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APEM

Environmental Imaging Solutions

Ornithological and Marine Fauna Aerial Survey Results of Lease Area OCS-A 0512

Equinor Wind US, LLC

Annual Report: November 2017 to October 2018

APEM Ref: P00002032

Issued February 2019

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Final	06-06-19	All	All	Amendments following client review	LJ

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1. Executive Summary

- A programme of 12 monthly aerial digital surveys of Equinor Wind US LLC's Lease Area OCS-A 0512 in the New York Bight were conducted between November 2017 and October 2018 using APEM Inc.'s (hereafter referred to as APEM) high-resolution camera system to capture digital still imagery. Images collected have been analyzed by APEM Inc. and quality assured by Normandeau Associates (hereafter referred to as Normandeau). Raw counts and design-based abundance estimates of all species and incidental observations recorded during the surveys are presented here as well as information on species distribution, and flight direction. The key findings from each of the monthly aerial digital surveys are summarized below;

- Survey 1 – November 2017

    - The most abundant group recorded in the November survey was gulls (n=129), followed by loons (n=102), ducks (n=97), gannets (n=75), phalaropes (n=60), marine mammals (n=5), fulmars (n=2), and alcids (n=2).

- Survey 2 – December 2017

    - The most abundant group recorded in the December survey was gulls (n=349), followed by alcids (n=70), loons (n=46), gannets (n=38), marine mammals (n=29), ducks (n=8), phalaropes (n=5), grebes (n=1), rays (n=1) and large bony fish (n=1).

- Survey 3 – January 2018

    - The most abundant group recorded in the January survey was alcids (n=98), followed by gannets (n=41), loons (n=25), gulls (n=10), marine mammals (n=7), ducks (n=4) and large bony fish (n=1).

- Survey 4 – February 2018

    - The most abundant group recorded in the February survey was alcids (n=12), followed by loons (n=10), gulls (n=7), ducks (n=4), gannets (n=4), large bony fish (n=2), and marine mammals (n=1).

- Survey 5 – March 2018

    - The most abundant group recorded in the March survey was alcids (n=213), followed by gulls (n=44), loons (n=38), marine mammals (n=12), ducks (n=11), gannets (n=1), and fulmars (n=1).

- Survey 6 – April 2018

    - The most abundant group recorded in the April survey was alcids (n=159), followed by gulls (n=32), cormorants (n=31), gannets (n=28), loons (n=11), and terns (n=1).

- Survey 7 – May 2018

- The most abundant group recorded in the May survey was terns (n=245), followed by fish (n=165), marine mammals (n=71), loons (n=64), gulls (n=19), shearwaters (n=7), gannets (n=3), cormorants (n=1), hawks (n=1), phalaropes (n=1), and petrels (n=1).

- Sterna terns and Atlantic bluefin tuna were recorded during the May survey. These are Listed Species (Federally listed as Threatened or Endangered, New York State and / or New Jersey State listed as Endangered). Unidentified Sterna tern species have been grouped as Listed Species in order to cover the potential for the individuals to be roseate terns, which are Listed. However a process of unidentified species apportionment will be undertaken for the ornithology baseline technical report to separate individuals into positively identified species, and as such they all may not be apportioned to roseate tern during that process.

- Survey 8 – June 2018

  - The most abundant species group recorded in the June survey was shearwaters (n=125), followed by marine mammals (n=23), gulls (n=10), turtles (n=8), sharks (n=6), sunfish (n=6), petrels (n=5), gannets (n=3), cormorants (n=2), and alcids (n=1).

  - Eight turtles were recorded, consisting of seven loggerhead turtles and one loggerhead / Kemp's Ridley turtle, and one humpback whale were recorded during the June survey. These species are Listed (Federally listed as Threatened or Endangered, and New York State and / or New Jersey State listed as Endangered).

- Survey 9 – July 2018

  - The most abundant species group recorded in the July survey was petrels (n=32), followed by shearwaters (n=27), shorebirds (n=16), turtles (n=11), sharks (n=9), ducks (n=2), large bony fish (n=2) and loons (n=1).

  - The turtle and shark species recorded in the July survey are Listed (Federally listed as Threatened or Endangered, and New York State and / or New Jersey State listed as Endangered).

- Survey 10 – August 2018

  - The most abundant group recorded in the August survey was rays (n=502), followed by shearwaters (n=16), turtles (n=13), sharks (n=4), petrels (n=2), herons (n=1) and gulls (n=1).

  - The 13 turtles recorded during the August 2018 survey are Listed (Federally listed as Threatened or Endangered, and New York State and / or New Jersey State listed as Endangered).

- Survey 11 – September 2018

- The most abundant species group recorded in the September survey was gulls (n=26), followed by shearwaters (n=21), turtles (n=3) rays (n=3), large bony fish (n=1), and marine mammals (n=1).

- Loggerhead sea turtles (n=3) were recorded in September. This species is considered a Listed Species (Federally listed as Threatened or Endangered, New York State and / or New Jersey State listed as Threatened).

- Survey 12 – October 2018

  - The most abundant species group recorded in the October survey was gannets (n=180), followed by ducks (n=169), gulls (n=76), loons (n=25), large bony fish (n=13), cormorants (n=7), turtles (n=2), marine mammals (n=1), alcids (n=1) and petrels (n=1).

  - Loggerhead sea turtles (n=2) were recorded in October. This species is considered a Listed Species (Federally listed as Threatened or Endangered, New York State and / or New Jersey State listed as Threatened).

- A summary of the raw counts for all species recorded in each season are presented in **Table 1**, with an indication of their protected status as being Listed, where applicable.

Table 1 Number of individuals recorded in each survey season and their Listed status

Species	Number of individuals (Season)				Listed
	Fall	Winter	Spring	Summer	
Mallard		6			No
American black duck	13	2			No
Surf scoter	23				No
White-winged scoter	15		4		No
Black scoter	196	2	7		No
Species unknown - scoter	19				No
Long-tailed duck		3			No
Species unknown - duck		3		2	No
Red-throated loon	66	19	19		No
Common loon	61	62	93	1	No
Species unknown - loon			1		No
Species unknown - grebe		1			No
Northern fulmar	2		1		No
Northern gannet	254	83	31	3	No
Red phalarope	50				No
Red / red-necked phalarope	10	5	1		No
Species unknown - cormorant	7		32	2	No
Dovekie		3			No
Murre / razorbill	3	175	371	1	No
Species unknown - alcid		2			No
Black-legged kittiwake	26	1	15		No

Species	Number of individuals (Season)				Listed
	Fall	Winter	Spring	Summer	
Bonaparte's gull	112	331	36		No
Ring-billed gull	2	2	2		No
Laughing gull	1		2	1	No
Herring gull	60	10	28	6	No
Lesser black-backed gull			2		No
Great black-backed gull	28	8	4	2	No
Species unknown – large gull		1	1		No
Species unknown – small gull		12	4	2	No
Forster's tern			1		No
Common tern			8		No
'Commic' / Forster's tern			170		No
Least tern			4		Yes [NJ]
Sterna tern species			60		Yes [NY/NJ]
Species unknown - tern			1		No
Sooty shearwater			1	15	No
Manx shearwater				2	No
Great shearwater	1			36	No
Cory's shearwater	14			83	No
Species unknown – large shearwater	6			27	No
Species unknown – small shearwater			5	3	No
Black-capped petrel				1	No
Species unknown - petrel	1			1	No
Species unknown – storm petrel			1	37	No
Species unknown - hawk			1		No
Great blue heron				1	No
Species unknown - shorebird				16	No
Common dolphin	5	22	68		No
Bottlenose dolphin		8		22	No
Harbour porpoise		3	10		No
Species unknown - dolphin		3	3		No
Common minke whale	2				No
Humpback whale				1	Yes
Species unknown – marine mammal		1	2		No
Loggerhead turtle	5			18	Yes
Loggerhead / Kemp's turtle				5	Yes
Kemp's Ridley turtle				8	Yes
Species unknown - turtle				1	Yes
Blue shark				6	No
Great white shark				1	No
Tiger shark				1	No
Species unknown -				1	No

Species	Number of individuals (Season)				Listed
	Fall	Winter	Spring	Summer	
Carcharhinidae					
Scalloped hammerhead				2	Yes
Species unknown - hammerhead				2	Yes
Species unknown - shark				6	No
Cownose ray	3	1		502	No
Ocean sunfish	3	3	2	8	No
Mahi-mahi			131		No
Atlantic bluefin tuna			7		Yes
Species unknown - tuna			24		No
Species unknown - fish	11	1			No

2. Introduction

APEM and Normandeau were contracted by Equinor to provide monthly aerial digital survey data of the Lease Area OCS-A 0512 offshore wind lease area from November 2017 until October 2018, to follow on from the first year of surveys (see Annex 1)

The aims and objectives of the work required by Equinor were to assess the abundance and distribution, primarily of birds, present in the Lease Area OCS-A 0512 offshore wind lease area, and also to gather information on other marine fauna such as marine mammals, sharks, rays, and turtles for site characterization. NYSERDA contracted Normandeau & APEM to undertake four quarterly surveys of Lease Area OCS-A 0512 (as well as a wider area termed Offshore Planning Area) in order to form the 'Year 1' data collection. APEM were contracted by Equinor separately to undertake a further programme of monthly aerial digital surveys of Lease Area OCS-A 0512 from November 2017 to October 2018, which form the 'Year 2' data collection of Lease Area OCS-A 0512. The purpose of the Year 1 and Year 2 data sets is to provide the baseline information required for conducting impact assessments and will meet the U.S. Bureau of Ocean Energy Management's (BOEM's) regulatory requirements for environmental review.

The area surveyed comprised of the Lease Area OCS-A 0512 offshore wind lease area (its proposed turbine array footprint) plus a 4 km (2.5 miles) buffer surrounding it, referred to herein as the Lease Area OCS-A 0512 plus 4 km buffer. The data in this report represent the total number of birds, other marine fauna, and incidental occurrences recorded across all images within the Lease Area OCS-A 0512 plus 4 km buffer, with some additional data on species recorded that fall just outside the proposed Lease Area OCS-A 0512 offshore wind lease area plus buffer region.

To meet the objectives of the project, images were captured using a grid-based survey design with a 1.5 cm ground sampling distance (GSD). Images were analyzed by APEM and quality control was undertaken by Normandeau.

This annual report summarizes the information collected following the completion of 12 monthly aerial digital surveys of Lease Area OCS-A 0512 between November 2017 and October 2018.

The following information is provided in Section 3:

- The number of surveys conducted;
- The dates, start and end times, and weather conditions;
- Survey and analysis methodology; and
- Health and safety notes.

The following information is provided in Section 4:

- The number of birds species / taxonomic group;
- Maps showing the locations of birds and actual survey route; and
- Flight direction information.

Anecdotal observations, for example shipping information recorded visually from the aircraft or captured in the imagery, has been provided in Section 5. Additionally, the locations of the vessels captured in the imagery are presented spatially within figures in Section 4.

3. Survey and Analysis Methodologies

Summary of Aerial Digital Surveys

A programme of twelve aerial digital surveys have been undertaken to cover November 2017 to October 2018 inclusive.

APEM has a bespoke camera system, termed “Shearwater III,” customized by in-house specialists for surveying the offshore environment. The camera system is integrated with custom flight planning software that allowed each survey transect to be accurately mapped out before the aircraft leaves the ground. Each image capture node is precisely defined, allowing the system to fire the camera exposures at exactly the right location. This ensures that each survey is flown with the same transect orientation and the camera is triggered at the same position along each transect within set tolerances. APEM’s planning systems enable tolerances on flight path along survey lines to be set automatically aborting survey lines that drift away from the aircraft’s planned flight line. APEM’s on-board camera technician continually monitored the imagery as it was collected to ensure the data collected fit for purpose. The camera technician would make the decision to cease data collection should the conditions become unsuitable for surveying and / or data collection. Subsequently, the survey would then be resumed at the next earliest opportunity.

The aerial digital surveys captured images along 28 lines spaced approximately 0.8 km across-track and 0.6 km along-track between image nodes within the Lease Area OCS-A 0512 plus 4 km buffer (**Figure 1**). Data collected were 1.5 cm GSD digital still images using a GPS-linked bespoke flight management system to ensure the tracks were flown with a high degree of accuracy. The aircraft’s internal GPS and IMU systems record to an accuracy of +/- 3 to 5 m as standard.

Imagery is captured in raw format and post-processed to ensure optimal quality for the subsequent stage of image analysis, to extract information on marine fauna or other notable occurrences. When a survey is completed, the data are checked to ensure the number of lines and the number of images collected is correct, and that the quality of the imagery is acceptable. Once the image analysis is completed, further Quality Control (QC) processes take place (see Summary of Quality Control).

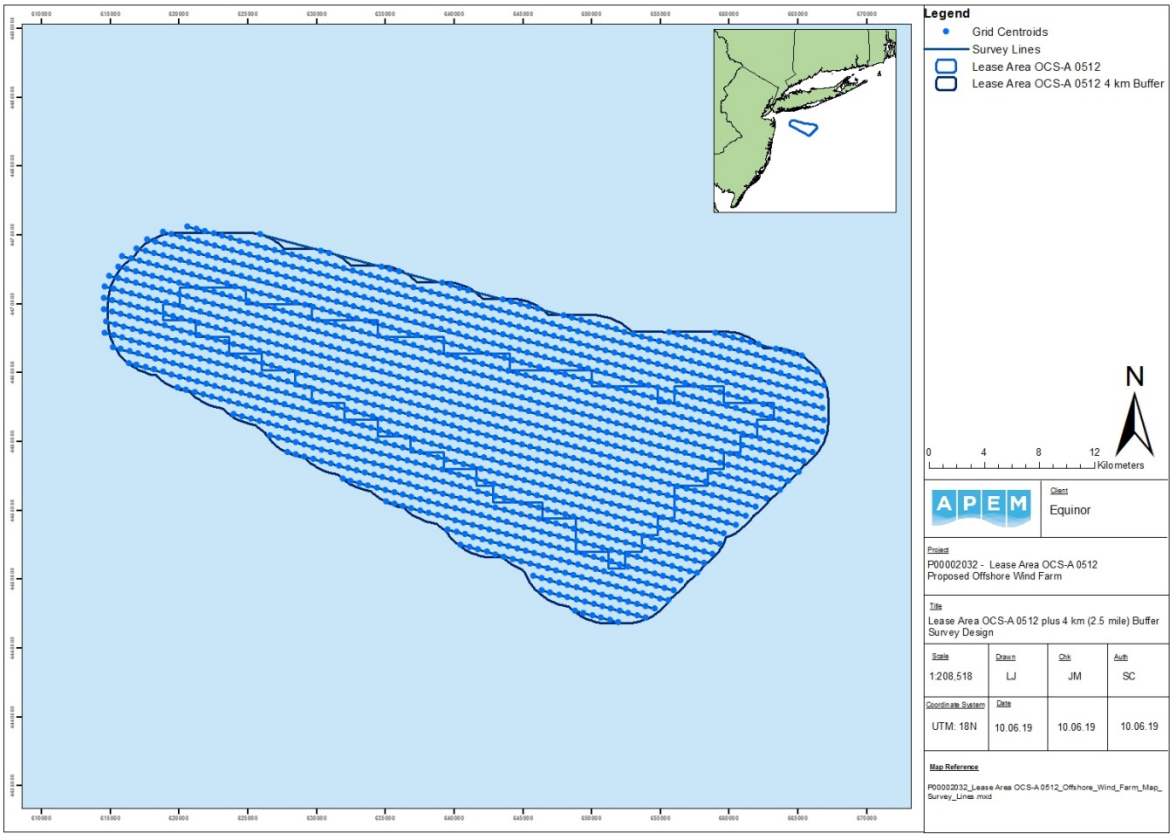


Figure 1 **Flight lines and image capture points of the aerial digital still imagery at Lease Area OCS-A 0512 plus 4 km (2.5 mile) buffer.**

No health or safety issues were reported during the surveys.

The date(s), start, and end times are provided for each aerial digital survey in **Table 2** with the corresponding weather conditions provided in **Table 3**. Weather conditions during all surveys were conducive to collecting and analyzing imagery for the purpose of providing data on the identification, distribution and abundance of bird species and marine fauna within the Lease Area OCS-A 0512 plus 4 km buffer. Favorable conditions for surveying are defined as there being no precipitation, a sea state of <4, wind speeds of <30 knots, visibility of >5 km, and sun angle of more than 5 degrees (depending on cloud cover and other environmental conditions). For safety reasons, no surveying takes place in icing conditions. The weather criteria follow the BOEM guidelines for aerial digital surveys of birds for projects requiring a Construction and Operation Plan (COP) (BOEM, 2017). Measures were also taken to minimize glint and glare, when conditions may be subject to this, such as avoiding surveying around midday when the sun angle has the greatest potential to impact image quality. Furthermore, in the unlikely event imagery were affected by glint or glare, additional imagery is collected through our survey method provides an alternative data set could be selected for analysis to ensure that sufficient coverage is achieved. The various weather conditions that these data were captured in would not affect the ability to detect marine fauna in the imagery.

The number of images and coverage collected per survey is presented in **Table 4**.

Table 2 **Date and start / end time (Coordinated Universal Time) for each flight for the November 2017 to October 2018 monthly surveys.**

Survey No.	Date	Flight Number	UTC Start Time (HH:MM)	UTC End Time (HH:MM)
1	11-28-17	1	13:28	16:42
		2	19:00	20:31
	11-29-17	3	14:04	17:47
2	12-15-17	1	13:47	18:08
	12-16-17	2	14:39	17:17
3	01-25-18	1	13:53	16:51
		2	19:00	21:04
	01-26-18	3	13:59	15:17
4	02-17-18	1	12:48	16:36
		2	18:09	20:46
5	03-06-18	1	13:45	16:35
		2	18:57	21:23
6	04-20-18	1	12:32	15:50
		2	18:42	21:44
7	05-21-18	1	12:11	15:00
		2	18:43	20:57
8	06-14-18	1	12:03	15:29
		2	18:34	20:52
9	07-29-18	1	12:25	16:17
		2	18:45	21:35
10	08-16-18	1	22:00	23:28
	08-17-18	2	11:44	15:43
11	09-27-18	1	13:44	17:18
		2	18:46	20:01
	09-29-18	3	12:45	14:03
12	10-26-18	1	13:16	16:34
		2	18:51	20:40

Table 3 **Weather conditions recorded for completed surveys to date: November 2017 to October 2018.**

Survey No.	Date	Douglas Sea State[1]	Turbidity[2]	Wind Speed (knots) / Direction	Cloud Cover (%)[3]	Visibility (km)	Air Temp (°F)
1	11-28	1 - 3	2	10 - 15 / NW or SW	1 - 3	> 10 km	39 - 48
	11-29	3 - 4	2	30 - 35 / W	1 - 5	> 10 km	54 - 59
2	12-15	1	0 - 1	7 - 10 / W	7 - 9	> 10 km	22 - 30

Survey No.	Date	Douglas Sea State[1]	Turbidity[2]	Wind Speed (knots) / Direction	Cloud Cover (%)[3]	Visibility (km)	Air Temp (°F)
	12-16	3 - 4	2	30 / W	2 - 4	> 10 km	31 - 32
3	01-25	2 - 3	1	25 / W or NW	0 - 2	> 10 km	21 - 29
	01-26	1	1	Negligible (calm)	0	> 10 km	23 - 27
4	02-17	1 - 3	1	15 - 20 / N or NE	5 - 15	> 10 km	28 - 34
5	03-06	1 - 2	1	Calm - 6 / NE	0 - 20	> 10 km	33 - 37
6	04-20	2 - 4	1 - 2	20 - 25 / N or NW	0 - 10	> 10 km	32 - 44
7	05-21	2 - 4	1 - 2	Calm - 10 / NE or SW	5 - 30	> 10 km	59 - 67
8	06-14	2 - 3	1	10 / NW	0 - 10	> 10 km	20 - 28
9	07-29	0-2	1	5 - 10 / W or NW	0 - 95	> 10 km	70 - 75
10	08-16	2	1	16 - 21 / E or S	40 - 60	> 6 km	82 - 83
	08-17	1	1	Calm - 14 / W or SW	10 - 100	> 6 km	80 - 81
11	09-27	1 - 3	1	10 - 22 / SW or E	40 - 100	> 10 km	61 - 64
	09-29	2 - 3	1	15 - 20 / NW	0 - 5	> 10 km	64 - 65
12	10-26	1	1	Calm - 8 / S	80 – 100	> 10 km	36 - 39

[1] 0 = Calm (Glassy), 1 = Calm (Rippled), 2 = Smooth, 3 = Slightly Moderate, 4 = Moderate
[2] 0 = Clear, 1 = Slightly Turbid, 2 = Moderately Turbid, 3 = Highly Turbid
[3] 0 = Clear, 1-10 = Few, 11-50 = Scattered, 51-95 = Broken, 96-100 = Overcast

Table 4 Number of images and survey coverage for each monthly survey.

Survey No.	Number of Images	Coverage (%)
1	12,196	12.58
2	12,175	12.91
3	12,176	12.94
4	12,176	12.64
5	12,176	12.48
6	12,180	13.20
7	12,180	13.24
8	12,175	12.13
9	12,174	13.36
10	12,230	13.39
11	12,236	12.81
12	12,176	12.69

Summary of Quality Control

Images were analyzed to enumerate birds to species level and to enumerate any other non-avian marine fauna. Survey data were uploaded to APEM's partner Normandeau's ReMOTe website in 'real time' as soon as image analysis was completed. These data are publically accessible[1]. Normandeau provided QC of the data to check for missed animals in 10% of images recorded as empty and also quality controlled 20% of the bird species identification undertaken by APEM (and 100% of Listed species). Normandeau identified 100% of the species of non-avian marine fauna including marine mammals, sharks, rays and turtles. Birds and marine fauna identified from the images were 'snagged' (i.e. located within the images) and categorized usually to species, but sometimes to the species grouping. The results of the QC are provided in **Table 5** and **Table 6**, demonstrating agreement exceeding 99% for all surveys.

Table 5 The number of blank images, blank images to QC, and results of the QC.

Survey No.	Blank Images	Blank Images QC'd	Image Number QC'd Not Blank	Agreement (%)
1	11,960	1,196	2	99.83
2	11,960	1,196	0	100.00
3	12,025	1,203	2	99.83
4	12,190	1,219	0	100.00
5	11,936	1,194	1	99.92
6	12,043	1,205	2	99.75
7	12,180	1,187	0	100.00
8	12,175	1,204	4	99.67
9	12,174	1,210	4	99.67
10	12,186	1,219	0	100.00
11	12,187	1,219	6	99.51
12	12,176	1,191	3	99.75

Table 6 The number of individuals that were found during blank image QC

Survey No.	Order Found by QC	Number of individuals
1	Avian	2
3	Large Bony Fish	3
5	Avian	1
6	Avian	1
	Ray	1
8	Avian	3
	Turtle	1
9	Avian	2
	Ray	1

[1] https://remote.normandeau.com/ewind_overview.php

Survey No.	Order Found by QC	Number of individuals
	Large bony fish	1
11	Avian	2
	Large Bony Fish	4
12	Avian	1
	Large Bony Fish	1
	Fish Shoal	1

Species Abundance Estimates

For each monthly aerial digital survey of the Lease Area OCS-A 0512 plus 4 km buffer, geo-referenced locations of marine fauna, contained within each individual digital still image were used to generate raw counts. Marine fauna locations contained within the boundaries of the two areas (Lease Area OCS-A 0512 and the 4 km buffer) were then extracted using ArcGIS, providing raw count data. These data are presented in this annual report for all species.

The raw counts were then divided by the number of images collected to give the mean number of animals per image (i). Population estimates (N) for each survey month were then generated by multiplying the mean number of animals per image by the total number of images required to cover the entire study area (A):

$N = i\ A$

Non-parametric bootstrap methods were used for variance estimation. A variability statistic was generated by re-sampling 999 times with replacement from the raw count data. The statistic was evaluated from each of these 999 bootstrap samples and upper and lower 95% confidence intervals of these 999 values were taken as the variability of the statistic over the population (Efron & Tibshirani, 1993).

A measure of precision was calculated using a Poisson estimator, suitable for a pseudo-Poisson over-dispersed distribution. This produced a CV based on the relationship of the standard error to the mean.

Analysis to account for the availability bias of particular marine fauna species has not been applied to the data in this report. Such corrections to account for availability bias for relevant birds species are presented in the ornithological baseline technical report (APEM, in prep).

All analysis and data manipulation carried out by APEM was conducted in the R programming language (R Development Core Team, 2012) and non-parametric 95% confidence intervals was generated using the 'boot' library of function (Canty & Ripley, 2010). This results in species-specific monthly abundance estimates being calculated from the raw count data, with upper and lower confidence limits. Where appropriate, a level of precision is also presented for each monthly abundance estimate. Dividing the monthly abundance estimates by the size of the Lease Area OCS-A 0512 or 4 km buffer sites calculates the density (e.g. bird per km^2) for any given species.

Species Distribution Maps

Each individual located by the surveys is geo-referenced and this allows those locations to be related to the boundary of Empire and any buffer placed around it out to 4 km. Seasonal relative density distribution maps were produced for total species using ArcGIS (version 9.2) by summing the number of individuals recorded in each image per season and then representing this sum of individuals as a dot on a map that was proportional to the number of individuals in that image; i.e. large numbers of individuals per image are represented by larger dots than smaller numbers of individuals per image. Seasons were classified as follows:

- Fall represented by the months of September, October and November;
- Winter represented by the months of December, January and February;
- Spring represented by the months of March, April and May; and
- Summer represented by the months of June, July and August.

Species Flight Direction Rose Diagrams

The flight direction of birds was recorded from all digital still images. Bearings of bird directions were plotted using Oriana to summarize overall directions of movement. The mean angle and mean vector is used to describe directional preferences and extent of 'agreement'. A Rayleigh test that assumes a null hypothesis of uniformity (i.e. scattered orientation in all directions) has been used, where a significant test indicates directionality of movement.

4. Species Accounts

The following species accounts present the raw counts, design-based abundance estimates, density estimates, behavioral and distribution data from the 12 month programme of aerial digital surveys of Lease Area OCS-A 0512 and a 4 km buffer (the Lease Area OCS-A 0512 plus 4 km buffer). The density estimates provide the number of individuals per square kilometer (e.g. bird per km^2). For purpose of this report, data are only presented for months where a species of bird or marine fauna were recorded. In some species, the separate abundance estimates for each of the two areas (the Lease Area OCS-A 0512 site and the 4 km buffer) differ from that of the abundance estimate for the Lease Area OCS-A 0512 plus 4 km buffer combined. This is due to the abundance estimates in the three areas being calculated independently and also due to slight differences in figures being rounded up of down.

4.1 Mallard

Mallards were recorded in a single month only, the December survey, within the 4 km buffer (**Table 7**). Six individuals were recorded, resulting in an abundance estimate of 47 individuals.

The six mallards (including one classified as a male) recorded in December were observed flying in a single group in the south of the 4 km buffer (**Figure 2**), flying in a south-easterly direction (**Figure 3**).

Table 7 **Raw counts and abundance and density estimates (No. estimated individuals per km^2) of mallards in: a) Lease Area OCS-A 0512 plus 4 km buffer, b) Lease Area OCS-A 0512, and c) the Lease Area OCS-A 0512 4 km buffer only.**

a) Lease Area OCS-A 0512 plus 4 km Buffer							
Survey	Raw Count	Abundance	Density	Flying	Sitting	Male	Female
Dec-17	6	46	0.06	6	0	1	0
b) Lease Area OCS-A 0512							
Survey	Raw Count	Abundance	Density	Flying	Sitting	Male	Female
Dec-17	0	0	-	0	0	0	0
c) 4 km Buffer							
Survey	Raw Count	Abundance	Density	Flying	Sitting	Male	Female
Dec-17	6	47	0.09	6	0	1	0

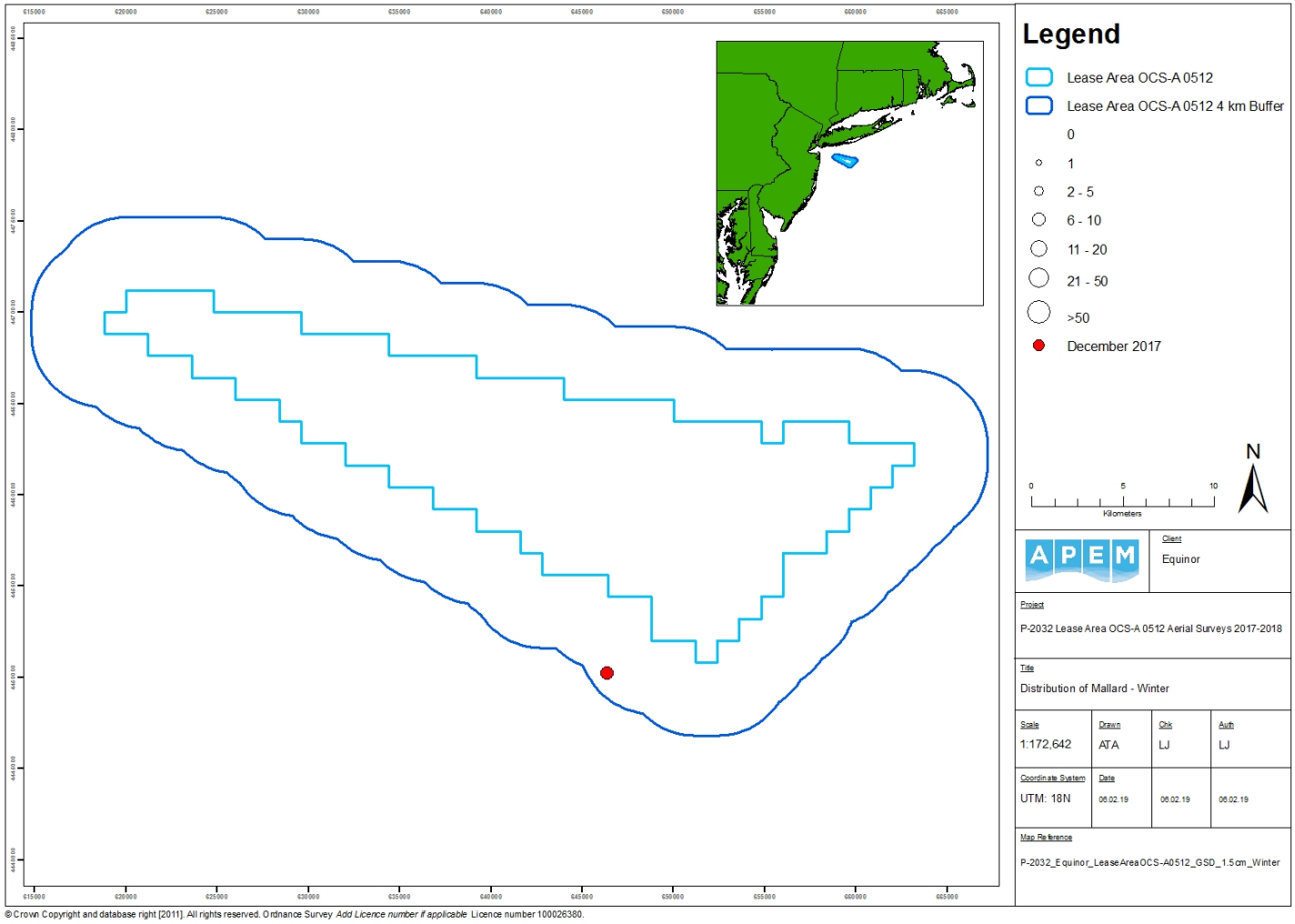
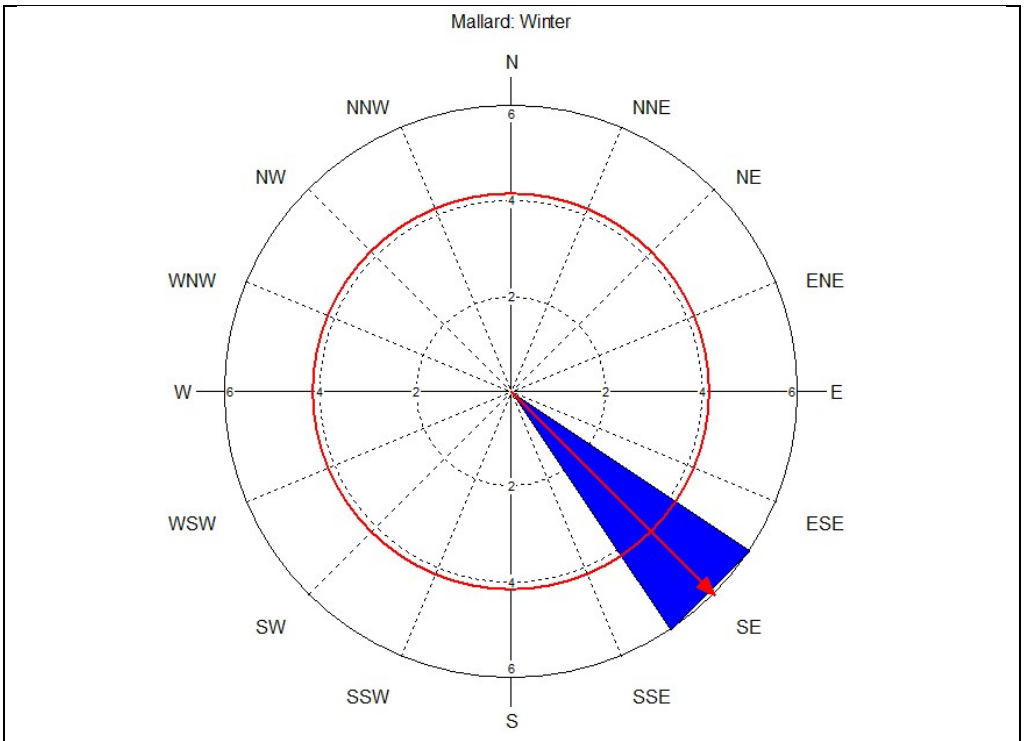


Figure 2 **Distribution of mallards recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the winter season.**



Number of Observations	**6**
Mean Vector (μ)	**135**
Length of Mean Vector (r)	**1**
Rayleigh Test (Z)	**6**
Rayleigh Test (p)	**< 1E-12**

Figure 3 Summary of flight direction of mallards (n=6) recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the winter season.

4.2 American Black Duck

Data presented in **Table 8** refer to American black ducks recorded within the Lease Area OCS-A 0512 plus 4 km buffer. A peak of 13 individuals, all within the Lease Area OCS-A 0512 site, were recorded in the November survey, resulting in an abundance estimate of 102 individuals. All 13 American black ducks were recorded flying in a single group in the west of the Lease Area OCS-A 0512 site (**Figure 4**). A further two American black ducks were recorded in the south 4 km buffer during the December survey (**Figure 5**), with an abundance estimate of 16 individuals.

The majority of ducks flew in a west-south-west to south-westerly direction during the November survey (fall). Two American black ducks were recorded flying in a south-easterly direction during December (**Figure 6**).

Table 8 **Raw counts and abundance and density estimates (No. estimated individuals per km^2) of American black ducks in: a) Lease Area OCS-A 0512 plus 4 km buffer, b) Lease Area OCS-A 0512, and c) the Lease Area OCS-A 0512 4 km buffer only.**

a) Lease Area OCS-A 0512 plus 4 km Buffer					
Survey	**Raw Count**	**Abundance**	**Density**	**Flying**	**Sitting**
Nov-17	13	103	0.13	13	0
Dec-17	2	15	0.02	2	0
b) Lease Area OCS-A 0512					
Survey	**Raw Count**	**Abundance**	**Density**	**Flying**	**Sitting**
Nov-17	13	102	0.32	13	0
Dec-17	0	0	-	0	0
c) 4 km Buffer					
Survey	**Raw Count**	**Abundance**	**Density**	**Flying**	**Sitting**
Nov-17	0	0	-	0	0
Dec-17	2	16	0.03	2	0

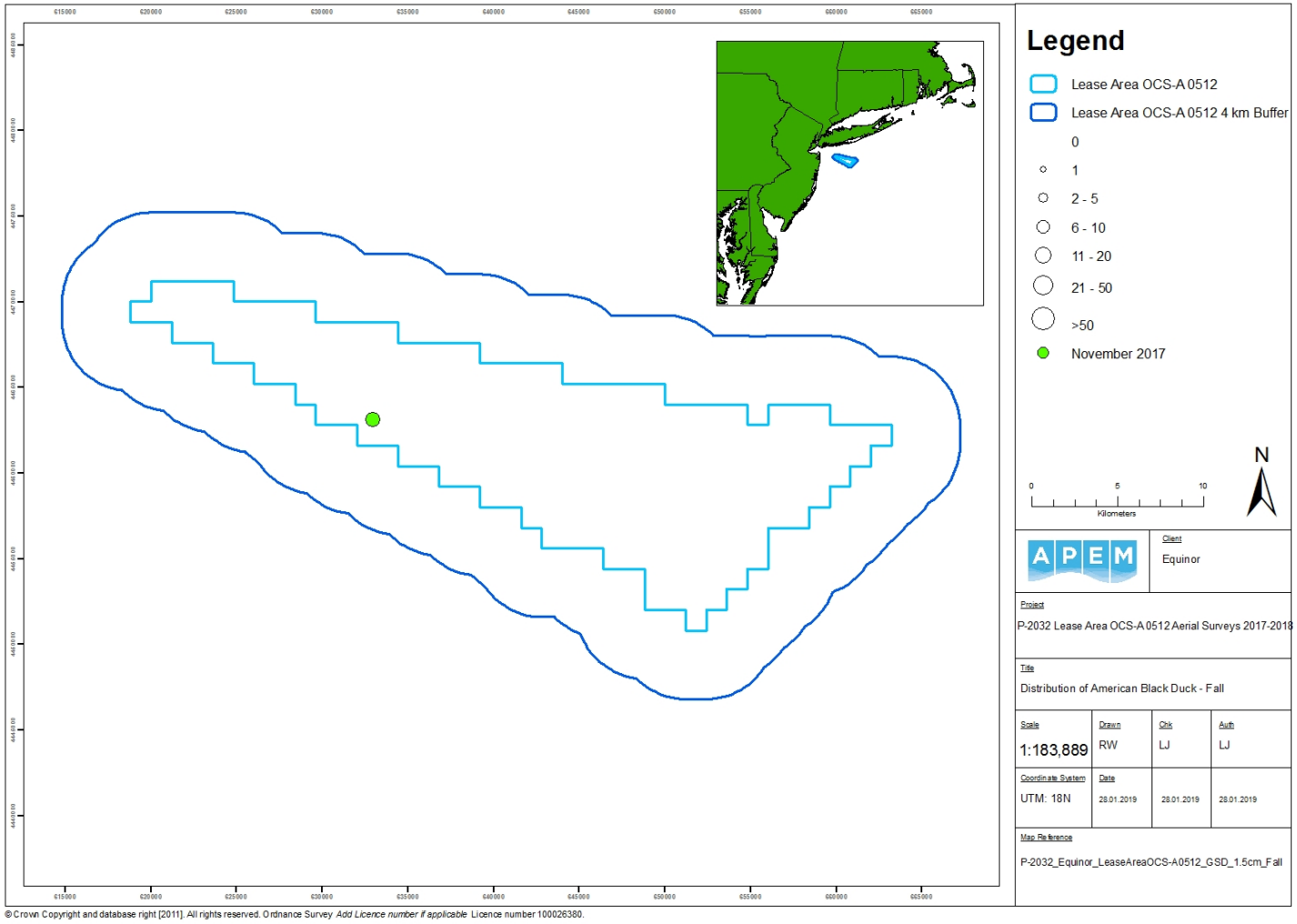


Figure 4 Distribution of American black ducks recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the fall season.

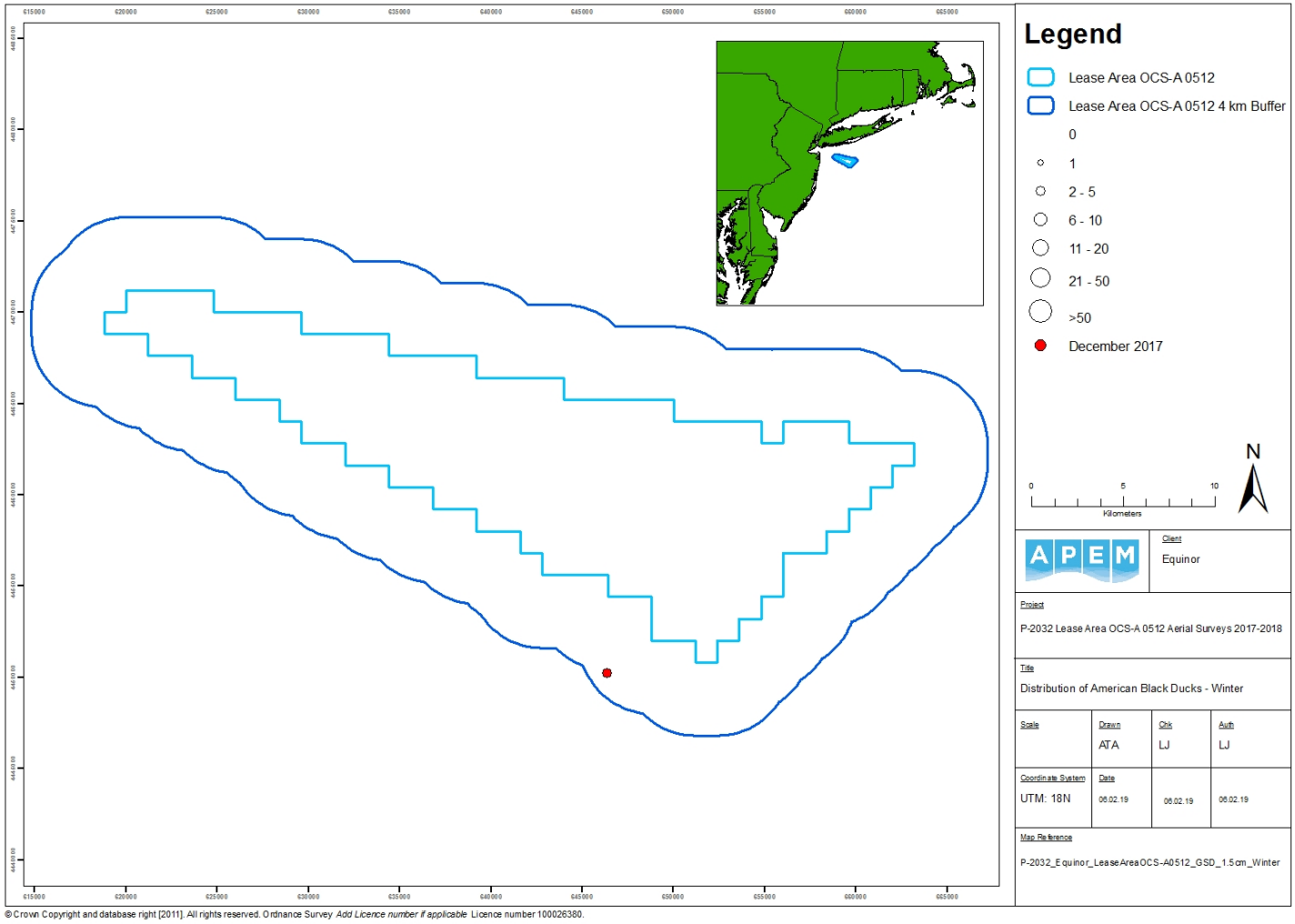
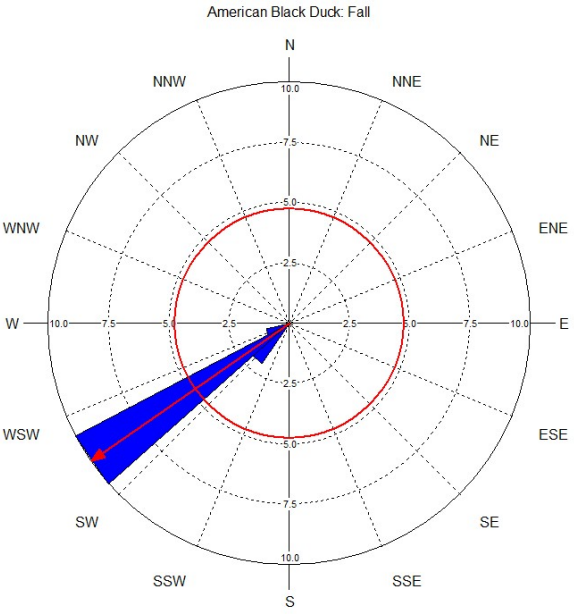
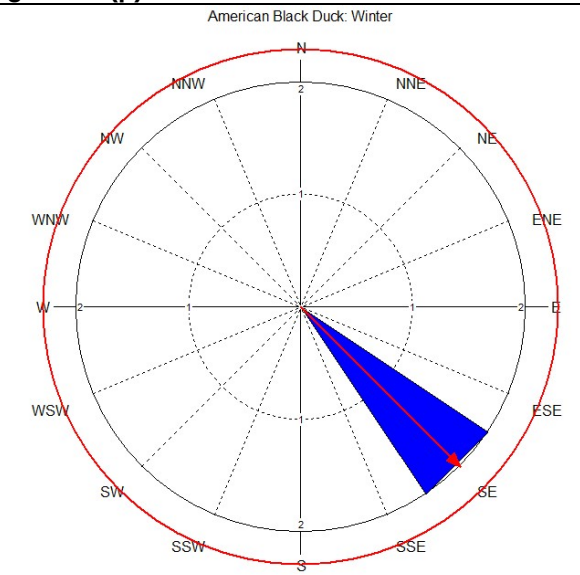


Figure 5 Distribution of American black ducks recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the winter season.



Number of Observations	**13**
Mean Vector (μ)	**235.231**
Length of Mean Vector (r)	**0.995**
Rayleigh Test (Z)	**12.883**
Rayleigh Test (p)	**1.3E-06**



Number of Observations	**2**
Mean Vector (μ)	**135**
Length of Mean Vector (r)	**1**
Rayleigh Test (Z)	**2**
Rayleigh Test (p)	**0.137**

Figure 6 **Summary of flight direction of American black duck (n=15) recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the fall and winter seasons.**

4.3 Surf Scoter

A peak of 16 surf scoters were recorded in October 2018, of which 11 were within the Lease Area OCS-A 0512 site and five within the 4 km buffer (**Table 9**), resulting in abundance estimates of 86 and 40 individuals, respectively.

Seven surf scoters (classified as five females and two males) were recorded in the November 2017 survey flying in a single group in the west of the 4 km buffer, all of which were recorded within the 4 km buffer (**Figure 7**).

Out of the 23 individuals recorded during the fall, 20 were recorded in flight. The surf scoters in flight showed a significant tendency to fly in a west-south-west direction (**Figure 8**).

Table 9 **Raw counts and abundance and density estimates (No. estimated individuals per km^2) of surf scoters in: a) Lease Area OCS-A 0512 plus 4 km buffer, b) Lease Area OCS-A 0512, and c) the Lease Area OCS-A 0512 4 km buffer only.**

a) Lease Area OCS-A 0512 plus 4 km Buffer							
Survey	Raw Count	Abundance	Density	Flying	Sitting	Male	Female
Nov-17	7	56	0.07	7	0	2	5
Oct-18	16	126	0.15	13	3	13	2
b) Lease Area OCS-A 0512							
Survey	Raw Count	Abundance	Density	Flying	Sitting	Male	Female
Nov-17	0	0	-	0	0	0	0
Oct-18	11	86	0.27	11	0	8	2
c) 4 km Buffer							
Survey	Raw Count	Abundance	Density	Flying	Sitting	Male	Female
Nov-17	7	56	0.11	7	0	2	5
Oct-18	5	40	0.08	2	3	5	0

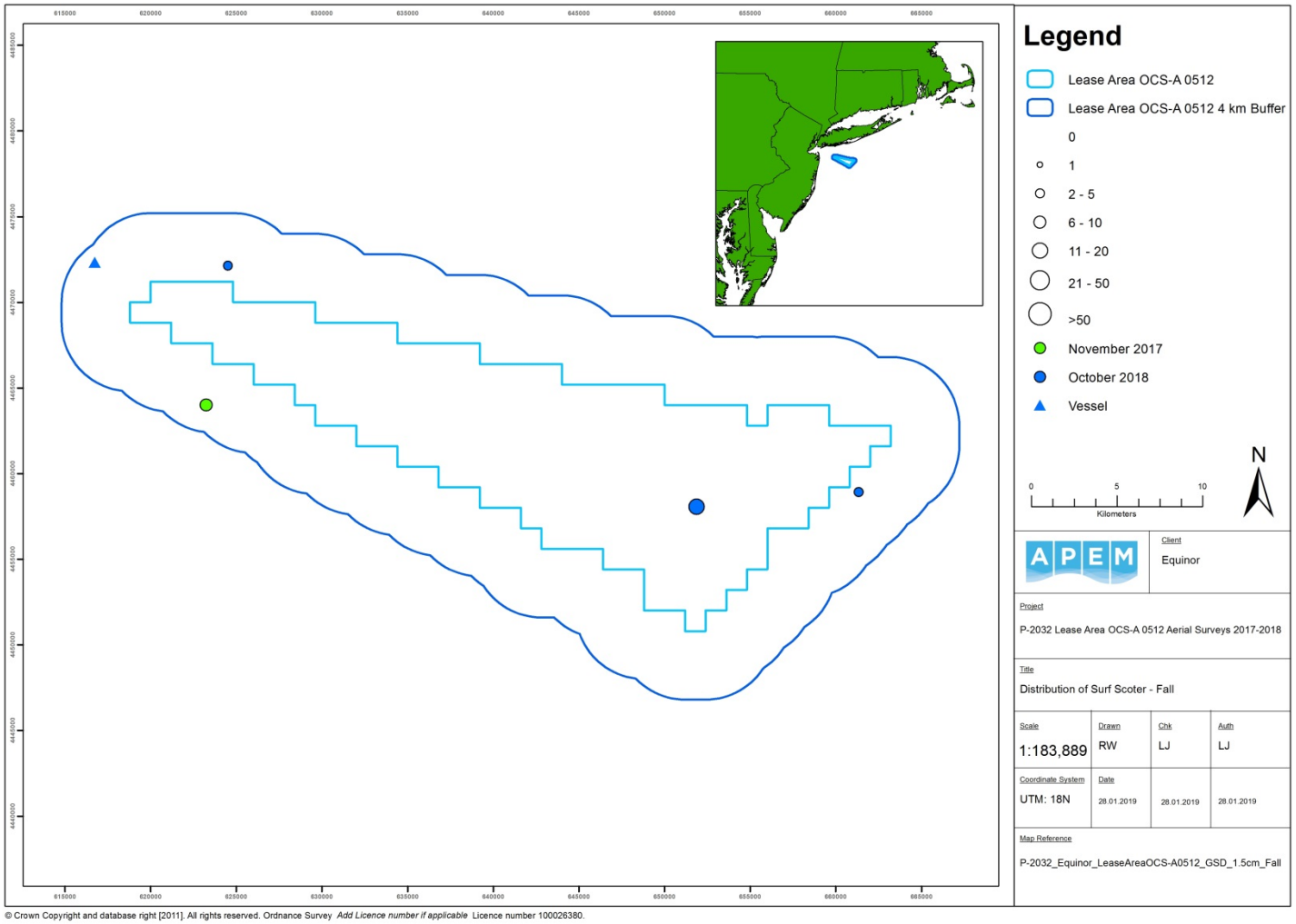
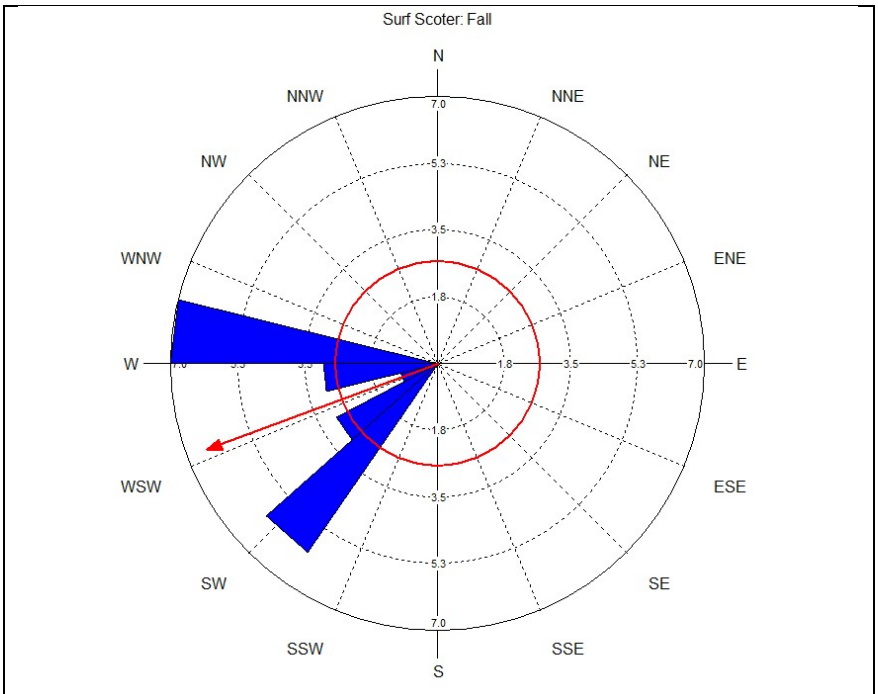


Figure 7 Distribution of Surf Scoter recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the fall season.



Number of Observations	**20**
Mean Vector (μ)	**249.543**
Length of Mean Vector (r)	**0.922**
Rayleigh Test (Z)	**16.995**
Rayleigh Test (p)	**5.9E-08**

Figure 8 Summary of flight direction of surf scoters (n=20) recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the fall season.

4.4 White-winged Scoter

White-winged scoters were recorded in three months throughout the survey period. Peak numbers were recorded in the 4 km buffer in the November survey with eight individuals, with an abundance estimate of 64 (**Table 10**). No white-winged scoters were recorded in the Lease Area OCS-A 0512 site.

The eight white-winged scoters (classified as three females and five males) recorded in November were in a single group located in the west of the 4 km buffer (**Figure 9**). The seven birds recorded in October were located in the west of the 4 km buffer. The four birds recorded in March were located in the west of the 4 km buffer (**Figure 10**).

During the fall 15 white-winged scoters were recorded in flight, but they did not show a tendency to fly in any one direction. Four white-winged scoters were recorded in spring, with three flying in a south-westerly direction and one in a west-south-westerly direction (**Figure 11**).

Table 10 **Raw counts and abundance and density estimates (No. estimated individuals per km^2) of white-winged scoters in: a) Lease Area OCS-A 0512 plus 4 km buffer, b) Lease Area OCS-A 0512, and c) the Lease Area OCS-A 0512 4 km buffer only.**

a) Lease Area OCS-A 0512 plus 4 km Buffer							
Survey	**Raw Count**	**Abundance**	**Density**	**Flying**	**Sitting**	**Male**	**Female**
Nov-17	8	64	0.08	8	0	5	3
Mar-17	4	32	0.04	4	0	2	2
Oct-18	7	55	0.07	7	0	4	0
b) Lease Area OCS-A 0512							
Survey	**Raw Count**	**Abundance**	**Density**	**Flying**	**Sitting**	**Male**	**Female**
Nov-17	0	0	-	0	0	0	0
Mar-17	0	0	-	0	0	0	0
Oct-18	0	0	-	0	0	0	0
c) 4 km Buffer							
Survey	**Raw Count**	**Abundance**	**Density**	**Flying**	**Sitting**	**Male**	**Female**
Nov-17	8	64	0.13	8	0	5	3
Mar-17	4	32	0.06	4	0	2	2
Oct-18	7	55	0.11	7	0	4	0

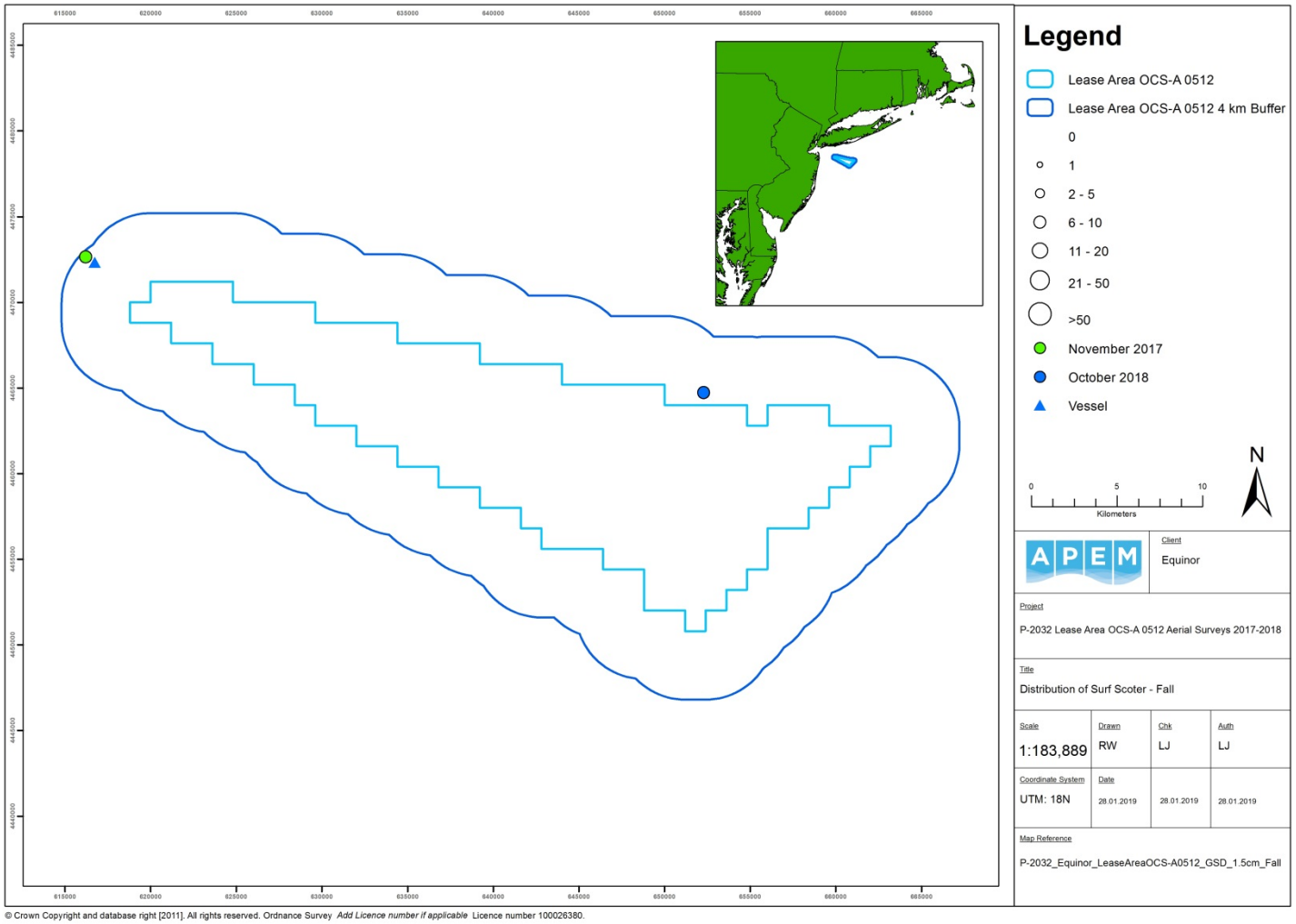


Figure 9 Distribution of white-winged scoter recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the fall season.

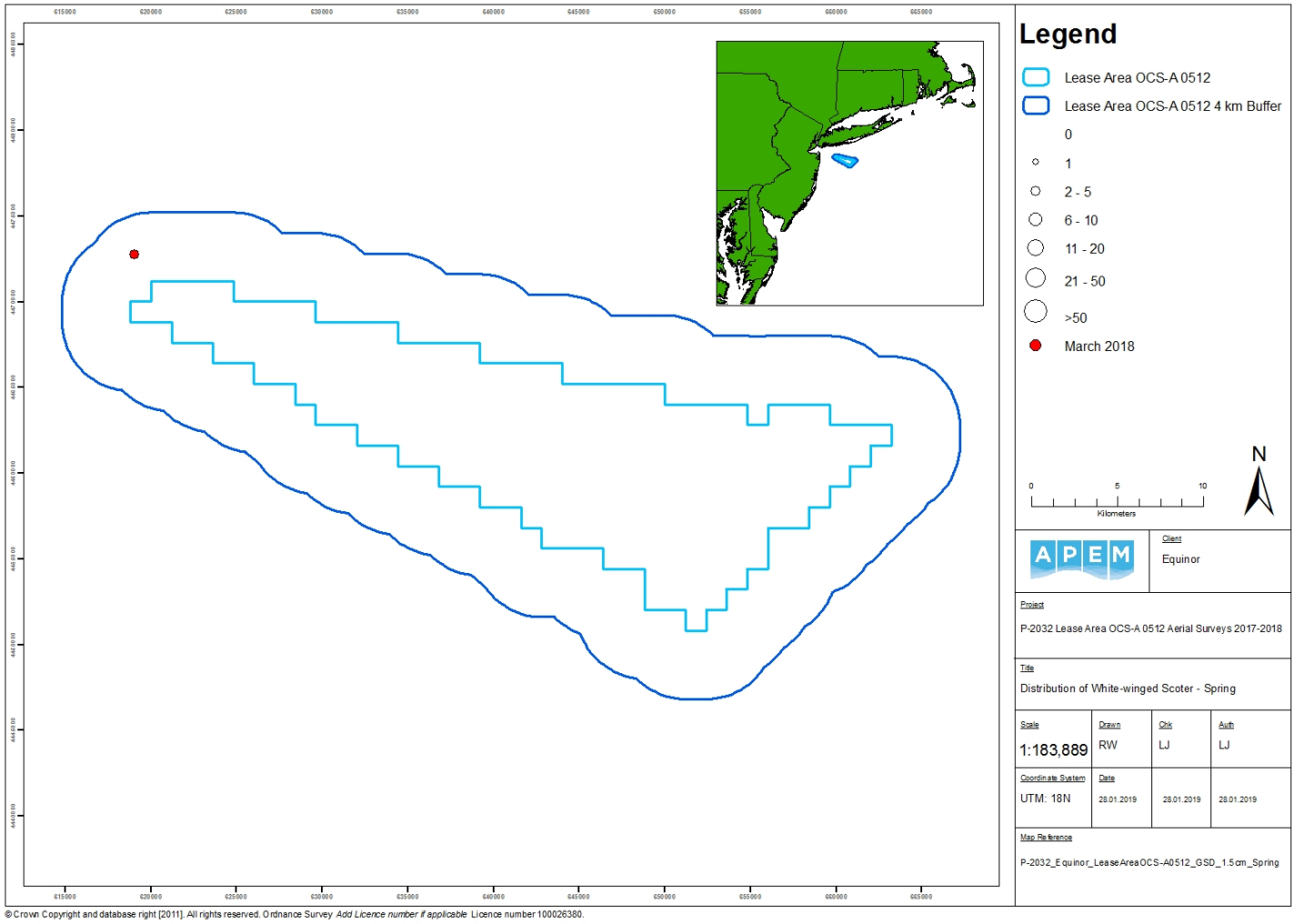
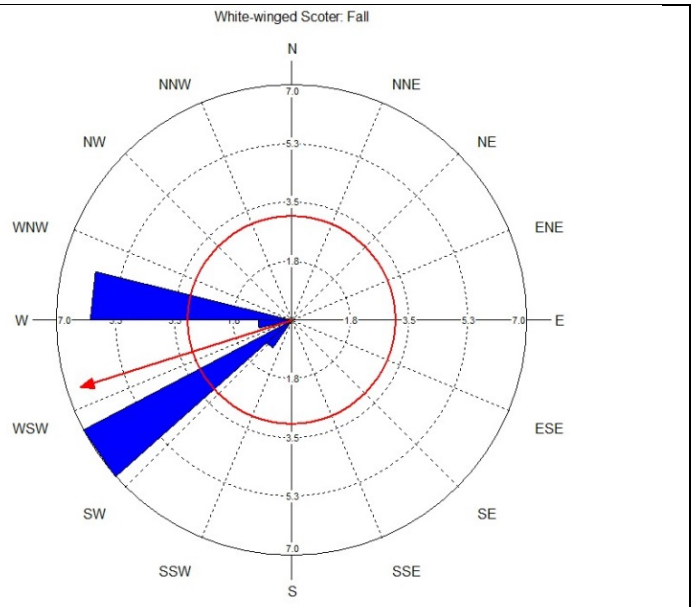
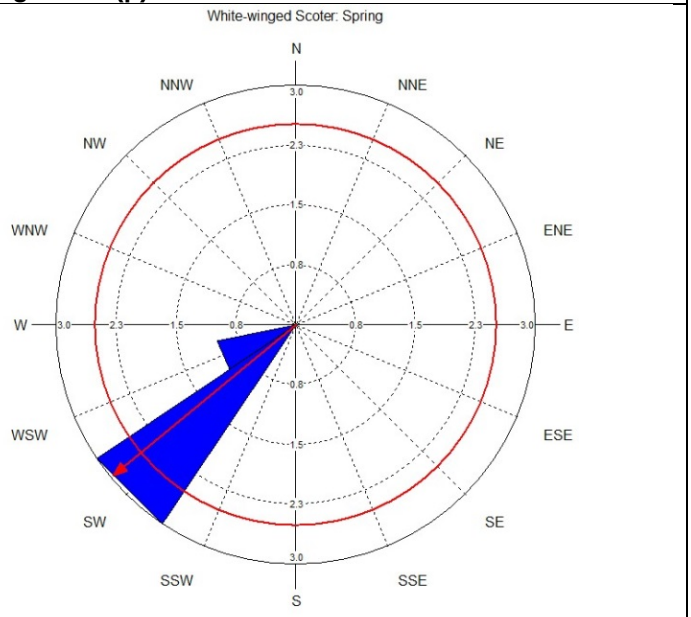


Figure 10 **Distribution of white-winged scoter recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the spring season.**



Number of Observations	**15**
Mean Vector (μ)	**252.342**
Length of Mean Vector (r)	**0.941**
Rayleigh Test (Z)	**13.274**
Rayleigh Test (p)	**7.4E-07**



Number of Observations	**4**
Mean Vector (μ)	**230.57**
Length of Mean Vector (r)	**0.986**
Rayleigh Test (Z)	**3.886**
Rayleigh Test (p)	**0.009**

Figure 11 Summary of flight direction of white-winged scoters (n=4) recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the fall and spring seasons.

4.5 Black Scoter

Peak numbers of black scoters were recorded in the October survey when 127 individuals were recorded, resulting in an abundance estimate of 1,001 within the entire Lease Area OCS-A 0512 plus 4 km buffer (**Table 11)** and an abundance estimate of 633 within the Lease Area OCS-A 0512 site.

Sixty-nine black scoters (classified as 56 females and 13 males) were recorded in the November survey. Sixty-eight of the individuals were recorded flying in a group in the northern region of the 4 km buffer, and a single flying individual to the west of the group. In October, 127 individuals were recorded in four separate groups, with 81 in the Lease Area OCS-A 0512 site and 46 in the 4 km buffer (**Figure 12**). In winter, two black scoters were recorded in the north-west of the Lease Area OCS-A 0512 site during February 2018 (**Figure 13**). In the spring, seven scoters were recorded in a group in the north-west of the Lease Area OCS-A 0512 plus 4 km buffer, inside the 4 km buffer, during March (**Figure 14**).

A total of 195 black scoters were recorded in flight in fall. Black scoters showed a significant tendency to fly in a west-south-west to westerly direction (**Figure 15**).

Table 11 **Raw counts and abundance and density estimates (No. estimated individuals per km^2) of black scoters in: a) Lease Area OCS-A 0512 plus 4 km buffer, b) Lease Area OCS-A 0512, and c) the Lease Area OCS-A 0512 4 km buffer only.**

a) Lease Area OCS-A 0512 plus 4 km Buffer							
Survey	**Raw Count**	**Abundance**	**Density**	**Flying**	**Sitting**	**Male**	**Female**
Nov-17	69	548	0.67	69	0	13	56
Feb-18	2	16	0.02	0	2	0	0
Mar-18	7	56	0.07	0	7	5	2
Oct-18	127	1001	1.22	126	1	108	18
b) Lease Area OCS-A 0512							
Survey	**Raw Count**	**Abundance**	**Density**	**Flying**	**Sitting**	**Male**	**Female**
Nov-17	0	0	-	0	0	0	0
Feb-18	2	16	0.05	0	2	0	0
Mar-18	0	0	-	0	0	0	0
Oct-18	81	633	1.97	81	0	72	9
c) 4 km Buffer							
Survey	**Raw Count**	**Abundance**	**Density**	**Flying**	**Sitting**	**Male**	**Female**
Nov-17	69	552	1.11	69	0	13	56
Feb-18	0	0	-	0	0	0	0
Mar-18	7	57	0.11	0	7	5	2
Oct-18	46	365	0.73	45	1	36	9

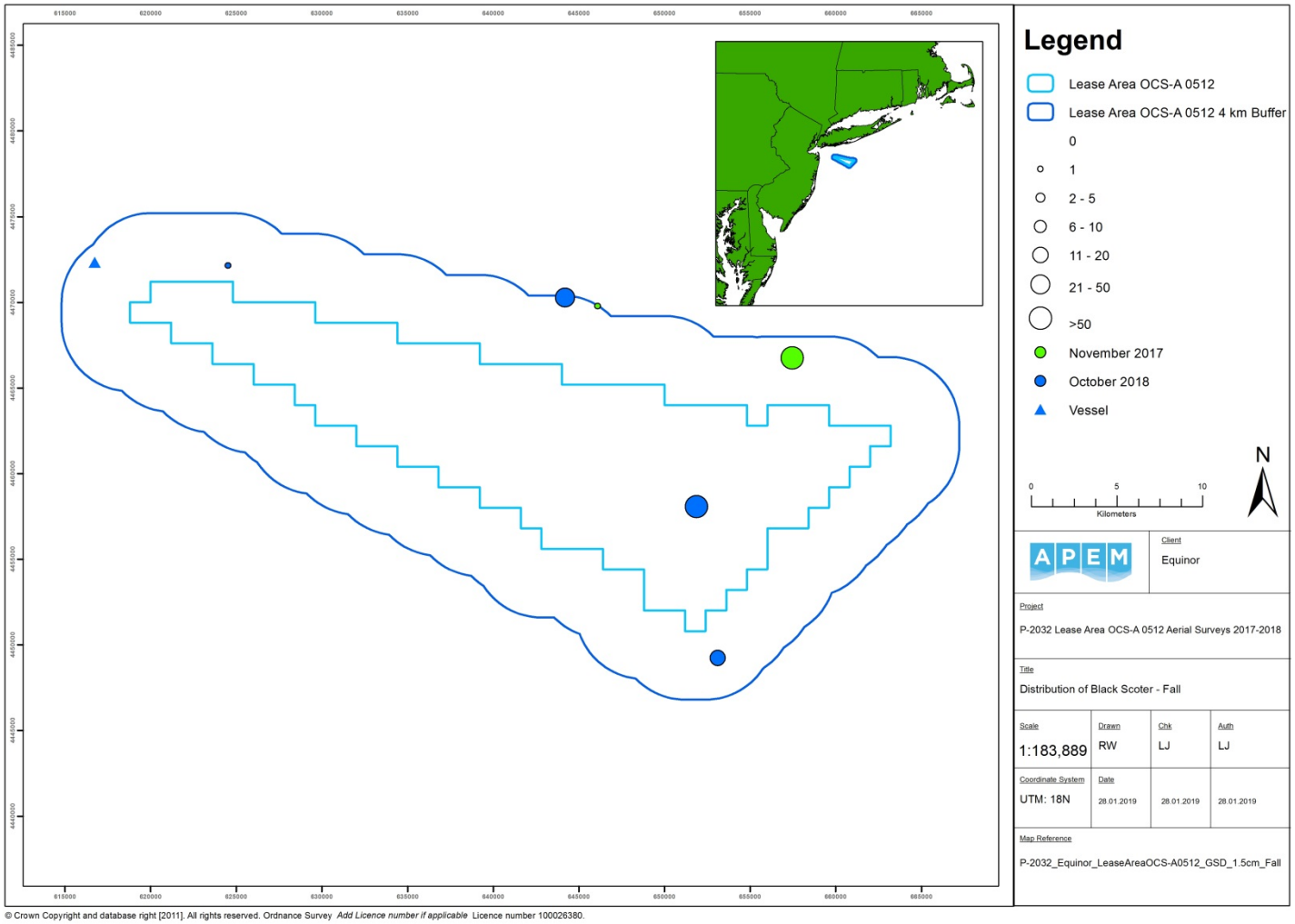


Figure 12 Distribution of black scoter recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the fall season.

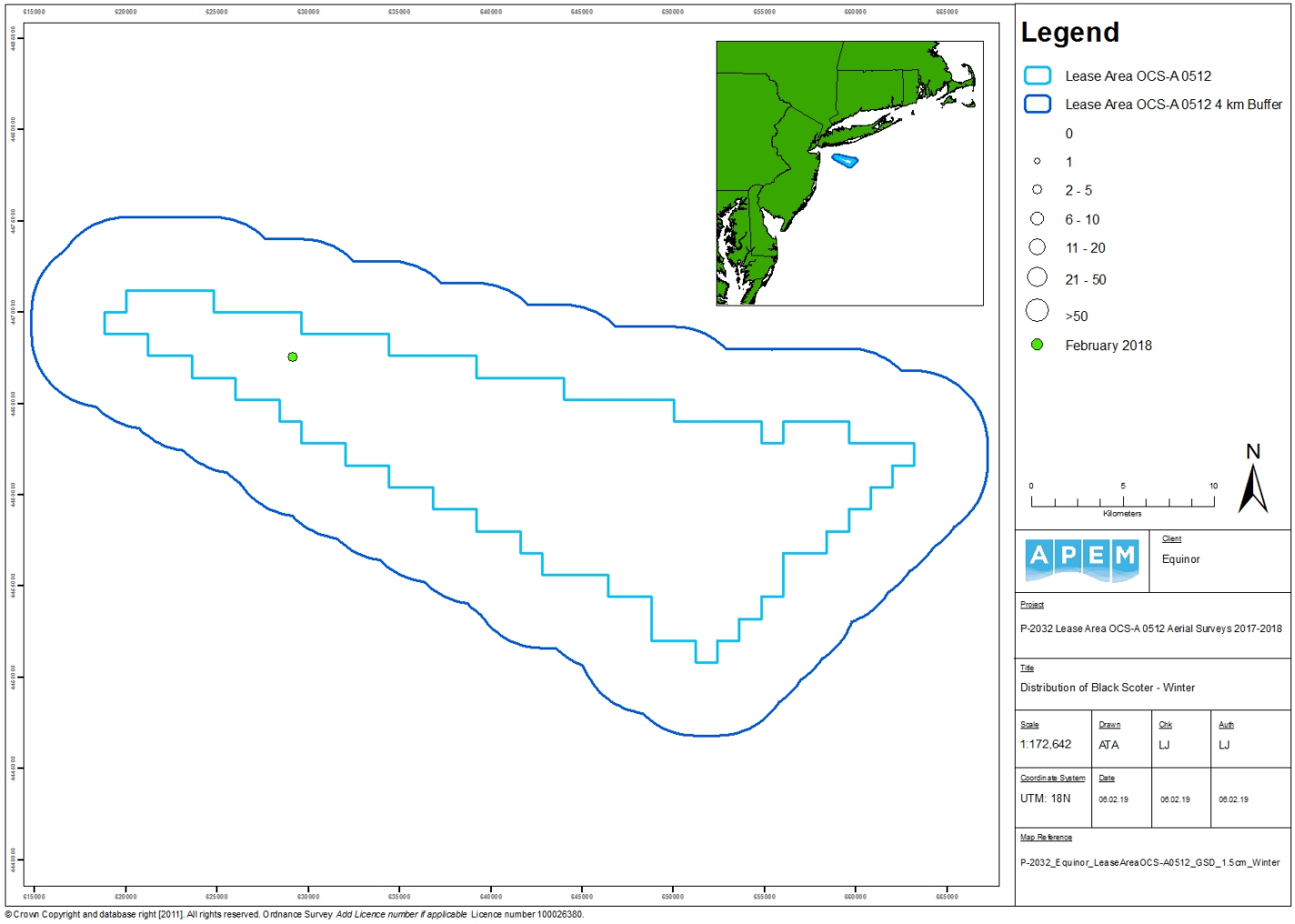


Figure 13 Distribution of black scoter recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the winter season.

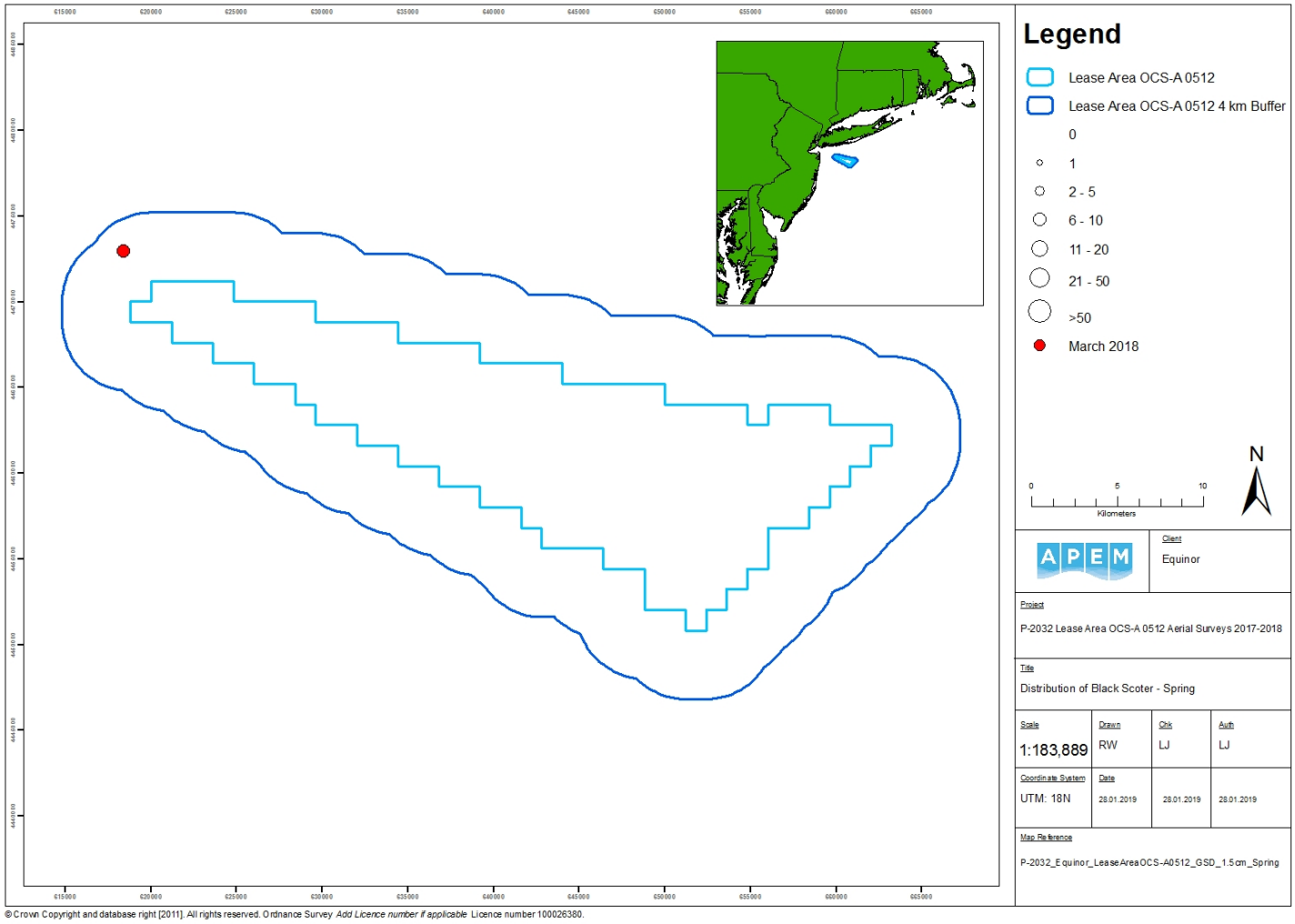
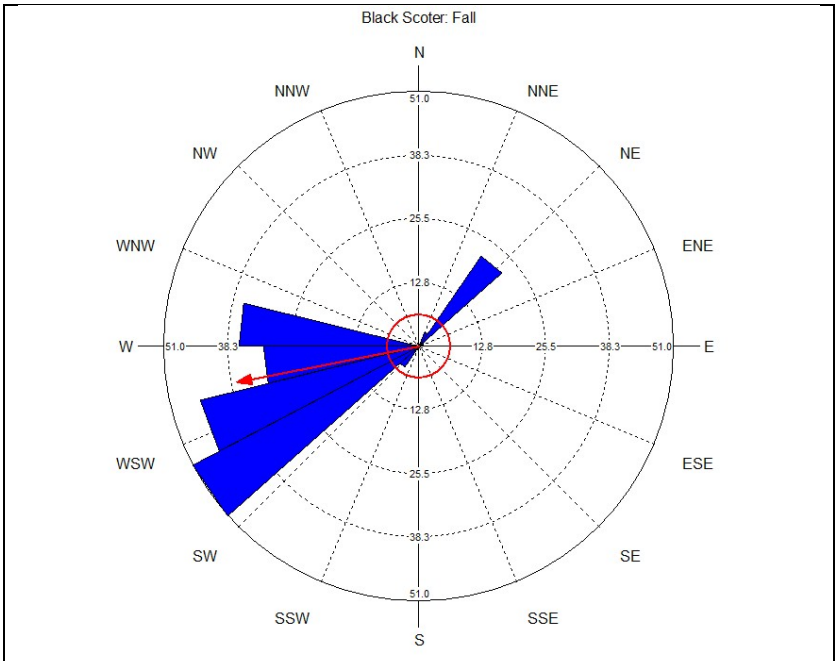


Figure 14 **Distribution of black scoter recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the spring season.**



Number of Observations	**195**
Mean Vector (μ)	**258.965**
Length of Mean Vector (r)	**0.726**
Rayleigh Test (Z)	**102.889**
Rayleigh Test (p)	**< 1E-12**

Figure 15 Summary of flight direction of black scoters (n=195) recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the fall season.

4.6 Species Unknown - Scoter

Unknown scoter species were recorded in the October survey only (**Table 12**), with 10 and nine individuals recorded in the Lease Area OCS-A 0512 site and 4 km buffer, respectively (**Figure 16**).

All 10 unknown scoter species recorded in the Lease Area OCS-A 0512 site were observed in flight, showing a significant tendency to fly in a west-south-westerly direction (**Figure 17**).

