Digital Aerial Baseline Survey of Marine Wildlife in Support of Offshore Wind Energy

Second Annual Report
Summer 2016-Spring 2018
Fourth Interim Report

NEW YORK STATE OF OPPORTUNITY. | NYSERDA

NORMANDEAU ASSOCIATES
Environmental Consultants

APEM

Digital Aerial Baseline Survey of Marine Wildlife in Support of Offshore Wind Energy

Second Annual Report

Summer 2016–Spring 2018
Fourth Interim Report

Prepared for
New York State Energy Research
and Development Authority
17 Columbia Circle
Albany, NY 12203-6399

Prepared by
Normandeau Associates Inc.
4581 NW 6th Street, Suite A
Gainesville, FL 32609
352-372-4747
www.normandeau.com

with

APEM Ltd
Riverview
A17 Embankment Business Park
Heaton Mersey
Stockport SK4 3GN

September 2019

Revision and Amendment Register

Version Number	Date	Section(s)	Page(s)	Summary of Changes	Approved by

Acknowledgments

This report was prepared by Normandeau Associates, Inc., in the course of performing work contracted for and sponsored by the New York State Energy Research and Development Authority (hereafter NYSERDA). The opinions expressed in this report do not necessarily reflect those of NYSERDA or the State of New York, and reference to any specific product, service, process, or method does not constitute an implied or expressed recommendation or endorsement of it. Further, NYSERDA, the State of New York, and the contractor make no warranties or representations, expressed or implied, as to the fitness for particular purpose or merchantability of any product, apparatus, or service, or the usefulness, completeness, or accuracy of any processes, methods, or other information contained, described, disclosed, or referred to in this report. NYSERDA, the State of New York, and the contractor make no representation that the use of any product, apparatus, process, method, or other information will not infringe privately owned rights and will assume no liability for any loss, injury, or damage resulting from, or occurring in connection with, the use of information contained, described, disclosed, or referred to in this report.

For bird images (Tables 16–18), used with permission: Trina Anderson and Jonathan Mays.

Contents

List of Figures

List of Tables

Acronyms and Abbreviations

ESA	Endangered Species Act
FAA	Federal Aviation Administration
GSD	Ground Sampling Distance
Normandeau	Normandeau Associates, Inc.
NYSERDA	New York State Energy Research and Development Authority
OPA	Offshore Planning Area
OSW	Offshore Wind
RSZ	Rotor-swept zone
WEA	Wind Energy Area

Summary

In support of New York State's commitment to incorporating offshore wind into its energy portfolio, the New York State Energy Research and Development Authority (NYSERDA) embarked on a multi-year ultra-high resolution aerial digital survey of marine resources in a 43,745.20 km^2 (12,754.06 mi^2) offshore planning area (OPA) in 2016. The OPA encompasses the waters of the New York Bight from Long Island southeast to the continental shelf break. Surveys are conducted on a quarterly basis, timed to coincide with periods of abundance of avian and marine species that could be vulnerable to impacts from offshore wind activities. This report summarizes the results of eight surveys conducted during Summer 2016 through Spring 2018. Each survey collected images covering at least 7% of the OPA.

For each survey, approximately 300,000 images were collected within the OPA using a transect design. During the first survey year, special attention was also paid to the wind energy area (WEA) using a more detailed grid survey design, collecting around 100,000 images. Each survey collected images covering at least 10% of the WEA. Information on the WEA surveys may be found in the second interim report available at https://remote.normandeau.com/aer_docs.php?pj=6. All referenced data in this report do not include the WEA.

There was some variation in sampling effort among surveys as a different camera system that captured a larger footprint was used after the Summer 2016 survey. Across all surveys, 98% of images did not contain any target species groups, vessels, or structures. Less than 2% of images contained target taxonomic groups. During the first eight surveys, biota included

- 68 species of birds
- 15 species of sharks
- 9 species of dolphins
- 9 species of whales
- 4 species of sea turtles
- 6 species of rays
- 3 species of seals

Some seasonal patterns were evident. In the Summer 2016 and Summer 2017 surveys, ray encounters were the most frequent. In the Summer surveys, after rays, the most frequently encountered groups were birds, marine mammals, sharks, and turtles. During the Fall 2016 and Fall 2017 surveys bird encounters were the most frequent, followed by marine mammals. The Winter 2016–2017 and Winter 2017–2018 surveys were also dominated by birds followed by marine mammals. In the Spring 2017 surveys, birds still dominated the samples, and there was a higher proportion of marine mammals, but the Spring 2018 survey was quite different, with sharks representing most of the sample followed by birds. No bats were found in imagery.

Species composition and abundance varied throughout the year and between years. The Summer 2016 and Summer 2017 surveys were dominated by storm-petrels and shearwaters. The Fall 2016 survey was dominated by gulls and gannets, and the Fall 2017 survey by phalaropes and gulls. Winter 2016–2017 was dominated by auks, gulls and gannets, and Winter 2017–2018 by shorebirds and gulls. Spring 2017 was dominated by *Sterna* terns and gulls, whereas Spring 2018 was dominated by phalaropes, ducks, and gulls.

Spatial patterns in bird abundance were apparent for some taxonomic groups, but absent for others. Black-capped petrels and Audubon's shearwaters did not show any substantial differences in distribution

among the seasons, but both species clustered near the shelf break and in the northeast corner of the OPA. Sooty shearwaters were also in the northeast corner of the OPA and beyond the -70 m isobath in the Spring surveys during which they were most frequently encountered, and Cory's shearwaters also showed a tendency to cluster in the northeast corner of the OPA, with fewer observations in the Fall dispersed along the eastern edge of the OPA and a more southward shift in distribution in the Spring 2017 survey. Gull observations occurred throughout the OPA, but most gull species tended to show nearshore tendencies in the Spring and Summer surveys. Black-legged kittiwakes, Bonaparte's gulls and small unidentified gulls were fairly evenly distributed. Nearshore tendencies for least and royal terns were evident in the Summer and Spring surveys and black terns were more offshore. Other tern including *Sterna* tern species also showed nearshore preferences in the Summer surveys but also occurred throughout the OPA with some confidently identified roseate terns found past the shelf break. Scoter species and long-tailed duck were primarily found nearshore. Phalaropes were generally found beyond the ≈60-m isobath. Loons were not encountered in the eastern area of the OPA, but were encountered elsewhere in the OPA. Common loons showed a tendency to be found beyond the -70 m isobaths, but red-throated loons appeared to be less depth associated.

The dominant flight direction for most bird species groups was from west-to-east and east-to-west; although, ducks tended to show a more south-to-north trend. Across all seasons, 73% of birds were recorded sitting on the water, 6% were observed flying in the rotor-swept zone (RSZ - defined as 25 m to 195 m in this report), and 9% were observed above or below the RSZ; flight height could not be calculated for the remaining 12% of individuals.

Although population sensitive species were distributed across the OPA, timing of aggregations varied with some spatial concentrations in the northeastern section during Summer 2016 and less so in the Summer 2017 survey. Species primarily driving these areas of sensitivity are Cory's shearwater, *Sterna* terns and black-capped petrel. The occurrence of population sensitive species during the Fall and Winter were sparse. Collision sensitive species were few in the Summer surveys, only occurring near shore during Summer 2016 survey and absent in Summer 2017 survey. Nearshore sensitivity is mostly driven by common terns, herring gulls, great black-backed gulls and gannets However, they occurred throughout the OPA during other seasons. There were some collision sensitive species nearer shore and near the shelf in the Fall 2016 survey, less so in the Fall 2017 survey, and in the Winter surveys the Winter 2016–2017 survey showed more collision sensitivity nearer the western edge of the OPA and nearer the shelf, whereas there was very little collision sensitivity in the Winter 2017–2018 survey. Displacement sensitive species were found primarily near shore throughout the year, although the Winter 2016–2017 aggregations were generally dense in the central and eastern portions of the OPA. Species driving these areas of displacement sensitivity are alcid species.

Turtles were most frequently observed in the Summer surveys with 96% of the observations occurring during this season. Loggerhead turtles were the most frequently found representing 79% of the total observations. Most turtles observed during the Summer, along with leatherback turtles observed during the Fall, occurred inside the 70-m isobath. Outside these findings, there were no obvious spatial patterns among species or seasons. Turtle travel direction followed primarily a WNW to ESE direction.

Seals were difficult to identify to the species level with 16% identified to species. Gray, harp and harbor seals were identified. Data were too sparse to define any patterns of activity for seals.

Dolphins were the most abundant of the marine mammals consisting of 96% of the observations followed by 1% whales and 0.5% seals; unidentified mammals consisted of 2% of the total mammal observations and based on size, these animals were either dolphins or seals. Dolphins were abundant in all seasons, particularly in Spring and Summer surveys. With the exception of unidentified dolphins, common dolphin

was the most abundant species in all but one seasonal survey; in the Summer Summer 2016 survey had more Risso's dolphin encounters. Pilot whale, Risso's dolphin, striped dolphin, Atlantic white-sided dolphin, Atlantic spotted dolphin, and rough-toothed dolphin all showed a definite preference for deeper water at the shelf break throughout the year. Dolphins were most frequently traveling in an ESE to WNW direction.

Fin whales were the most abundant species during the 2016 and 2017 Summer and Fall surveys, while common minke whales were the most abundant species during the Winter 2016–2017 and Spring 2017 and 2018 surveys. Humpback whales had the same relative abundance as common minke whales in Spring 2017, but were outnumbered by minke and sei whales in the Spring 2018 survey. North Atlantic right whales were present in the Winter 2016–2017 and Spring 2017 surveys. Whales showed a preference for the shelf break, although fin, humpback, minke, and north Atlantic right whales were also found elsewhere in the OPA. No spatial distribution patterns by season were evident. Whales were most frequently traveling in an ESE to WNW direction.

Rays only occurred during the Summer and Fall surveys, and >97% of observations occurred in the Summer surveys. Cownose and cownose/bullnose rays were the most abundant with 81% of the total observations. Cownose and cownose/bullnose rays were most frequent in the northwestern portion of the OPA, while unidentified rays were found throughout the OPA. Devil rays and manta rays were concentrated along the shelf break. Travel direction for rays showed some preference for a WNW to ESE direction in the Summer surveys.

The majority (91%) of shark observations occurred during the Spring 2018 survey. The remaining shark observations were mainly in the Summer surveys across the OPA. Only blue sharks, basking sharks, great white shark, scalloped hammerhead, smooth hammerhead, tiger sharks, hammerhead (unid.), and unknown shark species were observed during the Fall surveys. There were no spatial patterns of shark distributions evident in the OPA. Travel direction was highly variable but showed some WNW and ESE tendencies in the Summer 2017 survey.

Fifteen species positively identified as threatened and endangered species were recorded within the OPA during the first eight surveys not including species groups that may include listed species. Our categorization of threatened and endangered species was conservative and included species groups: "*Sterna* tern" (possibly representing roseate tern), "hammerhead shark (unid.)" (possibly representing scalloped hammerhead), and "turtle species unknown" (possibly representing all endangered turtles). Summer surveys recorded over 64% of listed species observations occurred, followed by Spring surveys representing 34% of observations. Both of these seasonal surveys were dominated by numbers of *Sterna* terns and loggerhead turtles. Roseate terns identified to species comprised only 0.4% of observations.

Results from aerial high-resolution surveys can provide insight into spatial and temporal animal distributions within a surveyed area. Data from these surveys can be used to inform wind turbine siting decisions at a high-level and site level through better understanding of species composition, relative abundance, and animal movements. This information can also be used in developing project-specific environmental documents such as Environmental Assessments and Environmental Impact Statements should the need arise.

1 Introduction

There is growing interest in developing offshore wind (OSW) energy in New York and elsewhere in the country. However, it is still unclear what impacts OSW development will have on wildlife, including corals, birds, bats, sea turtles, fish, and marine mammals. Data gaps interfere with federal and state regulator efforts to avoid or minimize potential negative impacts on wildlife from OSW development. There have been several efforts in New York and elsewhere along the Atlantic coast to identify and fill these gaps in recent years, but many research needs are still unmet. One of the most pressing research needs is baseline data on potential wildlife exposure. Knowledge about species presence and absence in development areas helps regulators form appropriate site-specific questions to be addressed by developers. Regional-scale baseline information on wildlife distributions, abundance, and movements by season can reveal the relative biodiversity of development sites. These types of surveys can also provide a better understanding of the potential effects of individual projects, as well as any potential cumulative effects of multiple projects.

The New York State Energy Research and Development Authority (NYSERDA) contracted with Normandeau Associates Inc. (Normandeau) and teaming partner APEM Inc. (APEM) to use high resolution aerial digital imagery to collect data on birds, marine mammals, sea turtles, cartilaginous fish, and other taxa encountered offshore. Surveys are conducted four times a year over three years. The surveys have been designed in light of available historical data and use the latest digital and sensor technology to provide high identification success.

Survey results for birds, marine mammals, turtles, and cartilaginous fish are presented in semiannual reports, which will cumulatively provide insight into interseasonal and interannual variation in species composition, densities, and distributions. This report is the fourth semi-annual report, providing the results of the first eight surveys (Summer 2016 through Spring 2018). Reports on bony fish and fish shoals are presented in separate reports.

This report draws on information presented in documents prepared on behalf of NYSERDA by Normandeau and available at https://remote.normandeau.com/nys_docs.php

Reports used in the preparation of this document include:

- Summer 2016 Survey 1
  - Survey Summary Report
  - Target Extraction Summary Report
  - Taxonomic Analysis Summary Report
- Fall 2016 Survey 2
  - Survey Summary Report
  - Target Extraction Summary Report
  - Taxonomic Analysis Summary Report
- First Semi-Annual Report Summer and Fall 2016
- Winter 2016–2017 Survey 3
  - Survey Summary Report
  - Target Extraction Summary Report
  - Taxonomic Analysis Summary Report
- Spring 2017 Survey 4
  - Survey Summary Report
  - Target Extraction Summary Report
  - Taxonomic Analysis Summary Report

- Second Semi-Annual Report Summer 2016 through Spring 2017
- Summer 2017 Survey 5
  - Survey Summary Report
  - Target Extraction Summary Report
  - Taxonomic Analysis Summary Report
- Third Semi-Annual Report Summer 2016 through Fall 2017
- Fall 2017 Survey 6
  - Survey Summary Report
  - Target Extraction Summary Report
  - Taxonomic Analysis Summary Report
- Winter 2017–2018 Survey 7
  - Survey Summary Report
  - Target Extraction Summary Report
  - Taxonomic Analysis Summary Report
- Spring 2018 Survey 8
  - Survey Summary Report
  - Target Extraction Summary Report
  - Taxonomic Analysis Summary Report

2 Methods

2.1. Data Collection

The New York OPA, including a 300-m buffer, covers 43,745.20 km^2 (12,754.06 mi^2). During the first year, the New York WEA, including a 4-km buffer, was also surveyed in a grid pattern, which covers 850.92 km^2 (248.09 mi^2). After the lease was awarded, survey effort over this area was reduced to the same pattern as the rest of the OPA. All referenced data in this report do not include the specific WEA data from year 1.

Eight surveys were completed within this reporting period (Table 1). There were differences in duration among surveys. Initially, the primary reason was the use of a different camera with a narrower field of view that was used for the Summer 2016 survey. This required more flying to achieve the target 7% coverage of the OPA. Minor differences over the following two surveys were attributable to adjustments for achieving correct coverage using a new camera system. Other factors that have continued to affect duration of surveys include weather conditions and day length. For all surveys, transects of the OPA covered approximately 3,062.2 km^2.

As mentioned, two different camera systems were used for the surveys. The Shearwater II camera system was used during the Summer 2016 survey, and the new Shearwater III camera system was used for all subsequent surveys. Both systems collected data at 1.5-cm ground sampling distance (GSD) and both surveys used a Piper Aztec twin engine aircraft. In addition, during the Summer 2016 survey of the OPA, data were collected at 0.75-cm GSD on near shore sample lines, which were flown at the lower altitude of approximately 152 m (500 ft) to accommodate restrictions imposed in controlled airspace around the John F. Kennedy Airport. Flight altitude for the remaining survey lines of the Summer survey was at 310.9 m (1,020 ft), and data were captured at 414.5 m (1,360 ft) for all of the subsequent surveys described in this report.

The survey team was based out of MacArthur Airport in Long Island, New York, for the duration of surveys. Because there are a number of local airfields on Long Island, the Federal Aviation Administration (FAA) imposes varying altitude restrictions that survey aircraft must obey. These are designated according to distance from the airfield. Flights parallel to the shoreline within the restricted zone ensure that the survey aircraft can maintain constant altitude over a complete transect, thus ensuring consistency in image resolution and areal coverage along transect. For all surveys, nearshore transects were flown parallel to the shoreline, and for the Fall 2016, Winter 2016–2017, Spring 2017, Summer 2017, Fall 2017, Winter 2017–2018, and Spring 2018 surveys, these were split into east and west segments (Figure 1, Figure 2). FAA-controlled altitude restrictions cease to be an issue several miles offshore. At this point, transects were oriented perpendicular to the shoreline and consequently to the bathymetry, providing optimal orientation for expected clines in the distribution of target species (Figure 3).

Daily survey time maximized crew hours and avoided mid-day when glare/glint was most prevalent, and surveys were not conducted when sea state was ≥4 or above, cloud base was <426.7 m (<1,400 ft), visibility was <5 km (3.1 mi), or wind speed was >30 knots (34.5 mph). The onboard camera technician continuously monitored the images collected and if they ceased to be of sufficient quality, image acquisition stopped until suitable conditions returned. At each capture point, surplus images are collected to allow for replacement of any image found unsuitable for analysis. Data collected for the OPA included a 300-m buffer. All data capture points located within the 300-m buffer of the OPA are included for analysis. The shape of the survey area sometimes means that a small part of the very large image might be outside of the 300-m buffer. Following each daily survey, sample imagery was evaluated to make sure it was of good quality for analysis. Data were backed up daily and shipped for analysis.

Table 1. Starting and Ending Dates, Number of Days to Complete for each Survey Period

Season	Reference Month	Date Started	Date Completed	Flight Days to Complete
Year 1				
Summer 2016	Aug 2016	26 Jul 2016	9 Aug 2016	13
Fall 2016	Nov 2016	5 Nov 2016	27 Nov 2016	10
Winter 2016–2017	Mar 2017	6 Mar 2017	3 Apr 2017	10
Spring 2017	May 2017	4 May 2017	21 May 2017	9
Year 2				
Summer 2017	Aug 2017	6 Aug 2017	21 Aug 2017	8
Fall 2017	Nov 2017	9 Nov 2017	27 Nov 2017	8
Winter 2017–2018	Feb 2018	18 Feb 2018	1 Mar 2018	6
Spring 2018	Apr 2018	27 Apr 2018	7 May 2018	5

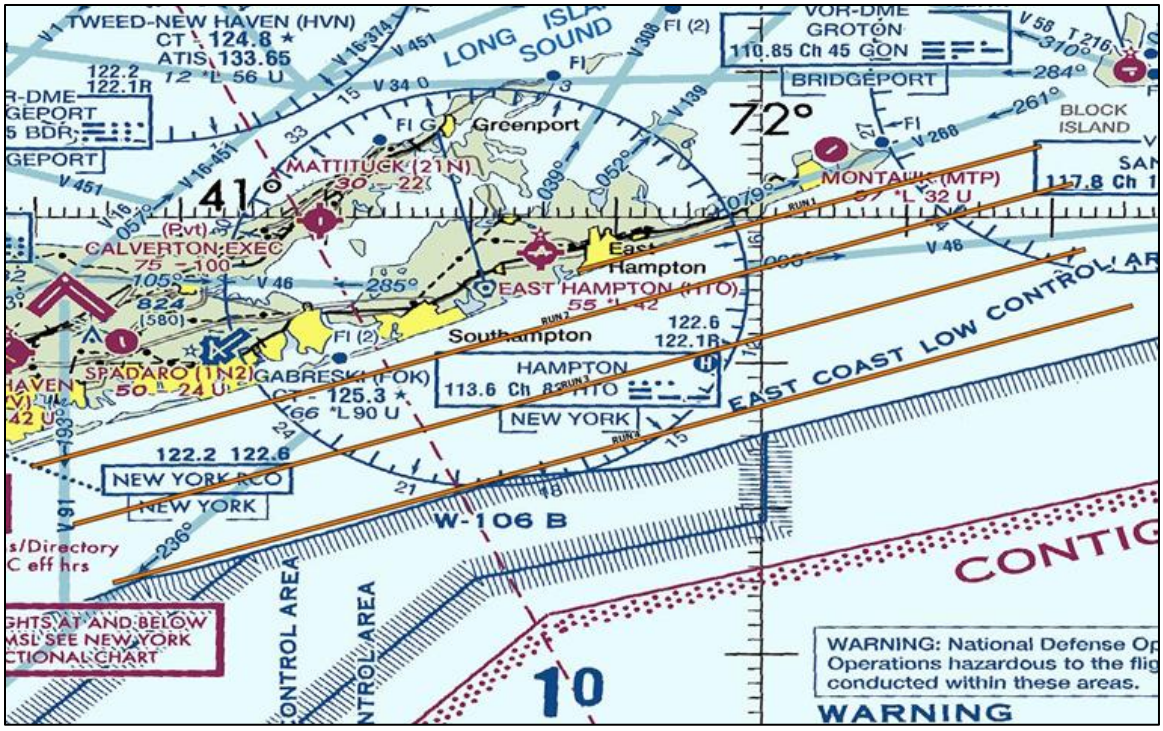

Figure 1. Flight plan used for Near Shore East.

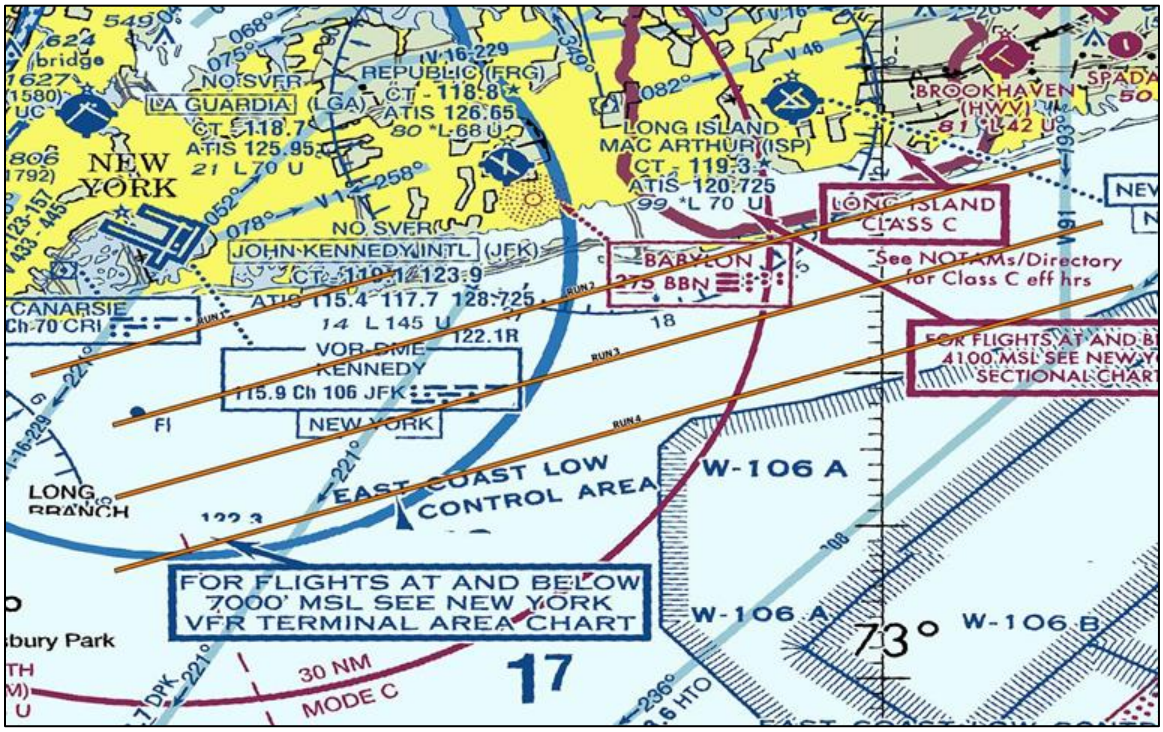

Figure 2. Flight plan used for Near Shore West.

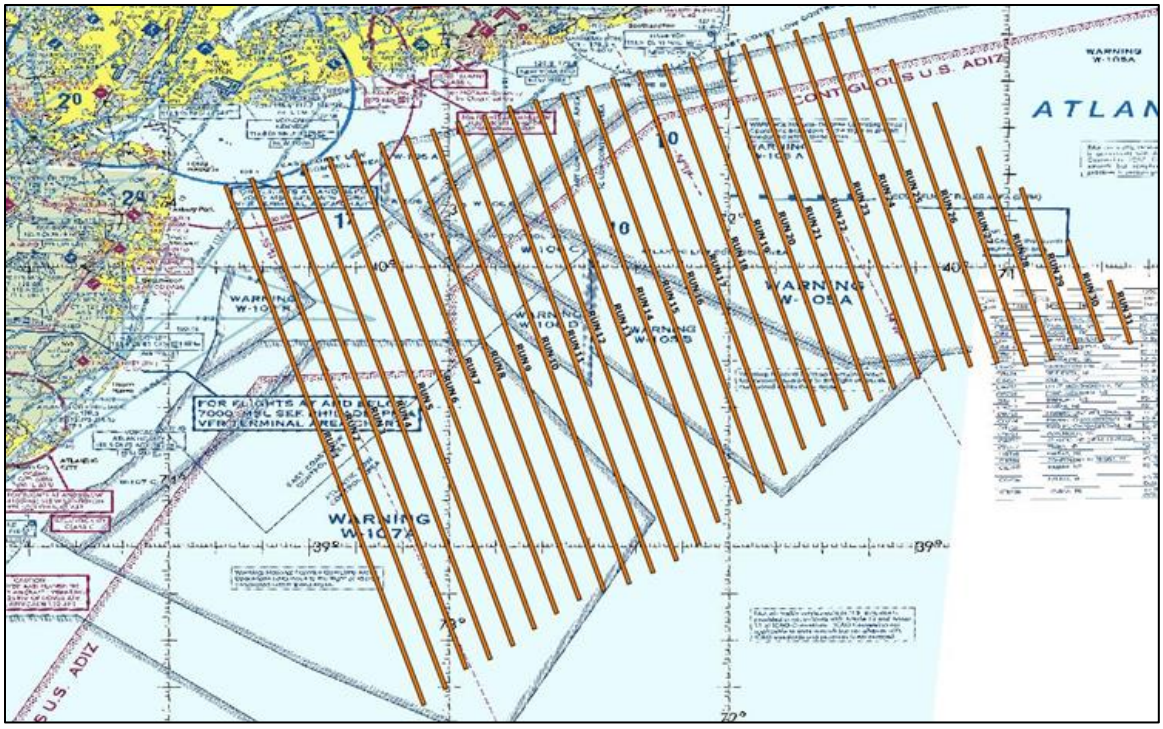

Figure 3. Flight plan used for the Offshore Planning Area.

2.2. Target Extraction and Quality Control

Target extraction is accomplished using automated and manual target identification and extraction methods, and all survey data undergo quality control. To continue monitoring the success of the automated and manual target extraction and ensure that data are not lost during the extraction process, a minimum of 10% of the blank images are screened for quality control. By contract, quality control of target extraction had to meet a minimum agreement of 90%, but self-imposed higher levels of agreement during the extraction process meant that any unusual slippage in agreement below 98% triggered a review of the analysts involved and early action was taken to maintain high confidence in the target extraction process. Once the target extraction is complete, all images found to contain organisms are transmitted to taxonomists for identification using the ReMOTe portal (https://remote.normandeau.com) for data management, identification, and reporting. Initial extraction categorizes targets into taxonomic groups and a cropped image of the animal is posted for identification.

2.3. Target Classification and Identification

Targets were categorized into ten groups representing birds, bats, turtles, marine mammals, rays, sharks, large bony fish, fish shoals, vessels, and fixed structures. These were then accessed for identification by biologists highly experienced in their taxonomic group, and identifications of species listed as "Endangered" or "Threatened" by the state or under the Endangered Species Act (ESA) were flagged. The identification of large bony fish was added later to the scope of work. For this reason large bony fish and fish shoals are reported independently of these semi-annual reports. Vessels were also a group that was not initially classified.

2.4. Identification Quality Control

A minimum of 20% of all images identified were reviewed by a second taxonomic expert, and taxonomic agreement had to meet a minimum of 90% concurrence. Failure to reach this would trigger a review of 100% of identifications made by the initial taxonomist. The 20% review included quality control review of 100% of ESA and State-listed species, and for endangered species a 100% agreement had to be reached on identifications. Additional experts in the species concerned were called in to arbitrate identifications when concurrence could not be reached.

2.5. Treatment of Unidentified Animals Closely Resembling Listed Species

The categorization of ESA or State-listed species was conservative, incorporating "*Sterna* tern" (possibly representing roseate tern), "hammerhead shark (unid.)" (possibly representing scalloped hammerhead), and "whale species unknown" (possibly representing blue, fin, sperm, or north Atlantic right whale). During the first six surveys, all unknown *Sterna* terns were lumped together. However, for the later surveys two categories were added to differentiate *Sterna* terns that were definitely not roseate terns, thus reducing the numbers of individuals classed as *Sterna* tern. Inability to identify the *Sterna* tern group to individual species was usually a result of the angle of the bird and an inability to see the bird's head and bill. With subsurface animals, the angle of the animal or depth of the animal in the water column often obscured characters required to differentiate animals to species; although, identifying many hammerhead sharks to species is difficult even when in close proximity.

2.6. Sensitivity Mapping

On behalf of BOEM, Normandeau developed a method to quantify the vulnerability of seabirds to offshore wind development on the Atlantic Outer Continental Shelf (Robinson Willmott et al. 2013). The method used data on bird species ecology that influenced sensitivity of species to population loss, collision, and displacement. To create the sensitivity maps, we divided the OPA into a grid of 10×10-km sampling units. Each bird observation from the Summer 2016 through Spring 2018 surveys within the sampling grid was assigned to a grid cell, and recorded species were ranked in descending order by sensitivity score. The total abundance of the 20% most sensitive species was computed for each sampling unit for each sensitivity index. For maps that show aggregated values across seasons, the average abundance per season was used instead of a total abundance. This was done to smooth interseasonal variation and so that the color ramp classifications would work across all maps. Collision sensitivity analysis was restricted to bird individuals flying in the RSZ (25–195 m), and spatial variation in abundance of birds sensitive to different impacts was mapped across the survey area.

2.7. Comparisons among Seasons

When comparing abundance of species and species groups among seasons, all numbers were corrected to account for equal effort across the entire survey area. Because the percent survey coverage among seasons varied, correcting to 100% of the areal coverage removes the potential nuisance effect of survey effort and allows for interseasonal and interannual comparisons moving forward.

Raw abundance for each observation was corrected for each season's survey effort. This correction accounted for unsurveyed portions of the area and estimates the total number of individuals in the OPA. This corrected abundance assumes an equal distribution of animals in surveyed and unsurveyed areas and that no double-counting occurred by animals moving among transects as the surveys occurred.

2.8. Weather Associations

While detailed weather data were collected during the surveys we did not attempt to relate species composition and abundance to weather variables. This was because surveys were scheduled so that weather conditions would be favorable for aerial surveys to identify marine fauna: a cloud base >1,400 ft, visibility >5 km, wind speed <30 knots, and sea state 4 or less. Requiring these conditions for each survey minimizes the weather variability among surveys and therefore we lack variation in weather conditions to relate to species composition, abundance, and distribution.

3 Results

3.1. Data Collection

Table 2 lists the data collected in the OPA during the first eight surveys. Variations in flight heights meant that there were fluctuations in areal coverage, which was always more than 7% and up to 9.04% (Table 2).

Table 2. Data Collected in the First Eight Surveys in the OPA only.

Survey	Size (km²)	# Images	Image Area Size (km²)	% Area Imaged	# Blank	% Blank
Summer 2016	43,745.20	289,393	3,204.02	7.32	285,818	98.76
Fall 2016	43,745.20	396,079	3,890.58	8.89	391,474	98.84
Winter 2016–2017	43,745.20	400,657	3,952.98	9.04	389,253	97.15
Spring 2017	43,745.20	338,141	3,293.25	7.53	334,050	98.79
Summer 2017	43,745.20	318,741	3,133.50	7.16	311,832	97.83
Fall 2017	43,745.20	323,554	3,168.68	7.24	319,811	98.84
Winter 2017–2018	43,745.20	320,107	3,147.14	7.19	315,434	98.54
Spring 2018	43,745.20	318,455	3,126.71	7.15	308,772	96.96

3.2. Target Extraction and Quality Control

Across all surveys of the OPA, the vast majority of images collected contained no evidence of living organisms, vessels, or structures. Table 3 shows the number of images collected, number and percentage of blank images detected, and the number of images sent for quality control review for each survey. The percentage of blank images from within the OPA during the first eight surveys ranged from 96.96 during Spring 2018 to 98.84 during Fall 2016 and Fall 2017. These numbers do not include numbers from WEA surveys of Year 1.

Table 3. Number of Images Collected, Number and Percentage of Blank Images Detected, and Number Sent for Quality Control Review for the First Eight Surveys in the OPA

Survey	Number of Images in Survey Area	Blank Images			
		Number	Percent	Number QC'd	Percent QC'd
Summer 2016	289,393	285,818	98.76	30,357	10.62
Fall 2016	396,079	391,474	98.84	39,480	10.08

Survey	Number of Images in Survey Area	Blank Images			
		Number	Percent	Number QC'd	Percent QC'd
Winter 2016–2017	400,657	389,253	97.15	39,052	10.03
Spring 2017	338,141	334,050	98.79	33,427	10.01
Summer 2017	318,741	311,832	97.83	31,271	10.03
Fall 2017	323,554	319,811	98.84	31,985	10.00
Winter 2017–2018	320,107	315,434	98.54	31,604	10.02
Spring 2018	318,455	308,772	96.96	30,912	10.01

In the Summer 2016 blank review, 70 of the 30,357 images that underwent quality control (QC) were determined to contain targets that had been missed in the initial target extraction (Table 4). The overall quality rate of the initial extraction was 99.77%, well within the quality control criteria established for the project (Table 4). Similar QC agreement was reached for all subsequent surveys (Table 4).

Table 4. Number of Blank Images sent for Quality Control Review, Number Found to be Blank/Not Blank, and Percent Agreement Reached for the First Eight Surveys

Survey	Number of Images			% Agreement Reached
	For QC	QC'd as Blank	QC'd Not Blank	
Summer 2016	30,357	30,287	70	99.77%
Fall 2016	39,480	39,452	28	99.93%
Winter 2016–2017	39,052	39,009	43	99.89%
Spring 2017	33,427	33,362	65	99.81%
Summer 2017	31,271	31,199	72	99.77%
Fall 2017	31,985	31,926	59	99.82%
Winter 2017–2018	31,604	31,573	31	99.90%
Spring 2018	30,912	30,840	72	99.77%

Of the 70 images from the Summer 2016 review, most images contained fish (n= 38), turtles (n=19), and birds (n=10). Only 3 contained marine mammals (Table 5). Similarly, the Summer 2017 data had 49 images containing fish but otherwise QC'd images contained 5 birds, no marine mammals, and 17 turtles (Table 5). In the Fall 2016 data, 23 images contained birds, 3 images contained fish, and 2 images contained marine mammals. The Fall 2017 QC'd data contained 36 birds, 19 bony fish, 2 turtles, 2 marine mammals, and no sharks or rays (Table 5). In the Winter 2016–2017 data, 32 images contained birds, 6 contained fish, and 5 contained marine mammals (Table 5). Of the 31 images from the Winter 2017–2018 target extraction data, 24 contained birds, 4 contained marine mammals, 2 contained fish, and one contained a shark (Table 5). Except for the 50 images containing fish, numbers of missed organisms were lower in the Spring 2017 data with only 10 images containing birds, 3 containing turtles, and 2 containing marine mammals. The 72 images from the Spring 2018 data contained 52 birds, 7 fish, 6 sharks, 4 rays, and 3 marine mammals (Table 5).

Number of individuals found during target extraction and presented by taxonomic group and by season can be found in Table 6. Across all eight seasons 135,915 animals were sent to taxonomic experts for identification including 83,700 birds, 9,954 marine mammals, 1,335 turtles, 25,193 sharks, and 15,733 rays (Table 6).

Table 5. Number of Individuals within Reported Taxonomic Groups Found During QC Process for the First Eight Surveys

Season	Number of Individuals in Blank QC						
	Birds	Mammals	Turtles	Fish	Sharks	Rays	TOTAL
Summer 2016	10	3	19	38	0	0	**70**
Summer 2017	5	0	17	49	0	0	**71**
Fall 2016	23	2	0	3	0	0	**28**
Fall 2017	36	2	2	19	0	0	**59**
Winter 2016–2017	32	5	0	6	0	0	**43**
Winter 2017-2018	24	4	0	2	1	0	**31**
Spring 2017	10	2	3	50	0	0	**65**
Spring 2018	52	3	0	7	6	4	**72**
Total	**192**	**21**	**41**	**174**	**7**	**4**	**439**

Table 6. Number of Individuals by Taxonomic Group by Season

Season	Number of Individuals					
	Birds	Mammals	Turtles	Sharks	Rays	Total
Summer 2016	1,860	924	560	643	8,103	**12,090**
Summer 2017	2,964	1,446	711	1,382	7,624	**14,127**
Fall 2016	12,245	1,118	39	4	4	**13,410**
Fall 2017	9,337	1,243	13	13	2	**10,608**
Winter 2016–2017	20,919	1,609	1	26	0	**22,555**
Winter 2017-2018	11,218	1,082	0	11	0	**12,311**
Spring 2017	3,668	1,687	10	180	0	**5,545**
Spring 2018	21,489	845	1	22,934	0	**45,269**
Total	**83,700**	**9,954**	**1,335**	**25,193**	**15,733**	**135,915**

3.3. Identification Success

There were 135,915 animals sent for identification with 29,153 going through quality control review (Table 7). Of these, 3,032 were considered endangered species, either identified as a listed species or in the same genus as a listed species where species-level identification was not possible, such as hammerhead [unid.] and *Sterna* tern (Table 8). A new species was added for endangered QC for the Summer 2017 survey: Giant Manta Ray, of which two were found in the Summer 2017 survey. All identifications reached and exceeded their targeted percent agreement (Table 7, Table 8) (see Appendix A for a list of species included in taxonomic groups).

Table 7. Total Number of Images by Taxonomic Group, Number Reviewed, and Percent Identification Agreement Reached

Taxonomic Group	Summer 2016–Spring 2018		
	Total Individuals	Number of Images for QC	% Agreement (rounded)
Birds	83,700	17,563	99
Marine Mammals	9,954	2,017	99
Turtles	1,335	1,335	100
Sharks	25,193	5,311	100
Rays	15,733	2,927	99
Total	**135,915**	**29,153**	99

Table 8. Number of Individuals of Threatened and Endangered Species by Taxonomic Group, Number Reviewed, and Percent Identification Agreement Reached

Season	Number of Individuals					
	Birds	Mammals	Turtles	Sharks	Rays	Total
Summer 2016	141	10	560	142	4	**857**
Summer 2017	13	8	711	455	2	**1,189**
Fall 2016	0	9	39	1	0	**49**
Fall 2017	1	7	13	3	0	**24**
Winter 2016–2017	0	12	1	0	0	**13**
Winter 2017-2018	0	2	0	0	0	**2**
Spring 2017	721	8	10	0	0	**739**
Spring 2018	44	14	1	0	0	**59**
Percent Agreement	*99*	*100*	*100*	*100*	*100*	***100***
Total	**1,019**	**170**	**1,435**	**701**	**106**	**3,032**

Identification success varied by taxonomic groups and by depth of subsurface animals. All identifications had a level of certainty ascribed to them (e.g., possible, probable, and definite). Some animals were identified as "possible" when a number of conspecifics had already been identified within that group (see Figure 4 for an example) and there was no evidence in literature that the animal moved in mixed species groups. A number of rays fell into this category. The certainty level "probable" was ascribed to species with the combination of physical characters available in the imagery and a high probability of a specific species presence in the area strongly suggested that identification. The certainty level "definite" was ascribed when all characters were present and the taxonomist was confident in the identification.

Subsurface animals were ranked as "breaching," "near surface," and "significantly submerged" (see Figure 4 for an example). These categorizations allowed evaluation of whether image quality, angle of the animal at point of capture, or depth in the water was the major factor affecting the ability to identify animals to species. Digital imagery captured from downward-pointing sensors "sees" through the water column more effectively than angled sensors and more animals are "observed." Visual surveyors from boats and digital

imagery captured by angled lenses will "see" fewer animals to a greater or lesser degree because subsurface animals are hidden by the water column. However, this improvement in reporting animal presence by downward facing lenses sometimes is at a cost of species identification because of the depth of the animal. Identification success results are presented by species group below.

Figure 4. Example of image showing difficulty of identification of more deeply submerged animals. Deeply submerged animals would be ascribed a certainty of "probable" if in a group of conspecifics, and ranked as "significantly submerged."

3.4. Relative Abundance of Animals

The relative abundance of each taxonomic group differed among seasons. We have corrected these numbers to assume equal coverage (effort) of the entire area as described in Section 2.7. In the Summer 2016 and Summer 2017 surveys, ray encounters were the most frequent, totaling 67% and 54%, respectively, of animals found in imagery (Table 9, Figure 5). In the Summer surveys, after rays, the most frequently encountered groups were birds (15% and 21% respectively), marine mammals (8% and 10% respectively), sharks (5% and 10% respectively), and turtles (representing 5% in both Summer surveys). During the Fall 2016 and Fall 2017 surveys, rays, turtles and sharks represented <1% of organisms observed, birds represented 91% and 88% of encounters respectively, and marine mammals 8% and 12% respectively (Table 9, Figure 5). The Winter 2016–2017 and Winter 2017–2018 surveys were dominated by birds (93% and 91% respectively) followed by marine mammals (7% and 9% respectively). The remaining taxonomic groups represented <1% of organisms observed (Table 9, Figure 5). In the Spring 2017 surveys, birds still dominated the sample representing 66% of organisms, and there was a higher proportion of marine mammals representing over 30% of the sample, but the Spring 2018 survey was quite different, with sharks representing 51% of the sample and birds representing 47% of the sample (Table 9, Figure 5). No bats were found in imagery.

Table 9. Total Corrected Abundance[1] of Individuals in Taxonomic Group by Season in the OPA

Survey	Taxonomic Group					Season Total
	Bird	Mammal	Turtle	Shark	Ray	
Summer 2016 (S1)	25,395	12,616	7,646	8,779	110,632	**165,068**
Summer 2017 (S5)	41,379	20,187	9,926	19,293	106,435	**197,220**
Fall 2016 (S2)	137,681	12,571	439	45	45	**150,781**
Fall 2017 (S6)	128,902	17,160	179	179	28	**146,448**
Winter 2016–2017 (S3)	231,498	17,806	11	288	0	**249,603**
Winter 2017–2018 (S7)	155,930	15,040	0	153	0	**171,123**
Spring 2017 (S4)	48,723	22,409	133	2,391	0	**73,656**
Spring 2018 (S8)	300,648	11,822	14	320,865	0	**633,349**
Total	**1,070,156**	**129,611**	**18,348**	**351,993**	**217,140**	**1,787,248**

[1] Corrected abundance was calculated by dividing the observed abundance by the percent of the area surveyed for each season. This accounts for differing amounts of area surveyed and makes abundances comparable across seasons. Corrected abundance values are frequently non-integers that have been rounded to whole numbers for display purposes. Column and row totals may not equal the sum of numbers shown in the table because the underlying values are non-integers.

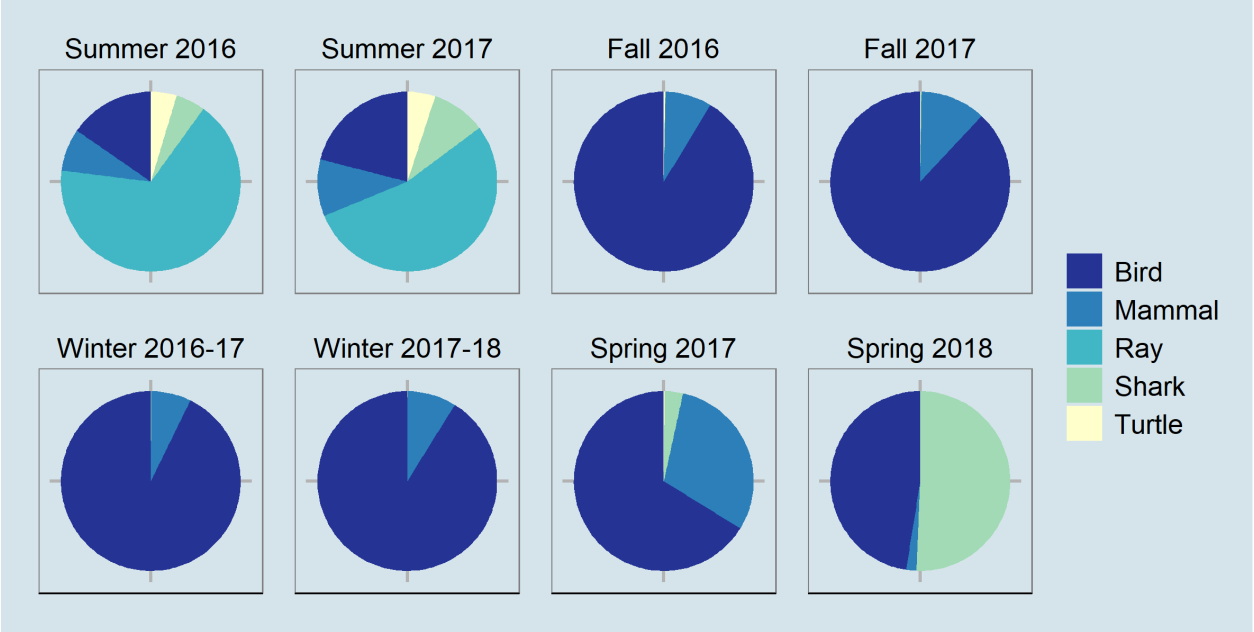

Figure 5. Relative abundance of taxonomic groups for the eight surveys.

3.5. Birds

3.5.1. Species Identification

Over the first eight surveys of the OPA, 83,700 birds were identified in imagery comprising 68 species (see Appendix B). All birds were classified to species group at a minimum (Appendix B). Avian species level

identifications varied by group depending on size and coloration. The largest and most distinct bird species found naturally had higher identification rates, and this included northern gannet with 100% of these identified to species (n=10,110), ardeidae (great-blue heron; n=1), northern fulmar (n=888), Canada goose (n=3), brown pelican (n=1), brown booby (n=1), swans (tundra swan; n=12), raptors (bald eagle [n=1] and osprey [n=3]), and nightjar (common nighthawk; n=1) (Table 12). We also identified 7 passerines to species, which were the only passerines recorded in the first eight surveys (snow bunting). These small birds have a very distinctive wing pattern that enabled us to identify them to species. Of the remaining species, loons had a 99% identification success (n=2,212), gulls 95% (n=22,282), terns (not *Sterna*) 92% (n=103), petrels 77% (n=31), sea ducks not including scoters 80% (n=322), skuas 83% (n=12), and shearwaters 79% (n= 1,656). Other species groups with multiple morphologically similar species expected in the project area had lower identification rates. Although 95% of auks were placed into species or species blends of murre/razorbill or common/thick-billed murre, only 55% were identified to species (n=13,633). Scoters have multiple species in the group where females are very difficult to distinguish; 36% of scoters were identified to species (n=9,927). Two species of morphologically similar species of phalaropes are found in the project area. These are red and red-necked phalaropes, and 52% of these small birds were ascribed to species (n=11,133). The *Sterna* tern group also contains difficult-to-distinguish species with 38% ascribed to species (n=1,471). Similarly, storm-petrels achieved a 36% identification success (n=3,371). Shorebird identification is always challenging with multiple small species having similar morphological traits; 32% of shorebirds were ascribed to species (n=6,136). Although a large-species group, the cormorant group has two morphologically similar species present in the area at certain times of the year; double-crested cormorant and great cormorant, and 24% of cormorants were identified to species (n=372) (Table 12; Appendix B).

Table 10. Species Identification Success Rates for Birds for All Surveys

Name	Number in Species Group	Number Identified to Species	Number of Species Unknown or Species Group	Percent ID Success
Goose	3	3	0	100
Swan	12	12	0	100
Duck (excluding Scoters)	322	257	65	80
Duck (Scoters)	9,927	3,539	6,388	36
Loon	2,212	2,182	30	99
Grebe	12	12	0	100
Fulmar	888	888	0	100
Petrel	31	24	7	77
Shearwater	1,656	1,305	351	79
Storm-petrel	3,371	1,228	2,143	36
Booby	1	1	0	100
Gannet	10,110	10,110	0	100
Cormorant	372	89	283	24
Pelican	1	1	0	100
Ardeidae	1	1	0	100

Name	Number in Species Group	Number Identified to Species	Number of Species Unknown or Species Group	Percent ID Success
Raptor	3	3	0	100
Shorebird	6,136	1,965	4,171	32
Phalarope	11,133	5,789	5,344	52
Skua	12	10	2	83
Auk	13,633	7,546	6,087	55
Gull	22,282	21,148	1,134	95
Tern	103	95	8	92
Sterna Tern	1,471	566	905	38
Nightjar	1	1	0	100
Passerine	7	7	0	100
TOTAL	**83,700**	**56,782**	**25,745**	

3.5.2. Species Composition and Abundance (Corrected for Effort)

Species composition and abundance was varied throughout the year and between years, highlighting not only the seasonal nature of avian activity, but also the interannual variation that can be expected. The Summer 2016 survey was dominated by storm-petrels (42%) and shearwaters (39%), and similarly with the Summer 2017 survey where storm-petrels accounted for 70% of the sample and shearwaters 19% of the sample (Figure 6, Table 11). The Fall 2016 survey was dominated by gulls (44%) and gannets (24%), and the Fall 2017 survey by phalaropes (32%) and gulls (27%); although 13% of the Fall 2016 survey sample contained phalaropes (Figure 6, Table 11). Winter 2016–2017 was dominated by auks (43%), gulls (26%) and gannets (20%), and Winter 2017–2018 by shorebirds (36%) and gulls (28%), with only 6% of the sample containing auks (Figure 6, Table 11). Spring 2017 was dominated by *Sterna* terns (35%) and gulls (24%), whereas *Sterna* terns represented <1% of the sample in Spring 2018, which was otherwise dominated by phalaropes (26%), ducks (24%), and gulls (21%). Auks represented 3% of the Spring 2017 survey (Figure 6, Table 11).

Relative abundance by each species group varied among seasons. The shift in species seasonal representation was marked, with avian species-group richness the lowest in the Summer 2016 survey (n=10), followed by Winter 2017–2018 (n=11 when splitting loons and grebes), Summer 2017 (n=12), Winter 2016–2017 (n=14 when splitting loons and grebes) and Spring 2017 (n=15), Fall 2016 (n=15), Fall 2017 (n=16), and Spring 2018 (n=17 when splitting booby from gannet and loons and grebes) (see Table 12, Appendix A and Appendix B for a list of species included in taxonomic groups and numbers by season). We do not include phalaropes in the group "shorebird" nor do we include *Sterna* terns with the overall group of terns (Table 12, Figure 6).

Table 11. Relative Abundance (%) by each Species Group and by Survey

Name	Corrected Abundance[1] (%)								Species Total %
	Summer		Fall		Winter		Spring		
	2016	2017	2016	2017	2016–2017	2017–2018	2017	2018	
Goose	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00
Swan	0.00	0.00	0.00	0.00	0.00	0.11	0.00	0.00	0.01
Duck	0.00	0.00	13.72	3.02	6.64	14.82	1.80	24.05	12.24
Loon and Grebe	0.16	0.17	2.22	3.37	2.84	1.72	6.54	2.80	2.65
Fulmar	0.00	0.00	0.02	0.64	0.23	6.28	1.36	0.10	1.06
Petrel	0.97	0.10	0.01	0.00	0.01	0.00	0.05	0.02	0.04
Shearwater	39.35	19.43	1.34	0.46	0.02	0.00	3.41	0.06	1.98
Storm-petrel	42.42	70.18	0.01	1.19	0.34	0.00	2.62	1.04	4.03
Booby and Gannet	0.00	0.13	24.00	8.11	19.67	7.41	5.64	5.85	12.08
Cormorant	0.32	0.00	0.55	1.18	0.01	0.00	0.44	0.79	0.44
Pelican	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00
Ardeidae	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00
Raptors	0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Shorebirds	0.38	0.98	0.38	21.35	0.00	35.89	0.00	0.16	7.33
Phalaropes	0.00	4.66	12.67	32.31	1.11	0.01	14.97	26.26	13.30
Skuas	0.00	0.00	0.01	0.01	0.00	0.02	0.11	0.02	0.01
Auks	0.00	0.13	0.65	1.17	42.79	5.79	2.89	17.37	16.29
Gulls	6.13	3.68	44.41	27.05	26.32	27.96	24.24	21.24	26.62
Terns	2.58	0.07	0.02	0.00	0.00	0.00	1.39	0.00	0.12
Sterna Terns	7.58	0.44	0.00	0.03	0.00	0.00	34.54	0.22	1.76
Nightjars	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Passerines	0.00	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.01
Season Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**

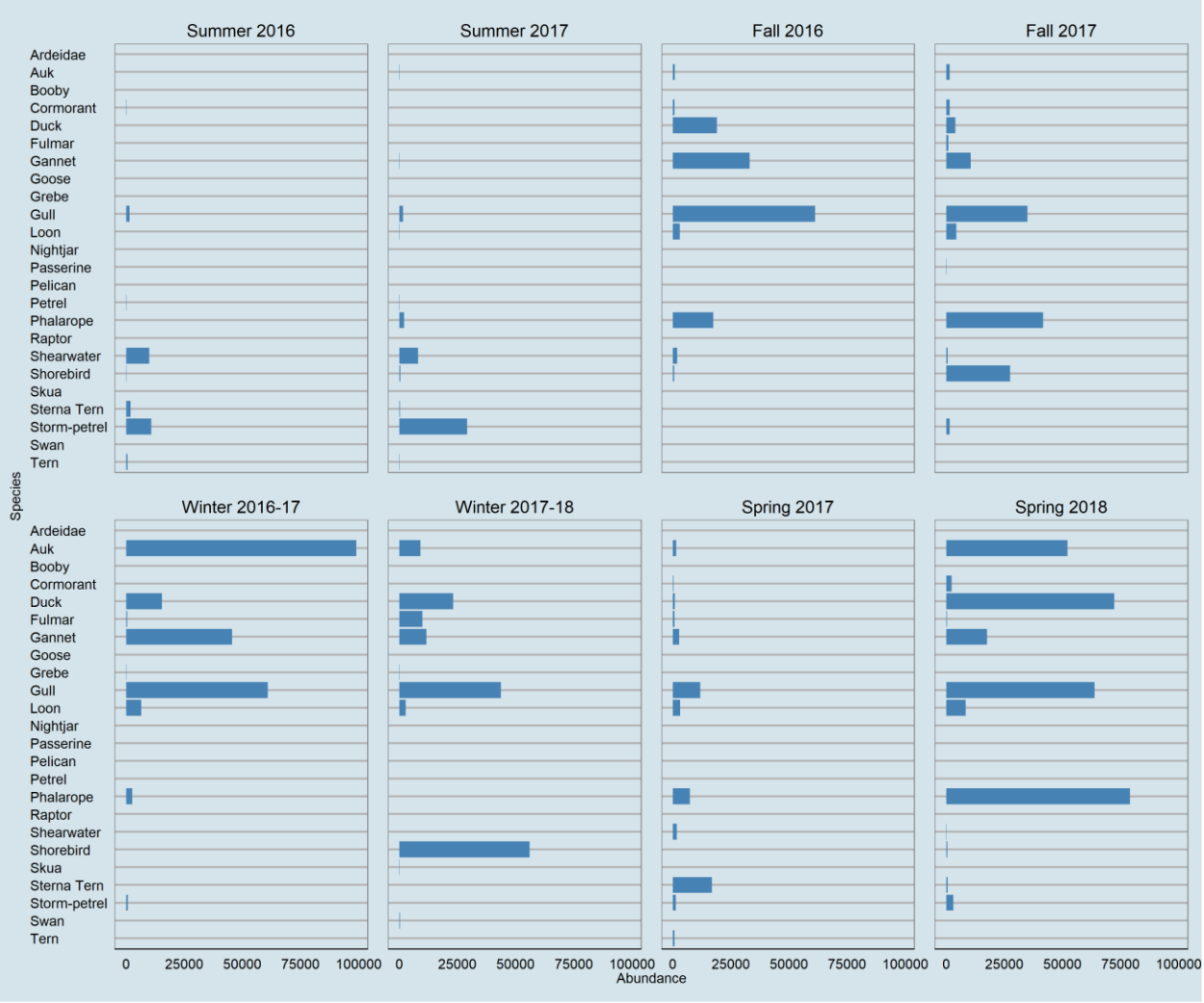

Figure 6. Relative abundance (corrected for effort) of avian taxonomic groups by survey.

Within each species group, seasonal abundance by species varied across the year.

Across all eight surveys, gulls were the most frequently encountered group and they were the second most diverse group, with 10 species identified. Numbers of gulls were highest during Fall and Winter in general, with more individuals encountered in Fall 2016 and Winter 2016–2017 than were encountered during Fall 2017 and Winter 2017–2018, where numbers were between 40% and 60% of those encountered during the same surveys the previous year. Despite this difference in densities, diversity remained similar with 8 species found in both of the Fall surveys, and 9 and 7 found respectively in the Winter 2016–2017 and Winter 2017–2018 surveys. Summer 2016 and Summer 2017 numbers were very similar to each other, with comparatively few gull encounters and low diversity, recording only 4 and 5 species respectively. Spring 2017 and Spring 2018 densities and diversity were completely different from each other. The Spring 2017 survey was similar to the densities and diversity of the Summer surveys, recording only 6 species. However, the Spring 2018 survey recorded densities similar to the Fall 2016 and Winter 2016–2017 surveys, and diversity was also similar with 10 species recorded. Across all 8 surveys, herring gulls and great-black-backed gulls were abundant, and ring-billed gulls were present but in lower numbers. For all but the

Summer 2016 survey, herring gulls were more abundant than great black-backed gulls. Black-legged kittiwake were present in the Fall and Winter surveys and in the Spring 2018 surveys. Laughing gulls were present in all surveys except for the Winter surveys, and lesser black-backed gulls were present in all but the Summer 2016 survey. The remaining species of little gull, Iceland gull, and glaucous gull were rarely encountered (Appendix B, Table 12, Table 13, Figure 7).

After gulls, the most frequently encountered species group was auks. Five species of auks were identified in images. This species group showed quite variable density fluctuations between years. When looking at numbers corrected for effort (Table 12), the numbers of auks in the Winter 2017–2018 survey represented less than 10% of those recorded in the Winter 2016–2017 survey, and the auks recorded in the Spring 2017 survey represented less than 3% of those recorded in the Spring 2018 survey. Numbers in the Summer and Fall surveys for all years remained low (Appendix B, Table 12, Figure 8).

Phalaropes were the next most frequently encountered species group, with two species recorded. For phalaropes the numbers were highest during the Spring 2018 survey where numbers were over 10 times higher than those recorded in the Spring 2017 survey. The Fall surveys recorded the next highest numbers although these also varied between years with the Fall 2017 survey recording more than twice as many phalaropes than the Fall 2016 survey. Few phalaropes were recorded in the Summer surveys (none in the Summer 2016 survey and very low numbers in the Summer 2017 survey; Appendix B, Table 12, Table 13, Figure 9).

Ducks, including scoters, were also encountered in high diversity and density in the Fall 2016 survey, both Winter surveys, and in the Spring 2018 survey; although, there were differences between years with Winter 2017–2018 having more than 30% more individuals recorded than the Winter 2016–2017 survey. Highest numbers were found in the Spring 2018 survey when nearly 70% more individuals were recorded. Very few were found in the Spring 2017 survey, and none in either of the Summer surveys. Eleven species were identified. Most individuals were one of the three scoter species (surf scoter, white-winged scoter, and black scoter). Rare species recorded were gadwall (recorded only in the Spring 2017 survey), king eider and common goldeneye only recorded in the Winter 2016–2017 survey, and common eider only recorded in the Fall 2017 survey. Other species encountered, although in low numbers, included long-tailed duck, bufflehead, red-breasted merganser, and lesser scaup (Appendix B, Table 12, Table 13, Figure 10).

Gannets occurred in high numbers in the Fall and Winter surveys, but again with quite large differences between years with Fall 2016 recording three times more than Fall 2017. Similarly with the Winter surveys, the Winter 2016–2017 recorded four times as many than the Winter 2017–2018. The same dramatic difference between densities for gannets in the Spring 2017 and the Spring 2018 surveys remains similar to the densities reported for other taxa, with a six-fold increase in encounter rates in the Spring 2018 survey compared to the Spring 2017 survey (Appendix B, Table 12, Table 13, Figure 11).

The Fall 2017 survey saw an increase in shorebird encounters, nearly all of which were over land. Most shorebirds were encountered in the Fall 2017 and Winter 2017–2018 surveys, and although most individuals were not identifiable to species, some imagery through the survey period allowed us to identify black-bellied plover, semipalmated plover, ruddy turnstone, sanderling, and dunlin. We do not include phalaropes in this section, as phalaropes tend to be pelagic and make true use of the ocean space being able to both forage and rest at sea (Appendix B, Table 12, Table 13, Figure 12).

Storm-petrels were encountered mainly in the Summer surveys, with the Summer 2017 survey recording nearly three times the number of that of the Summer 2016 survey. Many were difficult to identify to species, but Wilson's, Leach's and band-rumped storm-petrels were identified in the imagery (Appendix B, Table 12, Table 13, Figure 13).

Loons were present in all surveys but rarely encountered in the Summer surveys. Interannual variation was still evident, with higher numbers in the Winter 2016–2017 survey than the Winter 2017–2018, more in the Spring 2018 than in the Spring 2017 surveys, and more in the Fall 2017 than the Fall 2016 survey. Two species were present in all but the Summer surveys where only common loons were reported. In all other surveys, both common and red-throated loons were present (Appendix B, Table 12, Table 13, Figure 9).

Shearwater abundance varied by season and by year. Most shearwaters were encountered during the Summer surveys with four species being reported: Cory's, great, sooty, and Audubon's. Manx shearwaters were only encountered in the Fall 2017 survey. No shearwaters were encountered in the Winter 2017–2018 survey, and only low numbers were encountered in the Winter 2016–2017 survey and the Spring 2018 survey (Appendix B, Table 12, Table 13, Figure 14).

Spring proved to be the most likely season to encounter *Sterna* terns. Three species were identified: roseate, common, and Forster's terns. Forster's terns were recorded in the Fall 2017 survey and most terns were found in the Spring 2017 survey, including roseate terns (Appendix B, Table 12, Table 13, Figure 15).

