NORMANDEAU ASSOCIATES
ENVIRONMENTAL CONSULTANTS

Ornithological and Marine Fauna Aerial Digital Survey

Lease Area OCS-A 0490

First Semiannual Report
May 2022 through January 2023

April 12, 2023

US Wind

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First Semiannual Report
Covering May 2022 through January 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 exposure settings
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 represents information from six high-resolution aerial digital surveys performed in May, September, October, November, and December 2022, and January 2023. Images from each survey were reviewed using a combination of manual and automated processes, and 10% of the blank images 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 by km^2.

An average of 9,227 images were collected per survey and about 98% of those images had no targets. Across all surveys, 1,832 animals were sent to taxonomic experts for identification including 1,673 birds, 44 turtles, 15 marine mammals, 2 rays, 12 sharks, and 86 large bony fishes. For targets sent to a second species expert, identification agreement reached 100% across all taxonomic groups.

Of the 1,673 birds identified across all surveys (15 species), the most abundant species groups were gulls (78%) and loons (12%). The greatest density of birds was seen during the December 2022 survey (43%) followed by January 2023 (17%). September and October 2022 surveys had the least observed birds.

Over the six surveys, 44 turtles were identified in imagery representing four species and one species blend. The greatest numbers of turtles observed occurred during the September survey (43%; n=19) followed by October (39%; n=17).

Over the six surveys, 15 marine mammals were identified in imagery represented by two species: common dolphin (80%; n=12) and bottlenose dolphin (20%; n=3). Most marine mammals were seen during the January 2023 survey (80%) consisting of common dolphins. The bottlenose dolphins were seen in May 2022.

There were 2 rays and 12 sharks found in the imagery across all surveys. Rays were observed during the September 2022 survey. Most sharks were found during the September 2022 survey with 50% (n=6) followed by May (n=5), and October 2022 (n=1).

Across all surveys, 86 large bony fishes were seen with most observed during September 2022 (70%; n=60) and November 2022 (6%; n=15). The dominant species was tuna-species unknown with 74% (n=58) of all observations.

Across all surveys, 75% of the observations of listed species (n=59) were turtles (n=44), which were mostly seen during the September (n=19) and October (n=17) 2022 surveys.

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 US 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.

Ten surveys per year are planned within the Site. This report summarizes the results from the first six 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, overall it provides a more evenly distributed survey effort. The survey transects ran perpendicular to the coast were evenly spaced across the survey area (Figure 1).

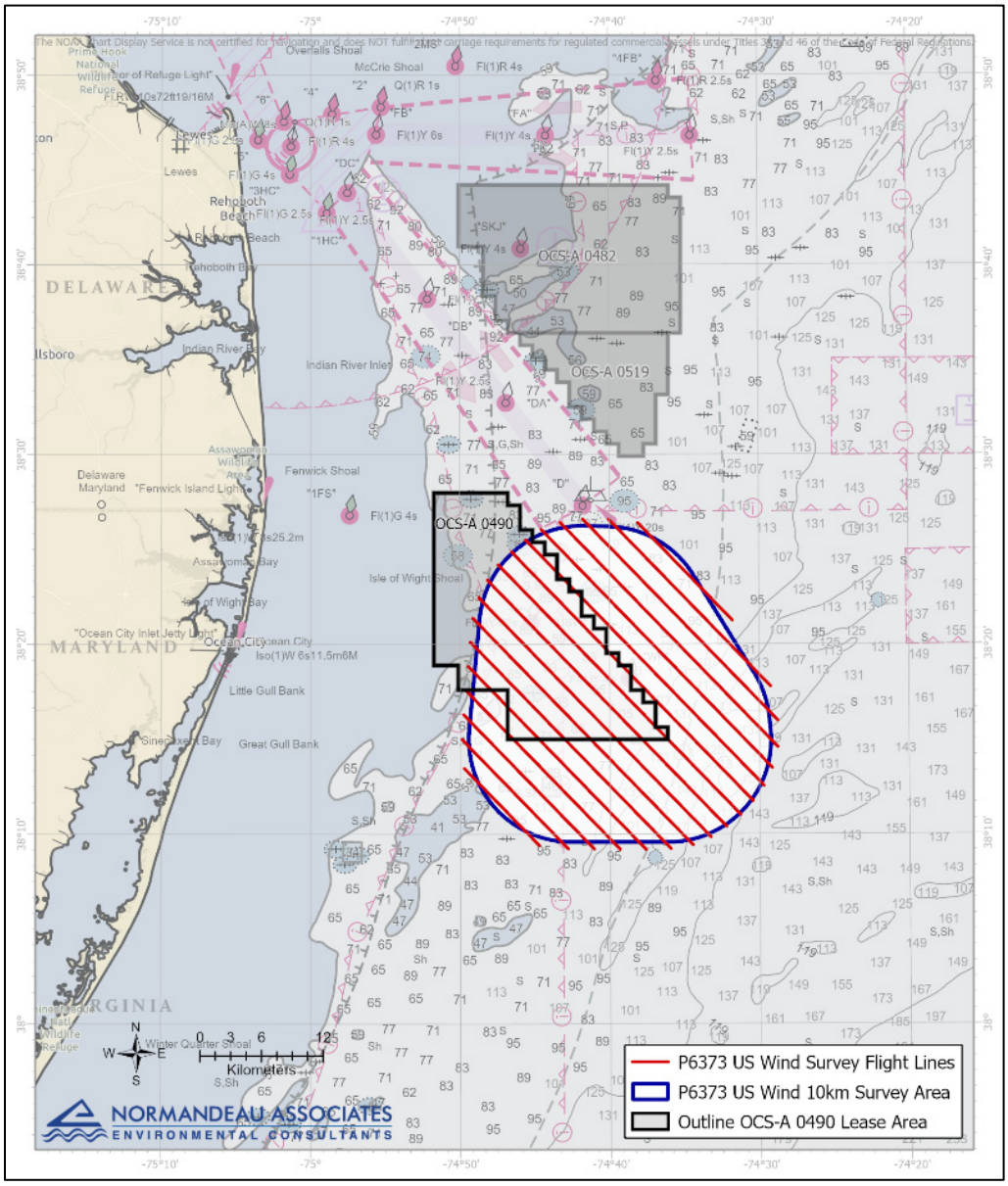

Figure 1. Transect with grid subsample design covering 40% of the study area.

2.2 Data Collection

The first six surveys were completed using APEM's flagship camera system Shearwater III. This system has an array of high specification sensors, which can be mounted in a variety of configurations to provide flexible surveying for the needs and conditions of each study. Although the Shearwater III can capture imagery at 1-cm ground sampling distance (GSD), operating it at this resolution significantly reduces the survey footprint without increasing the data quality (i.e., the ability to identify small individuals to species, such as piping plover). The system obtained

ideal resolution for species identification while providing cost-effective large image footprints. The flight altitude was also included in the consideration.

Shearwater III collected an array of still images 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 motored in flight by an APEM 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. 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 and heading of the camera at the point of capture along with line information. It is impossible to fly in a perfect line at constant altitude due to the effects of weather and atmospheric pressure on aircraft during flight. Commonly, an aircraft moves up and down 10–30 m during surveys of 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 allow 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 first six surveys occurred in May, September, October, November, and December 2022, and in January 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	12/01/22	1
6	2023 January	01/15/23	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 for 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 on x and y locations and 5 m on the z location. Data collected included a 10-km buffer. All data capture points within the buffer are included for analysis. Following each survey, sample imagery was evaluated to make sure it was of good 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 plus the 10-km buffer. 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 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 the 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 5K monitors with a minimum 60-cm 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 and included research scientists from the New England Aquarium and Massachusetts Shark Research Program.

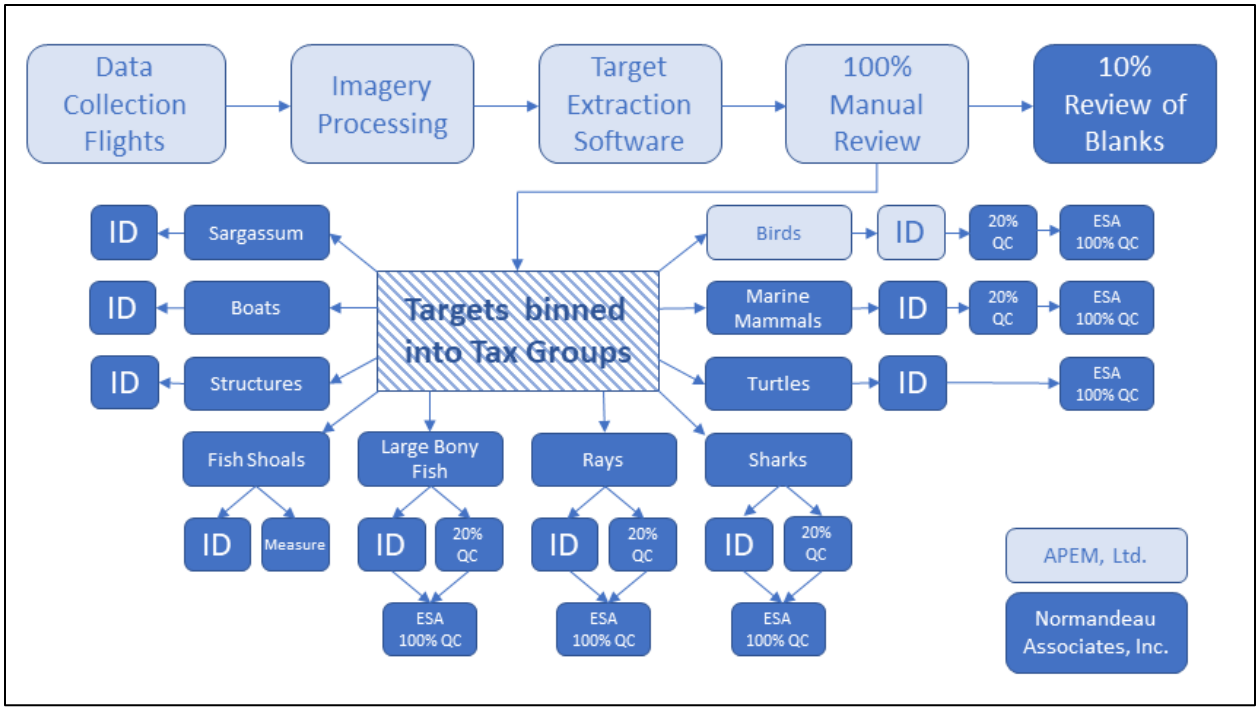

Figure 2. Data flow and quality control.

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 and 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, and 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. Previously, reference lengths from one source (Sibley 2001) were used in the FHC for US flight heights calculations. However, following a review of the comparison between reference lengths from different sources this was considered inadequate, and a wider review of literature determined more sources that would bolster the variability in body lengths that can be accounted for in the FHC (Table 2). Following a review of the literature, new bird reference lengths were produced by extracting the minimum and maximum body length from four sources for each avian species that could be expected. 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	21.2	-0.39
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	63.5	61	-2.5
	Great Black-backed Gull	76.2	68.25	-7.95
Sterna Tern	Forster's Tern	33.02	34.13	1.11
Loon	Red-throated Loon	63.5	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 the six 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	736.30	9,250	78.14	10.61	9,141	98.82	915	10.01
Sep 2022	736.30	9,255	76.28	10.36	9,196	99.36	921	10.02
Oct 2022	736.30	9,277	76.28	10.36	9,212	99.30	924	10.03
Nov 2022	736.30	9,255	76.28	10.36	9,092	98.24	910	10.01
Dec 2022	736.30	9,210	76.28	10.36	8,803	95.58	881	10.01
Jan 2023	736.30	9,115	77.81	10.57	8,901	97.65	891	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

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%, well within the QC criteria established for the project (Table 5).

For the September 2022 survey, 1 of the 921 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 99.89%, 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 were 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).

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	905	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	0	100.00

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.

Of the 7 images from the May 2022 review 4 large bony fish, 2 birds, and 1 ray were found (Table 6).

For the September 2022 review, 1 turtle was found during the QC process (Table 6).

During the October 2022 QC process, 1 turtle and 1 large bony fish were found (Table 6).

Of the 5 images from the November 2022 review, 2 birds, 2 large bony fish, and 1 turtle were found during the QC process (Table 6).

There were no animals found during the QC process for the January 2023 images (Table 6).

Over all surveys, 16 images had targets with most containing large bony fish (n=7; 44%) followed by birds (n=5; 31%), turtles (n=3; 19%), and rays (n=1; 6%). There were no marine mammals or 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 Fish	
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							–
TOTAL	**5**	**–**	**3**	**–**	**1**	**7**	**16**

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 six surveys, 1,832 animals were sent to taxonomic experts for identification including 1,673 birds (91%), 15 marine mammals (<1%), 44 turtles (2%), 12 sharks (<1%), 2 rays (<1%), and 86 large bony fish (5%) (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 fish (7%), 5 sharks (4%), and 5 turtles (4%) (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 fish (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 fish (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, 564 targets were identified including 542 birds (96%) followed by 15 large bony fish (3%), and 7 turtles (4%) (Table 7). No marine mammals, sharks, or rays were found (Table 7).

Of the 735 targets identified during the December 2022 survey, most were birds (n=733; 99%) followed by 1 large bony fish (<1%) and 1 turtle (<1%) (Table 7). There were no marine mammals, sharks, rays, or large bony fish 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 fish 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 Fish	
May 2022	106	3		5		8	122
Sep 2022	2		19	6	2	60	89
Oct 2022	1		17	1		2	21
Nov 2022	542		7			15	564
Dec 2022	733		1			1	735
Jan 2023	289	12					301
TOTAL	**1,673**	**15**	**44**	**12**	**2**	**86**	**1,832**

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, 1,832 animals were sent for identification with 395 going through QC review (Table 8). All identifications reached and exceeded their targeted percent agreement with an overall 100% agreement (Table 8).

During the May 2022 survey, 122 targets were identified and sent to taxonomic experts for identification, and QC review was performed on 26 individuals (21%). All identifications reached and exceeded their targeted percent agreement with an overall 100% agreement (Table 8).

For the September 2022 survey, 89 targets were identified and sent to taxonomic experts for identification, and QC review was performed on 26 individuals (29%). All identifications reached and exceeded their targeted percent agreement with an overall 100% agreement (Table 8).

During the October 2022 survey, 21 targets were identified and sent to taxonomic experts for identification. QC review was performed on 18 individuals (86%). All identifications reached and exceeded their targeted percent agreement with an overall 100% agreement (Table 8).

For the November 2022 survey, 564 targets were identified and sent to taxonomic experts for identification. QC review was performed on 117 individuals (21%). All identifications reached and exceeded their targeted percent agreement with an overall 100% agreement (Table 8).

During the December 2022 survey, 735 targets were identified and sent to taxonomic experts for identification. QC review was performed on 148 individuals (20%). All identifications reached and exceeded their targeted percent agreement with an overall 100% agreement (Table 8).

During the January 2023 survey, 301 targets were identified and sent to taxonomic experts for identification. QC review was performed on 60 individuals (20%). All identifications reached and exceeded their targeted percent agreement with an overall 100% agreement (Table 8).

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	0	0	–
	Sharks	5	0	–
	Rays	0	0	–
	Large Bony Fish	8	4	100
	TOTAL	**122**	**26**	**100**
Sep 2022	Birds	2	0	–
	Marine Mammals	0	0	–
	Turtles	19	19	100
	Sharks	6	5	100
	Rays	2	2	100
	Large Bony Fish	60	0	–
	TOTAL	**89**	**26**	**100**
Oct 2022	Birds	1	0	–
	Marine Mammals	0	0	–
	Turtles	17	17	100
	Sharks	1	1	100
	Rays	0	0	–
	Large Bony Fish	2	0	–
	TOTAL	**21**	**18**	**100**
Nov 2022	Birds	542	108	100
	Marine Mammals	0	0	–
	Turtles	7	7	100
	Sharks	0	0	–
	Rays	0	0	–
	Large Bony Fish	15	2	100
	TOTAL	**564**	**117**	**100**
Dec 2022	Birds	733	147	100
	Marine Mammals	0	0	–
	Turtles	1	1	100
	Sharks	0	0	–
	Rays	0	0	–
	Large Bony Fish	1	0	–
	TOTAL	**735**	**148**	**100**
Jan 2023	Birds	289	58	100
	Marine Mammals	12	2	100
	Turtles	0	0	–
	Sharks	0	0	–
	Rays	0	0	–
	Large Bony Fish	0	0	–
	TOTAL	**301**	**60**	**100**
ALL	Birds	**1,673**	**334**	**100**
	Marine Mammals	**15**	**3**	**100**
	Turtles	**44**	**44**	**100**
	Sharks	**12**	**6**	**100**
	Rays	**2**	**2**	**100**
	Large Bony Fish	**86**	**6**	**100**
TOTAL		**1,832**	**395**	**100**

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 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 Fish	
May 2022	4	0	0	0	0	2	6
Sep 2022	0	0	19	5	2	0	26
Oct 2022	0	0	17	1	0	0	18
Nov 2022	0	0	7	0	0	1	8
Dec 2022	0	0	1	0	0	0	1
Jan 2023	0	0	0	0	0	0	0
ALL	**4**	**0**	**44**	**6**	**2**	**3**	**59**
% 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 (40% 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 and Figure 3).