Table 12 **Raw counts and abundance and density estimates (No. estimated individuals per km^2) of unknown scoter species in: a) Lease Area OCS-A 0512 plus 4 km buffer, b) Lease Area OCS-A 0512, and c) the Lease Area OCS-A 0512 4 km buffer only.**

a) Lease Area OCS-A 0512 plus 4 km Buffer							
Survey	Raw Count	Abundance	Density	Flying	Sitting	Male	Female
Oct-18	19	150	0.18	10	9	4	5
b) Lease Area OCS-A 0512							
Survey	Raw Count	Abundance	Density	Flying	Sitting	Male	Female
Oct-18	10	78	0.24	10	0	1	4
c) 4 km Buffer							
Survey	Raw Count	Abundance	Density	Flying	Sitting	Male	Female
Oct-18	9	71	0.14	0	9	3	1

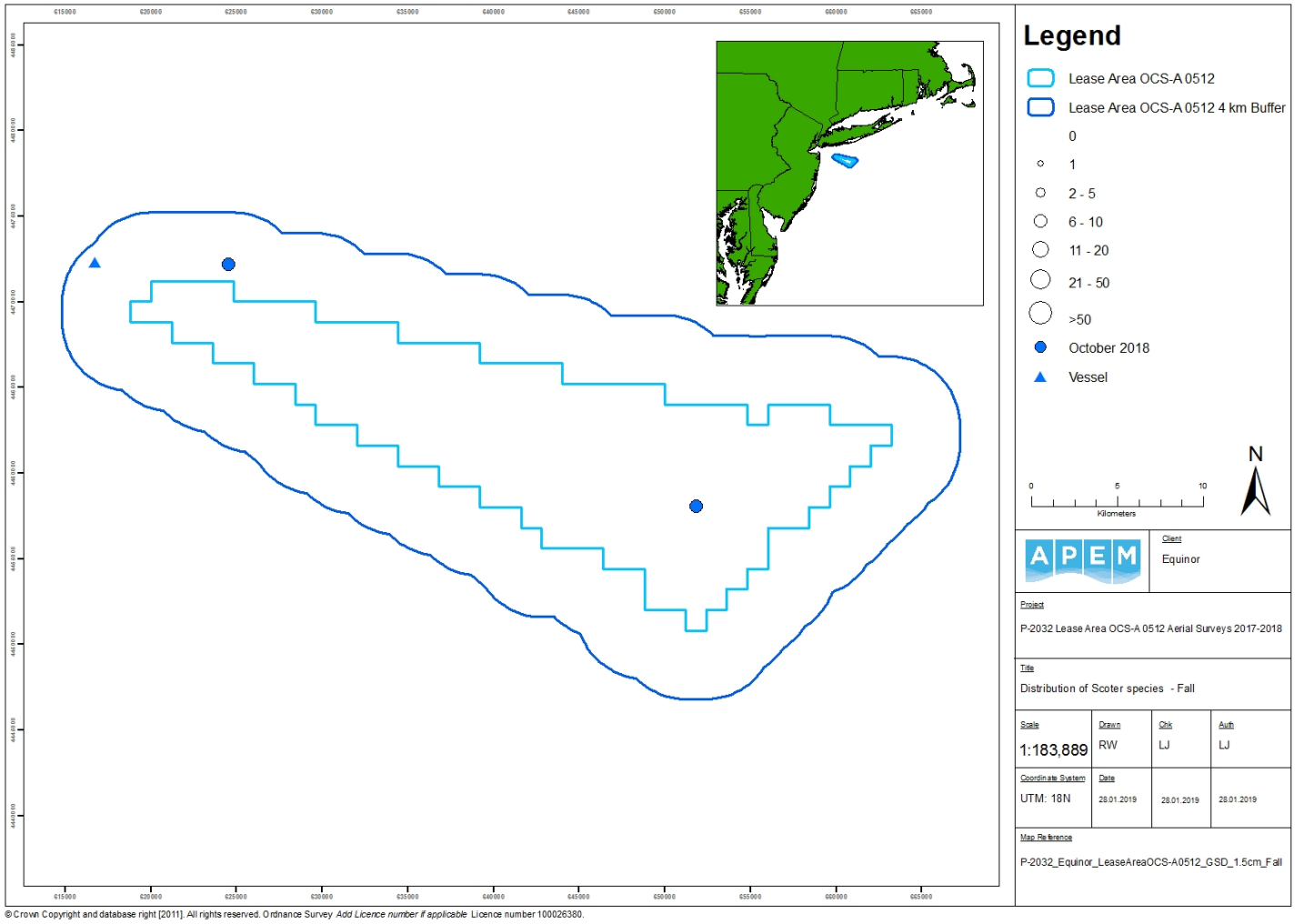
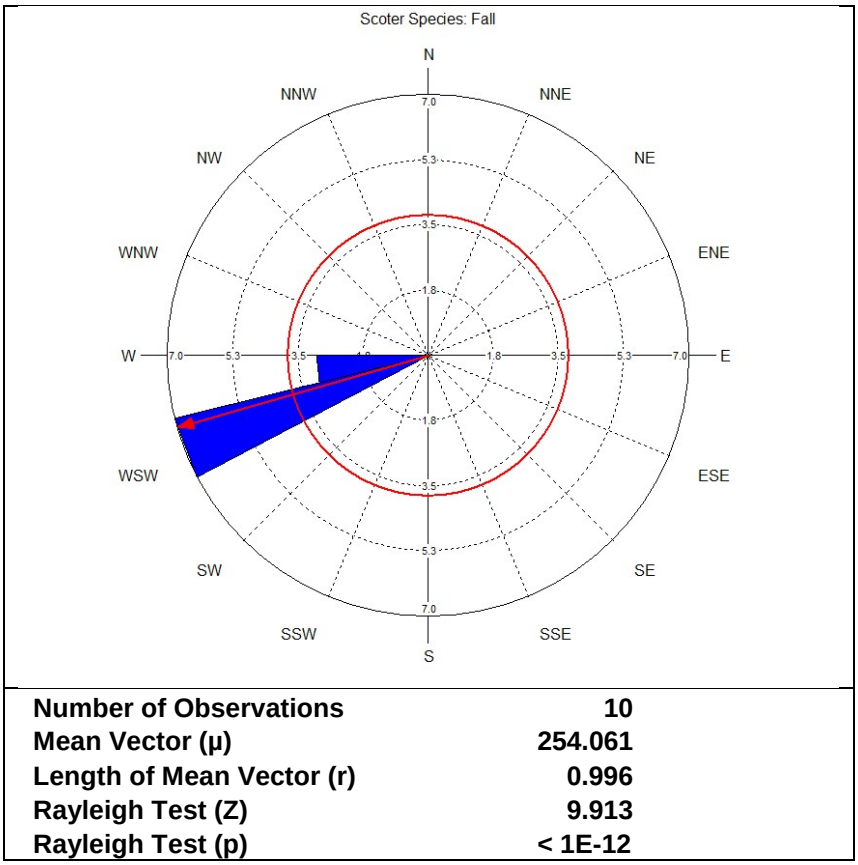


Figure 16 **Distribution of unknown scoter species recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the fall season.**



Number of Observations	**10**
Mean Vector (μ)	**254.061**
Length of Mean Vector (r)	**0.996**
Rayleigh Test (Z)	**9.913**
Rayleigh Test (p)	**< 1E-12**

Figure 17 Summary of flight direction of unknown scoter species (n=10) recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the fall season.

4.7 Long-tailed Duck

Long-tailed ducks were recorded in the January and February surveys only (the winter season), with raw counts of one and two, respectively, resulting in abundance estimates of eight and 16, all within the Lease Area OCS-A 0512 site (**Table 13**).

All three long-tailed ducks were recorded in the central region of the Lease Area OCS-A 0512 site (**Figure 18**).

Two long-tailed ducks were recorded flying in a north-north-easterly direction in winter (**Figure 19**).

Table 13 **Raw counts and abundance and density estimates (No. estimated individuals per km^2) of long-tailed ducks in: a) Lease Area OCS-A 0512 plus 4 km buffer, b) Lease Area OCS-A 0512, and c) the Lease Area OCS-A 0512 4 km buffer only.**

a) Lease Area OCS-A 0512 plus 4 km Buffer							
Survey	Raw Count	Abundance	Density	Flying	Sitting	Male	Female
Jan-18	1	8	0.01	0	1	0	0
Feb-18	2	16	0.02	2	0	1	1
b) Lease Area OCS-A 0512							
Survey	Raw Count	Abundance	Density	Flying	Sitting	Male	Female
Jan-18	1	8	0.02	0	1	0	0
Feb-18	2	16	0.05	2	0	1	1
c) 4 km Buffer							
Survey	Raw Count	Abundance	Density	Flying	Sitting	Male	Female
Jan-18	0	0	-	0	0	0	0
Feb-18	0	0	-	0	0	0	0

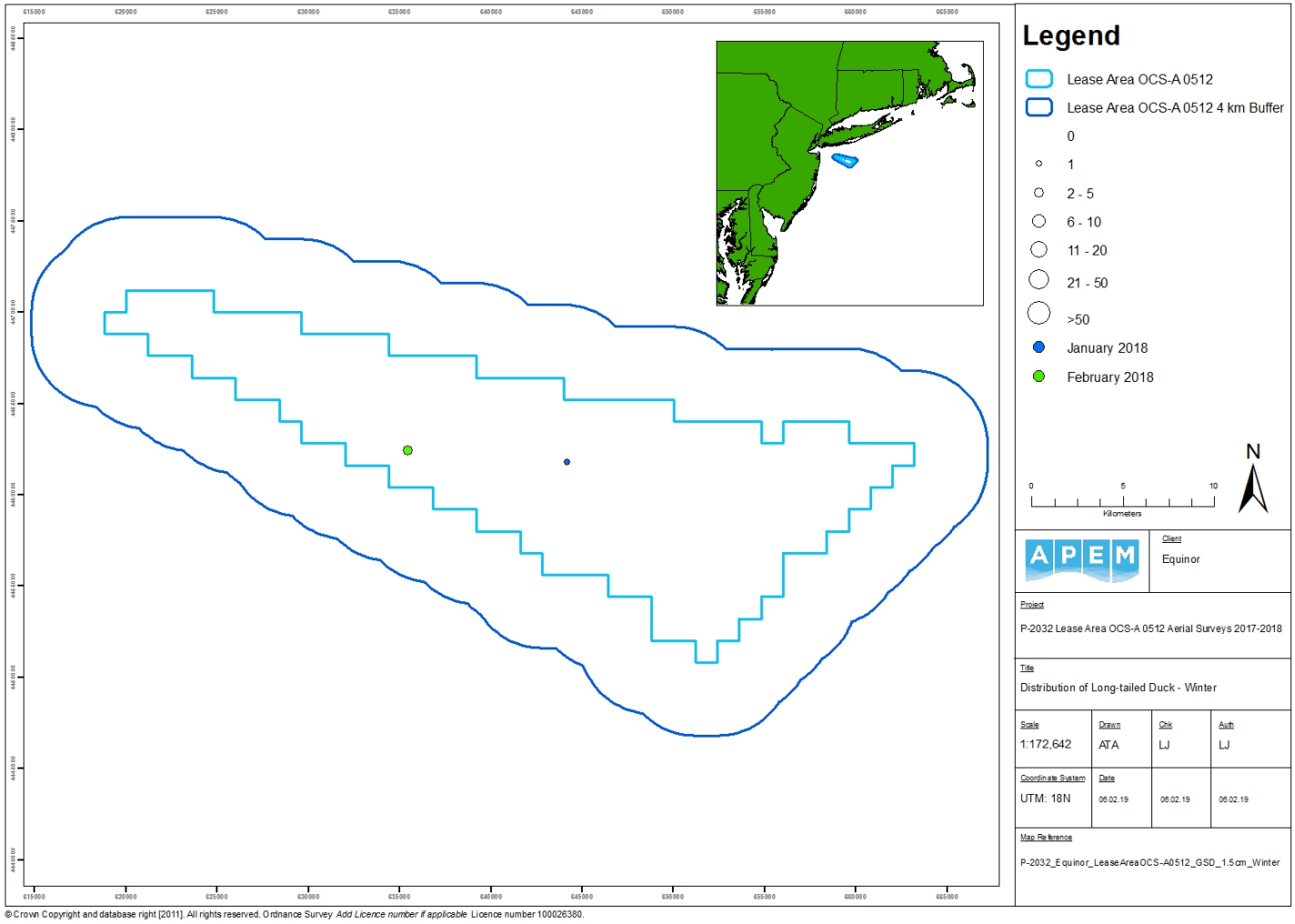
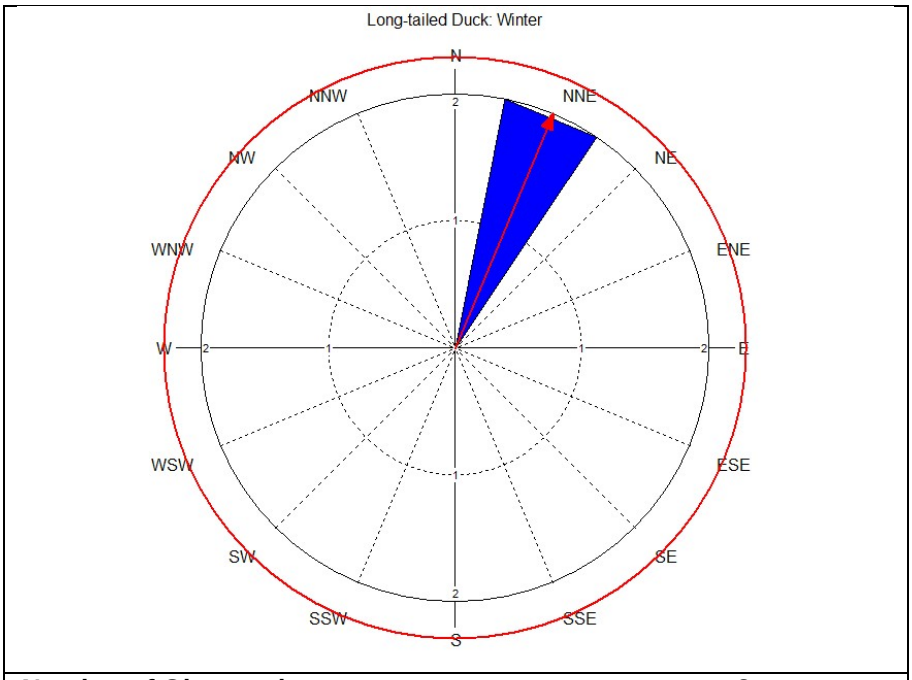


Figure 18 Distribution of long-tailed duck recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the winter season.



Number of Observations	**2**
Mean Vector (μ)	**22.5**
Length of Mean Vector (r)	**1**
Rayleigh Test (Z)	**2**
Rayleigh Test (p)	**0.137**

Figure 19 Summary of flight direction of long-tailed ducks (n=2) recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the winter season.

4.8 Species Unknown – Duck

Unknown ducks were recorded in the January and July surveys only, with a peak abundance estimate of 23 recorded in January in the 4 km buffer (**Table 14)**. No unknown duck species were recorded in the Lease Area OCS-A 0512 site.

In January, three unknown duck species were recorded in the north-eastern region of the 4 km buffer (**Figure 20**), whilst in July two unknown duck species were recorded in the 4 km buffer, just outside the Lease Area OCS-A 0512 site (**Figure 21**).

Three unknown species of duck were recorded flying in a north-easterly direction in winter (**Figure 22**).

Table 14 **Raw counts and abundance and density estimates (No. estimated individuals per km^2) of unknown duck species in: a) Lease Area OCS-A 0512 plus 4 km buffer, b) Lease Area OCS-A 0512, and c) the Lease Area OCS-A 0512 4 km buffer only.**

a) Lease Area OCS-A 0512 plus 4 km Buffer							
Survey	Raw Count	Abundance	Density	Flying	Sitting	Male	Female
Jan-18	3	23	0.03	3	0	0	0
Jul-18	2	15	0.02	0	2	1	1
b) Lease Area OCS-A 0512							
Survey	Raw Count	Abundance	Density	Flying	Sitting	Male	Female
Jan-18	0	0	-	0	0	0	0
Jul-18	0	0	-	0	0	0	0
c) 4 km Buffer							
Survey	Raw Count	Abundance	Density	Flying	Sitting	Male	Female
Jan-18	3	23	0.05	3	0	0	0
Jul-18	2	15	0.03	0	2	1	1

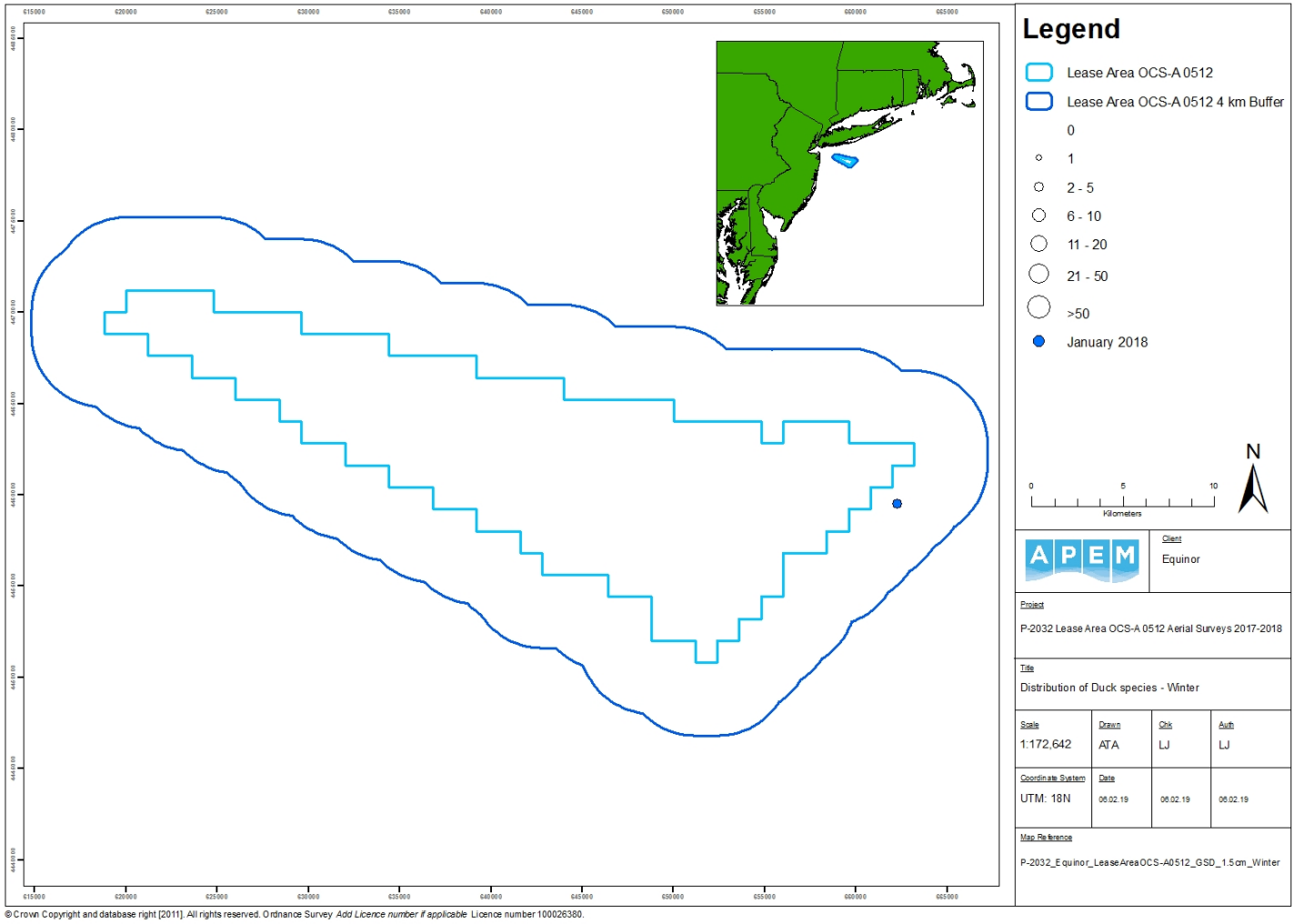


Figure 20 Distribution of unknown duck species recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the winter season.

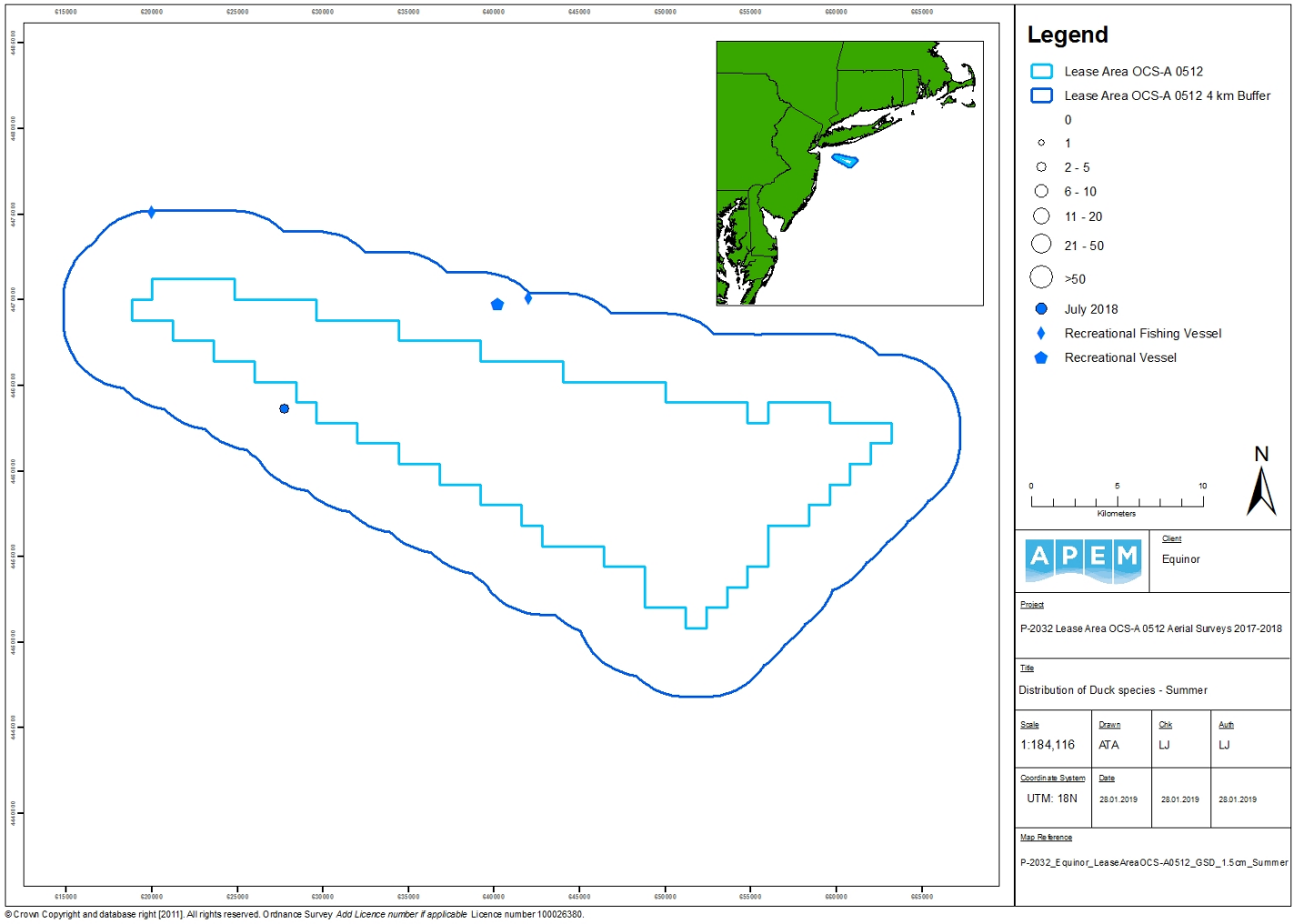
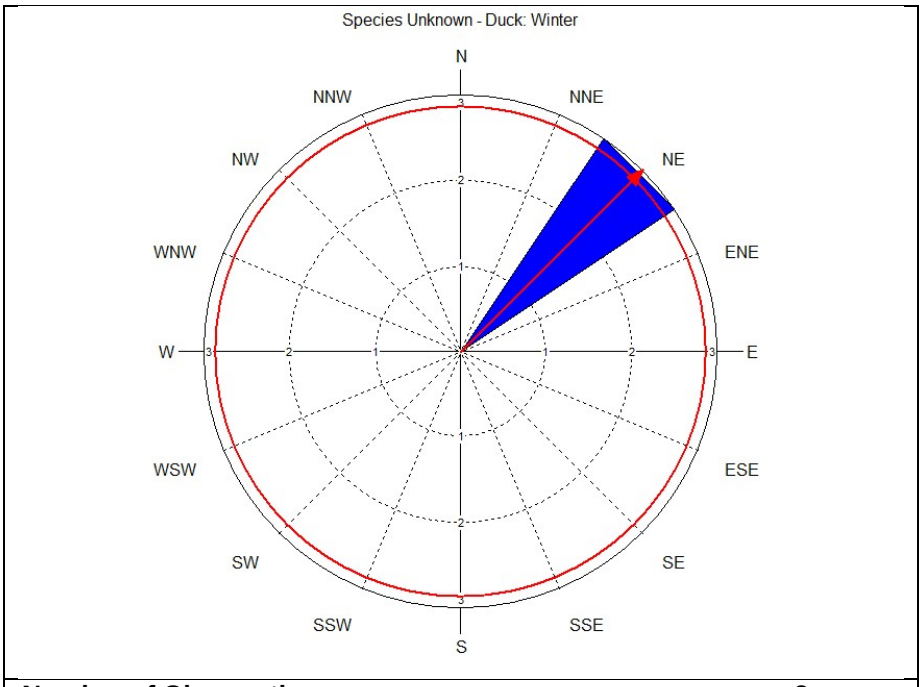


Figure 21 Distribution of unknown duck species recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the summer season.



Number of Observations	**3**
Mean Vector (μ)	**45**
Length of Mean Vector (r)	**1**
Rayleigh Test (Z)	**3**
Rayleigh Test (p)	**0.033**

Figure 22 Summary of flight direction of unknown duck species (n=3) recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the winter season.

4.9 Red-throated Loon

Red-throated loons were recorded in the first seven months of the survey period from November 2017 to May 2018, inclusive. A peak raw count of 66 individuals in the Lease Area OCS-A 0512 plus 4 km buffer were recorded in the November survey resulting in an abundance estimate of 525 (**Table 15**).

A total of 66 red-throated loons were recorded in fall, loosely distributed across the Lease Area OCS-A 0512 plus 4 km buffer in November (**Figure 23**). Across the winter season red-throated loons were loosely distributed across the Lease Area OCS-A 0512 plus 4 km buffer (**Figure 24**). A total of 19 loons were recorded in spring season, of which ten were recorded in the Lease Area OCS-A 0512 site and nine in the 4 km buffer zone (**Figure 25**).

For the peak month of November 62 red-throated loons were recorded in flight. Red-throated loons showed a significant tendency to fly in a west-south-westerly direction in the fall season. Seven red-throated loons were recorded flying in winter, with no significant tendency to fly in any one direction. Four red-throated loons were recorded in flight in spring 2018, showing a preference to fly in a northerly direction, with a mean vector of 5.8° (**Figure 26**).

Table 15 **Raw counts and abundance and density estimates (No. estimated individuals per km^2) of red-throated loons in: a) Lease Area OCS-A 0512 plus 4 km buffer, b) Lease Area OCS-A 0512, and c) the Lease Area OCS-A 0512 4 km buffer only.**

a) Lease Area OCS-A 0512 plus 4 km Buffer					
Survey	**Raw Count**	**Abundance**	**Density**	**Flying**	**Sitting**
Nov-17	66	525	0.64	62	4
Dec-17	10	77	0.09	6	4
Jan-18	7	54	0.07	0	7
Feb-18	2	16	0.02	1	1
Mar-18	3	24	0.03	2	1
Apr-18	4	30	0.04	2	2
May-18	12	91	0.11	0	12
b) Lease Area OCS-A 0512					
Survey	**Raw Count**	**Abundance**	**Density**	**Flying**	**Sitting**
Nov-17	27	212	0.66	26	1
Dec-17	7	53	0.17	3	4
Jan-18	2	15	0.05	0	2
Feb-18	1	8	0.02	1	0
Mar-18	3	24	0.07	2	1
Apr-18	2	15	0.05	0	2
May-18	5	37	0.12	0	5
c) 4 km Buffer					
Survey	**Raw Count**	**Abundance**	**Density**	**Flying**	**Sitting**
Nov-17	39	312	0.63	36	3
Dec-17	3	24	0.05	3	0
Jan-18	5	39	0.08	0	5
Feb-18	1	8	0.02	0	1
Mar-18	0	0	-	0	0
Apr-18	2	15	0.03	2	0
May-18	7	53	0.11	0	7

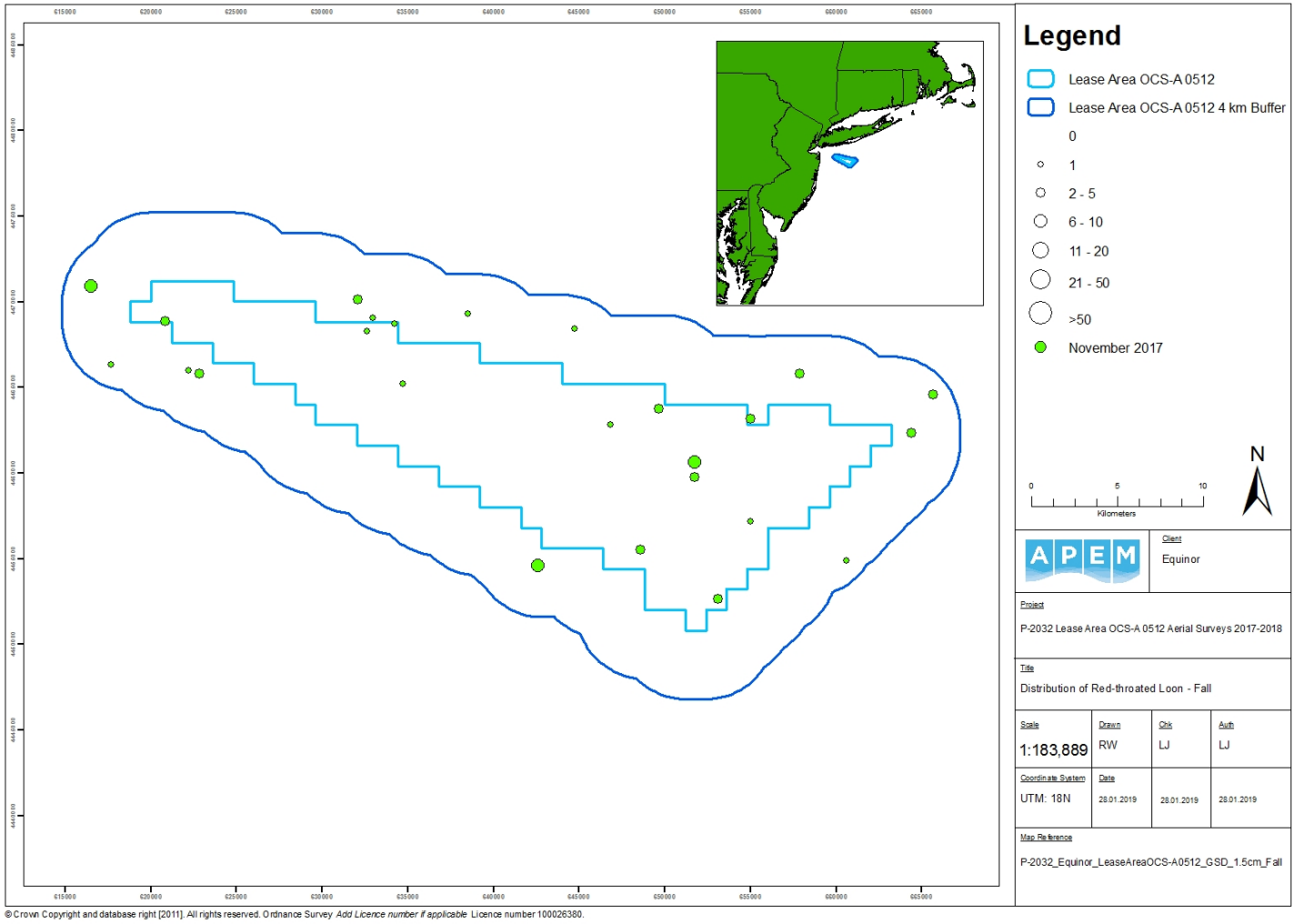


Figure 23 **Distribution of red-throated loons recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the fall season.**

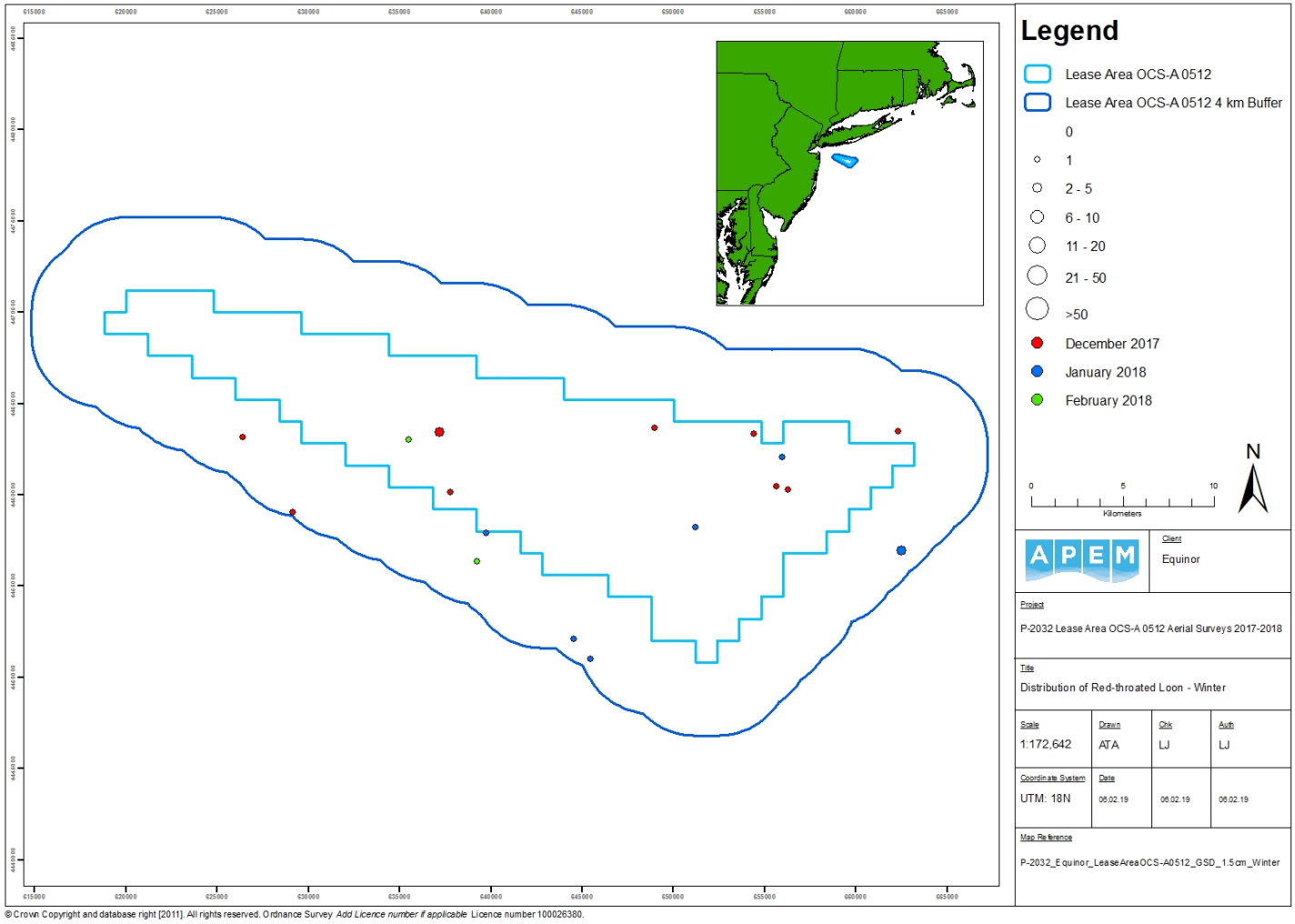


Figure 24 Distribution of red-throated loons recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the winter season.

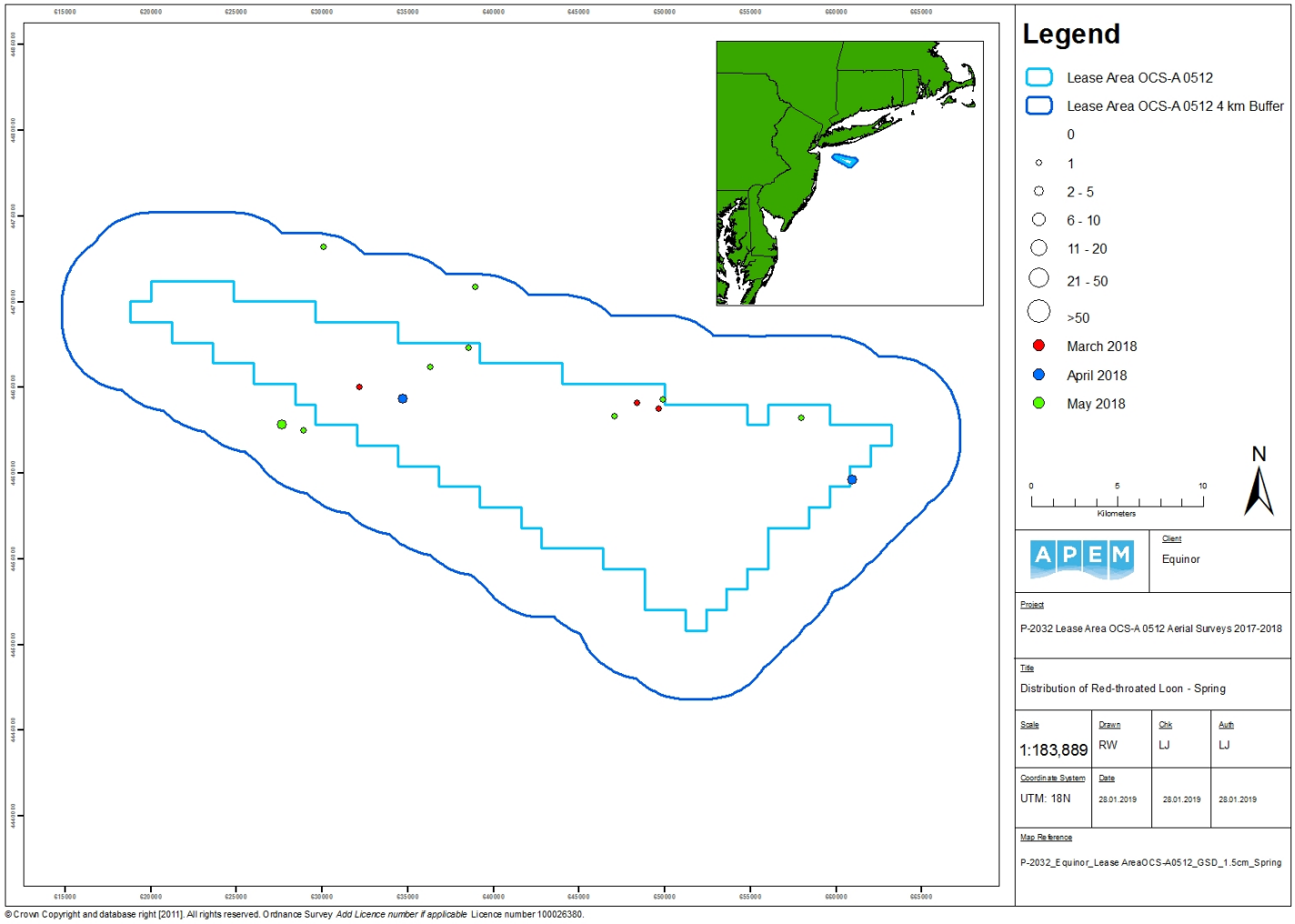
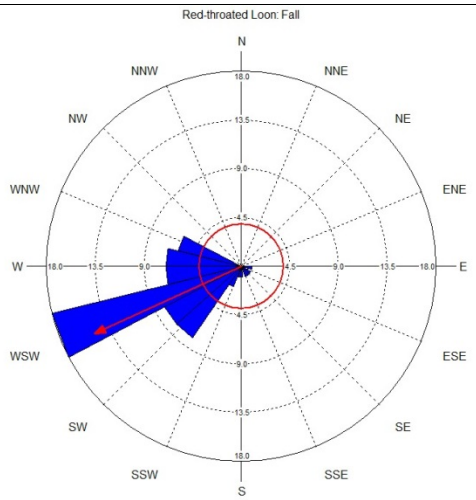
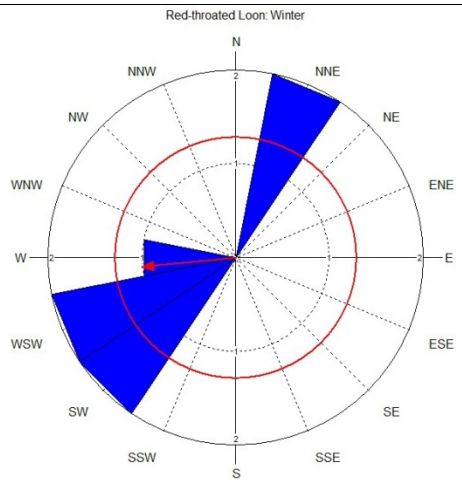


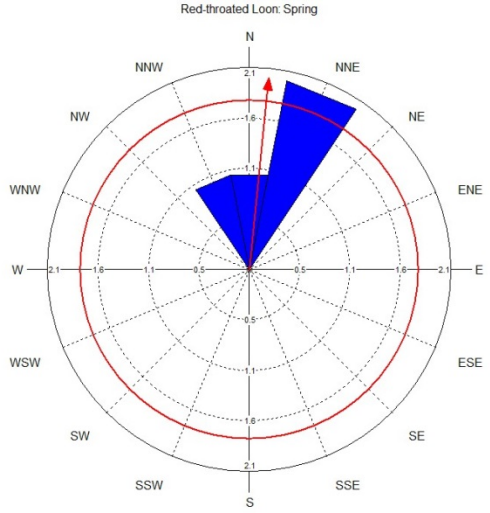
Figure 25 Distribution of red-throated loons recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the spring season.



Number of Observations	**62**
Mean Vector (μ)	**245.49**
Length of Mean Vector (r)	**0.828**
Rayleigh Test (Z)	**42.477**
Rayleigh Test (p)	**< 1E-12**



Number of Observations	**7**
Mean Vector (μ)	**264.579**
Length of Mean Vector (r)	**0.502**
Rayleigh Test (Z)	**1.762**
Rayleigh Test (p)	**0.175**



Number of Observations	**4**
Mean Vector (μ)	**5.794**
Length of Mean Vector (r)	**0.948**
Rayleigh Test (Z)	**3.593**
Rayleigh Test (p)	**0.015**

Figure 26 **Summary of flight direction of red-throated loons recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the fall (n=62), winter (n=7), spring (n=4) seasons.**

4.10 Common Loon

Common loons were recorded in all but three months (**Table 16**). A peak raw count of 19 individuals in the Lease Area OCS-A 0512 site and 33 individuals was recorded in the 4 km

buffer during the May survey, leading to the abundance estimates of 142 and 252 individuals, respectively.

A total of 61 common loons were recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the fall surveys (**Figure 27**), of which 36 were recorded in November and 25 in October. Individuals were primarily recorded in the northern 4 km buffer. In winter, common loons were recorded in all survey months: December, January, and February, and were loosely distributed across the Lease Area OCS-A 0512 plus 4 km buffer (**Figure 28**). Common loons were recorded in all months of spring: March, April, and May. The majority of individuals were recorded in the center and the west of the Lease Area OCS-A 0512 plus 4 km buffer, with very few being recorded in the east (**Figure 29**). A single common loon was recorded in the Lease Area OCS-A 0512 plus 4 km buffer in summer (July), on the edge of the Lease Area OCS-A 0512 site in the north of the Lease Area OCS-A 0512 plus 4 km buffer (**Figure 30**).

A total of 18 common loons were recorded in flight in fall. Common loons showed a tendency to fly in a west-south-westerly direction. Four common loons were recorded flying in winter; two were flying in a west-south-westerly direction, and two were flying in a west-north-westerly direction. Six common loons were recorded in flight in spring but did not show a preference to fly in any one direction (**Figure 31**).

Table 16 **Raw counts and abundance and density estimates (No. estimated individuals per km^2) of common loons in: a) Lease Area OCS-A 0512 plus 4 km buffer, b) Lease Area OCS-A 0512, and c) the Lease Area OCS-A 0512 4 km buffer only.**

a) Lease Area OCS-A 0512 plus 4 km Buffer						
Survey	**Raw Count**	**Abundance**	**Density**	**Flying**	**Sitting**	**Diving**
Nov-17	36	286	0.35	16	20	0
Dec-17	36	279	0.34	4	32	0
Jan-18	18	139	0.17	0	18	0
Feb-18	8	63	0.08	0	8	0
Mar-18	34	272	0.33	1	33	0
Apr-18	7	53	0.06	1	6	0
May-18	52	393	0.48	4	45	3
Jul-18	1	7	0.01	0	1	0
Oct-18	25	197	0.24	2	23	0
b) Lease Area OCS-A 0512						
Survey	**Raw Count**	**Abundance**	**Density**	**Flying**	**Sitting**	**Diving**
Nov-17	8	63	0.2	5	3	0
Dec-17	12	91	0.28	0	12	0
Jan-18	7	54	0.17	0	7	0
Feb-18	3	23	0.07	0	3	0
Mar-18	17	134	0.42	0	17	0
Apr-18	2	15	0.05	0	2	0
May-18	19	142	0.44	2	17	0
Jul-18	1	7	0.02	0	1	0
Oct-18	4	31	0.1	1	3	0
c) 4 km Buffer						

Survey	Raw Count	Abundance	Density	Flying	Sitting	Diving
Nov-17	28	224	0.45	11	17	0
Dec-17	24	188	0.38	4	20	0
Jan-18	11	85	0.17	0	11	0
Feb-18	5	40	0.08	0	5	0
Mar-18	17	137	0.27	1	16	0
Apr-18	5	39	0.08	1	4	0
May-18	33	252	0.51	2	28	3
Jul-18	0	0	-	0	0	0
Oct-18	21	166	0.33	1	20	0

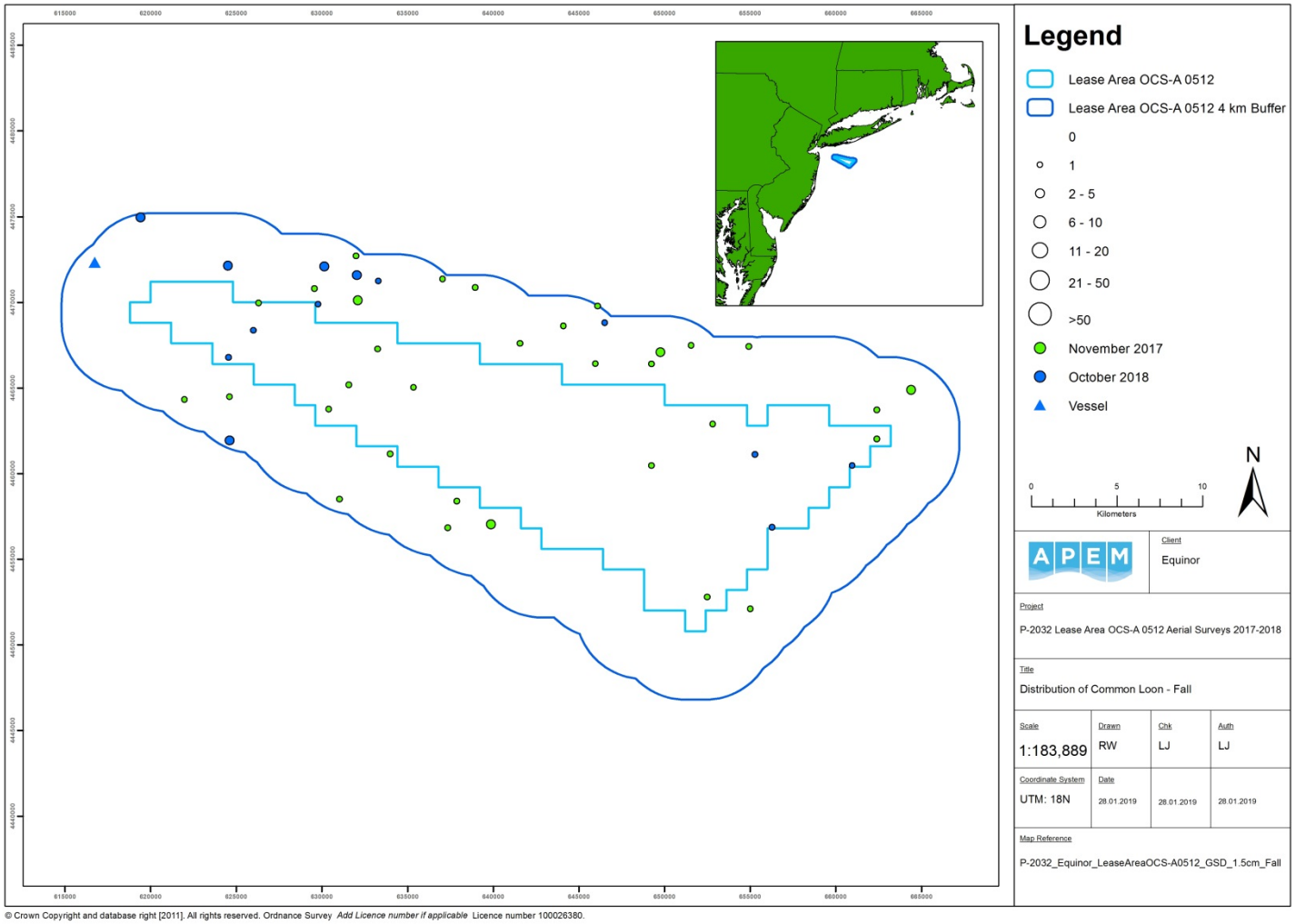


Figure 27 Distribution of common loons recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the fall season.

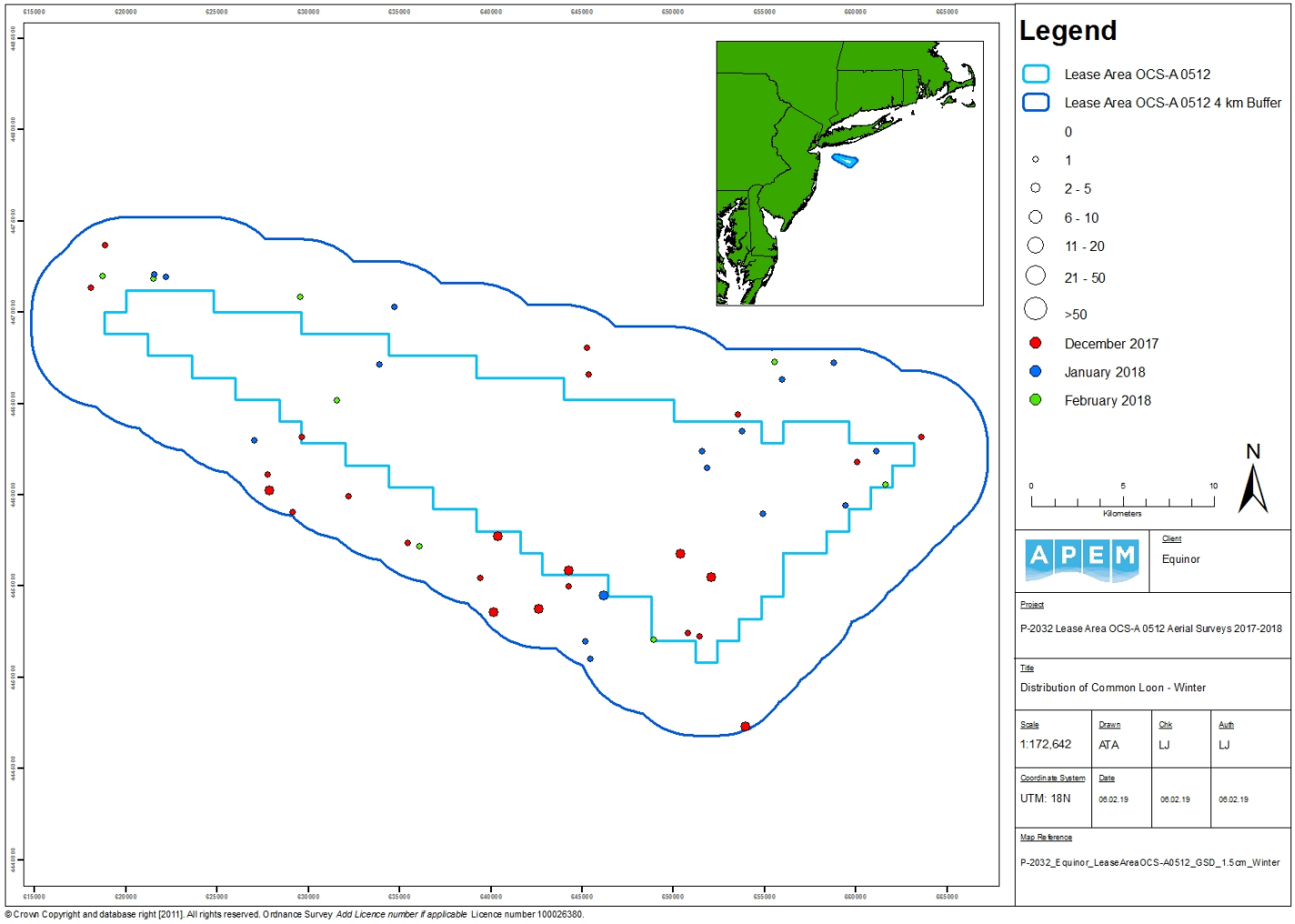


Figure 28 Distribution of common loons recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the winter season.

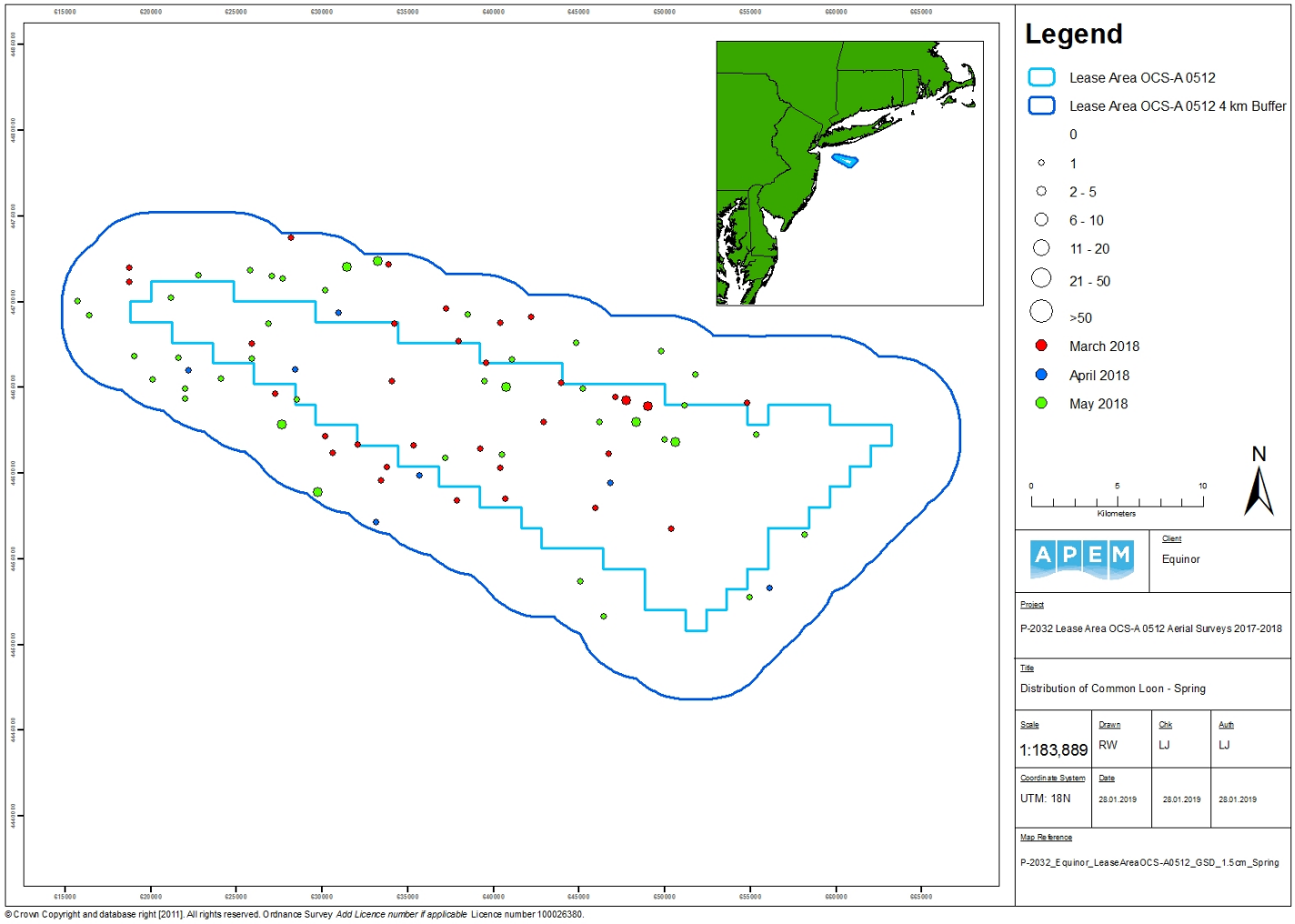


Figure 29 **Distribution of common loons recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the spring season.**

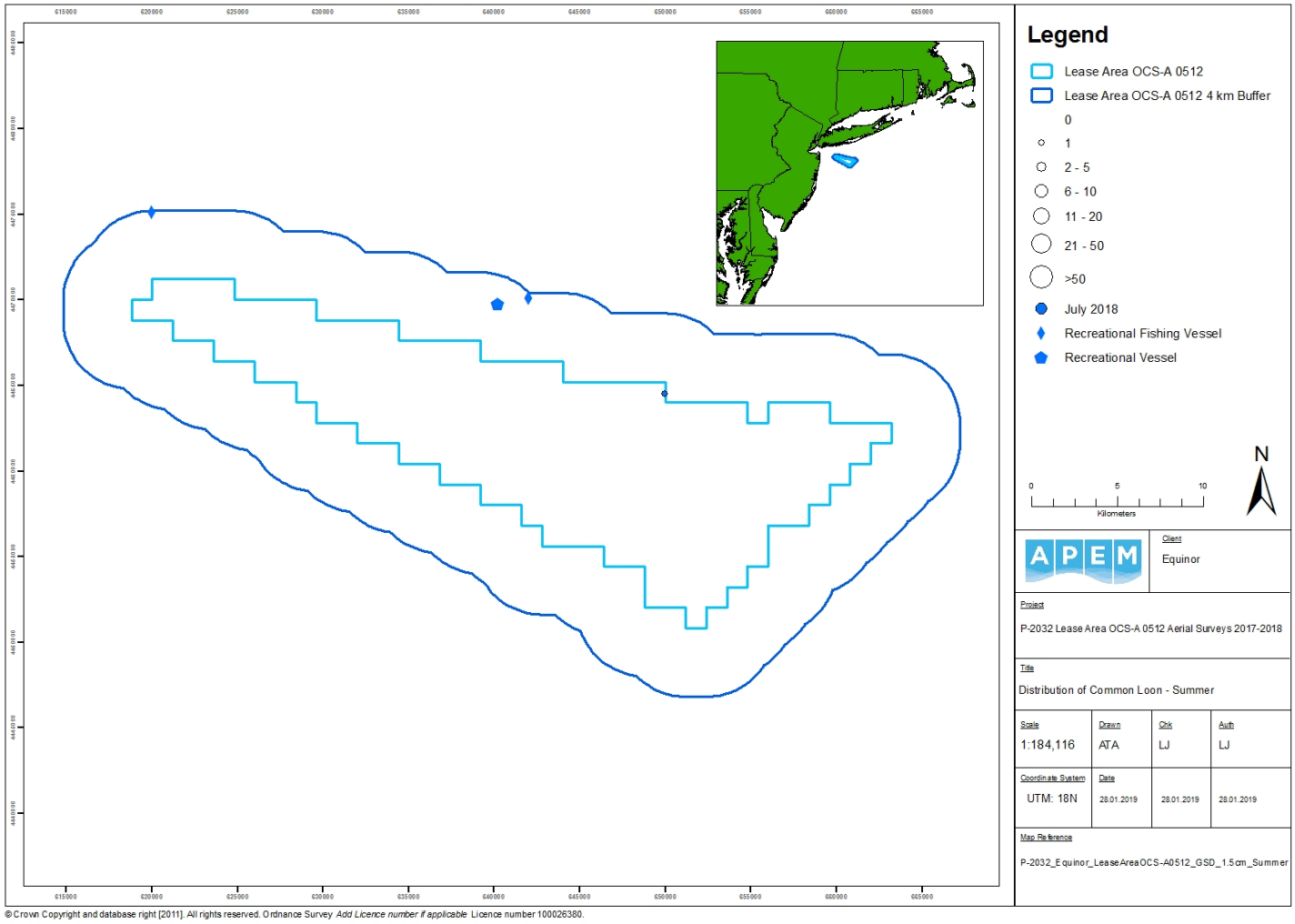
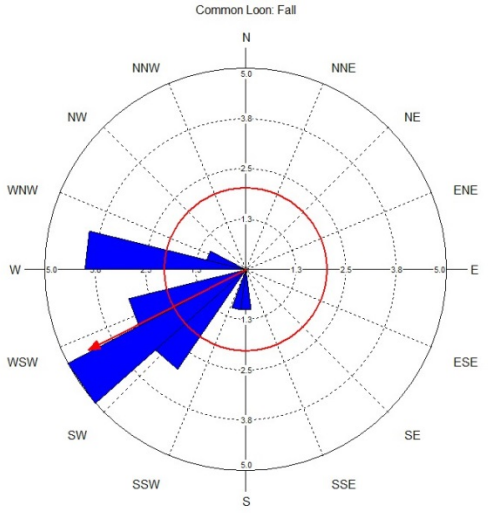
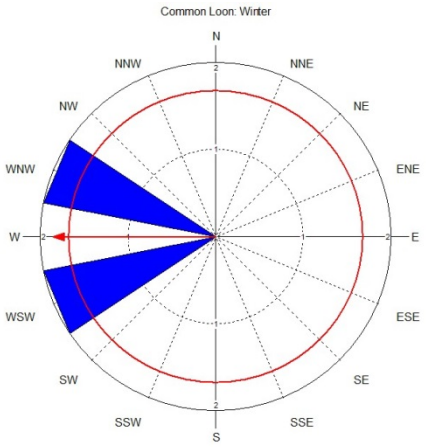


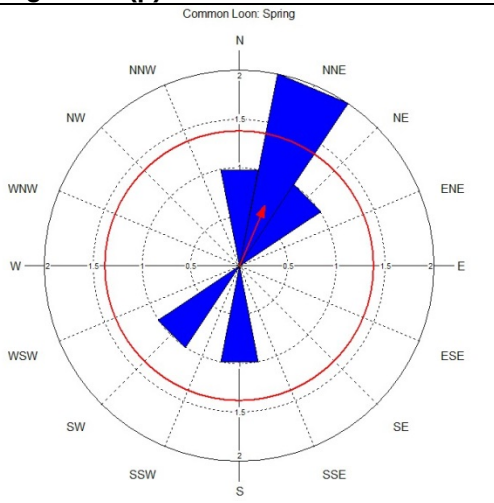
Figure 30 Distribution of common loons recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the summer season.



Number of Observations	**18**
Mean Vector (μ)	**243.0**
Length of Mean Vector (r)	**0.878**
Rayleigh Test (Z)	**13.889**
Rayleigh Test (p)	**3.6E-07**



Number of Observations	**4**
Mean Vector (μ)	**270**
Length of Mean Vector (r)	**0.924**
Rayleigh Test (Z)	**3.414**
Rayleigh Test (p)	**0.021**



Number of Observations	**6**
Mean Vector (μ)	**22.5**
Length of Mean Vector (r)	**0.333**
Rayleigh Test (Z)	**0.667**
Rayleigh Test (p)	**0.534**

Figure 31 **Summary of flight direction of common loons recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the fall (n=18), winter (n=4), and spring (n=6) seasons.**

4.11 Species Unknown - Loon

A single unknown loon was recorded in the March survey in the 4 km buffer, resulting in an abundance estimate of eight individuals and a density estimate of 0.02 birds / km^2. (**Table 17**, **Figure 32**).

Table 17 **Raw counts and abundance and density estimates (No. estimated individuals per km^2) of unknown loon species in: a) Lease Area OCS-A 0512 plus 4 km buffer, b) Lease Area OCS-A 0512, and c) the Lease Area OCS-A 0512 4 km buffer only.**

a) Lease Area OCS-A 0512 plus 4 km Buffer					
Survey	**Raw Count**	**Abundance**	**Density**	**Flying**	**Sitting**
Mar-18	1	8	0.01	0	1
b) Lease Area OCS-A 0512					
Survey	**Raw Count**	**Abundance**	**Density**	**Flying**	**Sitting**
Mar-18	0	0	-	0	0
c) 4 km Buffer					
Survey	**Raw Count**	**Abundance**	**Density**	**Flying**	**Sitting**
Mar-18	1	8	0.02	0	1

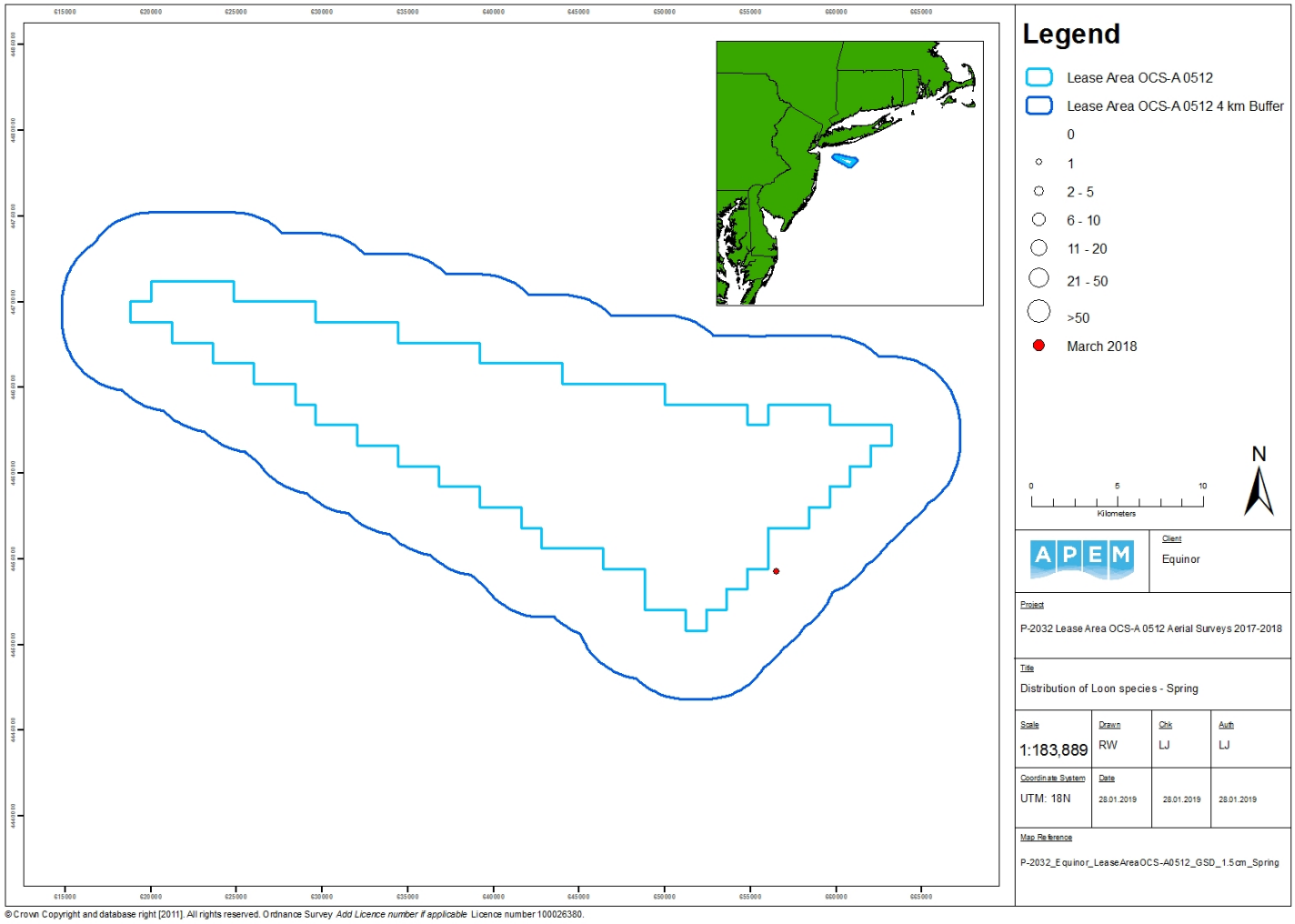


Figure 32 Distribution of unknown loon species recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the spring season.

4.12 Species Unknown – Grebe

A single unknown grebe was recorded in the December survey in the south-east of the Lease Area OCS-A 0512 site, giving an abundance estimate of eight individuals (**Table 18**, **Figure 33**).

Table 18 **Raw counts and abundance and density estimates (No. estimated individuals per km^2) of unknown grebe species in: a) Lease Area OCS-A 0512 plus 4 km buffer, b) Lease Area OCS-A 0512, and c) the Lease Area OCS-A 0512 4 km buffer only.**

a) Lease Area OCS-A 0512 plus 4 km Buffer					
Survey	**Raw Count**	**Abundance**	**Density**	**Flying**	**Sitting**
Dec-17	1	8	0.01	0	1
b) Lease Area OCS-A 0512					
Survey	**Raw Count**	**Abundance**	**Density**	**Flying**	**Sitting**
Dec-17	1	8	0.02	0	1
c) 4 km Buffer					
Survey	**Raw Count**	**Abundance**	**Density**	**Flying**	**Sitting**
Dec-17	0	0	-	0	0

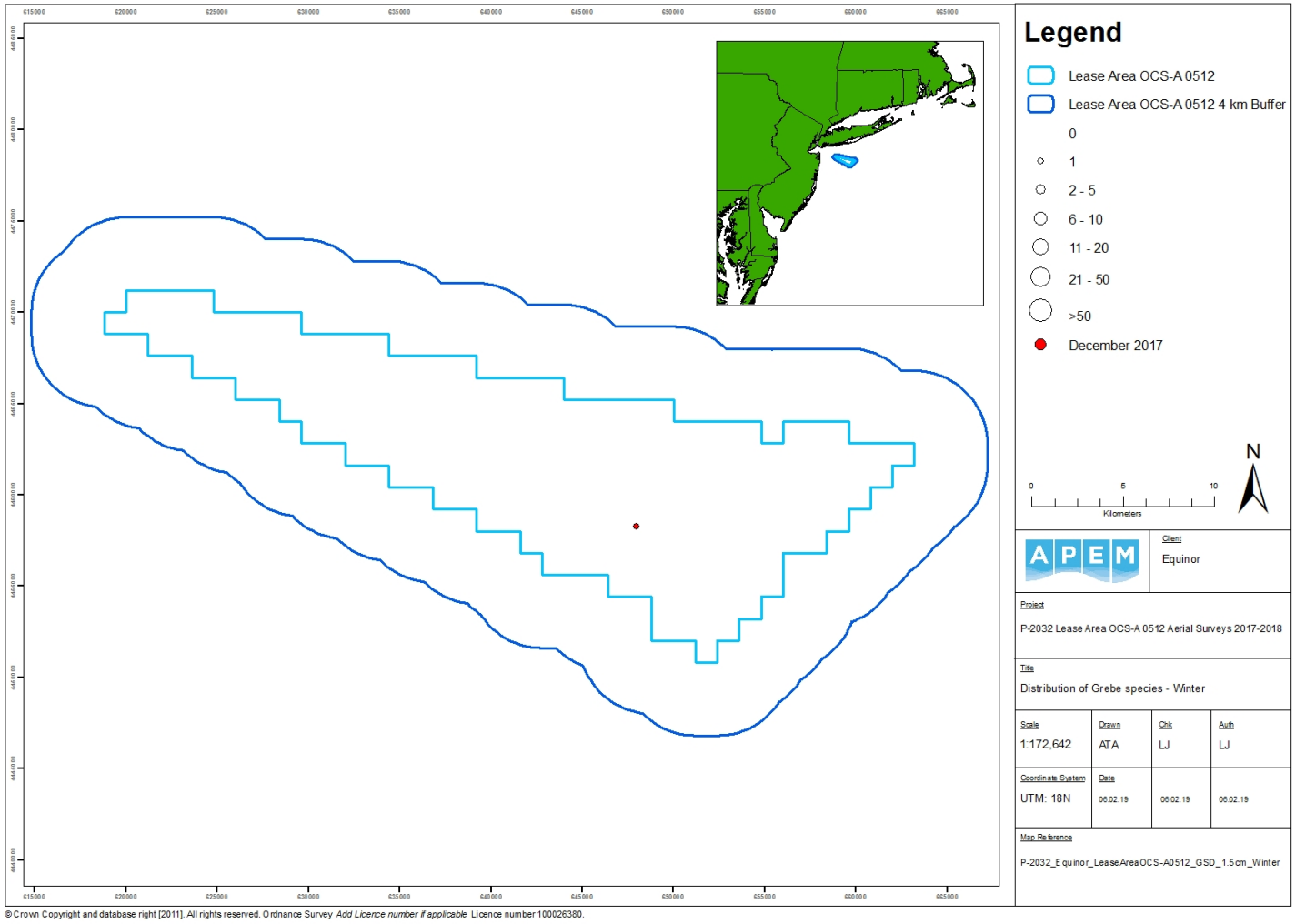


Figure 33 Distribution of unknown grebe species recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the winter season.

4.13 Northern Fulmar

Northern fulmars were recorded in the November and March surveys only (**Table 19**). A peak of two individuals were recorded in November in the 4 km buffer, resulting in an abundance estimate of 16, with a single individual recorded within the Lease Area OCS-A 0512 site during March.

The two northern fulmars recorded in November were observed sitting in the south of the 4 km buffer (**Figure 34**). The single northern fulmar recorded in March was also observed sitting, in the north-east of the Lease Area OCS-A 0512 site (**Figure 35**).

Table 19 **Raw counts and abundance and density estimates (No. estimated individuals per km^2) of northern fulmars in: a) Lease Area OCS-A 0512 plus 4 km buffer, b) Lease Area OCS-A 0512, and c) the Lease Area OCS-A 0512 4 km buffer only.**

a) Lease Area OCS-A 0512 plus 4 km Buffer					
Survey	**Raw Count**	**Abundance**	**Density**	**Flying**	**Sitting**
Nov-17	2	16	0.02	0	2
Mar-18	1	8	0.01	0	1
b) Lease Area OCS-A 0512					
Survey	**Raw Count**	**Abundance**	**Density**	**Flying**	**Sitting**
Nov-17	0	0	-	0	0
Mar-18	1	8	0.02	0	1
c) 4 km Buffer					
Survey	**Raw Count**	**Abundance**	**Density**	**Flying**	**Sitting**
Nov-17	2	16	0.03	0	2
Mar-18	0	0	-	0	0

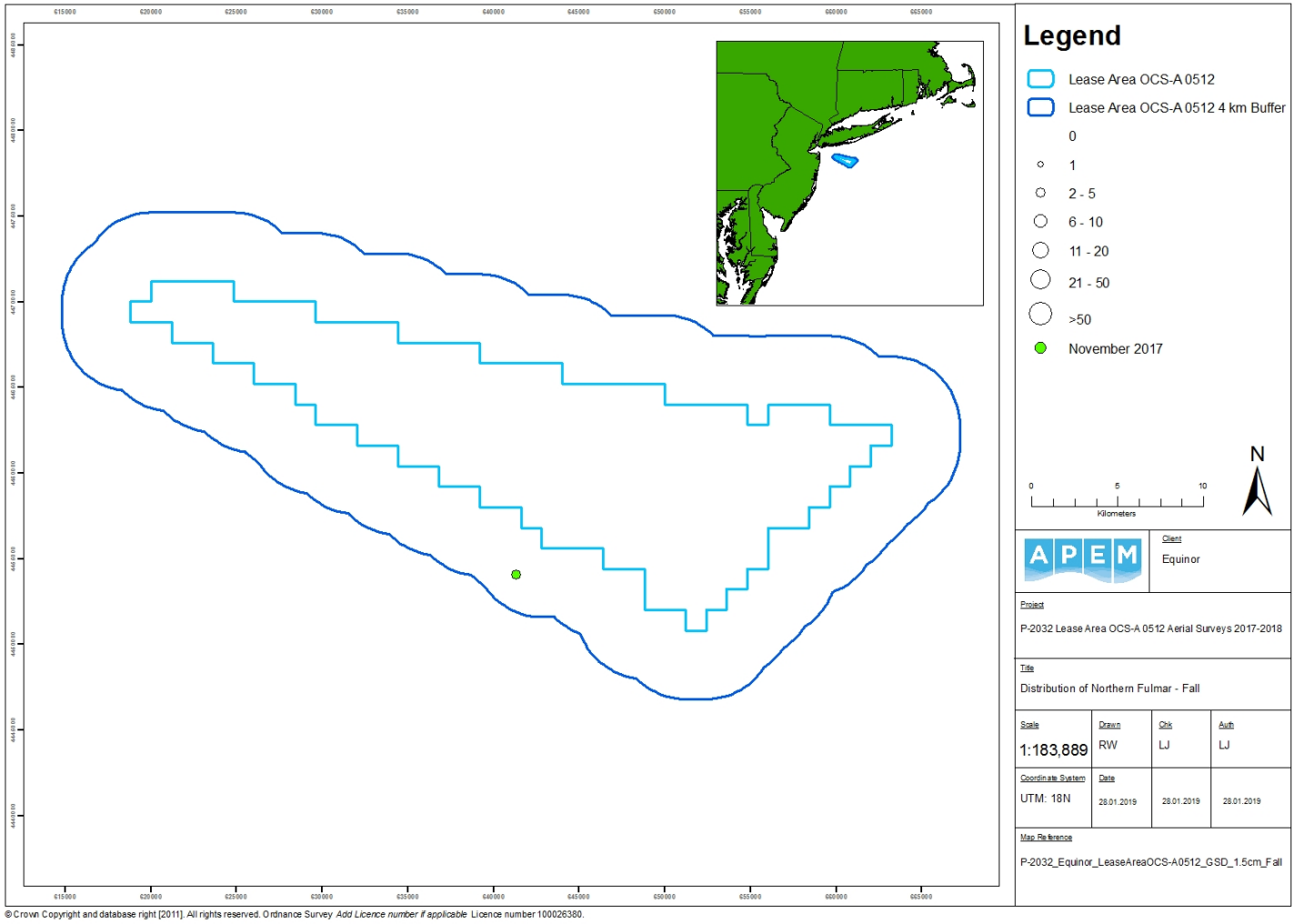


Figure 34 Distribution of northern fulmars recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the fall season.

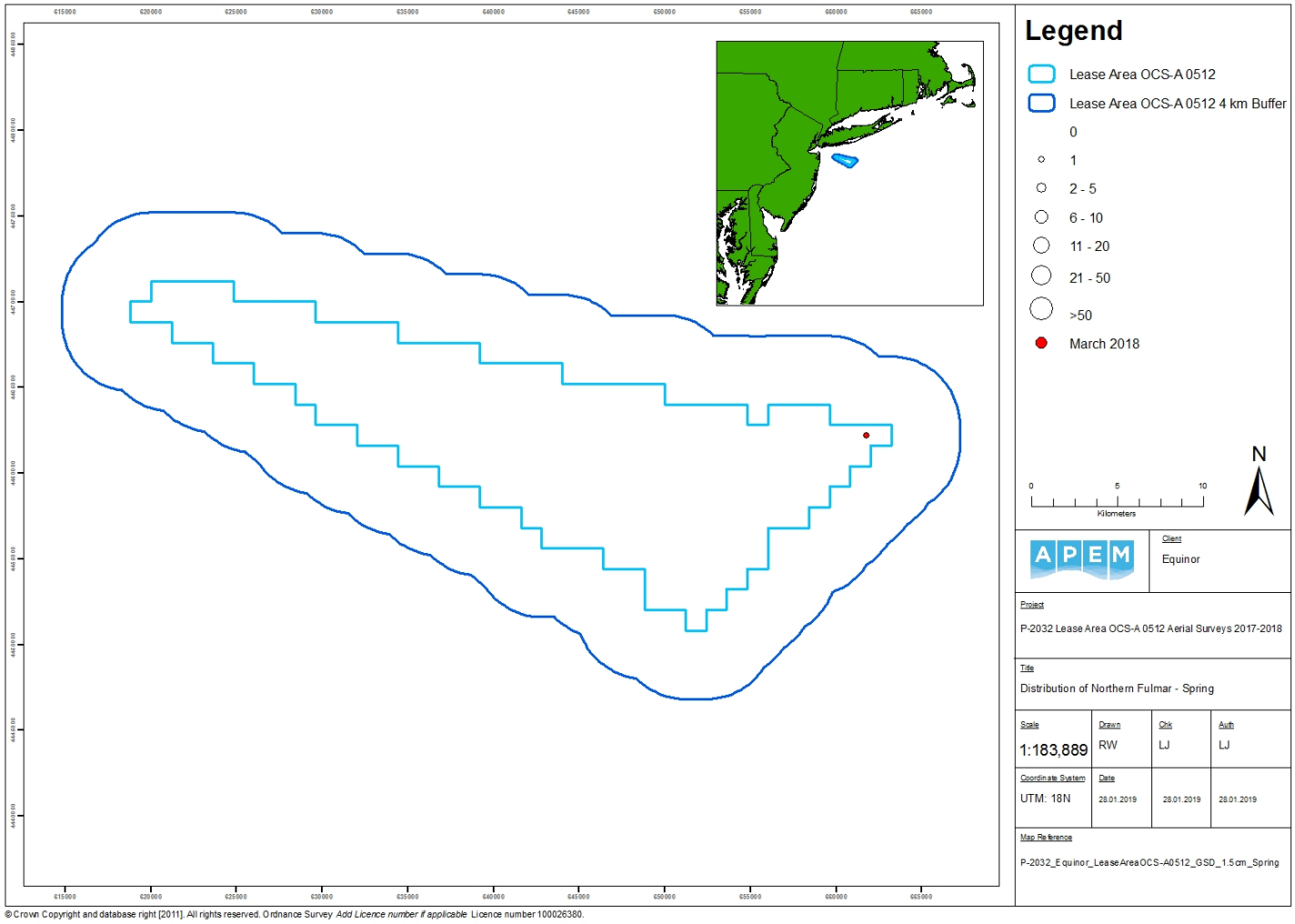


Figure 35 Distribution of northern fulmars recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the spring season.

4.14 Northern Gannet

Northern gannets were recorded in nine months, with higher numbers generally being recorded in the fall (**Table 20**). A peak of 179 individuals were recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the October survey, resulting in abundance estimates of 406 and 1,007 in the Lease Area OCS-A 0512 site and 4 km buffer, respectively.

A total of 254 northern gannets were recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the fall. In October, gannets were mostly distributed in the west of the Lease Area OCS-A 0512 plus 4 km buffer (**Figure 36**), whilst in the November survey; gannets were mostly distributed in the center of the Lease Area OCS-A 0512 plus 4 km buffer. In winter, northern gannets were recorded in all survey months: December, January, February, and were loosely distributed across the Lease Area OCS-A 0512 plus 4 km buffer. In December birds were predominantly located in the central and north-western regions. In January the majority of northern gannets were located in the east of the Lease Area OCS-A 0512 site, and in February individuals were located in the north-east of the Lease Area OCS-A 0512 plus 4 km buffer (**Figure 37**). In spring, northern gannets were recorded during all survey months: March, April and May. Birds were recorded mostly in the west of the Lease Area OCS-A 0512 plus 4 km buffer (**Figure 38**). A total of three northern gannets were recorded in the Lease Area OCS-A 0512 plus 4 km buffer in June (**Figure 39**). All three individuals were recorded in the south-east of the Lease Area OCS-A 0512 site.

A total of 49 northern gannets were recorded in flight in the fall in the Lease Area OCS-A 0512 plus 4 km buffer. Gannets showed a significant tendency to fly in a south-easterly direction. A total of 26 northern gannets were recorded flying in the winter and showed a preference to fly in a north-westerly direction, with a significant orientation around the mean of 313°. Thirteen northern gannets were recorded in flight in the spring period of the Lease Area OCS-A 0512 surveys but did not show a preference to fly in any one direction. Two northern gannets were recorded in flight in summer 2018. Both individuals were recorded flying in a north-north-westerly direction around a mean of 338° (**Figure 40**).

Table 20 **Raw counts and abundance and density estimates (No. estimated individuals per km^2) of northern gannets in: a) Lease Area OCS-A 0512 plus 4 km buffer, b) Lease Area OCS-A 0512, and c) the Lease Area OCS-A 0512 4 km buffer only.**

a) Lease Area OCS-A 0512 plus 4 km Buffer						
Survey	**Raw Count**	**Abundance**	**Density**	**Flying**	**Sitting**	**Diving**
Nov-17	75	596	0.73	20	55	0
Dec-17	38	294	0.36	16	22	0
Jan-18	41	317	0.39	8	33	0
Feb-18	4	32	0.04	2	1	1
Mar-18	1	8	0.01	0	1	0
Apr-18	27	205	0.04	10	17	0
May-18	3	23	0.03	3	0	0
Jun-18	3	25	0.03	2	1	0
Oct-18	179	1411	1.72	29	150	0
b) Lease Area OCS-A 0512						
Survey	**Raw Count**	**Abundance**	**Density**	**Flying**	**Sitting**	**Diving**
Nov-17	39	307	0.96	7	32	0

Dec-17	17	129	0.4	7	10	0
Jan-18	31	239	0.74	4	27	0
Feb-18	2	16	0.05	1	1	0
Mar-18	1	8	0.02	0	1	0
Apr-18	11	81	0.25	3	8	0
May-18	1	7	0.02	1	0	0
Jun-18	3	25	0.08	2	1	0
Oct-18	52	406	1.26	6	46	0
c) 4 km Buffer						
Survey	**Raw Count**	**Abundance**	**Density**	**Flying**	**Sitting**	**Diving**
Nov-17	36	288	0.58	13	23	0
Dec-17	21	165	0.33	9	12	0
Jan-18	10	77	0.15	4	6	0
Feb-18	2	16	0.03	1	0	1
Mar-18	0	0	-	0	0	0
Apr-18	16	123	0.25	7	9	0
May-18	2	15	0.03	2	0	0
Jun-18	0	0	-	0	0	0
Oct-18	127	1007	2.02	23	104	0

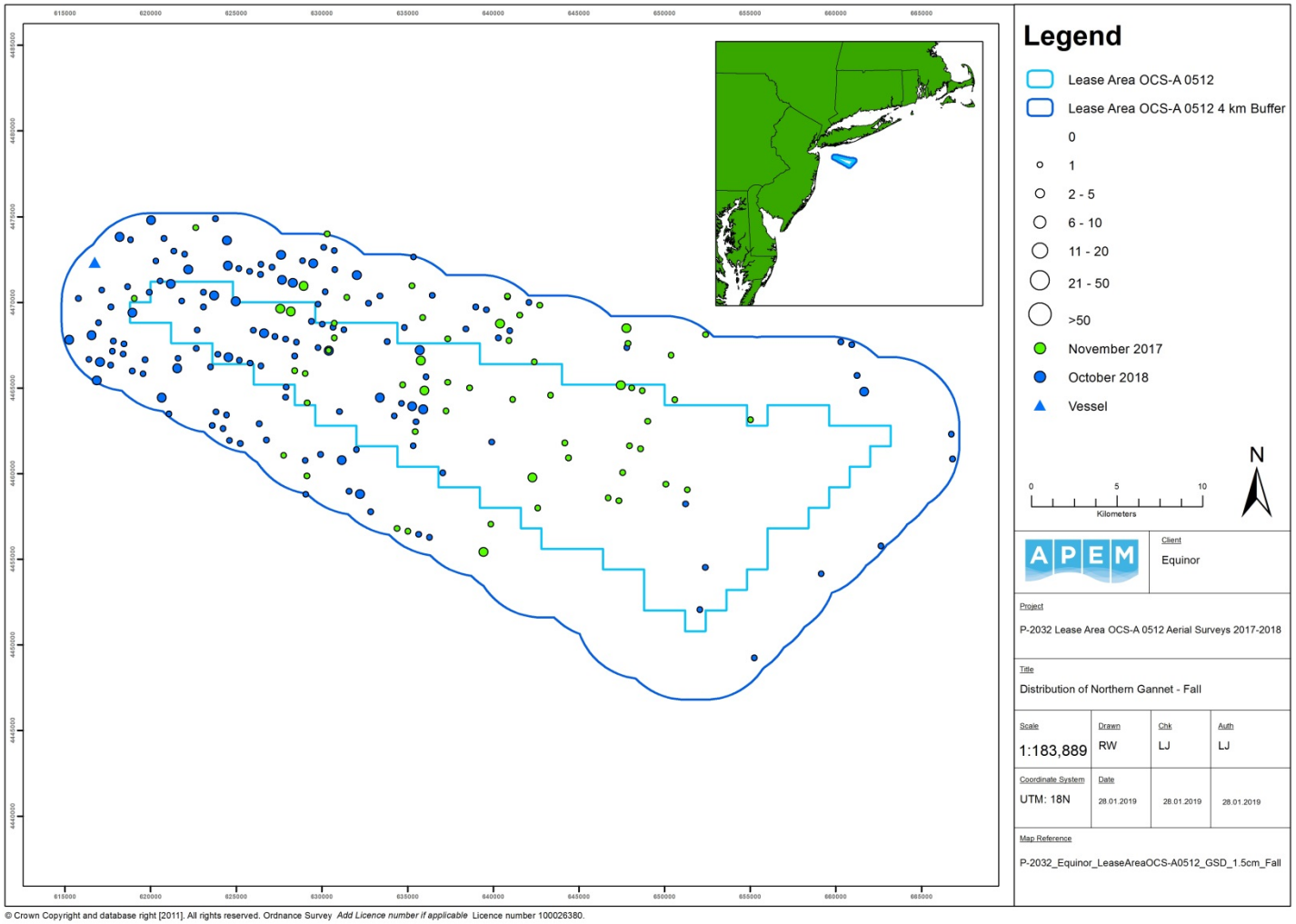


Figure 36 Distribution of northern gannets recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the fall season.

