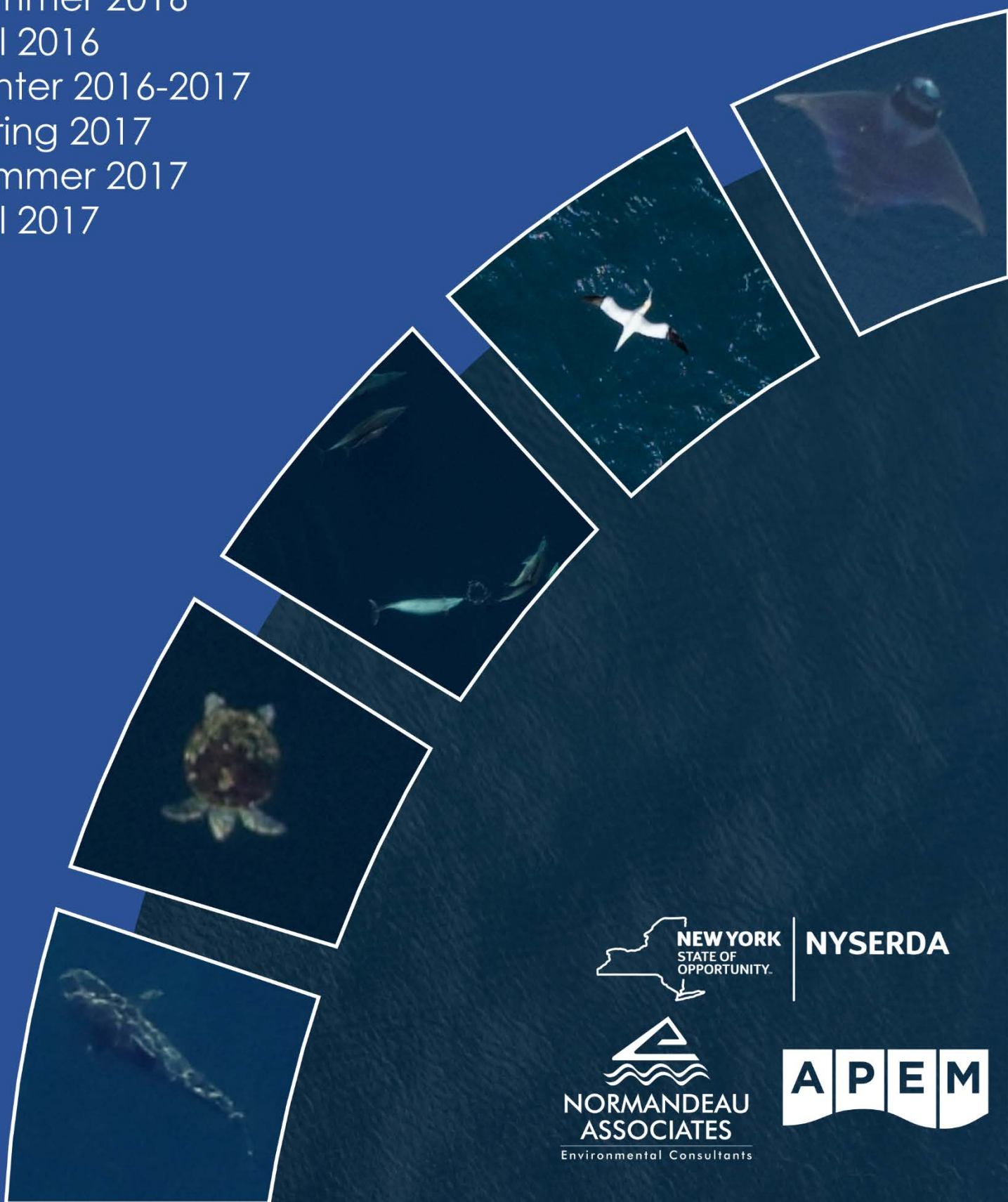
Digital Aerial Baseline Survey of Marine Wildlife in Support of Offshore Wind Energy

Third Interim Report

Summer 2016
Fall 2016
Winter 2016-2017
Spring 2017
Summer 2017
Fall 2017



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Environmental Consultants

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

Summer 2016 through Fall 2017 Third 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

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For bird images (Tables 22–24), used with permission: Trina Anderson and Jonathan Mays.

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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 six surveys conducted during Summer 2016 through Fall 2017. 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.

There was some variation in sampling effort between 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 six surveys, biota included

- 66 species of birds
- 16 species of sharks
- 10 species of dolphins
- 9 species of whales
- 4 species of sea turtles
- 6 species of rays
- 2 species of seals

Some seasonal patterns were evident. During the Summer surveys, the vast majority of the organisms observed were rays (60% of images) followed by birds (18% images), mammals (9%), sharks (7%), and turtles (5%). During the Fall surveys the vast majority of organisms observed were birds (90% of images) followed by mammals (9% of images), and <1%) of all other organisms. Winter very much followed the pattern of Fall with 93% of organisms observed being birds, 1% mammals, and <1% of all other organisms. In the Spring survey, birds again predominated, appearing in 66% of images, followed by mammals (30% of images), sharks (3%), and <1% turtles.

Bird species abundance varied widely across seasons with storm-petrels and shearwaters being dominant in the Summer surveys, gulls and gannets dominant in the Fall surveys, auks and gulls most abundant in Winter, and *Sterna* terns and gulls most abundant during the Spring. Sea ducks were present in all but the Summer surveys. Peak numbers for ducks were in the Fall and Winter surveys.

Spatial patterns in bird abundance were apparent for some taxonomic groups, but absent for others. Cory's shearwaters tended to cluster in the northeast corner of the OPA, while sooty shearwater was found primarily in the northeast portion of the OPA in Summer and in the southern portion in the Spring. Gull observations occurred throughout the OPA, but some concentrations were found nearshore. Royal terns and least terns were primarily observed >50 km

offshore, and roseate terns were found at the shelf break. Scoter species and long-tailed duck were primarily found nearshore. Phalaropes were generally found beyond the ≈60-m isobath.

The dominate 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, 53% of birds were recorded sitting on the water, 8% were observed flying in the rotor-swept zone (RSZ), and 17% were observed above or below the RSZ; flight height could not be calculated for the remaining 20% of individuals. Sensitivity indices showed that collision-sensitive species occurred most often near shore and along the western edge of the OPA. Displacement-sensitive species were most numerous in Winter and were found in the central and eastern portions of the OPA. Population-sensitive species most often congregated in the northeastern portion of the OPA in Summer and Winter, but this trend was not apparent in the other seasons.

The majority of shark observations (71%) were not classified to the species level. Most (98%) shark observations occurred during the Summer and Spring 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.

Dolphins were the most abundant of the marine mammals consisting of 96% of the observations followed by 1% seals and 1% whales; unidentified mammals consisted of 2% of the total mammal observations and 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 seasons with 41% of the total dolphin observations. 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.

Whales occurred during all seasons and fin whales were the most abundant overall with 29% of the observations. 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.

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.

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 was highly variable for rays and showed no distinct patterns.

Seals were difficult to identify to the species level and 88% of seals were classified as unknown. Of the seals that could be classified at the species level, gray seals were the most abundant with 8% of the observations. Fourteen positively identified threatened and endangered species were recorded within the OPA during the first six 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). Over 75% of listed species observations occurred in the Summer and Spring surveys, dominated by numbers of *Sterna* terns and loggerhead turtles.

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 inform 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 third semi-annual report, providing the results of the first six surveys (Summer 2016 through Fall 2017). 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
- Summer and Fall 2016 Semi-Annual Report
- 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
- First Annual Report Summer through Spring 2016–2017
- Summer 2017 Survey 5
    - Survey Summary Report
    - Target Extraction Summary Report
    - Taxonomic Analysis Summary Report
- Fall 2017 Survey 6
    - 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. Six 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, and Fall 2017 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	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

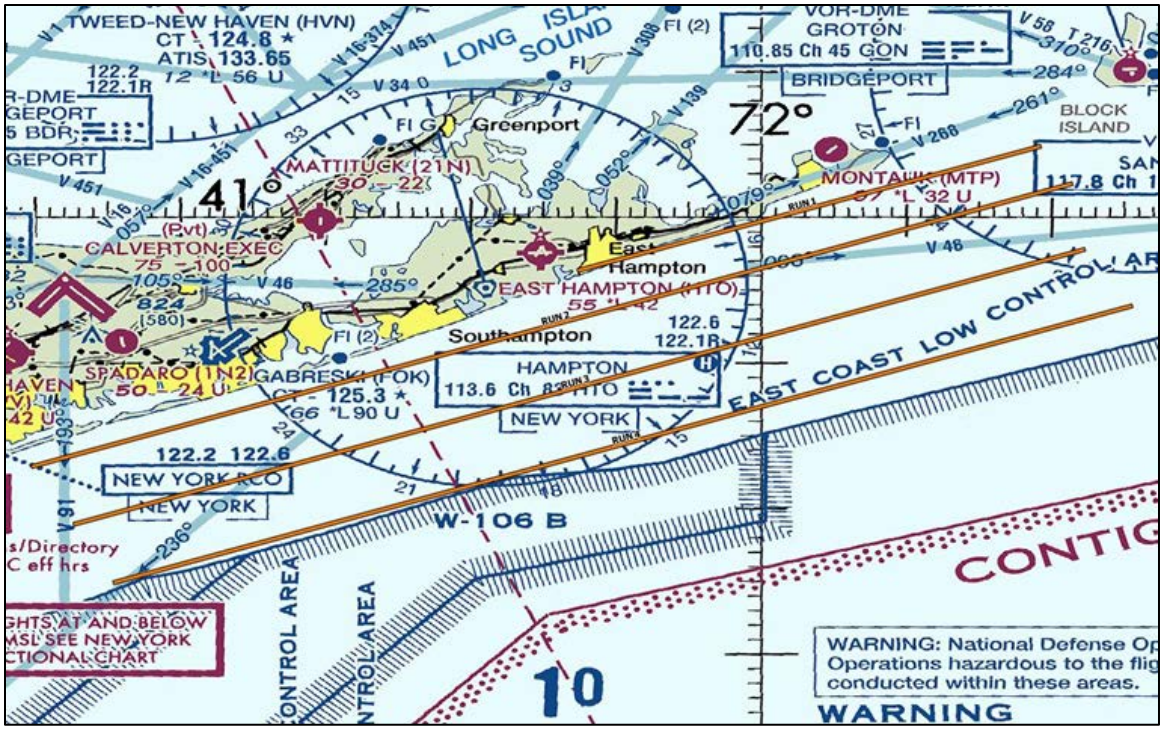


Figure 1. Flight plan used for Near Shore East.

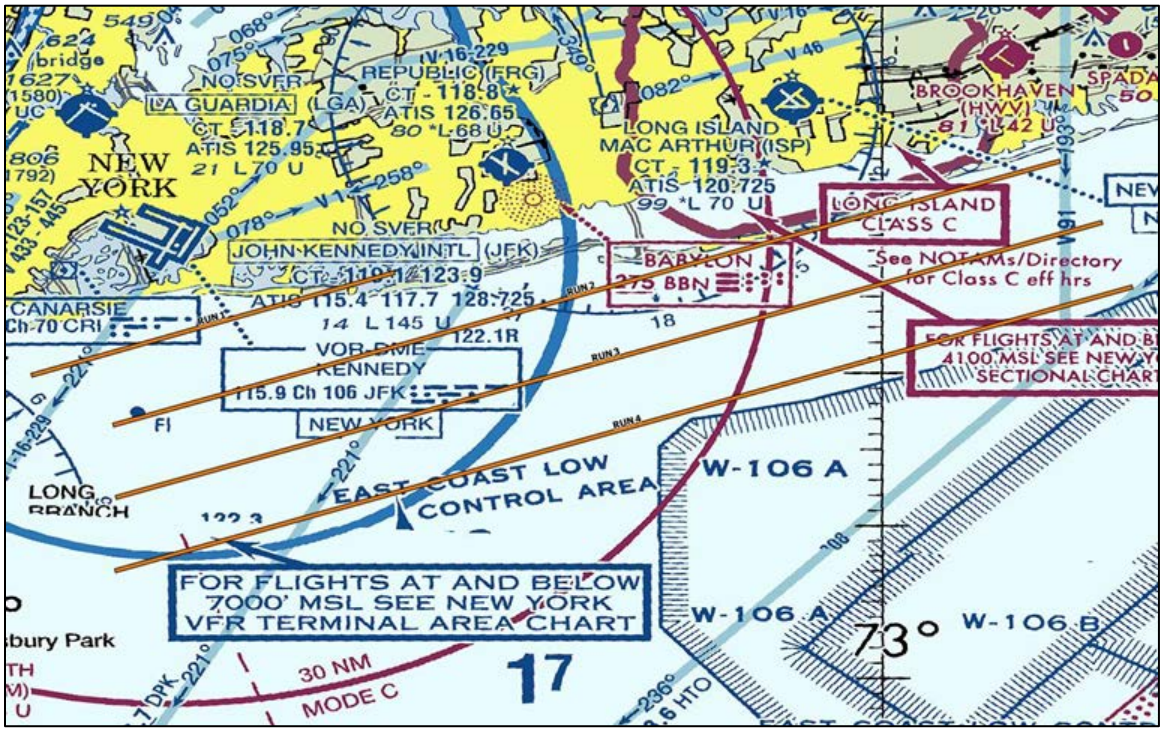


Figure 2. Flight plan used for Near Shore West.

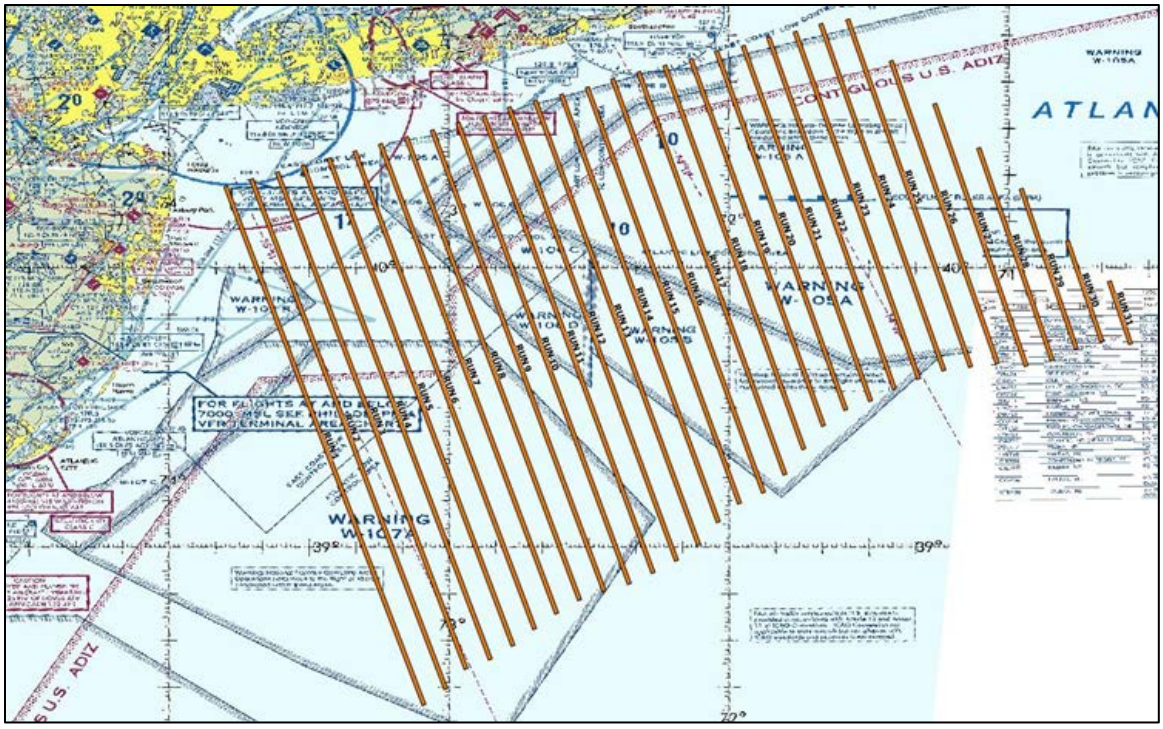


Figure 3. Flight plan used for the Offshore Planning Area.

2.2. Target Extraction and Quality Control

Target extraction is accomplished using automated and manual target identification and extraction methods, and all survey data undergoes 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. Once the target extraction is complete, all images found to contain organisms are transmitted to taxonomists for identification using the ReMOTe portal 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. Most of these are 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, with initial review of the group identifying only ocean sunfish. For this reason large bony fish and fish shoals are now 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). 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 is difficult even 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 Fall 2017 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 inter-seasonal variation and so that the color ramp classifications would work across all maps. Collision sensitivity analysis was restricted to bird individuals flying in the rotor swept area (25–195 m), and spatial variation in abundance of birds sensitive to different impacts was mapped across the survey area.

2.7. Comparisons between Seasons

When comparing abundance of species and species groups between seasons, all numbers were corrected to account for equal effort across the entire survey area. Because the percent survey coverage between seasons varied, correcting to 100% of the areal coverage removes the potential nuisance effect of survey effort and allows for inter-seasonal and inter-annual 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

During the Summer 2016 survey using the Shearwater II camera system, 289,393 images were collected for analysis covering 3,204.02 km^2 in the OPA, providing an overall coverage of 7.32% (Table 2). During the Fall 2016 survey using the Shearwater III camera (the camera used for all subsequent surveys), 396,079 images were collected over an area of 3,890.58 km^2 in the OPA, providing an overall coverage of 8.89% (Table 2). During the Winter 2016–2017 survey, 400,657 images were collected over an area of 3,952.98 km^2 in the OPA, providing an overall coverage of 9.04% (Table 2). During the Spring 2017 survey, 338,141 images were collected over an area of 3,293.25 km^2 in the OPA, providing an overall coverage of 7.53% (Table 2). During the Summer 2017 survey, 318,741 images were collected over an area of 3,133.5 km^2 in the OPA, providing an overall coverage of 7.16% (Table 2). During the Fall 2017 survey, 323,554 images were collected over an area of 3,168.68 km^2 in the OPA, providing an overall coverage of 7.24% (Table 2). 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 Six Surveys in the OPA

Survey	Size (km^2)	# Images	Image Area Size (km^2)	% 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

3.2. Target Extraction and Quality Control

Across all surveys, the vast majority of images collected contained no evidence of living organisms, vessels, or structures. In the Summer 2016 survey, more than 98% of the images from the OPA were blank (Table 3). In the Fall 2016 survey, more than 98% of the images from the OPA were blank (Table 3). In the Winter 2016–2017 survey, more than 97% of images were blank from the OPA (Table 3). In the Spring 2017 survey more than 98% of images were blank from the OPA (Table 3). In the Summer 2017 survey more that 97% of images were blank from the OPA, and in the Fall 2017 survey more than 98% of the images from the OPA were blank (Table 3).

Table 3. Number of Images Collected, Number of Blank Images Detected, and Number Sent for Quality Control Review for the First Six 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	27,838	9.74
Fall 2016	396,079	391,474	98.84	39,480	10.08
Winter 2016–2017	400,657	389,253	97.15	39,052	10.03

Survey	Number of Images in Survey Area	Blank Images			
		Number	Percent	Number QC'd	Percent QC'd
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

In the Summer 2016 blank review, 74 of the 30,789 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 99.76%, well within the quality control criteria established for the project (Table 4). Similar QC agreement was reached for all subsequent surveys: in the Fall 2016 data, 28 of the 40,598 images contained targets, as did 45 of the 40,430 images in the Winter 2016–2017 data, 66 of the 34,685 images in the Spring 2017 data, 71 of the 31,271 images in the Summer 2017 data, and 59 of the 31,985 images in the Fall 2017 data (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 Six Surveys

Survey	Number of Images			% Agreement Reached
	For QC	QC'd as Blank	QC'd Not Blank	
Summer 2016	30,789	30,715	74	99.76%
Fall 2016	40,598	40,570	28	99.93%
Winter 2016–2017	40,430	40,385	45	99.89%
Spring 2017	34,685	34,619	66	99.81%
Summer 2017	31,271	31,200	71	99.77%
Fall 2017	31,985	31,926	59	99.82%

Of the 74 images from the Summer 2016 review, most images contained fish (n= 40), turtles (n=21), and birds (n=10). Only 3 contained marine mammals (Table 5). In the Fall 2016 data, 23 images contained birds, 3 images contained fish, and 2 images contained marine mammals, and in the Winter 2016–2017 data, 33 images contained birds, 7 contained fish, and 5 contained marine mammals (Table 5). Except for the 50 images containing fish, numbers of missed organisms were lower in the Spring 2017 data with only 11 images containing birds, 3 containing turtles, and 2 containing marine mammals. Similarly, for the Summer 2017 data where 49 images reviewed contained fish but otherwise QC'd images contained 5 birds, no marine mammals, and 17 turtles (Table 5). The Fall 2017 QC'd data did not contain bony fish, but did contain 3 sharks, 13 turtles, 7 marine mammals, and one bird (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 six seasons, there were 51,285 birds sent for identification, 8,036 marine mammals, 1,348 turtles, 2,414 sharks, and 15,963 rays (Table 6).

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

Taxonomic Group Found in Image	Number of Individuals in Blank QC					
	Summer 2016	Fall 2016	Winter 2016–2017	Spring 2017	Summer 2017	Fall 2017
Birds	10	23	33	11	5	1
Marine Mammals	3	2	5	2	0	7
Turtles	21	0	0	3	17	13
Fish	40	3	7	50	49	0
Sharks	0	0	0	0	0	3
TOTAL	**74**	**28**	**45**	**66**	**71**	**24**

Table 6. Number of Individuals by Taxonomic Group by Season

Taxonomic Group	Number of Images						
	Summer 2016*	Fall 2016*	Winter 2016–2017*	Spring 2017*	Summer 2017	Fall 2017	Total
Birds	1,867	12,352	20,958	3,807	2,964	9,337	**51,285**
Marine Mammals	926	1,118	1,609	1,694	1,446	1,243	**8,036**
Turtles	573	40	1	10	711	13	**1348**
Sharks	807	4	26	182	1,382	13	**2,414**
Rays	8,333	4	0	0	7,624	2	**15,963**
Total	12,506	13,518	22,594	5,693	14,127	10,608	**79,046**

* Includes WEA survey area

3.3. Identification Success

There were 79,046 animals sent for identification (Table 7) with 17,830 going through quality control review. Of these, 2,899 were considered endangered species, either identified as a listed species or in the same genus as a listed species where species-level identification (i.e., hammerhead [unid.] and *Sterna* tern) was not possible (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. Numbers prior to Summer 2017 include both the OPA and WEA

Taxonomic Group	Summer 2016–Fall 2017		
	Total Individuals	Number of Images for QC	% Agreement (rounded)
Birds	51,285	11,130	99
Marine Mammals	8,036	1,628	100
Turtles	1,348	1,348	100
Sharks	2,414	757	99
Rays	15,963	2,967	100
Total	**79,046**	**17,830**	

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

Taxonomic Group	Number of Individuals						% Agreement Reached
	Summer 2016	Fall 2016	Winter 2016–2017	Spring 2017	Summer 2017	Fall 2017	
Birds	141	0	0	738	13	1	100
Marine Mammals	10	9	12	8	8	7	100
Turtles	573	40	1	10	711	13	100
Sharks	143	1	0	0	455	3	100
Rays	0	0	0	0	2	0	100
Total	**867**	**50**	**13**	**756**	**1,189**	**24**	**100**

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.

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 the methods. In the Summer 2016 survey, ray encounters were the most frequent, totaling 67% of animals found in imagery (Table 9, Figure 5). The Summer 2017 survey was similar to the Summer 2016 survey, with rays dominating the sample, although not as much as in the Summer 2016 sample. The Summer 2017 survey reported 54% rays, 21% birds, 10% each of marine mammals and sharks, and 5% turtles. During the Fall 2016 and Fall 2017 surveys, rays represented <1% of organisms observed and birds represented 91% and 88% of encounters, respectively (Table 9, Figure 5). The Winter 2016–2017 and Spring 2017 seasons were dominated by birds, although in the Spring 2017 survey there was a much higher proportion of mammals, which represented over 30% of the sample (Table 9, Figure 5). The other notable difference was in sharks, which were most frequent in the Summer surveys (5.3% of organisms during Summer 2016 survey and 10% of organisms in the Summer 2017 survey) and less frequent during the other seasons (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	25,410	12,623	7,650	8,784	110,697	**165,164**
Fall 2016	137,739	12,576	439	45	45	**150,844**
Winter 2016–2017	231,405	17,799	11	288	0	**249,502**
Spring 2017	48,712	22,404	133	2,390	0	**73,639**
Summer 2017	41,397	20,196	9,930	19,302	106,480	**197,304**
Fall 2017	128,964	17,169	180	180	28	**146,519**
Total	**613,626**	**102,765**	**18,343**	**30,988**	**217,250**	**982,972**

[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.

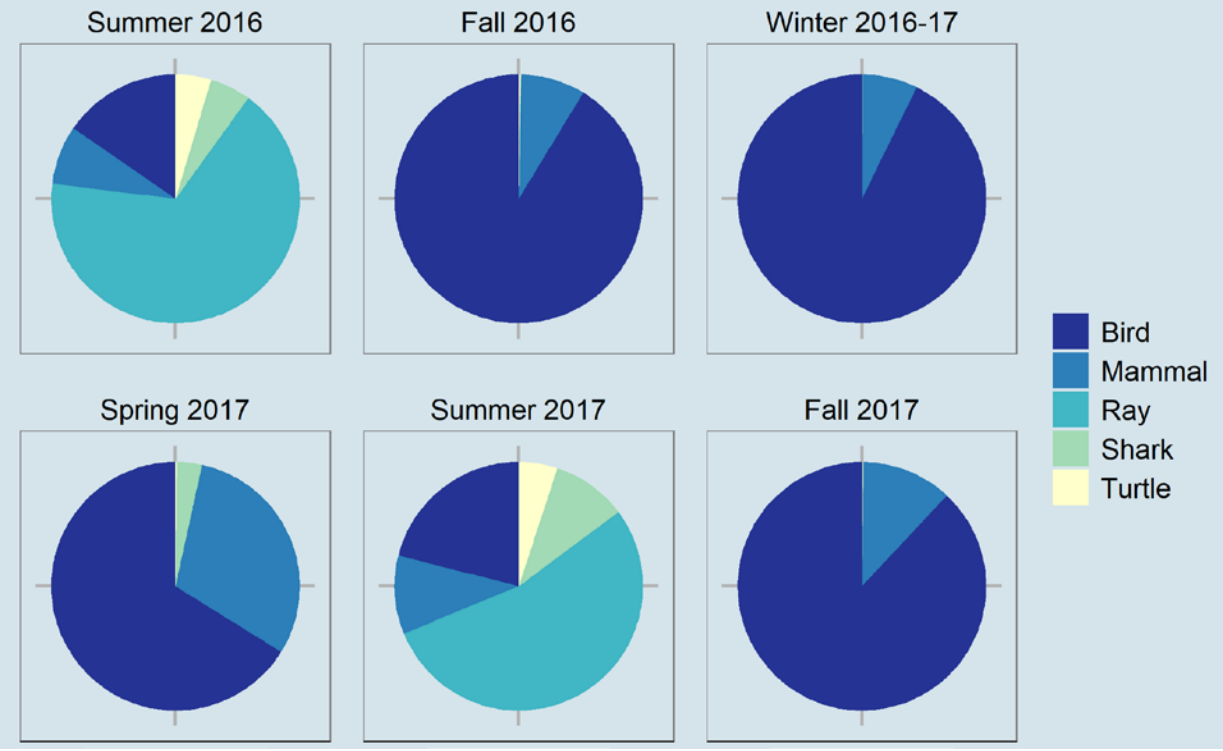


Figure 5. Relative abundance of taxonomic groups for the six surveys.

3.5. Birds

3.5.1. Species Identification

Over the six surveys of the OPA, 50,993 birds were identified in imagery comprising 84 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 (n=8,021) identified to species, ardeidae (great-blue heron; n=1), northern fulmar (n=162), skuas (n=6), Canada goose (n=3), brown pelican (n=1), and raptors (bald eagle [n=1] and osprey [n=1]). Skuas also had 100% identification success (n=6), loons 98% (n=3,418), sea ducks 93% (n=3,418), gulls 93% (n=14,581), terns (not *Sterna*) 92% (n=103), shearwaters 79% (n= 1,644), petrels 73% (n=26). Other species groups with multiple morphologically similar species expected in the project area had lower identification rates. Auks reached an identification rate of 69% (n=9,250), cormorants 44% (n=202), *Sterna* terns 40% (n=1,424), storm-petrels 40% (n=3,148), and 34% of phalaropes (n=5,488) (Appendix B).

3.5.2. Species Composition and Abundance

Species composition was varied throughout the year, highlighting the seasonal nature of avian activity. The Summer 2016 survey was dominated by storm-petrels (42%) and shearwaters (39%), and similarly with the Summer 2017 where storm-petrels accounted for 70% of the sample and shearwaters 19% of the sample (Figure 6). The Fall 2016 survey was dominated by gulls (44%) and gannets (24%), and the Fall 2017 by phalaropes (32%) and gulls (27%), although 13% of the Fall 2016 survey sample contained phalaropes (Figure 6). Winter 2016–2017 was dominated by auks (43%), gulls (26%) and gannets (20%) (Figure 6). Tern relative abundance was higher in the Summer 2016 survey (10% of sample) but after that they represented <1% of the samples excepting for the Spring 2017 survey where they represented >3% of the sample (Figure 6). Ducks were absent in the Summer 2016 and 2017 surveys, represented 14% of the Fall 2016 survey, 3% of the Fall 2017 survey, 7% of the Winter 2016–2017 survey, and 2% of the Spring 2017 survey (Figure 6). Gull relative abundance likewise fluctuated: lowest in the Summer 2016 and Summer 2017 surveys (6% and 4%, respectively), highest in the Fall 2016 and Fall 2017 surveys (44% and 27%, respectively), and moderate representing 26% in the Winter 2016–2017 survey and 24% in the Spring 2017 survey (Figure 6).

Relative abundance within each species group varied among seasons. The shift in species seasonal representation was marked, with avian species richness slightly lower in the Summer 2016 survey than in all subsequent surveys including the Summer 2017 survey (see Appendix A and Appendix B for a list of species included in taxonomic groups and numbers by season). Nine species groups were present in the Summer 2016 survey, 15 in the Fall 2016 survey, 14 in the Winter 2016–2017 survey, 14 in the Spring 2017 survey, 12 in the Summer 2017 survey and 16 in the Fall 2017 survey (Appendix B); with the caveat that we do not include phalaropes in the group “shorebird” and nor do we include *Sterna* terns with overall group of terns (Figure 6).

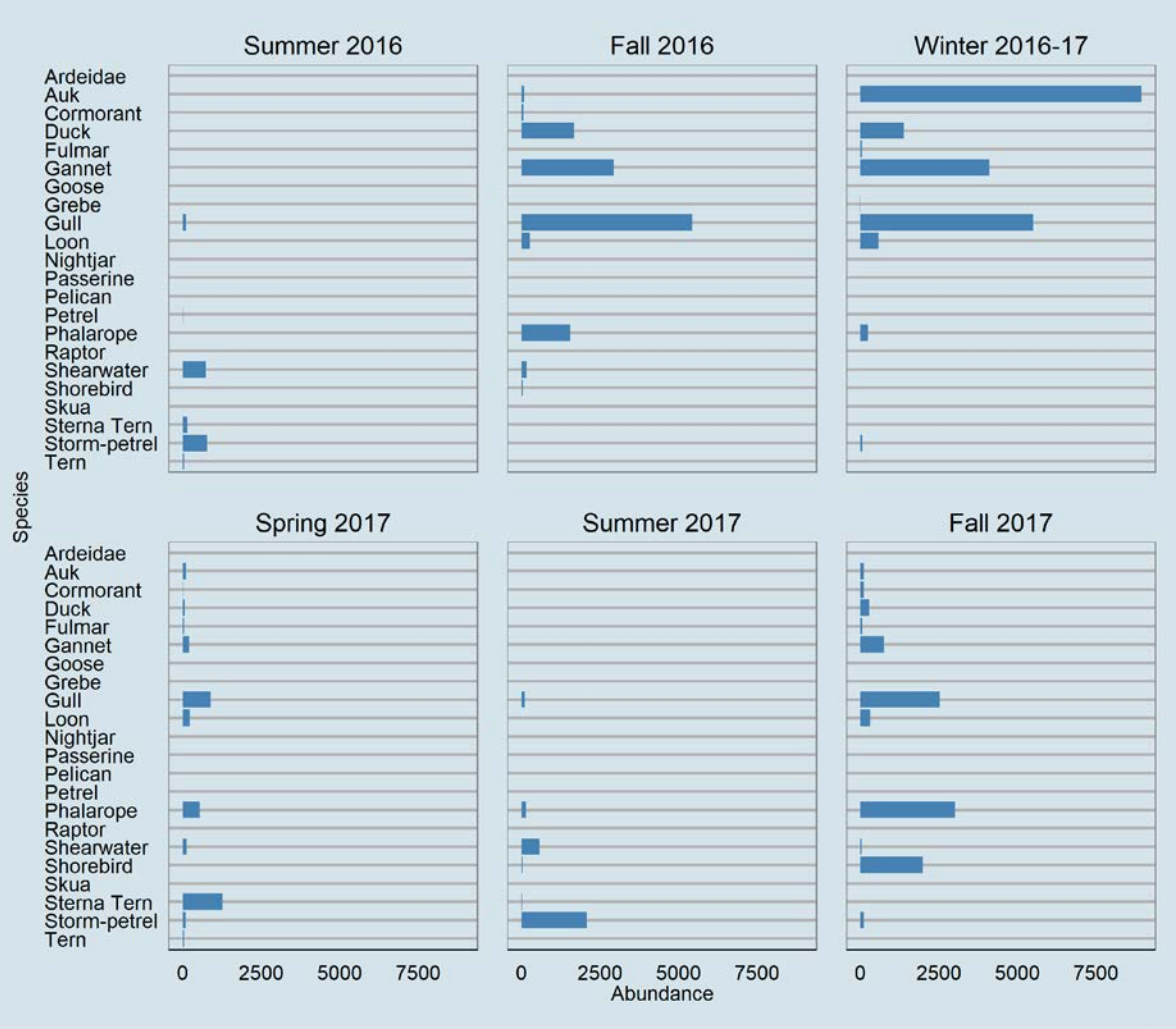


Figure 6. Relative abundance (raw observations) of avian taxonomic groups by survey.

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

There were nine gull species found across all six surveys. The 2016 and 2017 Summer surveys and the Spring 2017 survey had lower gull numbers than in the other surveys, with numbers higher in the Winter survey than in the two Fall surveys. Gull diversity also fluctuated with higher diversity in the Fall and Winter surveys across years than in the Summer or Spring with herring gull being the most frequently encountered species. Black-legged kittiwake, little gull, Iceland gull, and Bonaparte's gull were only encountered during the Fall and Winter surveys with glaucous gull only in the Winter 2016–2017 survey (Appendix B, Table 10, Table 11, Figure 7).

Five species of shearwater were recorded across all six surveys. Four species were recorded in the Summer 2016 survey, two in the Fall 2016 survey, one in the Winter 2016–2017 survey, and three each in the Spring 2017, Summer 2017, and Fall 2017 surveys. Cory's dominated in the Summer 2016 and Fall 2016 surveys; whereas, the Summer 2017 survey was dominated by great shearwaters. The Fall 2017 survey was dominated by Manx shearwaters, and the Winter 2016–2017 and Spring 2017 surveys were dominated by sooty shearwaters. In fact, only the Winter 2016–2017 survey had identified sooty

shearwater to species (Appendix B, Table 10, Table 11, Figure 8). Great shearwater was the second most encountered shearwater species in the 2016 and 2017 Summer and Fall surveys (Appendix B, Table 10, Table 11, Figure 8).

There were 11 duck species recorded across all six surveys. Six species were recorded in both the Fall 2016 and Fall 2017 surveys, nine in the Winter 2016–2017 survey, and five in the Spring 2017 survey. No duck species were recorded in either of the Summer surveys. Black scoters were the dominant identified scoter species for the two Fall surveys and for the Winter 2016–2017 surveys. However, in the Spring 2017 survey there were more scoters not identified to species, and for this survey red-breasted merganser was the dominant identified species in surveys with ducks recorded. The Fall 2016 survey was dominated by black scoters with over 98% more than any other species (Appendix B, Table 10, Table 11, Figure 9). The next most dominant species was surf scoters for the two Fall surveys but not for the Winter 2016–2017 survey where white-winged scoters were the next most encountered duck species (Appendix B, Table 10, Table 11, Figure 9). Buffleheads were present as the fourth most encountered species in the Fall 2016 and Winter 2016–2017 surveys but absent in the Fall 2017 and Spring 2017 surveys. Long-tailed duck were present in all surveys with ducks encountered, being the third most encountered species in the Fall 2017 and Spring 2017 surveys, and the fifth most encountered species in the Fall 2016 and Winter 2016–2017 surveys (Appendix B, Table 10, Table 11, Figure 9).

Murres/razorbills were present in all surveys except Summer 2016 when no auks were recorded. Murres/razorbills were the dominant species across most surveys, the exception being the Spring 2017 survey where Atlantic puffin dominated the sample and was the second most encountered auk species in the Winter 2016–2017 survey. The Fall 2016 and Winter 2016–2017 surveys both recorded dovekies (Appendix B, Table 10, Figure 10).

In the Summer 2016 survey, Wilson's storm-petrels and Cory's shearwaters were the most encountered species, which was similar to the Summer 2017 survey where storm-petrels were the most encountered species group followed by great shearwater (Figure 11, Figure 12). The Fall 2016 and Winter 2016–2017 surveys differed from the Fall 2017 survey with most encounters being northern gannets and herring gulls, closely followed in the Fall 2016 survey by black scoters and phalaropes and by auk species in the Winter 2016–2017 survey (Figure 13, Figure 14, Figure 15). However, in the Fall 2017 survey, fewer northern gannets were recorded in comparison to phalaropes and herring gulls (Figure 14). The Spring 2017 survey had a slightly different species dominance assemblage having more *Sterna* terns than herring gulls. Roseate terns were also positively identified in this survey (Figure 16).

Table 10. Avian Species Identified and the Corrected Number of Individuals within the OPA

Species	Corrected Abundance[1]						Species Total
	Summer 2016	Fall 2016	Winter 2016–2017	Spring 2017	Summer 2017	Fall 2017	
Canada Goose	0	0	11	0	0	28	39
Gadwall	0	34	0	0	0	0	34
Lesser Scaup	0	0	77	27	0	0	104
King Eider	0	0	11	0	0	0	11
Common Eider	0	0	0	0	0	55	55
Surf Scoter	0	416	2,600	0	0	539	3,554
White-winged Scoter	0	214	3,850	13	0	14	4,090

Species	Corrected Abundance[1]						Species Total
	Summer 2016	Fall 2016	Winter 2016–2017	Spring 2017	Summer 2017	Fall 2017	
Black Scoter	0	18,031	5,929	40	0	1,754	25,755
Scoter unid.	0	0	553	664	0	1,298	2,515
Long-tailed Duck	0	34	542	27	0	193	796
Bufflehead	0	56	1,195	0	0	0	1,251
Common Goldeneye	0	0	11	0	0	0	11
Red-breasted Merganser	0	0	55	93	0	28	176
Duck-species unknown	0	112	553	13	0	14	693
Red-throated Loon	0	2,497	2,666	319	0	2,224	7,706
Common Loon	41	540	3,783	2,829	42	1,934	9,168
Loon-species unknown	0	22	33	40	28	193	317
Horned Grebe	0	0	88	0	0	0	88
Northern Fulmar	0	34	542	664	0	829	2,069
Trindade Petrel	0	0	0	13	0	0	13
Black-capped Petrel	178	11	11	0	42	0	242
Petrel-species unknown	68	0	11	13	0	0	93
Cory's Shearwater	6,967	1,642	0	120	1,257	28	10,014
Great Shearwater	956	90	0	27	4,707	166	5,945
Sooty Shearwater	27	0	22	1,076	14	0	1,139
Manx Shearwater	0	0	0	0	0	221	221
Audubon's Shearwater	109	0	0	0	0	0	109
Shearwater-species unknown-Large	1,762	112	22	199	1,508	110	3,715
Shearwater-species unknown-Small	178	0	0	239	559	69	1,044
Wilson's Storm-Petrel	10,779	11	0	1,195	4,735	0	16,720
Leach's Storm-Petrel	0	0	33	13	28	28	102
Band-rumped Storm-Petrel	0	0	0	13	0	0	13
Storm-petrel-species unknown	0	0	752	53	24,288	1,506	26,599
Northern Gannet	0	33,060	45,509	2,749	56	10,456	91,829
Double-crested Cormorant	82	754	0	212	0	0	1,048
Cormorant-species unknown	0	0	33	0	0	1,519	1,553
Brown Pelican	0	11	0	0	0	0	11
Great Blue Heron	0	0	0	0	0	14	14
Osprey	14	0	0	0	0	0	14
Bald Eagle	14	0	0	0	0	0	14

Species	Corrected Abundance[1]						Species Total
	Summer 2016	Fall 2016	Winter 2016–2017	Spring 2017	Summer 2017	Fall 2017	
Black-bellied Plover	82	0	0	0	0	0	82
Semipalmated Plover	0	0	0	0	42	0	42
Ruddy Turnstone	0	0	0	0	0	1,837	1,837
Sanderling	0	0	0	0	0	1,616	1,616
Dunlin	0	0	0	0	0	23,522	23,522
Shorebird-species unknown	14	517	11	0	363	552	1,458
Red-necked Phalarope	0	776	0	226	14	0	1,016
Red Phalarope	0	0	0	13	0	24,503	24,516
Red/Red-necked Phalarope	0	16,670	2,577	7,052	1,690	17,099	45,089
Phalarope-species unknown	0	0	0	0	223	69	293
South Polar Skua	0	0	0	13	0	0	13
Pomarine Jaeger	0	11	0	13	0	0	25
Parasitic Jaeger	0	0	0	27	0	14	40
Dovekie	0	34	19,834	0	0	0	19,868
Common Murre	0	124	0	0	0	0	124
Common/Thick-billed Murre	0	0	33	0	0	0	33
Razorbill	0	270	23,097	53	0	28	23,448
Murre/Razorbill	0	0	22,821	398	28	1,326	24,573
Black Guillemot	0	11	88	0	0	0	100
Atlantic Puffin	0	0	26,405	598	0	110	27,113
Auk-species unknown	0	450	6,748	359	28	41	7,626
Black-legged Kittiwake	0	2,587	100	0	0	5,124	7,811
Bonaparte's Gull	0	12,160	6,803	0	0	9,820	28,783
Little Gull	0	45	66	0	0	0	111
Laughing Gull	191	8,751	0	465	182	1,091	10,680
Ring-billed Gull	109	1,024	2,434	13	28	1,326	4,934
Herring Gull	287	25,613	38,662	7,357	461	12,831	85,211
Iceland Gull	0	0	77	13	0	14	105
Lesser Black-backed Gull	0	101	254	146	28	207	737
Glaucous Gull	0	0	11	0	0	0	11
Great Black-backed Gull	710	4,162	10,664	3,413	349	2,569	21,867
Gull-species unknown - Large	55	180	254	13	42	525	1,069
Gull-species unknown - Small	150	6,535	1,504	385	433	1,326	10,334

Species	Corrected Abundance[1]						Species Total
	Summer 2016	Fall 2016	Winter 2016–2017	Spring 2017	Summer 2017	Fall 2017	
Gull-species unknown	55	11	66	0	0	55	188
Least Tern	451	0	0	651	0	0	1,102
Black Tern	0	0	0	27	14	0	41
Royal Tern	109	22	0	0	0	0	132
Tern-species unknown	96	0	0	0	14	0	110
Roseate Tern	0	0	0	199	0	0	199
Common Tern	0	0	0	7,251	0	0	7,251
Forster's Tern	0	0	0	0	0	28	28
Sterna Tern-species unknown	1,926	0	0	9,376	182	14	11,497
Common Nighthawk	0	0	0	0	14	0	14
Snow Bunting	0	0	0	0	0	97	97
Season Total	**25,410**	**137,739**	**231,405**	**48,712**	**41,397**	**128,964**	**613,626**

[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.