Density during November 2022 was the second highest of all surveys with 7.39 individuals/km^2 (31%). 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 and 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 and Figure 3).

Of the 1.56 individuals/km^2 (6.5%) found during May 2022, birds (1.36 birds/km^2; 86.9%) were the most often 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 and Figure 3).

September 2022 had the second lowest total abundance of all surveys with 1.17 individuals/km^2 (4.9%). Large bony fishes (0.79 fishes/km^2; 67%) were the most often 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 and Figure 3).

October 2022 had the lowest total abundance (1.17%) of all surveys. Of the 0.28 individuals/km^2, turtles (0.22 turtles/km^2; 81%) were the most often 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 and Figure 3).

Overall, birds represented the greatest number of occurrences with 91% of the combined total (Table 10). Large bony fishes were found 4.7% of the time followed by turtles (2.4%), marine mammals (0.8%), sharks (0.7%), and rays (0.1%) (Table 10).

Table 10. Density (per km^2) and percent of total of individuals (relative abundance) in taxonomic group by survey

Survey	Taxonomic Group												
	Avian	%	Mammal	%	Turtle	%	Shark	%	Ray	%	Large Bony Fish	%	Total
May 2022	1.3565	86.89	0.0384	2.46	–	–	0.064	4.1	–	–	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	7.1054	96.1	–	–	0.0918	1.24	–	–	–	–	0.1966	2.66	7.3938
Dec 2022	9.6093	99.73	–	–	0.0131	0.14	–	–	–	–	0.0131	0.14	9.6355
Jan 2023	3.7142	96.01	0.1542	3.99	–	–	–	–	–	–	–	–	3.8684
TOTAL	**21.8247**	**91.32**	**0.1926**	**0.82**	**0.5769**	**2.4**	**0.1558**	**0.66**	**0.0262**	**0.11**	**1.1249**	**4.69**	**23.9011**

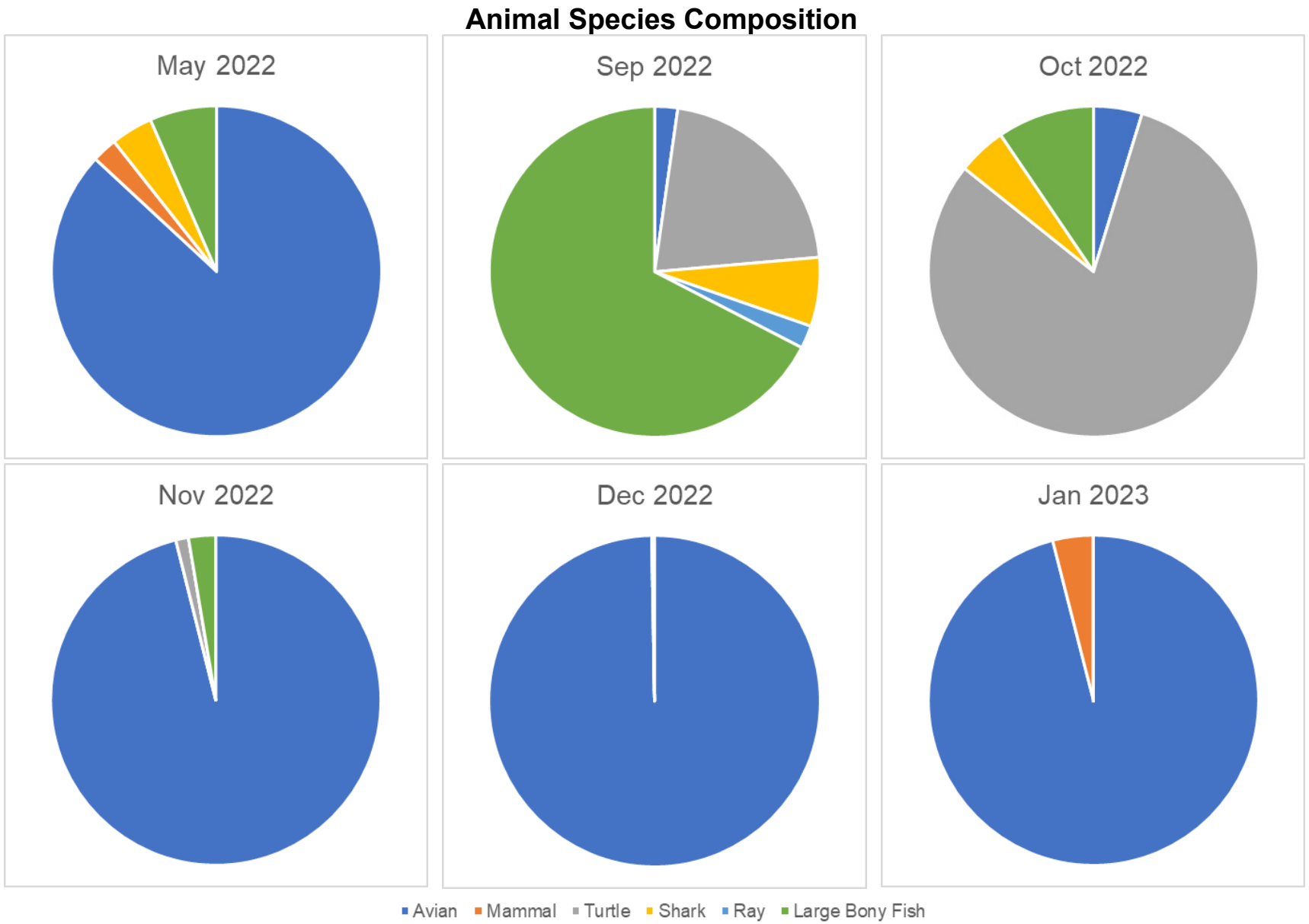

Figure 3. Percent composition of taxonomic groups found during each survey.

3.5 Birds

Species Identification

Over the six surveys, 1,673 birds were identified in imagery comprising 15 species; all birds were classified to species group at a minimum (Appendix B). Avian species-level identifications varied by group depending on size and coloration. The largest and most distinct bird species found naturally had higher identification rates, and this included phalaropes with 100% of these identified to species (n=2), fulmars (n=5), shearwaters (n=2), and gannets (n=24) (Table 11). Of the remaining species, auks (n=100; 91% identified to species), gulls (n=1,299; 99% identified to species), and loons (n=198; 99% identified to species) had high identification success rates (Table 11).

The *Sterna* tern group has difficult-to-distinguish species and of the 16 individuals encountered 6% were ascribed to species (n=1). No ducks (scoters) (n=2) and 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	0
Phalarope	2	2	–	100
Auk	110	100	10	91
Gull	1,306	1,299	7	99
Sterna Tern	16	1	15	6
Loon	199	198	1	99
Storm-petrel	3	–	3	0
Fulmar	5	5	–	100
Shearwater	2	2	–	100
Gannet	24	24	–	100
Unid. Avian	4	–	4	0

Species Composition and Density

Species composition and abundance was varied throughout the surveys, highlighting the seasonal nature of avian activity. The May 2022 survey was the most diverse with 7 species groups. The survey was dominated by loons (64%), *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). May 2022 was the only survey period when *Sterna* terns were found.

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 where auks and fulmars were found.

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

Species Group	Relative Abundance (%)						Species Total
	May 2022	Sep 2022	Oct 2022	Nov 2022	Dec 2022	Jan 2023	
Duck	1.89	0	0	0	0	0	0.12
Phalarope	0	0	0	0	0.27	0	0.12
Auk	0	0	0	0	0	38.06	6.58
Gull	10.38	0	100	95.94	90.31	38.75	78.06
Sterna Tern	15.09	0	0	0	0	0	0.96
Loon	64.15	0	0	3.51	9.28	15.22	11.89
Storm-petrel	0.94	100	0	0	0	0	0.18
Fulmar	0	0	0	0	0	1.73	0.3
Shearwater	0.94	0	0	0	0.14	0	0.12
Gannet	2.83	0	0	0.55	0	6.23	1.43
Unid. Avian	3.77	0	0	0	0	0	0.24
Totals	**100**	**100**	**100**	**100**	**100**	**100**	**100**

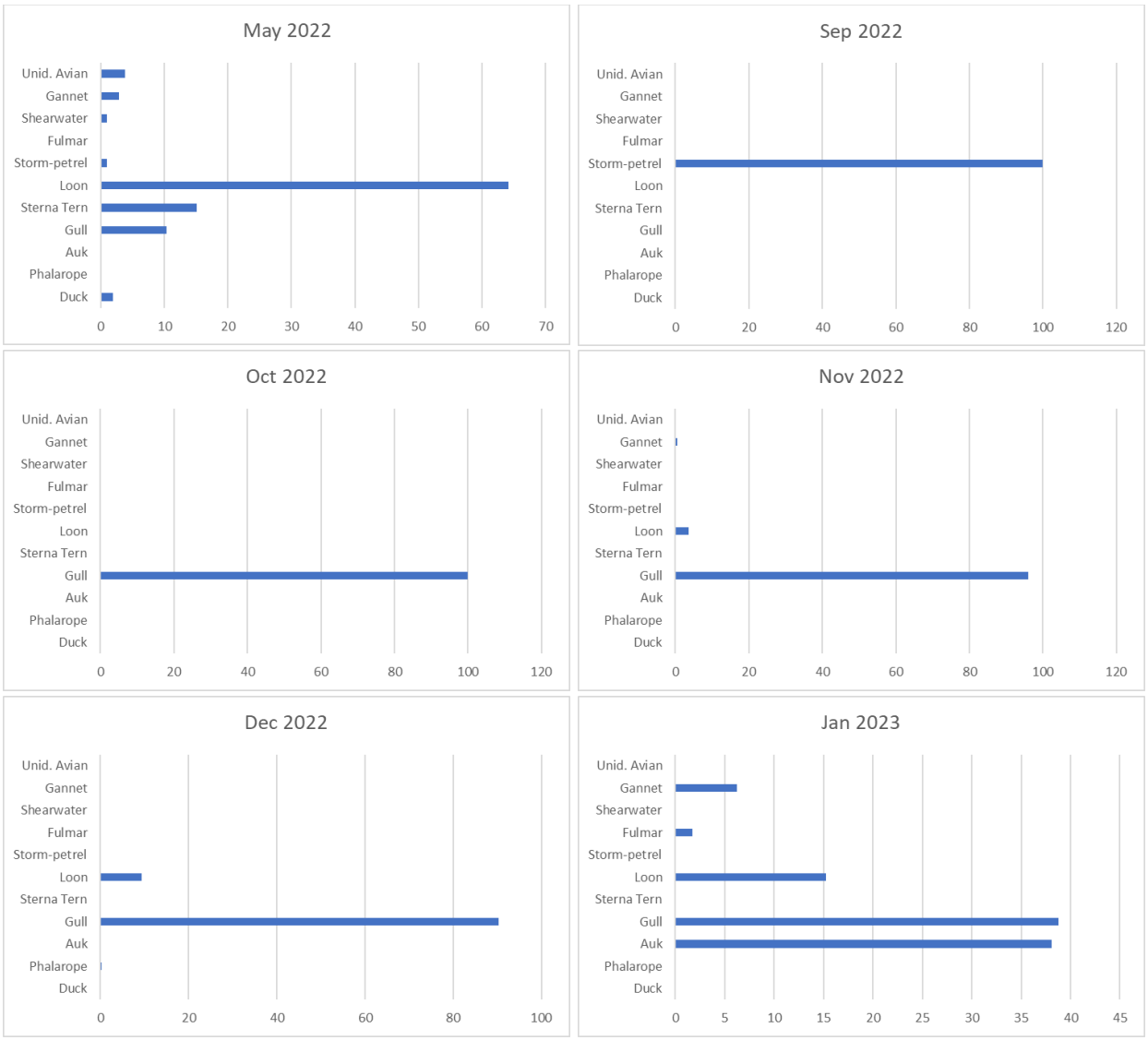

Figure 4. Density (per km^2) of avian species groups by survey.

The percent relative abundance of each avian species group for each survey is presented in Table 13. Across all surveys, gulls (17.1 birds/km^2; 78.3% of sample) was the most often encountered group followed by loons (2.58 birds/km^2; 11.8%) and auks (1.41 birds/km^2; 6.5%). Gulls and auks were the most diverse groups with 5 and 4 species identified, respectively, while there were only 2 loon species identified (Table 13, Figure 5). The number of gulls was highest during November 2022 (6.82 birds/km^2; 40%) and December 2022 (8.68 birds/km^2; 51%). All auk species were seen during the January 2023 survey (Table 13, Figure 5).

Loon densities were highest in the May (0.8702 birds/km^2), December (0.8915 birds/km^2), and January surveys (0.5655 birds/km^2). All months with loon observations were dominated by common loon (*Gavia immer*) (Table 14; Figure 6). Densities of gulls were highest in December 2022 (8.6786 birds/km^2) and November 2022 (6.817 birds/km^2) with both months dominated by Bonaparte's gull (*Chroicocephalus philadelphia*) (Table 14; Figure 6).

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

Species Group	Density (per km^2)												Species Total
	May 2022		Sep 2022		Oct 2022		Nov 2022		Dec 2022		Jan 2023		
	Density	%	Density	%	Density	%	Density	%	Density	%	Density	%	
Duck	**0.0256**	**100.00**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**0.0256**
Scoter unid.	0.0256	100.00	–	–	–	–	–	–	–	–	–	–	0.0256
Phalarope	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**0.0262**	**100.00**	**–**	**–**	**0.0262**
Red Phalarope	–	–	–	–	–	–	–	–	0.0262	100.00	–	–	0.0262
Auk	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**1.4137**	**100.00**	**1.4137**
Dovekie	–	–	–	–	–	–	–	–	–	–	0.1285	100.00	0.1285
Common/Thick-billed Murre	–	–	–	–	–	–	–	–	–	–	0.0514	100.00	0.0514
Razorbill	–	–	–	–	–	–	–	–	–	–	1.1567	100.00	1.1567
Murre/Razorbill	–	–	–	–	–	–	–	–	–	–	0.0129	100.00	0.0129
species unknown	–	–	–	–	–	–	–	–	–	–	0.0643	100.00	0.0643
Gull	**0.1408**	**0.84**	**–**	**–**	**0.0131**	**0.08**	**6.8170**	**39.82**	**8.6786**	**50.69**	**1.4394**	**8.58**	**17.0888**
Black-legged Kittiwake	–	–	–	–	–	–	–	–	–	–	0.5783	100.00	0.5783
Bonaparte's Gull	–	–	–	–	–	–	6.7252	43.81	8.5343	55.59	0.0900	0.60	15.3495
Laughing Gull	0.1152	75.00	–	–	0.0131	8.33	0.0262	16.67	–	–	–	–	0.1545
Herring Gull	–	–	–	–	–	–	–	–	–	–	0.3984	100.00	0.3984
Great Black-backed Gull	0.0256	5.00	–	–	–	–	0.0262	5.00	0.0918	17.50	0.3727	72.50	0.5163
species unknown - Small	–	–	–	–	–	–	0.0393	42.86	0.0524	57.14	–	–	0.0918
Sterna Tern	**0.2048**	**100.00**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**0.2048**
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**	**34.17**	**–**	**–**	**–**	**–**	**0.2491**	**9.55**	**0.8915**	**34.17**	**0.5655**	**22.11**	**2.5762**
Red-throated Loon	0.1024	100.00	–	–	–	–	–	–	–	–	–	–	0.1024
Common Loon	0.7551	31.05	–	–	–	–	0.2491	10.00	0.8915	35.79	0.5655	23.16	2.4611
species unknown	0.0128	100.00	–	–	–	–	–	–	–	–	–	–	0.0128
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**	**50.00**	**–**	**–**	**–**	**–**	**–**	**–**	**0.0131**	**50.00**	**–**	**–**	**0.0259**
Sooty Shearwater	0.0128	100.00	–	–	–	–	–	–	–	–	–	–	0.0128
Manx Shearwater	–	–	–	–	–	–	–	–	0.0131	100.00	–	–	0.0131
Gannet	**0.0384**	**12.50**	**–**	**–**	**–**	**–**	**0.0393**	**12.50**	**–**	**–**	**0.2313**	**75.00**	**0.3091**
Northern Gannet	0.0384	12.50	–	–	–	–	0.0393	12.50	–	–	0.2313	75.00	0.3091
Unid. Avian	**0.0512**	**100.00**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**0.0512**
species unknown	0.0512	100.00	–	–	–	–	–	–	–	–	–	–	0.0512
Total	**1.3565**	**6.34**	**0.0262**	**0.12**	**0.0131**	**0.06**	**7.1054**	**32.44**	**9.6093**	**43.87**	**3.7142**	**17.30**	**21.8248**