Three other tern species occurred mainly in the Summer 2016 and Spring 2017 surveys, and these were least, black, and royal terns (Appendix B, Table 12, Table 13).

Northern fulmar also showed interseasonal and interannual variation in encounters, with most birds present in the Winter 2017–2018 survey. Lower numbers were encountered in the Winter 2016–2017 and the Fall and Spring surveys, and there were no encounters in the Summer surveys (Appendix B, Table 12, Table 13, Figure 11).

Other species-group encounters were too infrequent to provide insight into interseasonal and interannual variations (Appendix B, Table 12, Table 13).

In the Summer 2016 survey, Wilson's storm-petrels and Cory's shearwaters were the most encountered species, similar to the Summer 2017 survey when Wilson's storm-petrels and great shearwater were the most encountered species (Figure 16). The Fall 2016 and Fall 2017 surveys differed markedly with most encounters being northern gannets and herring gulls, closely followed in the Fall 2016 survey by black scoters and phalaropes whereas phalaropes and herring gulls were followed by gannets in the Fall 2017 survey (Figure 17). This survey also encountered high numbers of dunlin, but these were on the shore on a developing sand bar and not in the true offshore. The Winter surveys also differed quite markedly. Although both surveys had high numbers of herring gulls and northern gannets, the Winter 2016–2017 survey encountered more auks, notably Atlantic puffin and razorbills, whereas the Winter 2017–2018 survey found fewer auks and more great black-backed gulls and fulmars (Figure 18). The Spring 2017 survey had a fewer birds in general that the Spring 2018 survey, with the species assemblage also slightly differing. Although scoters were numerous in the Spring 2018 survey, herring gulls, phalaropes, gannets and loons were encountered in both surveys, although in far fewer numbers than during the Spring 2018 survey. Roseate terns were identified in the Spring 2017 survey, but not in the Spring 2018 survey (Figure 19).

Table 12. Avian Species Identified and the Corrected Number of Individuals within the OPA

Name	Corrected Abundance[1]								Species Total
	Summer		Fall		Winter		Spring		
	2016	2017	2016	2017	2016–2017	2017–2018	2017	2018	
Goose	**-**	**-**	**-**	**28**	**11**	**-**	**-**	**-**	**39**
Canada Goose	-	-	-	28	11	-	-	-	**39**
Swan	**-**	**-**	**-**	**-**	**-**	**167**	**-**	**-**	**167**
Tundra Swan	-	-	-	-	-	167	-	-	**167**
Duck	**-**	**-**	**18,890**	**3,893**	**15,382**	**23,102**	**877**	**72,318**	**134,462**
Gadwall	-	-	34	-	-	-	-	-	**34**
Lesser Scaup	-	-	-	-	77	-	27	-	**104**
King Eider	-	-	-	-	11	-	-	-	**11**
Common Eider	-	-	-	55	-	-	-	-	**55**
Surf Scoter	-	-	416	538	2,601	125	-	1,483	**5,163**
White-winged Scoter	-	-	214	14	3,851	1,835	13	4,365	**10,291**
Black Scoter	-	-	18,024	1,753	5,932	42	40	392	**26,182**
Scoter unid.	-	-	-	1,298	553	20,475	664	66,051	**89,040**
Long-tailed Duck	-	-	34	193	542	598	27	-	**1,394**
Bufflehead	-	-	56	-	1,195	14	-	-	**1,265**
Common Goldeneye	-	-	-	-	11	-	-	-	**11**
Red-breasted Merganser	-	-	-	28	55	-	93	-	**176**
Duck-species unknown	-	-	112	14	553	14	13	28	**735**
Loon and Grebe	**41**	**70**	**3,058**	**4,349**	**6,574**	**2,683**	**3,188**	**8,408**	**28,384**
Red-throated Loon	-	-	2,496	2,223	2,667	486	319	2,253	**10,444**
Common Loon	41	42	540	1,933	3,785	2,099	2,829	6,128	**17,396**
Loon-species unknown	-	28	22	193	33	56	40	28	**400**
Horned Grebe	-	-	-	-	89	42	-	14	**144**

Name	Corrected Abundance[1]								Species Total
	Summer		Fall		Winter		Spring		
	2016	2017	2016	2017	2016–2017	2017–2018	2017	2018	
Fulmar	**-**	**-**	**34**	**828**	**542**	**9,799**	**664**	**294**	**12,162**
Northern Fulmar	-	-	34	828	542	9,799	664	294	**12,162**
Petrel	**246**	**42**	**11**	**-**	**22**	**-**	**27**	**70**	**418**
Trindade Petrel	-	-	-	-	-	-	13	-	**13**
Black-capped Petrel	177	42	11	-	11	-	-	70	**312**
Petrel-species unknown	68	-	-	-	11	-	13	-	**92**
Shearwater	**9,994**	**8,041**	**1,844**	**594**	**44**	**-**	**1,660**	**168**	**22,346**
Cory's Shearwater	6,963	1,256	1,642	28	-	-	120	-	**10,008**
Great Shearwater	956	4,705	90	166	-	-	27	-	**5,943**
Sooty Shearwater	27	14	-	-	22	-	1,076	126	**1,265**
Manx Shearwater	-	-	-	221	-	-	-	-	**221**
Audubon's Shearwater	109	-	-	-	-	-	-	-	**109**
Shearwater-species unknown-Large	1,761	1,508	112	110	22	-	199	14	**3,727**
Shearwater-species unknown-Small	177	558	-	69	-	-	239	28	**1,072**
Storm-petrel	**10,772**	**29,038**	**11**	**1,532**	**786**	**-**	**1,275**	**3,120**	**46,535**
Wilson's Storm-Petrel	10,772	4,733	11	-	-	-	1,195	-	**16,712**
Leach's Storm-Petrel	-	28	-	28	33	-	13	-	**102**
Band-rumped Storm-Petrel	-	-	-	-	-	-	13	-	**13**
Storm-petrel-species unknown	-	24,277	-	1,505	753	-	53	3,120	**29,708**
Booby and Gannet	**-**	**56**	**33,046**	**10,451**	**45,527**	**11,551**	**2,750**	**17,614**	**120,994**
Brown Booby	-	-	-	-	-	-	-	14	**14**
Northern Gannet	-	56	33,046	10,451	45,527	11,551	2,750	17,600	**120,980**
Cormorant	**82**	**-**	**753**	**1,519**	**33**	**-**	**213**	**2,378**	**4,978**
Double-crested Cormorant	82	-	753	-	-	-	213	-	**1,048**
Cormorant-species unknown	-	-	-	1,519	33	-	-	2,378	**3,930**

Name	Corrected Abundance[1]								Species Total
	Summer		Fall		Winter		Spring		
	2016	2017	2016	2017	2016–2017	2017–2018	2017	2018	
Pelican	**-**	**-**	**11**	**-**	**-**	**-**	**-**	**-**	**11**
Brown Pelican	-	-	11	-	-	-	-	-	**11**
Ardeidae	**-**	**-**	**-**	**14**	**-**	**-**	**-**	**-**	**14**
Great Blue Heron	-	-	-	14	-	-	-	-	**14**
Raptors	**27**	**-**	**-**	**-**	**-**	**-**	**-**	**14**	**41**
Osprey	14	-	-	-	-	-	-	14	**28**
Bald Eagle	14	-	-	-	-	-	-	-	**14**
Shorebirds	**96**	**405**	**517**	**27,514**	**11**	**55,961**	**-**	**476**	**84,980**
Black-bellied Plover	82	-	-	-	-	42	-	-	**124**
Semipalmated Plover	-	42	-	-	-	-	-	-	**42**
Ruddy Turnstone	-	-	-	1,836	-	-	-	-	**1,836**
Sanderling	-	-	-	1,615	-	-	-	-	**1,615**
Dunlin	-	-	-	23,511	-	-	-	-	**23,511**
Shorebird-species unknown	14	363	517	552	11	55,920	-	476	**57,852**
Phalaropes	**-**	**1,927**	**17,439**	**41,651**	**2,578**	**14**	**7,293**	**78,964**	**149,866**
Red-necked Phalarope	-	14	776	-	-	-	226	4,897	**5,912**
Red Phalarope	-	-	-	24,491	-	-	13	50,045	**74,549**
Red/Red-necked Phalarope	-	1,689	16,663	17,091	2,578	14	7,053	24,022	**69,112**
Phalarope-species unknown	-	223	-	69	-	-	-	-	**292**
Skuas	**-**	**-**	**11**	**14**	**-**	**28**	**53**	**56**	**162**
Great Skua	-	-	-	-	-	14	-	14	**28**
South Polar Skua	-	-	-	-	-	-	13	-	**13**
Pomarine Jaeger	-	-	11	-	-	-	13	-	**25**
Parasitic Jaeger	-	-	-	14	-	-	27	28	**68**
Skua-species unknown	-	-	-	-	-	14	-	14	**28**

Name	Corrected Abundance[1]								Species Total
	Summer		Fall		Winter		Spring		
	2016	2017	2016	2017	2016–2017	2017–2018	2017	2018	
Auks	**-**	**56**	**888**	**1,505**	**99,066**	**9,035**	**1,408**	**52,228**	**164,186**
Dovekie	-	-	34	-	19,842	195	-	-	**20,070**
Common Murre	-	-	124	-	-	-	-	-	**124**
Common/Thick-billed Murre	-	-	-	-	33	-	-	2,281	**2,314**
Razorbill	-	-	270	28	23,107	-	53	7,639	**31,096**
Murre/Razorbill	-	28	-	1,325	22,830	7,603	398	34,739	**66,924**
Black Guillemot	-	-	11	-	89	-	-	-	**100**
Atlantic Puffin	-	-	-	110	26,415	1,015	598	7,541	**35,679**
Auk-species unknown	-	28	450	41	6,750	222	359	28	**7,879**
Gulls	**1,556**	**1,522**	**61,144**	**34,873**	**60,920**	**43,590**	**11,809**	**63,868**	**279,283**
Black-legged Kittiwake	-	-	2,586	5,122	100	139	-	28	**7,975**
Bonaparte's Gull	-	-	12,155	9,816	6,808	1,765	-	11,123	**41,664**
Little Gull	-	-	45	-	66	-	-	14	**125**
Laughing Gull	191	181	8,748	1,091	-	-	465	434	**11,110**
Ring-billed Gull	109	28	1,023	1,325	2,435	361	13	238	**5,533**
Herring Gull	287	461	25,602	12,825	38,677	24,700	7,359	44,267	**154,178**
Iceland Gull	-	-	-	14	77	28	13	28	**160**
Lesser Black-backed Gull	-	28	101	207	255	236	146	448	**1,421**
Glaucous Gull	-	-	-	-	11	-	-	14	**25**
Great Black-backed Gull	710	349	4,160	2,568	10,668	15,248	3,414	6,296	**43,413**
Gull-species unknown - Large	55	42	180	525	255	556	13	168	**1,793**
Gull-species unknown - Small	150	433	6,533	1,325	1,505	542	385	811	**11,685**
Gull-species unknown	55	-	11	55	66	14	-	-	**201**
Terns	**655**	**28**	**22**	**-**	**-**	**-**	**677**	**-**	**1,383**
Least Tern	451	-	-	-	-	-	651	-	**1,101**

Name	Corrected Abundance[1]								Species Total
	Summer		Fall		Winter		Spring		
	2016	2017	2016	2017	2016–2017	2017–2018	2017	2018	
Black Tern	-	14	-	-	-	-	27	-	**41**
Royal Tern	109	-	22	-	-	-	-	-	**132**
Tern-species unknown	96	14	-	-	-	-	-	-	**110**
***Sterna* Terns**	**1,925**	**181**	**-**	**41**	**-**	**-**	**16,830**	**658**	**19,636**
Roseate Tern	-	-	-	-	-	-	199	-	**199**
Common Tern	-	-	-	-	-	-	7,253	42	**7,295**
Forster's Tern	-	-	-	28	-	-	-	-	**28**
Sterna Tern-species unknown	1,925	181	-	14	-	-	9,378	616	**12,114**
Nightjars	**-**	**14**	**-**	**-**	**-**	**-**	**-**	**-**	**14**
Common Nighthawk	-	14	-	-	-	-	-	-	**14**
Passerines	**-**	**-**	**-**	**97**	**-**	**-**	**-**	**-**	**97**
Snow Bunting	-	-	-	97	-	-	-	-	**97**
Season Total	**25,395**	**41,379**	**137,681**	**128,902**	**231,498**	**155,930**	**48,723**	**300,648**	**1,070,156**

[1] Corrected abundance was calculated by dividing the observed abundance by the percent of the area surveyed for each season. This accounts for differing amounts of area surveyed and makes abundances comparable across seasons. Corrected abundance values are frequently non-integers that have been rounded to whole numbers for display purposes. Column and row totals may not equal the sum of numbers shown in the table because the underlying values are non-integers.

Table 13. Percent of Overall Total in Species Group Represented by each Taxon*

Name	Corrected Abundance[1]								Species Total
	Summer		Fall		Winter		Spring		
	2016	2017	2016	2017	2016–2017	2017–2018	2017	2018	
Goose	**-**	**-**	**-**	**28**	**11**	**-**	**-**	**-**	**39**
Canada Goose	-	-	-	100.0	100.0	-	-	-	100.0
Swan	**-**	**-**	**-**	**-**	**-**	**167**	**-**	**-**	**167**
Tundra Swan	-	-	-	-	-	100.0	-	-	100.0
Duck	**-**	**-**	**18,890**	**3,893**	**15,382**	**23,102**	**877**	**72,318**	**134,462**
Gadwall	-	-	0.2	0.0	0.0	0.0	0.0	0.0	0.0
Lesser Scaup	-	-	0.0	0.0	0.5	0.0	3.0	0.0	0.1
King Eider	-	-	0.0	0.0	0.1	0.0	0.0	0.0	0.0
Common Eider	-	-	0.0	1.4	0.0	0.0	0.0	0.0	0.0
Surf Scoter	-	-	2.2	13.8	16.9	0.5	0.0	2.1	4.2
White-winged Scoter	-	-	1.1	0.4	25.0	7.9	1.5	6.0	7.9
Black Scoter	-	-	95.4	45.0	38.6	0.2	4.5	0.5	22.4
Scoter unid.	-	-	0.0	33.3	3.6	88.6	75.8	91.3	62.3
Long-tailed Duck	-	-	0.2	5.0	3.5	2.6	3.0	0.0	1.1
Bufflehead	-	-	0.3	0.0	7.8	0.1	0.0	0.0	1.1
Common Goldeneye	-	-	0.0	0.0	0.1	0.0	0.0	0.0	0.0
Red-breasted Merganser	-	-	0.0	0.7	0.4	0.0	10.6	0.0	0.1
Duck-species unknown	-	-	0.6	0.4	3.6	0.1	1.5	0.0	0.6
Loon and Grebe	**41**	**70**	**3,058**	**4,349**	**6,574**	**2,683**	**3,188**	**8,408**	**28,384**
Red-throated Loon	0.0	0.0	81.6	51.1	40.6	18.1	10.0	26.8	36.8
Common Loon	100.0	60.0	17.7	44.4	57.6	78.2	88.8	72.9	61.3
Loon-species unknown	0.0	40.0	0.7	4.4	0.5	2.1	1.3	0.3	1.4
Horned Grebe	0.0	0.0	0.0	0.0	1.4	1.6	0.0	0.2	0.5
Fulmar	**-**	**-**	**34**	**828**	**542**	**9,799**	**664**	**294**	**12,162**
Northern Fulmar	-	-	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Petrel	**246**	**42**	**11**	**-**	**22**	**-**	**27**	**70**	**418**
Trindade Petrel	0.0	0.0	0.0	-	0.0	-	50.0	0.0	3.2
Black-capped Petrel	72.2	100.0	100.0	-	50.0	-	0.0	100.0	74.2

Name	Corrected Abundance[1]								Species Total
	Summer		Fall		Winter		Spring		
	2016	2017	2016	2017	2016–2017	2017–2018	2017	2018	
Petrel-species unknown	27.8	0.0	0.0	-	50.0	-	50.0	0.0	22.6
Shearwater	**9,994**	**8,041**	**1,844**	**594**	**44**	**-**	**1,660**	**168**	**22,346**
Cory's Shearwater	69.7	15.6	89.0	4.7	0.0	-	7.2	0.0	45.7
Great Shearwater	9.6	58.5	4.9	27.9	0.0	-	1.6	0.0	25.9
Sooty Shearwater	0.3	0.2	0.0	0.0	50.0	-	64.8	75.0	5.7
Manx Shearwater	0.0	0.0	0.0	37.2	0.0	-	0.0	0.0	1.0
Audubon's Shearwater	1.1	0.0	0.0	0.0	0.0	-	0.0	0.0	0.5
Shearwater-species unknown-Large	17.6	18.8	6.1	18.6	50.0	-	12.0	8.3	16.5
Shearwater-species unknown-Small	1.8	6.9	0.0	11.6	0.0	-	14.4	16.7	4.7
Storm-petrel	**10,772**	**29,038**	**11**	**1,532**	**786**	**-**	**1,275**	**3,120**	**46,535**
Wilson's Storm-Petrel	100.0	16.3	100.0	0.0	0.0	-	93.8	0.0	36.2
Leach's Storm-Petrel	0.0	0.1	0.0	1.8	4.2	-	1.0	0.0	0.2
Band-rumped Storm-Petrel	0.0	0.0	0.0	0.0	0.0	-	1.0	0.0	0.0
Storm-petrel-species unknown	0.0	83.6	0.0	98.2	95.8	-	4.2	100.0	63.6
Booby and Gannet	**-**	**56**	**33,046**	**10,451**	**45,527**	**11,551**	**2,750**	**17,614**	**120,994**
Brown Booby	-	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0
Northern Gannet	-	100.0	100.0	100.0	100.0	100.0	100.0	99.9	100.0
Cormorant	**82**	**-**	**753**	**1,519**	**33**	**-**	**213**	**2,378**	**4,978**
Double-crested Cormorant	100.0	-	100.0	0.0	0.0	-	100.0	0.0	23.9
Cormorant-species unknown	0.0	-	0.0	100.0	100.0	-	0.0	100.0	76.1
Pelican	**-**	**-**	**11**	**-**	**-**	**-**	**-**	**-**	**11**
Brown Pelican	-	-	100.0	-	-	-	-	-	100.0
Ardeidae	**-**	**-**	**-**	**14**	**-**	**-**	**-**	**-**	**14**
Great Blue Heron	-	-	-	100.0	-	-	-	-	100.0
Raptors	**27**	**-**	**-**	**-**	**-**	**-**	**-**	**14**	**41**
Osprey	50.0	-	-	-	-	-	-	100.0	66.7
Bald Eagle	50.0	-	-	-	-	-	-	0.0	33.3
Shorebirds	**96**	**405**	**517**	**27,514**	**11**	**55,961**	**-**	**476**	**84,980**
Black-bellied Plover	85.7	0.0	0.0	0.0	0.0	0.1		0.0	0.1

Name	Corrected Abundance[1]								Species Total
	Summer		Fall		Winter		Spring		
	2016	2017	2016	2017	2016–2017	2017–2018	2017	2018	
Semipalmated Plover	0.0	10.3	0.0	0.0	0.0	0.0		0.0	0.0
Ruddy Turnstone	0.0	0.0	0.0	6.7	0.0	0.0		0.0	2.2
Sanderling	0.0	0.0	0.0	5.9	0.0	0.0		0.0	1.9
Dunlin	0.0	0.0	0.0	85.4	0.0	0.0		0.0	27.8
Shorebird-species unknown	14.3	89.7	100.0	2.0	100.0	99.9		100.0	68.0
Phalaropes	**-**	**1,927**	**17,439**	**41,651**	**2,578**	**14**	**7,293**	**78,964**	**149,866**
Red-necked Phalarope	-	0.7	4.4	0.0	0.0	0.0	3.1	6.2	3.9
Red Phalarope	-	0.0	0.0	58.8	0.0	0.0	0.2	63.4	48.1
Red/Red-necked Phalarope	-	87.7	95.6	41.0	100.0	100.0	96.7	30.4	47.8
Phalarope-species unknown	-	11.6	0.0	0.2	0.0	0.0	0.0	0.0	0.2
Skuas	**-**	**-**	**11**	**14**	**-**	**28**	**53**	**56**	**162**
Great Skua	-	-	0.0	0.0	-	50.0	0.0	25.0	16.7
South Polar Skua	-	-	0.0	0.0	-	0.0	25.0	0.0	8.3
Pomarine Jaeger	-	-	100.0	0.0	-	0.0	25.0	0.0	16.7
Parasitic Jaeger	-	-	0.0	100.0	-	0.0	50.0	50.0	41.7
Skua-species unknown	-	-	0.0	0.0	-	50.0	0.0	25.0	16.7
Auks	**-**	**56**	**888**	**1,505**	**99,066**	**9,035**	**1,408**	**52,228**	**164,186**
Dovekie	-	0.0	3.8	0.0	20.0	2.2	0.0	0.0	13.3
Common Murre	-	0.0	13.9	0.0	0.0	0.0	0.0	0.0	0.1
Common/Thick-billed Murre	-	0.0	0.0	0.0	0.0	0.0	0.0	4.4	1.2
Razorbill	-	0.0	30.4	1.8	23.3	0.0	3.8	14.6	19.5
Murre/Razorbill	-	50.0	0.0	88.1	23.0	84.2	28.3	66.5	38.3
Black Guillemot	-	0.0	1.3	0.0	0.1	0.0	0.0	0.0	0.1
Atlantic Puffin	-	0.0	0.0	7.3	26.7	11.2	42.5	14.4	22.4
Auk-species unknown		50.0	50.6	2.8	6.8	2.5	25.5	0.1	5.1
Gulls	**1,556**	**1,522**	**61,144**	**34,873**	**60,920**	**43,590**	**11,809**	**63,868**	**279,283**
Black-legged Kittiwake	0.0	0.0	4.2	14.7	0.2	0.3	0.0	0.0	2.8
Bonaparte's Gull	0.0	0.0	19.9	28.1	11.2	4.0	0.0	17.4	14.9
Little Gull	0.0	0.0	0.1	0.0	0.1	0.0	0.0	0.0	0.0

Name	Corrected Abundance[1]								Species Total
	Summer		Fall		Winter		Spring		
	2016	2017	2016	2017	2016–2017	2017–2018	2017	2018	
Laughing Gull	12.3	11.9	14.3	3.1	0.0	0.0	3.9	0.7	4.3
Ring-billed Gull	7.0	1.8	1.7	3.8	4.0	0.8	0.1	0.4	2.1
Herring Gull	18.4	30.3	41.9	36.8	63.5	56.7	62.3	69.3	55.0
Iceland Gull	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.0	0.1
Lesser Black-backed Gull	0.0	1.8	0.2	0.6	0.4	0.5	1.2	0.7	0.5
Glaucous Gull	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Great Black-backed Gull	45.6	22.9	6.8	7.4	17.5	35.0	28.9	9.9	15.3
Gull-species unknown - Large	3.5	2.8	0.3	1.5	0.4	1.3	0.1	0.3	0.6
Gull-species unknown - Small	9.6	28.4	10.7	3.8	2.5	1.2	3.3	1.3	4.4
Gull-species unknown	3.5	0.0	0.0	0.2	0.1	0.0	0.0	0.0	0.1
Terns	**655**	**28**	**22**	**-**	**-**	**-**	**677**	**-**	**1,383**
Least Tern	68.8	0.0	0.0	-	-	-	96.1	-	79.6
Black Tern	0.0	50.0	0.0	-	-	-	3.9	-	2.9
Royal Tern	16.7	0.0	100.0	-	-	-	0.0	-	9.7
Tern-species unknown	14.6	50.0	0.0	-	-	-	0.0	-	7.8
***Sterna* Terns**	**1,925**	**181**	**-**	**41**	**-**	**-**	**16,830**	**658**	**19,636**
Roseate Tern	0.0	0.0	-	0.0	-	-	1.2	0.0	1.0
Common Tern	0.0	0.0	-	0.0	-	-	43.1	6.4	37.3
Forster's Tern	0.0	0.0	-	66.7	-	-	0.0	0.0	0.1
Sterna Tern-species unknown	100.0	100.0	-	33.3	-	-	55.7	93.6	61.5
Nightjars	**-**	**14**	**-**	**-**	**-**	**-**	**-**	**-**	**14**
Common Nighthawk	-	100.0	-	-	-	-	-	-	100.0
Passerines	**-**	**-**	**-**	**97**	**-**	**-**	**-**	**-**	**97**
Snow Bunting	-	-	-	100.0	-	-	-	-	100.0
Season Total	**25,410**	**41,399**	**137,735**	**128,964**	**231,401**	**156,024**	**48,712**	**300,549**	**1,070,156**

*The pale blue rows represent the number of individuals, and the white rows represent the percent of the total within that species group.

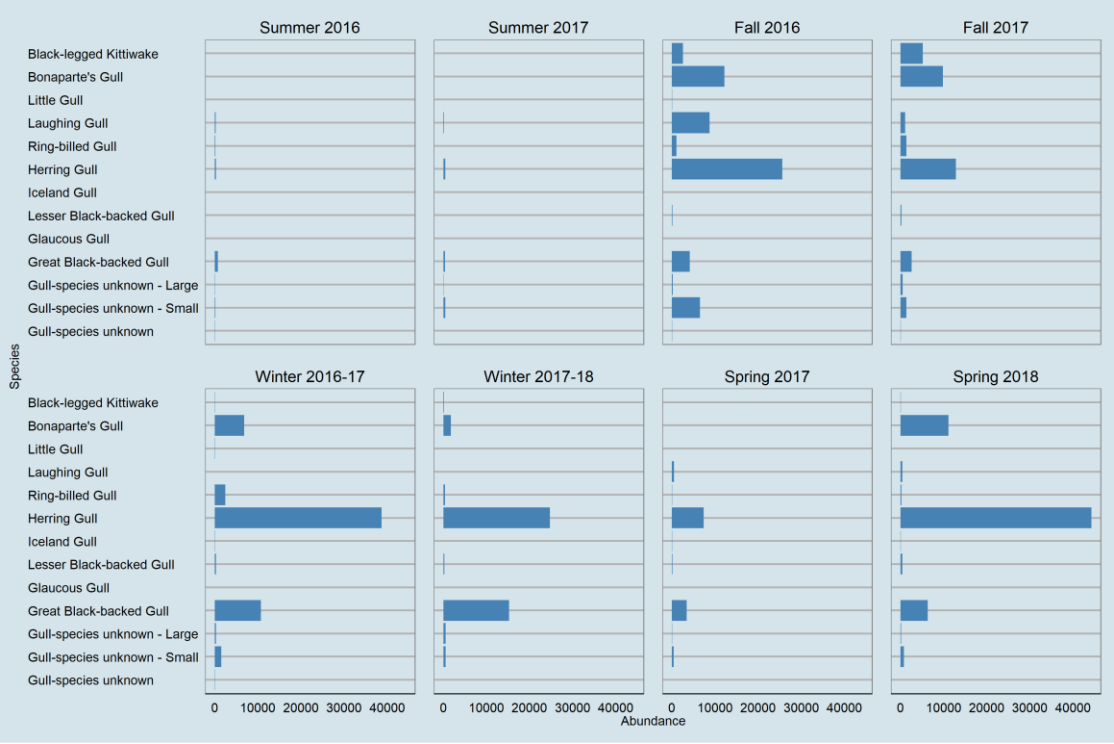

Figure 7. Relative abundance (corrected for effort) of gull species by survey across the OPA.

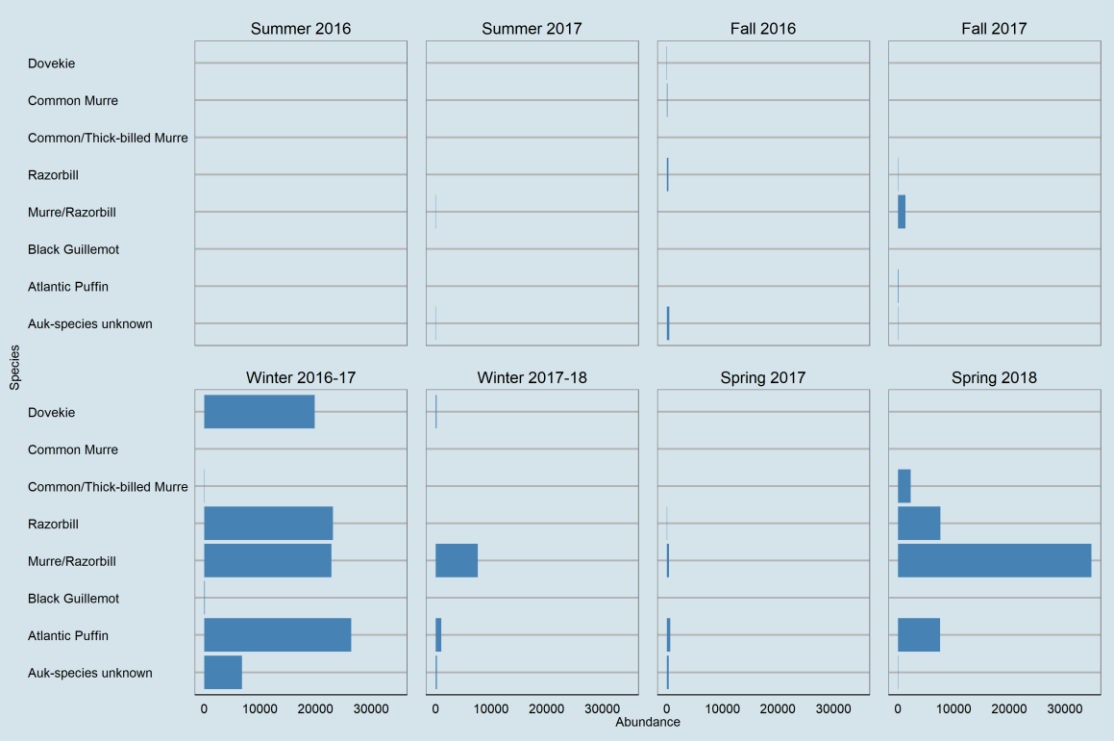

Figure 8. Relative abundance (corrected for effort) of auk species by survey across the OPA.

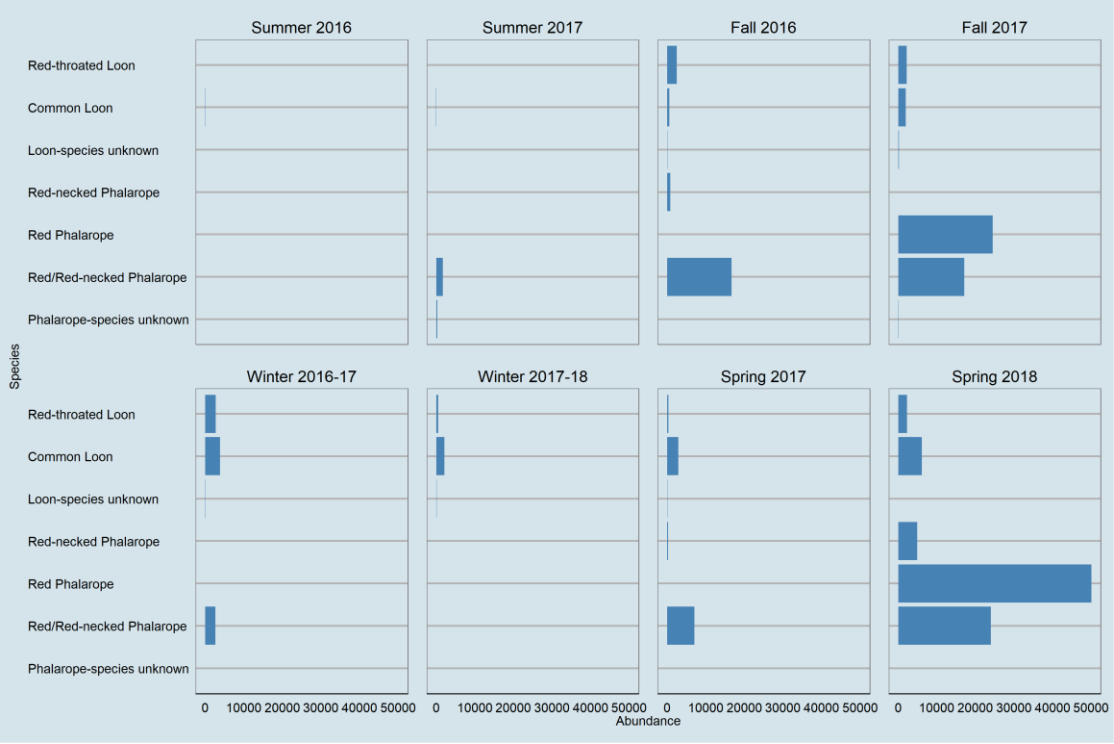

Figure 9. Relative abundance (corrected for effort) of phalaropes and loons by survey across the OPA.

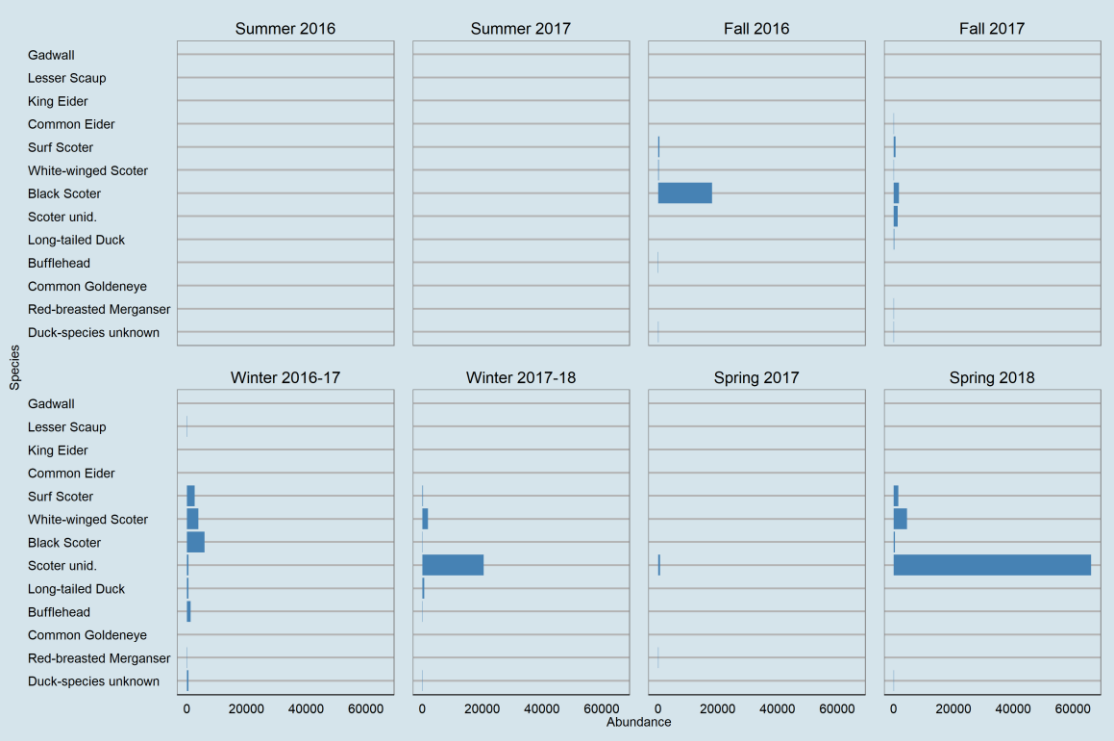

Figure 10. Relative abundance (corrected for effort) of duck species by survey across the OPA.

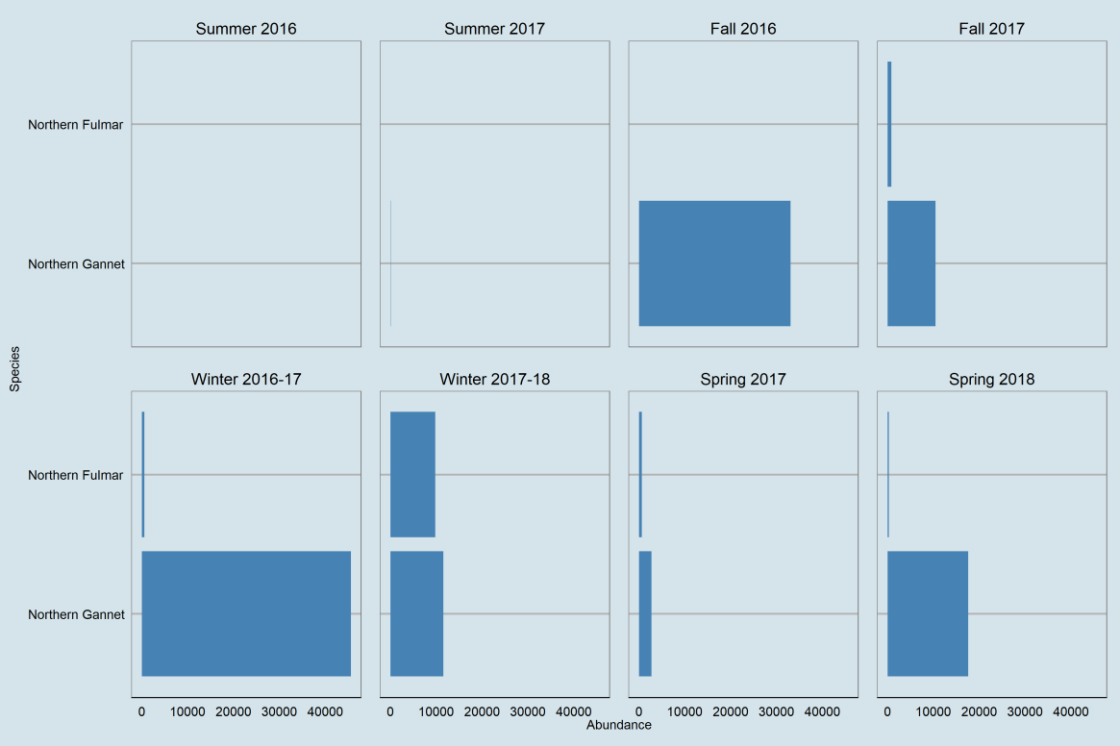

Figure 11. Relative abundance (corrected for effort) of gannet and fulmar species by survey across the OPA.

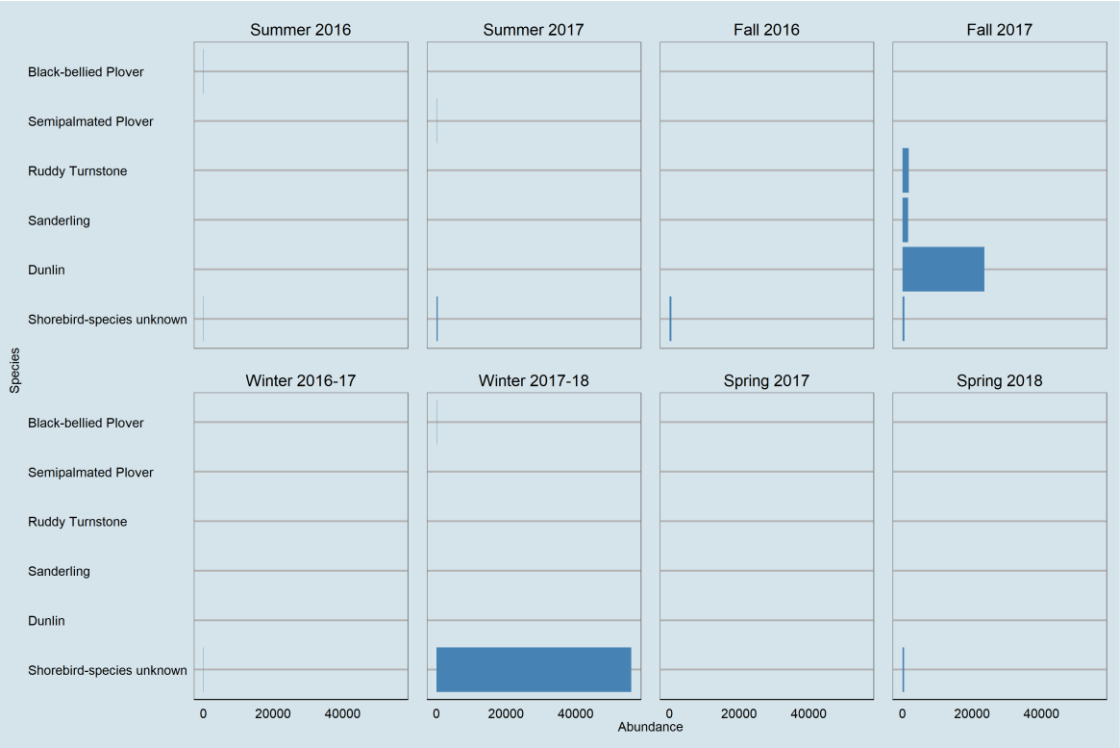

Figure 12. Relative abundance (corrected for effort) of shorebird species by survey across the OPA.

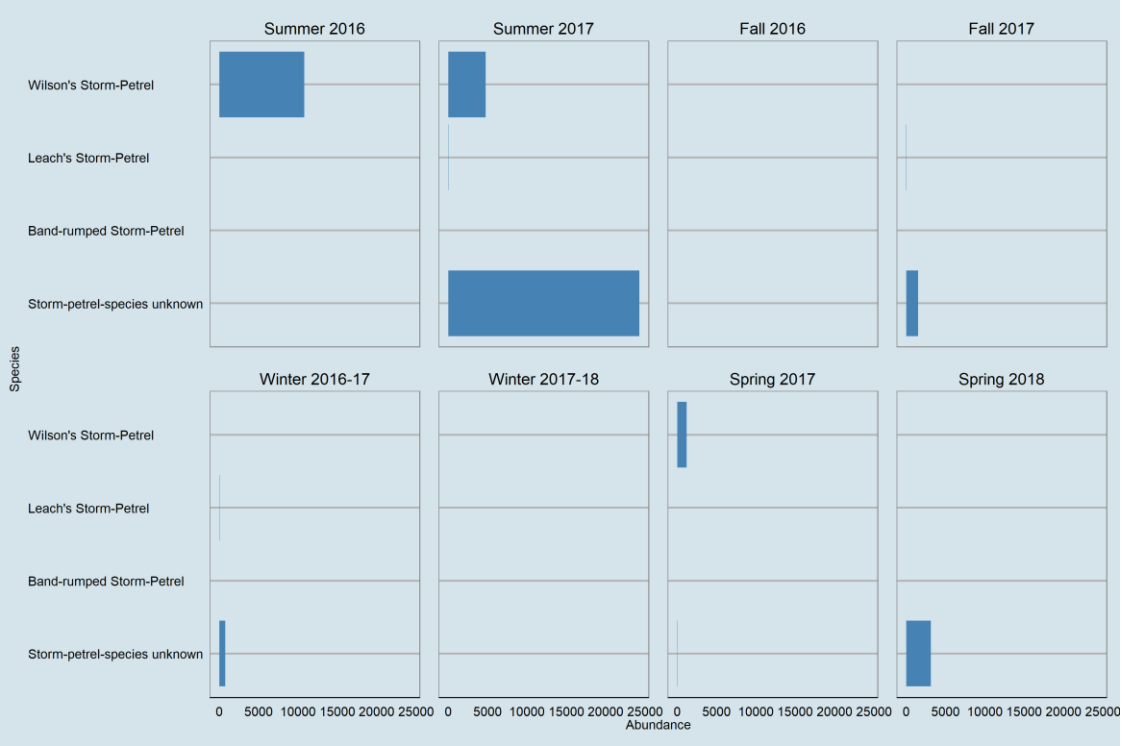

Figure 13. Relative abundance (corrected for effort) of storm-petrel species by survey across the OPA.

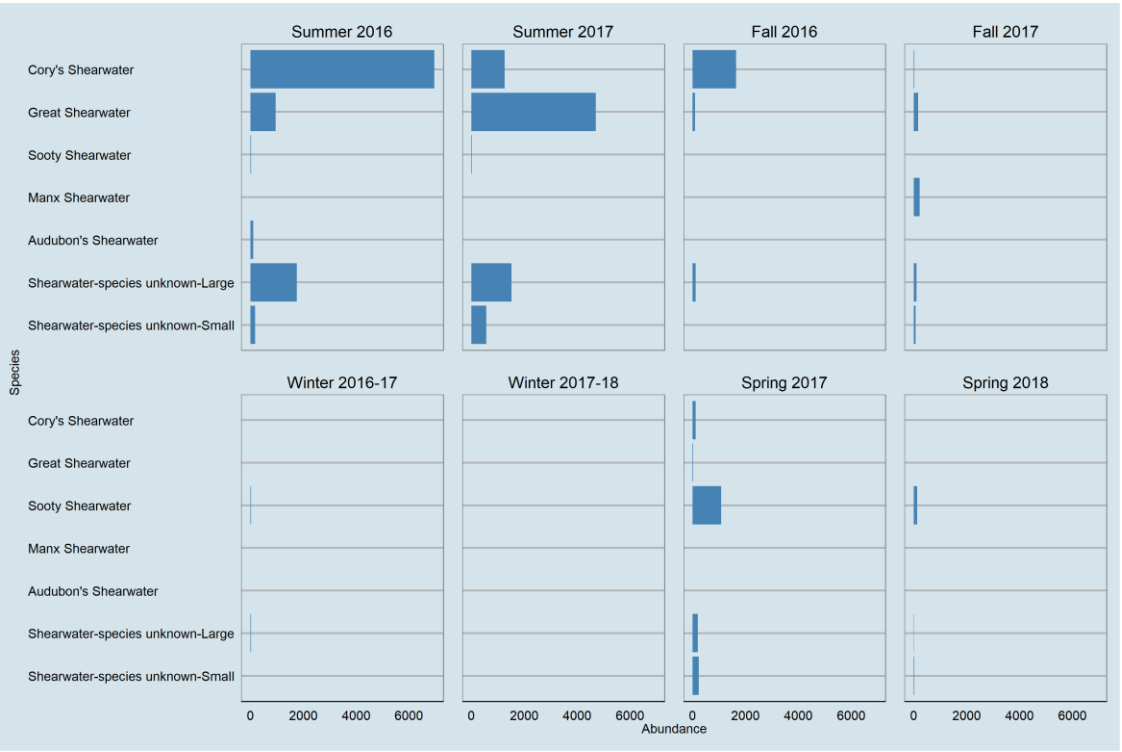

Figure 14. Relative abundance (corrected for effort) of shearwater species by survey across the OPA.

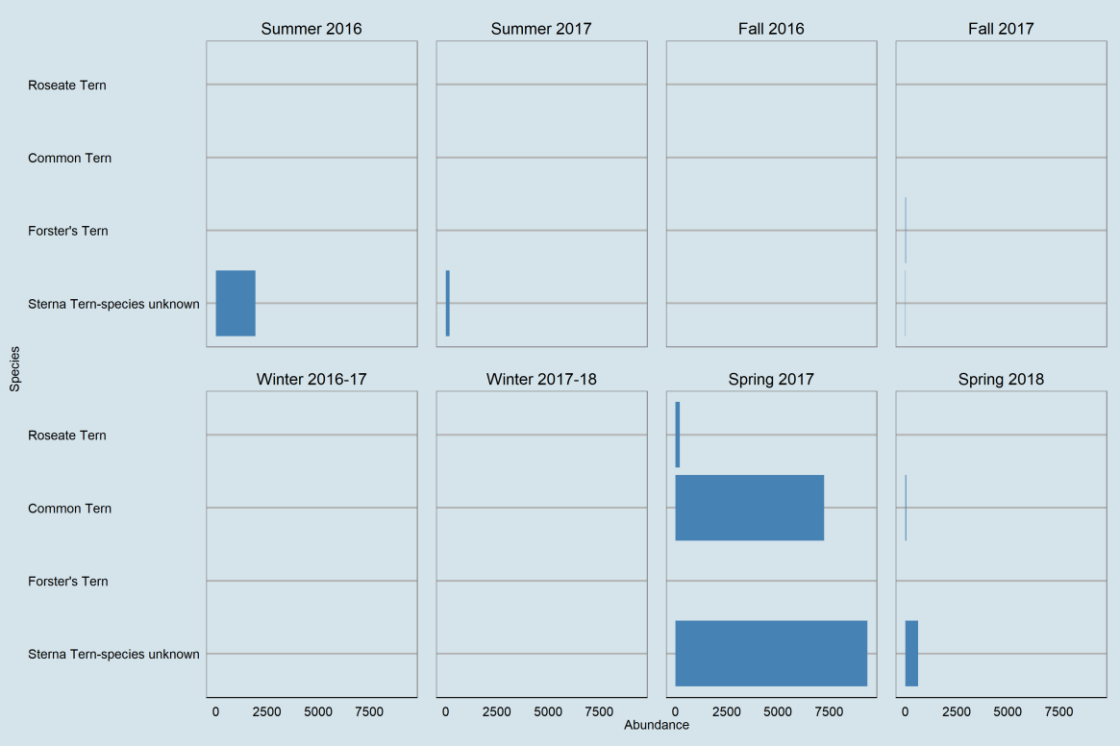

Figure 15. Relative abundance (corrected for effort) of *Sterna* tern species by survey across the OPA.

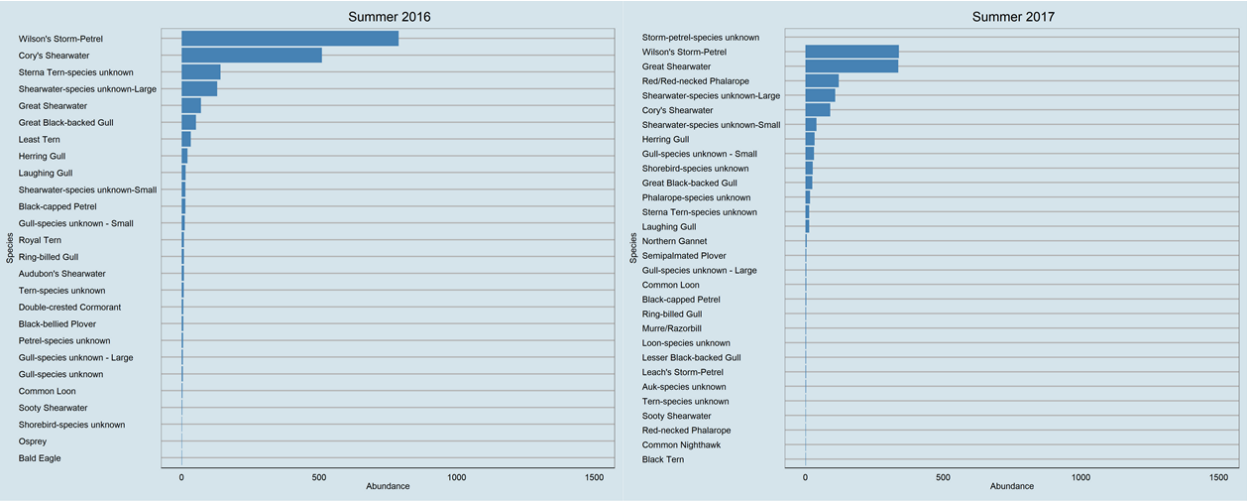

Figure 16. Number of individuals (corrected for effort) for each avian species identified during the Summer 2016 and Summer 2017 surveys across the OPA.

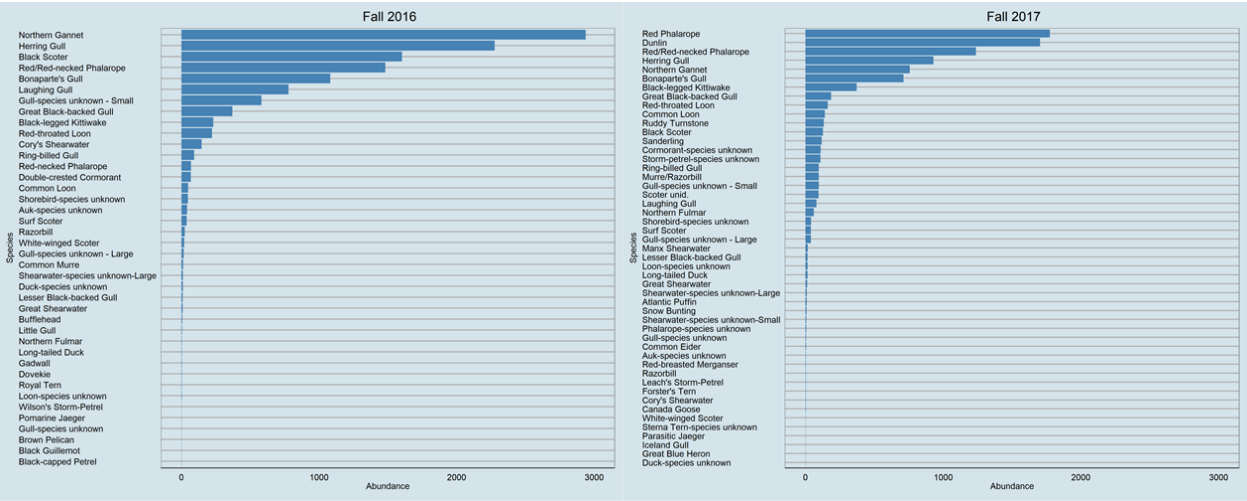

Figure 17. Number of individuals (corrected for effort) for each avian species identified during the Fall 2016 and Fall 2017 surveys across the OPA.

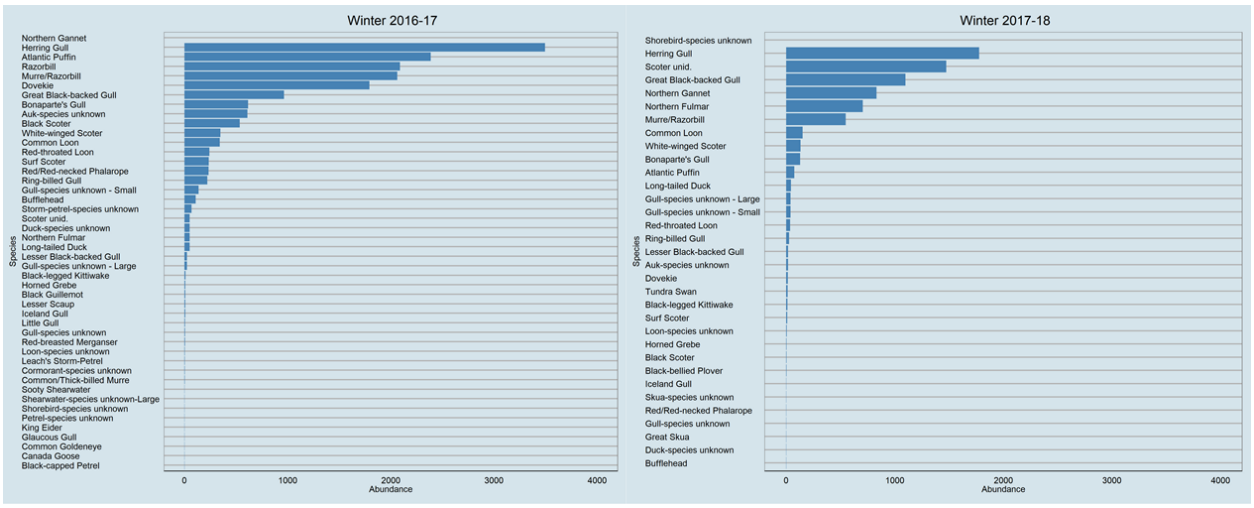

Figure 18. Number of individuals (corrected for effort) for each avian species identified during the Winter 2016–2017 and Winter 2017–2018 surveys across the OPA.

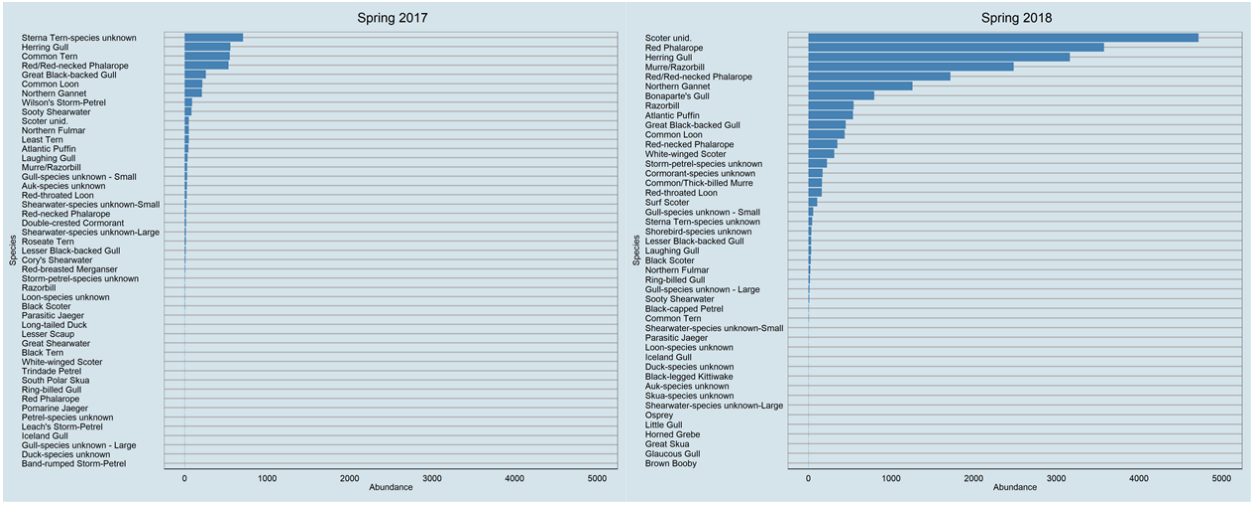

Figure 19. Number of individuals (corrected for effort) for each avian species identified during the Spring 2017 and Spring 2018 surveys across the OPA.

3.5.3. Spatial Distribution

Black-capped petrels and Audubon's shearwaters did not show any substantial differences in distribution among the seasons, but both species clustered near the shelf break and in the northeast corner of the OPA (Figure 20). Sooty shearwaters were found during the Summer surveys primarily in the northeast corner of the OPA and near the shelf break during the Spring surveys (Figure 20). Cory's shearwaters showed a tendency to cluster in the northeast corner of the OPA, with fewer observations in the Fall dispersed along the eastern edge of the OPA and a more southward shift in distribution in the Spring 2017 survey (Figure 21). Great shearwaters were more evenly distributed across the OPA across all surveys, showing no particular preferences (Figure 21) as were northern gannets, although encounters were sparser in the central and eastern areas (Figure 22).

Most gull species tended to show nearshore tendencies in the Spring and Summer surveys, possibly correlated with breeding activity. Herring gulls were found near shore as well as widely distributed during the rest of the seasons and showing some concentrations near the shelf break and in the Hudson Canyon area in the Winter surveys (Figure 23). Laughing gulls and ring-billed gulls tended to be found clustered nearer shore in the Fall surveys, and ring-billed gulls more out towards the shelf break in the Winter surveys. There were no laughing gull observations in the Winter surveys (Figure 24). Black-legged kittiwakes, Bonaparte's gulls and small unidentified gulls were fairly evenly distributed (Figure 24, Figure 25 and Figure 26). Great black-backed gulls were concentrated in the northeast and southeast portions of the OPA during the Fall and Winter surveys, closer to shore during the Summer surveys, and more widely dispersed during the Spring surveys (Figure 27).

Nearshore tendencies for least and royal terns were evident in the Summer and Spring surveys and black terns were more offshore (Figure 28). Other tern including *Sterna* tern species also showed nearshore preferences in the Summer surveys but also occurred throughout the OPA with some roseate terns found past the shelf break (Figure 29, Figure 30).

Sea ducks such as scoter species and long-tailed ducks were recorded primarily during the Fall and Winter surveys. With few exceptions, most observations were found nearshore (Figure 31).

Loons were mainly recorded during the Fall, Winter, and Spring while being almost entirely absent during the Summer. Although loons showed some preference for nearshore areas, many observations were distributed across a wide bathymetric gradient in the southern and western OPA (Figure 32, Figure 33).

Phalaropes were found in all seasons although they were rarely found in the Summer and only recorded during the Summer 2017 survey. In general, they were found beyond the 60-m isobath (Figure 34).

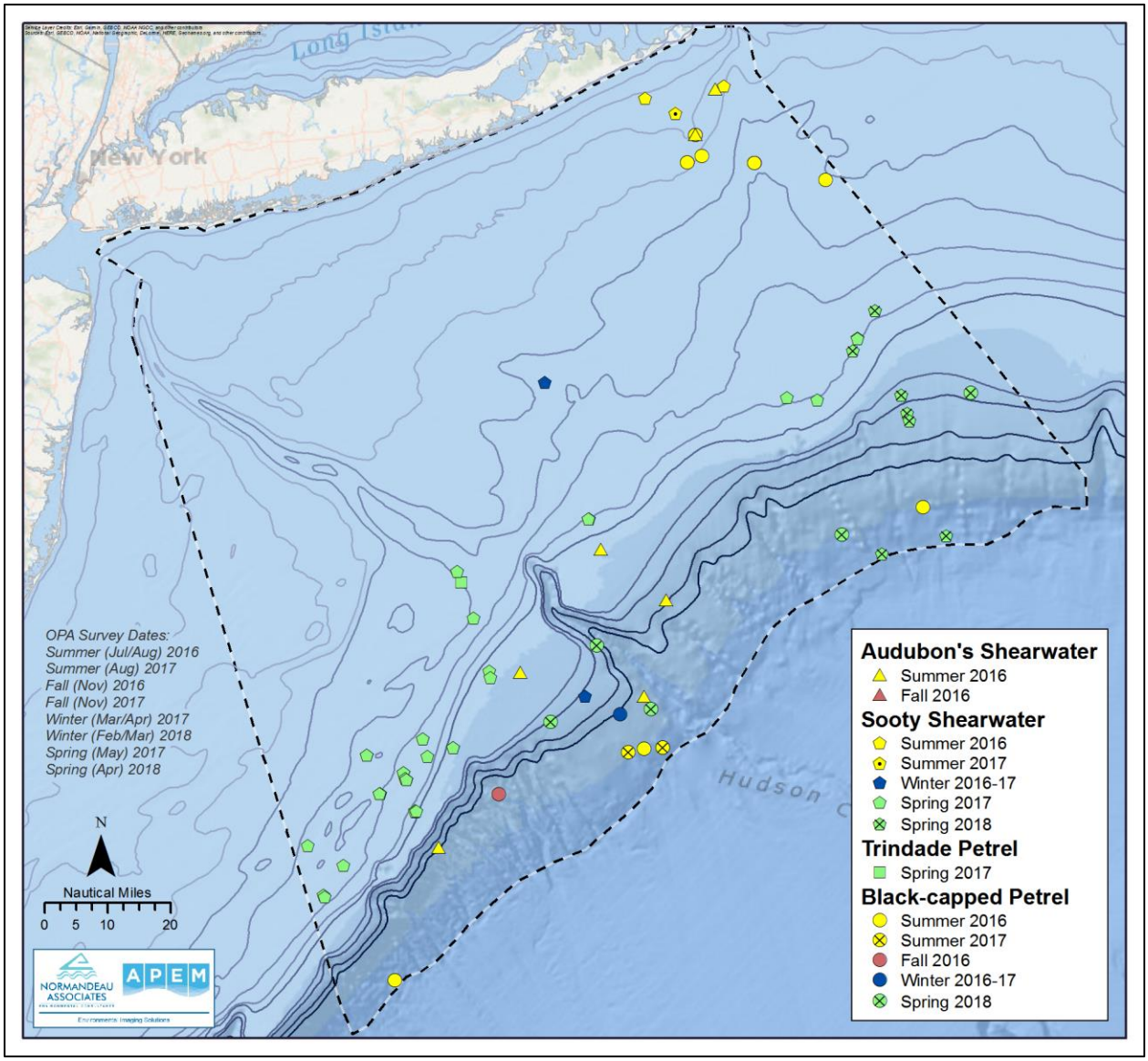

Figure 20. Distribution of Audubon's shearwater, sooty shearwater, Trindade petrel, and black-capped petrel during the Summer 2016–Spring 2018 surveys.

