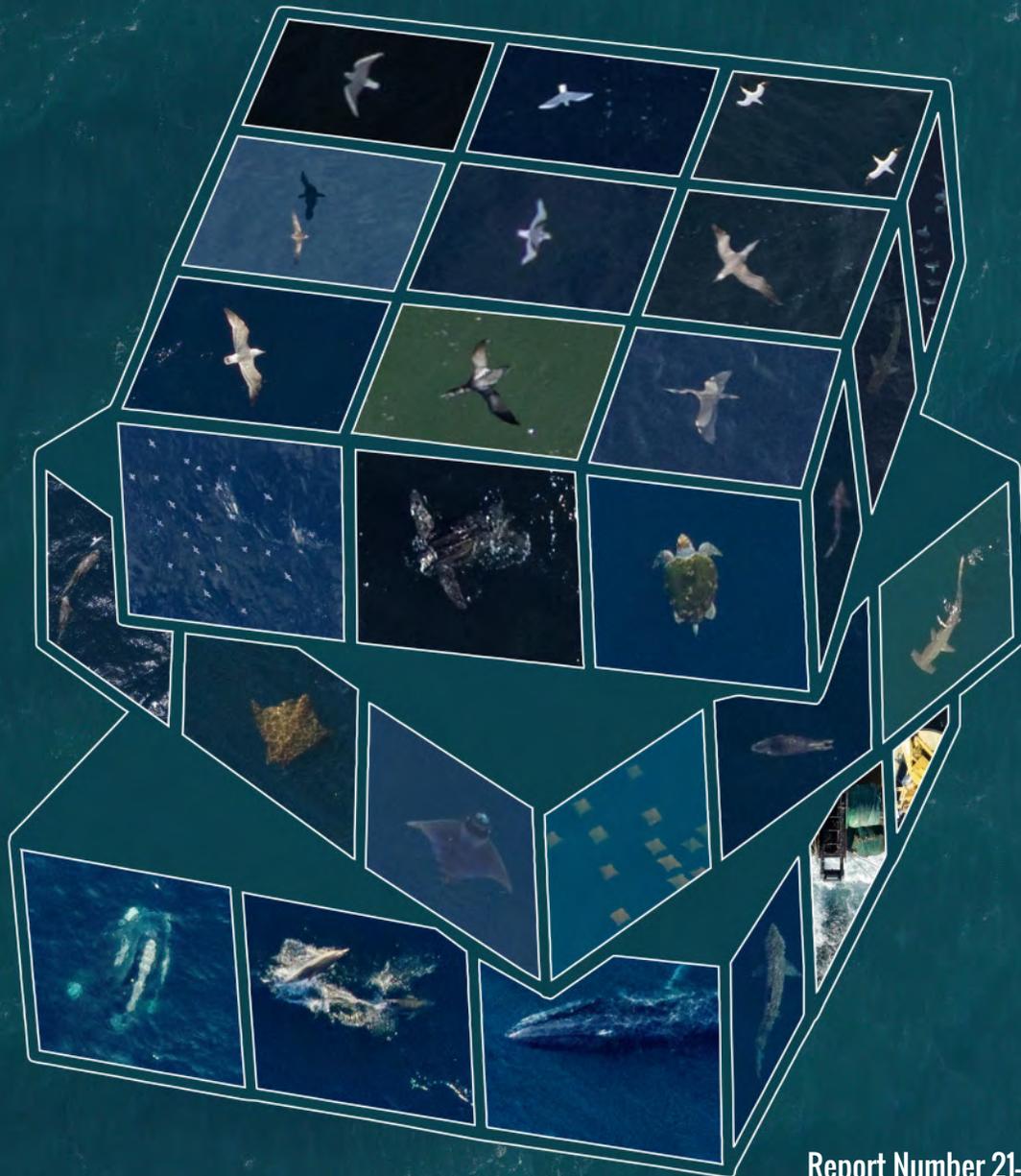


Digital Aerial Baseline Survey of Marine Wildlife in Support of Offshore Wind Energy:

Spatial and Temporal Marine Wildlife Distributions in the
New York Offshore Planning Area, Summer 2016–Spring 2019

Final Report | Volume 2: Results (Birds)



Report Number 21-07b | October 2021



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

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Final Report
Volume 2: Results (Birds)

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Abstract

NYSERDA tasked Normandeau Associates, Inc., and their teaming partner APEM Ltd. to collect aerial digital imagery over the New York Offshore Planning Area during 12 surveys spaced seasonally over three years between 2016 and 2019. Imagery was captured at a resolution of 1.5 cm at the sea surface and provides information on spatial and temporal abundances of birds, marine mammals, turtles, rays, sharks, large bony fishes, and fish shoals. Spatial patterns were analyzed within distance from shore and water depth zones and reference the proposed Call Areas within the surveyed planning area identified by BOEM at the time of writing. Seasonal density comparisons highlight the differences among zones for each species group. Except for turtles, densities were generally lower in the zone containing the identified BOEM Call Areas. Full Summary and Final Reports can also be found on remote.normandeau.com https://remote.normandeau.com/aer_docs.php?pj=6

Keywords

Marine mammals; Birds; Turtles; Rays; Sharks; Aerial Digital Surveys; NYSERDA; Normandeau; APEM; Call Area; Density; Distribution; Abundance; Marine Wildlife; Offshore Wind

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All aerial images were collected by APEM Ltd., and flight height calculation methodology information was provided by APEM Ltd.

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Acronyms and Abbreviations

BOEM	Bureau of Ocean Energy Management
ESA	Endangered Species Act
km ²	kilometers squared
m	meters
NYSERDA	New York State Energy Research and Development Authority
OPA	offshore planning area
QC	quality control
RSZ	rotor swept zone

1 Introduction

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 km² (12,754.06 mi²) 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 were conducted on a quarterly basis and timed to coincide with periods of abundance of bird and marine species that could be vulnerable to impacts from offshore wind activities.

Each survey collected images covering at least 7% of the OPA. All survey data have been summarized and are available at https://remote.normandeau.com/nys_aer_overview.php

This report summarizes the results of the 12 surveys for all bird species. It is volume 2 of five volumes:

- Volume 1: Methods, General Results, Limitations, and Discussion
- Volume 2: Results (Birds)
- Volume 3: Results (Turtles)
- Volume 4: Results (Marine Mammals)
- Volume 5: Results (Sharks and Rays)

2 Results (Birds)

There were 76 species of bird identified in imagery during surveys of the OPA (Appendix A). Over all 12 surveys, 140,372 individuals were recorded with most encounters in the Fall 2018 survey (Appendix B). Example images from each survey are in Appendix C.

2.1 Species Identification

All birds were classified to a species group at a minimum (Appendix B). Bird species level identifications varied by group depending on size and coloration. The largest and most distinct bird species found naturally had higher identification rates, and this included northern gannet with 100% of these identified to species (n=13,719), Ardeidae (great blue heron [n=3]; snowy egret [n=2]), northern fulmar (n=1,151), Canada goose (n=3), horned grebes (n=17), brown pelican (n=1), brown booby (n=1), swans (tundra swan; n=12), raptors (bald eagle [n=1]; osprey [n=5]), and nightjar (common nighthawk; n=1) (Table 1). Seven passerines were identified to species (snow bunting), which were the only passerines recorded in the 12 surveys. These small birds have a very distinctive wing pattern that enabled identification. Of the remaining species, loons had a 98% identification success (n=3,979), gulls 94% (n=39,882), terns (not *Sterna*) 91% (n=150), petrels 88% (n=52), sea ducks not including scoters 78% (n=343), skuas 76% (n=28), and shearwaters 67% (n=1,770).

Other species groups with multiple morphologically similar species expected in the project area had lower identification rates. Although 95% of auks were placed into species or species blends of murre/razorbill or common/thick-billed murre, only 52% were identified to species (n=9,663). Scoters have multiple species in the group where females are very difficult to distinguish; 54% of scoters were identified to species (n=9,248). Two species of morphologically similar species of phalaropes are found in the project area. These are red and red-necked phalaropes, and 66% of these small birds were ascribed to species (n=12,925). The *Sterna* tern group also contains difficult-to-distinguish species with 22% ascribed to species (n=757). Storm-petrels achieved a 16% identification success (n=1,230). Shorebird identification is always challenging with multiple small species having similar morphological traits; 24% of shorebirds were ascribed to species (n=1,988). Although a large-species group, the cormorant group has two morphologically similar species present in the area at certain times of the year; double-crested cormorant and great cormorant, and 14% of cormorants were identified to species (n=89) (Table 1; Appendix B).

Table 1. Species Identification Success Rates for Birds for All Surveys

Name	Number in Species Group	Number Identified to Species	Number of Species Unknown or Species Group	Percent ID Success
Goose	9	9	0	100
Swan	12	12	0	100
Duck (excluding Scoters)	437	343	94	78
Duck (Scoters)	17,233	9,248	7,985	54
Loon	4,072	3,979	93	98
Grebe	19	17	2	89
Fulmar	1,151	1,151	0	100
Petrel	59	52	7	88
Shearwater	2,648	1,770	878	67
Storm-petrel	7,586	1,230	6,356	16
Booby	1	1	0	100
Gannet	13,719	13,719	0	100
Cormorant	623	89	534	14
Pelican	1	1	0	100
Ardeidae	5	5	0	100
Raptor	6	6	0	100
Shorebird	8,243	1,988	6,255	24
Phalarope	19,691	12,925	6,766	66
Skua	37	28	9	76
Auk	18,740	9,663	9,077	52
Gull	42,503	39,882	2,621	94
Tern	164	150	14	91
<i>Sterna</i> Tern	3,392	757	2,635	22
Nightjar	1	1	0	100
Hirundine	12	0	12	0
Passerine	8	7	1	88

Accuracy assessments for birds showed an overall 99.6% accuracy at the species group level and an 84.8% accuracy at the species level. Among species groups, accuracy was also high with most species groups having >95% agreement between initial identification and quality control (QC) identification. The notable exception was terns where the QC had only 71% agreement with the initial identification (n=21); the QC observations not classified as terns were classified as *Sterna* terns, a similar species group (Table 2).

At the species level, identification accuracy was much more variable due to the increasing difficulty of identifying targets at lower taxonomic levels. Species with distinctive field marks and/or large body size (e.g., bald eagle, great black-backed gull) had high identification success. In contrast species that appear similar or occur as part of a species blend (e.g., phalaropes and terns) had lower identification accuracy (Table 3). For example, the full confusion matrix (based on the methods of Story and Congalton 1986) showed that of the 143 red-necked phalarope identifications made during the initial identification, only 37 individuals were identified by the QC observer; the remaining 106 birds were distributed among red phalarope (2), red/red-necked phalarope (103), and phalarope-species unknown (1). A similar finding occurs with common terns and similar species and species blends. Of the 558 targets initially identified as common terns, only 203 were QC'd as common terns; the remaining 355 individuals were QC'd as commic/common tern (3), Forester's Tern (3), *Sterna* tern unknown (346), sandwich tern (2), and tern-species unknown (1). The full matrix is not provided here due to size, but the main results are summarized here.

Table 2. Initial Identification Accuracy and QC ID Accuracy for Bird Species Groups

Species Group	Initial ID Success	QC ID Success	n (initial ID)	n (QC ID)
Goose	100.0%	100.0%	1	1
Swan	100.0%	100.0%	5	5
Duck	99.6%	99.6%	2,260	2,260
Loon	99.3%	99.9%	747	743
Grebe	100.0%	100.0%	2	2
Fulmar	99.0%	99.7%	294	292
Petrel	95.8%	100.0%	24	23
Shearwater	99.3%	99.1%	585	586
Storm-petrel	99.7%	99.8%	1492	1,490
Gannet	99.9%	99.9%	2,679	2,677
Cormorant	100.0%	100.0%	94	94
Raptor	100.0%	100.0%	2	2
Shorebird	97.2%	99.6%	1,044	1,019
Phalarope	99.8%	99.2%	4,602	4,632
Skua	100.0%	100.0%	6	6
Auk	99.4%	99.8%	4,079	4,063
Gull	99.8%	99.8%	8,848	8,850
Tern	100.0%	71.4%	15	21
<i>Sterna</i> Tern	99.6%	100.0%	2,118	2,111
Passerine	100.0%	100.0%	1	1

Table 3. Initial Identification Accuracy and QC ID Accuracy for Bird Species

Species	Initial ID Success	QC ID Success	n (initial ID)	n (QC ID)
Canada Goose	100.0%	100.0%	1	1
Tundra Swan	100.0%	100.0%	5	5
American Black Duck	100.0%	100.0%	1	1
Lesser Scaup	0.0%	NA ^a	2	0
Common Eider	100.0%	100.0%	1	1
Surf Scoter	82.6%	57.8%	144	206
White-winged Scoter	85.2%	87.8%	439	426
Black Scoter	87.6%	95.4%	500	459
Scoter unid.	85.8%	87.0%	1,116	1,101
Long-tailed Duck	100.0%	100.0%	18	18
Bufflehead	64.0%	94.1%	25	17
Common Merganser	100.0%	100.0%	1	1
Red-breasted Merganser	100.0%	100.0%	1	1
Duck-species unknown	58.3%	25.0%	12	28
Red-throated Loon	91.4%	98.4%	269	250
Common Loon	94.1%	99.5%	456	431
Loon-species unknown	86.4%	30.6%	22	62
Horned Grebe	50.0%	100.0%	2	1
Grebe-species unknown	NA ^a	0.0%	0	1
Northern Fulmar	99.0%	99.7%	294	292
Black-capped Petrel	100.0%	100.0%	23	23
Petrel-species unknown	0.0%	NA ^a	1	0
Cory's Shearwater	85.7%	94.7%	189	171
Great Shearwater	90.5%	93.1%	148	144
Sooty Shearwater	83.3%	100.0%	12	10
Manx Shearwater	61.5%	100.0%	13	8
Shearwater-species unknown-Large	78.8%	89.1%	208	184
Shearwater-species unknown-Small	53.3%	61.5%	15	13
Shearwater-species unknown	NA ^a	0.0%	0	56
Wilson's Storm-Petrel	77.6%	87.4%	214	190
White-faced Storm-Petrel	NA ^a	0.0%	0	2
Leach's Storm-Petrel	66.7%	66.7%	3	3
Band-rumped Storm-Petrel	NA ^a	0.0%	0	1
Storm-petrel-species unknown	97.5%	96.1%	1,275	1,294
Northern Gannet	99.9%	99.9%	2,679	2,677
Double-crested Cormorant	100.0%	35.5%	11	31
Cormorant-species unknown	75.9%	100.0%	83	63
Osprey	100.0%	100.0%	1	1

(continued)

Table 3. continued

Species	Initial ID Success	QC ID Success	n (initial ID)	n (QC ID)
Bald Eagle	100.0%	100.0%	1	1
Black-bellied Plover	100.0%	100.0%	4	4
Piping Plover	100.0%	100.0%	1	1
Ruddy Turnstone	100.0%	100.0%	42	42
Sanderling	96.4%	100.0%	28	27
Dunlin	100.0%	98.2%	376	383
Shorebird-species unknown	94.3%	99.5%	593	562
Red-necked Phalarope	25.9%	74.0%	143	50
Red Phalarope	43.1%	99.8%	3,048	1,316
Red/Red-necked Phalarope	98.6%	42.7%	1,407	3,251
Phalarope-species unknown	50.0%	13.3%	4	15
Great Skua	100.0%	100.0%	3	3
Pomarine Jaeger	100.0%	100.0%	1	1
Parasitic Jaeger	100.0%	100.0%	2	2
Dovekie	83.0%	94.2%	836	737
Common Murre	100.0%	66.7%	2	3
Common/Thick-billed Murre	75.0%	54.5%	24	33
Razorbill	53.8%	93.2%	487	281
Murre/Razorbill	82.1%	88.7%	1,589	1,471
Black Guillemot	50.0%	50.0%	2	2
Atlantic Puffin	61.9%	93.8%	931	614
Auk-species unknown	83.7%	18.9%	208	922
Black-legged Kittiwake	94.2%	97.7%	718	692
Bonaparte's Gull	91.5%	97.9%	1,086	1,015
Little Gull	50.0%	33.3%	2	3
Laughing Gull	93.6%	97.0%	312	301
Ring-billed Gull	88.4%	94.4%	172	161
Herring Gull	98.0%	98.9%	4,660	4,615
Iceland Gull	80.0%	100.0%	5	4
Lesser Black-backed Gull	85.7%	84.0%	49	50
Glaucous Gull	100.0%	33.3%	1	3
Great Black-backed Gull	97.4%	98.7%	1,316	1,299
Gull-species unknown - Large	62.6%	36.5%	99	170
Gull-species unknown - Small	88.5%	70.6%	408	511
Gull-species unknown	30.0%	23.1%	20	26
Least Tern	100.0%	83.3%	10	12
Black Tern	80.0%	100.0%	5	4
Tern-species unknown	NA ^a	0.0%	0	3
Roseate Tern	69.7%	92.0%	33	25

(continued)

Table 3. continued

Species	Initial ID Success	QC ID Success	n (initial ID)	n (QC ID)
Common Tern	36.4%	96.7%	558	210
Forster's Tern	91.7%	31.4%	12	35
Commic/Forster's Tern	92.0%	97.3%	501	474
<i>Sterna</i> Tern-species unknown	96.0%	71.2%	1,014	1,367
Snow Bunting	100.0%	100.0%	1	1
Harlequin Duck	NA ^a	0.0%	0	1
Sandwich Tern	NA ^a	0.0%	0	2

^a An NA value means that no individuals of that species were identified by the respective observer.

2.2 Species Composition

Species composition and percent relative occurrence was varied throughout the year and between years, highlighting not only the seasonal nature of avian activity, but also the interannual variation that can be expected. The Summer 2016 survey was dominated by storm-petrels (42%) and shearwaters (39%). Similarly, during the Summer 2017 survey storm-petrels accounted for 70% of the sample with shearwaters comprising 19% of the sample. However, during the Summer 2018 survey storm-petrels (44%) and shorebirds (30%) were dominant (Table 4). The Fall 2016 survey was dominated by gulls (44%) and gannets (24%) with ducks and phalaropes each representing 13% of the survey. The Fall 2017 survey was dominated by phalaropes (32%) and gulls (27%) with 21% of the samples being shorebirds. The Fall 2018 survey was dominated by gulls (47%) and phalaropes (27%) with auks being 7% of the sample (Table 4). Winter 2016–2017 was dominated by auks (43%), gulls (26%), and gannets (20%). The Winter 2017–2018 survey was dominated by shorebirds (36%) and gulls (28%), with 15% of the sample containing ducks (Table 4). The Winter 2018–2019 survey was dominated with gulls (38%) and ducks (33%) followed by auks (18%) (Table 4). Spring 2017 was dominated by *Sterna* terns (35%) and gulls (24%) with phalaropes representing 15%. *Sterna* terns represented <1% of the sample in Spring 2018, which was otherwise dominated by phalaropes (26%), ducks (24%), and gulls (21%). Auks represented 3% of the Spring 2017 survey and 17% during Spring 2018 (Table 4). The Spring 2019 survey was dominated by gulls (20%), storm-petrels (17%), phalaropes (15%), and *Sterna* terns (14%). Gannets (11%) and ducks (9%) were also found (Table 4).

Species relative occurrence varied among seasons. The shift in species seasonal representation was marked, with bird species group richness the lowest in the Summer 2016 survey (n=10), followed by Winter 2017–2018 and Winter 2018–2019 (n=11 when splitting loons and grebes), Summer 2017 (n=12), Summer 2018 (n=12), Winter 2016–2017 (n=12 when splitting loons and grebes), Spring 2017 (n=14), Fall 2016 (n=15), Fall 2017 (n=16), Fall 2018 (n=17), and Spring 2018 and Spring 2019 (n=17) with an overall species group richness of 25 for the 12 surveys (see Appendix A and Appendix B for a list of species in taxonomic groups and numbers by season). Phalaropes are not included in the group “shorebird,” nor are *Sterna* terns included with the overall group of terns.

Table 4. Percent Relative Occurrence by each Species Group and by Survey

Name	Percent Relative Occurrence												Species Total %
	Summer			Fall			Winter			Spring			
	2016	2017	2018	2016	2017	2018	2016–2017	2017–2018	2018–2019	2017	2018	2019	
Goose	0.00	0.00	0.00	0.00	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.01
Swan	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.11	0.00	0.00	0.00	0.00	0.01
Duck	0.00	0.00	0.00	13.72	3.02	5.46	6.64	14.82	33.17	1.80	24.05	8.88	12.59
Loon	0.16	0.17	0.12	2.22	3.37	3.22	2.80	1.69	2.35	6.54	2.80	5.85	2.90
Grebe	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.03	0.03	0.00	0.00	0.02	0.01
Fulmar	0.00	0.00	0.00	0.02	0.64	0.54	0.23	6.28	0.39	1.36	0.10	0.58	0.82
Petrel	0.97	0.10	0.12	0.01	0.00	0.00	0.01	0.00	0.00	0.05	0.02	0.18	0.04
Shearwater	39.35	19.43	10.24	1.34	0.46	1.81	0.02	0.00	0.01	3.41	0.06	0.37	1.89
Storm-petrel	42.42	70.18	43.58	0.01	1.19	0.02	0.34	0.00	0.00	2.62	1.04	17.36	5.40
Booby	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gannet	0.00	0.13	0.00	24.00	8.11	4.07	19.67	7.41	8.17	5.64	5.85	11.40	9.77
Cormorant	0.32	0.00	0.04	0.55	1.18	0.94	0.01	0.00	0.01	0.44	0.79	0.14	0.44
Pelican	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ardeidae	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00
Raptor	0.11	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Shorebird	0.38	0.98	30.10	0.38	21.35	2.52	0.00	35.89	0.00	0.00	0.16	0.15	5.87
Phalarope	0.00	4.66	0.16	12.67	32.31	27.39	1.11	0.01	0.02	14.97	26.26	14.84	14.03
Skua	0.00	0.00	0.02	0.01	0.01	0.04	0.00	0.02	0.03	0.11	0.02	0.08	0.03
Auk	0.00	0.13	0.00	0.65	1.17	6.85	42.79	5.79	18.08	2.89	17.37	5.72	13.35
Gull	6.13	3.68	10.00	44.41	27.05	47.05	26.32	27.96	37.74	24.24	21.24	20.16	30.28
Tern	2.58	0.07	1.03	0.02	0.00	0.00	0.00	0.00	0.00	1.39	0.00	0.09	0.12
<i>Sterna</i> Tern	7.58	0.44	4.52	0.00	0.03	0.00	0.00	0.00	0.00	34.54	0.22	14.15	2.42
Nightjar	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hirundine	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.01
Passerine	0.00	0.00	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
Totals	100	100	100	100	100	100	100	100	100	100	100	100	100

2.3 Species Hotspots

To account for spatial variation more effectively within the OPA, six discrete zones were considered (Figure 1):

- Zone 1: Coastal Zone
- Zone 2: Area for Consideration Zone
- Zone 3: Hudson Shelf Valley Zone
- Zone 4: Shelf Zone
- Zone 5: Shelf Slope Zone
- Zone 6: Shelf Break Zone

To quantify the number of species per km² surveyed (hereafter, species density), a 5×5-km grid was projected onto the OPA. The grid was then cut to each zone such that each grid cell was contained within one of the six zones (resulting in some variation in grid cell sizes along zone perimeters). For each season, the number of unique species was divided by the total effort within each grid cell to determine the number of species per km² of effort. Grid cells that had less than 1.0 km² of total survey effort to avoid extreme values were removed.

Species density was relatively consistent throughout Winter ($\bar{x} = 0.68 \pm 0.02$ species/km²), Fall ($\bar{x} = 0.64 \pm 0.01$ species/km²), and Spring ($\bar{x} = 0.60 \pm 0.01$ species/km²) and then decreased during the Summer ($\bar{x} = 0.37 \pm 0.01$ species/km²) (Figure 2, Figure 3). Across all seasons Zone 1 was consistently more speciose relative to the mean species density across the entire OPA (Figure 2, Figure 3). In the Fall, Zone 3 had the greatest species density throughout the OPA ($\bar{x} = 1.14 \pm 0.21$ species/km²) (Figure 2). Zone 5 had above average species density in both Winter ($\bar{x} = 0.90 \pm 0.06$ species/km²) and Spring ($\bar{x} = 0.83 \pm 0.05$ species/km²) (Figure 2, Figure 3).

Figure 1. Zones Defined in the Analyses and Location of the Call Areas

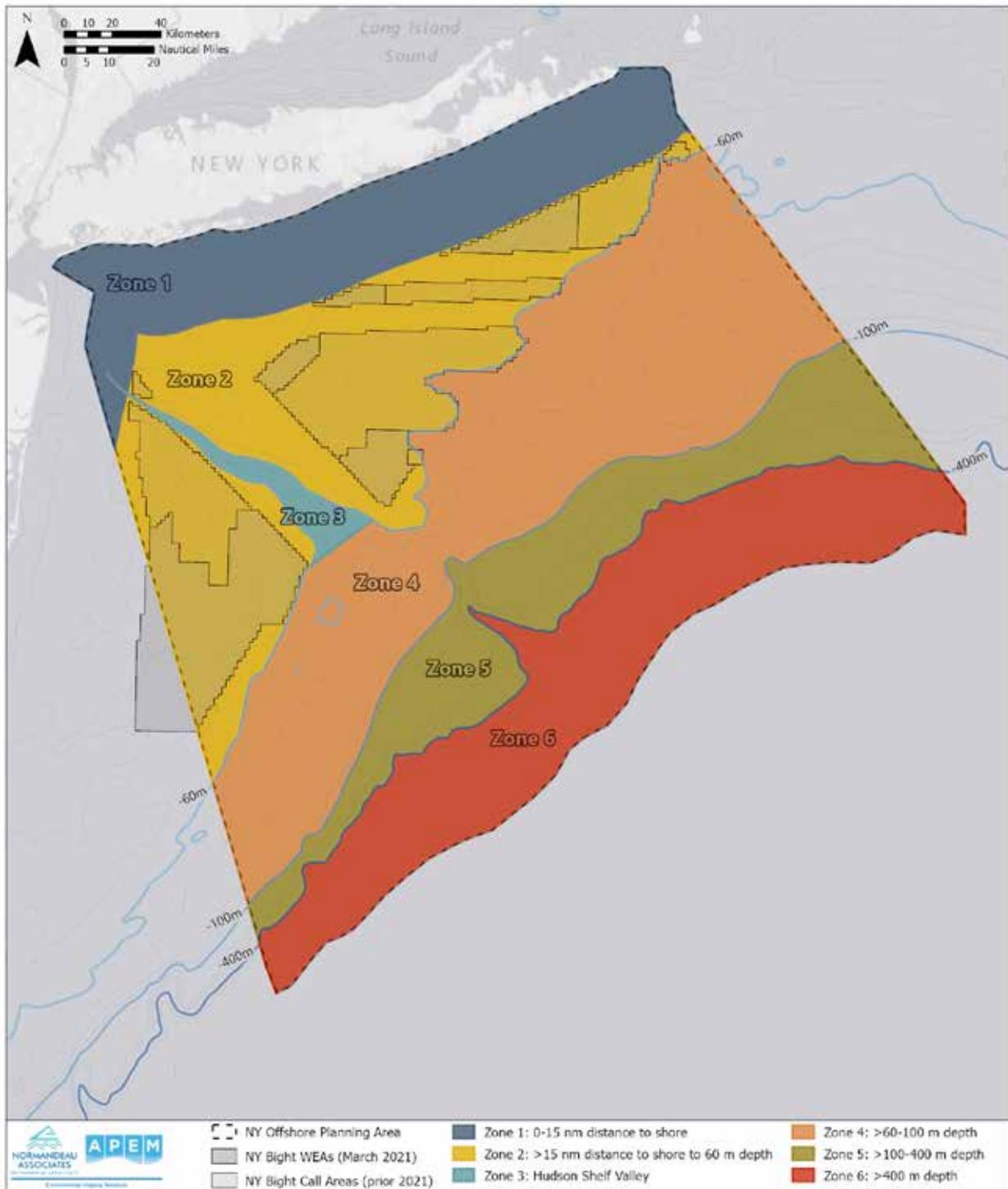


Figure 2. Avian Species Density (Species/km²) During Fall and Winter by Zone and Proximity to Call Areas

Inset figure shows estimated species densities (species/km²) within each zone.

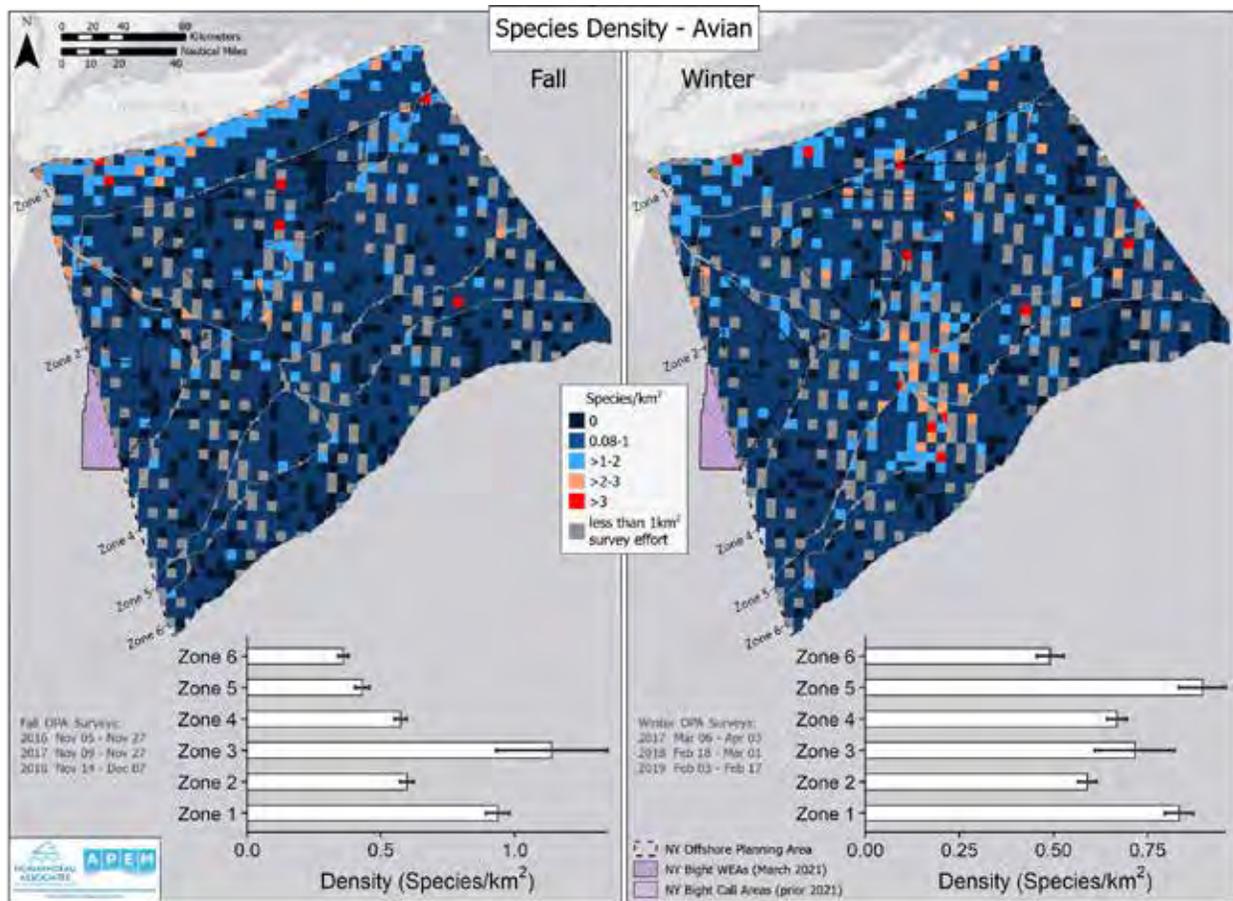
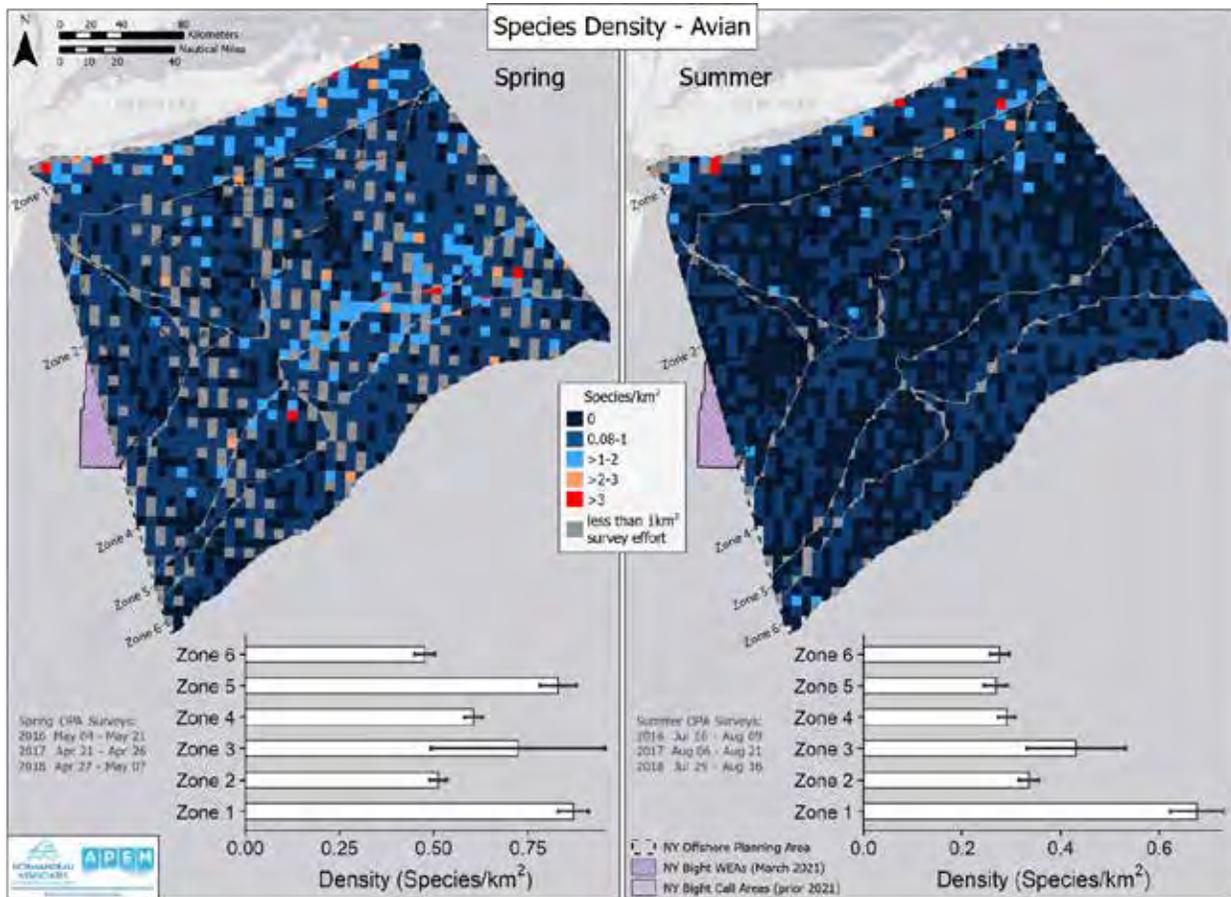


Figure 3. Avian Species Density (Species/km²) During Spring and Summer by Zone and Proximity to Call Areas

Inset figure shows estimated species densities (species/km²) within each zone.



2.4 Species Density by Survey

Within each species group, seasonal density by species varied across the year. Across all surveys, gulls were the most frequently encountered group (12.76 per km²) and they were the second most diverse group with 10 species identified. Numbers of gulls were highest during Fall and Winter in general, with more individuals encountered in Fall 2018 (3.64 per km²) and Winter 2018–2019 (1.81 per km²) than during other Fall and Winter surveys. The Spring 2018 survey also recorded high numbers of gulls (1.46 per km²). Despite this difference in densities, diversity remained similar with nine gull species found in Fall and Winter surveys and 10 gull species found in the Spring surveys. Diversity was lowest in the Summer surveys with five species recorded (Table 5).

Summer 2016 and Summer 2017 gull numbers were very similar (0.036 and 0.035 per km², respectively) with comparatively few gull encounters and low diversity recording only five species. The Summer 2018 survey encountered 4.34 times more gulls (0.15 per km²) than the previous two Summer surveys with five species recorded.

The Spring 2017, Spring 2018, and Spring 2019 gull densities (0.27, 1.46, and 0.77 per km²) and diversity (n=6, n=10, and n=8) differed from each other. The Spring 2017 survey diversity was similar to the Summer surveys, recording only six species. The Spring 2018 survey densities were similar to the Fall 2016 and Winter 2016–2017 surveys, and diversity was similar to Fall 2018 and Winter 2016–2017 with 10 species recorded.

Across all surveys, herring gulls (6.37 per km²) and great-black-backed gulls (1.90 per km²) were abundant; ring-billed gulls were present but in lower numbers (0.38 per km²). For all but the Summer 2016 and 2018 surveys, herring gulls were more abundant than great black-backed gulls. Black-legged kittiwake and Bonaparte's gull were present in the Fall and Winter surveys and in the Spring 2018 and Spring 2019 surveys. Laughing gulls were present in all surveys except for the Winter, and lesser black-backed gulls were present in all but the Summer 2016 survey. The remaining species of little gull, Iceland gull, and glaucous gull were rarely encountered (Appendix B, Table 5, Table 6).

After gulls, phalaropes were the next most frequently encountered species group (6.11 per km²) with two species recorded. For phalaropes, the numbers were highest during the Fall 2018 and Spring 2018 surveys (2.12 and 1.81 per km²). The Fall 2018 values were more than double the values for Fall 2017 (0.95 per km²) and 5 times higher than those for Fall 2016 (0.40 per km²). The Spring 2018 values were over 10 times higher than those recorded in the Spring 2017 survey (0.12 per km²) and three times higher than Spring 2019 (0.57 per km²). Few phalaropes were recorded in the Summer and Winter surveys (none in the Summer 2016 survey; Appendix B, Table 5, Table 6).

Auks were the next most frequently encountered species group (5.37 per km²). Five species of auks were identified in images. Densities in this species group showed high variability among years. When looking at numbers (Table 5), the numbers of auks in the Winter 2017–2018 survey represented less than 10% of those recorded in the Winter 2016–2017 survey, and the auks recorded in the Spring 2017 survey represented less than 3% of those recorded in the Spring 2018 survey. Numbers in the Summer and Fall surveys for all years except Fall 2018 remained low (Appendix B, Table 5, Table 6).

Ducks, including scoters, were encountered in high density in the Fall 2016 and Fall 2018 surveys, all Winter surveys, and the Spring 2018 and Spring 2019 surveys. There were differences among Winter surveys with Winter 2018–2019 (1.59 per km²) having 3 times more than Winter 2017–2018 (0.53 per km²) and 4.5 times more than the Winter 2016–2017 survey (0.35 per km²). Fall 2016 and Fall 2018 were similar in density (0.43 and 0.42 per km², respectively), both over five times higher than Fall 2017 (0.09 per km²). Highest numbers were found in the Spring 2018 survey (1.65 per km²) when nearly 70% more individuals were recorded. The Spring 2019 survey recorded 0.34 individuals per km² and very few were found in the Spring 2017 survey (0.02 per km²). No individuals were found in the Summer surveys. Overall, 14 species were identified. Most individuals were one of the three scoter species (surf scoter, white-winged scoter, and black scoter). Diversity for the Fall 2018 survey (nine species) was greater than the Fall 2016 and Fall 2017 surveys (both n=6). Although the Winter 2017–2018 survey recorded more individuals than Winter 2016–2018, the diversity was reversed with Winter 2016–2017 having nine species and Winter 2017–2018 having just five species. Although Spring 2018 had the highest number of individuals recorded among all surveys, diversity for this survey was low with just three species, which was similar to Spring 2019. Rare species recorded were gadwall (recorded only in the Fall 2016 survey), king eider, and common goldeneye, which were only recorded in the Winter 2016–2017 survey, and common eider only recorded in the Fall 2017 and Winter 2018–2019 surveys. Other species encountered, although in low numbers, included long-tailed duck, bufflehead, red-breasted merganser, and lesser scaup (Appendix B, Table 5, Table 6).

Gannets occurred in high numbers in the Fall and Winter surveys and in the Spring 2018 and Spring 2019 surveys. There were large differences among years with Fall 2016 recording three times more than Fall 2017 and over twice as many as Fall 2018. Similarly, the Winter 2016–2017 survey recorded four times as many than the Winter 2017–2018 survey and nearly three times more than Winter 2018–2019. There was a dramatic difference between densities for gannets in the Spring 2017 and the Spring 2018 and Spring 2019 surveys with a six-fold increase in encounter rates in the Spring 2018 and Spring 2019 surveys compared to the Spring 2017 survey (Appendix B, Table 5, Table 6.).

The Fall 2017 survey saw a change in the shoreline in part of the survey area with the development of a more pronounced sand bar, which persisted throughout the remaining surveys. This led to an increase in shorebird encounters. Most shorebirds were encountered in the Fall 2017 (0.63 per km²), Winter 2017–2018 (1.28 per km²), and Summer 2018 (0.47 per km²) surveys, and, although most

shorebirds could not be identified, some imagery through the survey period allowed us to identify American oystercatcher, black-bellied plover, semipalmated plover, ruddy turnstone, sanderling, dunlin, and piping plover (Spring 2018). Phalaropes are not included in this section, as phalaropes are pelagic and truly use the ocean space being able to both forage and rest at sea (Appendix B, Table 5, Table 6).

Storm-petrels were encountered mainly in the Summer surveys when 66% were recorded. The Summer 2017 (0.66 per km²) and Summer 2018 (0.67 per km²) surveys recorded nearly three times that of the Summer 2016 survey (0.25 per km²). There was also a surge in Spring 2019 when another 28% (0.66 per km²) were recorded. Many were difficult to identify to species, but Wilson's, white-faced, Leach's, and band-rumped (Summer 2017) storm-petrels were identified in the imagery (Appendix B, Table 5, Table 6).

Loons were present in all surveys but were rarely encountered in the Summer surveys (<1% of the total). Interannual variation was still evident, with higher numbers in the Winter 2016–2017 (0.15 per km²) and Winter 2018–2019 (0.11 per km²) than the Winter 2017–2018 (0.06 per km²); more in the Spring 2019 (0.22 per km²) and Spring 2018 surveys (0.19 per km²) than in the Spring 2017 (0.07 per km²) survey; and more in the Fall 2018 survey (0.25 per km²) than the Fall 2016 (0.07 per km²) and Fall 2017 (0.09 per km²) surveys. Two species were present in all but the Summer surveys where only common loons were reported. In all other surveys, both common and red-throated loons were present (Appendix B, Table 5, Table 6).

Shearwater abundance varied by season and by year. Most shearwaters were encountered during the Summer surveys with four species being reported: Cory's, great, sooty, and Audubon's. Manx shearwaters were encountered in the Fall 2017, Fall 2018, Winter 2018–2019, and Spring 2019 surveys. No shearwaters were encountered in the Winter 2017–2018 survey, and only low numbers were encountered in the Winter 2016–2017 survey and the Spring 2018 survey (Appendix B, Table 5, Table 6).

Spring proved to be the most likely season to encounter *Sterna* terns when 89% were recorded; although, they were also encountered during the Summer surveys in lower numbers. Three species were identified: roseate, common, and Forster's terns with Summer 2018 and Spring 2019 surveys being the most diverse. Forster's terns were recorded in the Fall 2017 and Summer 2018 surveys, and most terns were found in the Spring 2019 survey, including roseate terns (Appendix B, Table 5, Table 6).

Three other tern species occurred mainly in the Summer 2016, Summer 2018, and Spring 2017 surveys. These were least, black, and royal terns (Appendix B, Table 5, Table 6).

Northern fulmar also showed interseasonal and interannual variation in encounters, with most birds present in the Winter 2017–2018 survey (62%). Lower numbers were encountered in the Winter 2016–2017, Winter 2018–2019, and the Fall and Spring surveys; there were no encounters in the Summer surveys (Appendix B, Table 5, Table 6).

Other species group encounters were too infrequent to provide insight into interseasonal and interannual variations (Appendix B, Table 5, Table 6).

In the Summer 2016 survey, Wilson's storm-petrels (0.25 per km²) and Cory's shearwaters (0.16 per km²) were the most encountered species, which was similar to the Summer 2017 survey where Wilson's storm-petrels and great shearwater were the most encountered species. Great black-backed gull (0.07 per km²) and Cory's shearwaters (0.06 per km²) were the most encountered species during the Summer 2018 survey. The Fall 2017 and 2018 surveys were similar with most encounters being red phalarope and herring gulls; however, northern gannets and herring gulls were the most encountered species in the Fall 2016 survey. The Fall 2017 survey also encountered high numbers of dunlin, but these were on the shore on a developing sand bar and not in the true offshore. The Winter surveys also differed quite markedly. Although the surveys had high numbers of herring gulls and northern gannets, the Winter 2016–2017 survey encountered more auks (notably Atlantic puffin and razorbills) whereas the Winter 2017–2018 survey found fewer auks and more great black-backed gulls and fulmars.

Table 5. Bird Species Identified and the Density per km² and the Percent of Individuals within the OPA for Each Survey

Species Group	Density per km ²																								Species Total		
	Summer						Fall						Winter						Spring								
	2016		2017		2018		2016		2017		2018		2016-17		2017-18		2018-19		2017		2018		2019				
	Density	%	Density	%	Density	%	Density	%	Density	%	Density	%	Density	%	Density	%	Density	%	Density	%	Density	%	Density	%			
Goose	-	-	-	-	-	-	-	-	0.0006	22.22	0.0019	66.67	0.0003	11.11	-	-	-	-	-	-	-	-	-	-	0.0028		
Brant	-	-	-	-	-	-	-	-	-	-	0.0019	100.00	-	-	-	-	-	-	-	-	-	-	-	0.0019			
Canada Goose	-	-	-	-	-	-	-	-	0.0006	66.67	-	-	0.0003	33.33	-	-	-	-	-	-	-	-	-	0.0009			
Swan	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0038	100.00	-	-	-	-	-	-	-	-	0.0038			
Tundra Swan	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0038	100.00	-	-	-	-	-	-	-	-	0.0038			
Duck	-	-	-	-	-	-	0.4318	9.51	0.0890	1.60	0.4219	7.62	0.3516	7.87	0.5281	9.41	1.5918	28.34	0.0200	0.37	1.6532	29.25	0.3383	6.04	5.4259		
Gadwall	-	-	-	-	-	-	0.0008	100.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0008			
Mallard	-	-	-	-	-	-	-	-	-	-	0.0003	100.00	-	-	-	-	-	-	-	-	-	-	-	0.0003			
American Black Duck	-	-	-	-	-	-	-	-	-	-	0.0044	100.00	-	-	-	-	-	-	-	-	-	-	-	0.0044			
Lesser Scaup	-	-	-	-	-	-	-	-	-	-	-	-	0.0018	77.78	-	-	-	-	0.0006	22.22	-	-	-	0.0024			
King Eider	-	-	-	-	-	-	-	-	-	-	-	-	0.0003	100.00	-	-	-	-	-	-	-	-	-	0.0003			
Common Eider	-	-	-	-	-	-	-	-	0.0013	36.36	-	-	-	-	-	-	0.0022	63.64	-	-	-	-	-	0.0035			
Surf Scoter	-	-	-	-	-	-	0.0095	5.17	0.0123	5.45	0.0479	21.40	0.0594	32.87	0.0029	1.26	0.0137	6.01	-	-	0.0339	14.83	0.0295	13.01	0.2091		
White-winged Scoter	-	-	-	-	-	-	0.0049	0.36	0.0003	0.02	0.0247	1.51	0.0880	6.63	0.0419	2.52	1.3483	80.86	0.0003	0.02	0.0998	5.95	0.0355	2.14	1.6438		
Black Scoter	-	-	-	-	-	-	0.4120	48.75	0.0401	3.86	0.2804	27.22	0.1356	16.30	0.0010	0.09	0.0223	2.13	0.0009	0.09	0.0090	0.85	0.0073	0.70	0.9084		
Scoter unid.	-	-	-	-	-	-	-	-	0.0297	1.18	0.0576	2.30	0.0126	0.63	0.4680	18.45	0.1853	7.30	0.0152	0.63	1.5099	59.12	0.2632	10.39	2.5416		
Long-tailed Duck	-	-	-	-	-	-	0.0008	1.91	0.0044	8.92	0.0016	3.18	0.0124	31.21	0.0137	27.39	0.0130	26.11	0.0006	1.27	-	-	-	0.0465			
Bufflehead	-	-	-	-	-	-	0.0013	3.88	-	-	0.0009	2.33	0.0273	83.72	0.0003	0.78	0.0038	9.30	-	-	-	-	-	0.0337			
Common Goldeneye	-	-	-	-	-	-	-	-	-	-	-	-	0.0003	100.00	-	-	-	-	-	-	-	-	-	0.0003			
Common Merganser	-	-	-	-	-	-	-	-	-	-	0.0003	100.00	-	-	-	-	-	-	-	-	-	-	-	0.0003			
Red-breasted Merganser	-	-	-	-	-	-	-	-	0.0006	12.50	0.0003	6.25	0.0013	31.25	-	-	0.0003	6.25	0.0021	43.75	-	-	-	0.0047			
species unknown	-	-	-	-	-	-	0.0026	10.64	0.0003	1.06	0.0034	11.70	0.0126	53.19	0.0003	1.06	0.0029	9.57	0.0003	1.06	0.0006	2.13	0.0029	9.57	0.0260		
Loon	0.0009	0.07	0.0016	0.12	0.0019	0.15	0.0699	6.68	0.0994	7.74	0.2493	19.55	0.1482	14.39	0.0604	4.67	0.1129	8.72	0.0729	5.89	0.1922	14.76	0.2229	17.26	1.2326		
Red-throated Loon	-	-	-	-	-	-	0.0571	16.11	0.0508	11.68	0.1002	23.22	0.0610	17.49	0.0111	2.54	0.0280	6.39	0.0073	1.74	0.0515	11.68	0.0400	9.14	0.4069		
Common Loon	0.0009	0.12	0.0010	0.12	0.0019	0.23	0.0123	1.85	0.0442	5.38	0.1385	16.99	0.0865	13.15	0.0480	5.81	0.0801	9.69	0.0647	8.19	0.1401	16.84	0.1785	21.65	0.7967		
species unknown	-	-	0.0006	2.15	-	-	0.0005	2.15	0.0044	15.05	0.0107	36.56	0.0008	3.23	0.0013	4.30	0.0048	16.13	0.0009	3.23	0.0006	2.15	0.0044	15.05	0.0290		
Grebe	-	-	-	-	-	-	-	-	-	-	-	-	0.0003	5.26	0.0020	42.11	0.0010	15.79	0.0013	21.05	-	-	0.0003	5.26	0.0006	10.53	0.0055
Horned Grebe	-	-	-	-	-	-	-	-	-	-	0.0003	5.88	0.0020	47.06	0.0010	17.65	0.0013	23.53	-	-	0.0003	5.88	-	-	0.0049		
species unknown	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0006	100.00	0.0006		
Fulmar	-	-	-	-	-	-	0.0008	0.26	0.0189	5.21	0.0420	11.64	0.0124	4.26	0.2240	61.25	0.0188	5.13	0.0152	4.34	0.0067	1.82	0.0222	6.08	0.3609		
Northern Fulmar	-	-	-	-	-	-	0.0008	0.26	0.0189	5.21	0.0420	11.64	0.0124	4.26	0.2240	61.25	0.0188	5.13	0.0152	4.34	0.0067	1.82	0.0222	6.08	0.3609		
Petrel	0.0056	30.51	0.0010	5.08	0.0019	10.17	0.0003	1.69	-	-	-	-	0.0005	3.39	-	-	-	-	0.0006	3.39	0.0016	8.47	0.0070	37.29	0.0184		
Trindade Petrel	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0003	100.00	-	-	-	-	0.0003		
Black-capped Petrel	0.0041	25.49	0.0010	5.88	0.0019	11.76	0.0003	1.96	-	-	-	-	0.0003	1.96	-	-	-	-	-	-	0.0016	9.80	0.0070	43.14	0.0160		
species unknown	0.0016	71.43	-	-	-	-	-	-	-	-	-	-	0.0003	14.29	-	-	-	-	0.0003	14.29	-	-	-	-	0.0021		

(continued)

Table 5. continued

Species Group	Density per km ²																								Species Total	
	Summer						Fall						Winter						Spring							
	2016		2017		2018		2016		2017		2018		2016-17		2017-18		2018-19		2017		2018		2019			
	Density	%	Density	%	Density	%	Density	%	Density	%	Density	%	Density	%	Density	%	Density	%	Density	%	Density	%	Density	%		
Shearwater	0.2285	27.64	0.1838	21.75	0.1584	18.84	0.0422	6.19	0.0136	1.62	0.1397	16.84	0.0010	0.15	-	-	0.0006	0.08	0.0380	4.72	0.0038	0.45	0.0143	1.70	0.8238	
Cory's Shearwater	0.1592	52.96	0.0287	9.35	0.0632	20.66	0.0375	15.16	0.0006	0.21	0.0009	0.31	-	-	-	-	-	-	0.0027	0.93	-	-	0.0013	0.42	0.2942	
Great Shearwater	0.0218	11.16	0.1075	53.75	0.0308	15.47	0.0021	1.28	0.0038	1.91	0.0316	16.11	-	-	-	-	-	-	0.0006	0.32	-	-	-	-	0.1983	
Sooty Shearwater	0.0006	1.67	0.0003	0.83	0.0003	0.83	-	-	-	-	-	-	0.0005	1.67	-	-	-	-	0.0246	67.50	0.0029	7.50	0.0076	20.00	0.0369	
Manx Shearwater	-	-	-	-	-	-	-	-	0.0050	30.77	0.0081	50.00	-	-	-	-	0.0003	1.92	-	-	-	-	0.0029	17.31	0.0164	
Audubon's Shearwater	0.0025	100.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0025	
species unknown-Large	0.0403	16.39	0.0345	13.72	0.0632	25.29	0.0026	1.27	0.0025	1.02	0.0987	40.03	0.0005	0.25	-	-	-	-	0.0046	1.91	0.0003	0.13	-	-	0.2470	
species unknown-Small	0.0041	14.94	0.0128	45.98	0.0010	3.45	-	-	0.0016	5.75	0.0003	1.15	-	-	-	-	-	-	0.0055	20.69	0.0006	2.30	0.0016	5.75	0.0274	
species unknown	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0003	25.00	-	-	-	-	0.0010	75.00	0.0013	
Storm-petrel	0.2463	10.40	0.6638	27.42	0.6739	27.99	0.0003	0.01	0.0350	1.46	0.0019	0.08	0.0180	0.94	-	-	-	-	0.0292	1.27	0.0713	2.94	0.6614	27.50	2.4010	
Wilson's Storm-Petrel	0.2463	64.73	0.1082	27.81	-	-	0.0003	0.08	-	-	-	-	-	-	-	-	-	-	0.0273	7.38	-	-	-	-	0.3820	
White-faced Storm-Petrel	-	-	-	-	0.0006	100.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0006	
Leach's Storm-Petrel	-	-	0.0006	25.00	-	-	-	-	0.0006	25.00	-	-	0.0008	37.50	-	-	-	-	0.0003	12.50	-	-	-	-	0.0023	
Band-rumped Storm-Petrel	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0003	100.00	-	-	-	-	0.0003	
species unknown	-	-	0.5550	27.36	0.6733	33.37	-	-	0.0344	1.71	0.0019	0.09	0.0172	1.07	-	-	-	-	0.0012	0.06	0.0713	3.51	0.6614	32.82	2.0157	
Booby	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0003	100.00	-	-	0.0003	
Brown Booby	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0003	100.00	-	-	0.0003	
Gannet	-	-	0.0013	0.03	-	-	0.7554	21.42	0.2389	5.52	0.3151	7.33	1.0407	29.99	0.2640	6.06	0.3920	8.99	0.0629	1.51	0.4023	9.17	0.4344	9.99	3.9071	
Northern Gannet	-	-	0.0013	0.03	-	-	0.7554	21.42	0.2389	5.52	0.3151	7.33	1.0407	29.99	0.2640	6.06	0.3920	8.99	0.0629	1.51	0.4023	9.17	0.4344	9.99	3.9071	
Cormorant	0.0019	0.96	-	-	0.0006	0.32	0.0172	10.75	0.0347	17.66	0.0724	37.08	0.0008	0.48	-	-	0.0003	0.16	0.0049	2.57	0.0544	27.29	0.0054	2.73	0.1925	
Double-crested Cormorant	0.0019	6.74	-	-	-	-	0.0172	75.28	-	-	-	-	-	-	-	-	-	-	0.0049	17.98	-	-	-	-	0.0240	
species unknown	-	-	-	-	0.0006	0.37	-	-	0.0347	20.60	0.0724	43.26	0.0008	0.56	-	-	0.0003	0.19	-	-	0.0544	31.84	0.0054	3.18	0.1685	
Pelican	-	-	-	-	-	-	0.0003	100.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0003	
Brown Pelican	-	-	-	-	-	-	0.0003	100.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0003	
Ardeidae	-	-	-	-	-	-	-	-	0.0003	20.00	0.0003	20.00	-	-	-	-	-	-	-	-	-	-	-	0.0010	60.00	0.0016
Great Blue Heron	-	-	-	-	-	-	-	-	0.0003	33.33	0.0003	33.33	-	-	-	-	-	-	-	-	-	-	-	0.0003	33.33	0.0009
Snowy Egret	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0006	100.00	0.0006	
Raptor	0.0006	33.33	-	-	0.0010	50.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0003	16.67	-	-	0.0019	
Osprey	0.0003	20.00	-	-	0.0010	60.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0003	20.00	-	-	0.0016	
Bald Eagle	0.0003	100.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0003	
Shorebird	0.0022	0.08	0.0093	0.35	0.4653	17.78	0.0118	0.56	0.6290	24.18	0.1952	7.56	0.0003	0.01	1.2793	48.84	-	-	-	-	0.0109	0.41	0.0057	0.22	2.6088	
American Oystercatcher	-	-	-	-	0.0010	15.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0054	85.00	0.0063	
Black-bellied Plover	0.0019	54.55	-	-	0.0006	18.18	-	-	-	-	-	-	-	-	0.0010	27.27	-	-	-	-	-	-	-	-	0.0035	
Semipalmated Plover	-	-	0.0010	100.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0010	
Piping Plover	-	-	-	-	0.0003	100.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0003	
Ruddy Turnstone	-	-	-	-	-	-	-	-	0.0420	100.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0420	

Table 5. continued

Species Group	Density per km ²																								Species Total
	Summer						Fall						Winter						Spring						
	2016		2017		2018		2016		2017		2018		2016-17		2017-18		2018-19		2017		2018		2019		
	Density	%	Density	%	Density	%	Density	%	Density	%	Density	%	Density	%	Density	%	Density	%	Density	%	Density	%	Density	%	
Sanderling	-	-	-	-	-	-	-	-	0.0369	100.00	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0369	
Dunlin	-	-	-	-	-	-	-	-	0.5374	100.00	-	-	-	-	-	-	-	-	-	-	-	-	-	0.5374	
species unknown	0.0003	0.02	0.0083	0.42	0.4634	23.34	0.0118	0.74	0.0126	0.64	0.1952	9.96	0.0003	0.02	1.2783	64.32	-	-	-	-	0.0109	0.54	0.0003	0.02	1.9814
Phalarope	-	-	0.0440	0.70	0.0025	0.04	0.3987	7.88	0.9521	15.32	2.1185	34.35	0.0589	1.18	0.0003	0.01	0.0010	0.02	0.1667	2.79	1.8051	28.66	0.5657	9.06	6.1135
Red-necked Phalarope	-	-	0.0003	0.11	-	-	0.0177	7.90	-	-	0.0028	1.03	-	-	-	-	-	-	0.0052	1.95	0.1119	40.09	0.1354	48.91	0.2734
Red Phalarope	-	-	-	-	-	-	-	-	0.5599	14.72	1.9926	52.78	-	-	-	-	0.0003	0.01	0.0003	0.01	1.1440	29.68	0.1072	2.80	3.8042
Red/Red-necked Phalarope	-	-	0.0386	1.79	0.0025	0.12	0.3809	21.97	0.3907	18.35	0.1231	5.83	0.0589	3.45	0.0003	0.01	0.0006	0.03	0.1612	7.87	0.5491	25.46	0.3231	15.11	2.0293
species unknown	-	-	0.0051	76.19	-	-	-	-	0.0016	23.81	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0067
Skua	-	-	-	-	0.0003	2.70	0.0003	2.70	0.0003	2.70	0.0028	24.32	-	-	0.0006	5.41	0.0016	13.51	0.0012	10.81	0.0013	10.81	0.0032	27.03	0.0116
Great Skua	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0003	14.29	0.0016	71.43	-	-	0.0003	14.29	-	-	0.0022
South Polar Skua	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0003	50.00	-	-	0.0003	50.00	0.0006
Pomarine Jaeger	-	-	-	-	-	-	0.0003	50.00	-	-	-	-	-	-	-	-	-	-	0.0003	50.00	-	-	-	-	0.0006
Parasitic Jaeger	-	-	-	-	0.0003	5.88	-	-	0.0003	5.88	0.0006	11.76	-	-	-	-	-	-	0.0006	11.76	0.0006	11.76	0.0029	52.94	0.0054
species unknown	-	-	-	-	-	-	-	-	-	-	0.0022	77.78	-	-	0.0003	11.11	-	-	-	-	0.0003	11.11	-	-	0.0028
Auk	-	-	0.0013	0.02	-	-	0.0203	0.42	0.0344	0.58	0.5297	9.02	2.2646	47.77	0.2065	3.47	0.8676	14.56	0.0322	0.57	1.1939	19.92	0.2178	3.67	5.3684
Dovekie	-	-	-	-	-	-	0.0008	0.10	-	-	0.0031	0.35	0.4536	62.11	0.0044	0.48	0.3205	34.92	-	-	-	-	0.0187	2.04	0.8011
Common Murre	-	-	-	-	-	-	0.0028	100.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0028
Common/Thick-billed Murre	-	-	-	-	-	-	-	-	-	-	-	-	0.0008	1.79	-	-	0.0003	0.60	-	-	0.0521	97.02	0.0003	0.60	0.0535
Razorbill	-	-	-	-	-	-	0.0062	0.88	0.0006	0.07	-	-	0.5282	76.85	-	-	0.0029	0.33	0.0012	0.15	0.1746	20.10	0.0140	1.62	0.7277
Murre/Razorbill	-	-	0.0006	0.02	-	-	-	-	0.0303	1.19	0.5191	20.52	0.5219	25.55	0.1738	6.77	0.3125	12.17	0.0091	0.37	0.7941	30.75	0.0675	2.64	2.4290
Black Guillemot	-	-	-	-	-	-	0.0003	11.11	-	-	-	-	0.0020	88.89	-	-	-	-	-	-	-	-	-	-	0.0023
Atlantic Puffin	-	-	-	-	-	-	-	-	0.0025	0.20	0.0072	0.57	0.6038	59.10	0.0232	1.81	0.2060	16.04	0.0137	1.11	0.1724	13.34	0.1002	7.82	1.1290
species unknown	-	-	0.0006	0.24	-	-	0.0103	4.79	0.0009	0.36	0.0003	0.12	0.1543	73.05	0.0051	1.92	0.0254	9.58	0.0082	3.23	0.0006	0.24	0.0171	6.47	0.2230
Gull	0.0356	0.27	0.0348	0.26	0.1546	1.15	1.3977	12.79	0.7972	5.94	3.6384	27.33	1.3926	12.95	0.9965	7.38	1.8109	13.40	0.2699	2.09	1.4600	10.74	0.7683	5.70	12.7564
Black-legged Kittiwake	-	-	-	-	-	-	0.0591	6.38	0.1171	10.29	0.8787	77.77	0.0023	0.25	0.0032	0.28	0.0553	4.82	-	-	0.0006	0.06	0.0019	0.17	1.1182
Bonaparte's Gull	-	-	-	-	-	-	0.2779	22.14	0.2244	14.56	0.4179	27.32	0.1556	12.60	0.0404	2.60	0.0054	0.35	-	-	0.2543	16.28	0.0640	4.14	1.4398
Little Gull	-	-	-	-	-	-	0.0010	30.77	-	-	0.0006	15.38	0.0015	46.15	-	-	-	-	-	-	0.0003	7.69	-	-	0.0035
Laughing Gull	0.0044	0.59	0.0041	0.55	0.0041	0.55	0.2000	32.72	0.0249	3.32	0.4288	57.57	-	-	-	-	-	-	0.0106	1.47	0.0099	1.30	0.0146	1.93	0.7015
Ring-billed Gull	0.0025	0.63	0.0006	0.16	0.0273	6.80	0.0234	7.20	0.0303	7.59	0.2165	54.67	0.0557	17.41	0.0083	2.06	0.0070	1.74	0.0003	0.08	0.0054	1.34	0.0013	0.32	0.3785
Herring Gull	0.0066	0.10	0.0105	0.16	0.0321	0.48	0.5853	10.73	0.2932	4.38	1.1869	17.86	0.8841	16.47	0.5646	8.37	1.1146	16.52	0.1682	2.61	1.0119	14.91	0.4988	7.41	6.3568
Iceland Gull	-	-	-	-	-	-	-	-	0.0003	6.67	0.0003	6.67	0.0018	46.67	0.0006	13.33	-	-	0.0003	6.67	0.0006	13.33	0.0003	6.67	0.0043
Lesser Black-backed Gull	-	-	0.0006	0.80	0.0140	17.53	0.0023	3.59	0.0047	5.98	0.0210	26.69	0.0058	9.16	0.0054	6.77	0.0029	3.59	0.0033	4.38	0.0102	12.75	0.0070	8.76	0.0773
Glaucous Gull	-	-	-	-	-	-	-	-	-	-	-	-	0.0003	50.00	-	-	-	-	-	-	0.0003	50.00	-	-	0.0006
Great Black-backed Gull	0.0162	0.83	0.0080	0.40	0.0740	3.73	0.0951	5.92	0.0587	2.98	0.1685	8.61	0.2439	15.42	0.3486	17.55	0.5866	29.52	0.0780	4.11	0.1439	7.20	0.0742	3.74	1.8957
species unknown - Large	0.0012	0.93	0.0010	0.69	0.0025	1.85	0.0041	3.70	0.0120	8.80	0.0470	34.72	0.0058	5.32	0.0127	9.26	0.0245	17.82	0.0003	0.23	0.0038	2.78	0.0190	13.89	0.1340
species unknown - Small	0.0034	0.53	0.0099	1.48	0.0006	0.10	0.1493	27.73	0.0303	4.58	0.2597	39.57	0.0344	6.49	0.0124	1.86	0.0076	1.15	0.0088	1.38	0.0185	2.77	0.0821	12.36	0.6172

Table 5. continued

Species Group	Density per km ²																								Species Total
	Summer						Fall						Winter						Spring						
	2016		2017		2018		2016		2017		2018		2016-17		2017-18		2018-19		2017		2018		2019		
	Density	%	Density	%	Density	%	Density	%	Density	%	Density	%	Density	%	Density	%	Density	%	Density	%	Density	%	Density	%	
species unknown	0.0012	4.26	-	-	-	-	0.0003	1.06	0.0013	4.26	0.0125	42.55	0.0015	6.38	0.0003	1.06	0.0070	23.40	-	-	-	-	0.0051	17.02	0.0292
Tern	0.0150	29.27	0.0006	1.22	0.0159	30.49	0.0005	1.22	-	-	-	-	-	-	-	-	-	-	0.0155	31.10	-	-	0.0035	6.71	0.0510
Least Tern	0.0103	33.33	-	-	0.0041	13.13	-	-	-	-	-	-	-	-	-	-	-	-	0.0149	49.49	-	-	0.0013	4.04	0.0306
Black Tern	-	-	0.0003	2.50	0.0114	90.00	-	-	-	-	-	-	-	-	-	-	-	-	0.0006	5.00	-	-	0.0003	2.50	0.0127
Royal Tern	0.0025	72.73	-	-	0.0003	9.09	0.0005	18.18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0033
species unknown	0.0022	50.00	0.0003	7.14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0019	42.86	0.0044
Sterna Tern	0.0440	4.16	0.0041	0.38	0.0698	6.49	-	-	0.0009	0.09	-	-	-	-	-	-	-	-	0.3847	37.35	0.0150	1.39	0.5393	50.15	1.0580
Roseate Tern	-	-	-	-	0.0003	3.03	-	-	-	-	-	-	-	-	-	-	-	-	0.0046	45.45	-	-	0.0054	51.52	0.0103
Common Tern	-	-	-	-	0.0298	13.62	-	-	-	-	-	-	-	-	-	-	-	-	0.1658	79.13	0.0010	0.43	0.0149	6.81	0.2115
Forster's Tern	-	-	-	-	0.0013	11.76	-	-	0.0006	5.88	-	-	-	-	-	-	-	-	-	-	-	-	0.0089	82.35	0.0108
Commic/Forster's Tern	-	-	-	-	0.0213	4.13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.4927	95.87	0.5140
species unknown	0.0440	13.91	0.0041	1.28	0.0171	5.33	-	-	0.0003	0.10	-	-	-	-	-	-	-	-	0.2144	69.63	0.0141	4.34	0.0174	5.42	0.3115
Nightjar	-	-	0.0003	100.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0003
Common Nighthawk	-	-	0.0003	100.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0003
Hirundine	-	-	-	-	-	-	-	-	-	-	0.0038	100.00	-	-	-	-	-	-	-	-	-	-	-	-	0.0038
species unknown	-	-	-	-	-	-	-	-	-	-	0.0038	100.00	-	-	-	-	-	-	-	-	-	-	-	-	0.0038
Passerine	-	-	-	-	-	-	-	-	0.0022	87.50	0.0003	12.50	-	-	-	-	-	-	-	-	-	-	-	-	0.0025
Snow Bunting	-	-	-	-	-	-	-	-	0.0022	100.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0022
species unknown	-	-	-	-	-	-	-	-	-	-	0.0003	100.00	-	-	-	-	-	-	-	-	-	-	-	-	0.0003
Total	0.5805	1.33	0.9459	2.11	1.5462	3.47	3.1473	8.72	2.9467	6.65	7.7335	17.59	5.2920	14.90	3.5645	7.99	4.7987	10.75	1.1138	2.61	6.8727	15.31	3.8109	8.56	42.3527

Table 6. Density per km² of Species Group and Percent of Overall Total in Species Group Represented by Each Taxon

Bold rows represent the number of individuals per km²; the rows not bolded represent the percent of the species total within that species group.

Species	Density per km ²												Species Total
	Summer			Fall			Winter			Spring			
	2016	2017	2018	2016	2017	2018	2016-17	2017-18	2018-19	2017	2018	2019	
Goose	-	-	-	-	0.0006	0.0019	0.0003	-	-	-	-	-	0.0028
Brant						100.0							66.7
Canada Goose					100.0		100.0						33.3
Swan	-	-	-	-	-	-	-	0.0038	-	-	-	-	0.0038
Tundra Swan								100.0					100.0
Duck	-	-	-	0.4318	0.0890	0.4219	0.3516	0.5281	1.5918	0.0200	1.6532	0.3383	5.4259
Gadwall				0.2									
Mallard						0.1							
American Black Duck						1.0							0.1
Lesser Scaup							0.5			3.0			0.1
King Eider							0.1						
Common Eider					1.4				0.1				0.1
Surf Scoter				2.2	13.8	11.4	16.9	0.5	0.9		2.1	8.7	4.0
White-winged Scoter				1.1	0.4	5.9	25.0	7.9	84.7	1.5	6.0	10.5	29.7
Black Scoter				95.4	45.0	66.4	38.6	0.2	1.4	4.5	0.5	2.2	18.6
Scoter unid.					33.3	13.7	3.6	88.6	11.6	75.8	91.3	77.8	45.2
Long-tailed Duck				0.2	5.0	0.4	3.5	2.6	0.8	3.0			0.9
Bufflehead				0.3		0.2	7.8	0.1	0.2				0.7
Common Goldeneye							0.1						
Common Merganser						0.1							

Table 6. continued

Species	Abundance per km ²												Species Total	
	Summer			Fall			Winter			Spring				
	2016	2017	2018	2016	2017	2018	2016-17	2017-18	2018-19	2017	2018	2019		
Red-breasted Merganser					0.7	0.1	0.4				10.6			0.1
species unknown				0.6	0.4	0.8	3.6	0.1	0.2	1.5			0.8	0.5
Loon	0.0009	0.0016	0.0019	0.0699	0.0994	0.2493	0.1482	0.0604	0.1129	0.0729	0.1922	0.2229		1.2326
Red-throated Loon				81.6	51.1	40.2	41.1	18.4	24.8	10.0	26.8	17.9		33.8
Common Loon	100.0	60.0	100.0	17.6	44.4	55.5	58.4	79.5	71.0	88.8	72.9	80.1		63.9
species unknown		40.0		0.7	4.4	4.3	0.5	2.1	4.2	1.3	0.3	2.0		2.3
Grebe	-	-	-	-	-	0.0003	0.0020	0.0010	0.0013	-	0.0003	0.0006		0.0055
Horned Grebe						100.0	100.0	100.0	100.0		100.0			89.5
species unknown												100.0		10.5
Fulmar	-	-	-	0.0008	0.0189	0.0420	0.0124	0.2240	0.0188	0.0152	0.0067	0.0222		0.3609
Northern Fulmar				100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0		100.0
Petrel	0.0056	0.0010	0.0019	0.0003	-	-	0.0005	-	-	0.0006	0.0016	0.0070		0.0184
Trindade Petrel										50.0				1.7
Black-capped Petrel	72.2	100.0	100.0	100.0			50.0				100.0	100.0		86.4
species unknown	27.8						50.0			50.0				11.9
Shearwater	0.2285	0.1838	0.1584	0.0422	0.0136	0.1397	0.0010	-	0.0006	0.0380	0.0038	0.0143		0.8238
Cory's Shearwater	69.7	15.6	39.9	89.0	4.7	0.7				7.2		8.9		36.4
Great Shearwater	9.6	58.5	19.4	4.9	27.9	22.6				1.6				23.7
Sooty Shearwater	0.3	0.2	0.2				50.0			64.8	75.0	53.3		4.5
Manx Shearwater					37.2	5.8			50.0			20.0		2.0
Audubon's Shearwater	1.1													0.3
species unknown-Large	17.6	18.8	39.9	6.1	18.6	70.6	50.0			12.0	8.3			29.7
species unknown-Small	1.8	6.9	0.6		11.6	0.2				14.4	16.7	11.1		3.3
species unknown									50.0			6.7		0.2

Table 6. continued

Species	Abundance per km ²												Species Total
	Summer			Fall			Winter			Spring			
	2016	2017	2018	2016	2017	2018	2016-17	2017-18	2018-19	2017	2018	2019	
Storm-petrel	0.2463	0.6638	0.6739	0.0003	0.0350	0.0019	0.0180	-	-	0.0292	0.0713	0.6614	2.4010
Wilson's Storm-Petrel	100.0	16.3		100.0						93.8			16.1
White-faced Storm-Petrel			0.1										
Leach's Storm-Petrel		0.1			1.8		4.2			1.0			0.1
Band-rumped Storm-Petrel										1.0			
species unknown		83.6	99.9		98.2	100.0	95.8			4.2	100.0	100.0	83.8
Booby	-	-	-	-	-	-	-	-	-	-	0.0003	-	0.0003
Brown Booby											100.0		100.0
Gannet	-	0.0013	-	0.7554	0.2389	0.3151	1.0407	0.2640	0.3920	0.0629	0.4023	0.4344	3.9071
Northern Gannet		100.0		100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Cormorant	0.0019	-	0.0006	0.0172	0.0347	0.0724	0.0008	-	0.0003	0.0049	0.0544	0.0054	0.1925
Double-crested Cormorant	100.0			100.0						100.0			14.3
species unknown			100.0		100.0	100.0	100.0		100.0		100.0	100.0	85.7
Pelican	-	-	-	0.0003	-	-	-	-	-	-	-	-	0.0003
Brown Pelican				100.0									100.0
Ardeidae	-	-	-	-	0.0003	0.0003	-	-	-	-	-	0.0010	0.0016
Great Blue Heron					100.0	100.0						33.3	60.0
Snowy Egret												66.7	40.0
Raptor	0.0006	-	0.0010	-	-	-	-	-	-	-	0.0003	-	0.0019
Osprey	50.0		100.0								100.0		83.3
Bald Eagle	50.0												16.7
Shorebird	0.0022	0.0093	0.4653	0.0118	0.6290	0.1952	0.0003	1.2793	-	-	0.0109	0.0057	2.6088
American Oystercatcher			0.2									94.4	0.2
Black-bellied Plover	85.7		0.1					0.1					0.1

Table 6. continued

Species	Abundance per km ²												Species Total
	Summer			Fall			Winter			Spring			
	2016	2017	2018	2016	2017	2018	2016-17	2017-18	2018-19	2017	2018	2019	
Semipalmated Plover		10.3											
Piping Plover			0.1										
Ruddy Turnstone					6.7								1.6
Sanderling					5.9								1.4
Dunlin					85.4								20.7
species unknown	14.3	89.7	99.6	100.0	2.0	100.0	100.0	99.9			100.0	5.6	75.9
Phalarope	-	0.0440	0.0025	0.3987	0.9521	2.1185	0.0589	0.0003	0.0010	0.1667	1.8051	0.5657	6.1135
Red-necked Phalarope		0.7		4.4		0.1				3.1	6.2	23.9	4.4
Red Phalarope					58.8	94.1			33.3	0.2	63.4	18.9	61.2
Red/Red-necked Phalarope		87.7	100.0	95.6	41.0	5.8	100.0	100.0	66.7	96.7	30.4	57.1	34.3
species unknown		11.6			0.2								0.1
Skua	-	-	0.0003	0.0003	0.0003	0.0028	-	0.0006	0.0016	0.0012	0.0013	0.0032	0.0116
Great Skua								50.0	100.0		25.0		18.9
South Polar Skua										25.0		10.0	5.4
Pomarine Jaeger				100.0						25.0			5.4
Parasitic Jaeger			100.0		100.0	22.2				50.0	50.0	90.0	45.9
species unknown						77.8		50.0			25.0		24.3
Auk	-	0.0013	-	0.0203	0.0344	0.5297	2.2646	0.2065	0.8676	0.0322	1.1939	0.2178	5.3684
Dovekie				3.8		0.6	20.0	2.2	36.9			8.6	15.4
Common Murre				13.9									0.1
Common/Thick-billed Murre											4.4	0.1	0.9
Razorbill				30.4	1.8		23.3		0.3	3.8	14.6	6.4	14.5
Murre/Razorbill		50.0			88.1	98.0	23.0	84.2	36.0	28.3	66.5	31.0	43.1
Black Guillemot				1.3			0.1						

Table 6. continued

Species	Abundance per km ²												Species Total
	Summer			Fall			Winter			Spring			
	2016	2017	2018	2016	2017	2018	2016-17	2017-18	2018-19	2017	2018	2019	
Atlantic Puffin					7.3	1.4	26.7	11.2	23.7	42.5	14.4	46.0	21.6
species unknown		50.0		50.6	2.8	0.1	6.8	2.5	2.9	25.5	0.1	7.9	4.5
Gull	0.0356	0.0348	0.1546	1.3977	0.7972	3.6384	1.3926	0.9965	1.8109	0.2699	1.4600	0.7683	12.7564
Black-legged Kittiwake				4.2	14.7	24.1	0.2	0.3	3.1			0.2	8.5
Bonaparte's Gull				19.9	28.1	11.5	11.2	4.0	0.3		17.4	8.3	11.5
Little Gull				0.1			0.1						
Laughing Gull	12.3	11.9	2.7	14.3	3.1	11.8				3.9	0.7	1.9	5.6
Ring-billed Gull	7.0	1.8	17.7	1.7	3.8	5.9	4.0	0.8	0.4	0.1	0.4	0.2	3.0
Herring Gull	18.4	30.3	20.7	41.9	36.8	32.6	63.5	56.7	61.6	62.3	69.3	64.9	49.9
Iceland Gull							0.1	0.1		0.1			
Lesser Black-backed Gull		1.8	9.0	0.2	0.6	0.6	0.4	0.5	0.2	1.2	0.7	0.9	0.6
Glaucous Gull													
Great Black-backed Gull	45.6	22.9	47.8	6.8	7.4	4.6	17.5	35.0	32.4	28.9	9.9	9.7	14.7
species unknown - Large	3.5	2.8	1.6	0.3	1.5	1.3	0.4	1.3	1.4	0.1	0.3	2.5	1.0
species unknown - Small	9.6	28.4	0.4	10.7	3.8	7.1	2.5	1.2	0.4	3.3	1.3	10.7	4.9
species unknown	3.5				0.2	0.3	0.1		0.4			0.7	0.2
Tern	0.0150	0.0006	0.0159	0.0005	-	-	-	-	-	0.0155	-	0.0035	0.0510
Least Tern	68.8		26.0							96.1		36.4	60.4
Black Tern		50.0	72.0							3.9		9.1	24.4
Royal Tern	16.7		2.0	100.0									6.7
species unknown	14.6	50.0										54.5	8.5
Sterna Tern	0.0440	0.0041	0.0698	-	0.0009	-	-	-	-	0.3847	0.0150	0.5393	1.0580
Roseate Tern			0.5							1.2		1.0	1.0
Common Tern			42.7							43.1	6.4	2.8	20.3

Table 6. continued

Species	Abundance per km ²												Species Total
	Summer			Fall			Winter			Spring			
	2016	2017	2018	2016	2017	2018	2016-17	2017-18	2018-19	2017	2018	2019	
Forster's Tern			1.8		66.7							1.6	1.0
Commic/Forster's Tern			30.5									91.4	47.8
species unknown	100.0	100.0	24.5		33.3					55.7	93.6	3.2	29.9
Nightjar	-	0.0003	-	-	-	-	-	-	-	-	-	-	0.0003
Common Nighthawk		100.0											100.0
Hirundine	-	-	-	-	-	0.0038	-	-	-	-	-	-	0.0038
species unknown						100.0							100.0
Passerine	-	-	-	-	0.0022	0.0003	-	-	-	-	-	-	0.0025
Snow Bunting					100.0								87.5
species unknown						100.0							12.5
Total	0.5805	0.9459	1.5462	3.1473	2.9467	7.7335	5.2920	3.5645	4.7987	1.1138	6.8727	3.8109	42.3527

2.5 Spatial Patterns of Distribution and Flight

Density for the OPA and each zone was quantified for species with 30 or more total observations by taking the mean strip transect density determined by dividing the total count of individuals within the strip transect by the strip transect area. Densities are presented as individuals per km² surveyed plus or minus standard error of the mean. On the resulting heat maps, density is scaled to the maximum density across all seasons for each taxa. For species with fewer than 30 total observations we present a single point map showing the occurrence record spatially and temporally.

Flight metrics of the proportion of individuals sitting versus flying, flight headings, and median flight height per zone are presented for each species and species group with greater than 30 total observations. All bird observations in all surveys were classified as sitting or flying, and individuals with known flight heights were classified as outside or within the rotor swept zone (RSZ; 23–320 m). An overview of median flight heights and the number of flight heights across all species within and outside the RSZ may be found in Appendix D. The minimum, median, and maximum flight heights with associated error and standard deviation are presented in Appendix E.

2.5.1 All Birds

Surveys produced 140,372 bird observations. For all birds, mean density was greatest in the Winter ($\bar{x} = 4.45 \pm 0.58$ birds/km²) (Appendix B, Figure 4, Figure 5). In the Winter, density was above average in Zone 1 ($\bar{x} = 6.49 \pm 2.21$ birds/km²) and along Zone 5 ($\bar{x} = 8.24 \pm 1.67$ birds/km²). Fall and Spring densities were similar (\bar{x} Fall = 3.73 ± 0.47 birds/km²; \bar{x} Spring = 3.44 ± 0.33 birds/km²) and both had above average densities throughout Zone 1 (Figure 4, Figure 5). Summer represented the season with the lowest mean density of birds ($\bar{x} = 1.35 \pm 0.31$ birds/km²).

We observed 72,673 birds in flight, ranging from just one m or less above sea level to approximately 160 m. Though Summer had the fewest total avian observations (n=9,695) (Appendix B), it was the only season with most birds in flight (67%). During Fall, 38% of birds were in flight, 15% of birds were in flight in Winter, and 31% of birds were in flight in Spring. Further, Summer was the only season that the median flight altitude was below the RSZ within all six zones (Figure 6, Figure 7). Median flight height for all other seasons was within the RSZ and ranged between 25 m and 60 m (Figure 6, Figure 7). In the Fall and Winter, birds exhibited a slight pattern for northwesterly flight headings, in Spring birds exhibited a pattern of northerly flight headings, and in Summer there was no clear pattern of flight direction (Figure 8).

Figure 4. Spatial Distribution of Bird Species During Fall and Winter by Zone and Proximity to Call Areas

Heat map is scaled to the maximum density for the species/species group across all seasons. Inset bar plots display mean estimated densities \pm standard error of the mean for each zone.

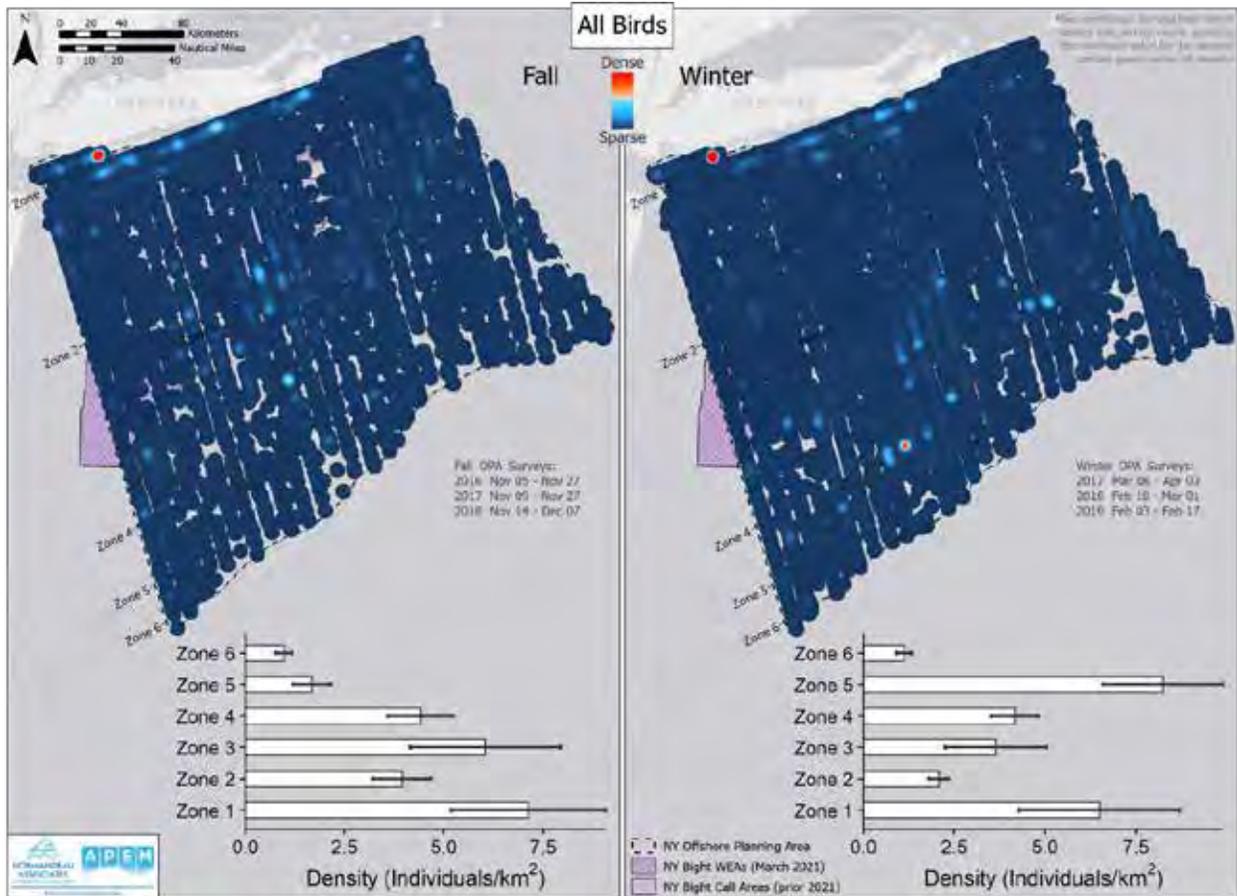


Figure 5. Spatial Distribution of Bird Species During Spring and Summer by Zone and Proximity to Call Areas

Heat map is scaled to the maximum density for the species/species group across all seasons. Inset bar plots display mean estimated densities \pm standard error of the mean for each zone.

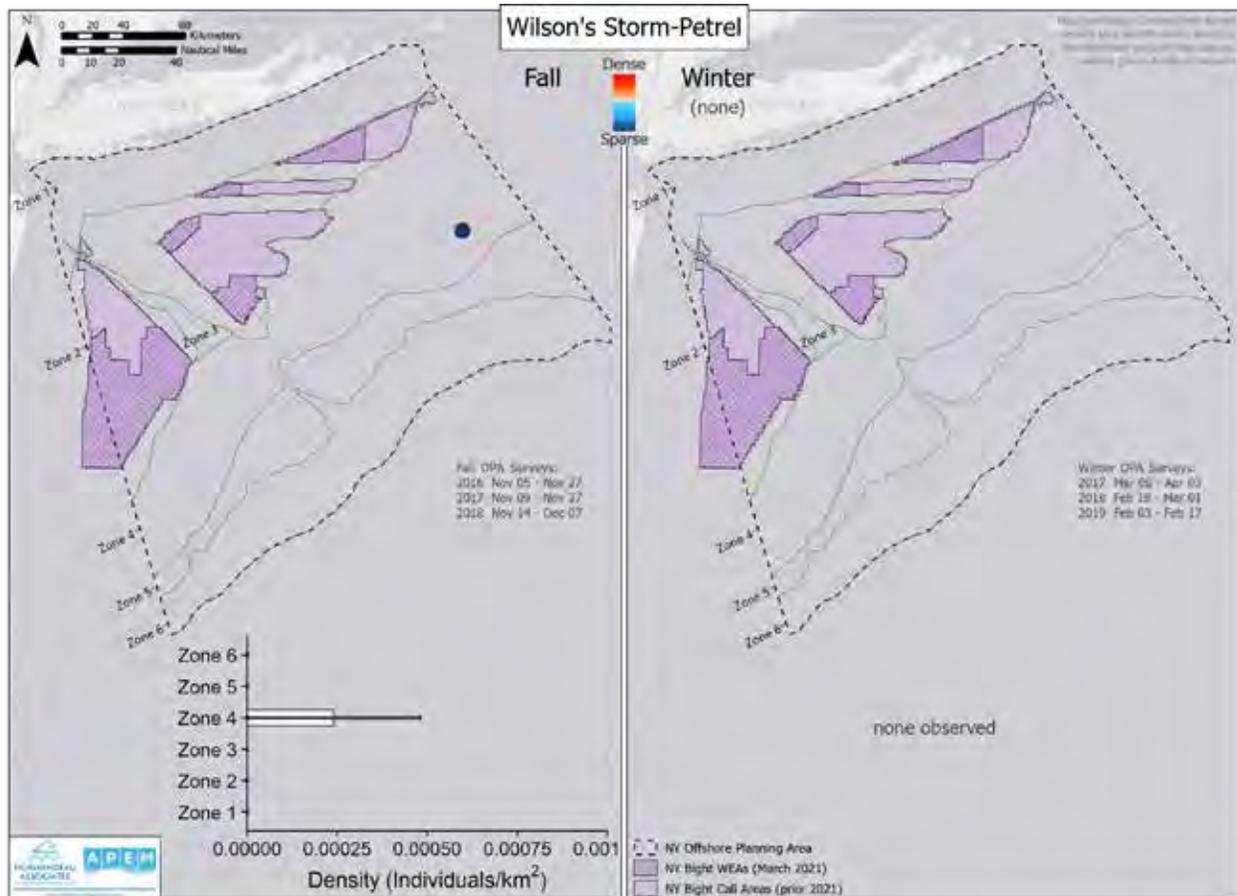


Figure 6. Spatial Distribution of Bird Species Sitting Relative to Birds in Flight During Fall and Winter Surveys

Solid blue points represent individuals with calculated flight height and blue points with an x represent individuals in flight without flight height data. A pie chart inset shows the proportion of individuals flying and sitting. A boxplot inset of flight height distribution by zone is displayed for all birds with known flight heights. Boxplots show the distribution of data among seasons. The dark horizontal line is the median flight height, and the box represents the middle 50% of data values. The lines to the left and right of the box represent the data points that are within 1.5 times the length of the box. Data beyond this range are shown as individual points.

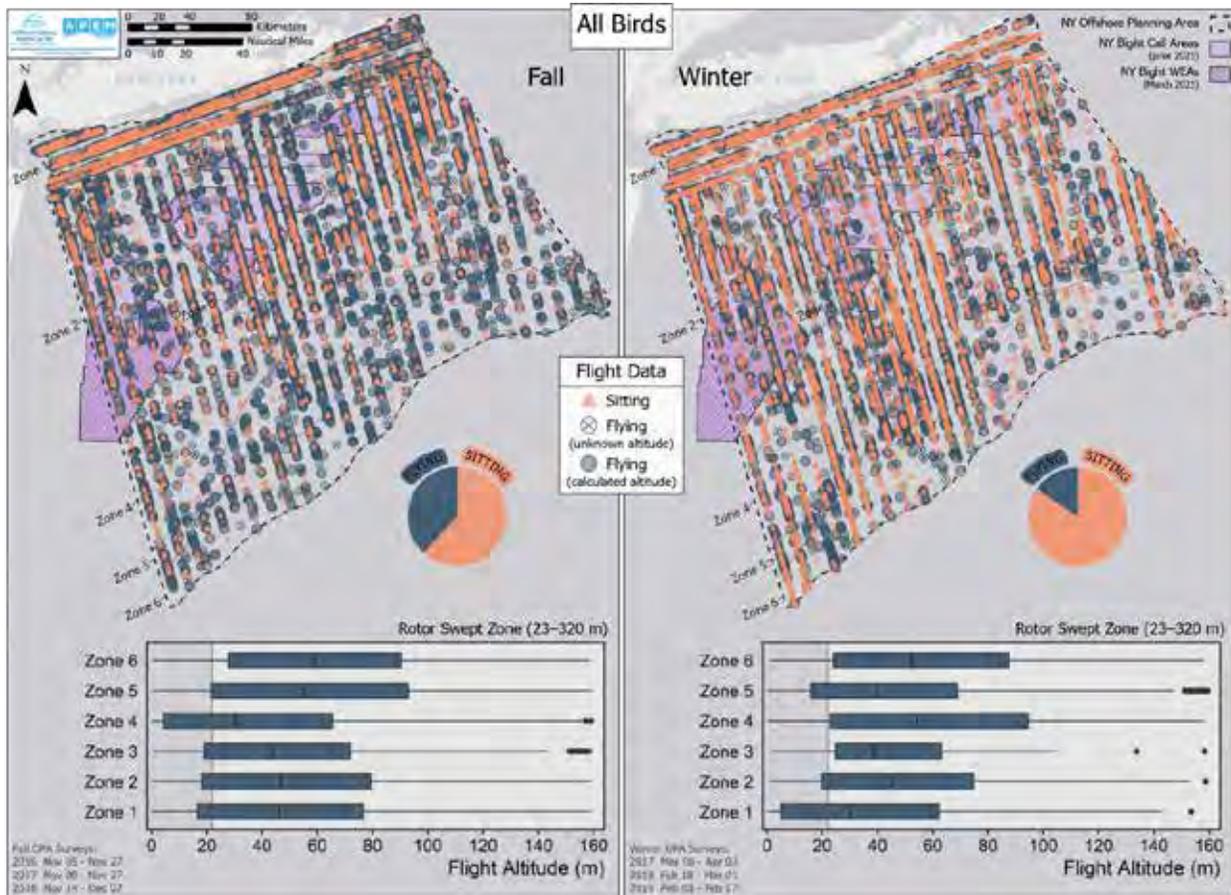


Figure 7. Spatial Distribution of Bird Species Sitting Relative to Birds in Flight for Spring and Summer Surveys

Solid blue points represent individuals with calculated flight height and blue points with an x represent individuals in flight without flight height data. A pie chart inset shows the proportion of individuals flying and sitting. A boxplot inset of flight height distribution by zone is displayed for all birds with known flight heights. Boxplots show the distribution of data among seasons. The dark horizontal line is the median flight height, the box represents the middle 50% of data values. The lines to the left and right of the box represent the data points that are within 1.5 times the length of the box. Data beyond this range are shown as individual points.

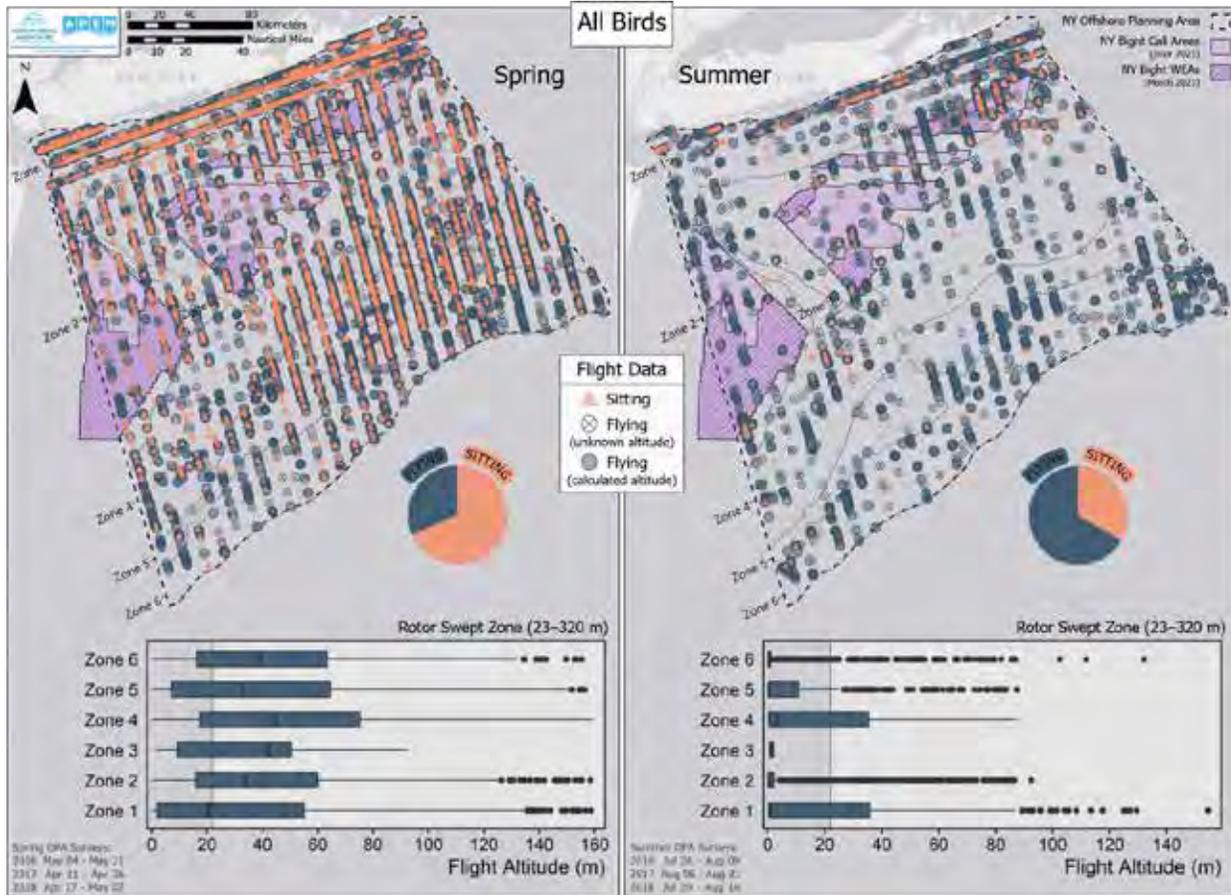
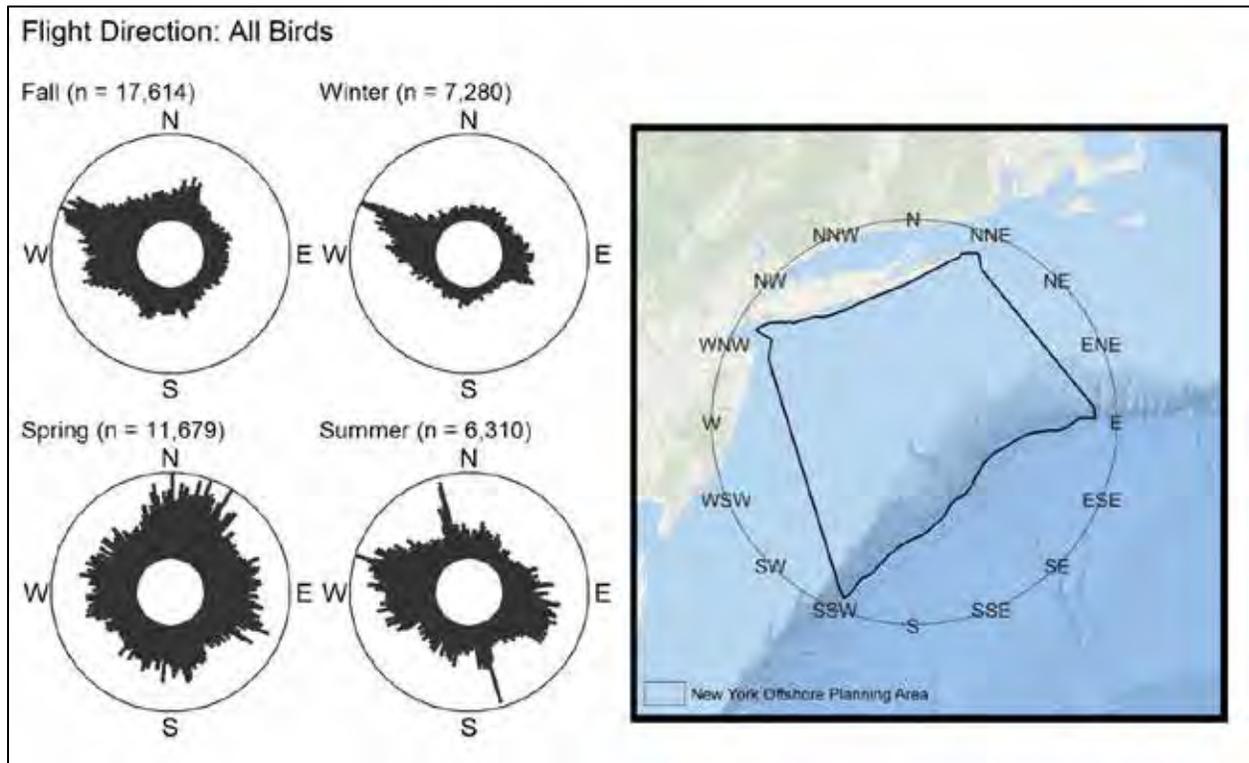


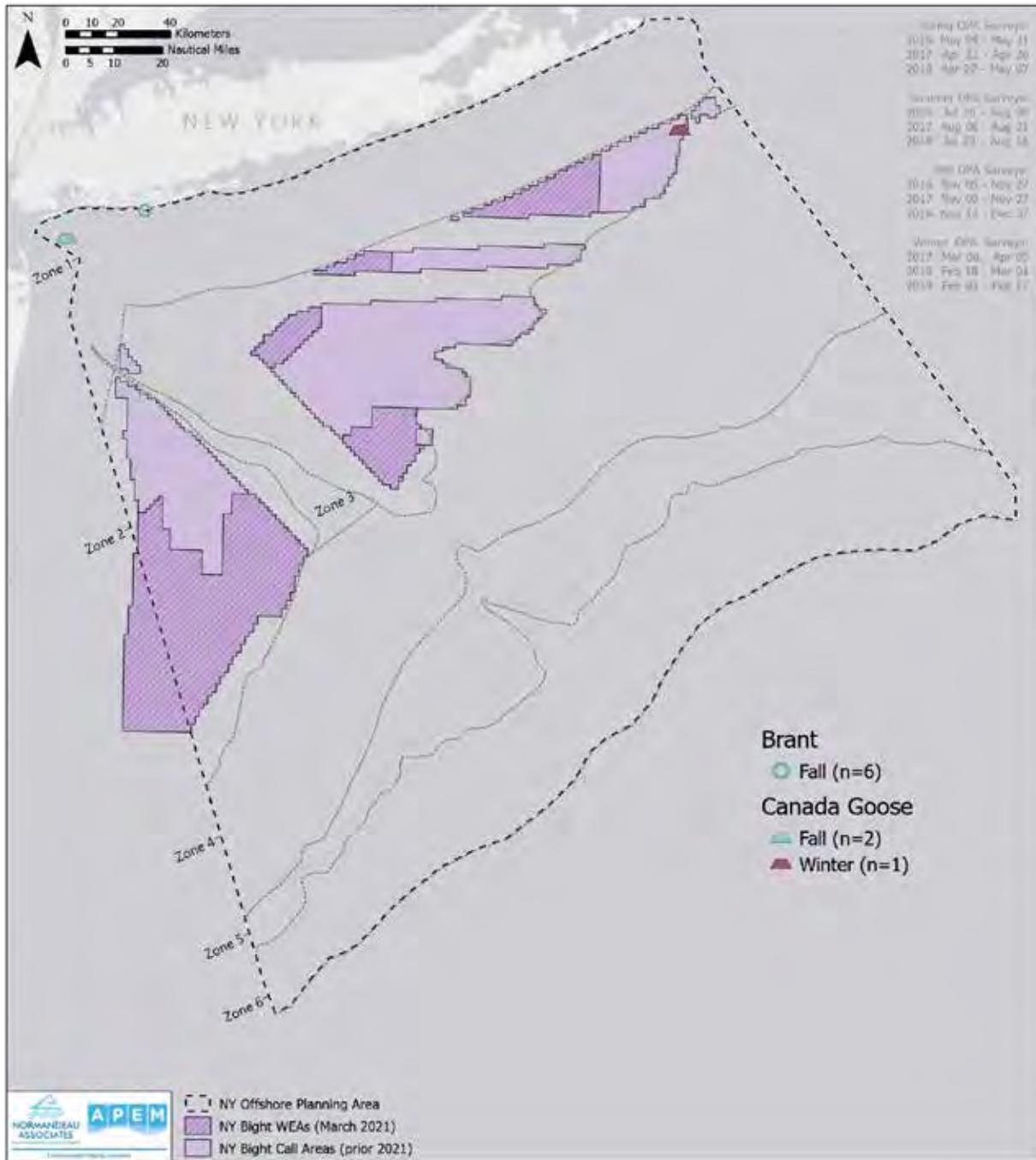
Figure 8. Direction of Flight of All Birds for All Surveys



2.5.2 Goose: Brant and Canada Goose

Six brant were observed in Zone 1 during the Fall, and Canada goose were observed twice in the Fall in Zone 1 and once in Zone 2 in the Winter (Figure 9).

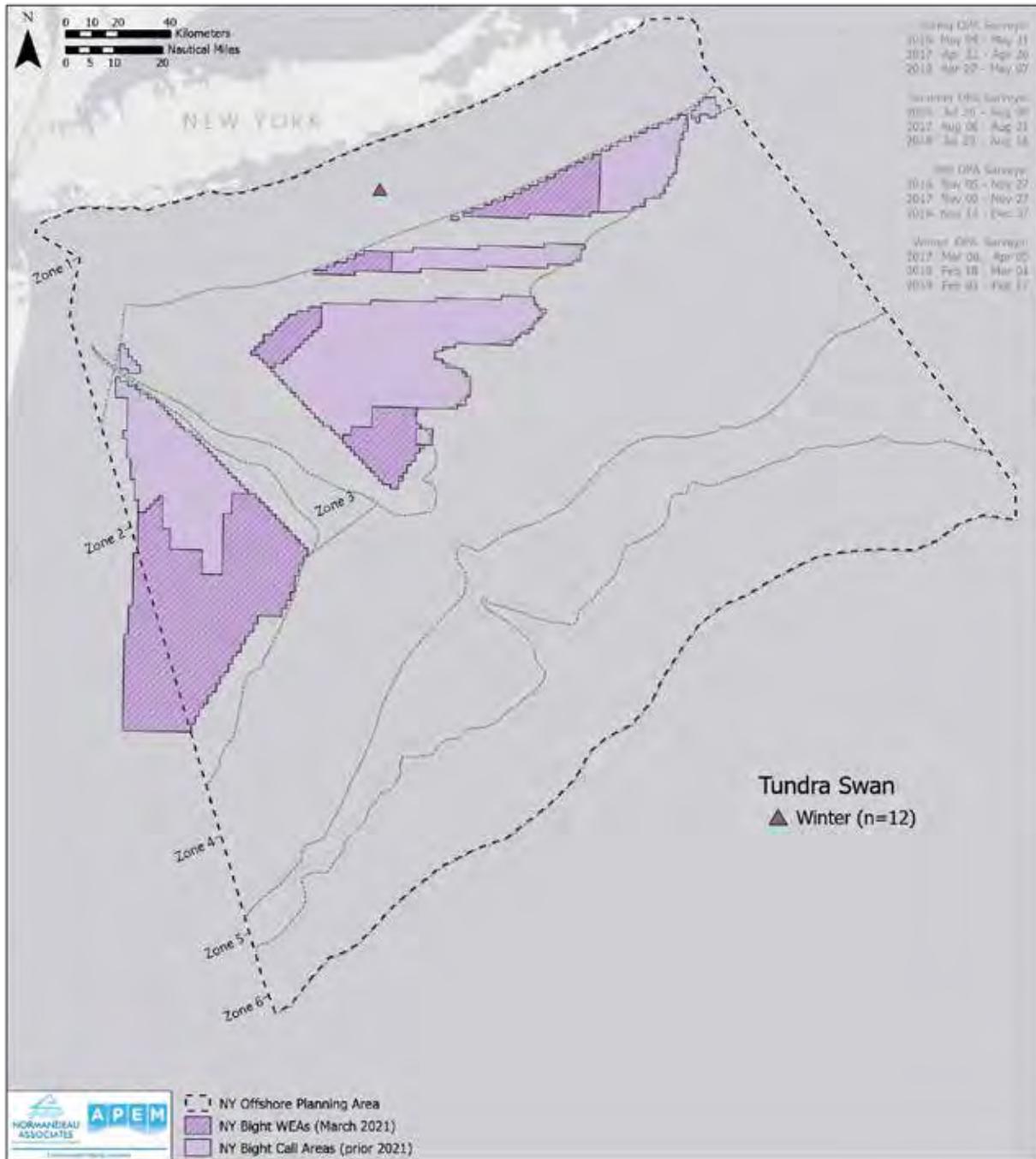
Figure 9. Spatial Distribution of Goose Species with Fewer than 30 Occurrences Across All Surveys



2.5.3 Tundra Swan

Twelve tundra swan were observed at the same location within Zone 1 during the Winter 2017–18 survey (Figure 10).

Figure 10. Spatial Distribution of Tundra Swan with Fewer than 30 Occurrences Across All Surveys



2.5.4 Duck

Across all seasons except Summer (when no ducks were observed), most of the ducks ($n=10,570$; Appendix B) were observed sitting nearer to shore in Zone 1 (Figure 11, Figure 12). Densities in Zone 1 ranged from approximately one bird/km² during Fall and Spring to ± 1.6 birds/km² during Winter (Figure 11, Figure 12). The 27% of individuals in flight during the Fall represented the greatest proportion of in-flight individuals with Winter and Spring only having 3% and 4% of individuals observed in flight, respectively (Figure 13, Figure 14). In all seasons ducks were observed, flight heights ranged between 1 m and 160 m (Figure 13, Figure 14). Median flight height was consistently below the RSZ within Zone 1 and within the RSZ in Zone 2 during Fall and Winter surveys (Figure 13, Figure 14). But a pattern of increased flight height as a function of distance from shore in all seasons was apparent. The Fall birds did not fly in a western direction as often as they were observed flying in the three other cardinal directions. In Spring, most ducks were observed flying in a northeastern direction (Figure 15).

2.5.4.1 White-winged Scoter

White-winged scoter were relatively uncommon in the Fall with 99 observations and a mean OPA density of 0.006 ± 0.002 birds/km² compared to the Winter ($n=4,721$) and Spring ($n=425$), which had mean densities of 0.16 birds/km² and 0.01 ± 0.01 birds/km², respectively (Appendix B, Figure 16, Figure 17). Observations of white-winged scoter were concentrated within Zone 1, and during Winter surveys Zone 1 density was 0.83 birds/km² (Figure 17). In the Fall, median flight height in Zone 1 was within the RSZ but in the Winter and Spring median flight height was below (10 m) (Figure 18, Figure 19). Direction of flight patterns are provided in Figure 20.

2.5.4.2 Black Scoter

Black scoter ($n=3,288$) were concentrated in Zone 1 in the Fall ($\bar{x} = 0.76 \pm 0.35$ birds/km²), Winter ($\bar{x} = 0.23 \pm 0.12$ birds/km²), and Spring ($\bar{x} = 0.009 \pm 0.004$ birds/km²) (Appendix B, Figure 21, Figure 22). For all seasons, median flight height was below the RSZ in Zone 1 and within the RSZ in Zone 2 (no Zone 2 observations during Spring surveys) (Figure 23, Figure 24). Flight directions were mixed with birds avoiding westward flight bearings in the Fall (Figure 25).

2.5.4.3 Long-tailed Duck

Long-tailed duck (n=157) were concentrated in Zone 1 in the Winter ($\bar{x} = 0.05 \pm 0.01$ birds/km²), Fall ($\bar{x} = 0.01 \pm 0.002$ birds/km²), and Spring ($\bar{x} = 0.002$ birds/km²) (Appendix B, Figure 26, Figure 27). Eighteen percent of long-tailed duck observations were in flight (Figure 28, Figure 29). In Spring only two long-tailed duck were observed, both sitting. All birds in flight were in Zone 1 and median flight height was approximately 32 m in Fall and 13 m in Winter. There was no observed pattern in flight direction (Figure 30).

2.5.4.4 Bufflehead

Bufflehead were observed in Fall (n=8) and Winter (n=121) primarily in Zone 1 (Appendix B, Figure 31). Five percent of bufflehead were observed in flight but Fall observations did not have associated flight height data (Figure 32). Flight height for the four individuals in flight during Winter surveys was below the RSZ (Figure 32). There was no observed pattern in flight direction (Figure 33).

2.5.4.5 Duck Species with Fewer than 30 Observations

Duck species observed fewer than 30 times across all surveys included gadwall (n=3), mallard (n =1), American black duck (n=14), lesser scaup (n=9), common goldeneye (n=1), king eider (n=1), common eider (n=11), common merganser (n =1), and red-breasted merganser (n=16) (Appendix B, Figure 34). These species were concentrated within Zone 1, but some individuals were detected in outer zones including a red-breasted merganser in Zones 5 and 6 and lesser scaup observed in Zone 5. All observations occurred outside of Summer surveys (Figure 34).

Figure 11. Spatial Distribution of Duck Species During Fall and Winter by Zone and Proximity to Call Areas

Heat map is scaled to the maximum density for the species/species group across all seasons. Inset bar plots display mean estimated densities \pm standard error of the mean for each zone.

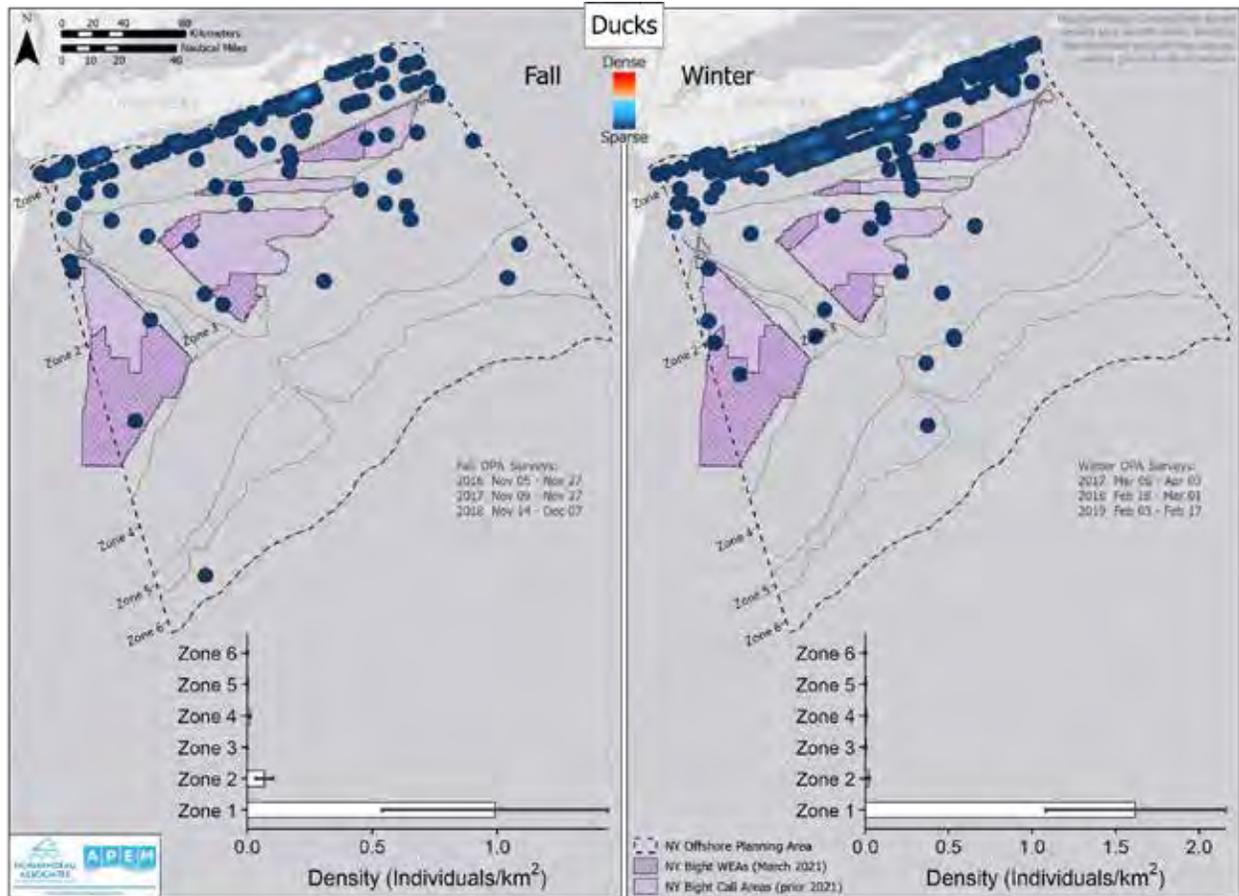


Figure 12. Spatial Distribution of Duck Species During Spring and Summer by Zone and Proximity to Call Areas

Heat map is scaled to the maximum density for the species/species group across all seasons. Inset bar plots display mean estimated densities \pm standard error of the mean for each zone.

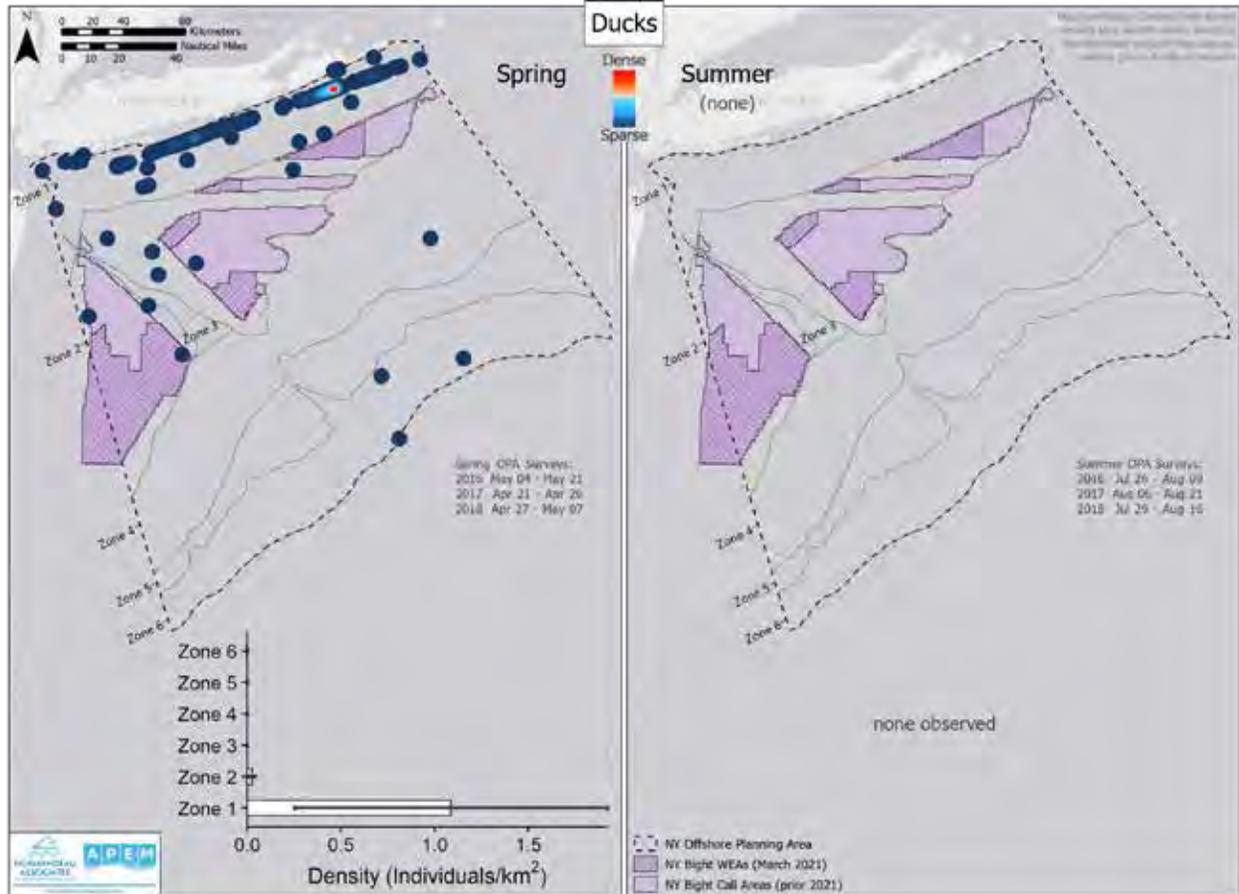


Figure 13. Spatial Distribution of Duck Species Sitting Relative to Birds in Flight During Fall and Winter Surveys

Solid blue points represent individuals with calculated flight height and blue points with an x represent individuals in flight without flight height data. A pie chart inset shows the proportion of individuals flying and sitting. A boxplot inset of flight height distribution by zone is displayed for all birds with known flight heights. Boxplots show the distribution of data among seasons. The dark horizontal line is the median flight height, and the box represents the middle 50% of data values. The lines to the left and right of the box represent the data points that are within 1.5 times the length of the box. Data beyond this range are shown as individual points.

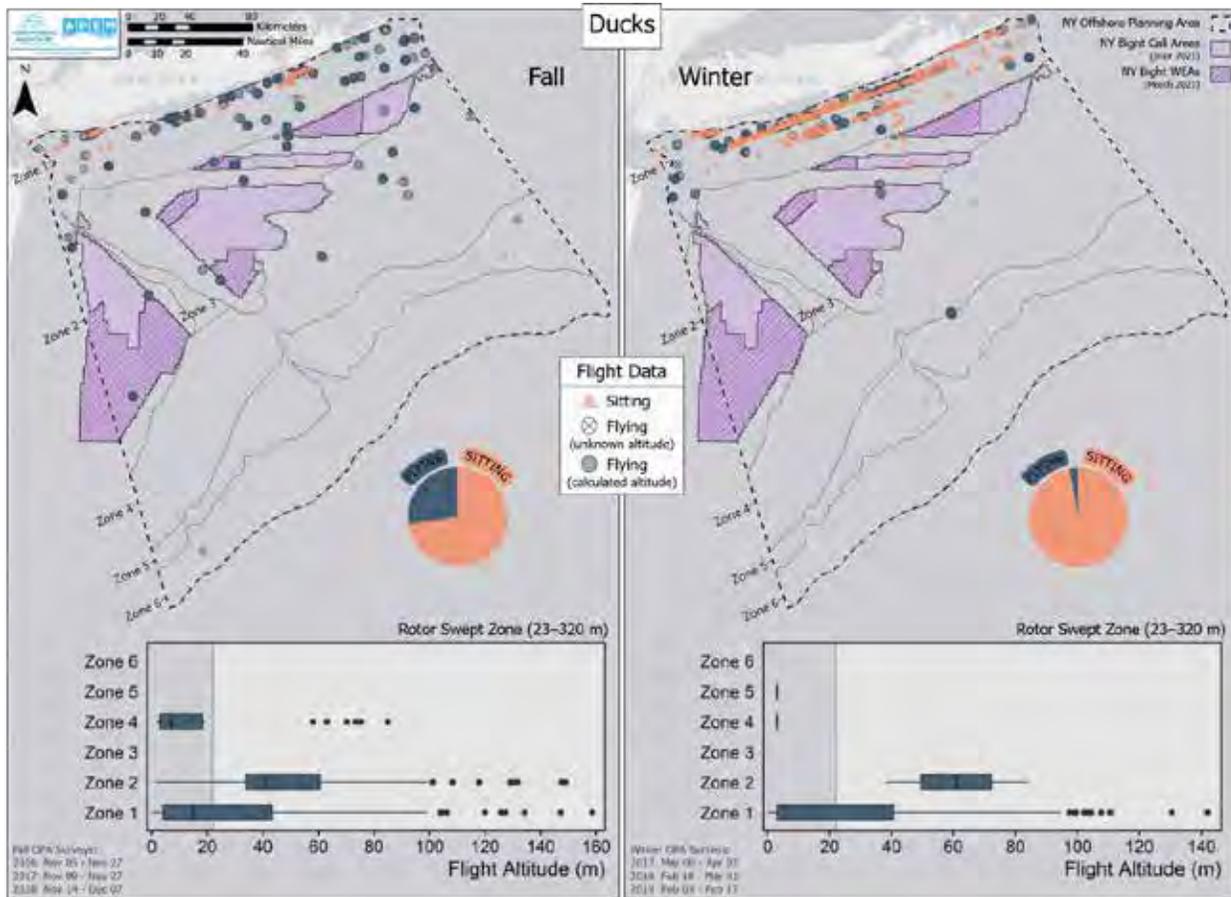


Figure 14. Spatial Distribution of Duck Species Sitting Relative to Birds in Flight During Spring and Summer Surveys

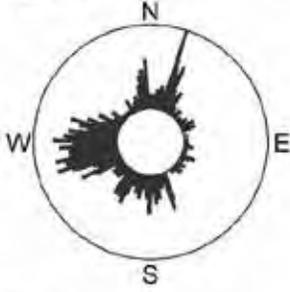
Solid blue points represent individuals with calculated flight height and blue points with an x represent individuals in flight without flight height data. A pie chart inset shows the proportion of individuals flying and sitting. A boxplot inset of flight height distribution by zone is displayed for all birds with known flight heights. Boxplots show the distribution of data among seasons. The dark horizontal line is the median flight height, and the box represents the middle 50% of data values. The lines to the left and right of the box represent the data points that are within 1.5 times the length of the box. Data beyond this range are shown as individual points.



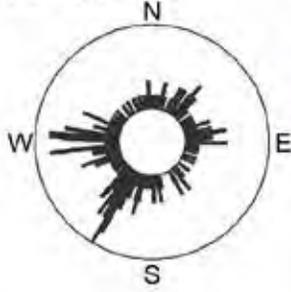
Figure 15. Direction of Travel of All Ducks for All Surveys

Flight Direction: All Ducks

Fall (n = 901)



Winter (n = 235)



Spring (n = 249)

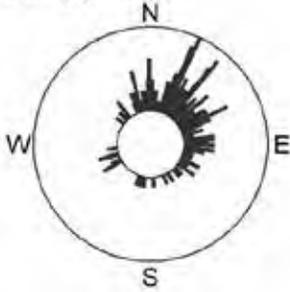


Figure 16. Spatial Distribution of White-winged Scoter During Fall and Winter by Zone and Proximity to Call Areas

Heat map is scaled to the maximum density for the species/species group across all seasons. Inset bar plots display mean estimated densities \pm standard error of the mean for each zone.

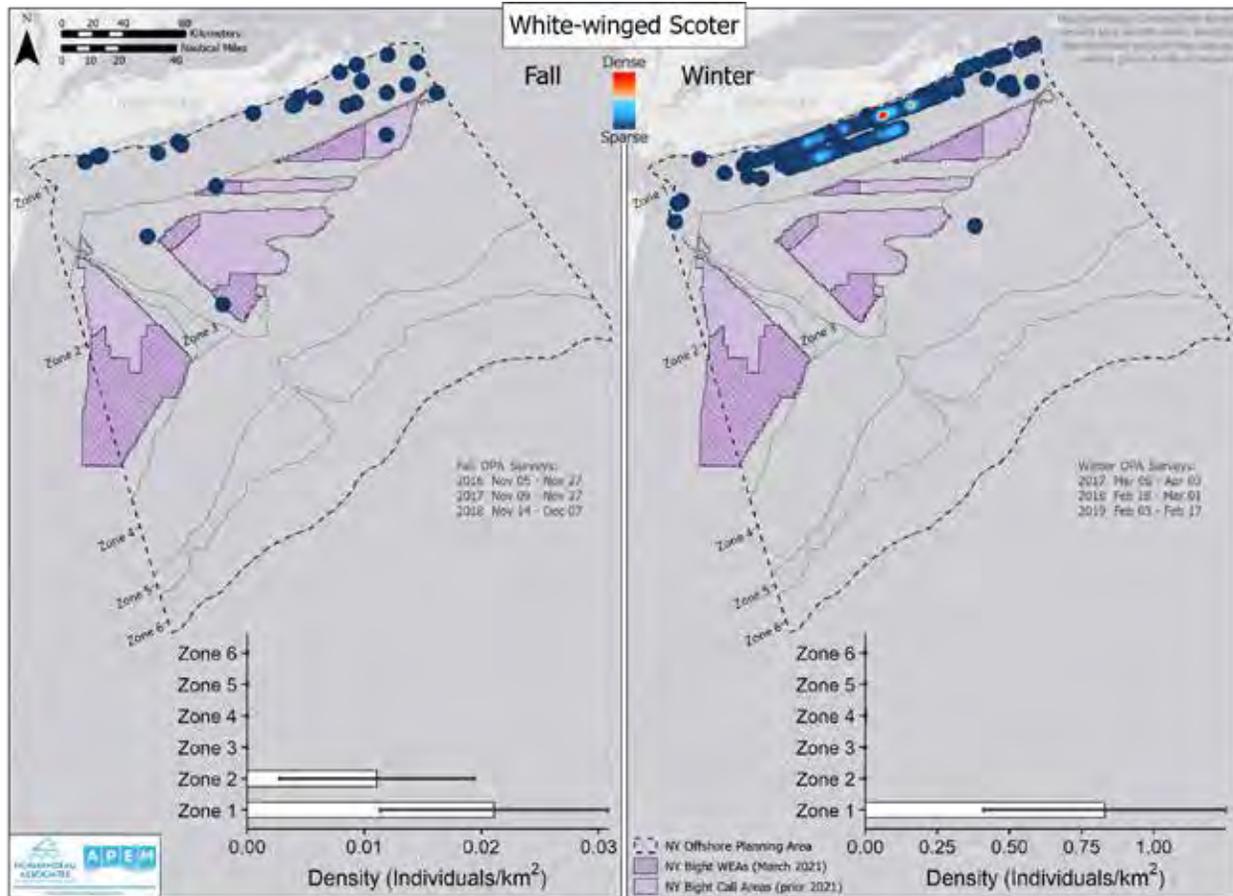


Figure 17. Spatial Distribution of White-winged Scoter During Spring and Summer by Zone and Proximity to Call Areas

Heat map is scaled to the maximum density for the species/species group across all seasons. Inset bar plots display mean estimated densities \pm standard error of the mean for each zone.

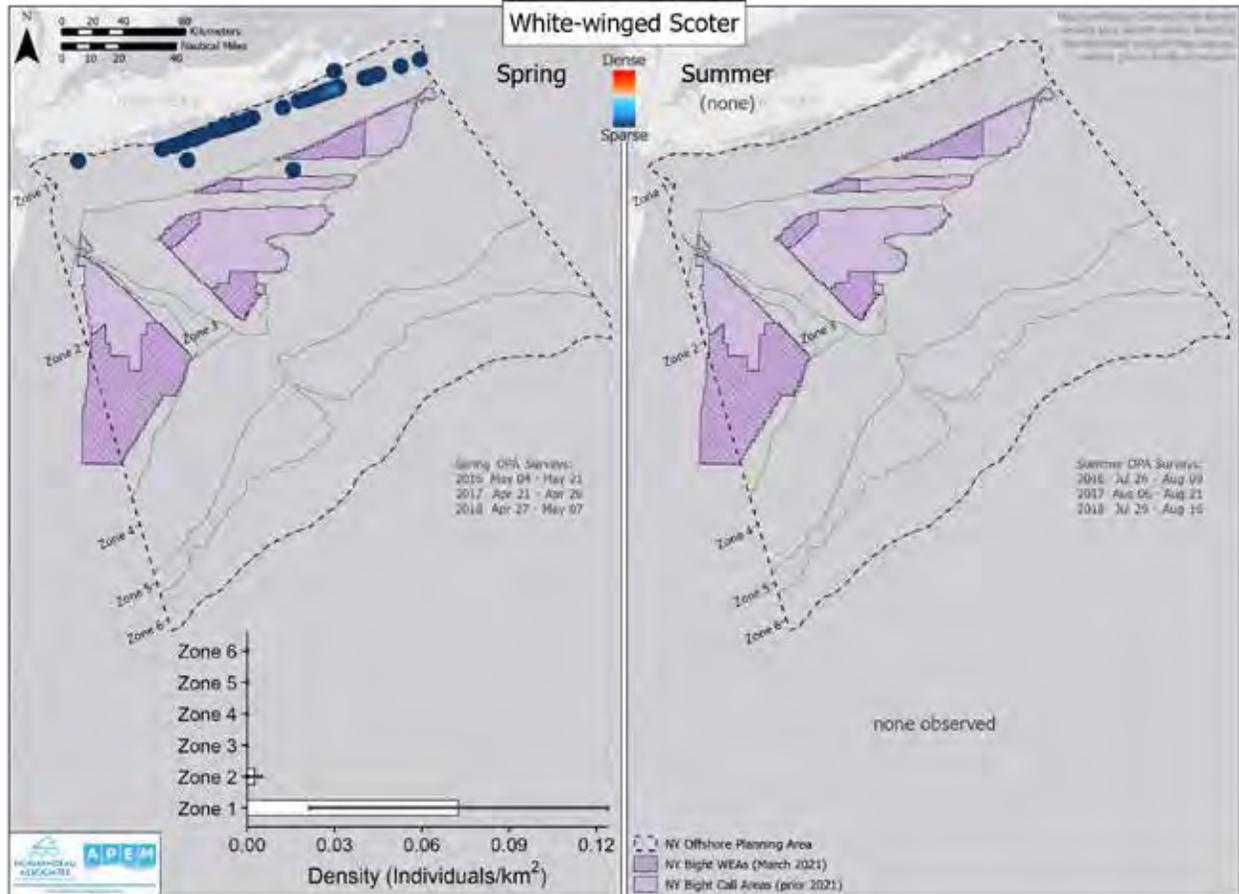


Figure 18. Spatial Distribution of White-winged Scoter Sitting Relative to Birds in Flight During Fall and Winter Surveys

Solid blue points represent individuals with calculated flight height and blue points with an x represent individuals in flight without flight height data. A pie chart inset shows the proportion of individuals flying and sitting. A boxplot inset of flight height distribution by zone is displayed for all birds with known flight heights. Boxplots show the distribution of data among seasons. The dark horizontal line is the median flight height, and the box represents the middle 50% of data values. The lines to the left and right of the box represent the data points that are within 1.5 times the length of the box. Data beyond this range are shown as individual points.

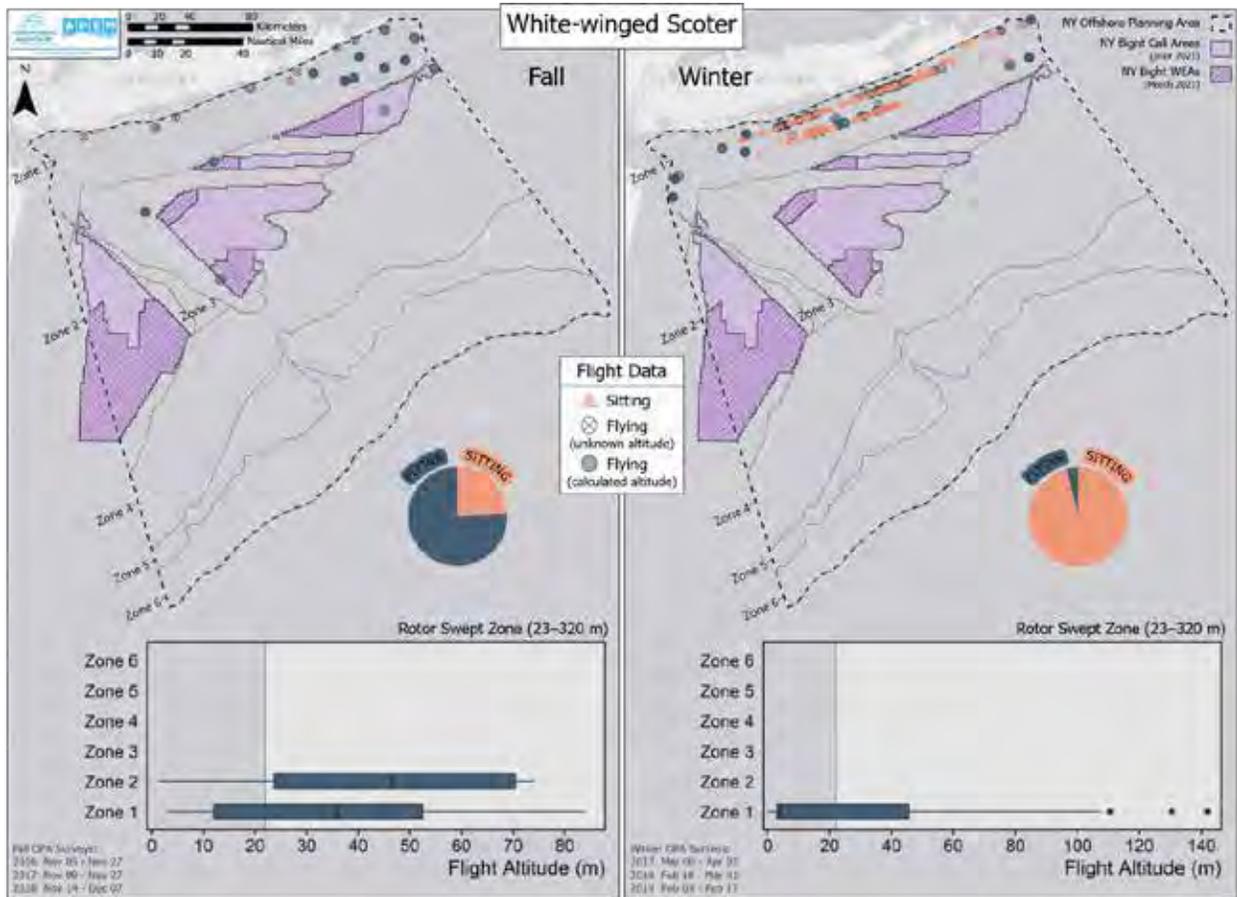


Figure 19. Spatial Distribution of White-winged Scoter Sitting Relative to Birds in Flight During Spring and Summer Surveys

Solid blue points represent individuals with calculated flight height and blue points with an x represent individuals in flight without flight height data. A pie chart inset shows the proportion of individuals flying and sitting. A boxplot inset of flight height distribution by zone is displayed for all birds with known flight heights. Boxplots show the distribution of data among seasons. The dark horizontal line is the median flight height, and the box represents the middle 50% of data values. The lines to the left and right of the box represent the data points that are within 1.5 times the length of the box. Data beyond this range are shown as individual points.

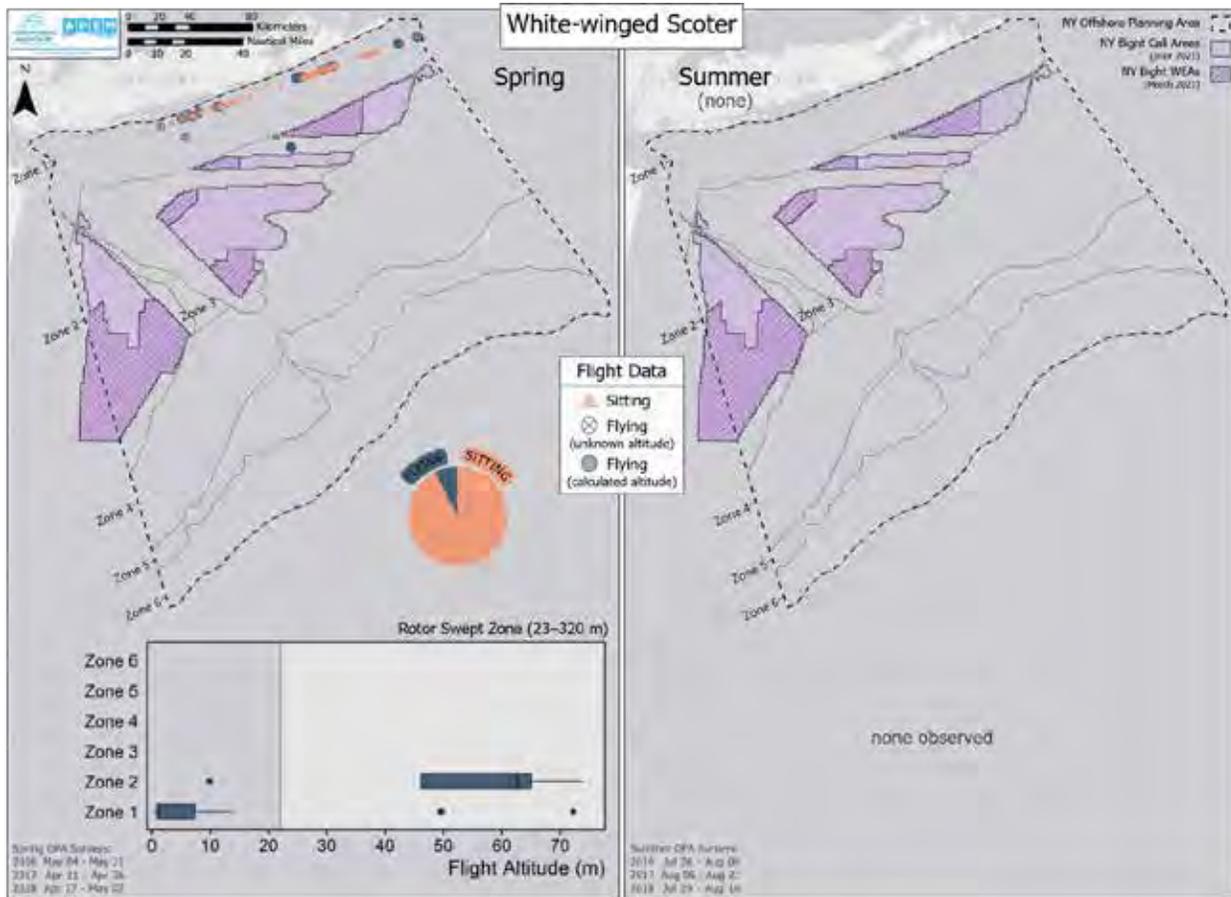


Figure 20. Direction of Flight of White-winged Scoter for All Surveys

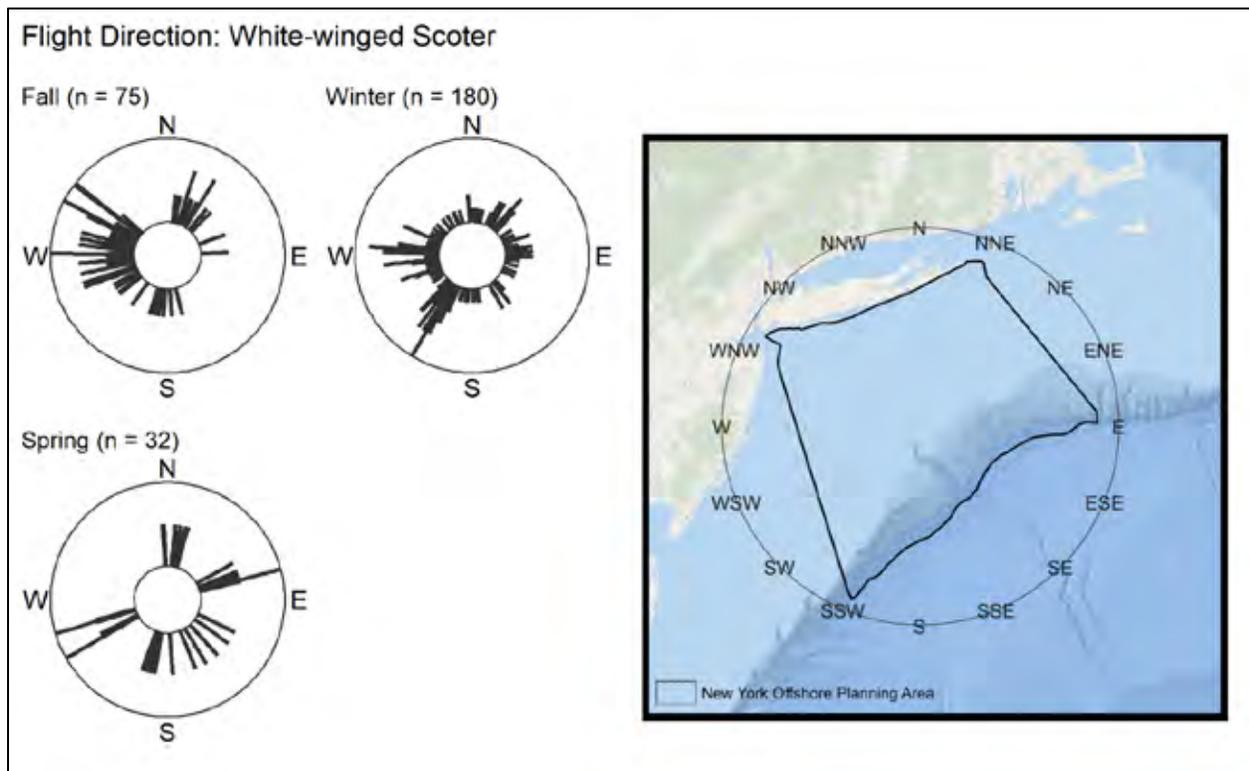


Figure 21. Spatial Distribution of Black Scoter During Fall and Winter by Zone and Proximity to Call Areas

Heat map is scaled to the maximum density for the species/species group across all seasons. Inset bar plots display mean estimated densities \pm standard error of the mean for each zone.