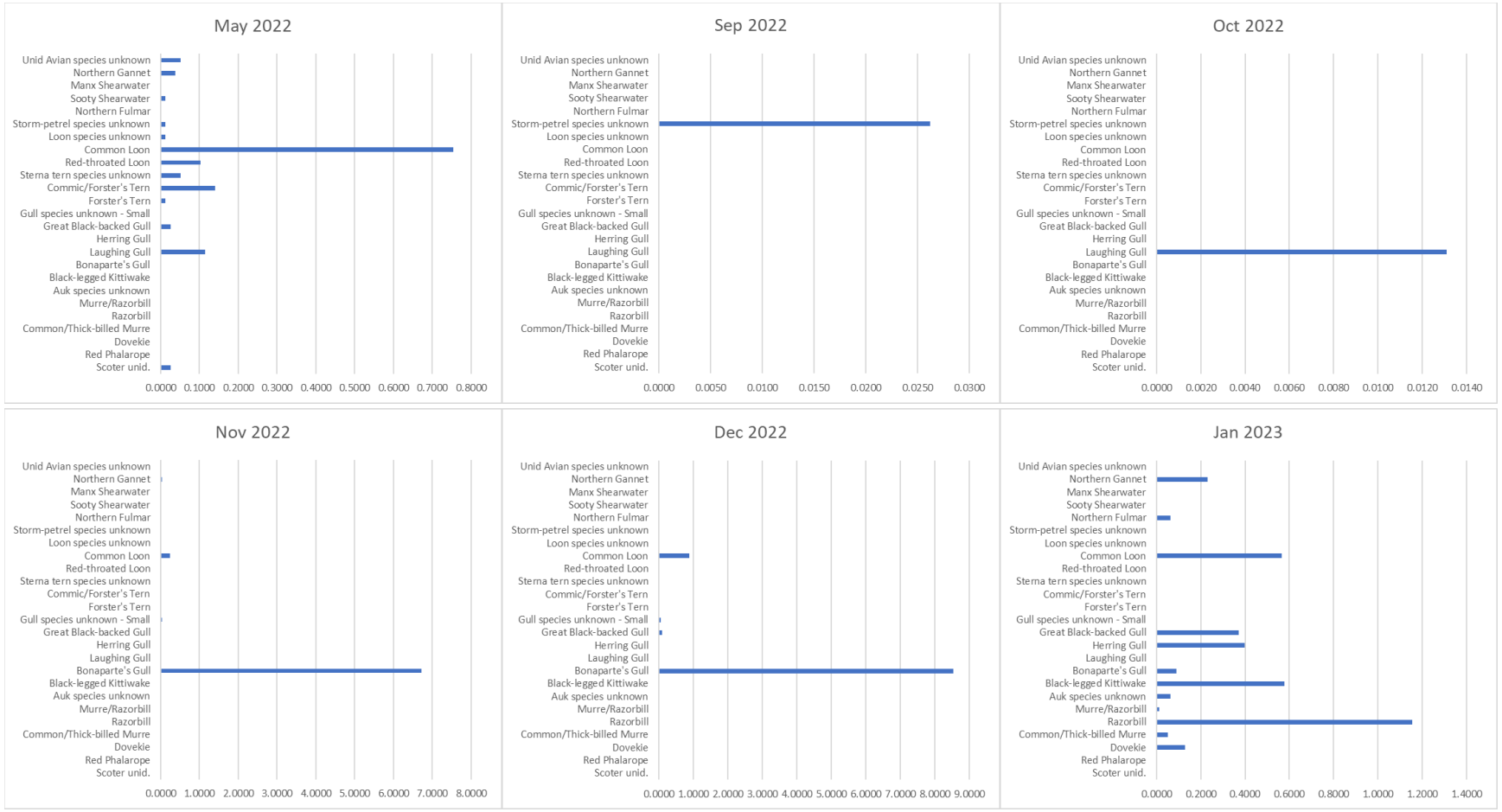

Figure 5. Density (per km^2) of avian species identified in the May 2022 through January 2023 surveys.

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	Density (per km^2)						Total
	May 2022	Sep 2022	Oct 2022	Nov 2022	Dec 2022	Jan 2023	
Duck	**0.0256**	**–**	**–**	**–**	**–**	**–**	**0.0256**
Scoter unid.	100						100
Phalarope	**–**	**–**	**–**	**–**	**0.0262**	**–**	**0.0262**
Red Phalarope					100		100
Auk	**–**	**–**	**–**	**–**	**–**	**1.4137**	**1.4137**
Dovekie						9.1	9.1
Common/Thick-billed Murre						3.6	3.6
Razorbill						81.8	81.8
Murre/Razorbill						0.9	0.9
species unknown						4.5	4.5
Gull	**0.1408**	**–**	**0.0131**	**6.817**	**8.6786**	**1.4394**	**17.0888**
Black-legged Kittiwake						40.2	3.4
Bonaparte's Gull				98.7	98.3	6.3	89.7
Laughing Gull	81.8		100	0.4			0.9
Herring Gull						27.7	2.4
Great Black-backed Gull	18.2			0.4	1.1	25.9	3.1
species unknown - Small				0.6	0.6		0.5
Sterna Tern	**0.2048**	**–**	**–**	**–**	**–**	**–**	**0.2048**
Forster's Tern	6.3						6.3
Commic/Forster's Tern	68.8						68.8
species unknown	25						25
Loon	**0.8702**	**–**	**–**	**0.2491**	**0.8915**	**0.5655**	**2.5762**
Red-throated Loon	11.8						4
Common Loon	86.8			100	100	100	95.5
species unknown	1.5						0.5
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**	**–**	**0.0259**
Sooty Shearwater	100						50
Manx Shearwater					100		50
Gannet	**0.0384**	**–**	**–**	**0.0393**	**–**	**0.2313**	**0.3091**
Northern Gannet	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**	**21.8248**

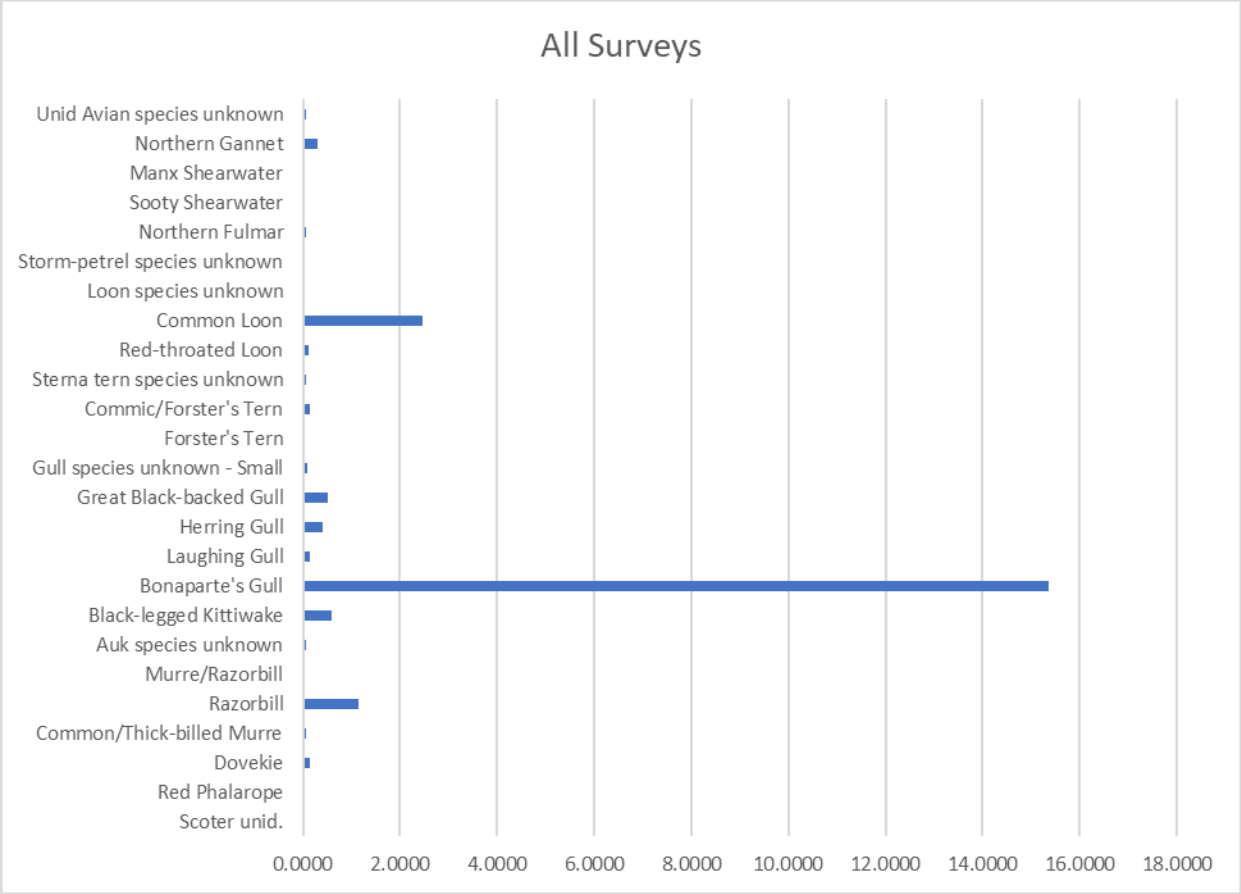

Figure 6. Density (per km^2) of avian species identified in all surveys.

Spatial Distribution

The spatial distribution of all bird species found in each of the May 2022 through January 2023 surveys is shown in Figure 7. Species found in the December 2022 survey were focused to the northeast of the Project and in what will become the TSS extension. The January 2023 encounters were predominantly to the southwest of the project.

Spatial distribution maps of individual bird species during the May 2022 through January 2023 surveys are shown in Appendix C. It can be noted that the January 2023 encounters in the southwest are mainly of razorbill (*Alca torda*), and in December 2022 in the northeast encounters were mainly of Bonaparte's gull (*Chroicocephalus philadelphia*).

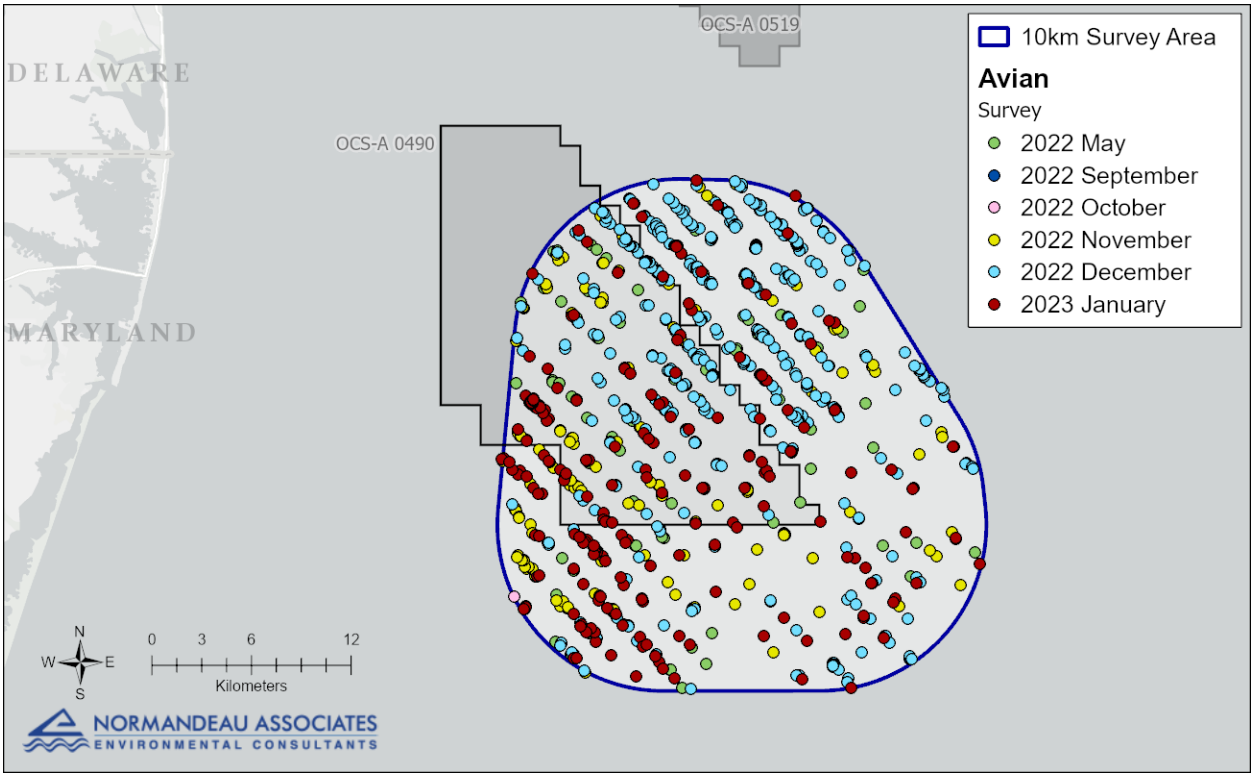

Figure 7. Spatial distribution of all bird species during all surveys.

Flight Height

All bird observations during the May 2022 through January 2023 surveys 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 survey for each species group (Table 15). Density per km^2 of all flying and sitting 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 each species and each survey.

Of all birds observed (n=1,673), 47% were observed sitting (n=779) and 53% were observed flying (n=894): 16% were flying within the RSZ (n=268), 12.3% were flying above or below the RSZ (n=207), and 25% had unknown flight heights (n=419) (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.

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 margins for each species are presented for each survey in Appendix E.

Table 15. Number of Flying and Sitting Birds, Abundance (per km^2), and Percent Within Each Survey Observed during the May 2022 through January 2023 Surveys

Season	Flight Height Unknown			Flying outside RSZ*			Flying within RSZ*			Sitting			Total Abundance
	No.	Abundance	% Within Survey	No.	Abundance	% Within Survey	No.	Abundance	% Within Survey	No.	Abundance	% Within Survey	
May 2022	18	0.2304	16.98	2	0.0256	1.89	3	0.0384	2.83	83	1.0622	78.3	106
Sep 2022	2	0.0262	100	–	–	0	–	–	0	–	–	0	2
Oct 2022	–	–	0	–	–	0	1	0.0131	100	–	–	0	1
Nov 2022	208	2.7268	38.38	97	1.2716	17.9	104	1.3634	19.19	133	1.7436	24.54	542
Dec 2022	114	1.4945	15.55	84	1.1012	11.46	133	1.7436	18.14	402	5.2701	54.84	733
Jan 2023	77	0.9896	26.64	24	0.3084	8.3	27	0.3470	9.34	161	2.0691	55.71	289
TOTAL	**419**	**5.4675**		**207**	**2.7069**		**268**	**3.5055**		**779**	**10.145**		**1,673**

* RSZ = 23–319 (m)

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

Species Group	May 2022		Sep 2022		Oct 2022		Nov 2022		Dec 2022		Jan 2023	
	No.	Median Altitude	No.	Median Altitude	No.	Median Altitude	No.	Median Altitude	No.	Median Altitude	No.	Median Altitude
Phalarope	–	–	–	–	–	–	–	–	1	37	–	–
Auk	–	–	–	–	–	–	–	–	–	–	4	35.1
Gull	5	27	–	–	1	29.7	201	23.8	213	32.3	45	25.2
Loon	–	–	–	–	–	–	–	–	3	77.6	–	–
Gannet	–	–	–	–	–	–	–	–	–	–	2	56.6

3.6 Turtles

Species Identification

Raw counts of turtle species identified in the May 2022 through January 2023 surveys are presented in Table 17. Over the six surveys, 44 turtles were identified in imagery representing four species and one species blend (Table 17). Of these, 72.7% (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=6). Of the 6 loggerhead/Kemp's species blend, none were significantly submerged and 4 (9.1%) of those not ascribed to any species were significantly submerged (Table 17).