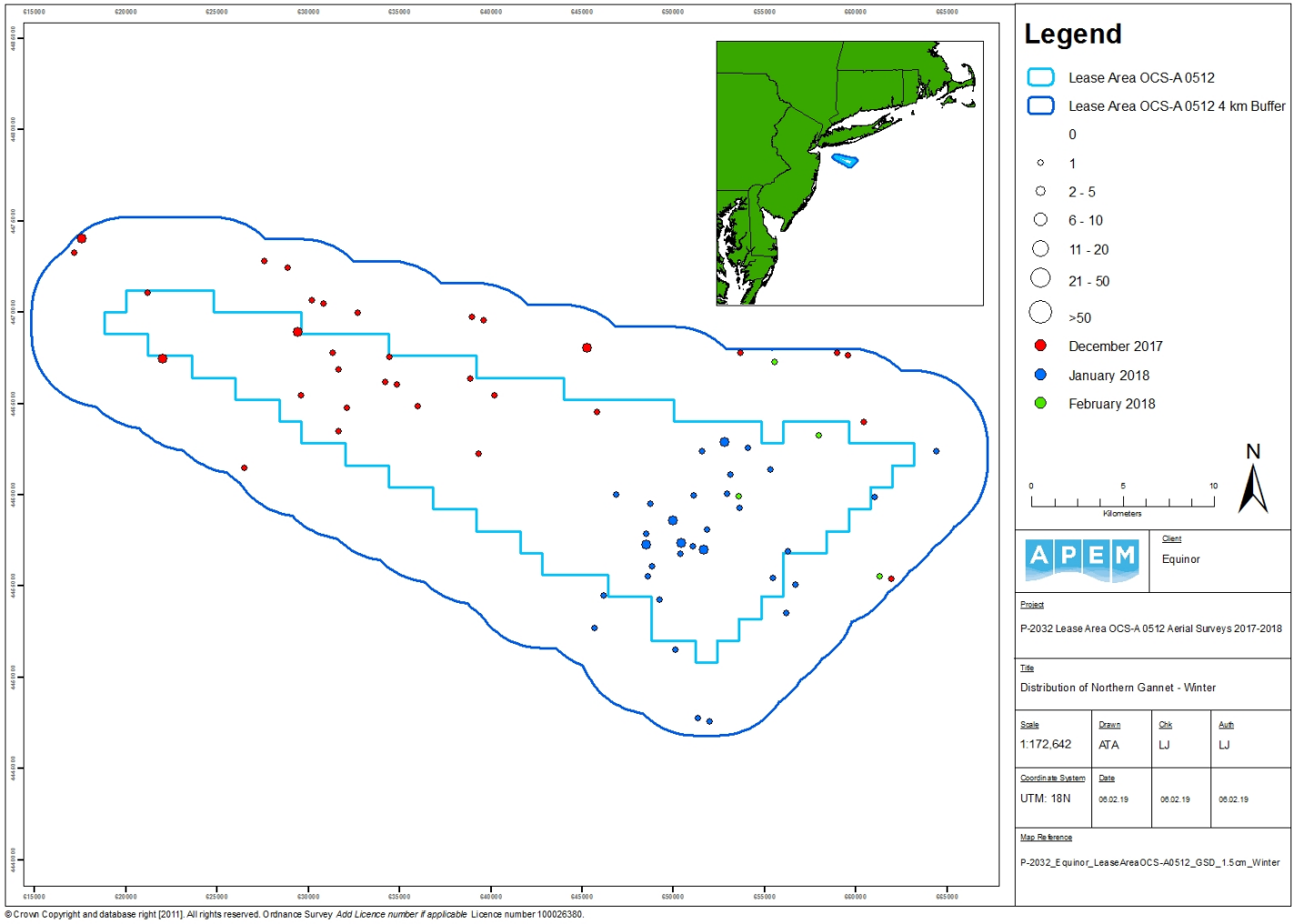


Figure 37 Distribution of northern gannets recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the winter season.

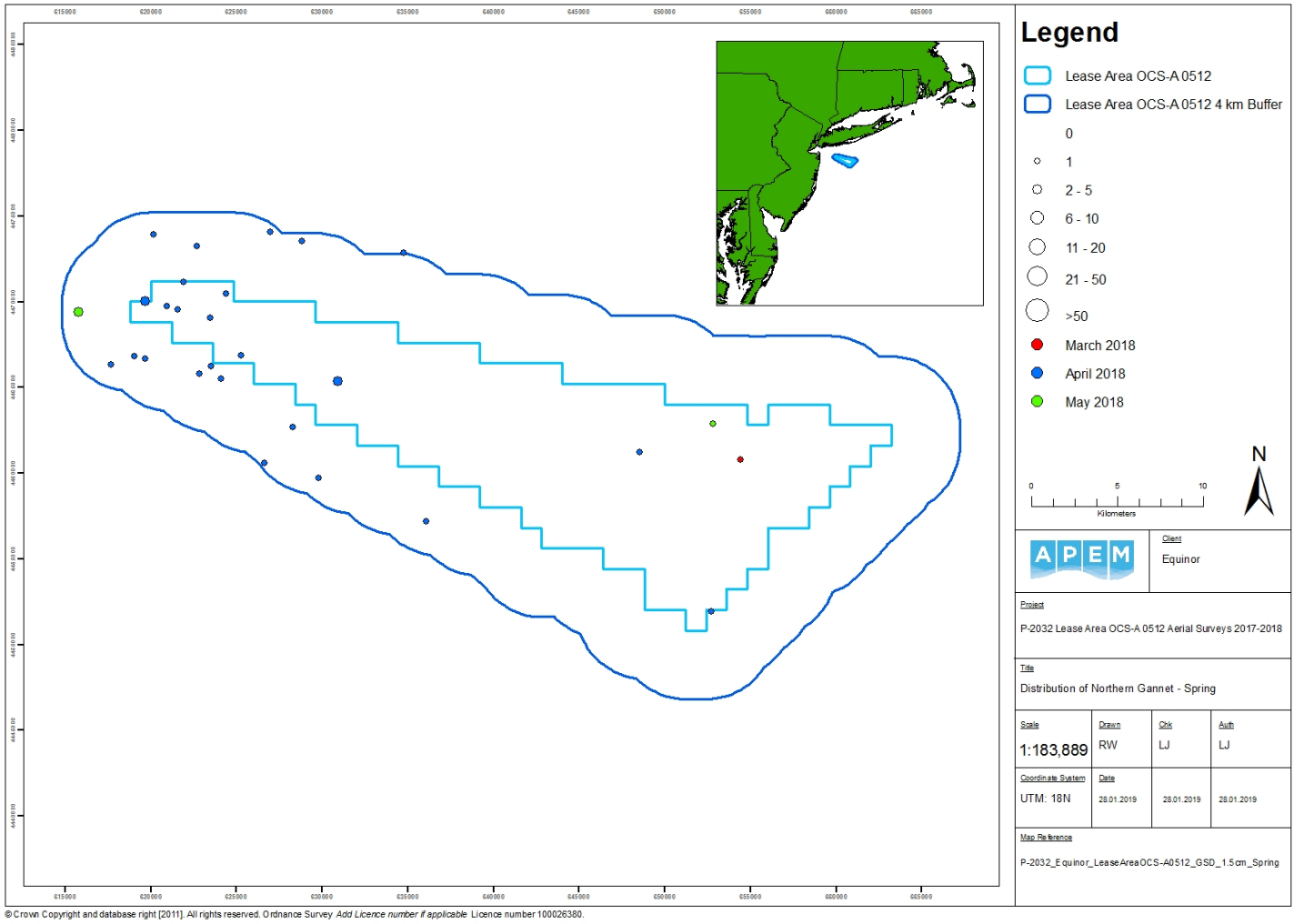


Figure 38 **Distribution of northern gannets recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the spring season.**

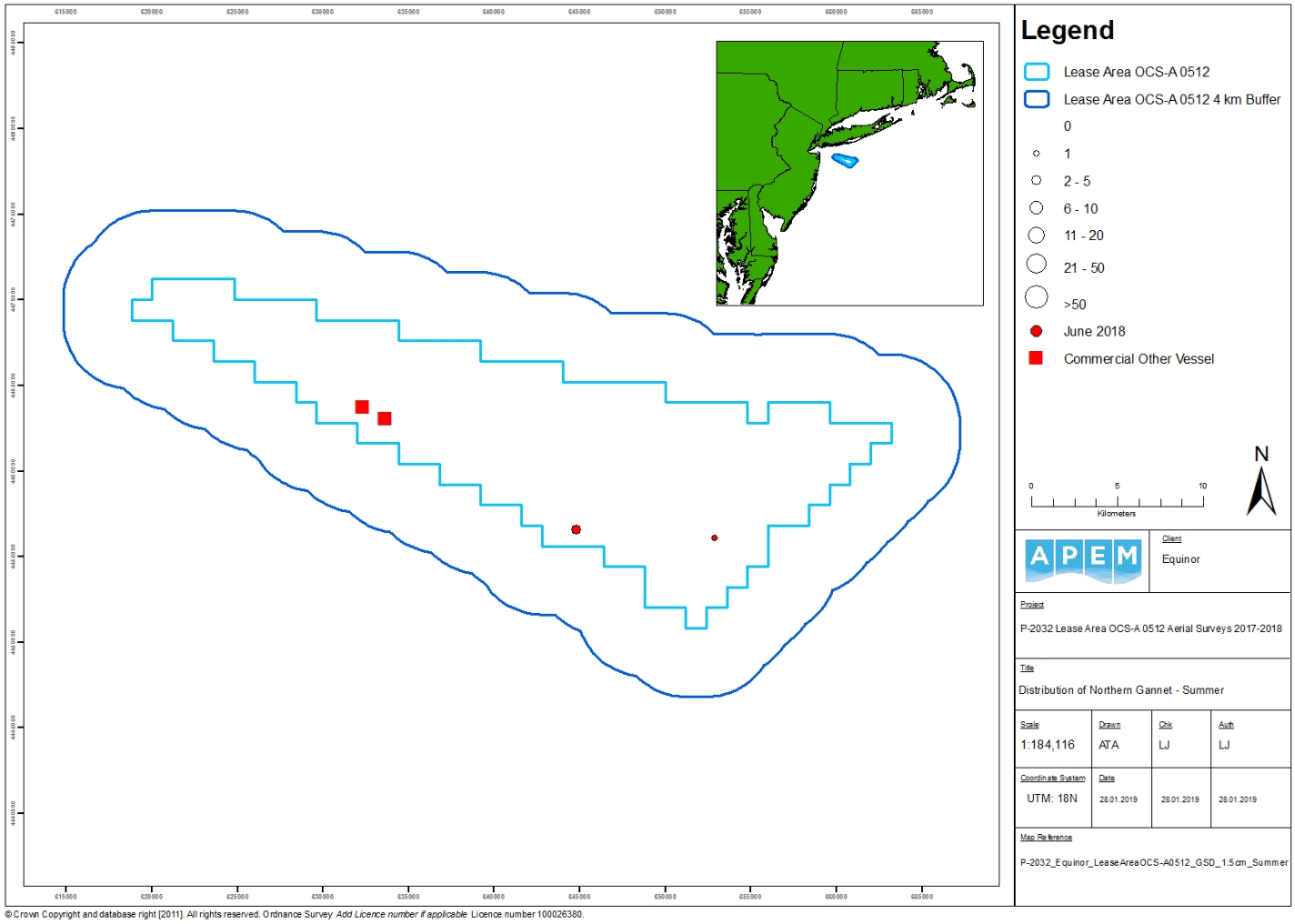
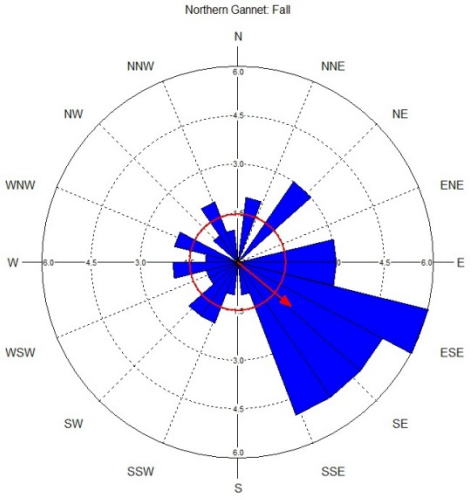
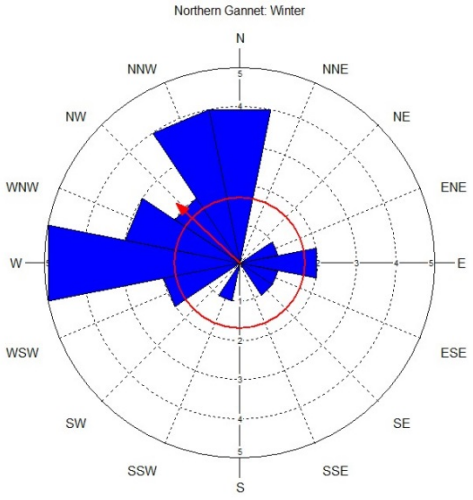


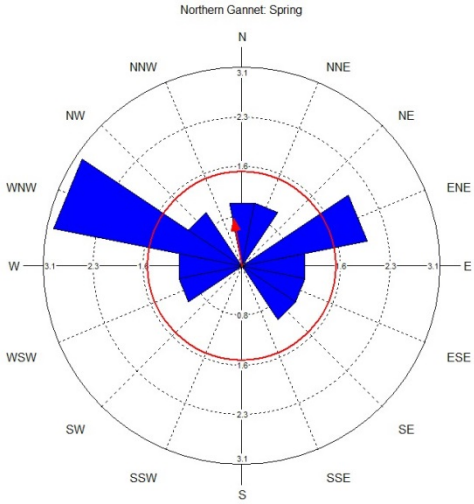
Figure 39 **Distribution of northern gannets recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the summer season.**



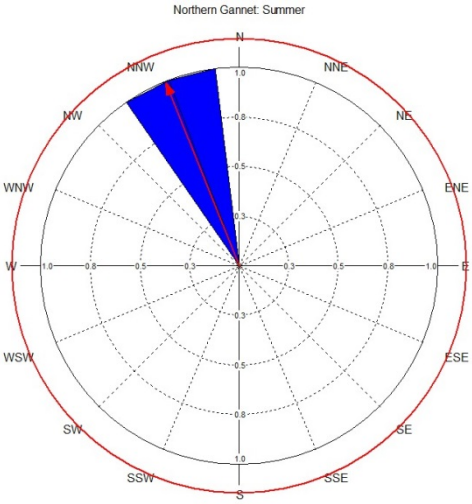
Number of Observations	**49**
Mean Vector (μ)	**129.3**
Length of Mean Vector (r)	**0.349**
Rayleigh Test (Z)	**5.956**
Rayleigh Test (p)	**0.002**



Number of Observations	**26**
Mean Vector (μ)	**313.13**
Length of Mean Vector (r)	**0.442**
Rayleigh Test (Z)	**5.086**
Rayleigh Test (p)	**0.005**



Number of Observations	**13**
Mean Vector (μ)	**350.008**
Length of Mean Vector (r)	**0.24**
Rayleigh Test (Z)	**0.748**
Rayleigh Test (p)	**0.482**



Number of Observations	**2**
Mean Vector (μ)	**338.045**
Length of Mean Vector (r)	**0.991**
Rayleigh Test (Z)	**1.965**
Rayleigh Test (p)	**0.144**

Figure 40 **Summary of flight direction of northern gannets recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the fall (n=49), winter (n=26), spring (n=13), and summer (n=2) seasons.**

4.15 Red Phalarope

Red phalaropes were recorded in the November survey only, with 35 individuals recorded in the Lease Area OCS-A 0512 site and a further 15 in the 4 km buffer, resulting in abundance estimates of 275 and 120, respectively (**Table 21**).

A total of 12 flying and 38 sitting red phalaropes were recorded in November. Nine groups of between one and 12 individuals were recorded throughout Lease Area OCS-A 0512 plus 4 km buffer. Eight of the groups were recorded in the east and one in the west of the Lease Area OCS-A 0512 plus 4 km buffer (**Figure 41**). A total of 12 red phalaropes were recorded flying in a north-easterly direction during the fall 2017/18 (**Figure 42**).

Table 21 **Raw counts and abundance and density estimates (No. estimated individuals per km^2) of red phalaropes in: a) Lease Area OCS-A 0512 plus 4 km buffer, b) Lease Area OCS-A 0512, and c) the Lease Area OCS-A 0512 4 km buffer only.**

a) Lease Area OCS-A 0512 plus 4 km Buffer					
Survey	**Raw Count**	**Abundance**	**Density**	**Flying**	**Sitting**
Nov-17	50	397	0.48	12	38
b) Lease Area OCS-A 0512					
Survey	**Raw Count**	**Abundance**	**Density**	**Flying**	**Sitting**
Nov-17	35	275	0.86	0	35
c) 4 km Buffer					
Survey	**Raw Count**	**Abundance**	**Density**	**Flying**	**Sitting**
Nov-17	15	120	0.24	12	3

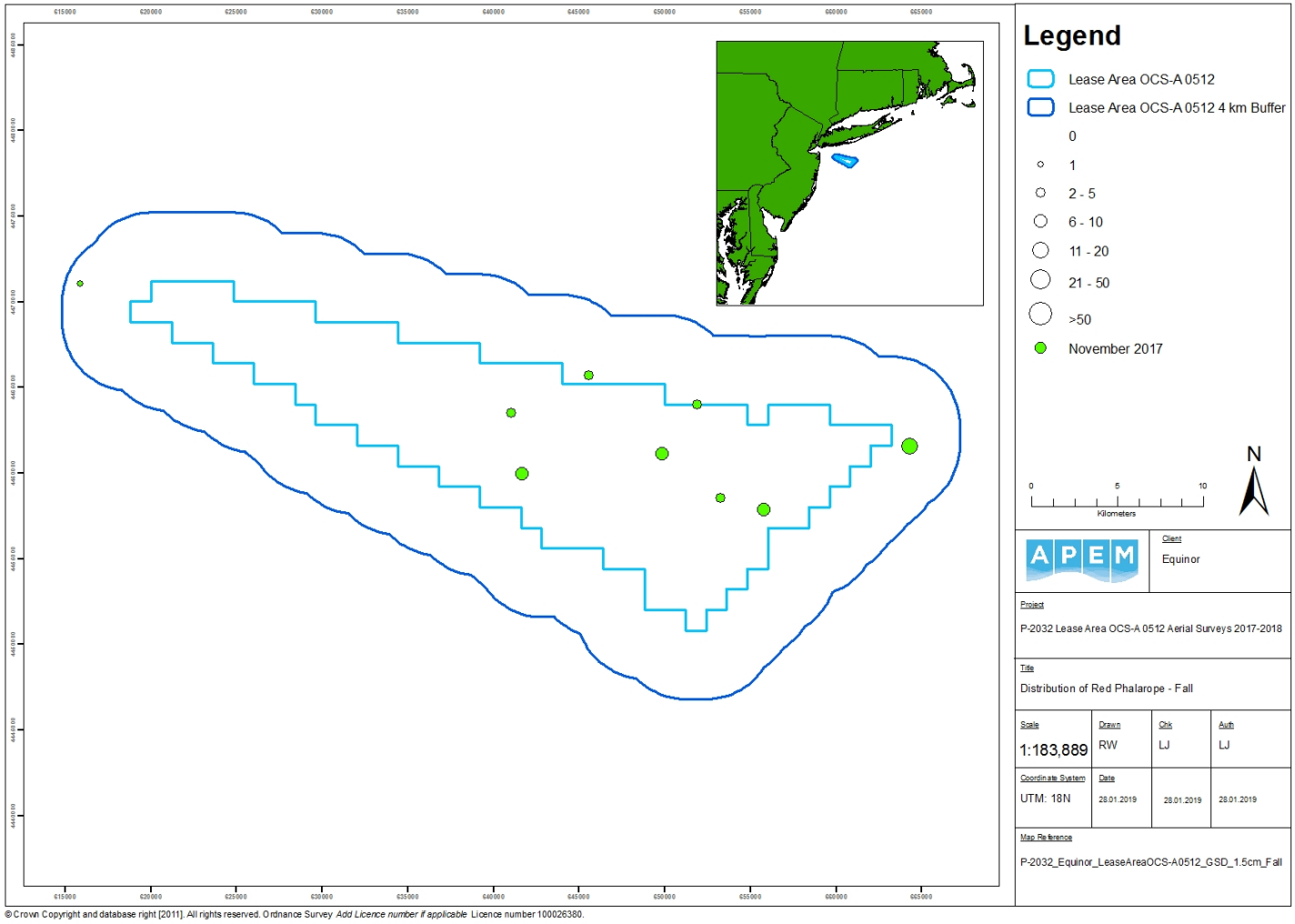
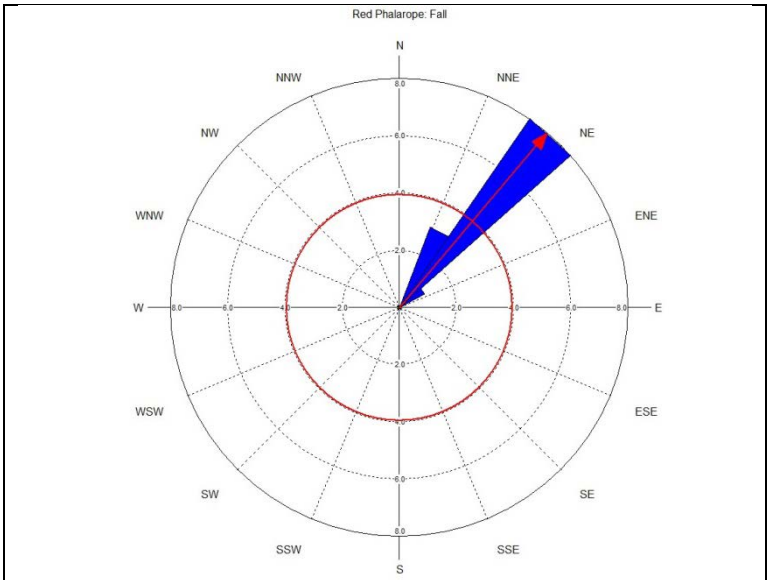


Figure 41 Distribution of red phalaropes recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the fall season.



Number of Observations	**12**
Mean Vector (μ)	**40.26**
Length of Mean Vector (r)	**0.993**
Rayleigh Test (Z)	**11.838**
Rayleigh Test (p)	**1.7E-06**

Figure 42 Summary of flight direction of red phalaropes (n=12) recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the fall season.

4.16 Red / Red-necked Phalarope

Red / red-necked phalaropes were recorded in three months, with 10 and five being recorded in the November and December surveys respectively, with a further one in the May survey. The peak abundance estimate was of 55 individuals in the Lease Area OCS-A 0512 site in November (**Table 22**).In November, four groups of between one and five individuals were recorded throughout the Lease Area OCS-A 0512 plus 4 km buffer, with three of the groups in the east and one in the west (**Figure 43**). In winter, red / red-necked phalaropes were recorded in December, located in the north-west and east of the 4 km buffer and in the center of the Lease Area OCS-A 0512 site (**Figure 44**). In May, one red / red-necked phalarope was recorded in the south of the 4 km buffer (**Figure 45**).

All individuals were recorded sitting on the water.

Table 22 Raw counts and abundance and density estimates (No. estimated individuals per km^2) of red / red-necked phalaropes in: a) Lease Area OCS-A 0512 plus 4 km buffer, b) Lease Area OCS-A 0512, and c) the Lease Area OCS-A 0512 4 km buffer only.

a) Lease Area OCS-A 0512 plus 4 km Buffer					
Survey	**Raw Count**	**Abundance**	**Density**	**Flying**	**Sitting**
Nov-17	10	79	0.1	0	10
Dec-17	5	39	0.05	0	5
May-18	1	8	0.01	0	1

b) Lease Area OCS-A 0512					
Survey	**Raw Count**	**Abundance**	**Density**	**Flying**	**Sitting**
Nov-17	7	55	0.17	0	7
Dec-17	3	23	0.07	0	3
May-18	0	0	-	0	0
c) 4 km Buffer					
Survey	**Raw Count**	**Abundance**	**Density**	**Flying**	**Sitting**
Nov-17	3	24	0.05	0	3
Dec-17	2	16	0.03	0	2
May-18	1	8	0.02	0	1

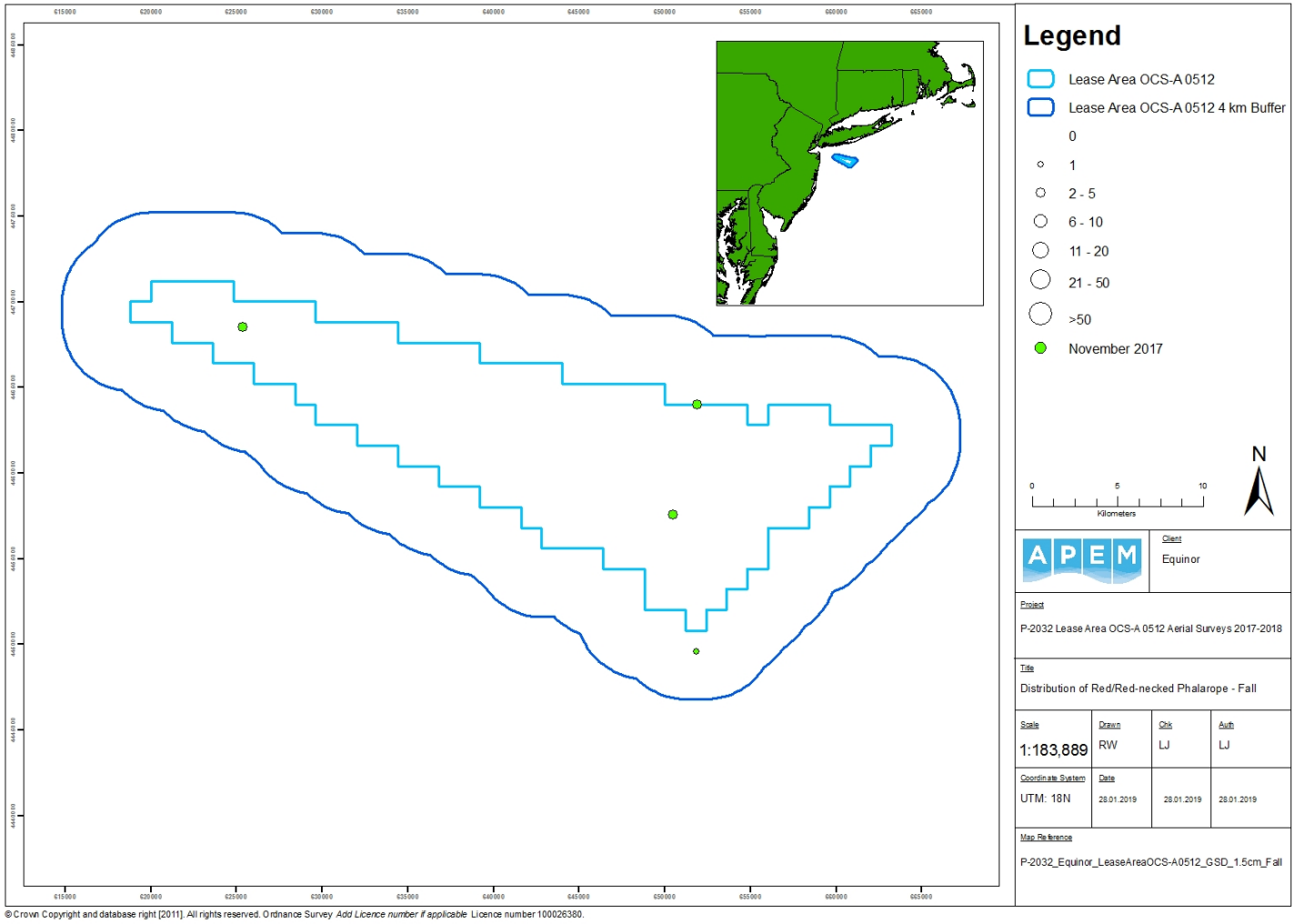


Figure 43 Distribution of red / red-necked phalaropes recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the fall season.

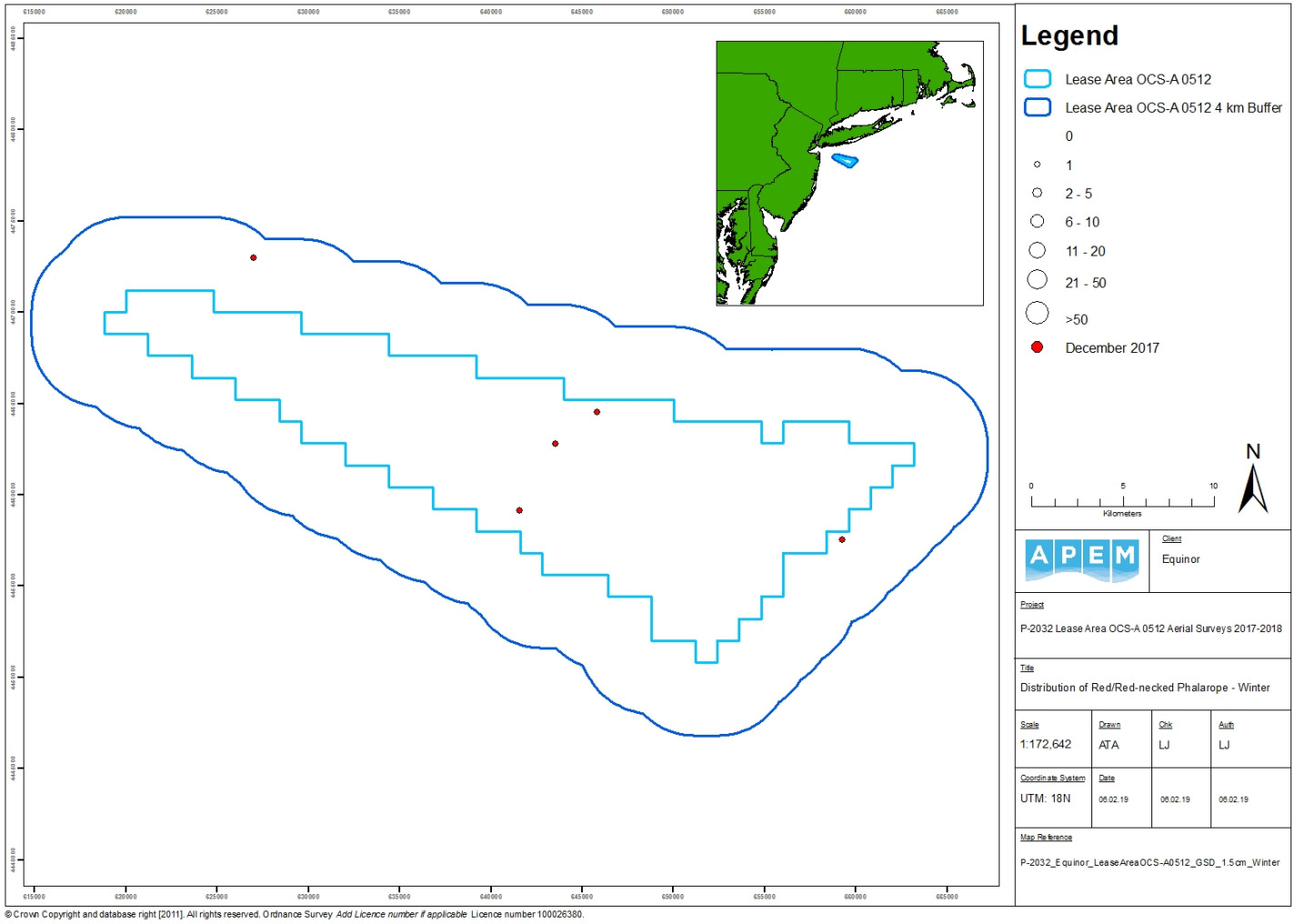


Figure 44 Distribution of red / red-necked phalaropes recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the winter season.

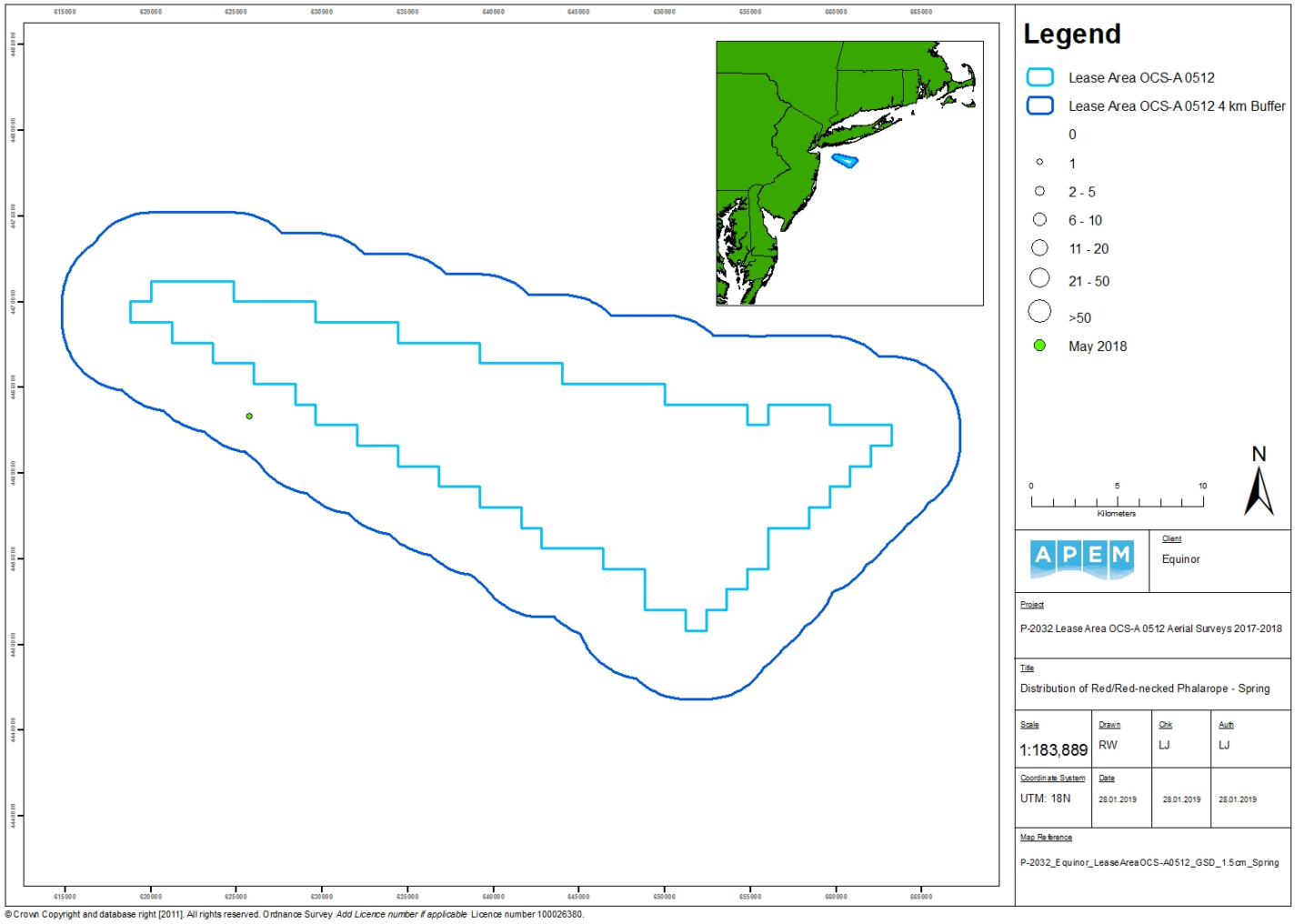


Figure 45 **Distribution of red / red-necked phalaropes recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the spring season.**

4.17 Unknown Species - Cormorant

Unknown cormorant species were mostly recorded in the spring, with a peak of 31 individuals recorded in the 4 km buffer in the April survey, resulting in an abundance estimate of 239 (**Table 23**). Cormorants were also recorded in the May, June and October surveys, but to a lesser extent. The peak count recorded within the Lease Area OCS-A 0512 site occurred in October, with seven individuals resulting in an abundance estimate of 55.

A group of seven unknown cormorant species were recorded in the east of the Lease Area OCS-A 0512 site in October (**Figure 46**). A total of 32 unknown cormorant species were recorded in spring, of which 31 were recorded in April and one in May (**Figure 47**). In April unknown cormorant species were recorded in a group in the north of the 4 km buffer zone, whilst in May, the single individual recorded was in the center of the Lease Area OCS-A 0512 site. In the summer two unknown cormorant species were recorded in the west of the 4 km buffer in June (**Figure 48**). Seven unknown cormorant species were recorded in flight in fall, flying in a west to west-south-westerly direction.

A total of 32 cormorant species were recorded in flight in the spring, all of which were recorded flying in a northerly direction around a mean of 0.7°. Two unknown cormorant species were recorded flying in a westerly direction in the summer period (**Figure 49**).

Table 23 **Raw counts and abundance and density estimates (No. estimated individuals per km^2) of unknown cormorant species in: a) Lease Area OCS-A 0512 plus 4 km buffer, b) Lease Area OCS-A 0512, and c) the Lease Area OCS-A 0512 4 km buffer only.**

a) Lease Area OCS-A 0512 plus 4 km Buffer					
Survey	**Raw Count**	**Abundance**	**Density**	**Flying**	**Sitting**
Apr-18	31	235	0.29	31	0
May-18	1	8	0.01	1	0
Jun-18	2	16	0.02	2	0
Oct-18	7	55	0.07	7	0
b) Lease Area OCS-A 0512					
Survey	**Raw Count**	**Abundance**	**Density**	**Flying**	**Sitting**
Apr-18	0	0	-	0	0
May-18	1	7	0.02	1	0
Jun-18	0	0	-	0	0
Oct-18	7	55	0.17	7	0
c) 4 km Buffer					
Survey	**Raw Count**	**Abundance**	**Density**	**Flying**	**Sitting**
Apr-18	31	239	0.48	31	0
May-18	0	0	-	0	0
Jun-18	2	16	0.03	2	0
Oct-18	0	0	-	0	0

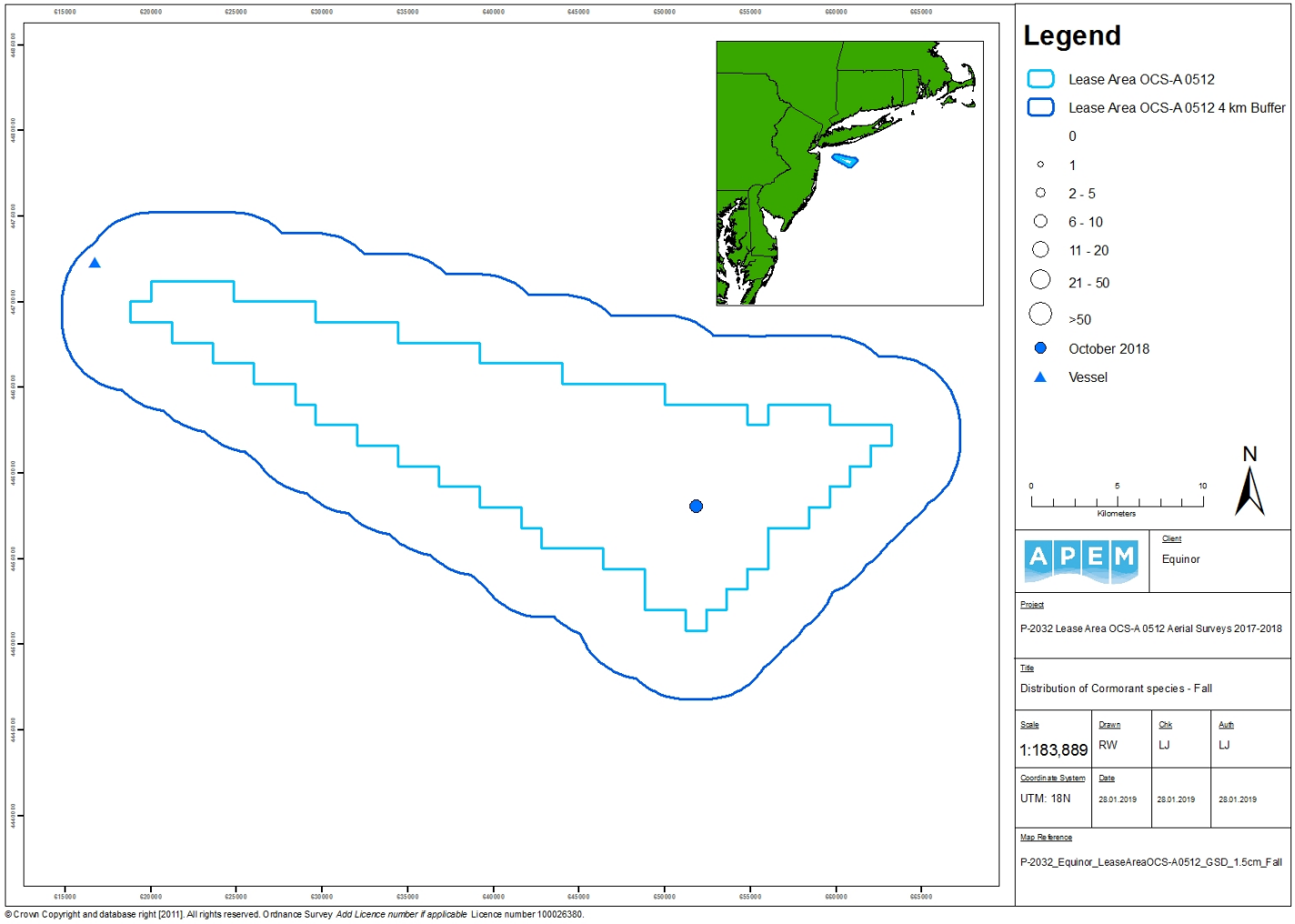


Figure 46 **Distribution of cormorant species recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the fall season.**

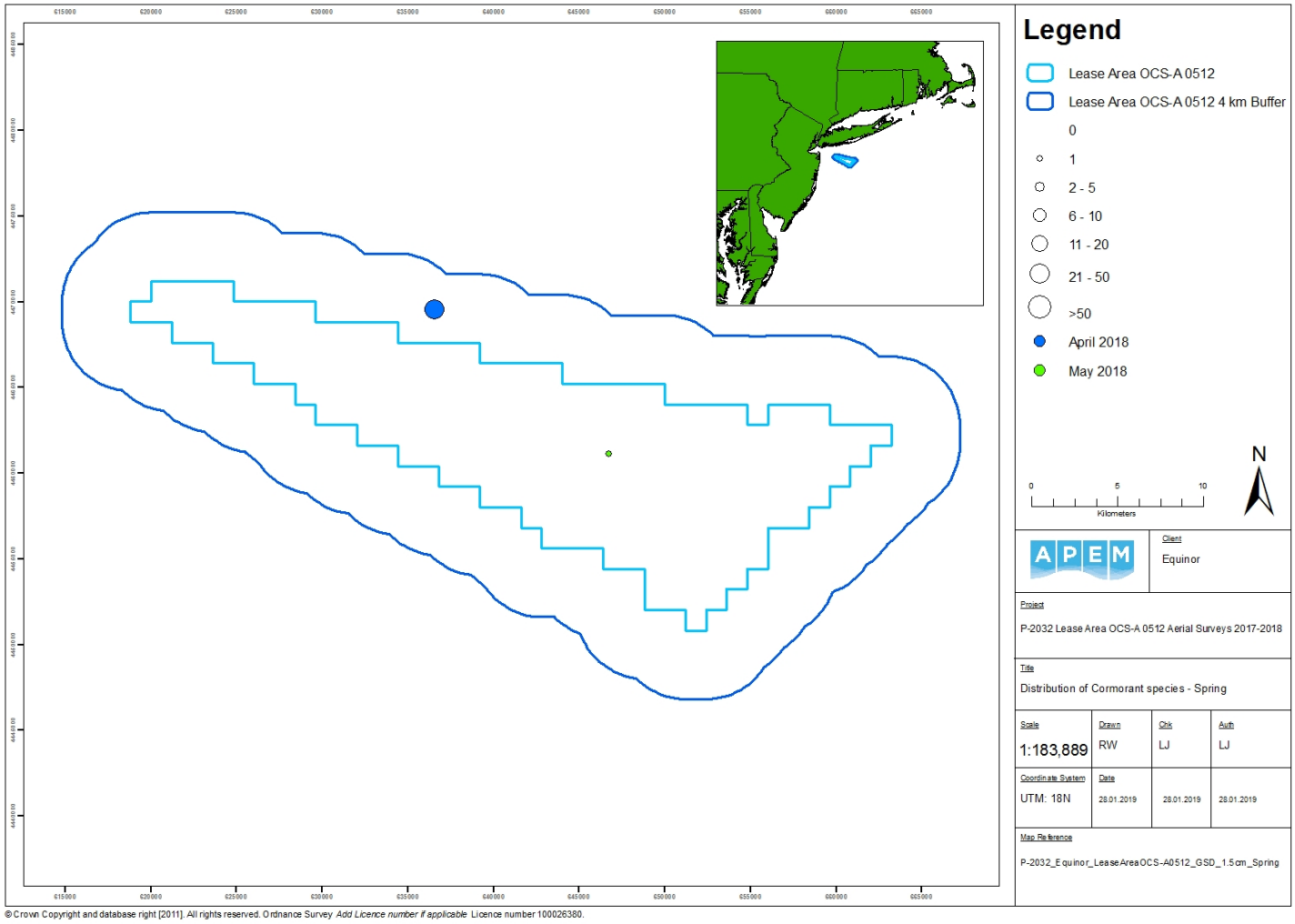


Figure 47 Distribution of cormorant species recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the spring season.

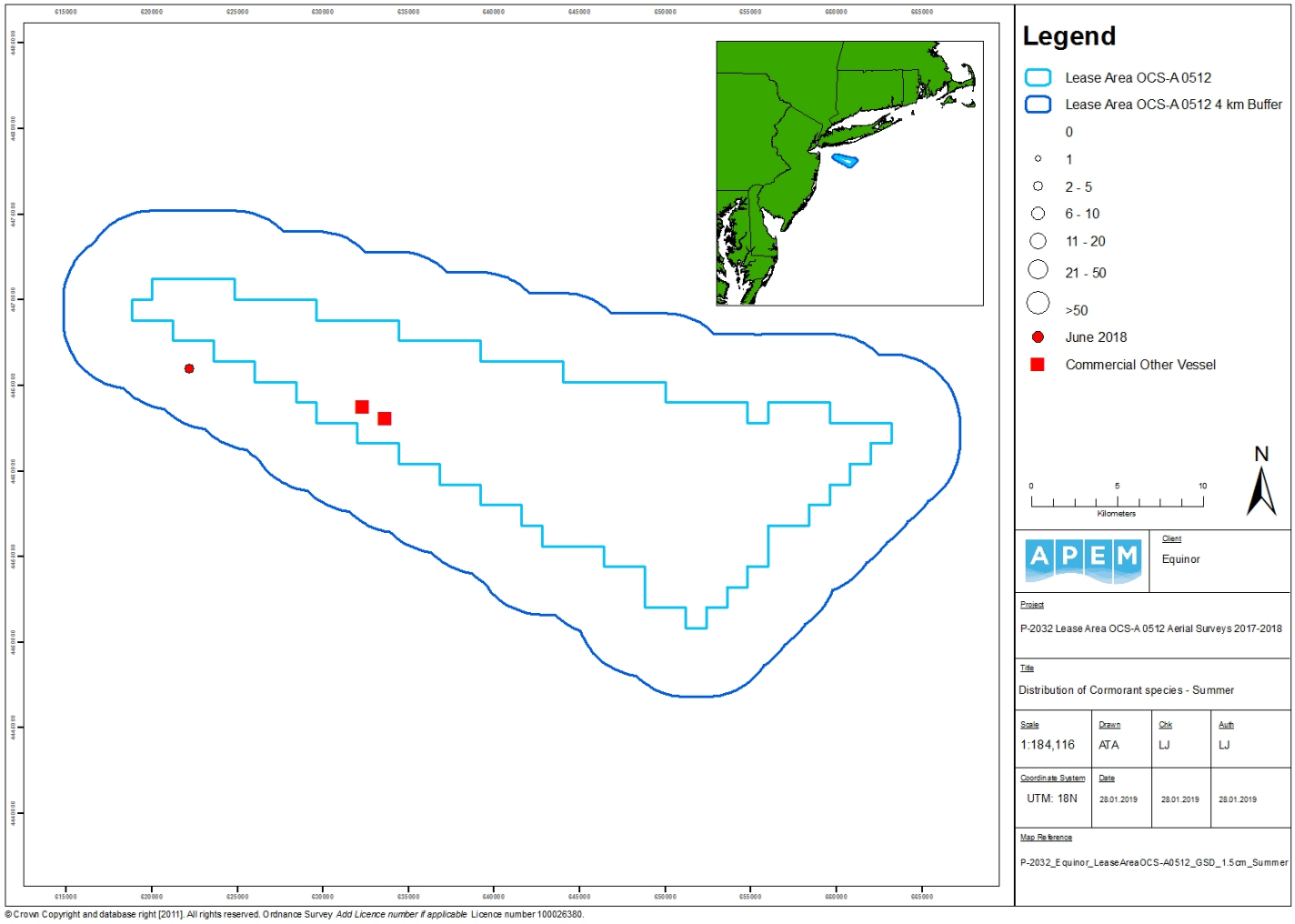
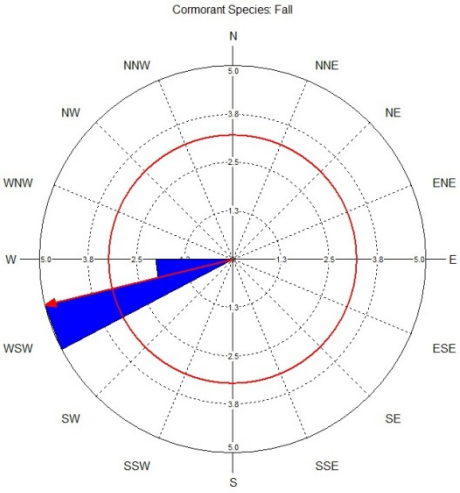
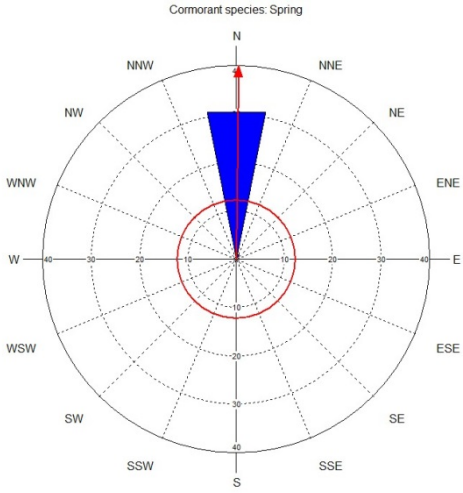


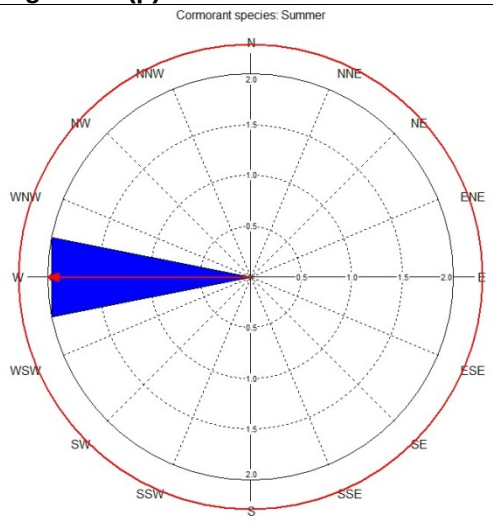
Figure 48 **Distribution of cormorant species recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the summer season.**



Number of Observations	**7**
Mean Vector (μ)	**256.41**
Length of Mean Vector (r)	**0.998**
Rayleigh Test (Z)	**6.969**
Rayleigh Test (p)	**< 1E-12**



Number of Observations	**32**
Mean Vector (μ)	**0.687**
Length of Mean Vector (r)	**0.998**
Rayleigh Test (Z)	**31.853**
Rayleigh Test (p)	**< 1E-12**



Number of Observations	**2**
Mean Vector (μ)	**270**
Length of Mean Vector (r)	**1**
Rayleigh Test (Z)	**2**
Rayleigh Test (p)	**0.137**

Figure 49 **Summary of flight direction of unknown cormorant species recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the fall (n=7), spring (n=32), and summer (n=2) seasons.**

4.18 Dovekie

Three dovekies were recorded in the 4 km buffer zone in the December survey, resulting in an abundance estimate of 24. Dovekies were not recorded in any other month (**Table 24**).

In December two dovekies were recorded in the north-east of the 4 km buffer and one was in the south of the Lease Area OCS-A 0512 site (**Figure 50**).

Table 24 **Raw counts and abundance and density estimates (No. estimated individuals per km^2) of dovekies in: a) Lease Area OCS-A 0512 plus 4 km buffer, b) Lease Area OCS-A 0512, and c) the Lease Area OCS-A 0512 4 km buffer only.**

a) Lease Area OCS-A 0512 plus 4 km Buffer					
Survey	**Raw Count**	**Abundance**	**Density**	**Flying**	**Sitting**
Dec-17	3	23	0.03	0	3
b) Lease Area OCS-A 0512					
Survey	**Raw Count**	**Abundance**	**Density**	**Flying**	**Sitting**
Dec-17	0	0	-	0	0
c) 4 km Buffer					
Survey	**Raw Count**	**Abundance**	**Density**	**Flying**	**Sitting**
Dec-17	3	24	0.05	0	3

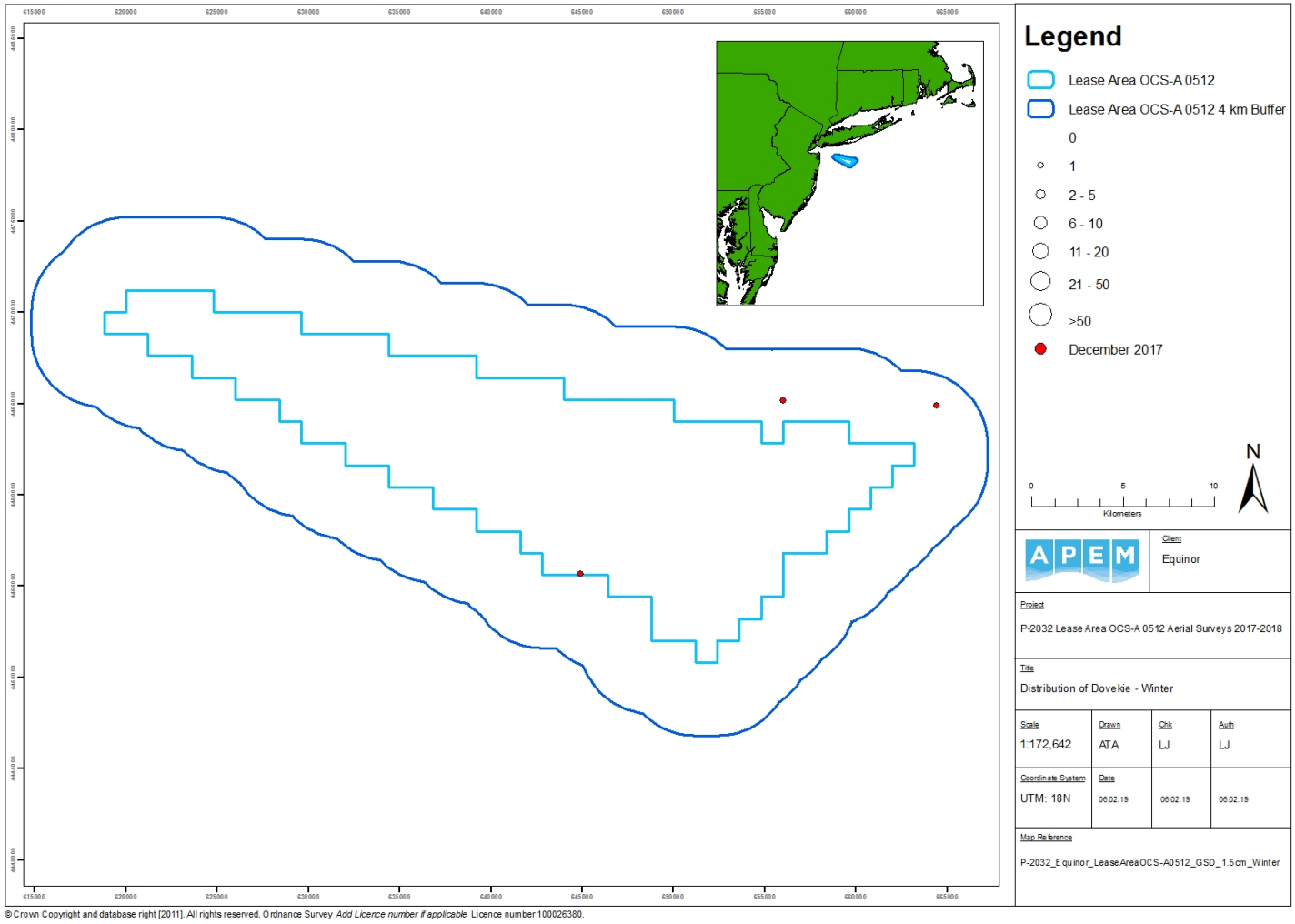


Figure 50 Distribution of dovekie recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the winter season.

4.19 Murre / Razorbill

The majority of murre / razorbills were recorded in the winter and spring (**Table 25**), with a further single individual in the June survey (summer). The peak counts were of 107 and 105 individuals recorded in the Lease Area OCS-A 0512 site in March, resulting in abundance estimates of 847 and 848, respectively.

In the November survey, two individuals were recorded in the north and south-west of the 4 km buffer (**Figure 51**). In the winter, murre / razorbills were recorded in December, January and February across the Lease Area OCS-A 0512 plus 4 km buffer with higher numbers observed in the east (**Figure 52**). In the spring, individuals were recorded in March and April across the Lease Area OCS-A 0512 plus 4 km buffer, with higher numbers recorded in the south-east (**Figure 53**). In the summer the single murre / razorbill was recorded in the west of the 4 km buffer (**Figure 54**).

Of the four murre / razorbills recorded in winter there was no significant tendency to fly in any one direction. Nineteen murres / razorbill were recorded in flight in the spring, with a significant to fly in a north to north-north westerly direction around a mean of 353° (**Figure 55**).

Table 25 **Raw counts and abundance and density estimates (No. estimated individuals per km^2) of murres / razorbills in: a) Lease Area OCS-A 0512 plus 4 km buffer, b) Lease Area OCS-A 0512, and c) the Lease Area OCS-A 0512 4 km buffer only.**

a) Lease Area OCS-A 0512 plus 4 km Buffer						
Survey	Raw Count	Abundance	Density	Flying	Sitting	Diving
Nov-17	2	16	0.02	0	2	0
Dec-17	65	504	0.62	1	64	0
Jan-18	98	757	0.92	3	95	0
Feb-18	12	95	0.12	0	12	0
Mar-18	212	1698	2.07	11	200	1
Apr-18	159	1205	0.17	8	151	0
Jun-18	1	8	0.01	0	1	0
Oct-18	1	8	0.01	0	1	0
b) Lease Area OCS-A 0512						
Survey	Raw Count	Abundance	Density	Flying	Sitting	Diving
Dec-17	0	0	-	0	0	0
Dec-17	35	266	0.83	0	35	0
Dec-17	25	193	0.6	1	24	0
Dec-17	3	23	0.07	0	3	0
Dec-17	107	847	2.64	2	104	1
Dec-17	100	737	2.3	0	100	0
Dec-17	0	0	-	0	0	0
Dec-17	1	8	0.02	0	1	0
c) 4 km Buffer						
Survey	Raw Count	Abundance	Density	Flying	Sitting	Diving
Dec-17	2	16	0.03	0	2	0
Dec-17	30	235	0.47	1	29	0

Dec-17	73	565	1.13	2	71	0
Dec-17	9	72	0.14	0	9	0
Dec-17	105	848	1.7	9	96	0
Dec-17	59	455	0.91	8	51	0
Dec-17	1	8	0.02	0	1	0
Dec-17	0	0	-	0	0	0

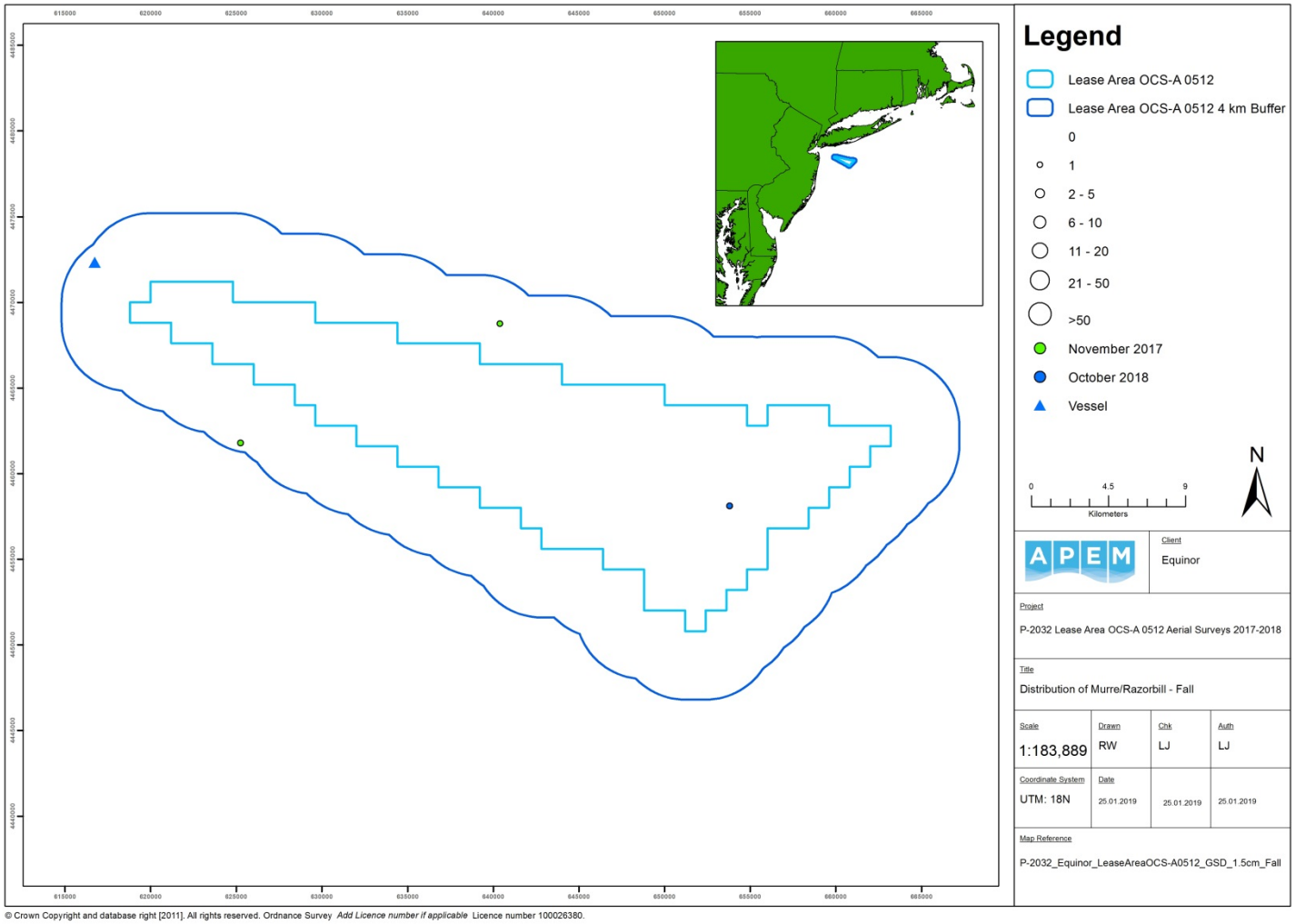


Figure 51 Distribution of murre / razorbills recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the fall season.

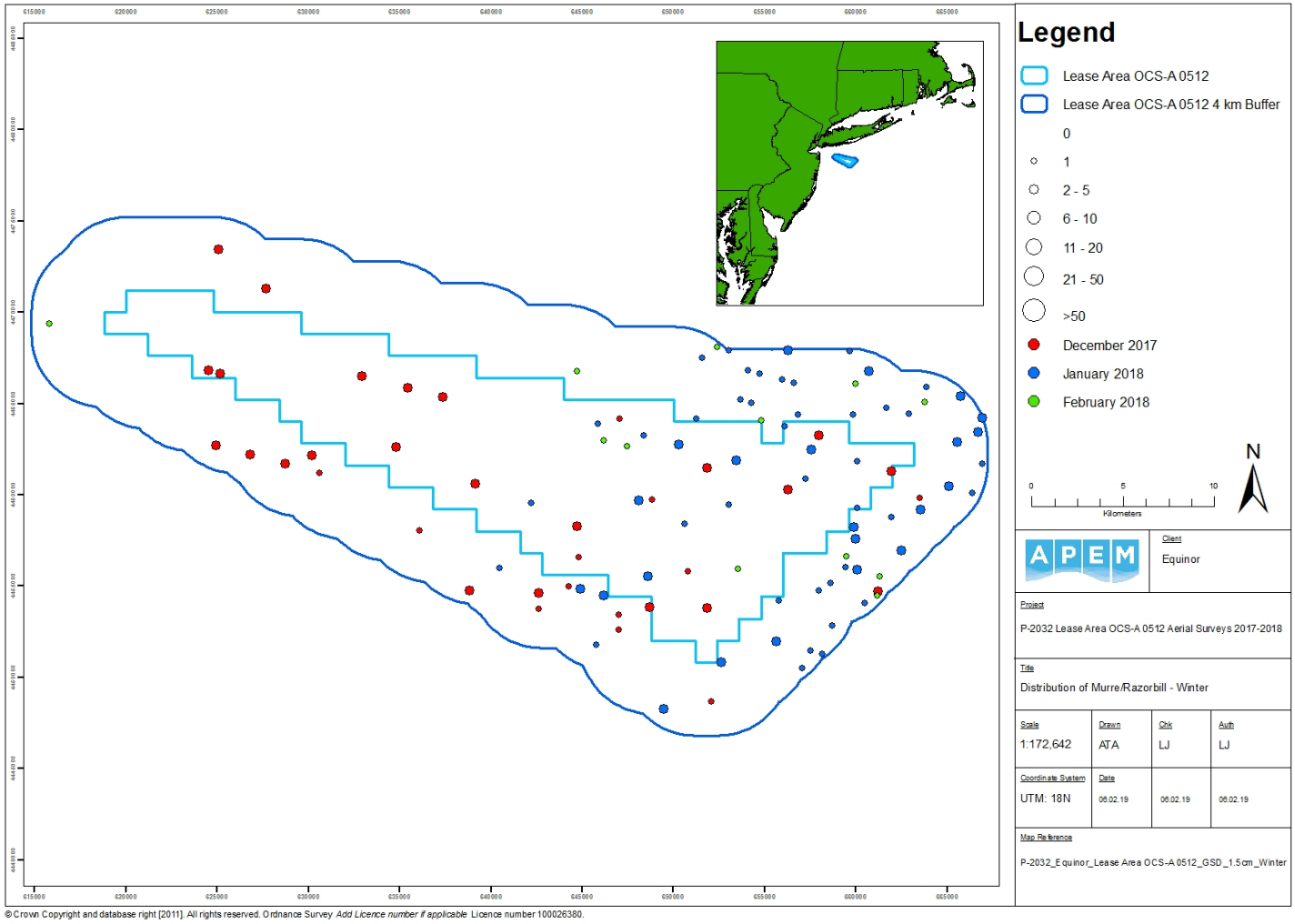


Figure 52 Distribution of murre / razorbills recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the winter season.

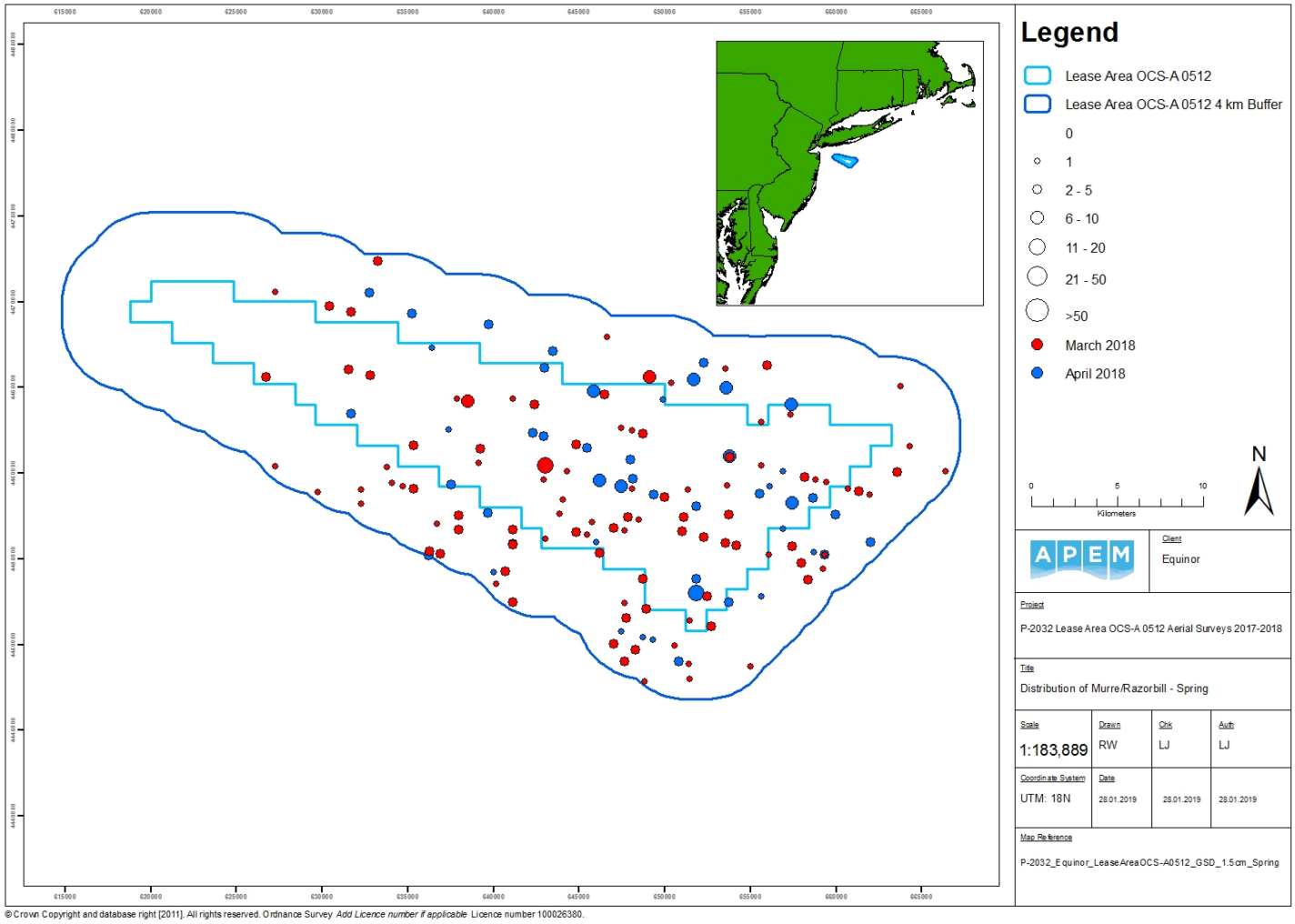


Figure 53 Distribution of murre / razorbills recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the spring season.

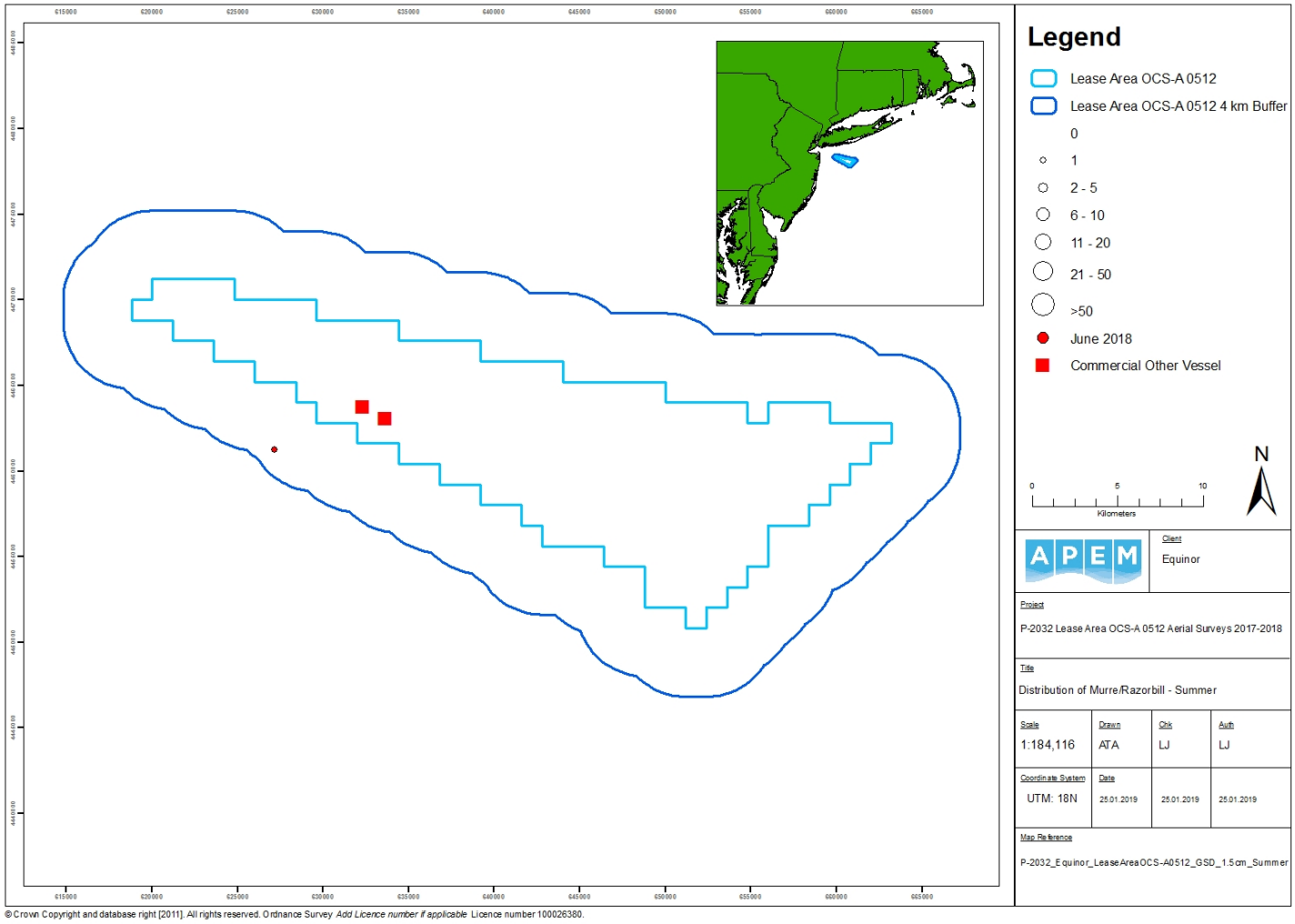
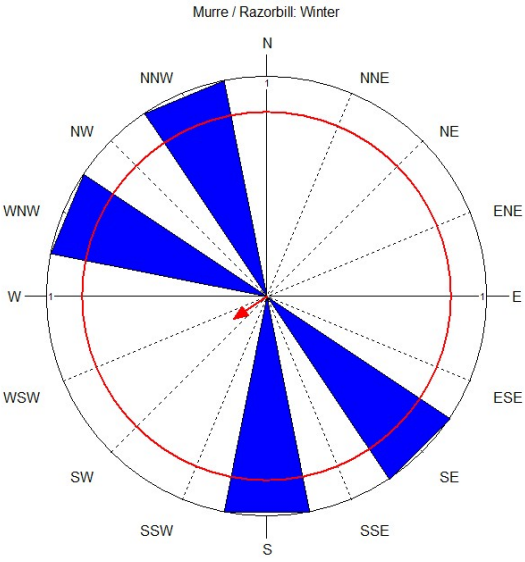
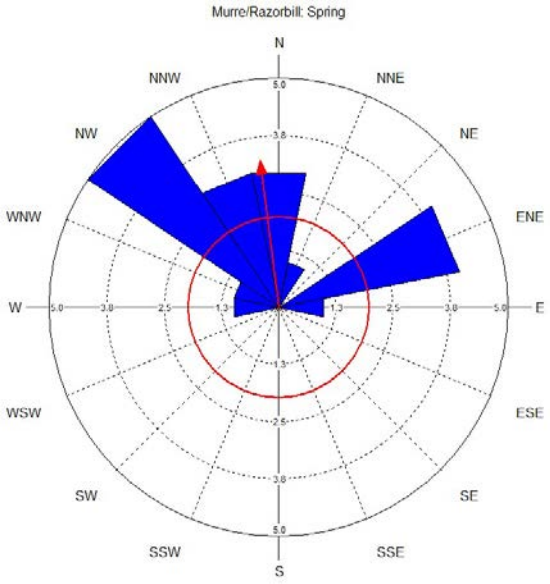


Figure 54 **Distribution of murre / razorbills recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the summer season.**



Number of Observations	**4**
Mean Vector (μ)	**236.25**
Length of Mean Vector (r)	**0.18**
Rayleigh Test (Z)	**0.13**
Rayleigh Test (p)	**0.891**



Number of Observations	**19**
Mean Vector (μ)	**352.823**
Length of Mean Vector (r)	**0.644**
Rayleigh Test (Z)	**7.886**
Rayleigh Test (p)	**0.000167**

Figure 55 **Summary of flight direction of murre / razorbills recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the winter (n=4) and spring (n=19) seasons.**

4.20 Species Unknown – Alcid

Two unknown alcids were recorded in the December survey in the south of the 4 km buffer (**Table 26**, **Figure 56**), resulting in an abundance estimate of 16.

Table 26 **Raw counts and abundance and density estimates (No. estimated individuals per km^2) of unknown alcid species in: a) Lease Area OCS-A 0512 plus 4 km buffer, b) Lease Area OCS-A 0512, and c) the Lease Area OCS-A 0512 4 km buffer only.**

a) Lease Area OCS-A 0512 plus 4 km Buffer					
Survey	Raw Count	Abundance	Density	Flying	Sitting
Dec-17	2	15	0.02	0	2
b) Lease Area OCS-A 0512					
Survey	Raw Count	Abundance	Density	Flying	Sitting
Dec-17	0	0	-	0	0
c) 4 km Buffer					
Survey	Raw Count	Abundance	Density	Flying	Sitting
Dec-17	2	16	0.03	0	2

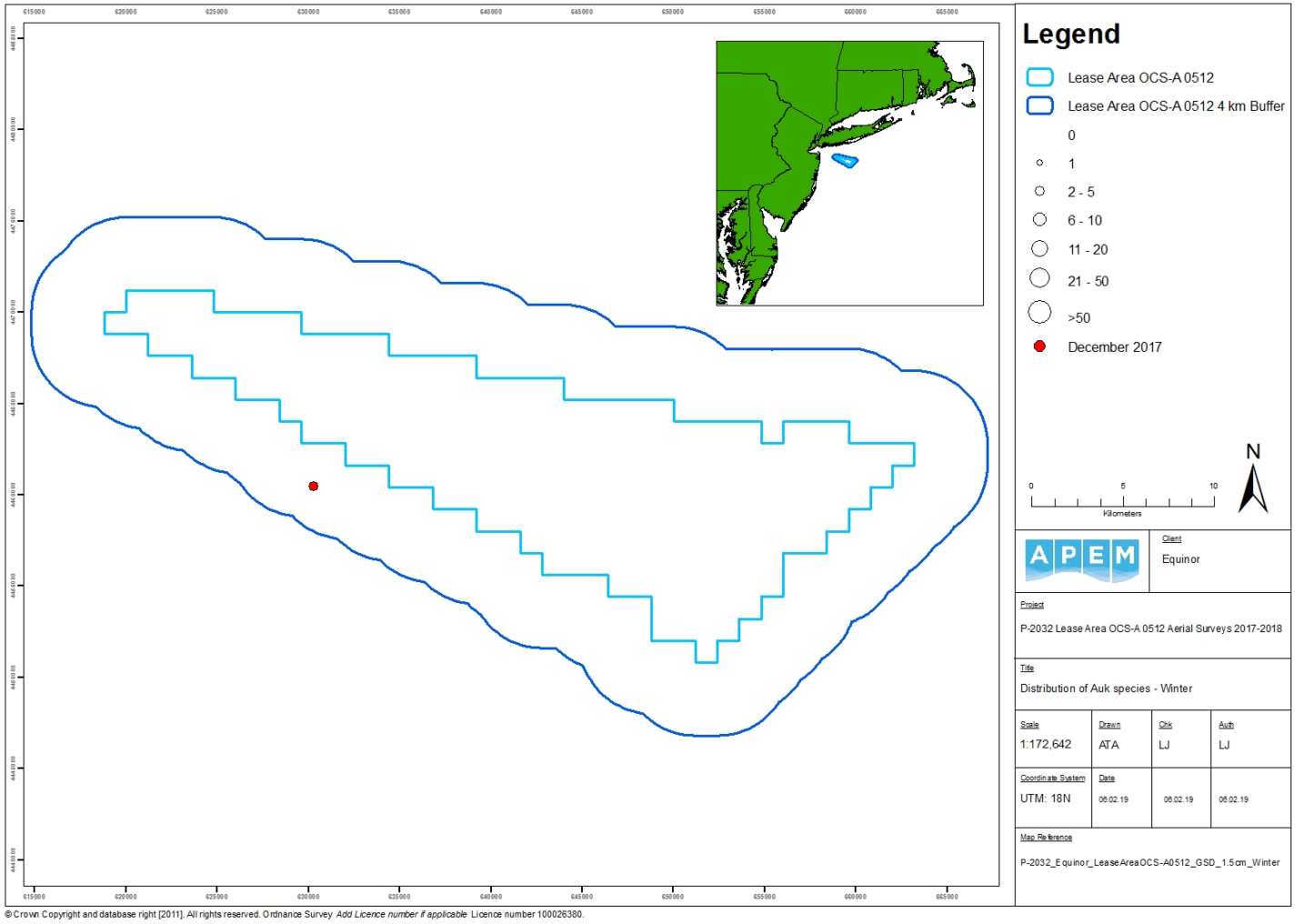


Figure 56 Distribution of unknown alcid species recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the winter season.

4.21 Black-legged Kittiwake

A peak count of 13 kittiwake were recorded in the Lease Area OCS-A 0512 site in the November survey, with a further 12 in the 4 km buffer in the same month, resulting in abundance estimates of 102 and 96, respectively (**Table 27**). Fifteen kittiwakes were also recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the March survey.

In the fall, black-legged kittiwakes were recorded in November and October (**Figure 57**), loosely distributed across the Lease Area OCS-A 0512 plus 4 km buffer. In the winter a single black-legged kittiwake was recorded in the north-east of the 4 km buffer (**Figure 58**). Black-legged kittiwakes were recorded in the spring in March, with the majority of individuals recorded in the east of the Lease Area OCS-A 0512 plus 4 km buffer (**Figure 59**).

In the fall 18 black-legged kittiwakes were recorded in flight, but did not show a tendency to fly in any one direction. A single black-legged kittiwake was recorded flying in a north-westerly direction during winter. Twelve black-legged kittiwakes were recorded in flight in spring, with a preference to fly in a north-easterly direction around a mean of 45° (**Figure 60**).