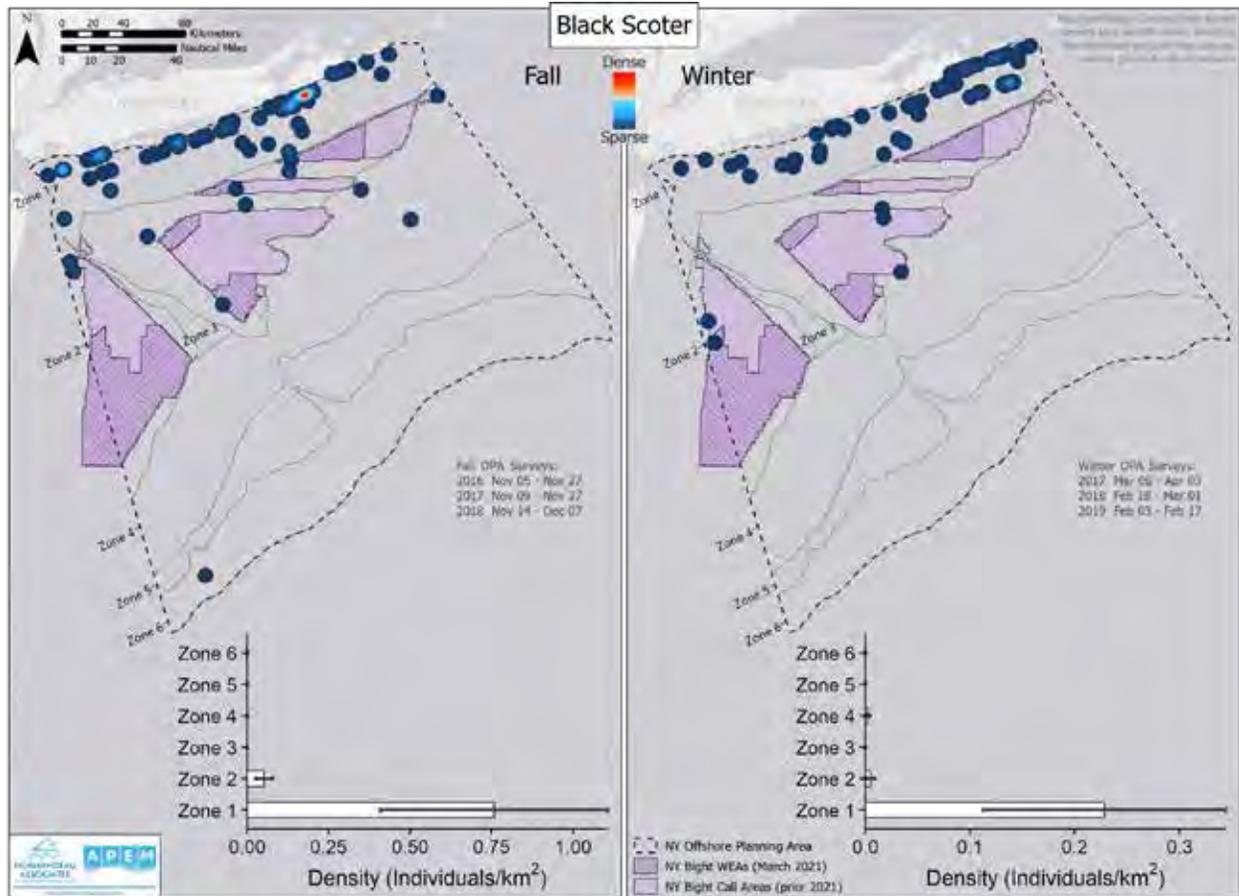


Figure 22. Spatial Distribution of Black Scoter During Spring and Summer by Zone and Proximity to Call Areas

Heat map is scaled to the maximum density for the species/species group across all seasons. Inset bar plots display mean estimated densities \pm standard error of the mean for each zone.

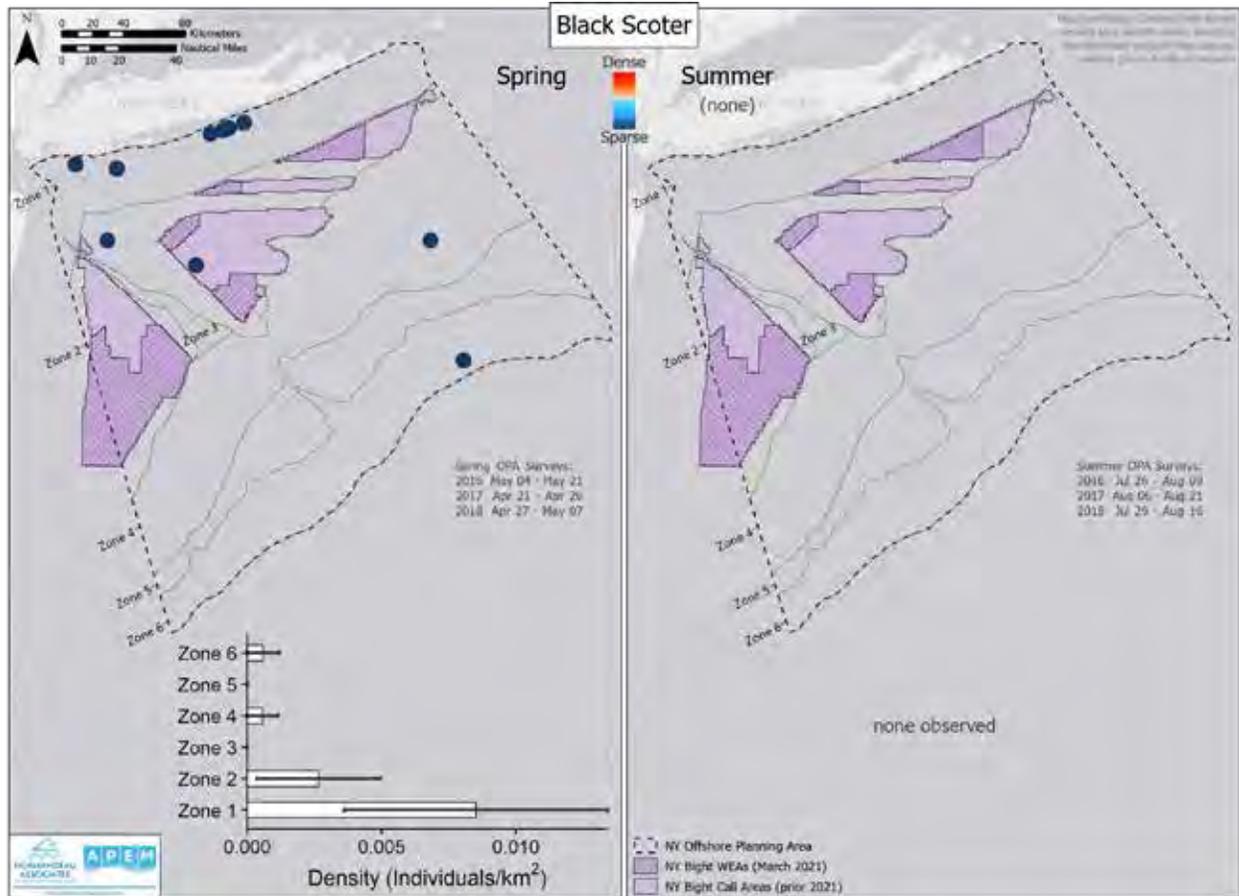


Figure 23. Spatial Distribution of Black Scoter Sitting Relative to Birds in Flight During Fall and Winter Surveys

Solid blue points represent individuals with calculated flight height and blue points with an x represent individuals in flight without flight height data. A pie chart inset shows the proportion of individuals flying and sitting. A boxplot inset of flight height distribution by zone is displayed for all birds with known flight heights. Boxplots show the distribution of data among seasons. The dark horizontal line is the median flight height, and the box represents the middle 50% of data values. The lines to the left and right of the box represent the data points that are within 1.5 times the length of the box. Data beyond this range are shown as individual points.

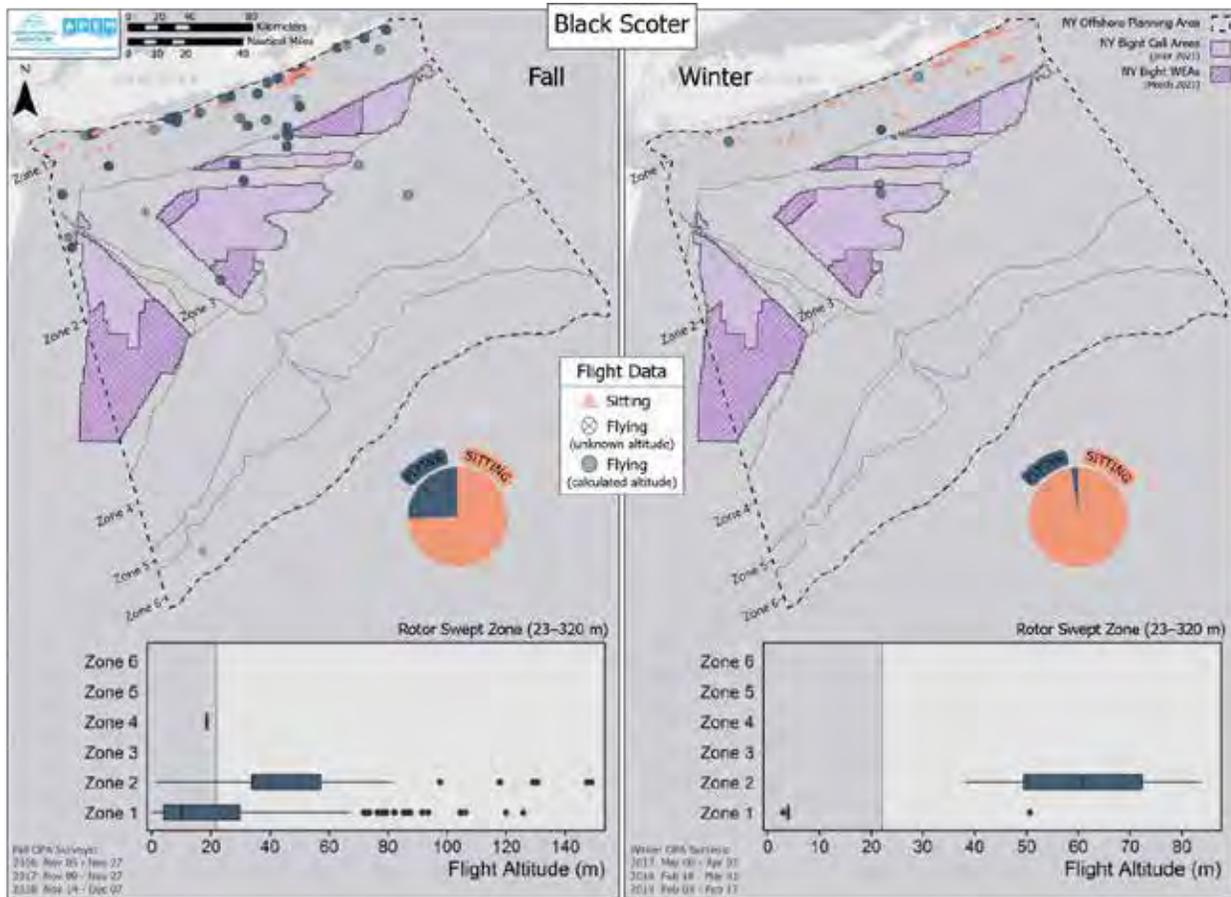


Figure 24. Spatial Distribution of Black Scoter Sitting Relative to Birds in Flight During Spring and Summer Surveys

Solid blue points represent individuals with calculated flight height and blue points with an x represent individuals in flight without flight height data. A pie chart inset shows the proportion of individuals flying and sitting. A boxplot inset of flight height distribution by zone is displayed for all birds with known flight heights. Boxplots show the distribution of data among seasons. The dark horizontal line is the median flight height, and the box represents the middle 50% of data values. The lines to the left and right of the box represent the data points that are within 1.5 times the length of the box. Data beyond this range are shown as individual points.

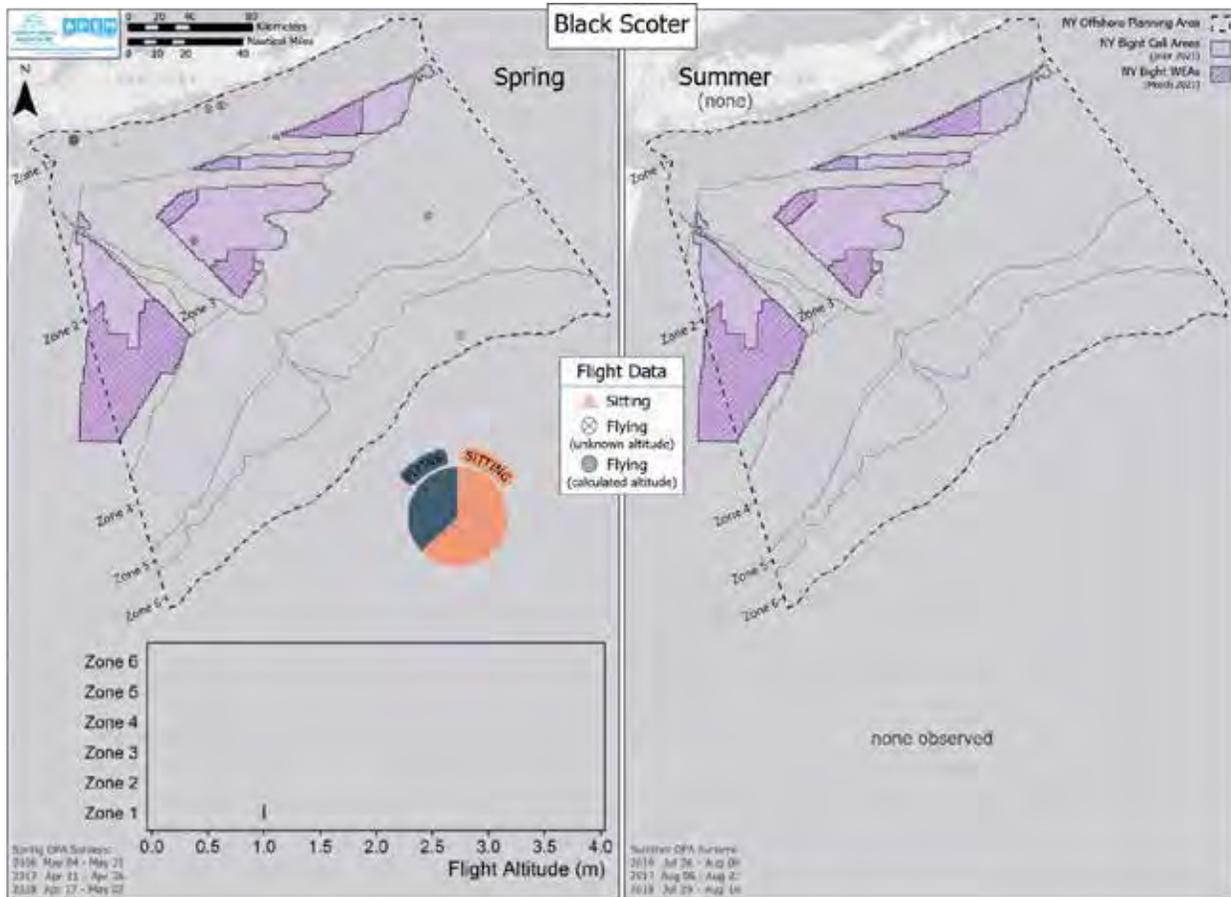


Figure 25. Direction of Flight of Black Scoter for All Surveys

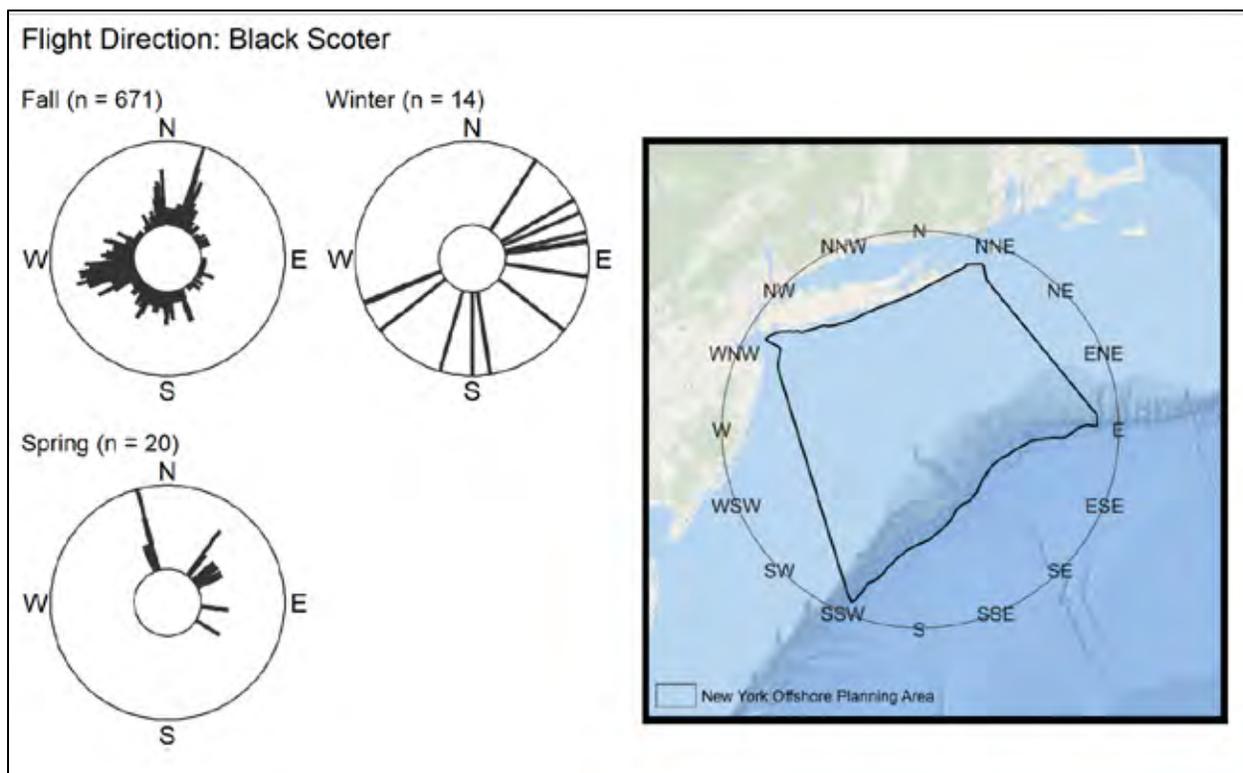


Figure 26. Spatial Distribution of Long-tailed Duck During Fall and Winter by Zone and Proximity to Call Areas

Heat map is scaled to the maximum density for the species/species group across all seasons. Inset bar plots display mean estimated densities \pm standard error of the mean for each zone.

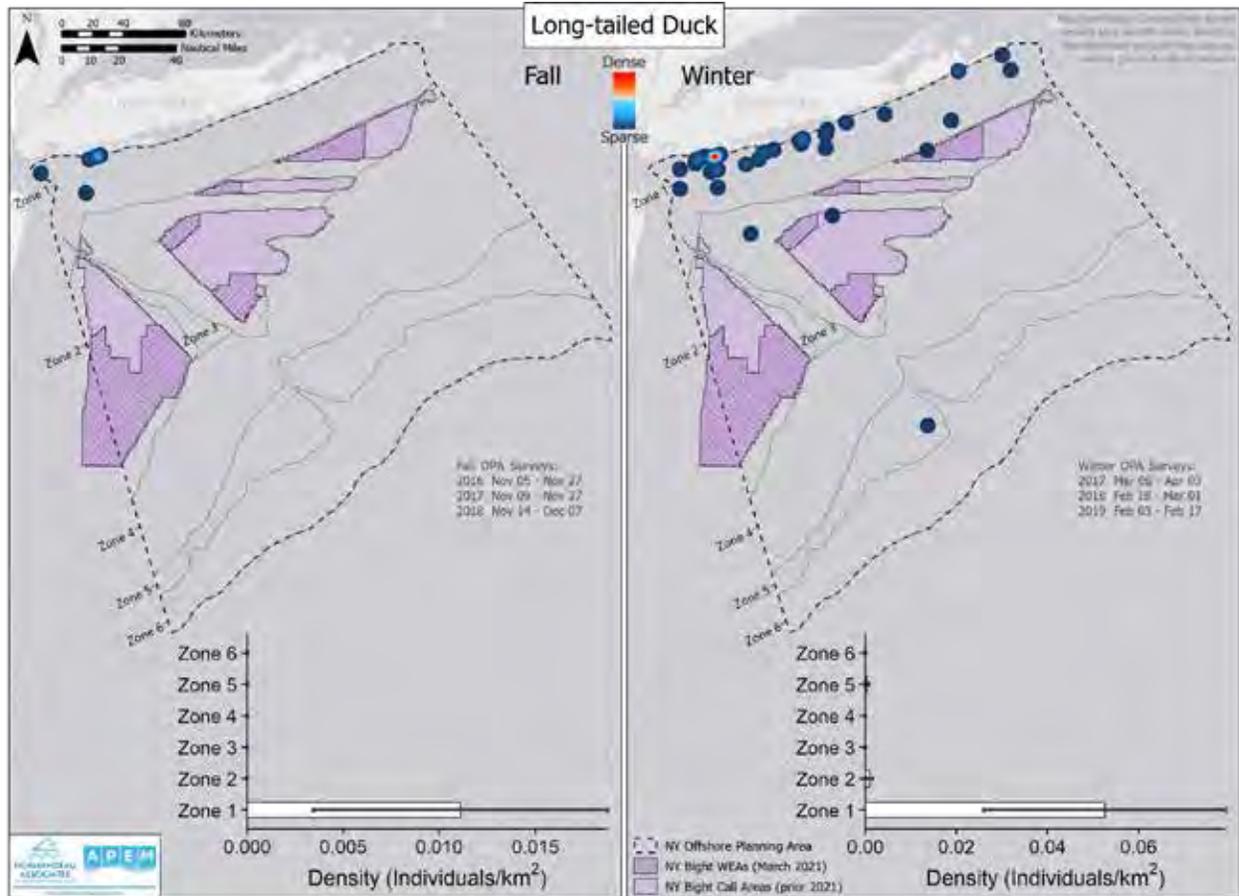


Figure 27. Spatial Distribution of Long-tailed Duck During Spring and Summer by Zone and Proximity to Call Areas

Heat map is scaled to the maximum density for the species/species group across all seasons. Inset bar plots display mean estimated densities \pm standard error of the mean for each zone.

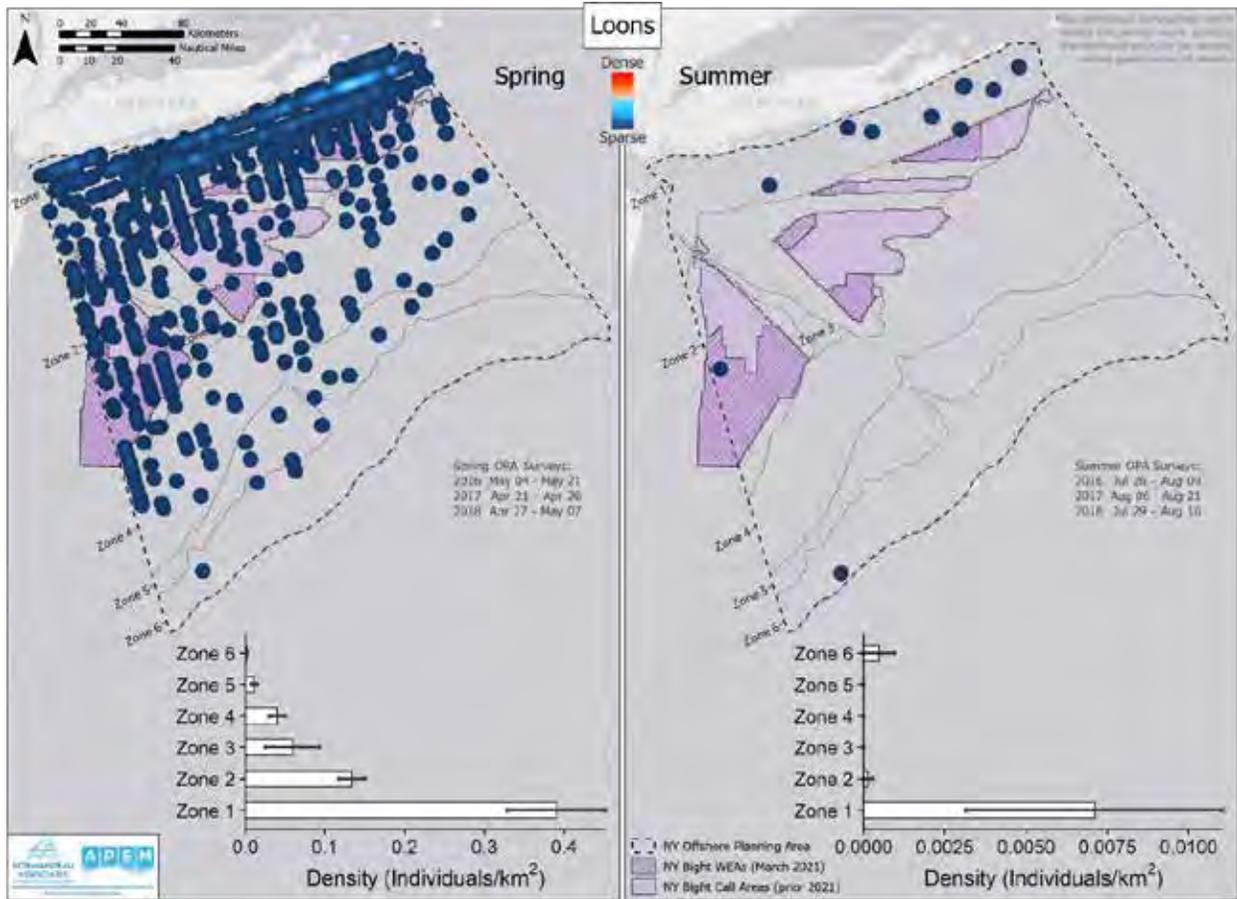


Figure 28. Spatial Distribution of Long-tailed Duck Sitting Relative to Birds in Flight During Fall and Winter Surveys

Solid blue points represent individuals with calculated flight height and blue points with an x represent individuals in flight without flight height data. A pie chart inset shows the proportion of individuals flying and sitting. A boxplot inset of flight height distribution by zone is displayed for all birds with known flight heights. Boxplots show the distribution of data among seasons. The dark horizontal line is the median flight height, and the box represents the middle 50% of data values. The lines to the left and right of the box represent the data points that are within 1.5 times the length of the box. Data beyond this range are shown as individual points.

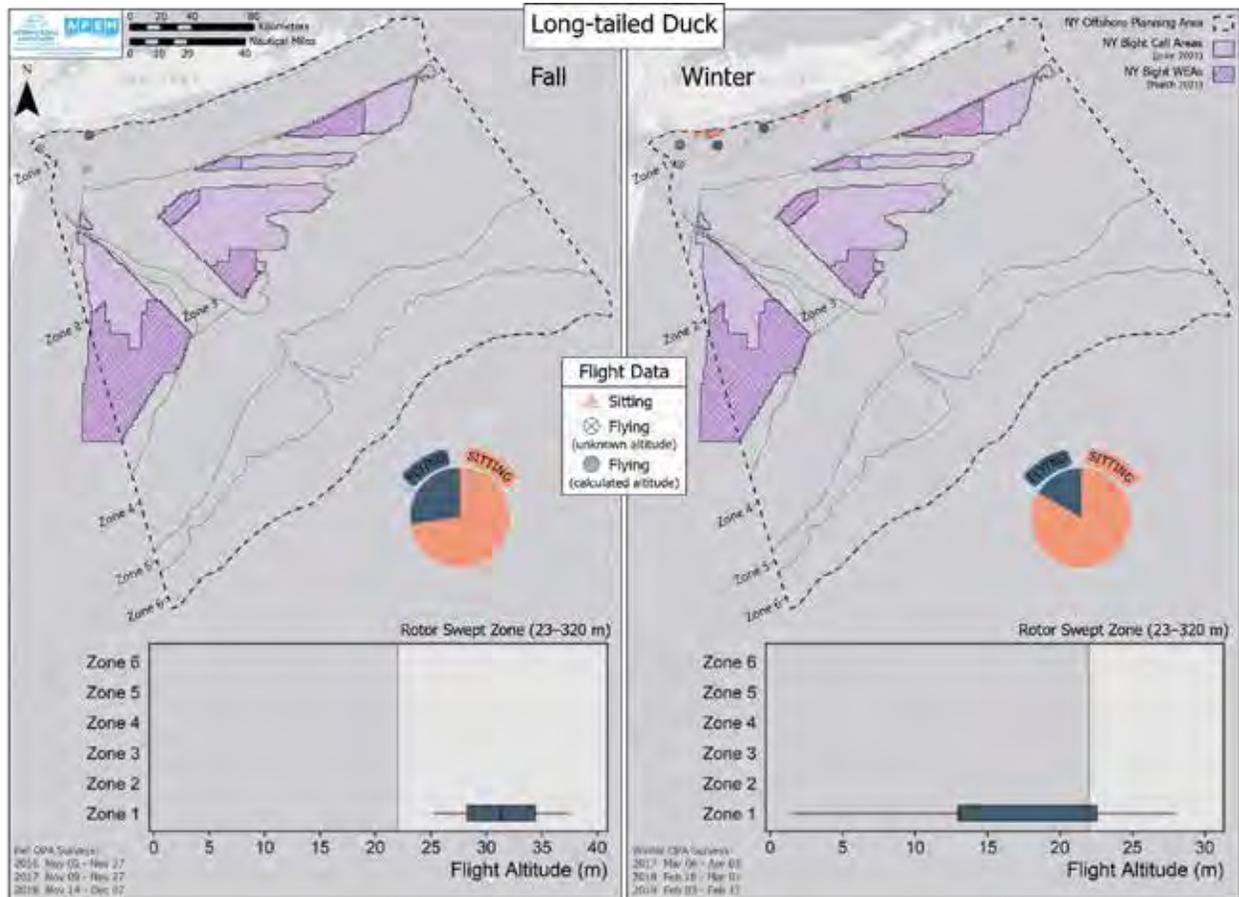


Figure 29. Spatial Distribution of Long-tailed Duck Sitting Relative to Birds in Flight During Spring and Summer Surveys

Solid blue points represent individuals with calculated flight height and blue points with an x represent individuals in flight without flight height data. A pie chart inset shows the proportion of individuals flying and sitting.

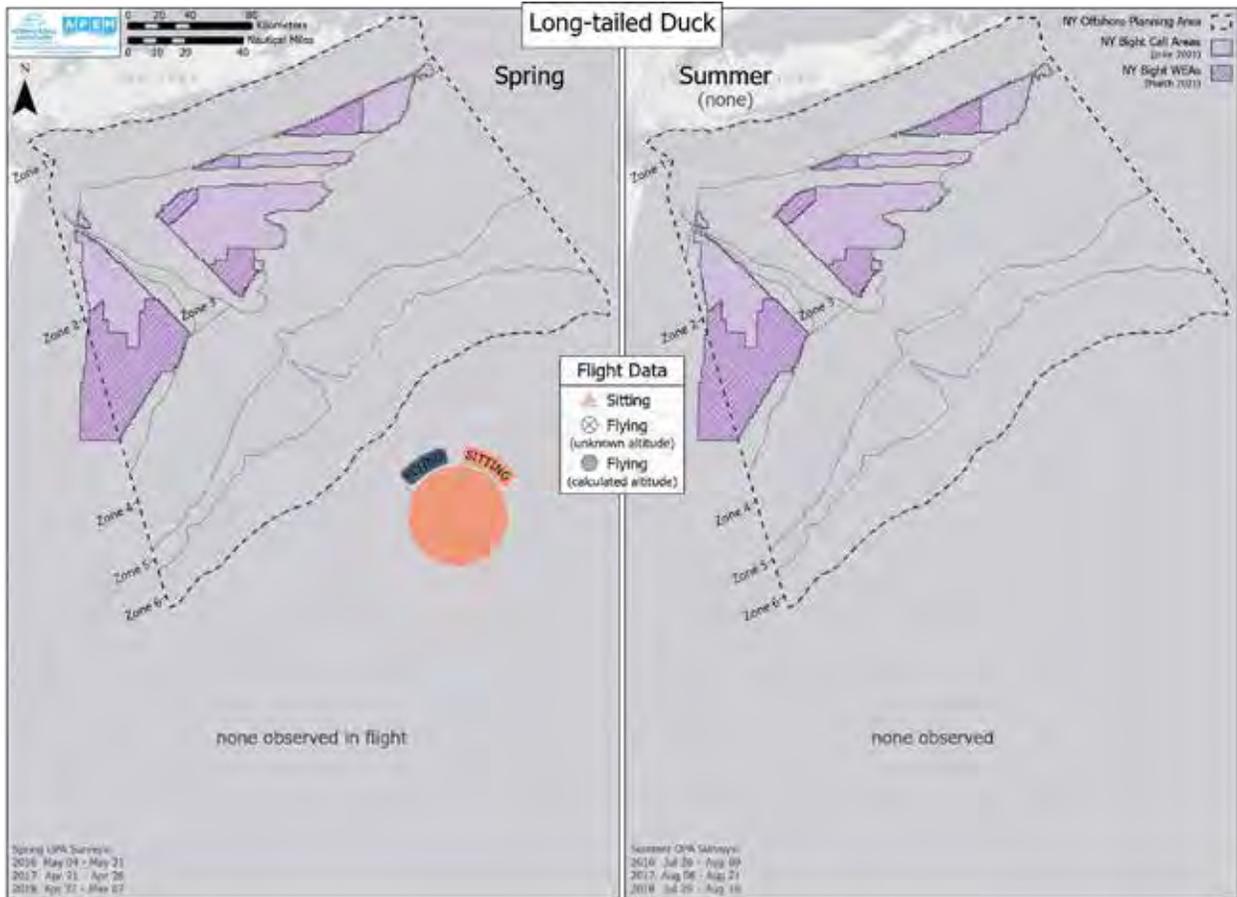


Figure 30. Direction of Flight of Long-tailed Ducks for All Surveys

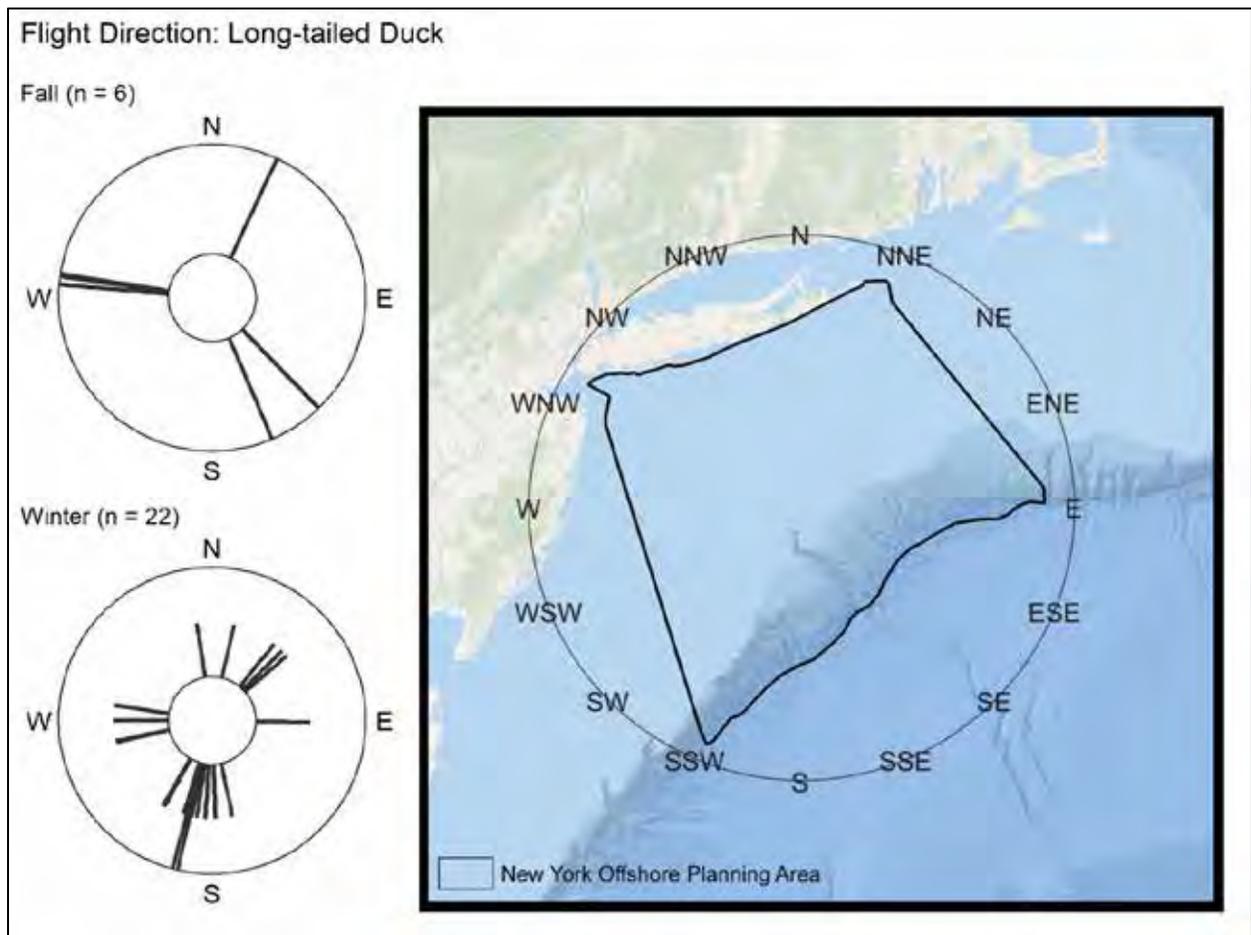


Figure 31. Spatial Distribution of Bufflehead During Fall and Winter by Zone and Proximity to Call Areas

Heat map is scaled to the maximum density for the species/species group across all seasons. Inset bar plots display mean estimated densities \pm standard error of the mean for each zone.

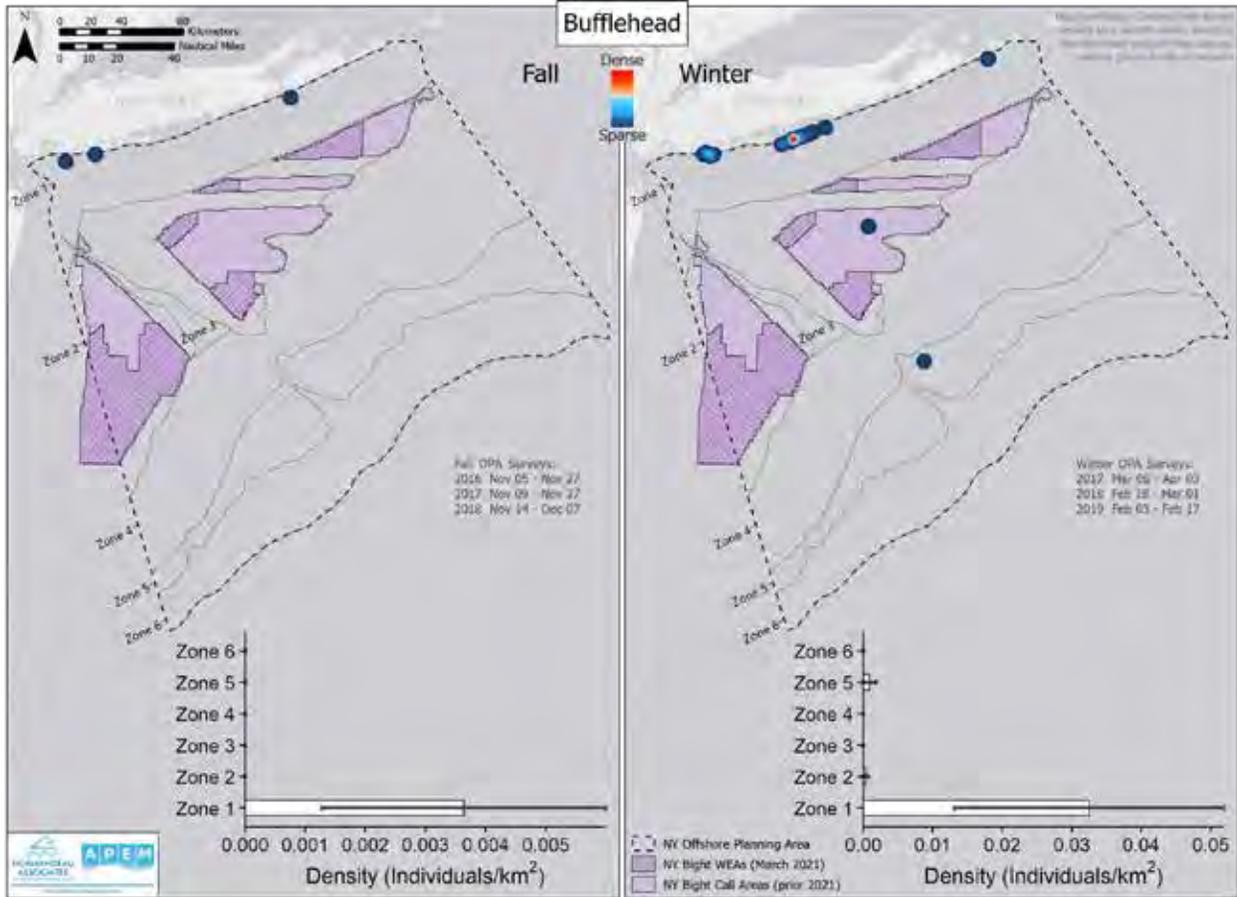


Figure 32. Spatial Distribution of Bufflehead Sitting Relative to Birds in Flight During Fall and Winter Surveys

Solid blue points represent individuals with calculated flight height and blue points with an x represent individuals in flight without flight height data. A pie chart inset shows the proportion of individuals flying and sitting. A boxplot inset of flight height distribution by zone is displayed for all birds with known flight heights. Boxplots show the distribution of data among seasons. The dark horizontal line is the median flight height, and the box represents the middle 50% of data values. The lines to the left and right of the box represent the data points that are within 1.5 times the length of the box. Data beyond this range are shown as individual points.

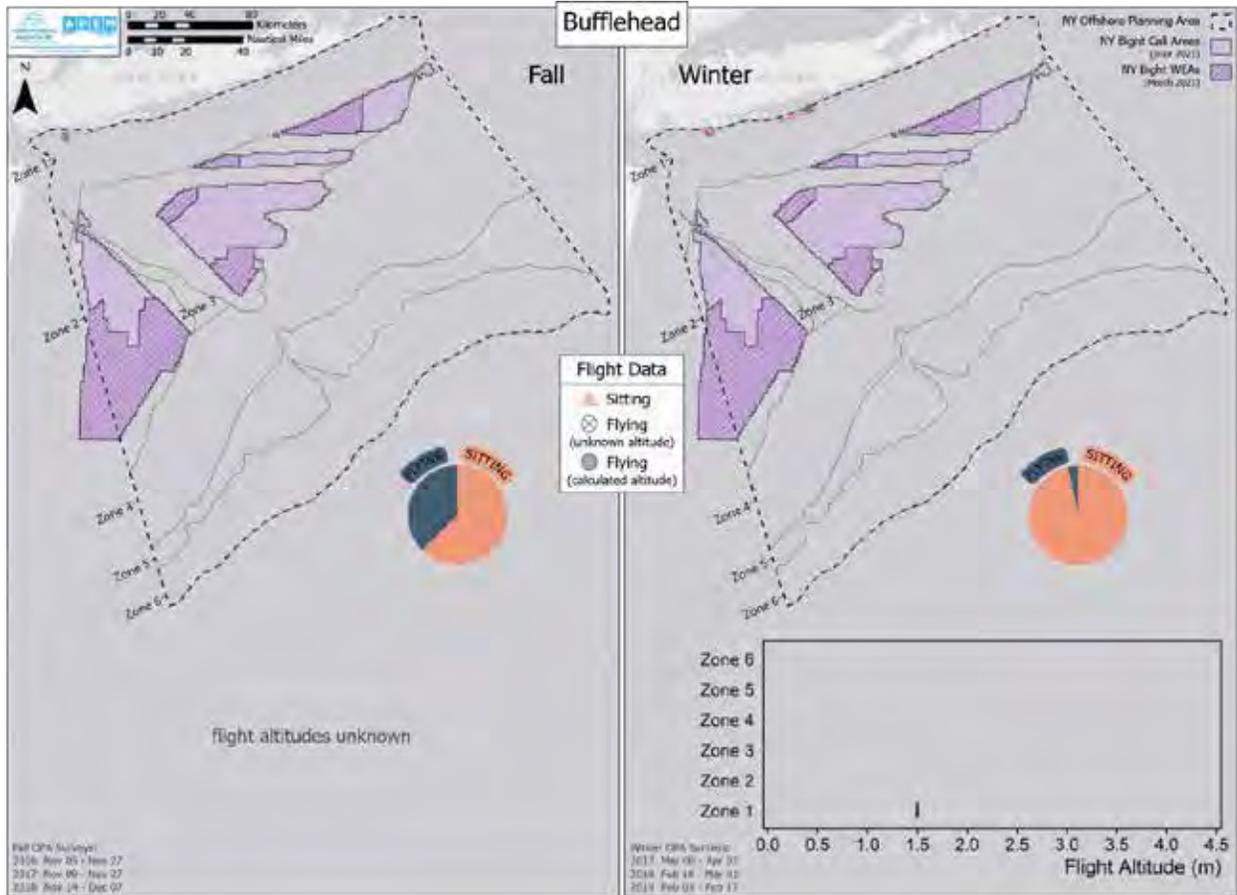


Figure 33. Direction of Flight of Buffleheads for All Surveys

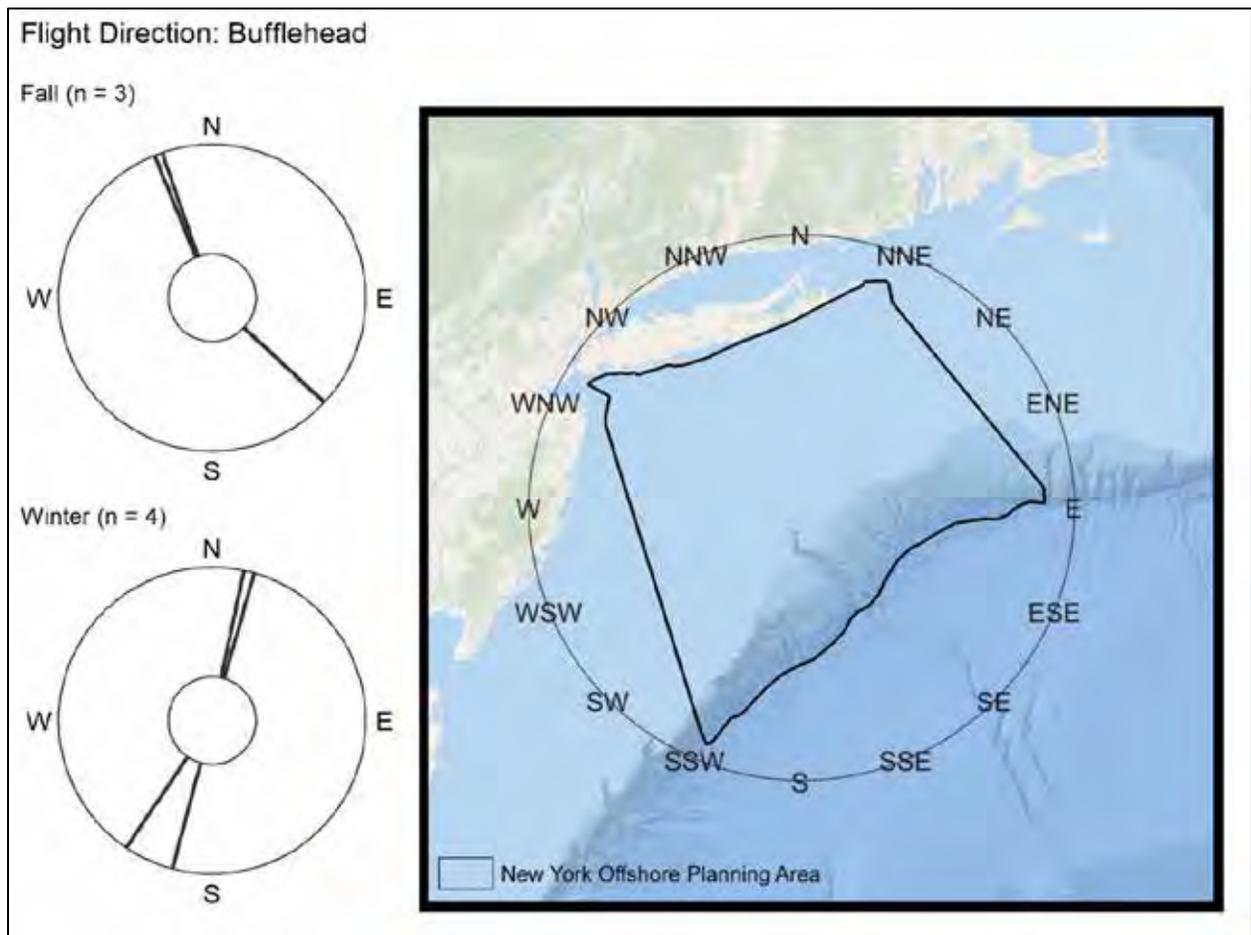
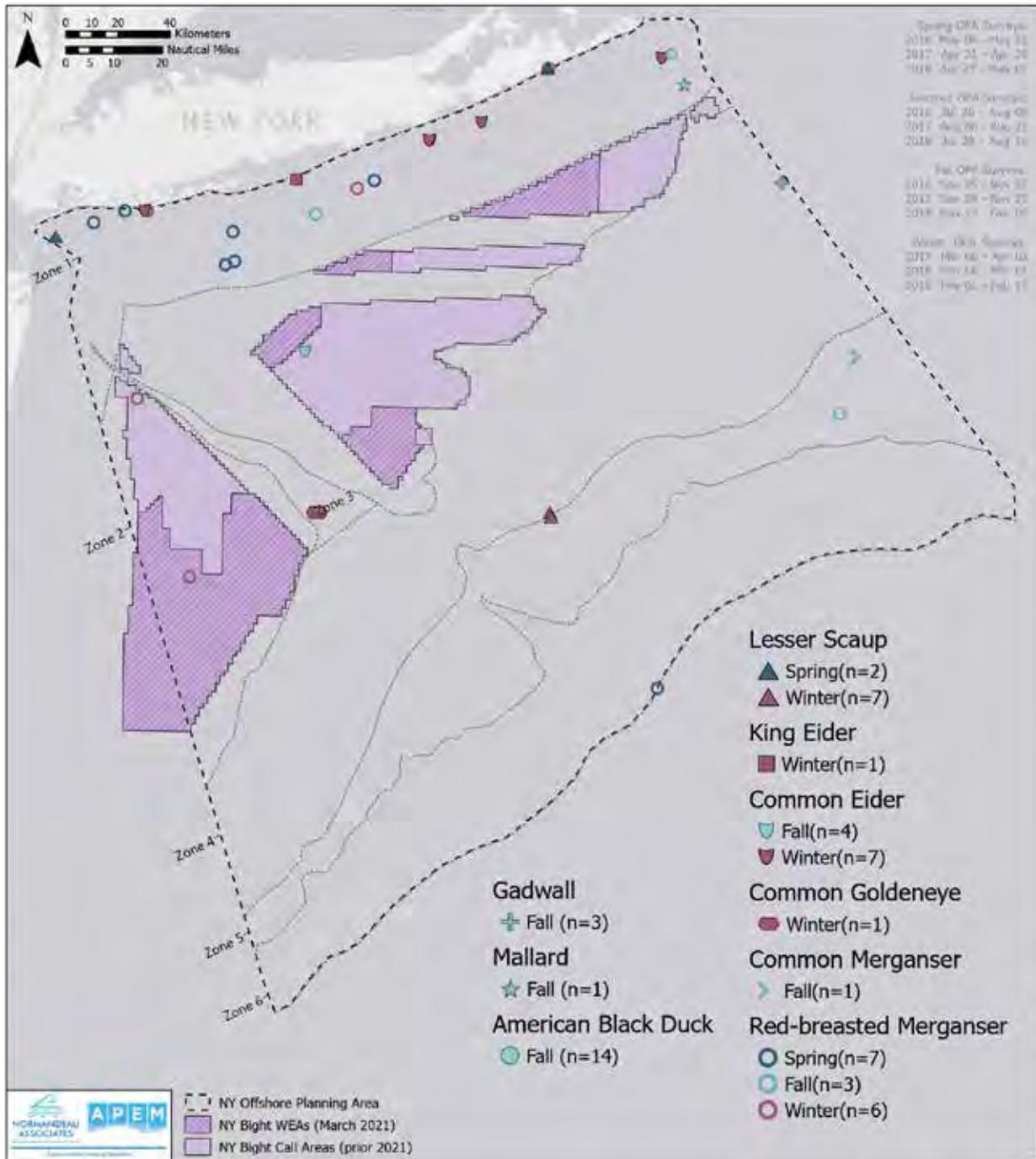


Figure 34. Spatial Distribution of Duck Species with Fewer than 30 Occurrences Across All Surveys



2.5.5 Loon

The loon taxonomic grouping included individuals classified as loon-species unknown (n=93), red-throated loon (n=1,378), and common loon (n=2,601). Loon were observed 4,072 times. The number of observations were distributed relatively even across Fall (n=1,383), Winter (n=1,131), and Spring (n=1,544) surveys, but had disproportionately fewer observations in Summer (n=14) (Appendix B, Figure 35, Figure 36). Across all seasons, loon mean density was greatest in Zone 1, highest of which was observed during Spring surveys ($\bar{x} = 0.39 \pm 0.06$ birds/km²) (Figure 35). Loon had consistently lower mean density estimates in Zones 5 and 6 relative to the OPA in all seasons except for Summer, which had low density estimates for all zones (Figure 35, Figure 36).

The greatest proportion of individuals observed in flight was in the Fall (37%). In the Winter and Spring only 10% and 9% of observations were of birds in flight (Figure 37, Figure 38). In Fall and Spring, median flight height was consistently within the RSZ in all 6 zones, ranging between 35 and 110 m above sea level (Figure 37, Figure 38). In the Winter, median flight height was below the RSZ in Zones 1 and 4. In the Summer, all individuals were observed sitting. In the Fall, birds exhibited a pattern of westerly flight, and in the Spring, birds exhibited a slight pattern of northeasterly flight heading (Figure 39).

2.5.5.1 Red-throated Loon

In Fall (n=703), Winter (n= 364), and Spring (n=630), red-throated loon concentrated in Zones 1, 2, and 4 (Appendix B, Figure 40, Figure 41). Across all seasons, mean density was greatest in Zone 1, ranging between $\bar{x} = 0.05 \pm 0.01$ birds/km² during the Spring and $\bar{x} = 0.16 \pm 0.06$ birds/km² during the Fall (Figure 40, Figure 41). In Fall, 50% of individuals were observed in flight compared to 25% in Winter and 23% in Spring. In Fall, Winter, and Spring median flight height was consistently within the RSZ in all zones, ranging between 35 and 110 m above sea level (Figure 42, Figure 43). No red-throated loon were observed in the Summer (Figure 42, Figure 43). In the Fall, birds preferred a westerly flight heading with no clear pattern of flight heading in the Winter. In the Spring, birds exhibited a slight pattern of northeasterly flight heading (Figure 44).

2.5.5.2 Common Loon

Common loon were widely distributed but concentrated in Zones 1, 2, and 4 in Fall (n=630) and in Zones 1 and 2 in Winter (n=745) and Spring (n=1,214) (Appendix B, Figure 45, Figure 46). Across all seasons, loon mean density was greatest in Zone 1, which was highest during Spring surveys ($\bar{x} = 0.32 \pm 0.06$ birds/km²) (Figure 45, Figure 46). In the Fall, 25% of birds were observed in flight. In the Winter only 4% common loon were observed in flight, and in the Spring, only 6% were flying (Figure 47, Figure 48). In Fall and Spring, median flight height in all zones was within the RSZ ranging between 35 and 80 m (considering zones with greater than one in-flight observation), and in Winter flight altitude was below the RSZ for all zones. In Summer (n=12) all individuals were observed sitting (Figure 47, Figure 48). In the Fall, the birds observed in flight showed a pattern of southwesterly flight heading (Figure 49).

Figure 35. Spatial Distribution of Loon Species During Fall and Winter by Zone and Proximity to Call Areas

Heat map is scaled to the maximum density for the species/species group across all seasons. Inset bar plots display mean estimated densities \pm standard error of the mean for each zone.

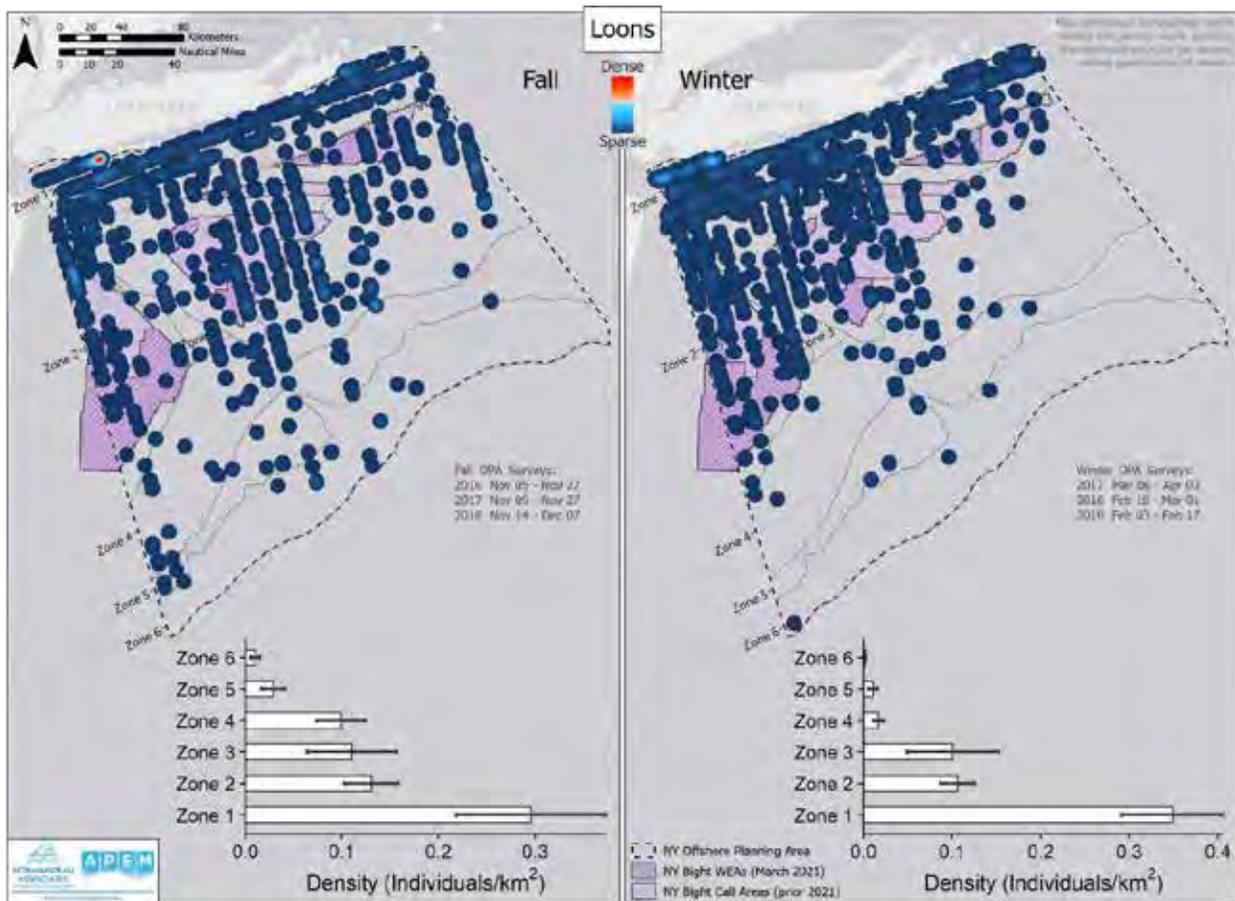


Figure 36. Spatial Distribution of Loon Species During Spring and Summer by Zone and Proximity to Call Areas

Heat map is scaled to the maximum density for the species/species group across all seasons. Inset bar plots display mean estimated densities \pm standard error of the mean for each zone.

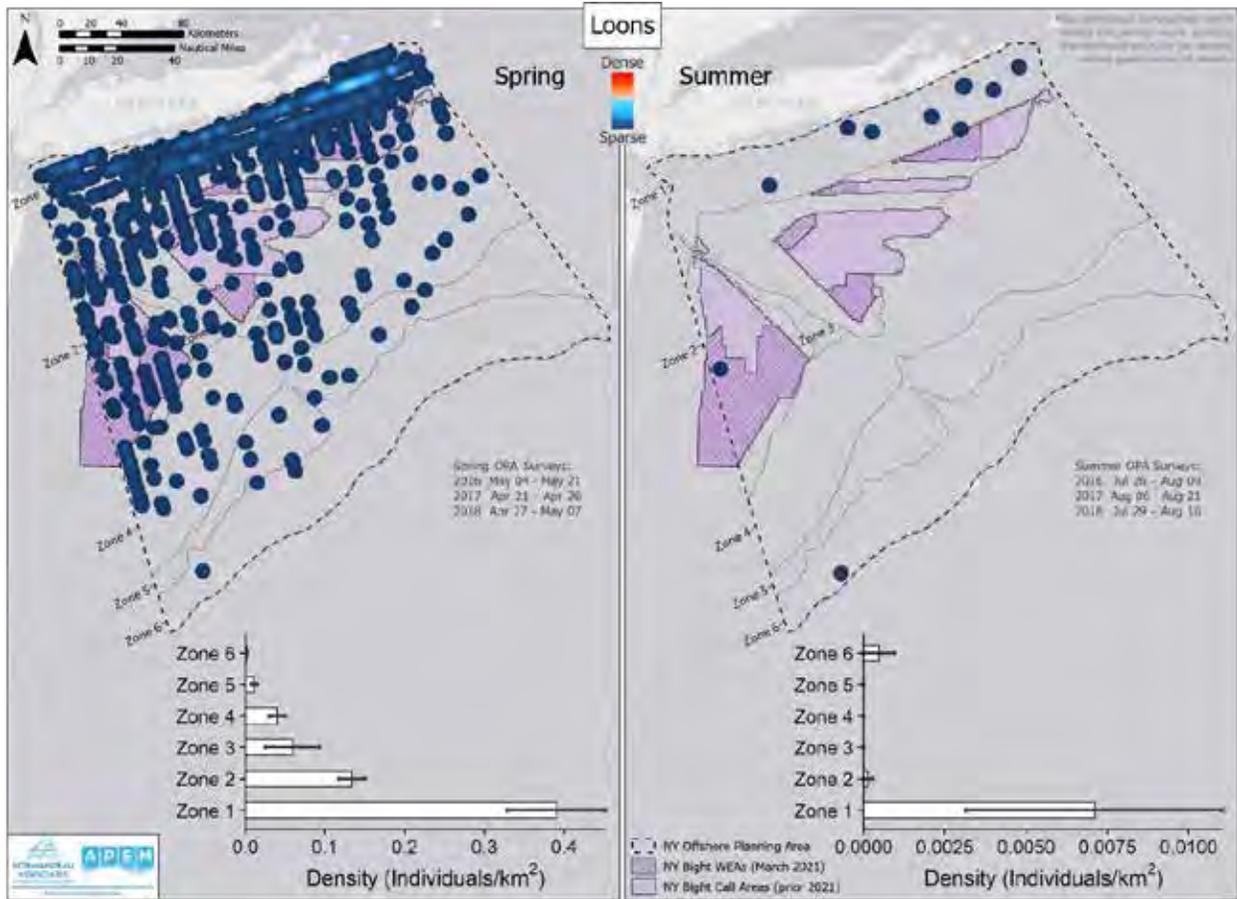


Figure 37. Spatial Distribution of Loons Sitting Relative to Birds in Flight During Fall and Winter Surveys

Solid blue points represent individuals with calculated flight height and blue points with an x represent individuals in flight without flight height data. A pie chart inset shows the proportion of individuals flying and sitting. A boxplot inset of flight height distribution by zone is displayed for all birds with known flight heights. Boxplots show the distribution of data among seasons. The dark horizontal line is the median flight height, the box represents the middle 50% of data values. The lines to the left and right of the box represent the data points that are within 1.5 times the length of the box. Data beyond this range are shown as individual points.

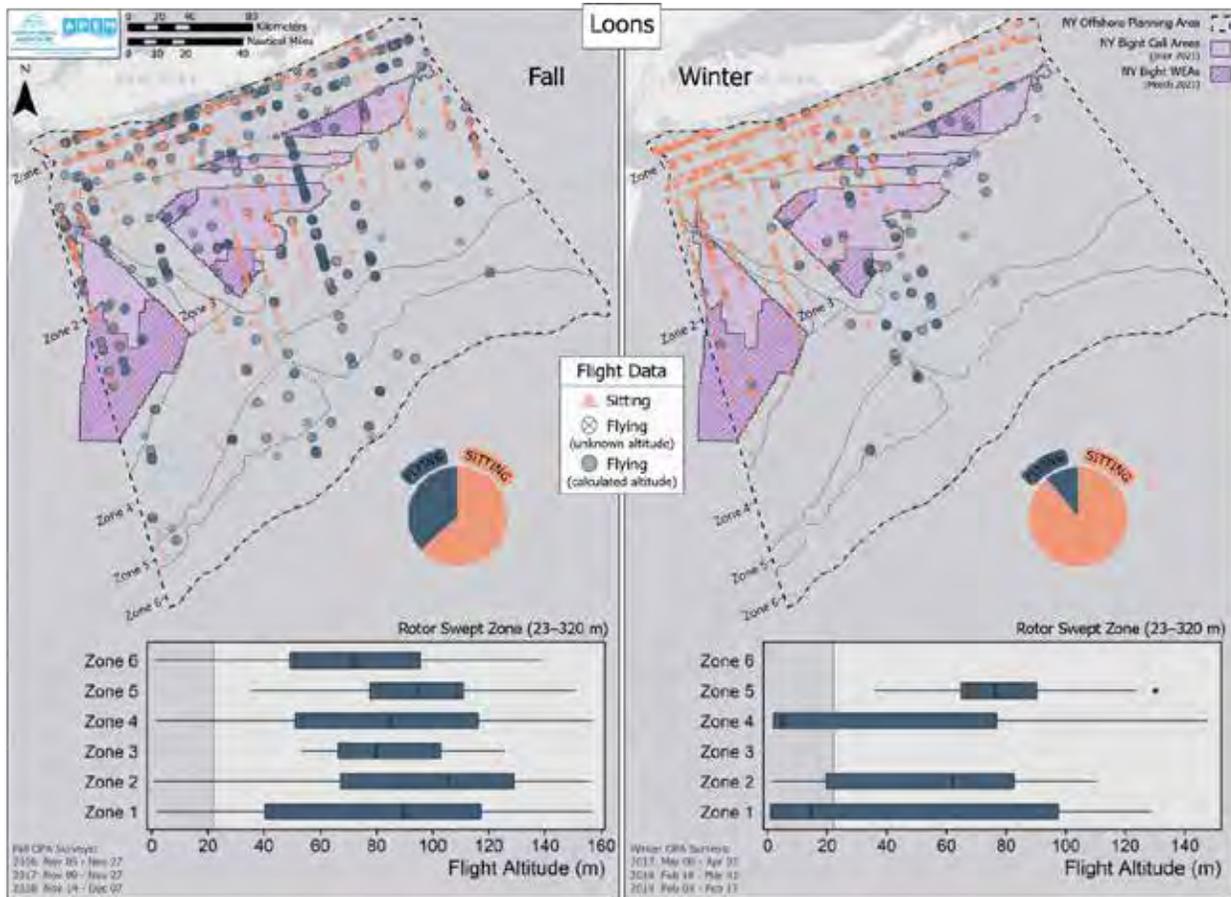


Figure 38. Spatial Distribution of Loons Sitting Relative to Birds in Flight During Spring and Summer Surveys

Solid blue points represent individuals with calculated flight height and blue points with an x represent individuals in flight without flight height data. A pie chart inset shows the proportion of individuals flying and sitting. A boxplot inset of flight height distribution by zone is displayed for all birds with known flight heights. Boxplots show the distribution of data among seasons. The dark horizontal line is the median flight height, and the box represents the middle 50% of data values. The lines to the left and right of the box represent the data points that are within 1.5 times the length of the box. Data beyond this range are shown as individual points.

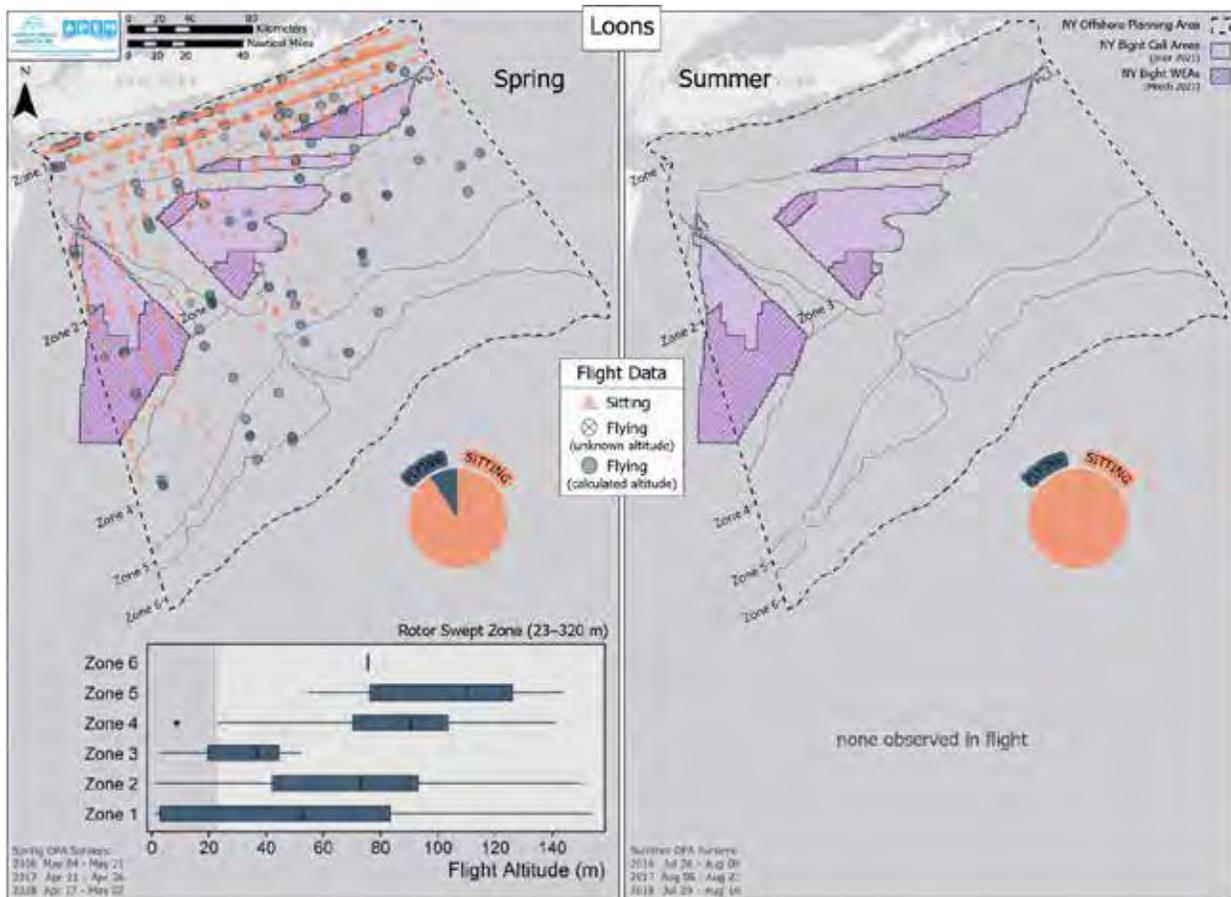


Figure 39. Direction of Flight of All Loons for All Surveys

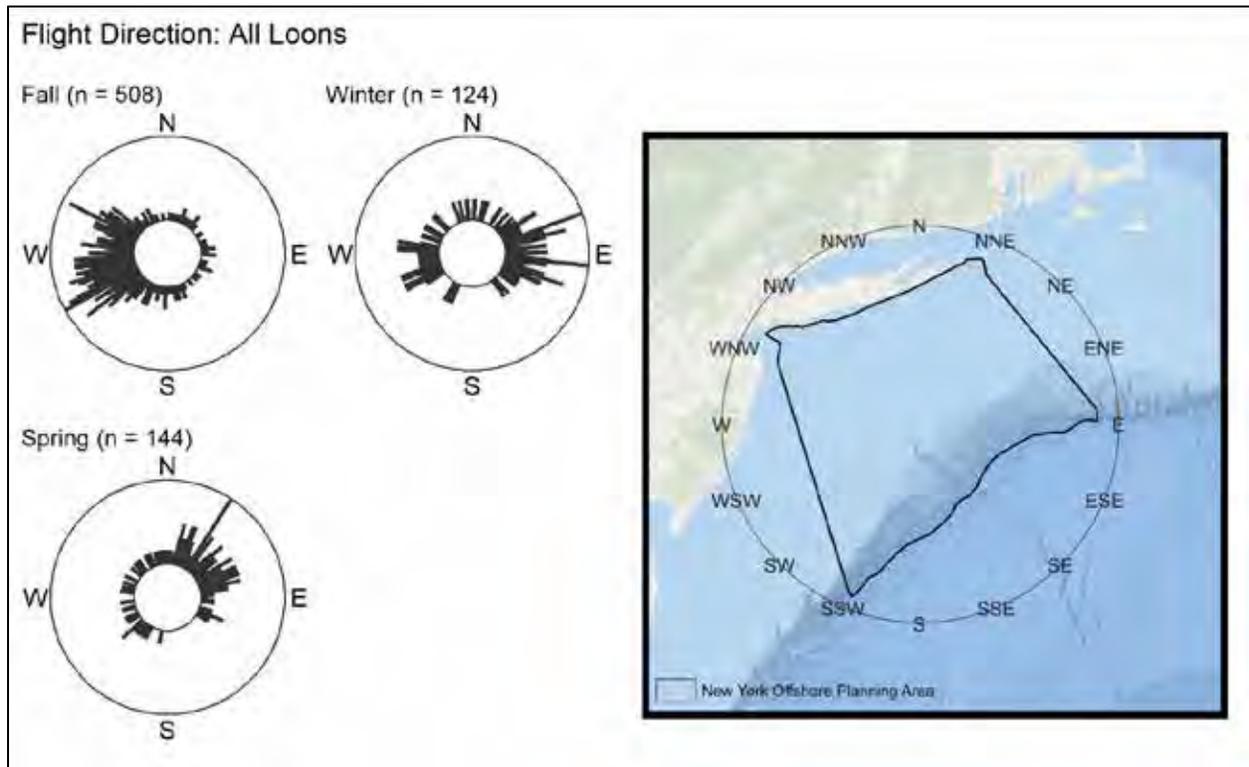


Figure 40. Spatial Distribution of Red-throated Loons During Fall and Winter by Zone and Proximity to Call Areas

Heat map is scaled to the maximum density for the species/species group across all seasons. Inset bar plots display mean estimated densities \pm standard error of the mean for each zone.

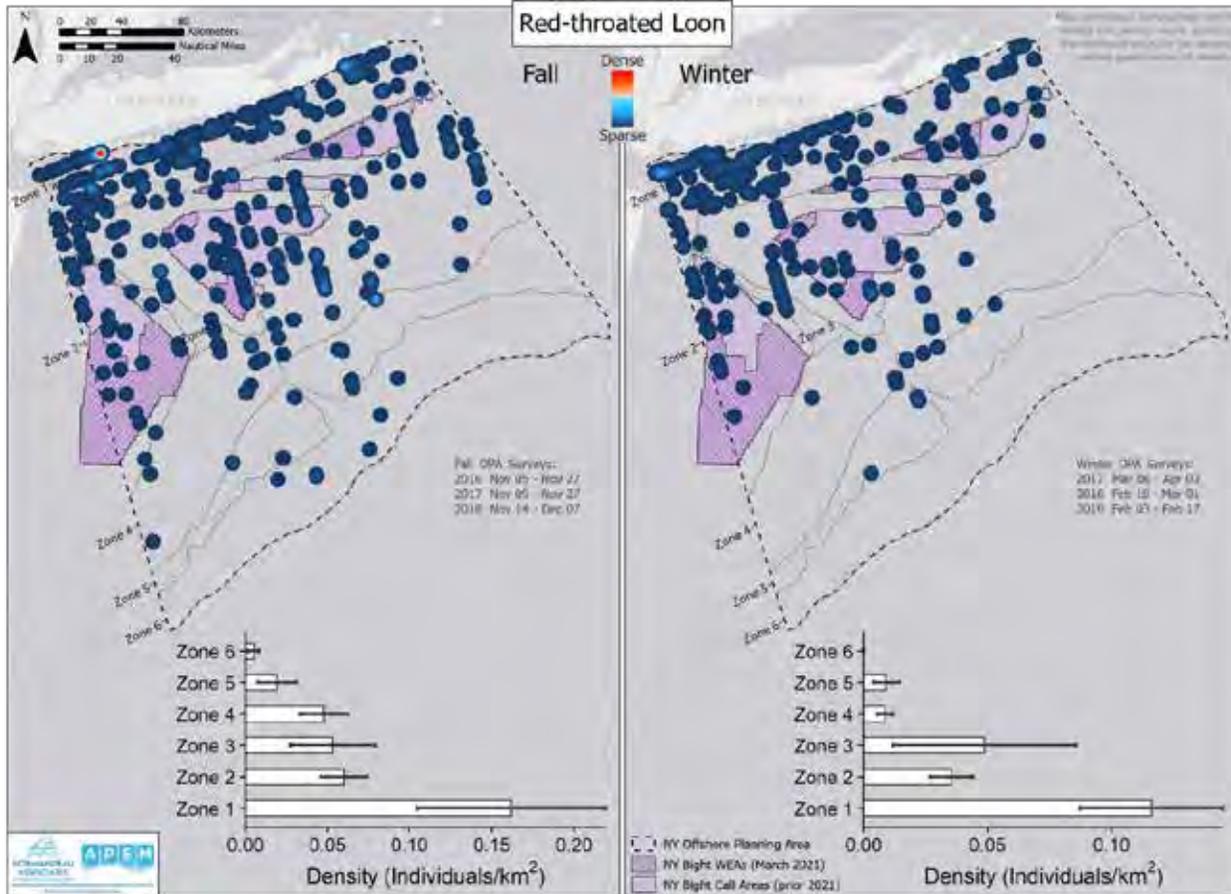


Figure 41. Spatial Distribution of Red-throated Loons During Spring and Summer by Zone and Proximity to Call Areas

Heat map is scaled to the maximum density for the species/species group across all seasons. Inset bar plots display mean estimated densities \pm standard error of the mean for each zone.

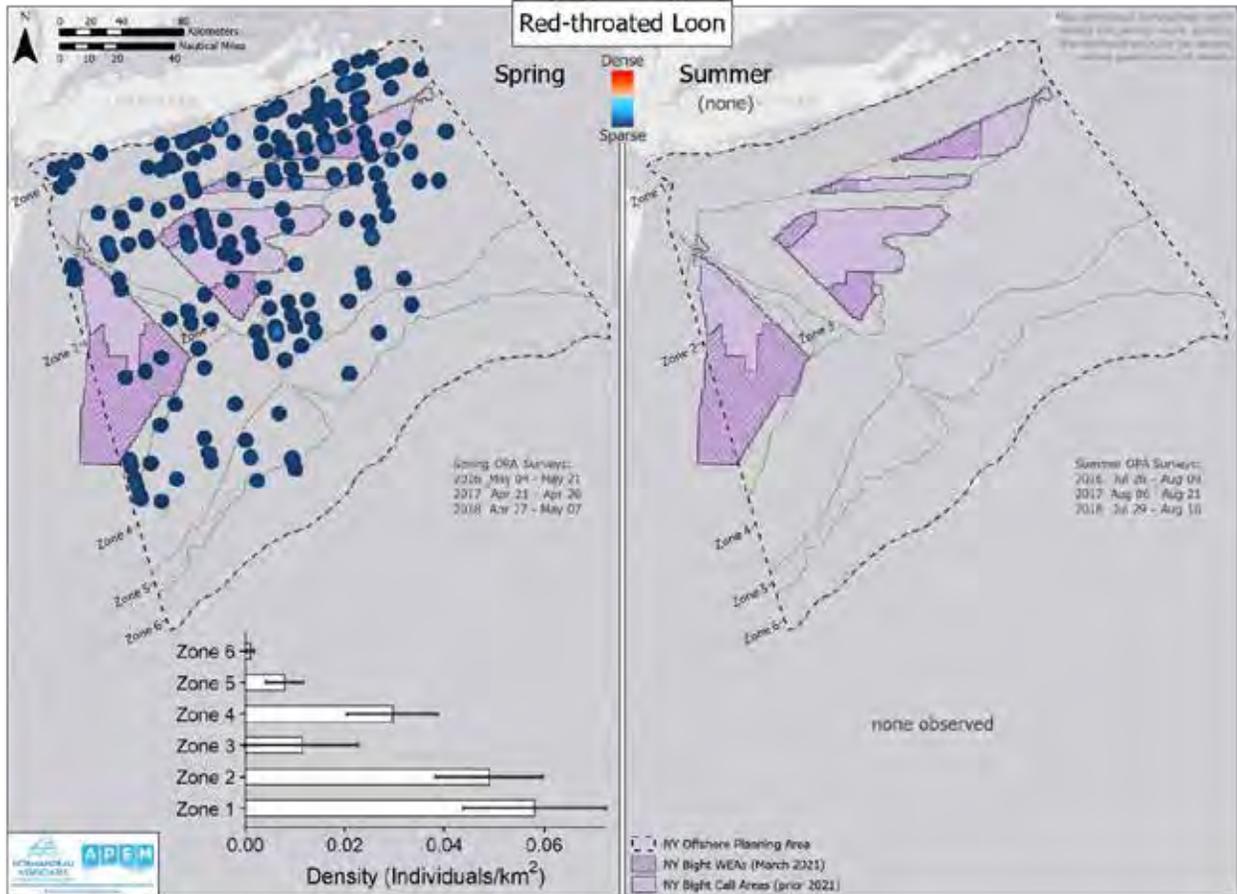


Figure 42. Spatial Distribution of Red-throated Loons Sitting Relative to Birds in Flight During Fall and Winter Surveys

Solid blue points represent individuals with calculated flight height and blue points with an x represent individuals in flight without flight height data. A pie chart inset shows the proportion of individuals flying and sitting. A boxplot inset of flight height distribution by zone is displayed for all birds with known flight heights. Boxplots show the distribution of data among seasons. The dark horizontal line is the median flight height, the box represents the middle 50% of data values. The lines to the left and right of the box represent the data points that are within 1.5 times the length of the box. Data beyond this range are shown as individual points.

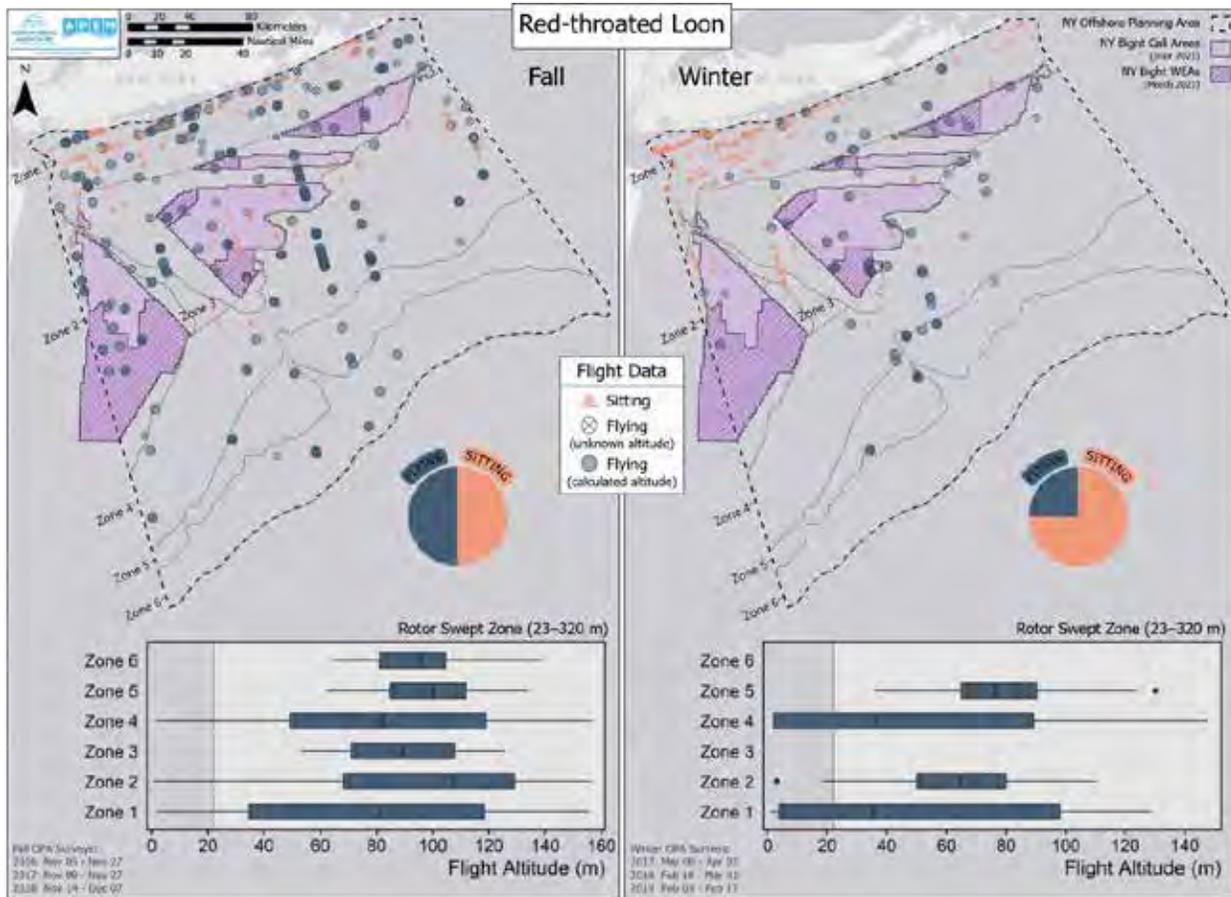


Figure 43. Spatial Distribution of Red-throated Loons Sitting Relative to Birds in Flight During Spring and Summer Surveys

Solid blue points represent individuals with calculated flight height and blue points with an x represent individuals in flight without flight height data. A pie chart inset shows the proportion of individuals flying and sitting. A boxplot inset of flight height distribution by zone is displayed for all birds with known flight heights. Boxplots show the distribution of data among seasons. The dark horizontal line is the median flight height, and the box represents the middle 50% of data values. The lines to the left and right of the box represent the data points that are within 1.5 times the length of the box. Data beyond this range are shown as individual points.

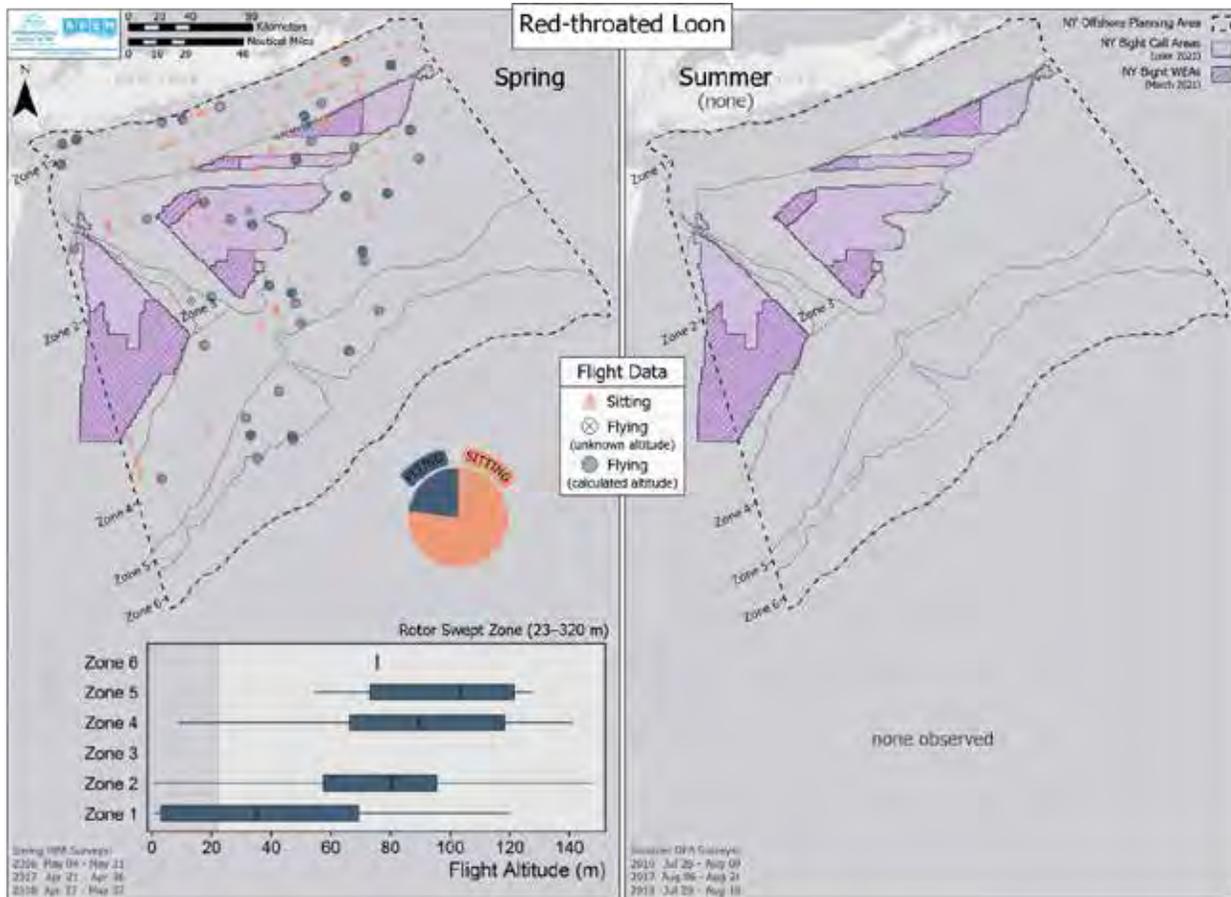


Figure 44. Direction of Flight of Red-throated Loons for All Surveys

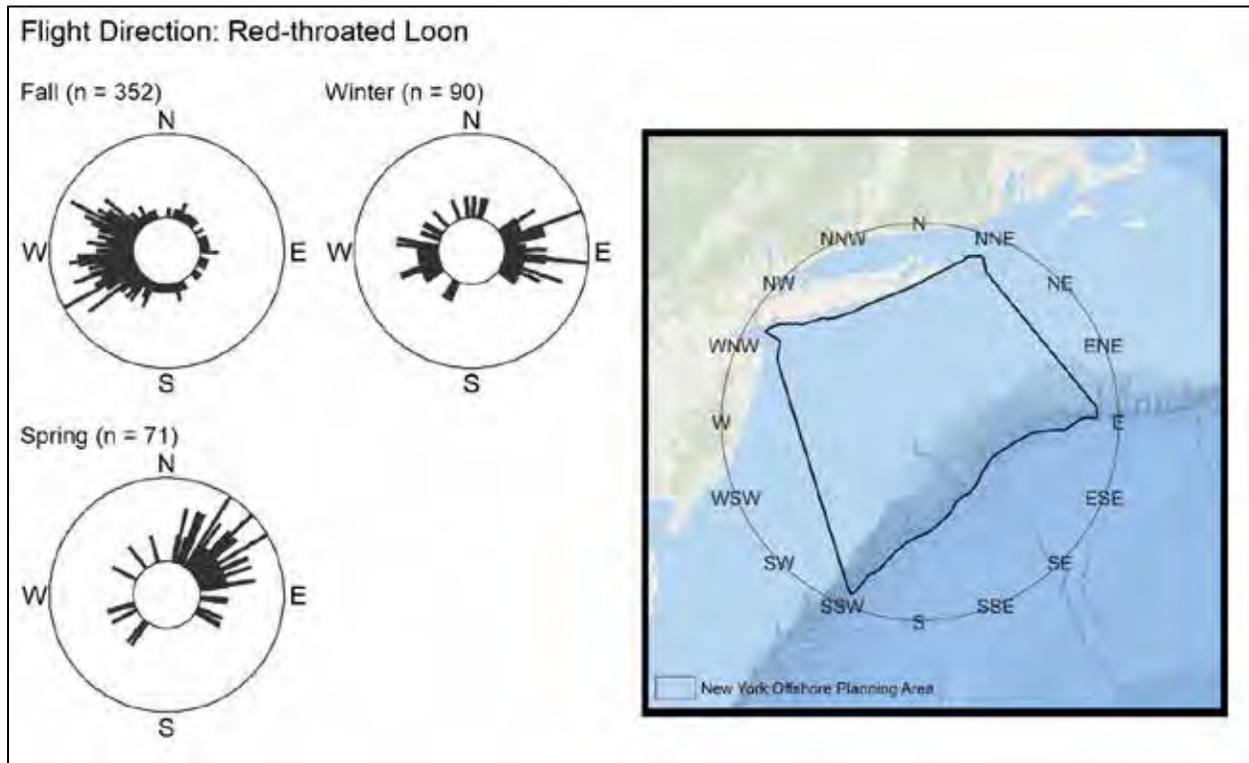


Figure 45. Spatial Distribution of Common Loons During Fall and Winter by Zone and Proximity to Call Areas

Heat map is scaled to the maximum density for the species/species group across all seasons. Inset bar plots display mean estimated densities \pm standard error of the mean for each zone.

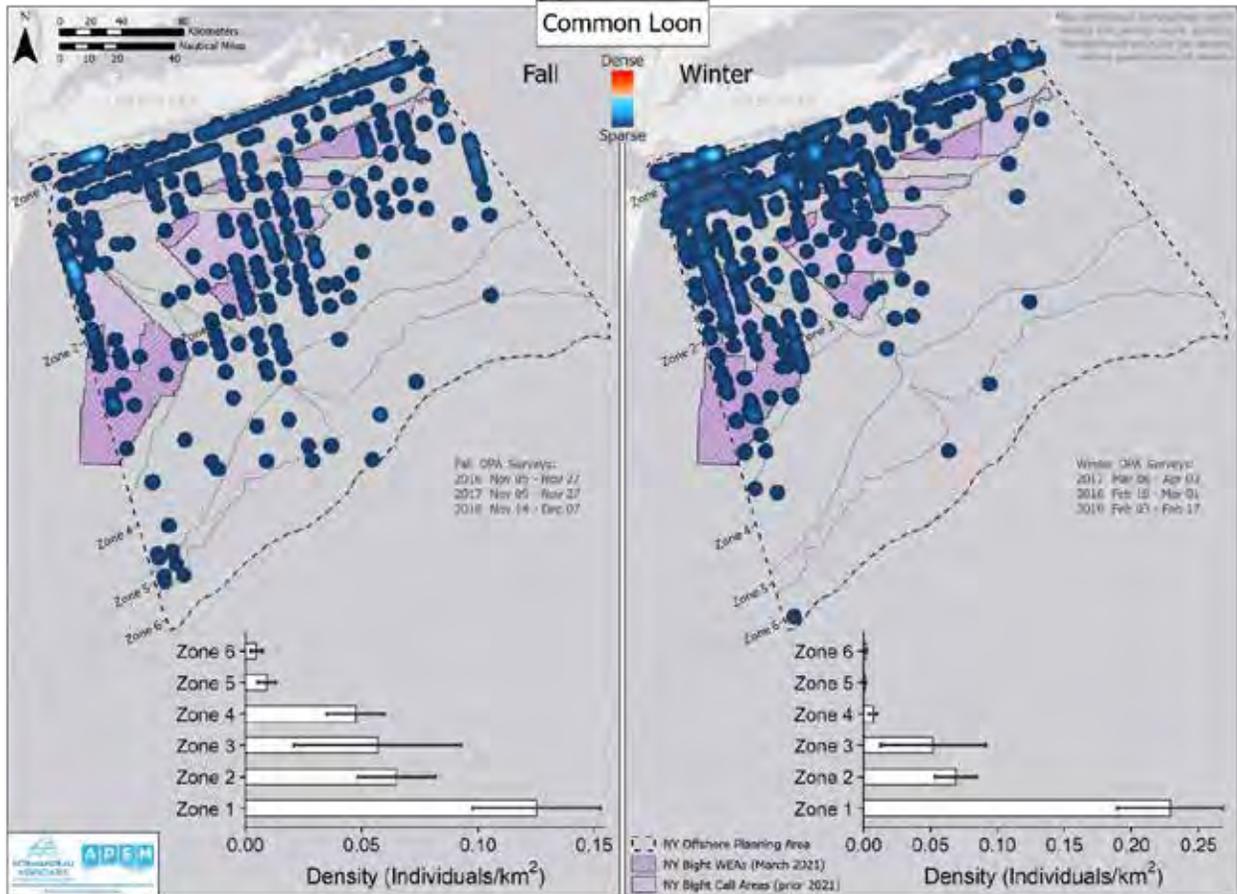


Figure 46. Spatial Distribution of Common Loons During Spring and Summer by Zone and Proximity to Call Areas

Heat map is scaled to the maximum density for the species/species group across all seasons. Inset bar plots display mean estimated densities \pm standard error of the mean for each zone.

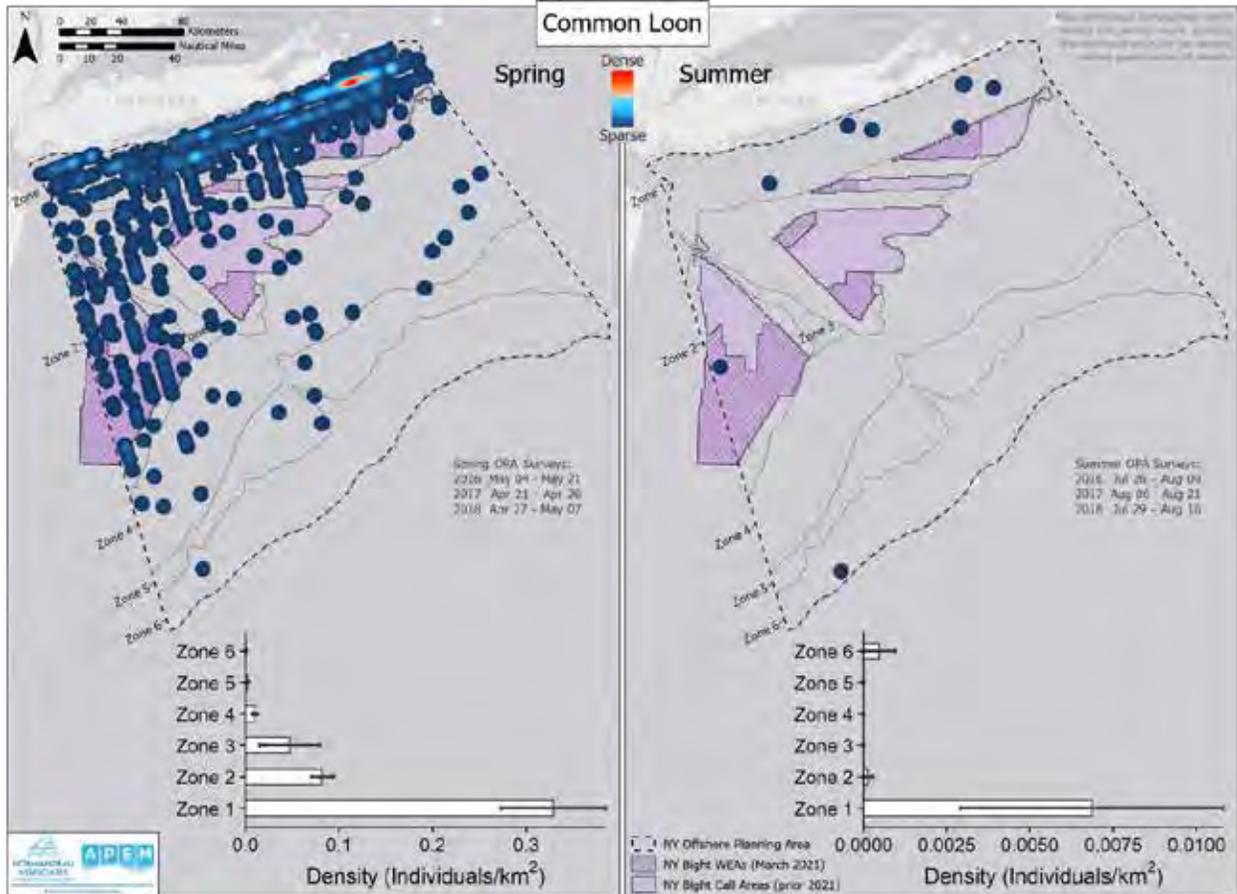


Figure 47. Spatial Distribution of Common Loons Sitting Relative to Birds in Flight During Fall and Winter Surveys

Solid blue points represent individuals with calculated flight height and blue points with an x represent individuals in flight without flight height data. A pie chart inset shows the proportion of individuals flying and sitting. A boxplot inset of flight height distribution by zone is displayed for all birds with known flight heights. Boxplots show the distribution of data among seasons. The dark horizontal line is the median flight height, the box represents the middle 50% of data values. The lines to the left and right of the box represent the data points that are within 1.5 times the length of the box. Data beyond this range are shown as individual points.

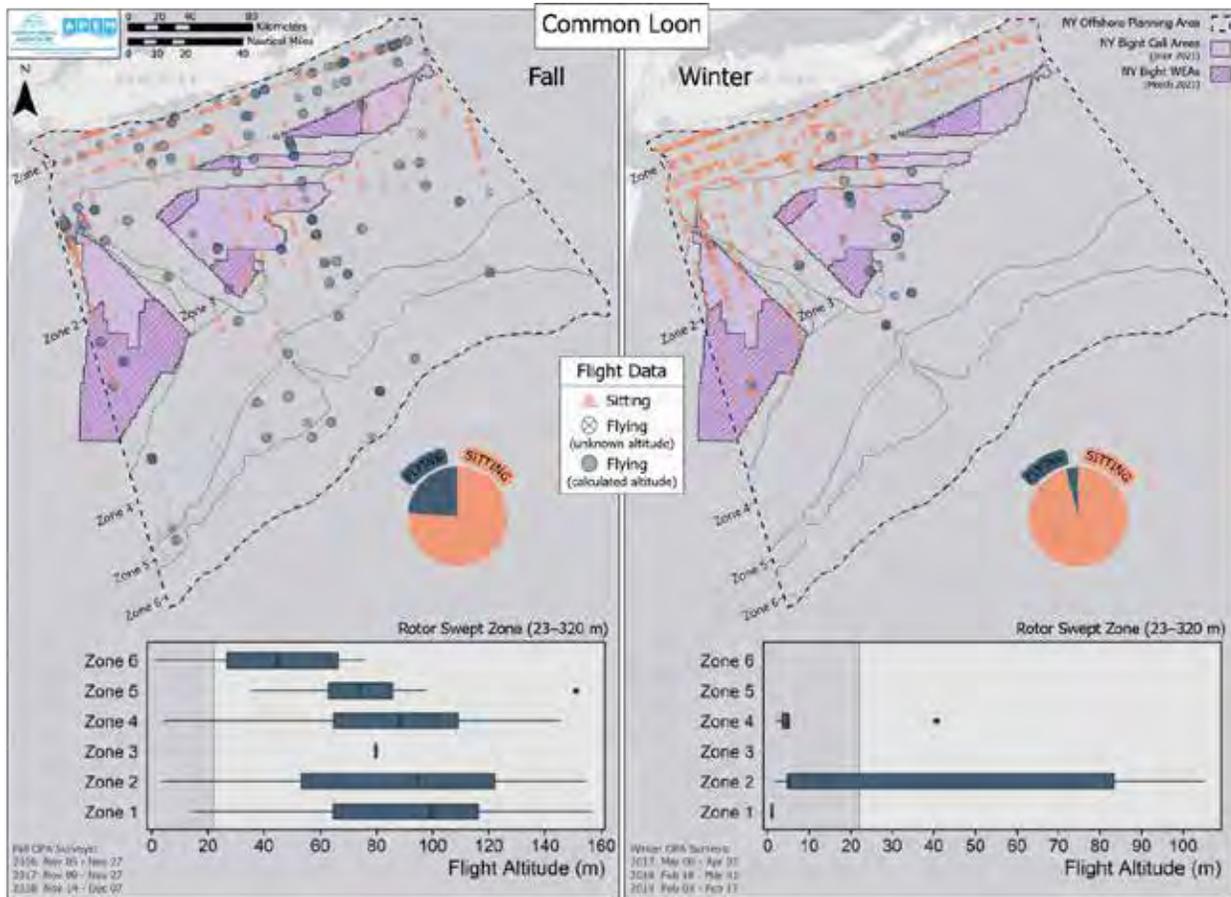


Figure 48. Spatial Distribution of Common Loons Sitting Relative to Birds in Flight During Spring and Summer Surveys

Solid blue points represent individuals with calculated flight height and blue points with an x represent individuals in flight without flight height data. A pie chart inset shows the proportion of individuals flying and sitting. A boxplot inset of flight height distribution by zone is displayed for all birds with known flight heights. Boxplots show the distribution of data among seasons. The dark horizontal line is the median flight height, and the box represents the middle 50% of data values. The lines to the left and right of the box represent the data points that are within 1.5 times the length of the box. Data beyond this range are shown as individual points.

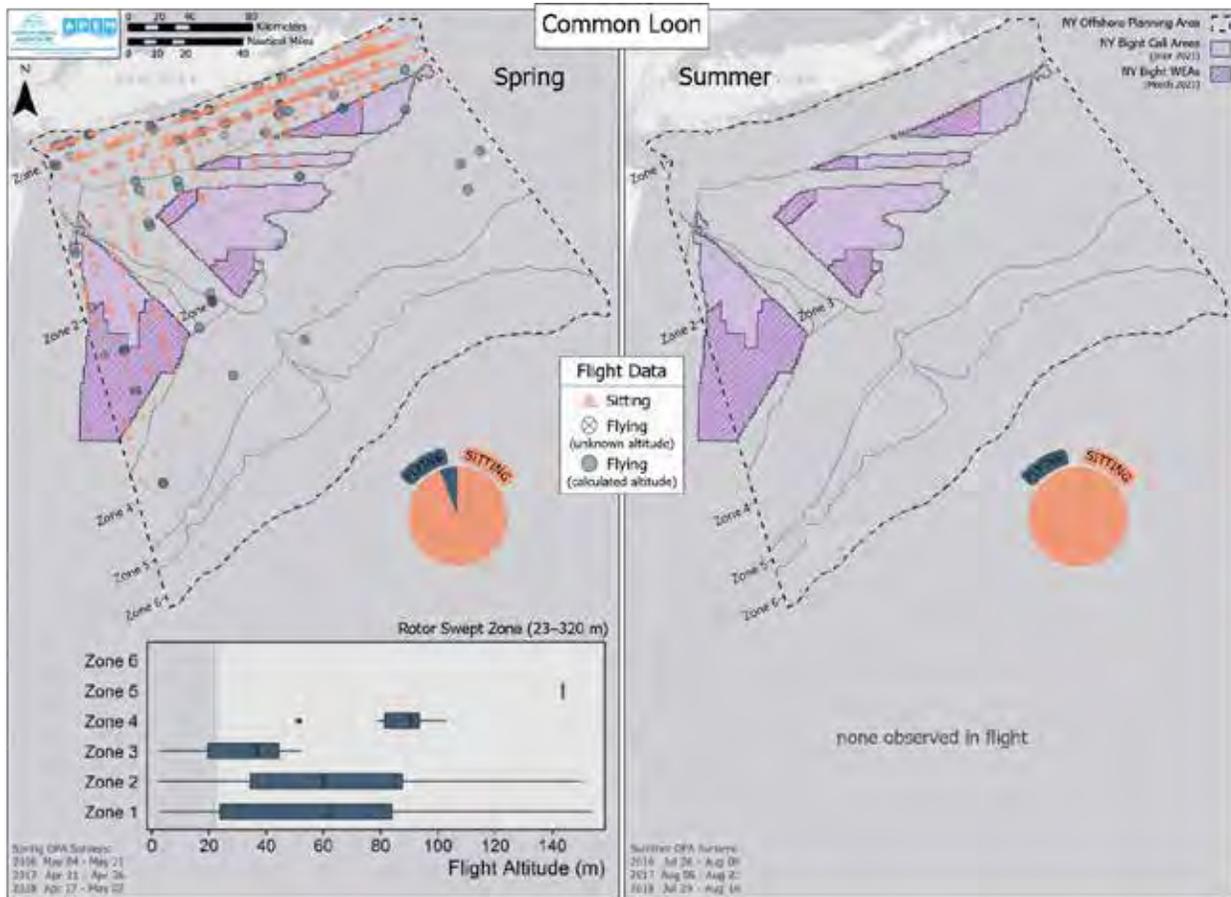
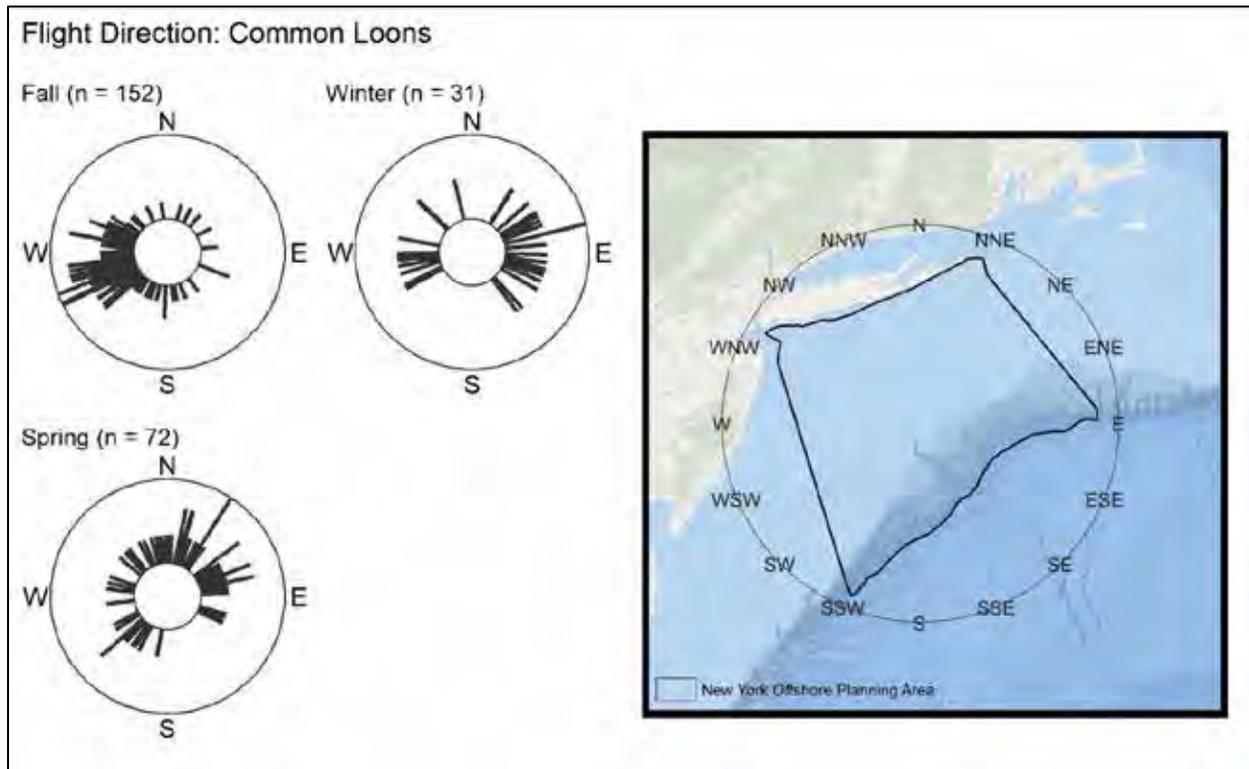


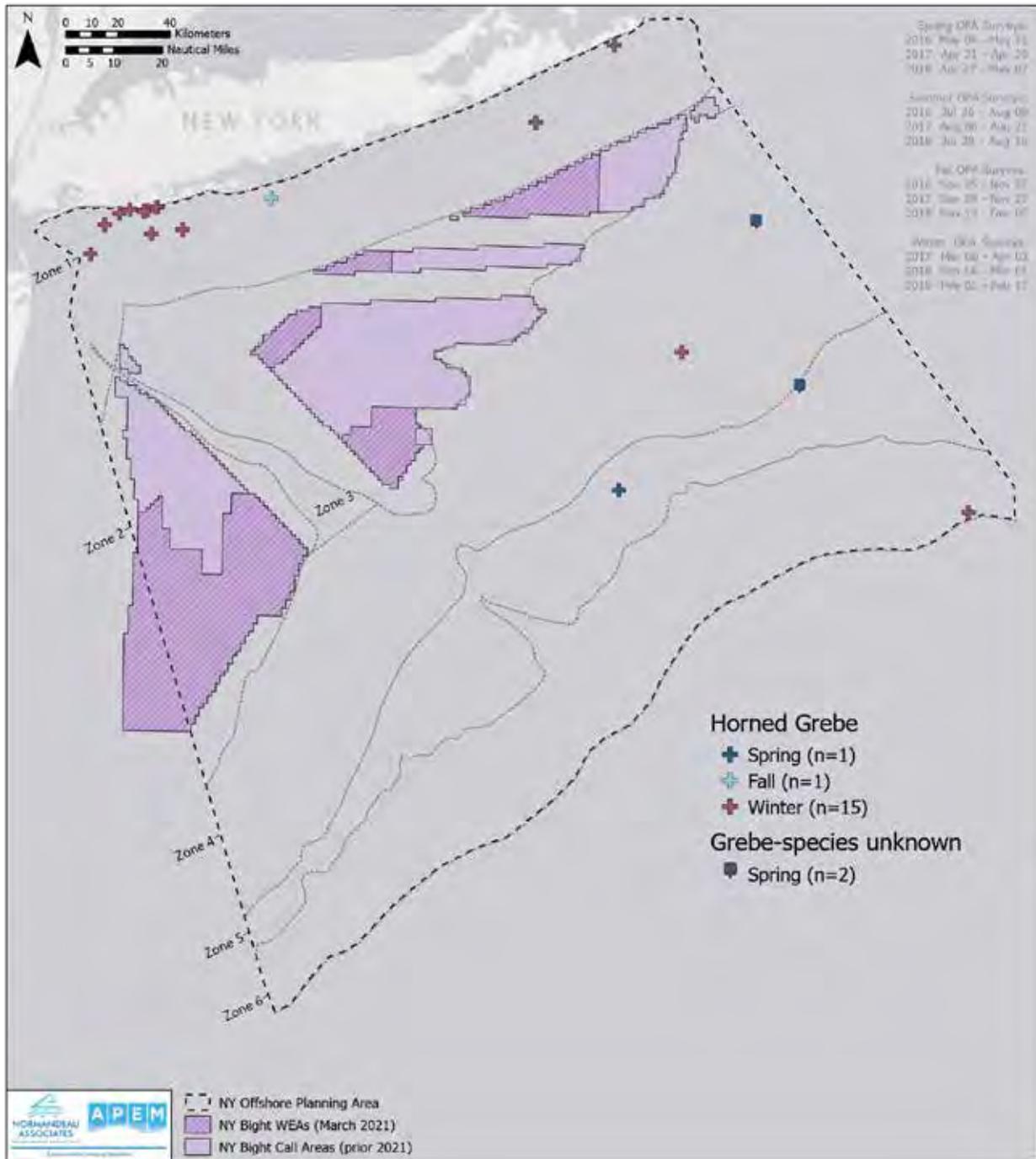
Figure 49. Direction of Travel of Common Loons for all Surveys



2.5.6 Grebe

Horned grebe (n=17) and grebe-species unknown (n=2) were relatively uncommon species classifications (Appendix B). Horned grebe were primarily observed in Zone 1, and grebe-species unknown were observed in Zones 4 and 5 (Figure 50).

Figure 50. Spatial Distribution of Grebe Species with Fewer than 30 Occurrences Across All Surveys



2.5.7 Northern Fulmar

Overall mean OPA density was greatest in the Winter ($\bar{x} = 0.07 \pm 0.2$ birds/km²) followed by Fall ($\bar{x} = 0.02 \pm 0.004$ birds/km²) and Spring ($\bar{x} = 0.01 \pm 0.003$ birds/km²) (Appendix B, Figure 51, Figure 52). There were no northern fulmar observed during Summer surveys. In general, northern fulmar were observed concentrating in Zones 4 and 5 of the OPA during Winter and Spring, and Zones 3, 4, and 5 during the Fall (Figure 51, Figure 52).

Northern fulmar exhibited median flight heights that were among the highest observed, ranging between 80 m and nearly 120 m (considering zones with greater than one in-flight observation) (Figure 53, Figure 54), and is one of the few groups where the majority of individuals were observed in flight across all three seasons the species was observed. In Fall (n=197), Winter (n=813), and Spring (n=141), northern fulmar were observed most frequently in the outer zones of the OPA (Figure 53, Figure 54). Across all observations, 74% of birds were in flight with no clear pattern of flight headings (Figure 55).

Figure 51. Spatial Distribution of Northern Fulmar During Fall and Winter by Zone and Proximity to Call Areas

Heat map is scaled to the maximum density for the species/species group across all seasons. Inset bar plots display mean estimated densities \pm standard error of the mean for each zone.

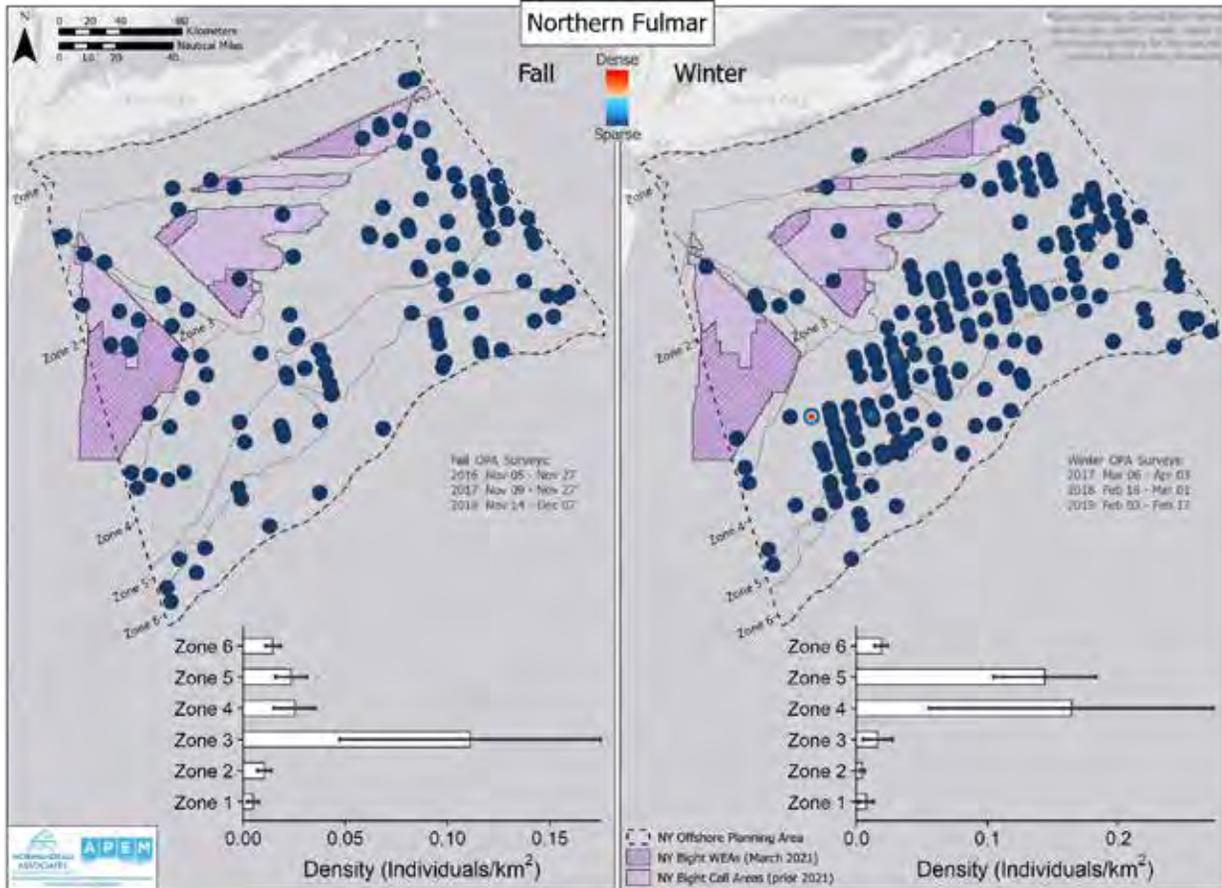


Figure 52. Spatial Distribution of Northern Fulmar During Spring and Summer by Zone and Proximity to Call Areas

Heat map is scaled to the maximum density for the species/species group across all seasons. Inset bar plots display mean estimated densities \pm standard error of the mean for each zone.

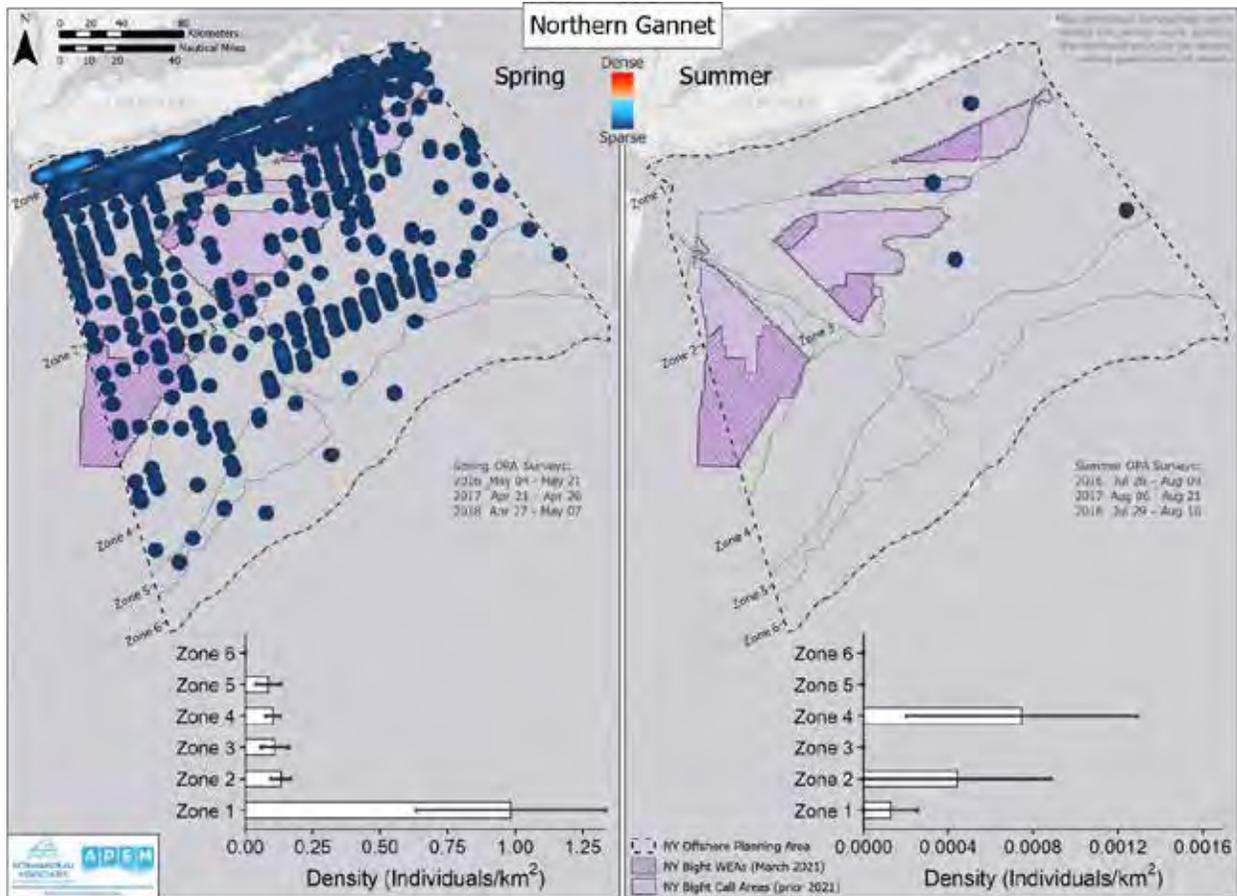


Figure 53. Spatial Distribution of Northern Fulmar Sitting Relative to Birds in Flight During Fall and Winter Surveys

Solid blue points represent individuals with calculated flight height and blue points with an x represent individuals in flight without flight height data. A pie chart inset shows the proportion of individuals flying and sitting. A boxplot inset of flight height distribution by zone is displayed for all birds with known flight heights. Boxplots show the distribution of data among seasons. The dark horizontal line is the median flight height, and the box represents the middle 50% of data values. The lines to the left and right of the box represent the data points that are within 1.5 times the length of the box. Data beyond this range are shown as individual points.

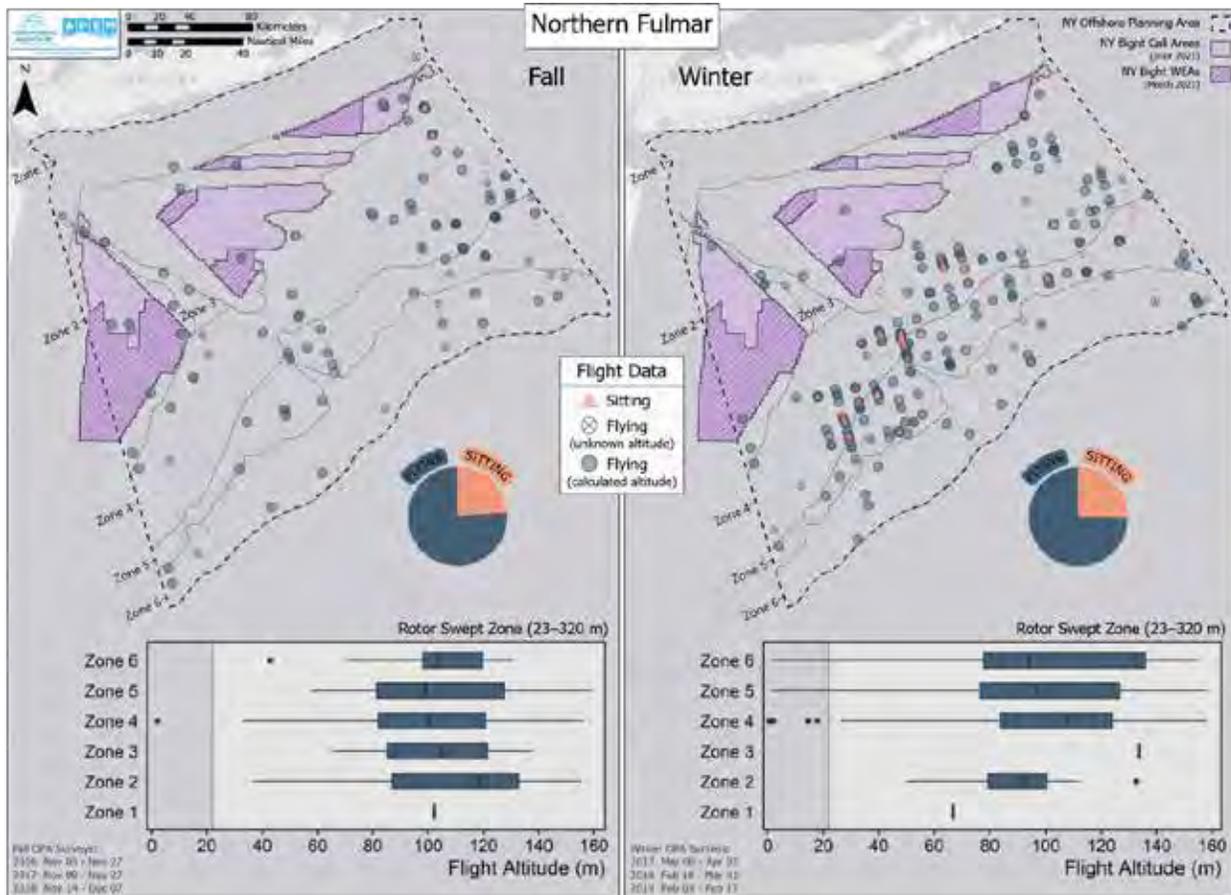
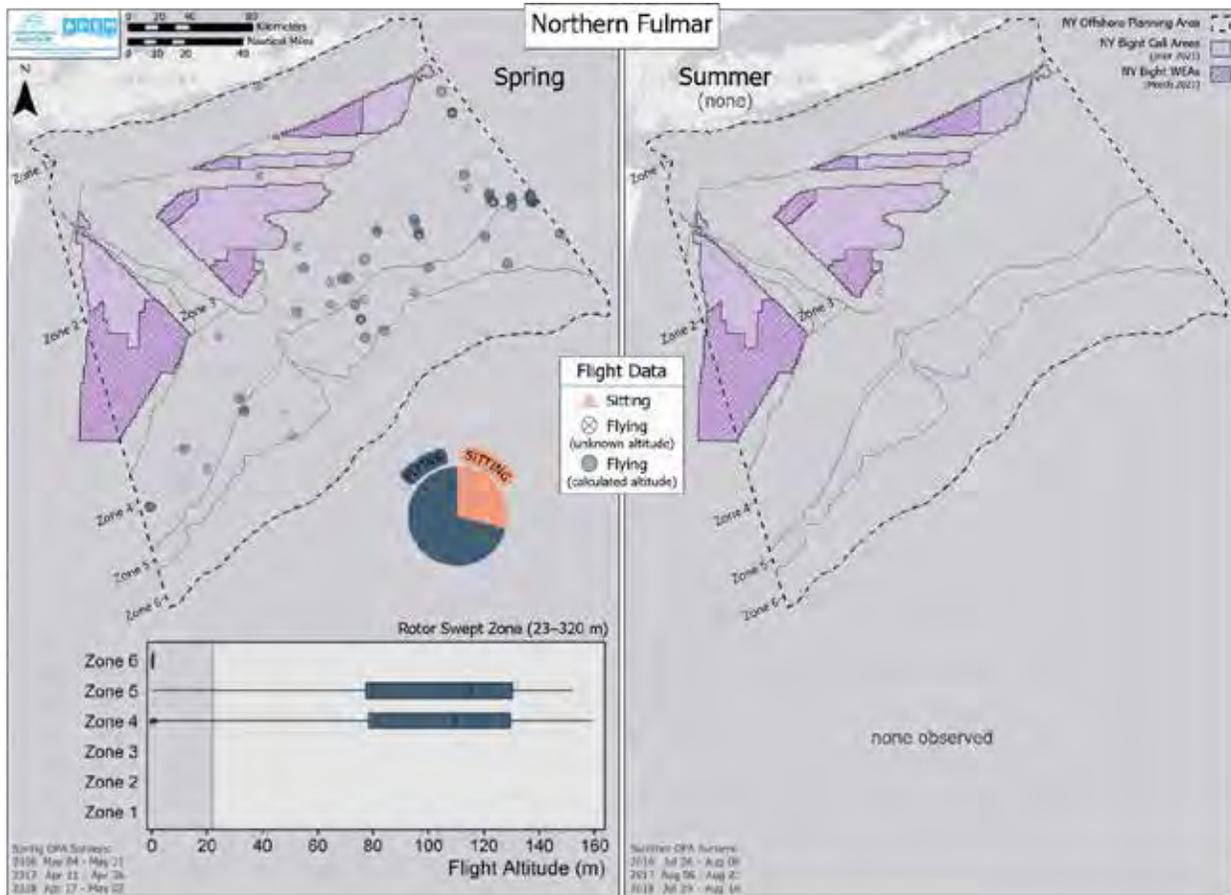


Figure 54. Spatial Distribution of Northern Fulmar Sitting Relative to Birds in Flight During Spring and Summer Surveys

Solid blue points represent individuals with calculated flight height and blue points with an x represent individuals in flight without flight height data. A pie chart inset shows the proportion of individuals flying and sitting. A boxplot inset of flight height distribution by zone is displayed for all birds with known flight heights. Boxplots show the distribution of data among seasons. The dark horizontal line is the median flight height, and the box represents the middle 50% of data values. The lines to the left and right of the box represent the data points that are within 1.5 times the length of the box. Data beyond this range are shown as individual points.



2.5.8.1 Black-capped Petrel

In Fall and Winter, black-capped petrels were observed twice (Figure 61, Figure 62). In Spring (n=27) and Summer (n=22), petrels were observed most frequently in the outer zones of the OPA, but in Summer individuals were also observed in the northeast of Zones 1, 2, and 4 (Appendix B, Figure 62). Overall mean OPA density was greatest in the Summer ($\bar{x} = 0.006 \pm 0.003$ birds/km²) and Spring ($\bar{x} = 0.003 \pm 0.0009$ birds/km²) (Figure 62).

In Fall and Winter, both individuals were in flight in Zone 6 but had no associated flight height data (Figure 63). In Spring 89% of birds were in flight and in Winter 91% were observed in flight (Figure 63, Figure 64). Median flight height was within the RSZ in all zones in the Spring and below the RSZ in Zone 6 during summer—the only zone with recorded flight heights (Figure 64). There was no pattern of flight heading observed in either season (Figure 65).

2.5.8.2 Petrel Species with Fewer than 30 Observations

Species observed fewer than 30 times across all surveys included petrel-species unknown (n=7) and Trindade petrel (n=1) (Appendix B, Figure 66). Individuals were most abundant in the Summer and in Zones 2 and 4–6.

Figure 56. Spatial Distribution of Petrels During Fall and Winter by Zone and Proximity to Call Areas

Heat map is scaled to the maximum density for the species/species group across all seasons. Inset bar plots display mean estimated densities \pm standard error of the mean for each zone.

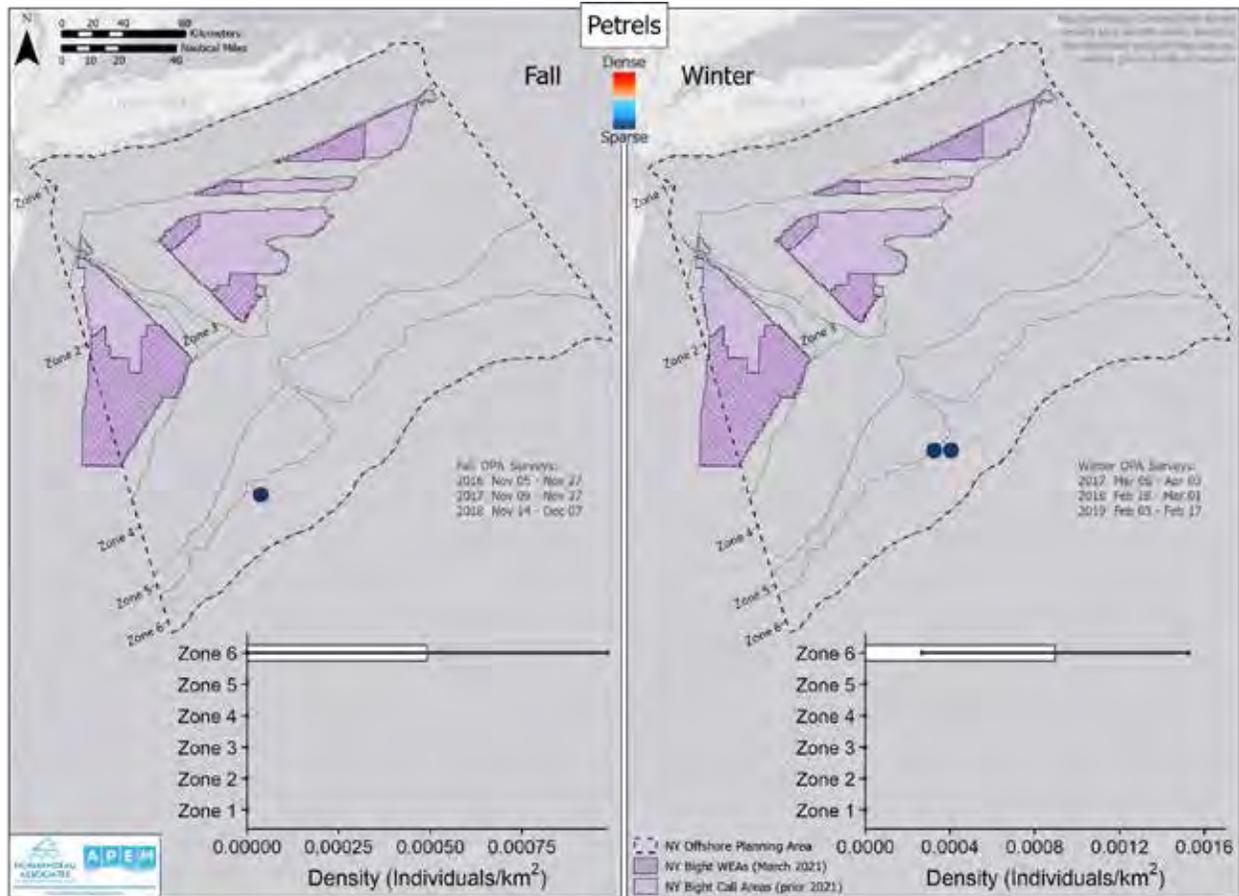


Figure 57. Spatial Distribution of Petrels During Spring and Summer by Zone and Proximity to Call Areas

Heat map is scaled to the maximum density for the species/species group across all seasons. Inset bar plots display mean estimated densities \pm standard error of the mean for each zone.

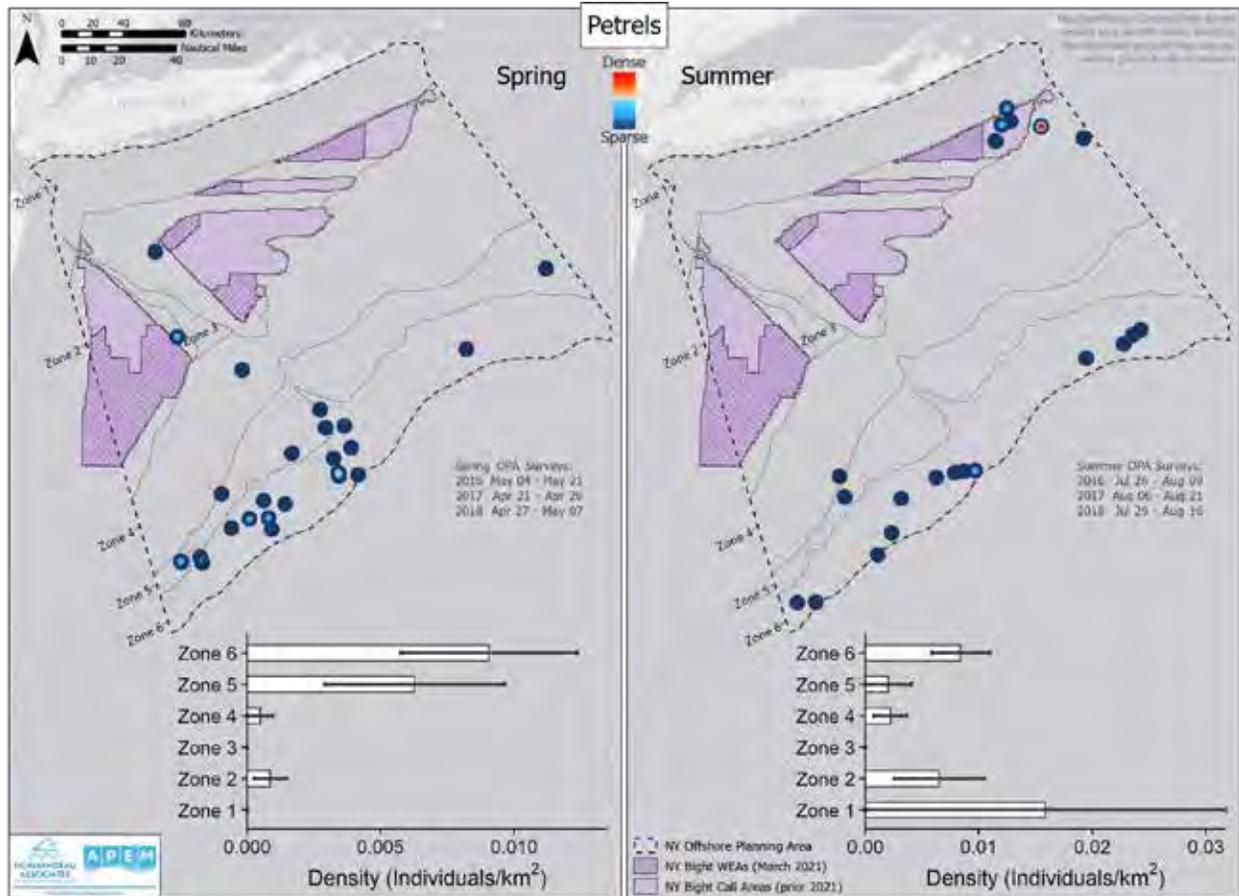


Figure 58. Spatial Distribution of Petrels Sitting Relative to Birds in Flight During Fall and Winter Surveys

Solid blue points represent individuals with calculated flight height and blue points with an x represent individuals in flight without flight height data. A pie chart inset shows the proportion of individuals flying and sitting.

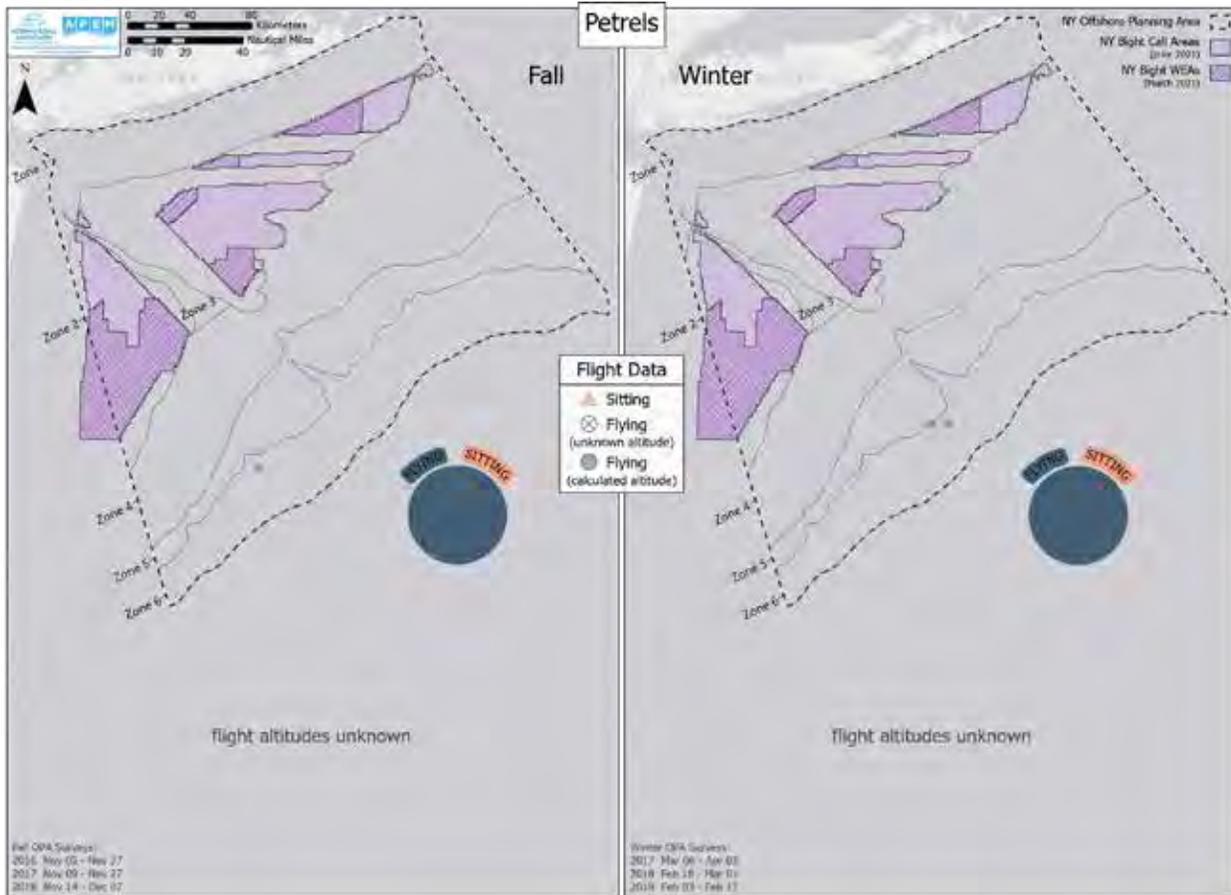


Figure 59. Spatial Distribution of Petrels Sitting Relative to Birds in Flight During Spring and Summer Surveys

Solid blue points represent individuals with calculated flight height and blue points with an x represent individuals in flight without flight height data. A pie chart inset shows the proportion of individuals flying and sitting. A boxplot inset of flight height distribution by zone is displayed for all birds with known flight heights. Boxplots show the distribution of data among seasons. The dark horizontal line is the median flight height, and the box represents the middle 50% of data values. The lines to the left and right of the box represent the data points that are within 1.5 times the length of the box. Data beyond this range are shown as individual points.

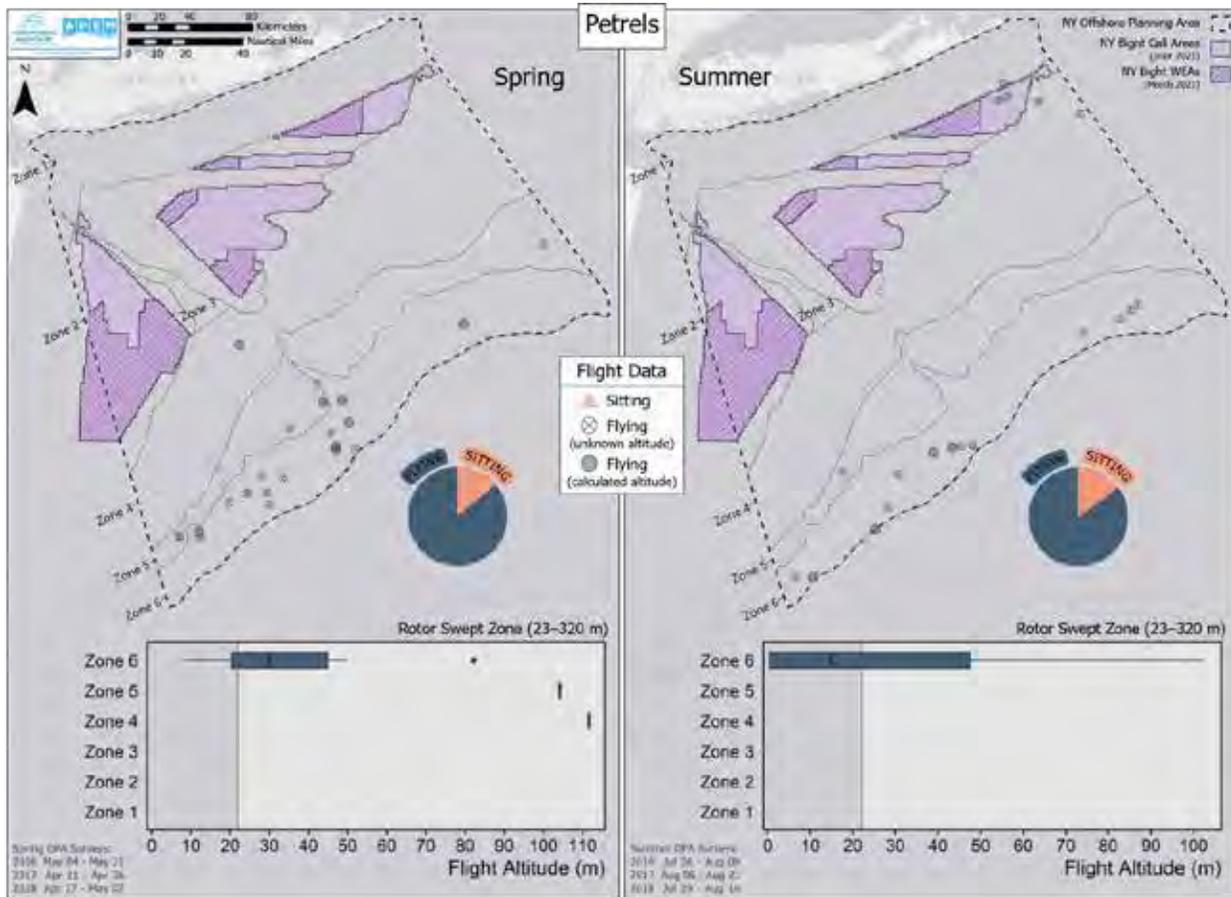


Figure 60. Direction of Flight of All Petrels for All Surveys

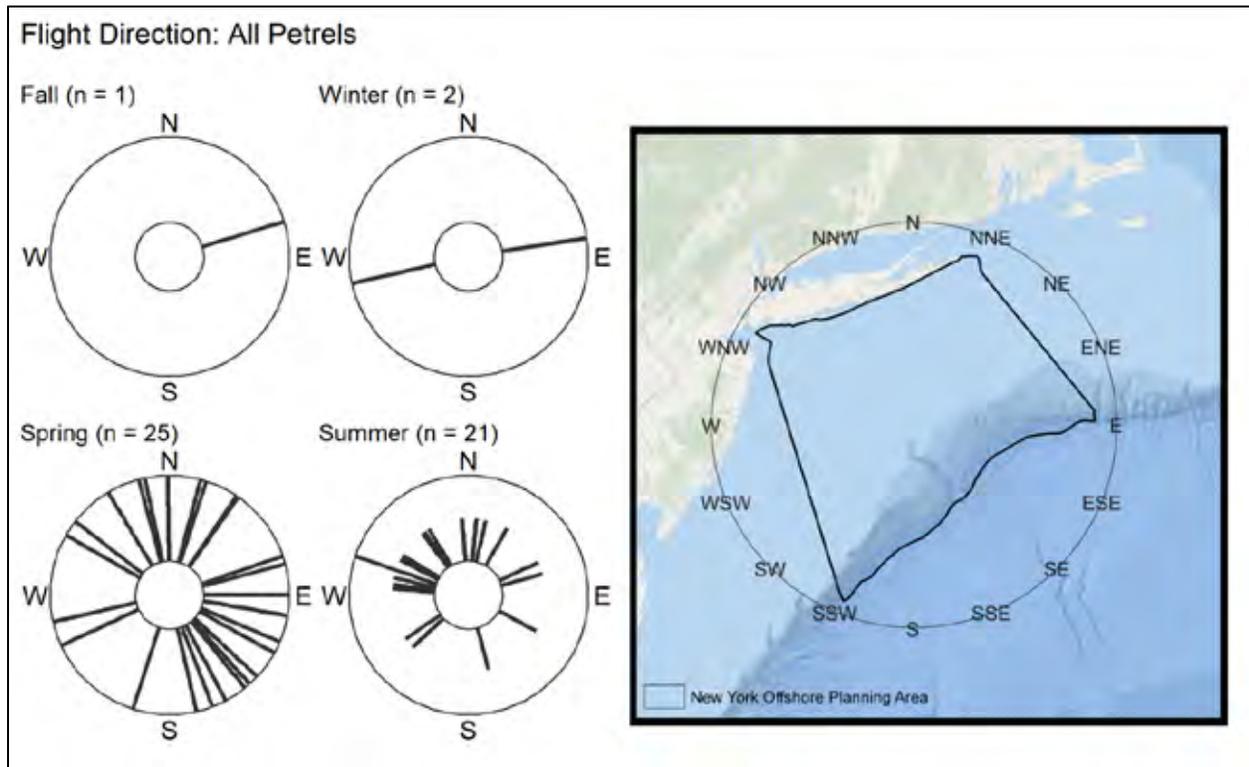


Figure 61. Spatial Distribution of Black-capped Petrels During Fall and Winter by Zone and Proximity to Call Areas

Heat map is scaled to the maximum density for the species/species group across all seasons. Inset bar plots display mean estimated densities \pm standard error of the mean for each zone.