Table 17. Turtle Species Identified in Each Survey

Species	Raw Counts												Total
	May 2022		Sep 2022		Oct 2022		Nov 2022		Dec 2022		Jan 2023		
	SS[1]	Tot	SS[1]	Tot	SS[1]	Tot	SS[1]	Tot	SS[1]	Tot	SS[1]	Tot	
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	–	–	6
TOTAL	–	–	10	19	4	17	1	7	1	1	–	–	44

* Listed under the Endangered Species Act
[1] Significantly submerged

Species Composition and Density

The overall density of turtles was fairly even during the September 2022 and October 2022 surveys with 0.25 turtles/km^2 (43% of the September 2022 survey) and 0.22 turtles/km^2 (39% of the October 2022 survey), with lower density during the November (0.09; 16%) and December 2022 (0.01; 2.3%) surveys (Table 18). No turtles were found during the May 2022 or January 2023 surveys. Overall, loggerhead turtles were the most frequently found species consisting of 55% of the total observations; the loggerhead/Kemp's blend and turtle-species unknown each accounted for 13.6% (0.08 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 September 2022 survey) followed by loggerhead/Kemp's with 0.026 turtles/km^2 (11%) (Table 18, Figure 8). The remaining species include leatherback turtle (*Dermochelys coriacea*), Kemp's ridley turtle (*Lepidochelys kempii*), and turtle-species unknown with 0.013 turtles/km^2 (5%) each (Table 18, Figure 8).

Encounters in October 2022 were dominated by loggerhead turtles (0.091 turtles/km^2; 41%) and loggerhead/Kemp's blend (0.052 turtles/km^2; 24%) followed by equal densities of leatherback turtles, green turtle (*Chelonia mydas*), and Kemp's ridley turtles (0.026 turtles/km^2; 12%) (Table 18, Figure 8).

During the November 2022 survey, loggerhead turtles were dominant with 0.039 turtles/km^2 (43%) followed by turtle-species unknown (0.026 turtles/km^2; 29%) and leatherback and green turtles (0.013 turtles/km^2; 14%). This is the only survey where green turtles were found.

The only turtles found during the December 2022 survey were turtle-species unknown (0.013 turtles/km^2) (Table 18, Figure 8).

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

Species	May 2022		Sep 2022		Oct 2022		Nov 2022		Dec 2022		Jan 2023		Species Total
	Density	%	Density	%	Density	%	Density	%	Density	%	Density	%	
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	16.67	0.0262	33.33	0.0262	33.33	0.0131	16.67	–	–	0.0787
TOTAL	**–**	**—**	**0.2491**	**43.18**	**0.2229**	**38.64**	**0.0918**	**15.91**	**0.0131**	**2.27**	**–**	**–**	**0.5768**

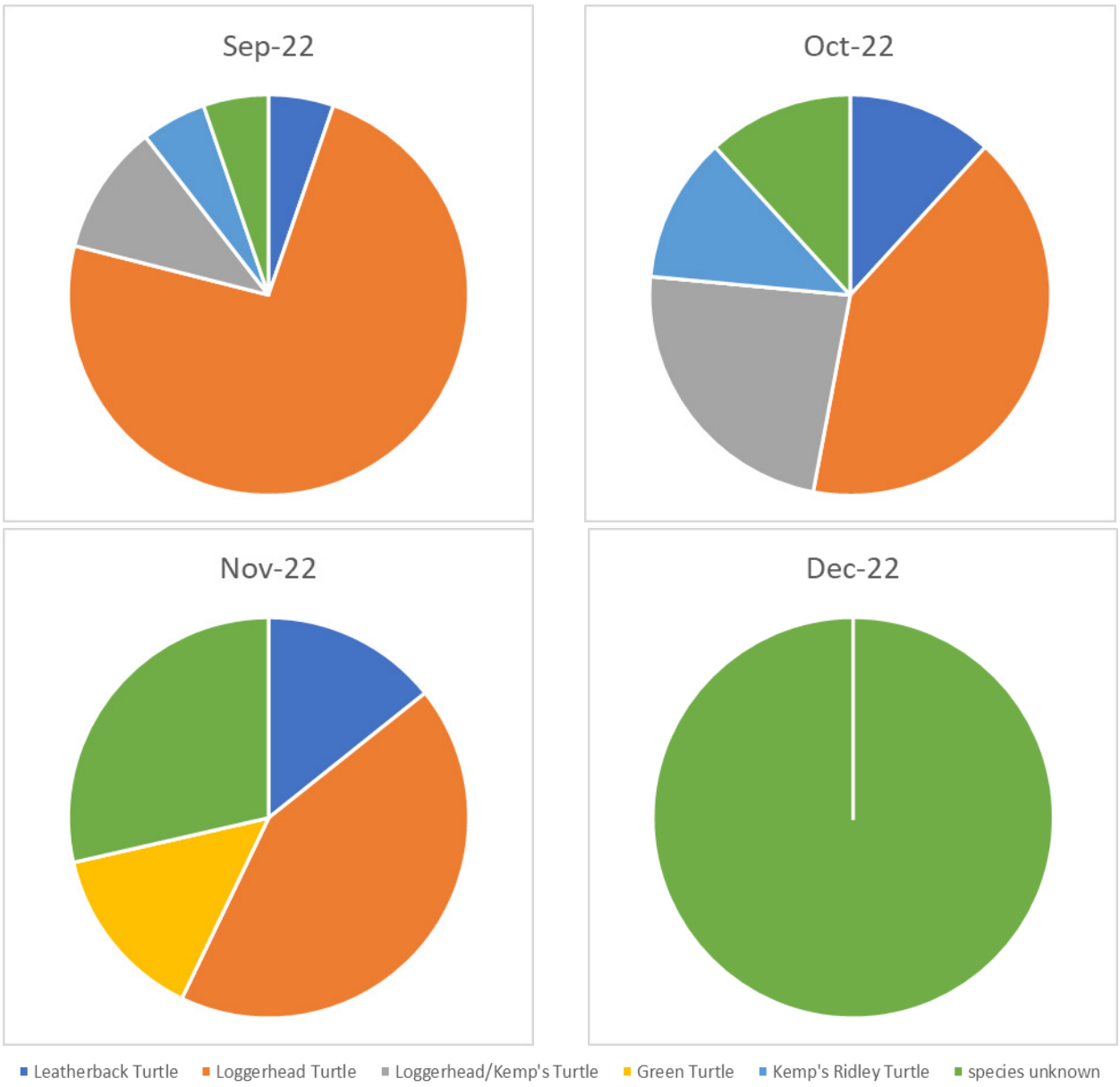

Figure 8. Density per km^2 of turtle species found during the May 2022 through January 2023 surveys.

Spatial Distribution

The spatial distribution of turtles found during all surveys is shown in Figure 10. The spatial distribution of individual turtle species for each survey is presented in Appendix F. There is no evidence of distinct spatial patterns.

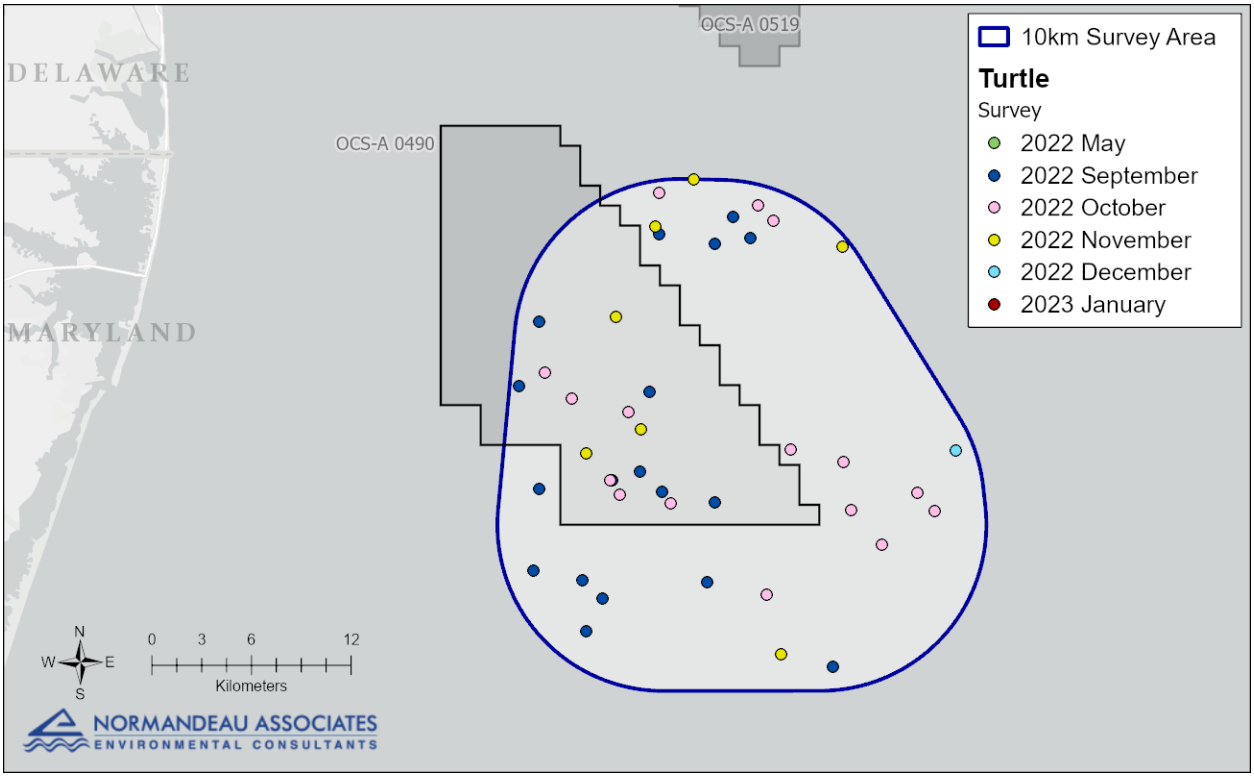

Figure 9. Spatial distribution of turtles during all surveys.

3.7 Marine Mammals

Species Identification

Raw counts of marine mammal species identified in the May 2022 through January 2023 surveys are presented in Table 19. Over the six surveys, 15 marine mammals were identified in imagery all of which were dolphins (Table 19).

All dolphins were ascribed to species), which provided an identification rate of 100% (Table 19). These include common dolphins (n=12; 80%) (*Delphinus delphis*) and bottlenose dolphins (n=3; 20%) (*Tursiops truncates*). Of the 15 dolphins encountered, only 1 was significantly submerged.

Table 19. Marine Mammals Identified in Each Survey

Species	Raw Counts												Total
	May 2022		Sep 2022		Oct 2022		Nov 2022		Dec 2022		Jan 2023		
	SS[1]	Tot	SS[1]	Tot	SS[1]	Tot	SS[1]	Tot	SS[1]	Tot	SS[1]	Tot	
Common Dolphin	0	–	0	–	0	–	0	–	0	–	8	**12**	12
Bottlenose Dolphin	1	**3**	0	–	0	–	0	–	0	–	0	–	3
TOTAL	**1**	**3**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**8**	**12**	**15**

[1] Significantly submerged

Species Composition and Density

Marine mammal species identified and the density (per km^2) of individuals for each survey are shown in Table 20. During all surveys, marine mammal observations included 100% dolphins (Table 20).

During the May 2022 survey, bottlenose dolphins were the only species found with 0.038 dolphins/km^2 (20% overall) (Table 20).

Common dolphins accounted for 100% of the individuals recorded in the January 2023 survey with 0.154 dolphins/km^2 (80% overall) (Table 20).

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

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

Species	May 2022		Sep 2022		Oct 2022		Nov 2022		Dec 2022		Jan 2023		Species Total
	Density	%	Density	%	Density	%	Density	%	Density	%	Density	%	
Common Dolphin	–	–	–	–	–	–	–	–	–	–	0.1542	100.00	0.1542
Bottlenose Dolphin	0.0384	100.00	–	–	–	–	–	–	–	–	–	–	0.0384
TOTAL	**0.0384**	**20.00**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**0.1542**	**80.00**	**0.1926**

Spatial Distribution

The spatial distribution of all marine mammals found during all surveys is shown in Figure 11. No marine mammals were recorded within the lease area; all were found within the 10-km buffer area. The spatial distribution of individual mammal species for each survey is presented in Appendix G.

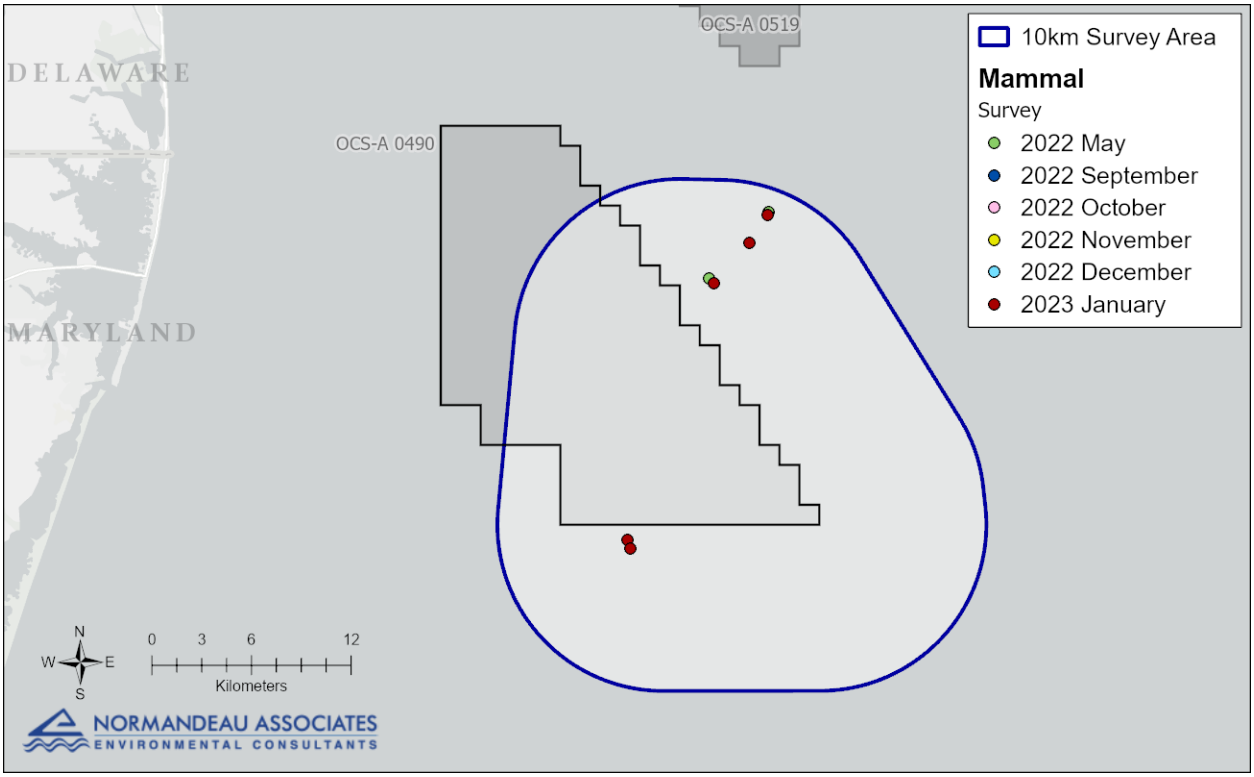

Figure 10. Spatial distribution of marine mammal species during all surveys.

3.8 Rays and Sharks

Species Identification

Raw counts of ray and shark species identified in the May 2022 through January 2023 surveys are presented in Table 21 and Table 22, respectively.

There were 2 rays 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, 12 sharks were found during all surveys dominated by hammerhead (unid.) (n=4), 2 of which were significantly submerged (Table 22). No sharks were seen in the imagery during the November 2022, December 2022, or January 2023 surveys.

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

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

There was only 1 shark species found during the October 2022 survey, which was a hammerhead (unid.) (Table 22).