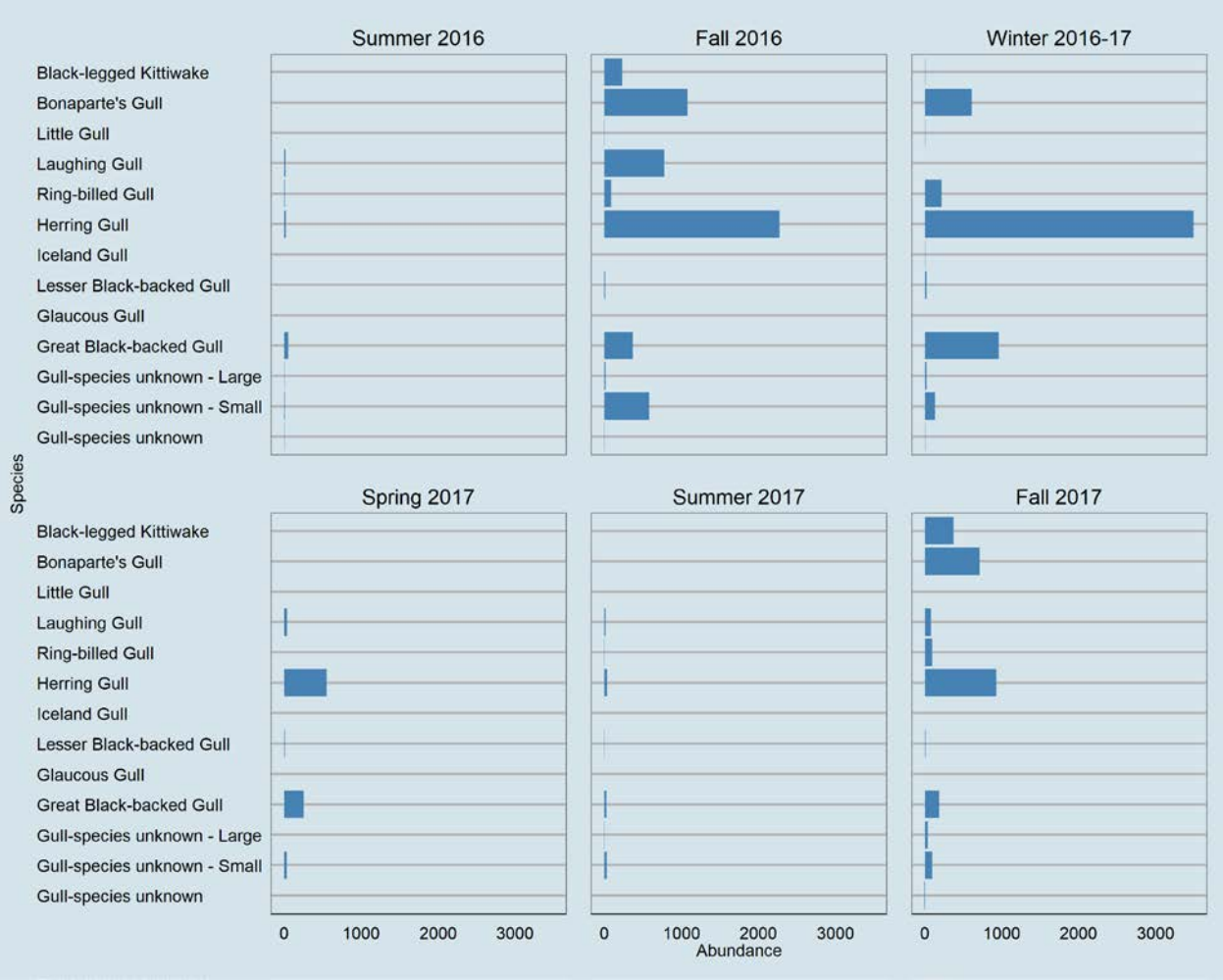


Figure 7. Relative abundance (raw observations) of gull species by survey across the OPA.

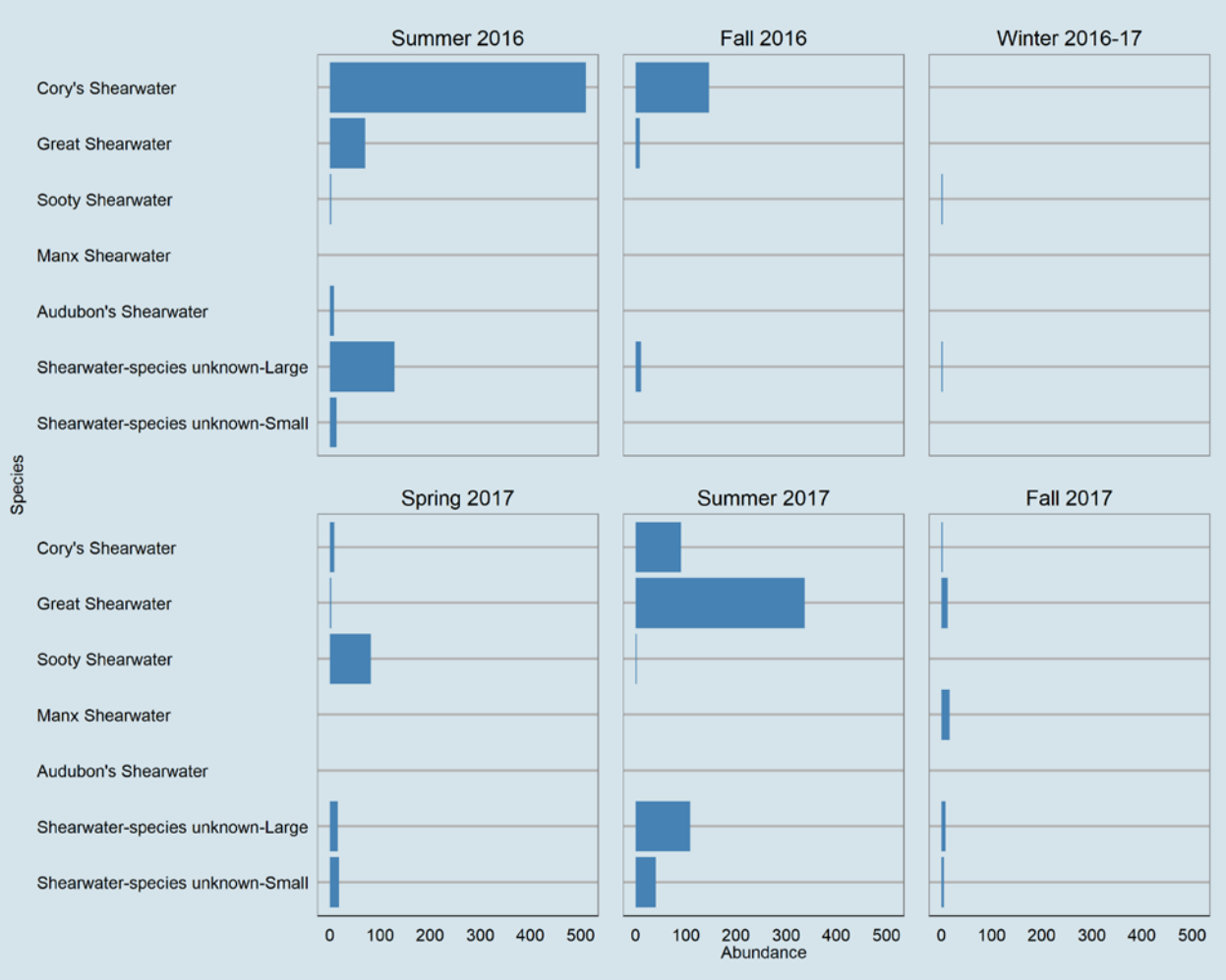


Figure 8. Relative abundance (raw observations) of shearwater species by survey across the OPA.

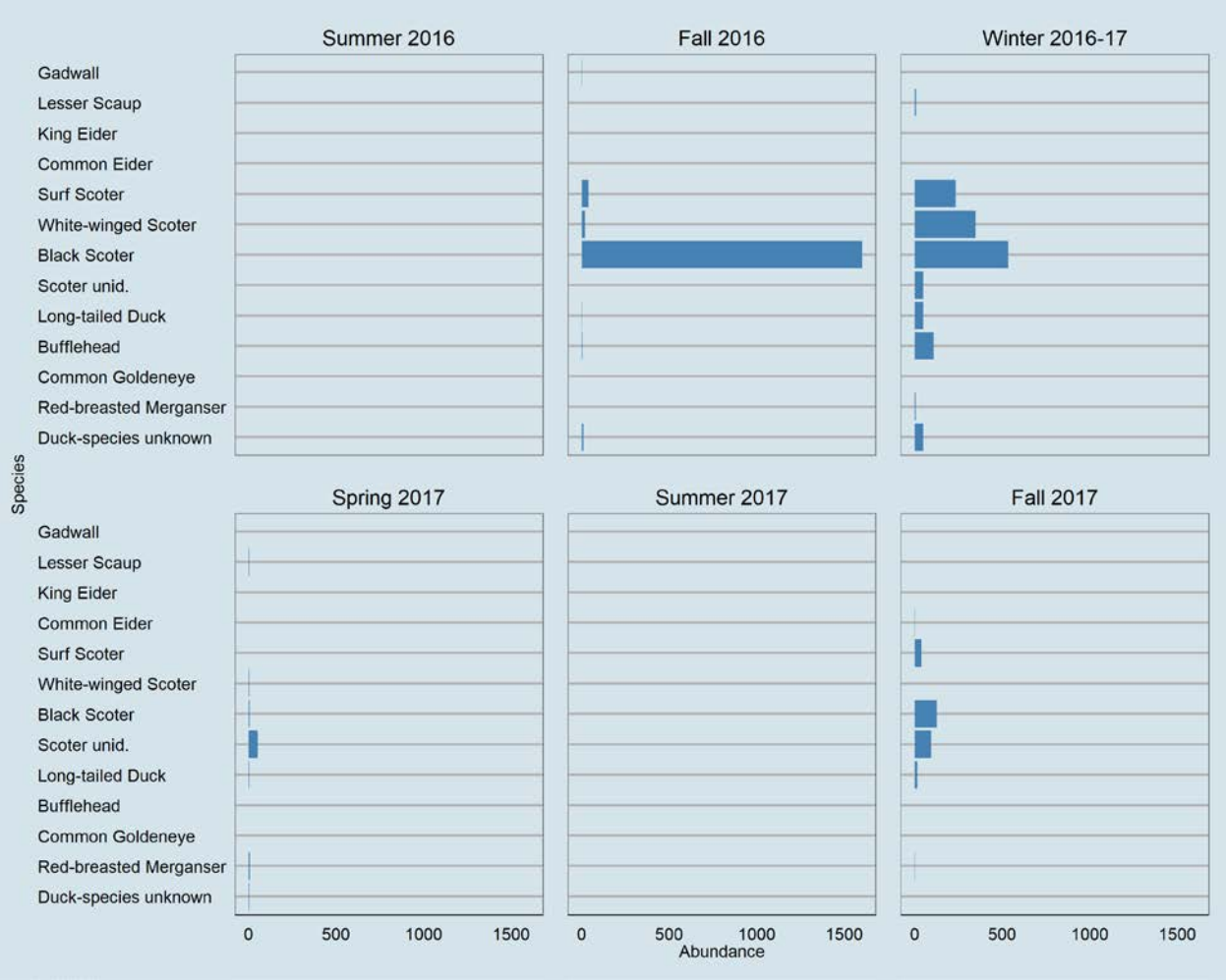


Figure 9. Relative abundance (raw observations) of ducks in the first six surveys across the OPA.

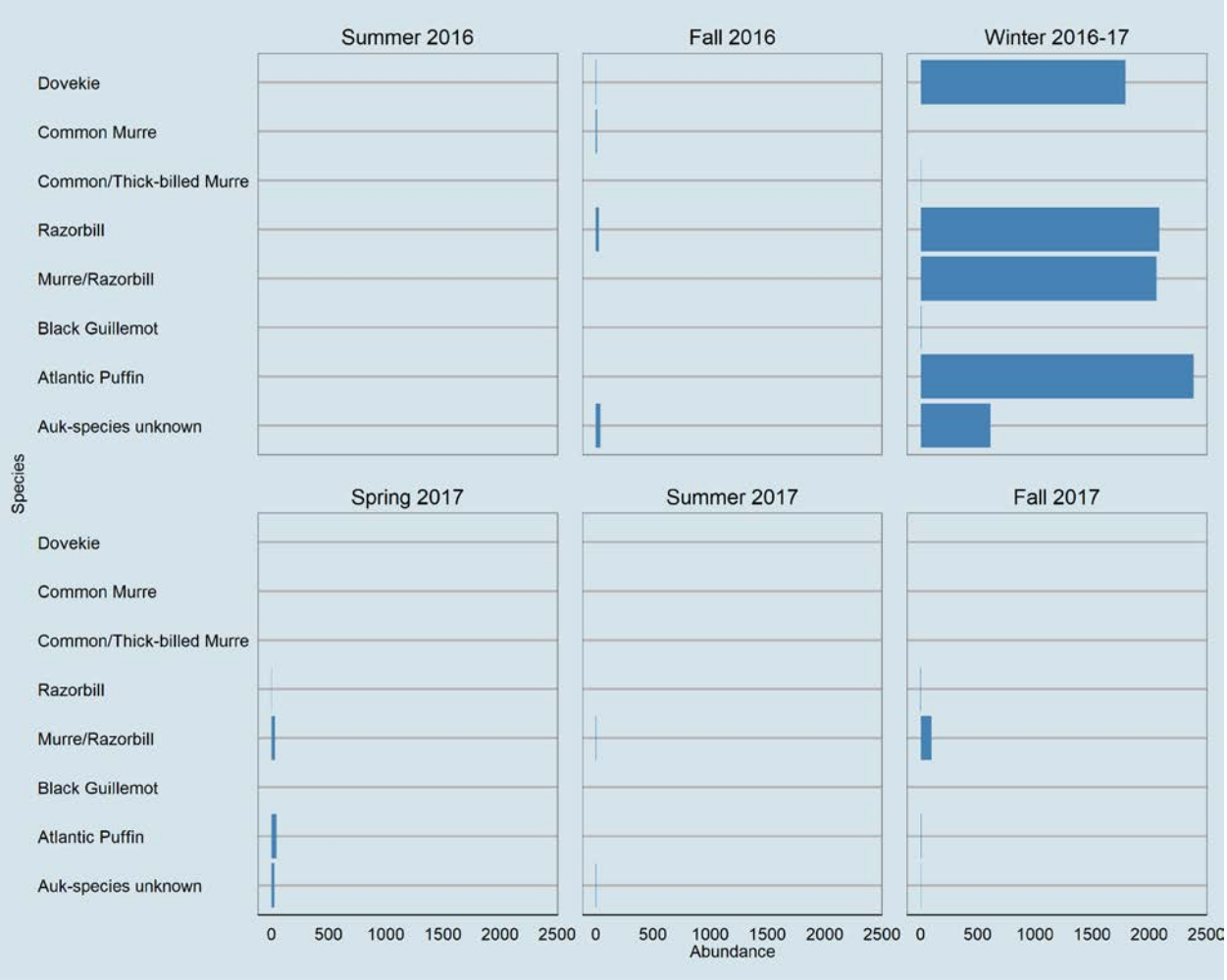


Figure 10. Relative abundance (raw observations) of Alcid species by survey across the OPA.

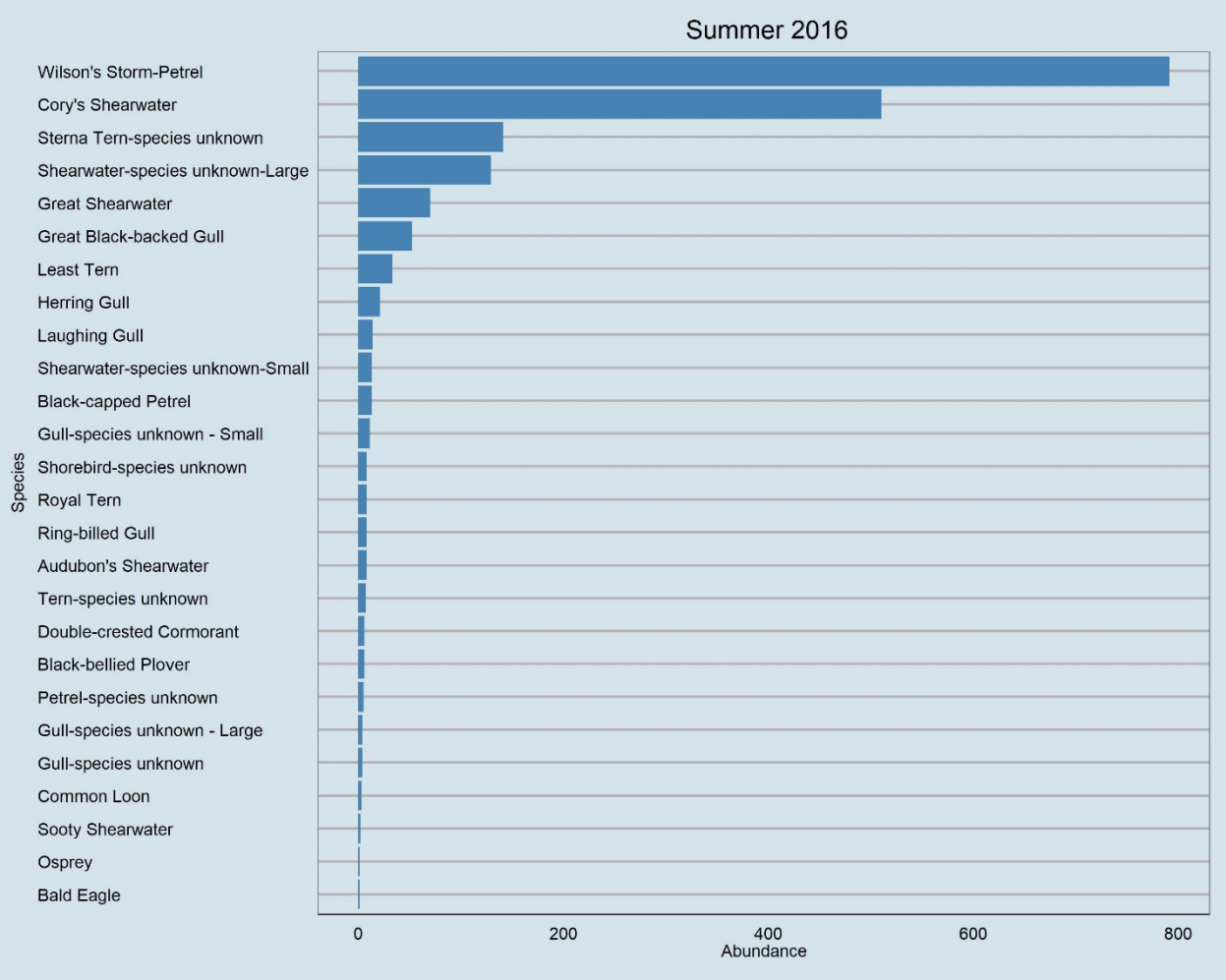


Figure 11. Number of individuals (raw observations) for each avian species identified during the Summer 2016 survey across the OPA.

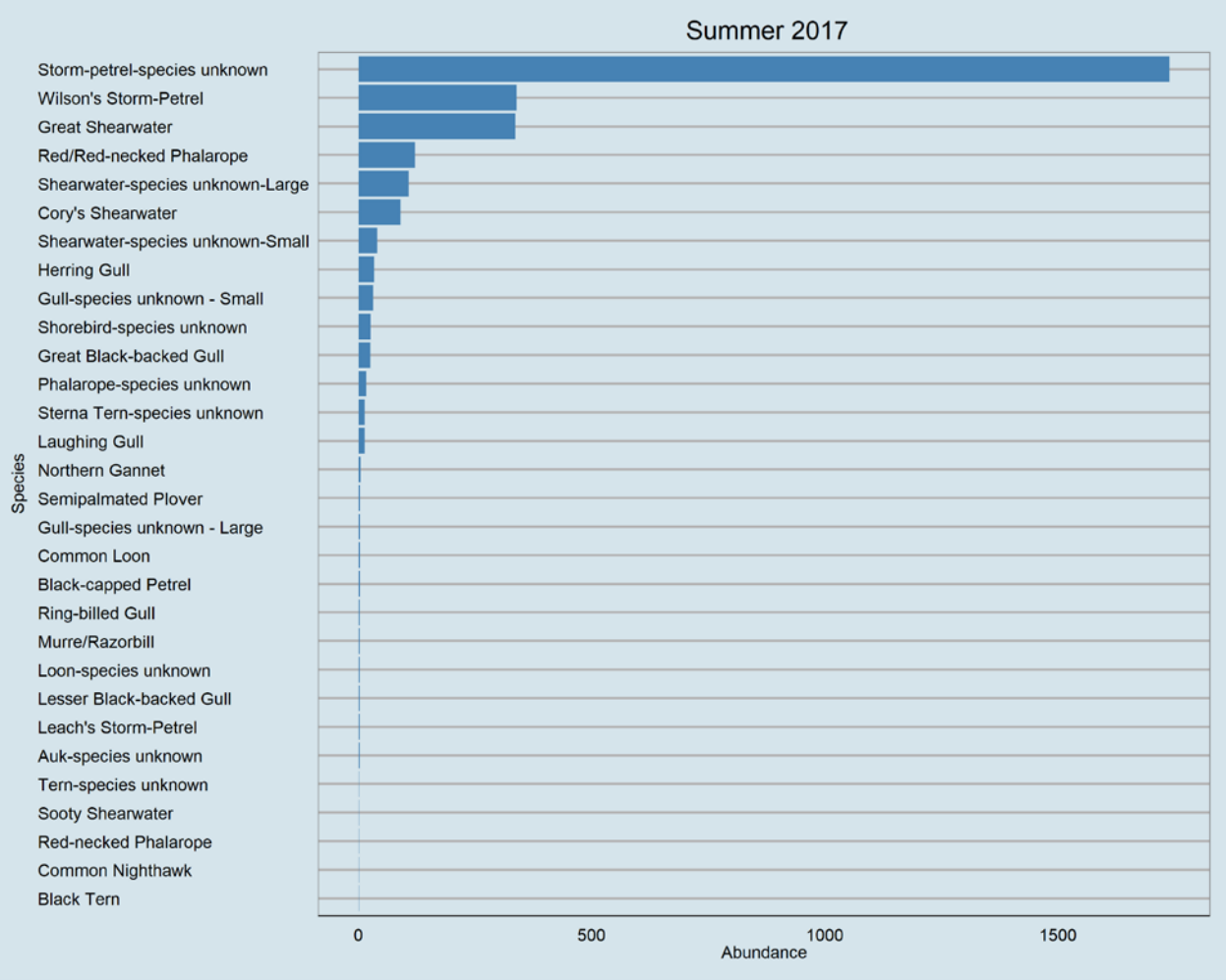


Figure 12. Number of individuals (raw observations) for each avian species identified during the Summer 2017 survey across the OPA.

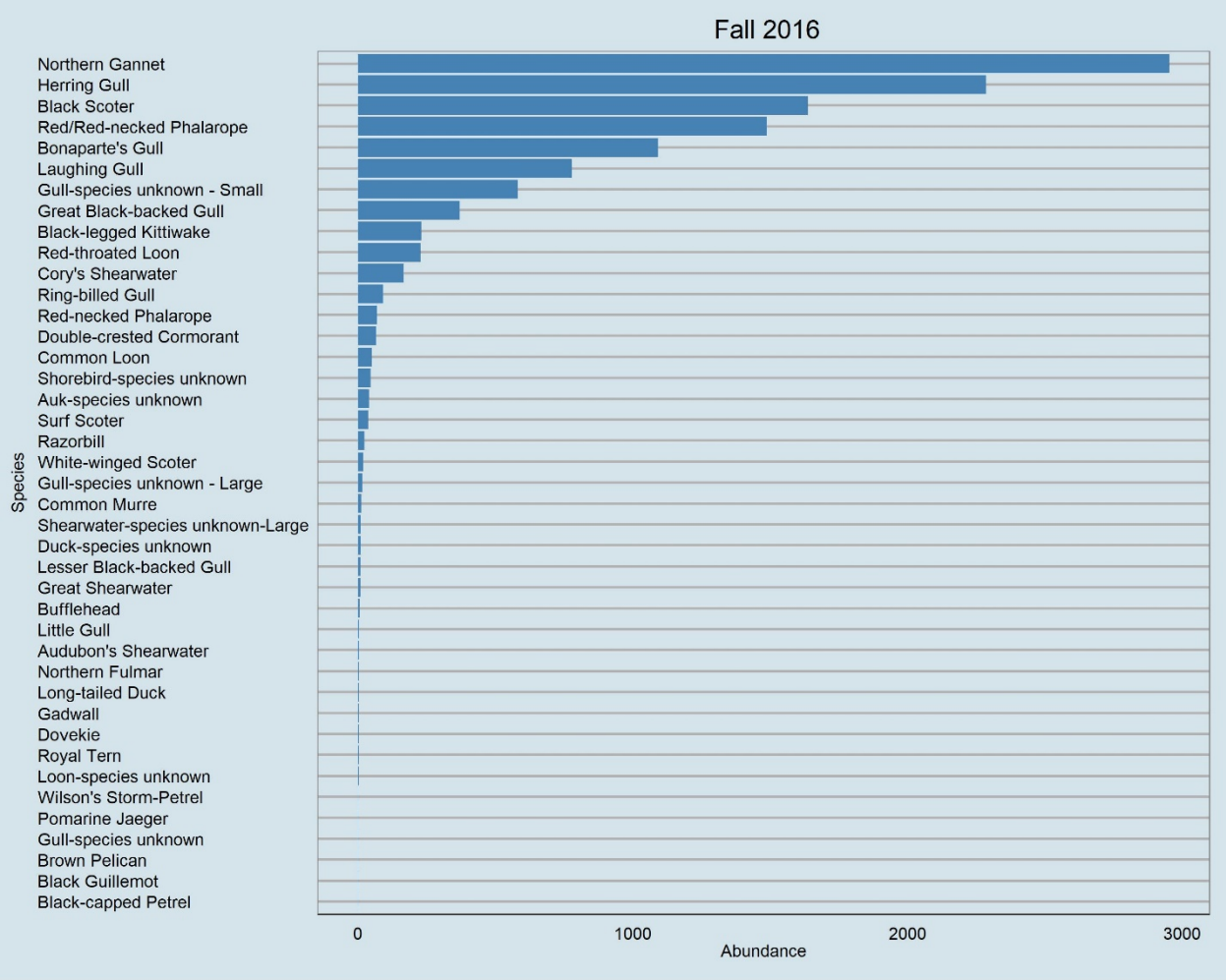


Figure 13. Number of individuals (raw observations) for each avian species identified during the Fall 2016 survey across the OPA.

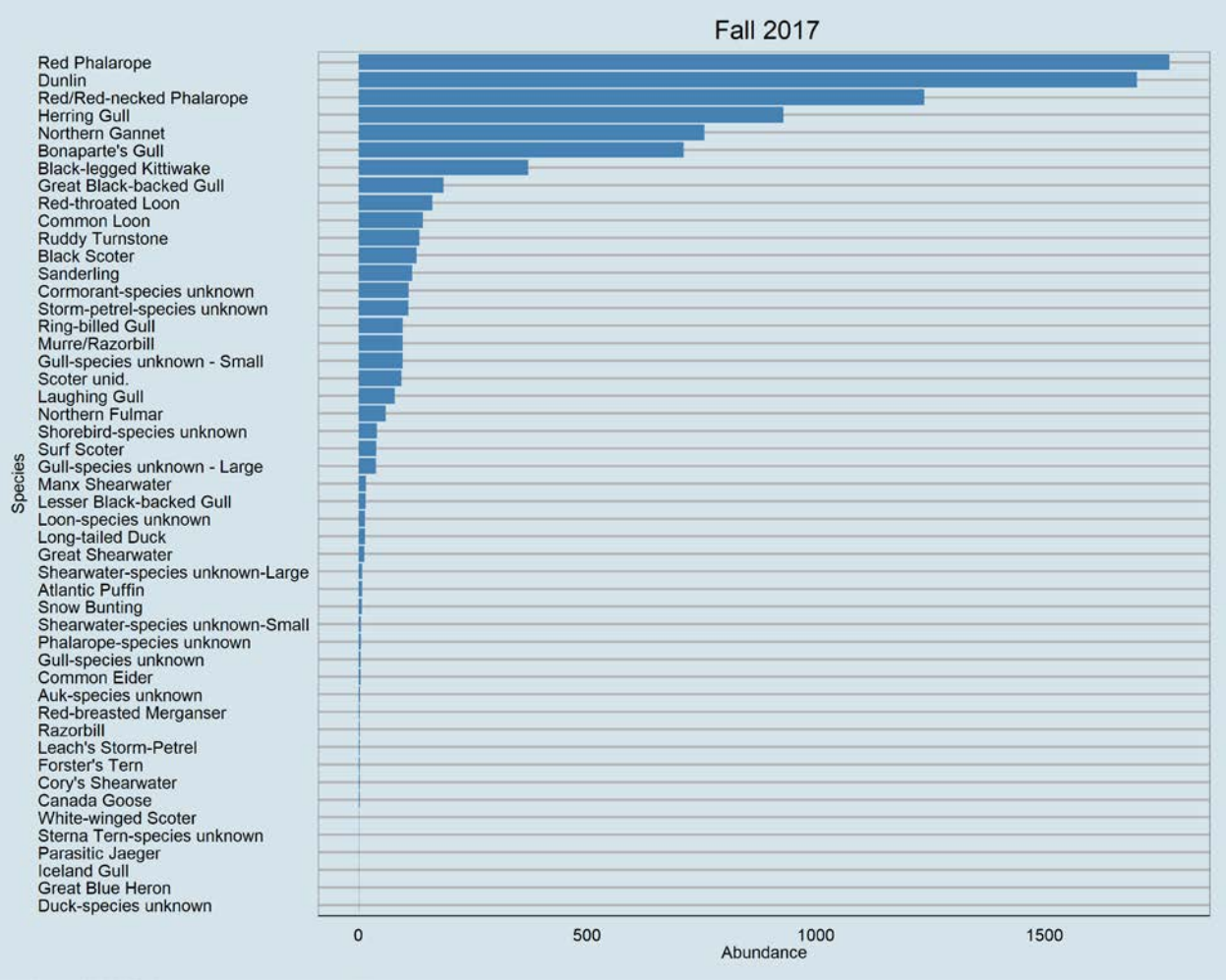


Figure 14. Number of individuals (raw observations) for each avian species identified during the Fall 2017 survey across the OPA.

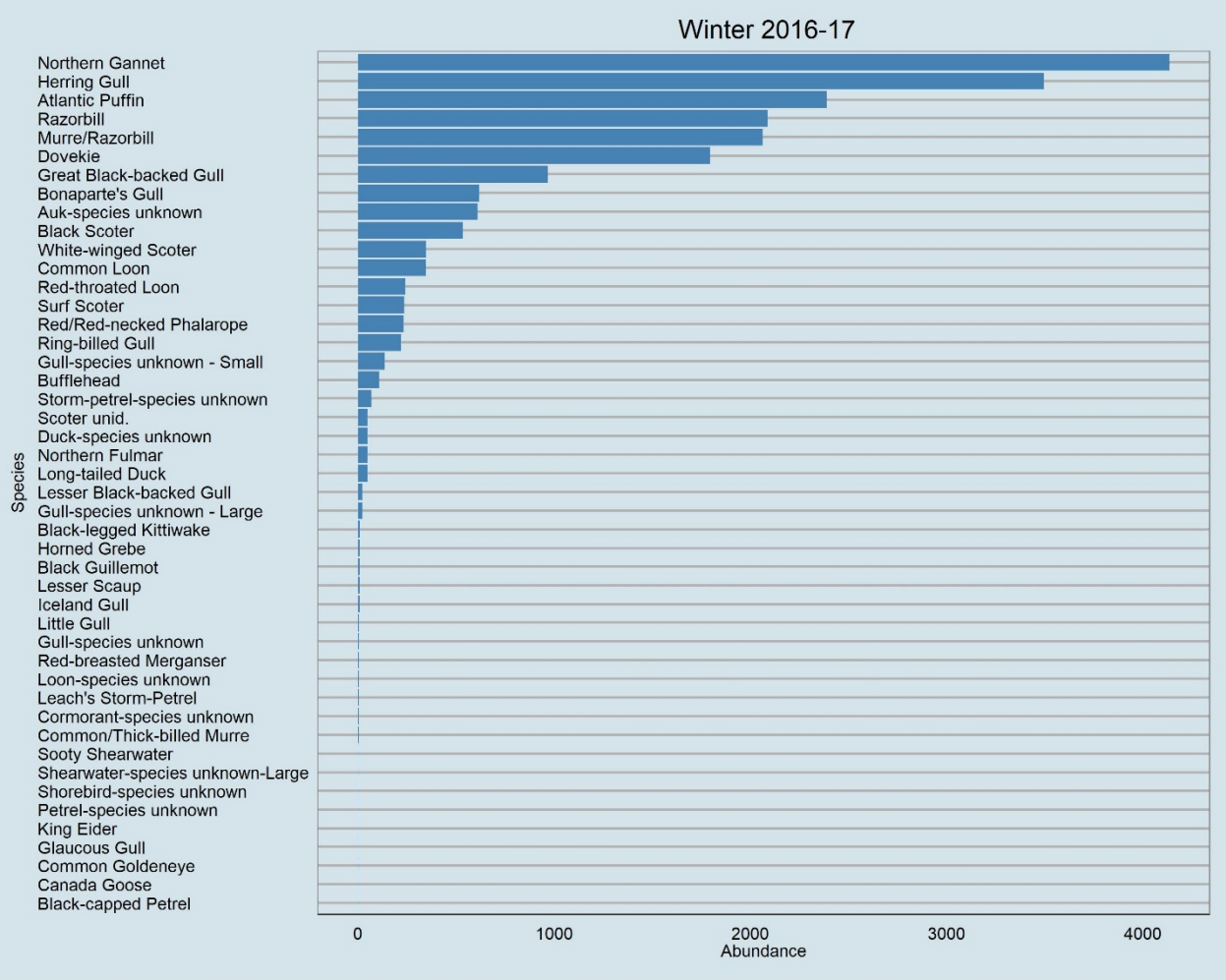


Figure 15. Number of individuals (raw observations) for each avian species identified during the Winter 2016–2017 survey across the OPA.

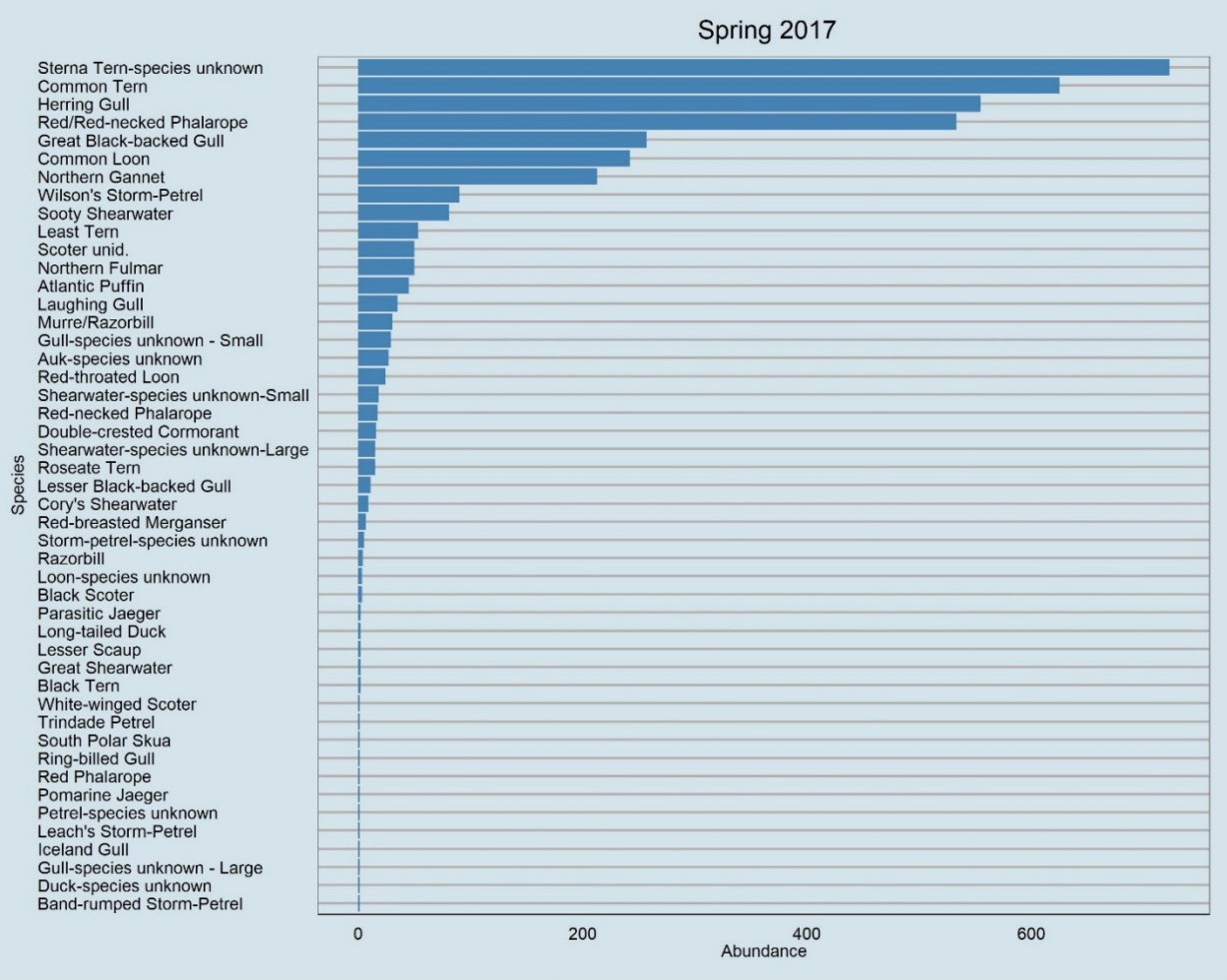


Figure 16. Number of individuals (raw observations) for each avian species identified during the Spring 2017 survey across the OPA.

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 both on the shelf break and in the northeast corner of the OPA (Figure 17). Sooty shearwaters were found during the Summer surveys primarily in the northeast corner of the OPA (Figure 17) and in the southern portion of the OPA during the Spring. Cory's shearwaters showed a tendency to cluster in the northeast corner of the OPA, with no apparent shift in distribution among the seasons (Figure 18). Great shearwaters were more evenly distributed across the OPA (Figure 18) as were northern gannets, although encounters were sparser in the central and eastern areas (Figure 19).

Most gull species tended to show nearshore tendencies in the Spring and Summer surveys, possibly correlated with breeding activity, with herring gulls near shore as well as widely distributed during the rest of the seasons and showing some concentrations in the northeast part of the OPA in all seasons (Figure 20). Laughing gulls and ring-billed gulls tended to be found clustered nearer shore in the Fall, whereas black-legged kittiwakes, Bonaparte's gulls, and small unidentified gulls were more evenly distributed (Figure 20, Figure 21, Figure 22, Figure 23). Great black-backed gulls were concentrated in the northeast and southeast portions of the OPA during winter (Figure 24).

Nearshore tendencies for least and royal terns were evident in the Summer and Spring surveys and black terns were more offshore (Figure 25). Other tern species also showed nearshore preferences but also occurred throughout the OPA with some roseate terns found past the shelf break (Figure 26, Figure 27).

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 28).

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 29, Figure 30).

Phalaropes were found in all seasons although they were rarely found in the Summer and only recorded during the 2017 Summer survey. In general, they were found beyond the 60-m isobath (Figure 31).

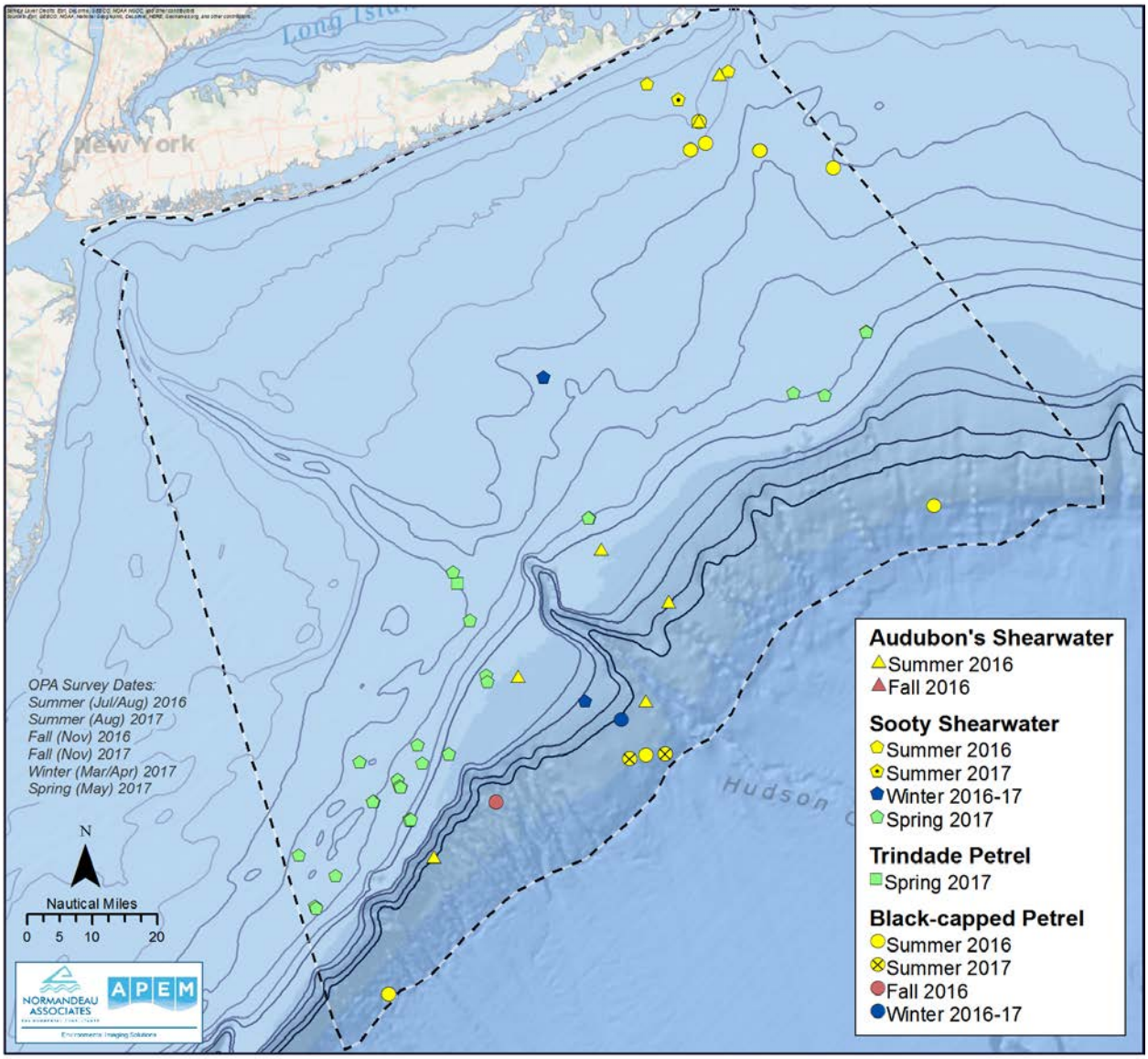


Figure 17. Distribution of black-capped petrel, Audubon's shearwater, sooty shearwater, and Trindade petrel during the Summer 2016–Fall 2017 surveys.

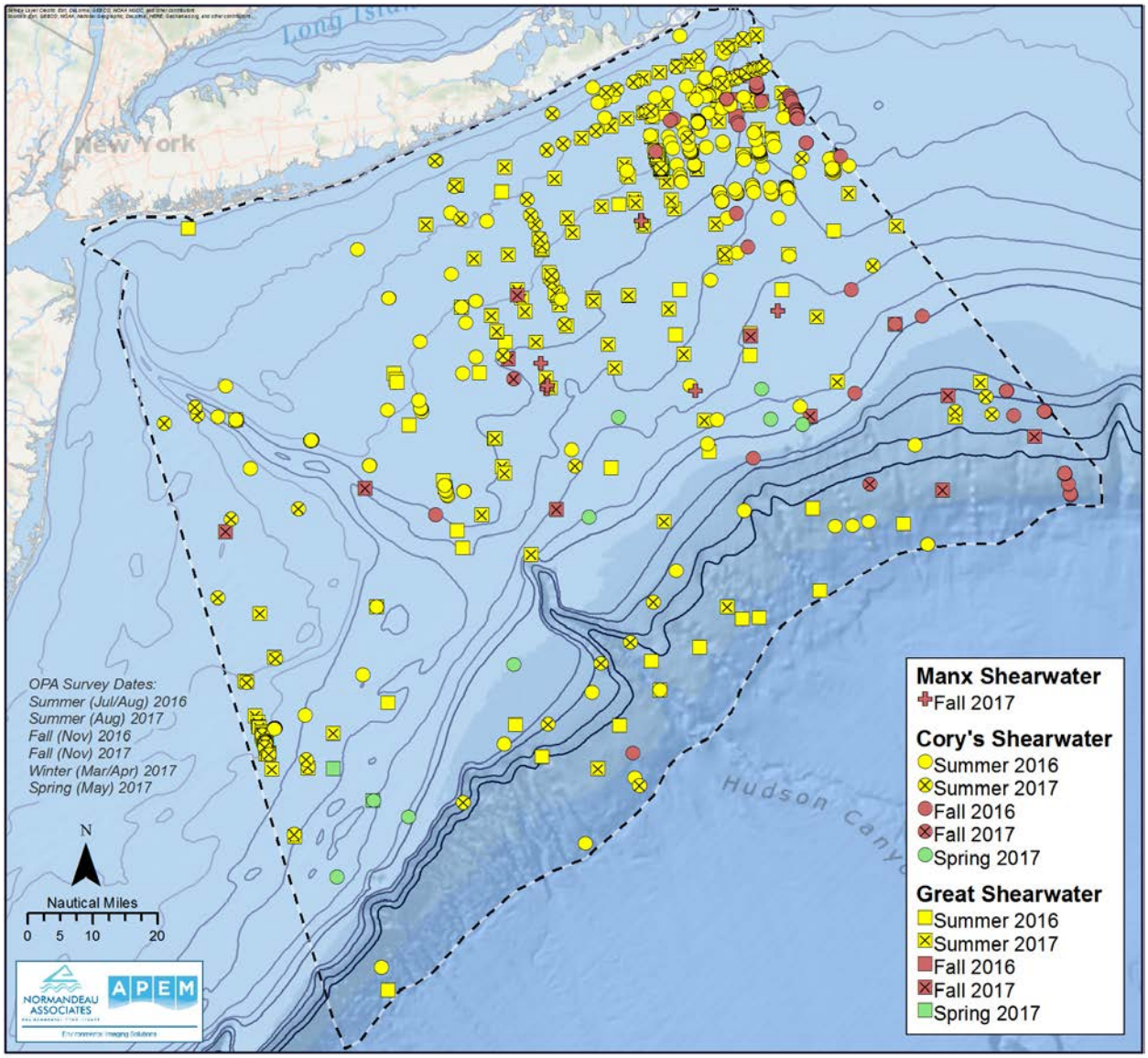


Figure 18. Distribution of Cory's and great shearwaters during the Summer 2016–Fall 2017 surveys.

