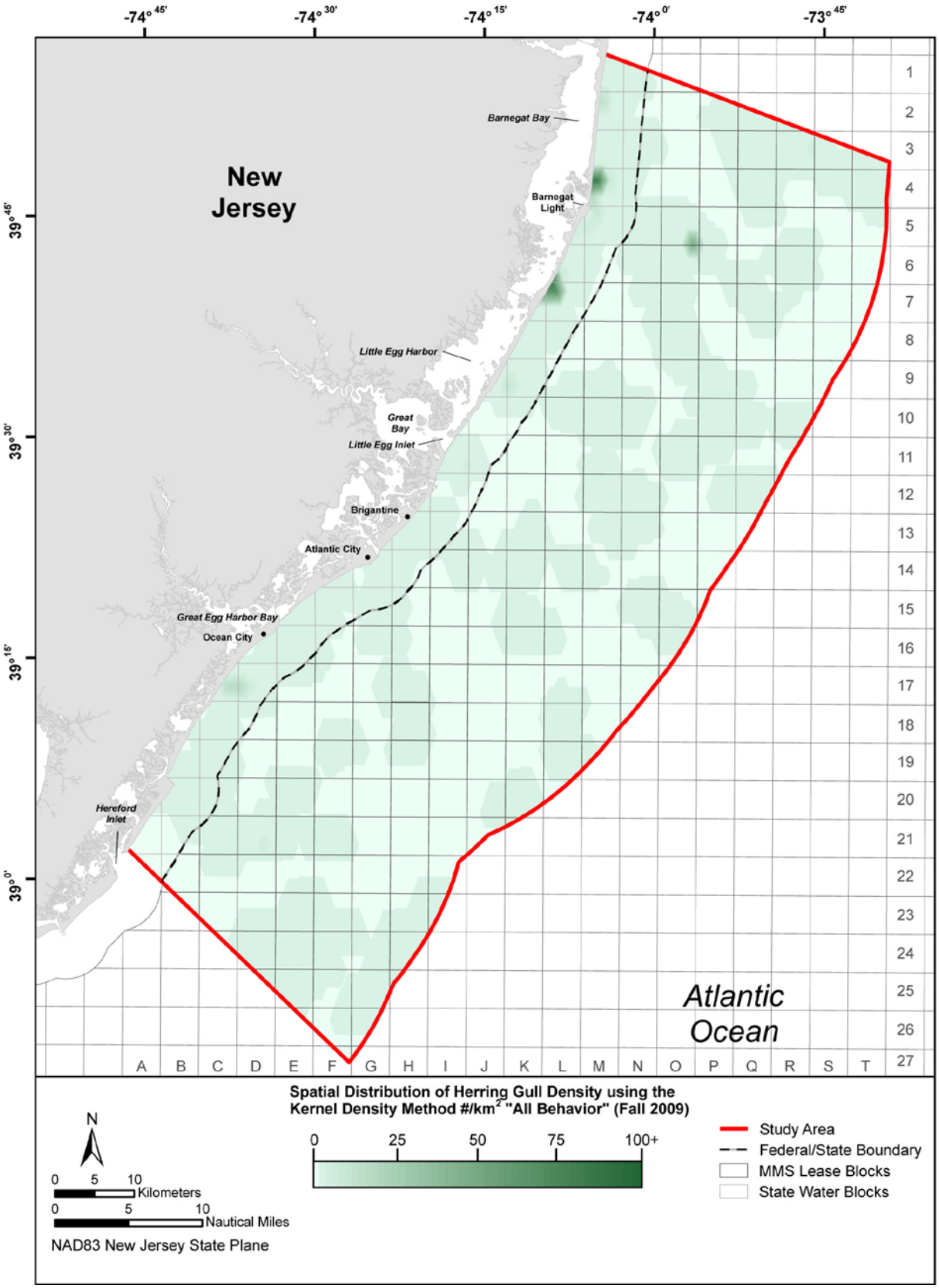

Figure M-433. Spatial distribution of Herring Gull density (#/km^2) in the Study Area for all behaviors using the kernel density method (Fall 2009).

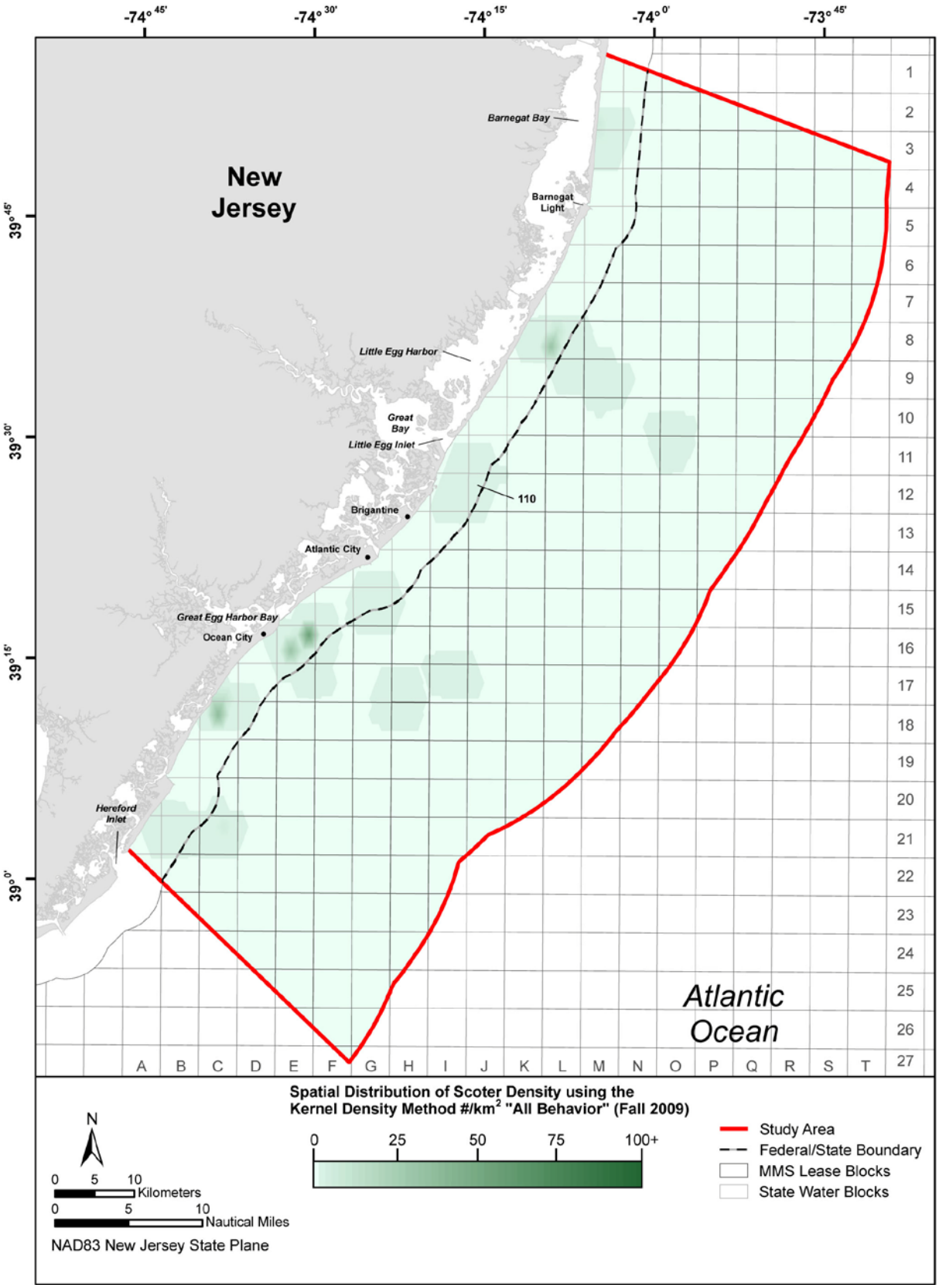

Figure M-434. Spatial distribution of scoter density (#/km^2) in the Study Area for all behaviors using the kernel density method (Fall 2009).

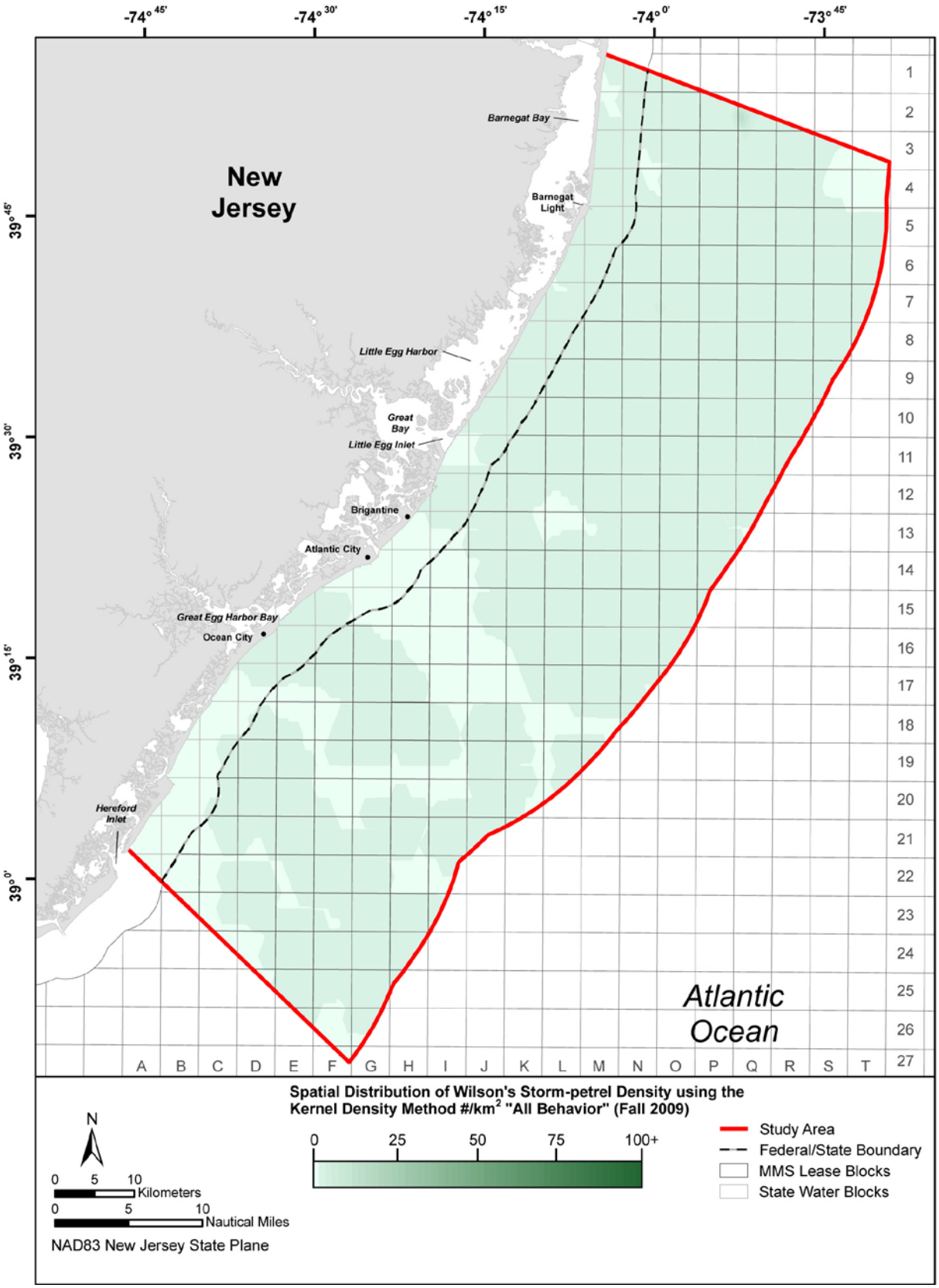

Figure M-435. Spatial distribution of Wilson's Storm-Petrel density (#/km^2) in the Study Area for all behaviors using the kernel density method (Fall 2009).

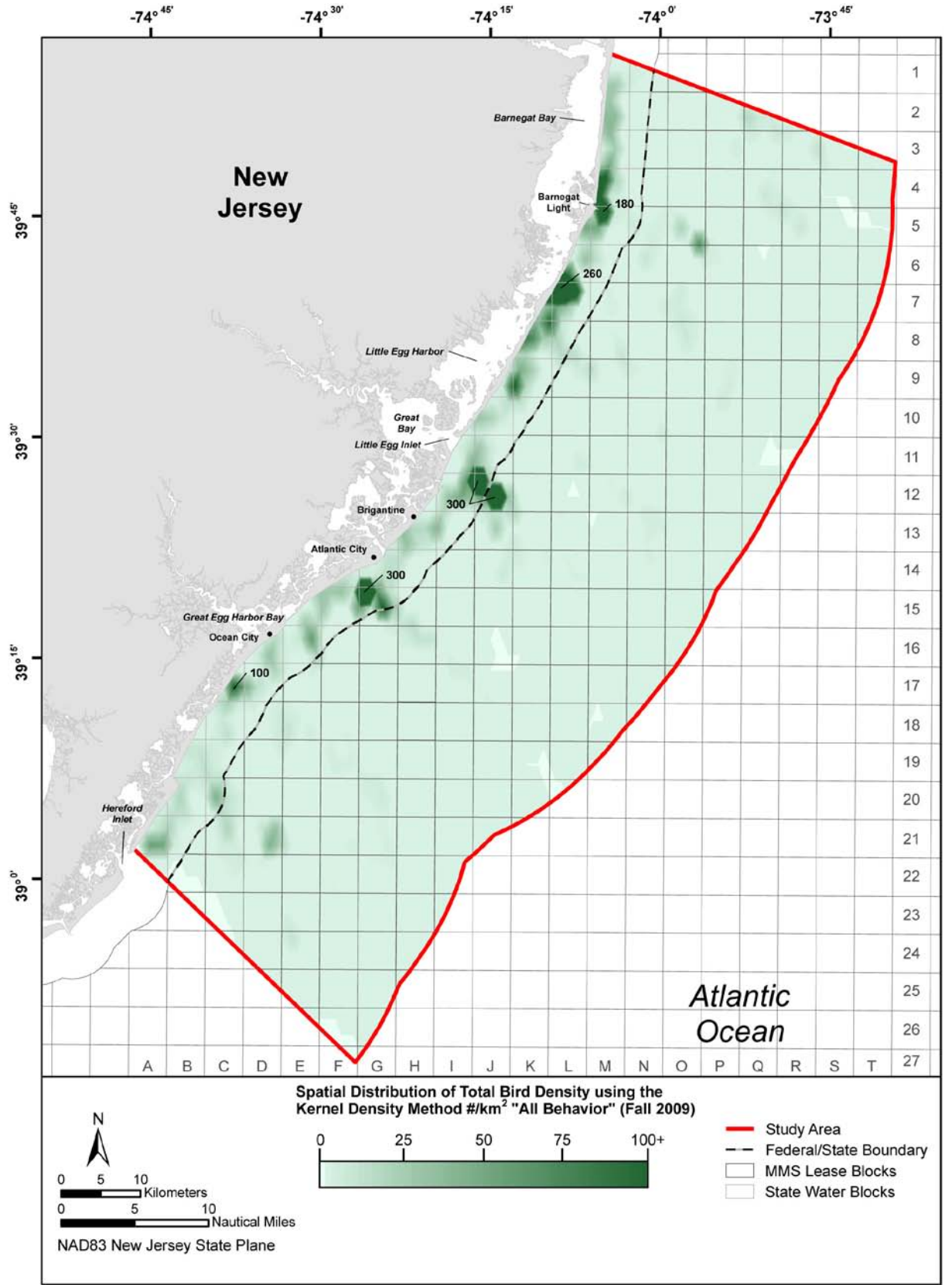

Figure M-436. Spatial distribution of total bird density (#/km^2) in the Study Area for all behaviors using the kernel density method (Fall 2009).

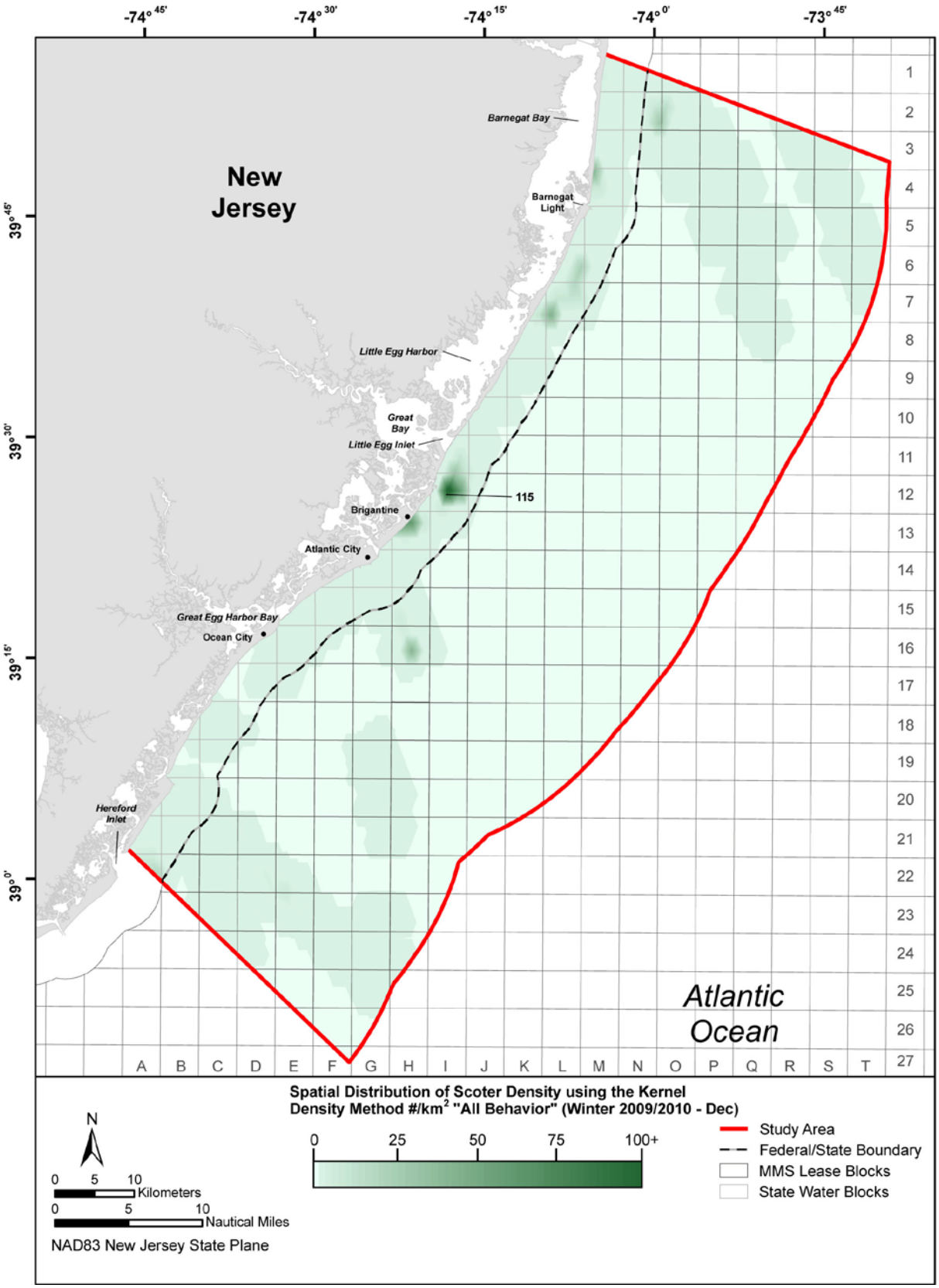

Figure M-437. Spatial distribution of scoter density (#/km^2) in the Study Area for all behaviors using the kernel density method (Winter 2010).

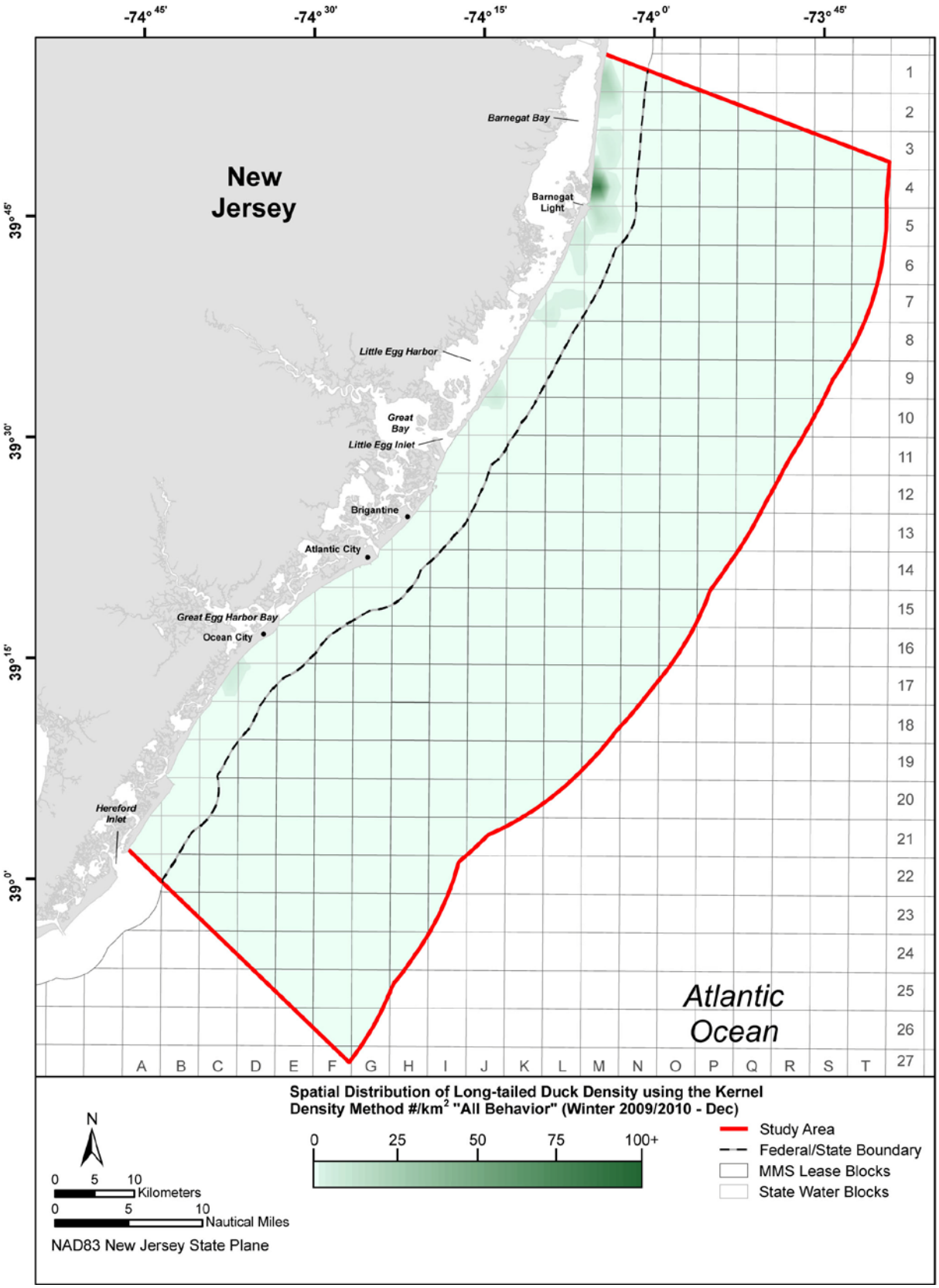

Figure M-438. Spatial distribution of Long-tailed Duck density (#/km^2) in the Study Area for all behaviors using the kernel density method (Winter 2010).

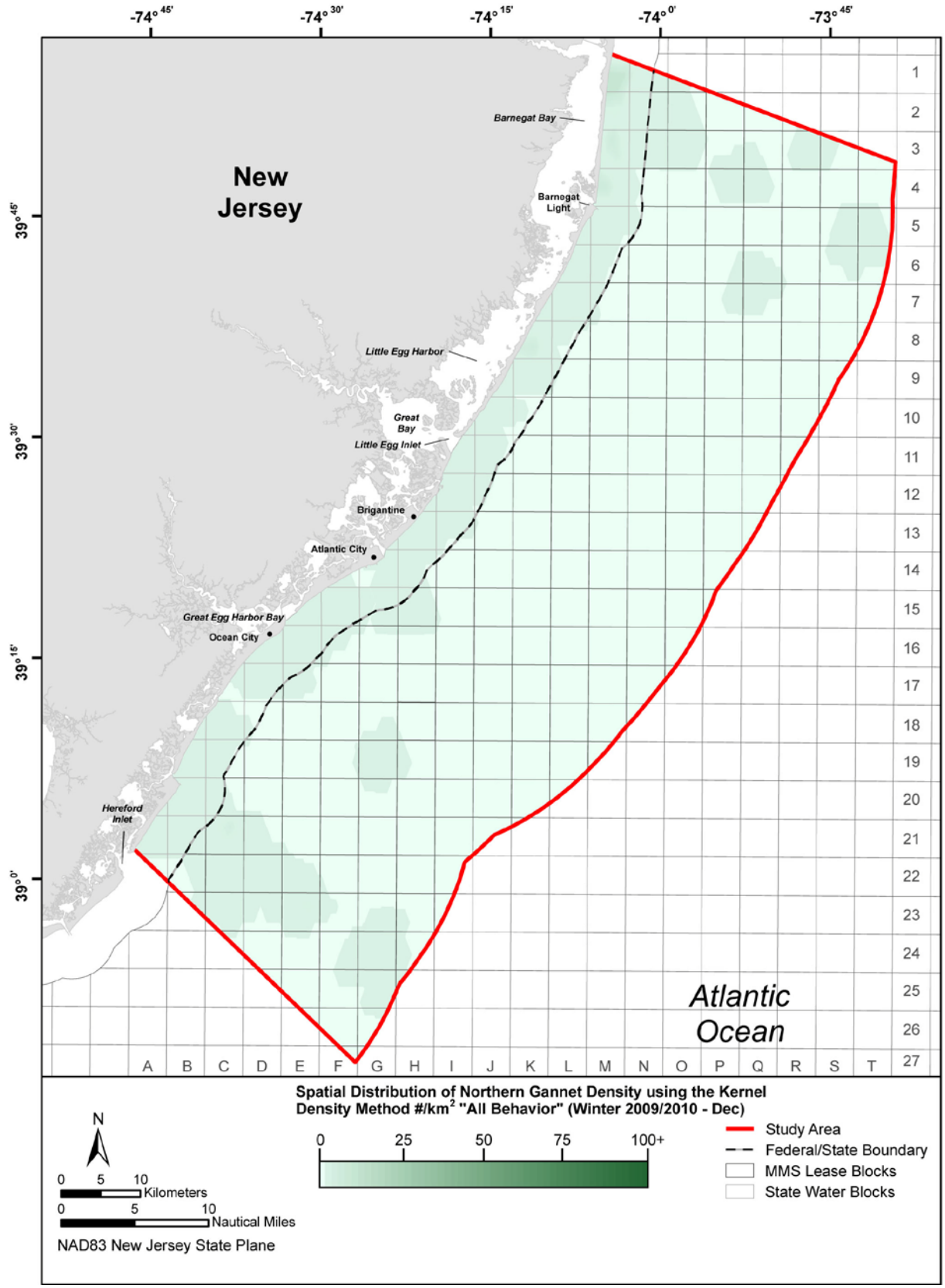

Figure M-439. Spatial distribution of Northern Gannet density (#/km^2) in the Study Area for all behaviors using the kernel density method (Winter 2010).

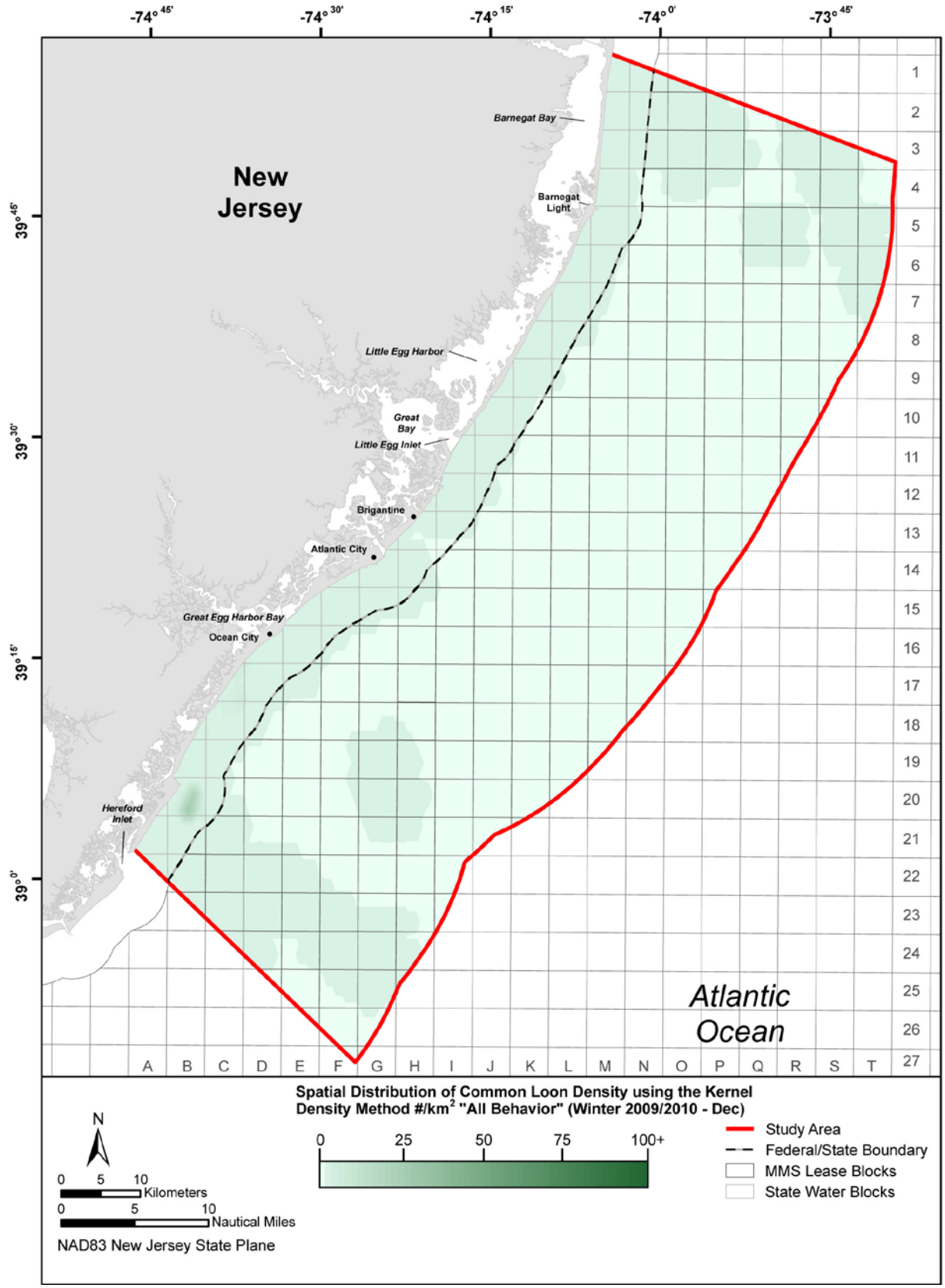

Figure M-440. Spatial distribution of Common Loon density (#/km^2) in the Study Area for all behaviors using the kernel density method (Winter 2010).

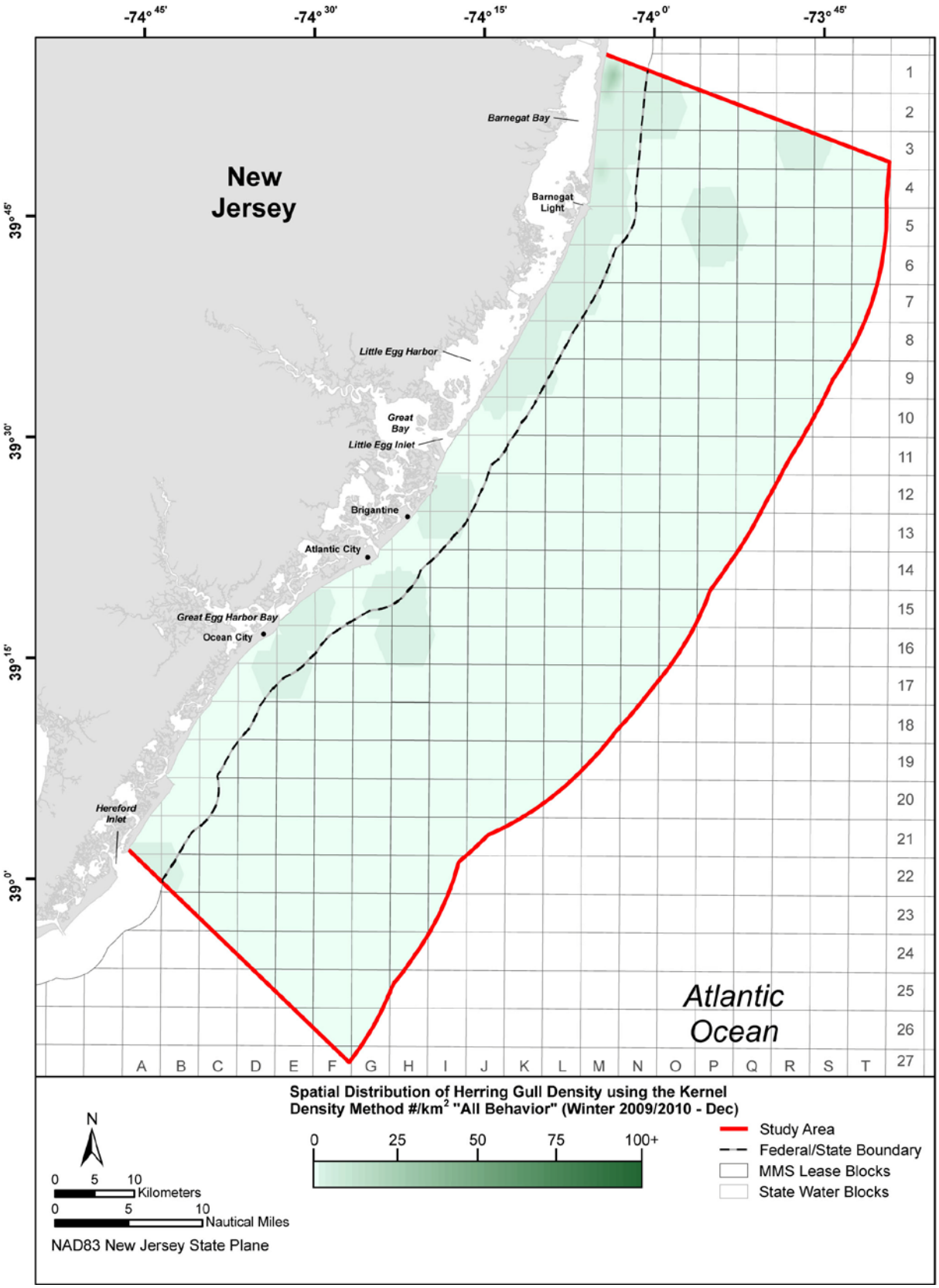

Figure M-441. Spatial distribution of Herring Gull density (#/km^2) in the Study Area for all behaviors using the kernel density method (Winter 2010).

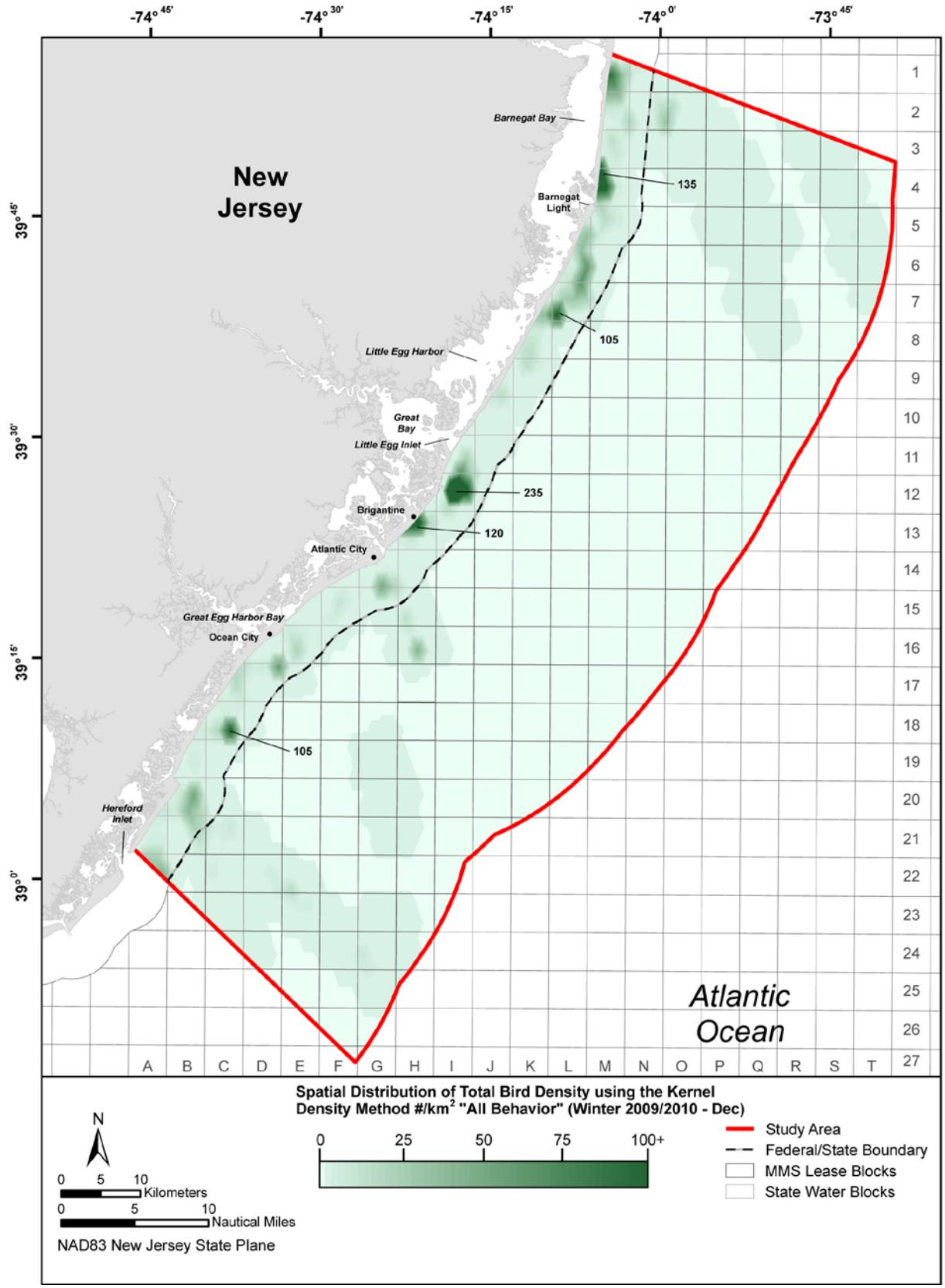

Figure M-442. Spatial distribution of total bird density (#/km^2) in the Study Area for all behaviors using the kernel density method (Winter 2010).

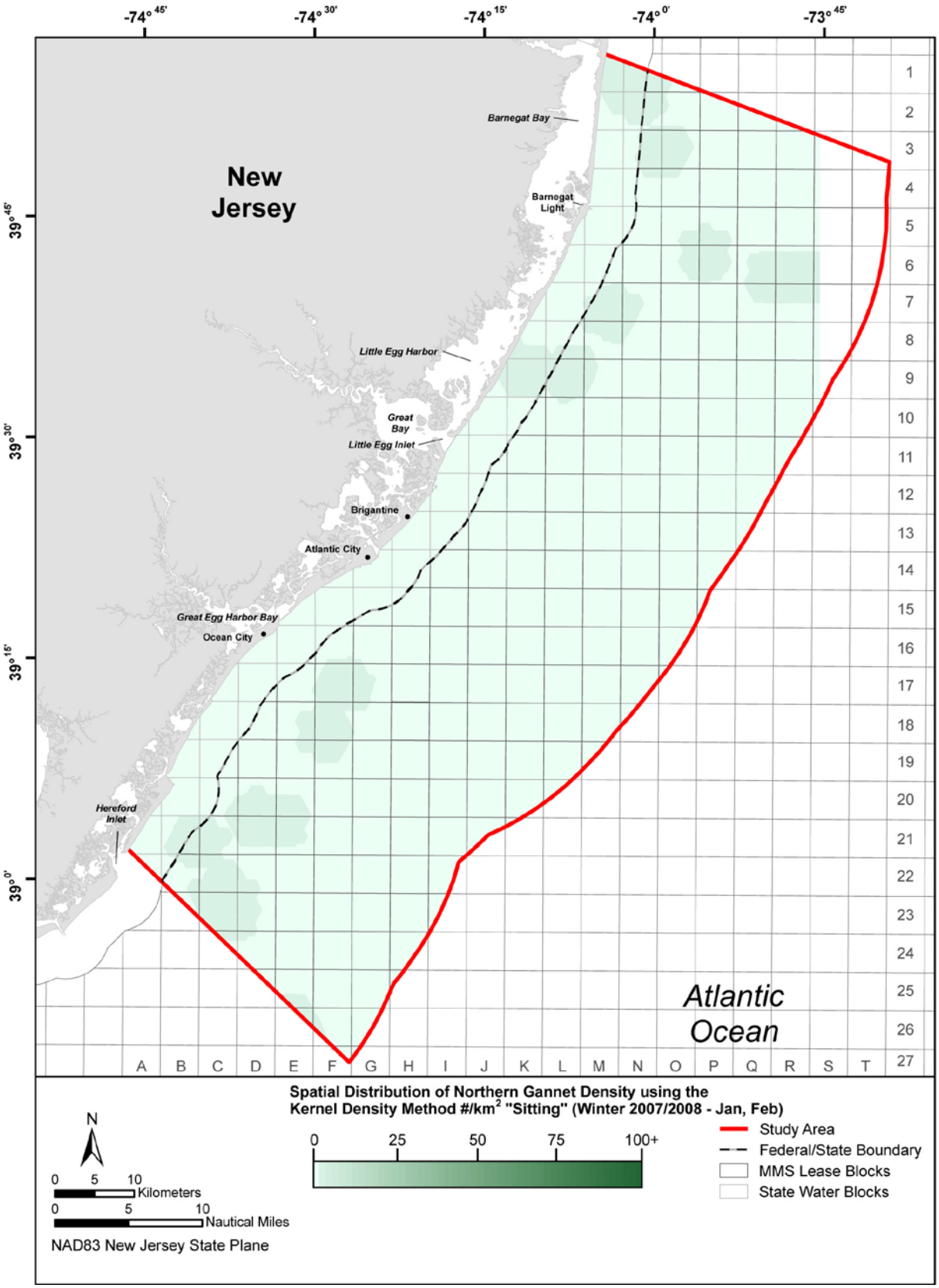

Figure M-443. Spatial distribution of Northern Gannet density (#/km^2) in the Study Area for sitting birds using the kernel density method (Winter 2008).

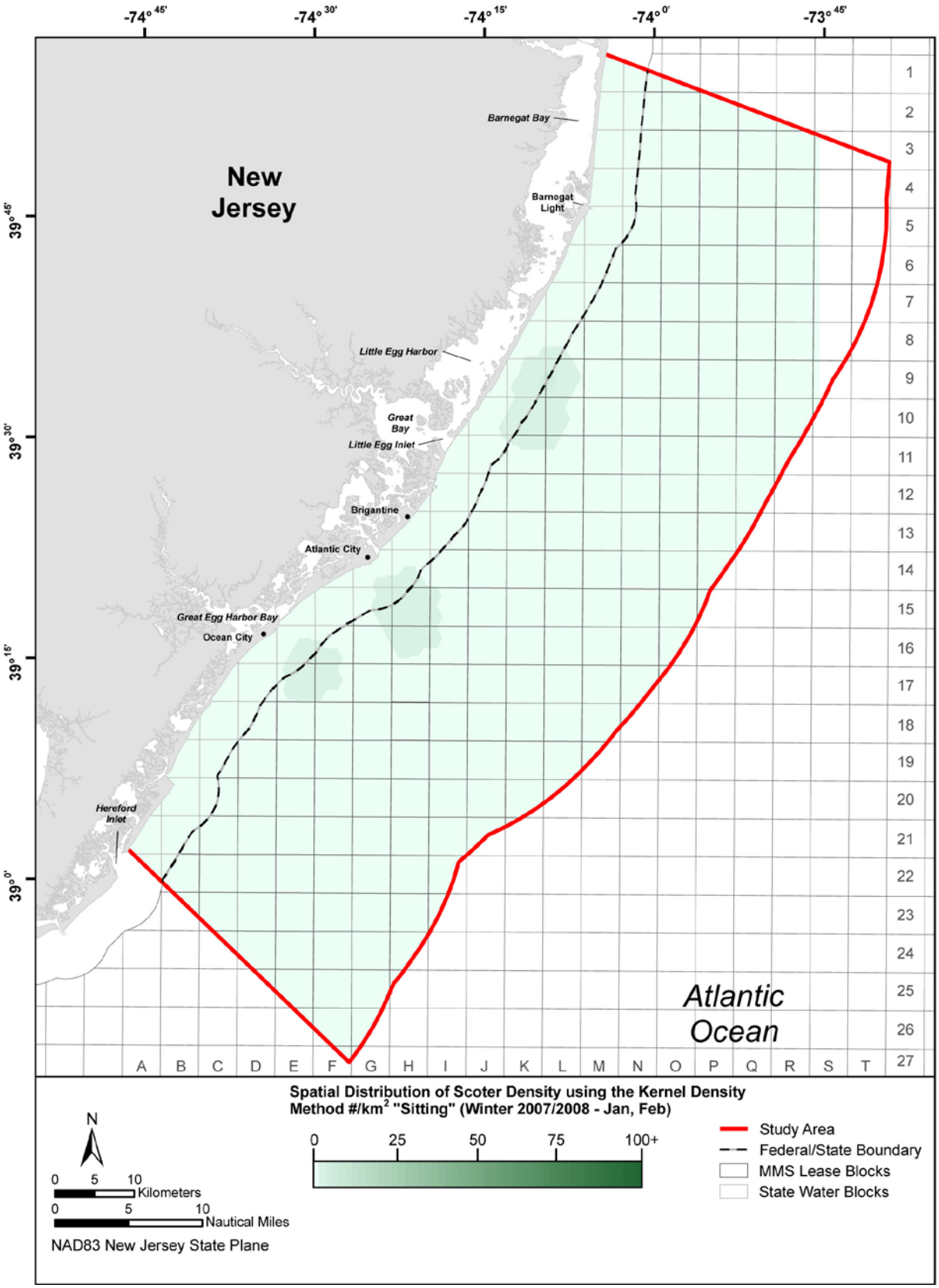

Figure M-444. Spatial distribution of scoter density (#/km^2) in the Study Area for sitting birds using the kernel density method (Winter 2008).

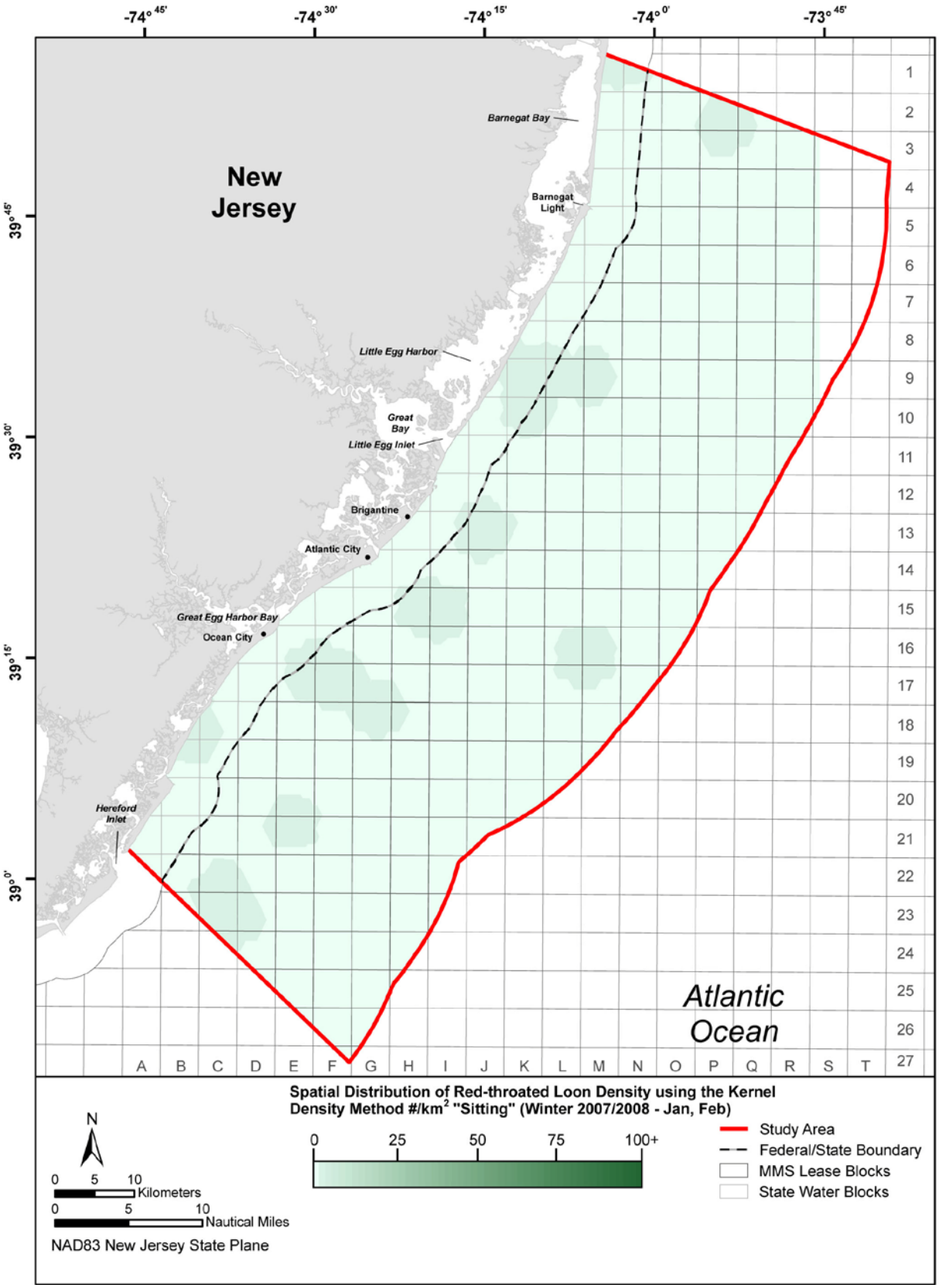

Figure M-445. Spatial distribution of Red-throated Loon density (#/km^2) in the Study Area for sitting birds using the kernel density method (Winter 2008).