Table 21. Rays Identified in Each Survey

Species	Raw Counts												Total
	May 2022		Sep 2022		Oct 2022		Nov 2022		Dec 2022		Jan 2023		
	SS[1]	Tot	SS[1]	Tot	SS[1]	Tot	SS[1]	Tot	SS[1]	Tot	SS[1]	Tot	
Giant Manta Ray*	–	–	0	2	–	–	–	–	–	–	–	–	2
TOTAL	**0**	**0**	**0**	**2**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2**

* Listed under the Endangered Species Act
[1] Significantly submerged

Table 22. Shark Species Identified in Each Survey

Species	Raw Counts												Total
	May 2022		Sep 2022		Oct 2022		Nov 2022		Dec 2022		Jan 2023		
	SS[1]	Tot	SS[1]	Tot	SS[1]	Tot	SS[1]	Tot	SS[1]	Tot	SS[1]	Tot	
Carcharhinidae (unid.)	0	3	–	–	–	–	–	–	–	–	–	–	3
Scalloped Hammerhead*	–	–	0	2	–	–	–	–	–	–	–	–	2
Hammerhead (unid.)*	–	–	2	3	0	1	–	–	–	–	–	–	4
species unknown	2	2	1	1	–	–	–	–	–	–	–	–	3
TOTAL	**2**	**5**	**3**	**6**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**12**

* Listed under the Endangered Species Act
[1] Significantly submerged

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 0.026 rays/km^2 (Table 23). Rays were not found in any other survey.

The overall density of sharks was greatest during the September 2022 survey with 0.079 sharks/km^2, or 50% of the total (Table 24). The dominant species during this survey was hammerhead (unid.) with 0.039 sharks/km^2 (49% of the sharks in September 2022) followed by scalloped hammerhead (0.0262; 33%) and shark-species unknown (0.0131; 17%) (Table 24). Scalloped hammerhead sharks were only seen during this survey.

The second highest density of sharks was during the May 2022 survey with 0.064 sharks/km^2 (41.7%) (Table 24). This survey was dominated by Carcharhinidae (unid.) with 0.038 sharks/km^2

(60%) followed by shark-species unknown (0.026; 40%) (Table 24). 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 0.013 sharks/km^2 (8.33% of all surveys) (Table 24).

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

Spatial Distribution

The spatial distribution of rays and sharks found during all surveys is shown in Figure 12 and Figure 13, 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 south of the lease area. Spatial distribution of individual species of rays and sharks is shown in Appendix H.

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

Species Group	May 2022		Sep 2022		Oct 2022		Nov 2022		Dec 2022		Jan 2023		Species Total
	Density	%	Density	%	Density	%	Density	%	Density	%	Density	%	
Giant Manta Ray	–	–	0.0262	100.00	–	–	–	–	–	–	–	–	0.0262
TOTAL	**–**	**–**	**0.0262**	**100.00**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**0.0262**

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

Species Group	May 2022		Sep 2022		Oct 2022		Nov 2022		Dec 2022		Jan 2023		Species Total
	Density	%	Density	%	Density	%	Density	%	Density	%	Density	%	
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
species unknown	0.0256	66.67	0.0131	33.33	–	–	–	–	–	–	–	–	0.0387
TOTAL	**0.0640**	**41.67**	**0.0787**	**50.00**	**0.0131**	**8.33**	**–**	**–**	**–**	**–**	**–**	**–**	**0.1558**

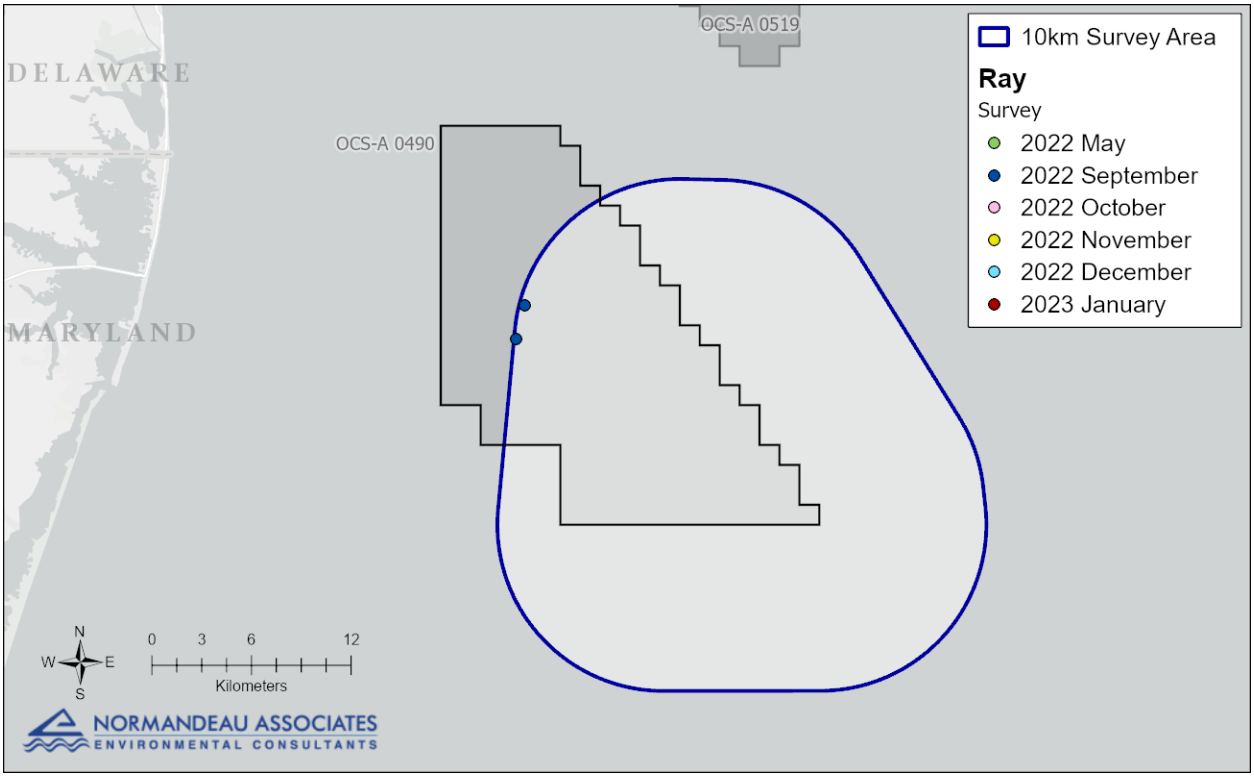

Figure 11. Spatial distribution of ray species during all surveys.

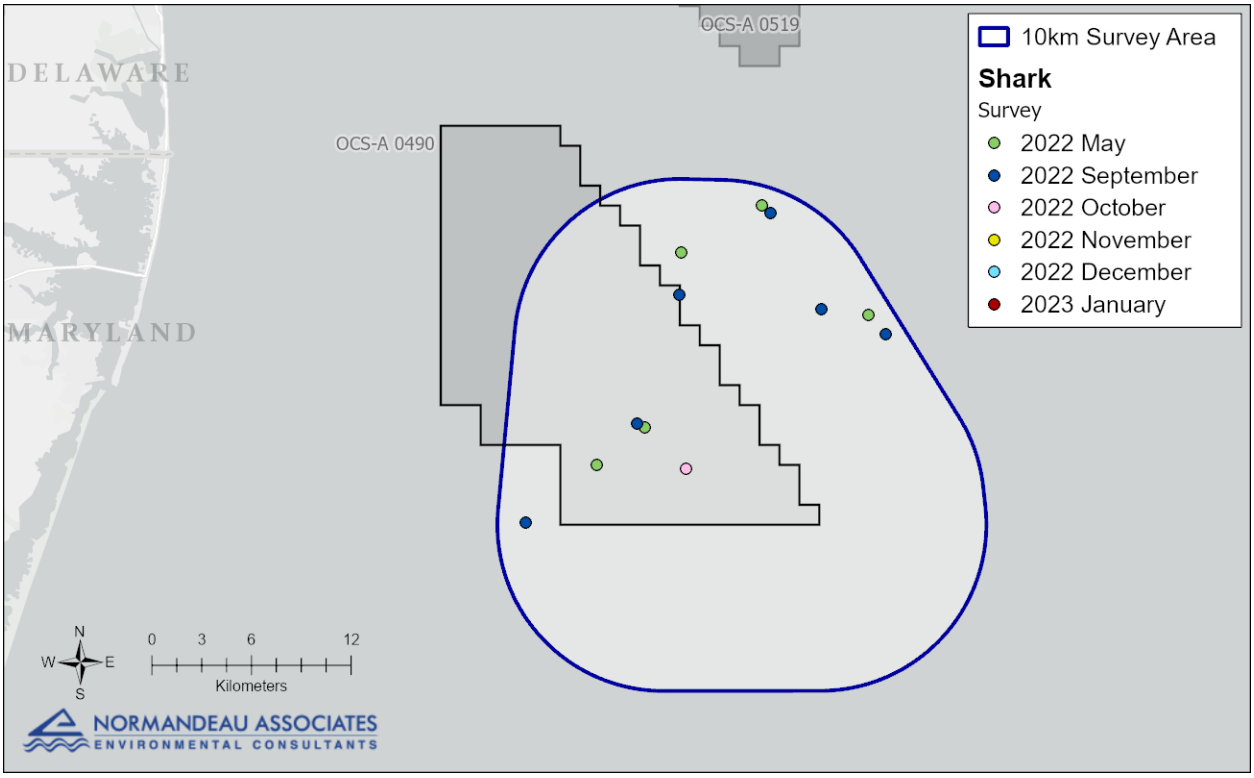

Figure 12. Spatial distribution of shark species during all surveys.

3.9 Large Bony Fish

Species Identification

Raw counts of large bony fishes identified in the May 2022 through January 2023 surveys are presented in Table 25. Over all surveys, 86 individuals represented 3 species and 3 unknown species groups. The identification success rate was 20% 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, only 1 (16%) was significantly submerged (Table 25).

The most dominant survey was September 2022 with 60 (70%) 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, 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 were significantly submerged.

During the November 2022 survey, 100% (n=15) of the individuals were identified to species level including 1 Atlantic bluefin tuna (6.6%) and 14 ocean sunfish (93.4%) (Table 25). None of these individuals were significantly submerged.

For the December 2022 survey, only 1 (1.2%) individual was seen and was ascribed to species (ocean sunfish). It was not significantly submerged (Table 25).

No large bony fishes were seen during the January 2023 survey (Table 25).

Table 25. Large Bony Fishes Identified in Each Survey

Species	Raw Counts												Total
	May 2022		Sep 2022		Oct 2022		Nov 2022		Dec 2022		Jan 2023		
	SS[1]	Tot	SS[1]	Tot	SS[1]	Tot	SS[1]	Tot	SS[1]	Tot	SS[1]	Tot	
Mahi-Mahi	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**
Mahi-Mahi	–	**–**	0	**1**	–	**–**	–	**–**	–	**–**	–	**–**	1
Tuna	**1**	**8**	**0**	**58**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**67**
Atlantic bluefin tuna*	0	**2**	–	**–**	–	**–**	0	**1**	–	**–**	–	**–**	3
species unknown	1	**6**	0	**58**	–	**–**	–	**–**	–	**–**	–	**–**	64
Sunfish	**0**	**0**	**0**	**0**	**0**	**2**	**0**	**14**	**0**	**1**	**0**	**0**	**17**
Ocean Sunfish	–	**–**	–	**–**	0	**1**	0	**14**	0	**1**	–	**–**	16
species unknown	–	**–**	–	**–**	0	**1**	–	**–**	–	**–**	–	**–**	1
Remora	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**
Remora unid.	–	**–**	0	**1**	–	**–**	–	**–**	–	**–**	–	**–**	1
TOTAL	**1**	**8**	**0**	**60**	**0**	**2**	**0**	**15**	**0**	**1**	**0**	**0**	**86**

* Listed under the Endangered Species Act
[1] Significantly submerged

Species Composition and Density

Large bony fishes identified and the density of large bony fishes per km^2 for each survey is shown in Table 26.

The May 2022 survey had an overall density of 0.1024 large bony fishes/km^2 (9.3% of the total) and was dominated by tuna-species unknown (0.0768 per km^2; 75%). Diversity was low with just 2 tuna species or unknown-tuna species group identified (Table 26).

The September 2022 survey had the greatest density of all surveys with 70% (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. with (0.0131 per km^2; 1.7%) (Table 26). Diversity was highest during this survey with 3 species or unknown-species groups identified.

During the October 2022 survey, the density was 0.0262 large bony fishes/km^2 (2.33%) (Table 26). Two sunfish species were found during this survey each representing 0.0131 per km^2 (Table 26).

November 2022 had the second highest density of all surveys with 17.4% (0.196 per km^2) of the total (Table 26) dominated by ocean sunfish (0.184 per km^2; 93%) followed by the only other species encountered, Atlantic bluefin tuna (0.0131 per km^2; 7%) (Table 26).

The lowest density of all surveys was during the December 2022 survey with just 1.2% (0.0131 per km^2) of the total (Table 26). Ocean sunfish was the only species encountered (Table 26).

There were no large bony fishes seen during the January 2023 survey (Table 26).

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

Subtype	Species/Species Group	May 2022		Sep 2022		Oct 2022		Nov 2022		Dec 2022		Jan 2023		Species Total
		Density	%	Density	%	Density	%	Density	%	Density	%	Density	%	
Mahi-Mahi	Mahi-Mahi	–	–	0.0131	100	–	–	–	–	–	–	–	–	0.0131
Tuna	Atlantic bluefin tuna	0.0256	66.67	–	–	–	–	0.0131	33.33	–	–	–	–	0.0387
Tuna	species unknown	0.0768	9.38	0.7604	90.63	–	–	–	–	–	–	–	–	0.8371
Sunfish	Ocean Sunfish	–	–	–	–	0.0131	6.25	0.1835	87.5	0.0131	6.25	–	–	0.2098
Sunfish	species unknown	–	–	–	–	0.0131	100	–	–	–	–	–	–	0.0131
Remora	Remora unid.	–	–	0.0131	100	–	–	–	–	–	–	–	–	0.0131
TOTAL		**0.1024**	**9.3**	**0.7866**	**69.77**	**0.0262**	**2.33**	**0.1966**	**17.44**	**0.0131**	**1.16**	**–**	**–**	**1.1249**

Spatial Distribution

The spatial distribution of all large bony fishes found during the May 2022 through January 2023 surveys is shown in Figure 14. The spatial distribution of individual species is shown in Appendix I. There were no apparent spatial preferences evident for large bony fish.

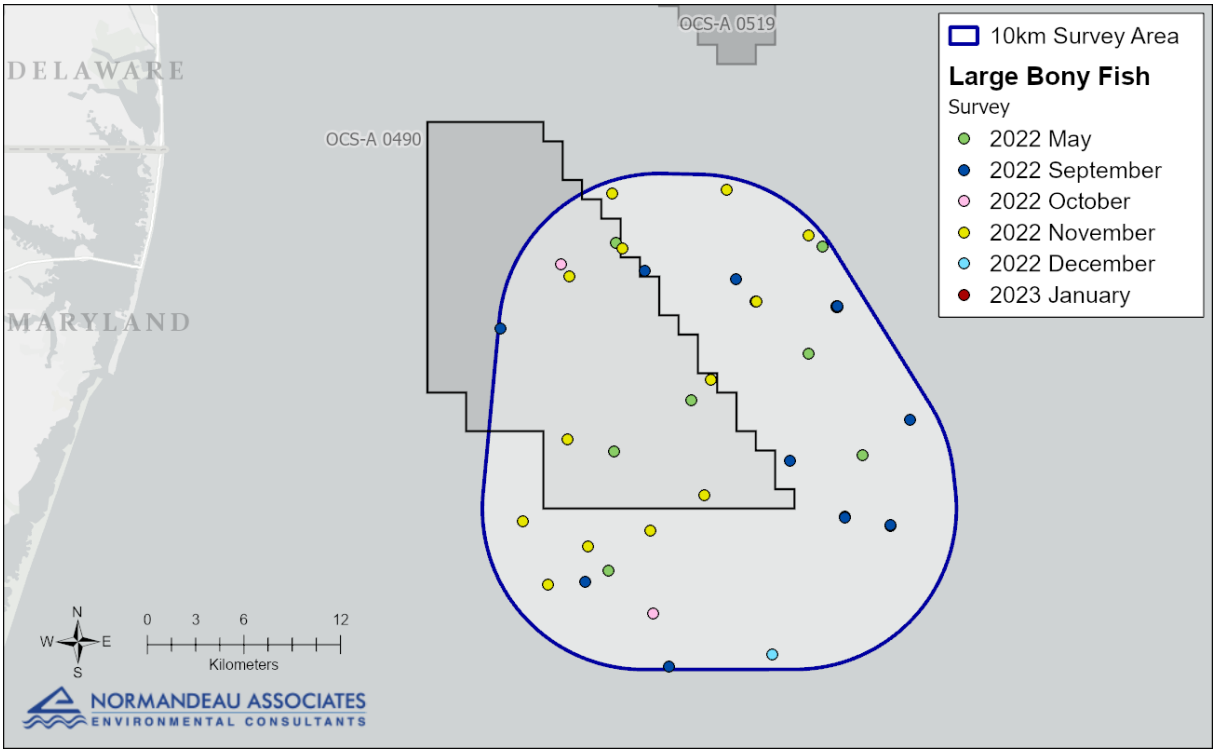

Figure 13. Spatial distribution of large bony fishes during all surveys.