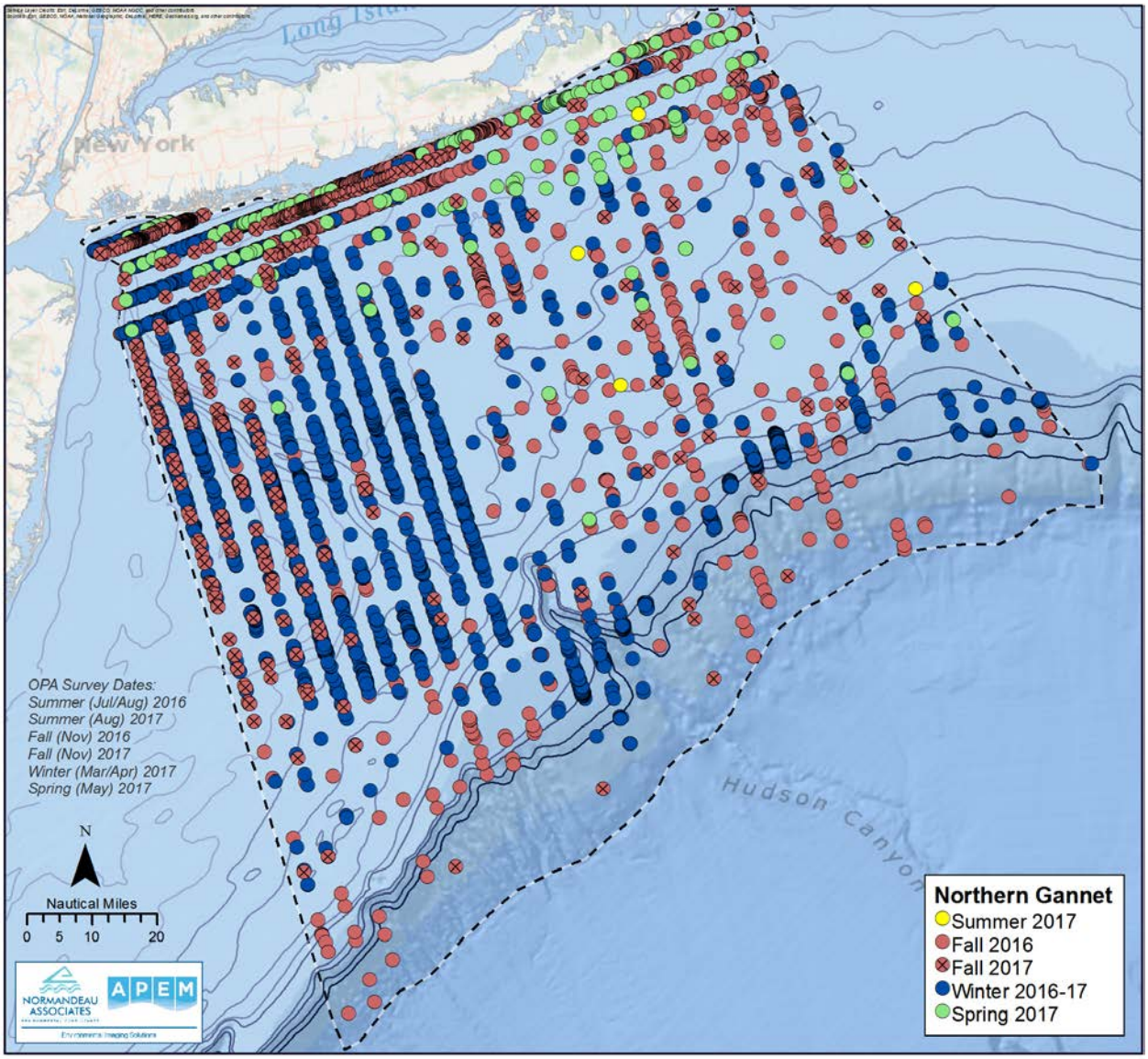


Figure 19. Distribution of northern gannet during the Summer 2016–Fall 2017 surveys.

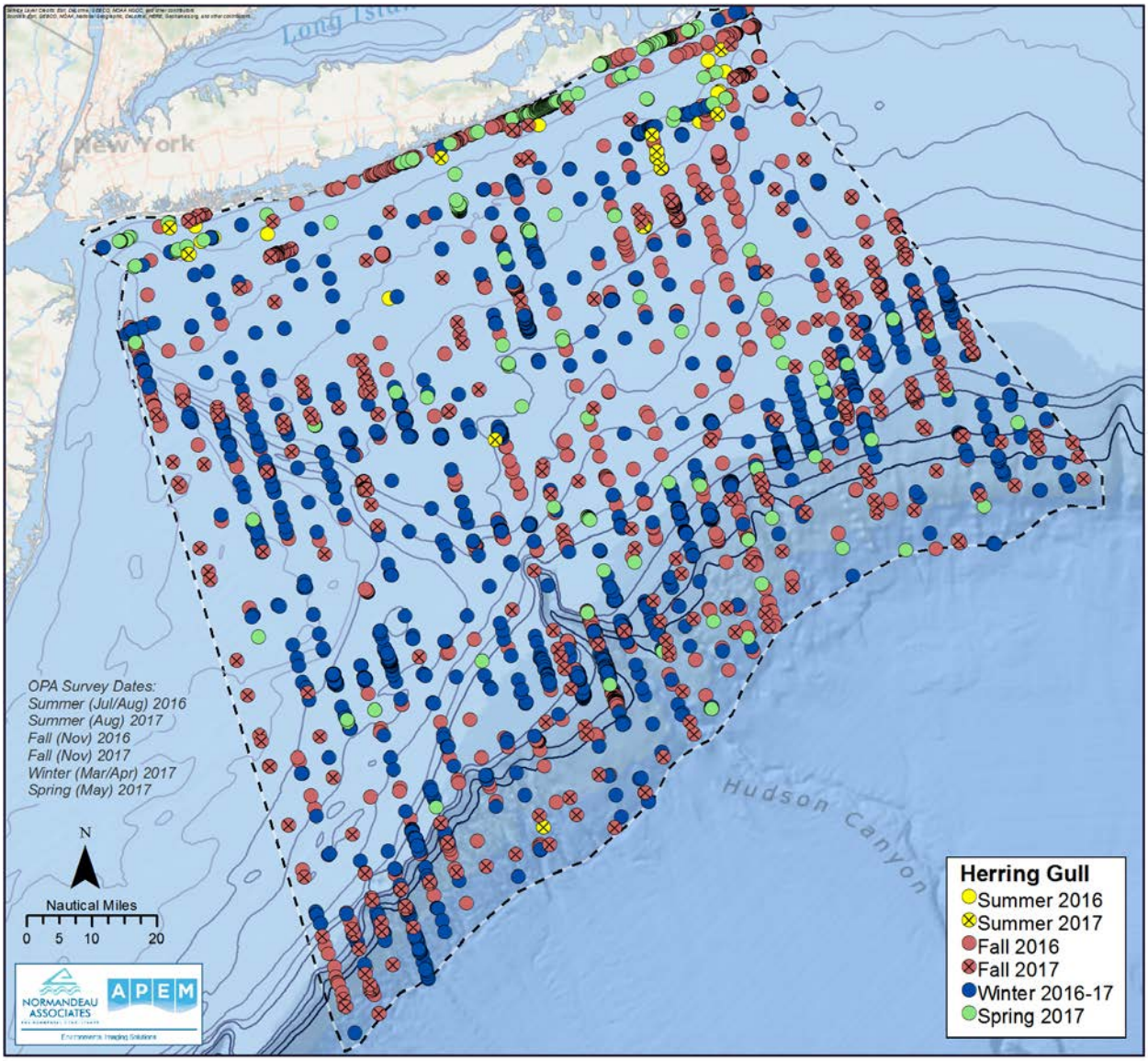


Figure 20. Distribution of herring gulls during the Summer 2016–Fall 2017 surveys.

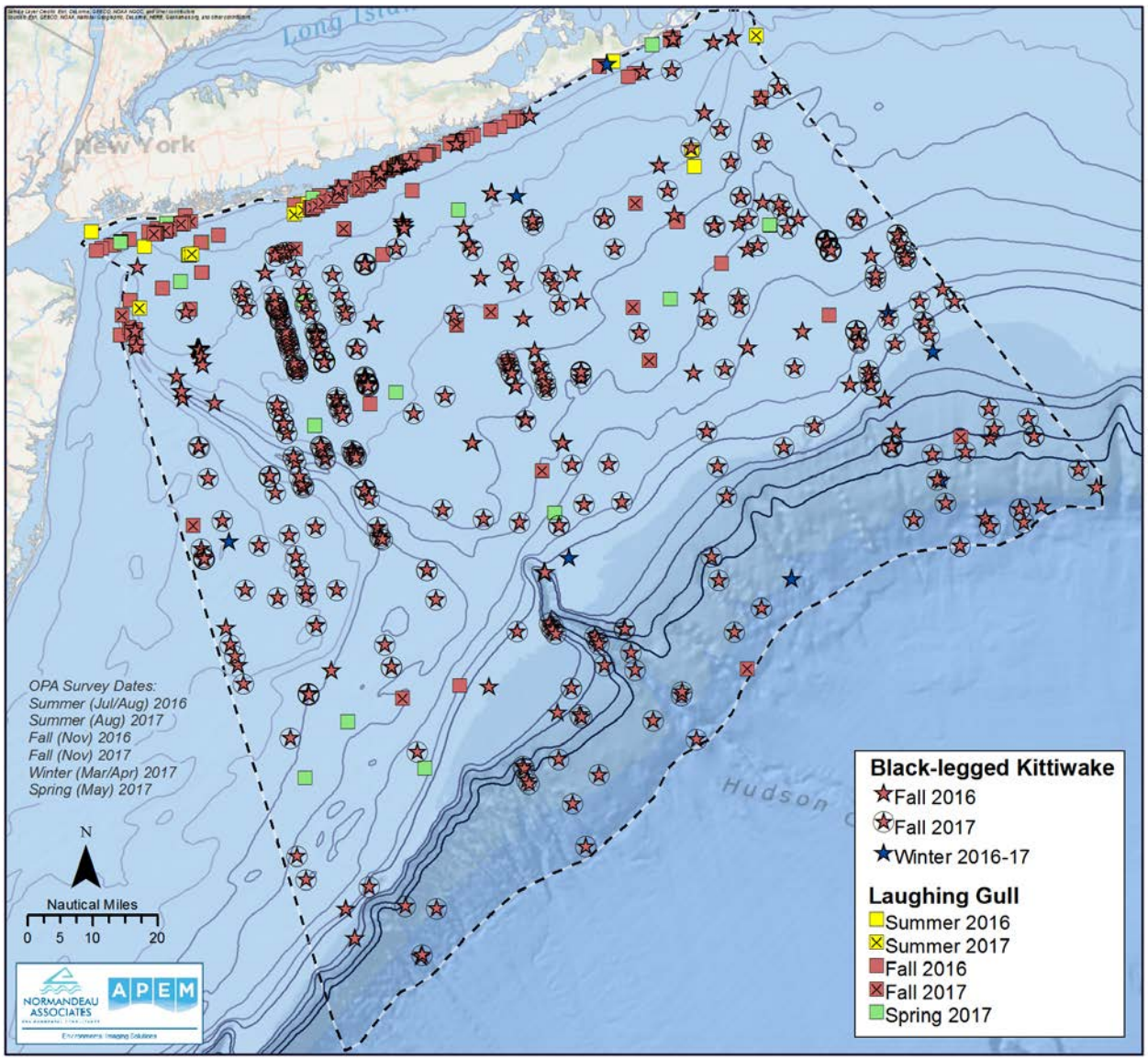


Figure 21. Distribution of select gull species during the Summer 2016–Fall 2017 surveys.

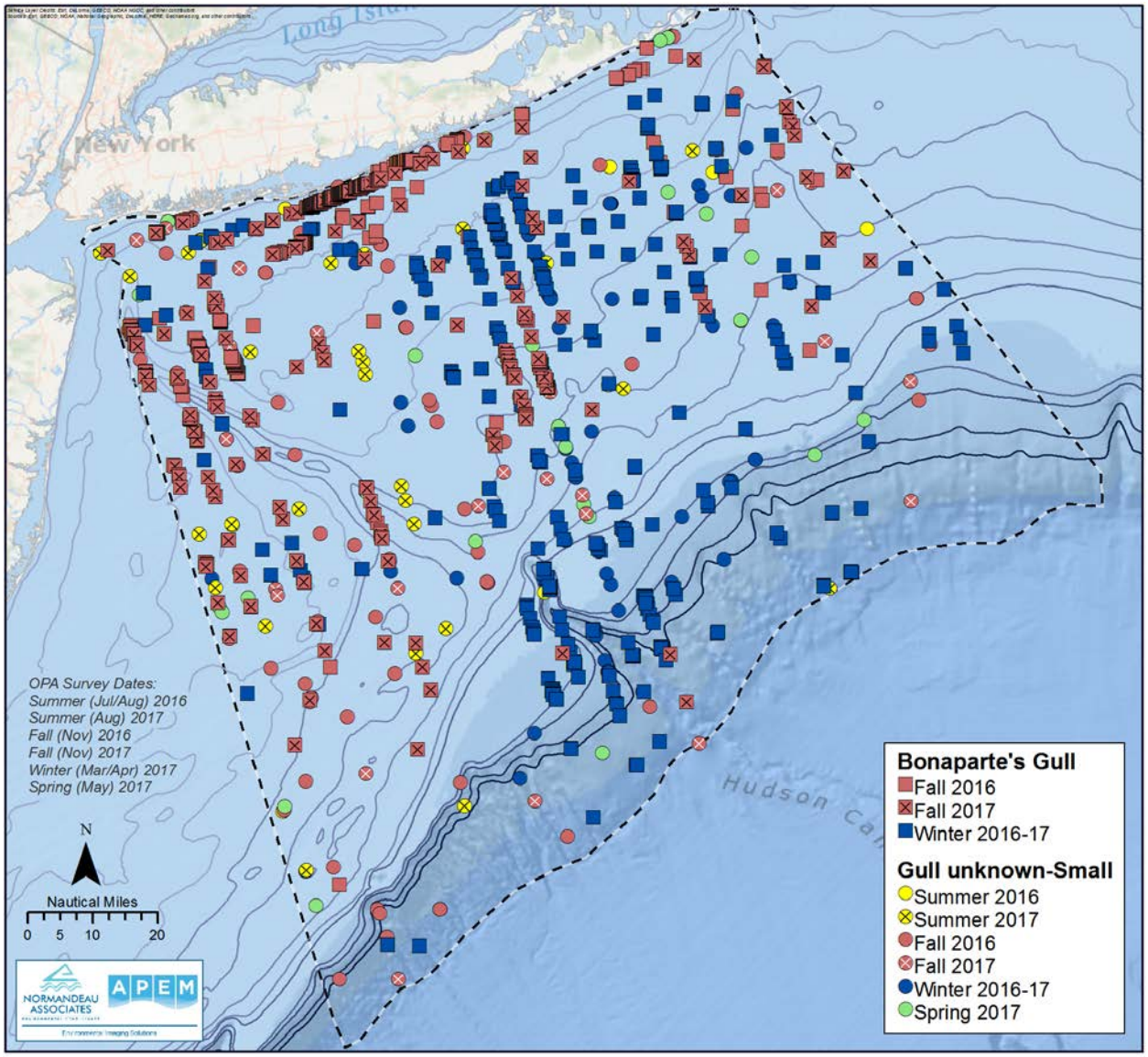


Figure 22. Distribution of select gull species during the Summer 2016–Fall 2017 surveys.

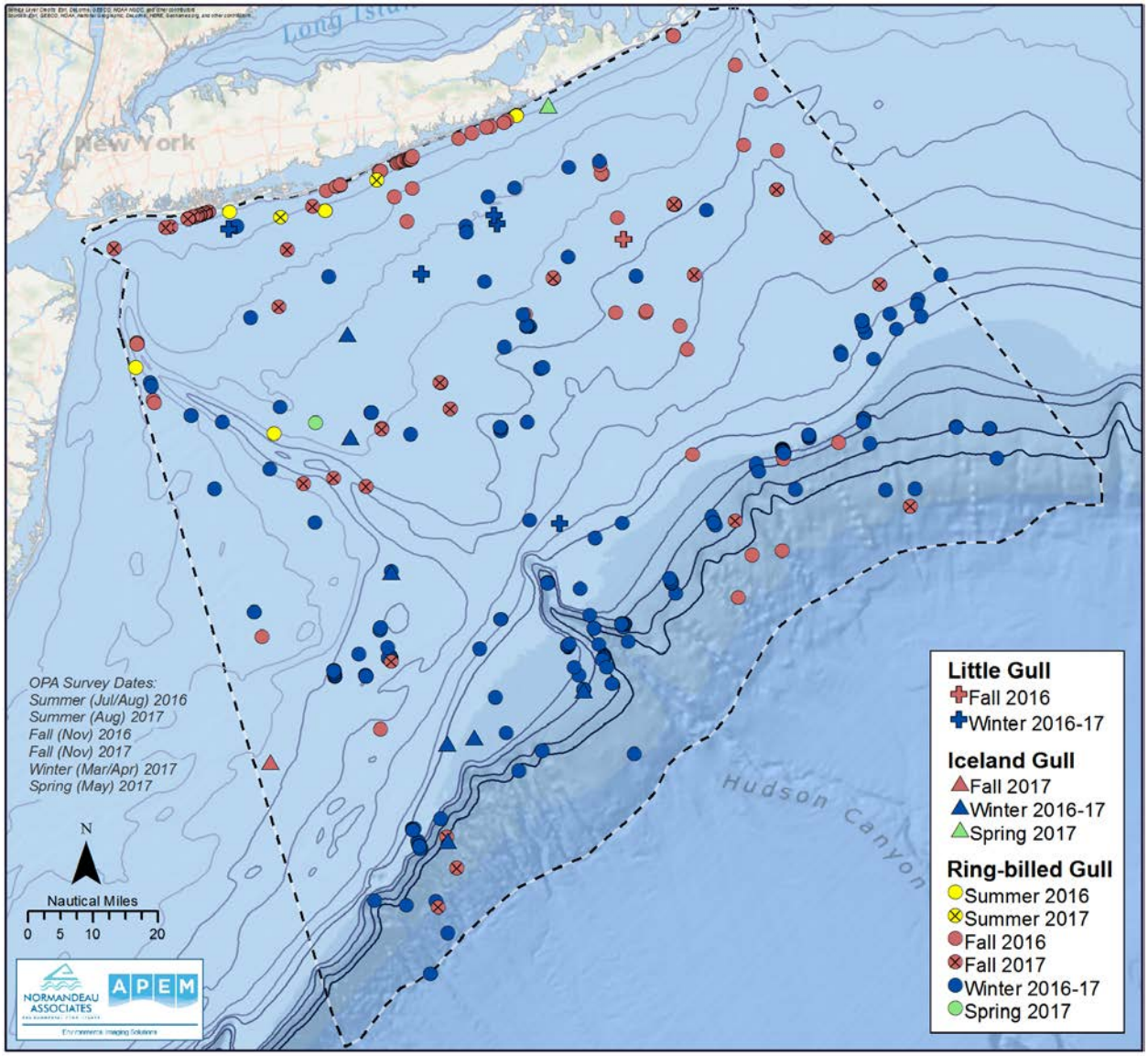


Figure 23. Distribution of select gull species during the Summer 2016–Fall 2017 surveys.

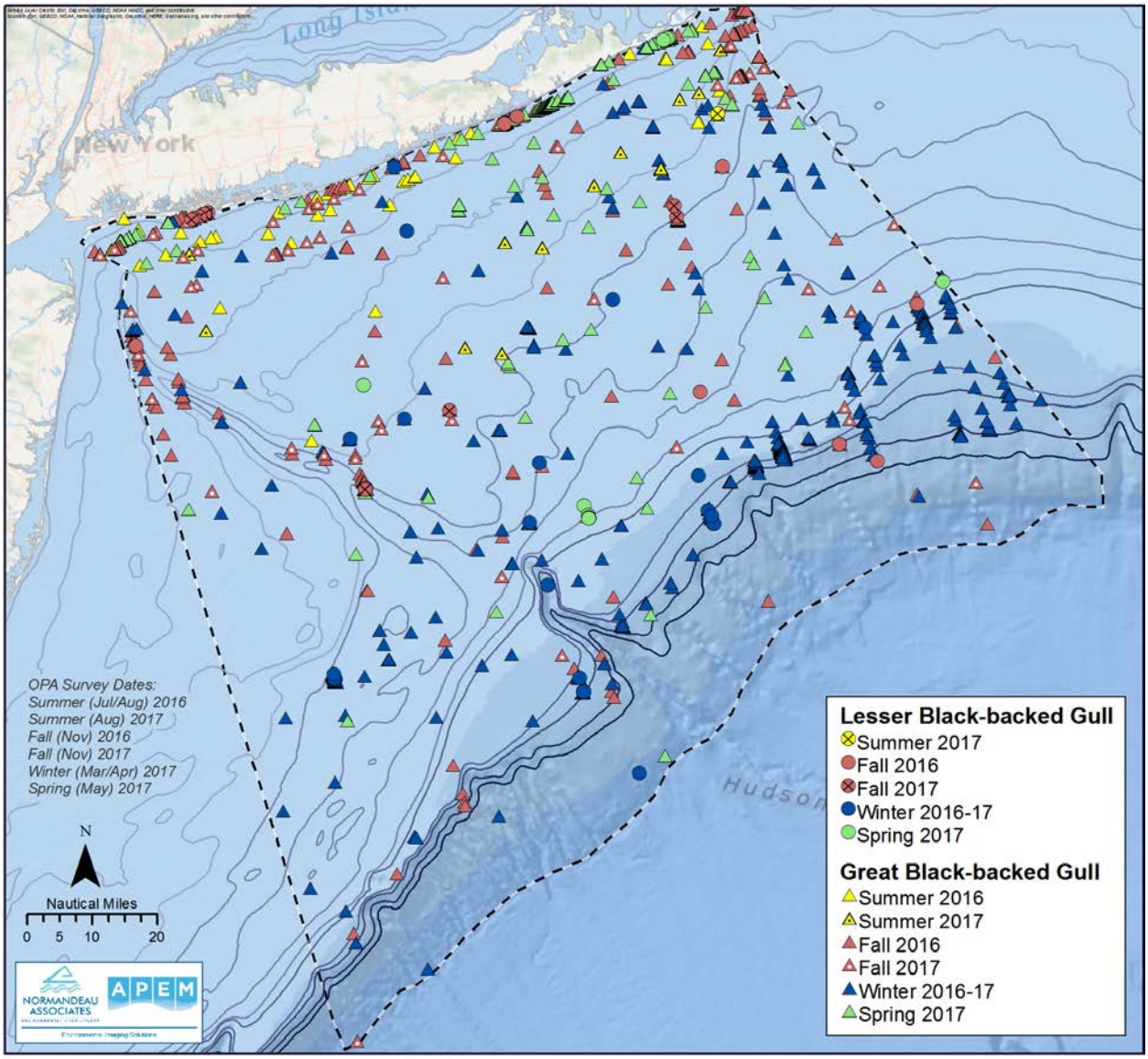


Figure 24. Distribution of select gull species during the Summer 2016–Fall 2017 surveys.

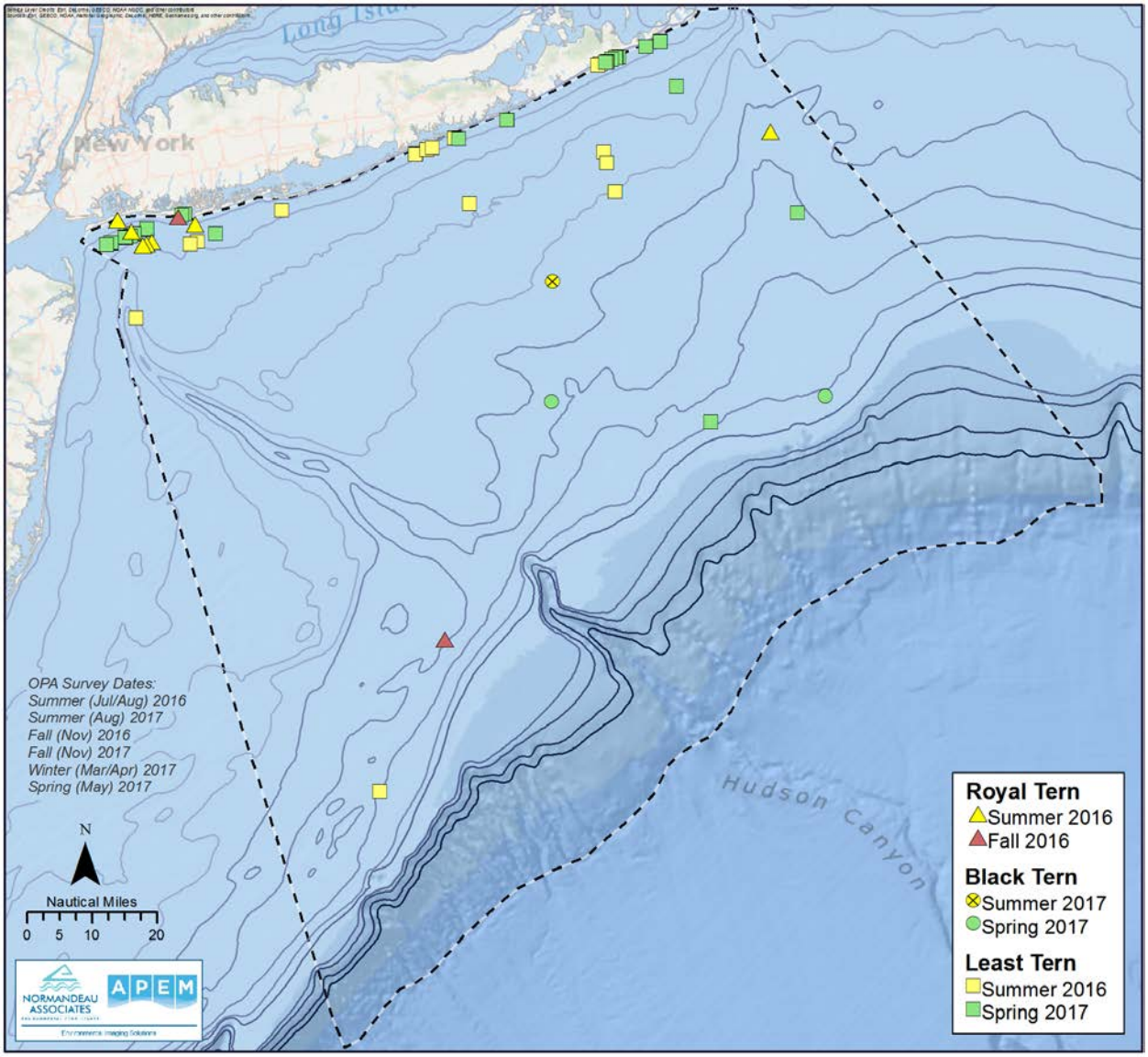


Figure 25. Distribution of black, least, and royal terns during the Summer 2016–Fall 2017 surveys.

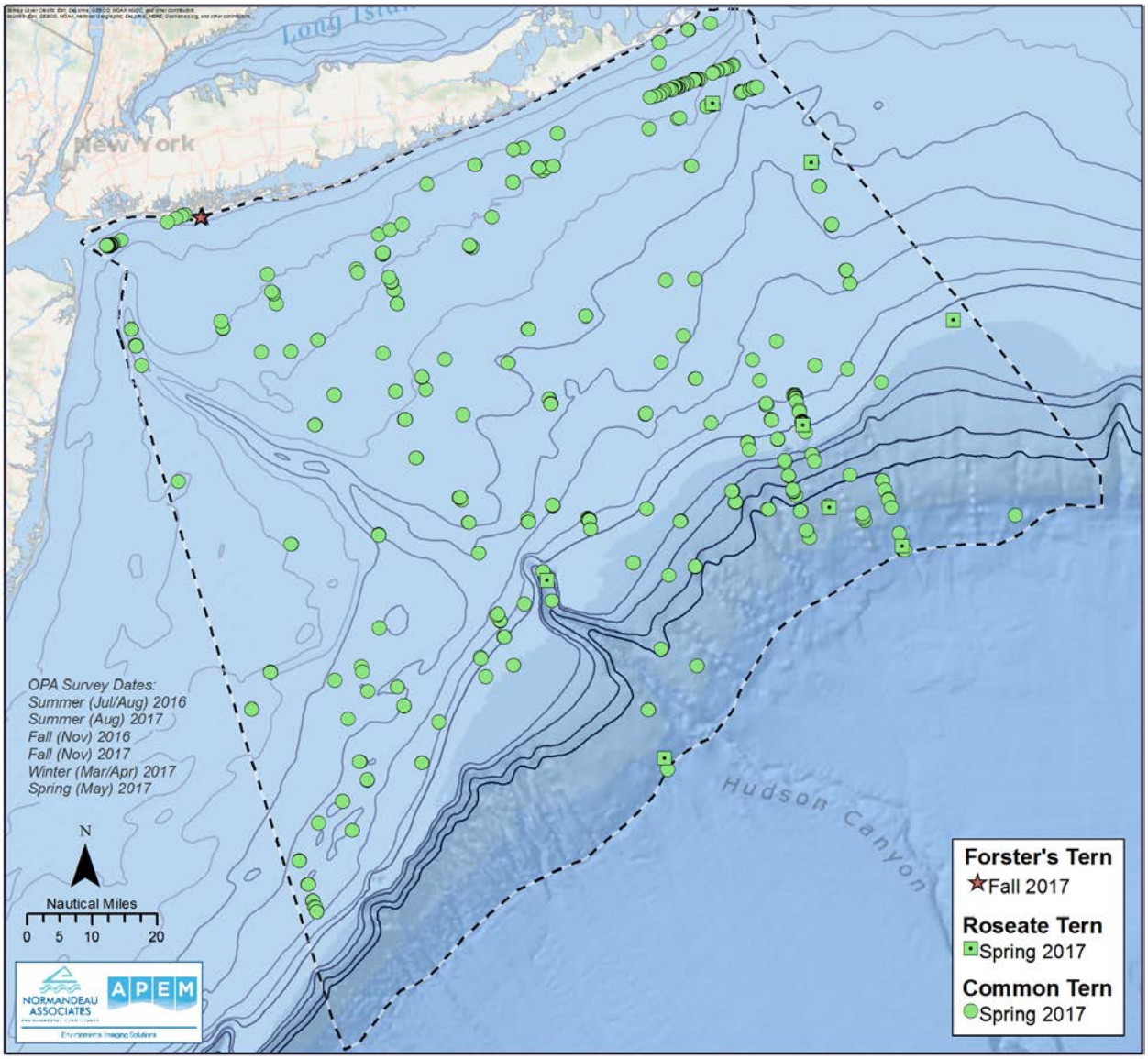


Figure 26. Distribution of *Sterna* terns during the Summer 2016–Fall 2017 surveys.

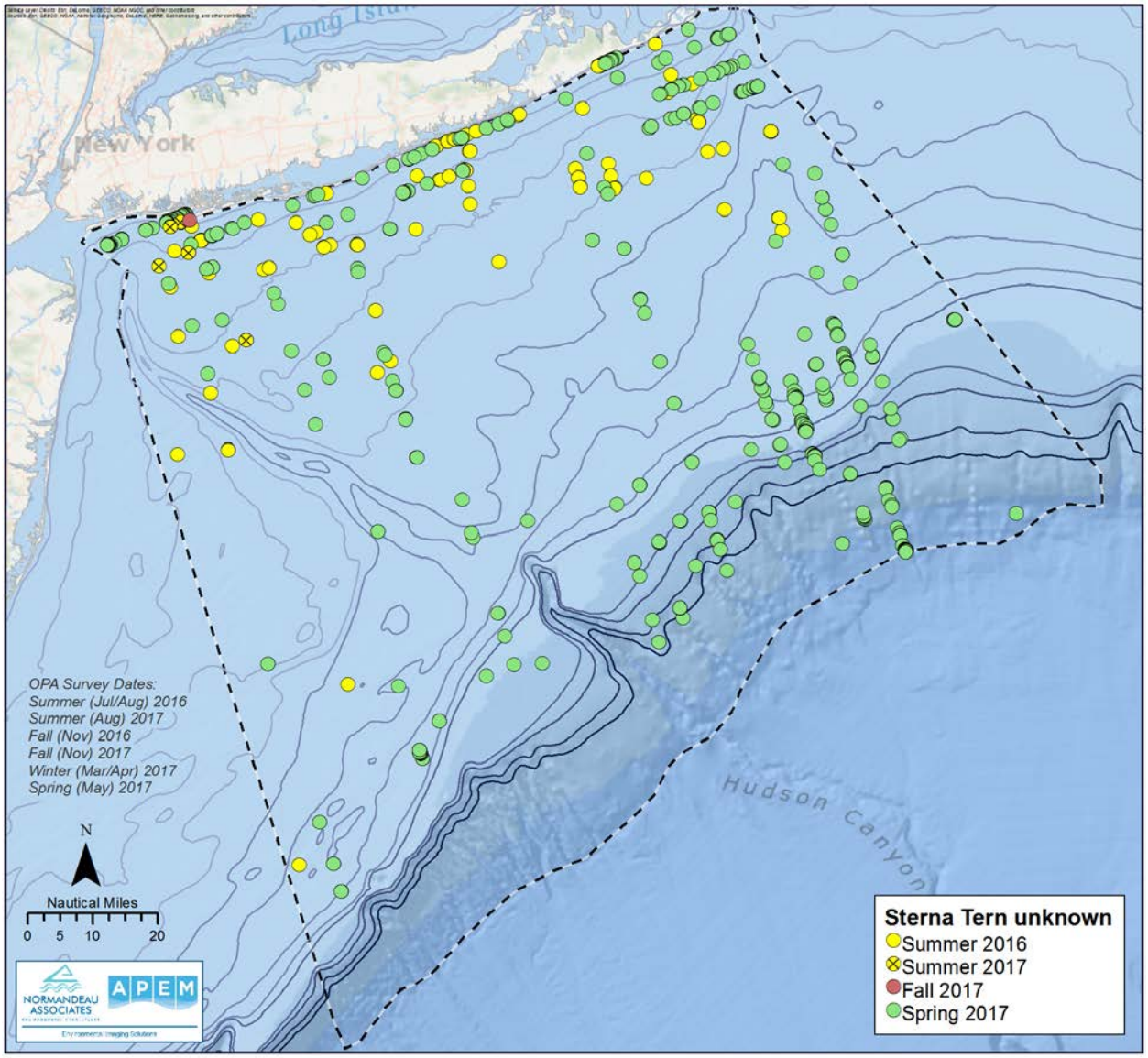


Figure 27. Distribution of *Sterna* terns (unknown) during the Summer 2016–Fall 2017 surveys.

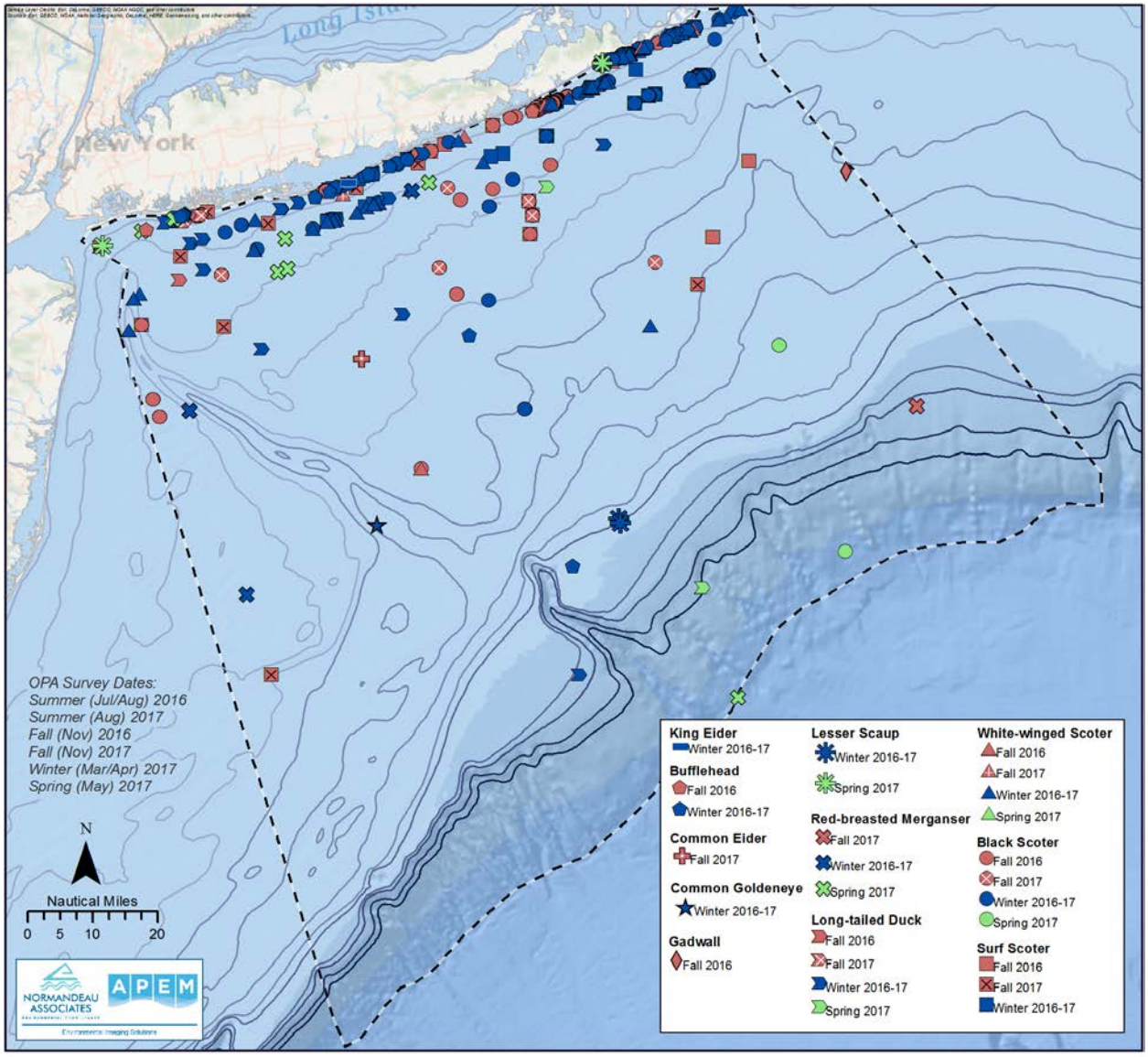


Figure 28. Distribution of sea ducks during the Summer 2016–Fall 2017 surveys.

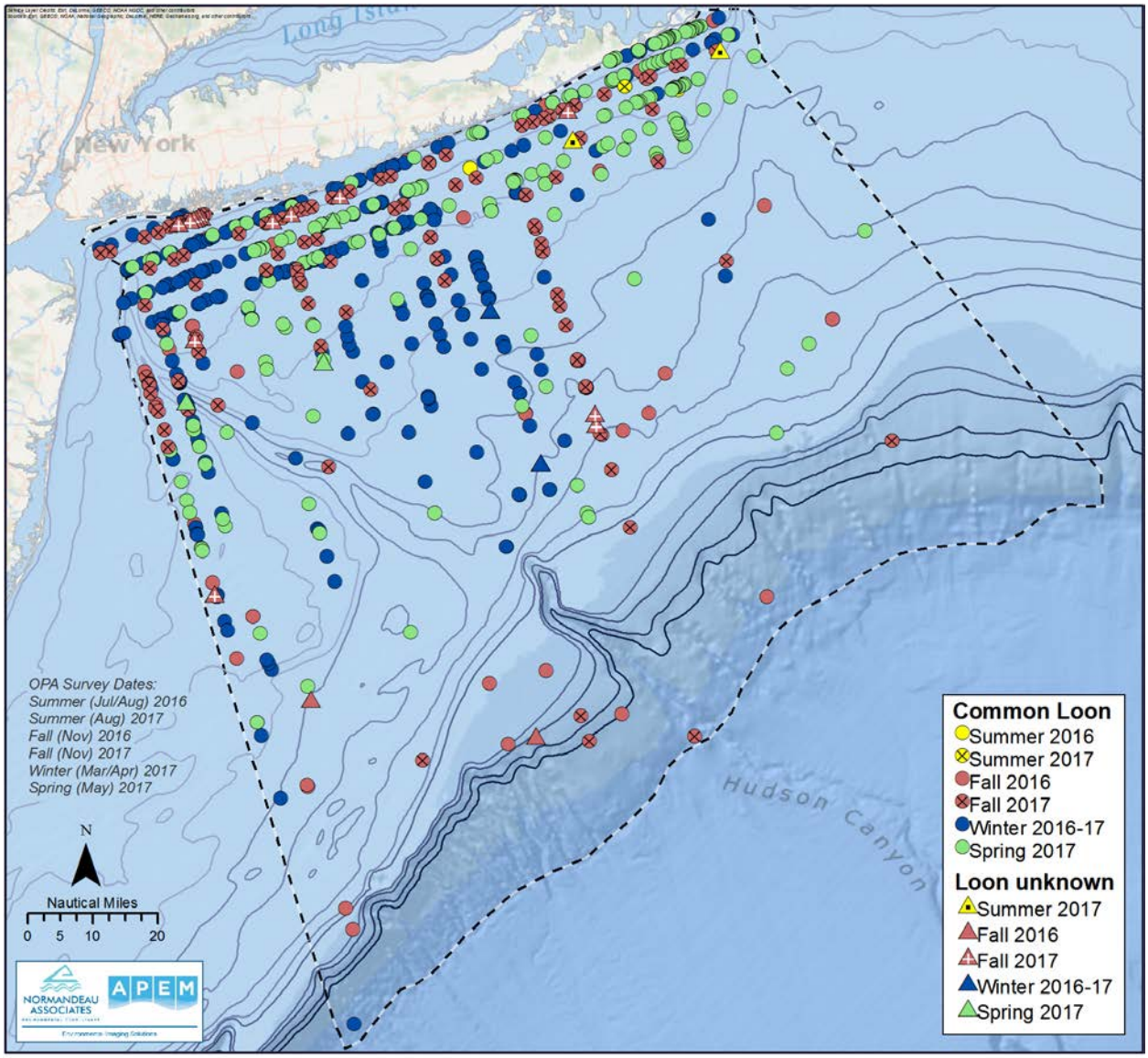


Figure 29. Distribution of common and unidentified loons during the Summer 2016–Fall 2017 surveys.