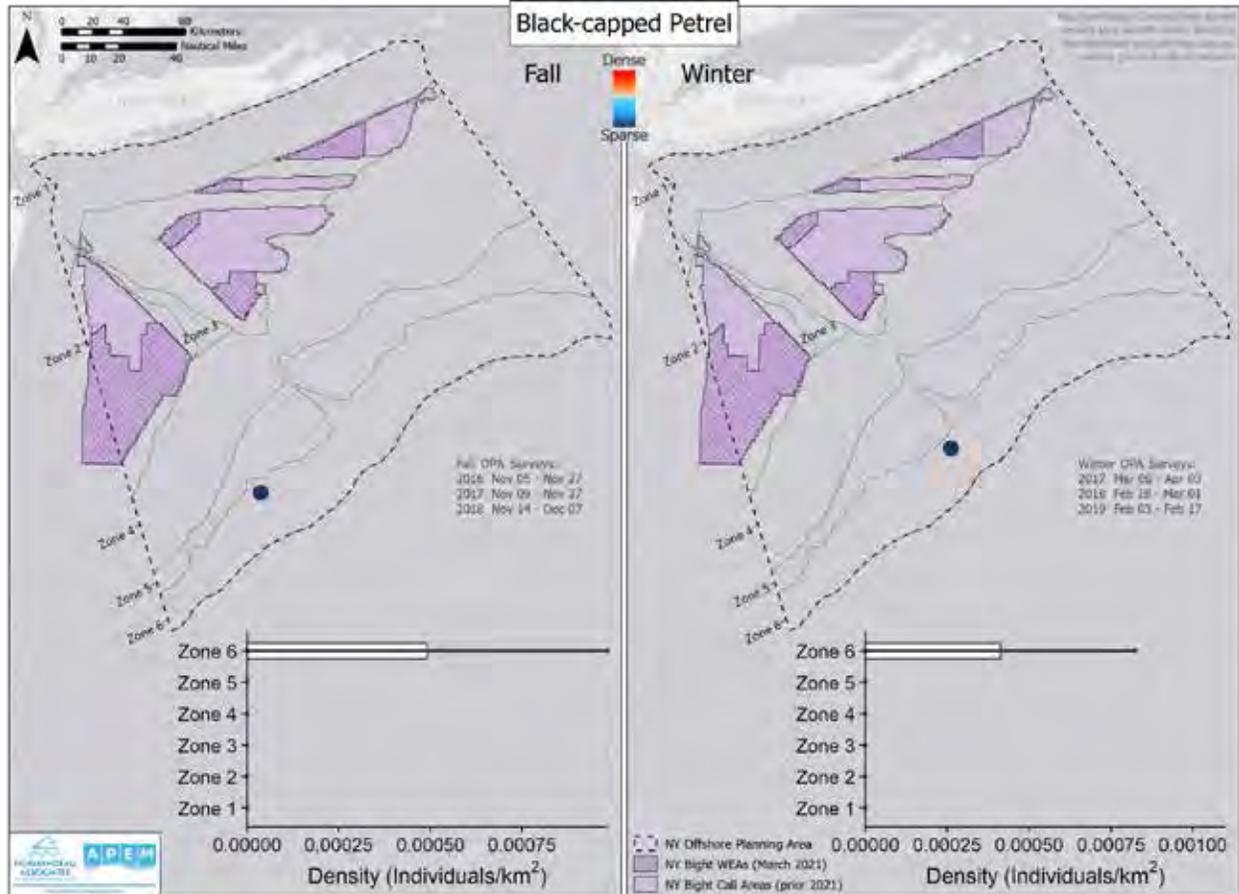


Figure 62. Spatial Distribution of Black-capped Petrels During Spring and Summer by Zone and Proximity to Call Areas

Heat map is scaled to the maximum density for the species/species group across all seasons. Inset bar plots display mean estimated densities \pm standard error of the mean for each zone.

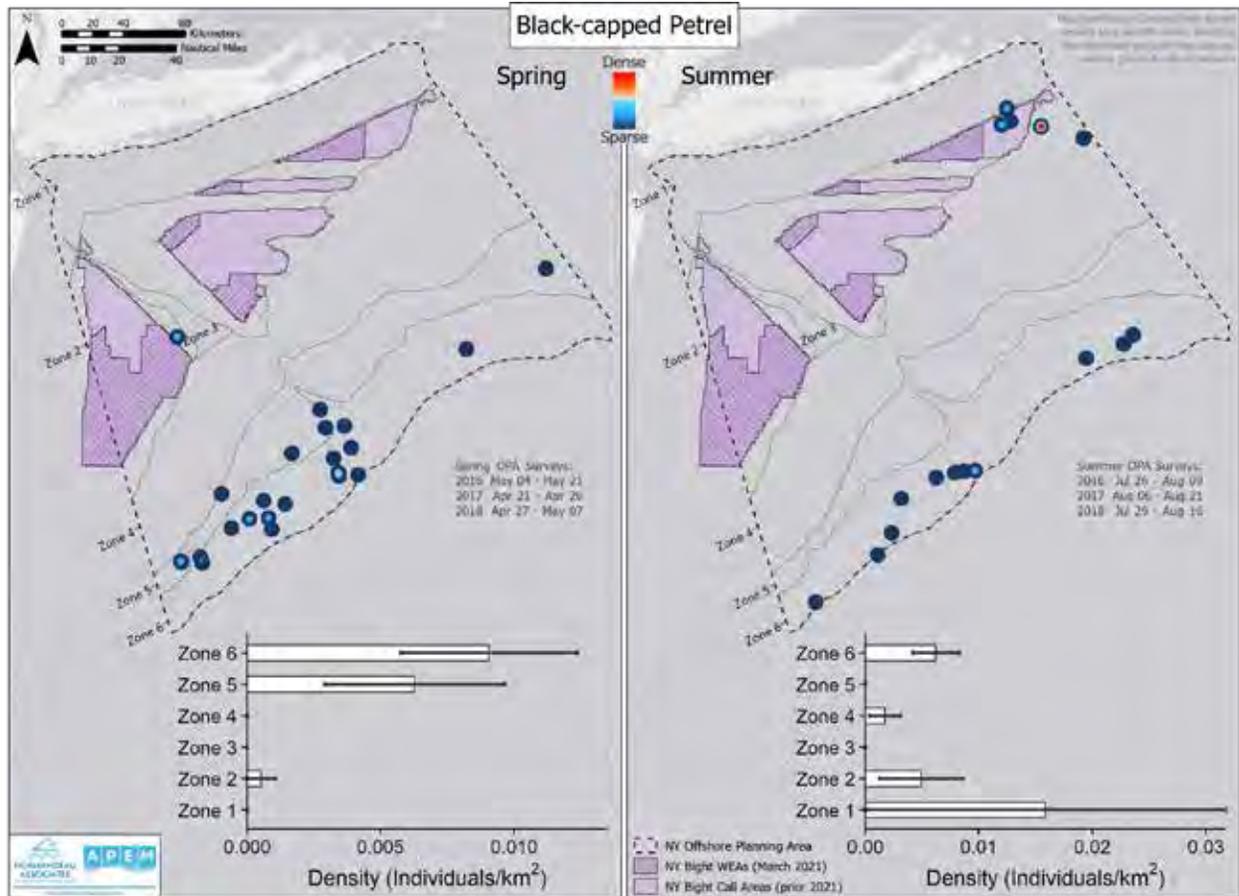


Figure 63. Spatial Distribution of Black-capped Petrels Sitting Relative to Birds in Flight During Fall and Winter Surveys

Solid blue points represent individuals with calculated flight height and blue points with an x represent individuals in flight without flight height data. A pie chart inset shows the proportion of individuals flying and sitting.

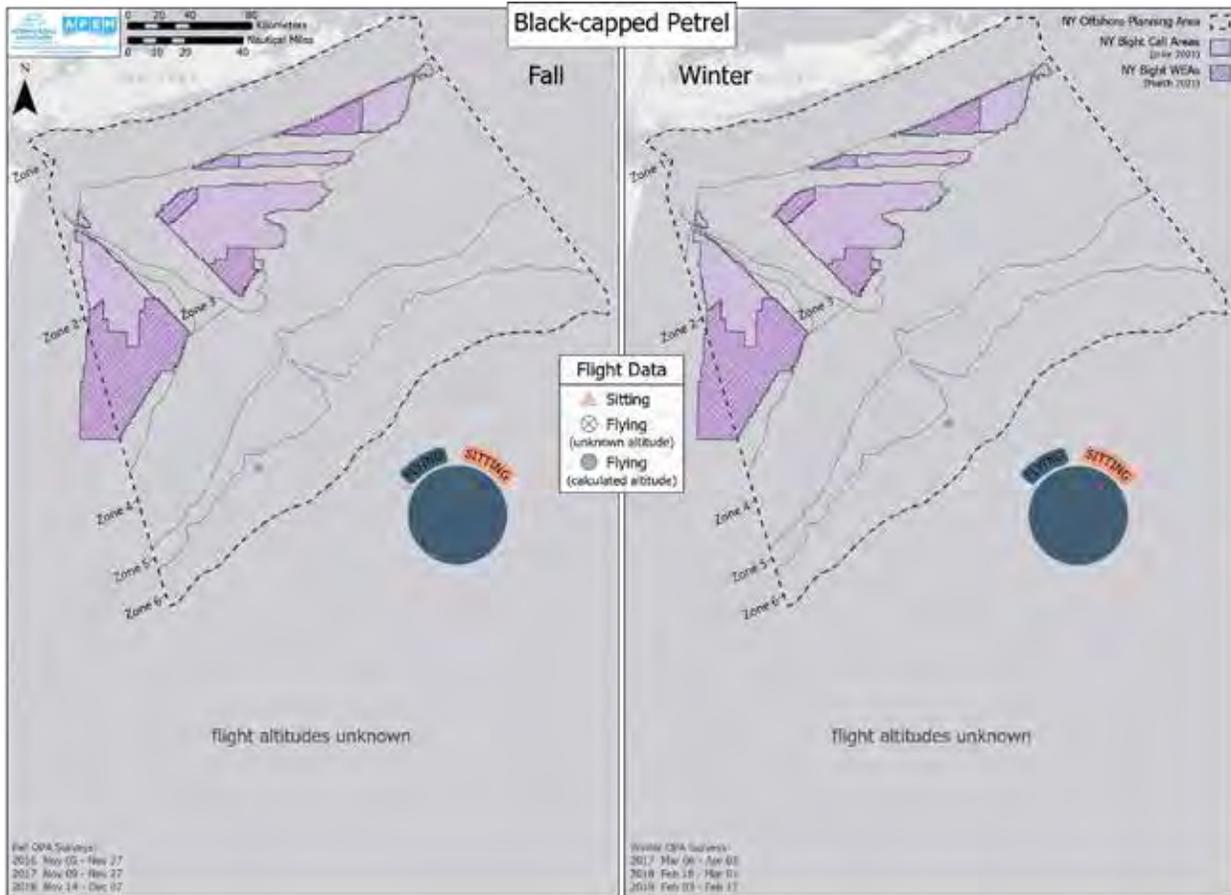


Figure 64. Spatial Distribution of Black-capped Petrels Sitting Relative to Birds in Flight During Spring and Summer Surveys

Solid blue points represent individuals with calculated flight height and blue points with an x represent individuals in flight without flight height data. A pie chart inset shows the proportion of individuals flying and sitting. A boxplot inset of flight height distribution by zone is displayed for all birds with known flight heights. Boxplots show the distribution of data among seasons. The dark horizontal line is the median flight height, and the box represents the middle 50% of data values. The lines to the left and right of the box represent the data points that are within 1.5 times the length of the box. Data beyond this range are shown as individual points.

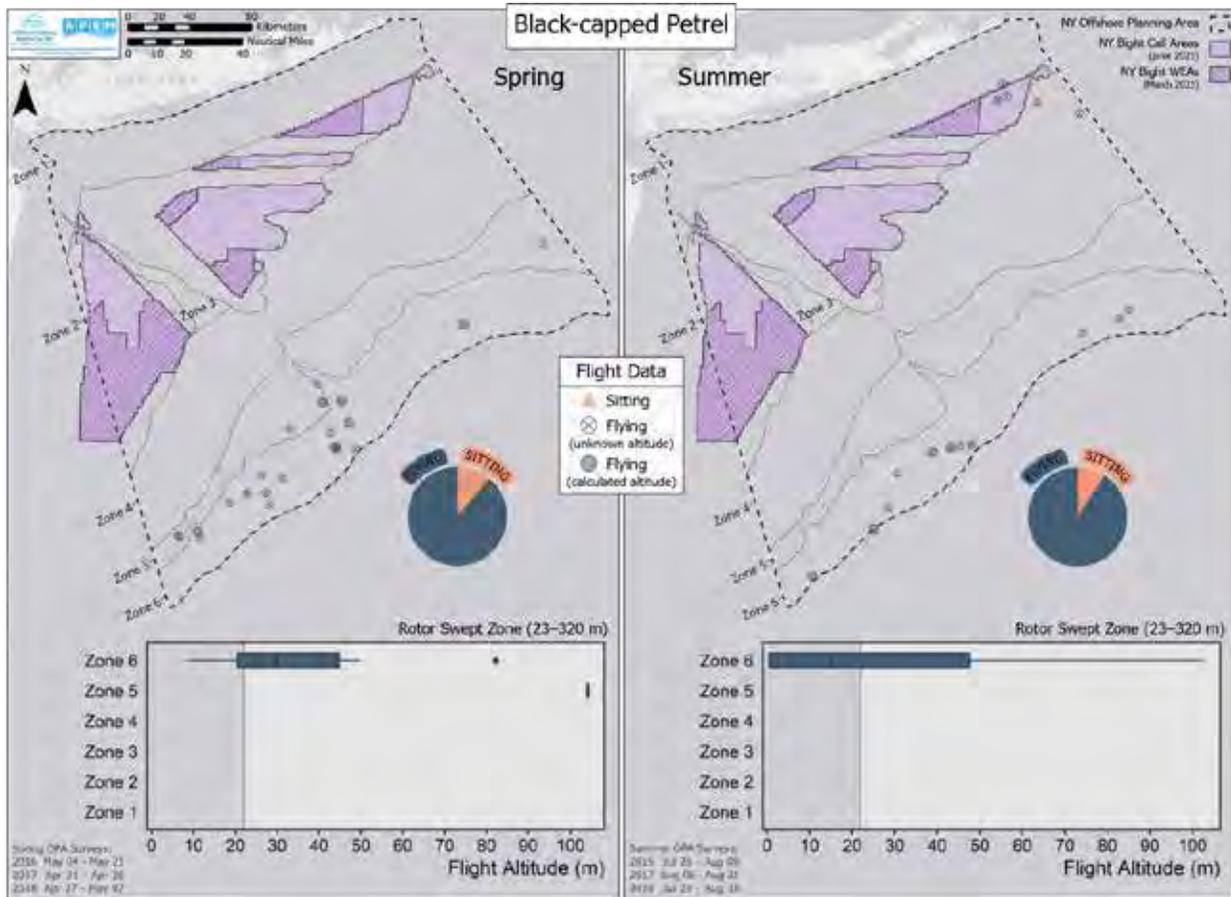


Figure 65. Direction of Flight of Black-capped Petrels for All Surveys

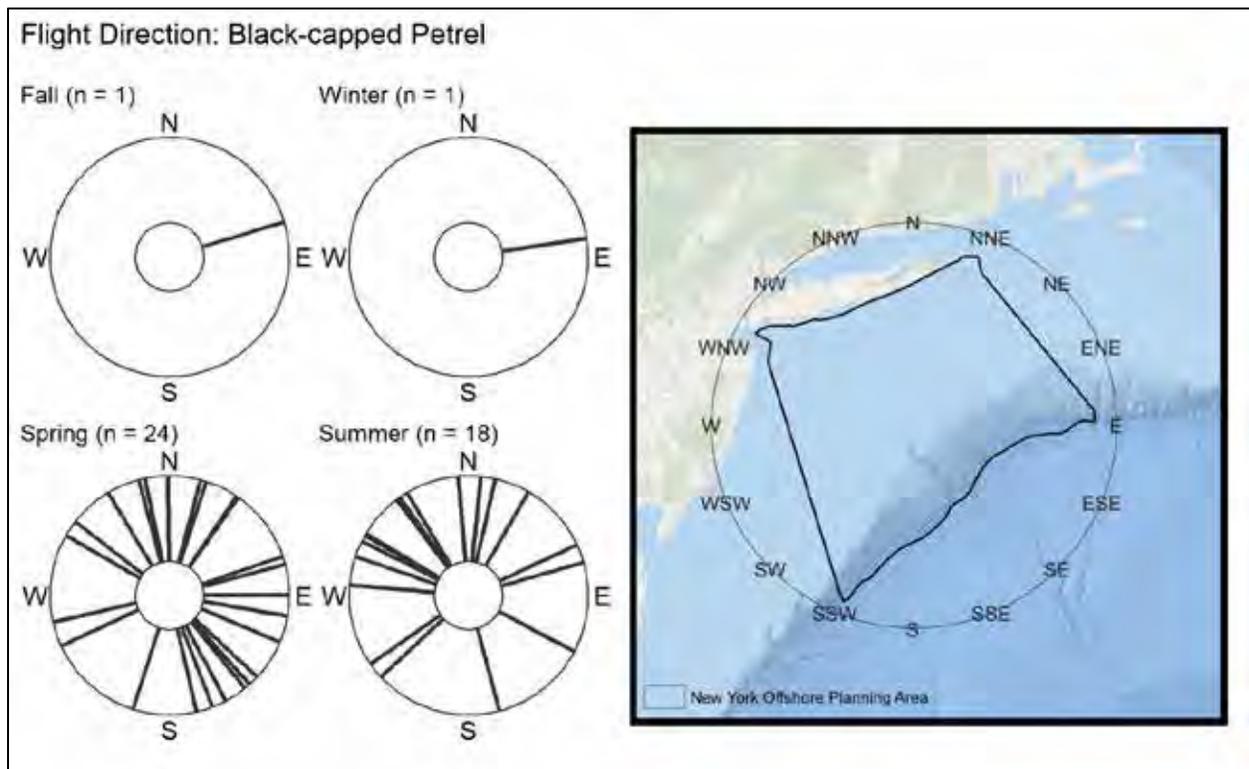
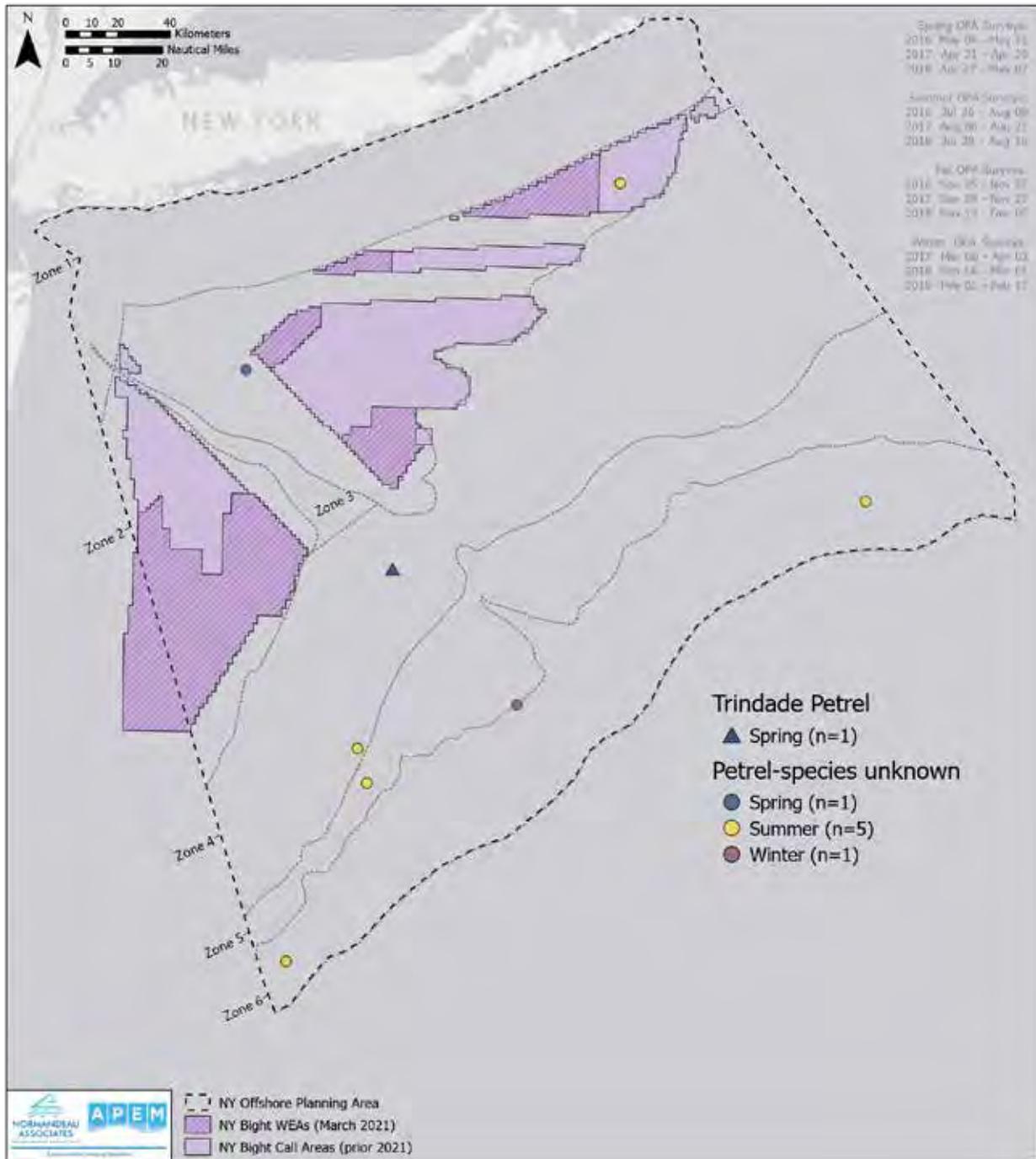


Figure 66. Spatial Distribution of Petrel Species with Fewer than 30 Occurrences Across All Surveys



2.5.9 Shearwater

The shearwater taxonomic grouping included individuals classified as shearwater-species unknown (n=4), shearwater-species unknown-large (n=787), shearwater-species unknown-small (n=87), Cory's shearwater (n=963), great shearwater (n=627), sooty shearwater (n=120), Manx shearwater (n=52), and Audubon's shearwater (n=8) (Appendix B). Shearwater were observed in all zones and seasons in the OPA (Appendix B, Figure 67, Figure 68). Overall mean OPA density was greatest in the Summer ($\bar{x} = 0.31 \pm 0.15$ birds/km²) followed by Fall ($\bar{x} = 0.09 \pm 0.03$ birds/km²), Spring, ($\bar{x} = 0.01 \pm 0.003$ birds/km²), and Winter ($\bar{x} = 0.0004 \pm 0.0002$ birds/km²) (Figure 67, Figure 68). Shearwater were present throughout the outer zones across all seasons (Figure 67, Figure 68). During Summer, shearwater density increased dramatically in Zone 1 resulting in the highest overall single zone mean density estimate across all seasons ($\bar{x} = 0.95 \pm 0.73$ birds/km²) (Figure 68).

Overall, 44% of shearwater were observed in flight (Figure 69, Figure 70). In Fall, Winter, and Spring median flight heights ranged between 1 and 90 m; however, in Summer median flight height was consistently below 2 m in all zones (Figure 69, Figure 70). In Summer shearwater exhibited a slight pattern for either southeasterly or northwesterly flight heading (Figure 71).

2.5.9.1 Cory's Shearwater

Cory's shearwater were observed throughout the OPA with most observations in the Summer (n=799) followed by Fall (n=151), and Spring (n=13) (Appendix B, Figure 72, Figure 73). No Cory's shearwater were observed in the Winter (Figure 72). In Fall, Cory's shearwater were observed in all zones and had the greatest mean zone density estimate within Zone 5 ($\bar{x} = 0.084 \pm 0.07$ birds/km²) followed by Zone 1 ($\bar{x} = 0.078 \pm 0.07$) (Figure 72). In Summer, Cory's shearwater were observed in all zones but were concentrated within Zones 1, 2, and 4 occupying the northernmost section of the OPA with Zone 1 having the greatest mean density estimate across all seasons and zones ($\bar{x} = 0.41 \pm 0.34$ birds/km²) (Figure 73).

In Fall, 57% of birds were observed in flight with median flight altitudes ranging from 1 and 45 m (considering zones with more than one observation) (Figure 74). In Spring, 10 of 13 birds were observed in flight with median flight heights within the RSZ in Zone 5 and below the RSZ in

Zone 4 (Figure 75). In the Summer, 59% of birds were observed in flight with median flight heights below the RSZ across all zones (Figure 75). In the Fall, birds showed a pattern of northwesterly flight headings (Figure 76). In the Spring, no pattern of flight heading was observed, and in the Summer, birds were observed with a slight pattern of easterly and westerly flight headings (Figure 76).

2.5.9.2 Great Shearwater

Great shearwater were observed in Summer (n=504) and Fall (n=121) but were absent or mostly absent in Winter (n=0) and Spring (n=2) (Appendix B, Figure 77, Figure 78). In Fall, great shearwater had the greatest mean zone density in Zone 2 ($\bar{x} = 0.03 \pm 0.01$ birds/km²) and specifically occupied a small pocket of the south-central region of Zone 2 (Figure 77). In Summer, individuals were distributed more equally throughout the OPA, but were again concentrated in Zone 2 ($\bar{x} = 0.15 \pm 0.08$ birds/km²) (Figure 78).

Overall, 56% of observations were of individuals in flight, and median flight height ranged between one and 30 m. Most individuals flew below the RSZ (Figure 79, Figure 80). Flight headings were mixed but in Summer there was a slight pattern of northerly flight headings (Figure 81).

2.5.9.3 Sooty Shearwater

Sooty shearwater were observed in Winter (n=2), Spring (n=114), and Summer (n=4) (Appendix B, Figure 82, Figure 83). In Winter, two flying sooty shearwater were observed: one in Zone 4 and one in Zone 5 (Figure 84, Figure 85). In Spring, when sooty shearwater were most frequently observed, individuals were most often observed in the outer zones with Zone 4 having the greatest mean density ($\bar{x} = 0.03 \pm 0.01$ birds/km²) (Figure 83).

In Spring, 45% of birds were observed in flight, and in Zone 4, median flight height was below the RSZ (Figure 85). In Summer, four sooty shearwater were observed: three in Zone 1 and one in Zone 4, all of which were flying (Figure 85). In the Spring, there was no observed pattern of flight heading (Figure 86).

2.5.9.4 Manx Shearwater

Manx shearwater were observed in Winter (n=1), Spring (n=9), and Fall (n=42) (Appendix B, Figure 87, Figure 88). In the Fall, most Manx shearwater were observed in Zone 4 ($\bar{x} = 0.01 \pm 0.004$ birds/km²) and the single Winter observation was also in Zone 4 (Figure 87). In the Fall, 45% of Manx shearwater were observed in flight with a median flight height below the RSZ (Figure 89). In Spring, two individuals were in flight (Figure 90). In the Fall, a slight pattern of southwesterly flight heading was observed (Figure 91).

2.5.9.5 Audubon's Shearwater

Audubon's shearwater were observed twice in the northeastern corner of Zone 1, and five individuals were observed in the outer Zones 5 and 6. All observations occurred during Summer surveys (Figure 92).

Figure 67. Spatial Distribution of Shearwater During Fall and Winter by Zone and Proximity to Call Areas

Heat map is scaled to the maximum density for the species/species group across all seasons. Inset bar plots display mean estimated densities \pm standard error of the mean for each zone.

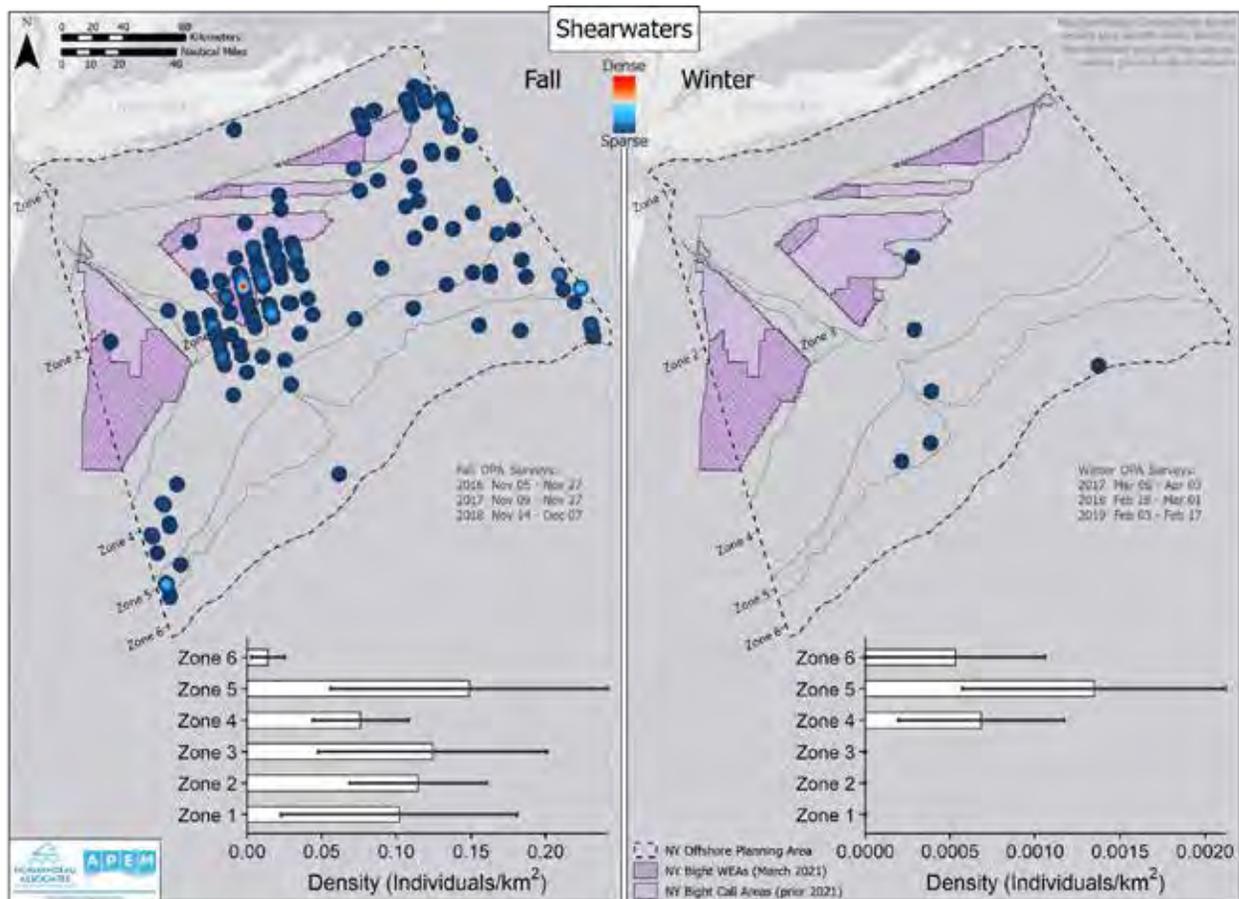


Figure 68. Spatial Distribution of Shearwater During Spring and Summer by Zone and Proximity to Call Areas

Heat map is scaled to the maximum density for the species/species group across all seasons. Inset bar plots display mean estimated densities \pm standard error of the mean for each zone.

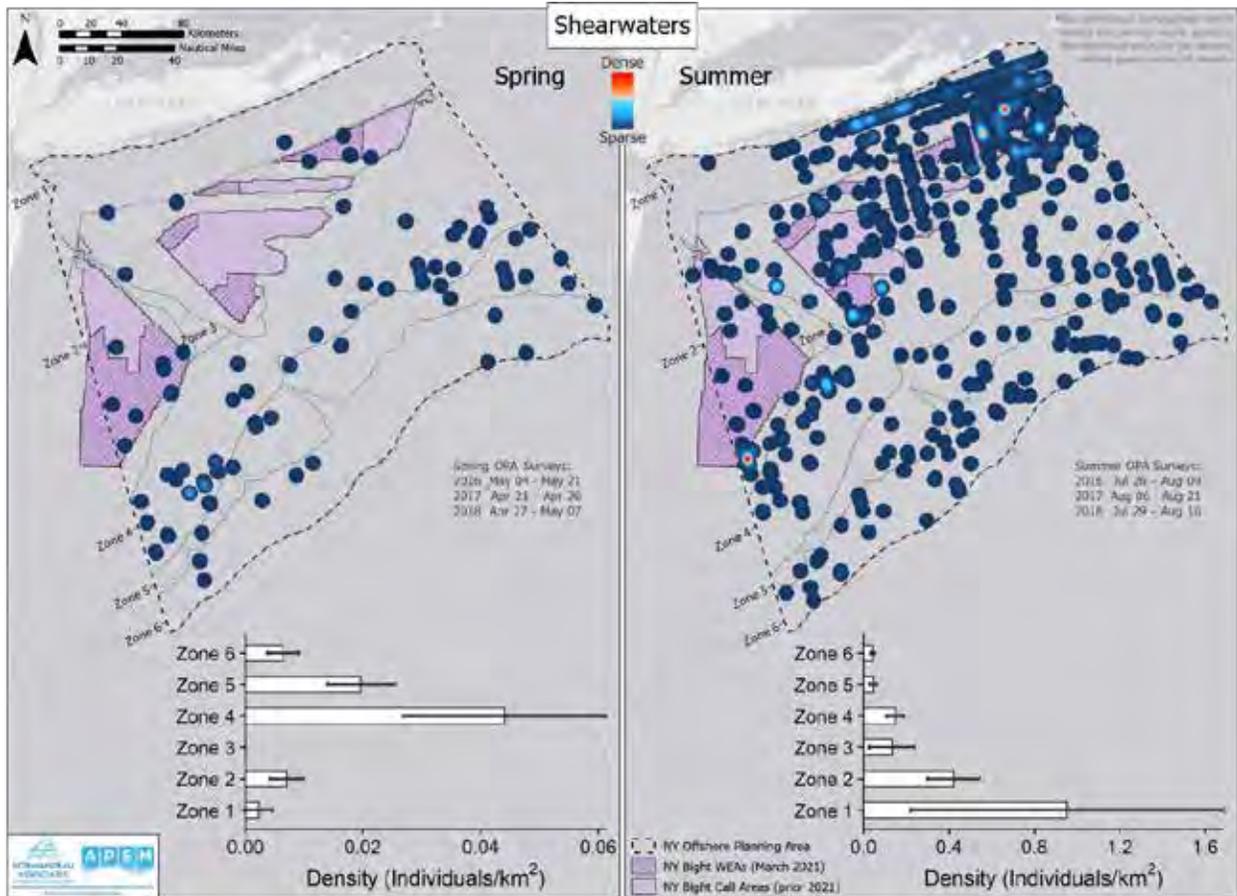


Figure 69. Spatial Distribution of Shearwater Sitting Relative to Birds in Flight During Fall and Winter Surveys

Solid blue points represent individuals with calculated flight height and blue points with an x represent individuals in flight without flight height data. A pie chart inset shows the proportion of individuals flying and sitting. A boxplot inset of flight height distribution by zone is displayed for all birds with known flight heights. Boxplots show the distribution of data among seasons. The dark horizontal line is the median flight height, and the box represents the middle 50% of data values. The lines to the left and right of the box represent the data points that are within 1.5 times the length of the box. Data beyond this range are shown as individual points.

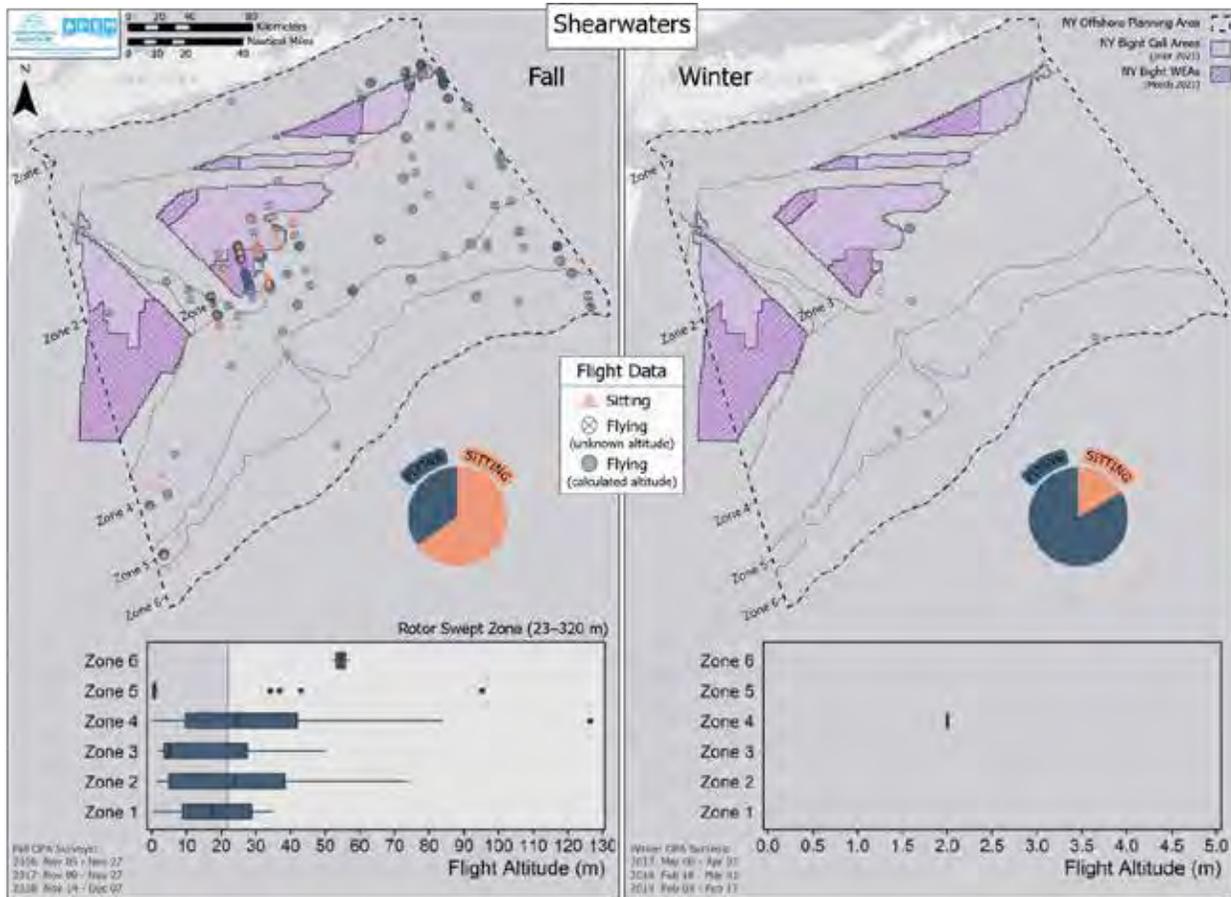


Figure 70. Spatial Distribution of Shearwater Sitting Relative to Birds in Flight During Spring and Summer Surveys

Solid blue points represent individuals with calculated flight height and blue points with an x represent individuals in flight without flight height data. A pie chart inset shows the proportion of individuals flying and sitting. A boxplot inset of flight height distribution by zone is displayed for all birds with known flight heights. Boxplots show the distribution of data among seasons. The dark horizontal line is the median flight height, and the box represents the middle 50% of data values. The lines to the left and right of the box represent the data points that are within 1.5 times the length of the box. Data beyond this range are shown as individual points.

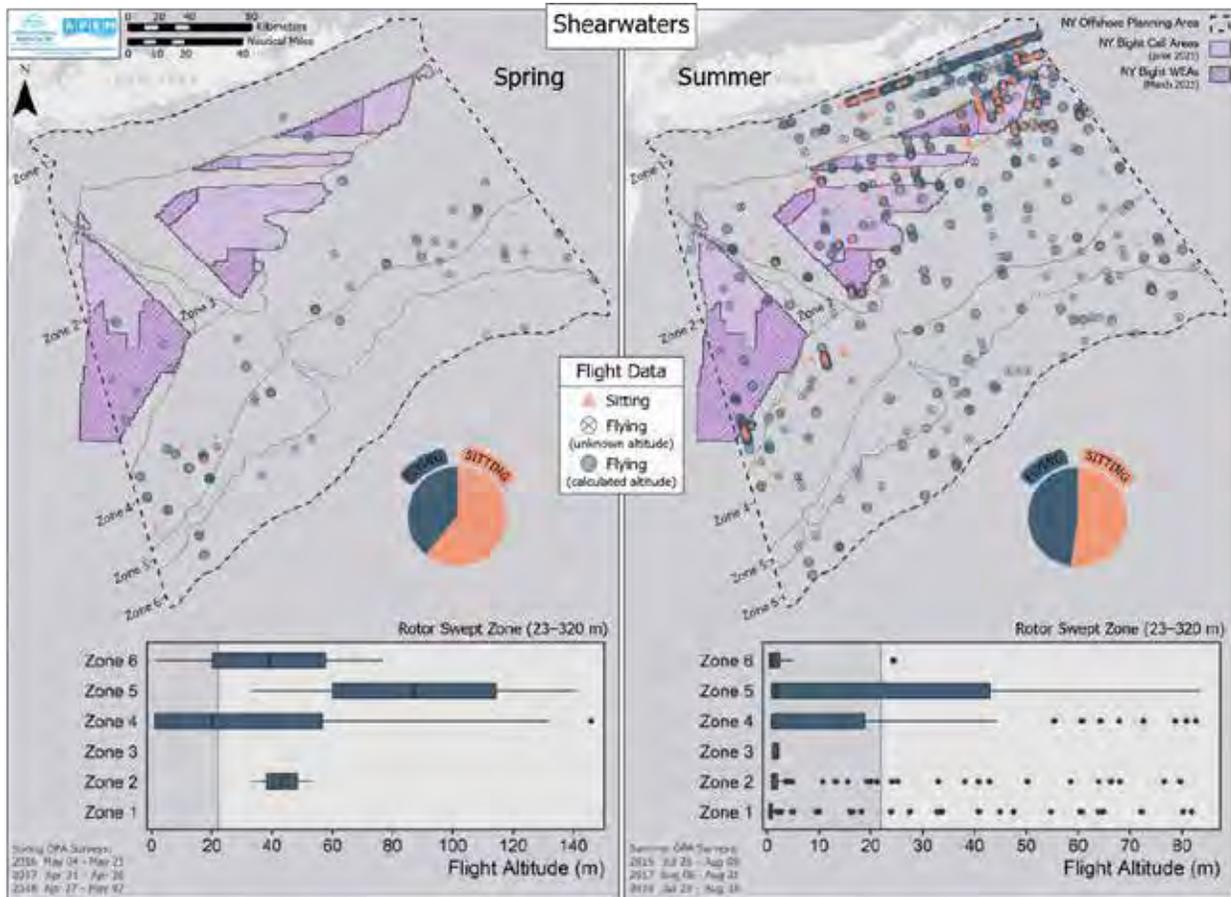


Figure 71. Direction of Flight of All Shearwaters for All Surveys

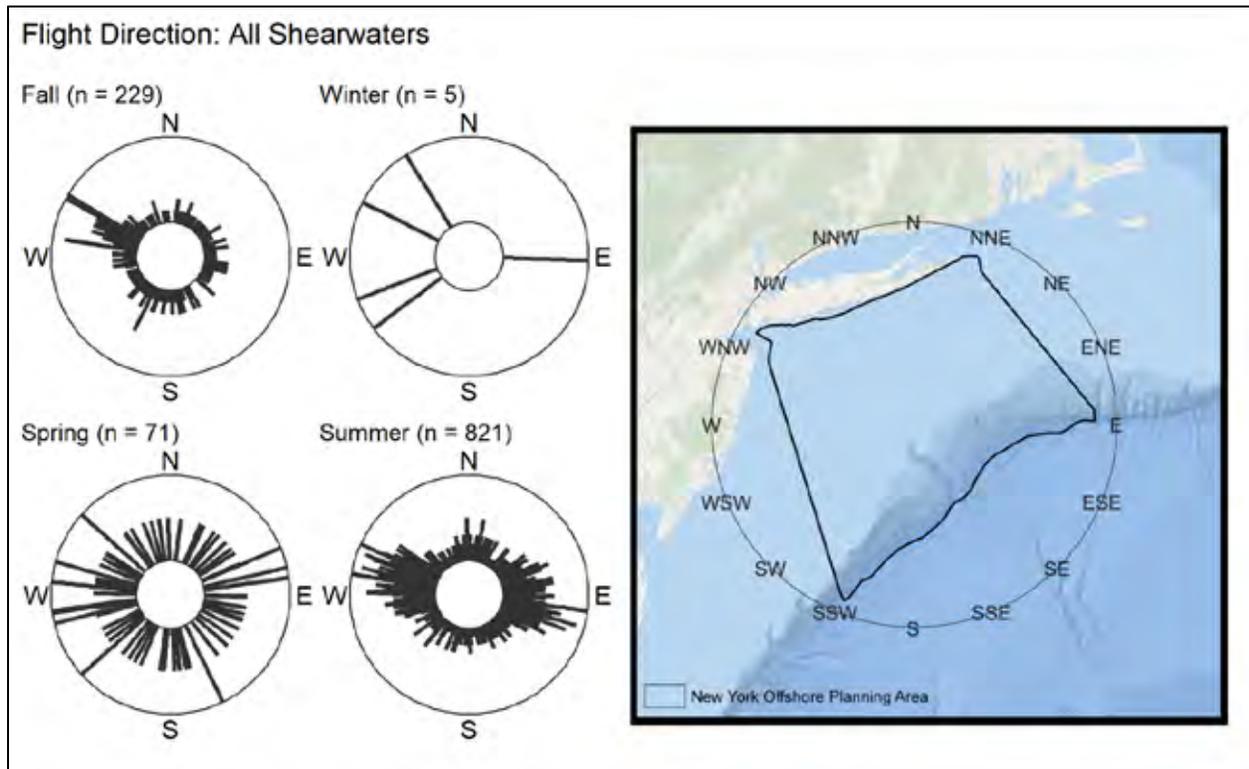


Figure 72. Spatial Distribution of Cory's Shearwater During Fall and Winter by Zone and Proximity to Call Areas

Heat map is scaled to the maximum density for the species/species group across all seasons. Inset bar plots display mean estimated densities \pm standard error of the mean for each zone.

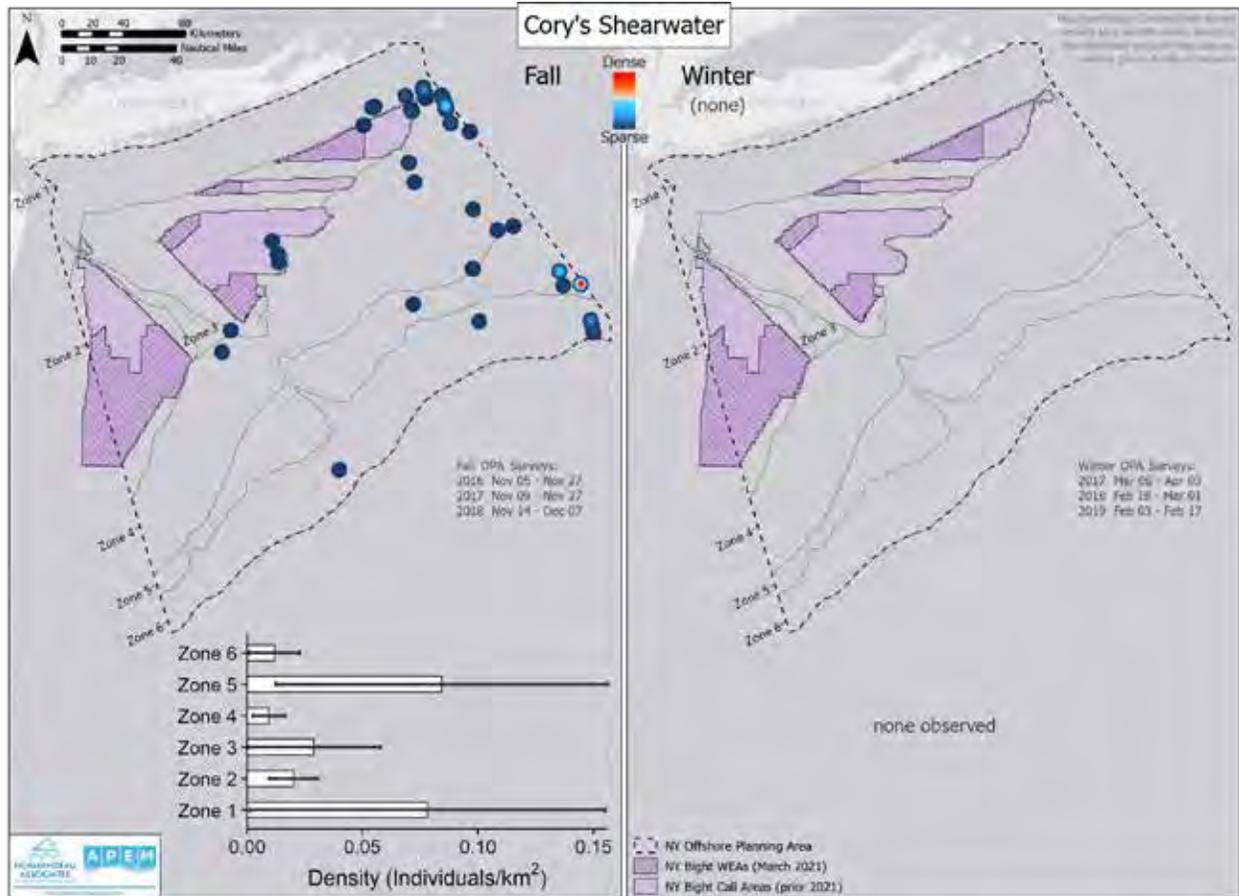


Figure 73. Spatial Distribution of Cory's Shearwater During Spring and Summer by Zone and Proximity to Call Areas

Heat map is scaled to the maximum density for the species/species group across all seasons. Inset bar plots display mean estimated densities \pm standard error of the mean for each zone.

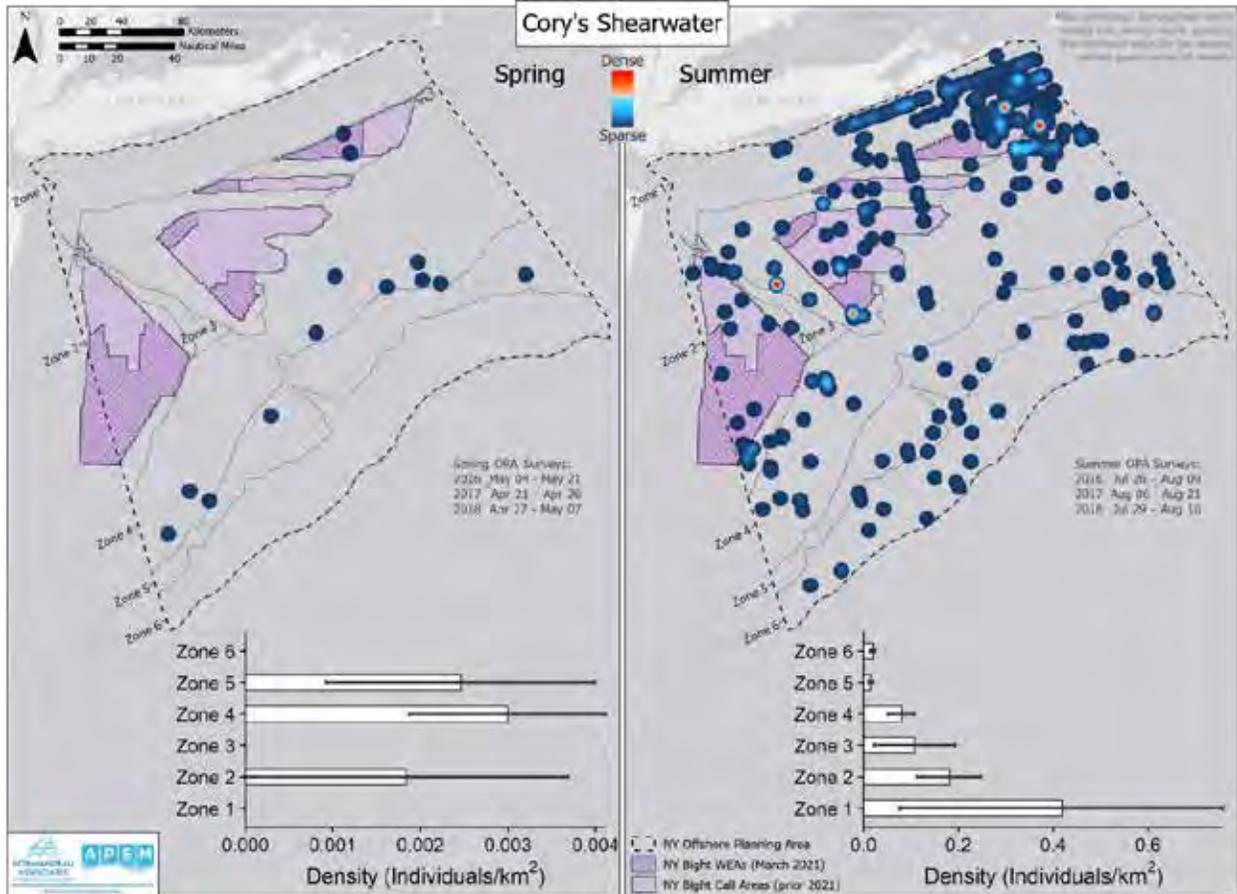


Figure 74. Spatial Distribution of Cory's Shearwater Sitting Relative to Birds in Flight During Fall and Winter Surveys

Solid blue points represent individuals with calculated flight height and blue points with an x represent individuals in flight without flight height data. A pie chart inset shows the proportion of individuals flying and sitting. A boxplot inset of flight height distribution by zone is displayed for all birds with known flight heights. Boxplots show the distribution of data among seasons. The dark horizontal line is the median flight height, the box represents the middle 50% of data values. The lines to the left and right of the box represent the data points that are within 1.5 times the length of the box. Data beyond this range are shown as individual points.

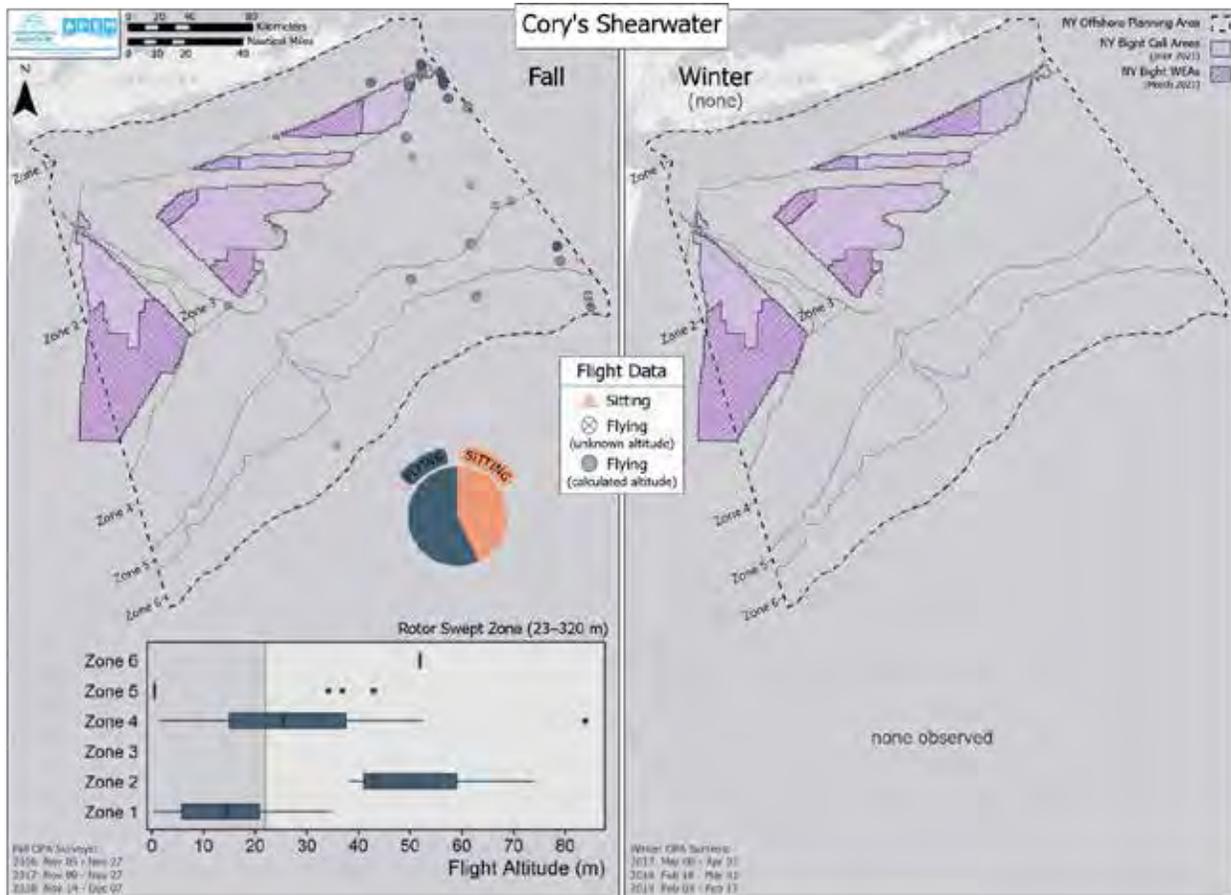


Figure 75. Spatial Distribution of Cory's Shearwater Sitting Relative to Birds in Flight During Spring and Summer Surveys

Solid blue points represent individuals with calculated flight height and blue points with an x represent individuals in flight without flight height data. A pie chart inset shows the proportion of individuals flying and sitting. A boxplot inset of flight height distribution by zone is displayed for all birds with known flight heights. Boxplots show the distribution of data among seasons. The dark horizontal line is the median flight height, and the box represents the middle 50% of data values. The lines to the left and right of the box represent the data points that are within 1.5 times the length of the box. Data beyond this range are shown as individual points.

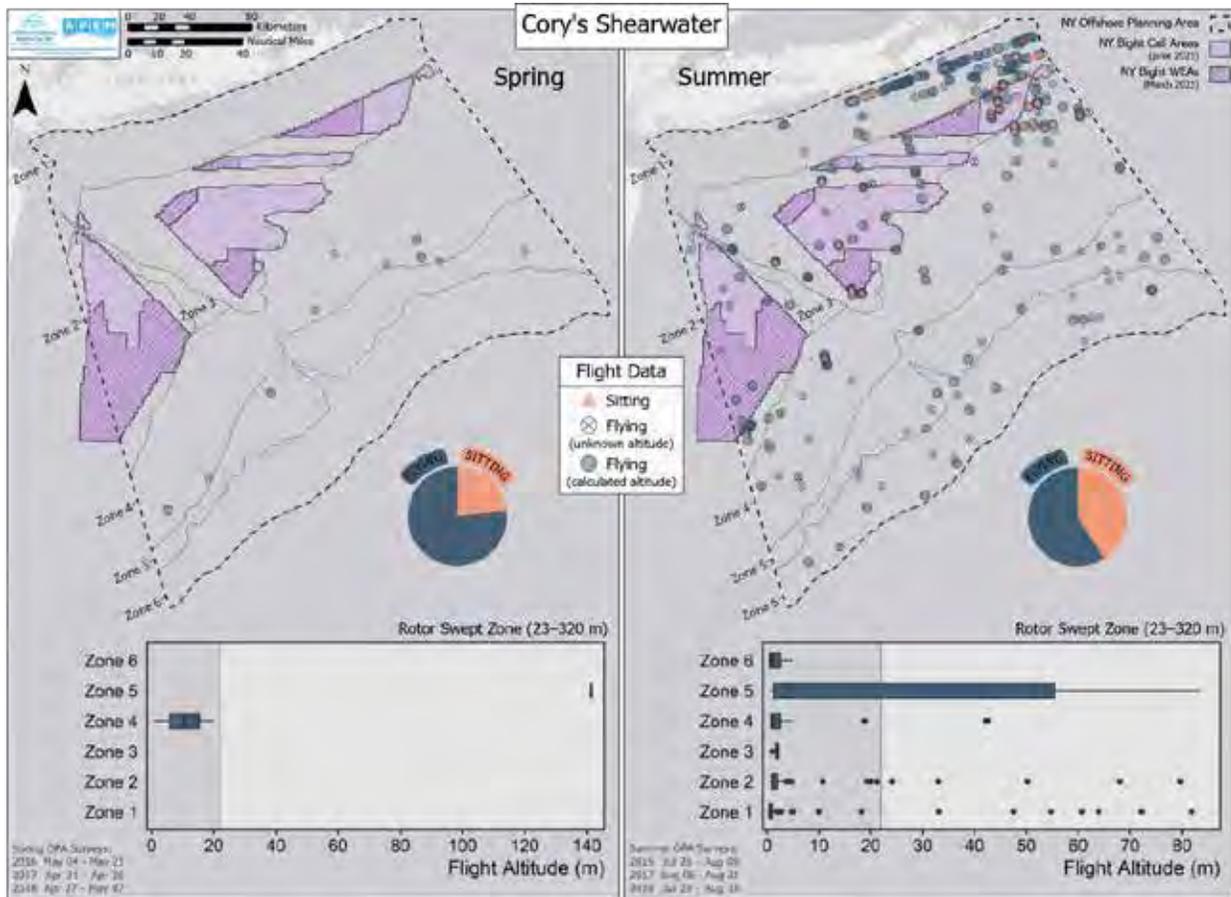


Figure 76. Direction of Flight of Cory's Shearwaters for All Surveys

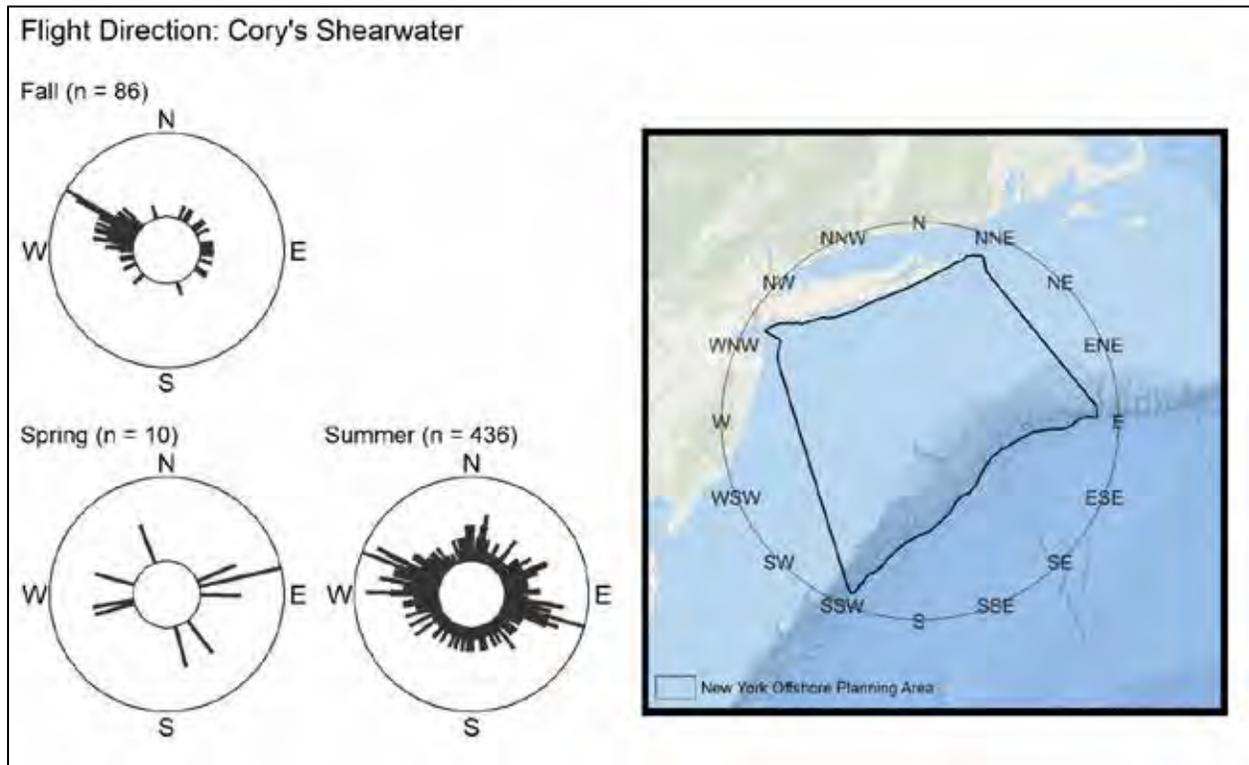


Figure 77. Spatial Distribution of Great Shearwater During Fall and Winter by Zone and Proximity to Call Areas

Heat map is scaled to the maximum density for the species/species group across all seasons. Inset bar plots display mean estimated densities \pm standard error of the mean for each zone.

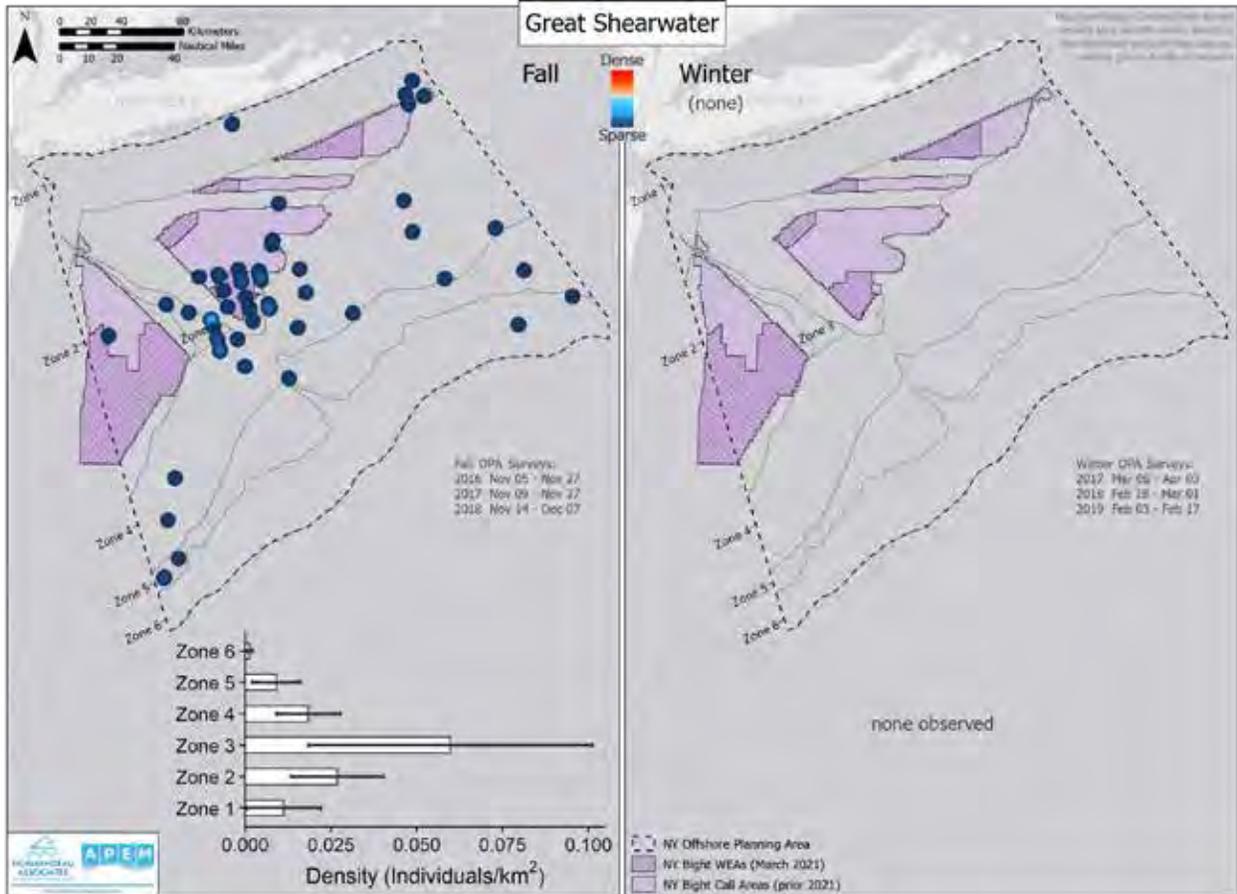


Figure 78. Spatial Distribution of Great Shearwater During Spring and Summer by Zone and Proximity to Call Areas

Heat map is scaled to the maximum density for the species/species group across all seasons. Inset bar plots display mean estimated densities \pm standard error of the mean for each zone.

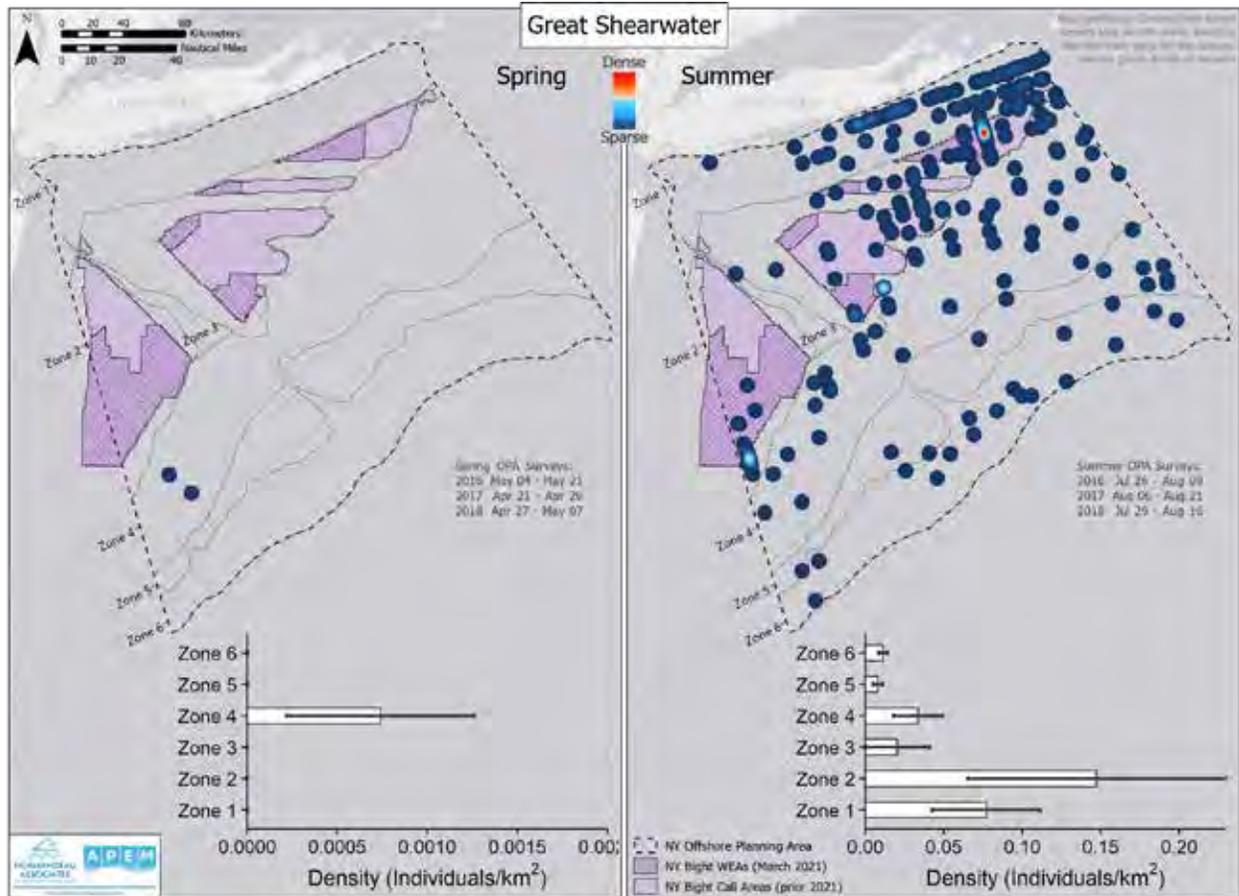


Figure 79. Spatial Distribution of Great Shearwater Sitting Relative to Birds in Flight During Fall and Winter Surveys

Solid blue points represent individuals with calculated flight height and blue points with an x represent individuals in flight without flight height data. A pie chart inset shows the proportion of individuals flying and sitting. A boxplot inset of flight height distribution by zone is displayed for all birds with known flight heights. Boxplots show the distribution of data among seasons. The dark horizontal line is the median flight height, and the box represents the middle 50% of data values. The lines to the left and right of the box represent the data points that are within 1.5 times the length of the box. Data beyond this range are shown as individual points.

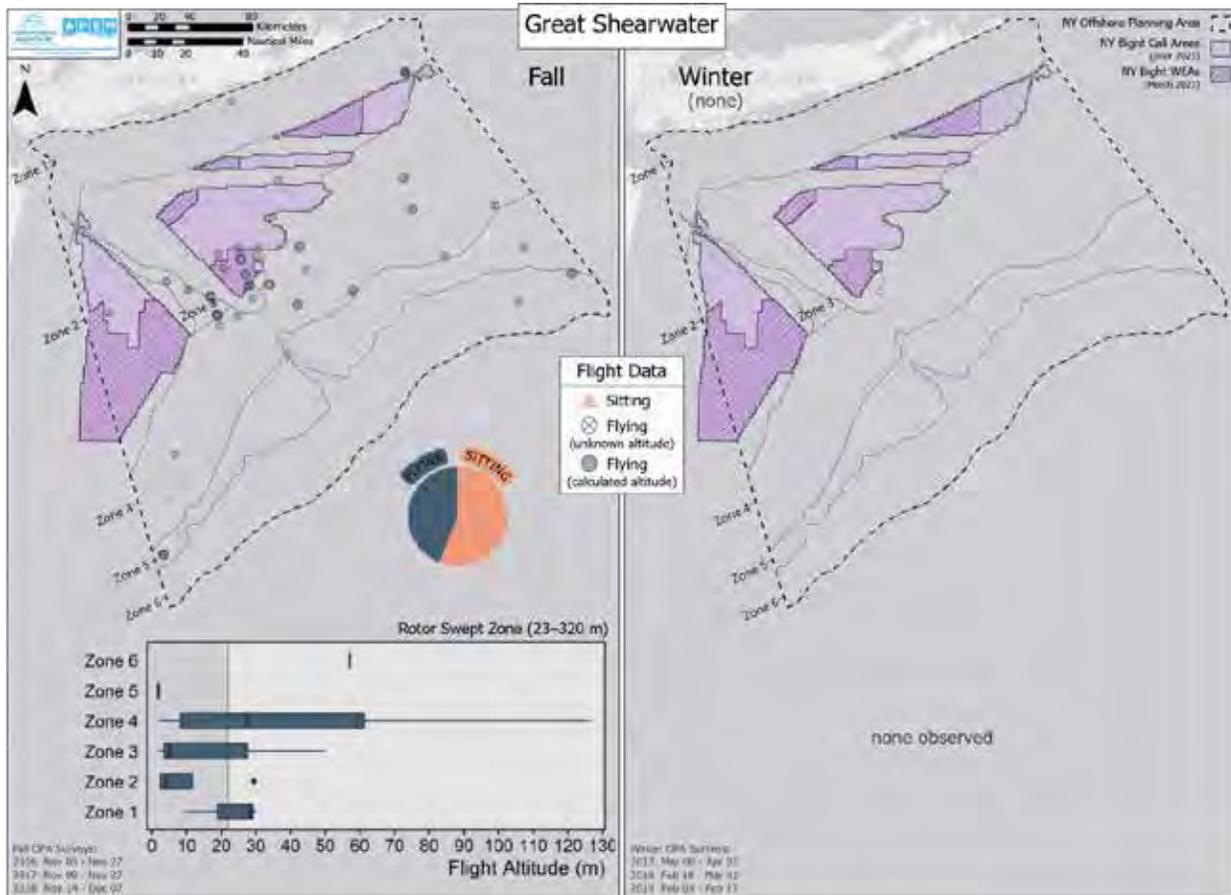


Figure 80. Spatial Distribution of Great Shearwater Sitting Relative to Birds in Flight During Spring and Summer Surveys

Solid blue points represent individuals with calculated flight height and blue points with an x represent individuals in flight without flight height data. A pie chart inset shows the proportion of individuals flying and sitting. A boxplot inset of flight height distribution by zone is displayed for all birds with known flight heights. Boxplots show the distribution of data among seasons. The dark horizontal line is the median flight height, and the box represents the middle 50% of data values. The lines to the left and right of the box represent the data points that are within 1.5 times the length of the box. Data beyond this range are shown as individual points.

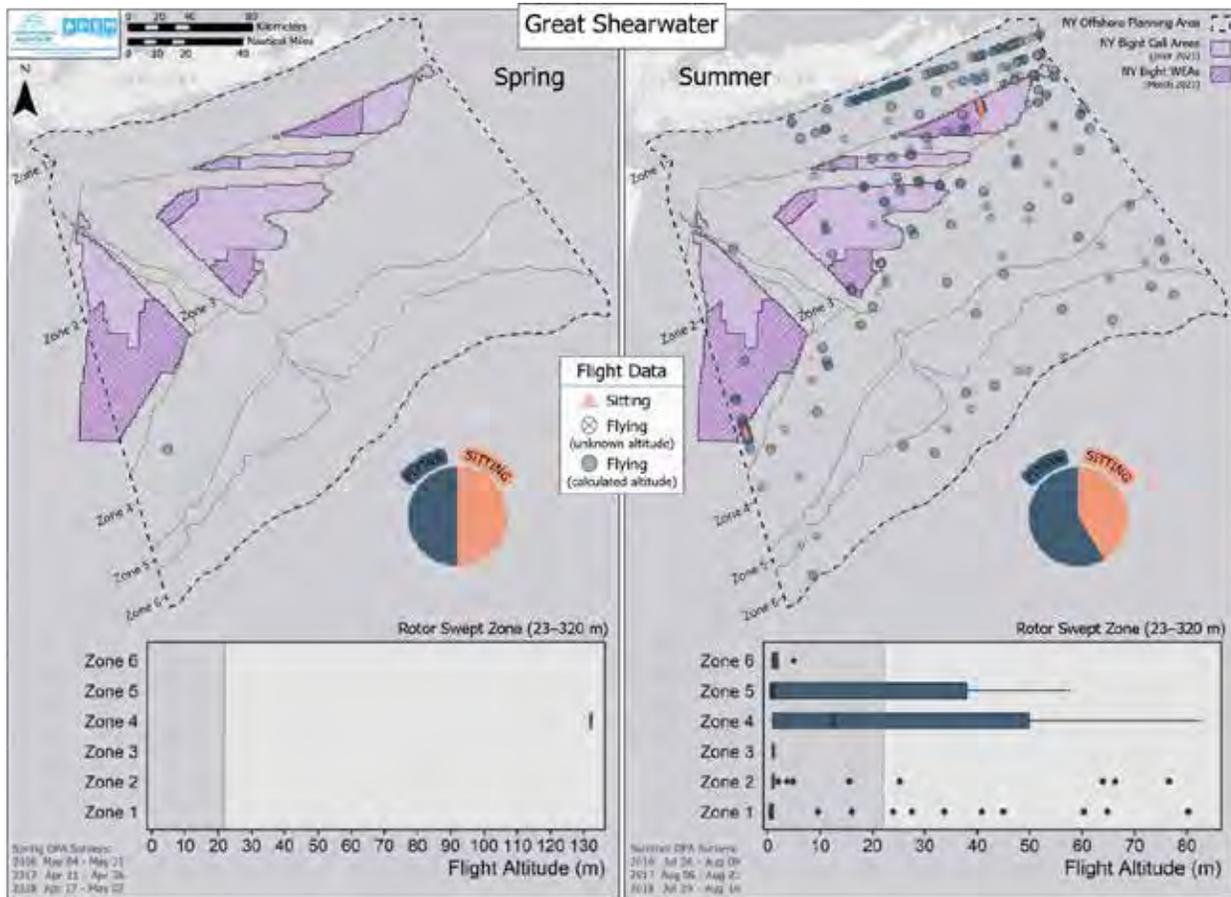


Figure 81. Direction of Flight of Great Shearwaters for All Surveys

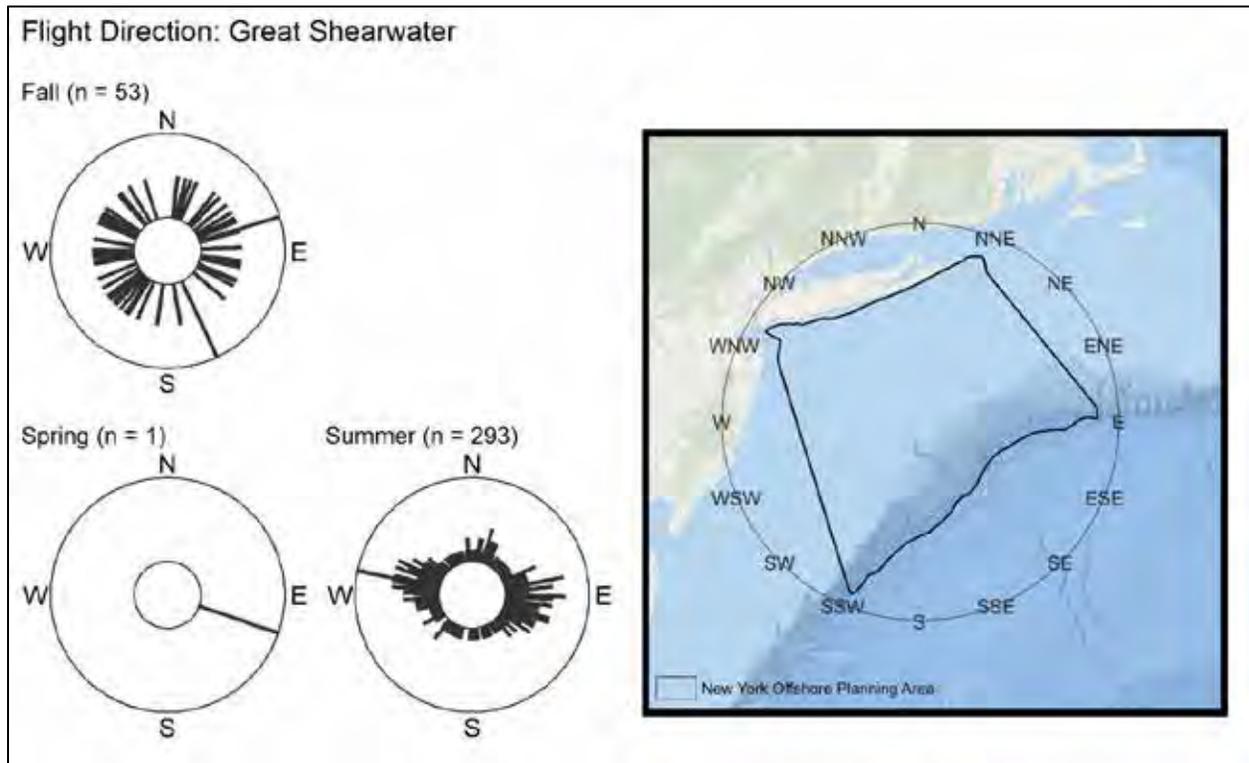


Figure 82. Spatial Distribution of Sooty Shearwater During Fall and Winter by Zone and Proximity to Call Areas

Heat map is scaled to the maximum density for the species/species group across all seasons. Inset bar plots display mean estimated densities \pm standard error of the mean for each zone.

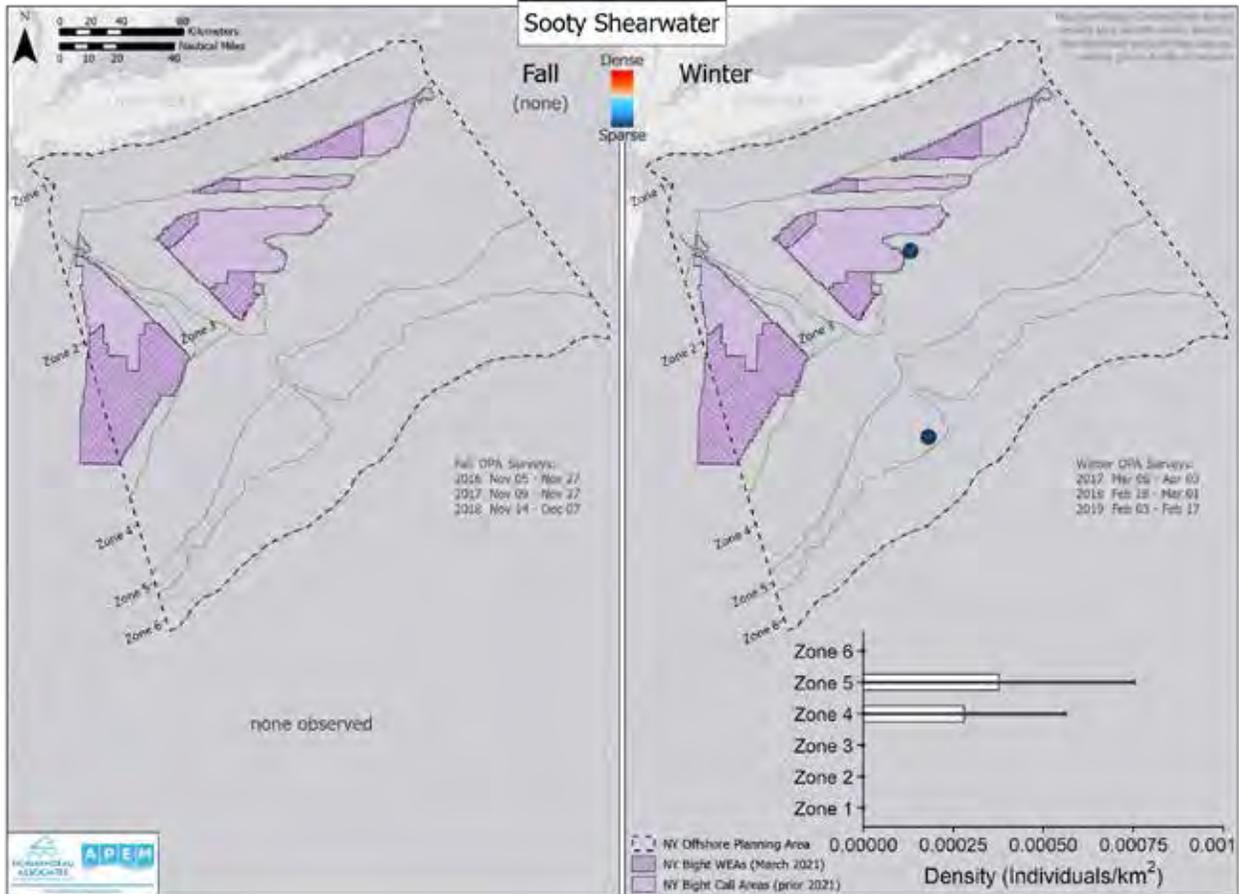


Figure 83. Spatial Distribution of Sooty Shearwater During Spring and Summer by Zone and Proximity to Call Areas

Heat map is scaled to the maximum density for the species/species group across all seasons. Inset bar plots display mean estimated densities \pm standard error of the mean for each zone.

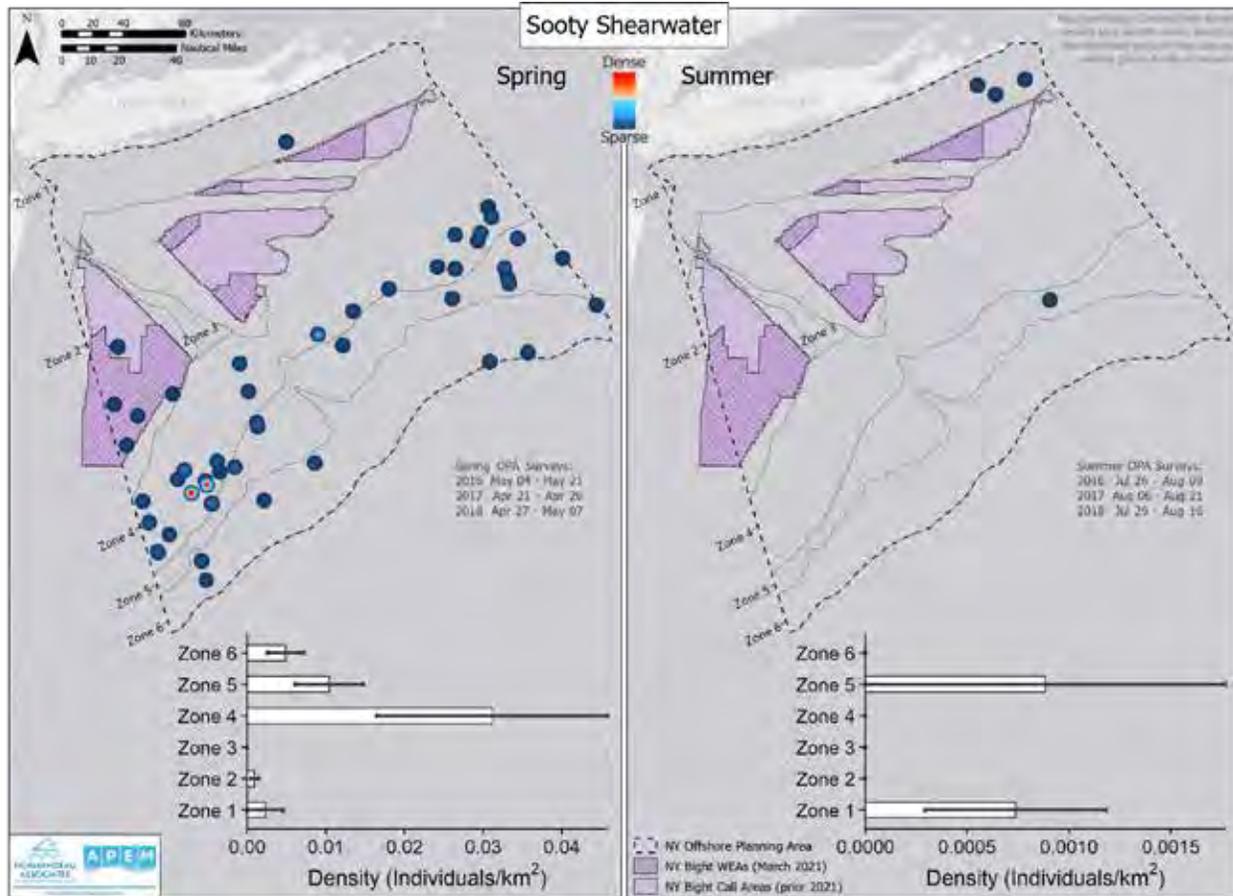


Figure 84. Spatial Distribution of Sooty Shearwater Sitting Relative to Birds in Flight During Fall and Winter Surveys

Solid blue points represent individuals with calculated flight height and blue points with an x represent individuals in flight without flight height data. A pie chart inset shows the proportion of individuals flying and sitting. A boxplot inset of flight height distribution by zone is displayed for all birds with known flight heights. Boxplots show the distribution of data among seasons. The dark horizontal line is the median flight height, and the box represents the middle 50% of data values. The lines to the left and right of the box represent the data points that are within 1.5 times the length of the box. Data beyond this range are shown as individual points.

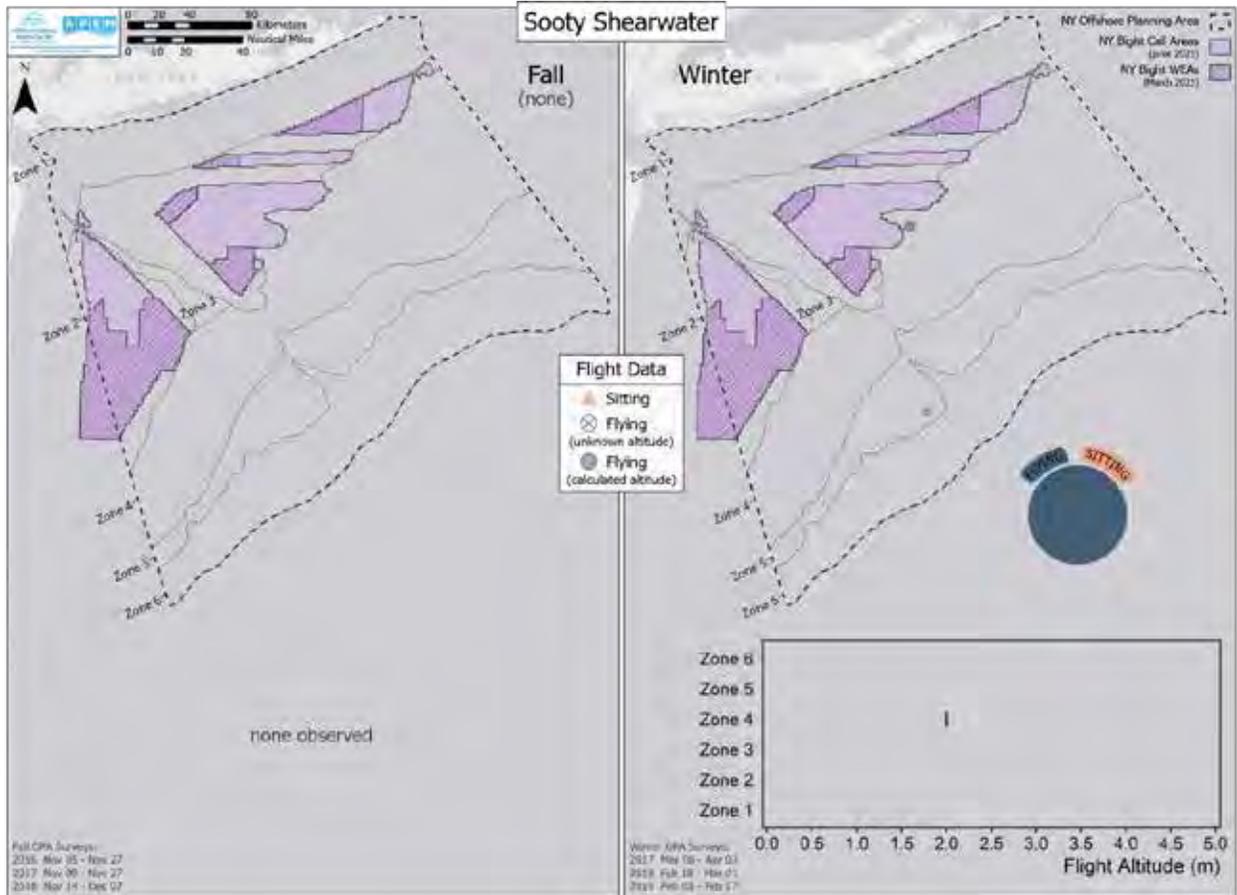


Figure 85. Spatial Distribution of Sooty Shearwater Sitting Relative to Birds in Flight During Spring and Summer Surveys

Solid blue points represent individuals with calculated flight height and blue points with an x represent individuals in flight without flight height data. A pie chart inset shows the proportion of individuals flying and sitting. A boxplot inset of flight height distribution by zone is displayed for all birds with known flight heights. Boxplots show the distribution of data among seasons. The dark horizontal line is the median flight height, and the box represents the middle 50% of data values. The lines to the left and right of the box represent the data points that are within 1.5 times the length of the box. Data beyond this range are shown as individual points.

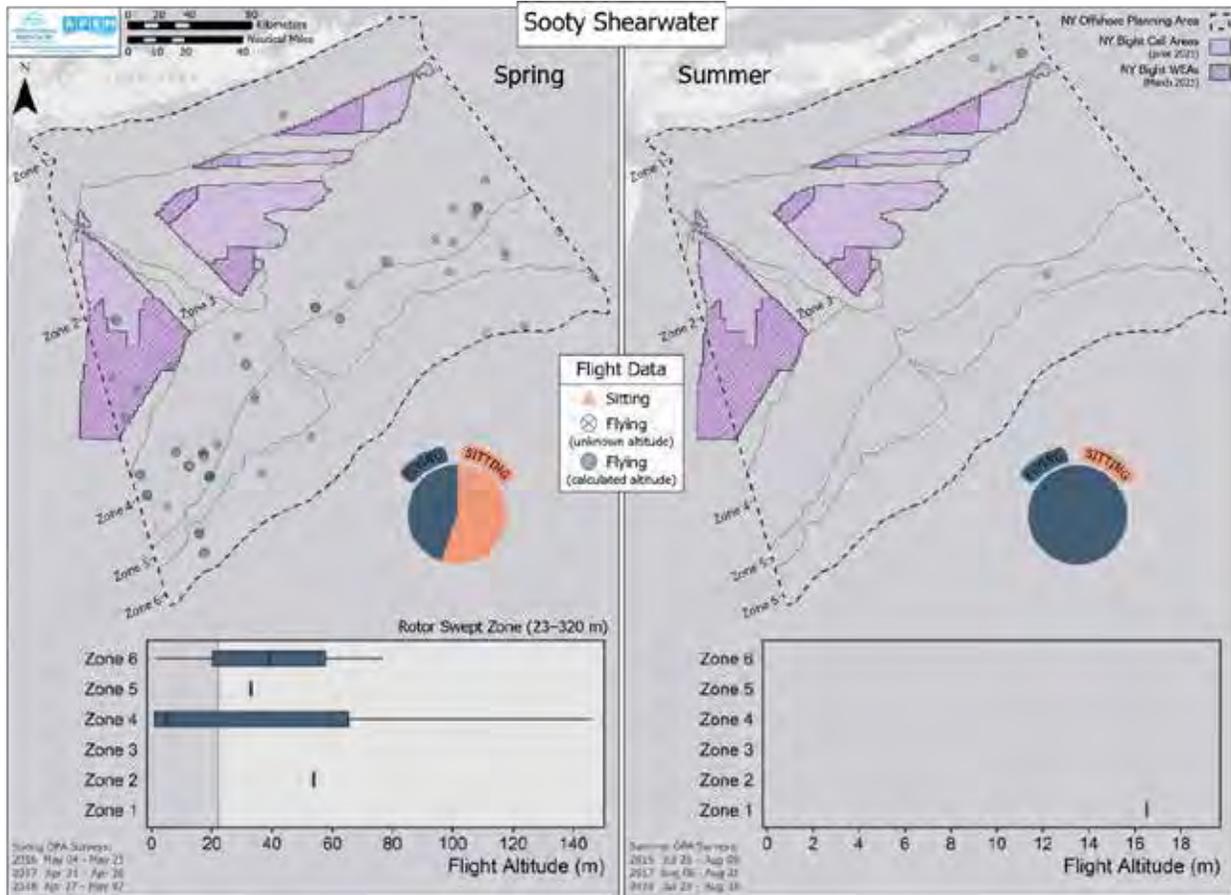


Figure 86. Direction of Flight of Sooty Shearwater for All Surveys

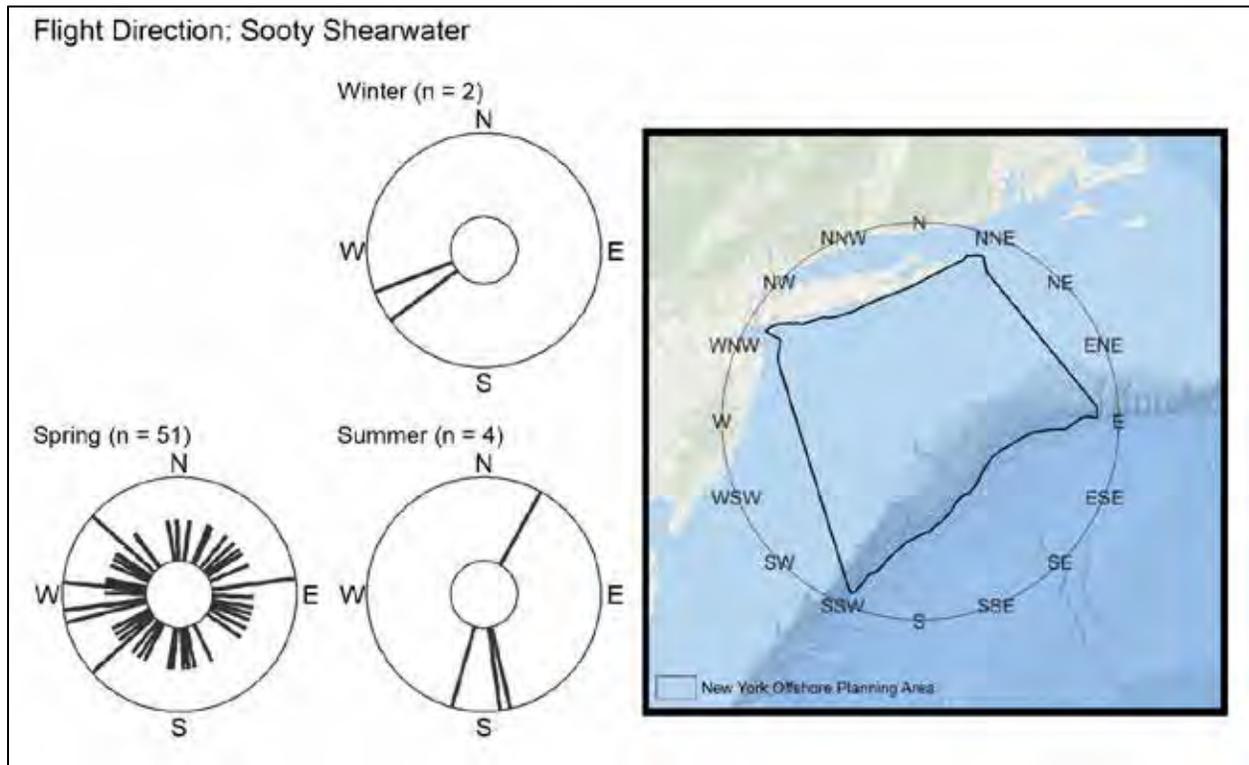


Figure 87. Spatial Distribution of Manx Shearwater During Fall and Winter by Zone and Proximity to Call Areas

Heat map is scaled to the maximum density for the species/species group across all seasons. Inset bar plots display mean estimated densities \pm standard error of the mean for each zone.

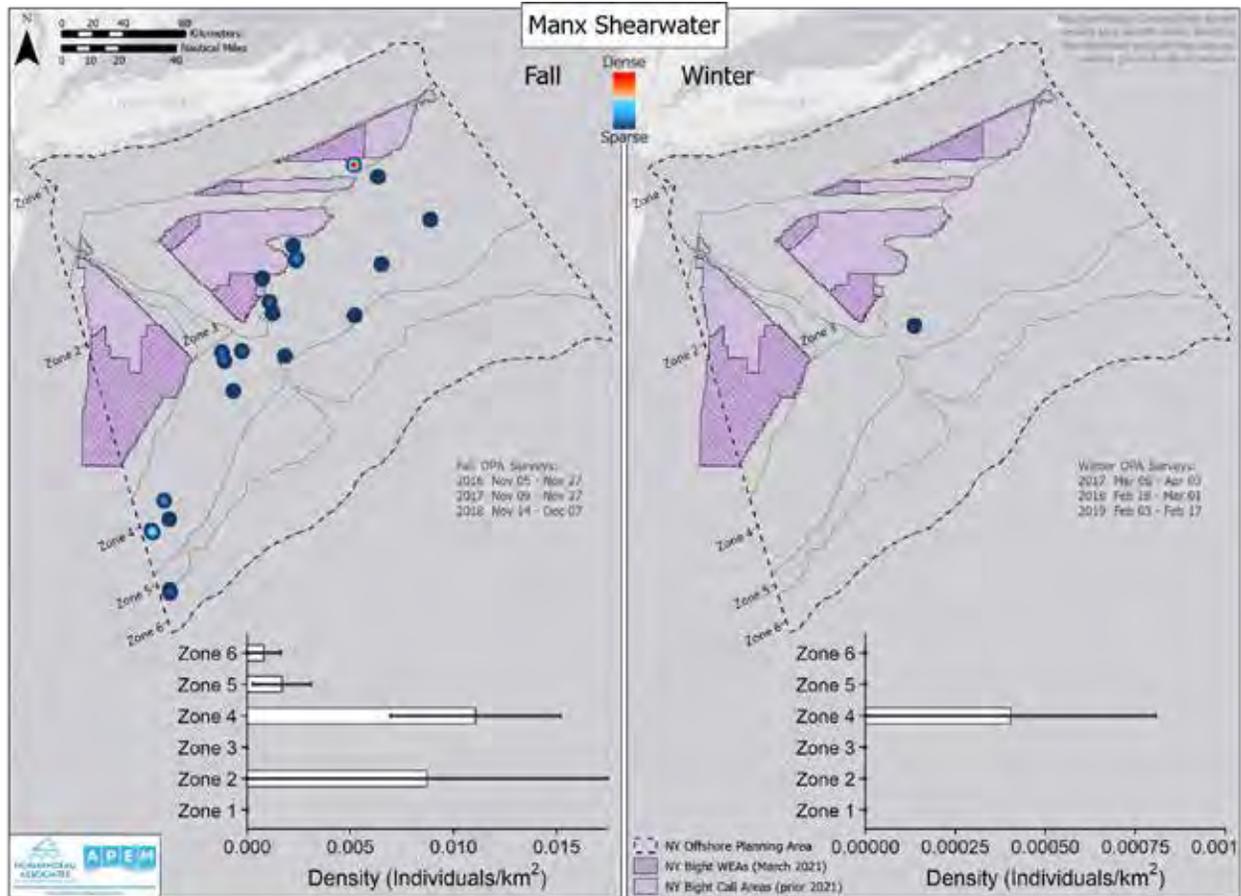


Figure 88. Spatial Distribution of Manx Shearwater During Spring and Summer by Zone and Proximity to Call Areas

Heat map is scaled to the maximum density for the species/species group across all seasons. Inset bar plots display mean estimated densities \pm standard error of the mean for each zone.

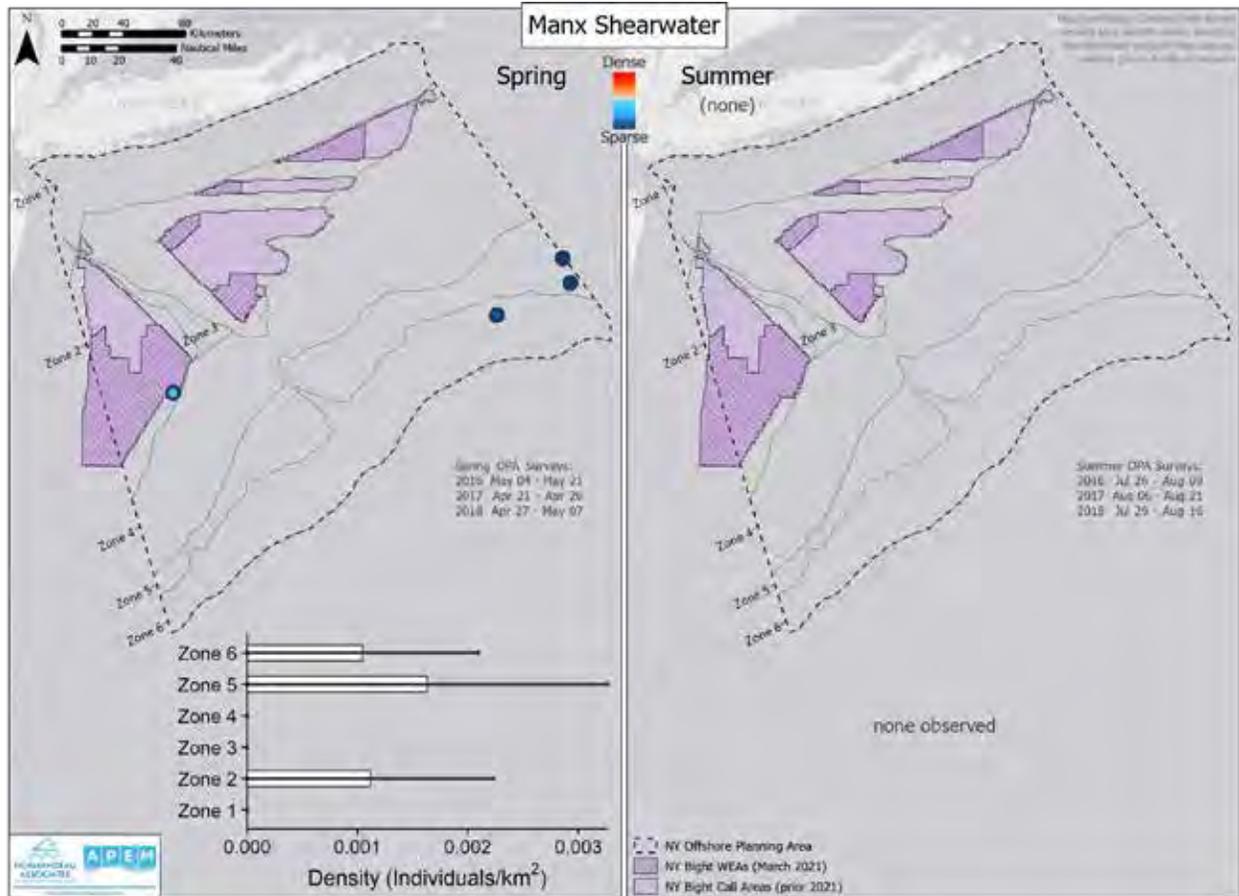


Figure 89. Spatial Distribution of Manx Shearwater Sitting Relative to Birds in Flight During Fall and Winter Surveys

Solid blue points represent individuals with calculated flight height and blue points with an x represent individuals in flight without flight height data. A pie chart inset shows the proportion of individuals flying and sitting. A boxplot inset of flight height distribution by zone is displayed for all birds with known flight heights. Boxplots show the distribution of data among seasons. The dark horizontal line is the median flight height, and the box represents the middle 50% of data values. The lines to the left and right of the box represent the data points that are within 1.5 times the length of the box. Data beyond this range are shown as individual points.

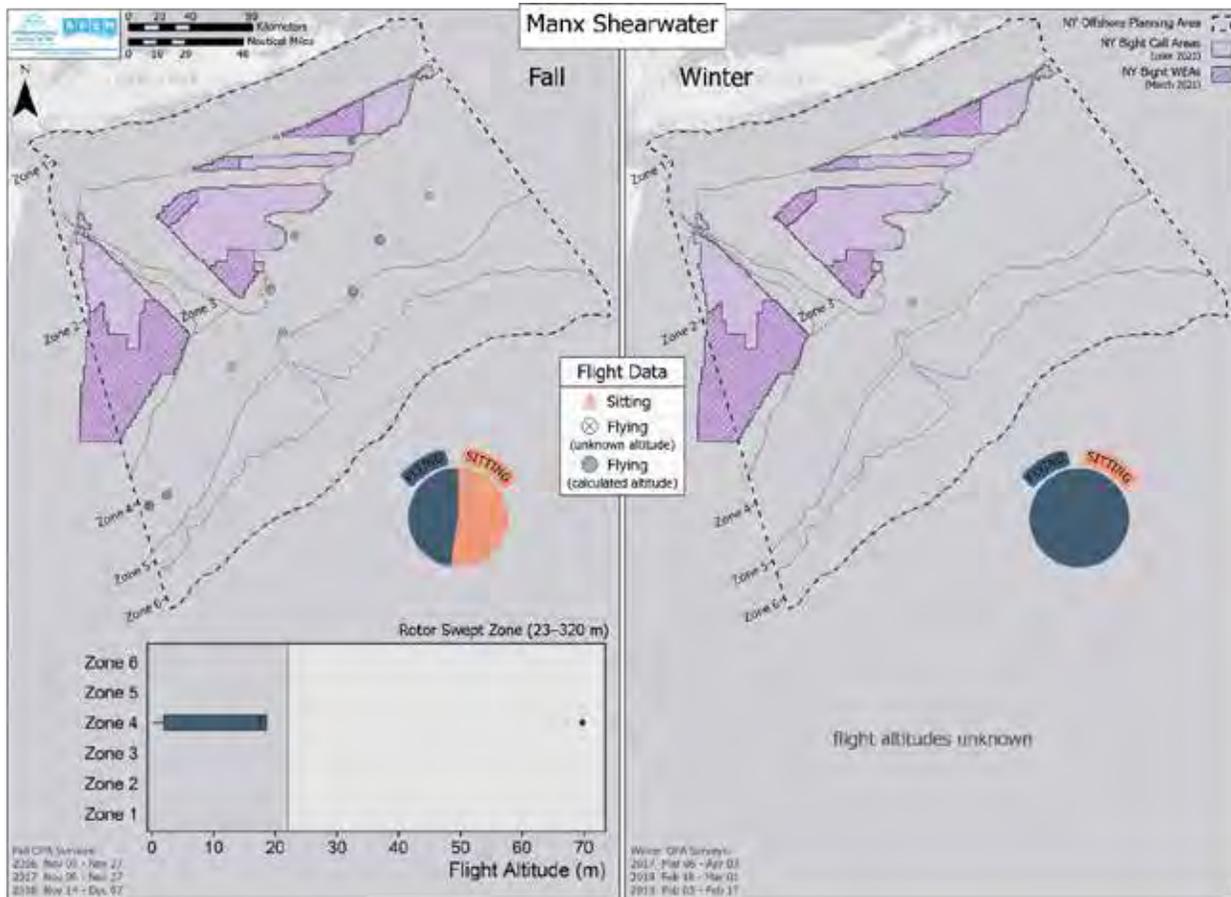


Figure 90. Spatial Distribution of Manx Shearwater Sitting Relative to Birds in Flight During Spring and Summer Surveys

Solid blue points represent individuals with calculated flight height and blue points with an x represent individuals in flight without flight height data. A pie chart inset shows the proportion of individuals flying and sitting.

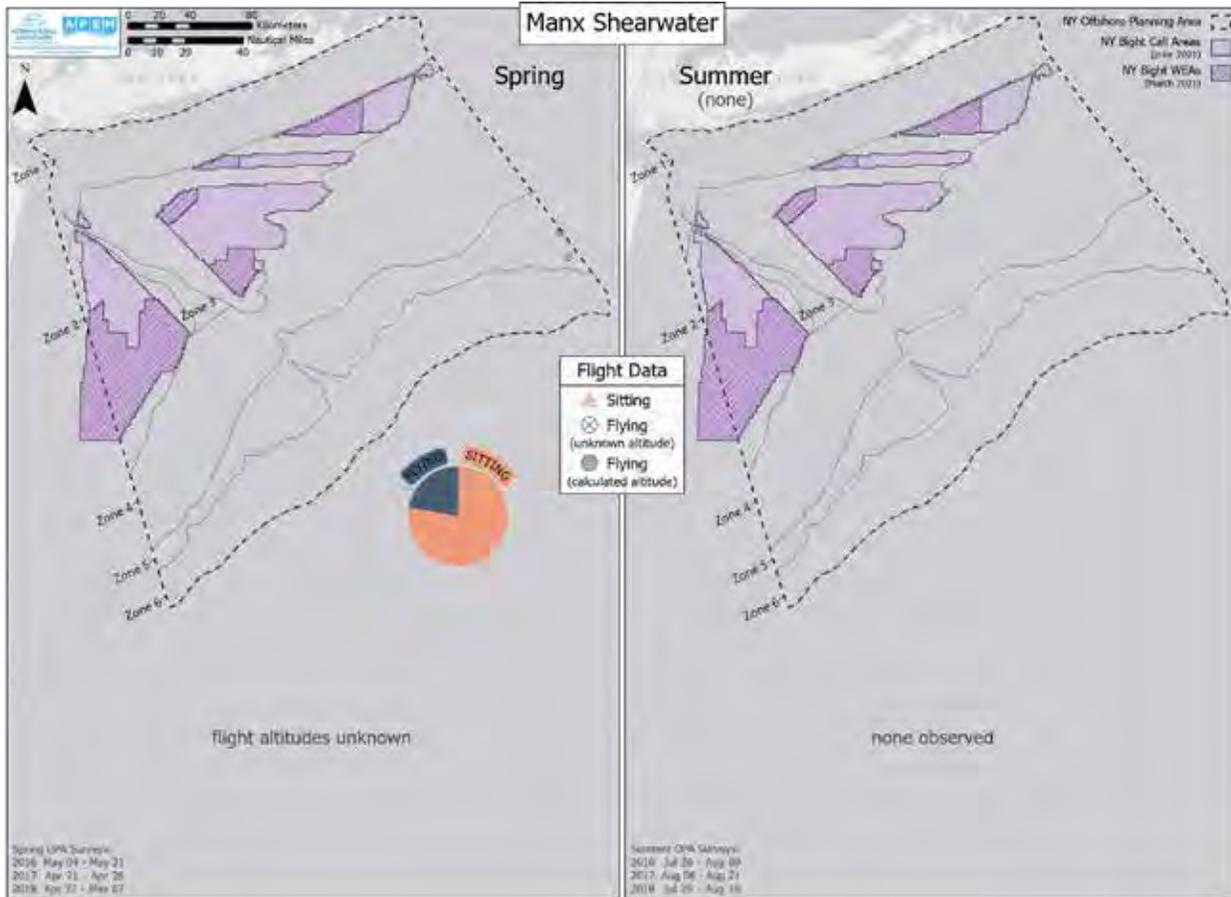


Figure 91. Direction of Flight of Manx Shearwaters for All Surveys

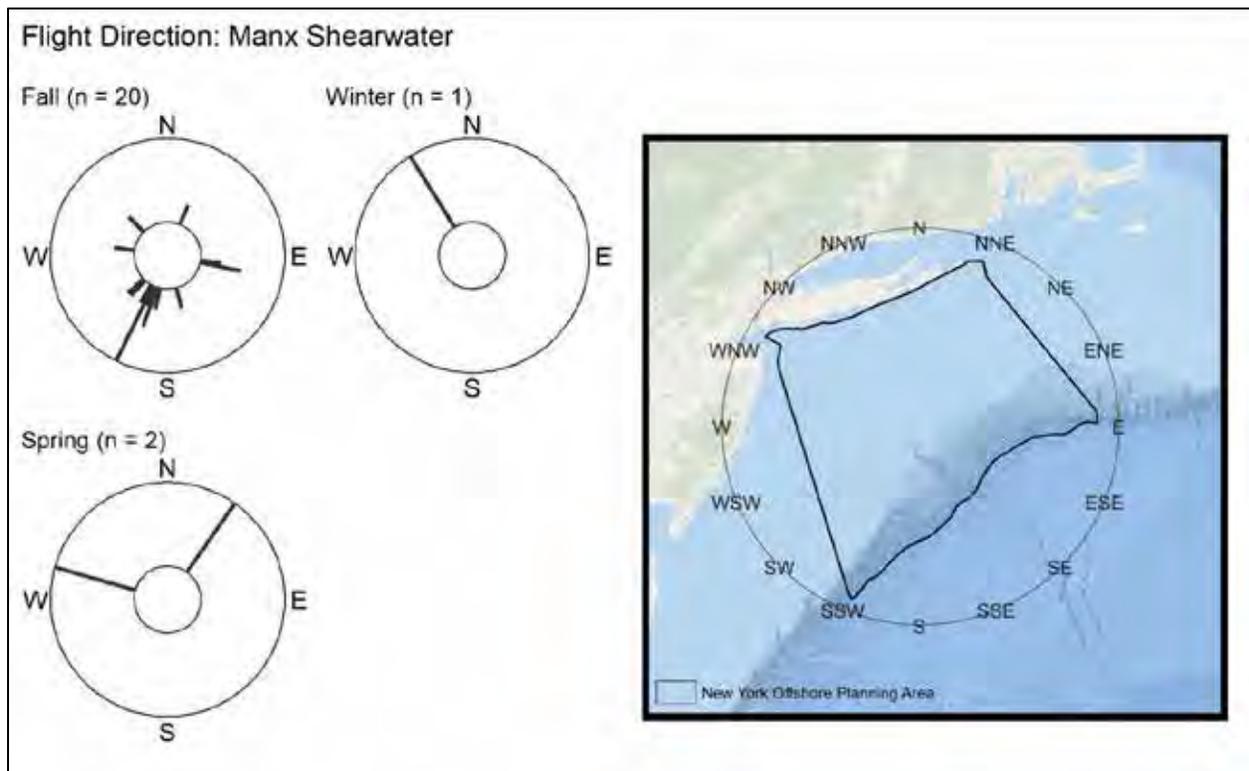
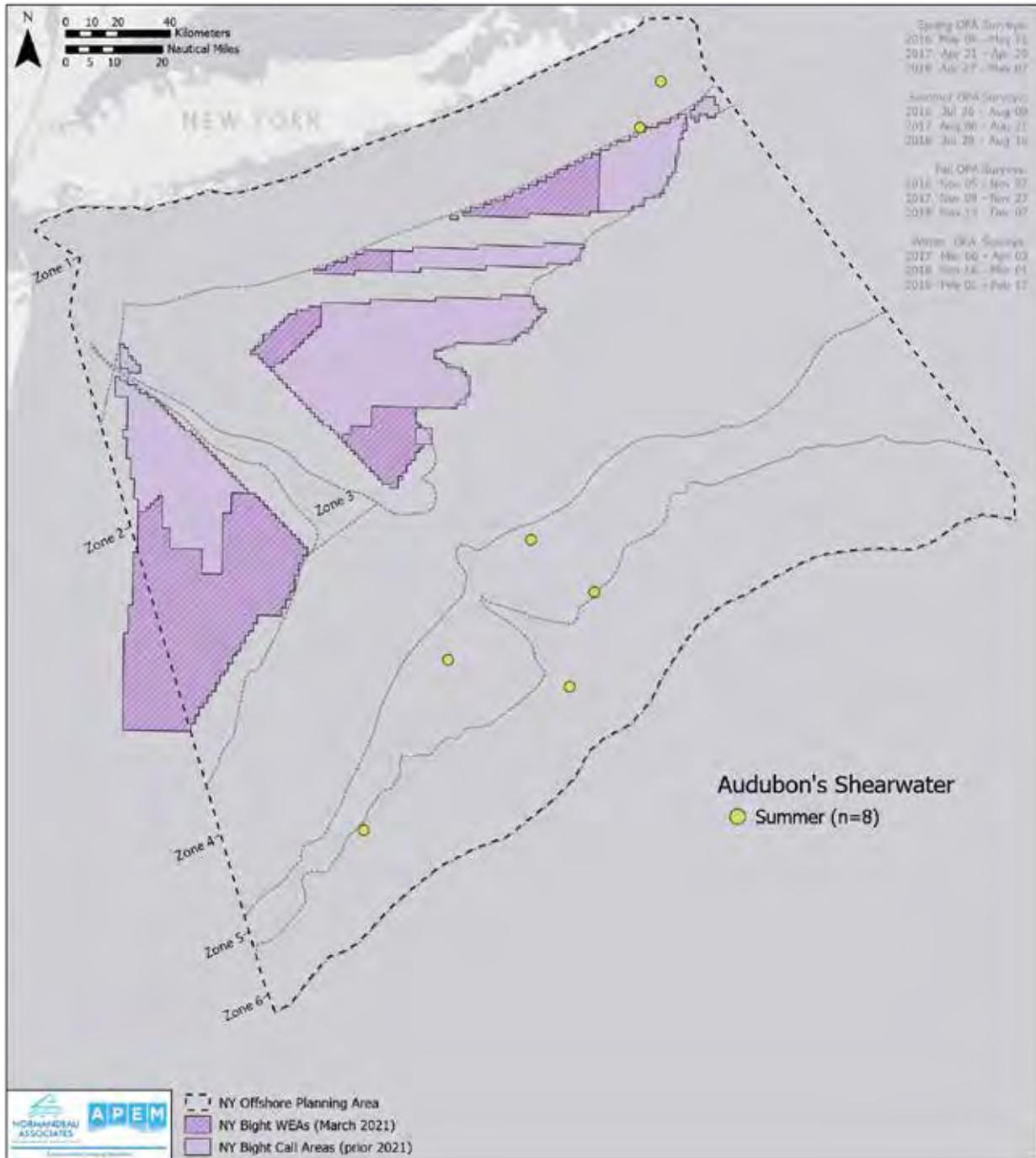


Figure 92. Spatial Distribution of Audubon's Shearwater



2.5.10 Storm-Petrel

The storm-petrel taxonomic grouping included individuals classified as storm-petrel-species unknown (n=6356), Wilson's storm-petrel (n=1,218), white-faced storm-petrel (n=2), Leach's storm-petrel (n=8), and band-rumped storm-petrel (n =1) (Appendix B). Considering the entire mean density estimates across the OPA, storm-petrel were most dense during Summer surveys (n=4,990; $\bar{x} = 0.75 \pm 0.19$ birds/km²), followed by Spring (n=2,405; $\bar{x} = 0.31 \pm 0.07$ birds/km²), Fall (n=118; $\bar{x} = 0.02 \pm 0.005$ birds/km²), and Winter (n=71; $\bar{x} = 0.007 \pm 0.004$ birds/km²) (Appendix B, Figure 93, Figure 94). Storm-petrel were more frequently observed in the outer zones of the OPA, with Fall density highest in Zones 3 and 6, Winter densities highest in Zones 5 and 6, and Spring and Summer densities highest in Zone 5 (Figure 93, Figure 94).

Overall, 97% of 7,584 observed storm-petrel were in flight. In Fall, all 118 storm-petrel were in flight with a median flight height within the RSZ for all zones except for Zone 4, which was below the RSZ (Figure 95). In Winter, storm-petrel were observed most frequently in Zones 5 and 6 with 89% of birds observed in flight. Flight heights were not available in Winter (Figure 95).

In Spring, storm-petrel were observed primarily in Zones 4, 5, and 6 with 98% of birds observed in flight. Median flight height was within the RSZ for Zones 2, 5, and 6 but below the RSZ in Zone 4 (Figure 96). In Summer, storm-petrel were observed throughout the OPA with 96% of birds observed in flight with median flight heights below the RSZ for all zones (Figure 96). In Fall, Winter, and Spring, there was no pattern of flight heading. In the Summer, birds had a slight pattern of travel to the east or west (Figure 97).

2.5.10.1 Wilson's Storm-Petrel

Wilson's storm-petrel were observed in Fall (n =1) and Spring (n=90), but Summer (n=1,128) accounted for 93% of the total observations (Appendix B, Figure 98, Figure 99). In Summer, Wilson's storm-petrel were observed in Zones 4 ($\bar{x} = 0.20 \pm 0.13$ birds/km²), 5 ($\bar{x} = 0.22 \pm 0.13$ birds/km²), and 6 ($\bar{x} = 0.37 \pm 0.11$ birds/km²) (Figure 99).

In Fall, one Wilson's storm-petrel was observed in flight in Zone 4 with no associated flight height data (Figure 100). In Winter there were no observed Wilson's storm-petrel (Figure 100). In Spring, 92% of birds were observed in flight with a median flight height within the RSZ for each zone (Figure 101). In Summer (n=1,127) Wilson's storm-petrel were observed in a clumped pattern of

distribution throughout the OPA with 87% of birds observed in flight and median flight height was below the RSZ for all zones (Figure 101). In Spring, the observed flight pattern was to the east and west. In Summer, birds were observed in flight with a pattern of travel to the east or west (Figure 102).

Figure 93. Spatial Distribution of Storm-Petrel During Fall and Winter by Zone and Proximity to Call Areas

Heat map is scaled to the maximum density for the species/species group across all seasons. Inset bar plots display mean estimated densities \pm standard error of the mean for each zone.

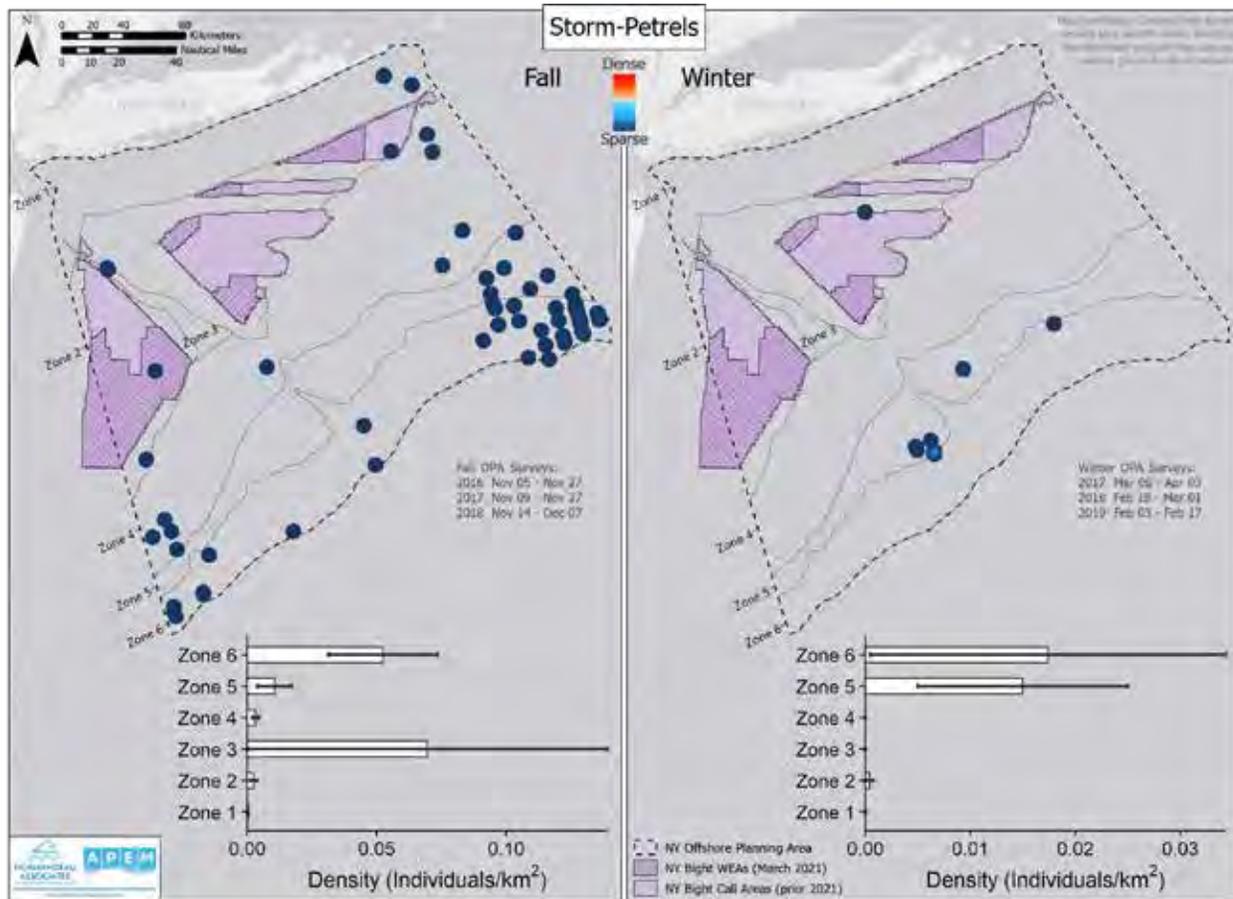


Figure 94. Spatial Distribution of Storm-Petrel During Spring and Summer by Zone and Proximity to Call Areas

Heat map is scaled to the maximum density for the species/species group across all seasons. Inset bar plots display mean estimated densities \pm standard error of the mean for each zone.

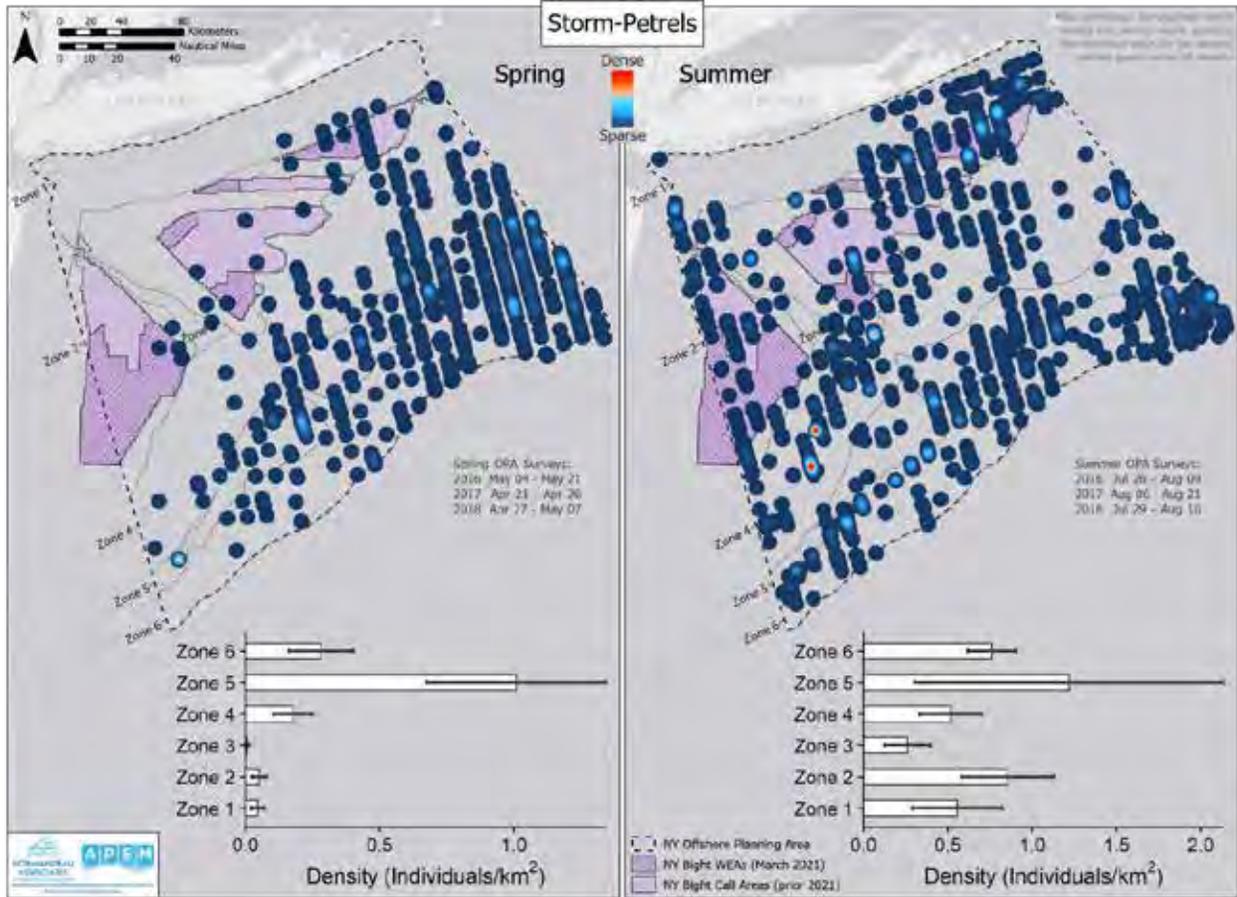


Figure 95. Spatial Distribution of Storm-Petrel Sitting Relative to Birds in Flight During Fall and Winter Surveys

Solid blue points represent individuals with calculated flight height and blue points with an x represent individuals in flight without flight height data. A pie chart inset shows the proportion of individuals flying and sitting. A boxplot inset of flight height distribution by zone is displayed for all birds with known flight heights. Boxplots show the distribution of data among seasons. The dark horizontal line is the median flight height, and the box represents the middle 50% of data values. The lines to the left and right of the box represent the data points that are within 1.5 times the length of the box. Data beyond this range are shown as individual points.

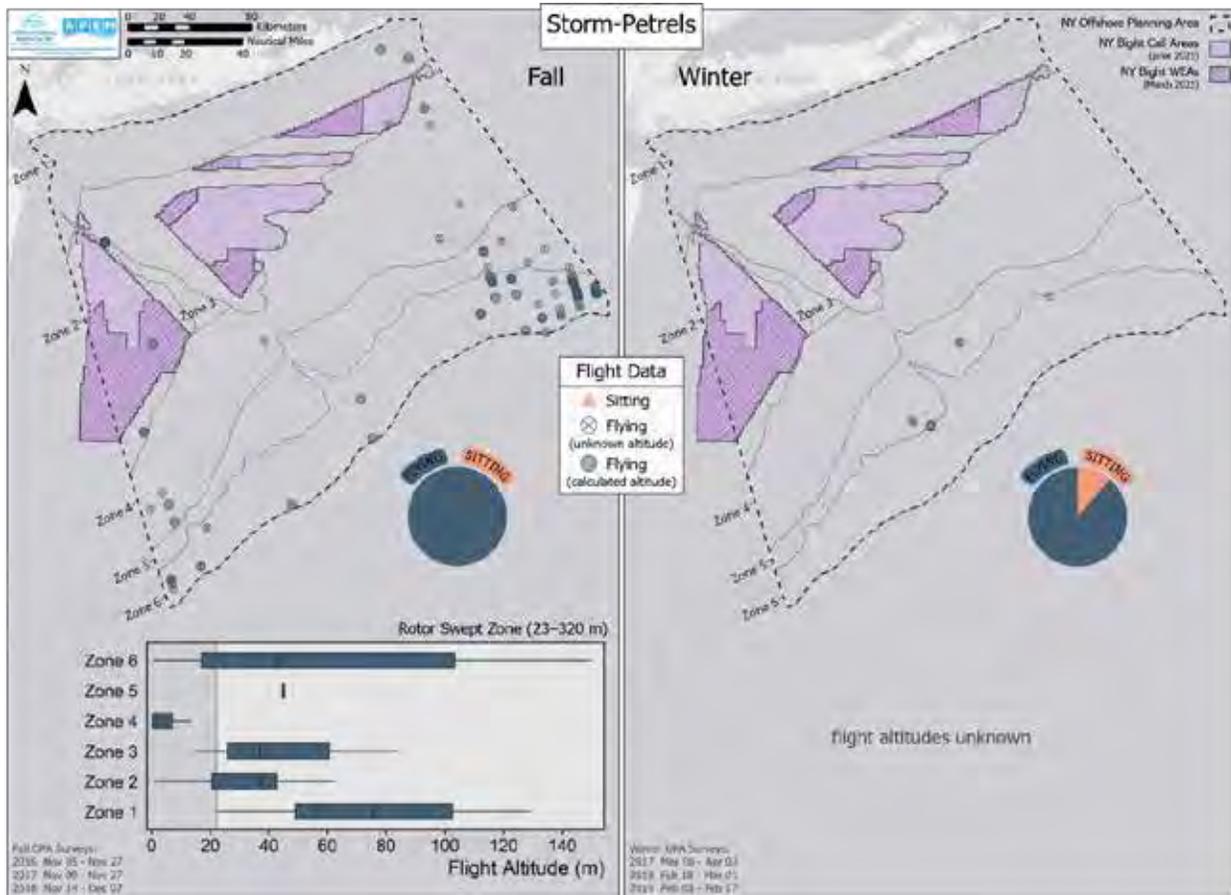


Figure 96. Spatial Distribution for Storm-Petrel Sitting Relative to Birds in Flight During Spring and Summer Surveys

Solid blue points represent individuals with calculated flight height and blue points with an x represent individuals in flight without flight height data. A pie chart inset shows the proportion of individuals flying and sitting. A boxplot inset of flight height distribution by zone is displayed for all birds with known flight heights. Boxplots show the distribution of data among seasons. The dark horizontal line is the median flight height, the box represents the middle 50% of data values. The lines to the left and right of the box represent the data points that are within 1.5 times the length of the box. Data beyond this range are shown as individual points.

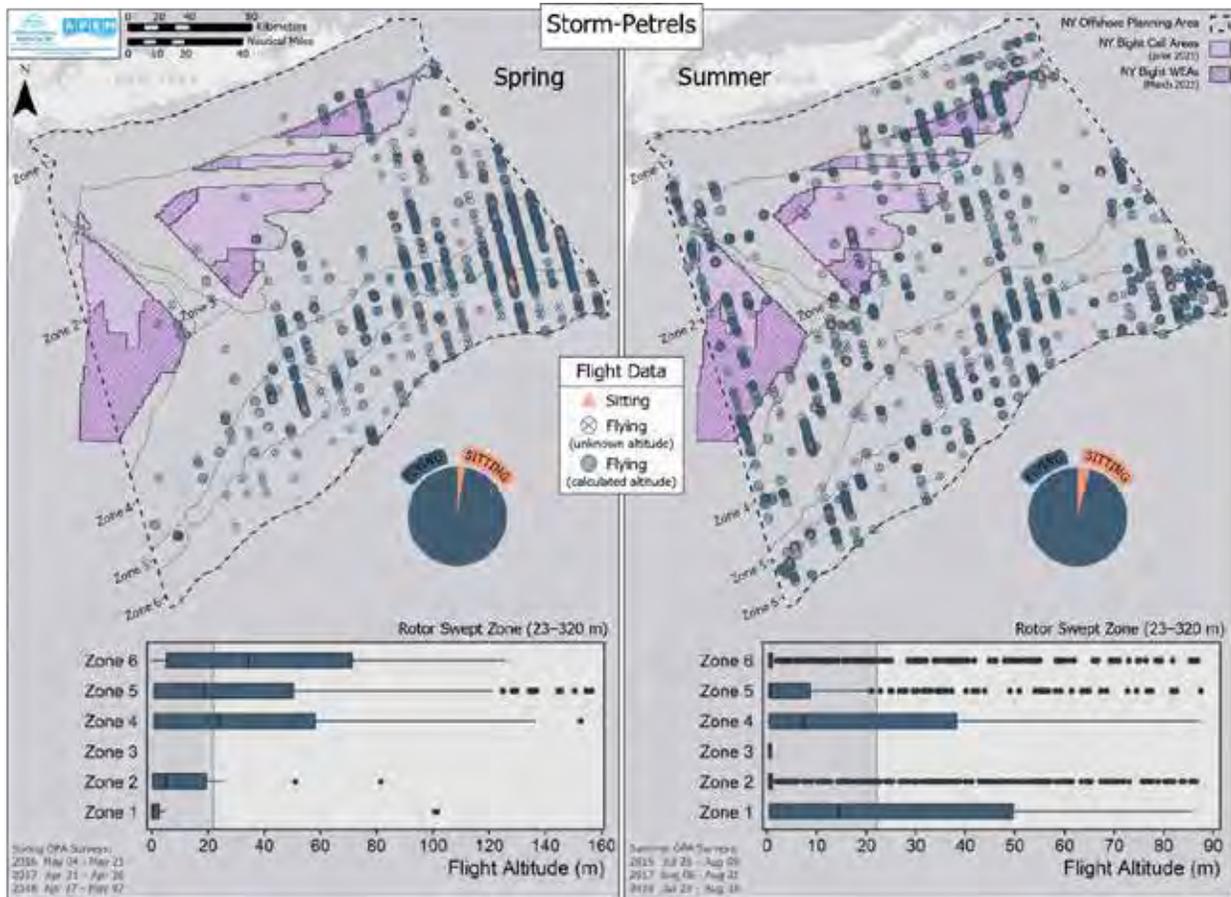


Figure 97. Direction of Flight of All Storm-Petrels for All Surveys

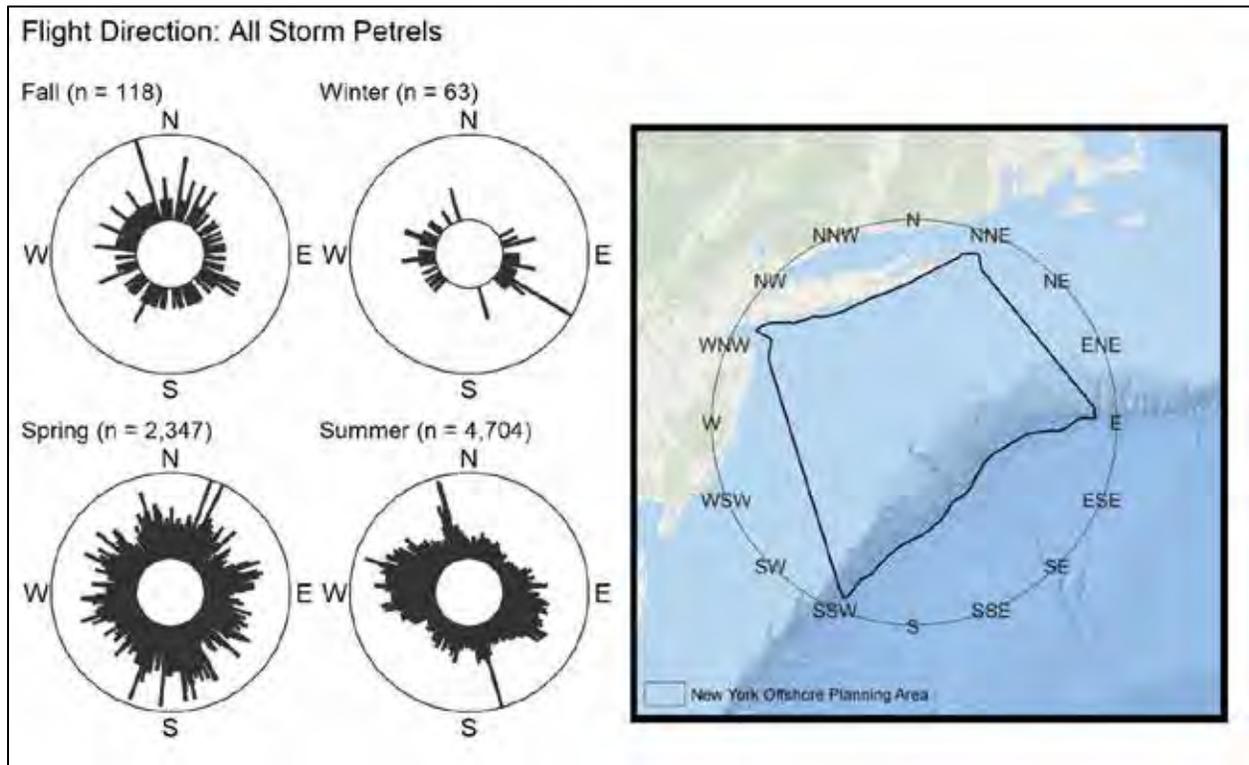


Figure 98. Spatial Distribution of Wilson's Storm-Petrel During Fall and Winter by Zone and Proximity to Call Areas

Heat map is scaled to the maximum density for the species/species group across all seasons. Inset bar plots display mean estimated densities \pm standard error of the mean for each zone.