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 the May 2022 through January 2023 surveys are presented in Table 27.

There were 59 ESA or State-listed species found in the imagery across all surveys (Table 27). Turtles accounted for 75% of the encounters with 44 observations. Of the 44 turtles, 55% (n=24) were identified as loggerhead turtles. The September 2022 survey had the most turtles with 19 (43%) followed by October 2022 with 17 (39%) and November 2022 with 7 (16%). One green turtle was seen in November, the only survey in which it was found. One turtle-species unknown was found in December 2022 and was the only turtle seen. There were no turtles in the May 2022 or January 2023 surveys (Table 27).

Shark species represented 10% (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 (n=3) and October (n=1) 2022 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 3 Atlantic bluefin tuna observed (5% of the total), 67% (n=2) were recorded during the May 2022 survey and 33% (n=1) during the November 2022 survey. No observations were made during the September, October December, or January surveys (Table 27).

Two giant manta rays (3.4% of the total) were seen with 100% of the occurrences during the September 2022 survey (Table 27).

Sterna terns consisted of 7% (n=4) of the observations of listed species but they were not identified to species level. All 4 occurrences were recorded during the May 2022 survey (Table 27). There were no other observations.

Table 27. ESA and State-listed Species Identified in the May 2022 through January 2023 Surveys

Subtype	Species/Species Group	May 2022	Sep 2022	Oct 2022	Nov 2022	Dec 2022	Jan 2023	Species Total
Sterna Tern	species unknown	4						4
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		6
Shark	Scalloped Hammerhead		2					2
Shark	Hammerhead (unid.)		3	1				4
Ray	Giant Manta Ray		2					2
Tuna	Atlantic bluefin tuna	2			1			3
TOTAL		**6**	**26**	**18**	**8**	**1**	**0**	**59**

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 0.7716 individuals/km^2. Across all surveys, 44% (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 31% (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 41% (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 and turtle-species unknown each accounted for another 14% (0.0787 per km^2) of the turtles. Hammerhead (unid.) sharks comprised 7% (0.0524 per km^2) of the total observations of listed species and were seen in September (0.0393 per km^2) and October (0.0131 per km^2) surveys (Table 28). Atlantic bluefin tuna represented 5% (0.0387 per km^2) of observations of listed species but was only seen during the May 2022 (0.0256 per km^2) and November 2022 (0.0131 per km^2) surveys (Table 28).

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

Subtype	Species/Species Group	May 2022		Sep 2022		Oct 2022		Nov 2022		Dec 2022		Jan 2023		Species Total
		Density	%	Density	%	Density	%	Density	%	Density	%	Density	%	
Sterna Tern	species unknown	0.0512	100.00	–	–	–	–	–	–	–	–	–	–	0.0512
Turtle	Leatherback Turtle	–	–	0.0131	25.00	0.0262	50.00	0.0131	25.00	–	–	–	–	0.0524
Turtle	Loggerhead Turtle	–	–	0.1835	58.33	0.0918	29.17	0.0393	12.50	–	–	–	–	0.3146
Turtle	Loggerhead/Kemp's Turtle	–	–	0.0262	33.33	0.0524	66.67	–	–	–	–	–	–	0.0787
Turtle	Green Turtle	–	–	–	–	–	–	0.0131	100.00	–	–	–	–	0.0131
Turtle	Kemp's Ridley Turtle	–	–	0.0131	33.33	0.0262	66.67	–	–	–	–	–	–	0.0393
Turtle	species unknown	–	–	0.0131	16.67	0.0262	33.33	0.0262	33.33	0.0131	16.67	–	–	0.0787
Shark	Scalloped Hammerhead	–	–	0.0262	100.00	–	–	–	–	–	–	–	–	0.0262
Shark	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	66.67	–	–	–	–	0.0131	33.33	–	–	–	–	0.0387
TOTAL		**0.0768**	**10.17**	**0.3408**	**44.07**	**0.2360**	**30.51**	**0.1049**	**13.56**	**0.0131**	**1.69**	**–**	**–**	**0.7716**

4 Discussion

Within this interim report one or two patterns stand out that will be of interest to the overall purpose of the Project. Monitoring the density and distribution of loons through the remaining months of this first annual study and observing shifts in a second year of study and 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 once the TSS is extended, before construction is in full swing, and once the Project is constructed.

5 References

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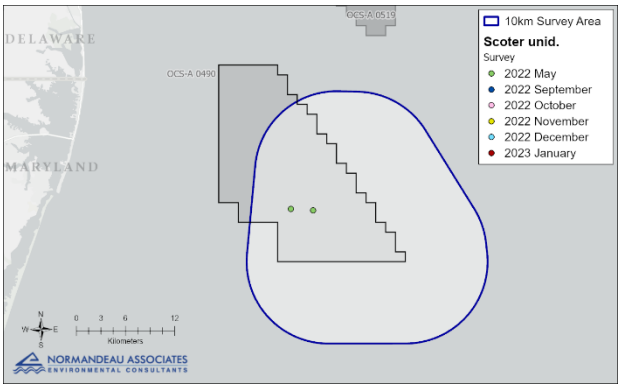
Appendix A: List of Species Found During the May 2022 through January 2023 Surveys (Taxonomic Order)

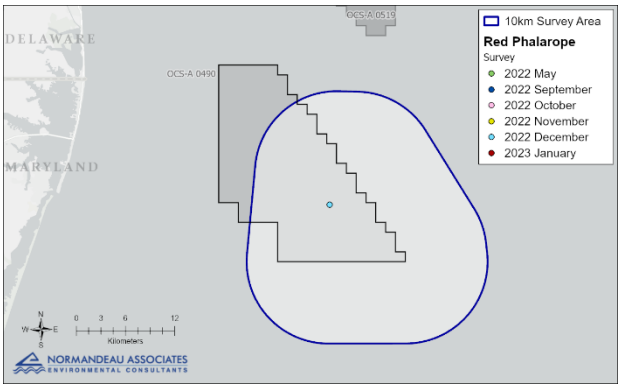
Common Name	Scientific Name	Class	Family
Red Phalarope	*Phalaropus fulicarius*	Aves	Scolopacidae
Dovekie	*Alle alle*	Aves	Alcidae
Razorbill	*Alca torda*	Aves	Alcidae
Black-legged Kittiwake	*Rissa tridactyla*	Aves	Laridae
Bonaparte's Gull	*Chroicocephalus philadelphia*	Aves	Laridae
Laughing Gull	*Leucophaeus atricilla*	Aves	Laridae
Herring Gull	*Larus argentatus*	Aves	Laridae
Great Black-backed Gull	*Larus marinus*	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
Common Dolphin	*Delphinus delphis*	Mammalia	Delphinidae
Bottlenose Dolphin	*Tursiops truncatus*	Mammalia	Delphinidae
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
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

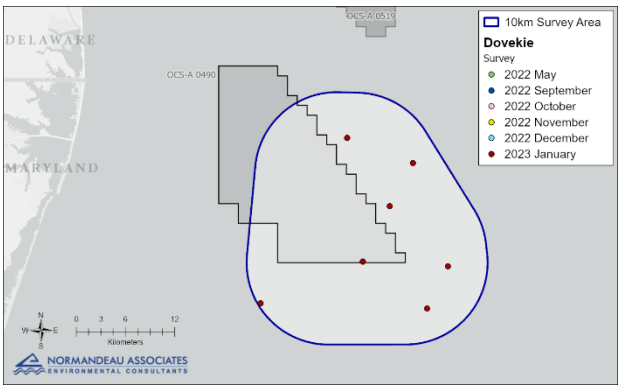
Appendix B: Avian Species Identified in Each Survey

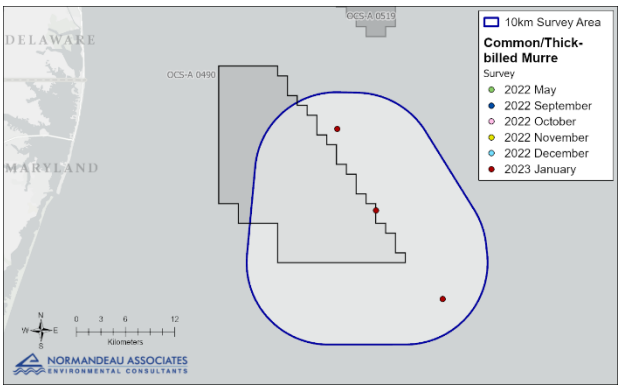
Species	Raw Counts						Species Total
	May 2022	Sep 2022	Oct 2022	Nov 2022	Dec 2022	Jan 2023	
Duck	**2**	**–**	**–**	**–**	**–**	**–**	**2**
Scoter unid.	2	–	–	–	–	–	2
Phalarope	**–**	**–**	**–**	**–**	**2**	**–**	**2**
Red Phalarope	–	–	–	–	2	–	2
Auk	**–**	**–**	**–**	**–**	**–**	**110**	**110**
Dovekie	–	–	–	–	–	10	10
Common/Thick-billed Murre	–	–	–	–	–	4	4
Razorbill	–	–	–	–	–	90	90
Murre/Razorbill	–	–	–	–	–	1	1
species unknown	–	–	–	–	–	5	5
Gull	**11**	**–**	**1**	**520**	**662**	**112**	**1,306**
Black-legged Kittiwake	–	–	–	–	–	45	45
Bonaparte's Gull	–	–	–	513	651	7	1,171
Laughing Gull	9	–	1	2	–	–	12
Herring Gull	–	–	–	–	–	31	31
Great Black-backed Gull	2	–	–	2	7	29	40
species unknown - Small	–	–	–	3	4	–	7
Sterna Tern	**16**	**–**	**–**	**–**	**–**	**–**	**16**
Forster's Tern	1	–	–	–	–	–	1
Commic/Forster's Tern	11	–	–	–	–	–	11
species unknown	4	–	–	–	–	–	4
Loon	**68**	**–**	**–**	**19**	**68**	**44**	**199**
Red-throated Loon	8	–	–	–	–	–	8
Common Loon	59	–	–	19	68	44	190
species unknown	1	–	–	–	–	–	1
Storm-petrel	**1**	**2**	**–**	**–**	**–**	**–**	**3**
species unknown	1	2	–	–	–	–	3
Fulmar	**–**	**–**	**–**	**–**	**–**	**5**	**5**
Northern Fulmar	–	–	–	–	–	5	5
Shearwater	**1**	**–**	**–**	**–**	**1**	**–**	**2**
Sooty Shearwater	1	–	–	–	–	–	1
Manx Shearwater	–	–	–	–	1	–	1
Gannet	**3**	**–**	**–**	**3**	**–**	**18**	**24**
Northern Gannet	3	–	–	3	–	18	24
Unid. Avian	**4**	**–**	**–**	**–**	**–**	**–**	**4**
species unknown	4	–	–	–	–	–	4
Total	**106**	**2**	**1**	**542**	**733**	**289**	**1,673**

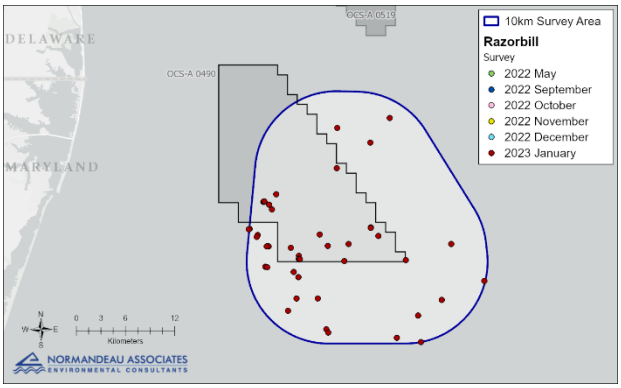
Appendix C: Spatial Distribution for Each Bird Species for Each Survey

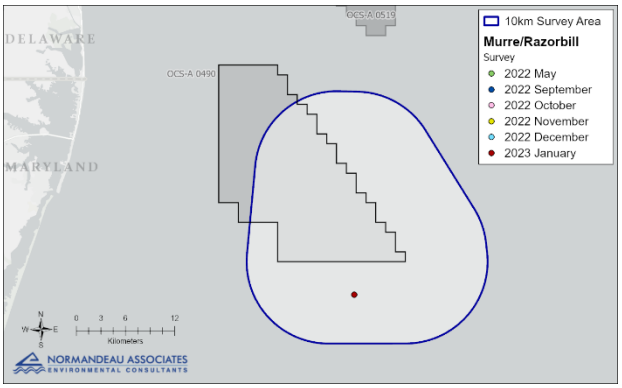


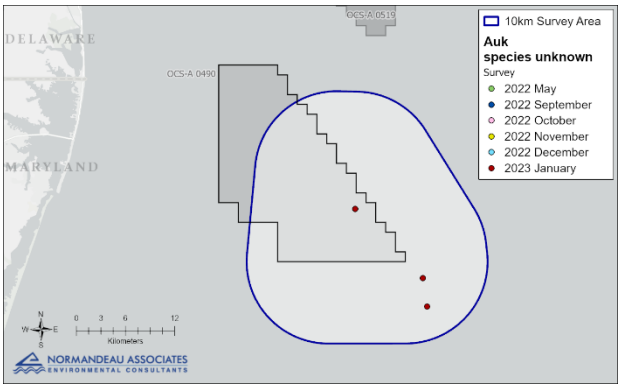


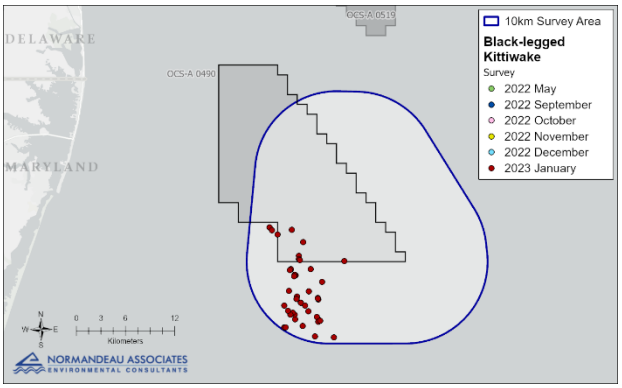


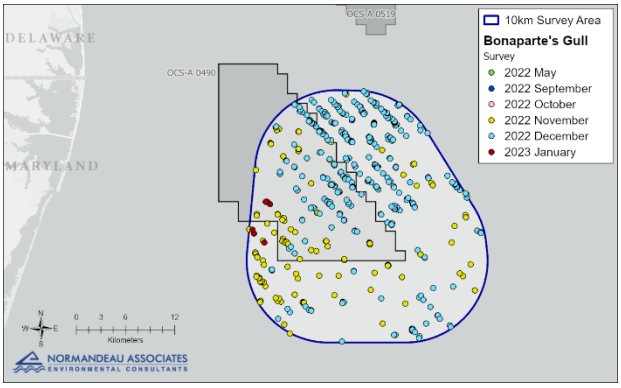


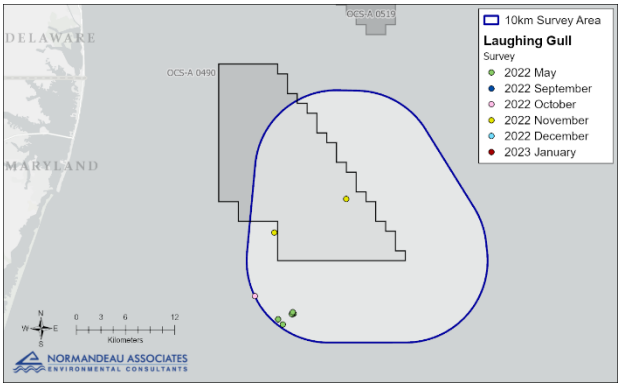


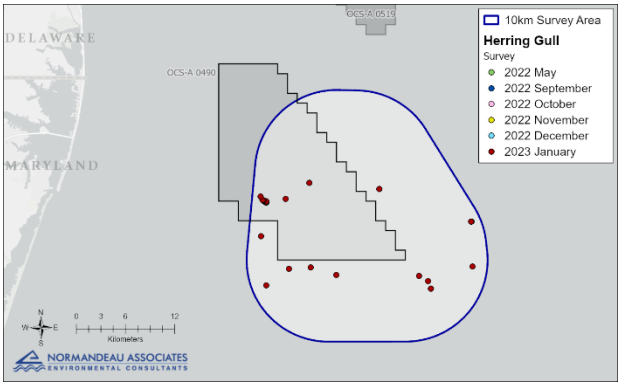







10km Survey Area
Bonaparte's Gull
Survey
2022 May
2022 September
2022 October
2022 November
2022 December
2023 January
OCS-A 0519
OCS-A 0490
DELAWARE
MARYLAND
Kilometers
NORMANDEAU ASSOCIATES
ENVIRONMENTAL CONSULTANTS