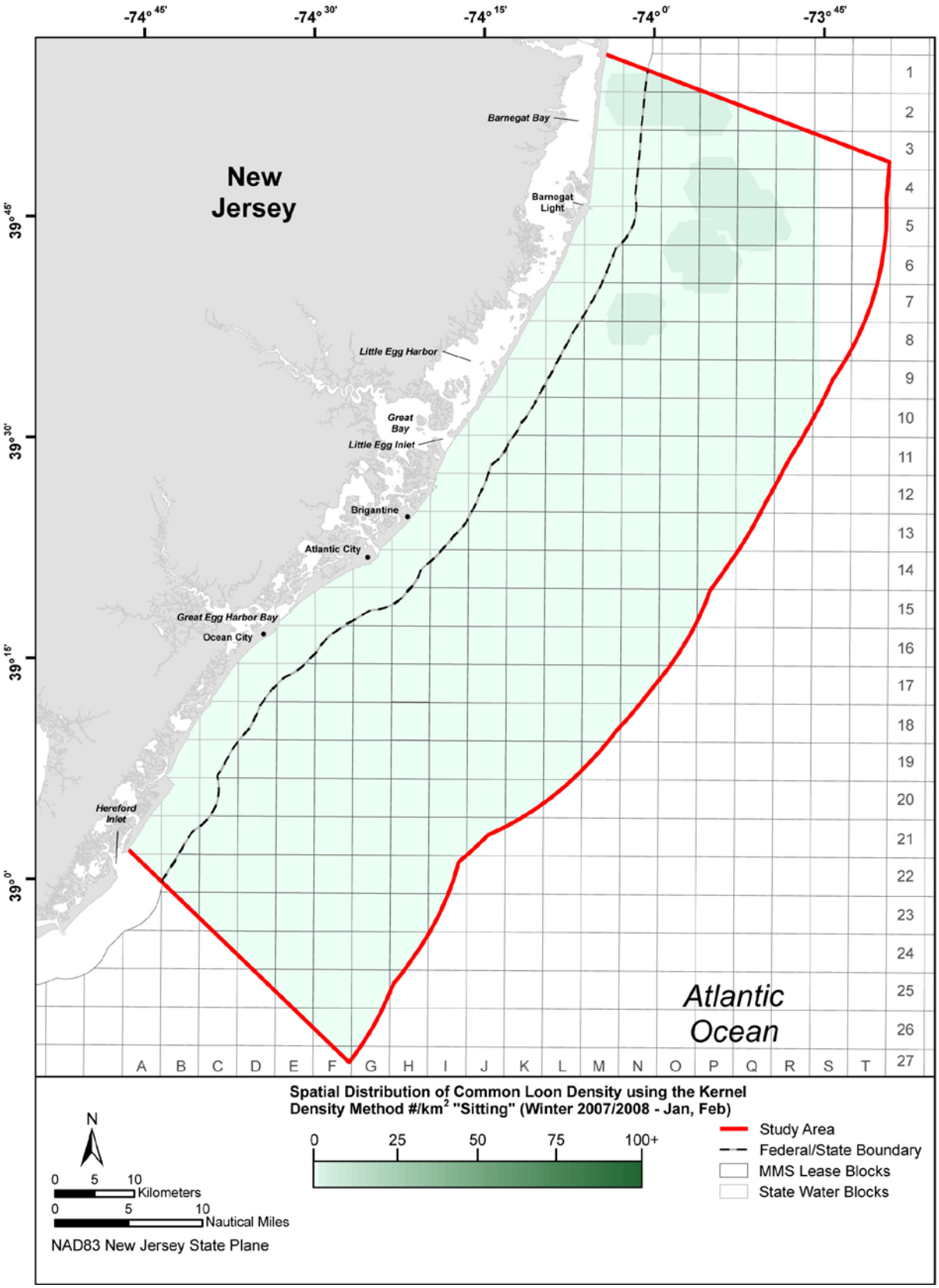

Figure M-446. Spatial distribution of Common Loon density (#/km^2) in the Study Area for sitting birds using the kernel density method (Winter 2008).

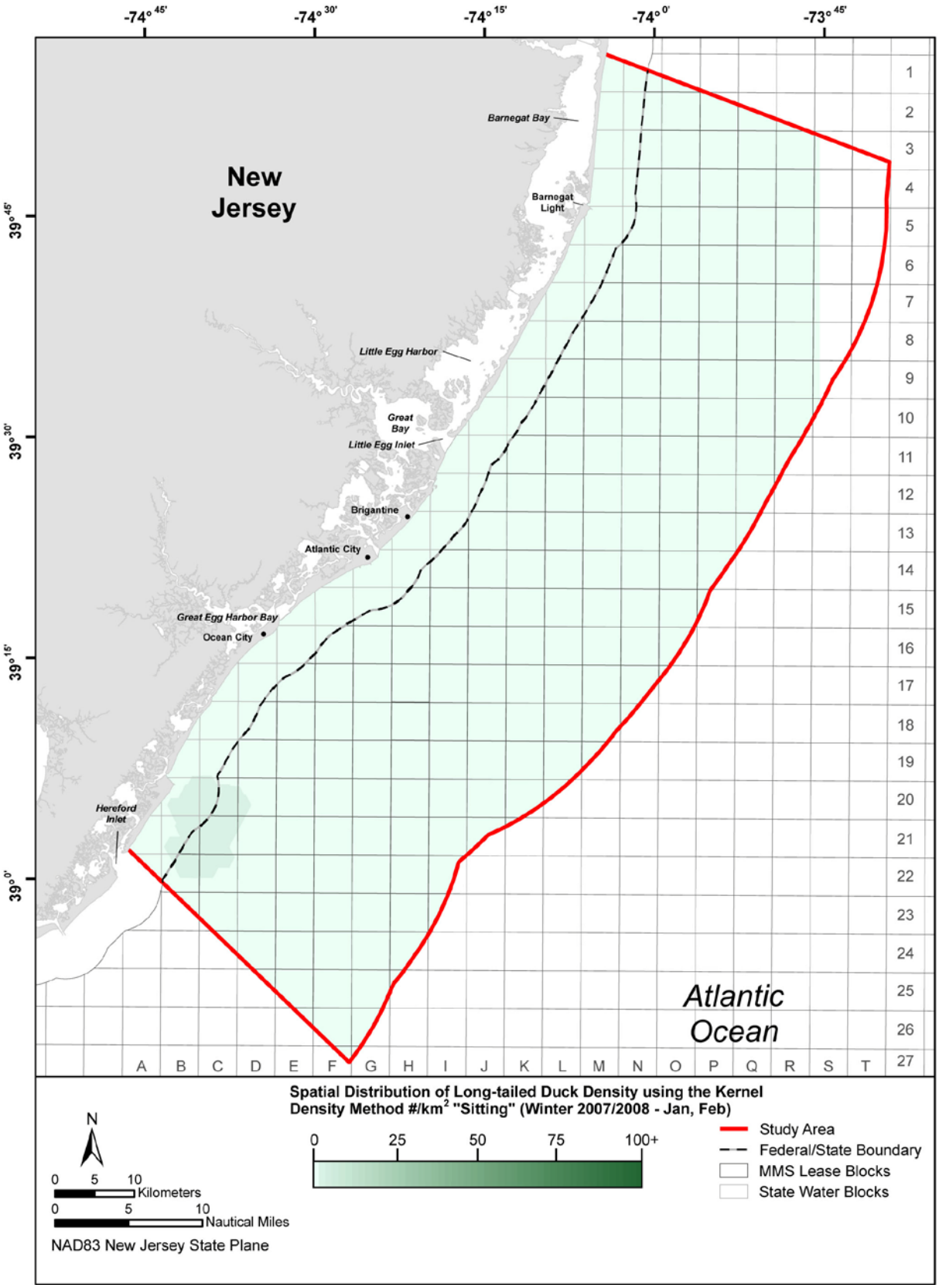

Figure M-447. Spatial distribution of Long-tailed Duck density (#/km^2) in the Study Area for sitting birds using the kernel density method (Winter 2008).

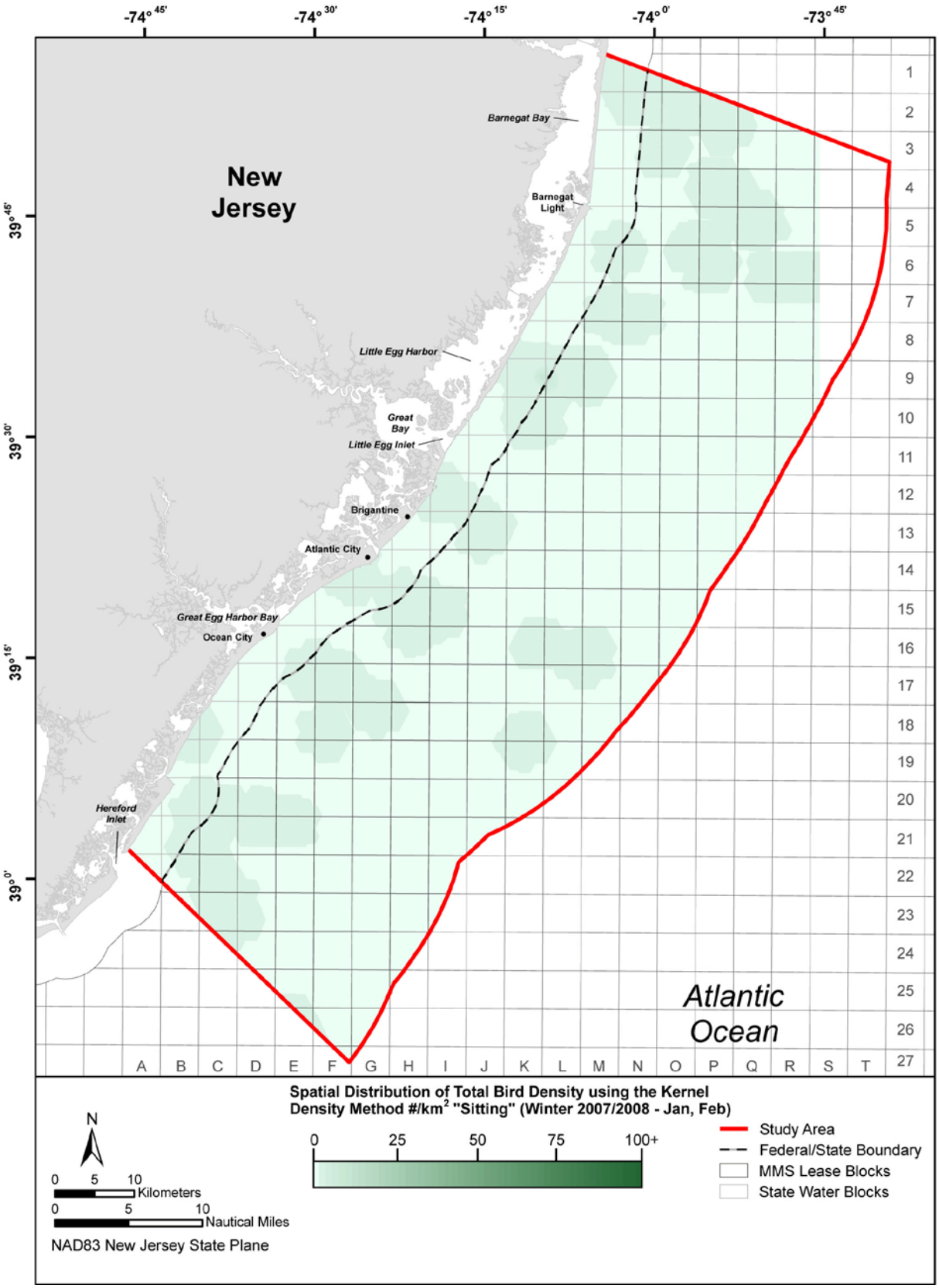

Figure M-448. Spatial distribution of total bird density (#/km^2) in the Study Area for sitting birds using the kernel density method (Winter 2008).

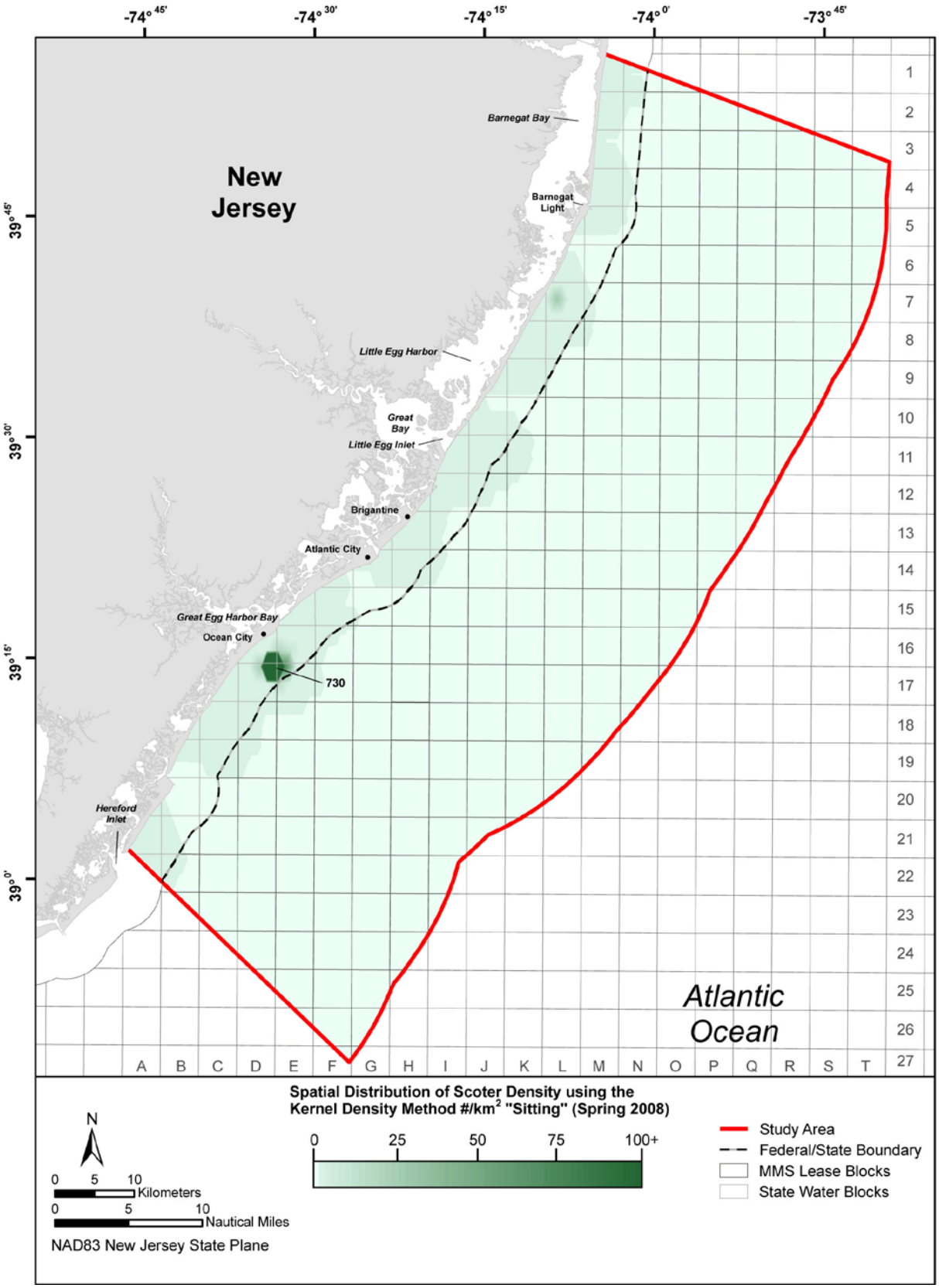

Figure M-449. Spatial distribution of scoter density (#/km^2) in the Study Area for sitting birds using the kernel density method (Spring 2008).

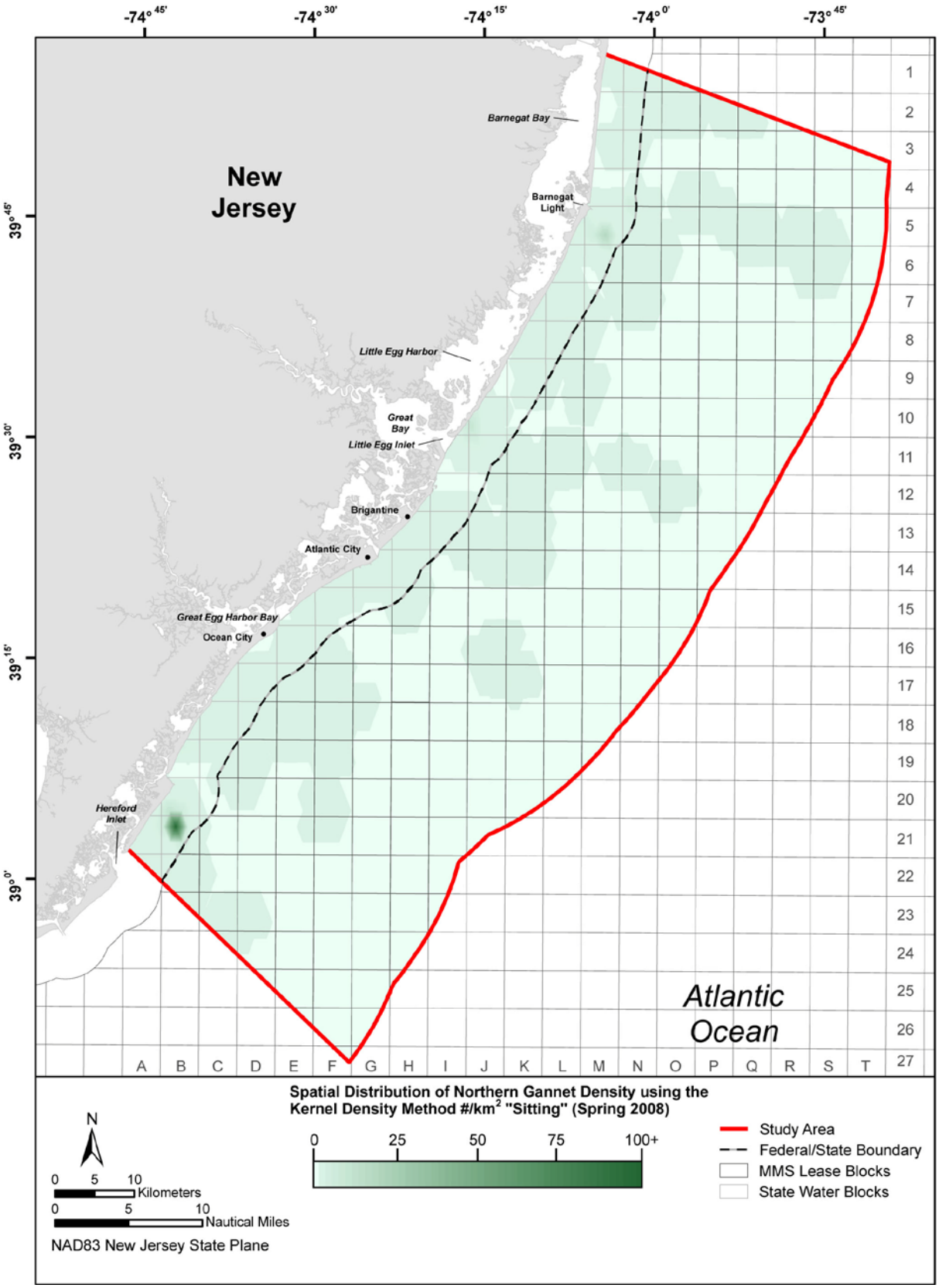

Figure M-450. Spatial distribution of Northern Gannet density (#/km^2) in the Study Area for sitting birds using the kernel density method (Spring 2008).

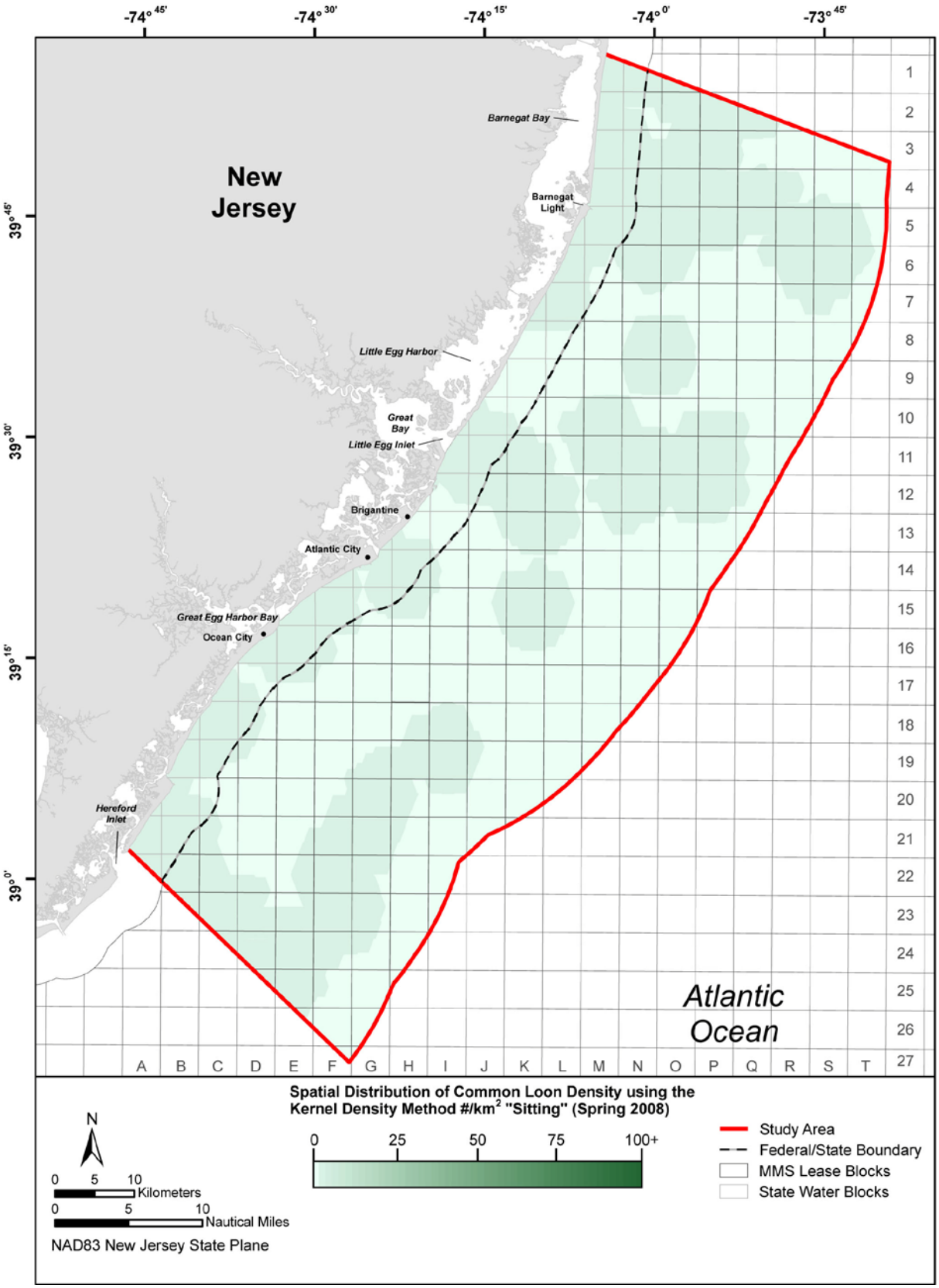

Figure M-451. Spatial distribution of Common Loon density (#/km^2) in the Study Area for sitting birds using the kernel density method (Spring 2008).

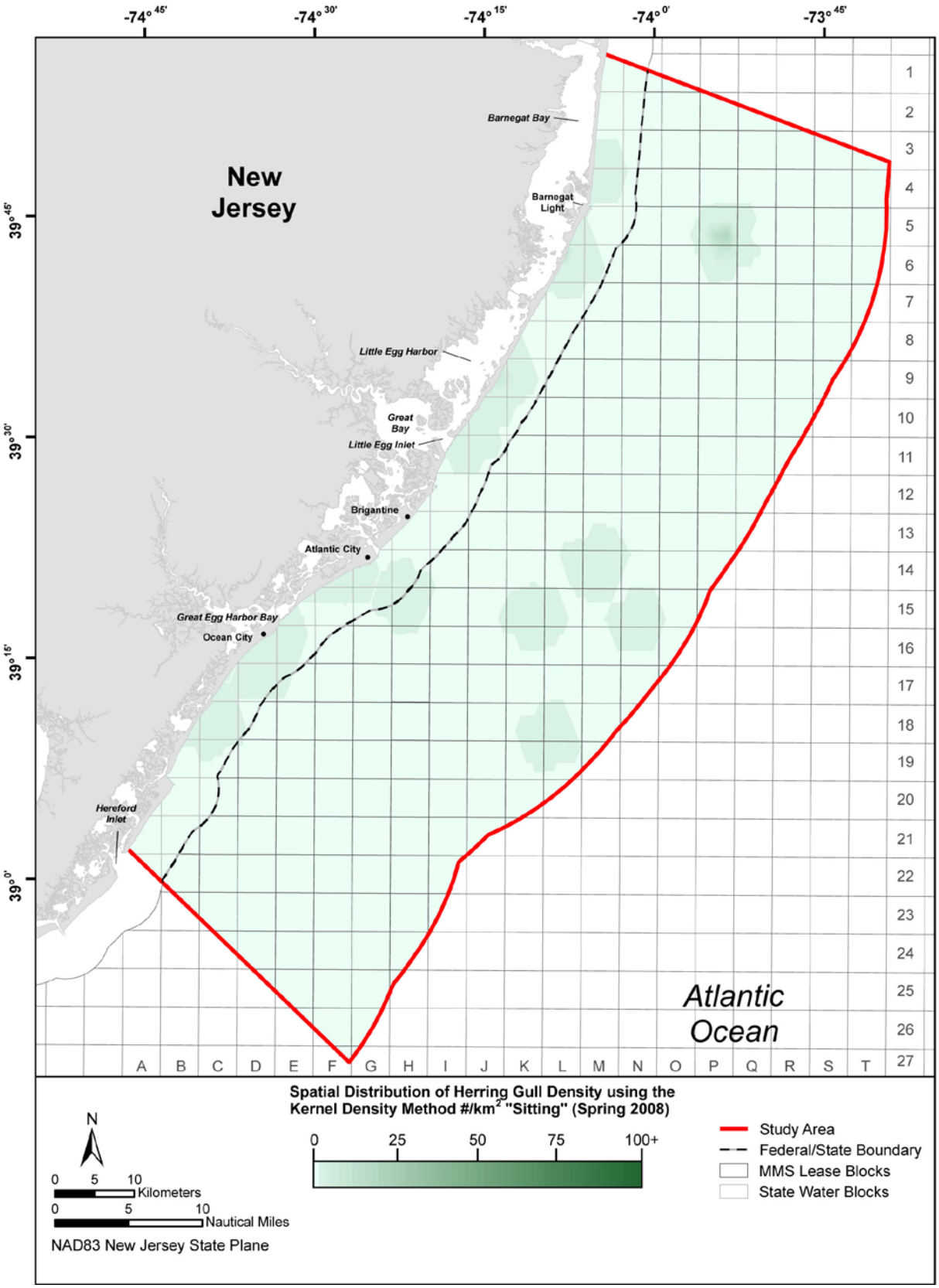

Figure M-452. Spatial distribution of Herring Gull density (#/km^2) in the Study Area for sitting birds using the kernel density method (Spring 2008).

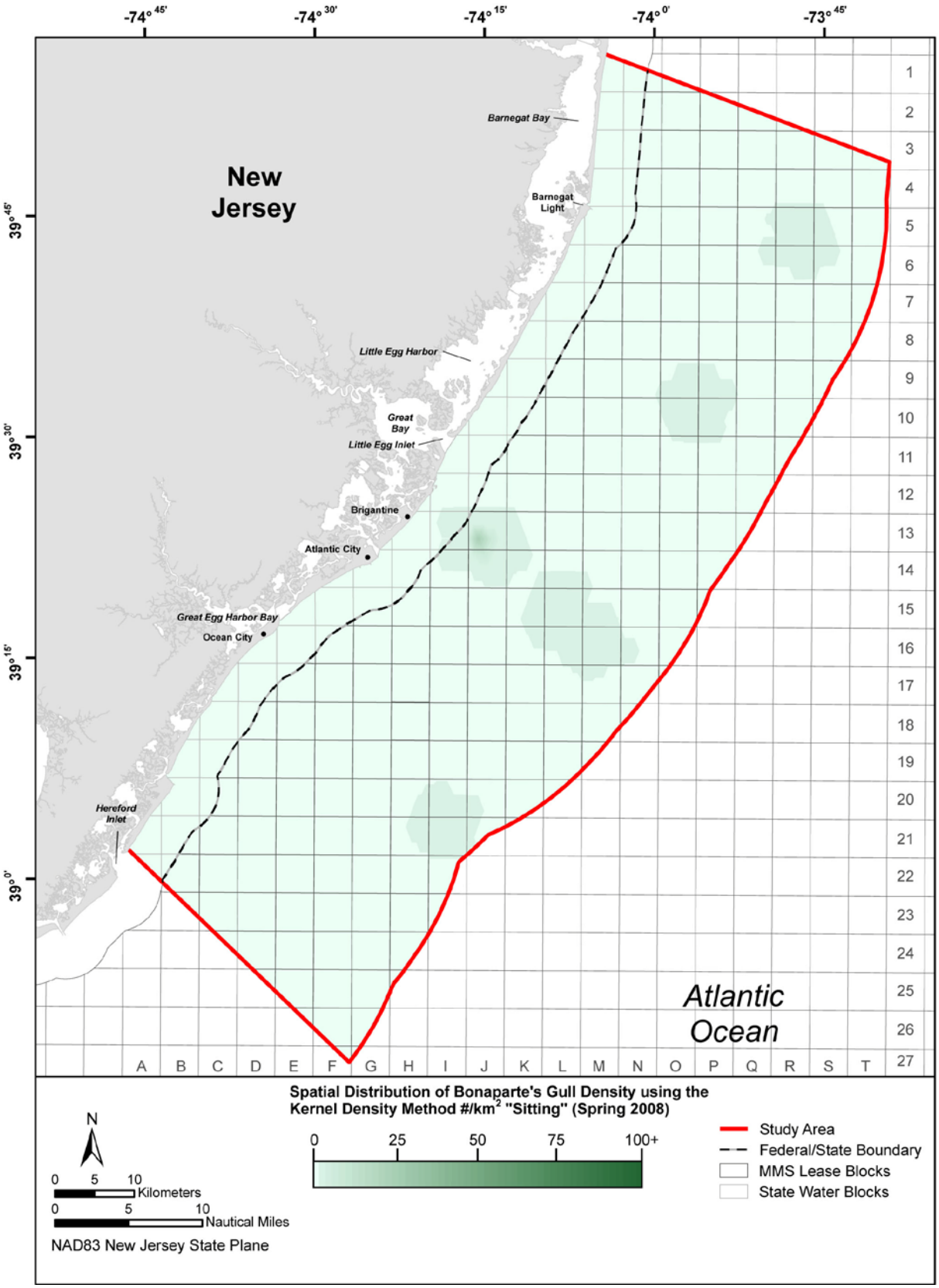

Figure M-453. Spatial distribution of Bonaparte's Gull density (#/km^2) in the Study Area for sitting birds using the kernel density method (Spring 2008).

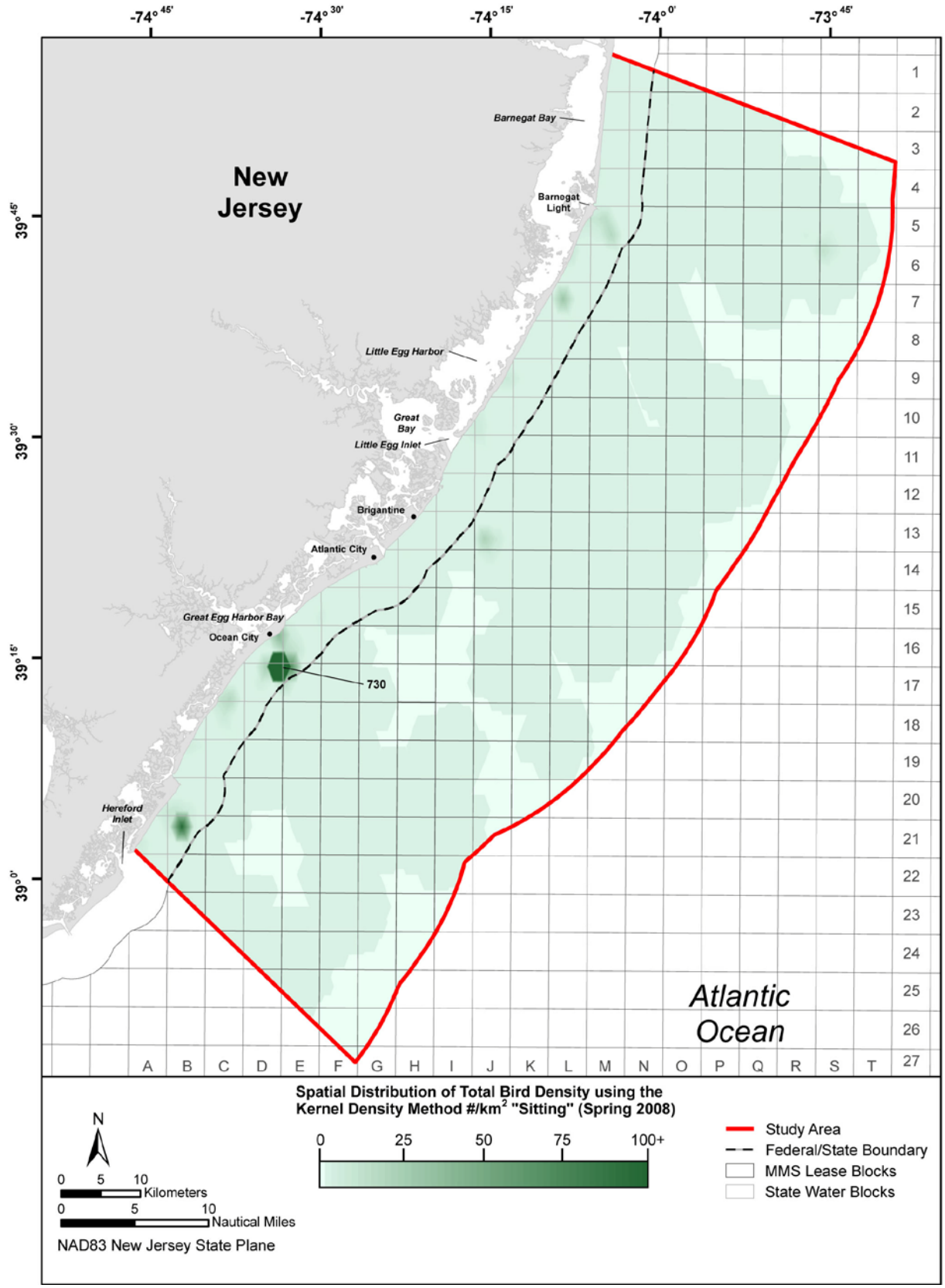

Figure M-454. Spatial distribution of total bird density (#/km^2) in the Study Area for sitting birds using the kernel density method (Spring 2008).

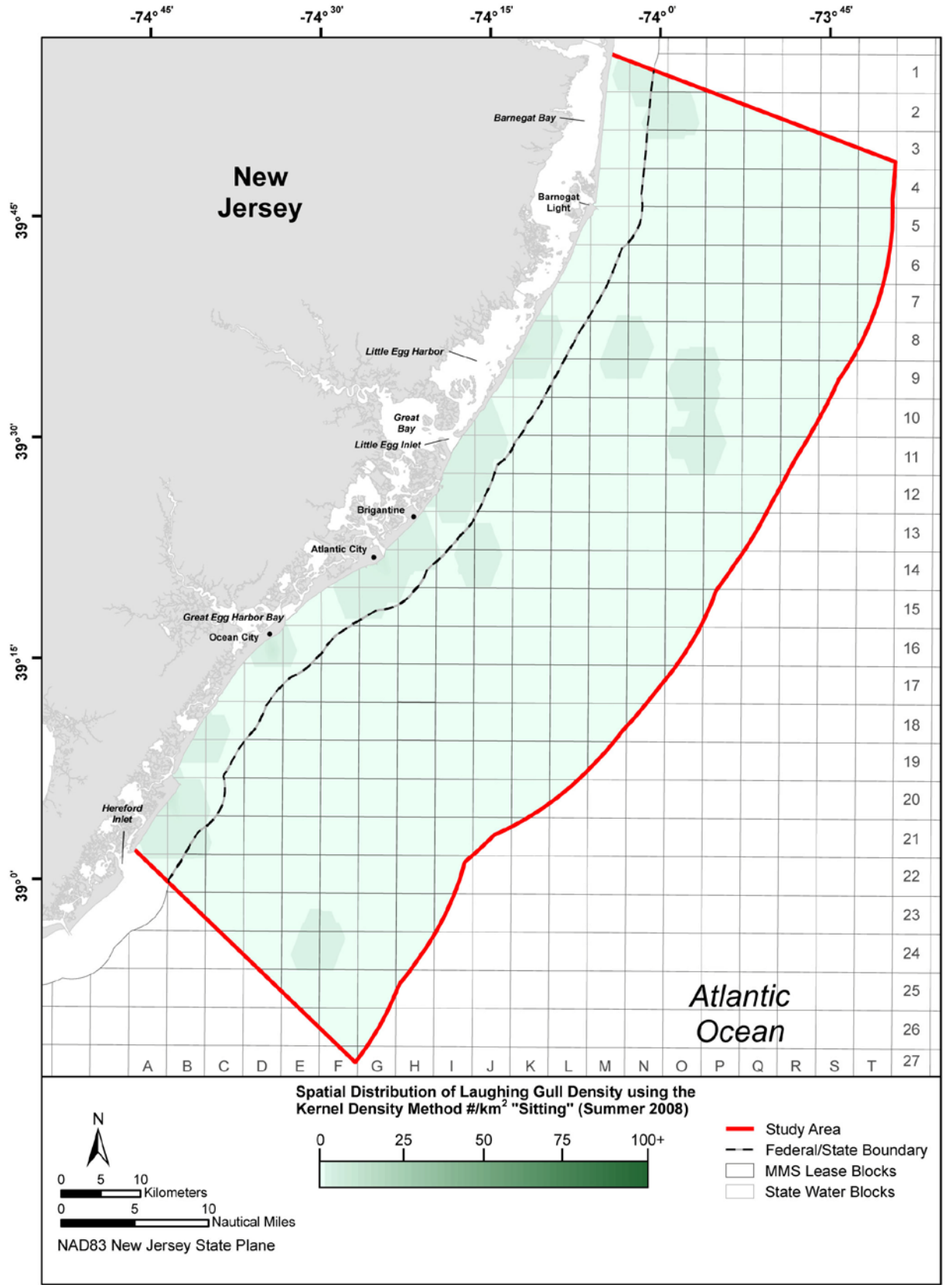

Figure M-455. Spatial distribution of Laughing Gull density (#/km^2) in the Study Area for sitting birds using the kernel density method (Summer 2008).

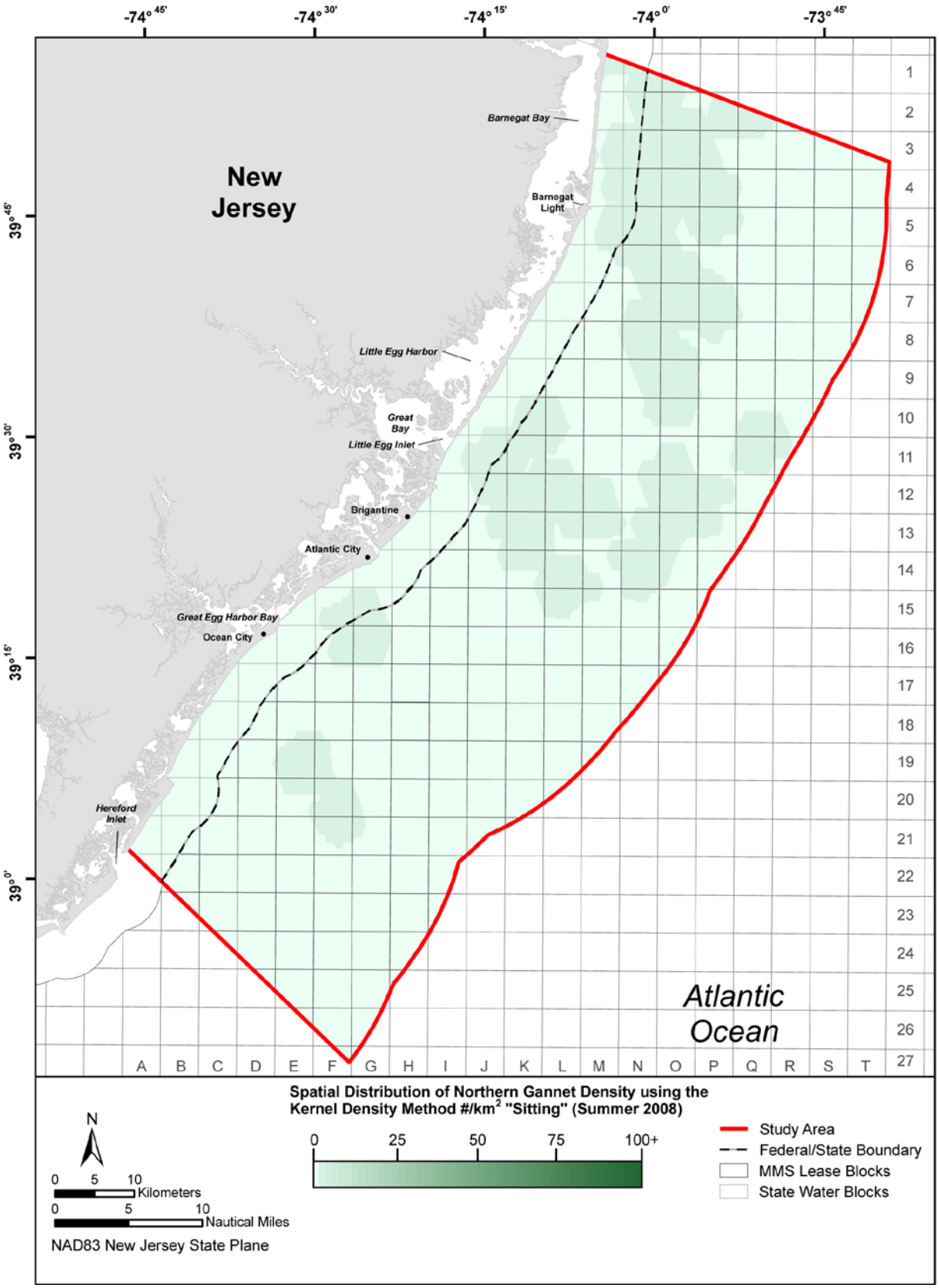

Figure M-456. Spatial distribution of Northern Gannet density (#/km^2) in the Study Area for sitting birds using the kernel density method (Summer 2008).

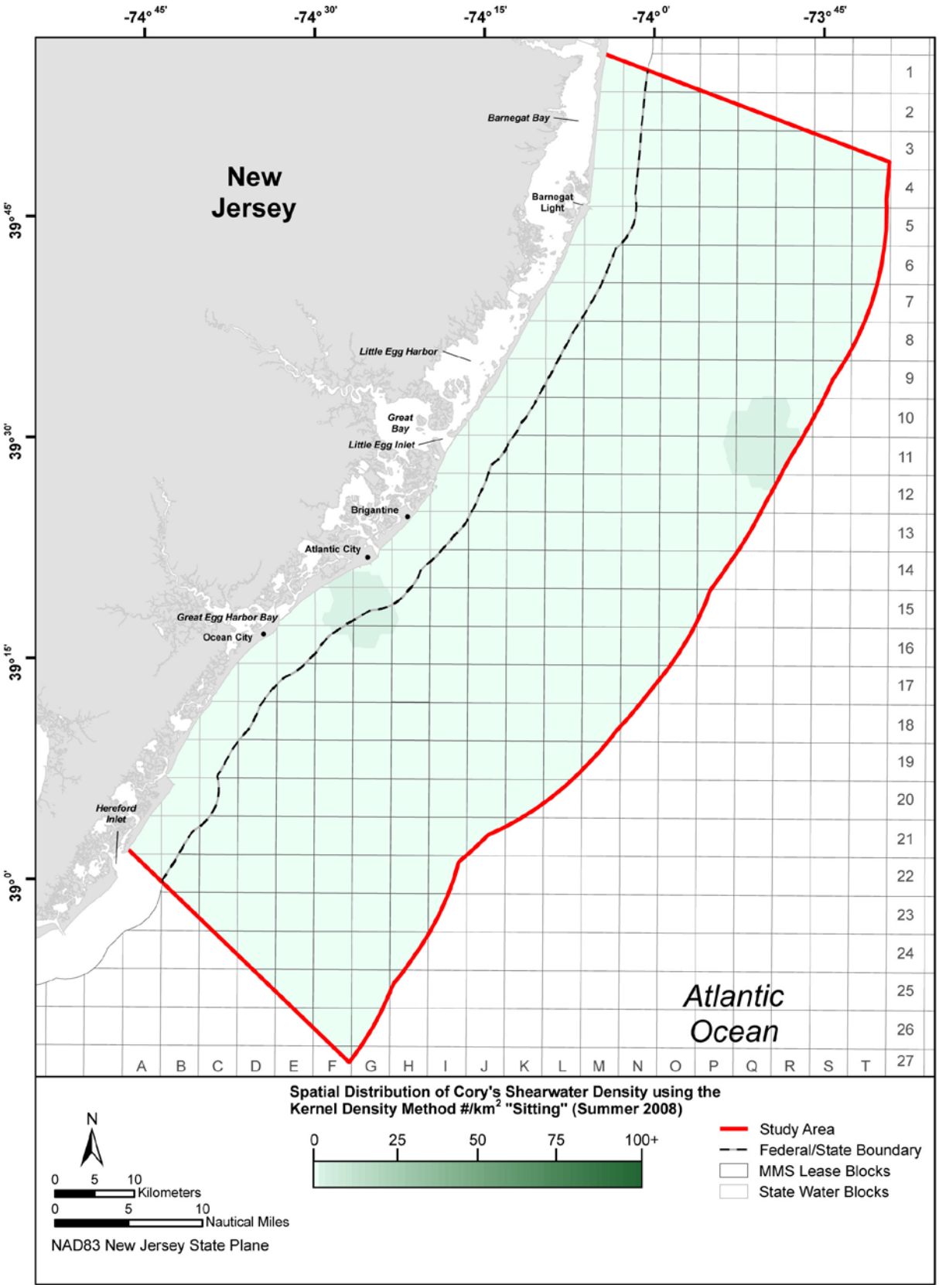

Figure M-457. Spatial distribution of Cory's Shearwater density (#/km^2) in the Study Area for sitting birds using the kernel density method (Summer 2008).

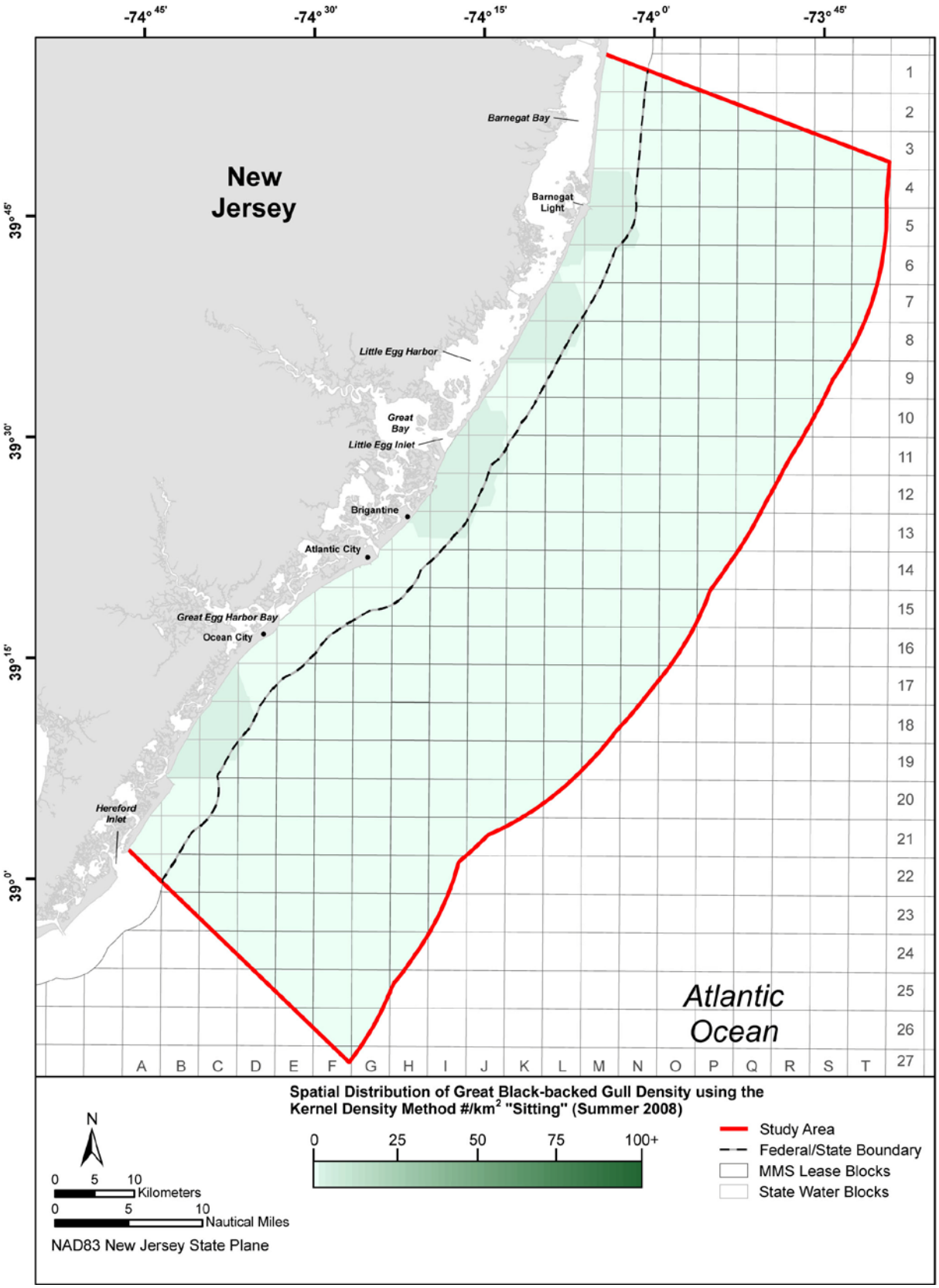

Figure M-458. Spatial distribution of Great Black-backed Gull density (#/km^2) in the Study Area for sitting birds using the kernel density method (Summer 2008).

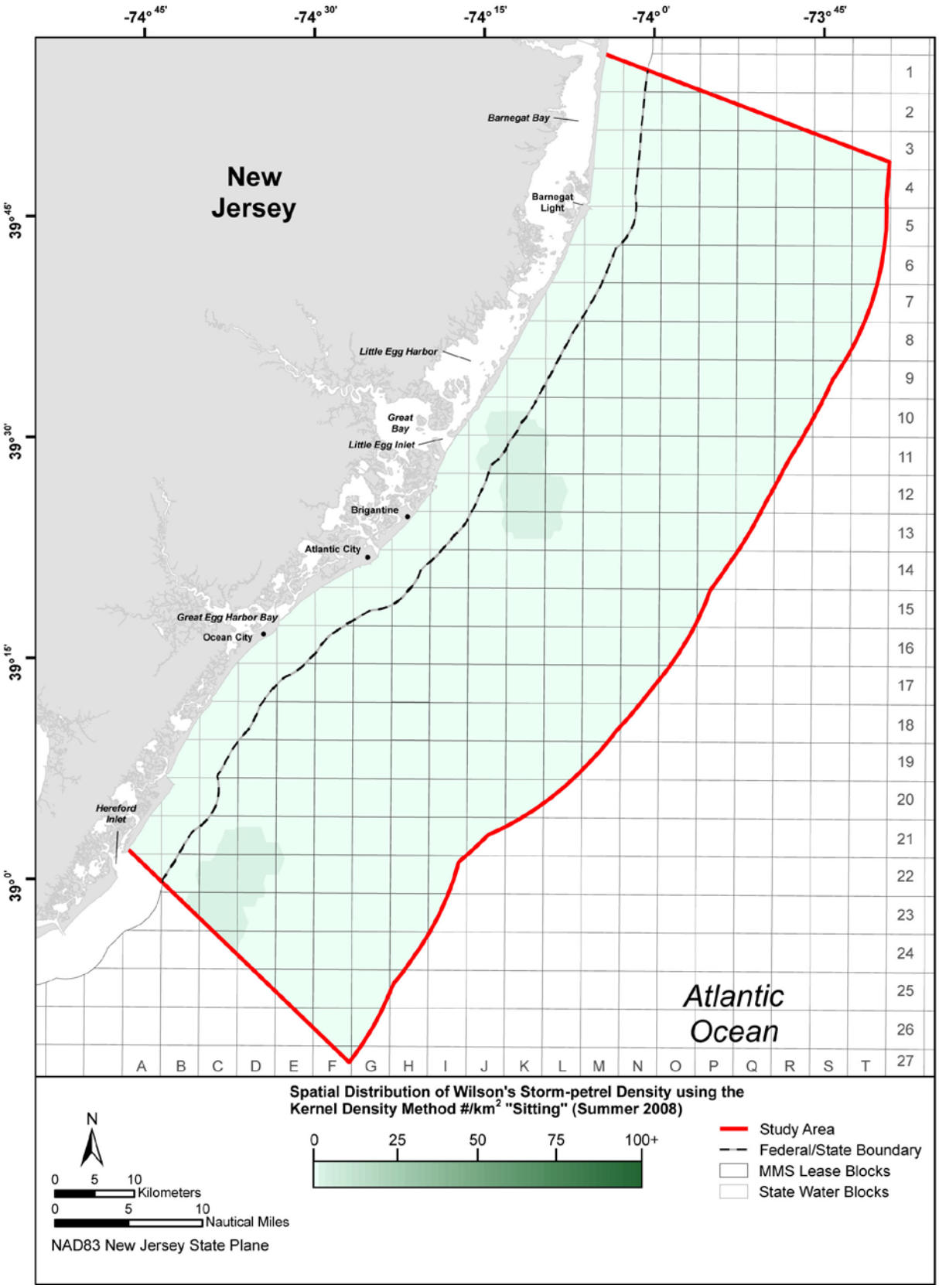

Figure M-459. Spatial distribution of Wilson's Storm-Petrel density (#/km^2) in the Study Area for sitting birds using the kernel density method (Summer 2008).