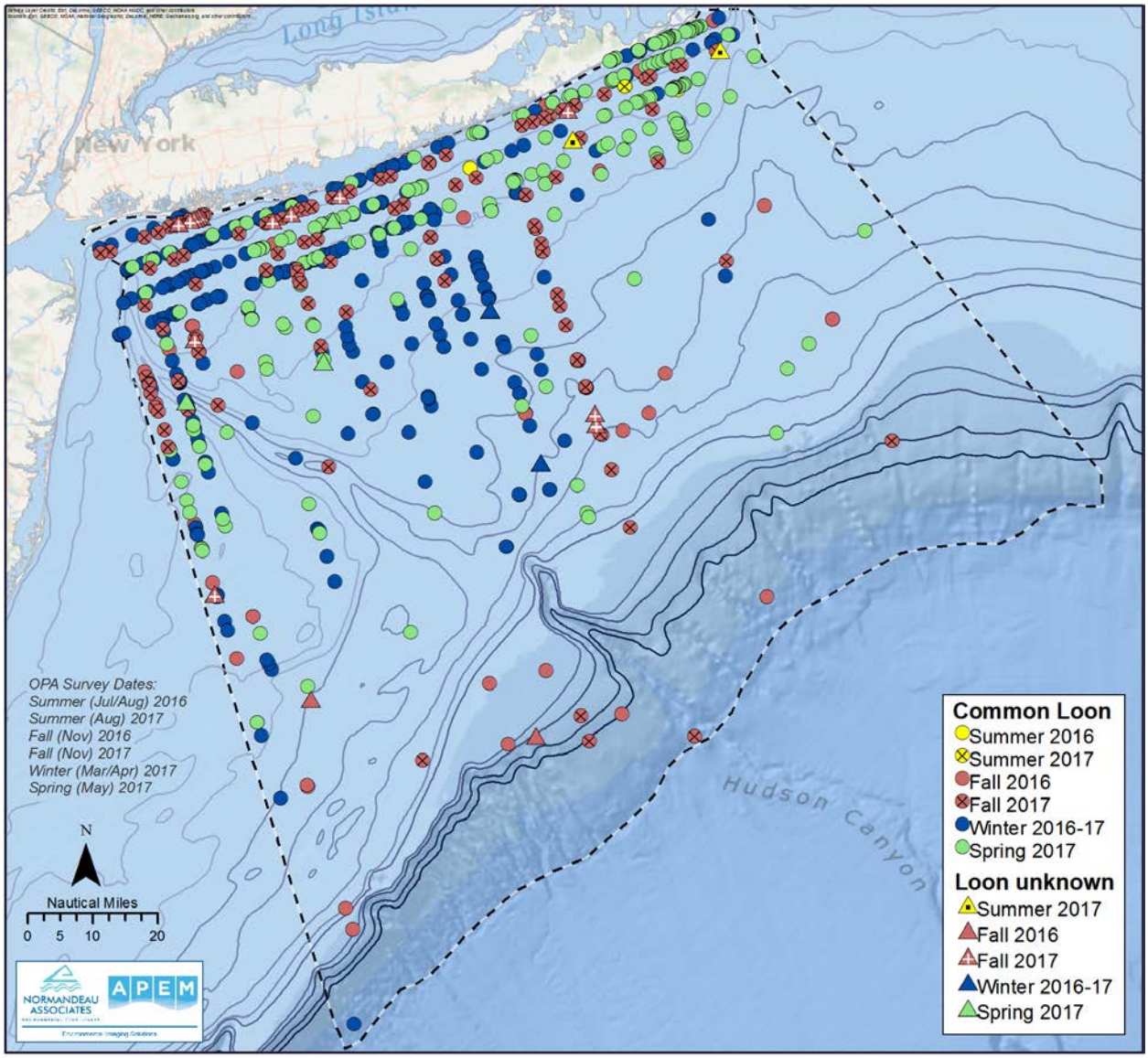


Figure 30. Distribution of red-throated loons during the Summer 2016–Fall 2017 surveys.

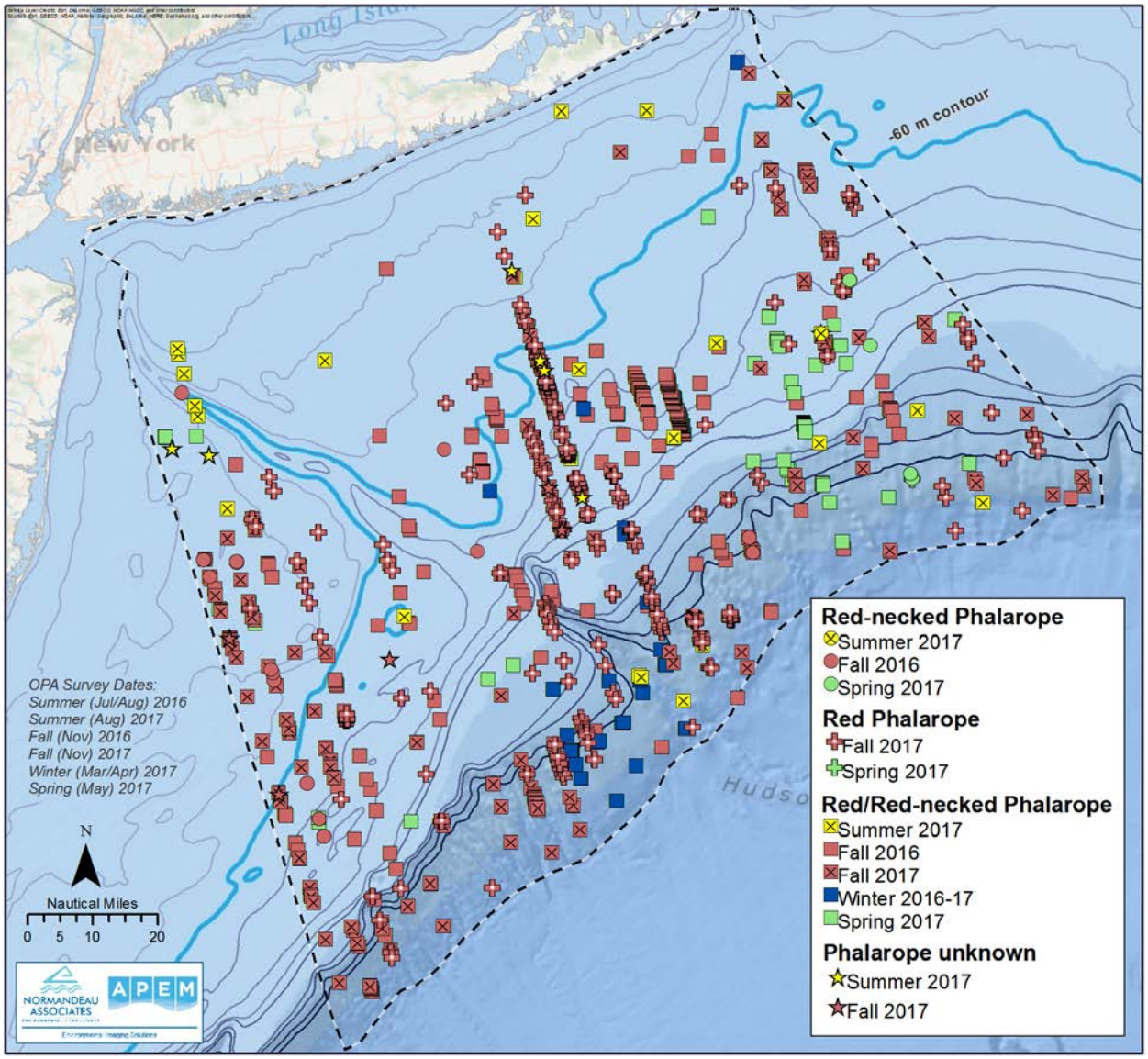


Figure 31. Distribution of phalaropes during the Summer 2016–Fall 2017 surveys.

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, with few observations in flight during other seasons (Figure 32). Cormorant flight direction was predominately WSW; although, in the Fall 2016 survey it was WNW and most individuals were flying <50 m (Figure 33). Duck travel direction primarily followed a south-to-north trend with most individuals flying at altitudes <50 m in the Fall 2016 survey and westerly directions in the Fall 2017 survey (Figure 34). Fulmar and gannet travel directions were primarily west-to-east and east-to-west and occurred with a variety of flight heights (Figure 35, Figure 36). Gull flight direction was predominately in a WNW directions with most individuals flying <50 m (Figure 37). Loon flight direction was primarily in westerly directions in the Fall, but was more

variable in the Winter (Figure 38). 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 survey and tended more to the NE (Figure 39). Shearwater flight direction was predominately WNW and ESE in most of the surveys with flight heights <50 m (Figure 40). Tern flight direction and flight height was highly variable and showed no consistent pattern within or among seasons; although, Spring did show a more northerly tendency (Figure 41, Figure 42). Storm-petrel flight direction followed an east-to-west and west-to-east trend in the seasons where flight direction data were available (Figure 43).

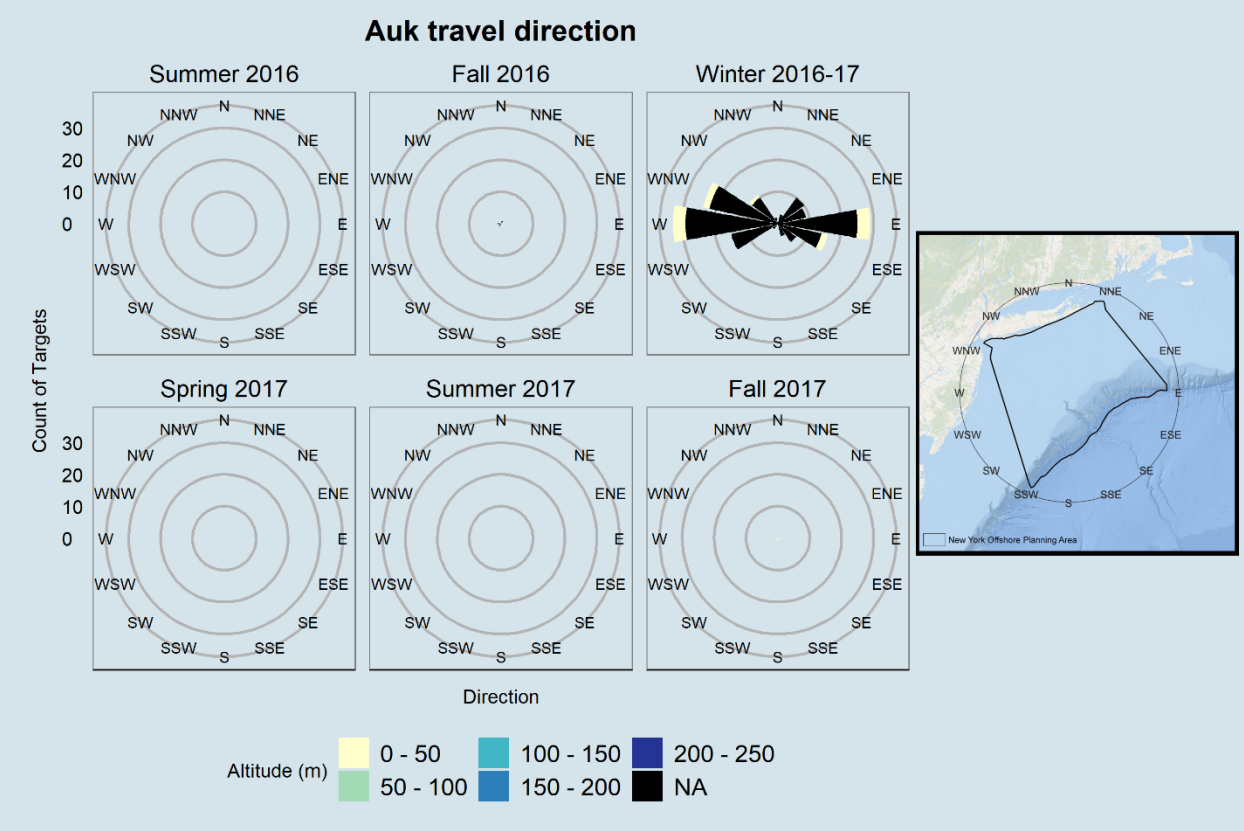


Figure 32. Flight height and direction of travel for auks observed during the Summer 2016–Fall 2017 surveys.

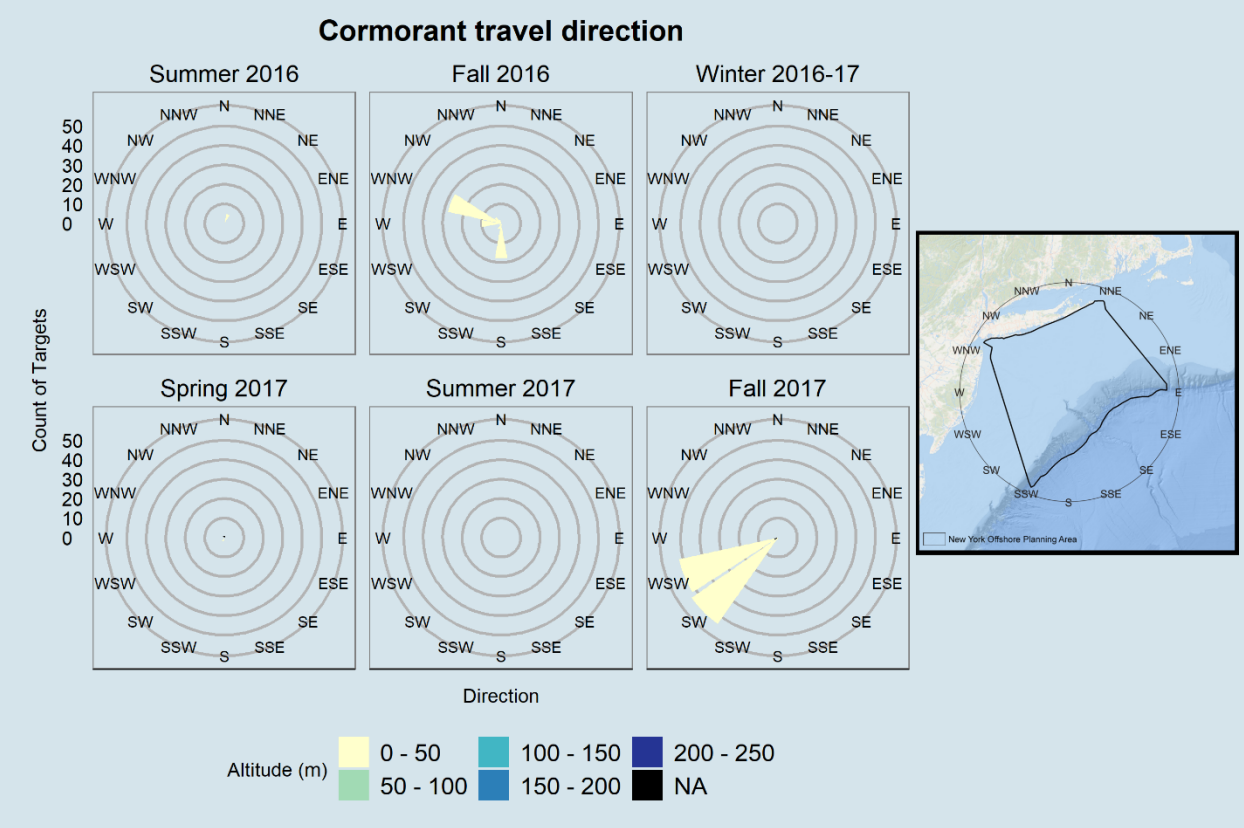


Figure 33. Flight height and direction of travel for cormorants observed during the Summer 2016–Fall 2017 surveys.

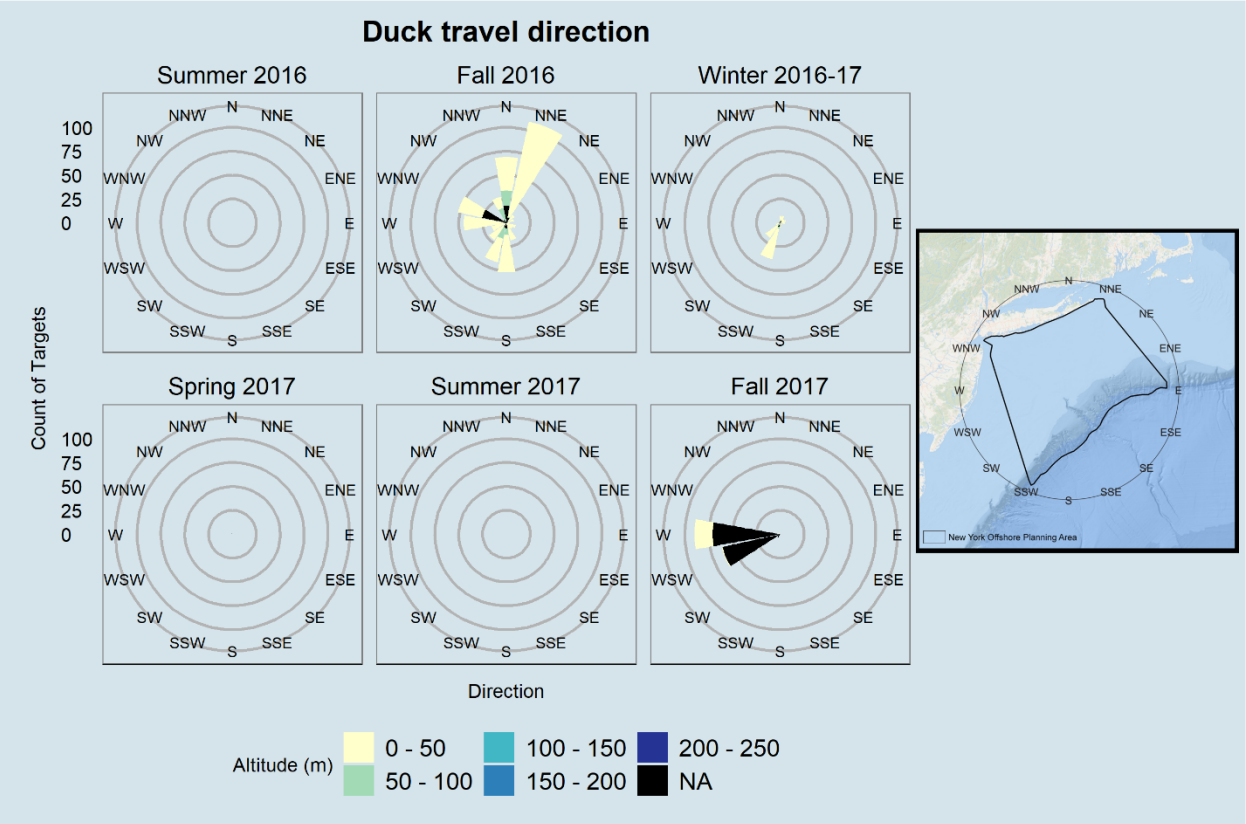


Figure 34. Flight height and direction of travel for ducks observed during the Summer 2016–Fall 2017 surveys.

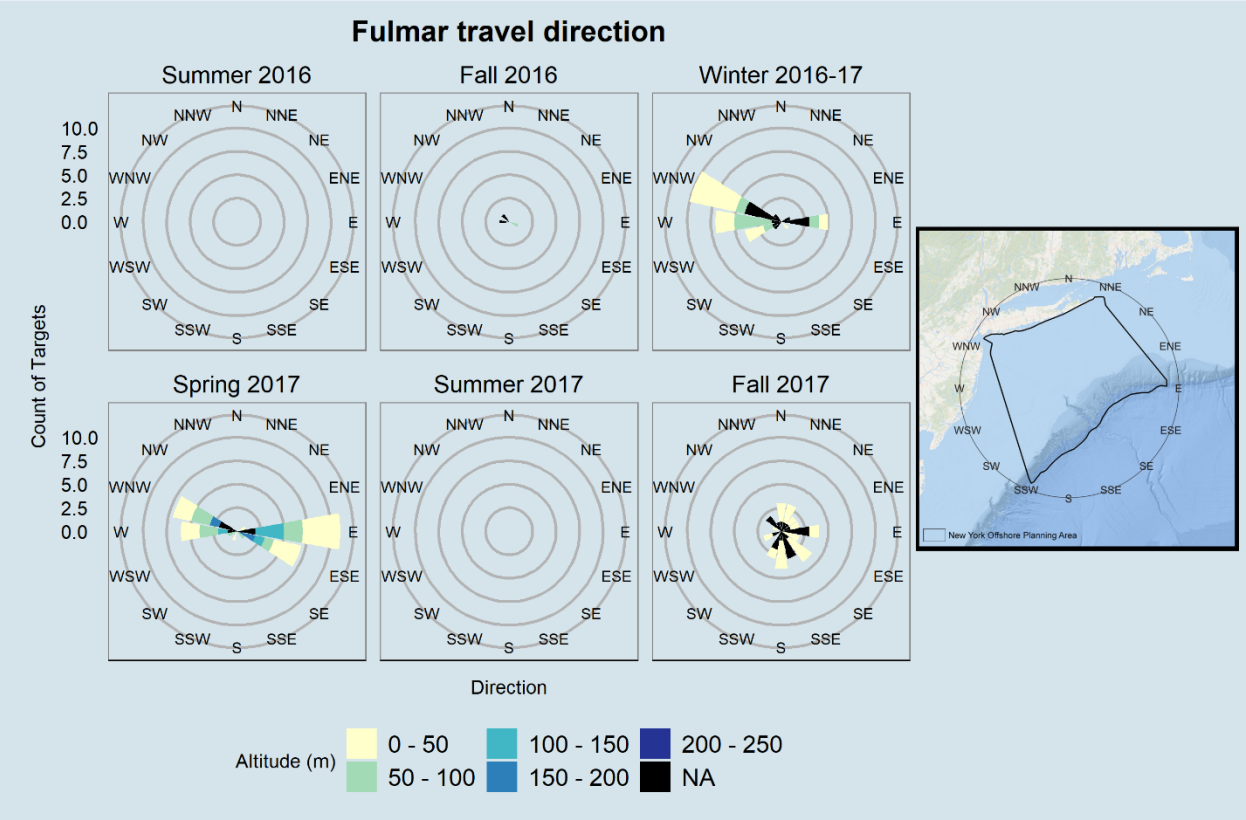


Figure 35. Flight height and direction of travel for fulmars observed during the Summer 2016–Fall 2017 surveys.

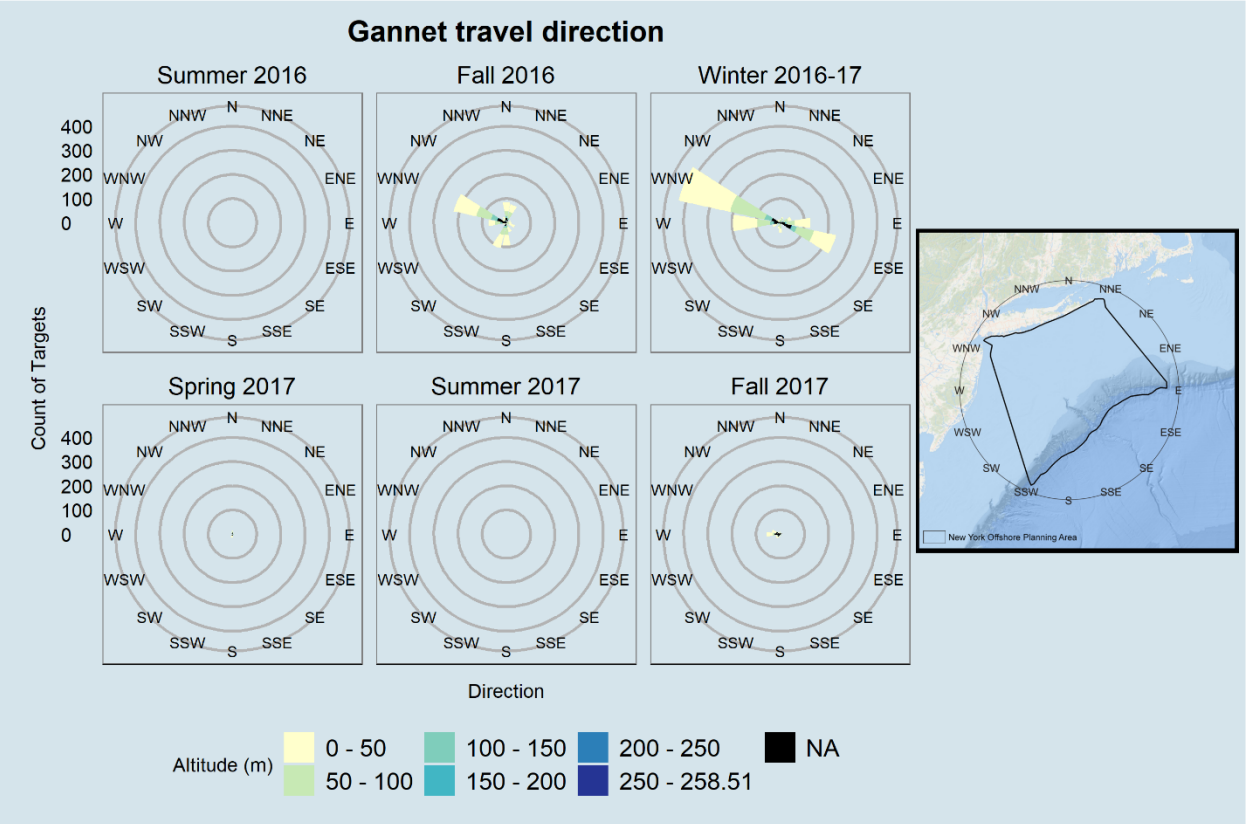


Figure 36. Flight height and direction of travel for gannets observed during the Summer 2016–Fall 2017 surveys.

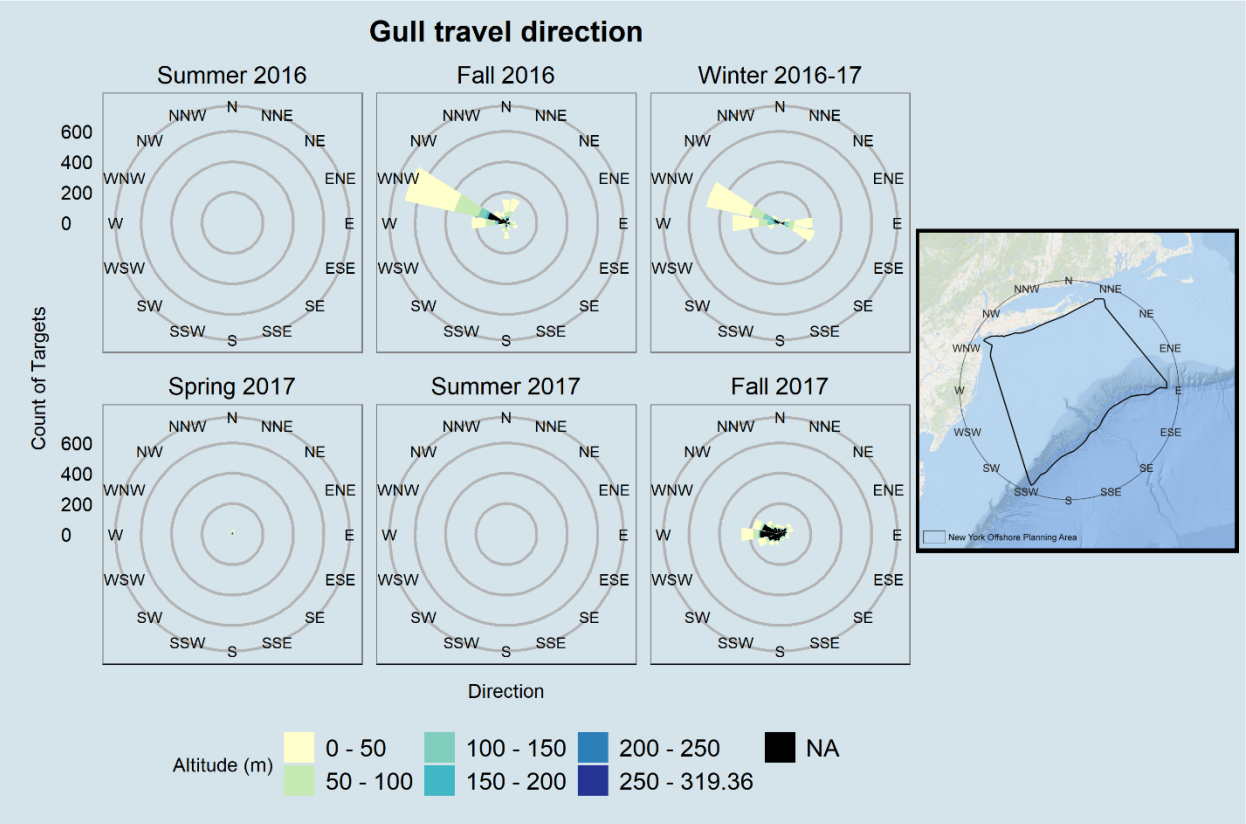


Figure 37. Flight height and direction of travel for gulls observed during the Summer 2016–Fall 2017 surveys.

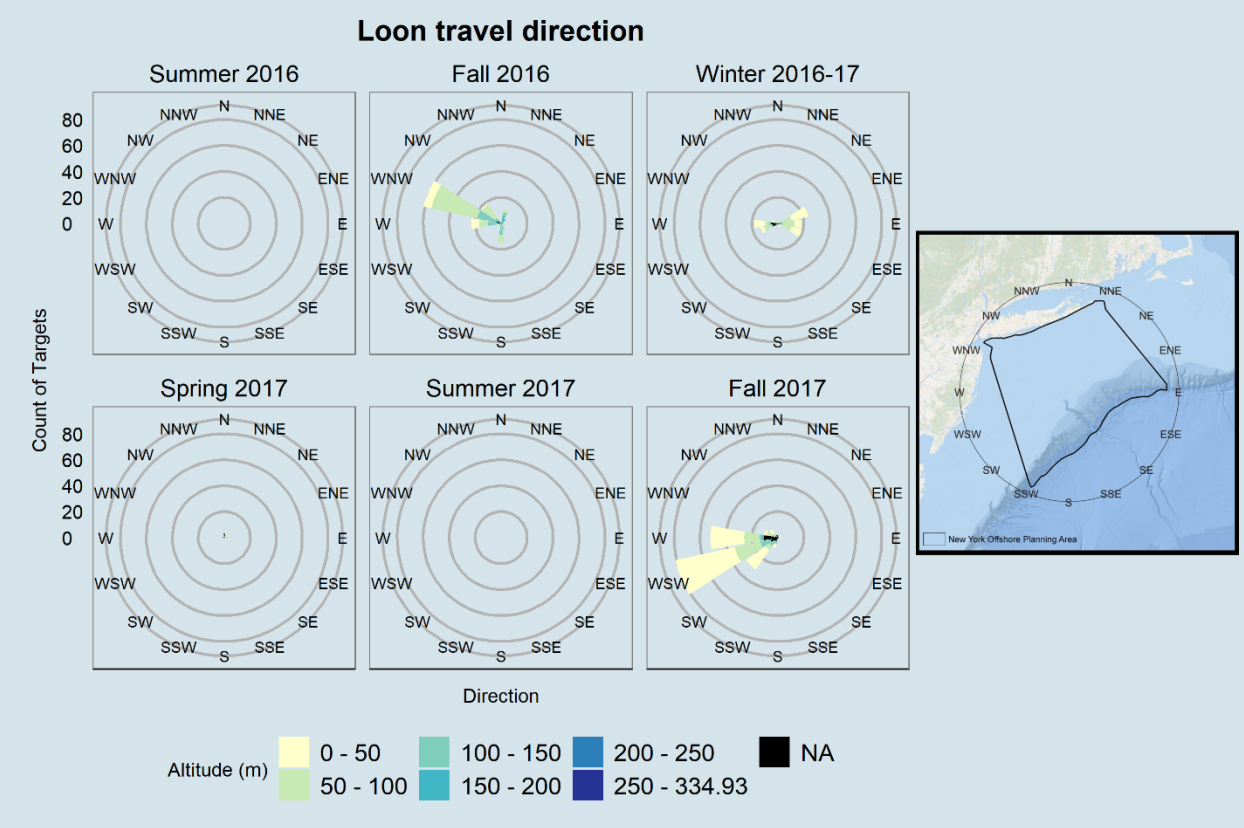


Figure 38. Flight height and direction of travel for loons observed during the Summer 2016–Fall 2017 surveys.

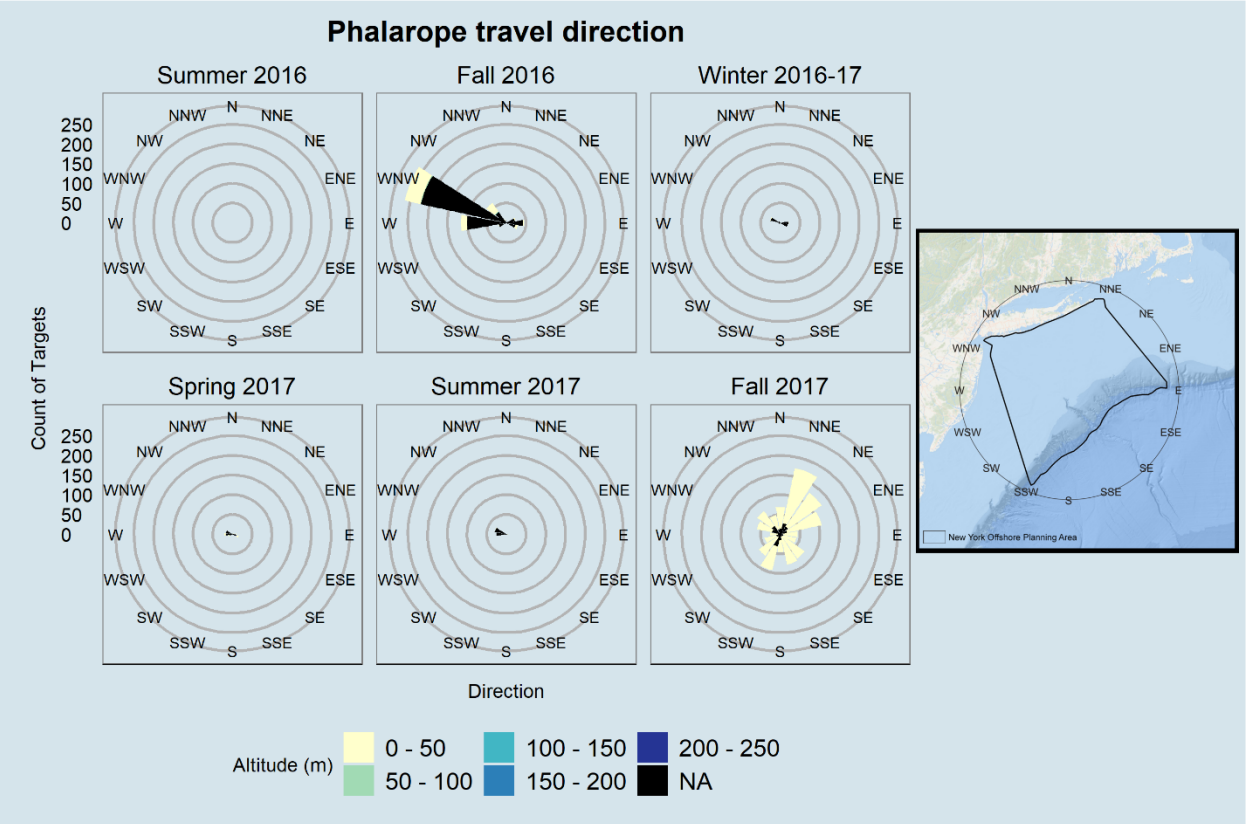


Figure 39. Flight height and direction of travel for phalaropes observed during the Summer 2016–Fall 2017 surveys.

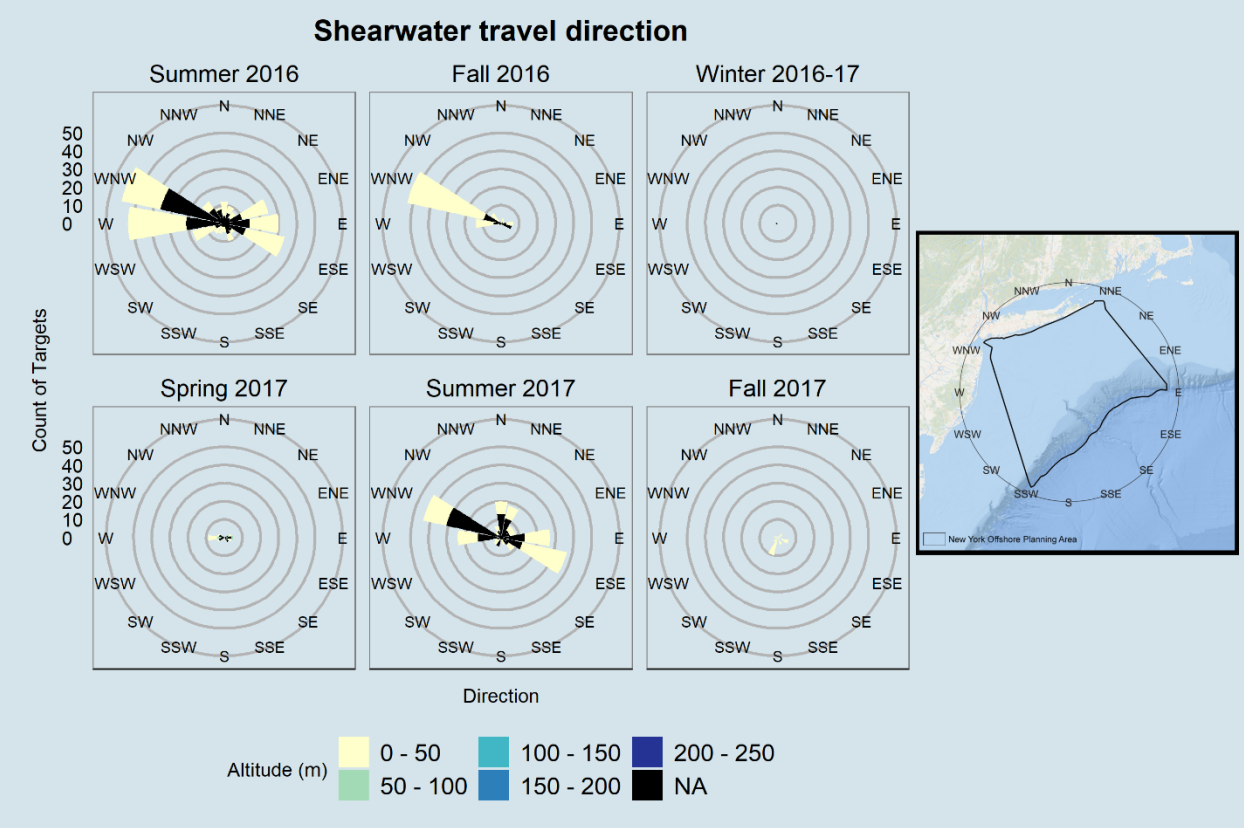


Figure 40. Flight height and direction of travel for shearwaters observed during the Summer 2016–Fall 2017 surveys.

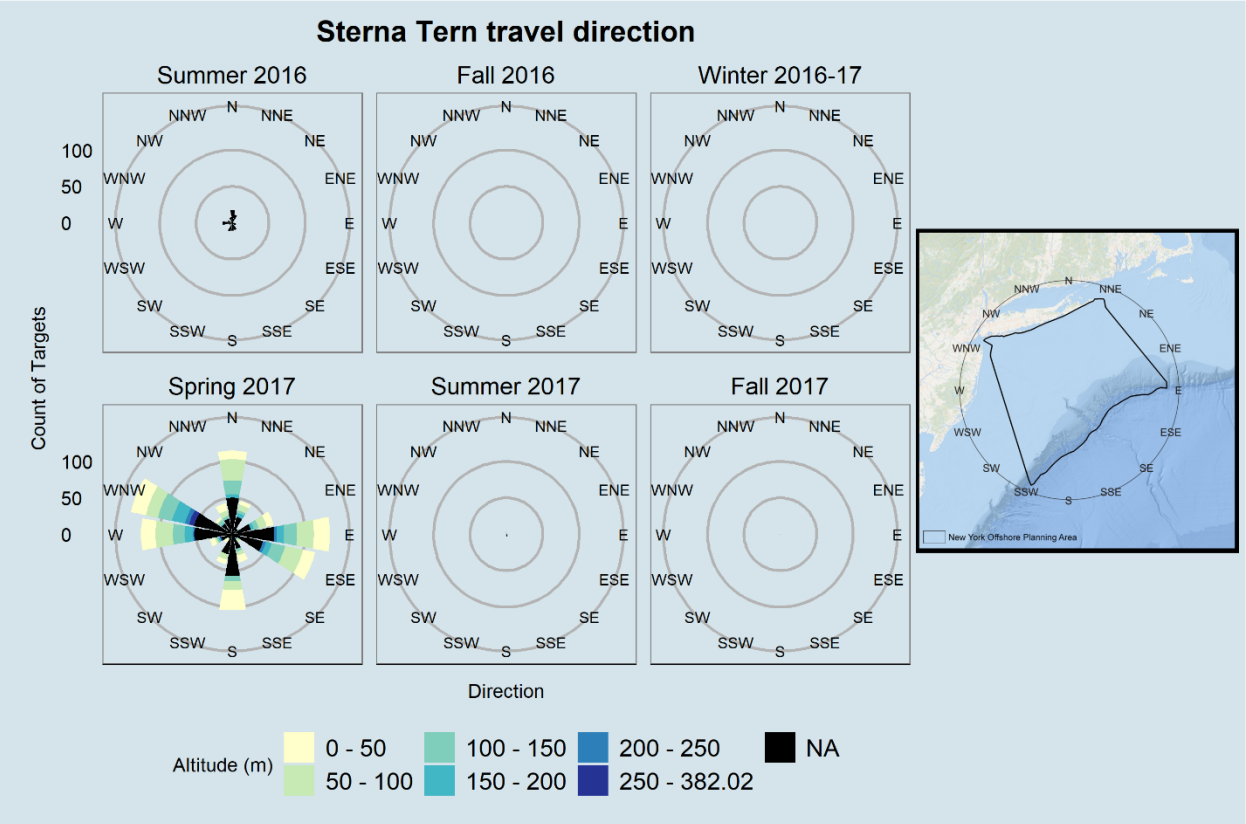


Figure 41. Flight height and direction of travel for *Sterna* terns observed during the Summer 2016–Fall 2017 surveys.

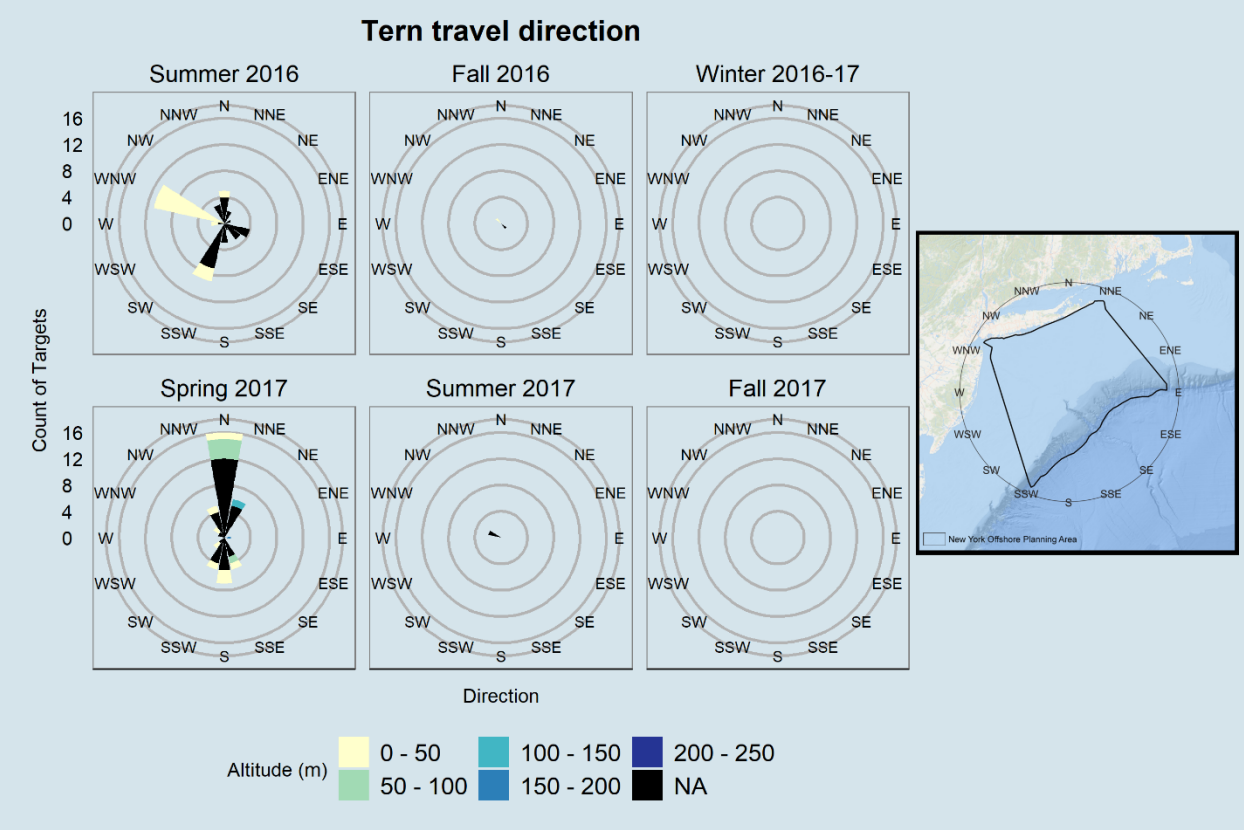


Figure 42. Flight height and direction of travel for terns observed during the Summer 2016–Fall 2017 surveys.