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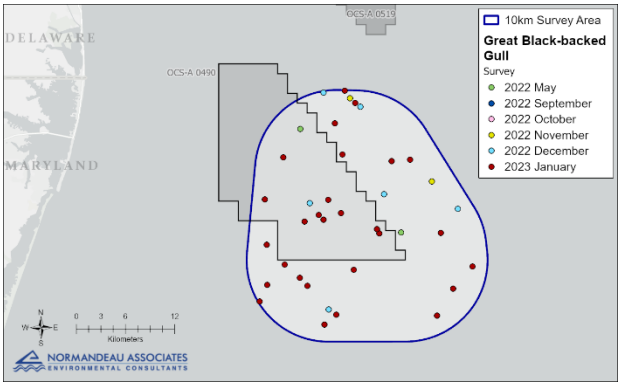
OCS-A 0490
DELAWARE
MARYLAND
Kilometers
NORMANDEAU ASSOCIATES
ENVIRONMENTAL CONSULTANTS


10km Survey Area
Great Black-backed Gull
Survey
2022 May
2022 September
2022 October
2022 November
2022 December
2023 January
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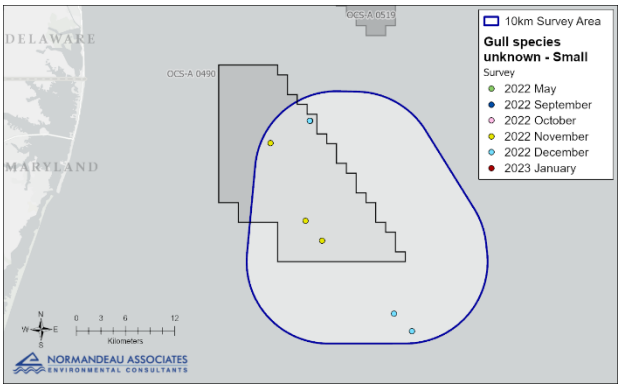
DELAWARE
MARYLAND
Kilometers
NORMANDEAU ASSOCIATES
ENVIRONMENTAL CONSULTANTS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Gull species unknown - Small
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2022 September
2022 October
2022 November
2022 December
2023 January
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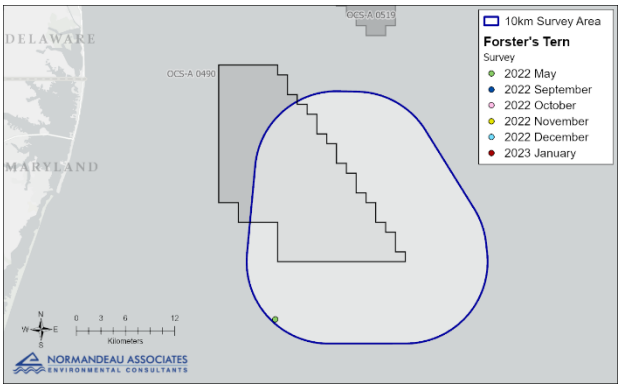
OCS-A 0490
DELAWARE
MARYLAND
Kilometers
NORMANDEAU ASSOCIATES
ENVIRONMENTAL CONSULTANTS


10km Survey Area
Forster's Tern
Survey
2022 May
2022 September
2022 October
2022 November
2022 December
2023 January
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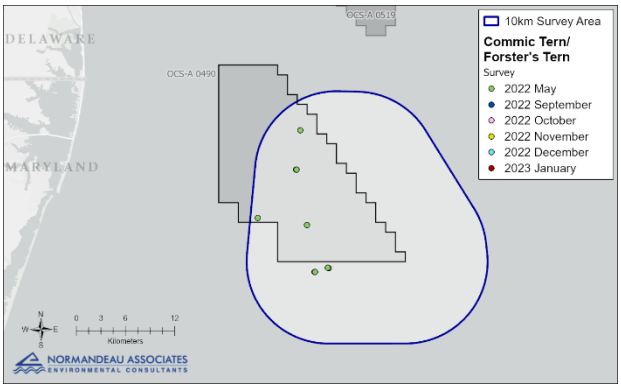
OCS-A 0490
DELAWARE
MARYLAND
Kilometers
NORMANDEAU ASSOCIATES
ENVIRONMENTAL CONSULTANTS


10km Survey Area
Commic Tern/ Forster's Tern
Survey
2022 May
2022 September
2022 October
2022 November
2022 December
2023 January
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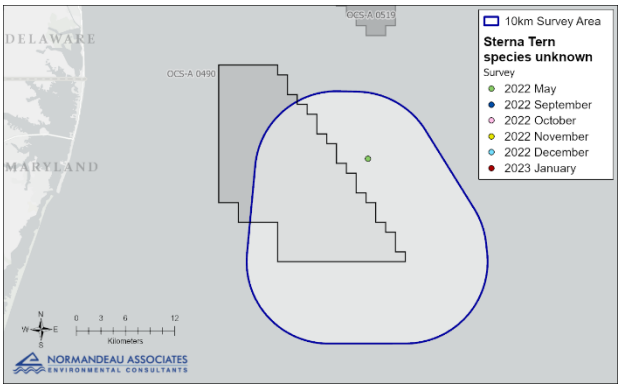
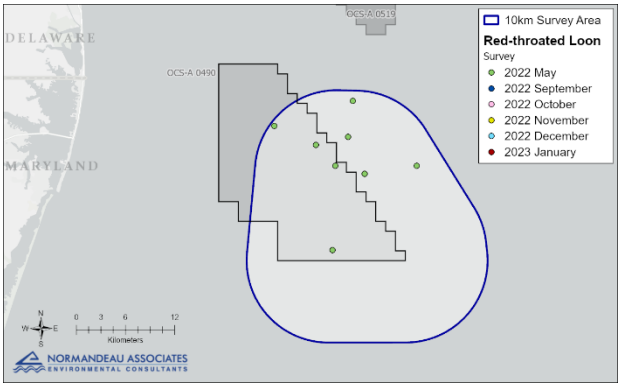
OCS-A 0490
DELAWARE
MARYLAND
Kilometers
NORMANDEAU ASSOCIATES
ENVIRONMENTAL CONSULTANTS


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


10km Survey Area
Red-throated Loon
Survey
2022 May
2022 September
2022 October
2022 November
2022 December
2023 January
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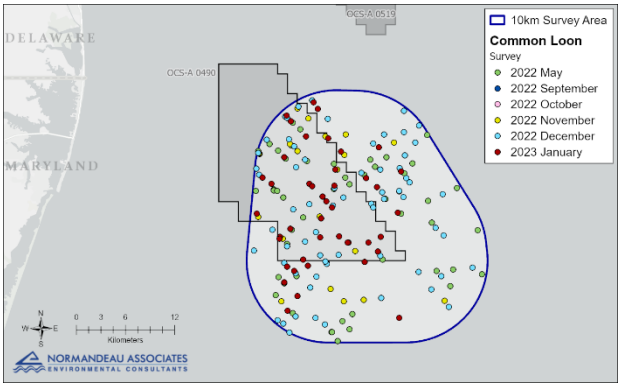
OCS-A 0490
DELAWARE
MARYLAND
Kilometers
NORMANDEAU ASSOCIATES
ENVIRONMENTAL CONSULTANTS


10km Survey Area
Common Loon
Survey
2022 May
2022 September
2022 October
2022 November
2022 December
2023 January
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MARYLAND
Kilometers
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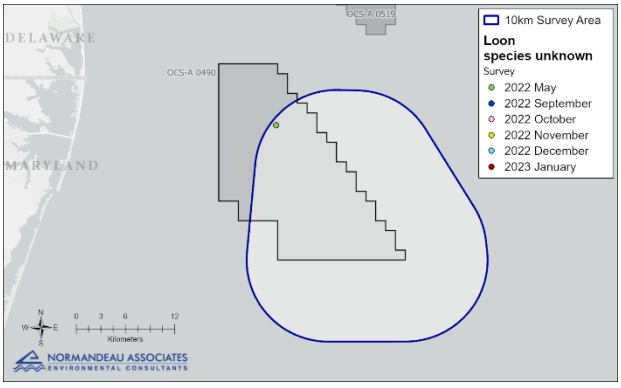
10km Survey Area
Loon
species unknown
Survey
2022 May
2022 September
2022 October
2022 November
2022 December
2023 January
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OCS-A 0490
DELAWARE
MARYLAND
Kilometers
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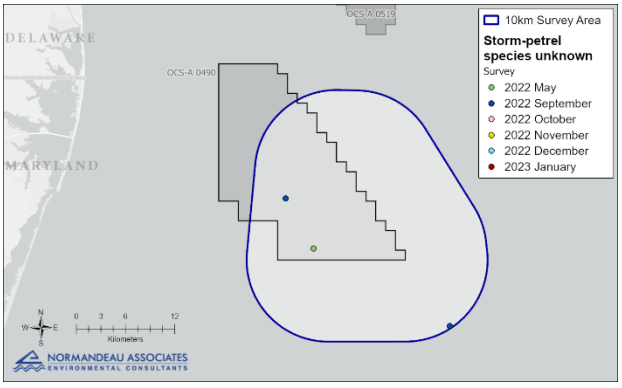
10km Survey Area
Storm-petrel
species unknown
Survey
2022 May
2022 September
2022 October
2022 November
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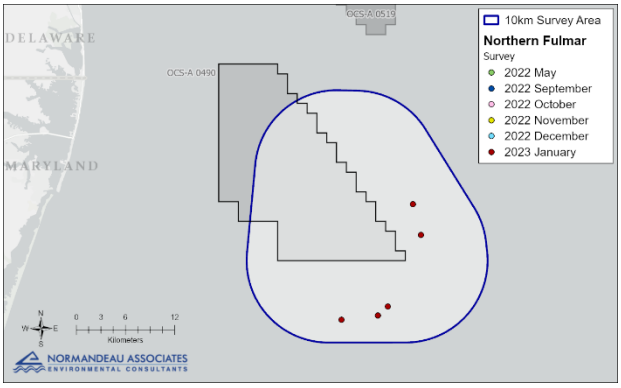
10km Survey Area
Northern Fulmar
Survey
2022 May
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2022 November
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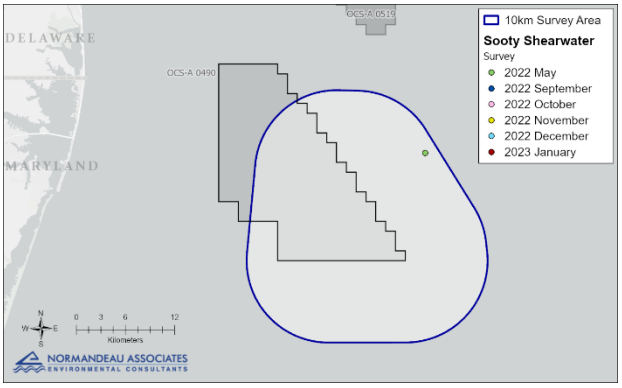
10km Survey Area
Sooty Shearwater
Survey
2022 May
2022 September
2022 October
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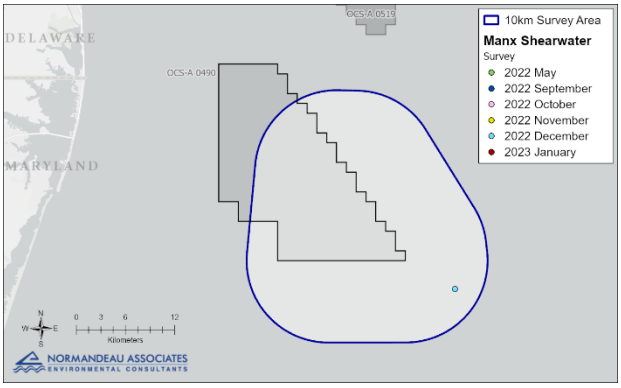
DELAWARE
MARYLAND
Kilometers
NORMANDEAU ASSOCIATES
ENVIRONMENTAL CONSULTANTS


10km Survey Area
Manx Shearwater
Survey
2022 May
2022 September
2022 October
2022 November
2022 December
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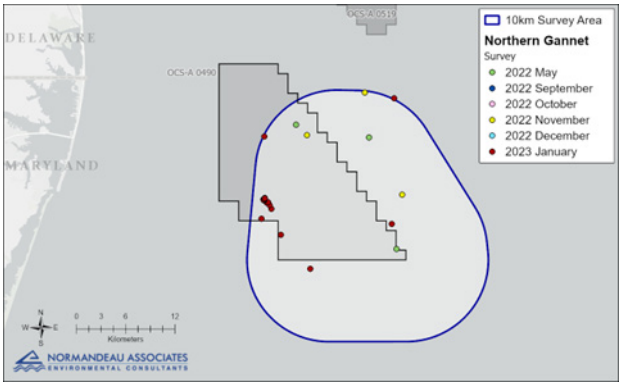
OCS-A 0519
OCS-A 0490
DELAWARE
MARYLAND
Kilometers
NORMANDEAU ASSOCIATES
ENVIRONMENTAL CONSULTANTS


10km Survey Area
Northern Gannet
Survey
2022 May
2022 September
2022 October
2022 November
2022 December
2023 January
OCS-A 0519
OCS-A 0490
DELAWARE
MARYLAND
Kilometers
NORMANDEAU ASSOCIATES
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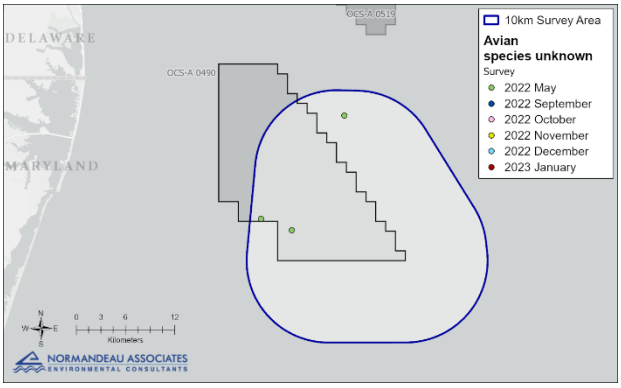
DELAWARE
MARYLAND
OCS-A 0519
OCS-A 0490
10km Survey Area
Avian
species unknown
Survey
2022 May
2022 September
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Kilometers
NORMANDEAU ASSOCIATES
ENVIRONMENTAL CONSULTANTS