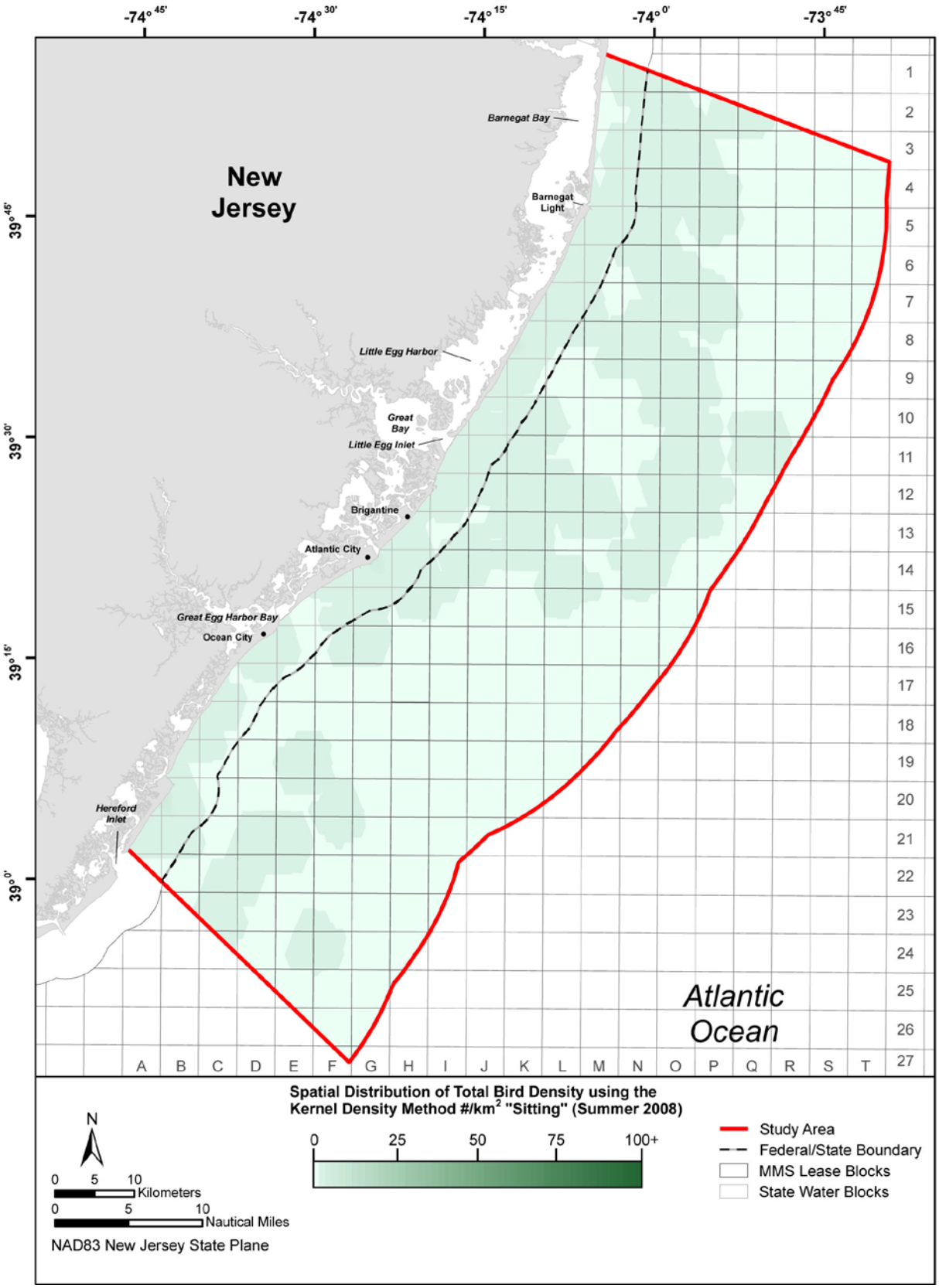

Figure M-460. Spatial distribution of total bird density (#/km^2) in the Study Area for sitting birds using the kernel density method (Summer 2008).

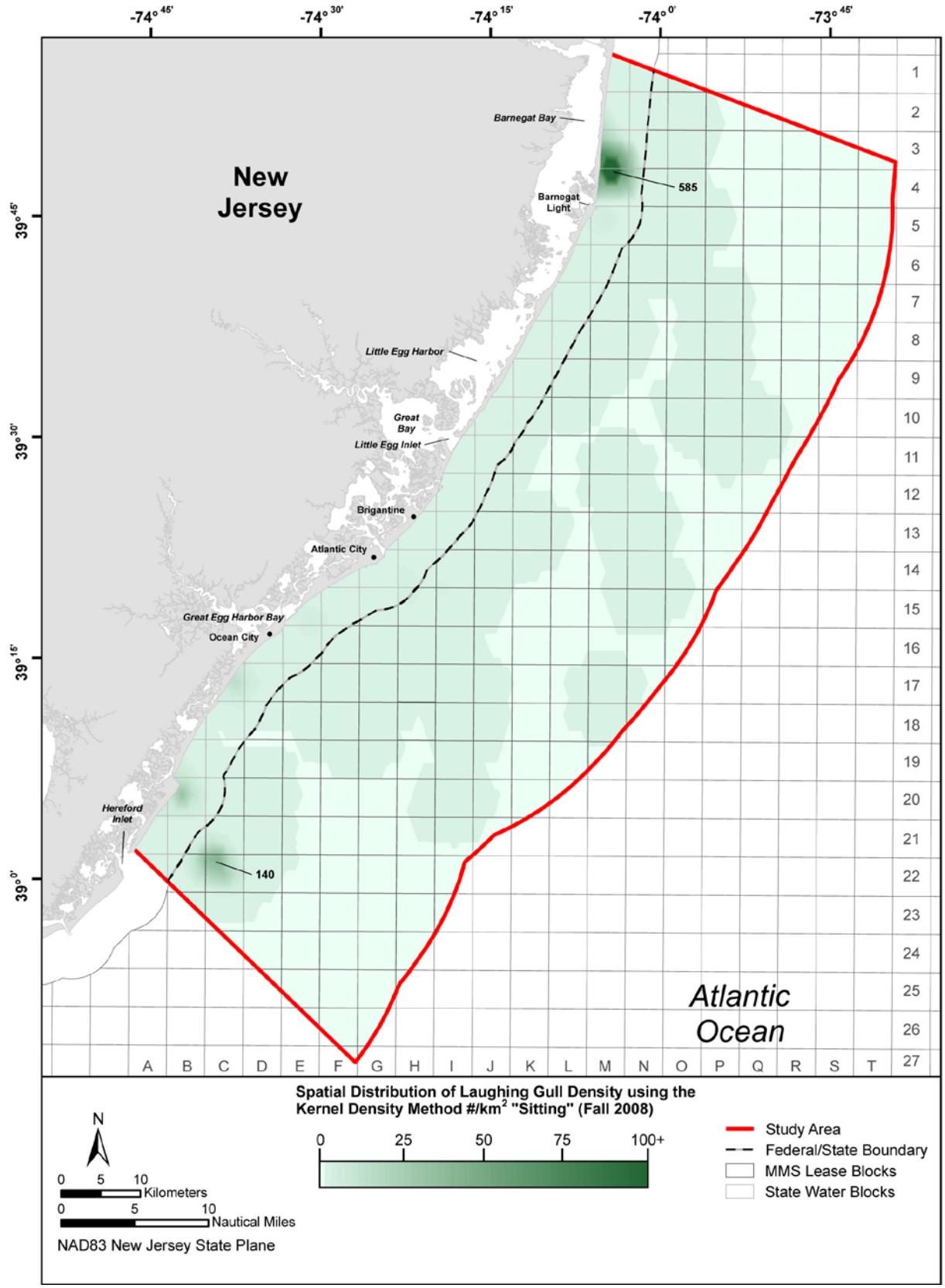

Figure M-461. Spatial distribution of Laughing Gull density (#/km^2) in the Study Area for sitting birds using the kernel density method (Fall 2008).

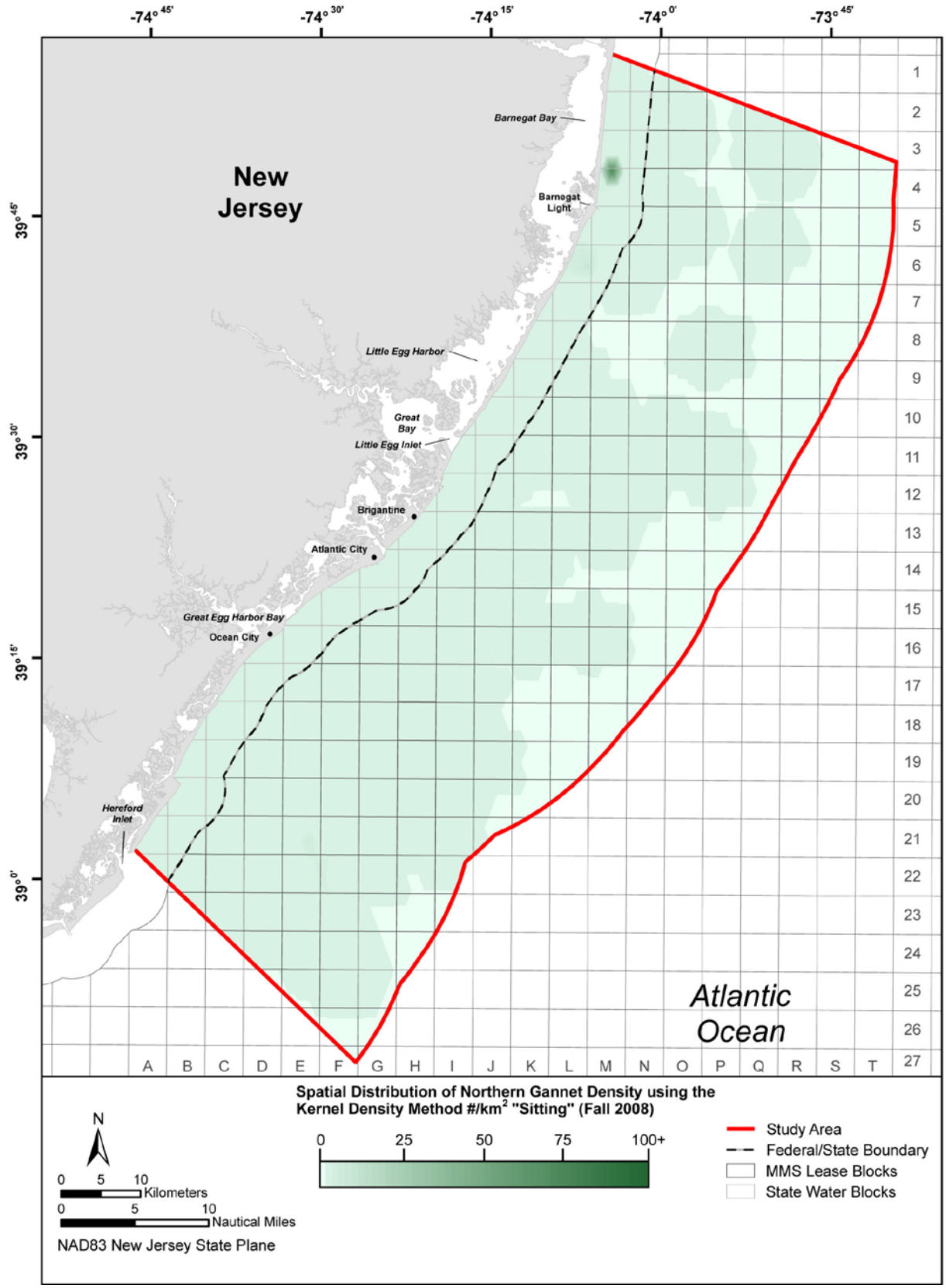

Figure M-462. Spatial distribution of Northern Gannet density (#/km^2) in the Study Area for sitting birds using the kernel density method (Fall 2008).

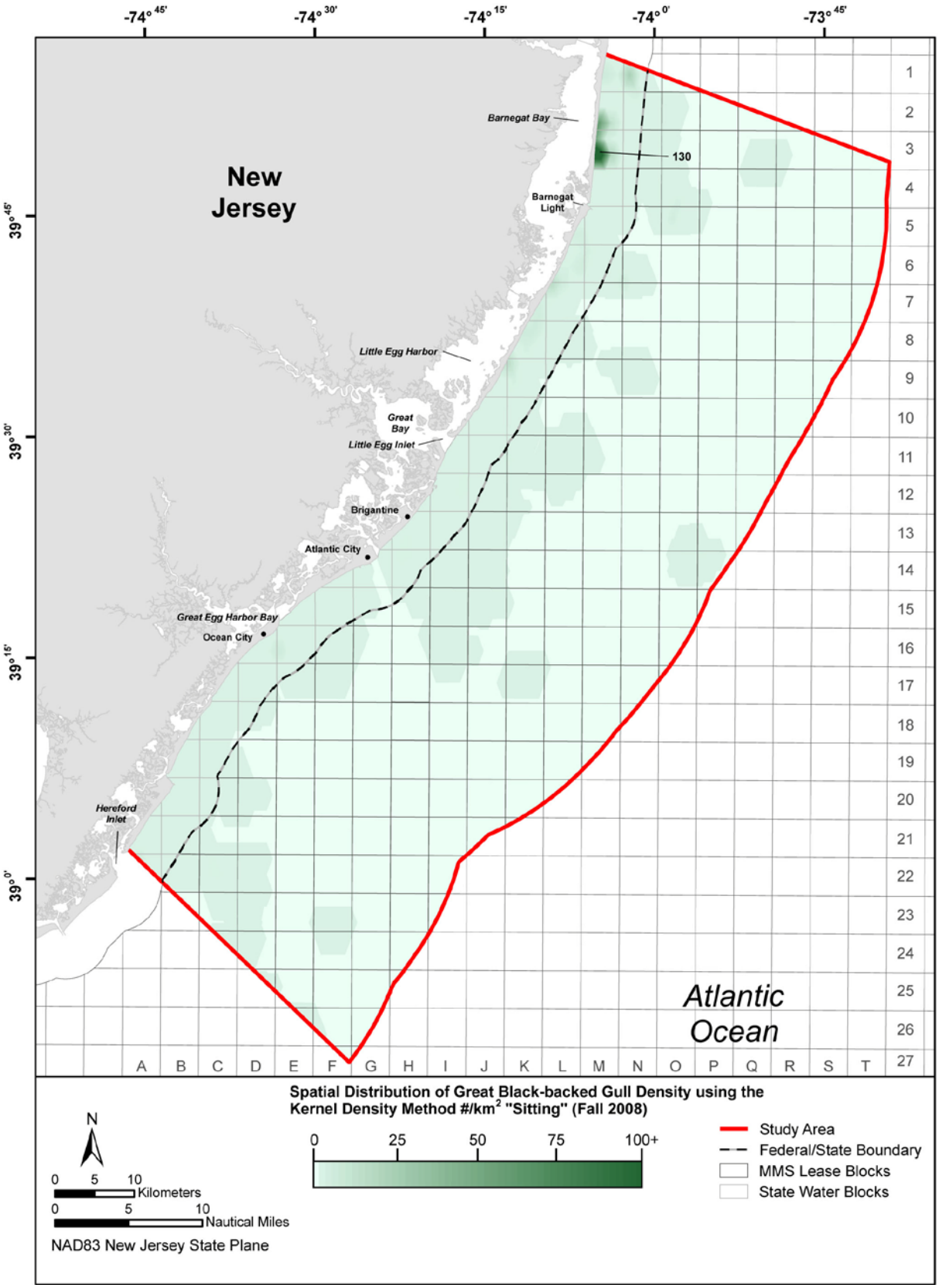

Figure M-463. Spatial distribution of Great Black-backed Gull density (#/km^2) in the Study Area for sitting birds using the kernel density method (Fall 2008).

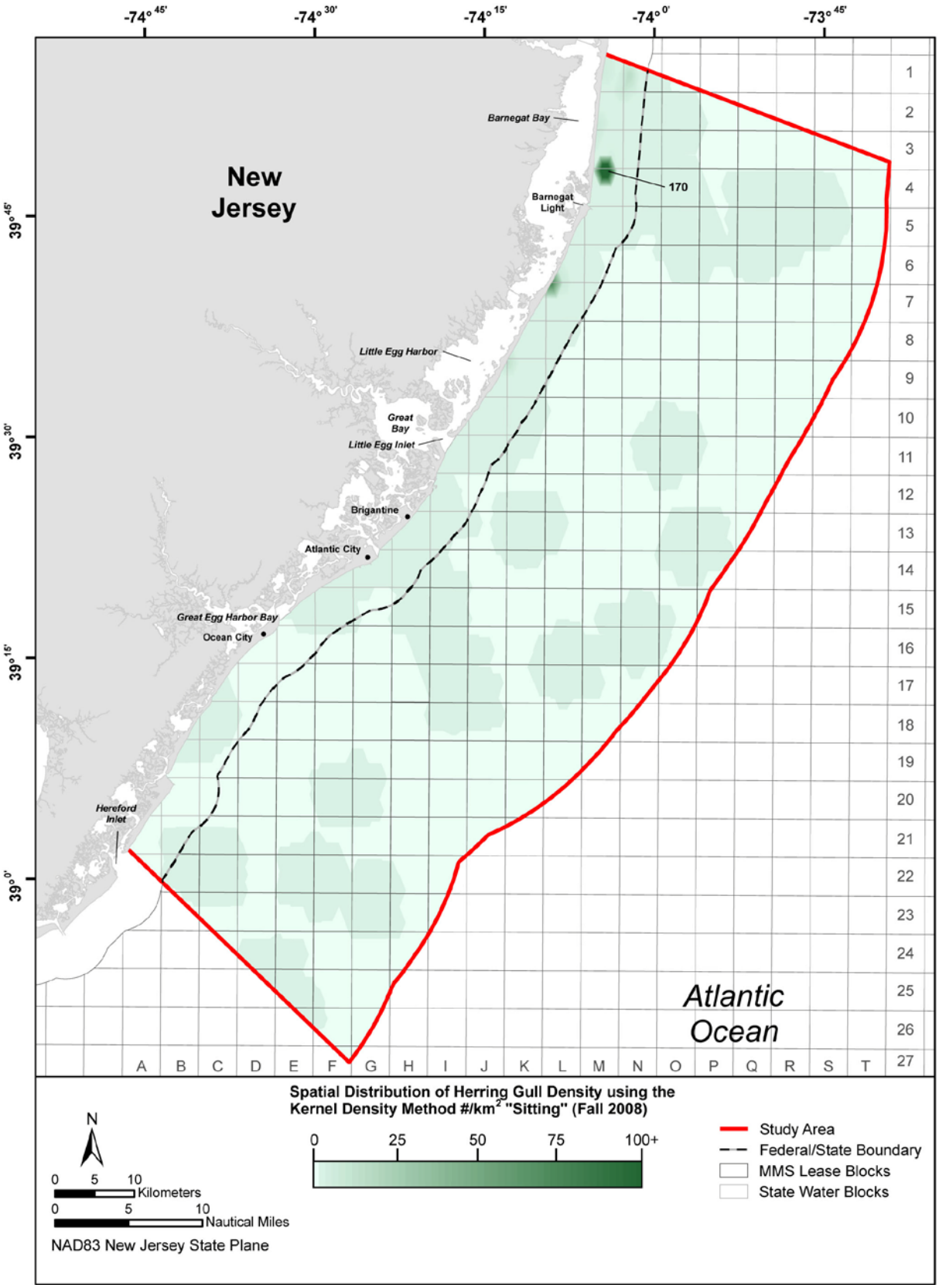

Figure M-464. Spatial distribution of Herring Gull density (#/km^2) in the Study Area for sitting birds using the kernel density method (Fall 2008).

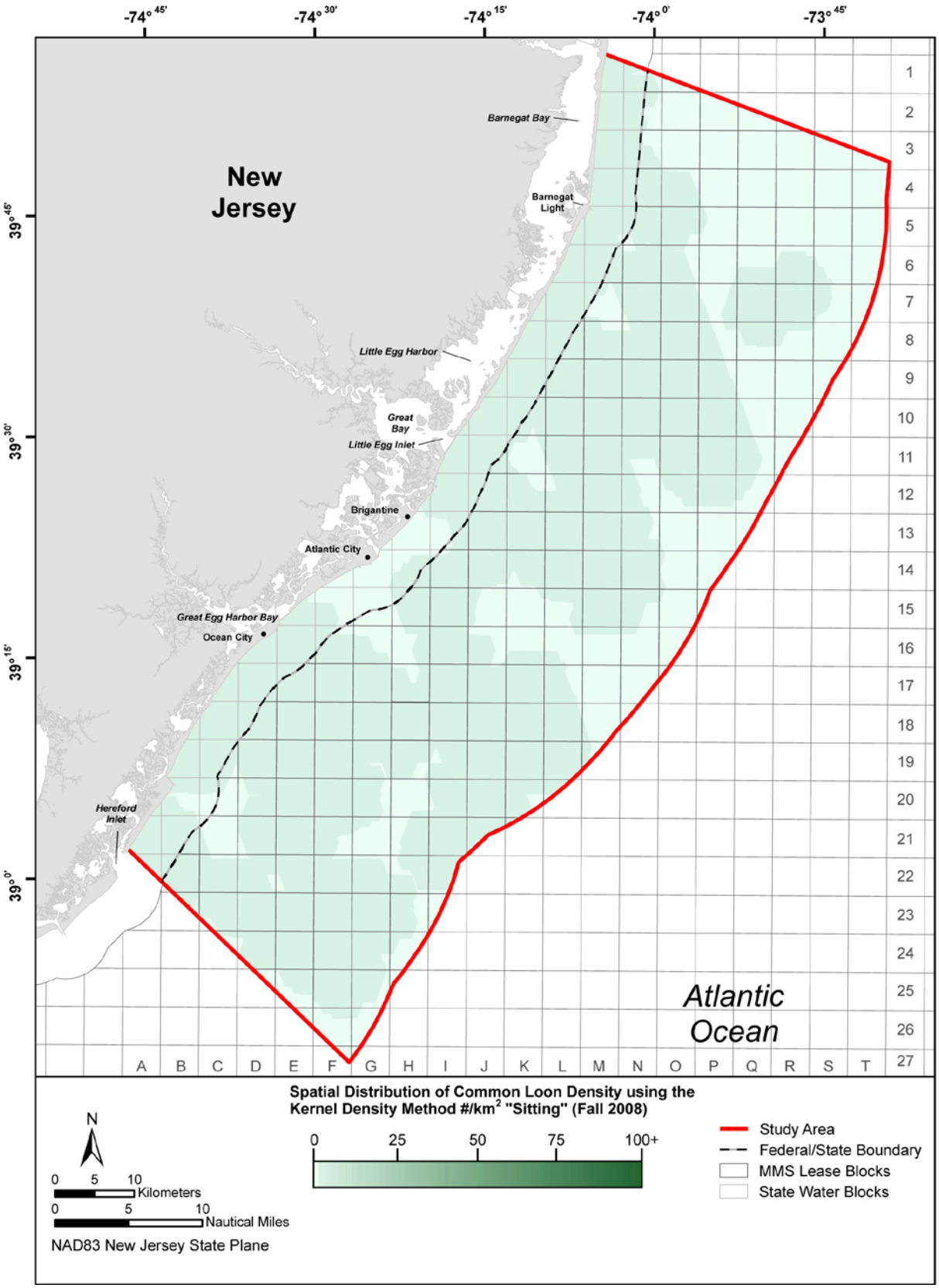

Figure M-465. Spatial distribution of Common Loon density (#/km^2) in the Study Area for sitting birds using the kernel density method (Fall 2008).

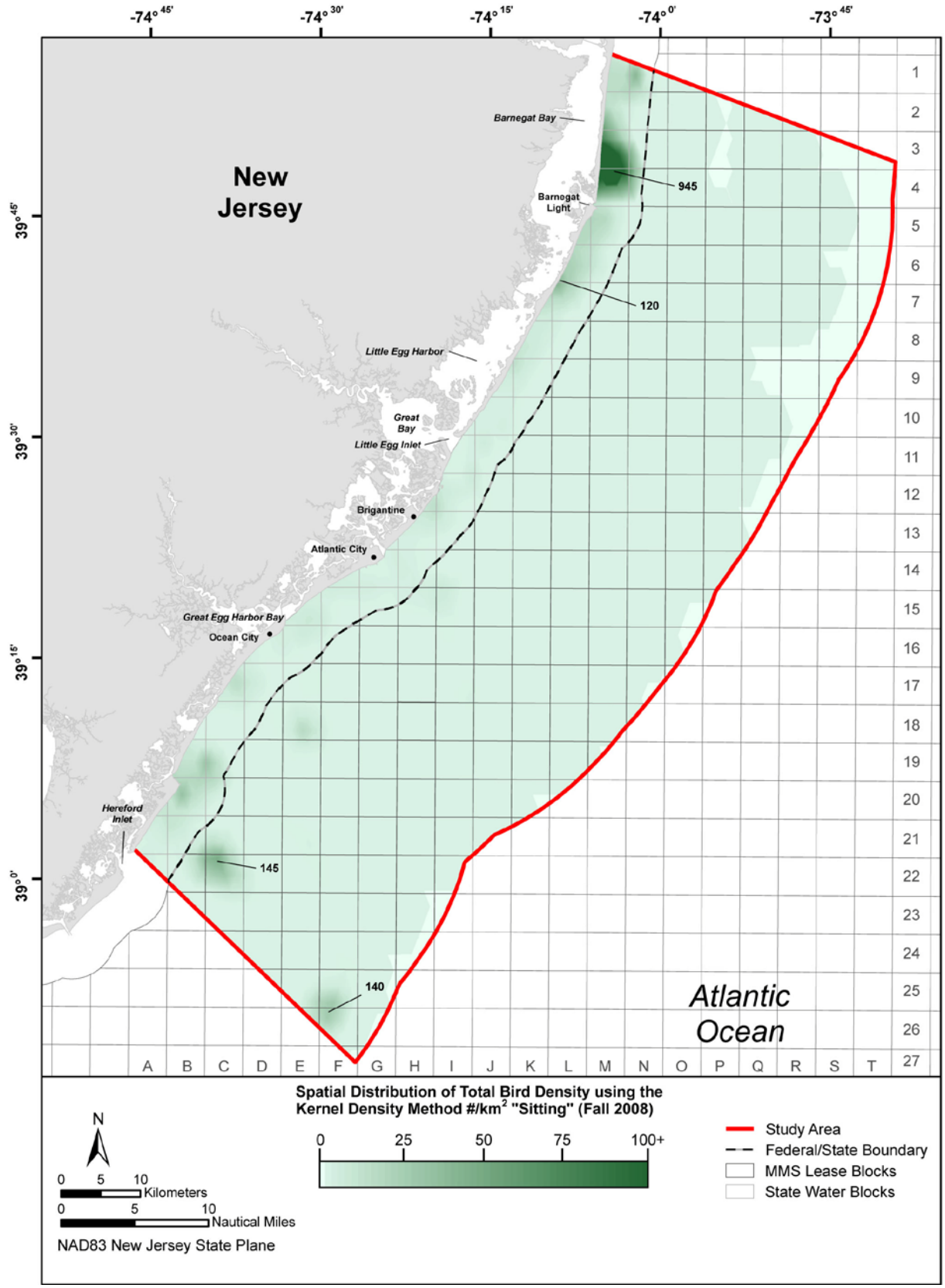

Figure M-466. Spatial distribution of total bird density (#/km^2) in the Study Area for sitting birds using the kernel density method (Fall 2008).

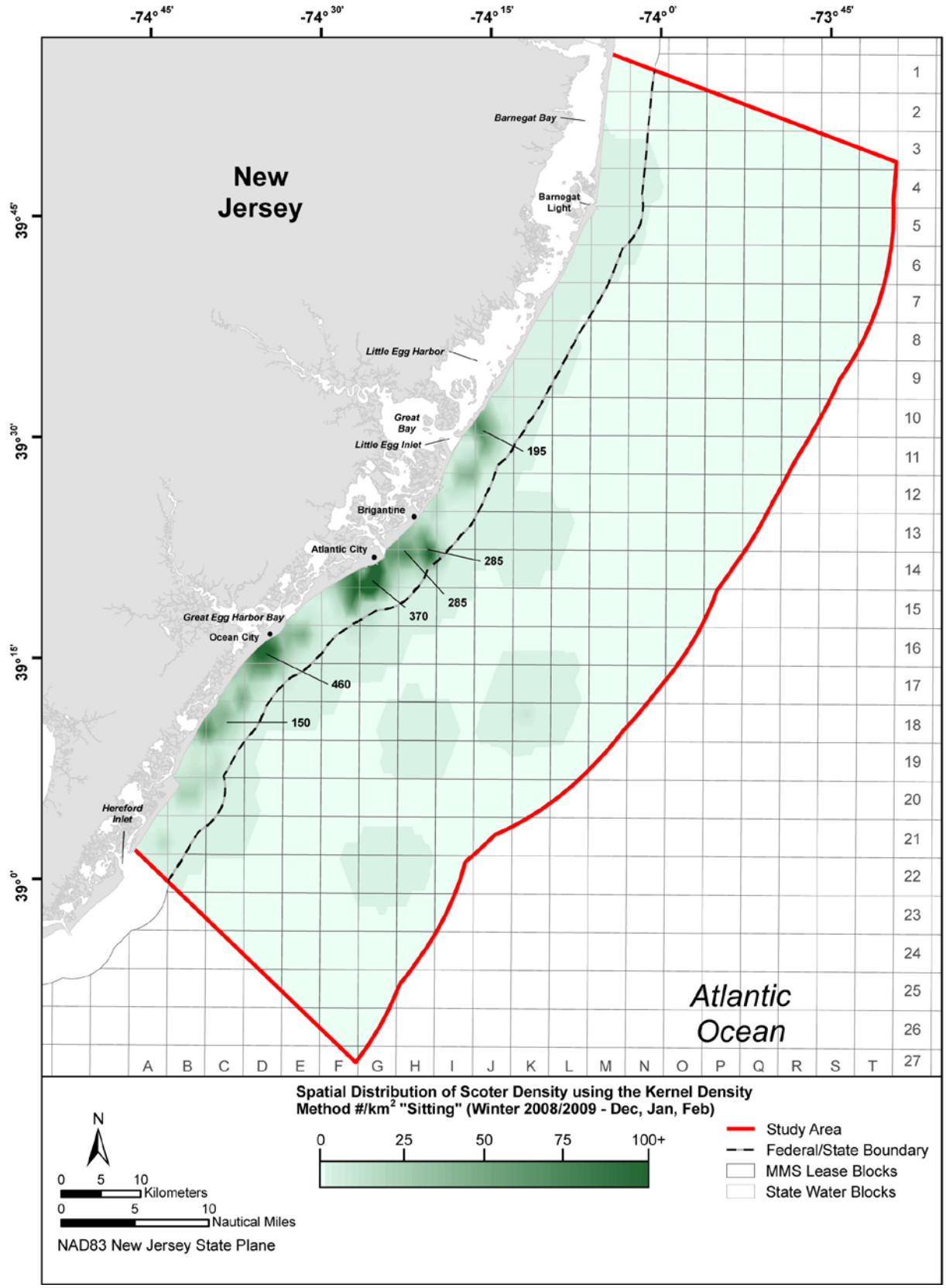

Figure M-467. Spatial distribution of scoter density (#/km^2) in the Study Area for sitting birds using the kernel density method (Winter 2008/2009).

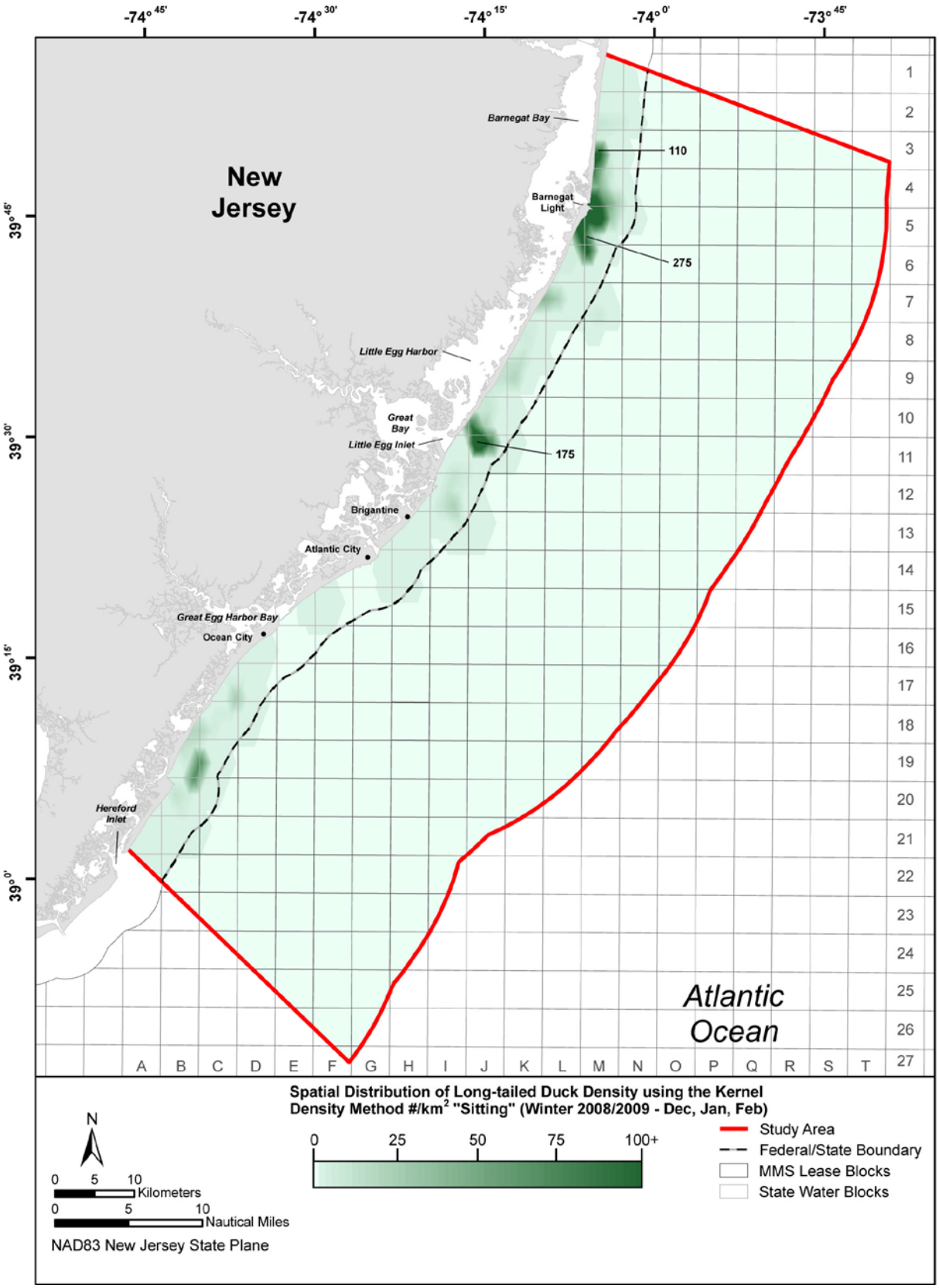

Figure M-468. Spatial distribution of Long-tailed Duck density (#/km^2) in the Study Area for sitting birds using the kernel density method (Winter 2008/2009).

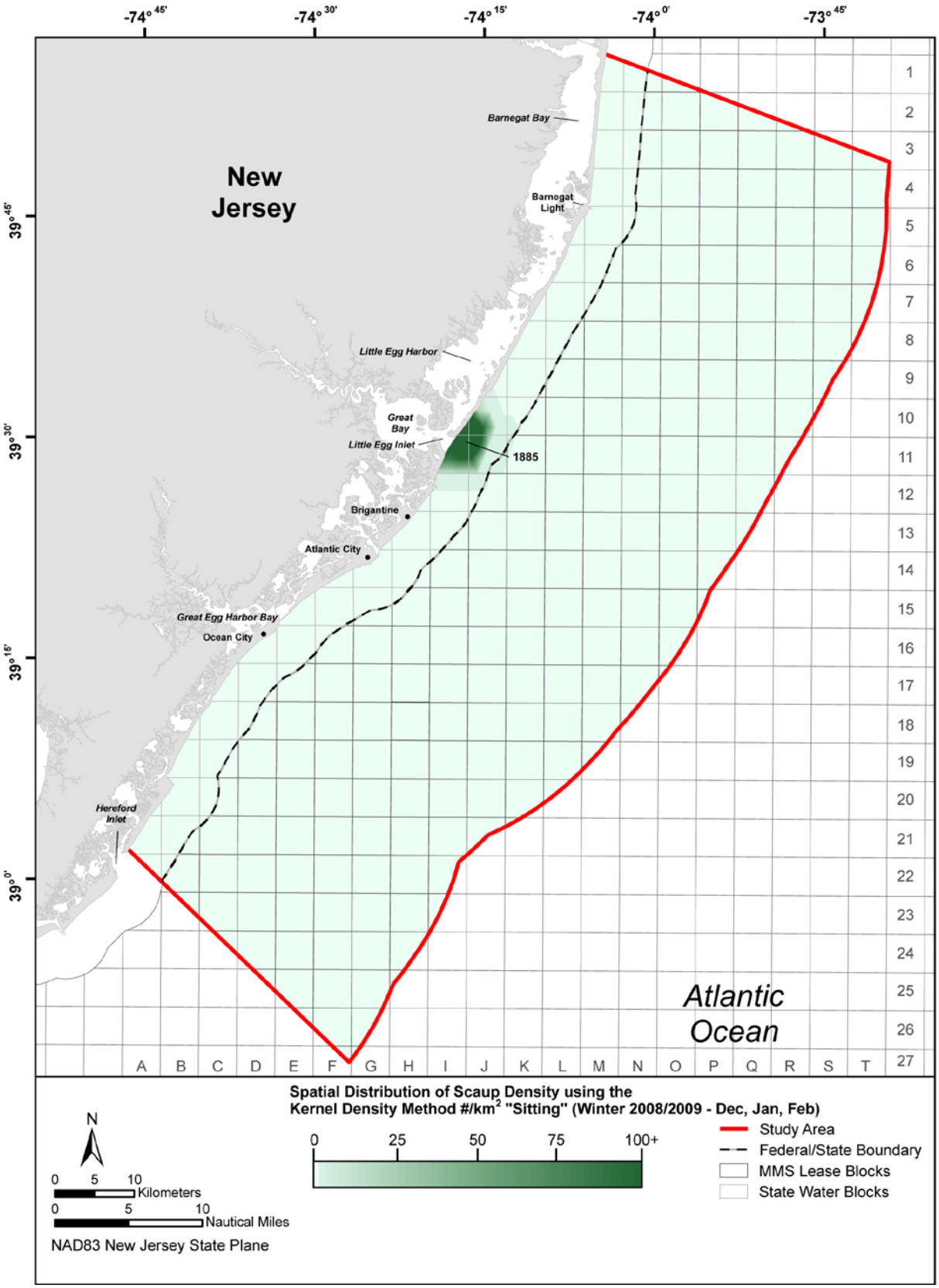

Figure M-469. Spatial distribution of scaup density (#/km^2) in the Study Area for sitting birds using the kernel density method (Winter 2008/2009).

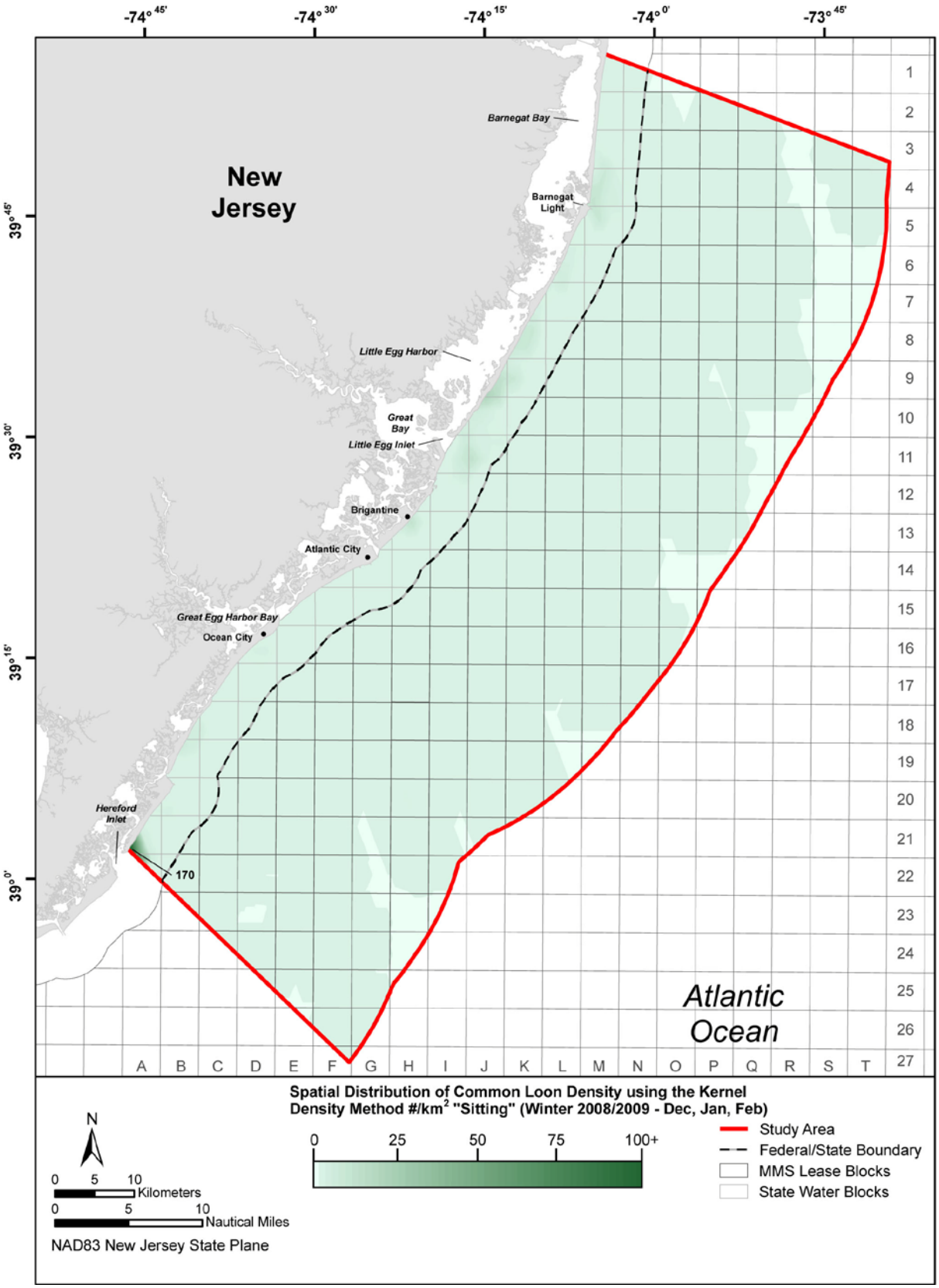

Figure M-470. Spatial distribution of Common Loon density (#/km^2) in the Study Area for sitting birds using the kernel density method (Winter 2008/2009).

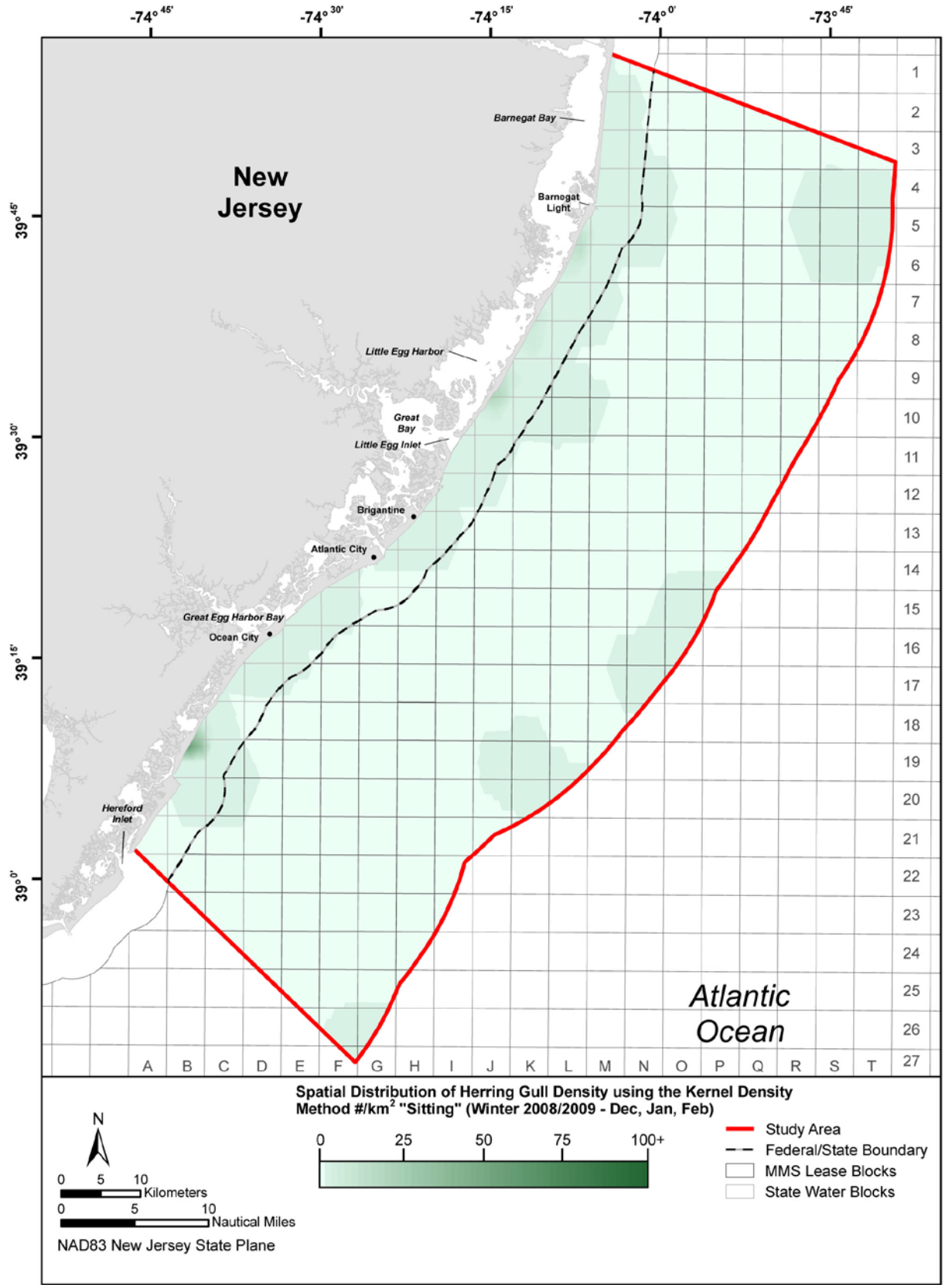

Figure M-471. Spatial distribution of Herring Gull density (#/km^2) in the Study Area for sitting birds using the kernel density method (Winter 2008/2009).

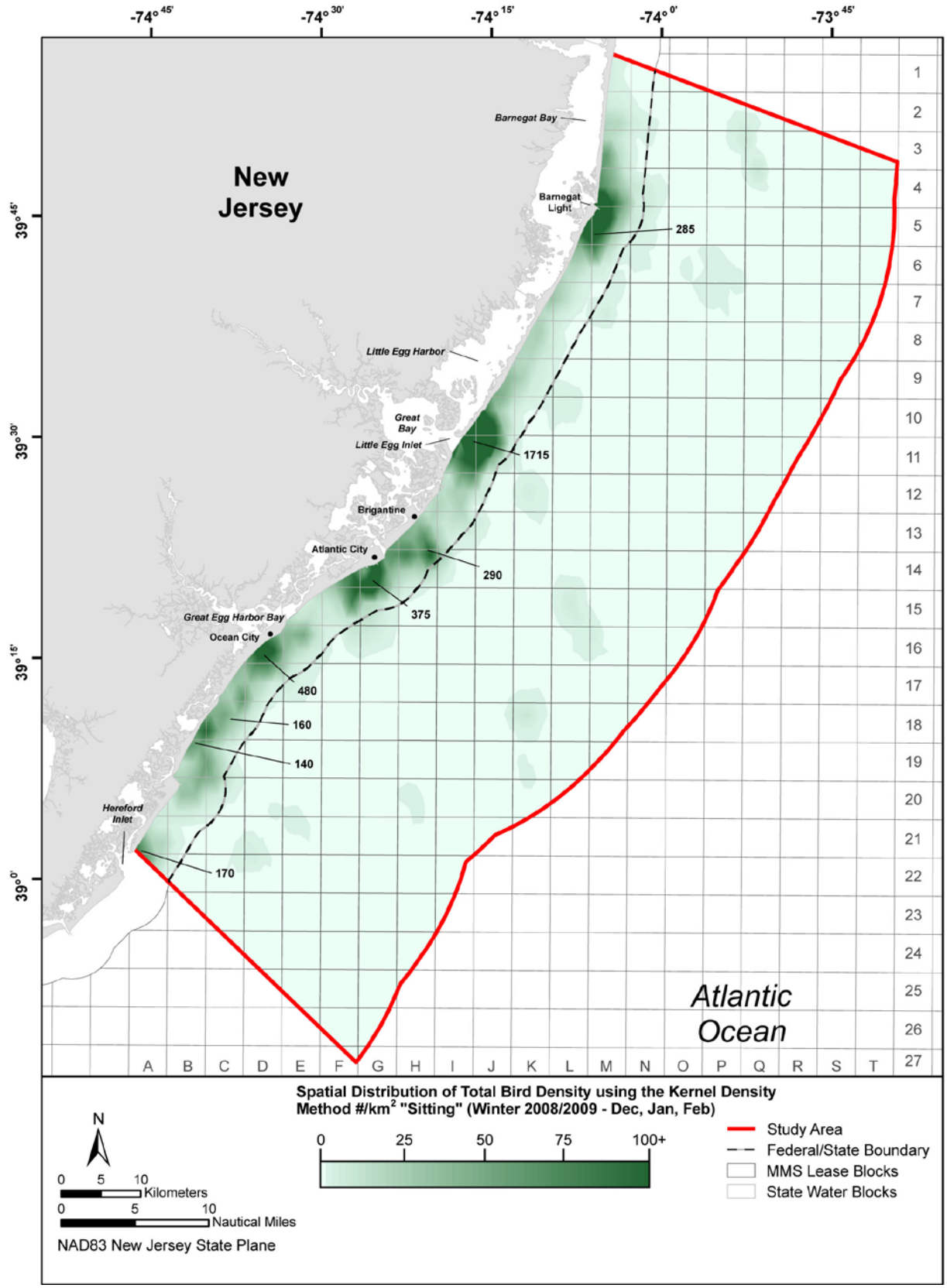

Figure M-472. Spatial distribution of total bird density (#/km^2) in the Study Area for sitting birds using the kernel density method (Winter 2008/2009).

