NORMANDEAU ASSOCIATES
ENVIRONMENTAL CONSULTANTS

Ornithological and Marine Fauna Aerial Digital Survey

Lease Area OCS-A 0490

First Annual Report
May 2022 through May 2023

October 2023

US Wind

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First Annual Report
Covering May 2022 through May 2023

Prepared For

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Acronyms and Abbreviations

APEM	APEM, Inc.
BOEM	Bureau of Ocean Energy Management
FHC	Flight height calculator
GNSS	Global navigation satellite system
GPS	Global positioning system
GSD	Ground sampling distance
ISO	International Organization for Standardization
Normandeau	Normandeau Associates, Inc.
Project	Offshore wind project
QC	Quality control
RMS	Root mean square
Site	Lease Area OCS-A 0490
SPS	Standard positioning service
Survey Plan	Avian Survey Plan
TSS	Traffic separation scheme
US Wind	US Wind, Inc.

Executive Summary

US Wind Inc. contracted Normandeau Associates, Inc., and its teaming partner APEM, Inc., to conduct high-resolution (1.5 cm at the ocean's surface) aerial digital surveys of Lease Area OCS-A 0490.

Aerial digital surveys were conducted using line transects that covered 40% of the study area in and around OCS A-0490, and data are subsampled to represent 10% coverage of the area surveyed using a grid-design as described in the survey plan.

This report presents information from ten high-resolution aerial digital surveys performed in May, September, October, November, and December 2022, and January, February, March, April, and May 2023. Images from each survey were reviewed using a combination of manual and automated processes, and a minimum of 10% of the blank images for each survey were reviewed manually for quality control of the target extraction processes. Targets extracted from each image were categorized into one of ten groups and sent to taxonomic experts for identification to the lowest taxonomic level possible. Taxonomic experts are considered to have at least 7 to 10 years as career taxonomists in their species group. At least 20% of all targets identified were reviewed by a second taxonomic expert. Species listed as endangered or threatened were flagged for additional review. When comparing abundance among seasons, we corrected densities using the differences in level of effort among surveys by dividing the raw number of observations in each survey by the extent of the area surveyed, thus providing densities per km^2.

An average of 9,240 images were collected per survey and about 98% of those images had no targets. Across all surveys, 2,784 animals were sent to taxonomic experts for identification including 2,569 birds, 46 turtles, 61 marine mammals, 2 rays, 14 sharks, and 93 large bony fishes. For targets sent to a second species expert, identification agreement reached 100% across all taxonomic groups.

Of the 2,569 birds identified across all surveys (21 species), the most abundant species groups were gulls (64%) and loons (23%). The greatest density of birds was seen during the December 2022 survey (29%) followed by November 2022 (21%), March 2023 (14%), January 2023 (11%), and May 2023 (10%). September and October 2022 surveys had the least observed birds (>1%).

The spatial distribution of birds during January 2023 in the southwest was mainly razorbill and black-legged kittiwake and in December 2022 in the northeast encounters were mainly of Bonaparte's gull. Bird distributions in November 2022 through May 2023 appear to show a relationship with boat traffic; although, at this point, data are too sparse to draw strong conclusions, and review of a further 10% of data would provide greater insight.

To look for associations with vessel traffic for species that might be considered sensitive to disturbance by vessels and thus vulnerable to displacement, we looked at the distributions of auks, loons, gannets, and kittiwake. Based on review of 10% of collected data, most dovekies were sitting, were encountered south of the project, and removed from most vessel traffic. Razorbills similarly were mostly sitting and outside of the main vessel lanes with only a few exceptions. Black-legged kittiwake were mostly flying, encountered south of the project (more west than the dovekies), but also well away from the busier vessel traffic. All loons were mostly

sitting. Red-throated loons especially appear to be found away from vessel traffic. Common loons, although widespread and with much higher densities, also appear to avoid the higher density vessel traffic. Data on northern gannet are a little sparse.

All bird observations were classified as sitting or flying, and species with known flight heights were classified as outside or within the RSZ (23–319 m) for each species group for each survey. Flight activity during each survey for each species and for all surveys combined includes flight height errors calculated by APEM for each survey.

Of all birds observed (n=2,569), 59% were observed sitting (n=1,514) and 41% were observed flying (n=1,052), 29% of which were flying within the RSZ (n=306), 21% were flying above or below the RSZ (n=225), and 50% had unknown flight heights (n=521). Unknown flight heights can occur when bird species' identification, size, or wingspan cannot be determined; a lack of these data limits the ability to estimate flight height.

Over all surveys, 46 turtles were identified in imagery representing four species and one species blend. The greatest numbers of turtles observed occurred during the September survey (41%; n=19) followed by October (37%; n=17). Overall, loggerhead turtles were the most frequently found species consisting of 52% of the total observations; turtle-species unknown accounted for 17% (0.1043 turtles/km^2) and the loggerhead/Kemp's blend accounted for 13% (0.0787 turtles/km^2) of the total observations over all surveys. With recognition of the low density of turtles encountered, they were found dispersed in low numbers across the study area with little evidence of avoidance of boat traffic.

Over the ten surveys, 61 marine mammals were identified in imagery represented by four species and one species blend: North Atlantic right whale (2%; n=1), bottlenose dolphin (59%; n=36), common dolphin (20%; n=12), harbor porpoise (2%; n=1), and bottlenose/Atlantic spotted dolphin (7%; n=4). Most marine mammals were seen during the February 2023 survey (30%), which consisted of 17 bottlenose dolphins and 1 North Atlantic right whale, followed by May 2023 (n=14; 23%), January 2023 (n=12; 20%), and April 2023 (n=11; 18%). The only other surveys with marine mammals were May 2022 and March 2023 (n=3; 5%).

During all surveys, marine mammal observations (0.7804 mammals/km^2) included 0.7676 dolphins/km^2 (n=60; 98%) and 0.0128 whales/km^2 (n=1; 2%). When spatial distribution of all marine mammals was analyzed, bottlenose dolphins were found widely dispersed across the study area, and there is little evidence of avoidance of boat traffic.

There were 2 rays and 14 sharks found in the imagery across all surveys. Giant manta rays were observed during the September 2022 survey. Most sharks were found during the September 2022 survey with 43% (n=6) followed by May 2022 (n=5), March 2023 (n=2), and October 2022 (n=1). Both giant manta rays were within the lease area in September 2022. Sharks were found both within and outside of the lease area although none were found directly south of the lease area. With recognition of the low number of individuals encountered, there is no evidence of distinct spatial patterns, or evidence of avoidance of active boat traffic routes.

Across all surveys, 92 large bony fishes were seen with most observed during September 2022 (65%; n=60) and November 2022 (16%; n=15), while the lowest density survey was December

2022. The dominant species was tuna-species unknown with 71% (n=65) of all observations. With recognition of the low number of individuals encountered, there is no evidence of distinct spatial patterns or evidence of avoidance of active boat traffic routes.

Across all surveys, 69% of the observations of listed species (n=67) were turtles (n=46), which were mostly seen during the September (n=19) and October (n=17) 2022 surveys. The overall density of ESA and State-listed species was 0.8739 individuals/km^2. Across all surveys, 39% (0.3408 individuals/km^2) of the observations of listed species occurred during the September 2022 survey with October 2022 being the next highest period representing 27% (0.2360 individuals/km^2). These numbers are mainly driven by the most frequently observed species (identified to species): loggerhead turtle, which consisted of 36% (0.3146 per km^2) of the total number of observations of listed species.

One or two patterns appear to stand out that will be of interest to the overall purpose of the study. Monitoring the density and distribution of loons and comparing differences among each year prior to the TSS extension will provide greater insight into the effects of boat traffic on these birds. Analysis of a further 10% of collected data would provide a more robust dataset to compare distributions and densities, particularly before the TSS is extended and before construction is in full swing. This more robust dataset would also conform to new draft recommendations for surveys, shortly to be released for review and public comment.

1 Introduction

US Wind, Inc. (US Wind) is developing an offshore wind project (Project) with up to two gigawatts within Lease Area OCS-A 0490 (Site), an area off the coast of Maryland on the Atlantic Outer Continental Shelf. The Project would include as many as 121 wind turbine generators, up to four offshore substations, and one MET tower in the roughly 80,000-acre lease area.

After completion of an avian risk assessment (Appendix II-N1 of the Construction and Operations Plan), US Wind commissioned development of an Avian Survey Plan (Survey Plan) to meet the Bureau of Ocean Energy Management (BOEM) standards under avian information requirements in 30 CFR Part 585 Subpart F. The Survey Plan addresses data gaps in the natural history of birds and bats (i.e., temporal and spatial distributions) and scientific data gaps (i.e., hypothesis-driven explanations of wind energy and wildlife interactions) in the offshore environment. The avian risk assessment identified several species known to be sensitive to displacement. Two factors with the potential to influence the distribution and densities of displacement-sensitive species were also identified: the U.S. Coast Guard's planned extension of a traffic separation scheme (TSS) and the proximity of an adjacent, active lease area OCS-A 0519 known as Skipjack.

An aerial digital study tested these hypotheses:

1. Shipping lanes near the Site will impact distributions and densities of displacement-sensitive species.
2. Siting an offshore wind facility in the Site will have displacement impacts on select species, but impacts will be a shift in distributions rather than changes in density.
3. Displacement for most species from the Site will be within 10 km of the Project boundary.

US Wind contracted Normandeau Associates, Inc. (Normandeau) and its teaming partner APEM, Inc. (APEM) to conduct high-resolution (1.5 cm at the ocean's surface) aerial digital surveys of parts of the Site with a surrounding buffer of 10 km, hereafter referred to as the survey area or 10 km survey area.

Ten surveys per year are planned within the Site. This report summarizes the results from the first ten preconstruction surveys—surveys completed before project build, before the TSS extension, and before any construction activity at the Site.

2 Methods

2.1 Survey Design

A grid survey design was selected for this study. The same proportion of area covered by a grid pattern provides greater accuracy when surveying aggregated species in comparison with the same coverage achieved by transect surveys (Elliott 1971; McGovern and Rehfisch 2015; Coppack et al. 2017). Transects were flown collecting strips of abutting imagery and images subsampled to provide 40% grid coverage. Although this survey design requires more flying

time, it provides a more evenly distributed survey effort. The survey transects run perpendicular to the coast are evenly spaced across the survey area (Figure 1).

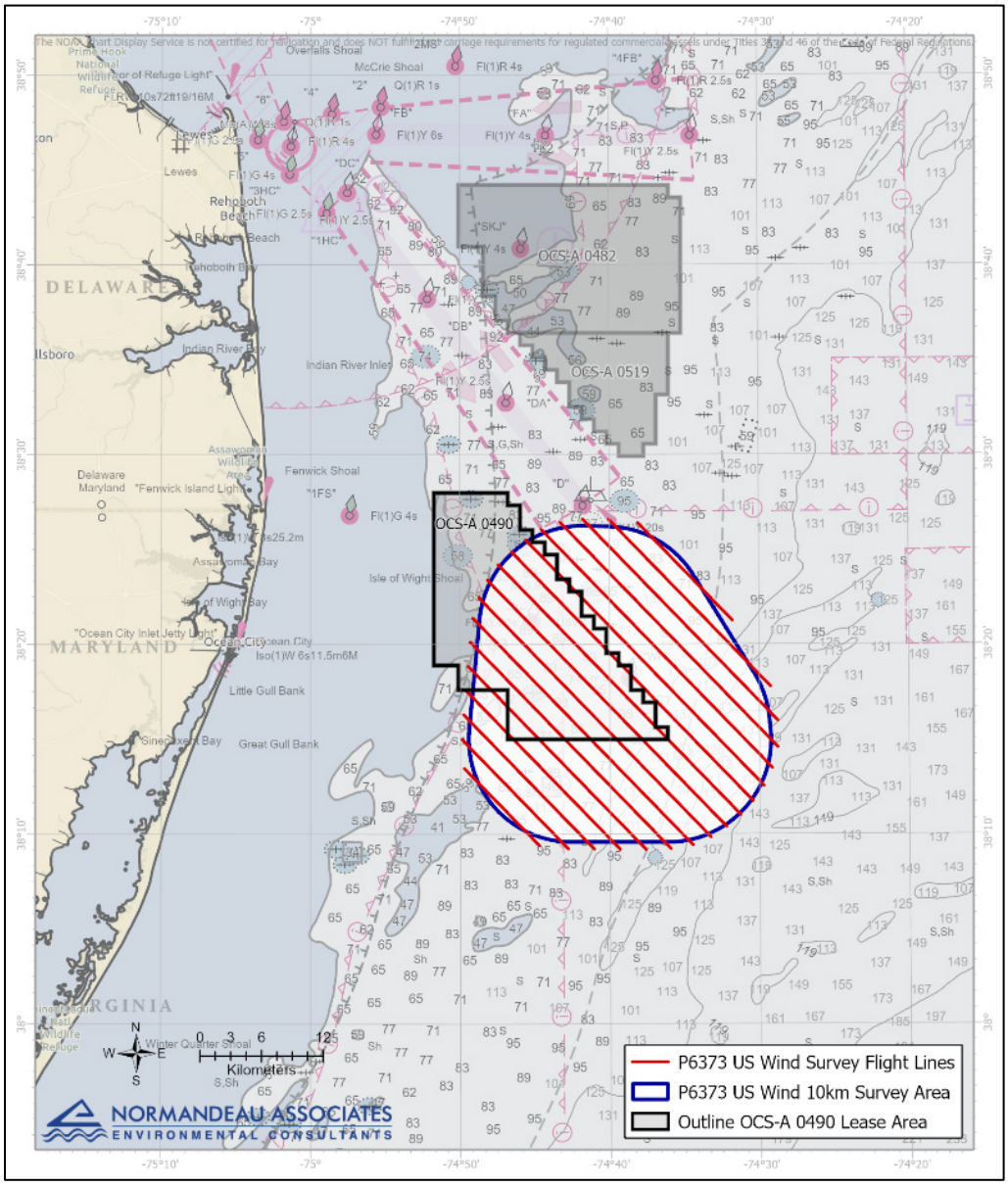


Figure 1. Transect with grid subsample design covering 40% of the study area.

2.2 Data Collection

The surveys were completed using APEM's Shearwater III camera system. This system has an array of high specification sensors, and captured imagery at 1.5-cm ground sampling distance (GSD). Operating it at higher resolution such as 1-cm significantly reduces the survey footprint without significantly increasing the data quality (i.e., the ability to identify small individuals such as piping plover to species). From an altitude of approximately 415 m (1,360 ft), an array of still images was collected from vertical (rather than angled) cameras. The imagery was captured in raw format producing sharp images. The shutter speed, aperture, and International Organization

for Standardization exposure settings (ISO) were monitored in flight by a technician to ensure the correct setting was selected for the conditions.

Custom survey planning and management software preprograms the survey transects and grids, and an integrated Applanix global navigation satellite system (GNSS) and inertial system make sure surveys are flown accurately. APEM's GNSS system has a manufacturer quoted, unprocessed Standard Positioning Service (SPS) Root mean square (RMS) error of 1.5–3.0 m (5–10 ft). The navigational system was calibrated with aircraft control systems and continuously monitored. Image acquisition was automatic, removing human error and ensuring data capture occurs over specified locations. As data capture occurred, global positioning system (GPS) data were automatically logged with each exposure including the xyz coordinates, heading of the camera at the point of capture, and line information. It is impossible to fly in a perfect line at constant altitude because of the weather and atmospheric pressure on aircraft during flight. Commonly, an aircraft moves up and down 10–30 m (33–98 ft) during surveys with long lines, and each captured image is likely to have some deviation from the planned vertical position. Spatial information collected automatically in real time, in particular the z coordinate (camera sensor height), is crucial to aid in species identification, which relies partially on organism size, and allows determination of avian flight heights.

Specific details of camera sensors and sensor configuration are not available in this report. This information is confidential and the intellectual property of APEM, Ltd.

The ten surveys occurred in May, September, October, November, and December 2022 and in January, February, March, April, and May 2023 (Table 1).

Table 1. Dates of Each Survey and Number of Days to Complete

Survey #	Survey	Date	Days to Complete
1	2022 May	05/19/22	1
2	2022 September	09/01/22	1
3	2022 October	10/14/22	1
4	2022 November	11/16/22	1
5	2022 December	12/02/22	1
6	2023 January	01/15/23	1
7	2023 February	02/15/23	1
8	2023 March	03/16/23	1
9	2023 April	04/14/23	1
10	2023 May	05/15/23	1

Daily survey time maximizes crew hours and avoids midday when glare/glint was most common. Surveys were not conducted when Douglas sea scale was ≥4, cloud base was <426.7 m (<1,400 ft), visibility was <5 km (3.1 mi), or wind speed was >30 knots (34.5 mph). The onboard camera technician continuously monitored the images and if they ceased to be of sufficient quality, image acquisition stopped until suitable conditions returned. At each capture point, surplus images are collected to allow replacement of any image found unsuitable for analysis. Location and flight height accuracy is monitored by multiple GPS sensors, and overall location accuracy

reaches 2.5 m (8 ft) on x and y locations and 5 m (16 ft) on the z location. All data capture points within the study area are included for analysis. Following each survey, sample imagery was evaluated for quality for analysis. Data were backed up daily and shipped for analysis.

The grid imagery footprint was at least 524 m × 219 m (0.114 km^2). Images were collected using the transect design described above within at least 40% of the study area. Only one quarter of the images (representing 10% of the study area) were analyzed to achieve a 10% grid design. The remaining unanalyzed data can be accessed later if needed.

2.3 Target Extraction and Quality Control (QC)

Target extraction is where images are reviewed, and targets of interest are identified. Targets of interest are not only biota, but also comprise physical structures such as buoys and boats. Target extraction is done using automated and manual target identification and extraction methods, and all survey data undergo QC. To continue monitoring the success of the target extraction and to make sure data are not lost, at least 10% of the blank images are screened for QC (Figure 2). By contract, there is at least 90% agreement in QC of target extraction, but self-imposed higher levels of agreement meant that any slippage in agreement below 98% would have triggered a review of the analysts involved and early action taken to maintain high confidence in the target extraction process. Once the target extraction is complete, all images found to contain organisms are transmitted to taxonomists for identification using Normandeau's ReMOTe portal (https://remote.normandeau.com) for data management, identification, and reporting. First extraction categorizes targets into taxonomic groups and a cropped image of the animal is posted for identification. The size and resolution of computer monitors can have a significant effect on the clarity of some characteristics of animals. Analysts involved in the review process recommend Ultra High-Definition monitors with a minimum 60-cm (24-in) screen.

Target Classification and Identification

Targets were categorized into ten groups representing birds, bats, turtles, marine mammals, rays, sharks, large bony fishes, fish shoals, vessels, and fixed structures (Figure 2). These were then accessed for identification by biologists highly experienced in their taxonomic group, and identifications of species listed as "Endangered" or "Threatened" by the state or under the Endangered Species Act (ESA) were flagged for additional review.

Identification and Quality Control

At least 20% of all images identified were reviewed by a second taxonomic expert, and taxonomic agreement had to meet at least 90% concurrence (Figure 2). Failure to reach this would trigger a review of 100% of identifications made by the initial taxonomist. The 20% review included QC review of 100% of ESA and State-listed species, and for endangered species a 100% agreement had to be reached on identifications. Additional experts in the species concerned were called in to arbitrate identifications when concurrence could not be reached. Taxonomic experts were considered to have at least 7 to 10 years as career taxonomists in their species group.

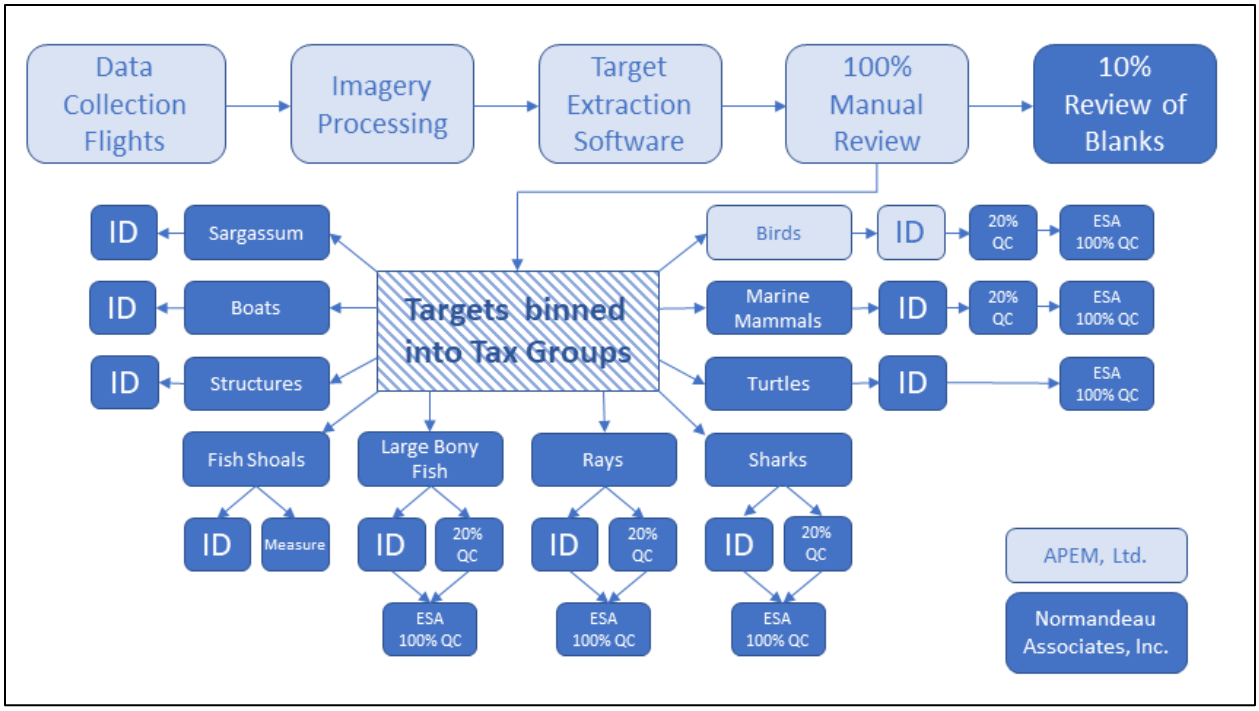


Figure 2. Data flow and quality control.

2.4 Weather Associations

While detailed weather data were collected during the surveys, an attempt to relate species composition and abundance to weather variables was not done. This was because surveys were scheduled so weather conditions would be favorable for aerial surveys to identify marine fauna: a cloud base >426.7 m (>1,400 ft), visibility >5 km, wind speed <30 knots, and sea state ≤4 on the Douglas sea scale (wind sea). Requiring these conditions for each survey reduces the weather variability among surveys, so we lack variation in weather conditions to relate to species composition, abundance, and distribution.

2.5 Bird Flight Height Calculations

APEM created a custom avian flight height calculator (FHC) for flying targets recorded in aerial digital surveys. The FHC was developed in-house aided by an Imperial College mathematician to estimate bird flight heights by using trigonometry and more complex mathematics.

Using the program to calculate flight height depends on the size of the bird species and the size of the bird relative to the image. The basic premise is that the higher the bird is flying, the greater the proportion of its reference body length will be in the image. The program uses the GPS height of the aircraft and analyst bird measurements from the imagery to estimate the flight height for each flying bird. It is not possible to estimate flight heights for birds that are not identified to species or are diving or turning sharply, as these individuals are not fully stretched out, so the measured lengths are unlikely to be comparable to the reference length of the relevant species.

Besides the GPS height of the aircraft, other important variables used in the FHC include camera specifications (business confidential) and species reference lengths from literature. These are combined to provide an estimated error for each species and each survey. For the FHC to estimate flight heights, the minimum and maximum expected body length of each species must be known, this is called the bird reference length. A review of literature determined sources that could help account for variability in body lengths and be used in the FHC (Table 2). Bird reference lengths were produced by extracting the minimum and maximum body length from four sources for each expected avian species. The four sources used were the Collins Bird Guide (Svensson et al. 2010), The Sibley Guide to Birds (Sibley 2001), The Cornell Lab (Cornell University 2020), and the British Trust for Ornithology (BTO 2020).

The comparison of the body length values from one data source against four other data sources results in a positive or negative value based on the estimated difference in the mean. A negative value could suggest overestimated flight height, and a positive value could suggest underestimation of flight height.

Table 2. Comparison of Mean Bird Body Reference Lengths Used to Estimate Flight Heights for Bird Species Found in Reported Surveys

Group	Common Name	Mean Body Reference Lengths		Difference
		One Source	Four Sources	
Phalarope	Red Phalarope	21.59	21.20	-0.39
Skua	Pomarine Jaeger	46.00	41.12	-4.88
Auk	Dovekie	20.96	19.99	-0.97
	Razorbill	43.18	41.17	-2.01
Gull	Black-legged Kittiwake	43.18	40.17	-3.01
	Bonaparte's Gull	34.29	33.36	-0.93
	Laughing Gull	41.91	40.23	-1.68
	Herring Gull	63.50	61.00	-2.5
	Iceland Gull	55.88	55.72	-0.16
	Lesser Black-backed Gull	53.34	55.34	2.00
	Great Black-backed Gull	76.20	68.25	-7.95
Tern	Common Tern	30.48	33.50	3.02
	Arctic Tern	30.48	33.62	3.14
Sterna Tern	Forster's Tern	33.02	34.13	1.11
Loon	Red-throated Loon	63.50	62.38	-1.13
	Common Loon	81.28	75.93	-5.35
Fulmar	Northern Fulmar	45.72	46.43	0.71
Shearwater	Sooty Shearwater	44.45	44.73	0.28
	Manx Shearwater	34.29	37.93	3.64
Gannet	Northern Gannet	93.98	94.31	0.33

3 Results

3.1 Data Collection

Table 3 lists the data collected during all surveys. All surveys were completed in a single mobilization in a single day (Table 1).

No daily survey protocols were exceeded; survey protocol for sea state was to avoid a sea state of ≥4 on the Douglas sea scale (wind sea) and protocol for wind speed was to avoid wind speeds of >30 knots ([34.5 mph], Table 4).

Table 3. Data Collected During Each Survey

Survey	Size (km²)	# Images	Image Area (km²)	% Area Imaged	Blank Images			
					# Blank	% Blank	# QC'd	% QC'd
May 2022	754.18	9,250	78.14	10.36	9,141	98.82	915	10.01
Sep 2022	754.18	9,255	76.28	10.11	9,196	99.36	921	10.02
Oct 2022	754.18	9,277	76.28	10.11	9,212	99.30	924	10.03
Nov 2022	754.18	9,255	76.28	10.11	9,092	98.24	910	10.01
Dec 2022	754.18	9,210	76.28	10.11	8,803	95.58	881	10.01
Jan 2023	754.18	9,115	77.81	10.32	8,901	97.65	891	10.01
Feb 2023	754.18	9,253	78.22	10.37	9,164	99.04	917	10.01
Mar 2023	754.18	9,250	78.22	10.37	9,068	98.03	907	10.00
Apr 2023	754.18	9,286	78.48	10.41	9,132	98.34	914	10.01
May 2023	754.18	9,250	78.14	10.36	9,081	98.17	909	10.01

Table 4. Minimum and Maximum Weather Variable Measurements During Surveys

Survey	Visibility (km)		Sea State (0–4)		Glint (%)		Turbidity (0–3)		Precipitation (mins)		Cloud (%)		Outside Air Temp (°C)		Wind Speed (kts)	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
May 2022	10+	10+	2	2	0	25	1	1	0	0	0	10	18	20	10	15
Sep 2022	10+	10+	1	1	0	15	0	0	0	0	0	10	19	19	23	23
Oct 2022	10	10	1	1	1	5	0	0	0	0	0	0	8	9	20	20
Nov 2022	10	10	1	1	0	5	1	2	0	0	0	10	11	11	8	10
Dec 2022	10	10	1	1	0	0	0	0	0	0	0	0	3	3	8	10
Jan 2023	6	10	3	3	0	0	3	3	0	0	70	100	1	6	17	17
Feb 2023	10	10	1	1	0	0	0	0	0	0	15	20	-4	-4	13	13
Mar 2023	10	10	2	2	0	0	0	0	0	0	0	5	5	5	15	15
Apr 2023	10	10	1	1	0	0	1	1	0	0	5	10	13	13	14	14
May 2023	10	10	2	2	0	10	1	1	0	0	95	100	52	52	23	23

3.2 Target Extraction and QC

During blank review of the May 2022 survey, 7 of the 915 images that underwent QC were determined to have targets missed in the initial target extraction (Table 5). The overall quality

rate of the initial extraction was 99.23%, which is well within the QC criteria established for the project (Table 5).

For the September 2022 survey, 1 of the 921 images that underwent QC was determined to have targets missed in the initial target extraction (Table 5). The overall quality rate of the initial extraction was 99.89%, well within the QC criteria established for the project (Table 5).

During the October 2022 survey, 2 of the 924 images that underwent QC were determined to have targets missed in the initial target extraction (Table 5). The overall quality rate of the initial extraction was 99.78%, well within the QC criteria established for the project (Table 5).

In November 2022, 5 of the 910 images that underwent QC were determined to have targets missed in the initial target extraction (Table 5). The overall quality rate of the initial extraction was 99.45%, well within the QC criteria established for the project (Table 5).

During blank review of the December 2022 survey, 1 of the 881 images that underwent QC was determined to have targets missed in the initial target extraction (Table 5). The overall quality rate of the initial extraction was 99.89%, well within the QC criteria established for the project (Table 5).

For the January 2023 survey, none of the 891 images that underwent QC were determined to have targets missed in the initial target extraction (Table 5). The overall quality rate of the initial extraction was 100.00% (Table 5).

During the February 2023 survey, 1 of the 917 images that underwent QC was determined to have targets missed in the initial target extraction (Table 5). The overall quality rate of the initial extraction was 99.89%, well within the QC criteria established for the project (Table 5).

In March 2023, 1 of the 907 images that underwent QC was determined to have targets missed in the initial target extraction (Table 5). The overall quality rate of the initial extraction was 99.89%, well within the QC criteria established for the project (Table 5).

During blank review of the April 2023 survey, 3 of the 914 images that underwent QC were determined to have targets missed in the initial target extraction (Table 5). The overall quality rate of the initial extraction was 99.67%, well within the QC criteria established for the project (Table 5).

For the May 2023 survey, 4 of the 909 images that underwent QC were determined to have targets missed in the initial target extraction (Table 5). The overall quality rate of the initial extraction was 99.56%, well within the QC criteria established for the project (Table 5).

Table 5. Quality Control Results for Blank Images for Each Survey

Survey	# Images for QC	# Images QC'd as Blank	# Images QC'd Not Blank	% Agreement Reached
May 2022	915	908	7	99.23
Sep 2022	921	920	1	99.89
Oct 2022	924	922	2	99.78
Nov 2022	910	905	5	99.45
Dec 2022	881	880	1	99.89
Jan 2023	891	891	–	100.00
Feb 2023	917	916	1	99.89
Mar 2023	907	906	1	99.89
Apr 2023	914	911	3	99.67
May 2023	909	905	4	99.56

Animals Found During QC by Taxonomic Group

The numbers of individuals within each taxonomic group found during the QC process for each survey are listed in Table 6 and summarized below:

- **May 2022**: Of the 7 images reviewed, 4 large bony fishes, 2 birds, and 1 ray were found (Table 6).
- **September 2022**: 1 turtle was found (Table 6).
- **October 2022**: 1 turtle and 1 large bony fish were found (Table 6).
- **November 2022**: Of the 5 images reviewed, 2 birds, 2 large bony fishes, and 1 turtle were found (Table 6).
- **December 2022**: 1 bird was found (Table 6).
- **January 2023**: No animals were found (Table 6).
- **February 2023**: 1 bird was found (Table 6).
- **March 2023**: 1 bird was found (Table 6).
- **April 2023**: 2 birds and 1 turtle were found (Table 6).
- **May 2023**: Within the 8 images reviewed, 2 birds (same image), 4 marine mammals (pod of dolphins), and 2 large bony fishes were found (Table 6).

Over all surveys, 29 targets were found within 25 images with most containing birds (n=11; 38%), followed by large bony fishes (n=9; 31%), turtles (n=4; 14%), marine mammals (n=4; 14%), and rays (n=1; 3%). There were no sharks found (Table 6).

Table 6. Number of Individuals within Reported Taxonomic Groups Found During Target Extraction QC Process for Each Survey

Survey	Taxonomic Group						Total
	Avian	Marine Mammals	Turtles	Sharks	Rays	Large Bony fishes	
May 2022	2	–	–	–	1	4	7
Sep 2022	–	–	1	–	–	–	1
Oct 2022	–	–	1	–	–	1	2
Nov 2022	2	–	1	–	–	2	5
Dec 2022	1	–	–	–	–	–	1
Jan 2023	–	–	–	–	–	–	–
Feb 2023	1	–	–	–	–	–	1
Mar 2023	1	–	–	–	–	–	1
Apr 2023	2	–	1	–	–	–	3
May 2023	2	4	–	–	–	2	8
TOTAL	**11**	**4**	**4**	**–**	**1**	**9**	**29**

Animals Found During Image Review by Taxonomic Group

The number of individuals found during target extraction are presented by taxonomic group for each survey in Table 7. Across all surveys, 2,784 animals were sent to taxonomic experts for identification including 2,569 birds (92%), 61 marine mammals (2%), 46 turtles (<2%), 14 sharks (<1%), 2 rays (<1%), and 92 large bony fishes (3%) (Table 7). A list of all species found during the surveys is provided in Appendix A.

During the May 2022 survey, 122 targets were identified including 106 birds (87%) followed by 8 large bony fishes (7%), 5 sharks (4%), and 3 marine mammals (2%) (Table 7). No turtles or rays were found during the May 2022 survey (Table 7).

For the September 2022 survey, 89 targets were identified including 60 large bony fishes (67%) followed by 19 turtles (21%), 6 sharks (7%), 2 rays (2%), and 2 birds (2%) (Table 7). No marine mammals were found (Table 7).

Of the 21 targets identified during the October 2022 survey, most were turtles (n=17; 81%) followed by large bony fishes (n=2; 10%), birds (n=1; 5%), and sharks (n=1; 5%) (Table 7). No marine mammals or rays were found (Table 7).

During the November 2022 survey, 566 targets were identified including 544 birds (96%) followed by 15 large bony fishes (3%), and 7 turtles (4%) (Table 7). No marine mammals, sharks, or rays were found (Table 7).

Of the 736 targets identified during the December 2022 survey, most were birds (n=734; 99%) followed by 1 large bony fish (<1%) and 1 turtle (<1%) (Table 7). There were no marine mammals, sharks, or rays found (Table 7).

For the January 2023 survey, 301 targets were identified, most of which were birds (n=289; 96%) followed by 12 marine mammals (n=12; 4%). There were no turtles, sharks, rays, or large bony fishes found (Table 7).

During the February 2023 survey, 129 targets were identified including 111 birds (86%) followed by 18 marine mammals (14%) (Table 7). No turtles, sharks, rays, or large boney fishes were found (Table 7).

For the March 2023 survey, 375 targets were identified including 364 birds (97%), followed by 6 large bony fishes (2%), 3 marine mammals (<1%), and 2 sharks (<1%) (Table 7). No turtles or rays were found (Table 7).

Of the 185 targets identified during the April 2023 survey, most were birds (n=174; 94%) followed by marine mammals (n=11; 6%) (Table 7). No turtles, sharks, rays, or large bony fishes were found (Table 7).

During the May 2023 survey, 260 targets were identified including 244 birds (94%) followed by 14 marine mammals (5%) and 2 turtles (<1%) (Table 7). No sharks, rays, or large bony fishes were found (Table 7).