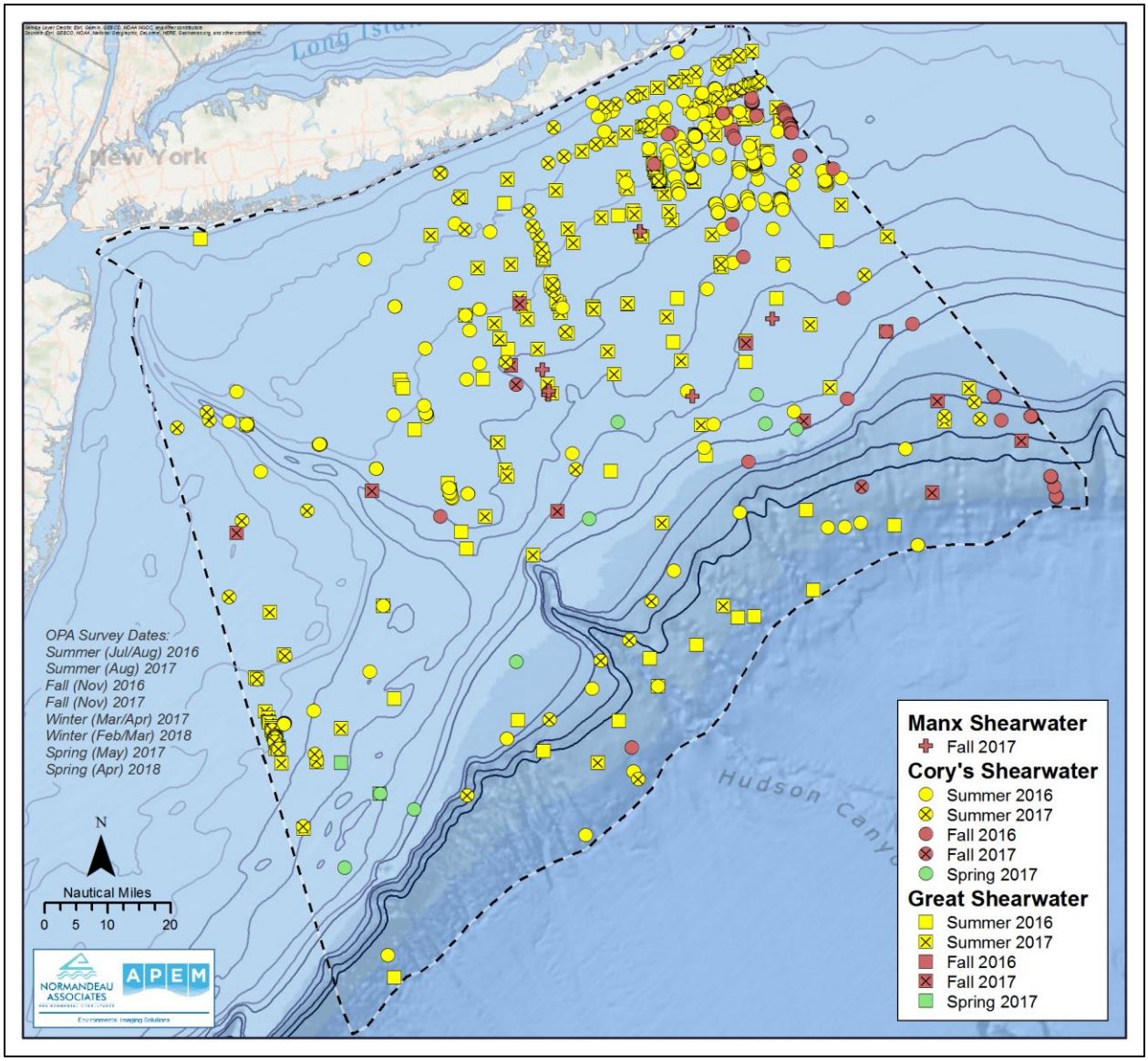

Figure 21. Distribution of manx, Cory's, and great shearwaters during the Summer 2016–Spring 2018 surveys.

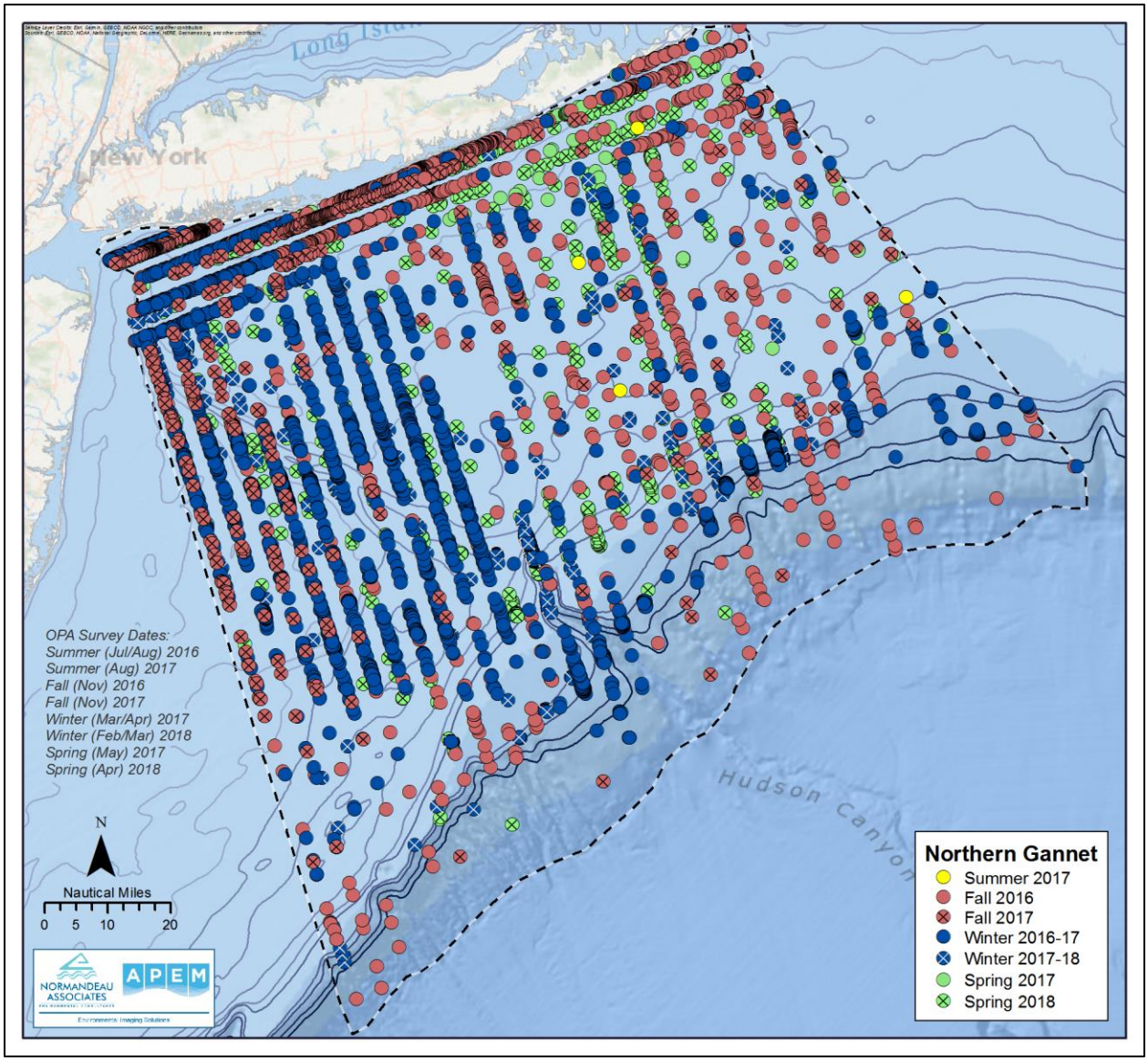

Figure 22. Distribution of northern gannet during the Summer 2016–Spring 2018 surveys.

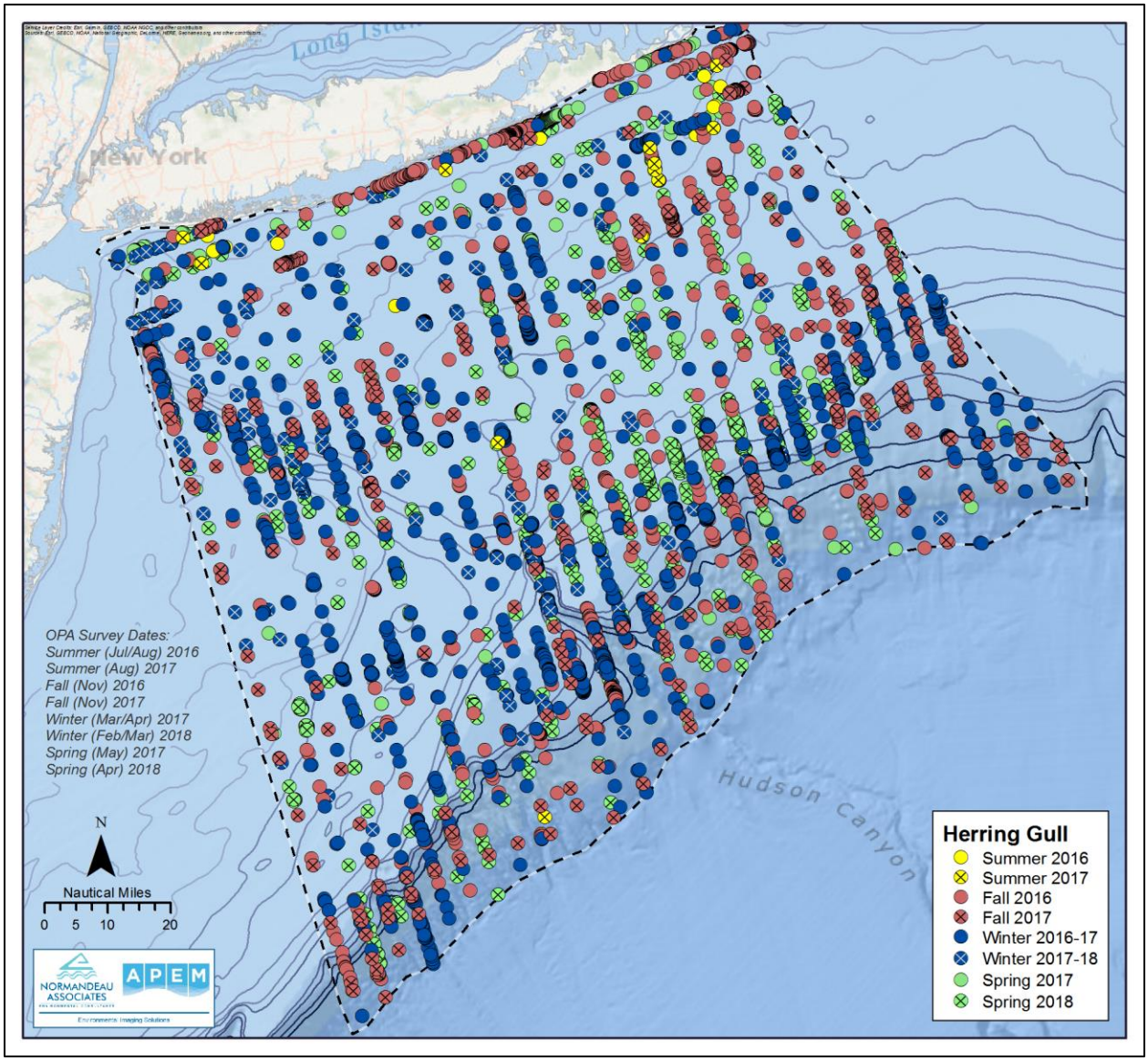

Figure 23. Distribution of herring gulls during the Summer 2016–Spring 2018 surveys.

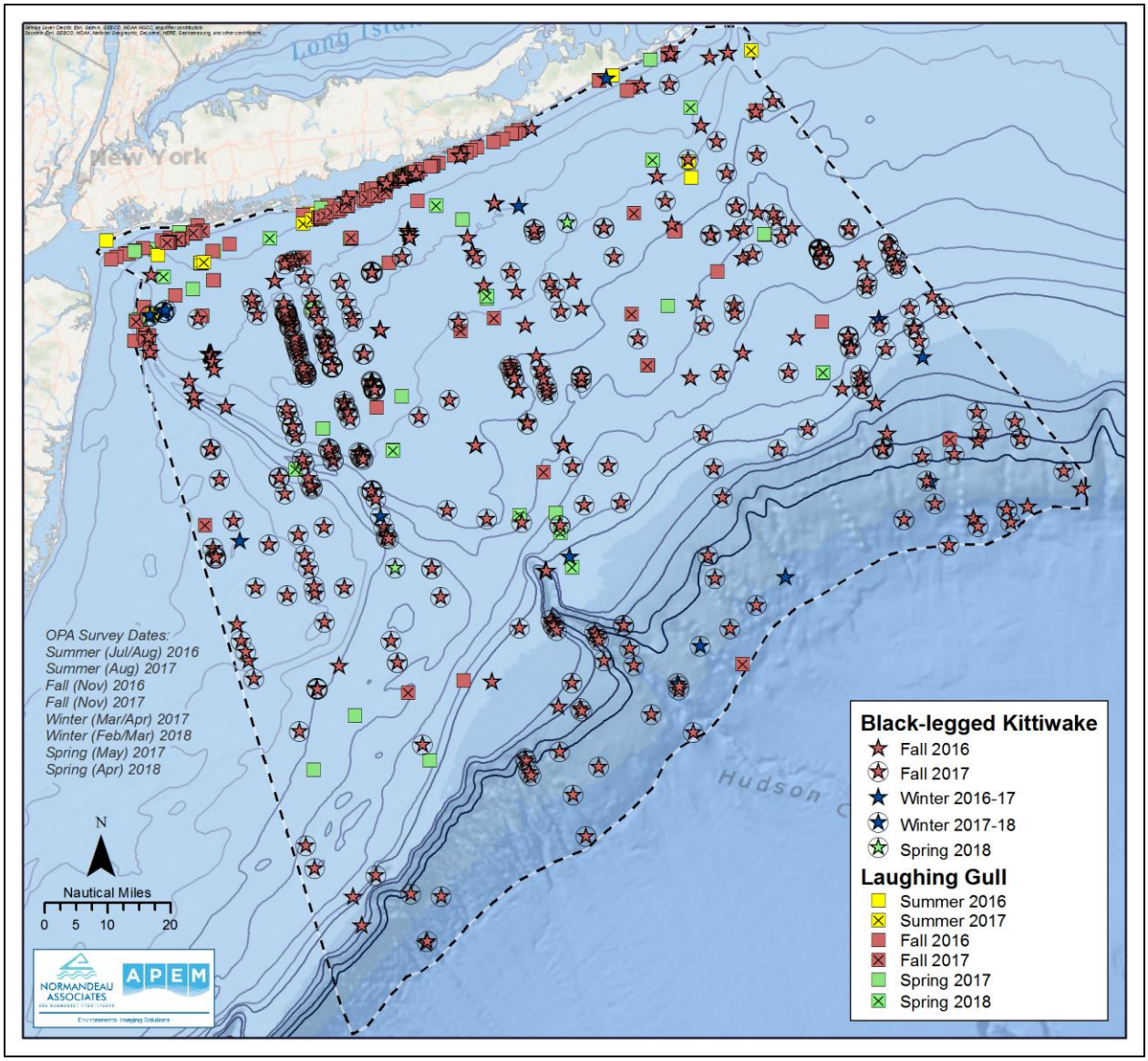

Figure 24. Distribution of black-legged kittwake and laughing gulls during the Summer 2016–Spring 2018 surveys.

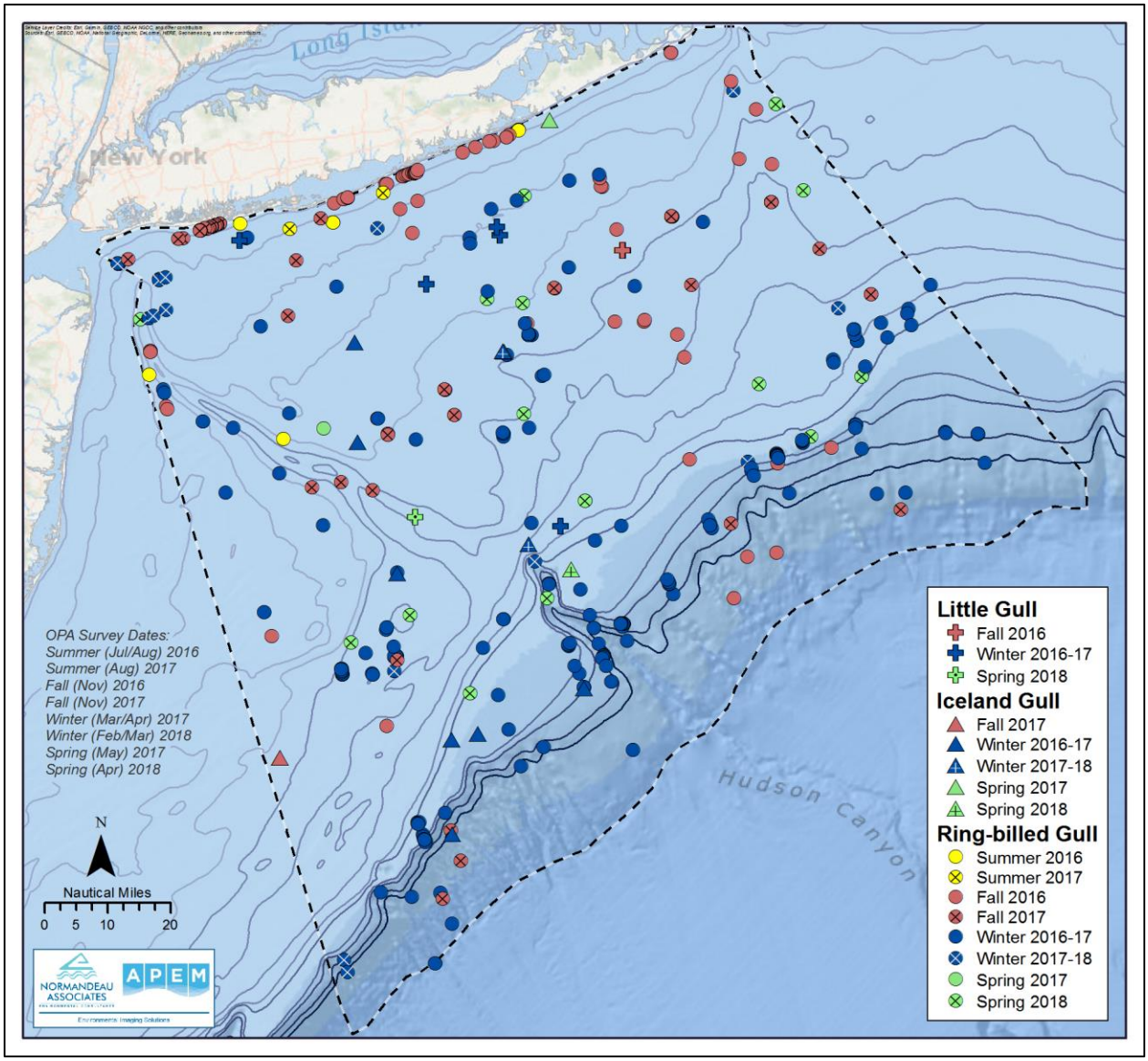

Figure 25. Distribution of little, Iceland, and ring-billed gulls during the Summer 2016–Spring 2018 surveys.

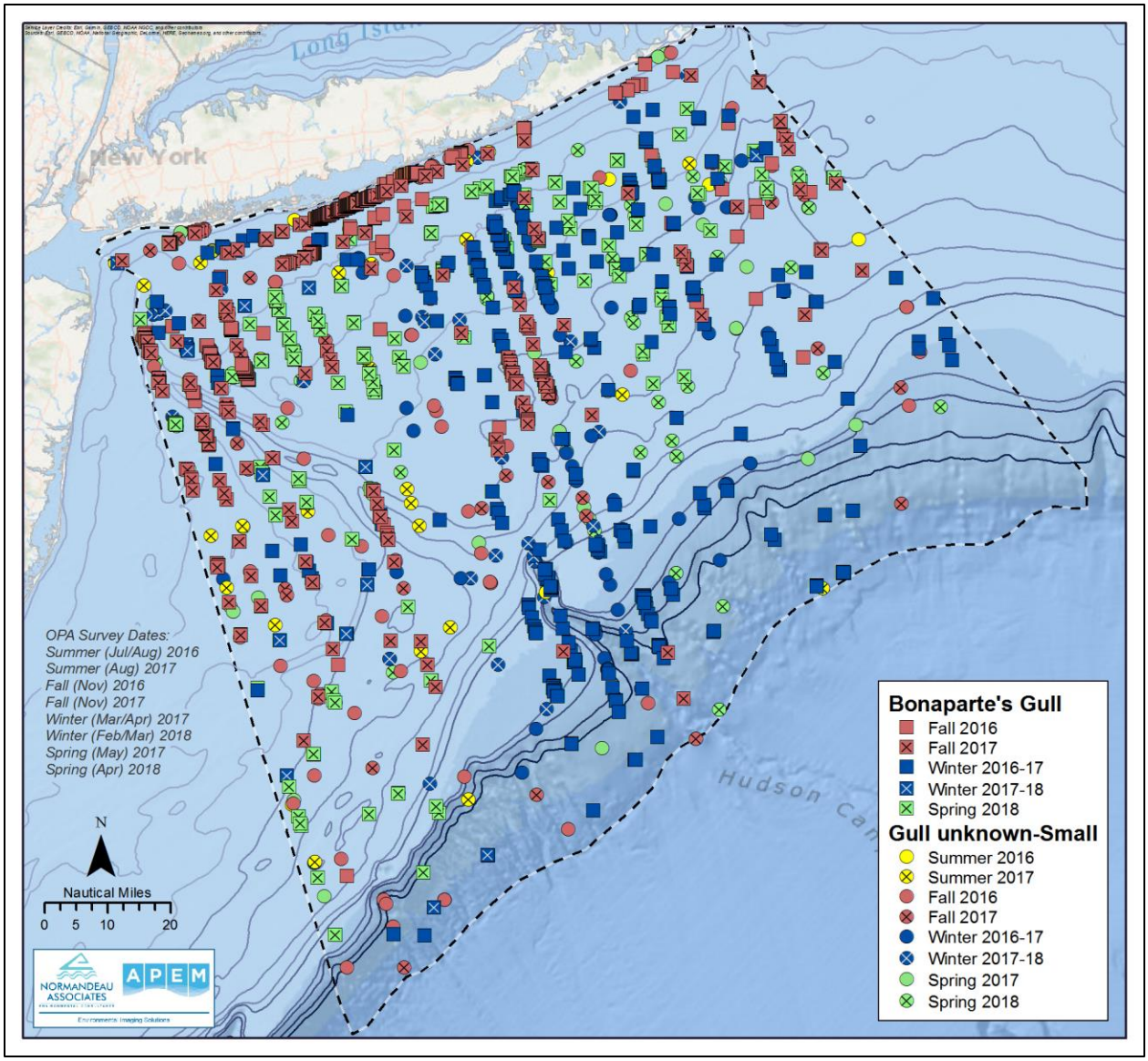

Figure 26. Distribution of Bonaparte's gull and small, unknown species of gull during the Summer 2016–Spring 2018 surveys.

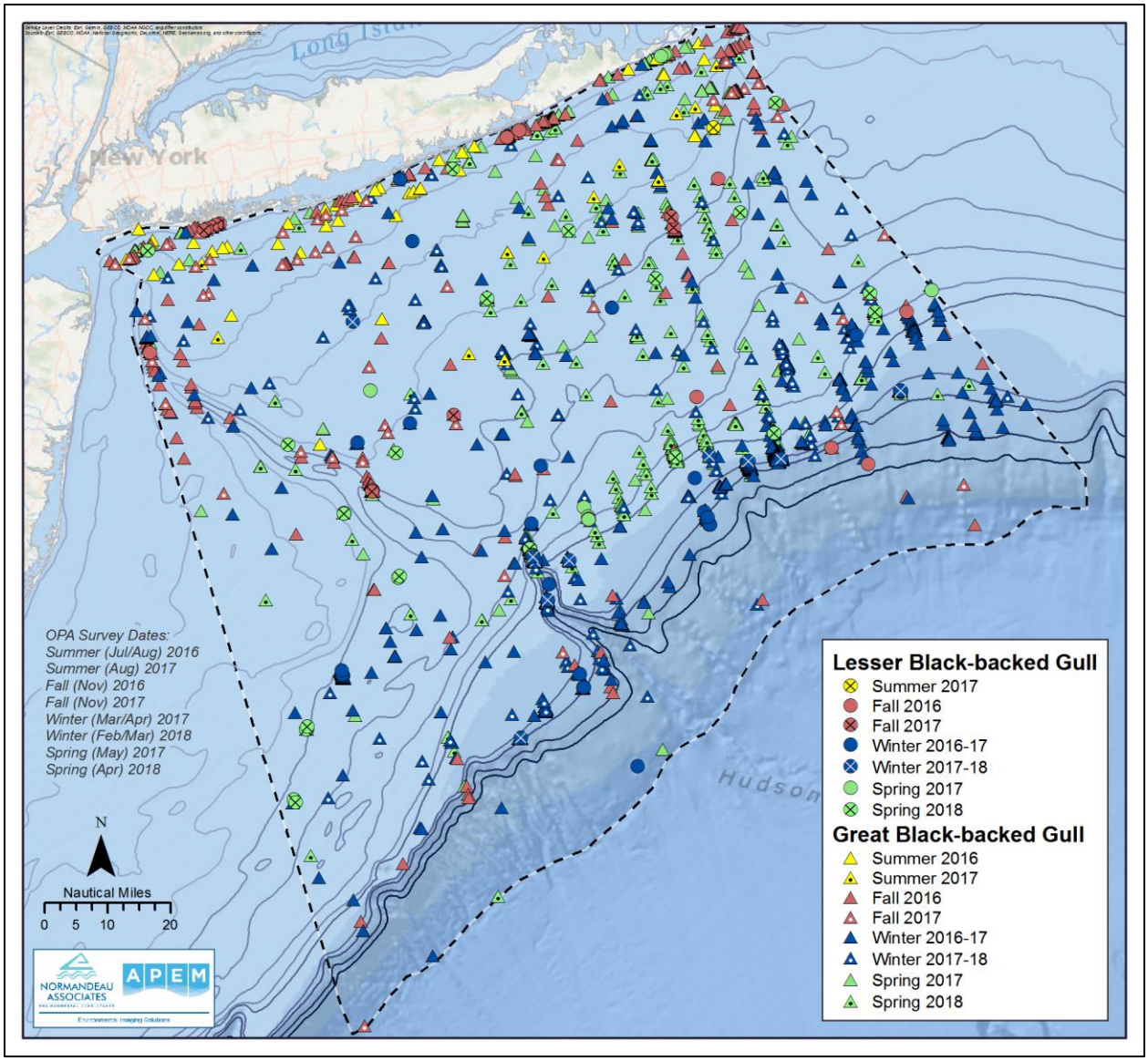

Figure 27. Distribution of lesser black-backed and great black-backed gulls during the Summer 2016–Spring 2018 surveys.

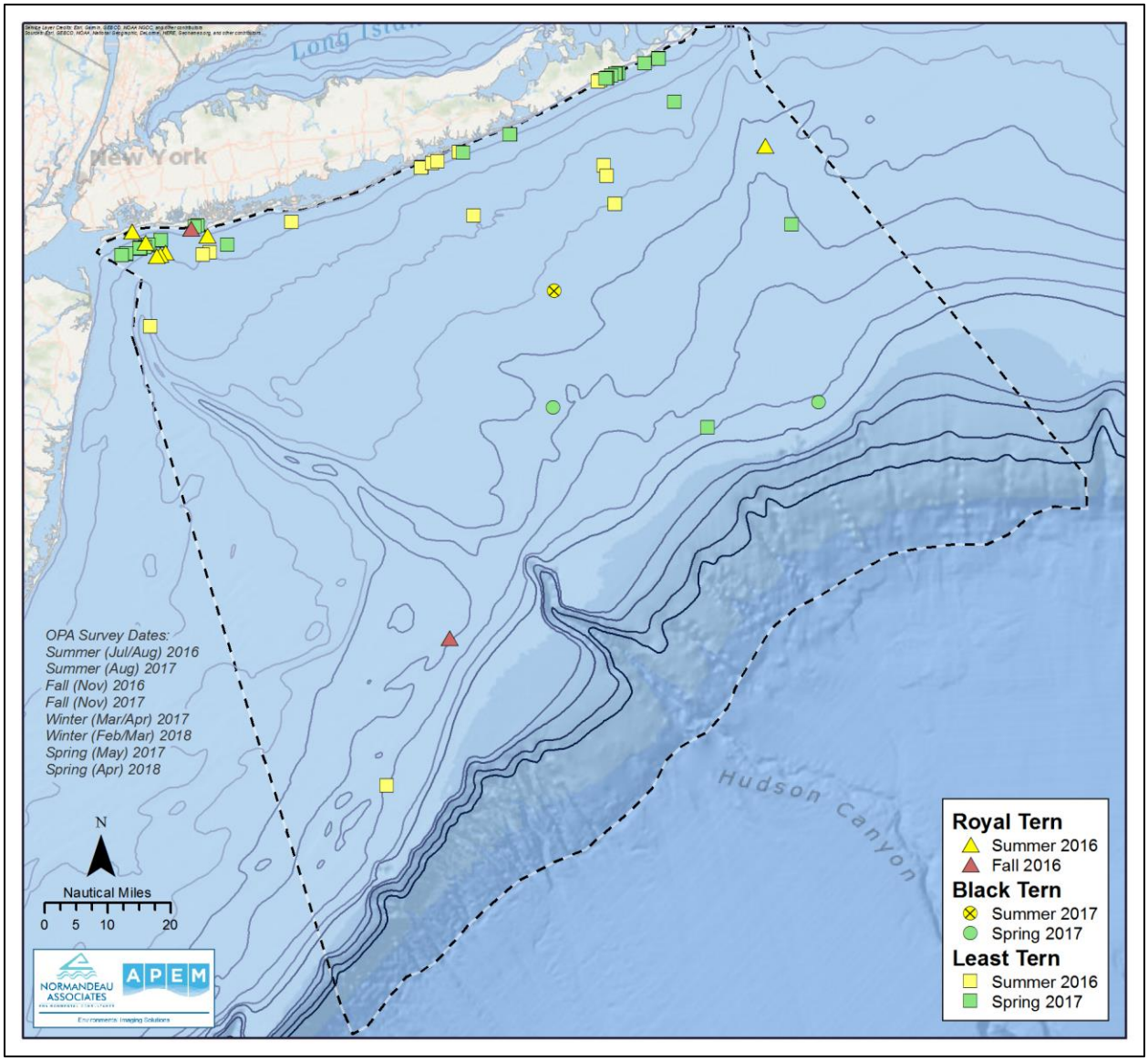

Figure 28. Distribution of royal, black, and least terns during the Summer 2016–Spring 2018 surveys.

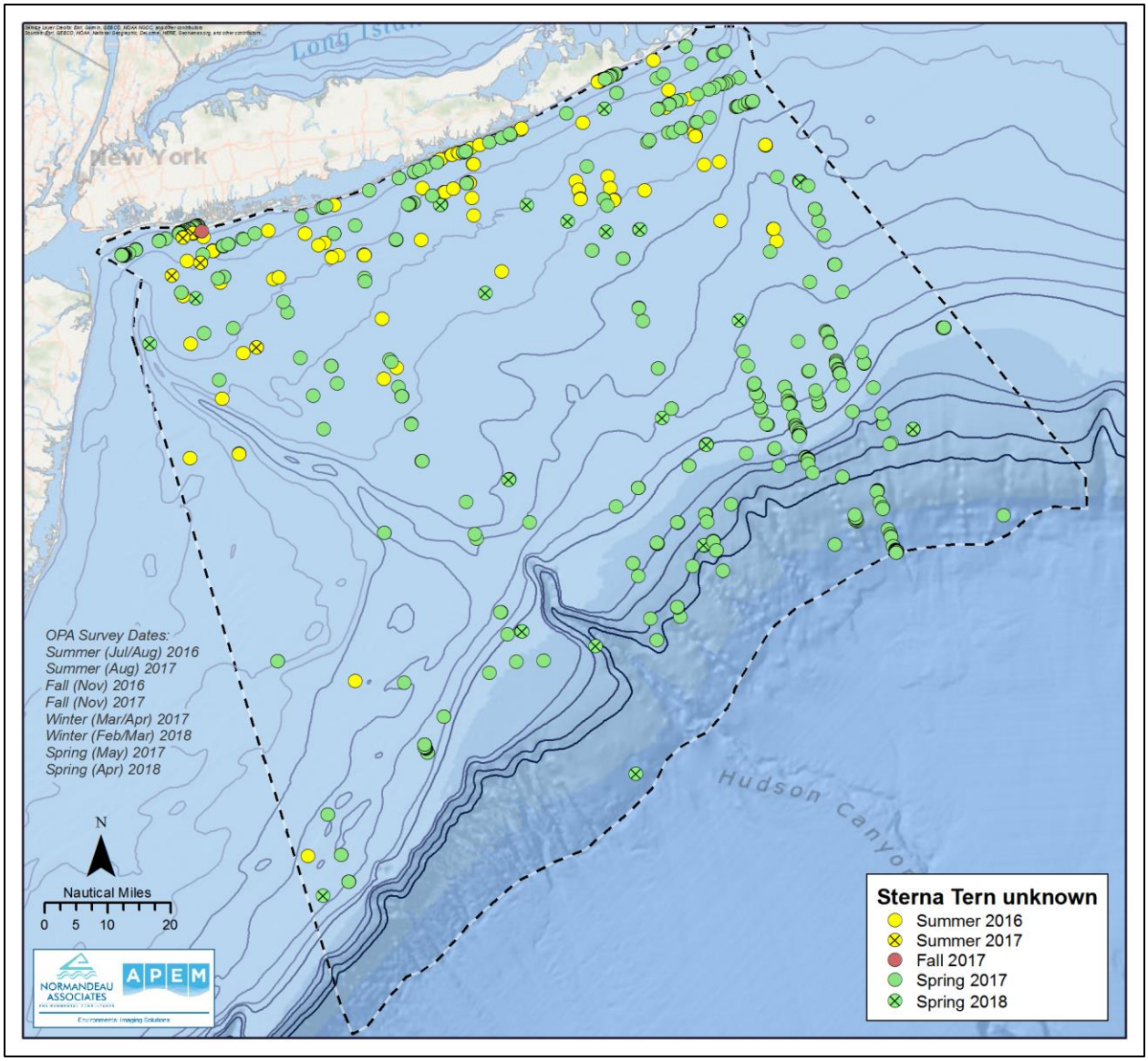

Figure 29. Distribution of unknown *Sterna* tern species during the Summer 2016–Spring 2018 surveys.

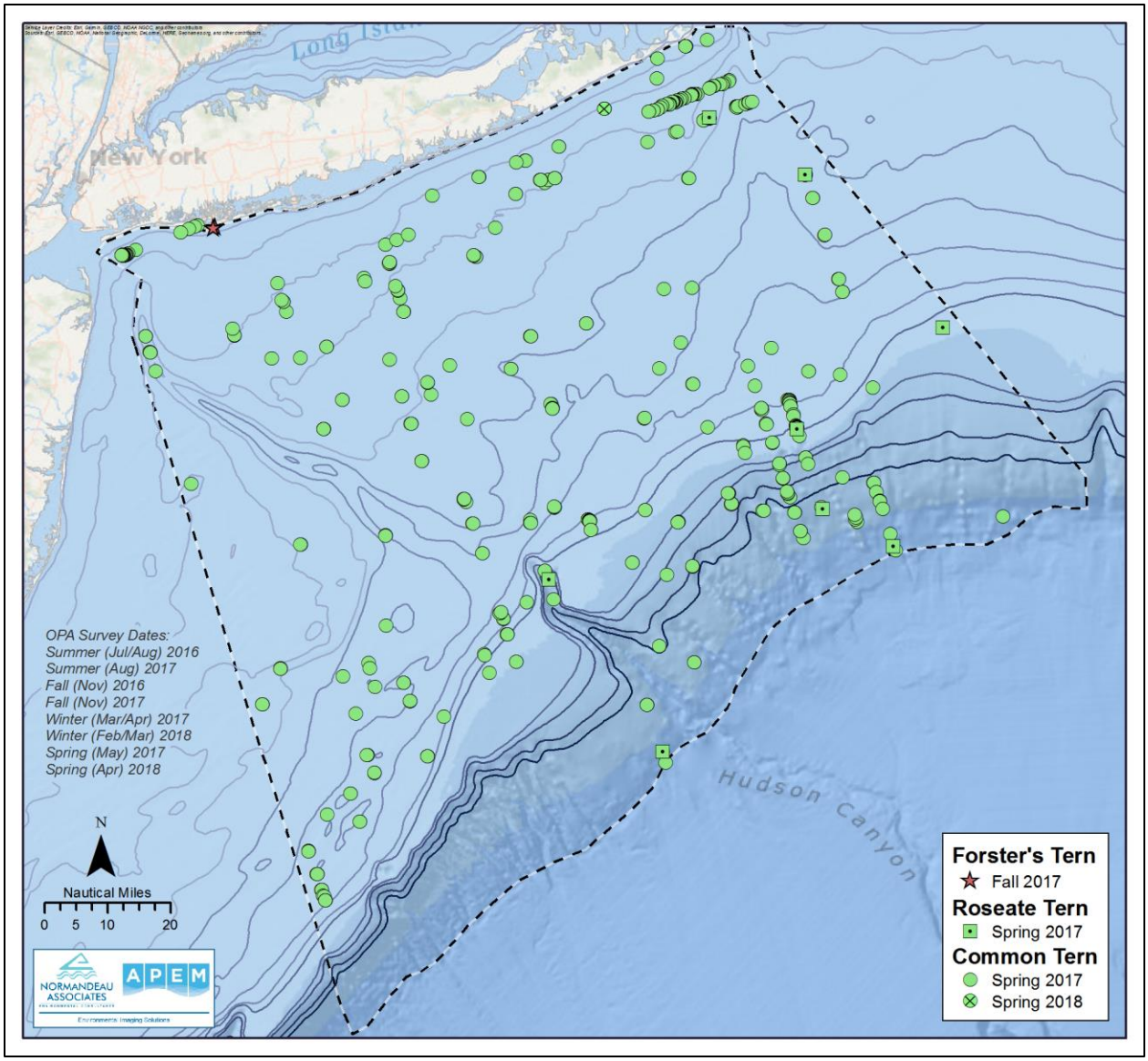

Figure 30. Distribution of Forster's, roseate, and common terns during the Summer 2016–Spring 2018 surveys.

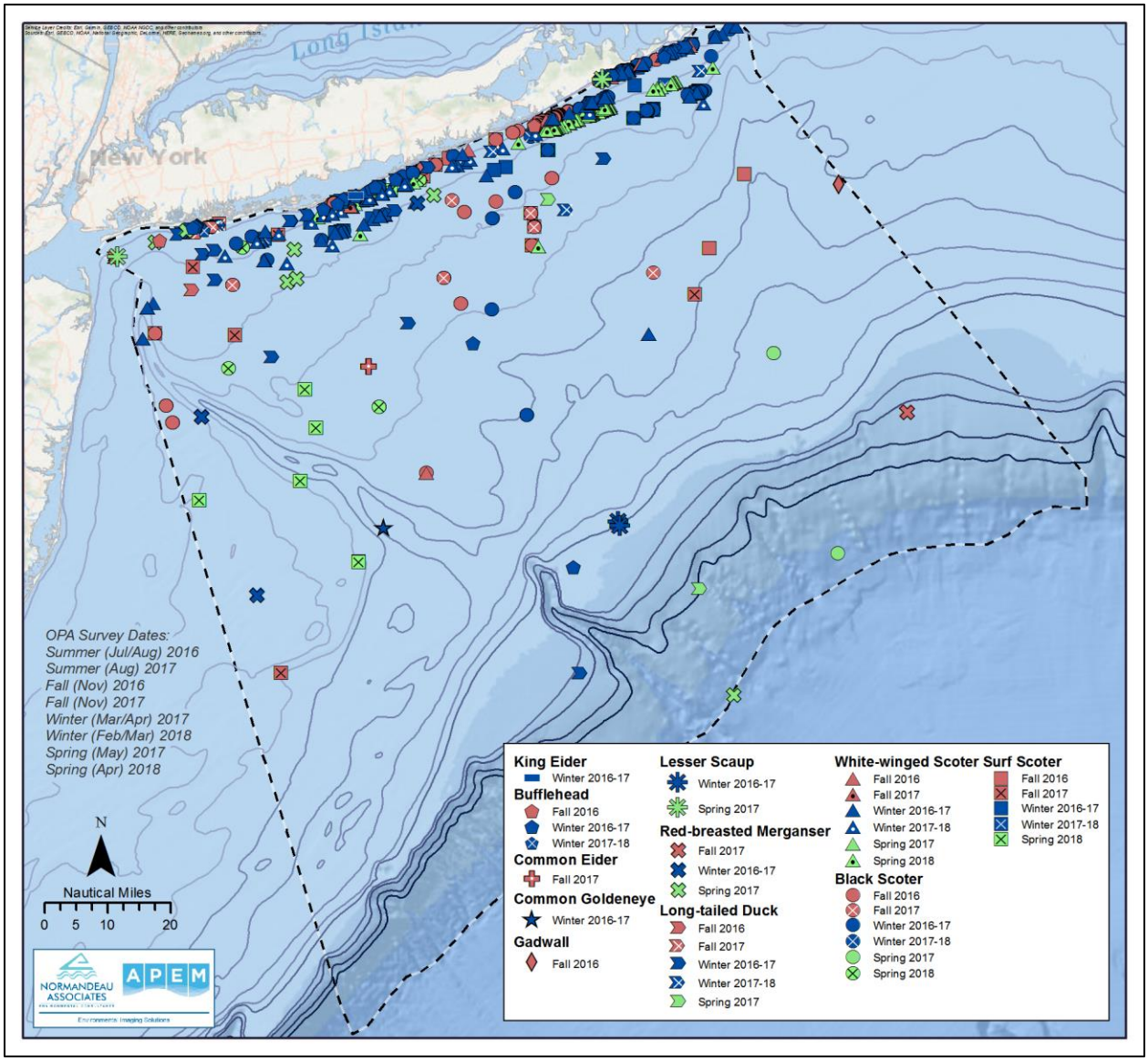

Figure 31. Distribution of sea ducks during the Summer 2016–Spring 2018 surveys.

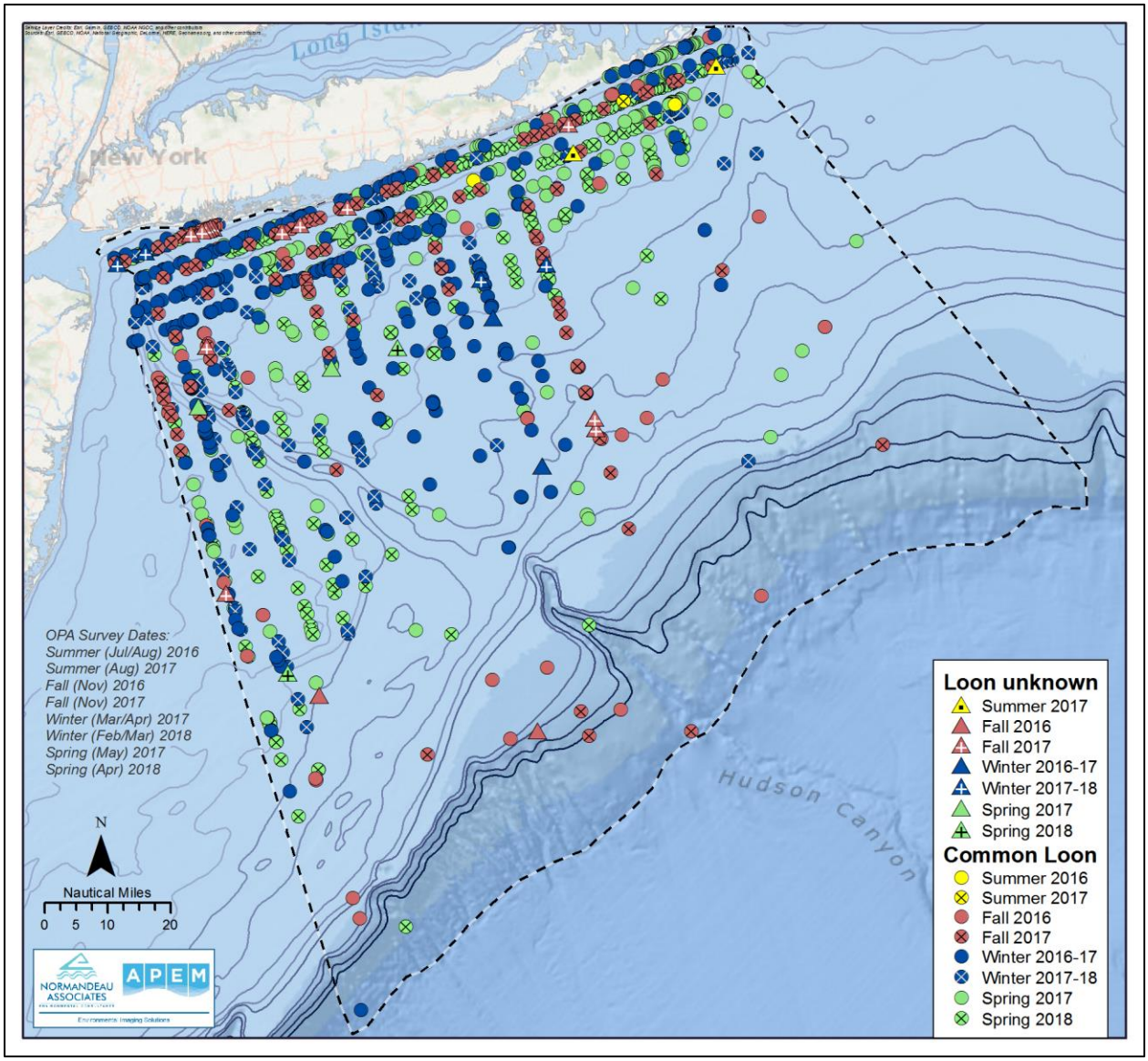

Figure 32. Distribution of common and unidentified loons during the Summer 2016–Spring 2018 surveys.

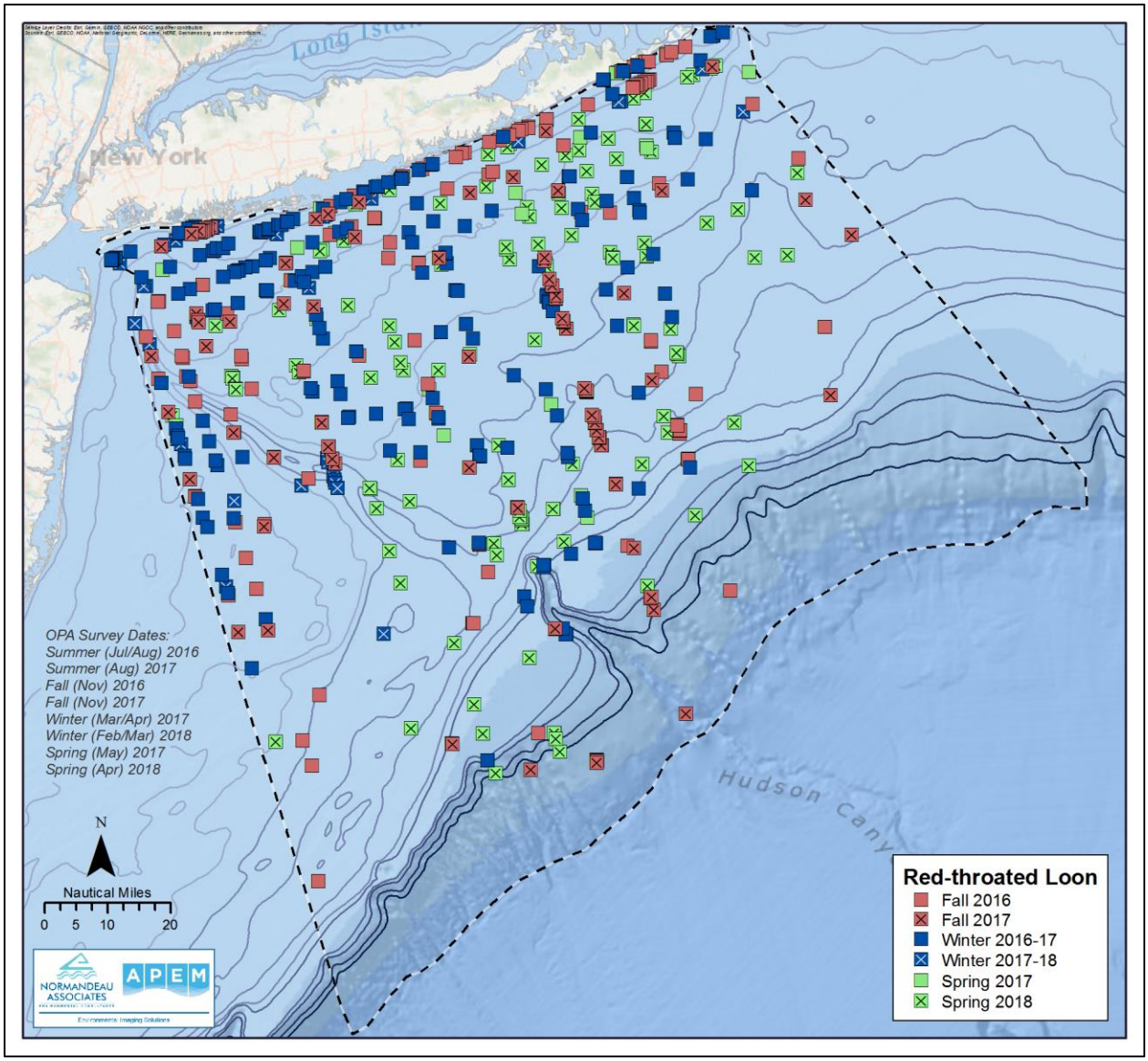

Figure 33. Distribution of red-throated loons during the Summer 2016–Spring 2018 surveys.

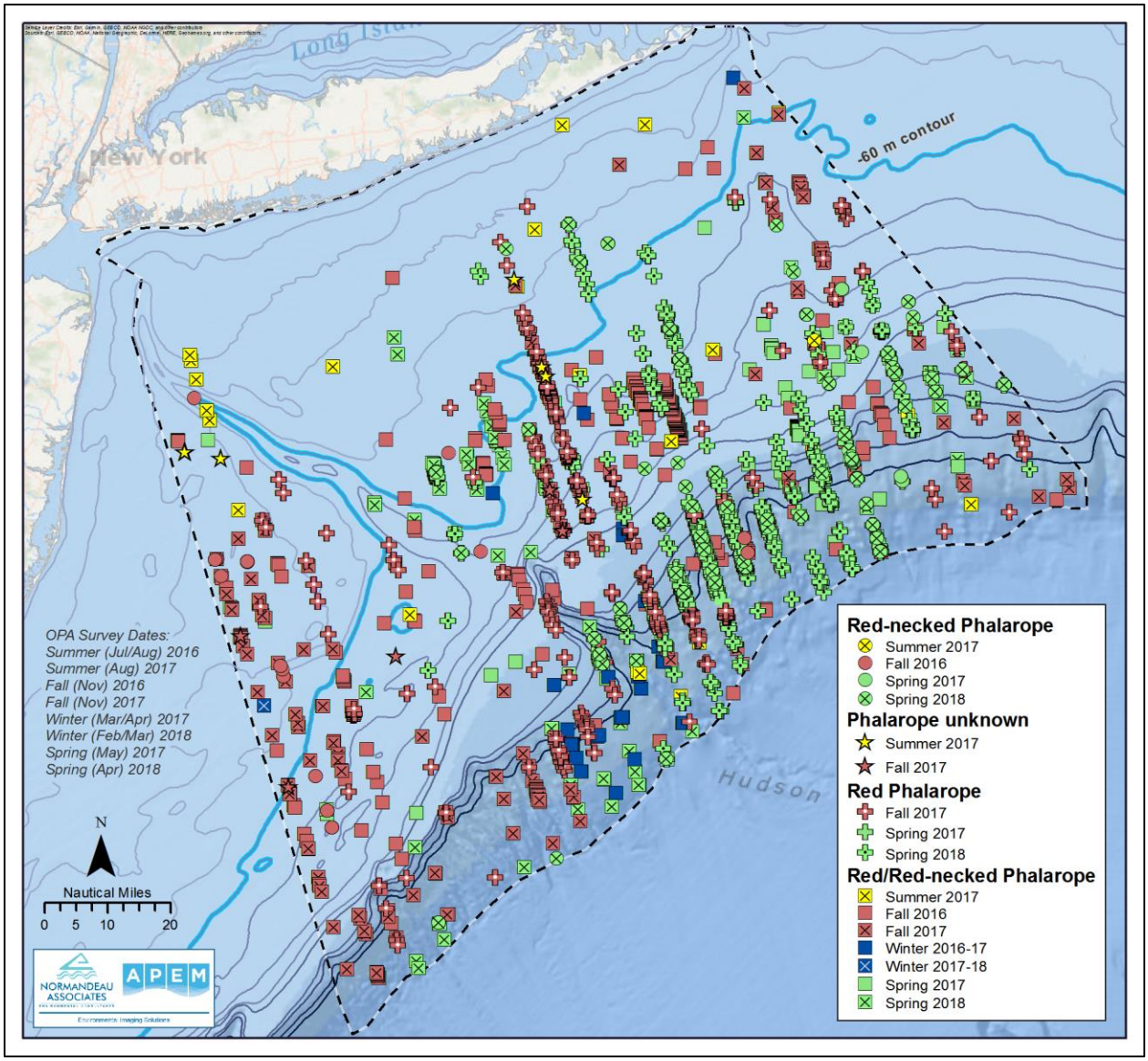

Figure 34. Distribution of phalaropes during the Summer 2016–Spring 2018 surveys.

3.5.4. Direction of Travel

Overall, the predominant directions for most avian groups were towards the WNW and ESE in the seasons where individuals were observed in flight. The discussion of species groups that follows is limited to those with sufficient sample sizes ($n \geq 10$ in one or more seasons) observed in flight. Auk flight direction was primarily west-to-east and east-to-west during Winter, and ENE in Spring 2018, with few observations in flight during other seasons. Calculated flight heights were largely below the RSZ (Figure 35). Cormorant flight direction was predominately WSW at a flight altitude below the rotor sweep area; although, in the Fall 2016 survey it was WNW and in Spring 2018 it was mostly N, and again where calculated, most individuals were flying <50 m (Figure 36). Duck travel direction primarily followed a south-to-north trend with most individuals flying at altitudes <50 m in the Fall 2016 survey, westerly directions in the Fall 2017 survey, and NNE in the Spring 2018 survey; where calculated, most flight

heights were <50 m (Figure 37). Fulmar travel directions were primarily west-to-east and east-to-west and occurred with a variety of flight heights in the Fall 2017 and Winter 2016–2017 surveys, and tended more to the SE, S and SSW at <50 m in the Winter 2017–2018 survey (Figure 38). Gannets had similar directional patterns primarily west-to-east and east-to-west at a variety of flight heights during the Fall and Winter surveys, but showed no preference in the Spring 2018 survey (Figure 39). Gull flight direction was predominately in a WNW directions with most individuals flying <50 m; again, little preference was shown in the Spring 2018 survey (Figure 40). Loon flight direction was primarily in westerly directions in the Fall, with flight heights tending to be higher in the Fall 2016 survey than in the Fall 2017 survey; direction and altitude was more variable in the Winter 2016–2017 and Spring 2018 surveys (Figure 41). Phalarope flight direction was strongly toward the WNW during the Fall 2016 survey and the Winter and Spring surveys, but showed more variability in the Fall 2017 and Spring 2018 surveys, tending more N, NNE, NE, and NW with more flights at altitudes of <50 m (Figure 42). Shearwater flight direction was predominately WNW and ESE in most of the surveys with flight heights <50 m (Figure 43). *Sterna* tern flight direction and flight height was highly variable and showed no consistent pattern within or among seasons (Figure 44); although, Spring did show a more northerly tendency for terns other than *Sterna* terns Figure 45). Storm-petrel flight direction followed an east-to-west and west-to-east trend in the seasons where flight direction data were available (Figure 46).

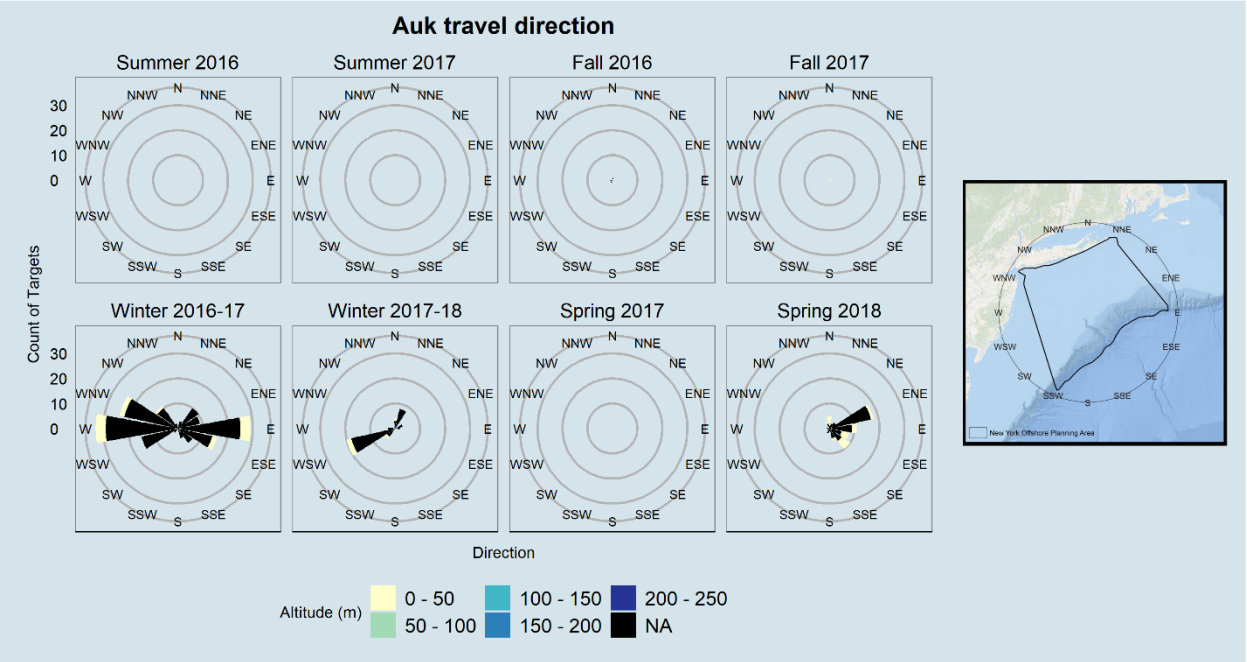

Figure 35. Flight height and direction of travel for auks observed during the Summer 2016–Spring 2018 surveys.

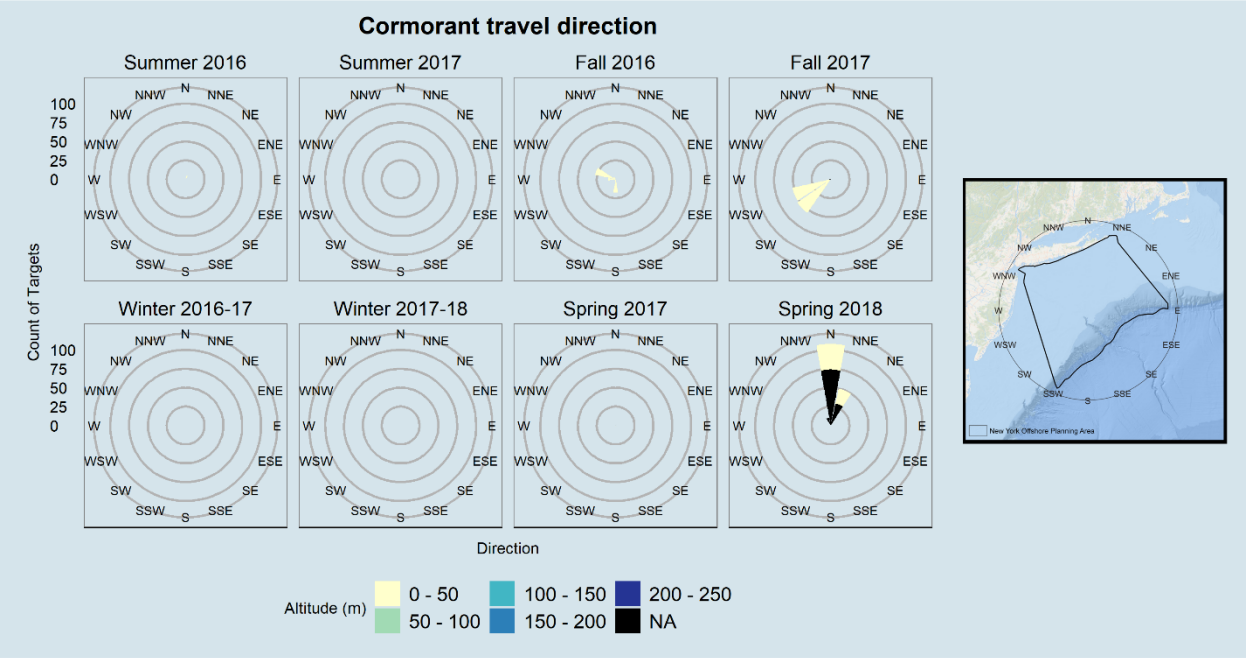

Figure 36. Flight height and direction of travel for cormorants observed during the Summer 2016–Spring 2018 surveys.