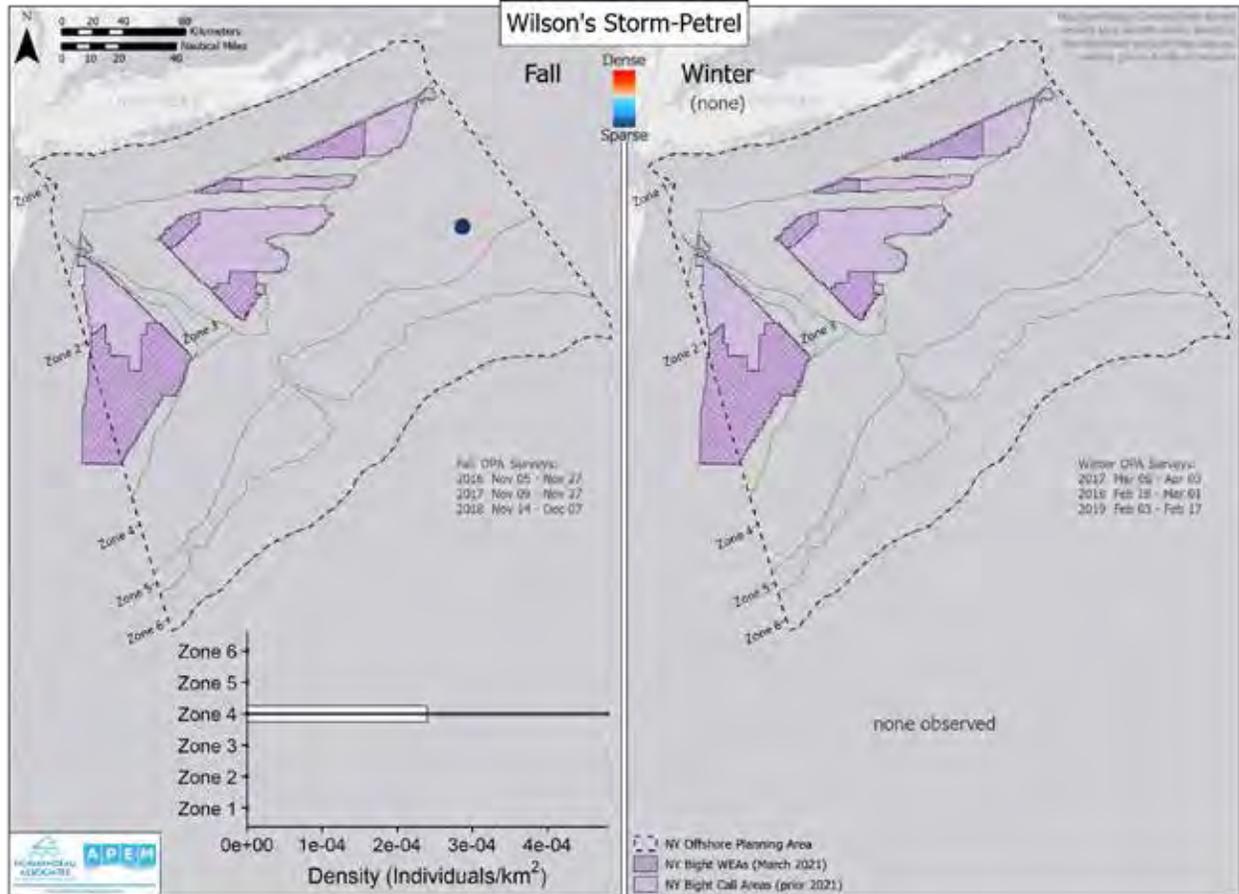


Figure 99. Spatial Distribution of Wilson's Storm-Petrel During Spring and Summer by Zone and Proximity to Call Areas

Heat map is scaled to the maximum density for the species/species group across all seasons. Inset bar plots display mean estimated densities \pm standard error of the mean for each zone.

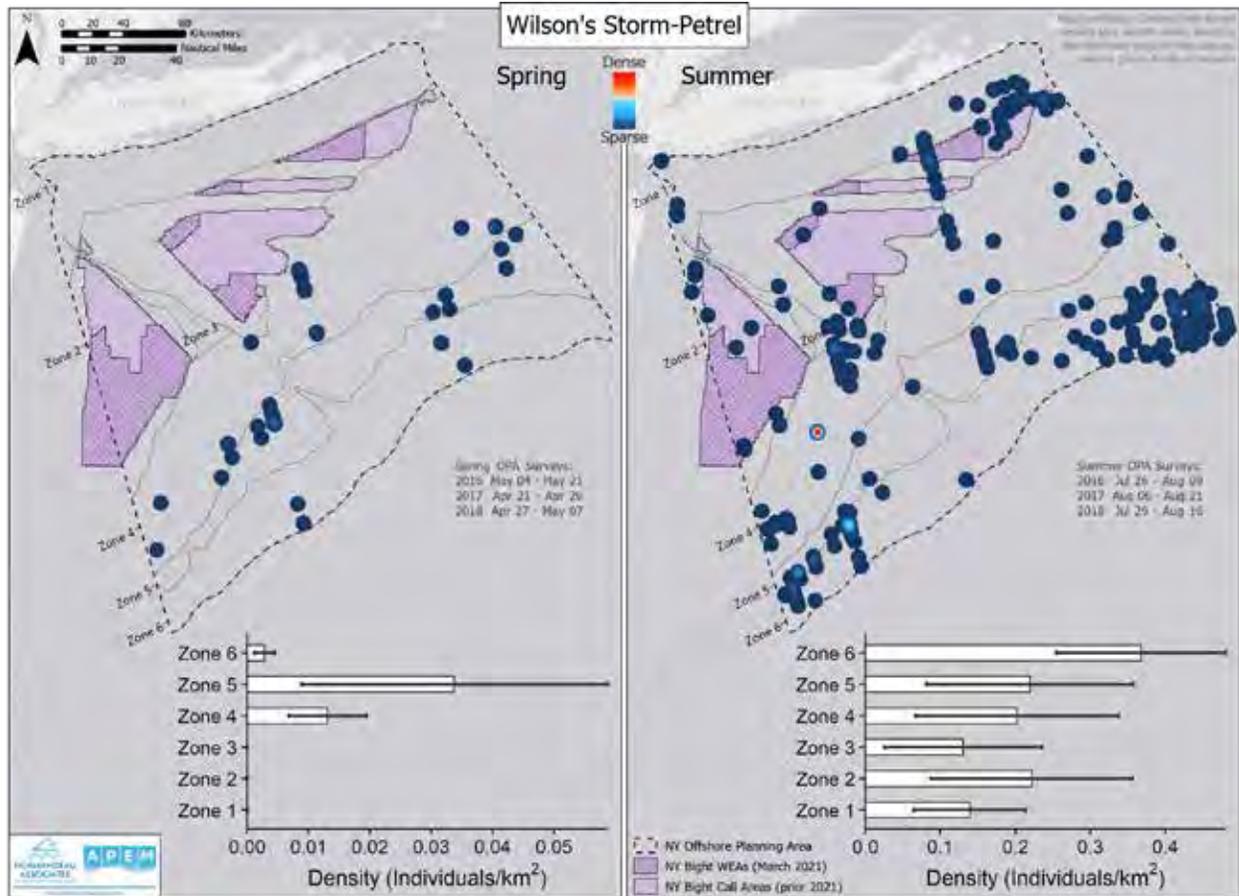


Figure 100. Spatial Distribution of Wilson's Storm-Petrel Sitting Relative to Birds in Flight During Fall and Winter Surveys

Solid blue points represent individuals with calculated flight height and blue points with an x represent individuals in flight without flight height data. A pie chart inset shows the proportion of individuals flying and sitting.

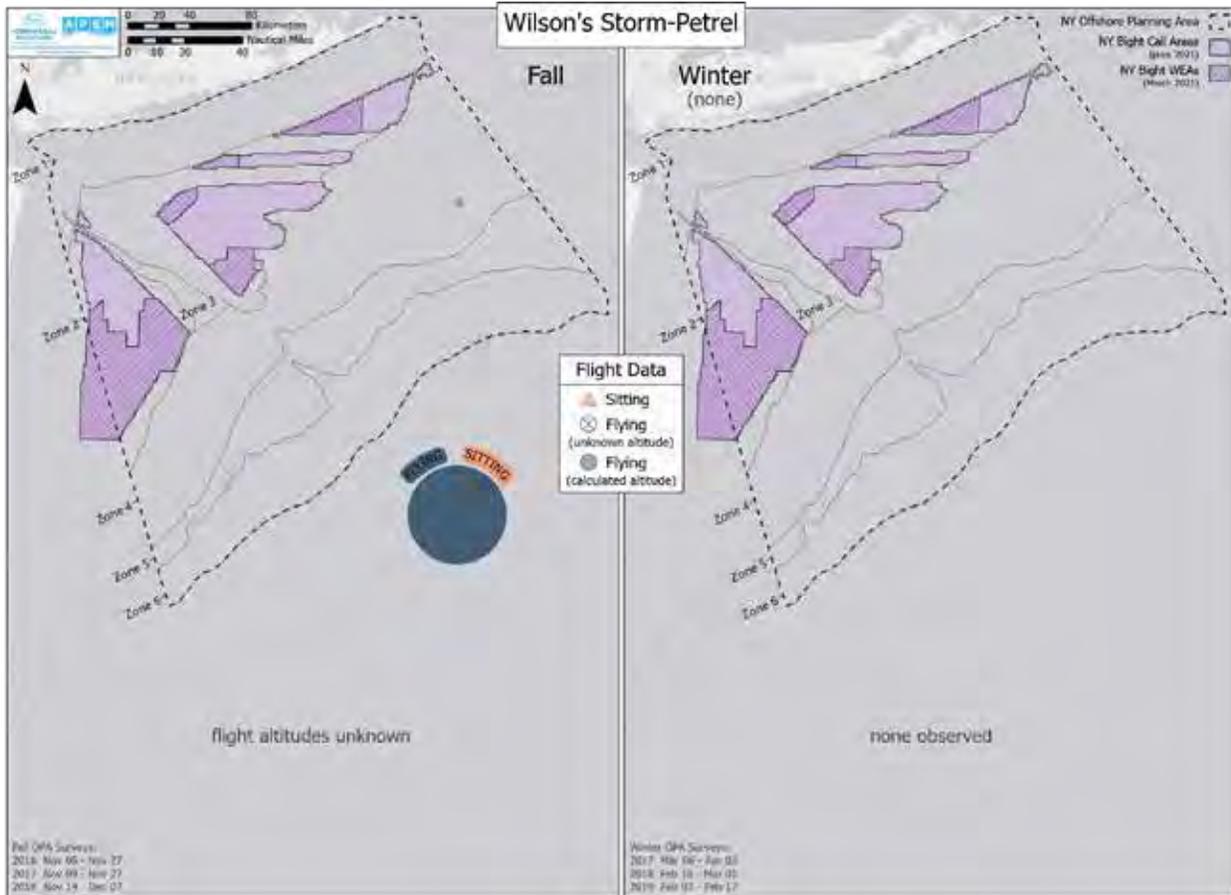


Figure 101. Spatial Distribution of Wilson's Storm-Petrel Sitting Relative to Birds in Flight During Spring and Summer Surveys

Solid blue points represent individuals with calculated flight height and blue points with an x represent individuals in flight without flight height data. A pie chart inset shows the proportion of individuals flying and sitting. A boxplot inset of flight height distribution by zone is displayed for all birds with known flight heights. Boxplots show the distribution of data among seasons. The dark horizontal line is the median flight height, and the box represents the middle 50% of data values. The lines to the left and right of the box represent the data points that are within 1.5 times the length of the box. Data beyond this range are shown as individual points.

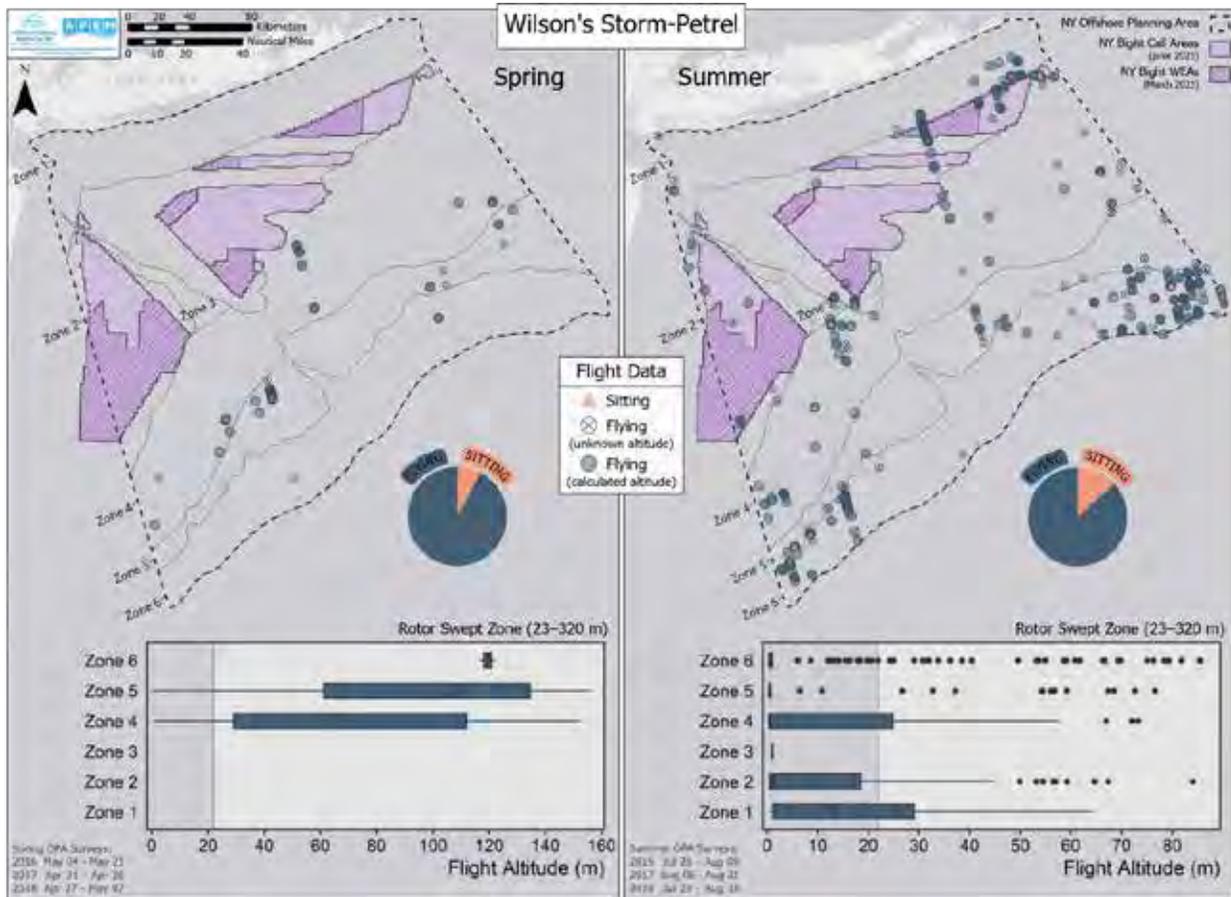
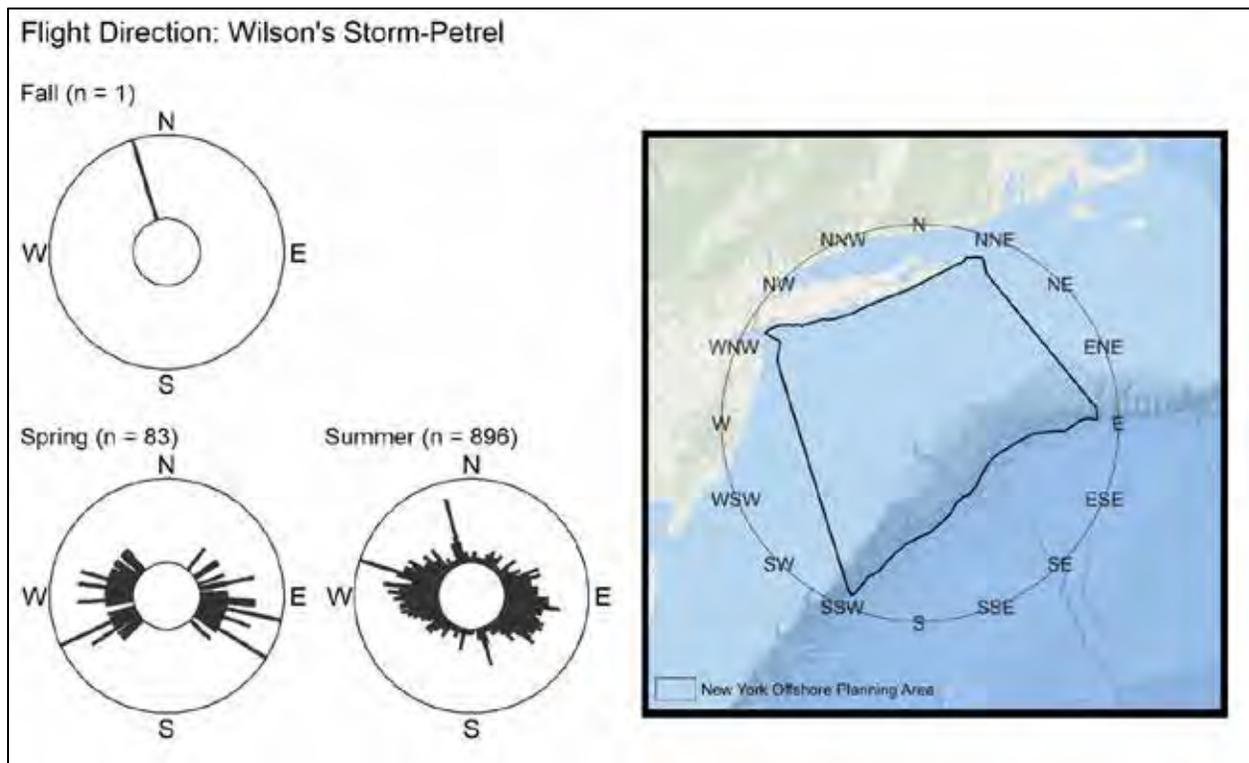


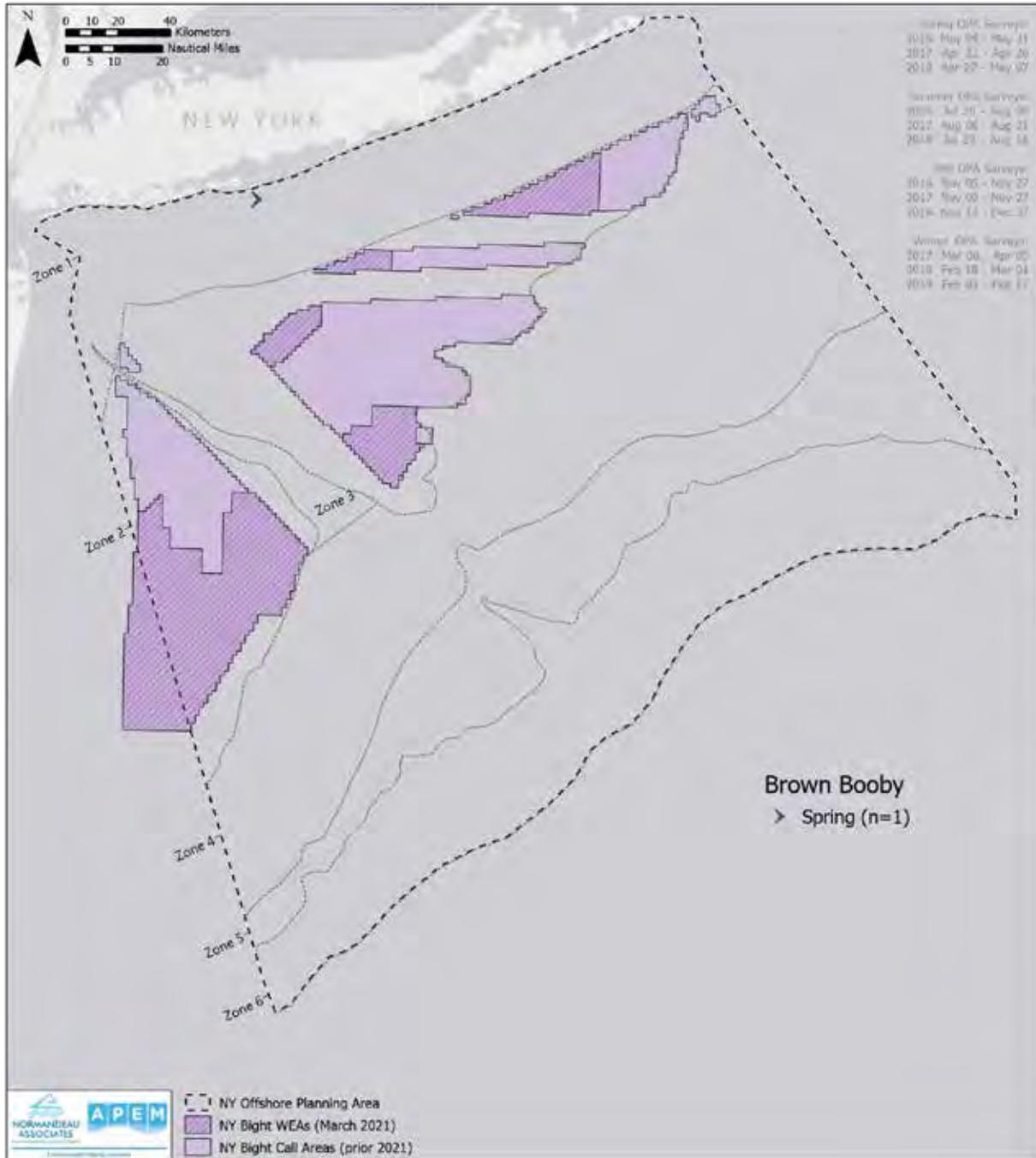
Figure 102. Direction of Flight of Wilson's Storm-Petrel for All Surveys



2.5.11 Booby

One brown booby was observed during the Spring within Zone 1 (Figure 103).

Figure 103. Spatial Distribution of Brown Booby



2.5.12 Northern Gannet

Northern gannet were among the most often observed species in the OPA with 13,719 observations distributed throughout Fall ($n=4,702$; $\bar{x} = 0.34 \pm 0.07$ birds/km²), Winter ($n=6,178$; $\bar{x} = 0.61 \pm 0.61$ birds/km²), Spring ($n=2,835$; $\bar{x} = 0.26 \pm 0.07$ birds/km²), and Summer ($n=4$; $\bar{x} < 0.001$ birds/km²) (Appendix B, Figure 104, Figure 105). Northern gannet occurred throughout the OPA but concentrated near shore during the Fall and Spring and in the western half of the OPA during the Winter (Figure 104, Figure 105). During Fall surveys, mean density estimates were highest in Zone 1 ($\bar{x} = 1.04 \pm 0.32$ birds/km²), and the same pattern of distribution was observed in Spring ($\bar{x} = 0.98 \pm 0.35$ birds/km²) (Figure 104, Figure 105). In Winter, mean density estimates were highest in Zone 5 ($\bar{x} = 1.35 \pm 0.42$ birds/km²), but were also high in Zone 3 ($\bar{x} = 1.30 \pm 0.43$ birds/km²) (Figure 104).

Overall, 31% of northern gannet were observed in flight with median flight height per zone ranging between 8 and 50 m across all seasons (Figure 106, Figure 107). In Fall, median flight height was within the RSZ for all zones ranging between 40 and 60 m (Figure 106). In Winter, 28% of birds were in flight with median flight heights within the RSZ for all zones except Zone 3, which was below the RSZ (Figure 106). In Spring 34% of birds were in flight and median flight height was within the RSZ for all zones except for Zone 1, which was below the RSZ (Figure 107). In the Fall and Winter, birds had a slight pattern of travel to the northwest. In the Spring, there was no observed pattern of flight heading (Figure 108).

Figure 104. Spatial Distribution of Northern Gannet During Fall and Winter by Zone and Proximity to Call Areas

Heat map is scaled to the maximum density for the species/species group across all seasons. Inset bar plots display mean estimated densities \pm standard error of the mean for each zone.

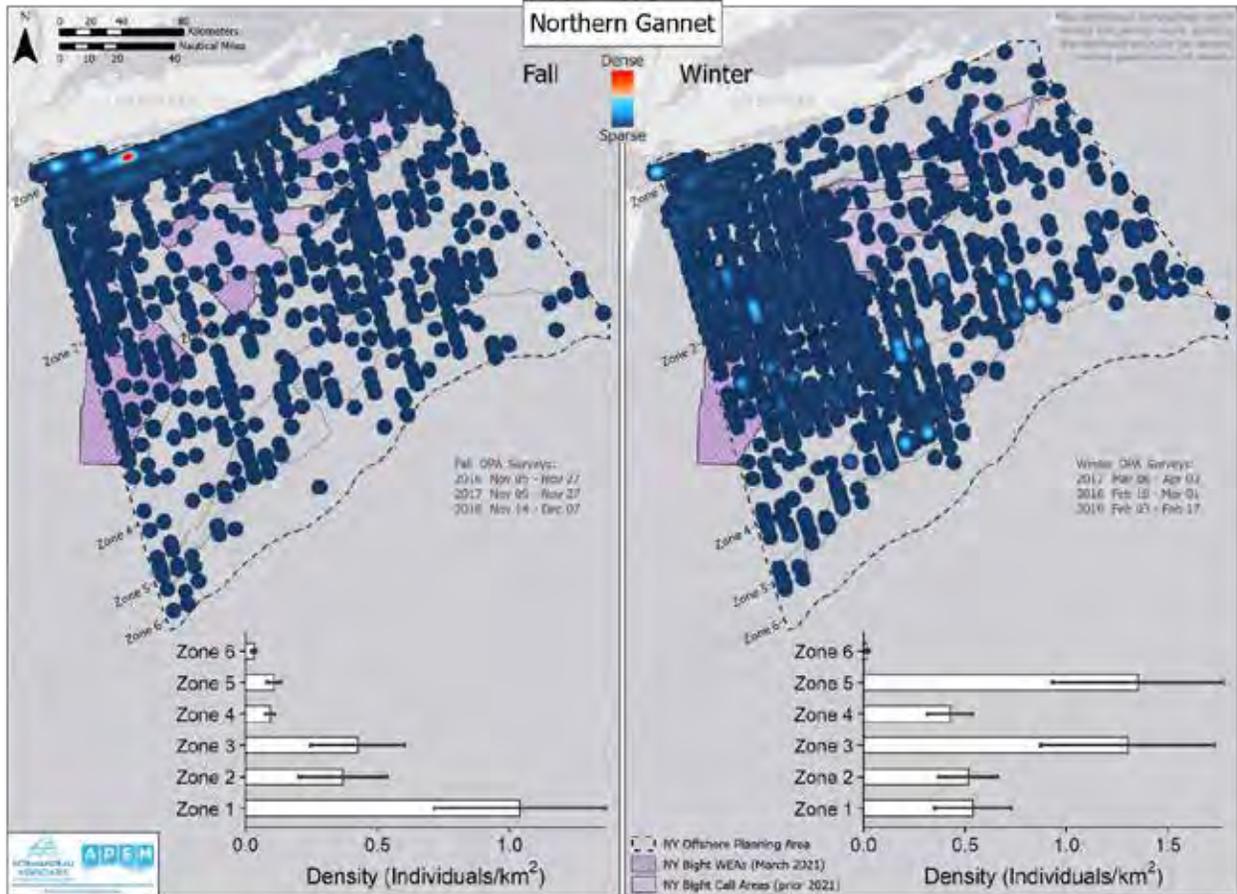


Figure 105. Spatial Distribution of Northern Gannet During Spring and Summer by Zone and Proximity to Call Areas

Heat map is scaled to the maximum density for the species/species group across all seasons. Inset bar plots display mean estimated densities \pm standard error of the mean for each zone.

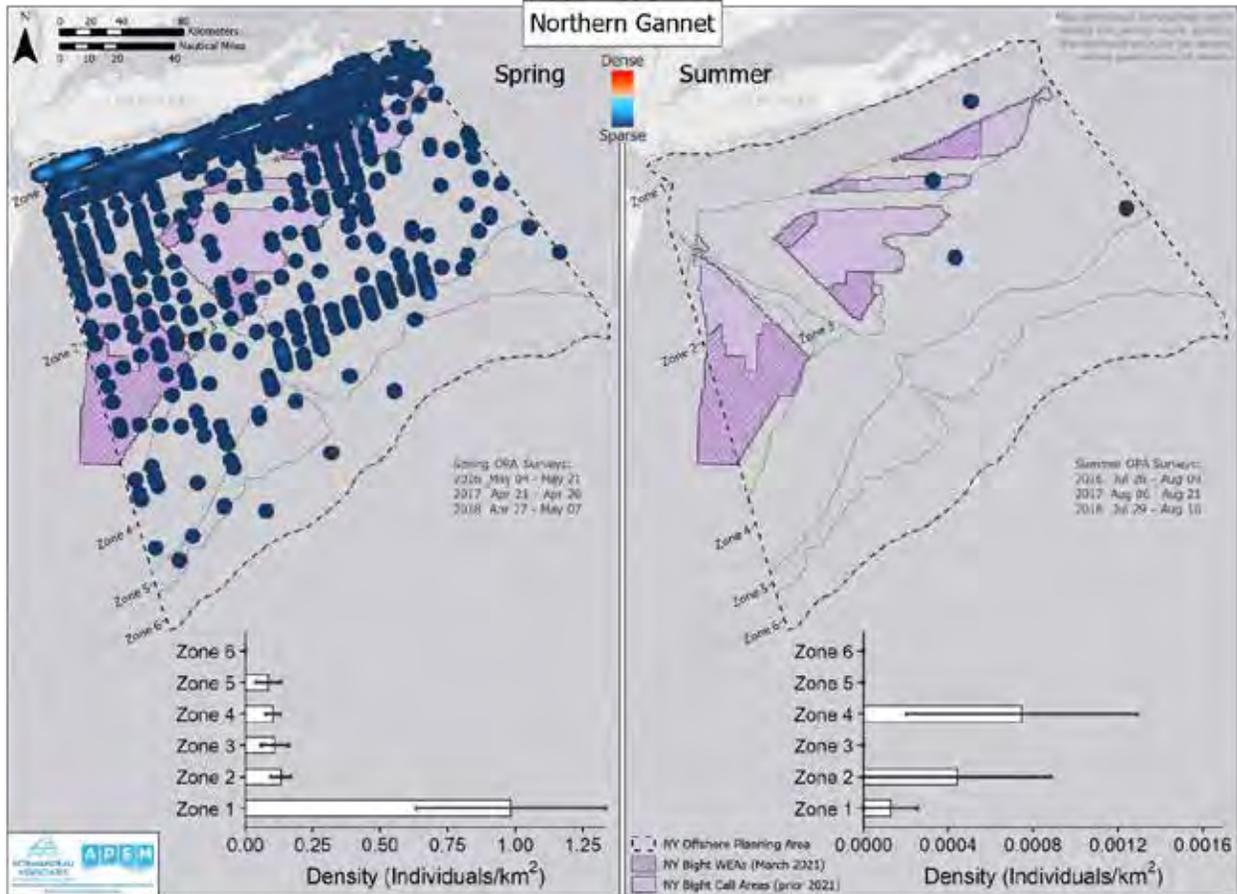


Figure 106. Spatial Distribution of Northern Gannet Sitting Relative to Birds in Flight During Fall and Winter Surveys

Solid blue points represent individuals with calculated flight height and blue points with an x represent individuals in flight without flight height data. A pie chart inset shows the proportion of individuals flying and sitting. A boxplot inset of flight height distribution by zone is displayed for all birds with known flight heights. Boxplots show the distribution of data among seasons. The dark horizontal line is the median flight height, and the box represents the middle 50% of data values. The lines to the left and right of the box represent the data points that are within 1.5 times the length of the box. Data beyond this range are shown as individual points.

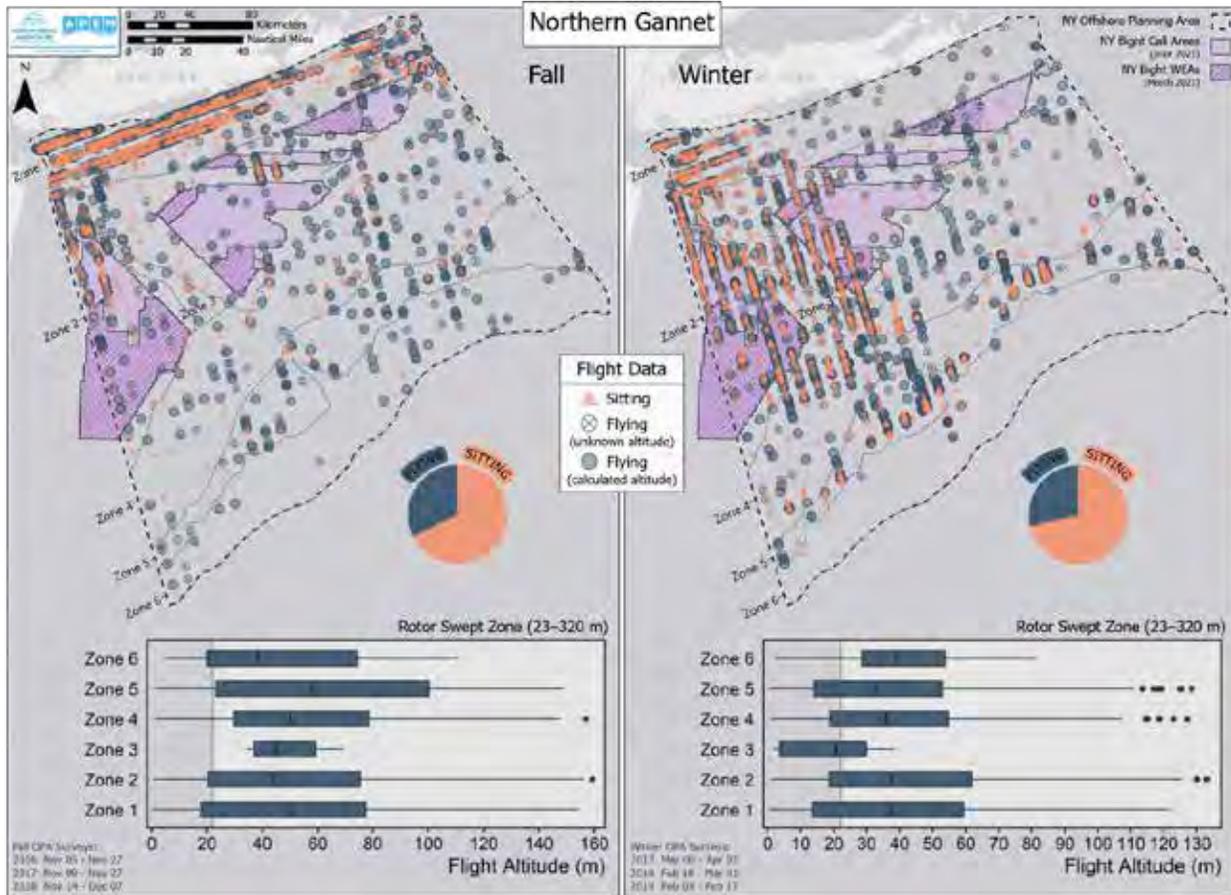


Figure 107. Spatial Distribution of Northern Gannet Sitting Relative to Birds in Flight During Spring and Summer Surveys

Solid blue points represent individuals with calculated flight height and blue points with an x represent individuals in flight without flight height data. A pie chart inset shows the proportion of individuals flying and sitting. A boxplot inset of flight height distribution by zone is displayed for all birds with known flight heights. Boxplots show the distribution of data among seasons. The dark horizontal line is the median flight height, and the box represents the middle 50% of data values. The lines to the left and right of the box represent the data points that are within 1.5 times the length of the box. Data beyond this range are shown as individual points.

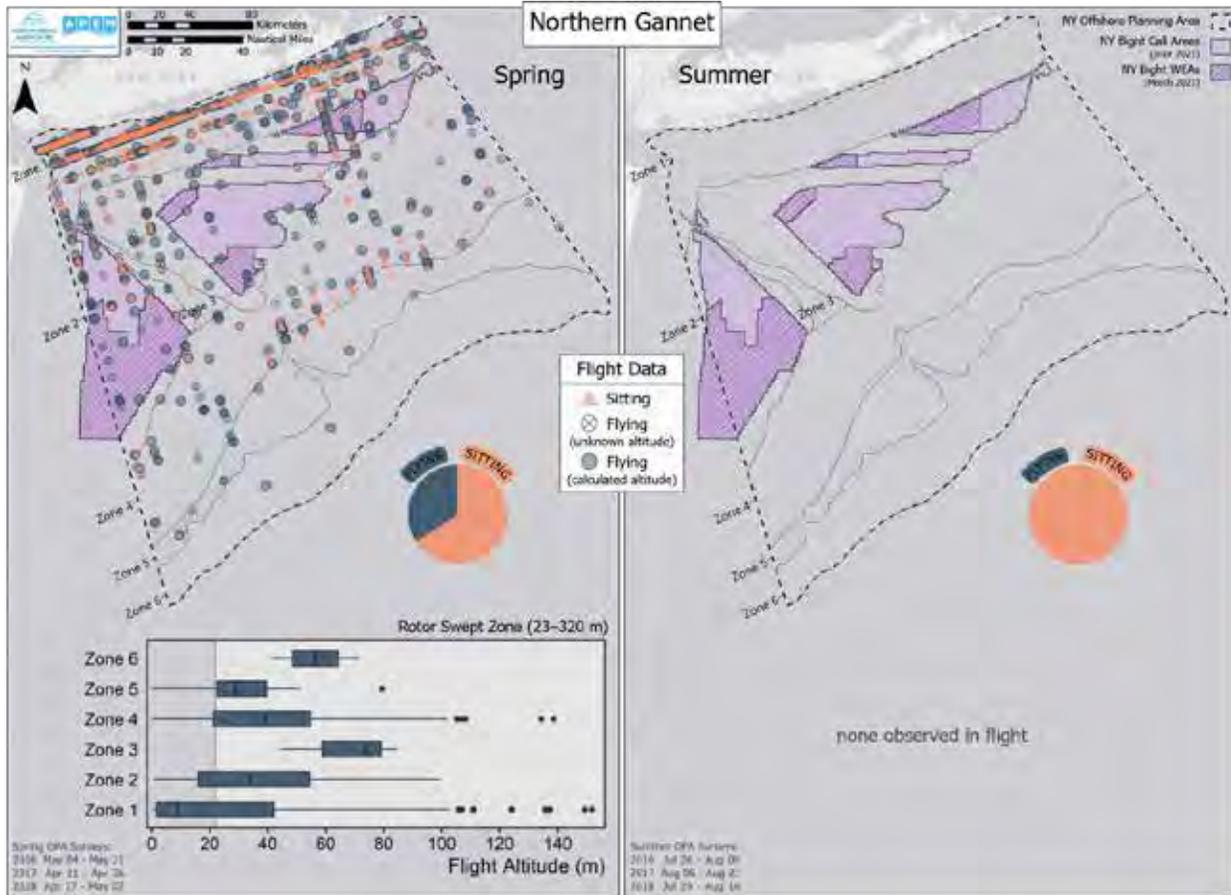
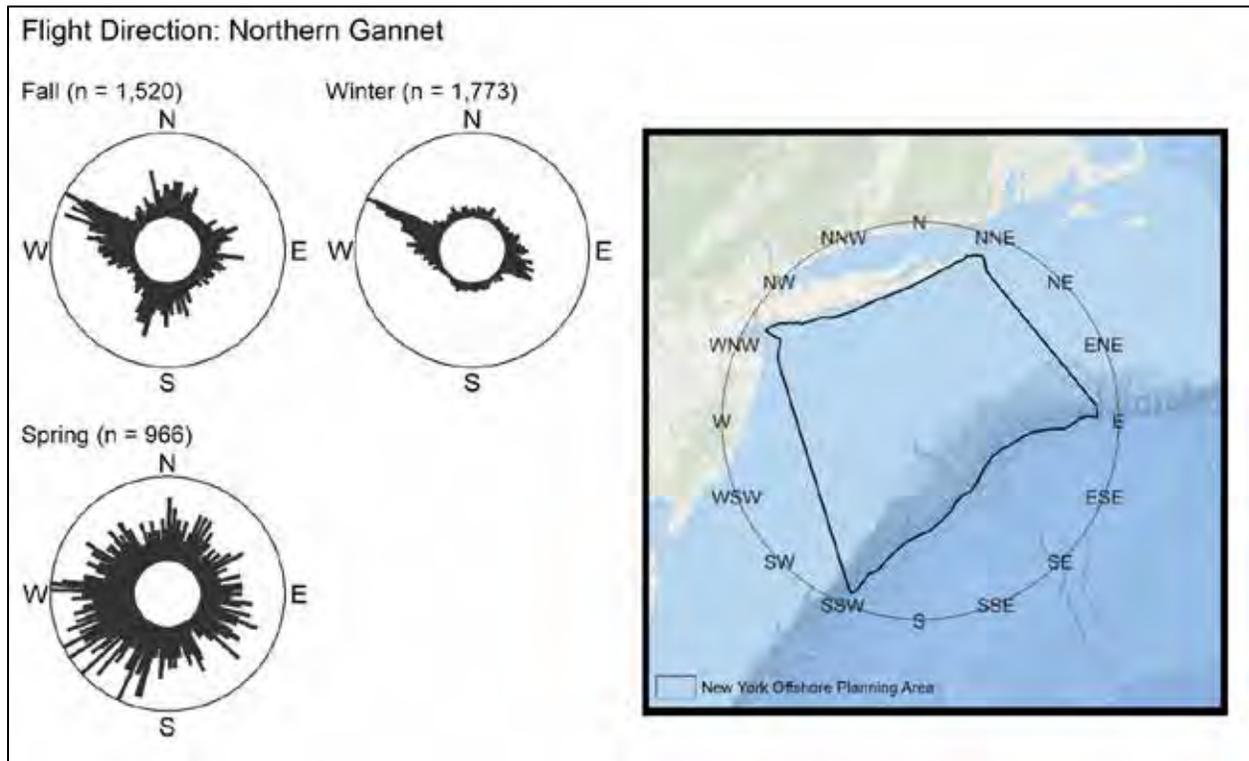


Figure 108. Direction of Flight of Northern Gannet for All Surveys



2.5.13 Cormorant

Of the 623 observed cormorants, 534 were identified to genus but not species. Across all seasons, cormorant were concentrated in Zone 1 with some individuals being observed in Zone 2 (Appendix B, Figure 109, Figure 110). Mean density estimates in Zone 1 were greatest in Fall ($n=364$; $\bar{x} = 0.63 \pm 0.54$ birds/km²), followed by Spring ($n=162$; $\bar{x} = 0.04 \pm 0.02$ birds/km²), Summer ($n=8$; $\bar{x} = 0.003 \pm 0.002$ birds/km²), and Winter ($n=4$; $\bar{x} < 0.001$ birds/km²) (Figure 109, Figure 110).

In Fall, 75% of 408 cormorant were in flight (Figure 111). Median flight height was just within the RSZ for Zone 1 and below the RSZ in Zone 2. In Spring, 92% of 203 cormorant were in flight (Figure 112). Median flight height was just within the RSZ for Zone 2 (25 m) and below the RSZ in Zone 1. In Summer, seven individuals were observed in flight and one individual was sitting (Figure 112). In Fall, cormorant had a direction of travel to the southwest, and in Spring, there was a distinct preference for northerly headings (Figure 113).

2.5.13.1 Double-crested Cormorant

Double-crested cormorant were observed in Fall ($n=67$), Spring ($n=16$), and Summer ($n=6$) (Appendix B, Figure 114, Figure 115). In the Fall, all double-crested cormorant were observed within Zones 1 and 2 (Figure 114).

All individuals observed in the Fall were in flight and median flight height was within the RSZ for Zone 1 and below the RSZ in Zone 2 (Figure 116). No birds were observed in the Winter (Figure 116). In Spring four of 16 double-crested cormorant were observed in flight, and in Summer, six birds were in flight (Figure 117). In the Fall, birds had a direction of flight toward the northwest and south, and in the Summer, birds were headed toward the north (Figure 118).

Figure 109. Spatial Distribution of Cormorant During Fall and Winter by Zone and Proximity to Call Areas

Heat map is scaled to the maximum density for the species/species group across all seasons. Inset bar plots display mean estimated densities \pm standard error of the mean for each zone.

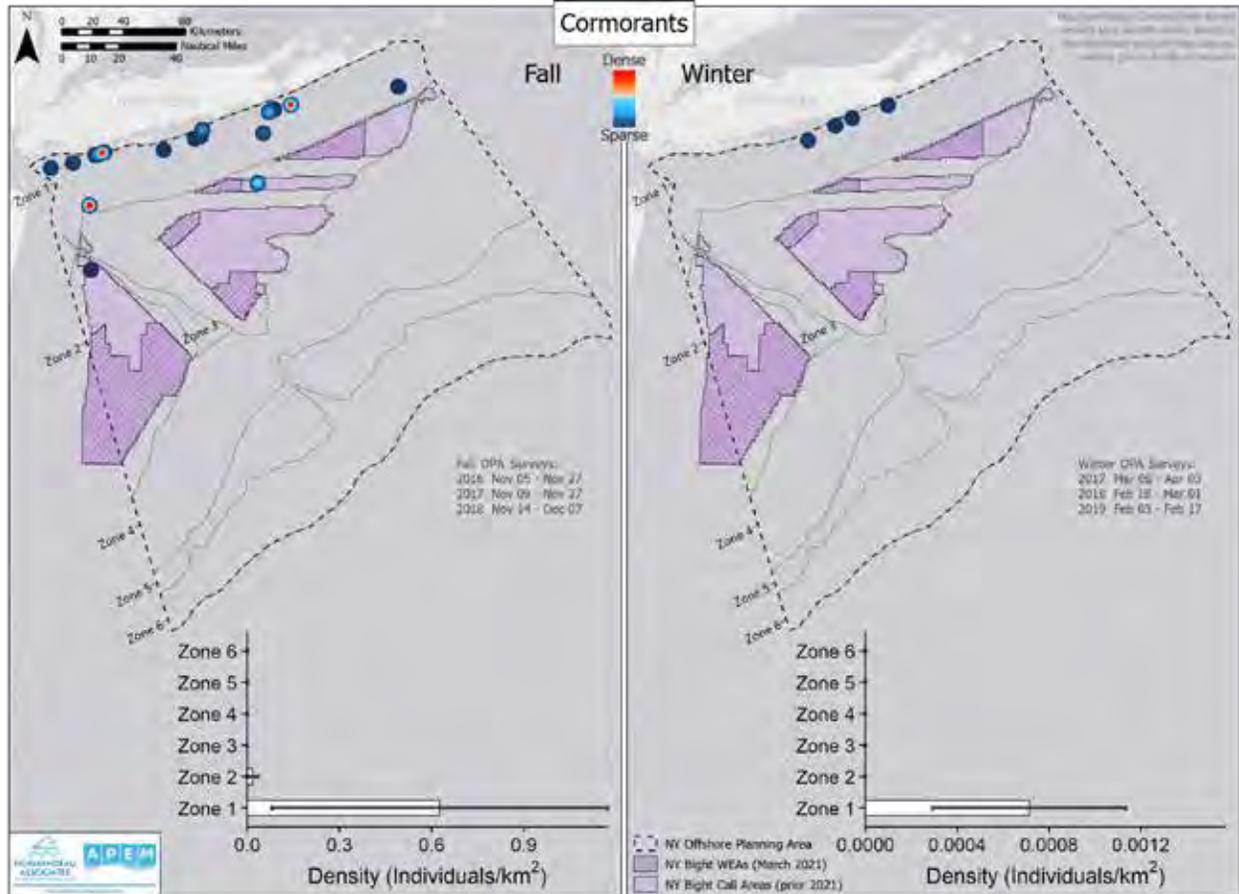


Figure 111. Spatial Distribution of Cormorant Sitting Relative to Birds in Flight During Fall and Winter Surveys

Solid blue points represent individuals with calculated flight height and blue points with an x represent individuals in flight without flight height data. A pie chart inset shows the proportion of individuals flying and sitting. A boxplot inset of flight height distribution by zone is displayed for all birds with known flight heights. Boxplots show the distribution of data among seasons. The dark horizontal line is the median flight height, and the box represents the middle 50% of data values. The lines to the left and right of the box represent the data points that are within 1.5 times the length of the box. Data beyond this range are shown as individual points.

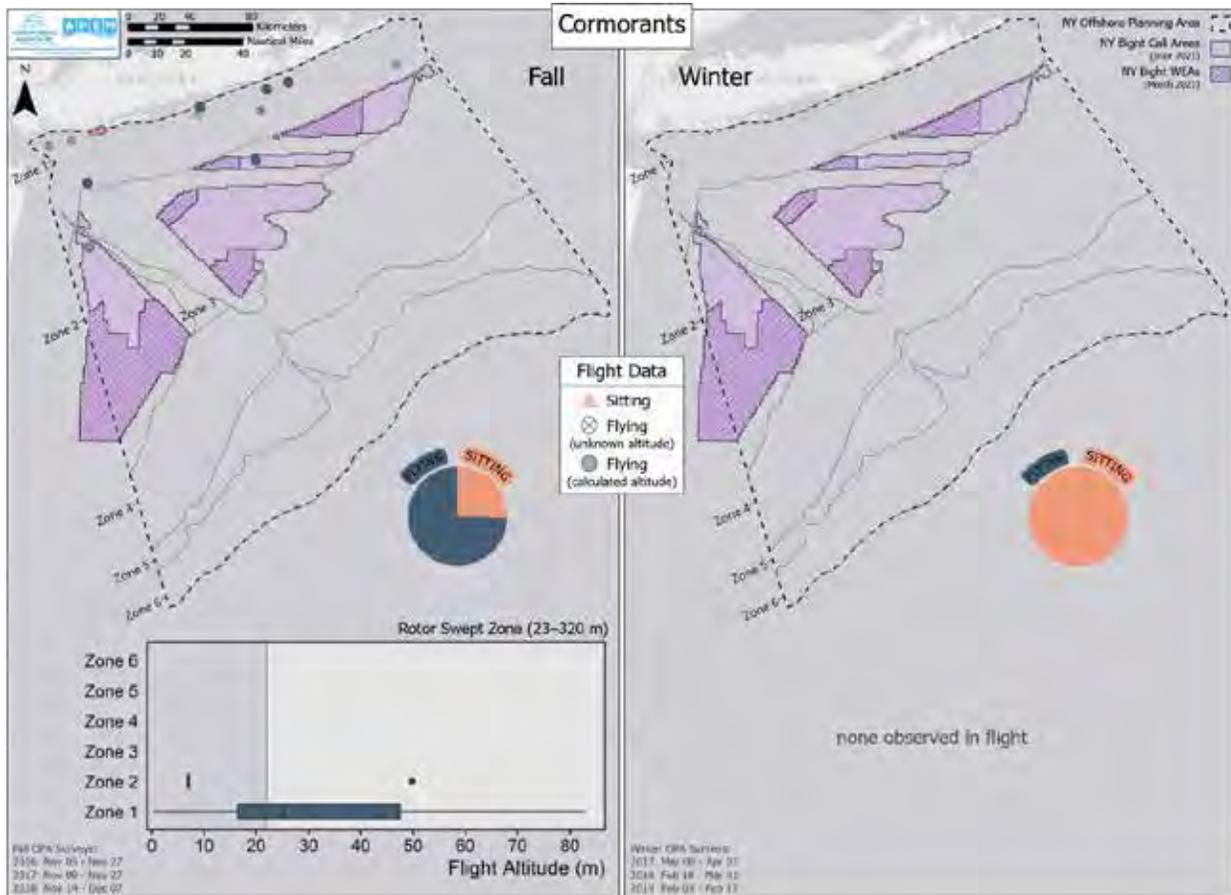


Figure 112. Spatial Distribution of Cormorant Sitting Relative to Birds in Flight During Spring and Summer Surveys

Solid blue points represent individuals with calculated flight height and blue points with an x represent individuals in flight without flight height data. A pie chart inset shows the proportion of individuals flying and sitting. A boxplot inset of flight height distribution by zone is displayed for all birds with known flight heights. Boxplots show the distribution of data among seasons. The dark horizontal line is the median flight height, and the box represents the middle 50% of data values. The lines to the left and right of the box represent the data points that are within 1.5 times the length of the box. Data beyond this range are shown as individual points.

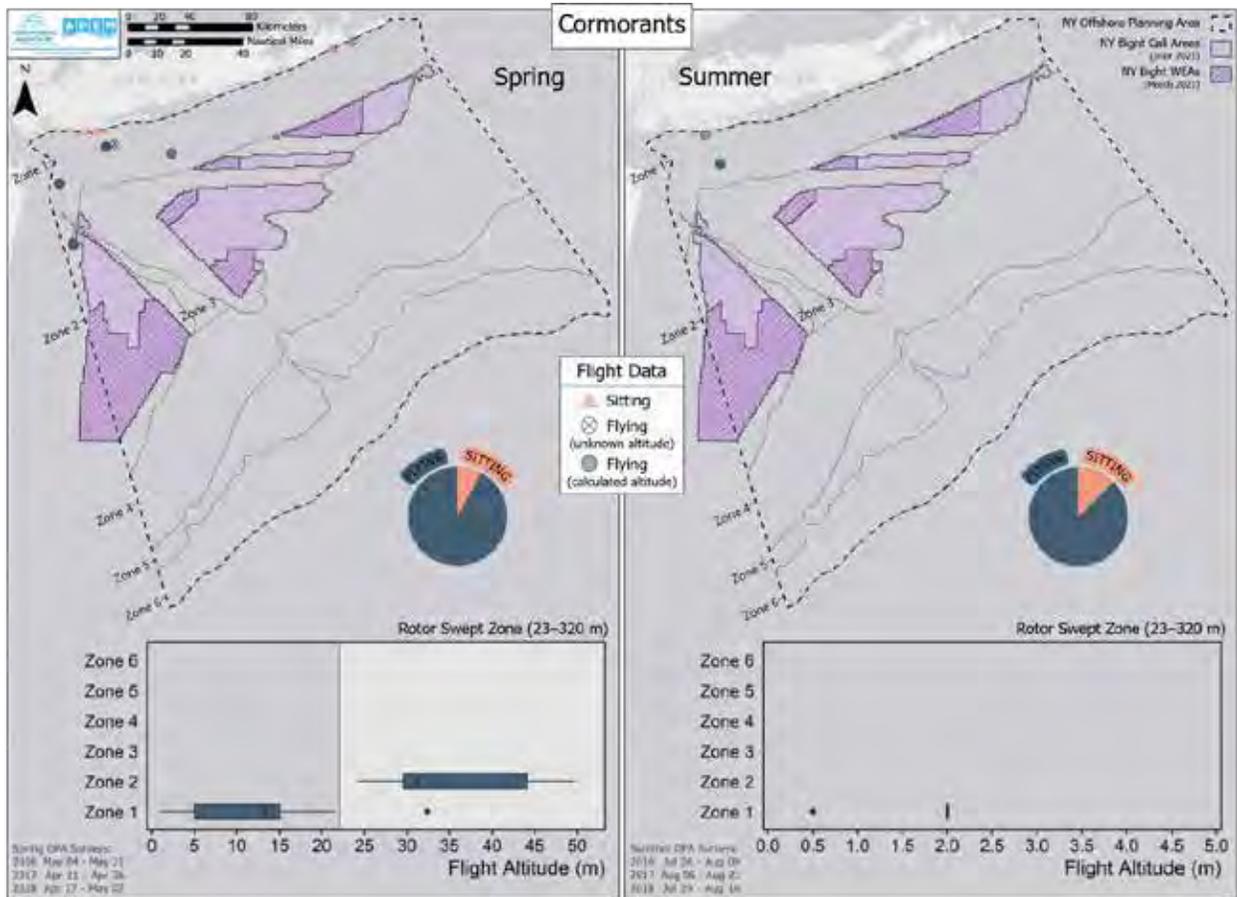


Figure 113. Direction of Flight of Cormorant for All Surveys

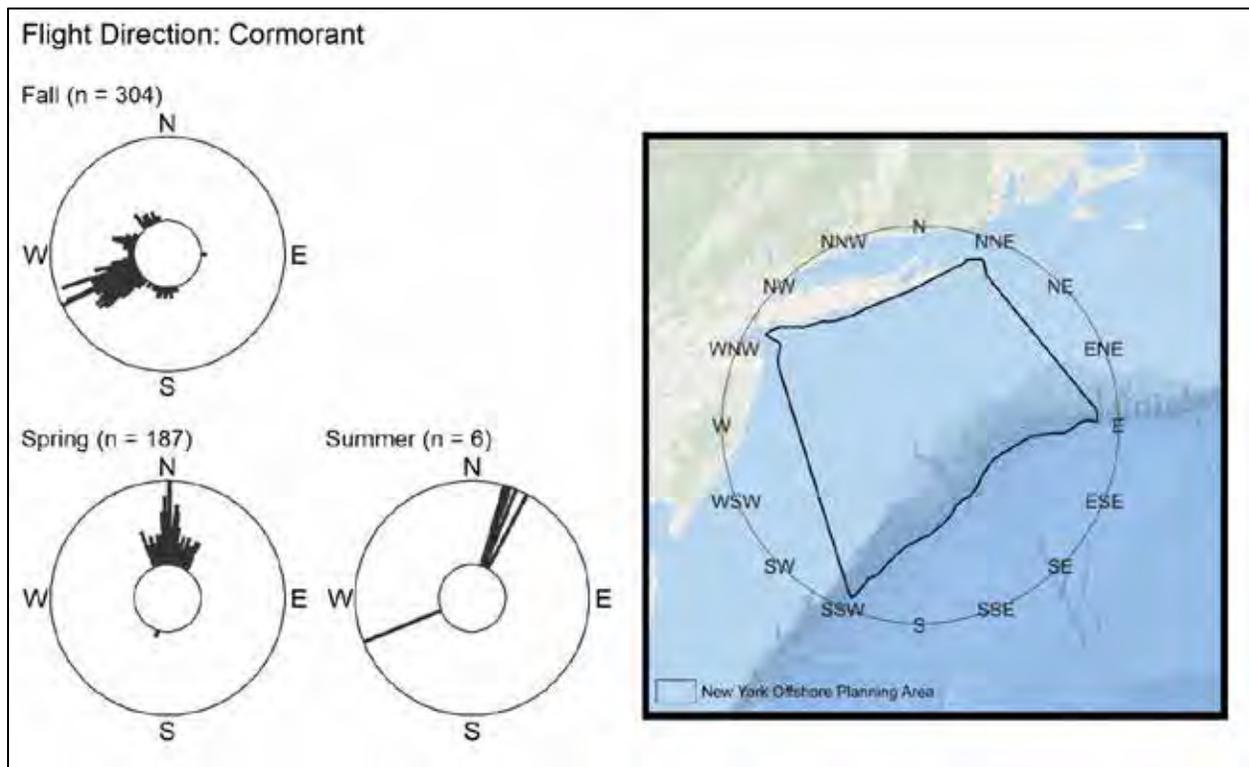


Figure 114. Spatial Distribution of Double-crested Cormorant During Fall and Winter by Zone and Proximity to Call Areas

Heat map is scaled to the maximum density for the species/species group across all seasons. Inset bar plots display mean estimated densities \pm standard error of the mean for each zone.

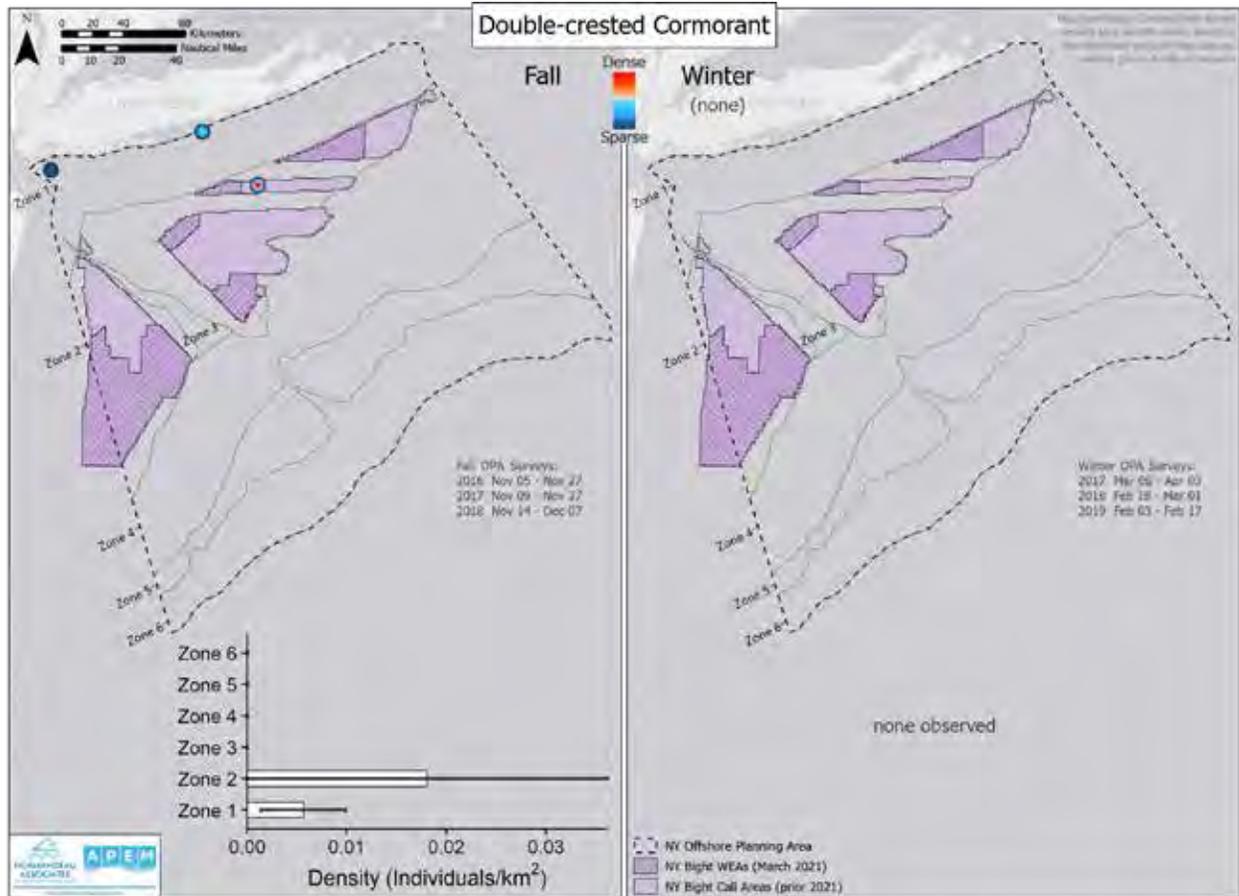


Figure 115. Spatial Distribution of Double-crested Cormorant During Spring and Summer by Zone and Proximity to Call Areas

Heat map is scaled to the maximum density for the species/species group across all seasons. Inset bar plots display mean estimated densities \pm standard error of the mean for each zone.

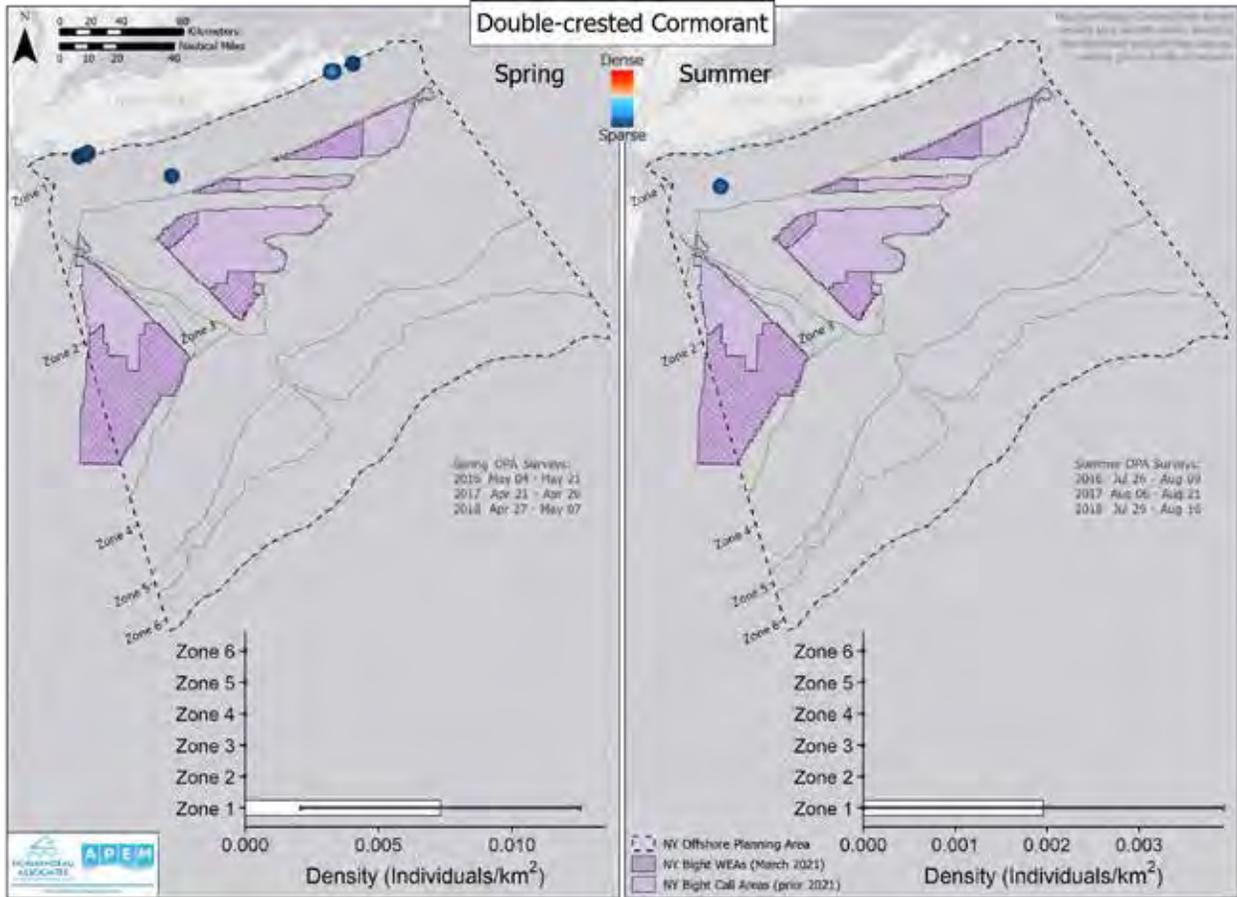


Figure 116. Spatial Distribution of Double-crested Cormorant Sitting Relative to Birds in Flight During Fall and Winter Surveys

Solid blue points represent individuals with calculated flight height and blue points with an x represent individuals in flight without flight height data. A pie chart inset shows the proportion of individuals flying and sitting. A boxplot inset of flight height distribution by zone is displayed for all birds with known flight heights. Boxplots show the distribution of data among seasons. The dark horizontal line is the median flight height, and the box represents the middle 50% of data values. The lines to the left and right of the box represent the data points that are within 1.5 times the length of the box. Data beyond this range are shown as individual points.

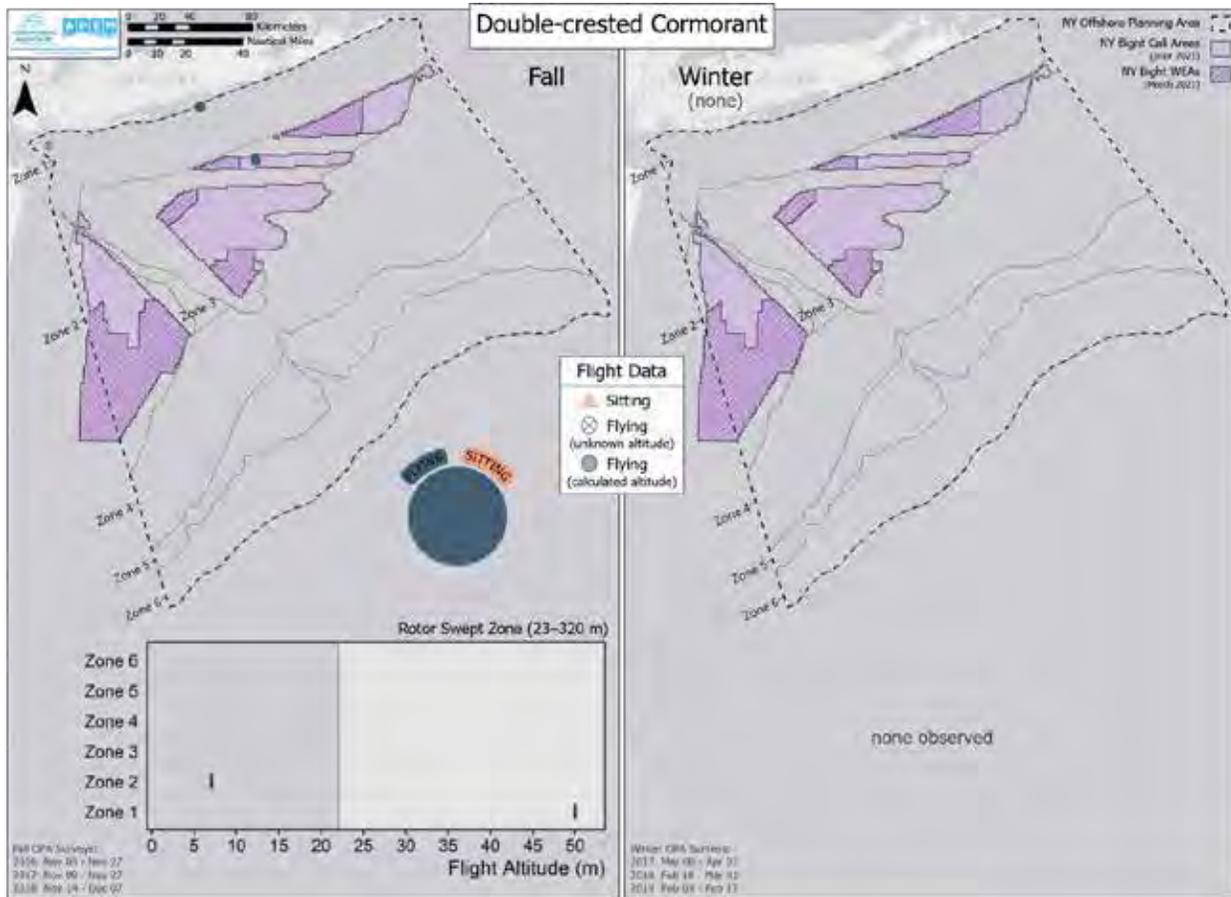


Figure 117. Spatial Distribution of Double-crested Cormorant Sitting Relative to Birds in Flight During Spring and Summer Surveys

Solid blue points represent individuals with calculated flight height and blue points with an x represent individuals in flight without flight height data. A pie chart inset shows the proportion of individuals flying and sitting. A boxplot inset of flight height distribution by zone is displayed for all birds with known flight heights. Boxplots show the distribution of data among seasons. The dark horizontal line is the median flight height, and the box represents the middle 50% of data values. The lines to the left and right of the box represent the data points that are within 1.5 times the length of the box. Data beyond this range are shown as individual points.

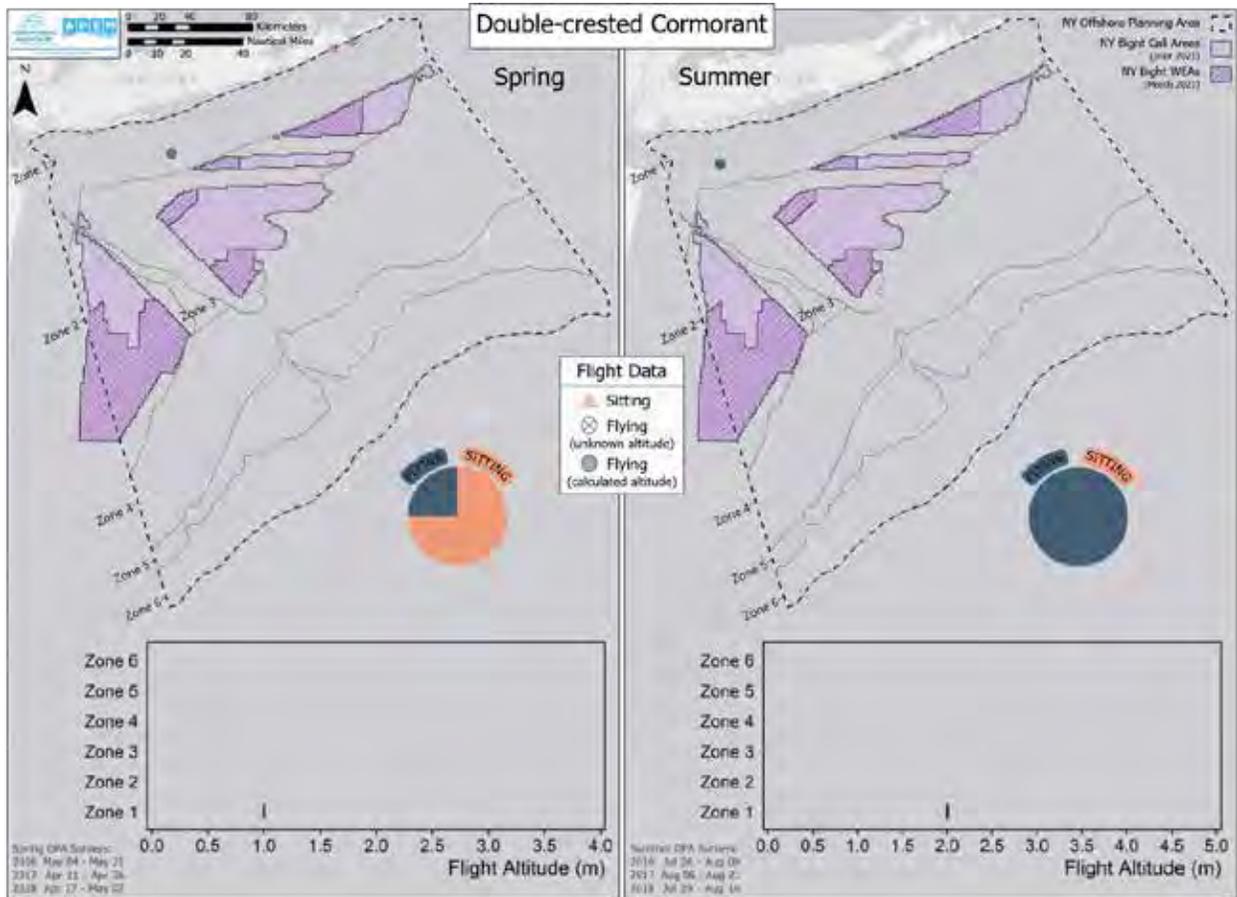
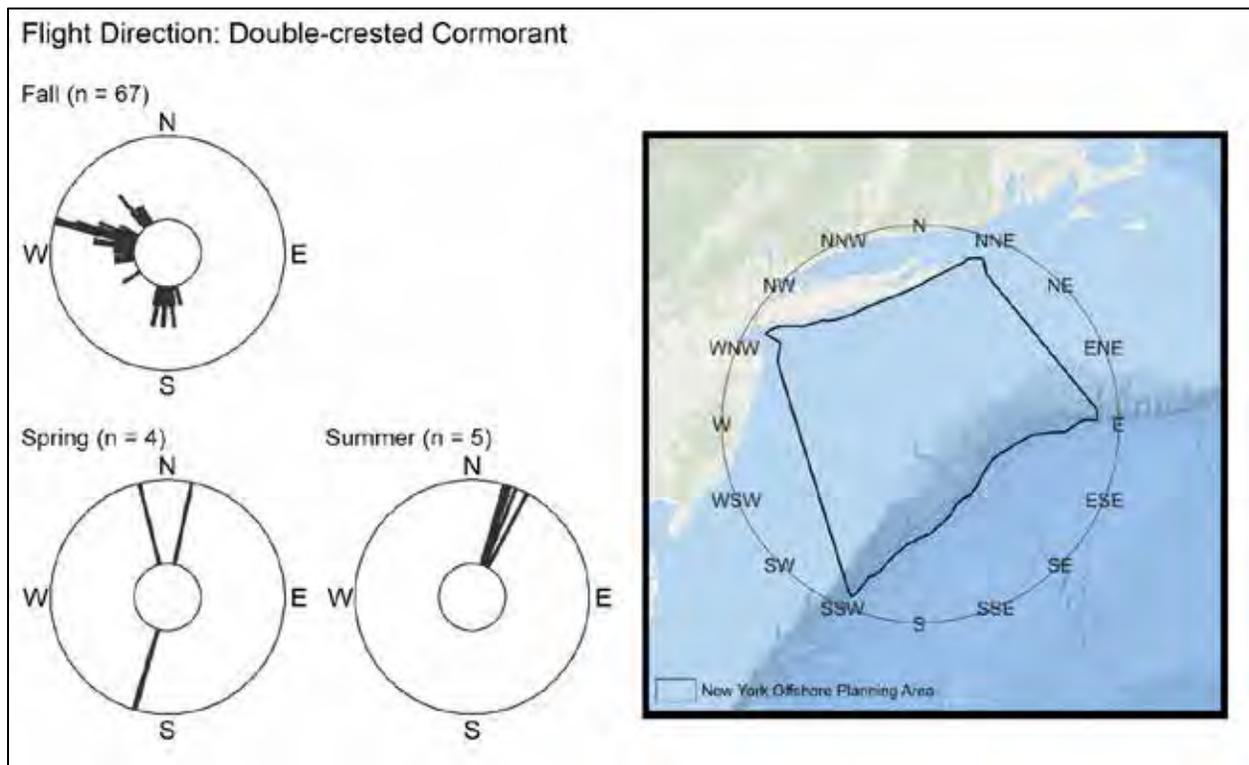


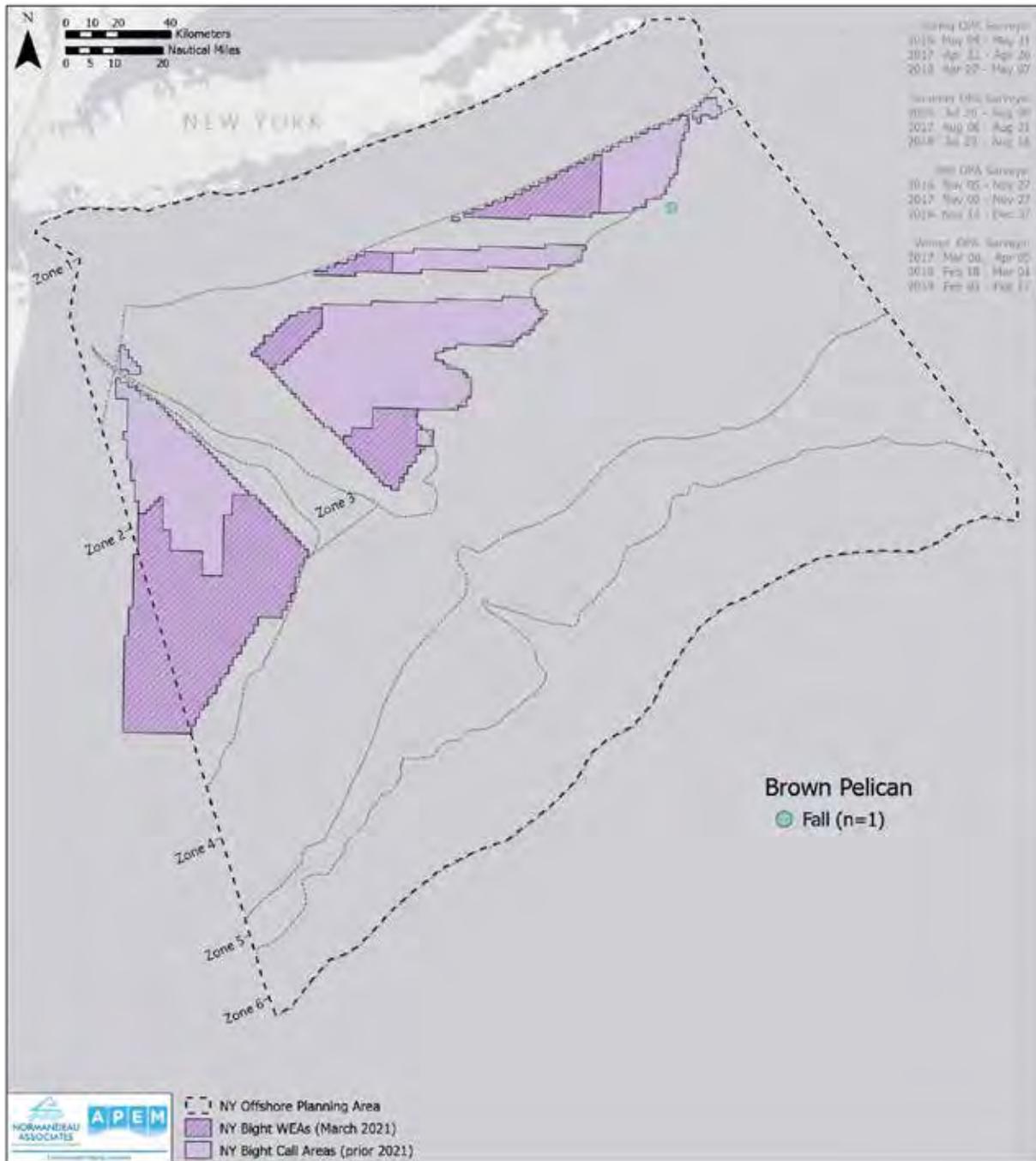
Figure 118. Direction of Flight of Double-crested Cormorant for All Surveys



2.5.14 Pelican

One brown pelican was observed during the Fall within Zone 4 (Figure 119).

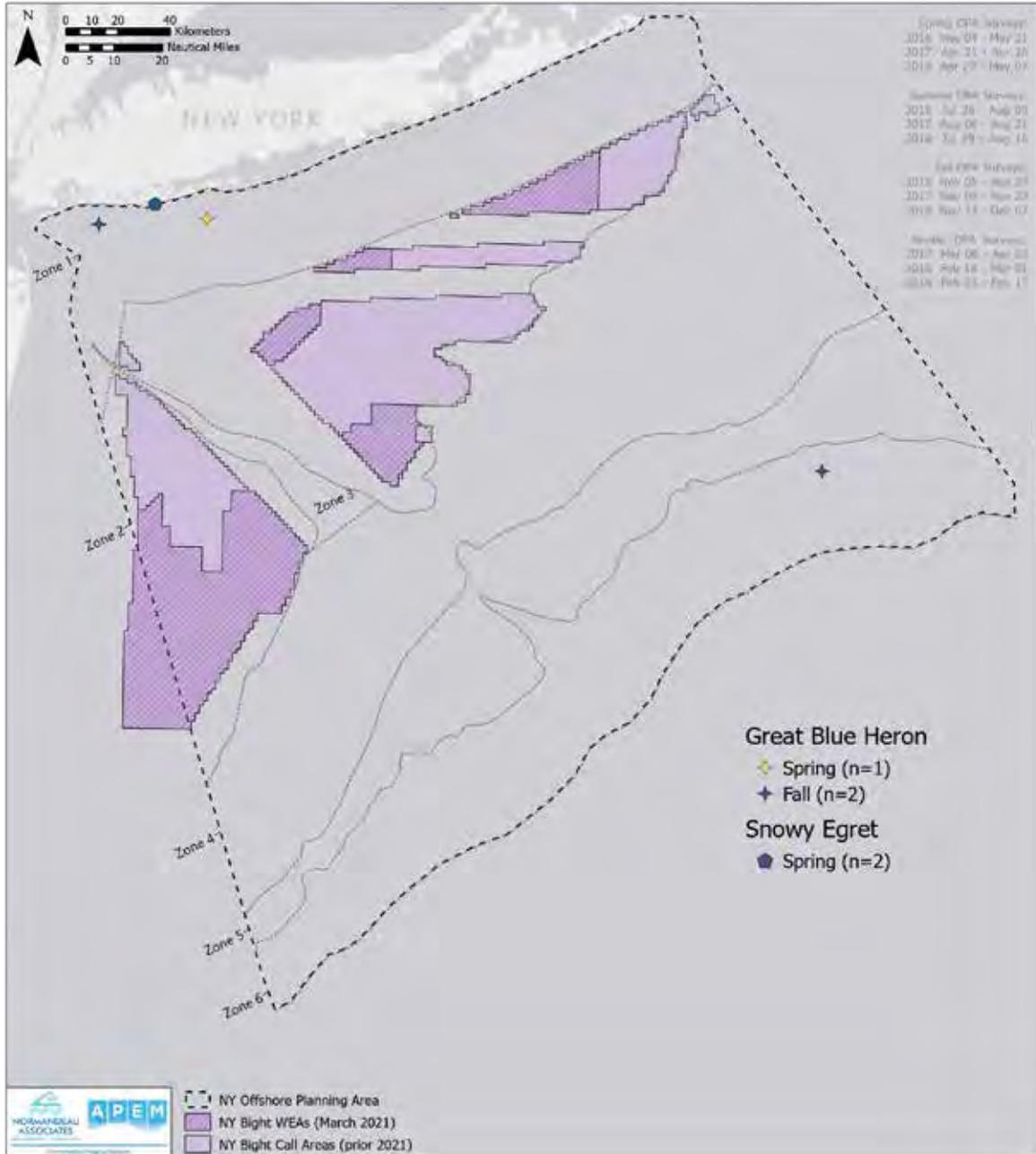
Figure 119. Spatial Distribution of Brown Pelican



2.5.15 Ardeidae

Five Ardeidae species were observed across all surveys with three great blue herons and two snowy egret (Appendix B, Figure 120). All individuals were observed in Zone 1 except for one snowy egret observed in Zone 6 during the Spring (Figure 120).

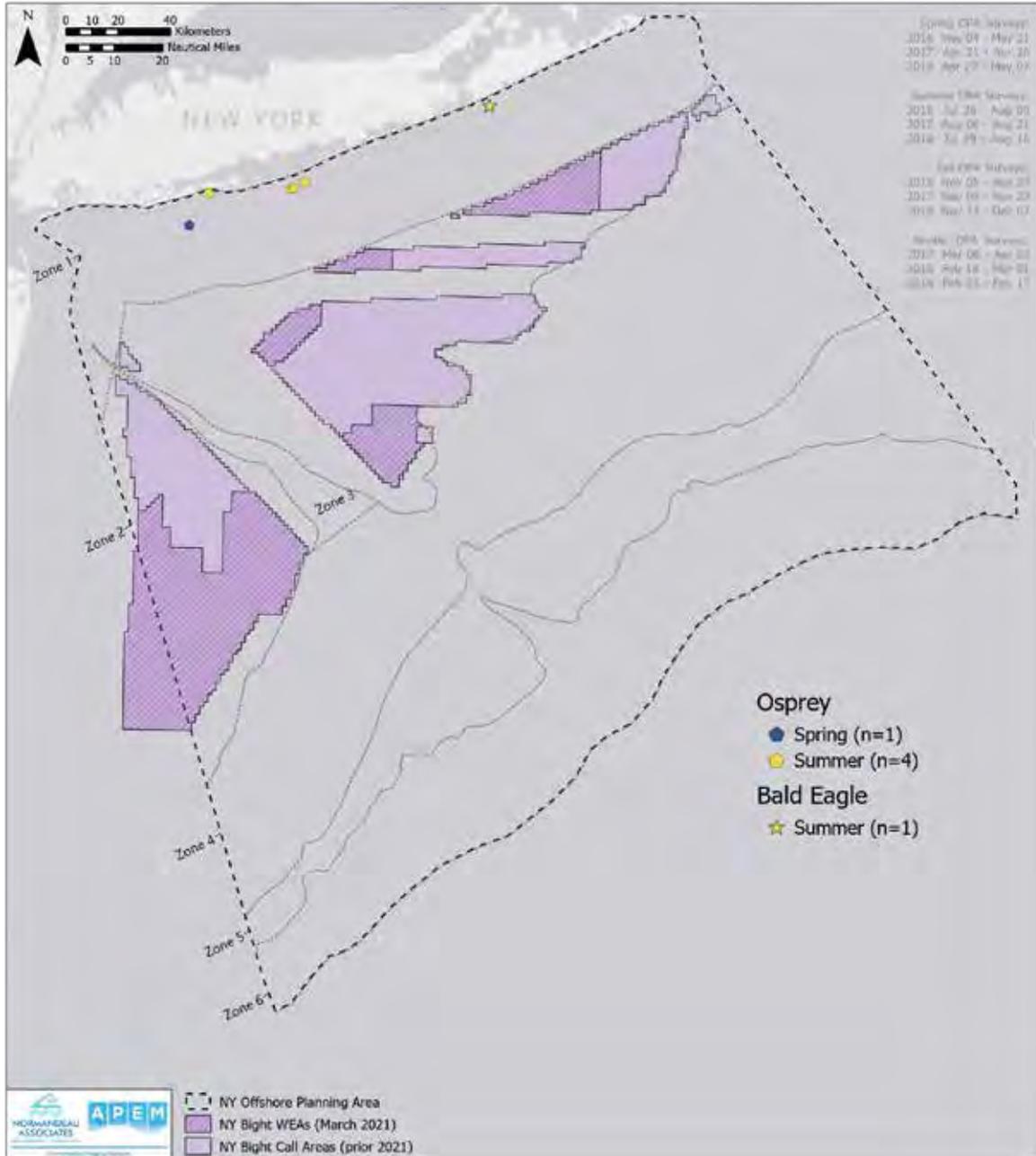
Figure 120. Spatial Distribution of Ardeidae Species with Fewer than 30 Occurrences Across All Surveys



2.5.16 Raptor

Six raptor species were observed across all surveys with four osprey and one bald eagle observed in the Summer and one osprey observed in the Spring (Appendix B, Figure 121). All individuals were observed in Zone 1.

Figure 121. Spatial Distribution of Raptor Species with Fewer than 30 Occurrences Across All Surveys



2.5.17 Shorebird

The shorebird taxonomic grouping included individuals classified as American oystercatcher (n=20), black-bellied plover (n=11), semipalmated plover (n=3), piping plover (n=1), ruddy turnstone (n=133), sanderling (n=117), dunlin (n=1,703), and shorebird-species unknown (n=6,255) (Appendix B). Overall, shorebird concentrated in Zone 1 and mean density estimates for Zone 1 were greatest in the Winter (n=4,026; $\bar{x} = 2.09 \pm 2.08$ birds/km²) followed by Fall (n=2,579; $\bar{x} = 1.31 \pm 1.05$ birds/km²), Summer (n=1,484; $\bar{x} = 0.58 \pm 0.56$ birds/km²), and Spring (n=18; $\bar{x} = 0.009 \pm 0.008$ birds/km²) (Figure 122, Figure 123). The vast majority of shorebird observations were isolated to the northwest corner of Zone 1 (Figure 122, Figure 123).

In Fall, 10% of shorebirds were in flight and median flight height was below the RSZ within Zone 1 (Figure 124). In Winter (n=4,027) only 1% of birds were in flight with a median flight height of 24 m (Figure 124). In Spring (n=52), 72% of birds were in flight, and in Summer (n=1,502) 9% of shorebirds were in flight (Figure 125). In the Fall, shorebirds were observed flying toward the south, and in the Winter and Summer, shorebirds were flying to the southwest (Figure 126).

Ruddy turnstone (n=133), sanderling (n=117), and dunlin (n=1,703) had the same patterns of distribution with all 1,953 observations in the Fall within the western portion of Zone 1 (Figure 127, Figure 128, Figure 129). All individuals were observed sitting except for three dunlin observed flying low (Figure 130, Figure 131, Figure 132). Direction of travel of Dunlin was toward to west–northwest (Figure 133).

Species observed fewer than 30 times across all surveys included American oystercatcher (n=20), black-bellied plover (n=11), semipalmated plover (n=3), piping plover (n=1) (Figure 134). All species and individuals were concentrated within Zone 1 on the coast except for one black-bellied plover observed in Zone 6 (Figure 134).

Figure 122. Spatial Distribution of Shorebirds During Fall and Winter by Zone and Proximity to Call Areas

Heat map is scaled to the maximum density for the species/species group across all seasons. Inset bar plots display mean estimated densities \pm standard error of the mean for each zone.

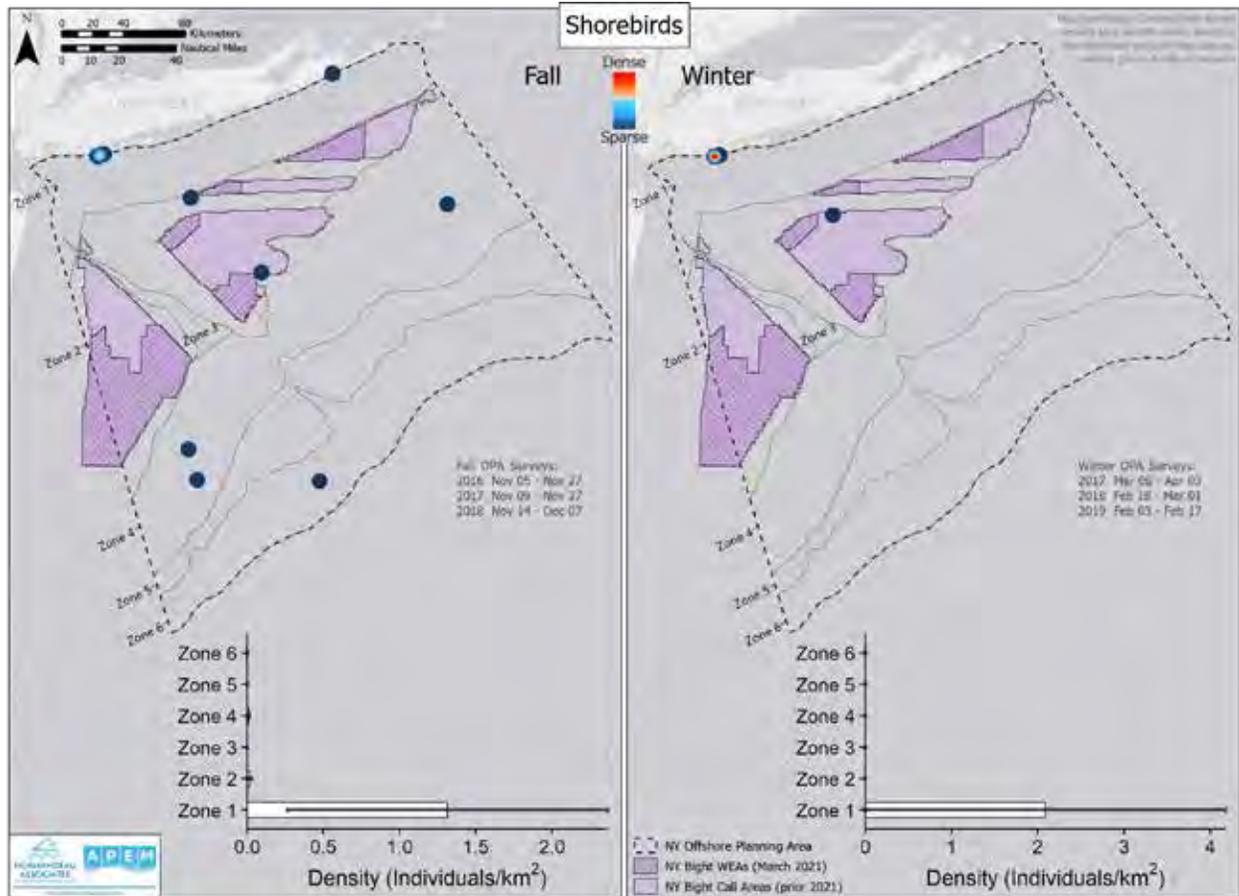


Figure 123. Spatial Distribution of Shorebirds During Spring and Summer by Zone and Proximity to Call Areas

Heat map is scaled to the maximum density for the species/species group across all seasons. Inset bar plots display mean estimated densities \pm standard error of the mean for each zone.

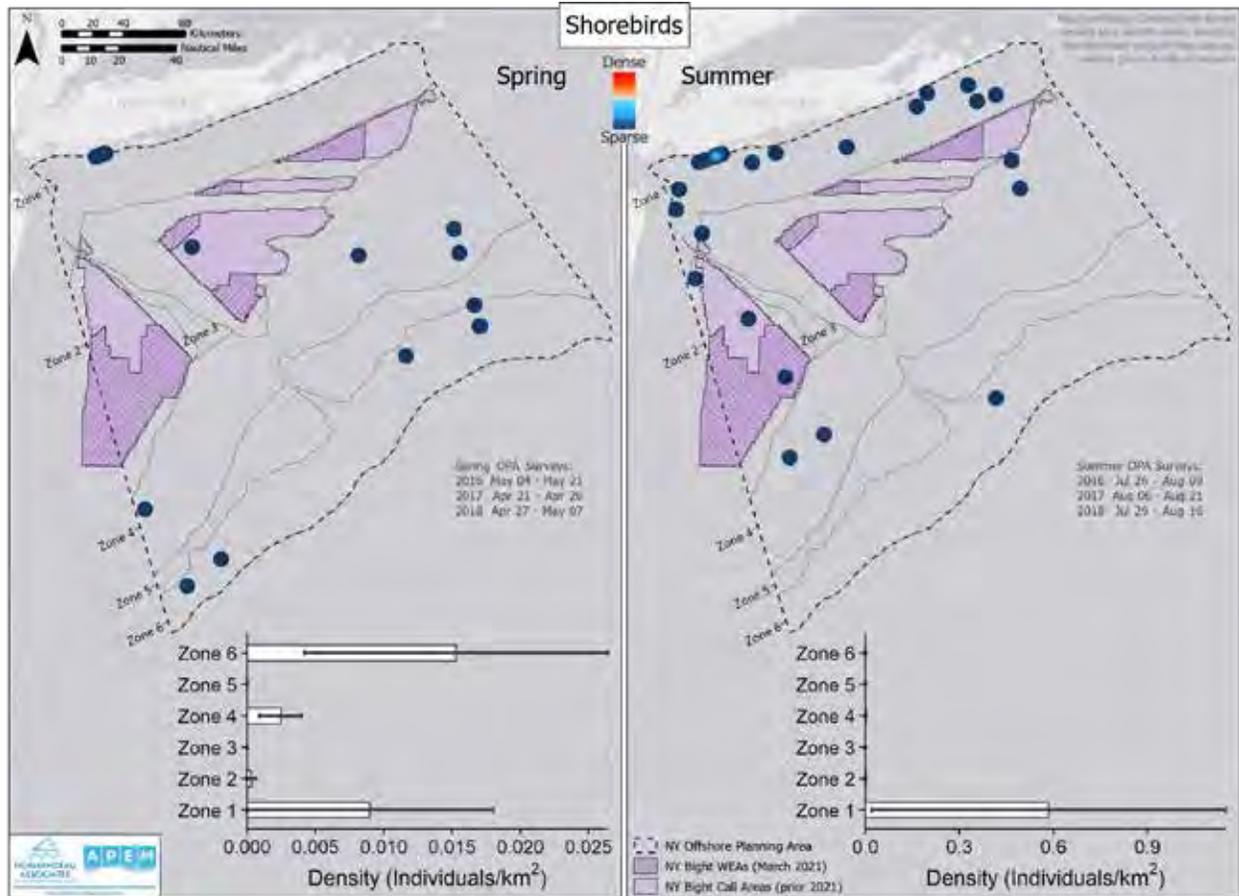


Figure 124. Spatial Distribution of Shorebirds Sitting Relative to Birds in Flight During Fall and Winter Surveys

Solid blue points represent individuals with calculated flight height and blue points with an x represent individuals in flight without flight height data. A pie chart inset shows the proportion of individuals flying and sitting. A boxplot inset of flight height distribution by zone is displayed for all birds with known flight heights. Boxplots show the distribution of data among seasons. The dark horizontal line is the median flight height, and the box represents the middle 50% of data values. The lines to the left and right of the box represent the data points that are within 1.5 times the length of the box. Data beyond this range are shown as individual points.

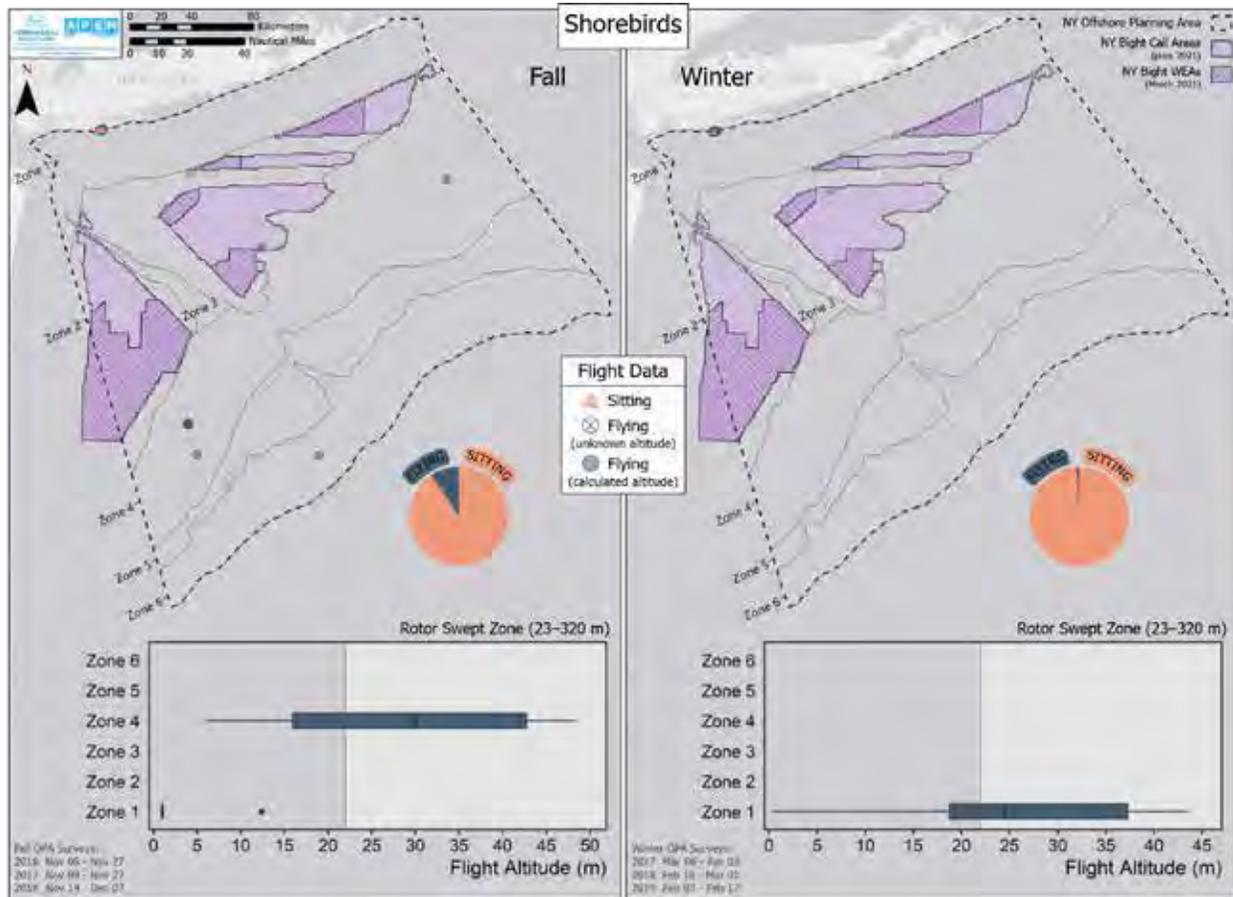


Figure 125. Spatial Distribution of Shorebirds Sitting Relative to Birds in Flight During Spring and Summer Surveys

Solid blue points represent individuals with calculated flight height and blue points with an x represent individuals in flight without flight height data. A pie chart inset shows the proportion of individuals flying and sitting. A boxplot inset of flight height distribution by zone is displayed for all birds with known flight heights. Boxplots show the distribution of data among seasons. The dark horizontal line is the median flight height, and the box represents the middle 50% of data values. The lines to the left and right of the box represent the data points that are within 1.5 times the length of the box. Data beyond this range are shown as individual points.

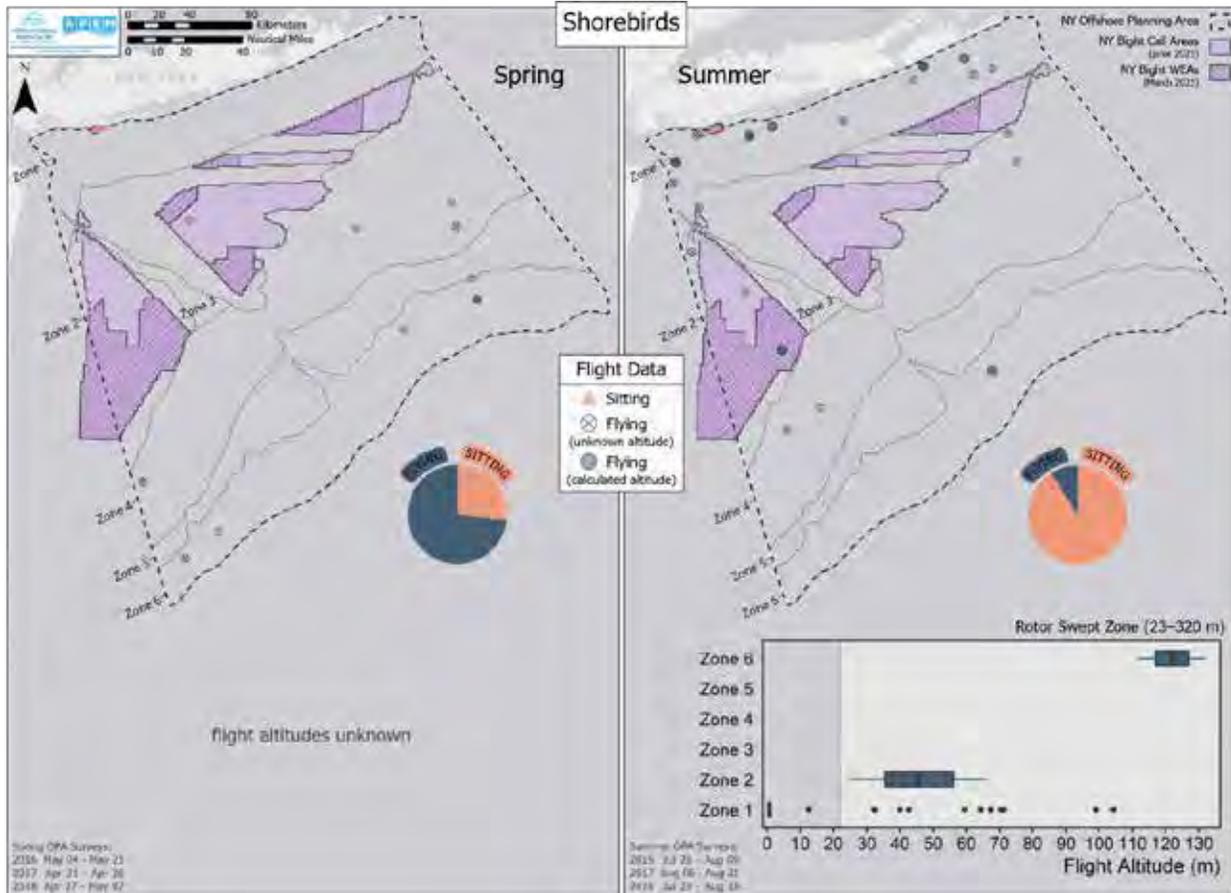


Figure 126. Direction of Flight of All Shorebirds for All Surveys

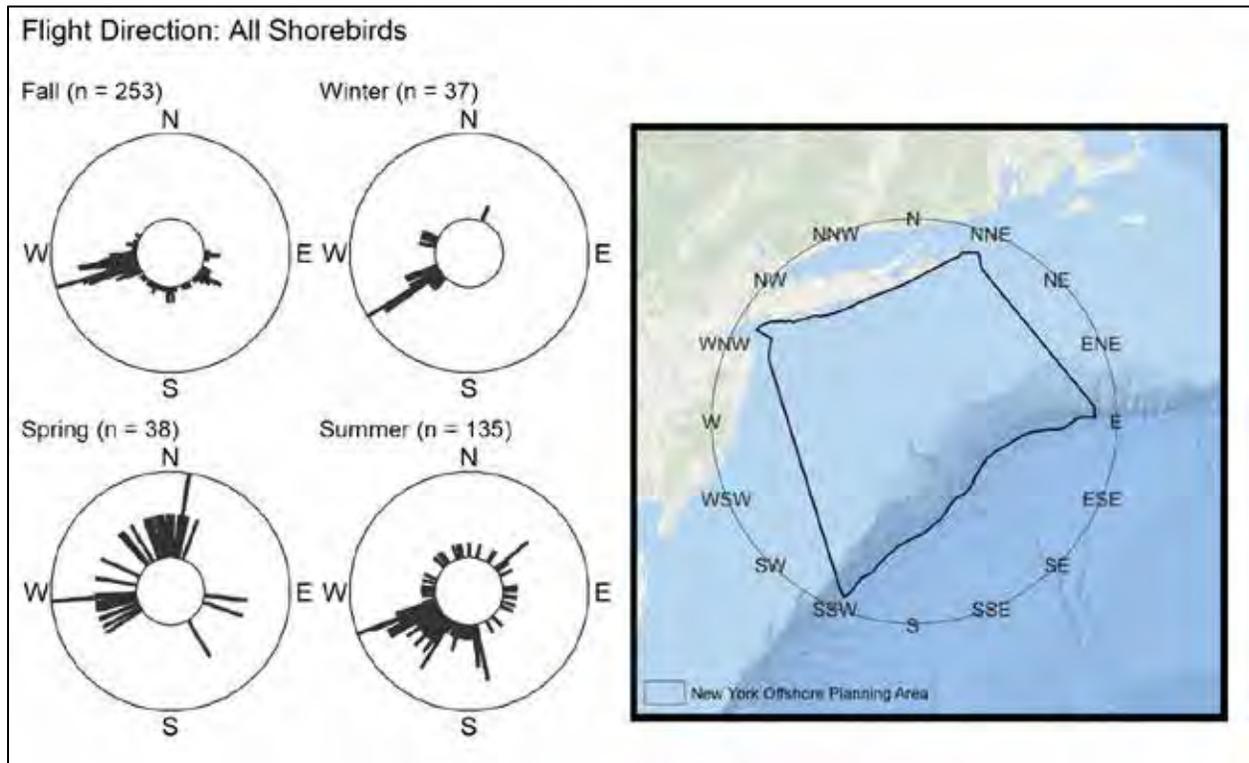


Figure 127. Spatial Distribution of Ruddy Turnstone During Fall and Winter by Zone and Proximity to Call Areas

Heat map is scaled to the maximum density for the species/species group across all seasons. Inset bar plots display mean estimated densities \pm standard error of the mean for each zone.

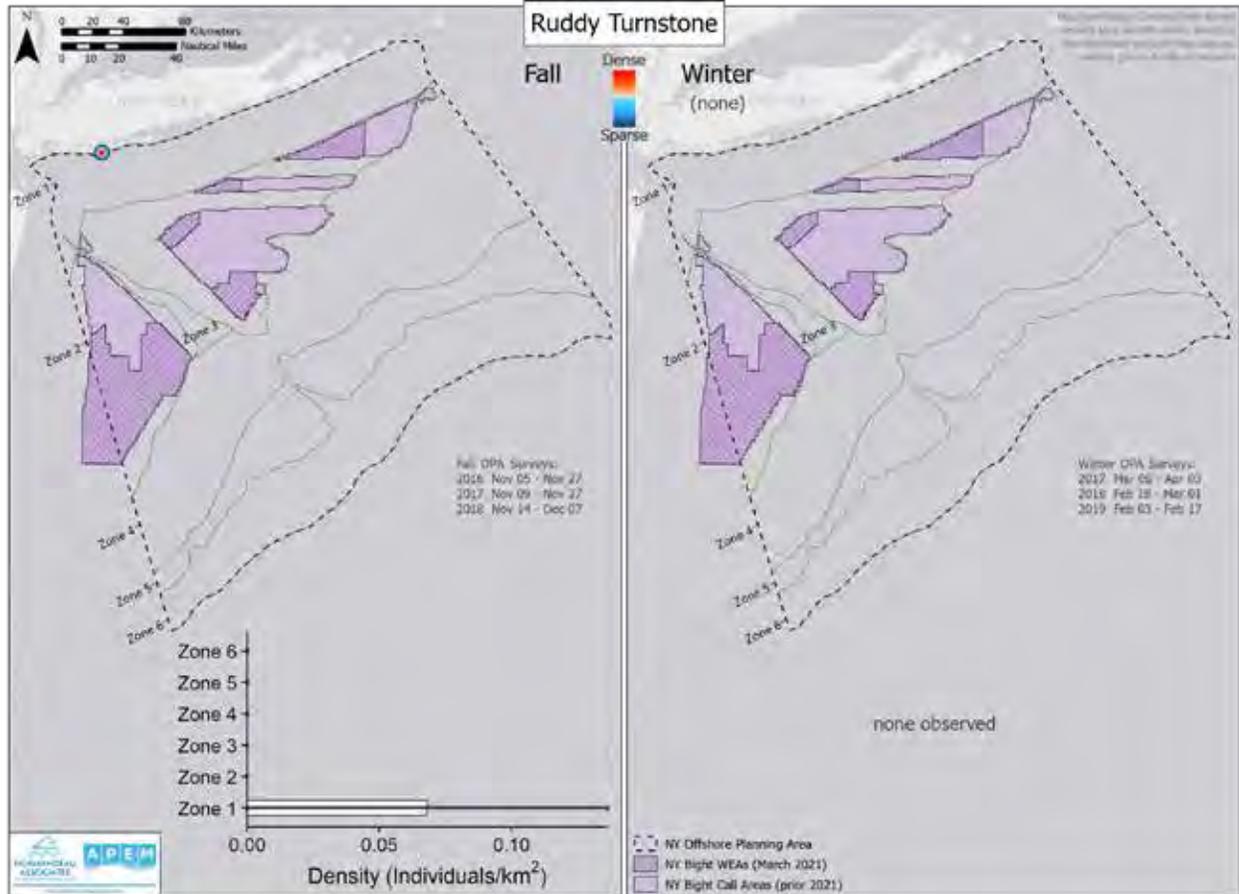


Figure 128. Spatial Distribution of Sanderlings During Fall and Winter by Zone and Proximity to Call Areas

Heat map is scaled to the maximum density for the species/species group across all seasons. Inset bar plots display mean estimated densities \pm standard error of the mean for each zone.

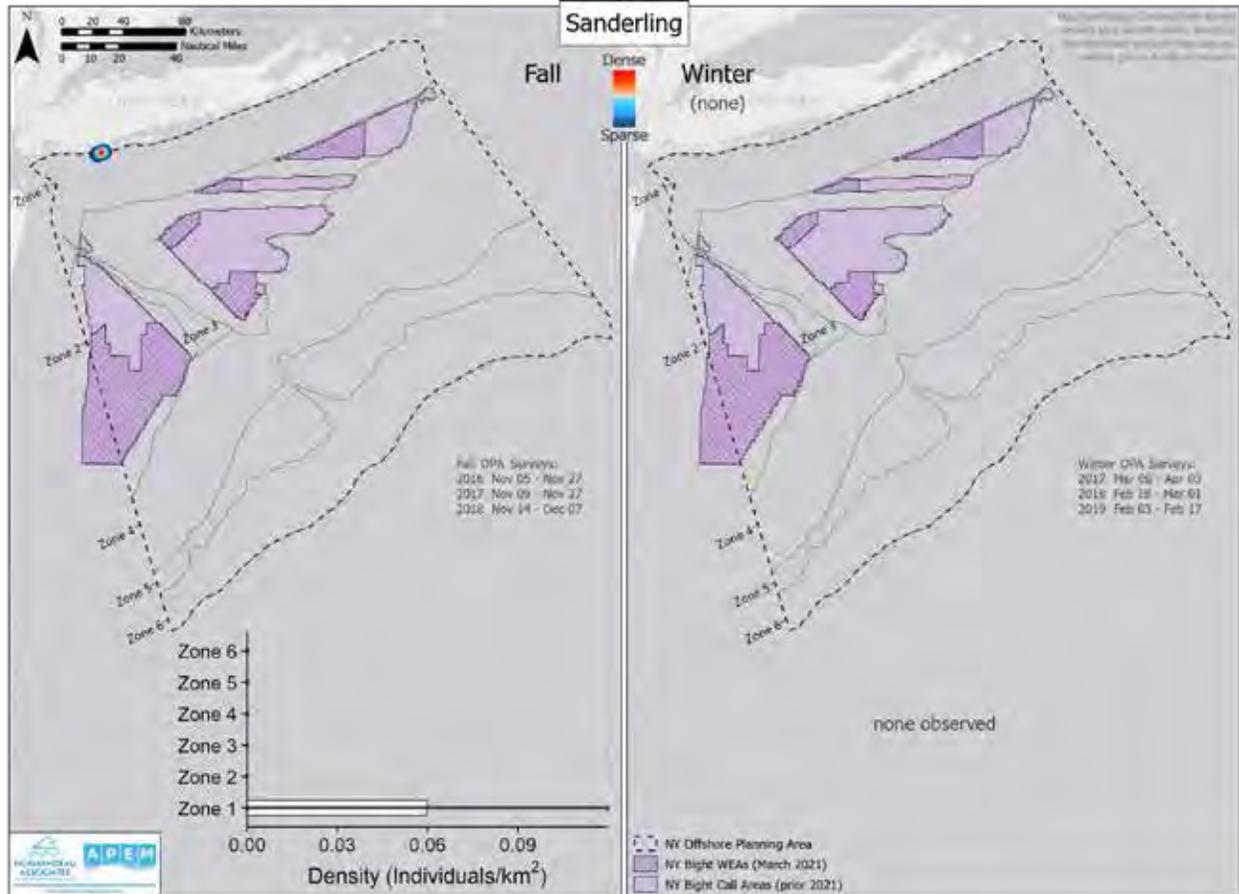


Figure 129. Spatial Distribution of Dunlin During Fall and Winter by Zone and Proximity to Call Areas

Heat map is scaled to the maximum density for the species/species group across all seasons. Inset bar plots display mean estimated densities \pm standard error of the mean for each zone.

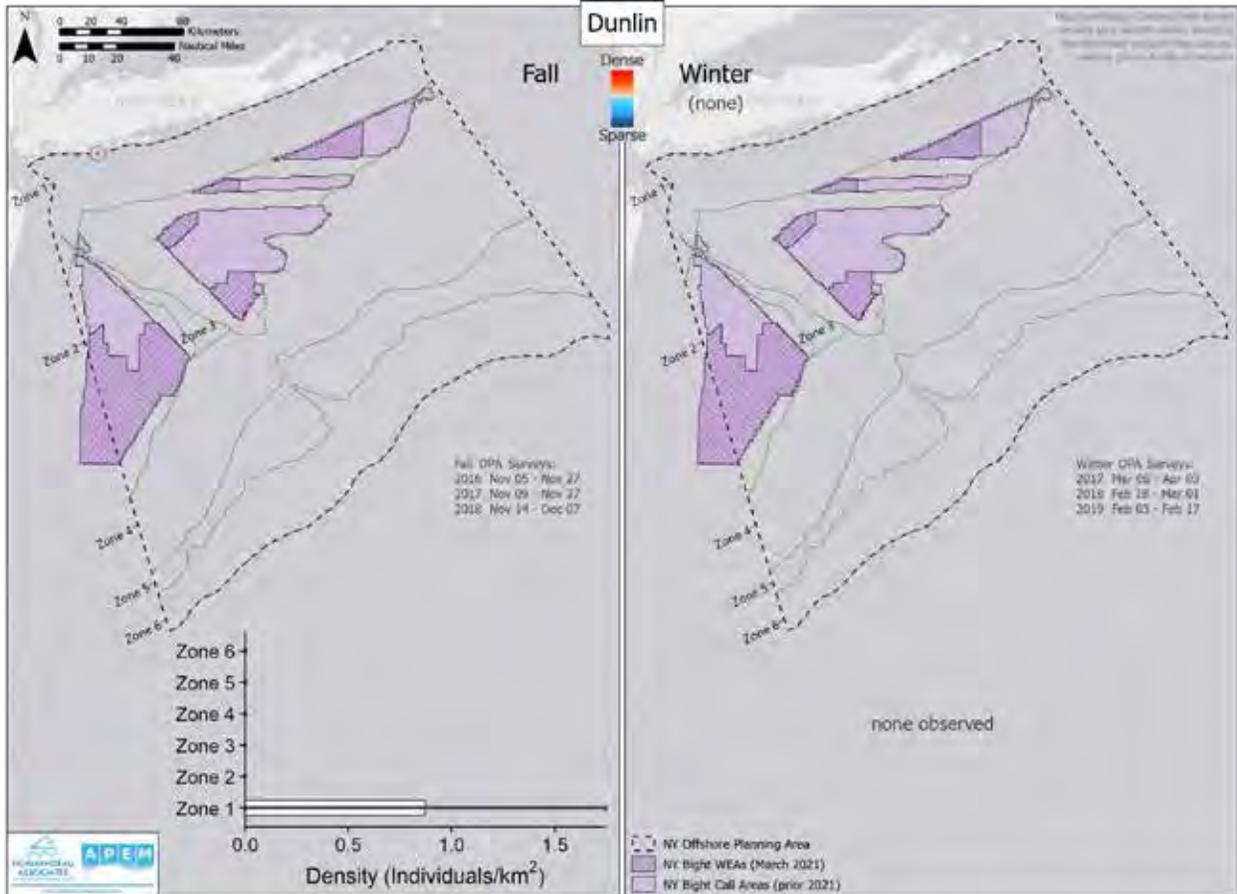


Figure 130. Spatial Distribution of Ruddy Turnstone Sitting Relative to Birds in Flight During Fall and Winter Surveys

Solid blue points represent individuals with calculated flight height and blue points with an x represent individuals in flight without flight height data. A pie chart inset shows the proportion of individuals flying and sitting.

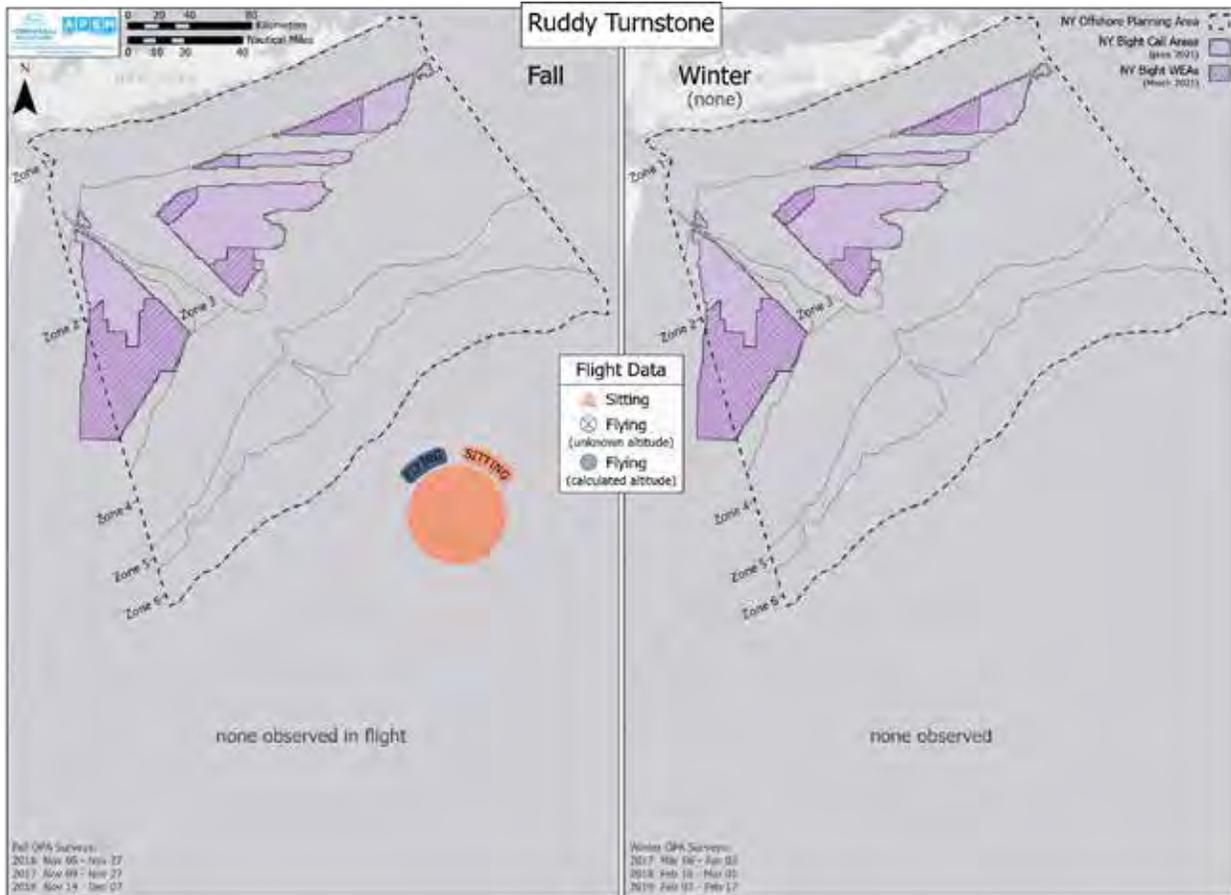


Figure 131. Spatial Distribution of Sanderling Sitting Relative to Birds in Flight During Fall and Winter Surveys

Solid blue points represent individuals with calculated flight height and blue points with an x represent individuals in flight without flight height data. A pie chart inset shows the proportion of individuals flying and sitting.

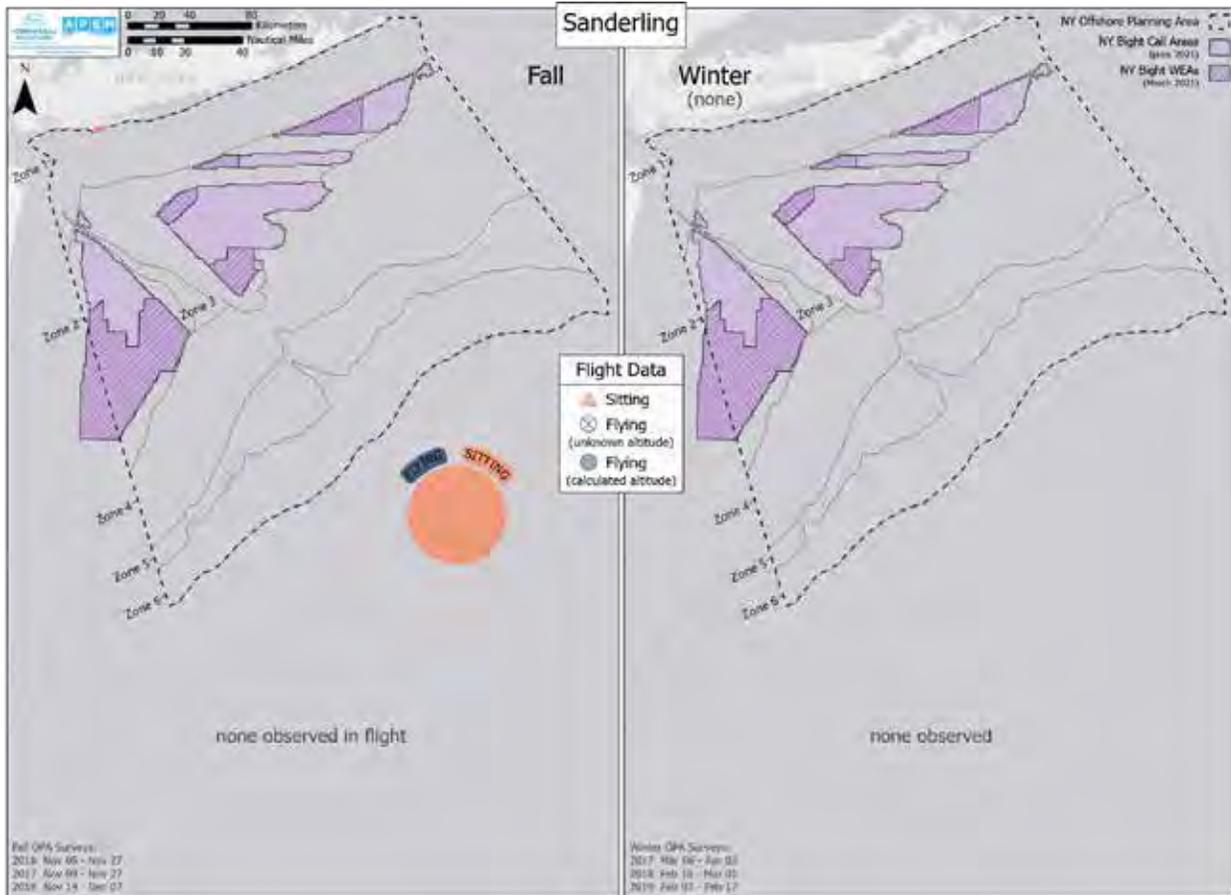


Figure 132. Spatial Distribution of Dunlin Sitting Relative to Birds in Flight During Fall and Winter Surveys

Solid blue points represent individuals with calculated flight height and blue points with an x represent individuals in flight without flight height data. A pie chart inset shows the proportion of individuals flying and sitting. A boxplot inset of flight height distribution by zone is displayed for all birds with known flight heights. Boxplots show the distribution of data among seasons. The dark horizontal line is the median flight height, and the box represents the middle 50% of data values. The lines to the left and right of the box represent the data points that are within 1.5 times the length of the box. Data beyond this range are shown as individual points.

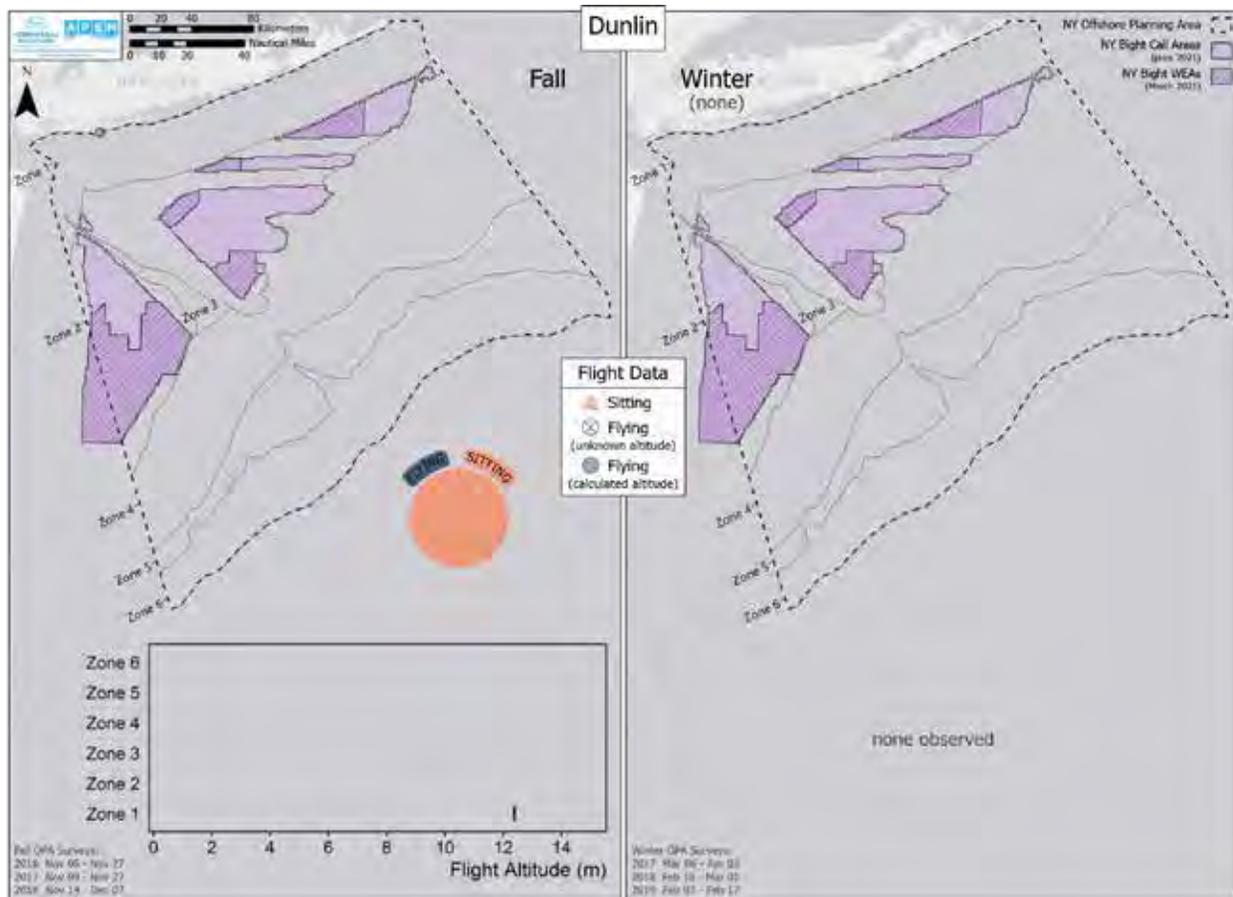


Figure 133. Direction of Flight of Dunlin for All Surveys

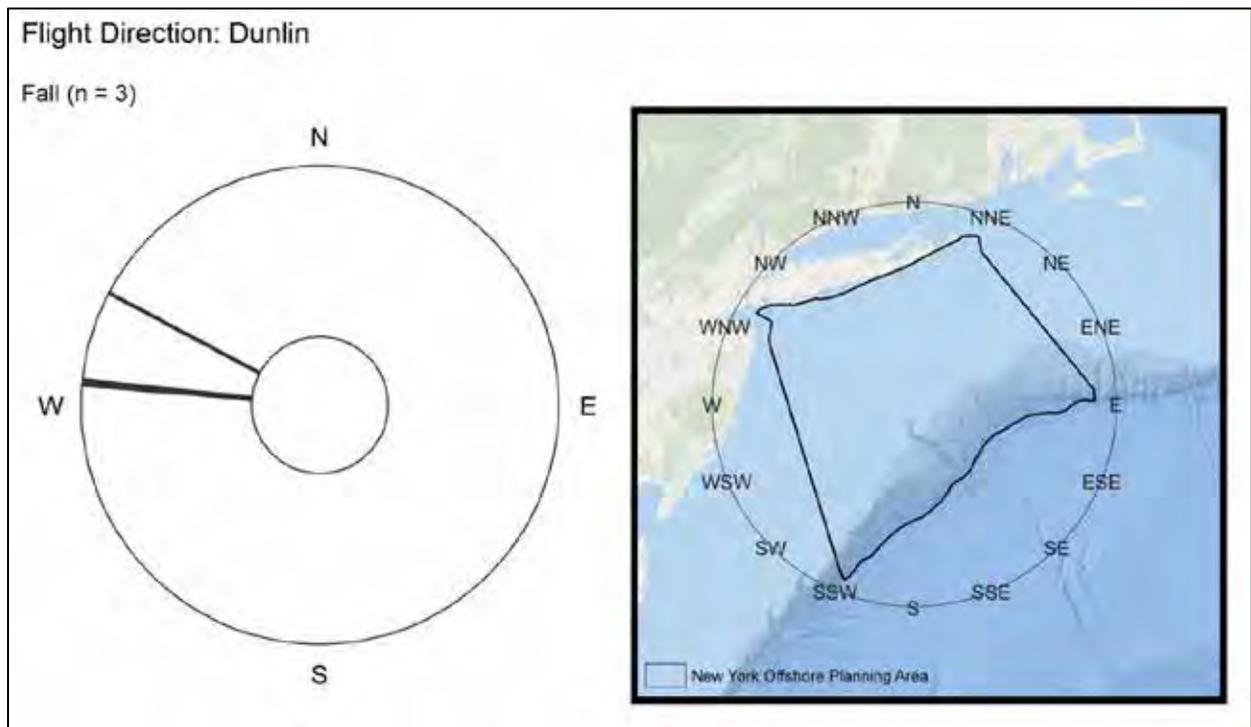
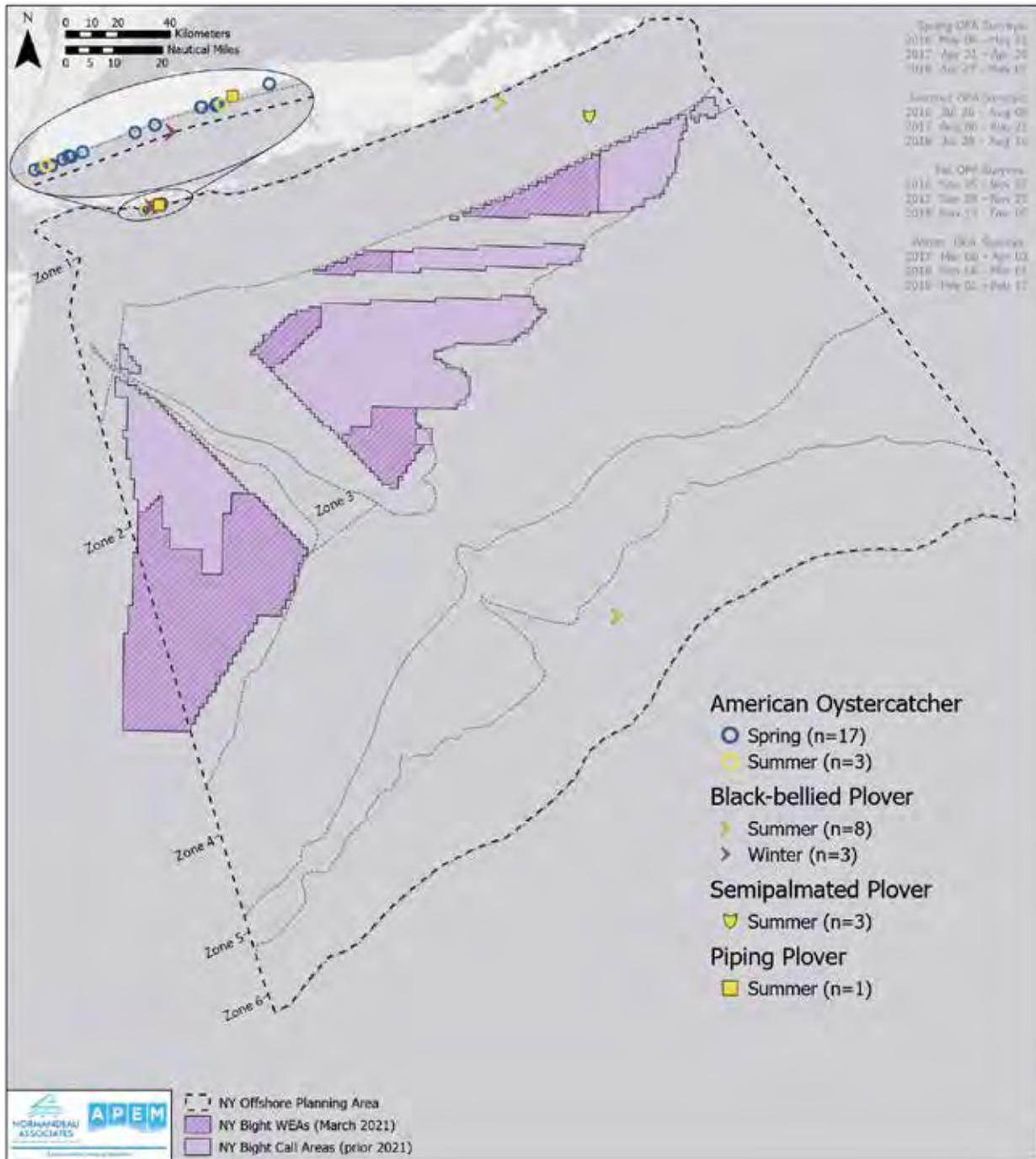


Figure 134. Spatial Distribution of Shorebird Species with Fewer than 30 Occurrences Across All Surveys



2.5.18 Phalarope

The phalarope taxonomic grouping included individuals classified as phalarope-species unknown (n=21), red-necked phalarope (n=873), red phalarope (n=12,052), and red/red-necked phalarope (n=6,745). Phalarope were frequently observed throughout the OPA with especially high observation rates in Fall (n=11,331) and Spring (n=7,977) (Appendix B, Figure 135, Figure 136). Overall phalarope mean density estimates across the OPA were greatest in the Fall (n=11,331; $\bar{x} = 0.85 \pm 0.14$ birds/km²) followed by Spring (n=7,977; $\bar{x} = 0.81 \pm 0.11$ birds/km²), Winter (n=237; $\bar{x} = 0.021 \pm 0.01$ birds/km²), and Summer (n=146; $\bar{x} = 0.009 \pm 0.002$ birds/km²) (Figure 135, Figure 136). In the Fall, phalarope were distributed throughout Zones 2–6 but had the greatest mean density estimate in Zone 4 (n=6,593; $\bar{x} = 2.4 \pm 0.56$ birds/km²), and in Winter, observations primarily occurred in Zone 6 (n=206; $\bar{x} = 0.095 \pm 0.05$ birds/km²) (Figure 135). In the Spring, phalarope were concentrated in the outer zones with Zone 5 (n=2,178; $\bar{x} = 1.59 \pm 0.31$ birds/km²) and Zone 6 (n=2,951; $\bar{x} = 1.54 \pm 0.37$ birds/km²) similarly dense (Figure 136).

Across all seasons 35% of birds were observed in flight, and median flight height across zones was varied ranging between five and 57 m (Figure 137, Figure 138). In Winter and Summer, when phalarope density was lowest, individuals were observed flying to the northwest or southeast (Figure 139).

2.5.18.1 Red-necked Phalarope

In Fall, 78 red-necked phalarope were observed in Zones 2–6. In Winter no red-necked phalarope were observed (Figure 140). In Spring, 794 red-necked phalarope were concentrated in the northwestern reaches of Zones 4–6 (Figure 141). In Fall, 13 of 78 birds were in flight with no clear pattern of flight headings and had a median flight height within the RSZ for all zones (Figure 142). In Summer we observed one individual flying through Zone 4 at a height of approximately 14 m above sea level (Figure 143). In the Spring, 61% of birds were in flight and displayed a slight pattern of northeasterly flight heading (Figure 144).

2.5.18.2 Red Phalarope

In Fall, 8,135 red phalarope were observed distributed throughout Zones 2–6 (Figure 145). In Winter, one red phalarope was observed sitting within Zone 2 (Figure 145). In Spring, 3,916 red phalarope were concentrated in the outer Zones 4–6, and in Summer, no red phalarope were seen (Figure 146). In Fall,

34% of birds were in flight with a median flight height below the RSZ within Zones 2–4 and within the RSZ in Zones 5 and 6 (Figure 147). In Spring, 48% of birds were in flight with a median flight height within the RSZ for all zones except Zone 2, which was below the RSZ (Figure 148). In the Fall, no pattern of flight direction could be ascertained, and in the Spring, birds had a slight pattern of flying to the northeast (Figure 149).

Figure 135. Spatial Distribution of Phalarope During Fall and Winter by Zone and Proximity to Call Areas

Heat map is scaled to the maximum density for the species/species group across all seasons. Inset bar plots display mean estimated densities \pm standard error of the mean for each zone.

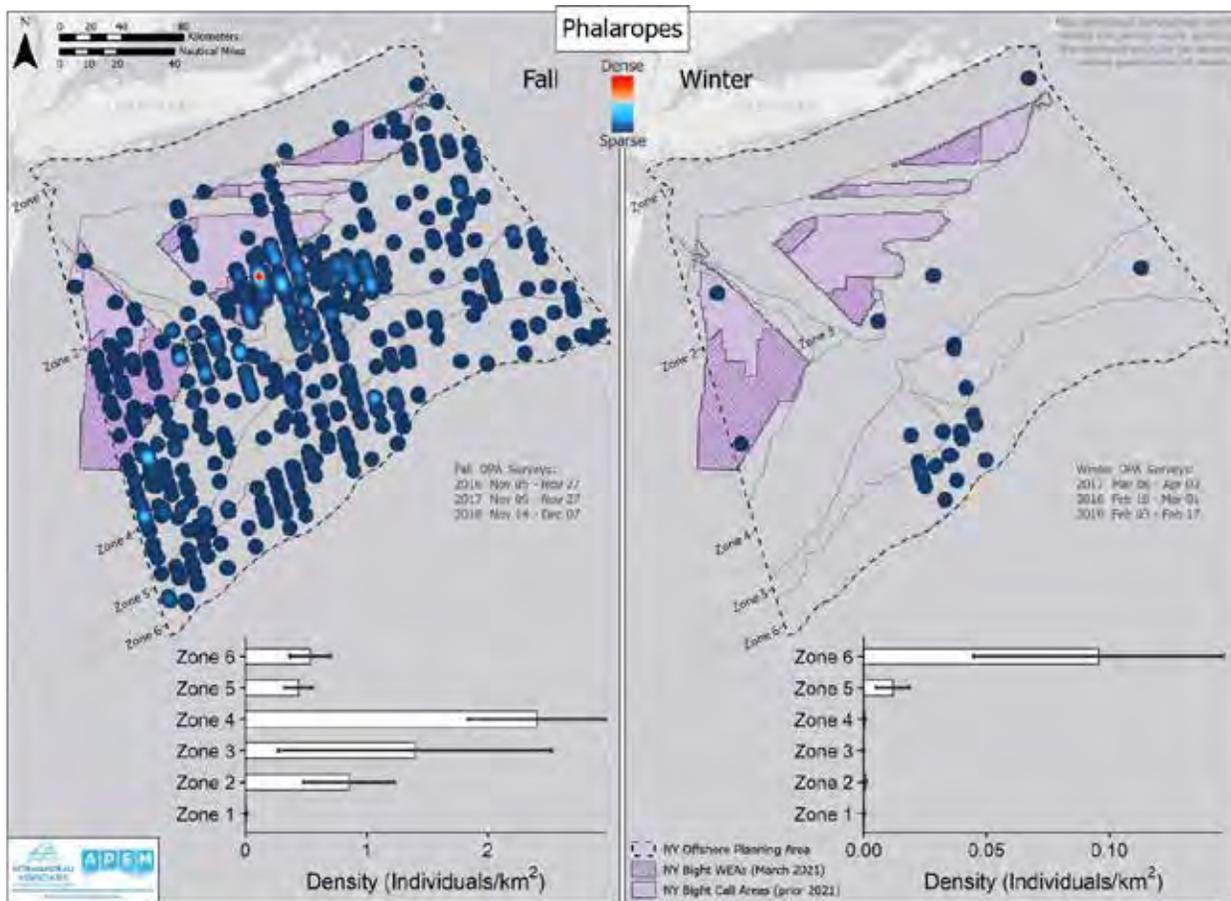


Figure 136. Spatial Distribution of Phalarope During Spring and Summer by Zone and Proximity to Call Areas

Heat map is scaled to the maximum density for the species/species group across all seasons. Inset bar plots display mean estimated densities \pm standard error of the mean for each zone.