Table 7. Number of Individuals within Reported Taxonomic Groups Found During Target Extraction Process and Sent for Identification for Each Survey

Survey	Taxonomic Group						Total
	Avian	Marine Mammals	Turtles	Sharks	Rays	Large Bony Fishes	
May 2022	106	3	–	5	–	8	122
Sep 2022	2	–	19	6	2	60	89
Oct 2022	1	–	17	1	–	2	21
Nov 2022	544	–	7	–	–	15	566
Dec 2022	734	–	1	–	–	1	736
Jan 2023	289	12	–	–	–	–	301
Feb 2023	111	18	–	–	–	–	129
Mar 2023	364	3	–	2	–	6	375
Apr 2023	174	11	–	–	–	–	185
May 2023	244	14	2	–	–	–	260
TOTAL	**2,569**	**61**	**46**	**14**	**2**	**92**	**2,784**

3.3 Identification Success

The total number of individuals (by taxonomic group), the number of images sent for QC, and the percent agreement reached for each survey are shown in Table 8. Overall, 2,784 animals were sent for identification with 591 (21%) going through QC review (Table 8). All identifications reached and exceeded their targeted percent agreement with an overall 100% agreement (Table 8). A summary per survey is presented below:

- **May 2022**: 122 targets were identified and sent to taxonomic experts for identification. QC review was performed on 26 individuals (21%) with 100% agreement (Table 8).
- **September 2022**: 89 targets were identified and sent to taxonomic experts for identification. QC review was performed on 26 individuals (29%) with 100% agreement (Table 8).
- **October 2022**: 21 targets were identified and sent to taxonomic experts for identification. QC review was performed on 18 individuals (86%) with 100% agreement (Table 8).
- **November 2022**: 566 targets were identified and sent to taxonomic experts for identification. QC review was performed on 117 individuals (21%) with 100% agreement (Table 8).
- **December 2022**: 736 targets were identified and sent to taxonomic experts for identification. QC review was performed on 148 individuals (20%) with 100% agreement (Table 8).
- **January 2023**: 301 targets were identified and sent to taxonomic experts for identification. QC review was performed on 60 individuals (20%) with 100% agreement (Table 8).
- **February 2023**: 129 targets were identified and sent to taxonomic experts for identification. QC review was performed on 27 individuals (21%) with 100% agreement (Table 8).
- **March 2023**: 375 targets were identified and sent to taxonomic experts for identification. QC review was performed on 78 individuals (21%) with 99% agreement (Table 8).
- **April 2023**: 185 targets were identified and sent to taxonomic experts for identification. QC review was performed on 37 individuals (20%) with 100% agreement (Table 8).
- **May 2023**: 260 targets were identified and sent to taxonomic experts for identification. QC review was performed on 54 individuals (21%) with 98% agreement (Table 8).

The number of threatened and endangered individuals within each taxonomic group and percent identification agreement for each survey are shown in Table 9. Accuracy assessments show 100% agreement when comparing the initial identification and the QC identification by type (e.g., all targets first identified as birds were QC'd as birds). At the species group level there was 100% agreement between the initial identification and the QC'd identification (Table 9).

Table 8. Number of Individuals by Taxonomic Group, Number of Images QC'd, and Percent Agreement Reached for Each Survey

Survey	Order	No. Individuals	No. Individuals for QC	% Agreement
May 2022	Birds	106	21	100
	Marine Mammals	3	1	–
	Turtles	–	–	–
	Sharks	5	–	–
	Rays	–	–	–
	Large Bony Fishes	8	4	100
	TOTAL	**122**	**26**	**100**

Survey	Order	No. Individuals	No. Individuals for QC	% Agreement
Sep 2022	Birds	2	–	–
	Marine Mammals	–	–	–
	Turtles	19	19	100
	Sharks	6	5	100
	Rays	2	2	100
	Large Bony Fishes	60	–	–
	TOTAL	**89**	**26**	**100**
Oct 2022	Birds	1	–	–
	Marine Mammals	–	–	–
	Turtles	17	17	100
	Sharks	1	1	100
	Rays	–	–	–
	Large Bony Fishes	2	–	–
	TOTAL	**21**	**18**	**100**
Nov 2022	Birds	544	108	100
	Marine Mammals	–	–	–
	Turtles	7	7	100
	Sharks	–	–	–
	Rays	–	–	–
	Large Bony Fishes	15	2	100
	TOTAL	**566**	**117**	**100**
Dec 2022	Birds	734	147	100
	Marine Mammals	–	–	–
	Turtles	1	1	100
	Sharks	–	–	–
	Rays	–	–	–
	Large Bony Fishes	1	–	–
	TOTAL	**736**	**148**	**100**
Jan 2023	Birds	289	58	100
	Marine Mammals	12	2	100
	Turtles	–	–	–
	Sharks	–	–	–
	Rays	–	–	–
	Large Bony Fishes	–	–	–
	TOTAL	**301**	**60**	**100**
Feb 2023	Birds	111	22	100
	Marine Mammals	18	5	100
	Turtles	–	–	–
	Sharks	–	–	–
	Rays	–	–	–
	Large Bony Fishes	–	–	–
	TOTAL	**129**	**27**	**100**
Mar 2023	Birds	364	72	97
	Marine Mammals	3	1	100
	Turtles	–	–	–
	Sharks	2	–	–
	Rays	–	–	–
	Large Bony Fishes	6	5	100
	TOTAL	**375**	**78**	**99**

Survey	Order	No. Individuals	No. Individuals for QC	% Agreement
Apr 2023	Birds	174	35	100
	Marine Mammals	11	2	100
	Turtles	–	–	–
	Sharks	–	–	–
	Rays	–	–	–
	Large Bony Fishes	–	–	–
	TOTAL	**185**	**37**	**100**
May 2023	Birds	244	49	98
	Marine Mammals	14	3	100
	Turtles	2	2	100
	Sharks	–	–	–
	Rays	–	–	–
	Large Bony Fishes	–	–	–
	TOTAL	**260**	**54**	**98**
ALL	Birds	2,569	512	99
	Marine Mammals	61	14	100
	Turtles	46	46	100
	Sharks	14	6	100
	Rays	2	2	100
	Large Bony Fishes	92	11	100
	TOTAL	**2,784**	**591**	**100**

Table 9. Number of Individuals of Threatened and Endangered Species by Taxonomic Group Reviewed and Percent Identification Agreement Reached for Each Survey

Survey	Taxonomic Group						TOTAL
	Birds	Marine Mammals	Turtles	Sharks	Rays	Large Bony Fishes	
May 2022	4	–	–	–	–	2	6
Sep 2022	–	–	19	5	2	–	26
Oct 2022	–	–	17	1	–	–	18
Nov 2022	–	–	7	–	–	1	8
Dec 2022	–	–	1	–	–	–	1
Jan 2023	–	–	–	–	–	–	—
Feb 2023	–	1	–	–	–	–	1
Mar 2023	–	–	–	–	–	5	5
Apr 2023	–	–	–	–	–	–	—
May 2023	–	–	2	–	–	–	2
ALL	**4**	**1**	**46**	**6**	**2**	**8**	**67**
% Agreement	**100**	**100**	**100**	**100**	**100**	**100**	**100**

3.4 Density and Relative Abundance

The density per km^2 and the percent relative abundance of each taxonomic group differed among surveys. Survey coverage bias was corrected by presenting densities per km^2 of area imaged and analyzed per survey. Density of individuals in each taxonomic group by survey is shown in Table 10 and Figure 3.

Density was greatest during December 2022 with 9.64 individuals/km^2 (27% of the total abundance for all surveys combined). Birds were the most frequent with 9.61 birds/km^2 (99.7%) followed by large bony fishes (0.01; 0.14%) and turtles (0.01; 0.14%). There were no marine mammals, sharks, or rays encountered (Table 10, Figure 3).

Density during November 2022 was the second highest of all surveys with 7.39 individuals/km^2 (21%). Birds were the most frequent with 7.11 birds/km^2 (96%) followed by large bony fishes (0.19; 2.7%) and turtles (0.09; 1.24%). There were no marine mammals, sharks, or rays encountered (Table 10, Figure 3).

The third highest density of individuals was during the March 2023 survey with 4.72 individuals/km^2 (13%). Birds were the most encountered group with 4.57 birds/km^2 (97.02) followed by large bony fishes (0.08; 1.6%), marine mammals (0.04; 0.81%), and sharks (0.03; 0.54%). There were no turtles, sharks, or rays encountered (Table 10, Figure 3).

Of the 3.87 individuals/km^2 (16% of all surveys combined) found during January 2023, birds (3.71 birds/km^2; 96%) were the most often encountered group followed by marine mammals (0.15; 4%). There were no turtles, sharks, rays, or large bony fishes encountered (Table 10, Figure 3).

Density during the May 2023 survey was 3.25 individuals/km^2 (9%) with birds being the most encountered group (3.06 birds/km^2; 94%) followed by marine mammals (0.17; 5.12%) and turtles (0.03; 0.79%). There were no sharks, rays, or large bony fishes encountered (Table 10, Figure 3).

During the April 2023 survey, 2.3 individuals/km^2 (6%) were encountered. The majority of this was birds (2.2 birds/km^2; 94%) followed by marine mammals with 0.14 mammals/km^2 (6%). There were no turtles, sharks, rays, or large bony fishes observed (Table 10, Figure 3).

The February 2023 survey was dominated by birds, which comprised 86% of (1.41 birds/km^2) of the 1.64 individuals per km^2 (5%) for the survey, followed by marine mammals (0.23; 14%). There were no turtles, sharks, rays, or large bony fishes encountered (Table 10, Figure 3).

Of the 1.56 individuals/km^2 (4.4%) found during May 2022, birds (1.36 birds/km^2; 86.9%) were the most encountered group followed by large bony fishes (0.10; 6.6%), sharks (0.06; 4.1%), and marine mammals (0.04; 2.5%). There were no turtles or rays encountered (Table 10, Figure 3).

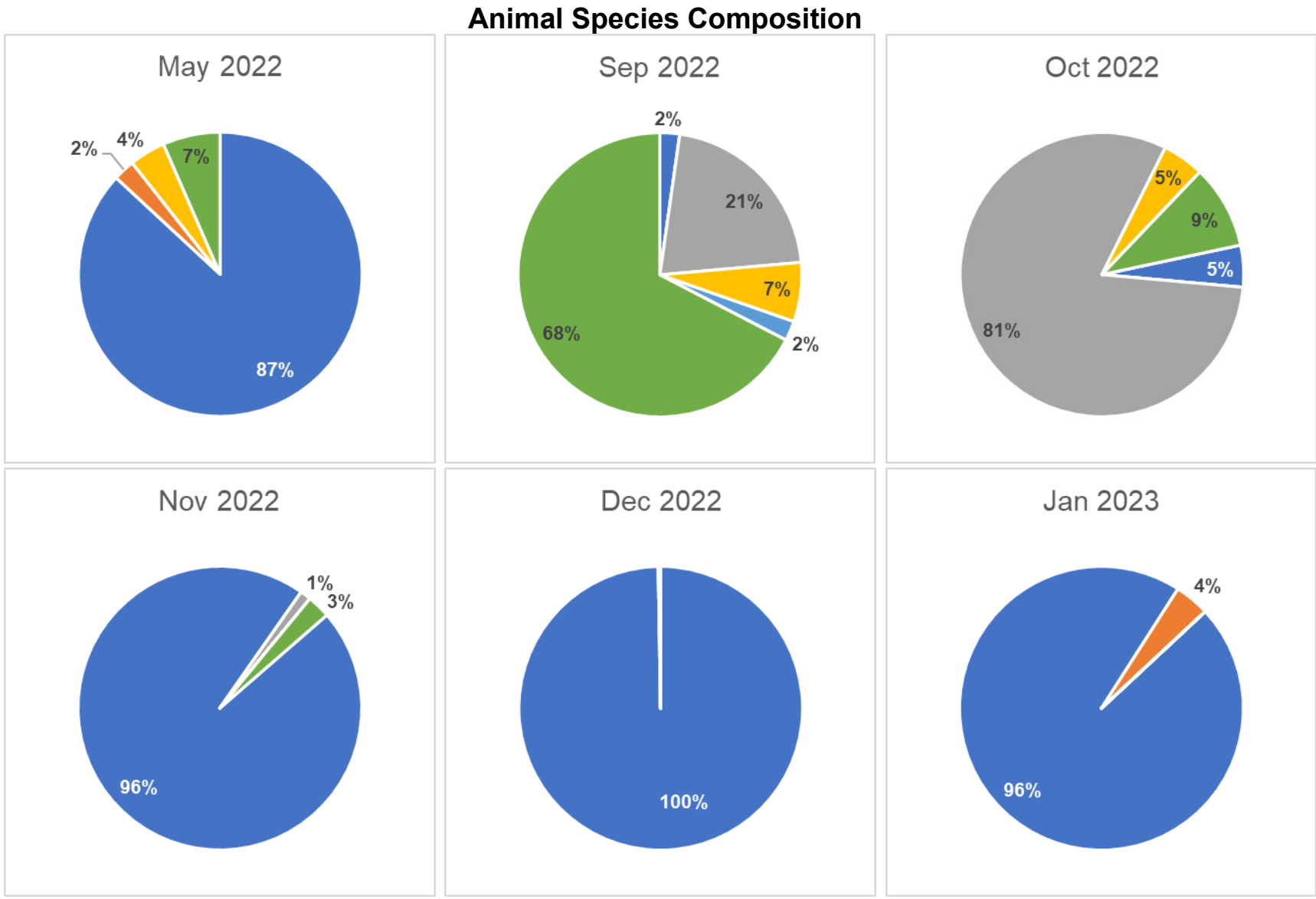
September 2022 had the second lowest total abundance of all surveys with 1.17 individuals/km^2 (3.3%). Large bony fishes (0.79 fishes/km^2; 67%) were the most encountered group followed by turtles (0.25; 21%), sharks (0.08; 6.7%), rays (0.03; 2.3%), and birds (0.03; 2.5%). There were no marine mammals encountered (Table 10, Figure 3).

October 2022 had the lowest total abundance with 0.28 individuals per km^2 (0.75%) of all surveys. Of the 0.28 individuals/km^2, turtles (0.22 turtles/km^2; 81%) were the most encountered group followed by large bony fishes (0.03; 9.5%), birds (0.01; 4.8%), and sharks (0.01; 4.8%). There were no marine mammals or rays encountered (Table 10, Figure 3).

Overall, birds represented the greatest number of occurrences with 92% (33.07 individuals/km^2) of the combined total (Table 10, Figure 3). Large bony fishes were found 3.2% of the time followed by marine mammals (2.17%), turtles (1.7%), sharks (0.51%), and rays (<0.1%) (Table 10, Figure 3).

Table 10. Density (per km^2) and Percent of Total of Individuals (Relative Abundance) in Taxonomic Group by Survey

	Taxonomic Group												
Survey	Avian	%	Mammal	%	Turtle	%	Shark	%	Ray	%	Large Bony Fishes	%	Total
May 2022	1.3565	86.89	0.0384	2.46	–	–	0.0640	4.10	–	–	0.1024	6.56	1.5613
Sep 2022	0.0262	2.25	–	–	0.2491	21.35	0.0787	6.74	0.0262	2.25	0.7866	67.42	1.1668
Oct 2022	0.0131	4.76	–	–	0.2229	80.95	0.0131	4.76	–	–	0.0262	9.52	0.2753
Nov 2022	7.1316	96.11	–	–	0.0918	1.24	–	–	–	–	0.1966	2.65	7.4200
Dec 2022	9.6224	99.73	–	–	0.0131	0.14	–	–	–	–	0.0131	0.14	9.6486
Jan 2023	3.7142	96.01	0.1542	3.99	–	–	–	–	–	–	–	–	3.8684
Feb 2023	1.4191	86.05	0.2301	13.95	–	–	–	–	–	–	–	–	1.6492
Mar 2023	4.6535	97.07	0.0384	0.80	–	–	0.0256	0.53	–	–	0.0767	1.60	4.7942
Apr 2023	2.2171	94.05	0.1402	5.95	–	–	–	–	–	–	–	–	2.3573
May 2023	3.1226	93.85	0.1792	5.38	0.0256	0.77	–	–	–	–	–	–	3.3274
TOTAL	**33.2763**	**92.28**	**0.7805**	**2.19**	**0.6025**	**1.65**	**0.1814**	**0.50**	**0.0262**	**0.07**	**1.2016**	**3.30**	**36.0685**


Animal Species Composition
May 2022
2%
4%
7%
87%
Sep 2022
2%
21%
7%
2%
68%
Oct 2022
5%
9%
5%
81%
Nov 2022
1%
3%
96%
Dec 2022
100%
Jan 2023
4%
96%

(continued)

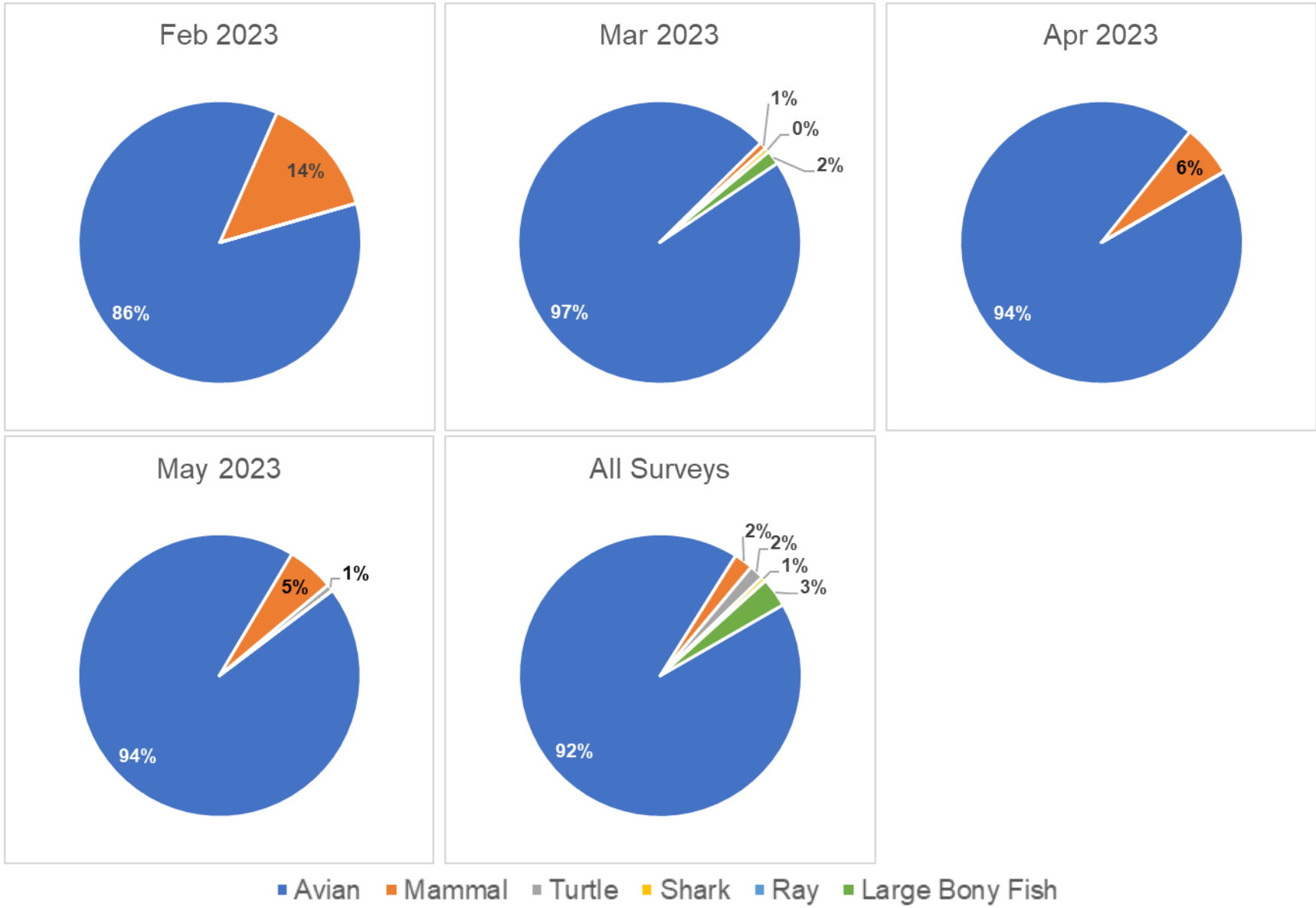


Figure 3. Percent composition of taxonomic groups found during each survey.

3.5 Birds

Species Identification

Over all surveys, 2,569 birds were identified in imagery comprising 21 species; at a minimum all birds were classified to species group (Appendix B). Avian species-level identifications varied by group depending on size and coloration. The largest and most distinct bird species found naturally had higher identification rates, and this included phalaropes with 100% of these identified to species (n=2), skuas (n=1), fulmars (n=5), and gannets (n=69) (Table 11). Of the remaining species, gulls (n=1,647; 99% identified to species), loons (n=582; 99% identified to species), and auks (n=214; 76% identified to species) had high identification success rates (Table 11).

The *Sterna* tern group has difficult-to-distinguish species, and of the 32 individuals encountered 34% were ascribed to species (n=11). No ducks (scoters) (n=2), shorebirds (n=4), or storm-petrels (n=3) were identified to species; however, only small numbers were seen (Table 11). There were 4 unidentified avian species encountered (Table 11). Raw counts of avian species identified in each survey are presented in Appendix B.

Table 11. 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
Duck (excluding Scoters)	–	–	–	–
Duck (Scoters)	2	–	2	–
Shorebird	4	–	4	–
Phalarope	2	2	–	100
Skua	1	1	–	100
Auk	214	162	52	76
Gull	1,647	1,631	16	99
Sterna Tern	32	11	21	34
Loon	582	574	8	99
Storm-petrel	3	–	3	–
Fulmar	5	5	–	100
Shearwater	4	2	2	50
Gannet	69	69	–	100
Unid. Avian	4	–	4	–

Species Composition and Density

Species composition and abundance was varied throughout the surveys, highlighting the seasonal nature of avian activity. The May 2022 and May 2023 surveys were the most diverse with 7 species groups. Both surveys were dominated by loons (64% and 57%, respectively). During May 2022 loons were followed by *Sterna* terns (15%) and gulls (10%) with gannets (3%), ducks (2%), storm-petrels (1%), shearwaters (1%), and unidentified avian species (4%) also found (Table 12, Figure 4). After loons, the May 2023 survey was dominated by gulls (32%) and

Sterna terns (7%). Other species groups included shorebirds (2%), auks (1%), shearwaters (1%), and skua (<1%) (Table 12, Figure 4). May 2022 and May 2023 were the only survey periods when *Sterna* terns were found. Ducks were only encountered during May 2022, and May 2023 was the only survey period when shorebirds and skuas were encountered (Table 12, Figure 4)

The September 2022 and October 2022 surveys were the least diverse among all surveys with only 1 species group encountered. The September 2022 survey was dominated by storm-petrels (100%). No other species groups were encountered (Table 12, Figure 4). During the October 2022 survey, gulls accounted for 100% of the sample. No other species groups were encountered (Table 12, Figure 4).

During the November 2022 survey, gulls (96%) were most dominant and loons (4%) and gannets (<1%) were also found (Table 12, Figure 4).

The December 2022 survey was dominated by gulls (90%) with loons (9%), phalaropes (<1%), and shearwaters (<1%) also found (Table 12, Figure 4). This is the only survey period when phalaropes were found.

The second most diverse survey period was January 2023 with 5 species groups encountered (Table 12, Figure 4). Auks (38%) and gulls (39%) were the most dominant followed by loons (15%), gannets (6%), and fulmars (2%) (Table 12, Figure 4). This is the only survey period when fulmars were found.

During the February 2023 survey, 4 species groups were encountered and was dominated by auks (46%) followed by gulls (26%), loons (25%), and gannets (5%) (Table 12, Figure 4).

The March 2023 survey had the same 4 species groups encountered during the February 2023 survey but with different relative abundance. This survey was dominated by gulls (46%) followed by loons (30%), auks (14%), and gannets (10%) (Table 12, Figure 4).

Three species groups were encountered during the April 2023 survey (Table 12, Figure 4). Loons were the most encountered species group (62%) followed by gulls (36%) and gannets (2%) (Table 12, Figure 4).

Overall, the dominant species groups were gulls (64%), which were encountered in 9 of the 10 survey periods, and loons (23%), which were encountered in 8 surveys, followed by auks (8%), gannets (3%), and *Sterna* terns (1%). All other species groups had <1% in relative abundance (Table 12, Figure 4).

Table 12. Percent Relative Abundance of Each Avian Species Group by Survey

Species Group	Relative Abundance (%)										Total
	May 2022	Sep 2022	Oct 2022	Nov 2022	Dec 2022	Jan 2023	Feb 2023	Mar 2023	Apr 2023	May 2023	
Duck	1.89	–	–	–	–	–	–	–	–	–	0.08
Shorebird	–	–	–	–	–	–	–	–	–	1.64	0.16
Phalarope	–	–	–	–	0.27	–	–	–	–	–	0.08
Skua	–	–	–	–	–	–	–	–	–	0.41	0.04
Auk	–	–	–	–	–	38.06	45.05	14.01	–	1.23	8.33
Gull	10.38	–	100.00	95.77	90.33	38.75	25.23	46.70	35.63	32.38	64.11
Sterna Tern	15.09	–	–	–	–	–	–	–	–	6.56	1.25
Loon	64.15	–	–	3.49	9.26	15.22	24.23	29.40	62.64	56.97	22.65
Storm-petrel	0.94	100.00	–	–	–	–	–	–	–	–	0.12
Fulmar	–	–	–	–	–	1.73	–	–	–	–	0.19
Shearwater	0.94	–	–	–	0.14	–	–	–	–	0.82	0.16
Gannet	2.83	–	–	0.74	–	6.23	4.50	9.89	1.72	–	2.69
Unid. Avian	3.77	–	–	–	–	–	–	–	–	–	0.16
Totals	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**

(continued)

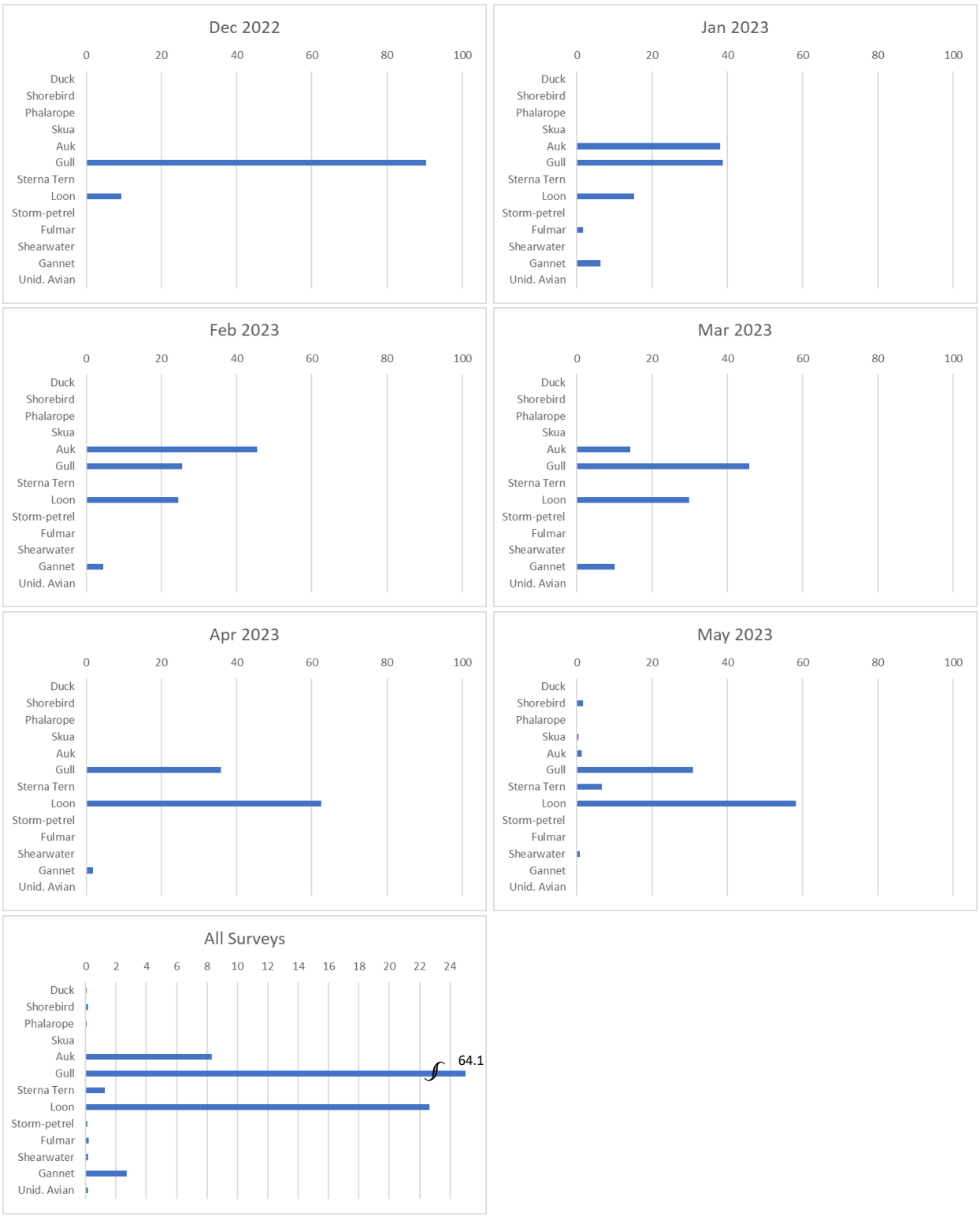


Figure 4. Density (per km^2) of avian species groups by survey.

The density and percent relative abundance of each avian species group is presented in Table 13 for each survey. Across all surveys, gulls (21.28 birds/km^2; 64.35%) was the most encountered species group followed by loons (7.44 birds/km^2; 22.5%) and auks (2.74 birds/km^2; 8.3%). Gulls and *Sterna* terns were the most diverse species groups with 7 and 4 species identified, respectively, while there were only 2 species identified for auks (with 2 species blends), loons, and shearwaters. All other species groups were comprised of a single species or species unknown (Table 13, Figure 5).

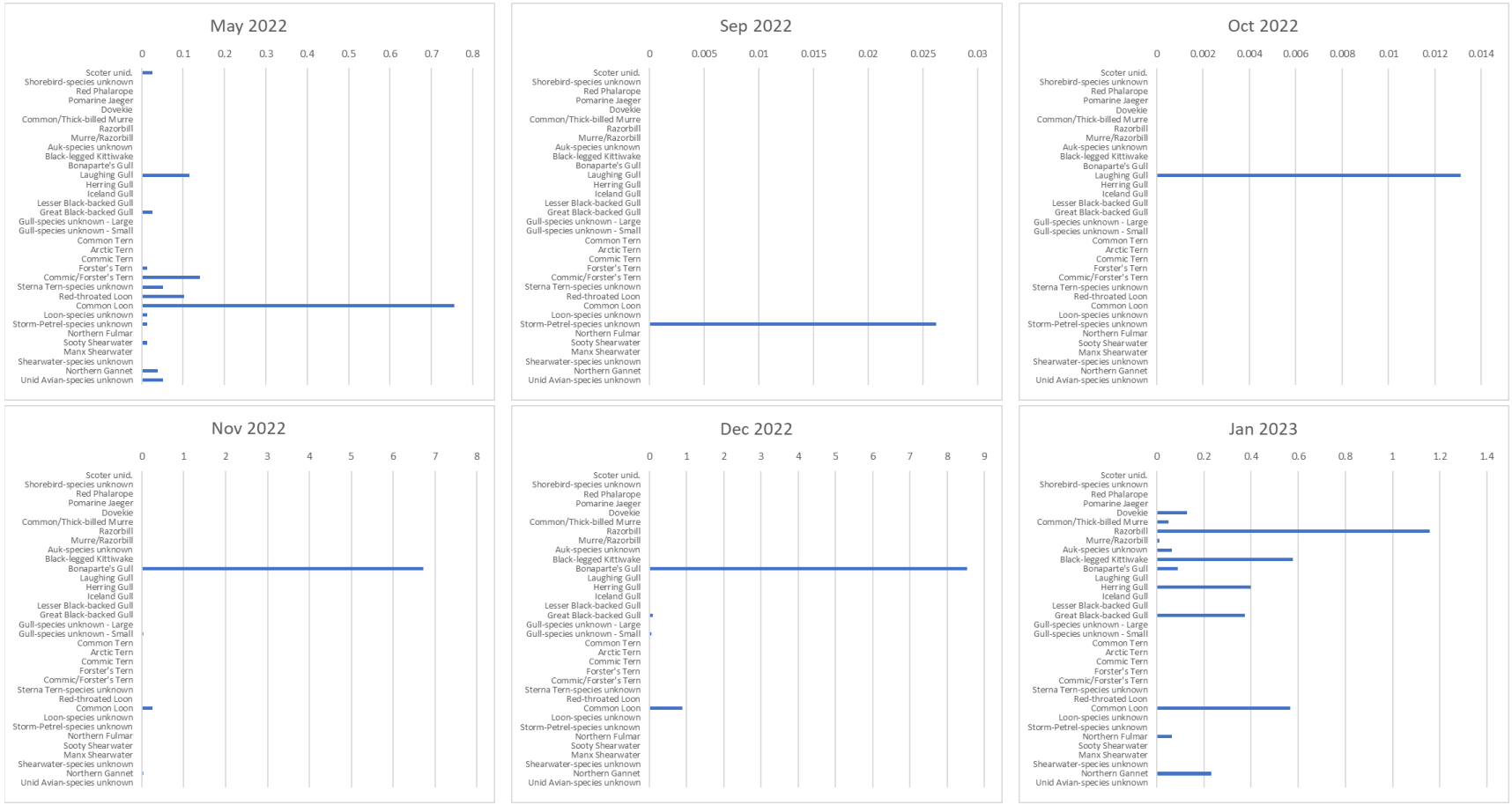
Densities of gulls were highest in December 2022 (8.6786 birds/km^2; 41% of all surveys) and November 2022 (6.817 birds/km^2; 32%) with both survey periods dominated by Bonaparte's gull (*Chroicocephalus philadelphia*) (Table 13, Figure 5; Table 14, Figure 6). *Sterna* terns were only encountered during the May 2022 (0.2048 birds/km^2; 50%) and May 2023 (0.2048 birds/km^2; 50%) surveys, but the species encountered were different in each survey. Auk species were seen during the January, February, March, and May 2023 surveys with decreasing diversity. Loons were observed in all surveys except September and October 2022 with the greatest diversity occurring in May 2022, March 2023, April 2023, and May 2023. A single different Shearwater species was encountered in each of the May 2022 (sooty shearwater), December 2022 (Manx shearwater), and May 2023 (shearwater-species unknown) surveys (Table 13, Figure 5).

Loon densities were highest in May 2023 (1.7789 birds/km^2; 24%), April 2023 (1.3761 birds/km^2; 19%), and March 2023 (1.3679 birds/km^2; 18%). The lowest density occurred in November 2022 (0.2491 birds/km^2; 3%). All months with loon observations were dominated by common loon (*Gavia* immer) except March 2023 and May 2023, which was dominated by red-throated loon (*Gavia stellata*). Common loon was the only species encountered during November 2022, December 2022, January 2023, and February 2023. No loons were observed during September 2022 or October 2022 (Table 14; Figure 6).