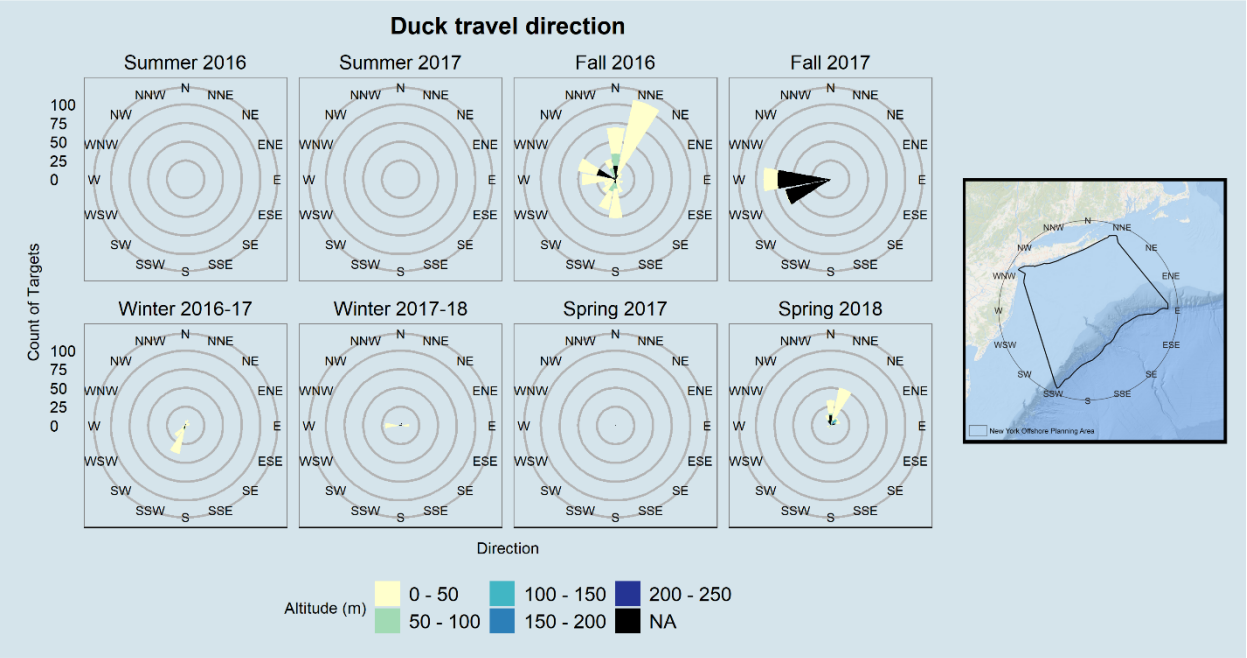

Figure 37. Flight height and direction of travel for ducks observed during the Summer 2016–Spring 2018 surveys.

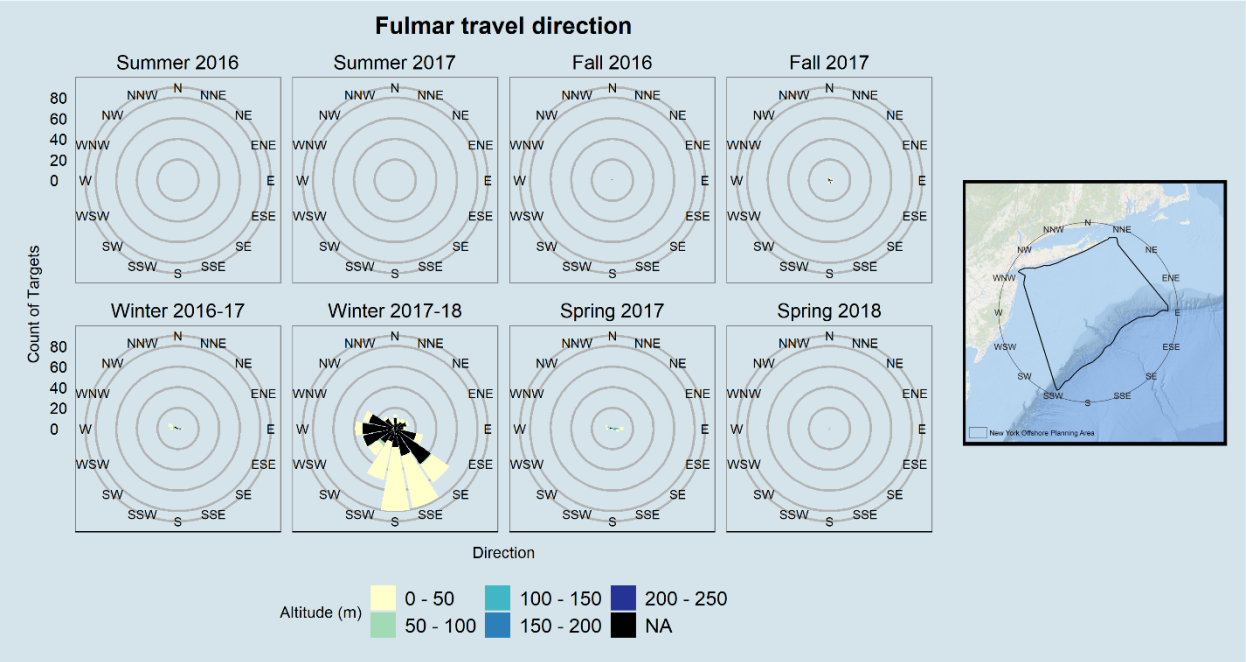

Figure 38. Flight height and direction of travel for fulmars observed during the Summer 2016–Spring 2018 surveys.

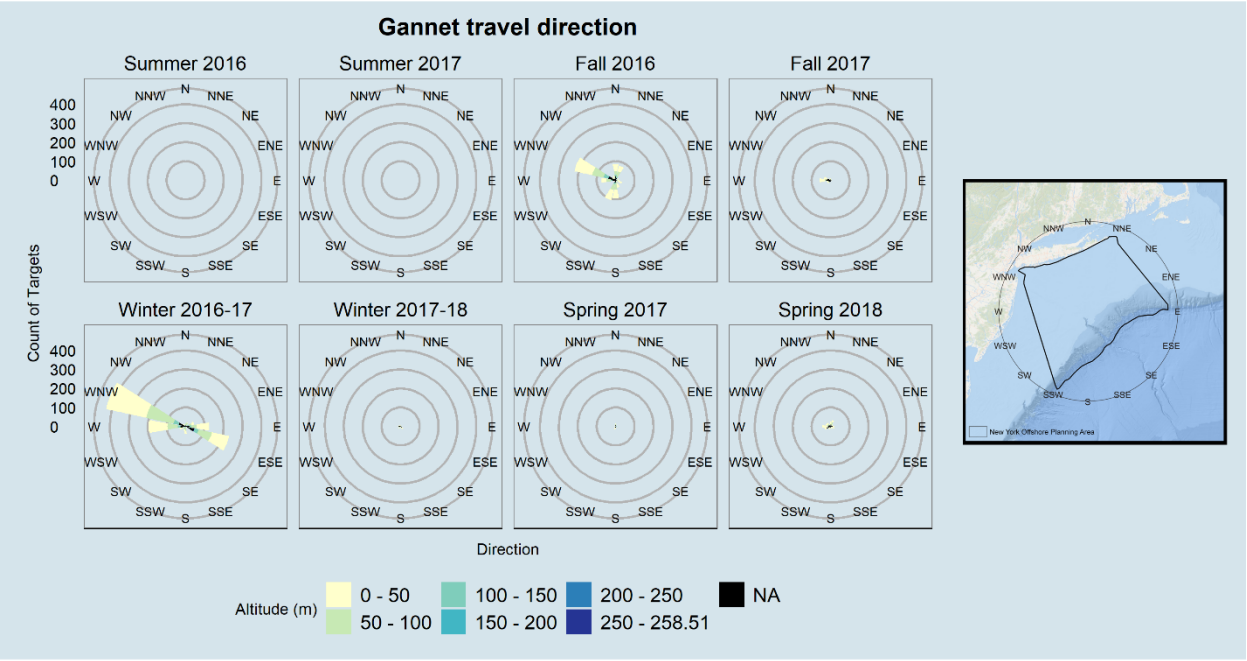

Figure 39. Flight height and direction of travel for gannets observed during the Summer 2016–Spring 2018 surveys.

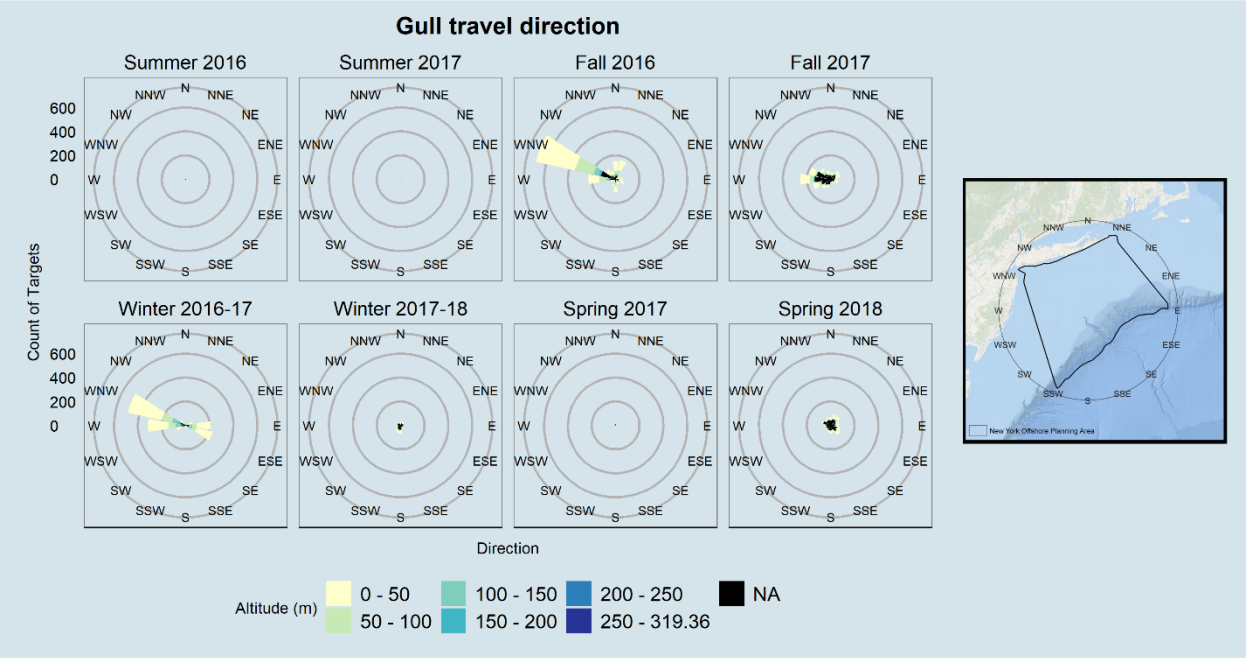

Figure 40. Flight height and direction of travel for gulls observed during the Summer 2016–Spring 2018 surveys.

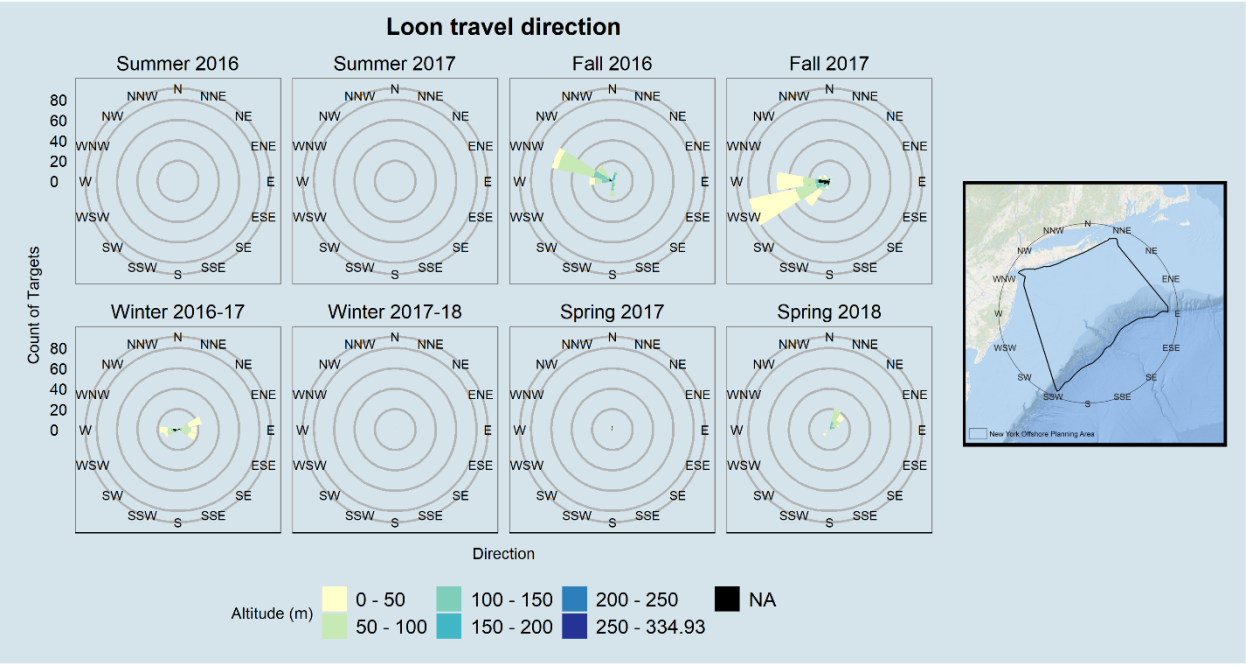

Figure 41. Flight height and direction of travel for loons observed during the Summer 2016–Spring 2018 surveys.

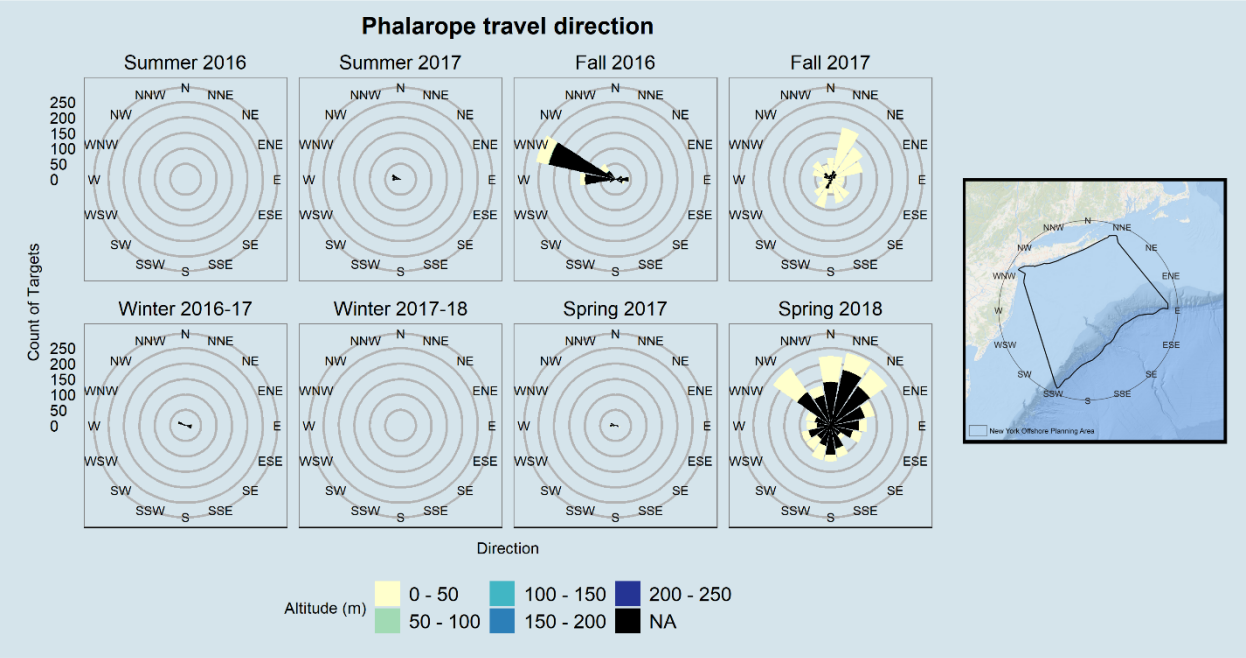

Figure 42. Flight height and direction of travel for phalaropes observed during the Summer 2016–Spring 2018 surveys.

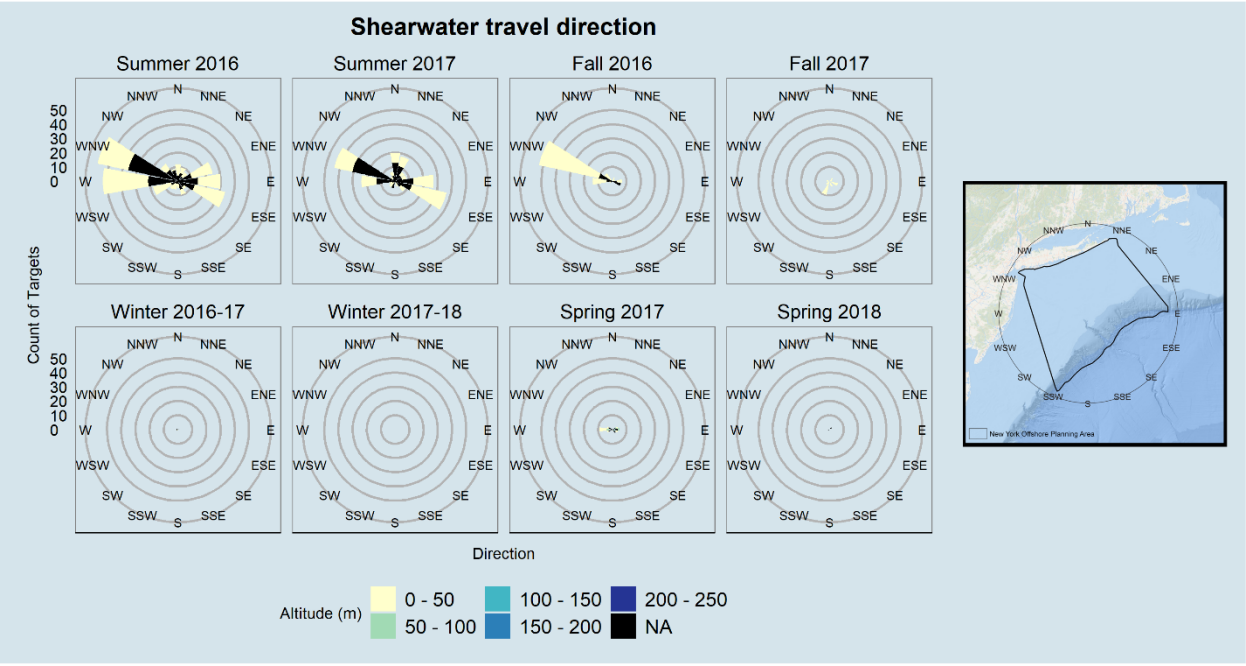

Figure 43. Flight height and direction of travel for shearwaters observed during the Summer 2016–Spring 2018 surveys.

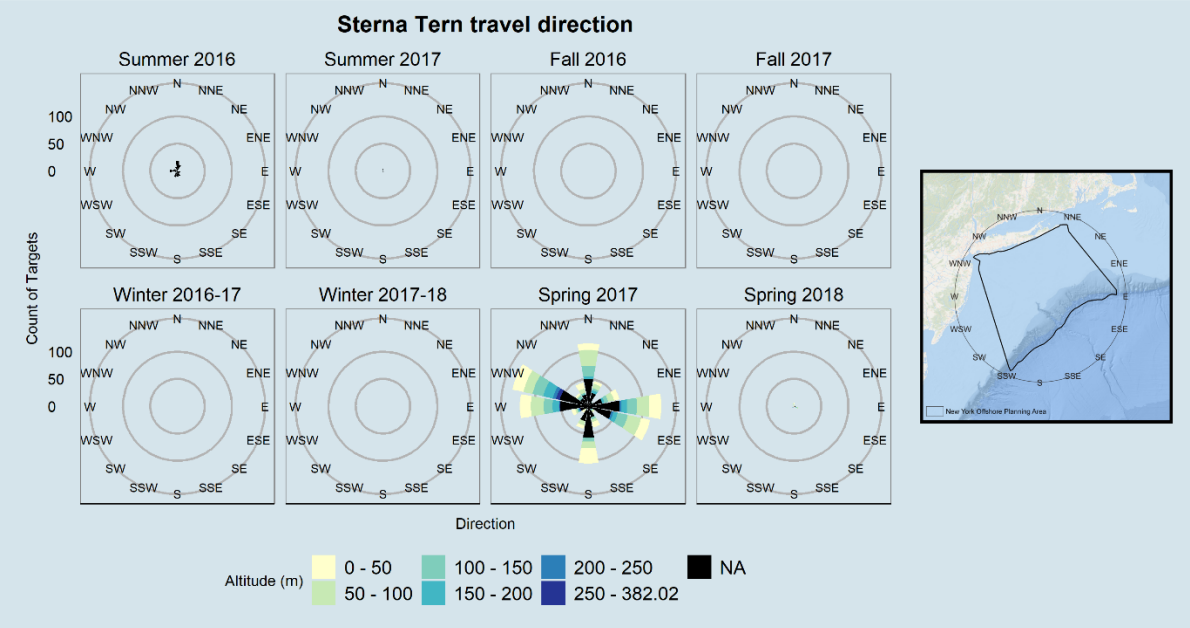

Figure 44. Flight height and direction of travel for *Sterna* terns observed during the Summer 2016–Spring 2018 surveys.

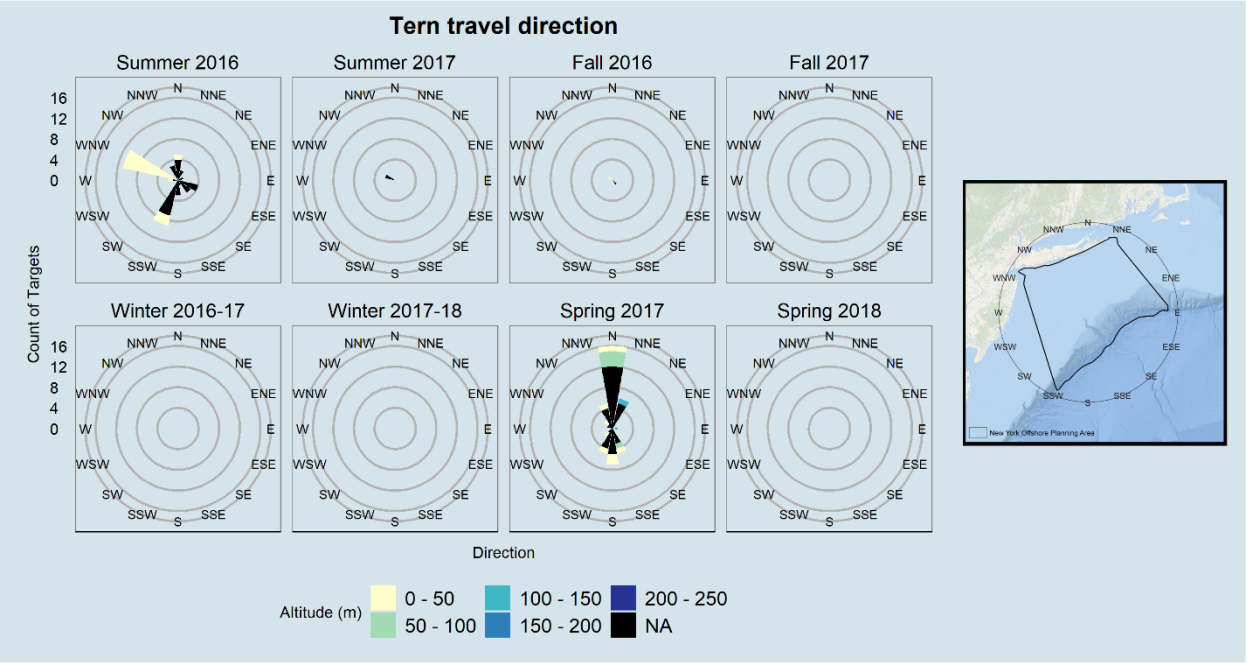

Figure 45. Flight height and direction of travel for terns observed during the Summer 2016–Spring 2018 surveys.

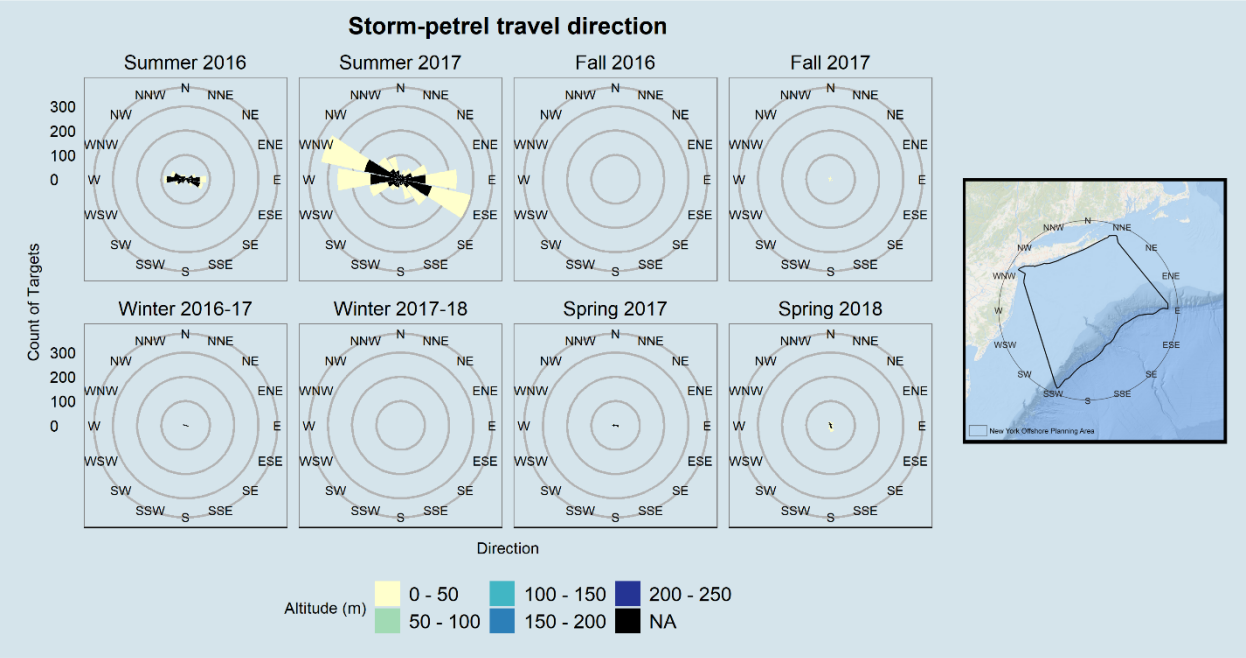

Figure 46. Flight height and direction of travel for storm-petrels observed during the Summer 2016–Spring 2018 surveys.

3.5.5. Flight Height

All bird observations in the Summer 2016 through Spring 2018 surveys were classified as sitting or flying, and species with known flight heights were classified as outside or within the RSZ (25–195 m) (Appendix C). All raw flight heights with associated error margin are presented in Appendix D. Of all birds observed in the OPA, 73% were observed sitting, 6% were flying within the RSZ, 9% were flying above or below the RSZ, and 12% had an unknown flight height (Table 14). Unknown flight heights can occur when bird species' identification, size, or wingspan cannot be determined; a lack of these data limits the ability to estimate flight height.

Within species groups there were no significant differences when considering standard deviation in mean flight height by season for gannets, gulls, loons, and phalaropes (Table 15). Both shearwater and duck average flight heights differed among seasons with shearwater flight height averaging over 30 m in Spring 2017 but <10 m during the other seasons (Figure 47). Duck flight height was significantly higher in Spring 2018 and Fall 2016 than in Fall 2017 and the Winter surveys (Table 15, Figure 48).

In the Summer 2016 survey, 33% of birds were observed sitting, 2% were flying within the RSZ, 20% were flying above or below the RSZ, and 45% had an unknown flight height (Table 14, Appendix C). Unknown flight heights largely comprised of select Wilson's storm-petrels (Appendix C). Of the individuals where flight height was calculable, gulls as a species group were observed flying the highest with an average flight height of 55 m (Table 15, Appendix C).

In the Summer 2017 survey, 19% of birds were observed sitting, 2% were flying within the RSZ, 20% were flying above or below the RSZ, and 45% had an unknown flight height (Table 14, Appendix C). Unknown flight heights largely comprised of storm-petrels (Appendix C). Of the individuals where flight

height was calculable, shorebirds and gulls were observed flying the highest with an average flight height falling within the RSZ of 80.6 m and 31.5 m, respectively (Table 15, Appendix C).

In the Fall 2016 survey, 66% of birds observed were sitting, 15% were flying within the RSZ, 10% were flying above or below the RSZ, and 9% had an unknown flight height (Table 14, Appendix C). Unknown flight heights were largely comprised of northern gannet, red/red-necked phalaropes, and herring gulls observed in flight (Appendix C). Of the individuals where flight height was calculable, loons and skuas as species groups were observed flying the highest with an average flight height of 97 m and 86 m, respectively (Table 15).

In the Fall 2017 survey, 62% of birds observed were sitting, 6.6% were flying within the RSZ, 17% were flying above or below the RSZ, and 14% had an unknown flight height (Table 14, Appendix C). Unknown flight heights were largely comprised of gulls, phalaropes, scoters, and northern gannet (Appendix C). Of the individuals where flight height was calculable, gulls, loons, and skuas were observed flying the highest with an average flight height of 48.8 m, 47.4 m, and 44.4 m, respectively (Table 15).

In the Winter 2016–2017 survey, 84% of birds were observed sitting, 8% were flying within the RSZ, 5% were flying above or below the RSZ, and 3% had an unknown flight height (Table 14, Appendix C). Unknown flight heights were largely comprised of a small number of northern gannet, red/red-necked phalaropes, razorbill, and Bonaparte's gulls observed in flight (Appendix C). Of the individuals where flight height was calculable, loons, gannets, and gulls as species groups were observed flying the highest with an average flight height of 51 m, 50 m, and 49 m, respectively (Table 15).

In the Winter 2017–2018 survey, 88% of birds were observed sitting, 2% were flying within the RSZ, 3% were flying above or below the RSZ, and 7% had an unknown flight height (Table 14, Appendix C). Unknown flight heights were largely comprised of select gulls and northern fulmars observed in flight (Appendix C). Of the individuals where flight height was calculable, loons were observed flying the highest with an average flight height of 67 m, followed by gulls with an average flight height of 36 m (Table 15).

In the Spring 2017 survey, 54% of birds were observed sitting, 17% were flying within the RSZ, 7% were flying above or below the RSZ, and 22% had an unknown flight height (Table 14, Appendix C). Unknown flight heights were largely comprised of select *Sterna* terns (Appendix C). Of the individuals where flight height was calculable, *Sterna* terns were observed flying the highest with an average flight height of 89 m (Table 15).

In the Spring 2018 survey, 79% of birds were observed sitting, 3% were flying within the RSZ, 5% flying above or below the RSZ, and 13% had an unknown flight height (Table 14, Appendix C). Unknown flight heights were largely comprised of select phalaropes and gulls (Appendix C). Of the individuals where flight height was calculable, *Sterna* terns were observed flying the highest with an average flight height of 79 m followed by loons and fulmars with average flight heights of 74 m and 69 m, respectively (Table 15).

Some species groups showed seasonal differences in flight height activity. The mean flight height for shearwaters was statistically significantly higher in the Spring 2017 survey (Figure 47), and for ducks the mean flight height was highest in the Spring 2018 survey (Figure 48). *Sterna* terns also showed higher mean flight height in the Spring surveys (Figure 49). Phalaropes, loons, and gulls showed no significant differences in mean flight height by season (Figure 50, Figure 51, and Figure 52). The mean flight heights for gannets across seasons and years varied (Figure 53).

Table 14. Corrected Number of All Flying and Sitting Birds Observed by Season during the Summer 2016–Spring 2018 Surveys

Season	Flight Height Unknown		Flying outside RSZ		Flying within RSZ		Sitting		Total Abundance
	Corrected Abundance	Percent Within Season	Corrected Abundance	Percent Within Season	Corrected Abundance	Percent Within Season	Corrected Abundance	Percent Within Season	
Summer 2016	11,510	45.32	5,011	19.73	532	2.10	8,342	32.85	**25,395**
Summer 2017	16,571	40.05	17,004	41.09	84	0.20	7,720	18.66	**41,379**
Fall 2016	12,987	9.43	13,155	9.55	20,857	15.16	90,682	65.86	**137,681**
Fall 2017	18,637	14.46	22,172	17.20	8,490	6.59	79,602	61.75	**128,902**
Winter 2016–2017	7,724	3.34	11,255	4.86	18,636	8.05	193,883	83.75	**231,498**
Winter 2017-18	10,967	7.03	5,129	3.29	3,086	1.98	136,748	87.70	**155,930**
Spring 2017	10,826	22.22	3,321	6.82	8,501	17.45	26,075	53.52	**48,723**
Spring 2018	38,279	12.73	16,397	5.45	7,639	2.54	238,333	79.27	**300,648**
Flight Height Total	**127,501**	**12%**	**93,444**	**9%**	**67,825**	**6%**	**781,385**	**73%**	**1,070,156**

[1] Corrected abundance was calculated by dividing the observed abundance by the percent of the area surveyed for each season. This accounts for differing amounts of area surveyed and makes abundances comparable across seasons. Corrected abundance values are frequently non-integers that have been rounded to whole numbers for display purposes. Column and row totals may not equal the sum of numbers shown in the table because the underlying values are non-integers.

[2]RSZ = 25-195 m

Table 15. Mean Flight Height and Mean Altitude Error* for Flying Birds (with Known Flight Height) by Species Group by Season in the OPA

Species Group	Summer 2016		Summer 2017		Fall 2016		Fall 2017		Winter 2016–2017		Winter 2017-18		Spring 2017		Spring 2018	
	Mean Altitude (m)	Mean Altitude Error (m)	Mean Altitude (m)	Mean Altitude Error (m)	Mean Altitude (m)	Mean Altitude Error (m)	Mean Altitude (m)	Mean Altitude Error (m)	Mean Altitude (m)	Mean Altitude Error (m)	Mean Altitude (m)	Mean Altitude Error (m)	Mean Altitude (m)	Mean Altitude Error (m)	Mean Altitude (m)	Mean Altitude Error (m)
Goose	-	-	-	-	-	-	-	-	4.0	22.41	-	-	-	-	-	-
Duck	-	-	-	-	21.1	13.45	6.5	12.74	13.8	22.69	11.2	25.45	-	-	31.0	26.77
Loon	-	-	-	-	97.0	21.99	47.4	41.54	51.1	24.72	67.2	26.79	61.6	16.02	73.9	29.40
Fulmar	-	-	-	-	56.5	27.02	7.0	18.74	40.9	14.67	17.0	21.91	65.4	13.33	69.2	22.39
Petrel	-	-	-	-	29.3	16.66	-	-	3.3	15.87	-	-	-	-	-	-
Shearwater	2.3	12.75	1.7	26.64	6.6	18.44	1.5	20.79	2.0	37.15	-	-	31.3	16.15	-	-
Storm-petrel	0.7	18.16	0.7	53.93	2.3	8.63	0.8	59.90	2.2	14.98	-	-	35.2	20.38	3.0	36.21
Booby	-	-	-	-	-	-	-	-	-	-	-	-	-	-	58.5	10.07
Gannet	-	-	-	-	52.2	15.14	32.4	17.05	50.1	16.28	25.8	23.37	53.4	17.98	35.0	24.20
Cormorant	2.0	16.16	-	-	20.8	14.88	12.5	35.62	-	-	-	-	1.0	19.44	12.0	30.25
Ardeidae	-	-	-	-	-	-	18.3	26.92	-	-	-	-	-	-	-	-
Raptor	-	-	-	-	-	-	-	-	-	-	-	-	-	-	47.6	5.56
Shorebird	-	-	80.6	6.96			1.2	37.67	-	-	-	-	-	-	-	-
Phalarope	-	-	5.3	42.50	8.4	26.56	1.3	36.57	4.7	30.12			30.4	22.78	7.9	27.82
Skua	-	-	-	-	85.5	31.73	44.4	41.55	-	-	-	-	35.3	49.18	30.2	25.03
Auk	-	-	-	-	6.6	25.13	0.9	33.67	6.7	12.62	23.6	19.66	-	-	1.5	28.06
Gull	55.0	13.66	31.5	11.66	50.1	16.50	48.8	13.75	49.4	16.36	35.6	22.61	52.7	16.08	39.7	23.86
Tern	9.2	16.25	-	-	18.5	6.39	-	-	-	-	-	-	51.3	15.16	-	-
Sterna Tern	1.0	-	-	-	-	-	5.0	83.93	-	-	-	-	89.3	23.90	78.6	42.32
Passerine	-	-	-	-	-	-	2.5	34.35	-	-	-	-	-	-	-	-

*Mean Altitude Error = the average error for each species in the species group

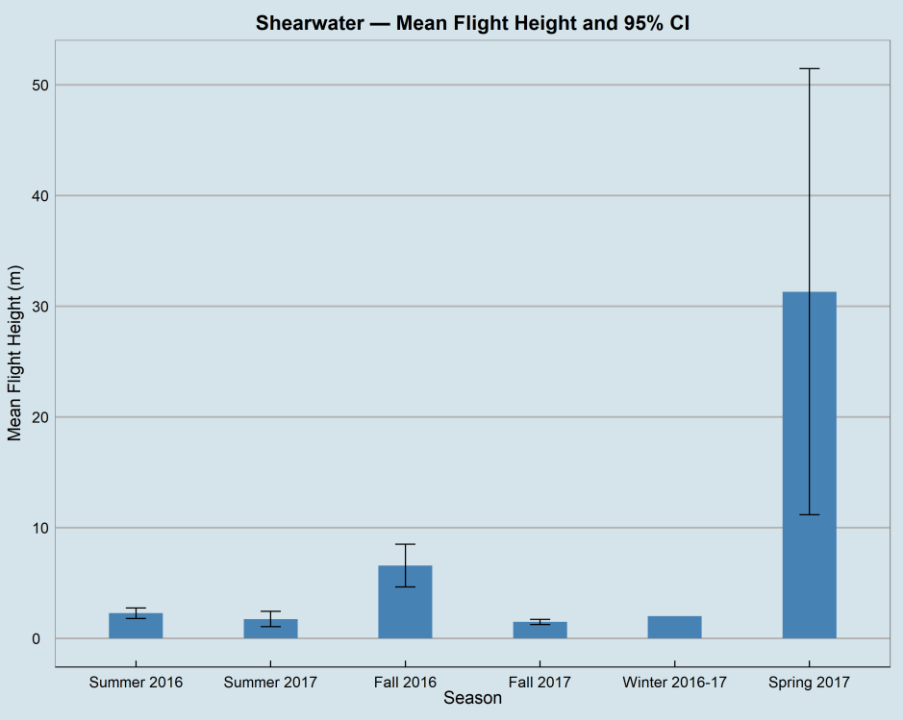

Figure 47. Mean and 95% confidence interval for shearwater flight height among seasons.

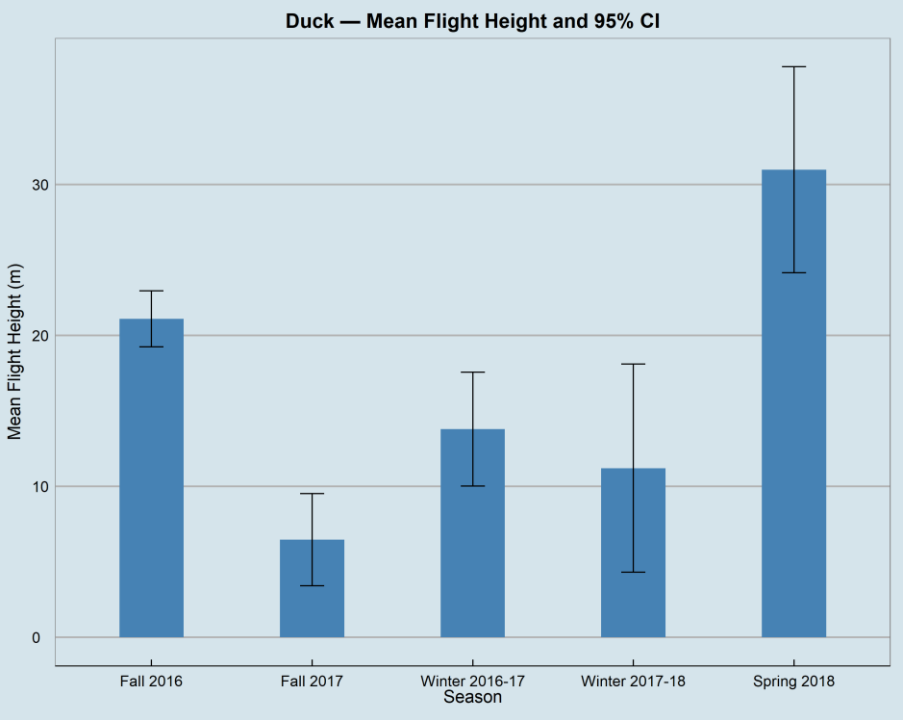

Figure 48. Mean and 95% confidence interval for duck flight height among seasons.

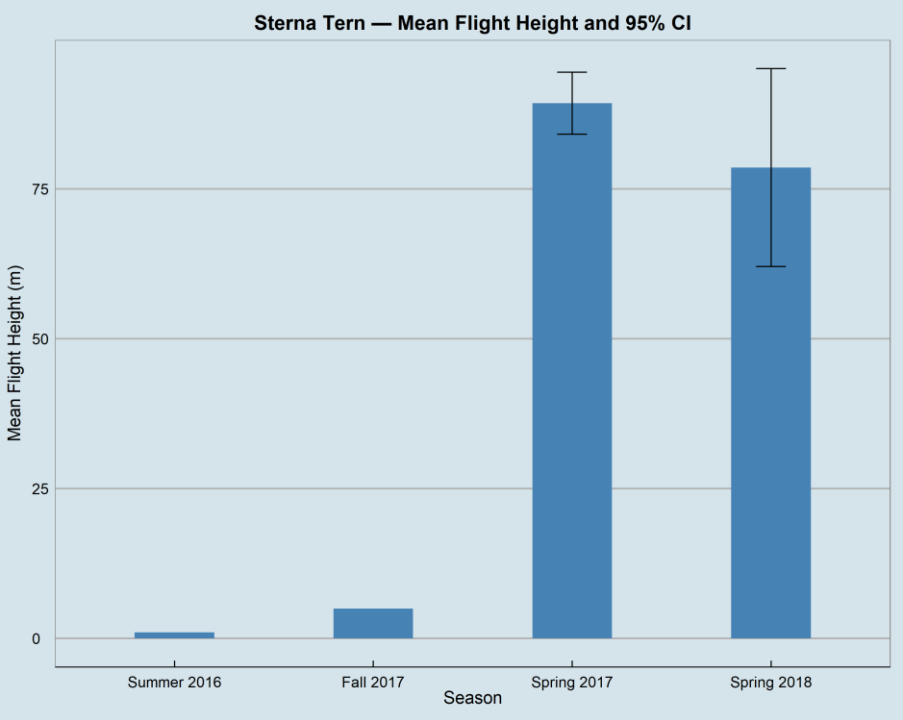

Figure 49. Mean and 95% confidence interval for *Sterna* tern flight height among seasons.

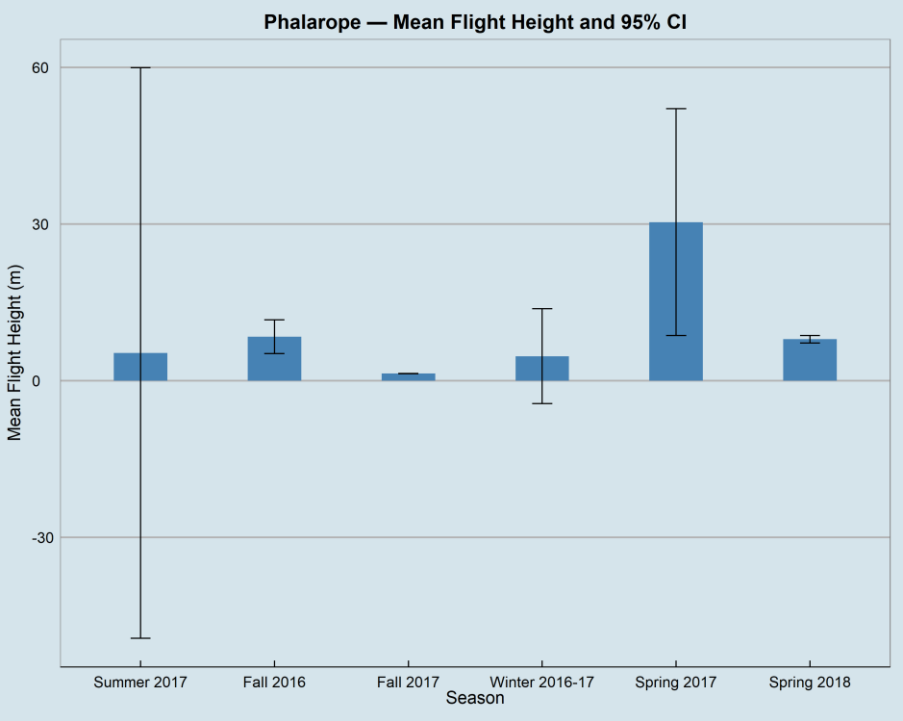

Figure 50. Mean and 95% confidence interval for phalarope flight height among seasons.

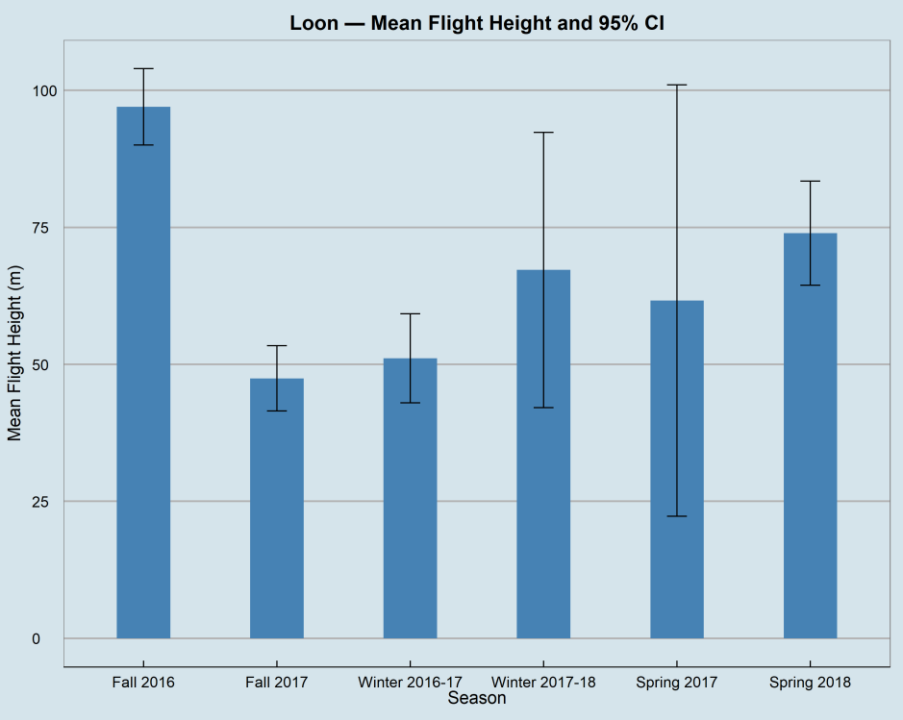

Figure 51. Mean and 95% confidence interval for loon flight height among seasons.

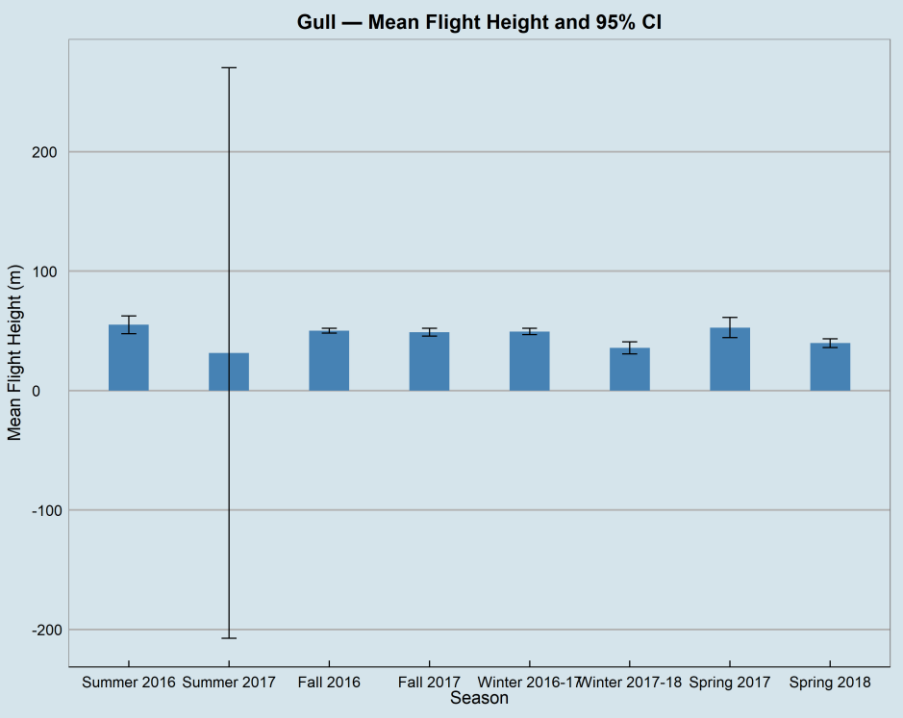

Figure 52. Mean and 95% confidence interval for gull flight height among seasons.

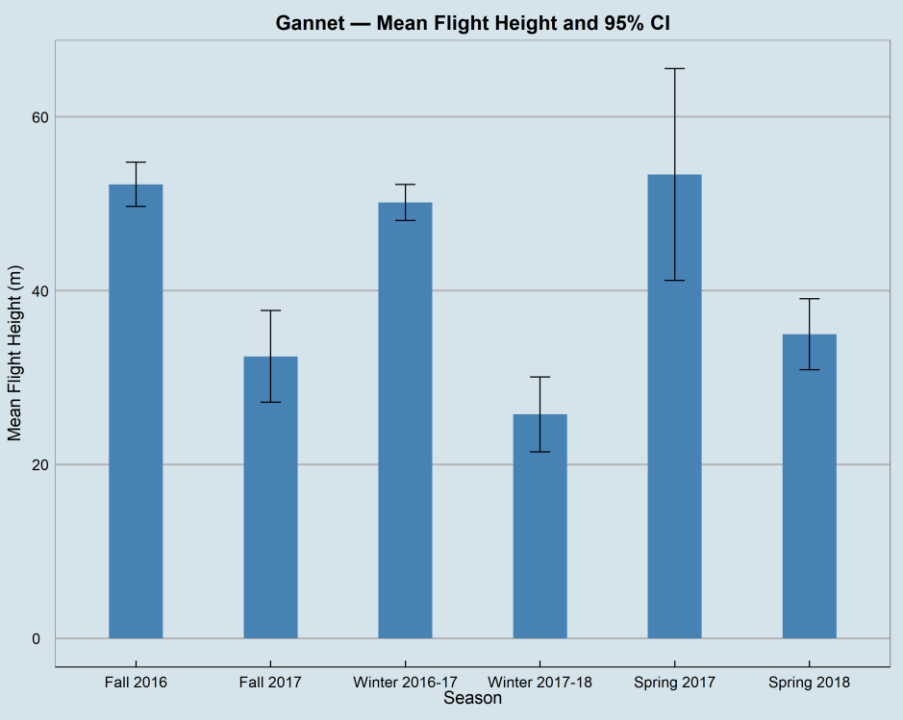

Figure 53. Mean and 95% confidence interval for gannet flight height among seasons.

3.5.6. Spatial Patterns of Flight Height

Distribution of gulls varied seasonally. They were concentrated near shore in the Summer surveys and widespread across the OPA during Fall, Winter, and Spring surveys. Gulls tended to fly at altitudes that fall within the RSZ, particularly when near shore during Summer. When offshore, most gulls were observed either within (25–195 m) or below the RSZ (Figure 54, Figure 55, Figure 56, Figure 57).

Gannets occur throughout the OPA, but tended to be concentrated near shore during the Fall and Spring. During the Fall, more gannets appeared to be flying within the RSZ near shore; whereas, during the Winter gannets were primarily concentrated in the western one-third of the OPA with many flying within the RSZ (Figure 58, Figure 59, Figure 60).

Loons were found sitting on the water nearer shore in the Summer and Fall surveys (Figure 61, Figure 62), and mostly sitting near shore and more widely distributed in the western parts of the OPA during the Winter and Spring surveys (Figure 63 and Figure 64).

Patterns for other species groups were indistinct as there were few flight height data for flying birds (Appendix C).

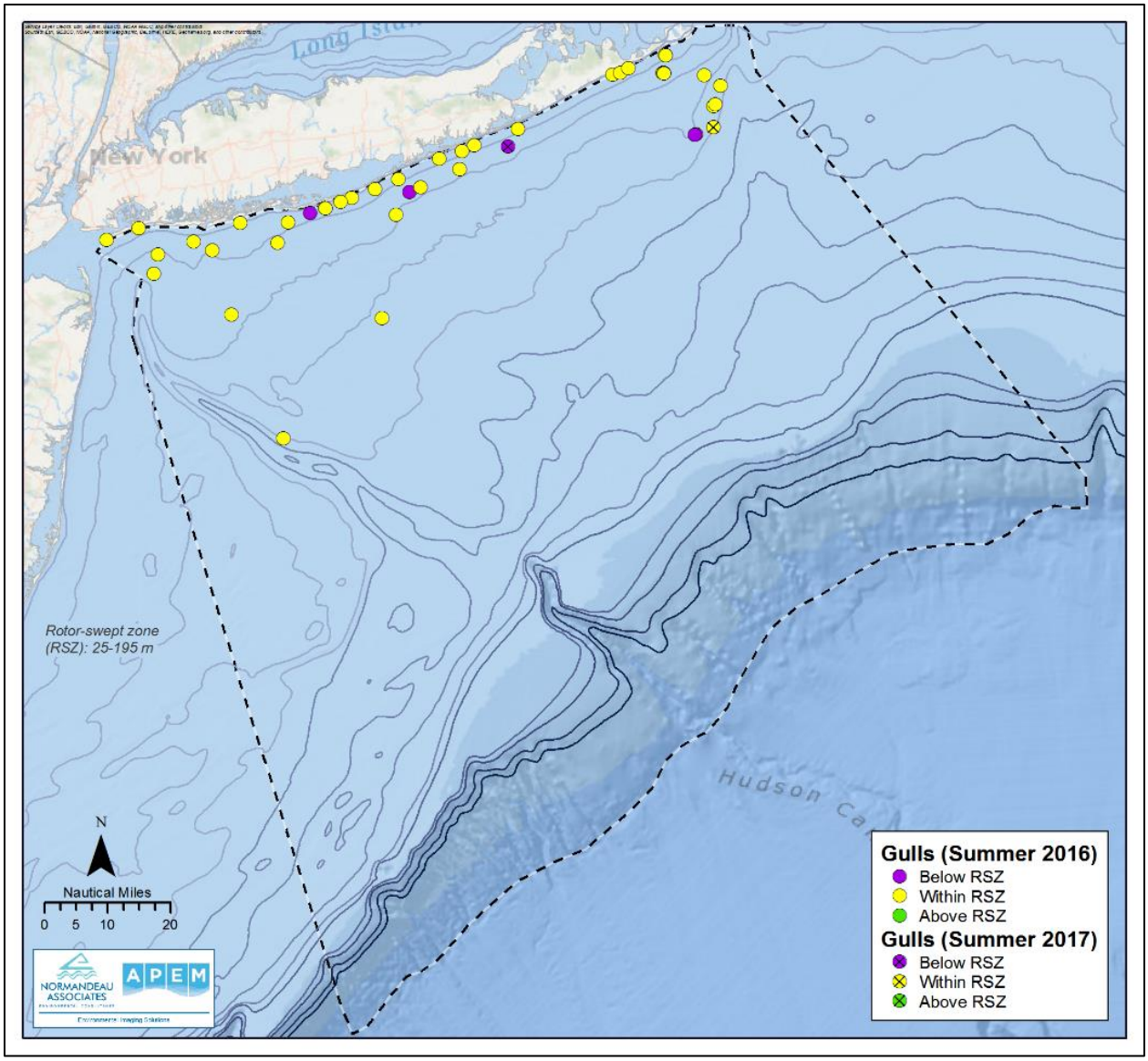

Figure 54. Spatial distribution of gull flight heights during the Summer 2016 and Summer 2017 surveys.

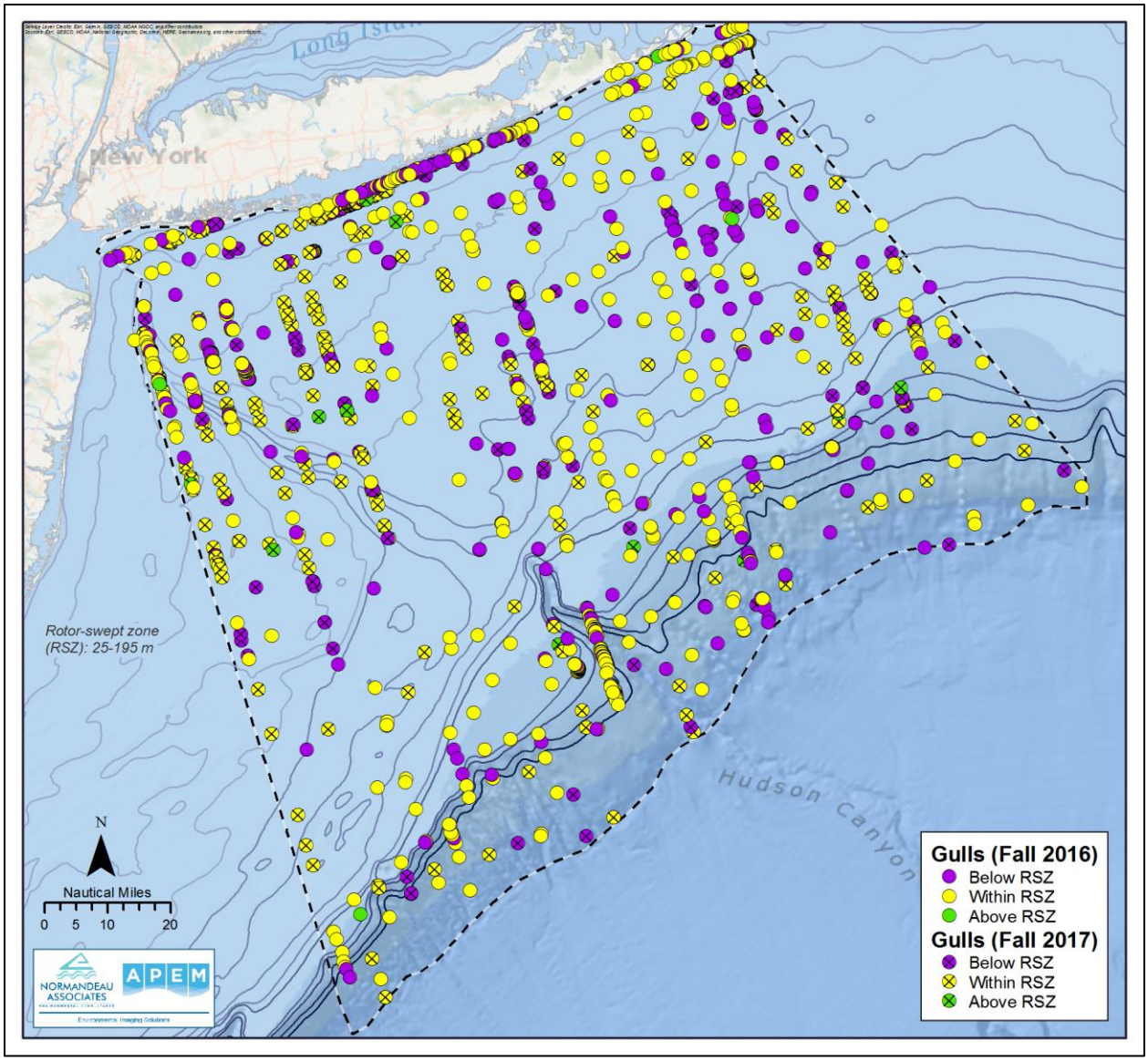

Figure 55. Spatial distribution of gull flight heights during the Fall 2016 and Fall 2017 surveys.

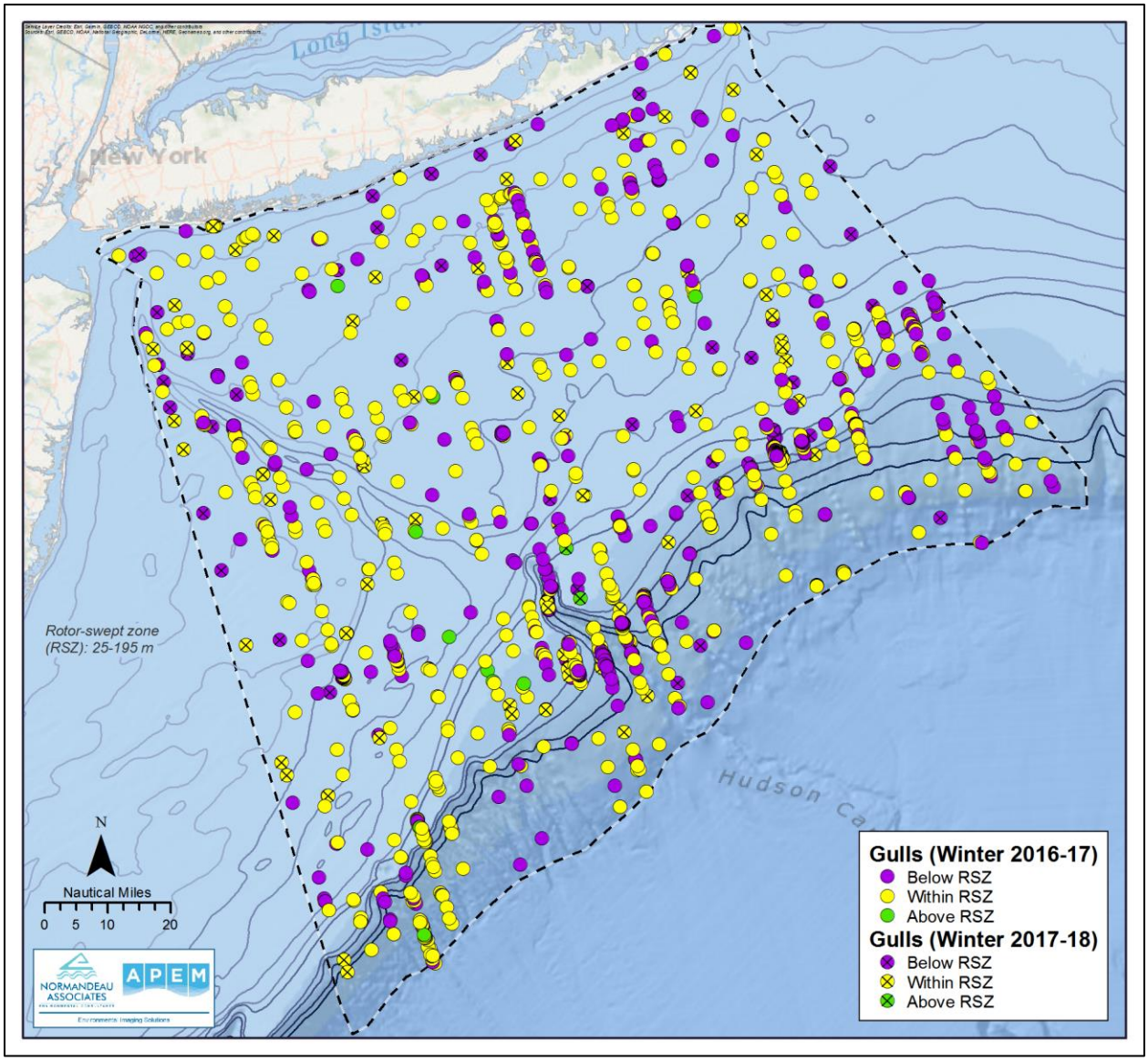

Figure 56. Spatial distribution of gull flight heights during the Winter 2016–2017 and Winter 2017–2018 surveys.