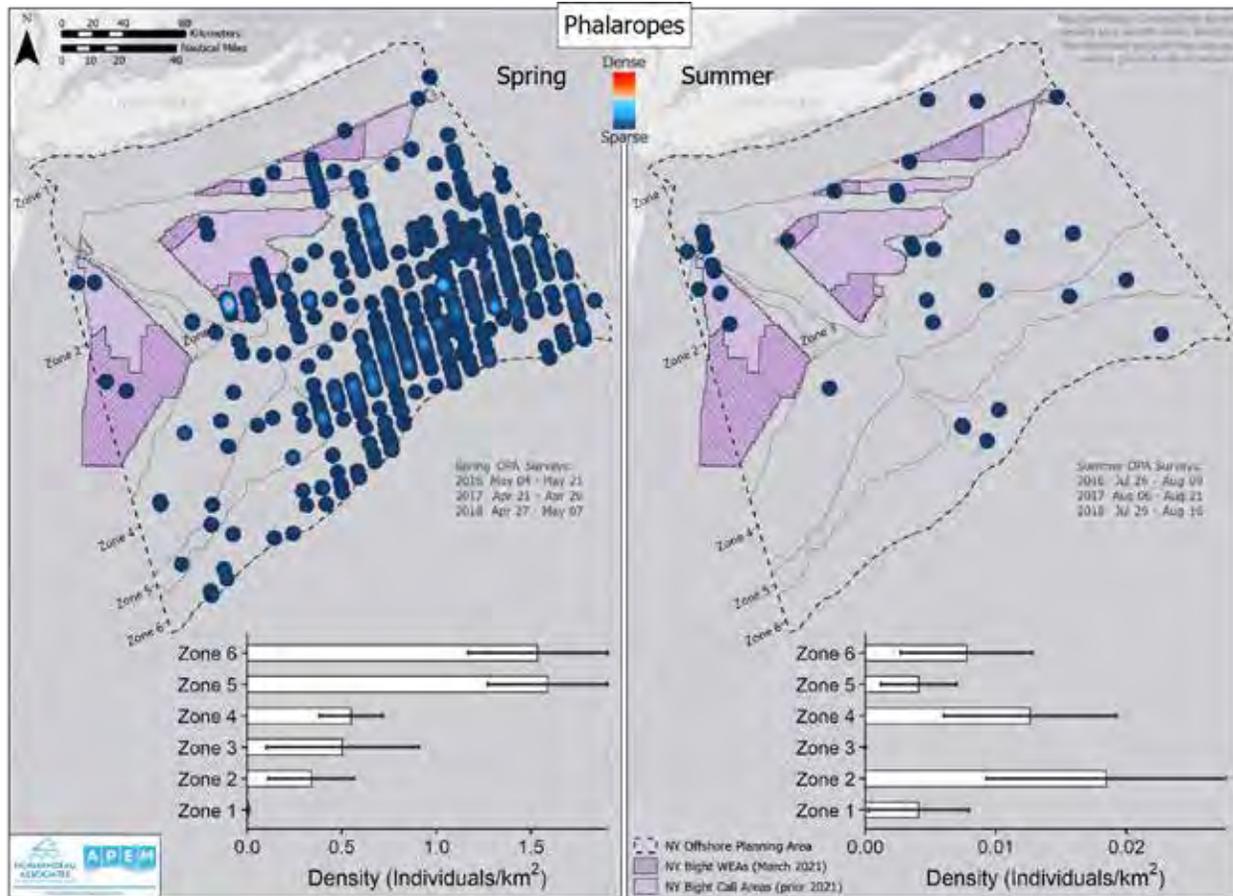


Figure 137. Spatial Distribution of Phalarope Sitting Relative to Birds in Flight During Fall and Winter Surveys

Solid blue points represent individuals with calculated flight height and blue points with an x represent individuals in flight without flight height data. A pie chart inset shows the proportion of individuals flying and sitting. A boxplot inset of flight height distribution by zone is displayed for all birds with known flight heights. Boxplots show the distribution of data among seasons. The dark horizontal line is the median flight height, and the box represents the middle 50% of data values. The lines to the left and right of the box represent the data points that are within 1.5 times the length of the box. Data beyond this range are shown as individual points.

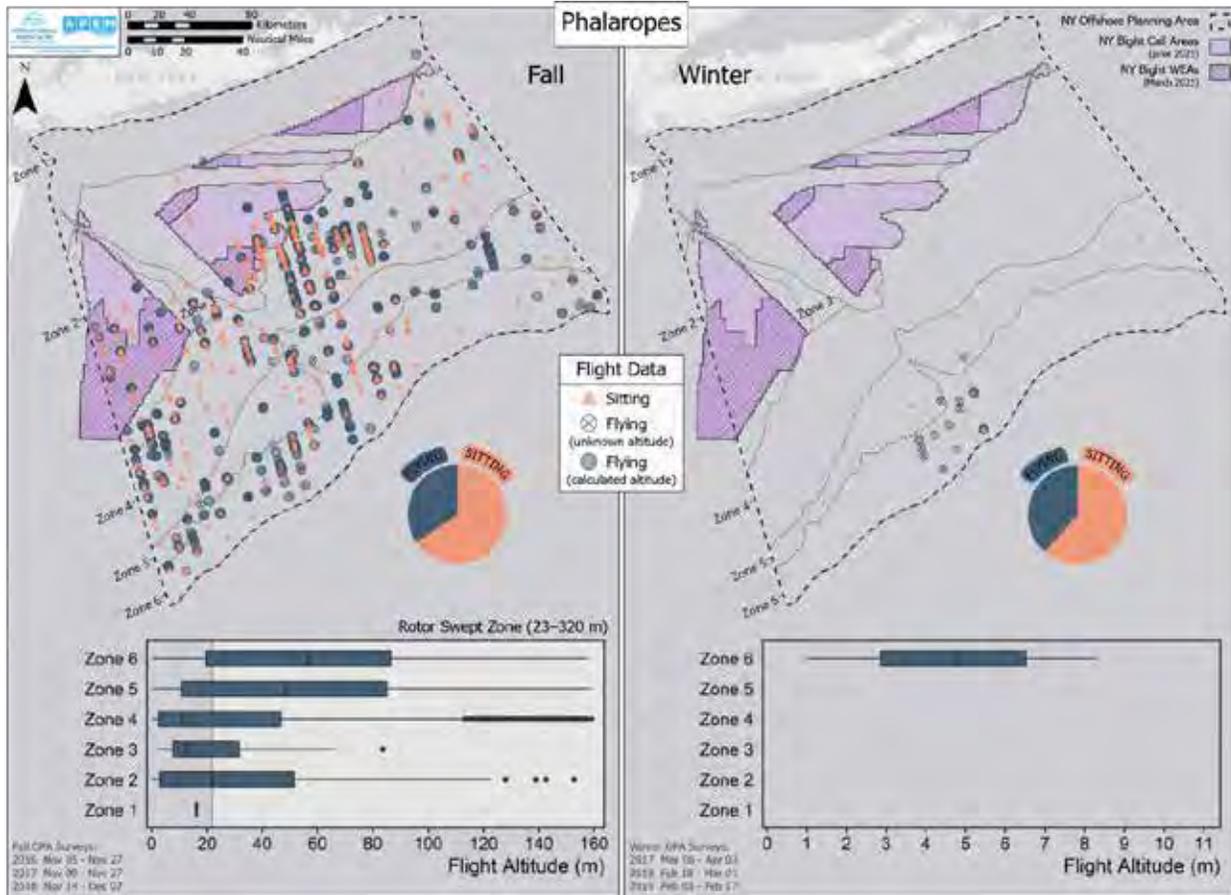


Figure 138. Spatial Distribution of Phalarope Sitting Relative to Birds in Flight During Spring and Summer Surveys

Solid blue points represent individuals with calculated flight height and blue points with an x represent individuals in flight without flight height data. A pie chart inset shows the proportion of individuals flying and sitting. A boxplot inset of flight height distribution by zone is displayed for all birds with known flight heights. Boxplots show the distribution of data among seasons. The dark horizontal line is the median flight height, and the box represents the middle 50% of data values. The lines to the left and right of the box represent the data points that are within 1.5 times the length of the box. Data beyond this range are shown as individual points.

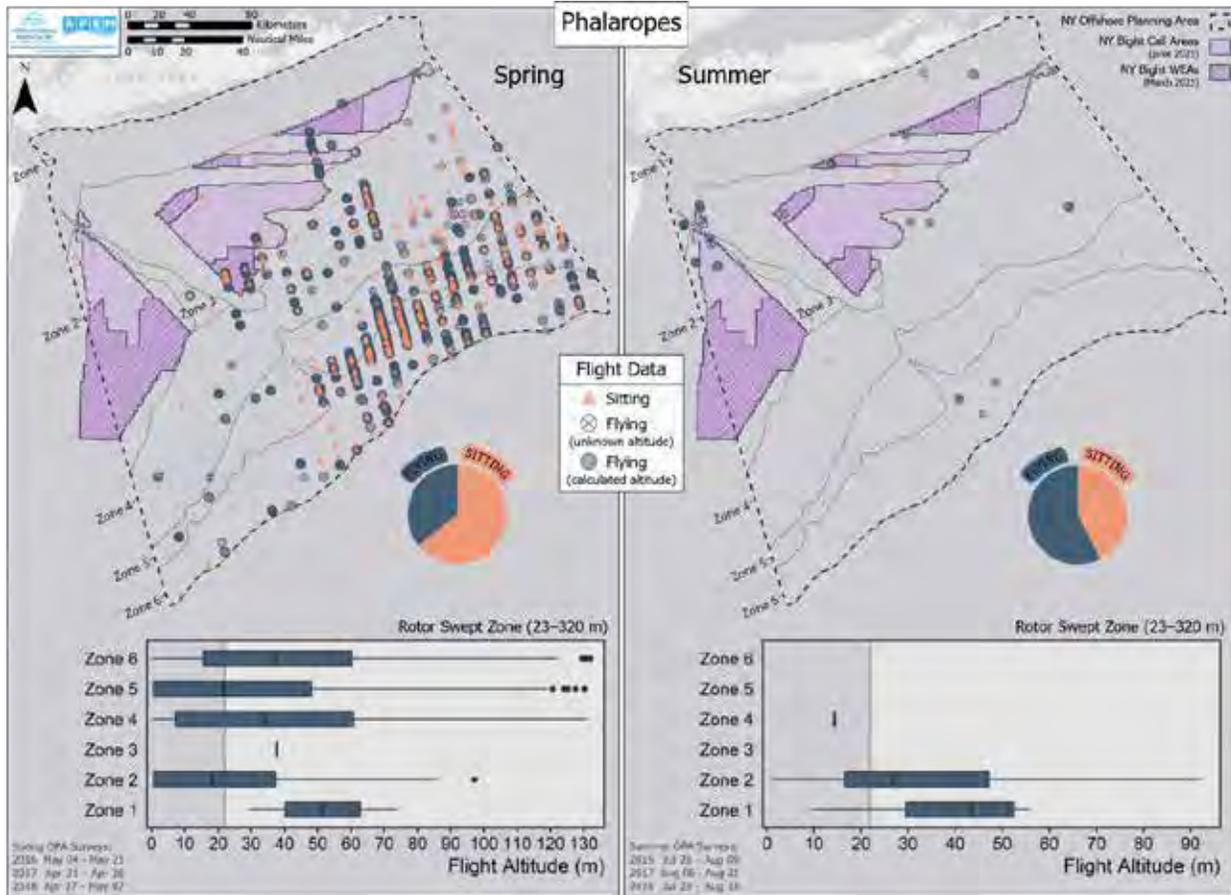


Figure 139. Direction of Flight of All Phalaropes for All Surveys

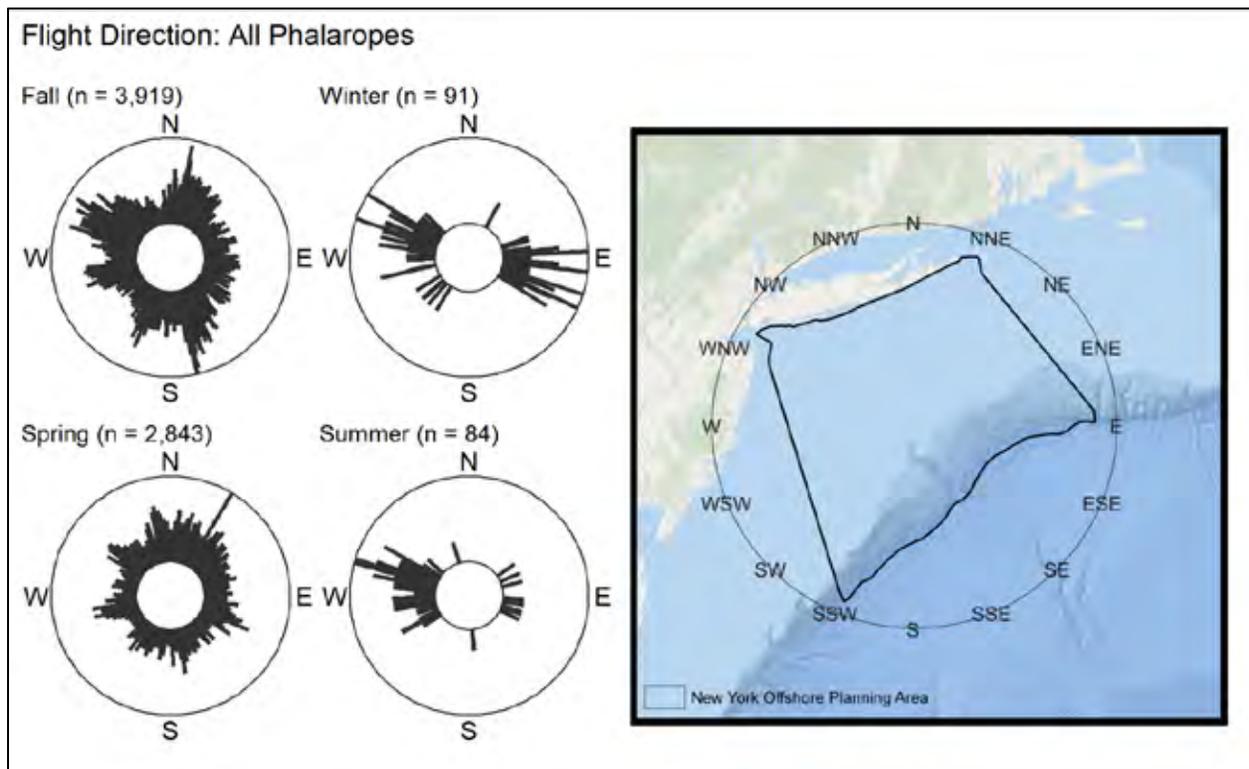


Figure 140. Spatial Distribution of Red-necked Phalarope During Fall and Winter by Zone and Proximity to Call Areas

Heat map is scaled to the maximum density for the species/species group across all seasons. Inset bar plots display mean estimated densities \pm standard error of the mean for each zone.

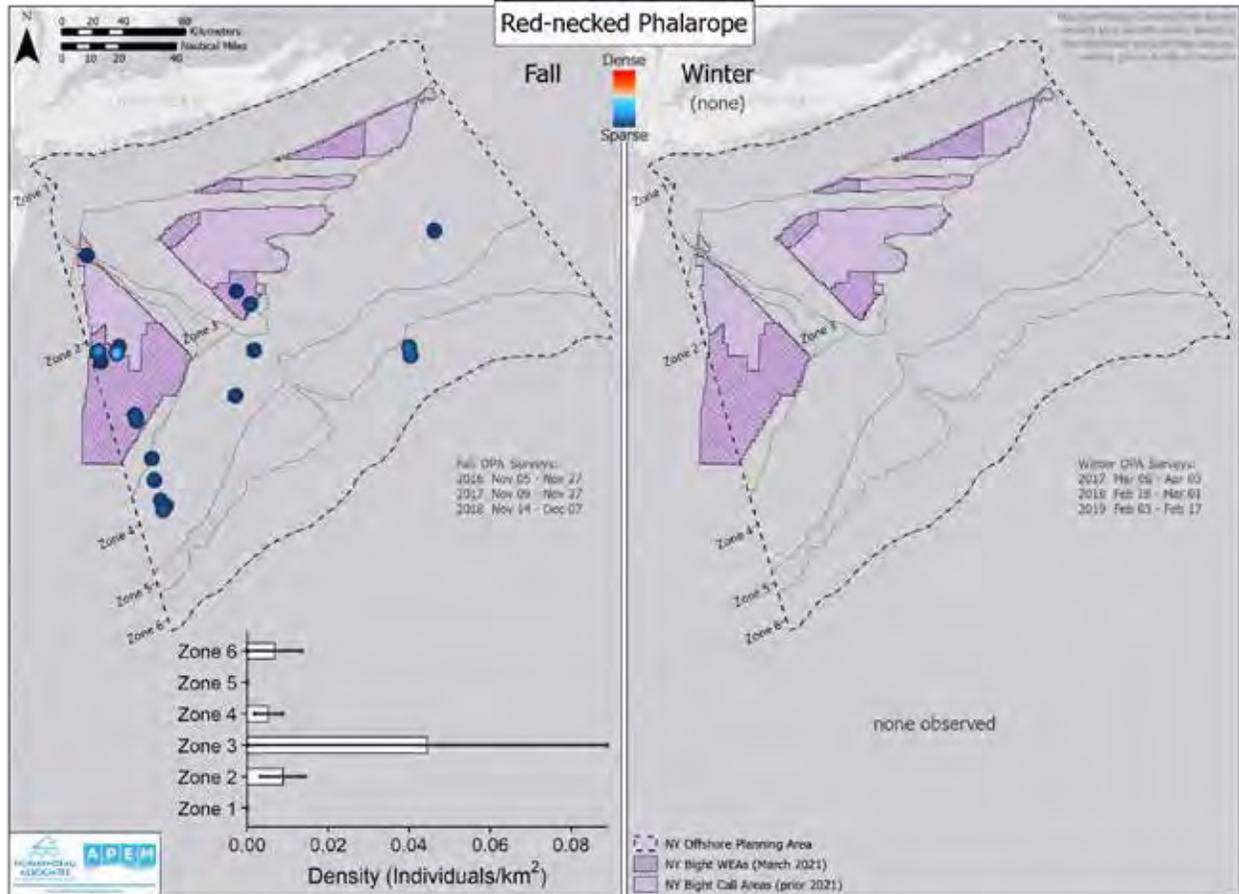


Figure 141. Spatial Distribution of Red-necked Phalarope During Spring and Summer by Zone and Proximity to Call Areas

Heat map is scaled to the maximum density for the species/species group across all seasons. Inset bar plots display mean estimated densities \pm standard error of the mean for each zone.

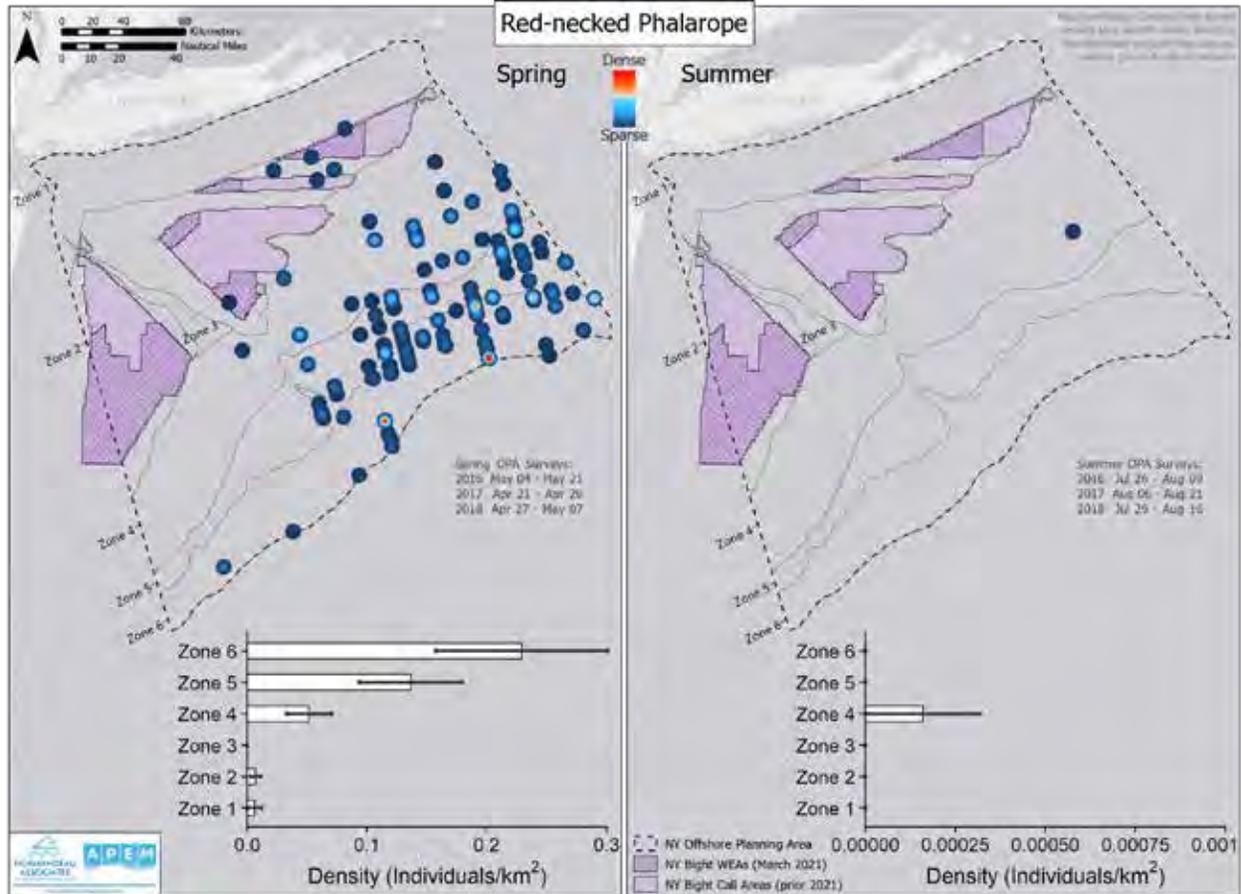


Figure 142. Spatial Distribution of Red-necked Phalarope Sitting Relative to Birds in Flight During Fall and Winter Surveys

Solid blue points represent individuals with calculated flight height and blue points with an x represent individuals in flight without flight height data. A pie chart inset shows the proportion of individuals flying and sitting. A boxplot inset of flight height distribution by zone is displayed for all birds with known flight heights. Boxplots show the distribution of data among seasons. The dark horizontal line is the median flight height, and the box represents the middle 50% of data values. The lines to the left and right of the box represent the data points that are within 1.5 times the length of the box. Data beyond this range are shown as individual points.

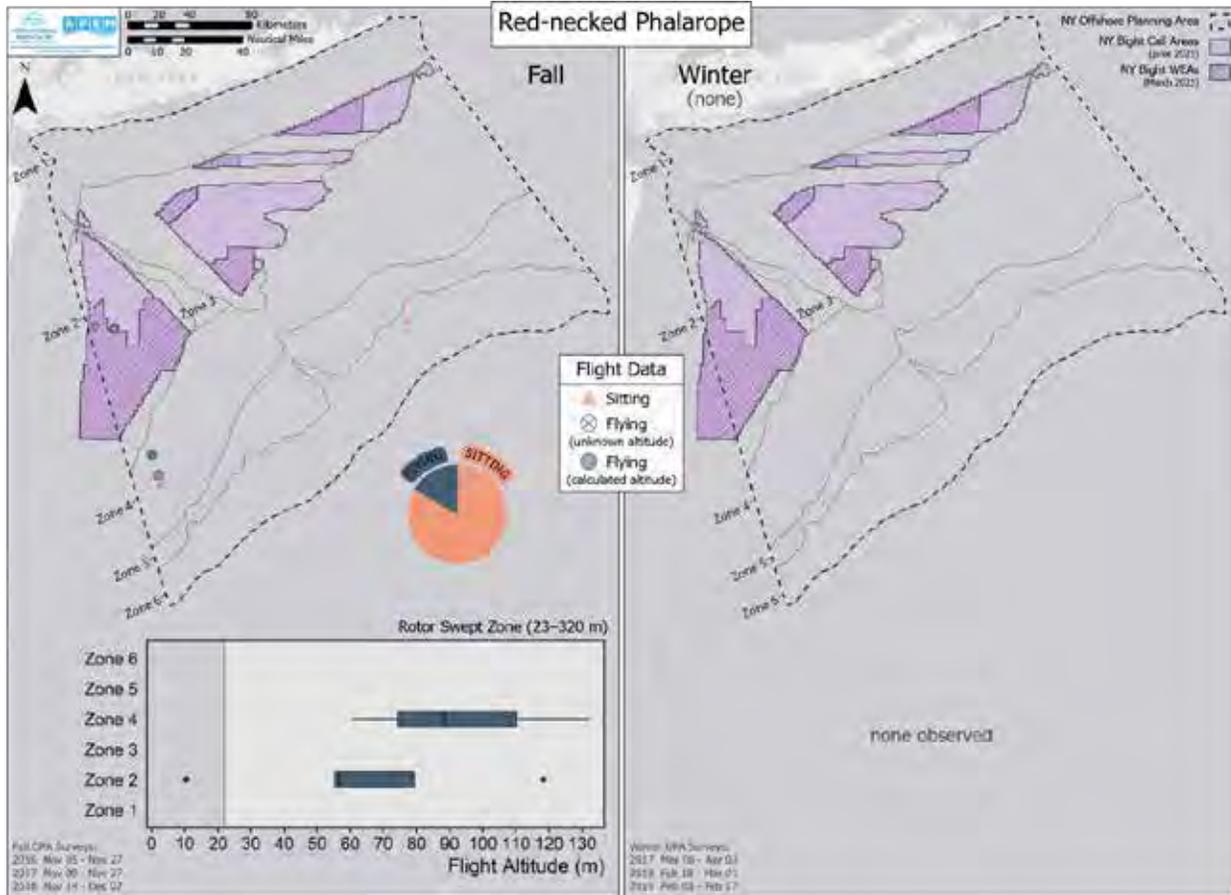


Figure 143. Spatial Distribution of Red-necked Phalarope Sitting Relative to Birds in Flight During Spring and Summer Surveys

Solid blue points represent individuals with calculated flight height and blue points with an x represent individuals in flight without flight height data. A pie chart inset shows the proportion of individuals flying and sitting. A boxplot inset of flight height distribution by zone is displayed for all birds with known flight heights. Boxplots show the distribution of data among seasons. The dark horizontal line is the median flight height, the box represents the middle 50% of data values. The lines to the left and right of the box represent the data points that are within 1.5 times the length of the box. Data beyond this range are shown as individual points.

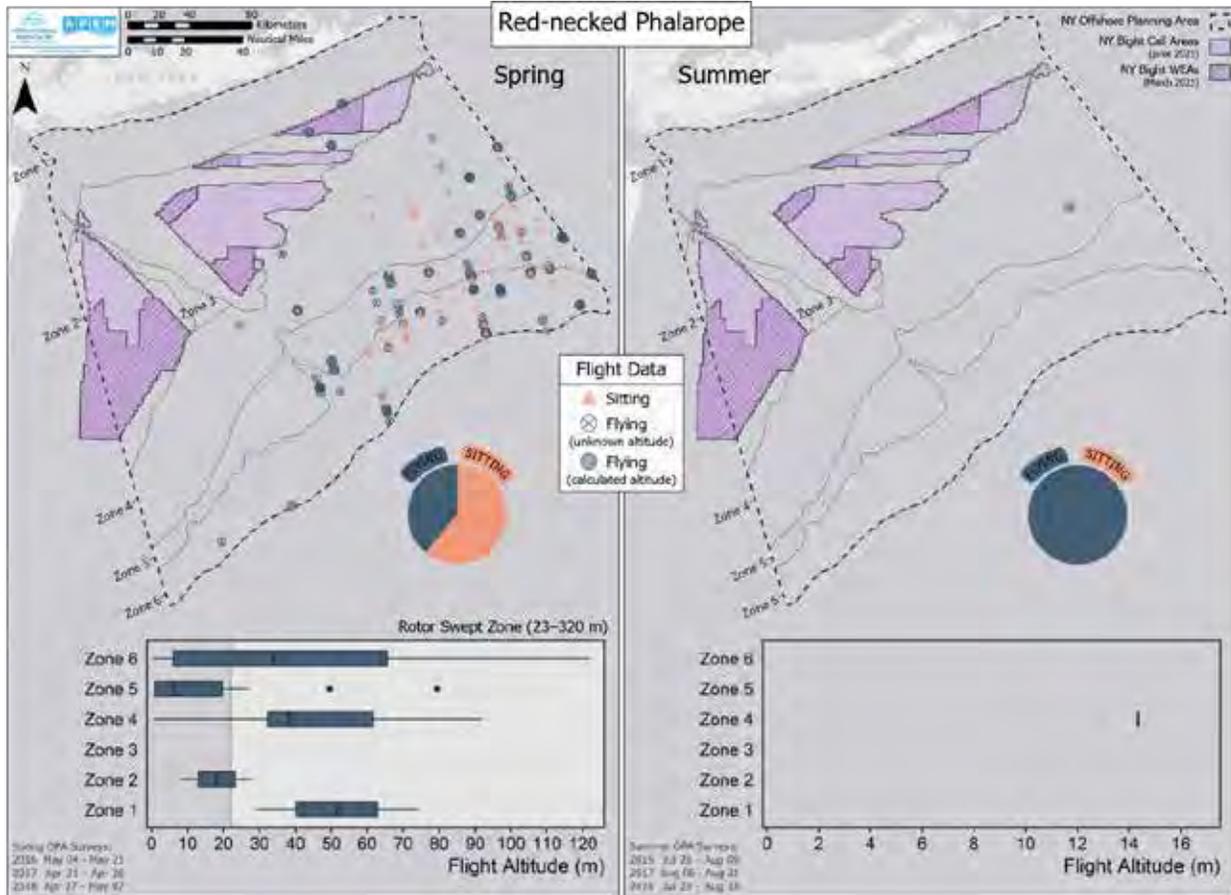


Figure 144. Direction of Flight of Red-necked Phalarope for All Surveys

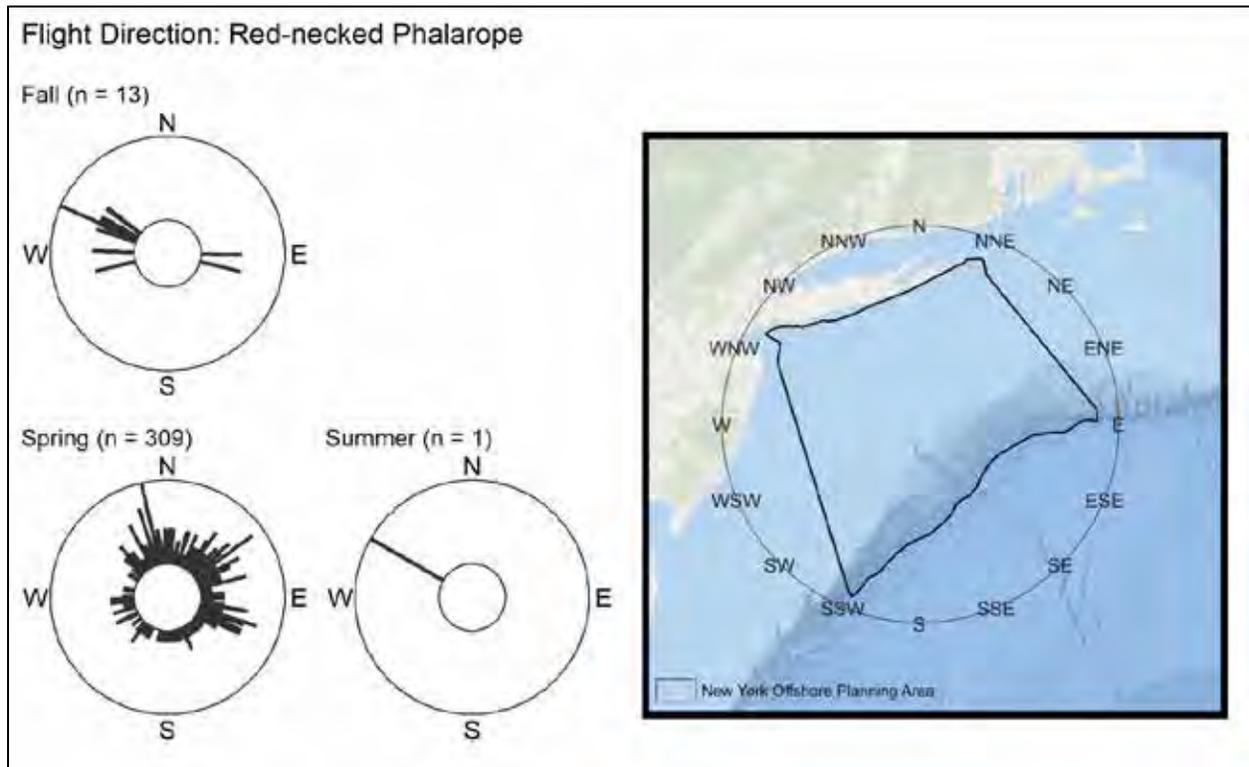


Figure 145. Spatial Distribution of Red Phalarope During Fall and Winter by Zone and Proximity to Call Areas

Heat map is scaled to the maximum density for the species/species group across all seasons. Inset bar plots display mean estimated densities \pm standard error of the mean for each zone.

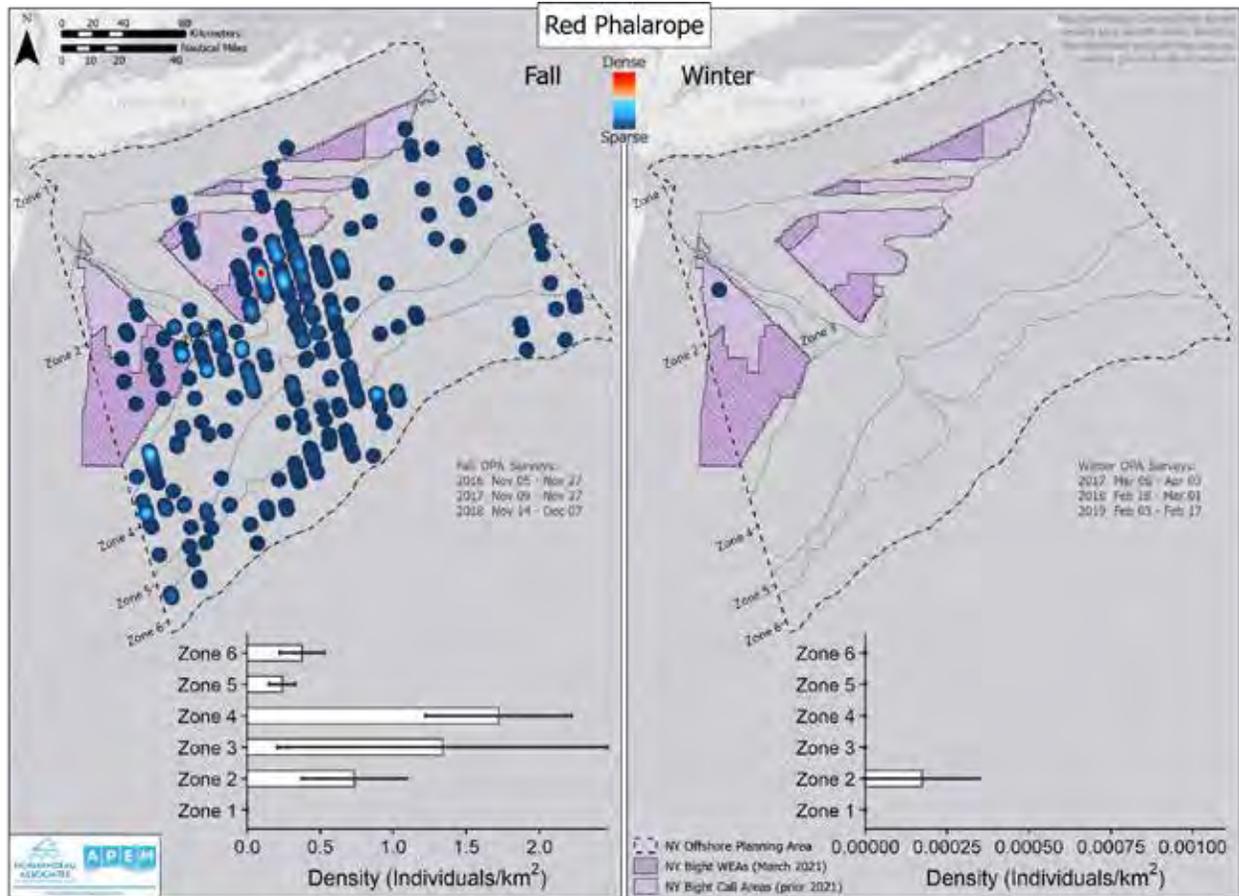


Figure 146. Spatial Distribution of Red Phalarope During Spring and Summer by Zone and Proximity to Call Areas

Heat map is scaled to the maximum density for the species/species group across all seasons. Inset bar plots display mean estimated densities \pm standard error of the mean for each zone.

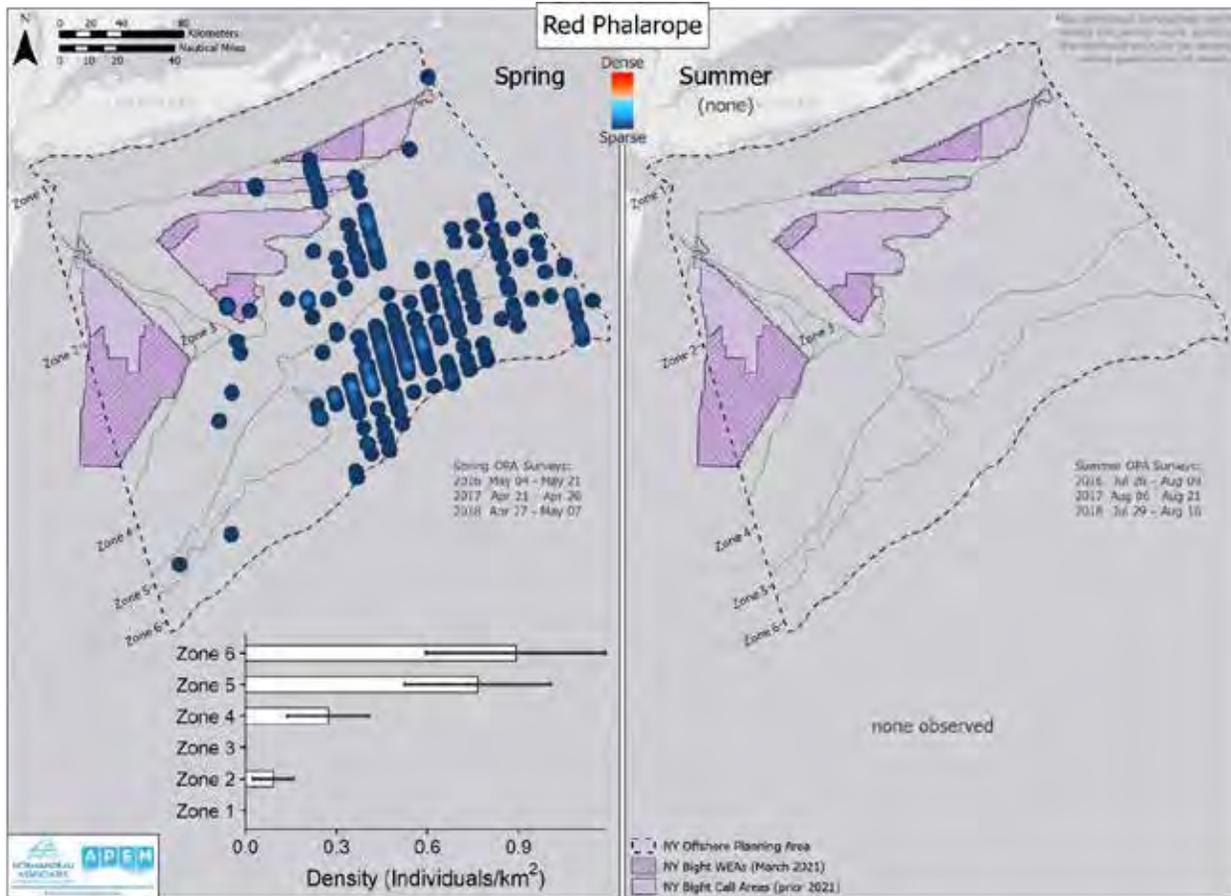


Figure 147. Spatial Distribution of Red Phalarope Sitting Relative to Birds in Flight During Fall and Winter Surveys

Solid blue points represent individuals with calculated flight height and blue points with an x represent individuals in flight without flight height data. A pie chart inset shows the proportion of individuals flying and sitting. A boxplot inset of flight height distribution by zone is displayed for all birds with known flight heights. Boxplots show the distribution of data among seasons. The dark horizontal line is the median flight height, and the box represents the middle 50% of data values. The lines to the left and right of the box represent the data points that are within 1.5 times the length of the box. Data beyond this range are shown as individual points.

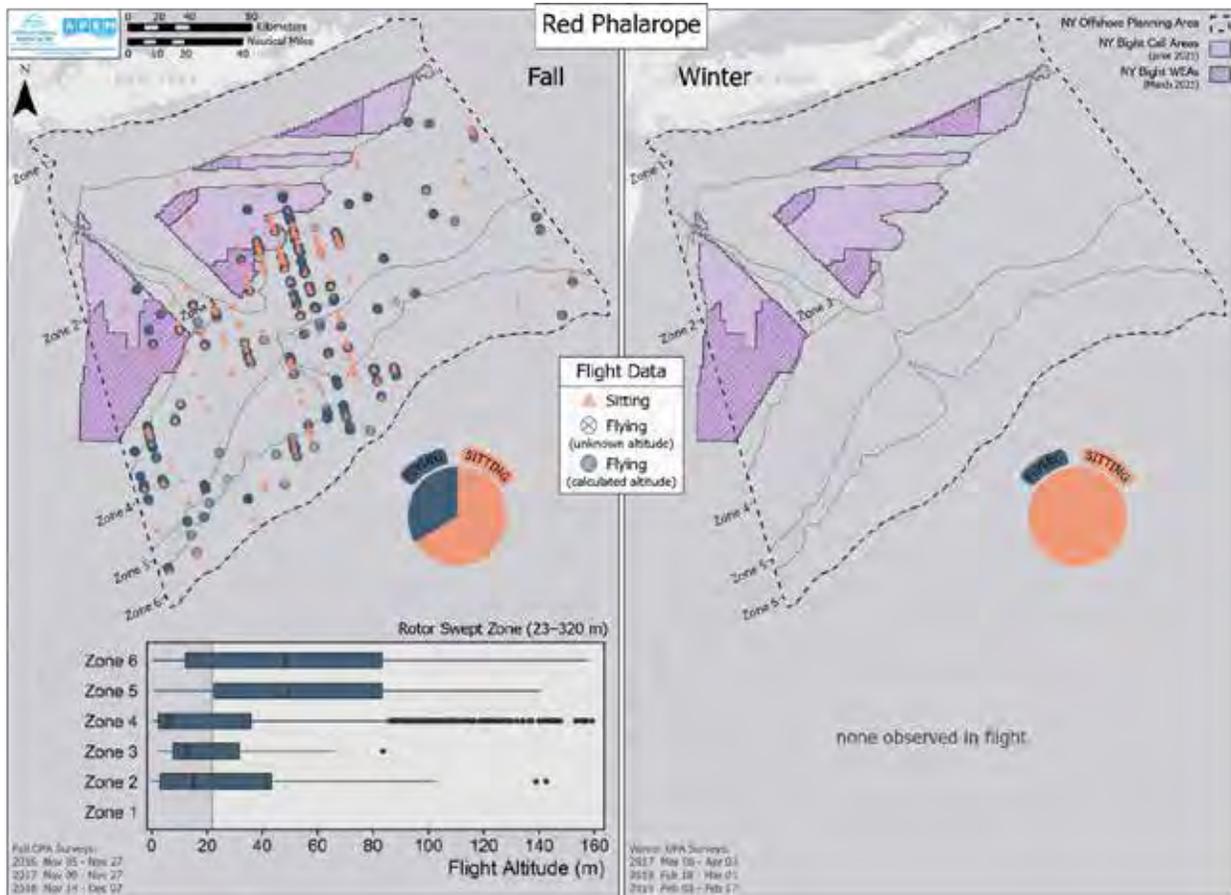


Figure 148. Spatial Distribution of Red Phalarope Sitting Relative to Birds in Flight During Spring and Summer Surveys

Solid blue points represent individuals with calculated flight height and blue points with an x represent individuals in flight without flight height data. A pie chart inset shows the proportion of individuals flying and sitting. A boxplot inset of flight height distribution by zone is displayed for all birds with known flight heights. Boxplots show the distribution of data among seasons. The dark horizontal line is the median flight height, and the box represents the middle 50% of data values. The lines to the left and right of the box represent the data points that are within 1.5 times the length of the box. Data beyond this range are shown as individual points.

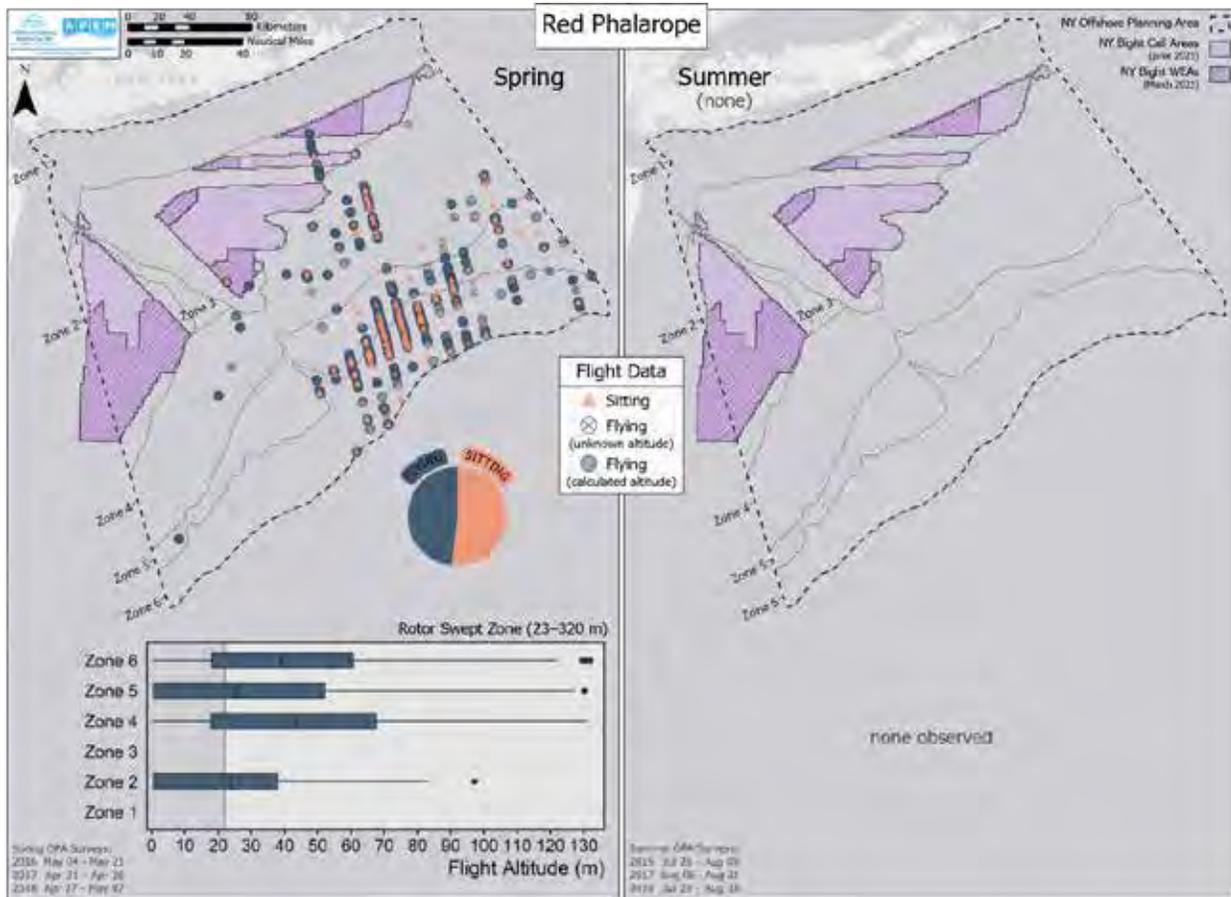
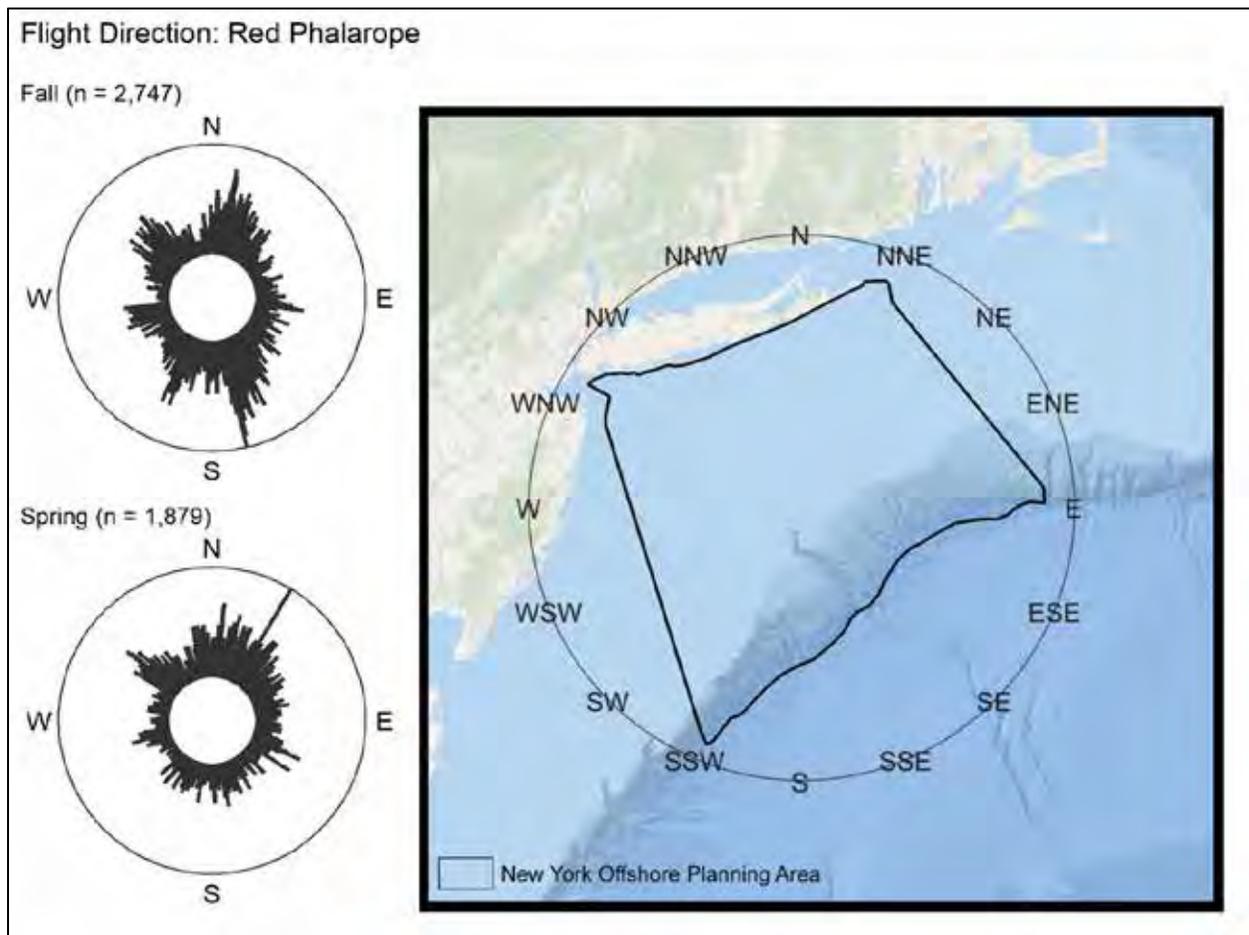


Figure 149. Direction of Flight of Red Phalarope for All Surveys



2.5.19 Skua

The skua taxonomic grouping included individuals classified as great skua (n=7), parasitic jaeger (n=17), pomarine jaeger (n=2), and south polar skua (n=2) (Figure 150). Another nine skua were identified as skua-species unknown. Overall skua density throughout the OPA was low but at least one individual was observed during each season (Appendix B, Figure 151, Figure 152). In Fall 11 skua were observed with four in flight. Three birds flew within the RSZ and one flew below (Figure 151). In Winter seven skua were observed in the outer three zones, six of which were flying at heights ranging between one and 35 m (Figure 152). In Spring 18 skua were observed, 15 of which were flying at heights approximately ranging between 15 and 148 m (Figure 153). In Summer one skua was seen flying north through Zone 4 (Figure 154).

Figure 150. Spatial Distribution of Skua Species with Fewer than 30 Occurrences Across All Surveys

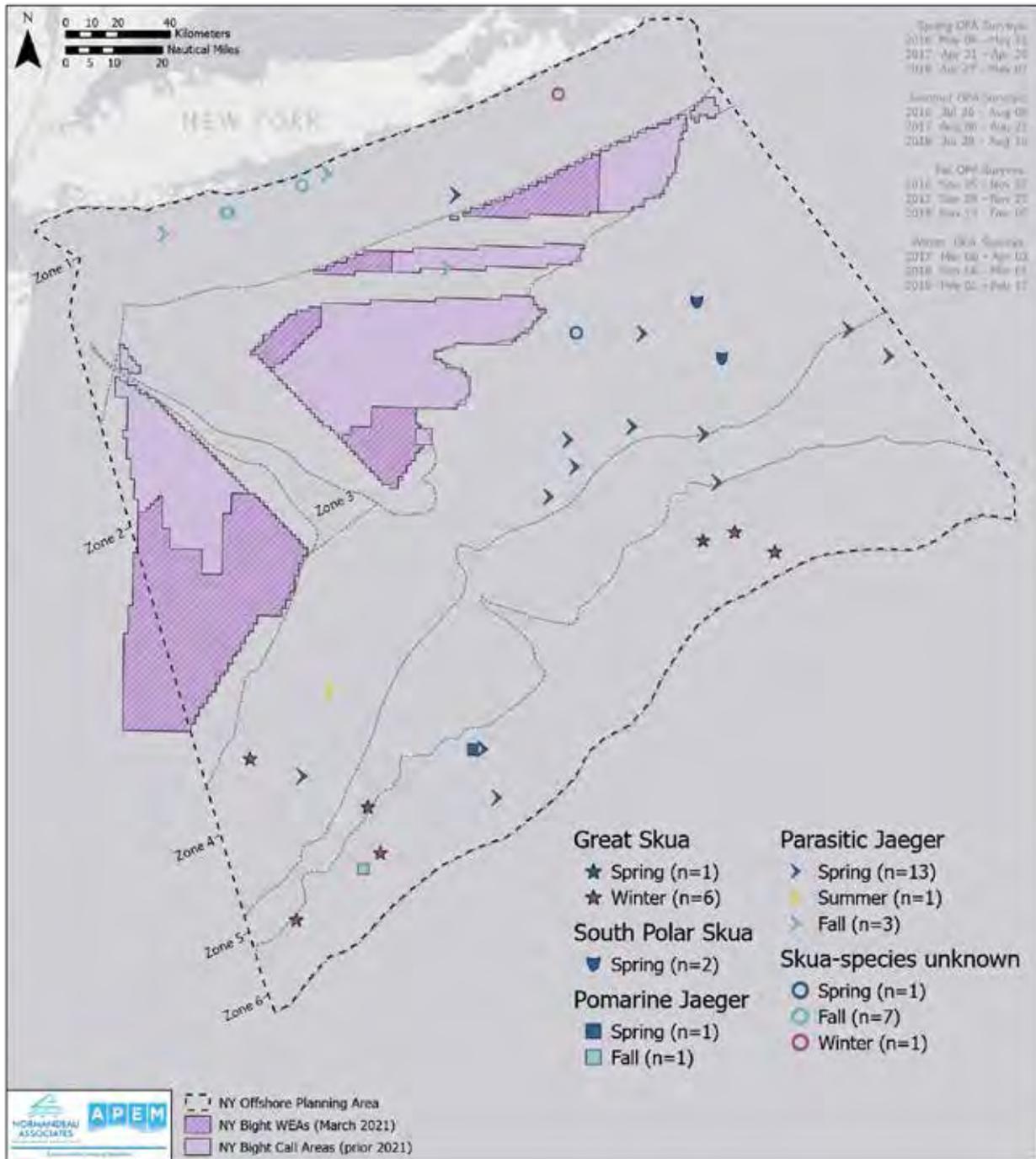


Figure 151. Spatial Distribution of Skua During Fall and Winter by Zone and Proximity to Call Areas

Heat map is scaled to the maximum density for the species/species group across all seasons. Inset bar plots display mean estimated densities \pm standard error of the mean for each zone.

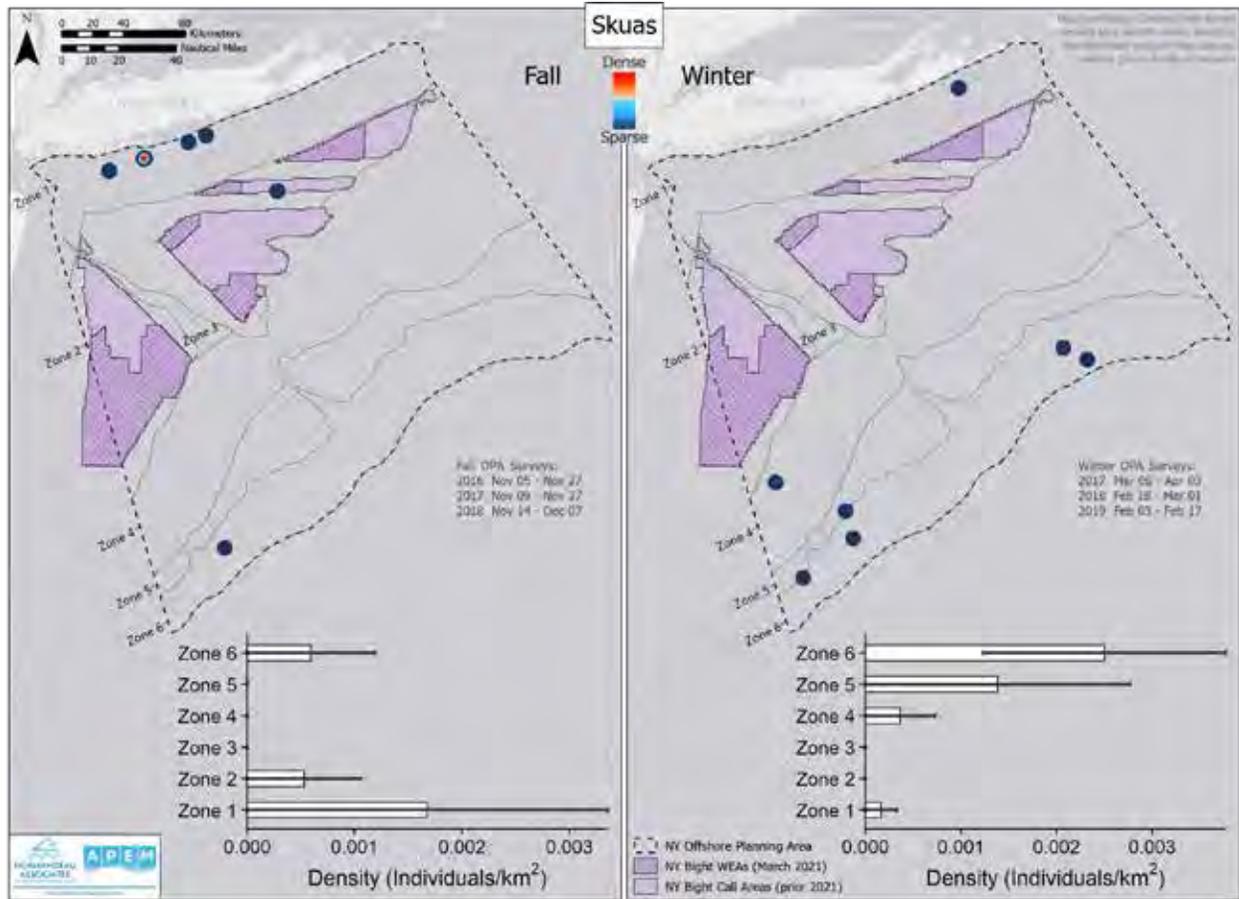


Figure 152. Spatial Distribution of Skua During Spring and Summer by Zone and Proximity to Call Areas

Heat map is scaled to the maximum density for the species/species group across all seasons. Inset bar plots display mean estimated densities \pm standard error of the mean for each zone.

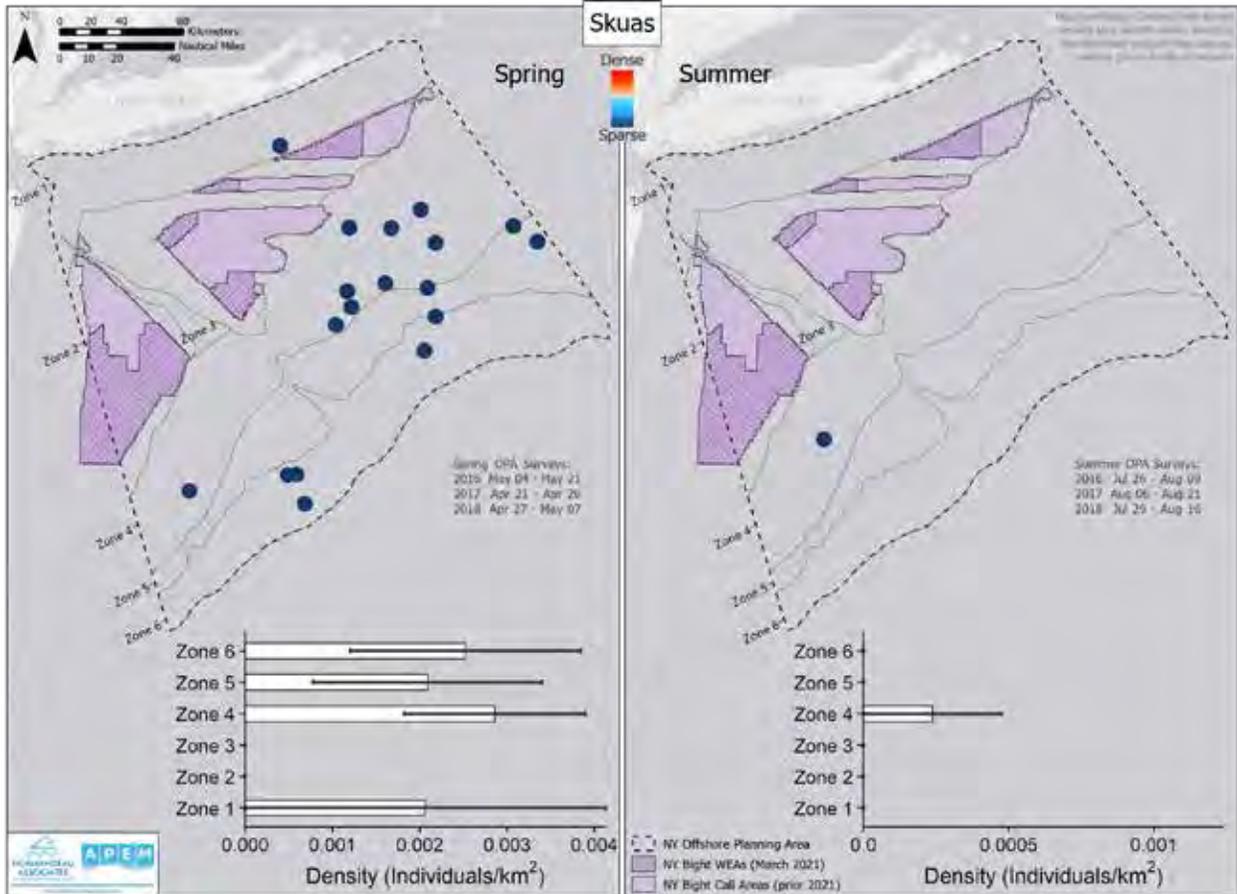


Figure 153. Spatial Distribution of Skua Sitting Relative to Birds in Flight During Fall and Winter Surveys

Solid blue points represent individuals with calculated flight height and blue points with an x represent individuals in flight without flight height data. A pie chart inset shows the proportion of individuals flying and sitting. A boxplot inset of flight height distribution by zone is displayed for all birds with known flight heights. Boxplots show the distribution of data among seasons. The dark horizontal line is the median flight height, and the box represents the middle 50% of data values. The lines to the left and right of the box represent the data points that are within 1.5 times the length of the box. Data beyond this range are shown as individual points.

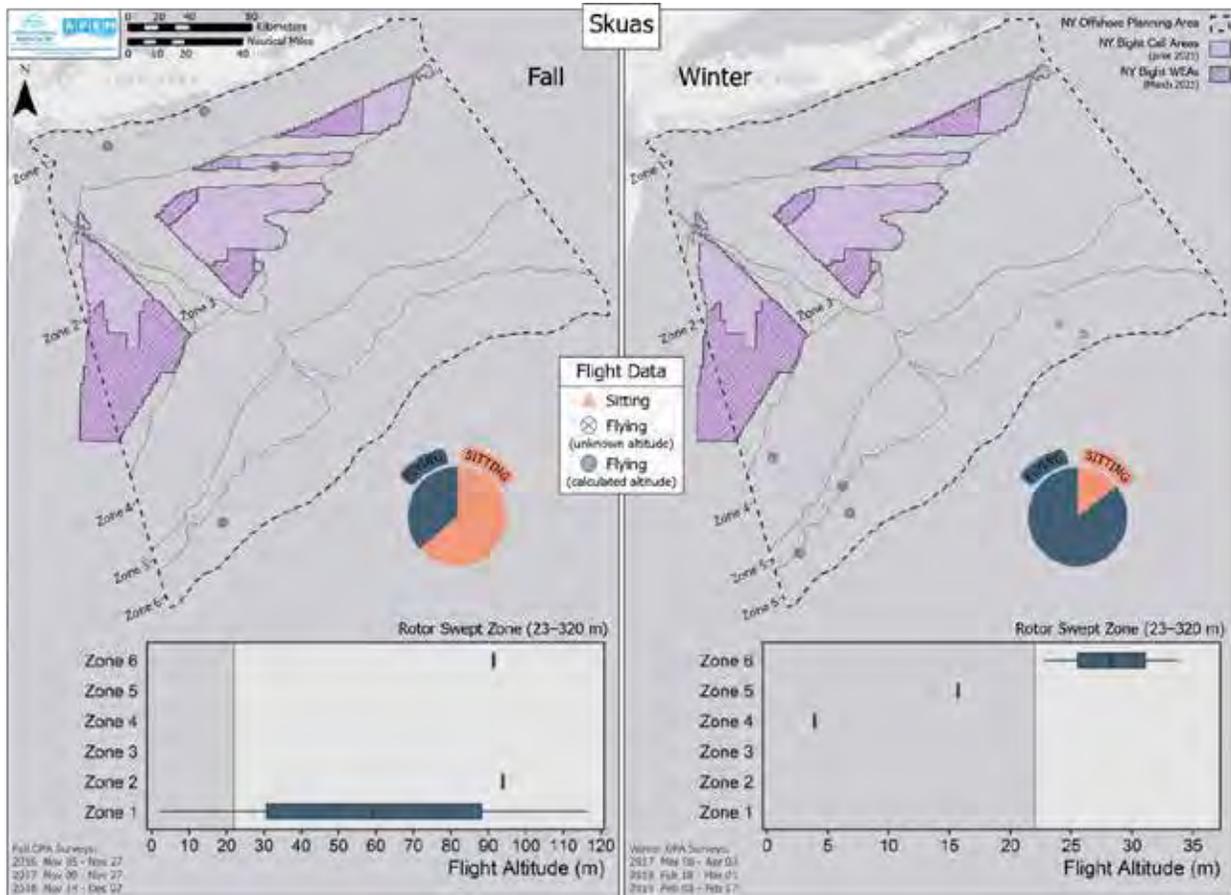
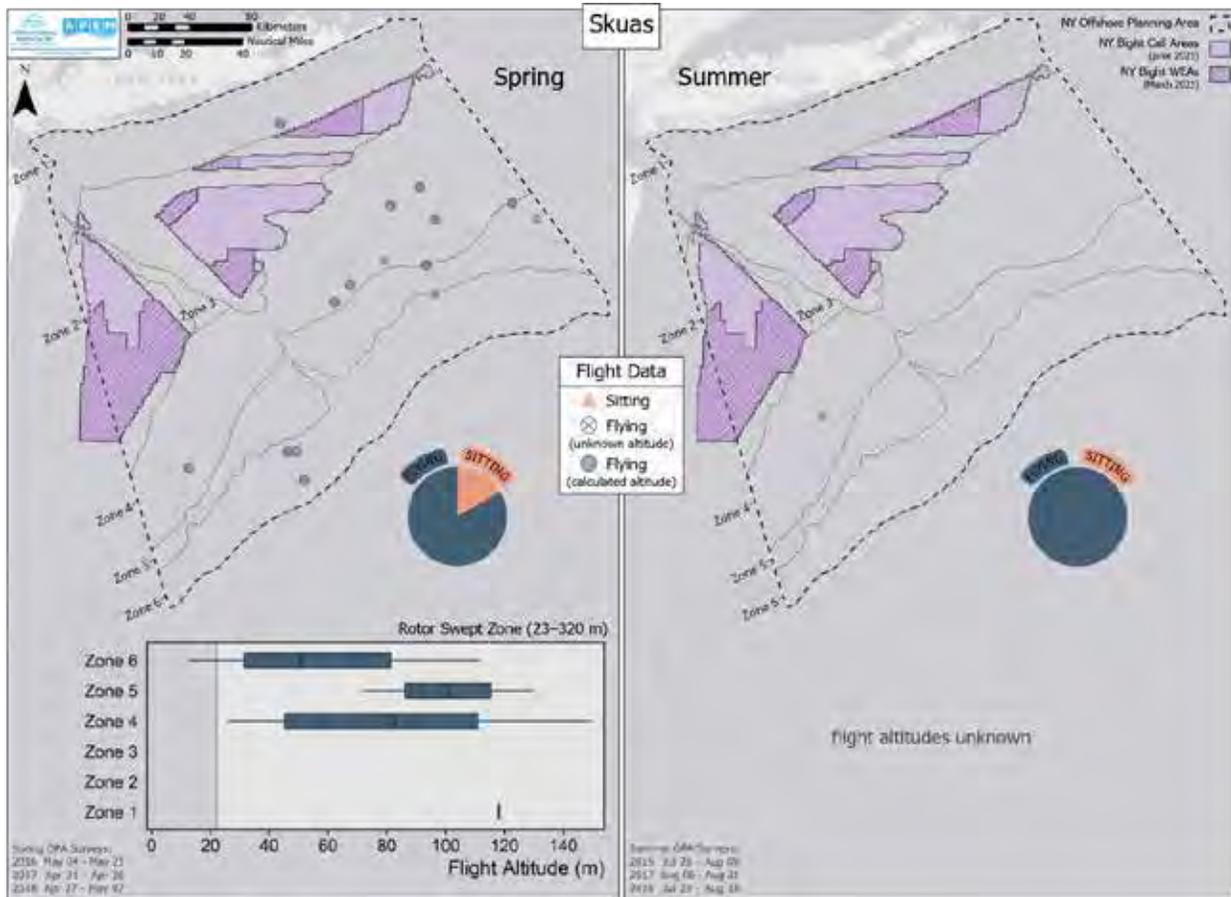


Figure 154. Spatial Distribution of Skua Sitting Relative to Birds in Flight During Spring and Summer Surveys

Solid blue points represent individuals with calculated flight height and blue points with an x represent individuals in flight without flight height data. A pie chart inset shows the proportion of individuals flying and sitting. A boxplot inset of flight height distribution by zone is displayed for all birds with known flight heights. Boxplots show the distribution of data among seasons. The dark horizontal line is the median flight height, and the box represents the middle 50% of data values. The lines to the left and right of the box represent the data points that are within 1.5 times the length of the box. Data beyond this range are shown as individual points.



2.5.20 Auk

Across three years of surveys, 18,740 auks were observed. Species classifications included auk-species unknown (n=835), dovekie (n=2,887), common murre (n=11), common murre/thick-billed murre (n=168), razorbill (n=2,717), murre/razorbill (n=8,074), black guillemot (n=9), and Atlantic puffin (n=4,039). Mean auk density was greatest during Winter surveys (n=12,331; $\bar{x} = 1.24 \pm 0.15$ birds/km²), twice as high as Spring, which had the second greatest mean density (n=4,526; $\bar{x} = 0.61 \pm 0.12$ birds/km²), followed by Fall (n=1,879; $\bar{x} = 0.18 \pm 0.05$ birds/km²) and Summer (n=4; $\bar{x} < 0.001$ birds/km²) (Appendix B, Figure 155, Figure 156).

In Winter, when auk density is highest, individuals concentrate in Zone 4 (n=6,269; $\bar{x} = 2.24 \pm 0.56$ birds/km²), and in Fall, mean auk density in Zones 2 and 4 was greater than the mean density for the OPA (Figure 155). In Spring, Zone 1 had the greatest concentration of auk (n=1,699; $\bar{x} = 1.52 \pm 0.59$ birds/km²) (Figure 156).

The vast majority of auk (97%) observations were of sitting individuals (Figure 157, Figure 158). In Winter, 3% of birds were in flight and only those flying within Zone 1 had a median flight height below the RSZ (Figure 157). During Fall, 6% of birds were in flight with no pattern of flight headings and median flight heights per zone ranging between 15 and 43 m (Figure 157, Figure 159). In Spring, 2% had median flight heights per zone ranging between one and 38 m (Figure 158).

2.5.20.1 Dovekie

Dovekie were frequently observed during Winter surveys (n=2,815; $\bar{x} = 0.25 \pm 0.04$ birds/km²) and relatively uncommon during Fall (n=13) and Spring (n=59) (Appendix B, Figure 160, Figure 161). In Winter, dovekie were more dense in the outer zones and most dense in Zone 4 (n=1,384; $\bar{x} = 0.46 \pm 0.15$ birds/km²) (Figure 160). During Fall and Spring all individuals were observed sitting, and during Winter only 3% were in flight (Figure 162, Figure 163, Figure 164). The flight altitude of the 83 flying individuals ranged between one and 153 m (Figure 162).

2.5.20.2 Murre/Razorbill

Overall, 8,074 targets were classified as murre/razorbill. Murre/razorbill were most frequently observed during the Winter (n=3,593), followed by Spring (n=2,726) and Fall (n=1,753) (Appendix B, Figure 165, Figure 166). During Summer, murre/razorbill were mostly absent (n=2). In Fall, murre/razorbill were

distributed throughout the northeastern portion of the OPA with the greatest density of individuals occurring in Zone 4 ($n=1,321$; $\bar{x} = 0.33 \pm 0.16$ birds/km²) (Figure 165). In Winter and Spring, individuals were more widely spread throughout the OPA than in Fall, and in both Winter and Spring, individuals concentrated in Zone 1 (Figure 165, Figure 166).

Three percent of birds were observed flying at heights ranging between four and 70 m (Figure 167, Figure 168). Median flight height per zone was mixed ranging between one and 54 m with most birds flying above the RSZ (Figure 167, Figure 168). Direction of flight for all surveys for murre/razorbill is presented in Figure 169.

2.5.20.3 Razorbill

Razorbill were most frequently observed during Winter surveys ($n=2,097$; $\bar{x} = 0.23 \pm 0.05$ birds/km²) and were nearly three times denser in Zone 4 ($1,333$; $\bar{x} = 0.62 \pm 0.25$ birds/km²) compared to the average OPA mean density (Figure 170). In Spring, razorbill ($n=594$; $\bar{x} = 0.06 \pm 0.024$ birds/km²) were concentrated in Zones 1 and 2 (Figure 171).

Razorbill were similar to the other auk species in that overall only 3% were observed in flight (Figure 172, Figure 173). In Fall, four of 26 birds were in flight with no pattern of flight headings and no associated flight height data (Figure 172, Figure 174). In Winter, 4% of birds were in flight ranging between one and 110 m above sea level (Figure 172). In Spring, only three of 594 individuals were observed in flight (Figure 173), and in Summer, no razorbill were observed (Figure 173).

2.5.20.4 Atlantic Puffin

Atlantic puffin density was greatest during the Winter ($n=3,108$; $\bar{x} = 0.30 \pm 0.04$ birds/km²) followed by Spring ($n=900$; $\bar{x} = 0.08 \pm 0.01$ birds/km²), Fall ($n=31$; $\bar{x} = 0.003 \pm 0.0008$ birds/km²), and Summer ($n=0$) (Appendix B, Figure 175, Figure 176). In both Winter and Spring, mean density was greatest in Zones 4 and 5 (Figure 175, Figure 176). Across all seasons, Atlantic puffin were observed sitting 99% of the time (Figure 177, Figure 178). During Winter, less than 1% of Atlantic puffin were observed in flight. The 31 individuals observed in flight had a slight pattern of southeasterly flight headings (Figure 179).

2.5.20.5 Auk Species with Fewer than 30 Observations

Common murre (n=11) and black guillemot (n=9) were relatively uncommon species classifications. Common murre were observed in the northernmost extent of Zone 2, and black guillemot were observed in Zone 1 and 2 (Figure 180).

Figure 155. Spatial Distribution of Auk During Fall and Winter by Zone and Proximity to Call Areas

Heat map is scaled to the maximum density for the species/species group across all seasons. Inset bar plots display mean estimated densities \pm standard error of the mean for each zone.

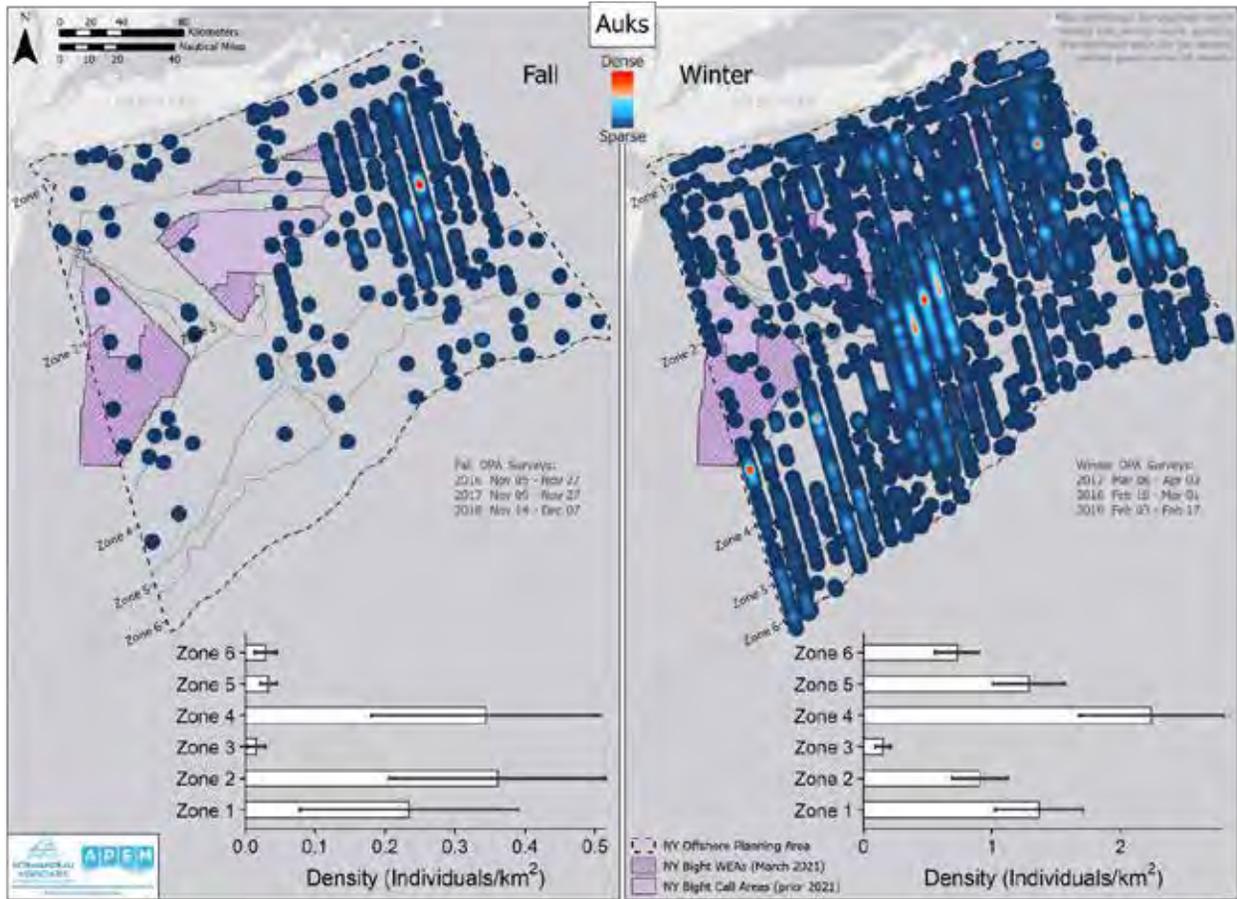


Figure 156. Spatial Distribution of Auk During Spring and Summer by Zone and Proximity to Call Areas

Heat map is scaled to the maximum density for the species/species group across all seasons. Inset bar plots display mean estimated densities \pm standard error of the mean for each zone.

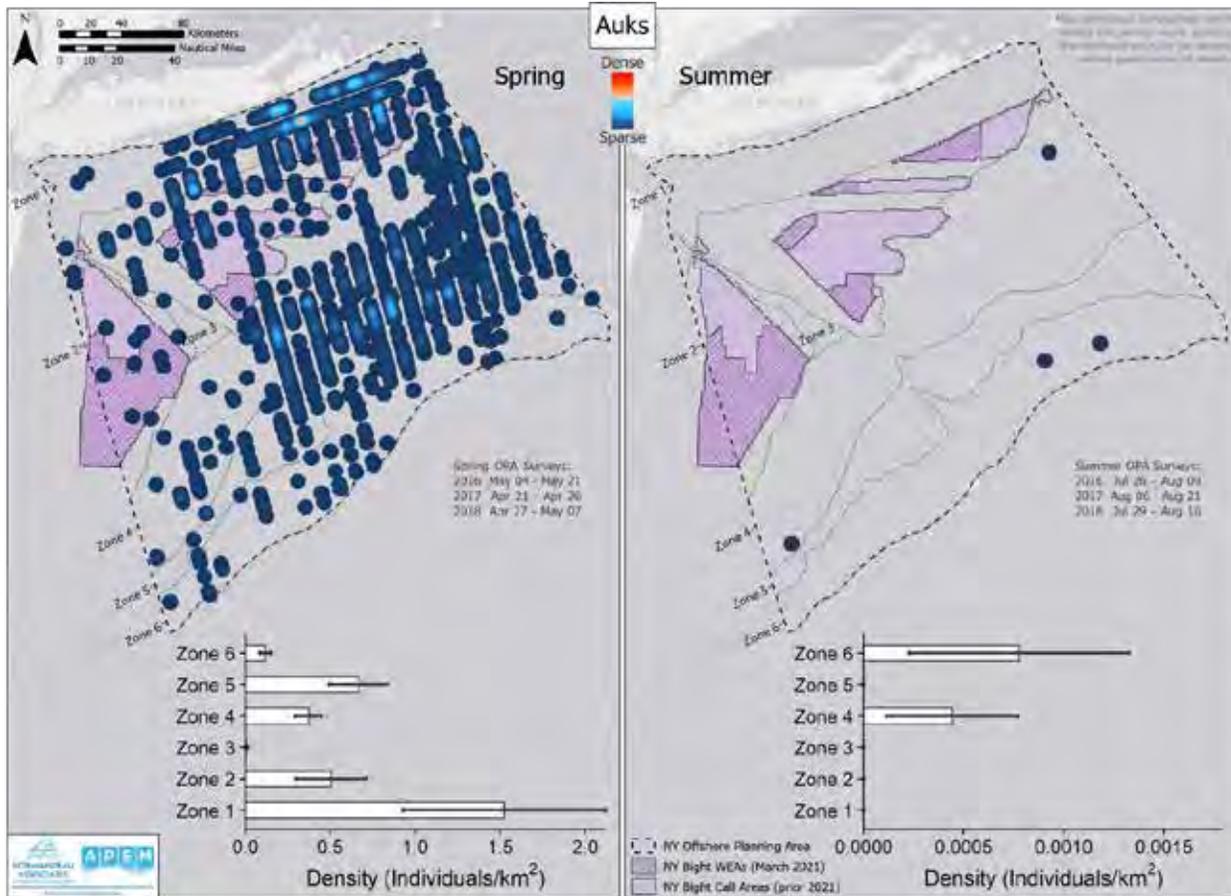


Figure 157. Spatial Distribution of Auk Sitting Relative to Birds in Flight During Fall and Winter Surveys

Solid blue points represent individuals with calculated flight height and blue points with an x represent individuals in flight without flight height data. A pie chart inset shows the proportion of individuals flying and sitting. A boxplot inset of flight height distribution by zone is displayed for all birds with known flight heights. Boxplots show the distribution of data among seasons. The dark horizontal line is the median flight height, and the box represents the middle 50% of data values. The lines to the left and right of the box represent the data points that are within 1.5 times the length of the box. Data beyond this range are shown as individual points.

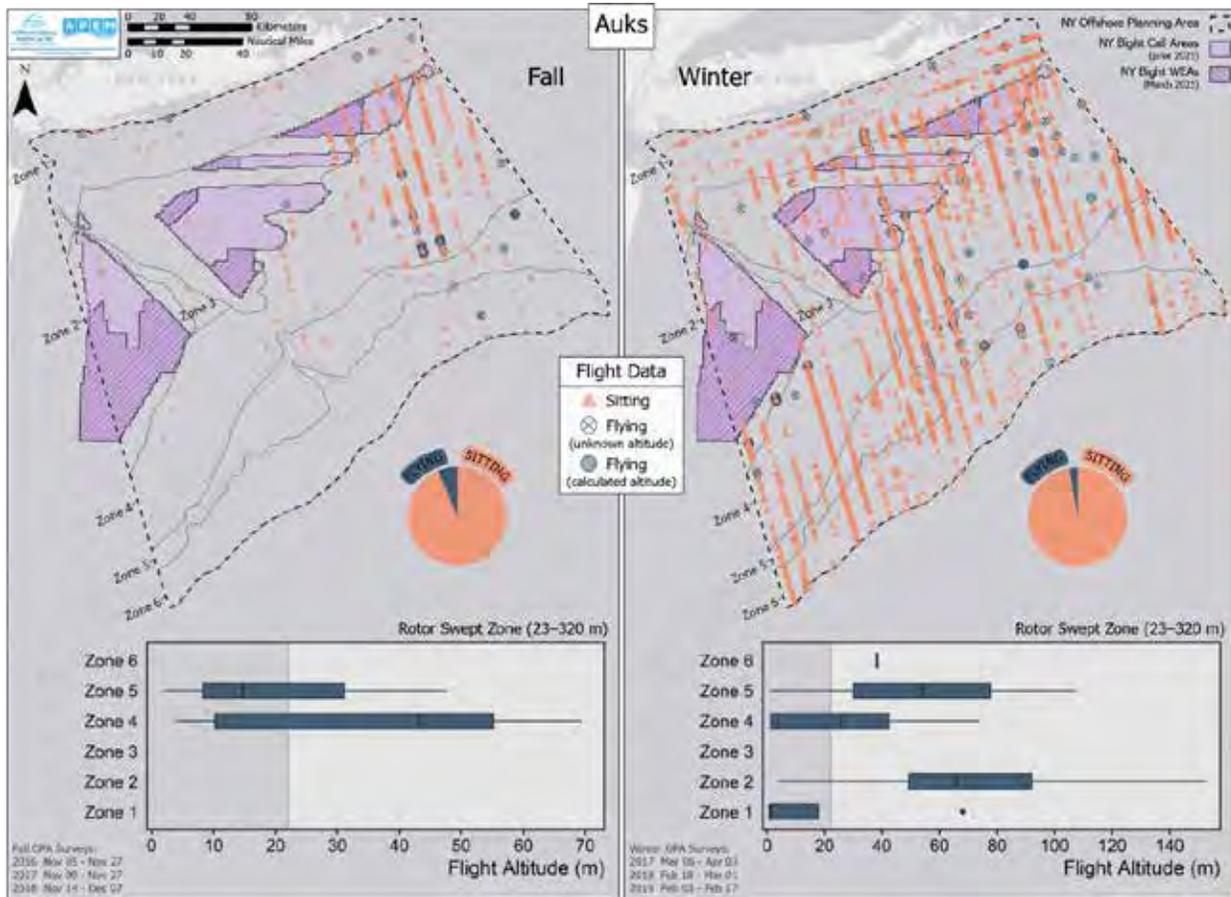


Figure 158. Spatial Distribution of Auk Sitting Relative to Birds in Flight During Spring and Summer Surveys

Solid blue points represent individuals with calculated flight height and blue points with an x represent individuals in flight without flight height data. A pie chart inset shows the proportion of individuals flying and sitting. A boxplot inset of flight height distribution by zone is displayed for all birds with known flight heights. Boxplots show the distribution of data among seasons. The dark horizontal line is the median flight height, and the box represents the middle 50% of data values. The lines to the left and right of the box represent the data points that are within 1.5 times the length of the box. Data beyond this range are shown as individual points.

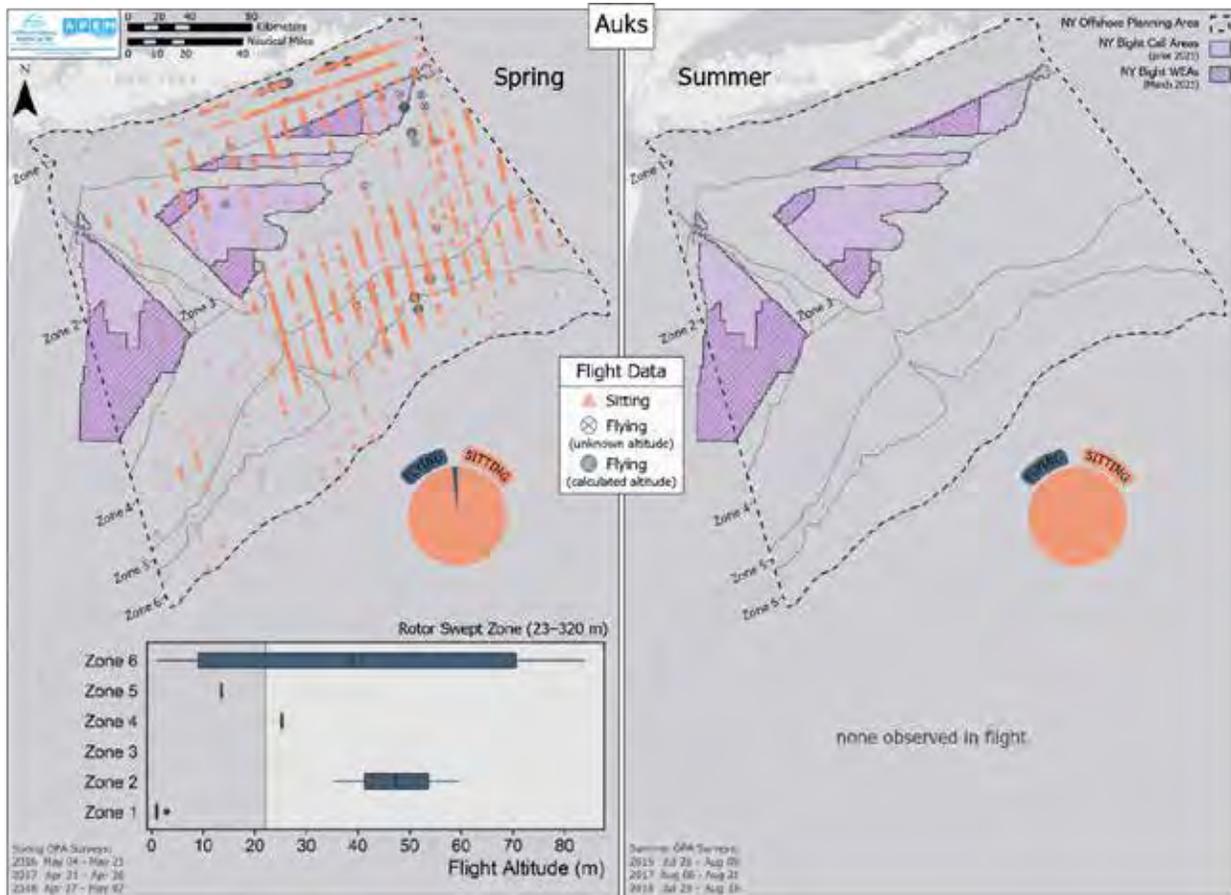


Figure 159. Direction of Flight of Auk for All Surveys

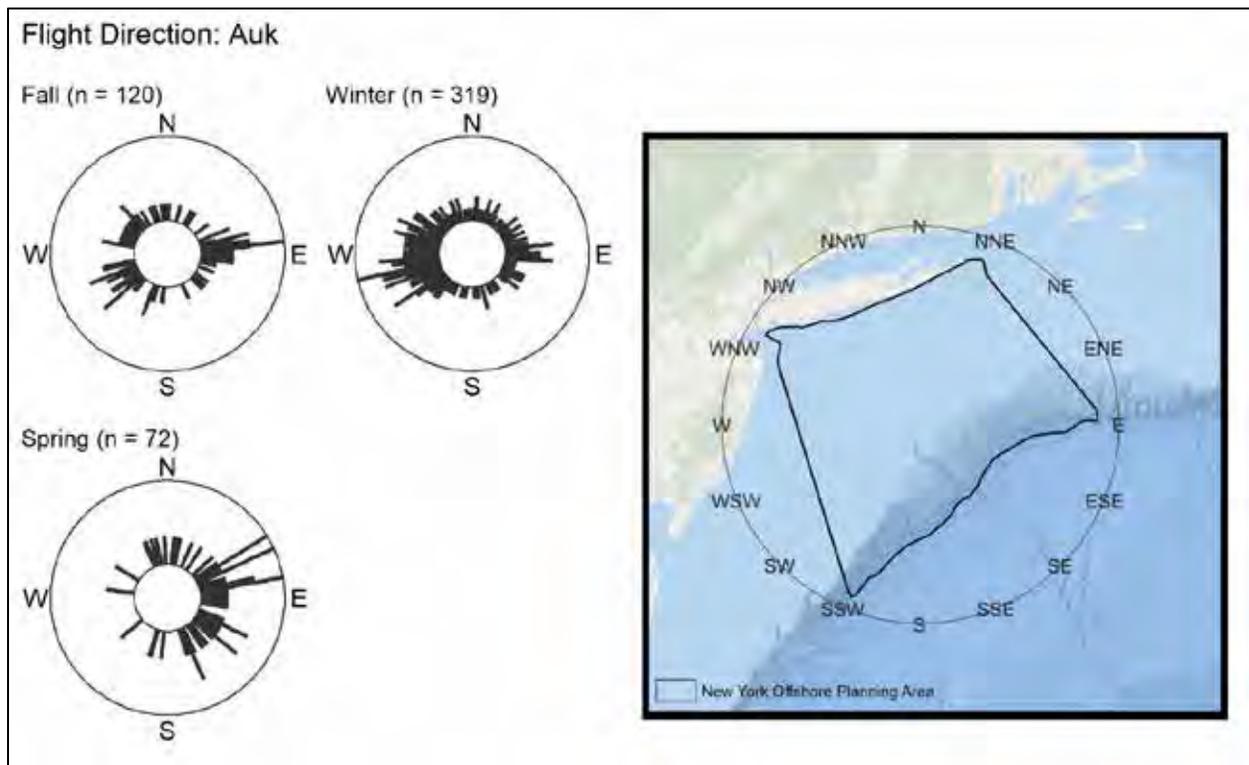


Figure 160. Spatial Distribution of Dovekie During Fall and Winter by Zone and Proximity to Call Areas

Heat map is scaled to the maximum density for the species/species group across all seasons. Inset bar plots display mean estimated densities \pm standard error of the mean for each zone.

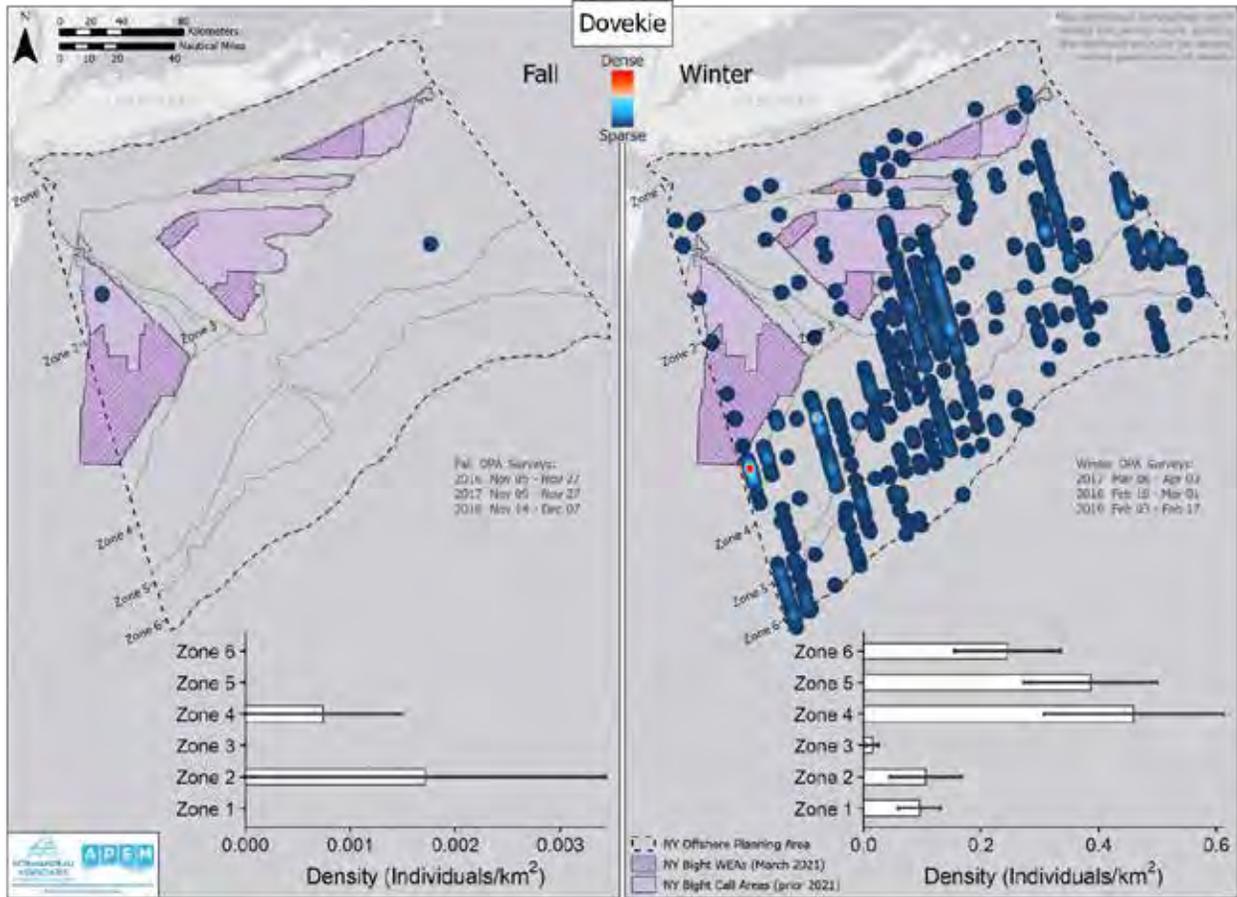


Figure 161. Spatial Distribution of Dovekie During Spring and Summer by Zone and Proximity to Call Areas

Heat map is scaled to the maximum density for the species/species group across all seasons. Inset bar plots display mean estimated densities \pm standard error of the mean for each zone.

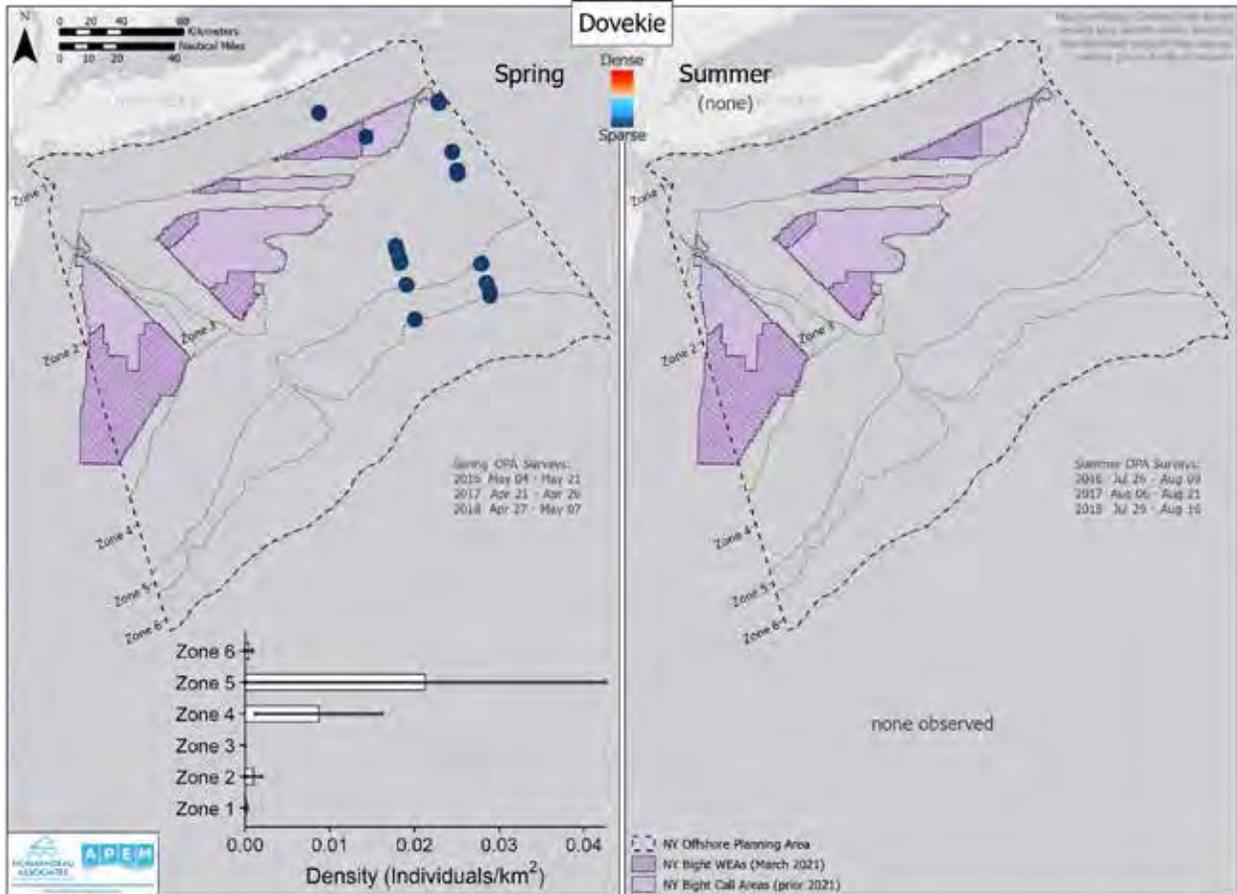


Figure 162. Spatial Distribution of Dovekie Sitting Relative to Birds in Flight During Fall and Winter Surveys

Solid blue points represent individuals with calculated flight height and blue points with an x represent individuals in flight without flight height data. A pie chart inset shows the proportion of individuals flying and sitting. A boxplot inset of flight height distribution by zone is displayed for all birds with known flight heights. Boxplots show the distribution of data among seasons. The dark horizontal line is the median flight height, and the box represents the middle 50% of data values. The lines to the left and right of the box represent the data points that are within 1.5 times the length of the box. Data beyond this range are shown as individual points.

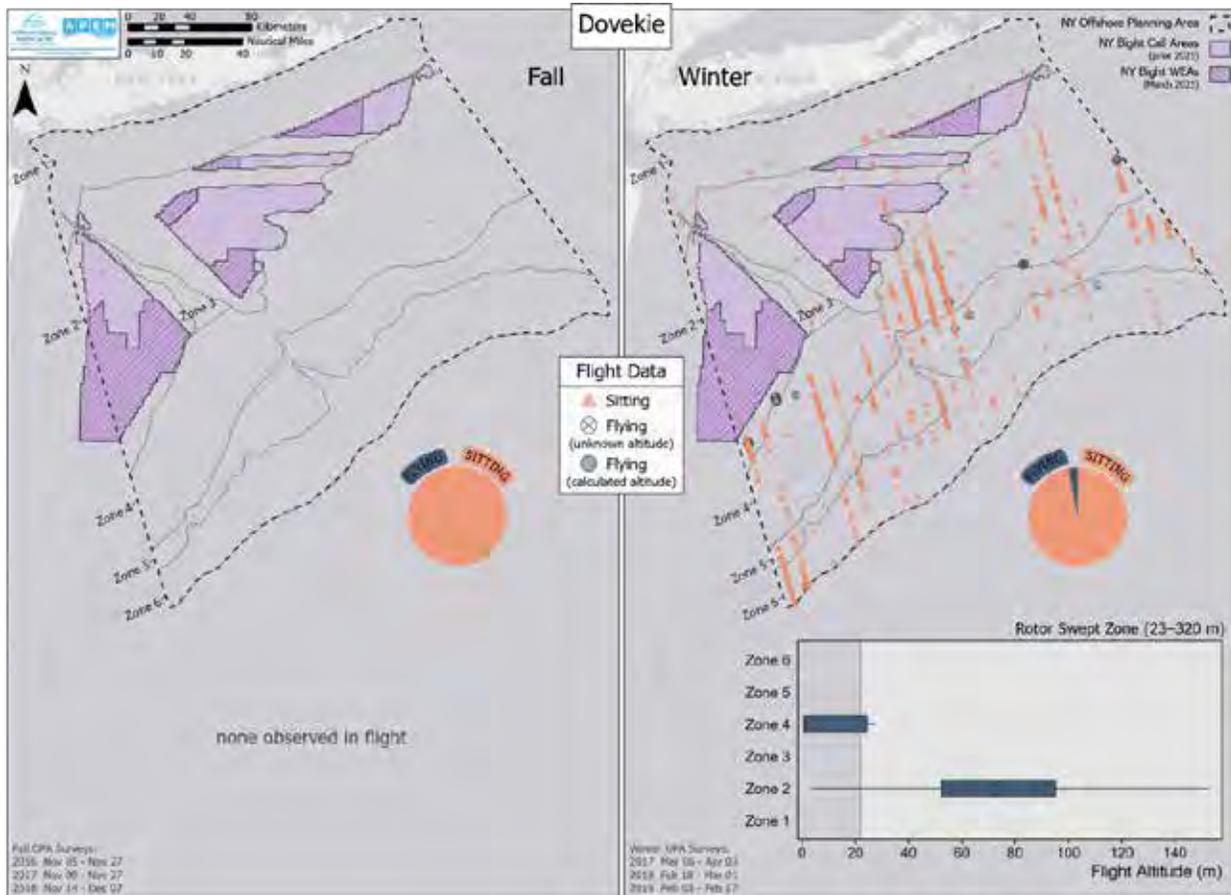


Figure 163. Spatial Distribution of Dovekie Sitting Relative to Birds in Flight During Spring and Summer Surveys

Solid blue points represent individuals with calculated flight height and blue points with an x represent individuals in flight without flight height data. A pie chart inset shows the proportion of individuals flying and sitting.

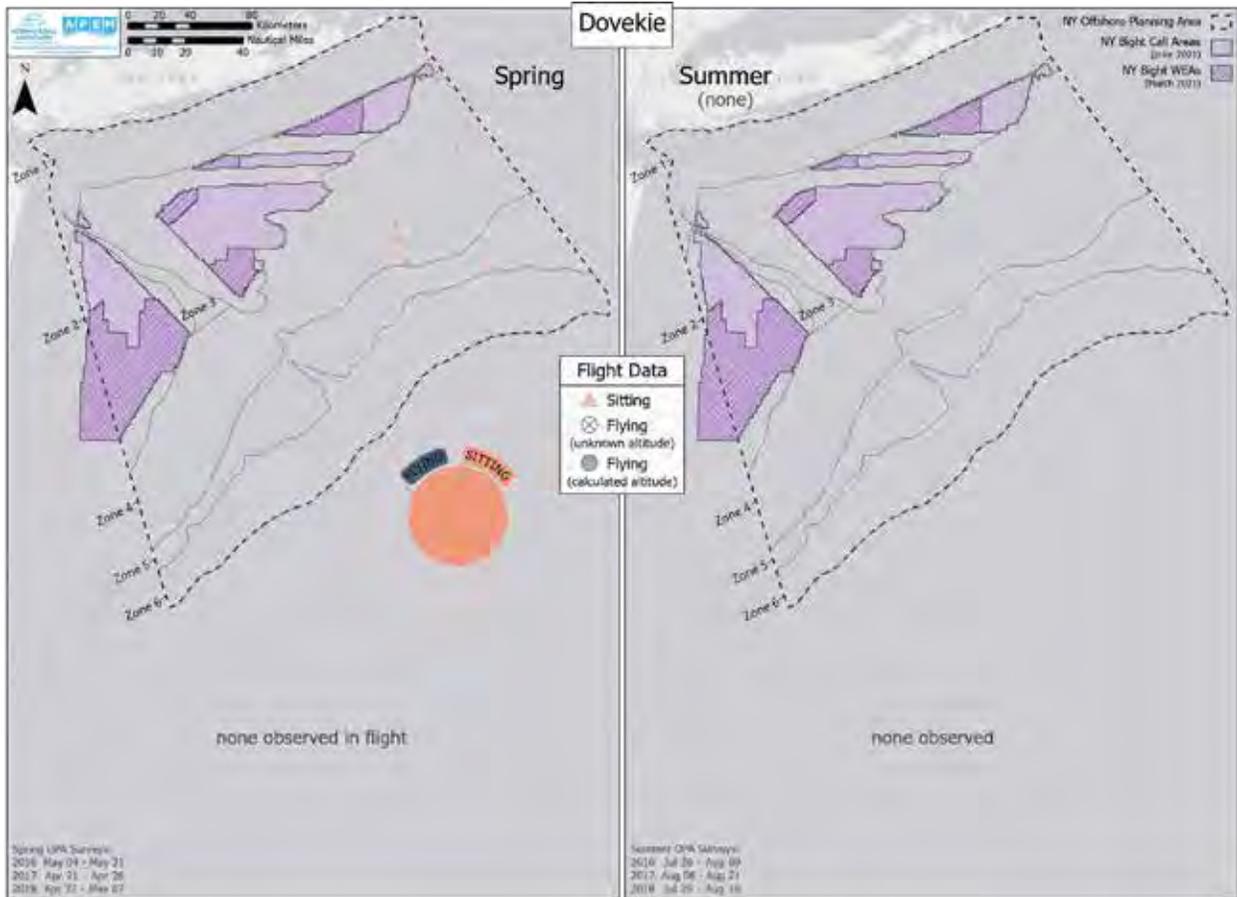


Figure 164. Direction of Flight of Dovekie for All Surveys

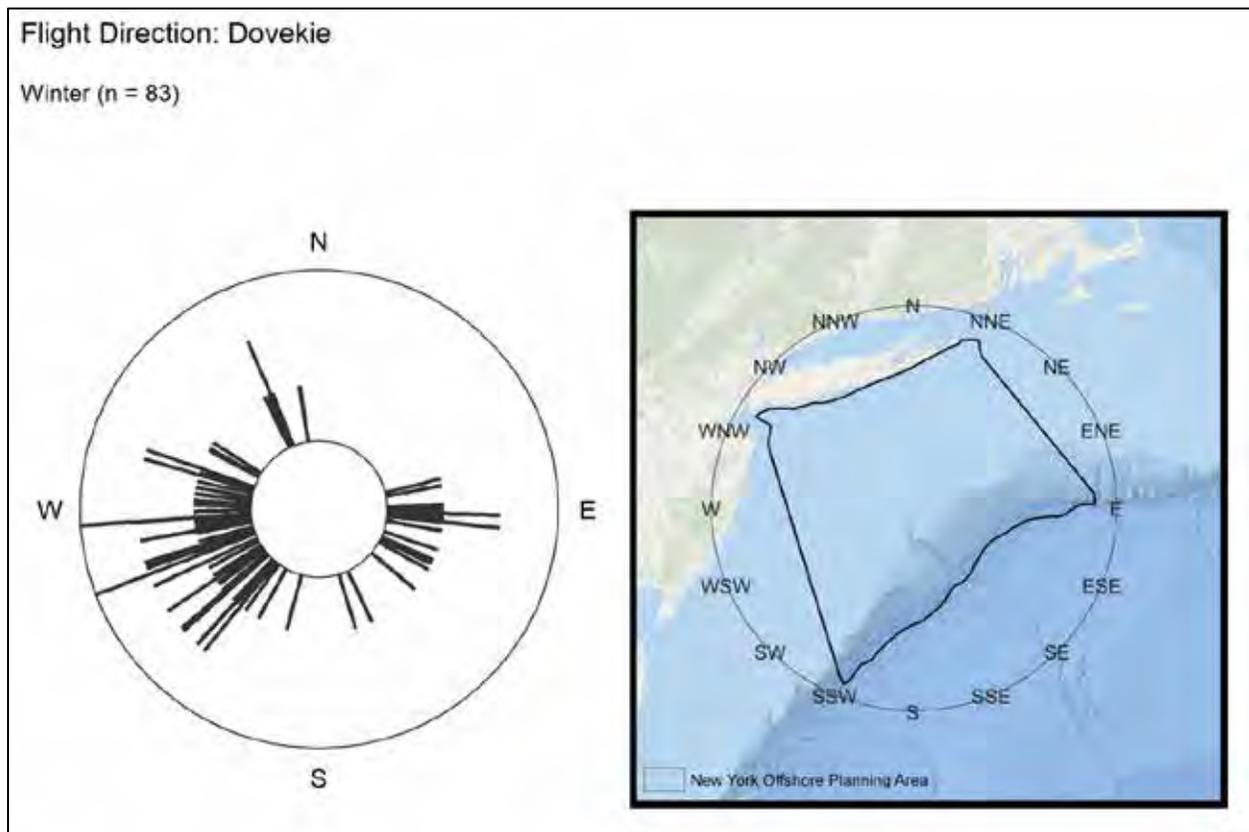


Figure 165. Spatial Distribution of Murre/Razorbill During Fall and Winter by Zone and Proximity to Call Areas

Heat map is scaled to the maximum density for the species/species group across all seasons. Inset bar plots display mean estimated densities \pm standard error of the mean for each zone.

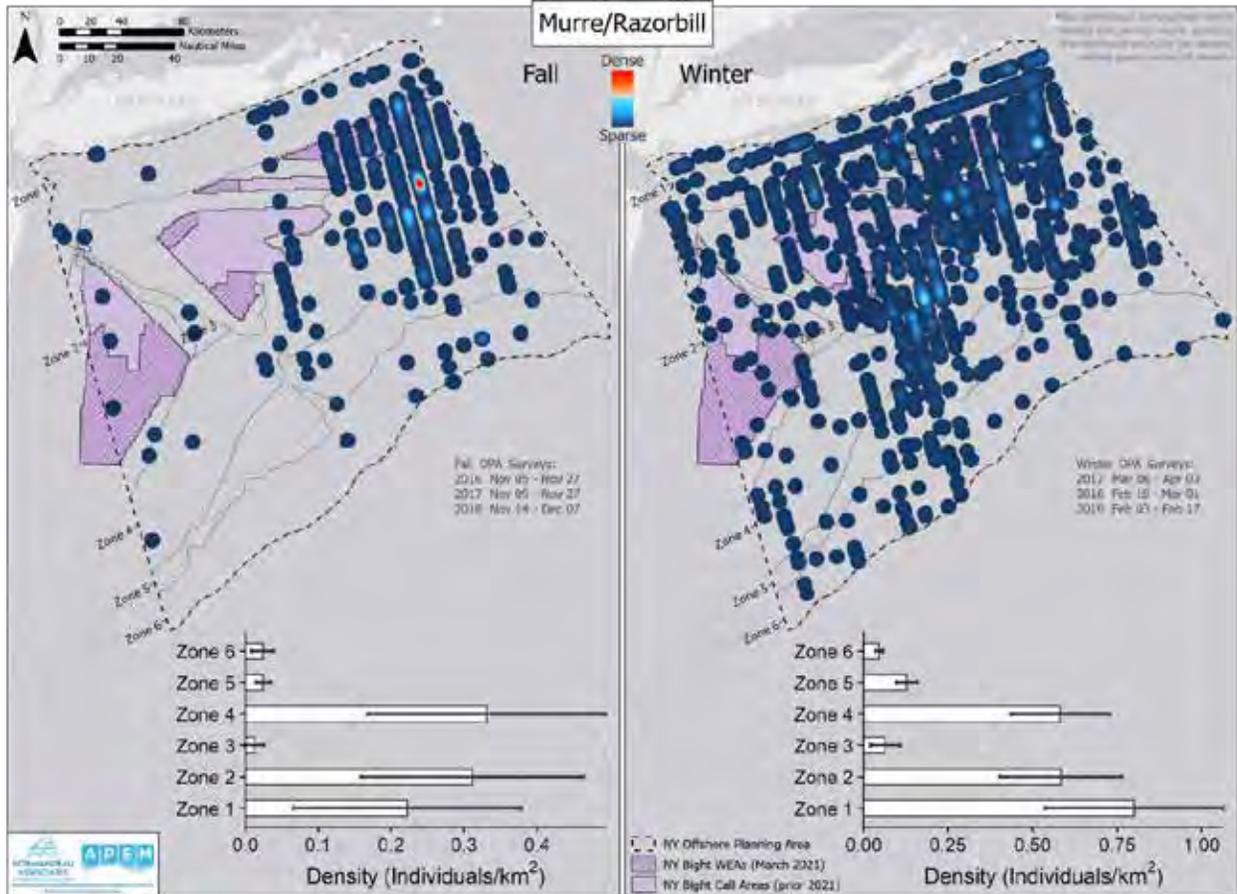


Figure 166. Spatial Distribution of Murre/Razorbill During Spring and Summer by Zone and Proximity to Call Areas

Heat map is scaled to the maximum density for the species/species group across all seasons. Inset bar plots display mean estimated densities \pm standard error of the mean for each zone.

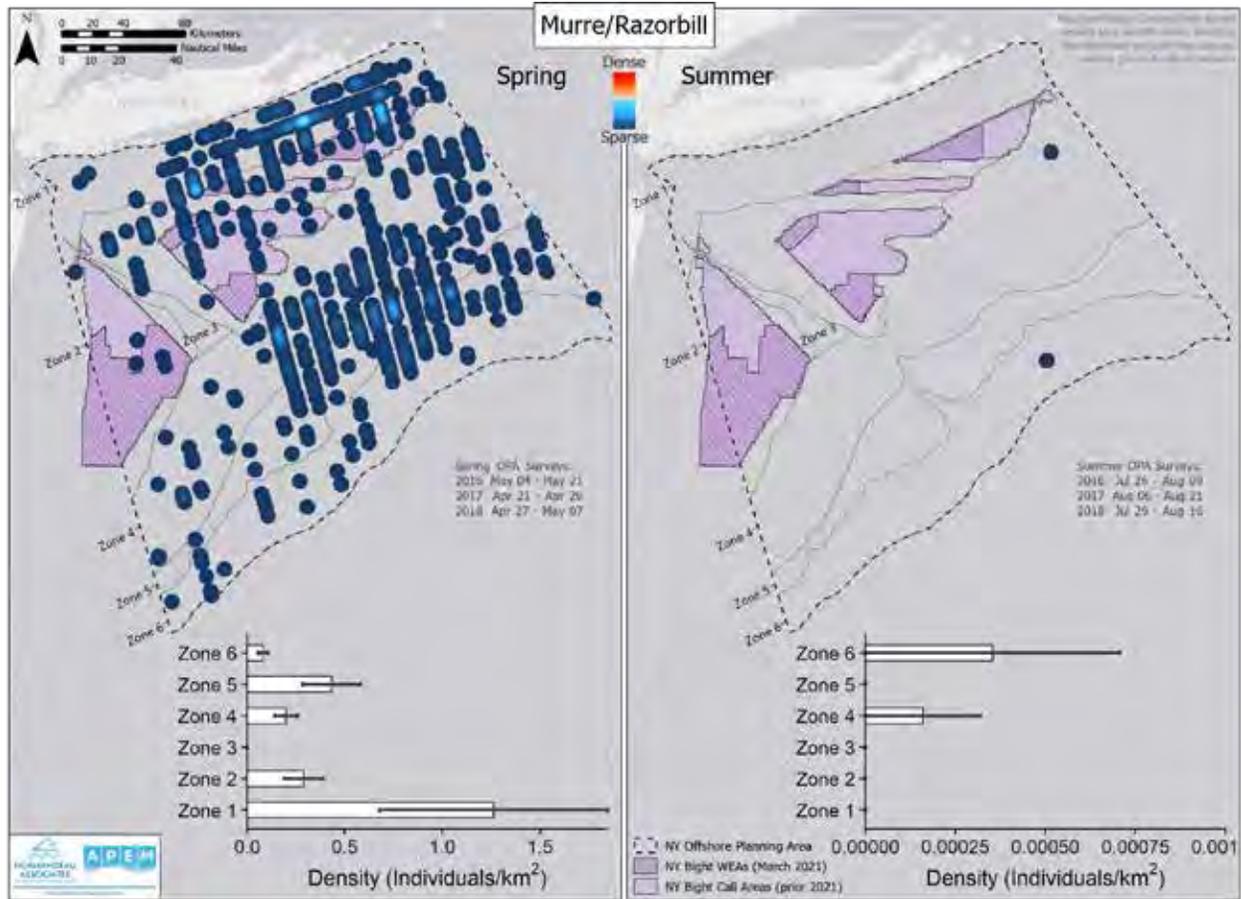


Figure 167. Spatial Distribution of Murre/Razorbill Sitting Relative to Birds in Flight During Fall and Winter Surveys

Solid blue points represent individuals with calculated flight height and blue points with an x represent individuals in flight without flight height data. A pie chart inset shows the proportion of individuals flying and sitting. A boxplot inset of flight height distribution by zone is displayed for all birds with known flight heights. Boxplots show the distribution of data among seasons. The dark horizontal line is the median flight height, the box represents the middle 50% of data values. The lines to the left and right of the box represent the data points that are within 1.5 times the length of the box. Data beyond this range are shown as individual points.

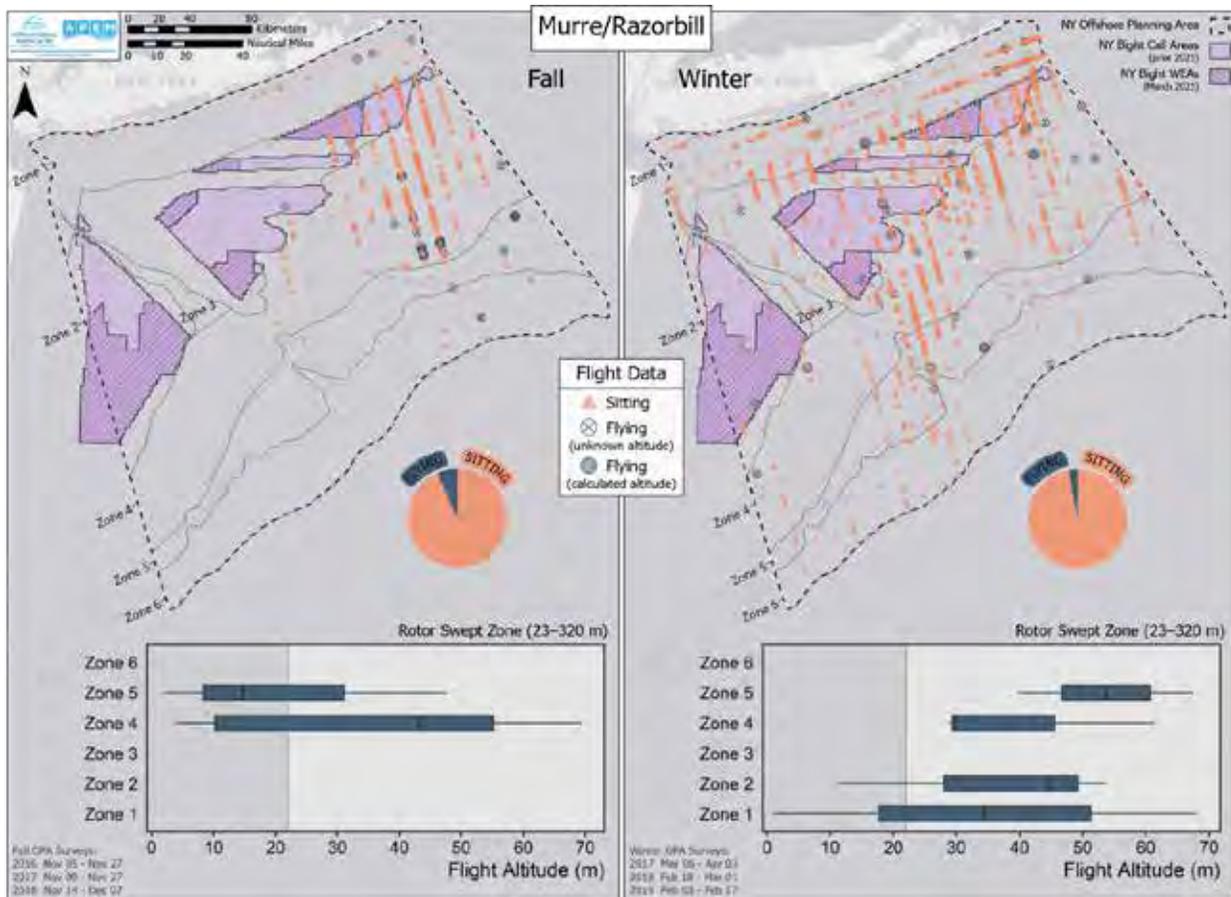


Figure 168. Spatial Distribution of Murre/Razorbill Sitting Relative to Birds in Flight During Spring and Summer Surveys

Solid blue points represent individuals with calculated flight height and blue points with an x represent individuals in flight without flight height data. A pie chart inset shows the proportion of individuals flying and sitting. A boxplot inset of flight height distribution by zone is displayed for all birds with known flight heights. Boxplots show the distribution of data among seasons. The dark horizontal line is the median flight height, and the box represents the middle 50% of data values. The lines to the left and right of the box represent the data points that are within 1.5 times the length of the box. Data beyond this range are shown as individual points.

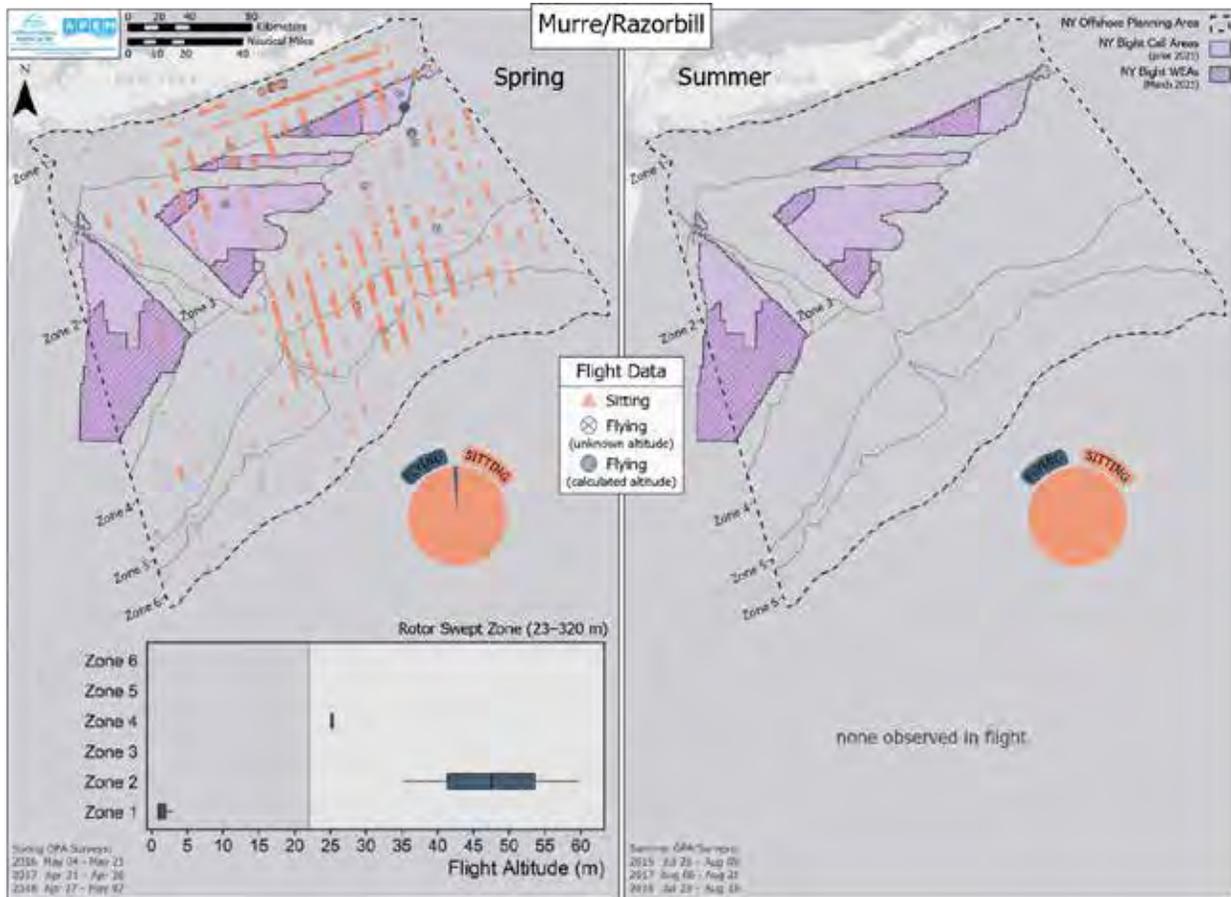


Figure 169. Direction of Flight of Murre/Razorbill for All Surveys

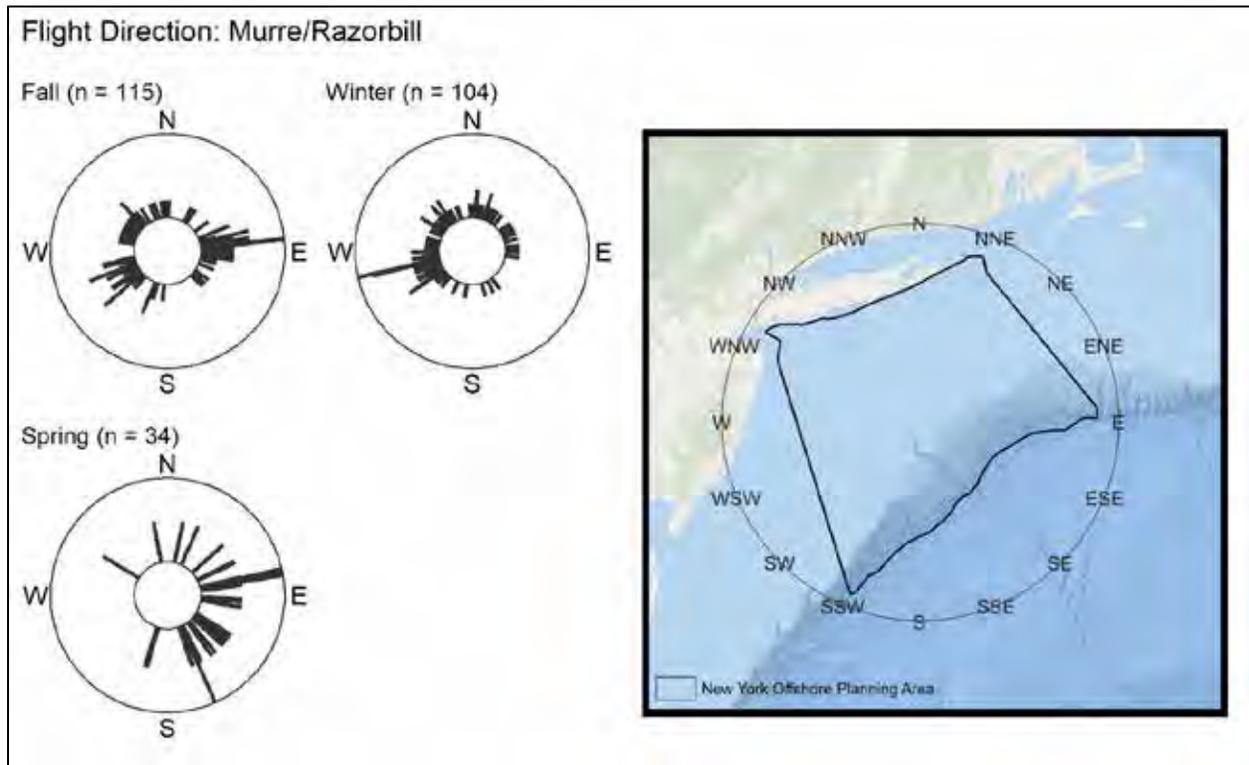


Figure 170. Spatial Distribution of Razorbill During Fall and Winter by Zone and Proximity to Call Areas

Heat map is scaled to the maximum density for the species/species group across all seasons. Inset bar plots display mean estimated densities \pm standard error of the mean for each zone.

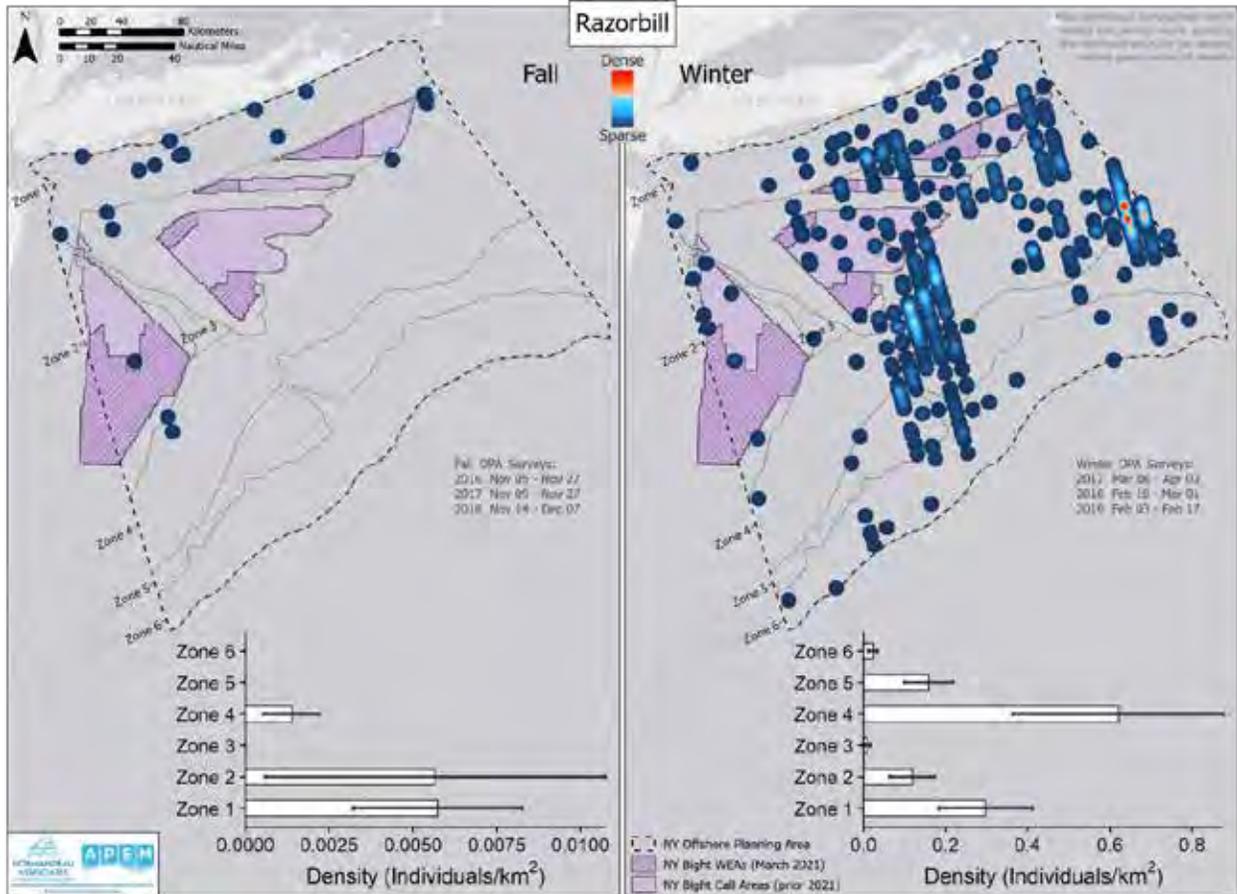


Figure 171. Spatial Distribution of Razorbill During Spring and Summer by Zone and Proximity to Call Areas

Heat map is scaled to the maximum density for the species/species group across all seasons. Inset bar plots display mean estimated densities \pm standard error of the mean for each zone.

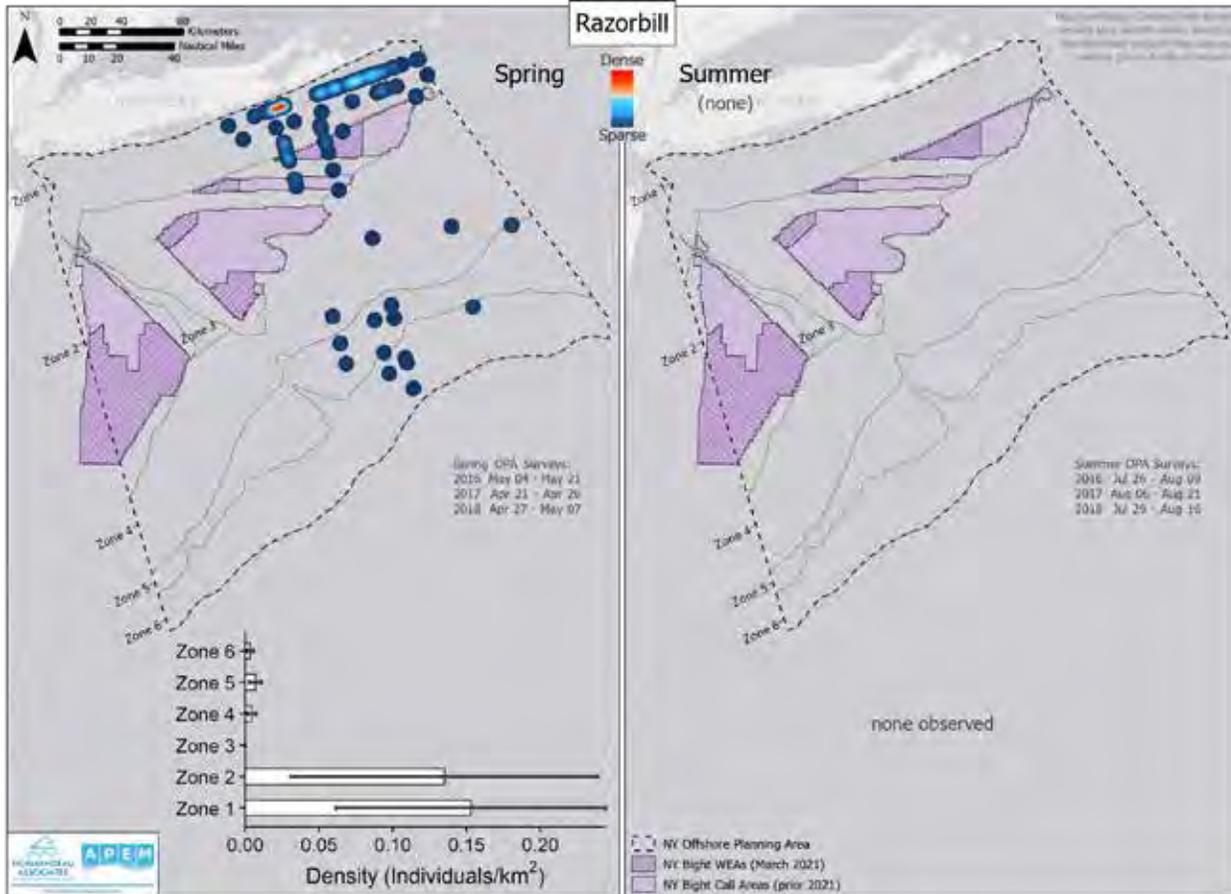


Figure 172. Spatial Distribution of Razorbill Sitting Relative to Birds in Flight During Fall and Winter Surveys

Solid blue points represent individuals with calculated flight height and blue points with an x represent individuals in flight without flight height data. A pie chart inset shows the proportion of individuals flying and sitting. A boxplot inset of flight height distribution by zone is displayed for all birds with known flight heights. Boxplots show the distribution of data among seasons. The dark horizontal line is the median flight height, and the box represents the middle 50% of data values. The lines to the left and right of the box represent the data points that are within 1.5 times the length of the box. Data beyond this range are shown as individual points.

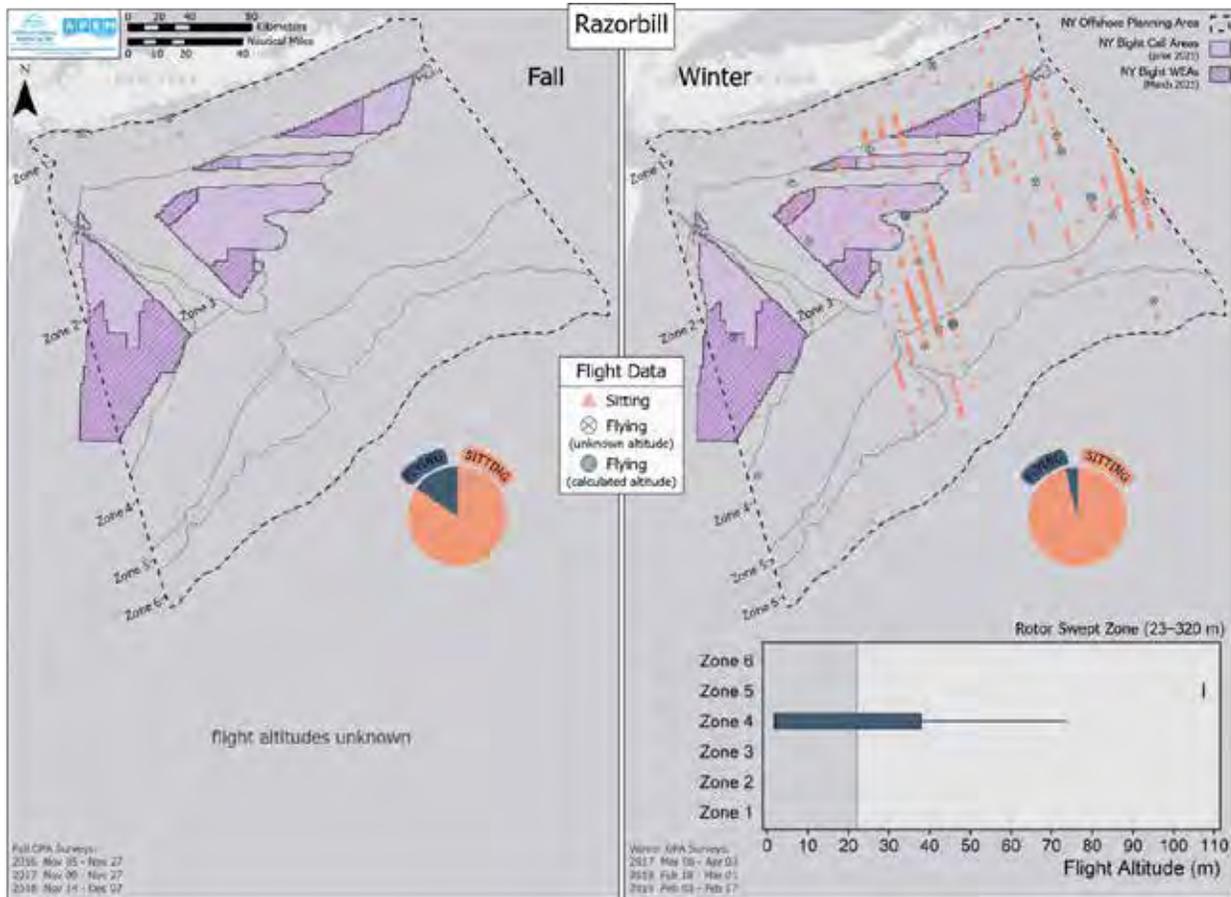


Figure 173. Spatial Distribution of Razorbill Sitting Relative to Birds in Flight During Spring and Summer Surveys

Solid blue points represent individuals with calculated flight height and blue points with an x represent individuals in flight without flight height data. A pie chart inset shows the proportion of individuals flying and sitting. A boxplot inset of flight height distribution by zone is displayed for all birds with known flight heights. Boxplots show the distribution of data among seasons. The dark horizontal line is the median flight height, and the box represents the middle 50% of data values. The lines to the left and right of the box represent the data points that are within 1.5 times the length of the box. Data beyond this range are shown as individual points.