Table 13. Density (D [per km^2]) and Percent of Total Avian Species Identified in All Surveys

	Density (per km^2)																				
	May 22		Sep 22		Oct 22		Nov 22		Dec 22		Jan 23		Feb 23		Mar 23		Apr 23		May 23		
Species Group	D	%	D	%	D	%	D	%	D	%	D	%	D	%	D	%	D	%	D	%	Total
Duck	**0.0256**	**100.00**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**0.0256**
Scoter unid.	0.0256	100.00	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.0256
Shorebird	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**0.0512**	**100.00**	**0.0512**
species unknown	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.0512	100.00	0.0512
Phalarope	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**0.0262**	**100.00**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**0.0262**
Red Phalarope	–	–	–	–	–	–	–	–	0.0262	100.00	–	–	–	–	–	–	–	–	–	–	0.0262
Skua	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**0.0128**	**100.00**	**0.0128**
Pomarine Jaeger	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.0128	100.00	0.0128
Auk	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**1.4137**	**51.40**	**0.6392**	**23.36**	**0.6520**	**23.83**	**–**	**–**	**0.0384**	**1.40**	**2.7433**
Dovekie	–	–	–	–	–	–	–	–	–	–	0.1285	17.86	0.5881	82.14	–	–	–	–	–	–	0.7166
Common/Thick-billed Murre	–	–	–	–	–	–	–	–	–	–	0.0514	11.76	0.0511	11.76	0.3324	76.47	–	–	–	–	0.4349
Razorbill	–	–	–	–	–	–	–	–	–	–	1.1567	84.91	–	–	0.1662	12.26	–	–	0.0384	2.83	1.3613
Murre/Razorbill	–	–	–	–	–	–	–	–	–	–	0.0129	7.69	–	–	0.1534	92.31	–	–	–	–	0.1663
species unknown	–	–	–	–	–	–	–	–	–	–	0.0643	100.00	–	–	–	–	–	–	–	–	0.0643
Gull	**0.1408**	**0.67**	**–**	**–**	**0.0131**	**0.06**	**6.8301**	**31.63**	**8.6917**	**40.26**	**1.4394**	**6.80**	**0.3580**	**1.70**	**2.1734**	**10.32**	**0.7900**	**3.76**	**1.0110**	**4.80**	**21.4474**
Black-legged Kittiwake	–	–	–	–	–	–	–	–	–	–	0.5783	95.74	–	–	0.0256	4.26	–	–	–	–	0.6039
Bonaparte's Gull	–	–	–	–	–	–	6.7383	38.13	8.5475	48.37	0.0900	0.52	0.0128	0.07	2.0199	11.72	0.2039	1.19	–	–	17.6124
Laughing Gull	0.1152	34.62	–	–	0.0131	3.85	0.0262	7.69	–	–	–	–	–	–	–	–	0.0255	7.69	0.1536	46.15	0.3336
Herring Gull	–	–	–	–	–	–	–	–	–	–	0.3984	26.96	0.1662	11.30	0.0767	5.22	0.3950	26.96	0.4351	29.57	1.4714
Iceland Gull	–	–	–	–	–	–	–	–	–	–	–	–	0.0128	100.00	–	–	–	–	–	–	0.0128
Lesser Black-backed Gull	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.0128	4.35	0.0892	30.43	0.1920	65.22	0.2939
Great Black-backed Gull	0.0256	2.82	–	–	–	–	0.0262	2.82	0.0918	9.86	0.3727	40.85	0.1662	18.31	0.0256	2.82	0.0510	5.63	0.1536	16.90	0.9126
species unknown - Large	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.0255	25.00	0.0768	75.00	0.1023
species unknown - Small	–	–	–	–	–	–	0.0393	37.50	0.0524	50.00	–	–	–	–	0.0128	12.50	–	–	–	–	0.1046
***Sterna* Tern**	**0.2048**	**50.00**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**0.2048**	**50.00**	**0.4095**
Common Tern	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.0384	100.00	0.0384
Arctic Tern	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.0896	100.00	0.0896
Commic Tern	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.0768	100.00	0.0768

Species Group	Density (per km²)																				
	May 22		Sep 22		Oct 22		Nov 22		Dec 22		Jan 23		Feb 23		Mar 23		Apr 23		May 23		
	D	%	D	%	D	%	D	%	D	%	D	%	D	%	D	%	D	%	D	%	Total
Forster's Tern	0.0128	100.00	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.0128
Commic/Forster's Tern	0.1408	100.00	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.1408
species unknown	0.0512	100.00	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.0512
Loon	**0.8702**	**11.68**	**–**	**–**	**–**	**–**	**0.2491**	**3.26**	**0.8915**	**11.68**	**0.5655**	**7.56**	**0.3580**	**4.81**	**1.3679**	**18.38**	**1.3889**	**18.73**	**1.7789**	**23.88**	**7.4699**
Red-throated Loon	0.1024	8.99	–	–	–	–	–	–	–	–	–	–	0.0128	1.11	0.8054	70.00	0.2166	18.89	0.0128	1.11	1.1500
Common Loon	0.7551	12.19	–	–	–	–	0.2491	3.93	0.8915	14.05	0.5655	9.09	0.3452	5.58	0.5242	8.47	1.1340	18.22	1.7533	28.31	6.2177
species unknown	0.0128	12.50	–	–	–	–	–	–	–	–	–	–	–	–	0.0384	37.50	0.0382	37.50	0.0128	12.50	0.1022
Storm-petrel	**0.0128**	**33.33**	**0.0262**	**66.67**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**0.0390**
species unknown	0.0128	33.33	0.0262	66.67	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.0390
Fulmar	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**0.0643**	**100.00**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**0.0643**
Northern Fulmar	–	–	–	–	–	–	–	–	–	–	0.0643	100.00	–	–	–	–	–	–	–	–	0.0643
Shearwater	**0.0128**	**25.00**	**–**	**–**	**–**	**–**	**–**	**–**	**0.0131**	**25.00**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**0.0256**	**50.00**	**0.0515**
Sooty Shearwater	0.0128	100.00	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.0128
Manx Shearwater	–	–	–	–	–	–	–	–	0.0131	100.00	–	–	–	–	–	–	–	–	–	–	0.0131
species unknown	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.0256	100.00	0.0256
Gannet	**0.0384**	**4.35**	**–**	**–**	**–**	**–**	**0.0524**	**5.80**	**–**	**–**	**0.2313**	**26.09**	**0.0639**	**7.25**	**0.4602**	**52.17**	**0.0382**	**4.35**	**–**	**–**	**0.8846**
Northern Gannet	0.0384	4.35	–	–	–	–	0.0524	5.80	–	–	0.2313	26.09	0.0639	7.25	0.4602	52.17	0.0382	4.35	–	–	0.8846
Unid. Avian	**0.0512**	**100.00**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**0.0512**
species unknown	0.0512	100.00	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.0512
Total	**1.3565**	**4.13**	**0.0262**	**0.08**	**0.0131**	**0.04**	**7.1316**	**21.19**	**9.6224**	**28.59**	**3.7142**	**11.26**	**1.4191**	**4.31**	**4.6535**	**14.18**	**2.2171**	**6.78**	**3.1226**	**9.51**	**33.2764**


May 2022
0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8
Sep 2022
0 0.005 0.01 0.015 0.02 0.025 0.03
Oct 2022
0 0.002 0.004 0.006 0.008 0.01 0.012 0.014
Nov 2022
0 1 2 3 4 5 6 7 8
Dec 2022
0 1 2 3 4 5 6 7 8 9
Jan 2023
0 0.2 0.4 0.6 0.8 1 1.2 1.4
Scoter unid.
Shorebird-species unknown
Red Phalarope
Pomarine Jaeger
Dovekie
Common/Thick-billed Murre
Razorbill
Murre/Razorbill
Auk-species unknown
Black-legged Kittiwake
Bonaparte's Gull
Laughing Gull
Herring Gull
Iceland Gull
Lesser Black-backed Gull
Great Black-backed Gull
Gull-species unknown - Large
Gull-species unknown - Small
Common Tern
Arctic Tern
Commic Tern
Forster's Tern
Commic/Forster's Tern
Sterna Tern-species unknown
Red-throated Loon
Common Loon
Loon-species unknown
Storm-Petrel-species unknown
Northern Fulmar
Sooty Shearwater
Manx Shearwater
Shearwater-species unknown
Northern Gannet
Unid Avian-species unknown

(continued)

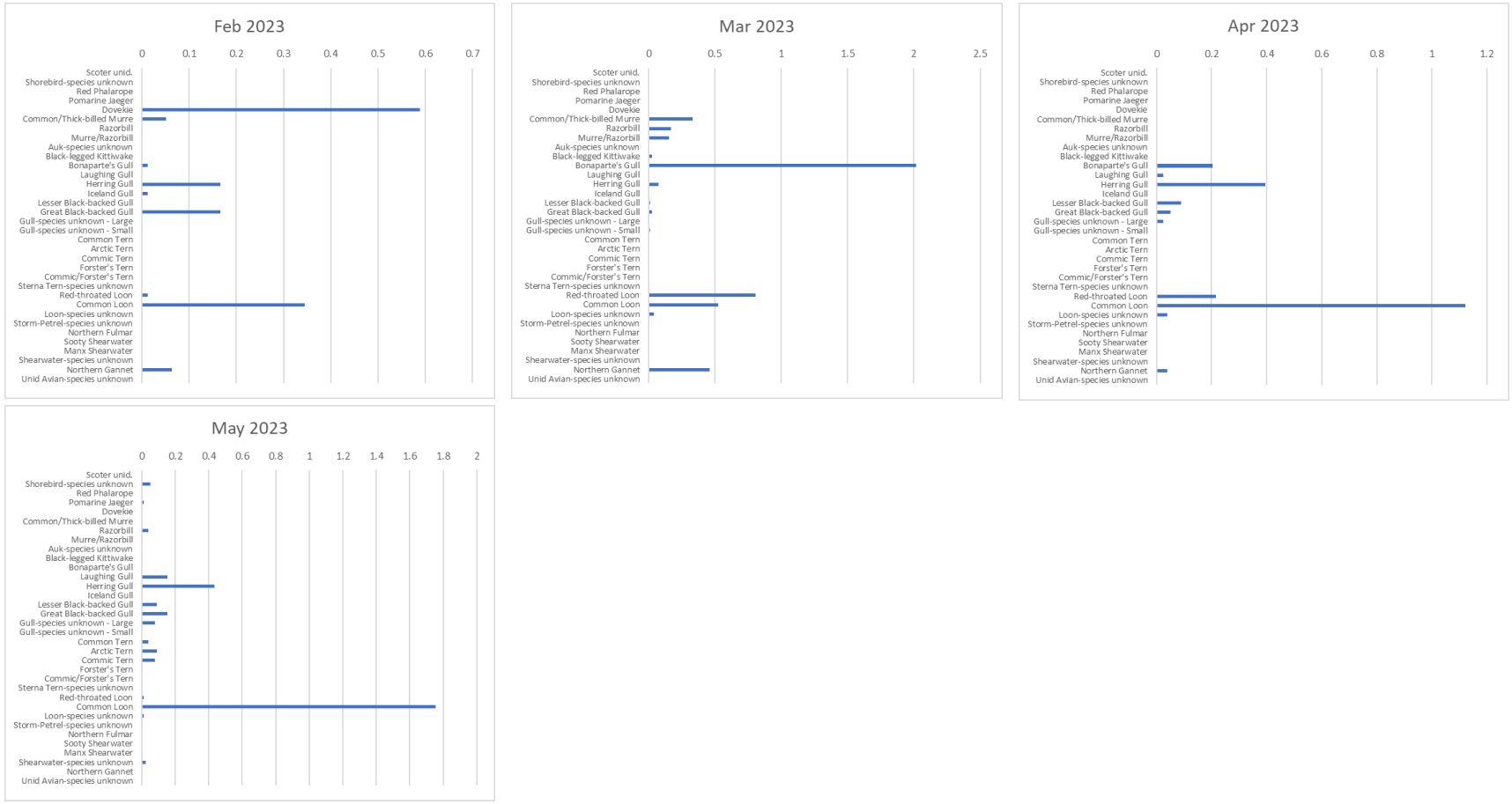


Figure 5. Density (per km^2) of avian species identified in the May 2022 through May 2023 surveys.

Table 14. Percent of Overall Total in Species Group Represented by Each Taxon
The pale blue rows represent the number of birds/km^2 and the white rows represent the percent of the total within that species group

Species	Abundance per km^2										Species Total
	May 22	Sep 22	Oct 22	Nov 22	Dec 22	Jan 23	Feb 23	Mar 23	Apr 23	May 23	
Duck	**0.0256**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**0.0256**
Scoter unid.	100	–	–	–	–	–	–	–	–	–	100
Shorebird	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**0.0512**	**0.0512**
species unknown	–	–	–	–	–	–	–	–	–	100	100
Phalarope	**–**	**–**	**–**	**–**	**0.0262**	**–**	**–**	**–**	**–**	**–**	**0.0262**
Red Phalarope	–	–	–	–	100	–	–	–	–	–	100
Skua	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**0.0128**	**0.0128**
Pomarine Jaeger	–	–	–	–	–	–	–	–	–	100	100
Auk	**–**	**–**	**–**	**–**	**–**	**1.4137**	**0.6392**	**0.652**	**–**	**0.0384**	**2.7433**
Dovekie	–	–	–	–	–	9.1	92	–	–	–	26.2
Common/Thick–billed Murre	–	–	–	–	–	3.6	8	51	–	–	15.9
Razorbill	–	–	–	–	–	81.8	–	25.5	–	100	49.5
Murre/Razorbill	–	–	–	–	–	0.9	–	23.5	–	–	6.1
species unknown	–	–	–	–	–	4.5	–	–	–	–	2.3
Gull	**0.1408**	**–**	**0.0131**	**6.817**	**8.6786**	**1.4394**	**0.358**	**2.0967**	**0.79**	**0.947**	**21.2805**
Black–legged Kittiwake	–	–	–	–	–	40.2	–	1.2	–	–	2.9
Bonaparte's Gull	–	–	–	98.7	98.3	6.3	3.6	92.7	25.8	–	82
Laughing Gull	81.8	–	100	0.4	–	–	–	–	3.2	16.2	1.6
Herring Gull	–	–	–	–	–	27.7	46.4	3.7	50	40.5	6.8
Iceland Gull	–	–	–	–	–	–	3.6	–	–	–	0.1
Lesser Black–backed Gull	–	–	–	–	–	–	–	0.6	11.3	18.9	1.3
Great Black–backed Gull	18.2	–	–	0.4	1.1	25.9	46.4	1.2	6.5	16.2	4.3
species unknown – Large	–	–	–	–	–	–	–	–	3.2	8.1	0.5
species unknown – Small	–	–	–	0.6	0.6	–	–	0.6	–	–	0.5
***Sterna* Tern**	**0.2048**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**0.2048**	**0.4095**
Common Tern	–	–	–	–	–	–	–	–	–	18.8	9.4
Arctic Tern	–	–	–	–	–	–	–	–	–	43.8	21.9
Commic Tern	–	–	–	–	–	–	–	–	–	37.5	18.8
Forster's Tern	6.3	–	–	–	–	–	–	–	–	–	3.1
Commic/Forster's Tern	68.8	–	–	–	–	–	–	–	–	–	34.4
species unknown	25	–	–	–	–	–	–	–	–	–	12.5
Loon	**0.8702**	**–**	**–**	**0.2491**	**0.8915**	**0.5655**	**0.3452**	**1.3679**	**1.3761**	**1.7789**	**7.4444**
Red–throated Loon	11.8	–	–	–	–	–	–	58.9	15.7	0.7	15.3
Common Loon	86.8	–	–	100	100	100	100	38.3	81.5	98.6	83.3
species unknown	1.5	–	–	–	–	–	–	2.8	2.8	0.7	1.4
Storm–petrel	**0.0128**	**0.0262**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**0.039**
species unknown	100	100	–	–	–	–	–	–	–	–	100
Fulmar	**–**	**–**	**–**	**–**	**–**	**0.0643**	**–**	**–**	**–**	**–**	**0.0643**
Northern Fulmar	–	–	–	–	–	100	–	–	–	–	100
Shearwater	**0.0128**	**–**	**–**	**–**	**0.0131**	**–**	**–**	**–**	**–**	**0.0256**	**0.0515**
Sooty Shearwater	100	–	–	–	–	–	–	–	–	–	25
Manx Shearwater	–	–	–	–	100	–	–	–	–	–	25

Species	Abundance per km²										Species Total
	May 22	Sep 22	Oct 22	Nov 22	Dec 22	Jan 23	Feb 23	Mar 23	Apr 23	May 23	
species unknown	–	–	–	–	–	–	–	–	–	100	50
Gannet	**0.0384**	**–**	**–**	**0.0393**	**–**	**0.2313**	**0.0639**	**0.4602**	**0.0382**	**–**	**0.8714**
Northern Gannet	100	–	–	100	–	100	100	100	100	–	100
Unid. Avian	**0.0512**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**0.0512**
species unknown	100	–	–	–	–	–	–	–	–	–	100
Total	**1.3565**	**0.0262**	**0.0131**	**7.1054**	**9.6093**	**3.7142**	**1.4063**	**4.5768**	**2.2044**	**3.0586**	**33.0709**

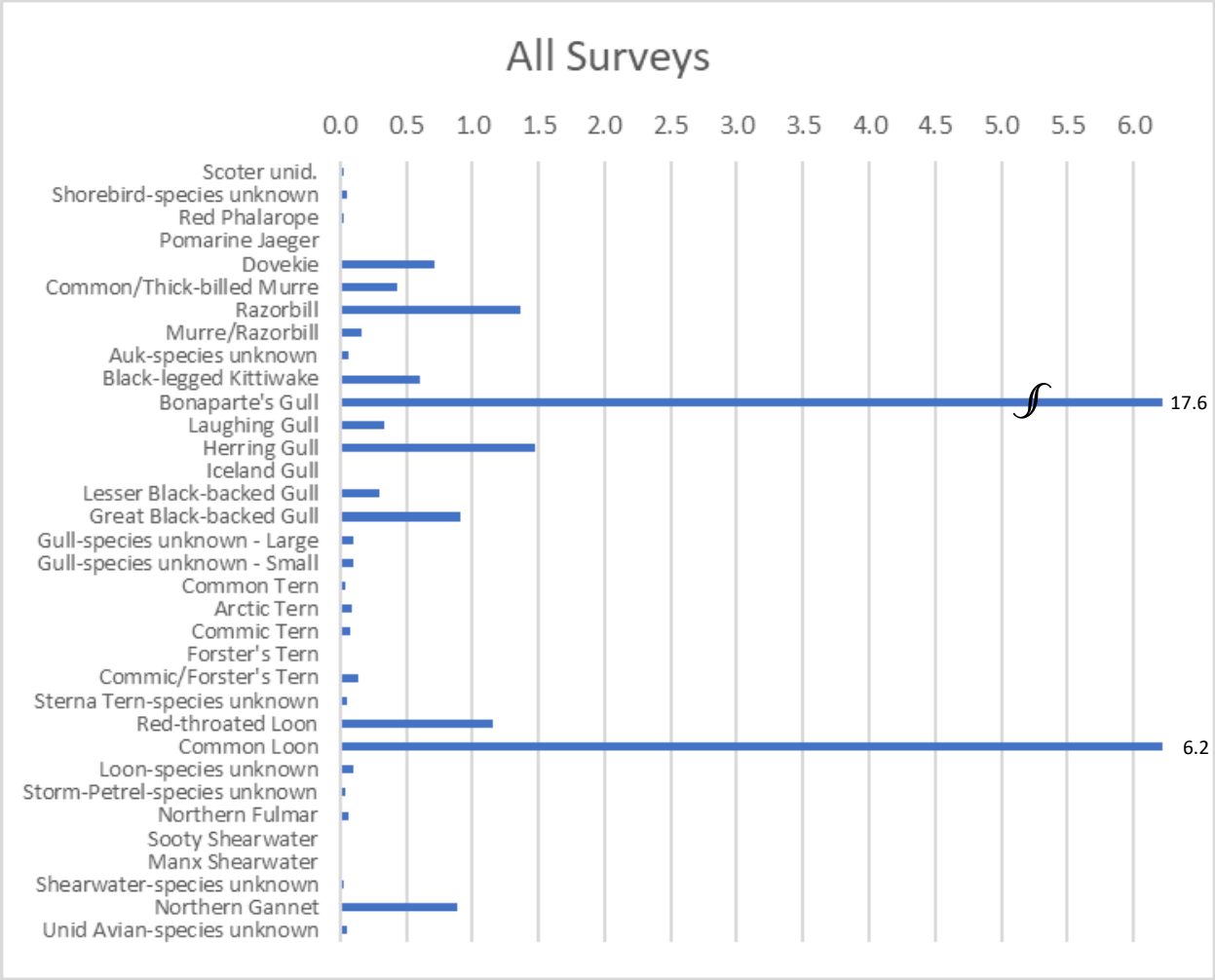


Figure 6. Density (per km²) of avian species identified in all surveys.

Spatial Distribution

To look for associations with typical boat traffic routes, we have overlaid boat traffic on the maps below, and we divided the study area into three sections to compare bird densities among each area. The spatial distribution of all bird species combined found in each survey is shown in Figure 7 through Figure 16. Spatial distribution maps of individual bird species during the May 2022 through May 2023 surveys are shown in Appendix C. From the appendix maps it can be noted that the January 2023 encounters in the southwest are mainly of razorbill (*Alca torda*) and black-legged kittiwake (*Rissa tridactyla*) and in December 2022 in the northeast encounters were mainly of Bonaparte's gull (*Chroicocephalus philadelphia*). Bird distributions in November 2022 through May 2023 appear to show a relationship with boat traffic; although, at this point, data are too sparse to draw strong conclusions and review of a further 10% of data would provide greater insight.

Distribution Maps of All Bird Species Combined for Each Survey

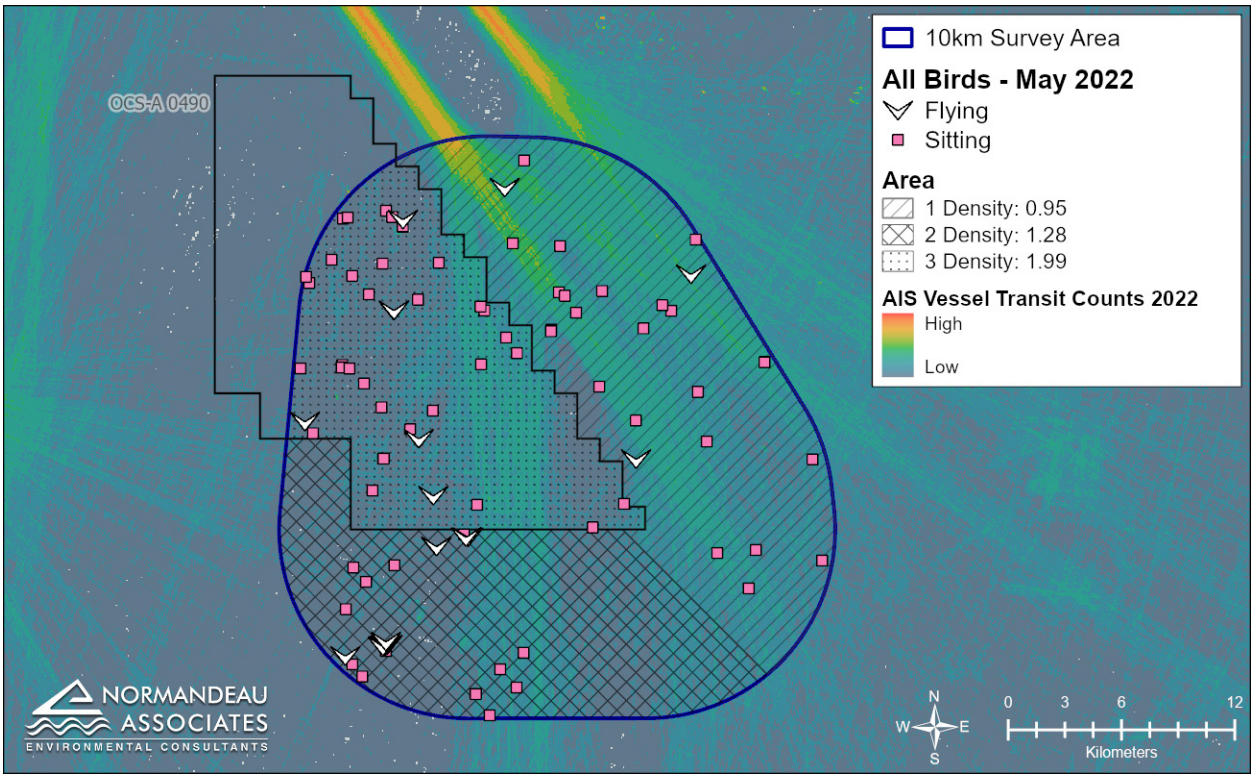


Figure 7. Spatial distribution and density of all flying and sitting bird species shown in relationship to 2022 AIS vessel transit counts during the May 2022 survey.

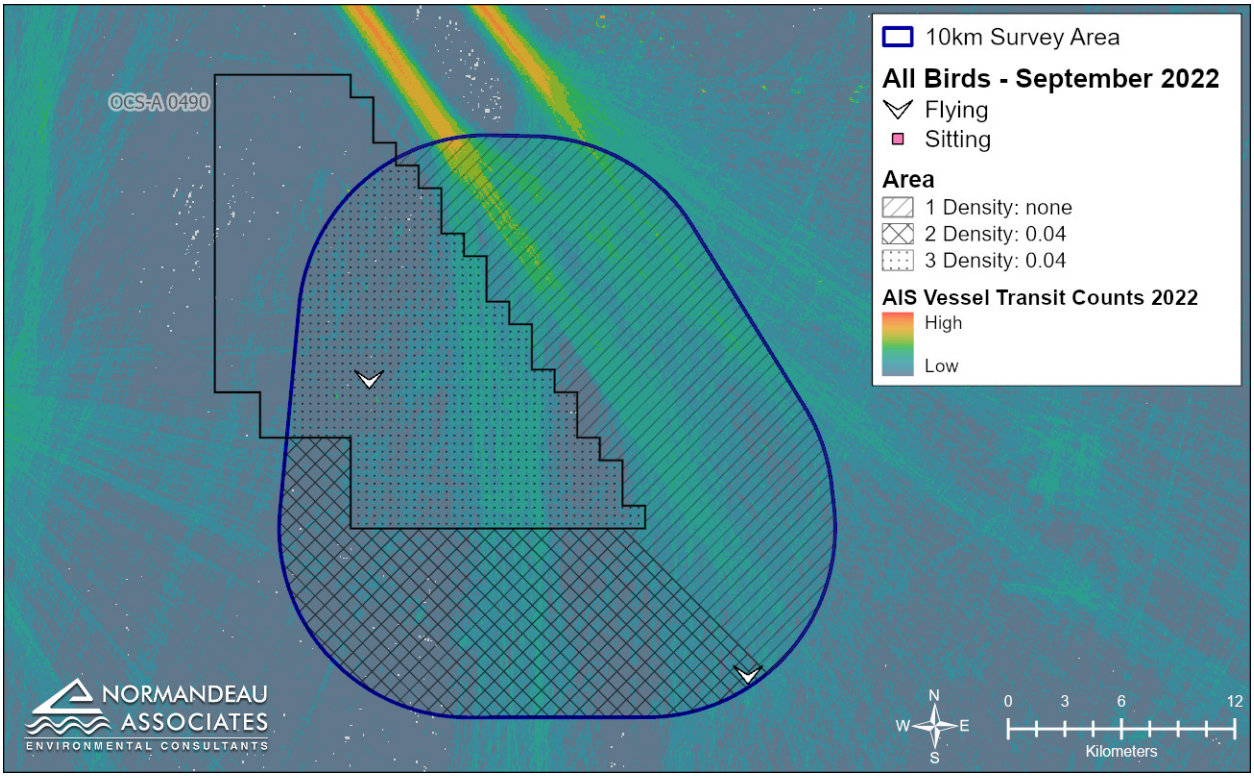


Figure 8. Spatial distribution and density of all flying and sitting bird species shown in relationship to 2022 AIS vessel transit counts during the September 2022 survey.

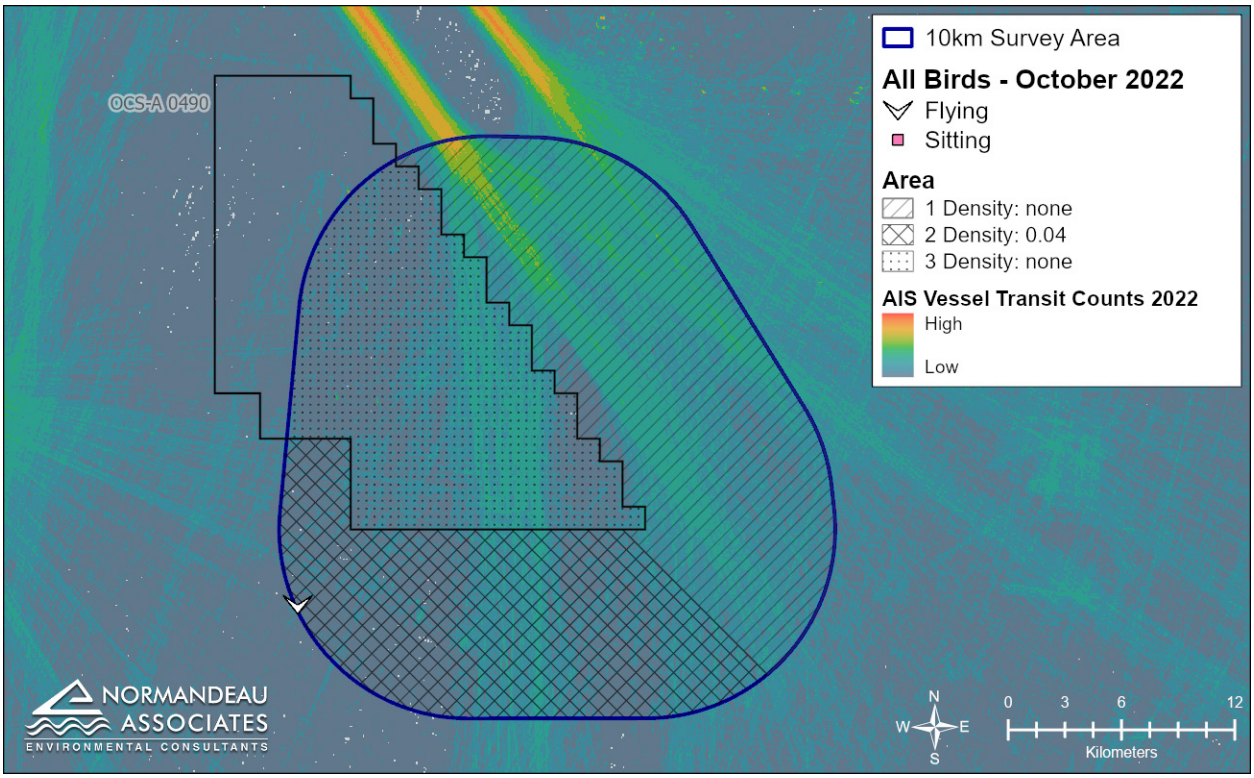


Figure 9. Spatial distribution and density of all flying and sitting bird species shown in relationship to 2022 AIS vessel transit counts during the October 2022 survey.

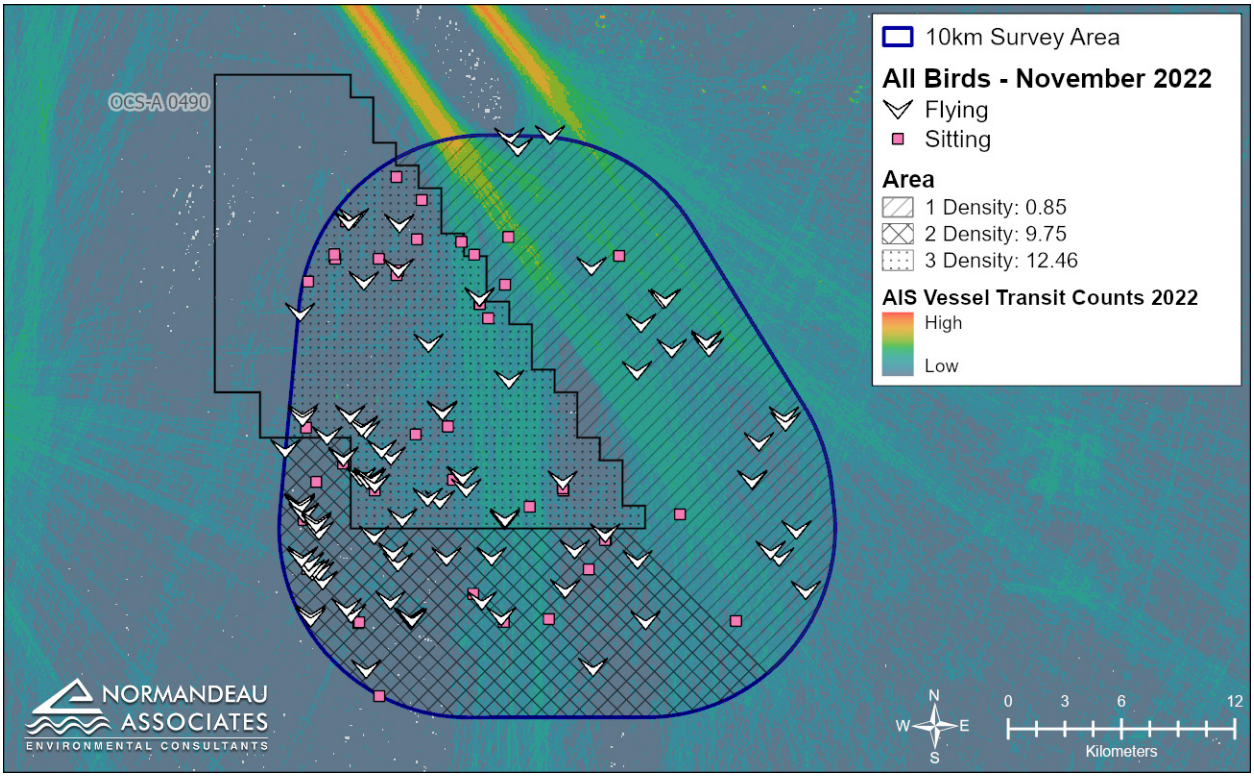


Figure 10. Spatial distribution and density of all flying and sitting bird species shown in relationship to 2022 AIS vessel transit counts during the November 2022 survey.

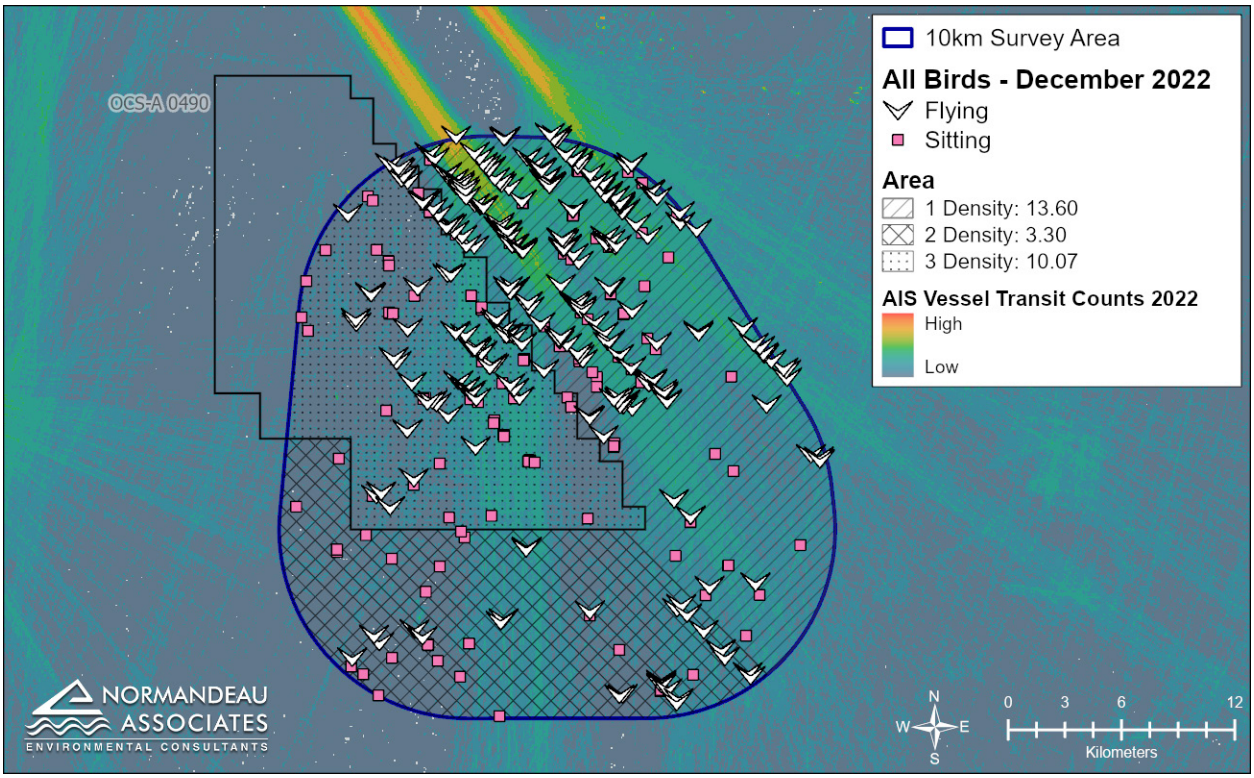


Figure 11. Spatial distribution and density of all flying and sitting bird species shown in relationship to 2022 AIS vessel transit counts during the December 2022 survey.