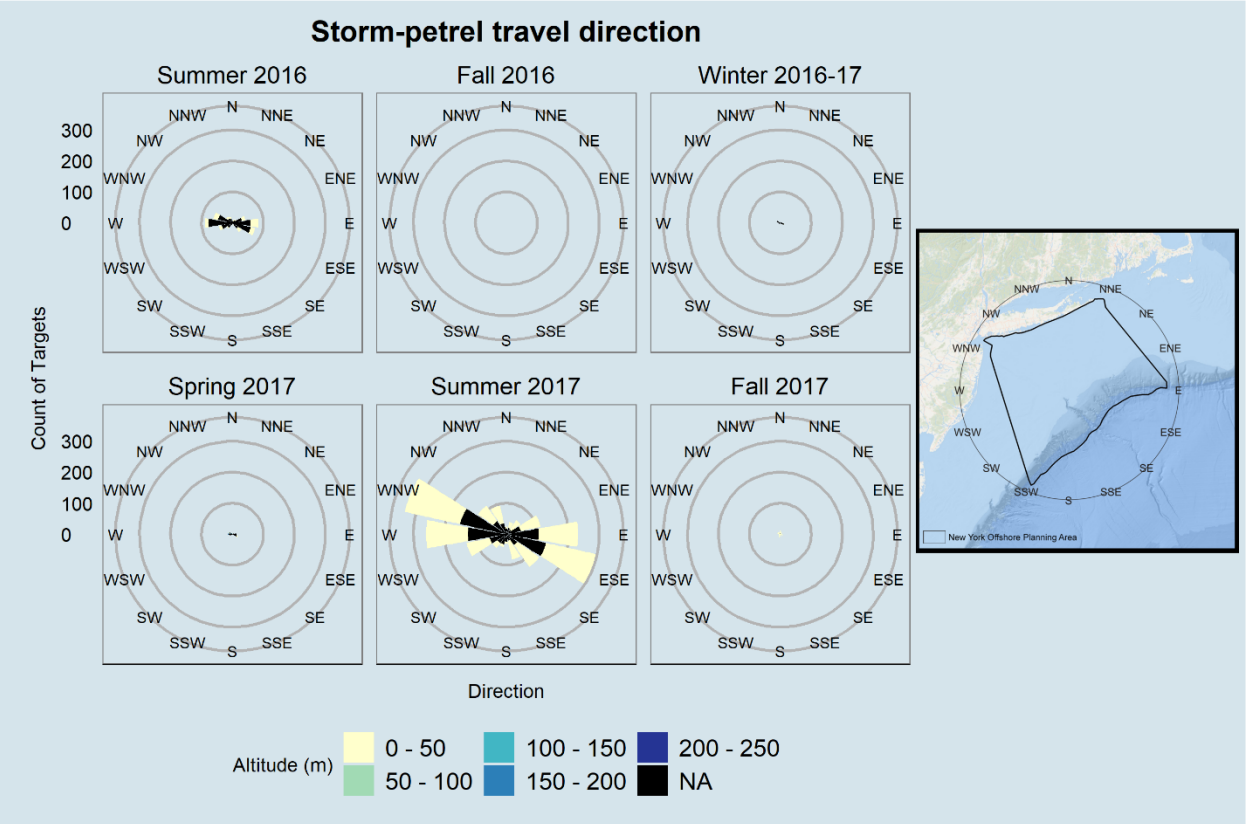


Figure 43. Flight height and direction of travel for storm-petrels observed during the Summer 2016–Fall 2017 surveys.

3.5.5. Flight Height

All bird observations in the Summer 2016 through Fall 2017 surveys were classified as sitting or flying. All raw flight heights with associated error margin are presented in Appendix D. Species with known flight heights were classified as outside or within the RSZ (25–195 m). Of all birds observed in the OPA, 53% were observed sitting, 8% were flying within the RSZ, 17% were flying above or below the RSZ, and 22% had an unknown flight height (Table 11). 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 12). Both shearwater and duck average flight heights differed among seasons with shearwater flight height averaging over 30 m in the Spring but <10 m during the other seasons (Figure 44). Duck flight height was significantly higher in Fall 2016 than in Fall 2017 and Winter 2016–2017 (Table 12, Figure 45).

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 (Appendix C). Unknown flight heights largely comprised of select Wilson's storm-petrels. 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 12, Appendix C).

In the Summer 2017 survey, 19% of birds were observed sitting, <1% were flying within the RSZ, 41% were flying above or below the RSZ, and 40% had an unknown flight height (Appendix C). Unknown flight heights largely comprised of storm-petrels. Of the individuals where flight height was calculable, shorebirds and gulls were observed flying the highest with an average flight height of 80.57 m and 31.5 m, respectively (Table 12, 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 (Appendix C). Unknown flight heights were largely comprised of northern gannet, red/red-necked phalaropes, and herring gulls observed in flight. 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 85 m, respectively (Table 12).

In the Fall 2017 survey, 62% of birds observed were sitting, 6.5% were flying within the RSZ, 17% were flying above or below the RSZ, and 14% had an unknown flight height (Appendix C). Unknown flight heights were largely comprised of gulls, phalaropes, scoters, and northern gannet. Of the individuals where flight height was calculable, gulls, loons, and skuas were observed flying the highest with an average flight height of 48.84 m, 47.43 m, and 44.41 m, respectively (Table 12).

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. Unknown flight heights were largely comprised of select 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 50 m, respectively (Table 12).

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. 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 12).

Table 11. Corrected Number of All Flying and Sitting Birds Observed by Season during the Summer 2016–Spring 2017 Surveys

Flight Category	Total/Percent within Season	Season						Total
		Summer 2016	Fall 2016	Winter 2016–2017	Spring 2017	Summer 2017	Fall 2017	
Flight Height Unknown	Corrected Abundance[1]	11,079	12,992	7,721	10,770	16,578	18,646	77,787
	Percent	44%	10%	3%	22%	40%	14%	
Flying outside RSZ[2]	Corrected Abundance	5,464	13,150	11,250	3,320	17,011	22,182	72,378
	Percent	21%	9%	5%	7%	41%	17%	
Flying within RSZ	Corrected Abundance	533	20,877	18,628	8,486	84	8,494	57,103
	Percent	2%	15%	8%	17%	<1%	7%	

Flight Category	Total/Percent within Season	Season						Total
		Summer 2016	Fall 2016	Winter 2016–2017	Spring 2017	Summer 2017	Fall 2017	
Sitting	Corrected Abundance	8,333	90,720	193,805	26,135	7,723	79,641	406,358
	Percent	33%	66%	84%	54%	19%	62%	
Total Abundance		**25,410**	**137,739**	**231,405**	**48,712**	**41,397**	**128,964**	**613,626**

[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 12. 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		Fall 2016		Winter 2016–2017		Spring 2017		Summer 2017		Fall 2017	
	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	13.8	22.69	.	.	.	.	6.5	12.74
Loon	.	.	97.0	21.99	51.1	24.72	61.6	16.02	.	.	47.4	41.54
Fulmar	.	.	56.5	27.02	40.9	14.67	65.4	13.33	.	.	7.0	18.74
Petrel	.	.	29.3	16.66	3.3	15.87	.	.	.	.	.	.
Shearwater	2.3	12.75	6.6	18.44	2.0	37.15	31.3	16.15	1.7	26.64	1.5	20.79
Storm-petrel	0.7	18.16	2.3	8.63	2.2	14.98	35.2	20.38	0.7	53.93	0.8	59.90
Gannet	.	.	52.2	15.14	50.1	16.28	53.4	17.98	.	.	32.4	17.05
Cormorant	2.0	16.16	20.8	14.88	.	.	1.0	19.44	.	.	12.5	35.62
Ardeidae	.	.	.	.	.	.	.	.	.	.	18.3	26.92
Shorebird	.	.	.	.	.	.	.	.	80.6	6.96	1.2	37.67
Phalarope	.	.	8.4	26.56	4.7	30.12	30.4	22.78	5.3	42.50	1.3	36.57
Skua	.	.	85.5	31.73	.	.	35.3	49.18	.	.	44.4	41.55
Auk	.	.	6.6	25.13	6.7	12.62	.	.	.	.	0.9	33.67
Gull	55.0	13.66	50.1	16.50	49.4	16.36	52.7	16.08	31.5	11.66	48.8	13.75
Tern	9.2	16.25	18.5	6.39	.	.	51.3	15.16	.	.	.	.
Sterna Tern	1.0	.	.	.	.	.	89.3	23.90	.	.	5.0	83.93
Passerine	.	.	.	.	.	.	.	.	.	.	2.5	34.35

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

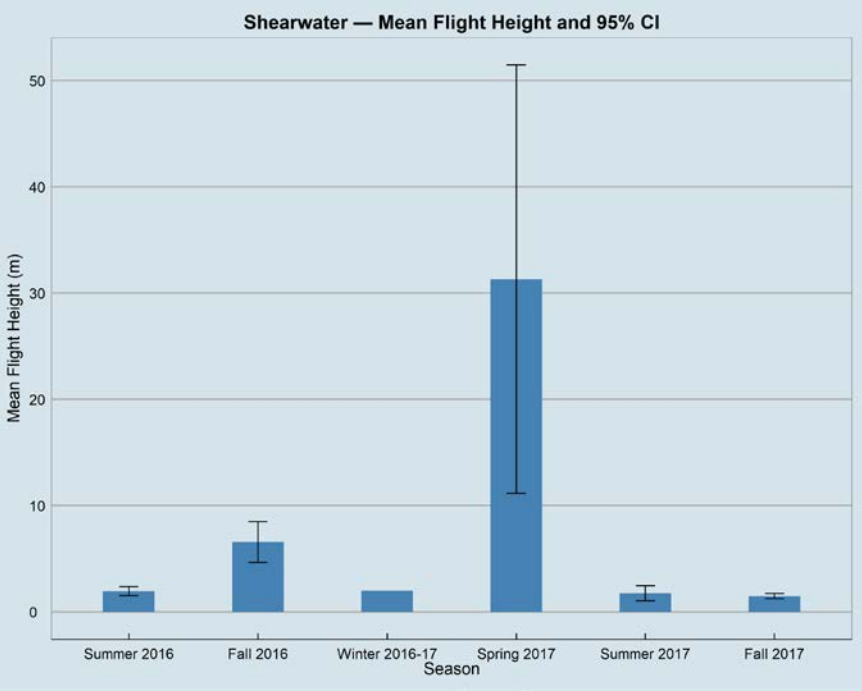


Figure 44. Mean and 95% confidence interval for shearwater flight height among seasons.

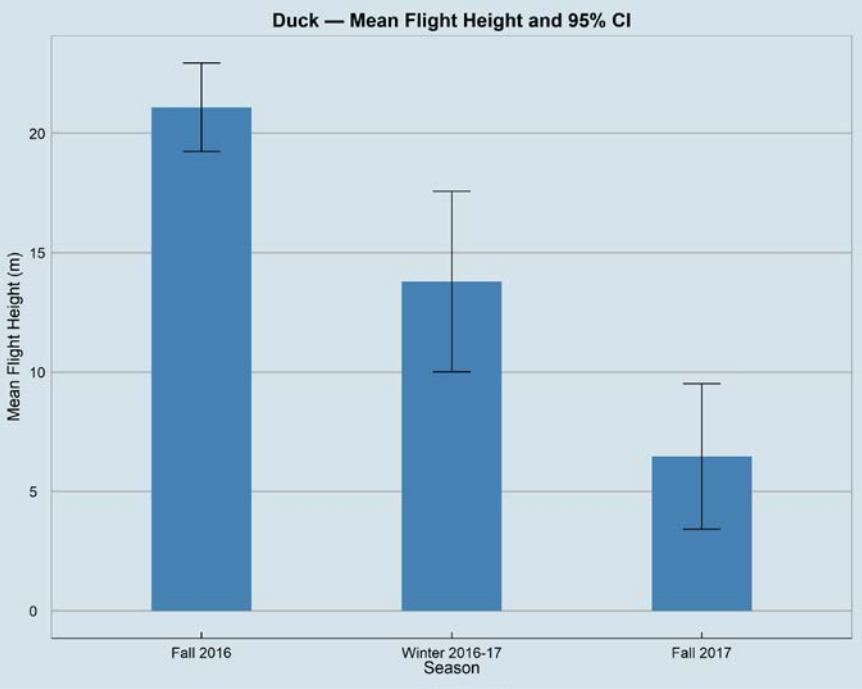


Figure 45. Mean and 95% confidence interval for duck flight height among seasons.

3.5.6. Spatial Patterns of Flight Height

Distribution of gulls varied seasonally. They were concentrated near shore in the Summer surveys, widespread across the OPA during Fall and Winter surveys, and in Spring they were present across the OPA but somewhat more concentrated near shore. When near shore, gulls tended to be flying within the RSZ during Summer, but this trend was not consistent in other seasons. When off shore, most gulls were observed either within (25–195 m) or below the RSZ (Figure 46, Figure 47, Figure 48, Figure 49).

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 (Figure 49, Figure 50); whereas, during the winter gannets were primarily concentrated in the western one-third of the OPA with many flying within the RSZ (Figure 51).

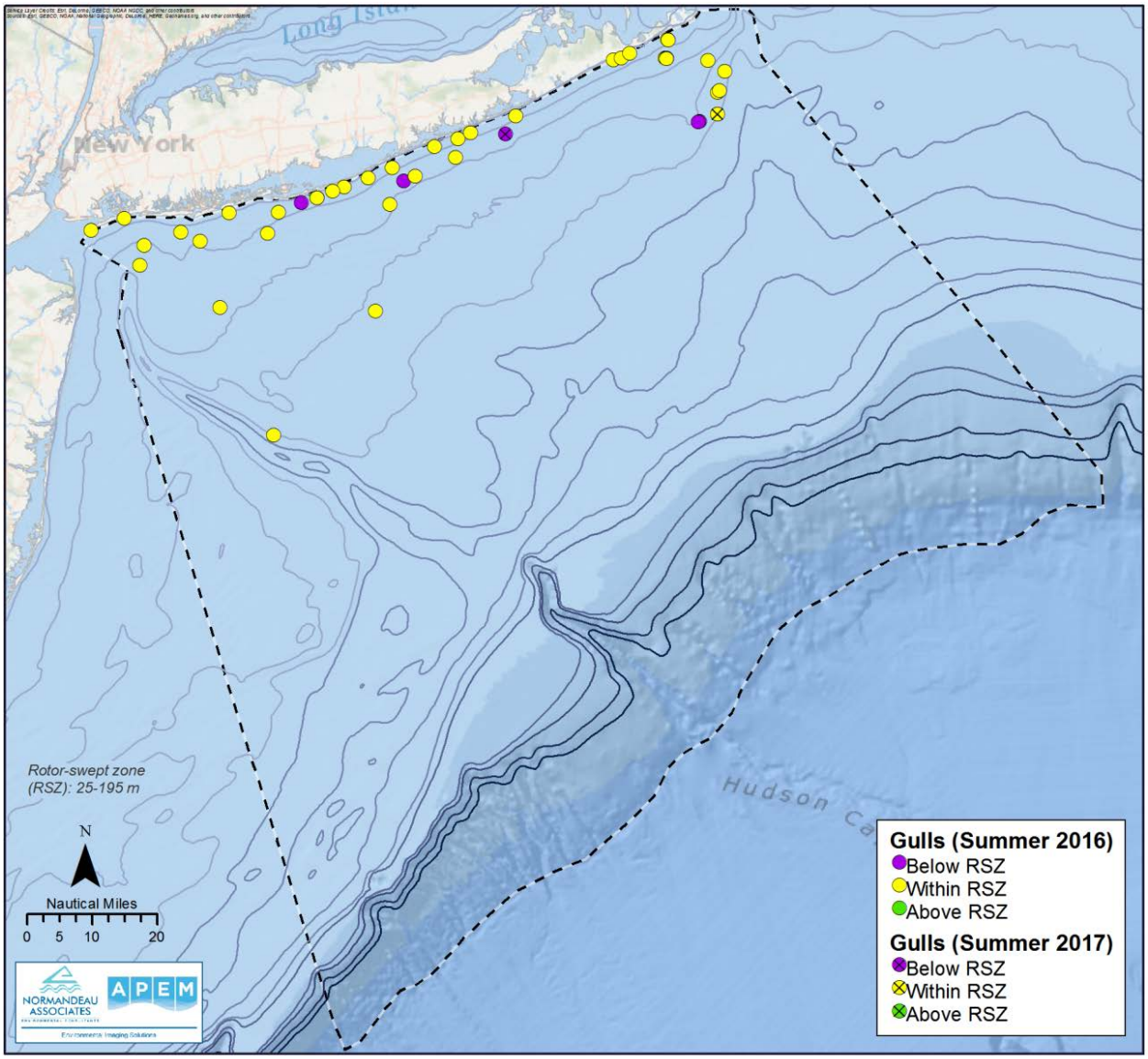


Figure 46. Spatial distribution of gull flight heights during the Summer 2016 and Summer 2017 surveys.

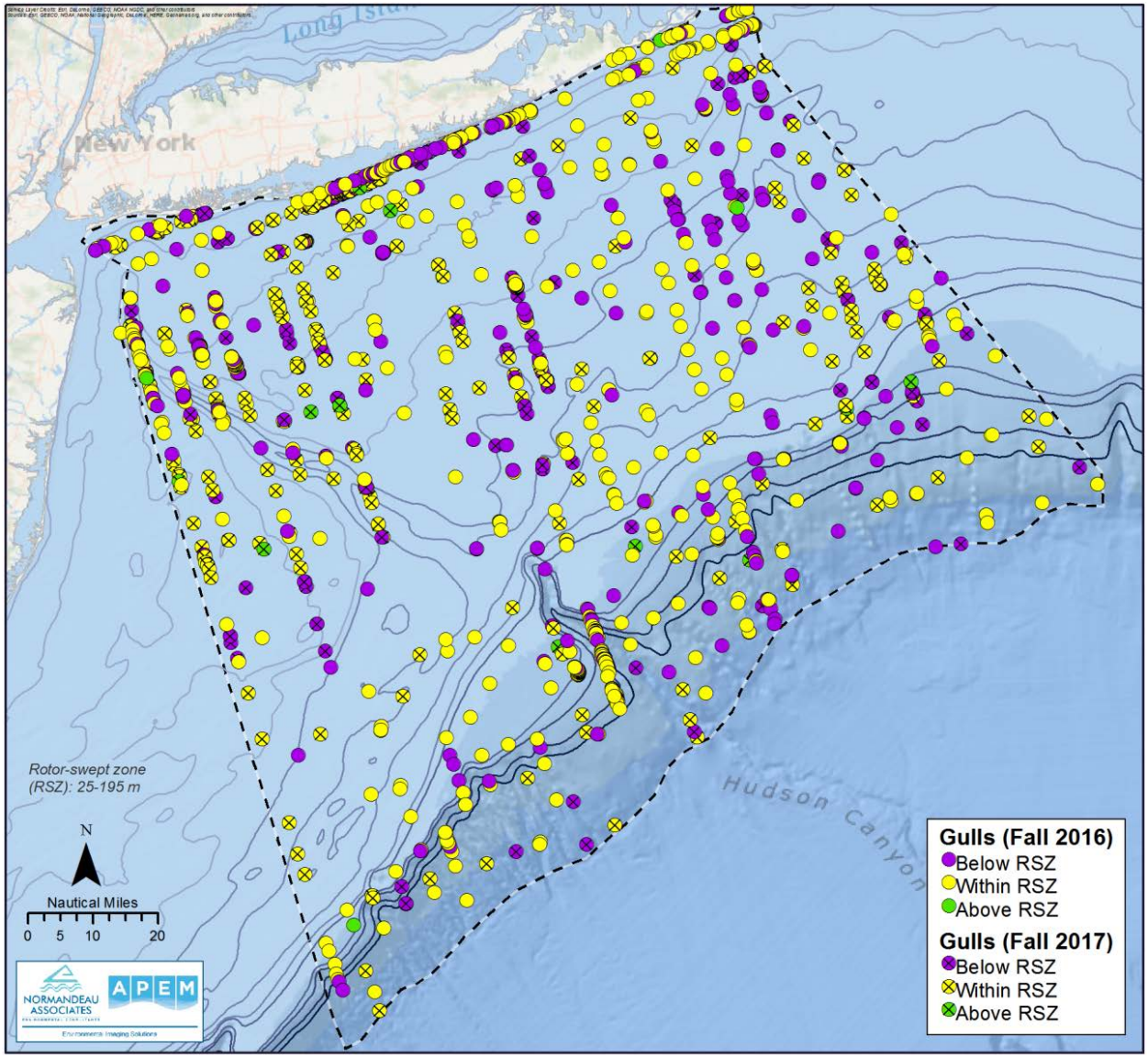


Figure 47. Spatial distribution of gull flight heights during the Fall 2016 and Fall 2017 surveys.

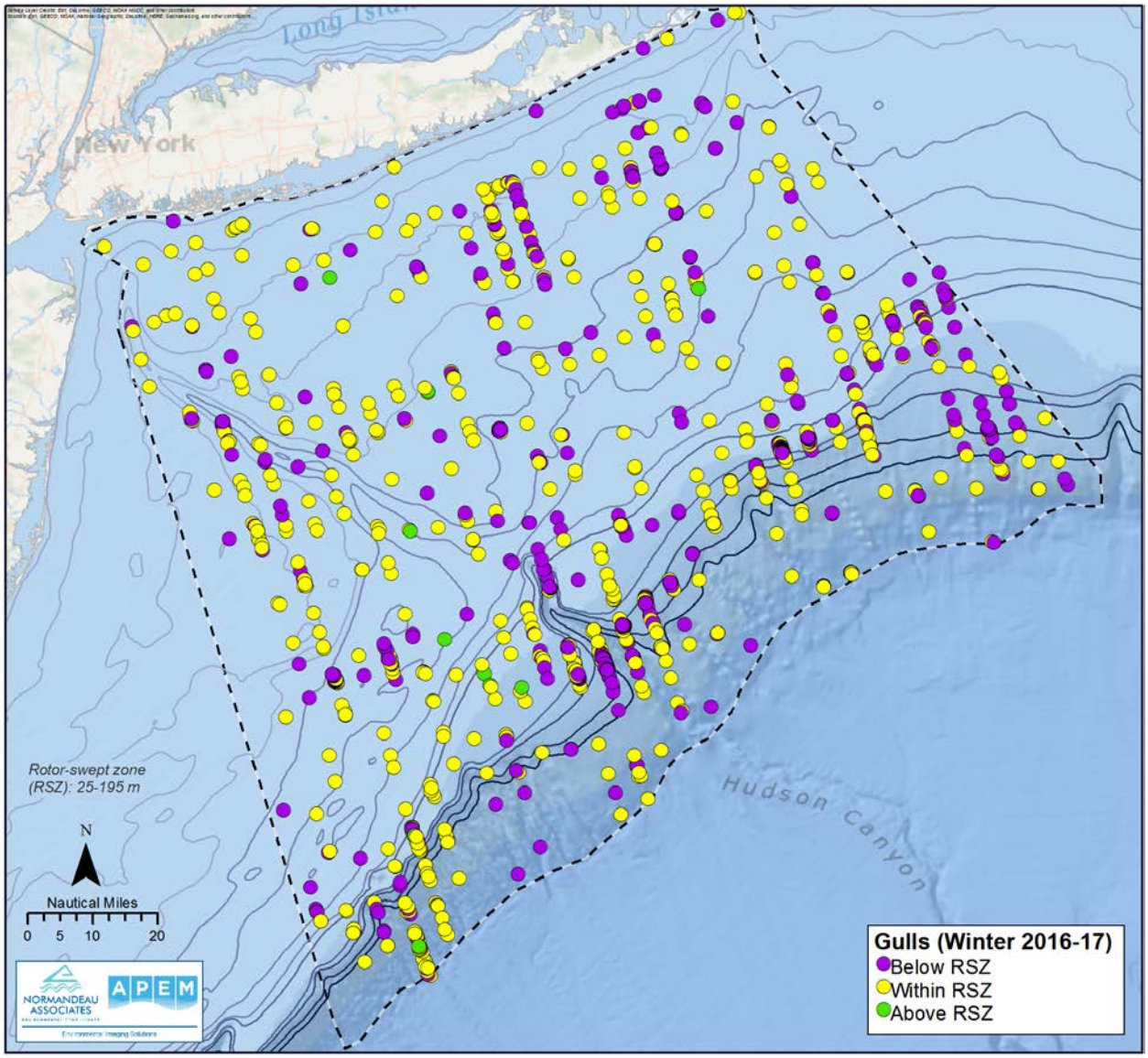


Figure 48. Spatial distribution of gull flight heights during the Winter 2016–2017 survey.

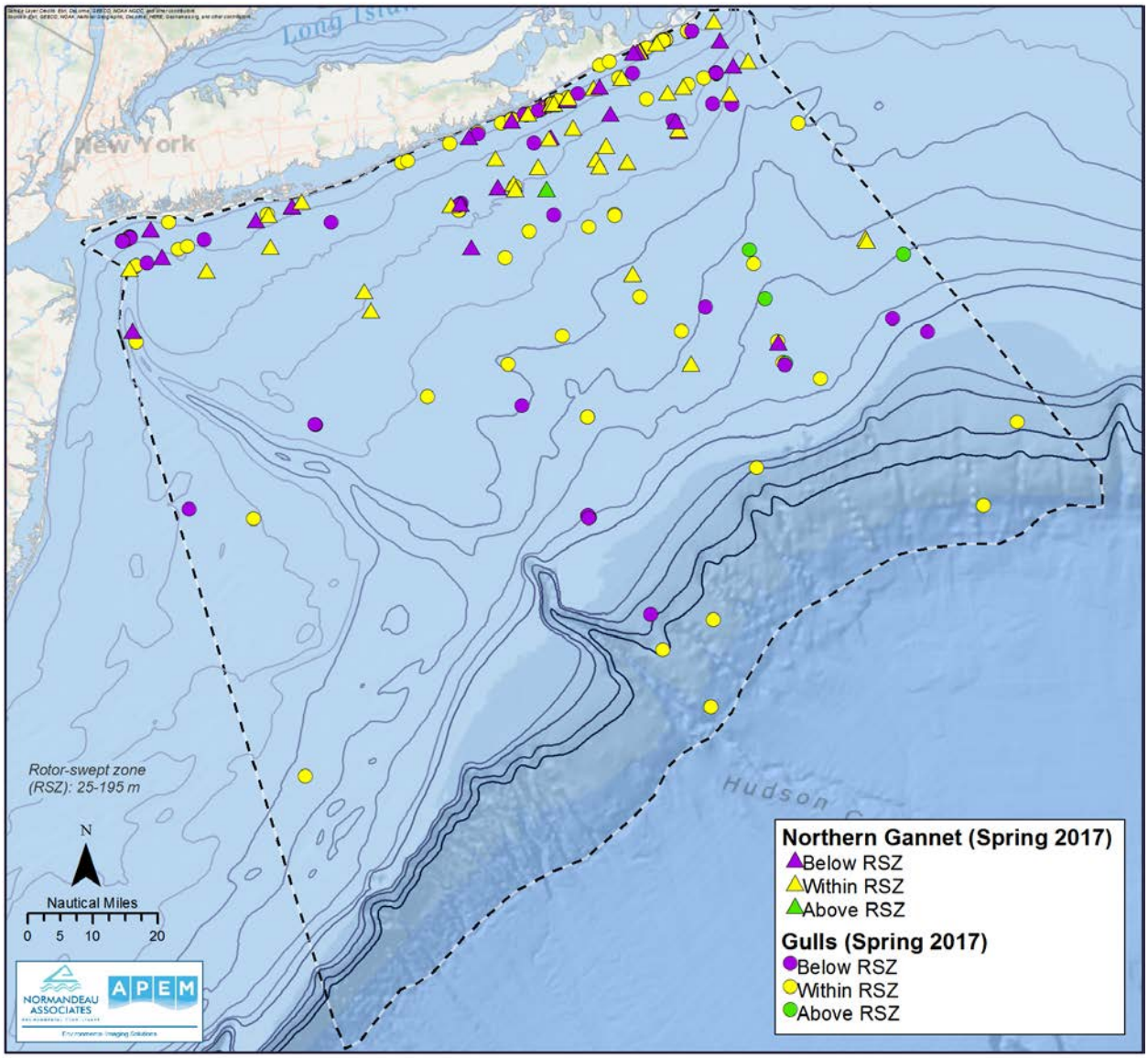


Figure 49. Spatial distribution of gannet and gull flight heights during the Spring 2017 survey.

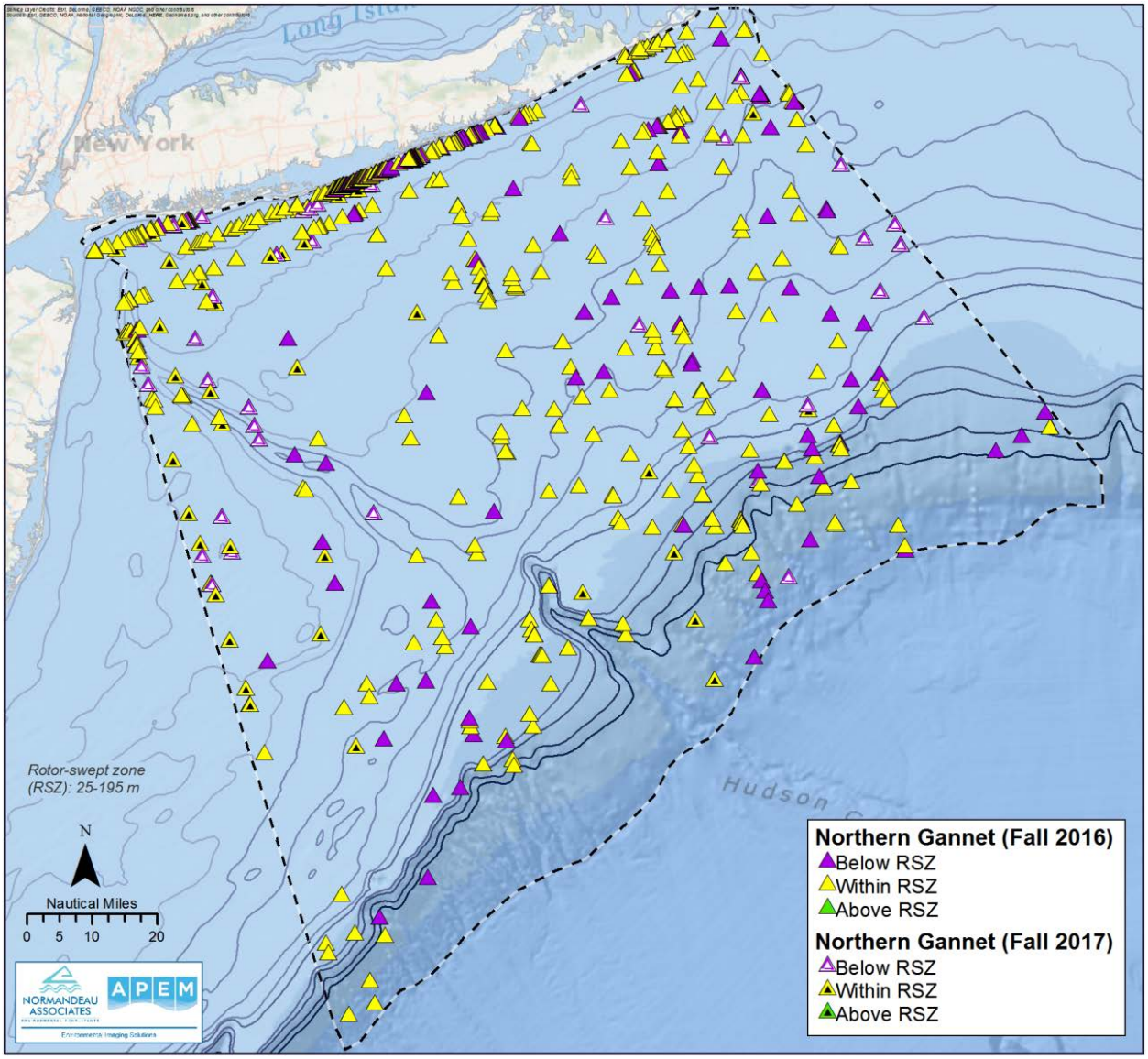


Figure 50. Spatial distribution of gannet flight heights during the Fall 2016 and Fall 2017 surveys.

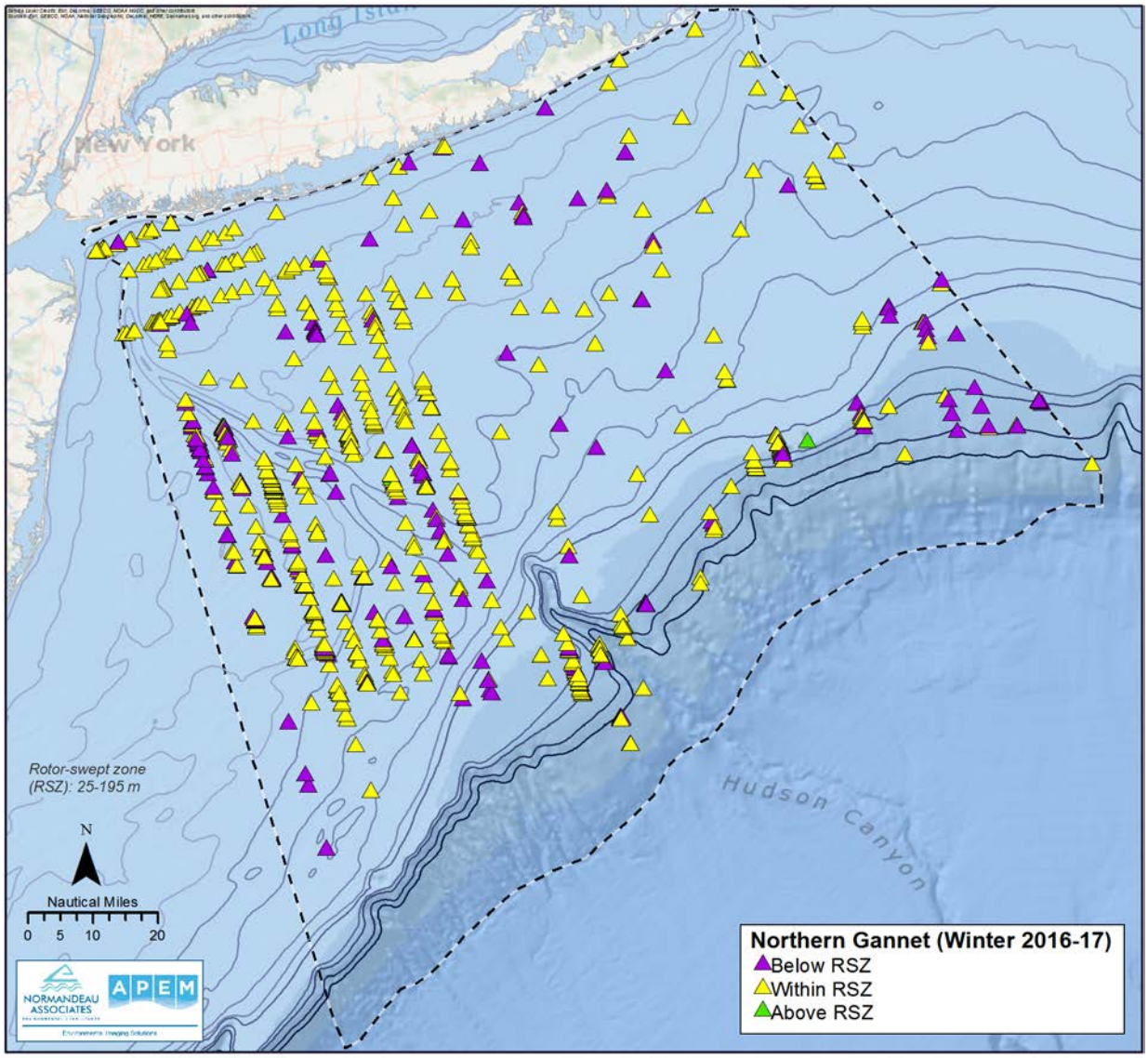


Figure 51. Spatial distribution of gannet flight heights during the Winter 2016–2017 survey.

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 to be not known 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 13, Table 14, and Table 15.

Table 13. 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 14. 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 15. 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 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 all six surveys, some population sensitivity shows in the northeastern section of the OPA, a little collision sensitivity near shore in the northcentral area of the OPA, and some displacement sensitivity along the eastern edge, the central, and nearshore areas of the OPA (Figure 52).

Population sensitive species were distributed across the OPA with some spatial concentrations in the northeastern section, particularly during Summer 2016, but less so in Summer 2017. 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 52, Figure). Collision sensitive species only occur near shore during Summer, but occurred throughout the OPA during other seasons of the first six surveys. There were either low or absent concentrations of collision sensitive species in the Summer surveys, with some sensitivity occurring near shore, along the western portion of the OPA, and along or near the shelf break during other seasons (Figure 52, Figure 54). Displacement sensitive species were found primarily nearshore throughout the year, although the Winter distribution has high concentrations found in the central and eastern sections of the OPA. This high displacement sensitivity during Winter largely represents some species of ducks, loons, and auks that have restricted habitat flexibility (Figure 52, Figure 55).

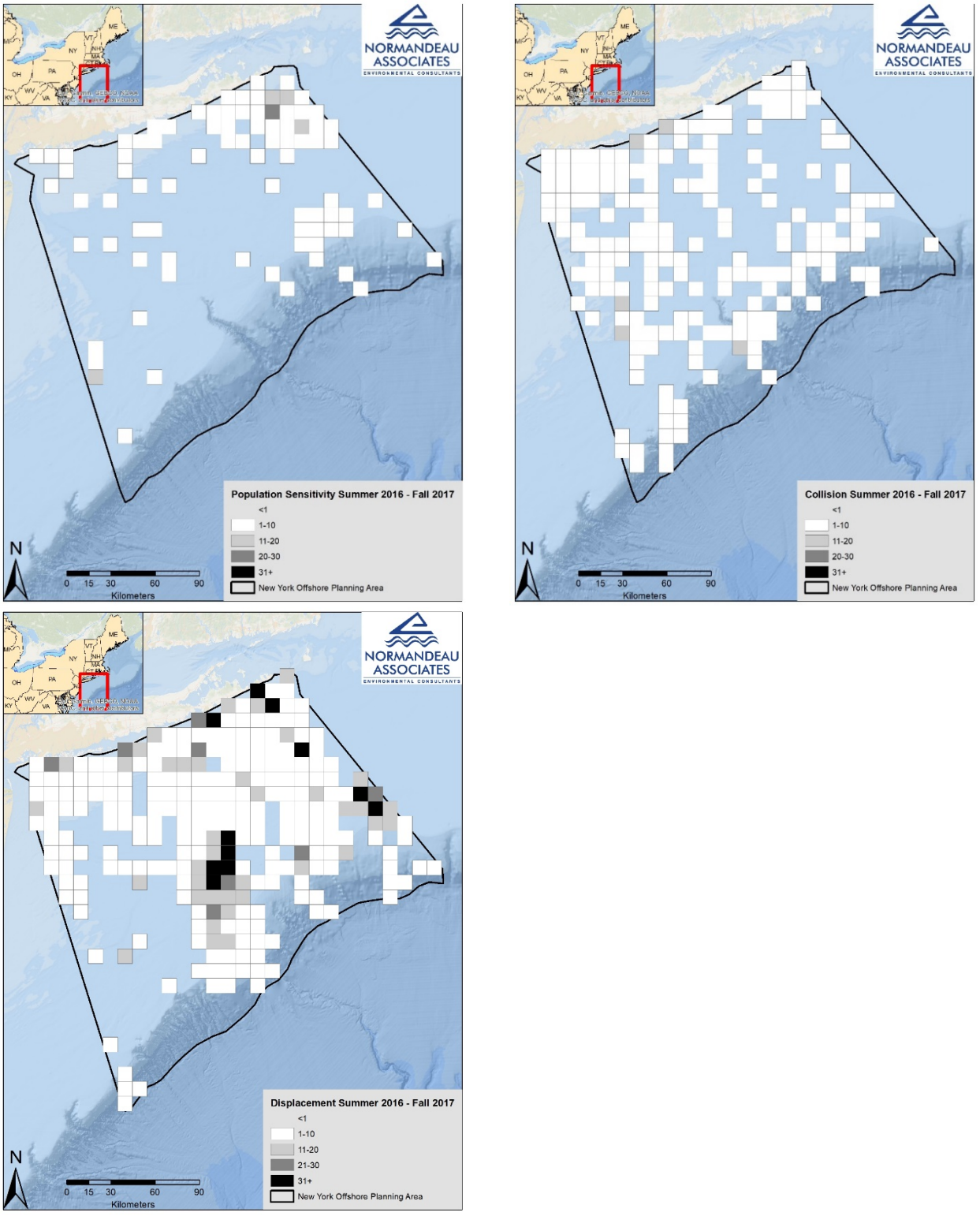


Figure 52. Average number of population-sensitive, collision-sensitive, and displacement-sensitive individuals per grid cell for species (described in Table 13, Table 14, and Table 15, respectively) across the Summer 2016–Fall 2017 surveys.

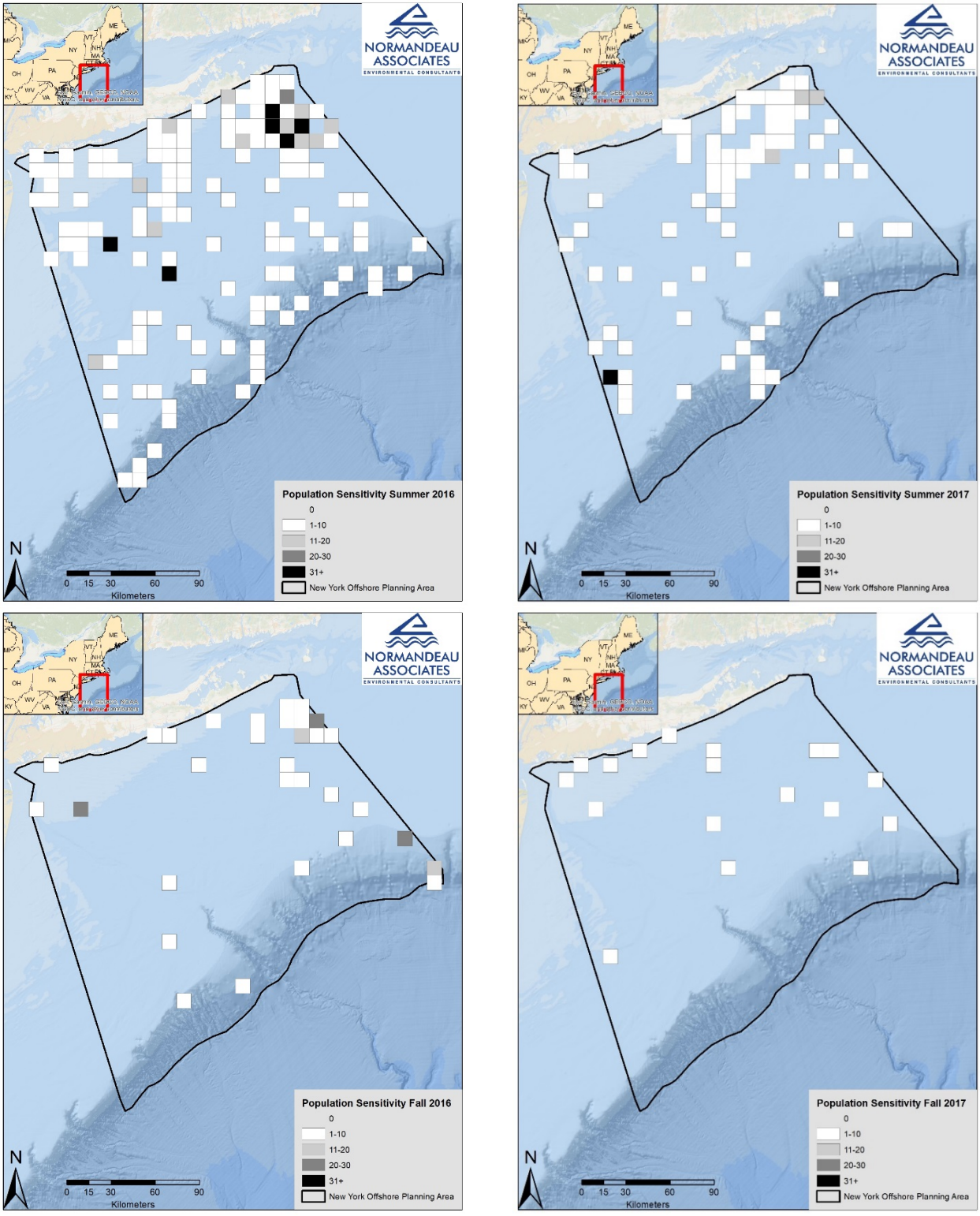


Figure 53. Total number of population-sensitive individuals (listed in Table 13) by grid cell for each season during the Summer 2016–Fall 2017 surveys.