Table 27 **Raw counts and abundance and density estimates (No. estimated individuals per km^2) of black-legged kittiwakes in: a) Lease Area OCS-A 0512 plus 4 km buffer, b) Lease Area OCS-A 0512, and c) the Lease Area OCS-A 0512 4 km buffer only.**

a) Lease Area OCS-A 0512 plus 4 km Buffer					
Survey	Raw Count	Abundance	Density	Flying	Sitting
Nov-17	25	199	0.24	17	8
Dec-17	1	8	0.01	1	0
Mar-18	15	120	0.15	12	3
Oct-18	1	8	0.01	1	0
b) Lease Area OCS-A 0512					
Survey	Raw Count	Abundance	Density	Flying	Sitting
Nov-17	13	102	0.32	10	3
Dec-17	0	0	-	0	0
Mar-18	8	63	0.2	5	3
Oct-18	0	0	-	0	0
c) 4 km Buffer					
Survey	Raw Count	Abundance	Density	Flying	Sitting
Nov-17	12	96	0.19	7	5
Dec-17	1	8	0.02	1	0
Mar-18	7	57	0.11	7	0
Oct-18	1	8	0.02	1	0

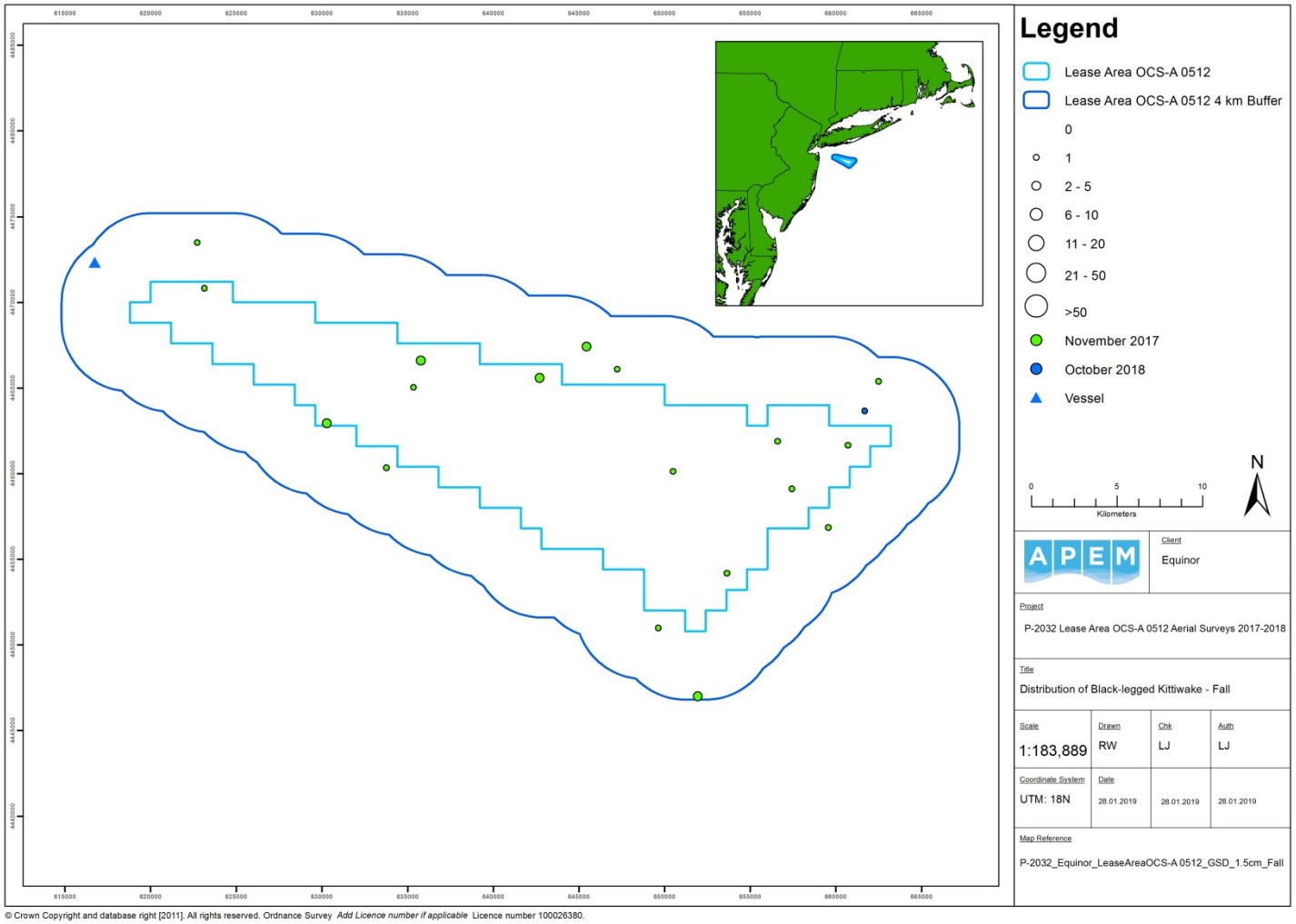


Figure 57 Distribution of black-legged kittiwakes recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the fall season.

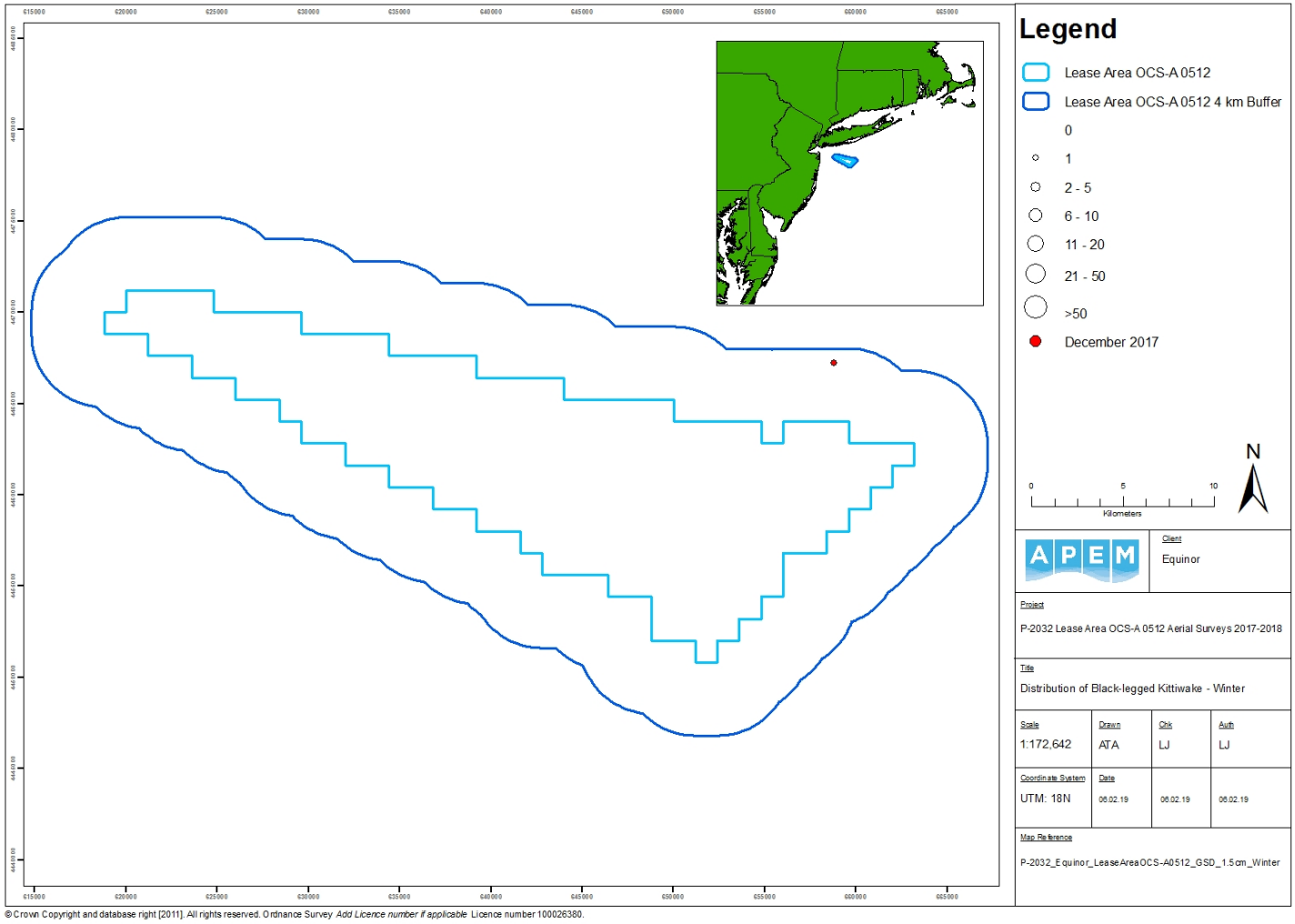


Figure 58 Distribution of black-legged kittiwakes recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the winter season.

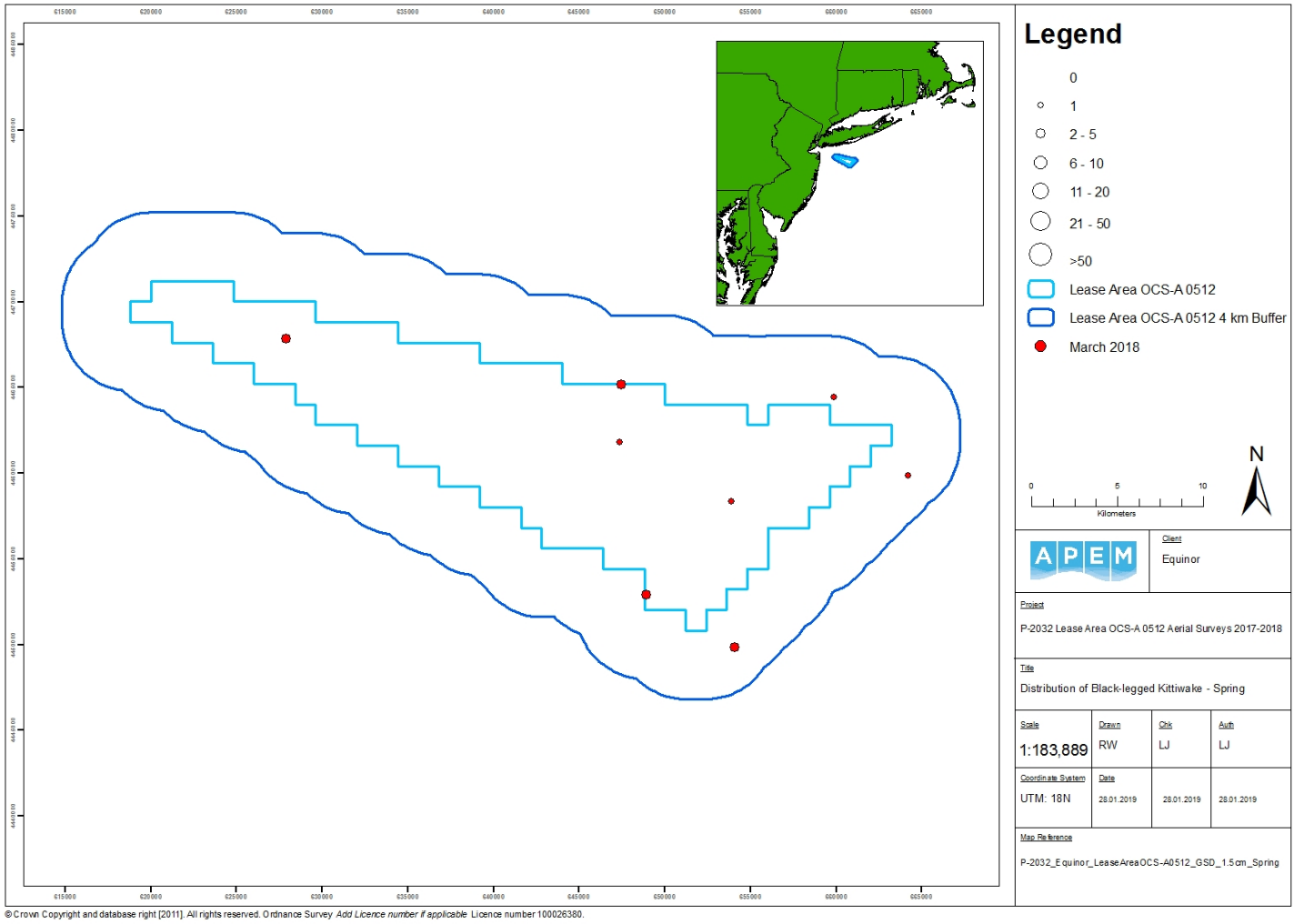
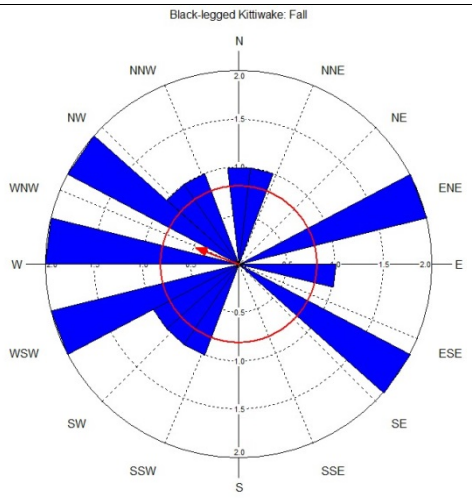
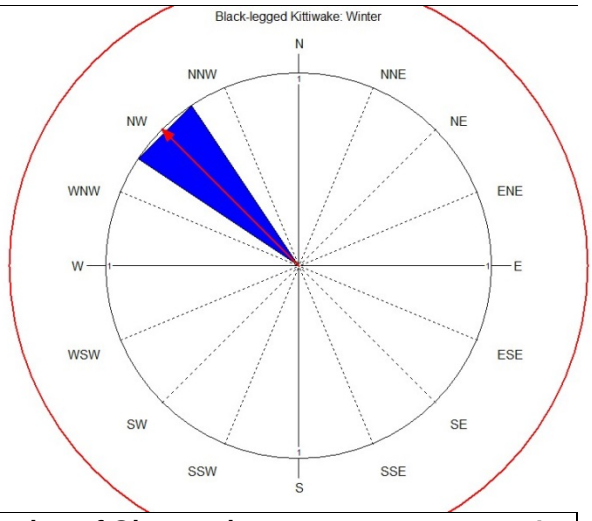


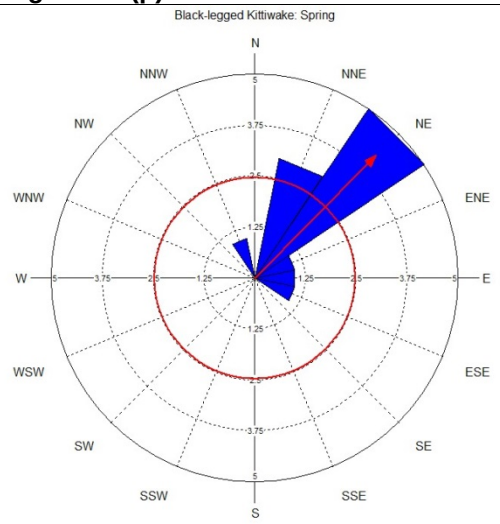
Figure 59 **Distribution of black-legged kittiwakes recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the spring season.**



Number of Observations	**18**
Mean Vector (μ)	**290.474**
Length of Mean Vector (r)	**0.238**
Rayleigh Test (Z)	**1.02**
Rayleigh Test (p)	**0.366**



Number of Observations	**1**
Mean Vector (μ)	**315**
Length of Mean Vector (r)	**1**
Rayleigh Test (Z)	**1**
Rayleigh Test (p)	**0.512**



Number of Observations	**12**
Mean Vector (μ)	**44.672**
Length of Mean Vector (r)	**0.847**
Rayleigh Test (Z)	**8.616**
Rayleigh Test (p)	**0.0000122**

Figure 60 **Summary of flight direction of black-legged kittiwakes recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the fall (n=18), winter (n=1), and spring (n=12) seasons.**

4.22 Bonaparte's Gull

Peak count numbers were recorded in the late fall / early winter, with 330 individuals in the December survey, resulting in an abundance estimate of 1,999., the majority of which were

recorded in the 4 km buffer (**Table 28)**. A total of 101 individuals were recorded in the November survey, with fewer numbers also recorded in the October survey (n=11), as well as in the spring. The peak number recorded within the Lease Area OCS-A 0512 site occurred in December with 75 individuals, resulting in an abundance of 571.

In the fall, Bonaparte's gulls were recorded in November and October, which were loosely distributed across the Lease Area OCS-A 0512 plus 4 km buffer (**Figure 61**). In winter, Bonaparte's gulls were recorded in December and February and were predominantly located in the east and south east of the Lease Area OCS-A 0512 plus 4 km buffer (**Figure 62**). In the spring surveys, individuals were recorded in March and April, which were mostly distributed in the east of the Lease Area OCS-A 0512 plus 4 km buffer (**Figure 63**).

A total of 64 Bonaparte's gulls were recorded in flight in the fall, which did not show a preference to fly in any one direction. A total of 220 Bonaparte's gulls were recorded flying in winter, which showed a preference to fly in a south-westerly direction with a significant orientation around the mean of 238°. A total of 21 Bonaparte's gulls were recorded in flight during the spring, which showed a significant preference to fly in a north-north-westerly direction around a mean of 342° (**Figure 64**).

Table 28 **Raw counts and abundance and density estimates (No. estimated individuals per km^2) of Bonaparte's gulls in: a) Lease Area OCS-A 0512 plus 4 km buffer, b) Lease Area OCS-A 0512, and c) the Lease Area OCS-A 0512 4 km buffer only.**

a) Lease Area OCS-A 0512 plus 4 km Buffer					
Survey	**Raw Count**	**Abundance**	**Density**	**Flying**	**Sitting**
Nov-17	101	803	0.98	57	44
Dec-17	330	2557	3.12	219	111
Feb-18	1	8	0.01	1	0
Mar-18	9	72	0.09	7	2
Apr-18	27	205	0.25	14	13
Oct-18	11	87	0.11	7	4
b) Lease Area OCS-A 0512					
Survey	**Raw Count**	**Abundance**	**Density**	**Flying**	**Sitting**
Nov-17	66	519	1.62	24	42
Dec-17	75	571	1.78	23	52
Feb-18	0	0	-	0	0
Mar-18	5	40	0.12	3	2
Apr-18	16	118	0.37	6	10
Oct-18	6	47	0.15	3	3
c) 4 km Buffer					
Survey	**Raw Count**	**Abundance**	**Density**	**Flying**	**Sitting**
Nov-17	35	280	0.56	33	2
Dec-17	255	1999	4.1	196	59
Feb-18	1	8	0.02	1	0
Mar-18	4	32	0.06	4	0
Apr-18	11	85	0.17	8	3
Oct-18	5	40	0.08	4	1

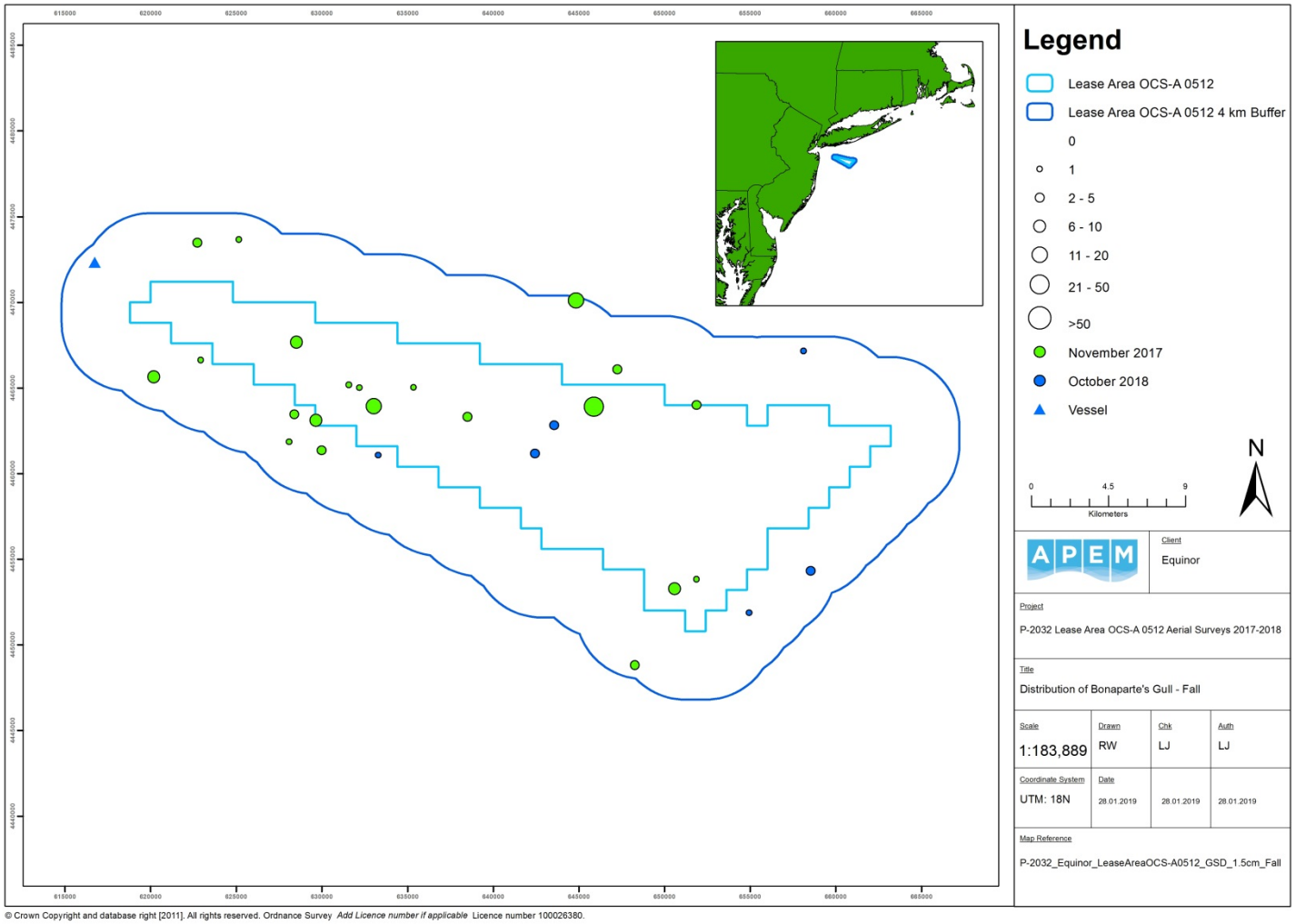


Figure 61 Distribution of Bonaparte's gulls recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the fall season.

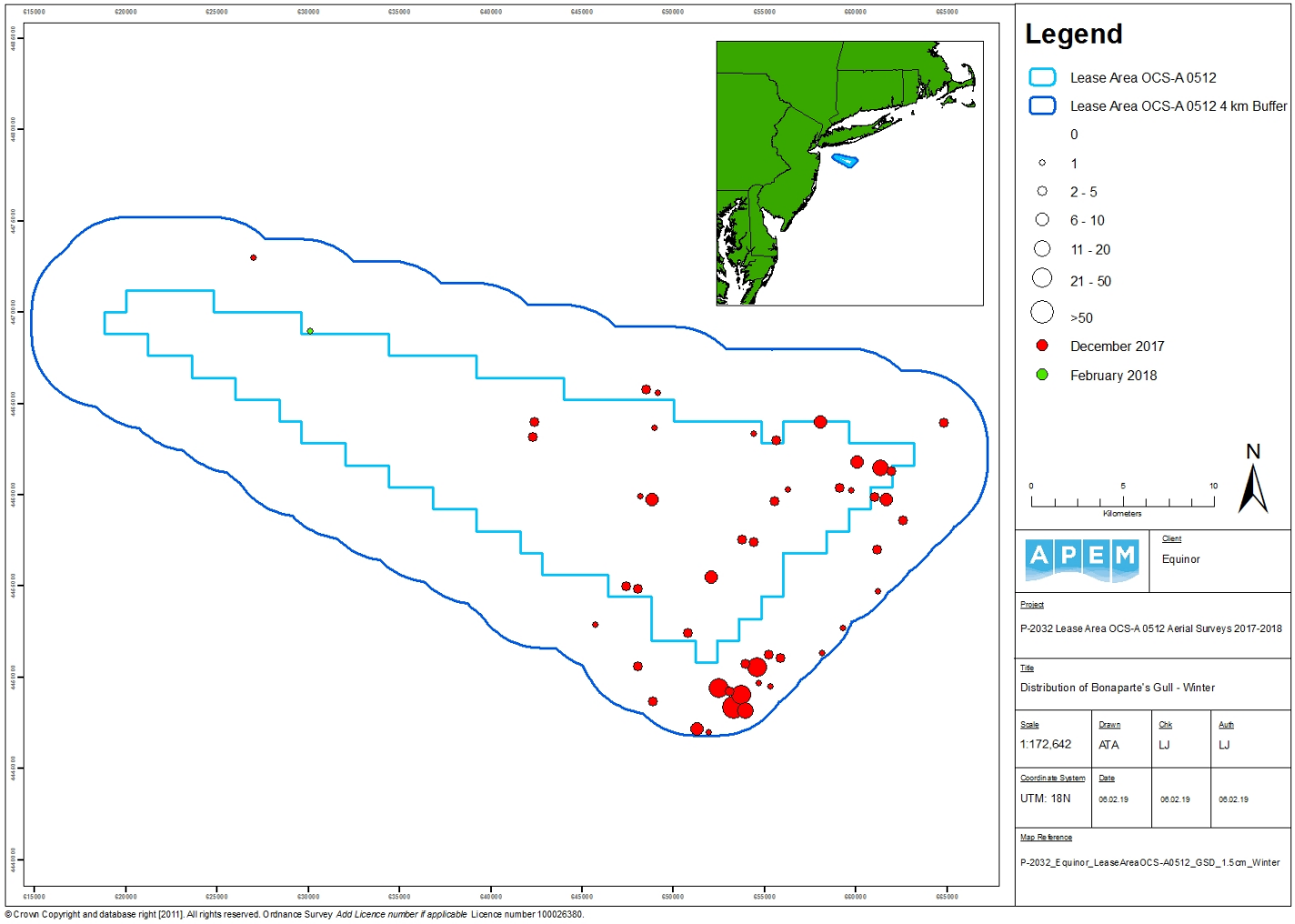


Figure 62 Distribution of Bonaparte's gulls recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the winter season.

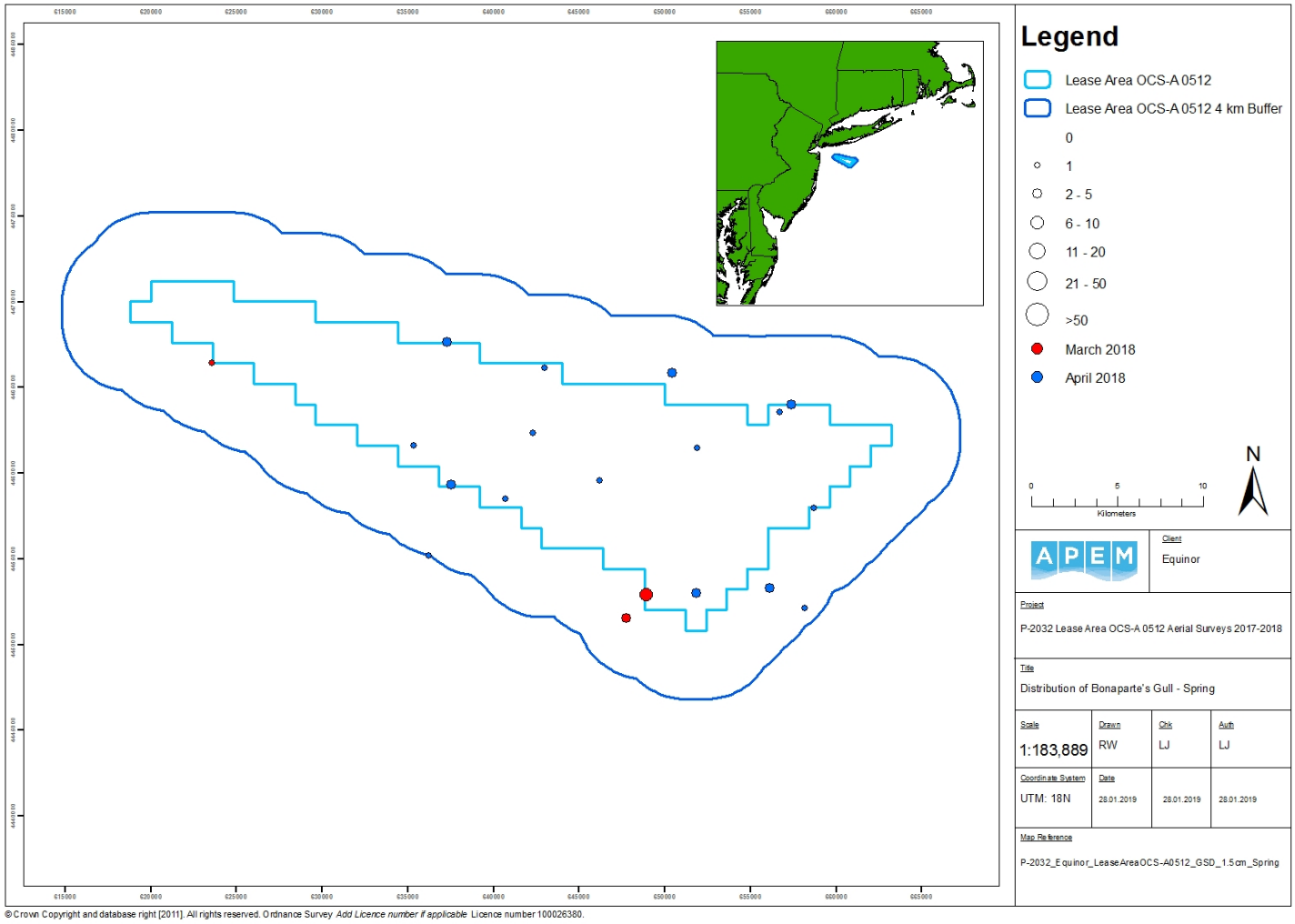
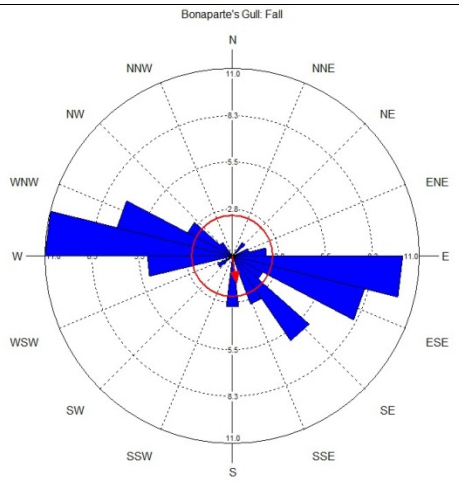
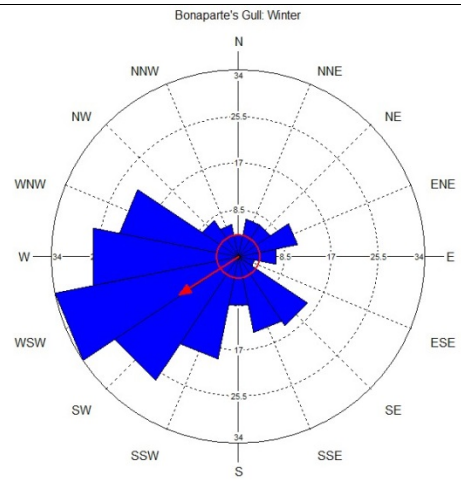


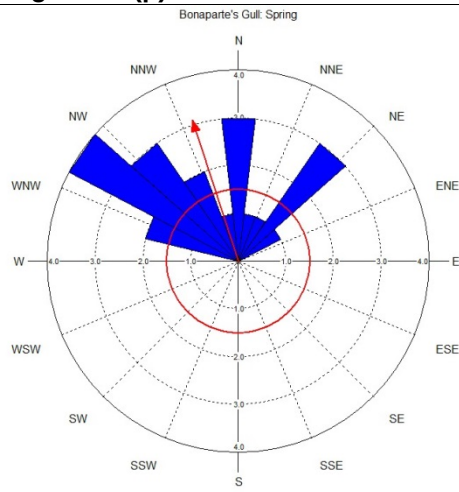
Figure 63 Distribution of Bonaparte's gulls recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the spring season.



Number of Observations	**64**
Mean Vector (μ)	**170.871**
Length of Mean Vector (r)	**0.144**
Rayleigh Test (Z)	**1.325**
Rayleigh Test (p)	**0.266**



Number of Observations	**220**
Mean Vector (μ)	**237.613**
Length of Mean Vector (r)	**0.374**
Rayleigh Test (Z)	**30.812**
Rayleigh Test (p)	**< 1E-12**



Number of Observations	**21**
Mean Vector (μ)	**341.855**
Length of Mean Vector (r)	**0.773**
Rayleigh Test (Z)	**12.558**
Rayleigh Test (p)	**5.6E-07**

Figure 64 **Summary of flight direction of Bonaparte's gulls recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the fall (n=64), winter (n=220), and spring (n=21) seasons.**

4.23 Ring-billed Gull

Ring-billed gulls were recorded in low numbers throughout the survey period, with a peak count of two individuals in the May survey, resulting in abundance estimates of 15 (**Table 29**).

A single ring-billed gull was recorded in each of the November and September surveys in the west and north of the 4 km buffer (**Figure 65**). In the winter, two ring-billed gulls were recorded; one in December located in the north-west 4 km buffer and one in January located in the south of the 4 km buffer (**Figure 66**). In the spring, two ring-billed gulls were recorded in May. Both were recorded in the north-east of the Lease Area OCS-A 0512 plus 4 km buffer, with one in the Lease Area OCS-A 0512 site and one in the 4 km buffer (**Figure 67**).

Two ring-billed gulls were recorded in flight in the fall, one flying in a south-westerly direction and the other in a west-south-westerly direction. Two ring-billed gulls were recorded in flight during winter, one was flying in a south-westerly direction and one was flying in a north-north-easterly direction. A single ring-billed gull was recorded flying in a north-easterly direction in spring 2018 (**Figure 68**).

Table 29 **Raw counts and abundance and density estimates (No. estimated individuals per km^2) of ring-billed gulls in: a) Lease Area OCS-A 0512 plus 4 km buffer, b) Lease Area OCS-A 0512, and c) the Lease Area OCS-A 0512 4 km buffer only.**

a) Lease Area OCS-A 0512 plus 4 km Buffer					
Survey	**Raw Count**	**Abundance**	**Density**	**Flying**	**Sitting**
Nov-17	1	8	0.01	1	0
Dec-17	1	8	0.01	1	0
Jan-18	1	8	0.01	1	0
May-18	2	15	0.02	1	1
Sep-18	1	8	0.01	1	0
b) Lease Area OCS-A 0512					
Survey	**Raw Count**	**Abundance**	**Density**	**Flying**	**Sitting**
Nov-17	0	0	-	0	0
Dec-17	0	0	-	0	0
Jan-18	0	0	-	0	0
May-18	1	7	0.02	0	1
Sep-18	0	0	-	0	0
c) 4 km Buffer					
Survey	**Raw Count**	**Abundance**	**Density**	**Flying**	**Sitting**
Nov-17	1	8	0.02	1	0
Dec-17	1	8	0.02	1	0
Jan-18	1	8	0.02	1	0
May-18	1	8	0.02	1	0
Sep-18	1	8	0.02	1	0

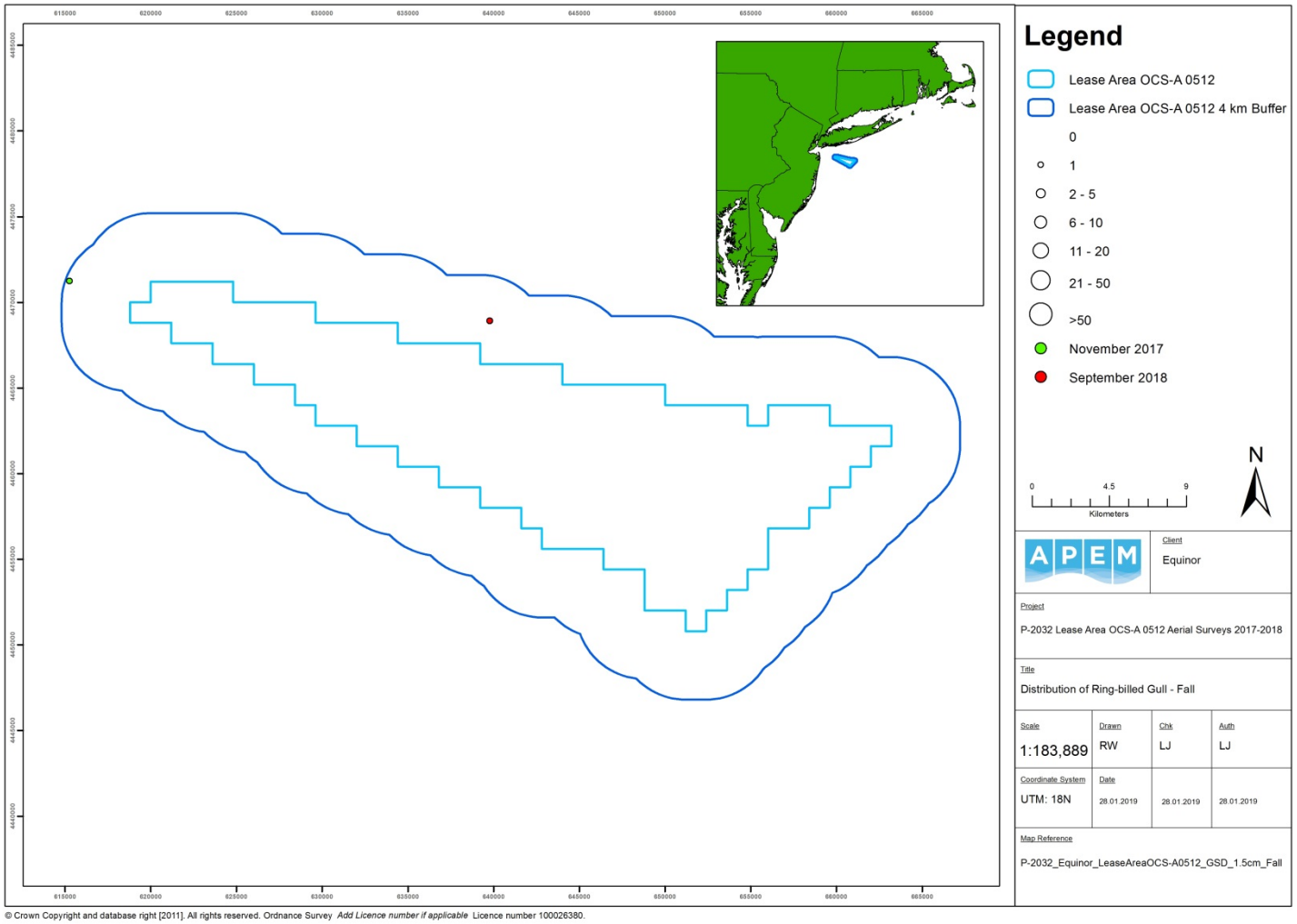


Figure 65 **Distribution of ring-billed gulls recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the fall season.**

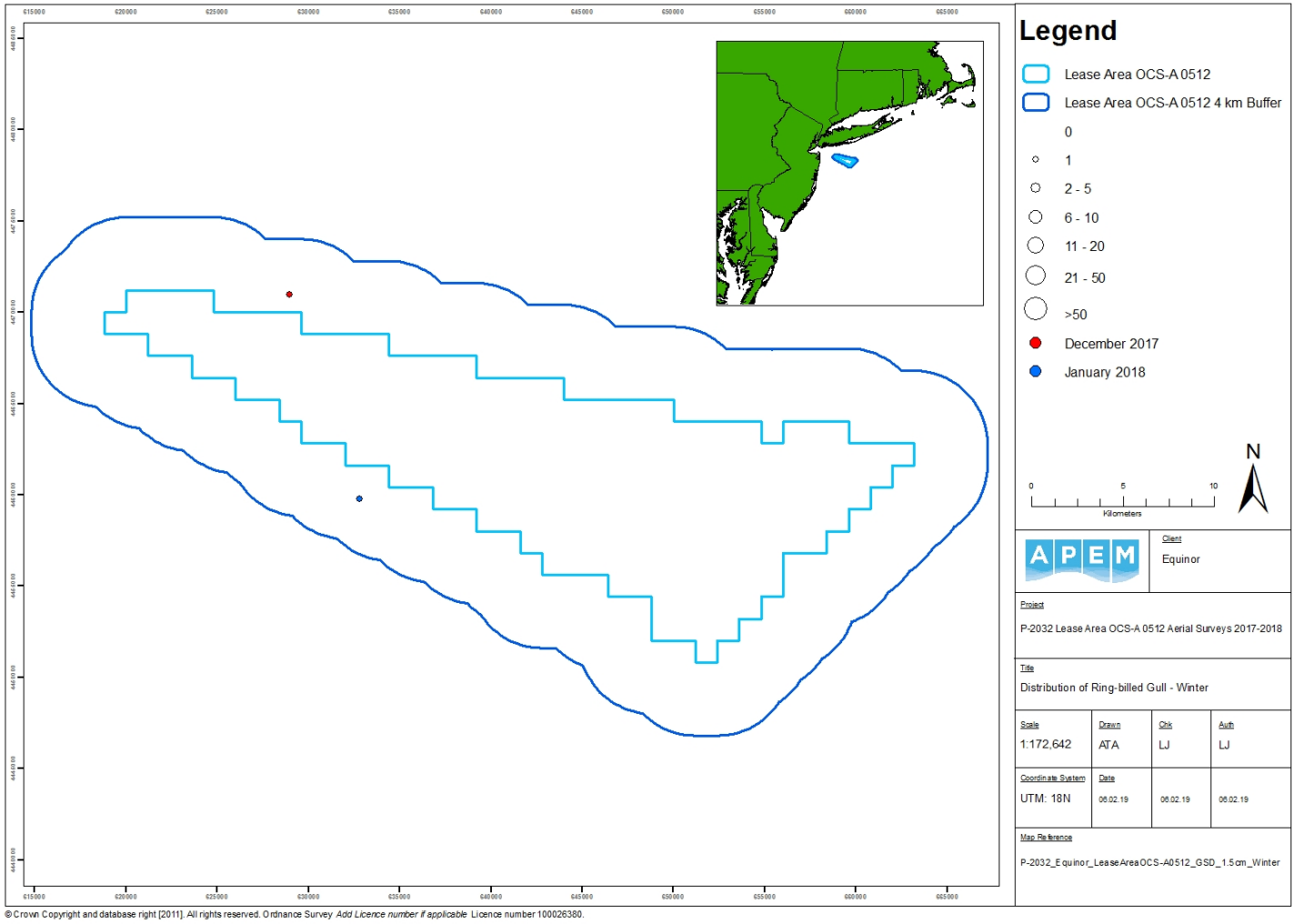


Figure 66 Distribution of ring-billed gulls recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the winter season.

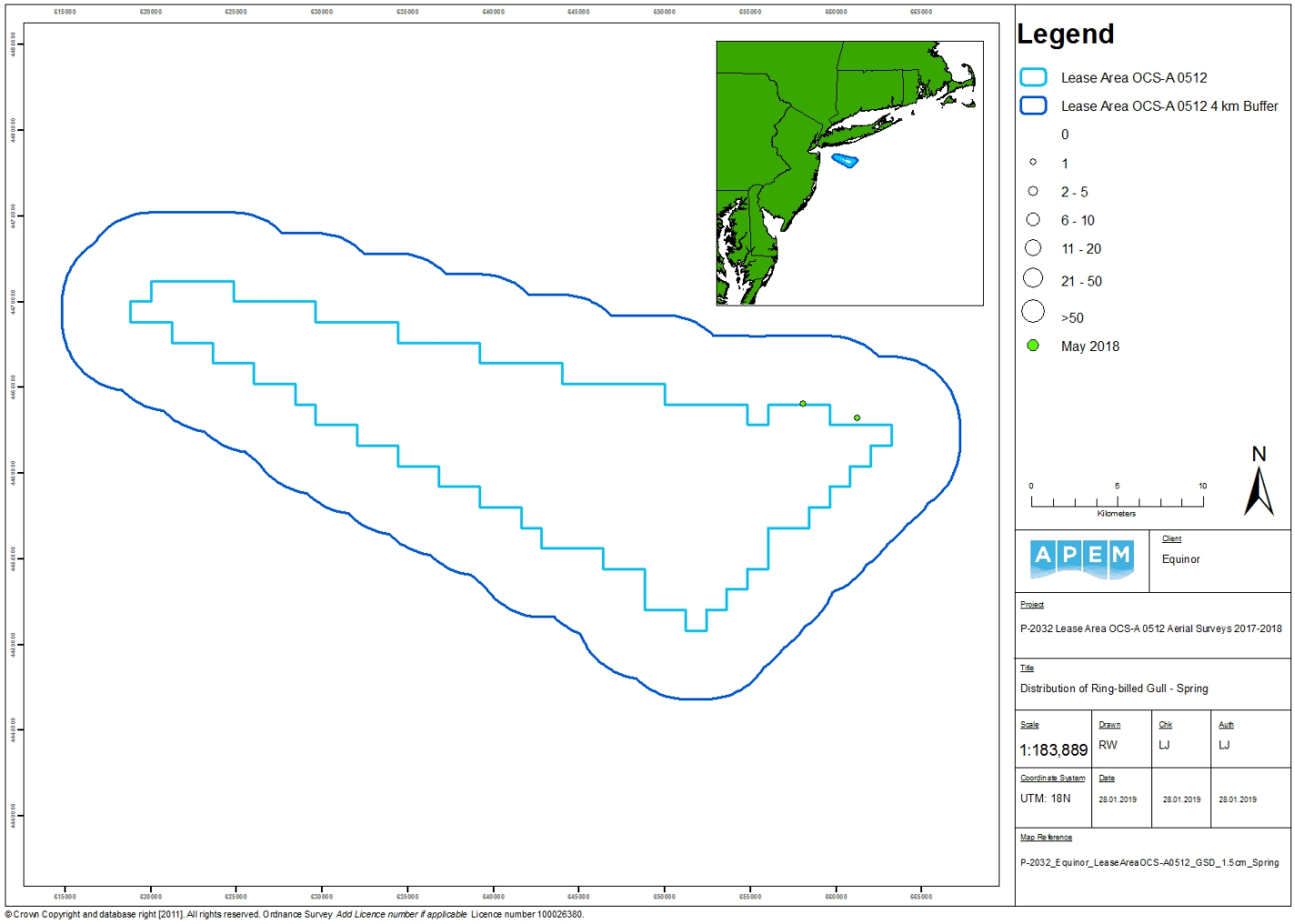
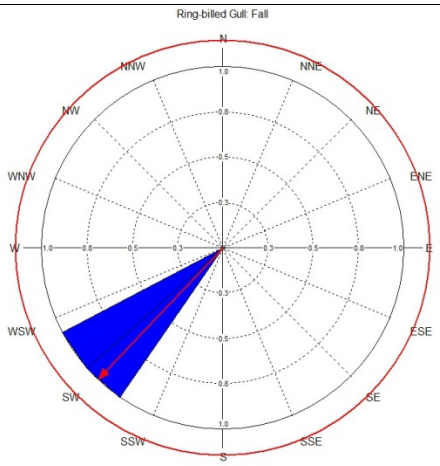
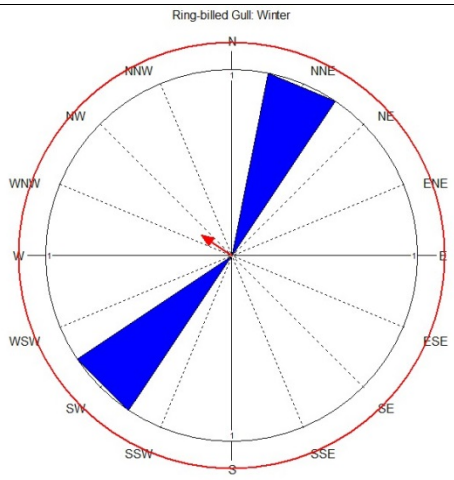


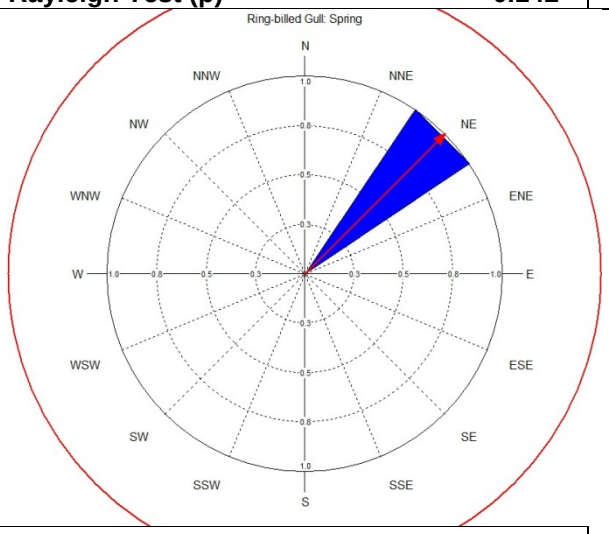
Figure 67 **Distribution of ring-billed gulls recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the spring season.**



Number of Observations	**2**
Mean Vector (μ)	**223.512**
Length of Mean Vector (r)	**0.993**
Rayleigh Test (Z)	**1.973**
Rayleigh Test (p)	**0.142**



Number of Observations	**2**
Mean Vector (μ)	**303.75**
Length of Mean Vector (r)	**0.195**
Rayleigh Test (Z)	**0.076**
Rayleigh Test (p)	**0.943**



Number of Observations	**1**
Mean Vector (μ)	**45**
Length of Mean Vector (r)	**1**
Rayleigh Test (Z)	**1**
Rayleigh Test (p)	**0.512**

Figure 68 **Summary of flight direction of ring-billed gulls recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the fall (n=2), winter (n=2), and spring (n=1) seasons.**

4.24 Laughing Gull

A peak count of two laughing gulls were recorded in the 4 km buffer in the May survey, resulting in an abundance estimate of 15. Single individuals were also recorded in the June and October surveys, resulting in abundance estimates of eight (**Table 30**).

In the fall, a single laughing gull was recorded in the west of the 4 km buffer in October (**Figure 69**). In spring, two laughing gulls were recorded in May, both within the 4 km buffer, one in the east and the other in the south (**Figure 70**). A single laughing gull was recorded in the north of the 4 km buffer in June (**Figure 71**).

A single laughing gull was recorded flying in a south-westerly direction in the fall, a single laughing gull was recorded flying in a west-north-westerly direction in the spring and a single laughing gull was recorded flying in a west-south-westerly direction in the summer (**Figure 72**).

Table 30 **Raw counts and abundance and density estimates (No. estimated individuals per km^2) of laughing gulls in: a) Lease Area OCS-A 0512 plus 4 km buffer, b) Lease Area OCS-A 0512, and c) the Lease Area OCS-A 0512 4 km buffer only.**

a) Lease Area OCS-A 0512 plus 4 km Buffer					
Survey	**Raw Count**	**Abundance**	**Density**	**Flying**	**Sitting**
May-18	2	15	0.02	1	1
Jun-18	1	8	0.01	1	0
Oct-18	1	8	0.01	1	0
b) Lease Area OCS-A 0512					
Survey	**Raw Count**	**Abundance**	**Density**	**Flying**	**Sitting**
May-18	0	0	-	0	0
Jun-18	0	0	-	0	0
Oct-18	0	0	-	0	0
c) 4 km Buffer					
Survey	**Raw Count**	**Abundance**	**Density**	**Flying**	**Sitting**
May-18	2	15	0.03	1	1
Jun-18	1	8	0.02	1	0
Oct-18	1	8	0.02	1	0

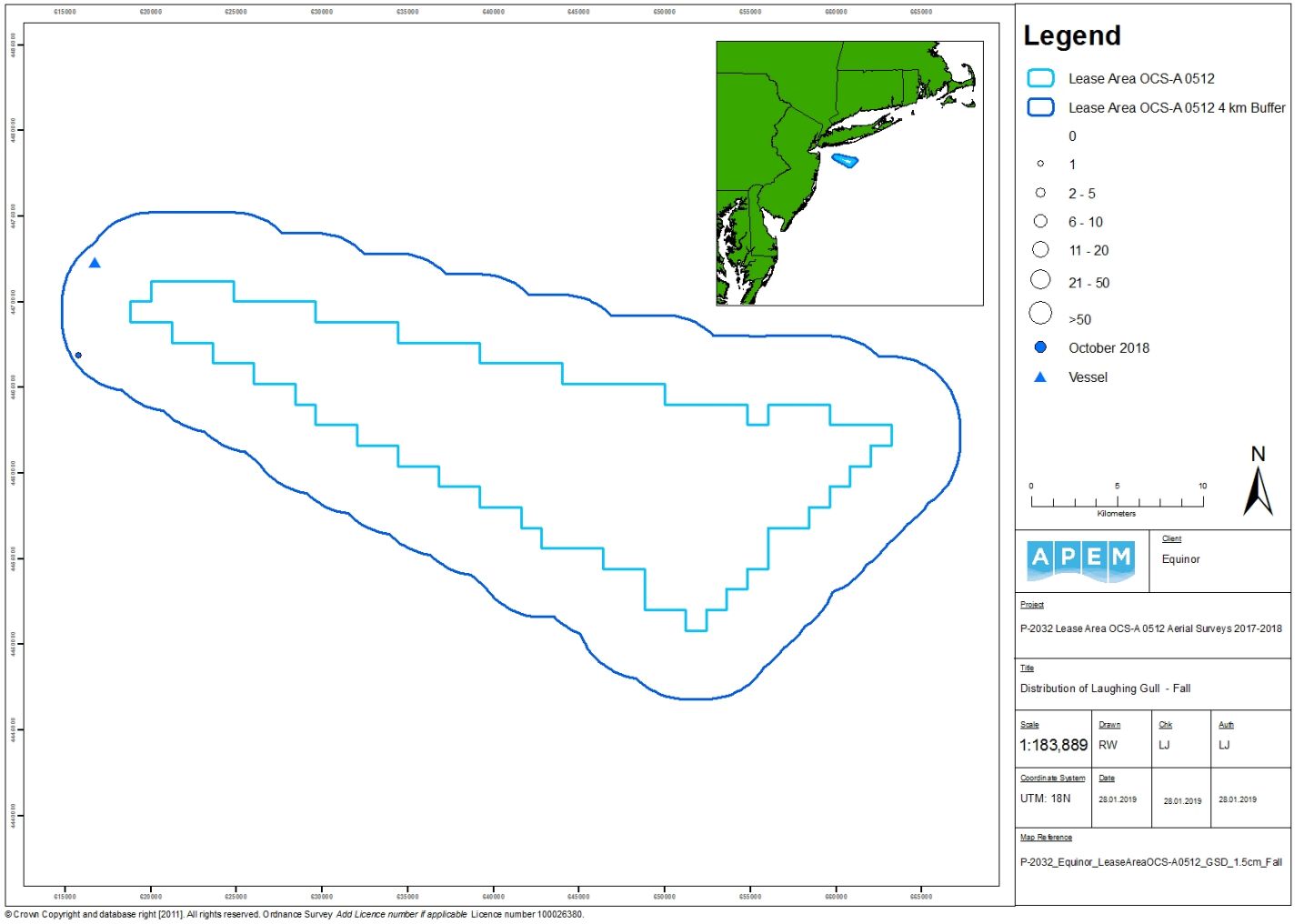


Figure 69 **Distribution of laughing gulls recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the fall season.**

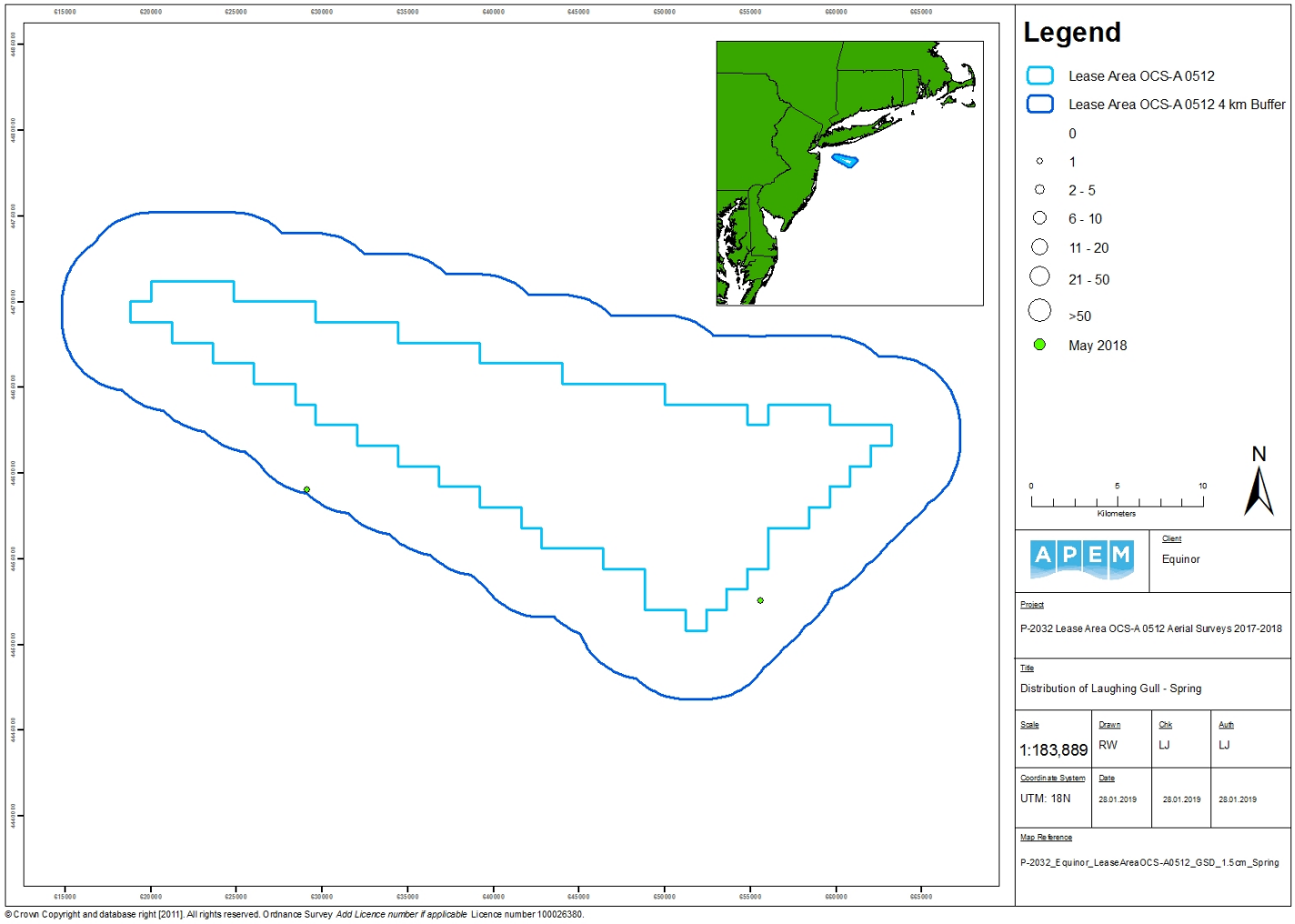


Figure 70 **Distribution of laughing gulls recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the spring season.**

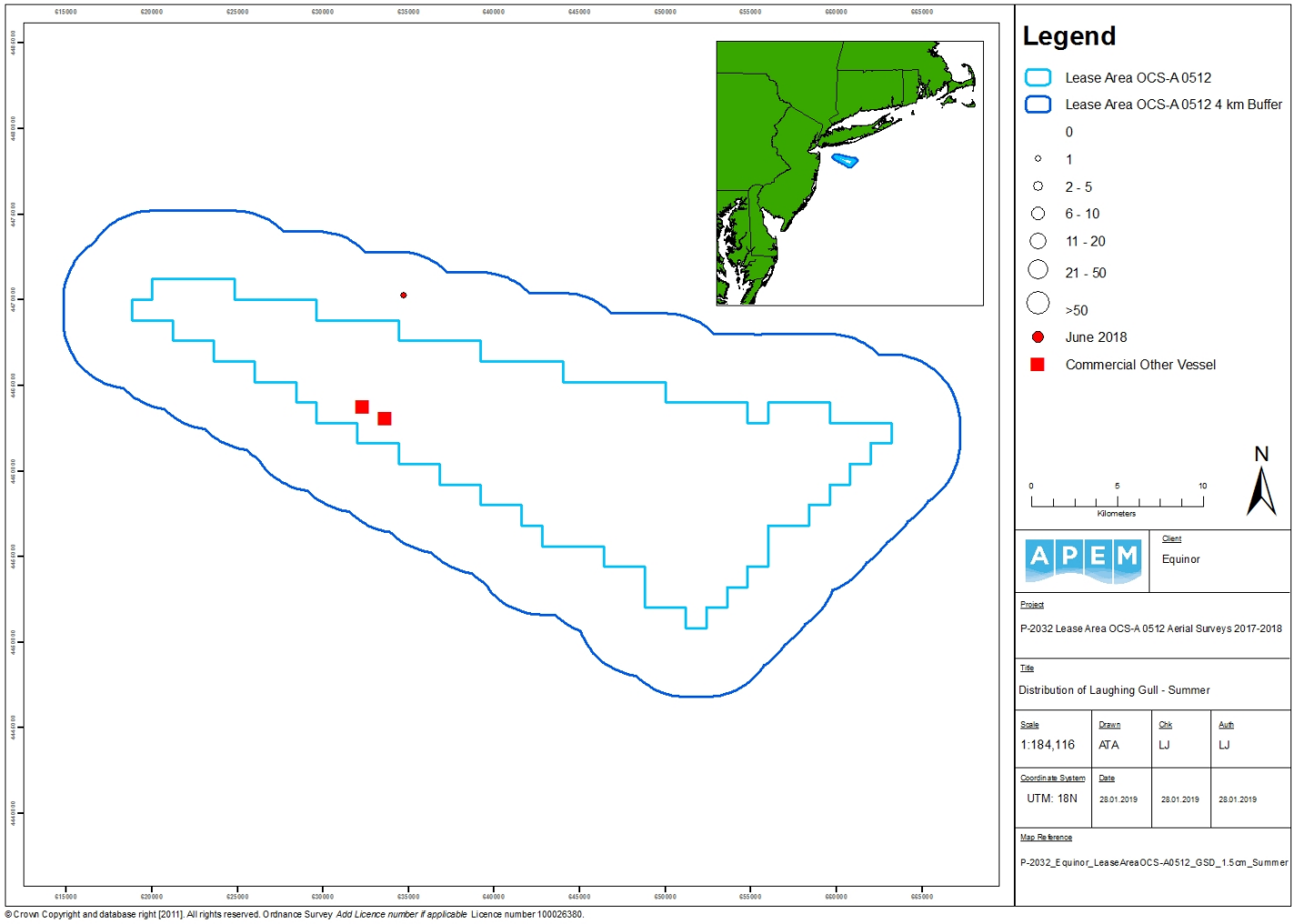
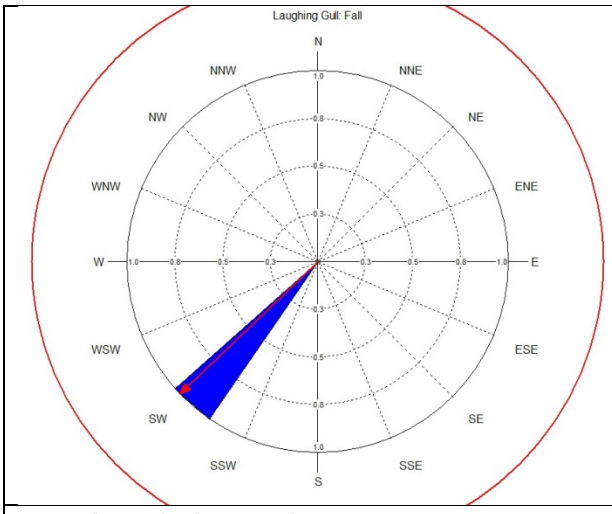
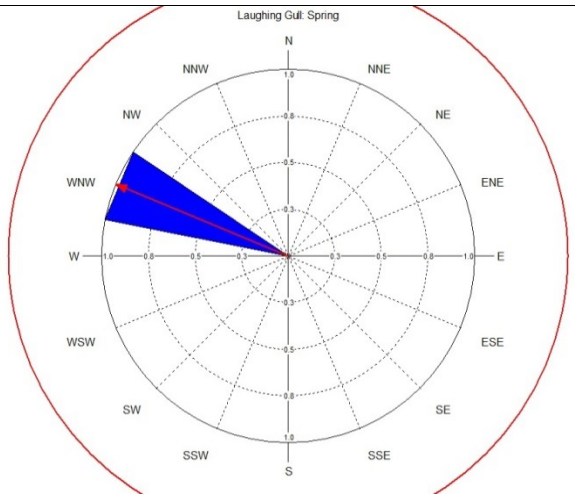


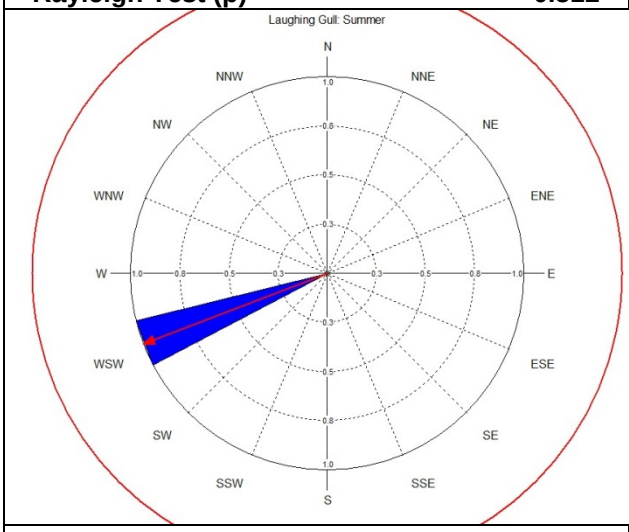
Figure 71 Distribution of laughing gulls recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the summer 2018 season.



Number of Observations	**1**
Mean Vector (μ)	**226.465**
Length of Mean Vector (r)	**1**
Rayleigh Test (Z)	**1**
Rayleigh Test (p)	**0.512**



Number of Observations	**1**
Mean Vector (μ)	**292.5**
Length of Mean Vector (r)	**1**
Rayleigh Test (Z)	**1**
Rayleigh Test (p)	**0.512**



Number of Observations	**1**
Mean Vector (μ)	**248.948**
Length of Mean Vector (r)	**1**
Rayleigh Test (Z)	**1**
Rayleigh Test (p)	**0.512**

Figure 72 **Summary of flight direction of laughing gulls recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the fall (n=1), spring (n=1), and summer (n=1) seasons.**

4.25 Herring Gull

Herring gulls were recorded in all but two months in the survey period, with a peak count of 46 individuals in the October survey, resulting in a abundance estimate of 362 (**Table 31**).

In the fall, herring gulls were recorded in the Lease Area OCS-A 0512 plus 4 km buffer in all months: November, September, and October, loosely distributed around the Lease Area

OCS-A 0512 plus 4 km buffer (**Figure 73**). In winter, herring gulls were recorded in all months: December, January, and February, loosely distributed across the Lease Area OCS-A 0512 site and the south of the 4 km buffer (**Figure 74**). In the spring, herring gulls were recorded in all months: March, April, and May, with individuals loosely distributed across the Lease Area OCS-A 0512 plus 4 km buffer, with a slightly greater concentration in the east (**Figure 75**). Herring gulls were recorded in the summer in fewer numbers compared to the other seasons. In June, individuals were recorded in the north of the 4 km buffer as well as in the south-east in both the Lease Area OCS-A 0512 site and the 4 km buffer (**Figure 76**).

A total of 34 herring gulls were recorded in flight in the fall, which showed a tendency to fly in a west-north-westerly direction. Seven herring gulls were recorded flying in winter, but did not show a significant tendency to fly in any one direction. Fifteen herring gulls were recorded in flight in spring 2018, which showed a significant preference to fly in a northerly direction around a mean of 5°. Five herring gulls were recorded in flight in summer, but did not show a preference to fly in any one direction (**Figure 77**).

Table 31 **Raw counts and abundance and density estimates (No. estimated individuals per km^2) of herring gulls in: a) Lease Area OCS-A 0512 plus 4 km buffer, b) Lease Area OCS-A 0512, and c) the Lease Area OCS-A 0512 4 km buffer only.**

a) Lease Area OCS-A 0512 plus 4 km Buffer					
Survey	**Raw Count**	**Abundance**	**Density**	**Flying**	**Sitting**
Nov-17	2	16	0.02	1	1
Dec-17	3	23	0.03	3	0
Jan-18	4	31	0.04	1	3
Feb-18	3	24	0.03	3	0
Mar-18	17	136	0.17	10	7
Apr-18	3	23	0.03	3	0
May-18	8	60	0.07	2	6
Jun-18	6	49	0.06	5	1
Sep-18	12	94	0.11	10	2
Oct-18	46	362	0.44	23	23
b) Lease Area OCS-A 0512					
Survey	**Raw Count**	**Abundance**	**Density**	**Flying**	**Sitting**
Nov-17	0	0	-	0	0
Dec-17	0	0	-	0	0
Jan-18	1	8	0.02	1	0
Feb-18	2	16	0.05	2	0
Mar-18	8	63	0.2	4	4
Apr-18	3	22	0.07	3	0
May-18	5	37	0.12	1	4
Jun-18	2	16	0.05	1	1
Sep-18	6	46	0.14	5	1
Oct-18	28	219	0.68	13	15
c) 4 km Buffer					
Survey	**Raw Count**	**Abundance**	**Density**	**Flying**	**Sitting**
Nov-17	2	16	0.03	1	1
Dec-17	3	24	0.05	3	0

Jan-18	3	23	0.05	0	3
Feb-18	1	8	0.02	1	0
Mar-18	9	73	0.15	6	3
Apr-18	0	0	-	0	0
May-18	3	23	0.05	1	2
Jun-18	4	33	0.07	4	0
Sep-18	6	47	0.09	5	1
Oct-18	18	143	0.29	10	8

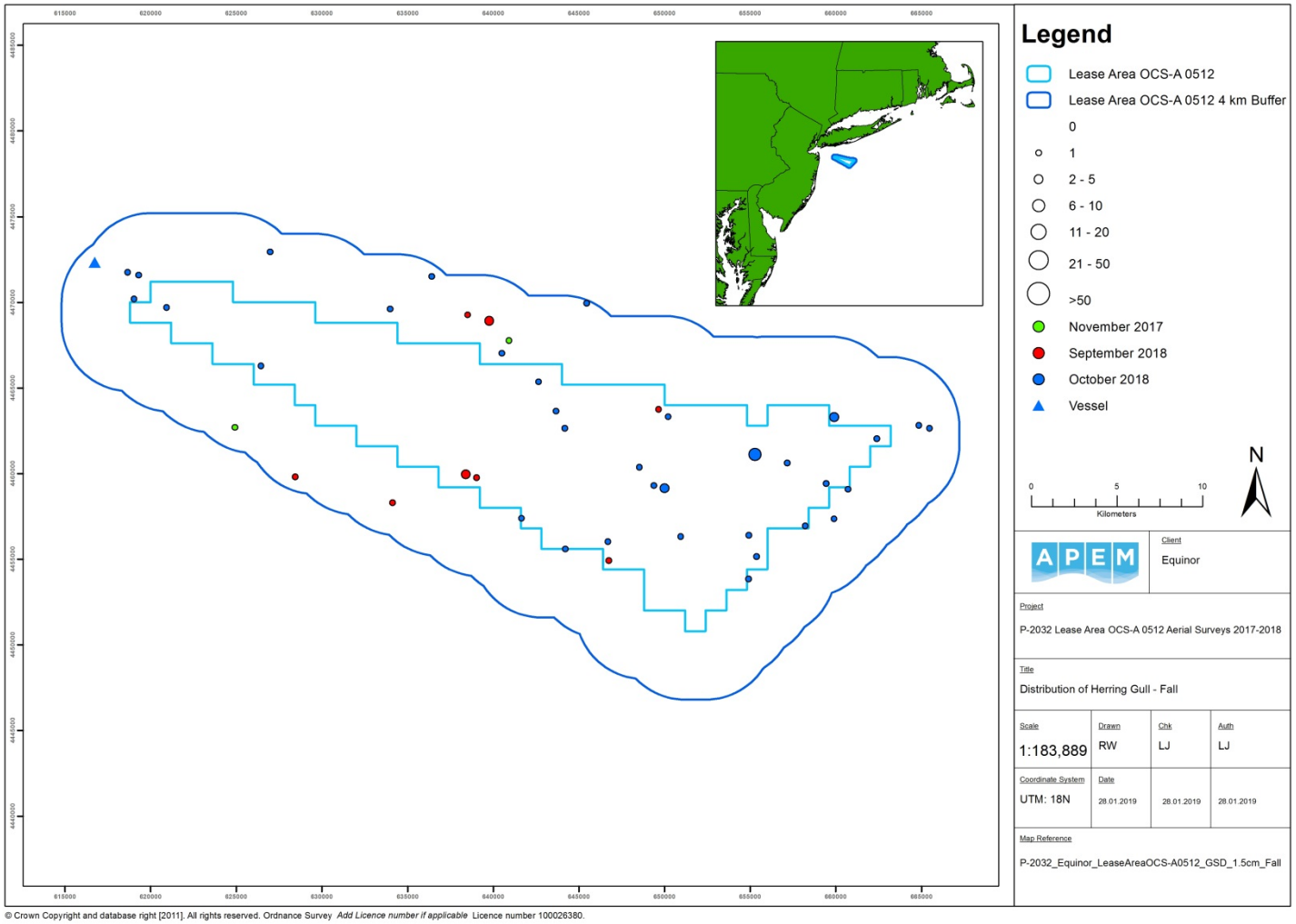


Figure 73 Distribution of herring gulls recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the fall season.

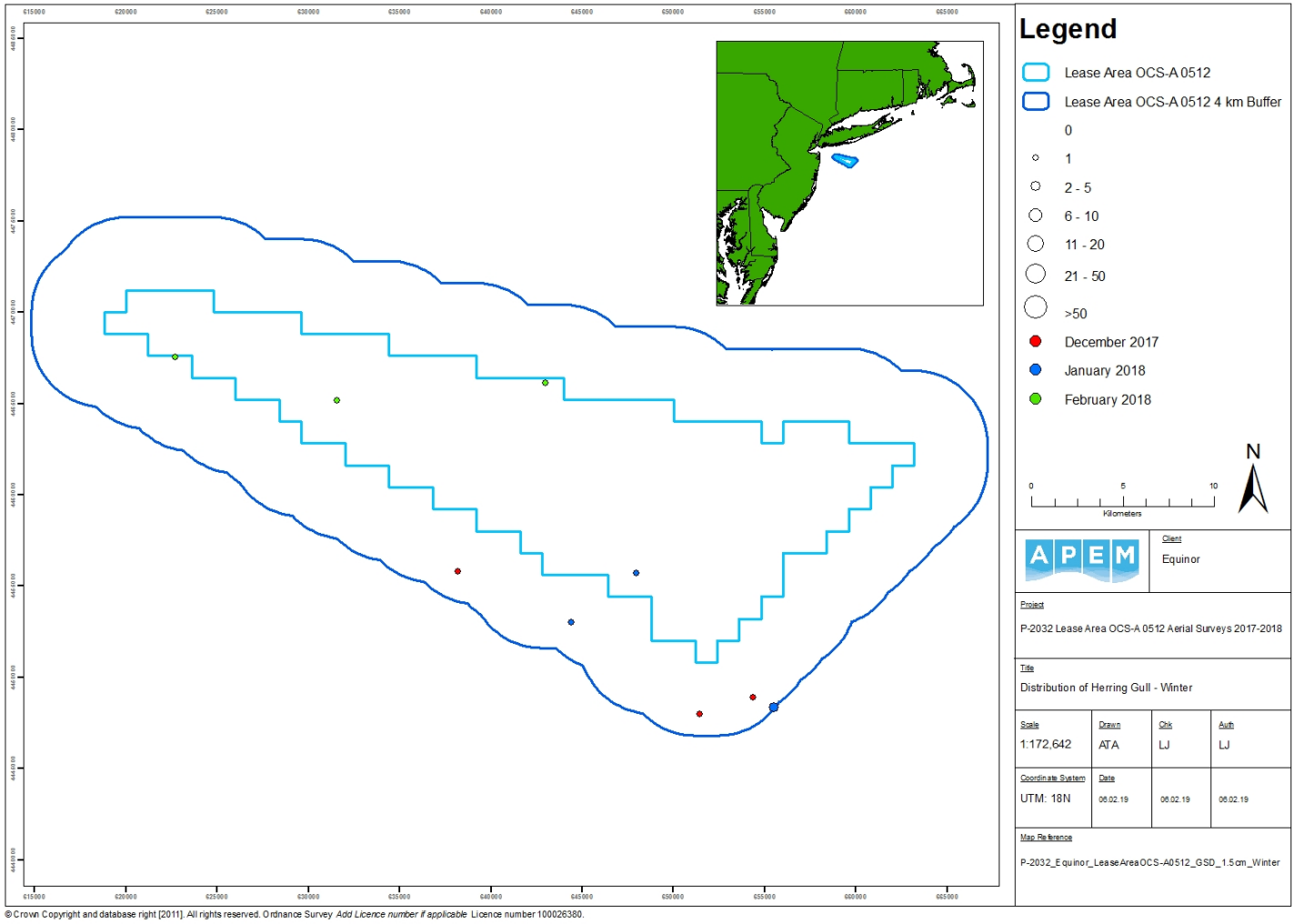


Figure 74 Distribution of herring gulls recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the winter season.

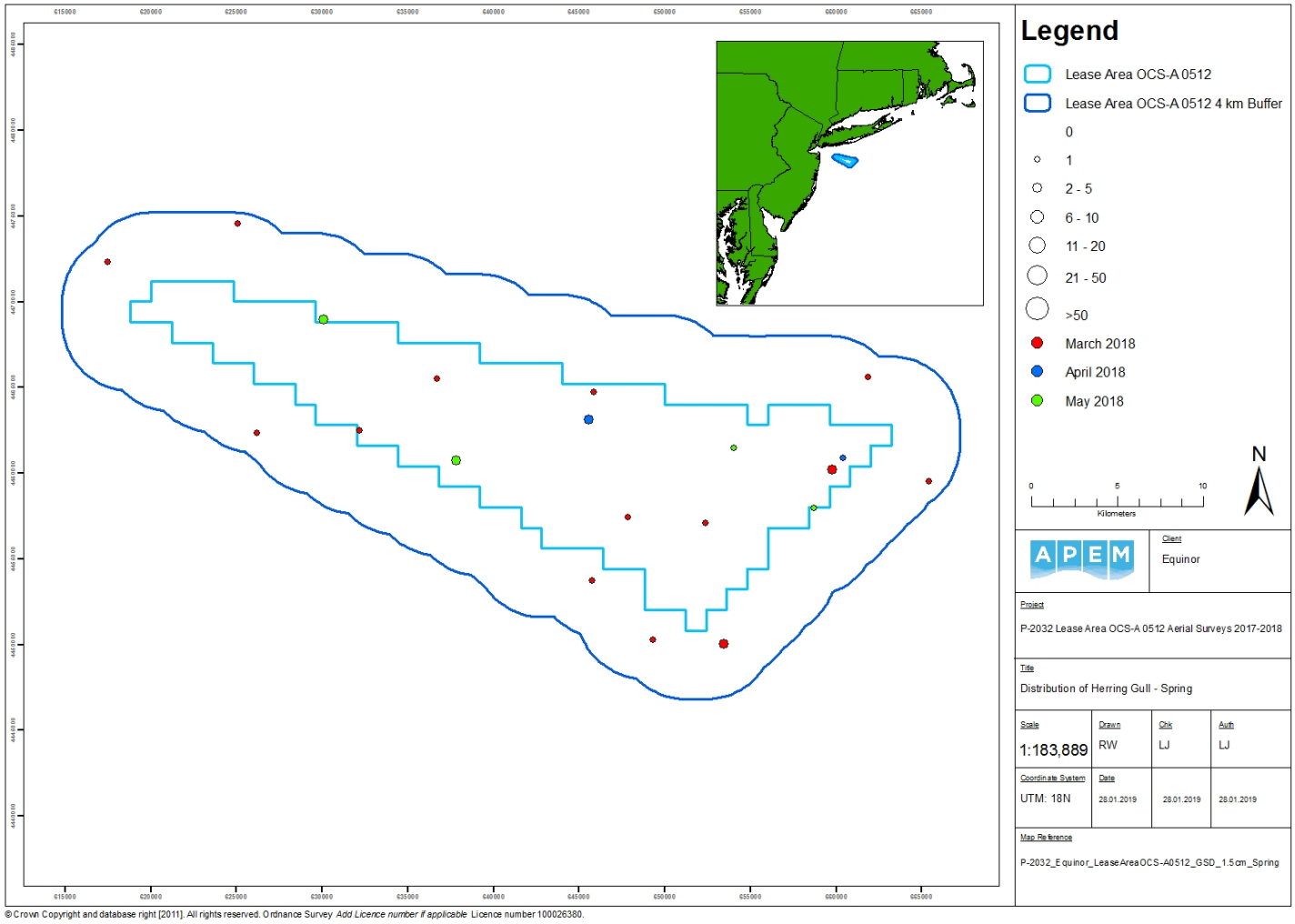


Figure 75 **Distribution of herring gulls recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the spring season.**

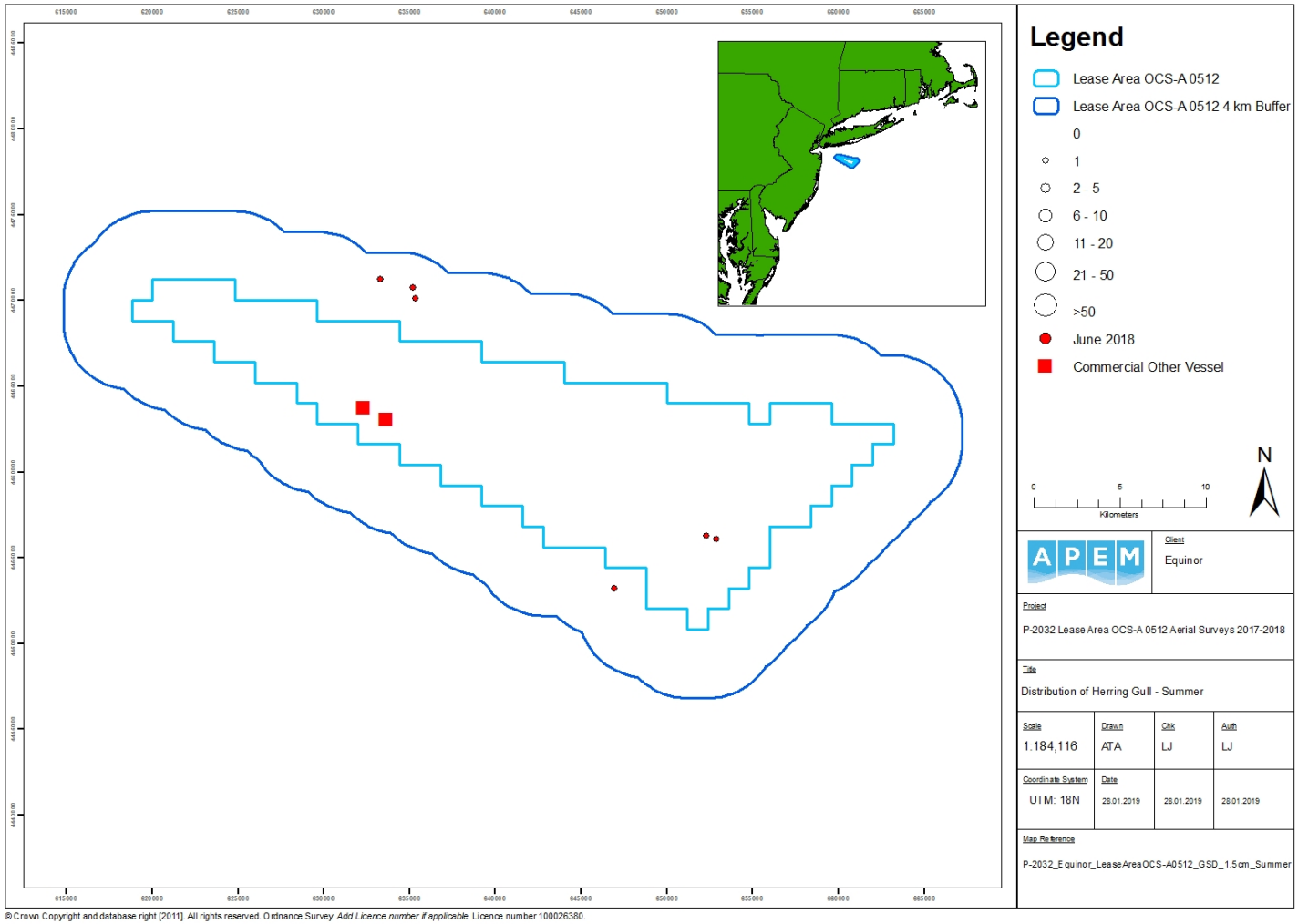
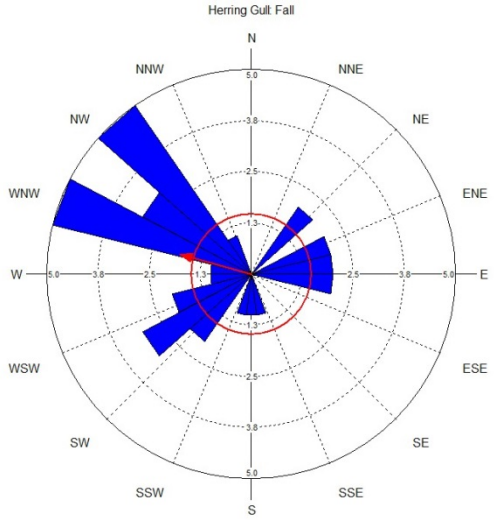
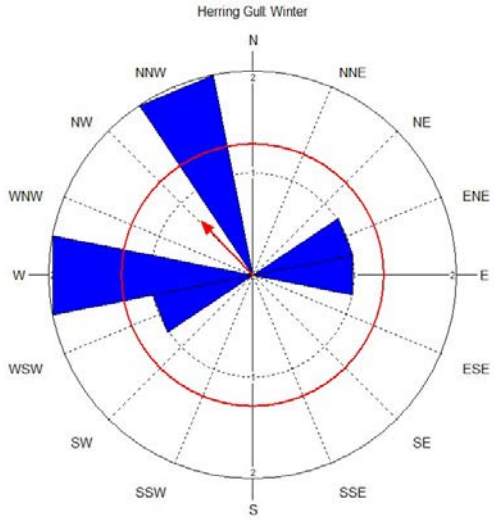


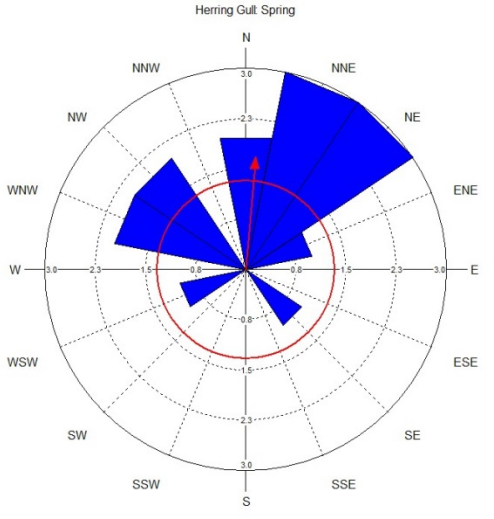
Figure 76 Distribution of herring gulls recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the summer season.