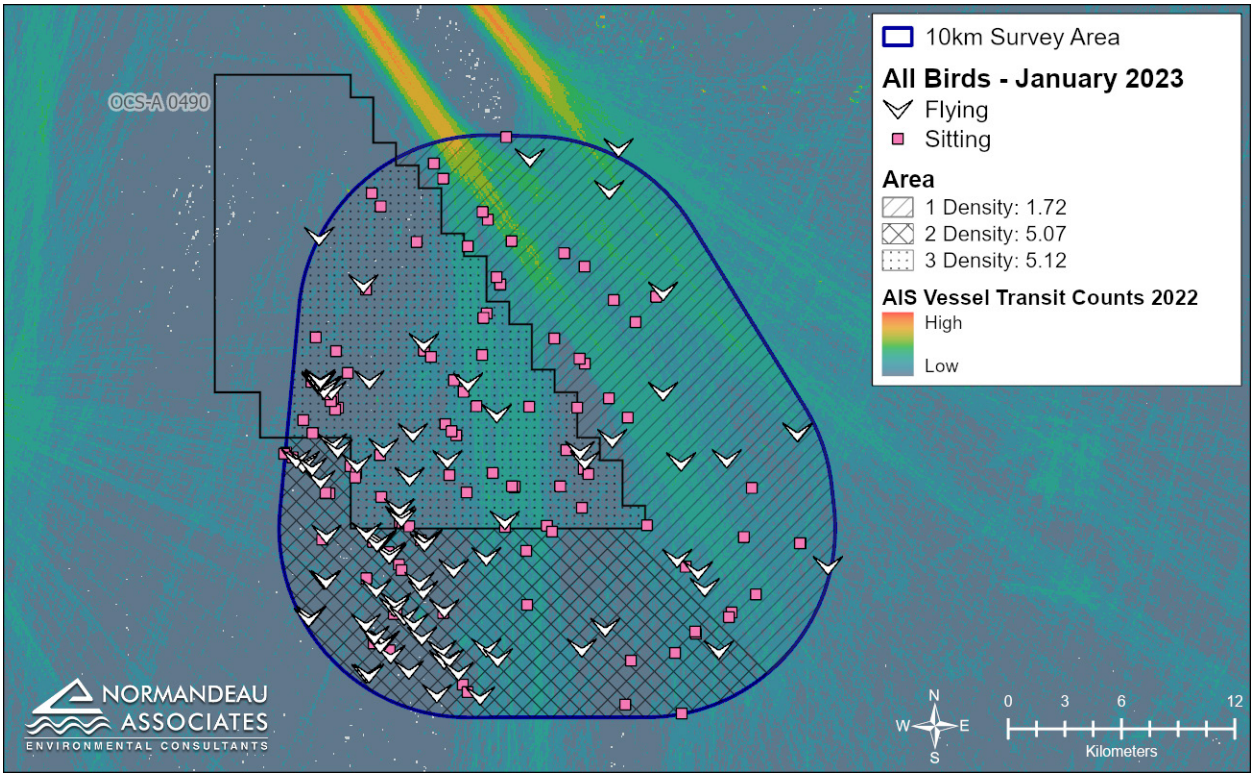


Figure 12. Spatial distribution and density of all flying and sitting bird species shown in relationship to 2022 AIS vessel transit counts during the January 2023 survey.

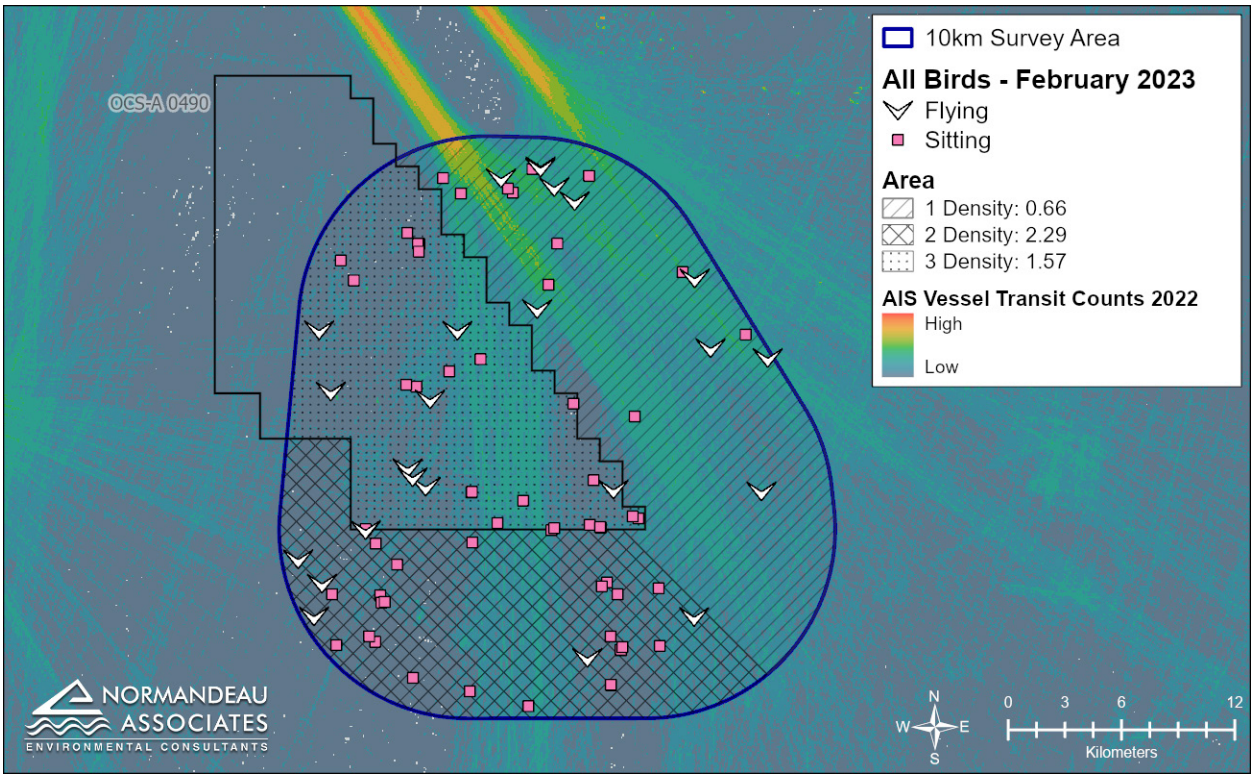


Figure 13. Spatial distribution and density of all flying and sitting bird species shown in relationship to 2022 AIS vessel transit counts during the February 2023 survey.

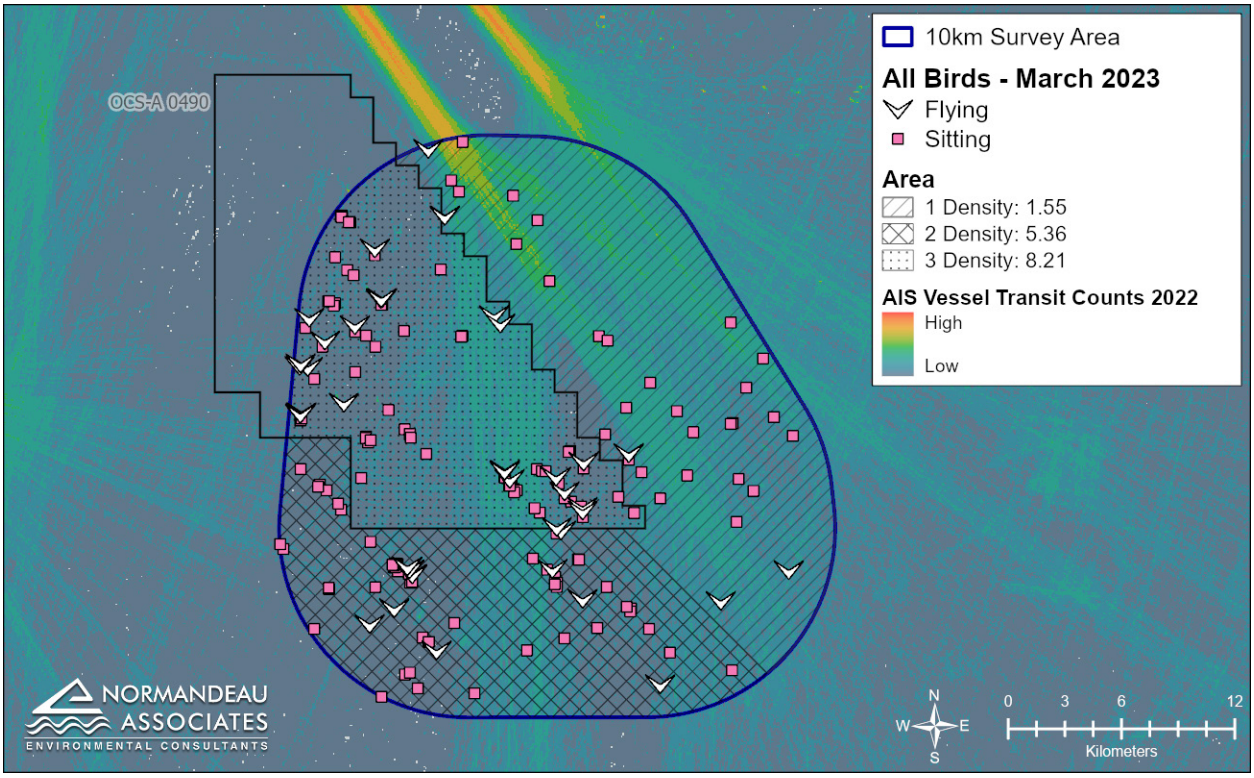


Figure 14. Spatial distribution and density of all flying and sitting bird species shown in relationship to 2022 AIS vessel transit counts during the March 2023 survey.

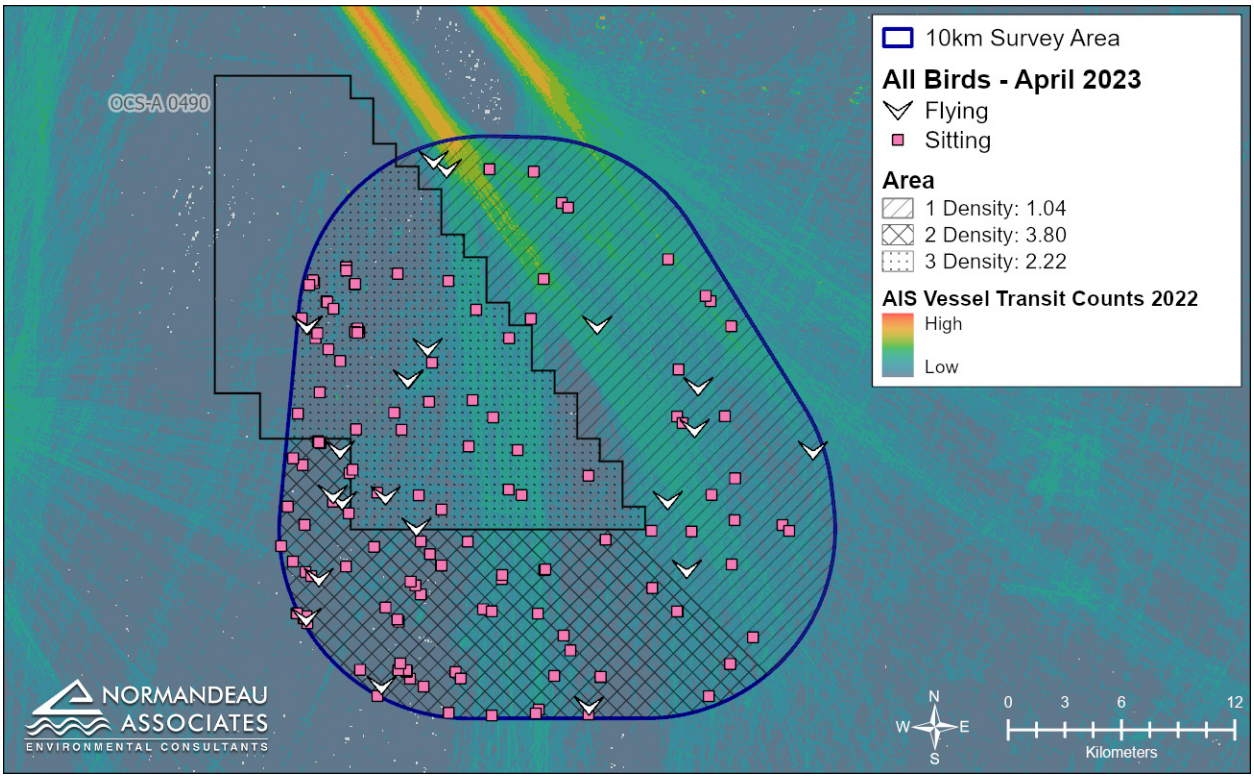


Figure 15. Spatial distribution and density of all flying and sitting bird species shown in relationship to 2022 AIS vessel transit counts during the April 2023 survey.

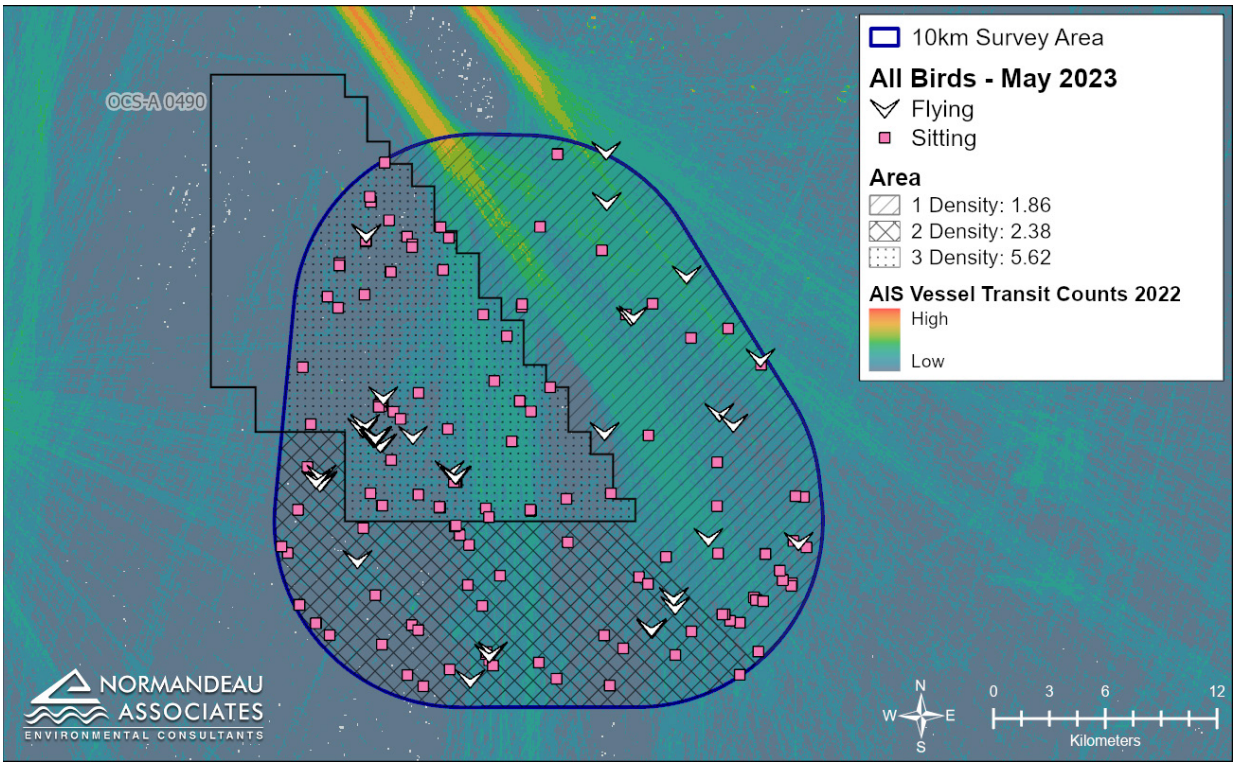


Figure 16. Spatial distribution and density of all flying and sitting bird species shown in relationship to 2022 AIS vessel transit counts during the May 2023 survey.

To look for associations with vessel traffic for species that might be considered sensitive to disturbance by vessels and thus vulnerable to displacement, we looked at the distributions of auks, loons, gannets, and kittiwake (Figure 17 through Figure 23). The densities generated within the divided study area allow a quick comparison of bird densities among each area. We have also plotted which birds were flying or sitting and these are shown on the maps below.

Based on review of 10% of collected data, most dovekies were sitting rather than flying and were encountered in Area 2, south of the project and removed from most vessel traffic (Figure 17). Razorbills similarly were mostly sitting and outside of the main vessel lanes with only a few exceptions (Figure 18). Black-legged kittiwake were mostly flying, encountered in Area 2 (more west than the dovekies), but also well away from the busier vessel traffic (Figure 19). All loons were mostly sitting rather than flying. Red-throated loons especially appear to be found away from vessel traffic (Figure 20). Common loons, although widespread and with much higher densities also appear to avoid the higher density vessel traffic (Figure 21). Data on northern gannet are a little sparse (Figure 23).

Distribution Maps of Species-Specific Bird Groups

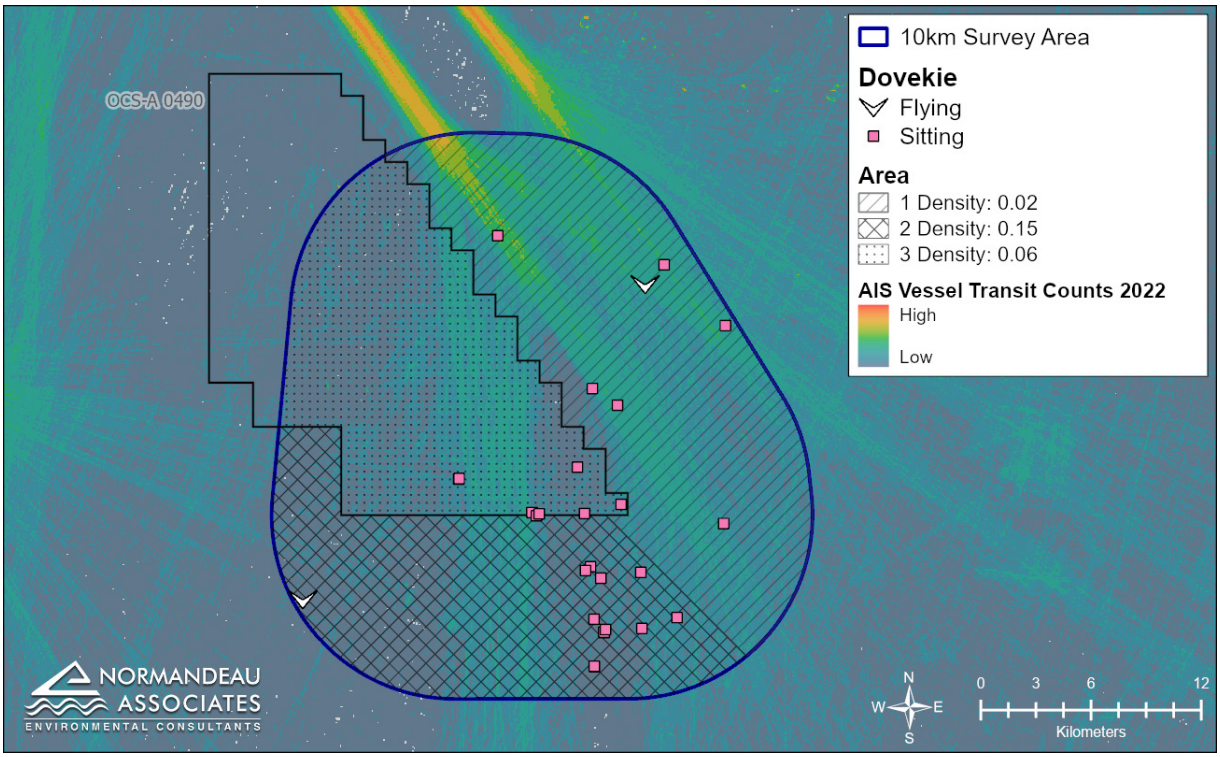


Figure 17. Spatial distribution and density of all flying and sitting dovekies shown in relationship to 2022 AIS vessel transit counts during all surveys.

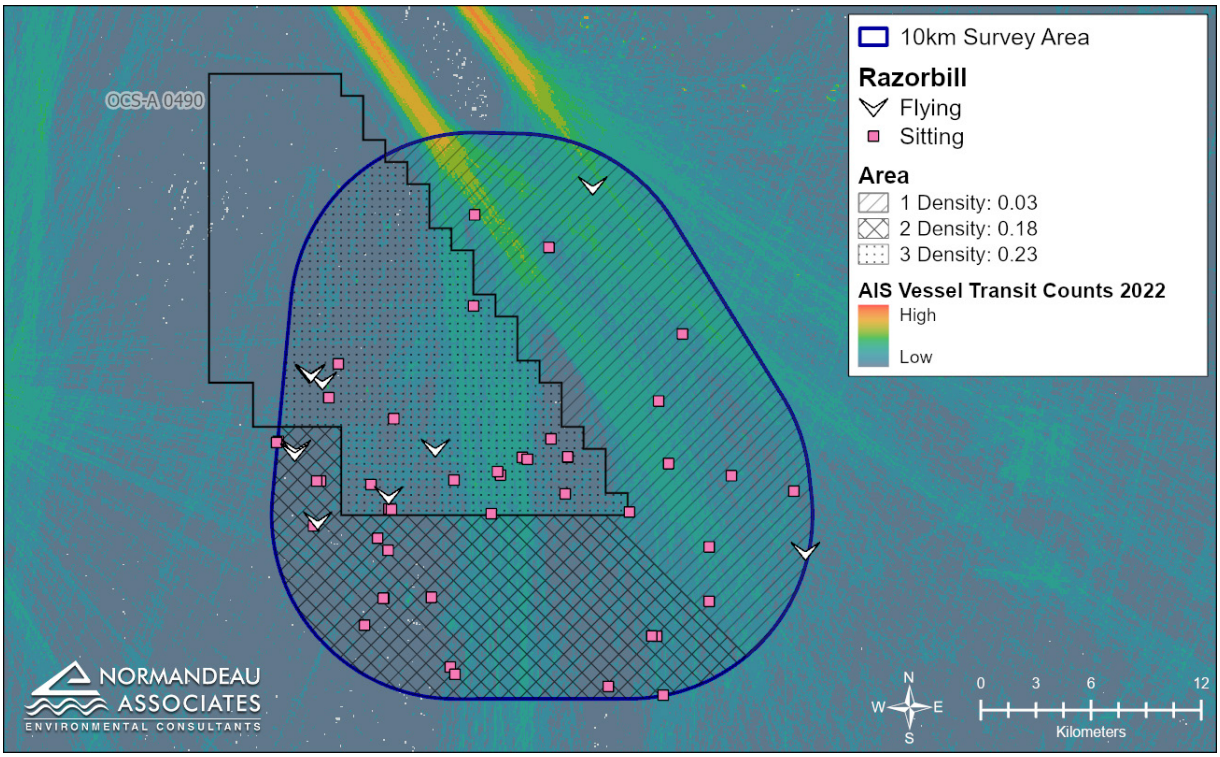


Figure 18. Spatial distribution and density of all flying and sitting razorbills shown in relationship to 2022 AIS vessel transit counts during all surveys.

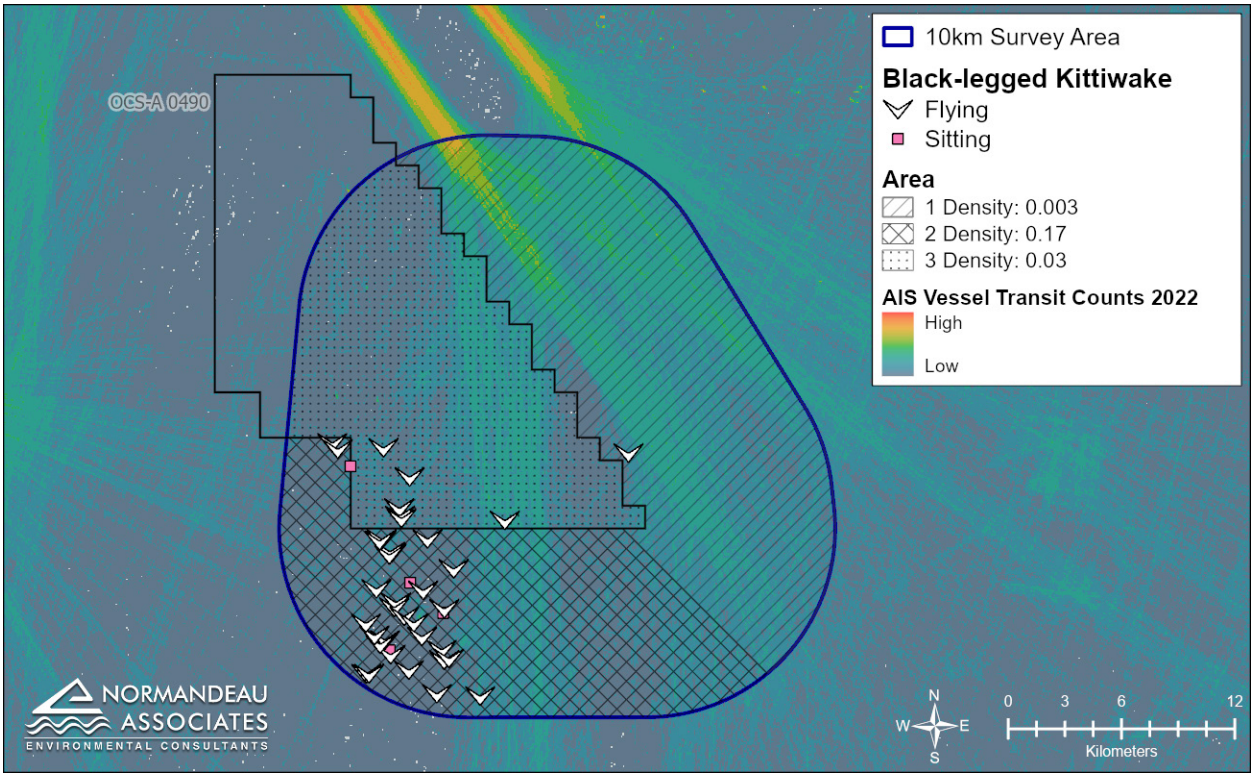


Figure 19. Spatial distribution and density of all flying and sitting black-legged kittiwakes shown in relationship to 2022 AIS vessel transit counts during all surveys.

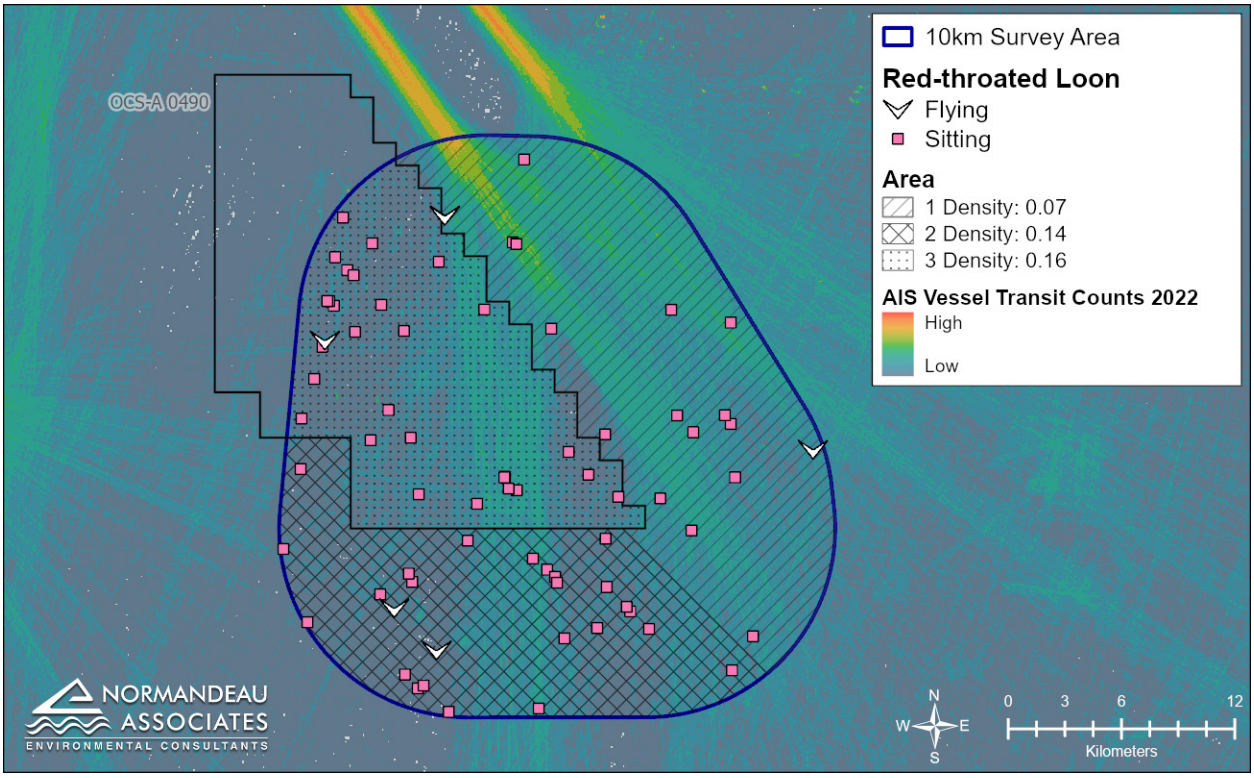


Figure 20. Spatial distribution and density of all flying and sitting red-throated loons shown in relationship to 2022 AIS vessel transit counts during all surveys.

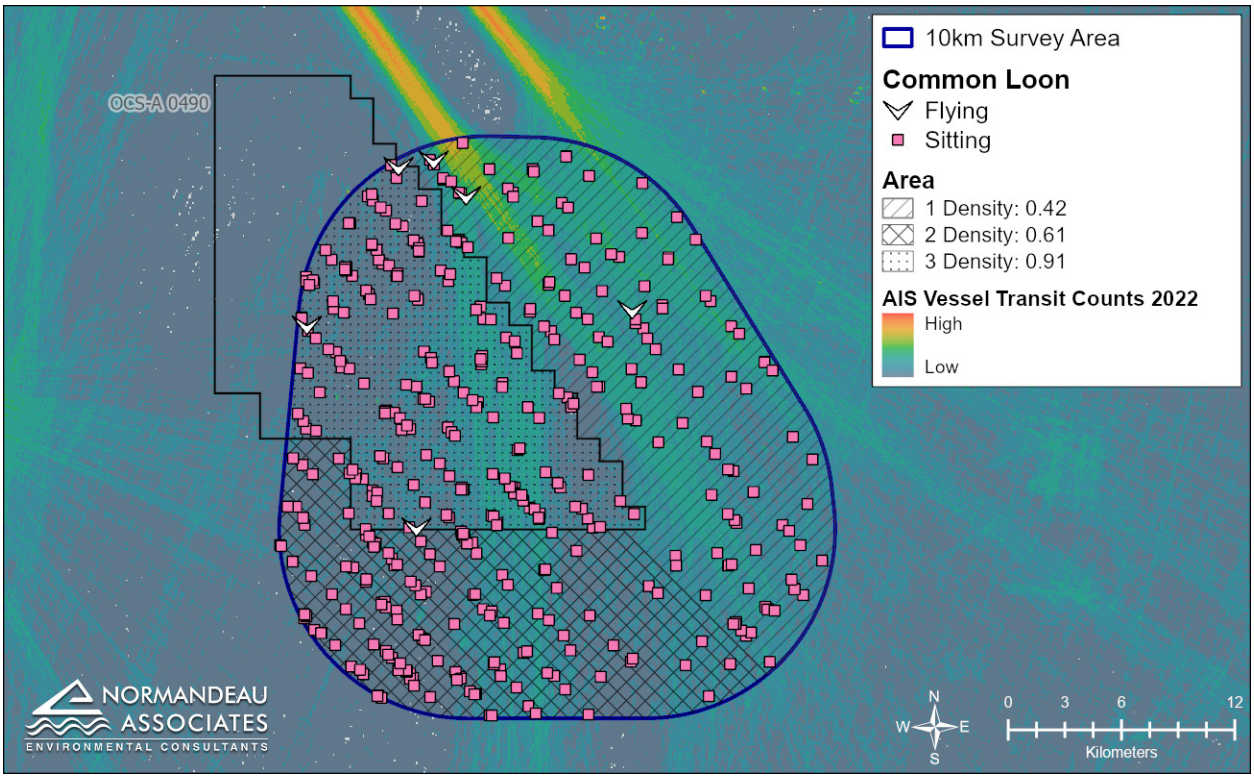


Figure 21. Spatial distribution and density of all flying and sitting common loons shown in relationship to 2022 AIS vessel transit counts during all surveys.

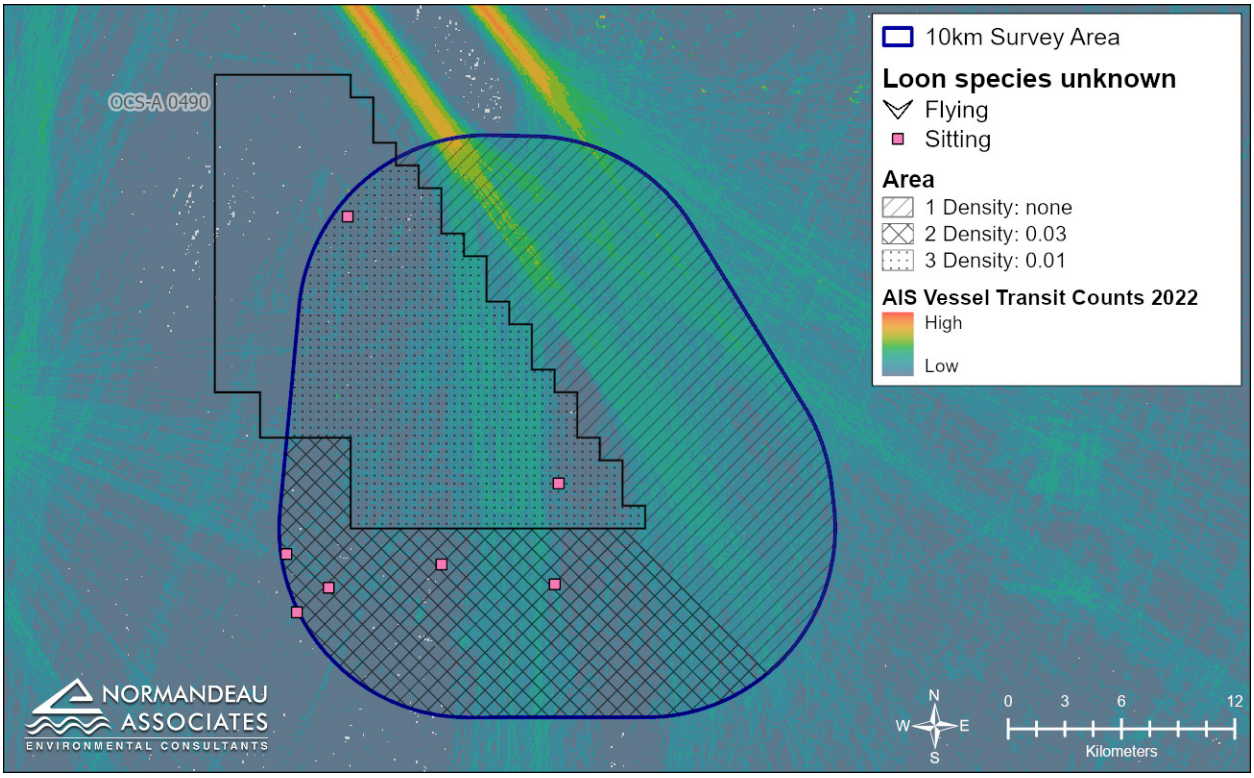


Figure 22. Spatial distribution and density of all flying and sitting loon-species unknown shown in relationship to 2022 AIS vessel transit counts during all surveys.