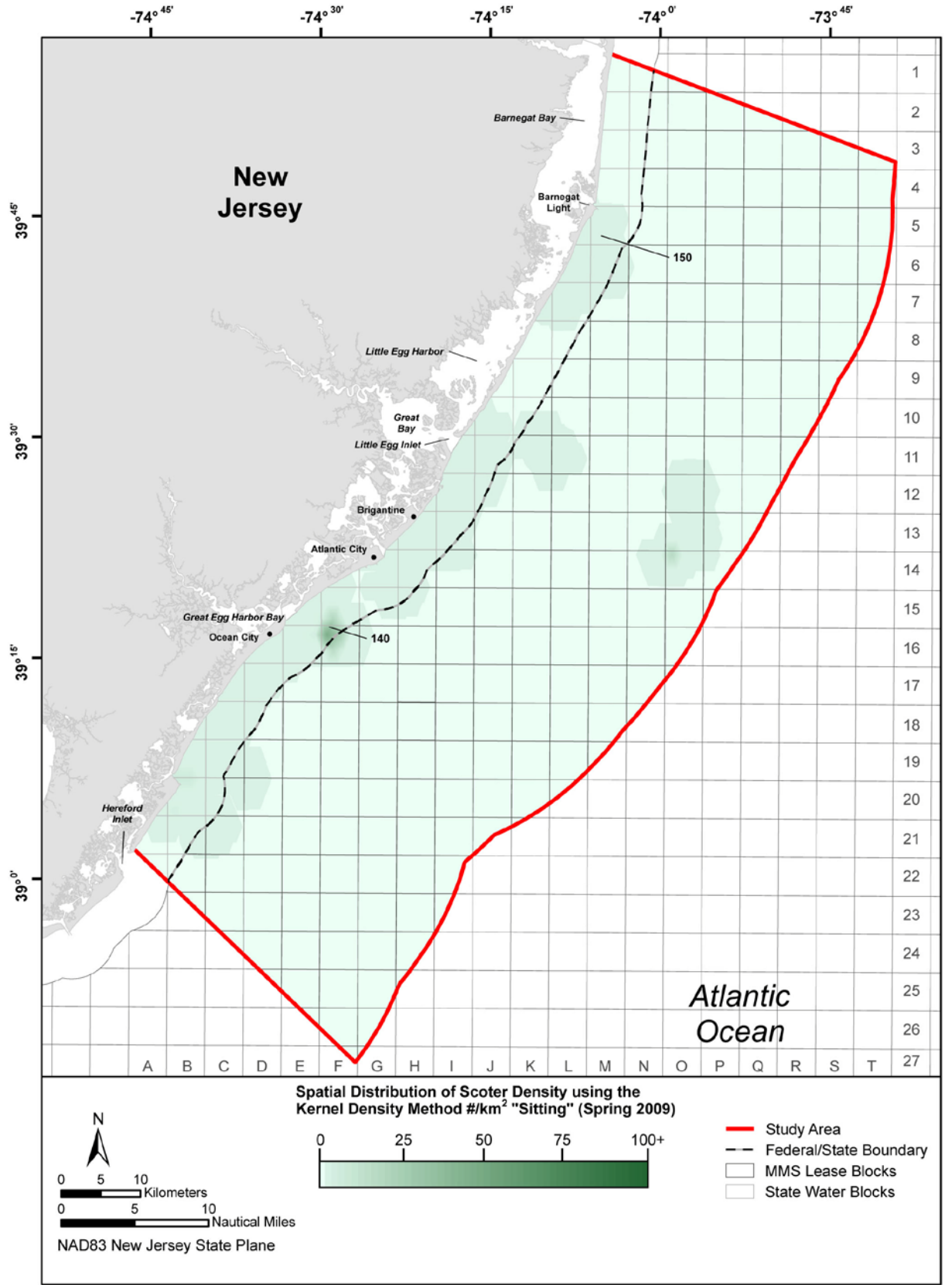

Figure M-473. Spatial distribution of scoter density (#/km^2) in the Study Area for sitting birds using the kernel density method (Spring 2009).

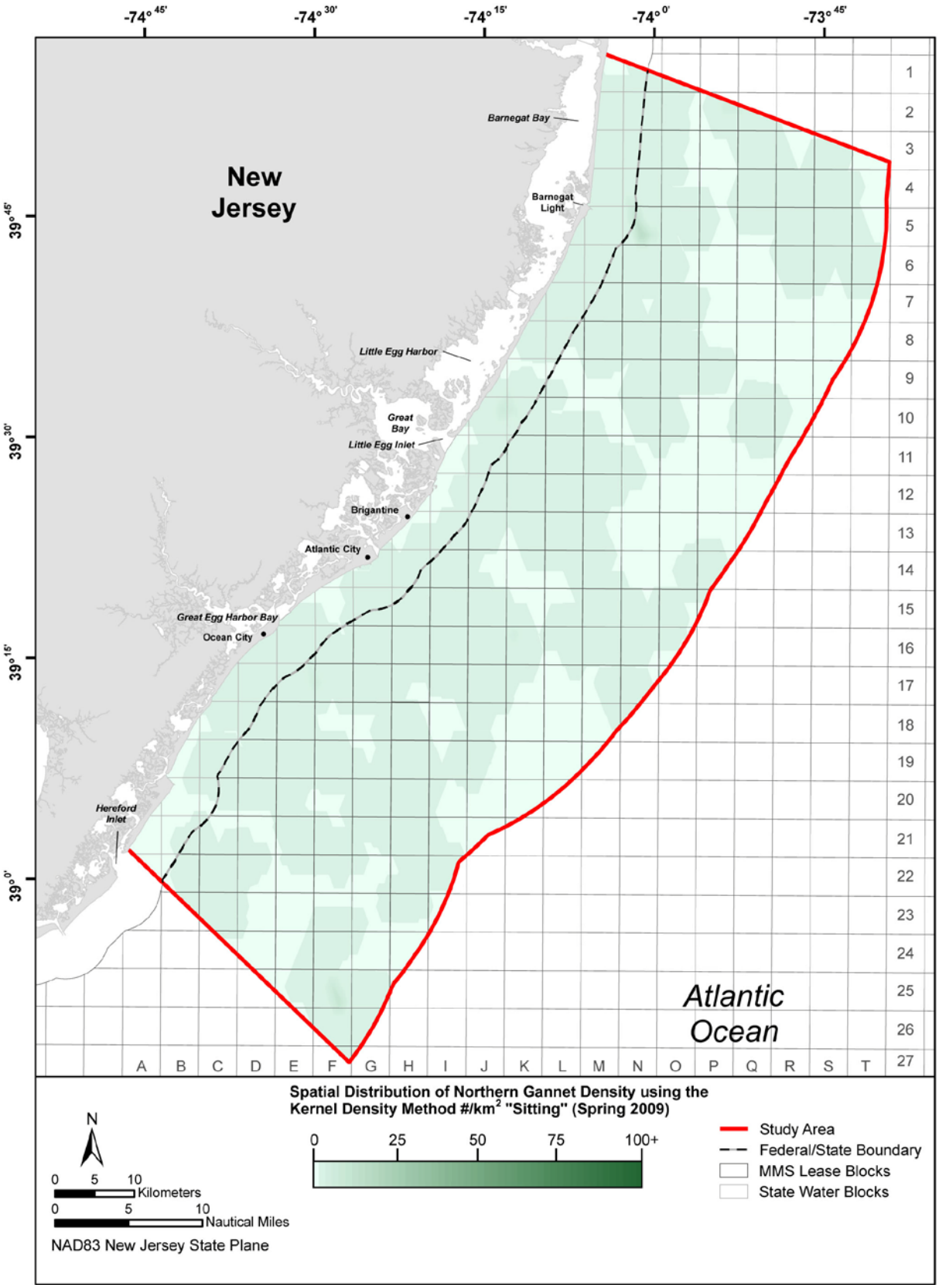

Figure M-474. Spatial distribution of Northern Gannet density (#/km^2) in the Study Area for sitting birds using the kernel density method (Spring 2009).

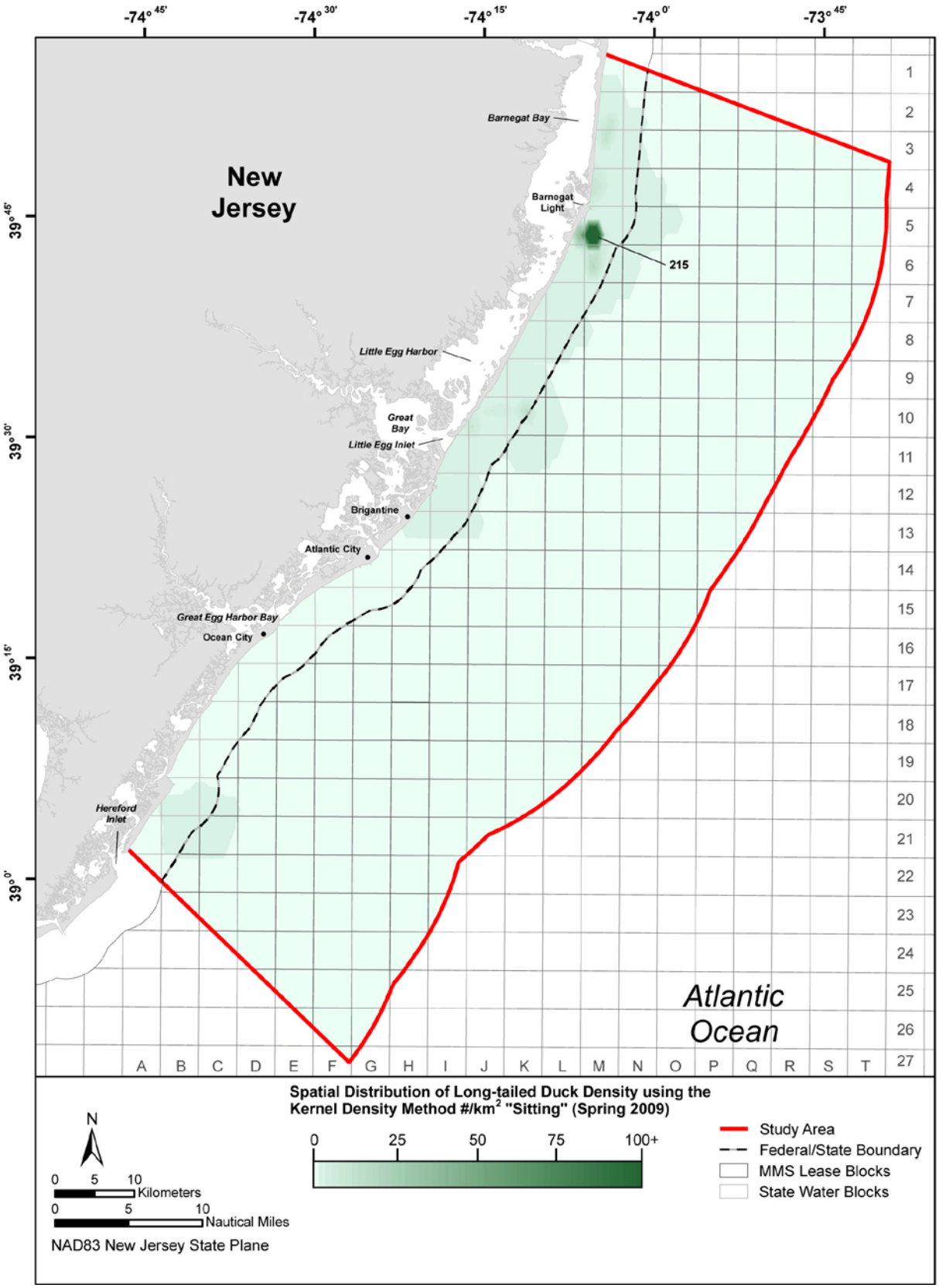

Figure M-475.Spatial distribution of Long-tailed Duck density (#/km^2) in the Study Area for sitting birds using the kernel density method (Spring 2009).

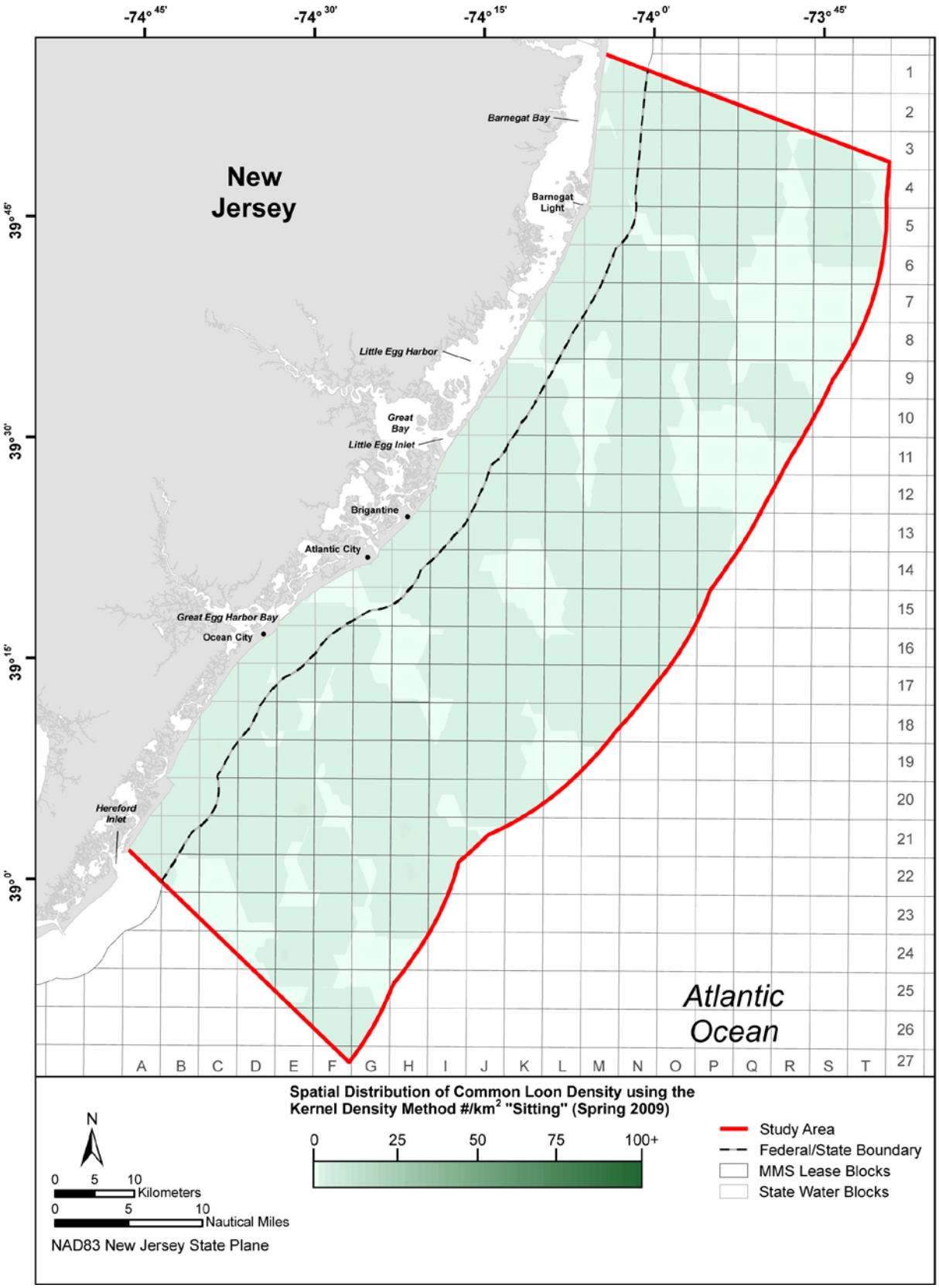

Figure M-476. Spatial distribution of Common Loon density (#/km^2) in the Study Area for sitting birds using the kernel density method (Spring 2009).

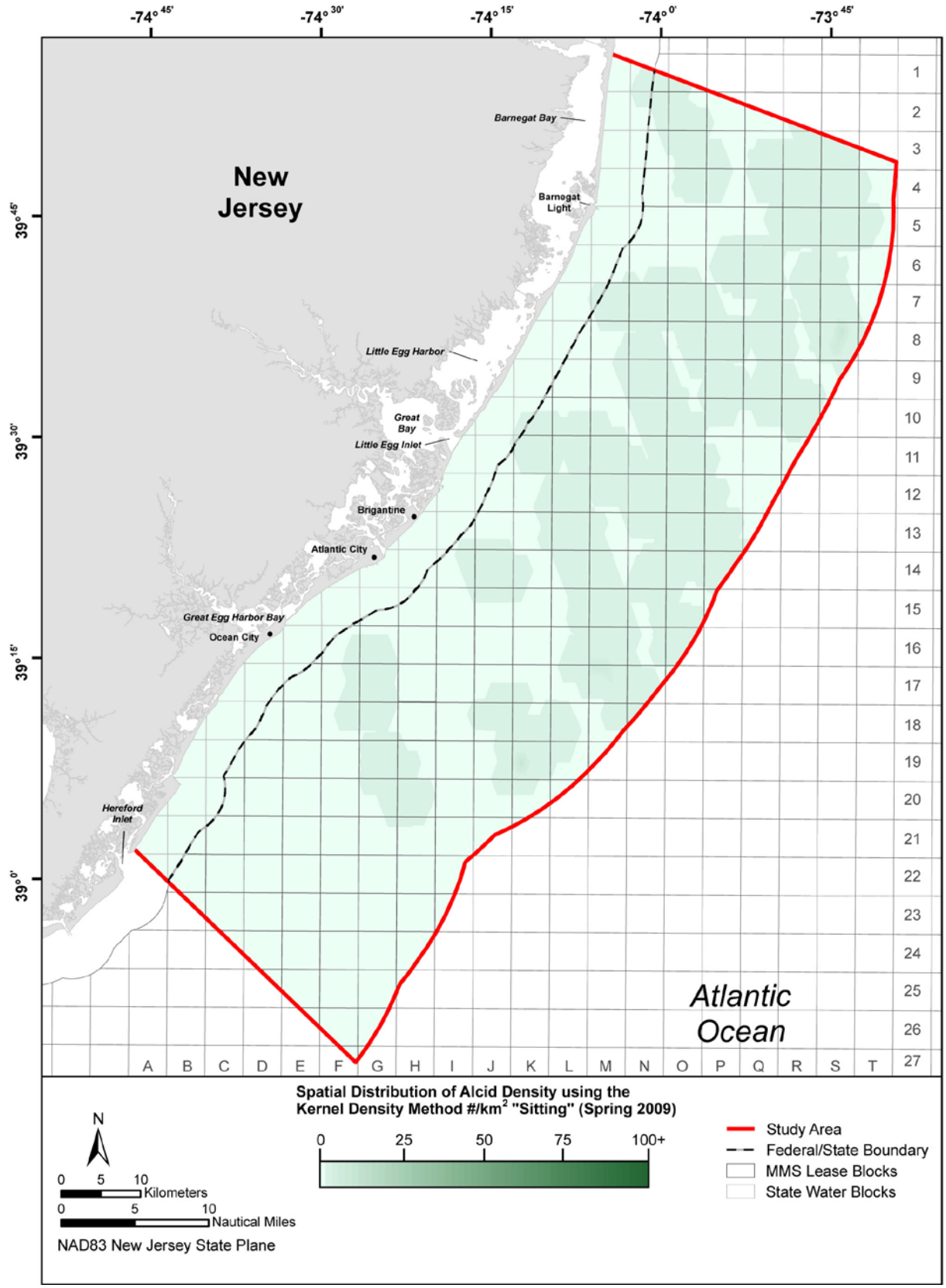

Figure M-477. Spatial distribution of alcid density (#/km^2) in the Study Area for sitting birds using the kernel density method (Spring 2009).

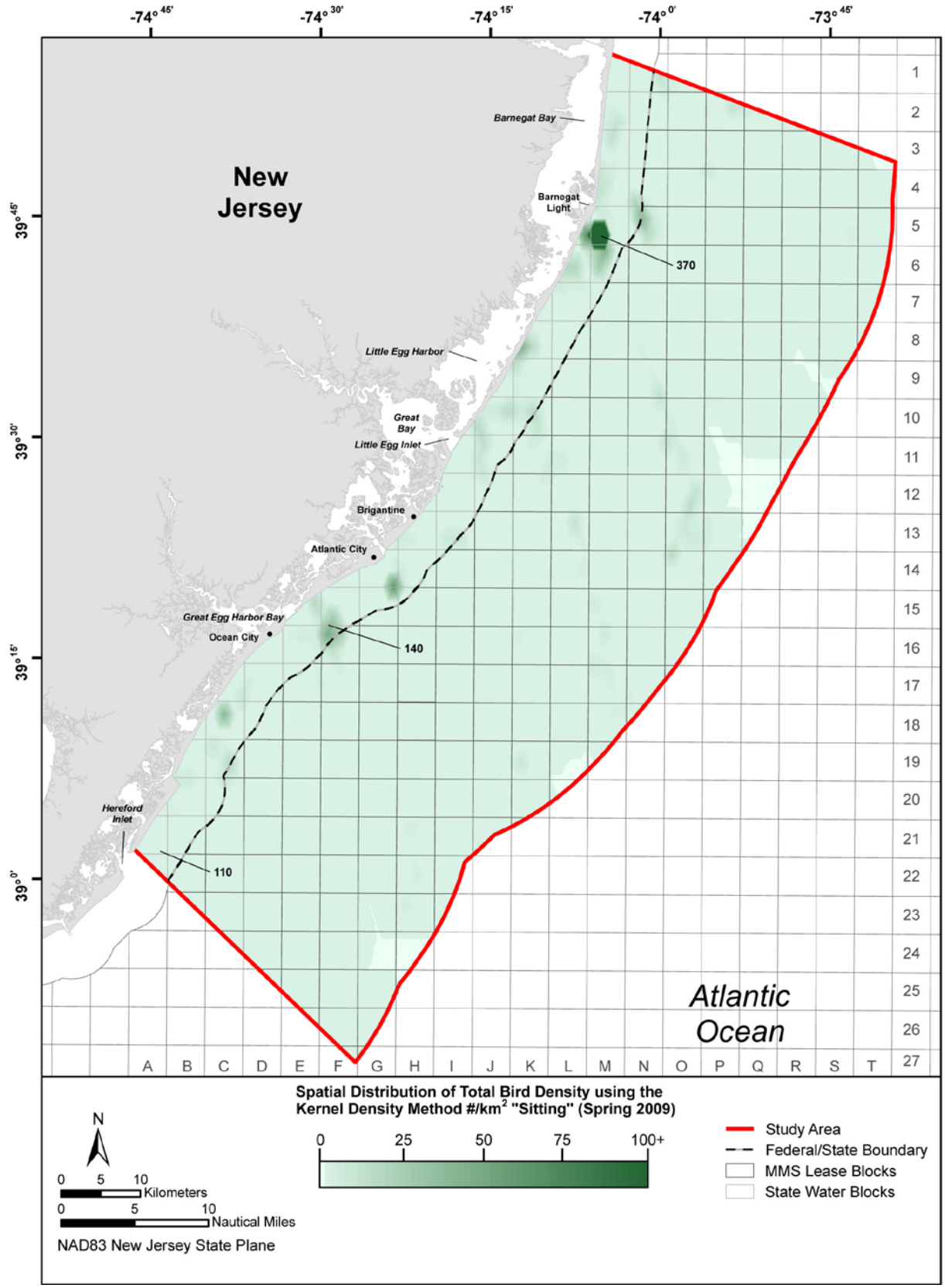

Figure M-478. Spatial distribution of total bird density (#/km^2) in the Study Area for sitting birds using the kernel density method (Spring 2009).

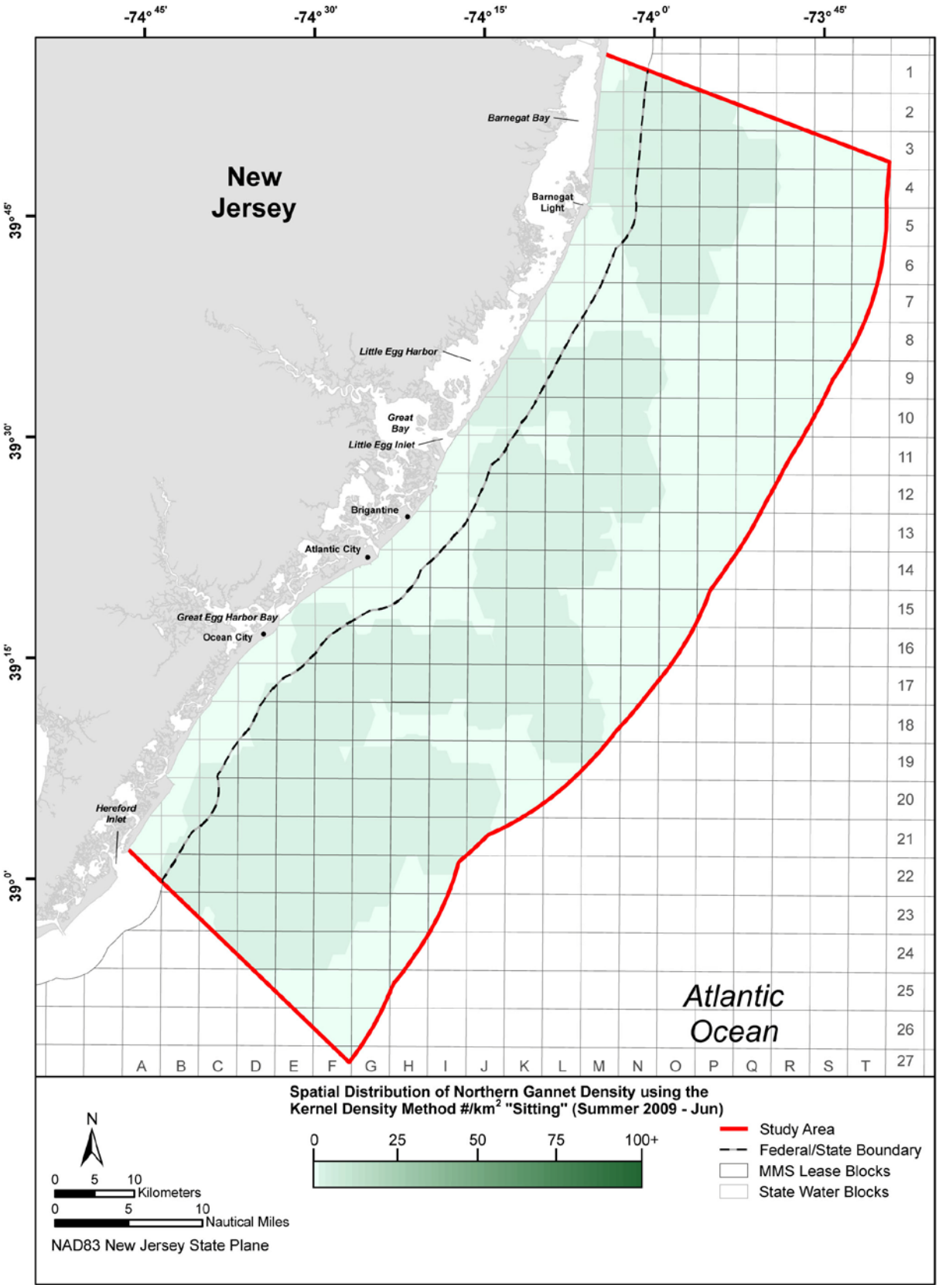

Figure M-479. Spatial distribution of Northern Gannet density (#/km^2) in the Study Area for sitting birds using the kernel density method (Summer 2009).

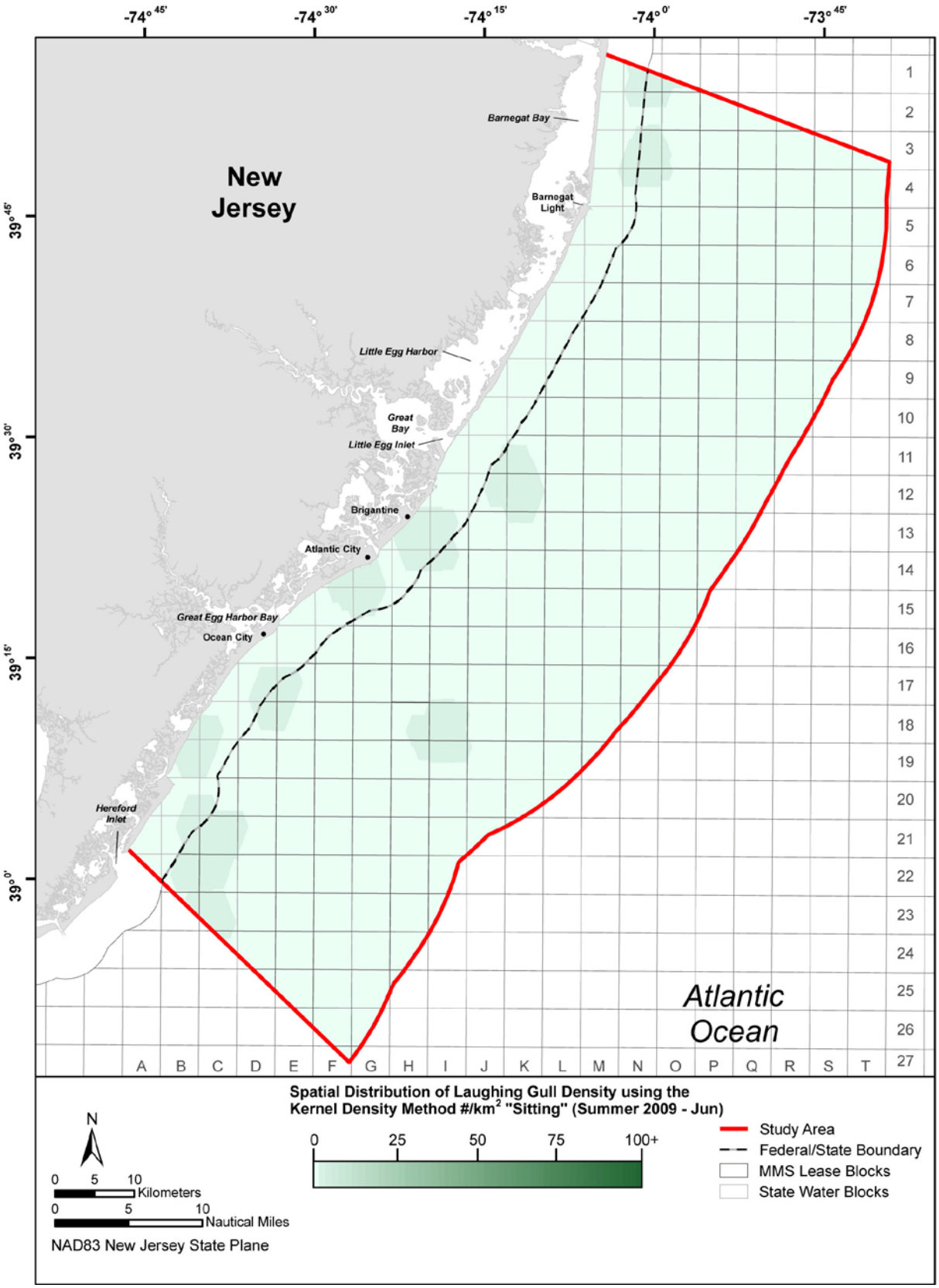

Figure M-480. Spatial distribution of Laughing Gull density (#/km^2) in the Study Area for sitting birds using the kernel density method (Summer 2009).

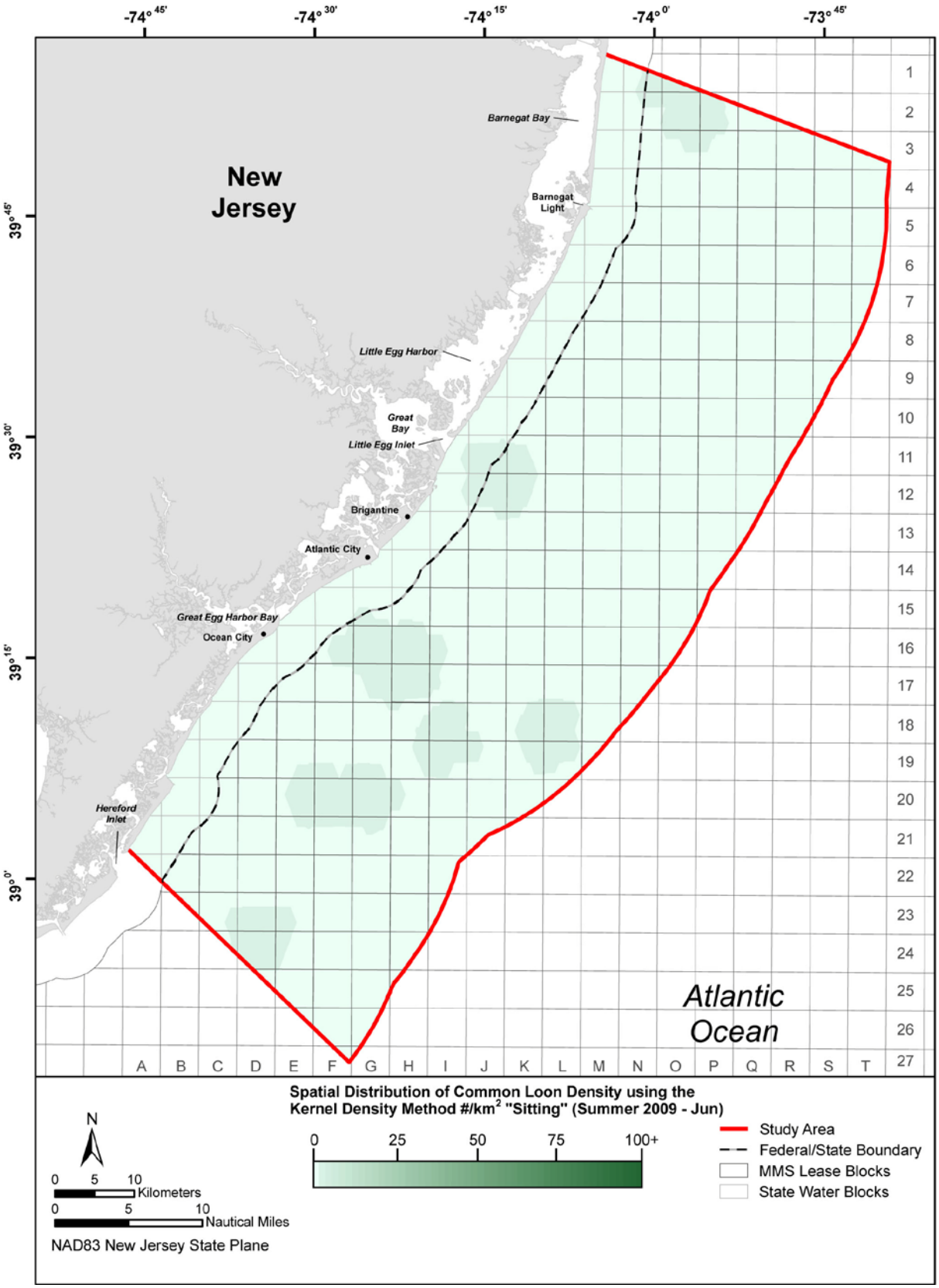

Figure M-481. Spatial distribution of Common Loon density (#/km^2) in the Study Area for sitting birds using the kernel density method (Summer 2009).

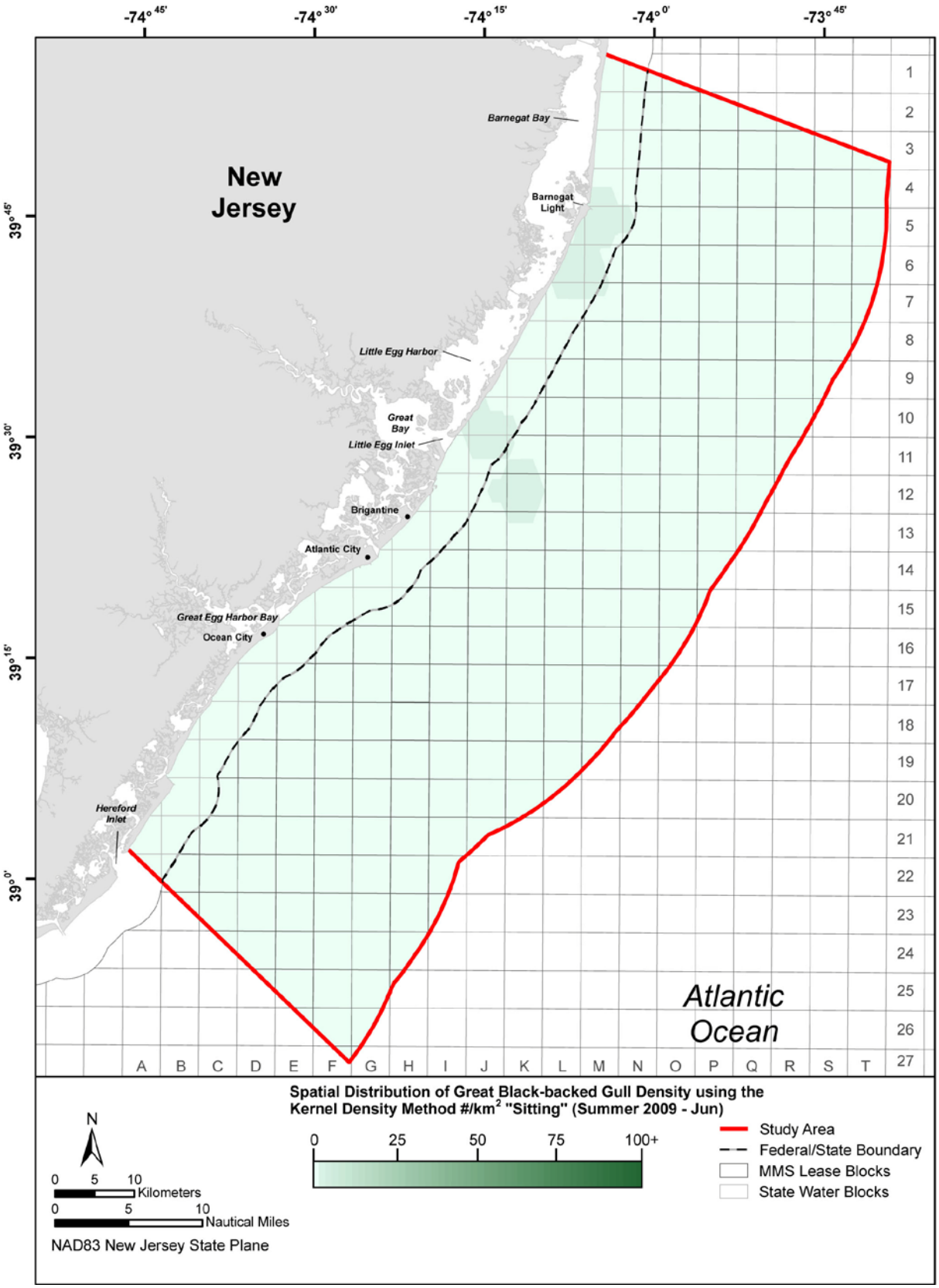

Figure M-482. Spatial distribution of Great Black-backed Gull density (#/km^2) in the Study Area for sitting birds using the kernel density method (Summer 2009).

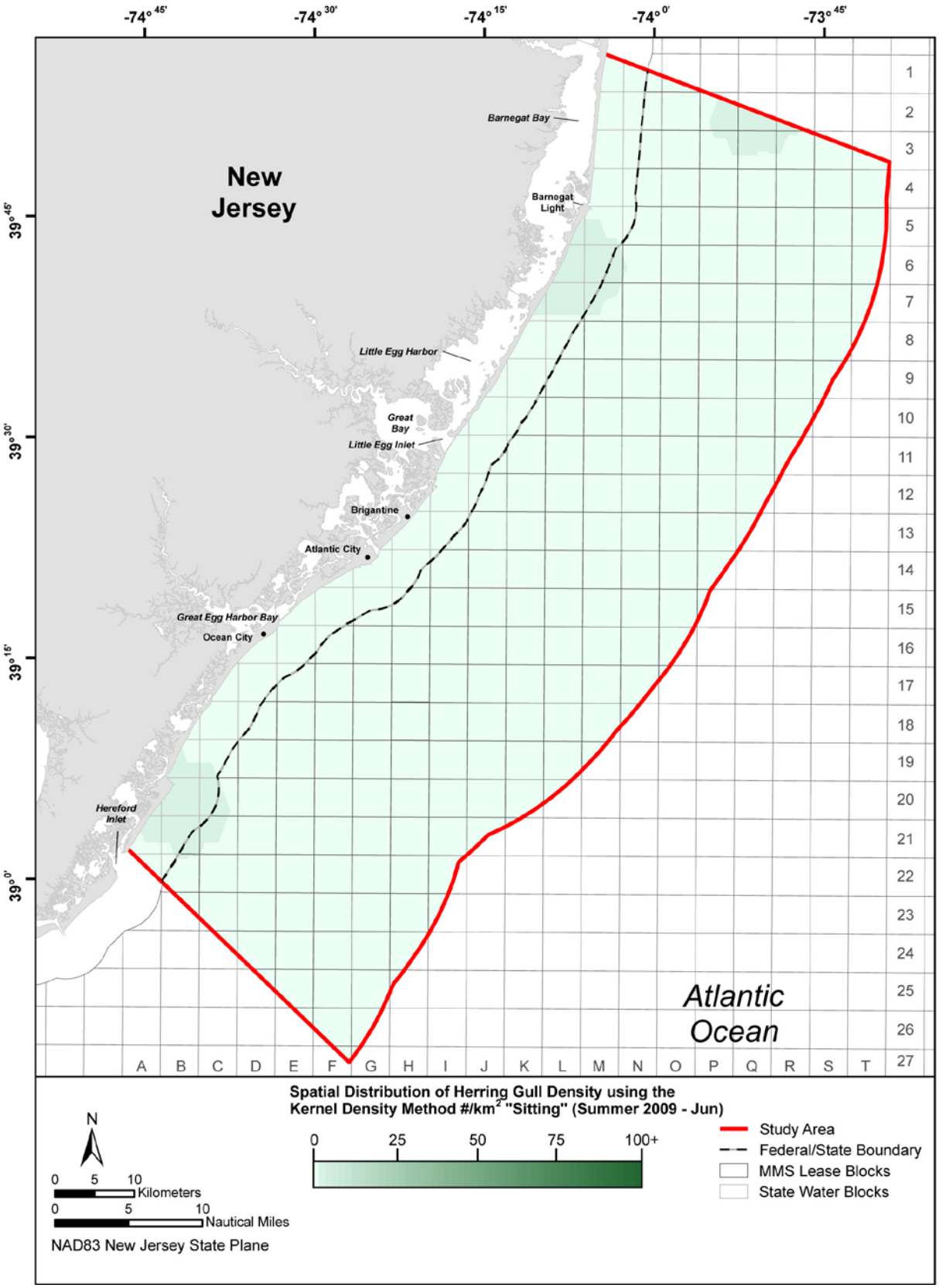

Figure M-483. Spatial distribution of Herring Gull density (#/km^2) in the Study Area for sitting birds using the kernel density method (Summer 2009).

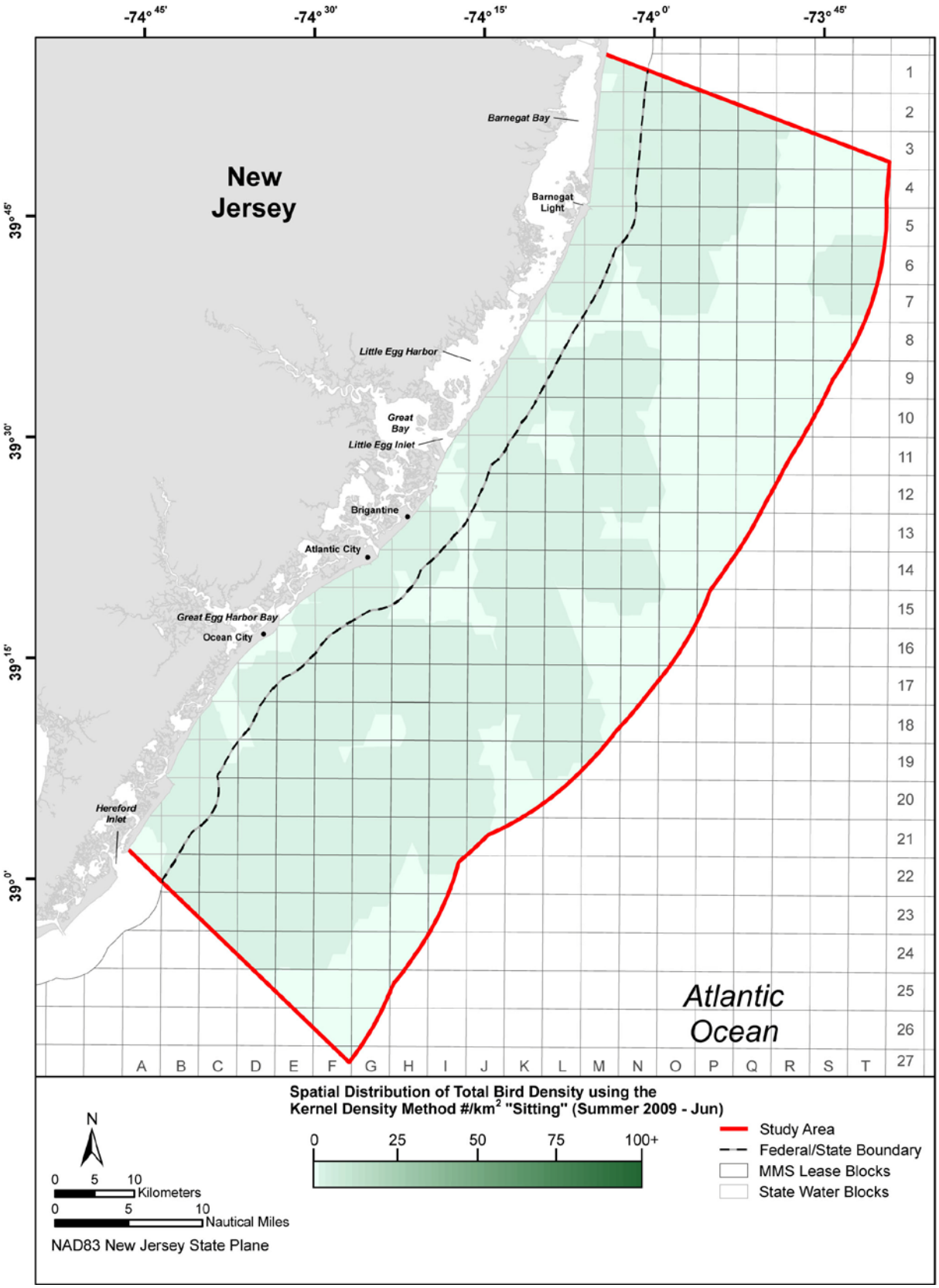

Figure M-484. Spatial distribution of total bird density (#/km^2) in the Study Area for sitting birds using the kernel density method (Summer 2009).

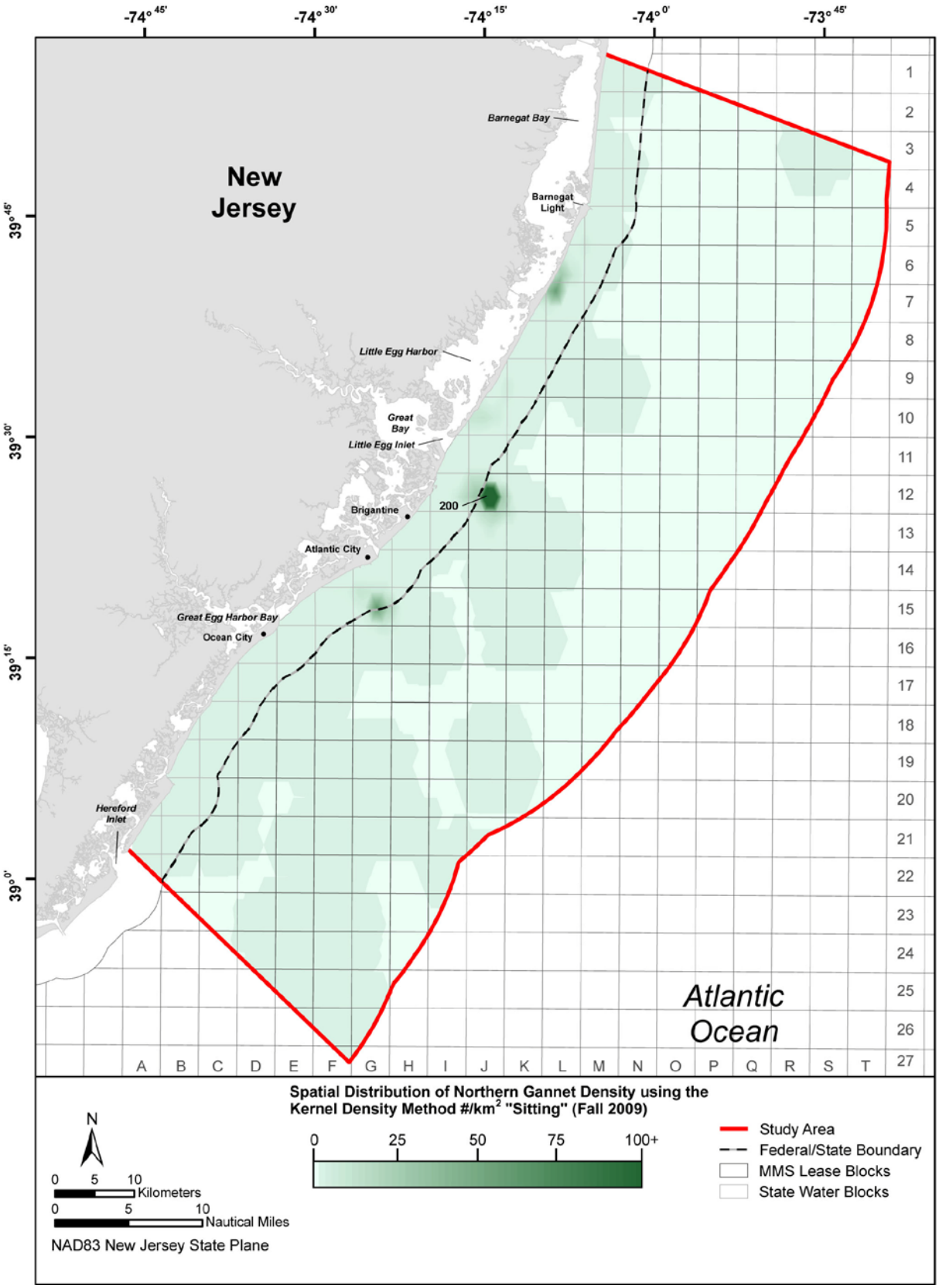

Figure M-485. Spatial distribution of Northern Gannet density (#/km^2) in the Study Area for sitting birds using the kernel density method (Fall 2009).