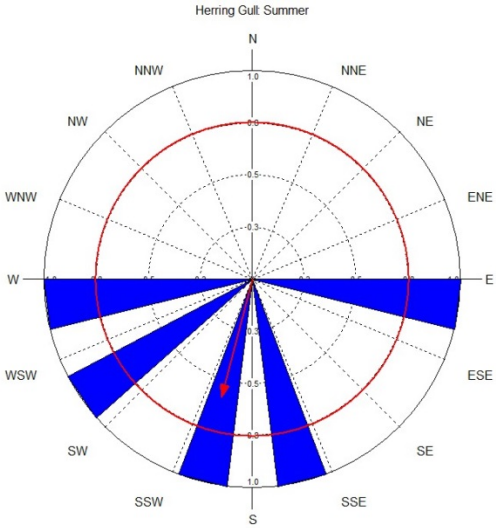
Number of Observations	**34**
Mean Vector (μ)	**285.457**
Length of Mean Vector (r)	**0.359**
Rayleigh Test (Z)	**4.384**
Rayleigh Test (p)	**0.011**



Number of Observations	**7**
Mean Vector (μ)	**316.306**
Length of Mean Vector (r)	**0.365**
Rayleigh Test (Z)	**0.933**
Rayleigh Test (p)	**0.408**



Number of Observations	**15**
Mean Vector (μ)	**4.882**
Length of Mean Vector (r)	**0.56**
Rayleigh Test (Z)	**4.699**
Rayleigh Test (p)	**0.007**



Number of Observations	**5**
Mean Vector (μ)	**194.877**
Length of Mean Vector (r)	**0.581**
Rayleigh Test (Z)	**1.687**
Rayleigh Test (p)	**0.191**

Figure 77 **Summary of flight direction of herring gulls recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the fall (n=34), winter (n=7), spring (n=15), and summer (n=5) seasons.**

4.26 Lesser Black-backed Gull

In April a single individual was observed in the east of the Lease Area OCS-A 0512 site, whilst in May a single individual was recorded in the 4 km buffer (**Table 32, Figure 78**), resulting in abundance estimates of eight April and May, respectively.

Table 32 **Raw counts and abundance and density estimates (No. estimated individuals per km^2) of lesser black-backed gulls in: a) Lease Area OCS-A 0512 plus 4 km buffer, b) Lease Area OCS-A 0512, and c) the Lease Area OCS-A 0512 4 km buffer only.**

a) Lease Area OCS-A 0512 plus 4 km Buffer					
Survey	**Raw Count**	**Abundance**	**Density**	**Flying**	**Sitting**
Apr-18	1	8	0.01	0	1
May-18	1	8	0.01	0	1
b) Lease Area OCS-A 0512					
Survey	**Raw Count**	**Abundance**	**Density**	**Flying**	**Sitting**
Apr-18	1	7	0.02	0	1
May-18	0	0	-	0	0
c) 4 km Buffer					
Survey	**Raw Count**	**Abundance**	**Density**	**Flying**	**Sitting**
Apr-18	0	0	-	0	0
May-18	1	8	0.02	0	1

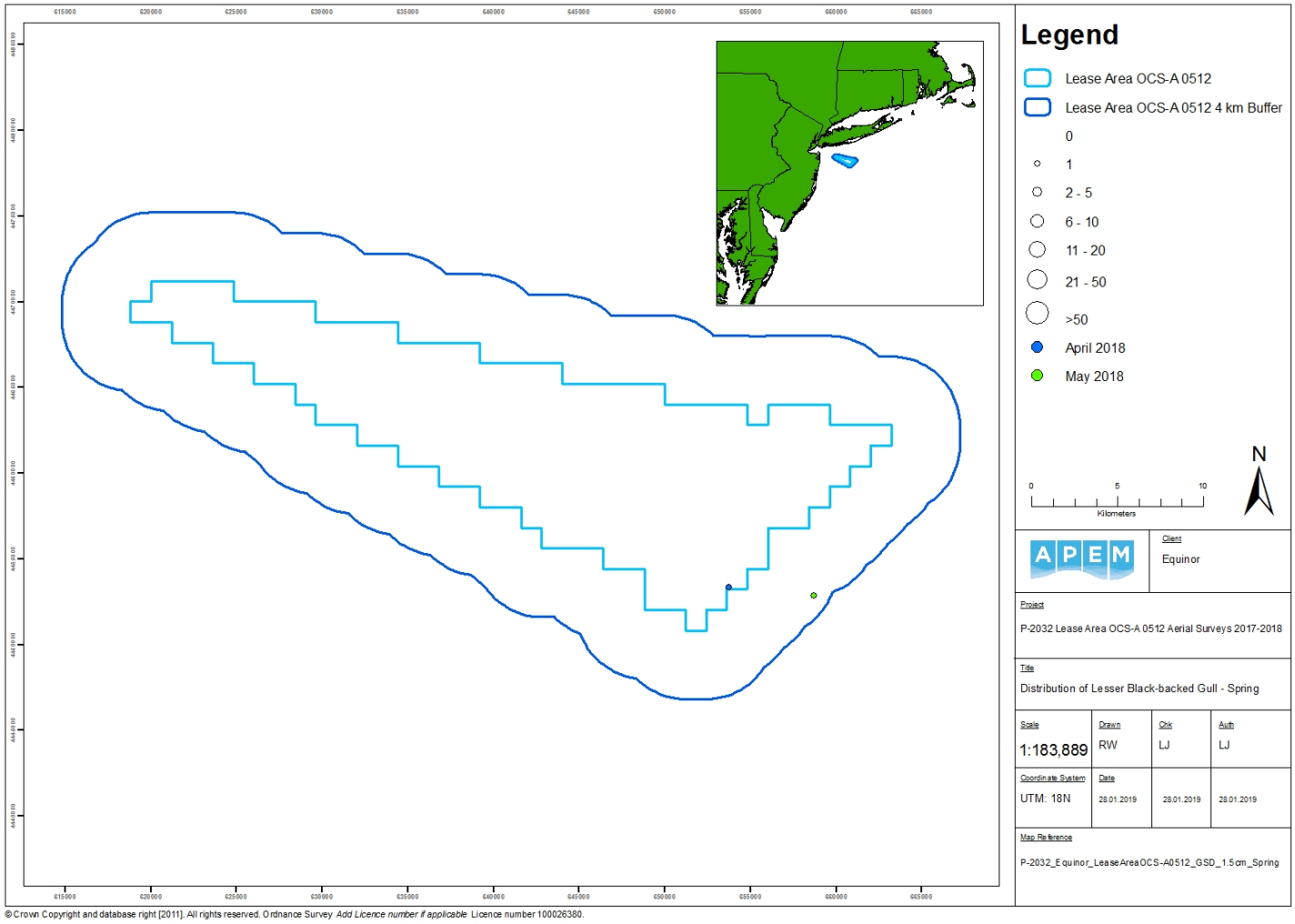


Figure 78 Distribution of lesser black-backed gulls recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the spring season.

4.27 Great Black-backed Gull

Peak counts of great black-backed gulls were recorded in the in the September and October surveys, with 13 and 15 individuals, respectively. These counts led to abundance estimates of 102 and 118. The peak abundance estimate for the both the Lease Area OCS-A 0512 site and the 4 km buffer was in October, with 47 in the Lease Area OCS-A 0512 site and 71 in the 4 km buffer. Great black-backed gulls were generally recorded in fewer numbers throughout the survey period (**Table 33**), with individuals being recorded in every month bar November, March and July.

In the fall great black-backed gulls were recorded in September and October, with individuals loosely distributed across the Lease Area OCS-A 0512 plus 4 km buffer (**Figure 79**). In winter, great black-backed gulls were recorded in December, January, and February, with individuals loosely distributed across the Lease Area OCS-A 0512 plus 4 km buffer (**Figure 80**). In the spring, great black-backed gulls were recorded in April and May, in both the Lease Area OCS-A 0512 site and the 4 km buffer (**Figure 81**). In summer, great black-backed gulls were recorded in June and August, with a single individual recorded in each survey. In June, the gull was recorded in the east of the Lease Area OCS-A 0512 site, whilst in August; the individual was recorded in the west of the 4 km buffer (**Figure 82**).

Fourteen great back-backed gulls were recorded in flight in the fall and showed a tendency to fly in a south to south-south-easterly direction. Three great black-backed gulls were recorded flying in winter, two were flying in a westerly direction and one was flying in an east-south-easterly direction. A single great back-backed gull was recorded in spring 2018, flying in a north-easterly direction. Two great black-backed gulls were recorded in flight in summer 2018. One was recorded flying in a westerly direction, the other in a south-south-westerly direction (**Figure 83**).

Table 33 **Raw counts and abundance and density estimates (No. estimated individuals per km^2) of great black-backed gulls in: a) Lease Area OCS-A 0512 plus 4 km buffer, b) Lease Area OCS-A 0512, and c) the Lease Area OCS-A 0512 4 km buffer only.**

a) Lease Area OCS-A 0512 plus 4 km Buffer					
Survey	**Raw Count**	**Abundance**	**Density**	**Flying**	**Sitting**
Dec-17	2	15	0.02	0	2
Jan-18	4	31	0.04	2	2
Feb-18	2	16	0.02	1	1
Apr-18	1	8	0.01	1	0
May-18	3	23	0.03	0	3
Jun-18	1	8	0.01	1	0
Aug-18	1	7	0.01	1	0
Sep-18	13	102	0.12	5	8
Oct-18	15	118	0.14	9	6
b) Lease Area OCS-A 0512					
Survey	**Raw Count**	**Abundance**	**Density**	**Flying**	**Sitting**
Dec-17	1	8	0.02	0	1
Jan-18	1	8	0.02	0	1
Feb-18	1	8	0.02	0	1

Apr-18	1	7	0.02	1	0
May-18	1	7	0.02	0	1
Jun-18	1	8	0.02	1	0
Aug-18	0	0	-	0	0
Sep-18	5	38	0.12	2	3
Oct-18	6	47	0.15	4	2
c) 4 km Buffer					
Survey	**Raw Count**	**Abundance**	**Density**	**Flying**	**Sitting**
Dec-17	1	8	0.02	0	1
Jan-18	3	23	0.05	2	1
Feb-18	1	8	0.02	1	0
Apr-18	0	0	-	0	0
May-18	2	15	0.03	0	2
Jun-18	0	0	-	0	0
Aug-18	1	8	0.02	1	0
Sep-18	8	63	0.13	3	5
Oct-18	9	71	0.14	5	4

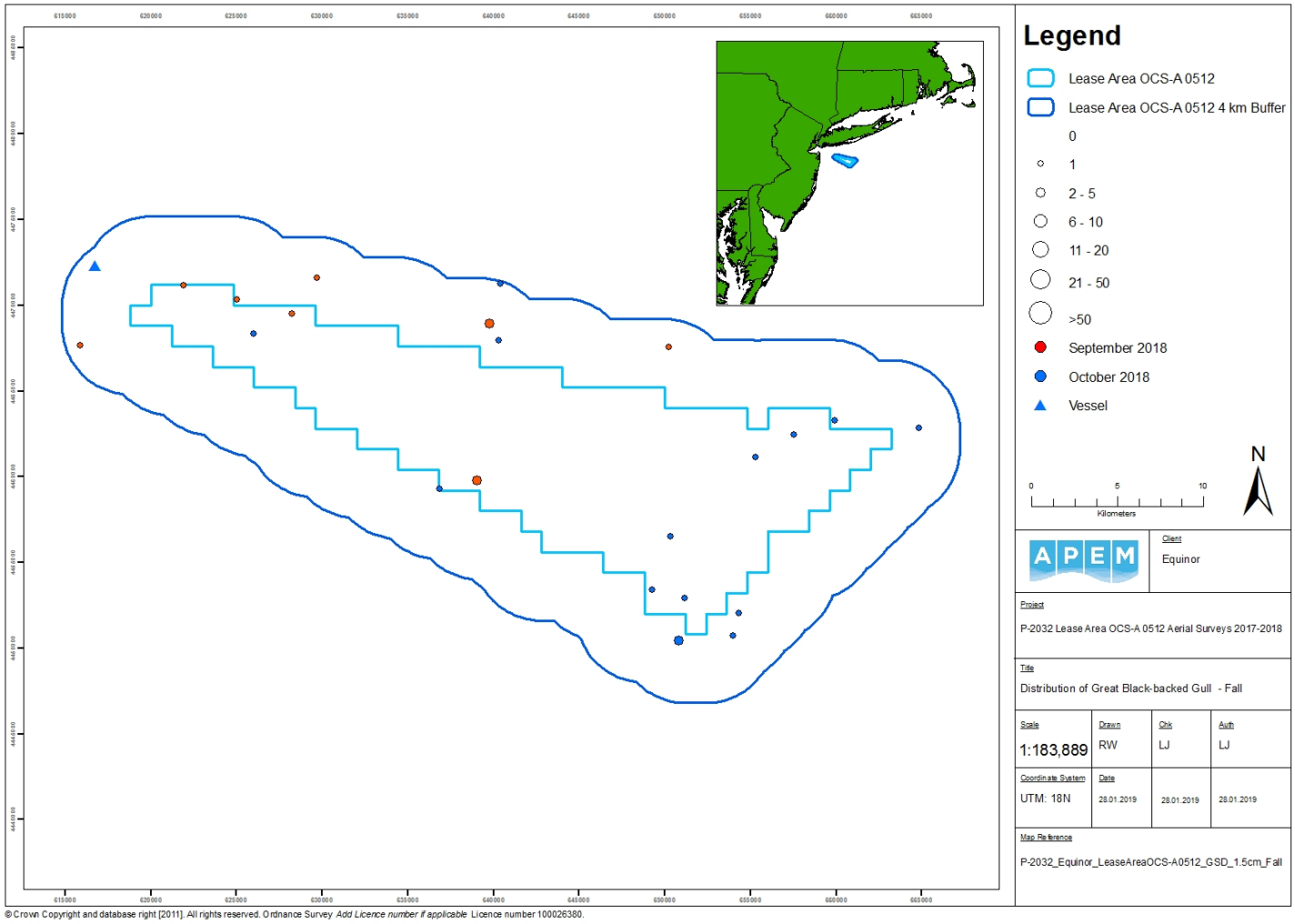


Figure 79 **Distribution of great black-backed gulls recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the fall season.**

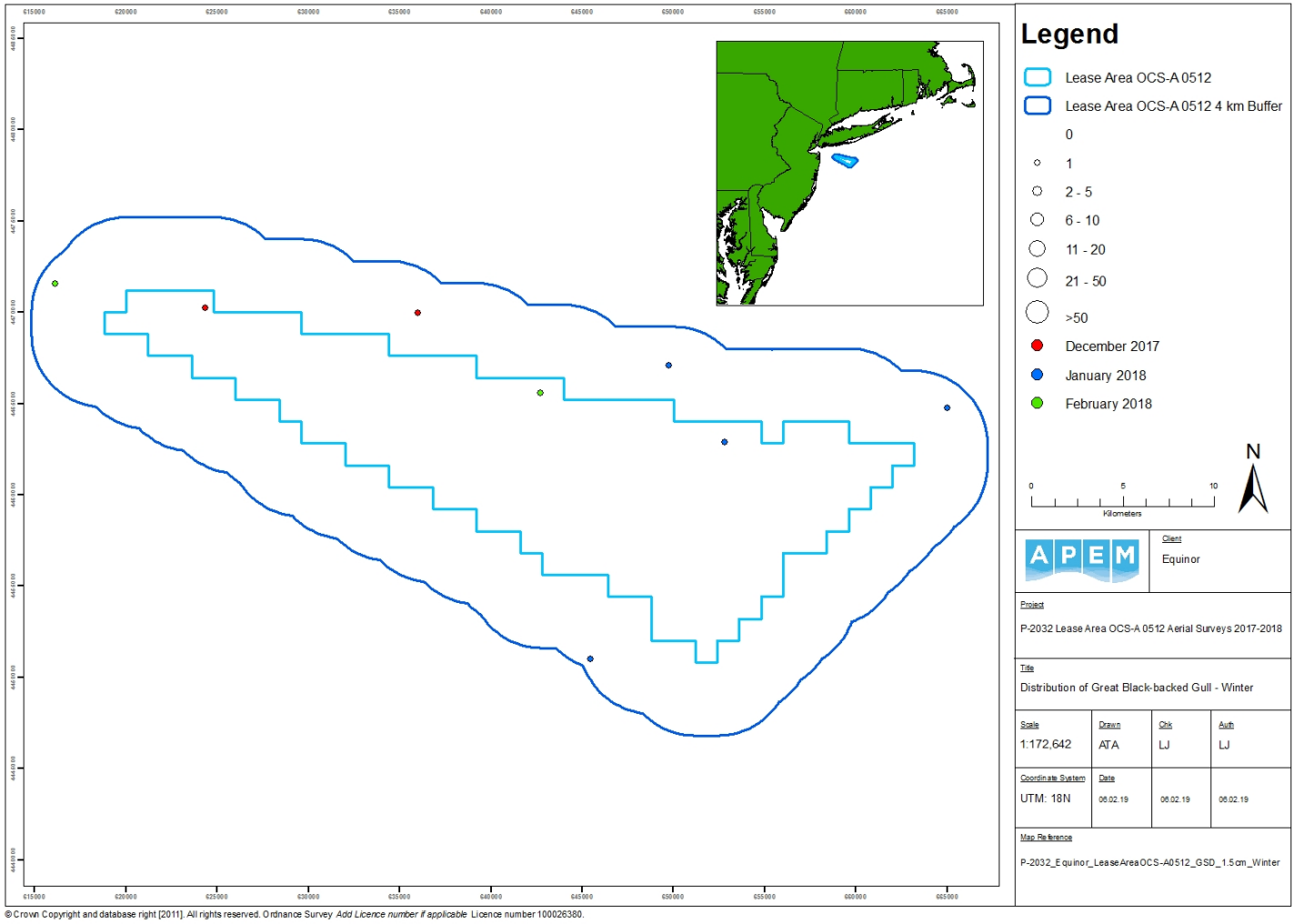


Figure 80 Distribution of great black-backed gulls recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the winter season.

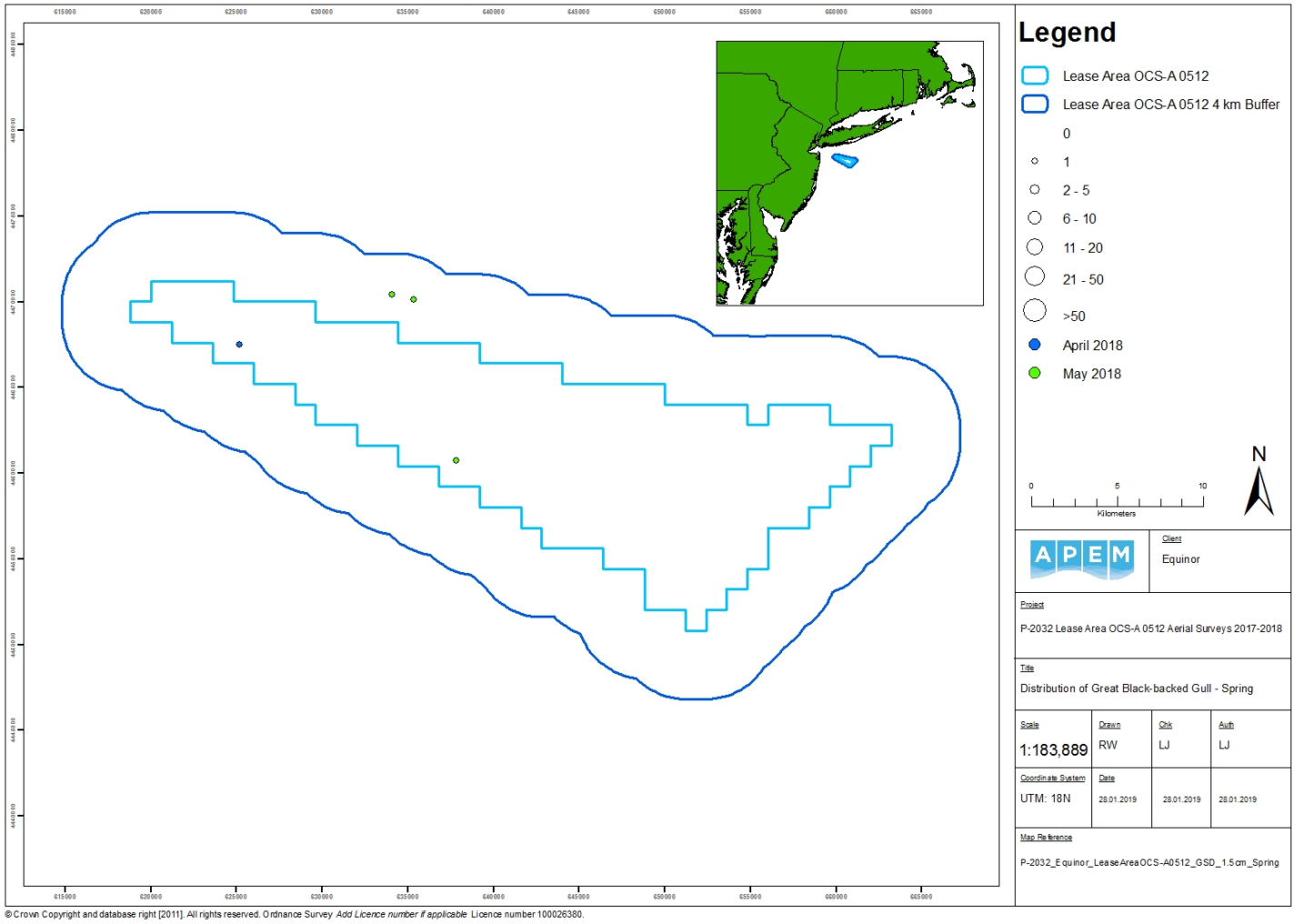


Figure 81 **Distribution of great black-backed gulls recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the spring season.**

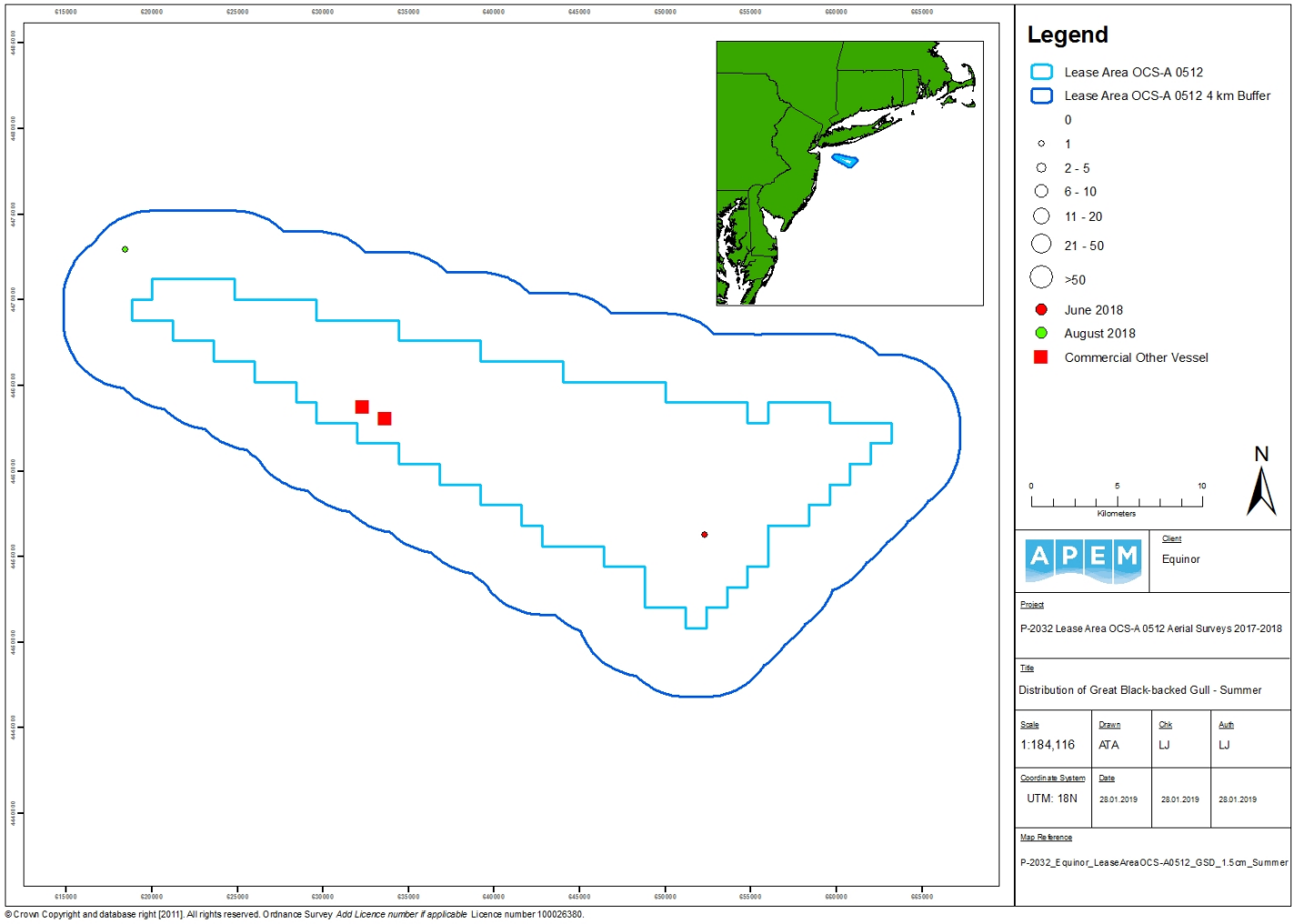
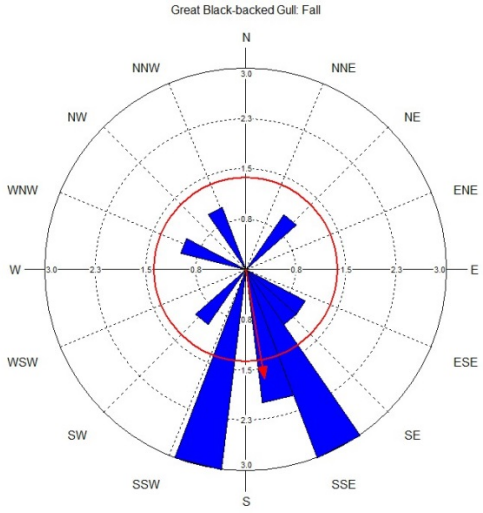
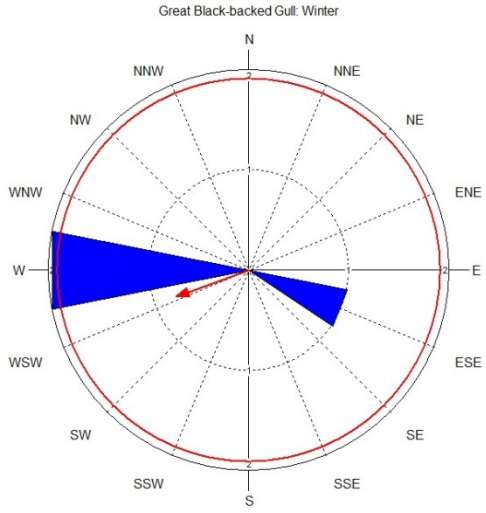


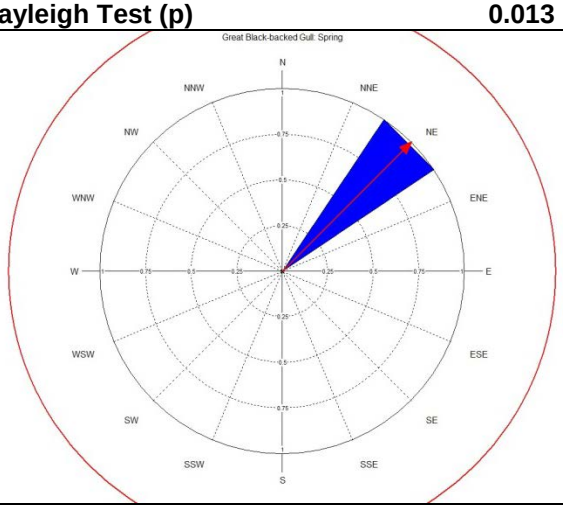
Figure 82 **Distribution of great black-backed gulls recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the summer season.**



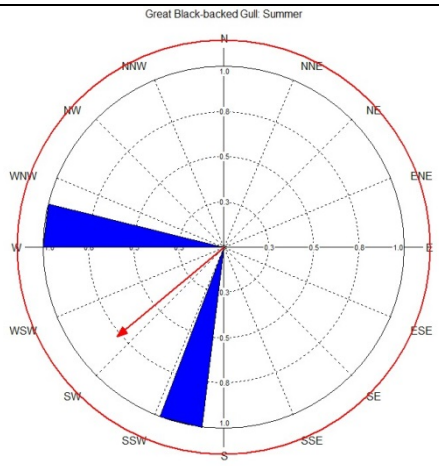
Number of Observations	**14**
Mean Vector (μ)	**170.416**
Length of Mean Vector (r)	**0.547**
Rayleigh Test (Z)	**4.185**
Rayleigh Test (p)	**0.013**



Number of Observations	**3**
Mean Vector (μ)	**250.424**
Length of Mean Vector (r)	**0.381**
Rayleigh Test (Z)	**0.435**
Rayleigh Test (p)	**0.686**



Number of Observations	**1**
Mean Vector (μ)	**45**
Length of Mean Vector (r)	**1**
Rayleigh Test (Z)	**1**
Rayleigh Test (p)	**0.512**



Number of Observations	**2**
Mean Vector (μ)	**230.439**
Length of Mean Vector (r)	**0.768**
Rayleigh Test (Z)	**1.18**
Rayleigh Test (p)	**0.357**

Figure 83 **Summary of flight direction of black scoters recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the fall (n=14), winter (n=3), spring (n=1), and summer (n=2) seasons.**

4.28 Species Unknown – Large Gull

Single unknown large gull species were recorded in the 4 km buffer in the December and May surveys (**Table 34**).

In winter, the unknown large gull species was recorded in the north of the Lease Area OCS-A 0512 site (**Figure 84**). In spring, the unknown large gull was recorded in the north-west of the 4 km buffer in May (**Figure 85**).

One unknown large gull species was recorded flying in a south-south-westerly direction during winter (**Figure 86**).

Table 34 **Raw counts and abundance and density estimates (No. estimated individuals per km^2) of unknown large gull species in: a) Lease Area OCS-A 0512 plus 4 km buffer, b) Lease Area OCS-A 0512, and c) the Lease Area OCS-A 0512 4 km buffer only.**

a) Lease Area OCS-A 0512 plus 4 km Buffer					
Survey	**Raw Count**	**Abundance**	**Density**	**Flying**	**Sitting**
Dec-17	1	8	0.01	1	0
May-18	1	8	0.01	0	1
b) Lease Area OCS-A 0512					
Survey	**Raw Count**	**Abundance**	**Density**	**Flying**	**Sitting**
Dec-17	0	0	-	0	0
May-18	0	0	-	0	0
c) 4 km Buffer					
Survey	**Raw Count**	**Abundance**	**Density**	**Flying**	**Sitting**
Dec-17	1	8	0.02	1	0
May-18	1	8	0.02	0	1

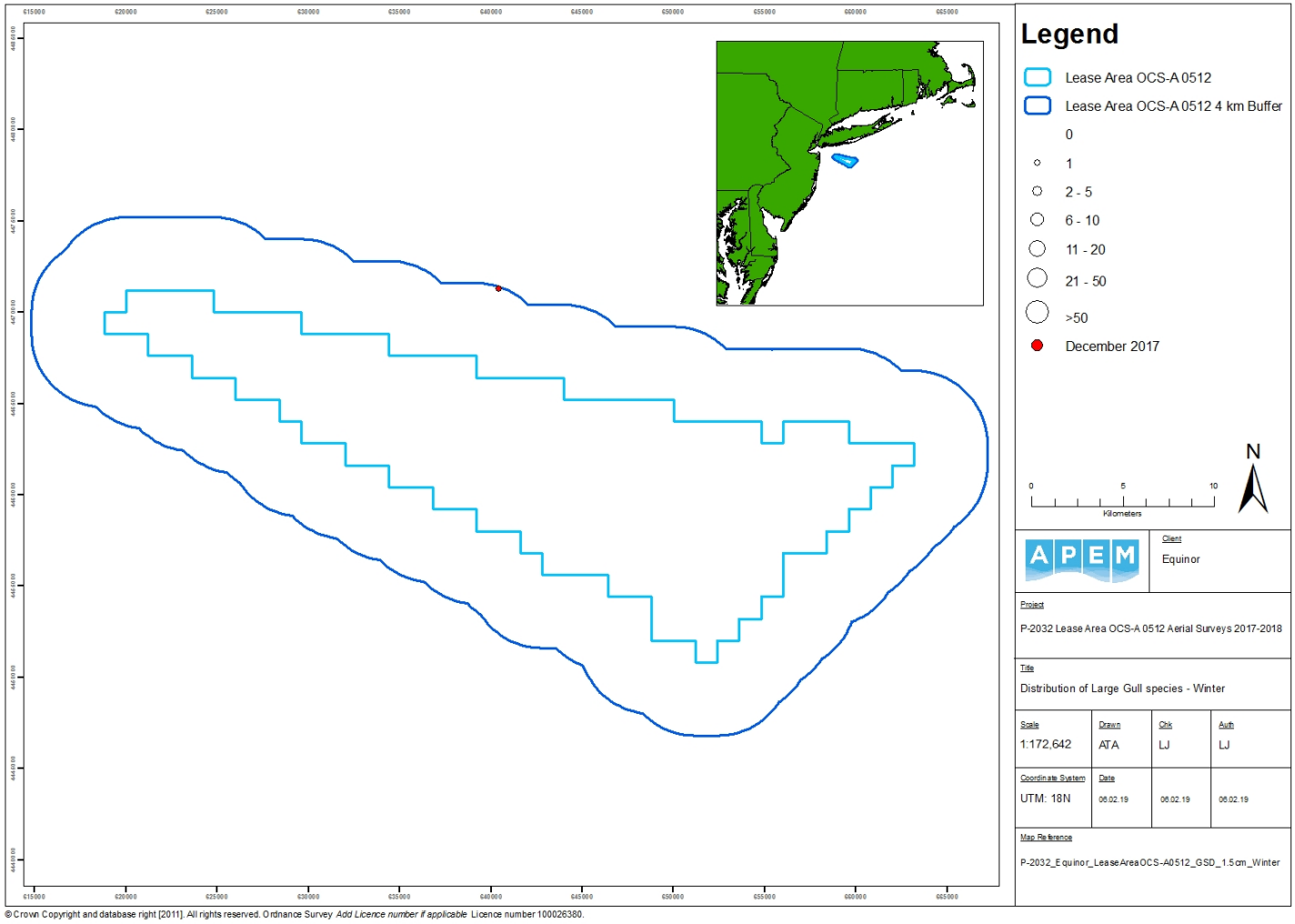


Figure 84 Distribution of unknown large gull species recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the winter season.

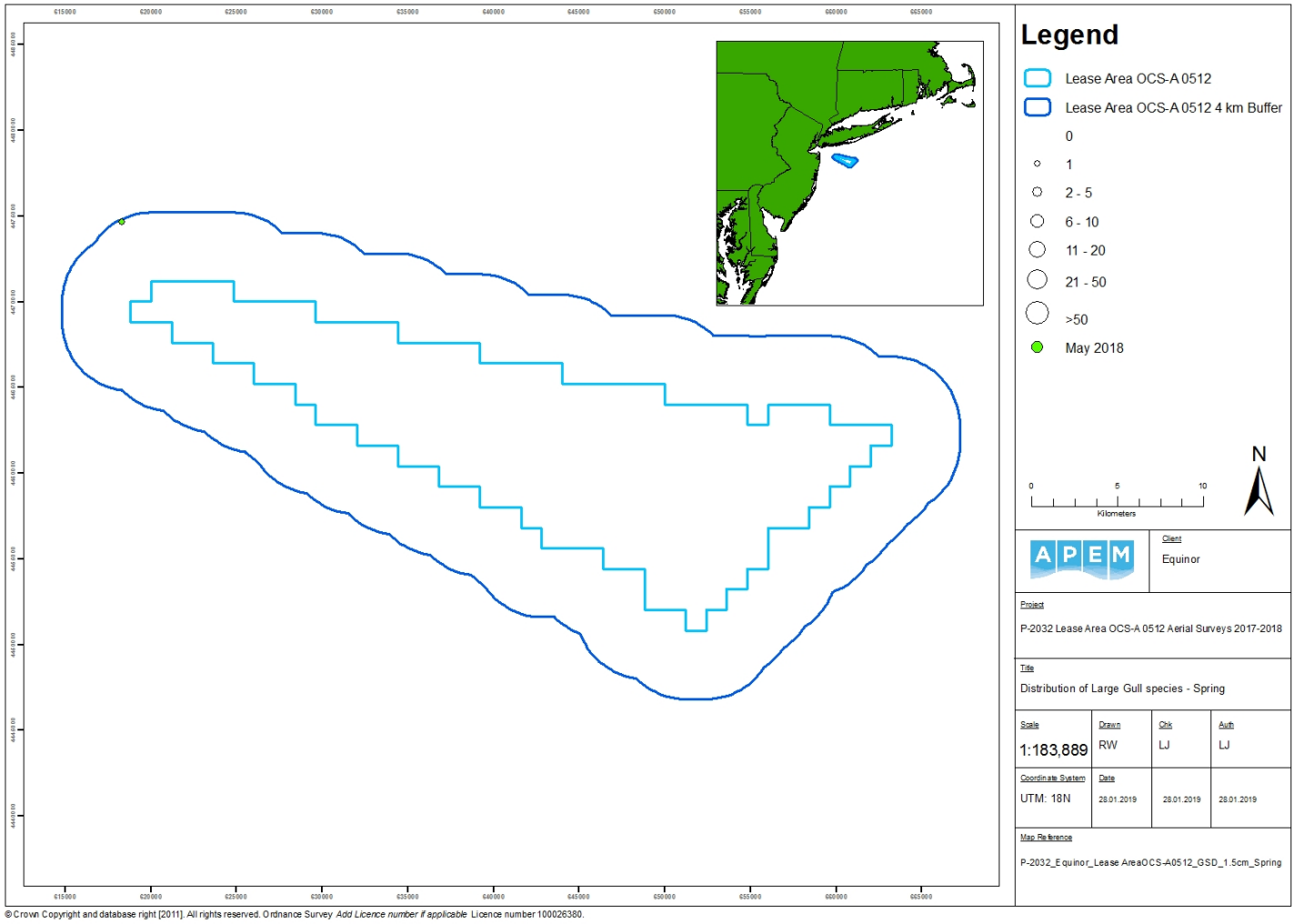
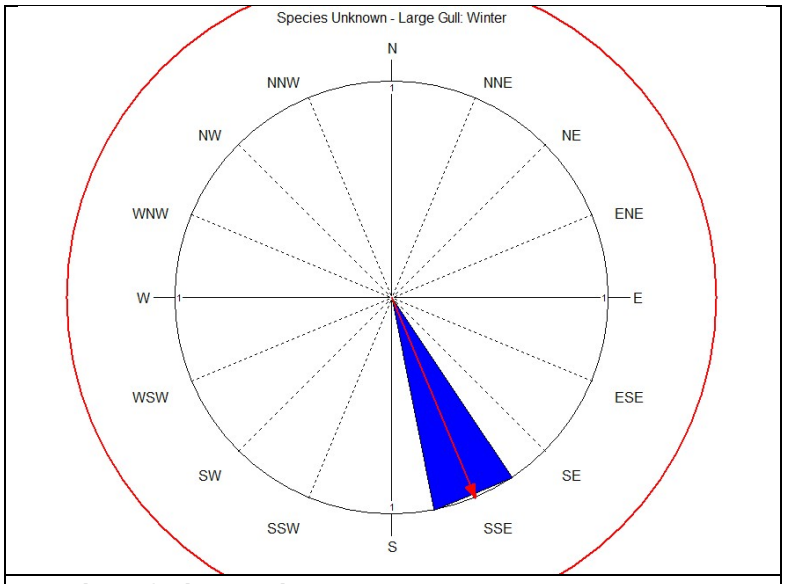


Figure 85 Distribution of unknown large gull species recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the spring season.



Number of Observations	**1**
Mean Vector (μ)	**157.5**
Length of Mean Vector (r)	**1**
Rayleigh Test (Z)	**1**
Rayleigh Test (p)	**0.512**

Figure 86 Summary of flight direction of unknown large gull species (n=1) recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the winter season.

4.29 Species Unknown – Small Gull

Unknown small gull species were recorded in the winter and spring, with a peak count of 11 individuals in the December survey, resulting in an abundance estimate of 65 (**Table 35**).

In winter, unknown small gull species were recorded in December and February, loosely distributed across the Lease Area OCS-A 0512 plus 4 km buffer (**Figure 87**). In spring, unknown small gulls were recorded in March and May, with two individuals recorded in each month. In March, one individual was recorded in the south of the Lease Area OCS-A 0512 site, and one in the south of the 4 km buffer. In May, both individuals were recorded in the north of the Lease Area OCS-A 0512 site (**Figure 88**). Two individuals were recorded in June; one was recorded in the north of the Lease Area OCS-A 0512 site and one in the north of the 4 km buffer (**Figure 89**).

A single unknown species of small gull was recorded flying in a west-north-westerly direction in winter. A single small gull species was recorded flying in a east-south-east to south-south-easterly direction in summer (**Figure 90**).

Table 35 Raw counts and abundance and density estimates (No. estimated individuals per km^2) of unknown small gulls species in: a) Lease Area OCS-A 0512 plus 4 km buffer, b) Lease Area OCS-A 0512, and c) the Lease Area OCS-A 0512 4 km buffer only.

a) Lease Area OCS-A 0512 plus 4 km Buffer					
Survey	**Raw Count**	**Abundance**	**Density**	**Flying**	**Sitting**

Dec-17	11	85	0.1	1	10
Feb-18	1	8	0.01	0	1
Mar-18	2	16	0.02	0	2
May-18	2	15	0.02	0	2
Jun-18	2	16	0.02	1	1
b) Lease Area OCS-A 0512					
Survey	**Raw Count**	**Abundance**	**Density**	**Flying**	**Sitting**
Dec-17	3	23	0.07	0	3
Feb-18	1	8	0.02	0	1
Mar-18	1	8	0.02	0	1
May-18	2	15	0.05	0	2
Jun-18	1	8	0.02	1	0
c) 4 km Buffer					
Survey	**Raw Count**	**Abundance**	**Density**	**Flying**	**Sitting**
Dec-17	8	63	0.13	1	7
Feb-18	0	0	-	0	0
Mar-18	1	8	0.02	0	1
May-18	0	0	-	0	0
Jun-18	1	8	0.02	0	1

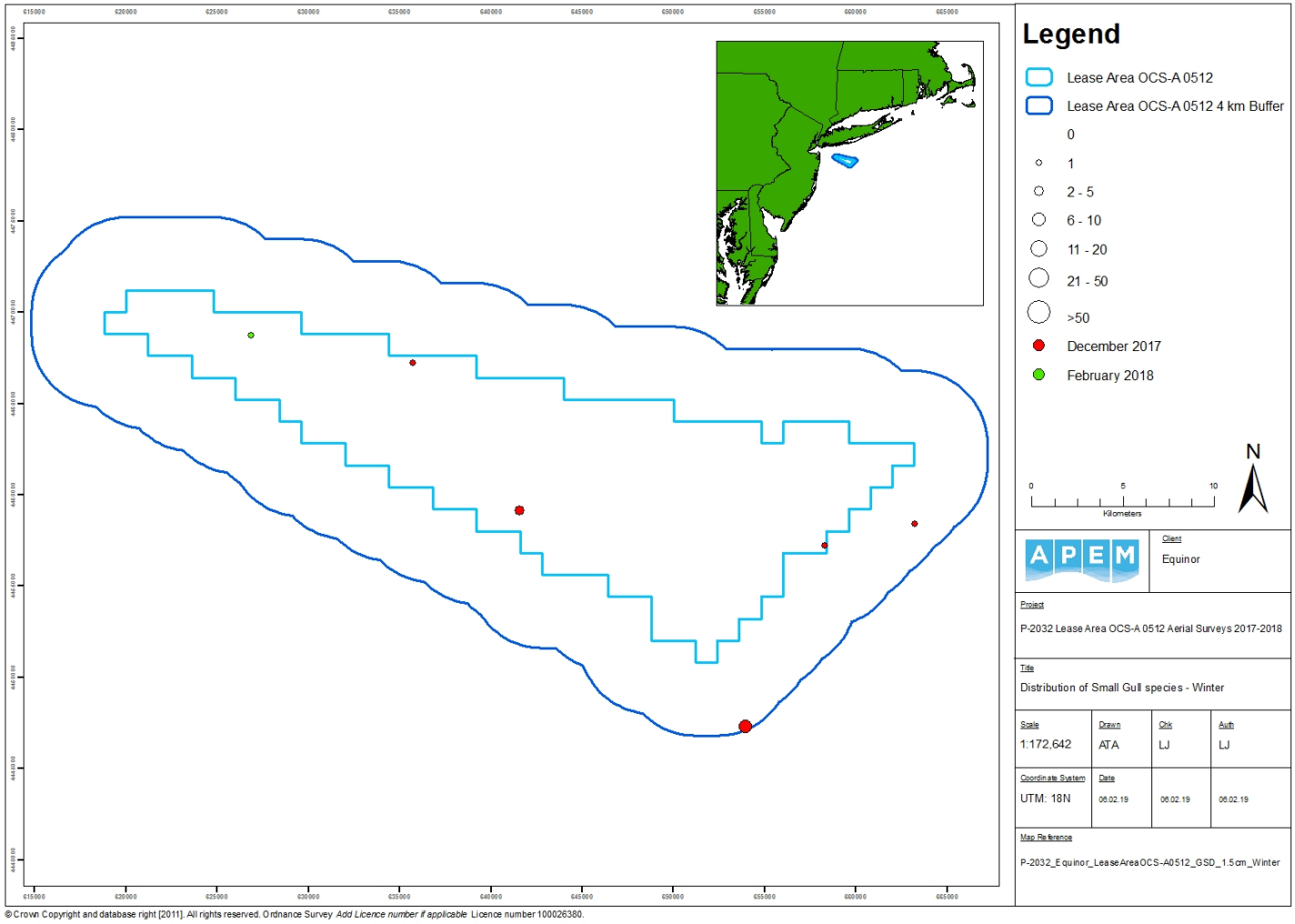


Figure 87 Distribution of unknown small gull species recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the winter season.

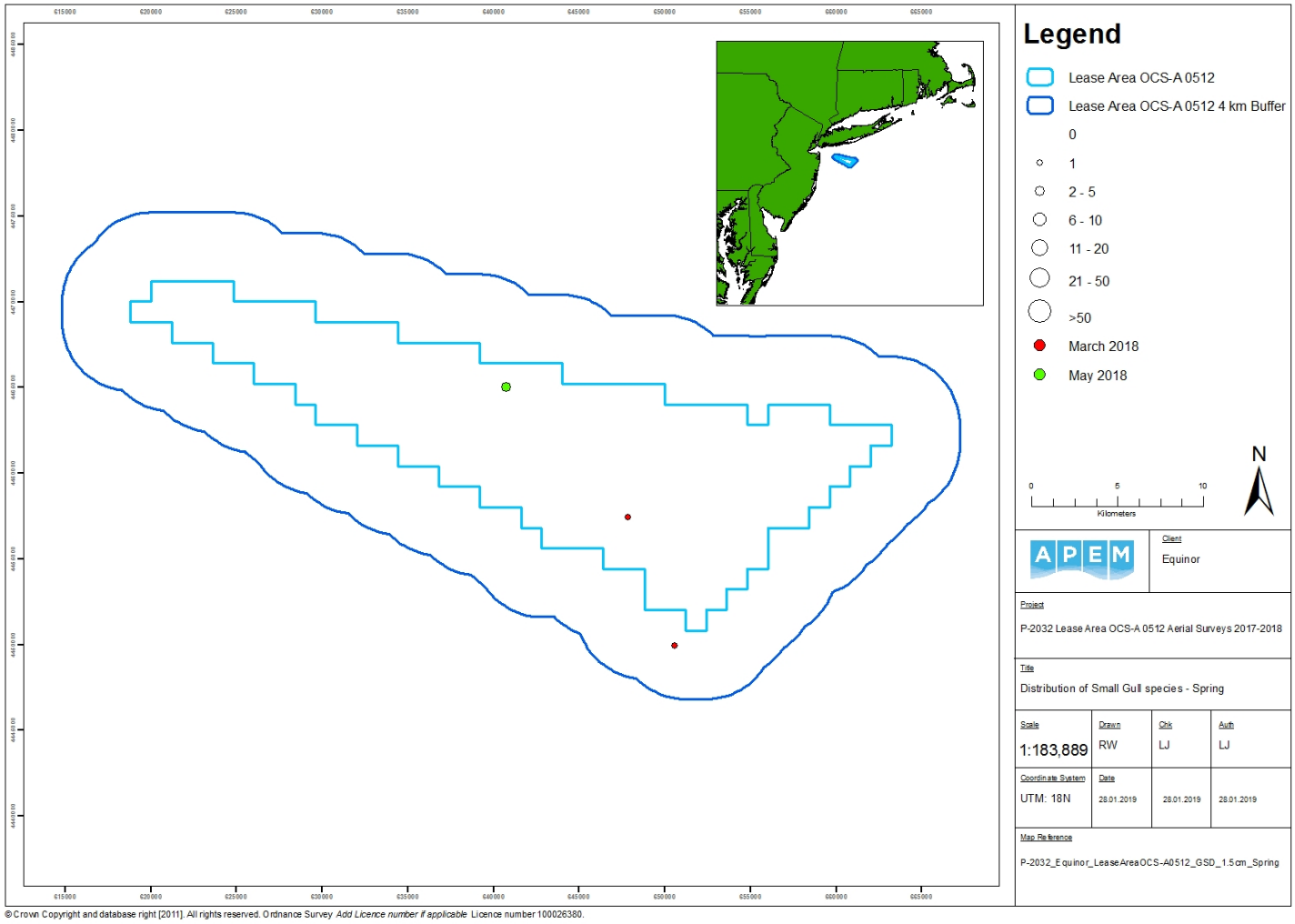


Figure 88 **Distribution of unknown small gull species recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the spring season.**

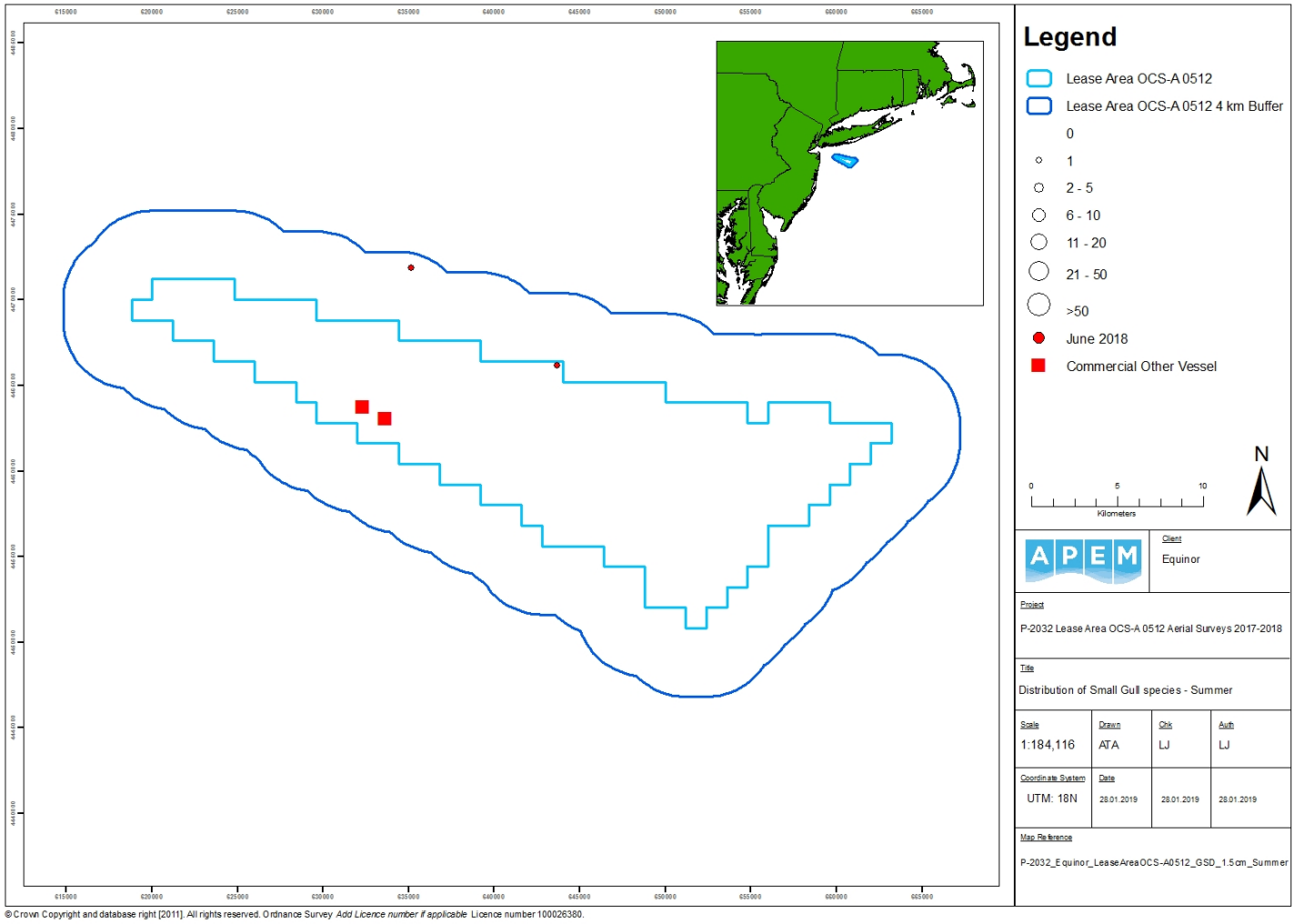
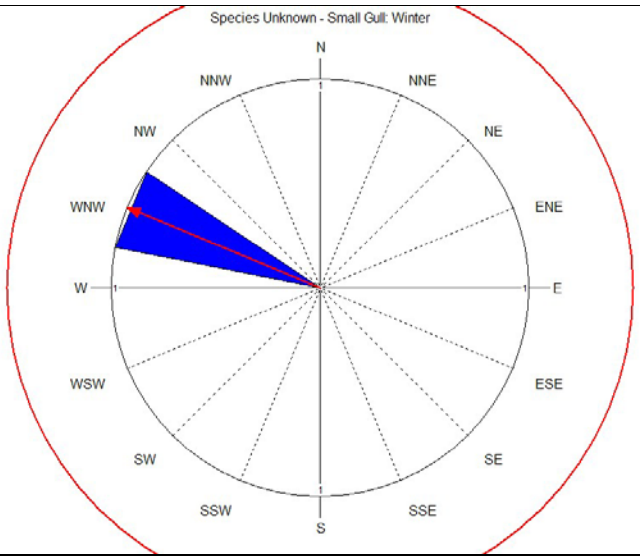
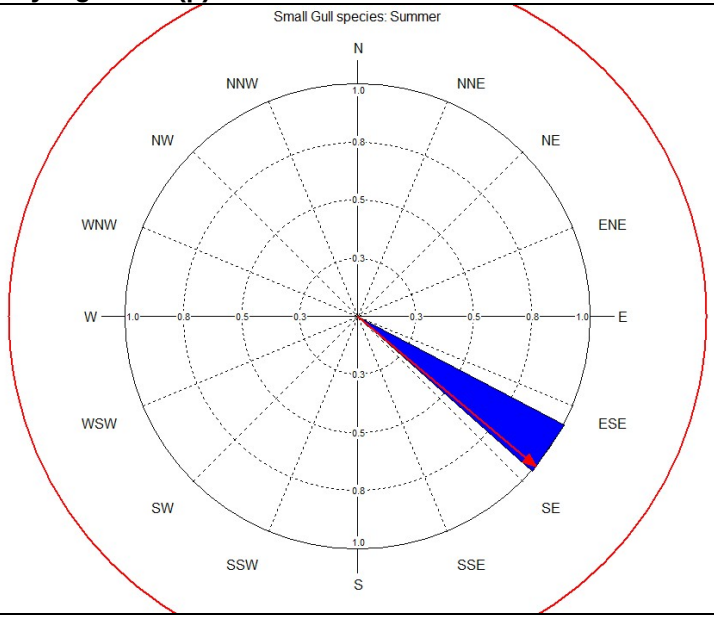


Figure 89 **Distribution of unknown small gull species recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the summer season.**



Number of Observations	**1**
Mean Vector (μ)	**292.5**
Length of Mean Vector (r)	**1**
Rayleigh Test (Z)	**1**
Rayleigh Test (p)	**0.512**



Number of Observations	**1**
Mean Vector (μ)	**130.035**
Length of Mean Vector (r)	**1**
Rayleigh Test (Z)	**1**
Rayleigh Test (p)	**0.512**

Figure 90 Summary of flight direction of unknown small gull species recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the winter (n=1), and summer (n=1) seasons.

4.30 Forster's Tern

A single Forster's tern was recorded in the south 4 km buffer in the May survey, resulting in an abundance estimate of eight (**Table 36, Figure 91**).

The individual Forster's tern was recorded flying at 21 m asl in a south-westerly direction in the spring 2018 (**Figure 92**).

Table 36 **Raw counts and abundance and density estimates (No. estimated individuals per km^2) of Forster's terns in: a) Lease Area OCS-A 0512 plus 4 km buffer, b) Lease Area OCS-A 0512, and c) the Lease Area OCS-A 0512 4 km buffer only.**

a) Lease Area OCS-A 0512 plus 4 km Buffer					
Survey	Raw Count	Abundance	Density	Flying	Sitting
May-18	1	8	0.01	1	0
b) Lease Area OCS-A 0512					
Survey	Raw Count	Abundance	Density	Flying	Sitting
May-18	0	0	-	0	0
c) 4 km Buffer					
Survey	Raw Count	Abundance	Density	Flying	Sitting
May-18	1	8	0.02	1	0

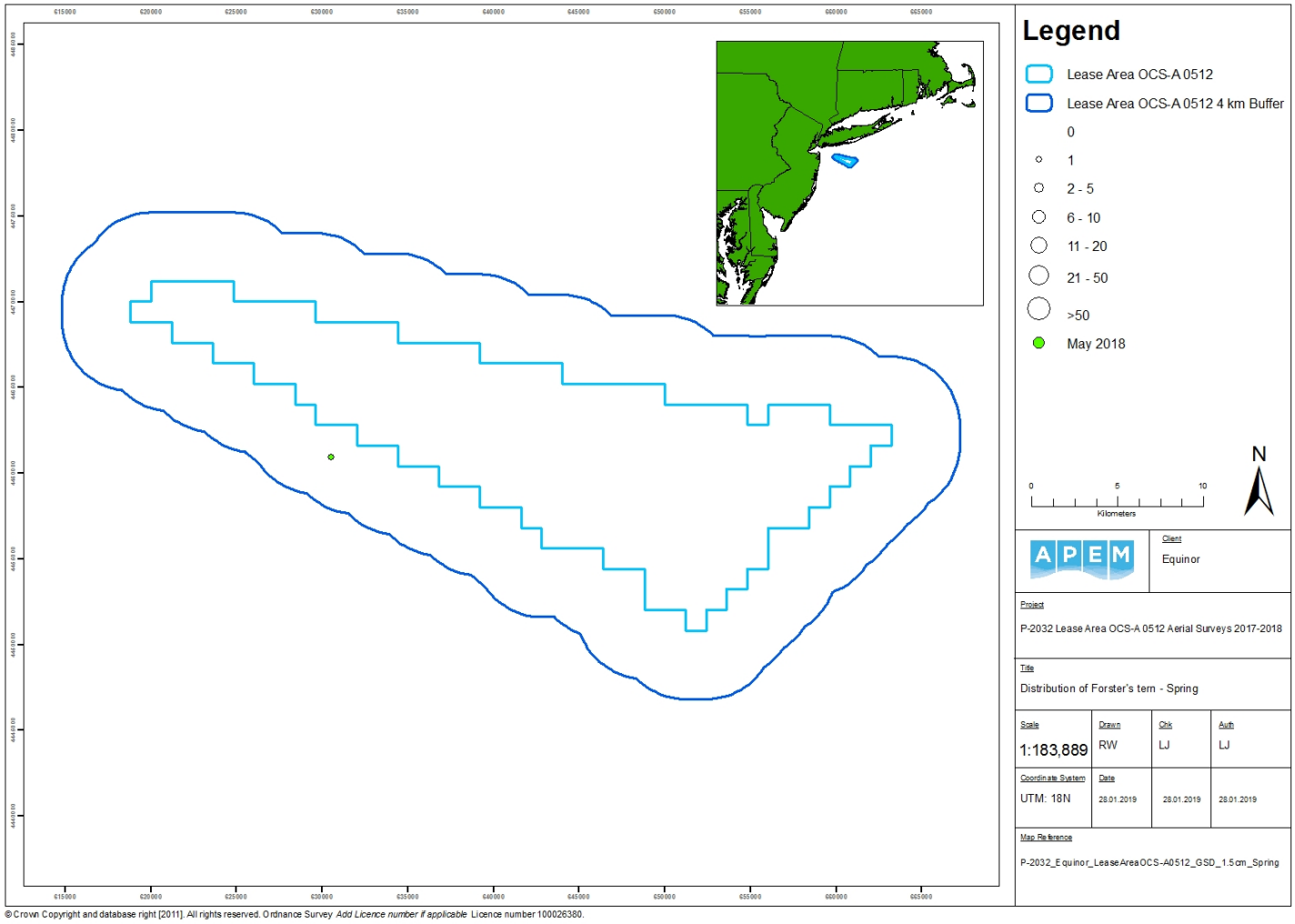
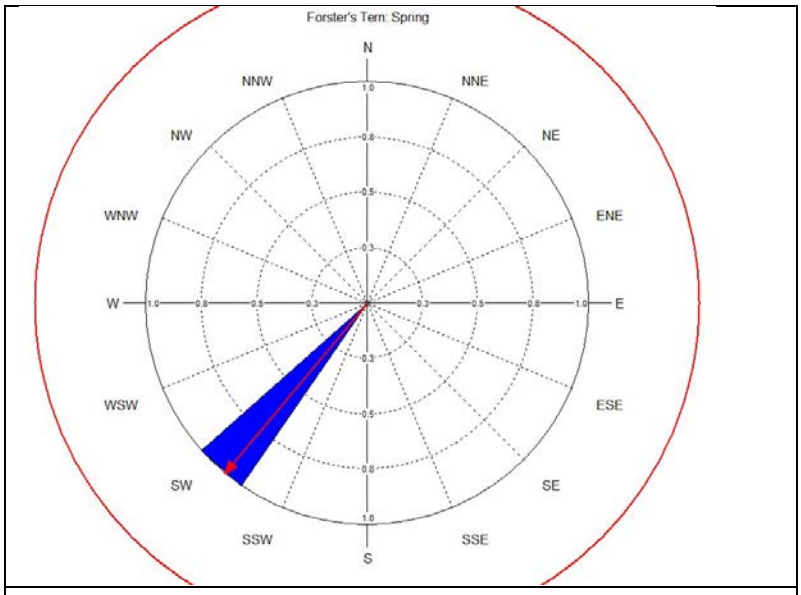


Figure 91 **Distribution of Forster's terns recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the spring season.**



Number of Observations	**1**
Mean Vector (μ)	**219.985**
Length of Mean Vector (r)	**1**
Rayleigh Test (Z)	**1**
Rayleigh Test (p)	**0.512**

Figure 92 **Summary of flight direction of Forster's terns (n=1) recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the spring season.**

4.31 Common Tern

Common terns were recorded in the May survey only with a raw count of eight, resulting in an abundance estimate of 60. Of the total eight individuals recorded, six were in the Lease Area OCS-A 0512 site, resulting in an abundance estimate of 45 (**Table 37, Figure 93**).

Eight common terns were recorded in flight in spring, which did not show a preference to fly in any one direction (**Figure 94**).

Table 37 **Raw counts and abundance and density estimates (No. estimated individuals per km^2) of common terns in: a) Lease Area OCS-A 0512 plus 4 km buffer, b) Lease Area OCS-A 0512, and c) the Lease Area OCS-A 0512 4 km buffer only.**

a) Lease Area OCS-A 0512 plus 4 km Buffer					
Survey	**Raw Count**	**Abundance**	**Density**	**Flying**	**Sitting**
May-18	8	60	0.07	8	0
b) Lease Area OCS-A 0512					
Survey	**Raw Count**	**Abundance**	**Density**	**Flying**	**Sitting**
May-18	6	45	0.14	6	0
c) 4 km Buffer					
Survey	**Raw Count**	**Abundance**	**Density**	**Flying**	**Sitting**
May-18	2	15	0.03	2	0

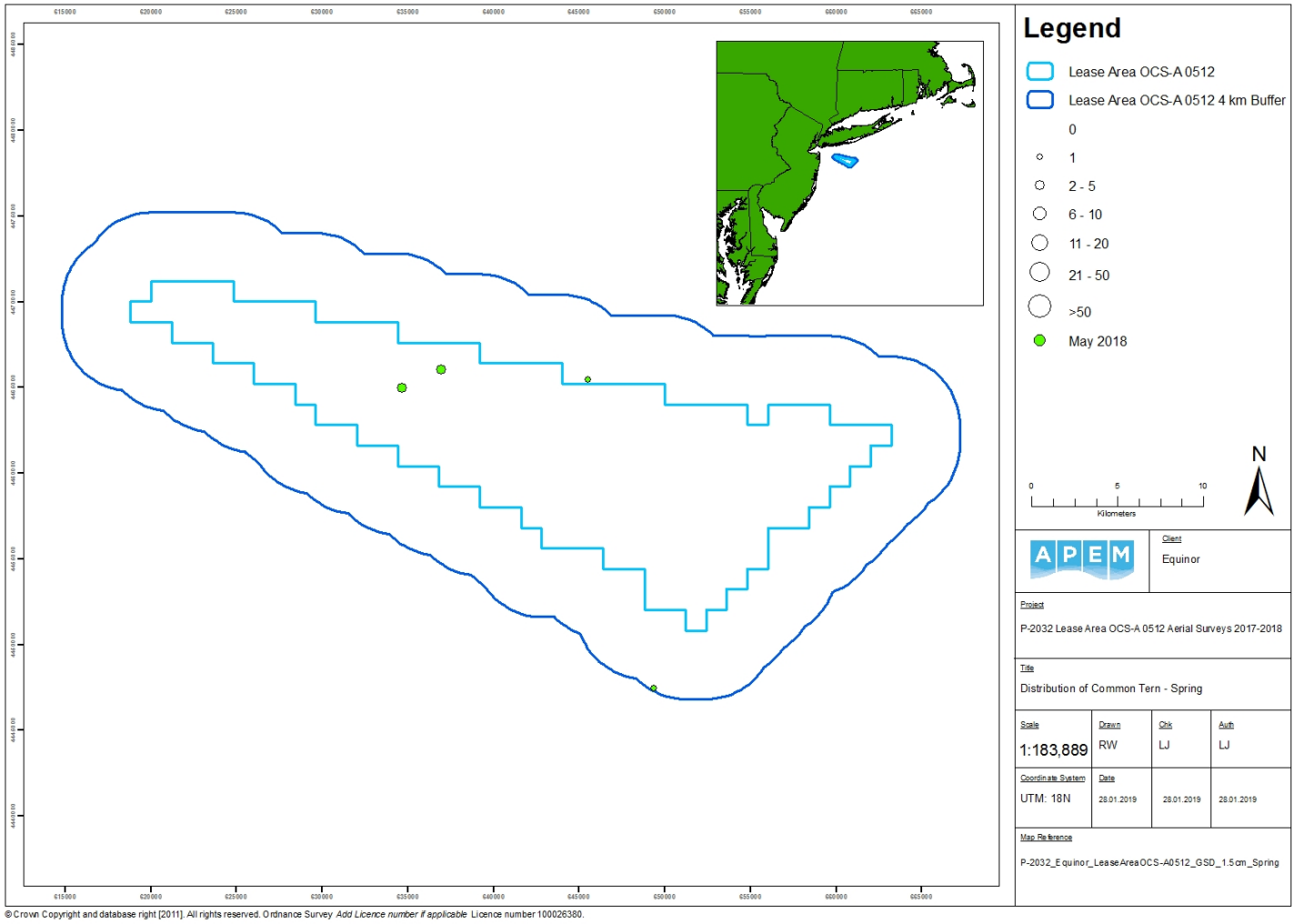
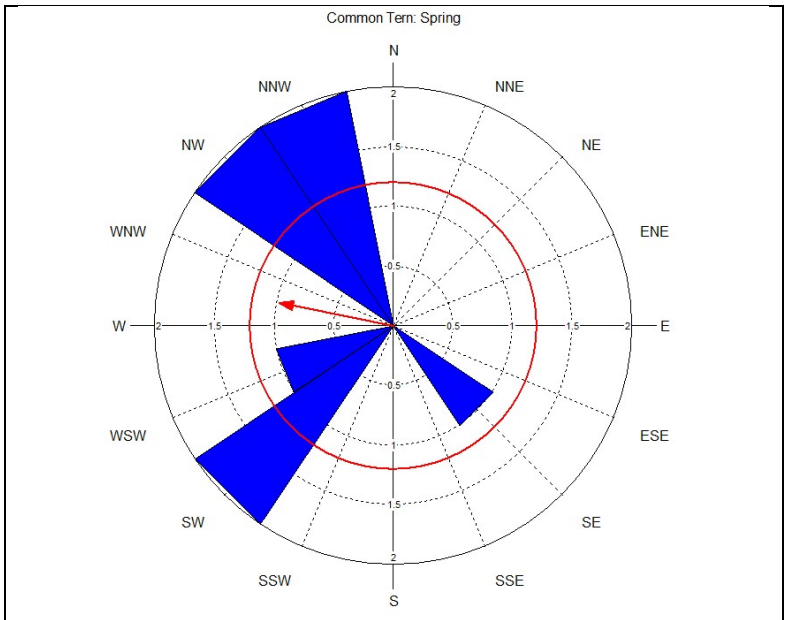


Figure 93 Distribution of common terns recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the spring season.



Number of Observations	**8**
Mean Vector (μ)	**281.25**
Length of Mean Vector (r)	**0.486**
Rayleigh Test (Z)	**1.887**
Rayleigh Test (p)	**0.153**

Figure 94 **Summary of flight direction of common terns (n=8) recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the spring season.**

4.32 'Commic' / Forster's Tern

A total of 170 'commic' / Forster's terns were recorded in the May survey, of which 94 were recorded in the 4 km buffer and 76 in the Lease Area OCS-A 0512 site, resulting in abundance estimates of 717 and 566, respectively (**Table 38**). Terns were loosely distributed across the Lease Area OCS-A 0512 plus 4 km buffer, with the greatest concentration in the center (**Figure 95**). All individuals were recorded in flight in May (the spring), which showed a preference to fly in a southerly direction around a mean of 186° (**Figure 96**).

Table 38 **Raw counts and abundance and density estimates (No. estimated individuals per km^2) of 'commic' / Forster's terns in: a) Lease Area OCS-A 0512 plus 4 km buffer, b) Lease Area OCS-A 0512, and c) the Lease Area OCS-A 0512 4 km buffer only.**

a) Lease Area OCS-A 0512 plus 4 km Buffer					
Survey	**Raw Count**	**Abundance**	**Density**	**Flying**	**Sitting**
May-18	170	1284	1.57	170	0
b) Lease Area OCS-A 0512					
Survey	**Raw Count**	**Abundance**	**Density**	**Flying**	**Sitting**
May-18	76	566	1.76	76	0
c) 4 km Buffer					

Survey	Raw Count	Abundance	Density	Flying	Sitting
May-18	94	717	1.44	94	0

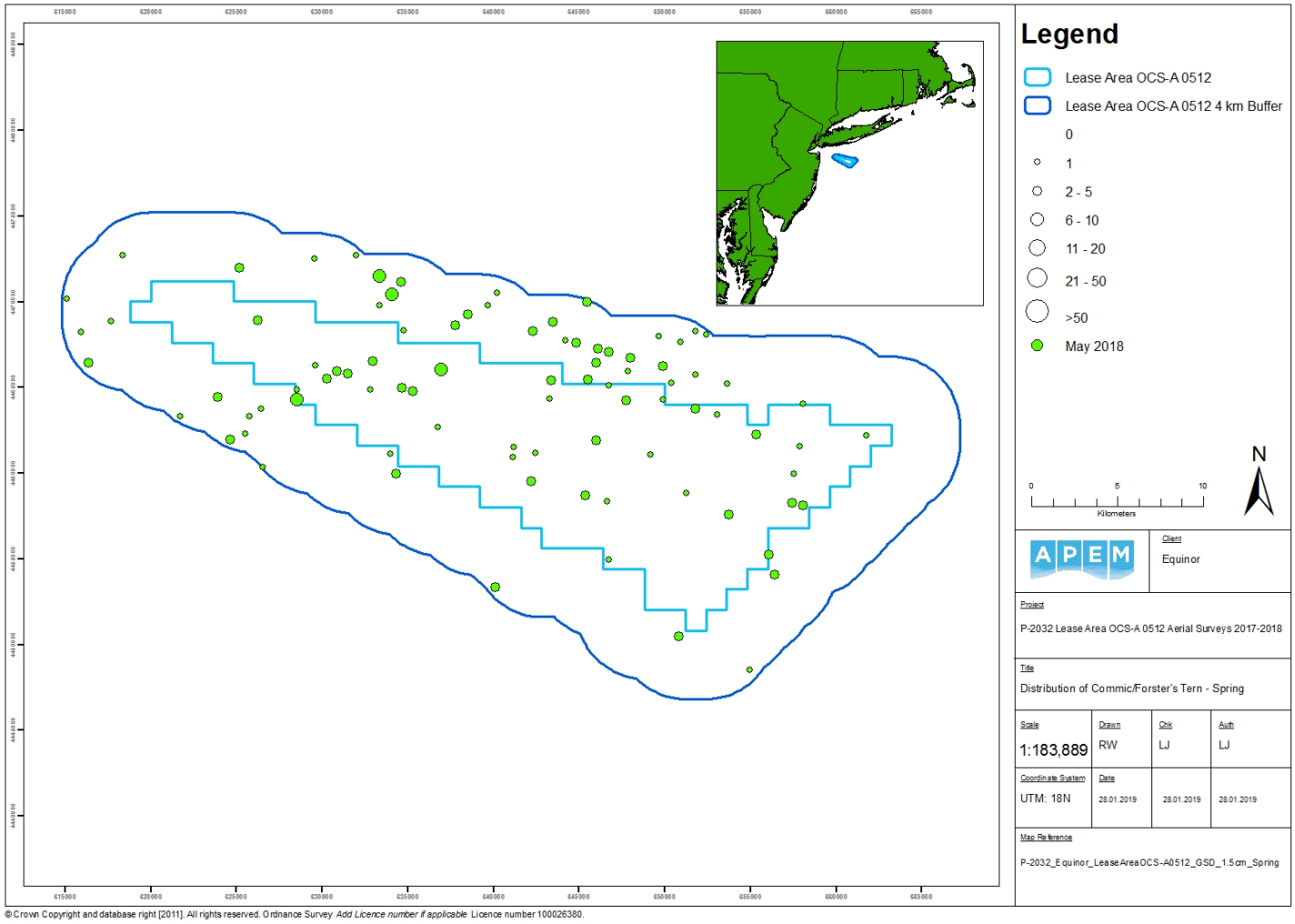
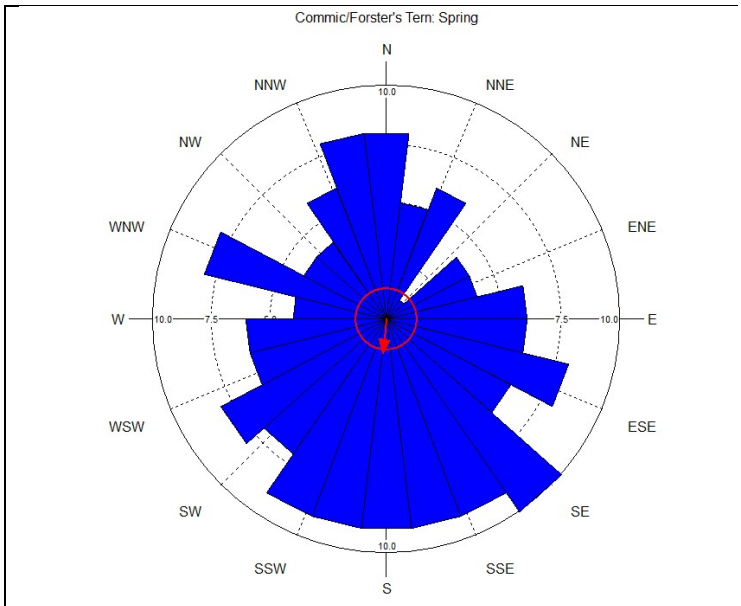


Figure 95 Distribution of 'Commic' / Forster's terns recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the spring season.



Number of Observations	**170**
Mean Vector (μ)	**186.167**
Length of Mean Vector (r)	**0.144**
Rayleigh Test (Z)	**3.535**
Rayleigh Test (p)	**0.029**

Figure 96 **Summary of flight direction of 'Commic' / Forster's (n=170) recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the spring season.**

4.33 Least Tern

Four least terns were recorded in the 4 km buffer in the May survey, resulting in an abundance estimate of 31 (**Table 39**). All individuals were recorded in the 4 km buffer, with three in the north and one in the south (**Figure 97**).

Four least terns were recorded in flight in spring, which did not show a preference to fly in any one direction (**Figure 98**).

Table 39 **Raw counts and abundance and density estimates (No. estimated individuals per km^2) of least terns in: a) Lease Area OCS-A 0512 plus 4 km buffer, b) Lease Area OCS-A 0512, and c) the Lease Area OCS-A 0512 4 km buffer only.**

a) Lease Area OCS-A 0512 plus 4 km Buffer					
Survey	**Raw Count**	**Abundance**	**Density**	**Flying**	**Sitting**
May-18	4	30	0.04	4	0
b) Lease Area OCS-A 0512					
Survey	**Raw Count**	**Abundance**	**Density**	**Flying**	**Sitting**
May-18	0	0	-	0	0
c) 4 km Buffer					
Survey	**Raw Count**	**Abundance**	**Density**	**Flying**	**Sitting**

May-18	4	31	0.06	4	0

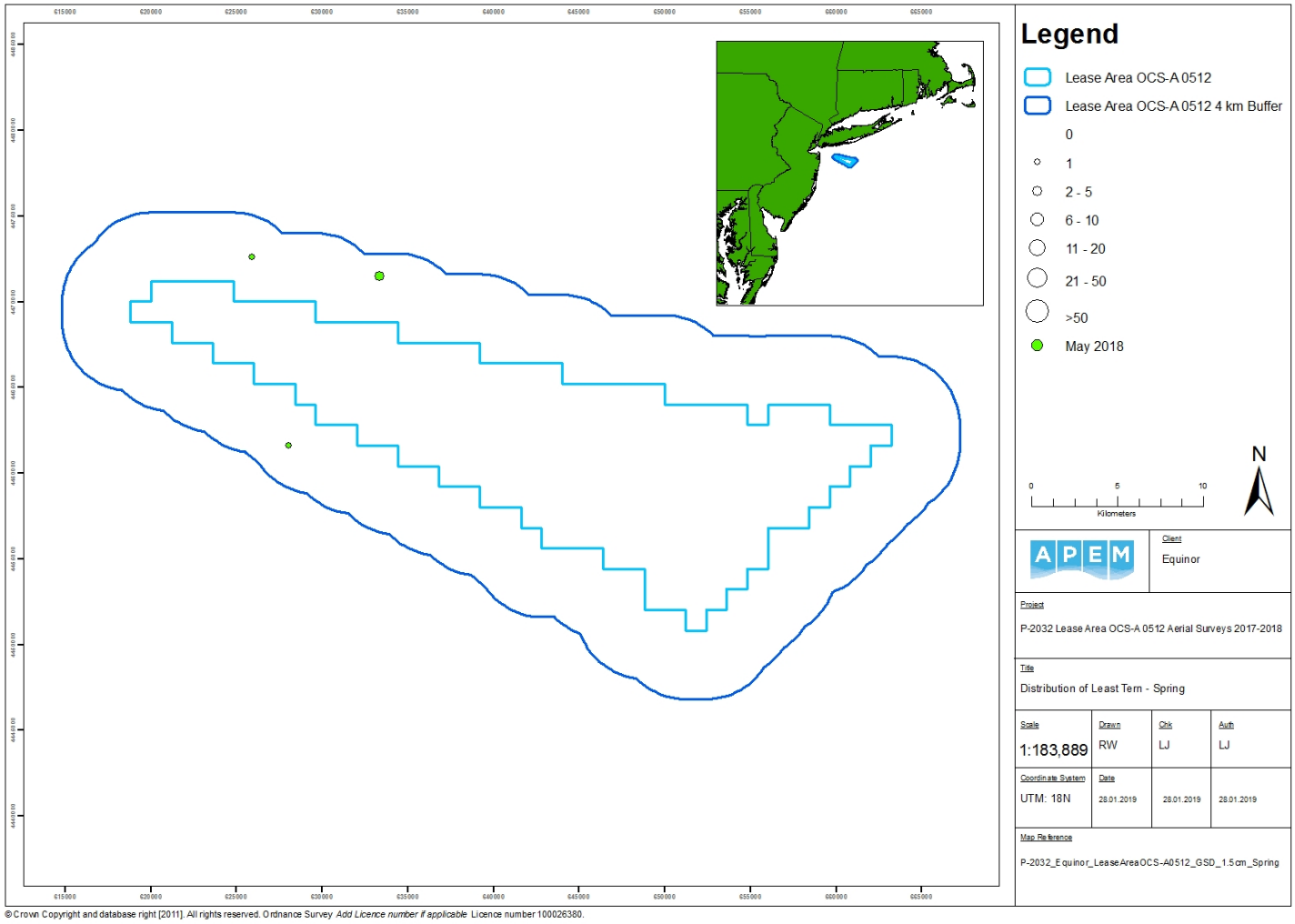
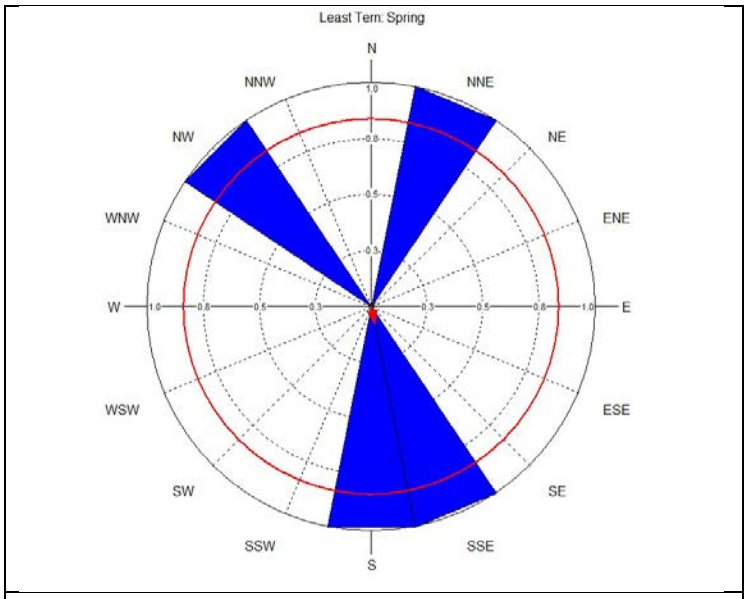


Figure 97 **Distribution of least terns recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the spring season.**



Number of Observations	**4**
Mean Vector (μ)	**168.75**
Length of Mean Vector (r)	**0.075**
Rayleigh Test (Z)	**0.022**
Rayleigh Test (p)	**0.981**

Figure 98 **Summary of flight direction of least terns (n=4) recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the spring season.**

4.34 Sterna Tern Species

Sixty unknown Sterna tern species were recorded in the May survey, of which nine were observed in the Lease Area OCS-A 0512 site and 51 in the 4 km buffer (**Table 40**), resulting in abundance estimates of 67 and 389, respectively. The majority of individuals were recorded in the 4 km buffer (**Figure 99**).