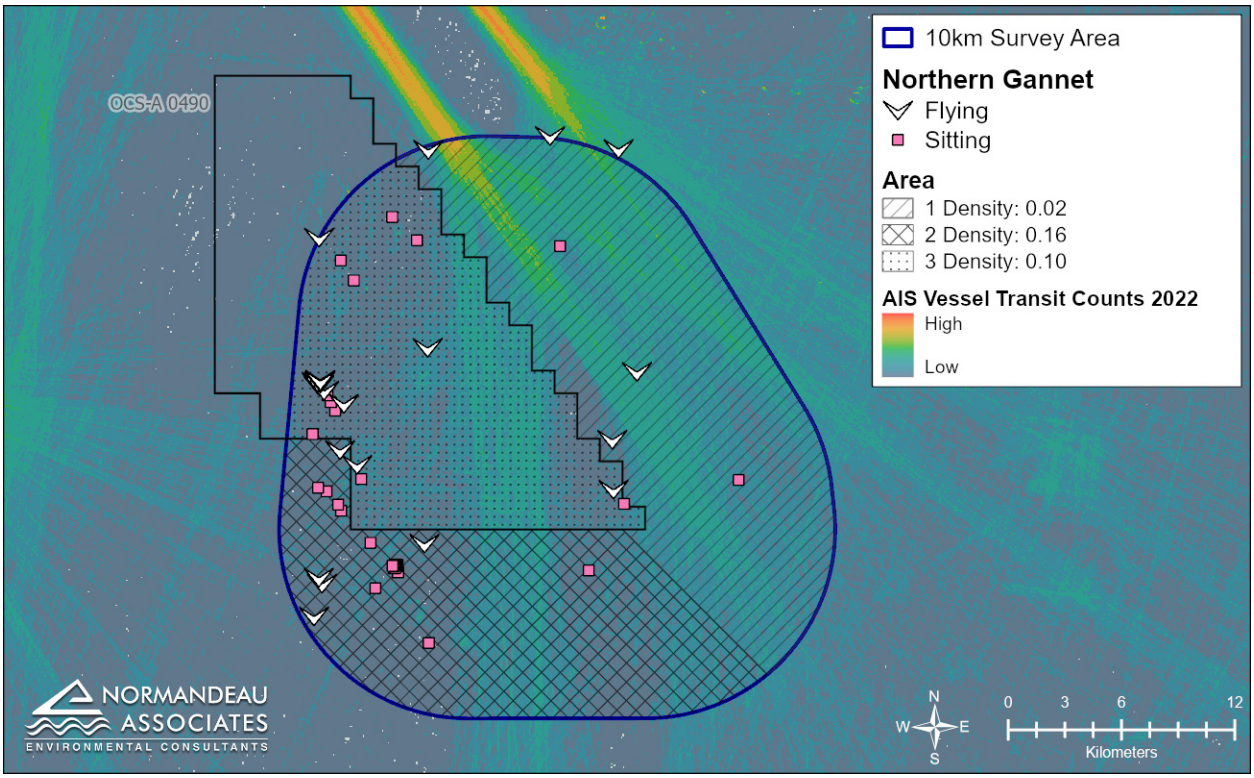


Figure 23. Spatial distribution and density of all flying and sitting northern gannets shown in relationship to 2022 AIS vessel transit counts during all surveys.

Flight Height

All bird observations were classified as sitting or flying, and species with known flight heights were classified as outside or within the RSZ (23–319 m) for each species group for each survey (Table 15). Density per km^2 of all bird species during each survey is shown in Appendix D. Flight activity during each survey for each species and for all surveys combined is shown in Appendix E, which includes flight height errors calculated by APEM (see Section 2.5 for error values for each species) for each survey.

Of all birds observed (n=2,569), 59% were observed sitting (n=1,514) and 41% were observed flying (n=1,052), 29% of which were flying within the RSZ (n=306), 21% were flying above or below the RSZ (n=225), and 50% had unknown flight heights (n=521) (Table 15). Unknown flight heights can occur when bird species' identification, size, or wingspan cannot be determined; a lack of these data limits the ability to estimate flight height (see Section 2.5).

Median flight height data for flying birds (with known flight heights) by species group for each survey are shown in Table 16. All raw flight heights with associated error for each species are presented for each survey in Appendix E.

Table 15. Number of Flying and Sitting Birds, Density (D [per km^2]), and Percent Within Each Survey Observed during Each Survey

	Flight Height Unknown			Flying outside RSZ*			Flying within RSZ*			Sitting			
Season	No.	D	% Within Survey	No.	D	% Within Survey	No.	D	% Within Survey	No.	D	% Within Survey	Total
May 2022	18	0.2304	16.98	2	0.0256	1.89	3	0.0384	2.83	83	1.0622	78.30	106
Sep 2022	2	0.0262	100.00	–	–	–	–	–	–	–	–	–	2
Oct 2022	1	0.0131	100.00	–	–	–	–	–	–	–	–	–	1
Nov 2022	208	2.7268	38.24	97	1.2716	17.83	104	1.3634	19.12	134	1.7567	24.63	544
Dec 2022	115	1.5076	15.67	84	1.1012	11.44	132	1.7305	17.98	402	5.2701	54.77	734
Jan 2023	77	0.9896	26.64	24	0.3084	8.30	27	0.3470	9.34	161	2.0691	55.71	289
Feb 2023	10	0.1278	9.01	1	0.0128	0.90	14	0.1790	12.61	86	1.0995	77.48	111
Mar 2023	31	0.3963	8.52	10	0.1278	2.75	21	0.2685	5.77	301	3.8481	82.69	364
Apr 2023	15	0.1911	8.62	5	0.0637	2.87	4	0.0510	2.30	150	1.9113	86.21	174
May 2023	44	0.5631	18.03	2	0.0256	0.82	1	0.0128	0.41	197	2.5211	80.74	244
TOTAL	**521**	**6.7721**		**225**	**2.9368**		**306**	**3.9905**		**1,514**	**19.5381**		**2,569**

* RSZ = 23–319 (m)

Table 16. Median Flight Height (MFH; m) of Flying Birds (with Known Flight Height) by Species Group by Survey

Species Group	May 22		Sep 22		Oct 22		Nov 22		Dec 22		Jan 23		Feb 23		Mar 23		Apr 23		May 23	
	#	MFH	#	MFH	#	MFH	#	MFH	#	MFH	#	MFH	#	MFH	#	MFH	#	MFH	#	MFH
Skua	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	19.3
Auk	–	–	–	–	–	–	–	–	–	–	4	35.1	–	–	–	–	–	–	–	–
Gull	5	27.0	–	–	–	–	201	23.8	213	32.3	45	25.2	13	63.3	23	31.2	6	17.5	1	37.6
Sterna Tern	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	6.7
Loon	–	–	–	–	–	–	–	–	3	77.6	–	–	–	–	6	87.3	3	65.4	–	–
Gannet	–	–	–	–	–	–	–	–	–	–	2	56.6	2	44.2	2	9.6	–	–	–	–

3.6 Turtles

Species Identification

Raw counts of turtle species identified in each survey are presented in Table 17. During all surveys, 46 turtles were identified in imagery representing 4 species and 1 species blend (Table 17). Of these, 70% (n=32) were ascribed to species; the remaining were ascribed to the species blend loggerhead/Kemp's (n=6) or were not ascribed to species (n=8). Of the 6 identified as loggerhead/Kemp's species blend, 3 were significantly submerged, and 4 of those not ascribed to any species were significantly submerged (Table 17).

Table 17. Turtle Species Identified and Number of Significantly Submerged (SS) in Each Survey

Species	Raw Counts																				TOT
	May 22		Sep 22		Oct 22		Nov 22		Dec 22		Jan 23		Feb 23		Mar 23		Apr 23		May 23		
	SS	#	SS	#	SS	#	SS	#	SS	#	SS	#	SS	#	SS	#	SS	#	SS	#	
Leatherback Turtle*	–	–	–	1	1	2	–	1	–	–	–	–	–	–	–	–	–	–	–	–	4
Loggerhead Turtle*	–	–	7	14	1	7	–	3	–	–	–	–	–	–	–	–	–	–	–	–	24
Loggerhead/Kemp's Turtle*	–	–	2	2	1	4	–	–	–	–	–	–	–	–	–	–	–	–	–	–	6
Green Turtle*	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	1
Kemp's Ridley Turtle*	–	–	–	1	–	2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	3
species unknown*	–	–	1	1	1	2	1	2	1	1	–	–	–	–	–	–	–	–	–	2	8
TOTAL	–	–	10	19	4	17	1	7	1	1	–	–	–	–	–	–	–	–	–	2	46

* Listed under the Endangered Species Act

Species Composition and Density

The overall density of turtles was fairly even during the September 2022 and October 2022 surveys with 0.2491 turtles/km^2 (41% of all surveys) and 0.2229 turtles/km^2 (37%), with lower density during the November (0.0918; 15%), December 2022 (0.0131; 2%), and May 2023 (0.0256; 4%) surveys (Table 18). No turtles were found during the May 2022, January 2023, February 2023, March 2023, and April 2023 surveys. Overall, loggerhead turtles were the most frequently found species consisting of 52% of the total observations; turtle-species unknown accounted for 17% (0.1043 turtles/km^2) and the loggerhead/Kemp's blend accounted for 13% (0.0787 turtles/km^2) of the total observations over all surveys.

In the September 2022 survey, peak encounters were loggerhead turtle (*Caretta caretta*; 0.1835 turtles/km^2; 74% of the survey) followed by loggerhead/Kemp's with 0.0262 turtles/km^2 (11%) (Table 18, Figure 24). The remaining species include leatherback turtle (*Dermochelys coriacea*), Kemp's ridley turtle (*Lepidochelys kempii*), and turtle-species unknown with 0.0131 turtles/km^2 (5%) each (Table 18, Figure 24).

Encounters in October 2022 were dominated by loggerhead turtles (0.0918 turtles/km^2; 41%) and loggerhead/Kemp's blend (0.0524 turtles/km^2; 24%) followed by equal densities of leatherback turtle, Kemp's ridley turtle, and turtle-species unknown (0.0262 turtles/km^2; 12%) (Table 18, Figure 24).

During the November 2022 survey, loggerhead turtles were dominant with 0.0393 turtles/km^2 (43%) followed by turtle-species unknown (0.0262 turtles/km^2; 29%) and leatherback and green turtles (*Chelonia mydas*) (0.0131 turtles/km^2; 14%). This is the only survey where green turtles were found.

The only turtles found during the December 2022 and May 2023 surveys were turtle-species unknown (0.0131 and 0.0256 turtles/km^2, respectively) (Table 18, Figure 24).

Table 18. Density (D [per km^2]) and Percent of Total Turtle Species Identified in All Surveys

Species	May 22		Sep 22		Oct 22		Nov 22		Dec 22		Jan 23		Feb 23		Mar 23		Apr 23		May 23		Species Total
	D	%	D	%	D	%	D	%	D	%	D	%	D	%	D	%	D	%	D	%	
Leatherback Turtle	–	–	0.0131	25.00	0.0262	50.00	0.0131	25.00	–	–	–	–	–	–	–	–	–	–	–	–	0.0524
Loggerhead Turtle	–	–	0.1835	58.33	0.0918	29.17	0.0393	12.50	–	–	–	–	–	–	–	–	–	–	–	–	0.3146
Loggerhead/Kemp's Turtle	–	–	0.0262	33.33	0.0524	66.67	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.0787
Green Turtle	–	–	–	–	–	–	0.0131	100.00	–	–	–	–	–	–	–	–	–	–	–	–	0.0131
Kemp's Ridley Turtle	–	–	0.0131	33.33	0.0262	66.67	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.0393
species unknown	–	–	0.0131	12.50	0.0262	25.00	0.0262	25.00	0.0131	12.50	–	–	–	–	–	–	–	–	0.0256	25.00	0.1043
TOTAL	**–**	**–**	**0.2491**	**41.30**	**0.2229**	**36.96**	**0.0918**	**15.22**	**0.0131**	**2.17**	**–**	**–**	–	–	–	–	–	–	**0.0256**	**4.35**	**0.6024**

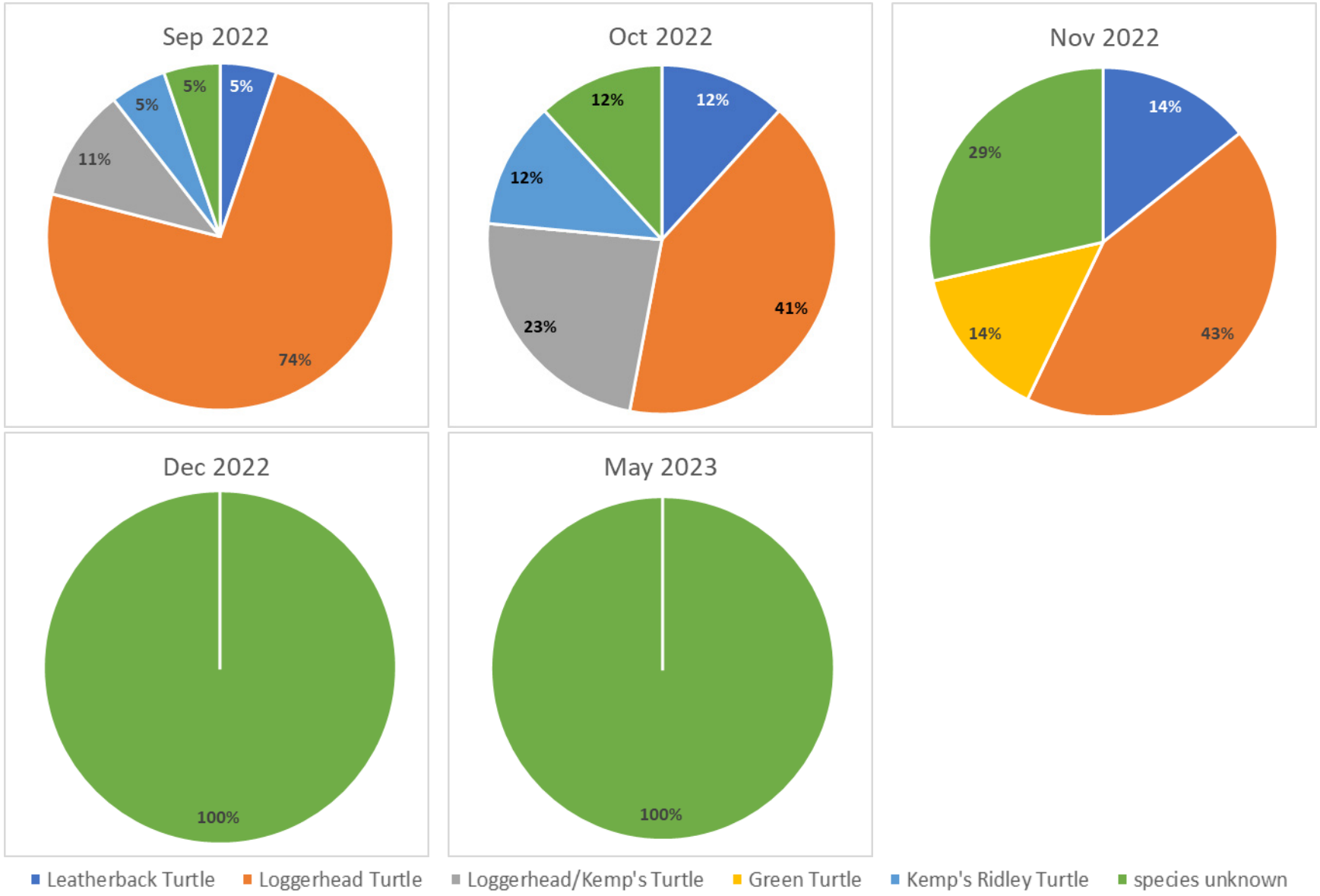


Figure 24. Density per km^2 of turtle species found during the May 2022 through May 2023 surveys.

Spatial Distribution

The spatial distribution of turtles found during all surveys is shown in Figure 25. The spatial distribution of individual turtle species for each survey is presented in Appendix F. With recognition of the low density of turtles encountered, they were found dispersed in low numbers across the study area with little evidence of avoidance of boat traffic.

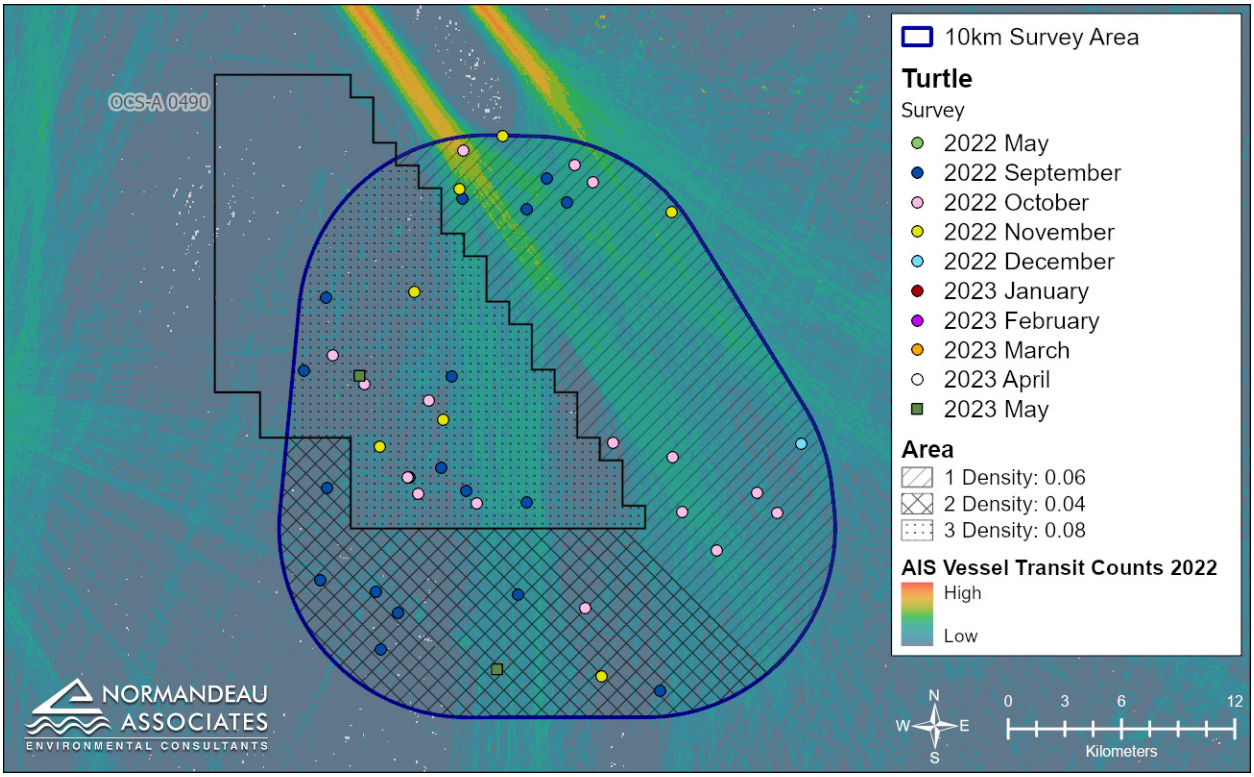


Figure 25. Spatial distribution and density of turtles shown in relationship to 2022 AIS vessel transit counts during all surveys.

3.7 Marine Mammals

Species Identification

Raw counts of marine mammal species identified in each survey are presented in Table 19. Over all surveys, 61 marine mammals were identified in imagery, 98% of which were dolphins (Table 19).

Of the 60 dolphins encountered, 49 dolphins were ascribed to species, which provided an identification rate of 82% (Table 19). The remaining 11 dolphins were ascribed to the bottlenose/Atlantic spotted dolphin species blend (n=4) or dolphin-species unknown (n=7). Identified species include common dolphins (*Delphinus delphis*) (n=12; 20%), bottlenose dolphins (*Tursiops truncates*) (n=36; 61%), and harbor porpoise (*Phocoena phocoena*) (n=1; >2%). Of the 60 dolphins encountered, 45 (75%) were significantly submerged; of the 11 individuals assigned to the bottlenose/Atlantic spotted dolphin species blend or dolphin-species unknown, 10 (91%) were significantly submerged (Table 19).

Table 19. Marine Mammals Identified in Each Survey and Number of Significantly Submerged (SS)

Species	Raw Counts																				TOT
	May 22		Sep 22		Oct 22		Nov 22		Dec 22		Jan 23		Feb 23		Mar 23		Apr 23		May 23		
	SS	#	SS	#	SS	#	SS	#	SS	#	SS	#	SS	#	SS	#	SS	#	SS	#	
Whale	–	–	–	–	–	–	–	–	–	–	–	–	1	1	–	–	–	–	–	–	1
North Atlantic Right Whale*	–	–	–	–	–	–	–	–	–	–	–	–	1	1	–	–	–	–	–	–	1
Dolphin	1	3	–	–	–	–	–	–	–	–	8	12	12	17	3	3	11	11	10	14	60
Common Dolphin	–	–	–	–	–	–	–	–	–	–	8	12	–	–	–	–	–	–	–	–	12
Bottlenose Dolphin	1	3	–	–	–	–	–	–	–	–	–	–	12	17	2	2	7	7	4	7	36
Harbor Porpoise	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	1	–	–	–	–	1
Bottlenose/Atlantic Spotted	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	4	4	–	–	4
species unknown	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	6	7	7
Totals	1	3	—	—	—	—	—	—	—	—	8	12	13	18	3	3	11	11	10	14	61

* Listed under the Endangered Species Act

Species Composition and Density

Marine mammal species identified and density (per km^2) of individuals for each survey are shown in Table 20 and Figure 26. During all surveys, marine mammal observations (0.7804 mammals/km^2) included 0.7676 dolphins/km^2 (n=60; 98%) and 0.0128 whales/km^2 (n=1; 2%) (Table 19, Table 20).

During the May 2022 survey, bottlenose dolphin was the only species encountered with 0.0384 dolphins/km^2 (5% of all surveys) (Table 20, Figure 26).

Common dolphins accounted for 100% of the individuals recorded in the January 2023 survey with 0.1542 dolphins/km^2 (20% overall) and were only observed during this survey (Table 20, Figure 26).

The February 2023 survey had the greatest density of marine mammals (0.2301 mammals/km^2; 30%). One North Atlantic right whale (*Eubalaena glacialis*)—the only whale species observed during all surveys—was encountered (0.0128 whales/km^2; 6% of the survey) along with 17 bottlenose dolphins (0.2173 dolphins/km^2; 94% of the survey) (Table 19, Table 20, Figure 26).

Marine mammal observations during the March 2023 survey (0.0384 mammals/km^2; 5% of all surveys) included bottlenose dolphins (0.0256 dolphins/km^2; 67%) and harbor porpoise (0.0128 dolphins/km^2; 33%) (Table 20, Figure 26).

During the April 2023 survey, bottlenose dolphins (0.0892 dolphins/km^2; 64% of the survey) and bottlenose/Atlantic spotted dolphin species blend (0.0510 dolphins/km^2; 36% of the survey) were observed, accounting for 0.1402 mammals/km^2, or 18% of all surveys (Table 20, Figure 26).

The May 2023 survey had the second greatest density with 0.1792 dolphins/km^2 (23% of all surveys) and consisted of bottlenose dolphins and dolphin-species unknown with 0.0896 dolphins/km^2 each (50% of the survey) (Table 20, Figure 26).

There were no marine mammals found during the September 2022, October 2022, November 2022, or December 2022 surveys (Table 20).

Table 20. Density (D [per km^2]) and Percent of Total Marine Mammal Species Identified in All Surveys

Species	May 22		Sep 22		Oct 22		Nov 22		Dec 22		Jan 23		Feb 23		Mar 23		Apr 23		May 23		Total
	D	%	D	%	D	%	D	%	D	%	D	%	D	%	D	%	D	%	D	%	
North Atlantic Right Whale*	–	–	–	–	–	–	–	–	–	–	–	–	0.0128	100.00	–	–	–	–	–	–	0.0128
Whale Total	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**0.0128**	**100.00**	**–**	**–**	**–**	**–**	**–**	**–**	**0.0128**
Common Dolphin	–	–	–	–	–	–	–	–	–	–	0.1542	100.00	–	–	–	–	–	–	–	–	0.1542
Bottlenose Dolphin	0.0384	8.33	–	–	–	–	–	–	–	–	–	–	0.2173	47.22	0.0256	5.56	0.0892	19.44	0.0896	19.44	0.4601
Harbor Porpoise	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.0128	100.00	–	–	–	–	0.0128
Bottlenose/Atlantic Spotted	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.0510	100.00	–	–	0.0510
species unknown	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.0896	100.00	0.0896
TOTAL	**0.0384**	**4.92**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**0.1542**	**19.67**	**0.2301**	**29.51**	**0.0384**	**4.92**	**0.1402**	**18.03**	**0.1792**	**22.95**	**0.7804**

* Listed under the Endangered Species Act

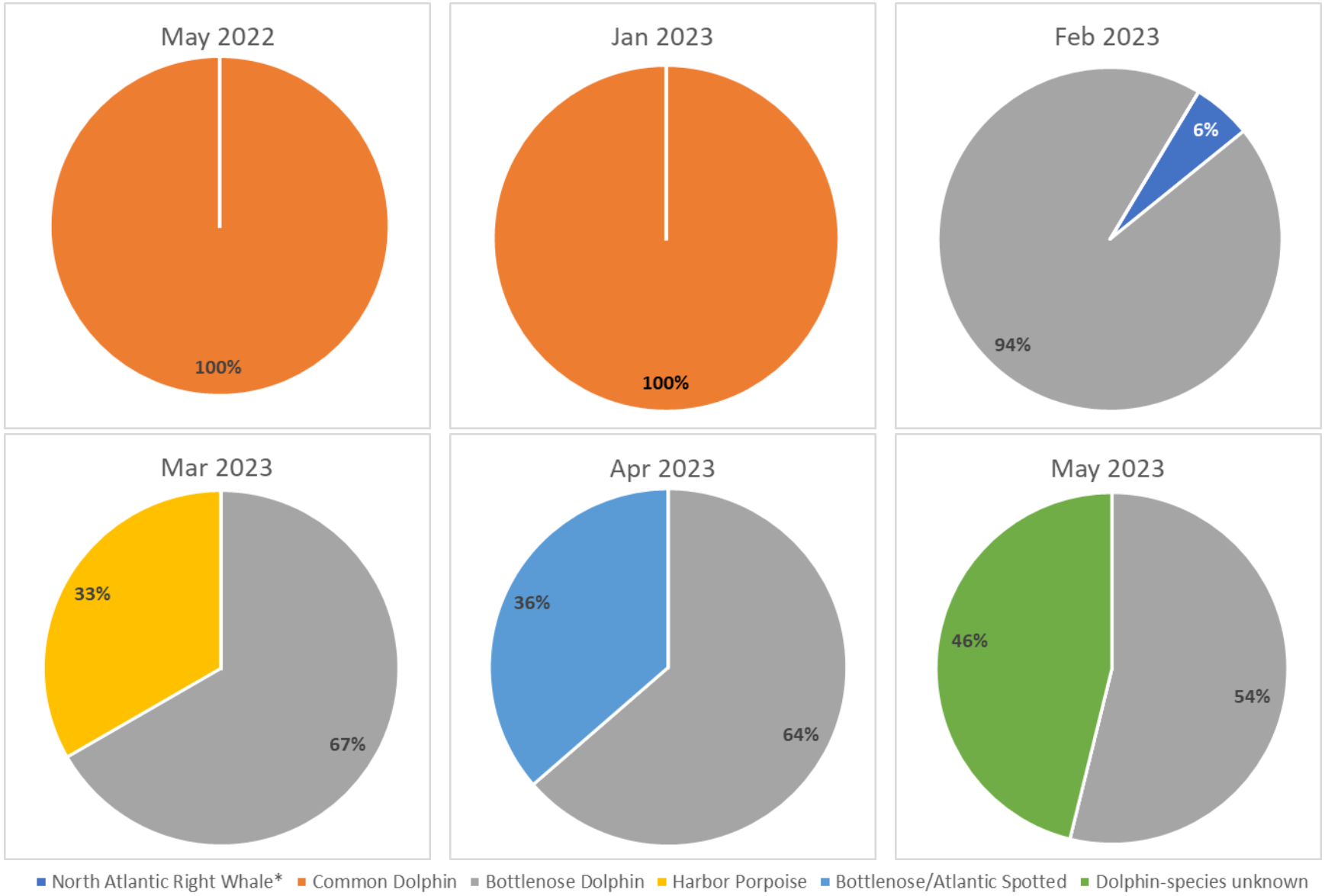


Figure 26. Density per km^2 of marine mammal species found during the May 2022 through May 2023 surveys.

Spatial Distribution

The spatial distribution of all marine mammals found during all surveys is shown in Figure 27. The spatial distribution of individual mammal species for each survey is presented in Appendix G. As mentioned, bottlenose dolphins were the most frequently encountered species and Appendix G maps show that bottlenose dolphins were found widely dispersed across the study area and there is little evidence of avoidance of boat traffic.

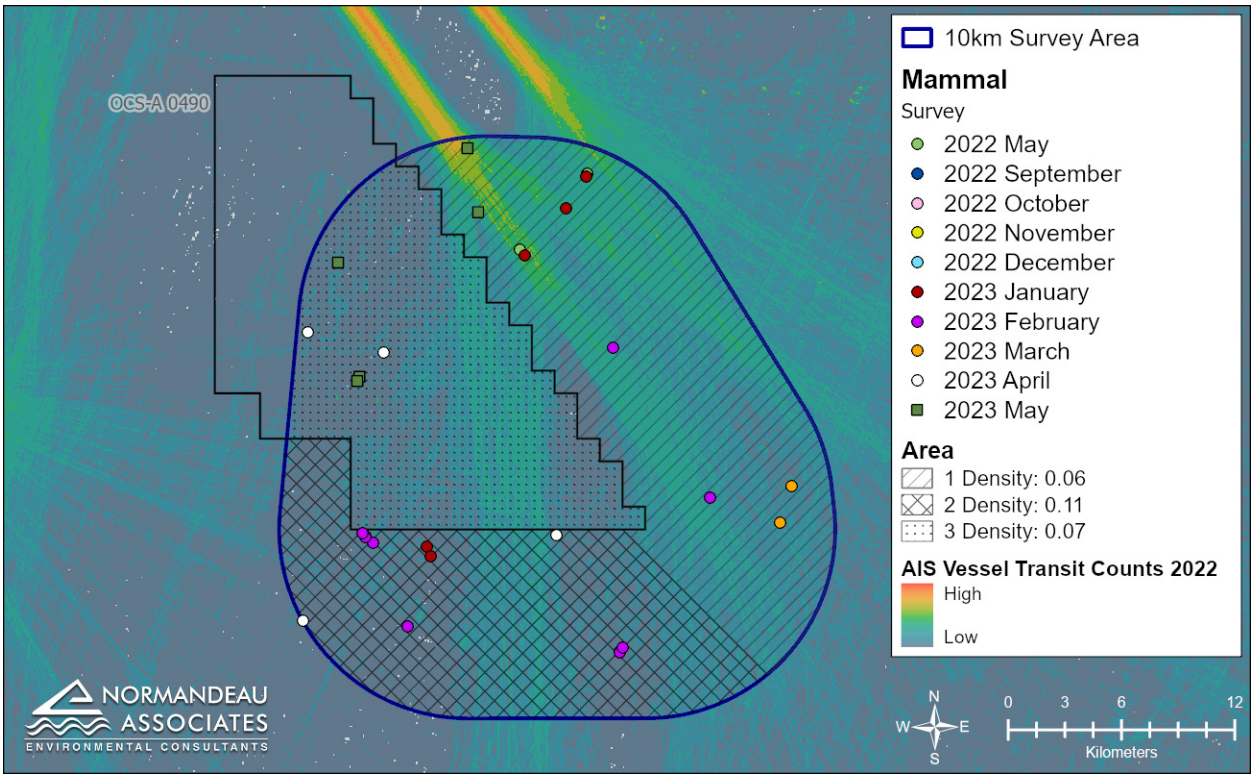


Figure 27. Spatial distribution and density of marine mammal species shown in relationship to the 2022 AIS vessel transit counts during all surveys.

3.8 Rays and Sharks

Species Identification

Raw counts of ray and shark species identified in each survey are presented in Table 21 and Table 22, respectively.

There were 2 giant manta rays (*Manta birostris*) found in the imagery during the September 2022 survey, none of which were significantly submerged (Table 21). No rays were found in any other survey.

Overall, 14 sharks were observed dominated by hammerhead (unid.) (n=4; 29%), 2 of which were significantly submerged (Table 22). No sharks were seen in the imagery during the November 2022, December 2022, January 2023, February 2023, April 2023, or May 2023 surveys.

During the May 2022 survey there were 5 (36% overall) individuals encountered, 3 of which were Carcharhinidae (unid.) (60% of the survey) with 2 shark-species unknown, both of which were significantly submerged (Table 22).

During the September 2022 survey, 6 sharks (43% overall) were seen and were dominated by hammerhead (unid.) (n=3; 50%) with 2 being significantly submerged. Other species included scalloped hammerhead (*Sphyrna lewini*; n=2; 33%) and shark-species unknown (n=1; 16%), which was significantly submerged (Table 22).

There was only 1 shark (7% overall) observed during the October 2022 survey, which was a hammerhead (unid.) (Table 22).

There were 2 spurdogs (*Squalus acanthias*) (14% overall) observed during the March 2023 survey, neither of which were significantly submerged (Table 22).

Table 21. Rays Identified in Each Survey and Number of Significantly Submerged (SS)

	Raw Counts																				
	May 22		Sep 22		Oct 22		Nov 22		Dec 22		Jan 23		Feb 23		Mar 23		Apr 23		May 23		
Species	SS	#	SS	#	SS	#	SS	#	SS	#	SS	#	SS	#	SS	#	SS	#	SS	#	TOT
Giant Manta Ray*	–	–	–	2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2
TOTAL	–	–	–	2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2

* Listed under the Endangered Species Act

Table 22. Shark Species Identified in Each Survey and Number of Significantly Submerged (SS)

	Raw Counts																				
	May 22		Sep 22		Oct 22		Nov 22		Dec 22		Jan 23		Feb 23		Mar 23		Apr 23		May 23		
Species	SS	#	SS	#	SS	#	SS	#	SS	#	SS	#	SS	#	SS	#	SS	#	SS	#	TOT
Carcharhinidae (unid.)	–	3	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	3
Scalloped Hammerhead*	–	–	–	2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2
Hammerhead (unid.)*	–	–	2	3	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	4
Spurdog	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2	–	–	–	–	2
species unknown	2	2	1	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	3
TOTAL	2	5	3	6	–	1	–	–	–	–	–	–	–	–	–	2	–	–	–	–	14

* Listed under the Endangered Species Act

Species Composition and Density

Ray and shark species identified and the density per km^2 of individuals for each survey are shown in Table 23 and Table 24, respectively.

Giant manta rays (*Manta birostris*) were the only species seen during the September 2022 survey with a density of 0.0262 rays/km^2 (Table 23). Rays were not observed in any other survey.

The overall density of sharks was greatest during the September 2022 survey with 0.0787 sharks/km^2, or 43% of all surveys (Table 24). The dominant species during this survey was hammerhead (unid.) with 0.0393 sharks/km^2 (49%) followed by scalloped hammerhead (0.0262; 33%) and shark-species unknown (0.0131; 17%) (Table 24, Figure 28). Scalloped hammerhead sharks were only seen during this survey.