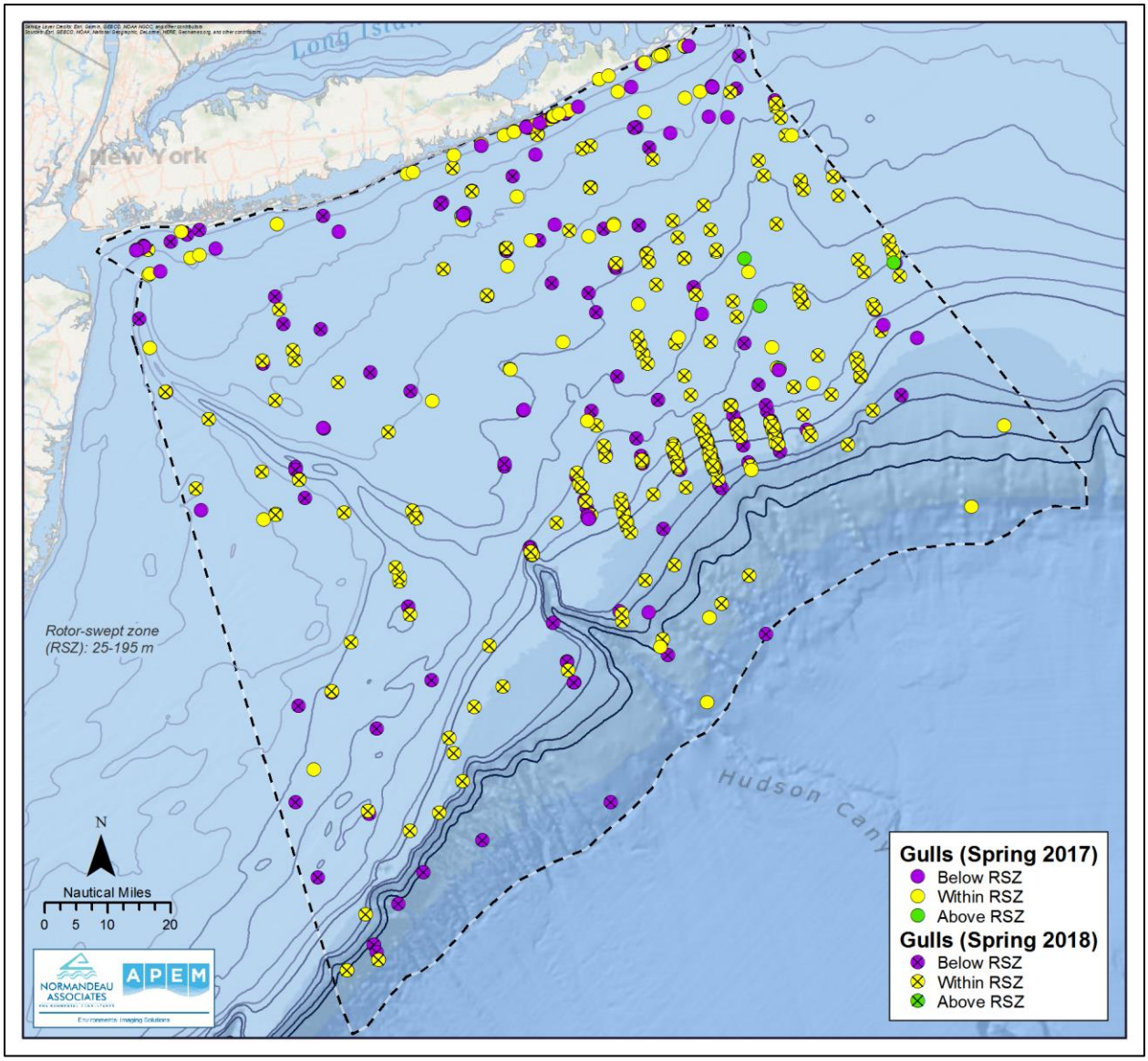

Figure 57. Spatial distribution of gull flight heights during the Spring 2017 and Spring 2018 surveys.

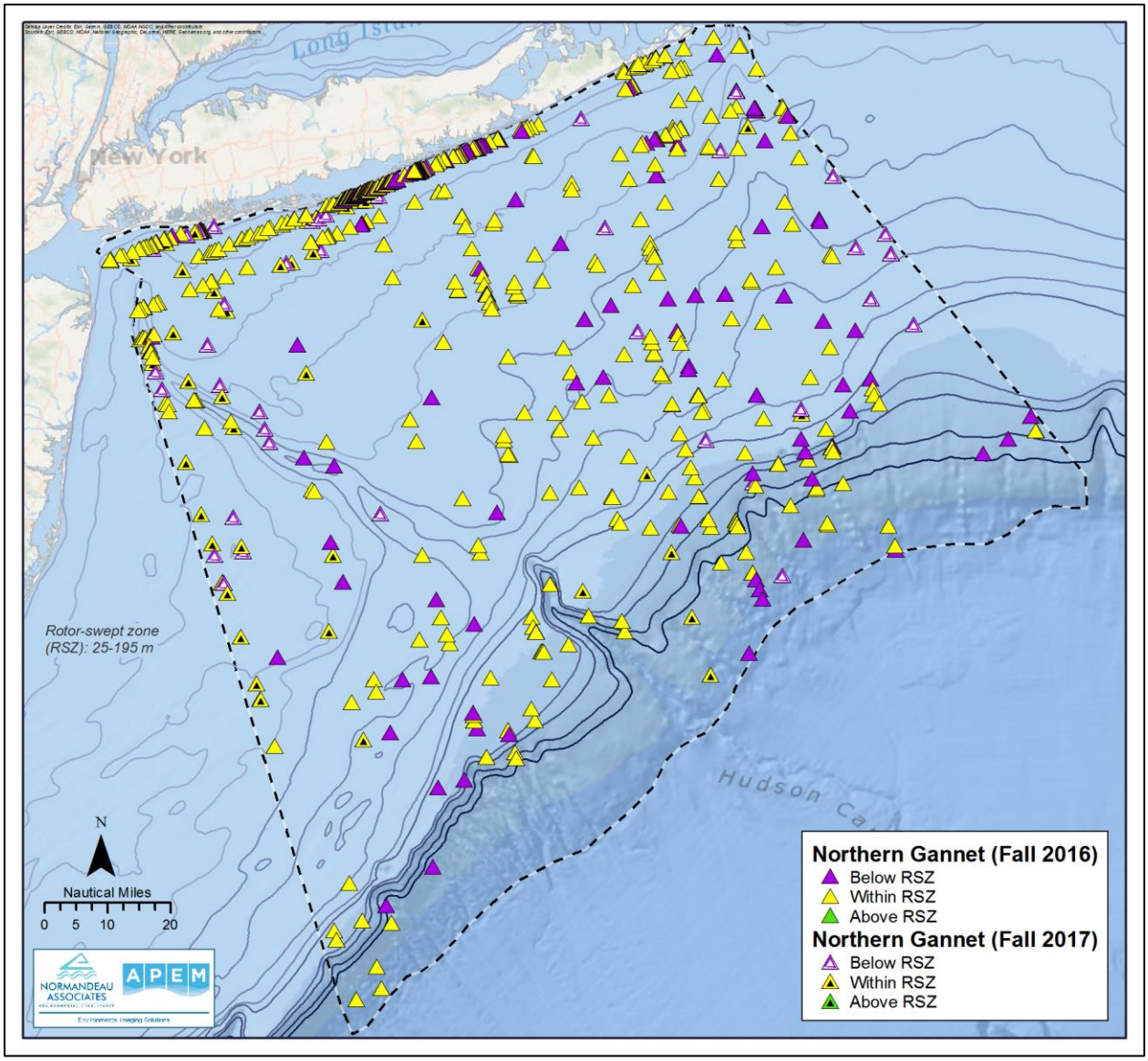

Figure 58. Spatial distribution of northern gannet flight heights during the Fall 2016 and Fall 2017 surveys.

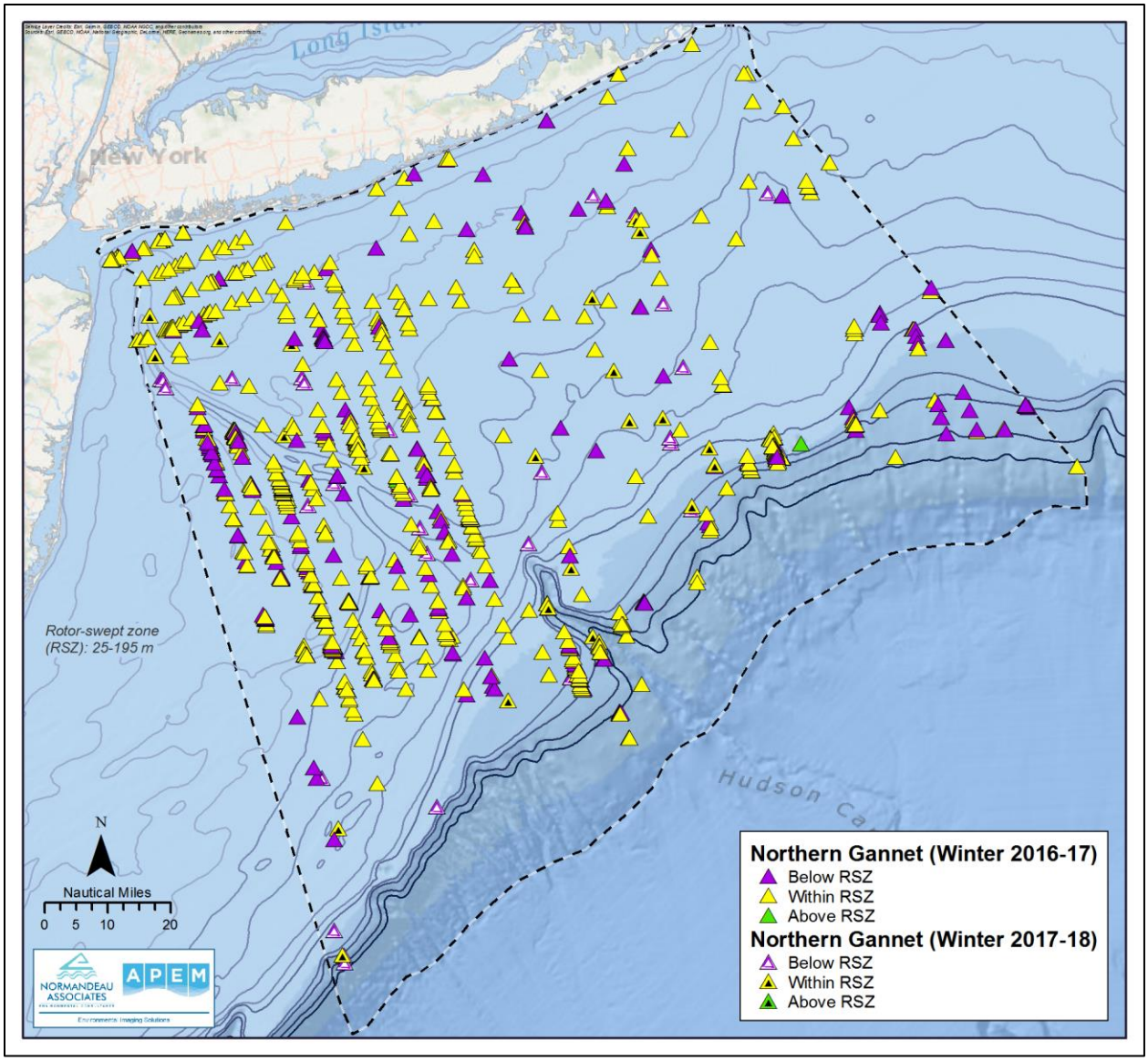

Figure 59. Spatial distribution of northern gannet flight heights during the Winter 2016–2017 and Winter 2017–2018 surveys.

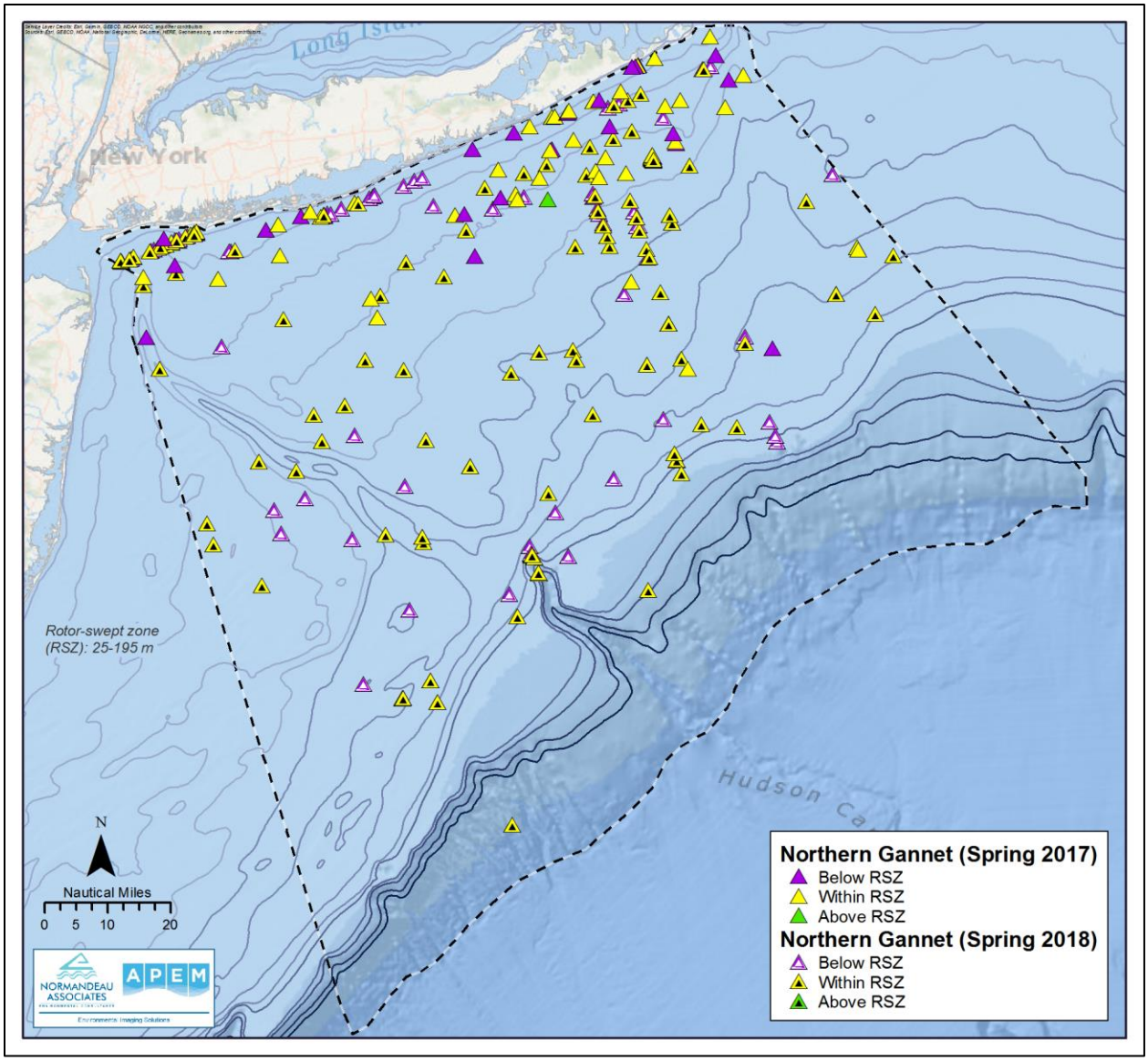

Figure 60. Spatial distribution of northern gannet flight heights during the Spring 2017 and Spring 2018 survey.

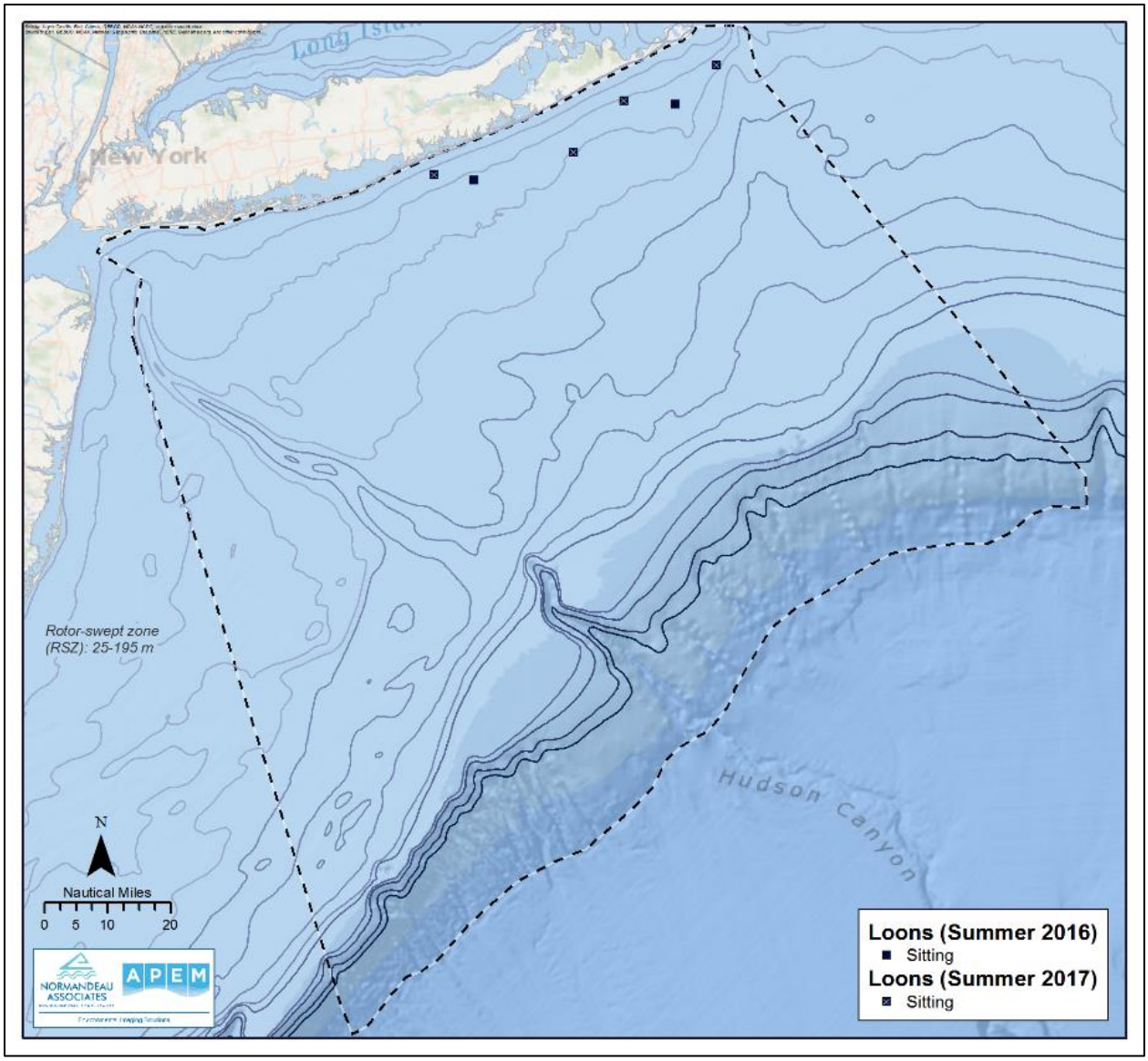

Figure 61. Spatial distribution of loon flight heights during the Summer 2016 and Summer 2017 surveys.

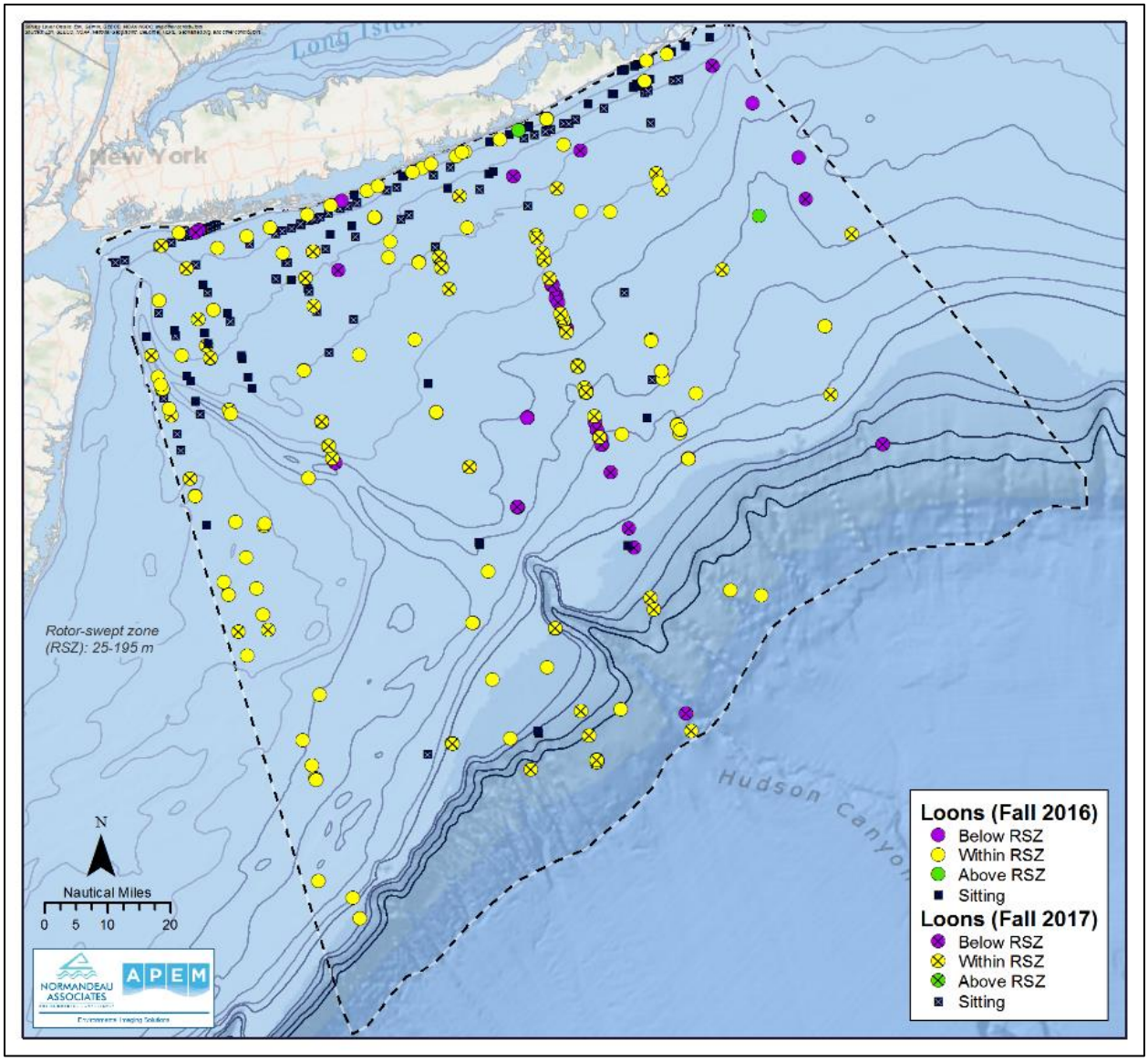

Figure 62. Spatial distribution of loon flight heights during the Fall 2016 and Fall 2017 surveys.

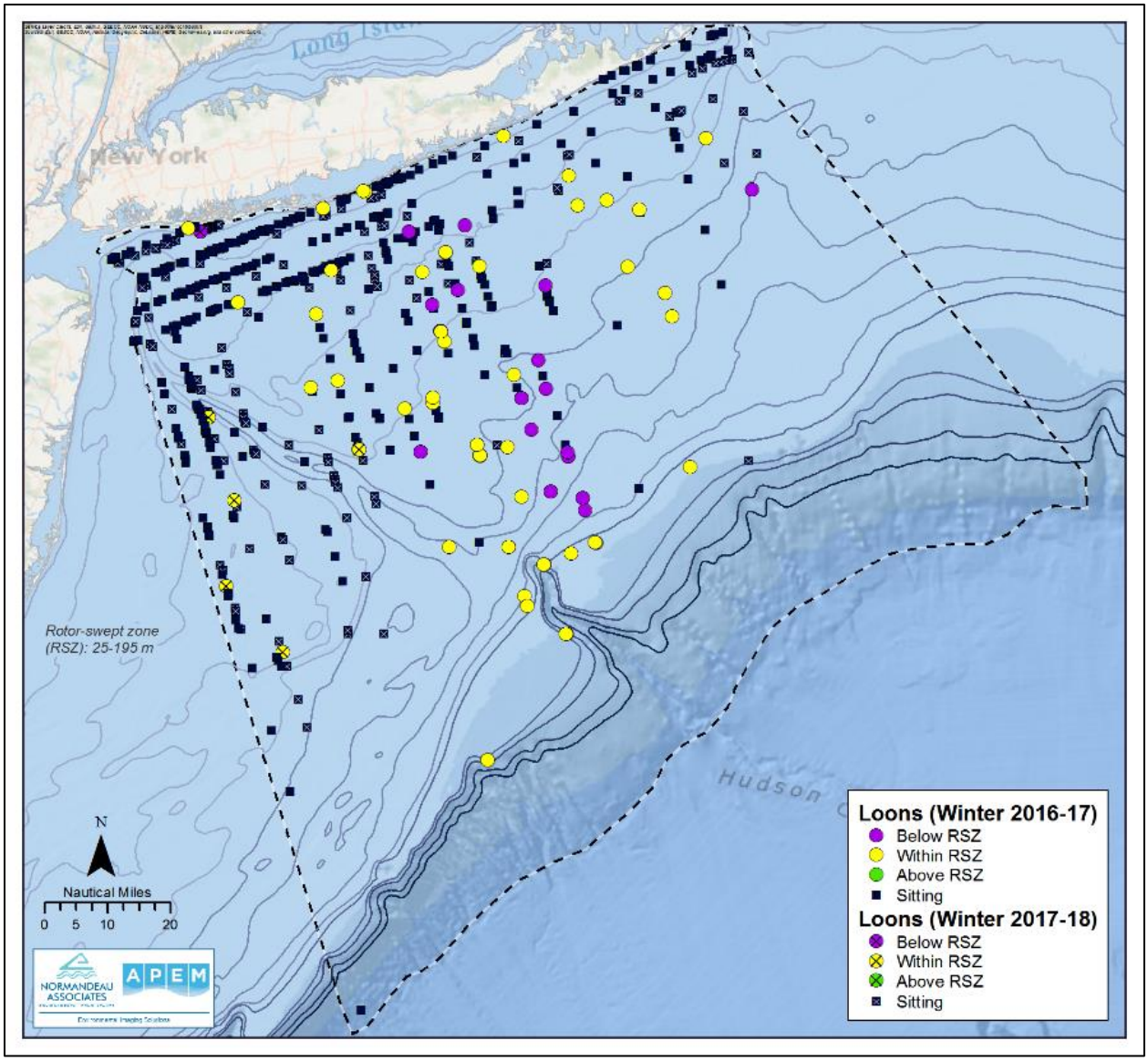

Figure 63. Spatial distribution of loon flight heights during the Winter 2016–2017 and Winter 2017–2018 surveys.

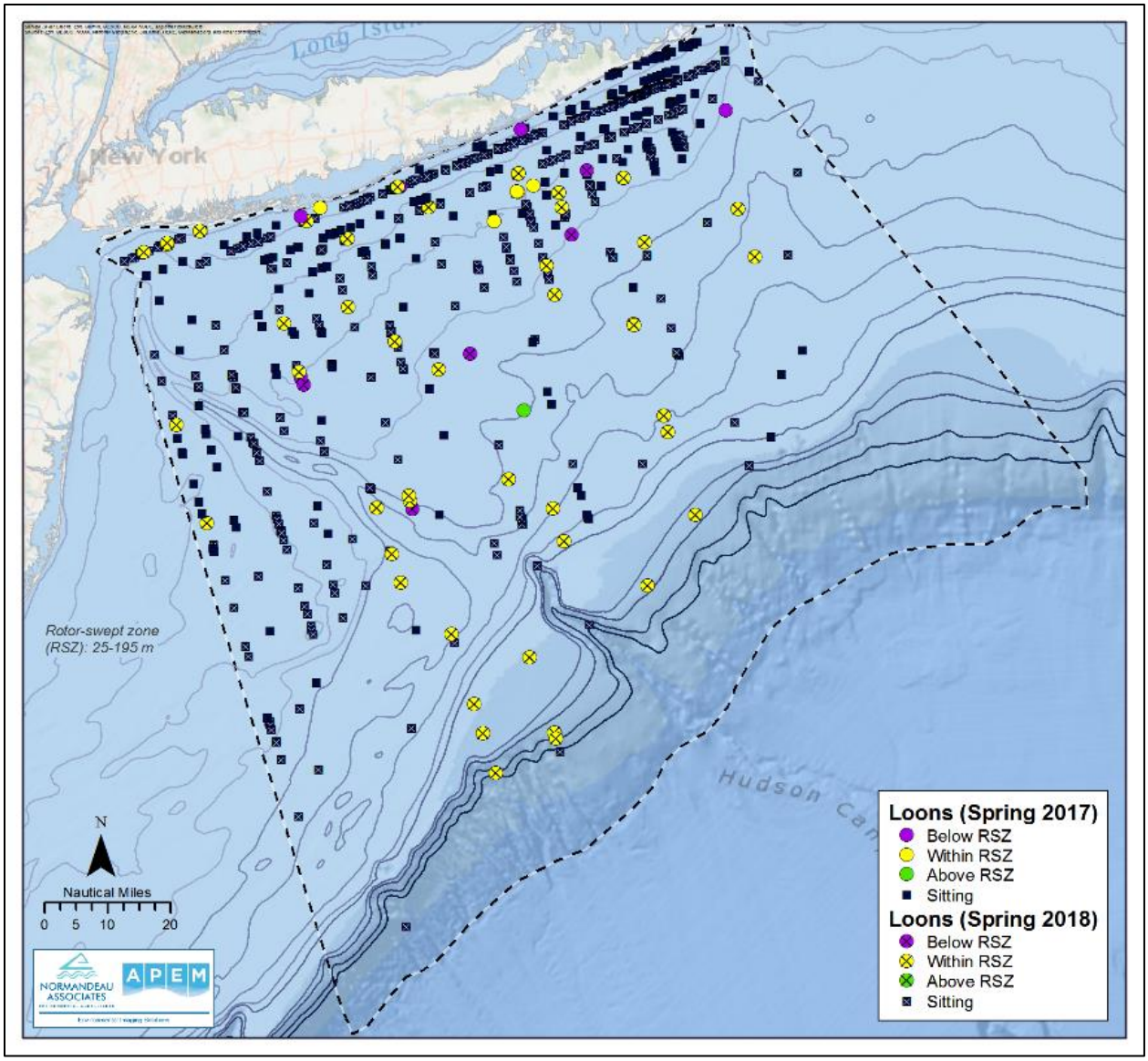

Figure 64. Spatial distribution of loon flight heights during the Spring 2017 and Spring 2018 survey.

3.5.7. Sensitivity Analysis

We examined the broad-scale variation in relative sensitivity of birds to wind development within the OPA using three sensitivity indices developed in a BOEM study (Robinson Willmott et al. 2013): population sensitivity, collision sensitivity, and displacement sensitivity. Population Sensitivity represents species with low global population numbers, which are potentially range restricted, have high adult survival rates, and correspondingly low fecundity. These species also tend to have high conservation status at a State and/or Federal level. Collision Sensitivity generally represents species that frequently fly during twilight or at night, tend not to avoid wind farms in other parts of the world, and spend a considerable amount of time in the area over the course of a year, thus heightening risk of collision. Displacement Sensitivity represents species that have restricted habitat flexibility for foraging opportunity as opposed to those species that forage in a variety of habitats. Species used in each sensitivity map are displayed in Table 16, Table 17, and Table 18.

Table 16. Species used in Population Sensitive Bird Abundance Mapping, and their Sensitivity Rank

Common Name	Population Sensitivity Rank
Black-capped Petrel	1
Trindade Petrel	2
Petrel-species unknown	3
Least Tern	4
Roseate Tern	5
Band-rumped Storm-Petrel	6
Cory's Shearwater	7
Audubon's Shearwater	8
Shearwater-species unknown-Large	9
Sterna Tern-species unknown	10
Shearwater-species unknown-Small	11
Royal Tern	12
Surf Scoter	13
King Eider	14
South Polar Skua	15
Tundra Swan	16
Skua-species unknown	17

Table 17. Species used in Collision Sensitive Bird Abundance Mapping, and their Sensitivity Rank

Common Name	Collision Sensitivity Rank
Herring Gull	1
Great Black-backed Gull	2
Parasitic Jaeger	3
Red Phalarope	4
Pomarine Jaeger	5
Gull-species unknown - Large	6
Roseate Tern	7
Red/Red-necked Phalarope	8
Phalarope-species unknown	9
Northern Gannet	10
Petrel-species unknown	11
Red-necked Phalarope	12
Black-capped Petrel	13
Trindade Petrel	14
Common Tern	15
King Eider	16
South Polar Skua	17

Table 18. Species used in Displace–ment Sensitive Bird Abundance Mapping, and their Sensitivity Rank

Common Name	Displacement Sensitivity Rank
Black Guillemot	1
Common Eider	2
Roseate Tern	3
Atlantic Puffin	4
Razorbill	5
Surf Scoter	6
Duck-species unknown	7
Scoter unid.	8
Black Scoter	9
Auk-species unknown	10
Red-throated Loon	11
Loon-species unknown	12
Murre/Razorbill	13
Common Loon	14
White-winged Scoter	15
Great Black-backed Gull	16
Black-capped Petrel	17
Trindade Petrel	18

Sensitivity indices and associated maps are readily interpretable and can be used to inform siting decisions at broad scales. More spatially detailed data such as those collected using grid-design survey methodology with high coverage can be examined to help inform finer-scale siting decisions at the project level. The combined maps represent an average abundance across the timeframe shown in the map. Single season maps represent the total number of birds in each cell.

When all data were pooled across the first eight surveys, some population sensitivity shows in the northeastern section of the OPA, very little collision sensitivity is evident, and some displacement sensitivity shows along the eastern edge, the central, and nearshore areas of the OPA (Figure 65).

Although population sensitive species were distributed across the OPA, timing of aggregations varied with some spatial concentrations in the northeastern section during Summer 2016 and less so in the Summer 2017 survey. The occurrence of population sensitive species during the Fall and Winter were sparse; although, more population sensitivity is apparent near shore in the Winter and in the Spring appears to be more scattered (Figure 66). When pooled by season these spatial patterns still hold true (Figure 67).

Collision sensitive species were few in the Summer surveys, only occurring near shore during Summer 2016 survey and absent in Summer 2017 survey. However, they occurred throughout the OPA during other seasons (Figure 68). There were some collision sensitive species nearer shore and near the shelf in the Fall 2016 survey, but this was not evident in the Fall 2017 survey. Similarly with the Winter surveys, the Winter 2016–2017 survey showed more collision sensitivity nearer the western edge of the OPA and nearer the shelf, whereas there was very little collision sensitivity in the Winter 2017–2018 survey. Both Spring surveys showed different and patchy collision sensitivity (Figure 68). When data for each season were pooled, highest aggregations of collision sensitive species occurred during the Fall surveys nearer shore, and during the Winter surveys along the western edge (Figure 69).

Displacement sensitive species were found primarily near shore throughout the year, although the Winter 2016–2017 aggregations were generally dense in the central and eastern portions of the OPA (Figure 70). This high displacement sensitivity during Winter 2016–2017 largely represents some species of ducks, loons, and auks that have restricted habitat flexibility, whereas in the Winter 2017–2018, numbers of these species were lower than the previous year, but then higher in the Spring 2018 survey. For this reason, the displacement sensitivity map for Spring 2018 shows higher aggregations in the central and nearer shore areas of the OPA when compared to the Spring 2017 survey (Figure 70). The seasonal assessment for displacement sensitivity pooled across two years of data show these same patterns of occurrence in the Winter and Spring (Figure 71).

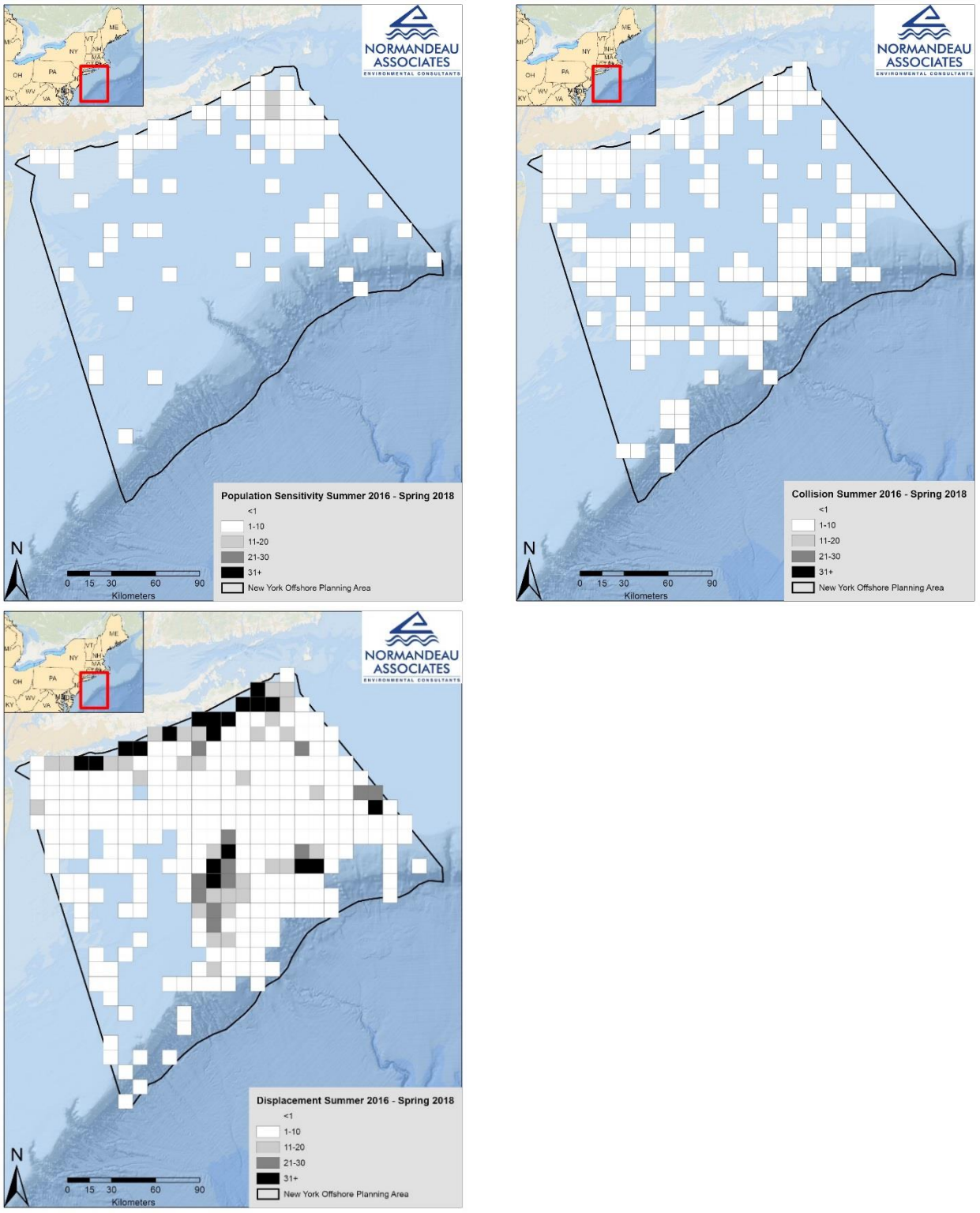

Figure 65. Average number of population-sensitive, collision-sensitive, and displacement-sensitive individuals per grid cell for species (described in Table 16, Table 17, and Table 18, respectively) across the Summer 2016–Spring 2018 surveys.

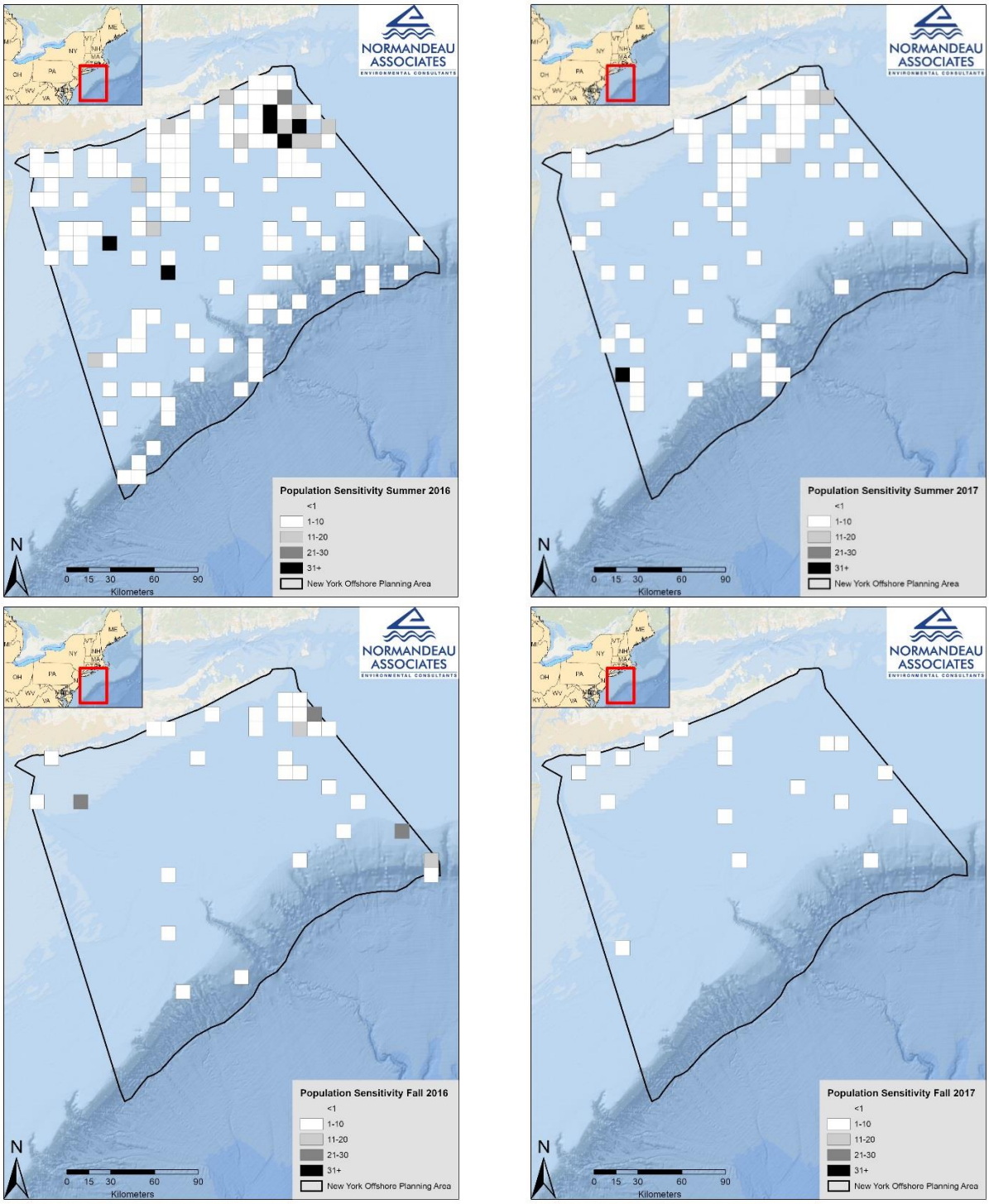

Figure 66. Total number of population-sensitive individuals (listed in Table 16) by grid cell for each season during the Summer 2016–Spring 2018 surveys (figure continued on next page).

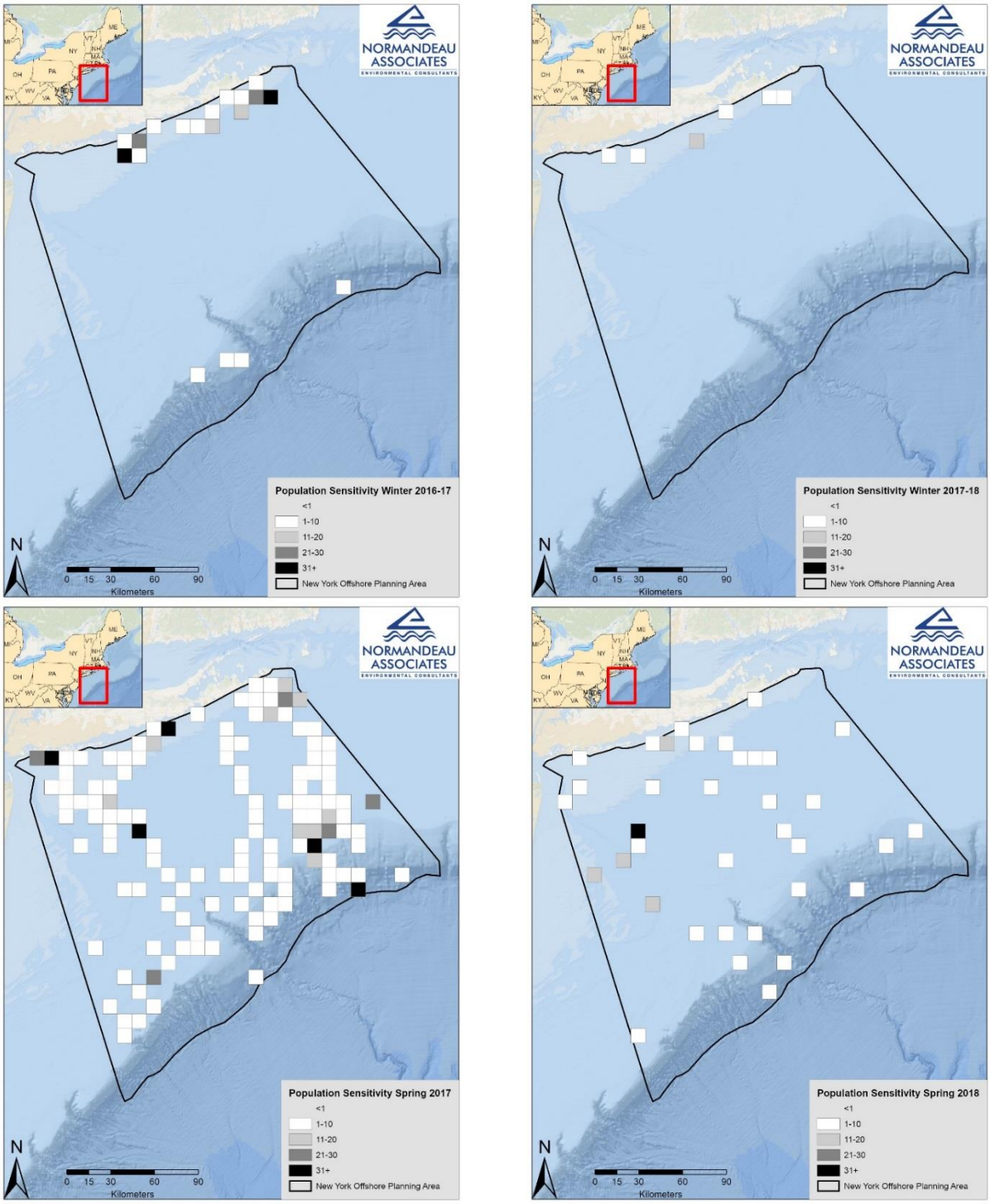

Figure 66. (Continued)

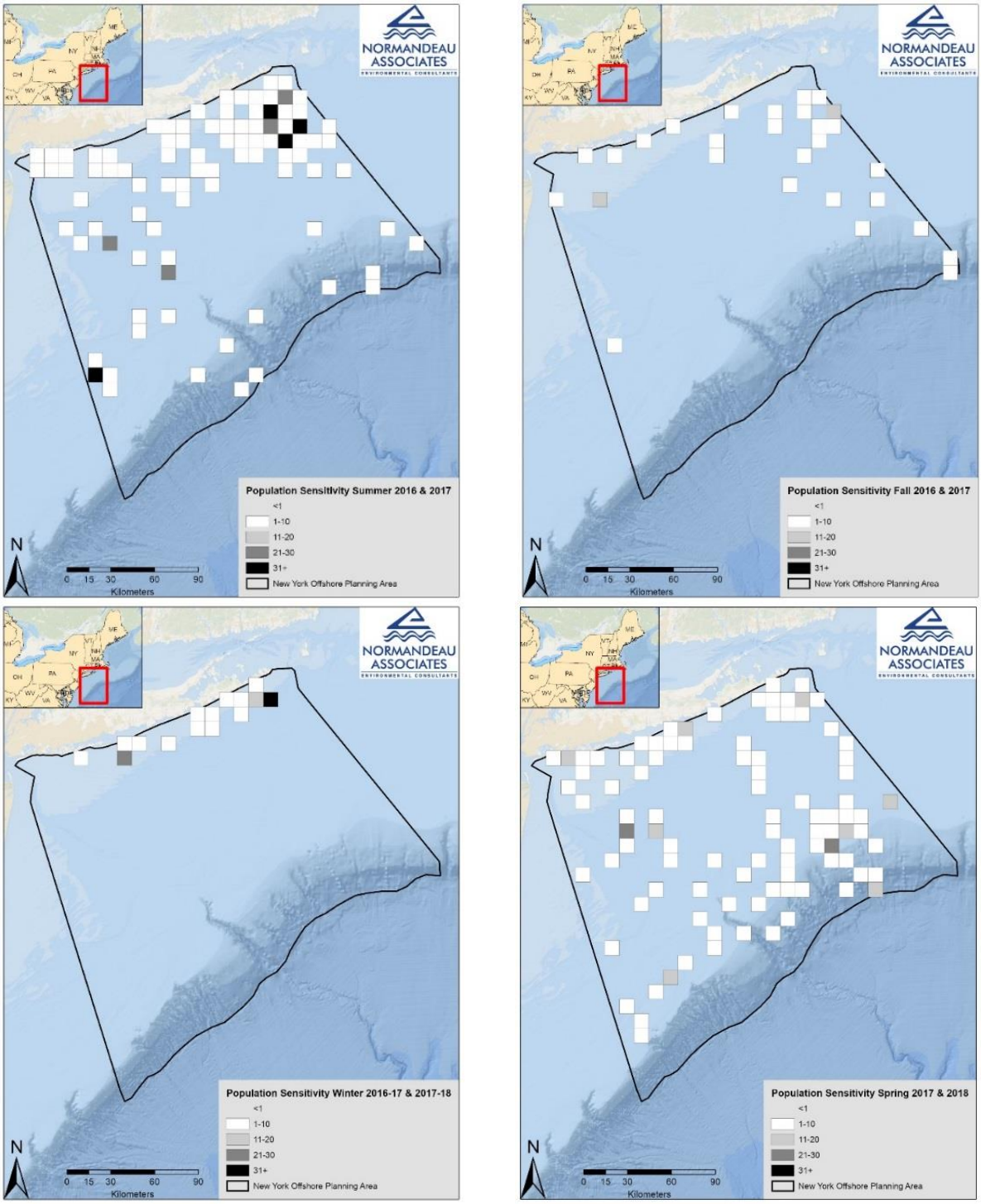

Figure 67. Total number of population-sensitive individuals (listed in Table 16) by grid cell, averaged by season over two years of seasonal surveys.

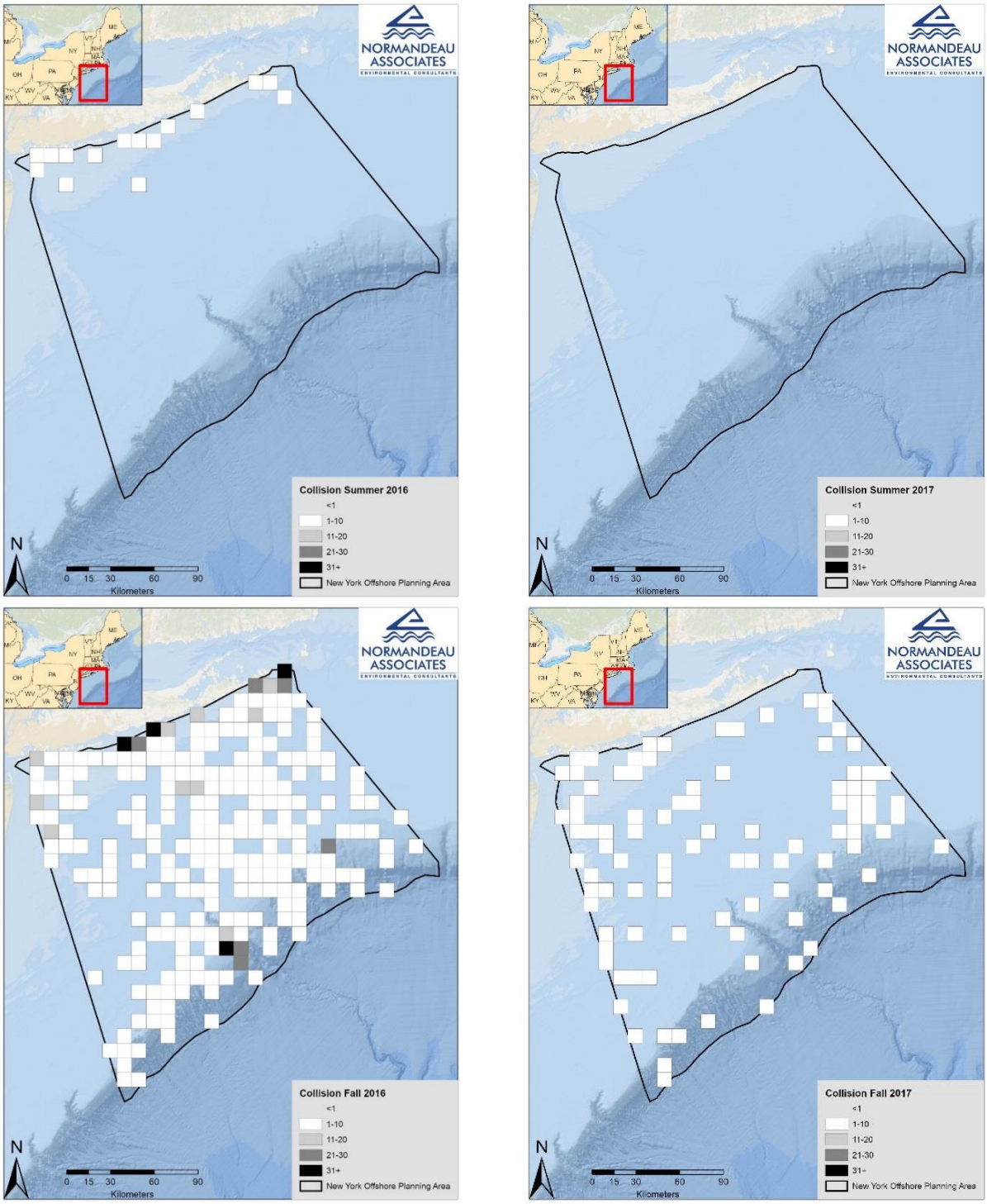

Figure 68. Total number of collision-sensitive individuals (Table 17) by grid cell for each season during the Summer 2016–Spring 2018 surveys. No collision-sensitive species were observed flying within the rotor swept zone during Summer 2017 (figure continued on next page).

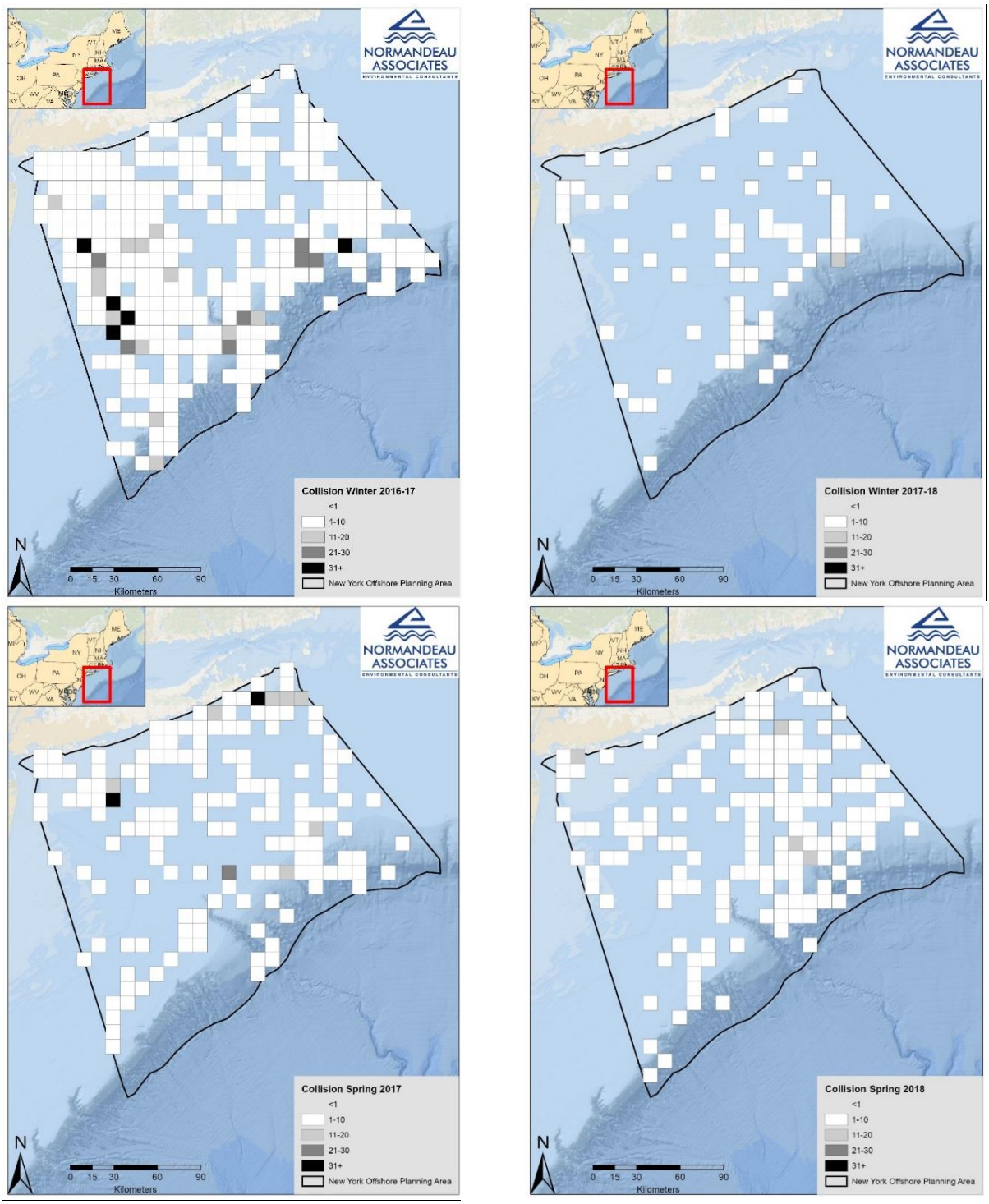

Figure 68. (Continued)

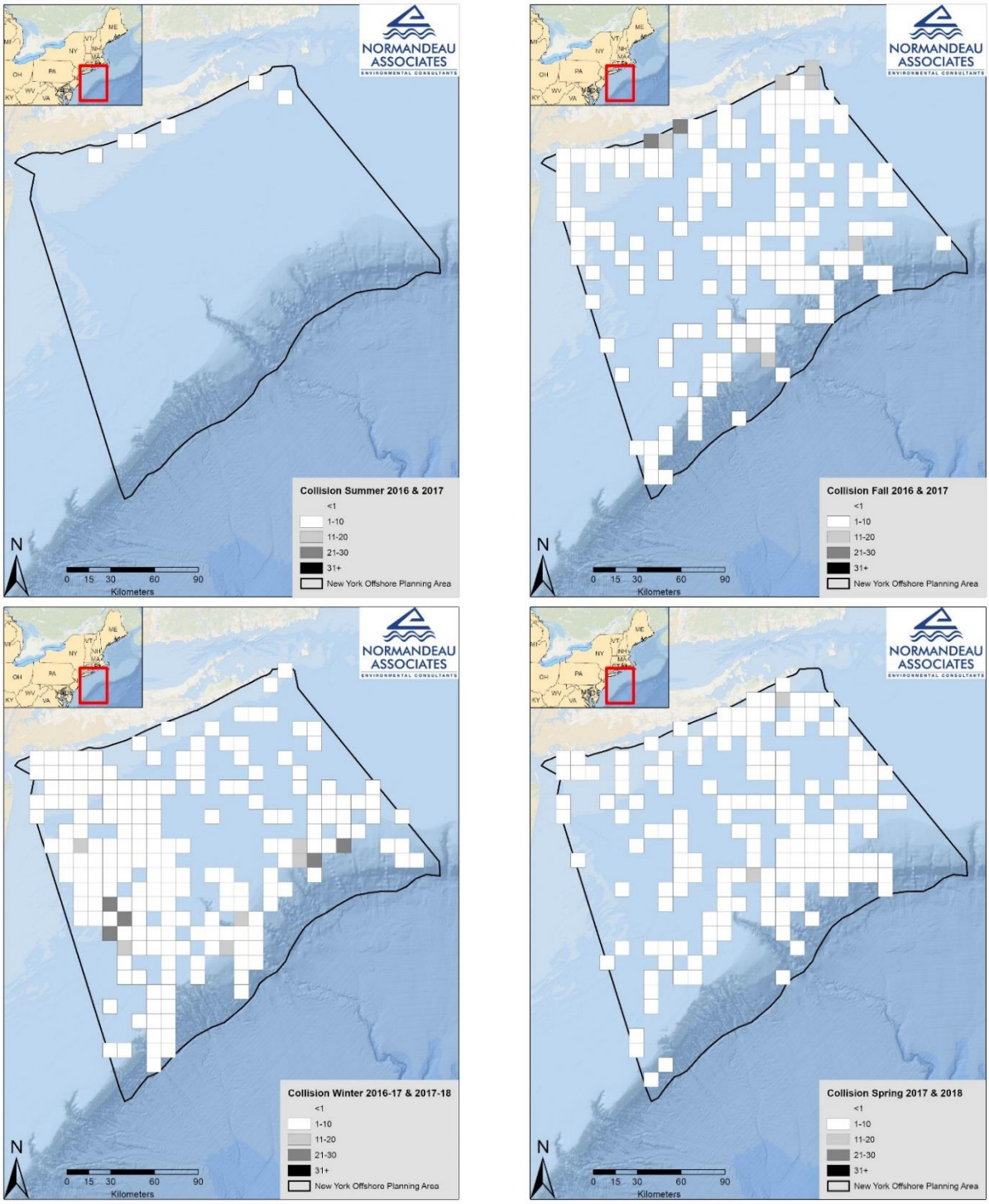

Figure 69. Total number of collision-sensitive individuals (listed in Table 16) by grid cell, averaged by season over two years of seasonal surveys.