A total of eleven sterna tern species were recorded in flight in spring, which showed a preference to fly in a southerly direction; however, this preference was not significant (**Figure 100**).

Table 40 **Raw counts and abundance and density estimates (No. estimated individuals per km^2) of Sterna tern species in: a) Lease Area OCS-A 0512 plus 4 km buffer, b) Lease Area OCS-A 0512, and c) the Lease Area OCS-A 0512 4 km buffer only.**

a) Lease Area OCS-A 0512 plus 4 km Buffer						
Survey	**Raw Count**	**Abundance**	**Density**	**Flying**	**Sitting**	**Perched**
May-18	60	453	0.55	11	47	2
b) Lease Area OCS-A 0512						
Survey	**Raw Count**	**Abundance**	**Density**	**Flying**	**Sitting**	**Perched**
May-18	9	67	0.21	5	2	2
c) 4 km Buffer						

Survey	Raw Count	Abundance	Density	Flying	Sitting	Perched
May-18	51	389	0.78	6	45	0

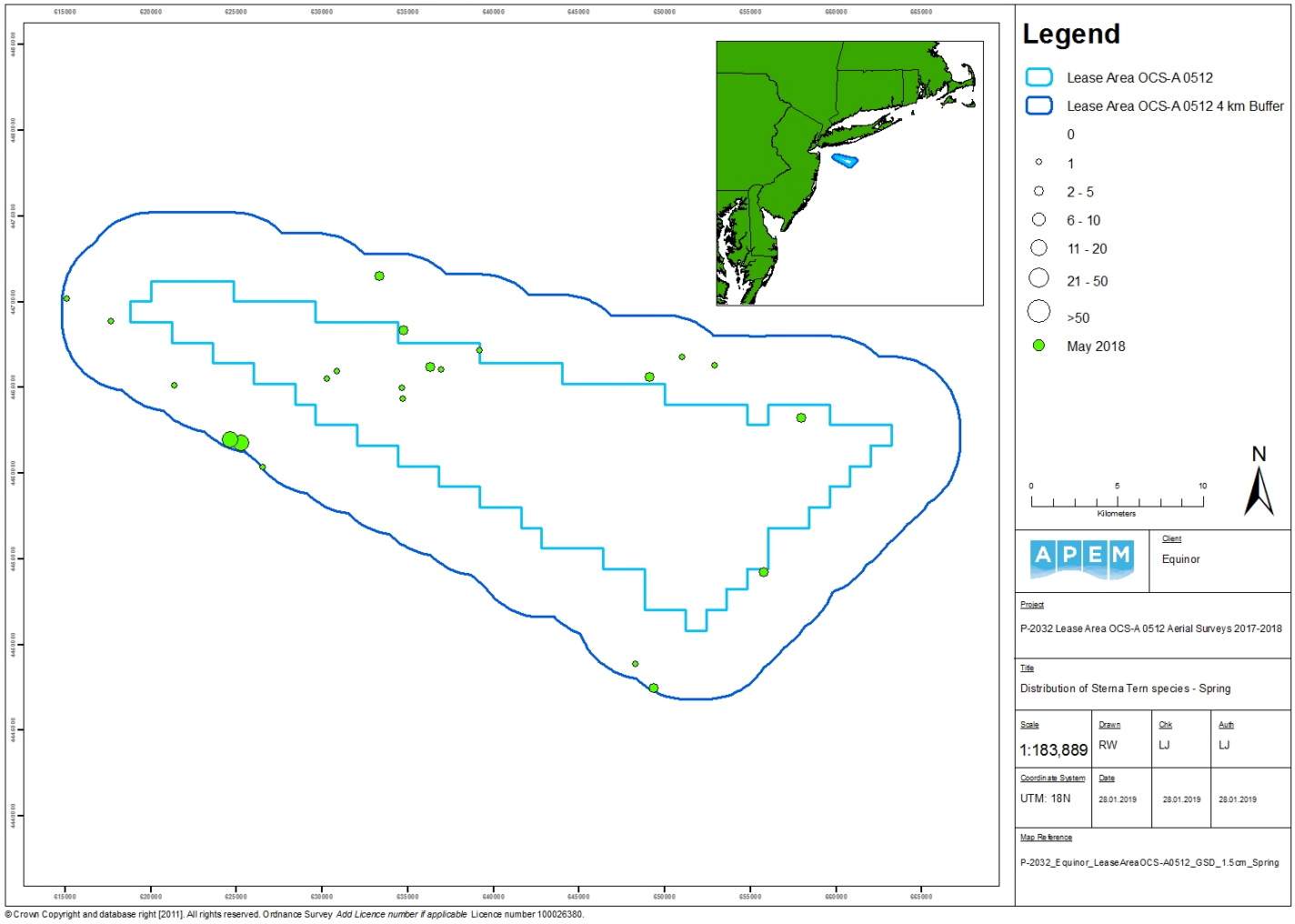
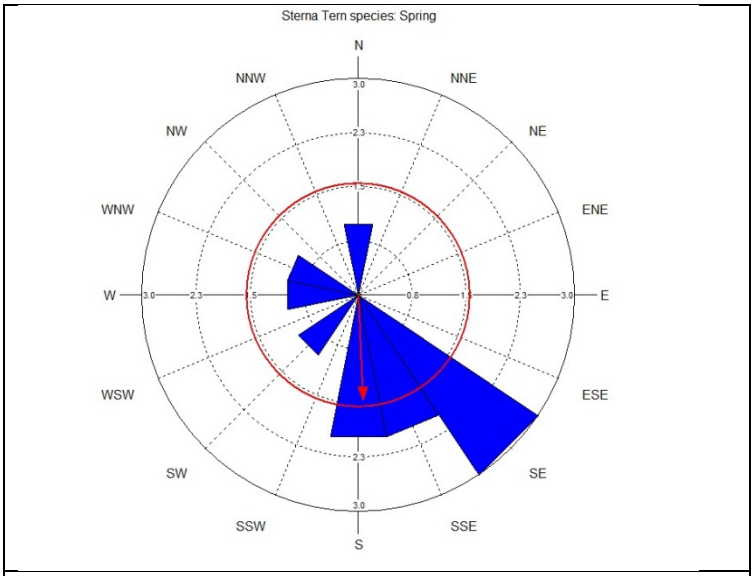


Figure 99 **Distribution of Sterna tern species recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the spring season.**



Number of Observations	**11**
Mean Vector (μ)	**177.234**
Length of Mean Vector (r)	**0.482**
Rayleigh Test (Z)	**2.553**
Rayleigh Test (p)	**0.075**

Figure 100 **Summary of flight direction of Sterna tern species (n=11) recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the spring season.**

4.35 Species Unknown – Tern

A single unknown tern species was recorded in the April survey in the south of the 4 km buffer, resulting in an abundance estimate of eight (**Table 41**, **Figure 101**).

Table 41 **Raw counts and abundance and density estimates (No. estimated individuals per km^2) of unknown tern species in: a) Lease Area OCS-A 0512 plus 4 km buffer, b) Lease Area OCS-A 0512, and c) the Lease Area OCS-A 0512 4 km buffer only.**

a) Lease Area OCS-A 0512 plus 4 km Buffer					
Survey	**Raw Count**	**Abundance**	**Density**	**Flying**	**Sitting**
Apr-18	1	8	0.01	0	1
b) Lease Area OCS-A 0512					
Survey	**Raw Count**	**Abundance**	**Density**	**Flying**	**Sitting**
Apr-18	0	0	-	0	0
c) 4 km Buffer					
Survey	**Raw Count**	**Abundance**	**Density**	**Flying**	**Sitting**
Apr-18	1	8	0.02	0	1

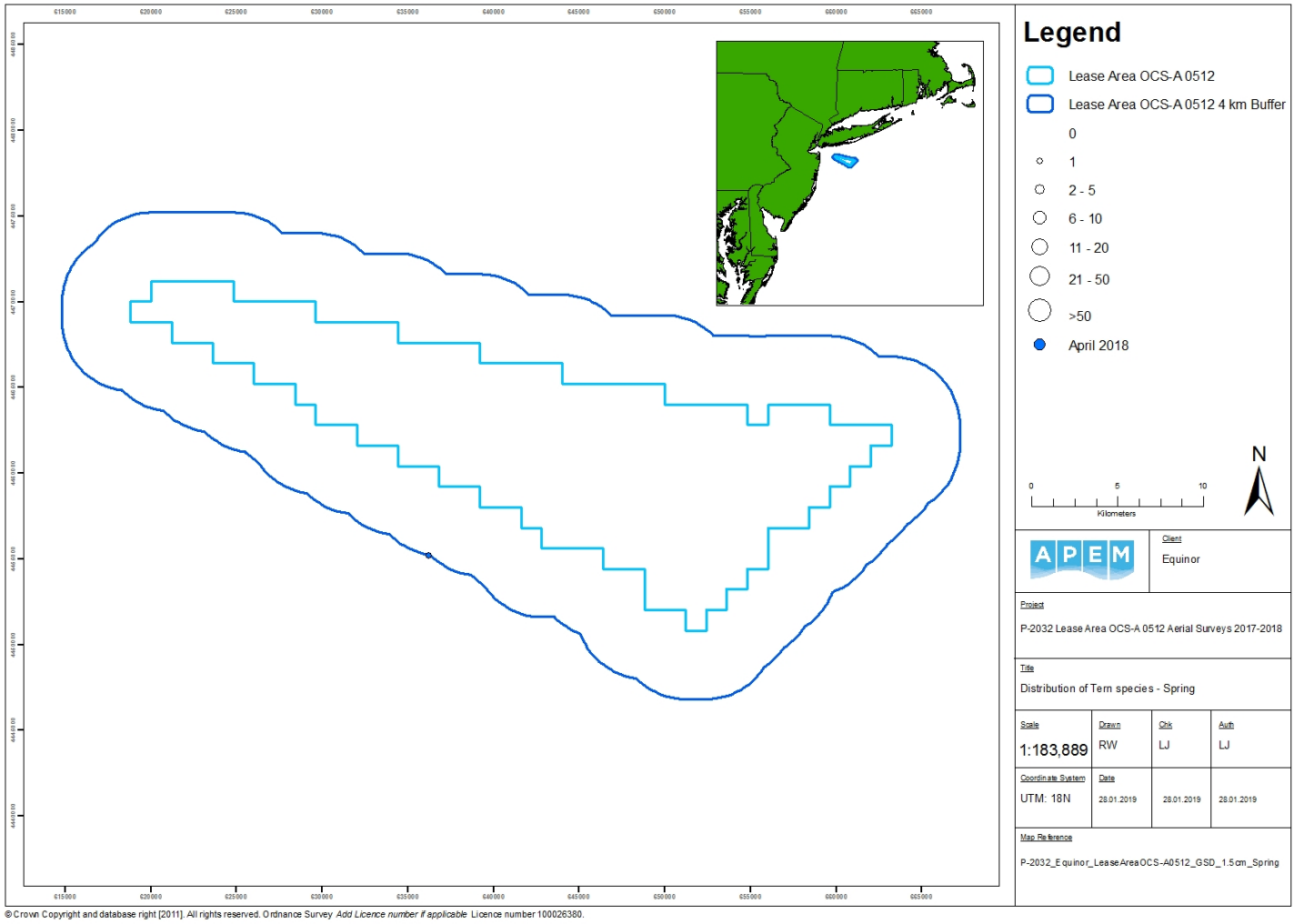


Figure 101 Distribution of unknown tern species recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the spring season.

4.36 Sooty Shearwater

Sooty shearwaters were recorded in the May and June surveys, with a peak count of 15 in June, of which nine were observed in the Lease Area OCS-A 0512 site. An abundance estimate of 74 was calculated for the Lease Area OCS-A 0512 site in June, and 49 in the 4 km buffer (**Table 42**).

One sooty shearwater was recorded in the Lease Area OCS-A 0512 plus 4 km buffer in May, recorded in the east of the 4 km buffer (**Figure 102**). Fifteen sooty shearwaters were recorded in the north and in the south-east of the Lease Area OCS-A 0512 plus 4 km buffer in June (**Figure 103**).

A single sooty shearwater was recorded flying in a southerly direction in the spring. A total of 14 sooty shearwaters were recorded in flight in summer, and showed a preference to fly in a north-north-westerly direction around a mean of 344° (**Figure 104**).

Table 42 **Raw counts and abundance and density estimates (No. estimated individuals per km^2) of sooty shearwaters in: a) Lease Area OCS-A 0512 plus 4 km buffer, b) Lease Area OCS-A 0512, and c) the Lease Area OCS-A 0512 4 km buffer only.**

a) Lease Area OCS-A 0512 plus 4 km Buffer					
Survey	**Raw Count**	**Abundance**	**Density**	**Flying**	**Sitting**
May-18	1	8	0.01	1	0
Jun-18	15	124	0.15	14	1
b) Lease Area OCS-A 0512					
Survey	**Raw Count**	**Abundance**	**Density**	**Flying**	**Sitting**
May-18	0	0	-	0	0
Jun-18	9	74	0.23	9	0
c) 4 km Buffer					
Survey	**Raw Count**	**Abundance**	**Density**	**Flying**	**Sitting**
May-18	1	8	0.02	1	0
Jun-18	6	49	0.1	5	1

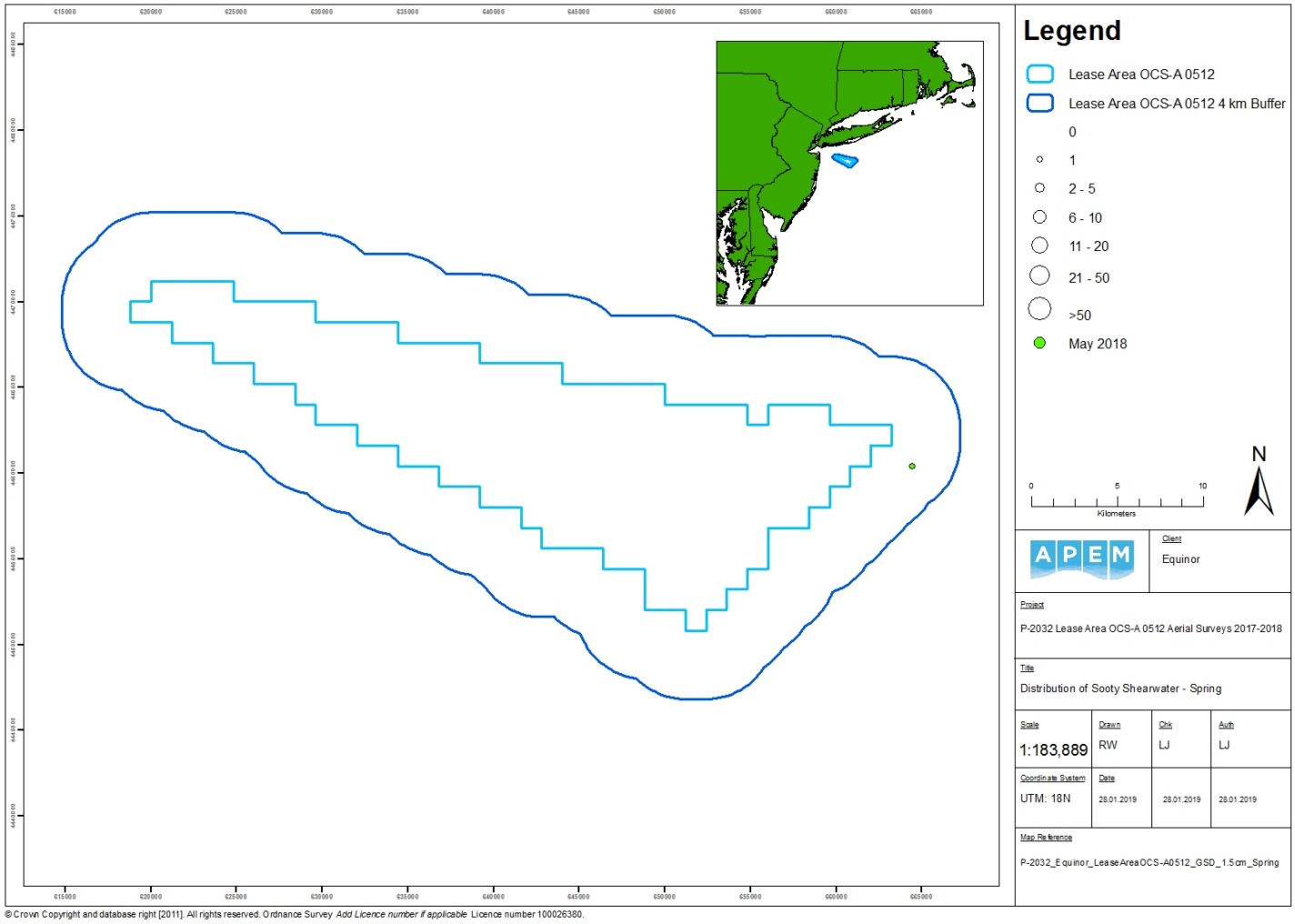


Figure 102 Distribution of sooty shearwater recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the spring season.

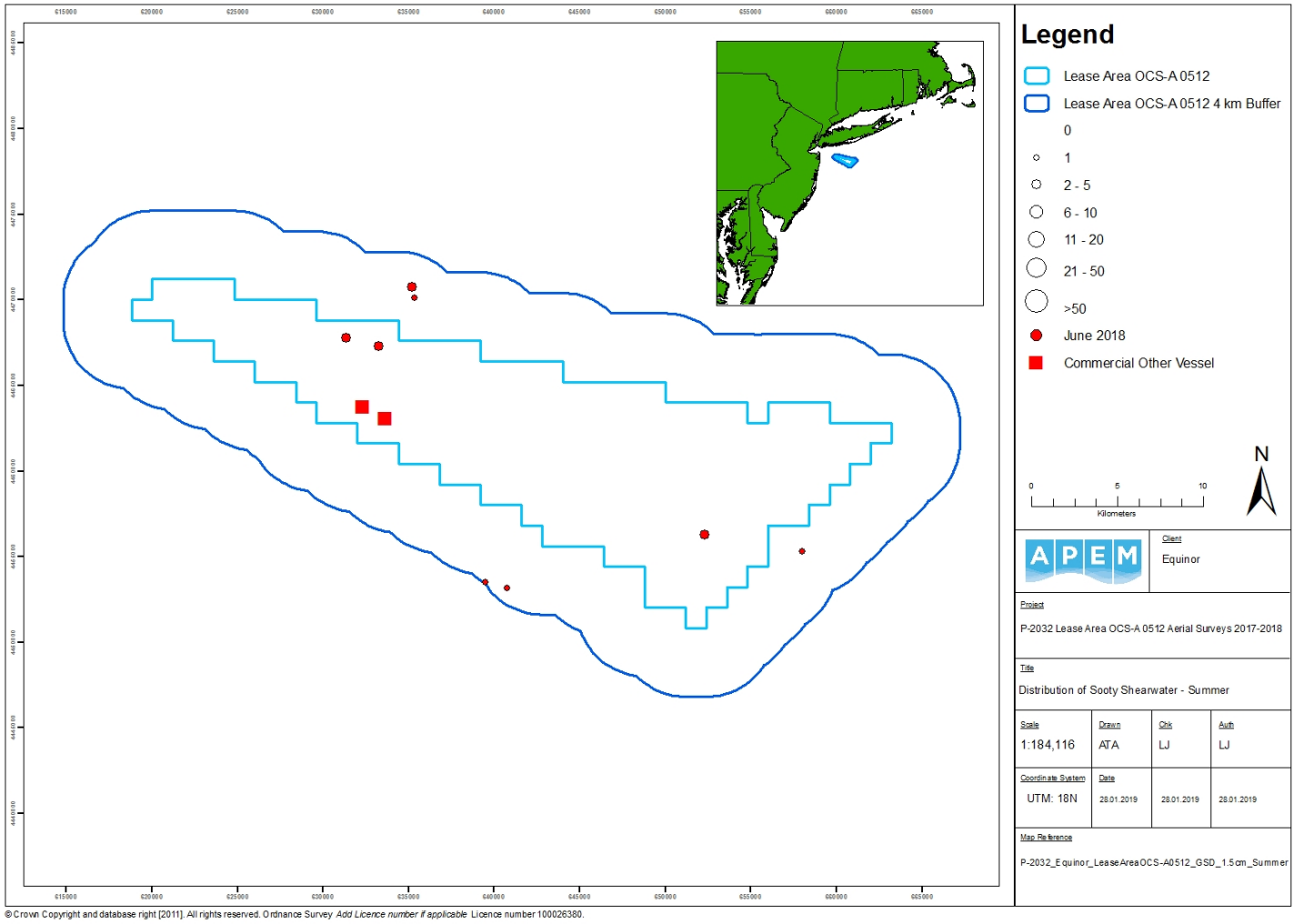
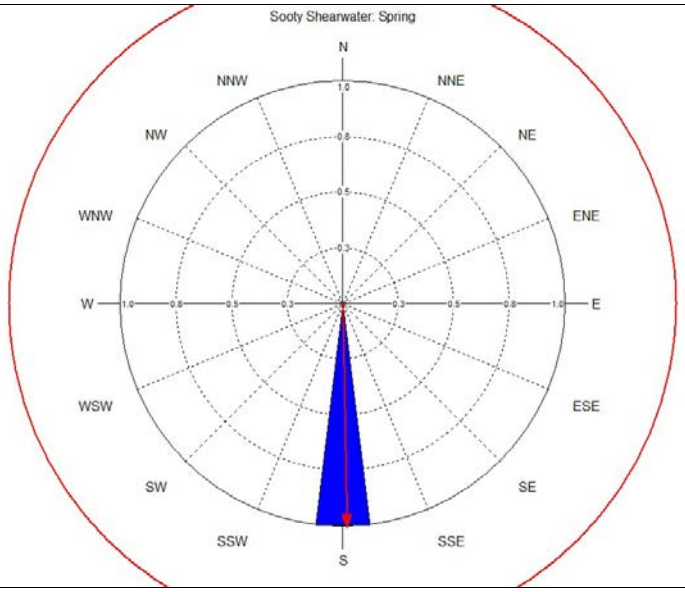
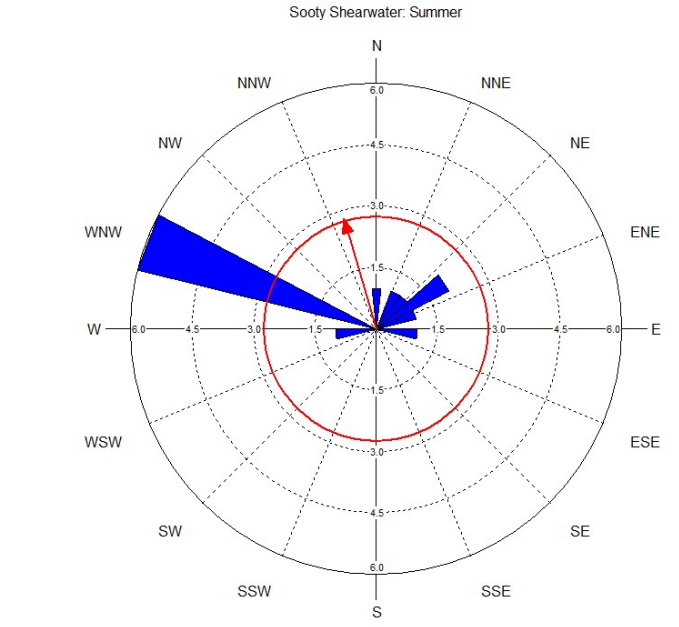


Figure 103 Distribution of sooty shearwater recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the summer season.



Number of Observations	**1**
Mean Vector (μ)	**179.027**
Length of Mean Vector (r)	**1**
Rayleigh Test (Z)	**1**
Rayleigh Test (p)	**0.512**



Number of Observations	**14**
Mean Vector (μ)	**343.543**
Length of Mean Vector (r)	**0.465**
Rayleigh Test (Z)	**3.034**
Rayleigh Test (p)	**0.045**

Figure 104 **Summary of flight direction of sooty shearwaters recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the spring (n=1) and summer (n=14) seasons.**

4.37 Manx Shearwater

Two Manx shearwaters were recorded in the north of the 4 km buffer in the June survey, resulting in an abundance estimate of 16 (**Table 43, Figure 105**). No other Manx shearwaters were recorded throughout the survey period.

Two Manx shearwaters were recorded in flight in summer; one was recorded flying in a westerly direction, the other in a southerly direction (**Figure 106**).

Table 43 **Raw counts and abundance and density estimates (No. estimated individuals per km^2) of Manx shearwaters in: a) Lease Area OCS-A 0512 plus 4 km buffer, b) Lease Area OCS-A 0512, and c) the Lease Area OCS-A 0512 4 km buffer only.**

a) Lease Area OCS-A 0512 plus 4 km Buffer					
Survey	**Raw Count**	**Abundance**	**Density**	**Flying**	**Sitting**
Jun-18	2	16	0.02	2	0
b) Lease Area OCS-A 0512					
Survey	**Raw Count**	**Abundance**	**Density**	**Flying**	**Sitting**
Jun-18	0	0	-	0	0
c) 4 km Buffer					
Survey	**Raw Count**	**Abundance**	**Density**	**Flying**	**Sitting**
Jun-18	2	16	0.03	2	0

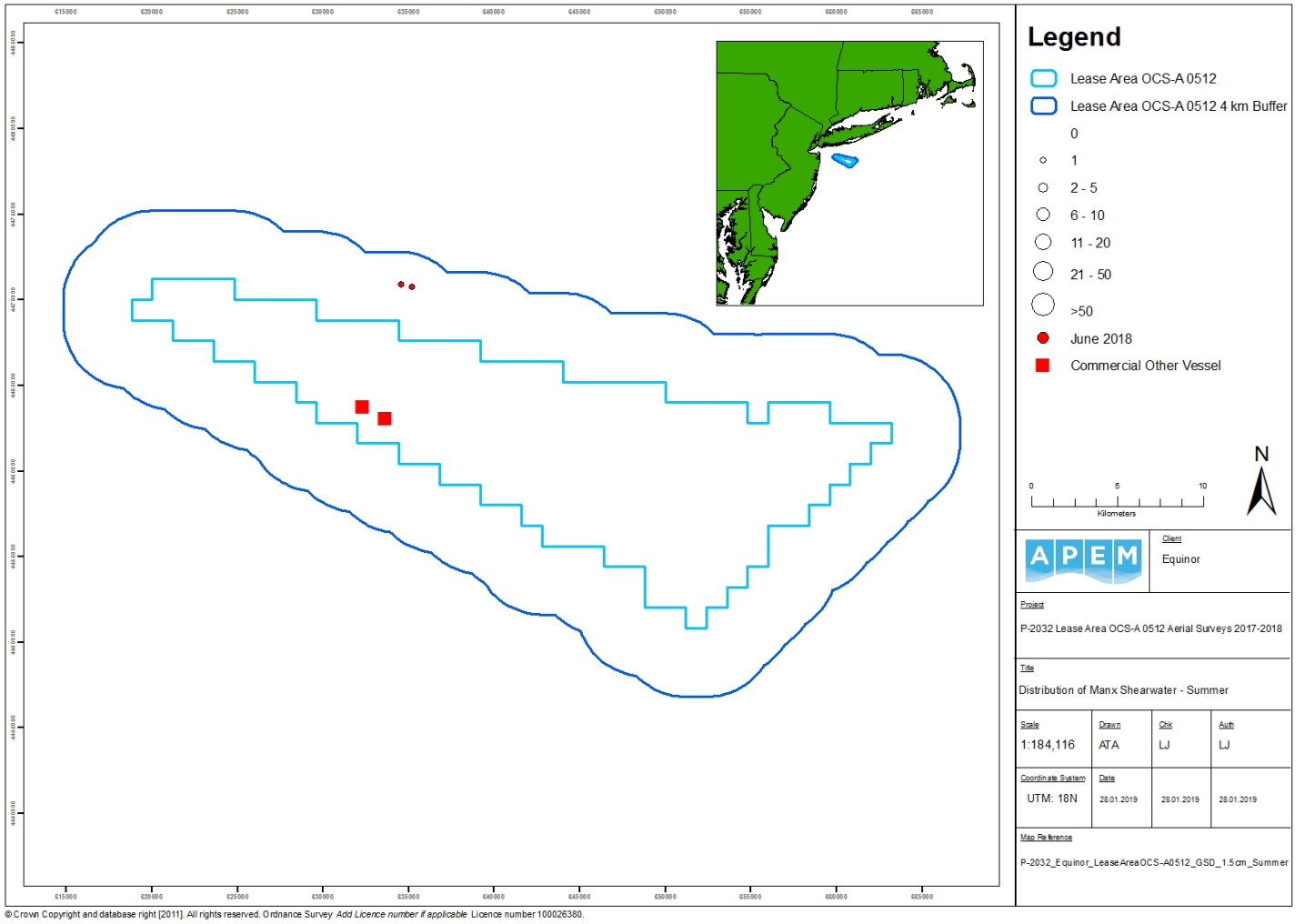
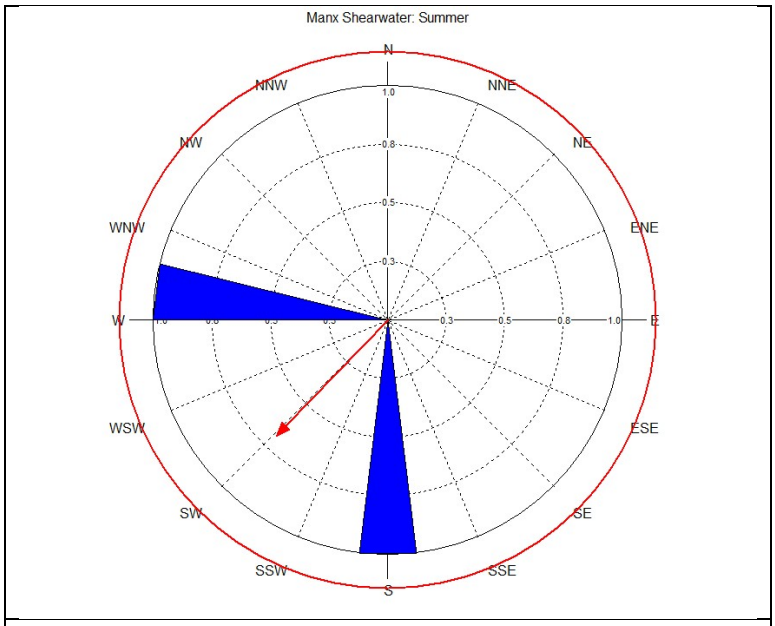


Figure 105 **Distribution of Manx shearwater recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the summer season.**



Number of Observations	**2**
Mean Vector (μ)	**223.934**
Length of Mean Vector (r)	**0.682**
Rayleigh Test (Z)	**0.929**
Rayleigh Test (p)	**0.457**

Figure 106 **Summary of flight direction of Manx shearwaters (n=2) recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the summer season.**

4.38 Great Shearwater

Great shearwaters were recorded in the Lease Area OCS-A 0512 plus 4 km buffer from June to October, with a peak of 18 in June (**Table 44**). Of the 18 recorded in June, 11 were located within the Lease Area OCS-A 0512 site and seven in the 4 km buffer, resulting in abundance estimates of 91 and 58, respectively.

A single great shearwater was recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the fall, in the east of the 4 km buffer (**Figure 107**). In the summer great shearwaters were recorded in June, July, and August, mostly recorded in the east of the Lease Area OCS-A 0512 plus 4 km buffer (**Figure 108**).

A single great shearwater was recorded flying in an east-north-easterly direction in the fall. A total of 34 great shearwaters were recorded in flight in the summer and showed a tendency to fly around a mean of 251° (**Figure 109**).

Table 44 **Raw counts and abundance and density estimates (No. estimated individuals per km^2) of great shearwaters in: a) Lease Area OCS-A 0512 plus 4 km buffer, b) Lease Area OCS-A 0512, and c) the Lease Area OCS-A 0512 4 km buffer only.**

a) Lease Area OCS-A 0512 plus 4 km Buffer					
Survey	**Raw Count**	**Abundance**	**Density**	**Flying**	**Sitting**
Jun-18	18	148	0.18	17	1

Jul-18	17	127	0.15	16	1
Aug-18	1	7	0.01	1	0
Sep-18	1	8	0.01	1	0
b) Lease Area OCS-A 0512					
Survey	**Raw Count**	**Abundance**	**Density**	**Flying**	**Sitting**
Jun-18	11	91	0.28	10	1
Jul-18	4	30	0.09	4	0
Aug-18	0	0	-	0	0
Sep-18	0	0	-	0	0
c) 4 km Buffer					
Survey	**Raw Count**	**Abundance**	**Density**	**Flying**	**Sitting**
Jun-18	7	58	0.12	7	0
Jul-18	13	97	0.19	12	1
Aug-18	1	8	0.02	1	0
Sep-18	1	8	0.02	1	0

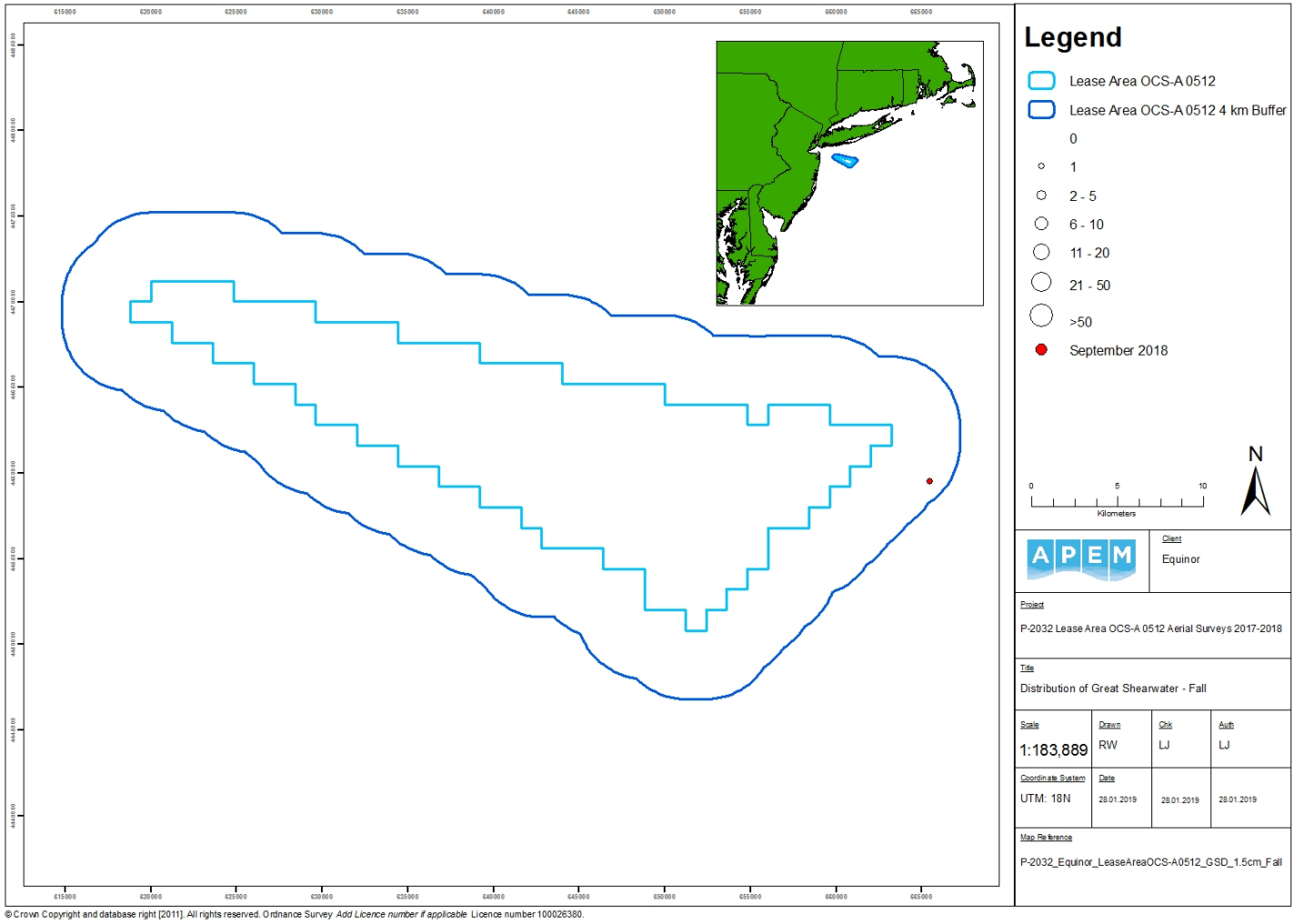


Figure 107 Distribution of great shearwater recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the fall season.

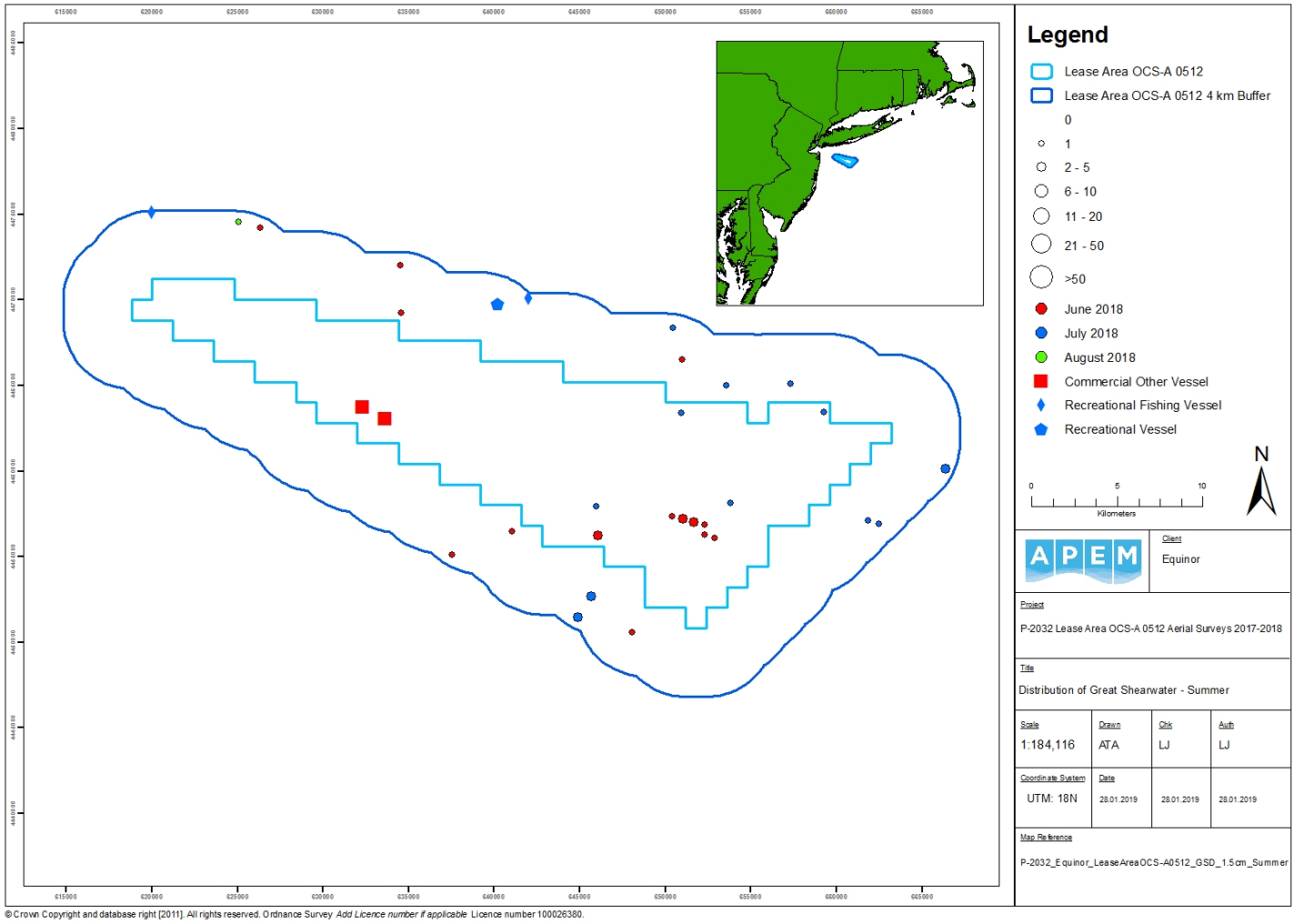
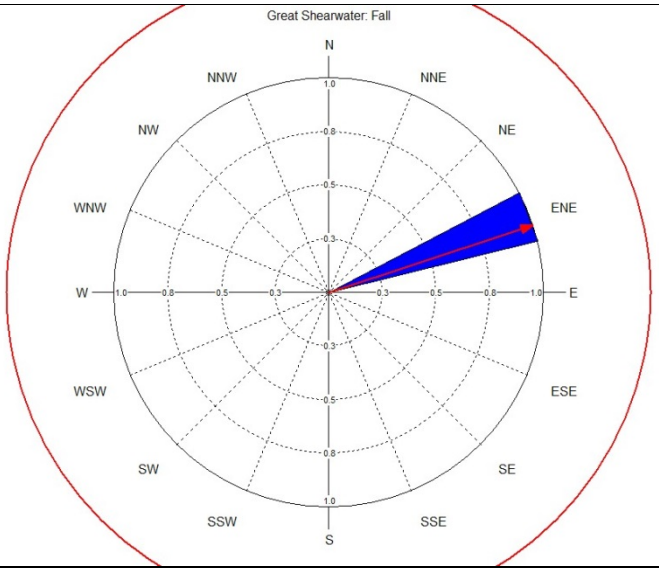
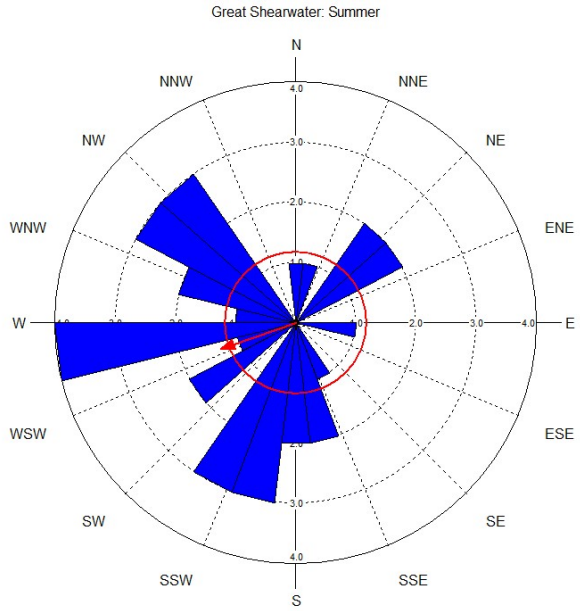


Figure 108 Distribution of great shearwater recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the summer season.



Number of Observations	**1**
Mean Vector (μ)	**71.76**
Length of Mean Vector (r)	**1**
Rayleigh Test (Z)	**1**
Rayleigh Test (p)	**0.512**



Number of Observations	**34**
Mean Vector (μ)	**250.795**
Length of Mean Vector (r)	**0.329**
Rayleigh Test (Z)	**3.681**
Rayleigh Test (p)	**0.024**

Figure 109 **Summary of flight direction of great shearwaters recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the fall (n=1), and summer (n=34) seasons.**

4.39 Cory's Shearwater

Cory's shearwaters were recorded during the summer months, with a peak count of 62 individuals in the June survey, resulting in an abundance estimate of 511 (**Table 45**).

Fourteen Cory's shearwaters were recorded in the fall, with individuals mostly recorded in the 4 km buffer (**Figure 110**). In the summer Cory's shearwaters were recorded in June, July, and August, which were loosely distributed across the Lease Area OCS-A 0512 plus 4 km buffer (**Figure 111**).

A total of 72 Cory's shearwaters were recorded in flight in summer, which showed a preference to fly around a mean of 263° (**Figure 112**).

Table 45 **Raw counts and abundance and density estimates (No. estimated individuals per km^2) of Cory's shearwaters in: a) Lease Area OCS-A 0512 plus 4 km buffer, b) Lease Area OCS-A 0512, and c) the Lease Area OCS-A 0512 4 km buffer only.**

a) Lease Area OCS-A 0512 plus 4 km Buffer					
Survey	**Raw Count**	**Abundance**	**Density**	**Flying**	**Sitting**
Jun-18	62	511	0.62	54	8
Jul-18	8	60	0.07	7	1
Aug-18	13	97	0.12	11	2
Sep-18	14	109	0.13	13	1
b) Lease Area OCS-A 0512					
Survey	**Raw Count**	**Abundance**	**Density**	**Flying**	**Sitting**
Jun-18	32	264	0.82	29	3
Jul-18	5	37	0.12	4	1
Aug-18	5	37	0.12	4	1
Sep-18	3	23	0.07	3	0
c) 4 km Buffer					
Survey	**Raw Count**	**Abundance**	**Density**	**Flying**	**Sitting**
Jun-18	30	247	0.5	25	5
Jul-18	3	22	0.04	3	0
Aug-18	8	60	0.12	7	1
Sep-18	11	87	0.17	10	1

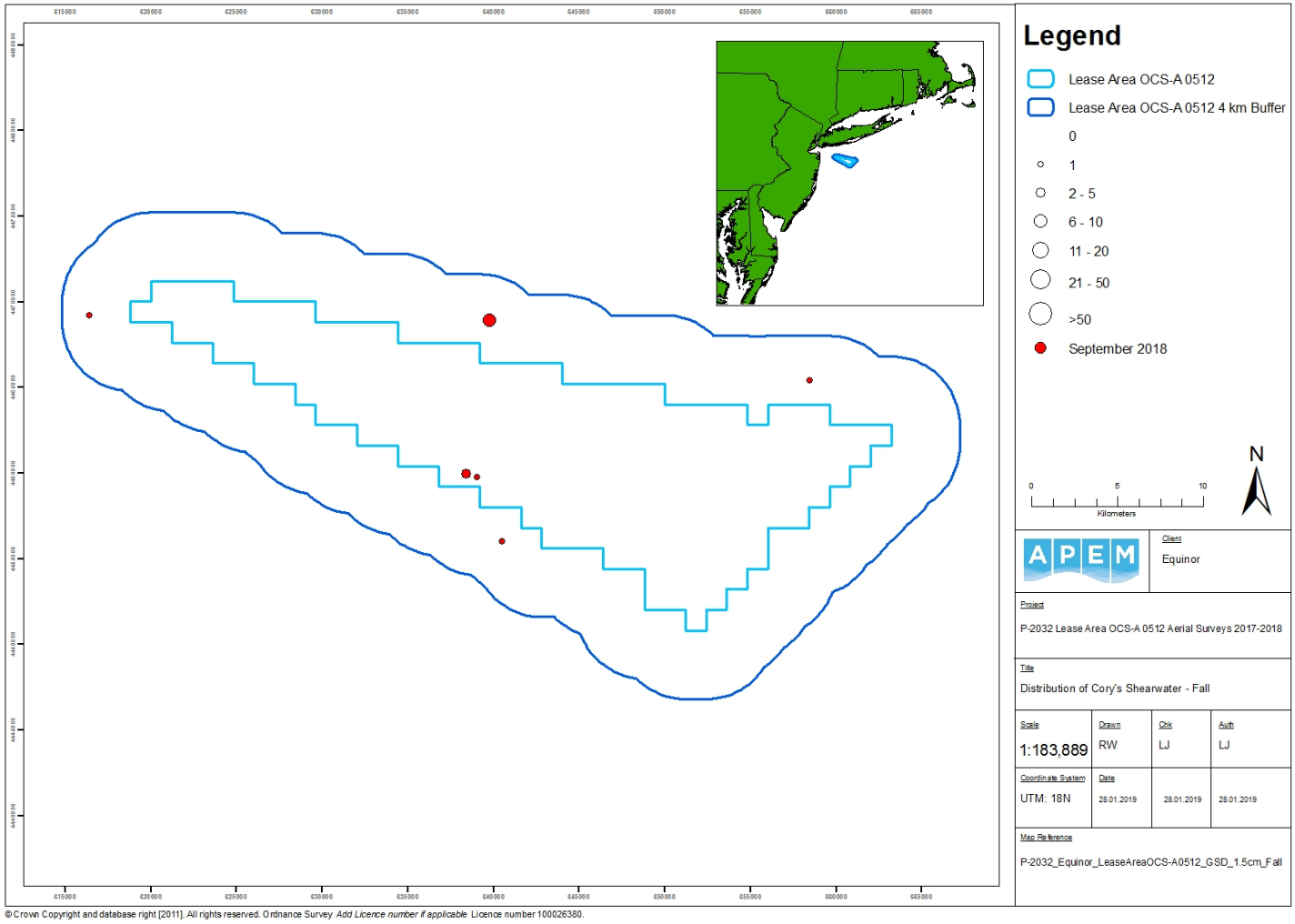


Figure 110 Distribution of Cory's shearwater recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the fall 2017-2018 season.

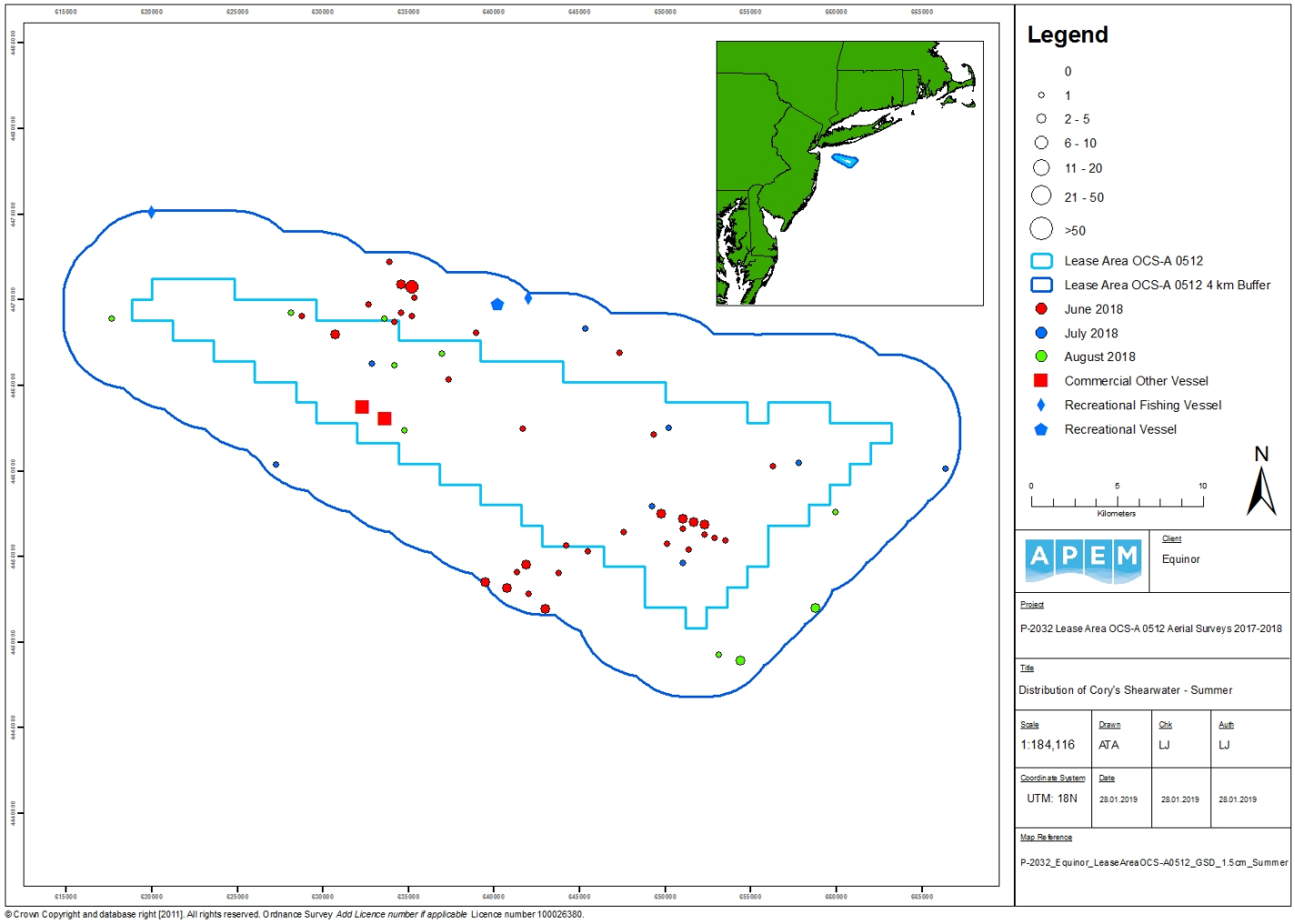
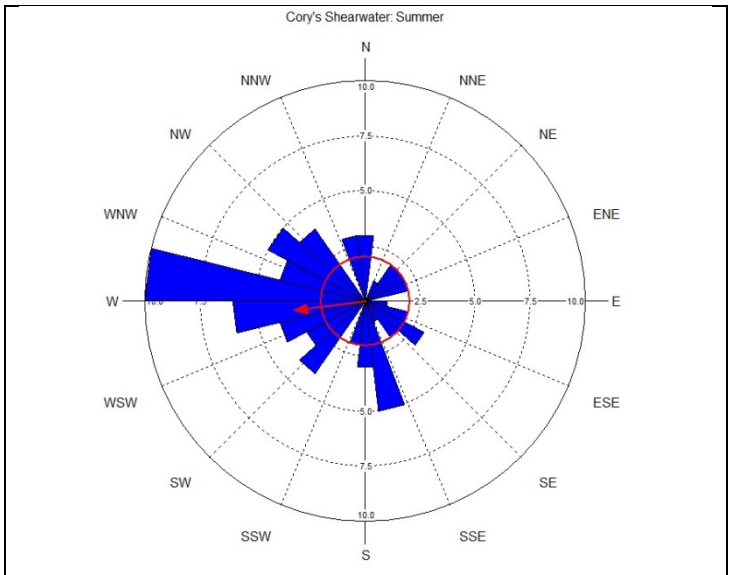


Figure 111 Distribution of Cory's shearwater recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the summer season.



Number of Observations	**72**
Mean Vector (μ)	**262.969**
Length of Mean Vector (r)	**0.322**
Rayleigh Test (Z)	**7.482**
Rayleigh Test (p)	**0.000563**

Figure 112 **Summary of flight direction of Cory's shearwaters (n=72)) recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the summer season.**

4.40 Species Unknown – Large Shearwater

A peak count of 25 unknown large shearwaters were recorded in the June survey, of which 12 were observed in the Lease Area OCS-A 0512 site and 13 in the 4 km buffer, resulting in abundance estimates of 99 and 107, respectively. A peak count was recorded with an estimated 107 individuals in the 4 km buffer in June (**Table 46**). Unknown large shearwaters were also recorded in the July and September surveys.

In September, six unknown large shearwaters were recorded, which were recorded in a group in the north of the 4 km buffer (**Figure 113**). In summer, unknown large shearwaters were recorded in June and July, which were loosely distributed across the Lease Area OCS-A 0512 plus 4 km buffer (**Figure 114**).

Three unknown large shearwaters were recorded in flight in fall, which did not show a preference to fly in any one direction. Fourteen large shearwater species were recorded in flight in summer, which showed a preference to fly in a west to west-south-westerly direction around a mean of 256° (**Figure 115**).

Table 46 **Raw counts and abundance and density estimates (No. estimated individuals per km^2) of unknown large shearwater species in: a) Lease Area OCS-A 0512 plus 4 km buffer, b) Lease Area OCS-A 0512, and c) the Lease Area OCS-A 0512 4 km buffer only.**

a) Lease Area OCS-A 0512 plus 4 km Buffer					
Survey	**Raw Count**	**Abundance**	**Density**	**Flying**	**Sitting**
Jun-18	25	206	0.25	14	11
Jul-18	2	15	0.02	0	2
Sep-18	6	47	0.06	3	3
b) Lease Area OCS-A 0512					
Survey	**Raw Count**	**Abundance**	**Density**	**Flying**	**Sitting**
Jun-18	12	99	0.31	10	2
Jul-18	0	0	-	0	0
Sep-18	0	0	-	0	0
c) 4 km Buffer					
Survey	**Raw Count**	**Abundance**	**Density**	**Flying**	**Sitting**
Jun-18	13	107	0.21	4	9
Jul-18	2	15	0.03	0	2
Sep-18	6	47	0.09	3	3

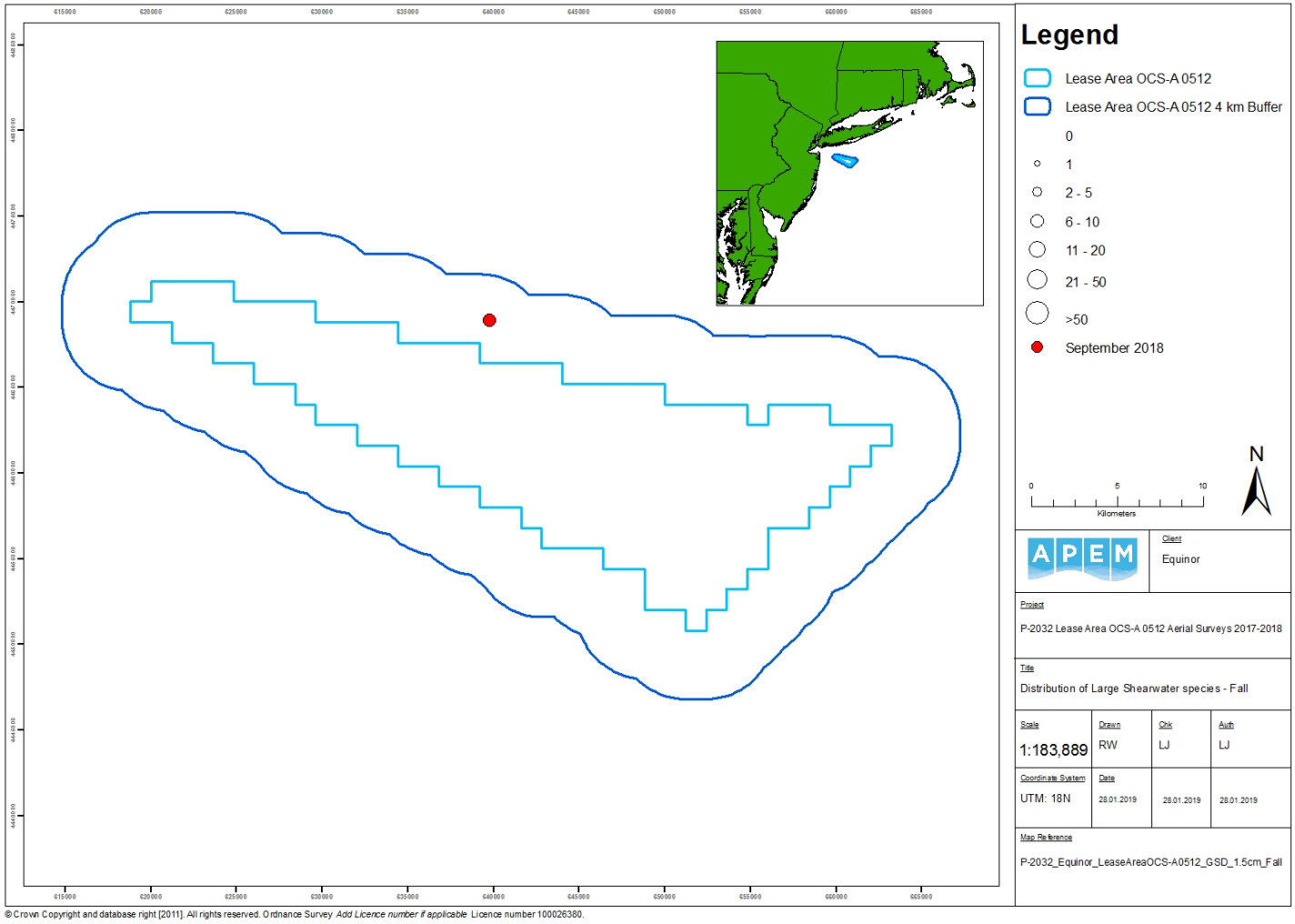


Figure 113 Distribution of unknown large shearwater species recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the fall season.

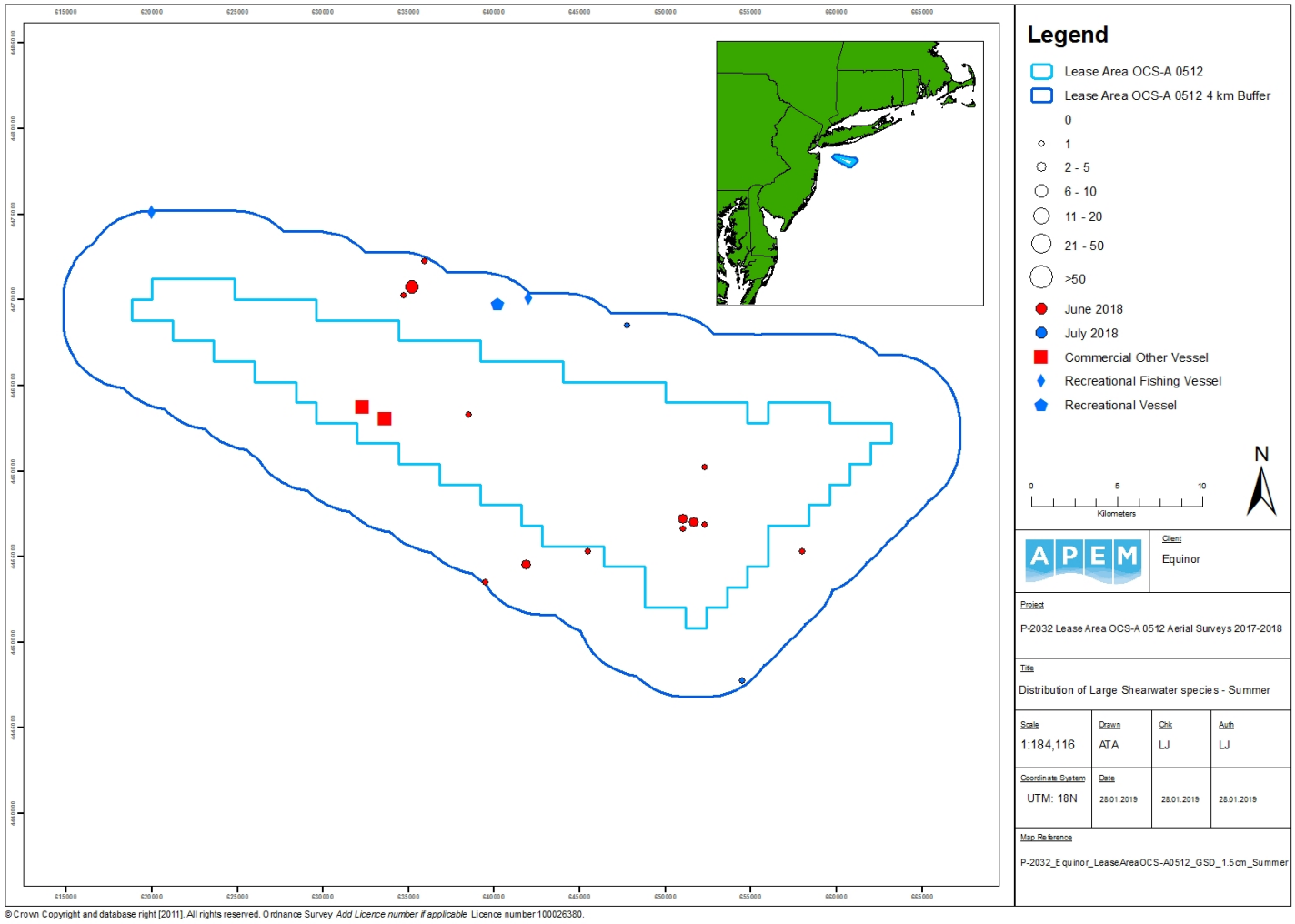
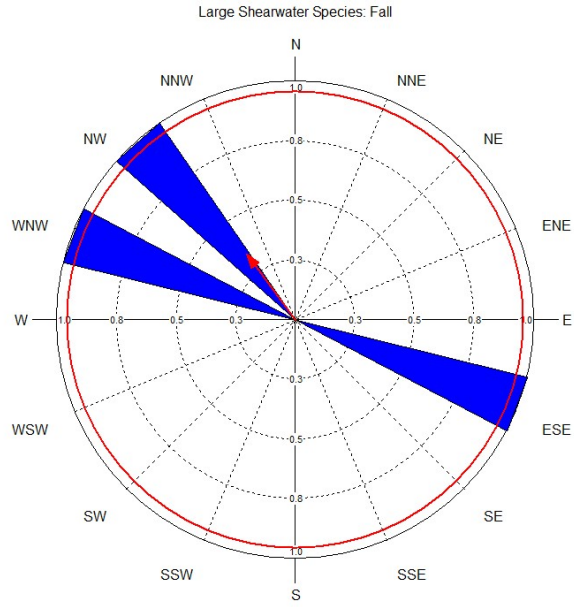
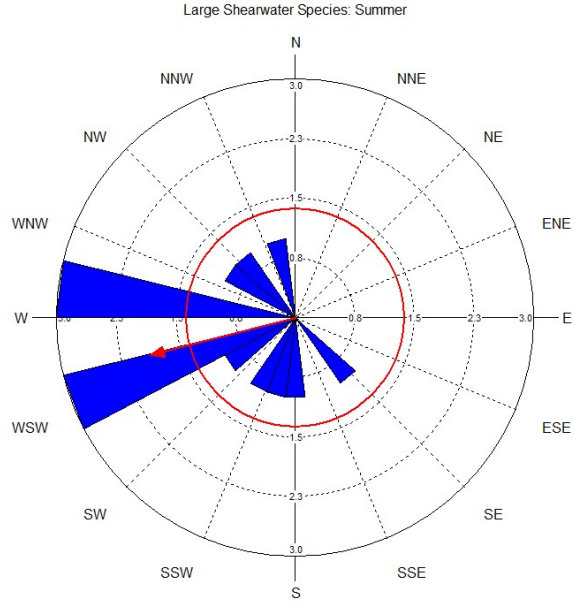


Figure 114 Distribution of unknown large shearwater species recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the summer season.



Number of Observations	**3**
Mean Vector (μ)	**323.493**
Length of Mean Vector (r)	**0.338**
Rayleigh Test (Z)	**0.343**
Rayleigh Test (p)	**0.744**



Number of Observations	**14**
Mean Vector (μ)	**255.629**
Length of Mean Vector (r)	**0.625**
Rayleigh Test (Z)	**5.473**
Rayleigh Test (p)	**0.003**

Figure 115 **Summary of flight direction of unknown large shearwater species recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the fall (n=3), and summer (n=14) season.**

4.41 Species Unknown – Small Shearwater

Unknown small shearwater species were recorded in the May and June surveys (**Table 47**), with a peak count of 5 individuals in May resulting in an abundance estimate of 38.

Five unknown small shearwaters were recorded in May, which were loosely distributed across the Lease Area OCS-A 0512 plus 4 km buffer (**Figure 116**). Three unknown small shearwaters were recorded in June, which were recorded in the 4 km buffer (**Figure 117**).

A single small shearwater species was recorded in flight in the spring, which were recorded flying in a north-easterly direction. In the summer a single small shearwater species was recorded flying in a south-easterly direction (**Figure 118**).

Table 47 **Raw counts and abundance and density estimates (No. estimated individuals per km^2) of unknown small shearwater species in: a) Lease Area OCS-A 0512 plus 4 km buffer, b) Lease Area OCS-A 0512, and c) the Lease Area OCS-A 0512 4 km buffer only.**

a) Lease Area OCS-A 0512 plus 4 km Buffer					
Survey	**Raw Count**	**Abundance**	**Density**	**Flying**	**Sitting**
May-18	5	38	0.05	1	4
Jun-18	3	25	0.03	1	2
b) Lease Area OCS-A 0512					
Survey	**Raw Count**	**Abundance**	**Density**	**Flying**	**Sitting**
May-18	2	15	0.05	1	1
Jun-18	0	0	-	0	0
c) 4 km Buffer					
Survey	**Raw Count**	**Abundance**	**Density**	**Flying**	**Sitting**
May-18	3	23	0.05	0	3
Jun-18	3	25	0.05	1	2

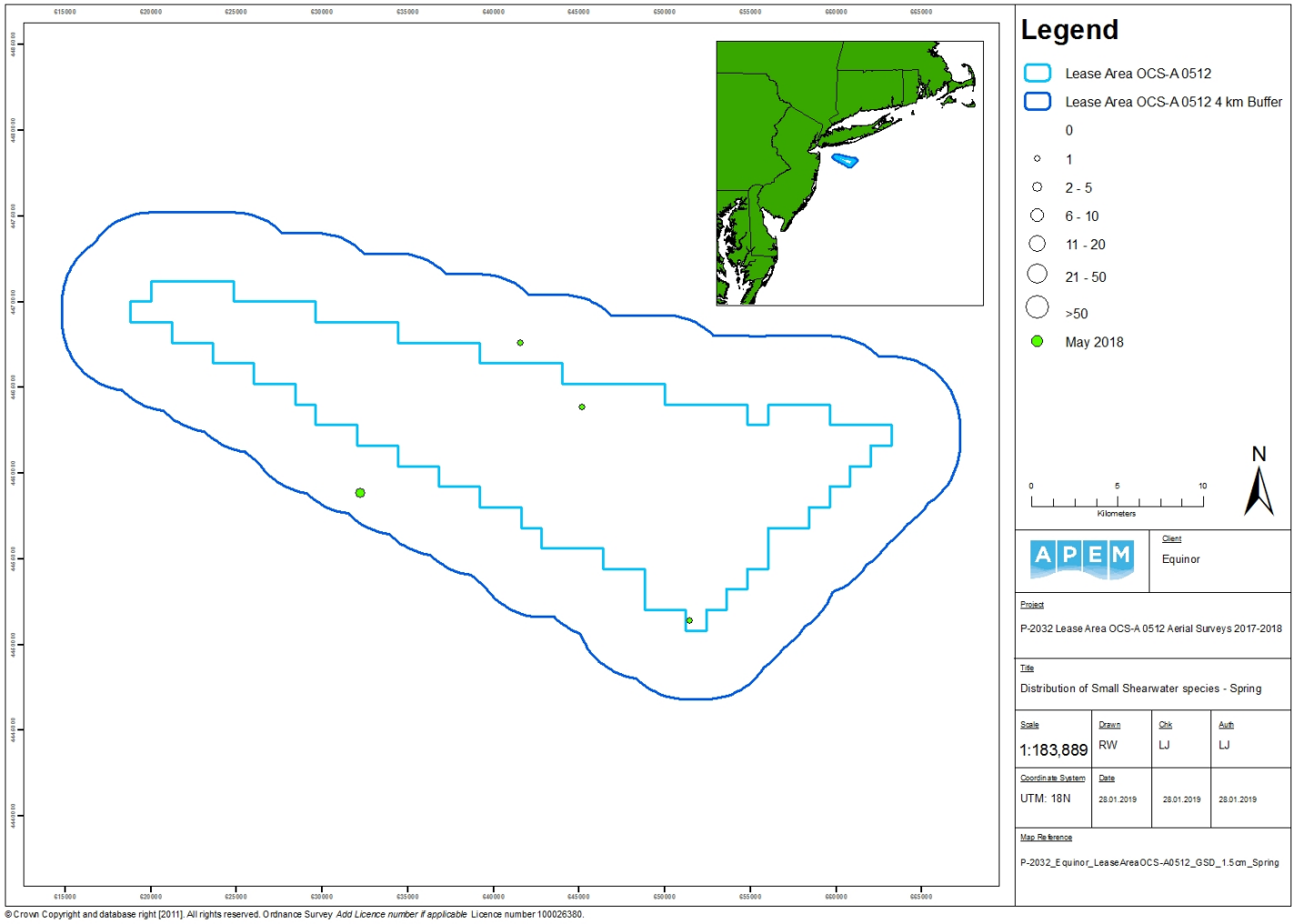


Figure 116 Distribution of unknown small shearwater species recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the spring season.

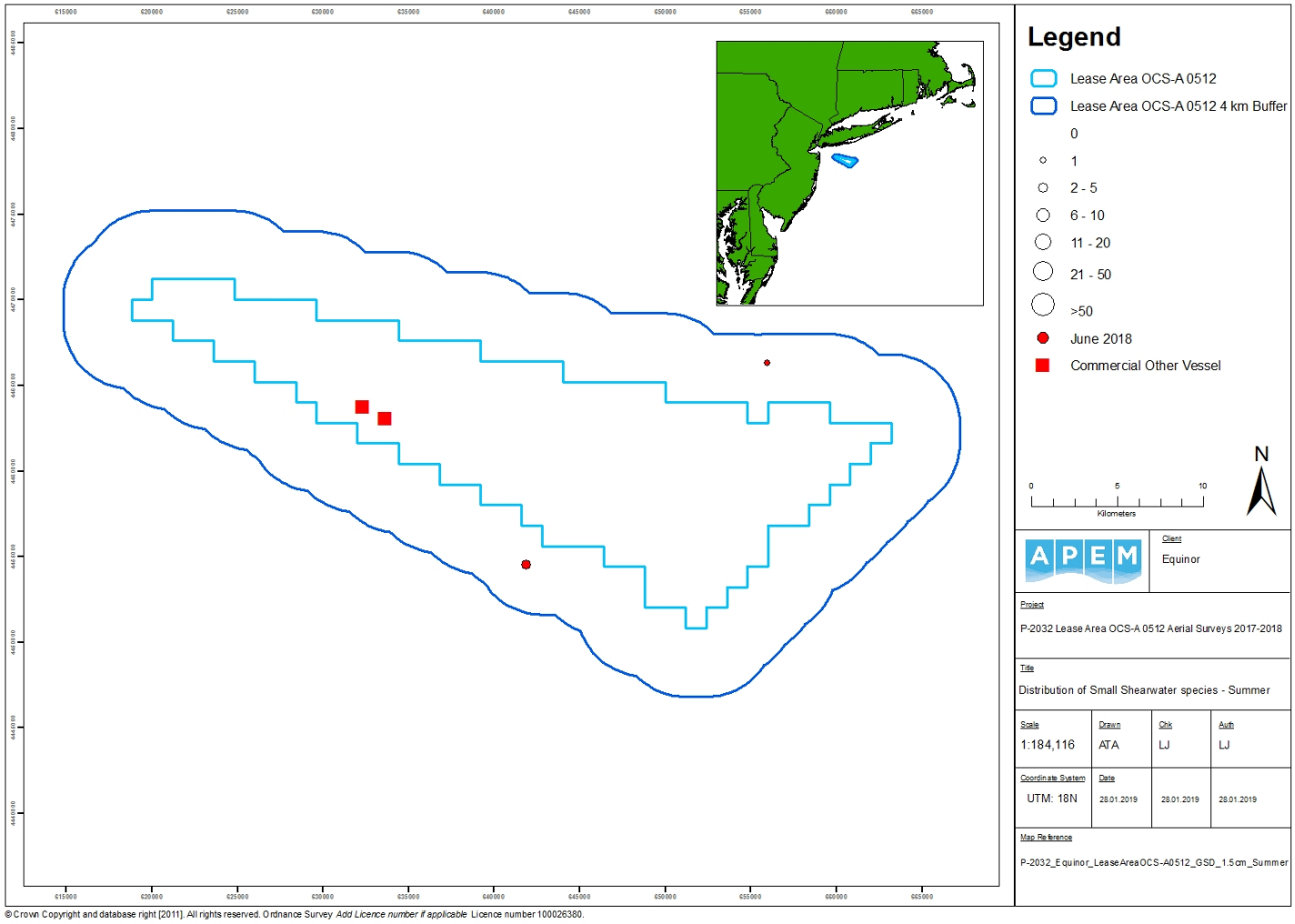
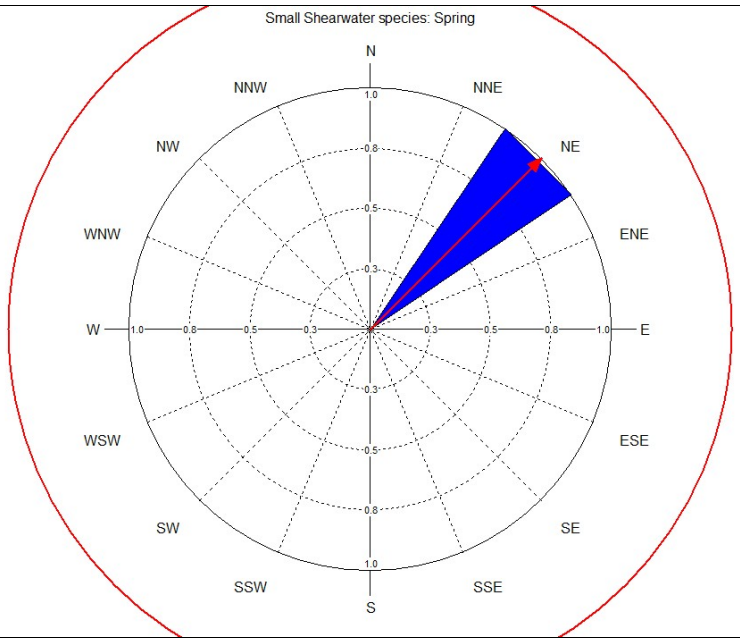
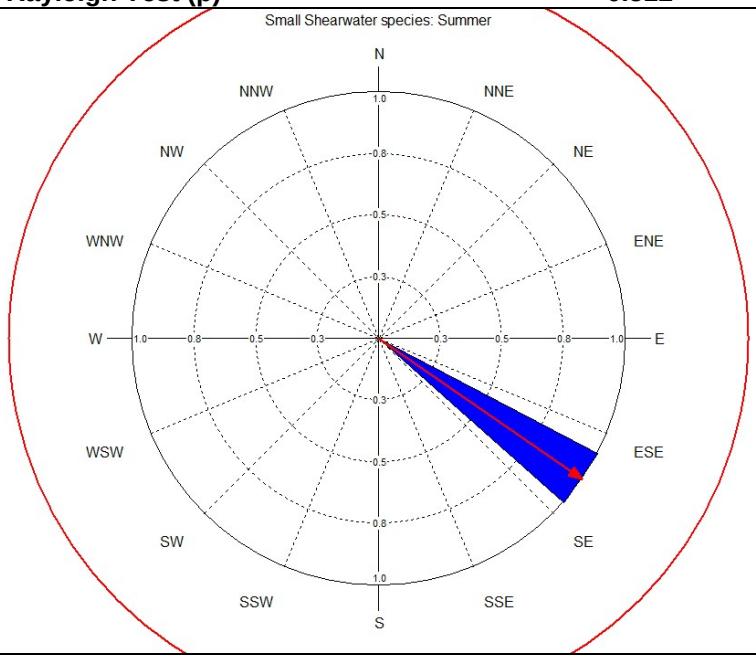


Figure 117 Distribution of unknown small shearwater species recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the summer season.



Number of Observations	**1**
Mean Vector (μ)	**45**
Length of Mean Vector (r)	**1**
Rayleigh Test (Z)	**1**
Rayleigh Test (p)	**0.512**



Number of Observations	**1**
Mean Vector (μ)	**124.625**
Length of Mean Vector (r)	**1**
Rayleigh Test (Z)	**1**
Rayleigh Test (p)	**0.512**

Figure 118 **Summary of flight direction of unknown small shearwater species recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the spring (n=1), and summer (n=1) seasons.**

4.42 Black-capped Petrel

A single black-capped petrel was recorded in the August survey in the east of the 4 km buffer, resulting in an abundance estimate of eight (**Table 48, Figure 119**).

The single black-capped petrel was recorded in flight in summer, flying in a south-south-westerly direction (**Figure 120**).

Table 48 **Raw counts and abundance and density estimates (No. estimated individuals per km^2) of black-capped petrels in: a) Lease Area OCS-A 0512 plus 4 km buffer, b) Lease Area OCS-A 0512, and c) the Lease Area OCS-A 0512 4 km buffer only.**

a) Lease Area OCS-A 0512 plus 4 km Buffer					
Survey	Raw Count	Abundance	Density	Flying	Sitting
Aug-18	1	7	0.01	1	0
b) Lease Area OCS-A 0512					
Survey	Raw Count	Abundance	Density	Flying	Sitting
Aug-18	0	0	-	0	0
c) 4 km Buffer					
Survey	Raw Count	Abundance	Density	Flying	Sitting
Aug-18	1	8	0.02	1	0

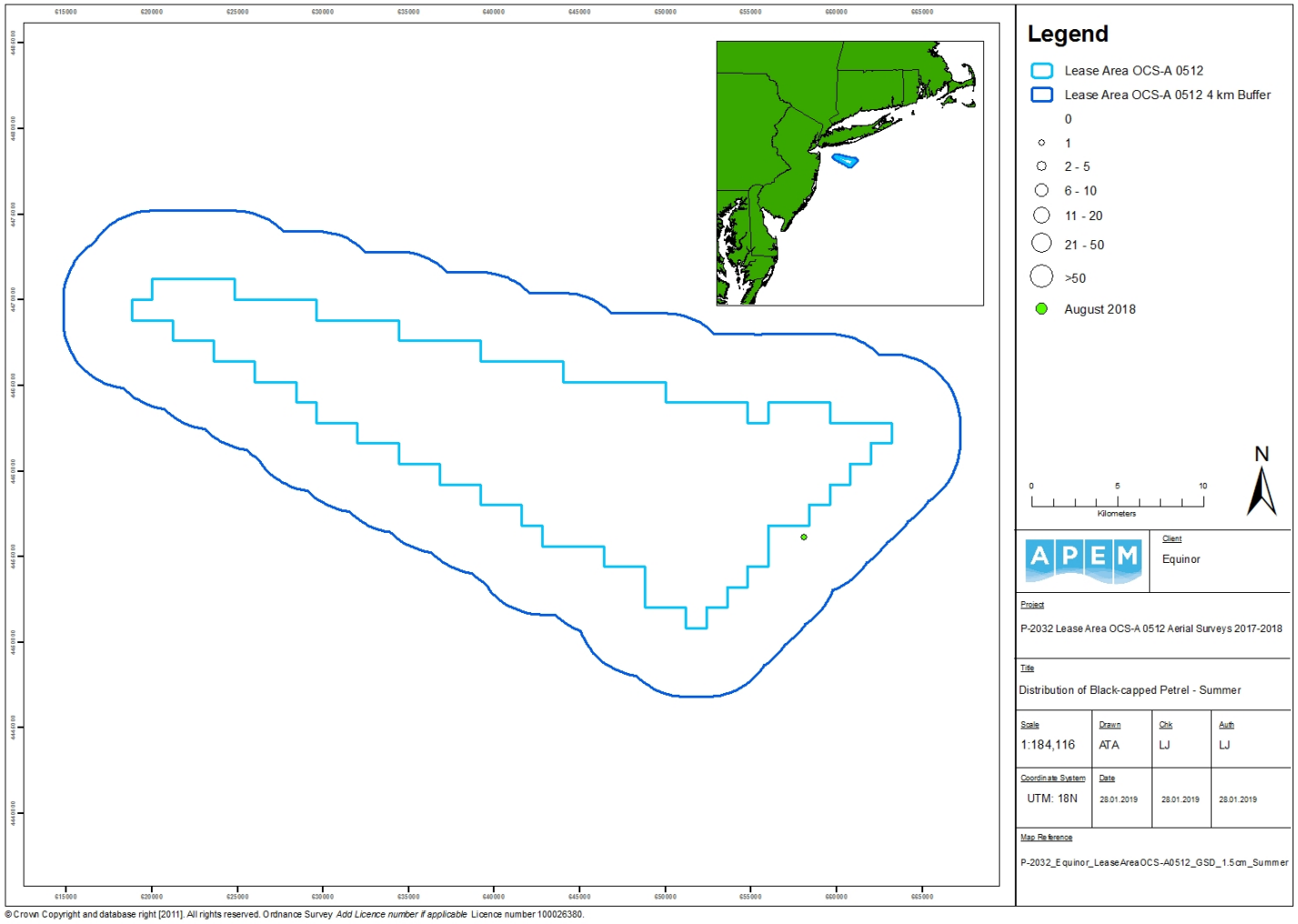
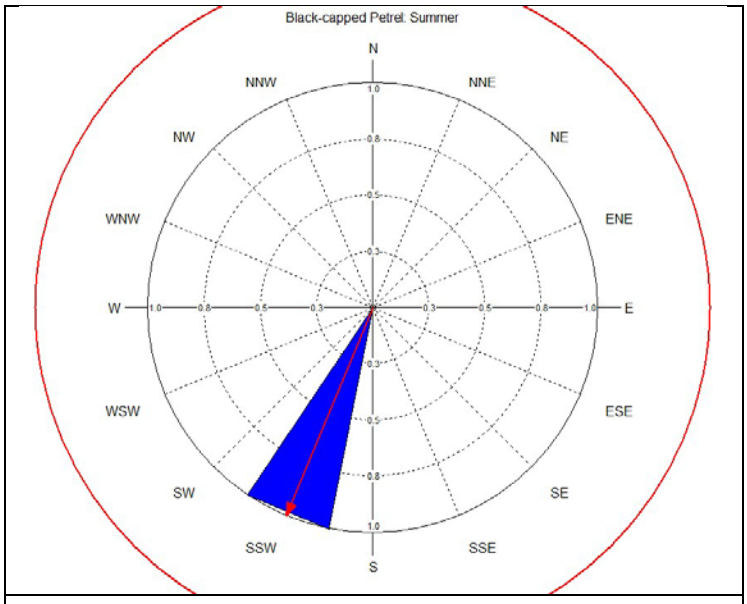


Figure 119 Distribution of black-capped petrels recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the summer season.