The second highest density of sharks was during the May 2022 survey with 0.0640 sharks/km^2 (36%) (Table 24, Figure 28). This survey was dominated by Carcharhinidae (unid.) with 0.0384 sharks/km^2 (60%) followed by shark-species unknown (0.0256; 40%) (Table 24, Figure 28). Carcharhinidae (unid.) were only found during this survey.

There was only 1 shark species seen during the October 2022 survey, which was a hammerhead (unid.) with 0.0131 sharks/km^2 (7% of all surveys) (Table 24, Figure 28).

During the March 2023 survey, 2 spurdogs (0.0256 sharks/km^2; 14% overall) were observed (Table 24, Figure 28). This species was not observed during any other survey.

No sharks were found during the November 2022, December 2022, January 2023, February 2023, April 2023, or May 2023 surveys (Table 24).

Table 23. Density (D [per km^2]) and Percent of Total Ray Species Identified in All Surveys

Species	May 22		Sep 22		Oct 22		Nov 22		Dec 22		Jan 23		Feb 23		Mar 23		Apr 23		May 23		Species Total
	D	%	D	%	D	%	D	%	D	%	D	%	D	%	D	%	D	%	D	%	
Giant Manta Ray*	–	–	0.0262	100.00	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.0262
TOTAL	–	**–**	**0.0262**	**100.00**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**0.0262**

* Listed under the Endangered Species Act

Table 24. Density (D [per km^2]) and Percent of Total Shark Species Identified in All Surveys

Species	May 22		Sep 22		Oct 22		Nov 22		Dec 22		Jan 23		Feb 23		Mar 23		Apr 23		May 23		Species Total
	D	%	D	%	D	%	D	%	D	%	D	%	D	%	D	%	D	%	D	%	
Carcharhinidae (unid.)	0.0384	100.00	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.0384
Scalloped Hammerhead*	–	–	0.0262	100.00	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.0262
Hammerhead (unid.)*	–	–	0.0393	75.00	0.0131	25.00	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.0524
Spurdog	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.0256	100.00	–	–	–	–	0.0256
species unknown	0.0256	66.67	0.0131	33.33	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.0387
Total	**0.0640**	**35.71**	**0.0787**	**42.86**	**0.0131**	**7.14**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**0.0256**	**14.29**	**–**	**–**	**–**	**–**	**0.1813**

* Listed under the Endangered Species Act

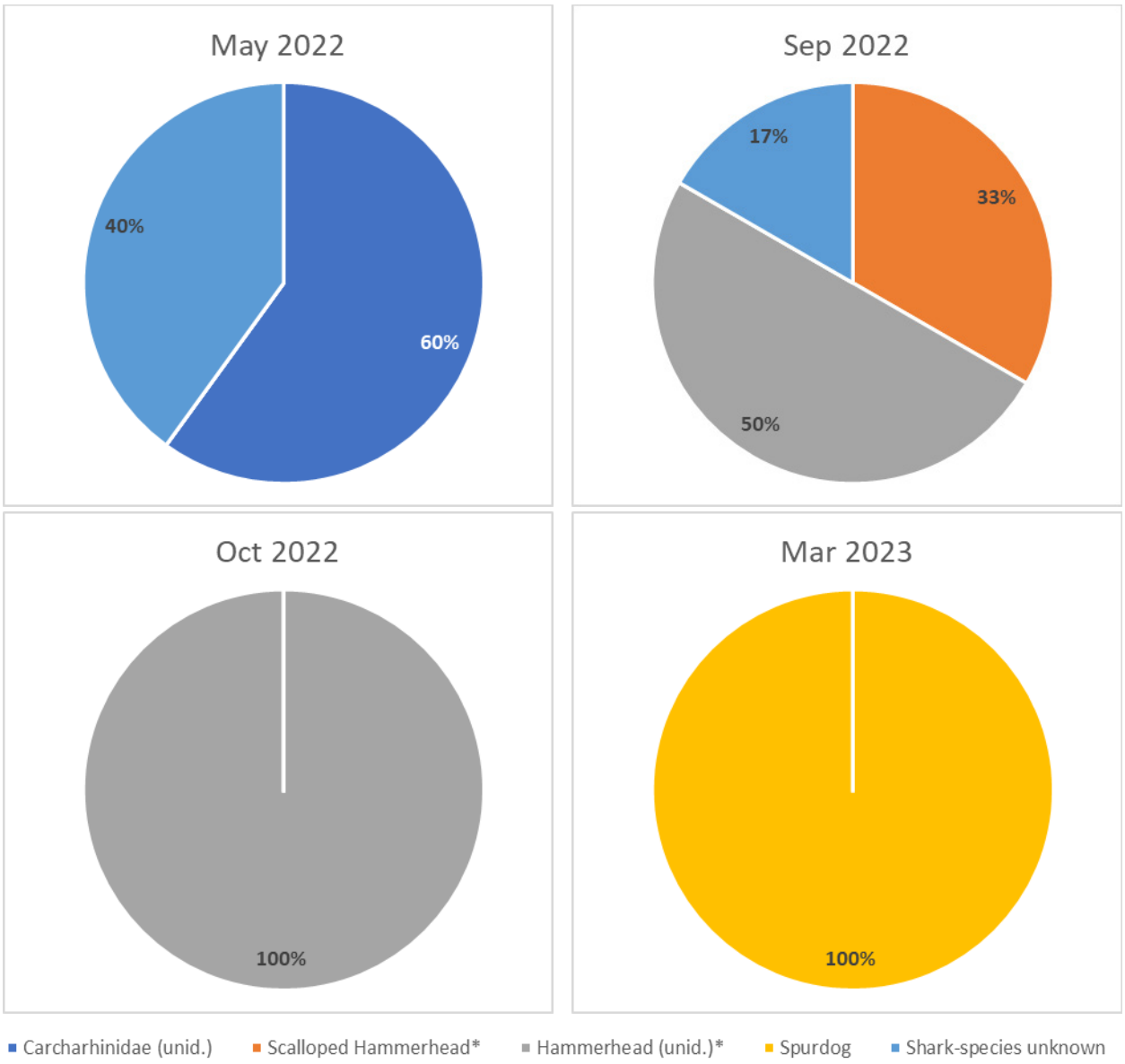


Figure 28. Density per km^2 of shark species found during the May 2022 through May 2023 surveys.

Spatial Distribution

The spatial distribution of rays and sharks found during all surveys is shown in Figure 29 and Figure 30, respectively. Both rays were giant manta ray and were within the lease area in September 2022. Sharks were found both within and outside of the lease area although none were found directly south of the lease area. With recognition of the low number of individuals encountered, there is no evidence of distinct spatial patterns, or evidence of avoidance of active boat traffic routes. Spatial distribution of individual species of rays and sharks is shown in Appendix H.

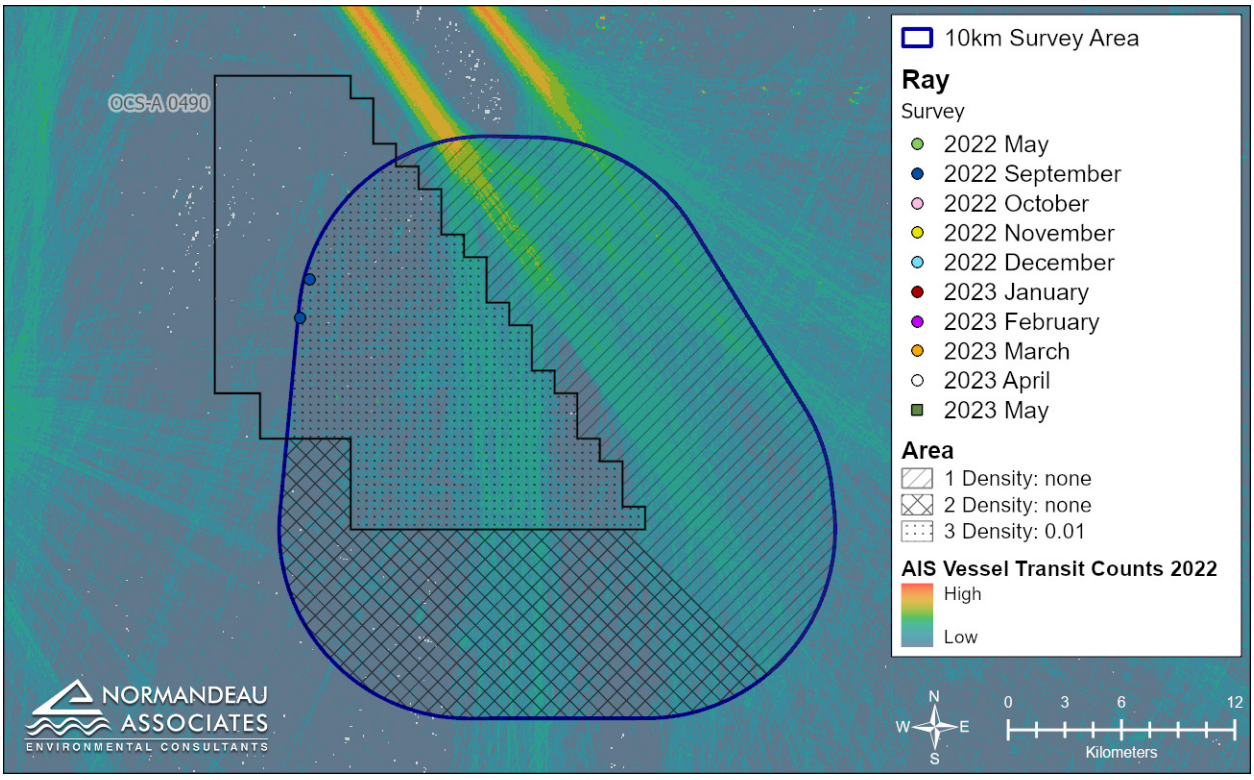


Figure 29. Spatial distribution and density of all ray species shown in relationship to 2022 AIS vessel transit counts during all surveys.

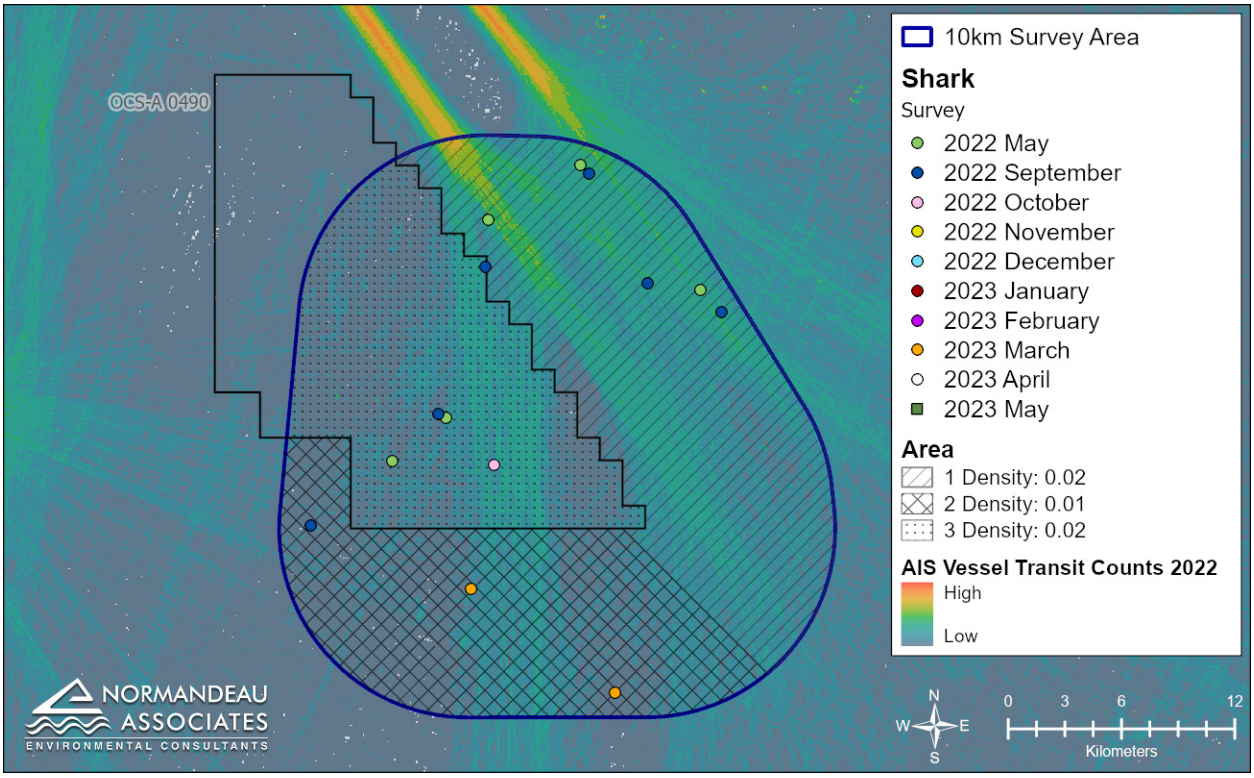


Figure 30. Spatial distribution and density of all shark species shown in relationship to 2022 AIS vessel transit counts during all surveys.

3.9 Large Bony Fishes

Species Identification

Raw counts of large bony fishes identified in all surveys are presented in Table 25. Over all surveys, 92 individuals represented 3 species and 3 unknown species groups. The identification success rate was 27% for this taxonomic group, with 1 individual significantly submerged (Table 25).

Of the 8 individuals recorded during the May 2022 survey, 2 (25%) were identified to species with Atlantic bluefin tuna (*Thunnus thynnus*) representing 100% of the identified species. Of the 6 remaining individuals (tuna-species unknown), only 1 (16%) was significantly submerged (Table 25).

The most dominant survey was September 2022 with 60 (65%) individuals encountered (Table 25). During this survey, only 1 of the 60 individuals was ascribed to a species (<2%) (mahi–mahi [*Coryphaena hippurus*]). Of the 59 individuals not identified to species (tuna-species unknown and remora-species unknown), none were significantly submerged (Table 25).

For the October 2022 survey, 2 (2.3%) individuals were found with 1 ascribed to species (ocean sunfish [*Mola mola*]) and 1 as sunfish-species unknown (Table 25). Neither individual was significantly submerged.

During the November 2022 survey, 100% (n=15) of the individuals were identified to species level including 1 Atlantic bluefin tuna (7%) and 14 ocean sunfish (*Mola mola;* 93%) (Table 25). None of these individuals were significantly submerged.

For the December 2022 survey, only 1 individual was seen and was ascribed to species (ocean sunfish). It was not significantly submerged (Table 25).

During March 2023, 6 individuals of tuna were observed and 5 (83%) were identified as Atlantic bluefin tuna and 1 (17%) as tuna-species unknown. None of these individuals were significantly submerged (Table 25).

No large bony fishes were seen during the January 2023, February 2023, April 2023, or May 2023 surveys (Table 25).

Table 25. Large Bony Fishes Identified and Number of Significantly Submerged (SS) in Each Survey

	Raw Counts																				
	May 22		Sep 22		Oct 22		Nov 22		Dec 22		Jan 23		Feb 23		Mar 23		Apr 23		May 23		
Species	SS	#	SS	#	SS	#	SS	#	SS	#	SS	#	SS	#	SS	#	SS	#	SS	#	TOT
Mahi–Mahi	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1
Mahi–Mahi	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1
Tuna	1	8	–	58	–	–	–	1	–	–	–	–	–	–	–	6	–	–	–	–	73
Atlantic bluefin tuna *	–	2	–	–	–	–	–	1	–	–	–	–	–	–	–	5	–	–	–	–	8
species unknown	1	6	–	58	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	65
Sunfish	–	–	–	–	–	2	–	14	–	1	–	–	–	–	–	–	–	–	–	–	17
Ocean Sunfish	–	–	–	–	–	1	–	14	–	1	–	–	–	–	–	–	–	–	–	–	16
species unknown	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1
Remora	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1
Remora unid.	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1
Totals	1	8	–	60	–	2	–	15	–	1	–	–	–	–	–	6	–	–	–	–	92

* Listed under the Endangered Species Act

Species Composition and Density

The identity and density of large bony fishes (per km^2) for each survey is shown in Table 26 and Figure 31.

The May 2022 survey had an overall density of 0.1024 large bony fishes/km^2 (9% of the total) and was dominated by tuna-species unknown (0.0768 per km^2; 75% of the survey). Diversity was low with just 1 tuna species and 1 tuna-species unknown group identified (Table 26, Figure 31).

The September 2022 survey had the greatest density of all surveys with 65% (0.7866 large bony fishes/km^2) of the total. This survey was dominated by tuna-species unknown (0.7604 per km^2; 97%) followed by mahi-mahi and remora-species unid. each with (0.0131 per km^2; 1.7%) (Table 26, Figure 31). This is the only survey when mahi-mahi and remora-species unid. were observed.

During the October 2022 survey, the density of 0.0262 large bony fishes/km^2 accounted for 2.17% of all surveys (Table 26, Figure 31). Two sunfish species (ocean sunfish and sunfish-

species unknown) were observed during this survey each representing 0.0131 per km^2 (Table 26, Figure 31). This is the only survey when sunfish-species unknown were observed.

November 2022 had the second highest density of all surveys with 16.3% (0.1966 large bony fishes/ km^2) of the total (Table 26, Figure 31). Ocean sunfish (0.1835 per km^2; 93% of the survey) was dominant followed by the only other species encountered, Atlantic bluefin tuna (0.0131 per km^2; 7%) (Table 26, Figure 31). Diversity was highest during this survey with 2 species identified.

The lowest density of all surveys was during the December 2022 survey with 1.09% (0.0131 large bony fishes/km^2) of the total (Table 26, Figure 31). Ocean sunfish was the only species encountered (Table 26, Figure 31).

During the March 2023 survey, 0.0767 large bony fishes/km^2 (6.5%) were observed. The dominant species was Atlantic bluefin tuna (0.0639 large bony fishes/km^2; 83%). The only other species/species groups observed as tuna-species unknown (0.0128 large bony fishes/km^2; 17%) (Table 26, Figure 31).

There were no large bony fishes seen during the January 2023, February 2023, April 2023, or May 2023 surveys (Table 26).

Table 26. Density (D [per km^2]) and Percent of Total Large Bony Fish Species Identified in All Surveys

Species	May 22		Sep 22		Oct 22		Nov 22		Dec 22		Jan 23		Feb 23		Mar 23		Apr 23		May 23		Species Total
	D	%	D	%	D	%	D	%	D	%	D	%	D	%	D	%	D	%	D	%	
Mahi–Mahi																					
Mahi–Mahi	–	–	0.0131	100.00	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.0131
Tuna																					
Atlantic bluefin tuna*	0.0256	25.00	–	–	–	–	0.0131	12.50	–	–	–	–	–	–	0.0639	62.5	–	–	–	–	0.1026
species unknown	0.0768	9.23	0.7604	89.23	–	–	–	–	–	–	–	–	–	–	0.0128	1.54	–	–	–	–	0.8499
Sunfish																					
Ocean Sunfish	–	–	–	–	0.0131	6.25	0.1835	87.50	0.0131	6.25	–	–	–	–	–	–	–	–	–	–	0.2098
species unknown	–	–	–	–	0.0131	100.00	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.0131
Remora																					
Remora unid.	–	–	0.0131	100.00	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.0131
TOTAL	**0.1024**	**8.70**	**0.7866**	**65.22**	**0.0262**	**2.17**	**0.1966**	**16.30**	**0.0131**	**1.09**	**–**	**–**	**–**	**–**	**0.0767**	**6.52**	**–**	**–**	**–**	**–**	**1.2016**

* Listed under the Endangered Species Act

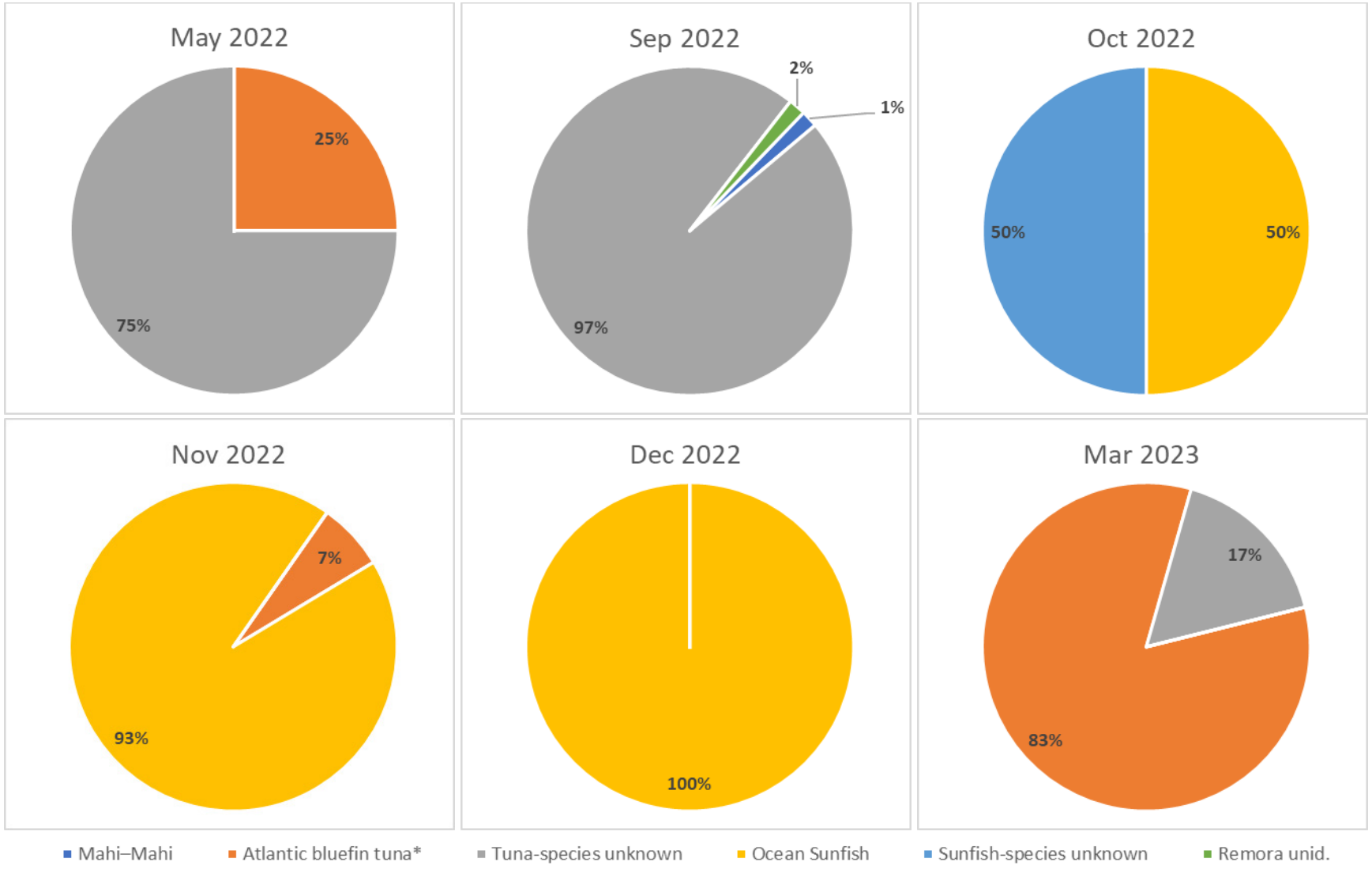


Figure 31. Density per km^2 of large bony fish species found during the May 2022 through May 2023 surveys.

Spatial Distribution

The spatial distribution of all large bony fishes found during the May 2022 through May 2023 surveys is shown in Figure 32. With recognition of the low number of individuals encountered, there is no evidence of distinct spatial patterns or evidence of avoidance of active boat traffic routes. The spatial distribution of individual species is shown in Appendix I.

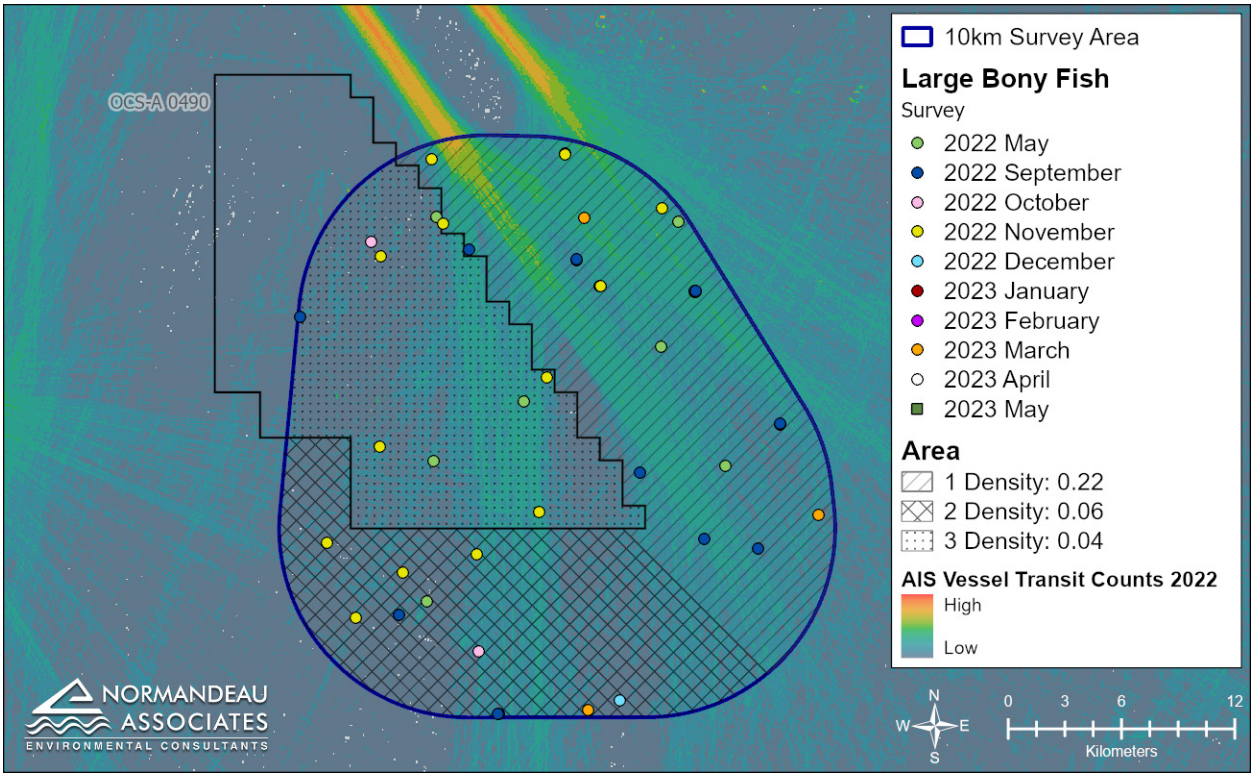


Figure 32. Spatial distribution and density of all large bony fish species shown in relationship to 2022 AIS vessel transit counts during all surveys.

3.10 Threatened and Endangered Species

Species Identification

The categorization of ESA or State-listed species was conservative, incorporating "*Sterna* tern" (possibly representing roseate tern), "hammerhead (unid.)" (possibly representing scalloped hammerhead), and "turtle-species unknown" (possibly representing all endangered turtles). Raw counts of ESA or State-listed species identified in each survey are presented in Table 27.

There were 67 ESA or State-listed species found in the imagery across all surveys (Table 27). Turtles accounted for 69% of the encounters with 46 observations. Of the 46 turtles, 52% (n=24) were identified as loggerhead turtles. The September 2022 survey had the most turtles with 19 (41%) followed by October 2022 (n=17; 37%) and November 2022 (n=7; 15%). One green turtle was seen in November 2022, the only survey in which it was observed. One turtle-species unknown was observed in December 2022 and was the only turtle seen. Two turtle-species unknown were observed in May 2023 and were the only turtles seen. There were no turtles in the May 2022, January 2023, February 2023, March 2023, April 2023 surveys (Table 27).

Shark species represented 9% (n=6) of the ESA and State-listed species seen in all surveys. This group was dominated by hammerhead (unid.) with 67% (n=4) of the total and were seen in the September 2022 (n=3) and October 2022 (n=1) surveys. Scalloped hammerhead sharks represented 34% (n=2) and were seen in the September 2022 survey (Table 27). No other surveys had shark species encountered.

Of the 8 Atlantic bluefin tuna observed (12% of the total), 25% (n=2) were recorded during the May 2022 survey, 13% (n=1) during the November 2022 survey, and 63% (n=5) were observed during March 2023. No observations were made during the September 2022, October 2022, December 2022, January 2023, February 2023, April 2023, or May 2023 surveys (Table 27).

Two giant manta rays (3% of the total) were seen with 100% of the occurrences during the September 2022 survey (Table 27).

Sterna terns consisted of 6% (n=4) of the observations of listed species but they were not identified to species level. All occurrences were recorded during the May 2022 survey (Table 27). There were no other observations.

One North Atlantic right whale (1.5%) was observed during the February 2023 survey. No other occurrences were observed (Table 27).

Table 27. ESA and State–listed Species Identified in Each Survey

Subtype	Species/Species Group	May 22	Sep 22	Oct 22	Nov 22	Dec 22	Jan 23	Feb 23	Mar 23	Apr 23	May 23	Total
Sterna Tern	species unknown	4	–	–	–	–	–	–	–	–	–	4
Whale	North Atlantic Right Whale	–	–	–	–	–	–	1	–	–	–	1
Turtle	Leatherback Turtle	–	1	2	1	–	–	–	–	–	–	4
Turtle	Loggerhead Turtle	–	14	7	3	–	–	–	–	–	–	24
Turtle	Loggerhead/Kemp's Turtle	–	2	4	–	–	–	–	–	–	–	6
Turtle	Green Turtle	–	–	–	1	–	–	–	–	–	–	1
Turtle	Kemp's Ridley Turtle	–	1	2	–	–	–	–	–	–	–	3
Turtle	species unknown	–	1	2	2	1	–	–	–	–	2	8
Shark	Scalloped Hammerhead	–	2	–	–	–	–	–	–	–	–	2
Shark	Hammerhead (unid.)	–	3	1	–	–	–	–	–	–	–	4
Ray	Giant Manta Ray	–	2	–	–	–	–	–	–	–	–	2
Tuna	Atlantic bluefin tuna	2	–	–	1	–	–	–	5	–	–	8
TOTAL		**6**	**26**	**18**	**8**	**1**	**—**	**1**	**5**	**—**	**2**	**67**

Species Composition and Density

ESA and State-listed species identified and the density per km^2 for each survey is listed in Table 28. The overall density of ESA and State-listed species was 0.8739 individuals/km^2. Across all surveys, 39% (0.3408 individuals/km^2) of the observations of listed species occurred during the September 2022 survey with October 2022 being the next highest period representing 27% (0.2360 individuals/km^2) (Table 28). These numbers are mainly driven by the most frequently observed species (identified to species): loggerhead turtle, which consisted of 36% (0.3146 per km^2) of the total number of observations of listed species. Loggerhead turtles were seen in

September 2022 (58%), October 2018 (29%), and November (13%) (Table 28). Loggerhead/ Kemp's ridley turtle species blend accounted for another 9% (0.0787 per km^2) of the listed species. Hammerhead (unid.) sharks comprised 6% (0.0524 per km^2) of the total observations of listed species and were seen in September 2022 (0.0393 per km^2) and October 2022 (0.0131 per km^2) surveys (Table 28). Atlantic bluefin tuna represented 12% (0.1026 per km^2) of observations of listed species and was seen during the May 2022 (0.0256 per km^2), November 2022 (0.0131 per km^2), and March 2023 (0.0639 per km^2) surveys (Table 28).

4 Discussion

Within this annual report one or two patterns appear to stand out that will be of interest to the overall purpose of the Project. Monitoring the density and distribution of loons and comparing differences between each year prior to the TSS extension will provide greater insight into the effects of boat traffic on these birds. It will be of value to analyse a further 10% of collected data to obtain a more robust dataset to compare distributions and densities, particularly before the TSS is extended and before construction is in full swing.