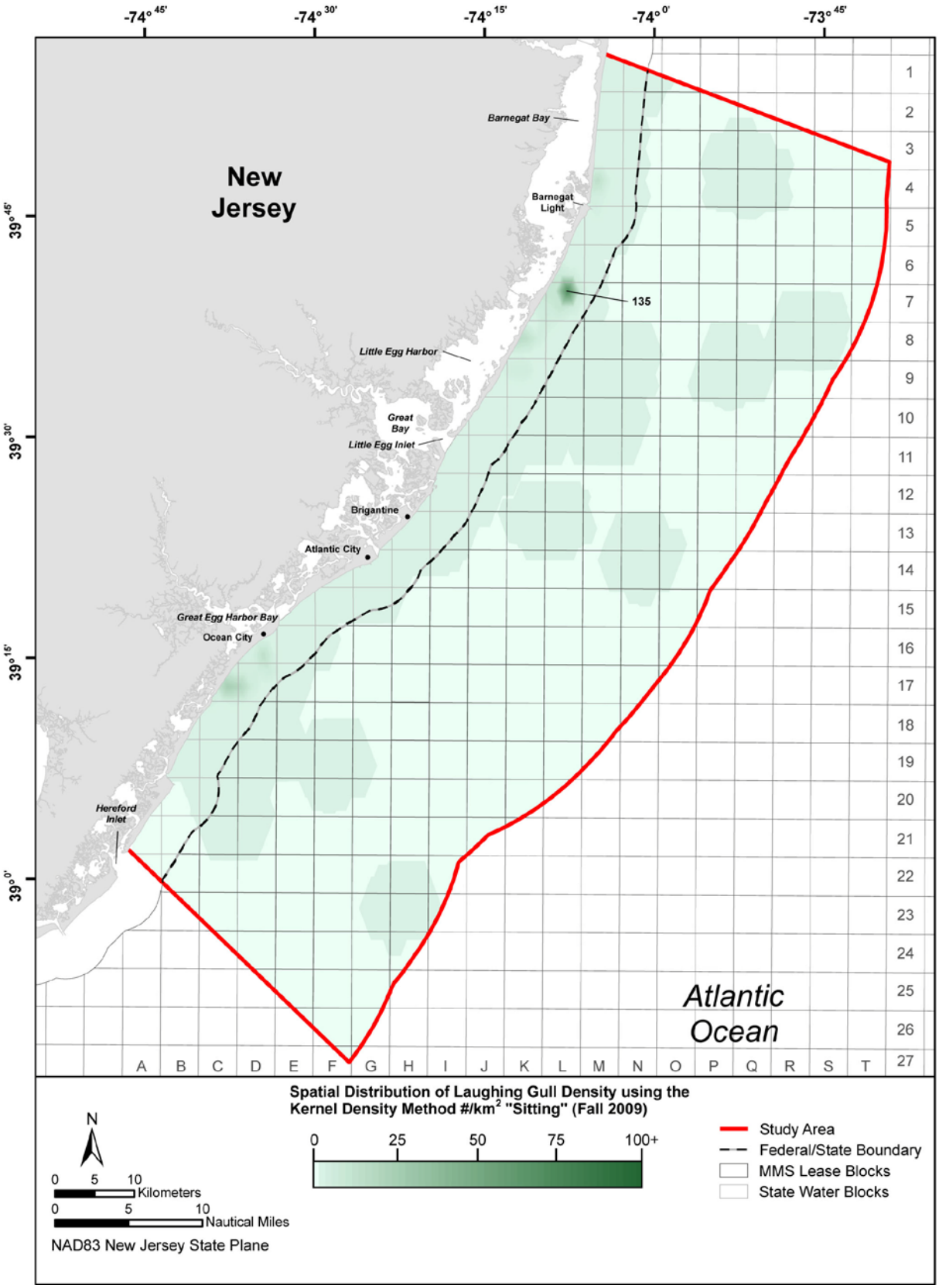

Figure M-486. Spatial distribution of Laughing Gull density (#/km^2) in the Study Area for sitting birds using the kernel density method (Fall 2009).

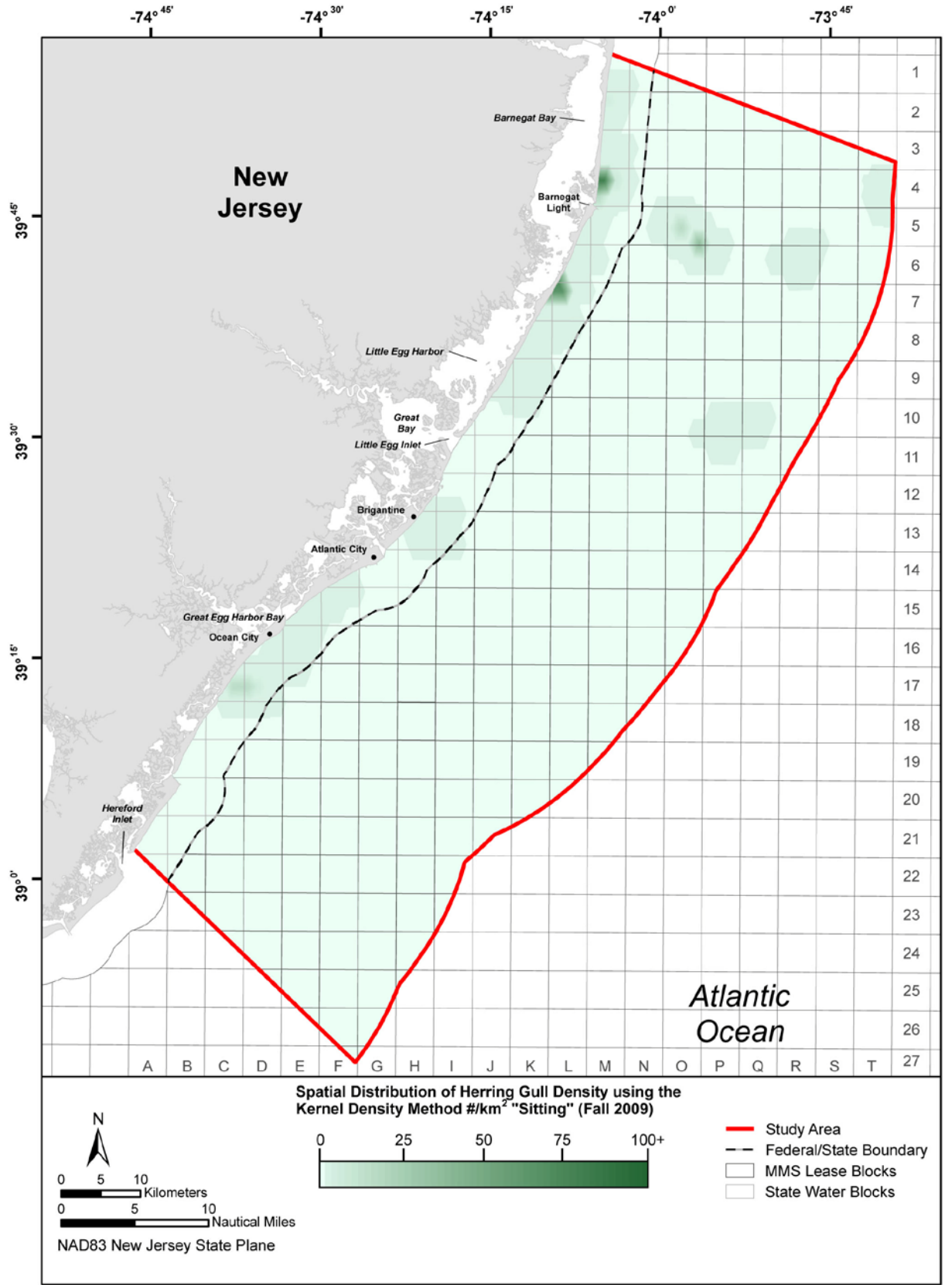

Figure M-487. Spatial distribution of Herring Gull density (#/km^2) in the Study Area for sitting birds using the kernel density method (Fall 2009).

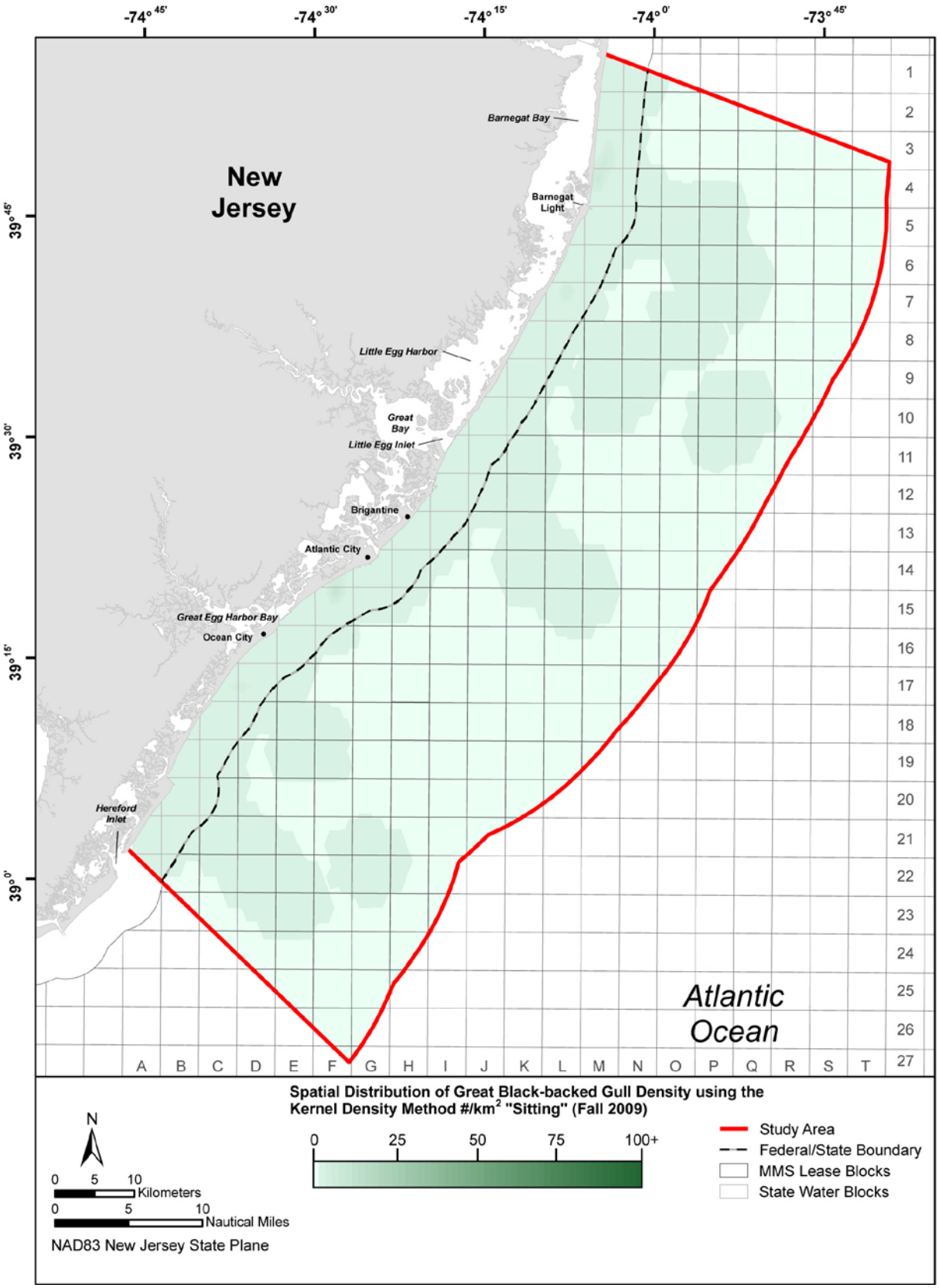

Figure M-488. Spatial distribution of Great Black-backed Gull density (#/km^2) in the Study Area for sitting birds using the kernel density method (Fall 2009).

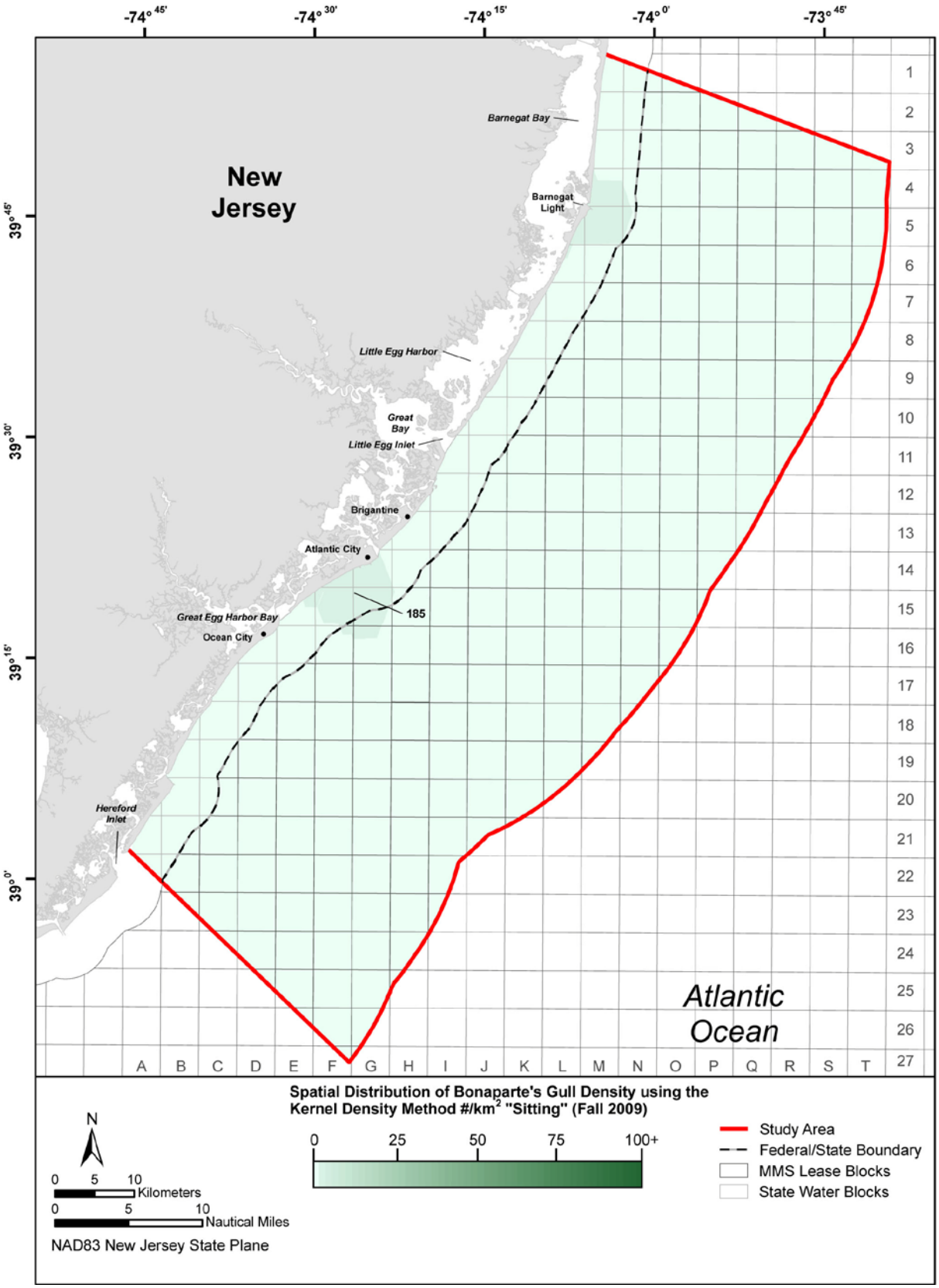

Figure M-489. Spatial distribution of Bonaparte's Gull density (#/km^2) in the Study Area for sitting birds using the kernel density method (Fall 2009).

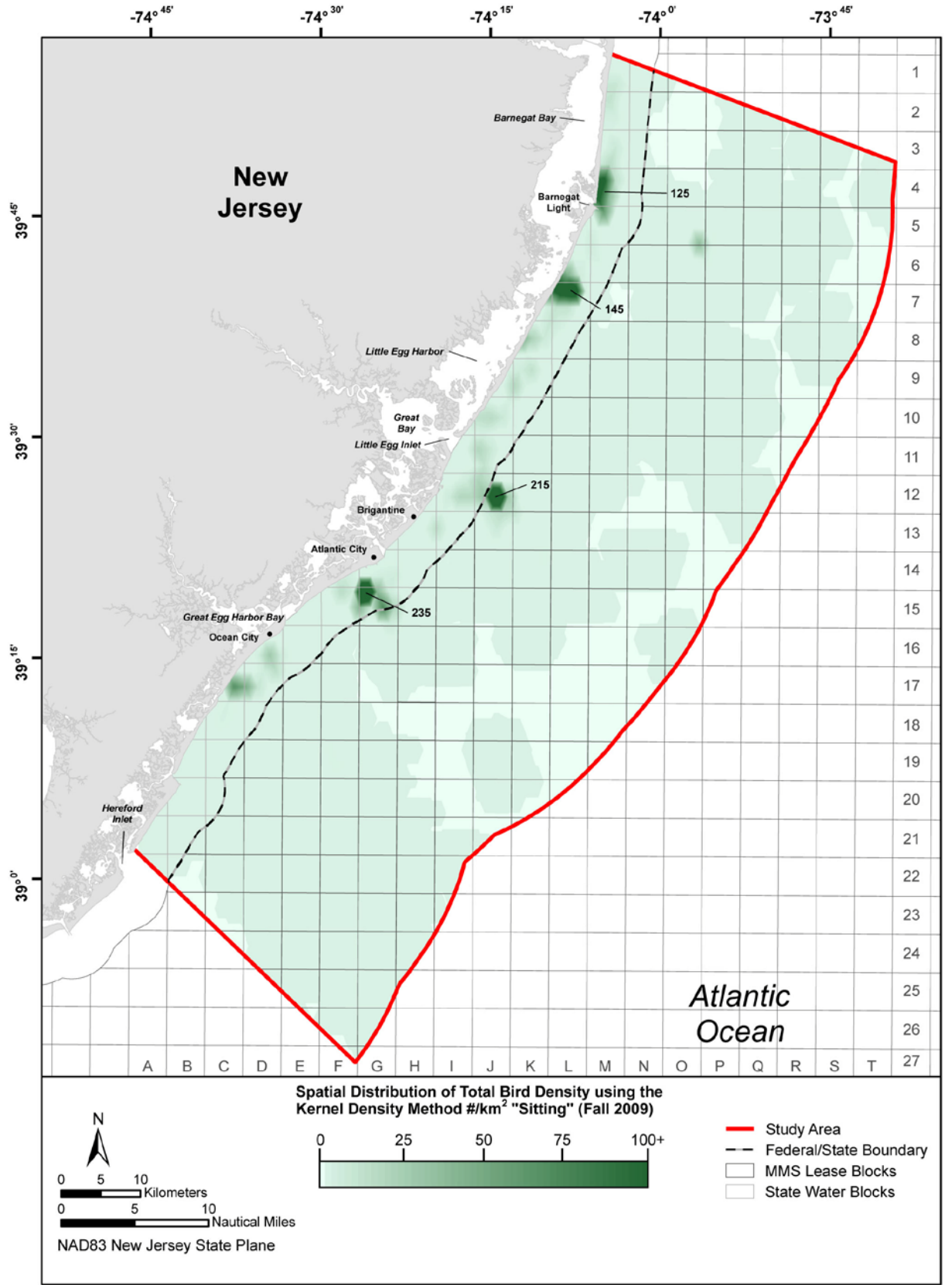

Figure M-490. Spatial distribution of total bird density (#/km^2) in the Study Area for sitting birds using the kernel density method (Fall 2009).

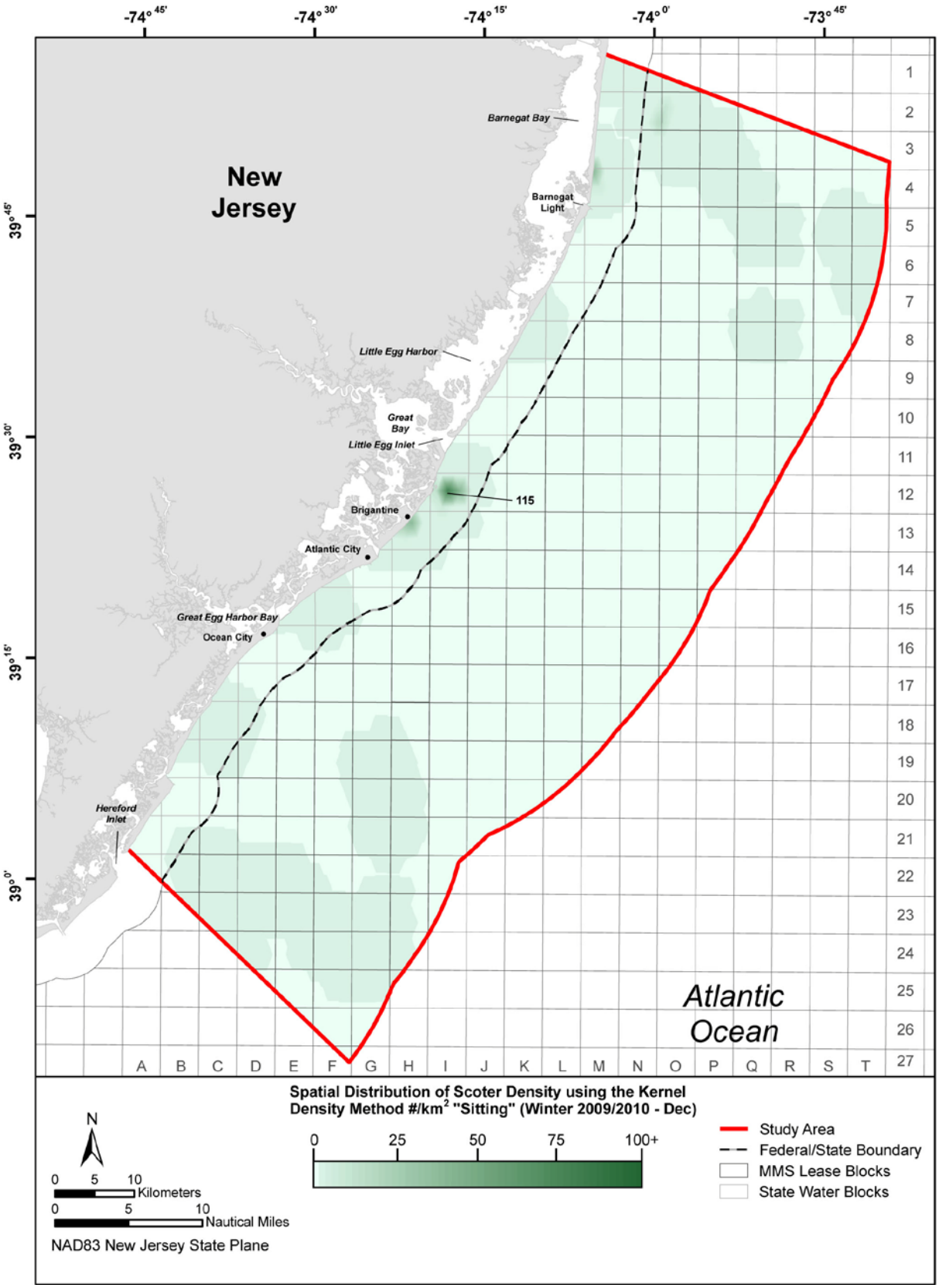

Figure M-491. Spatial distribution of scoter density (#/km^2) in the Study Area for sitting birds using the kernel density method (Winter 2010).

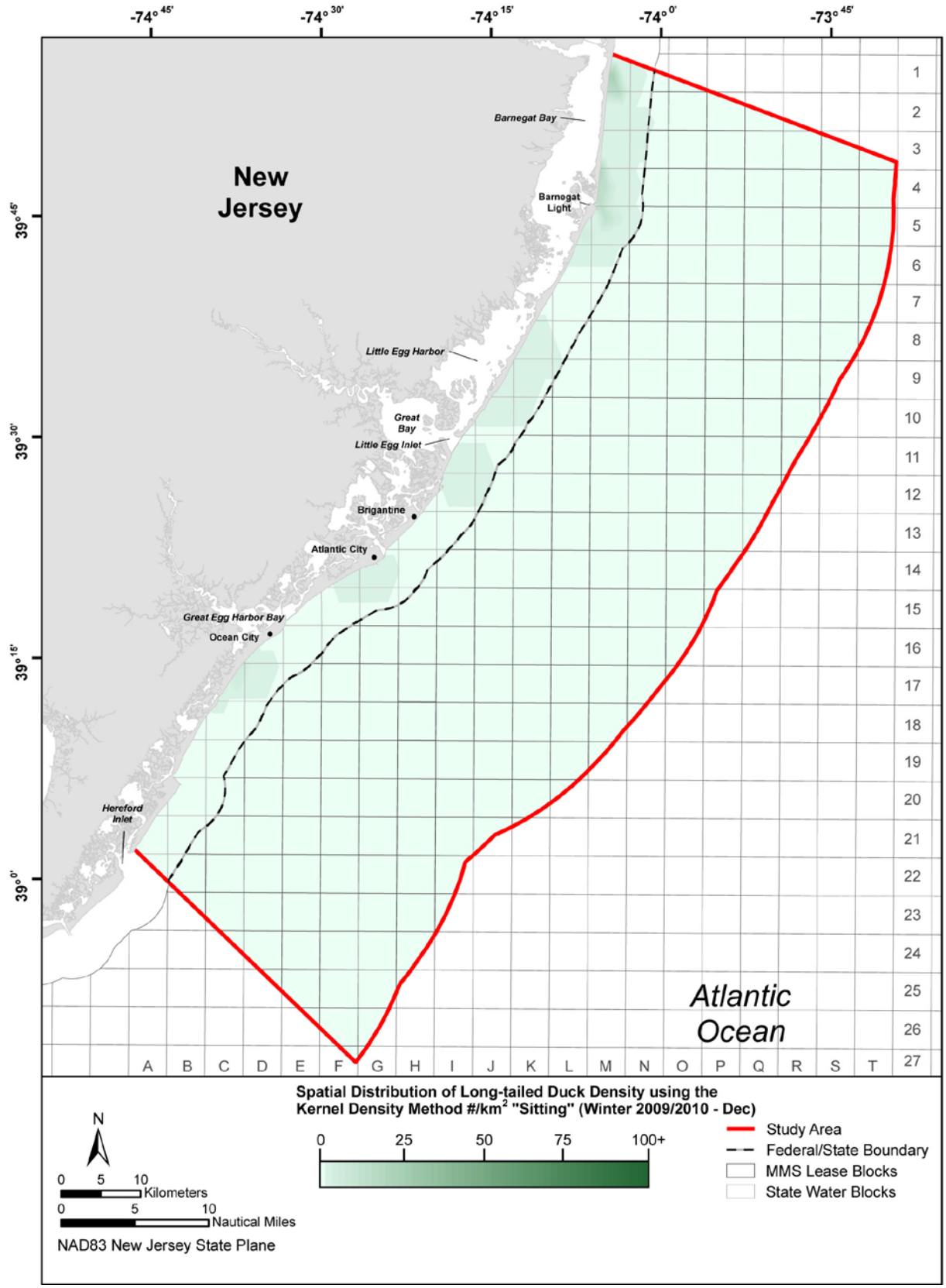

Figure M-492. Spatial distribution of Long-tailed Duck density (#/km^2) in the Study Area for sitting birds using the kernel density method (Winter 2010).

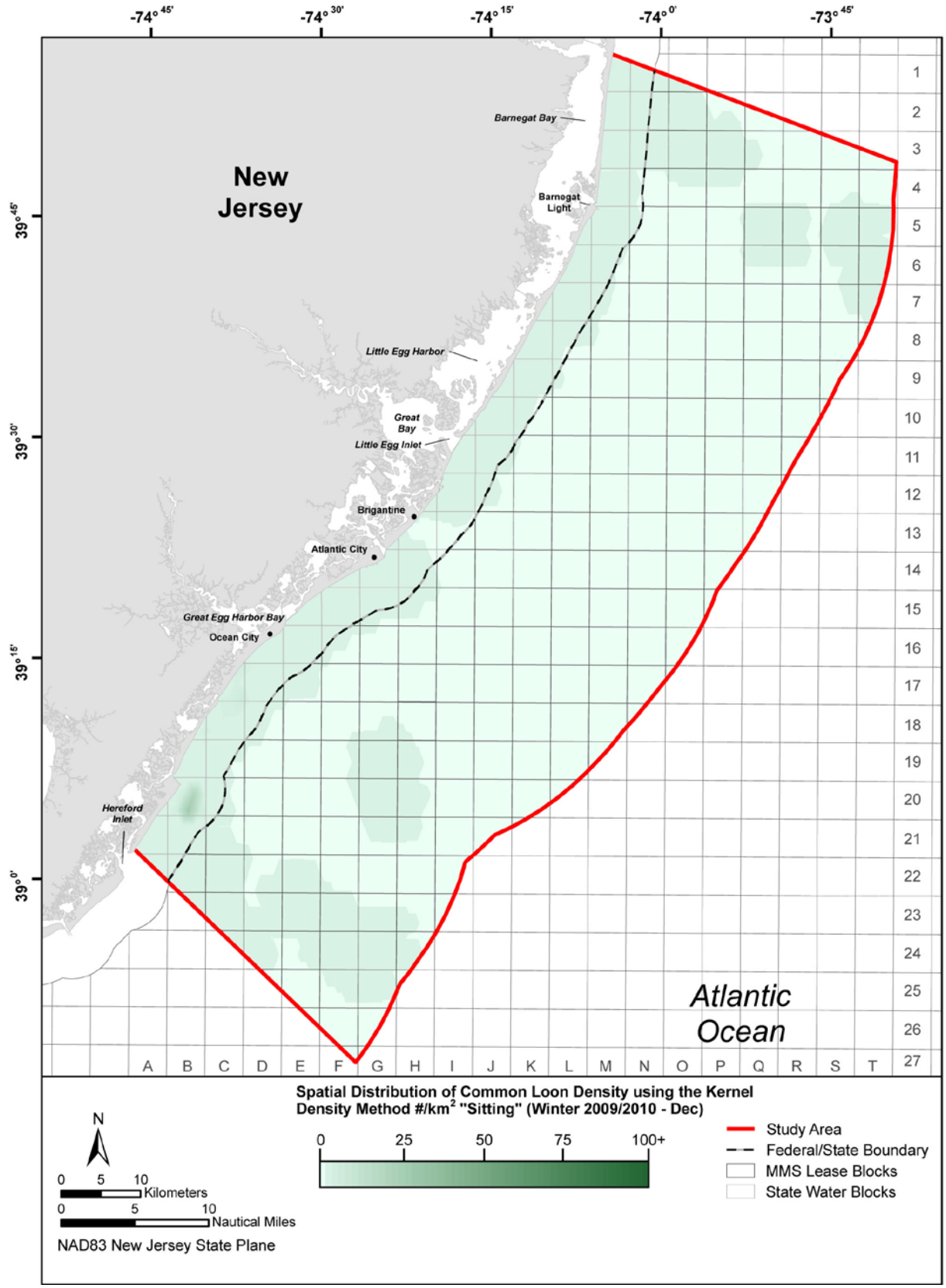

Figure M-493. Spatial distribution of Common Loon density (#/km^2) in the Study Area for sitting birds using the kernel density method (Winter 2010).

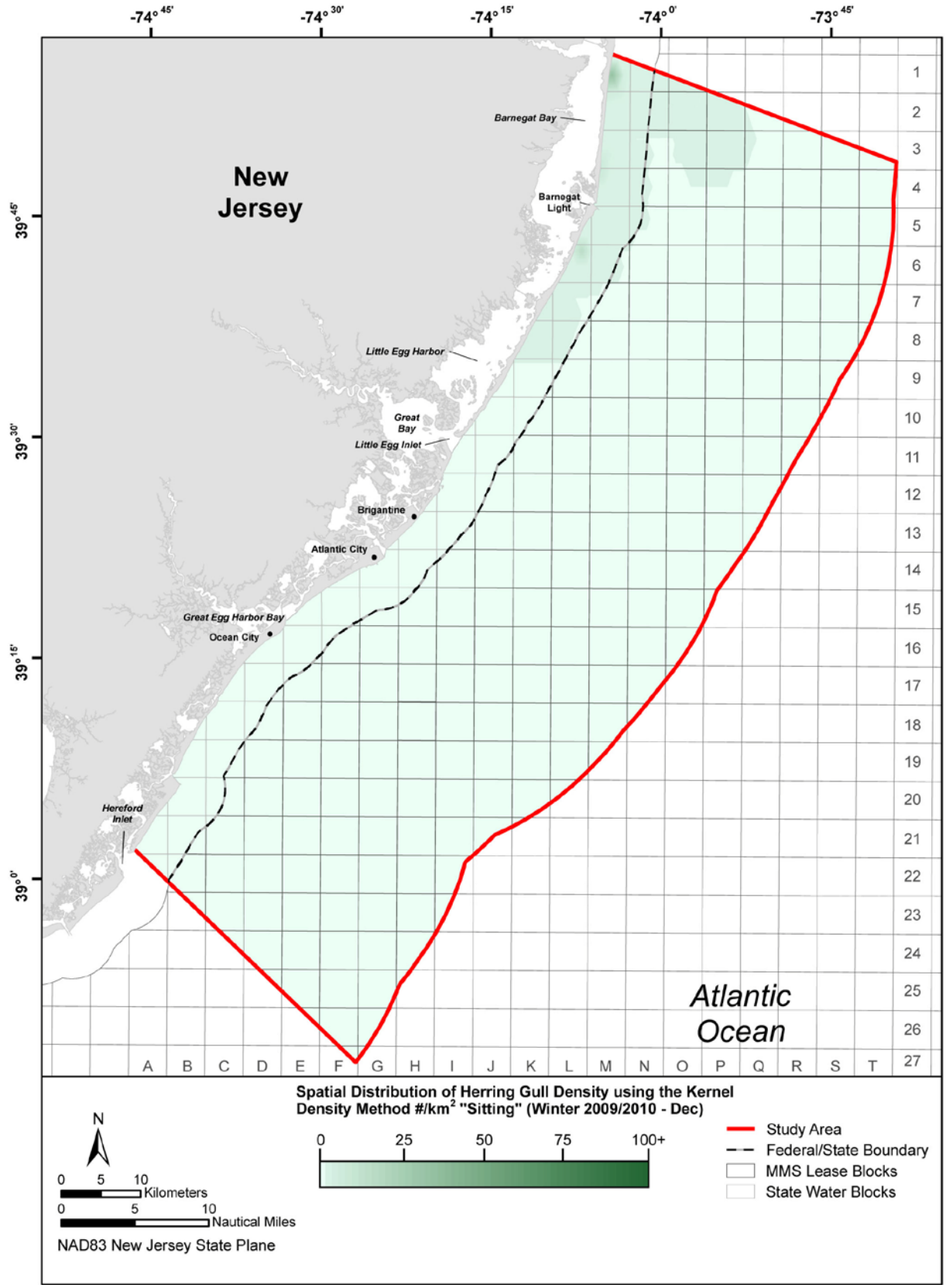

Figure M-494. Spatial distribution of Herring Gull density (#/km^2) in the Study Area for sitting birds using the kernel density method (Winter 2010).

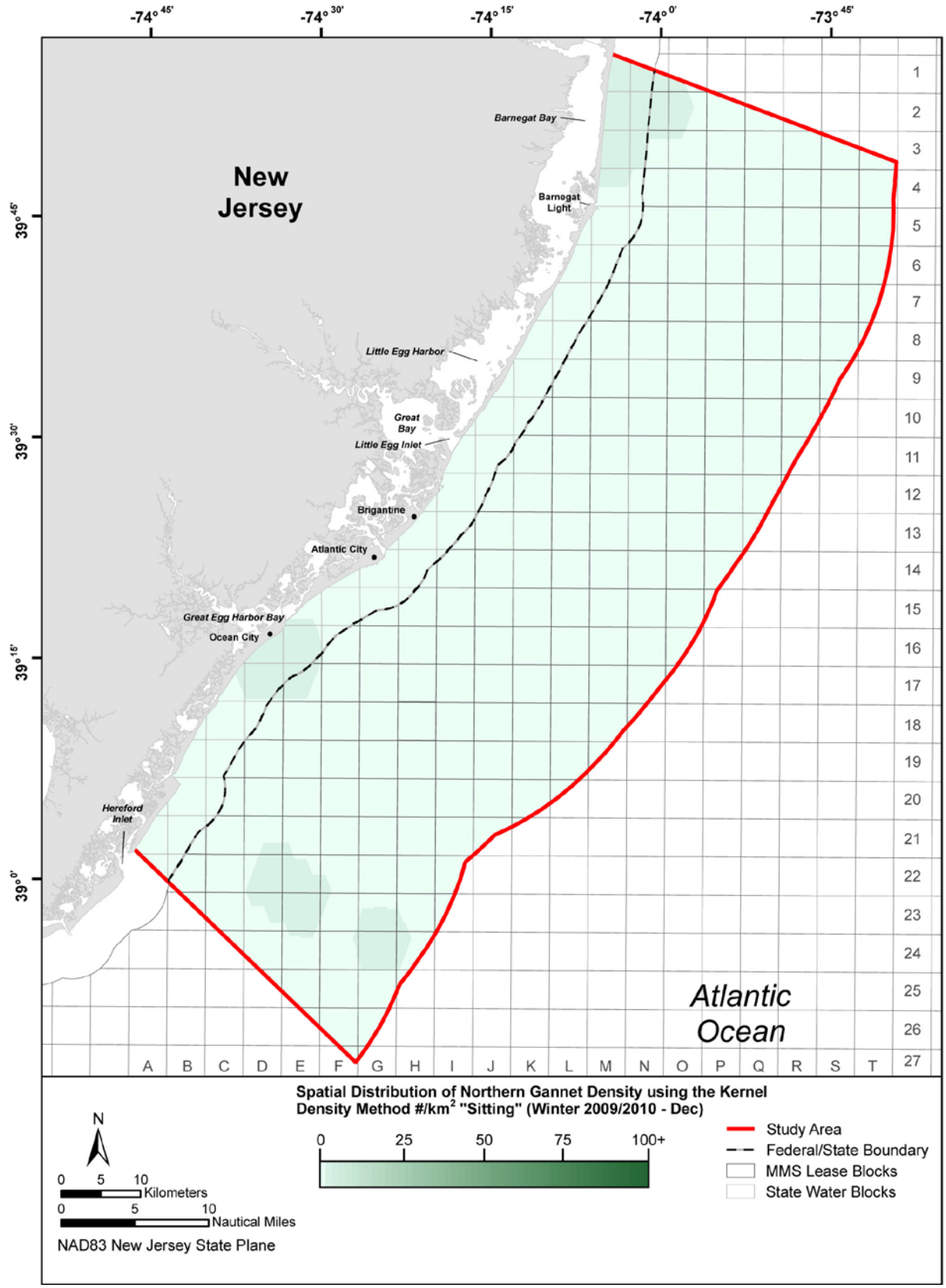

Figure M-495. Spatial distribution of Northern Gannet density (#/km^2) in the Study Area for sitting birds using the kernel density method (Winter 2010).

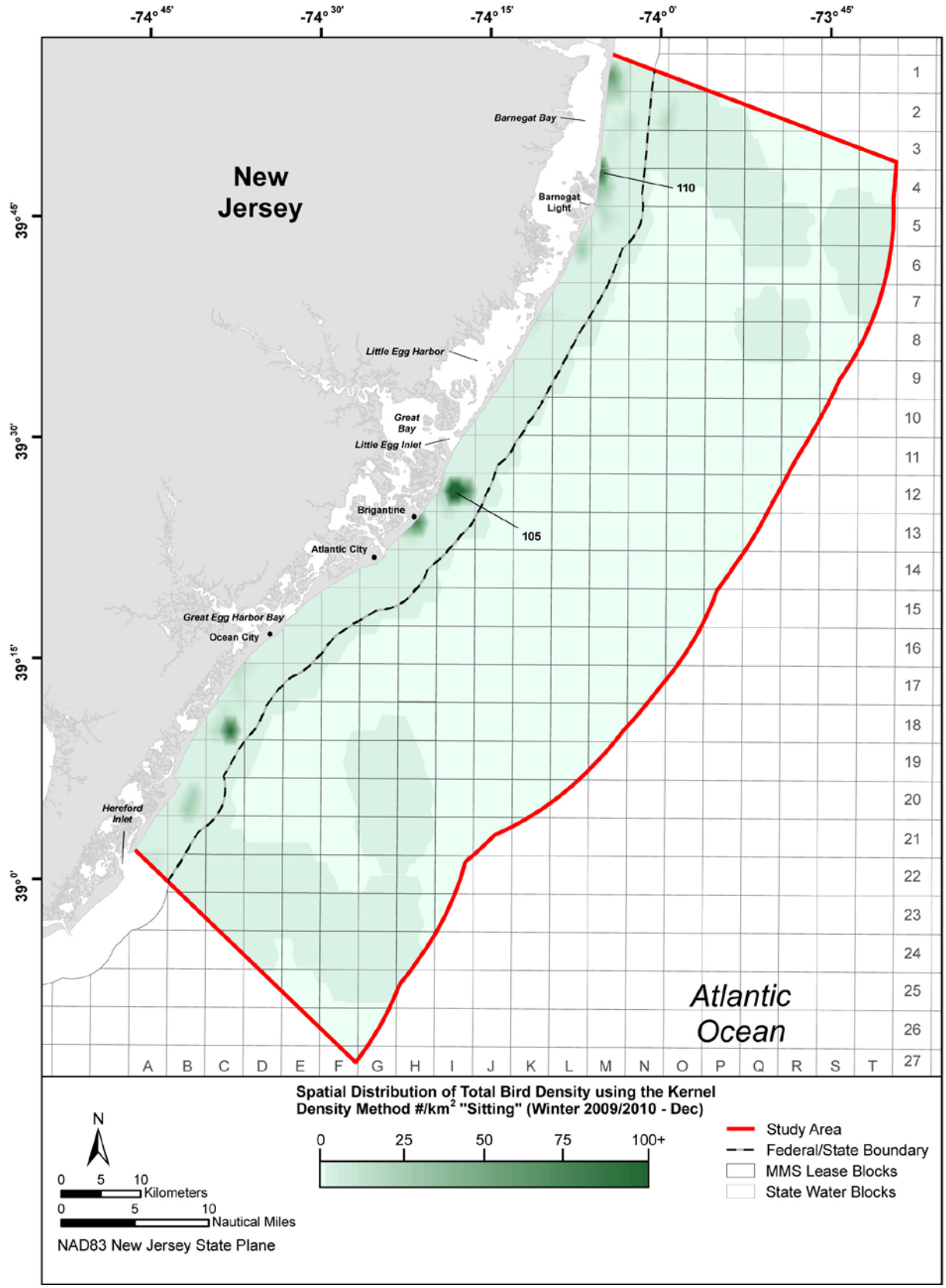

Figure M-496. Spatial distribution of total bird density (#/km^2) in the Study Area for sitting birds using the kernel density method (Winter 2010).

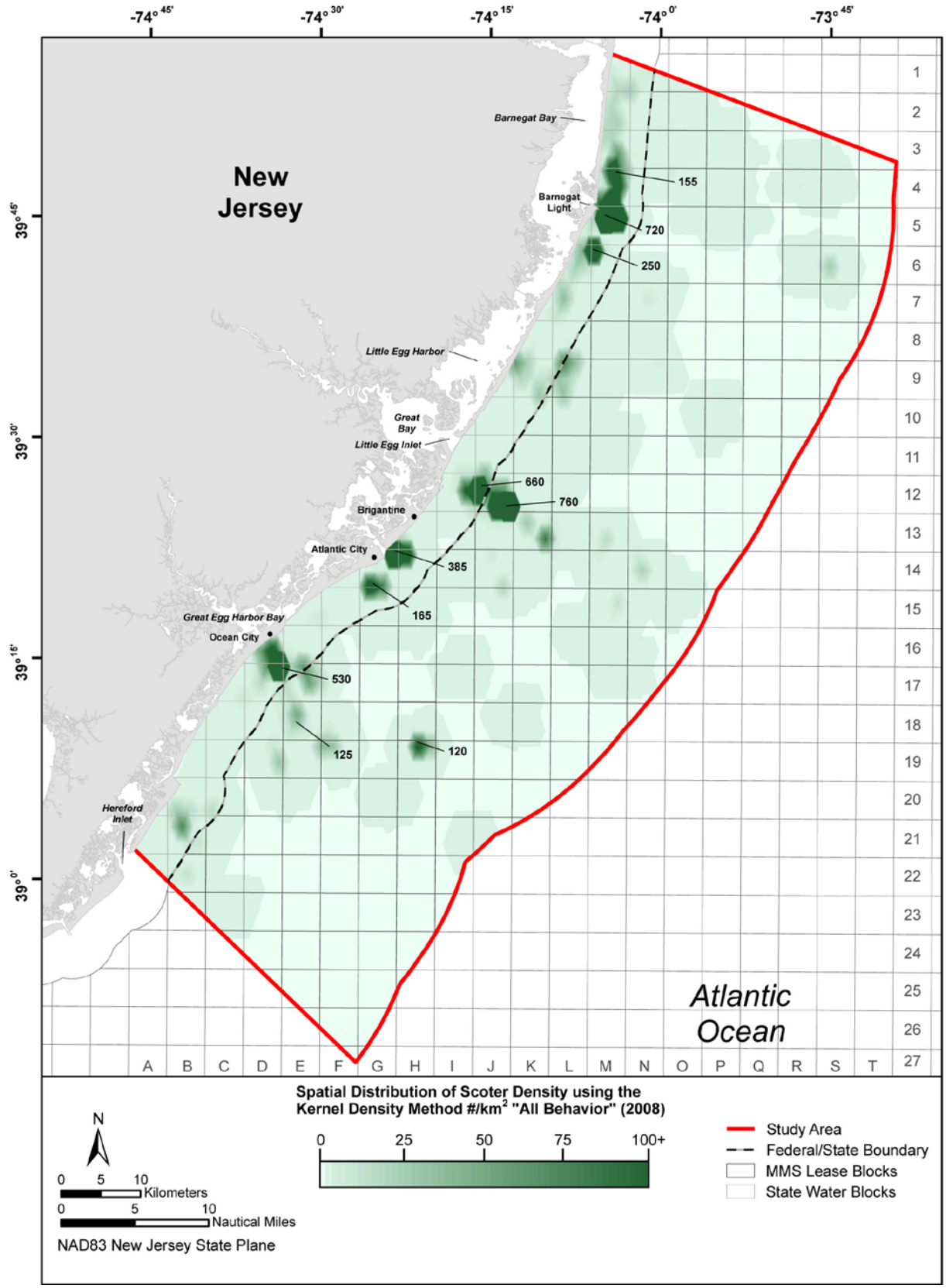

Figure M-497. Spatial distribution of scoter density (#/km^2) in the Study Area for all behaviors using the kernel density method (2008).

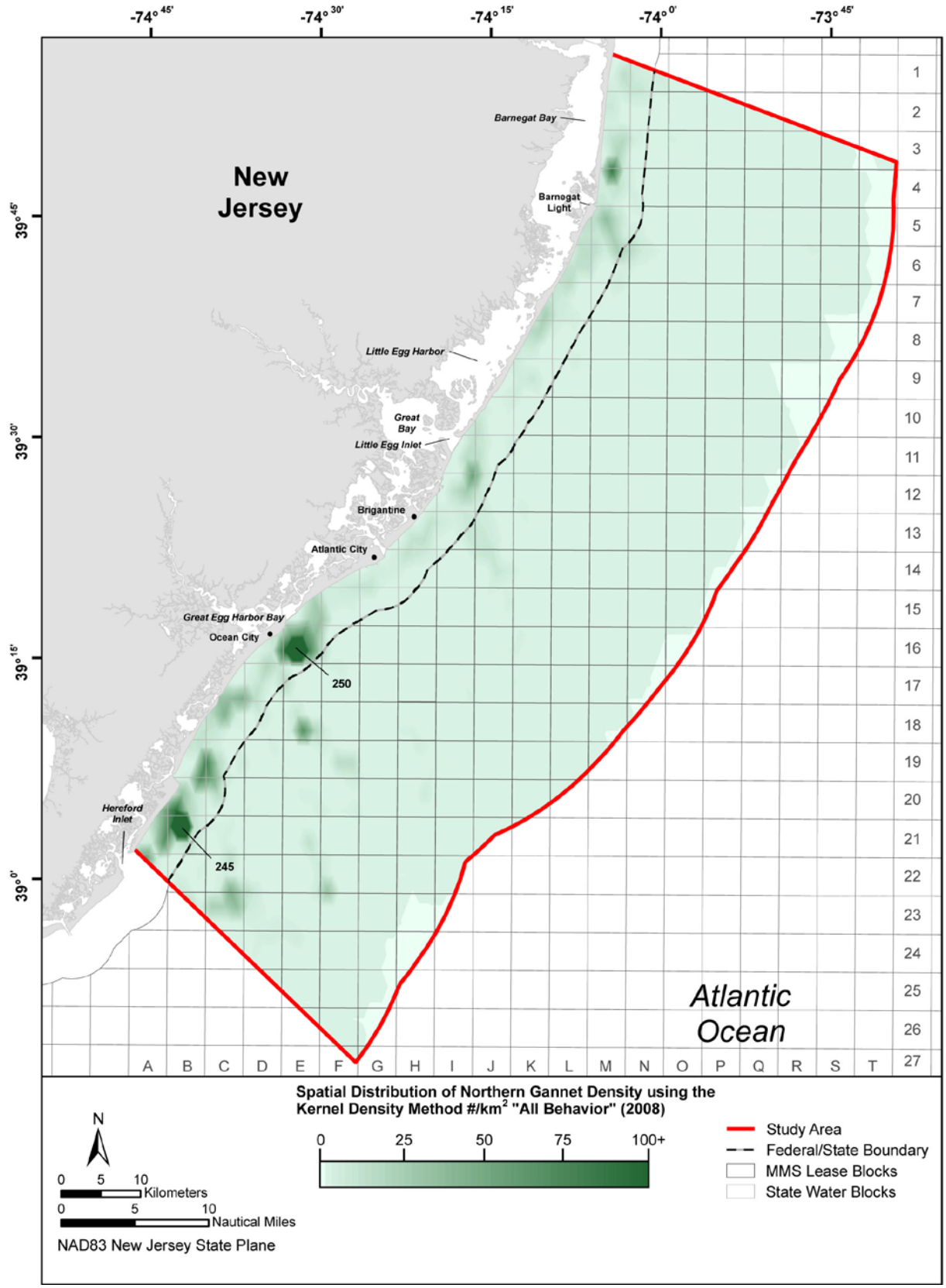

Figure M-498. Spatial distribution of Northern Gannet density (#/km^2) in the Study Area for all behaviors using the kernel density method (2008).

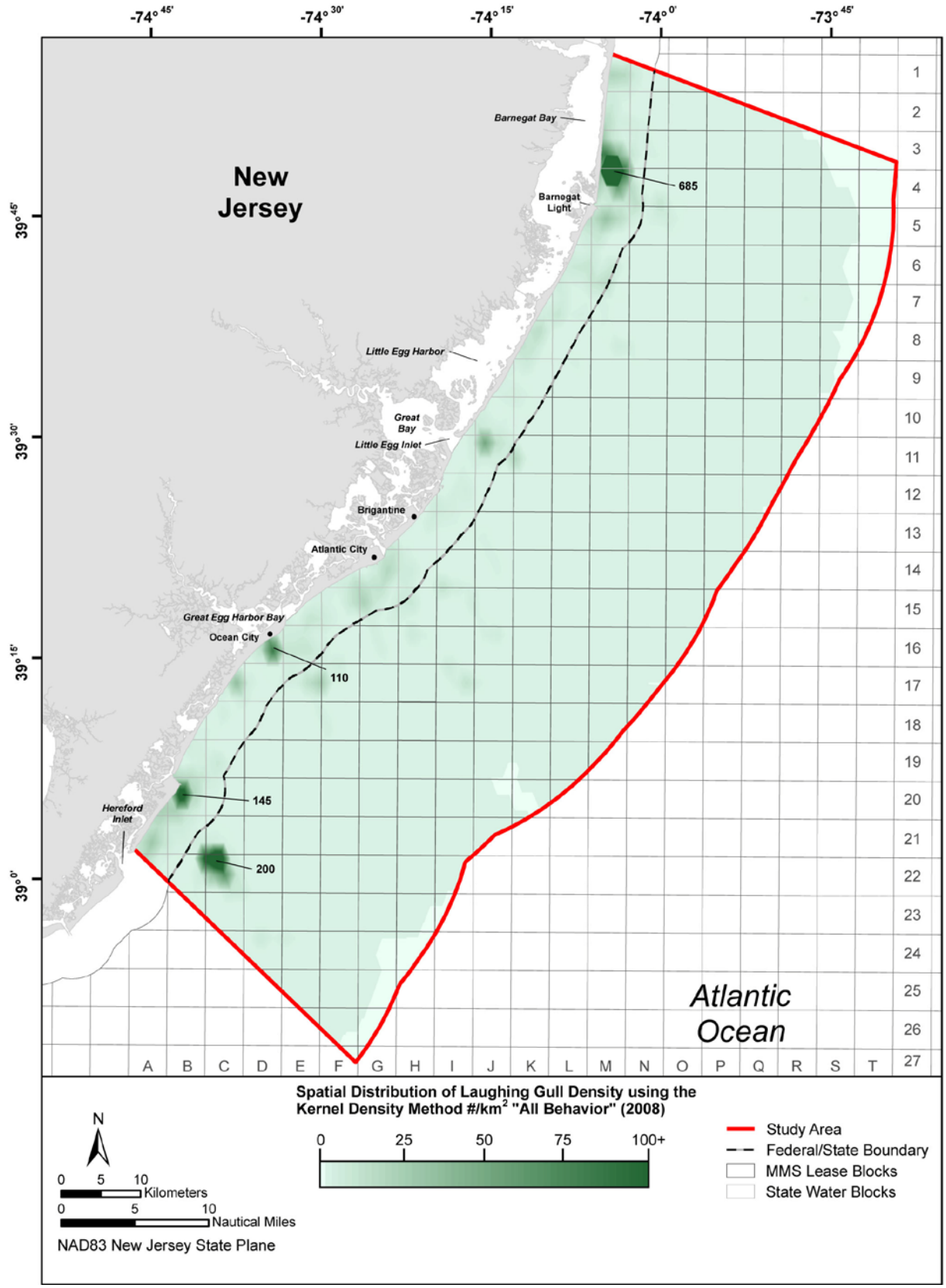

Figure M-499. Spatial distribution of Laughing Gull density (#/km^2) in the Study Area for all behaviors using the kernel density method (2008).