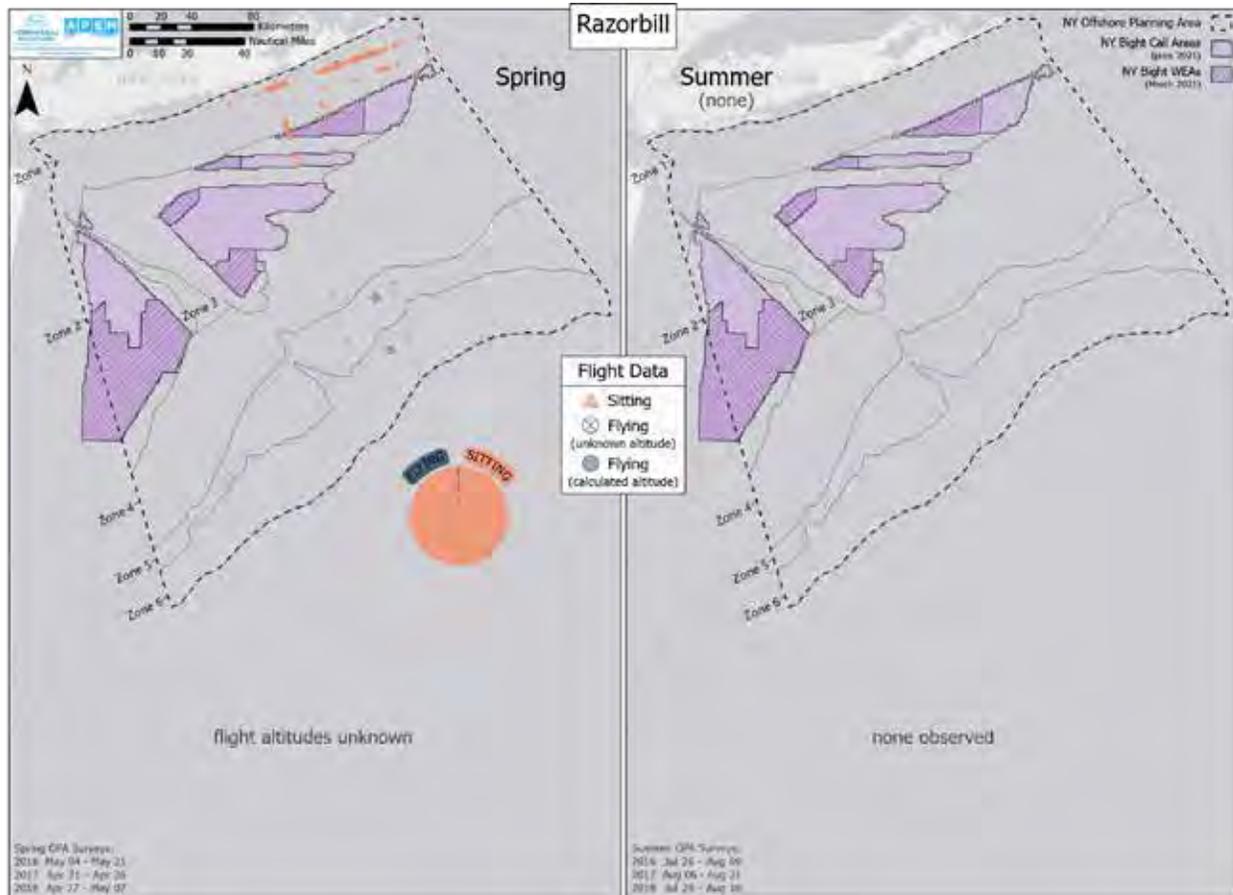


Figure 174. Direction of Flight of Razorbill for All Surveys

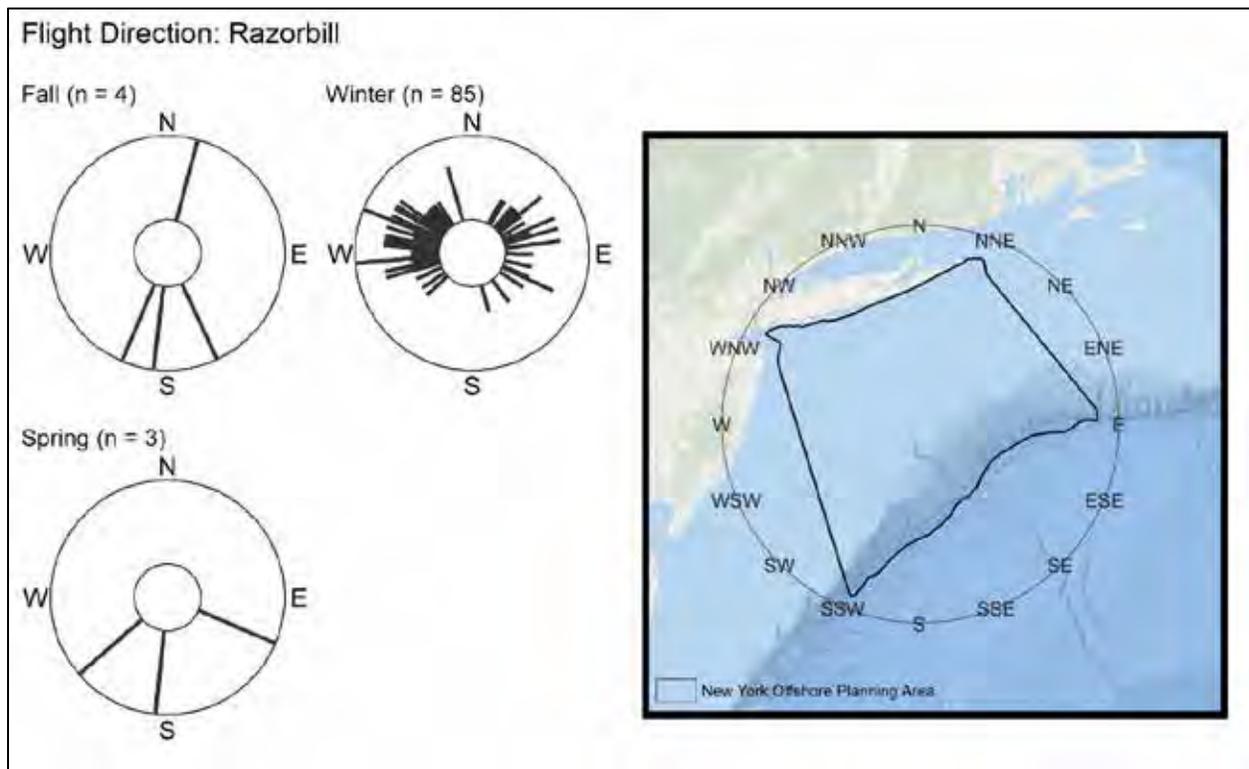


Figure 175. Spatial Distribution of Atlantic Puffin During Fall and Winter by Zone and Proximity to Call Areas

Heat map is scaled to the maximum density for the species/species group across all seasons. Inset bar plots display mean estimated densities \pm standard error of the mean for each zone.

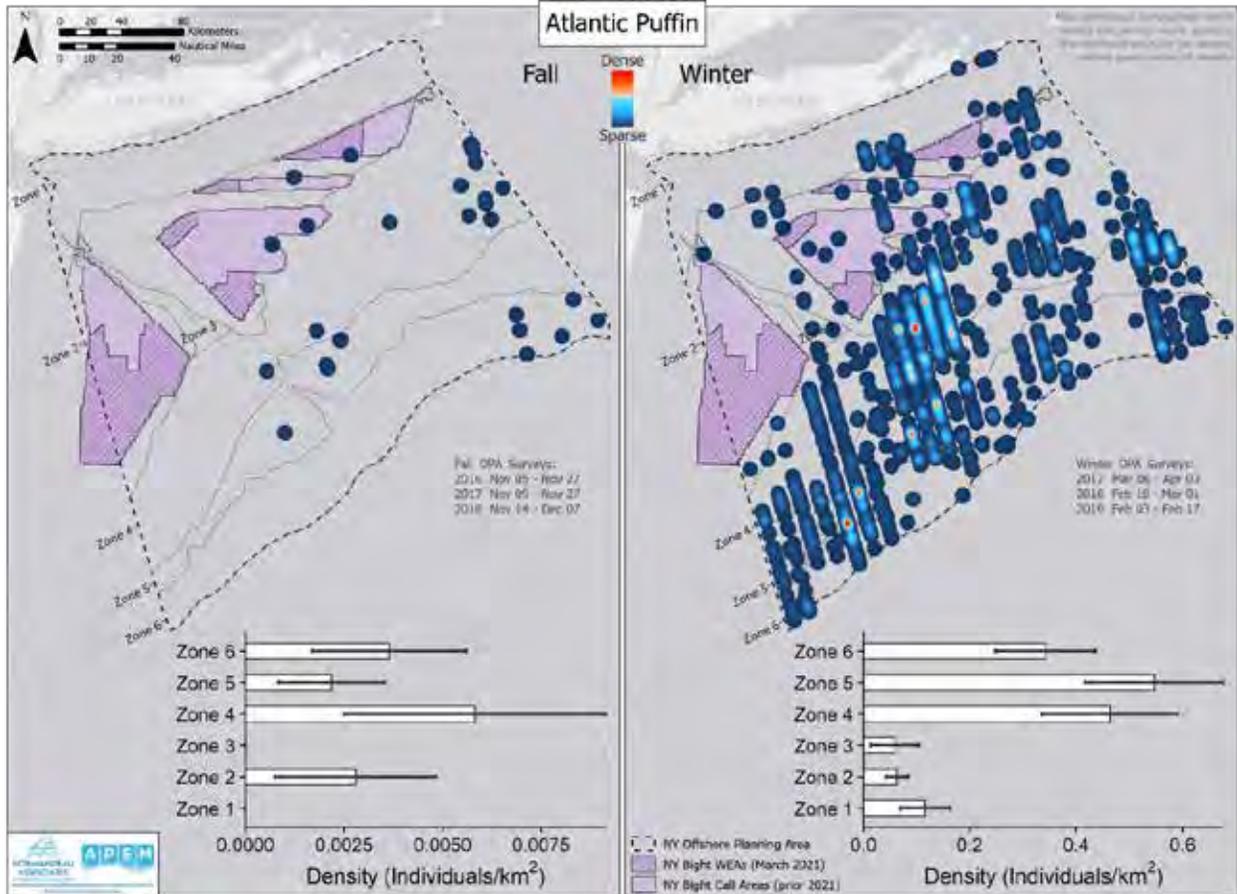


Figure 176. Spatial Distribution of Atlantic Puffin During Spring and Summer by Zone and Proximity to Call Areas

Heat map is scaled to the maximum density for the species/species group across all seasons. Inset bar plots display mean estimated densities \pm standard error of the mean for each zone.

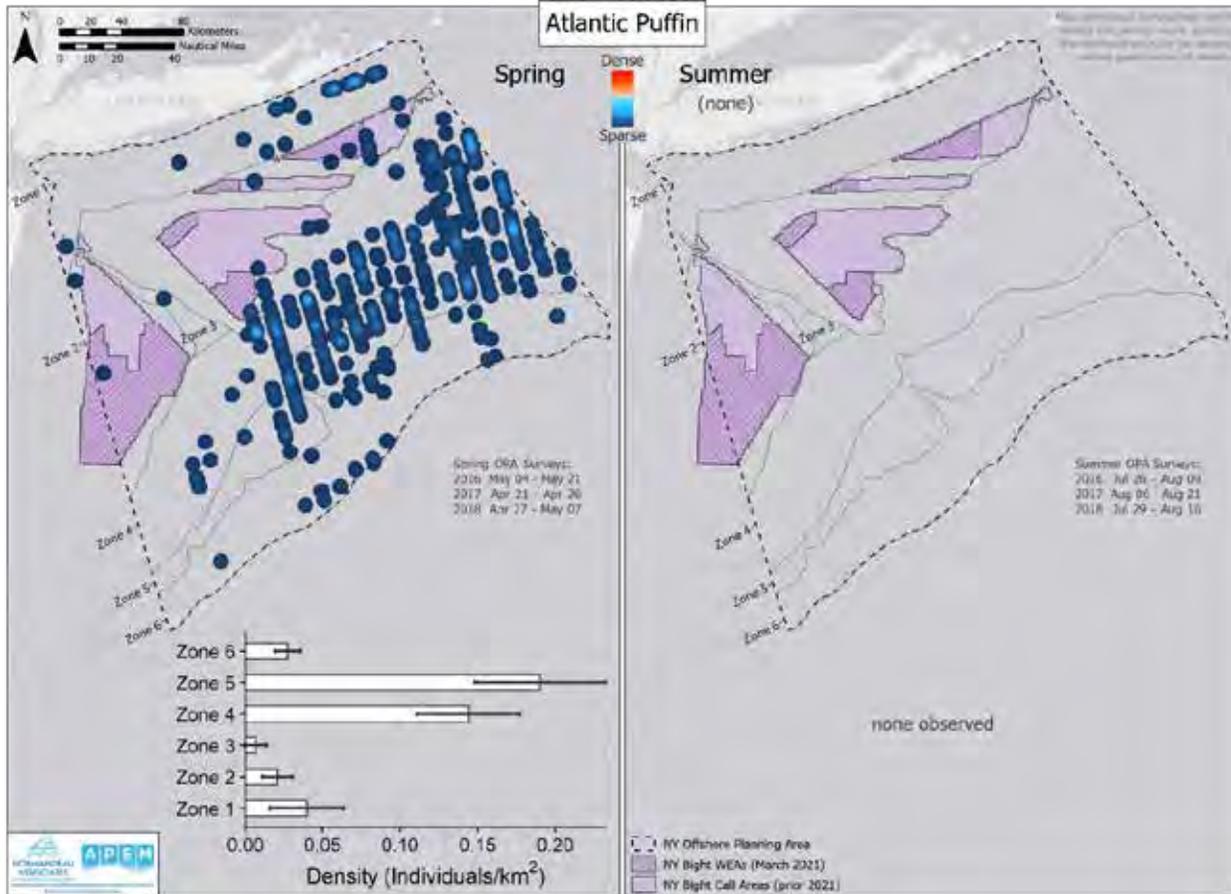


Figure 177. Spatial Distribution of Atlantic Puffin Sitting Relative to Birds in Flight During Fall and Winter Surveys

Solid blue points represent individuals with calculated flight height and blue points with an x represent individuals in flight without flight height data. A pie chart inset shows the proportion of individuals flying and sitting. A boxplot inset of flight height distribution by zone is displayed for all birds with known flight heights. Boxplots show the distribution of data among seasons. The dark horizontal line is the median flight height, and the box represents the middle 50% of data values. The lines to the left and right of the box represent the data points that are within 1.5 times the length of the box. Data beyond this range are shown as individual points.

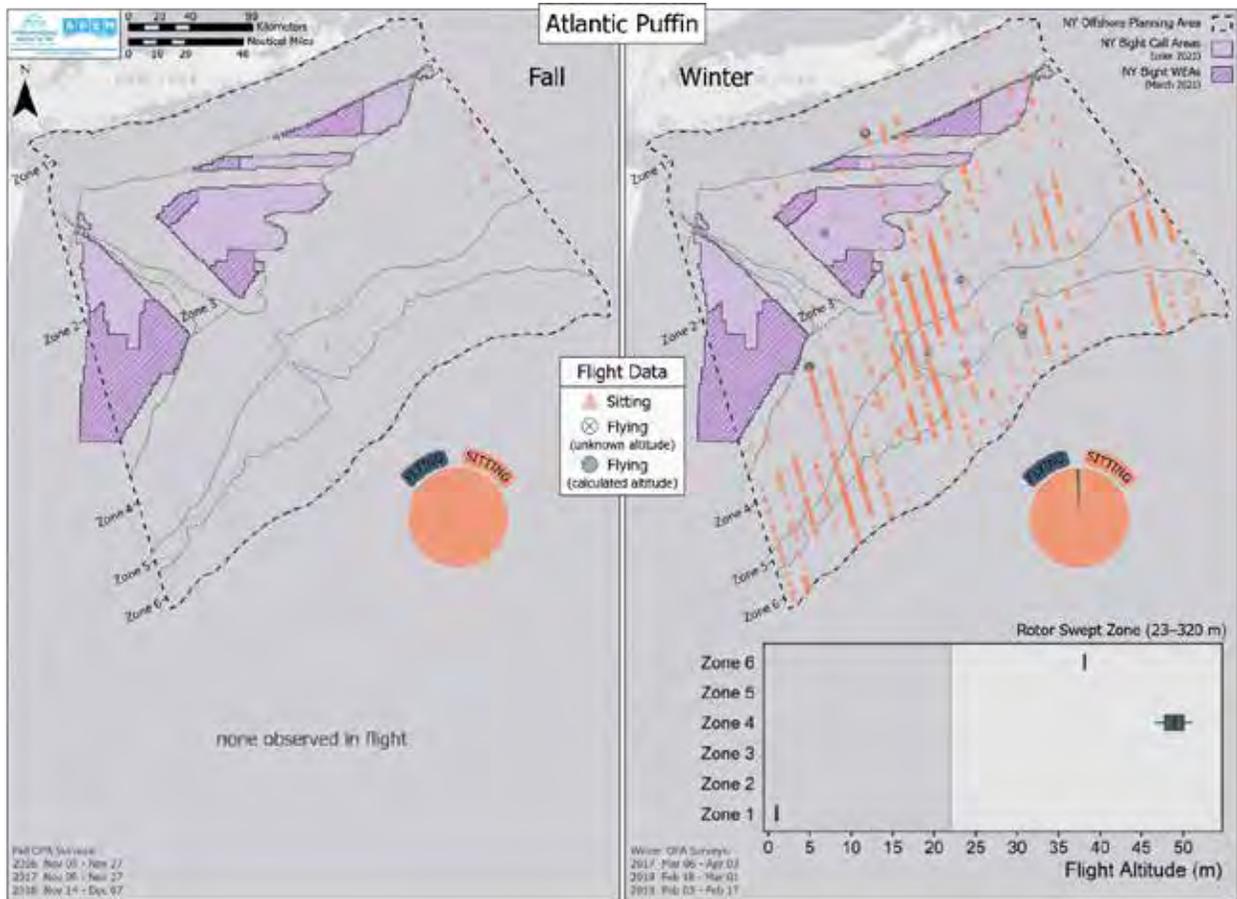


Figure 178. Spatial Distribution of Atlantic Puffin Sitting Relative to Birds in Flight During Spring and Summer Surveys

Solid blue points represent individuals with calculated flight height and blue points with an x represent individuals in flight without flight height data. A pie chart inset shows the proportion of individuals flying and sitting. A boxplot inset of flight height distribution by zone is displayed for all birds with known flight heights. Boxplots show the distribution of data among seasons. The dark horizontal line is the median flight height, and the box represents the middle 50% of data values. The lines to the left and right of the box represent the data points that are within 1.5 times the length of the box. Data beyond this range are shown as individual points.

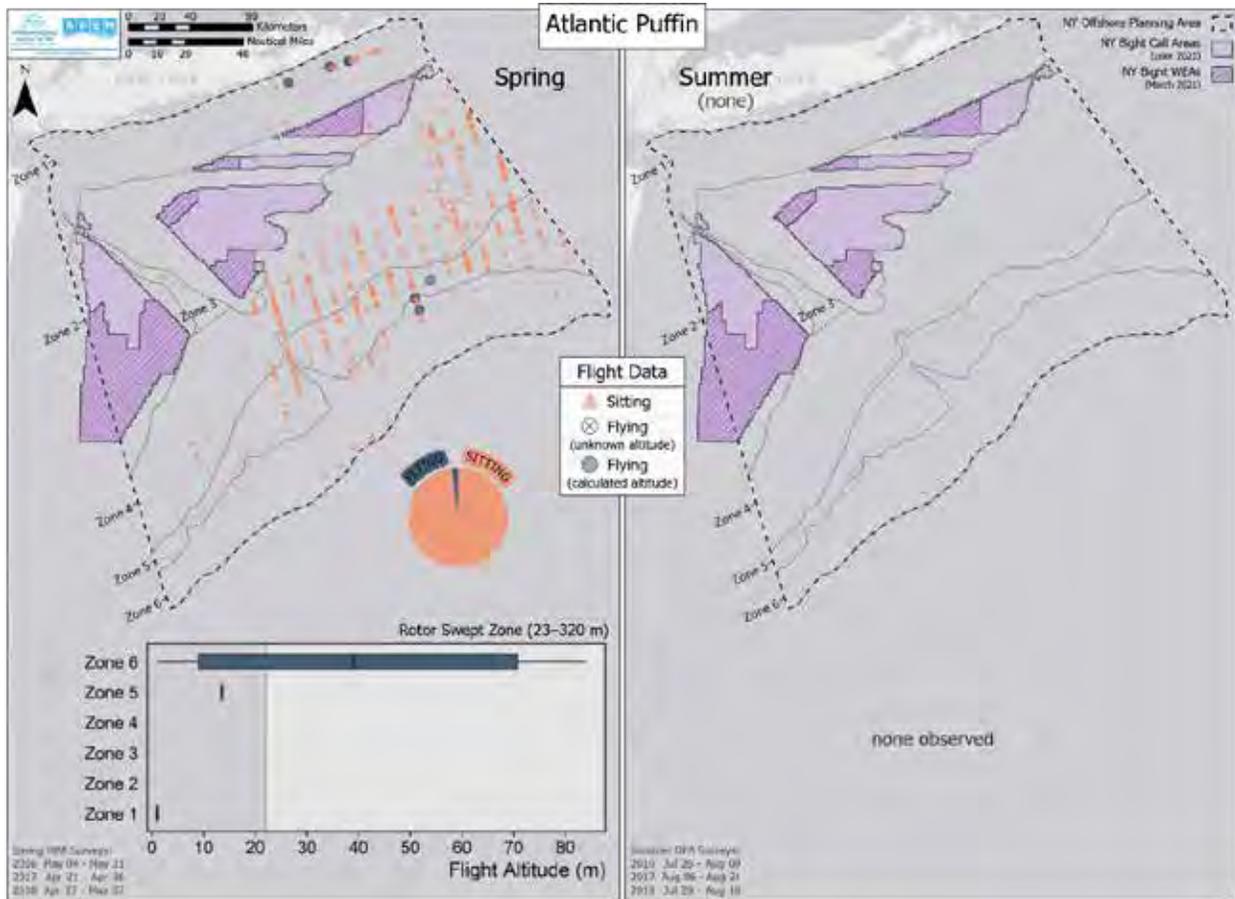


Figure 179. Direction of Flight of Atlantic Puffin for All Surveys

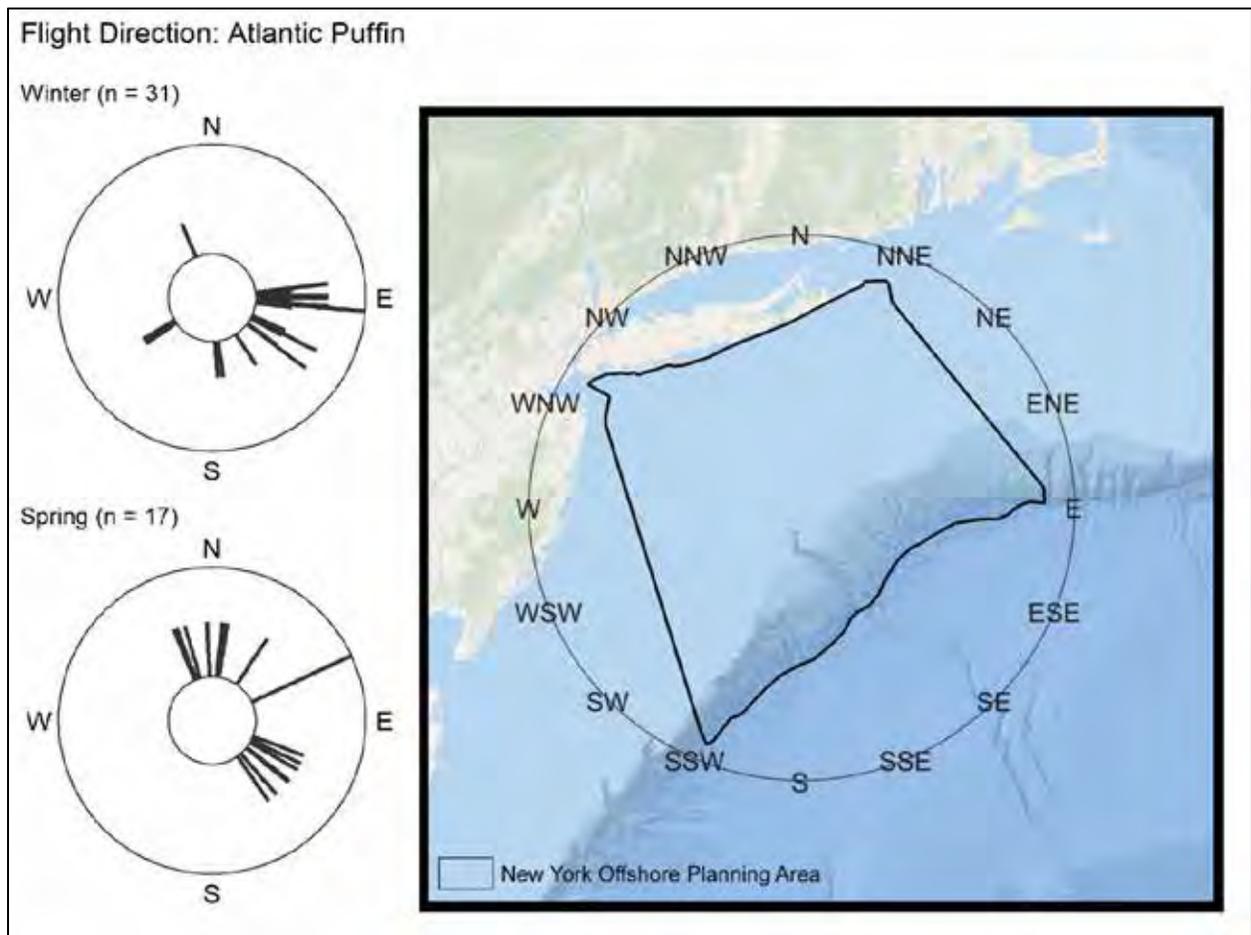
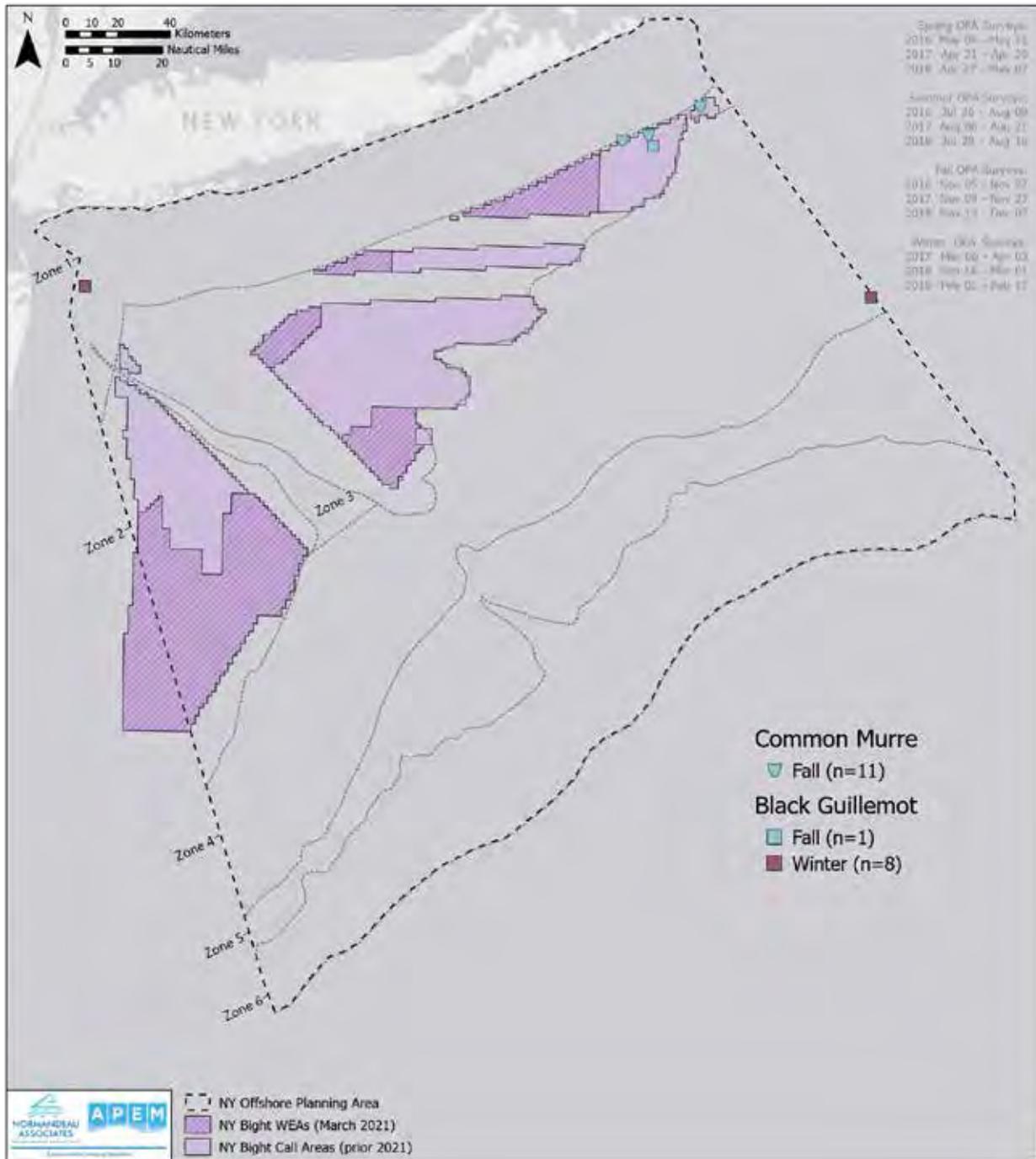


Figure 180. Spatial Distribution of Auk Species with Fewer than 30 Occurrences Across All Surveys



2.5.21 Gull

The gull taxonomic grouping included individuals classified as gull-species unknown (n=94), gull-species unknown-large (n=432), gull-species unknown-small (n=2,095), black-legged kittiwake (n=3,607), Bonaparte's gull (n=4,882), little gull (n=15), laughing gull (n=2,378), ring-billed gull (n=1,264), herring gull (n=21,219), Iceland gull (n=15), lesser black-backed gull (n=251), glaucous gull (n=2), and great black-backed gull (n=6,251). Across all surveys, 42,503 gull were observed in the OPA. The greatest number of gull observations occurred in the Fall (n=19,579), followed by Winter (n=14,337), Spring (n=7,877), and Summer (n=710) (Appendix B). Across all seasons, gull density was highest within Zone 5 during Winter surveys (n=7,834; $\bar{x} = 5.42 \pm 1.32$ birds/km²) (Figure 181). During Fall, Winter, and Spring surveys, gull consistently exhibited above average density within Zone 3 (Figure 181, Figure 182).

In Fall, 49% of birds were in flight with a pattern of northwesterly flight headings, and median flight heights were above the RSZ in all zones ranging between one and 160 m above sea level (Figure 183). In Winter, 28% of birds were in flight with a median flight height within the RSZ in all zones, and individual flight heights ranged between one and 160 m above sea level (Figure 183). In Spring, 25% of birds were in flight with median flight height within the RSZ in all zones but Zone 3. Individual flight heights ranged between one and 160 m above sea level (Figure 184). In Summer, 22% of birds were in flight ranging between one and 150 m above sea level (Figure 184). In Winter, birds exhibited a flight pattern to the northwest, and in Spring, there was no pattern of flight headings (Figure 185).

2.5.21.1 Black-legged Kittiwake

The vast majority of black-legged kittiwake were observed in the Fall (n=3,406; $\bar{x} = 0.27 \pm 0.04$ birds/km²) when they were distributed throughout the OPA but had an above average density in Zone 2 (n=1,012; $\bar{x} = 0.48 \pm 0.12$ birds/km²), Zone 3 (n=153; $\bar{x} = 0.81 \pm 0.51$ birds/km²), and Zone 4 (n=1,902; $\bar{x} = 0.55 \pm 0.15$ birds/km²) (Figure 186). In Winter we observed 193 black-legged kittiwake distributed throughout the OPA (Figure 186). Black-legged kittiwake were encountered infrequently during Spring (n=8) and Summer (n=0) (Figure 187).

In Fall, 26% of birds were in flight with a median flight height within the RSZ in all zones ranging between one and 160 m above sea level (Figure 188). In Winter, 81% of birds were in flight with median flight heights within the RSZ in all zones ranging between one and 140 m above sea level (Figure 188). In Spring, eight black-legged kittiwake were observed: four in flight and four sitting (Figure 189). In Fall, birds had a pattern of northwesterly flight headings, and in Winter, there was no pattern of flight headings (Figure 190).

2.5.21.2 Bonaparte's Gull

Overall, 4,882 Bonaparte's gull were observed with the greatest density in the Fall ($n=3,126$; $\bar{x} = 0.20 \pm 0.04$ birds/km²) followed by Spring and Winter (Figure 191, Figure 192). In Summer, no Bonaparte's gull were observed. During Fall and Spring, density was greatest within Zone 1, and during Winter surveys, density was greatest within Zone 2.

In Fall, 62% of individuals were in flight with median flight heights within the RSZ in all zones (Figure 193). In Winter, 51% of birds were in flight with median flight heights within the RSZ in all zones (Figure 193). In Spring, 42% of individuals were in flight and flight height ranged between one and 150 m above sea level (Figure 194). In Fall, birds showed a pattern of northwesterly flight headings. In Winter, birds had a pattern of southeasterly and westerly flight headings, and in Spring, there was no pattern of flight headings (Figure 195).

2.5.21.3 Laughing Gull

The vast majority (94%) of laughing gull were observed during Fall surveys ($n=2,226$) and were concentrated in Zone 1 (Figure 196). No laughing gull were observed in Winter. In Spring, 112 laughing gull were concentrated within Zone 1 (Figure 197).

In Fall, 63% of birds were in flight with median flight heights within the RSZ in all zones (Figure 198). In Spring, 56% of birds were in flight with flight heights ranging between one and 150 m above sea level (Figure 199). In Summer, 40 laughing gull were observed concentrated in Zone 1 with 18 of 40 individuals observed in flight ranging between one and 60 m above sea level (Figure 199). In Fall and Spring, birds showed no pattern of flight heading (Figure 200).

2.5.21.4 Ring-billed Gull

Ring-billed gull were most frequently observed during Fall (n=878) followed by Winter (n=268), Summer (n=96), Spring (n=22) (Figure 201, Figure 202). In Fall, ring-billed gull were concentrated in Zone 1 (n=791; $\bar{x} = 0.21 \pm 0.1$ birds/km²) (Figure 201). In Winter, individuals were concentrated in Zone 5 (n=112; $\bar{x} = 0.09 \pm 0.025$ birds/km²) (Figure 201). In Summer, mean density in Zone 1 was above the OPA density (n=95; $\bar{x} = 0.04 \pm 0.03$ birds/km²) (Figure 202).

In Fall, 80% of birds were in flight with a median flight height within the RSZ in all zones (Figure 203). In Winter, 53% of birds were in flight (Figure 203). In Spring, eight individuals were flying between 10 and 80 m above sea level, and in Summer, seven individuals were flying between 10 and 70 m above sea level (Figure 204). In Fall, birds showed no pattern of flight headings, and in Winter, there was a pattern of northwesterly or southeasterly flight headings (Figure 205).

2.5.21.5 Herring Gull

Mean herring gull density in the OPA was greatest during Winter surveys (n=8,778; $\bar{x} = 1.01 \pm 0.2$ birds/km²) followed by Fall (n=6,995; $\bar{x} = 0.64 \pm 0.12$ birds/km²), Spring (n=5,291; $\bar{x} = 0.44 \pm 0.07$ birds/km²), and Summer (n=155; $\bar{x} = 0.02 \pm 0.01$ birds/km²) (Figure 206, Figure 207). Herring gull were widely distributed throughout the OPA except during Summer surveys when herring gull were concentrated in Zone 1 (Figure 206, Figure 207).

In Fall, 33% of birds were in flight with a median flight height within the RSZ in all zones ranging between 40 and 60 m above sea level (Figure 208). In Winter, 25% of birds were in flight with a median flight height within the RSZ in all zones; individual flight heights ranged between one and 160 m above sea level (Figure 208). In Spring, 21% of birds were in flight and flight heights ranged between one and 160 m above sea level. In Summer, 26% of birds were in flight, all within Zone 1, with a median flight height below the RSZ (Figure 209). In Fall, birds showed a pattern of northwesterly flight headings, in Winter, there was a pattern of northwesterly flight headings, and in Spring, there was no pattern of flight headings (Figure 210).

2.5.21.6 Lesser Black-backed Gull

Mean lesser black-backed gull density in the OPA was overall relatively low and even across seasons with Fall having the greatest mean density ($n=91$; $\bar{x} = 0.009 \pm 0.004$ birds/km²) followed by Spring ($n=65$; $\bar{x} = 0.007 \pm 0.002$ birds/km²), Winter ($n=49$; $\bar{x} = 0.006 \pm 0.001$ birds/km²), and Summer ($n=46$; $\bar{x} = 0.005 \pm 0.003$ birds/km²) (Figure 211, Figure 212). In Fall, lesser black-backed gull concentrated in Zone 1 with 13 individuals flying between 15 and 150 m above sea level (Figure 213). In Winter, 10 individuals were in flight between 40 and 140 m above sea level (Figure 213). In Spring, 21 individuals were flying between 1 and 90 m above sea level, and in Summer, 3 individuals were in flight between one and 120 m above sea level. (Figure 214). Patterns of flight headings for lesser black-backed gull for all surveys are presented in Figure 215.

2.5.21.7 Great Black-backed Gull

Mean great black-backed gull density in the OPA was greatest during Winter ($n=3,906$; $\bar{x} = 0.47 \pm 0.1$ birds/km²) followed by Fall ($n=1,094$; $\bar{x} = 0.11 \pm 0.02$ birds/km²), Spring ($n=941$; $\bar{x} = 0.09 \pm 0.01$ birds/km²), and Summer ($n=310$; $\bar{x} = 0.027 \pm 0.01$ birds/km²) (Appendix B, Figure 216, Figure 217). Across all seasons, great black-backed gull had mean densities below the OPA mean within Zone 6 (Figure 216, Figure 217). In Winter, the Zone 5 density estimate was over three times the mean density estimate of the OPA (Figure 216).

In Fall, 37% of birds were in flight with a median flight height within the RSZ in all zones that ranged between approximately 45 and 80 m above sea level (Figure 218). In Winter, 28% of birds were in flight with flight heights ranging between one and 150 m above sea level (Figure 218). In Spring, 26% of birds were in flight and flight heights ranged between one and 130 m above sea level (Figure 219). In Summer, 25% of birds were in flight; median flight heights in Zone 1 were below 10 m above sea level (Figure 219). In Fall and Winter, birds showed a pattern of northwesterly flight headings, and in Spring and Summer, there was no pattern of flight headings (Figure 220).

2.5.21.8 Gull Species with Fewer than 30 Observations

Little gull ($n=13$), Iceland gull ($n=15$), and glaucous gull ($n=2$) were relatively uncommon species classifications but were distributed widely throughout the OPA and observed in all seasons except Summer (Figure 221).

Figure 181. Spatial Distribution of Gull Species During Fall and Winter by Zone and Proximity to Call Areas

Heat map is scaled to the maximum density for the species/species group across all seasons. Inset bar plots display mean estimated densities \pm standard error of the mean for each zone.

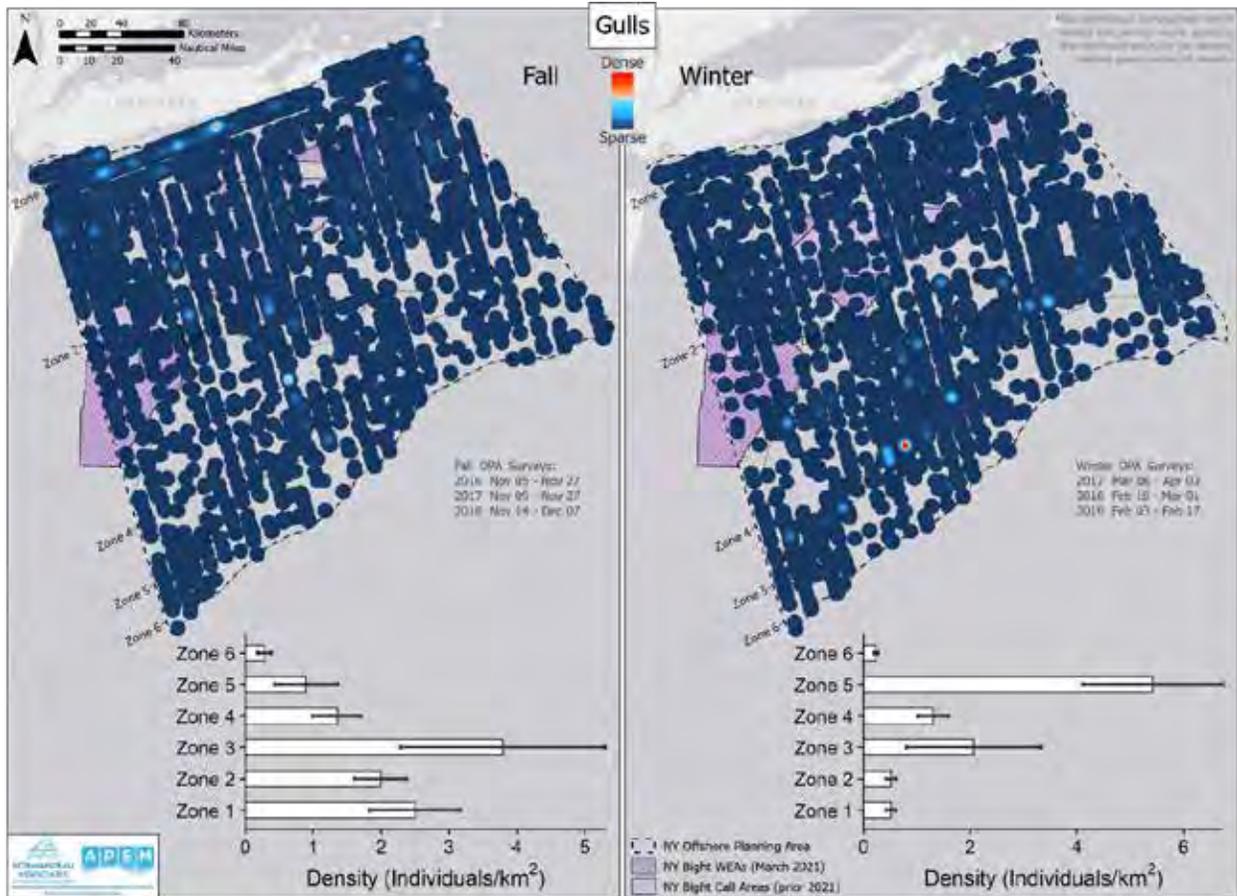


Figure 182. Spatial Distribution of Gull Species During Spring and Summer by Zone and Proximity to Call Areas

Heat map is scaled to the maximum density for the species/species group across all seasons. Inset bar plots display mean estimated densities \pm standard error of the mean for each zone.

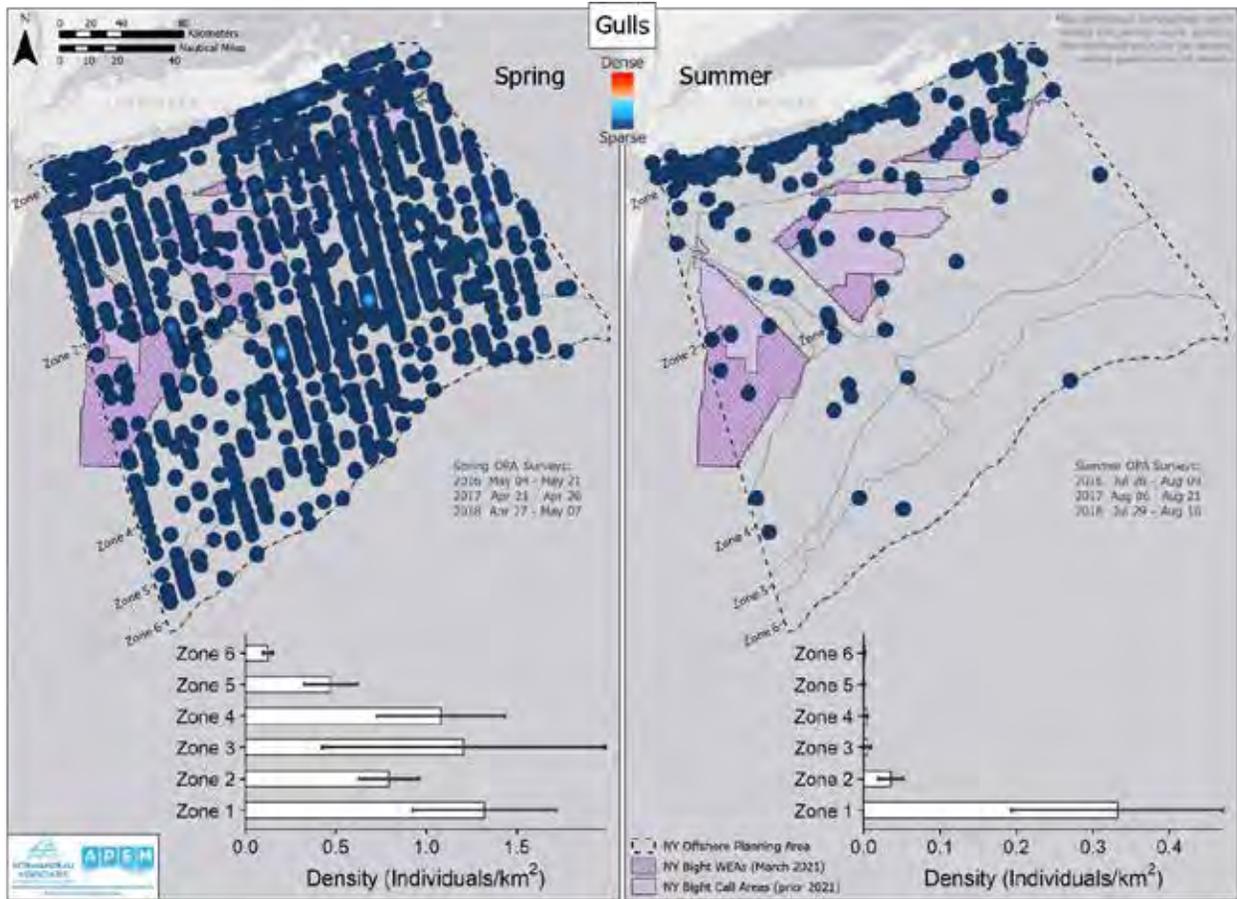


Figure 183. Spatial Distribution of Gull Species Sitting Relative to Birds in Flight During Fall and Winter Surveys

Solid blue points represent individuals with calculated flight height and blue points with an x represent individuals in flight without flight height data. A pie chart inset shows the proportion of individuals flying and sitting. A boxplot inset of flight height distribution by zone is displayed for all birds with known flight heights. Boxplots show the distribution of data among seasons. The dark horizontal line is the median flight height, the box represents the middle 50% of data values. The lines to the left and right of the box represent the data points that are within 1.5 times the length of the box. Data beyond this range are shown as individual points.

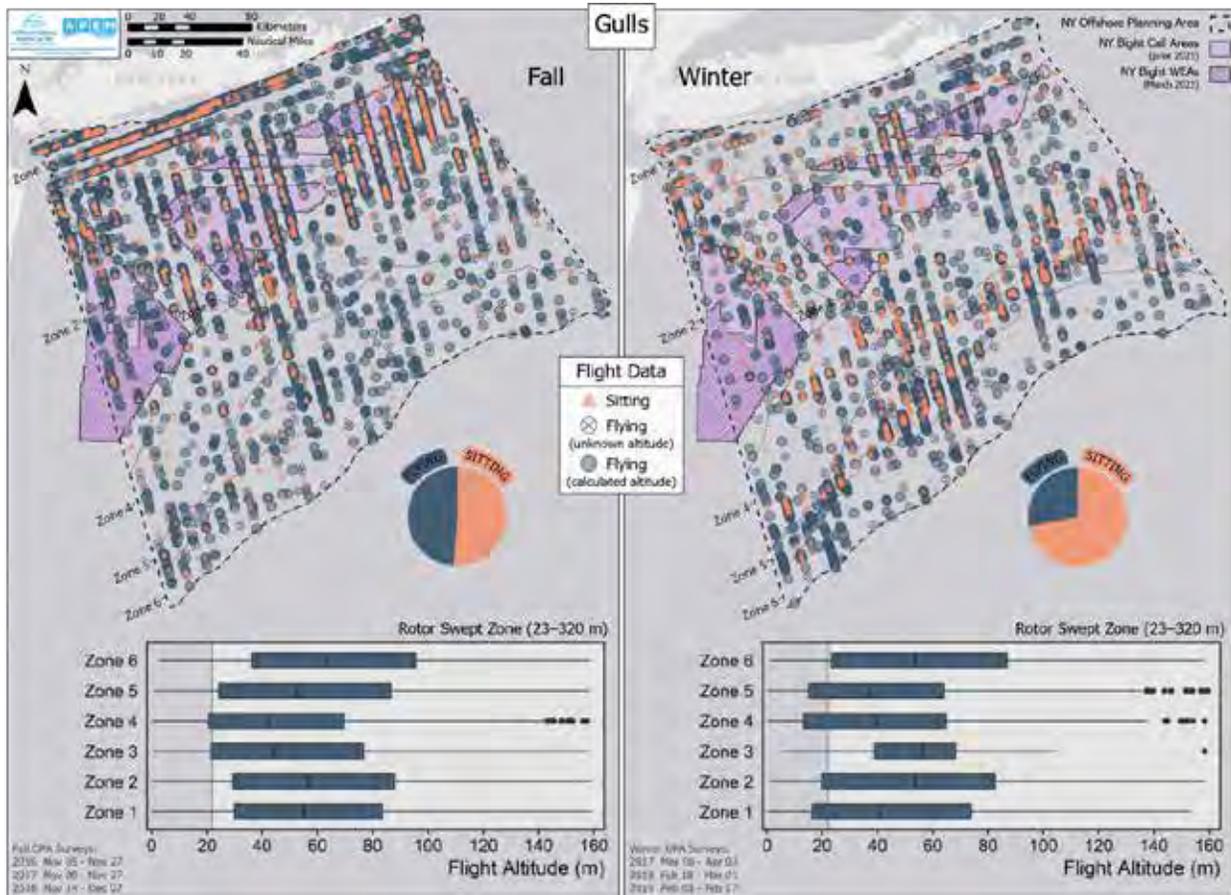


Figure 184. Spatial Distribution of Gull Species Sitting Relative to Birds in Flight During Spring and Summer Surveys

Solid blue points represent individuals with calculated flight height and blue points with an x represent individuals in flight without flight height data. A pie chart inset shows the proportion of individuals flying and sitting. A boxplot inset of flight height distribution by zone is displayed for all birds with known flight heights. Boxplots show the distribution of data among seasons. The dark horizontal line is the median flight height, and the box represents the middle 50% of data values. The lines to the left and right of the box represent the data points that are within 1.5 times the length of the box. Data beyond this range are shown as individual points.

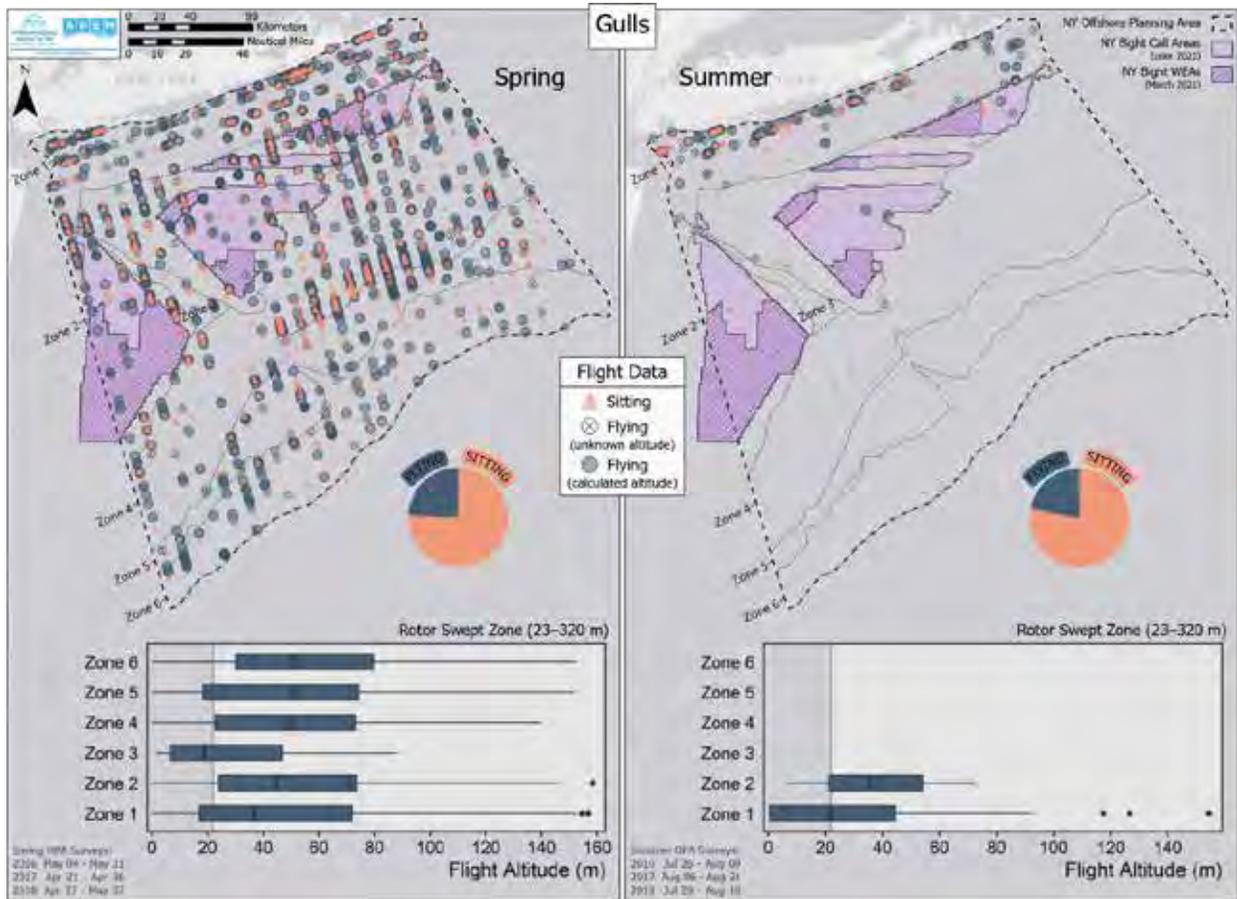


Figure 185. Direction of Flight of All Gull Species for All Surveys

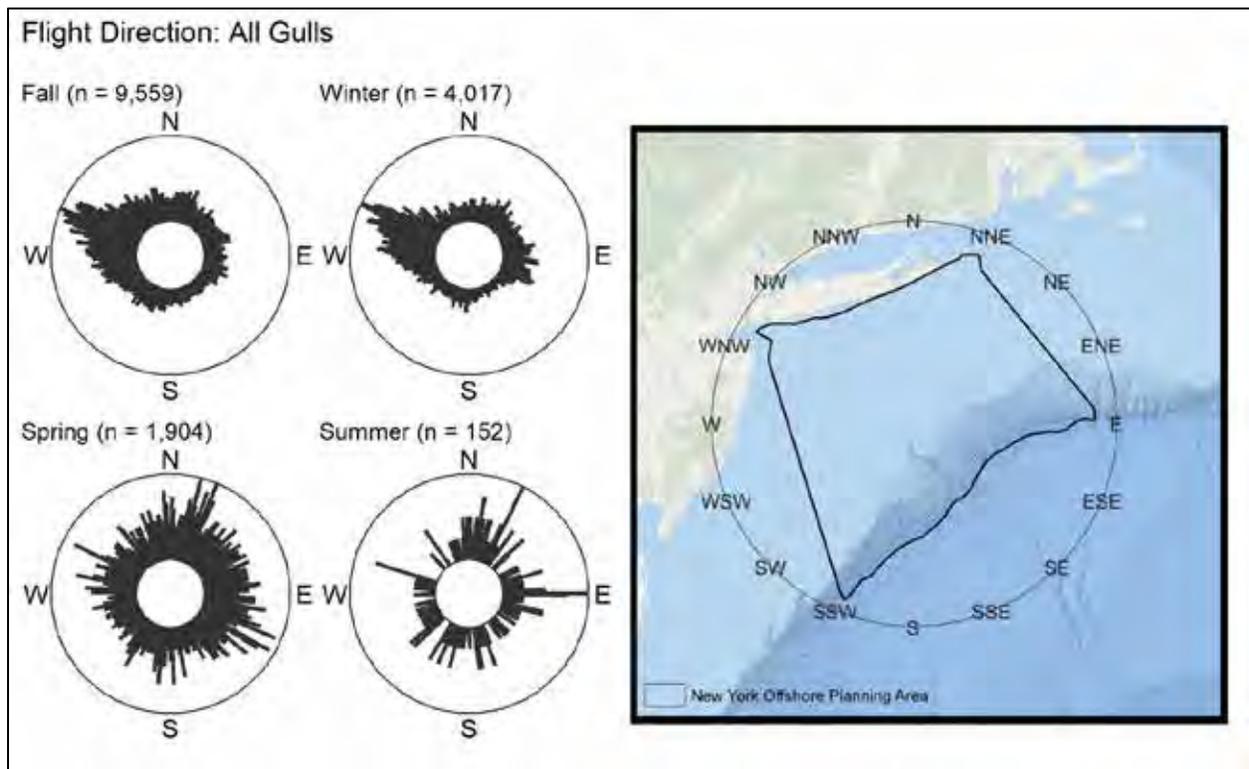


Figure 186. Spatial Distribution of Black-legged Kittiwake During Fall and Winter by Zone and Proximity to Call Areas

Heat map is scaled to the maximum density for the species/species group across all seasons. Inset bar plots display mean estimated densities \pm standard error of the mean for each zone.

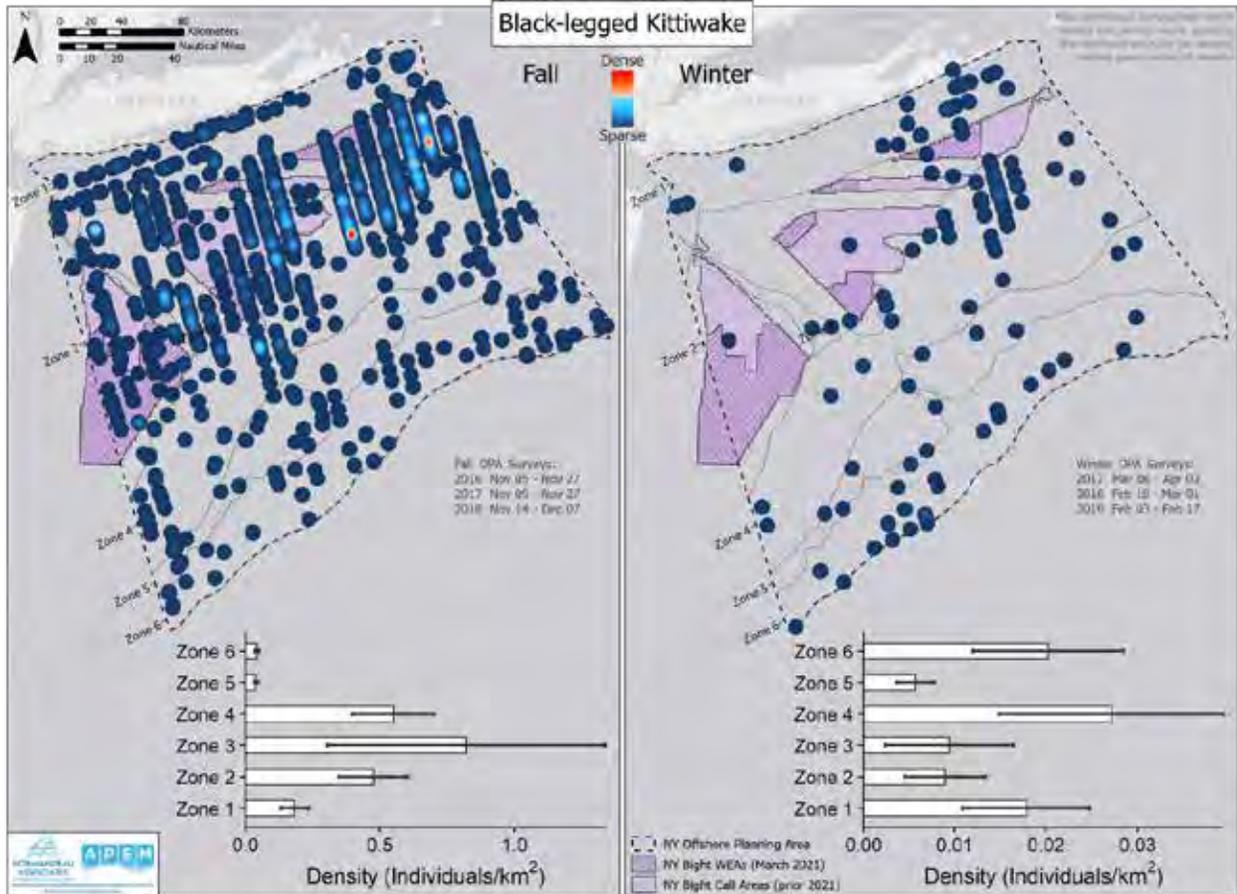


Figure 187. Spatial Distribution of Black-legged Kittiwake During Spring and Summer by Zone and Proximity to Call Areas

Heat map is scaled to the maximum density for the species/species group across all seasons. Inset bar plots display mean estimated densities \pm standard error of the mean for each zone.

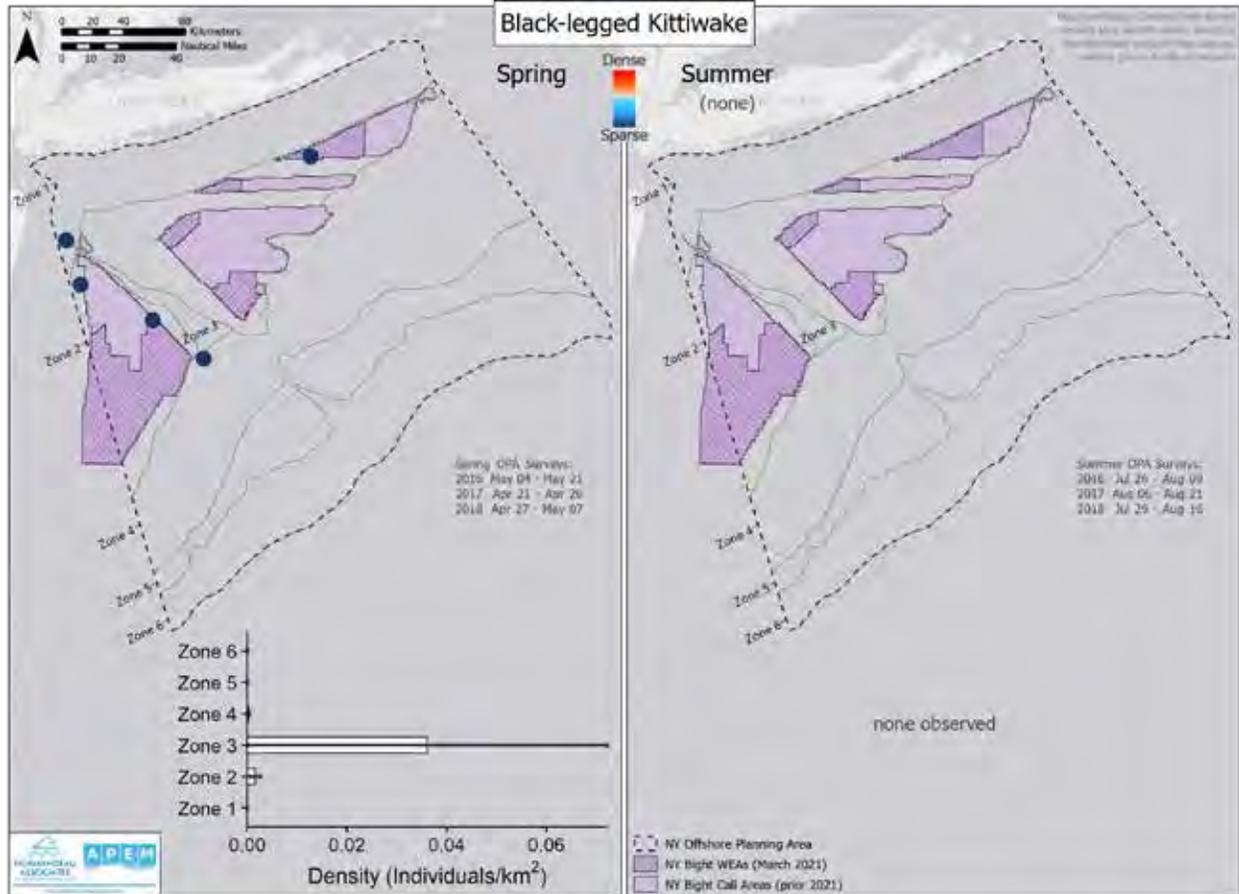


Figure 188. Spatial Distribution of Black-legged Kittiwake Sitting Relative to Birds in Flight During Fall and Winter Surveys

Solid blue points represent individuals with calculated flight height and blue points with an x represent individuals in flight without flight height data. A pie chart inset shows the proportion of individuals flying and sitting. A boxplot inset of flight height distribution by zone is displayed for all birds with known flight heights. Boxplots show the distribution of data among seasons. The dark horizontal line is the median flight height, the box represents the middle 50% of data values. The lines to the left and right of the box represent the data points that are within 1.5 times the length of the box. Data beyond this range are shown as individual points.

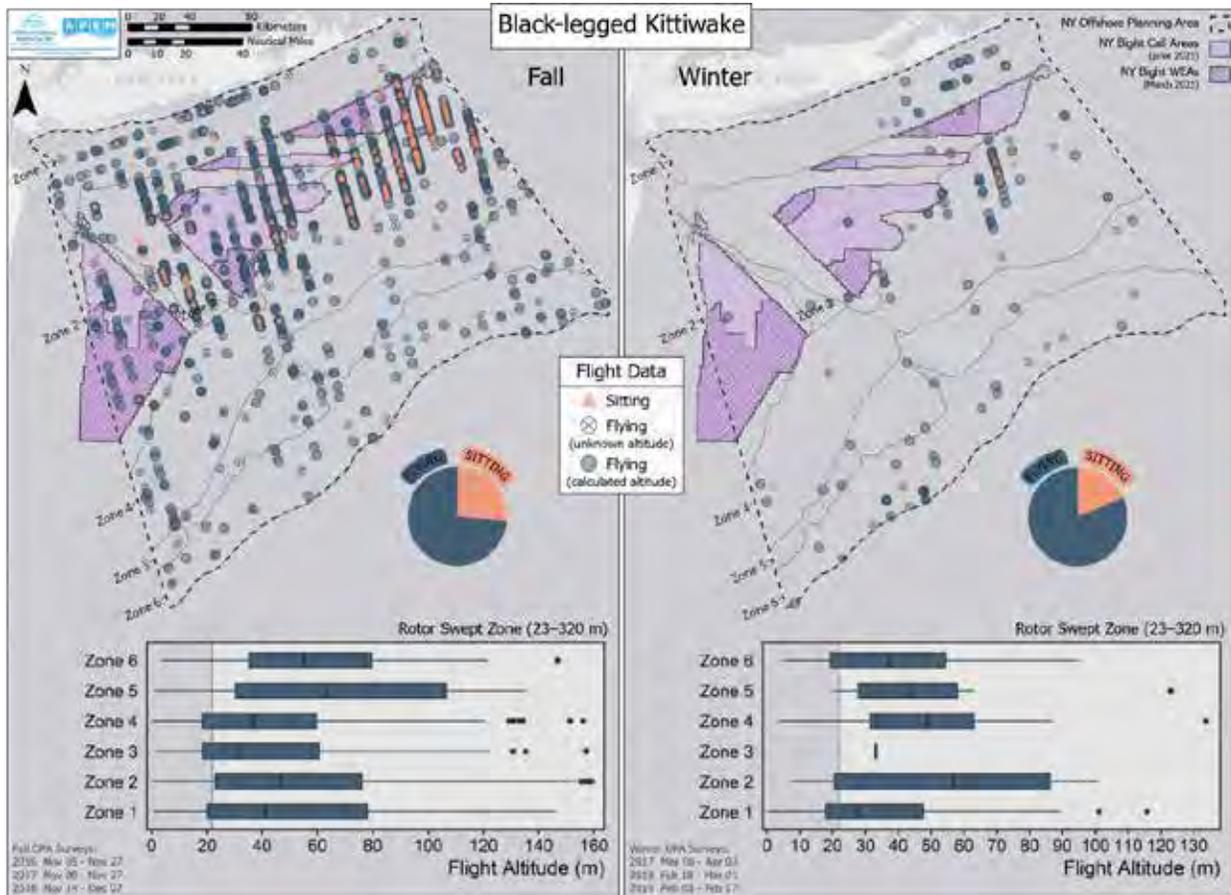


Figure 189. Spatial Distribution of Black-legged Kittiwake Sitting Relative to Birds in Flight During Spring and Summer Surveys

Solid blue points represent individuals with calculated flight height and blue points with an x represent individuals in flight without flight height data. A pie chart inset shows the proportion of individuals flying and sitting. A boxplot inset of flight height distribution by zone is displayed for all birds with known flight heights. Boxplots show the distribution of data among seasons. The dark horizontal line is the median flight height, and the box represents the middle 50% of data values. The lines to the left and right of the box represent the data points that are within 1.5 times the length of the box. Data beyond this range are shown as individual points.

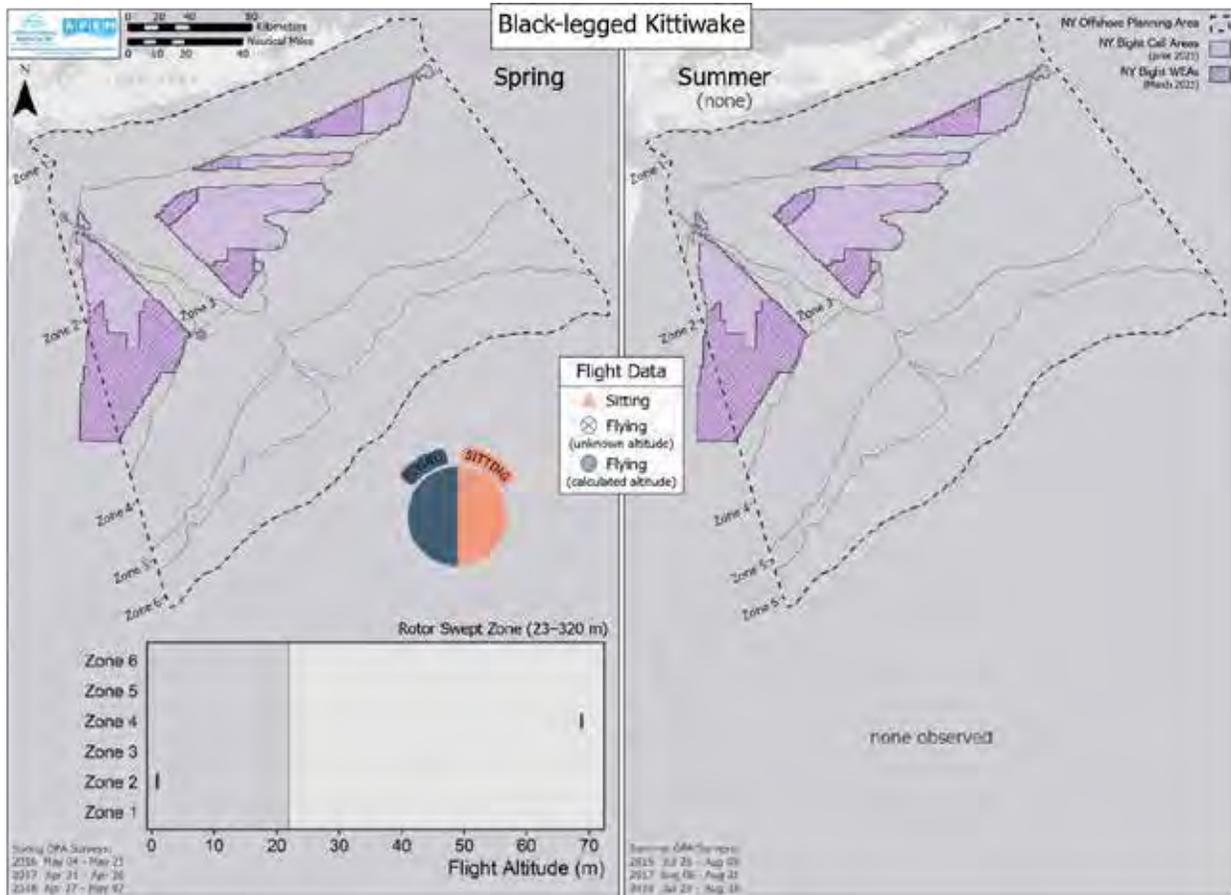


Figure 190. Direction of Flight of Black-legged Kittiwake for All Surveys

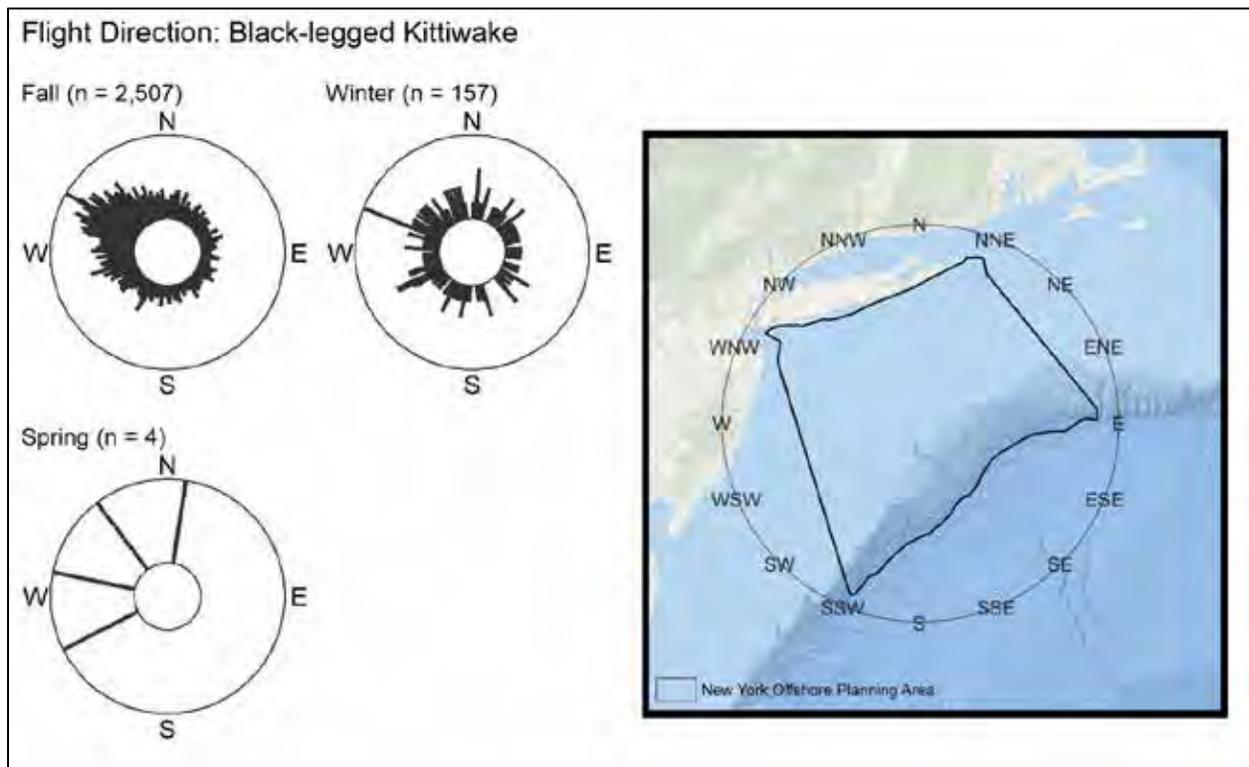


Figure 191. Spatial Distribution of Bonaparte's Gull During Fall and Winter by Zone and Proximity to Call Areas

Heat map is scaled to the maximum density for the species/species group across all seasons. Inset bar plots display mean estimated densities \pm standard error of the mean for each zone.

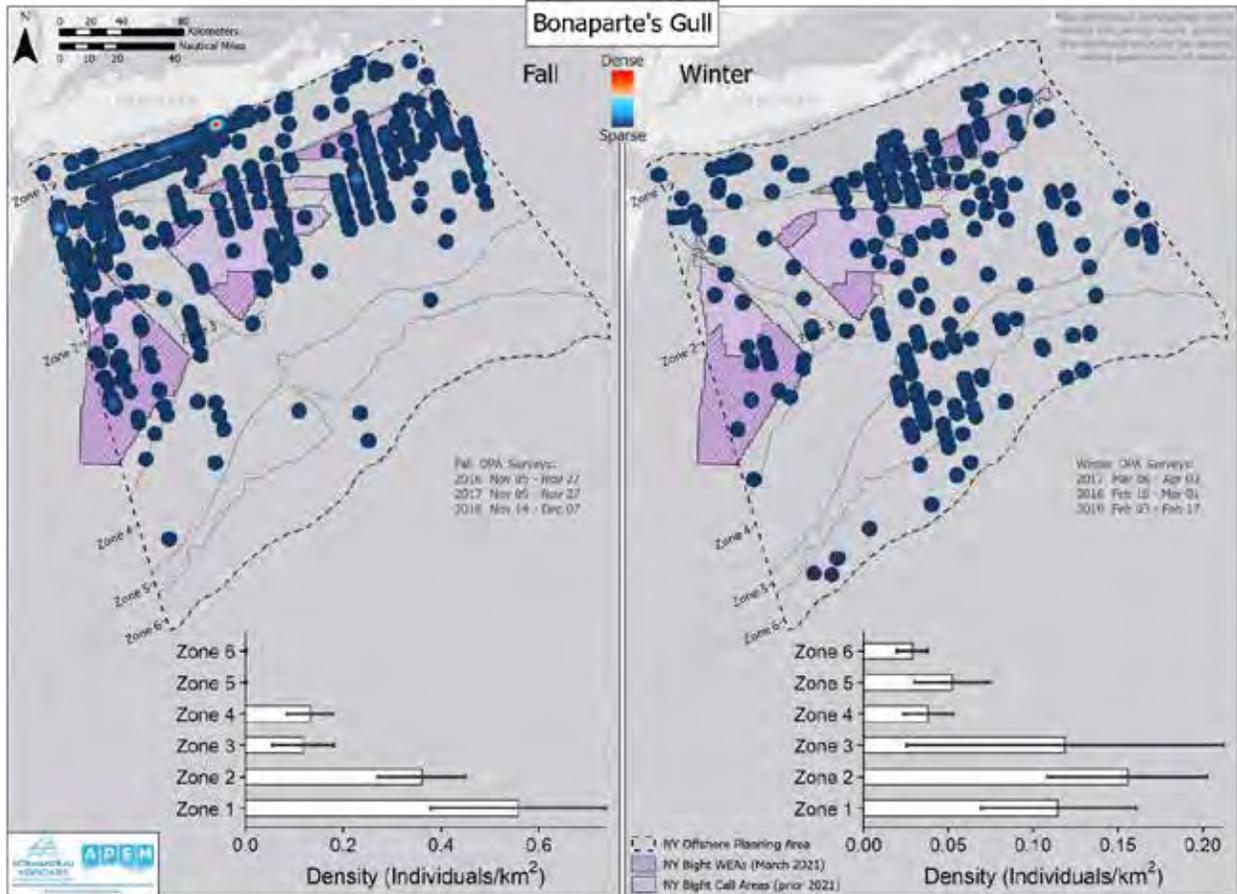


Figure 192. Spatial Distribution of Bonaparte's Gull During Spring and Summer by Zone and Proximity to Call Areas

Heat map is scaled to the maximum density for the species/species group across all seasons. Inset bar plots display mean estimated densities \pm standard error of the mean for each zone.

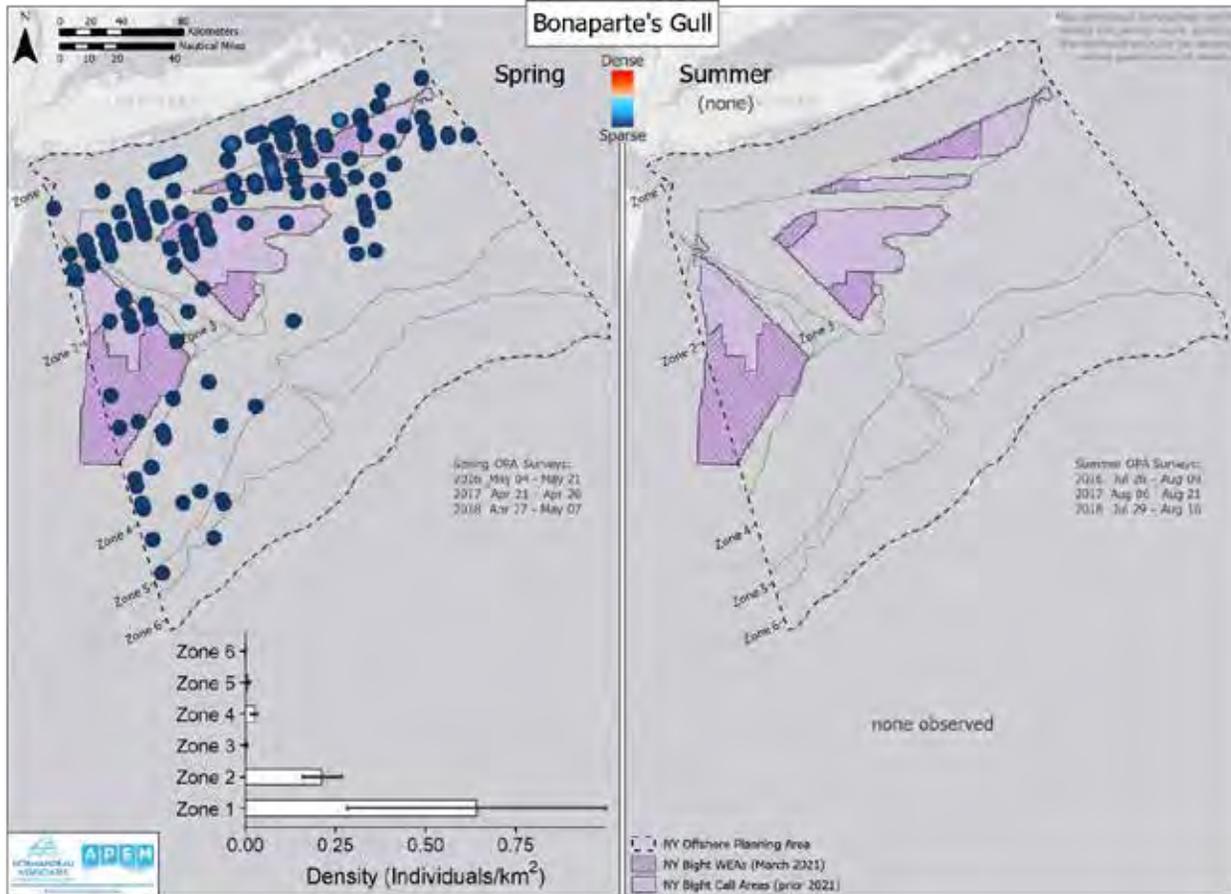


Figure 193. Spatial Distribution of Bonaparte's Gull Sitting Relative to Birds in Flight During Fall and Winter Surveys

Solid blue points represent individuals with calculated flight height and blue points with an x represent individuals in flight without flight height data. A pie chart inset shows the proportion of individuals flying and sitting. A boxplot inset of flight height distribution by zone is displayed for all birds with known flight heights. Boxplots show the distribution of data among seasons. The dark horizontal line is the median flight height, the box represents the middle 50% of data values. The lines to the left and right of the box represent the data points that are within 1.5 times the length of the box. Data beyond this range are shown as individual points.

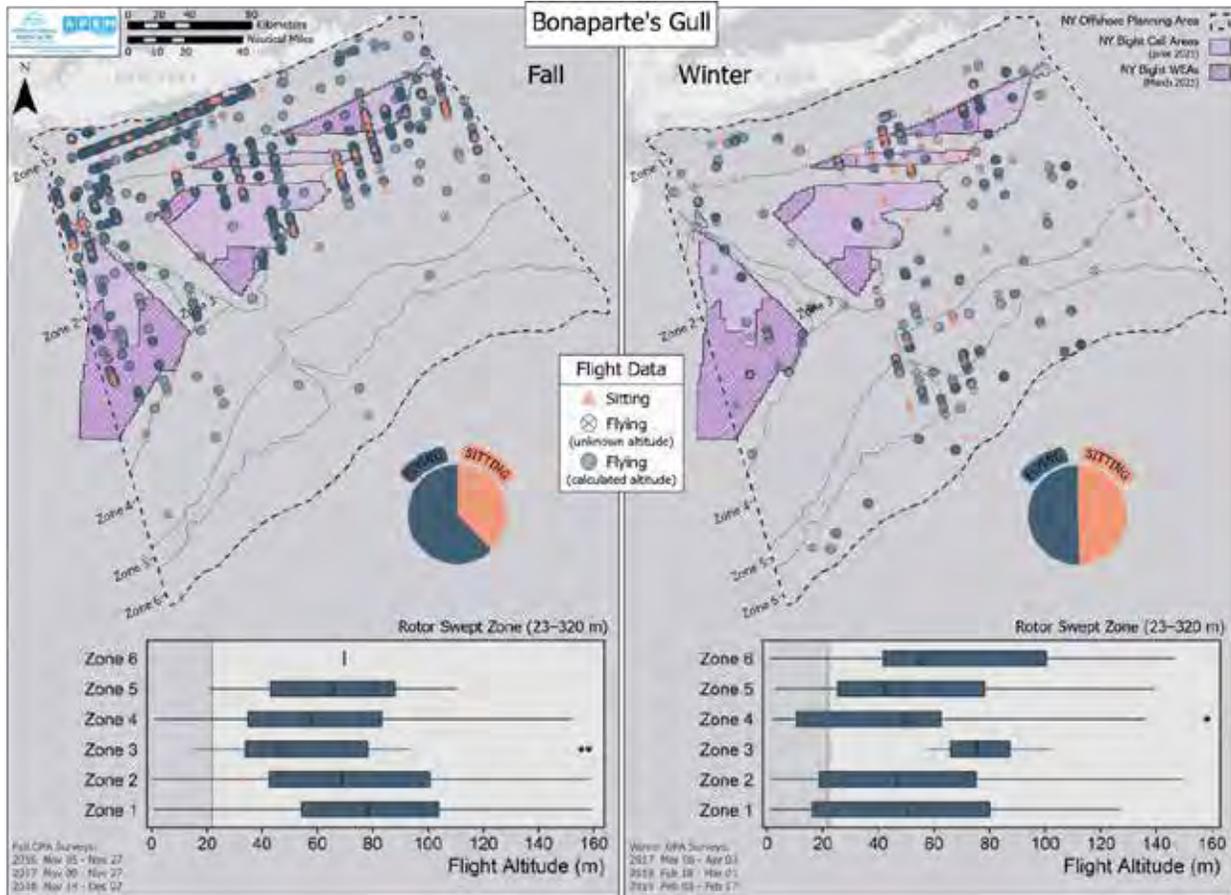


Figure 194. Spatial Distribution of Bonaparte's Gull Sitting Relative to Birds in Flight During Spring and Summer Surveys

Solid blue points represent individuals with calculated flight height and blue points with an x represent individuals in flight without flight height data. A pie chart inset shows the proportion of individuals flying and sitting. A boxplot inset of flight height distribution by zone is displayed for all birds with known flight heights. Boxplots show the distribution of data among seasons. The dark horizontal line is the median flight height, the box represents the middle 50% of data values. The lines to the left and right of the box represent the data points that are within 1.5 times the length of the box. Data beyond this range are shown as individual points.

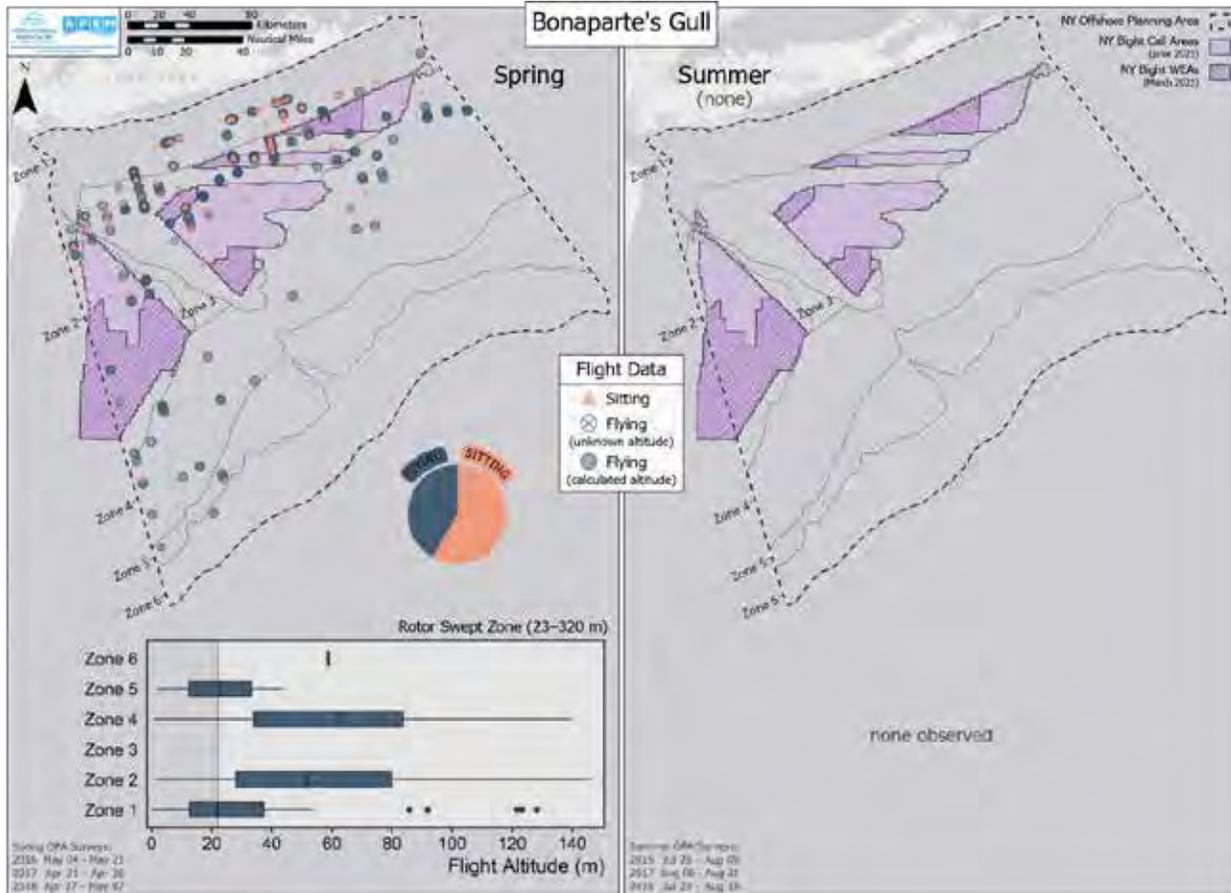


Figure 195. Direction of Flight of Bonaparte's Gull for All Surveys

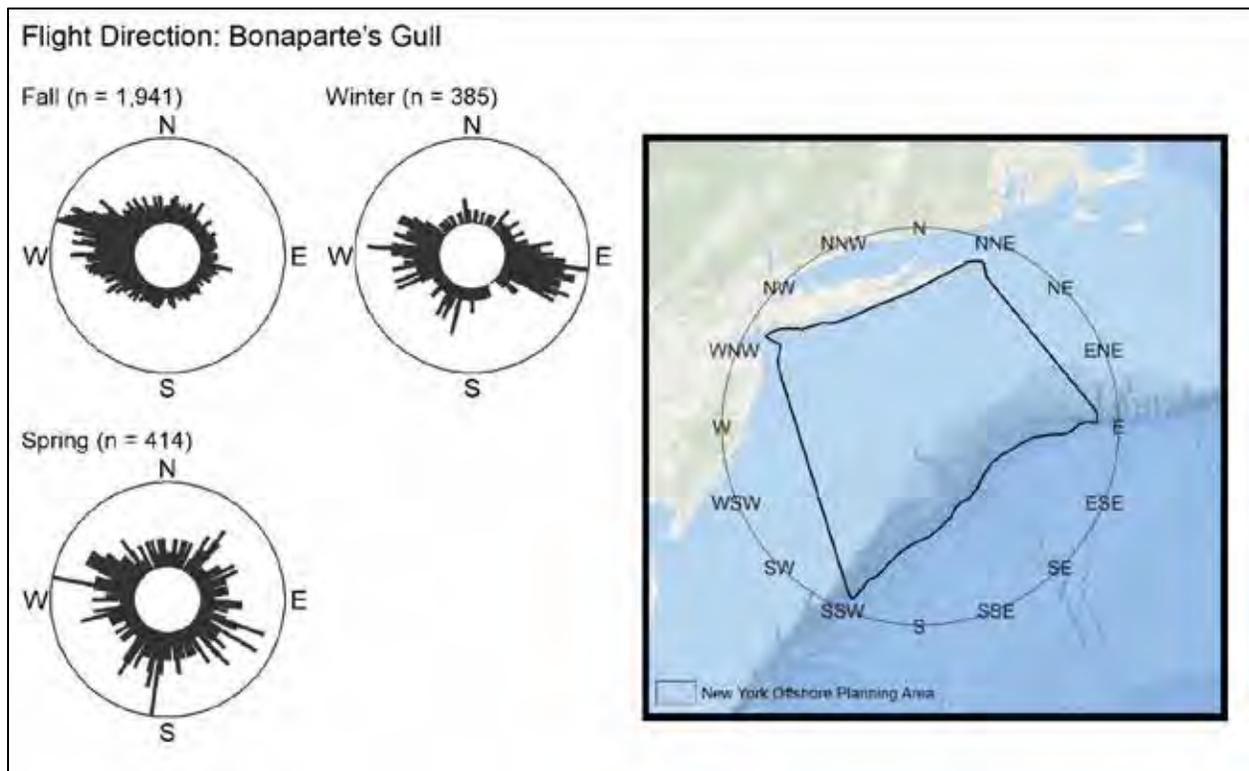


Figure 196. Spatial Distribution of Laughing Gull During Fall and Winter by Zone and Proximity to Call Areas

Heat map is scaled to the maximum density for the species/species group across all seasons. Inset bar plots display mean estimated densities \pm standard error of the mean for each zone.

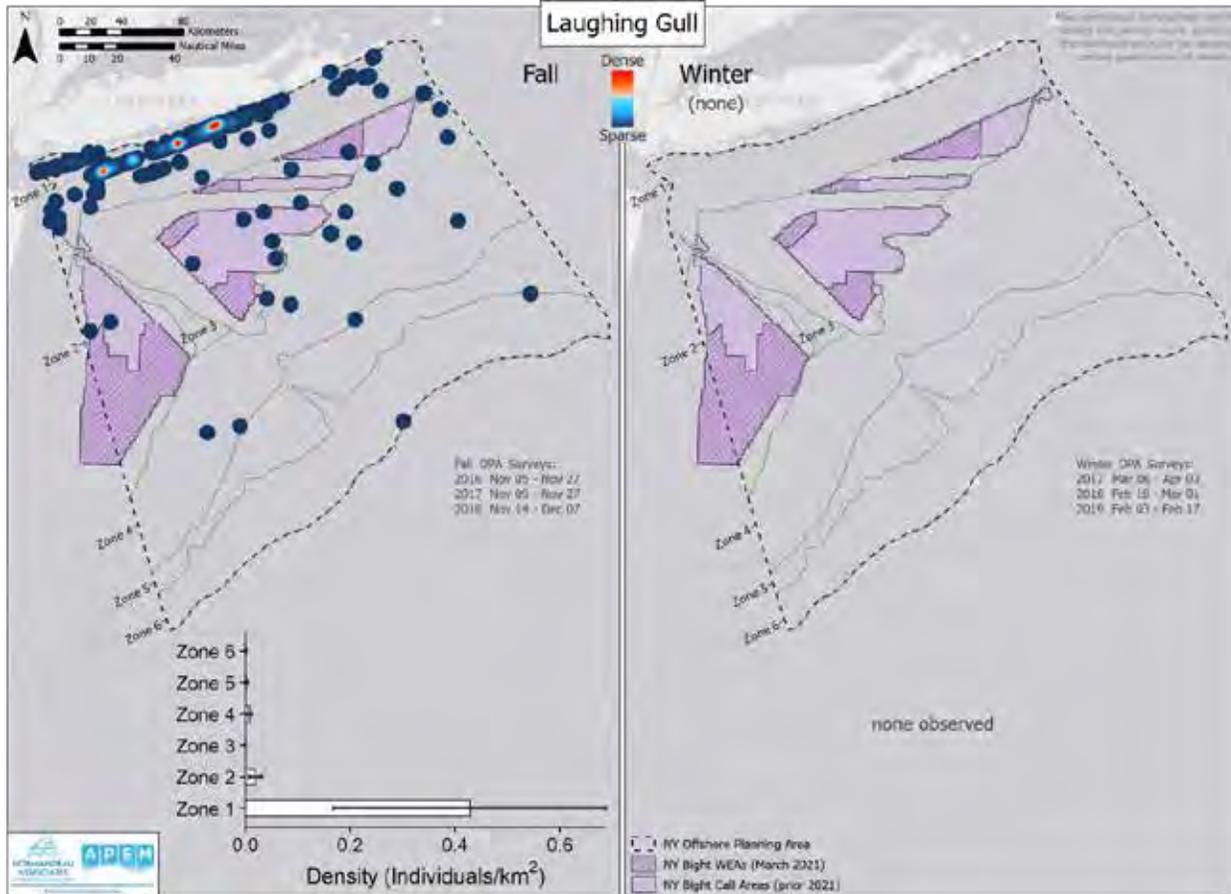


Figure 197. Spatial Distribution of Laughing Gull During Spring and Summer by Zone and Proximity to Call Areas

Heat map is scaled to the maximum density for the species/species group across all seasons. Inset bar plots display mean estimated densities \pm standard error of the mean for each zone.

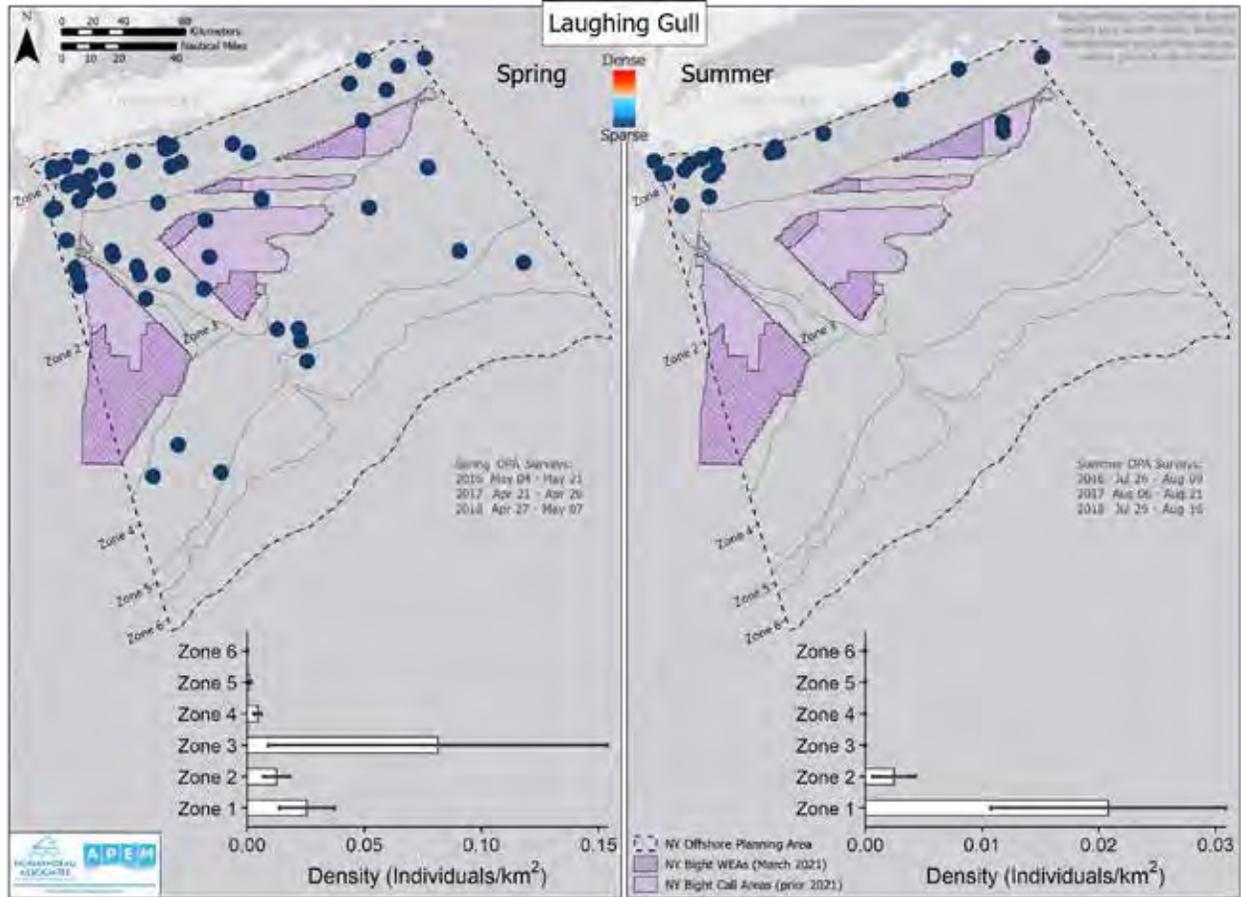


Figure 198. Spatial Distribution of Laughing Gull Sitting Relative to Birds in Flight During Fall and Winter Surveys

Solid blue points represent individuals with calculated flight height and blue points with an x represent individuals in flight without flight height data. A pie chart inset shows the proportion of individuals flying and sitting. A boxplot inset of flight height distribution by zone is displayed for all birds with known flight heights. Boxplots show the distribution of data among seasons. The dark horizontal line is the median flight height, and the box represents the middle 50% of data values. The lines to the left and right of the box represent the data points that are within 1.5 times the length of the box. Data beyond this range are shown as individual points.

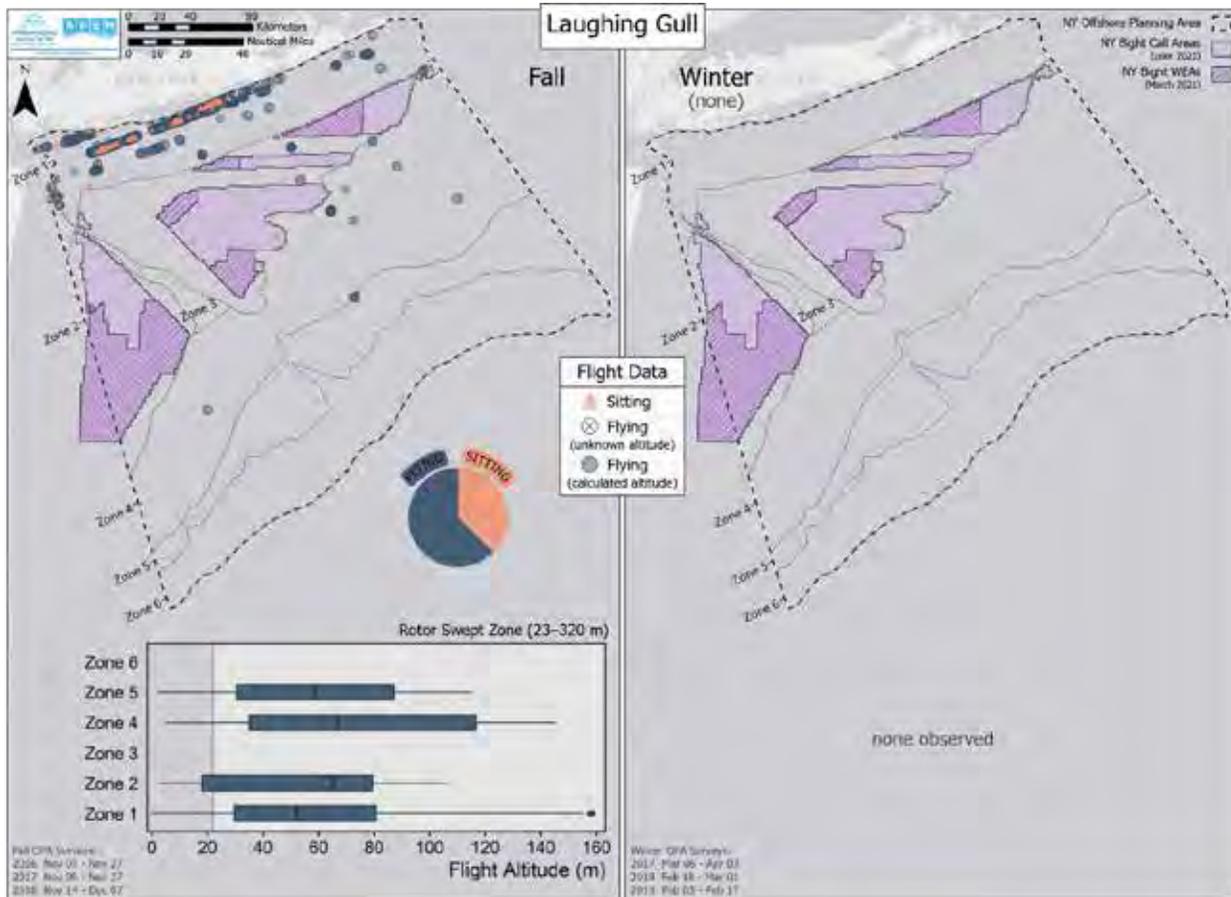


Figure 199. Spatial Distribution of Laughing Gull Sitting Relative to Birds in Flight During Spring and Summer Surveys

Solid blue points represent individuals with calculated flight height and blue points with an x represent individuals in flight without flight height data. A pie chart inset shows the proportion of individuals flying and sitting. A boxplot inset of flight height distribution by zone is displayed for all birds with known flight heights. Boxplots show the distribution of data among seasons. The dark horizontal line is the median flight height, and the box represents the middle 50% of data values. The lines to the left and right of the box represent the data points that are within 1.5 times the length of the box. Data beyond this range are shown as individual points.

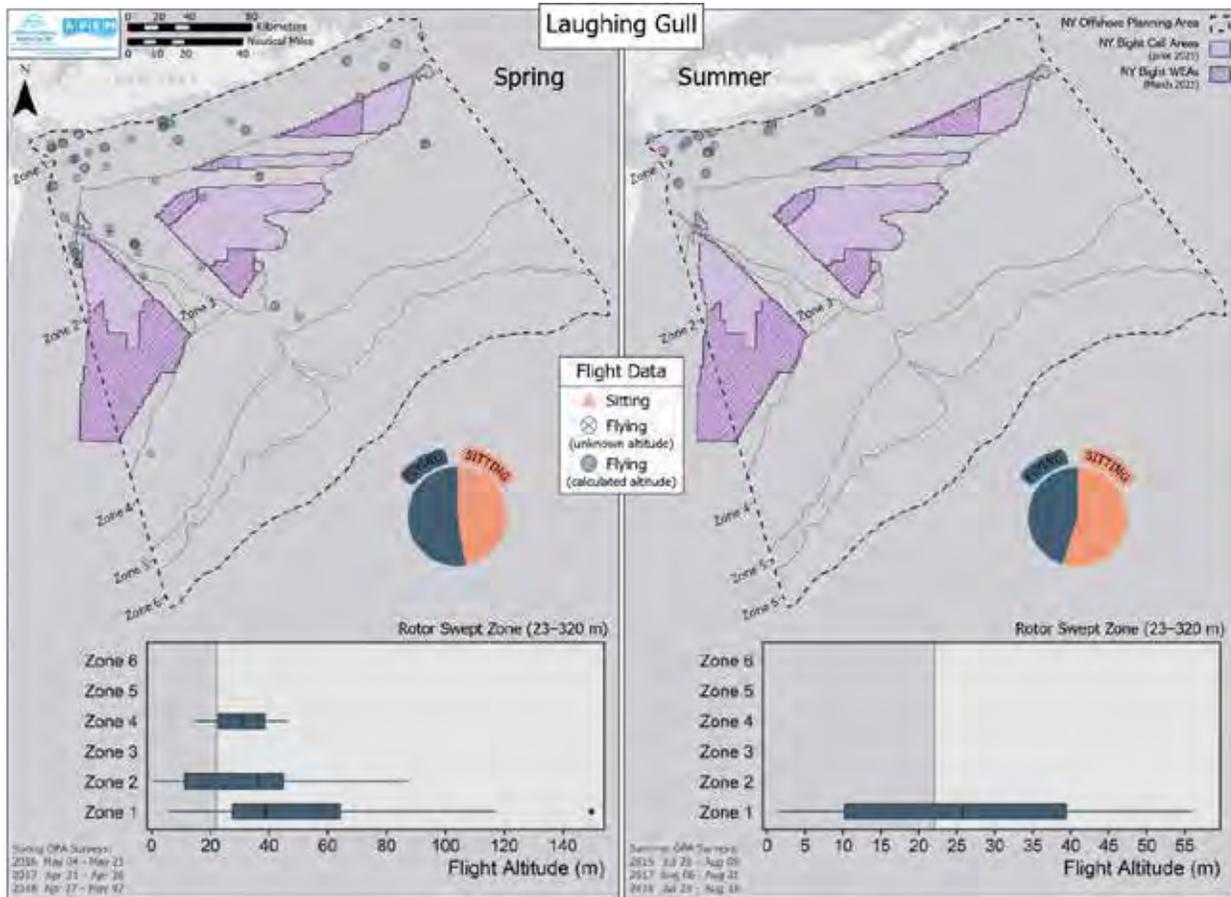


Figure 200. Direction of Flight of Laughing Gull for All Surveys

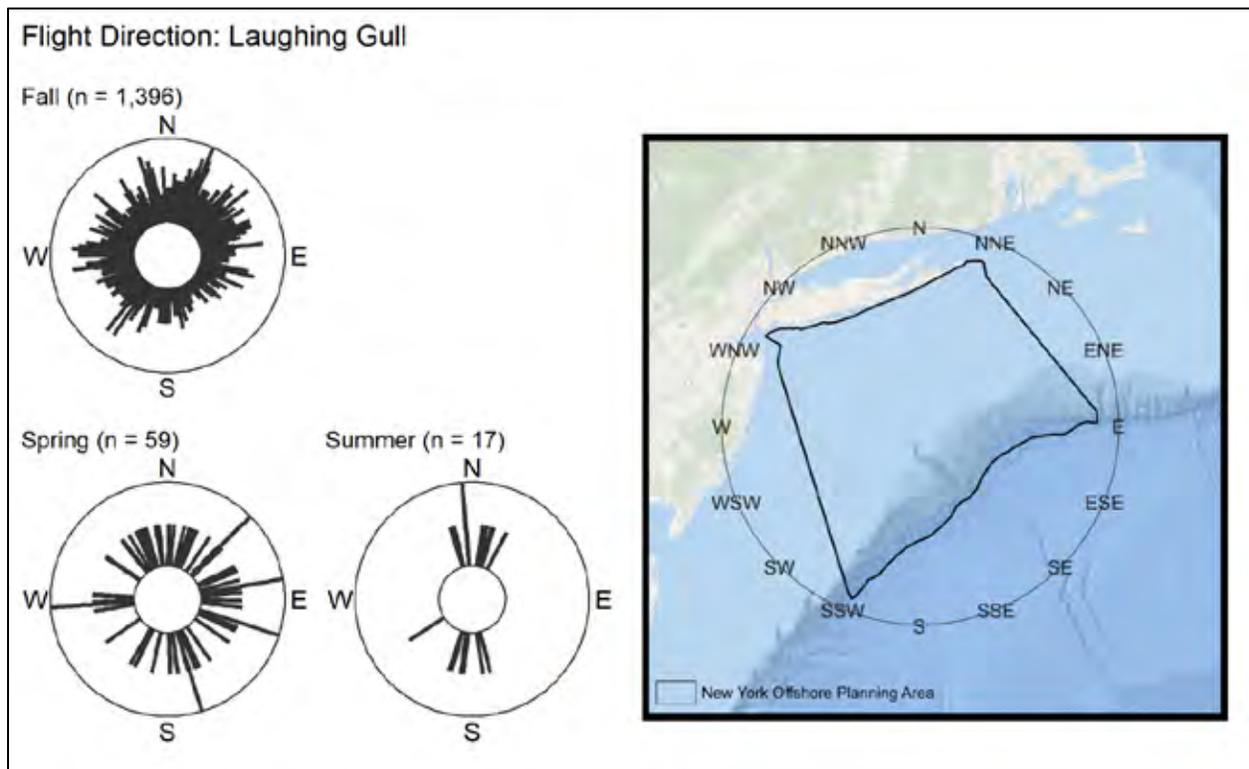


Figure 201. Spatial Distribution of Ring-billed Gull During Fall and Winter by Zone and Proximity to Call Areas

Heat map is scaled to the maximum density for the species/species group across all seasons. Inset bar plots display mean estimated densities \pm standard error of the mean for each zone.

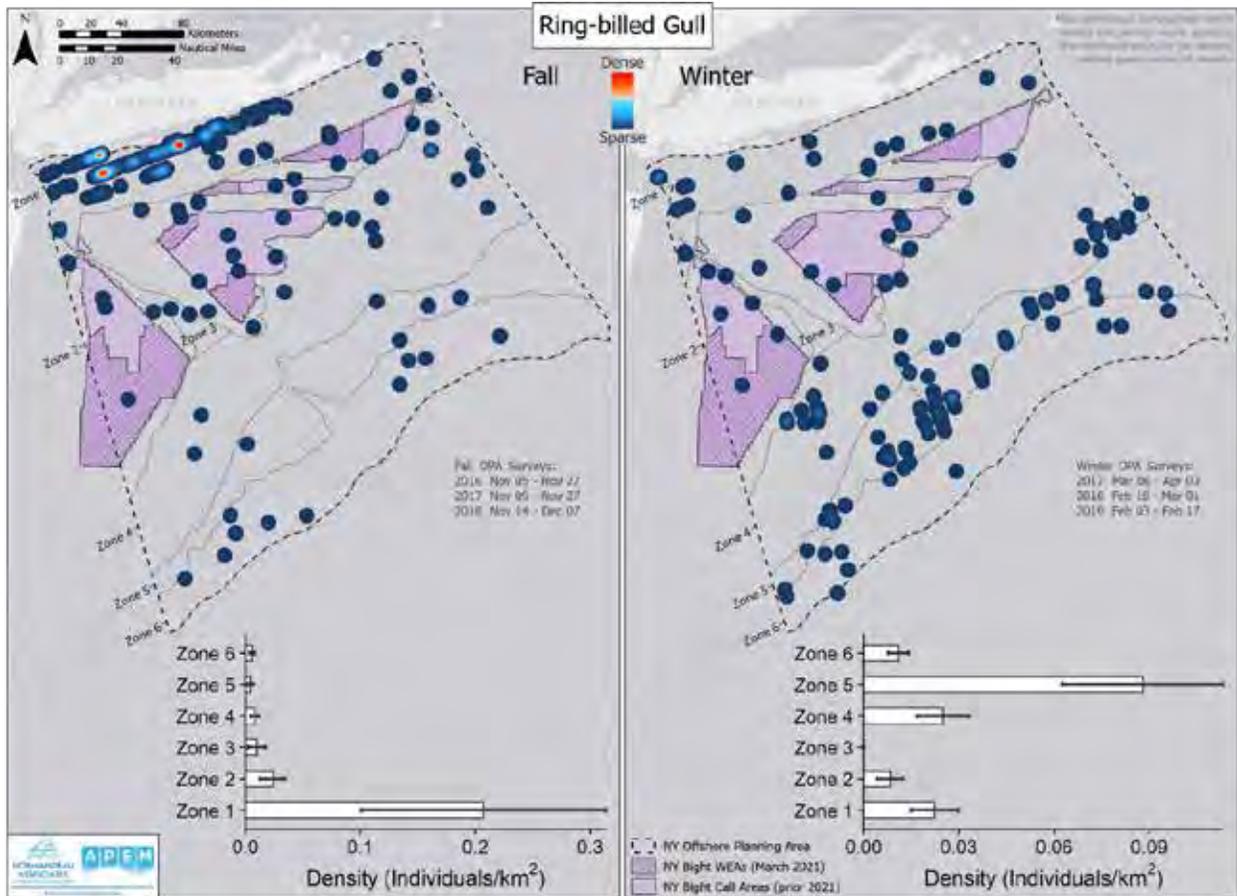


Figure 202. Spatial Distribution of Ring-billed Gull During Spring and Summer by Zone and Proximity to Call Areas

Heat map is scaled to the maximum density for the species/species group across all seasons. Inset bar plots display mean estimated densities \pm standard error of the mean for each zone.

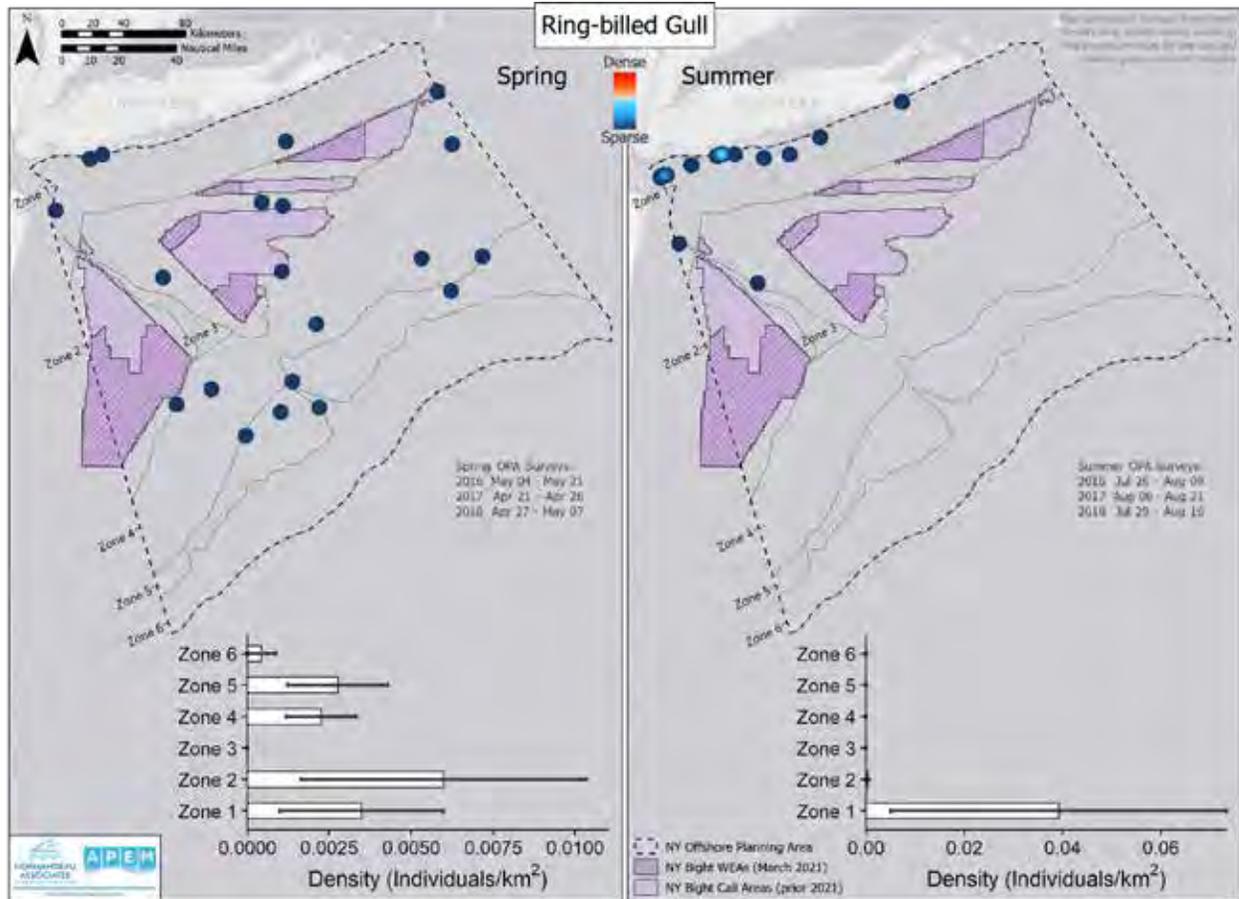


Figure 203. Spatial Distribution of Ring-billed Gull Sitting Relative to Birds in Flight During Fall and Winter Surveys

Solid blue points represent individuals with calculated flight height and blue points with an x represent individuals in flight without flight height data. A pie chart inset shows the proportion of individuals flying and sitting. A boxplot inset of flight height distribution by zone is displayed for all birds with known flight heights. Boxplots show the distribution of data among seasons. The dark horizontal line is the median flight height, the box represents the middle 50% of data values. The lines to the left and right of the box represent the data points that are within 1.5 times the length of the box. Data beyond this range are shown as individual points.

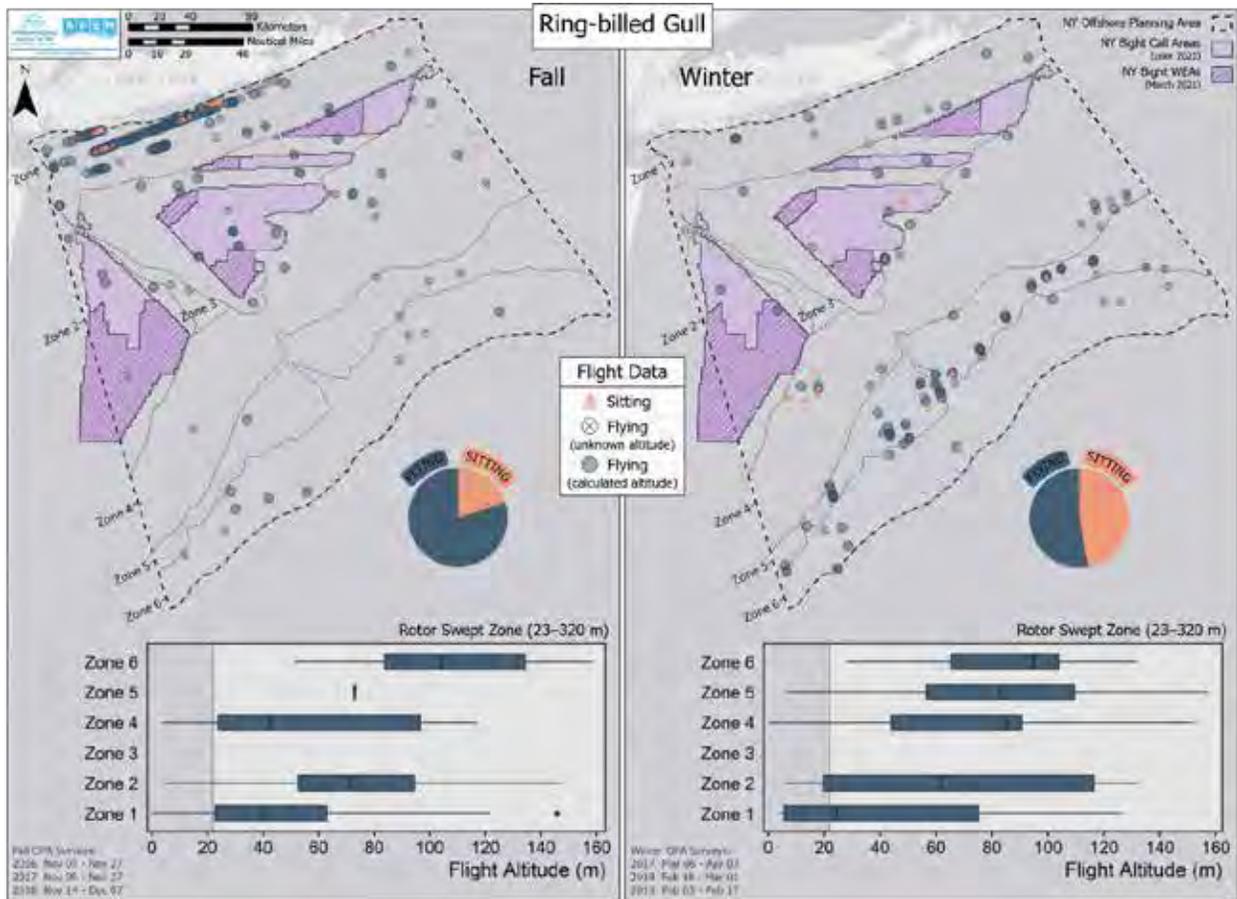


Figure 204. Spatial Distribution of Ring-billed Gull Sitting Relative to Birds in Flight During Spring and Summer Surveys

Solid blue points represent individuals with calculated flight height and blue points with an x represent individuals in flight without flight height data. A pie chart inset shows the proportion of individuals flying and sitting. A boxplot inset of flight height distribution by zone is displayed for all birds with known flight heights. Boxplots show the distribution of data among seasons. The dark horizontal line is the median flight height, and the box represents the middle 50% of data values. The lines to the left and right of the box represent the data points that are within 1.5 times the length of the box. Data beyond this range are shown as individual points.

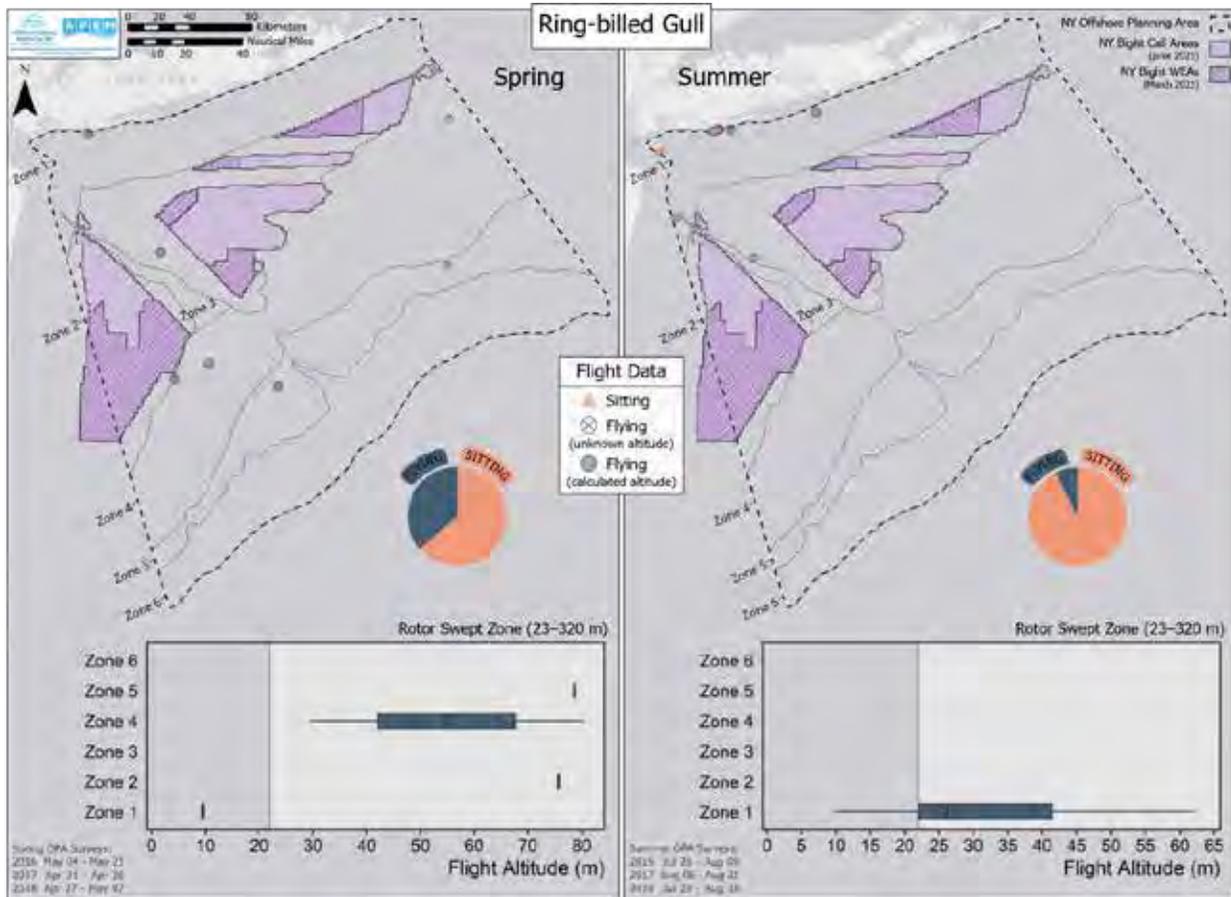


Figure 205. Direction of Flight of Ring-billed Gull for All Surveys

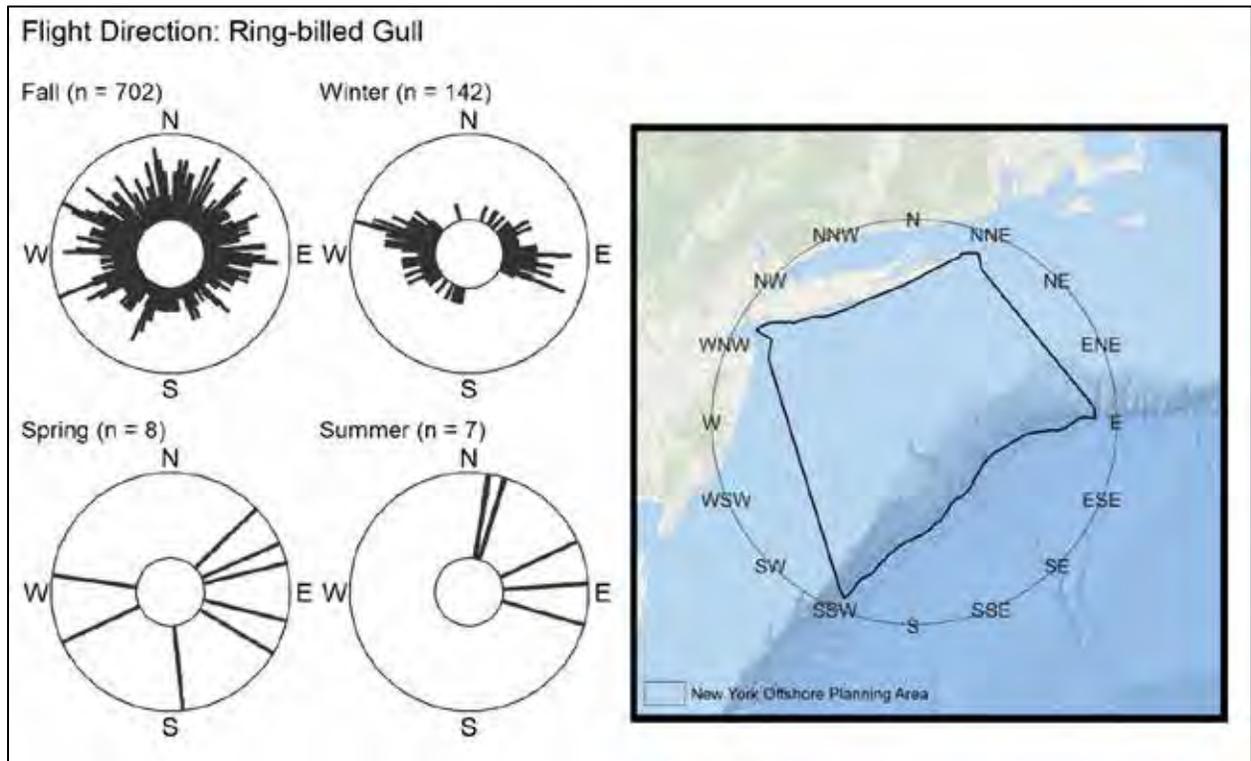


Figure 206. Spatial Distribution of Herring Gull During Fall and Winter by Zone and Proximity to Call Areas

Heat map is scaled to the maximum density for the species/species group across all seasons. Inset bar plots display mean estimated densities \pm standard error of the mean for each zone.

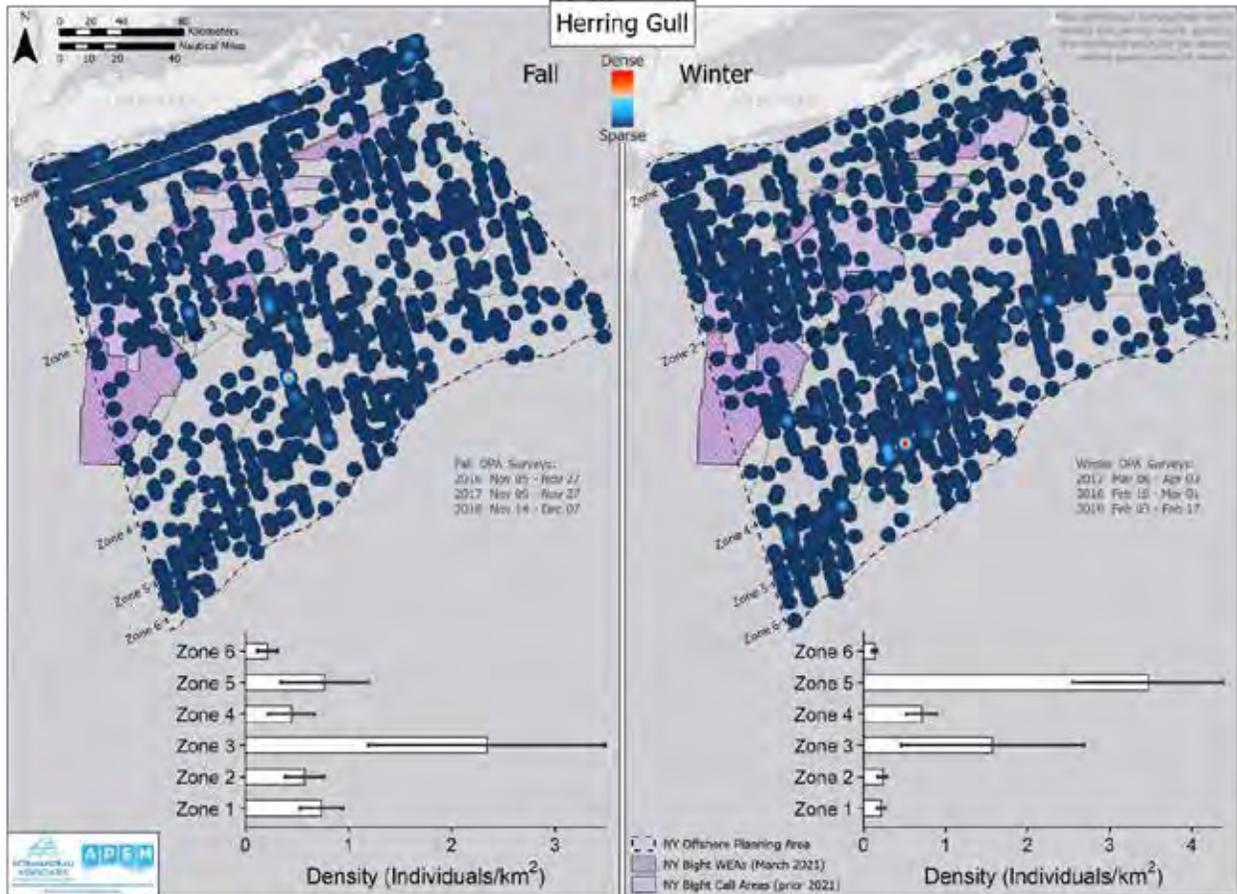


Figure 207. Spatial Distribution of Herring Gull During Spring and Summer by Zone and Proximity to Call Areas

Heat map is scaled to the maximum density for the species/species group across all seasons. Inset bar plots display mean estimated densities \pm standard error of the mean for each zone.

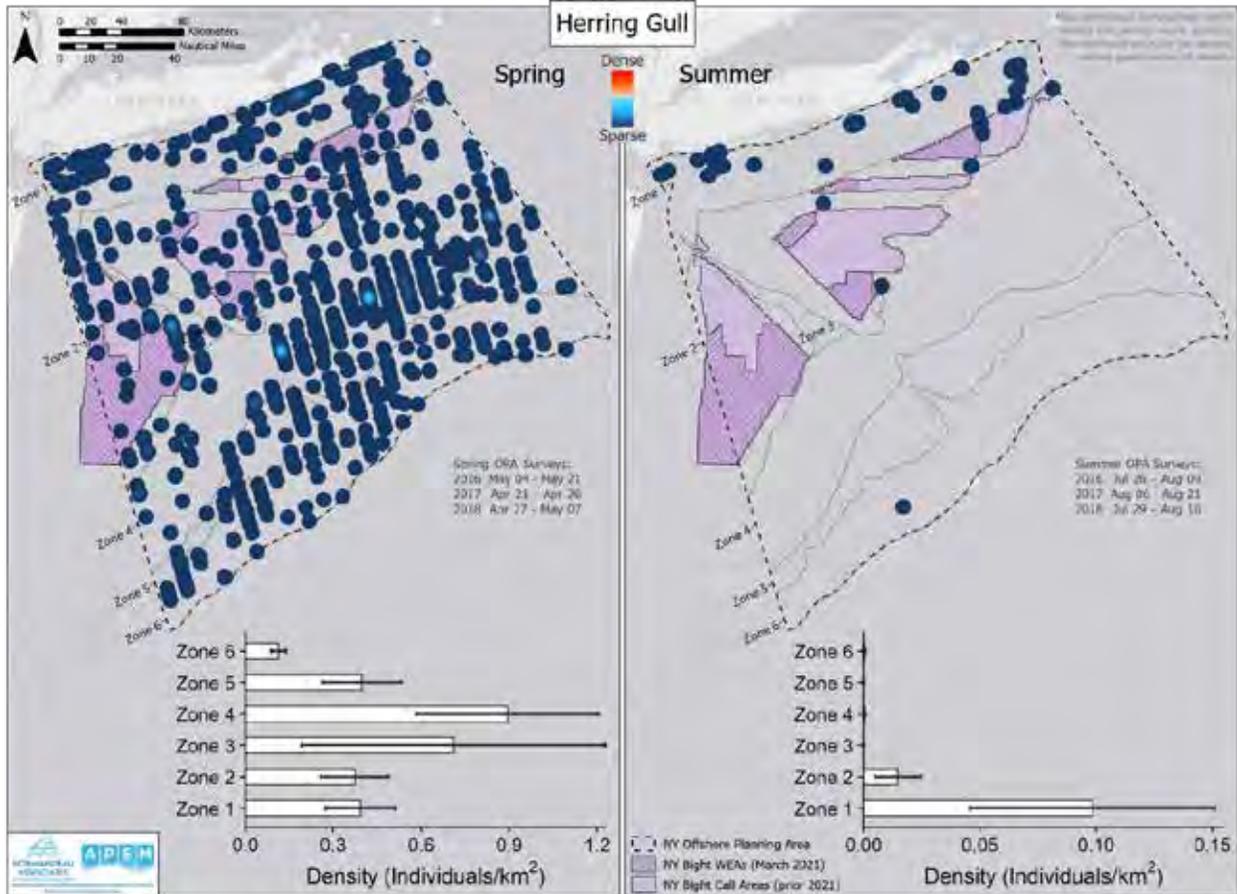


Figure 208. Spatial Distribution of Herring Gull Sitting Relative to Birds in Flight During Fall and Winter Surveys

Solid blue points represent individuals with calculated flight height and blue points with an x represent individuals in flight without flight height data. A pie chart inset shows the proportion of individuals flying and sitting. A boxplot inset of flight height distribution by zone is displayed for all birds with known flight heights. Boxplots show the distribution of data among seasons. The dark horizontal line is the median flight height, and the box represents the middle 50% of data values. The lines to the left and right of the box represent the data points that are within 1.5 times the length of the box. Data beyond this range are shown as individual points.

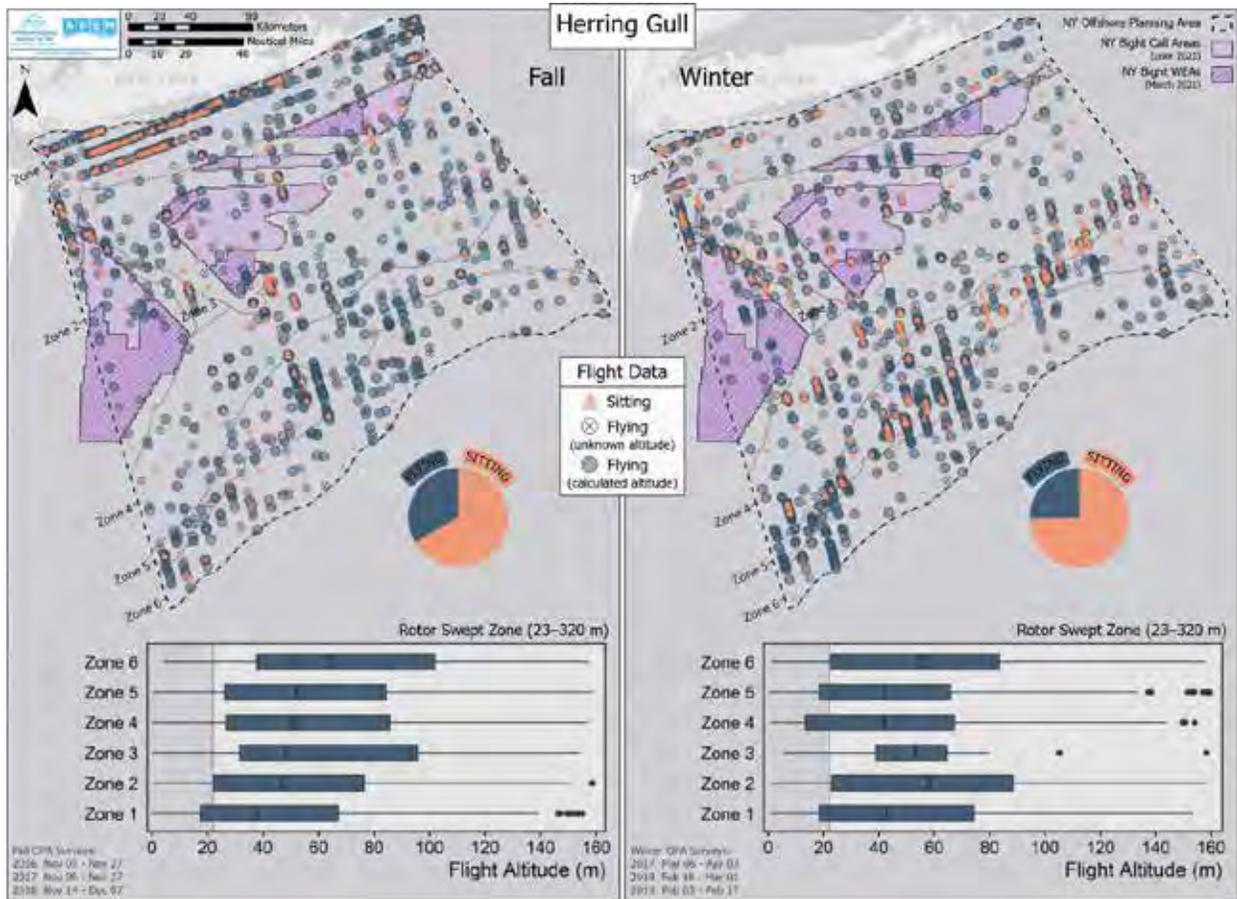


Figure 209. Spatial Distribution of Herring Gull Sitting Relative to Birds in Flight During Spring and Summer Surveys

Solid blue points represent individuals with calculated flight height and blue points with an x represent individuals in flight without flight height data. A pie chart inset shows the proportion of individuals flying and sitting. A boxplot inset of flight height distribution by zone is displayed for all birds with known flight heights. Boxplots show the distribution of data among seasons. The dark horizontal line is the median flight height, the box represents the middle 50% of data values. The lines to the left and right of the box represent the data points that are within 1.5 times the length of the box. Data beyond this range are shown as individual points.

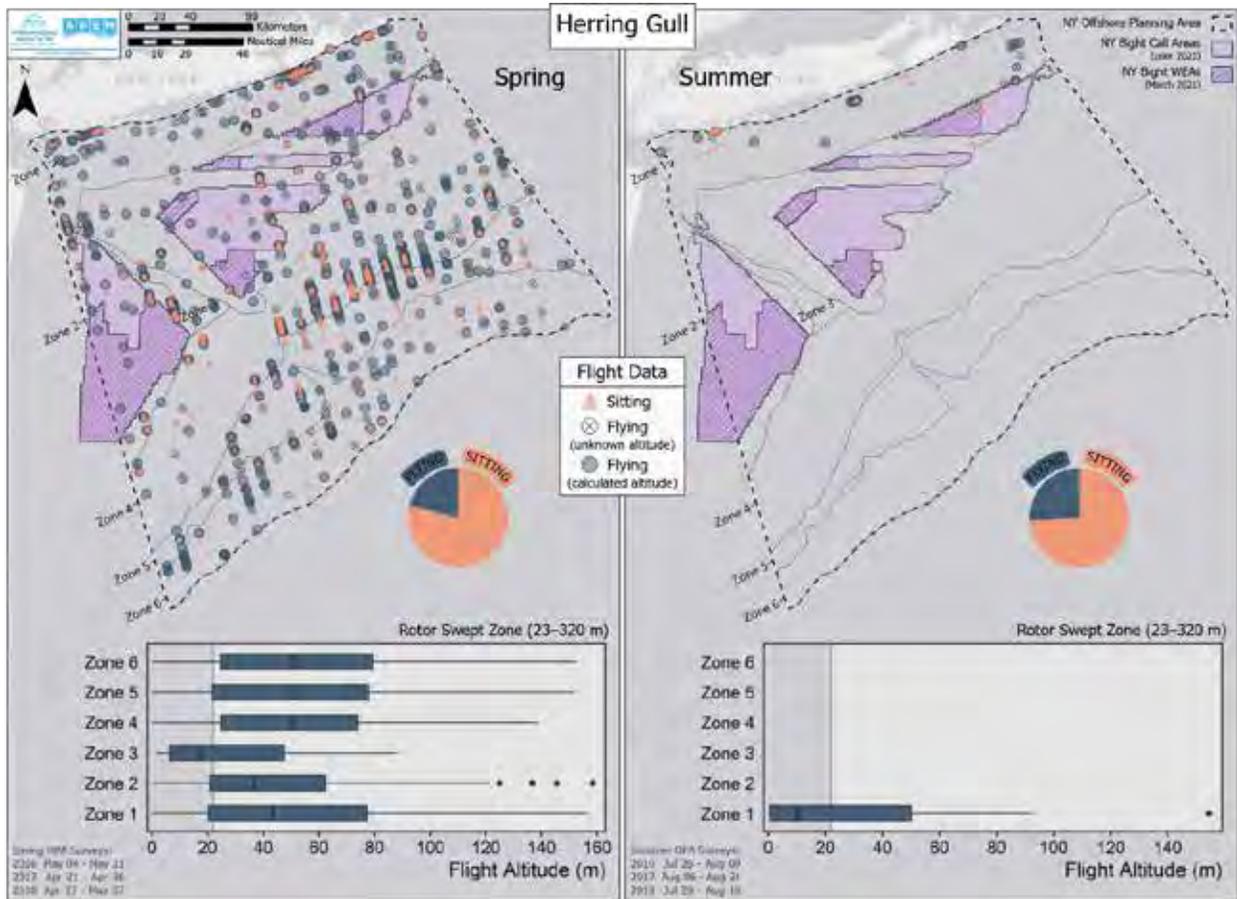


Figure 210. Direction of Flight of Herring Gull for All Surveys

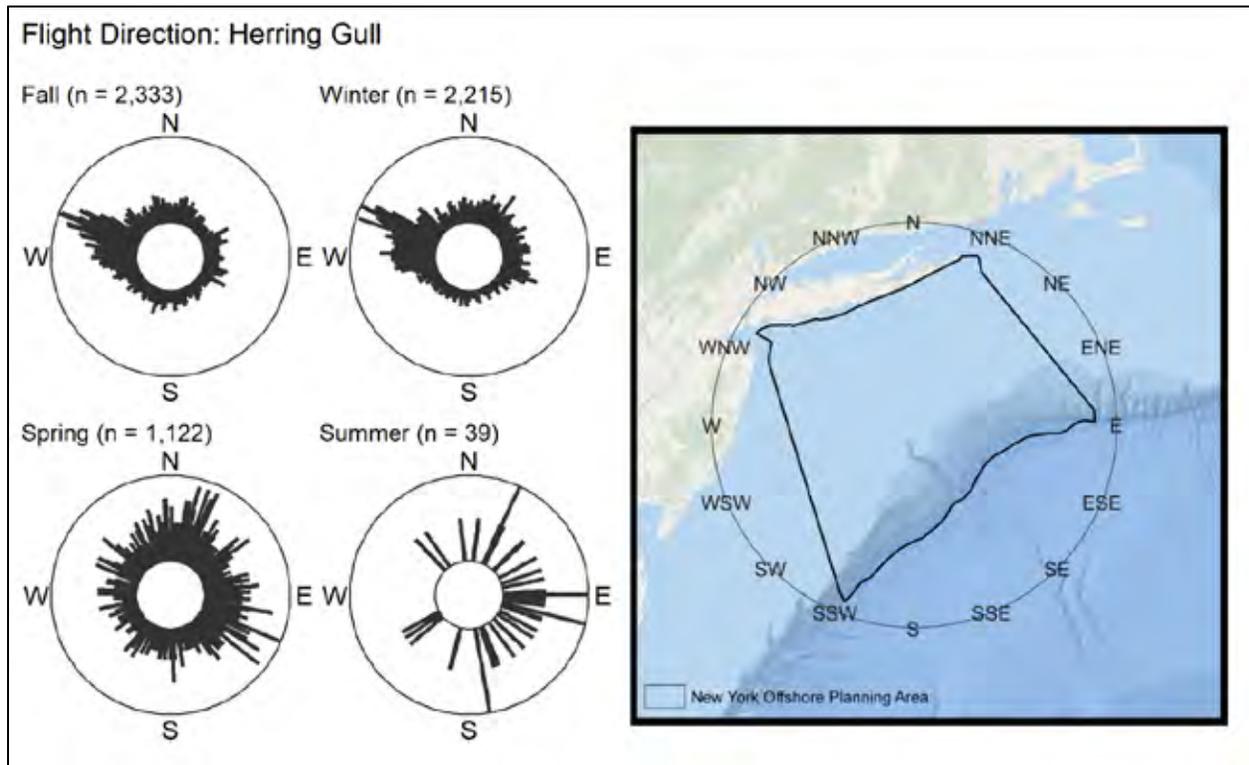


Figure 211. Spatial Distribution of Lesser Black-backed Gull During Fall and Winter by Zone and Proximity to Call Areas

Heat map is scaled to the maximum density for the species/species group across all seasons. Inset bar plots display mean estimated densities \pm standard error of the mean for each zone.