Table 28. Density (D [per km^2]) and Percent of Total Threatened and Endangered Species Identified in All Surveys

Species	May 22		Sep 22		Oct 22		Nov 22		Dec 22		Jan 23		Feb 23		Mar 23		Apr 23		May 23		Species Total
	D	%	D	%	D	%	D	%	D	%	D	%	D	%	D	%	D	%	D	%	
***Sterna* Tern**																					
species unknown	0.0512	100.00	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.0512
Whale																					
North Atlantic Right Whale*	–	–	–	–	–	–	–	–	–	–	–	–	0.0128	100.00	–	–	–	–	–	–	0.0128
Turtle																					
Leatherback Turtle*	–	–	0.0131	25.00	0.0262	50.00	0.0131	25.00	–	–	–	–	–	–	–	–	–	–	–	–	0.0524
Loggerhead Turtle*	–	–	0.1835	58.33	0.0918	29.17	0.0393	12.50	–	–	–	–	–	–	–	–	–	–	–	–	0.3146
Loggerhead/Kemp's Turtle*	–	–	0.0262	33.33	0.0524	66.67	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.0787
Green Turtle*	–	–	–	–	–	–	0.0131	100.00	–	–	–	–	–	–	–	–	–	–	–	–	0.0131
Kemp's Ridley Turtle*	–	–	0.0131	33.33	0.0262	66.67	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.0393
species unknown	–	–	0.0131	12.50	0.0262	25.00	0.0262	25.00	0.0131	12.50	–	–	–	–	–	–	–	–	0.0256	25.00	0.1043
Shark																					
Scalloped Hammerhead*	–	–	0.0262	100.00	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.0262
Hammerhead (unid.)*	–	–	0.0393	75.00	0.0131	25.00	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.0524
Ray																					
Giant Manta Ray*	–	–	0.0262	100.00	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.0262
Tuna																					
Atlantic bluefin tuna*	0.0256	25.00	–	–	–	–	0.0131	12.50	–	–	–	–	–	–	0.0639	62.50	–	–	–	–	0.1026
TOTAL	**0.0768**	**8.96**	**0.3408**	**38.81**	**0.2360**	**26.87**	**0.1049**	**11.94**	**0.0131**	**1.49**	**–**	**–**	**0.0128**	**1.49**	**0.0639**	**7.46**	**–**	**–**	**0.0256**	**2.99**	**0.8739**

5 References

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Appendix A: List of Species Found During All Surveys (Taxonomic Order)

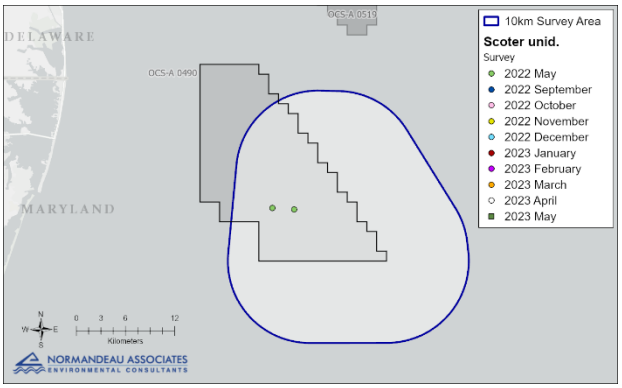
Common Name	Scientific Name	Class	Family
Red Phalarope	*Phalaropus fulicarius*	Aves	Scolopacidae
Pomarine Jaeger	*Stercorarius pomarinus*	Aves	Stercorariidae
Dovekie	*Alle alle*	Aves	Alcidae
Razorbill	*Alca torda*	Aves	Alcidae
Black-legged Kittiwake	*Rissa tridactyla*	Aves	Laridae
Bonaparte's Gull	*Chroicocephalus philadelphia*	Aves	Laridae
Laughing Gull	*Leucophaeus atricilla*	Aves	Laridae
Herring Gull	*Larus argentatus*	Aves	Laridae
Iceland Gull	*Larus glaucoides*	Aves	Laridae
Lesser Black-backed Gull	*Larus fuscus*	Aves	Laridae
Great Black-backed Gull	*Larus marinus*	Aves	Laridae
Common Tern	*Sterna hirundo*	Aves	Laridae
Arctic Tern	*Sterna paradisaea*	Aves	Laridae
Forster's Tern	*Sterna forsteri*	Aves	Laridae
Red-throated Loon	*Gavia stellata*	Aves	Gaviidae
Common Loon	*Gavia immer*	Aves	Gaviidae
Northern Fulmar	*Fulmarus glacialis*	Aves	Procellariidae
Sooty Shearwater	*Ardenna grisea*	Aves	Procellariidae
Manx Shearwater	*Puffinus puffinus*	Aves	Procellariidae
Northern Gannet	*Morus bassanus*	Aves	Sulidae
North Atlantic Right Whale	*Eubalaena glacialis*	Mammalia	Balaenidae
Common Dolphin	*Delphinus delphis*	Mammalia	Delphinidae
Bottlenose Dolphin	*Tursiops truncatus*	Mammalia	Delphinidae
Harbor Porpoise	*Phocoena phocoena*	Mammalia	Phocoenidae
Leatherback Turtle	*Dermochelys coriacea*	Reptilia	Dermochelyidae
Loggerhead Turtle	*Caretta caretta*	Reptilia	Cheloniidae
Green Turtle	*Chelonia mydas*	Reptilia	Cheloniidae
Kemp's Ridley Turtle	*Lepidochelys kempii*	Reptilia	Cheloniidae
Scalloped Hammerhead	*Sphyrna lewini*	Chondrichthyes	Sphyrnidae
Spurdog	*Squalus acanthias*	Chondrichthyes	Squalidae
Giant Manta Ray	*Manta birostris*	Chondrichthyes	Mobulidae
Mahi-Mahi	*Coryphaena hippurus*	Actinopterygii	Coryphaenidae
Atlantic bluefin tuna	*Thunnus thynnus*	Actinopterygii	Scombridae
Ocean Sunfish	*Mola Mola*	Actinopterygii	Molidae
Remora unid.	*Echeneidae*	Actinopterygii	Echeneidae

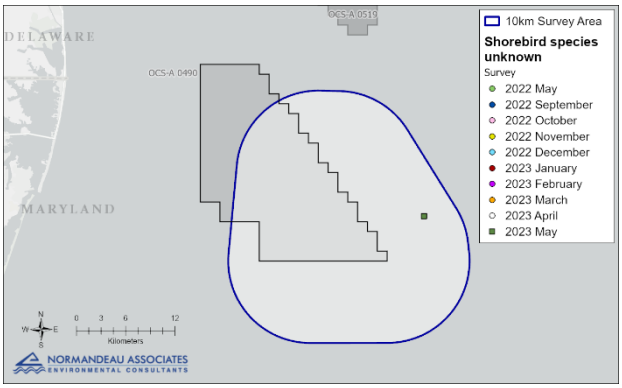
Appendix B: Avian Species Identified in Each Survey

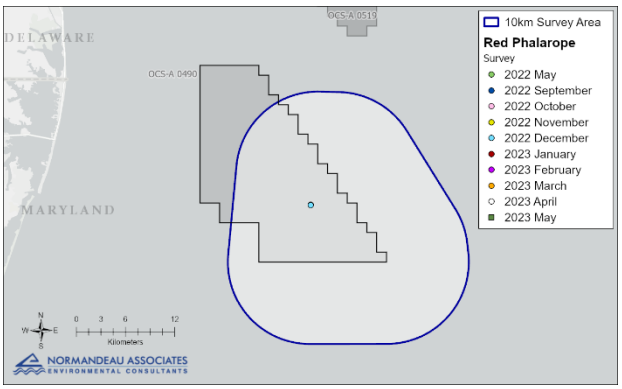
Species	Raw Counts										Total
	May 22	Sep 22	Oct 22	Nov 22	Dec 22	Jan 23	Feb 23	Mar 23	Apr 23	May 23	
Duck	**2**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**2**
Scoter unid.	2	–	–	–	–	–	–	–	–	–	2
Shorebird	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**4**	**4**
species unknown	–	–	–	–	–	–	–	–	–	4	4
Phalarope	**–**	**–**	**–**	**–**	**2**	**–**	**–**	**–**	**–**	**–**	**2**
Red Phalarope	–	–	–	–	2	–	–	–	–	–	2
Skua	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**1**	**1**
Pomarine Jaeger	–	–	–	–	–	–	–	–	–	1	1
Auk	**–**	**–**	**–**	**–**	**–**	**110**	**50**	**51**	**–**	**3**	**214**
Dovekie	–	–	–	–	–	10	46	–	–	–	56
Common/Thick-billed Murre	–	–	–	–	–	4	4	26	–	–	34
Razorbill	–	–	–	–	–	90	–	13	–	3	106
Murre/Razorbill	–	–	–	–	–	1	–	12	–	–	13
species unknown	–	–	–	–	–	5	–	–	–	–	5
Gull	**11**	**–**	**1**	**521**	**663**	**112**	**28**	**170**	**62**	**79**	**1,647**
Black-legged Kittiwake	–	–	–	–	–	45	–	2	–	–	47
Bonaparte's Gull	–	–	–	514	652	7	1	158	16	–	1,348
Laughing Gull	9	–	1	2	–	–	–	–	2	12	26
Herring Gull	–	–	–	–	–	31	13	6	31	34	115
Iceland Gull	–	–	–	–	–	–	1	–	–	–	1
Lesser Black-backed Gull	–	–	–	–	–	–	–	1	7	15	23
Great Black-backed Gull	2	–	–	2	7	29	13	2	4	12	71
species unknown - Large	–	–	–	–	–	–	–	–	2	6	8
species unknown - Small	–	–	–	3	4	–	–	1	–	–	8
***Sterna* Tern**	**16**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**16**	**32**
Common Tern	–	–	–	–	–	–	–	–	–	3	3
Arctic Tern	–	–	–	–	–	–	–	–	–	7	7
Commic Tern	–	–	–	–	–	–	–	–	–	6	6
Forster's Tern	1	–	–	–	–	–	–	–	–	–	1
Commic/Forster's Tern	11	–	–	–	–	–	–	–	–	–	11
species unknown	4	–	–	–	–	–	–	–	–	–	4
Loon	**68**	**–**	**–**	**19**	**68**	**44**	**28**	**107**	**109**	**139**	**582**
Red-throated Loon	8	–	–	–	–	–	1	63	17	1	90
Common Loon	59	–	–	19	68	44	27	41	89	137	484

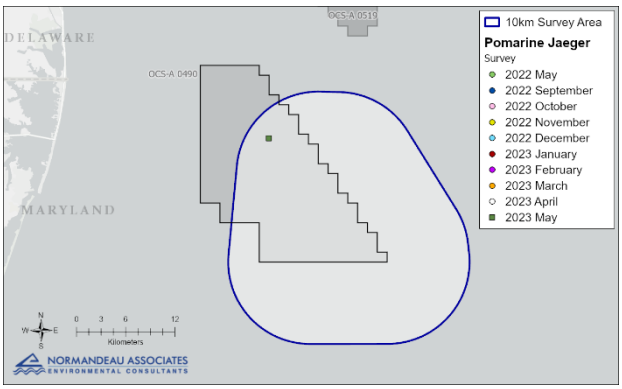
Species	Raw Counts										Total
	May 22	Sep 22	Oct 22	Nov 22	Dec 22	Jan 23	Feb 23	Mar 23	Apr 23	May 23	
species unknown	1	–	–	–	–	–	–	3	3	1	8
Storm-petrel	**1**	**2**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**3**
species unknown	1	2	–	–	–	–	–	–	–	–	3
Fulmar	**–**	**–**	**–**	**–**	**–**	**5**	**–**	**–**	**–**	**–**	**5**
Northern Fulmar	–	–	–	–	–	5	–	–	–	–	5
Shearwater	**1**	**–**	**–**	**–**	**1**	**–**	**–**	**–**	**–**	**2**	**4**
Sooty Shearwater	1	–	–	–	–	–	–	–	–	–	1
Manx Shearwater	–	–	–	–	1	–	–	–	–	–	1
species unknown	–	–	–	–	–	–	–	–	–	2	2
Gannet	**3**	**–**	**–**	**4**	**–**	**18**	**5**	**36**	**3**	**–**	**69**
Northern Gannet	3	–	–	4	–	18	5	36	3	–	69
Unid. Avian	**4**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**4**
species unknown	4	–	–	–	–	–	–	–	–	–	4
Total	**106**	**2**	**1**	**544**	**734**	**289**	**111**	**364**	**174**	**244**	**2,569**

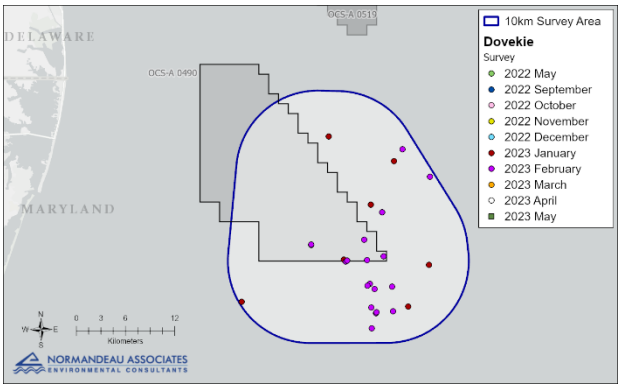
Appendix C: Spatial Distribution for Each Bird Species for Each Survey

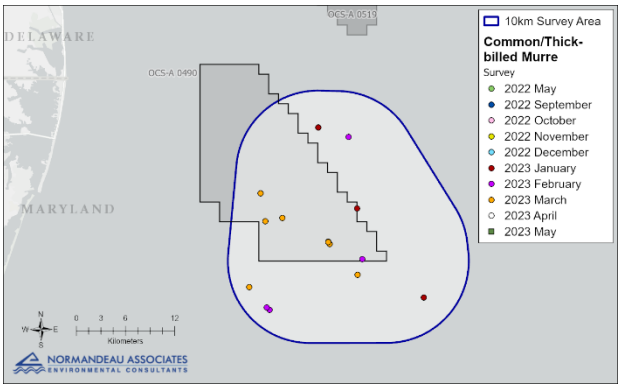


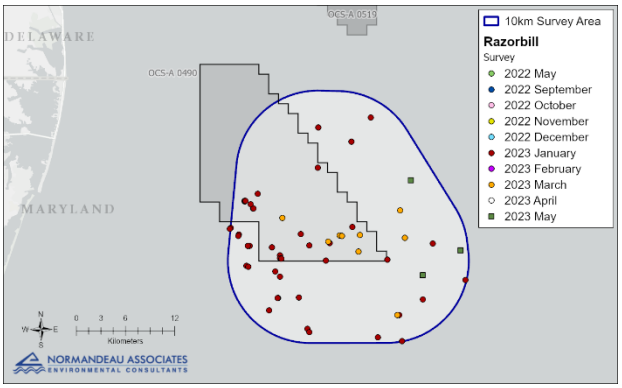


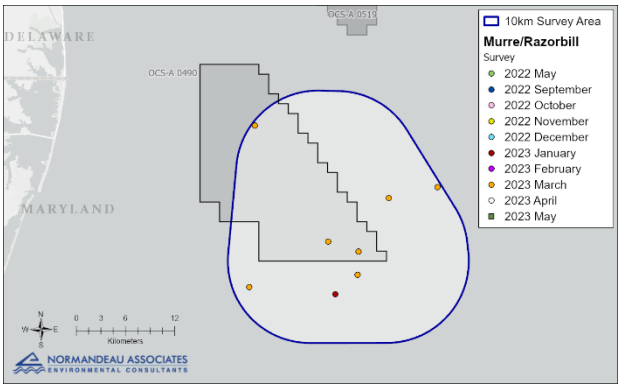


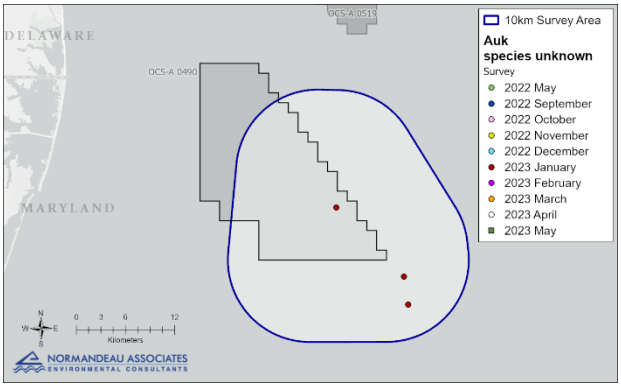








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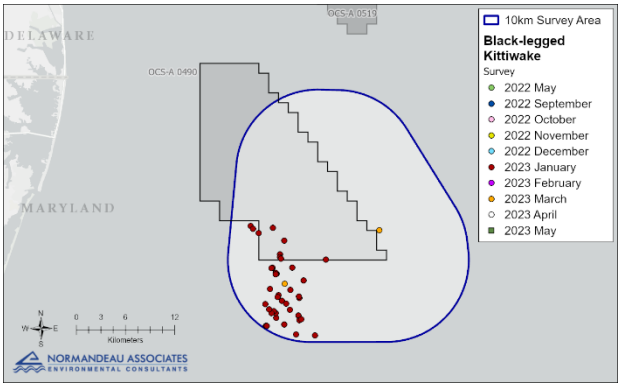
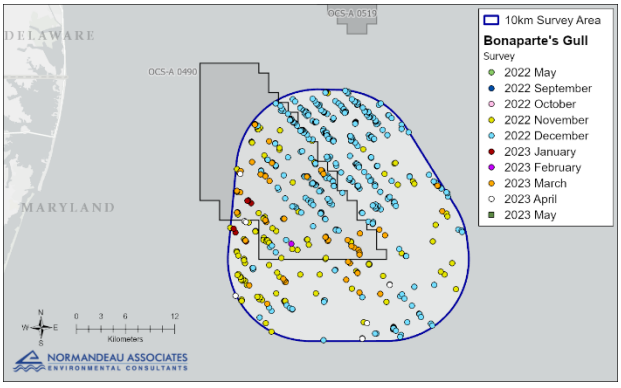
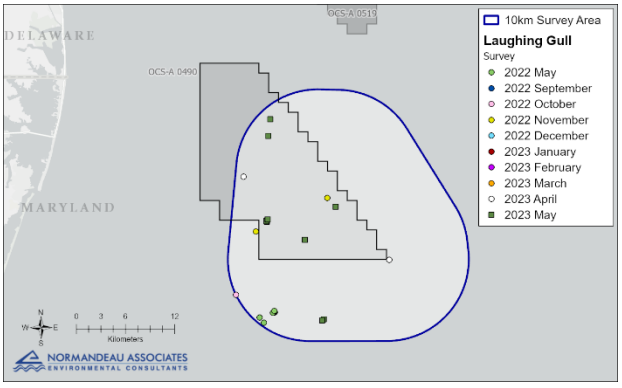
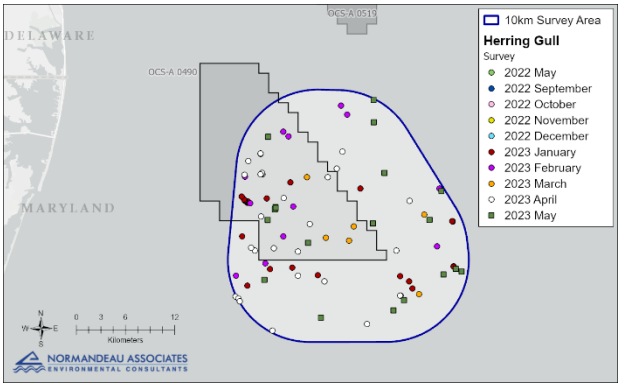
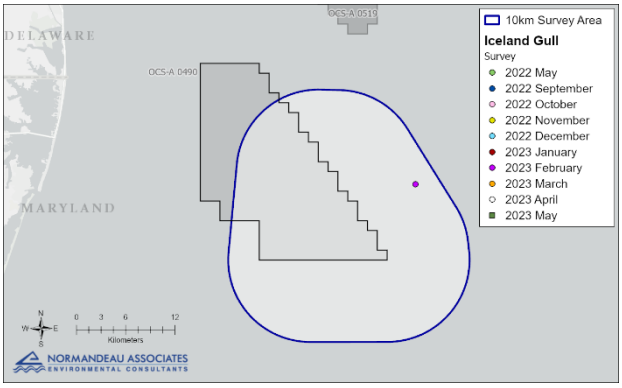
Auk species unknown
Survey
2022 May
2022 September
2022 October
2022 November
2022 December
2023 January
2023 February
2023 March
2023 April
2023 May
DELAWARE
MARYLAND
OCS-A 0490
OCS-A 0519
Kilometers
NORMANDEAU ASSOCIATES
ENVIRONMENTAL CONSULTANTS

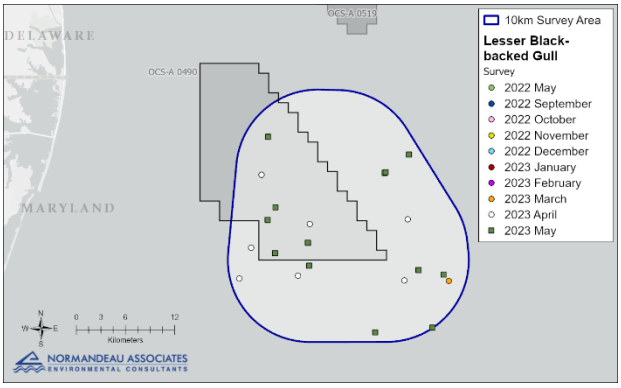

10km Survey Area
Black-legged Kittiwake
Survey
2022 May
2022 September
2022 October
2022 November
2022 December
2023 January
2023 February
2023 March
2023 April
2023 May
DELAWARE
MARYLAND
OCS-A 0490
OCS-A 0519
Kilometers
NORMANDEAU ASSOCIATES
ENVIRONMENTAL CONSULTANTS

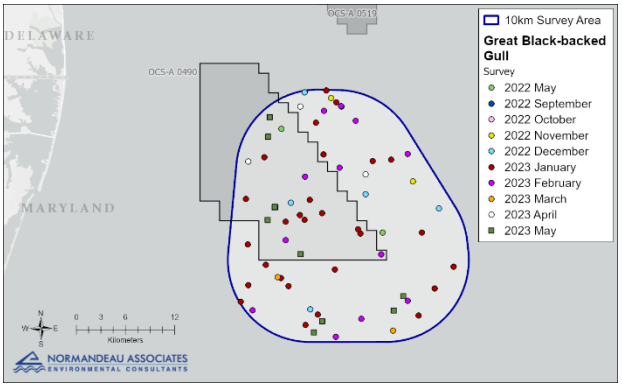

10km Survey Area
Bonaparte's Gull
Survey
2022 May
2022 September
2022 October
2022 November
2022 December
2023 January
2023 February
2023 March
2023 April
2023 May
DELAWARE
MARYLAND
OCS-A 0490
OCS-A 0519
Kilometers
NORMANDEAU ASSOCIATES
ENVIRONMENTAL CONSULTANTS

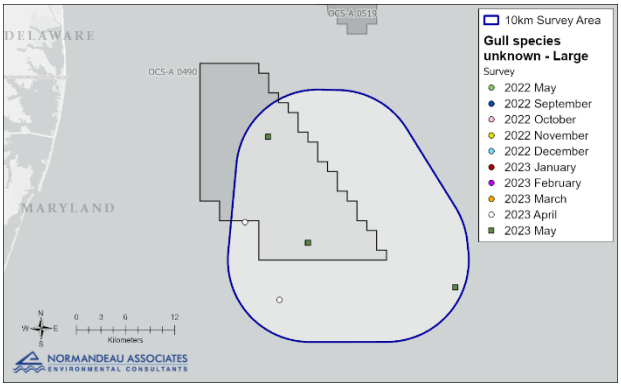

10km Survey Area
Laughing Gull
Survey
2022 May
2022 September
2022 October
2022 November
2022 December
2023 January
2023 February
2023 March
2023 April
2023 May
DELAWARE
MARYLAND
OCS-A 0490
OCS-A 0519
Kilometers
NORMANDEAU ASSOCIATES
ENVIRONMENTAL CONSULTANTS


10km Survey Area
Herring Gull
Survey
2022 May
2022 September
2022 October
2022 November
2022 December
2023 January
2023 February
2023 March
2023 April
2023 May
DELAWARE
MARYLAND
OCS-A 0490
OCS-A 0519
Kilometers
NORMANDEAU ASSOCIATES
ENVIRONMENTAL CONSULTANTS


10km Survey Area
Iceland Gull
Survey
2022 May
2022 September
2022 October
2022 November
2022 December
2023 January
2023 February
2023 March
2023 April
2023 May
DELAWARE
MARYLAND
OCS-A 0490
OCS-A 0519
Kilometers
NORMANDEAU ASSOCIATES
ENVIRONMENTAL CONSULTANTS


10km Survey Area
Lesser Black-backed Gull
Survey
2022 May
2022 September
2022 October
2022 November
2022 December
2023 January
2023 February
2023 March
2023 April
2023 May
DELAWARE
MARYLAND
OCS-A 0490
OCS-A 0519
Kilometers
NORMANDEAU ASSOCIATES
ENVIRONMENTAL CONSULTANTS


10km Survey Area
Great Black-backed Gull
Survey
2022 May
2022 September
2022 October
2022 November
2022 December
2023 January
2023 February
2023 March
2023 April
2023 May
DELAWARE
MARYLAND
OCS-A 0490
OCS-A 0519
Kilometers
NORMANDEAU ASSOCIATES
ENVIRONMENTAL CONSULTANTS


DELAWARE
MARYLAND
OCS-A 0490
OCS-A 0519
10km Survey Area
Gull species unknown - Large
Survey
2022 May
2022 September
2022 October
2022 November
2022 December
2023 January
2023 February
2023 March
2023 April
2023 May
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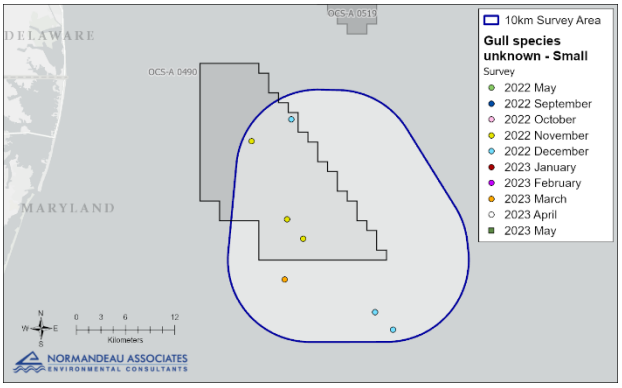
Kilometers
NORMANDEAU ASSOCIATES
ENVIRONMENTAL CONSULTANTS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MARYLAND
OCS-A 0490
OCS-A 0519
10km Survey Area
Gull species unknown - Small
Survey
2022 May
2022 September
2022 October
2022 November
2022 December
2023 January
2023 February
2023 March
2023 April
2023 May
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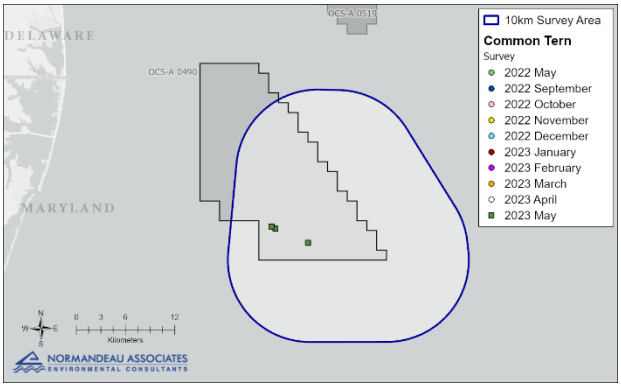
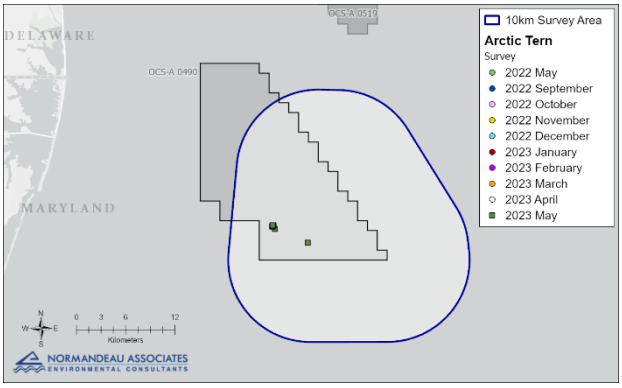
Kilometers
NORMANDEAU ASSOCIATES
ENVIRONMENTAL CONSULTANTS


DELAWARE
MARYLAND
OCS-A 0490
OCS-A 0519
10km Survey Area
Common Tern
Survey
2022 May
2022 September
2022 October
2022 November
2022 December
2023 January
2023 February
2023 March
2023 April
2023 May
0 3 6 12
Kilometers
NORMANDEAU ASSOCIATES
ENVIRONMENTAL CONSULTANTS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MARYLAND
OCS-A 0490
OCS-A 0519
10km Survey Area
Arctic Tern
Survey
2022 May
2022 September
2022 October
2022 November
2022 December
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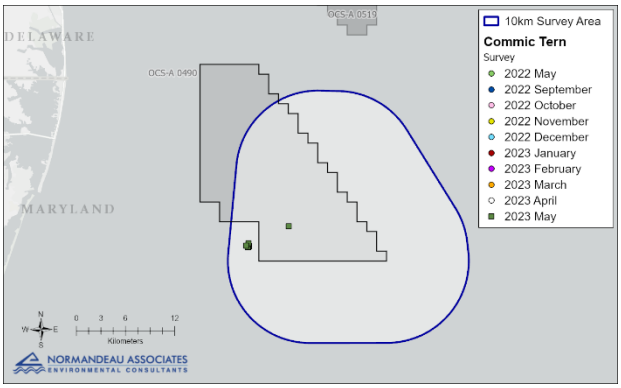
Kilometers
NORMANDEAU ASSOCIATES
ENVIRONMENTAL CONSULTANTS


DELAWARE
MARYLAND
OCS-A 0490
OCS-A 0519
10km Survey Area
Commic Tern
Survey
2022 May
2022 September
2022 October
2022 November
2022 December
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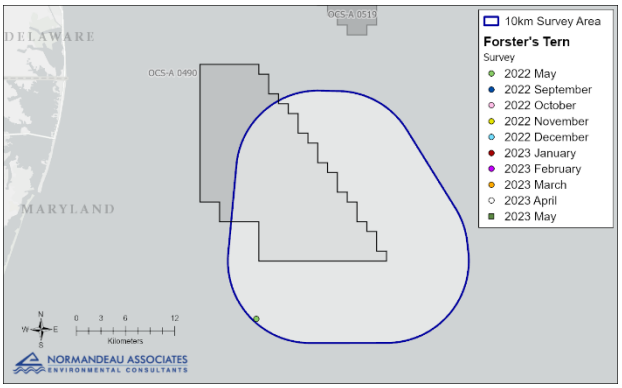
2023 May
0 3 6 12
Kilometers
NORMANDEAU ASSOCIATES
ENVIRONMENTAL CONSULTANTS


DELAWARE
MARYLAND
OCS-A 0490
OCS-A 0519
10km Survey Area
Forster's Tern
Survey
2022 May
2022 September
2022 October
2022 November
2022 December
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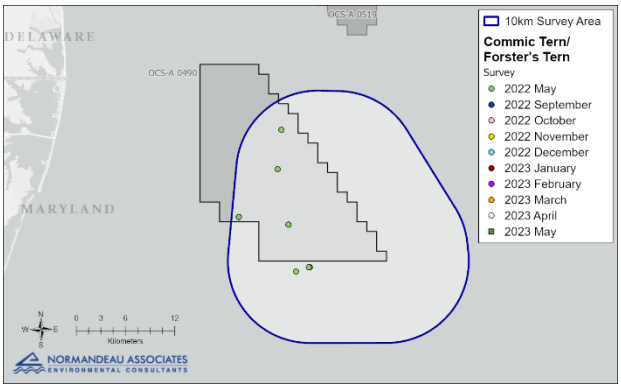
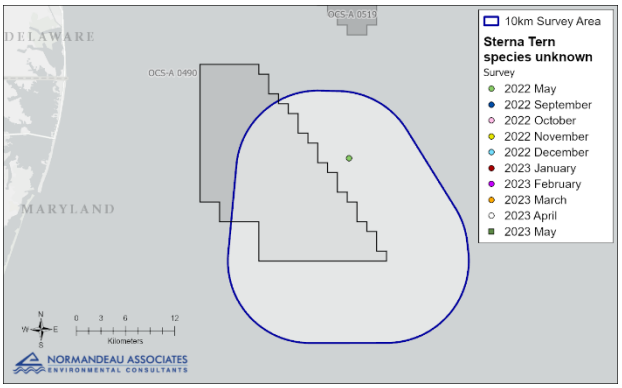
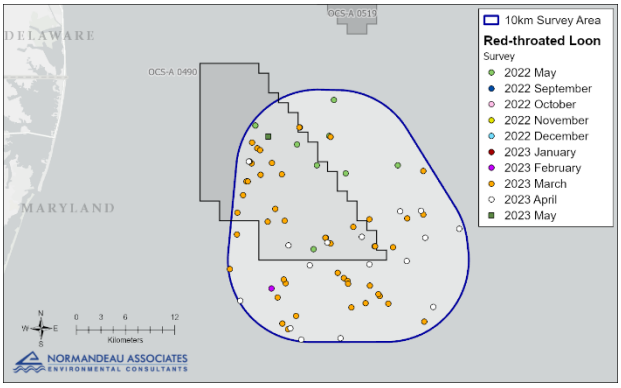
2023 February
2023 March
2023 April
2023 May
0 3 6 12
Kilometers
NORMANDEAU ASSOCIATES
ENVIRONMENTAL CONSULTANTS


DELAWARE
MARYLAND
OCS-A 0490
OCS-A 0519
10km Survey Area
Commic Tern/
Forster's Tern
Survey
2022 May
2022 September
2022 October
2022 November
2022 December
2023 January
2023 February
2023 March
2023 April
2023 May
0 3 6 12
Kilometers
NORMANDEAU ASSOCIATES
ENVIRONMENTAL CONSULTANTS


DELAWARE
MARYLAND
OCS-A 0490
OCS-A 0519
10km Survey Area
Sterna Tern
species unknown
Survey
2022 May
2022 September
2022 October
2022 November
2022 December
2023 January
2023 February
2023 March
2023 April
2023 May
0 3 6 12
Kilometers
NORMANDEAU ASSOCIATES
ENVIRONMENTAL CONSULTANTS


DELAWARE
MARYLAND
OCS-A 0490
OCS-A 0519
10km Survey Area
Red-throated Loon
Survey
2022 May
2022 September
2022 October
2022 November
2022 December
2023 January
2023 February
2023 March
2023 April
2023 May
0 3 6 12
Kilometers
NORMANDEAU ASSOCIATES
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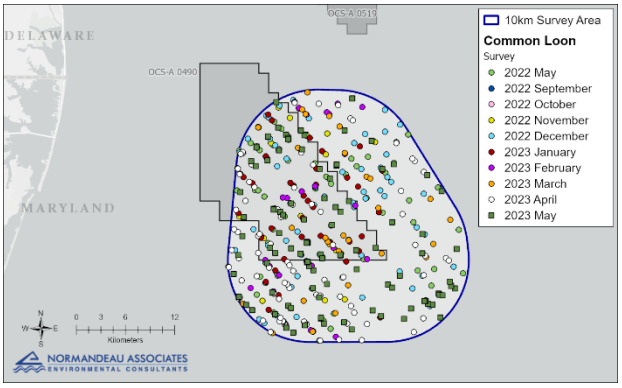
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MARYLAND
OCS-A 0490
OCS-A 0519
10km Survey Area
Common Loon
Survey
2022 May
2022 September
2022 October
2022 November
2022 December
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2023 March
2023 April
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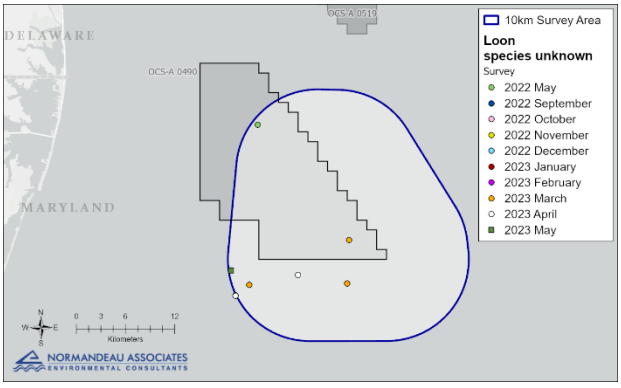
Kilometers
NORMANDEAU ASSOCIATES
ENVIRONMENTAL CONSULTANTS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Loon
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Survey
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2022 September
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2022 November
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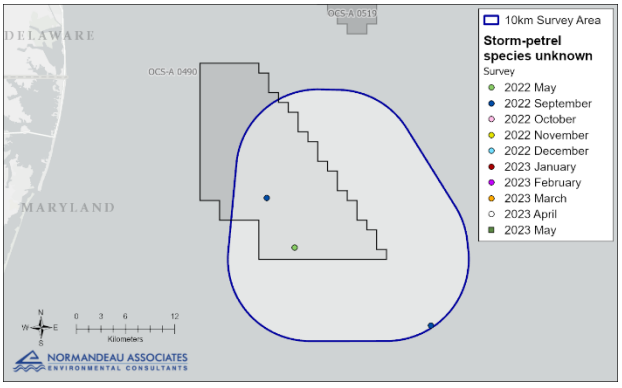
NORMANDEAU ASSOCIATES
ENVIRONMENTAL CONSULTANTS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MARYLAND
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10km Survey Area
Storm-petrel
species unknown
Survey
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2022 September
2022 October
2022 November
2022 December
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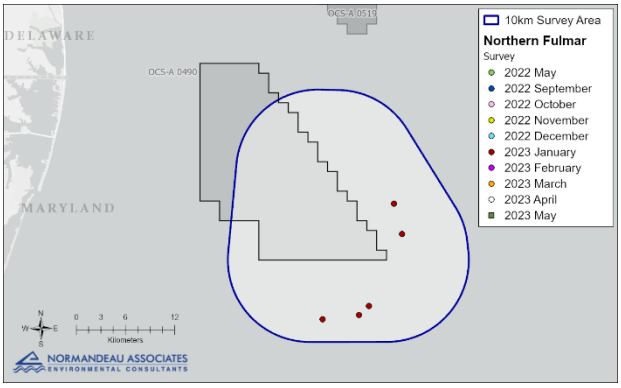
Kilometers
NORMANDEAU ASSOCIATES
ENVIRONMENTAL CONSULTANTS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MARYLAND
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10km Survey Area
Northern Fulmar
Survey
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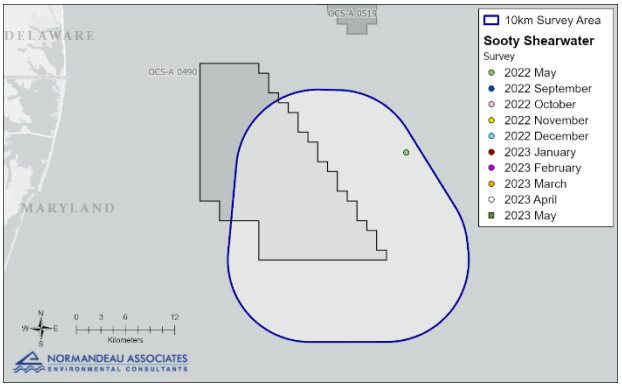
NORMANDEAU ASSOCIATES
ENVIRONMENTAL CONSULTANTS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MARYLAND
OCS-A 0490
OCS-A 0519
10km Survey Area
Sooty Shearwater
Survey
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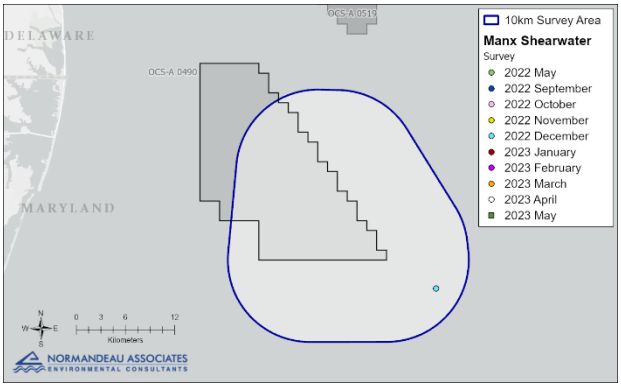
2022 September
2022 October
2022 November
2022 December
2023 January
2023 February
2023 March
2023 April
2023 May
0 3 6 12
Kilometers
NORMANDEAU ASSOCIATES
ENVIRONMENTAL CONSULTANTS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MARYLAND
OCS-A 0490
OCS-A 0519
10km Survey Area
Manx Shearwater
Survey
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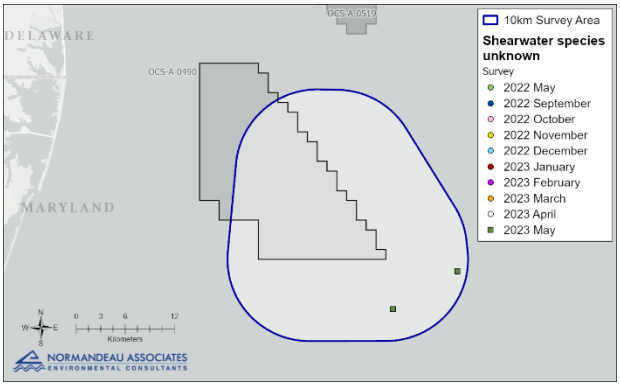
2022 September
2022 October
2022 November
2022 December
2023 January
2023 February
2023 March
2023 April
2023 May
0 3 6 12
Kilometers
NORMANDEAU ASSOCIATES
ENVIRONMENTAL CONSULTANTS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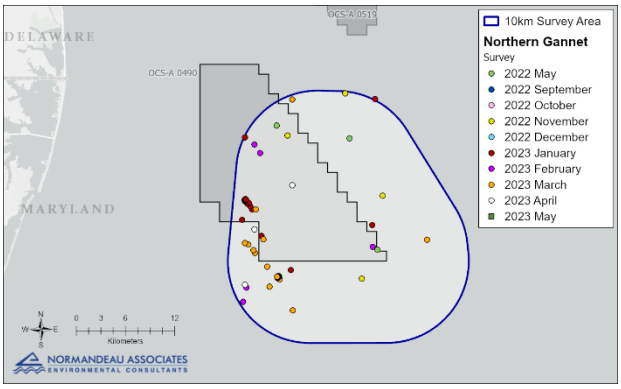
OCS-A 0490
OCS-A 0519
10km Survey Area
Shearwater species
unknown
Survey
2022 May
2022 September
2022 October
2022 November
2022 December
2023 January
2023 February
2023 March
2023 April
2023 May
0 3 6 12
Kilometers
NORMANDEAU ASSOCIATES
ENVIRONMENTAL CONSULTANTS