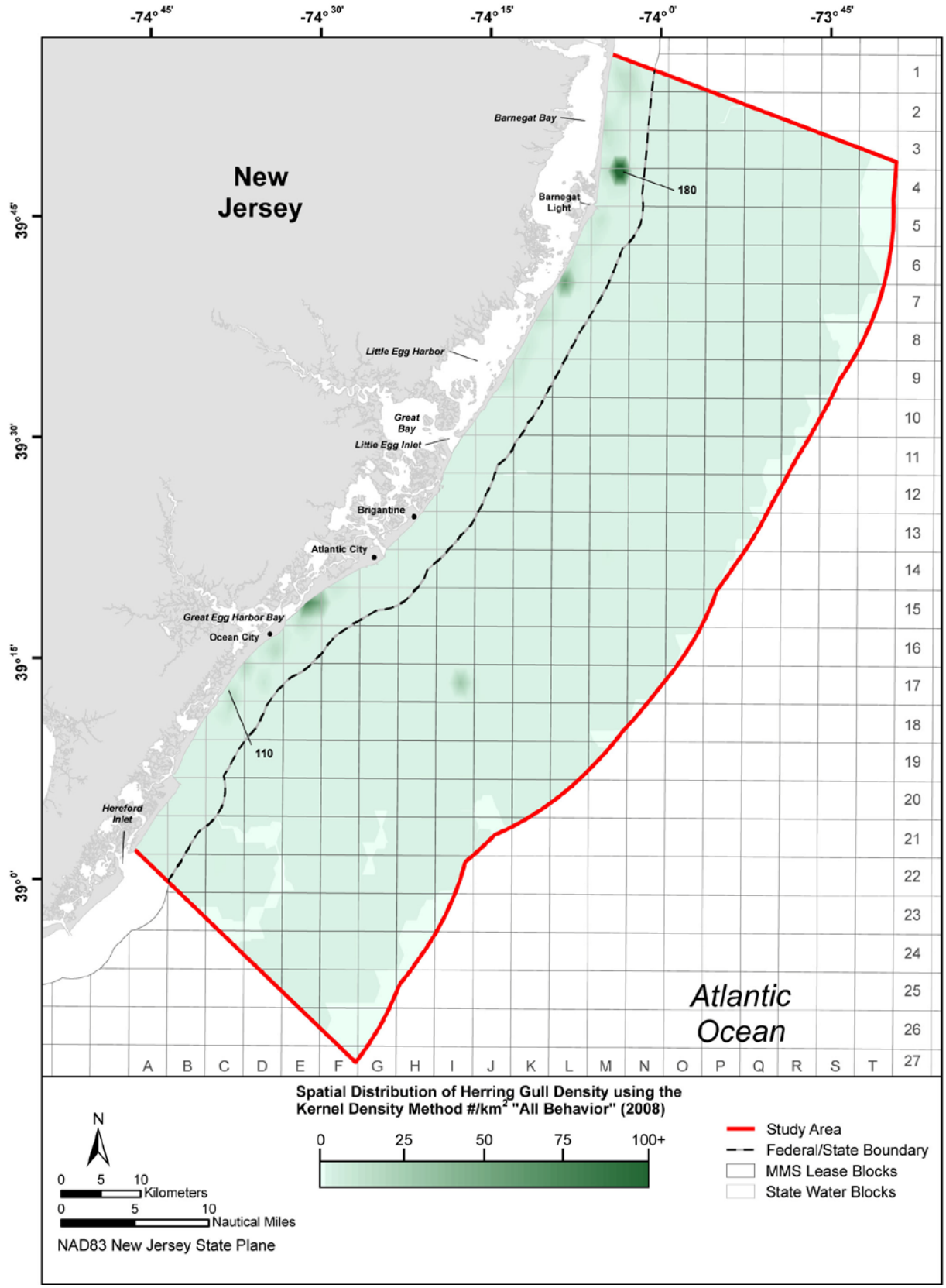

Figure M-500. Spatial distribution of Herring Gull density (#/km^2) in the Study Area for all behaviors using the kernel density method (2008).

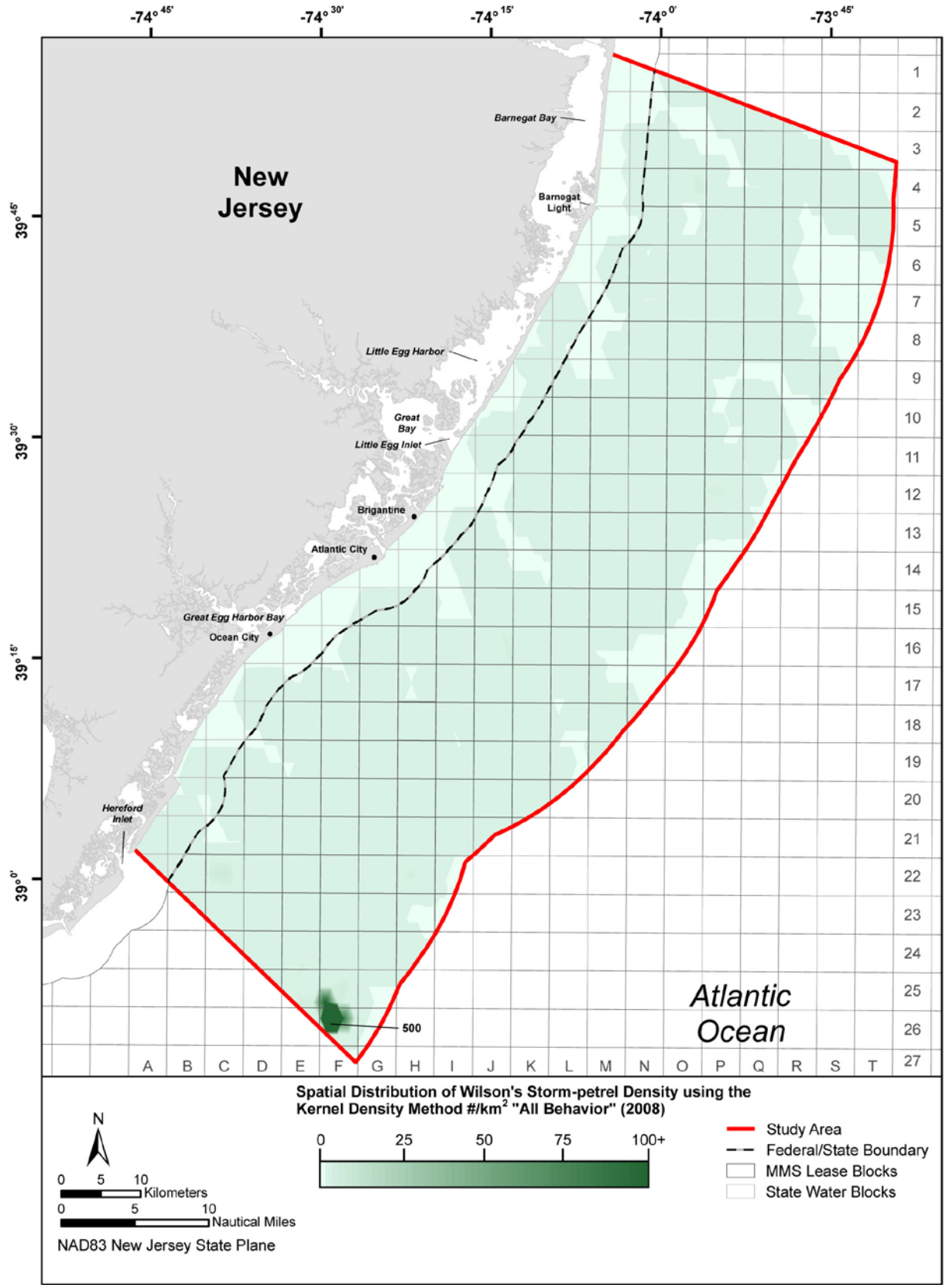

Figure M-501. Spatial distribution of Wilson's Storm-Petrel density (#/km^2) in the Study Area for all behaviors using the kernel density method (2008).

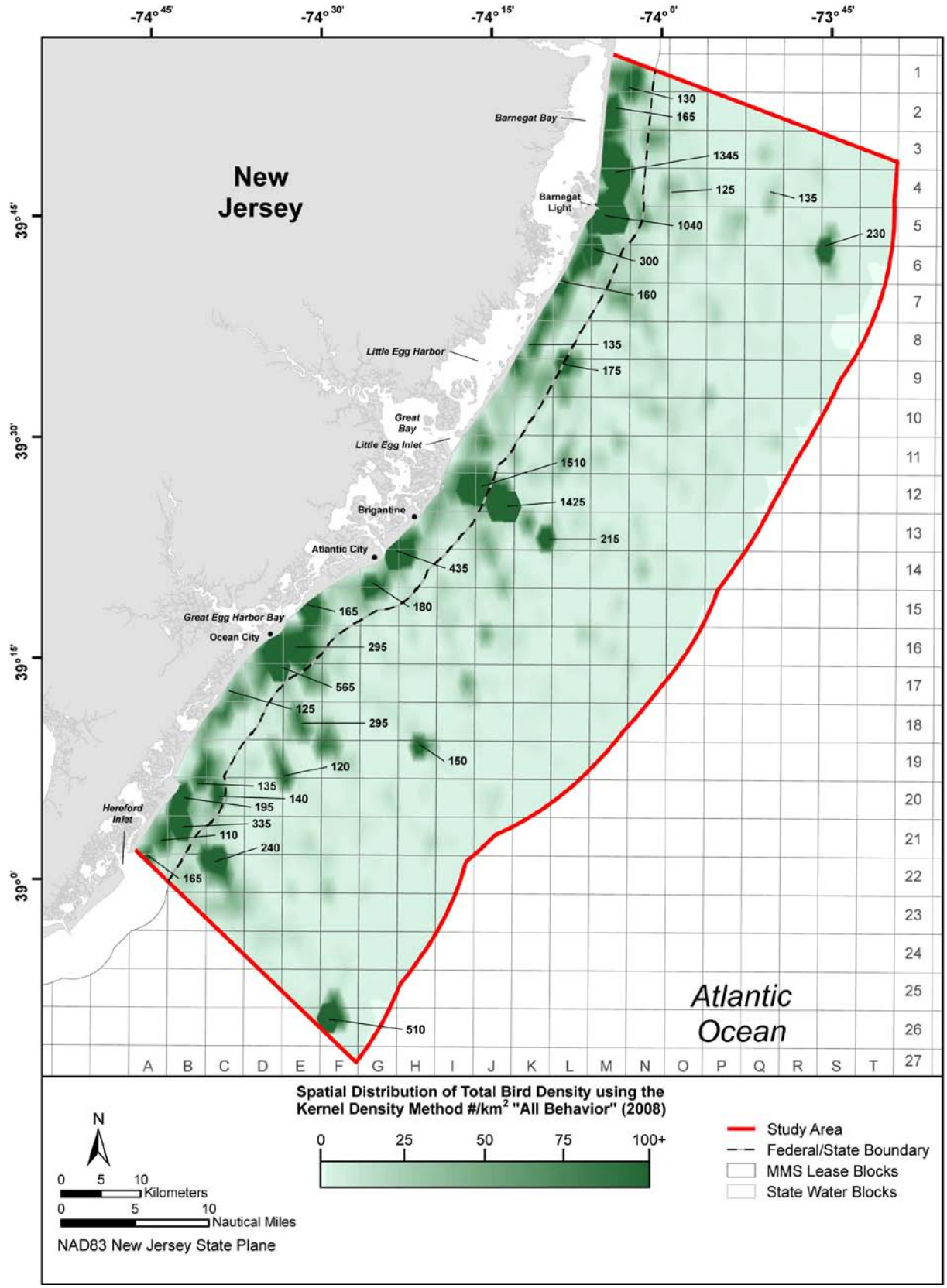

Figure M-502. Spatial distribution of total bird density (#/km^2) in the Study Area for all behaviors using the kernel density method (2008).

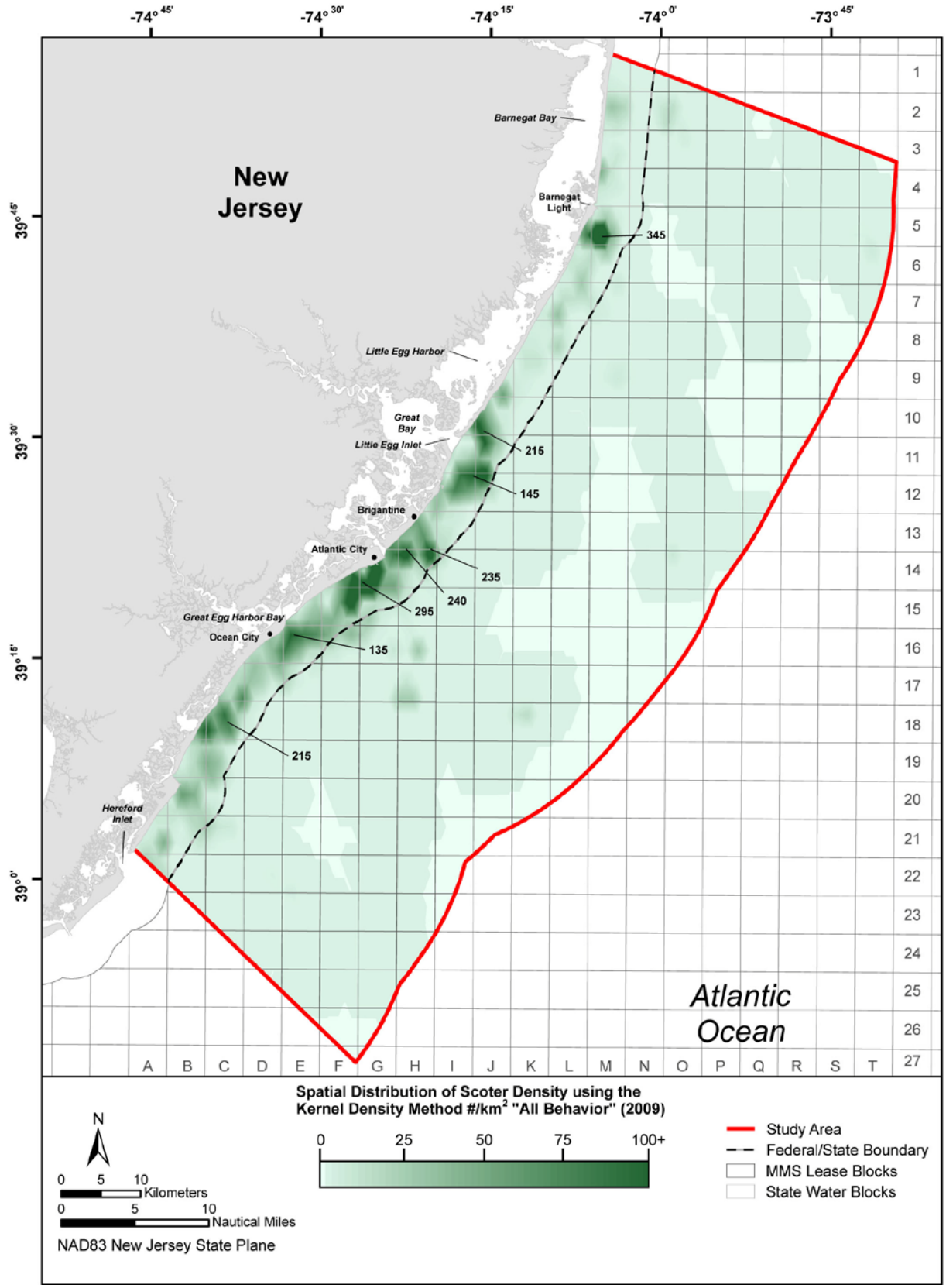

Figure M-503. Spatial distribution of scoter density (#/km^2) in the Study Area for all behaviors using the kernel density method (2009).

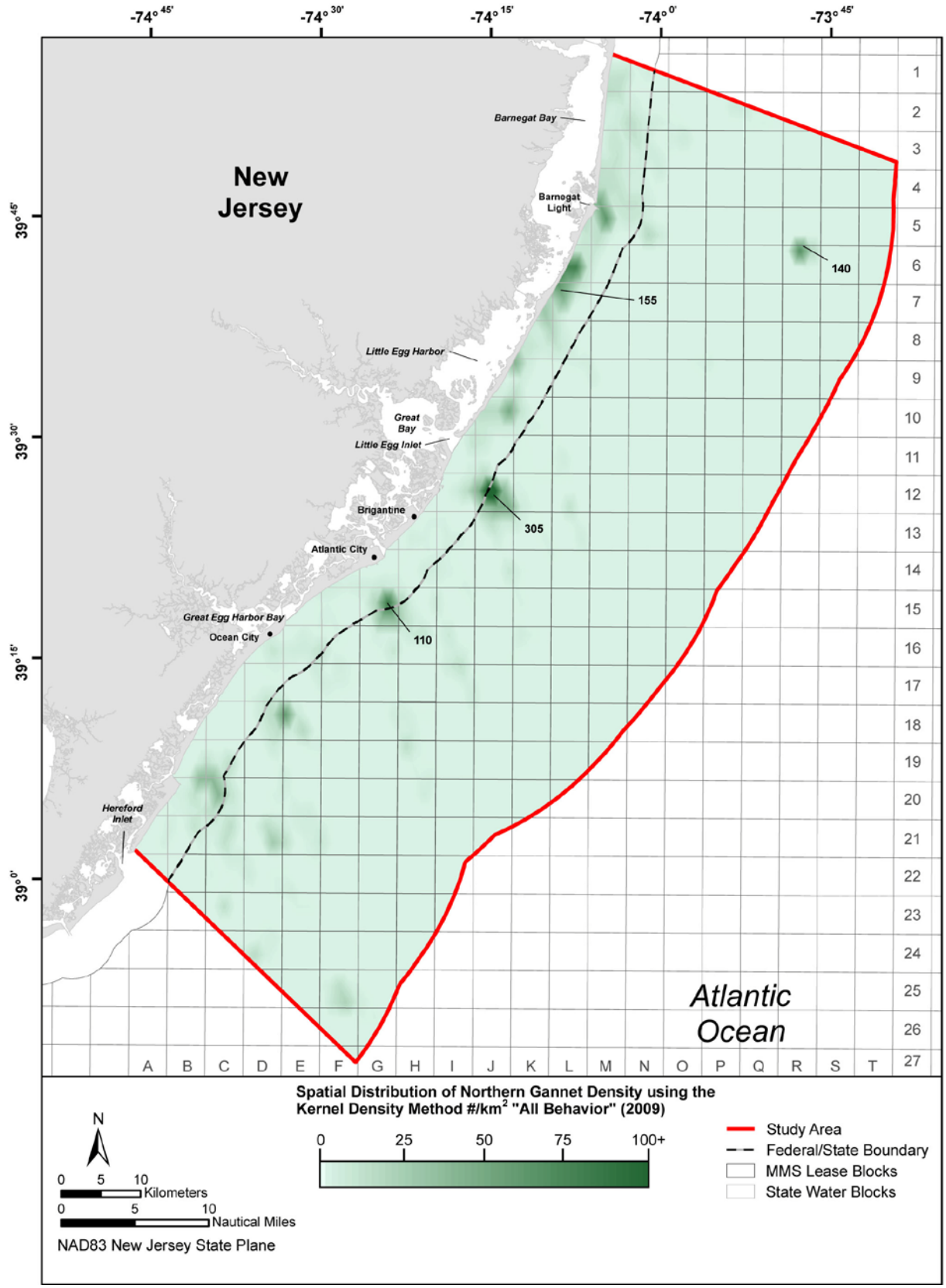

Figure M-504. Spatial distribution of Northern Gannet density (#/km^2) in the Study Area for all behaviors using the kernel density method (2009).

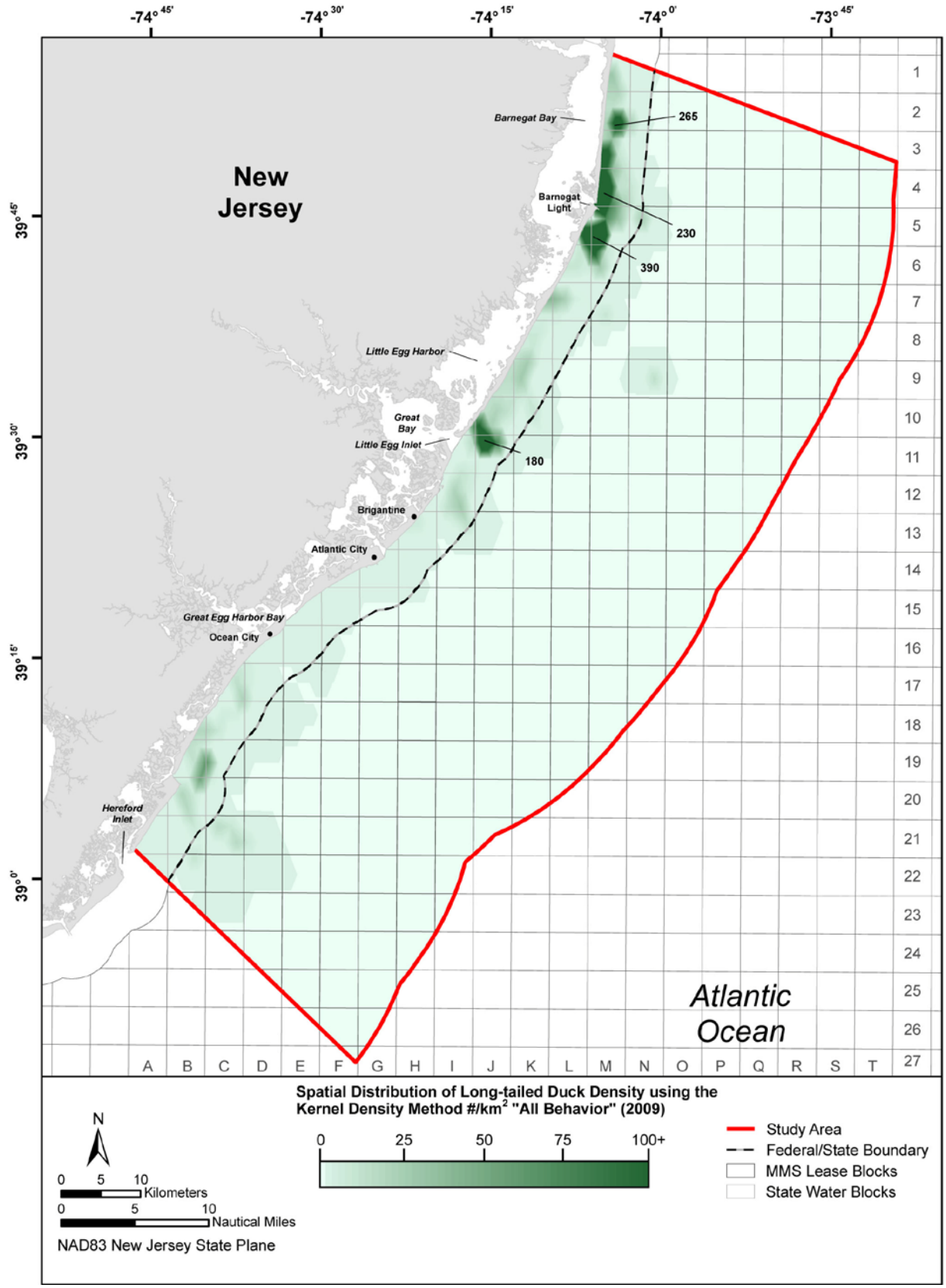

Figure M-505. Spatial distribution of Long-tailed Duck density (#/km^2) in the Study Area for all behaviors using the kernel density method (2009).

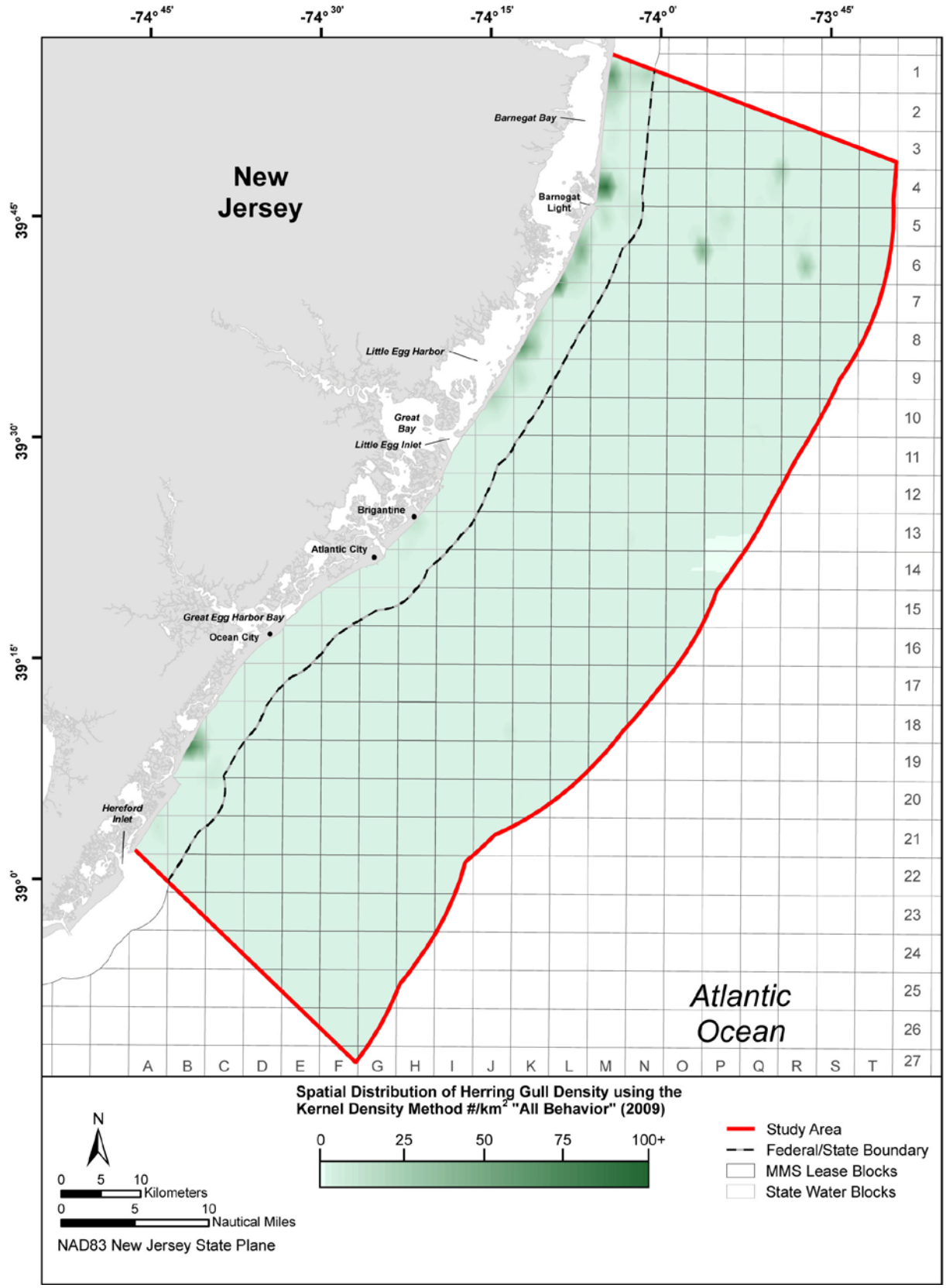

Figure M-506. Spatial distribution of Herring Gull density (#/km^2) in the Study Area for all behaviors using the kernel density method (2009).

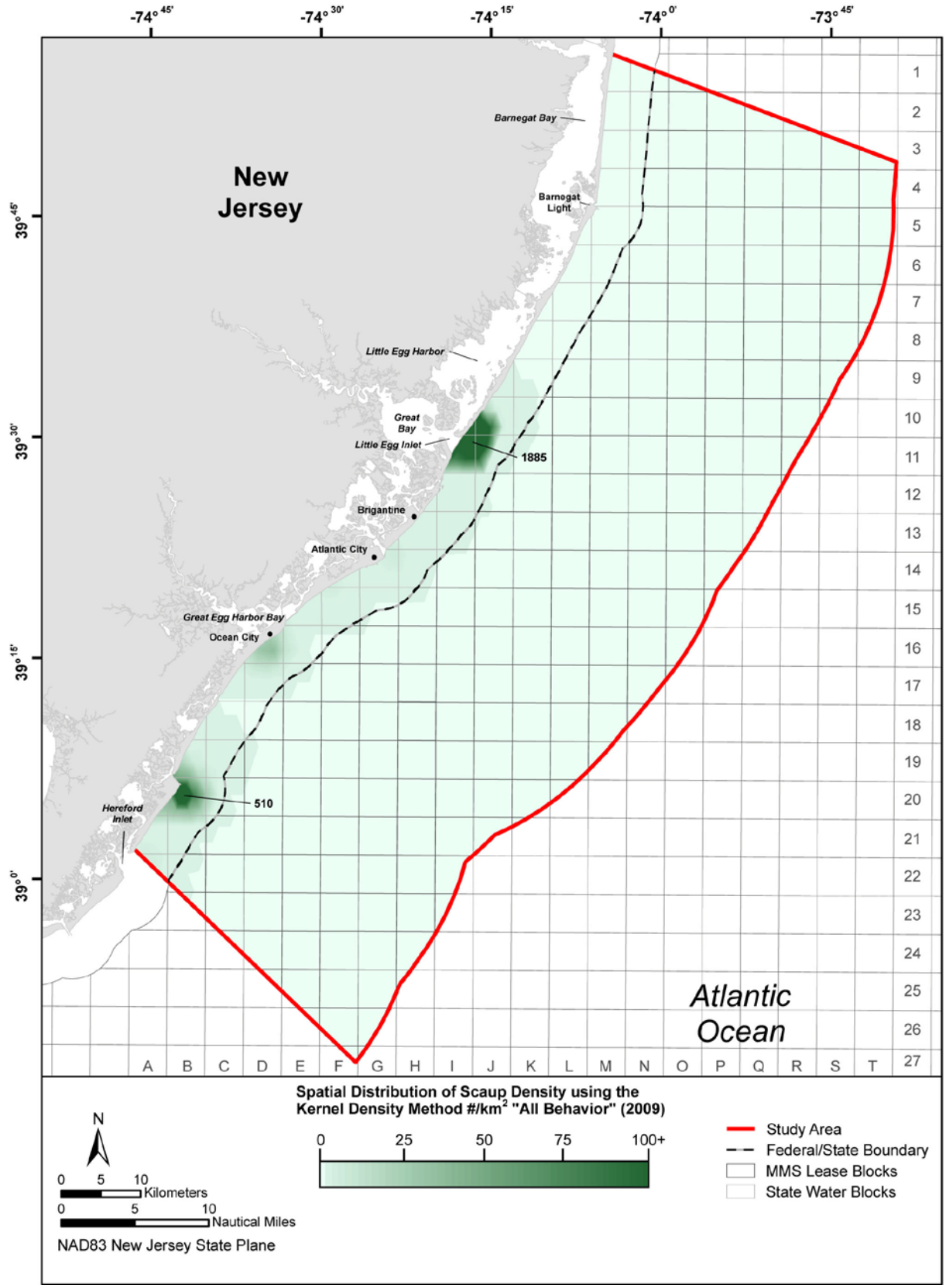

Figure M-507. Spatial distribution of scaup density (#/km^2) in the Study Area for all behaviors using the kernel density method (2009).

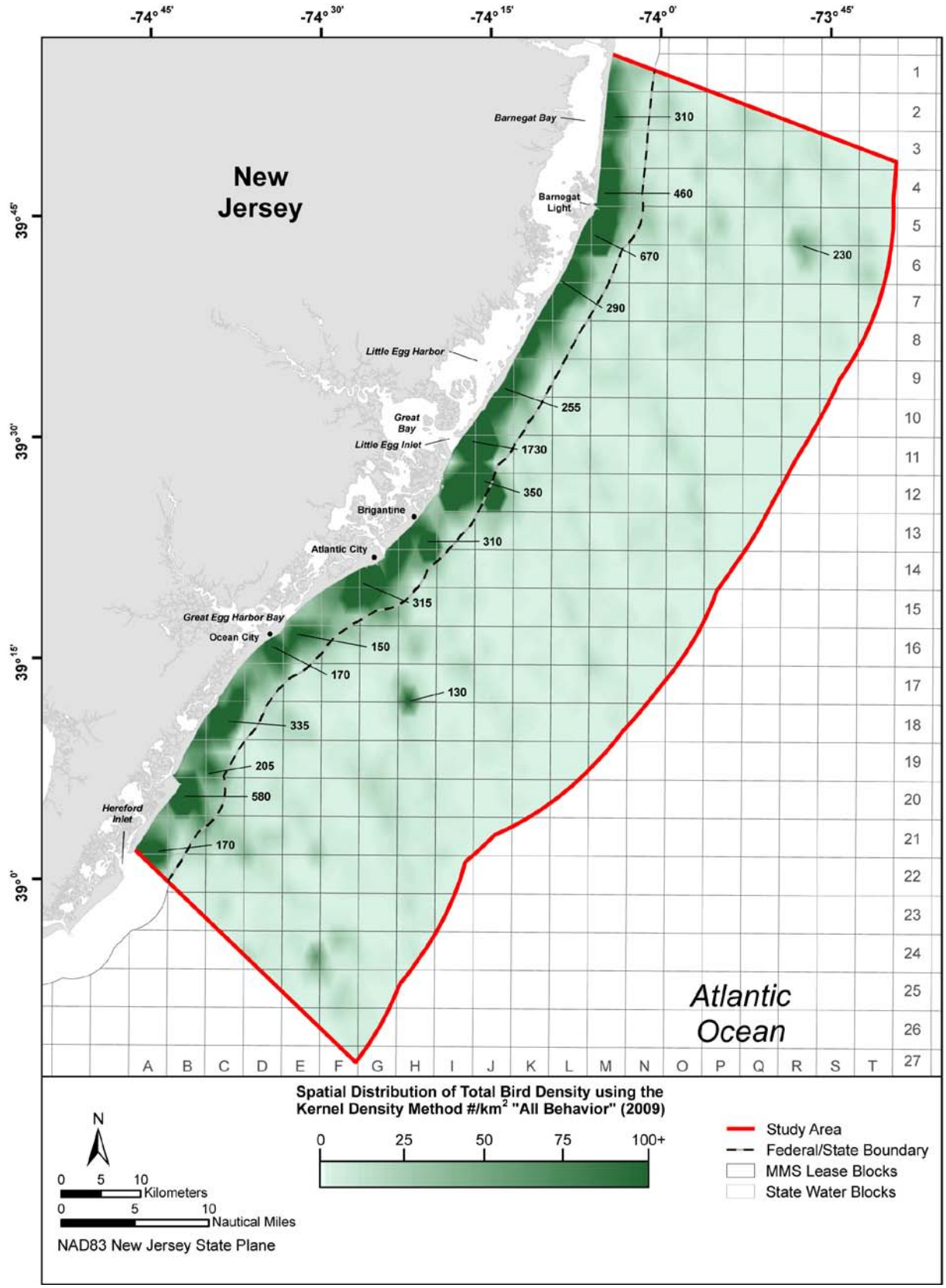

Figure M-508. Spatial distribution of total bird density (#/km^2) in the Study Area for all behaviors using the kernel density method (2009).

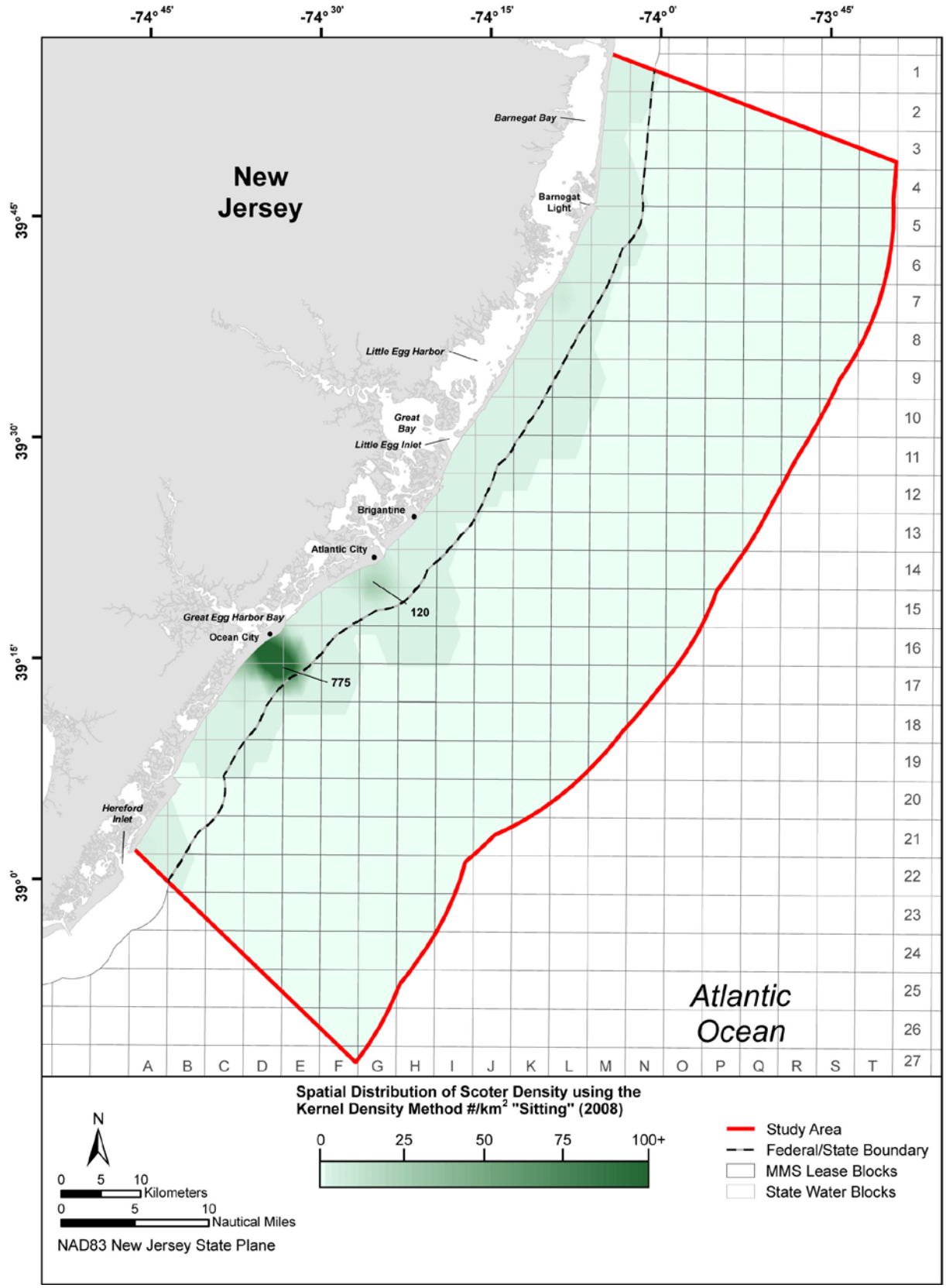

Figure M-509. Spatial distribution of scoter density (#/km^2) in the Study Area for sitting birds using the kernel density method (2008).

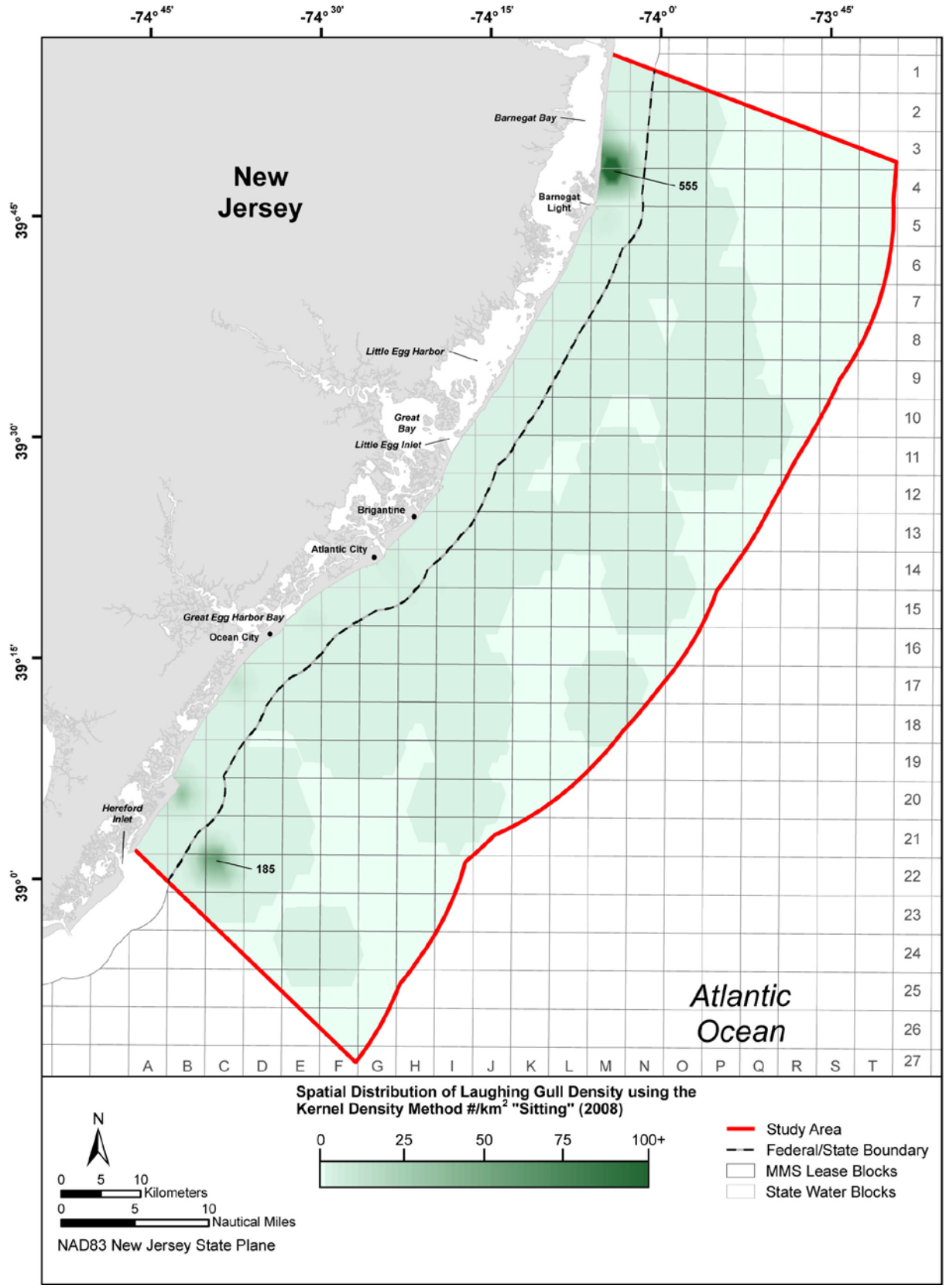

Figure M-510. Spatial distribution of Laughing Gull density (#/km^2) in the Study Area for sitting birds using the kernel density method (2008).

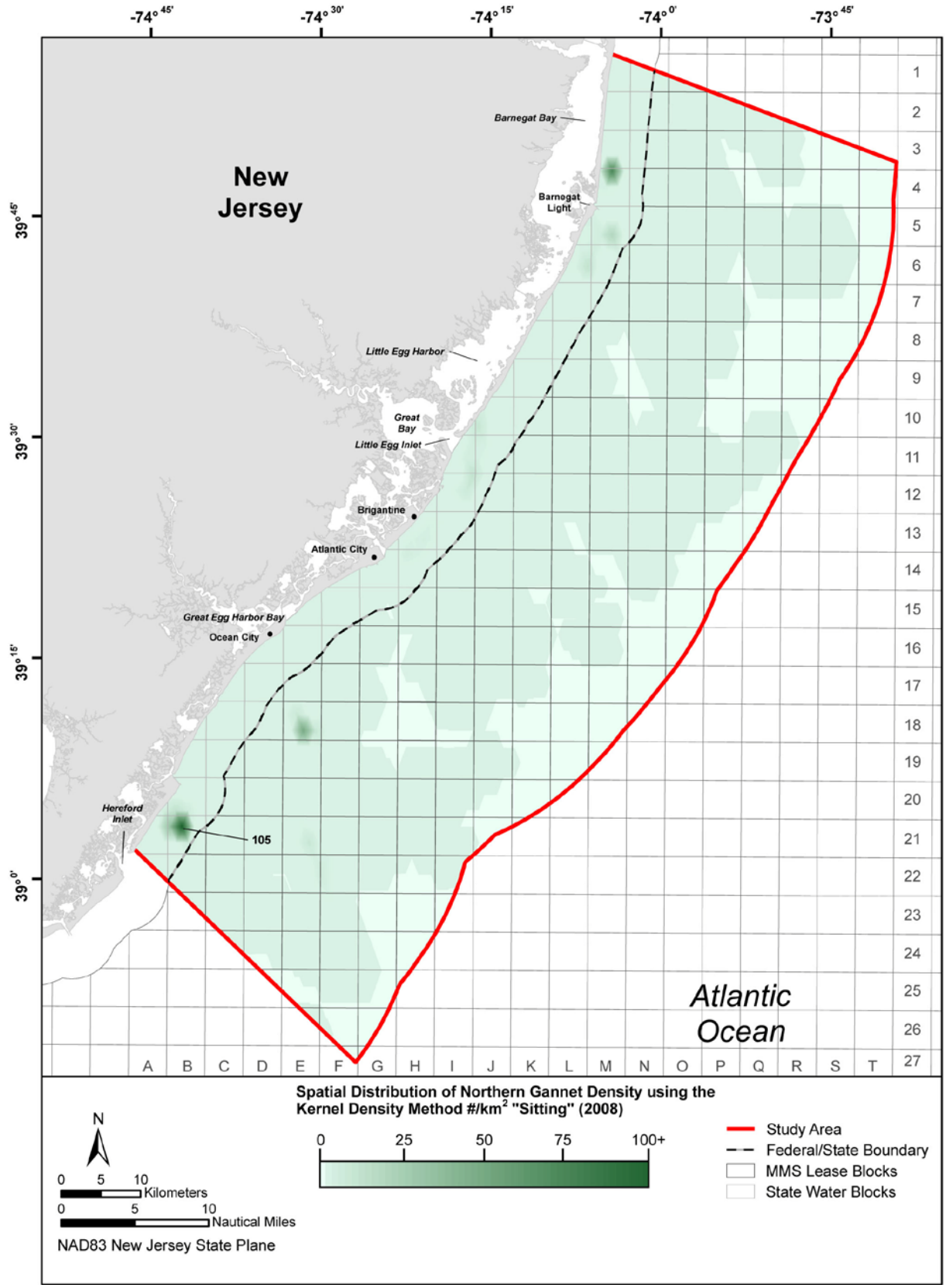

Figure M-511. Spatial distribution of Northern Gannet density (#/km^2) in the Study Area for sitting birds using the kernel density method (2008).

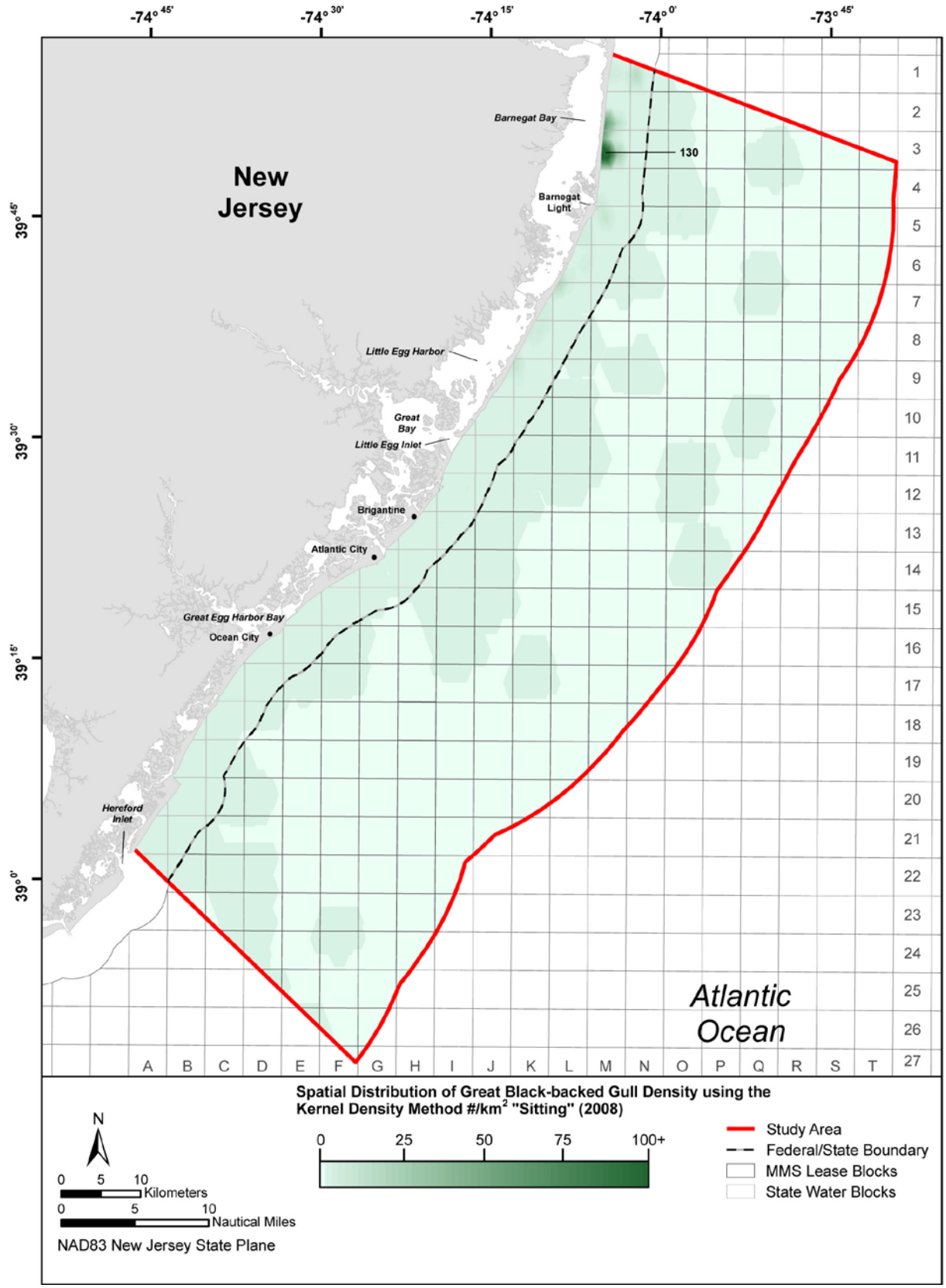

Figure M-512. Spatial distribution of Great Black-backed Gull density (#/km^2) in the Study Area for sitting birds using the kernel density method (2008).