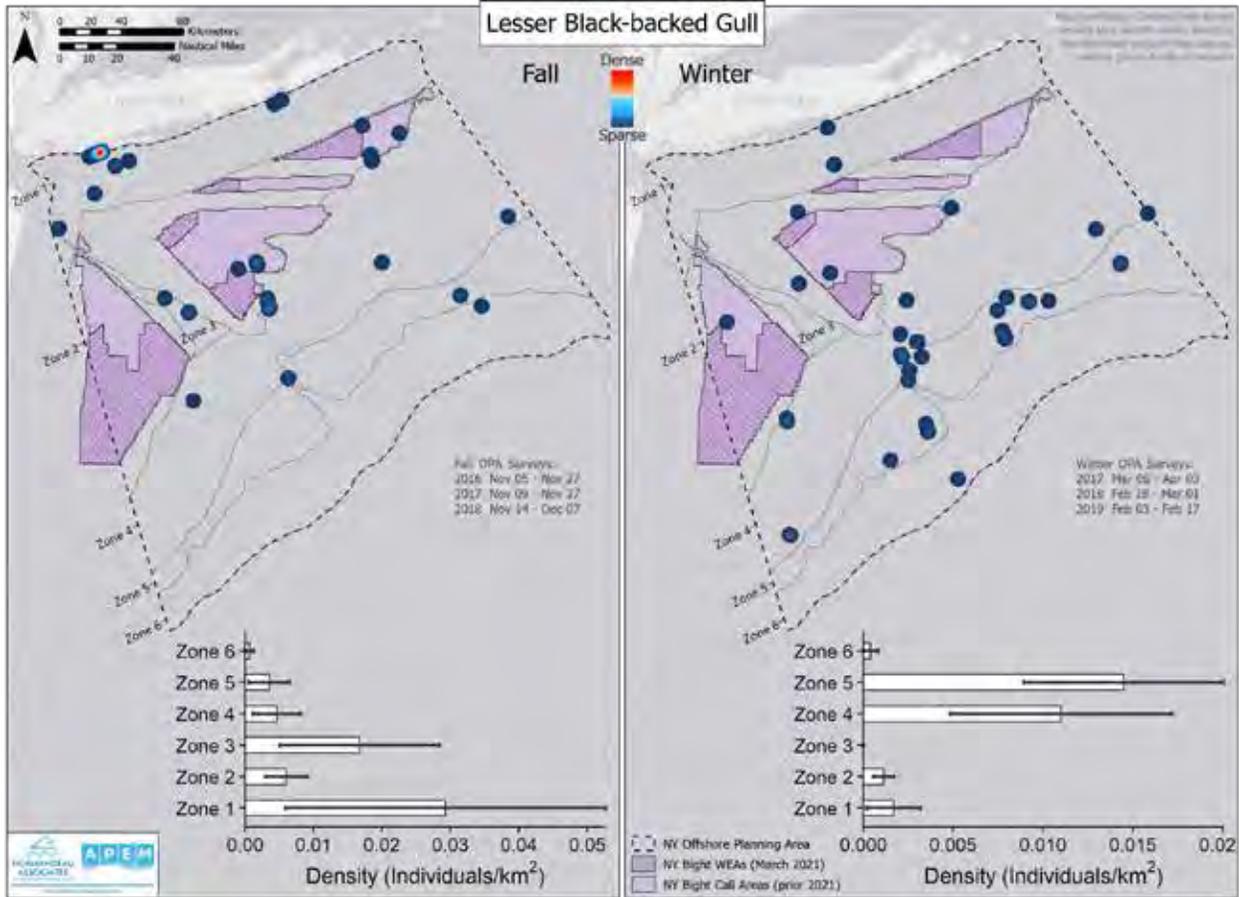


Figure 212. Spatial Distribution of Lesser Black-backed Gull During Spring and Summer by Zone and Proximity to Call Areas

Heat map is scaled to the maximum density for the species/species group across all seasons. Inset bar plots display mean estimated densities \pm standard error of the mean for each zone.

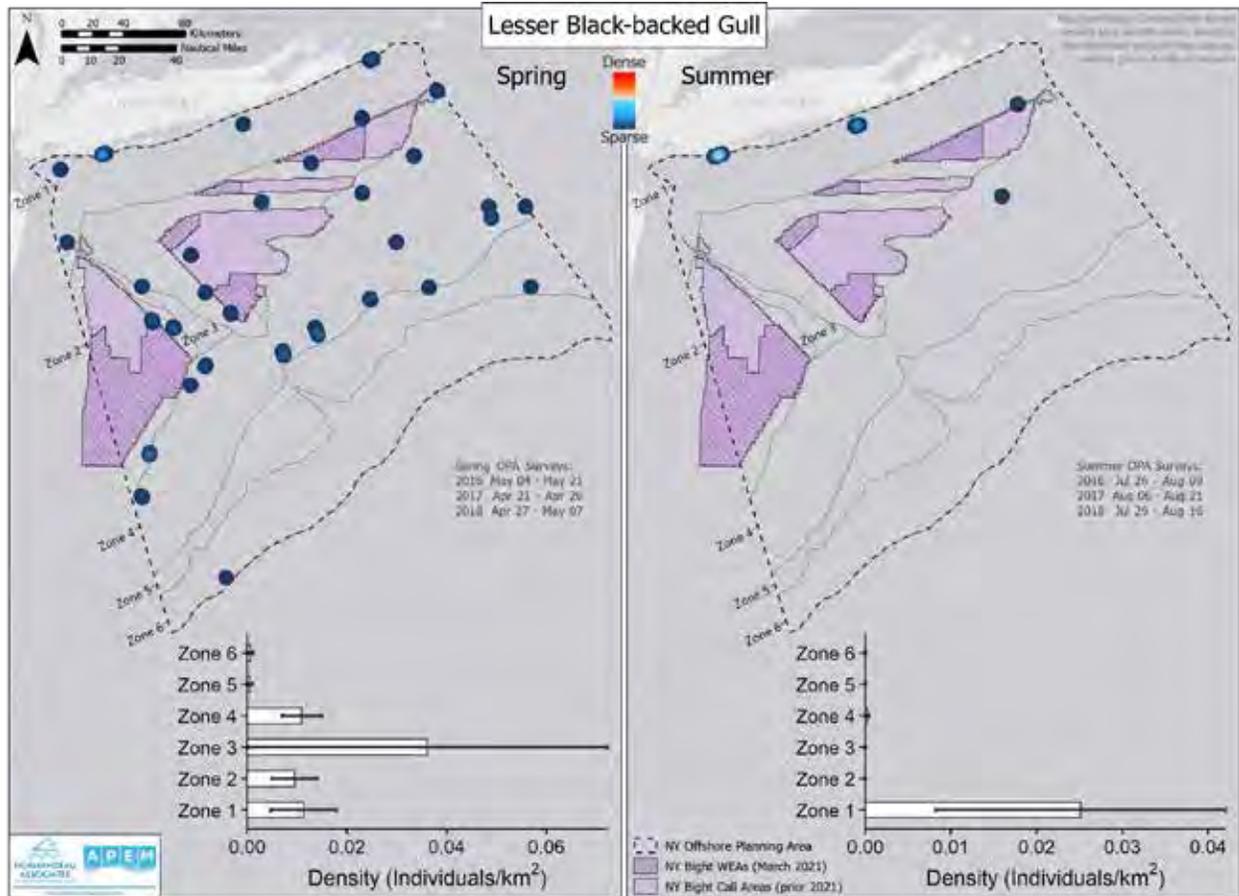


Figure 213. Spatial Distribution of Lesser Black-backed Gull Sitting Relative to Birds in Flight During Fall and Winter Surveys

Solid blue points represent individuals with calculated flight height and blue points with an x represent individuals in flight without flight height data. A pie chart inset shows the proportion of individuals flying and sitting. A boxplot inset of flight height distribution by zone is displayed for all birds with known flight heights. Boxplots show the distribution of data among seasons. The dark horizontal line is the median flight height, and the box represents the middle 50% of data values. The lines to the left and right of the box represent the data points that are within 1.5 times the length of the box. Data beyond this range are shown as individual points.

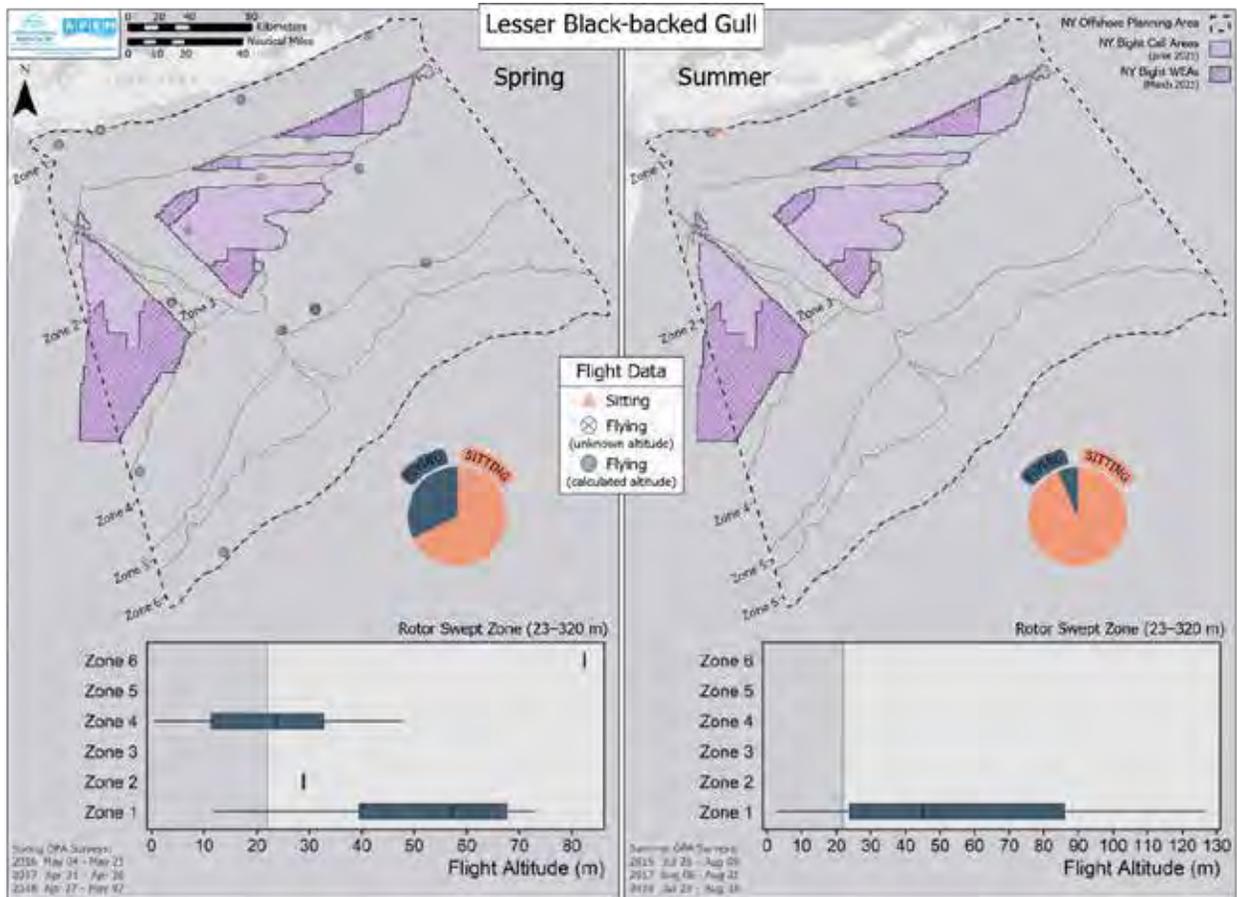


Figure 214. Spatial Distribution of Lesser Black-backed Gull Sitting Relative to Birds in Flight During Spring and Summer Surveys

Solid blue points represent individuals with calculated flight height and blue points with an x represent individuals in flight without flight height data. A pie chart inset shows the proportion of individuals flying and sitting. A boxplot inset of flight height distribution by zone is displayed for all birds with known flight heights. Boxplots show the distribution of data among seasons. The dark horizontal line is the median flight height, and the box represents the middle 50% of data values. The lines to the left and right of the box represent the data points that are within 1.5 times the length of the box. Data beyond this range are shown as individual points.

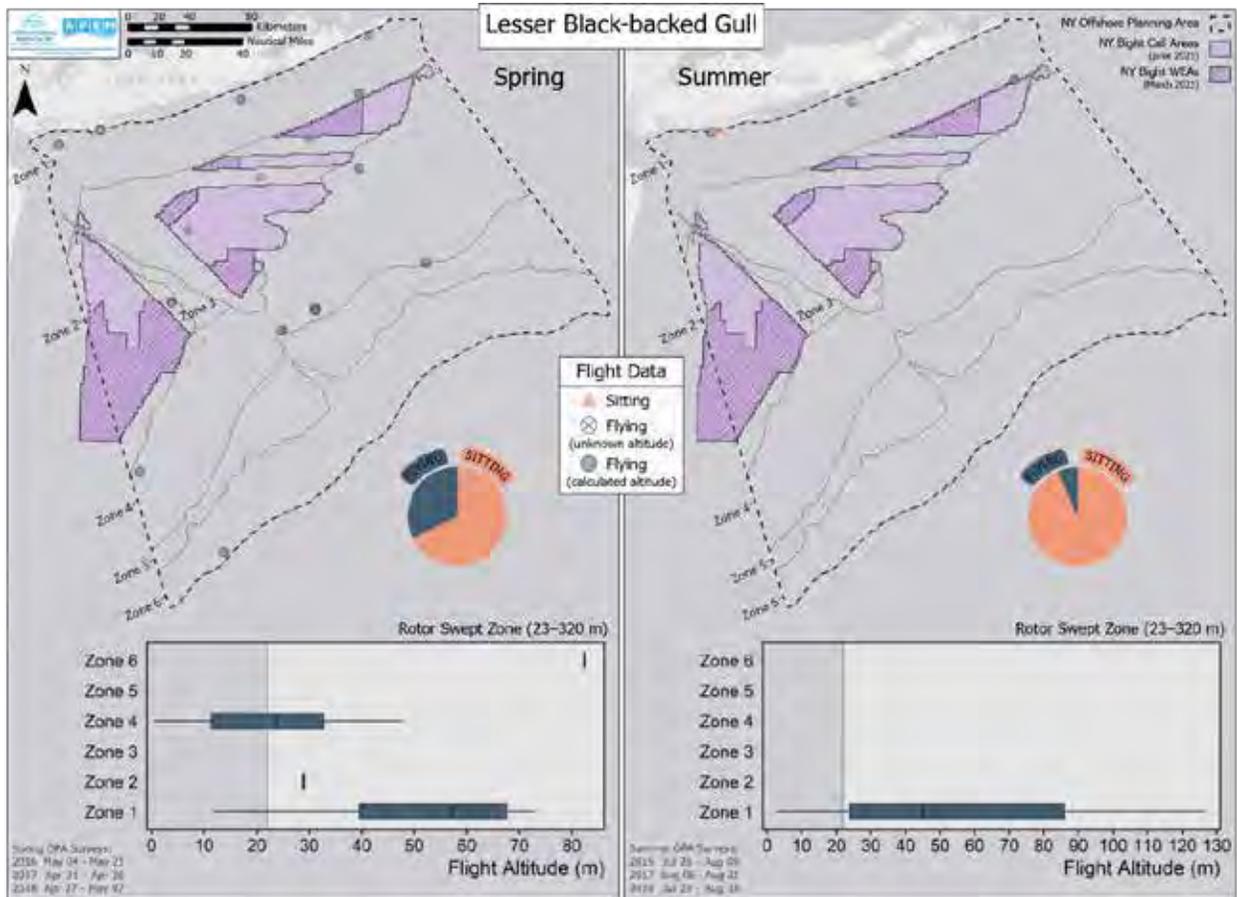


Figure 215. Direction of Flight of Lesser Black-backed Gull for All Surveys

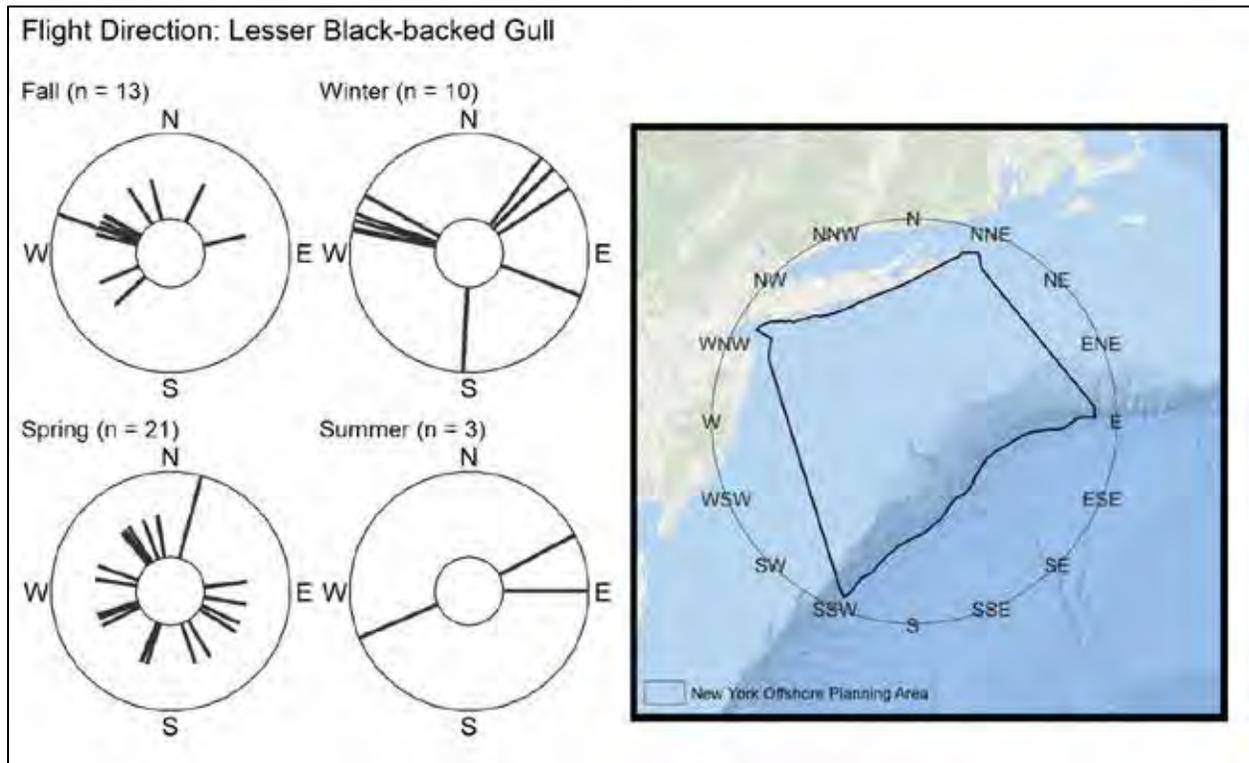


Figure 216. Spatial Distribution of Great Black-backed Gull During Fall and Winter by Zone and Proximity to Call Areas

Heat map is scaled to the maximum density for the species/species group across all seasons. Inset bar plots display mean estimated densities \pm standard error of the mean for each zone.

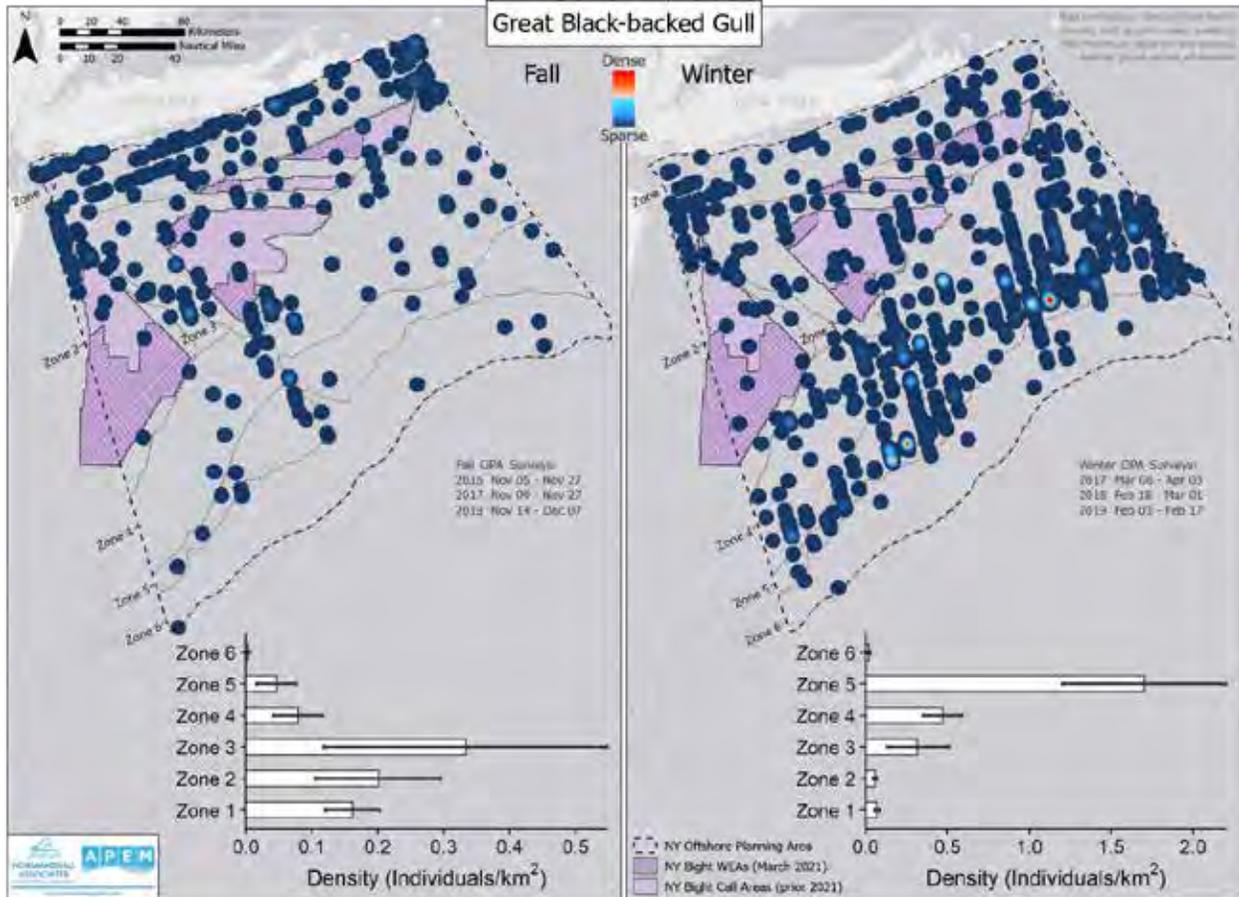


Figure 217. Spatial Distribution of Great Black-backed Gull During Spring and Summer by Zone and Proximity to Call Areas

Heat map is scaled to the maximum density for the species/species group across all seasons. Inset bar plots display mean estimated densities \pm standard error of the mean for each zone.

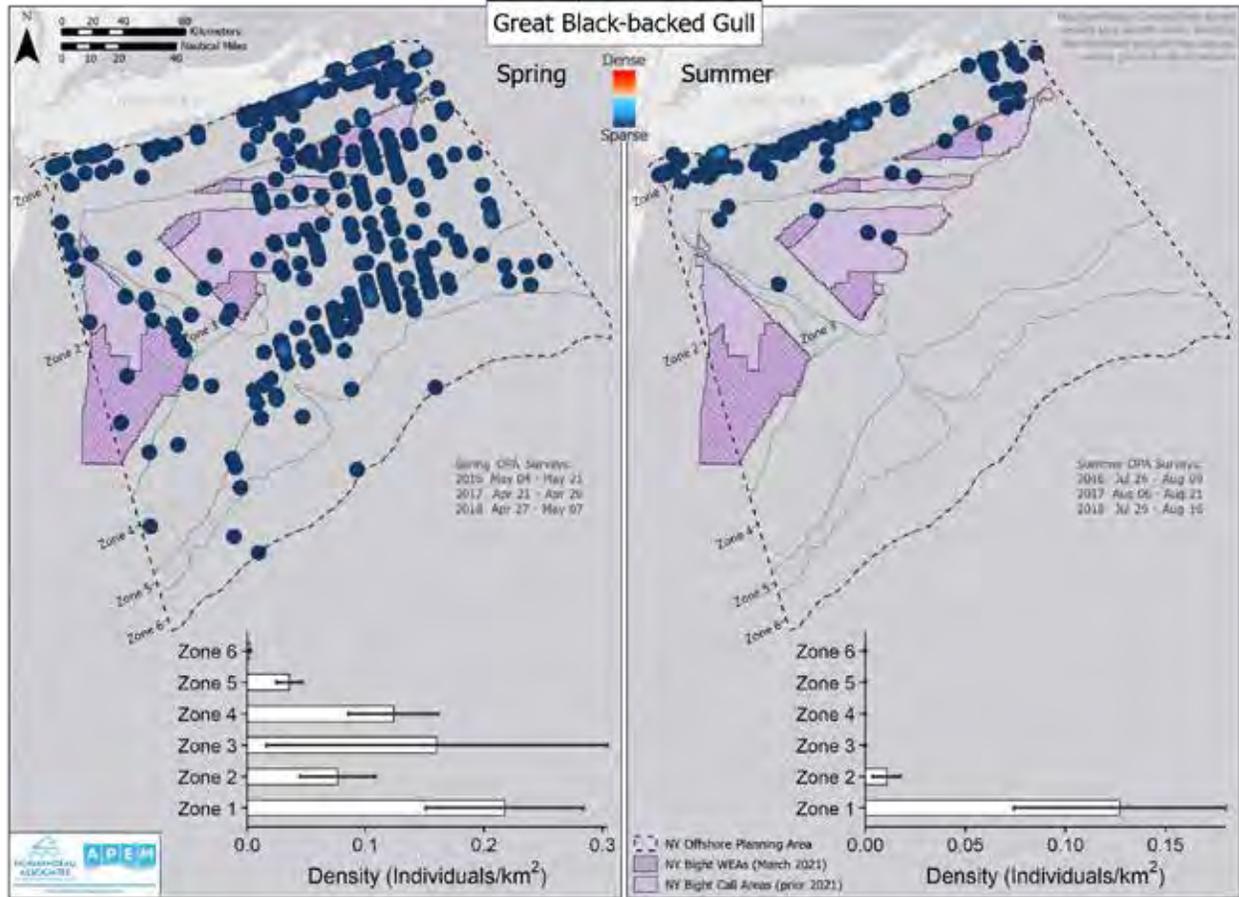


Figure 218. Spatial Distribution of Great Black-backed Gull Sitting Relative to Birds in Flight During Fall and Winter Surveys

Solid blue points represent individuals with calculated flight height and blue points with an x represent individuals in flight without flight height data. A pie chart inset shows the proportion of individuals flying and sitting. A boxplot inset of flight height distribution by zone is displayed for all birds with known flight heights. Boxplots show the distribution of data among seasons. The dark horizontal line is the median flight height, the box represents the middle 50% of data values. The lines to the left and right of the box represent the data points that are within 1.5 times the length of the box. Data beyond this range are shown as individual points.

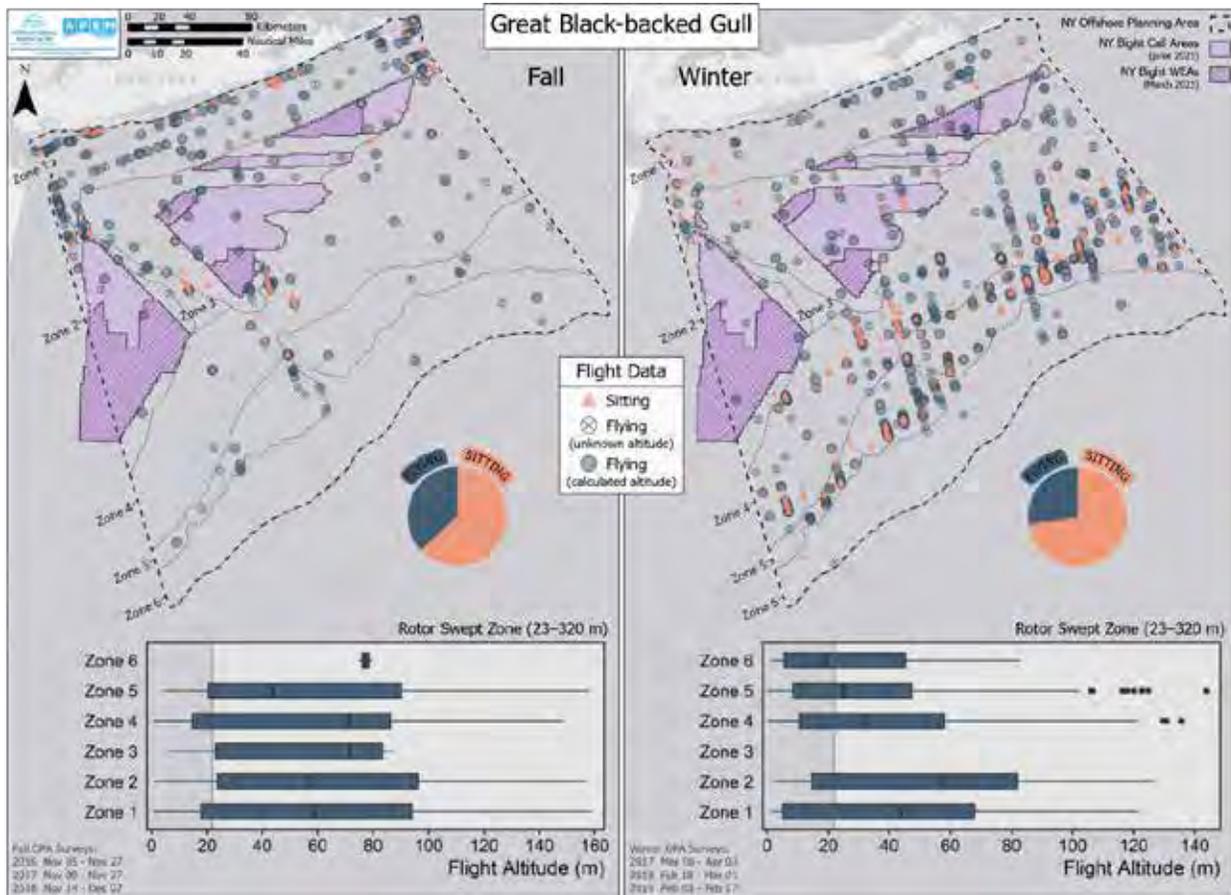


Figure 219. Spatial Distribution of Great Black-backed Gull Sitting Relative to Birds in Flight During Spring and Summer Surveys

Solid blue points represent individuals with calculated flight height and blue points with an x represent individuals in flight without flight height data. A pie chart inset shows the proportion of individuals flying and sitting. A boxplot inset of flight height distribution by zone is displayed for all birds with known flight heights. Boxplots show the distribution of data among seasons. The dark horizontal line is the median flight height, and the box represents the middle 50% of data values. The lines to the left and right of the box represent the data points that are within 1.5 times the length of the box. Data beyond this range are shown as individual points.

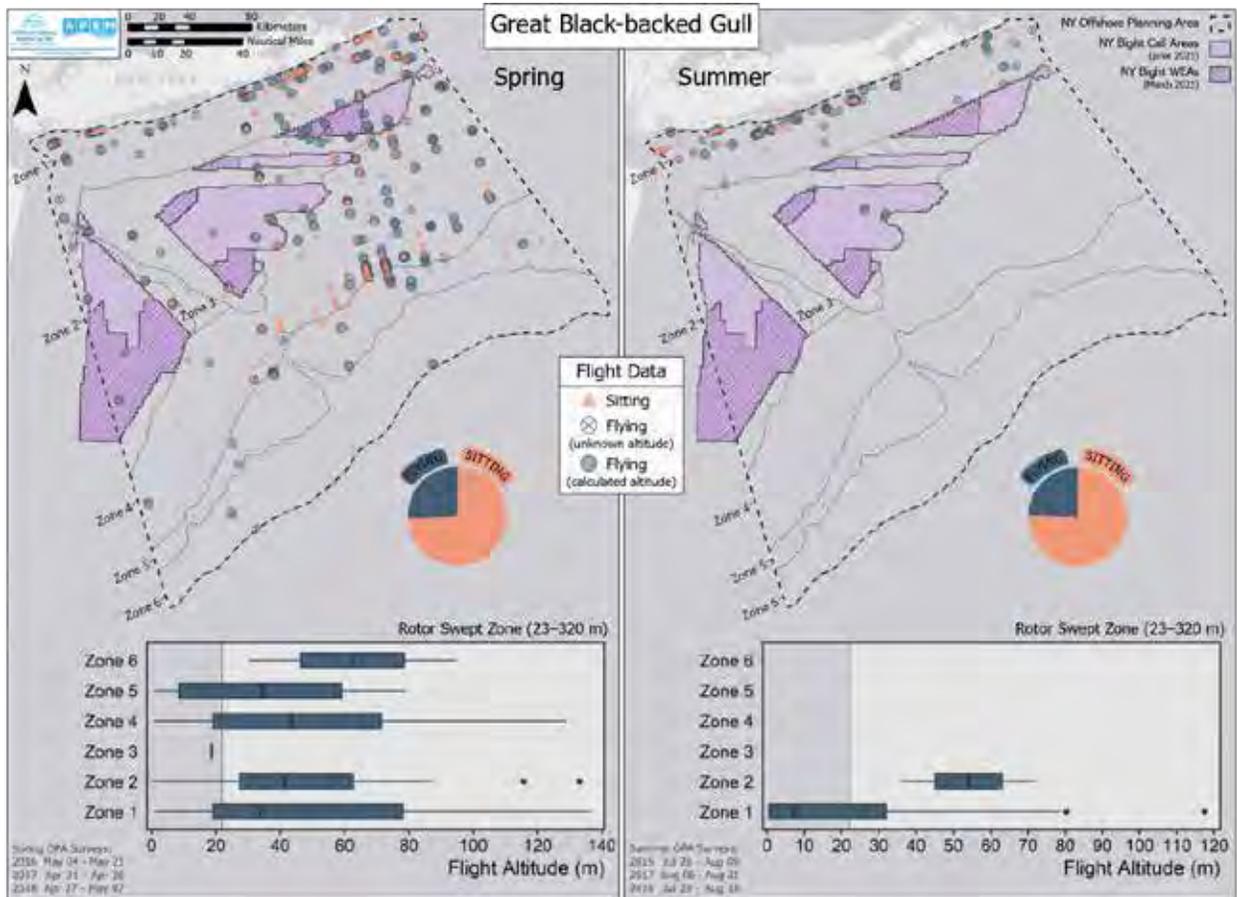


Figure 220. Direction of Flight of Great Black-backed Gull for All Surveys

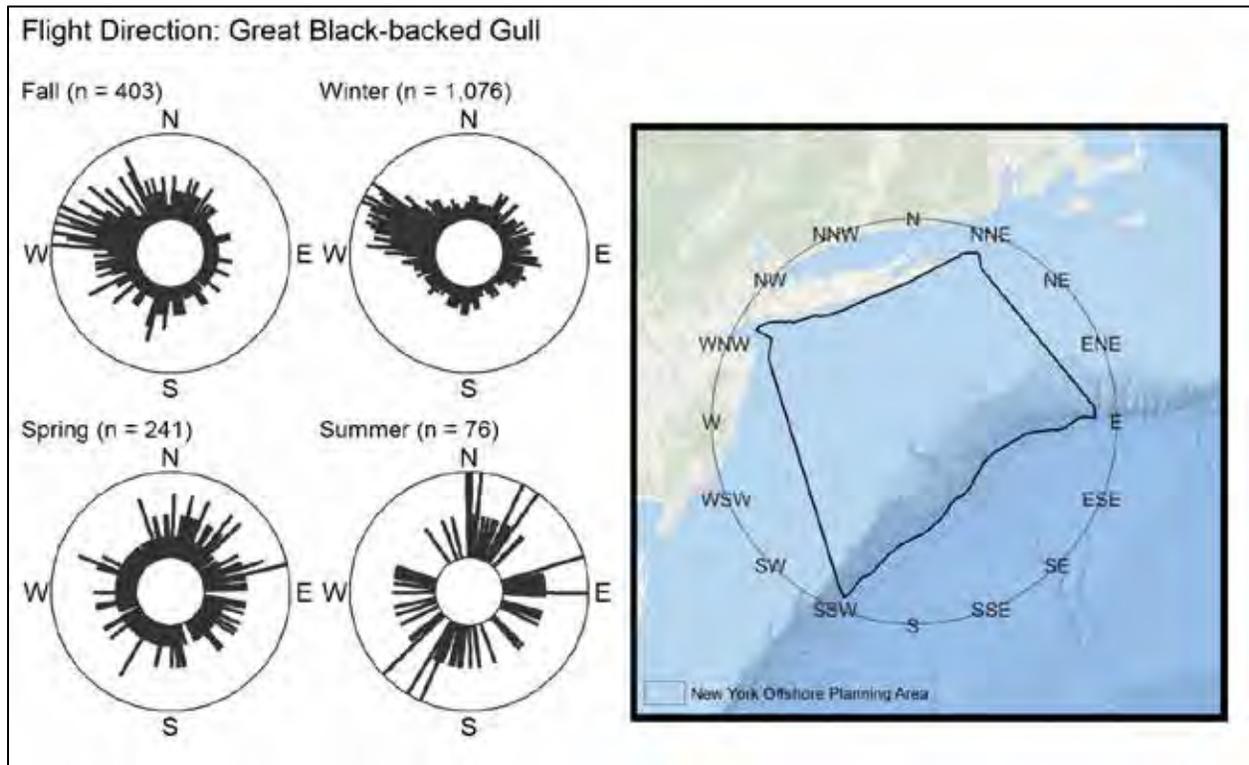
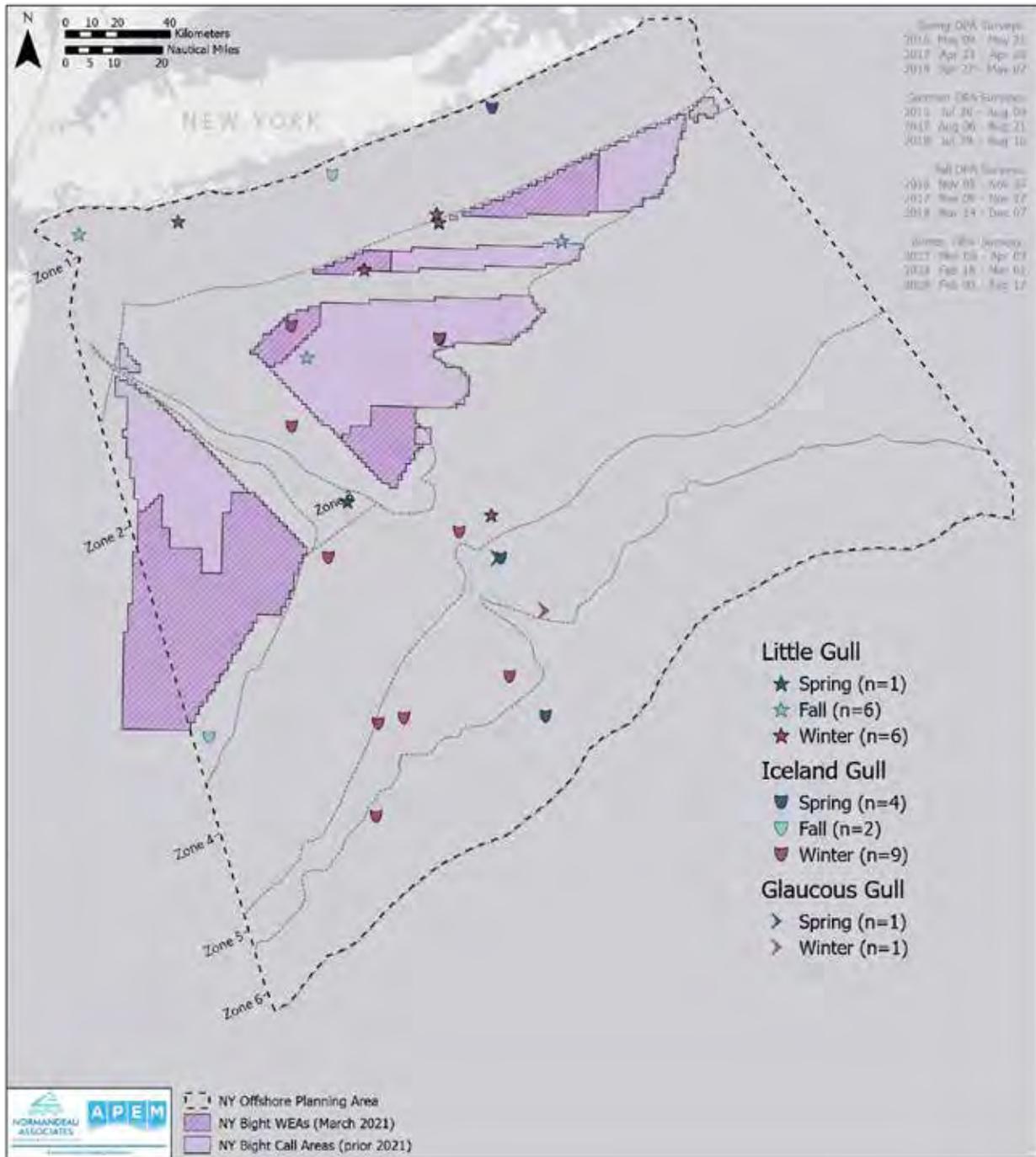


Figure 221. Spatial Distribution of Gull Species with Fewer than 30 Occurrences Across All Surveys



2.5.22 Tern

The tern taxonomic grouping included individuals classified as great least tern, royal tern, least tern, and tern-species unknown. During Fall (n=2) and Winter (n=0) tern were infrequently observed (Figure 222). Tern density was greatest in the OPA during Summer (n=100; $\bar{x} = 0.02 \pm 0.007$ birds/km²) followed by Spring (n=62; $\bar{x} = 0.006 \pm 0.003$ birds/km²) when individuals were concentrated within Zone 1 (Figure 223).

In Fall, both individuals were observed in flight (Figure 224). In Spring, 95% of 62 tern were observed in flight with flight heights ranging between one and 160 m above sea level (Figure 225). In Summer, tern were concentrated in Zone 1 and 65% were in flight at heights ranging between 1 and 110 m above sea level (Figure 225). Direction of flight patterns for all surveys are shown in Figure 226.

2.5.22.1 Least Tern

Least tern were not observed during Fall or Winter surveys and had approximately the same low mean density during Summer ($\bar{x} = 0.008 \pm 0.004$ birds/km²) and Spring ($\bar{x} = 0.005 \pm 0.003$ birds/km²) concentrating in Zone 1 (Figure 227). In Spring, all least tern were in flight with flight heights ranging between approximately one and 160 m above sea level (Figure 228). In Summer, all least tern were in flight with flight heights ranging between approximately one and 110 m above sea level (Figure 228). In Spring, least tern exhibited northerly and southerly flight headings (Figure 229).

2.5.22.2 Black Tern

Black tern were not observed during Fall or Winter surveys, and density was overall low but greater during Summer ($\bar{x} = 0.003 \pm 0.002$ birds/km²) relative to Spring ($\bar{x} < 0.001$ birds/km²). In Summer, black tern were concentrated within Zone 1 (Figure 230). In Spring, we observed two of three black tern in flight; in Summer we observed two of 35 black tern in flight (Figure 231). Direction of flight for black tern for all surveys is shown in Figure 232.

Figure 222. Spatial Distribution of Tern Species During Fall and Winter by Zone and Proximity to Call Areas

Heat map is scaled to the maximum density for the species/species group across all seasons. Inset bar plots display mean estimated densities \pm standard error of the mean for each zone.

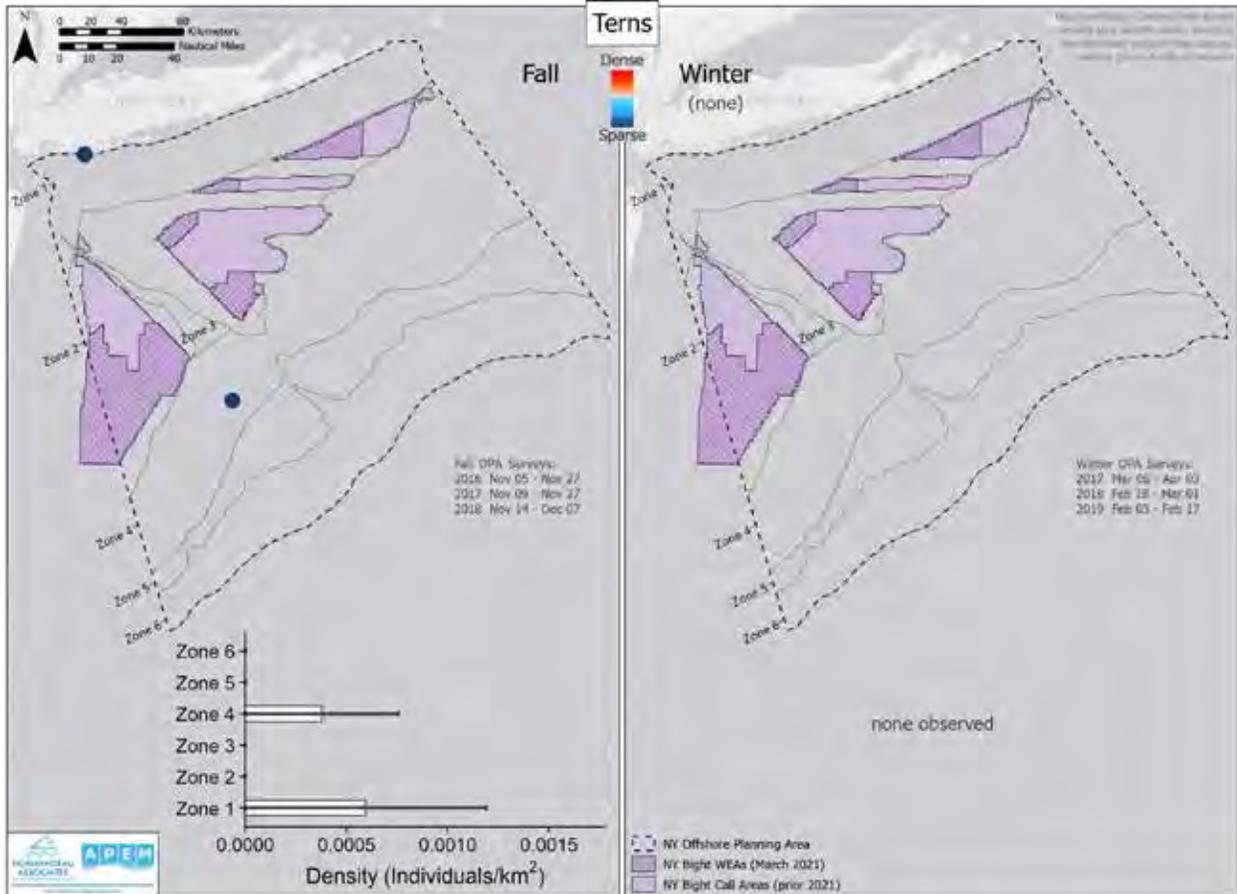


Figure 223. Spatial Distribution of Tern Species During Spring and Summer by Zone and Proximity to Call Areas

Heat map is scaled to the maximum density for the species/species group across all seasons. Inset bar plots display mean estimated densities \pm standard error of the mean for each zone.

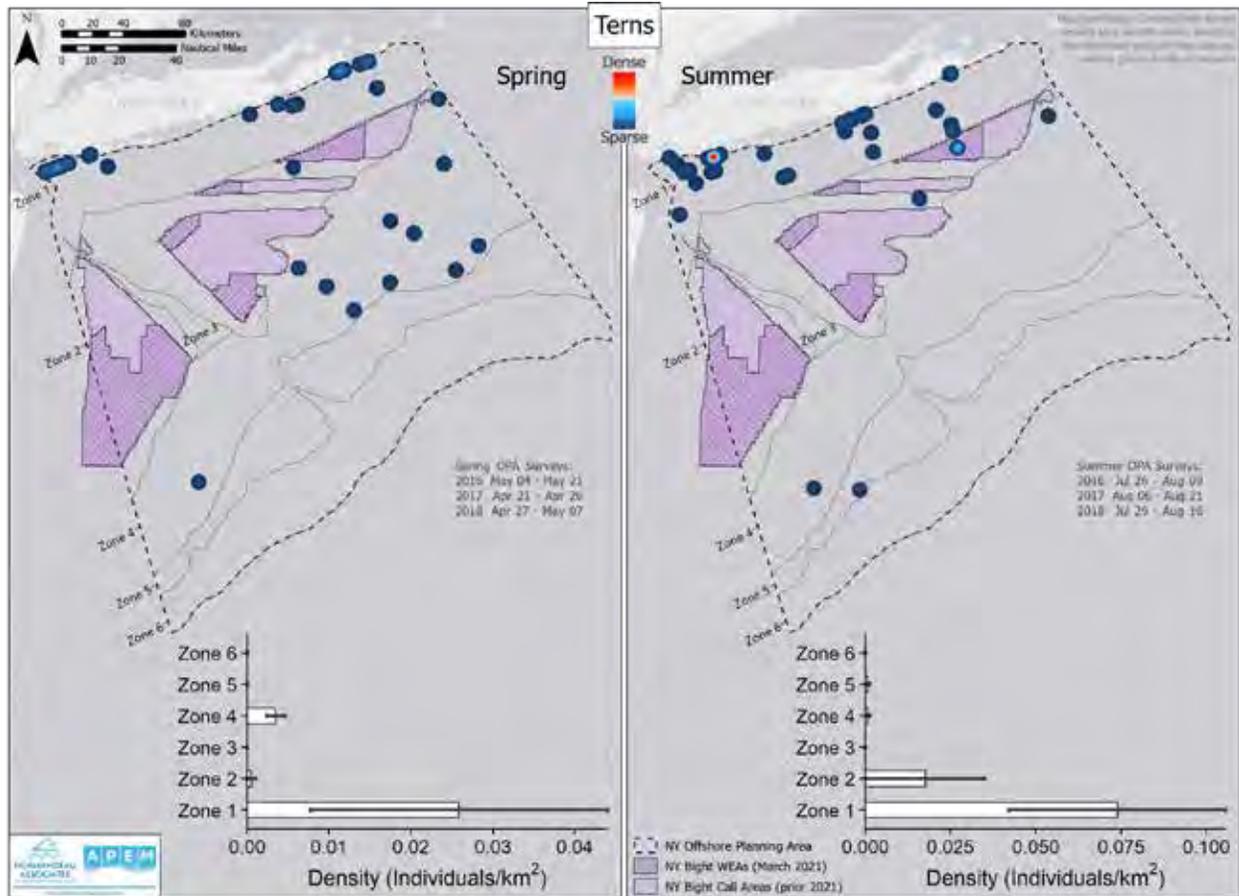


Figure 224. Spatial Distribution of Tern Sitting Relative to Birds in Flight During Fall and Winter Surveys

Solid blue points represent individuals with calculated flight height and blue points with an x represent individuals in flight without flight height data. A pie chart inset shows the proportion of individuals flying and sitting.

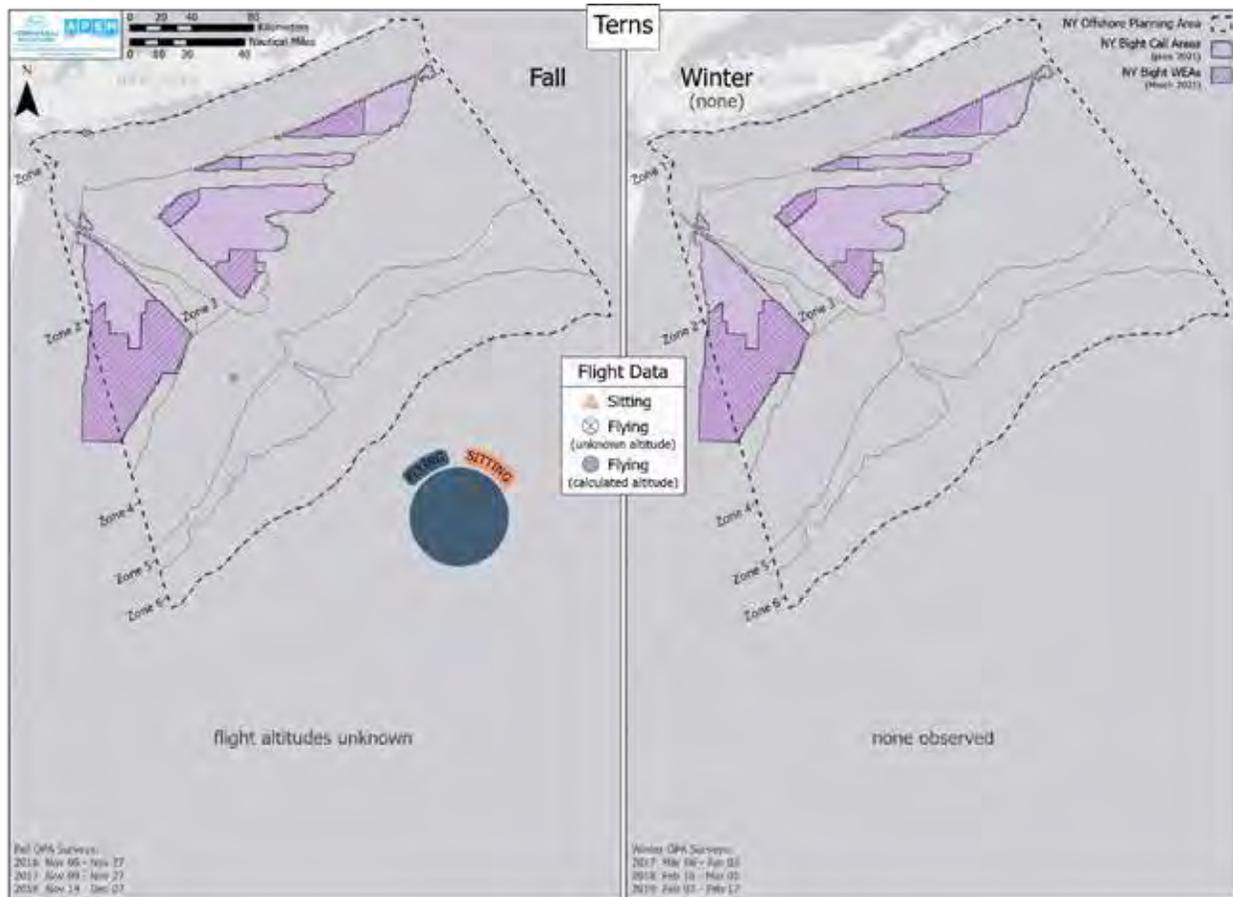


Figure 225. Spatial Distribution of Tern Sitting Relative to Birds in Flight During Spring and Summer Surveys

Solid blue points represent individuals with calculated flight height and blue points with an x represent individuals in flight without flight height data. A pie chart inset shows the proportion of individuals flying and sitting. A boxplot inset of flight height distribution by zone is displayed for all birds with known flight heights. Boxplots show the distribution of data among seasons. The dark horizontal line is the median flight height, and the box represents the middle 50% of data values. The lines to the left and right of the box represent the data points that are within 1.5 times the length of the box. Data beyond this range are shown as individual points.

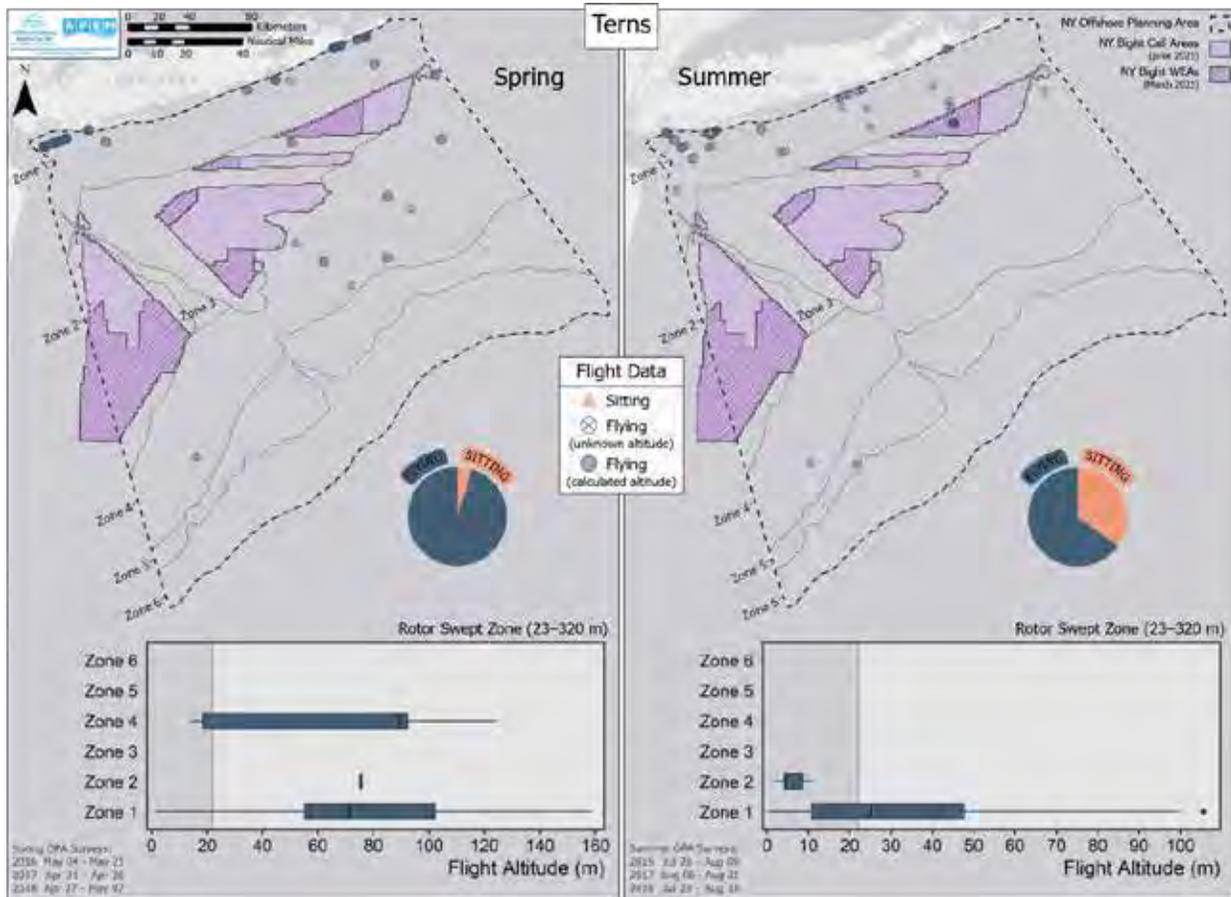


Figure 226. Direction of Flight of All Tern Species for All Surveys

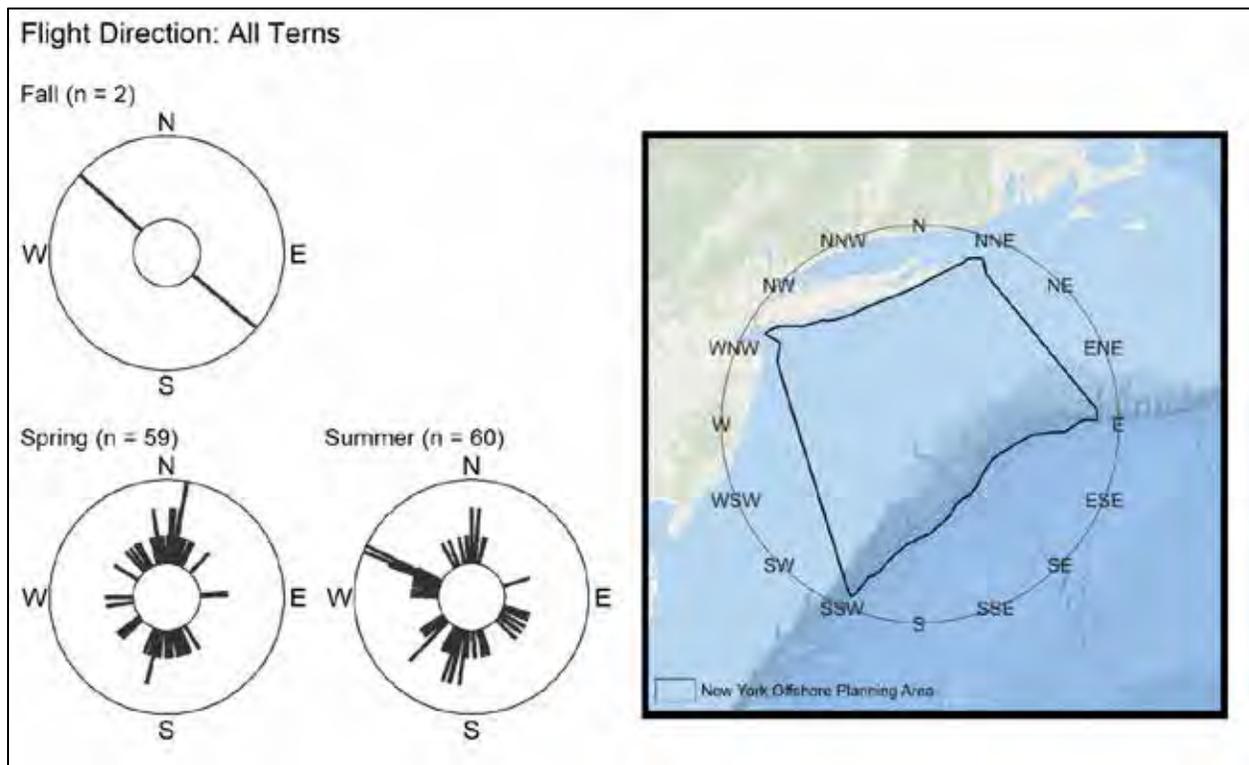


Figure 227. Spatial Distribution of Least Tern During Spring and Summer by Zone and Proximity to Call Areas

Heat map is scaled to the maximum density for the species/species group across all seasons. Inset bar plots display mean estimated densities \pm standard error of the mean for each zone.

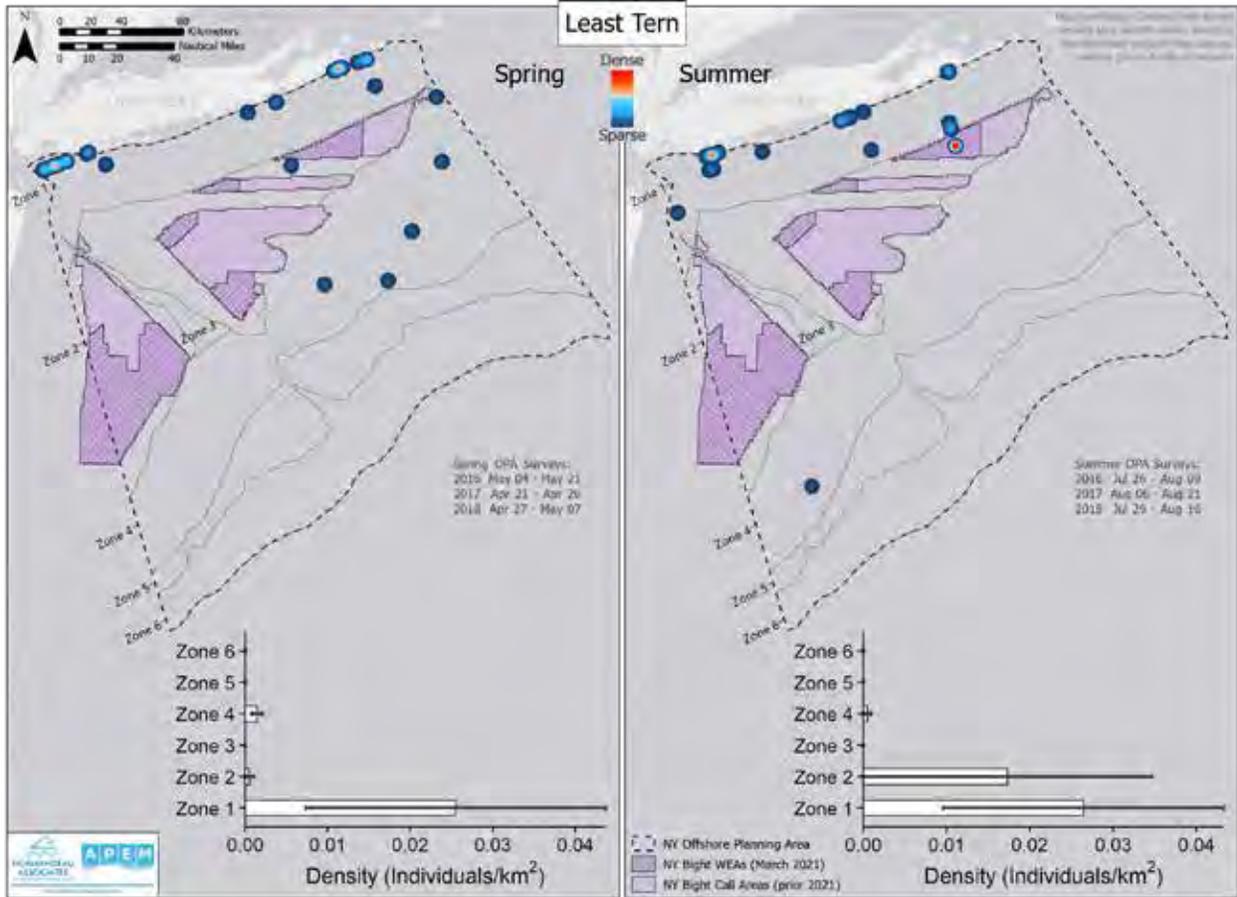


Figure 228. Spatial Distribution of Least Tern Sitting Relative to Birds in Flight During Spring and Summer Surveys

Solid blue points represent individuals with calculated flight height and blue points with an x represent individuals in flight without flight height data. A pie chart inset shows the proportion of individuals flying and sitting. A boxplot inset of flight height distribution by zone is displayed for all birds with known flight heights. Boxplots show the distribution of data among seasons. The dark horizontal line is the median flight height, and the box represents the middle 50% of data values. The lines to the left and right of the box represent the data points that are within 1.5 times the length of the box. Data beyond this range are shown as individual points.

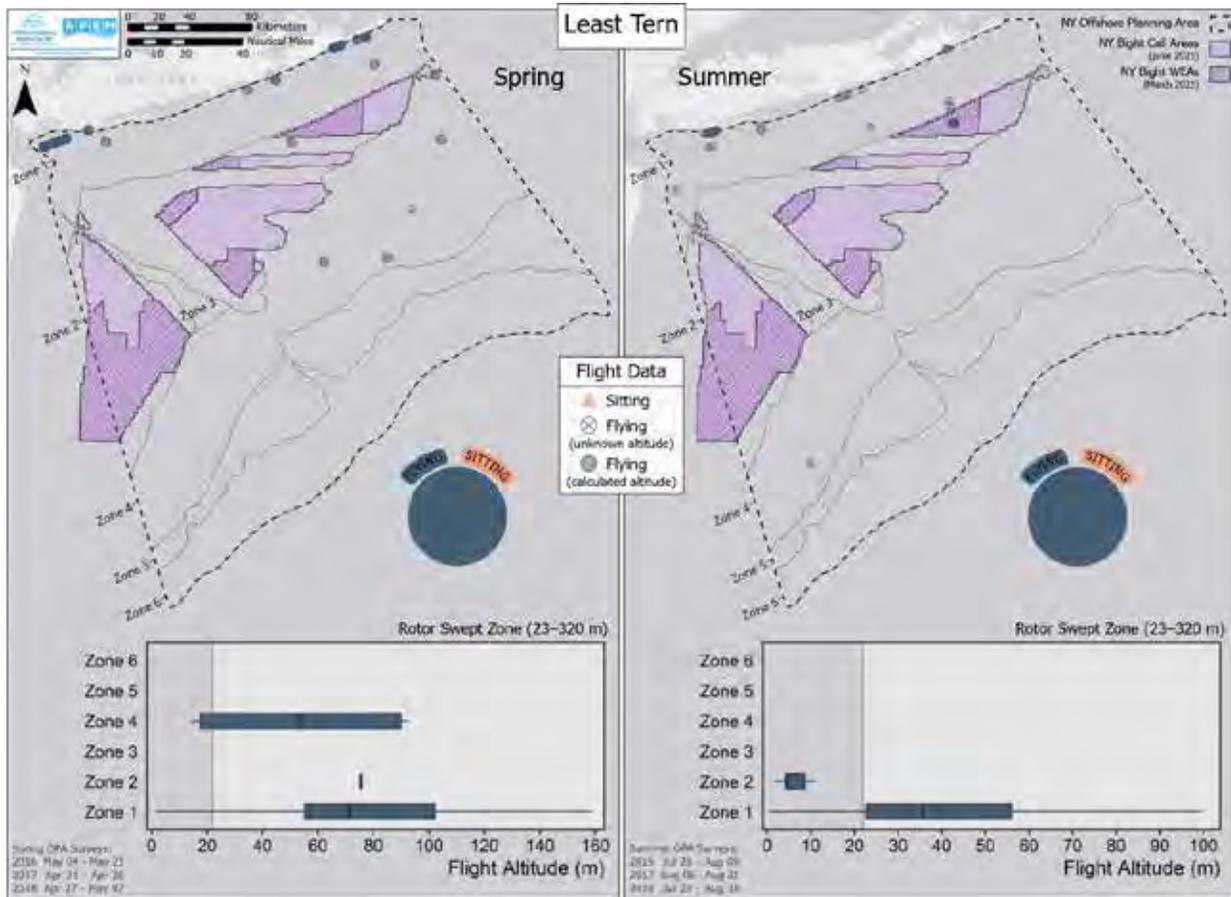


Figure 229. Direction of Flight of Least Tern for All Surveys

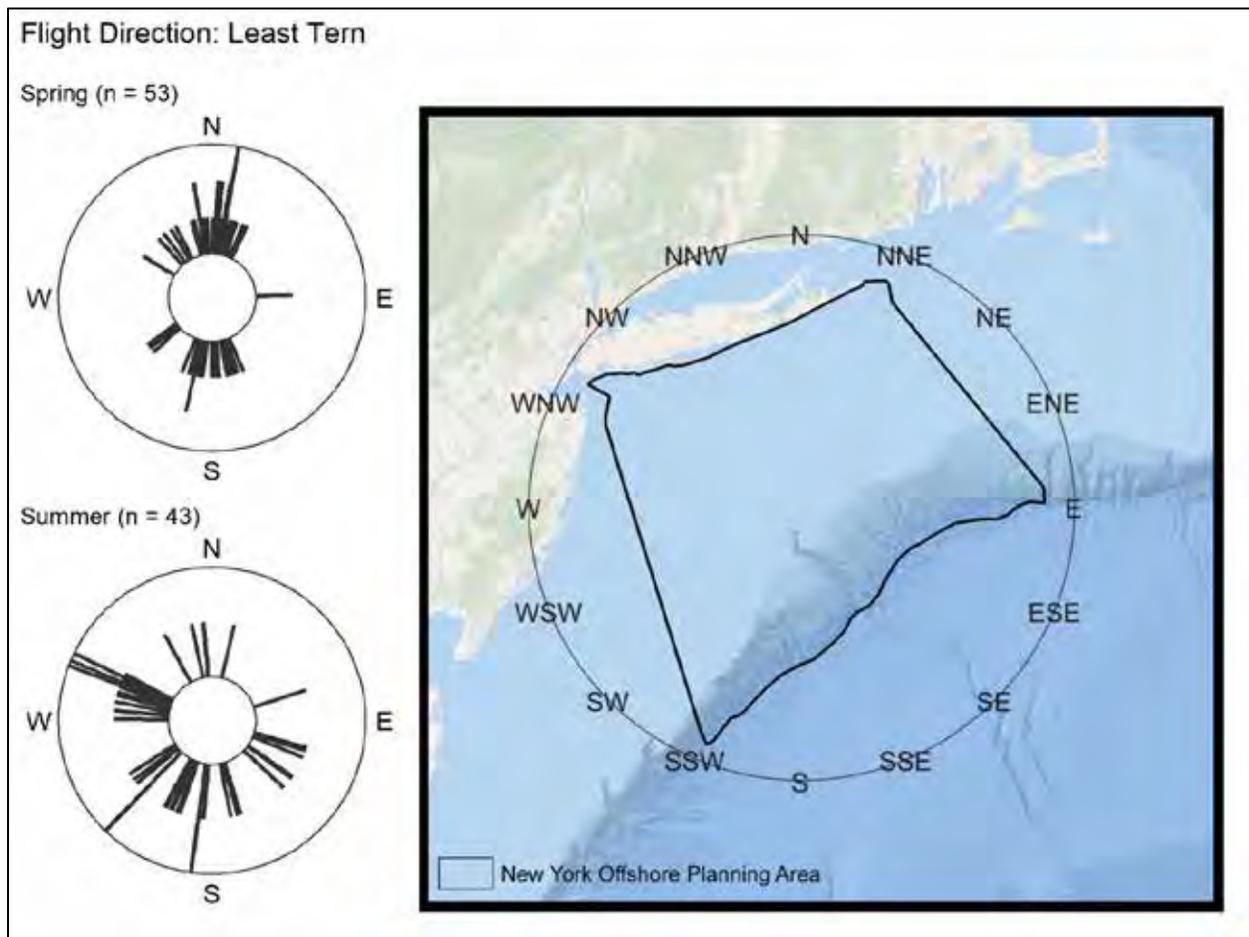


Figure 230. Spatial Distribution of Black Tern During Spring and Summer by Zone and Proximity to Call Areas

Heat map is scaled to the maximum density for the species/species group across all seasons. Inset bar plots display mean estimated densities \pm standard error of the mean for each zone.

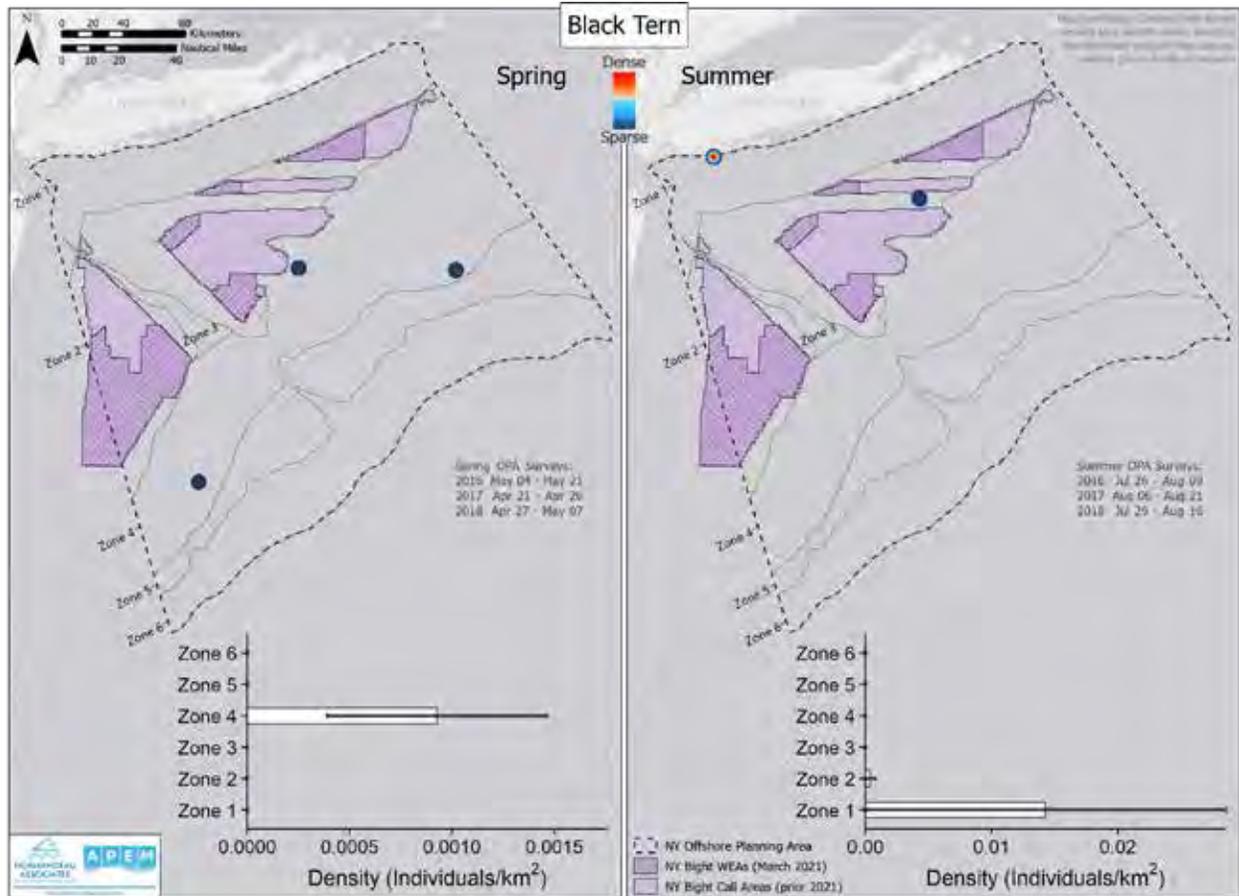


Figure 231. Spatial Distribution of Black Tern Sitting Relative to Birds in Flight During Spring and Summer Surveys

Solid blue points represent individuals with calculated flight height and blue points with an x represent individuals in flight without flight height data. A pie chart inset shows the proportion of individuals flying and sitting. A boxplot inset of flight height distribution by zone is displayed for all birds with known flight heights. Boxplots show the distribution of data among seasons. The dark horizontal line is the median flight height, and the box represents the middle 50% of data values. The lines to the left and right of the box represent the data points that are within 1.5 times the length of the box. Data beyond this range are shown as individual points.

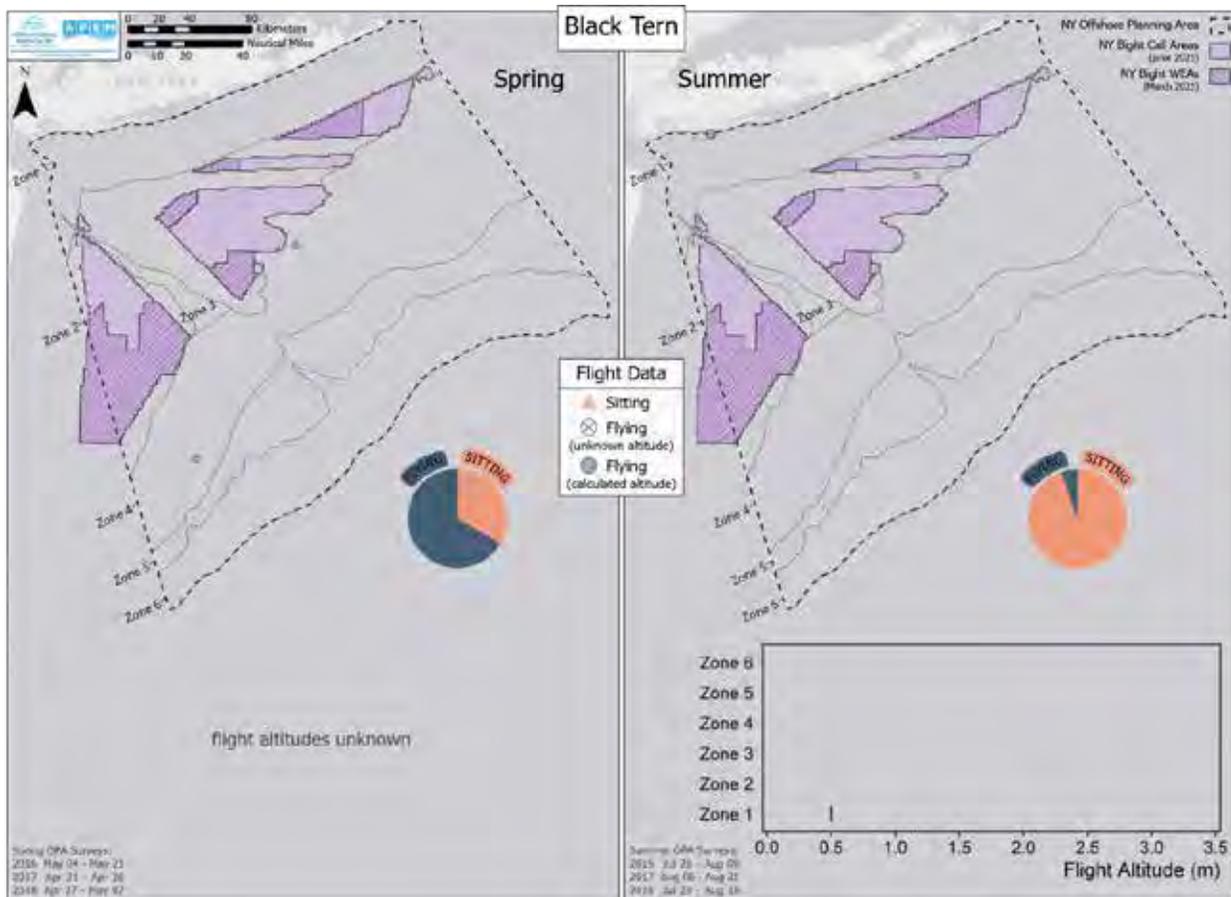
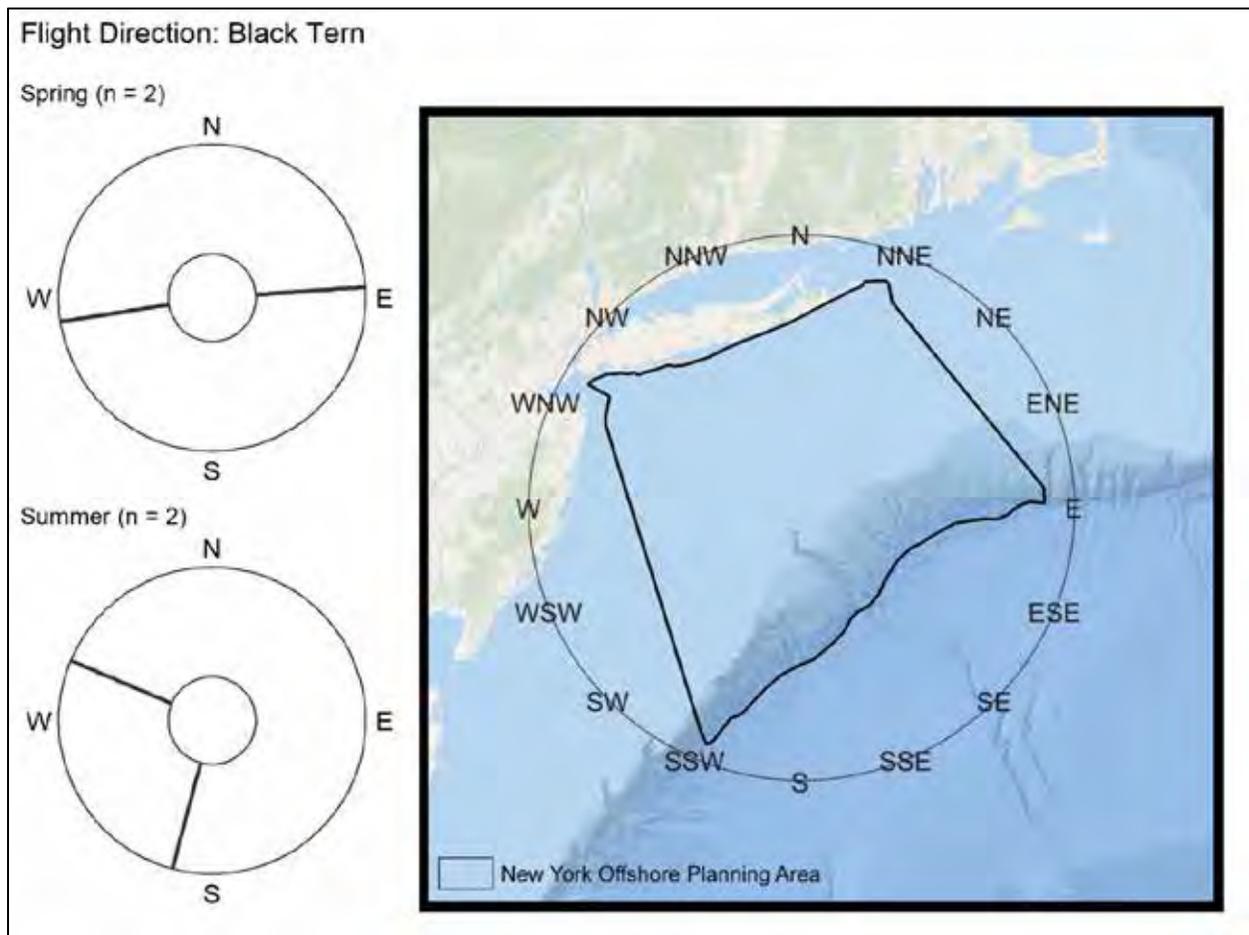


Figure 232. Direction of Flight of Black Tern for All Surveys



2.5.23 *Sterna* Tern

The *Sterna* tern taxonomic grouping included individuals classified as commic/Forster's tern, roseate tern, common tern, Forester's tern, and *Sterna* tern-species unknown. During Fall (n=3) and Winter (n=0) *Sterna* tern were infrequently observed (Figure 233). Mean density was greatest in the OPA during Spring (n=3,015; $\bar{x} = 0.30 \pm 0.04$ birds/km²) followed by Summer (n=374; $\bar{x} = 0.06 \pm 0.025$ birds/km²) (Appendix B, Figure 234). In Spring, *Sterna* tern were broadly distributed throughout the OPA and had above average density within Zone 5 (Figure 234). In Summer, *Sterna* tern were concentrated within Zone 1 (Figure 234).

In Fall, all three *Sterna* tern were flying within Zone 3 (Figure 235). In Spring, 80% of birds were in flight with median flight heights within the RSZ in all zones (Figure 236). In Summer, 88% of birds were in flight with flight heights ranging between one and 130 m above sea level (Figure 236). In Spring birds had no pattern of flight heading, and in Summer, there was a pattern of southwesterly flight headings (Figure 237).

2.5.23.1 Roseate Tern

Roseate tern density was generally low throughout the OPA (Appendix B, Figure 238) but was greatest during Spring ($\bar{x} = 0.003 \pm 0.001$ birds/km²) when 32 of 33 total observations occurred. During Spring, mean density estimates were greater in the outer zones (Zones 4–6) relative to the inner zones (Zones 1–3) (Figure 238). The single non-Spring survey observation occurred in Zone 1 during Summer.

During Spring, all 32 individuals were in flight ranging between one and 130 m above sea level (Figure 239). In Summer, one roseate tern was observed flying in Zone 1 with no associated flight height data. There was no pattern in flight headings (Figure 240).

2.5.23.2 Common Tern

Common tern were not observed in the OPA during Fall or Winter. Density was greatest during Spring ($\bar{x} = 0.06 \pm 0.009$ birds/km²) followed by Summer ($\bar{x} = 0.007 \pm 0.007$ birds/km²) (Appendix B, Figure 241). During Spring, individuals were distributed throughout the OPA but concentrated in Zone 1, and in Summer all individuals were observed in Zone 1 (Figure 241).

In Spring, 597 common tern were observed throughout the OPA with 99% observed in flight, and median flight height was within the RSZ for all zones. In Summer, all 94 common tern were observed in Zone 1 and in flight with mixed flight headings, which ranged from one to 80 m above sea level (Figure 242). In Spring, there was no pattern in flight heading (Figure 243).

2.5.23.3 Forester's Tern

Forester's tern density in the OPA was overall low with Spring having the greatest density ($\bar{x} = 0.002 \pm 0.001$ birds/km²), followed by Summer and Fall, which both had extremely low density estimates ($\bar{x} < 0.001$ birds/km²) (Figure 244, Figure 245). In Fall, two Forester's tern were both observed flying within the RSZ near shore in Zone 1 (Figure 246). In Spring, 21 of 28 Forester's tern were observed in flight with heights between 5 and 60 m above sea level. In Summer, all individuals were in flight in Zone 1 (Figure 247). Direction of flight patterns are shown in Figure 248.

Figure 233. Spatial Distribution of *Sterna* Tern During Fall and Winter by Zone and Proximity to Call Areas

Heat map is scaled to the maximum density for the species/species group across all seasons. Inset bar plots display mean estimated densities \pm standard error of the mean for each zone.

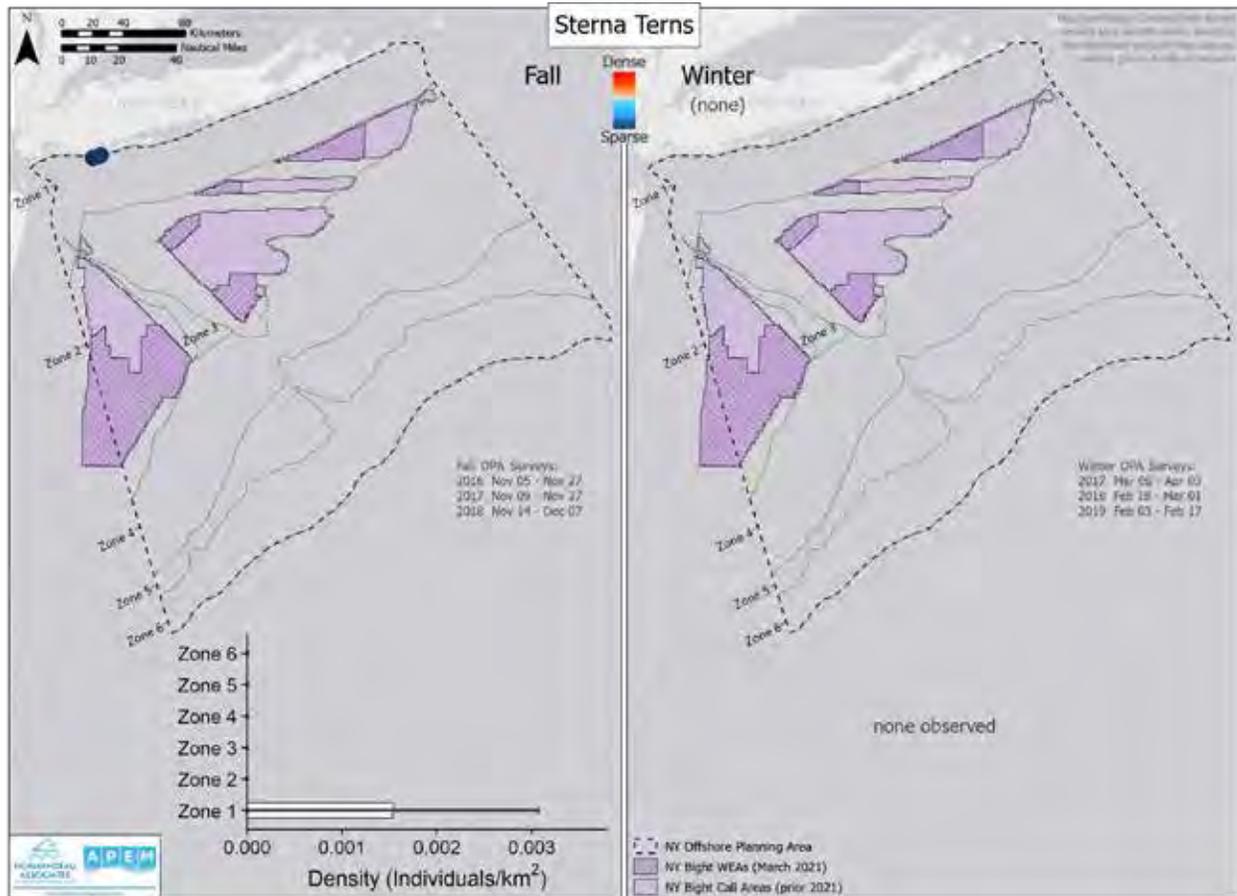


Figure 234. Spatial Distribution of *Sterna* Tern During Spring and Summer by Zone and Proximity to Call Areas.

Heat map is scaled to the maximum density for the species/species group across all seasons. Inset bar plots display mean estimated densities \pm standard error of the mean for each zone.

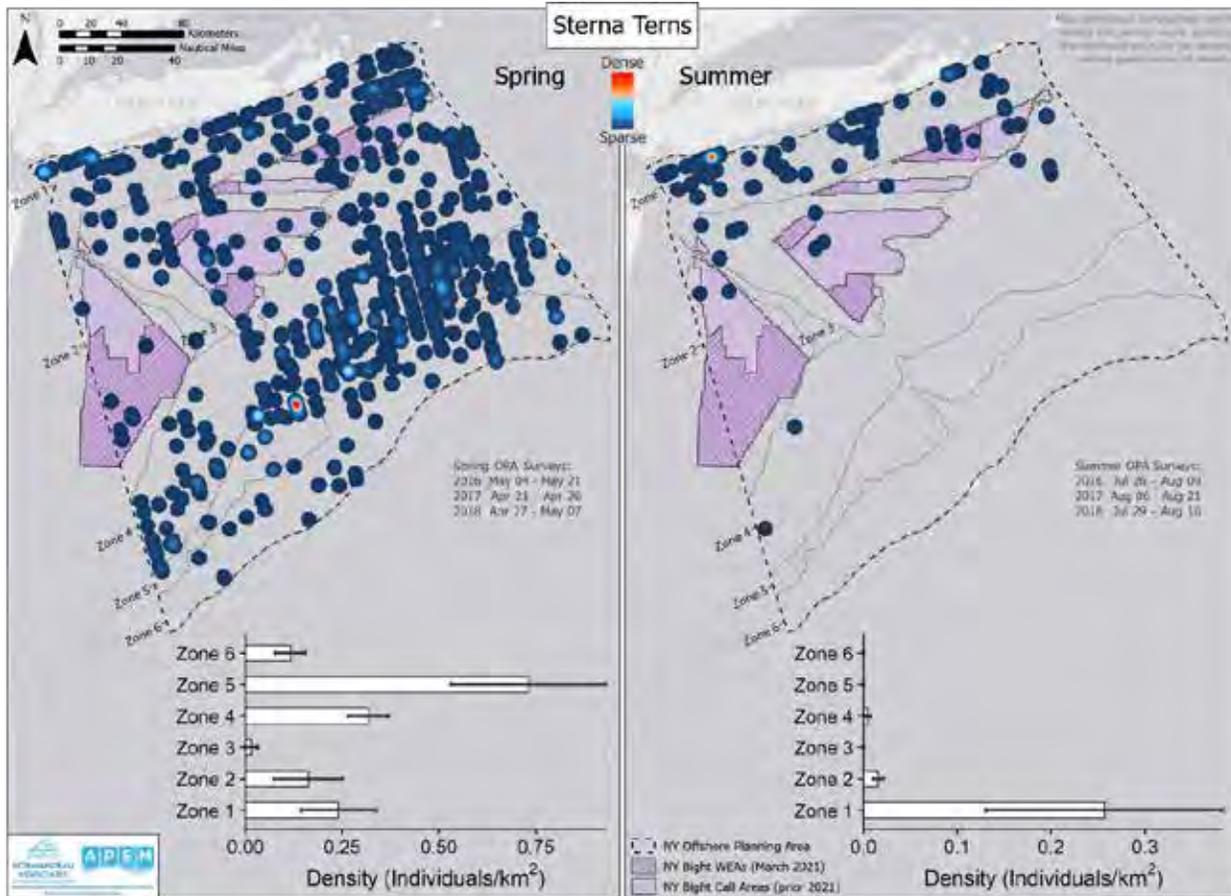


Figure 235. Spatial Distribution of *Sterna* Tern Sitting Relative to Birds in Flight During Fall and Winter Surveys

Solid blue points represent individuals with calculated flight height and blue points with an x represent individuals in flight without flight height data. A pie chart inset shows the proportion of individuals flying and sitting. A boxplot inset of flight height distribution by zone is displayed for all birds with known flight heights. Boxplots show the distribution of data among seasons. The dark horizontal line is the median flight height, and the box represents the middle 50% of data values. The lines to the left and right of the box represent the data points that are within 1.5 times the length of the box. Data beyond this range are shown as individual points..

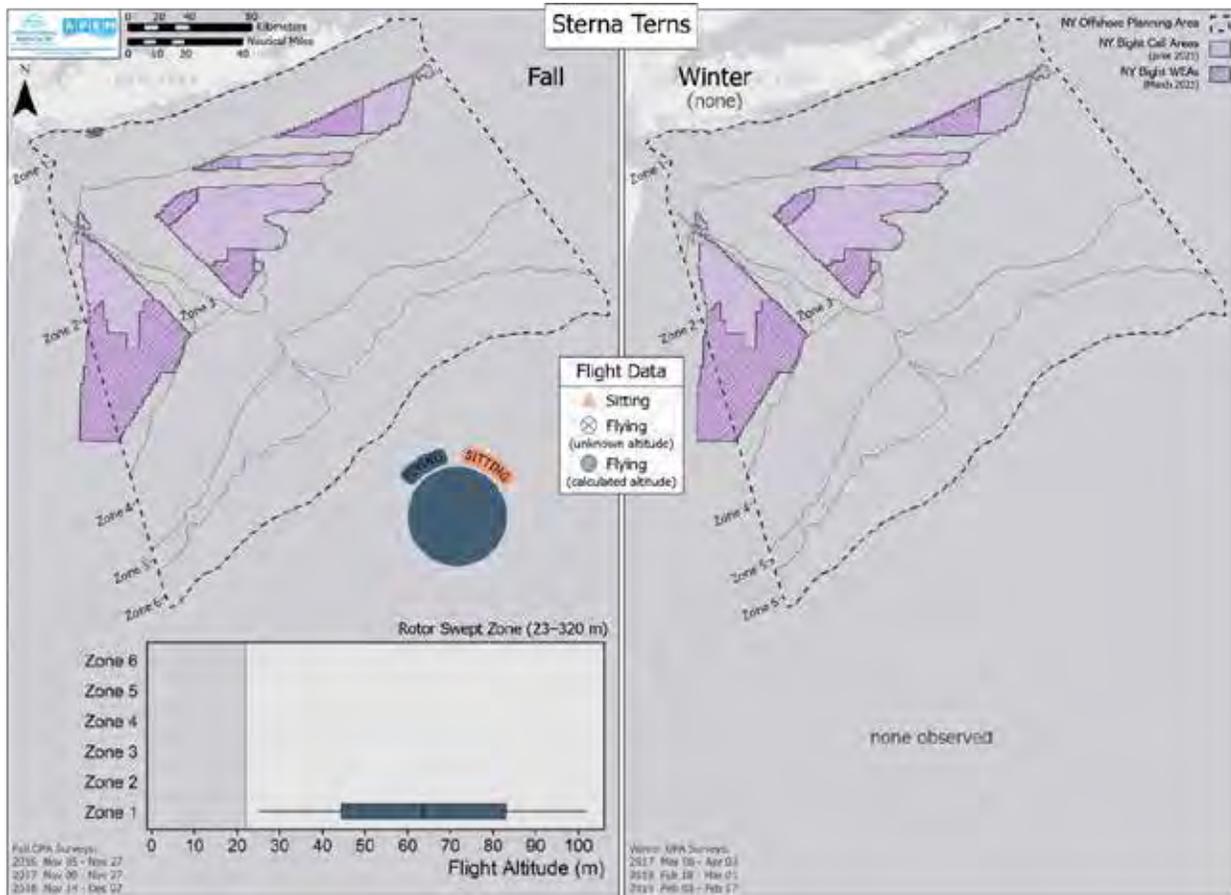


Figure 236. Spatial Distribution of *Sterna* Tern Sitting Relative to Birds in Flight During Spring and Summer Surveys

Solid blue points represent individuals with calculated flight height and blue points with an x represent individuals in flight without flight height data. A pie chart inset shows the proportion of individuals flying and sitting. A boxplot inset of flight height distribution by zone is displayed for all birds with known flight heights. Boxplots show the distribution of data among seasons. The dark horizontal line is the median flight height, the box represents the middle 50% of data values. The lines to the left and right of the box represent the data points that are within 1.5 times the length of the box. Data beyond this range are shown as individual points.

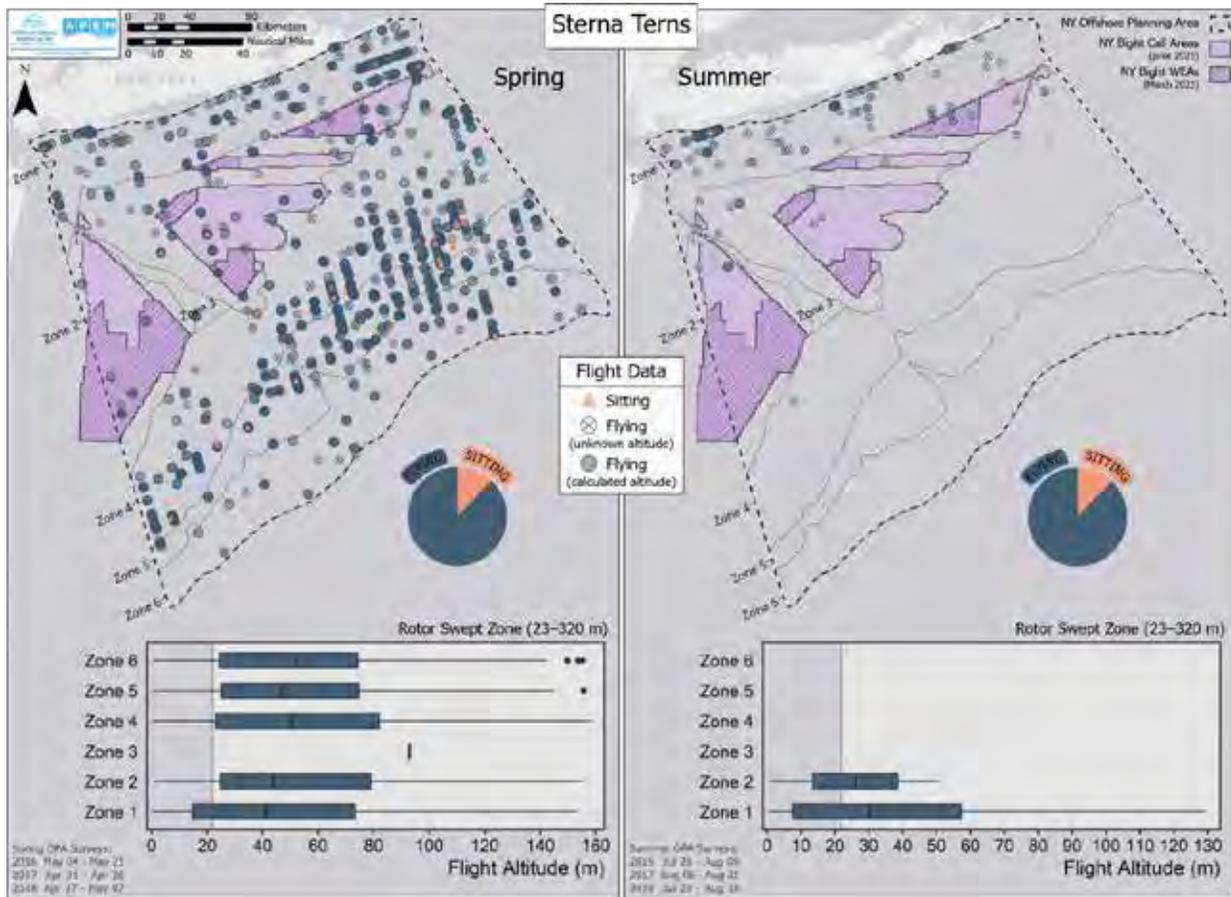


Figure 237. Direction of Flight of All *Sterna* Terns for All Surveys

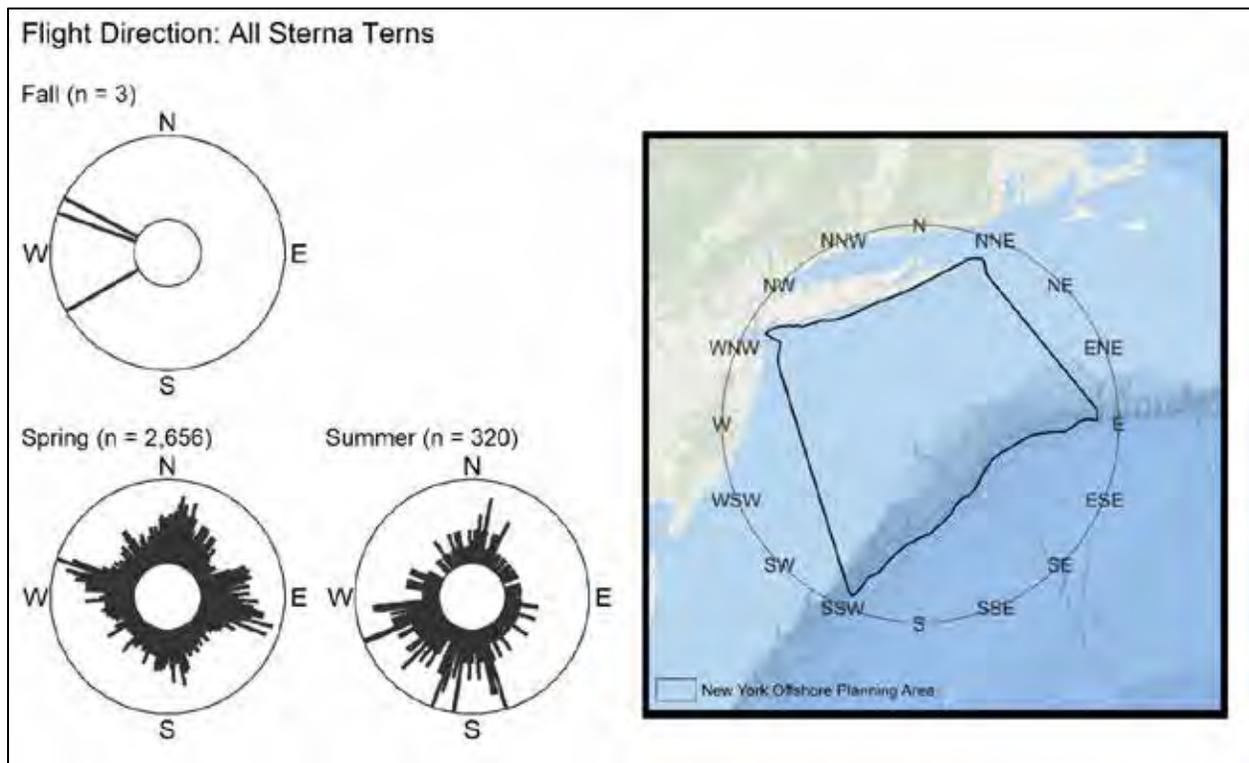


Figure 238. Spatial Distribution of Roseate Tern During Spring and Summer by Zone and Proximity to Call Areas

Heat map is scaled to the maximum density for the species/species group across all seasons. Inset bar plots display mean estimated densities \pm standard error of the mean for each zone.

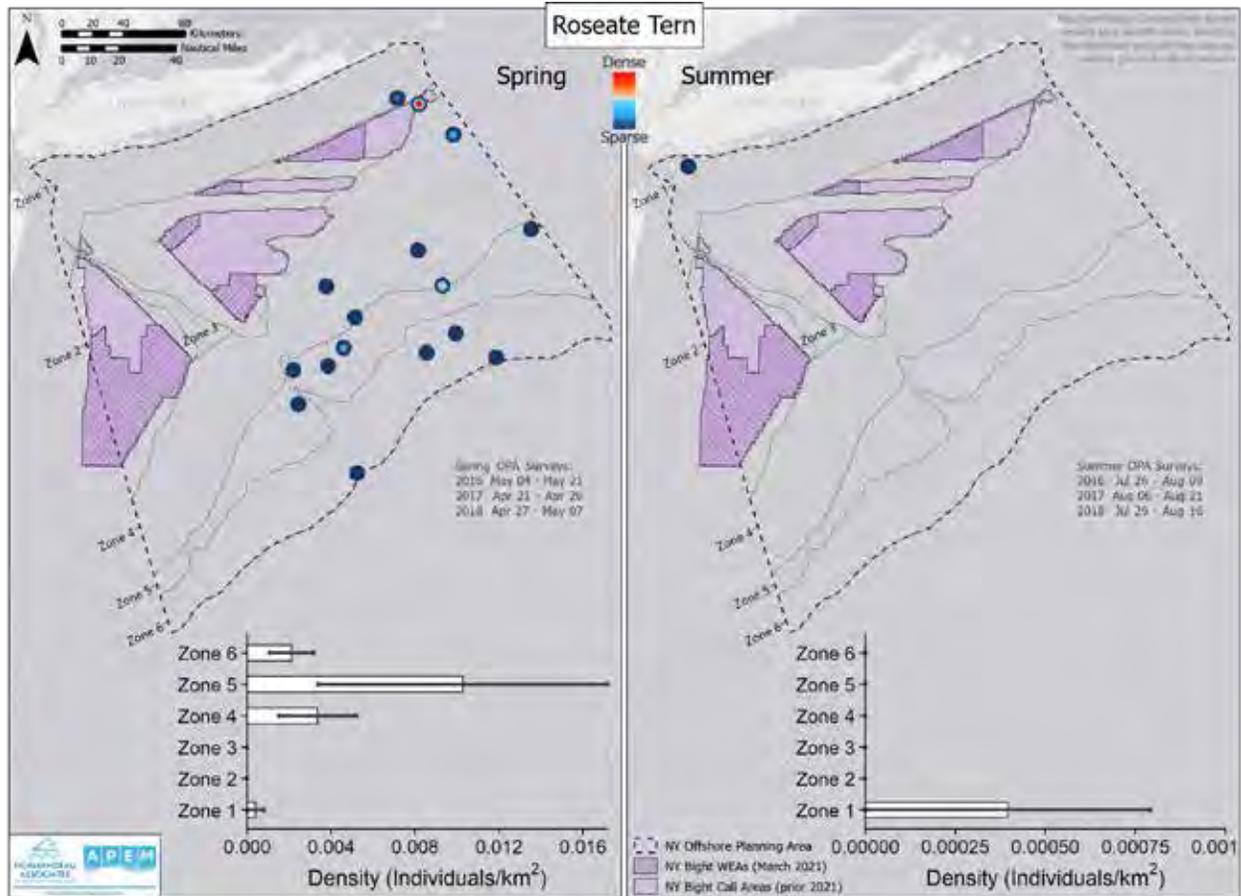


Figure 239. Spatial Distribution of Roseate Tern Sitting Relative to Birds in Flight During Spring and Summer Surveys

Solid blue points represent individuals with calculated flight height and blue points with an x represent individuals in flight without flight height data. A pie chart inset shows the proportion of individuals flying and sitting. A boxplot inset of flight height distribution by zone is displayed for all birds with known flight heights. Boxplots show the distribution of data among seasons. The dark horizontal line is the median flight height, and the box represents the middle 50% of data values. The lines to the left and right of the box represent the data points that are within 1.5 times the length of the box. Data beyond this range are shown as individual points.

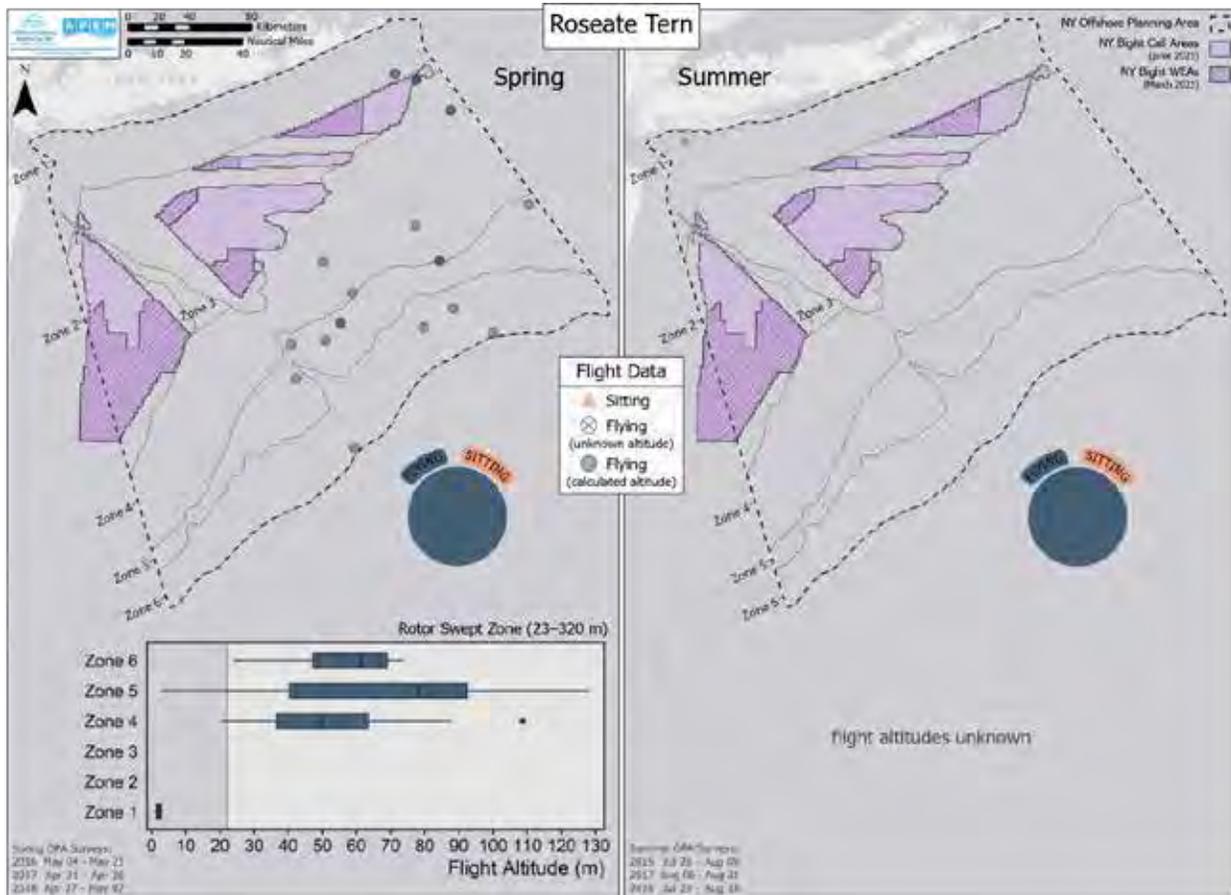


Figure 240. Direction of Flight of Roseate Tern for All Surveys

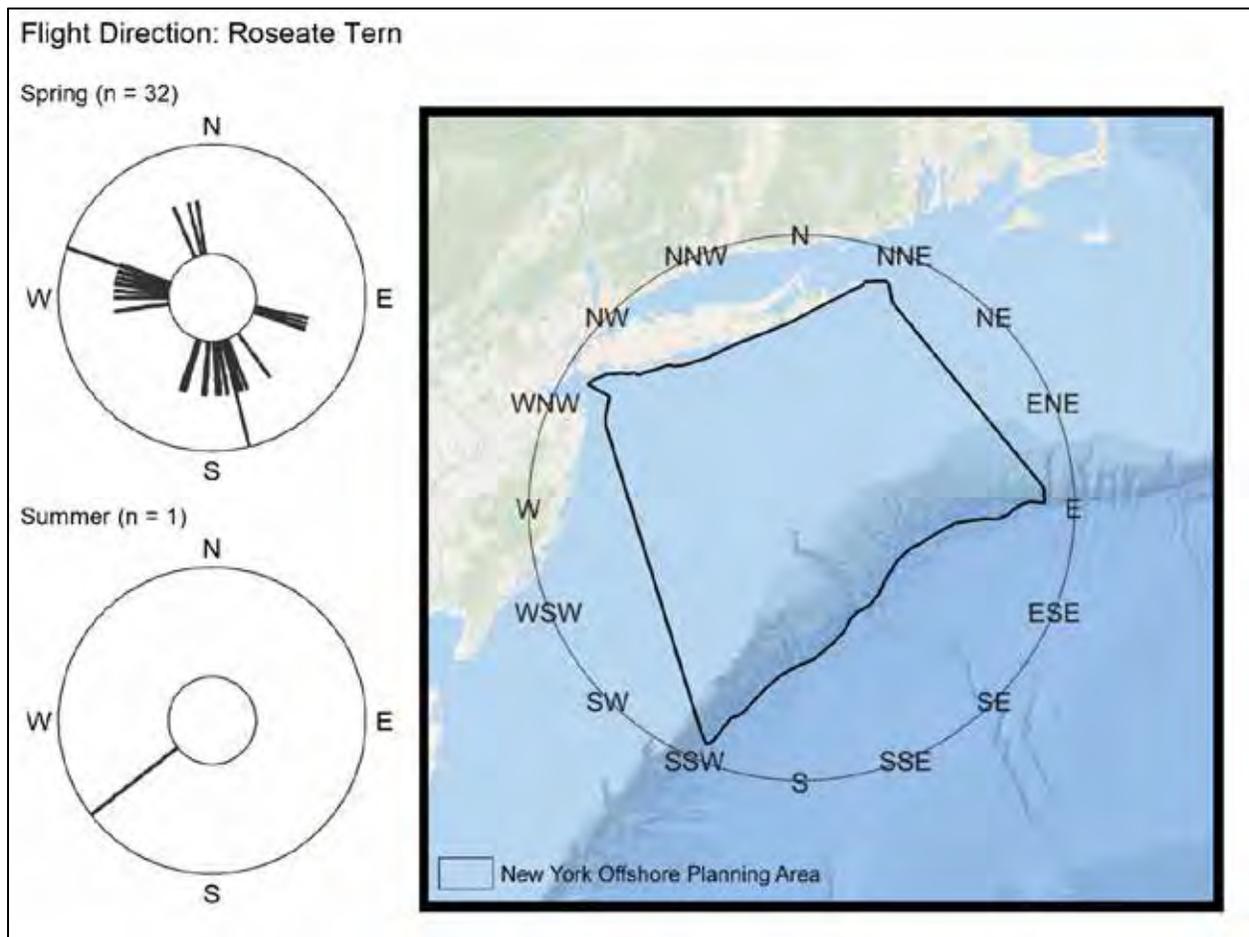


Figure 242. Spatial Distribution of Common Tern Sitting Relative to Birds in Flight During Spring and Summer Surveys

Solid blue points represent individuals with calculated flight height and blue points with an x represent individuals in flight without flight height data. A pie chart inset shows the proportion of individuals flying and sitting. A boxplot inset of flight height distribution by zone is displayed for all birds with known flight heights. Boxplots show the distribution of data among seasons. The dark horizontal line is the median flight height, and the box represents the middle 50% of data values. The lines to the left and right of the box represent the data points that are within 1.5 times the length of the box. Data beyond this range are shown as individual points.

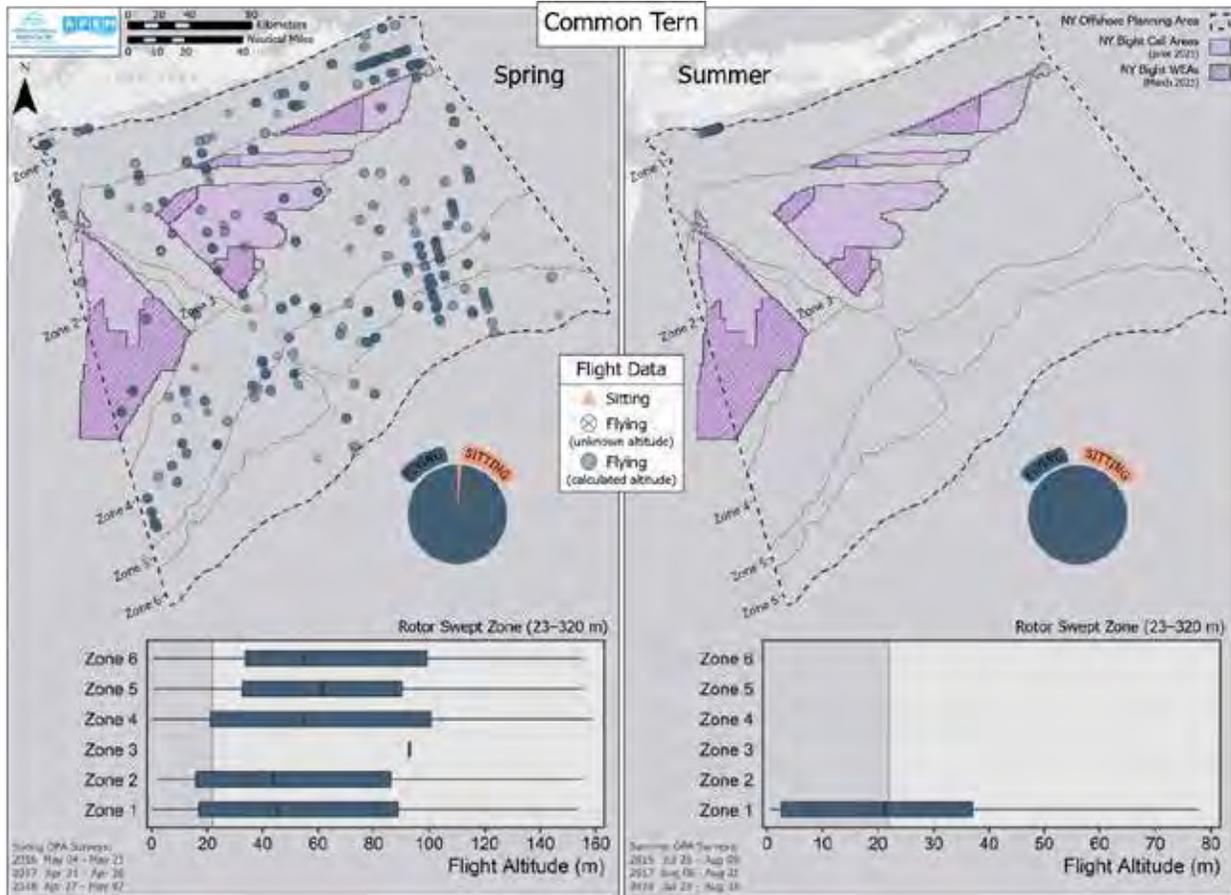


Figure 243. Direction of Flight of Common Tern for All Surveys

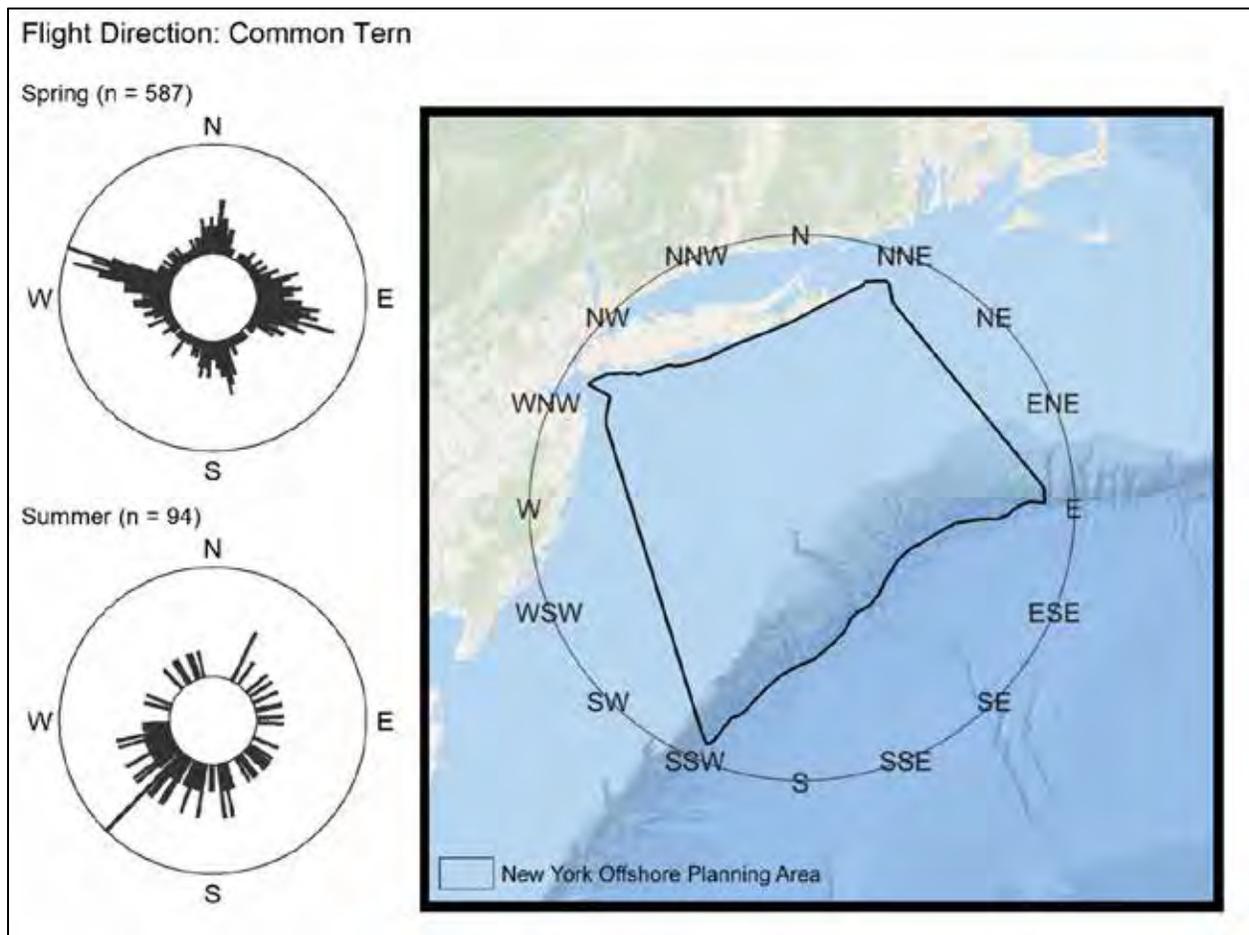


Figure 244. Spatial Distribution of Forster's Tern During Fall and Winter by Zone and Proximity to Call Areas

Heat map is scaled to the maximum density for the species/species group across all seasons. Inset bar plots display mean estimated densities \pm standard error of the mean for each zone.

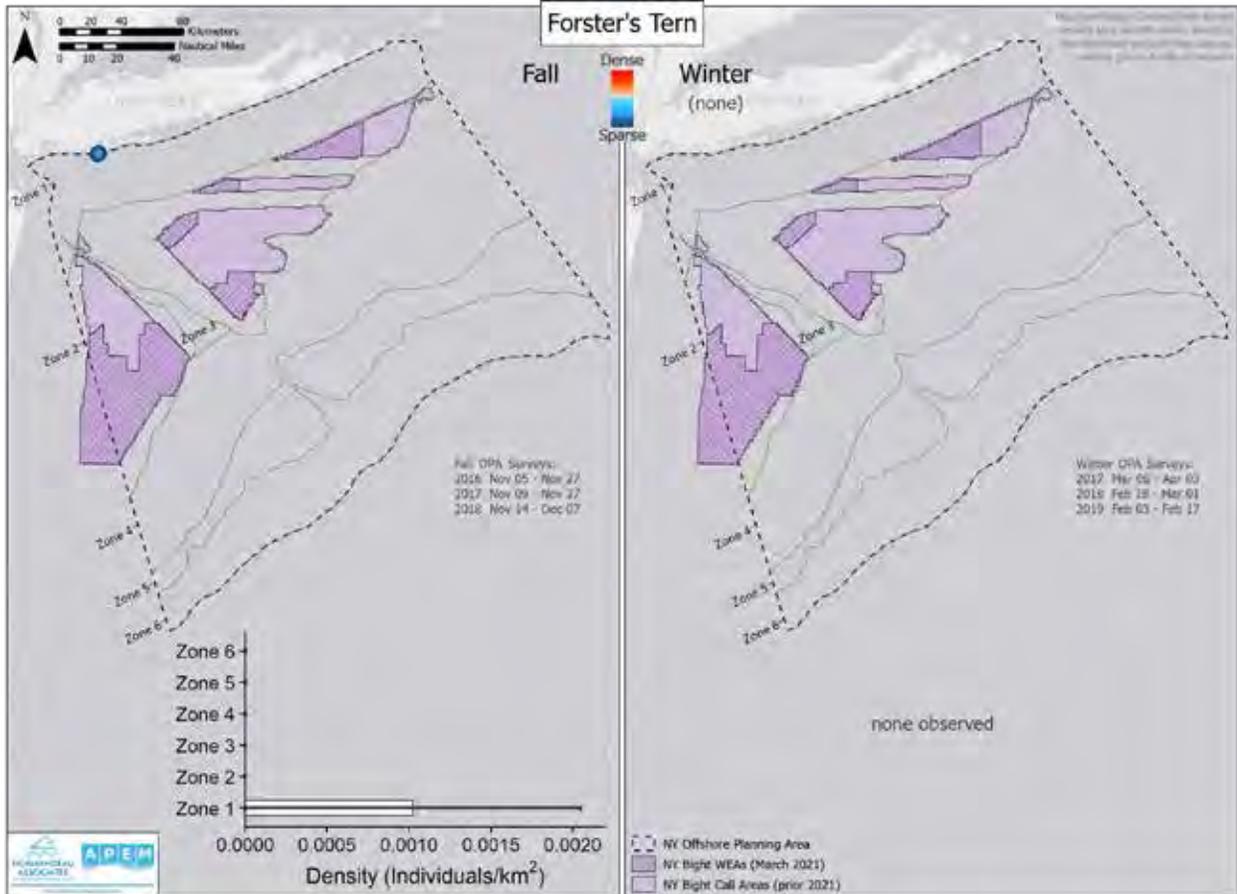


Figure 245. Spatial Distribution of Forster's Tern During Spring and Summer by Zone and Proximity to Call Areas

Heat map is scaled to the maximum density for the species/species group across all seasons. Inset bar plots display mean estimated densities \pm standard error of the mean for each zone.

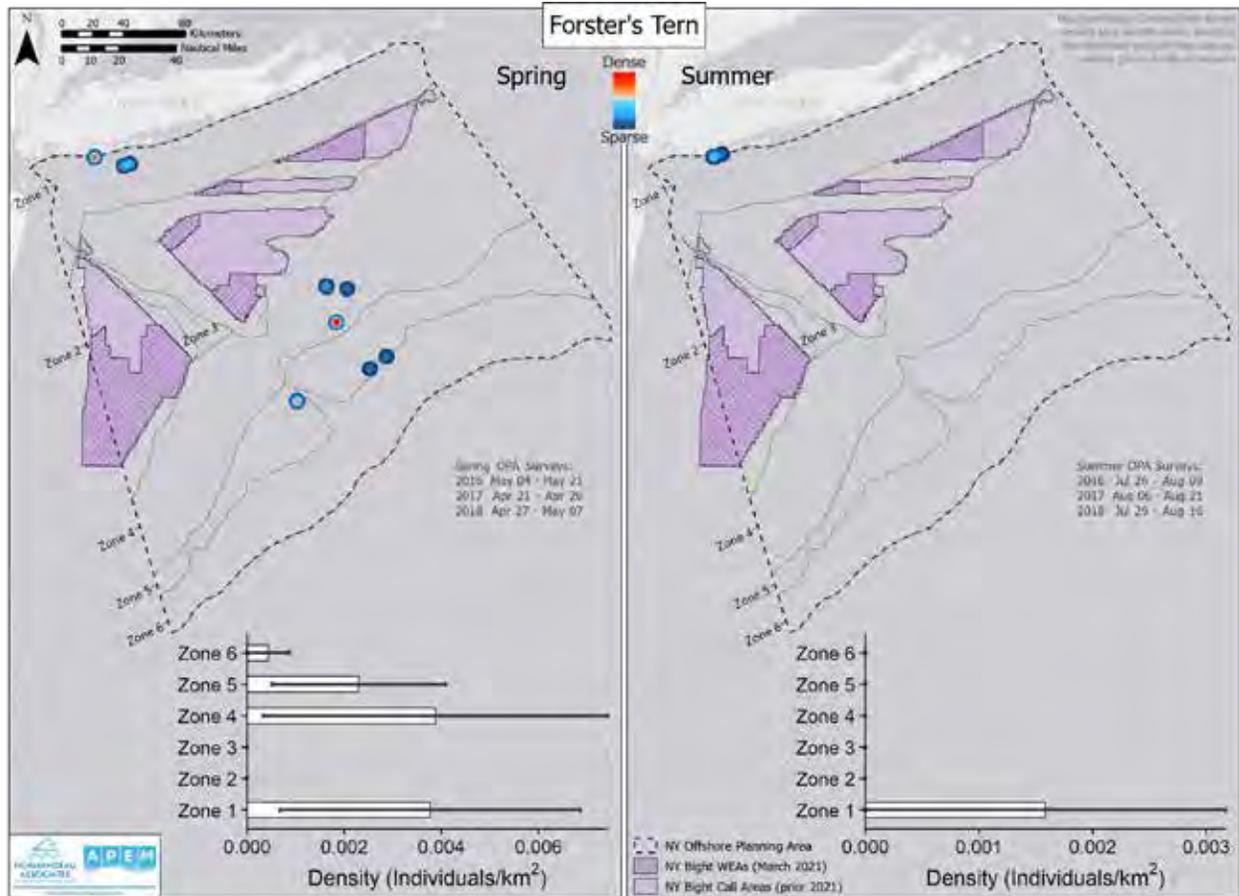


Figure 246. Spatial Distribution of Forrester's Tern Sitting Relative to Birds in Flight During Fall and Winter Surveys

Solid blue points represent individuals with calculated flight height and blue points with an x represent individuals in flight without flight height data. A pie chart inset shows the proportion of individuals flying and sitting. A boxplot inset of flight height distribution by zone is displayed for all birds with known flight heights. Boxplots show the distribution of data among seasons. The dark horizontal line is the median flight height, and the box represents the middle 50% of data values. The lines to the left and right of the box represent the data points that are within 1.5 times the length of the box. Data beyond this range are shown as individual points.

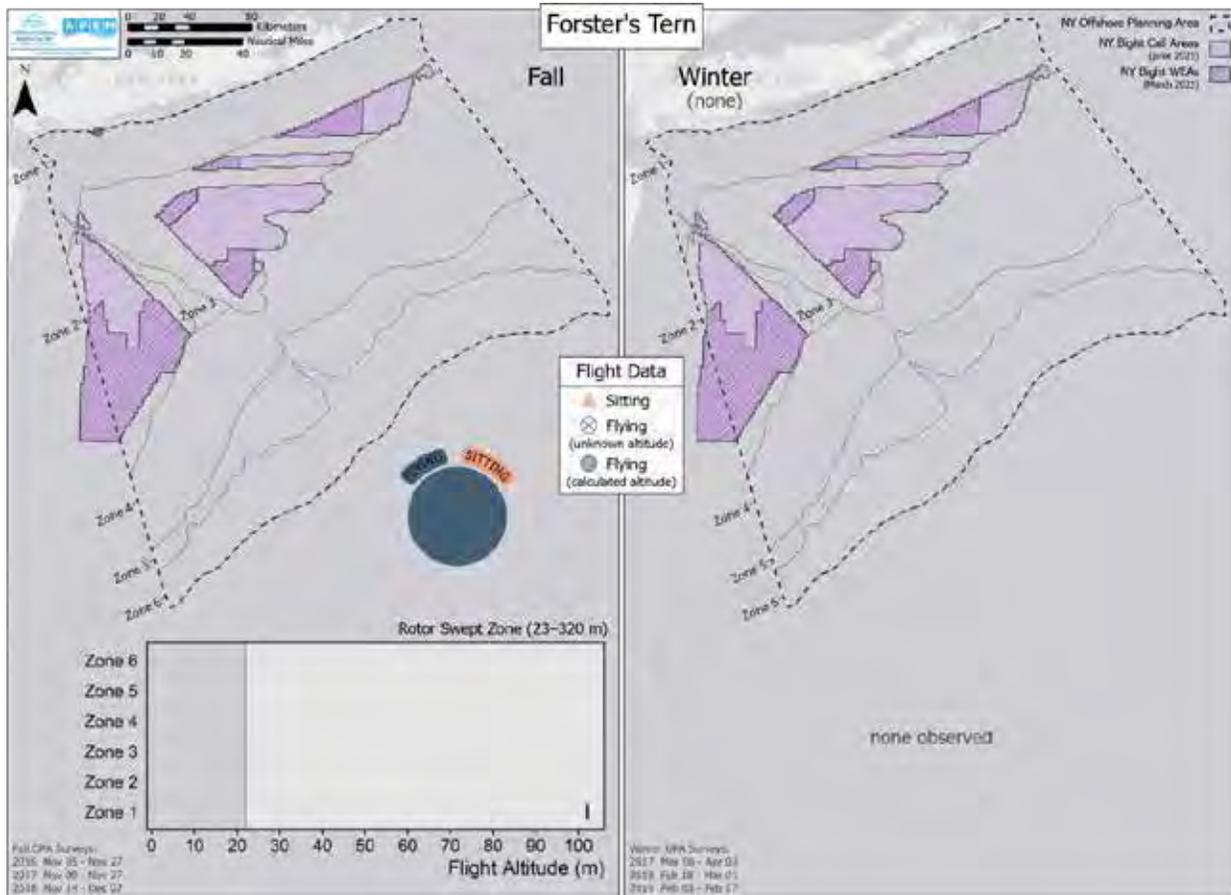


Figure 247. Spatial Distribution of Forster's Tern Sitting Relative to Birds in Flight During Spring and Summer Surveys

Solid blue points represent individuals with calculated flight height and blue points with an x represent individuals in flight without flight height data. A pie chart inset shows the proportion of individuals flying and sitting. A boxplot inset of flight height distribution by zone is displayed for all birds with known flight heights. Boxplots show the distribution of data among seasons. The dark horizontal line is the median flight height, and the box represents the middle 50% of data values. The lines to the left and right of the box represent the data points that are within 1.5 times the length of the box. Data beyond this range are shown as individual points.

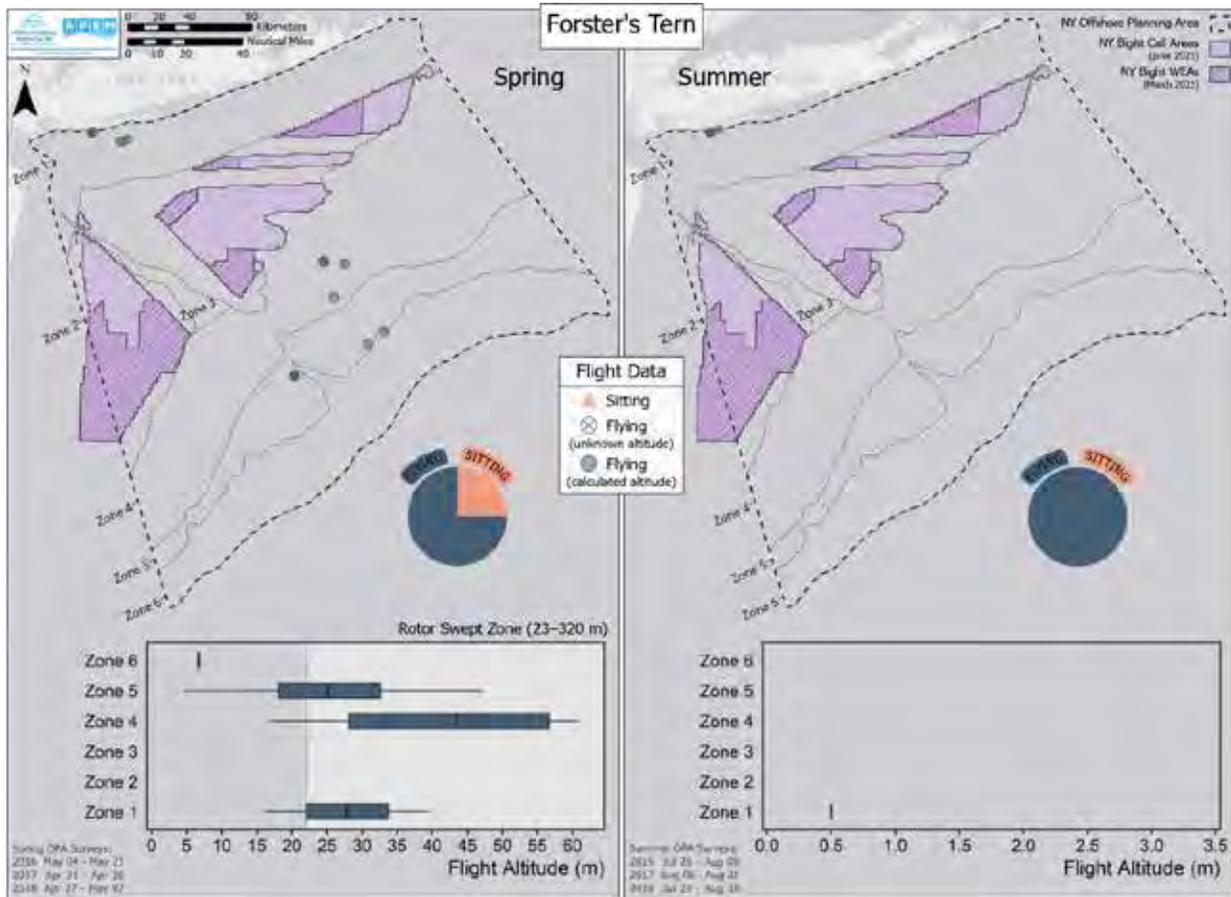
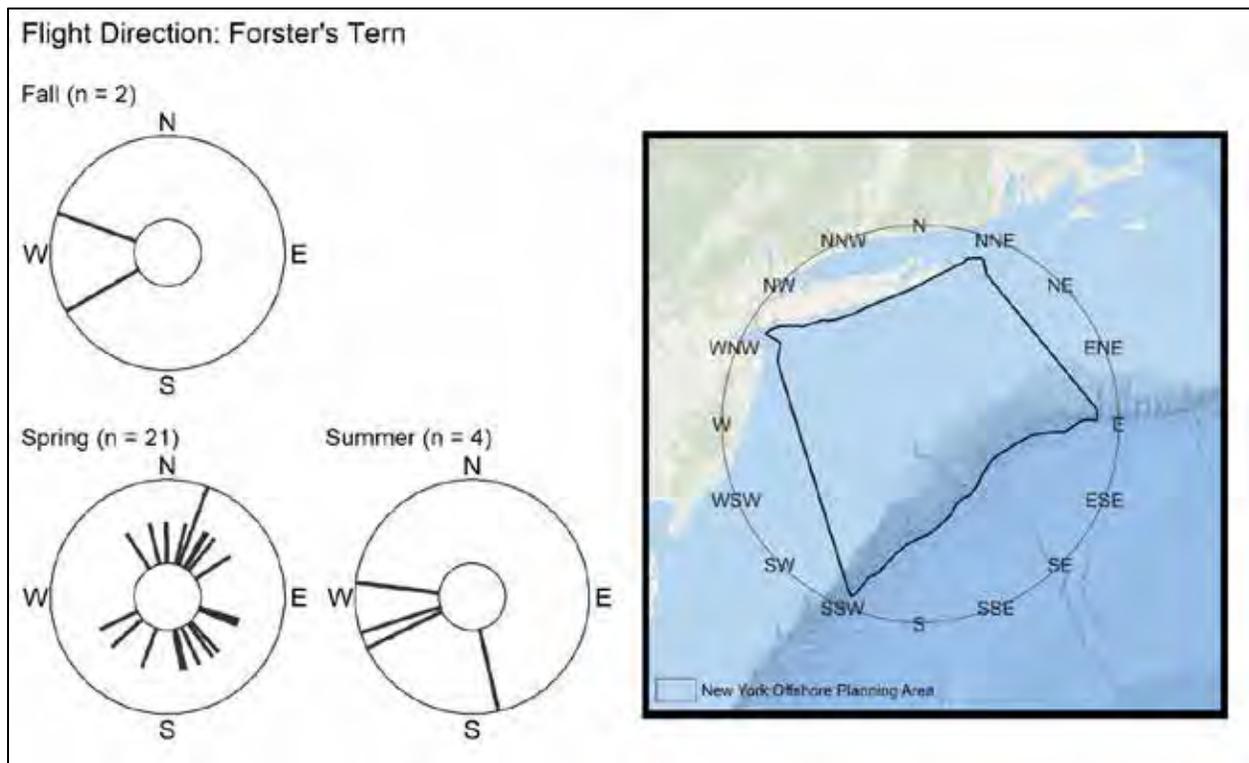


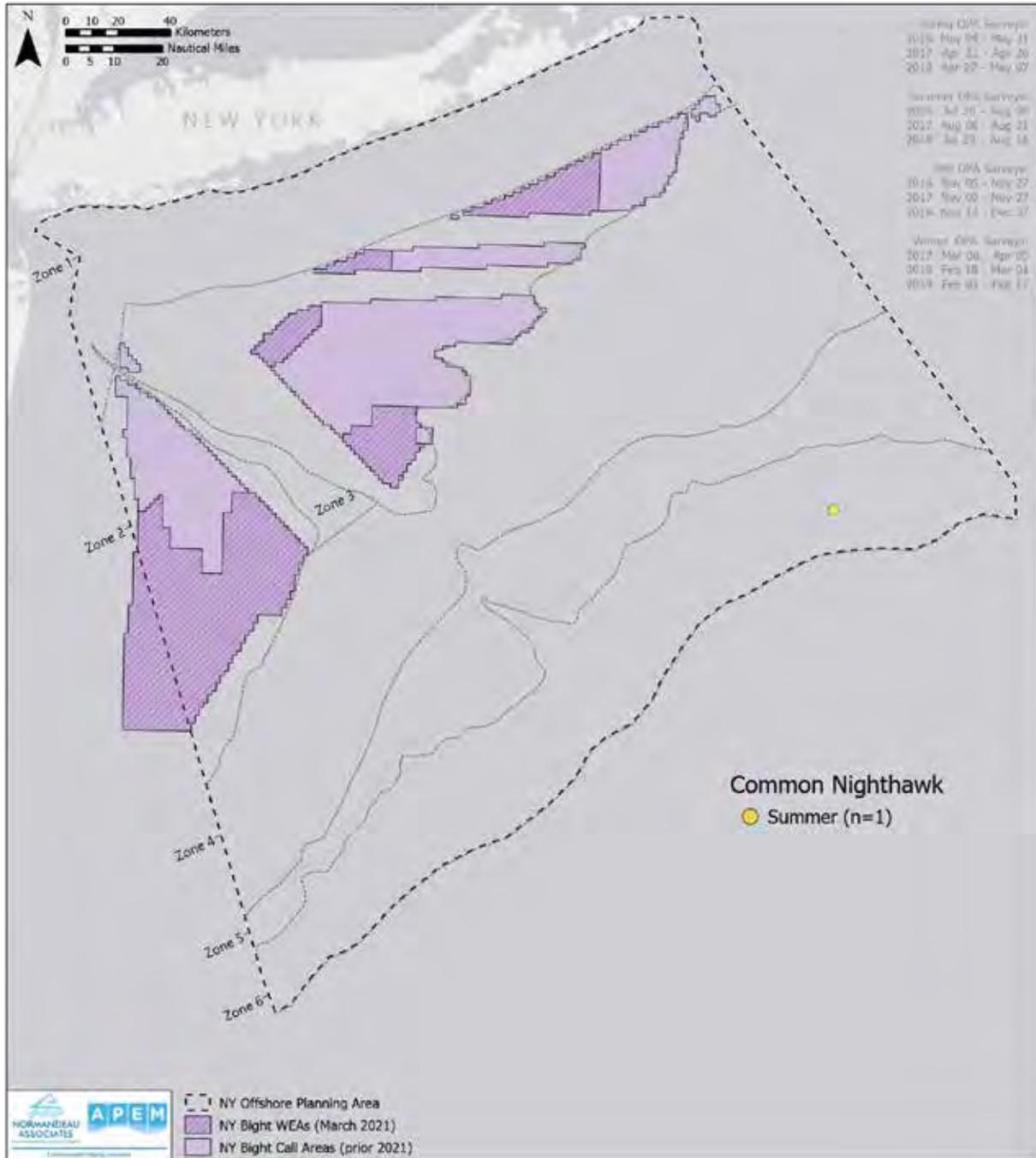
Figure 248. Direction of Flight of Forster's Tern for All Surveys



2.5.24 Nightjar

One common nighthawk was observed during the Summer 2017 survey within Zone 6 (Figure 249).