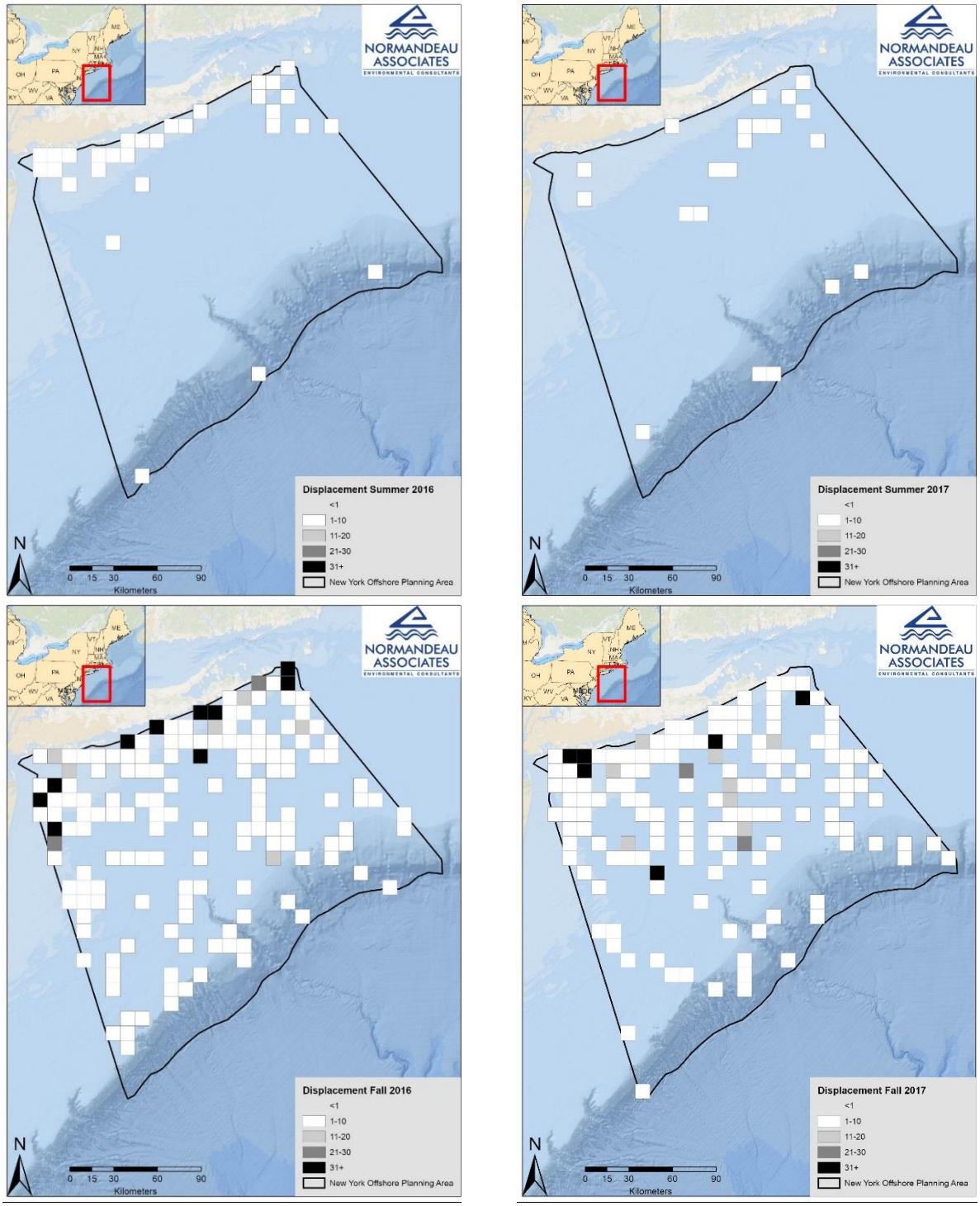

Figure 70. Total number of displacement-sensitive individuals (listed in Table 18) by grid cell for each season during the Summer 2016–Spring 2018 surveys (figure continued on next page).

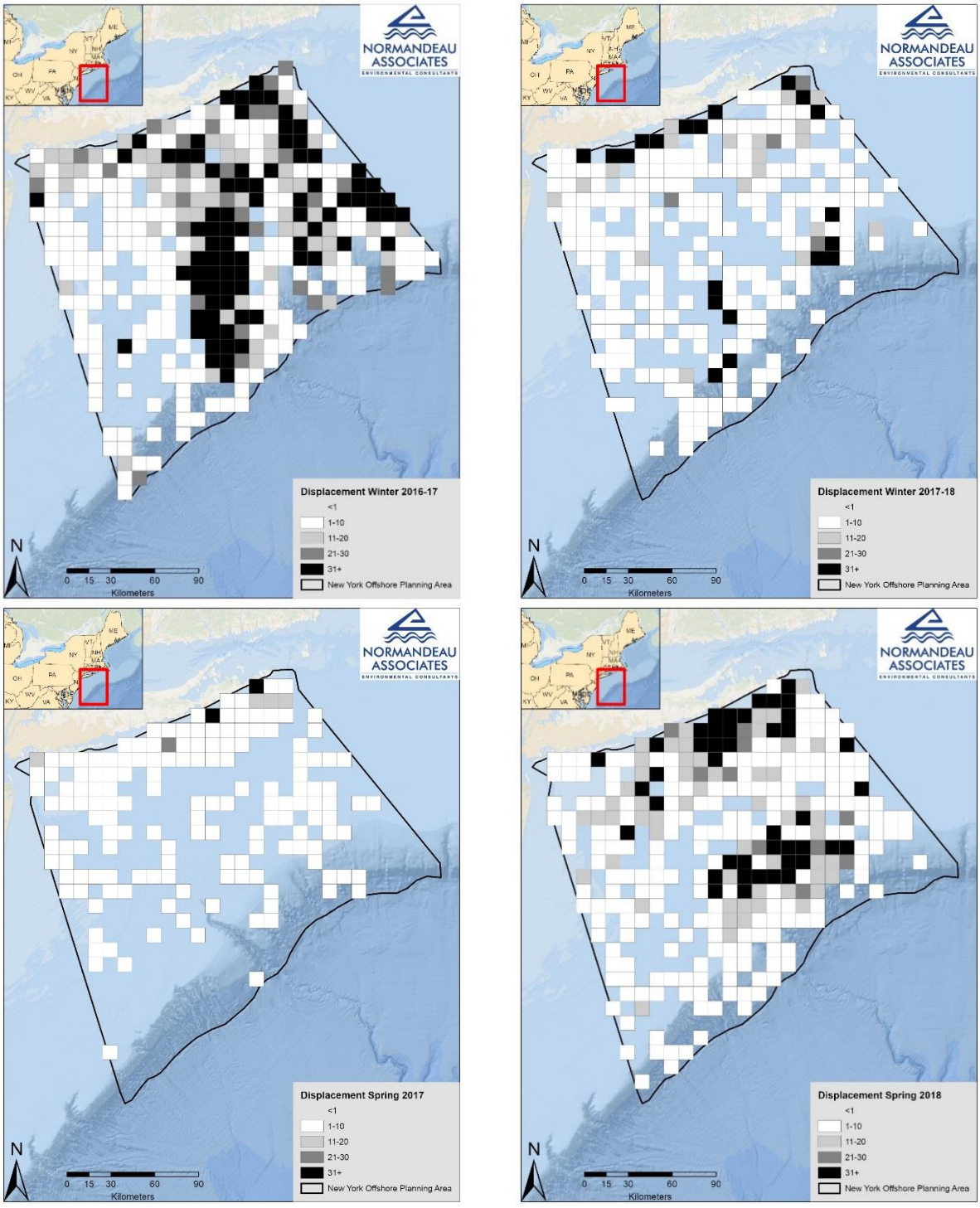

Figure 70. (Continued)

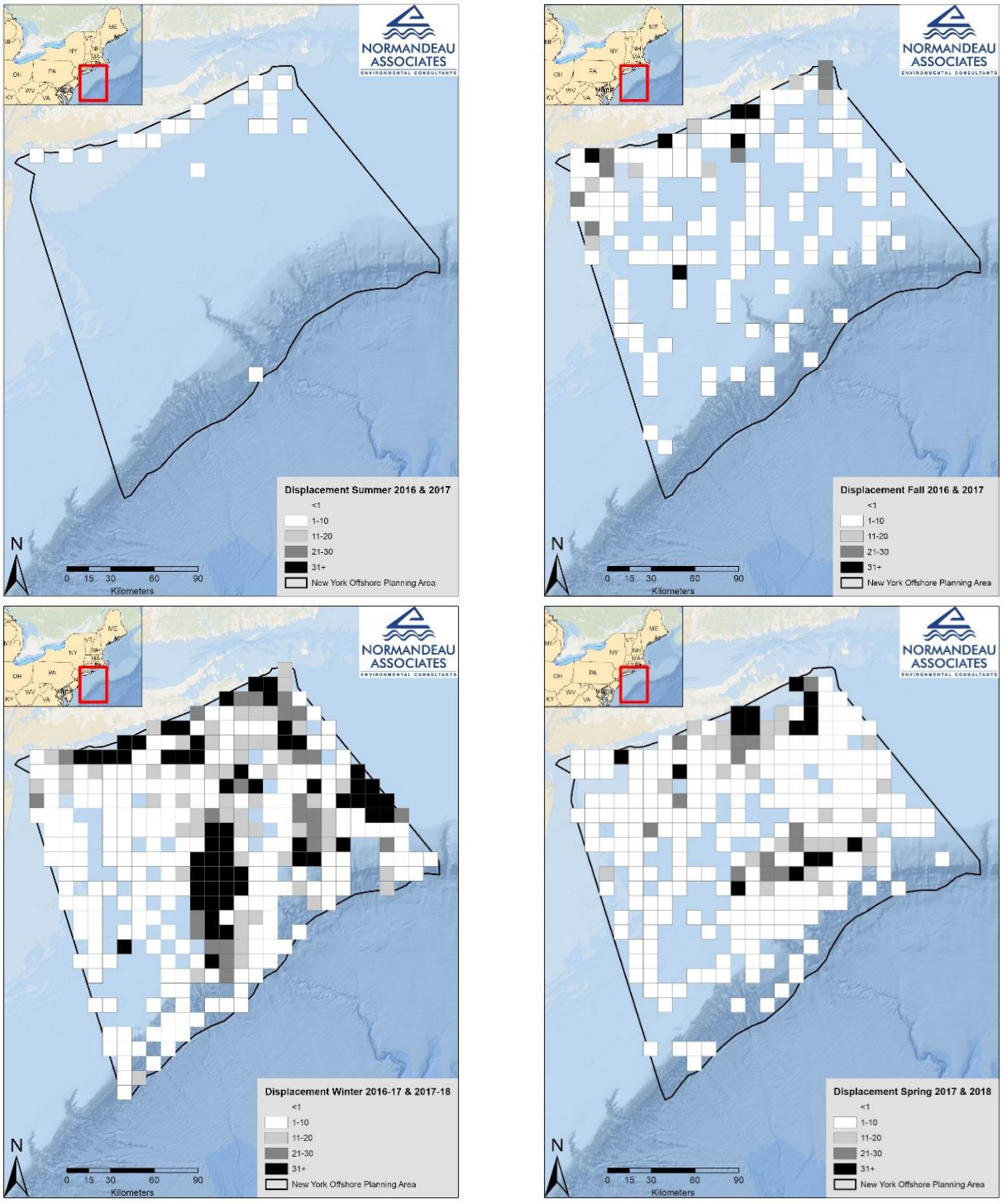

Figure 71. Total number of displacement-sensitive individuals (listed in Table 18) by grid cell, averaged by season over two years of seasonal surveys.

3.6. Turtles

3.6.1. Species Identification

Over the eight surveys, 1,335 turtles were identified in imagery in the OPA (Appendix E). Of these, 86% were ascribed to species, the remaining were either ascribed to the species blend loggerhead/Kemp's (n=33) or were not ascribed to species (n=157). Ten (30%) of the loggerhead/Kemp's species blend were significantly submerged and 129 (82%) of those not ascribed to any species were significantly submerged (Appendix E).

3.6.2. Species Composition and Abundance (Corrected for Effort)

Peak encounters for turtles were in the Summer 2016 and Summer 2017 surveys when 96% of turtles for the eight surveys were observed (Table 19, Figure 72). Loggerhead turtles were the most frequently encountered, consisting of 79% of the total observations. In the Fall 2016 survey, peak encounters were leatherback turtles whereas in the Fall 2017 survey it was loggerhead and Kemp's ridley turtles. For the remaining surveys, loggerhead turtles were the most abundant species (Table 19, Figure 72). Green turtles were only found in the Summer 2016 survey (Table 19, Figure 72).

3.6.3. Spatial Distribution

Most turtles observed during the Summer along with leatherback turtles observed during the Fall occurred inside the 70-m isobath (Figure 73, Figure 74). Other than depth, there were no obvious patterns among species or seasons.

3.6.4. Direction of Travel

Turtle travel direction predominately followed a west-to-east and east-to-west direction in the Summer surveys with minimal data available in the other seasons (Figure 75).

Table 19. Turtle Species Identified and Corrected Number of Individuals in the OPA from the Summer 2016 through Spring 2018 Surveys

	Corrected Abundance[1]								
	Summer		Fall		Winter		Spring		
Species	2016	2017	2016	2017	2016–2017	2017–2018	2017	2018	Total
Leatherback Turtle	123	70	315	28	0	0	0	0	**536**
Loggerhead Turtle	5,297	9,060	67	69	11	0	66	0	**14,570**
Loggerhead/Kemp's Turtle	137	279	0	14	0	0	27	0	**457**
Green Turtle	14	0	0	0	0	0	0	0	**14**
Kemp's Ridley Turtle	205	335	11	69	0	0	13	0	**633**
Turtle-species unknown	1,870	181	45	0	0	0	27	14	**2,137**
Season Total	**7,646**	**9,925**	**438**	**180**	**11**	**0**	**133**	**14**	**18,347**

[1] Corrected abundance was calculated by dividing the observed abundance by the percent of the area surveyed for each season. This accounts for differing amounts of area surveyed and makes abundances comparable across seasons. Corrected abundance values are frequently non-integers that have been rounded to whole numbers for display purposes. Column and row totals may not equal the sum of numbers shown in the table because the underlying values are non-integers.

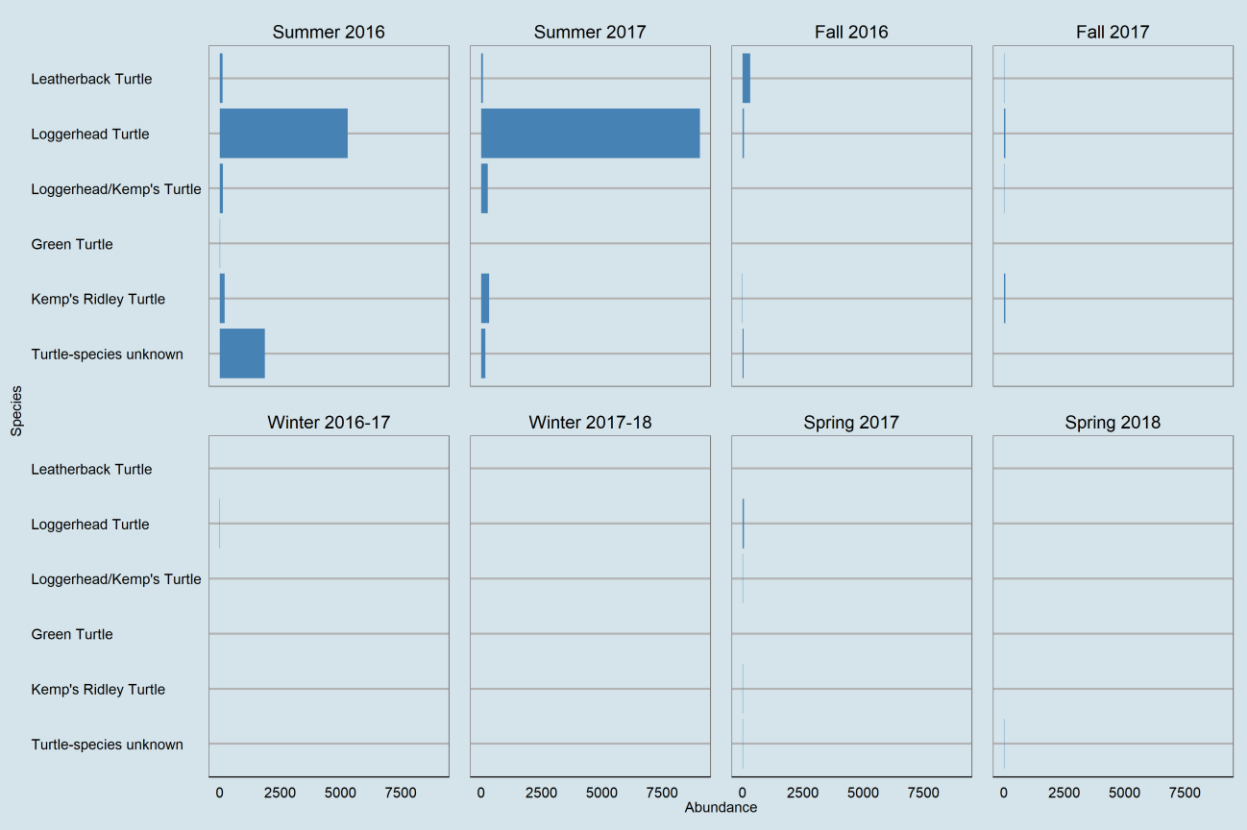

Figure 72. Relative abundance (corrected for effort) for each turtle species during the Summer 2016–Spring 2018 surveys.

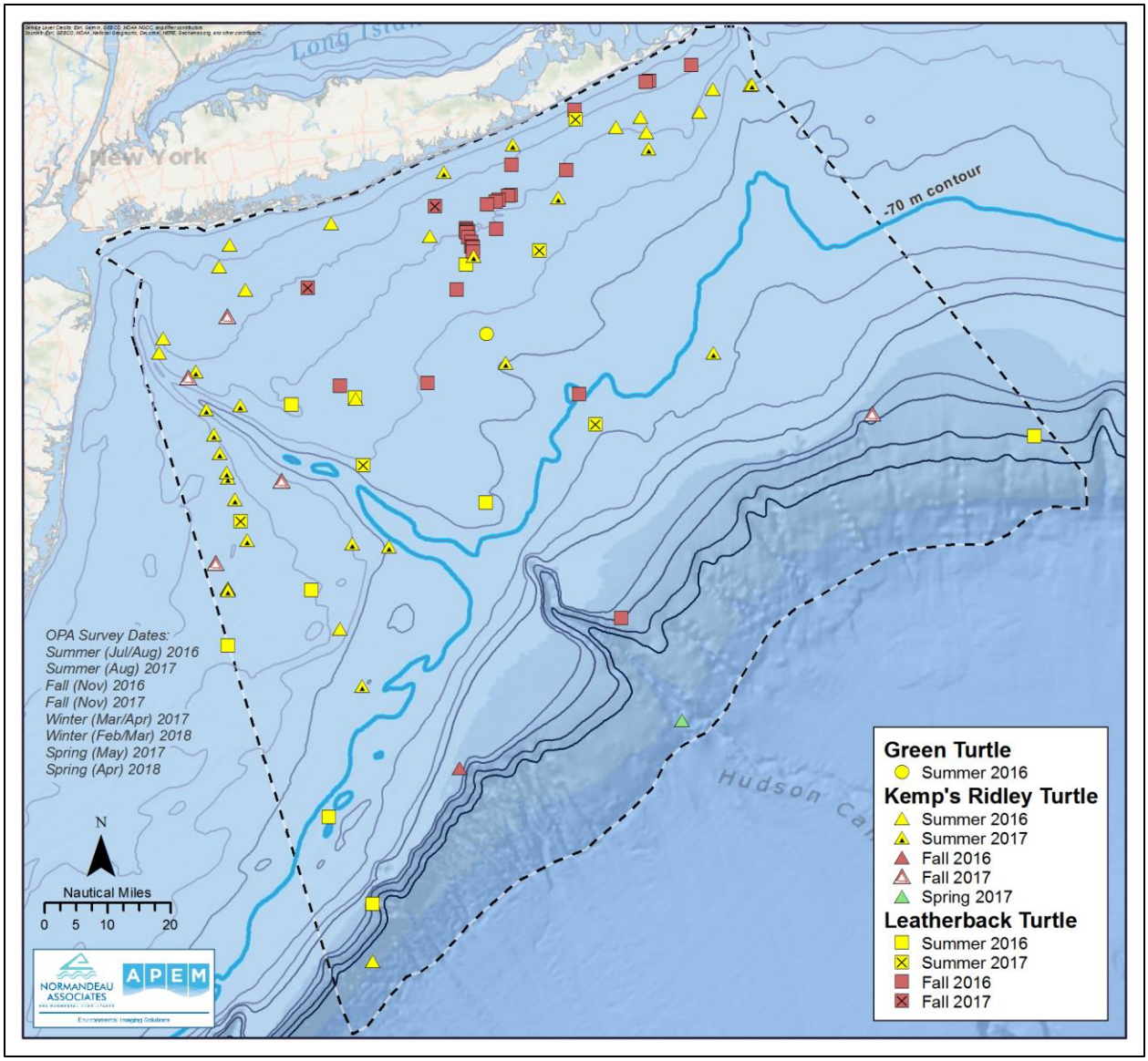

Figure 73. Distribution of green, Kemp's ridley, and leatherback turtles during the Summer 2016–Spring 2018 surveys.

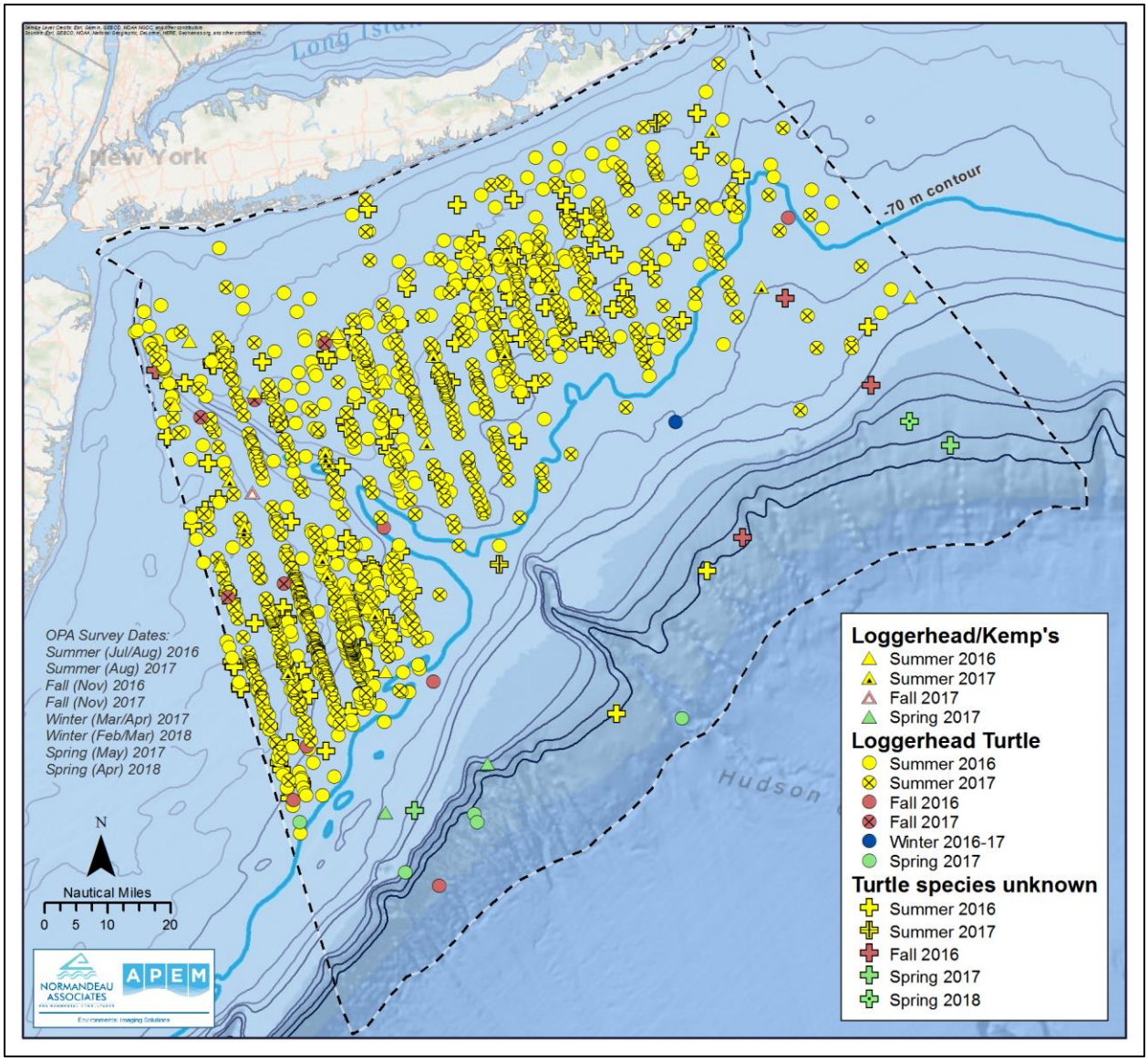

Figure 74. Distribution of loggerhead/Kemp's, loggerhead, and unidentified turtles during the Summer 2016–Spring 2018 surveys.

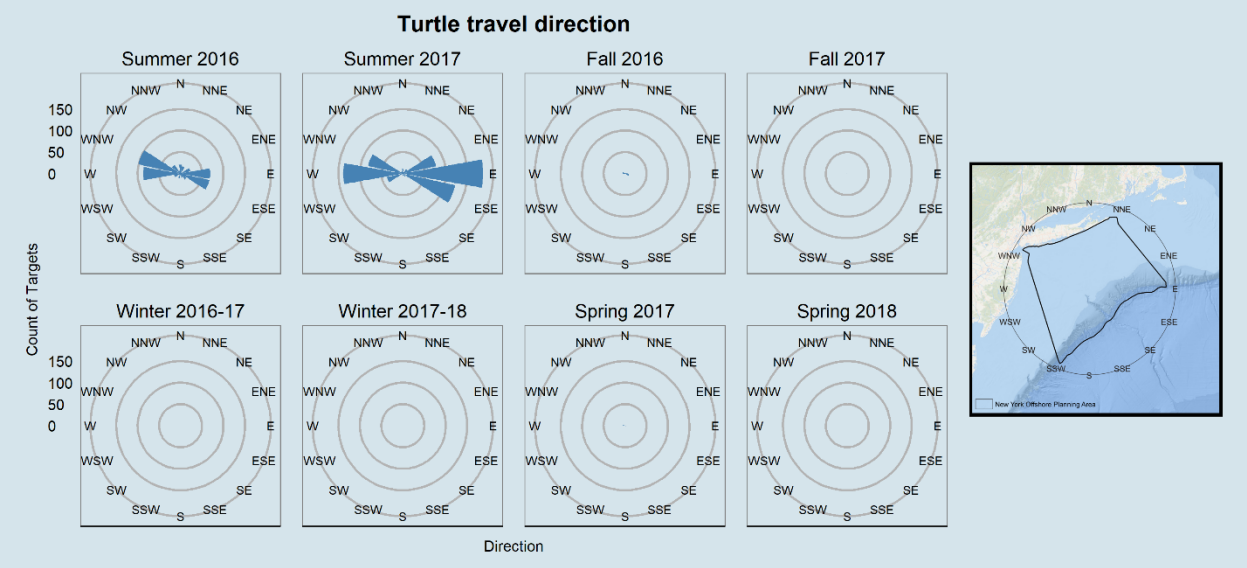

Figure 75. Direction of travel for turtles observed during the Summer 2016–Spring 2018 surveys.

3.7. Marine Mammals

3.7.1. Species Identification

Over the eight surveys, 9,954 marine mammals were identified in imagery in the OPA (Appendix F). Identification rates between marine mammal taxonomic groups varied with most (96%) mammals found being dolphins (n=9,555), only 1% found were whales (n=134), and 0.5% seals (n=64). There were 201 unidentified mammals (2%), which, based on size, were likely to be either dolphins or seals (Appendix F).

For dolphins, 3,356 were not ascribed to species. These included a species blend of common/white-sided dolphin (n=42), pilot whale unid. (n=212), and unidentified dolphins (n=3,102), which provided an identification rate of 34%. Of these, 2,624 (78%) were significantly submerged (Appendix F). Of the 3,102 unidentified dolphins, 2,471 (80%) were significantly submerged (Appendix F). Of the 201 animals that could have been either dolphin or seal, 161 (80%) were significantly submerged.

Sixty-four seals were found in imagery across the eight surveys (Appendix F), of which 10 individuals (16%) were identified to species. Sixteen of the remaining 54 (30%) were rated as significantly submerged (Appendix F).

Across the eight surveys, 134 whales were found in the imagery. Ninety-seven (72%) were identified to species, 18 (13%) were identified as beaked whale (unid.), and 19 (14%) remained as whale species unknown. Of the 19 unidentified whales, 16 (84%) were significantly submerged (Appendix F).

3.7.2. Species Composition and Abundance (Corrected for Effort)

During the first eight surveys in the OPA, marine mammal observations included 96% dolphins, 2% unidentified mammals, <1% seals, and 1% whales (Table 20).

Seals were the least abundant of the identified marine mammals consisting of <1% of the total observations. Seals were not observed during the Summer 2016 survey; although, there were 2 unidentified seals found during the Summer 2017 survey. One harp seal was observed during the Spring 2017 survey, and two gray seals in the Spring 2018 survey (see Appendix F for raw numbers), but most seals (75%) were found during the Fall 2016 and Winter 2016–2017 surveys (Table 20, Figure 76, and Appendix F).

Fin whales were the most abundant species during the 2016 and 2017 Summer and Fall surveys, while common minke whales were the most abundant species during the Winter 2016–2017 and Spring 2017 and 2018 surveys (Table 20). Humpback whales had the same relative abundance as common minke whales in Spring 2017, but were outnumbered by minke and sei whales in the Spring 2018 survey (Table 20, Figure 77). Sperm whales were only observed in the Fall 2016 and Summer 2017 surveys, dwarf sperm whales were only present in the Summer 2017 survey, and pygmy sperm whales were only present in the Fall 2017 survey (Table 20, Figure 77).

Common dolphins were the most frequently encountered species in all surveys except for the Summer 2016 survey, where Risso's dolphins were the most frequently encountered identified dolphins (Table 20, Figure 78). Unknown dolphins were the most abundant during the Summer 2016 and Fall 2016 surveys. Risso's, common, and bottlenose dolphins were present for all surveys (Table 20, Figure 78). Rough-toothed dolphins were present in the Winter 2016–2017 and Summer 2017 surveys and striped dolphins were present in the Fall 2016, Winter 2016–2017, Winter 2017–2018, Summer 2017, and Spring 2018 surveys (Table 20, Figure 78).

3.7.3. Spatial Distribution

Whales showed a preference for the deeper waters nearer the shelf break; although, fin, humpback, minke, sei, and north Atlantic right whales were also found elsewhere in the OPA. No seasonal distribution patterns were evident as numbers of whales were low (Figure 79, Figure 80).

Bottlenose dolphins, common dolphins, and harbor porpoises were fairly widespread for all surveys, with perhaps some concentration in the deeper half of the OPA in the Winter and along the shelf break in the Spring (Figure 81). The less abundant pilot whales, Risso's dolphins, striped dolphins, Atlantic white-sided dolphins, Atlantic spotted dolphins, and rough-toothed dolphins showed a definite preference for deeper water at the shelf break for all seasons (Figure 82, Figure 83).

3.7.4. Direction of Travel

Whale travel direction was primarily to the ESE in the Fall 2016, Winter 2016–2017, and Spring 2017 surveys (Figure 84). There was some variability in travel direction during the Fall 2017, Winter 2017–2018, and Spring 2018 surveys and a more WNW preference in the Summer 2017 survey (Figure 84). Dolphin travel direction was primarily in a W and WNW to E and ESE direction and an ESE to WNW direction across all seasons (Figure 85).

Table 20. Marine Mammal Species Identified and Corrected Number of Individuals in the OPA from the Summer 2016 through Spring 2018 Surveys

Subtype	Species	Corrected Abundance[1]								Total
		Summer		Fall		Winter		Spring		
		2016	2017	2016	2017	2016–2017	2017–2018	2017	2018	
Seal	Gray Seal	0	0	11	0	33	0	0	28	**72**
	Harp Seal	0	0	0	0	0	0	13	0	**13**
	Harbor Seal	0	0	0	0	11	28	0	0	**39**
	Seal-species unknown	0	28	135	14	343	42	0	70	**631**
	Season Total	0	28	146	14	387	70	13	98	**756**
Whale	North Atlantic Right Whale	0	0	0	0	44	0	27	0	**71**
	Blue Whale	0	0	11	0	11	0	0	0	**22**
	Common Minke Whale	14	0	0	14	77	14	66	112	**297**
	Fin Whale	137	56	56	55	55	28	13	42	**442**
	Sei Whale	0	14	0	0	0	0	0	84	**98**
	Humpback Whale	0	0	11	41	22	0	66	70	**210**
	Dwarf Sperm Whale	0	28	0	0	0	0	0	0	**28**
	Pygmy Sperm Whale	0	0	0	28	0	0	0	0	**28**
	Sperm Whale	0	42	22	0	0	0	0	0	**64**
	Beaked Whale (unid.)	109	0	45	0	11	56	13	0	**234**
	Whale-species unknown	14	14	0	83	55	28	40	14	**248**
	Season Total	274	154	145	221	275	126	225	322	**1,742**
Dolphin	Common Dolphin	765	11,908	2,507	7,772	6,264	7,006	11,317	3,204	**50,743**
	Short-finned Pilot Whale	0	335	0	0	0	0	0	0	**335**
	Pilot Whale (unid.)	1,393	726	101	276	0	0	385	0	**2,881**
	Risso's Dolphin	2,266	1,954	1,394	511	542	792	1,740	2,294	**11,493**
	Atlantic White-sided Dolphin	0	0	180	0	77	28	0	0	**285**
	Rough-toothed dolphin	0	209	0	0	11	0	0	0	**220**
	Atlantic Spotted Dolphin	0	0	607	0	0	0	40	0	**647**
	Striped Dolphin	0	84	843	0	55	1,251	0	1,133	**3,366**

Subtype	Species	Corrected Abundance[1]								Total
		Summer		Fall		Winter		Spring		
		2016	2017	2016	2017	2016–2017	2017–2018	2017	2018	
	Bottlenose Dolphin	1,311	2,443	663	939	1,461	403	2,298	686	**10,204**
	Common/White-sided Dolphin	0	0	0	0	177	0	53	308	**538**
	Harbor Porpoise	0	0	45	0	2,125	375	226	1,189	**3,960**
	Dolphin-species unknown	6,608	1,773	5,937	7,358	6,064	4,921	4,636	2,504	**39,801**
	Season Total	12,343	19,432	12,277	16,856	16,776	14,776	20,695	11,318	**124,473**
Unid. Mammal	Unid. Mammal-species unknown	0	572	0	69	365	69	1,474	84	**2,633**
	Season Total	0	572	0	69	365	69	1,474	84	**2,633**
	Seasonal Grand Total	12,617	20,186	12,568	17,160	17,803	15,041	22,407	11,822	**129,604**

[1] Corrected abundance was calculated by dividing the observed abundance by the percent of the area surveyed for each season. This accounts for differing amounts of area surveyed and makes abundances comparable across seasons. Corrected abundance values are frequently non-integers that have been rounded to whole numbers for display purposes. Column and row totals may not equal the sum of numbers shown in the table because the underlying values are non-integers.

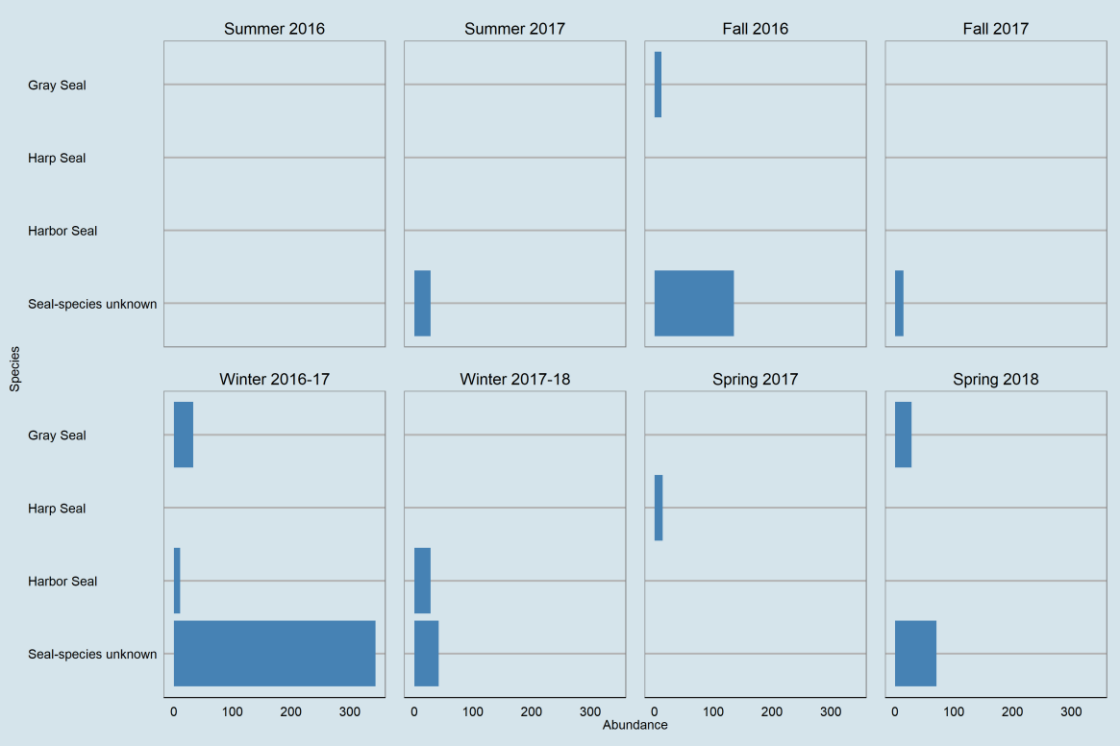

Figure 76. Relative abundance (corrected for effort) for each seal species during the Summer 2016 through Spring 2018 surveys.

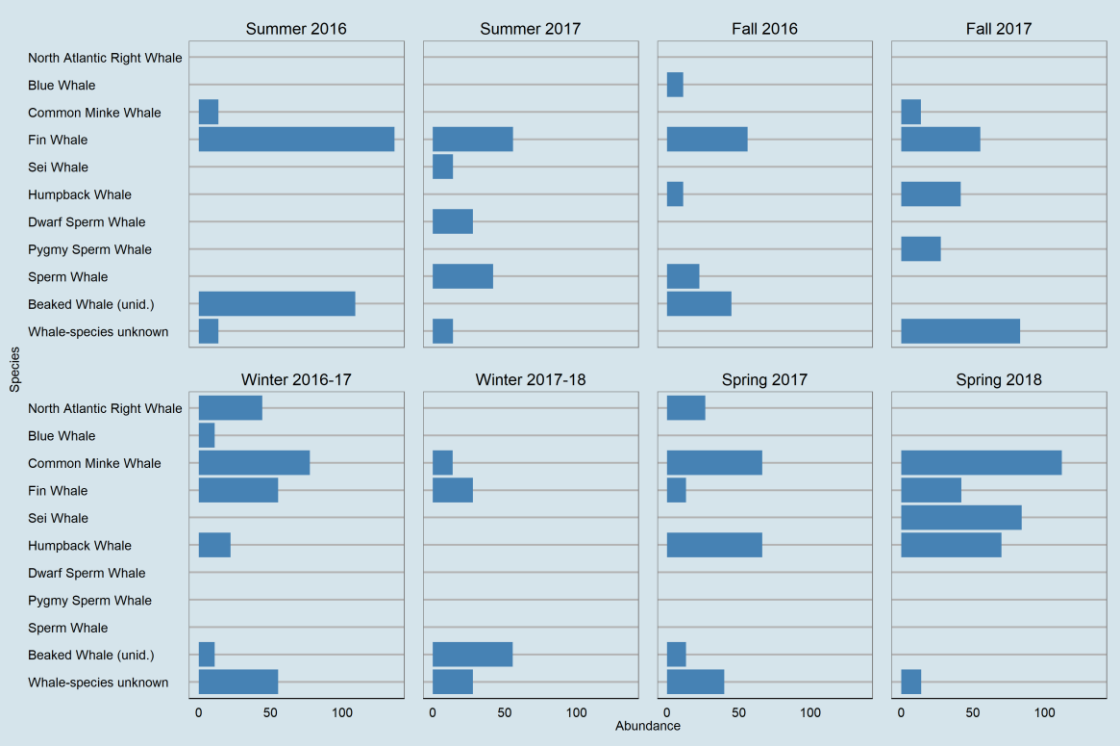

Figure 77. Relative abundance (corrected for effort) for each whale species during the Summer 2016 through Spring 2018 surveys.

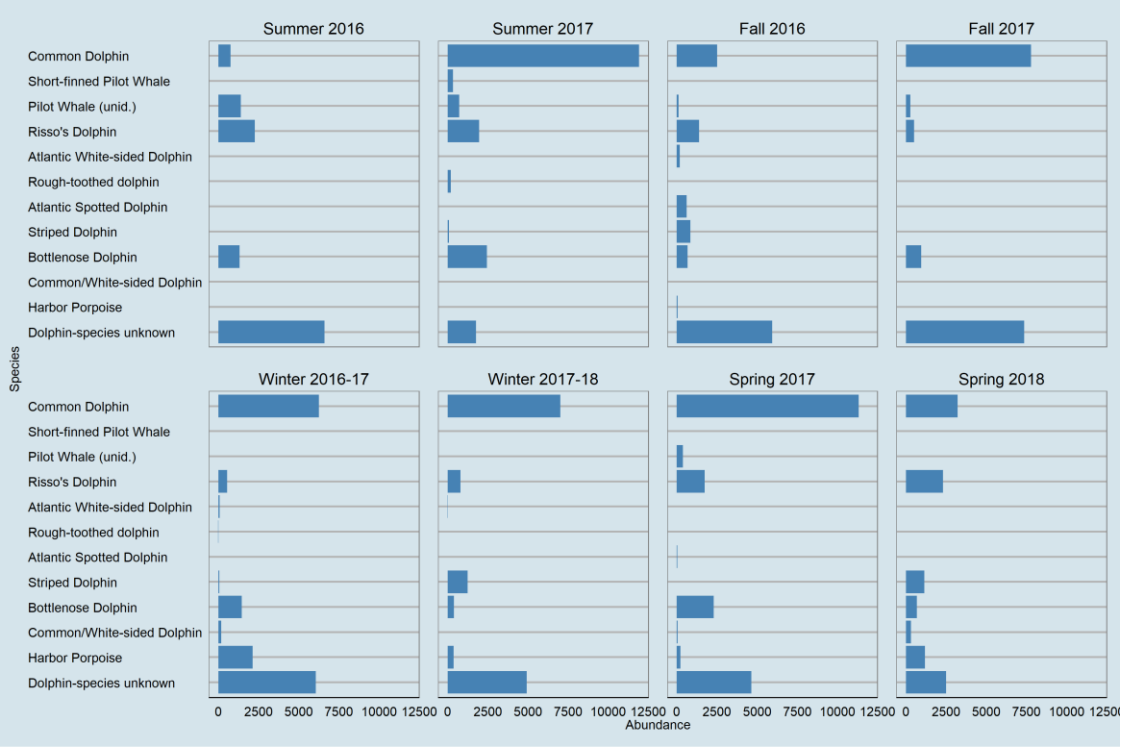

Figure 78. Relative abundance (corrected for effort) for each dolphin identified during the Summer 2016 through Spring 2018 surveys.

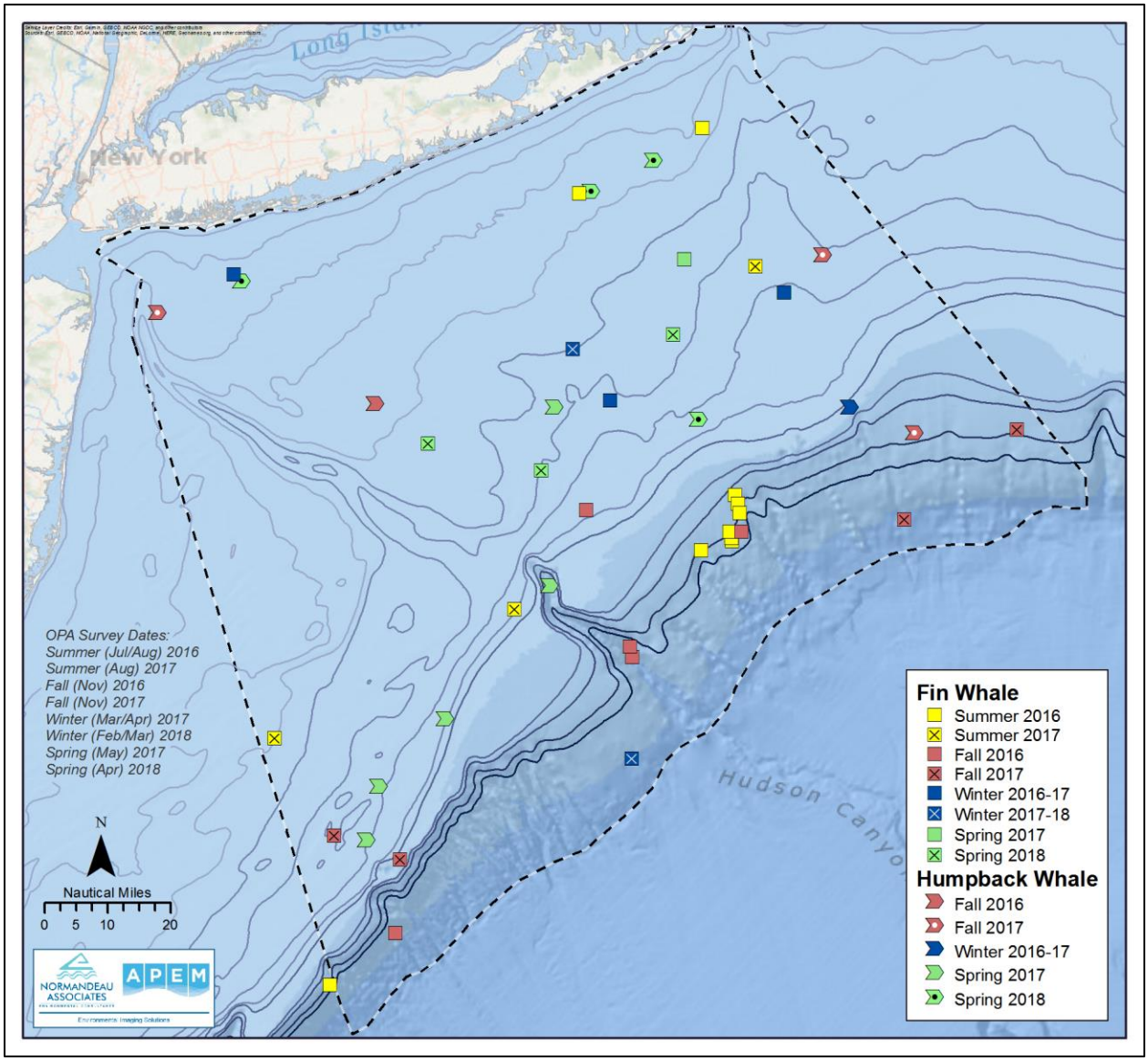

Figure 79. Distribution of fin and humpback whales during the Summer 2016–Spring 2018 surveys.

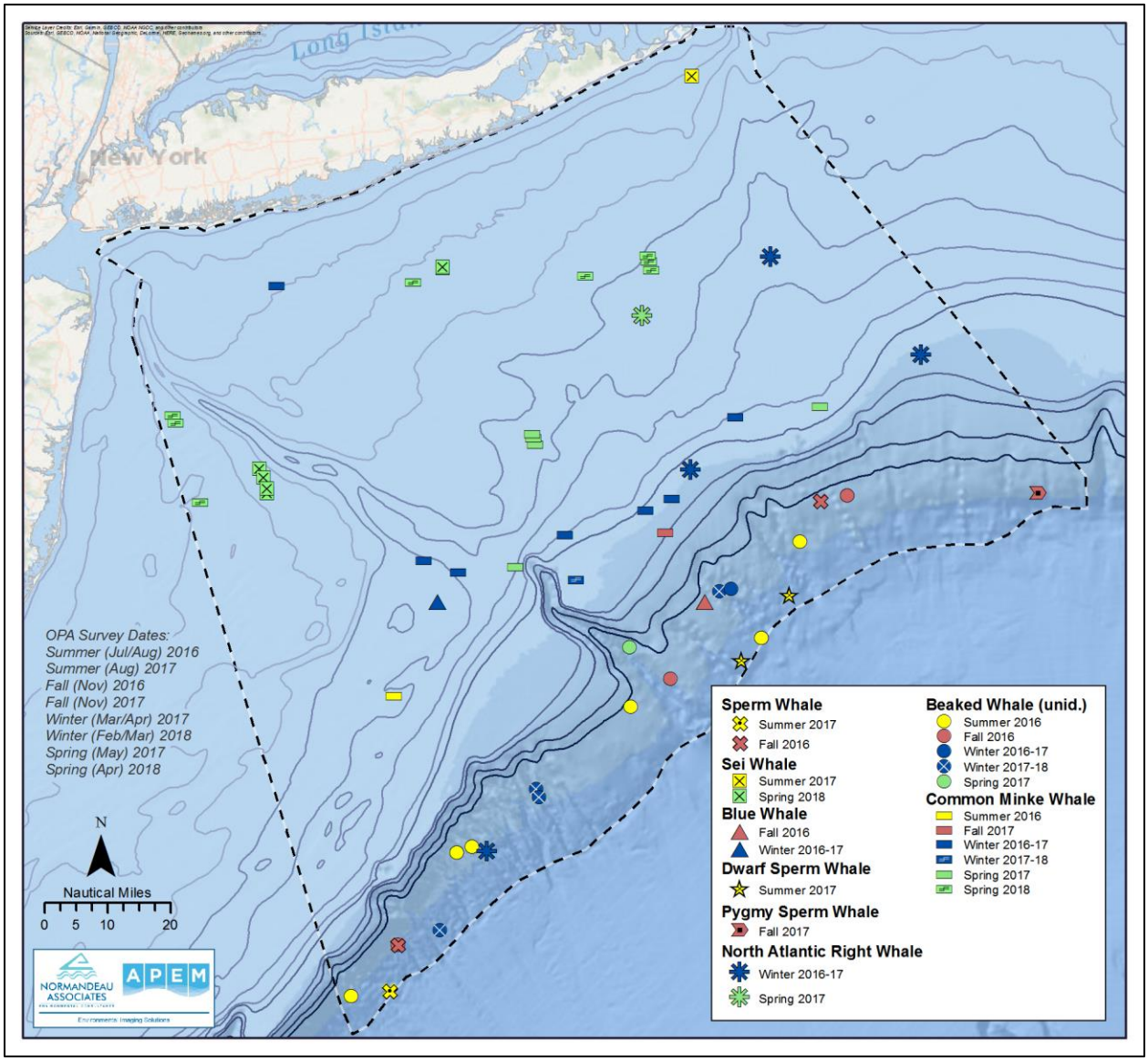

Figure 80. Distribution of sperm, sei, blue, dwarf sperm, pygmy sperm, north Atlantic right, unidentified beaked whale, and common minke whales during the Summer 2016–Spring 2018 surveys.

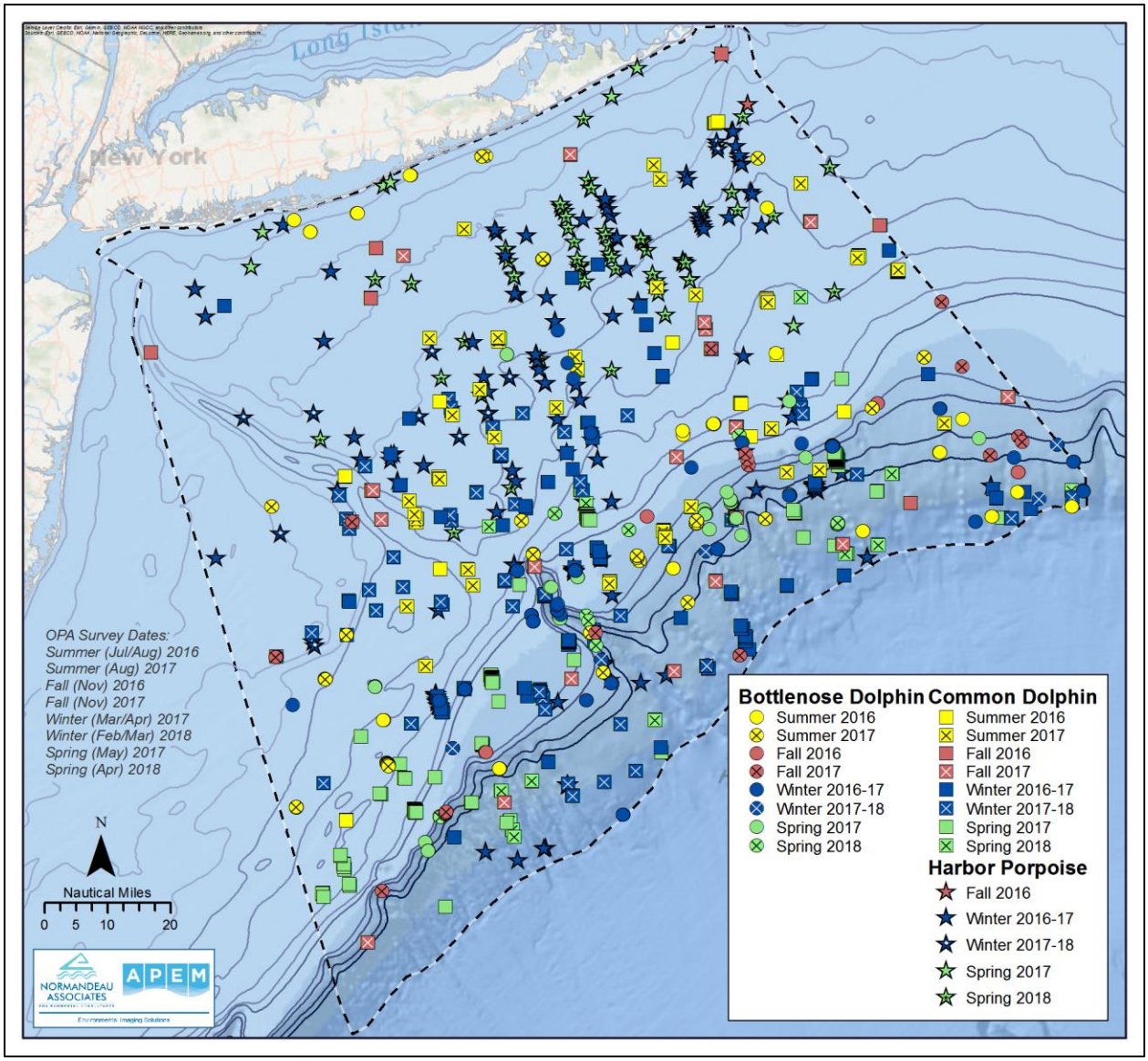

Figure 81. Distribution of bottlenose and common dolphins and harbor porpoise during the Summer 2016–Spring 2018 surveys.

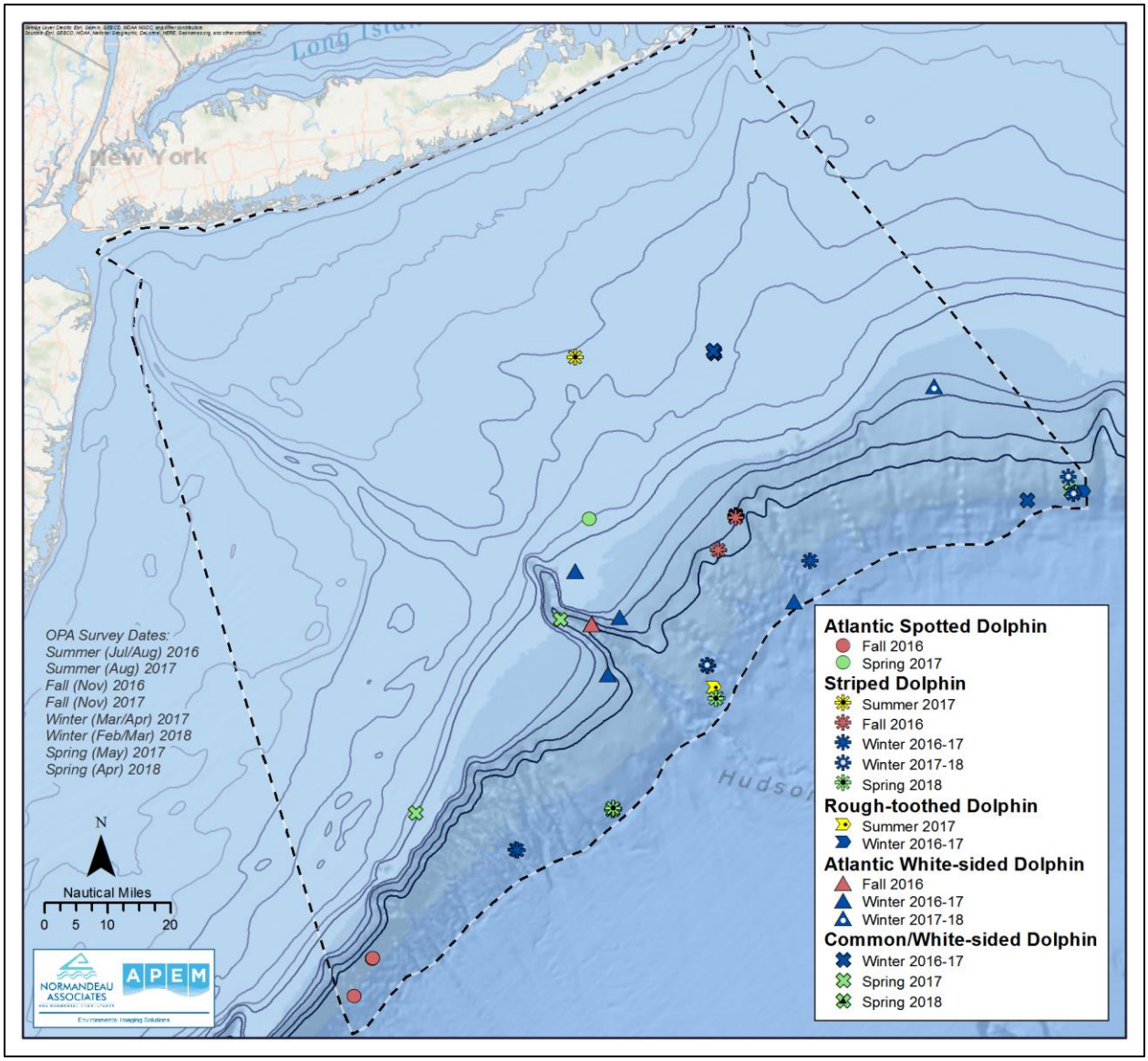

Figure 82. Distribution of Atlantic spotted, striped, rough-toothed, Atlantic white-sided, and common/white-sided dolphins during the Summer 2016–Spring 2018 surveys.