(continued)

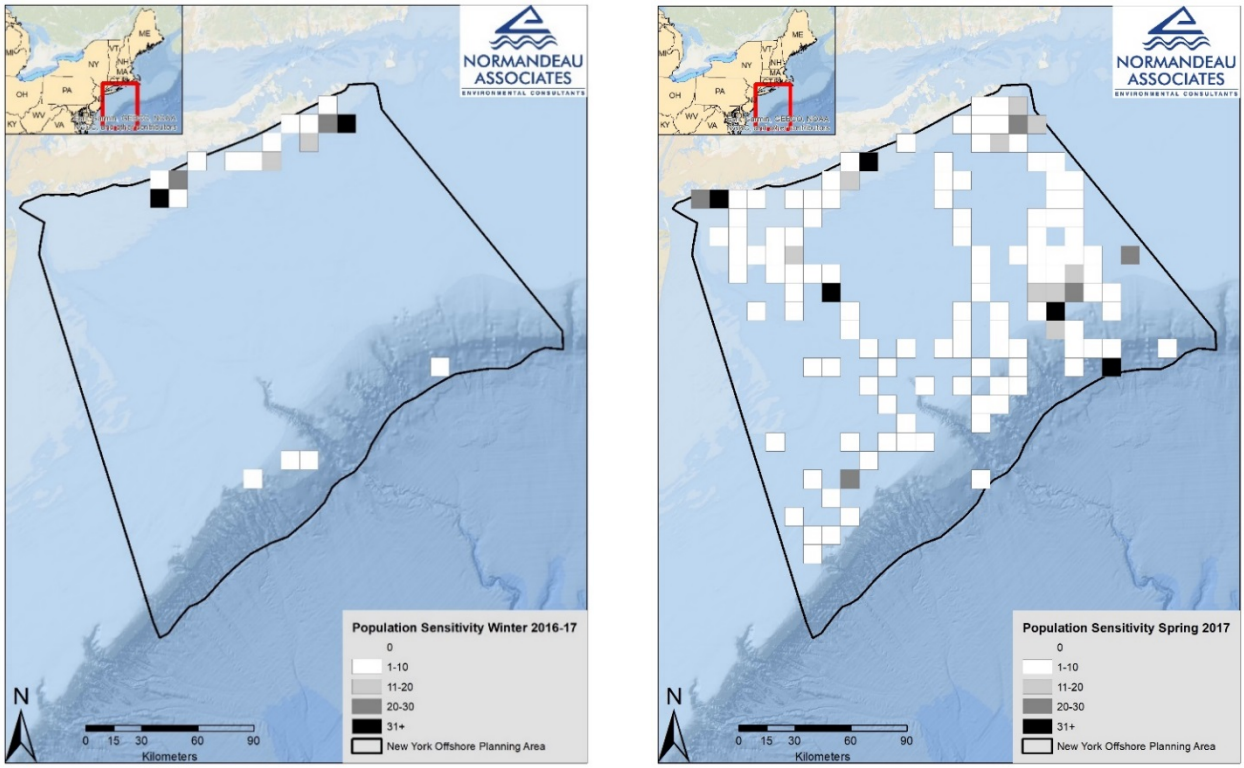


Figure 53. (continued)

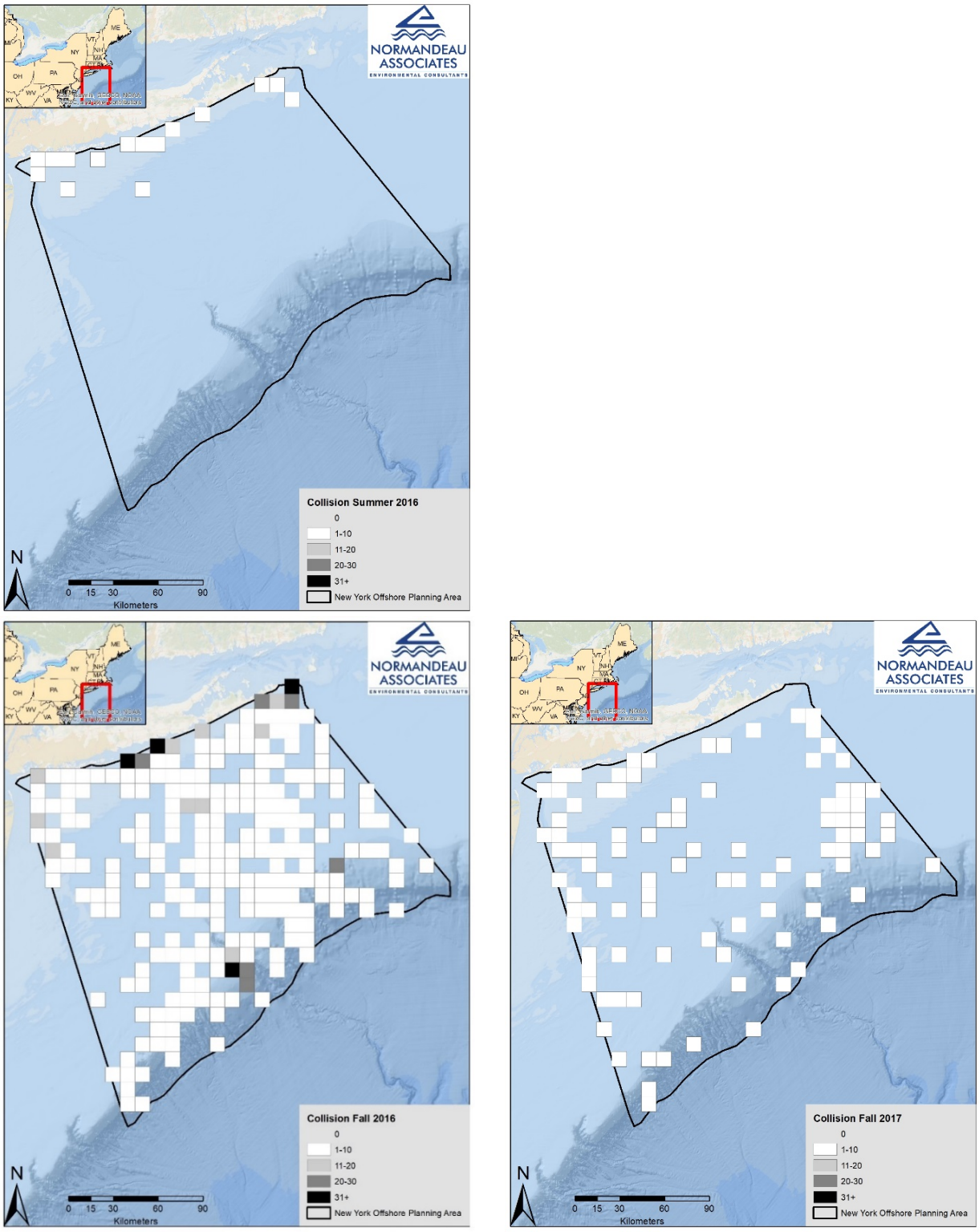


Figure 54. Total number of collision-sensitive individuals (Table 14) by grid cell for each season during the Summer 2016–Fall 2017 surveys. No collision-sensitive species were observed flying within the rotor swept zone during Summer 2017.

(continued)

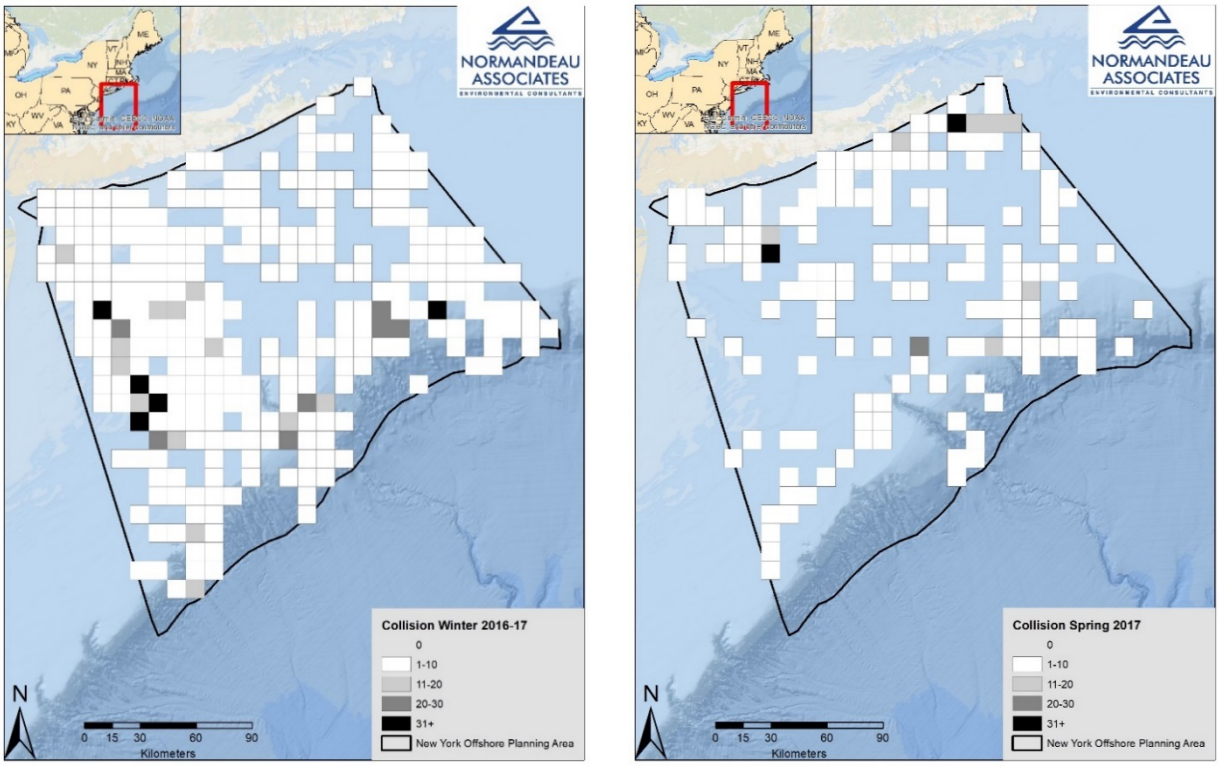


Figure 54. (continued)

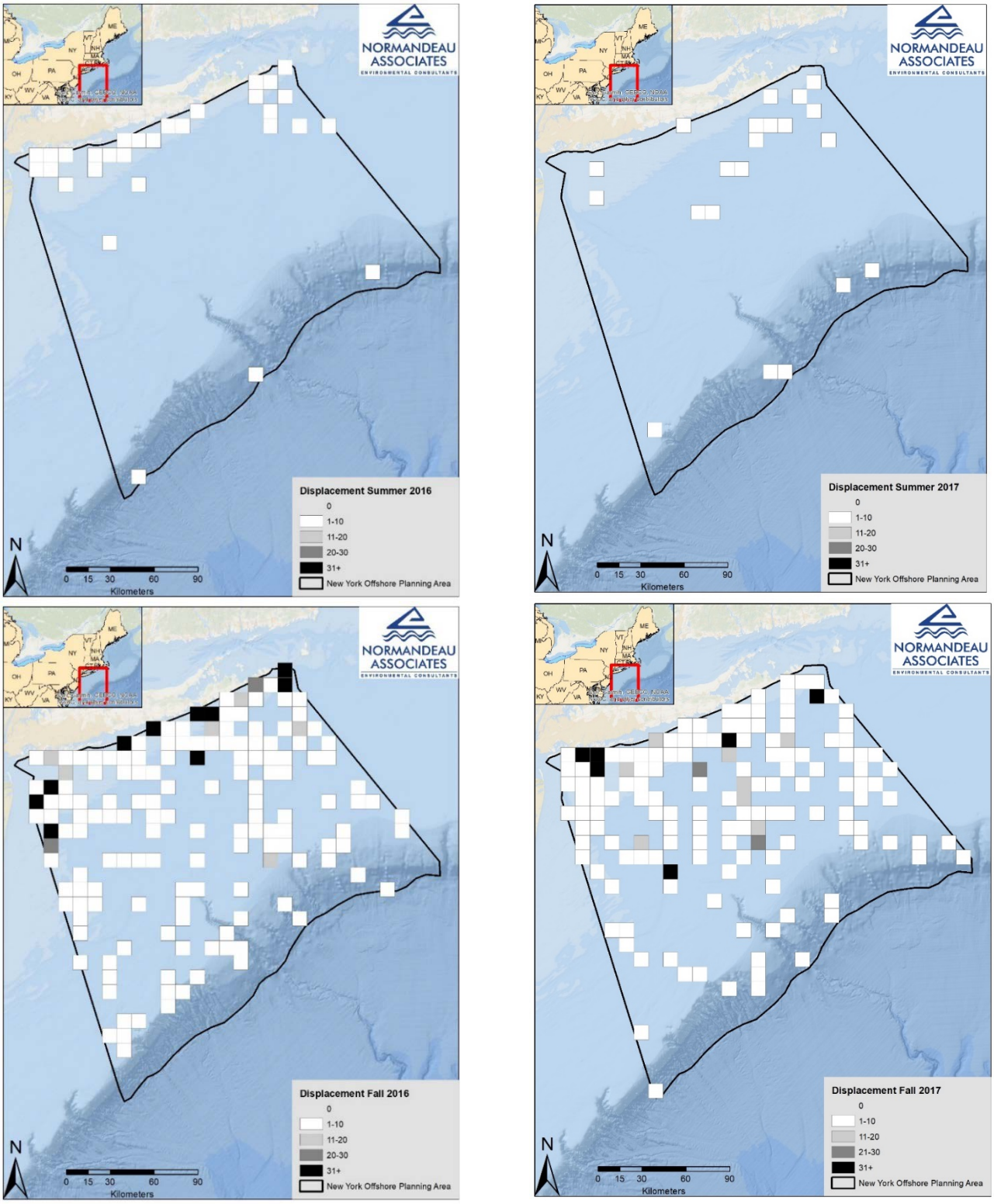
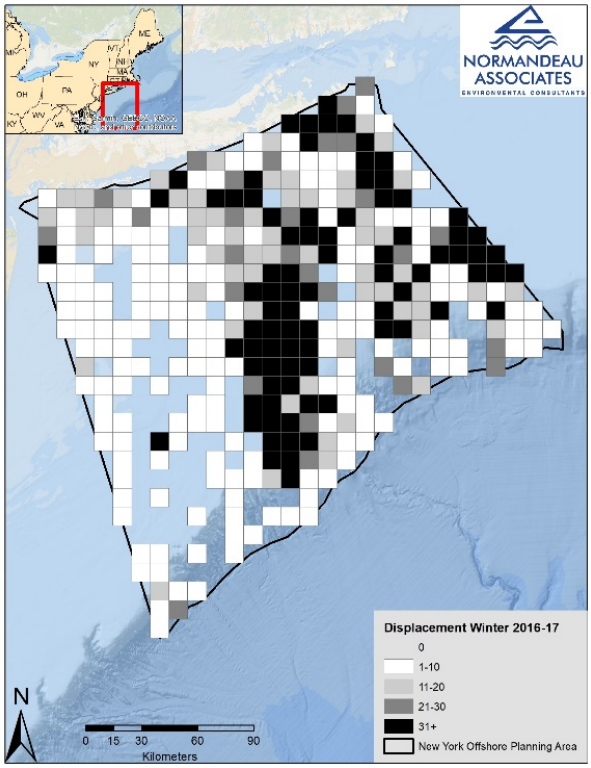


Figure 55. Total number of displacement-sensitive individuals (listed in Table 15) by grid cell for each season during the Summer 2016–Fall 2017 surveys.

(continued)



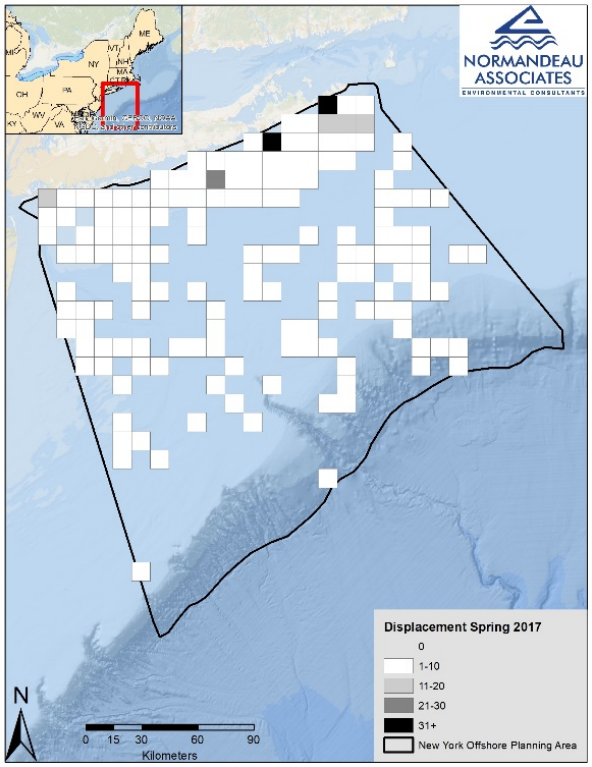


Figure 55. (continued)

3.6. Turtles

3.6.1. Species Identification

Over the six surveys, 1,334 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=156). Ten (30%) of the loggerhead/Kemp's species blend were significantly submerged and 129 (83%) of those not ascribed to any species were significantly submerged (Appendix E).

3.6.2. Species Composition and Abundance

Peak encounters for turtles were in the Summer 2016 and Summer 2017 surveys when 96% of turtles for the six surveys were observed (Table 16, Figure 56). 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 16, Figure 56). Green turtles were only found in the Summer 2016 survey (Table 16, Figure 56).

3.6.3. Spatial Distribution

Most turtles observed during the Summer along with leatherback turtles observed during the Fall occurred in water inside the 70-m isobath (Figure 57, Figure 58). 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 59).

Table 16. Turtle Species Identified and Corrected Number of Individuals in the OPA from the Summer 2016 through Spring 2017 Surveys

Species	Corrected Abundance[1]						Total
	Summer 2016	Fall 2016	Winter 2016–2017	Spring 2017	Summer 2017	Fall 2017	
Leatherback Turtle	123	315	0	0	70	28	**535**
Loggerhead Turtle	5,301	67	11	66	9,064	69	**14,579**
Loggerhead/Kemp's Turtle	137	0	0	27	279	14	**456**
Green Turtle	14	0	0	0	0	0	**14**
Kemp's Ridley Turtle	205	11	0	13	335	69	**634**
Turtle-species unknown	1,872	45	0	27	182	0	**2,125**
Season Total	**7,650**	**439**	**11**	**133**	**9,930**	**180**	**18,343**

[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.

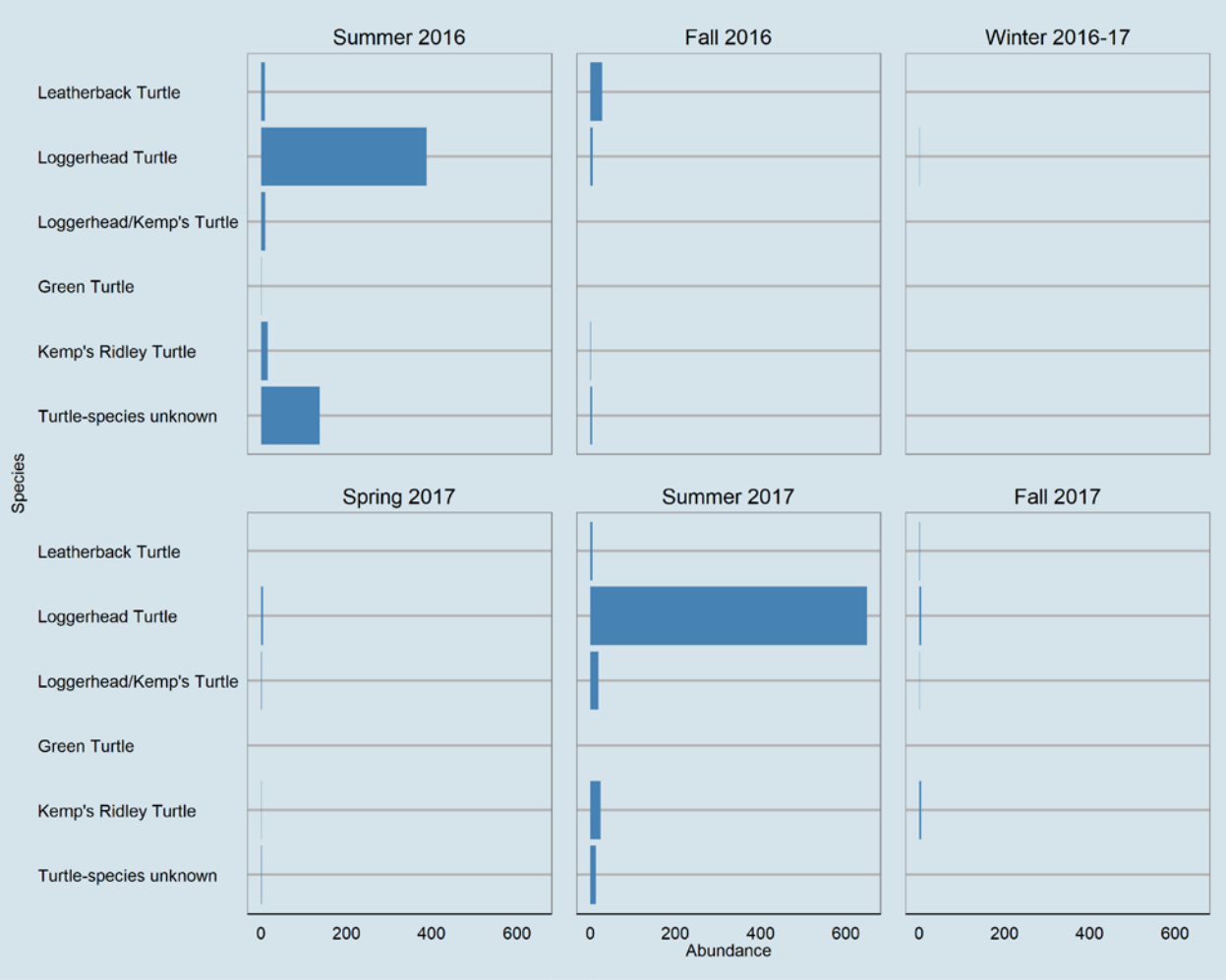


Figure 56. Number of individuals (raw observations) for each turtle species identified during the Summer 2016–Fall 2017 surveys.

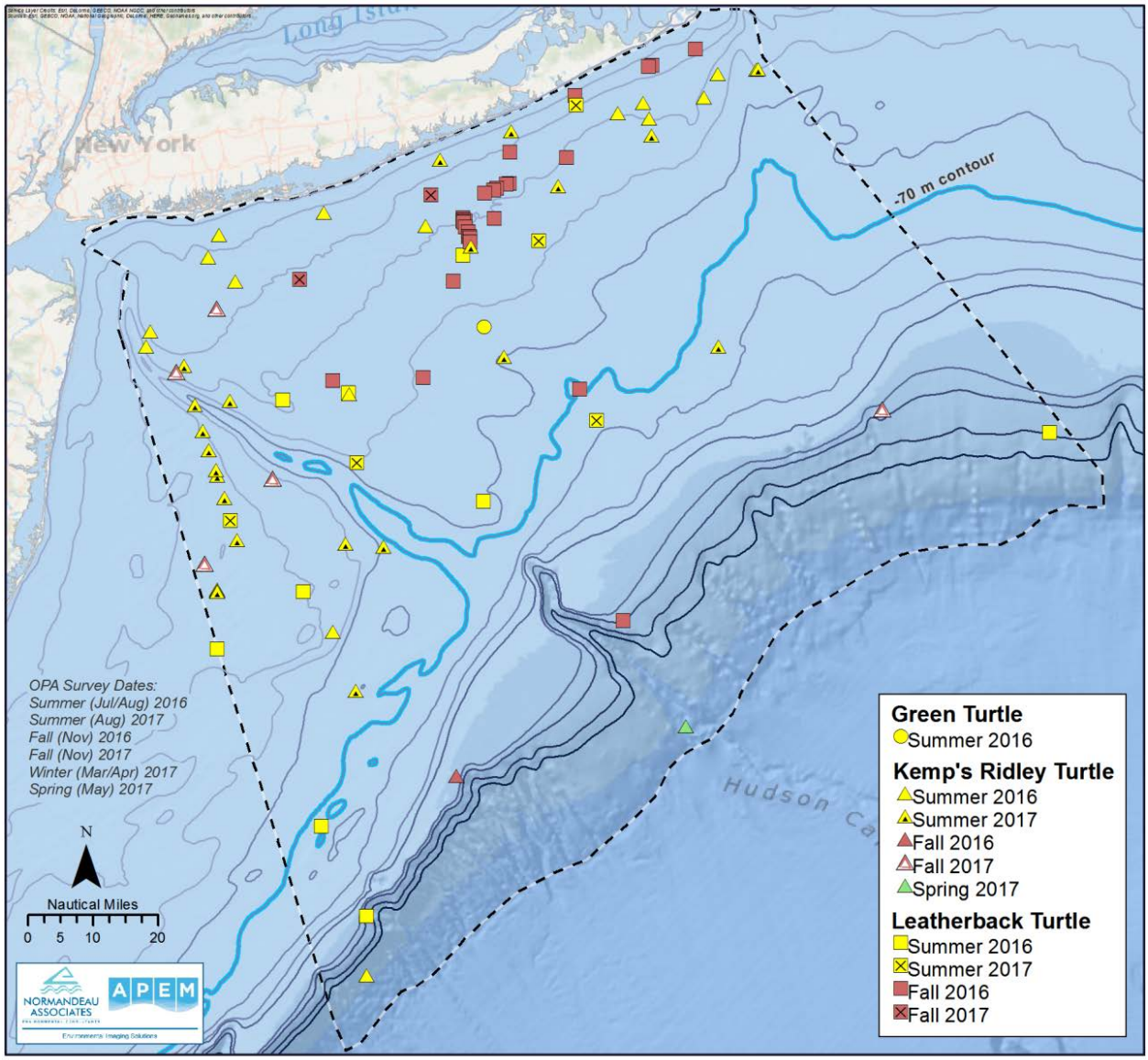


Figure 57. Distribution of green, Kemp's ridley, and leatherback turtles during the Summer 2016–Fall 2017 surveys.

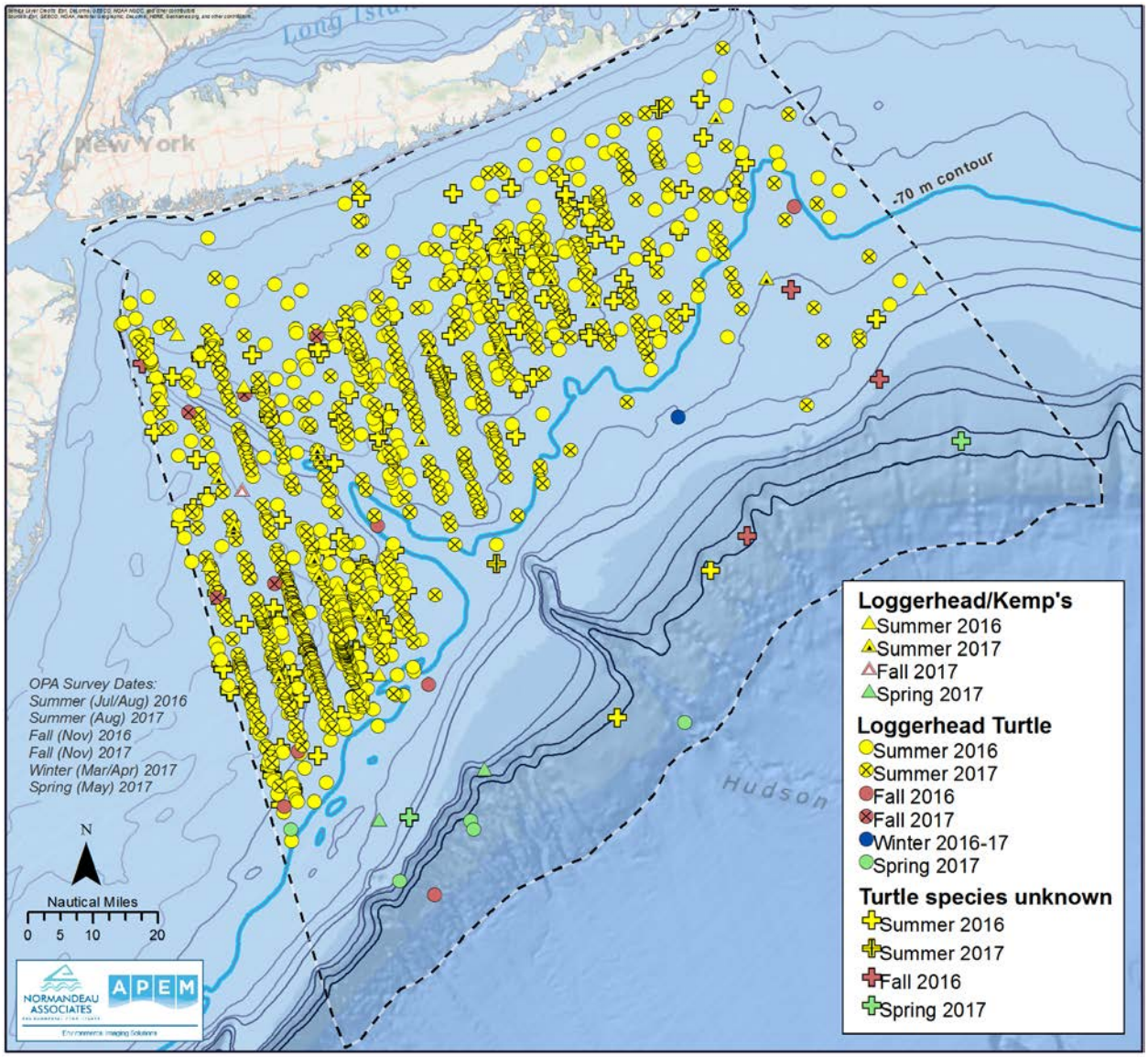


Figure 58. Distribution of loggerhead, loggerhead/Kemp's, and unidentified turtles during the Summer 2016–Fall 2017 surveys.

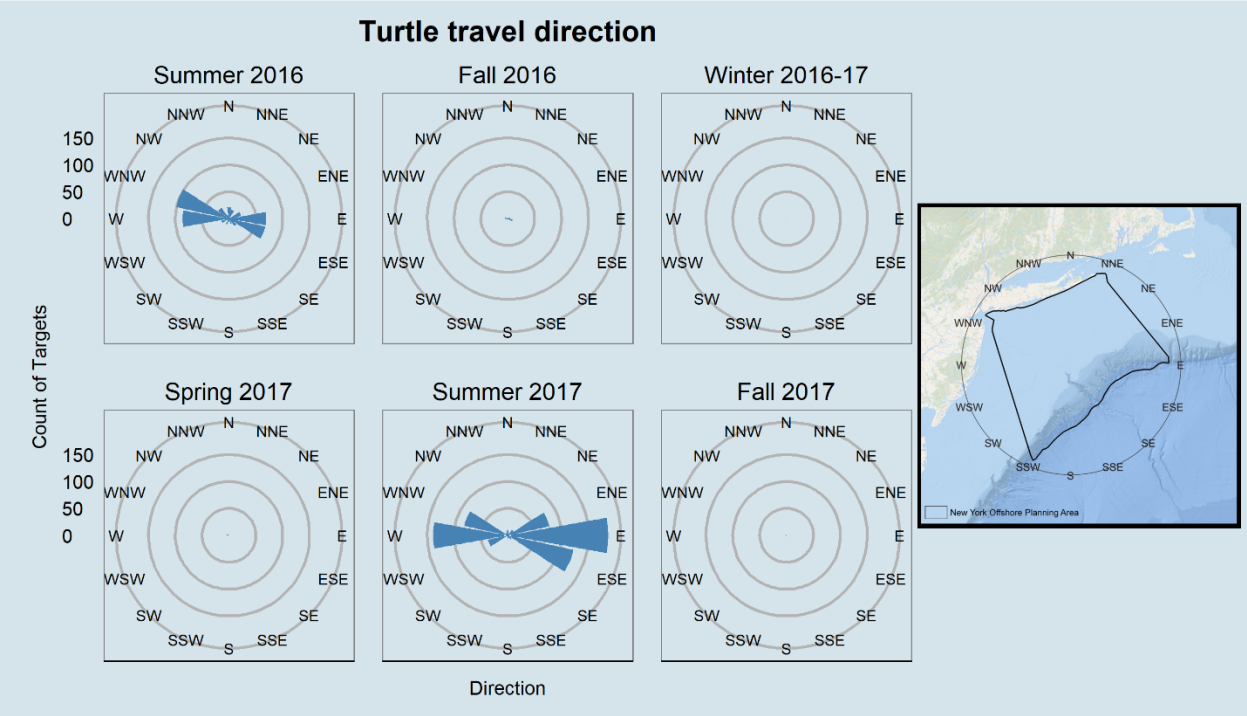


Figure 59. Direction of travel for turtles observed during the Summer 2016–Fall 2017 surveys.

3.7. Marine Mammals

3.7.1. Species Identification

Over the six surveys, 8,027 marine mammals were identified in imagery in the OPA (Appendix F). Identification rates between marine mammal taxonomic groups varied with most (96%) of mammals found were dolphins (n=7,683), only 1% found were whales (n=102), and 1% seals (n=52). There were 190 unidentified mammals (2%), which were either dolphins or seals (Appendix F).

For dolphins, 2,589 were not ascribed to species. These included a species blend of common/white-sided dolphin (n=20) and unidentified dolphins (n=2,569), which provided an identification rate of 34%. Of these, 2,025 (78%) were significantly submerged (Appendix F, Table 17). There were also 212 individuals identified as pilot whale (unid.), 133 (63%) of which were significantly submerged. Of the 2,569 unidentified dolphins, 2,032 (79%) were significantly submerged (Appendix F). Of the 190 animals that could have been either dolphin or seal, 152 (80%) were significantly submerged.

Fifty-two seals were found in imagery across the six surveys (Appendix F), of which six individuals (12%) were identified to species. Fifteen of the remaining 46 (33%) were rated as significantly submerged (Appendix F).

Across the six surveys, 102 whales were found in the imagery. Seventy-two (71%) were identified to species, 14 (14%) were identified as beaked whale (unid.), and 16 (16%) remained as whale species unknown. Of the 16 unidentified whales, 13 (81%) were significantly submerged (Appendix F).

3.7.2. Species Composition and Abundance

During the first six surveys in the OPA, marine mammal observations included 96% dolphins, 2% unidentified mammals, <1% seals, and 1% whales (Table 17).

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 survey, but most seals (91%) were found during the Fall 2016 and Winter 2016–2017 surveys (Table 17, Figure 60).

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 and Spring surveys; humpback whales had the same relative abundance as common minke whales in Spring (Table 17, Figure 61). Sperm whales were only observed in the Fall 2016 and Summer 2017 surveys, dwarf sperm whales were present in the Summer 2017 survey, and pygmy sperm whales were present in the Fall 2017 survey (Table 17, Figure 61).

Common dolphins were the most frequently encountered species in the Winter 2016–2017 through Fall 2017 surveys (Table 17, Figure 62). Unknown dolphins were the most abundant during the Summer 2016 and Fall 2016 surveys, and Risso's and bottlenose dolphins were present for all surveys (Table 17, Figure 62). Rough-toothed dolphins were present in the Winter 2016–2017 and Summer 2017 surveys and striped dolphins in the Fall 2016, Winter 2016–2017, and Summer 2017 surveys (Table 17, Figure 62).

3.7.3. Spatial Distribution

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 seasonal distribution patterns were evident as numbers of whales were low (Figure 63, Figure 64).

Bottlenose dolphins, common dolphins, and harbor porpoises were fairly widespread for all surveys, with some concentration in the deeper half of the OPA in the Winter and along the shelf break in the Spring (Figure 65). 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 66, Figure 67).

3.7.4. Direction of Travel

Whale travel direction was primarily to the ESE in the Fall, Winter, and Spring, though there was some variability in travel direction during the Fall 2017 survey, and a more WNW preference in the Summer 2017 survey (Figure 68). Dolphin travel direction was primarily in a W and WNW to E and ESE and ESE to WNW direction across all seasons (Figure 69).

Table 17. Marine Mammal Species Identified and Corrected Number of Individuals in the OPA from the Summer 2016 through Spring 2017 Surveys

Subtype	Species	Corrected Abundance[1]						Total
		Summer 2016	Fall 2016	Winter 2016–2017	Spring 2017	Summer 2017	Fall 2017	
Seal	Gray Seal	0	11	33	0	0	0	**44**
	Harp Seal	0	0	0	13	0	0	**13**
	Harbor Seal	0	0	11	0	0	0	**11**
	Seal-species unknown	0	135	343	0	28	14	**520**
	Season Total	**0**	**146**	**387**	**13**	**28**	**14**	**588**
Whale	North Atlantic Right Whale	0	0	44	27	0	0	**71**
	Blue Whale	0	11	11	0	0	0	**22**
	Common Minke Whale	14	0	77	66	0	14	**171**
	Fin Whale	137	56	55	13	56	55	**373**
	Sei Whale	0	0	0	0	14	0	**14**
	Humpback Whale	0	11	22	66	0	41	**141**
	Dwarf Sperm Whale	0	0	0	0	28	0	**28**
	Pygmy Sperm Whale	0	0	0	0	0	28	**28**
	Sperm Whale	0	22	0	0	42	0	**64**
	Beaked Whale (unid.)	109	45	11	13	0	0	**179**
	Whale-species unknown	14	0	55	40	14	83	**206**
	Season Total	**273**	**146**	**277**	**226**	**154**	**221**	**1,296**
Dolphin	Common Dolphin	765	2,508	6,261	11,315	11,913	7,776	**40,539**
	Short-finned Pilot Whale	0	0	0	0	335	0	**335**
	Pilot Whale (unid.)	1,393	101	0	385	726	276	**2,882**
	Risso's Dolphin	2,268	1,395	542	1,740	1,955	511	**8,411**
	Atlantic White-sided Dolphin	0	180	77	0	0	0	**257**
	Rough-toothed dolphin	0	0	11	0	209	0	**221**
	Atlantic Spotted Dolphin	0	607	0	40	0	0	**647**
	Striped Dolphin	0	844	55	0	84	0	**983**
	Bottlenose Dolphin	1,311	664	1,460	2,297	2,444	939	**9,116**
	Common/White-sided Dolphin	0	0	177	53	0	0	**230**
	Harbor Porpoise	0	45	2,124	226	0	0	**2,395**
	Dolphin-species unknown	6,612	5,939	6,062	4,635	1,774	7,362	**32,384**
	Season Total	**12,350**	**12,283**	**16,770**	**20,691**	**19,441**	**16,865**	**98,400**
Unid. Mammal	Unid. Mammal-species unknown	0	0	365	1,474	573	69	**2,481**
	Season Total	**0**	**0**	**365**	**1,474**	**573**	**69**	**2,481**
	Seasonal Grand Total	**12,623**	**12,576**	**17,799**	**22,404**	**20,196**	**17,169**	**102,765**

[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.

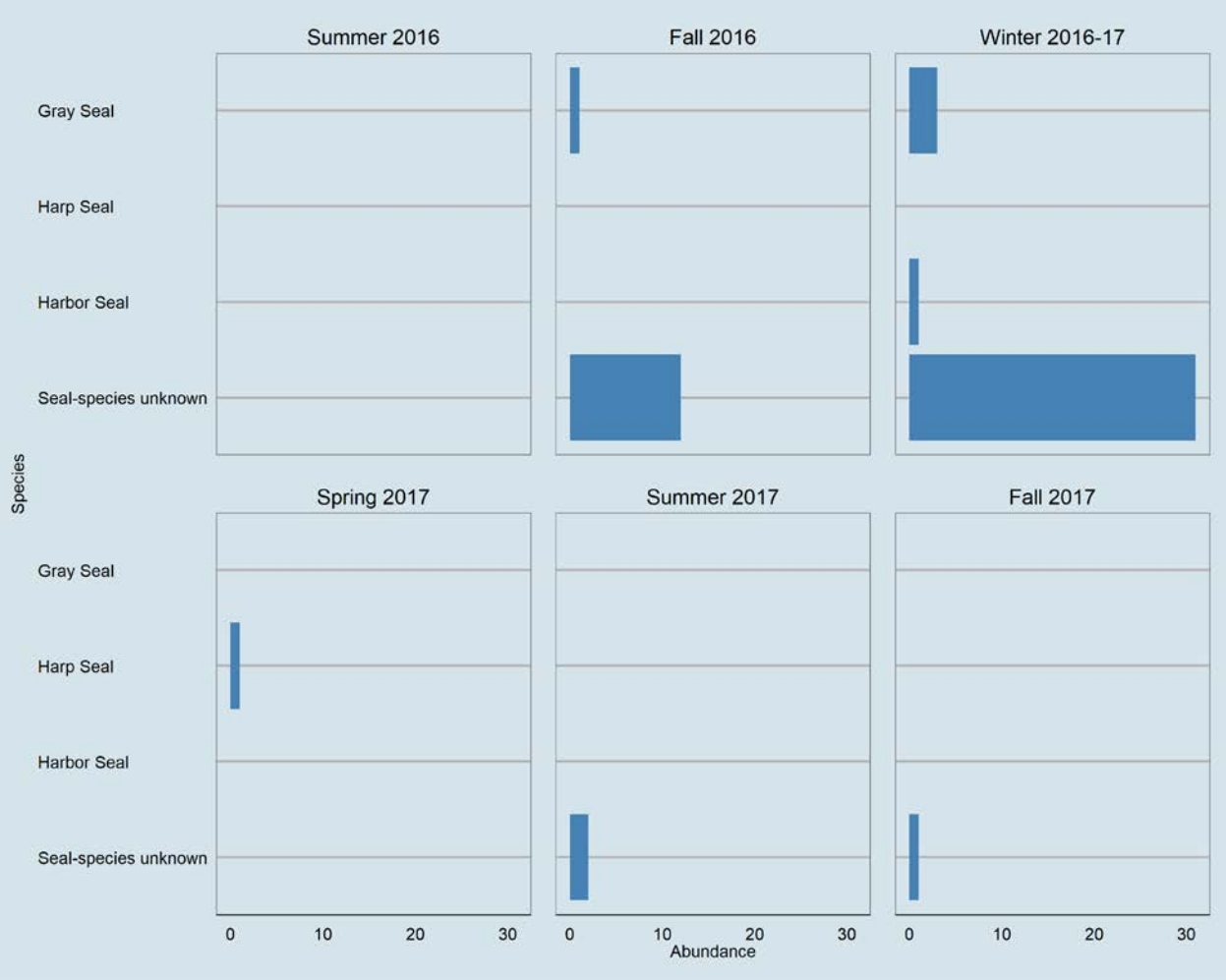


Figure 60. Number of individuals (raw observations) for each seal species identified during the Summer 2016 through Fall 2017 surveys.

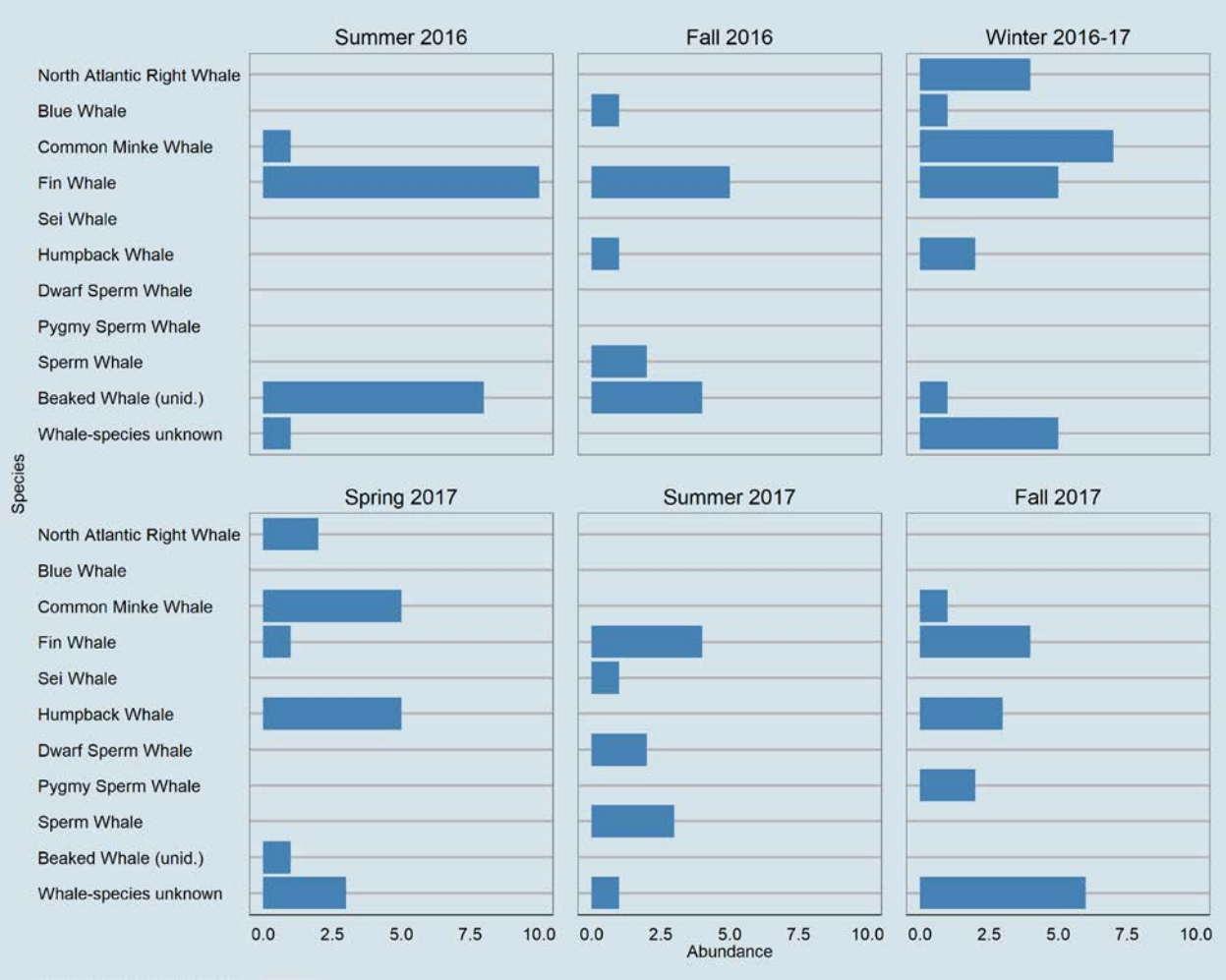


Figure 61. Number of individuals (raw observations) for each whale species identified during the Summer 2016 through Fall 2017 surveys.