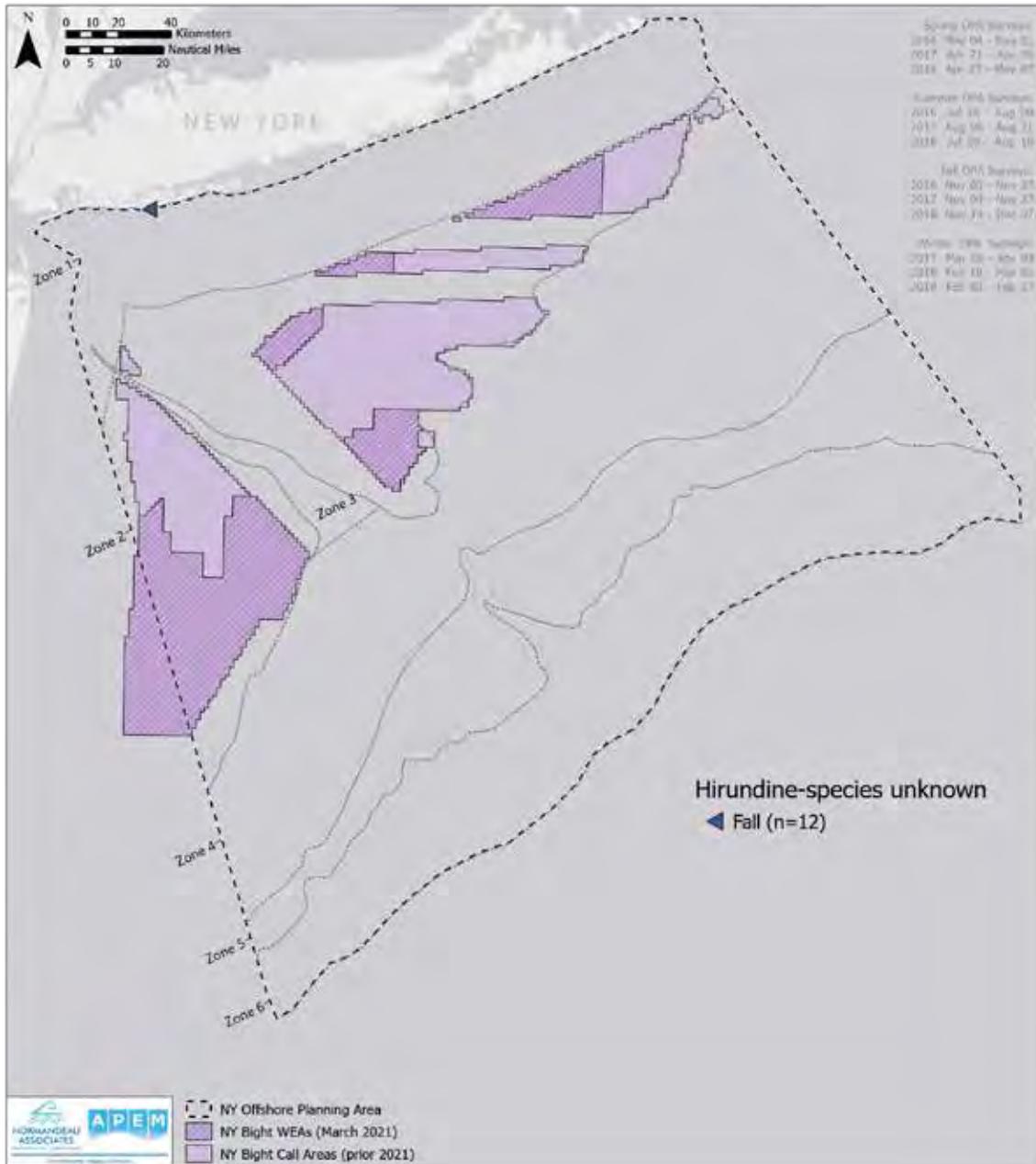
Figure 249. Spatial Distribution of Common Nighthawk



2.5.25 Hirundine

An unknown hirundine species was observed 12 times at a single location within Zone 1 in the Fall 2018 survey (Figure 250).

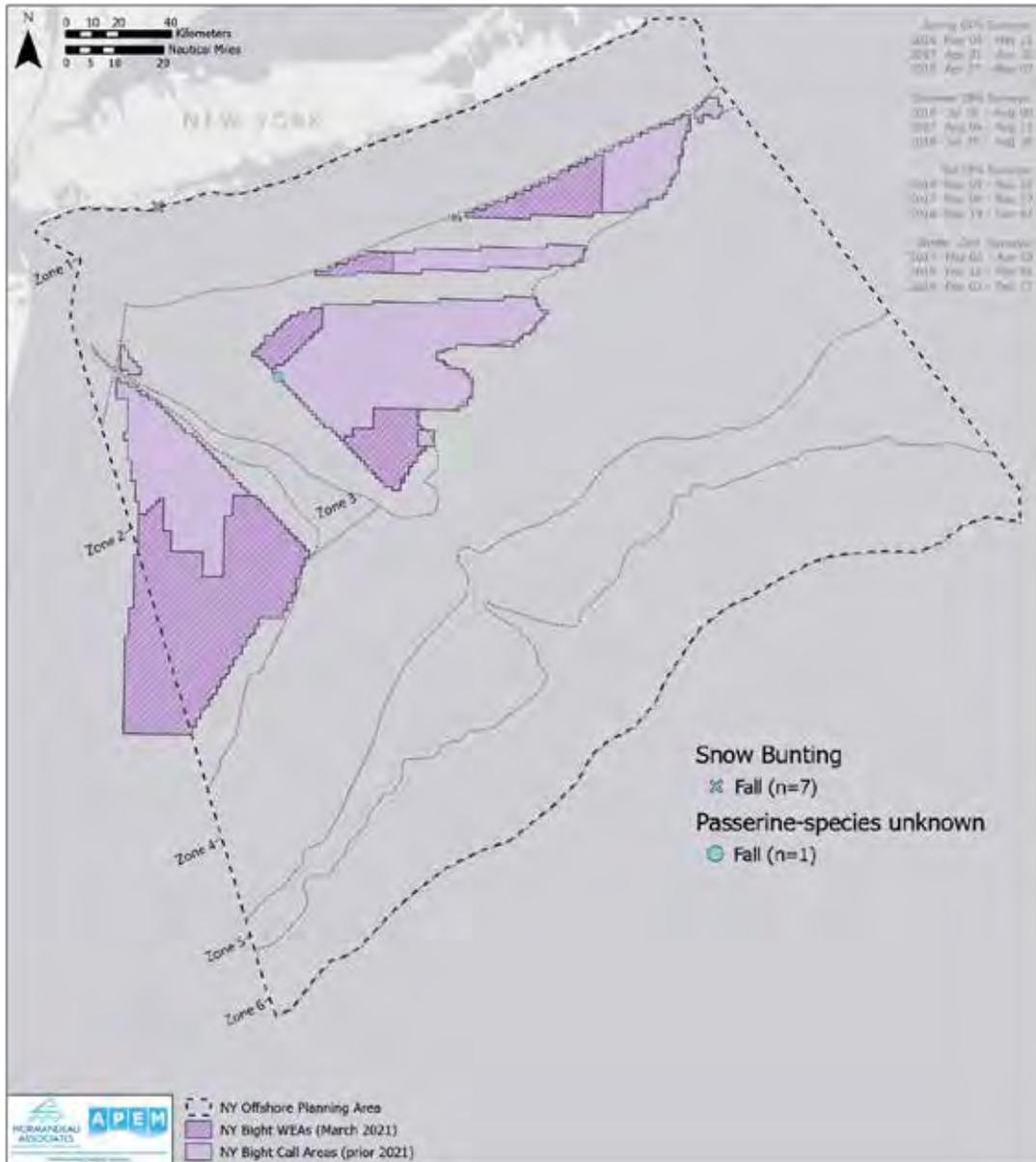
Figure 250. Spatial Distribution of Hirundine Species with Fewer than 30 Occurrences Across All Surveys.



2.5.26 Passerine

During Fall 2017, seven snow bunting were observed in Zone 1, and in Fall 2018, one unidentified passerine species was observed in Zone 2 (Figure 251).

Figure 251. Spatial Distribution of Passerine Species with Fewer than 30 Occurrences Across All Surveys



2.6 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 have high conservation status at a State and/or Federal level. Collision sensitivity generally represents species that frequently fly during twilight or at night, are not known to avoid wind farms in other parts of the world and spend considerable time in the area during 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 7, Table 8, and Table 9.

Sensitivity indices and associated maps are readily interpretable and can 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 birds in each cell.

When all data were pooled across all surveys, some population sensitivity shows in the northeastern section of the OPA, some low collision sensitivity is evident near shore and at the shelf break, and displacement sensitivity shows along the nearshore and central areas of the OPA (Figure 252).

Although population-sensitive species were distributed across the OPA, timing of aggregations varied with some spatial concentrations in the northeastern section during Summer 2016 and less so in the Summer 2017 and 2018 surveys. Population-sensitive species during the Fall and Winter were sparse; although, more population sensitivity is apparent near shore in the Winter, and in the Fall and Spring surveys appears to be more scattered (Figure 253). When pooled by season these patterns still hold true (Figure 254).

There was higher collision sensitivity evident in the Fall than other seasons, with highest Fall sensitivity during the 2018 survey. Collision-sensitive species were few in the Summer surveys. However, they occurred throughout the OPA during other seasons (Figure 255). There were some collision-sensitive species nearer shore and near the shelf in the Fall 2016 and 2018 surveys but more central in the Fall 2017 survey. The Winter surveys showed more collision sensitivity in deeper water of the OPA and nearer the shelf. All Spring surveys showed different and patchy collision sensitivity; although, Spring 2018 showed more collision sensitivity than either of the other Spring surveys (Figure 255). When data for each season were pooled, spatial patterns still hold true (Figure 256).

Displacement-sensitive species were found primarily near shore throughout the year; although during the Fall 2018, they were much denser in the northeast portion of the OPA, and in the Spring 2018 survey, aggregations were generally dense in the coastal and central portions of the OPA (Figure 257). This high displacement sensitivity during Fall 2018 and Spring 2018 surveys largely represents some species of ducks, loons, and auks that have restricted habitat flexibility, whereas in the Winter 2017–2018, numbers of these species were lower than the previous year and the following Winter 2018–2019 survey. Those species were again present in higher densities in the Spring 2018 survey and to some extent in the Spring 2019 survey. For this reason, the displacement sensitivity map for Spring 2018 shows higher aggregations in the central and nearer shore areas of the OPA when compared to the Spring 2017 survey and higher nearer shore in the Spring 2019 survey (Figure 257). The seasonal assessment for displacement sensitivity pooled across two years of data show these same patterns of occurrence in the Winter and Spring (Figure 258).

Table 7. 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
<i>Sterna</i> 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 8. 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 9. Species used in Displacement-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



Figure 252. Average Number of Population-Sensitive, Collision-Sensitive, and Displacement-Sensitive Individuals per Grid Cell for All Surveys

Species are listed in Table 7, Table 8, and Table 9, respectively.

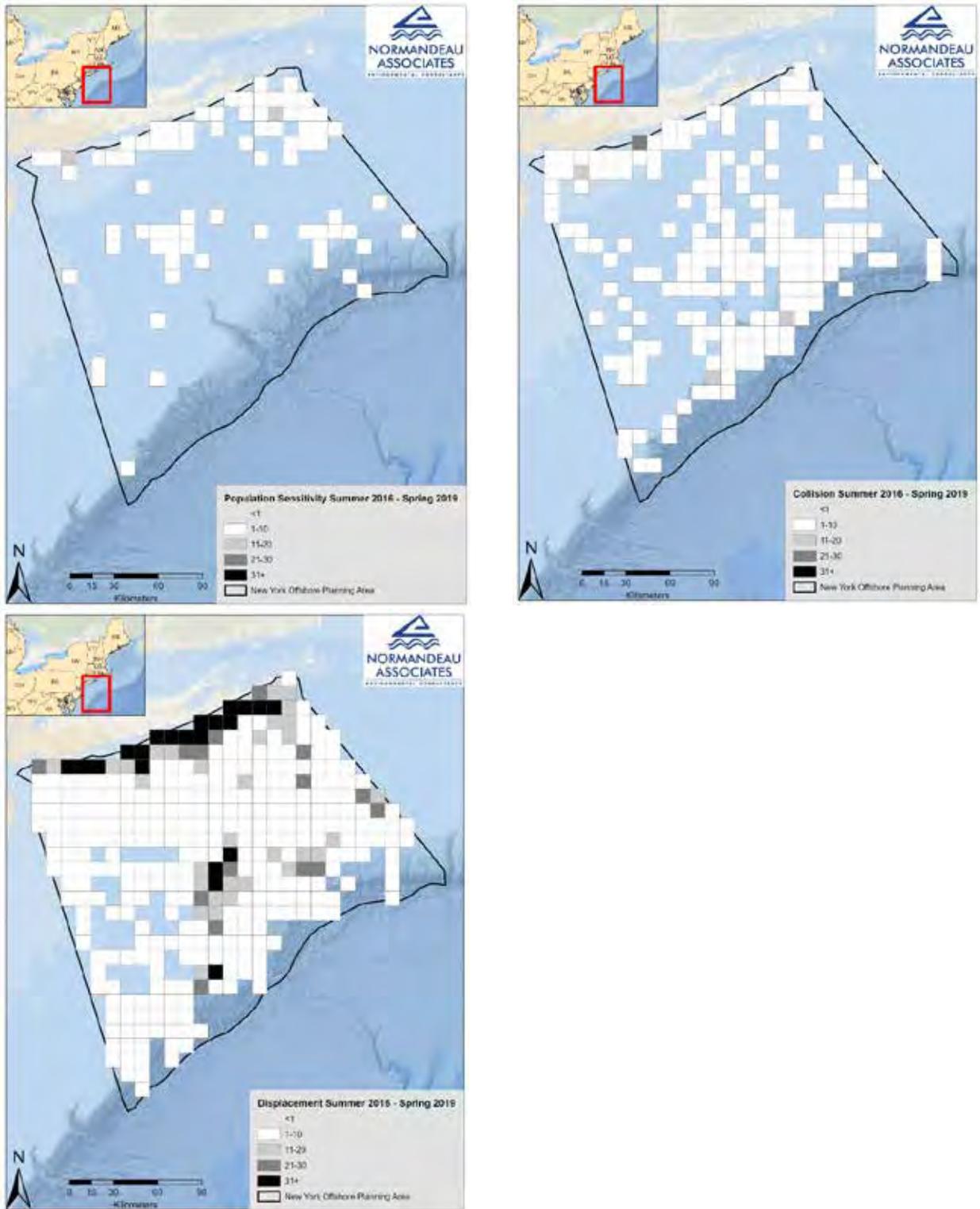


Figure 253. Total Number of Population-Sensitive Individuals by Grid Cell for Each Survey

Population-sensitive species listed in Table 7; figure continued next page.

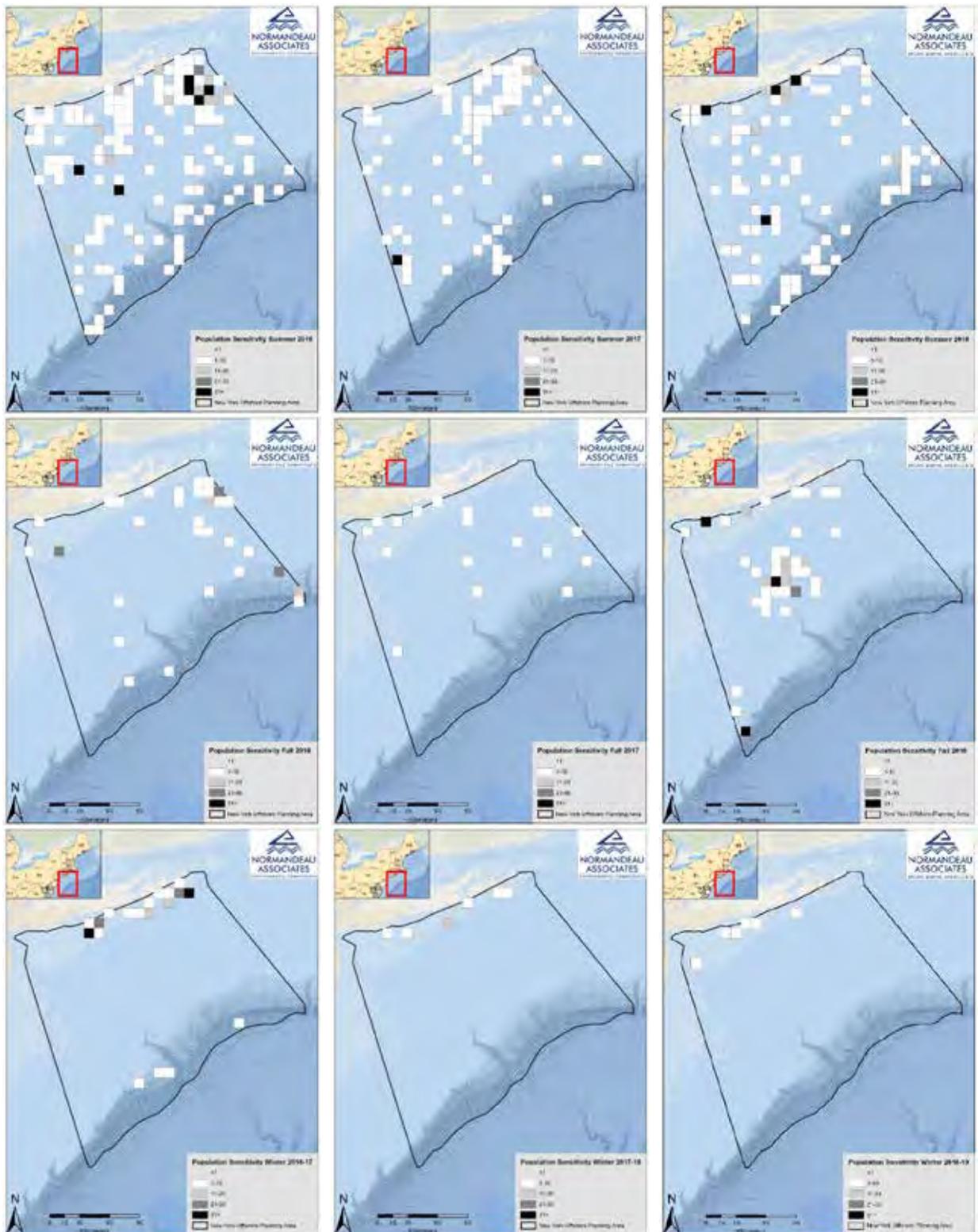


Figure 253. continued

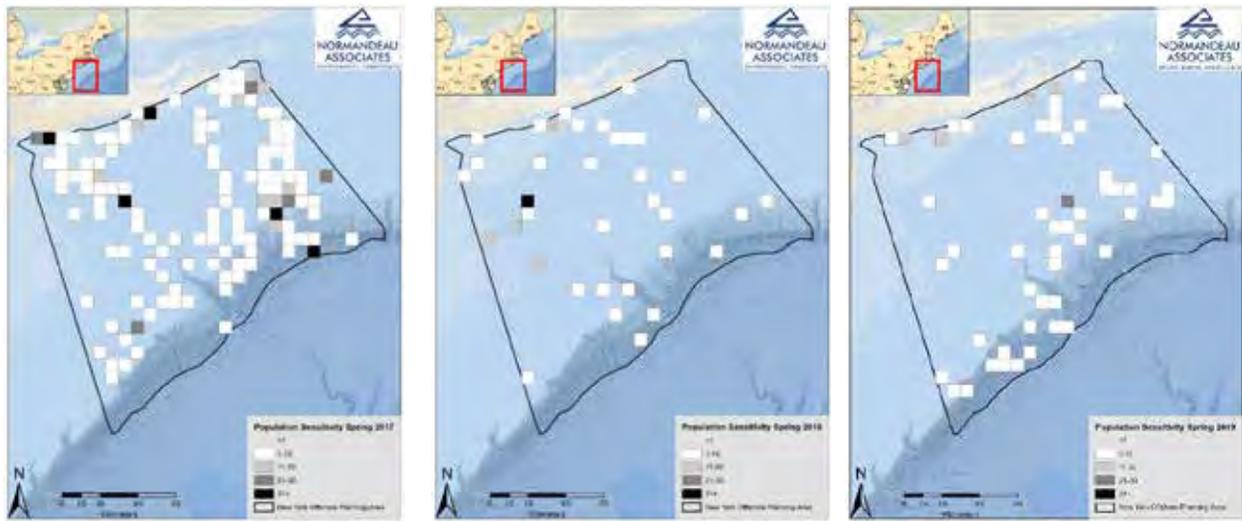


Figure 254. Total Number of Population-Sensitive Individuals by Grid Cell Averaged by Season for All Surveys

Population-sensitive species listed in Table 7.

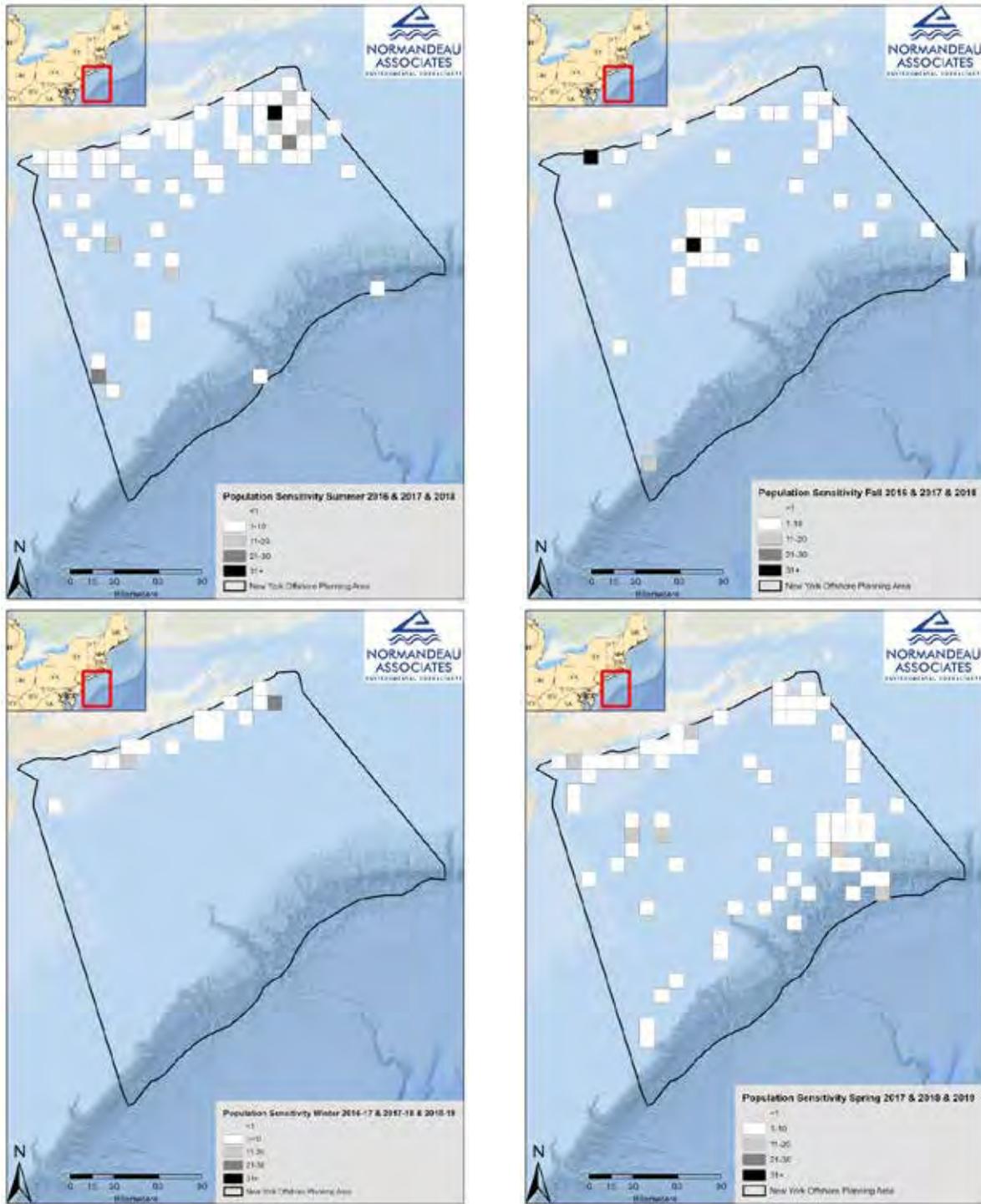


Figure 255. Total Number of Collision-Sensitive Individuals by Grid Cell for Each Survey

Collision-sensitive species listed in Table 8; figure continued next page.

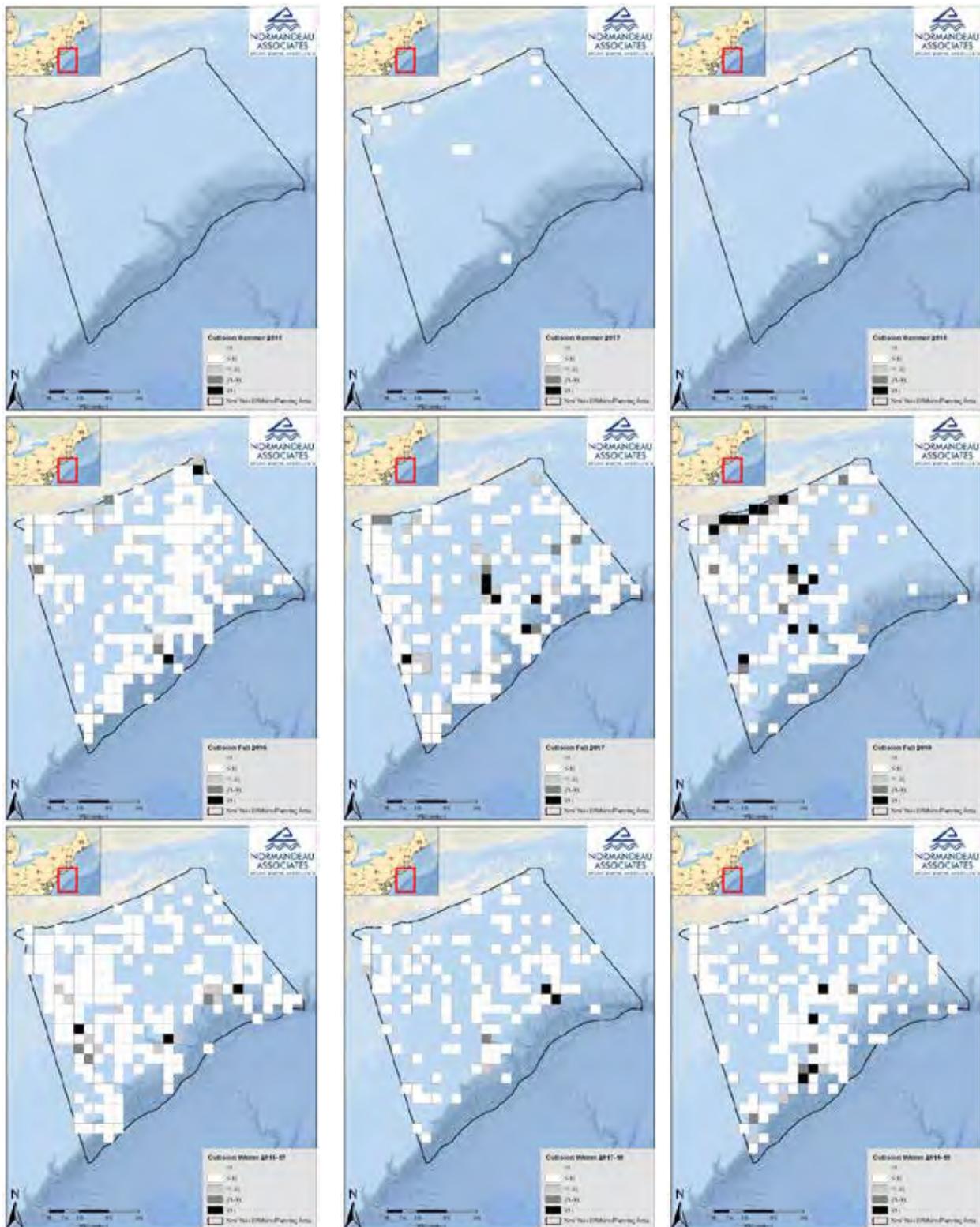


Figure 255. continued

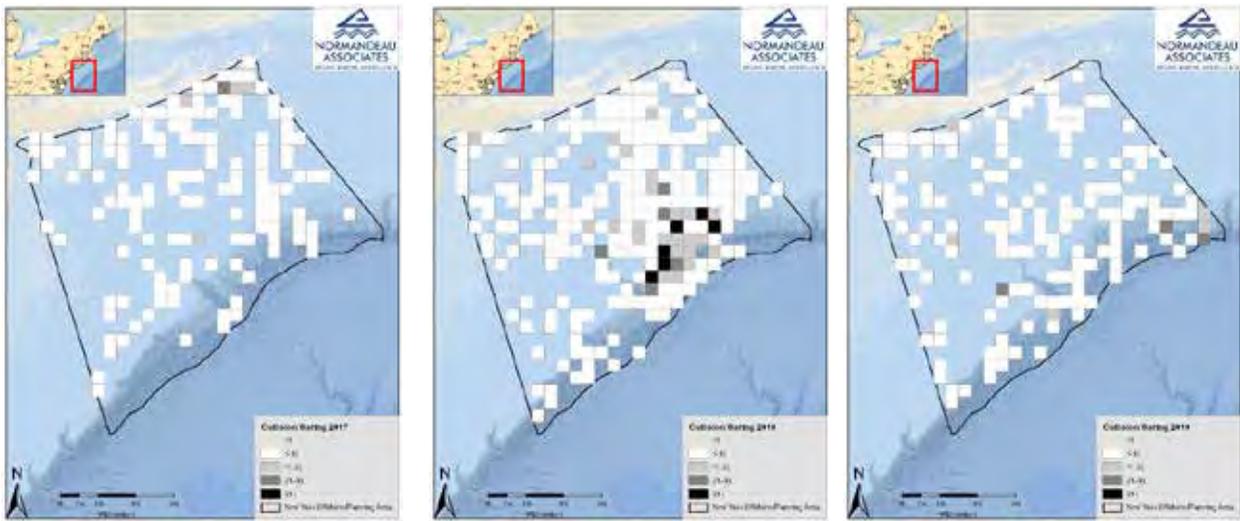


Figure 256. Total Number of Collision-Sensitive Individuals by Grid Cell Averaged by Season for All Surveys

Collision-sensitive species listed in Table 8.

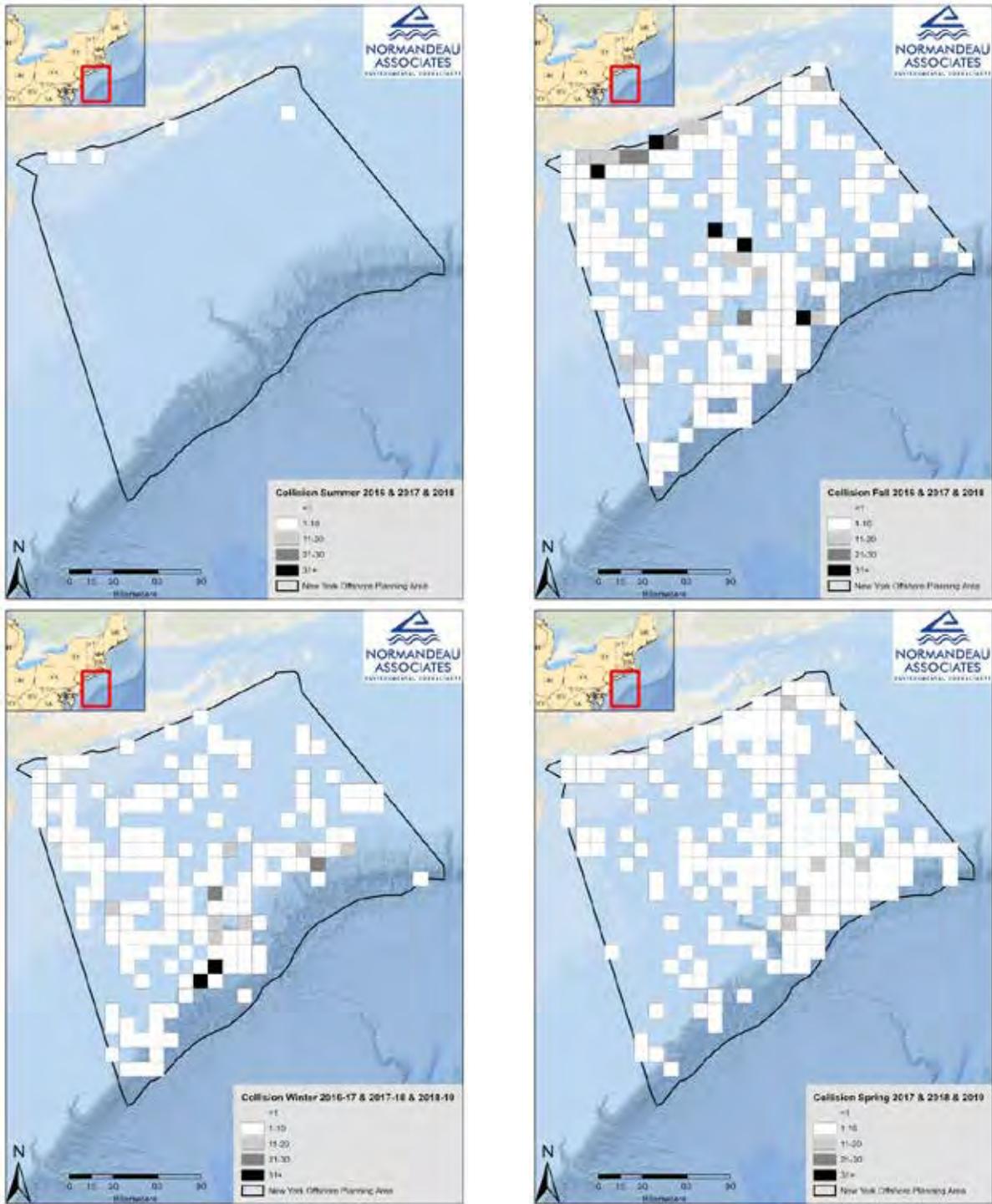


Figure 257. Total Number of Displacement-Sensitive Individuals by Grid Cell for All Surveys

Displacement-sensitive species listed in Table 9; figure continued next page.

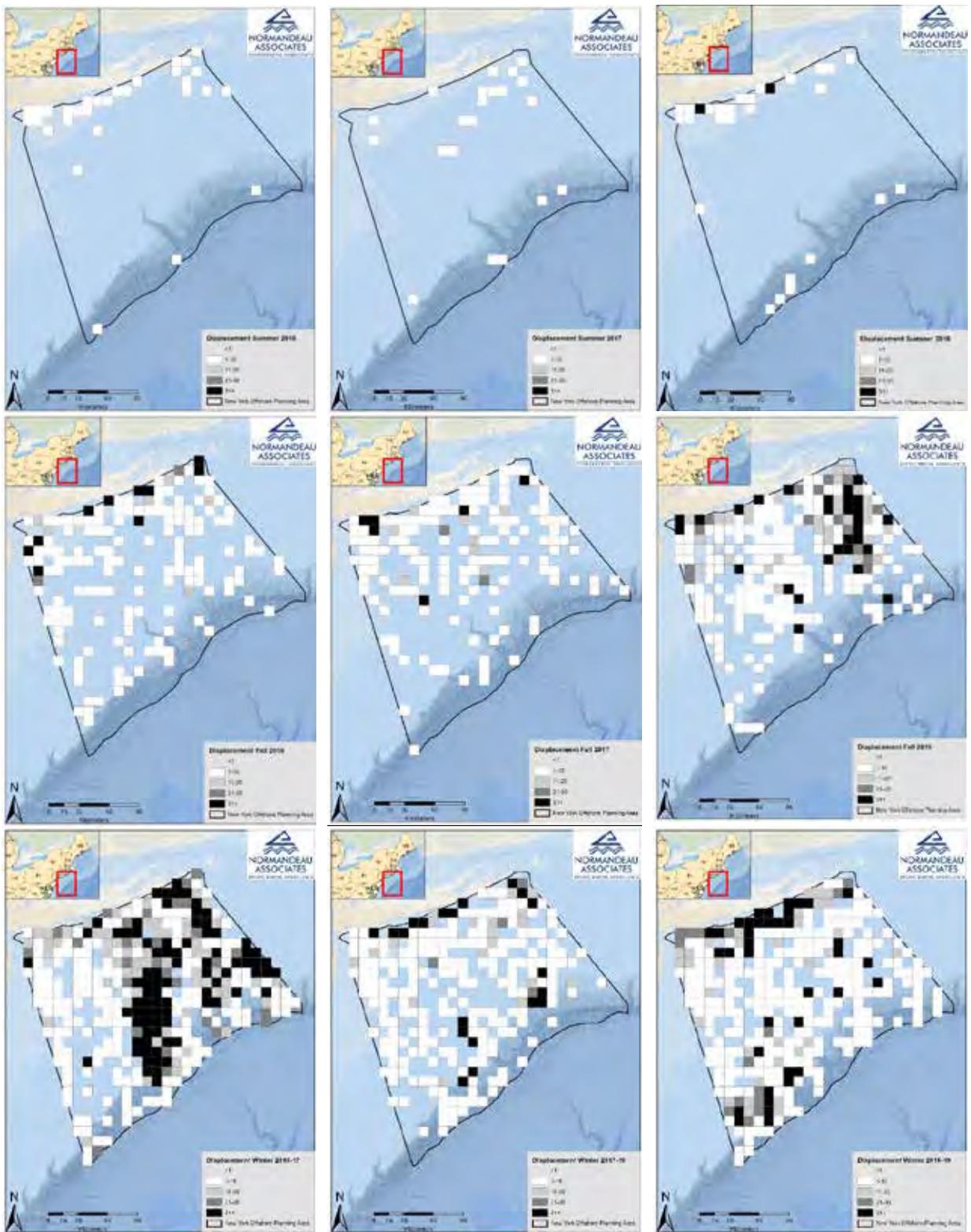


Figure 257. continued

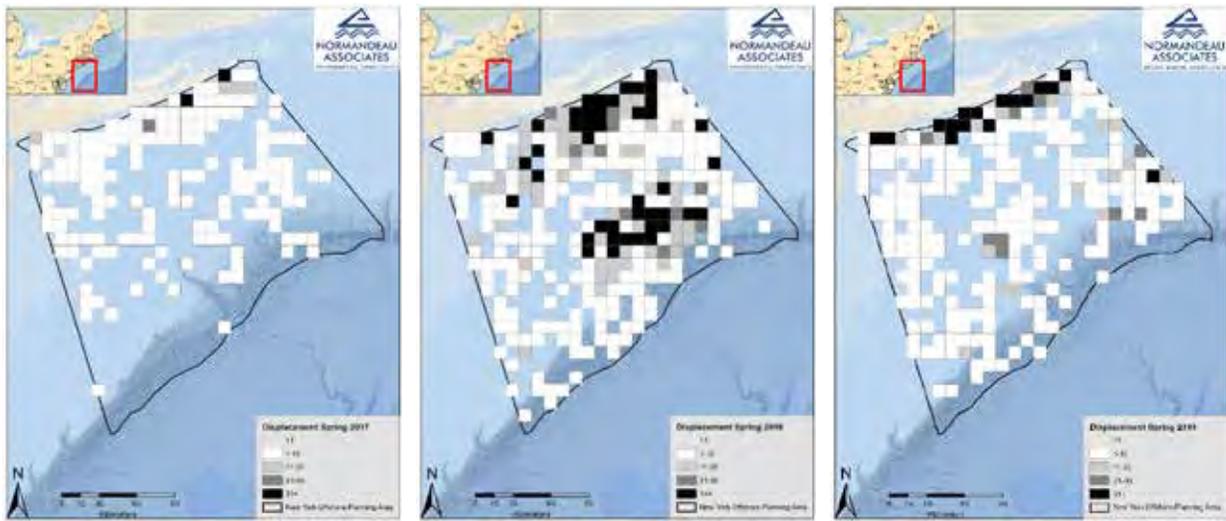
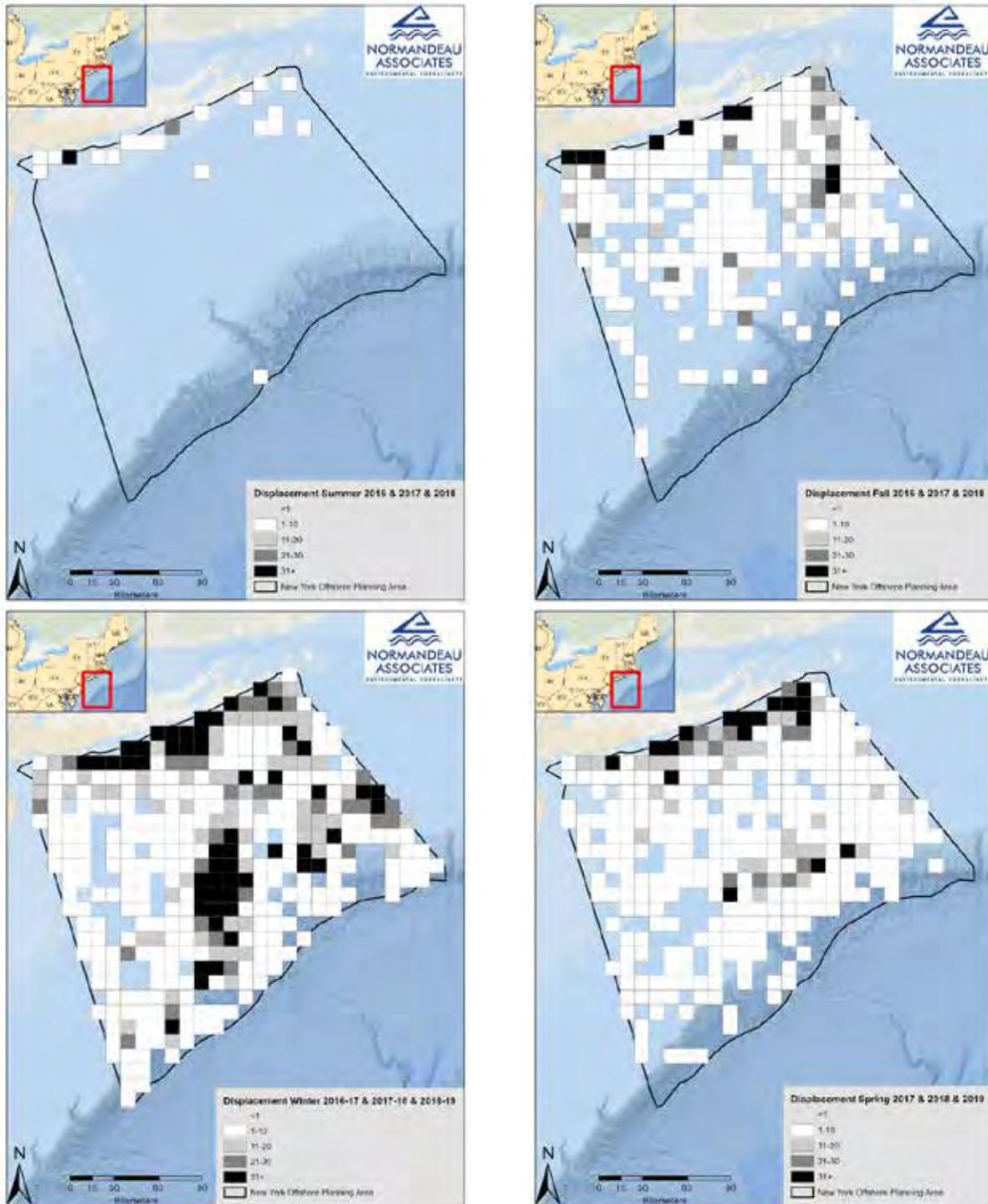


Figure 258. Total Number of Displacement-Sensitive Individuals by Grid Cell Averaged by Season for All Surveys

Displacement-sensitive species listed in Table 9.



3 References

- Robinson Willmott JC, Forcey G, Kent A. 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.
- Story M, Congalton RG. 1986. Accuracy Assessment: A User's Perspective. *Photogrammetric Engineering and Remote Sensing* 52:397–399.

Appendix A. Common and Scientific Names for Taxa Identified in Surveys

Table A–1. Common and Scientific Names for Taxa Identified in the Summer 2016 through Spring 2019 Surveys

Species highlighted in light grey are ESA or State-Listed Species

Common Name	Scientific Name
BIRDS	Aves
Goose	
Brant	<i>Branta bernicla</i>
Canada Goose	<i>Branta canadensis</i>
Swan	
Tundra Swan	<i>Cygnus columbianus</i>
Duck	
Gadwall	<i>Mareca strepera</i>
Mallard	<i>Anas platyrhynchos</i>
American Black Duck	<i>Anas rubripes</i>
Lesser Scaup	<i>Aythya affinis</i>
King Eider	<i>Somateria spectabilis</i>
Common Eider	<i>Somateria mollissima</i>
Surf Scoter	<i>Melanitta perspicillata</i>
White-winged Scoter	<i>Melanitta fusca</i>
Black Scoter	<i>Melanitta americana</i>
Long-tailed Duck	<i>Clangula hyemalis</i>
Bufflehead	<i>Bucephala albeola</i>
Common Goldeneye	<i>Bucephala clangula</i>
Common Merganser	<i>Mergus merganser</i>
Red-breasted Merganser	<i>Mergus serrator</i>
Loon	
Red-throated Loon	<i>Gavia stellata</i>
Common Loon	<i>Gavia immer</i>
Grebe	
Horned Grebe	<i>Podiceps auritus</i>
Fulmar	
Northern Fulmar	<i>Fulmarus glacialis</i>
Petrel	
Trindade Petrel	<i>Pterodroma arminjoniana</i>
Black-capped Petrel	<i>Pterodroma hasitata</i>

(continued)

Table A–1. continued

Common Name	Scientific Name
Shearwater	
Cory's Shearwater	<i>Calonectris diomedea</i>
Great Shearwater	<i>Ardenna gravis</i>
Sooty Shearwater	<i>Ardenna grisea</i>
Manx Shearwater	<i>Puffinus puffinus</i>
Audubon's Shearwater	<i>Puffinus lherminieri</i>
Storm-petrel	
Wilson's Storm-Petrel	<i>Oceanites oceanicus</i>
White-faced Storm-Petrel	<i>Pelagodroma marina</i>
Leach's Storm-Petrel	<i>Oceanodroma leucorhoa</i>
Band-rumped Storm-Petrel	<i>Oceanodroma castro</i>
Booby	
Brown Booby	<i>Sula leucogaster</i>
Gannet	
Northern Gannet	<i>Morus bassanus</i>
Cormorant	
Double-crested Cormorant	<i>Phalacrocorax auritus</i>
Pelican	
Brown Pelican	<i>Pelecanus occidentalis</i>
Ardeidae	
Great Blue Heron	<i>Ardea herodias</i>
Snowy Egret	<i>Egretta thula</i>
Raptor	
Osprey	<i>Pandion haliaetus</i>
Bald Eagle	<i>Haliaeetus leucocephalus</i>
Shorebird	
American Oystercatcher	<i>Haematopus palliatus</i>
Black-bellied Plover	<i>Pluvialis squatarola</i>
Semipalmated Plover	<i>Charadrius semipalmatus</i>
Piping Plover	<i>Charadrius melodus</i>
Ruddy Turnstone	<i>Arenaria interpres</i>
Sanderling	<i>Calidris alba</i>
Dunlin	<i>Calidris alpina</i>
Phalarope	
Red-necked Phalarope	<i>Phalaropus lobatus</i>
Red Phalarope	<i>Phalaropus fulicarius</i>
Skua	
Great Skua	<i>Stercorarius skua</i>
South Polar Skua	<i>Stercorarius maccormicki</i>
Pomarine Jaeger	<i>Stercorarius pomarinus</i>

(continued)

Table A-1. continued

Common Name	Scientific Name
Parasitic Jaeger	<i>Stercorarius parasiticus</i>
Auk	
Dovekie	<i>Alle alle</i>
Common Murre	<i>Uria aalge</i>
Razorbill	<i>Alca torda</i>
Black Guillemot	<i>Cepphus grylle</i>
Atlantic Puffin	<i>Fratercula arctica</i>
Gull	
Black-legged Kittiwake	<i>Rissa tridactyla</i>
Bonaparte's Gull	<i>Chroicocephalus philadelphia</i>
Little Gull	<i>Hydrocoloeus minutus</i>
Laughing Gull	<i>Leucophaeus atricilla</i>
Ring-billed Gull	<i>Larus delawarensis</i>
Herring Gull	<i>Larus argentatus</i>
Iceland Gull	<i>Larus glaucoides</i>
Lesser Black-backed Gull	<i>Larus fuscus</i>
Glaucous Gull	<i>Larus hyperboreus</i>
Great Black-backed Gull	<i>Larus marinus</i>
Tern	
Least Tern	<i>Sternula antillarum</i>
Black Tern	<i>Chlidonias niger</i>
Royal Tern	<i>Thalasseus maximus</i>
Sterna Tern	
Roseate Tern	<i>Sterna dougallii</i>
Common Tern	<i>Sterna hirundo</i>
Forster's Tern	<i>Sterna forsteri</i>
Nightjar	
Common Nighthawk	<i>Chordeiles minor</i>
Passerine	
Snow Bunting	<i>Plectrophenax nivalis</i>

Appendix B. Number of Birds per Survey

Table B-1. Number of Birds per Survey Identified in Imagery Captured over 12 Surveys in the New York Offshore Planning Area

Species	Raw Numbers												Species Total
	Summer			Fall			Winter			Spring			
	2016	2017	2018	2016	2017	2018	2016–2017	2017–2018	2018–2019	2017	2018	2019	
Goose	-	-	-	-	2	6	1	-	-	-	-	-	9
Brant	-	-	-	-	-	6	-	-	-	-	-	-	6
Canada Goose	-	-	-	-	2	-	1	-	-	-	-	-	3
Swan	-	-	-	-	-	-	-	12	-	-	-	-	12
Tundra Swan	-	-	-	-	-	-	-	12	-	-	-	-	12
Duck	-	-	-	1,680	282	1,347	1,390	1,662	5,007	66	5,169	1,067	17,670
Gadwall	-	-	-	3	-	-	-	-	-	-	-	-	3
Mallard	-	-	-	-	-	1	-	-	-	-	-	-	1
American Black Duck	-	-	-	-	-	14	-	-	-	-	-	-	14
Lesser Scaup	-	-	-	-	-	-	7	-	-	2	-	-	9
King Eider	-	-	-	-	-	-	1	-	-	-	-	-	1
Common Eider	-	-	-	-	4	-	-	-	7	-	-	-	11
Surf Scoter	-	-	-	37	39	153	235	9	43	-	106	93	715
White-winged Scoter	-	-	-	19	1	79	348	132	4,241	1	312	112	5,245
Black Scoter	-	-	-	1,603	127	895	536	3	70	3	28	23	3,288
Scoter unid.	-	-	-	-	94	184	50	1,473	583	50	4,721	830	7,985
Long-tailed Duck	-	-	-	3	14	5	49	43	41	2	-	-	157
Bufflehead	-	-	-	5	-	3	108	1	12	-	-	-	129
Common Goldeneye	-	-	-	-	-	-	1	-	-	-	-	-	1
Common Merganser	-	-	-	-	-	1	-	-	-	-	-	-	1
Red-breasted Merganser	-	-	-	-	2	1	5	-	1	7	-	-	16
species unknown	-	-	-	10	1	11	50	1	9	1	2	9	94

(continued)

Table B-1. continued

Species	Raw Numbers												Species Total
	Summer			Fall			Winter			Spring			
	2016	2017	2018	2016	2017	2018	2016– 2017	2017– 2018	2018– 2019	2017	2018	2019	
Loon	3	5	6	272	315	796	586	190	355	240	601	703	4,072
Red-throated Loon	-	-	-	222	161	320	241	35	88	24	161	126	1,378
Common Loon	3	3	6	48	140	442	342	151	252	213	438	563	2,601
species unknown	-	2	-	2	14	34	3	4	15	3	2	14	93
Grebe	-	-	-	-	-	1	8	3	4	-	1	2	19
Horned Grebe	-	-	-	-	-	1	8	3	4	-	1	-	17
species unknown	-	-	-	-	-	-	-	-	-	-	-	2	2
Fulmar	-	-	-	3	60	134	49	705	59	50	21	70	1,151
Northern Fulmar	-	-	-	3	60	134	49	705	59	50	21	70	1,151
Petrel	18	3	6	1	-	-	2	-	-	2	5	22	59
Trindade Petrel	-	-	-	-	-	-	-	-	-	1	-	-	1
Black-capped Petrel	13	3	6	1	-	-	1	-	-	-	5	22	51
species unknown	5	-	-	-	-	-	1	-	-	1	-	-	7
Shearwater	732	576	499	164	43	446	4	-	2	125	12	45	2,648
Cory's Shearwater	510	90	199	146	2	3	-	-	-	9	-	4	963
Great Shearwater	70	337	97	8	12	101	-	-	-	2	-	-	627
Sooty Shearwater	2	1	1	-	-	-	2	-	-	81	9	24	120
Manx Shearwater	-	-	-	-	16	26	-	-	1	-	-	9	52
Audubon's Shearwater	8	-	-	-	-	-	-	-	-	-	-	-	8
species unknown-Large	129	108	199	10	8	315	2	-	-	15	1	-	787
species unknown-Small	13	40	3	-	5	1	-	-	-	18	2	5	87
species unknown	-	-	-	-	-	-	-	-	1	-	-	3	4
Storm-petrel	789	2,080	2,123	1	111	6	71	-	-	96	223	2,086	7,586

(continued)

Table B-1. continued

Species	Raw Numbers												Species Total
	Summer			Fall			Winter			Spring			
	2016	2017	2018	2016	2017	2018	2016-2017	2017-2018	2018-2019	2017	2018	2019	
Wilson's Storm-Petrel	789	339	-	1	-	-	-	-	-	90	-	-	1,219
White-faced Storm-Petrel	-	-	2	-	-	-	-	-	-	-	-	-	2
Leach's Storm-Petrel	-	2	-	-	2	-	3	-	-	1	-	-	8
Band-rumped Storm-Petrel	-	-	-	-	-	-	-	-	-	1	-	-	1
species unknown	-	1,739	2,121	-	109	6	68	-	-	4	223	2,086	6,356
Booby	-	-	-	-	-	-	-	-	-	-	1	-	1
Brown Booby	-	-	-	-	-	-	-	-	-	-	1	-	1
Gannet	-	4	-	2,939	757	1,006	4,114	831	1,233	207	1,258	1,370	13,719
Northern Gannet	-	4	-	2,939	757	1,006	4,114	831	1,233	207	1,258	1,370	13,719
Cormorant	6	-	2	67	110	231	3	-	1	16	170	17	623
Double-crested Cormorant	6	-	-	67	-	-	-	-	-	16	-	-	89
species unknown	-	-	2	-	110	231	3	-	1	-	170	17	534
Pelican	-	-	-	1	-	-	-	-	-	-	-	-	1
Brown Pelican	-	-	-	1	-	-	-	-	-	-	-	-	1
Ardeidae	-	-	-	-	1	1	-	-	-	-	-	3	5
Great Blue Heron	-	-	-	-	1	1	-	-	-	-	-	1	3
Snowy Egret	-	-	-	-	-	-	-	-	-	-	-	2	2
Raptor	2	-	3	-	-	-	-	-	-	-	1	-	6
Osprey	1	-	3	-	-	-	-	-	-	-	1	-	5
Bald Eagle	1	-	-	-	-	-	-	-	-	-	-	-	1
Shorebird	7	29	1,466	46	1,993	623	1	4,026	-	-	34	18	8,243

(continued)

Table B-1. continued

Species	Raw Numbers												Species Total
	Summer			Fall			Winter			Spring			
	2016	2017	2018	2016	2017	2018	2016– 2017	2017– 2018	2018– 2019	2017	2018	2019	
American Oystercatcher	-	-	3	-	-	-	-	-	-	-	-	17	20
Black-bellied Plover	6	-	2	-	-	-	-	3	-	-	-	-	11
Semipalmated Plover	-	3	-	-	-	-	-	-	-	-	-	-	3
Piping Plover	-	-	1	-	-	-	-	-	-	-	-	-	1
Ruddy Turnstone	-	-	-	-	133	-	-	-	-	-	-	-	133
Sanderling	-	-	-	-	117	-	-	-	-	-	-	-	117
Dunlin	-	-	-	-	1,703	-	-	-	-	-	-	-	1,703
species unknown	1	26	1,460	46	40	623	1	4,023	-	-	34	1	6,255
Phalarope	-	138	8	1,551	3,017	6,763	233	1	3	549	5,644	1,784	19,691
Red-necked Phalarope	-	1	-	69	-	9	-	-	-	17	350	427	873
Red Phalarope	-	-	-	-	1,774	6,361	-	-	1	1	3,577	338	12,052
Red/Red-necked Phalarope	-	121	8	1,482	1,238	393	233	1	2	531	1,717	1,019	6,745
species unknown	-	16	-	-	5	-	-	-	-	-	-	-	21
Skua	-	-	1	1	1	9	-	2	5	4	4	10	37
Great Skua	-	-	-	-	-	-	-	1	5	-	1	-	7
South Polar Skua	-	-	-	-	-	-	-	-	-	1	-	1	2
Pomarine Jaeger	-	-	-	1	-	-	-	-	-	1	-	-	2
Parasitic Jaeger	-	-	1	-	1	2	-	-	-	2	2	9	17
species unknown	-	-	-	-	-	7	-	1	-	-	1	-	9
Auk	-	4	-	79	109	1,691	8,952	650	2,729	106	3,733	687	18,740
Dovekie	-	-	-	3	-	10	1,793	14	1,008	-	-	59	2,887
Common Murre	-	-	-	11	-	-	-	-	-	-	-	-	11

(continued)

Table B-1. continued

Species	Raw Numbers												Species Total
	Summer			Fall			Winter			Spring			
	2016	2017	2018	2016	2017	2018	2016-2017	2017-2018	2018-2019	2017	2018	2019	
Common/Thick-billed Murre	-	-	-	-	-	-	3	-	1	-	163	1	168
Razorbill	-	-	-	24	2	-	2,088	-	9	4	546	44	2,717
Murre/Razorbill	-	2	-	-	96	1,657	2,063	547	983	30	2,483	213	8,074
Black Guillemot	-	-	-	1	-	-	8	-	-	-	-	-	9
Atlantic Puffin	-	-	-	-	8	23	2,387	73	648	45	539	316	4,039
species unknown	-	2	-	40	3	1	610	16	80	27	2	54	835
Gull	114	109	487	5,438	2,526	11,615	5,505	3,136	5,696	889	4,565	2,423	42,503
Black-legged Kittiwake	-	-	-	230	371	2,805	9	10	174	-	2	6	3,607
Bonaparte's Gull	-	-	-	1,081	711	1,334	615	127	17	-	795	202	4,882
Little Gull	-	-	-	4	-	2	6	-	-	-	1	-	13
Laughing Gull	14	13	13	778	79	1,369	-	-	-	35	31	46	2,378
Ring-billed Gull	8	2	86	91	96	691	220	26	22	1	17	4	1,264
Herring Gull	21	33	101	2,277	929	3,789	3,495	1,777	3,506	554	3,164	1,573	21,219
Iceland Gull	-	-	-	-	1	1	7	2	-	1	2	1	15
Lesser Black-backed Gull	-	2	44	9	15	67	23	17	9	11	32	22	251
Glaucous Gull	-	-	-	-	-	-	1	-	-	-	1	-	2
Great Black-backed Gull	52	25	233	370	186	538	964	1,097	1,845	257	450	234	6,251
species unknown - Large	4	3	8	16	38	150	23	40	77	1	12	60	432
species unknown - Small	11	31	2	581	96	829	136	39	24	29	58	259	2,095

(continued)

Table B-1. continued

Species	Raw Numbers												Species Total
	Summer			Fall			Winter			Spring			
	2016	2017	2018	2016	2017	2018	2016-2017	2017-2018	2018-2019	2017	2018	2019	
species unknown	4	-	-	1	4	40	6	1	22	-	-	16	94
Tern	48	2	50	2	-	-	-	-	-	51	-	11	164
Least Tern	33	-	13	-	-	-	-	-	-	49	-	4	99
Black Tern	-	1	36	-	-	-	-	-	-	2	-	1	40
Royal Tern	8	-	1	2	-	-	-	-	-	-	-	-	11
species unknown	7	1	-	-	-	-	-	-	-	-	-	6	14
Sterna Tern	141	13	220	-	3	-	-	-	-	1,267	47	1,701	3,392
Roseate Tern	-	-	1	-	-	-	-	-	-	15	-	17	33
Common Tern	-	-	94	-	-	-	-	-	-	546	3	47	690
Forster's Tern	-	-	4	-	2	-	-	-	-	-	-	28	34
Commic/Forster's Tern	-	-	67	-	-	-	-	-	-	-	-	1,554	1,621
species unknown	141	13	54	-	1	-	-	-	-	706	44	55	1,014
Nightjar	-	1	-	-	-	-	-	-	-	-	-	-	1
Common Nighthawk	-	1	-	-	-	-	-	-	-	-	-	-	1
Hirundine	-	-	-	-	-	12	-	-	-	-	-	-	12
species unknown	-	-	-	-	-	12	-	-	-	-	-	-	12
Passerine	-	-	-	-	7	1	-	-	-	-	-	-	8
Snow Bunting	-	-	-	-	7	-	-	-	-	-	-	-	7
species unknown	-	-	-	-	-	1	-	-	-	-	-	-	1
Total	1,860	2,964	4,871	12,245	9,337	24,688	20,919	11,218	15,094	3,668	21,489	12,019	140,372

Appendix C. Representative Bird Images from Each Survey

Summer 2016



Black-capped Petrel



Osprey



Great Black-backed Gull

Fall 2016



Cory's Shearwater



Great Shearwater



Herring Gull



Black Scoter

Winter 2016–2017



Iceland Gull



Great Black-backed Gull

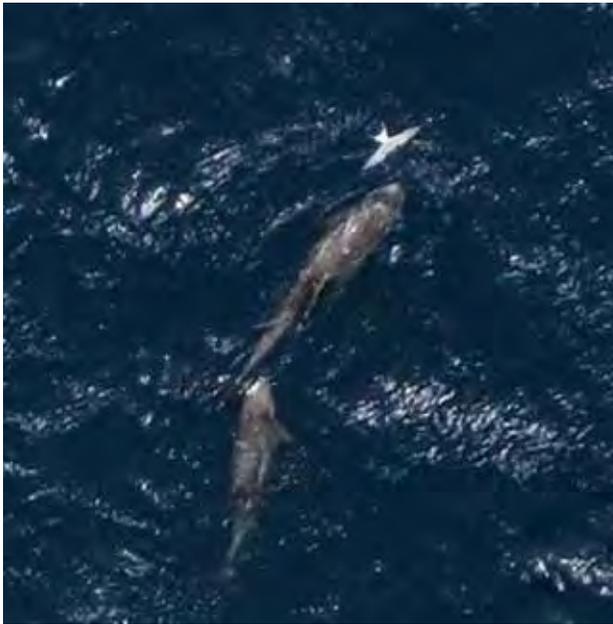


Northern Gannet



Razorbill

Spring 2017



Sterna Tern with Risso's Dolphins



Trindade Petrel



Parasitic Jaeger



Common Tern with Bottlenose Dolphins

Summer 2017



Common Nighthawk



Great Black-backed Gull and Herring Gull



Cory's Shearwater



Black-capped Petrel

Fall 2017



Great Blue Heron



Black Scoter



Canada Geese



Northern Gannet

Winter 2017–2018



White-winged Scoter



Northern Gannet



Common Loon



Great Black-backed Gull

Spring 2018



Surf Scoter



Northern Gannet



Common Loon

Summer 2018



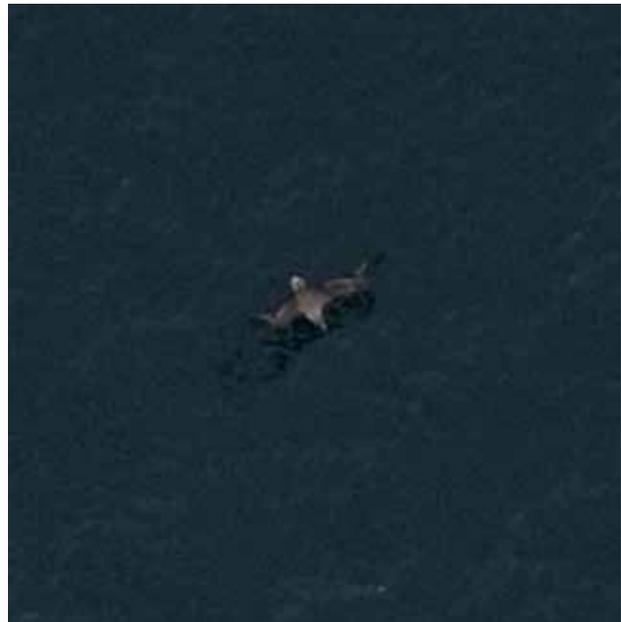
Roseate Tern



Royal Tern



White-faced Storm-petrel



Cory's Shearwater

Fall 2018



Red Phalarope



Red-throated Loon



Black-legged Kittiwake

Winter 2018–2019



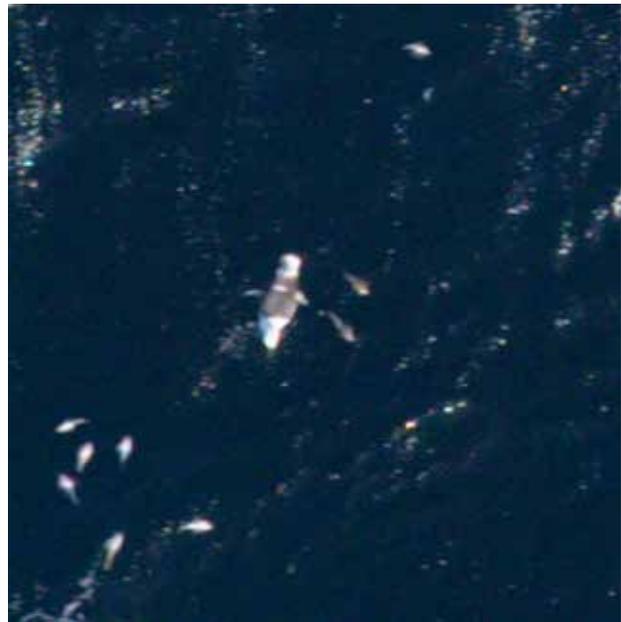
Great Skua



Black-legged Kittiwake



Black-legged Kittiwake



Great Black-backed Gull with Fish By-catch

Spring 2019



Roseate Tern



Northern Fulmar



Great Blue Heron



White-winged Scoter

Appendix D. Bird Flight Activity

Table D-1. Number and Median Flight Height (m [Alt.]) for Flying Birds (with Known Flight Height) by Species Group by Season in the OPA

Species Group	Summer 2016		Summer 2017		Summer 2018		Fall 2016		Fall 2017		Fall 2018		Winter 2016-17		Winter 2017-18		Winter 2018-19		Spring 2017		Spring 2018		Spring 2019		
	#	Median Altitude (m)	#	Median Altitude (m)	#	Median Altitude (m)	#	Median Altitude (m)	#	Median Altitude (m)	#	Median Altitude (m)	#	Median Altitude (m)	#	Median Altitude (m)	#	Median Altitude (m)	#	Median Altitude (m)	#	Median Altitude (m)	#	Median Altitude (m)	
Goose	-	-	-	-	-	-	-	-	2	66.5	-	-	1	4.0	-	-	-	-	-	-	-	-	-	-	-
Duck	-	-	-	-	-	-	417	15.0	124	53.4	171	3.0	79	3.0	37	1.0	55	41.5	-	-	97	16.0	83	2.0	
Loon	-	-	-	-	-	-	93	81.8	153	105.8	115	84.5	79	56.7	6	93.8	4	77.8	13	61.7	69	82.2	51	45.9	
Grebe	-	-	-	-	-	-	-	-	-	-	1	94.0	-	-	-	-	-	-	-	-	-	-	-	-	
Fulmar	-	-	-	-	-	-	-	-	24	115.6	101	97.7	9	117.3	494	106.4	48	98.0	19	121.2	8	85.1	41	109.3	
Petrel	1	0.5	1	102.4	2	14.9	-	-	-	-	-	-	-	-	-	-	-	-	1	111.6	2	29.9	5	49.8	
Shearwater	178	1.0	146	1.0	162	0.5	52	11.9	7	57.1	38	10.6	1	2.0	-	-	-	-	20	15.3	-	-	9	33.0	
Storm-petrel	207	0.5	1,344	0.5	979	5.4	-	-	41	43.4	6	0.5	-	-	-	-	-	-	65	94.2	108	1.0	738	24.7	
Booby	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	88.3	-	-	
Gannet	-	-	-	-	-	-	322	47.4	178	71.1	331	38.7	665	35.9	105	36.2	288	33.5	66	61.9	221	38.9	315	1.5	
Cormorant	6	2.0	-	-	1	0.5	64	7.0	68	23.3	50	21.9	-	-	-	-	-	-	2	1.0	59	14.7	2	37.7	
Ardeidae	-	-	-	-	-	-	-	-	1	60.1	-	-	-	-	-	-	-	-	-	-	-	-	1	33.0	
Raptor	-	-	-	-	3	90.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	63.9	-	-	
Shorebird	6	70.8	4	48.3	68	0.5	-	-	1	12.4	174	1.0	-	-	10	24.4	-	-	-	-	-	-	-	-	
Phalarope	-	-	5	14.4	7	43.5	113	3.0	907	73.8	1,652	3.0	3	4.7	-	-	-	-	22	44.9	1,403	29.5	218	31.4	
Skua	-	-	-	-	-	-	1	91.4	1	93.8	2	59.4	-	-	1	22.7	3	15.7	4	115.0	2	48.7	6	82.6	
Auk	-	-	-	-	-	-	-	-	-	-	14	43.0	11	1.0	6	42.3	52	62.1	-	-	22	1.0	-	-	
Gull	7	40.8	18	40.4	61	3.3	974	60.1	1,025	82.1	4,100	45.6	993	38.1	416	49.1	1,206	40.4	147	54.5	727	42.7	342	47.9	
Tern	14	5.3	-	-	10	30.4	-	-	-	-	-	-	-	-	-	-	-	-	39	70.6	-	-	4	90.7	
<i>Sterna</i> Tern	1	1.0	8	51.3	122	29.9	-	-	2	63.7	-	-	-	-	-	-	-	-	459	47.5	22	37.4	945	46.7	
Hirundine	-	-	-	-	-	-	-	-	-	-	12	33.0	-	-	-	-	-	-	-	-	-	-	-	-	
Passerine	-	-	-	-	-	-	-	-	5	45.0	1	33.0	-	-	-	-	-	-	-	-	-	-	-	-	

Table D–2. Abundance and Percent of All Flying and Sitting Birds Observed by Season during the Summer 2016–Spring 2019 Surveys

Survey	Flight Height Unknown		Flying outside RSZ ¹		Flying within RSZ ¹		Sitting		Total
	#	% Within Season	#	% Within Season	#	% Within Season	#	% Within Season	
Summer 2016	829	44.57	376	20.22	44	2.37	611	32.85	1,860
Summer 2017	885	29.86	1,282	43.25	244	8.23	553	18.66	2,964
Summer 2018	1,392	28.58	970	19.91	445	9.14	2,064	42.37	4,871
Fall 2016	2,144	17.51	738	6.03	1,298	10.60	8,065	65.86	12,245
Fall 2017	1,032	11.05	333	3.57	2,206	23.63	5,766	61.75	9,337
Fall 2018	3,098	12.55	2,689	10.89	4,079	16.52	14,822	60.04	24,688
Winter 2016–17	1,558	7.45	721	3.45	1,120	5.35	17,520	83.75	20,919
Winter 2017–18	305	2.72	178	1.59	897	8.00	9,838	87.70	11,218
Winter 2018–19	846	5.60	459	3.04	1,197	7.93	12,592	83.42	15,094
Spring 2017	845	23.04	205	5.59	652	17.78	1,966	53.60	3,668
Spring 2018	1,712	7.97	1,140	5.31	1,602	7.45	17,035	79.27	21,489
Spring 2019	2,778	23.11	1,078	8.97	1,682	13.99	6,481	53.92	12,019

¹ RSZ = 23–320 m

Table D–3. Bird Flight Activity in the Summer 2016 through Spring 2019 Surveys

Species	Flight Height Unknown		Flying outside RSZ		Flying within RSZ		Sitting		Total
	No.	% Within Season	No.	% Within Season	No.	% Within Season	No.	% Within Season	
Summer 2016									
Common Loon	-	--	-	--	-	--	3	100.00	3
Black-capped Petrel	10	76.92	1	7.69	-	--	2	15.38	13
Petrel-species unknown	3	60.00	-	--	-	--	2	40.00	5
Cory's Shearwater	104	20.39	140	27.45	3	0.59	263	51.57	510
Great Shearwater	29	41.43	29	41.43	3	4.29	9	12.86	70
Sooty Shearwater	1	50.00	1	50.00	-	--	-	--	2
Audubon's Shearwater	1	12.50	2	25.00	-	--	5	62.50	8
Shearwater-species unknown-Large	28	21.71	-	--	-	--	101	78.29	129
Shearwater-species unknown-Small	10	76.92	-	--	-	--	3	23.08	13
Wilson's Storm-Petrel	433	54.88	182	23.07	25	3.17	149	18.88	789
Double-crested Cormorant	-	--	6	100.00	-	--	-	--	6
Osprey	1	100.00	-	--	-	--	-	--	1
Bald Eagle	1	100.00	-	--	-	--	-	--	1
Black-bellied Plover	-	--	-	--	6	100.00	-	--	6
Shorebird-species unknown	1	100.00	-	--	-	--	-	--	1
Laughing Gull	7	50.00	-	--	-	--	7	50.00	14
Ring-billed Gull	2	25.00	-	--	1	12.50	5	62.50	8
Herring Gull	6	28.57	1	4.76	1	4.76	13	61.90	21
Great Black-backed Gull	29	55.77	2	3.85	2	3.85	19	36.54	52

(continued)

Table D-3. continued

Species	Flight Height Unknown		Flying outside RSZ		Flying within RSZ		Sitting		Total
	No.	% Within Season	No.	% Within Season	No.	% Within Season	No.	% Within Season	
Gull-species unknown – Large	1	25.00	-	--	-	--	3	75.00	4
Gull-species unknown - Small	5	45.45	-	--	-	--	6	54.55	11
Gull-species unknown	1	25.00	-	--	-	--	3	75.00	4
Least Tern	23	69.70	9	27.27	1	3.03	-	--	33
Royal Tern	4	50.00	2	25.00	2	25.00	-	--	8
Tern-species unknown	7	100.00	-	--	-	--	-	--	7
<i>Sterna</i> Tern-species unknown	122	86.52	1	0.71	-	--	18	12.77	141
Season Total	829	44.57	376	20.22	44	2.37	611	32.85	1,860
Summer 2017									
Common Loon	-	--	-	--	-	--	3	100.00	3
Loon-species unknown	-	--	-	--	-	--	2	100.00	2
Black-capped Petrel	2	66.67	-	--	1	33.33	-	--	3
Cory's Shearwater	19	21.11	34	37.78	9	10.00	28	31.11	90
Great Shearwater	51	15.13	70	20.77	25	7.42	191	56.68	337
Sooty Shearwater	1	100.00	-	--	-	--	-	--	1
Shearwater-species unknown-Large	6	5.56	2	1.85	5	4.63	95	87.96	108
Shearwater-species unknown-Small	2	5.00	-	--	1	2.50	37	92.50	40
Wilson's Storm-Petrel	112	33.04	170	50.15	56	16.52	1	0.29	339
Leach's Storm-Petrel	1	50.00	-	--	1	50.00	-	--	2
Storm-petrel species unknown	582	33.47	997	57.33	120	6.90	40	2.30	1,739
Northern Gannet	-	--	-	--	-	--	4	100.00	4
Semipalmated Plover	3	100.00	-	--	-	--	-	--	3
Shorebird-species unknown	22	84.62	-	--	4	15.38	-	--	26
Red-necked Phalarope	-	--	1	100.00	-	--	-	--	1
Red/Red-necked Phalarope	61	50.41	2	1.65	-	--	58	47.93	121

(continued)

Table D-3. continued

Species	Flight Height Unknown		Flying outside RSZ		Flying within RSZ		Sitting		Total
	No.	% Within Season	No.	% Within Season	No.	% Within Season	No.	% Within Season	
Phalarope-species unknown	10	62.50	1	6.25	1	6.25	4	25.00	16
Murre/Razorbill	-	--	-	--	-	--	2	100.00	2
Auk-species unknown	-	--	-	--	-	--	2	100.00	2
Laughing Gull	1	7.69	-	--	4	30.77	8	61.54	13
Ring-billed Gull	-	--	-	--	1	50.00	1	50.00	2
Herring Gull	1	3.03	-	--	6	18.18	26	78.79	33
Lesser Black-backed Gull	-	--	-	--	1	50.00	1	50.00	2
Great Black-backed Gull	2	8.00	1	4.00	2	8.00	20	80.00	25
Gull-species unknown - Large	1	33.33	-	--	1	33.33	1	33.33	3
Gull-species unknown - Small	-	--	1	3.23	1	3.23	29	93.55	31
Black Tern	1	100.00	-	--	-	--	-	--	1
Tern-species unknown	1	100.00	-	--	-	--	-	--	1
<i>Sterna</i> Tern-species unknown	5	38.46	3	23.08	5	38.46	-	--	13
Common Nighthawk	1	100.00	-	--	-	--	-	--	1
Season Total	885	29.86	1,282	43.25	244	8.23	553	18.66	2,964
Summer 2018									
Common Loon	-	--	-	--	-	--	6	100.00	6
Black-capped Petrel	4	66.67	1	16.67	1	16.67	-	--	6
Cory's Shearwater	86	43.22	72	36.18	5	2.51	36	18.09	199
Great Shearwater	22	22.68	61	62.89	6	6.19	8	8.25	97
Sooty Shearwater	1	100.00	-	--	-	--	-	--	1
Shearwater-species unknown-Large	16	8.04	16	8.04	2	1.01	165	82.91	199
Shearwater-species unknown-Small	2	66.67	-	--	-	--	1	33.33	3
White-faced Storm-Petrel	-	--	2	100.00	-	--	-	--	2
Storm-petrel species unknown	1,139	53.70	655	30.88	322	15.18	5	0.24	2,121

(continued)

Table D-3. continued

Species	Flight Height Unknown		Flying outside RSZ		Flying within RSZ		Sitting		Total
	No.	% Within Season	No.	% Within Season	No.	% Within Season	No.	% Within Season	
Cormorant-species unknown	-	--	1	50.00	-	--	1	50.00	2
Osprey	-	--	-	--	3	100.00	-	--	3
American Oystercatcher	-	--	1	33.33	-	--	2	66.67	3
Black-bellied Plover	-	--	-	--	2	100.00	-	--	2
Piping Plover	-	--	-	--	-	--	1	100.00	1
Shorebird-species unknown	31	2.12	63	4.32	2	0.14	1,364	93.42	1,460
Red/Red-necked Phalarope	1	12.50	1	12.50	6	75.00	-	--	8
Parasitic Jaeger	1	100.00	-	--	-	--	-	--	1
Laughing Gull	-	--	5	38.46	1	7.69	7	53.85	13
Ring-billed Gull	-	--	2	2.33	1	1.16	83	96.51	86
Herring Gull	-	--	16	15.84	9	8.91	76	75.25	101
Lesser Black-backed Gull	-	--	1	2.27	1	2.27	42	95.45	44
Great Black-backed Gull	13	5.58	16	6.87	9	3.86	195	83.69	233
Gull-species unknown - Large	-	--	-	--	-	--	8	100.00	8
Gull-species unknown - Small	-	--	-	--	-	--	2	100.00	2
Least Tern	5	38.46	3	23.08	5	38.46	-	--	13
Black Tern	-	--	1	2.78	-	--	35	97.22	36
Royal Tern	-	--	-	--	1	100.00	-	--	1
Roseate Tern	1	100.00	-	--	-	--	-	--	1
Common Tern	27	28.72	34	36.17	33	35.11	-	--	94
Forster's Tern	3	75.00	1	25.00	-	--	-	--	4
Commic/Forster's Tern	27	40.30	16	23.88	24	35.82	-	--	67
<i>Sterna</i> Tern-species unknown	13	24.07	2	3.70	12	22.22	27	50.00	54
Season Total	1,392	28.58	970	19.91	445	9.14	2,064	42.37	4,871

(continued)

Table D-3. continued

Species	Flight Height Unknown		Flying outside RSZ		Flying within RSZ		Sitting		Total
	No.	% Within Season	No.	% Within Season	No.	% Within Season	No.	% Within Season	
Fall 2016									
Gadwall	3	100.00	-	--	-	--	-	--	3
Surf Scoter	1	2.70	26	70.27	3	8.11	7	18.92	37
White-winged Scoter	15	78.95	1	5.26	3	15.79	-	--	19
Black Scoter	58	3.62	262	16.34	122	7.61	1,161	72.43	1,603
Long-tailed Duck	3	100.00	-	--	-	--	-	--	3
Bufflehead	3	60.00	-	--	-	--	2	40.00	5
Duck-species unknown	-	--	-	--	-	--	10	100.00	10
Red-throated Loon	55	24.77	10	4.50	57	25.68	100	45.05	222
Common Loon	11	22.92	6	12.50	20	41.67	11	22.92	48
Loon-species unknown	1	50.00	-	--	-	--	1	50.00	2
Northern Fulmar	3	100.00	-	--	-	--	-	--	3
Black-capped Petrel	1	100.00	-	--	-	--	-	--	1
Cory's Shearwater	35	23.97	30	20.55	19	13.01	62	42.47	146
Great Shearwater	2	25.00	1	12.50	2	25.00	3	37.50	8
Shearwater-species unknown-Large	9	90.00	-	--	-	--	1	10.00	10
Wilson's Storm-Petrel	1	100.00	-	--	-	--	-	--	1
Northern Gannet	538	18.31	78	2.65	244	8.30	2,079	70.74	2,939
Double-crested Cormorant	3	4.48	43	64.18	21	31.34	-	--	67
Brown Pelican	1	100.00	-	--	-	--	-	--	1
Shorebird-species unknown	3	6.52	-	--	-	--	43	93.48	46
Red-necked Phalarope	5	7.25	1	1.45	7	10.14	56	81.16	69
Red/Red-necked Phalarope	469	31.65	95	6.41	10	0.67	908	61.27	1,482
Pomarine Jaeger	-	--	-	--	1	100.00	-	--	1
Dovekie	-	--	-	--	-	--	3	100.00	3

(continued)

Table D-3. continued

Species	Flight Height Unknown		Flying outside RSZ		Flying within RSZ		Sitting		Total
	No.	% Within Season	No.	% Within Season	No.	% Within Season	No.	% Within Season	
Common Murre	-	--	-	--	-	--	11	100.00	11
Razorbill	4	16.67	-	--	-	--	20	83.33	24
Black Guillemot	1	100.00	-	--	-	--	-	--	1
Auk-species unknown	-	--	-	--	-	--	40	100.00	40
Black-legged Kittiwake	133	57.83	18	7.83	26	11.30	53	23.04	230
Bonaparte's Gull	135	12.49	14	1.30	282	26.09	650	60.13	1,081
Little Gull	2	50.00	-	--	2	50.00	-	--	4
Laughing Gull	111	14.27	13	1.67	39	5.01	615	79.05	778
Ring-billed Gull	40	43.96	5	5.49	8	8.79	38	41.76	91
Herring Gull	396	17.39	110	4.83	386	16.95	1,385	60.83	2,277
Lesser Black-backed Gull	4	44.44	1	11.11	-	--	4	44.44	9
Great Black-backed Gull	80	21.62	24	6.49	46	12.43	220	59.46	370
Gull-species unknown - Large	5	31.25	-	--	-	--	11	68.75	16
Gull-species unknown - Small	11	1.89	-	--	-	--	570	98.11	581
Gull-species unknown	-	--	-	--	-	--	1	100.00	1
Royal Tern	2	100.00	-	--	-	--	-	--	2
Season Total	2,144	17.51	738	6.03	1,298	10.60	8,065	65.86	12,245
Fall 2017									
Canada Goose	-	--	-	--	2	100.00	-	--	2
Common Eider	-	--	-	--	-	--	4	100.00	4
Surf Scoter	7	17.95	2	5.13	25	64.10	5	12.82	39
White-winged Scoter	-	--	-	--	-	--	1	100.00	1
Black Scoter	27	21.26	28	22.05	67	52.76	5	3.94	127
Scoter unid.	-	--	-	--	-	--	94	100.00	94
Long-tailed Duck	1	7.14	-	--	2	14.29	11	78.57	14

(continued)

Table D-3. continued

Species	Flight Height Unknown		Flying outside RSZ		Flying within RSZ		Sitting		Total
	No.	% Within Season	No.	% Within Season	No.	% Within Season	No.	% Within Season	
Red-breasted Merganser	-	--	-	--	-	--	2	100.00	2
Duck-species unknown	1	100.00	-	--	-	--	-	--	1
Red-throated Loon	33	20.50	2	1.24	108	67.08	18	11.18	161
Common Loon	18	12.86	3	2.14	38	27.14	81	57.86	140
Loon-species unknown	1	7.14	-	--	2	14.29	11	78.57	14
Northern Fulmar	12	20.00	-	--	24	40.00	24	40.00	60
Cory's Shearwater	1	50.00	-	--	1	50.00	-	--	2
Great Shearwater	8	66.67	-	--	3	25.00	1	8.33	12
Manx Shearwater	12	75.00	1	6.25	-	--	3	18.75	16
Shearwater-species unknown-Large	2	25.00	-	--	1	12.50	5	62.50	8
Shearwater-species unknown-Small	4	80.00	-	--	1	20.00	-	--	5
Leach's Storm-Petrel	1	50.00	1	50.00	-	--	-	--	2
Storm-petrel species unknown	69	63.30	12	11.01	28	25.69	-	--	109
Northern Gannet	42	5.55	22	2.91	156	20.61	537	70.94	757
Cormorant-species unknown	39	35.45	32	29.09	36	32.73	3	2.73	110
Great Blue Heron	-	--	-	--	1	100.00	-	--	1
Ruddy Turnstone	-	--	-	--	-	--	133	100.00	133
Sanderling	-	--	-	--	-	--	117	100.00	117
Dunlin	2	0.12	1	0.06	-	--	1,700	99.82	1,703
Shorebird-species unknown	14	35.00	-	--	-	--	26	65.00	40
Red Phalarope	176	9.92	92	5.19	479	27.00	1,027	57.89	1,774
Red/Red-necked Phalarope	91	7.35	21	1.70	312	25.20	814	65.75	1,238
Phalarope-species unknown	1	20.00	-	--	3	60.00	1	20.00	5
Parasitic Jaeger	-	--	-	--	1	100.00	-	--	1

(continued)

Table D-3. continued

Species	Flight Height Unknown		Flying outside RSZ		Flying within RSZ		Sitting		Total
	No.	% Within Season	No.	% Within Season	No.	% Within Season	No.	% Within Season	
Razorbill	-	--	-	--	-	--	2	100.00	2
Murre/Razorbill	4	4.17	-	--	-	--	92	95.83	96
Atlantic Puffin	-	--	-	--	-	--	8	100.00	8
Auk-species unknown	-	--	-	--	-	--	3	100.00	3
Black-legged Kittiwake	66	17.79	40	10.78	196	52.83	69	18.60	371
Bonaparte's Gull	215	30.24	17	2.39	419	58.93	60	8.44	711
Laughing Gull	25	31.65	12	15.19	35	44.30	7	8.86	79
Ring-billed Gull	25	26.04	7	7.29	18	18.75	46	47.92	96
Herring Gull	88	9.47	28	3.01	184	19.81	629	67.71	929
Iceland Gull	-	--	-	--	-	--	1	100.00	1
Lesser Black-backed Gull	1	6.67	-	--	2	13.33	12	80.00	15
Great Black-backed Gull	26	13.98	8	4.30	36	19.35	116	62.37	186
Gull-species unknown - Large	2	5.26	1	2.63	-	--	35	92.11	38
Gull-species unknown - Small	15	15.63	2	2.08	20	20.83	59	61.46	96
Gull-species unknown	-	--	-	--	-	--	4	100.00	4
Forster's Tern	1	50.00	-	--	1	50.00	-	--	2
<i>Sterna</i> Tern-species unknown	-	--	-	--	1	100.00	-	--	1
Snow Bunting	2	28.57	1	14.29	4	57.14	-	--	7
Season Total	1,032	11.05	333	3.57	2,206	23.63	5,766	61.75	9,337
Fall 2018									
Brant	-	--	-	--	-	--	6	100.00	6
Mallard	-	--	-	--	1	100.00	-	--	1
American Black Duck	5	35.71	2	14.29	7	50.00	-	--	14
Surf Scoter	12	7.84	18	11.76	8	5.23	115	75.16	153
(continued)									
White-winged Scoter	23	29.11	13	16.46	20	25.32	23	29.11	79

Table D-3. continued

Species	Flight Height Unknown		Flying outside RSZ		Flying within RSZ		Sitting		Total
	No.	% Within Season	No.	% Within Season	No.	% Within Season	No.	% Within Season	
Black Scoter	19	2.12	76	8.49	12	1.34	788	88.04	895
Scoter unid.	5	2.72	5	2.72	6	3.26	168	91.30	184
Long-tailed Duck	-	--	-	--	-	--	5	100.00	5
Bufflehead	-	--	-	--	-	--	3	100.00	3
Common Merganser	1	100.00	-	--	-	--	-	--	1
Red-breasted Merganser	-	--	-	--	-	--	1	100.00	1
Duck-species unknown	5	45.45	-	--	3	27.27	3	27.27	11
Red-throated Loon	12	3.75	15	4.69	60	18.75	233	72.81	320
Common Loon	16	3.62	4	0.90	36	8.14	386	87.33	442
Loon-species unknown	-	--	-	--	-	--	34	100.00	34
Horned Grebe	-	--	-	--	1	100.00	-	--	1
Northern Fulmar	10	7.46	2	1.49	99	73.88	23	17.16	134
Cory's Shearwater	-	--	-	--	-	--	3	100.00	3
Great Shearwater	24	23.76	10	9.90	3	2.97	64	63.37	101
Manx Shearwater	3	11.54	3	11.54	1	3.85	19	73.08	26
Shearwater-species unknown-Large	31	9.84	11	3.49	10	3.17	263	83.49	315
Shearwater-species unknown-Small	1	100.00	-	--	-	--	-	--	1
Storm-petrel species unknown	-	--	6	100.00	-	--	-	--	6
Northern Gannet	109	10.83	121	12.03	210	20.87	566	56.26	1,006
Cormorant-species unknown	80	34.63	28	12.12	22	9.52	101	43.72	231
Great Blue Heron	1	100.00	-	--	-	--	-	--	1
Shorebird-species unknown	59	9.47	172	27.61	2	0.32	390	62.60	623
Red-necked Phalarope	-	--	-	--	-	--	9	100.00	9
Red Phalarope	405	6.37	1,178	18.52	417	6.56	4,361	68.56	6,361
Red/Red-necked Phalarope	100	25.45	17	4.33	40	10.18	236	60.05	393

(continued)

Table D-3. continued

Species	Flight Height Unknown		Flying outside RSZ		Flying within RSZ		Sitting		Total
	No.	% Within Season	No.	% Within Season	No.	% Within Season	No.	% Within Season	
Parasitic Jaeger	-	--	1	50.00	1	50.00	-	--	2
Skua-species unknown	-	--	-	--	-	--	7	100.00	7
Dovekie	-	--	-	--	-	--	10	100.00	10
Murre/Razorbill	97	5.85	6	0.36	8	0.48	1,546	93.30	1,657
Atlantic Puffin	-	--	-	--	-	--	23	100.00	23
Auk-species unknown	-	--	-	--	-	--	1	100.00	1
Black-legged Kittiwake	848	30.23	361	12.87	819	29.20	777	27.70	2,805
Bonaparte's Gull	113	8.47	95	7.12	653	48.95	473	35.46	1,334
Little Gull	-	--	-	--	1	50.00	1	50.00	2
Laughing Gull	233	17.02	180	13.15	748	54.64	208	15.19	1,369
Ring-billed Gull	135	19.54	114	16.50	350	50.65	92	13.31	691
Herring Gull	513	13.54	207	5.46	422	11.14	2,647	69.86	3,789
Iceland Gull	-	--	-	--	1	100.00	-	--	1
Lesser Black-backed Gull	2	2.99	1	1.49	2	2.99	62	92.54	67
Great Black-backed Gull	112	20.82	25	4.65	46	8.55	355	65.99	538
Gull-species unknown - Large	48	32.00	3	2.00	1	0.67	98	65.33	150
Gull-species unknown - Small	76	9.17	14	1.69	36	4.34	703	84.80	829
Gull-species unknown	-	--	1	2.50	20	50.00	19	47.50	40
Hirundine species unknown	-	--	-	--	12	100.00	-	--	12
Passerine species unknown	-	--	-	--	1	100.00	-	--	1
Season Total	3,098	12.55	2,689	10.89	4,079	16.52	14,822	60.04	24,688
Winter 2016-17									
Canada Goose	-	--	1	100.00	-	--	-	--	1
Lesser Scaup	-	--	7	100.00	-	--	-	--	7
King Eider	-	--	-	--	-	--	1	100.00	1

(continued)

Table D-3. continued

Species	Flight Height Unknown		Flying outside RSZ		Flying within RSZ		Sitting		Total
	No.	% Within Season	No.	% Within Season	No.	% Within Season	No.	% Within Season	
Surf Scoter	4	1.70	-	--	-	--	231	98.30	235
White-winged Scoter	15	4.31	49	14.08	2	0.57	282	81.03	348
Black Scoter	1	0.19	9	1.68	1	0.19	525	97.95	536
Scoter unid.	-	--	-	--	-	--	50	100.00	50
Long-tailed Duck	4	8.16	7	14.29	3	6.12	35	71.43	49
Bufflehead	3	2.78	-	--	-	--	105	97.22	108
Common Goldeneye	-	--	-	--	-	--	1	100.00	1
Red-breasted Merganser	-	--	-	--	1	20.00	4	80.00	5
Duck-species unknown	-	--	-	--	-	--	50	100.00	50
Red-throated Loon	22	9.13	13	5.39	48	19.92	158	65.56	241
Common Loon	8	2.34	15	4.39	3	0.88	316	92.40	342
Loon-species unknown	3	100.00	-	--	-	--	-	--	3
Horned Grebe	-	--	-	--	-	--	8	100.00	8
Northern Fulmar	21	42.86	3	6.12	6	12.24	19	38.78	49
Black-capped Petrel	1	100.00	-	--	-	--	-	--	1
Petrel-species unknown	1	100.00	-	--	-	--	-	--	1
Sooty Shearwater	1	50.00	1	50.00	-	--	-	--	2
Shearwater-species unknown-Large	2	100.00	-	--	-	--	-	--	2
Leach's Storm-Petrel	3	100.00	-	--	-	--	-	--	3
Storm-petrel species unknown	60	88.24	-	--	-	--	8	11.76	68
Northern Gannet	560	13.61	227	5.52	438	10.65	2,889	70.22	4,114
Cormorant-species unknown	-	--	-	--	-	--	3	100.00	3
Shorebird-species unknown	1	100.00	-	--	-	--	-	--	1
Red/Red-necked Phalarope	88	37.77	3	1.29	-	--	142	60.94	233
Dovekie	11	0.61	3	0.17	-	--	1,779	99.22	1,793

(continued)

Table D-3. continued

Species	Flight Height Unknown		Flying outside RSZ		Flying within RSZ		Sitting		Total
	No.	% Within Season	No.	% Within Season	No.	% Within Season	No.	% Within Season	
Common/Thick-billed Murre	-	--	-	--	-	--	3	100.00	3
Razorbill	81	3.88	2	0.10	2	0.10	2,003	95.93	2,088
Murre/Razorbill	28	1.36	-	--	-	--	2,035	98.64	2,063
Black Guillemot	-	--	-	--	-	--	8	100.00	8
Atlantic Puffin	23	0.96	2	0.08	-	--	2,362	98.95	2,387
Auk-species unknown	12	1.97	2	0.33	-	--	596	97.70	610
Black-legged Kittiwake	4	44.44	1	11.11	2	22.22	2	22.22	9
Bonaparte's Gull	134	21.79	57	9.27	136	22.11	288	46.83	615
Little Gull	4	66.67	-	--	-	--	2	33.33	6
Ring-billed Gull	50	22.73	10	4.55	62	28.18	98	44.55	220
Herring Gull	309	8.84	199	5.69	344	9.84	2,643	75.62	3,495
Iceland Gull	1	14.29	-	--	1	14.29	5	71.43	7
Lesser Black-backed Gull	3	13.04	-	--	3	13.04	17	73.91	23
Glaucous Gull	-	--	-	--	-	--	1	100.00	1
Great Black-backed Gull	94	9.75	110	11.41	68	7.05	692	71.78	964
Gull-species unknown - Large	4	17.39	-	--	-	--	19	82.61	23
Gull-species unknown - Small	2	1.47	-	--	-	--	134	98.53	136
Gull-species unknown	-	--	-	--	-	--	6	100.00	6
Season Total	1,558	7.45	721	3.45	1,120	5.35	17,520	83.75	20,919
Winter 2017-18									
Tundra Swan	-	--	-	--	-	--	12	100.00	12
Surf Scoter	-	--	-	--	-	--	9	100.00	9
White-winged Scoter	7	5.30	24	18.18	11	8.33	90	68.18	132
Black Scoter	-	--	-	--	-	--	3	100.00	3
Scoter unid.	-	--	-	--	-	--	1,473	100.00	1,473

(continued)

Table D-3. continued

Species	Flight Height Unknown		Flying outside RSZ		Flying within RSZ		Sitting		Total
	No.	% Within Season	No.	% Within Season	No.	% Within Season	No.	% Within Season	
Long-tailed Duck	3	6.98	1	2.33	-	--	39	90.70	43
Bufflehead	-	--	1	100.00	-	--	-	--	1
Duck-species unknown	-	--	-	--	-	--	1	100.00	1
Red-throated Loon	1	2.86	1	2.86	1	2.86	32	91.43	35
Common Loon	1	0.66	-	--	4	2.65	146	96.69	151
Loon-species unknown	-	--	-	--	-	--	4	100.00	4
Horned Grebe	-	--	-	--	-	--	3	100.00	3
Northern Fulmar	29	4.11	12	1.70	482	68.37	182	25.82	705
Northern Gannet	35	4.21	25	3.01	80	9.63	691	83.15	831
Black-bellied Plover	3	100.00	-	--	-	--	-	--	3
Shorebird-species unknown	23	0.57	5	0.12	5	0.12	3,990	99.18	4,023
Red/Red-necked Phalarope	-	--	-	--	-	--	1	100.00	1
Great Skua	-	--	1	100.00	-	--	-	--	1
Skua-species unknown	-	--	-	--	-	--	1	100.00	1
Dovekie	-	--	-	--	-	--	14	100.00	14
Murre/Razorbill	41	7.50	1	0.18	5	0.91	500	91.41	547
Atlantic Puffin	-	--	-	--	-	--	73	100.00	73
Auk-species unknown	-	--	-	--	-	--	16	100.00	16
Black-legged Kittiwake	-	--	1	10.00	2	20.00	7	70.00	10
Bonaparte's Gull	4	3.15	4	3.15	34	26.77	85	66.93	127
Ring-billed Gull	3	11.54	-	--	2	7.69	21	80.77	26
Herring Gull	94	5.29	56	3.15	171	9.62	1,456	81.94	1,777
Iceland Gull	1	50.00	-	--	-	--	1	50.00	2
Lesser Black-backed Gull	-	--	-	--	2	11.76	15	88.24	17
Great Black-backed Gull	54	4.92	46	4.19	98	8.93	899	81.95	1,097

(continued)

Table D–3. continued

Species	Flight Height Unknown		Flying outside RSZ		Flying within RSZ		Sitting		Total
	No.	% Within Season	No.	% Within Season	No.	% Within Season	No.	% Within Season	
Gull-species unknown - Large	5	12.50	-	--	-	--	35	87.50	40
Gull-species unknown - Small	-	--	-	--	-	--	39	100.00	39
Gull-species unknown	1	100.00	-	--	-	--	-	--	1
Season Total	305	2.72	178	1.59	897	8.00	9,838	87.70	11,218
Winter 2018-19									
Common Eider	-	--	-	--	-	--	7	100.00	7
Surf Scoter	2	4.65	1	2.33	-	--	40	93.02	43
White-winged Scoter	21	0.50	10	0.24	41	0.97	4,169	98.30	4,241
Black Scoter	1	1.43	-	--	2	2.86	67	95.71	70
Scoter unid.	-	--	-	--	-	--	583	100.00	583
Long-tailed Duck	3	7.32	1	2.44	-	--	37	90.24	41
Bufflehead	-	--	-	--	-	--	12	100.00	12
Red-breasted Merganser	-	--	-	--	-	--	1	100.00	1
Duck-species unknown	-	--	-	--	-	--	9	100.00	9
Red-throated Loon	-	--	1	1.14	3	3.41	84	95.45	88
Common Loon	-	--	-	--	-	--	252	100.00	252
Loon-species unknown	-	--	-	--	-	--	15	100.00	15
Horned Grebe	-	--	-	--	-	--	4	100.00	4
Northern Fulmar	6	10.17	-	--	48	81.36	5	8.47	59
Manx Shearwater	1	100.00	-	--	-	--	-	--	1
Shearwater-species unknown	-	--	-	--	-	--	1	100.00	1
Northern Gannet	120	9.73	97	7.87	191	15.49	825	66.91	1,233
Cormorant-species unknown	-	--	-	--	-	--	1	100.00	1
Red Phalarope	-	--	-	--	-	--	1	100.00	1
Red/Red-necked Phalarope	-	--	-	--	-	--	2	100.00	2

(continued)

Table D-3. continued

Species	Flight Height Unknown		Flying outside RSZ		Flying within RSZ		Sitting		Total
	No.	% Within Season	No.	% Within Season	No.	% Within Season	No.	% Within Season	
Great Skua	2	40.00	2	40.00	1	20.00	-	--	5
Dovekie	24	2.38	4	0.40	41	4.07	939	93.15	1,008
Common/Thick-billed Murre	1	100.00	-	--	-	--	-	--	1
Razorbill	-	--	-	--	-	--	9	100.00	9
Murre/Razorbill	25	2.54	1	0.10	3	0.31	954	97.05	983
Atlantic Puffin	3	0.46	-	--	3	0.46	642	99.07	648
Auk-species unknown	1	1.25	-	--	-	--	79	98.75	80
Black-legged Kittiwake	56	32.18	23	13.22	68	39.08	27	15.52	174
Bonaparte's Gull	-	--	5	29.41	11	64.71	1	5.88	17
Ring-billed Gull	3	13.64	3	13.64	9	40.91	7	31.82	22
Herring Gull	277	7.90	189	5.39	577	16.46	2,463	70.25	3,506
Lesser Black-backed Gull	1	11.11	-	--	1	11.11	7	77.78	9
Great Black-backed Gull	291	15.77	121	6.56	194	10.51	1,239	67.15	1,845
Gull-species unknown - Large	8	10.39	1	1.30	-	--	68	88.31	77
Gull-species unknown - Small	-	--	-	--	1	4.17	23	95.83	24
Gull-species unknown	-	--	-	--	3	13.64	19	86.36	22
Season Total	846	5.60	459	3.04	1,197	7.93	12,592	83.42	15,094
Spring 2017									
Lesser Scaup	-	--	-	--	-	--	2	100.00	2
White-winged Scoter	-	--	-	--	-	--	1	100.00	1
Black Scoter	3	100.00	-	--	-	--	-	--	3
Scoter unid.	-	--	-	--	-	--	50	100.00	50
Long-tailed Duck	-	--	-	--	-	--	2	100.00	2
Red-breasted Merganser	-	--	-	--	-	--	7	100.00	7
Duck-species unknown	-	--	-	--	-	--	1	100.00	1

(continued)

Table D-3. continued

Species	Flight Height Unknown		Flying outside RSZ		Flying within RSZ		Sitting		Total
	No.	% Within Season	No.	% Within Season	No.	% Within Season	No.	% Within Season	
Red-throated Loon	-	--	-	--	1	4.17	23	95.83	24
Common Loon	3	1.41	1	0.47	11	5.16	198	92.96	213
Loon-species unknown	-	--	-	--	-	--	3	100.00	3
Northern Fulmar	16	32.00	5	10.00	14	28.00	15	30.00	50
Trindade Petrel	-	--	-	--	1	100.00	-	--	1
Petrel-species unknown	-	--	-	--	-	--	1	100.00	1
Cory's Shearwater	4	44.44	3	33.33	1	11.11	1	11.11	9
Great Shearwater	-	--	-	--	1	50.00	1	50.00	2
Sooty Shearwater	10	12.35	8	9.88	6	7.41	57	70.37	81
Shearwater-species unknown-Large	1	6.67	-	--	-	--	14	93.33	15
Shearwater-species unknown-Small	-	--	-	--	1	5.56	17	94.44	18
Wilson's Storm-Petrel	21	23.33	8	8.89	54	60.00	7	7.78	90
Leach's Storm-Petrel	1	100.00	-	--	-	--	-	--	1
Band-rumped Storm-Petrel	-	--	-	--	1	100.00	-	--	1
Storm-petrel species unknown	-	--	-	--	2	50.00	2	50.00	4
Northern Gannet	34	16.43	13	6.28	53	25.60	107	51.69	207
Double-crested Cormorant	2	12.50	2	12.50	-	--	12	75.00	16
Red-necked Phalarope	-	--	2	11.76	15	88.24	-	--	17
Red Phalarope	-	--	-	--	1	100.00	-	--	1
Red/Red-necked Phalarope	63	11.86	4	0.75	-	--	464	87.38	531
South Polar Skua	-	--	-	--	1	100.00	-	--	1
Pomarine Jaeger	-	--	-	--	1	100.00	-	--	1
Parasitic Jaeger	-	--	-	--	2	100.00	-	--	2
Razorbill	-	--	-	--	-	--	4	100.00	4
Murre/Razorbill	-	--	-	--	-	--	30	100.00	30

(continued)

Table D-3. continued

Species	Flight Height Unknown		Flying outside RSZ		Flying within RSZ		Sitting		Total
	No.	% Within Season	No.	% Within Season	No.	% Within Season	No.	% Within Season	
Atlantic Puffin	-	--	-	--	-	--	45	100.00	45
Auk-species unknown	-	--	-	--	-	--	27	100.00	27
Laughing Gull	6	17.14	-	--	5	14.29	24	68.57	35
Ring-billed Gull	-	--	-	--	1	100.00	-	--	1
Herring Gull	33	5.96	24	4.33	77	13.90	420	75.81	554
Iceland Gull	-	--	-	--	1	100.00	-	--	1
Lesser Black-backed Gull	2	18.18	2	18.18	2	18.18	5	45.45	11
Great Black-backed Gull	22	8.56	10	3.89	25	9.73	200	77.82	257
Gull-species unknown - Large	-	--	-	--	-	--	1	100.00	1
Gull-species unknown - Small	1	3.45	-	--	-	--	28	96.55	29
Least Tern	10	20.41	7	14.29	32	65.31	-	--	49
Black Tern	1	50.00	-	--	-	--	1	50.00	2
Roseate Tern	1	6.67	4	26.67	10	66.67	-	--	15
Common Tern	176	32.23	94	17.22	267	48.90	9	1.65	546
<i>Sterna</i> Tern-species unknown	435	61.61	18	2.55	66	9.35	187	26.49	706
Season Total	845	23.04	205	5.59	652	17.78	1,966	53.60	3,668
Spring 2018									
Surf Scoter	29	27.36	53	50.00	24	22.64	-	--	106
White-winged Scoter	7	2.24	13	4.17	7	2.24	285	91.35	312
Black Scoter	12	42.86	-	--	-	--	16	57.14	28
Scoter unid.	-	--	-	--	-	--	4,721	100.00	4,721
Duck-species unknown	-	--	-	--	-	--	2	100.00	2
Red-throated Loon	2	1.24	3	1.86	38	23.60	118	73.29	161
Common Loon	-	--	2	0.46	26	5.94	410	93.61	438
Loon-species unknown	1	50.00	-	--	-	--	1	50.00	2

(continued)

Table D-3. continued

Species	Flight Height Unknown		Flying outside RSZ		Flying within RSZ		Sitting		Total
	No.	% Within Season	No.	% Within Season	No.	% Within Season	No.	% Within Season	
Horned Grebe	-	--	-	--	-	--	1	100.00	1
Northern Fulmar	3	14.29	-	--	8	38.10	10	47.62	21
Black-capped Petrel	3	60.00	-	--	2	40.00	-	--	5
Sooty Shearwater	5	55.56	-	--	-	--	4	44.44	9
Shearwater-species unknown-Large	-	--	-	--	-	--	1	100.00	1
Shearwater-species unknown-Small	-	--	-	--	-	--	2	100.00	2
Storm-petrel species unknown	107	47.98	97	43.50	11	4.93	8	3.59	223
Brown Booby	-	--	-	--	1	100.00	-	--	1
Northern Gannet	137	10.89	73	5.80	148	11.76	900	71.54	1,258
Cormorant-species unknown	111	65.29	55	32.35	4	2.35	-	--	170
Osprey	-	--	-	--	1	100.00	-	--	1
Shorebird-species unknown	34	100.00	-	--	-	--	-	--	34
Red-necked Phalarope	126	36.00	21	6.00	13	3.71	190	54.29	350
Red Phalarope	552	15.43	440	12.30	731	20.44	1,854	51.83	3,577
Red/Red-necked Phalarope	95	5.53	144	8.39	54	3.15	1,424	82.94	1,717
Great Skua	-	--	-	--	-	--	1	100.00	1
Parasitic Jaeger	-	--	-	--	2	100.00	-	--	2
Skua-species unknown	-	--	-	--	-	--	1	100.00	1
Common/Thick-billed Murre	18	11.04	-	--	-	--	145	88.96	163
Razorbill	3	0.55	-	--	-	--	543	99.45	546
Murre/Razorbill	27	1.09	3	0.12	3	0.12	2,450	98.67	2,483
Atlantic Puffin	1	0.19	14	2.60	2	0.37	522	96.85	539
Auk-species unknown	-	--	-	--	-	--	2	100.00	2
Black-legged Kittiwake	-	--	1	50.00	1	50.00	-	--	2
Bonaparte's Gull	128	16.10	51	6.42	131	16.48	485	61.01	795

(continued)

Table D-3. continued

Species	Flight Height Unknown		Flying outside RSZ		Flying within RSZ		Sitting		Total
	No.	% Within Season	No.	% Within Season	No.	% Within Season	No.	% Within Season	
Little Gull	-	--	-	--	1	100.00	-	--	1
Laughing Gull	11	35.48	3	9.68	3	9.68	14	45.16	31
Ring-billed Gull	3	17.65	-	--	2	11.76	12	70.59	17
Herring Gull	222	7.02	122	3.86	313	9.89	2,507	79.24	3,164
Iceland Gull	1	50.00	-	--	-	--	1	50.00	2
Lesser Black-backed Gull	4	12.50	2	6.25	5	15.63	21	65.63	32
Glaucous Gull	-	--	-	--	-	--	1	100.00	1
Great Black-backed Gull	40	8.89	33	7.33	57	12.67	320	71.11	450
Gull-species unknown - Large	1	8.33	-	--	-	--	11	91.67	12
Gull-species unknown - Small	5	8.62	1	1.72	1	1.72	51	87.93	58
Common Tern	-	--	1	33.33	2	66.67	-	--	3
<i>Sterna</i> Tern-species unknown	24	54.55	8	18.18	11	25.00	1	2.27	44
Season Total	1,712	7.97	1,140	5.31	1,602	7.45	17,035	79.27	21,489
Spring 2019									
Surf Scoter	12	12.90	74	79.57	3	3.23	4	4.30	93
White-winged Scoter	2	1.79	3	2.68	-	--	107	95.54	112
Black Scoter	2	8.70	3	13.04	-	--	18	78.26	23
Scoter unid.	1	0.12	-	--	-	--	829	99.88	830
Duck-species unknown	1	11.11	-	--	-	--	8	88.89	9
Red-throated Loon	-	--	10	7.94	17	13.49	99	78.57	126
Common Loon	5	0.89	8	1.42	16	2.84	534	94.85	563
Loon-species unknown	-	--	-	--	-	--	14	100.00	14
Grebe-species unknown	-	--	-	--	-	--	2	100.00	2
Northern Fulmar	13	18.57	8	11.43	33	47.14	16	22.86	70
Black-capped Petrel	14	63.64	2	9.09	3	13.64	3	13.64	22

(continued)

Table D-3. continued

Species	Flight Height Unknown		Flying outside RSZ		Flying within RSZ		Sitting		Total
	No.	% Within Season	No.	% Within Season	No.	% Within Season	No.	% Within Season	
Cory's Shearwater	2	50.00	-	--	-	--	2	50.00	4
Sooty Shearwater	15	62.50	3	12.50	4	16.67	2	8.33	24
Manx Shearwater	2	22.22	-	--	-	--	7	77.78	9
Shearwater-species unknown-Small	3	60.00	-	--	-	--	2	40.00	5
Shearwater-species unknown	-	--	-	--	2	66.67	1	33.33	3
Storm-petrel species unknown	1,307	62.66	353	16.92	385	18.46	41	1.97	2,086
Northern Gannet	196	14.31	226	16.50	89	6.50	859	62.70	1,370
Cormorant-species unknown	11	64.71	-	--	2	11.76	4	23.53	17
Great Blue Heron	-	--	-	--	1	100.00	-	--	1
Snowy Egret	-	--	-	--	-	--	2	100.00	2
American Oystercatcher	3	17.65	-	--	-	--	14	82.35	17
Shorebird-species unknown	1	100.00	-	--	-	--	-	--	1
Red-necked Phalarope	99	23.19	18	4.22	15	3.51	295	69.09	427
Red Phalarope	62	18.34	36	10.65	68	20.12	172	50.89	338
Red/Red-necked Phalarope	214	21.00	30	2.94	51	5.00	724	71.05	1,019
South Polar Skua	-	--	-	--	1	100.00	-	--	1
Parasitic Jaeger	3	33.33	1	11.11	4	44.44	1	11.11	9
Dovekie	-	--	-	--	-	--	59	100.00	59
Common/Thick-billed Murre	-	--	-	--	-	--	1	100.00	1
Razorbill	-	--	-	--	-	--	44	100.00	44
Murre/Razorbill	1	0.47	-	--	-	--	212	99.53	213
Atlantic Puffin	-	--	-	--	-	--	316	100.00	316
Auk-species unknown	-	--	-	--	-	--	54	100.00	54
Black-legged Kittiwake	2	33.33	-	--	-	--	4	66.67	6
Bonaparte's Gull	29	14.36	15	7.43	61	30.20	97	48.02	202

(continued)

Table D-3. continued

Species	Flight Height Unknown		Flying outside RSZ		Flying within RSZ		Sitting		Total
	No.	% Within Season	No.	% Within Season	No.	% Within Season	No.	% Within Season	
Laughing Gull	20	43.48	4	8.70	7	15.22	15	32.61	46
Ring-billed Gull	-	--	1	25.00	1	25.00	2	50.00	4
Herring Gull	119	7.57	49	3.12	163	10.36	1,242	78.96	1,573
Iceland Gull	-	--	-	--	1	100.00	-	--	1
Lesser Black-backed Gull	1	4.55	1	4.55	2	9.09	18	81.82	22
Great Black-backed Gull	23	9.83	8	3.42	23	9.83	180	76.92	234
Gull-species unknown - Large	11	18.33	-	--	-	--	49	81.67	60
Gull-species unknown - Small	5	1.93	-	--	3	1.16	251	96.91	259
Gull-species unknown	-	--	-	--	3	18.75	13	81.25	16
Least Tern	1	25.00	-	--	3	75.00	-	--	4
Black Tern	1	100.00	-	--	-	--	-	--	1
Tern-species unknown	3	50.00	-	--	1	16.67	2	33.33	6
Roseate Tern	-	--	1	5.88	16	94.12	-	--	17
Common Tern	16	34.04	8	17.02	23	48.94	-	--	47
Forster's Tern	10	35.71	5	17.86	6	21.43	7	25.00	28
Commic/Forster's Tern	534	34.36	209	13.45	666	42.86	145	9.33	1,554
<i>Sterna</i> Tern-species unknown	34	61.82	2	3.64	9	16.36	10	18.18	55
Season Total	2,778	23.11	1,078	8.97	1,682	13.99	6,481	53.92	12,019

Appendix E. Flight Heights for Flying Birds Observed During Each Survey

Table E–1. Number (n), Minimum (m), Maximum (m), Median (m), Standard Deviation, and Altitude Error of Flight Heights (m) for Flying Birds Observed During Each Survey

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

Species	N	Min	Max	Median	Std Dev	Error
Summer 2016						
Black-capped Petrel	1	0.5	0.5	0.5		22.6624
Cory's Shearwater	143	0.5	79.6	1.0	10.29	46.3179
Great Shearwater	32	1.0	82.6	1.0	16.35	38.0378
Sooty Shearwater	1	16.5	16.5	16.5		49.6676
Audubon's Shearwater	2	1.0	2.0	1.5	0.71	44.7280
Wilson's Storm-Petrel	207	0.5	79.3	0.5	16.38	44.9641
Double-crested Cormorant	6	2.0	2.0	2.0	0.00	28.9737
Black-bellied Plover	6	59.5	104.2	70.8	18.37	30.2950
Ring-billed Gull	1	62.2	62.2	62.2		27.7134
Herring Gull	2	7.0	154.5	80.8	104.28	25.1468
Great Black-backed Gull	4	4.0	117.4	31.2	49.94	62.0257
Least Tern	10	1.6	39.4	5.3	10.95	44.2700
Royal Tern	4	0.1	27.4	13.3	14.63	25.3723
<i>Sterna</i> Tern-species unknown	1	1.0	1.0	1.0		54.1902
Summer 2017						
Black-capped Petrel	1	102.4	102.4	102.4		28.2516
Cory's Shearwater	43	1.0	81.9	1.0	23.51	51.3471
Great Shearwater	95	0.3	80.8	1.0	24.40	50.9287
Shearwater-species unknown-Large	7	1.0	64.2	38.1	22.75	38.7485
Shearwater-species unknown-Small	1	40.8	40.8	40.8		53.8930
Wilson's Storm-Petrel	226	0.3	85.6	0.5	24.97	48.2581
Leach's Storm-Petrel	1	53.6	53.6	53.6		31.3547
Storm-petrel species unknown	1,117	0.3	86.8	0.5	17.53	54.7303
Shorebird-species unknown	4	25.2	66.3	48.3	21.33	46.7822
Red-necked Phalarope	1	14.4	14.4	14.4		37.4852
Red/Red-necked Phalarope	2	1.0	9.6	5.3	6.08	31.4794
Phalarope-species unknown	2	21.7	92.4	57.0	49.97	54.6712
Laughing Gull	4	39.0	56.0	44.2	8.19	38.4825
Ring-billed Gull	1	41.4	41.4	41.4		47.7371
Herring Gull	6	31.8	66.4	39.3	13.11	39.9704
Lesser Black-backed Gull	1	126.6	126.6	126.6		31.7433

(continued)

Table E-1. continued

Species	N	Min	Max	Median	Std Dev	Error
Great Black-backed Gull	3	22.3	72.3	35.9	25.84	39.4648
Gull-species unknown - Large	1	44.0	44.0	44.0		26.0441
Gull-species unknown - Small	2	6.3	32.9	19.6	18.77	41.8229
<i>Sterna</i> Tern-species unknown	8	5.2	101.5	51.3	40.82	33.3668
Summer 2018						
Black-capped Petrel	2	0.5	29.3	14.9	20.37	46.4812
Cory's Shearwater	77	0.5	83.5	0.5	13.04	82.9495
Great Shearwater	67	0.5	80.2	0.5	16.19	80.2519
Shearwater-species unknown-Large	18	0.5	79.6	0.5	19.14	53.5939
White-faced Storm-Petrel	2	0.3	10.7	5.5	7.34	68.5008
Storm-petrel species unknown	977	0.0	87.5	5.4	24.01	79.4990
Cormorant-species unknown	1	0.5	0.5	0.5		558.9210
Osprey	3	39.2	101.1	90.1	32.99	61.3283
American Oystercatcher	1	12.5	12.5	12.5		41.7282
Black-bellied Plover	2	111.7	132.1	121.9	14.38	32.0693
Shorebird-species unknown	65	0.5	42.6	0.5	7.08	64.2506
Red/Red-necked Phalarope	7	16.6	55.9	43.5	13.95	33.4554
Laughing Gull	6	1.5	30.4	10.7	10.68	35.7393
Ring-billed Gull	3	9.8	26.1	22.2	8.50	43.6051
Herring Gull	25	0.5	93.0	0.5	31.86	46.3981
Lesser Black-backed Gull	2	2.6	45.0	23.8	30.02	29.7252
Great Black-backed Gull	25	0.5	80.3	1.0	25.88	47.5477
Least Tern	8	0.4	99.8	30.4	36.39	42.1417
Black Tern	1	0.5	0.5	0.5		491.5620
Royal Tern	1	105.5	105.5	105.5		12.5894
Common Tern	67	0.5	77.9	21.3	23.24	83.0032
Forster's Tern	1	0.5	0.5	0.5		215.8240
Commic/Forster's Tern	40	0.3	129.4	33.1	40.41	53.1827
<i>Sterna</i> Tern-species unknown	14	14.6	127.1	54.4	34.18	48.5486
Fall 2016						
Surf Scoter	29	3.0	53.1	7.0	14.13	37.4970
White-winged Scoter	4	18.0	72.2	51.5	25.19	43.2712
Black Scoter	384	4.0	86.9	15.0	19.95	37.4534
Red-throated Loon	67	1.2	156.7	84.5	41.47	35.6507
Common Loon	26	4.0	155.6	73.0	46.43	36.6890
Cory's Shearwater	49	0.2	83.9	9.0	20.97	48.4543
Great Shearwater	3	9.8	30.2	28.2	11.25	25.7883
Northern Gannet	322	0.0	159.3	47.4	38.40	35.5012
Double-crested Cormorant	64	7.0	50.0	7.0	20.35	39.3698

(continued)

Table E-1. continued

Species	N	Min	Max	Median	Std Dev	Error
Red-necked Phalarope	8	10.4	132.4	70.0	38.67	24.1820
Red/Red-necked Phalarope	105	0.2	82.4	3.0	13.24	36.8714
Pomarine Jaeger	1	91.4	91.4	91.4		18.0188
Black-legged Kittiwake	44	0.2	157.7	32.1	51.47	35.6000
Bonaparte's Gull	296	0.8	143.8	70.4	28.58	37.2552
Little Gull	2	33.6	60.1	46.8	18.77	47.3091
Laughing Gull	52	0.0	142.1	70.1	40.27	38.9413
Ring-billed Gull	13	1.5	116.8	39.9	38.11	39.7596
Herring Gull	496	0.0	158.8	53.3	42.04	37.3318
Lesser Black-backed Gull	1	2.5	2.5	2.5		19.6253
Great Black-backed Gull	70	0.6	158.0	59.6	43.66	38.1075
Fall 2017						
Canada Goose	2	51.2	81.8	66.5	21.66	40.2118
Surf Scoter	27	11.3	158.6	71.3	36.97	44.1093
Black Scoter	95	0.0	149.0	50.3	36.09	35.4639
Long-tailed Duck	2	25.2	37.5	31.3	8.73	37.2881
Red-throated Loon	110	0.6	156.4	107.7	35.68	36.4492
Common Loon	41	3.4	151.6	98.3	38.98	32.7907
Loon-species unknown	2	106.3	112.6	109.4	4.44	36.1010
Northern Fulmar	24	41.4	155.2	115.6	26.34	35.6434
Cory's Shearwater	1	51.9	51.9	51.9		21.8098
Great Shearwater	3	42.5	126.4	57.1	44.84	31.6854
Manx Shearwater	1	17.5	17.5	17.5		35.1718
Shearwater-species unknown-Large	1	95.2	95.2	95.2		73.6453
Shearwater-species unknown-Small	1	76.2	76.2	76.2		26.7321
Leach's Storm-Petrel	1	13.8	13.8	13.8		36.4542
Storm-petrel species unknown	40	1.2	150.0	44.2	46.43	39.6919
Northern Gannet	178	1.1	156.2	71.1	40.59	39.8304
Cormorant-species unknown	68	0.4	61.0	23.3	14.96	34.9366
Great Blue Heron	1	60.1	60.1	60.1		32.6189
Dunlin	1	12.4	12.4	12.4		66.7526
Red Phalarope	571	0.9	159.1	65.4	39.90	37.0758
Red/Red-necked Phalarope	333	1.6	159.2	88.7	40.45	36.3163
Phalarope-species unknown	3	79.7	157.3	101.3	40.03	44.2739
Parasitic Jaeger	1	93.8	93.8	93.8		21.0111
Black-legged Kittiwake	236	0.3	159.2	69.1	43.89	36.4337
Bonaparte's Gull	436	1.3	158.8	92.5	38.77	38.0110
Laughing Gull	47	0.0	158.8	57.2	52.72	35.4040
Ring-billed Gull	25	5.4	158.7	68.5	49.05	36.6335

(continued)

Table E-1. continued

Species	N	Min	Max	Median	Std Dev	Error
Herring Gull	212	0.2	158.4	76.2	45.02	38.1720
Lesser Black-backed Gull	2	33.2	144.6	88.9	78.78	28.5191
Great Black-backed Gull	44	5.9	148.7	72.2	41.28	38.0506
Gull-species unknown - Large	1	16.8	16.8	16.8		21.8854
Gull-species unknown - Small	22	14.2	153.7	90.2	38.98	38.4519
Forster's Tern	1	102.1	102.1	102.1		71.4092
<i>Sterna</i> Tern-species unknown	1	25.2	25.2	25.2		33.5830
Snow Bunting	5	10.3	73.5	45.0	24.15	34.9939
Fall 2018						
Mallard	1	40.0	40.0	40.0		35.5784
American Black Duck	9	3.1	103.9	75.1	36.07	40.4279
Surf Scoter	26	2.0	82.4	8.4	24.53	41.2585
White-winged Scoter	33	1.3	84.0	35.9	27.12	33.0234
Black Scoter	88	0.8	87.5	2.0	18.06	43.2357
Scoter unid.	11	1.0	131.6	35.4	43.32	44.9768
Duck-species unknown	3	38.1	101.1	40.8	35.63	37.8139
Red-throated Loon	75	2.0	155.9	81.5	46.85	34.5962
Common Loon	40	1.0	156.8	91.8	42.60	36.3403
Horned Grebe	1	94.0	94.0	94.0		40.4676
Northern Fulmar	101	2.0	159.4	97.7	32.50	36.1018
Great Shearwater	13	2.0	67.5	5.2	21.26	44.9867
Manx Shearwater	4	0.2	69.8	10.3	32.50	41.1738
Shearwater-species unknown-Large	21	0.3	62.6	18.1	21.77	39.2827
Storm-petrel species unknown	6	0.5	0.5	0.5	0.00	56.2063
Northern Gannet	331	1.0	136.1	38.7	31.78	46.3734
Cormorant-species unknown	50	0.4	82.9	21.9	20.73	36.1787
Shorebird-species unknown	174	1.0	48.4	1.0	4.88	26.3722
Red Phalarope	1,595	0.0	86.3	3.0	20.29	43.8670
Red/Red-necked Phalarope	57	0.0	118.2	39.8	31.74	35.6183
Parasitic Jaeger	2	2.0	116.9	59.4	81.23	38.9490
Murre/Razorbill	14	2.0	69.4	43.0	24.56	35.0676
Black-legged Kittiwake	1,180	0.1	120.4	37.8	28.10	39.0876
Bonaparte's Gull	748	0.0	159.3	64.7	37.46	36.7406
Little Gull	1	46.0	46.0	46.0		40.2070
Laughing Gull	928	0.1	150.2	51.8	34.41	36.4858
Ring-billed Gull	464	0.2	121.7	41.2	27.65	37.9586
Herring Gull	629	0.0	124.4	37.6	29.51	37.9971
Iceland Gull	1	94.2	94.2	94.2		39.7733
Lesser Black-backed Gull	3	14.5	90.7	35.3	39.40	34.5662

(continued)

Table E-1. continued

Species	N	Min	Max	Median	Std Dev	Error
Great Black-backed Gull	71	0.9	159.0	50.4	46.09	37.2189
Gull-species unknown - Large	4	1.5	49.2	18.4	19.92	36.9630
Gull-species unknown - Small	50	0.0	152.9	52.6	42.60	38.2270
Gull-species unknown	21	2.0	33.0	33.0	6.76	45.0082
Hirundine species unknown	12	33.0	33.0	33.0	0.00	34.7935
Passerine species unknown	1	33.0	33.0	33.0		42.9591
Winter 2016-17						
Canada Goose	1	4.0	4.0	4.0		37.3131
Lesser Scaup	7	3.0	3.0	3.0	0.00	27.1390
White-winged Scoter	51	3.0	38.9	3.0	8.11	25.9435
Black Scoter	10	3.0	83.7	4.0	25.28	42.0905
Long-tailed Duck	10	8.0	28.0	13.0	7.74	41.6600
Red-breasted Merganser	1	130.5	130.5	130.5		90.5574
Red-throated Loon	61	1.0	147.7	67.8	37.21	36.2074
Common Loon	18	1.0	61.6	5.0	16.74	36.1762
Northern Fulmar	9	5.0	152.7	117.3	63.95	37.7634
Sooty Shearwater	1	2.0	2.0	2.0		29.1718
Northern Gannet	665	0.5	133.0	35.9	33.57	36.0229
Red/Red-necked Phalarope	3	1.0	8.3	4.7	3.65	50.4338
Dovekie	3	1.0	1.0	1.0	0.00	57.9701
Razorbill	4	2.0	107.3	37.8	52.91	40.2213
Atlantic Puffin	2	1.0	1.0	1.0	0.00	38.0175
Auk-species unknown	2	1.0	1.0	1.0	0.00	26.9985
Black-legged Kittiwake	3	15.9	133.7	26.8	65.10	36.4235
Bonaparte's Gull	193	1.0	158.3	46.5	40.29	36.1121
Ring-billed Gull	72	0.2	157.6	84.1	41.26	37.1053
Herring Gull	543	0.1	159.4	44.2	44.45	36.4376
Iceland Gull	1	100.9	100.9	100.9		30.1954
Lesser Black-backed Gull	3	37.2	113.4	40.7	43.04	34.1664
Great Black-backed Gull	178	0.8	86.3	10.0	19.27	36.3667
Winter 2017-18						
White-winged Scoter	35	1.0	103.0	1.0	34.29	43.8292
Long-tailed Duck	1	1.5	1.5	1.5		68.2373
Bufflehead	1	1.5	1.5	1.5		33.8615
Red-throated Loon	2	1.0	64.2	32.6	44.72	27.9776
Common Loon	4	90.5	105.1	98.7	6.12	27.1908
Northern Fulmar	494	0.5	158.5	106.4	32.78	36.5451
Northern Gannet	105	0.5	99.4	36.2	24.09	39.3372
Shorebird-species unknown	10	0.2	43.6	24.4	13.98	37.2397

(continued)

Table E-1. continued

Species	N	Min	Max	Median	Std Dev	Error
Great Skua	1	22.7	22.7	22.7		46.0976
Murre/Razorbill	6	1.0	67.7	42.3	24.01	48.2375
Black-legged Kittiwake	3	21.8	40.4	33.0	9.37	43.3503
Bonaparte's Gull	38	1.4	122.2	64.9	32.74	37.1128
Ring-billed Gull	2	93.4	127.0	110.2	23.77	34.0032
Herring Gull	227	1.0	158.5	54.8	36.73	39.0300
Lesser Black-backed Gull	2	64.8	82.6	73.7	12.60	27.6572
Great Black-backed Gull	144	0.5	143.8	40.1	34.96	37.7816
Winter 2018-19						
Surf Scoter	1	7.7	7.7	7.7		41.7522
White-winged Scoter	51	0.0	141.9	44.3	35.59	42.7072
Black Scoter	2	38.0	50.6	44.3	8.89	55.8200
Long-tailed Duck	1	20.7	20.7	20.7		43.8209
Red-throated Loon	4	14.6	115.3	77.8	45.46	51.0312
Northern Fulmar	48	46.5	156.4	98.0	31.31	37.6320
Northern Gannet	288	0.3	103.0	33.5	24.52	39.6997
Great Skua	3	3.9	33.9	15.7	15.09	47.5312
Dovekie	45	3.8	153.0	67.1	37.81	41.8886
Murre/Razorbill	4	11.2	68.1	41.8	25.19	45.8905
Atlantic Puffin	3	38.2	51.2	46.7	6.60	49.3461
Black-legged Kittiwake	91	0.0	123.0	39.7	29.01	41.3280
Bonaparte's Gull	16	10.1	106.5	39.7	27.85	45.4084
Ring-billed Gull	12	4.0	131.7	55.1	39.66	37.1921
Herring Gull	766	0.3	119.2	41.9	27.97	39.2181
Lesser Black-backed Gull	1	144.8	144.8	144.8		41.3479
Great Black-backed Gull	315	0.2	130.8	34.8	32.57	40.4595
Gull-species unknown - Large	1	17.0	17.0	17.0		24.0899
Gull-species unknown - Small	1	40.2	40.2	40.2		37.1397
Gull-species unknown	3	33.0	33.0	33.0	0.00	37.1397
Spring 2017						
Red-throated Loon	1	41.9	41.9	41.9		30.2156
Common Loon	12	20.0	153.8	71.7	38.11	36.4491
Northern Fulmar	19	1.0	159.0	121.2	61.50	38.4235
Trindade Petrel	1	111.6	111.6	111.6		15.3148
Cory's Shearwater	4	1.0	141.3	15.3	65.82	46.1996
Great Shearwater	1	132.1	132.1	132.1		29.9536
Sooty Shearwater	14	1.0	146.0	2.3	50.43	38.8223
Shearwater-species unknown-Small	1	47.7	47.7	47.7		26.4679
Wilson's Storm-Petrel	62	0.1	156.5	96.2	49.12	34.0997

(continued)

Table E-1. continued

Species	N	Min	Max	Median	Std Dev	Error
Band-rumped Storm-Petrel	1	66.2	66.2	66.2		46.0520
Storm-petrel species unknown	2	34.2	136.0	85.1	72.00	41.2741
Northern Gannet	66	0.6	151.8	61.9	42.18	38.8255
Double-crested Cormorant	2	1.0	1.0	1.0	0.00	63.4501
Red-necked Phalarope	17	1.2	121.8	55.9	31.73	37.2687
Red Phalarope	1	65.7	65.7	65.7		24.9331
Red/Red-necked Phalarope	4	4.4	7.7	4.7	1.55	46.1024
South Polar Skua	1	149.6	149.6	149.6		18.9554
Pomarine Jaeger	1	111.8	111.8	111.8		34.5659
Parasitic Jaeger	2	40.2	118.1	79.2	55.11	31.8195
Laughing Gull	5	46.3	149.7	82.2	41.57	39.4960
Ring-billed Gull	1	75.7	75.7	75.7		39.4103
Herring Gull	101	0.3	158.4	58.5	45.42	36.4710
Iceland Gull	1	45.0	45.0	45.0		57.5049
Lesser Black-backed Gull	4	14.7	31.3	23.7	7.05	31.0472
Great Black-backed Gull	35	1.0	136.5	34.8	38.66	40.6450
Least Tern	39	1.5	158.8	70.6	44.33	36.7631
Roseate Tern	14	0.9	104.6	41.8	31.77	35.2872
Common Tern	361	0.2	158.6	51.9	44.50	36.8178
<i>Sterna</i> Tern-species unknown	84	0.9	112.6	39.4	28.33	39.3011
Spring 2018						
Surf Scoter	77	1.6	83.7	16.0	19.07	53.4145
White-winged Scoter	20	1.0	74.0	7.2	28.50	33.3733
Red-throated Loon	41	1.0	147.6	84.7	36.19	40.7142
Common Loon	28	2.1	139.1	75.2	31.55	36.6260
Northern Fulmar	8	65.5	159.2	85.1	34.51	31.7724
Black-capped Petrel	2	29.7	30.0	29.9	0.18	36.0701
Storm-petrel species unknown	108	1.0	80.7	1.0	15.30	60.5978
Brown Booby	1	88.3	88.3	88.3		28.9406
Northern Gannet	221	0.2	111.1	38.9	27.78	37.5807
Cormorant-species unknown	59	2.1	49.8	14.7	8.31	74.8906
Osprey	1	63.9	63.9	63.9		27.2748
Red-necked Phalarope	34	0.2	81.6	11.2	26.74	38.4545
Red Phalarope	1,171	0.1	132.0	33.4	31.54	41.4482
Red/Red-necked Phalarope	198	0.1	86.1	0.5	22.97	42.1903
Parasitic Jaeger	2	25.7	71.7	48.7	32.56	48.0334
Murre/Razorbill	6	1.0	59.7	14.1	23.86	43.1561
Atlantic Puffin	16	1.0	83.9	1.0	25.26	36.5276
Black-legged Kittiwake	2	0.9	68.8	34.8	47.98	32.2473

(continued)

Table E-1. continued

Species	N	Min	Max	Median	Std Dev	Error
Bonaparte's Gull	182	0.0	141.9	43.3	34.40	51.6936
Little Gull	1	44.4	44.4	44.4		44.0052
Laughing Gull	6	5.8	87.3	28.4	30.82	40.7262
Ring-billed Gull	2	29.3	80.4	54.9	36.14	38.8927
Herring Gull	435	0.1	139.2	43.9	33.91	40.4504
Lesser Black-backed Gull	7	0.3	73.1	36.7	28.63	43.1378
Great Black-backed Gull	90	0.0	133.0	35.3	34.25	37.2710
Gull-species unknown - Small	2	13.7	92.2	53.0	55.54	37.4018
Common Tern	3	13.5	58.4	48.2	23.55	45.2657
<i>Sterna</i> Tern-species unknown	19	6.3	80.0	33.5	25.39	35.2862
Spring 2019						
Surf Scoter	77	1.0	41.3	2.0	7.67	45.7178
White-winged Scoter	3	0.2	2.5	2.5	1.32	34.4703
Black Scoter	3	1.0	1.0	1.0	0.00	44.4396
Red-throated Loon	27	2.5	123.6	64.7	43.26	41.7006
Common Loon	24	2.6	150.3	45.7	49.94	36.9307
Northern Fulmar	41	0.2	151.9	109.3	48.44	35.0447
Black-capped Petrel	5	8.4	104.2	49.8	41.06	53.4870
Sooty Shearwater	7	1.5	76.6	33.0	26.74	47.3474
Shearwater-species unknown	2	33.0	33.0	33.0	0.00	108.6650
Storm-petrel species unknown	738	0.0	129.7	24.7	33.28	45.8496
Northern Gannet	315	0.2	86.8	1.5	21.24	42.5993
Cormorant-species unknown	2	31.2	44.1	37.7	9.13	48.6504
Great Blue Heron	1	33.0	33.0	33.0		22.9522
Red-necked Phalarope	33	0.5	95.3	22.1	26.59	47.0853
Red Phalarope	104	1.1	99.2	35.3	23.43	42.9135
Red/Red-necked Phalarope	81	0.1	101.7	30.7	26.20	52.8706
South Polar Skua	1	104.4	104.4	104.4		27.3627
Parasitic Jaeger	5	12.5	130.0	60.8	47.87	36.9096
Bonaparte's Gull	76	1.0	146.3	53.4	38.93	41.7799
Laughing Gull	11	0.2	46.7	36.4	15.40	45.8491
Ring-billed Gull	2	9.6	78.6	44.1	48.85	39.1248
Herring Gull	212	0.0	152.7	50.2	35.15	42.1445
Iceland Gull	1	66.5	66.5	66.5		32.3380
Lesser Black-backed Gull	3	11.9	82.4	48.8	35.28	39.8215
Great Black-backed Gull	31	0.9	117.7	44.7	34.81	45.1233
Gull-species unknown - Small	3	64.4	121.8	79.5	29.78	27.0430
Gull-species unknown	3	33.0	33.0	33.0	0.00	43.0917
Least Tern	3	75.4	92.2	89.3	8.97	37.4617

(continued)

Table E-1. continued

Species	N	Min	Max	Median	Std Dev	Error
Tern-species unknown	1	124.4	124.4	124.4		55.8249
Roseate Tern	17	13.4	128.4	64.8	31.49	36.1772
Common Tern	31	0.4	102.4	54.1	25.71	45.2055
Forster's Tern	11	4.8	60.9	27.7	18.96	44.6866
Commic/Forster's Tern	875	0.3	153.6	46.5	33.31	44.0398
<i>Sterna</i> Tern-species unknown	11	1.6	104.9	48.2	30.55	38.9150
All Surveys						
Canada Goose	3	4.0	81.8	51.2	39.21	37.3131–40.2118
Mallard	1	40.0	40.0	40.0		35.5784
American Black Duck	9	3.1	103.9	75.1	36.07	40.4279
Lesser Scaup	7	3.0	3.0	3.0	0.00	27.1390
Surf Scoter	237	1.0	158.6	10.0	28.87	37.497–53.4145
White-winged Scoter	197	0.0	141.9	13.7	33.07	25.9435–43.8292
Black Scoter	582	0.0	149.0	15.0	26.41	35.4639–55.82
Scoter unid.	11	1.0	131.6	35.4	43.32	44.9768
Long-tailed Duck	14	1.5	37.5	13.0	9.85	37.2881–68.2373
Bufflehead	1	1.5	1.5	1.5		33.8615
Red-breasted Merganser	1	130.5	130.5	130.5		90.5574
Duck-species unknown	3	38.1	101.1	40.8	35.63	37.8139
Red-throated Loon	388	0.6	156.7	84.4	42.70	27.9776–51.0312
Common Loon	193	1.0	156.8	76.7	45.38	27.1908–36.9307
Loon-species unknown	2	106.3	112.6	109.4	4.44	36.1010
Horned Grebe	1	94.0	94.0	94.0		40.4676
Northern Fulmar	744	0.2	159.4	105.5	35.05	31.7724–38.4235
Trindade Petrel	1	111.6	111.6	111.6		15.3148
Black-capped Petrel	11	0.5	104.2	29.7	38.50	22.6624–53.487
Cory's Shearwater	317	0.2	141.3	1.0	18.05	21.8098–82.9495
Great Shearwater	214	0.3	132.1	1.0	24.01	25.7883–80.2519
Sooty Shearwater	23	1.0	146.0	16.5	42.08	29.1718–49.6676
Manx Shearwater	5	0.2	69.8	17.5	28.24	35.1718–41.1738
Audubon's Shearwater	2	1.0	2.0	1.5	0.71	44.7280
Shearwater-species unknown-Large	47	0.3	95.2	7.4	25.59	38.7485–73.6453
Shearwater-species unknown-Small	3	40.8	76.2	47.7	18.76	26.4679–53.893
Shearwater-species unknown	2	33.0	33.0	33.0	0.00	108.6650
Wilson's Storm-Petrel	495	0.1	156.5	0.5	36.41	34.0997–48.2581
White-faced Storm-Petrel	2	0.3	10.7	5.5	7.34	68.5008
Leach's Storm-Petrel	2	13.8	53.6	33.7	28.11	31.3547–36.4542
Band-rumped Storm-Petrel	1	66.2	66.2	66.2		46.0520
Storm-petrel species unknown	2,988	0.0	150.0	1.0	27.48	39.6919–79.499

(continued)

Table E-1. continued

Species	N	Min	Max	Median	Std Dev	Error
Brown Booby	1	88.3	88.3	88.3		28.9406
Northern Gannet	2,491	0.0	159.3	36.0	34.58	35.5012–46.3734
Double-crested Cormorant	72	1.0	50.0	7.0	20.12	28.9737–63.4501
Cormorant-species unknown	180	0.4	82.9	16.8	16.54	34.9366–558.921
Great Blue Heron	2	33.0	60.1	46.6	19.18	22.9522–32.6189
Osprey	4	39.2	101.1	77.0	27.70	27.2748–61.3283
American Oystercatcher	1	12.5	12.5	12.5		41.7282
Black-bellied Plover	8	59.5	132.1	85.1	25.93	30.295–32.0693
Dunlin	1	12.4	12.4	12.4		66.7526
Shorebird-species unknown	253	0.2	66.3	1.0	9.76	26.3722–64.2506
Red-necked Phalarope	93	0.2	132.4	27.5	33.06	24.182–47.0853
Red Phalarope	3,442	0.0	159.1	22.0	34.09	24.9331–43.867
Red/Red-necked Phalarope	790	0.0	159.2	37.4	46.09	31.4794–52.8706
Phalarope-species unknown	5	21.7	157.3	92.4	48.56	44.2739–54.6712
Great Skua	4	3.9	33.9	19.2	12.56	46.0976–47.5312
South Polar Skua	2	104.4	149.6	127.0	31.93	18.9554–27.3627
Pomarine Jaeger	2	91.4	111.8	101.6	14.47	18.0188–34.5659
Parasitic Jaeger	12	2.0	130.0	66.3	44.50	21.0111–48.0334
Dovekie	48	1.0	153.0	64.0	40.50	41.8886–57.9701
Razorbill	4	2.0	107.3	37.8	52.91	40.2213
Murre/Razorbill	30	1.0	69.4	37.5	24.17	35.0676–48.2375
Atlantic Puffin	21	1.0	83.9	1.0	25.47	36.5276–49.3461
Auk-species unknown	2	1.0	1.0	1.0	0.00	26.9985
Black-legged Kittiwake	1,559	0.0	159.2	40.0	33.57	32.2473–43.3503
Bonaparte's Gull	1,985	0.0	159.3	66.9	38.95	36.1121–51.6936
Little Gull	4	33.6	60.1	45.2	10.90	40.207–47.3091
Laughing Gull	1,059	0.0	158.8	51.7	35.92	35.404–45.8491
Ring-billed Gull	598	0.2	158.7	44.9	33.25	27.7134–47.7371
Herring Gull	3,654	0.0	159.4	45.2	37.49	25.1468–46.3981
Iceland Gull	4	45.0	100.9	80.4	25.84	30.1954–57.5049
Lesser Black-backed Gull	29	0.3	144.8	37.2	41.85	19.6253–43.1378
Great Black-backed Gull	1,010	0.0	159.0	32.4	36.35	36.3667–62.0257
Gull-species unknown - Large	7	1.5	49.2	17.0	16.87	21.8854–36.963
Gull-species unknown - Small	80	0.0	153.7	68.2	43.53	27.043–41.8229
Gull-species unknown	27	2.0	33.0	33.0	5.97	37.1397–45.0082
Least Tern	60	0.4	158.8	57.1	45.38	36.7631–44.27
Black Tern	1	0.5	0.5	0.5		491.5620
Royal Tern	5	0.1	105.5	25.0	43.05	12.5894–25.3723
Tern-species unknown	1	124.4	124.4	124.4		55.8249

(continued)

Table E-1. continued

Species	N	Min	Max	Median	Std Dev	Error
Roseate Tern	31	0.9	128.4	55.0	33.14	35.2872–36.1772
Common Tern	462	0.2	158.6	44.6	42.76	36.8178–83.0032
Forster's Tern	13	0.5	102.1	27.7	28.17	44.6866–215.824
Commic/Forster's Tern	915	0.3	153.6	45.8	33.63	44.0398–53.1827
<i>Sterna</i> Tern-species unknown	138	0.9	127.1	41.4	29.95	33.3668–54.1902
Hirundine species unknown	12	33.0	33.0	33.0	0.00	34.7935
Snow Bunting	5	10.3	73.5	45.0	24.15	34.9939
Passerine species unknown	1	33.0	33.0	33.0		42.9591

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