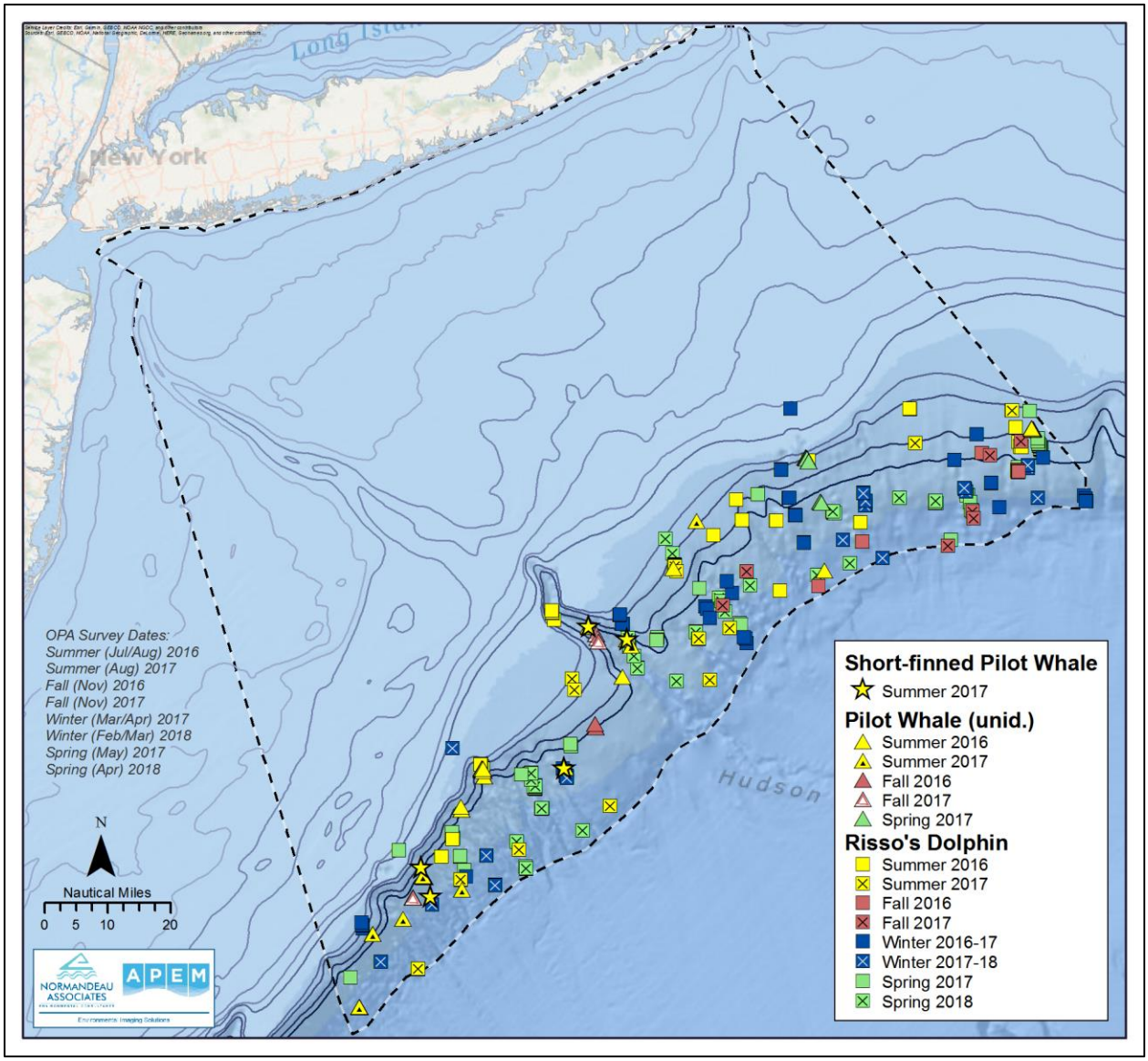

Figure 83. Distribution of short-finned pilot whales, unidentified pilot whales, and Risso's dolphins during the Summer 2016–Spring 2018 surveys.

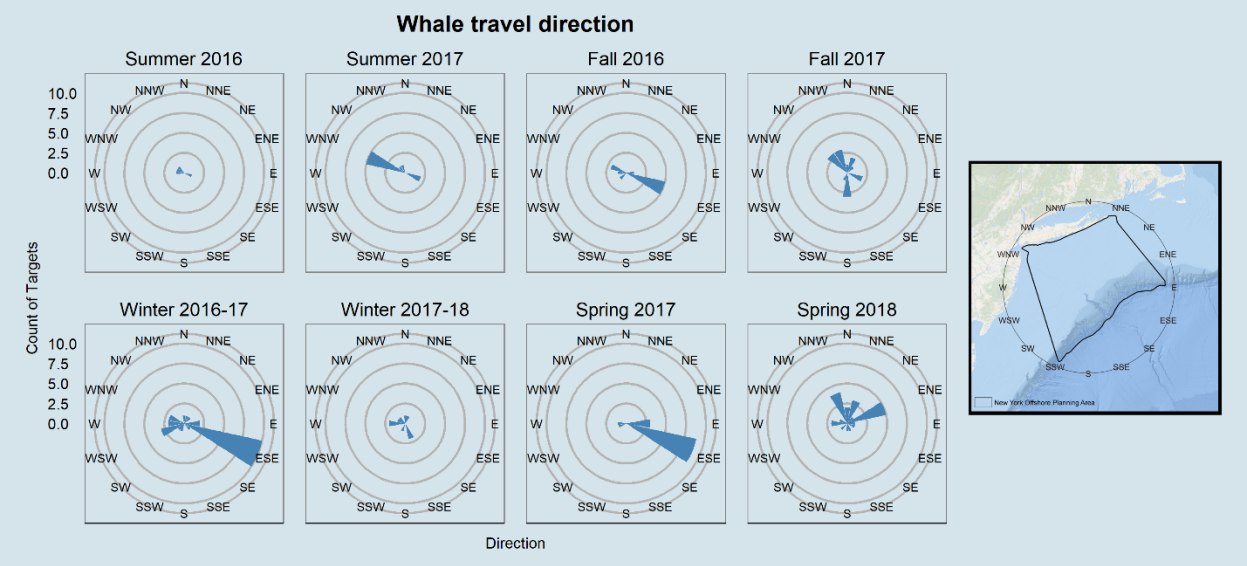

Figure 84. Direction of travel for whales observed during the Summer 2016 through Spring 2018 surveys.

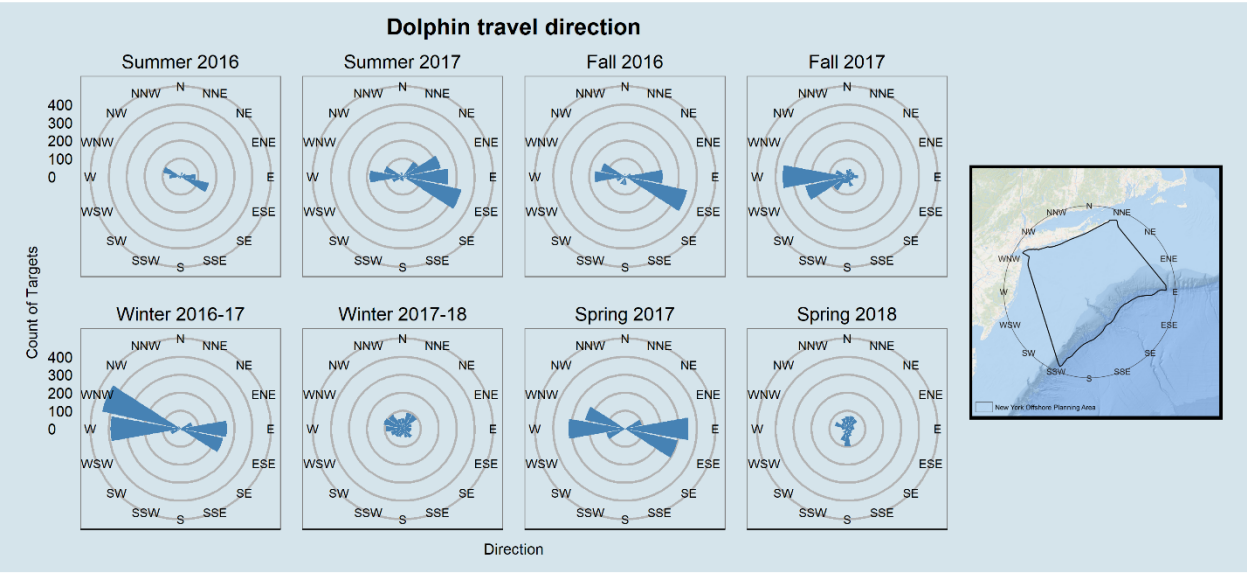

Figure 85. Direction of travel for dolphins observed during the Summer 2016 through Spring 2018 surveys.

3.8. Rays and Sharks

3.8.1. Species Identification

There were 15,733 rays found in the imagery in the OPA (Appendix G) and they were found only in the two summer and two fall surveys. Across all surveys, 50% of rays (n= 7,893) were ascribed to species. There were 5,444 rays ascribed to the species blend cownose/bullnose ray and 2,397 as ray species

unknown (Appendix G). Of the cownose/bullnose ray group, 72% (n=3,931) were rated as significantly submerged as were 82% (n=1,966) of the ray species unknown (Appendix G).

Over all eight surveys, the identification success for sharks varied between taxonomic groups (Appendix G). Of the 25,193 sharks found in the Summer 2016 through Spring 2018 surveys in the OPA, 91% (n=22,871) were spurdogs found in the Spring 2018 survey (Figure 86; Appendix G). Of the remaining sharks, 3% (n=732) were identified as shark species unknown, 2% (n=457) were Carcharhinidae (unid.), and 1% (n=357) were hammerhead (unid.), making a total of 1,546 unidentified sharks and an identification success rate of 94% to species (Appendix G). Many of these species are difficult to distinguish at even very close quarters. There were 257 (56%) of the Carcharhinidae (unid.), 175 (49%) of the hammerhead (unid.), and 380 (52%) of the shark species unknown that were significantly submerged (Appendix G).

Figure 86. Spurdogs found in the Spring 2018 survey

3.8.2. Species Composition and Abundance (Corrected for Effort)

Rays were only observed in the OPA during the Summer and Fall surveys (Table 21, Figure 87) with densities greater in the summer. Only <1% of ray observations occurred in the Fall surveys (Table 21, Figure 87). Of the rays recorded in the Summer surveys in the OPA, 48% were cownose rays, 35% were identified as cownose/bullnose rays, 1% giant devil ray, <1% Chilean devil ray, and <1% giant manta rays (Table 21, Figure 87). The remaining 15% of rays were not ascribed to species or species group (Table 21). Of the six rays recorded during the Fall surveys, one giant devil ray and one cownose/bullnose ray were identified (Appendix G). The remaining rays were not ascribed to species or species group (Table 21, Figure 87, and Appendix G).

The majority (91%) of shark observations occurred during the Spring 2018 survey (Table 22). The remaining shark observations were mainly in the Summer surveys across the OPA. Only blue sharks, basking sharks, great white shark, scalloped hammerhead, smooth hammerhead, tiger sharks, hammerhead (unid.), and unknown shark species were observed during the Fall surveys. During the Winter 2016–2017 and Winter 2017–2018 surveys, only basking shark, blue shark, spurdog, and unknown shark species were found. For the Spring 2017 survey, only basking shark, blue shark, great white shark, unidentified Carcharhinidae, and unknown shark species were found (Table 22, Figure 88). Abundance of sharks was the third highest among seasons during Spring 2017 with basking sharks being the most abundant species (Table 22, Figure 88).

3.8.3. Spatial Distribution

During the Summer 2016 and 2017 surveys, which recorded the most rays, patterns of clumped distribution were evident on the western edges of the OPA for cownose, bullnose, and cownose/bullnose rays (Figure 89). When reviewing only unidentified rays, presence is more broadly distributed; although, the same clumped distributions are also evident along with additional aggregations including at the shelf

break (Figure 90). The shelf break aggregation of unidentified rays also correlates with aggregations of the larger manta rays and devil rays (Figure 91).

There were no clear distribution patterns among sharks, including scalloped hammerhead and hammerhead (unid.) sharks (Figure 92, Figure 93). However spurdogs in the Spring 2018 survey appeared to mainly stay east of the Hudson Canyon (Figure 94).

3.8.4. Direction of Travel

Travel direction for rays showed some preference for a WNW to ESE direction in the Summer surveys (Figure 95). Travel direction for sharks was highly variable but showed a similar WNW to ESE direction in the Summer 2017 survey (Figure 96).

Table 21. Ray Species Identified and Corrected Number of Individuals in the OPA from the Summer 2016 through Spring 2018 Surveys*

Species	Corrected Abundance[1]				Total
	Summer 2016	Summer 2017	Fall 2016	Fall 2017	
Bluntnose Stingray	14	0	0	0	**14**
Giant Manta Ray	55	28	0	0	**83**
Giant Devil Ray	2,116	237	0	14	**2,367**
Chilean Devil Ray	969	698	0	0	**1,667**
Bullnose Ray	0	1,215	0	0	**1,215**
Cownose/Bullnose Ray	47,295	27,628	11	0	**74,934**
Cownose Ray	44,714	59,039	0	0	**103,753**
Ray-species unknown	15,469	17,590	34	14	**33,107**
Season Total	**110,632**	**106,435**	**45**	**28**	**217,140**

*There were no observations during Winter and Spring surveys.

[1] Corrected abundance was calculated by dividing the observed abundance by the percent of the area surveyed for each season. This accounts for differing amounts of area surveyed and makes abundances comparable across seasons. Corrected abundance values are frequently non-integers that have been rounded to whole numbers for display purposes. Column and row totals may not equal the sum of numbers shown in the table because the underlying values are non-integers.

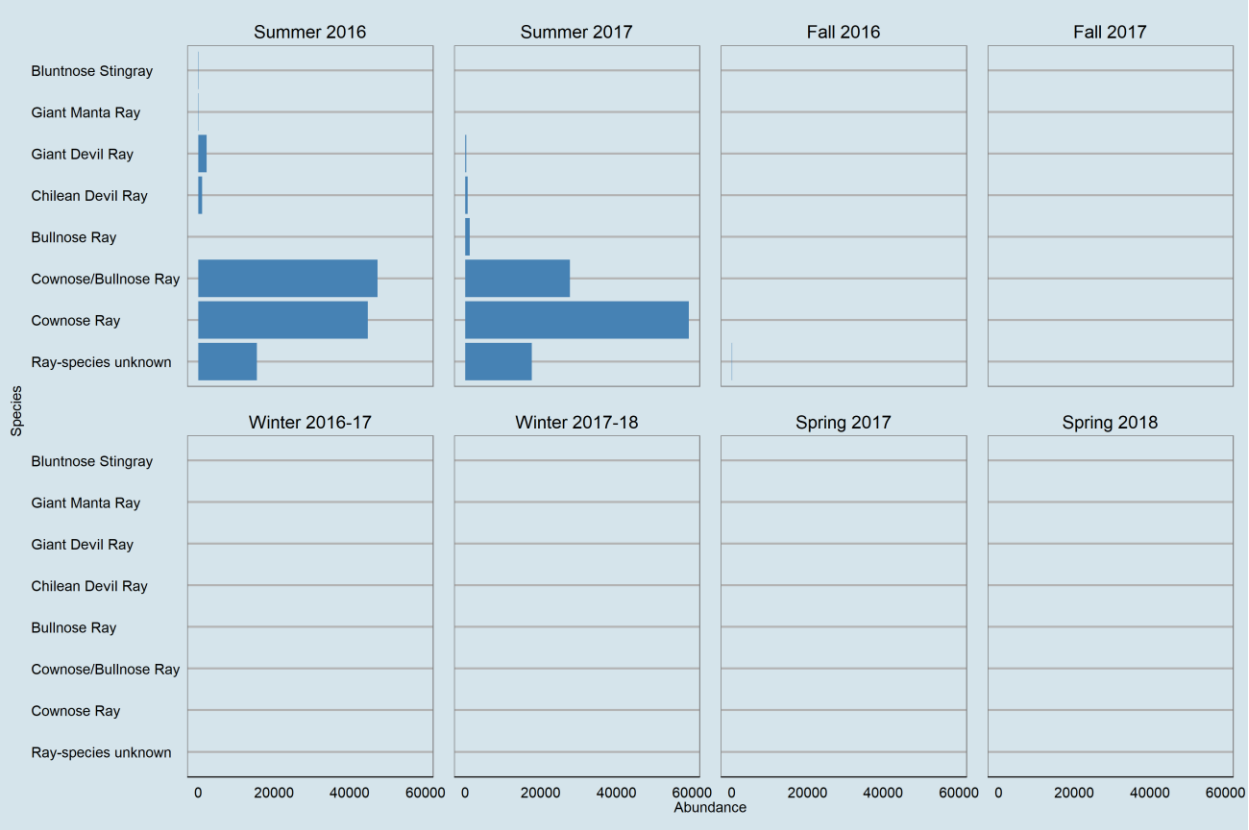

Figure 87. Relative abundance (corrected for effort) for each ray species identified during the Summer 2016 through Spring 2018 surveys.

Table 22. Shark Species Identified and Corrected Number of Individuals in the OPA from the Summer 2016 through Spring 2018 Surveys

Species	Corrected Abundance[1]								Total
	Summer		Fall		Winter		Spring		
	2016	2017	2016	2017	2016–2017	2017–2018	2017	2018	
Whale Shark	14	140	0	0	0	0	0	0	**154**
Sand Tiger Shark	0	14	0	0	0	0	0	0	**14**
Thresher Shark	27	70	0	0	0	0	0	0	**97**
Basking Shark	14	1,857	0	14	155	125	1,315	644	**4,124**
Great White Shark	14	181	0	14	0	0	27	0	**236**
Shortfin Mako	14	56	0	0	0	0	0	0	**70**
Blue Shark	68	293	22	41	22	28	452	210	**1,136**
Carcharhinidae (unid.)	1,802	4,467	0	28	0	0	40	0	**6,337**
Dusky Shark	14	28	0	0	0	0	0	0	**42**
Oceanic Whitetip Shark	14	0	0	0	0	0	0	0	**14**
Sandbar Shark	0	293	0	0	0	0	0	0	**293**
Tiger Shark	55	112	0	14	0	0	0	0	**181**
Great Hammerhead	109	14	0	0	0	0	0	0	**123**
Smooth Hammerhead	123	782	0	14	0	0	0	0	**919**
Scalloped Hammerhead	246	2,974	0	28	0	0	0	0	**3,248**
Hammerhead (unid.)	1,679	3,239	11	14	0	0	0	0	**4,943**
Spurdog	0	0	0	0	22	0	0	319,984	**320,006**
Shark-species unknown	4,587	4,774	11	14	89	0	558	28	**10,061**
Season Total	8,780	19,294	44	181	288	153	2,392	320,866	**351,998**

[1] Corrected abundance was calculated by dividing the observed abundance by the percent of the area surveyed for each season. This accounts for differing amounts of area surveyed and makes abundances comparable across seasons. Corrected abundance values are frequently non-integers that have been rounded to whole numbers for display purposes. Column and row totals may not equal the sum of numbers shown in the table because the underlying values are non-integers.

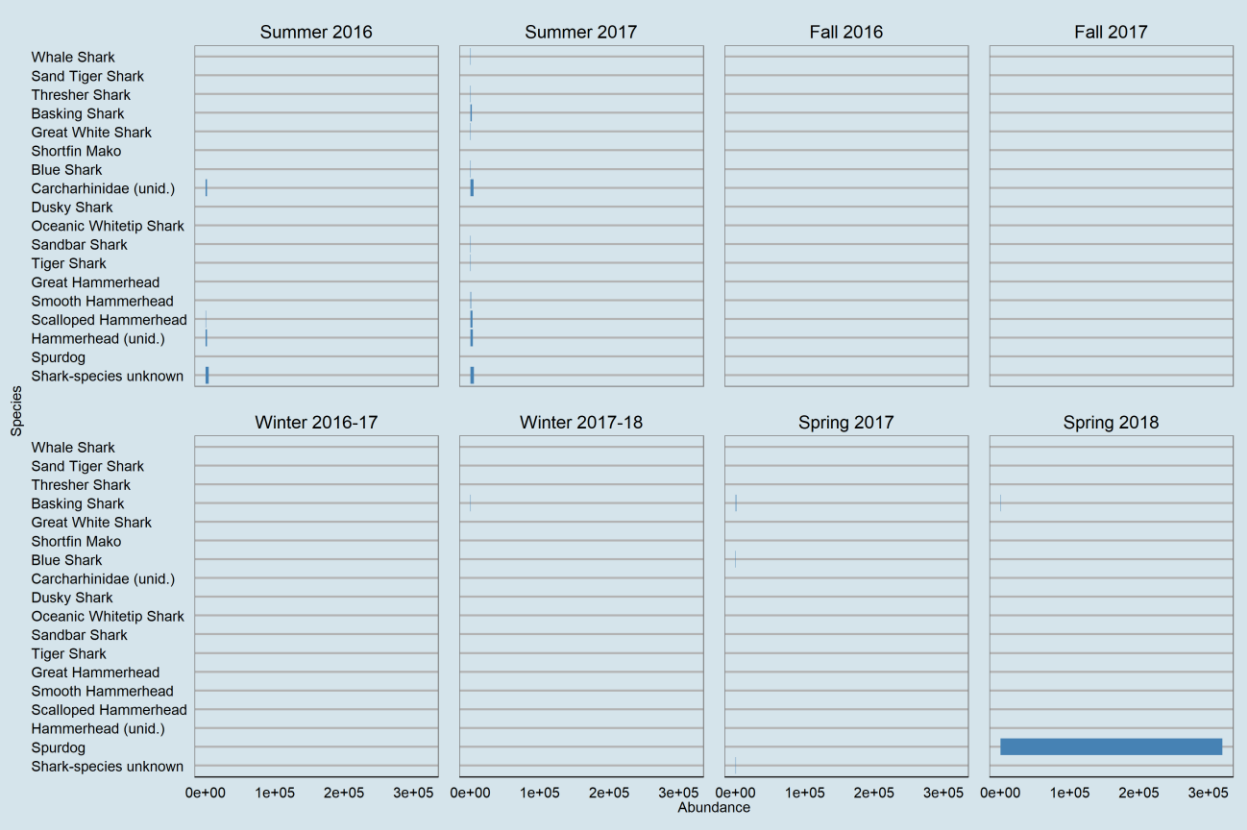

Figure 88. Relative abundance (corrected for effort) for each shark species identified during the Summer 2016 through Spring 2018 surveys.

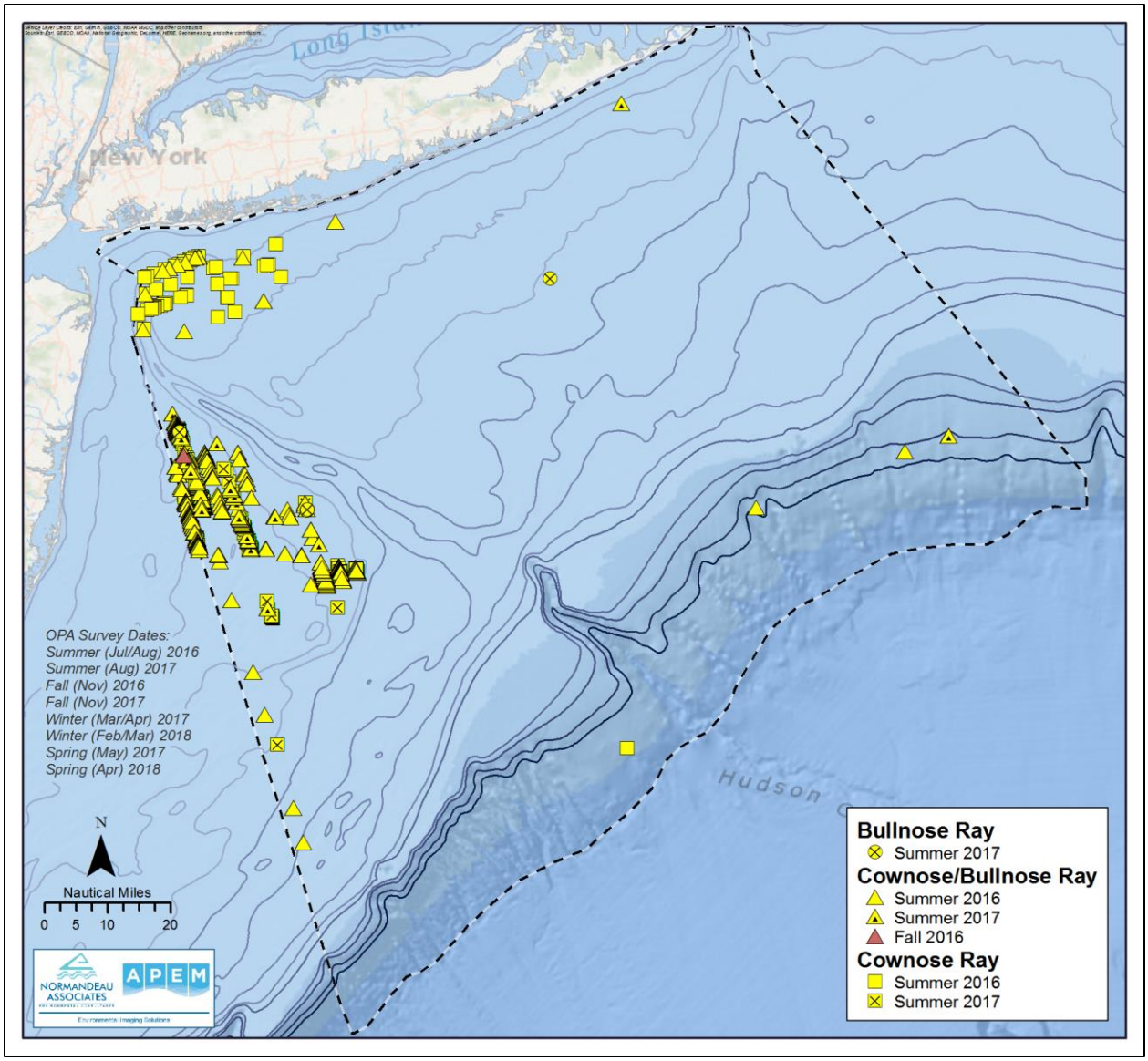

Figure 89. Distribution of bullnose, cownose/bullnose, and cownose rays during the Summer 2016–Spring 2018 surveys.

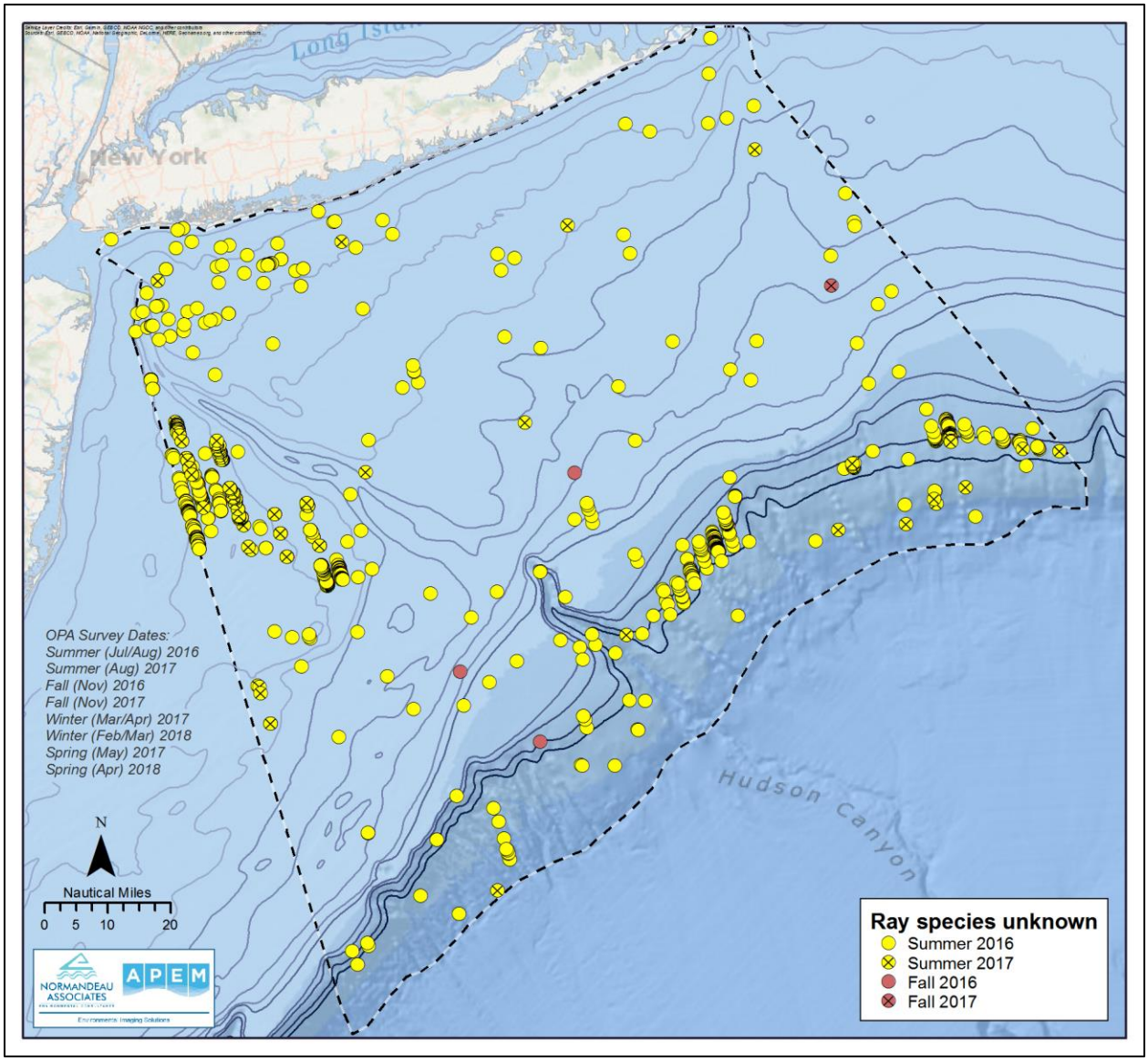

Figure 90. Distribution of unidentified rays during the Summer 2016–Spring 2018 surveys.

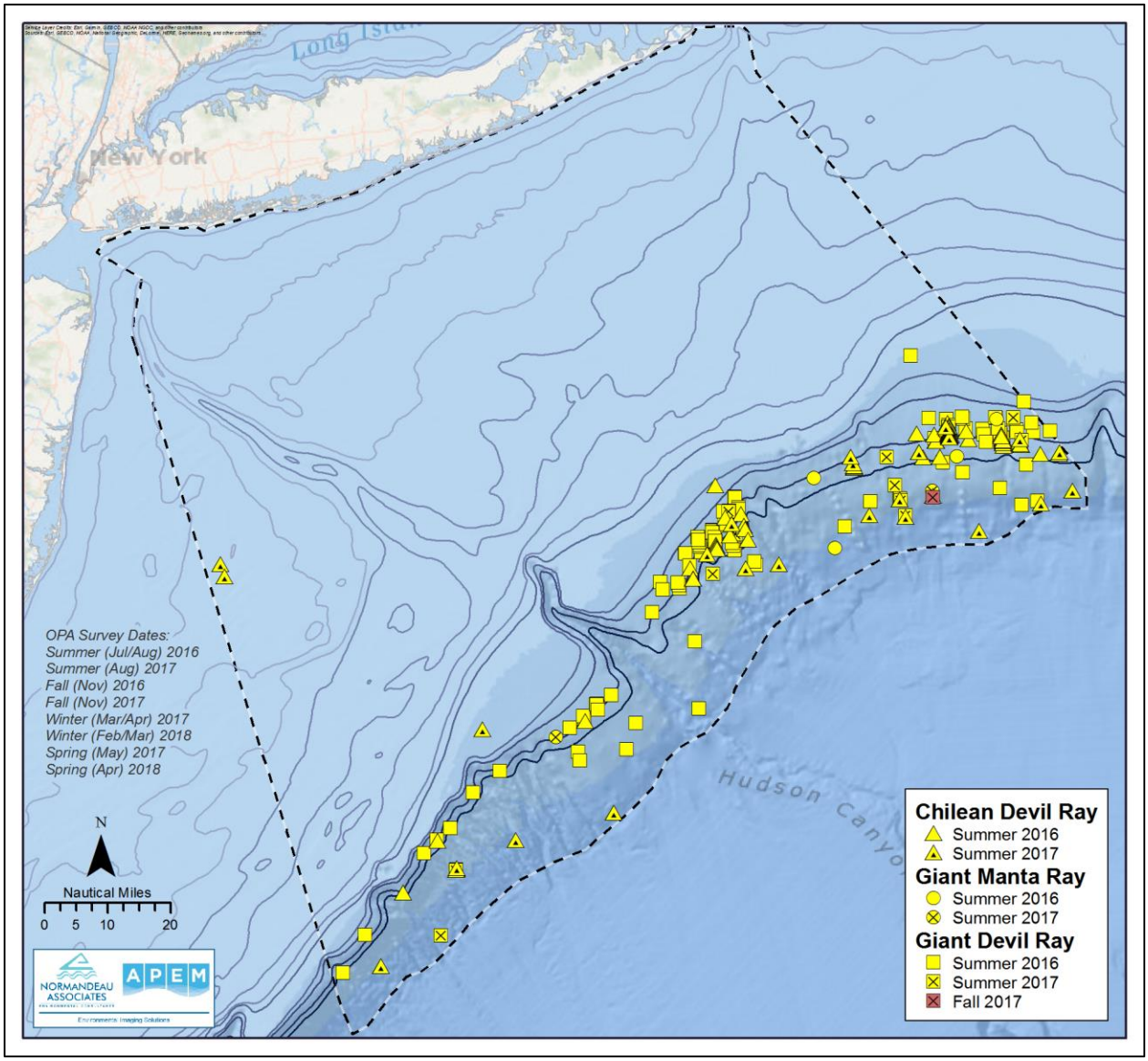

Figure 91. Distribution of Chilean devil, giant manta, and giant devil rays during the Summer 2016–Spring 2018 surveys.

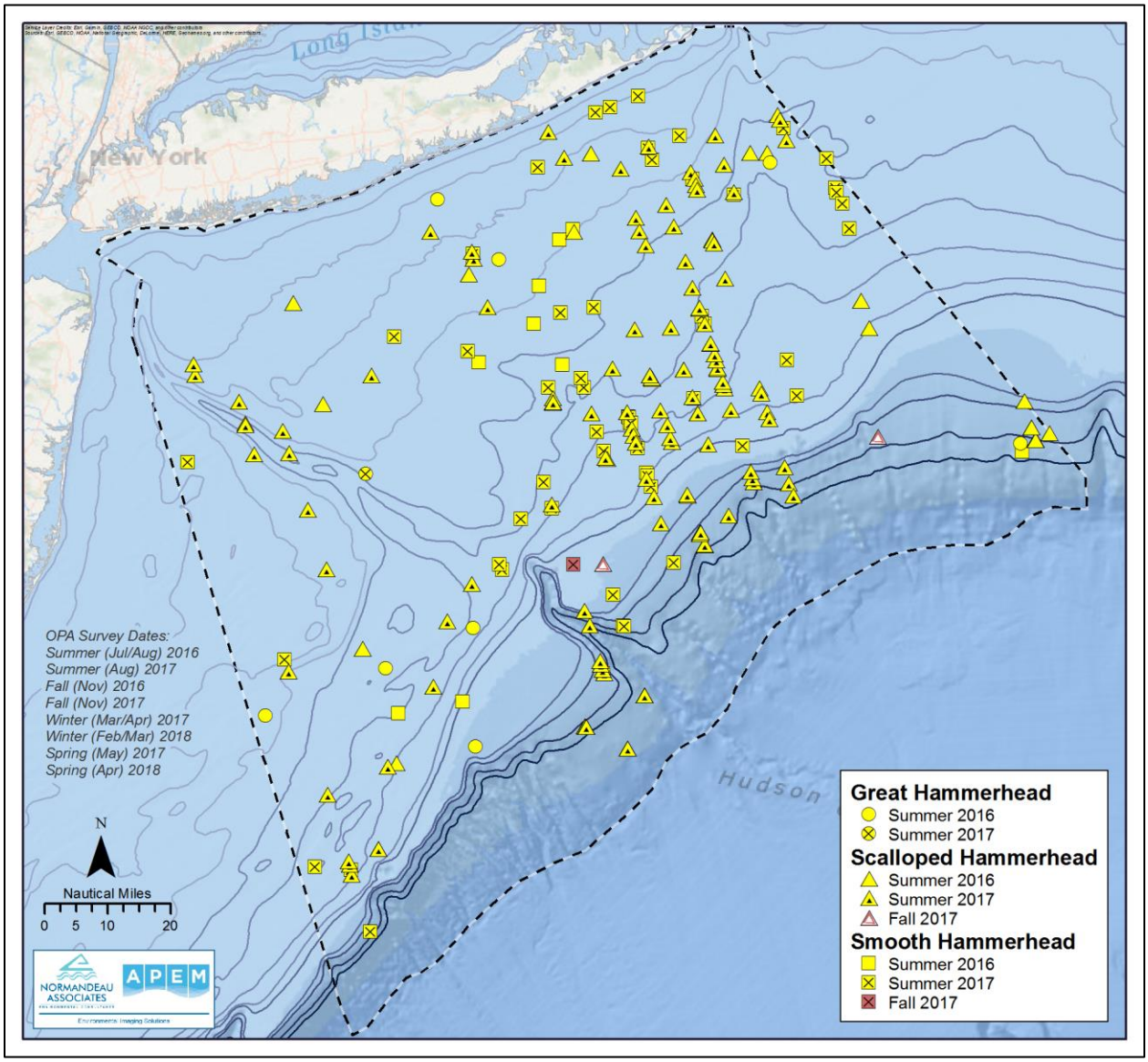

Figure 92. Distribution of great, scalloped, and smooth hammerhead sharks during the Summer 2016–Spring 2018 surveys.

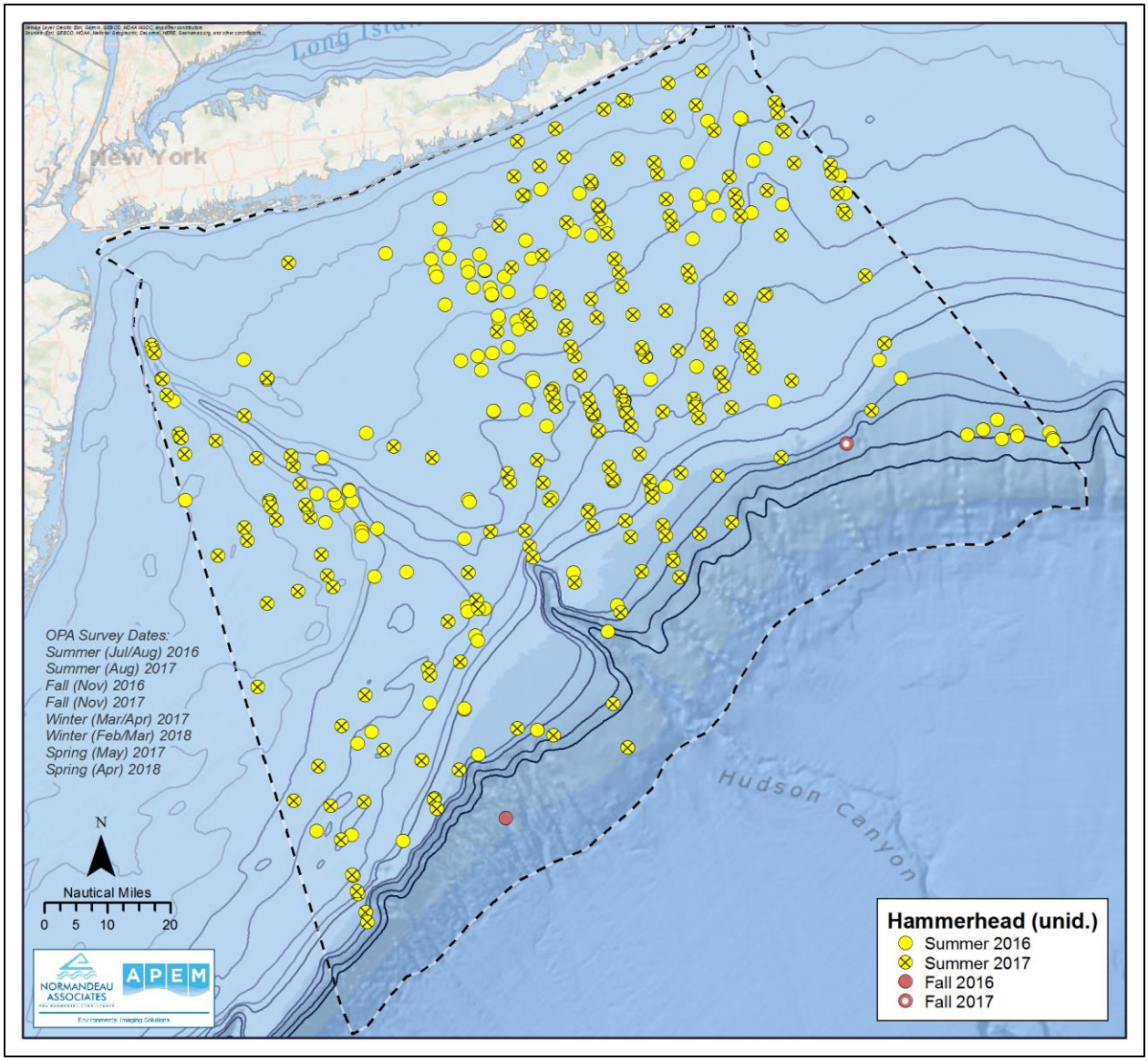

Figure 93. Distribution of unidentified hammerhead sharks during the Summer 2016–Spring 2018 surveys.

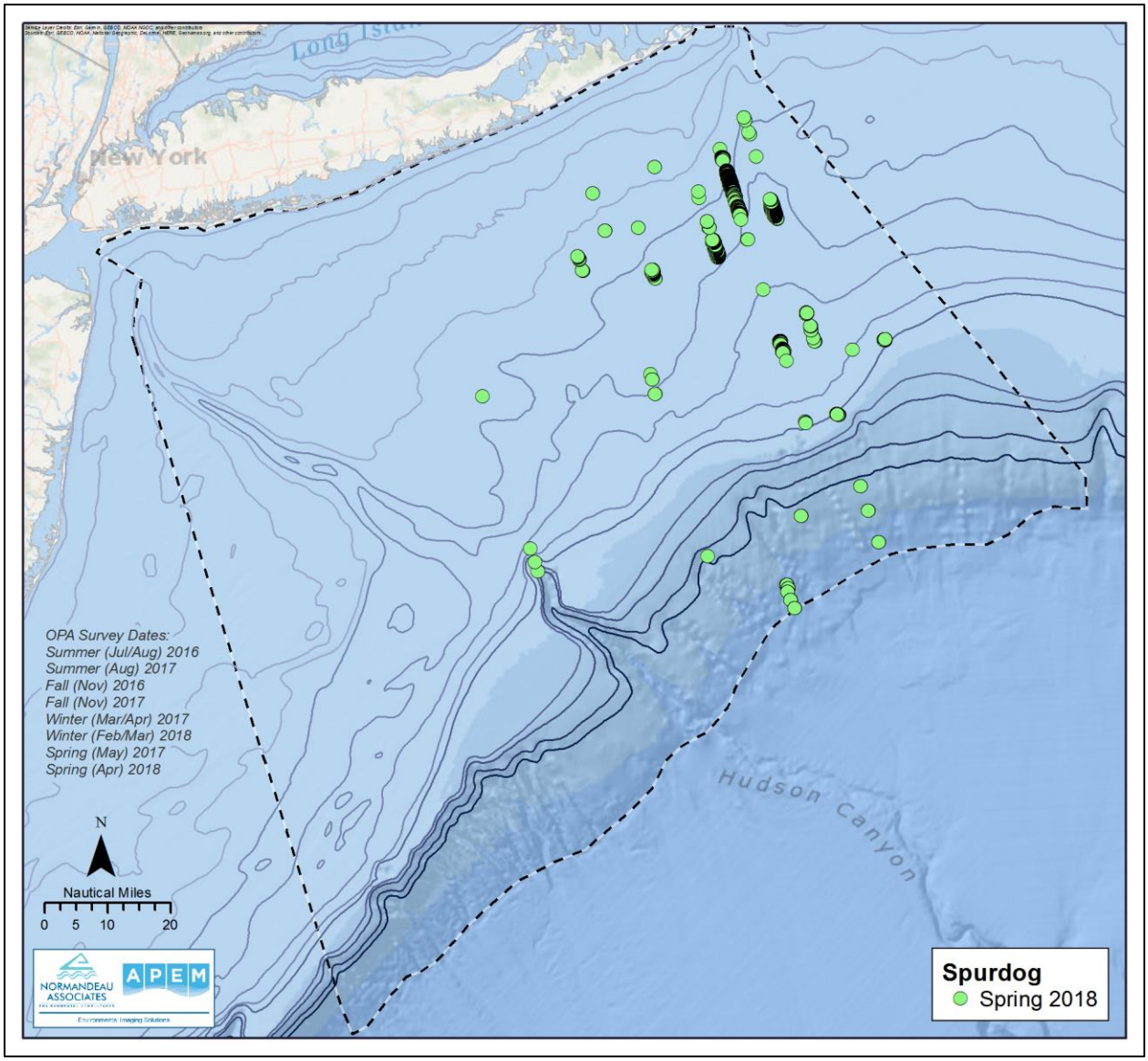

Figure 94. Distribution of spurdogs during the Spring 2018 survey.

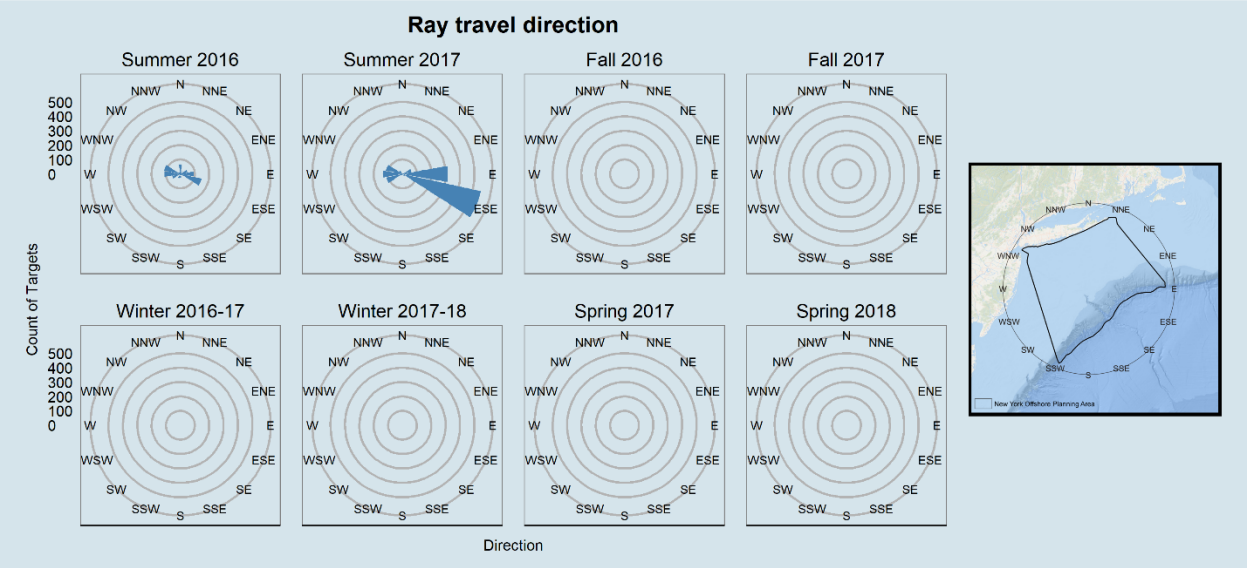

Figure 95. Direction of travel for rays observed during the Summer 2016 through Spring 2018 surveys.

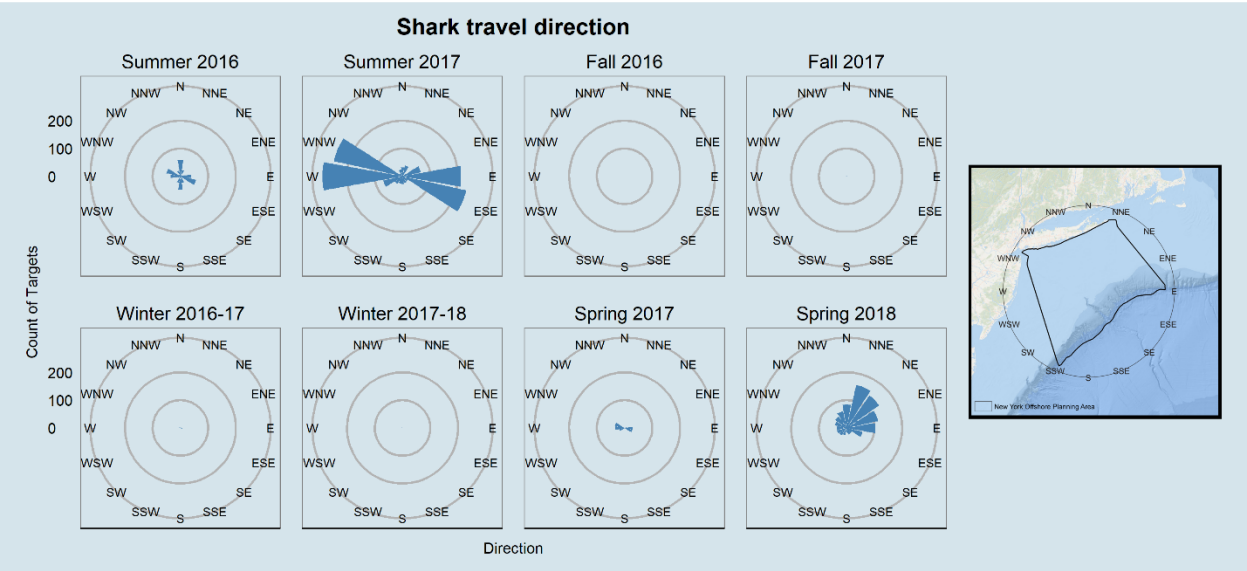

Figure 96. Direction of travel for sharks observed during the Summer 2016 through Spring 2018 surveys.

3.9. Threatened and Endangered Species

The categorization of ESA or State-listed species was conservative, incorporating "*Sterna* tern" (possibly representing roseate tern), "hammerhead (unid.)" (possibly representing scalloped hammerhead), and "turtle species unknown" (possibly representing all endangered turtles) (Table 23). Across the OPA, 64% of the observations of listed species occurred during the Summer 2016 and Summer 2017 surveys with Spring being the next highest period for observations representing 34% of observations (Table 23). These

numbers are mainly driven by the most frequently observed species (identified to species): loggerhead turtle, which consisted of 28% of the total number of observations of listed species (Table 23). *Sterna* terns consisted of 24% of the observations of listed species, but there is no way to know what percentage of these were roseate terns. Roseate terns identified to species comprised only 0.4% of observations (Table 23). Atlantic Bluefin Tuna represented 22% of observations of listed species, although large bony fish are the subject of a different summary report.

Table 23. Corrected Number of ESA and State Listed Species found during the Summer 2016 through Spring 2018 surveys in the OPA

Subtype	Species	Corrected Abundance[1]								Total
		Summer		Fall		Winter		Spring		
		2016	2017	2016	2017	2016–2017	2017–2018	2017	2018	
Sterna Tern	Roseate Tern	0	0	0	0	0	0	199	0	**199**
	Sterna Tern-species unknown	1,925	181	0	14	0	0	9,378	616	**12,114**
Whale	North Atlantic Right Whale	0	0	0	0	44	0	27	0	**71**
	Blue Whale	0	0	11	0	11	0	0	0	**22**
	Fin Whale	137	56	56	55	55	28	13	42	**442**
	Sei Whale	0	14	0	0	0	0	0	84	**98**
	Humpback Whale	0	0	11	41	22	0	66	70	**210**
	Sperm Whale	0	42	22	0	0	0	0	0	**64**
Turtle	Leatherback Turtle	123	70	315	28	0	0	0	0	**536**
	Loggerhead Turtle	5,297	9,060	67	69	11	0	66	0	**14,570**
	Loggerhead/Kemp's Turtle	137	279	0	14	0	0	27	0	**457**
	Green Turtle	14	0	0	0	0	0	0	0	**14**
	Kemp's Ridley Turtle	205	335	11	69	0	0	13	0	**633**
	Turtle-species unknown	1,870	181	45	0	0	0	27	14	**2,137**
Shark	Whale Shark	14	140	0	0	0	0	0	0	**154**
	Scalloped Hammerhead	246	2,974	0	28	0	0	0	0	**3,248**
	Hammerhead (unid.)	1,679	3,239	11	14	0	0	0	0	**4,943**
Ray	Giant Manta Ray	55	28	0	0	0	0	0	0	**83**
Tuna	Atlantic Bluefin tuna	2,185	2,178	0	0	0	0	13	6,953	**11,329**
	Season Total	**13,887**	**18,777**	**549**	**332**	**143**	**28**	**9,829**	**7,779**	**51,324**

[1] Corrected abundance was calculated by dividing the observed abundance by the percent of the area surveyed for each season. This accounts for differing amounts of area surveyed and makes abundances comparable across seasons. Corrected abundance values are frequently non-integers that have been rounded to whole numbers for display purposes. Column and row totals may not equal the sum of numbers shown in the table because the underlying values are non-integers.

4 References

Robinson Willmott, J. C., G. Forcey, and A. Kent. 2013. The Relative Vulnerability of Migratory Bird Species to Offshore Wind Energy Projects on the Atlantic Outer Continental Shelf: An Assessment Method and Database. Final Report to the U.S. Department of the Interior, Bureau of Ocean Energy Management, Office of Renewable Energy Programs. OCS Study BOEM 2013.

Appendix A. Common and Scientific Names for Taxa Identified in the Summer 2016 through Spring 2018 Surveys

Common Name	Scientific Name
BIRDS	**Aves**
Geese	
Canada Goose	Branta canadensis
Swan	
Tundra Swan	Cygnus columbianus
Ducks	
Gadwall	Mareca strepera
Lesser Scaup	Aythya affinis
King Eider	Somateria spectabilis
Common Eider	Somateria mollissima
Surf Scoter	Melanitta perspicillata
White-winged Scoter	Melanitta fusca
Black Scoter	Melanitta americana
Long-tailed Duck	Clangula hyemalis
Bufflehead	Bucephala albeola
Common Goldeneye	Bucephala clangula
Red-breasted Merganser	Mergus serrator
Loons	
Red-throated Loon	Gavia stellata
Common Loon	Gavia immer
Grebes	
Horned Grebe	Podiceps auritus
Fulmars	
Northern Fulmar	Fulmarus glacialis
Petrels	
Trindade Petrel	Pterodroma arminjoniana
Black-capped Petrel	Pterodroma hasitata
Shearwaters	
Cory's Shearwater	Calonectris diomedea
Great Shearwater	Ardenna gravis
Sooty Shearwater	Ardenna grisea
Manx Shearwater	Puffinus puffinus
Audubon's Shearwater	Puffinus lherminieri
Storm-Petrels	
Wilson's Storm-Petrel	Oceanites oceanicus

Common Name	Scientific Name
Leach's Storm-Petrel	Oceanodroma leucorhoa
Band-rumped Storm-Petrel	Oceanodroma castro
Booby	
Brown Booby	Sula leucogaster
Gannets	
Northern Gannet	Morus bassanus
Cormorants	
Double-crested Cormorant	Phalacrocorax auritus
Pelicans	
Brown Pelican	Pelecanus occidentalis
Ardeidae	
Great Blue Heron	Ardea herodias
Raptors	
Osprey	Pandion haliaetus
Bald Eagle	Haliaeetus leucocephalus
Shorebirds	
Black-bellied Plover	Pluvialis squatarola
Semipalmated Plover	Charadrius semipalmatus
Ruddy Turnstone	Arenaria interpres
Sanderling	Calidris alba
Dunlin	Calidris alpina
Red-necked Phalarope	Phalaropus lobatus
Red Phalarope	Phalaropus fulicarius
Skuas and Jaegers	
Great Skua	Stercorarius skua
South Polar Skua	Stercorarius maccormicki
Pomarine Jaeger	Stercorarius pomarinus
Parasitic Jaeger	Stercorarius parasiticus
Auks	
Dovekie	Alle alle
Common Murre	Uria aalge
Razorbill	Alca torda
Black Guillemot	Cepphus grylle
Atlantic Puffin	Fratercula arctica
Gulls	
Black-legged Kittiwake	Rissa tridactyla
Bonaparte's Gull	Chroicocephalus philadelphia
Little Gull	Hydrocoloeus minutus

Common Name	Scientific Name
Laughing Gull	Leucophaeus atricilla
Ring-billed Gull	Larus delawarensis
Herring Gull	Larus argentatus
Iceland Gull	Larus glaucoides
Lesser Black-backed Gull	Larus fuscus
Glaucous Gull	Larus hyperboreus
Great Black-backed Gull	Larus marinus
Terns	
Least Tern	Sternula antillarum
Black Tern	Chlidonias niger
Royal Tern	Thalasseus maximus
Roseate Tern	Sterna dougallii
Common Tern	Sterna hirundo
Forster's Tern	Sterna forsteri
Nightjar	
Common Nighthawk	Chordeiles minor
Passerine	
Snow Bunting	Plectrophenax nivalis
MARINE MAMMALS	**Mammalia**
Seals	
Gray Seal	Halichoerus grypus
Harp Seal	Pagophilus groenlandicus
Harbor Seal	Phoca vitulina
Whales	
North Atlantic Right Whale	Eubalaena glacialis
Blue Whale	Balaenoptera musculus
Common Minke Whale	Balaenoptera acutorostrata
Fin Whale	Balaenoptera physalus
Sei Whale	Balaenoptera borealis
Humpback Whale	Megaptera novaeangliae
Dwarf Sperm Whale	Kogia sima
Pygmy Sperm Whale	Kogia breviceps
Sperm Whale	Physeter macrocephalus
Dolphins	
Common Dolphin	Delphinus delphis
Short-finned Pilot Whale	Globicephala macrorhynchus
Risso's Dolphin	Grampus griseus
Atlantic White-sided Dolphin	Lagenorhynchus acutus

Common Name	Scientific Name
Rough-toothed dolphin	Steno bredanensis
Atlantic Spotted Dolphin	Stenella frontalis
Striped Dolphin	Stenella coeruleoalba
Bottlenose Dolphin	Tursiops truncatus
Harbor Porpoise	Phocoena phocoena
TURTLES	**Reptilia**
Soft-shell Turtles	
Leatherback Turtle	Dermochelys coriacea
Hard-shell Turtles	
Loggerhead Turtle	Caretta caretta
Green Turtle	Chelonia mydas
Kemp's Ridley Turtle	Lepidochelys kempii
SHARKS AND RAYS	**Chondrichthyes**
Sharks	
Whale Shark	Rhincodon typus
Sand Tiger Shark	Carcharias taurus
Thresher Shark	Alopias vulpinus
Basking Shark	Cetorhinus maximus
Great White Shark	Carcharodon carcharias
Shortfin Mako	Isurus oxyrinchus
Blue Shark	Prionace glauca
Dusky Shark	Carcharhinus obscurus
Oceanic Whitetip Shark	Carcharhinus longimanus
Sandbar Shark	Carcharhinus plumbeus
Tiger Shark	Galeocerdo cuvier
Great Hammerhead	Sphyrna mokarran
Smooth Hammerhead	Sphyrna zygaena
Scalloped Hammerhead	Sphyrna lewini
Spurdog	Squalus acanthias
Rays	
Bluntnose Stingray	Dasyatis say
Giant Manta Ray	Manta birostris
Giant Devil Ray	Mobula mobula
Chilean Devil Ray	Mobula tarapacana
Bullnose Ray	Myliobatis freminvillii
Cownose Ray	Rhinoptera bonasus

Appendix B. Avian Species Identified in the Summer 2016 through Spring 2018 Surveys

These are raw numbers and no effort correction has been made.