Number of Observations	**1**
Mean Vector (μ)	**202.5**
Length of Mean Vector (r)	**1**
Rayleigh Test (Z)	**1**
Rayleigh Test (p)	**0.512**

Figure 120 **Summary of flight direction of black-capped petrels (n=1) recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the summer season.**

4.43 Species Unknown - Petrel

Unknown petrel species were recorded in the August and October surveys, with single individuals recorded in each month in the Lease Area OCS-A 0512 site (**Table 49**).

In October, the individual bird was recorded in the center of the Lease Area OCS-A 0512 site (**Figure 121**). In August, the individual bird was recorded in the east of the Lease Area OCS-A 0512 site (**Figure 122**).

One unknown petrel species was observed flying in a west-north-westerly direction and one observed flying in a westerly direction in fall 2017/18 (**Figure 123**).

Table 49 **Raw counts and abundance and density estimates (No. estimated individuals per km^2) of unknown petrel species in: a) Lease Area OCS-A 0512 plus 4 km buffer, b) Lease Area OCS-A 0512, and c) the Lease Area OCS-A 0512 4 km buffer only.**

a) Lease Area OCS-A 0512 plus 4 km Buffer					
Survey	**Raw Count**	**Abundance**	**Density**	**Flying**	**Sitting**
Aug-18	1	7	0.01	1	0
Oct-18	1	8	0.01	1	0
b) Lease Area OCS-A 0512					
Survey	**Raw Count**	**Abundance**	**Density**	**Flying**	**Sitting**
Aug-18	1	7	0.02	1	0

Oct-18	1	8	0.02	1	0
c) 4 km Buffer					
Survey	**Raw Count**	**Abundance**	**Density**	**Flying**	**Sitting**
Aug-18	0	0	-	0	0
Oct-18	0	0	-	0	0

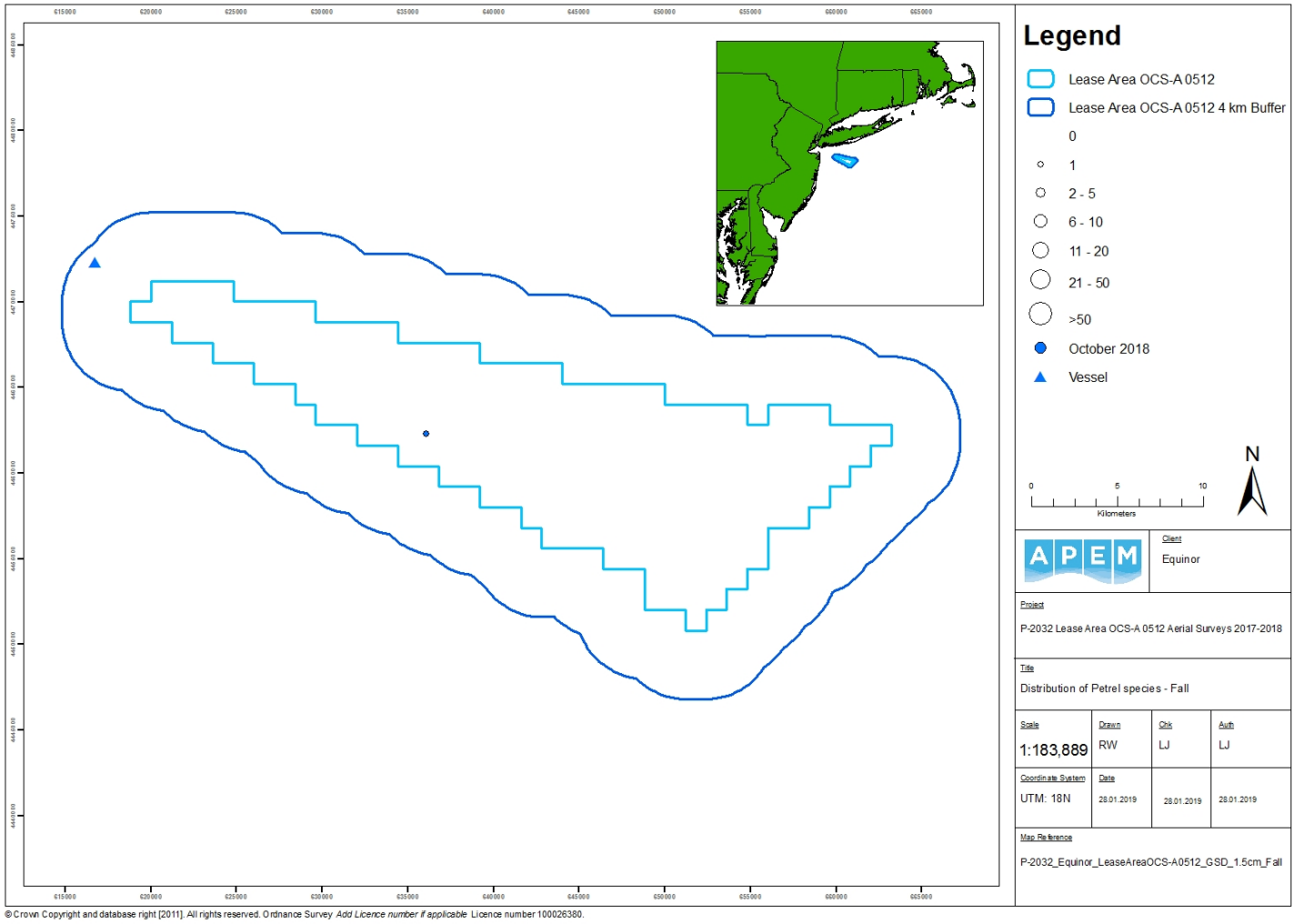


Figure 121 Distribution of unknown petrel species recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the fall season.

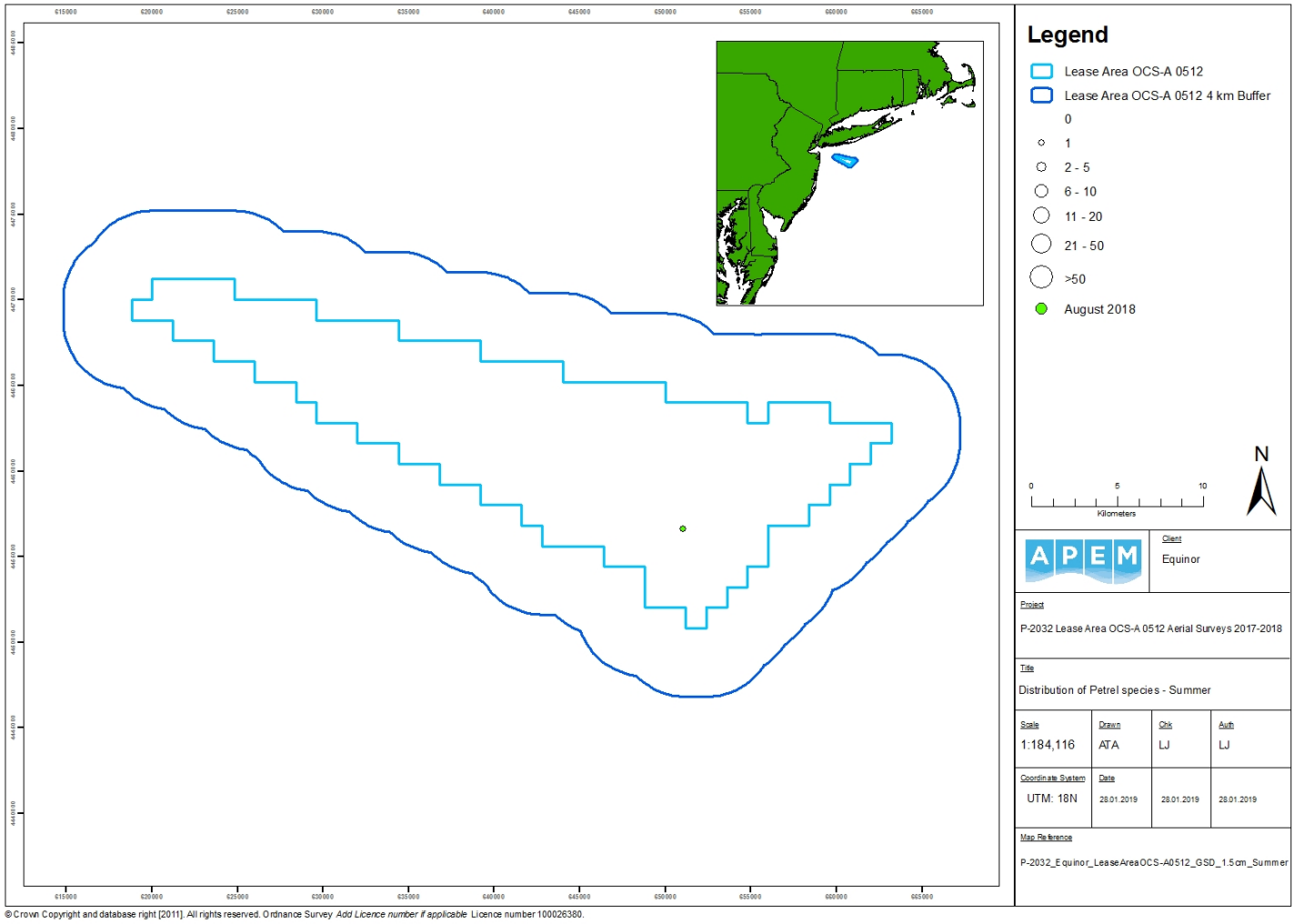
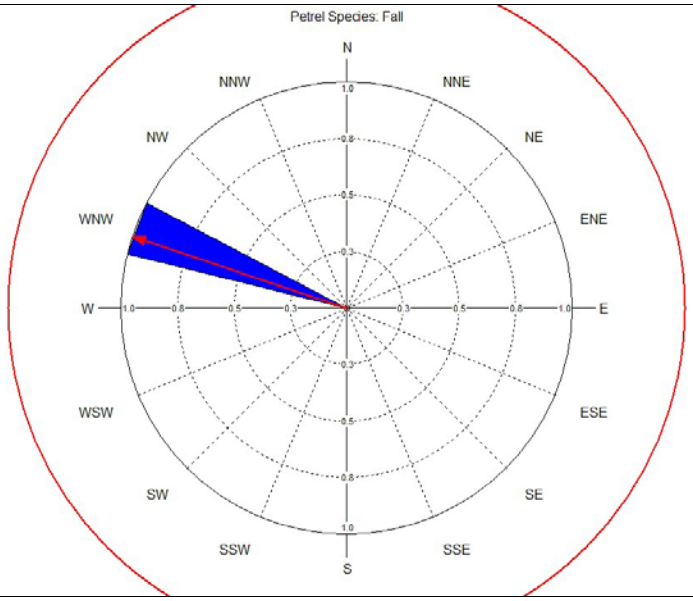
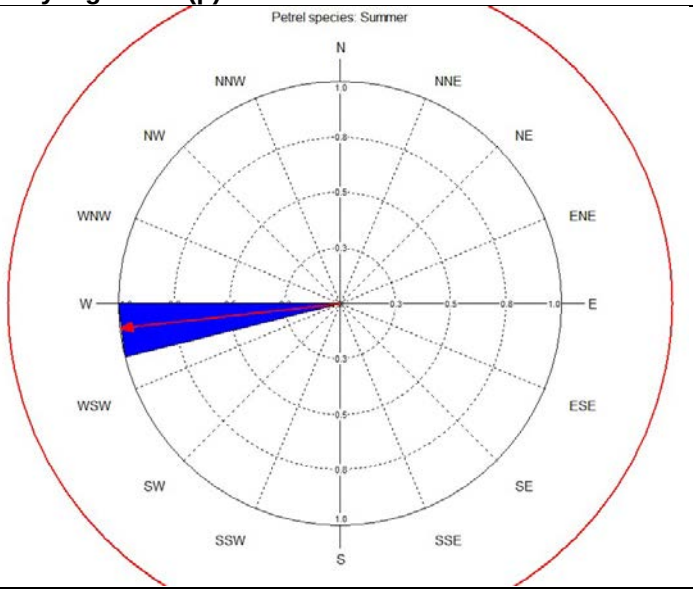


Figure 122 Distribution of unknown petrel species recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the summer season.



Number of Observations	**1**
Mean Vector (μ)	**288.567**
Length of Mean Vector (r)	**1**
Rayleigh Test (Z)	**1**
Rayleigh Test (p)	**0.512**



Number of Observations	**1**
Mean Vector (μ)	**263.73**
Length of Mean Vector (r)	**1**
Rayleigh Test (Z)	**1**
Rayleigh Test (p)	**0.512**

Figure 123 **Summary of flight direction of unknown petrel species recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the fall (n=1), summer (n=1) seasons.**

4.44 Species Unknown – Storm Petrel

Unknown storm petrel species were recorded in surveys between May and July, inclusive, with a peak count in the 4 km buffer in July of 31 individuals (**Table 50**), resulting in an abundance estimate of 232. The peak number recorded in the Lease Area OCS-A 0512 site occurred in June with four individuals resulting in an abundance estimate of 33.

In the spring, a single unknown storm petrel was recorded in the west of the 4 km buffer (**Figure 124**). In the summer, unknown storm petrels were recorded in June and July, which were mostly loosely distributed across the Lease Area OCS-A 0512 site and the 4 km buffer, respectively (**Figure 125**).

A single storm petrel species was recorded flying in a south-south-easterly direction in spring 2018. A total of 37 unknown storm petrel species were recorded in flight in summer 2018 and showed a preference to fly around a mean of 219° (**Figure 126**).

Table 50 **Raw counts and abundance and density estimates (No. estimated individuals per km^2) of unknown storm petrel species in: a) Lease Area OCS-A 0512 plus 4 km buffer, b) Lease Area OCS-A 0512, and c) the Lease Area OCS-A 0512 4 km buffer only.**

a) Lease Area OCS-A 0512 plus 4 km Buffer					
Survey	**Raw Count**	**Abundance**	**Density**	**Flying**	**Sitting**
May-18	1	8	0.01	1	0
Jun-18	5	41	0.05	5	0
Jul-18	32	240	0.29	32	0
b) Lease Area OCS-A 0512					
Survey	**Raw Count**	**Abundance**	**Density**	**Flying**	**Sitting**
May-18	1	7	0.02	1	0
Jun-18	4	33	0.1	4	0
Jul-18	1	7	0.02	1	0
c) 4 km Buffer					
Survey	**Raw Count**	**Abundance**	**Density**	**Flying**	**Sitting**
May-18	0	0	-	0	0
Jun-18	1	8	0.02	1	0
Jul-18	31	232	0.47	31	0

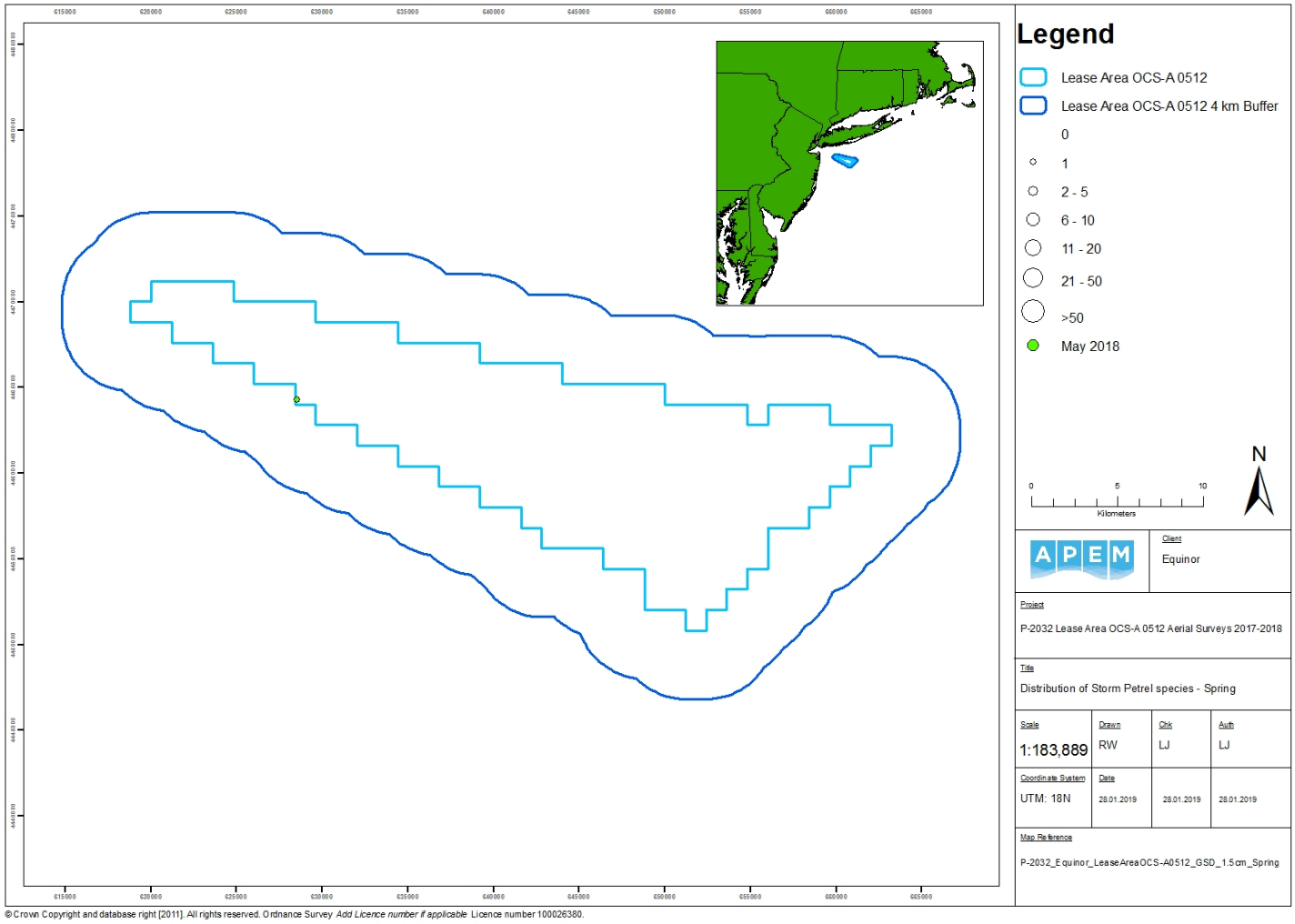


Figure 124 Distribution of unknown storm petrel species recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the spring season.

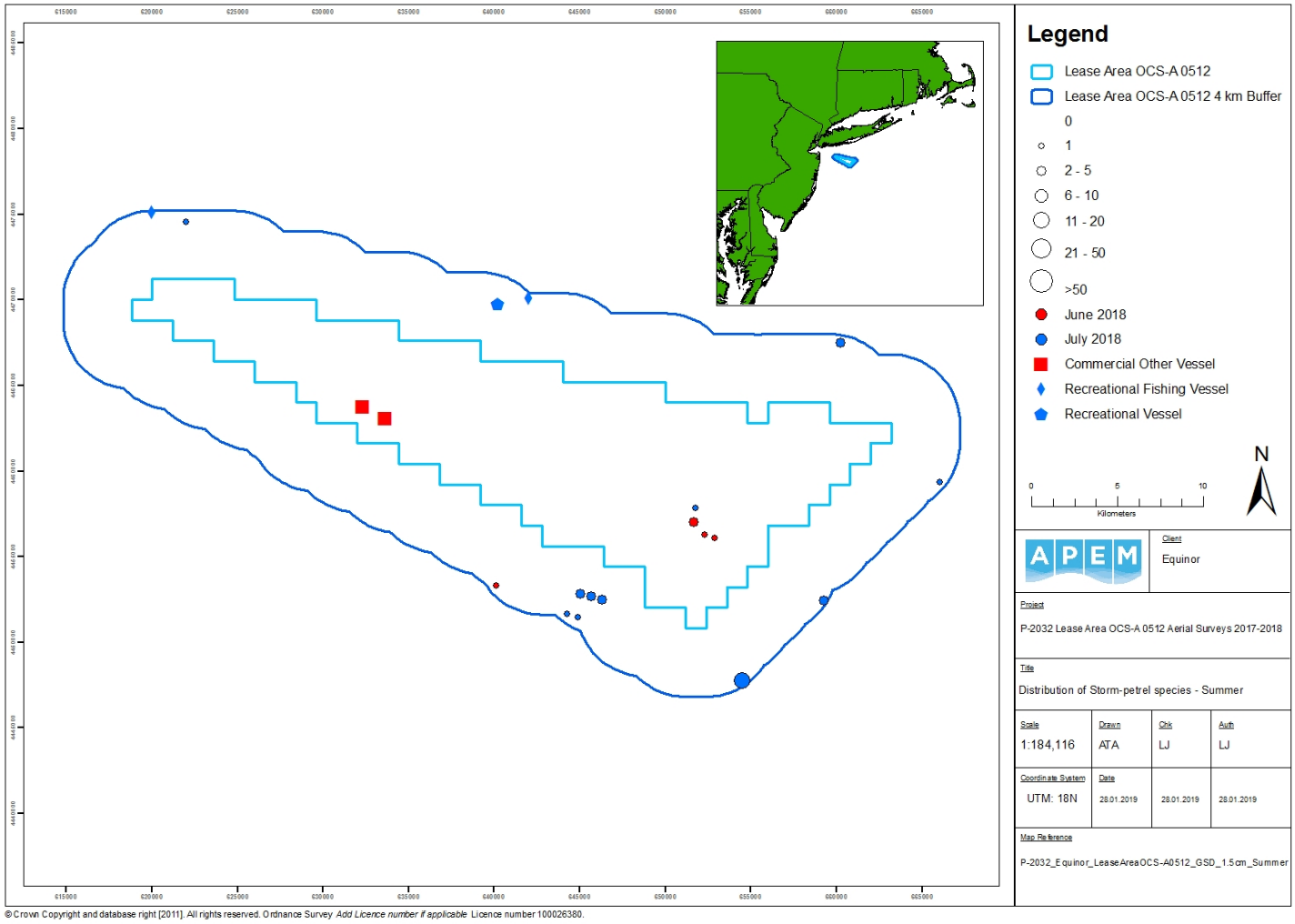
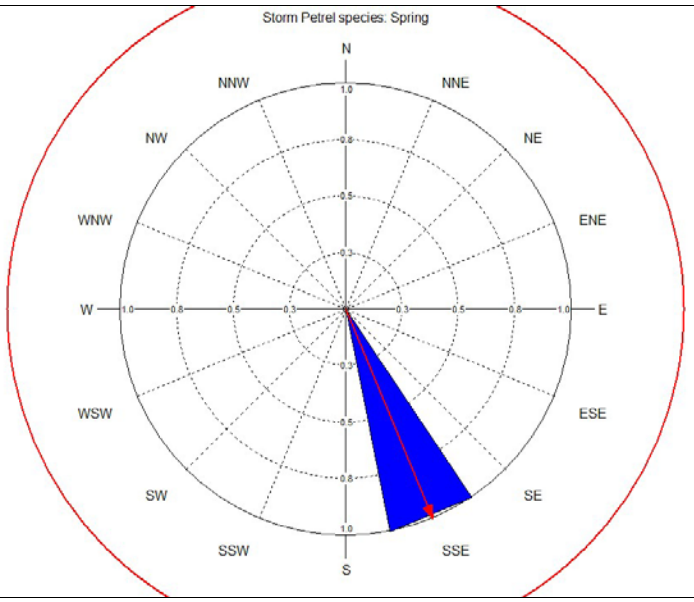
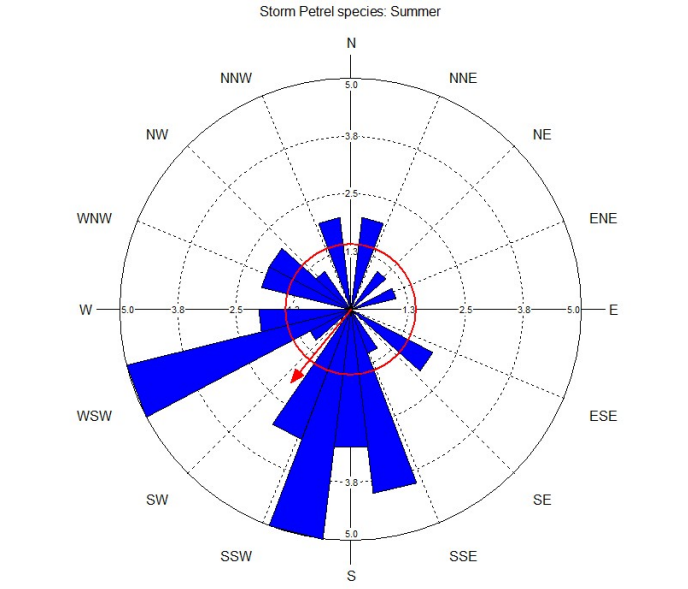


Figure 125 Distribution of unknown storm petrel species recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the summer season.



Number of Observations	**1**
Mean Vector (μ)	**157.5**
Length of Mean Vector (r)	**1**
Rayleigh Test (Z)	**1**
Rayleigh Test (p)	**0.512**



Number of Observations	**37**
Mean Vector (μ)	**219.41**
Length of Mean Vector (r)	**0.406**
Rayleigh Test (Z)	**6.111**
Rayleigh Test (p)	**0.002**

Figure 126 **Summary of flight direction of unknown storm petrel species recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the spring (n=1), and summer (n=37) seasons.**

4.45 Species Unknown - Hawk

A single unknown hawk species was recorded in the May survey in the west of the 4 km buffer, resulting in an abundance estimate of eight (**Table 51, Figure 127**).

The hawk was recorded flying at 35 m asl in a north-north-west to northerly direction (**Figure 128**).

Table 51 **Raw counts and abundance and density estimates (No. estimated individuals per km^2) of unknown hawk species in: a) Lease Area OCS-A 0512 plus 4 km buffer, b) Lease Area OCS-A 0512, and c) the Lease Area OCS-A 0512 4 km buffer only.**

a) Lease Area OCS-A 0512 plus 4 km Buffer					
Survey	**Raw Count**	**Abundance**	**Density**	**Flying**	**Sitting**
May-18	1	8	0.01	1	0
b) Lease Area OCS-A 0512					
Survey	**Raw Count**	**Abundance**	**Density**	**Flying**	**Sitting**
May-18	0	0	-	0	0
c) 4 km Buffer					
Survey	**Raw Count**	**Abundance**	**Density**	**Flying**	**Sitting**
May-18	1	8	0.02	1	0

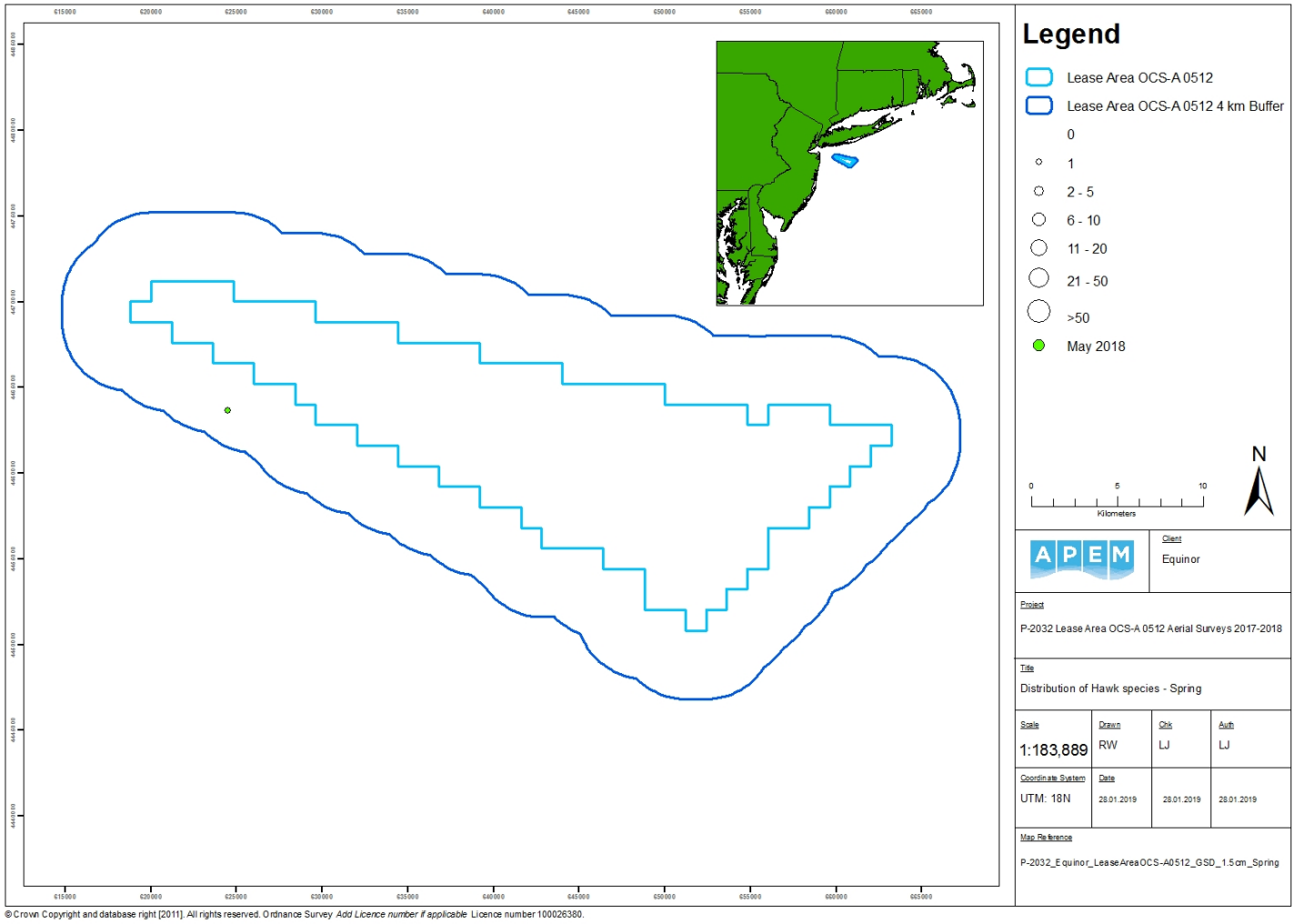
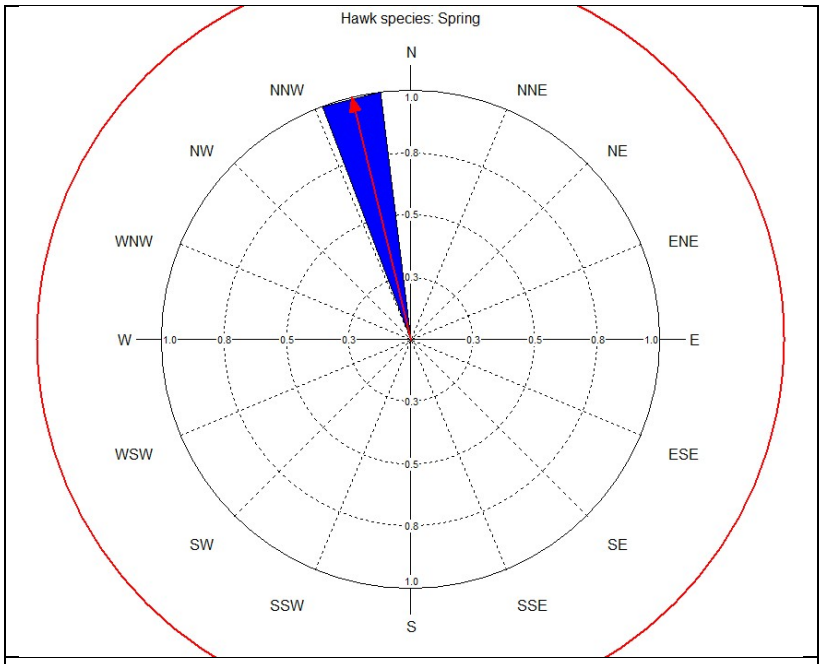


Figure 127 Distribution of unknown hawk species recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the spring season.



Number of Observations	**1**
Mean Vector (μ)	**346.328**
Length of Mean Vector (r)	**1**
Rayleigh Test (Z)	**1**
Rayleigh Test (p)	**0.512**

Figure 128 **Summary of flight direction of unknown hawk species (n=1) recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the spring season.**

4.46 Great Blue Heron

A single great blue heron was recorded in the August survey in the 4 km buffer, resulting in an abundance estimate of eight individuals. No other great blue herons were recorded (**Table 52**).

The individual was recorded in the west of the Lease Area OCS-A 0512 plus 4 km buffer in the 4 km buffer (**Figure 129**), flying in a south-westerly direction (**Figure 130**).

Table 52 **Raw counts and abundance and density estimates (No. estimated individuals per km^2) of great blue herons in: a) Lease Area OCS-A 0512 plus 4 km buffer, b) Lease Area OCS-A 0512, and c) the Lease Area OCS-A 0512 4 km buffer only.**

a) Lease Area OCS-A 0512 plus 4 km Buffer					
Survey	**Raw Count**	**Abundance**	**Density**	**Flying**	**Sitting**
Aug-18	1	7	0.01	1	0
b) Lease Area OCS-A 0512					
Survey	**Raw Count**	**Abundance**	**Density**	**Flying**	**Sitting**
Aug-18	0	0	-	0	0
c) 4 km Buffer					
Survey	**Raw Count**	**Abundance**	**Density**	**Flying**	**Sitting**
Aug-18	1	8	0.02	1	0

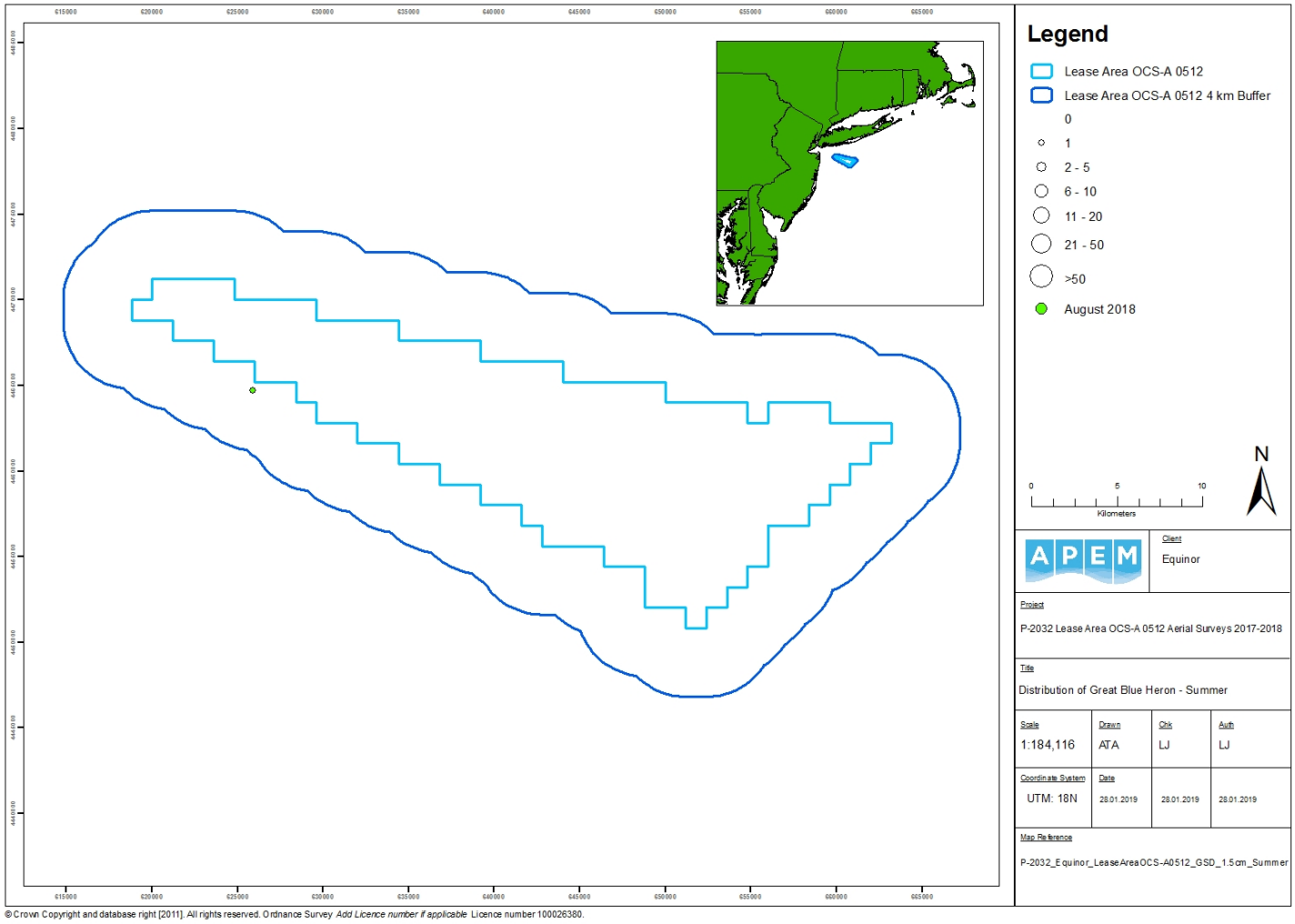
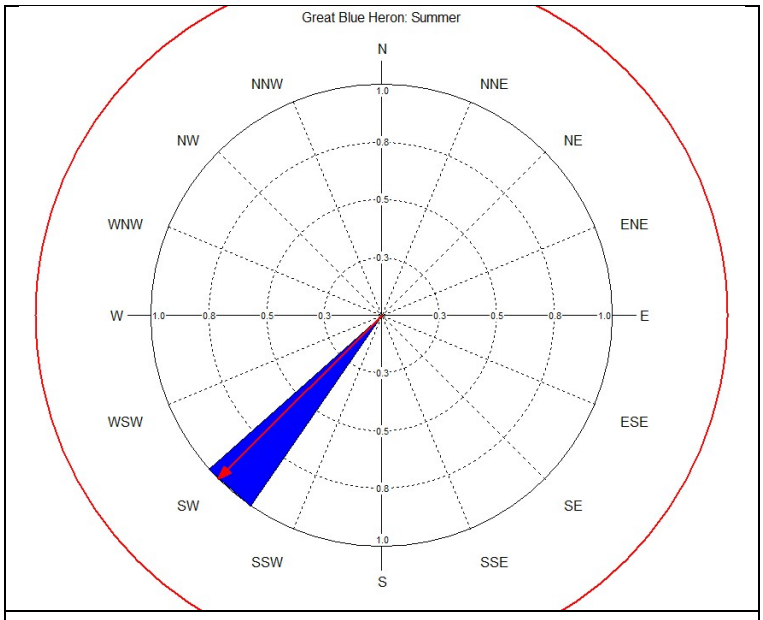


Figure 129 Distribution of great blue herons recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the summer season.



Number of Observations	**1**
Mean Vector (μ)	**225.039**
Length of Mean Vector (r)	**1**
Rayleigh Test (Z)	**1**
Rayleigh Test (p)	**0.512**

Figure 130 **Summary of flight direction of great blue herons (n=1) recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the summer season.**

4.47 Species Unknown - Shorebird

Sixteen unknown shorebird species were recorded in the July survey in the 4 km buffer, resulting in an abundance estimate of 120 individuals (**Table 53, Figure 131**).

All 16 unknown shorebird species were recorded in flight, which showed a significant preference to fly in a westerly direction around a mean of 261° (**Figure 132**).

Table 53 **Raw counts and abundance and density estimates (No. estimated individuals per km^2) of unknown shorebird species in: a) Lease Area OCS-A 0512 plus 4 km buffer, b) Lease Area OCS-A 0512, and c) the Lease Area OCS-A 0512 4 km buffer only.**

a) Lease Area OCS-A 0512 plus 4 km Buffer					
Survey	**Raw Count**	**Abundance**	**Density**	**Flying**	**Sitting**
Jul-18	16	120	0.15	16	0
b) Lease Area OCS-A 0512					
Survey	**Raw Count**	**Abundance**	**Density**	**Flying**	**Sitting**
Jul-18	0	0	-	0	0
c) 4 km Buffer					
Survey	**Raw Count**	**Abundance**	**Density**	**Flying**	**Sitting**
Jul-18	16	120	0.24	16	0

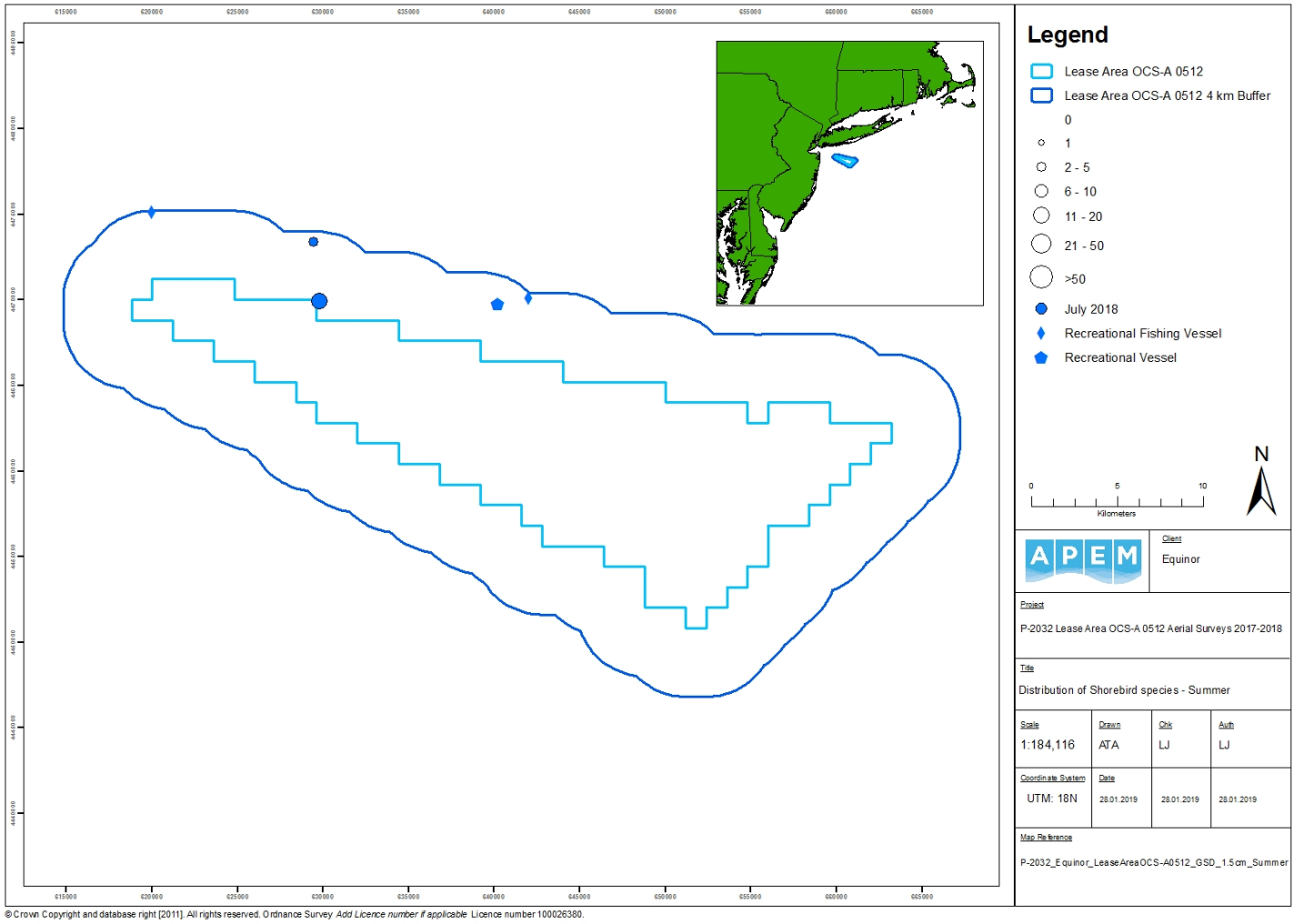
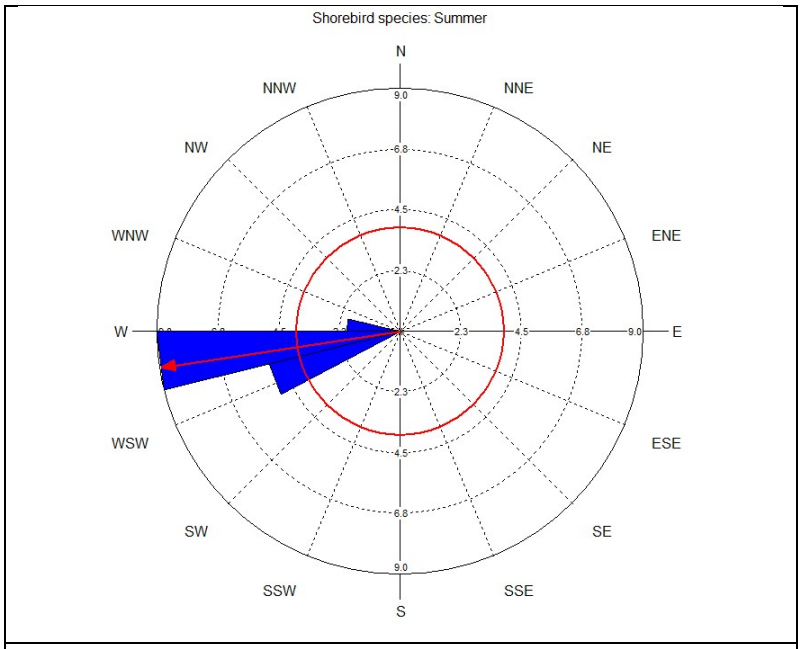


Figure 131 Distribution of unknown shorebird species recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the summer season.



Number of Observations	**16**
Mean Vector (μ)	**261.423**
Length of Mean Vector (r)	**0.992**
Rayleigh Test (Z)	**15.756**
Rayleigh Test (p)	**2.2E-07**

Figure 132 **Summary of flight direction of shorebird species (n=16) recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the summer season.**

4.48 Common Dolphin

A peak raw count of 68 common dolphins was recorded in the May survey, all of which were observed in the Lease Area OCS-A 0512 site, giving an abundance estimate of 506 (**Table 54**).

In November the group of five individuals was recorded in the northern region of the buffer (**Figure 133**). In winter, common dolphins were recorded in December in the south-east corner of the 4 km, and in January in the north-east corner of the wind farm (**Figure 134**). In May, a large group of 68 common dolphins was recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the east of the Lease Area OCS-A 0512 site (**Figure 135**).

Table 54 **Raw counts and abundance and density estimates (No. estimated individuals per km^2) of common dolphins in: a) Lease Area OCS-A 0512 plus 4 km buffer, b) Lease Area OCS-A 0512, and c) the Lease Area OCS-A 0512 4 km buffer only.**

a) Lease Area OCS-A 0512 plus 4 km Buffer					
Survey	**Raw Count**	**Abundance**	**Density**	**Surfacing**	**Submerged**
Nov-17	5	40	0.05	0	5
Dec-17	18	139	0.17	1	17
Jan-18	4	31	0.04	1	3
May-18	68	514	0.63	16	52

b) Lease Area OCS-A 0512					
Survey	**Raw Count**	**Abundance**	**Density**	**Surfacing**	**Submerged**
Nov-17	0	0	-	0	0
Dec-17	0	0	-	0	0
Jan-18	4	31	0.1	1	3
May-18	68	506	1.58	16	52
c) 4 km Buffer					
Survey	**Raw Count**	**Abundance**	**Density**	**Surfacing**	**Submerged**
Nov-17	5	40	0.08	0	5
Dec-17	18	141	0.28	1	17
Jan-18	0	0	-	0	0
May-18	0	0	-	0	0

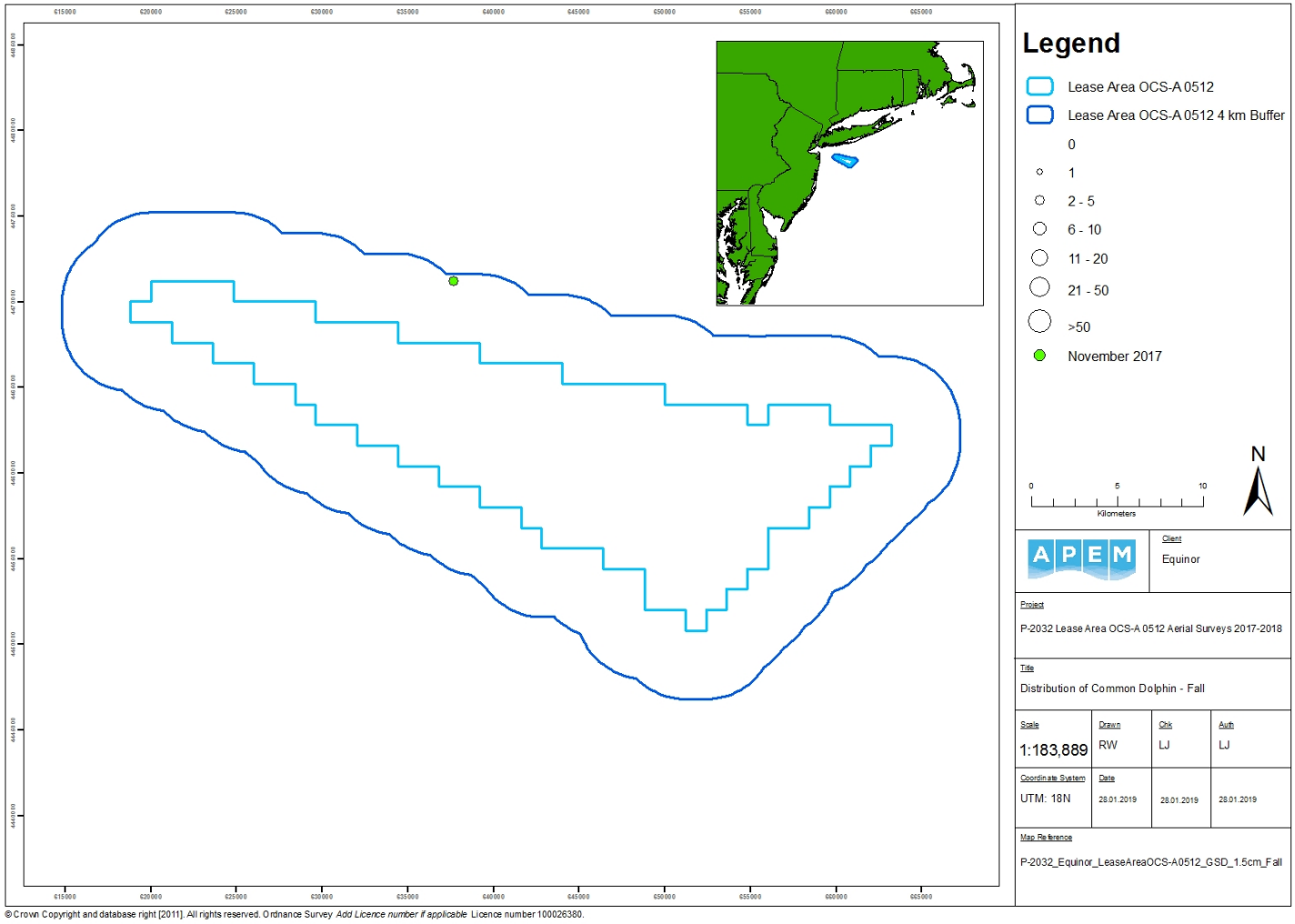


Figure 133 Distribution of common dolphins recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the fall season.

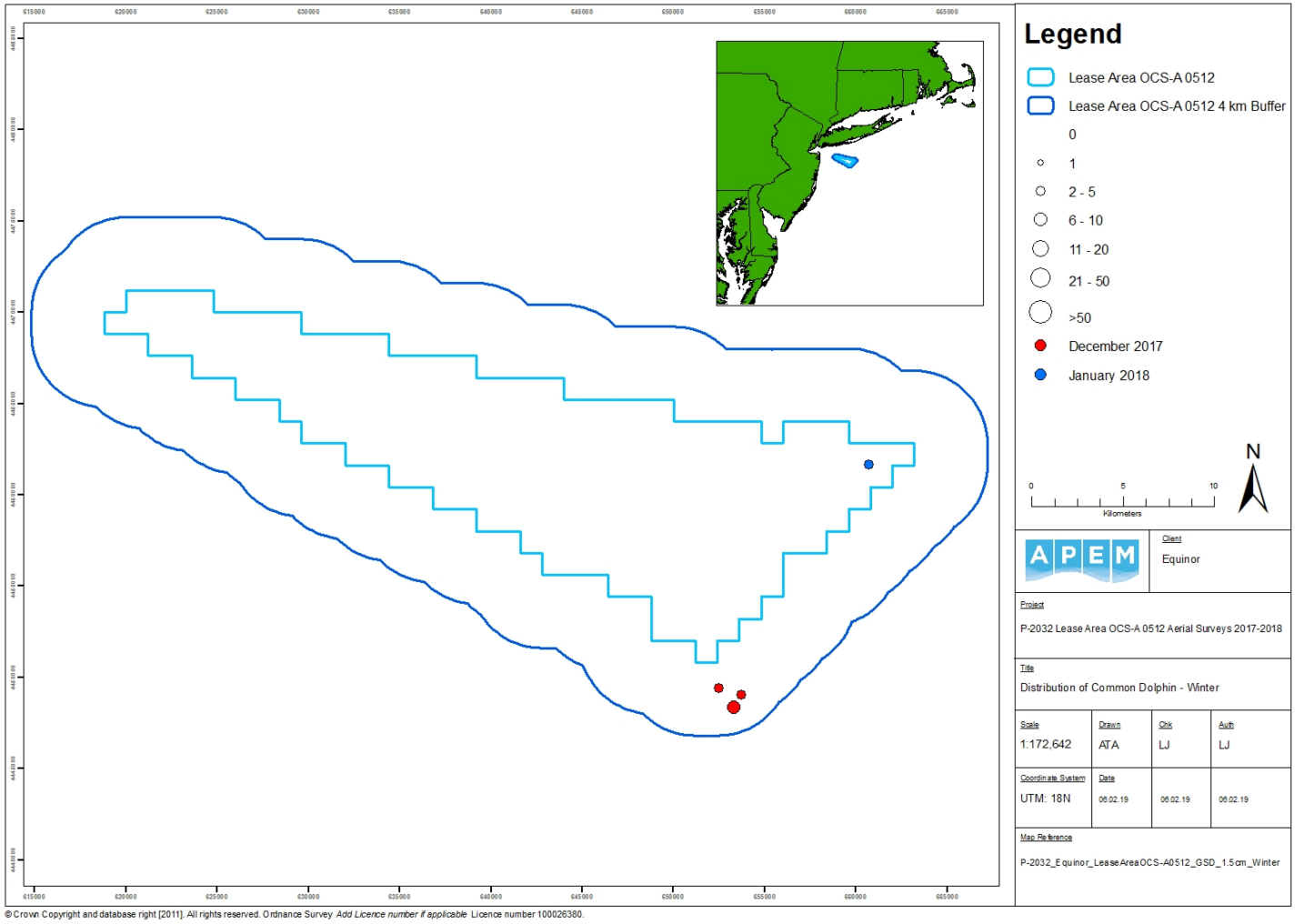


Figure 134 Distribution of common dolphins recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the winter season.

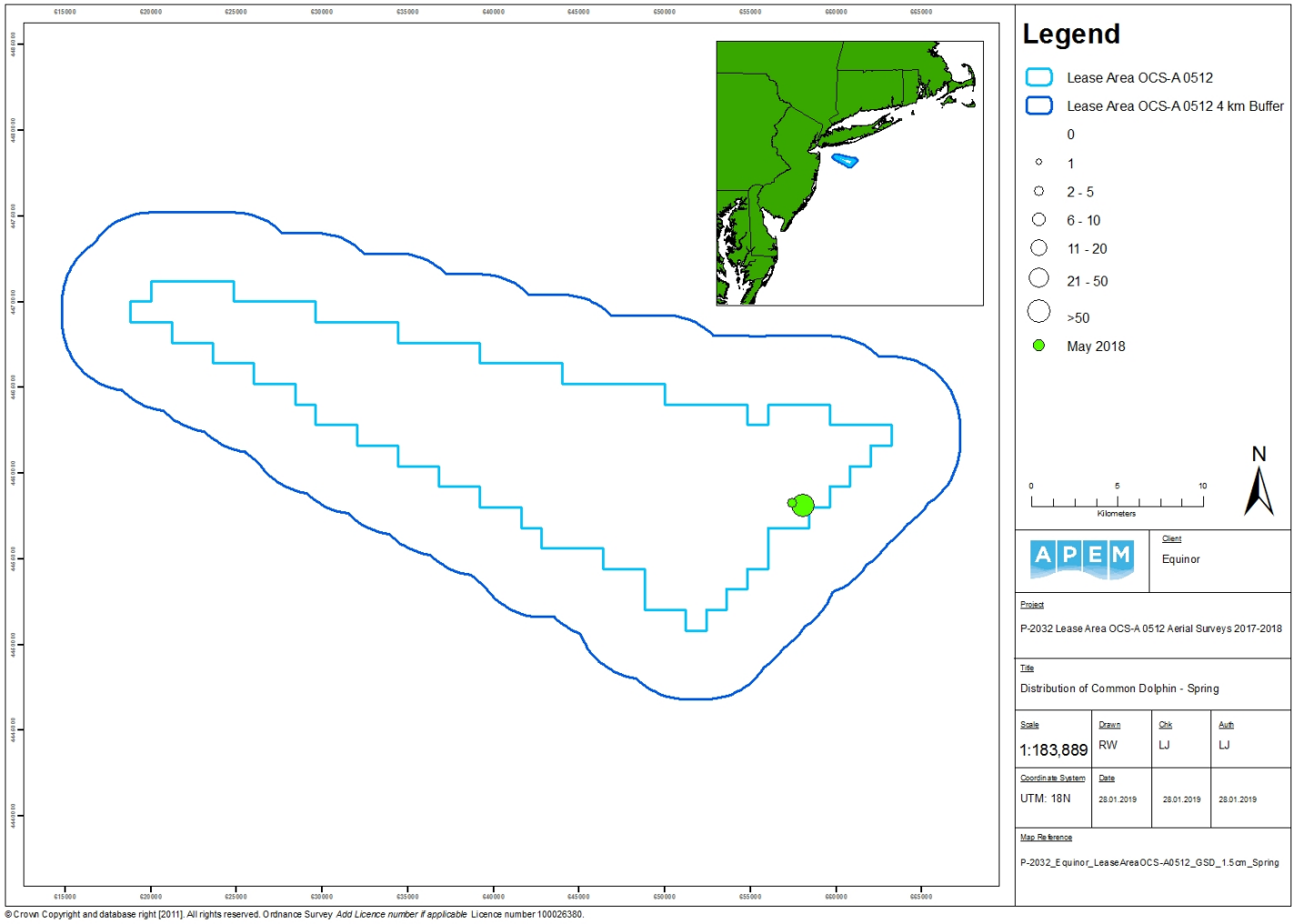


Figure 135 Distribution of common dolphins recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the spring season.

4.49 Bottlenose Dolphin

A peak of 22 bottlenose dolphins was recorded in the 4 km buffer in the June survey, with an abundance estimate of 181. A further seven individuals were recorded in December, and one was recorded in February (**Table 55**).

In winter, seven bottlenose dolphins were recorded in December located in the centre of the wind farm, and a single bottlenose dolphin was recorded in February located in the north-east of the 4 km buffer (**Figure 136**). Twenty-two bottlenose dolphins were recorded in the Lease Area OCS-A 0512 plus 4 km buffer in June. All individuals were recorded in the west of the site in the 4 km buffer (**Figure 137**).

Table 55 **Raw counts and abundance and density estimates (No. estimated individuals per km^2) of bottlenose dolphins in: a) Lease Area OCS-A 0512 plus 4 km buffer, b) Lease Area OCS-A 0512, and c) the Lease Area OCS-A 0512 4 km buffer only.**

a) Lease Area OCS-A 0512 plus 4 km Buffer					
Survey	**Raw Count**	**Abundance**	**Density**	**Surfacing**	**Submerged**
Dec-17	7	54	0.07	0	7
Feb-18	1	8	0.01	1	0
Jun-18	22	181	0.22	4	18
b) Lease Area OCS-A 0512					
Survey	**Raw Count**	**Abundance**	**Density**	**Surfacing**	**Submerged**
Dec-17	7	53	0.17	0	7
Feb-18	0	0	-	0	0
Jun-18	0	0	-	0	0
c) 4 km Buffer					
Survey	**Raw Count**	**Abundance**	**Density**	**Surfacing**	**Submerged**
Dec-17	0	0	-	0	0
Feb-18	1	8	0.02	1	0
Jun-18	22	181	0.36	4	18

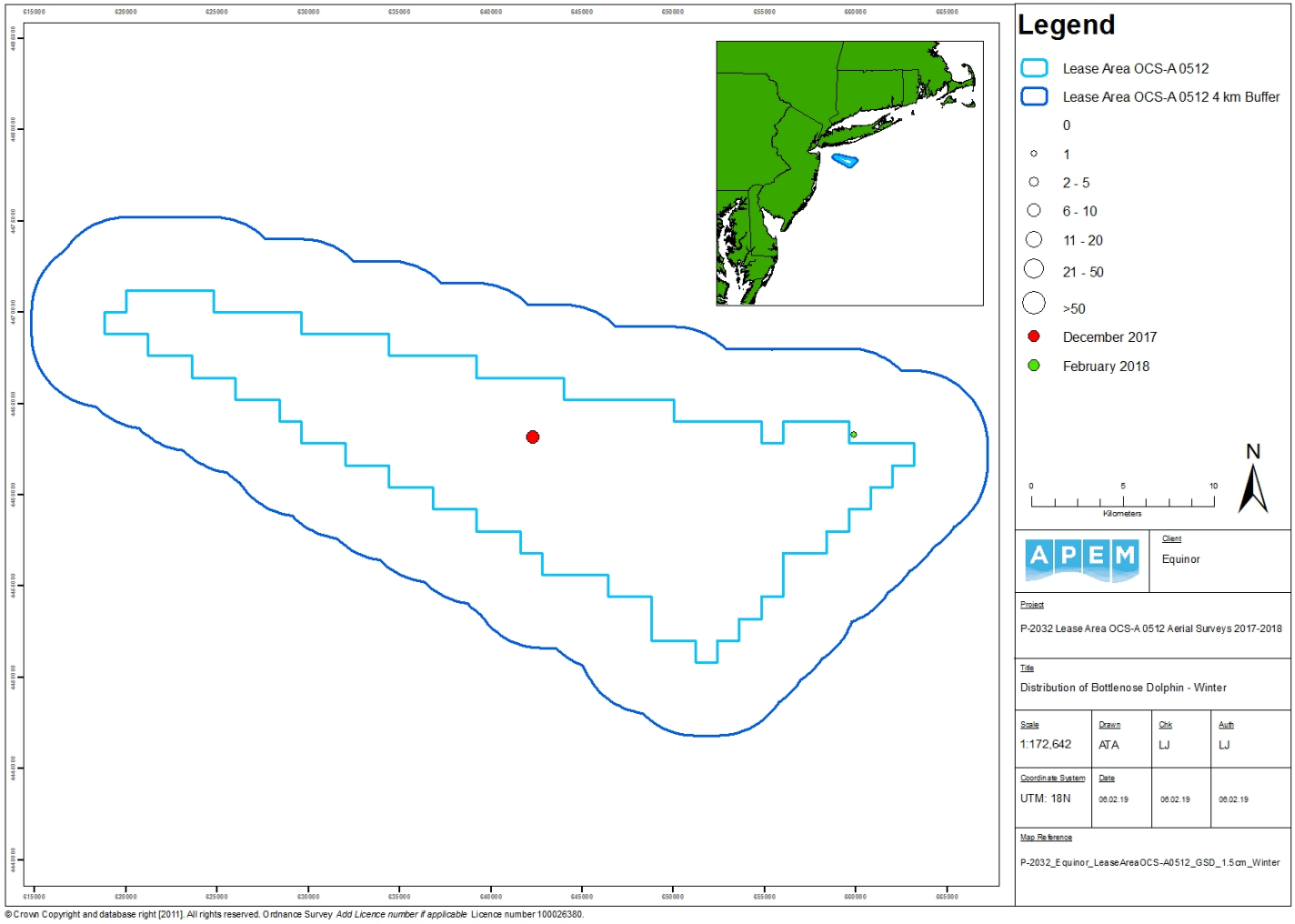


Figure 136 Distribution of bottlenose dolphins recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the winter season.

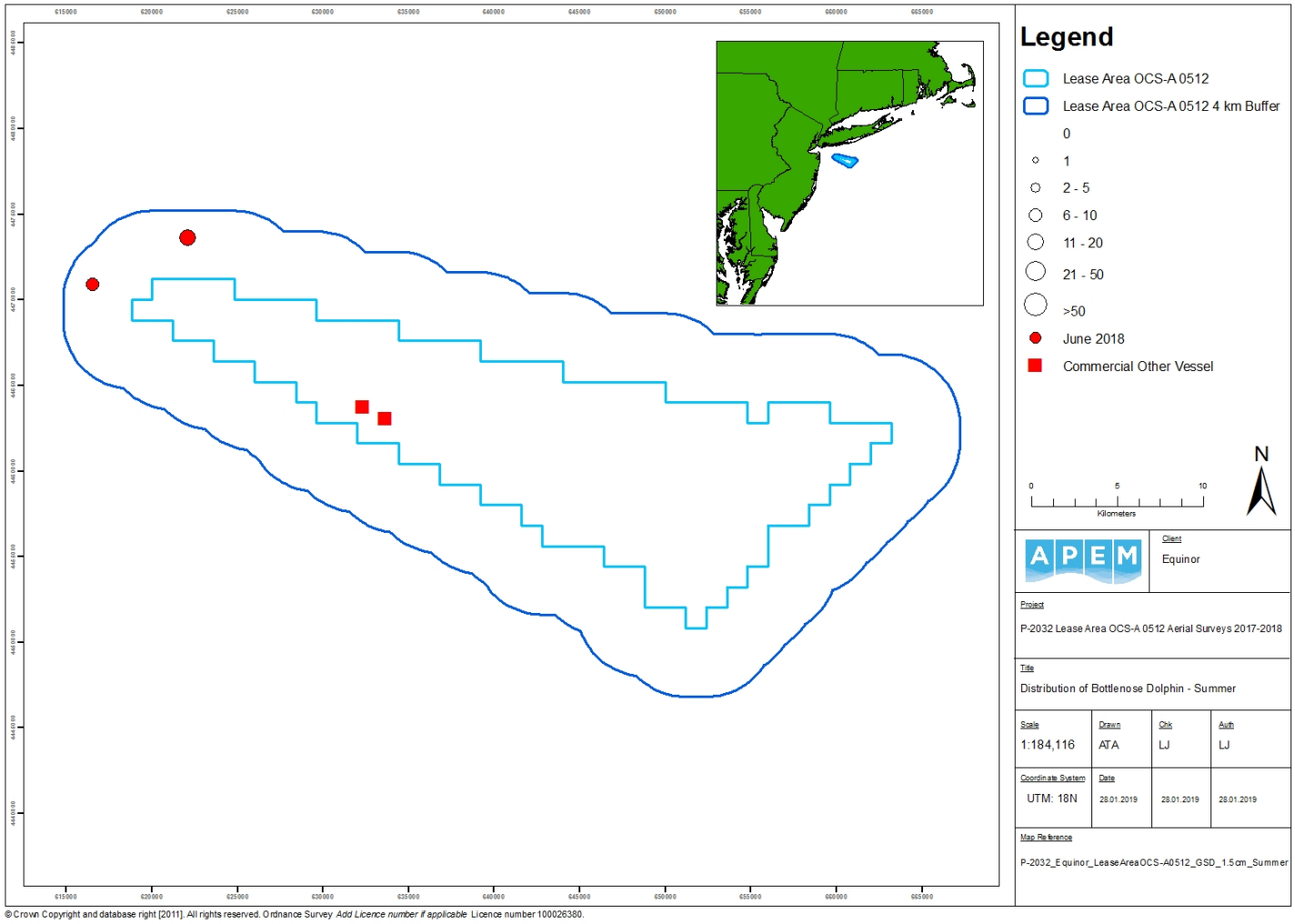


Figure 137 Distribution of bottlenose dolphins recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the summer season.

4.50 Harbor Porpoise

Harbor porpoises were recorded in the December and March surveys. A peak raw count of ten individuals was recorded in March, of which eight were observed in the 4 km buffer, giving an abundance estimate of 65 (**Table 56**).

In winter, three harbor porpoises were recorded in December located in the south-east region of the 4 km buffer (**Figure 138**). In March, ten harbor porpoises were recorded in the Lease Area OCS-A 0512 plus 4 km buffer, of which eight were recorded in the 4 km buffer. Half of the porpoises were recorded in the south-east of the Lease Area OCS-A 0512 plus 4 km buffer (**Figure 139**).

Table 56 **Raw counts and abundance and density estimates (No. estimated individuals per km^2) of harbor porpoises in: a) Lease Area OCS-A 0512 plus 4 km buffer, b) Lease Area OCS-A 0512, and c) the Lease Area OCS-A 0512 4 km buffer only.**

a) Lease Area OCS-A 0512 plus 4 km Buffer					
Survey	Raw Count	Abundance	Density	Surfacing	Submerged
Dec-17	3	23	0.03	0	3
Mar-18	10	80	0.1	2	8
b) Lease Area OCS-A 0512					
Survey	Raw Count	Abundance	Density	Surfacing	Submerged
Dec-17	0	0	-	0	0
Mar-18	2	16	0.05	0	2
c) 4 km Buffer					
Survey	Raw Count	Abundance	Density	Surfacing	Submerged
Dec-17	3	24	0.05	0	3
Mar-18	8	65	0.13	2	6

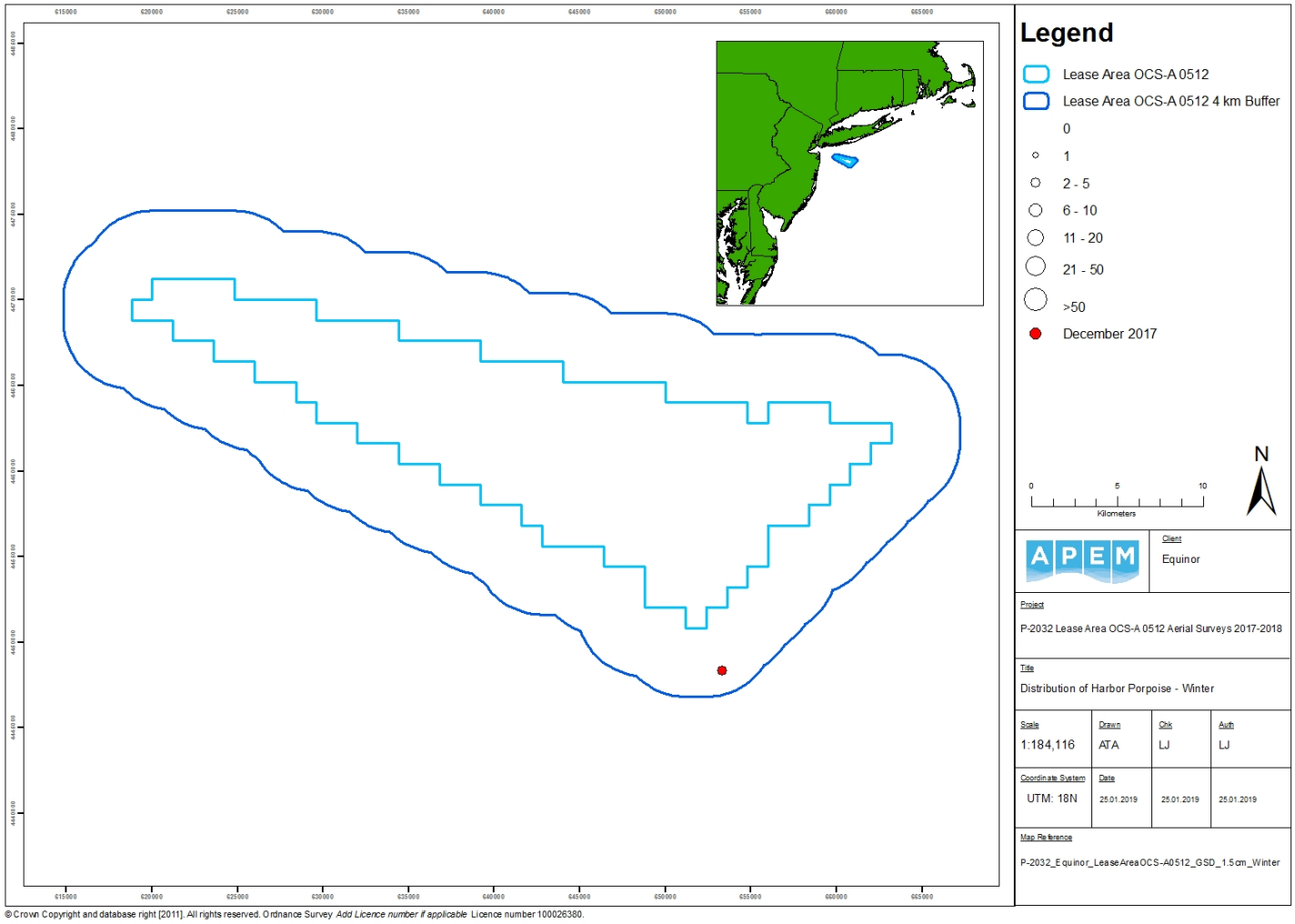


Figure 138 Distribution of harbor porpoises recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the winter season.

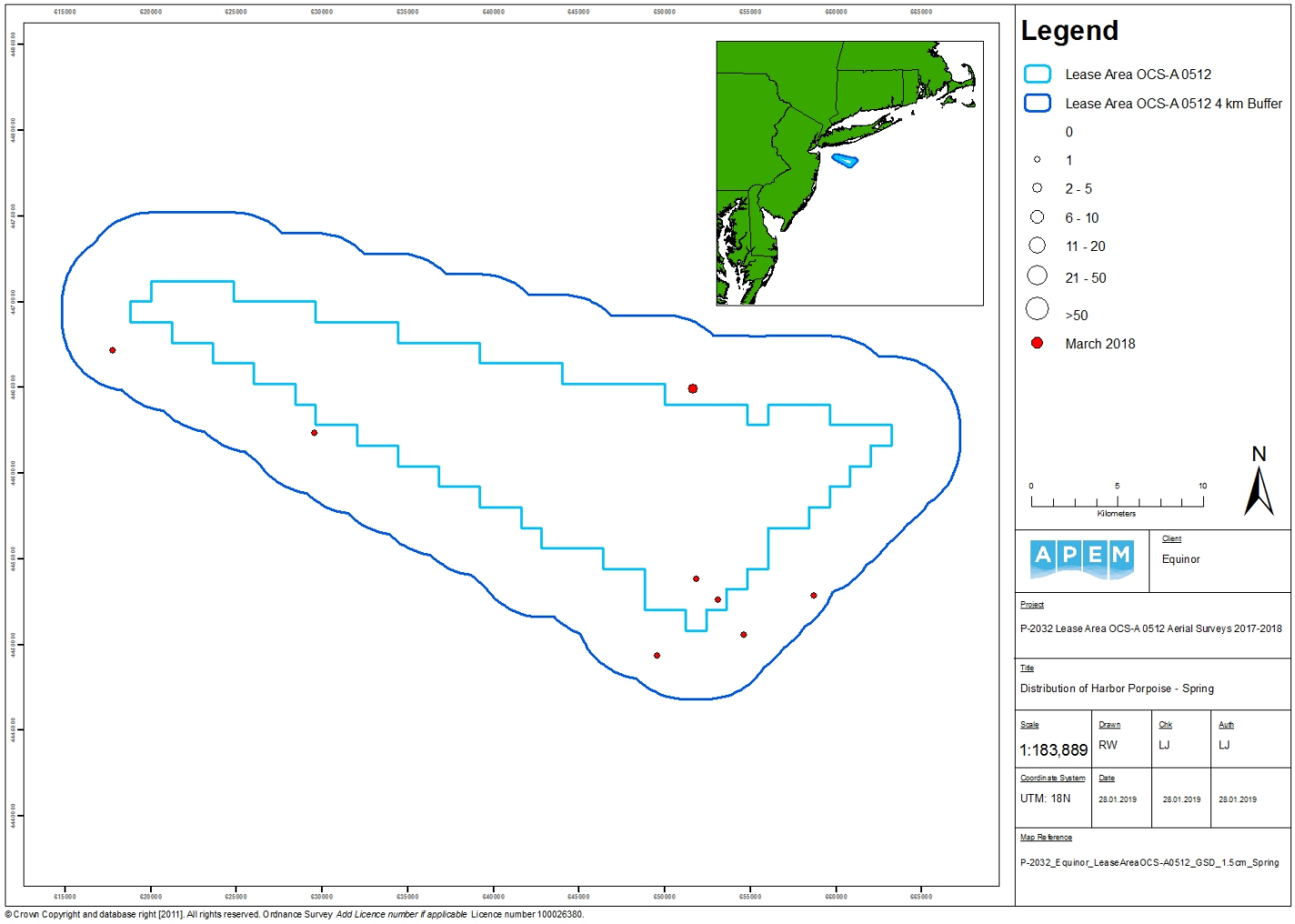


Figure 139 Distribution of harbor porpoises recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the spring season.

4.51 Species Unknown – Dolphin

Three unknown dolphin species were recorded in each of the January and May surveys. Individuals were recorded in the Lease Area OCS-A 0512 site in January and in the 4 km buffer in May (**Table 57**), with an abundance estimate of 23 in both months.

In winter, three unknown dolphin species were recorded in January. A group of two individuals was recorded in the north eastern region of the wind farm and the remaining individual was recorded to the west of the group (**Figure 140**). In the spring, three unknown dolphin species were recorded in May. All individuals were recorded in the 4 km buffer, with two in the northern buffer and one in the south (**Figure 141**).

Table 57 **Raw counts and abundance and density estimates (No. estimated individuals per km^2) of unknown dolphins in: a) Lease Area OCS-A 0512 plus 4 km buffer, b) Lease Area OCS-A 0512, and c) the Lease Area OCS-A 0512 4 km buffer only.**

a) Lease Area OCS-A 0512 plus 4 km Buffer					
Survey	**Raw Count**	**Abundance**	**Density**	**Surfacing**	**Submerged**
Jan-18	3	23	0.03	0	3
May-18	3	23	0.03	0	3
b) Lease Area OCS-A 0512					
Survey	**Raw Count**	**Abundance**	**Density**	**Surfacing**	**Submerged**
Jan-18	3	23	0.07	0	3
May-18	0	0	-	0	0
c) 4 km Buffer					
Survey	**Raw Count**	**Abundance**	**Density**	**Surfacing**	**Submerged**
Jan-18	0	0	-	0	0
May-18	3	23	0.05	0	3

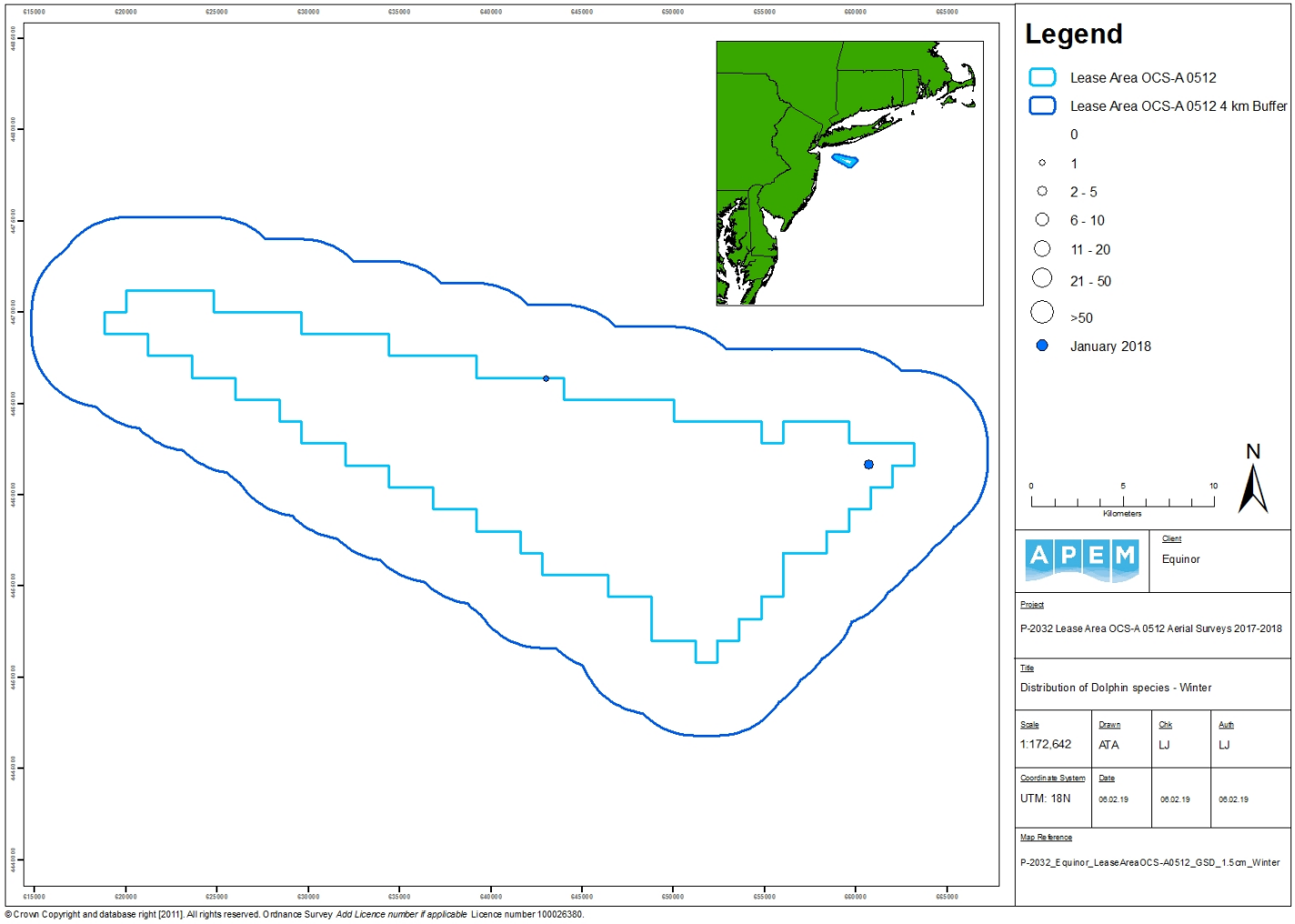


Figure 140 Distribution of unknown dolphin species recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the winter season.

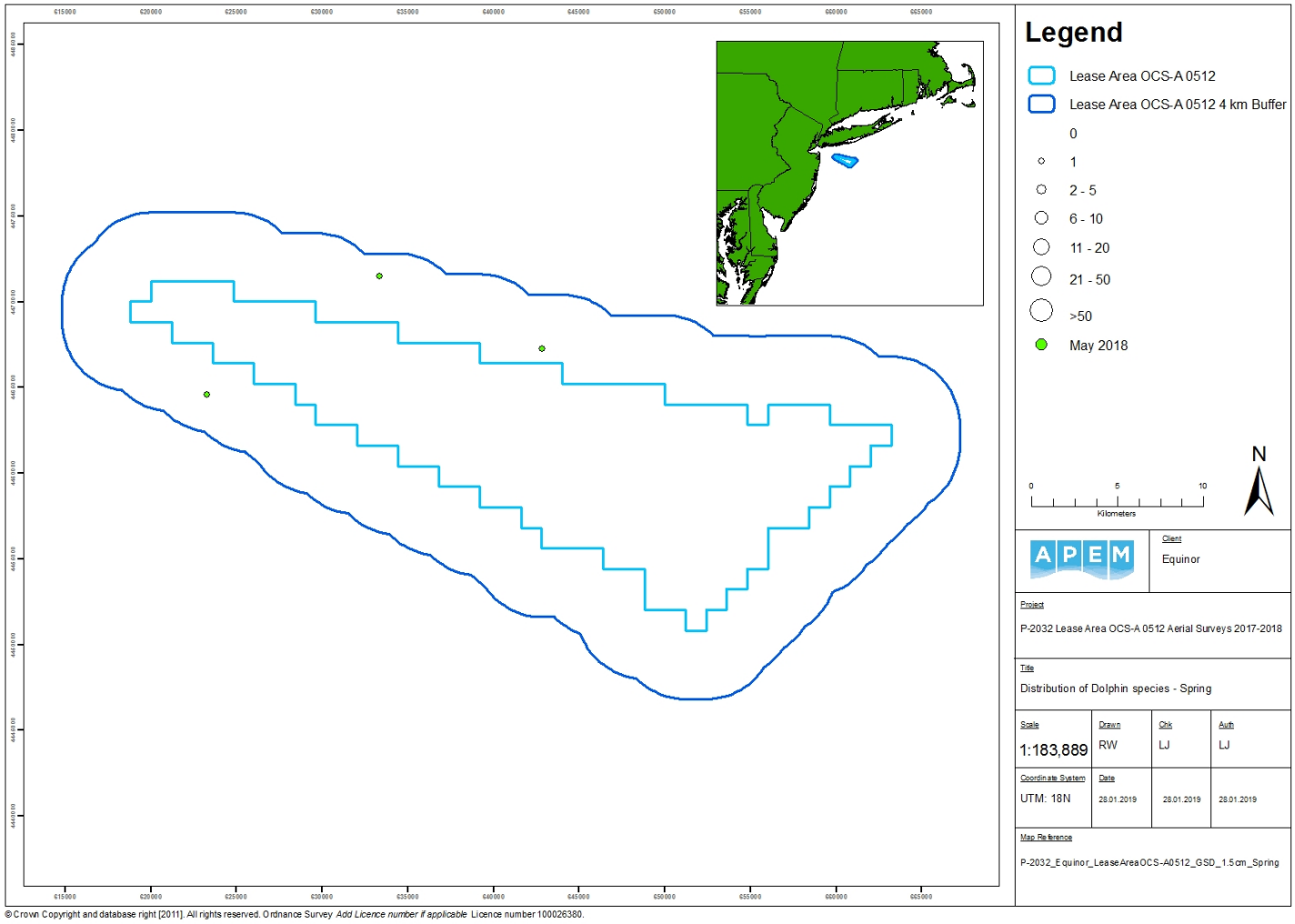


Figure 141 Distribution of unknown dolphin species recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the spring season.