DELAWARE
MARYLAND
OCS-A 0490
OCS-A 0519
10km Survey Area
Northern Gannet
Survey
2022 May
2022 September
2022 October
2022 November
2022 December
2023 January
2023 February
2023 March
2023 April
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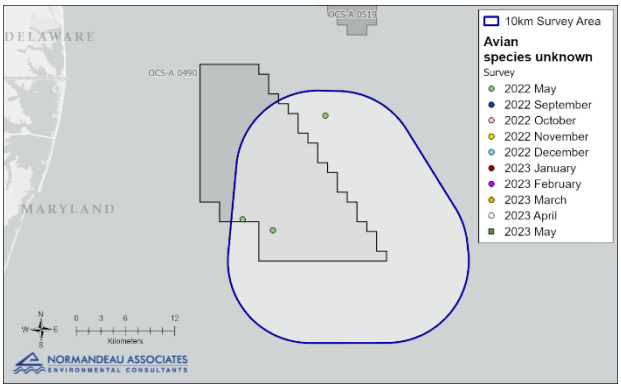
0 3 6 12
Kilometers
NORMANDEAU ASSOCIATES
ENVIRONMENTAL CONSULTANTS


DELAWARE
MARYLAND
OCS-A 0490
OCS-A 0519
10km Survey Area
Avian
species unknown
Survey
2022 May
2022 September
2022 October
2022 November
2022 December
2023 January
2023 February
2023 March
2023 April
2023 May
N
W
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0 3 6 12
Kilometers
NORMANDEAU ASSOCIATES
ENVIRONMENTAL CONSULTANTS

Appendix D: Avian Flight Activity for Each Species During Each Survey

Species	Flight Height Unknown			Flying outside RSZ			Flying within RSZ			Sitting			Total	
	#	Density (km²)	% Within Season	#	Density (km²)	% Within Season	#	Density (km²)	% Within Season	#	Density (km²)	% Within Season	#	Density (km²)
2022 May														
Scoter unid.	–	–	–	–	–	–	–	–	–	2	0.0256	100.00	2	0.0256
Laughing Gull	2	0.0256	22.22	2	0.0256	22.22	3	0.0384	33.33	2	0.0256	22.22	9	0.1152
Great Black-backed Gull	1	0.0128	50.00	–	–	–	–	–	–	1	0.0128	50.00	2	0.0256
Forster's Tern	1	0.0128	100.00	–	–	–	–	–	–	–	–	–	1	0.0128
Commic/Forster's Tern	11	0.1408	100.00	–	–	–	–	–	–	–	–	–	11	0.1408
Sterna Tern species unk	–	–	–	–	–	–	–	–	–	4	0.0512	100.00	4	0.0512
Red-throated Loon	–	–	–	–	–	–	–	–	–	8	0.1024	100.00	8	0.1024
Common Loon	–	–	–	–	–	–	–	–	–	59	0.7551	100.00	59	0.7551
Loon species unk	–	–	–	–	–	–	–	–	–	1	0.0128	100.00	1	0.0128
Storm-petrel species unk	1	0.0128	100.00	–	–	–	–	–	–	–	–	–	1	0.0128
Sooty Shearwater	1	0.0128	100.00	–	–	–	–	–	–	–	–	–	1	0.0128
Northern Gannet	–	–	–	–	–	–	–	–	–	3	0.0384	100.00	3	0.0384
Unid. Avian species unk	1	0.0128	25.00	–	–	–	–	–	–	3	0.0384	75.00	4	0.0512
Season Total	**18**	**0.2304**	**16.98**	**2**	**0.0256**	**1.89**	**3**	**0.0384**	**2.83**	**83**	**1.0622**	**78.30**	**106**	**1.3565**
2022 September														
Storm-petrel species unk	2	0.0262	100.00	–	–	–	–	–	–	–	–	–	2	0.0262
Season Total	**2**	**0.0262**	**100.00**	**0**	**–**	**0.00**	**0**	**–**	**0.00**	**0**	**–**	**0.00**	**2**	**0.0262**
2022 October														
Laughing Gull	–	–	–	–	–	–	1	0.0131	100.00	–	–	–	1	0.0131
Season Total	**0**	**–**	**0.00**	**0**	**–**	**0.00**	**1**	**0.0131**	**100.00**	**0**	**–**	**0.00**	**1**	**0.0131**
2022 November														
Bonaparte's Gull	202	2.6481	39.30	97	1.2716	18.87	104	1.3634	20.23	110	1.4421	21.40	514	6.7383
Laughing Gull	2	0.0262	100.00	–	–	–	–	–	–	–	–	–	2	0.0262
Great Black-backed Gull	2	0.0262	100.00	–	–	–	–	–	–	–	–	–	2	0.0262
Gull species unknown - Small	–	–	–	–	–	–	–	–	–	3	0.0393	100.00	3	0.0393
Common Loon	–	–	–	–	–	–	–	–	–	19	0.2491	100.00	19	0.2491
Northern Gannet	2	0.0262	50.00	–	–	–	–	–	–	2	0.0262	50.00	4	0.0524

Species	Flight Height Unknown			Flying outside RSZ			Flying within RSZ			Sitting			Total	
	#	Density (km^2)	% Within Season	#	Density (km^2)	% Within Season	#	Density (km^2)	% Within Season	#	Density (km^2)	% Within Season	#	Density (km^2)
Season Total	**208**	**2.7268**	**38.24**	**97**	**1.2716**	**17.83**	**104**	**1.3634**	**19.12**	**134**	**1.7567**	**24.63**	**544**	**7.1316**
2022 December														
Red Phalarope	1	0.0131	50.00	–	–	–	–	–	–	1	0.0131	50.00	2	0.0262
Bonaparte's Gull	113	1.4814	17.33	83	1.0881	12.73	127	1.6649	19.48	328	4.2999	50.31	652	8.5475
Great Black-backed Gull	1	0.0131	14.29	1	0.0131	14.29	2	0.0262	28.57	3	0.0393	42.86	7	0.0918
Gull species unknown - Small	–	–	–	–	–	–	–	–	–	4	0.0524	100.00	4	0.0524
Common Loon	–	–	–	–	–	–	3	0.0393	4.41	65	0.8521	95.59	68	0.8915
Manx Shearwater	–	–	–	–	–	–	–	–	–	1	0.0131	100.00	1	0.0131
Season Total	**115**	**1.5076**	**15.67**	**84**	**1.1012**	**11.44**	**132**	**1.7305**	**17.98**	**402**	**5.2701**	**54.77**	**734**	**9.6224**
2023 January														
Dovekie	1	0.0129	10.00	2	0.0257	20.00	2	0.0257	20.00	5	0.0643	50.00	10	0.1285
Common/Thick-billed Murre	–	–	–	–	–	–	–	–	–	4	0.0514	100.00	4	0.0514
Razorbill	20	0.2570	22.22	–	–	–	–	–	–	70	0.8996	77.78	90	1.1567
Murre/Razorbill	–	–	–	–	–	–	–	–	–	1	0.0129	100.00	1	0.0129
Auk species unknown	–	–	–	–	–	–	–	–	–	5	0.0643	100.00	5	0.0643
Black-legged Kittiwake	9	0.1157	20.00	16	0.2056	35.56	14	0.1799	31.11	6	0.0771	13.33	45	0.5783
Bonaparte's Gull	2	0.0257	28.57	1	0.0129	14.29	2	0.0257	28.57	2	0.0257	28.57	7	0.0900
Herring Gull	17	0.2185	54.84	3	0.0386	9.68	4	0.0514	12.90	7	0.0900	22.58	31	0.3984
Great Black-backed Gull	11	0.1414	37.93	2	0.0257	6.90	3	0.0386	10.34	13	0.1671	44.83	29	0.3727
Common Loon	–	–	–	–	–	–	–	–	–	44	0.5655	100.00	44	0.5655
Northern Fulmar	5	0.0643	100.00	–	–	–	–	–	–	–	–	–	5	0.0643
Northern Gannet	12	0.1542	66.67	–	–	–	2	0.0257	11.11	4	0.0514	22.22	18	0.2313
Season Total	**77**	**0.9896**	**26.64**	**24**	**0.3084**	**8.30**	**27**	**0.3470**	**9.34**	**161**	**2.0691**	**55.71**	**289**	**3.7142**
2023 February														
Dovekie	–	–	–	–	–	–	–	–	–	46	0.5881	100.00	46	0.5881
Common/Thick-billed Murre	–	–	–	–	–	–	–	–	–	4	0.0511	100.00	4	0.0511
Bonaparte's Gull	1	0.0128	100.00	–	–	–	–	–	–	–	–	–	1	0.0128
Herring Gull	4	0.0511	30.77	–	–	–	7	0.0895	53.85	2	0.0256	15.38	13	0.1662
Iceland Gull	1	0.0128	100.00	–	–	–	–	–	–	–	–	–	1	0.0128
Great Black-backed Gull	3	0.0384	23.08	–	–	–	6	0.0767	46.15	4	0.0511	30.77	13	0.1662

Species	Flight Height Unknown			Flying outside RSZ			Flying within RSZ			Sitting			Total	
	#	Density (km^2)	% Within Season	#	Density (km^2)	% Within Season	#	Density (km^2)	% Within Season	#	Density (km^2)	% Within Season	#	Density (km^2)
Red-throated Loon	–	–	–	–	–	–	–	–	–	1	0.0128	100.00	1	0.0128
Common Loon	–	–	–	–	–	–	–	–	–	27	0.3452	100.00	27	0.3452
Northern Gannet	1	0.0128	20.00	1	0.0128	20.00	1	0.0128	20.00	2	0.0256	40.00	5	0.0639
Season Total	**10**	**0.1278**	**9.01**	**1**	**0.0128**	**0.90**	**14**	**0.1790**	**12.61**	**86**	**1.0995**	**77.48**	**111**	**1.4191**
2023 March														
Common/Thick-billed Murre	–	–	–	–	–	–	–	–	–	26	0.3324	100.00	26	0.3324
Razorbill	–	–	–	–	–	–	–	–	–	13	0.1662	100.00	13	0.1662
Murre/Razorbill	–	–	–	–	–	–	–	–	–	12	0.1534	100.00	12	0.1534
Black-legged Kittiwake	1	0.0128	50.00	–	–	–	–	–	–	1	0.0128	50.00	2	0.0256
Bonaparte's Gull	30	0.3835	18.99	8	0.1023	5.06	12	0.1534	7.59	107	1.3679	67.72	158	2.0199
Herring Gull	–	–	–	–	–	–	1	0.0128	16.67	5	0.0639	83.33	6	0.0767
Lesser Black-backed Gull	–	–	–	–	–	–	1	0.0128	100.00	–	–	–	1	0.0128
Great Black-backed Gull	–	–	–	–	–	–	1	0.0128	50.00	1	0.0128	50.00	2	0.0256
Gull species unknown - Small	–	–	–	–	–	–	–	–	–	1	0.0128	100.00	1	0.0128
Red-throated Loon	–	–	–	–	–	–	6	0.0767	9.52	57	0.7287	90.48	63	0.8054
Common Loon	–	–	–	–	–	–	–	–	–	41	0.5242	100.00	41	0.5242
Loon species unknown	–	–	–	–	–	–	–	–	–	3	0.0384	100.00	3	0.0384
Northern Gannet	–	–	–	2	0.0256	5.56	–	–	–	34	0.4347	94.44	36	0.4602
Season Total	**31**	**0.3963**	**8.52**	**10**	**0.1278**	**2.75**	**21**	**0.2685**	**5.77**	**301**	**3.8481**	**82.69**	**364**	**4.6535**
2023 April														
Bonaparte's Gull	3	0.0382	18.75	–	–	–	–	–	–	13	0.1656	81.25	16	0.2039
Laughing Gull	–	–	–	–	–	–	–	–	–	2	0.0255	100.00	2	0.0255
Herring Gull	6	0.0765	19.35	3	0.0382	9.68	–	–	–	22	0.2803	70.97	31	0.3950
Lesser Black-backed Gull	1	0.0127	14.29	1	0.0127	14.29	–	–	–	5	0.0637	71.43	7	0.0892
Great Black-backed Gull	1	0.0127	25.00	–	–	–	2	0.0255	50.00	1	0.0127	25.00	4	0.0510
Gull species unknown - Large	–	–	–	–	–	–	–	–	–	2	0.0255	100.00	2	0.0255
Red-throated Loon	–	–	–	–	–	–	1	0.0127	5.88	16	0.2039	94.12	17	0.2166
Common Loon	1	0.0127	1.12	1	0.0127	1.12	1	0.0127	1.12	86	1.0958	96.63	89	1.1340
Loon species unknown	–	–	–	–	–	–	–	–	–	3	0.0382	100.00	3	0.0382

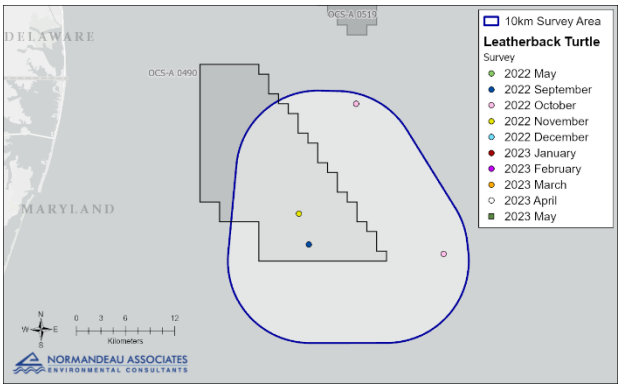
Species	Flight Height Unknown			Flying outside RSZ			Flying within RSZ			Sitting			Total	
	#	Density (km^2)	% Within Season	#	Density (km^2)	% Within Season	#	Density (km^2)	% Within Season	#	Density (km^2)	% Within Season	#	Density (km^2)
Northern Gannet	3	0.0382	100.00	–	–	–	–	–	–	–	–	–	3	0.0382
Season Total	**15**	**0.1911**	**8.62**	**5**	**0.0637**	**2.87**	**4**	**0.0510**	**2.30**	**150**	**1.9113**	**86.21**	**174**	**2.2171**
2023 May														
Shorebird species unknown	4	0.0512	100.00	–	–	–	–	–	–	–	–	–	4	0.0512
Pomarine Jaeger	–	–	–	1	0.0128	100.00	–	–	–	–	–	–	1	0.0128
Razorbill	–	–	–	–	–	–	–	–	–	3	0.0384	100.00	3	0.0384
Laughing Gull	7	0.0896	58.33	–	–	–	–	–	–	5	0.0640	41.67	12	0.1536
Herring Gull	9	0.1152	26.47	–	–	–	1	0.0128	2.94	24	0.3071	70.59	34	0.4351
Lesser Black-backed Gull	4	0.0512	26.47	–	–	–	–	–	–	11	0.1408	73.33	15	0.1920
Great Black-backed Gull	3	0.0384	25.00	–	–	–	–	–	–	9	0.1152	75.00	12	0.1536
Gull species unknown - Large	–	–	–	–	–	–	–	–	–	6	0.0768	100.00	6	0.0768
Common Tern	3	0.0384	100.00	–	–	–	–	–	–	–	–	–	3	0.0384
Arctic Tern	6	0.0768	85.71	1	0.0128	14.29	–	–	–	–	–	–	7	0.0896
Commic Tern	6	0.0768	100.00	–	–	–	–	–	–	–	–	–	6	0.0768
Red-throated Loon	–	–	–	–	–	–	–	–	–	1	0.0128	100.00	1	0.0128
Common Loon	–	–	–	–	–	–	–	–	–	137	1.7533	100.00	137	1.7533
Loon species unknown	–	–	–	–	–	–	–	–	–	1	0.0128	100.00	1	0.0128
Shearwater species unknown	2	0.0256	100.00	–	–	–	–	–	–	–	–	–	2	0.0256
Season Total	**44**	**0.5631**	**18.03**	**2**	**0.0256**	**0.82**	**1**	**0.0128**	**0.41**	**197**	**2.5211**	**80.74**	**244**	**3.1266**

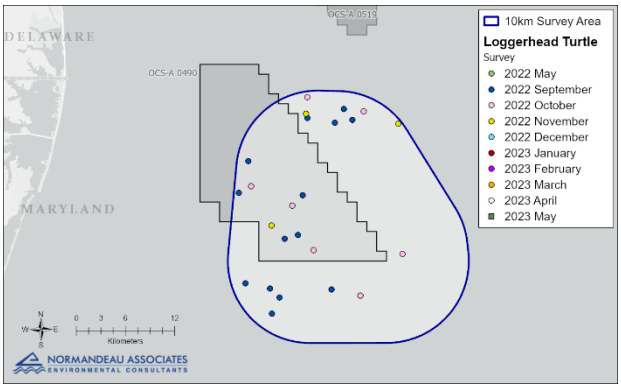
Appendix E: Flight Heights for Flying Birds Observed During Each Survey

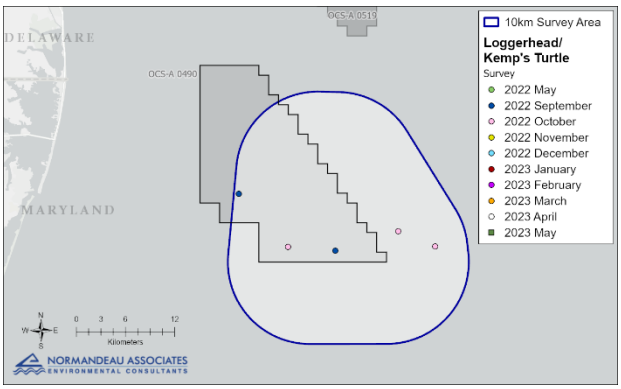
Species	N	Min	Max	Mean	Std Dev	Median	Error
May 2022							
Laughing Gull	5	3.6	34.4	19.8	13.91	27.0	31.5864
Sep 2022							
Oct 2022							
Nov 2022							
Bonaparte's Gull	201	0.4	86.5	27.7	20.42	23.8	34.1296
Dec 2022							
Bonaparte's Gull	210	0.4	128.6	35.0	24.15	32.3	34.7749
Great Black-backed Gull	3	0.1	106.8	65.1	57.04	88.3	38.6569
Common Loon	3	51.2	115.8	81.5	32.47	77.6	16.1854
Jan 2023							
Dovekie	4	16.3	77.7	41.0	29.67	35.1	45.6528
Black-legged Kittiwake	30	0.04	57.1	23.1	17.38	18.3	47.6745
Bonaparte's Gull	3	21.6	50.3	40.6	16.49	49.9	34.3179
Herring Gull	7	2.1	70.4	30.8	23.41	28.3	70.0984
Great Black-backed Gull	5	12.1	40.1	26.0	12.29	25.2	46.5378
Northern Gannet	2	37.4	75.9	56.6	27.24	56.6	34.2211
Feb 2023							
Herring Gull	7	25.2	90.5	50.3	23.08	50.1	66.2665
Great Black-backed Gull	6	34.2	197.6	100.2	54.49	92.3	34.34
Northern Gannet	2	3.1	85.3	44.2	58.18	44.2	34.8153
2023 March							
Bonaparte's Gull	20	3.8	83.5	28.0	22.16	25.7	58.42
Herring Gull	1	66.9	66.9	66.9		66.9	131.85
Lesser Black-backed Gull	1	65.8	65.8	65.8		65.8	78.39
Great Black-backed Gull	1	57.1	57.1	57.1		57.1	84.69
Red-throated Loon	6	53.8	115.0	83.2	22.99	87.3	43.21
Northern Gannet	2	7.5	11.6	9.6	2.87	9.6	43.25
2023 April							
Herring Gull	3	1.3	18.9	12.1	9.47	16.1	86.43
Lesser Black-backed Gull	1	9.6	9.6	9.6		9.6	36.51
Great Black-backed Gull	2	36.5	49.1	42.8	8.93	42.8	73.58
Red-throated Loon	1	65.4	65.4	65.4		65.4	45.02
Common Loon	2	11.7	116.6	64.2	74.21	64.2	41.97
2023 May							
Pomarine Jaeger	1	19.3	19.3	19.3		19.3	113.466
Herring Gull	1	37.6	37.6	37.6		37.6	74.35
Arctic Tern	1	6.7	6.7	6.7		6.7	55.2861

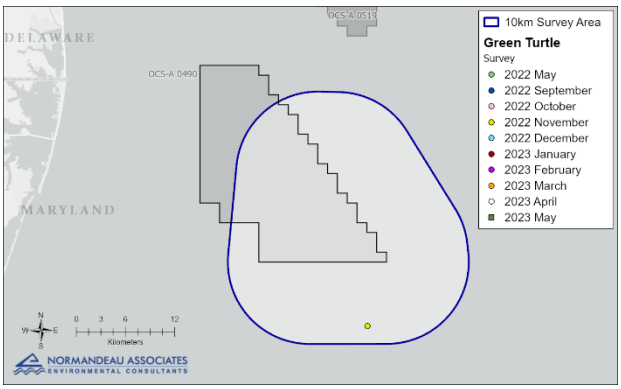
Species	N	Min	Max	Mean	Std Dev	Median	Error
All Surveys							
Pomarine Jaeger	1	19.3	19.3	19.3		19.3	113.466
Dovekie	4	16.3	77.7	41.0	29.67	35.1	45.6528
Black-legged Kittiwake	30	0.04	57.1	23.1	17.38	18.3	47.6745
Bonaparte's Gull	434	0.4	128.6	31.3	22.60	26.6	34.1296–58.42
Laughing Gull	5	3.6	34.4	19.8	13.91	27.0	31.5864
Herring Gull	19	1.3	90.5	37.3	24.63	32.2	66.2665–131.85
Lesser Black-backed Gull	2	9.6	65.8	37.7	39.73	37.7	36.51–78.39
Great Black-backed Gull	17	0.1	197.6	62.9	48.78	49.1	34.34-84.69
Arctic Tern	1	6.7	6.7	6.7		6.7	55.2861
Red-throated Loon	7	53.8	115.0	80.6	22.04	82.9	43.21–45.02
Common Loon	5	11.7	116.6	74.6	44.66	77.6	16.1854–41.97
Northern Gannet	6	3.1	85.3	36.8	36.10	24.5	24.2211–43.25

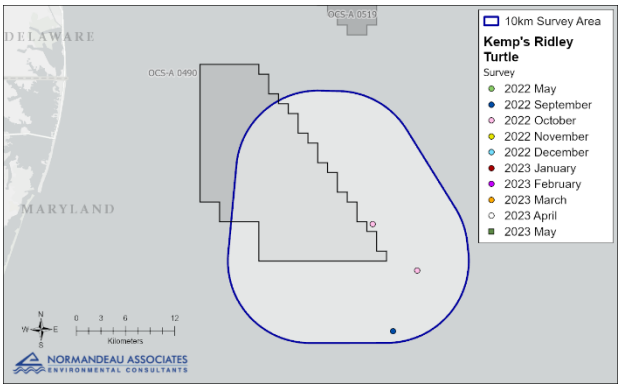
Appendix F: Spatial Distribution of Turtle Species for Each Survey

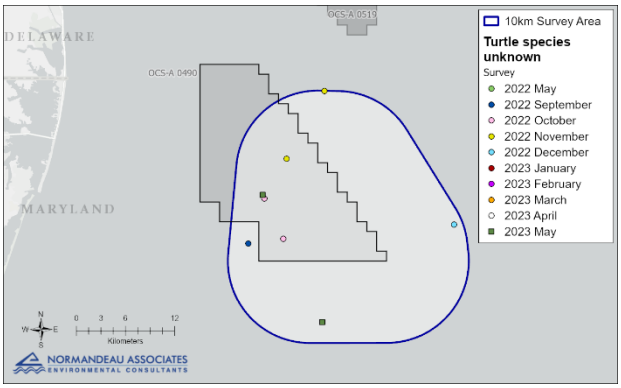




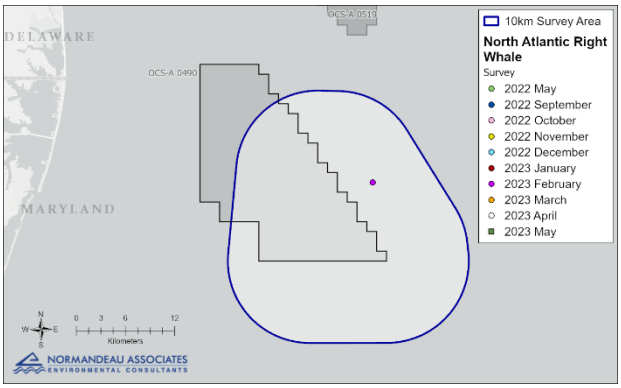


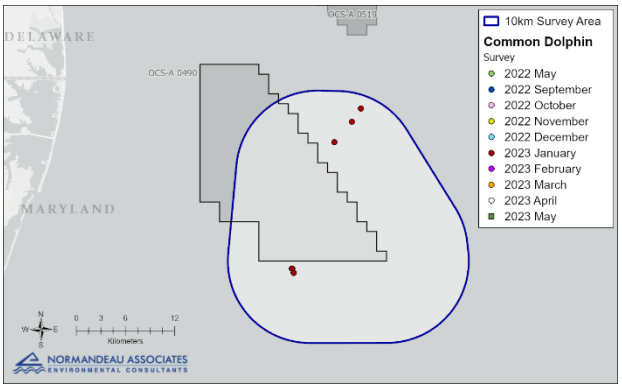


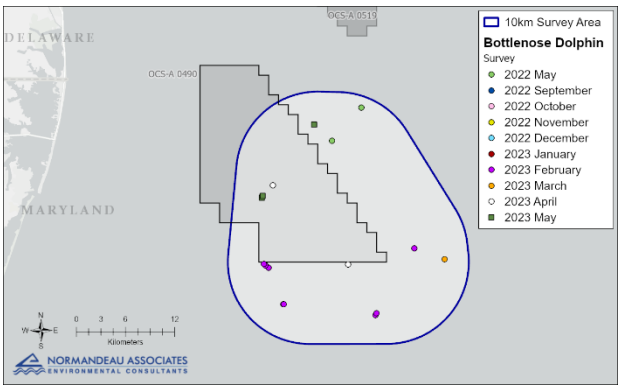


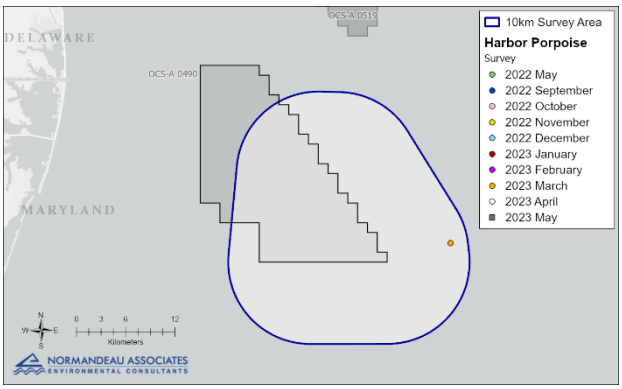


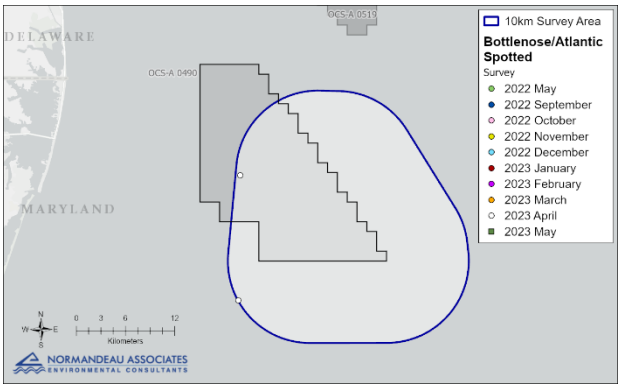
Appendix G: Spatial Distribution of Marine Mammal Species for Each Survey

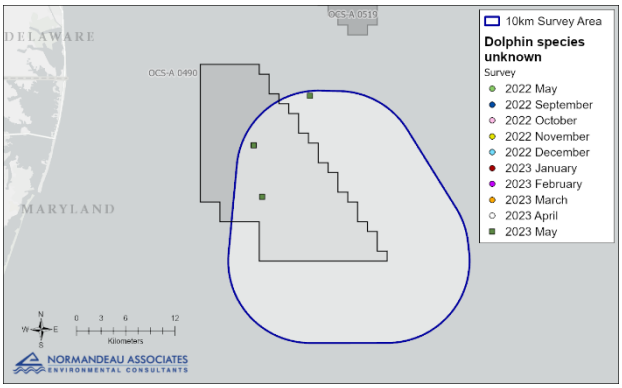




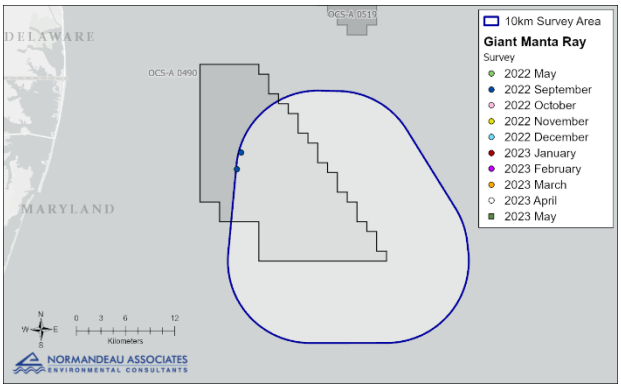


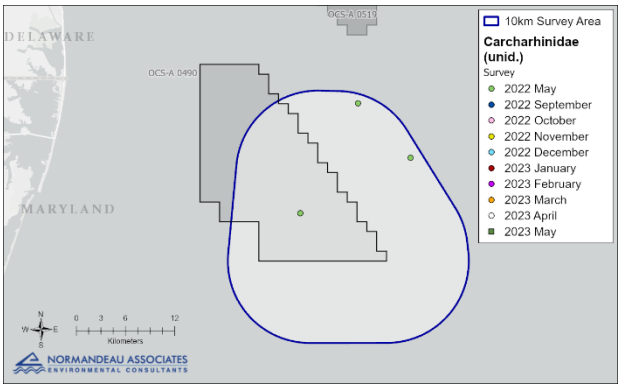


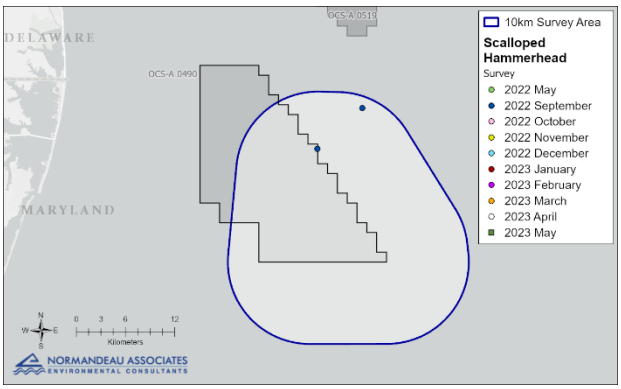


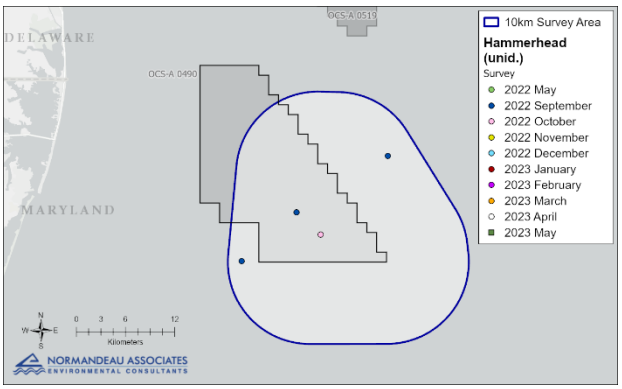


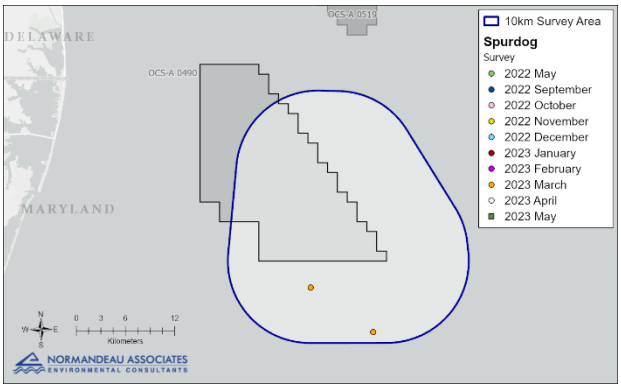
Appendix H: Spatial Distribution of Ray and Shark Species for Each Survey

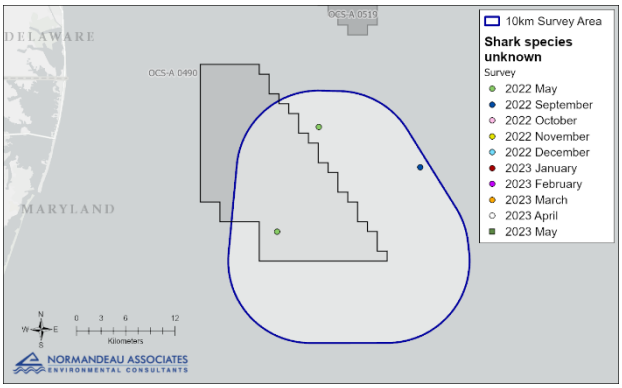












Appendix I: Spatial Distribution of Large Bony Fish Species for Each Survey