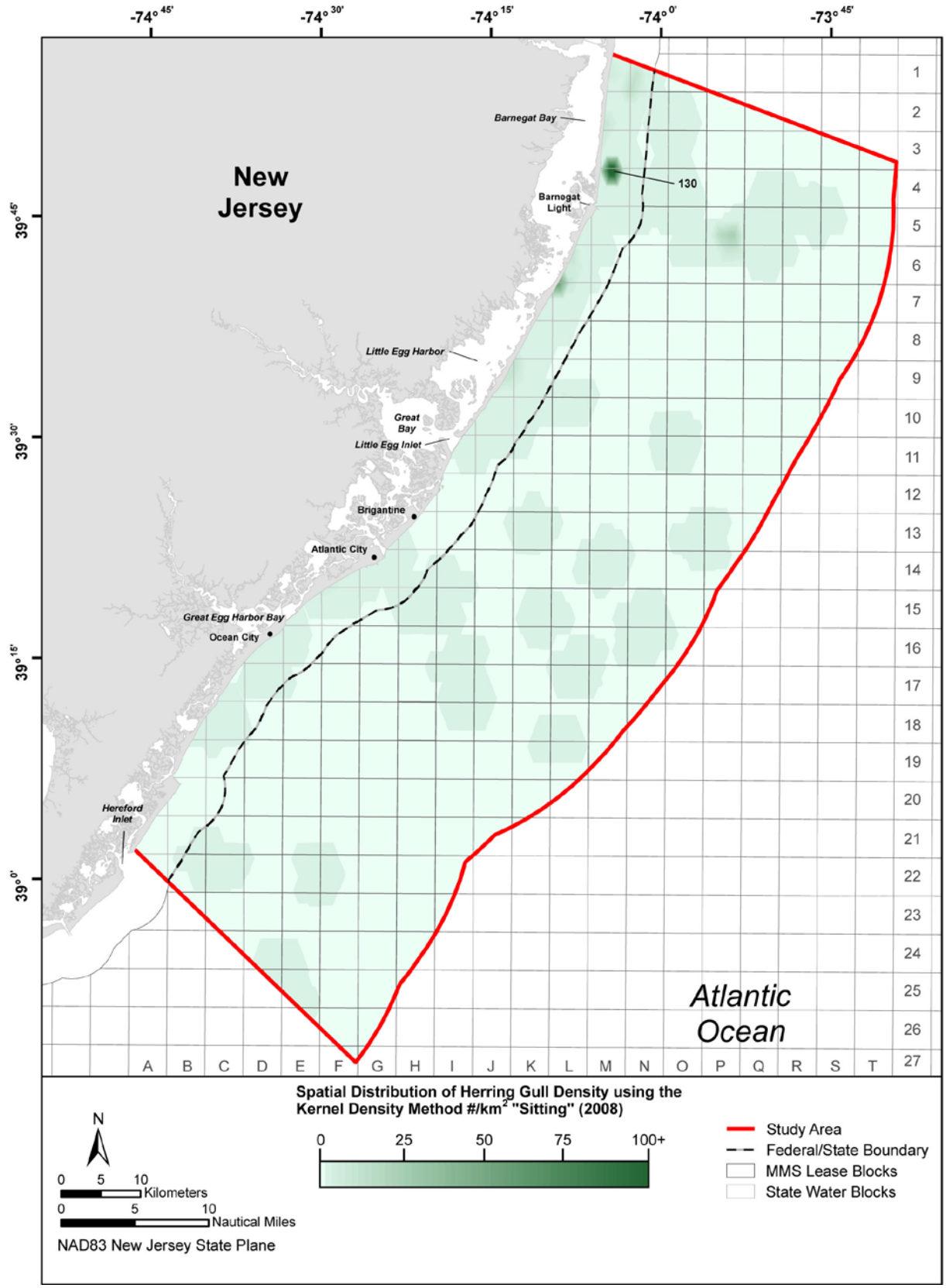

Figure M-513. Spatial distribution of Herring Gull density (#/km^2) in the Study Area for sitting birds using the kernel density method (2008).

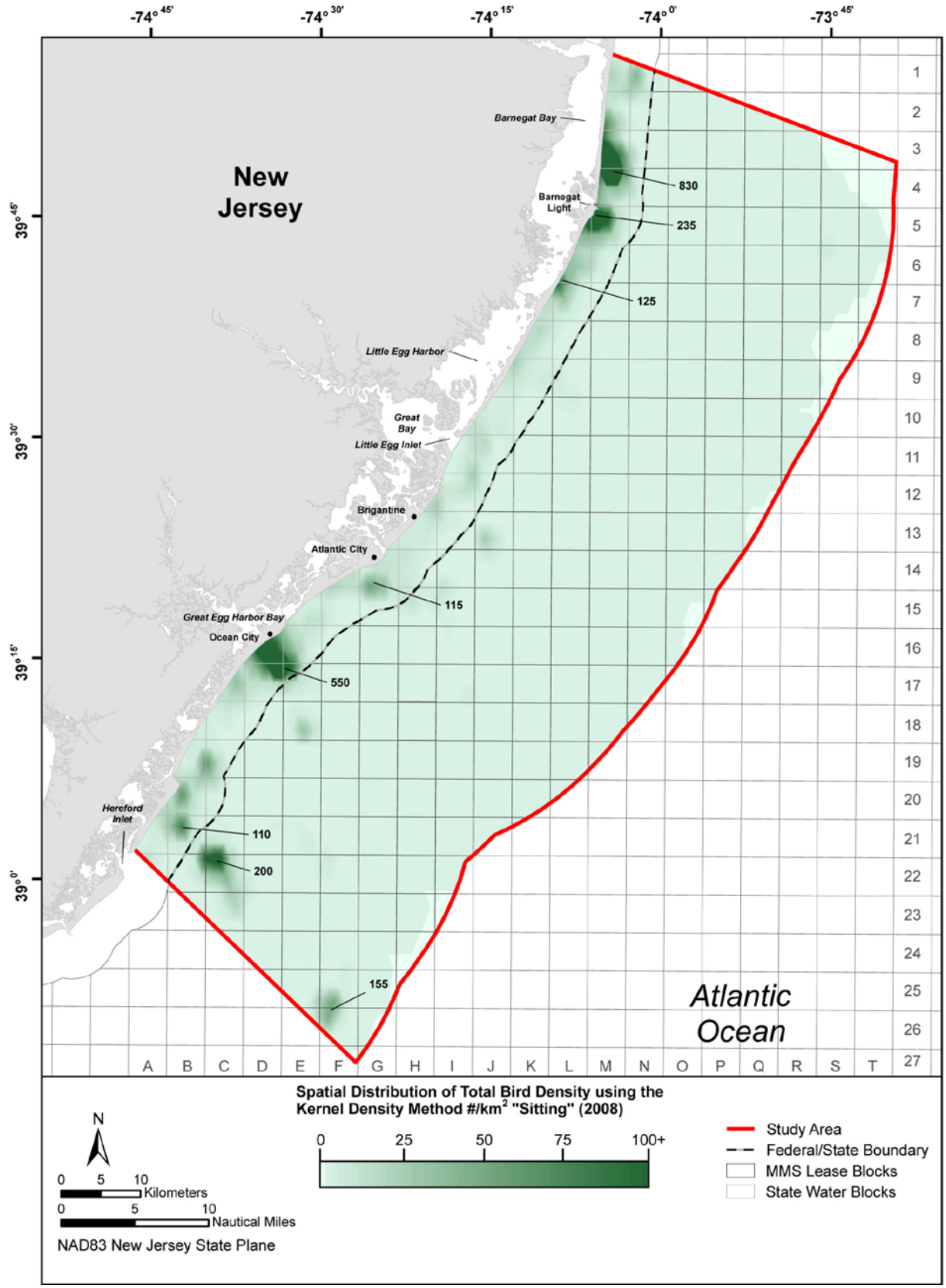

Figure M-514. Spatial distribution of total bird density (#/km^2) in the Study Area for sitting birds using the kernel density method (2008).

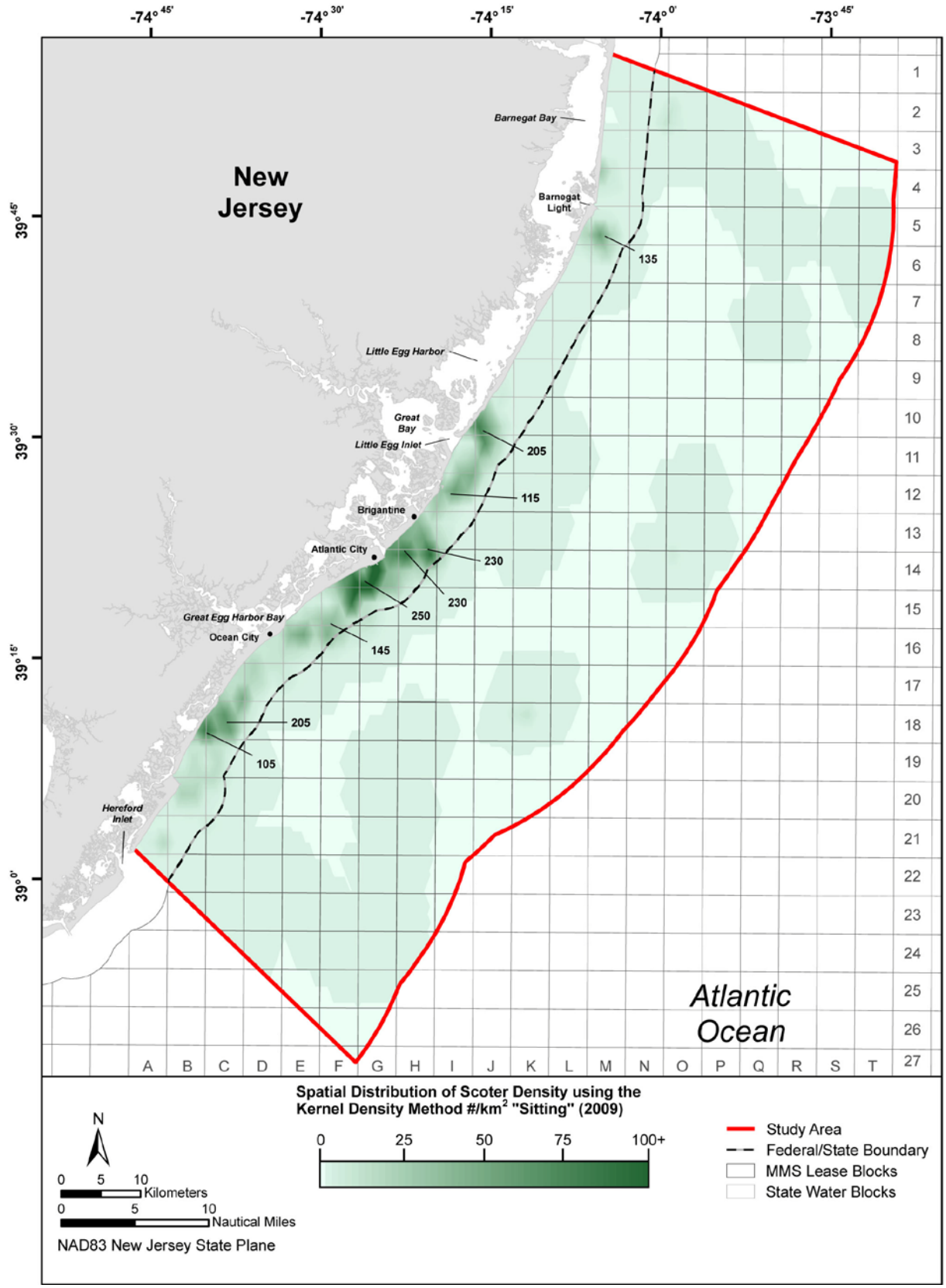

Figure M-515. Spatial distribution of scoter density (#/km^2) in the Study Area for sitting birds using the kernel density method (2009).

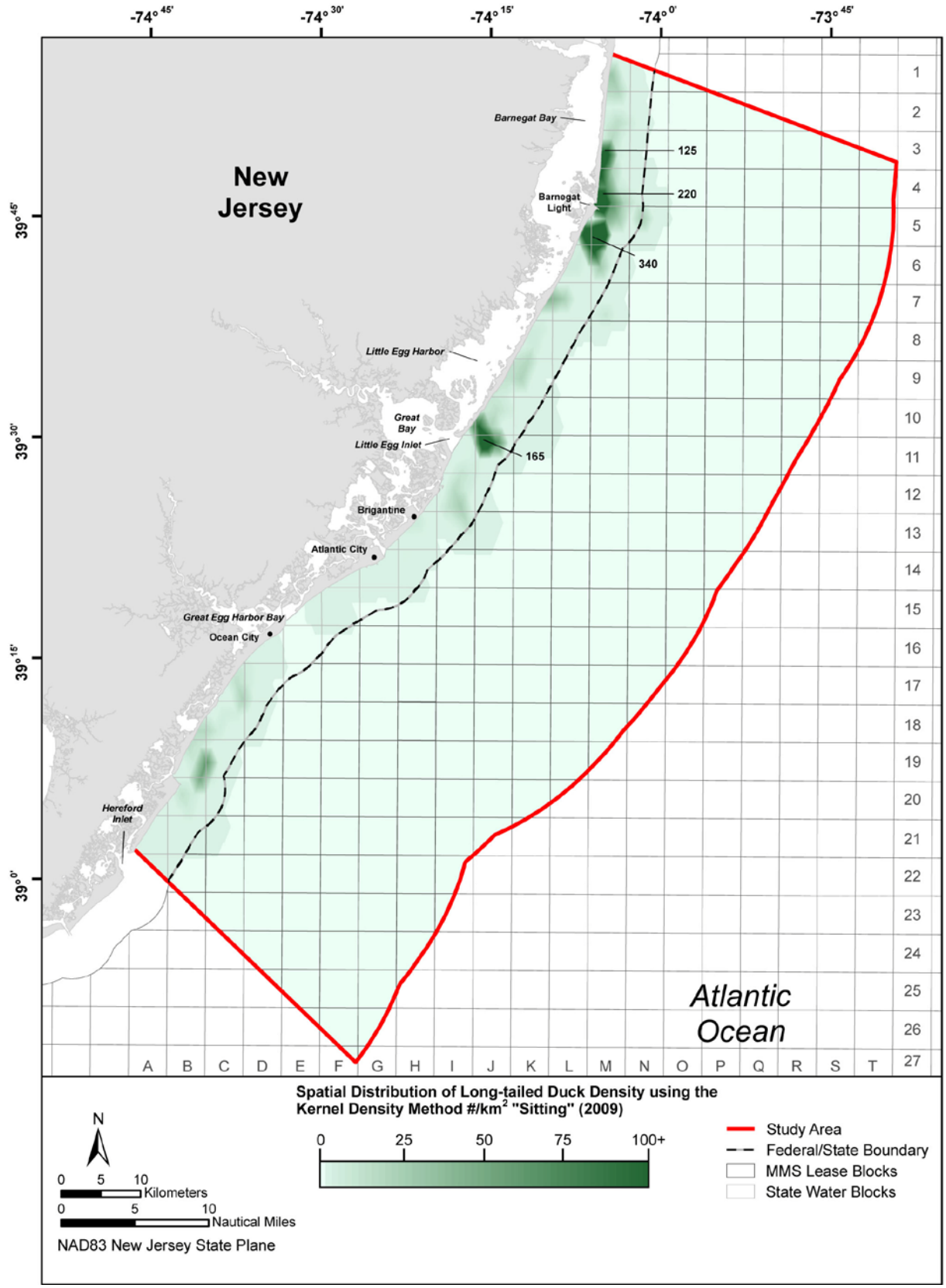

Figure M-516. Spatial distribution of Long-tailed Duck density (#/km^2) in the Study Area for sitting birds using the kernel density method (2009).

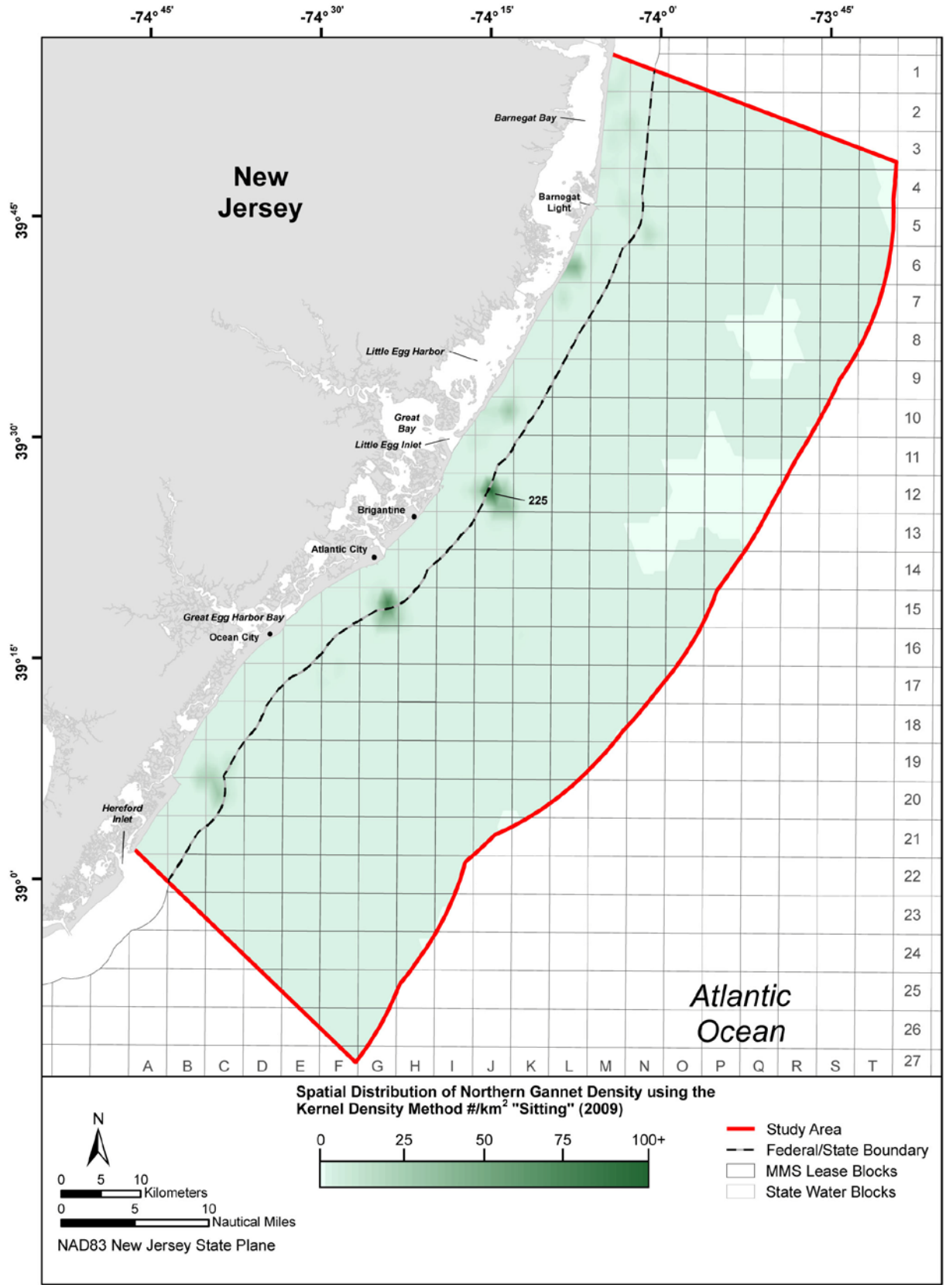

Figure M-517. Spatial distribution of Northern Gannet density (#/km^2) in the Study Area for sitting birds using the kernel density method (2009).

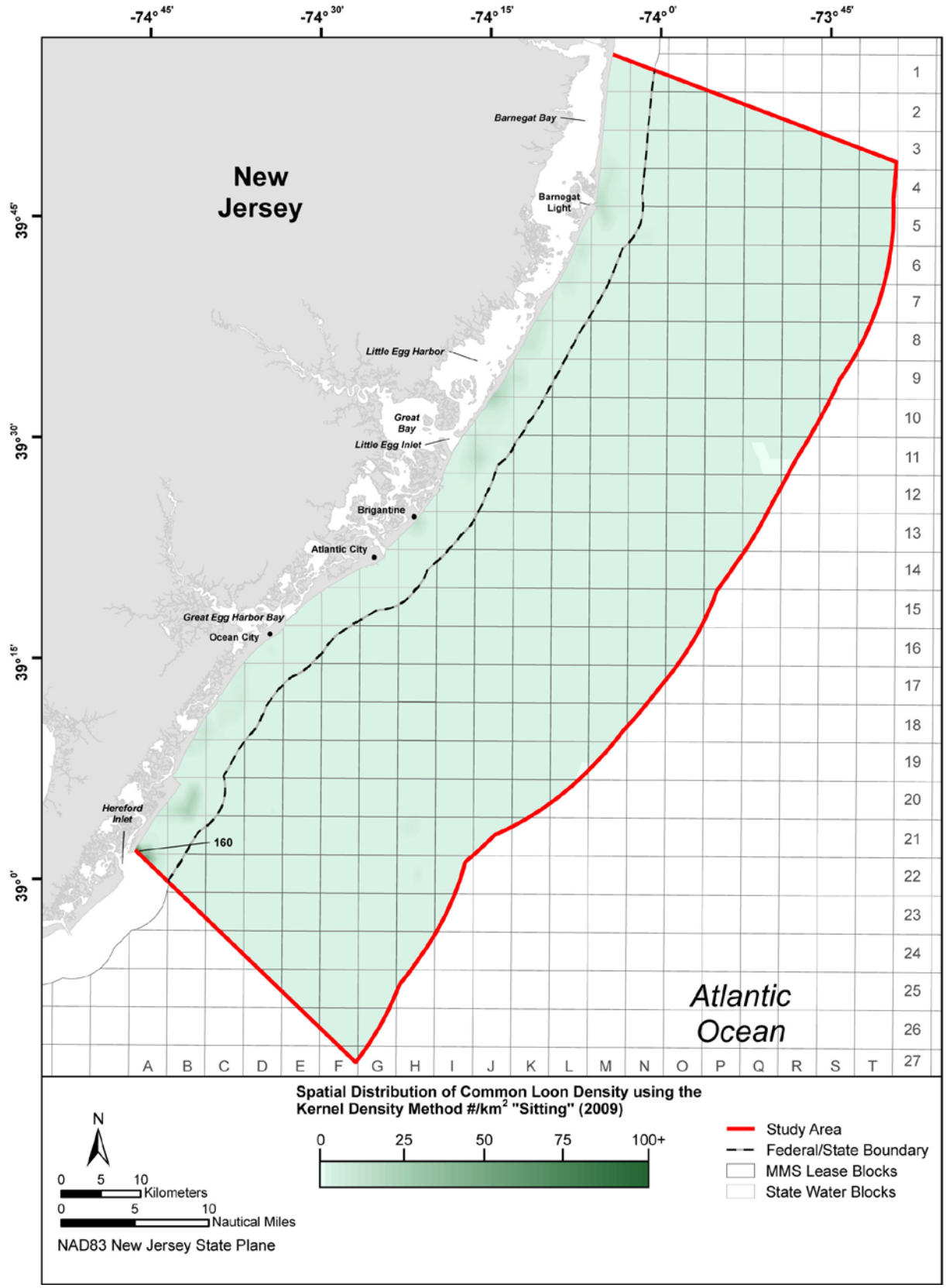

Figure M-518. Spatial distribution of Common Loon density (#/km^2) in the Study Area for sitting birds using the kernel density method (2009).

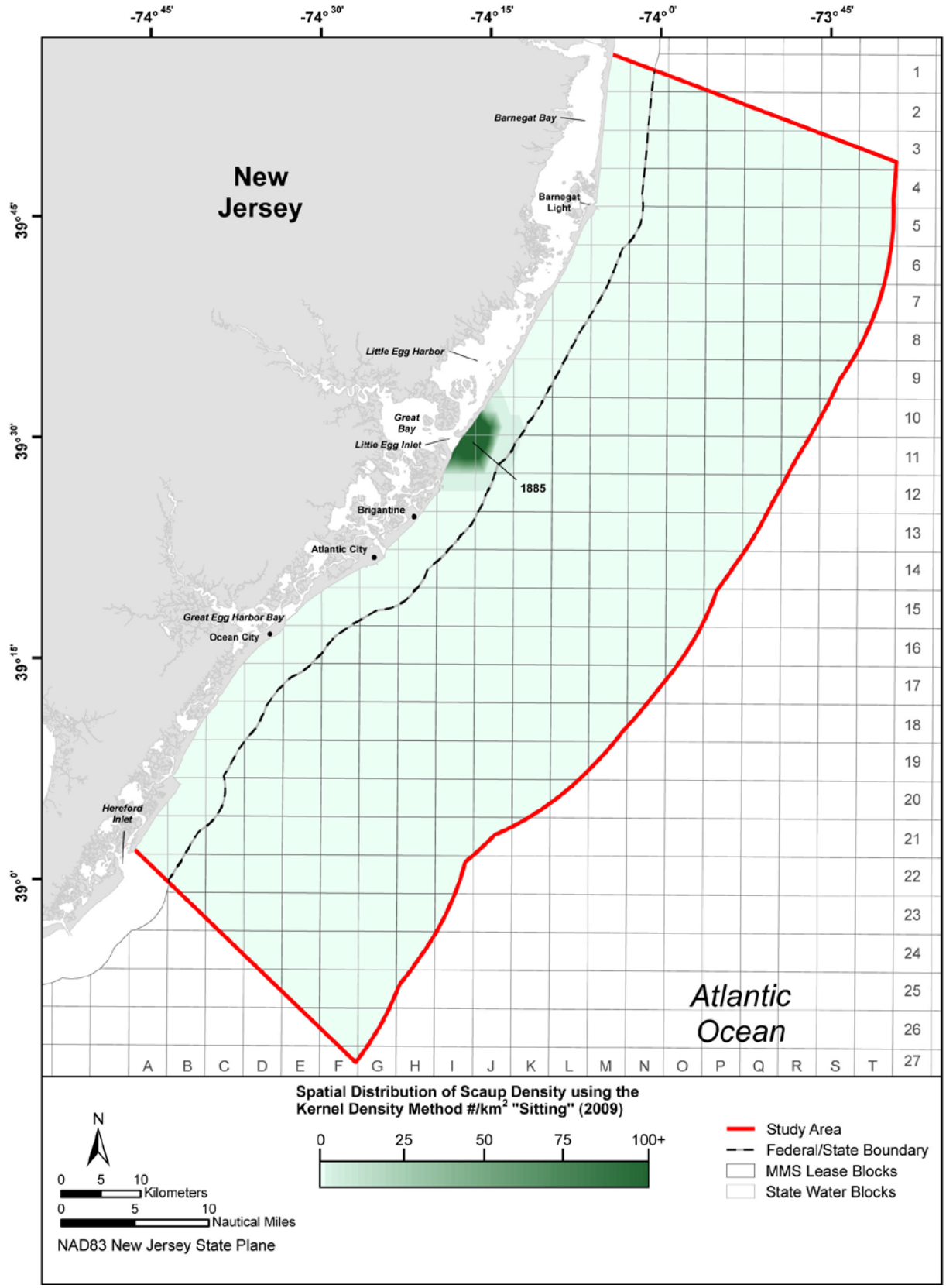

Figure M-519. Spatial distribution of scaup density (#/km^2) in the Study Area for sitting birds using the kernel density method (2009).

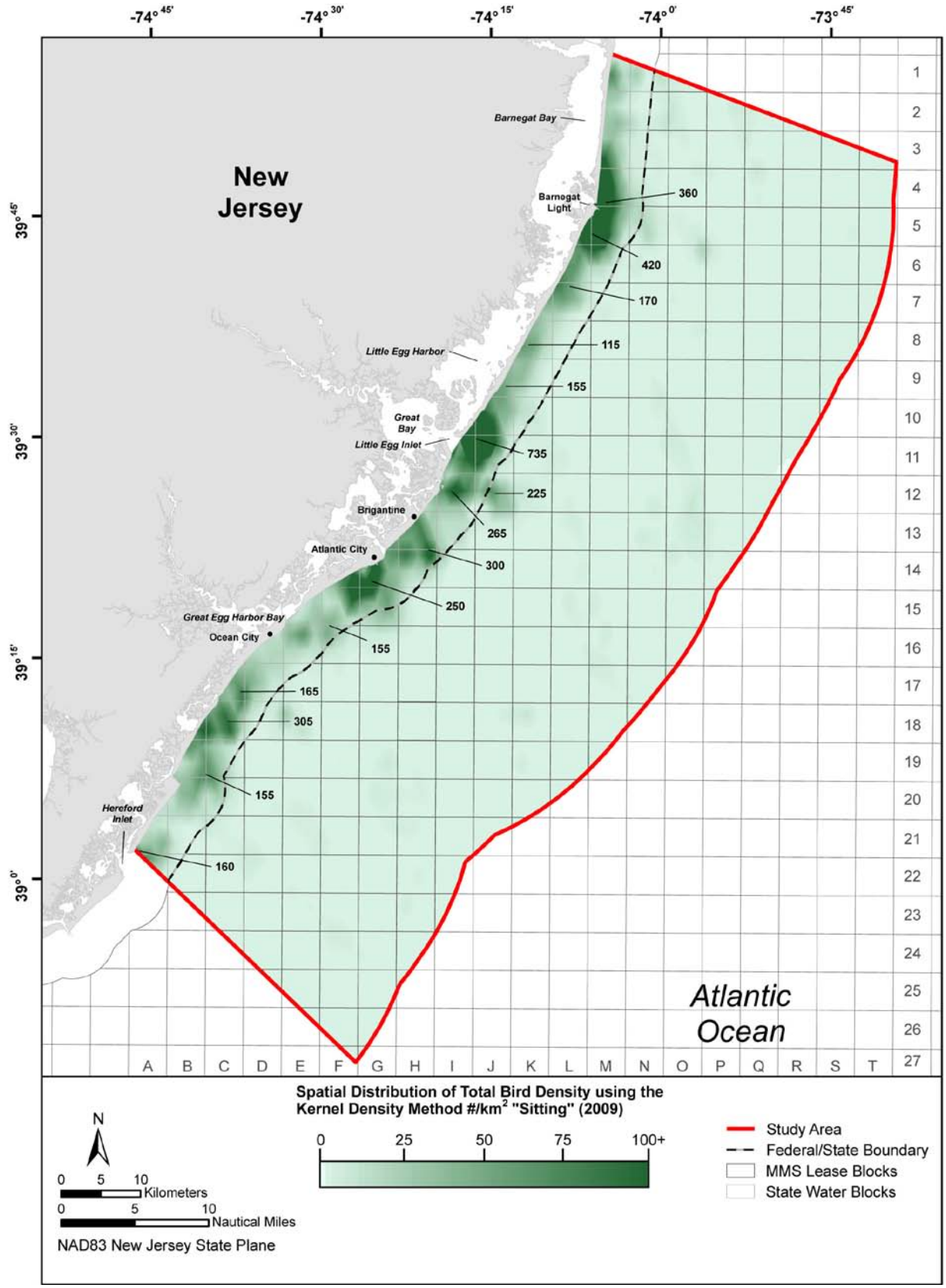

Figure M-520. Spatial distribution of total bird density (#/km^2) in the Study Area for sitting birds using the kernel density method (2009).

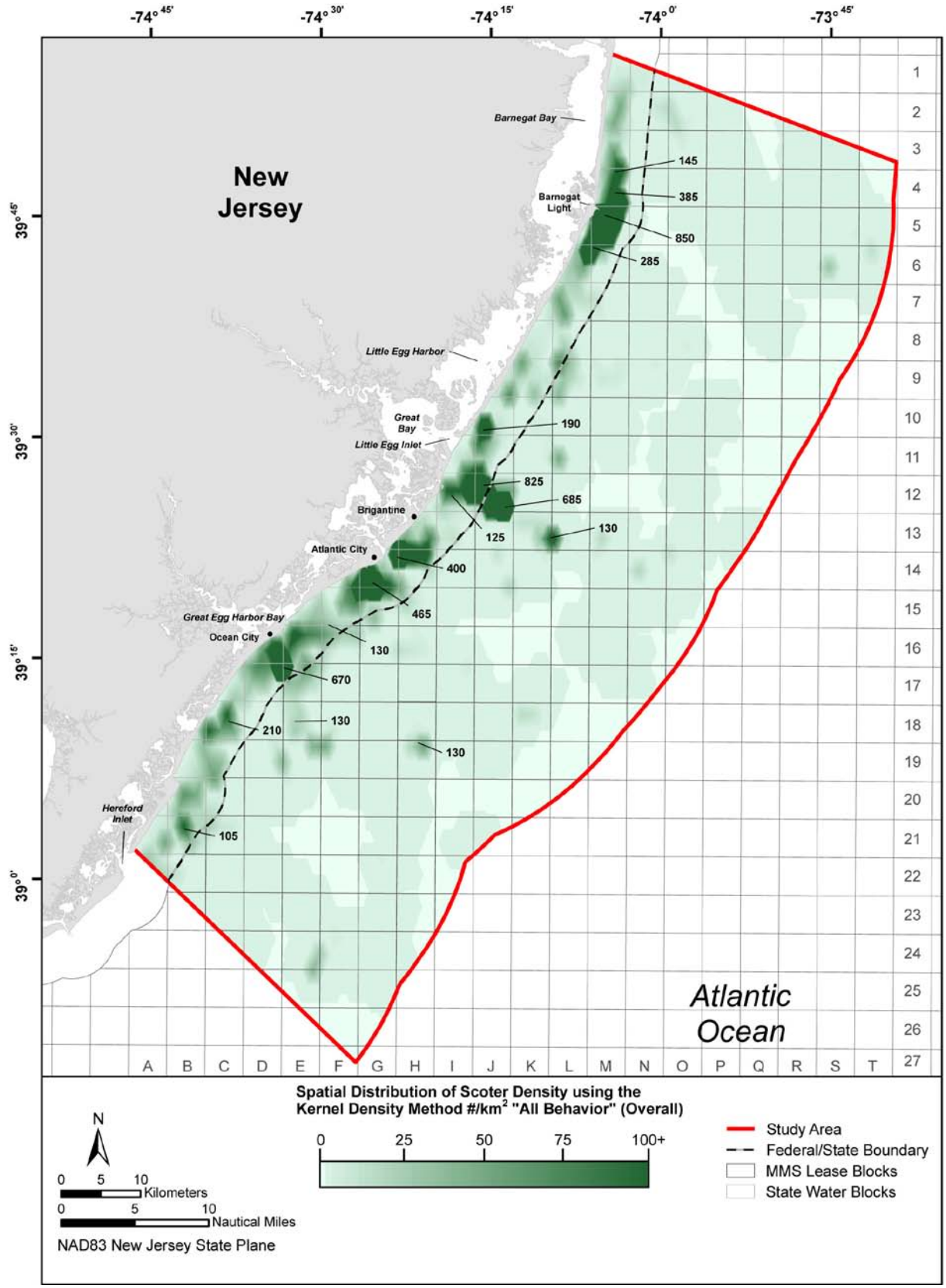

Figure M-521. Spatial distribution of scoter density (#/km^2) in the Study Area for all behaviors using the kernel density method (overall).

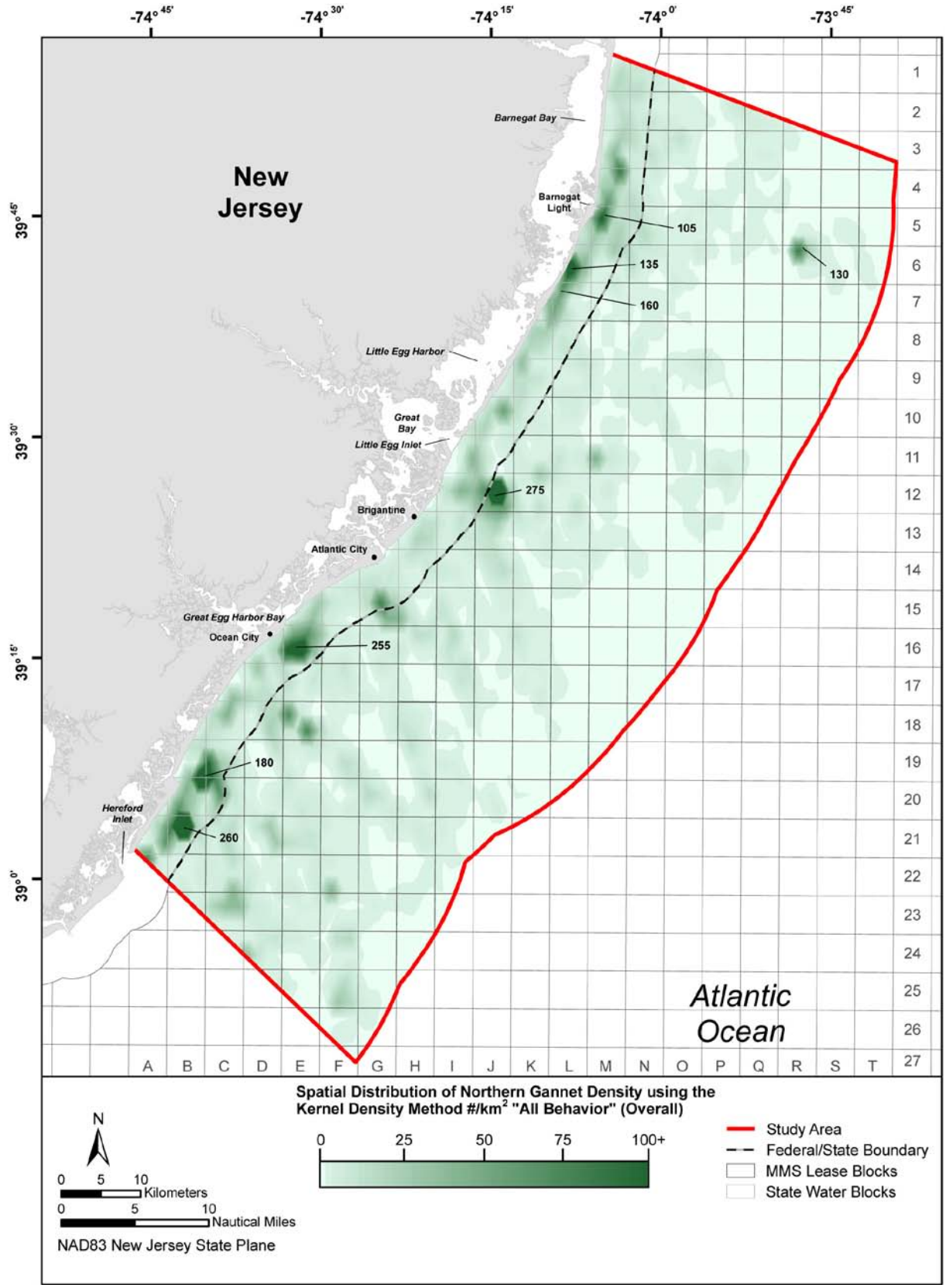

Figure M-522. Spatial distribution of Northern Gannet density (#/km^2) in the Study Area for all behaviors using the kernel density method (overall).

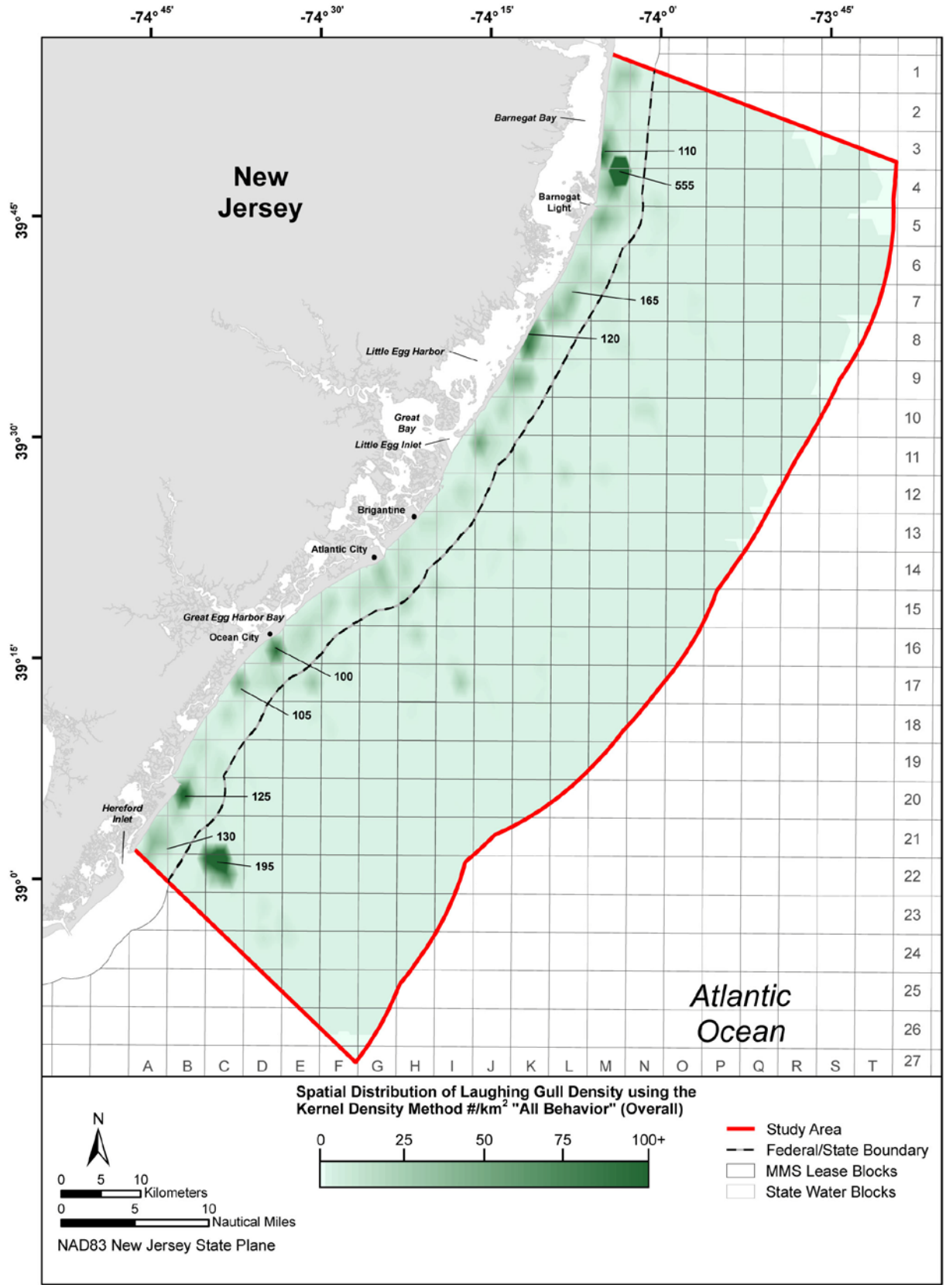

Figure M-523. Spatial distribution of Laughing Gull density (#/km^2) in the Study Area for all behaviors using the kernel density method (overall).

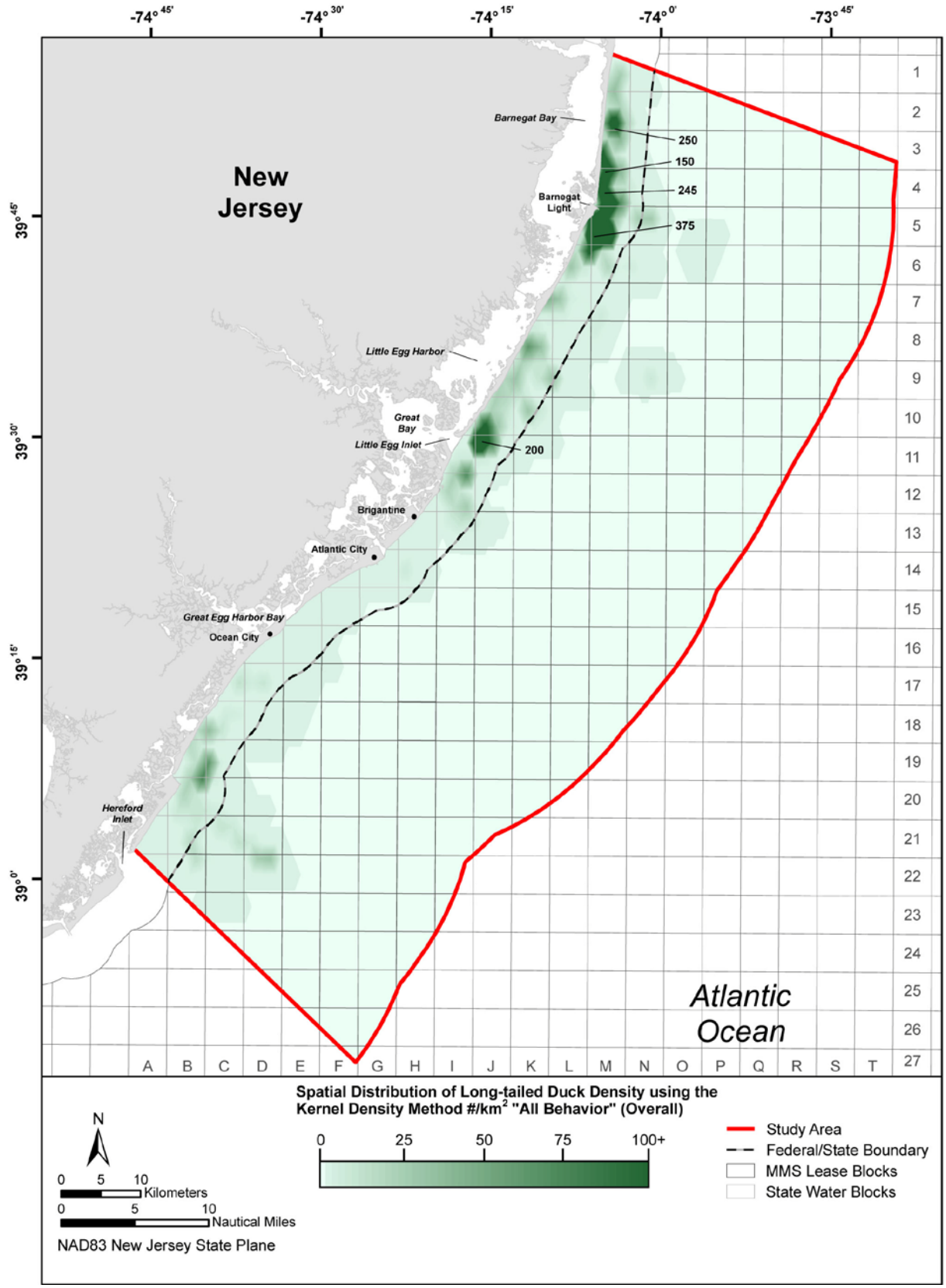

Figure M-524. Spatial distribution of Long-tailed Duck density (#/km^2) in the Study Area for all behaviors using the kernel density method (overall).

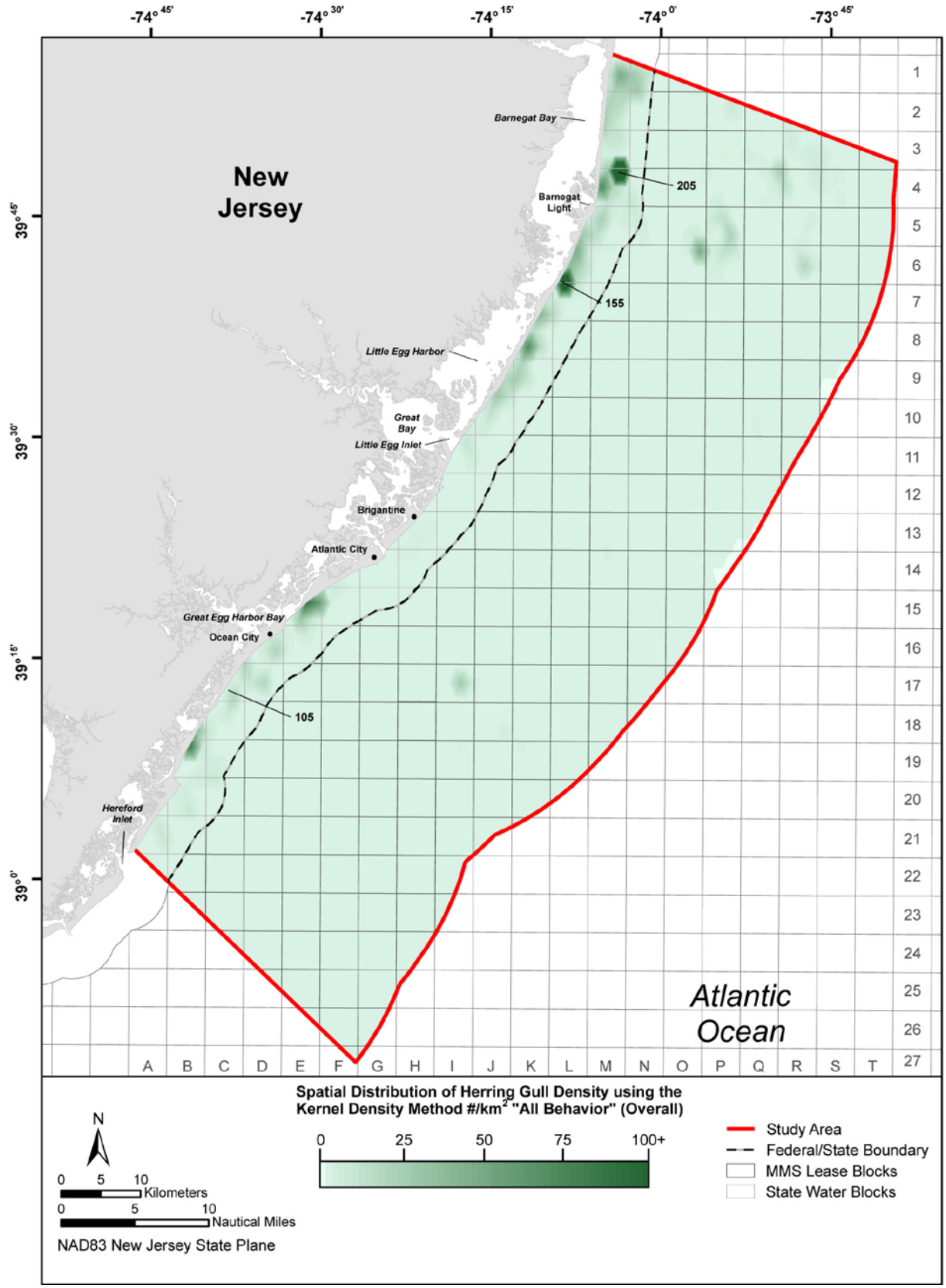

Figure M-525. Spatial distribution of Herring Gull density (#/km^2) in the Study Area for all behaviors using the kernel density method (overall).

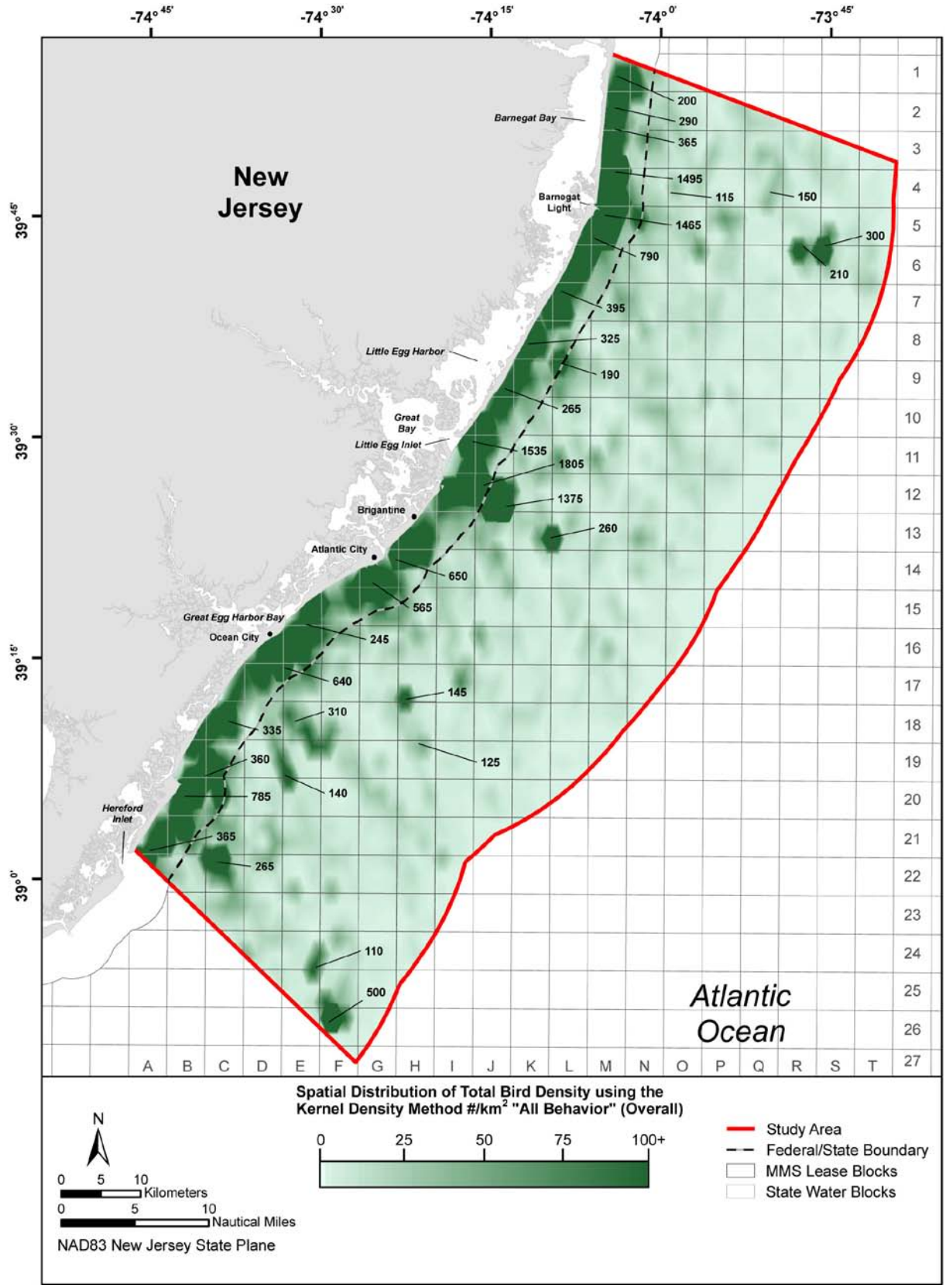

Figure M-526. Spatial distribution of total bird density (#/km^2) in the Study Area for all behaviors using the kernel density method (overall).