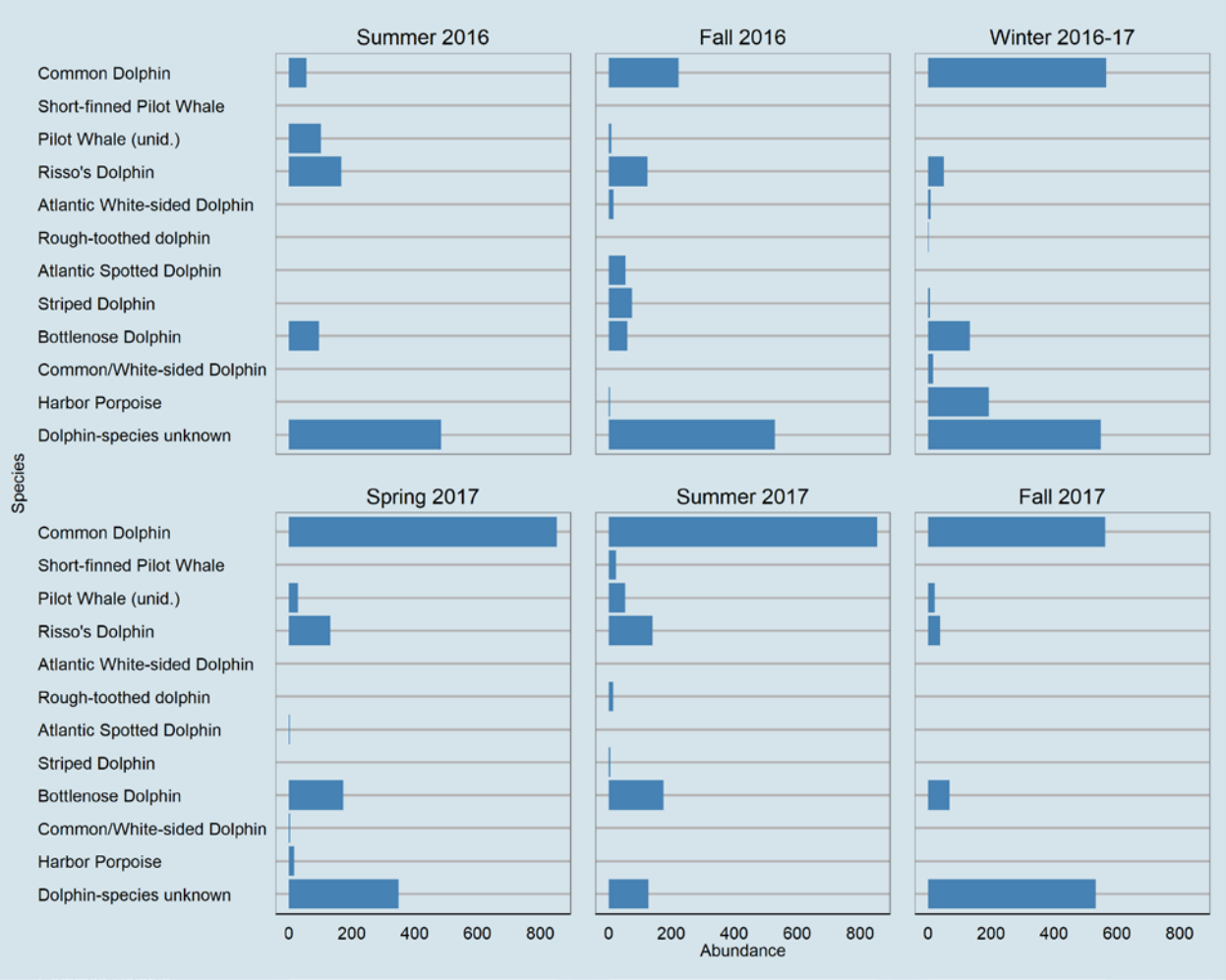


Figure 62. Number of individuals (raw observations) for each dolphin species identified during the Summer 2016 through Fall 2017 surveys.

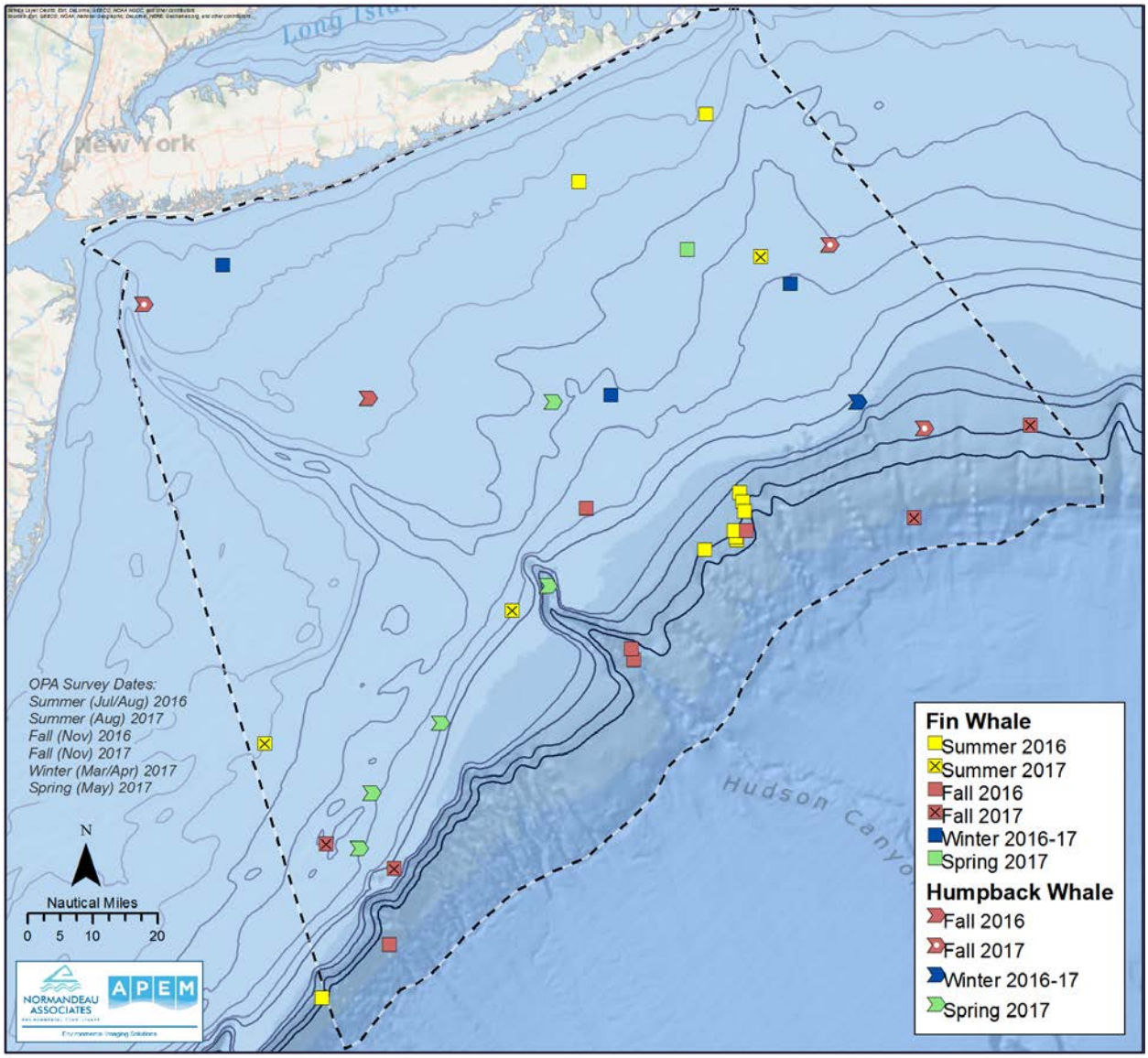


Figure 63. Distribution of humpback and fin whales during the Summer 2016–Fall 2017 surveys.

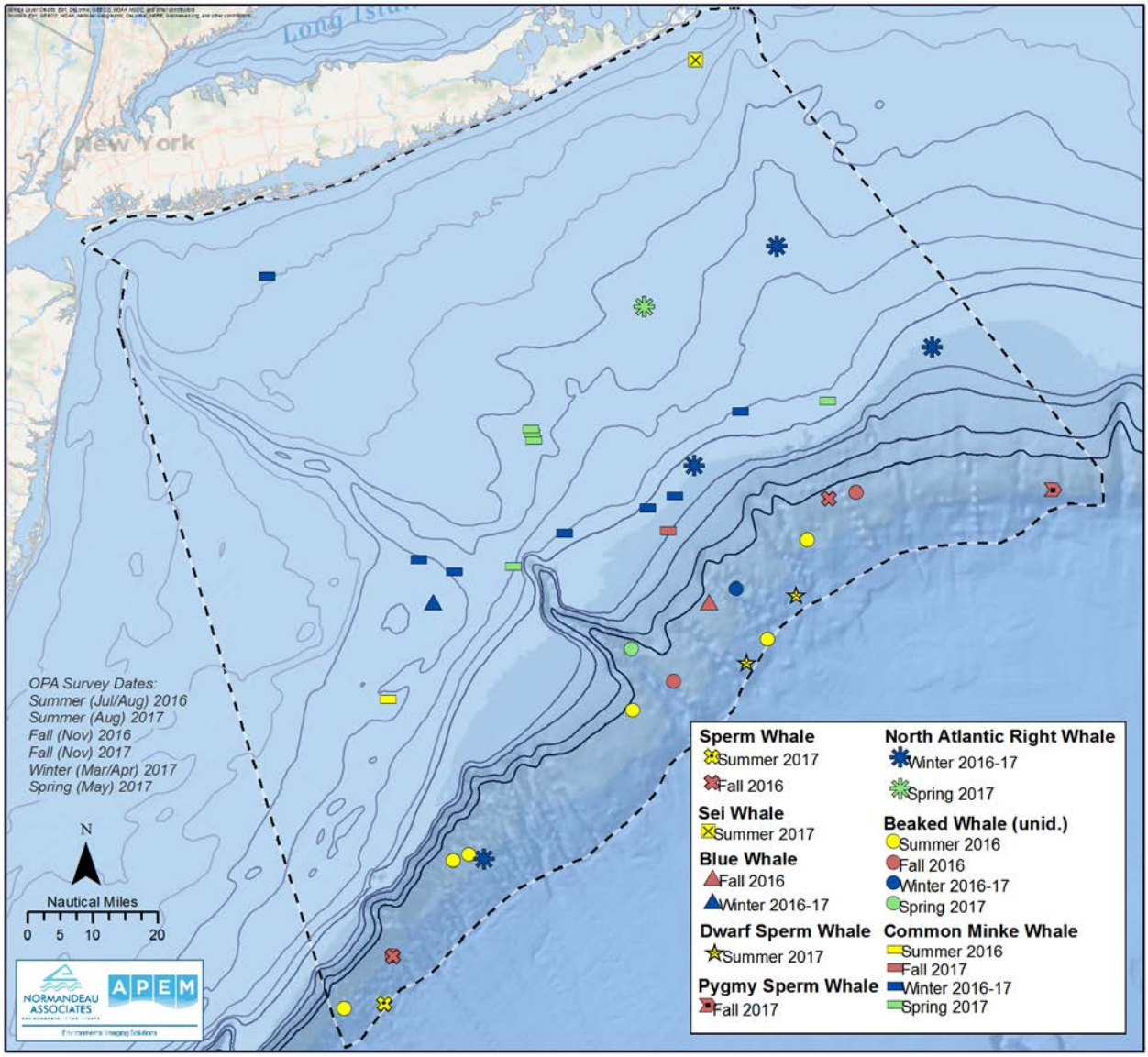


Figure 64. Distribution of blue, north Atlantic right, minke, sperm, sei, dwarf sperm, pygmy sperm and unidentified beaked whales during the Summer 2016–Fall 2017 surveys.

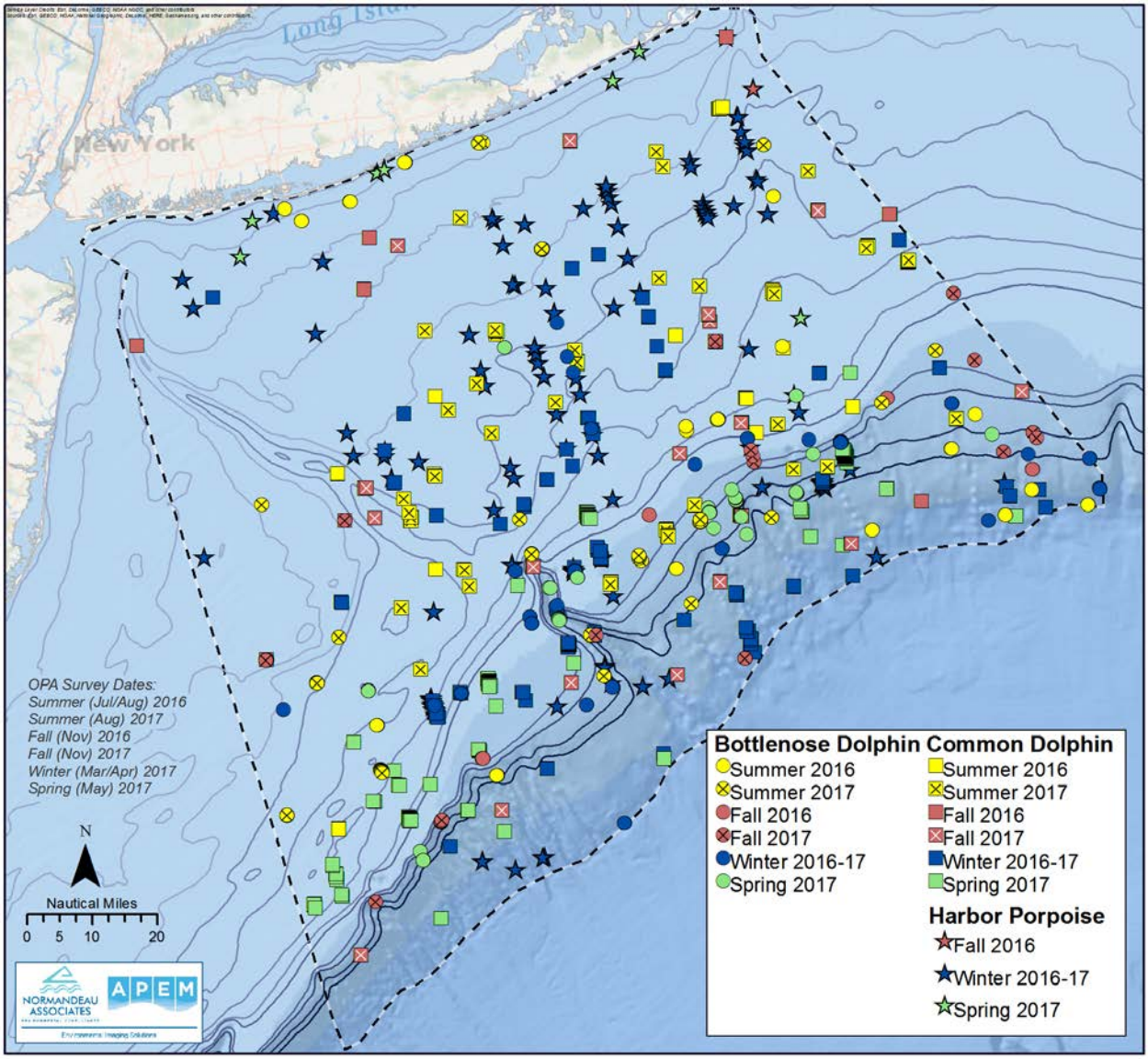


Figure 65. Distribution of common and bottlenose dolphins and harbor porpoise during the Summer 2016–Fall 2017 surveys.

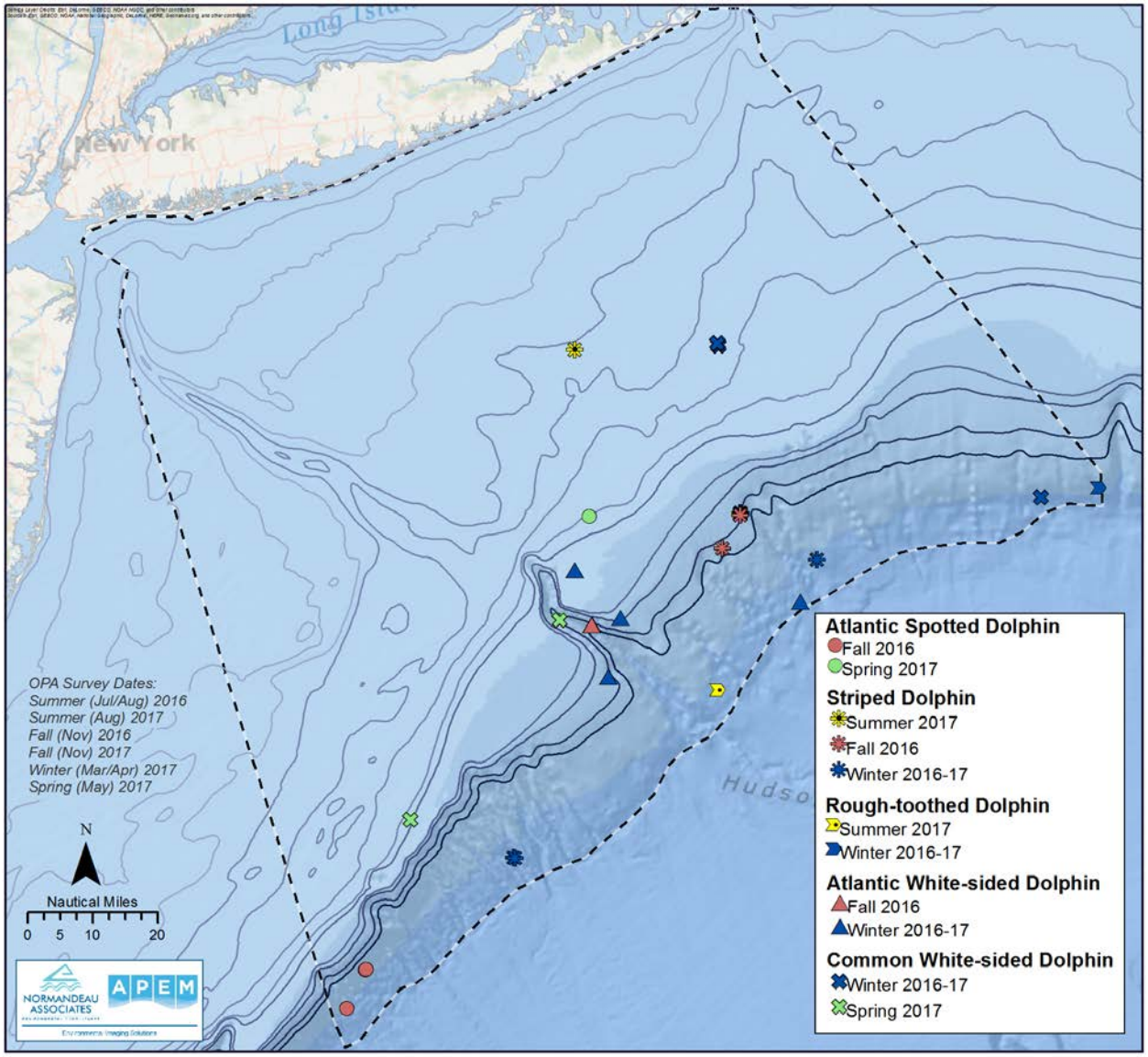


Figure 66. Distribution of striped, Atlantic white-sided, Atlantic spotted, and rough-toothed dolphin during the Summer 2016–Fall 2017 surveys.

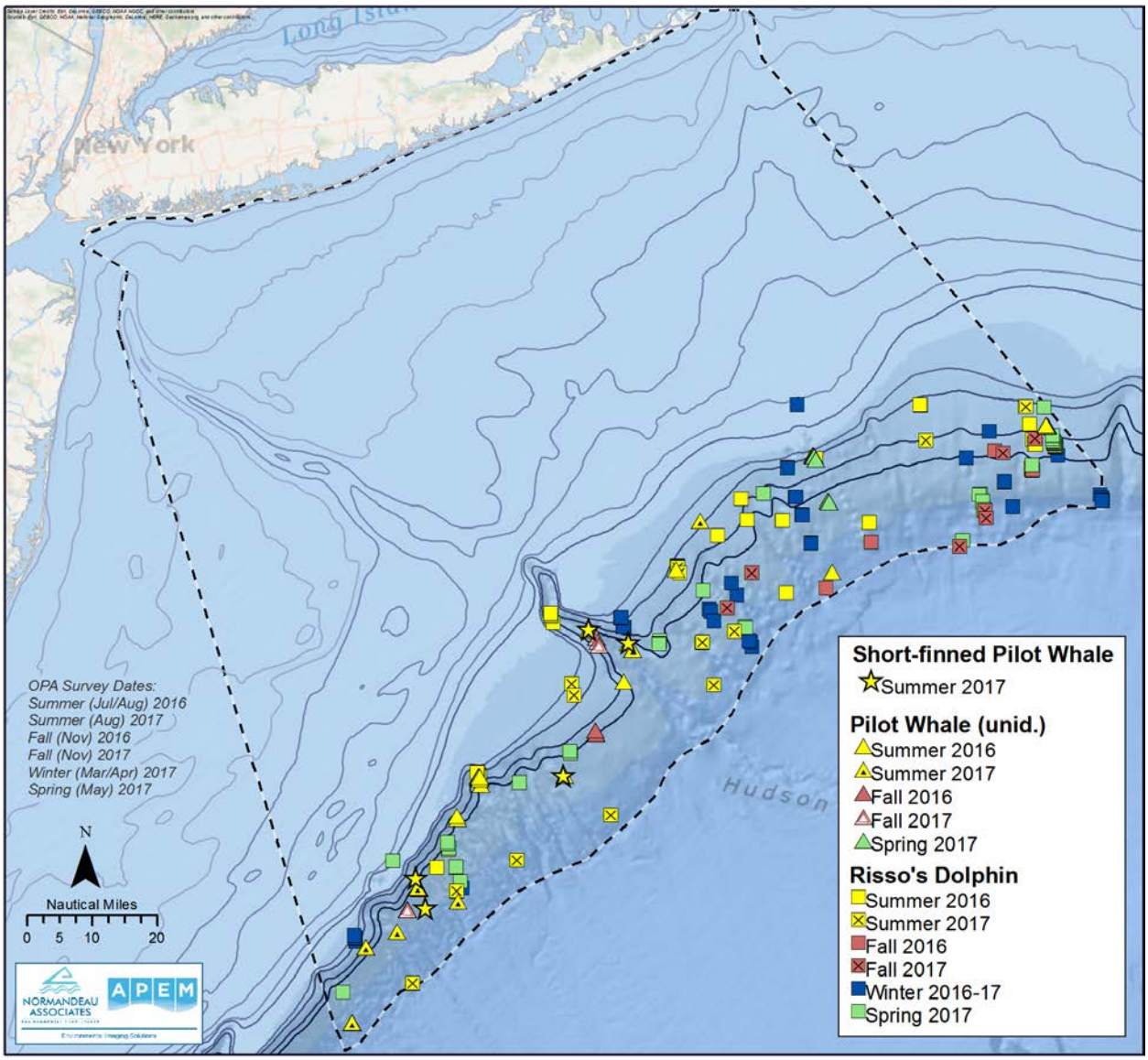


Figure 67. Distribution of pilot whale and Risso's dolphin during the Summer 2016–Fall 2017 surveys.

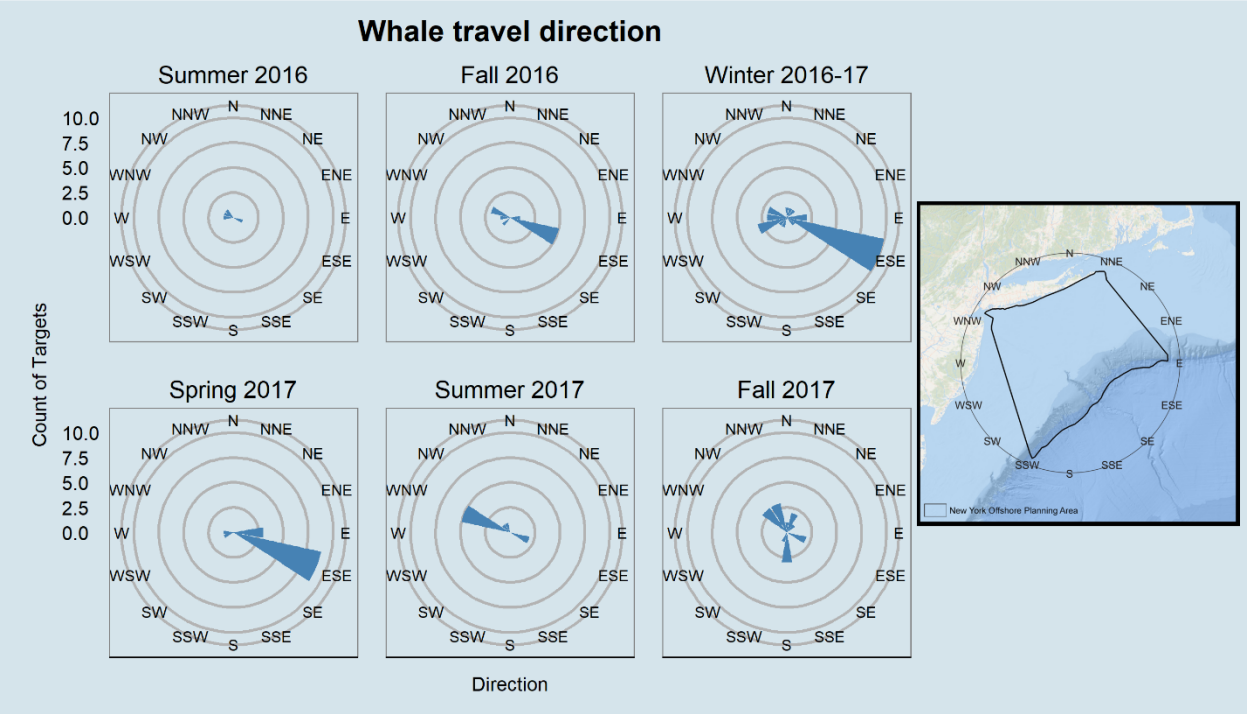


Figure 68. Direction of travel for whales observed during the Summer 2016 through Fall 2017 surveys.

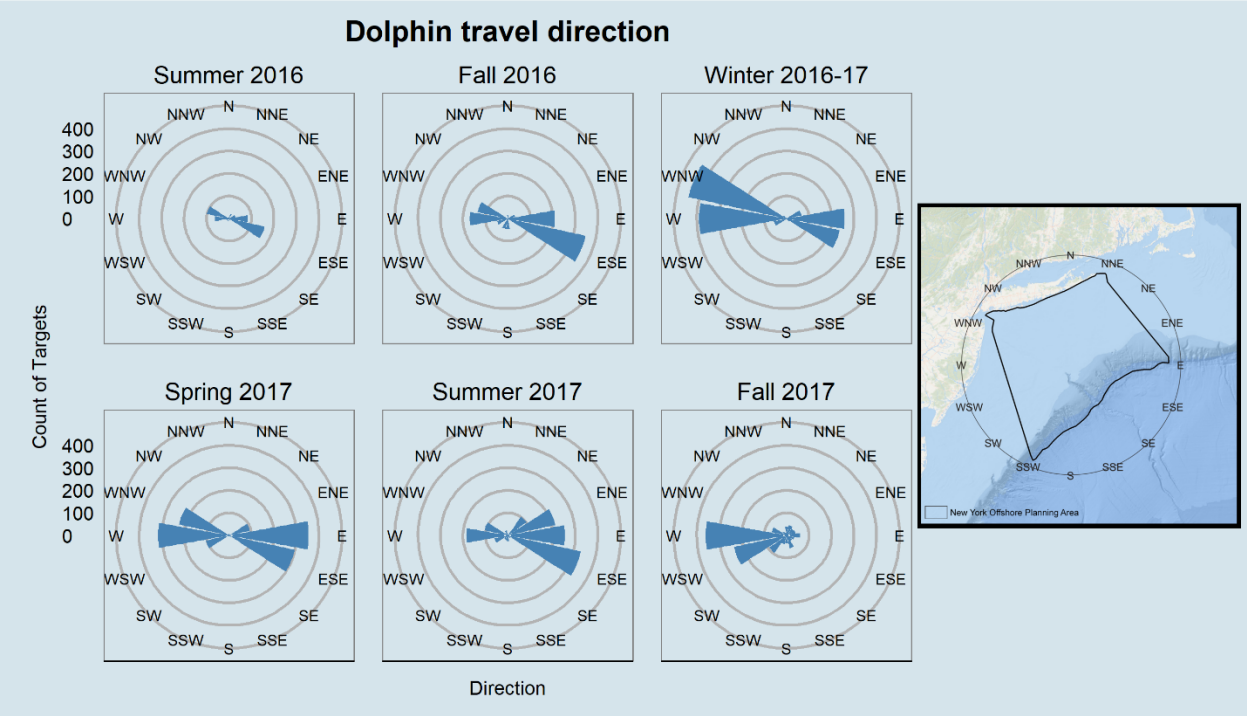


Figure 69. Direction of travel for dolphins observed during the Summer 2016 through Fall 2017 surveys.

3.8. Rays and Sharks

3.8.1. Species Identification

There were 15,733 rays found in the imagery in the OPA. 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 six surveys, the identification success for sharks varied between taxonomic groups (Appendix G). Of the 2,248 sharks found in the Summer 2016 through Fall 2017 surveys in the OPA, 33% (n=730) were shark species unknown, 20% (n=457) were Carcharhinidae (unid.), and 16% (n=357) were hammerhead (unid.), making a total of 1,544 unidentified sharks and an identification success rate of 31% 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 378 (52%) of the shark species unknown that were significantly submerged (Appendix G).

3.8.2. Species Composition and Abundance

Rays were only observed in the OPA during the Summer and Fall surveys (Table 18, Figure 70), with densities greater in the summer. Only <1% of ray observations occurred in the Fall surveys (Table 18, Figure 70). 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. The remaining 15% of rays were not ascribed to species or species group (Table 18). Of the six rays

recorded during the Fall surveys, one giant devil ray and one cownose/bullnose ray were identified. The remaining rays were not ascribed to species or species group (Table 18, Figure 70).

The majority (91%) of shark observations occurred during the Summer surveys across the OPA. Only blue sharks, basking sharks, great white shark, scalloped hammerhead, smooth hammerhead and tiger sharks, hammerhead (unid.), and unknown shark species were observed during the Fall surveys. During the Winter 2016–2017 survey, 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. Those observations only consisted of 9% of the total observations for the six surveys (Table 19, Figure 71). Abundance of sharks was the second highest among seasons during Spring with basking sharks being the most abundant species (Table 19, Figure 71).

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 72). 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 73). The shelf break aggregation of unidentified rays also correlates with aggregations of the larger manta rays and devil rays (Figure 74).

There were no clear distribution patterns among sharks, including scalloped hammerhead and hammerhead (unid.) sharks (Figure 75, Figure 76).

3.8.4. Direction of Travel

Travel direction for rays showed some preference for a WNW to ESE direction in the Summer surveys (Figure 77). Travel direction for sharks was highly variable but showed a similar WNW to ESE direction in the Summer 2017 survey (Figure 78).

Table 18. Ray Species Identified and Corrected Number of Individuals in the OPA from the Summer 2016 through Fall 2017 Surveys

Species	Corrected Abundance[1]				Total
	Summer 2016	Fall 2016	Summer 2017	Fall 2017	
Bluntnose Stingray	14	0	0	0	**14**
Giant Manta Ray	55	0	28	0	**83**
Giant Devil Ray	2,117	0	251	14	**2,383**
Chilean Devil Ray	970	0	684	0	**1,654**
Bullnose Ray	0	0	1,215	0	**1,215**
Cownose/Bullnose Ray	47,322	11	27,640	0	**74,973**
Cownose Ray	44,740	0	59,064	0	**103,805**
Ray-species unknown	15,478	34	17,598	14	**33,123**
Season Total	**110,697**	**45**	**106,480**	**28**	**217,250**

[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.

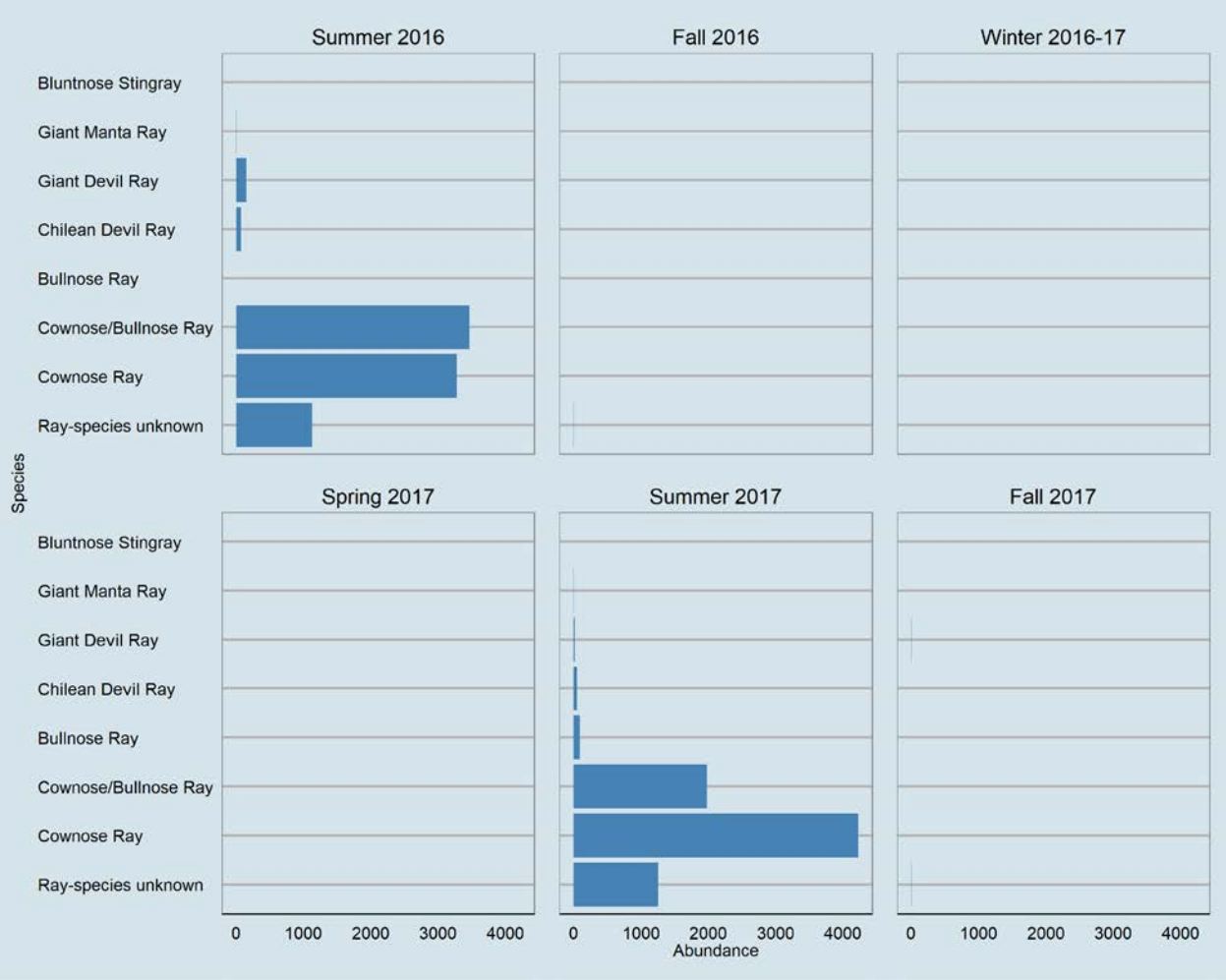


Figure 70. Number of individuals (raw observations) for each ray species identified during the Summer 2016 through Fall 2017 surveys.

Table 19. Shark Species Identified and Corrected Number of Individuals in the OPA from the Summer 2016 through Fall 2017 Surveys

Species	Corrected Abundance[1]						Total
	Summer 2016	Fall 2016	Winter 2016–2017	Spring 2017	Summer 2017	Fall 2017	
Whale Shark	14	0	0	0	140	0	**153**
Sand Tiger Shark	0	0	0	0	14	0	**14**
Thresher Shark	27	0	0	0	70	0	**97**
Basking Shark	14	0	155	1,315	1,858	14	**3,355**
Great White Shark	14	0	0	27	182	14	**236**
Shortfin Mako	14	0	0	0	56	0	**70**
Blue Shark	68	22	22	452	293	41	**899**
Carcharhinidae (unid.)	1,803	0	0	40	4,469	28	**6,340**
Dusky Shark	14	0	0	0	28	0	**42**
Oceanic Whitetip Shark	14	0	0	0	0	0	**14**
Sandbar Shark	0	0	0	0	293	0	**293**
Tiger Shark	55	0	0	0	112	14	**180**
Great Hammerhead	109	0	0	0	14	0	**123**
Smooth Hammerhead	123	0	0	0	782	14	**919**
Scalloped Hammerhead	246	0	0	0	2,975	28	**3,248**
Hammerhead (unid.)	1,680	11	0	0	3,240	14	**4,946**
Spurdog	0	0	22	0	0	0	**22**
Shark-species unknown	4,590	11	88	558	4,777	14	**10,038**
Season Total	8,784	45	288	2,390	19,302	180	**30,988**

[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.

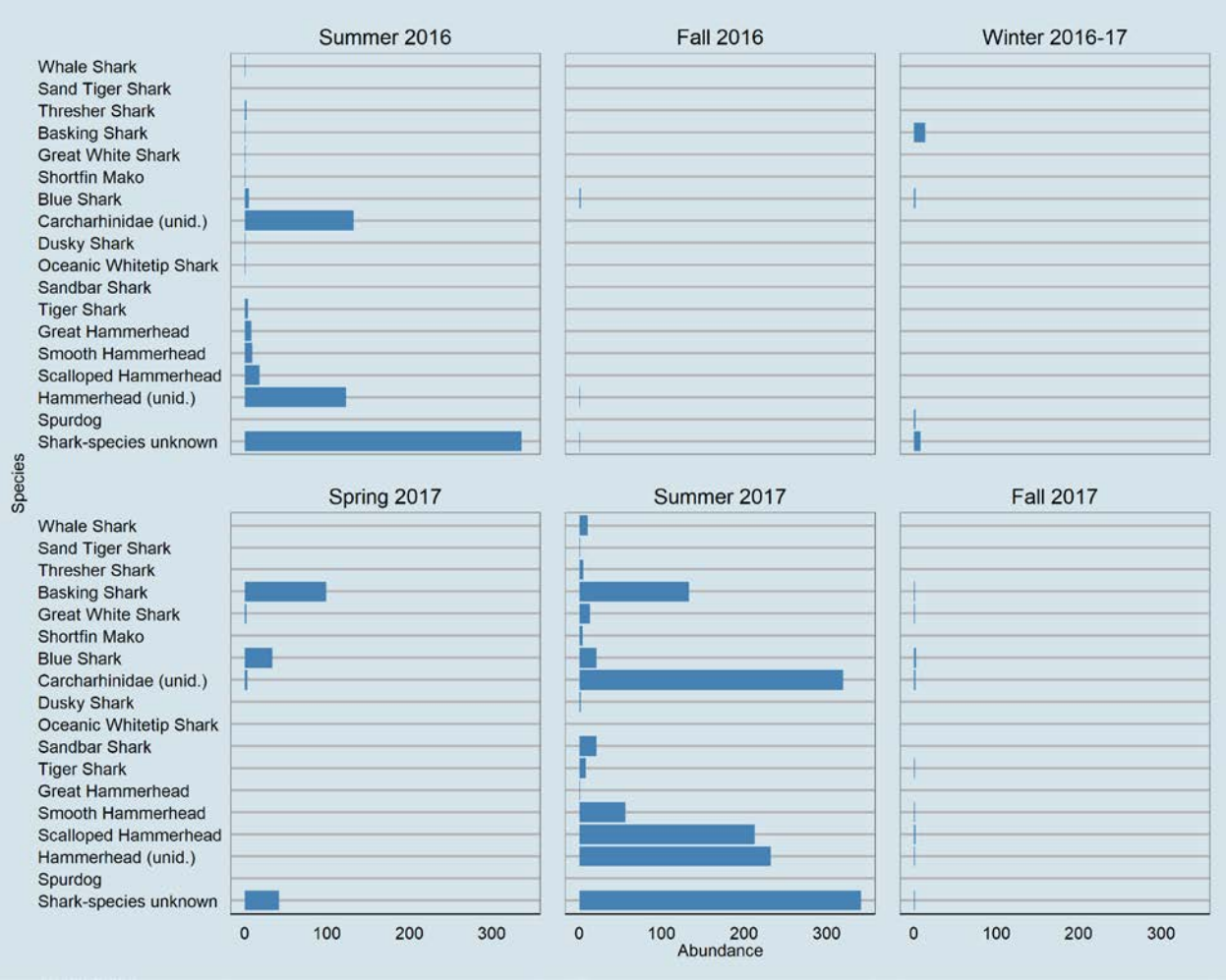


Figure 71. Number of individuals (raw observations) for each shark species identified during the Summer 2016 through Fall 2017 surveys.

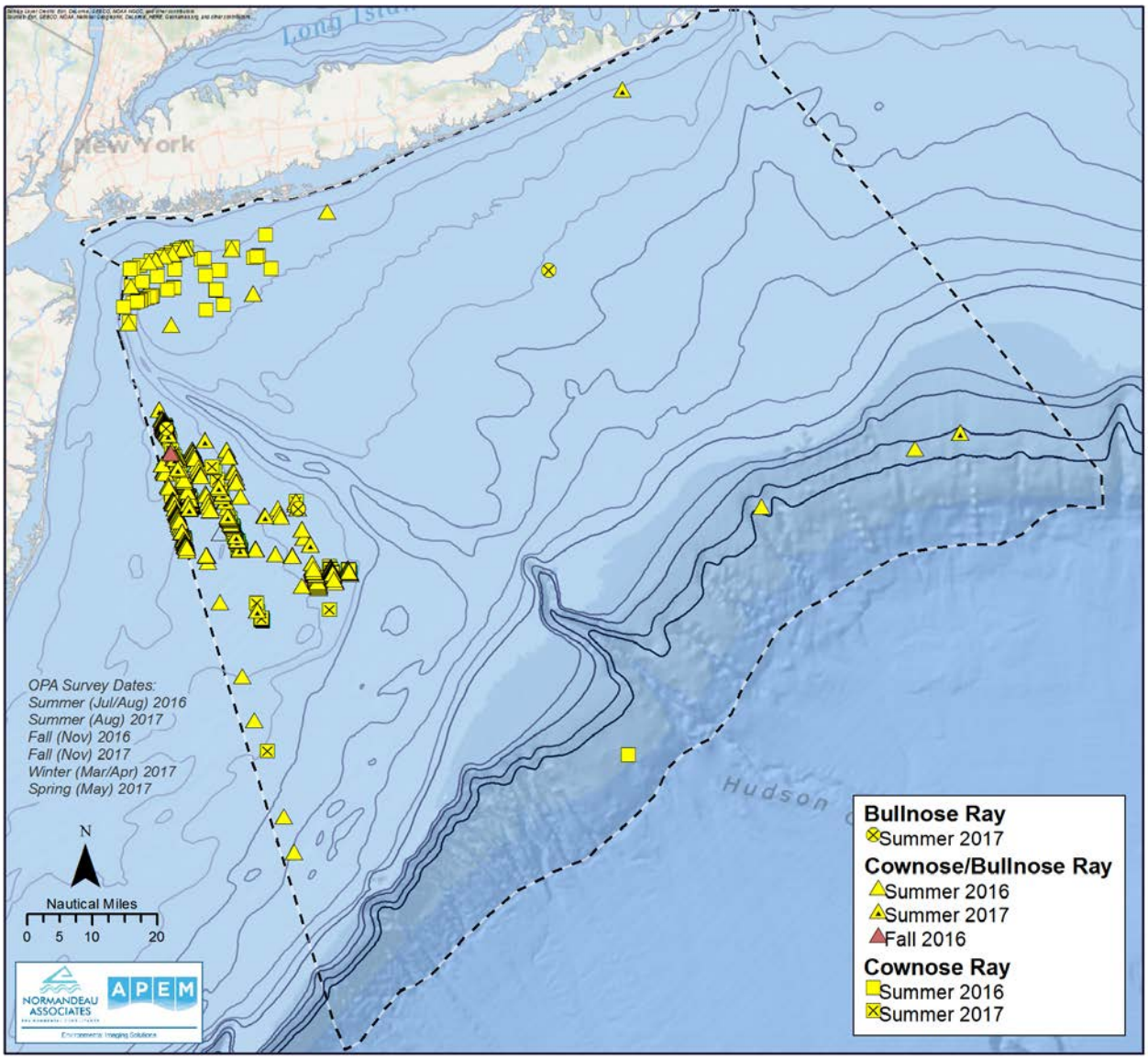


Figure 72. Distribution of bullnose and cownose/bullnose rays during the Summer 2016–Fall 2017 surveys.