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

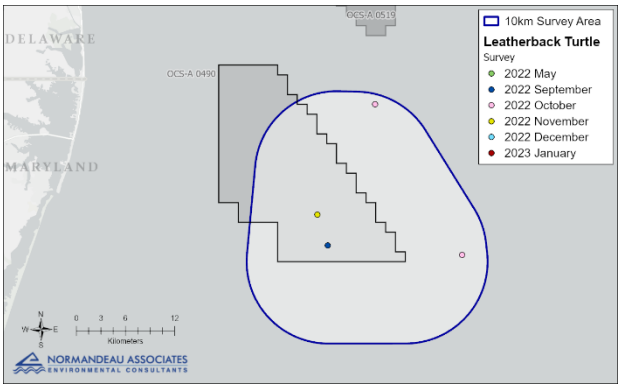
Species	Flight Height Unknown			Flying outside RSZ			Flying within RSZ			Sitting			Total	
	#	Abundance	% Within Season	#	Abundance	% Within Season	#	Abundance	% Within Season	#	Abundance	% Within Season	#	Abundance
May 2022														
Scoter unid.	–	–	–	–	–	–	–	–	–	2	0.0256	100	2	0.0256
Laughing Gull	–	–	–	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	2	0.0256
Forster's Tern	–	–	–	–	–	–	–	–	–	–	–	–	1	0.0128
Commic/Forster's Tern	–	–	–	–	–	–	–	–	–	–	–	–	11	0.1408
Sterna Tern species unk	–	–	–	–	–	–	–	–	–	4	0.0512	100	4	0.0512
Red-throated Loon	–	–	–	–	–	–	–	–	–	8	0.1024	100	8	0.1024
Common Loon	–	–	–	–	–	–	–	–	–	59	0.7551	100	59	0.7551
Loon species unknown	–	–	–	–	–	–	–	–	–	1	0.0128	100	1	0.0128
Storm-petrel species unk	–	–	–	–	–	–	–	–	–	–	–	–	1	0.0128
Sooty Shearwater	–	–	–	–	–	–	–	–	–	–	–	–	1	0.0128
Northern Gannet	–	–	–	–	–	–	–	–	–	3	0.0384	100	3	0.0384
Unid. Avian species	–	–	–	–	–	–	–	–	–	3	0.0384	75	4	0.0512
Season Total	**0**	**–**	**0**	**2**	**0.0256**	**1.89**	**3**	**0.0384**	**2.83**	**83**	**1.0622**	**78.3**	**106**	**1.3565**
Sep 2022														
Storm-petrel species unk	–	–	–	–	–	–	–	–	–	–	–	–	2	0.0262
Season Total	**0**	**–**	**0**	**0**	**–**	**0**	**0**	**–**	**0**	**0**	**–**	**0**	**2**	**0.0262**
Oct 2022														
Laughing Gull	–	–	–	–	–	–	1	0.0131	100	–	–	–	1	0.0131
Season Total	**0**	**–**	**0**	**0**	**–**	**0**	**1**	**0.0131**	**100**	**0**	**–**	**0**	**1**	**0.0131**
Nov 2022														
Bonaparte's Gull	202	2.6481	39.38	97	1.2716	18.91	104	1.3634	20.27	110	1.4421	21.44	513	6.7252
Laughing Gull	2	0.0262	100	–	–	–	–	–	–	–	–	–	2	0.0262
Great Black-backed Gull	2	0.0262	100	–	–	–	–	–	–	–	–	–	2	0.0262
Gull species unk - Small	–	–	–	–	–	–	–	–	–	3	0.0393	100	3	0.0393
Common Loon	–	–	–	–	–	–	–	–	–	19	0.2491	100	19	0.2491
Northern Gannet	2	0.0262	66.67	–	–	–	–	–	–	1	0.0131	33.33	3	0.0393
Season Total	**208**	**2.7268**	**38.38**	**97**	**1.2716**	**17.9**	**104**	**1.3634**	**19.19**	**133**	**1.7436**	**24.54**	**542**	**7.1054**

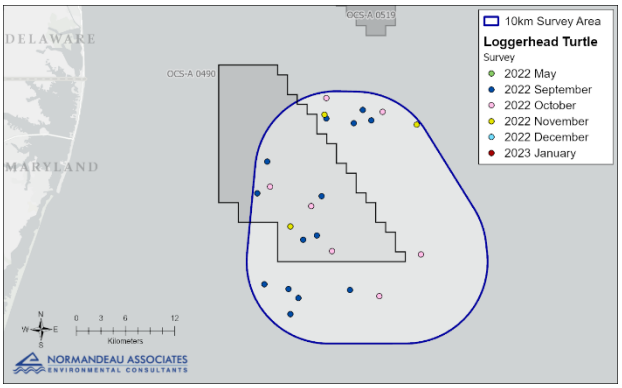
Species	Flight Height Unknown			Flying outside RSZ			Flying within RSZ			Sitting			Total	
	#	Abundance	% Within Season	#	Abundance	% Within Season	#	Abundance	% Within Season	#	Abundance	% Within Season	#	Abundance
Dec 2022														
Red Phalarope	–	–	–	–	–	–	1	0.0131	50	1	0.0131	50	2	0.0262
Bonaparte's Gull	113	1.4814	17.36	83	1.0881	12.75	127	1.6649	19.51	328	4.2999	50.38	651	8.5343
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 unk - Small	–	–	–	–	–	–	–	–	–	4	0.0524	100	4	0.0524
Common Loon	–	–	–	–	–	–	3	0.0393	4.41	65	0.8521	95.59	68	0.8915
Manx Shearwater	–	–	–	–	–	–	–	–	–	1	0.0131	100	1	0.0131
Season Total	**114**	**1.4945**	**15.55**	**84**	**1.1012**	**11.46**	**133**	**1.7436**	**18.14**	**402**	**5.2701**	**54.84**	**733**	**9.6093**
Jan 2023														
Dovekie	1	0.0129	10	2	0.0257	20	2	0.0257	20	5	0.0643	50	10	0.1285
Common/Thick-billed Murre	–	–	–	–	–	–	–	–	–	4	0.0514	100	4	0.0514
Razorbill	20	0.257	22.22	–	–	–	–	–	–	70	0.8996	77.78	90	1.1567
Murre/Razorbill	–	–	–	–	–	–	–	–	–	1	0.0129	100	1	0.0129
Auk species unk	–	–	–	–	–	–	–	–	–	5	0.0643	100	5	0.0643
Black-legged Kittiwake	9	0.1157	20	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	0.09
Herring Gull	17	0.2185	54.84	3	0.0386	9.68	4	0.0514	12.9	7	0.09	22.58	31	0.3984
Great Black-backed Gull	11	0.1414	37.93	2	0.0257	6.9	3	0.0386	10.34	13	0.1671	44.83	29	0.3727
Common Loon	–	–	–	–	–	–	–	–	–	44	0.5655	100	44	0.5655
Northern Fulmar	5	0.0643	100	–	–	–	–	–	–	–	–	–	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**	**8.3**	**27**	**0.347**	**9.34**	**161**	**2.0691**	**55.71**	**289**	**3.7142**

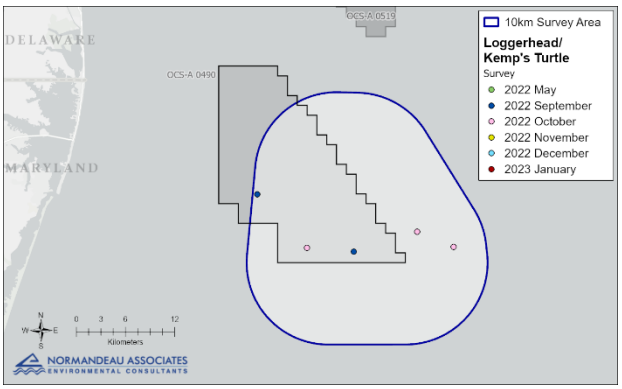
Appendix E: Flight Heights for Flying Birds Observed During Each Survey

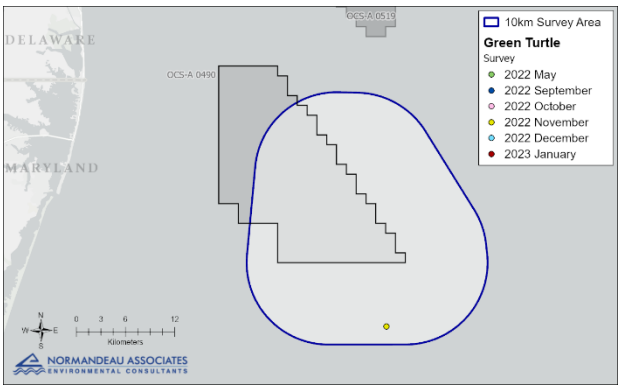
Species	N	Min	Max	Mean	Std Dev	Median	Error
May 2022							
Laughing Gull	5	3.6	34.4	19.8	13.91	27.0	31.5864
Sep 2022							
Oct 2022							
Laughing Gull	1	29.7	29.7	29.7		29.7	0
Nov 2022							
Bonaparte's Gull	201	0.4	86.5	27.7	20.42	23.8	34.1296
Dec 2022							
Red Phalarope	1	37	37	37		37.0	0
Bonaparte's Gull	210	0.4	128.6	35	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	29.67	35.1	45.6528
Black-legged Kittiwake	30	0	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	12.29	25.2	46.5378
Northern Gannet	2	37.4	75.9	56.6	27.24	56.6	32.9639
All Surveys							
Red Phalarope	1	37	37	37		37.0	0
Dovekie	4	16.3	77.7	41	29.67	35.1	46.6528
Black-legged Kittiwake	30	0	57.1	23.1	17.38	18.3	47.6745
Bonaparte's Gull	414	0.4	128.6	31.5	22.63	26.6	34.4075
Laughing Gull	6	3.6	34.4	21.5	13.08	27.4	31.5864
Herring Gull	7	2.1	70.4	30.8	23.41	28.3	70.0984
Great Black-backed Gull	8	0.1	106.8	40.6	37.76	30.9	42.5973
Common Loon	3	51.2	115.8	81.5	32.47	77.6	16.1854
Northern Gannet	2	37.4	75.9	56.6	27.24	56.6	32.9639

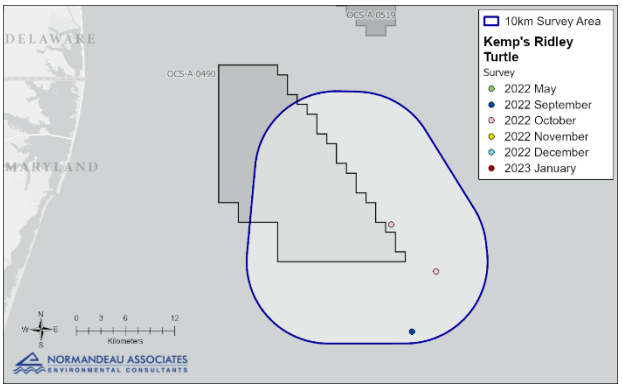
Appendix F: Spatial Distribution of Turtle Species for Each Survey

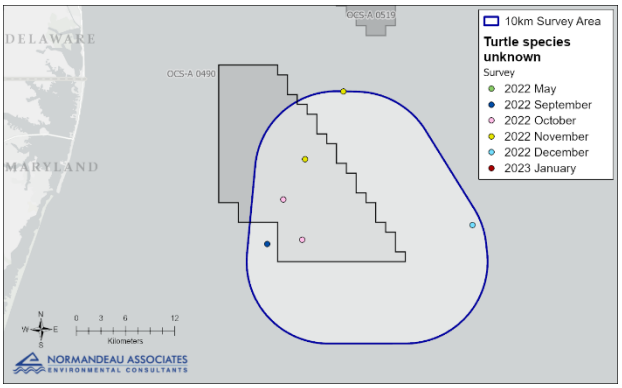




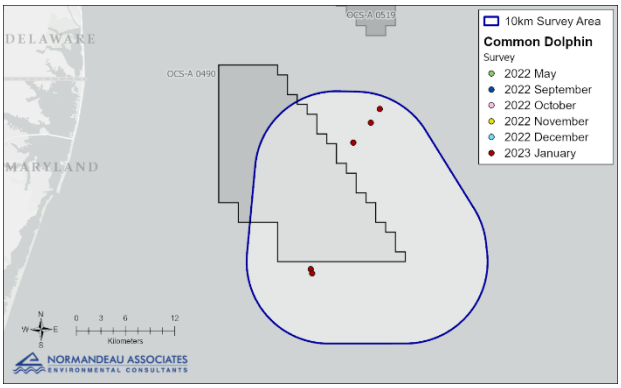


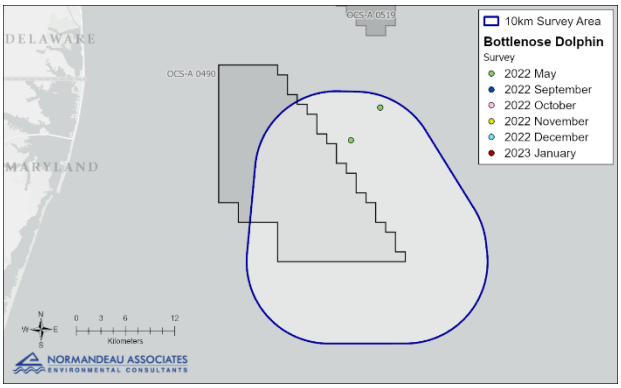




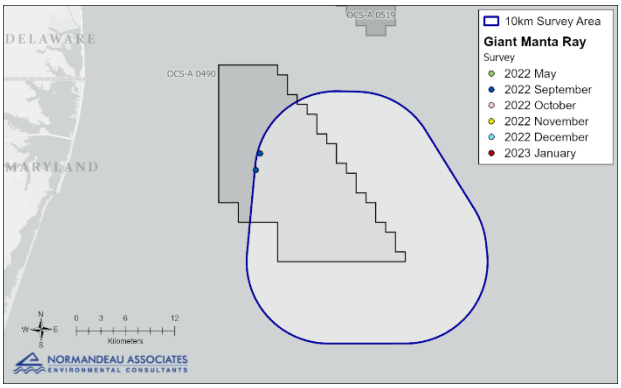


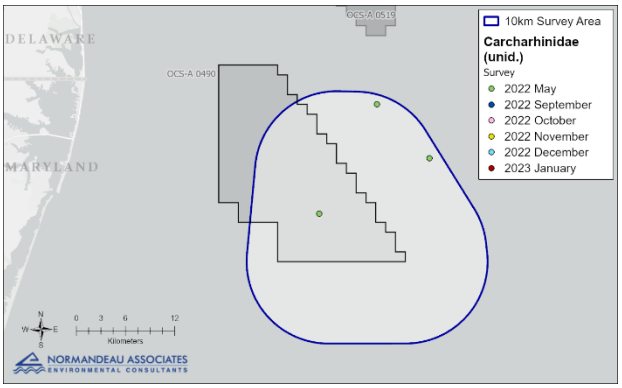
Appendix G: Spatial Distribution of Marine Mammal Species for Each Survey

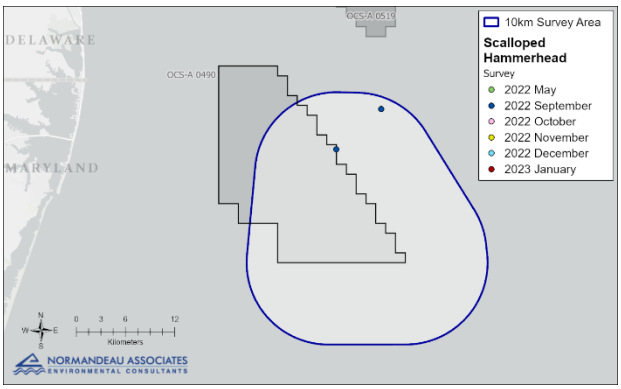


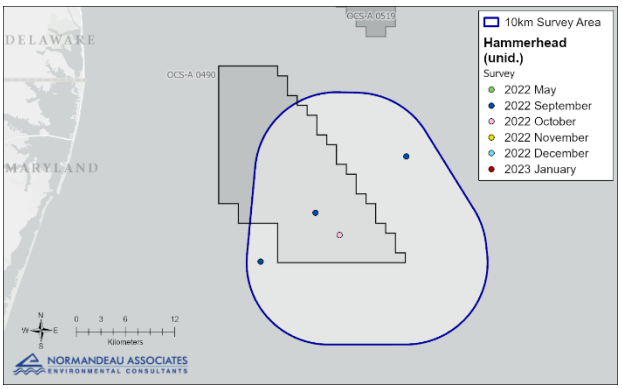


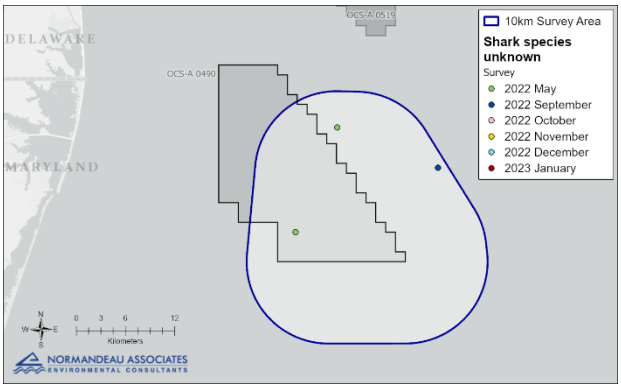
Appendix H: Spatial Distribution of Ray and Shark Species for Each Survey











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