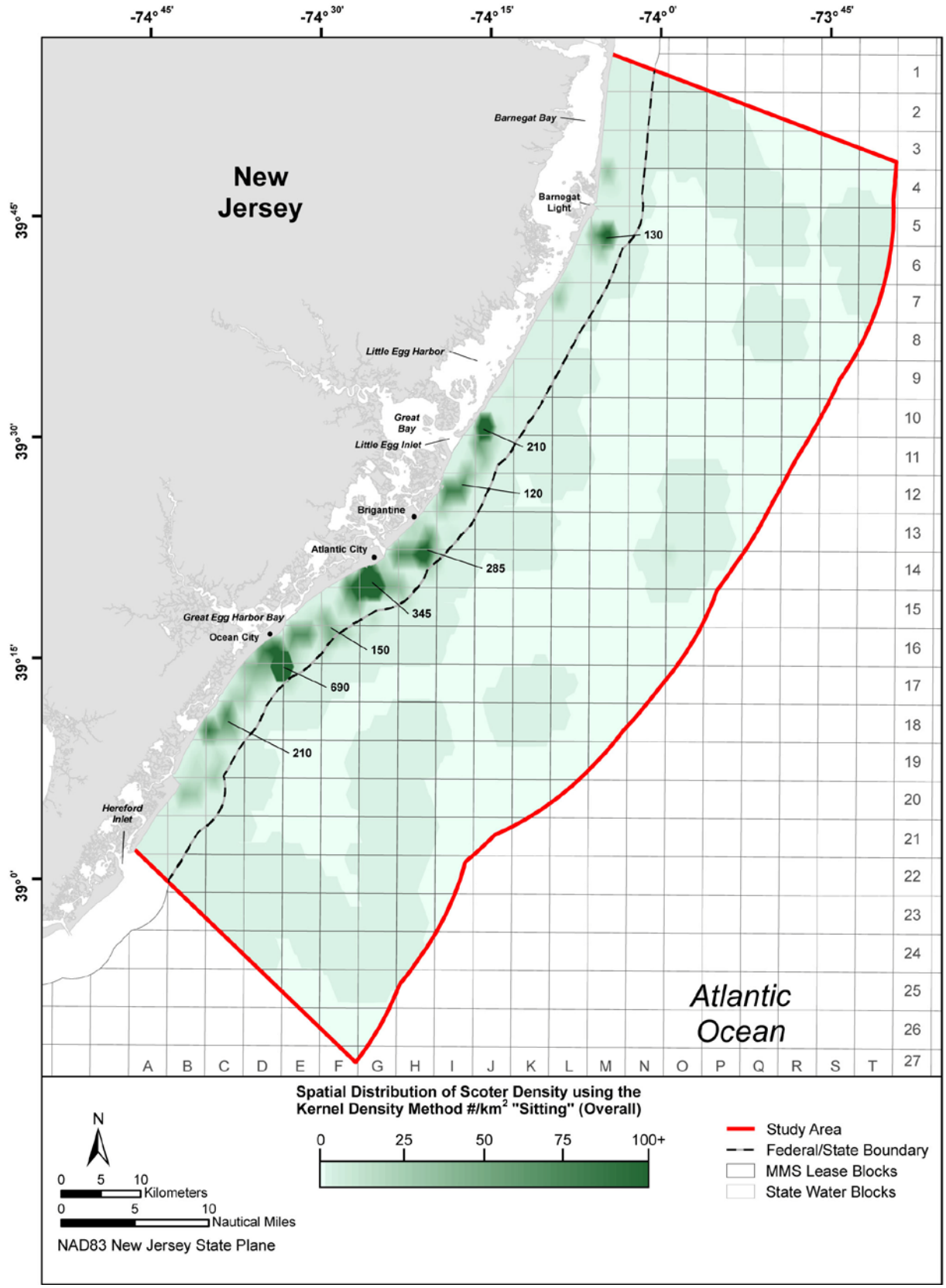

Figure M-527. Spatial distribution of scoter density (#/km^2) in the Study Area for sitting birds using the kernel density method (overall).

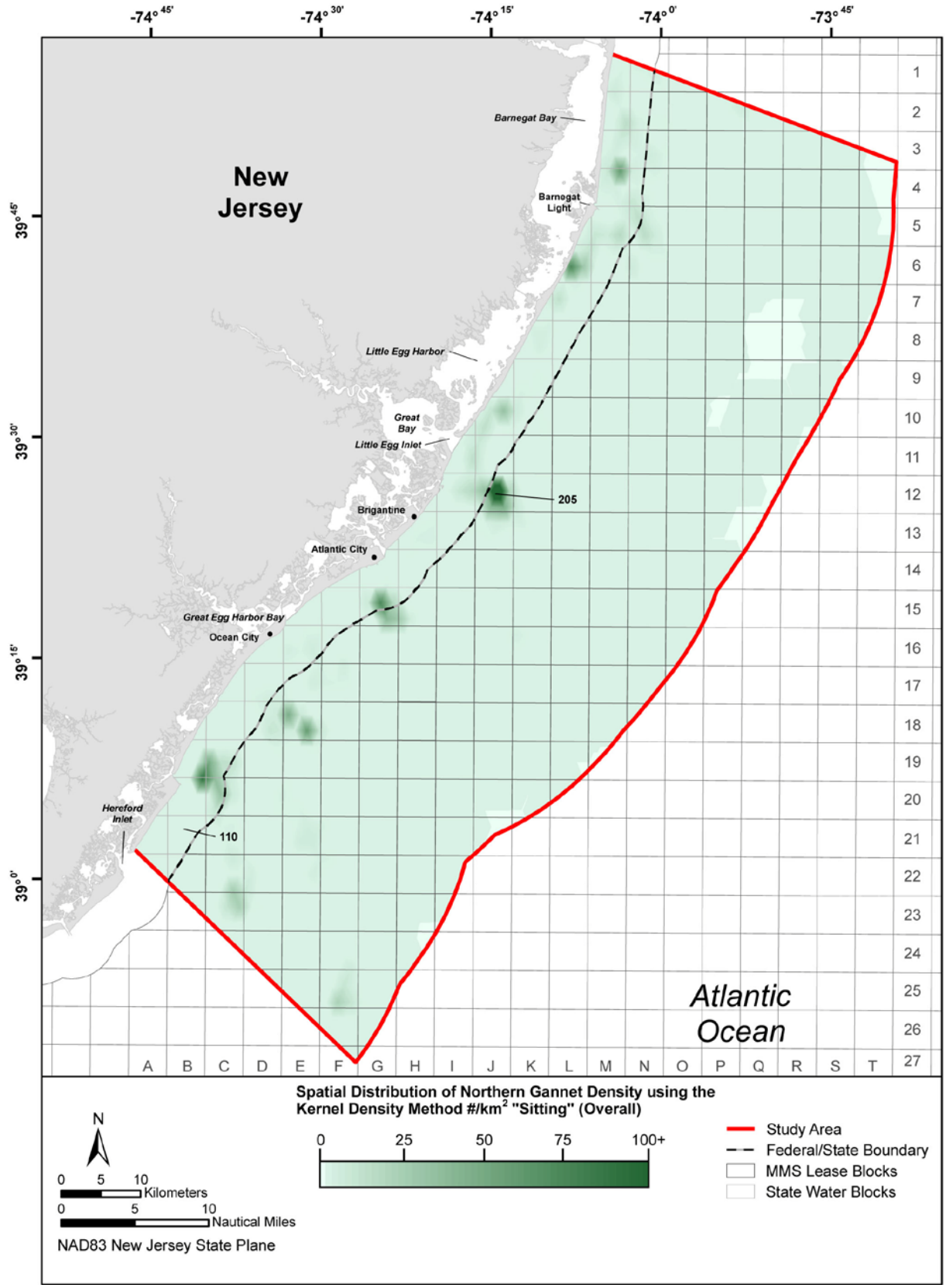

Figure M-528. Spatial distribution of Northern Gannet density (#/km^2) in the Study Area for sitting birds using the kernel density method (overall).

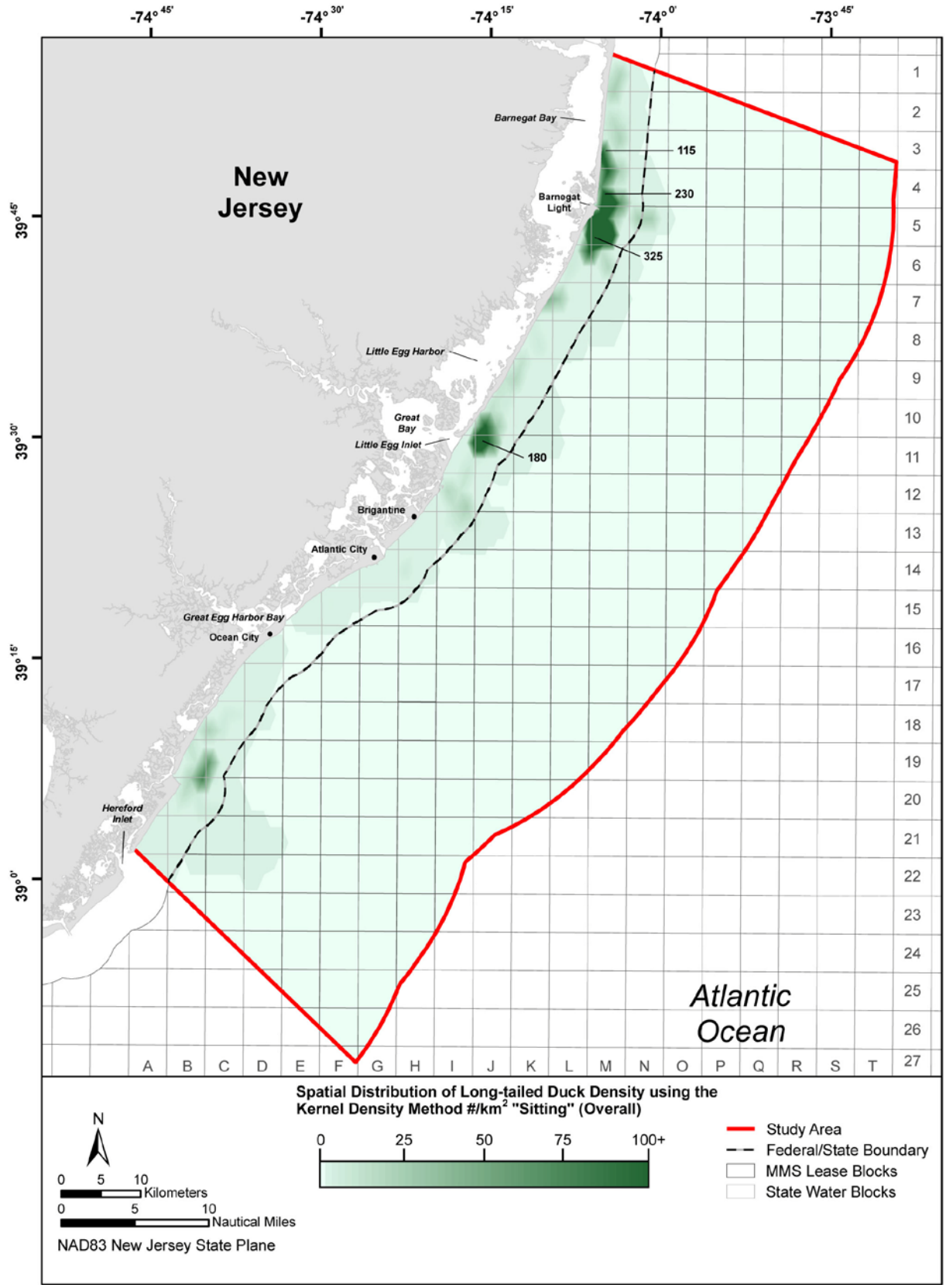

Figure M-529. Spatial distribution of Long-tailed Duck density (#/km^2) in the Study Area for sitting birds using the kernel density method (overall).

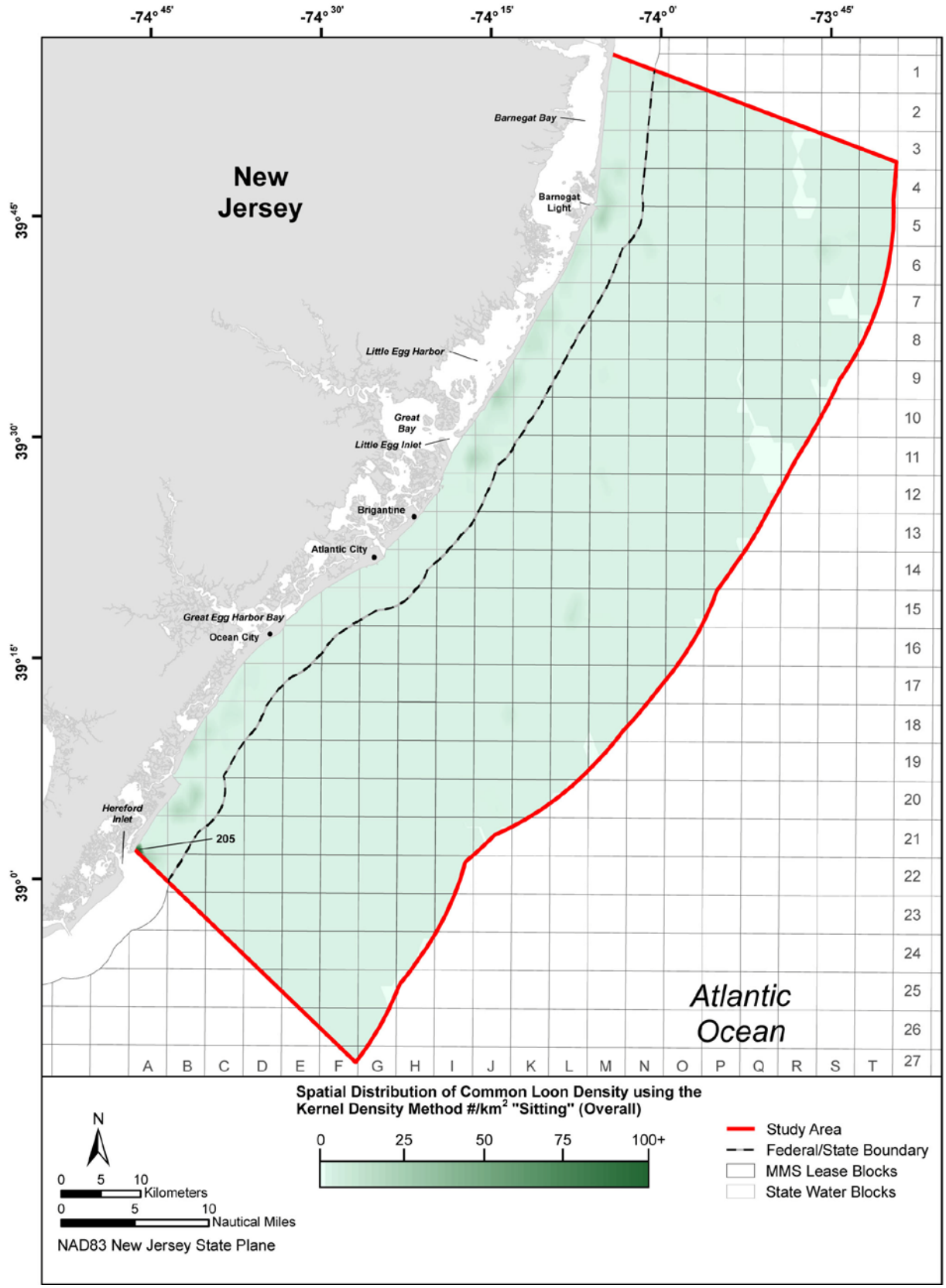

Figure M-530. Spatial distribution of Common Loon density (#/km2) in the Study Area for sitting birds using the kernel density method (overall).

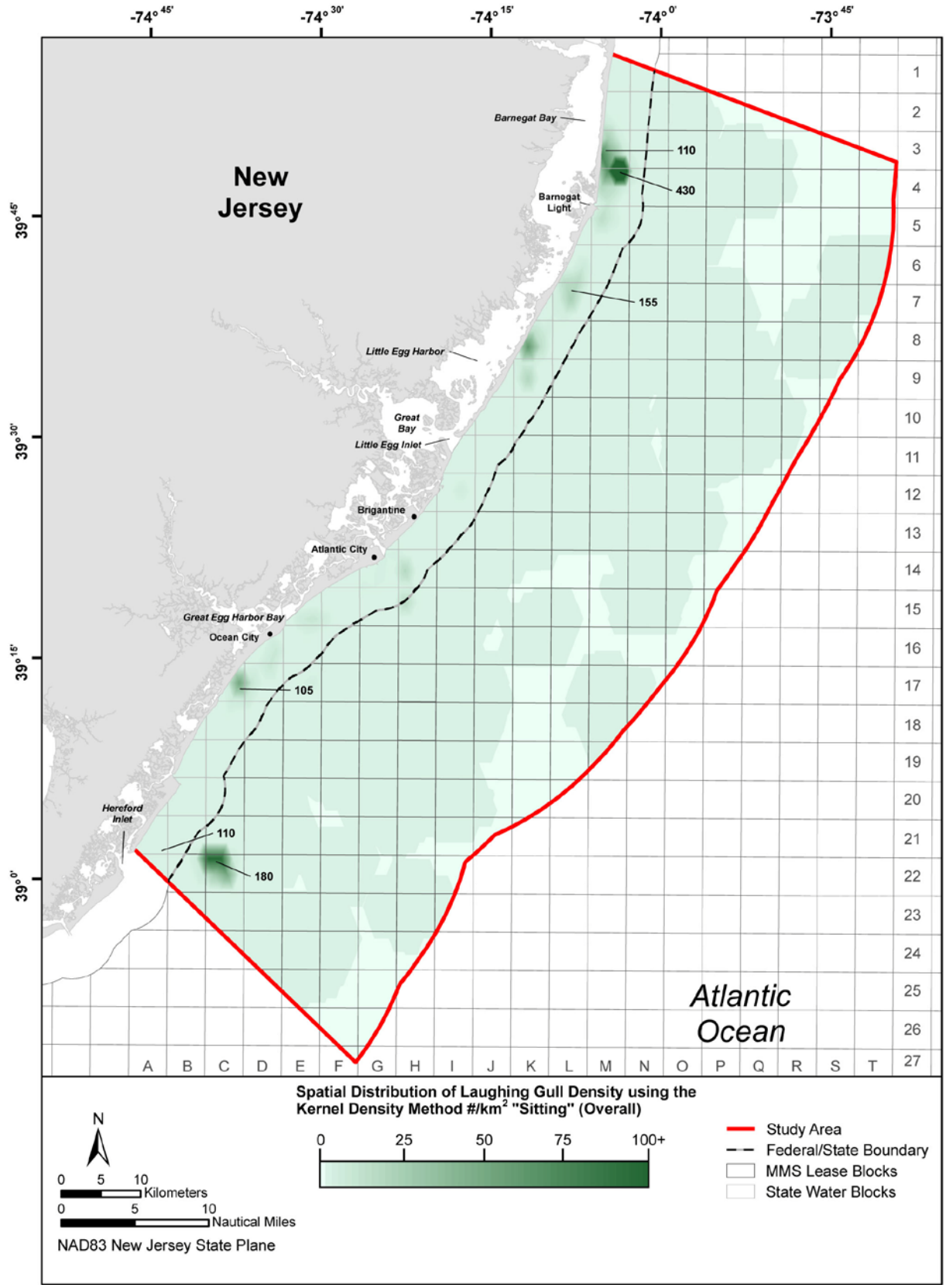

Figure M-531. Spatial distribution of Laughing Gull density (#/km^2) in the Study Area for sitting birds using the kernel density method (overall).

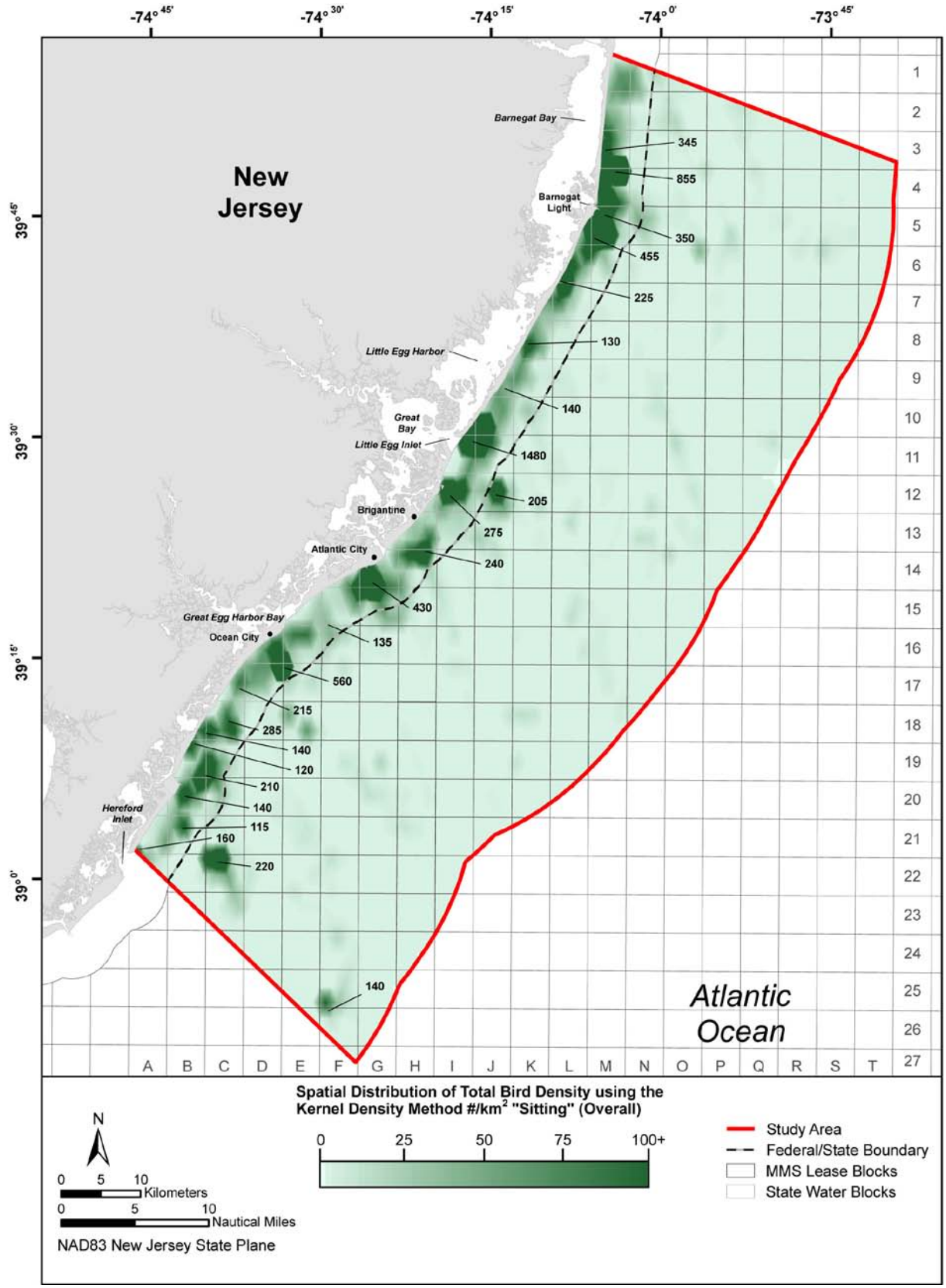

Figure M-532. Spatial distribution of total bird density (#/km^2) in the Study Area for sitting birds using the kernel density method (overall).

APPENDIX N

SUPPLEMENTAL AVIAN AERIAL SURVEY DATA

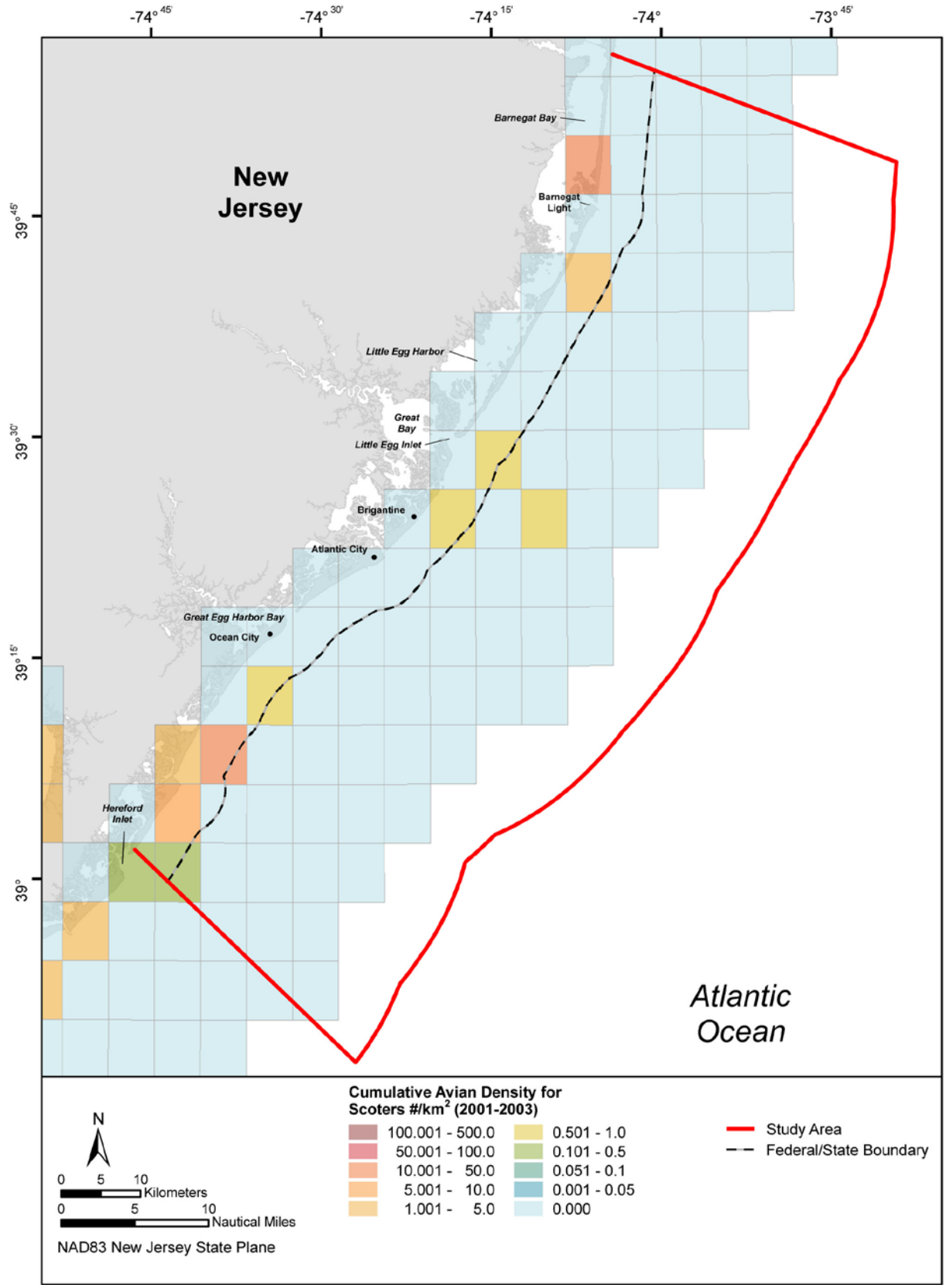

Figure N-1. Cumulative avian density for scoters (#/km^2) from 2001 to 2003.

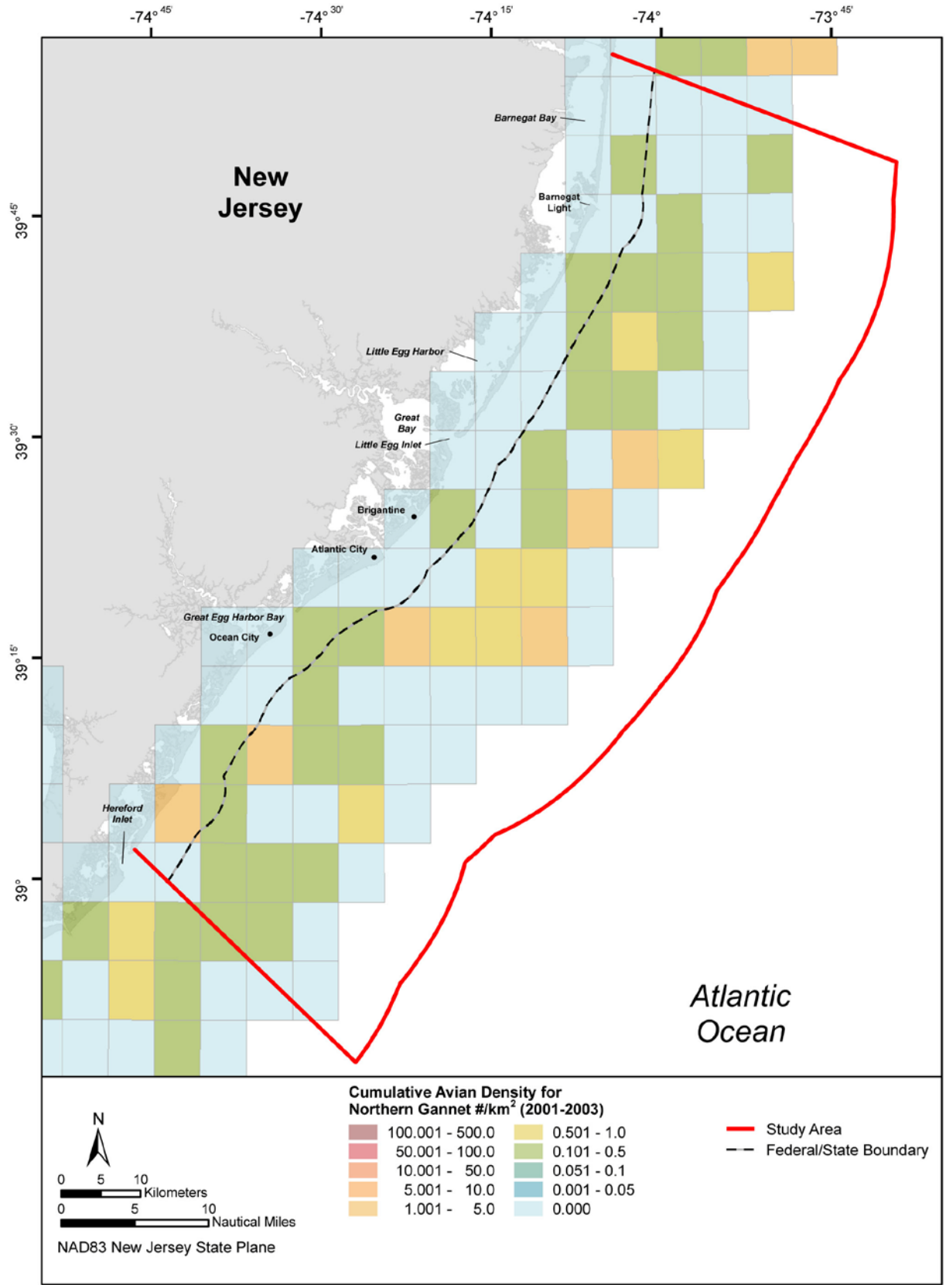

Figure N-2. Cumulative avian density for Northern Gannets (#/km^2) from 2001 to 2003.

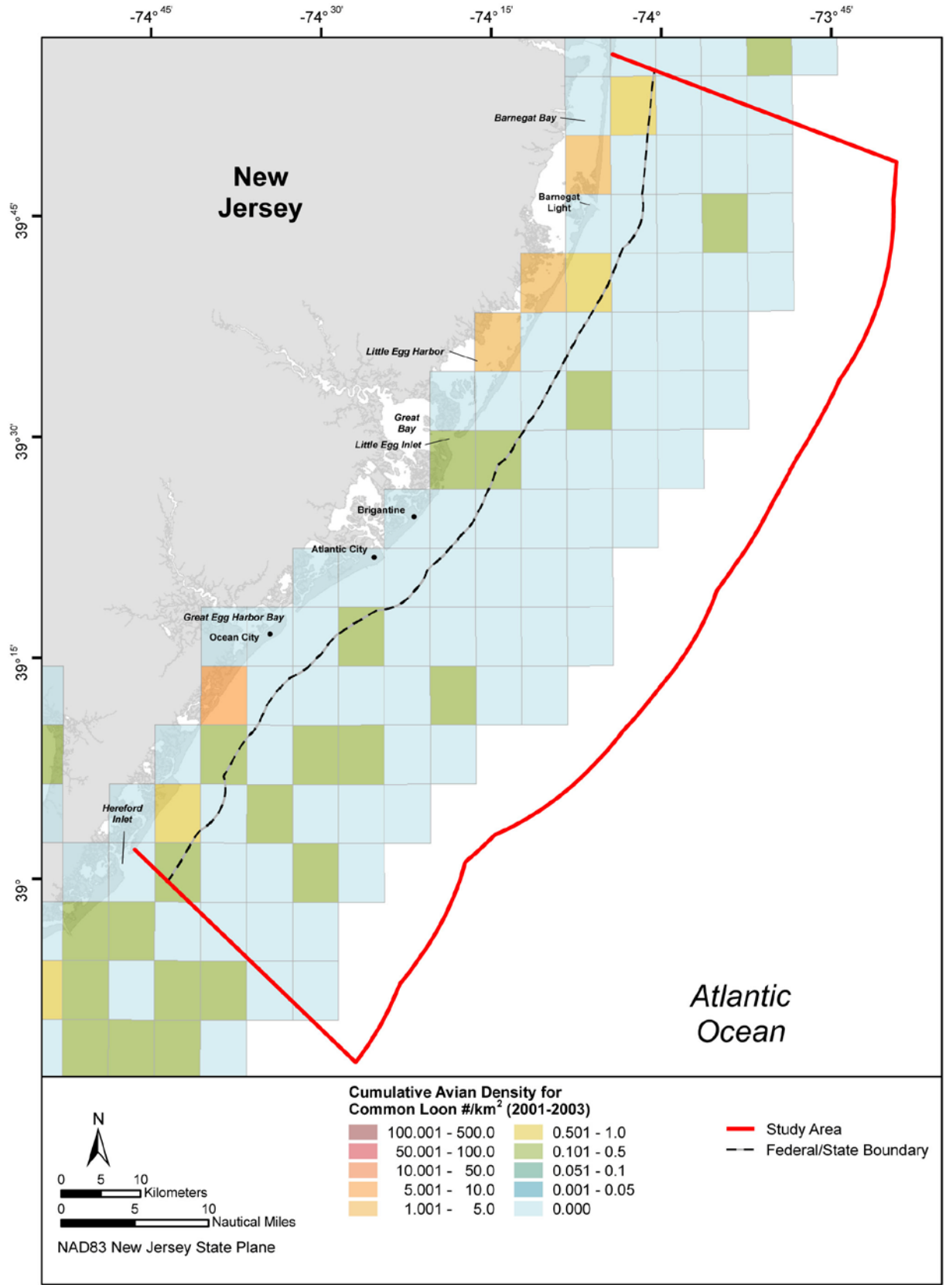

Figure N-3. Cumulative avian density for Common Loons (#/km^2) from 2001 to 2003.

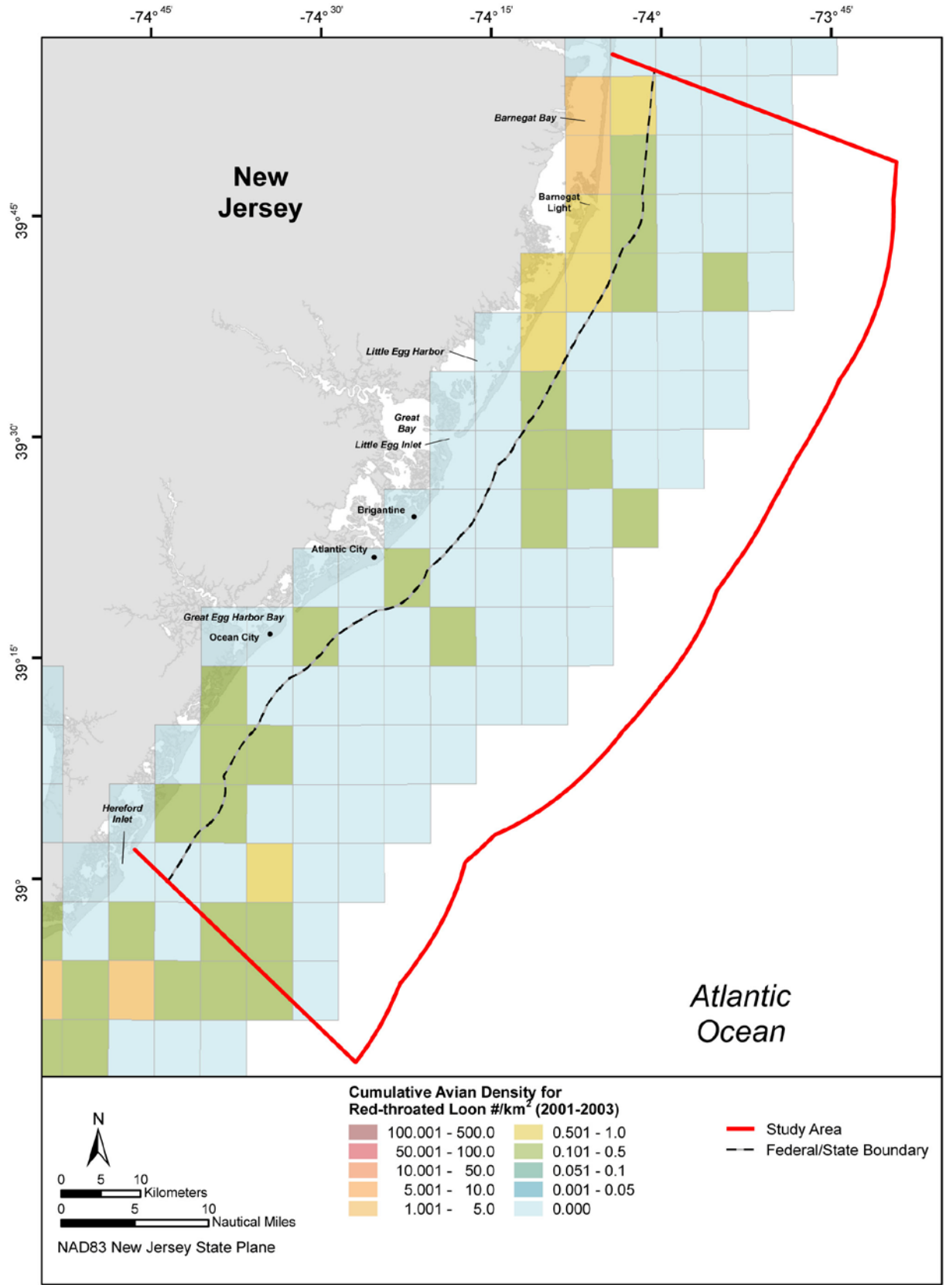

Figure N-4. Cumulative avian density for Red-throated Loons (#/km^2) from 2001 to 2003.

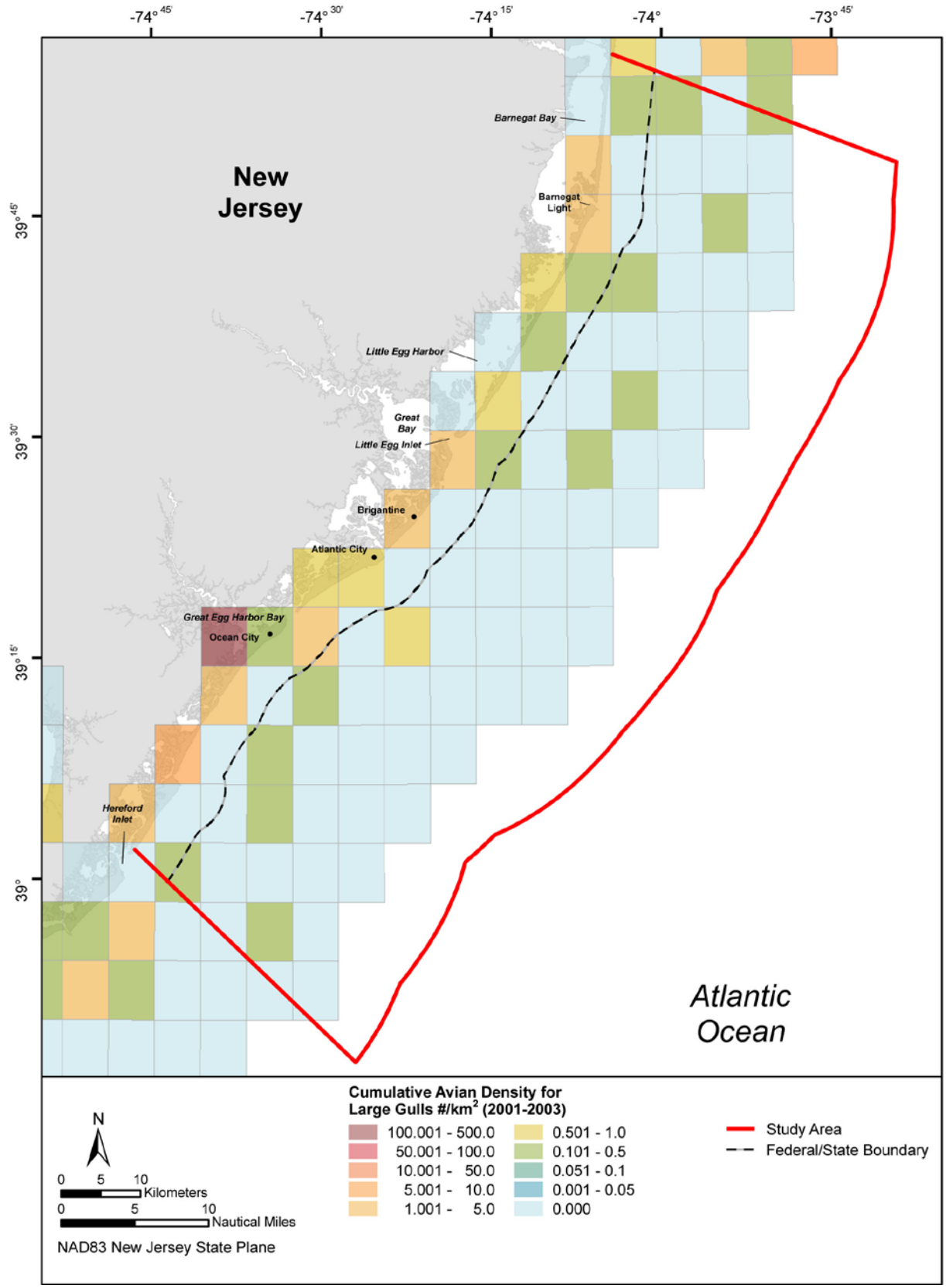

Figure N-5. Cumulative avian density for Large Gulls (#/km^2) from 2001 to 2003.

APPENDIX O

GLOSSARY TERMS

2-sample t-test—uses ratio data to compare the means of two samples

Algorithm—a step-by-step problem-solving procedure, such as an established, recursive computational procedure for solving a problem in a finite number of steps

Analysis of variance (ANOVA) test—used to compare several samples at the same time

Avian radar ground truth (ARGT)—the act of verifying radar data by collecting visual observations of targets and comparing them with the radar

Bathymetry—the measurement of the depth of the ocean floor from the water surface

Batschelet test—a non-parametric test that is a modification of the Hodges-Ajne test (and is more powerful) such that a specific angle is specified when testing the null hypothesis

Bearing—the direction, usually in degrees, to a sighted object (e.g., bird)

Bin (data)—a group of data that represents a subset of the total data

Chi-square (X^2) GOF test—uses categorical data to determine an expected outcome

Circular statistics—used to determine the nature of the statistical distribution of avian flight directions and their variability with respect to species, taxonomic group, month, and season

Circular uniformity—having no mean direction

Clutter—non-targets that show up as a target on a radar screen; e.g., rain, waves

Clutter map—a map produced by a radar which identifies areas of clutter (static or dynamic objects) within the surveillance range of the radar

Confidence interval—quantification of how good a statistical estimate is

Cumulative—increasing in effect, size, quantity by successive additions

Cumulative frequency distribution (CFD)—useful in determining medians, percentiles, and other quantiles

Demultiplexer—a device that horizontally stretches each half of a mutiplexed video picture at its input and provides them separately at its two outputs

Detection (radar)—any echo with a reflectivity that is sufficiently above the real-time background clutter

Directional rose diagram (flight compass rose)—graphical representation of bird movement where the length of each "spoke" radiating off the center indicates the number of birds traveling in that direction

Diurnal—occurring during the daytime

Endangered species—a species that is in danger of becoming extinct throughout all or a significant portion of its range

False tracks—with reference to radar, tracks generated by non-biological targets (e.g., ships, planes, waves)

Flux—number of birds that pass through a specific vertical sample volume in a given unit of time

Generalized additive model (GAM)—useful for predicting the response of avian density at sea in terms of environmental predictors and survey effort, and for examining the influence and shape of explanatory variables for predicting changes in predator density at sea

Generalized linear model (GLM)—useful for predicting the response of avian density at sea in terms of environmental predictors and survey effort

Goodness-of-fit (GOF) test—used to test the statistical significance of conformity of a given sample of nominal scale data (e.g., counts, abundances) to a specified or expected frequency distribution

Guild (bird)—a group of birds that utilize resources in a similar way; e.g., ducks, loons, gulls, terns, etc.

Histogram—a graph of a frequency distribution with bars of equal width; the height of each bar represents a frequency value

Hodges-Ajne test—an omnibus test used to investigate whether a sample could arise from a uniformly distributed population

Homoscedacity—within a scatter plot, the scatter placement is essentially the same

Hotelling test—parametric test that requires the sample of directional datasets to conform to angular normal distribution and homoscedacity

Hotspot—a region where the avian density exceeds the mean by 1.96 standard deviations

Hypothesis—a proposed explanation for a phenomenon; it is scientifically tested to be accepted or rejected

Isobath—a contour line connecting points of equal water depths on a chart

Kernel density—a non-parametric smoothing interpolation method used to discern structure or relationships in data

Knot—a) a unit of speed measured as one nautical mile per hour. b) Distance measured as 1 nautical mile

Kolmogorov-Smirnov GOF test—a goodness-of-fit test used for ordinal (rank) data, and is more powerful than a chi-square test; used to assess whether observed data follow a normal distribution

Kriging—a geospatial interpolation method that can potentially be applied to estimate avian density from transect and radar data

Kruskal-Wallis test—non-parametric test for distributions drawn from more than two populations

Mann-Whitney test—non-parametric test for two samples

Mean—the average of a number of values

Mean traffic rate—the number of (radar) tracks through a set distance for a given period of time, used to determine fluxes or changes in the number of targets over an area

Median—the middle number when a set of values are arranged in numerical order

Migration traffic rate (MTR)—the number of birds (targets) crossing 1.6 km (1 mi) of front per hour

Moore's test—a non-parametric modification of the Rayleigh test, which can be used to test a sample of mean angles

Morphology—the form and structure of individual organisms

Multiplexer—a device that horizontally squeezes two unsynchronized video sources to fit in the left and right halves of a TV or monitor

Nautical mile—equivalent to 1.15 statue (land) miles or approximately 1.85 kilometers

Nearshore—an area adjacent to the coastline (e.g., sampling or MMS grid)

Non-parametric Wilcoxon paired-sample test—also called a signed-rank test; used to test the symmetry of a distribution around the median, using either 1-tailed or 2-tailed tests

Normal distribution—a symetrical distribution, represented on a graph by a bell curve, in which the number with the highest frequency is in the center and numbers with with the lowest frequency are at each end

Offshore—in general, all areas over water away from shore. In addition, offshore can be used to denote all areas not adjacent to land

Omnibus test—does not require the assumption of a unimodal data distribution and is applicable to unimodal, bimodal, and multimodal distributions

Ornithology—the study of birds

Paired-sample t-test—used for ecological data that consist of observations that are not totally independent between the two samples; the data are paired in some way

Parametric statistic—any statistic computed by procedures that assume the data were drawn from a normal distribution (i.e., has a mean and standard deviation)

Pelagic—refers to organisms that a) live at or near the surface of the ocean, far from land, or b) seabirds that live far out to sea and return to shore only to breed

Power analysis—allows one to decide how large a sample is needed to make statistical judgments

Pulse repetition frequency (PRF)—the number of times per second that radar transmits a pulse and listens

Quartile—(in a frequency distribution) one of the values of a variable which divides the distribution of the variable into four groups having equal frequencies

Range—distance to an object (e.g., bird, ship)

Radar echoes—reflected radar signal from an object

Recounted tracks—with reference to radar, a radar track(s) which have been dropped by the radar for a period and re-identified by the radar (following the same bearing and having the same flight speed as the initial target)

Rayleigh test—a parametric test used to determine whether the given sampled population is uniformly distributed around a circle (i.e., possesses circular uniformity)

Rotor swept zone (RSZ)—the area of sky encompassed by a wind turbine's blades

Scatter plot—a visual display of the relationship between two variables, represented as points displayed between two axes; the straighter the line the points form, the stronger the relationship between the two variables

Sea clutter—any static or dynamic object (e.g., ships, waves, meteorlogical towers) that has the potential, depending on size or strength, to prevent accurate collection of radar data

Sea state—condition of the sea, usually based on a scale of increasing wind and speed

Skew—to bias, distort, slant

Species of concern—informal term indicating a species that may need conservation action

Standard deviation (SD)—the square root of the variance (which is the dispersion around the mean of a sample or population)

Taxon—a group of organisms that represent a taxonomic rank (e.g., family, genus, species)

Temporal—pertaining to time

Thermal infrared camera—a camera that detects the heat generated by a target

Threatened species—a species that is likely to become endangered in the forseeable future

Topographic feature—any static or dynamic object (builing, car, trees, waves) on the land or the sea

Track (radar)—radar data that contain a target's range bearing, bearing, size, and strength

TracScan—an S-band, 10-cm [4-in] wavelength that determines the range, flight direction, speed, and heading of targets in a horizontal sample volume

Tri-sector—divide into three separate components

V-test—non-parametric test that is a modification of the Rayleigh test

VerCat—an X-band, 3-cm [1-in] wavelength that determines the altitude and range of targets of different size and is used to measure the flux of targets (the number of birds that passes through the vertical sample volume in a given unit of time)

Video peak store (VPS)—a memory-based device that captures either the darkest or whitest level for each input pixel and displays the feature's path over time

Virga—falling rain which evaporates before it hits the earth's surface

Watson's 1-sample U^2 GOF test—non-parametric test that normalizes the angular directional data from a 0° to 360° range to a range of 0 to 1

Wilcoxon paired-sample (signed rank) test—non-parametric two-sample test

APPENDIX P

SUPPLEMENTAL LITERATURE

Appendix P-1

Marine Bird Literature

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Appendix P-2

Offshore Wind Farm Literature

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