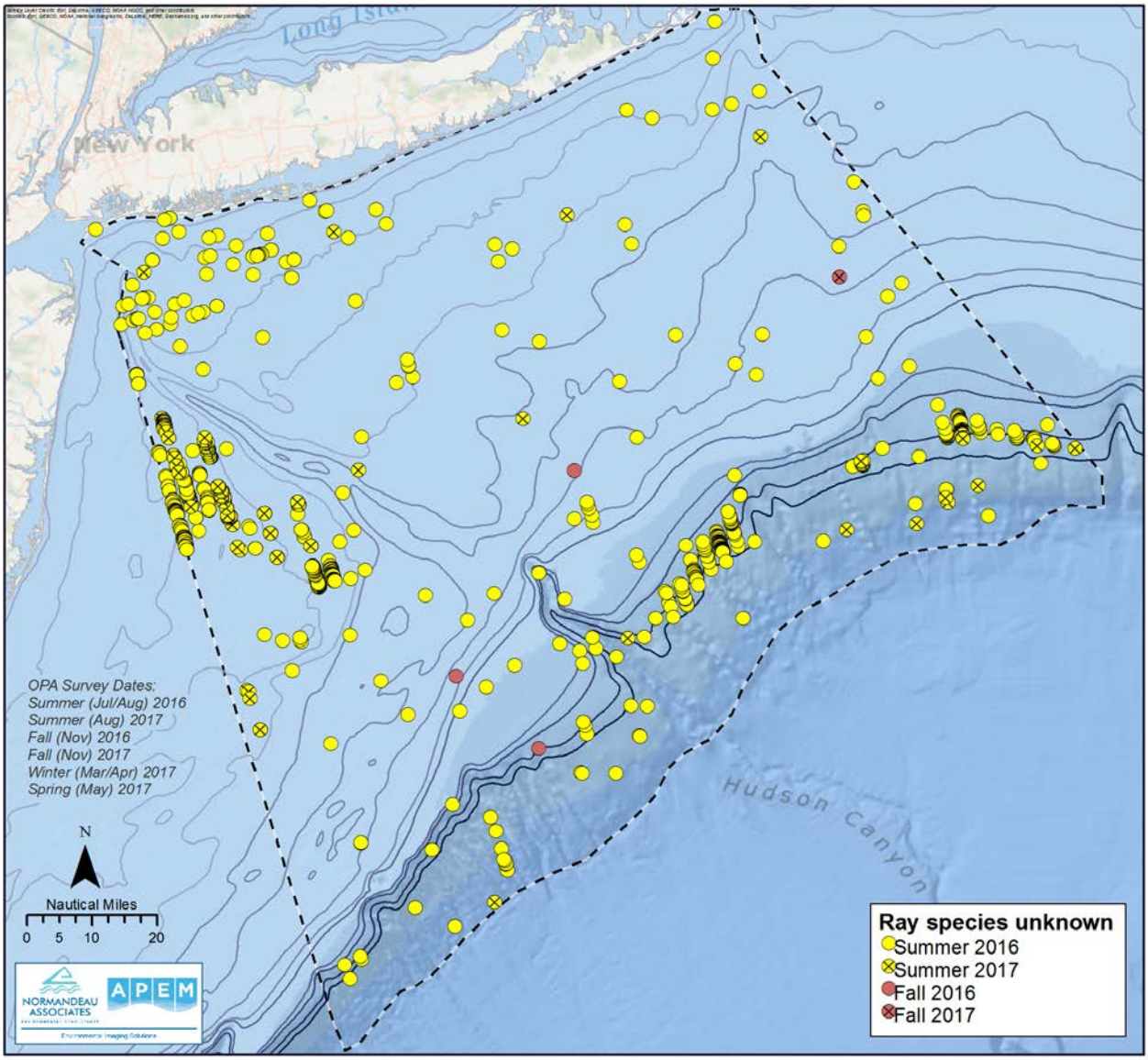


Figure 73. Distribution of unidentified rays during the Summer 2016–Fall 2017 surveys.

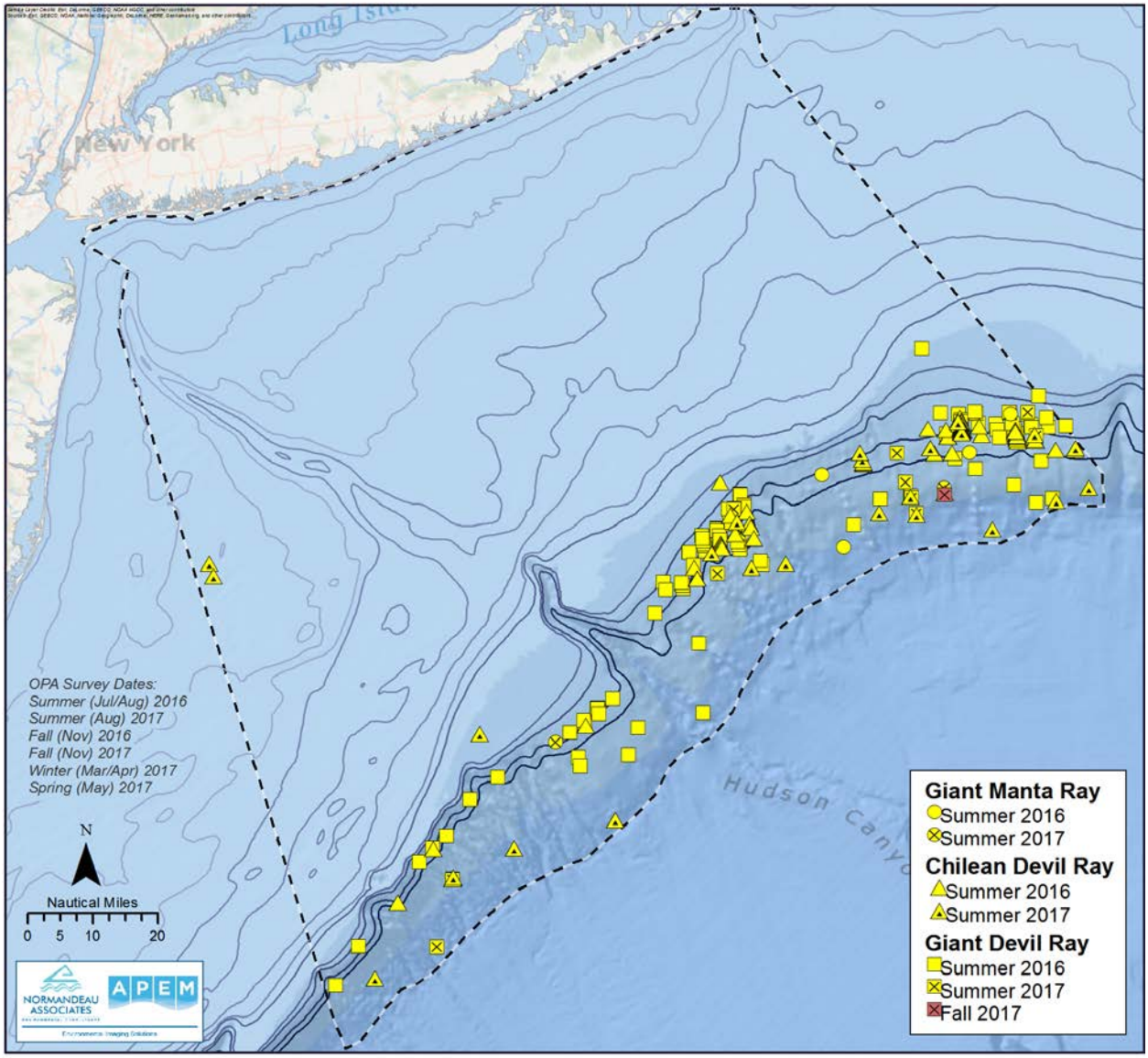


Figure 74. Distribution of manta rays and devil rays during the Summer 2016–Fall 2017 surveys.

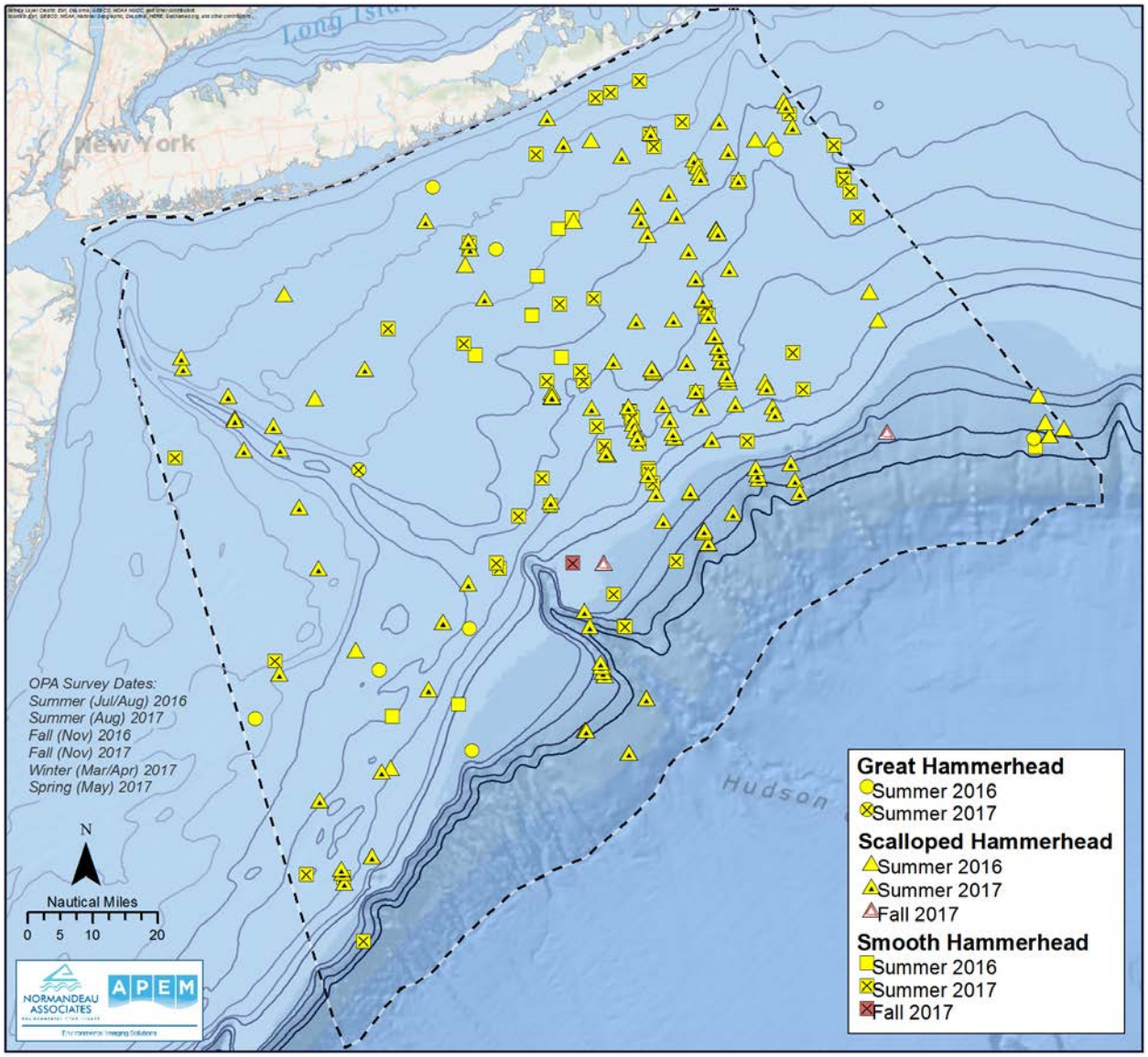


Figure 75. Distribution of hammerhead and scalloped hammerhead sharks during the Summer 2016–Fall 2017 surveys.

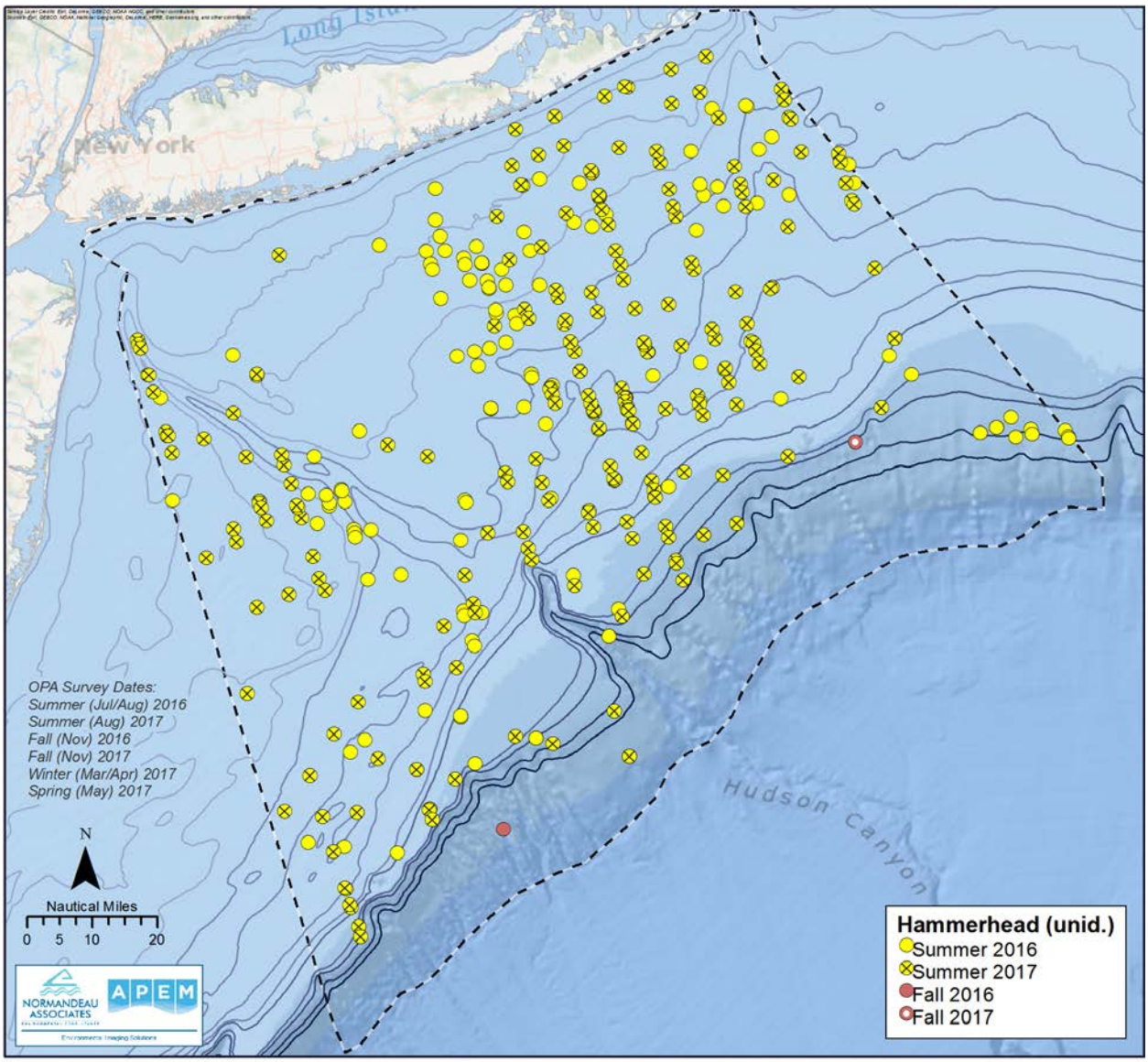


Figure 76. Distribution of unknown hammerhead sharks during the Summer 2016–Fall 2017 surveys.

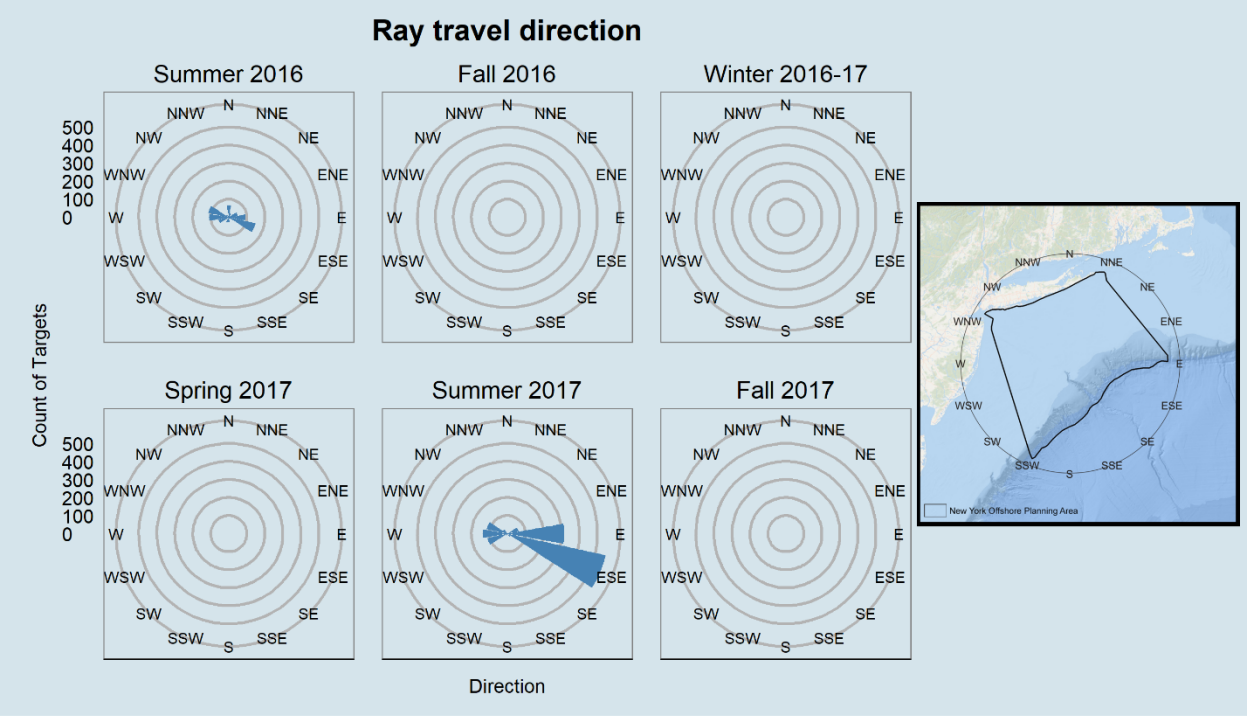


Figure 77. Direction of travel for rays observed during the Summer 2016 through Fall 2017 surveys.

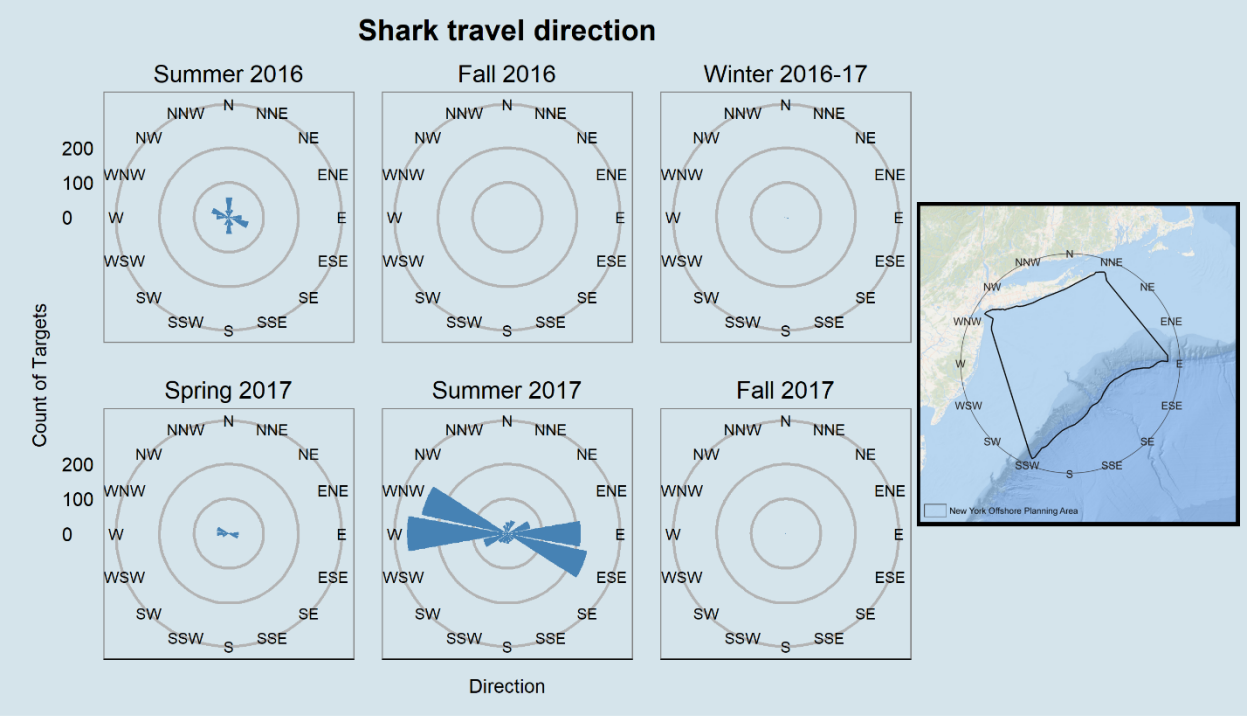


Figure 78. Direction of travel for sharks observed during the Summer 2016 through Fall 2017 surveys.

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 20). Across the OPA, 75% of the observations of listed species occurred during the Summer 2016 and Summer 2017 surveys with Spring being the next highest period for observations. These numbers are mainly driven by the most frequently observed species (identified to species): loggerhead turtle, which consisted of 33% of the total number of observations of listed species (Table 20). *Sterna* terns consisted of 26% 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 0.5% of observations (Table 20).

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.

Table 20. Corrected Number of ESA and State Listed Species found during the Summer 2016 through Spring 2017 surveys in the OPA

Subtype	Species	Corrected Abundance[1]						Total Abundance
		Summer 2016	Fall 2016	Winter 2016–2017	Spring 2017	Summer 2017	Fall 2017	
Sterna Tern	Roseate Tern	0	0	0	199	0	0	**199**
	Sterna Tern-species unknown	1,926	0	0	9,376	182	14	**11,497**
Whale	North Atlantic Right Whale	0	0	44	27	0	0	**71**
	Blue Whale	0	11	11	0	0	0	**22**
	Fin Whale	137	56	55	13	56	55	**373**
	Sei Whale	0	0	0	0	14	0	**14**
	Humpback Whale	0	11	22	66	0	41	**141**
	Sperm Whale	0	22	0	0	42	0	**64**
Turtle	Leatherback Turtle	123	315	0	0	70	28	**535**
	Loggerhead Turtle	5,301	67	11	66	9,064	69	**14,579**
	Loggerhead/Kemp's Turtle	137	0	0	27	279	14	**456**
	Green Turtle	14	0	0	0	0	0	**14**
	Kemp's Ridley Turtle	205	11	0	13	335	69	**634**
	Turtle-species unknown	1,872	45	0	27	182	0	**2,125**
Shark	Whale Shark	14	0	0	0	140	0	**153**
	Scalloped Hammerhead	246	0	0	0	2,975	28	**3,248**
	Hammerhead (unid.)	1,680	11	0	0	3,240	14	**4,946**
Ray	Giant Manta Ray	55	0	0	0	28	0	**83**
Tuna	Atlantic bluefin tuna	2,186	0	0	13	2,179	0	**4,378**
	Season Total	13,893	551	144	9,827	18,785	331	**43,532**

[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.

Appendix A. Common and Scientific Names for Taxa Identified in the Summer 2016 through Fall 2017 Surveys

Common Name	Scientific Name
BIRDS	**Aves**
Geese	
Canada Goose	Branta canadensis
Ducks	
Gadwall	Mareca strepera
Lesser Scaup	Aythya affinis
King Eider	Somateria spectabilis
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
Leach's Storm-Petrel	Oceanodroma leucorhoa
Band-rumped Storm-Petrel	Oceanodroma castro

Common Name	Scientific Name
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	
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
Laughing Gull	Leucophaeus atricilla
Ring-billed Gull	Larus delawarensis
Herring Gull	Larus argentatus
Iceland Gull	Larus glaucoides
Lesser Black-backed Gull	Larus fuscus

Common Name	Scientific Name
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
Rough-toothed dolphin	Steno bredanensis
Atlantic Spotted Dolphin	Stenella frontalis
Striped Dolphin	Stenella coeruleoalba
Bottlenose Dolphin	Tursiops truncatus
Harbor Porpoise	Phocoena phocoena

Common Name	Scientific Name
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 2016 Summer through Fall 2017 Surveys

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

New York Offshore Planning Area

Name	Number in Species Group	Summer 2016	Fall 2016	Winter 2016–2017	Spring 2017	Summer 2017	Fall 2017
Goose	**3**	**0**	**0**	**1**	**0**	**0**	**2**
Canada Goose		0	0	1	0	0	2
Duck	**3,418**	**0**	**1,680**	**1,390**	**66**	**0**	**282**
Gadwall		0	3	0	0	0	0
Lesser Scaup		0	0	7	2	0	0
King Eider		0	0	1	0	0	0
Common Eider		0	0	0	0	0	4
Surf Scoter		0	37	235	0	0	39
White-winged Scoter		0	19	348	1	0	1
Black Scoter		0	1,603	536	3	0	127
Scoter unid.		0	0	50	50	0	94
Long-tailed Duck		0	3	49	2	0	14
Bufflehead		0	5	108	0	0	0
Common Goldeneye		0	0	1	0	0	0
Red-breasted Merganser		0	0	5	7	0	2
Duck-species unknown		0	10	50	1	0	1
Loon	**1,421**	**3**	**272**	**586**	**240**	**5**	**315**
Red-throated Loon		0	222	241	24	0	161
Common Loon		3	48	342	213	3	140
Loon-species unknown		0	2	3	3	2	14
Grebe	**8**	**0**	**0**	**8**	**0**	**0**	**0**
Horned Grebe		0	0	8	0	0	0
Fulmar	**162**	**0**	**3**	**49**	**50**	**0**	**60**
Northern Fulmar		0	3	49	50	0	60
Petrel	**26**	**18**	**1**	**2**	**2**	**3**	**0**
Trindade Petrel		0	0	0	1	0	0
Black-capped Petrel		13	1	1	0	3	0
Petrel-species unknown		5	0	1	1	0	0
Shearwater	**1,644**	**732**	**164**	**4**	**125**	**576**	**43**
Cory's Shearwater		510	146	0	9	90	2
Great Shearwater		70	8	0	2	337	12
Sooty Shearwater		2	0	2	81	1	0

Name	Number in Species Group	Summer 2016	Fall 2016	Winter 2016–2017	Spring 2017	Summer 2017	Fall 2017
Manx Shearwater		0	0	0	0	0	16
Audubon's Shearwater		8	0	0	0	0	0
Shearwater-species unknown-Large		129	10	2	15	108	8
Shearwater-species unknown-Small		13	0	0	18	40	5
Storm-petrel	**3,148**	**789**	**1**	**71**	**96**	**2,080**	**111**
Wilson's Storm-Petrel		789	1	0	90	339	0
Leach's Storm-Petrel		0	0	3	1	2	2
Band-rumped Storm-Petrel		0	0	0	1	0	0
Storm-petrel-species unknown		0	0	68	4	1,739	109
Gannet	**8,021**	**0**	**2,939**	**4,114**	**207**	**4**	**757**
Northern Gannet		0	2,939	4,114	207	4	757
Cormorant	**202**	**6**	**67**	**3**	**16**	**0**	**110**
Double-crested Cormorant		6	67	0	16	0	0
Cormorant-species unknown		0	0	3	0	0	110
Pelican	**1**	**0**	**1**	**0**	**0**	**0**	**0**
Brown Pelican		0	1	0	0	0	0
Ardeidae	**1**	**0**	**0**	**0**	**0**	**0**	**1**
Great Blue Heron		0	0	0	0	0	1
Raptor	**2**	**2**	**0**	**0**	**0**	**0**	**0**
Osprey		1	0	0	0	0	0
Bald Eagle		1	0	0	0	0	0
Shorebird	**2,076**	**7**	**46**	**1**	**0**	**29**	**1,993**
Black-bellied Plover		6	0	0	0	0	0
Semipalmated Plover		0	0	0	0	3	0
Ruddy Turnstone		0	0	0	0	0	133
Sanderling		0	0	0	0	0	117
Dunlin		0	0	0	0	0	1,703
Shorebird-species unknown		1	46	1	0	26	40
Phalarope	**5,488**	**0**	**1,551**	**233**	**549**	**138**	**3,017**
Red-necked Phalarope		0	69	0	17	1	0
Red Phalarope		0	0	0	1	0	1,774
Red/Red-necked Phalarope		0	1,482	233	531	121	1,238

Name	Number in Species Group	Summer 2016	Fall 2016	Winter 2016–2017	Spring 2017	Summer 2017	Fall 2017
Phalarope-species unknown		0	0	0	0	16	5
Skua	**6**	**0**	**1**	**0**	**4**	**0**	**1**
South Polar Skua		0	0	0	1	0	0
Pomarine Jaeger		0	1	0	1	0	0
Parasitic Jaeger		0	0	0	2	0	1
Auk	**9,250**	**0**	**79**	**8,952**	**106**	**4**	**109**
Dovekie		0	3	1,793	0	0	0
Common Murre		0	11	0	0	0	0
Common/Thick-billed Murre		0	0	3	0	0	0
Razorbill		0	24	2,088	4	0	2
Murre/Razorbill		0	0	2,063	30	2	96
Black Guillemot		0	1	8	0	0	0
Atlantic Puffin		0	0	2,387	45	0	8
Auk-species unknown		0	40	610	27	2	3
Gull	**14,581**	**114**	**5,438**	**5,505**	**889**	**109**	**2,526**
Black-legged Kittiwake		0	230	9	0	0	371
Bonaparte's Gull		0	1,081	615	0	0	711
Little Gull		0	4	6	0	0	0
Laughing Gull		14	778	0	35	13	79
Ring-billed Gull		8	91	220	1	2	96
Herring Gull		21	2,277	3,495	554	33	929
Iceland Gull		0	0	7	1	0	1
Lesser Black-backed Gull		0	9	23	11	2	15
Glaucous Gull		0	0	1	0	0	0
Great Black-backed Gull		52	370	964	257	25	186
Gull-species unknown - Large		4	16	23	1	3	38
Gull-species unknown - Small		11	581	136	29	31	96
Gull-species unknown		4	1	6	0	0	4
Tern	**103**	**48**	**2**	**0**	**51**	**2**	**0**
Least Tern		33	0	0	49	0	0
Black Tern		0	0	0	2	1	0
Royal Tern		8	2	0	0	0	0
Tern-species unknown		7	0	0	0	1	0

Name	Number in Species Group	Summer 2016	Fall 2016	Winter 2016–2017	Spring 2017	Summer 2017	Fall 2017
Sterna Tern	**1,424**	**141**	**0**	**0**	**1,267**	**13**	**3**
Roseate Tern		0	0	0	15	0	0
Common Tern		0	0	0	546	0	0
Forster's Tern		0	0	0	0	0	2
Sterna Tern-species unknown		141	0	0	706	13	1
Nightjar	**1**	**0**	**0**	**0**	**0**	**1**	**0**
Common Nighthawk		0	0	0	0	1	0
Passerine	**7**	**0**	**0**	**0**	**0**	**0**	**7**
Snow Bunting		0	0	0	0	0	7

[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**

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	
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**
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**

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	
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**
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**

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	
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**
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**

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	
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**
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**

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	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**
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**

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	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**
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**

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	
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**
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**

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	
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**
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**

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	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**

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 Six Surveys

Species	N	Altitude (m)			STD	ERROR
		MIN	MAX	MEAN		
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	.	.
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
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

Species	N	Altitude (m)			STD	ERROR
		MIN	MAX	MEAN		
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
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

Species	N	Altitude (m)			STD	ERROR
		MIN	MAX	MEAN		
Great Black-backed Gull	257	0.6	252.0	32.2	41.74	18.65
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
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
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

Species	N	Altitude (m)			STD	ERROR
		MIN	MAX	MEAN		
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 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
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

Appendix E. Turtle Species Identified in the Summer 2016 through Fall 2017 Surveys

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

New York Offshore Planning Area

Species	Number in Taxonomic Group	Summer 2016	Fall 2016	Winter 2016–2017	Spring 2017	Summer 2017	Fall 2017
Leatherback Turtle*	44	9	28	0	0	5	2
Loggerhead Turtle*	1,054	388	6	1	5	649	5
Loggerhead/Kemp's Turtle*	33	10	0	0	2	20	1
Green Turtle*	1	1	0	0	0	0	0
Kemp's Ridley Turtle*	46	15	1	0	1	24	5
Species unknown*	156	137	4	0	2	13	0
Total	**1,334**	**560**	**39**	**1**	**10**	**711**	**13**

*Listed under the Endangered Species Act

Species	Abundance												Total Abundance
	Summer 2016		Fall 2016		Winter 2016–2017		Spring 2017		Summer 2017		Fall 2017		
	Sig Sub**	Total	Sig Sub	Total	Sig Sub	Total	Sig Sub	Total	Sig Sub	Total	Sig Sub	Total	
Leatherback Turtle*	9	9	2	28	0	0	0	0	1	5	0	2	**44**
Loggerhead Turtle*	225	388	1	6	0	1	0	5	96	649	1	5	**1,054**
Loggerhead/Kemp's Turtle*	6	10	0	0	0	0	0	2	3	20	1	1	**33**
Green Turtle*	1	1	0	0	0	0	0	0	0	0	0	0	**1**
Kemp's Ridley Turtle*	11	15	0	1	0	0	0	1	1	24	2	5	**46**
Species unknown*	121	137	1	4	0	0	0	2	7	13	0	0	**156**
Season Total	**373**	**560**	**4**	**39**	**0**	**1**	**0**	**10**	**108**	**711**	**4**	**13**	**1,334**

*Listed under the Endangered Species Act

**Significantly submerged

Appendix F. Marine Mammals Identified in the Summer 2016 through Fall 2017 Surveys

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

New York Offshore Planning Area

Species	Number in Taxonomic Group	Summer 2016	Fall 2016	Winter 2016–2017	Spring 2017	Summer 2017	Fall 2017
Seal	**52**	**0**	**13**	**35**	**1**	**2**	**1**
Gray Seal	0	0	1	3	0	0	0
Harp Seal	0	0	0	0	1	0	0
Harbor Seal	0	0	0	1	0	0	0
Seal species unknown	0	0	12	31	0	2	1
Whale	**102**	**20**	**13**	**25**	**17**	**11**	**16**
North Atlantic Right Whale	0	0	0	4	2	0	0
Blue Whale*[a]	0	0	1	1	0	0	0
Common Minke Whale	0	1	0	7	5	0	1
Fin Whale*[a]	0	10	5	5	1	4	4
Sei Whale	0	0	0	0	0	1	0
Humpback Whale[a]	0	0	1	2	5	0	3
Dwarf Sperm Whale	0	0	0	0	0	2	0
Pygmy Sperm Whale	0	0	0	0	0	0	2
Sperm Whale*	0	0	2	0	0	3	0
Beaked Whale (unid.)	0	8	4	1	1	0	0
Whale species unknown	0	1	0	5	3	1	6
Dolphin	**7,683**	**904**	**1,092**	**1,516**	**1,558**	**1,392**	**1,221**
Atlantic Spotted Dolphin	0	0	54	0	3	0	0
Atlantic White-sided Dolphin	0	0	16	7	0	0	0
Bottlenose Dolphin	0	96	59	132	173	175	68
Common Dolphin	0	56	223	566	852	853	563
Common/White-sided Dolphin	0	0	0	16	4	0	0
Harbor Porpoise	0	0	4	192	17	0	0
Risso's Dolphin	0	166	124	49	131	140	37
Rough-toothed Dolphin	0	0	0	1	0	15	0
Short-finned Pilot Whale	0	0	0	0	0	24	0
Pilot Whale (unid.)	0	102	9	0	29	52	20
Striped Dolphin	0	0	75	5	0	6	0
Dolphin species unknown	0	484	528	548	349	127	533
Mammal unknown	**190**	**0**	**0**	**33**	**111**	**41**	**5**
Total	**8,027**	**924**	**1,118**	**1,609**	**1,687**	**1,446**	**1,243**

* Listed under the Endangered Species Act

[a] Listed as threatened or endangered by NYSDEC

Species	Abundance												Total Abundance
	Summer 2016		Fall 2016		Winter 2016–2017		Spring 2017		Summer 2017		Fall 2017		
	Sig Sub**	Total	Sig Sub	Total	Sig Sub	Total	Sig Sub	Total	Sig Sub	Total	Sig Sub	Total	
Seal													
Gray Seal	0	0	0	1	0	3	0	0	0	0	0	0	**4**
Harp Seal	0	0	0	0	0	0	0	1	0	0	0	0	**1**
Harbor Seal	0	0	0	0	0	1	0	0	0	0	0	0	**1**
Seal-species unknown	0	0	4	12	10	31	0	0	1	2	0	1	**46**
Whale													
North Atlantic Right Whale	0	0	0	0	3	4	0	2	0	0	0	0	**6**
Blue Whale	0	0	1	1	0	1	0	0	0	0	0	0	**2**
Common Minke Whale	0	1	0	0	3	7	1	5	0	0	0	1	**14**
Fin Whale	2	10	1	5	3	5	1	1	0	4	3	4	**29**
Sei Whale	0	0	0	0	0	0	0	0	0	1	0	0	**1**
Humpback Whale	0	0	0	1	2	2	0	5	0	0	2	3	**11**
Dwarf Sperm Whale	0	0	0	0	0	0	0	0	0	2	0	0	**2**
Pygmy Sperm Whale	0	0	0	0	0	0	0	0	0	0	0	2	**2**
Sperm Whale	0	0	1	2	0	0	0	0	1	3	0	0	**5**
Beaked Whale (unid.)	2	8	1	4	1	1	1	1	0	0	0	0	**14**
Whale-species unknown	0	1	0	0	4	5	3	3	1	1	5	6	**16**
Dolphin													
Common Dolphin	13	56	75	223	381	566	557	852	552	853	440	563	**3,113**
Short-finned Pilot Whale	0	0	0	0	0	0	0	0	8	24	0	0	**24**
Pilot Whale (unid.)	78	102	0	9	0	0	21	29	22	52	12	20	**212**
Risso's Dolphin	0	166	0	124	25	49	88	131	64	140	22	37	**647**
Atlantic White-sided Dolphin	0	0	11	16	2	7	0	0	0	0	0	0	**23**
Rough-toothed dolphin	0	0	0	0	0	1	0	0	9	15	0	0	**16**
Atlantic Spotted Dolphin	0	0	37	54	0	0	2	3	0	0	0	0	**57**
Striped Dolphin	0	0	53	75	3	5	0	0	5	6	0	0	**86**
Bottlenose Dolphin	2	96	31	59	81	132	112	173	91	175	38	68	**703**
Common/White-sided Dolphin	0	0	0	0	2	16	0	4	0	0	0	0	**20**
Harbor Porpoise	0	0	2	4	111	192	15	17	0	0	0	0	**213**
Dolphin-species unknown	422	484	315	528	409	548	287	349	103	127	487	533	**2,569**
Unidentified Mammal													
Unid. Mammal-species unknown	0	0	0	0	25	33	90	111	33	41	4	5	**190**
Season Total	**519**	**924**	**532**	**1,118**	**1,065**	**1,609**	**1,178**	**1,687**	**890**	**1,446**	**1,013**	**1,243**	**8,027**

*Significantly submerged

Appendix G. Rays and Sharks Identified in the Summer 2016 through Fall 2017 Surveys

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

New York Offshore Planning Area

Name	Number in Taxonomic Group	Summer 2016	Fall 2016	Winter 2016–2017	Spring 2017	Summer 2017	Fall 2017
Rays	**15,733**	**8,103**	**4**	**0**	**0**	**7,624**	**2**
Bluntnose Stingray		1	0	0	0	0	0
Giant Manta Ray		4	0	0	0	2	0
Giant Devil Ray		155	0	0	0	18	1
Chilean Devil Ray		71	0	0	0	49	0
Bullnose Ray		0	0	0	0	87	0
Cownose/Bullnose Ray		3,464	1	0	0	1,979	0
Cownose Ray		3,275	0	0	0	4,229	0
Ray species unknown		1,133	3	0	0	1,260	1
Sharks	**2,248**	**643**	**4**	**26**	**180**	**1,382**	**13**
Whale Shark		1	0	0	0	10	0
Sand Tiger Shark		0	0	0	0	1	0
Thresher Shark		2	0	0	0	5	0
Basking Shark		1	0	14	99	133	1
Great White Shark		1	0	0	2	13	1
Shortfin Mako		1	0	0	0	4	0
Blue Shark		5	2	2	34	21	3
Bull Shark		0	0	0	0	0	0
Carcharhinidae (unid.)		132	0	0	3	320	2
Dusky Shark		1	0	0	0	2	0
Oceanic Whitetip Shark		1	0	0	0	0	0
Sandbar Shark		0	0	0	0	21	0
Tiger Shark		4	0	0	0	8	1
Great Hammerhead		8	0	0	0	1	0
Smooth Hammerhead		9	0	0	0	56	1
Scalloped Hammerhead*		18	0	0	0	213	2
Hammerhead (unid.)		123	1	0	0	232	1
Spurdog		0	0	2	0	0	0
Shark species unknown		336	1	8	42	342	1

*Listed under the Endangered Species Act

Species	Abundance												Total Abundance
	Summer 2016		Fall 2016		Winter 2016–2017		Spring 2017		Summer 2017		Fall 2017		
	Sig Sub**	Total	Sig Sub	Total	Sig Sub	Total	Sig Sub	Total	Sig Sub	Total	Sig Sub	Total	
Bluntnose Stingray	1	1	0	0	0	0	0	0	0	0	0	0	**1**
Giant Manta Ray	2	4	0	0	0	0	0	0	1	2	0	0	**6**
Giant Devil Ray	74	155	0	0	0	0	0	0	6	18	0	1	**174**
Chilean Devil Ray	10	71	0	0	0	0	0	0	19	49	0	0	**120**
Bullnose Ray	0	0	0	0	0	0	0	0	14	87	0	0	**87**
Cownose/Bullnose Ray	2,172	3,464	1	1	0	0	0	0	1,758	1,979	0	0	**5,444**
Cownose Ray	1,405	3,275	0	0	0	0	0	0	1,180	4,229	0	0	**7,504**
Ray-species unknown	714	1,133	0	3	0	0	0	0	1,251	1,260	1	1	**2,397**
Season Total	**4,378**	**8,103**	**1**	**4**	**0**	**0**	**0**	**0**	**4,229**	**7,624**	**1**	**2**	**15,733**

*Significantly submerged

Species	Abundance												Total Abundance
	Summer 2016		Fall 2016		Winter 2016–2017		Spring 2017		Summer 2017		Fall 2017		
	Sig Sub*	Total	Sig Sub	Total	Sig Sub	Total	Sig Sub	Total	Sig Sub	Total	Sig Sub	Total	
Whale Shark	0	1	0	0	0	0	0	0	4	10	0	0	**11**
Sand Tiger Shark	0	0	0	0	0	0	0	0	0	1	0	0	**1**
Thresher Shark	0	2	0	0	0	0	0	0	4	5	0	0	**7**
Basking Shark	0	1	0	0	8	14	68	99	125	133	0	1	**248**
Great White Shark	0	1	0	0	0	0	2	2	5	13	0	1	**17**
Shortfin Mako	0	1	0	0	0	0	0	0	0	4	0	0	**5**
Blue Shark	0	5	1	2	0	2	6	34	9	21	1	3	**67**
Carcharhinidae (unid.)	1	132	0	0	0	0	1	3	255	320	0	2	**457**
Dusky Shark	0	1	0	0	0	0	0	0	0	2	0	0	**3**
Oceanic Whitetip Shark	0	1	0	0	0	0	0	0	0	0	0	0	**1**
Sandbar Shark	0	0	0	0	0	0	0	0	2	21	0	0	**21**
Tiger Shark	0	4	0	0	0	0	0	0	0	8	0	1	**13**
Great Hammerhead	0	8	0	0	0	0	0	0	1	1	0	0	**9**
Smooth Hammerhead	0	9	0	0	0	0	0	0	11	56	0	1	**66**
Scalloped Hammerhead	0	18	0	0	0	0	0	0	70	213	0	2	**233**
Hammerhead (unid.)	0	123	1	1	0	0	0	0	174	232	0	1	**357**
Spurdog	0	0	0	0	0	2	0	0	0	0	0	0	**2**
Shark-species unknown	0	336	1	1	7	8	34	42	335	342	1	1	**730**
Season Total	**1**	**643**	**3**	**4**	**15**	**26**	**111**	**180**	**995**	**1,382**	**2**	**13**	**2,248**

*Significantly submerged