New York Offshore Planning Area

Name	Number in Species Group	Summer 2016	Summer 2017	Fall 2016	Fall 2017	Winter 2016–2017	Winter 2017–2018	Spring 2017	Spring 2018
Goose	**3**	**0**	**0**	**0**	**2**	**1**	**0**	**0**	**0**
Canada Goose		0	0	0	2	1	0	0	0
Swan	**12**	**0**	**0**	**0**	**0**	**0**	**12**	**0**	**0**
Tundra Swan		**0**	0	0	0	0	12	0	0
Duck	**10,249**	**0**	**0**	**1,680**	**282**	**1,390**	**1,662**	**66**	**5,169**
Gadwall		0	0	3	0	0	0	0	0
Lesser Scaup		0	0	0	0	7	0	2	0
King Eider		0	0	0	0	1	0	0	0
Common Eider		0	0	0	4	0	0	0	0
Surf Scoter		0	0	37	39	235	9	0	106
White-winged Scoter		0	0	19	1	348	132	1	312
Black Scoter		0	0	1,603	127	536	3	3	28
Scoter unid.		0	0	0	94	50	1,473	50	4,721
Long-tailed Duck		0	0	3	14	49	43	2	0
Bufflehead		0	0	5	0	108	1	0	0
Common Goldeneye		0	0	0	0	1	0	0	0
Red-breasted Merganser		0	0	0	2	5	0	7	0
Duck-species unknown		0	0	10	1	50	1	1	2
Loon	**2,212**	**3**	**5**	**272**	**315**	**586**	**190**	**240**	**601**
Red-throated Loon		0	0	222	161	241	35	24	161
Common Loon		3	3	48	140	342	151	213	438
Loon-species unknown		0	2	2	14	3	4	3	2

Name	Number in Species Group	Summer 2016	Summer 2017	Fall 2016	Fall 2017	Winter 2016–2017	Winter 2017–2018	Spring 2017	Spring 2018
Grebe	**12**	**0**	**0**	**0**	**0**	**8**	**3**	**0**	**1**
Horned Grebe		0	0	0	0	8	3	0	1
Fulmar	**888**	**0**	**0**	**3**	**60**	**49**	**705**	**50**	**21**
Northern Fulmar		0	0	3	60	49	705	50	21
Petrel	**31**	**18**	**3**	**1**	**0**	**2**	**0**	**2**	**5**
Trindade Petrel		0	0	0	0	0	0	1	0
Black-capped Petrel		13	3	1	0	1	0	0	5
Petrel-species unknown		5	0	0	0	1	0	1	0
Shearwater	**1,656**	**732**	**576**	**164**	**43**	**4**	**0**	**125**	**12**
Cory's Shearwater		510	90	146	2	0	0	9	0
Great Shearwater		70	337	8	12	0	0	2	0
Sooty Shearwater		2	1	0	0	2	0	81	9
Manx Shearwater		0	0	0	16	0	0	0	0
Audubon's Shearwater		8	0	0	0	0	0	0	0
Shearwater-species unknown-Large		129	108	10	8	2	0	15	1
Shearwater-species unknown-Small		13	40	0	5	0	0	18	2
Storm-petrel	**3,371**	**789**	**2,080**	**1**	**111**	**71**	**0**	**96**	**223**
Wilson's Storm-Petrel		789	339	1	0	0	0	90	0
Leach's Storm-Petrel		0	2	0	2	3	0	1	0
Band-rumped Storm-Petrel		0	0	0	0	0	0	1	0
Storm-petrel-species unknown		0	1,739	0	109	68	0	4	223
Booby	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**
Brown Booby		0	0	0	0	0	0	0	1
Gannet	**10,110**	**0**	**4**	**2,939**	**757**	**4,114**	**831**	**207**	**1,258**
Northern Gannet		0	4	2,939	757	4,114	831	207	1,258
Cormorant	**372**	**6**	**0**	**67**	**110**	**3**	**0**	**16**	**170**
Double-crested Cormorant		6	0	67	0	0	0	16	0

Name	Number in Species Group	Summer 2016	Summer 2017	Fall 2016	Fall 2017	Winter 2016–2017	Winter 2017–2018	Spring 2017	Spring 2018
Cormorant-species unknown		0	0	0	110	3	0	0	170
Pelican	**1**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**
Brown Pelican		0	0	1	0	0	0	0	0
Ardeidae	**1**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**
Great Blue Heron		0	0	0	1	0	0	0	0
Raptor	**3**	**2**	**0**	**0**	**0**	**0**	**0**	**0**	**1**
Osprey		1	0	0	0	0	0	0	1
Bald Eagle		1	0	0	0	0	0	0	0
Shorebird	**6,136**	**7**	**29**	**46**	**1,993**	**1**	**4,026**	**0**	**34**
Black-bellied Plover		6	0	0	0	0	3	0	0
Semipalmated Plover		0	3	0	0	0	0	0	0
Ruddy Turnstone		0	0	0	133	0	0	0	0
Sanderling		0	0	0	117	0	0	0	0
Dunlin		0	0	0	1,703	0	0	0	0
Shorebird-species unknown		1	26	46	40	1	4,023	0	34
Phalarope	**11,133**	**0**	**138**	**1,551**	**3,017**	**233**	**1**	**549**	**5,644**
Red-necked Phalarope		0	1	69	0	0	0	17	350
Red Phalarope		0	0	0	1,774	0	0	1	3,577
Red/Red-necked Phalarope		0	121	1,482	1,238	233	1	531	1,717
Phalarope-species unknown		0	16	0	5	0	0	0	0
Skua	**12**	**0**	**0**	**1**	**1**	**0**	**2**	**4**	**4**
Great Skua		0	0	0	0	0	1	0	1
South Polar Skua		0	0	0	0	0	0	1	0
Pomarine Jaeger		0	0	1	0	0	0	1	0
Parasitic Jaeger		0	0	0	1	0	0	2	2
Skua-species unknown		0	0	0	0	0	1	0	1
Auk	**13,633**	**0**	**4**	**79**	**109**	**8,952**	**650**	**106**	**3,733**
Dovekie		0	0	3	0	1,793	14	0	0

Name	Number in Species Group	Summer 2016	Summer 2017	Fall 2016	Fall 2017	Winter 2016–2017	Winter 2017–2018	Spring 2017	Spring 2018
Common Murre		0	0	11	0	0	0	0	0
Common/Thick-billed Murre		0	0	0	0	3	0	0	163
Razorbill		0	0	24	2	2,088	0	4	546
Murre/Razorbill		0	2	0	96	2,063	547	30	2,483
Black Guillemot		0	0	1	0	8	0	0	0
Atlantic Puffin		0	0	0	8	2,387	73	45	539
Auk-species unknown		0	2	40	3	610	16	27	2
Gull	**22,282**	**114**	**109**	**5,438**	**2,526**	**5,505**	**3,136**	**889**	**4,565**
Black-legged Kittiwake		0	0	230	371	9	10	0	2
Bonaparte's Gull		0	0	1,081	711	615	127	0	795
Little Gull		0	0	4	0	6	0	0	1
Laughing Gull		14	13	778	79	0	0	35	31
Ring-billed Gull		8	2	91	96	220	26	1	17
Herring Gull		21	33	2,277	929	3,495	1,777	554	3,164
Iceland Gull		0	0	0	1	7	2	1	2
Lesser Black-backed Gull		0	2	9	15	23	17	11	32
Glaucous Gull		0	0	0	0	1	0	0	1
Great Black-backed Gull		52	25	370	186	964	1,097	257	450
Gull-species unknown - Large		4	3	16	38	23	40	1	12
Gull-species unknown - Small		11	31	581	96	136	39	29	58
Gull-species unknown		4	0	1	4	6	1	0	0
Tern	**103**	**48**	**2**	**2**	**0**	**0**	**0**	**51**	**0**
Least Tern		33	0	0	0	0	0	49	0
Black Tern		0	1	0	0	0	0	2	0
Royal Tern		8	0	2	0	0	0	0	0
Tern-species unknown		7	1	0	0	0	0	0	0
Sterna Tern	**1,471**	**141**	**13**	**0**	**3**	**0**	**0**	**1,267**	**47**
Roseate Tern		0	0	0	0	0	0	15	0

Name	Number in Species Group	Summer 2016	Summer 2017	Fall 2016	Fall 2017	Winter 2016–2017	Winter 2017–2018	Spring 2017	Spring 2018
Common Tern		0	0	0	0	0	0	546	3
Forster's Tern		0	0	0	2	0	0	0	0
Sterna Tern-species unknown		141	13	0	1	0	0	706	44
Nightjar	**1**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**
Common Nighthawk		0	1	0	0	0	0	0	0
Passerine	**7**	**0**	**0**	**0**	**7**	**0**	**0**	**0**	**0**
Snow Bunting		0	0	0	7	0	0	0	0
TOTAL	**83,700**	**1,860**	**2,964**	**12,245**	**9,337**	**20,919**	**11,218**	**3,668**	**21,489**

[a] Listed as species of concern by NYSDEC
[b] Listed as threatened by NYSDEC

Appendix C. Avian Flight Activity in the Summer 2016 through Fall 2017 Surveys

Corrected Number of Sitting and Flying Birds Found in Each Survey

Species	Flight Height Unknown		Flying outside RSZ		Flying within RSZ		Sitting		Total Abundance
	Corrected Abundance[1]	Percent within Flight Category	Corrected Abundance[1]	Percent within Flight Category	Corrected Abundance[1]	Percent within Flight Category	Corrected Abundance[1]	Percent within Flight Category	
Summer 2016									
Common Loon	0	0.00	0	0.00	0	0.00	41	1.00	**41**
Black-capped Petrel	150	0.85	0	0.00	0	0.00	27	0.15	**178**
Petrel-species unknown	41	0.60	0	0.00	0	0.00	27	0.40	**68**
Cory's Shearwater	1,380	0.20	1,995	0.29	0	0.00	3,593	0.52	**6,967**
Great Shearwater	423	0.44	410	0.43	0	0.00	123	0.13	**956**
Sooty Shearwater	27	1.00	0	0.00	0	0.00	0	0.00	**27**
Audubon's Shearwater	14	0.13	27	0.25	0	0.00	68	0.63	**109**
Shearwater-species unknown-Large	383	0.22	0	0.00	0	0.00	1,380	0.78	**1,762**
Shearwater-species unknown-Small	137	0.77	0	0.00	0	0.00	41	0.23	**178**
Wilson's Storm-Petrel	6,530	0.61	2,213	0.21	0	0.00	2,036	0.19	**10,779**
Double-crested Cormorant	0	0.00	82	1.00	0	0.00	0	0.00	**82**
Osprey	14	1.00	0	0.00	0	0.00	0	0.00	**14**
Bald Eagle	14	1.00	0	0.00	0	0.00	0	0.00	**14**
Black-bellied Plover	82	1.00	0	0.00	0	0.00	0	0.00	**82**
Shorebird-species unknown	14	1.00	0	0.00	0	0.00	0	0.00	**14**
Laughing Gull	41	0.21	14	0.07	41	0.21	96	0.50	**191**
Ring-billed Gull	14	0.13	0	0.00	27	0.25	68	0.63	**109**
Herring Gull	27	0.10	14	0.05	68	0.24	178	0.62	**287**
Great Black-backed Gull	41	0.06	27	0.04	383	0.54	260	0.37	**710**
Gull-species unknown - Large	14	0.25	0	0.00	0	0.00	41	0.75	**55**
Gull-species unknown - Small	68	0.45	0	0.00	0	0.00	82	0.55	**150**
Gull-species unknown	14	0.25	0	0.00	0	0.00	41	0.75	**55**
Least Tern	273	0.61	178	0.39	0	0.00	0	0.00	**451**
Royal Tern	55	0.50	41	0.38	14	0.13	0	0.00	**109**
Tern-species unknown	96	1.00	0	0.00	0	0.00	0	0.00	**96**

Species	Flight Height Unknown		Flying outside RSZ		Flying within RSZ		Sitting		Total Abundance
	Corrected Abundance[1]	Percent within Flight Category	Corrected Abundance[1]	Percent within Flight Category	Corrected Abundance[1]	Percent within Flight Category	Corrected Abundance[1]	Percent within Flight Category	
Sterna Tern-species unknown	1,667	0.87	14	0.01	0	0.00	246	0.13	**1,926**
Height Total	**11,516**		**5,014**		**533**		**8,347**		**25,410**
Fall 2016									
Gadwall	0	0.00	34	1.00	0	0.00	0	0.00	**34**
Surf Scoter	11	0.03	281	0.68	45	0.11	79	0.19	**416**
White-winged Scoter	180	0.84	22	0.11	11	0.05	0	0.00	**214**
Black Scoter	607	0.03	2,913	0.16	1,451	0.08	13,060	0.72	**18,031**
Long-tailed Duck	0	0.00	11	0.33	22	0.67	0	0.00	**34**
Bufflehead	0	0.00	34	0.60	0	0.00	22	0.40	**56**
Duck-species unknown	0	0.00	0	0.00	0	0.00	112	1.00	**112**
Red-throated Loon	34	0.01	45	0.02	1,294	0.52	1,125	0.45	**2,497**
Common Loon	0	0.00	67	0.13	349	0.65	124	0.23	**540**
Loon-species unknown	11	0.50	0	0.00	0	0.00	11	0.50	**22**
Northern Fulmar	22	0.67	0	0.00	11	0.33	0	0.00	**34**
Black-capped Petrel	0	0.00	0	0.00	11	1.00	0	0.00	**11**
Cory's Shearwater	202	0.12	709	0.43	34	0.02	697	0.42	**1,642**
Great Shearwater	22	0.25	11	0.13	22	0.25	34	0.38	**90**
Shearwater-species unknown-Large	101	0.90	0	0.00	0	0.00	11	0.10	**112**
Wilson's Storm-Petrel	0	0.00	11	1.00	0	0.00	0	0.00	**11**
Northern Gannet	1,755	0.05	1,890	0.06	6,029	0.18	23,386	0.71	**33,060**
Double-crested Cormorant	0	0.00	517	0.69	236	0.31	0	0.00	**754**
Brown Pelican	11	1.00	0	0.00	0	0.00	0	0.00	**11**
Shorebird-species unknown	34	0.07	0	0.00	0	0.00	484	0.93	**517**
Red-necked Phalarope	146	0.19	0	0.00	0	0.00	630	0.81	**776**
Red/Red-necked Phalarope	5,264	0.32	1,069	0.06	124	0.01	10,214	0.61	**16,670**
Pomarine Jaeger	0	0.00	0	0.00	11	1.00	0	0.00	**11**
Dovekie	0	0.00	0	0.00	0	0.00	34	1.00	**34**
Common Murre	0	0.00	0	0.00	0	0.00	124	1.00	**124**
Razorbill	22	0.08	22	0.08	0	0.00	225	0.83	**270**
Black Guillemot	11	1.00	0	0.00	0	0.00	0	0.00	**11**

Species	Flight Height Unknown		Flying outside RSZ		Flying within RSZ		Sitting		Total Abundance
	Corrected Abundance[1]	Percent within Flight Category	Corrected Abundance[1]	Percent within Flight Category	Corrected Abundance[1]	Percent within Flight Category	Corrected Abundance[1]	Percent within Flight Category	
Auk-species unknown	0	0.00	0	0.00	0	0.00	450	1.00	**450**
Black-legged Kittiwake	911	0.35	461	0.18	619	0.24	596	0.23	**2,587**
Bonaparte's Gull	461	0.04	1,102	0.09	3,285	0.27	7,312	0.60	**12,160**
Little Gull	45	1.00	0	0.00	0	0.00	0	0.00	**45**
Laughing Gull	304	0.03	585	0.07	945	0.11	6,918	0.79	**8,751**
Ring-billed Gull	90	0.09	135	0.13	371	0.36	427	0.42	**1,024**
Herring Gull	2,047	0.08	2,756	0.11	5,231	0.20	15,579	0.61	**25,613**
Lesser Black-backed Gull	11	0.11	34	0.33	11	0.11	45	0.44	**101**
Great Black-backed Gull	495	0.12	427	0.10	765	0.18	2,475	0.59	**4,162**
Gull-species unknown - Large	56	0.31	0	0.00	0	0.00	124	0.69	**180**
Gull-species unknown - Small	124	0.02	0	0.00	0	0.00	6,412	0.98	**6,535**
Gull-species unknown	0	0.00	0	0.00	0	0.00	11	1.00	**11**
Royal Tern	11	0.50	11	0.50	0	0.00	0	0.00	**22**
Height Total	**12,992**		**13,150**		**20,877**		**90,720**		**137,739**
Winter 2016–2017									
Canada Goose	0	0.00	11	1.00	0	0.00	0	0.00	**11**
Lesser Scaup	0	0.00	77	1.00	0	0.00	0	0.00	**77**
King Eider	0	0.00	0	0.00	0	0.00	11	1.00	**11**
Surf Scoter	44	0.02	0	0.00	0	0.00	2,555	0.98	**2,600**
White-winged Scoter	44	0.01	564	0.15	122	0.03	3,119	0.81	**3,850**
Black Scoter	0	0.00	122	0.02	0	0.00	5,808	0.98	**5,929**
Scoter unid.	0	0.00	0	0.00	0	0.00	553	1.00	**553**
Long-tailed Duck	11	0.02	77	0.14	66	0.12	387	0.71	**542**
Bufflehead	33	0.03	0	0.00	0	0.00	1,162	0.97	**1,195**
Common Goldeneye	0	0.00	0	0.00	0	0.00	11	1.00	**11**
Red-breasted Merganser	0	0.00	0	0.00	11	0.20	44	0.80	**55**
Duck-species unknown	0	0.00	0	0.00	0	0.00	553	1.00	**553**
Red-throated Loon	144	0.05	144	0.05	631	0.24	1,748	0.66	**2,666**
Common Loon	11	0.00	199	0.05	77	0.02	3,496	0.92	**3,783**
Loon-species unknown	33	1.00	0	0.00	0	0.00	0	0.00	**33**

Species	Flight Height Unknown		Flying outside RSZ		Flying within RSZ		Sitting		Total Abundance
	Corrected Abundance[1]	Percent within Flight Category	Corrected Abundance[1]	Percent within Flight Category	Corrected Abundance[1]	Percent within Flight Category	Corrected Abundance[1]	Percent within Flight Category	
Horned Grebe	0	0.00	0	0.00	0	0.00	88	1.00	**88**
Northern Fulmar	133	0.24	55	0.10	144	0.27	210	0.39	**542**
Black-capped Petrel	0	0.00	11	1.00	0	0.00	0	0.00	**11**
Petrel-species unknown	11	1.00	0	0.00	0	0.00	0	0.00	**11**
Sooty Shearwater	11	0.50	11	0.50	0	0.00	0	0.00	**22**
Shearwater-species unknown-Large	22	1.00	0	0.00	0	0.00	0	0.00	**22**
Leach's Storm-Petrel	22	0.67	11	0.33	0	0.00	0	0.00	**33**
Storm-petrel-species unknown	664	0.88	0	0.00	0	0.00	88	0.12	**752**
Northern Gannet	1,881	0.04	3,009	0.07	8,662	0.19	31,958	0.70	**45,509**
Cormorant-species unknown	0	0.00	0	0.00	0	0.00	33	1.00	**33**
Shorebird-species unknown	11	1.00	0	0.00	0	0.00	0	0.00	**11**
Red/Red-necked Phalarope	973	0.38	33	0.01	0	0.00	1,571	0.61	**2,577**
Dovekie	122	0.01	33	0.00	0	0.00	19,679	0.99	**19,834**
Common/Thick-billed Murre	0	0.00	0	0.00	0	0.00	33	1.00	**33**
Razorbill	863	0.04	66	0.00	11	0.00	22,157	0.96	**23,097**
Murre/Razorbill	310	0.01	0	0.00	0	0.00	22,511	0.99	**22,821**
Black Guillemot	0	0.00	0	0.00	0	0.00	88	1.00	**88**
Atlantic Puffin	254	0.01	22	0.00	0	0.00	26,128	0.99	**26,405**
Auk-species unknown	133	0.02	22	0.00	0	0.00	6,593	0.98	**6,748**
Black-legged Kittiwake	11	0.11	11	0.11	55	0.56	22	0.22	**100**
Bonaparte's Gull	852	0.13	1,361	0.20	1,405	0.21	3,186	0.47	**6,803**
Little Gull	44	0.67	0	0.00	0	0.00	22	0.33	**66**
Ring-billed Gull	122	0.05	33	0.01	1,195	0.49	1,084	0.45	**2,434**
Herring Gull	730	0.02	3,750	0.10	4,945	0.13	29,237	0.76	**38,662**
Iceland Gull	0	0.00	0	0.00	22	0.29	55	0.71	**77**
Lesser Black-backed Gull	0	0.00	0	0.00	66	0.26	188	0.74	**254**
Glaucous Gull	0	0.00	0	0.00	0	0.00	11	1.00	**11**
Great Black-backed Gull	166	0.02	1,626	0.15	1,217	0.11	7,655	0.72	**10,664**
Gull-species unknown - Large	44	0.17	0	0.00	0	0.00	210	0.83	**254**
Gull-species unknown - Small	22	0.01	0	0.00	0	0.00	1,482	0.99	**1,504**

Species	Flight Height Unknown		Flying outside RSZ		Flying within RSZ		Sitting		Total Abundance
	Corrected Abundance[1]	Percent within Flight Category	Corrected Abundance[1]	Percent within Flight Category	Corrected Abundance[1]	Percent within Flight Category	Corrected Abundance[1]	Percent within Flight Category	
Gull-species unknown	0	0.00	0	0.00	0	0.00	66	1.00	**66**
Height Total	**7,721**		**11,250**		**18,628**		**193,805**		**231,405**
Spring 2017									
Lesser Scaup	0	0.00	0	0.00	0	0.00	27	1.00	**27**
White-winged Scoter	0	0.00	0	0.00	0	0.00	13	1.00	**13**
Black Scoter	40	1.00	0	0.00	0	0.00	0	0.00	**40**
Scoter unid.	0	0.00	0	0.00	0	0.00	664	1.00	**664**
Long-tailed Duck	0	0.00	0	0.00	0	0.00	27	1.00	**27**
Red-breasted Merganser	0	0.00	0	0.00	0	0.00	93	1.00	**93**
Duck-species unknown	0	0.00	0	0.00	0	0.00	13	1.00	**13**
Red-throated Loon	0	0.00	0	0.00	13	0.04	305	0.96	**319**
Common Loon	80	0.03	53	0.02	66	0.02	2,629	0.93	**2,829**
Loon-species unknown	0	0.00	0	0.00	0	0.00	40	1.00	**40**
Northern Fulmar	66	0.10	120	0.18	279	0.42	199	0.30	**664**
Trindade Petrel	13	1.00	0	0.00	0	0.00	0	0.00	**13**
Petrel-species unknown	0	0.00	0	0.00	0	0.00	13	1.00	**13**
Cory's Shearwater	80	0.67	13	0.11	13	0.11	13	0.11	**120**
Great Shearwater	0	0.00	0	0.00	13	0.50	13	0.50	**27**
Sooty Shearwater	146	0.14	120	0.11	53	0.05	757	0.70	**1,076**
Shearwater-species unknown-Large	13	0.07	0	0.00	0	0.00	186	0.93	**199**
Shearwater-species unknown-Small	0	0.00	0	0.00	13	0.06	226	0.94	**239**
Wilson's Storm-Petrel	956	0.80	106	0.09	40	0.03	93	0.08	**1,195**
Leach's Storm-Petrel	13	1.00	0	0.00	0	0.00	0	0.00	**13**
Band-rumped Storm-Petrel	13	1.00	0	0.00	0	0.00	0	0.00	**13**
Storm-petrel-species unknown	27	0.50	0	0.00	0	0.00	27	0.50	**53**
Northern Gannet	505	0.18	332	0.12	491	0.18	1,421	0.52	**2,749**
Double-crested Cormorant	27	0.13	27	0.13	0	0.00	159	0.75	**212**
Red-necked Phalarope	53	0.24	120	0.53	53	0.24	0	0.00	**226**
Red Phalarope	0	0.00	0	0.00	13	1.00	0	0.00	**13**
Red/Red-necked Phalarope	823	0.12	66	0.01	0	0.00	6,162	0.87	**7,052**

Species	Flight Height Unknown		Flying outside RSZ		Flying within RSZ		Sitting		Total Abundance
	Corrected Abundance[1]	Percent within Flight Category	Corrected Abundance[1]	Percent within Flight Category	Corrected Abundance[1]	Percent within Flight Category	Corrected Abundance[1]	Percent within Flight Category	
South Polar Skua	13	1.00	0	0.00	0	0.00	0	0.00	**13**
Pomarine Jaeger	13	1.00	0	0.00	0	0.00	0	0.00	**13**
Parasitic Jaeger	13	0.50	0	0.00	13	0.50	0	0.00	**27**
Razorbill	0	0.00	0	0.00	0	0.00	53	1.00	**53**
Murre/Razorbill	0	0.00	0	0.00	0	0.00	398	1.00	**398**
Atlantic Puffin	0	0.00	0	0.00	0	0.00	598	1.00	**598**
Auk-species unknown	0	0.00	0	0.00	0	0.00	359	1.00	**359**
Laughing Gull	106	0.23	0	0.00	40	0.09	319	0.69	**465**
Ring-billed Gull	13	1.00	0	0.00	0	0.00	0	0.00	**13**
Herring Gull	491	0.07	531	0.07	757	0.10	5,578	0.76	**7,357**
Iceland Gull	0	0.00	0	0.00	13	1.00	0	0.00	**13**
Lesser Black-backed Gull	13	0.09	40	0.27	27	0.18	66	0.45	**146**
Great Black-backed Gull	212	0.06	332	0.10	212	0.06	2,656	0.78	**3,413**
Gull-species unknown - Large	0	0.00	0	0.00	0	0.00	13	1.00	**13**
Gull-species unknown - Small	13	0.03	0	0.00	0	0.00	372	0.97	**385**
Least Tern	478	0.73	80	0.12	93	0.14	0	0.00	**651**
Black Tern	0	0.00	13	0.50	0	0.00	13	0.50	**27**
Roseate Tern	27	0.13	0	0.00	173	0.87	0	0.00	**199**
Common Tern	890	0.12	1,062	0.15	5,179	0.71	120	0.02	**7,251**
Sterna Tern-species unknown	5,631	0.60	305	0.03	943	0.10	2,497	0.27	**9,376**
Height Total	**10,770**		**3,320**		**8,499**		**26,122**		**48,712**
Summer 2017									
Common Loon	0	0.00	0	0.00	0	0.00	42	1.00	**42**
Loon-species unknown	0	0.00	0	0.00	0	0.00	28	1.00	**28**
Black-capped Petrel	42	1.00	0	0.00	0	0.00	0	0.00	**42**
Cory's Shearwater	475	0.38	391	0.31	0	0.00	391	0.31	**1,257**
Great Shearwater	1,061	0.23	978	0.21	0	0.00	2,668	0.57	**4,707**
Sooty Shearwater	14	1.00	0	0.00	0	0.00	0	0.00	**14**
Shearwater-species unknown-Large	154	0.10	28	0.02	0	0.00	1,327	0.88	**1,508**
Shearwater-species unknown-Small	28	0.05	0	0.00	14	0.03	517	0.93	**559**

Species	Flight Height Unknown		Flying outside RSZ		Flying within RSZ		Sitting		Total Abundance
	Corrected Abundance[1]	Percent within Flight Category	Corrected Abundance[1]	Percent within Flight Category	Corrected Abundance[1]	Percent within Flight Category	Corrected Abundance[1]	Percent within Flight Category	
Wilson's Storm-Petrel	2,444	0.52	2,277	0.48	0	0.00	14	0.00	**4,735**
Leach's Storm-Petrel	28	1.00	0	0.00	0	0.00	0	0.00	**28**
Storm-petrel-species unknown	10,419	0.43	13,296	0.55	14	0.00	559	0.02	**24,288**
Northern Gannet	0	0.00	0	0.00	0	0.00	56	1.00	**56**
Semipalmated Plover	0	0.00	0	0.00	42	1.00	0	0.00	**42**
Shorebird-species unknown	363	1.00	0	0.00	0	0.00	0	0.00	**363**
Red-necked Phalarope	14	1.00	0	0.00	0	0.00	0	0.00	**14**
Red/Red-necked Phalarope	852	0.50	28	0.02	0	0.00	810	0.48	**1,690**
Phalarope-species unknown	168	0.75	0	0.00	0	0.00	56	0.25	**223**
Murre/Razorbill	0	0.00	0	0.00	0	0.00	28	1.00	**28**
Auk-species unknown	0	0.00	0	0.00	0	0.00	28	1.00	**28**
Laughing Gull	70	0.38	0	0.00	0	0.00	112	0.62	**182**
Ring-billed Gull	14	0.50	0	0.00	0	0.00	14	0.50	**28**
Herring Gull	98	0.21	0	0.00	0	0.00	363	0.79	**461**
Lesser Black-backed Gull	0	0.00	0	0.00	14	0.50	14	0.50	**28**
Great Black-backed Gull	70	0.20	0	0.00	0	0.00	279	0.80	**349**
Gull-species unknown - Large	14	0.33	14	0.33	0	0.00	14	0.33	**42**
Gull-species unknown - Small	28	0.06	0	0.00	0	0.00	405	0.94	**433**
Black Tern	14	1.00	0	0.00	0	0.00	0	0.00	**14**
Tern-species unknown	14	1.00	0	0.00	0	0.00	0	0.00	**14**
Sterna Tern-species unknown	182	1.00	0	0.00	0	0.00	0	0.00	**182**
Common Nighthawk	14	1.00	0	0.00	0	0.00	0	0.00	**14**
Height Total	**16,578**		**17,011**		**84**		**7,723**		**41,397**
Fall 2017									
Canada Goose	28	1.00	0	0.00	0	0.00	0	0.00	**28**
Common Eider	0	0.00	0	0.00	0	0.00	55	1.00	**55**
Surf Scoter	207	0.38	262	0.49	0	0.00	69	0.13	**539**
White-winged Scoter	0	0.00	0	0.00	0	0.00	14	1.00	**14**
Black Scoter	1,644	0.94	41	0.02	0	0.00	69	0.04	**1,754**
Scoter unid.	0	0.00	0	0.00	0	0.00	1,298	1.00	**1,298**

Species	Flight Height Unknown		Flying outside RSZ		Flying within RSZ		Sitting		Total Abundance
	Corrected Abundance[1]	Percent within Flight Category	Corrected Abundance[1]	Percent within Flight Category	Corrected Abundance[1]	Percent within Flight Category	Corrected Abundance[1]	Percent within Flight Category	
Long-tailed Duck	41	0.21	0	0.00	0	0.00	152	0.79	**193**
Red-breasted Merganser	0	0.00	0	0.00	0	0.00	28	1.00	**28**
Duck-species unknown	14	1.00	0	0.00	0	0.00	0	0.00	**14**
Red-throated Loon	359	0.16	677	0.30	939	0.42	249	0.11	**2,224**
Common Loon	69	0.04	166	0.09	580	0.30	1,119	0.58	**1,934**
Loon-species unknown	41	0.21	0	0.00	0	0.00	152	0.79	**193**
Northern Fulmar	249	0.30	221	0.27	28	0.03	331	0.40	**829**
Cory's Shearwater	0	0.00	28	1.00	0	0.00	0	0.00	**28**
Great Shearwater	0	0.00	152	0.92	0	0.00	14	0.08	**166**
Manx Shearwater	0	0.00	180	0.81	0	0.00	41	0.19	**221**
Shearwater-species unknown-Large	0	0.00	41	0.38	0	0.00	69	0.63	**110**
Shearwater-species unknown-Small	0	0.00	69	1.00	0	0.00	0	0.00	**69**
Leach's Storm-Petrel	0	0.00	28	1.00	0	0.00	0	0.00	**28**
Storm-petrel-species unknown	14	0.01	1,492	0.99	0	0.00	0	0.00	**1,506**
Northern Gannet	1,450	0.14	829	0.08	760	0.07	7,417	0.71	**10,456**
Cormorant-species unknown	28	0.02	1,450	0.95	0	0.00	41	0.03	**1,519**
Great Blue Heron	0	0.00	14	1.00	0	0.00	0	0.00	**14**
Ruddy Turnstone	0	0.00	0	0.00	0	0.00	1,837	1.00	**1,837**
Sanderling	0	0.00	0	0.00	0	0.00	1,616	1.00	**1,616**
Dunlin	0	0.00	41	0.00	0	0.00	23,481	1.00	**23,522**
Shorebird-species unknown	41	0.08	152	0.28	0	0.00	359	0.65	**552**
Red Phalarope	1,547	0.06	8,771	0.36	0	0.00	14,185	0.58	**24,503**
Red/Red-necked Phalarope	1,796	0.11	4,061	0.24	0	0.00	11,243	0.66	**17,099**
Phalarope-species unknown	14	0.20	41	0.60	0	0.00	14	0.20	**69**
Parasitic Jaeger	0	0.00	0	0.00	14	1.00	0	0.00	**14**
Razorbill	0	0.00	0	0.00	0	0.00	28	1.00	**28**
Murre/Razorbill	0	0.00	55	0.04	0	0.00	1,271	0.96	**1,326**
Atlantic Puffin	0	0.00	0	0.00	0	0.00	110	1.00	**110**
Auk-species unknown	0	0.00	0	0.00	0	0.00	41	1.00	**41**
Black-legged Kittiwake	2,638	0.51	525	0.10	1,008	0.20	953	0.19	**5,124**

Species	Flight Height Unknown		Flying outside RSZ		Flying within RSZ		Sitting		Total Abundance
	Corrected Abundance[1]	Percent within Flight Category	Corrected Abundance[1]	Percent within Flight Category	Corrected Abundance[1]	Percent within Flight Category	Corrected Abundance[1]	Percent within Flight Category	
Bonaparte's Gull	4,144	0.42	1,478	0.15	3,370	0.34	829	0.08	**9,820**
Laughing Gull	608	0.56	83	0.08	304	0.28	97	0.09	**1,091**
Ring-billed Gull	414	0.31	180	0.14	97	0.07	635	0.48	**1,326**
Herring Gull	2,224	0.17	815	0.06	1,105	0.09	8,688	0.68	**12,831**
Iceland Gull	0	0.00	0	0.00	0	0.00	14	1.00	**14**
Lesser Black-backed Gull	14	0.07	14	0.07	14	0.07	166	0.80	**207**
Great Black-backed Gull	483	0.19	207	0.08	276	0.11	1,602	0.62	**2,569**
Gull-species unknown - Large	41	0.08	0	0.00	0	0.00	483	0.92	**525**
Gull-species unknown - Small	511	0.39	0	0.00	0	0.00	815	0.61	**1,326**
Gull-species unknown	0	0.00	0	0.00	0	0.00	55	1.00	**55**
Forster's Tern	28	1.00	0	0.00	0	0.00	0	0.00	**28**
Sterna Tern-species unknown	0	0.00	14	1.00	0	0.00	0	0.00	**14**
Snow Bunting	0	0.00	97	1.00	0	0.00	0	0.00	**97**
Height Total	**18,646**		**22,182**		**8,494**		**79,641**		**128,964**
Winter 2017–2018									
Tundra Swan	0	0.00	0	0.00	0	0.00	167	1.00	**167**
Surf Scoter	0	0.00	0	0.00	0	0.00	125	1.00	**125**
White-winged Scoter	111	0.06	362	0.20	111	0.06	1,252	0.68	**1,836**
Black Scoter	0	0.00	0	0.00	0	0.00	42	1.00	**42**
Scoter unid.	0	0.00	0	0.00	0	0.00	20,487	1.00	**20,487**
Long-tailed Duck	42	0.07	14	0.02	0	0.00	542	0.91	**598**
Bufflehead	0	0.00	14	1.00	0	0.00	0	0.00	**14**
Duck-species unknown	0	0.00	0	0.00	0	0.00	14	1.00	**14**
Red-throated Loon	0	0.00	14	0.03	28	0.06	445	0.91	**487**
Common Loon	0	0.00	0	0.00	70	0.03	2,031	0.97	**2,100**
Loon-species unknown	0	0.00	0	0.00	0	0.00	56	1.00	**56**
Horned Grebe	0	0.00	0	0.00	0	0.00	42	1.00	**42**
Northern Fulmar	3,978	0.41	2,434	0.25	862	0.09	2,531	0.26	**9,805**
Northern Gannet	793	0.07	668	0.06	487	0.04	9,611	0.83	**11,558**
Black-bellied Plover	42	1.00	0	0.00	0	0.00	0	0.00	**42**

Species	Flight Height Unknown		Flying outside RSZ		Flying within RSZ		Sitting		Total Abundance
	Corrected Abundance[1]	Percent within Flight Category	Corrected Abundance[1]	Percent within Flight Category	Corrected Abundance[1]	Percent within Flight Category	Corrected Abundance[1]	Percent within Flight Category	
Shorebird-species unknown	459	0.01	0	0.00	0	0.00	55,494	0.99	**55,953**
Red/Red-necked Phalarope	0	0.00	0	0.00	0	0.00	14	1.00	**14**
Great Skua	14	1.00	0	0.00	0	0.00	0	0.00	**14**
Skua-species unknown	0	0.00	0	0.00	0	0.00	14	1.00	**14**
Dovekie	0	0.00	0	0.00	0	0.00	195	1.00	**195**
Murre/Razorbill	584	0.08	42	0.01	28	0.00	6,954	0.91	**7,608**
Atlantic Puffin	0	0.00	0	0.00	0	0.00	1,015	1.00	**1,015**
Auk-species unknown	0	0.00	0	0.00	0	0.00	223	1.00	**223**
Black-legged Kittiwake	14	0.10	28	0.20	0	0.00	97	0.70	**139**
Bonaparte's Gull	250	0.14	111	0.06	223	0.13	1,182	0.67	**1,766**
Ring-billed Gull	14	0.04	14	0.04	42	0.12	292	0.81	**362**
Herring Gull	2,698	0.11	862	0.03	904	0.04	20,250	0.82	**24,715**
Iceland Gull	14	0.50	0	0.00	0	0.00	14	0.50	**28**
Lesser Black-backed Gull	0	0.00	0	0.00	28	0.12	209	0.88	**236**
Great Black-backed Gull	1,919	0.13	556	0.04	278	0.02	12,503	0.82	**15,257**
Gull-species unknown - Large	28	0.05	14	0.03	28	0.05	487	0.88	**556**
Gull-species unknown - Small	0	0.00	0	0.00	0	0.00	542	1.00	**542**
Gull-species unknown	14	1.00	0	0.00	0	0.00	0	0.00	**14**
Height Total	**10,974**		**5,132**		**3,088**		**136,829**		**156,022**
Spring 2018									
Surf Scoter	168	0.11	965	0.65	350	0.24	0	0.00	**1,483**
White-winged Scoter	84	0.02	154	0.04	140	0.03	3,986	0.91	**4,364**
Black Scoter	168	0.43	0	0.00	0	0.00	224	0.57	**392**
Scoter unid.	0	0.00	0	0.00	0	0.00	66,028	1.00	**66,028**
Duck-species unknown	0	0.00	0	0.00	0	0.00	28	1.00	**28**
Red-throated Loon	0	0.00	70	0.03	531	0.24	1,650	0.73	**2,252**
Common Loon	14	0.00	84	0.01	294	0.05	5,734	0.94	**6,126**
Loon-species unknown	14	0.50	0	0.00	0	0.00	14	0.50	**28**
Horned Grebe	0	0.00	0	0.00	0	0.00	14	1.00	**14**
Northern Fulmar	70	0.24	14	0.05	70	0.24	140	0.48	**294**

Species	Flight Height Unknown		Flying outside RSZ		Flying within RSZ		Sitting		Total Abundance
	Corrected Abundance[1]	Percent within Flight Category	Corrected Abundance[1]	Percent within Flight Category	Corrected Abundance[1]	Percent within Flight Category	Corrected Abundance[1]	Percent within Flight Category	
Black-capped Petrel	70	1.00	0	0.00	0	0.00	0	0.00	**70**
Sooty Shearwater	70	0.56	0	0.00	0	0.00	56	0.44	**126**
Shearwater-species unknown-Large	0	0.00	0	0.00	0	0.00	14	1.00	**14**
Shearwater-species unknown-Small	0	0.00	0	0.00	0	0.00	28	1.00	**28**
Storm-petrel-species unknown	1,497	0.48	1,483	0.48	28	0.01	112	0.04	**3,119**
Brown Booby	0	0.00	0	0.00	14	1.00	0	0.00	**14**
Northern Gannet	1,916	0.11	1,287	0.07	1,804	0.10	12,587	0.72	**17,594**
Cormorant-species unknown	1,622	0.68	741	0.31	14	0.01	0	0.00	**2,378**
Osprey	0	0.00	0	0.00	14	1.00	0	0.00	**14**
Shorebird-species unknown	476	1.00	0	0.00	0	0.00	0	0.00	**476**
Red-necked Phalarope	2,042	0.42	196	0.04	0	0.00	2,657	0.54	**4,895**
Red Phalarope	16,867	0.34	6,601	0.13	629	0.01	25,930	0.52	**50,028**
Red/Red-necked Phalarope	2,112	0.09	1,986	0.08	0	0.00	19,916	0.83	**24,014**
Great Skua	0	0.00	0	0.00	0	0.00	14	1.00	**14**
Parasitic Jaeger	14	0.50	0	0.00	14	0.50	0	0.00	**28**
Skua-species unknown	0	0.00	0	0.00	0	0.00	14	1.00	**14**
Common/Thick-billed Murre	252	0.11	0	0.00	0	0.00	2,028	0.89	**2,280**
Razorbill	42	0.01	0	0.00	0	0.00	7,594	0.99	**7,636**
Murre/Razorbill	406	0.01	56	0.00	0	0.00	34,266	0.99	**34,727**
Atlantic Puffin	70	0.01	168	0.02	0	0.00	7,301	0.97	**7,538**
Auk-species unknown	0	0.00	0	0.00	0	0.00	28	1.00	**28**
Black-legged Kittiwake	14	0.50	0	0.00	14	0.50	0	0.00	**28**
Bonaparte's Gull	3,343	0.30	364	0.03	629	0.06	6,783	0.61	**11,119**
Little Gull	0	0.00	0	0.00	14	1.00	0	0.00	**14**
Laughing Gull	196	0.45	28	0.06	14	0.03	196	0.45	**434**
Ring-billed Gull	0	0.00	0	0.00	70	0.29	168	0.71	**238**
Herring Gull	5,091	0.12	1,902	0.04	2,196	0.05	35,063	0.79	**44,252**
Iceland Gull	14	0.50	0	0.00	0	0.00	14	0.50	**28**
Lesser Black-backed Gull	70	0.16	14	0.03	70	0.16	294	0.66	**448**
Glaucous Gull	0	0.00	0	0.00	0	0.00	14	1.00	**14**

Species	Flight Height Unknown		Flying outside RSZ		Flying within RSZ		Sitting		Total Abundance
	Corrected Abundance[1]	Percent within Flight Category	Corrected Abundance[1]	Percent within Flight Category	Corrected Abundance[1]	Percent within Flight Category	Corrected Abundance[1]	Percent within Flight Category	
Great Black-backed Gull	1,343	0.21	196	0.03	280	0.04	4,476	0.71	**6,294**
Gull-species unknown - Large	14	0.08	0	0.00	0	0.00	154	0.92	**168**
Gull-species unknown - Small	98	0.12	0	0.00	0	0.00	713	0.88	**811**
Common Tern	0	0.00	0	0.00	42	1.00	0	0.00	**42**
Sterna Tern-species unknown	112	0.18	84	0.14	406	0.66	14	0.02	**615**
Height Total	**38,266**		**16,392**		**7,636**		**238,252**		**300,545**

Appendix D. Flight Heights for Flying Birds Observed during Each Survey

*Species groups that show a mean but no standard deviation were only observed one time within the given season.

Number, Minimum, Maximum, Mean, Standard Deviation*, and Altitude Error of Flight Heights for Flying Birds Observed during Each of the First Eight Surveys

Species	N	MIN	MAX	MEAN	STD	ERROR
Summer 2016						
Cory's Shearwater	146	0.5	20.0	2.4	3.46	12.44
Great Shearwater	30	1.0	9.6	1.8	1.74	14.80
Audubon's Shearwater	2	1.0	2.0	1.5	0.71	4.73
Wilson's Storm-Petrel	162	0.5	1.0	0.7	0.24	18.16
Double-crested Cormorant	6	2.0	2.0	2.0	0.00	16.16
Laughing Gull	4	6.5	50.3	31.7	18.40	9.70
Ring-billed Gull	2	51.2	73.0	62.1	15.41	7.47
Herring Gull	6	10.0	98.0	51.4	32.75	16.58
Great Black-backed Gull	30	7.9	99.4	58.4	22.07	14.01
Least Tern	13	1.6	11.3	6.6	2.96	19.60
Royal Tern	4	6.0	25.5	17.8	9.18	5.37
Sterna Tern-species unknown	1	1.0	1.0	1.0		
Summer 2017						
Cory's Shearwater	28	1.0	1.0	1.0	0.00	26.87
Great Shearwater	70	0.2	20.3	1.7	3.14	26.35
Shearwater-species unknown-Large	2	1.0	2.3	1.6	0.91	31.25
Shearwater-species unknown-Small	1	25.7	25.7	25.7		30.91
Wilson's Storm-Petrel	163	0.5	6.9	0.7	0.95	28.88
Storm-petrel-species unknown	953	0.5	40.3	0.7	1.74	58.22
Semipalmated Plover	3	73.6	89.1	80.6	7.85	6.96
Red/Red-necked Phalarope	2	1.0	9.6	5.3	6.08	42.50
Lesser Black-backed Gull	1	50.3	50.3	50.3		11.66
Gull-species unknown - Large	1	12.7	12.7	12.7		
Fall 2016						
Gadwall	3	10.5	13.2	12.2	1.52	11.56
Surf Scoter	29	3.0	48.0	12.7	14.34	15.48
White-winged Scoter	3	11.4	104.2	44.5	51.76	13.54
Black Scoter	388	4.0	65.8	21.6	19.51	13.28
Long-tailed Duck	3	17.7	35.0	28.9	9.75	23.21
Bufflehead	3	8.6	12.3	10.2	1.93	8.10
Red-throated Loon	119	1.8	201.4	98.4	38.20	24.34

Species	N	MIN	MAX	MEAN	STD	ERROR
Common Loon	37	5.0	334.9	92.5	59.99	14.43
Northern Fulmar	1	56.5	56.5	56.5		27.02
Black-capped Petrel	1	29.3	29.3	29.3		16.66
Cory's Shearwater	66	0.4	29.8	5.9	7.28	18.47
Great Shearwater	3	12.4	28.5	22.1	8.57	17.88
Wilson's Storm-Petrel	1	2.3	2.3	2.3		8.63
Northern Gannet	704	0.1	166.7	52.2	34.36	15.14
Double-crested Cormorant	67	7.0	50.0	20.8	19.97	14.88
Red/Red-necked Phalarope	106	0.2	114.9	8.4	16.81	26.56
Pomarine Jaeger	1	85.5	85.5	85.5		31.73
Razorbill	2	6.6	6.6	6.6	0.02	25.13
Black-legged Kittiwake	96	0.4	102.8	35.4	26.00	19.24
Bonaparte's Gull	390	0.8	162.5	46.0	28.66	17.96
Laughing Gull	136	0.3	173.2	46.0	37.96	12.34
Ring-billed Gull	45	0.8	164.3	61.5	46.94	12.21
Herring Gull	710	0.0	319.4	54.0	46.41	16.30
Lesser Black-backed Gull	4	2.5	108.9	37.2	48.44	27.34
Great Black-backed Gull	106	0.7	265.6	53.0	48.87	16.74
Royal Tern	1	18.5	18.5	18.5		6.39
Fall 2017						
Surf Scoter	19	3.0	21.3	7.1	7.21	12.54
Black Scoter	3	2.1	2.6	2.4	0.24	13.97
Red-throated Loon	117	2.2	183.8	44.1	37.75	49.31
Common Loon	54	1.5	148.8	54.6	42.53	24.70
Northern Fulmar	18	0.6	36.5	7.0	10.36	18.74
Cory's Shearwater	2	1.0	2.2	1.6	0.89	21.29
Great Shearwater	11	0.4	3.8	1.7	1.03	13.83
Manx Shearwater	13	1.0	1.9	1.5	0.30	18.47
Shearwater-species unknown-Large	3	1.1	1.4	1.2	0.17	18.98
Shearwater-species unknown-Small	5	0.5	1.9	1.0	0.54	43.05
Leach's Storm-Petrel	2	1.5	1.5	1.5	0.01	2.71
Storm-petrel-species unknown	108	0.2	1.9	0.8	0.32	60.96
Northern Gannet	115	1.1	115.0	32.4	28.50	17.05
Cormorant-species unknown	105	2.1	15.8	12.5	2.31	35.62
Great Blue Heron	1	18.3	18.3	18.3		26.92
Dunlin	3	0.3	0.4	0.3	0.04	37.67
Shorebird-species unknown	11	1.0	1.9	1.4	0.28	
Red Phalarope	635	0.2	2.8	1.3	0.48	33.97
Red/Red-necked Phalarope	294	0.2	3.0	1.4	0.44	42.12

Species	N	MIN	MAX	MEAN	STD	ERROR
Phalarope-species unknown	3	1.1	2.4	1.8	0.66	41.61
Parasitic Jaeger	1	44.4	44.4	44.4		41.55
Murre/Razorbill	4	0.5	1.3	0.9	0.39	33.67
Black-legged Kittiwake	111	0.7	170.0	41.7	31.34	12.22
Bonaparte's Gull	351	1.4	131.8	42.7	27.23	10.46
Laughing Gull	28	8.9	139.7	49.6	36.02	13.51
Ring-billed Gull	20	1.2	156.6	32.2	45.04	25.91
Herring Gull	139	1.5	293.0	70.2	69.11	20.11
Lesser Black-backed Gull	2	4.7	81.3	43.0	54.16	29.71
Great Black-backed Gull	35	2.2	224.2	58.0	62.47	18.66
Sterna Tern-species unknown	1	5.0	5.0	5.0		83.93
Snow Bunting	7	2.1	2.8	2.5	0.27	34.35
Winter 2016–2017						
Canada Goose	1	4.0	4.0	4.0		22.41
Lesser Scaup	7	3.0	3.0	3.0	0.00	20.63
White-winged Scoter	62	3.0	72.7	13.6	18.98	22.63
Black Scoter	11	2.5	4.0	3.5	0.65	20.10
Long-tailed Duck	13	13.0	69.4	24.8	15.94	26.25
Red-breasted Merganser	1	68.9	68.9	68.9		23.18
Red-throated Loon	70	1.0	153.0	62.7	37.19	26.78
Common Loon	25	1.0	97.9	18.7	27.51	18.97
Northern Fulmar	18	5.0	89.6	40.9	24.39	14.67
Black-capped Petrel	1	3.3	3.3	3.3		15.87
Sooty Shearwater	1	2.0	2.0	2.0		37.15
Leach's Storm-Petrel	1	2.2	2.2	2.2		14.98
Northern Gannet	1055	0.1	258.5	50.1	34.38	16.28
Red/Red-necked Phalarope	3	1.0	8.3	4.7	3.65	30.12
Dovekie	3	1.0	1.0	1.0	0.00	9.31
Razorbill	7	1.5	35.3	12.4	12.66	17.06
Atlantic Puffin	2	1.0	1.0	1.0	0.00	2.06
Auk-species unknown	2	1.0	1.0	1.0	0.00	
Black-legged Kittiwake	6	6.4	48.5	36.8	15.72	21.78
Bonaparte's Gull	250	1.0	146.9	35.2	33.26	16.12
Ring-billed Gull	111	7.9	209.3	119.1	38.42	11.16
Herring Gull	786	0.1	312.0	49.3	49.82	16.39
Iceland Gull	2	95.3	138.6	116.9	30.65	15.33
Lesser Black-backed Gull	6	41.2	139.3	91.2	39.27	15.41
Great Black-backed Gull	257	0.6	252.0	32.2	41.74	18.65

Species	N	MIN	MAX	MEAN	STD	ERROR
Winter 2017–2018						
White-winged Scoter	34	0.6	77.3	11.8	20.83	24.18
Long-tailed Duck	1	1.5	1.5	1.5		59.79
Bufflehead	1	1.5	1.5	1.5		34.16
Red-throated Loon	3	1.0	82.2	50.6	43.51	33.79
Common Loon	5	51.4	94.6	77.2	17.38	22.59
Northern Fulmar	237	0.0	85.0	17.0	14.26	21.91
Northern Gannet	83	0.5	87.5	25.8	19.78	23.37
Murre/Razorbill	5	1.0	47.5	23.6	19.73	19.66
Black-legged Kittiwake	2	9.6	20.3	14.9	7.62	18.60
Bonaparte's Gull	24	8.2	69.4	32.9	15.75	20.89
Ring-billed Gull	4	7.9	106.3	64.6	43.05	23.28
Herring Gull	127	0.5	221.7	36.0	33.76	22.16
Lesser Black-backed Gull	2	47.1	67.3	57.2	14.32	28.18
Great Black-backed Gull	60	0.7	280.6	32.9	51.30	21.55
Gull-species unknown - Large	3	13.1	109.7	58.6	48.56	74.59
Spring 2017						
Red-throated Loon	1	69.1	69.1	69.1		17.32
Common Loon	9	10.1	203.8	60.8	58.28	15.87
Northern Fulmar	30	1.0	183.8	65.4	52.99	13.33
Cory's Shearwater	2	1.0	61.2	31.1	42.55	10.85
Great Shearwater	1	122.0	122.0	122.0		14.19
Sooty Shearwater	13	1.0	82.5	23.1	33.42	16.56
Shearwater-species unknown-Small	1	47.7	47.7	47.7		23.30
Wilson's Storm-Petrel	11	0.4	189.5	35.2	61.95	20.38
Northern Gannet	62	0.3	217.4	53.4	47.96	17.98
Double-crested Cormorant	2	1.0	1.0	1.0	0.00	19.44
Red-necked Phalarope	13	0.8	66.7	23.0	17.40	21.04
Red Phalarope	1	54.7	54.7	54.7		17.55
Red/Red-necked Phalarope	5	4.5	201.1	44.5	87.55	28.34
Parasitic Jaeger	1	35.3	35.3	35.3		49.18
Laughing Gull	3	49.4	149.2	97.4	50.03	13.93
Herring Gull	97	0.2	214.1	56.7	51.80	14.70
Iceland Gull	1	38.1	38.1	38.1		19.40
Lesser Black-backed Gull	5	12.1	112.6	38.9	41.63	16.22
Great Black-backed Gull	41	1.0	222.7	42.0	53.04	19.40
Least Tern	13	1.2	103.5	40.0	38.36	16.12
Black Tern	1	198.1	198.1	198.1		2.62
Roseate Tern	13	40.7	119.2	67.7	23.30	13.45

Species	N	MIN	MAX	MEAN	STD	ERROR
Common Tern	470	1.0	382.0	96.6	64.61	13.30
Sterna Tern-species unknown	94	0.9	197.7	55.5	46.14	78.36
Spring 2018						
Surf Scoter	94	7.0	162.4	32.2	38.76	28.13
White-winged Scoter	21	0.3	67.9	25.4	27.65	20.68
Red-throated Loon	43	0.7	178.7	84.3	41.81	33.75
Common Loon	27	4.3	127.4	57.5	30.40	22.46
Northern Fulmar	6	12.4	89.6	69.2	29.20	22.39
Storm-petrel-species unknown	108	0.3	33.1	3.0	5.76	36.21
Brown Booby	1	58.5	58.5	58.5		10.07
Northern Gannet	221	0.1	162.2	35.0	30.77	24.20
Cormorant-species unknown	54	4.0	34.3	12.0	6.13	30.25
Osprey	1	47.6	47.6	47.6		5.56
Red-necked Phalarope	14	0.3	9.5	2.1	2.84	32.22
Red Phalarope	517	0.1	77.3	9.6	10.14	26.70
Red/Red-necked Phalarope	142	0.1	21.3	2.4	4.73	31.47
Parasitic Jaeger	1	30.2	30.2	30.2		25.03
Murre/Razorbill	4	0.5	9.8	3.1	4.48	17.12
Atlantic Puffin	12	1.0	1.0	1.0	0.00	31.70
Black-legged Kittiwake	1	47.9	47.9	47.9		24.15
Bonaparte's Gull	71	3.9	134.7	48.9	44.80	22.22
Little Gull	1	29.3	29.3	29.3		34.24
Laughing Gull	3	11.0	57.7	30.0	24.55	20.75
Ring-billed Gull	5	34.8	181.3	126.1	63.28	17.14
Herring Gull	293	0.1	162.9	36.8	34.11	24.45
Lesser Black-backed Gull	6	1.2	70.9	40.1	25.50	17.64
Great Black-backed Gull	34	2.0	98.4	33.6	25.43	24.24
Common Tern	3	70.9	79.8	76.6	5.00	12.05
Sterna Tern-species unknown	35	3.9	295.0	78.7	52.41	44.91

Appendix E. Turtle Species Identified in the Summer 2016 through Spring 2018 Surveys

These are raw numbers and no effort correction has been made.

New York Offshore Planning Area

Species	Abundance																Total
	Summer 2016		Summer 2017		Fall 2016		Fall 2017		Winter 2016–2017		Winter 2017–2018		Spring 2017		Spring 2018		
	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	
Leatherback Turtle*	9	**9**	1	**5**	2	**28**	0	**2**	0	**0**	0	**0**	0	**0**	0	0	**44**
Loggerhead Turtle*	225	**388**	96	**649**	1	**6**	1	**5**	0	**1**	0	**0**	0	**5**	0	**0**	**1,054**
Loggerhead/ Kemp's Turtle*	6	**10**	3	**20**	0	**0**	1	**1**	0	**0**	0	**0**	0	**2**	0	**0**	**33**
Green Turtle*	1	**1**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	**1**
Kemp's Ridley Turtle*	11	**15**	1	**24**	0	**1**	2	**5**	0	**0**	0	**0**	0	**1**	0	**0**	**46**
Species unknown*	121	**137**	7	**13**	1	**4**	0	**0**	0	**0**	0	**0**	0	**2**	0	**1**	**157**
Season Total	**373**	**560**	**108**	**711**	**4**	**39**	**4**	**13**	**0**	**1**	**0**	**0**	**0**	**10**	**0**	**1**	**1,335**

*Listed under the Endangered Species Act

**Significantly submerged

Appendix F. Marine Mammals Identified in the Summer 2016 through Spring 2018 Surveys

These are raw numbers and no effort correction has been made.

New York Offshore Planning Area

Species	Abundance																Total
	Summer 2016		Summer 2017		Fall 2016		Fall 2017		Winter 2016–2017		Winter 2017–2018		Spring 2017		Spring 2018		
	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	
Seal	**0**	**0**	**1**	**2**	**4**	**13**	**0**	**1**	**10**	**35**	**1**	**5**	**0**	**1**	**0**	**7**	**64**
Gray Seal	0	**0**	0	**0**	0	**1**	0	**0**	0	**3**	0	**0**	0	**0**	0	**2**	**6**
Harp Seal	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**1**	0	**0**	**1**
Harbor Seal	0	**0**	0	**0**	0	**0**	0	**0**	0	**1**	0	**2**	0	**0**	0	**0**	**3**
Seal-species unknown	0	**0**	1	**2**	4	**12**	0	**1**	10	**31**	1	**3**	0	**0**	0	**5**	**54**
Whale	**4**	**20**	**2**	**11**	**4**	**13**	**10**	**16**	**16**	**25**	**6**	**9**	**6**	**17**	**12**	**23**	**134**
North Atlantic Right Whale	0	**0**	0	**0**	0	**0**	0	**0**	3	**4**	0	**0**	0	**2**	0	**0**	**6**
Blue Whale	0	**0**	0	**0**	1	**1**	0	**0**	0	**1**	0	**0**	0	**0**	0	**0**	**2**
Common Minke Whale	0	**1**	0	**0**	0	**0**	0	**1**	3	**7**	0	**1**	1	**5**	5	**8**	**23**
Fin Whale	2	**10**	0	**4**	1	**5**	3	**4**	3	**5**	2	**2**	1	**1**	0	**3**	**34**
Sei Whale	0	**0**	0	**1**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	4	**6**	**7**
Humpback Whale	0	**0**	0	**0**	0	**1**	2	**3**	2	**2**	0	**0**	0	**5**	2	**5**	**16**
Dwarf Sperm Whale	0	**0**	0	**2**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	**2**
Pygmy Sperm Whale	0	**0**	0	**0**	0	**0**	0	**2**	0	**0**	0	**0**	0	**0**	0	**0**	**2**
Sperm Whale	0	**0**	1	**3**	1	**2**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	**5**
Beaked Whale (unid.)	2	**8**	0	**0**	1	**4**	0	**0**	1	**1**	2	**4**	1	**1**	0	**0**	**18**
Whale-species unknown	0	**1**	1	**1**	0	**0**	5	**6**	4	**5**	2	**2**	3	**3**	1	**1**	**19**
Dolphin	**515**	**904**	**854**	**1,392**	**524**	**1,092**	**999**	**1,221**	**1,014**	**1,516**	**704**	**1,063**	**1,082**	**1,558**	**531**	**809**	**9,555**
Common Dolphin	13	**56**	552	**853**	75	**223**	440	**563**	381	**566**	292	**504**	557	**852**	150	**229**	**3,846**
Short-finned Pilot Whale	0	**0**	8	**24**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	**24**
Pilot Whale (unid.)	78	**102**	22	**52**	0	**9**	12	**20**	0	**0**	0	**0**	21	**29**	0	**0**	**212**

Species	Abundance																Total
	Summer 2016		Summer 2017		Fall 2016		Fall 2017		Winter 2016–2017		Winter 2017–2018		Spring 2017		Spring 2018		
	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	
Risso's Dolphin	0	**166**	64	**140**	0	**124**	22	**37**	25	**49**	29	**57**	88	**131**	86	**164**	**868**
Atlantic White-sided Dolphin	0	**0**	0	**0**	11	**16**	0	**0**	2	**7**	1	**2**	0	**0**	0	**0**	**25**
Rough-toothed dolphin	0	**0**	9	**15**	0	**0**	0	**0**	0	**1**	0	**0**	0	**0**	0	**0**	**16**
Atlantic Spotted Dolphin	0	**0**	0	**0**	37	**54**	0	**0**	0	**0**	0	**0**	2	**3**	0	**0**	**57**
Striped Dolphin	0	**0**	5	**6**	53	**75**	0	**0**	3	**5**	56	**90**	0	**0**	58	**81**	**257**
Bottlenose Dolphin	2	**96**	91	**175**	31	**59**	38	**68**	81	**132**	22	**29**	112	**173**	33	**49**	**781**
Common/White-sided Dolphin	0	**0**	0	**0**	0	**0**	0	**0**	2	**16**	0	**0**	0	**4**	18	**22**	**42**
Harbor Porpoise	0	**0**	0	**0**	2	**4**	0	**0**	111	**192**	12	**27**	15	**17**	30	**85**	**325**
Dolphin-species unknown	422	**484**	103	**127**	315	**528**	487	**533**	409	**548**	292	**354**	287	**349**	156	**179**	**3,102**
Unidentified Mammal																	
Unid. Mammal-species unknown	0	**0**	33	**41**	0	**0**	4	**5**	25	**33**	4	**5**	90	**111**	5	**6**	**201**
Season Total	**519**	**924**	**890**	**1,446**	**532**	**1,118**	**1,013**	**1,243**	**1,065**	**1,609**	**715**	**1,082**	**1,178**	**1,687**	**548**	**845**	**9,954**

*Significantly submerged

Appendix G. Rays and Sharks Identified in the Summer 2016 through Spring 2018 Surveys

These are raw numbers and no effort correction has been made.

New York Offshore Planning Area

Species	Abundance																Total
	Summer 2016		Summer 2017		Fall 2016		Fall 2017		Winter 2016–2017		Winter 2017–2018		Spring 2017		Spring 2018		
	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	
Ray	**4,378**	**8,103**	**4,229**	**7,624**	**1**	**4**	**1**	**2**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**15,733**
Bluntnose Stingray	1	**1**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	**1**
Giant Manta Ray	2	**4**	1	**2**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	**6**
Giant Devil Ray	74	**155**	6	**18**	0	**0**	0	**1**	0	**0**	0	**0**	0	**0**	0	**0**	**174**
Chilean Devil Ray	10	**71**	19	**49**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	**120**
Bullnose Ray	0	**0**	14	**87**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	**87**
Cownose/Bullnose Ray	2,172	**3,464**	1,758	**1,979**	1	**1**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	**5,444**
Cownose Ray	1,405	**3,275**	1,180	**4,229**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	**7,504**
Ray-species unknown	714	**1,133**	1,251	**1,260**	0	**3**	1	**1**	0	**0**	0	**0**	0	**0**	0	**0**	**2,397**
Shark	**1**	**643**	**995**	**1,382**	**3**	**4**	**2**	**13**	**15**	**26**	**5**	**11**	**111**	**180**	**74**	**22,934**	**25,193**
Whale Shark	0	**1**	4	**10**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	**11**
Sand Tiger Shark	0	**0**	0	**1**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	**1**
Thresher Shark	0	**2**	4	**5**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	**7**
Basking Shark	0	**1**	125	**133**	0	**0**	0	**1**	8	**14**	4	**9**	68	**99**	14	**46**	**303**
Great White Shark	0	**1**	5	**13**	0	**0**	0	**1**	0	**0**	0	**0**	2	**2**	0	**0**	**17**
Shortfin Mako	0	**1**	0	**4**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	**5**
Blue Shark	0	**5**	9	**21**	1	**2**	1	**3**	0	**2**	1	**2**	6	**34**	0	**15**	**84**
Carcharhinidae (unid.)	1	**132**	255	**320**	0	**0**	0	**2**	0	**0**	0	**0**	1	**3**	0	**0**	**457**
Dusky Shark	0	**1**	0	**2**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	**3**
Oceanic Whitetip Shark	0	**1**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	**1**

Species	Abundance																Total
	Summer 2016		Summer 2017		Fall 2016		Fall 2017		Winter 2016–2017		Winter 2017–2018		Spring 2017		Spring 2018		
	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	SS**	Tot	
Sandbar Shark	0	**0**	2	**21**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	**21**
Tiger Shark	0	**4**	0	**8**	0	**0**	0	**1**	0	**0**	0	**0**	0	**0**	0	**0**	**13**
Great Hammerhead	0	**8**	1	**1**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	**9**
Smooth Hammerhead	0	**9**	11	**56**	0	**0**	0	**1**	0	**0**	0	**0**	0	**0**	0	**0**	**66**
Scalloped Hammerhead	0	**18**	70	**213**	0	**0**	0	**2**	0	**0**	0	**0**	0	**0**	0	**0**	**233**
Hammerhead (unid.)	0	**123**	174	**232**	1	**1**	0	**1**	0	**0**	0	**0**	0	**0**	0	**0**	**357**
Spurdog	0	**0**	0	**0**	0	**0**	0	**0**	0	**2**	0	**0**	0	**0**	58	**22,871**	**22,873**
Shark-species unknown	0	**336**	335	**342**	1	**1**	1	**1**	7	**8**	0	**0**	34	**42**	2	**2**	**732**
Season Total	**1**	**643**	**995**	**1,382**	**3**	**4**	**2**	**13**	**15**	**26**	**5**	**11**	**111**	**180**	**74**	**22,934**	**25,193**

*Significantly submerged