4.52 Common Minke Whale

One common minke whale was observed in the 4 km buffer in each of the September and October surveys, resulting in abundance estimates of eight per month (**Table 58**).

Two common minke whales were recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the fall. Both were recorded in the north of the Lease Area OCS-A 0512 plus 4 km buffer in the 4 km buffer (**Figure 142**).

Table 58 **Raw counts and abundance and density estimates (No. estimated individuals per km^2) of common minke whales in: a) Lease Area OCS-A 0512 plus 4 km buffer, b) Lease Area OCS-A 0512, and c) the Lease Area OCS-A 0512 4 km buffer only.**

a) Lease Area OCS-A 0512 plus 4 km Buffer					
Survey	Raw Count	Abundance	Density	Surfacing	Submerged
Sep-18	1	8	0.01	0	1
Oct-18	1	8	0.01	0	1
b) Lease Area OCS-A 0512					
Survey	Raw Count	Abundance	Density	Surfacing	Submerged
Sep-18	0	0	-	0	0
Oct-18	0	0	-	0	0
c) 4 km Buffer					
Survey	Raw Count	Abundance	Density	Surfacing	Submerged
Sep-18	1	8	0.02	0	1
Oct-18	1	8	0.02	0	1

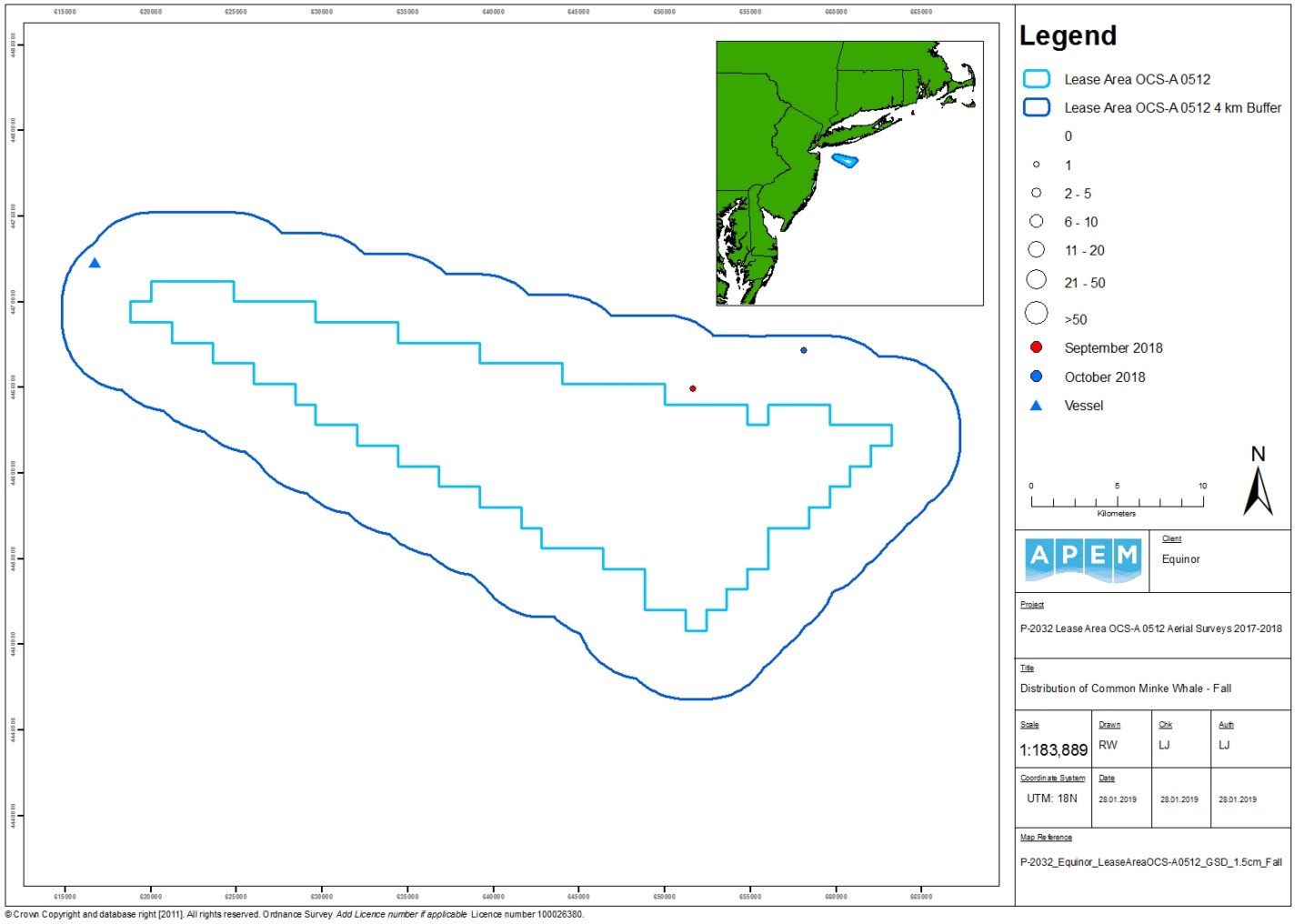


Figure 142 Distribution of common minke whales recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the fall season.

4.53 Humpback Whale

A single humpback whale was recorded in the east of the 4 km buffer in the June survey, resulting in an abundance estimate of eight (**Table 59, Figure 143**).

Table 59 **Raw counts and abundance and density estimates (No. estimated individuals per km^2) of humpback whales in: a) Lease Area OCS-A 0512 plus 4 km buffer, b) Lease Area OCS-A 0512, and c) the Lease Area OCS-A 0512 4 km buffer only.**

a) Lease Area OCS-A 0512 plus 4 km Buffer					
Survey	**Raw Count**	**Abundance**	**Density**	**Surfacing**	**Submerged**
Jun-18	1	8	0.01	0	1
b) Lease Area OCS-A 0512					
Survey	**Raw Count**	**Abundance**	**Density**	**Surfacing**	**Submerged**
Jun-18	0	0	-	0	0
c) 4 km Buffer					
Survey	**Raw Count**	**Abundance**	**Density**	**Surfacing**	**Submerged**
Jun-18	1	8	0.02	0	1

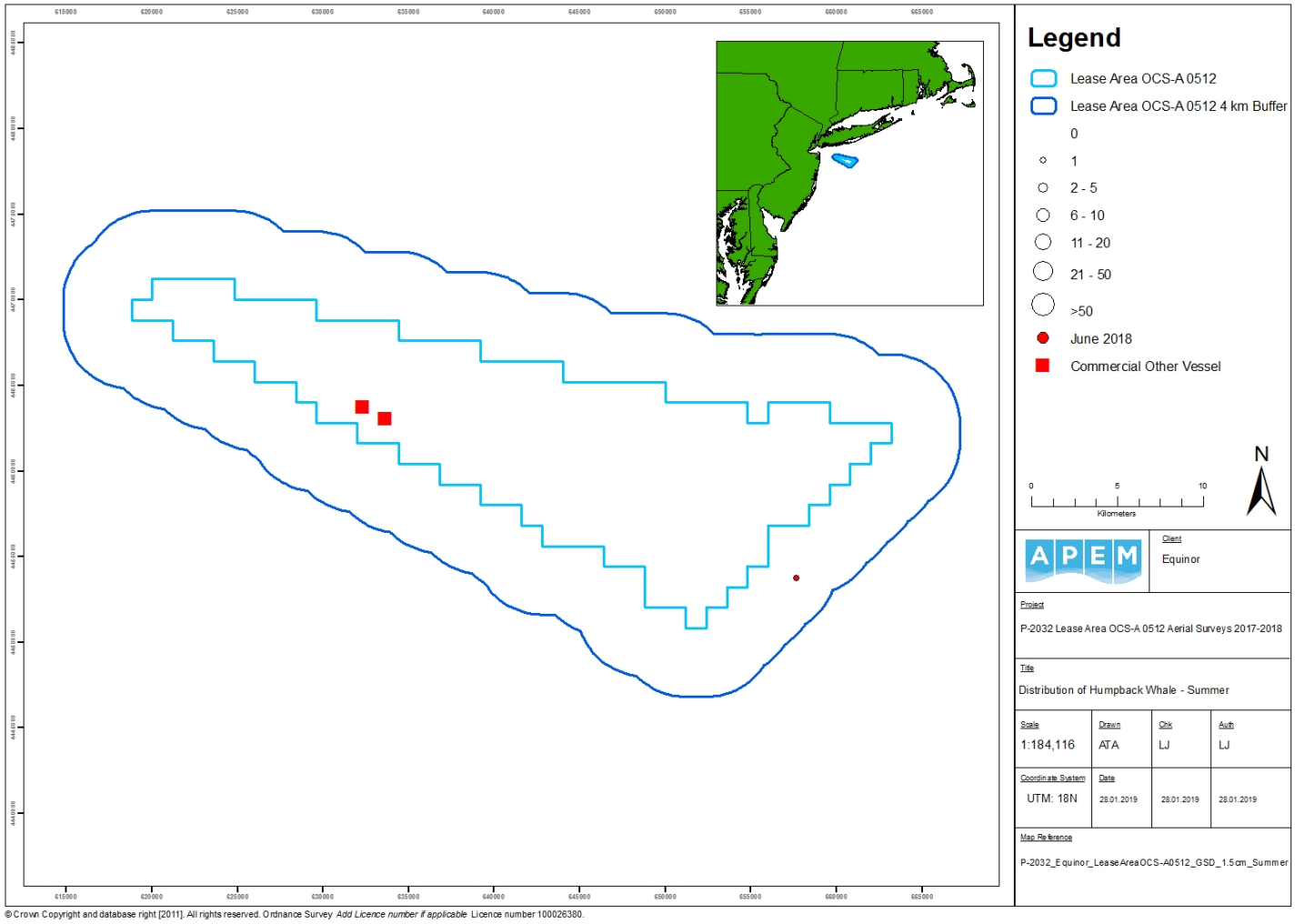


Figure 143 Distribution of humpback whales recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the summer season.

4.54 Species Unknown – Marine Mammal

Unknown marine mammals were recorded in two months only, with a peak of two in the March survey in the 4 km buffer (**Table 60**) resulting in an abundance estimate of 16.

In winter, a single unknown marine mammal species was recorded in the December survey in the south-east region of the 4 km buffer (**Figure 144**). Two unknown marine mammal species were recorded in the west of the Lease Area OCS-A 0512 plus 4 km buffer in the March survey. The two individuals were recorded in a pair in the west of the Lease Area OCS-A 0512 plus 4 km buffer in the 4 km buffer (**Figure 145**).

Table 60 **Raw counts and abundance and density estimates (No. estimated individuals per km^2) of unknown marine mammal species in: a) Lease Area OCS-A 0512 plus 4 km buffer, b) Lease Area OCS-A 0512, and c) the Lease Area OCS-A 0512 4 km buffer only.**

a) Lease Area OCS-A 0512 plus 4 km Buffer					
Survey	**Raw Count**	**Abundance**	**Density**	**Surfacing**	**Submerged**
Dec-17	1	8	0.01	0	1
Mar-18	2	16	0.02	0	2
b) Lease Area OCS-A 0512					
Survey	**Raw Count**	**Abundance**	**Density**	**Surfacing**	**Submerged**
Dec-17	0	0	-	0	0
Mar-18	0	0	-	0	0
c) 4 km Buffer					
Survey	**Raw Count**	**Abundance**	**Density**	**Surfacing**	**Submerged**
Dec-17	1	8	0.02	0	1
Mar-18	2	16	0.03	0	2

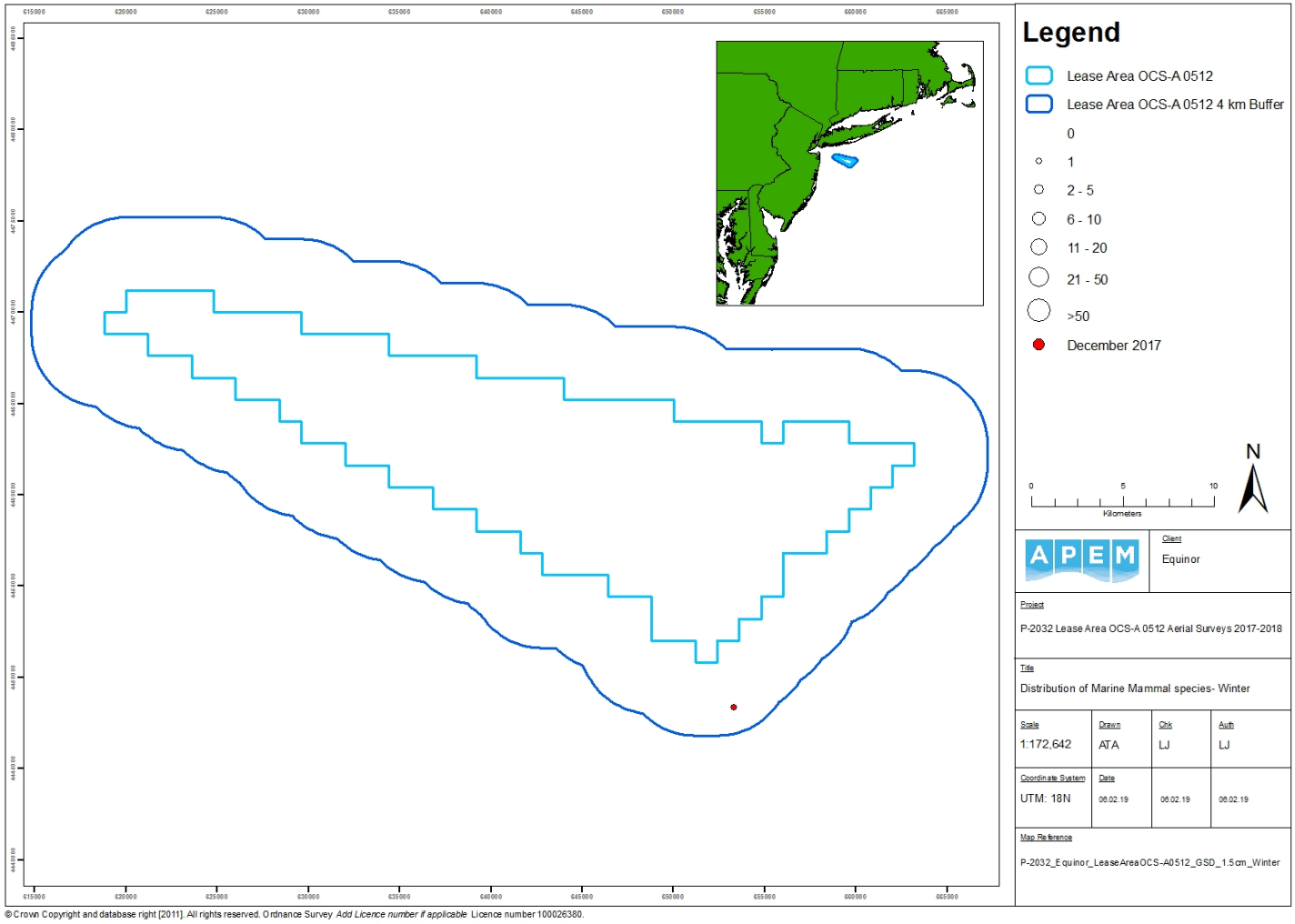


Figure 144 Distribution of unknown marine mammal species recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the winter season.

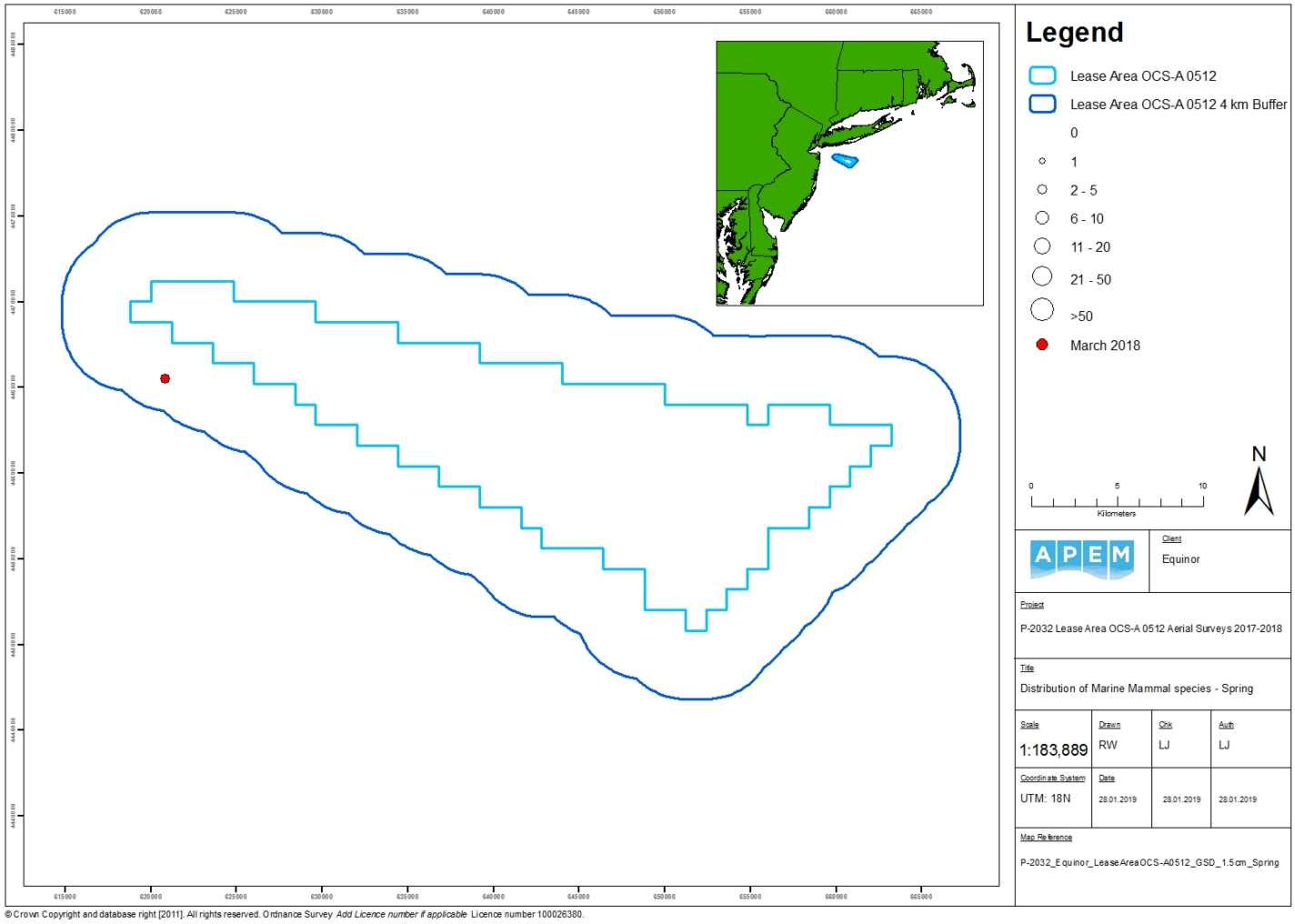


Figure 145 **Distribution of unknown marine mammal species recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the spring season.**

4.55 Loggerhead Turtle

Loggerhead turtles were recorded in the summer and fall. A peak raw count of seven individuals was recorded in the June survey, with number gradually decreasing in the following months. A peak abundance estimate was recorded in the 4 km buffer in March at 41 individuals (**Table 61**). The peak abundance estimate for the Lease Area OCS-A 0512 site occurred in August with 22.

In fall, loggerhead turtles were recorded in the September and October surveys. Individuals were mostly recorded in the center of the Lease Area OCS-A 0512 plus 4 km buffer (**Figure 146**). In summer, loggerhead turtles were recorded in all months, June, July and August, and individuals were mostly distributed in the east of the Lease Area OCS-A 0512 plus 4 km buffer in both the Lease Area OCS-A 0512 site and the 4 km buffer (**Figure 147**).

Table 61 **Raw counts and abundance and density estimates (No. estimated individuals per km^2) of loggerhead turtles in: a) Lease Area OCS-A 0512 plus 4 km buffer, b) Lease Area OCS-A 0512, and c) the Lease Area OCS-A 0512 4 km buffer only.**

a) Lease Area OCS-A 0512 plus 4 km Buffer					
Survey	Raw Count	Abundance	Density	Surfacing	Submerged
Jun-18	7	58	0.07	2	5
Jul-18	6	45	0.05	2	4
Aug-18	5	37	0.05	3	2
Sep-18	3	23	0.03	2	1
Oct-18	2	16	0.02	1	1
b) Lease Area OCS-A 0512					
Survey	Raw Count	Abundance	Density	Surfacing	Submerged
Jun-18	2	16	0.05	1	1
Jul-18	2	15	0.05	1	1
Aug-18	3	22	0.07	2	1
Sep-18	2	15	0.05	1	1
Oct-18	1	8	0.02	0	1
c) 4 km Buffer					
Survey	Raw Count	Abundance	Density	Surfacing	Submerged
Jun-18	5	41	0.08	1	4
Jul-18	4	30	0.06	1	3
Aug-18	2	15	0.03	1	1
Sep-18	1	8	0.02	1	0
Oct-18	1	8	0.02	1	0

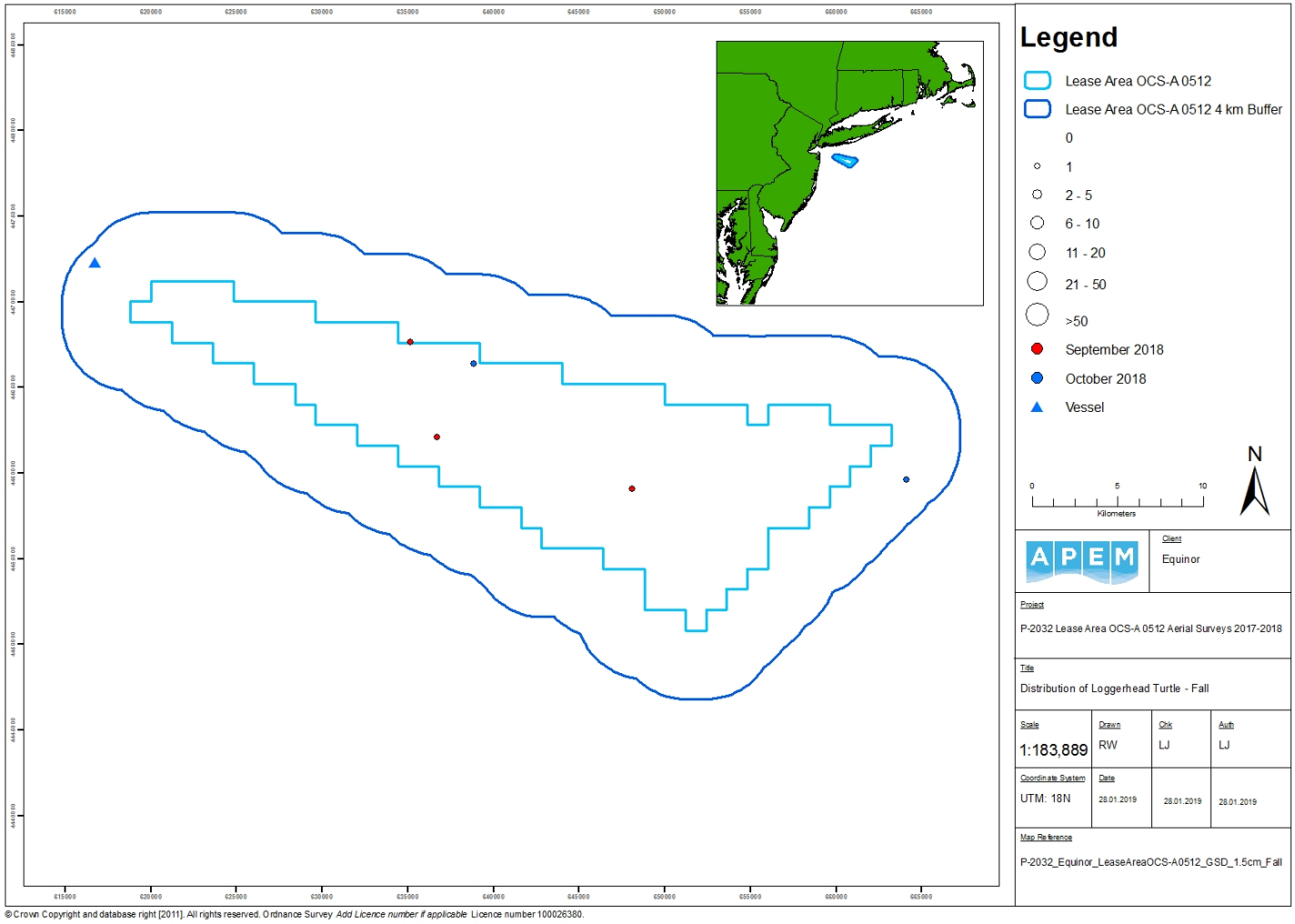


Figure 146 Distribution of loggerhead turtles recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the fall season.

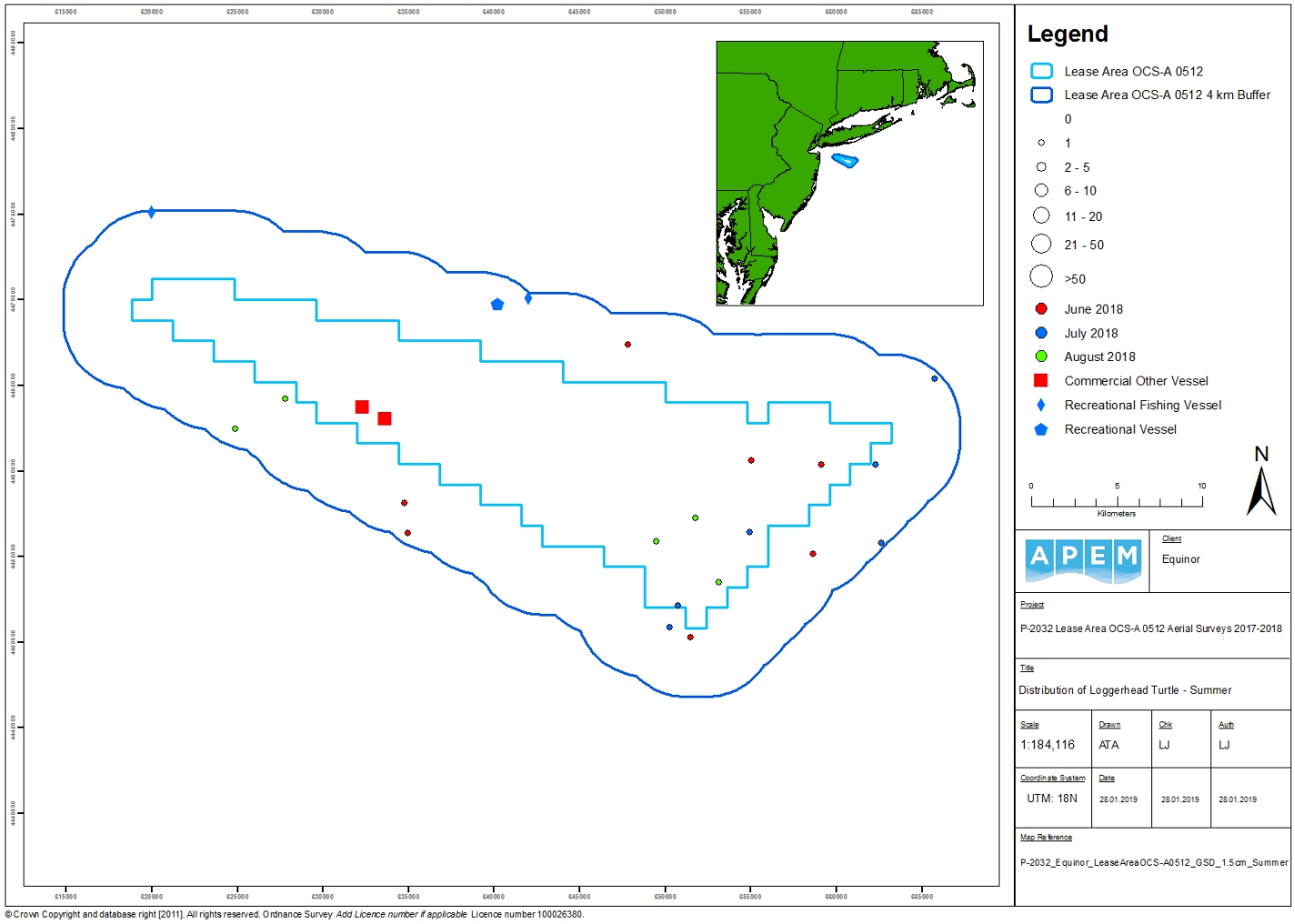


Figure 147 Distribution of loggerhead turtles recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the summer season.

4.56 Loggerhead / Kemp's Turtle

Unknown loggerhead / Kemp's turtles were recorded in the summer months from June to August 2018 (**Table 62**). A peak raw count of three individuals was recorded in the August survey, two of which were recorded in the 4 km buffer, at an abundance estimate of 15. The peak abundance for the Lease Area OCS-A 0512 site was seven.

Loggerhead's / Kemp's turtles were recorded in each of June, July and August, with a total of five individuals. A single individual was recorded in the west of the Lease Area OCS-A 0512 site, with the other four in the 4 km buffer (**Figure 148**).

Table 62 **Raw counts and abundance and density estimates (No. estimated individuals per km^2) of loggerhead / Kemp's turtles in: a) Lease Area OCS-A 0512 plus 4 km buffer, b) Lease Area OCS-A 0512, and c) the Lease Area OCS-A 0512 4 km buffer only.**

a) Lease Area OCS-A 0512 plus 4 km Buffer					
Survey	**Raw Count**	**Abundance**	**Density**	**Surfacing**	**Submerged**
Jun-18	1	8	0.01	0	1
Jul-18	1	7	0.01	0	1
Aug-18	3	22	0.03	1	2
b) Lease Area OCS-A 0512					
Survey	**Raw Count**	**Abundance**	**Density**	**Surfacing**	**Submerged**
Jun-18	0	0	-	0	0
Jul-18	0	0	-	0	0
Aug-18	1	7	0.02	0	1
c) 4 km Buffer					
Survey	**Raw Count**	**Abundance**	**Density**	**Surfacing**	**Submerged**
Jun-18	1	8	0.02	0	1
Jul-18	1	7	0.01	0	1
Aug-18	2	15	0.03	2	0

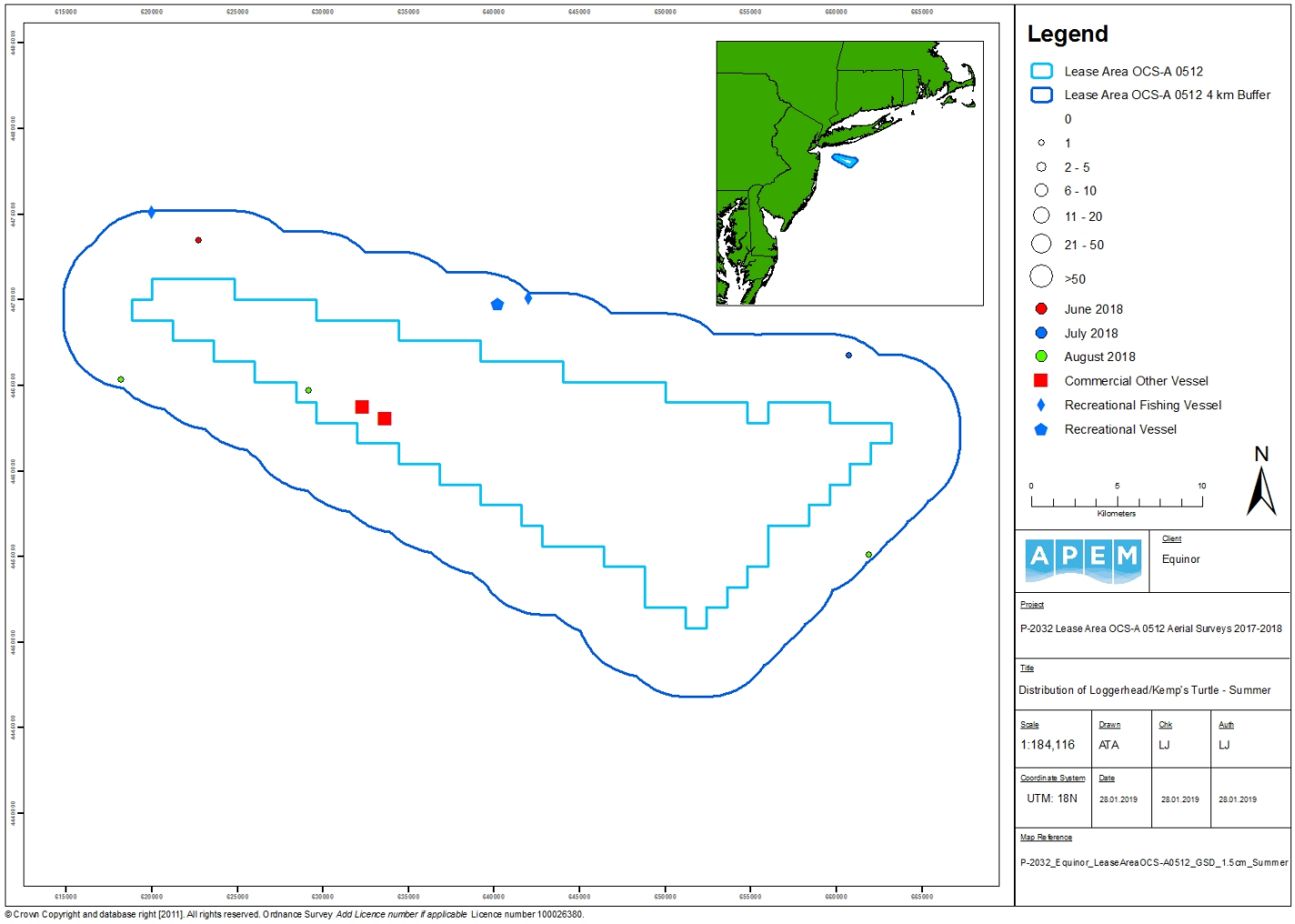


Figure 148 Distribution of loggerhead / Kemp's turtles recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the summer season.

4.57 Kemp's Ridley Turtle

Kemp's Ridley turtles were recorded in the July and August surveys, with four animals being recorded in each month (**Table 63**). A peak raw count of three animals was recorded in August in the Lease Area OCS-A 0512 site, giving an abundance estimate of 22 individuals.

A total of eight Kemp's Ridley turtles were recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the summer. Individuals were recorded throughout the Lease Area OCS-A 0512 plus 4 km buffer, with three individuals in the 4 km buffer and five in the Lease Area OCS-A 0512 site (**Figure 149**).

Table 63 **Raw counts and abundance and density estimates (No. estimated individuals per km^2) of Kemp's Ridley turtles in: a) Lease Area OCS-A 0512 plus 4 km buffer, b) Lease Area OCS-A 0512, and c) the Lease Area OCS-A 0512 4 km buffer only.**

a) Lease Area OCS-A 0512 plus 4 km Buffer					
Survey	**Raw Count**	**Abundance**	**Density**	**Surfacing**	**Submerged**
Jul-18	4	30	0.04	0	4
Aug-18	4	30	0.04	0	4
b) Lease Area OCS-A 0512					
Survey	**Raw Count**	**Abundance**	**Density**	**Surfacing**	**Submerged**
Jul-18	2	15	0.05	0	2
Aug-18	3	22	0.07	0	3
c) 4 km Buffer					
Survey	**Raw Count**	**Abundance**	**Density**	**Surfacing**	**Submerged**
Jul-18	2	15	0.03	0	2
Aug-18	1	8	0.02	0	1

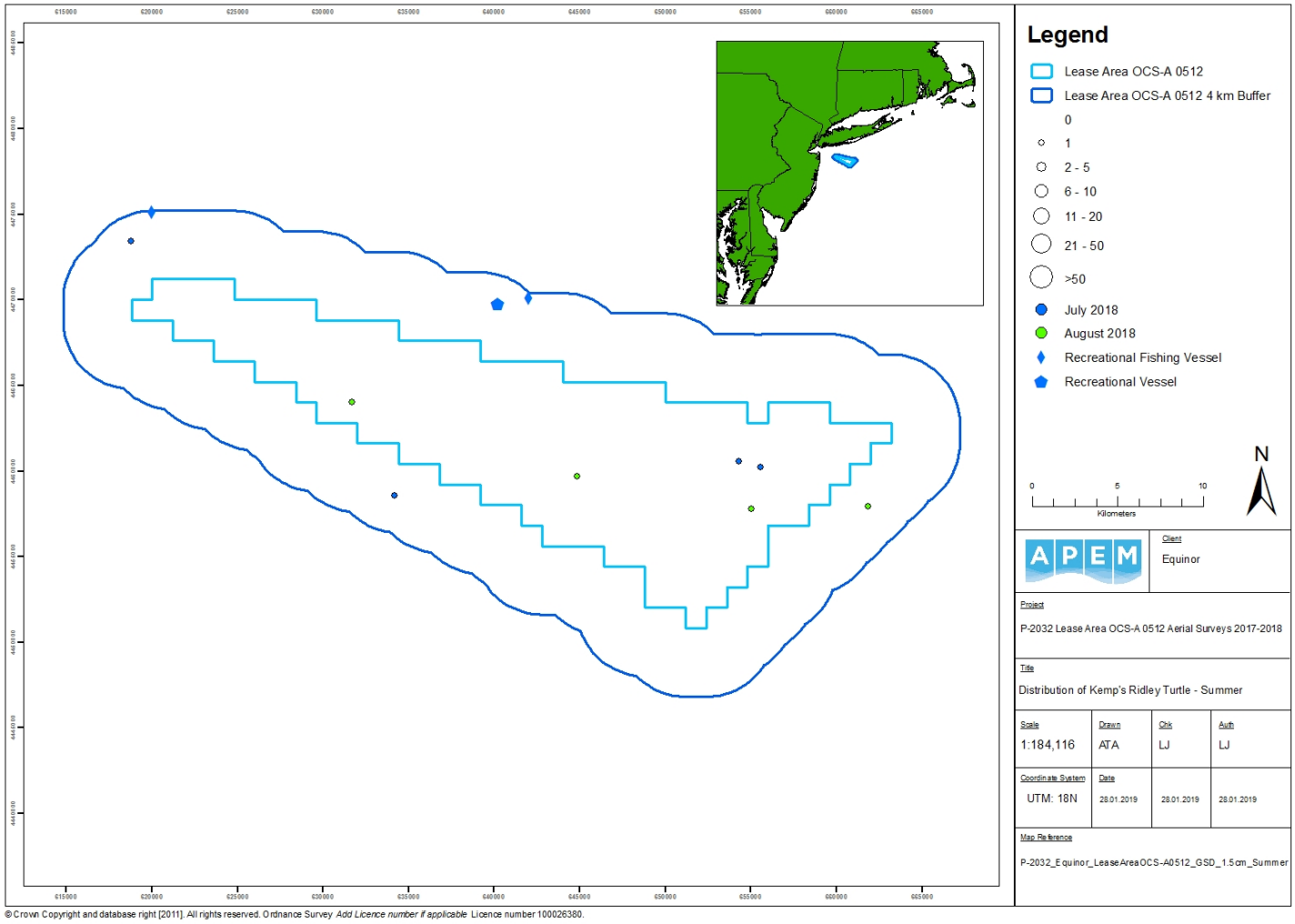


Figure 149 Distribution of Kemp's / Ridley's turtles recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the summer season.

4.58 Species Unknown - Turtle

A single unknown turtle species was recorded in the east of the Lease Area OCS-A 0512 plus 4 km buffer, inside the 4 km buffer in the August survey, giving an abundance estimate of eight individuals (**Table 64, Figure 150**).

Table 64 **Raw counts and abundance and density estimates (No. estimated individuals per km^2) of unknown turtle species in: a) Lease Area OCS-A 0512 plus 4 km buffer, b) Lease Area OCS-A 0512, and c) the Lease Area OCS-A 0512 4 km buffer only.**

a) Lease Area OCS-A 0512 plus 4 km Buffer					
Survey	Raw Count	Abundance	Density	Surfacing	Submerged
Aug-18	1	7	0.01	0	1
b) Lease Area OCS-A 0512					
Survey	Raw Count	Abundance	Density	Surfacing	Submerged
Aug-18	0	0	-	0	0
c) 4 km Buffer					
Survey	Raw Count	Abundance	Density	Surfacing	Submerged
Aug-18	1	8	0.02	0	1

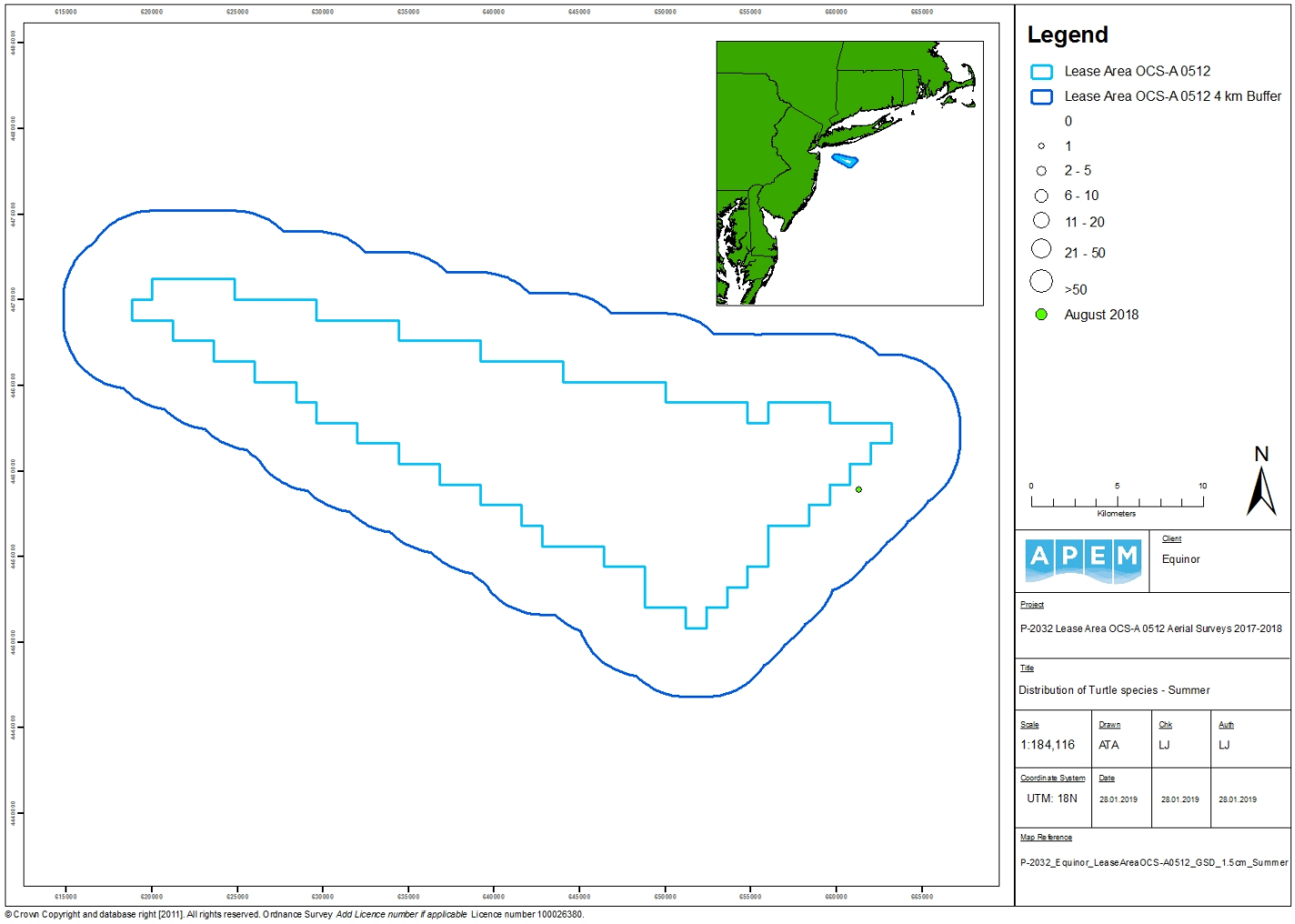


Figure 150 Distribution of unknown turtle species recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the summer season.

4.59 Blue Shark

Six blue sharks were recorded in the June survey, of which five were observed in the 4 km buffer (**Table 65**), giving an abundance estimate of 41. A single blue shark was recorded within the Lease Area OCS-A 0512 site resulting in an abundance estimate of eight.

A total of six blue sharks were recorded in the Lease Area OCS-A 0512 plus 4 km buffer in June. Blue sharks were concentrated in the east of the Lease Area OCS-A 0512 plus 4 km buffer, with five sharks in the 4 km buffer and one in the Lease Area OCS-A 0512 site (**Figure 151**).

Table 65 **Raw counts and abundance and density estimates (No. estimated individuals per km^2) of blue sharks in: a) Lease Area OCS-A 0512 plus 4 km buffer, b) Lease Area OCS-A 0512, and c) the Lease Area OCS-A 0512 4 km buffer only.**

a) Lease Area OCS-A 0512 plus 4 km Buffer					
Survey	Raw Count	Abundance	Density	Surfacing	Submerged
Jun-18	6	49	0.06	0	6
b) Lease Area OCS-A 0512					
Survey	Raw Count	Abundance	Density	Surfacing	Submerged
Jun-18	1	8	0.02	0	1
c) 4 km Buffer					
Survey	Raw Count	Abundance	Density	Surfacing	Submerged
Jun-18	5	41	0.08	0	5

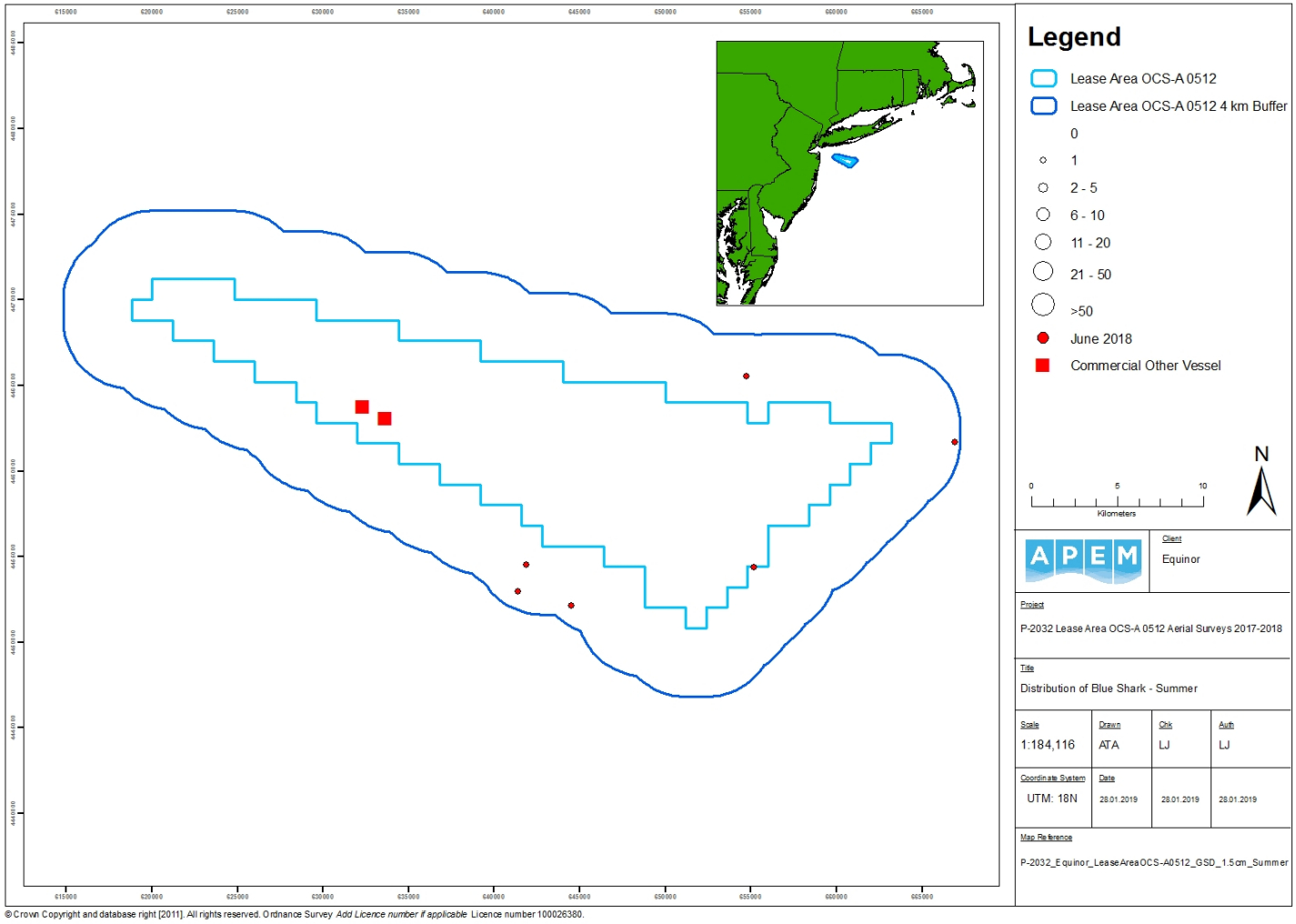


Figure 151 Distribution of blue sharks recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the summer season.

4.60 Great White Shark

A single great white shark was recorded in the north-west of the Lease Area OCS-A 0512 plus 4 km buffer in 4 km buffer in the July survey, resulting in an abundance estimate of 7 (**Table 66, Figure 152**).

Table 66 **Raw counts and abundance and density estimates (No. estimated individuals per km^2) of great white sharks in: a) Lease Area OCS-A 0512 plus 4 km buffer, b) Lease Area OCS-A 0512, and c) the Lease Area OCS-A 0512 4 km buffer only.**

a) Lease Area OCS-A 0512 plus 4 km Buffer					
Survey	Raw Count	Abundance	Density	Surfacing	Submerged
Jul-18	1	7	0.01	0	1
b) Lease Area OCS-A 0512					
Survey	Raw Count	Abundance	Density	Surfacing	Submerged
Jul-18	0	0	-	0	0
c) 4 km Buffer					
Survey	Raw Count	Abundance	Density	Surfacing	Submerged
Jul-18	1	7	0.01	0	1

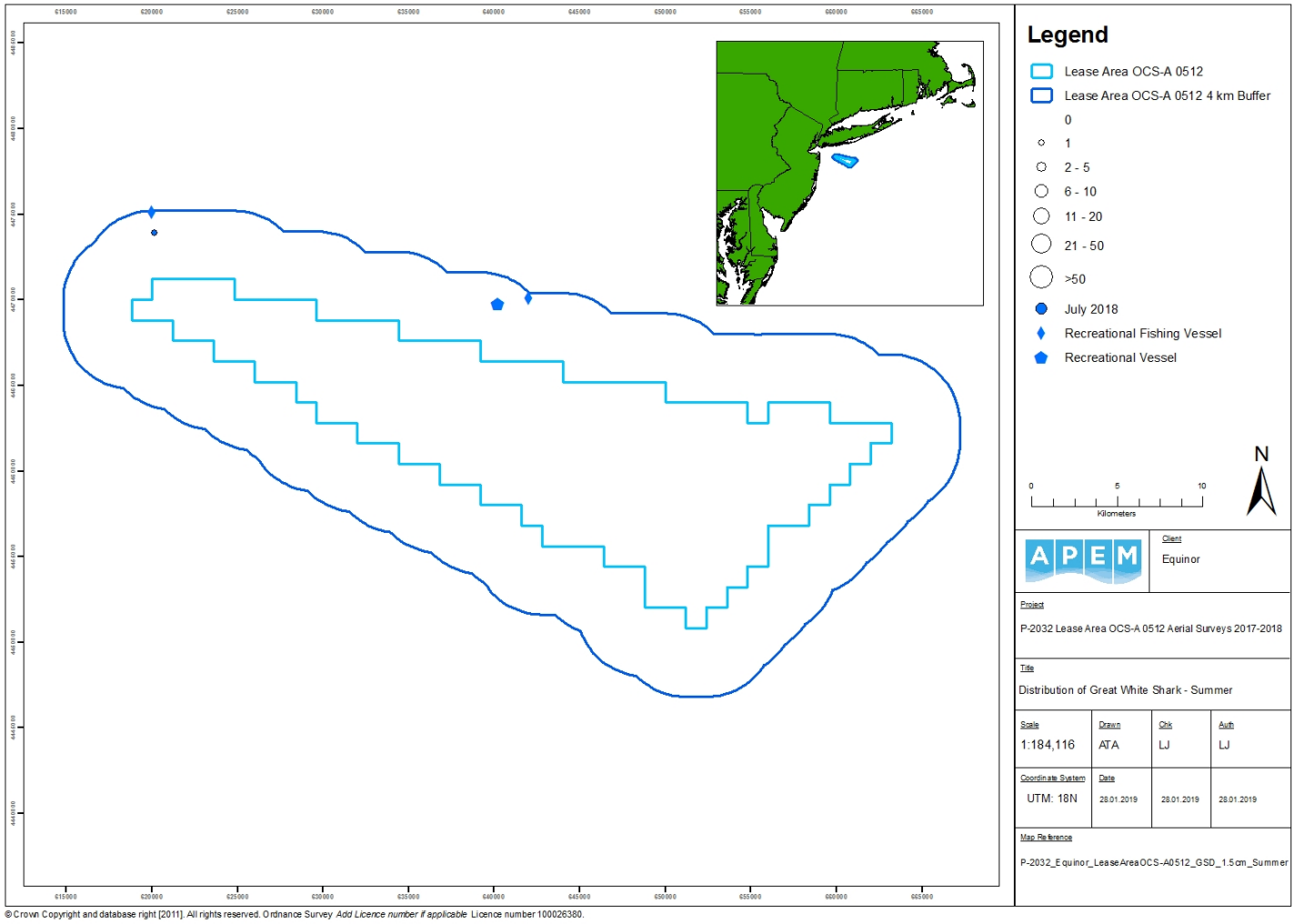


Figure 152 Distribution of great white sharks recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the summer season.

4.61 Tiger Shark

A single tiger Shark was recorded in the south of the Lease Area OCS-A 0512 plus 4 km buffer in 4 km buffer in the July survey, giving an abundance estimate of seven (**Table 67, Figure 153**).

Table 67 **Raw counts and abundance and density estimates (No. estimated individuals per km^2) of tiger sharks in: a) Lease Area OCS-A 0512 plus 4 km buffer, b) Lease Area OCS-A 0512, and c) the Lease Area OCS-A 0512 4 km buffer only.**

a) Lease Area OCS-A 0512 plus 4 km Buffer					
Survey	Raw Count	Abundance	Density	Surfacing	Submerged
Jul-18	1	7	0.01	0	1
b) Lease Area OCS-A 0512					
Survey	Raw Count	Abundance	Density	Surfacing	Submerged
Jul-18	0	0	-	0	0
c) 4 km Buffer					
Survey	Raw Count	Abundance	Density	Surfacing	Submerged
Jul-18	1	7	0.01	0	1

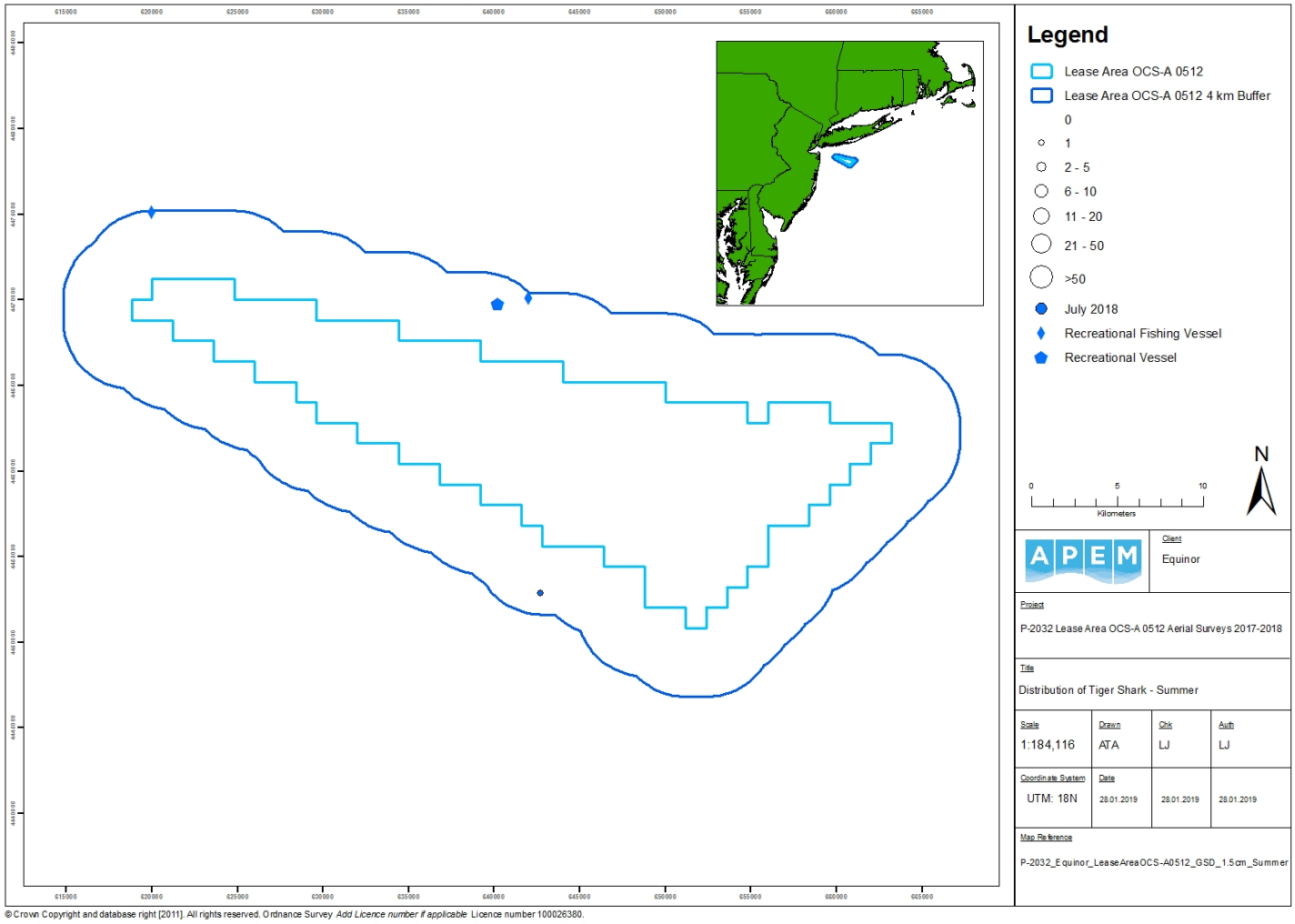


Figure 153 Distribution of tiger sharks recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the summer season.

4.62 Species Unknown - Carcharhinidae

A single Carcharhinidae species was recorded in the July survey inside the Lease Area OCS-A 0512 site (**Table 68, Figure 154**) with an abundance estimate of seven.

Table 68 **Raw counts and abundance and density estimates (No. estimated individuals per km^2) of unknown Carcharhinidaes in: a) Lease Area OCS-A 0512 plus 4 km buffer, b) Lease Area OCS-A 0512, and c) the Lease Area OCS-A 0512 4 km buffer only.**

a) Lease Area OCS-A 0512 plus 4 km Buffer					
Survey	Raw Count	Abundance	Density	Surfacing	Submerged
Jul-18	1	7	0.01	0	1
b) Lease Area OCS-A 0512					
Survey	Raw Count	Abundance	Density	Surfacing	Submerged
Jul-18	1	7	0.02	0	1
c) 4 km Buffer					
Survey	Raw Count	Abundance	Density	Surfacing	Submerged
Jul-18	0	0	-	0	0

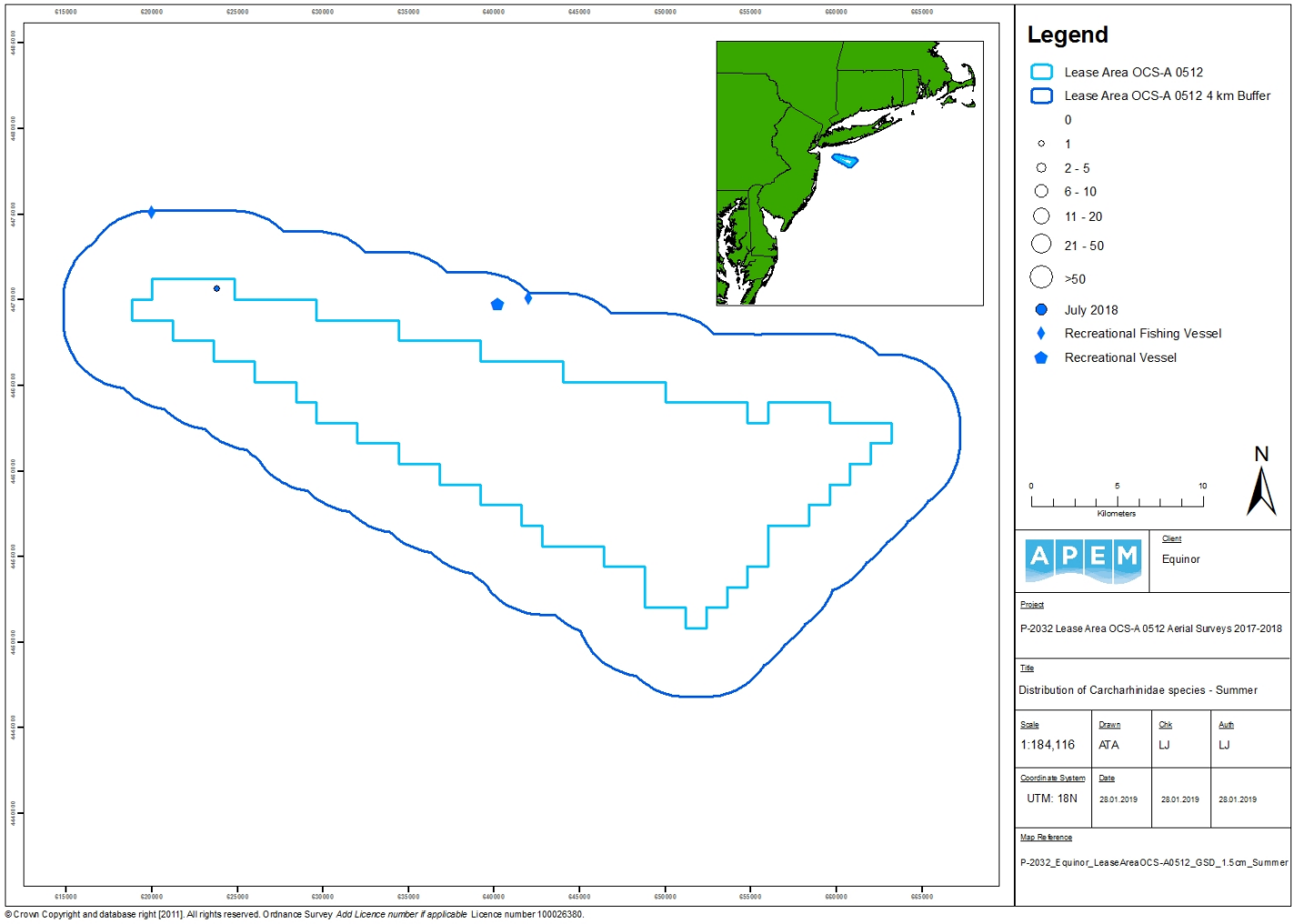


Figure 154 Distribution of unknown Carcharhinidae species recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the summer season.

4.63 Scalloped Hammerhead

Two scalloped hammerheads were recorded in the July survey (**Table 69**), with one being recorded in each of the Lease Area OCS-A 0512 site and 4 km buffer sites. Abundance estimates of seven were recorded for each area.

In summer, two scalloped hammerheads were recorded in the south of the Lease Area OCS-A 0512 plus 4 km buffer, with one recorded in the Lease Area OCS-A 0512 site and the other in the 4 km buffer (**Figure 155**).

Table 69 **Raw counts and abundance and density estimates (No. estimated individuals per km^2) of scalloped hammerheads in: a) Lease Area OCS-A 0512 plus 4 km buffer, b) Lease Area OCS-A 0512, and c) the Lease Area OCS-A 0512 4 km buffer only.**

a) Lease Area OCS-A 0512 plus 4 km Buffer					
Survey	Raw Count	Abundance	Density	Surfacing	Submerged
Jul-18	2	15	0.02	0	2
b) Lease Area OCS-A 0512					
Survey	Raw Count	Abundance	Density	Surfacing	Submerged
Jul-18	1	7	0.02	0	1
c) 4 km Buffer					
Survey	Raw Count	Abundance	Density	Surfacing	Submerged
Jul-18	1	7	0.01	0	1

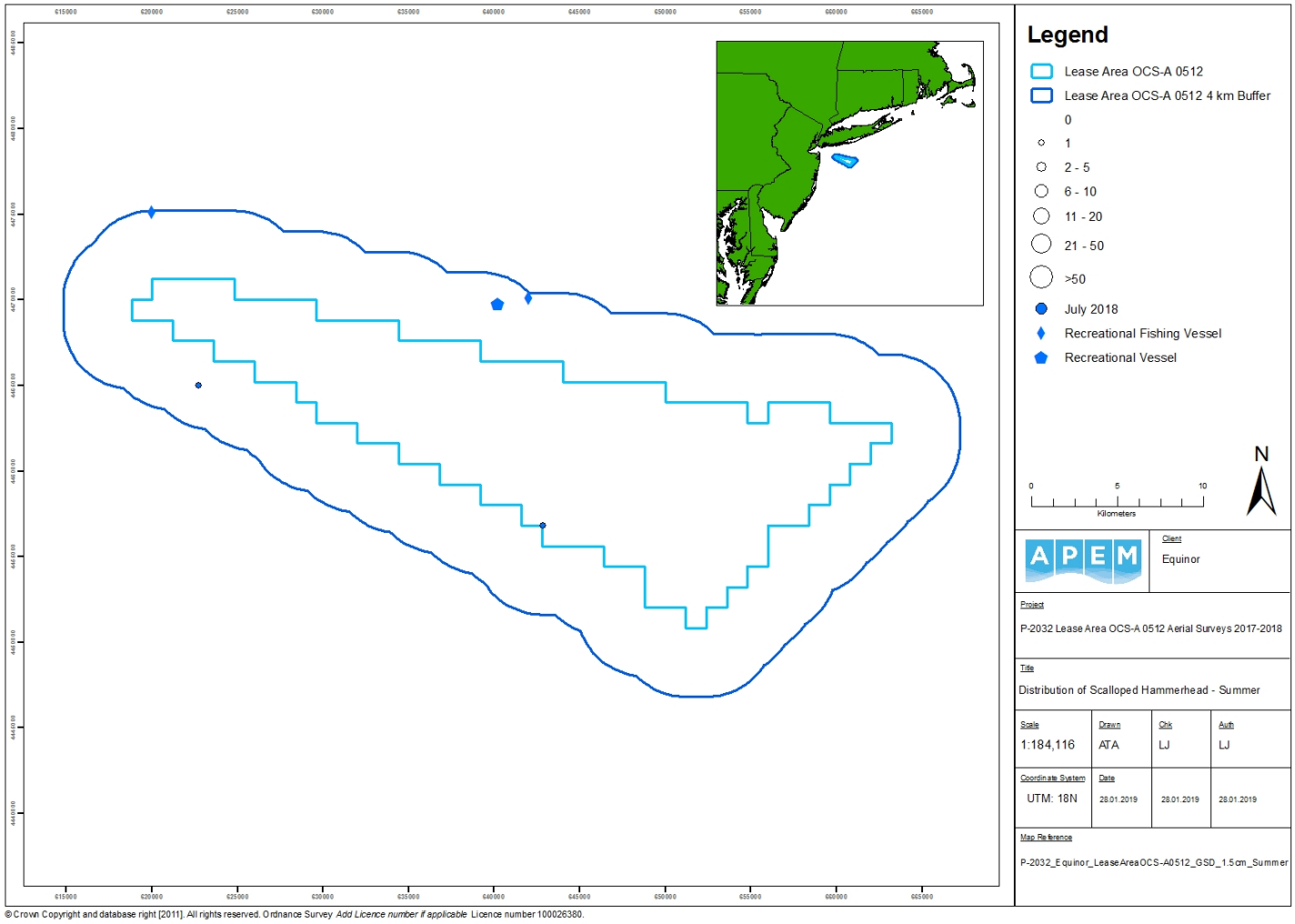


Figure 155 Distribution of scalloped hammerheads recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the summer season.

4.64 Species Unknown - Hammerhead

Two unknown hammerhead species were recorded in the July survey, with one being observed in each of the Lease Area OCS-A 0512 site and 4 km buffer areas. Abundance estimates of seven were recorded (**Table 70**).

In July, two unknown hammerheads were recorded in the Lease Area OCS-A 0512 plus 4 km buffer. One individual was recorded in the south of the Lease Area OCS-A 0512 plus 4 km buffer in the Lease Area OCS-A 0512 site, whilst the other was recorded in the west in the 4 km buffer (**Figure 156**).

Table 70 **Raw counts and abundance and density estimates (No. estimated individuals per km^2) of unknown hammerhead species in: a) Lease Area OCS-A 0512 plus 4 km buffer, b) Lease Area OCS-A 0512, and c) the Lease Area OCS-A 0512 4 km buffer only.**

a) Lease Area OCS-A 0512 plus 4 km Buffer					
Survey	Raw Count	Abundance	Density	Surfacing	Submerged
Jul-18	2	15	0.02	0	2
b) Lease Area OCS-A 0512					
Survey	Raw Count	Abundance	Density	Surfacing	Submerged
Jul-18	1	7	0.02	0	1
c) 4 km Buffer					
Survey	Raw Count	Abundance	Density	Surfacing	Submerged
Jul-18	1	7	0.01	0	1

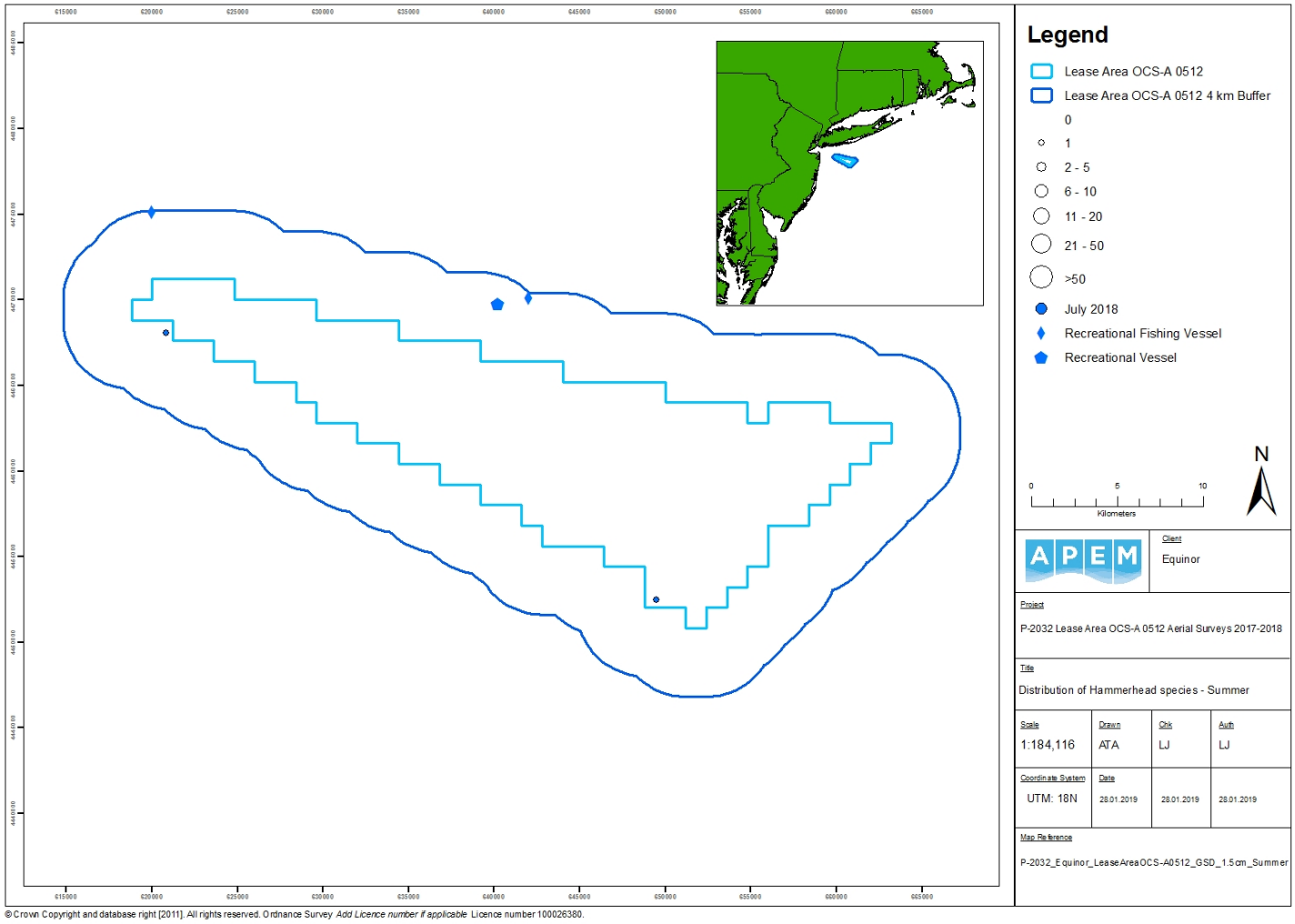


Figure 156 Distribution of unknown hammerhead species recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the summer season.

4.65 Species Unknown - Shark

Unknown shark species were recorded in the July and August surveys, with a peak of four individuals in August. All individuals were observed in the eastern region of the Lease Area OCS-A 0512 plus 4 km buffer within the 4 km buffer, giving a peak abundance estimate of 30 in August (**Table 71, Figure 157**).

Table 71 **Raw counts and abundance and density estimates (No. estimated individuals per km^2) of unknown shark species in: a) Lease Area OCS-A 0512 plus 4 km buffer, b) Lease Area OCS-A 0512, and c) the Lease Area OCS-A 0512 4 km buffer only.**

a) Lease Area OCS-A 0512 plus 4 km Buffer					
Survey	**Raw Count**	**Abundance**	**Density**	**Surfacing**	**Submerged**
Jul-18	2	15	0.02	0	2
Aug-18	4	30	0.04	0	4
b) Lease Area OCS-A 0512					
Survey	**Raw Count**	**Abundance**	**Density**	**Surfacing**	**Submerged**
Jul-18	0	0	-	0	0
Aug-18	0	0	-	0	0
c) 4 km Buffer					
Survey	**Raw Count**	**Abundance**	**Density**	**Surfacing**	**Submerged**
Jul-18	2	15	0.03	0	2
Aug-18	4	30	0.06	0	4

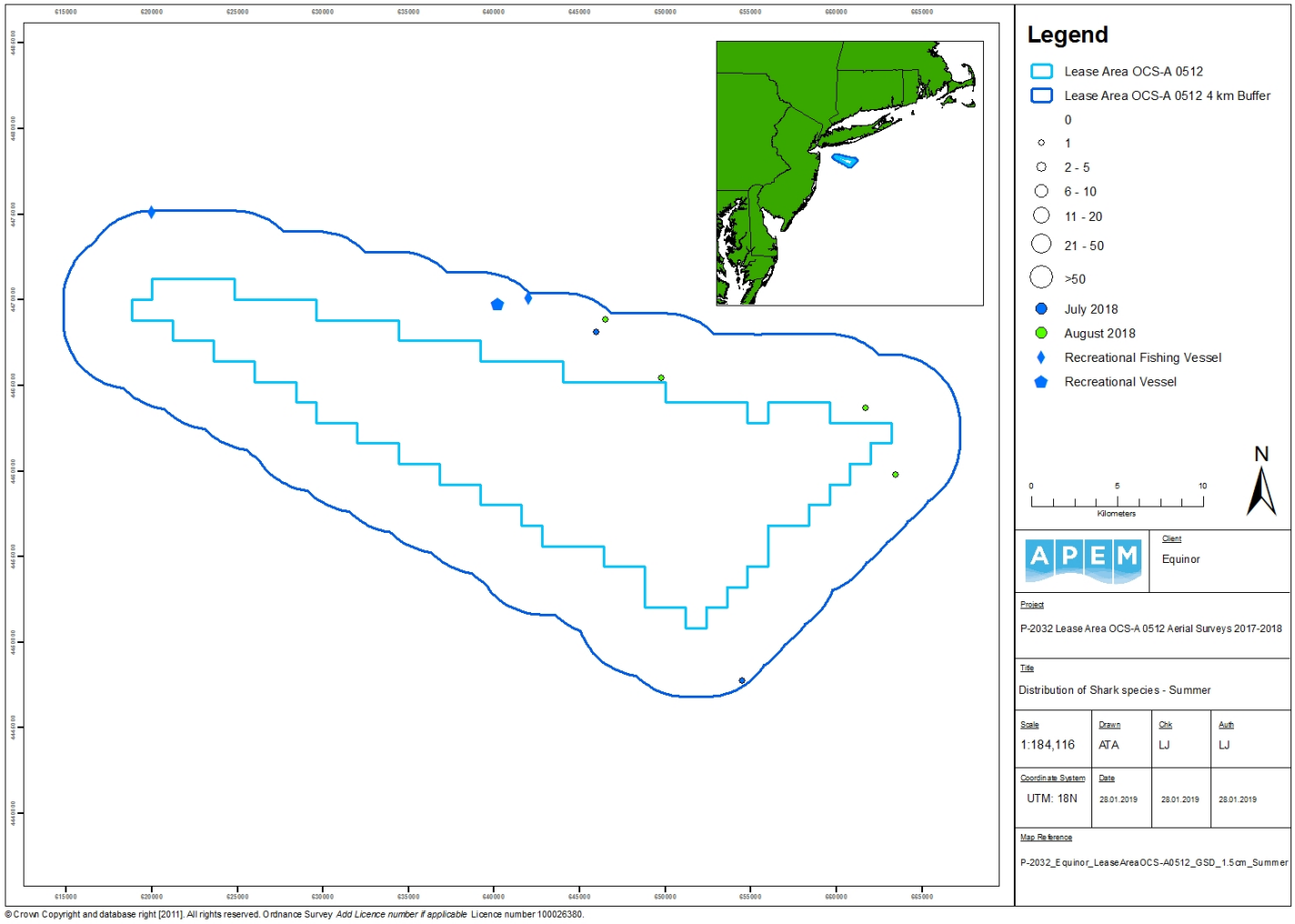


Figure 157 **Distribution of unknown shark species recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the summer season.**

4.66 Cownose Ray

A peak raw count of 502 cownose rays were recorded in the August survey (**Table 72**), of which all 355 were recorded in the 4 km buffer with an abundance estimate of 2,671. Low numbers of cownose rays were also recorded in the December and September surveys. The peak abundance estimate of cownose rays in the Lease Area OCS-A 0512 site was 1,086.

A total of three cownose rays were recorded in the Lease Area OCS-A 0512 plus 4 km buffer in September. All three were recorded in a group in the north of the Lease Area OCS-A 0512 plus 4 km buffer, in the 4 km buffer (**Figure 158**). In winter, a single cownose ray was recorded in December, located in the north-west region of the 4 km buffer (**Figure 159**). A total of 502 cownose rays were recorded in four groups in the Lease Area OCS-A 0512 plus 4 km buffer in August. All individuals were recorded in the north-east of the Lease Area OCS-A 0512 plus 4 km buffer, with 147 recorded in the Lease Area OCS-A 0512 site and 355 in the 4 km buffer (**Figure 160**).

Table 72 **Raw counts and abundance and density estimates (No. estimated individuals per km^2) of cownose rays in: a) Lease Area OCS-A 0512 plus 4 km buffer, b) Lease Area OCS-A 0512, and c) the Lease Area OCS-A 0512 4 km buffer only.**

a) Lease Area OCS-A 0512 a plus 4 km Buffer					
Survey	Raw Count	Abundance	Density	Surfacing	Submerged
Dec-17	1	8	0.01	0	1
Aug-18	502	3749	4.57	0	502
Sep-18	3	23	0.03	0	3
b) Lease Area OCS-A 0512					
Survey	Raw Count	Abundance	Density	Surfacing	Submerged
Dec-17	0	0	-	0	0
Aug-18	147	1086	3.38	0	147
Sep-18	0	0	-	0	0
c) 4 km Buffer					
Survey	Raw Count	Abundance	Density	Surfacing	Submerged
Dec-17	1	8	0.02	0	1
Aug-18	355	2671	5.36	0	355
Sep-18	3	24	0.05	0	3

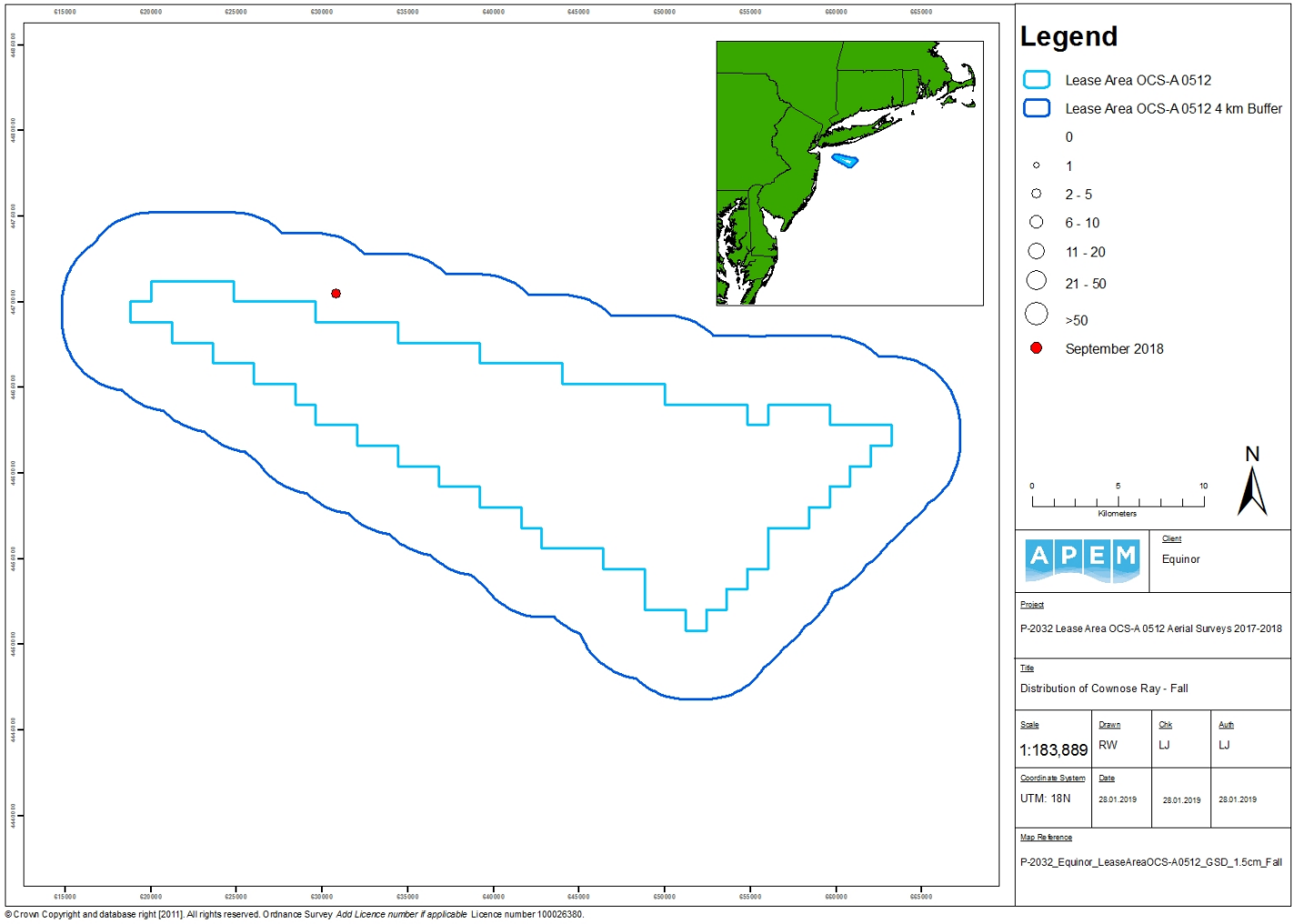


Figure 158 Distribution of cownose rays recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the fall season.

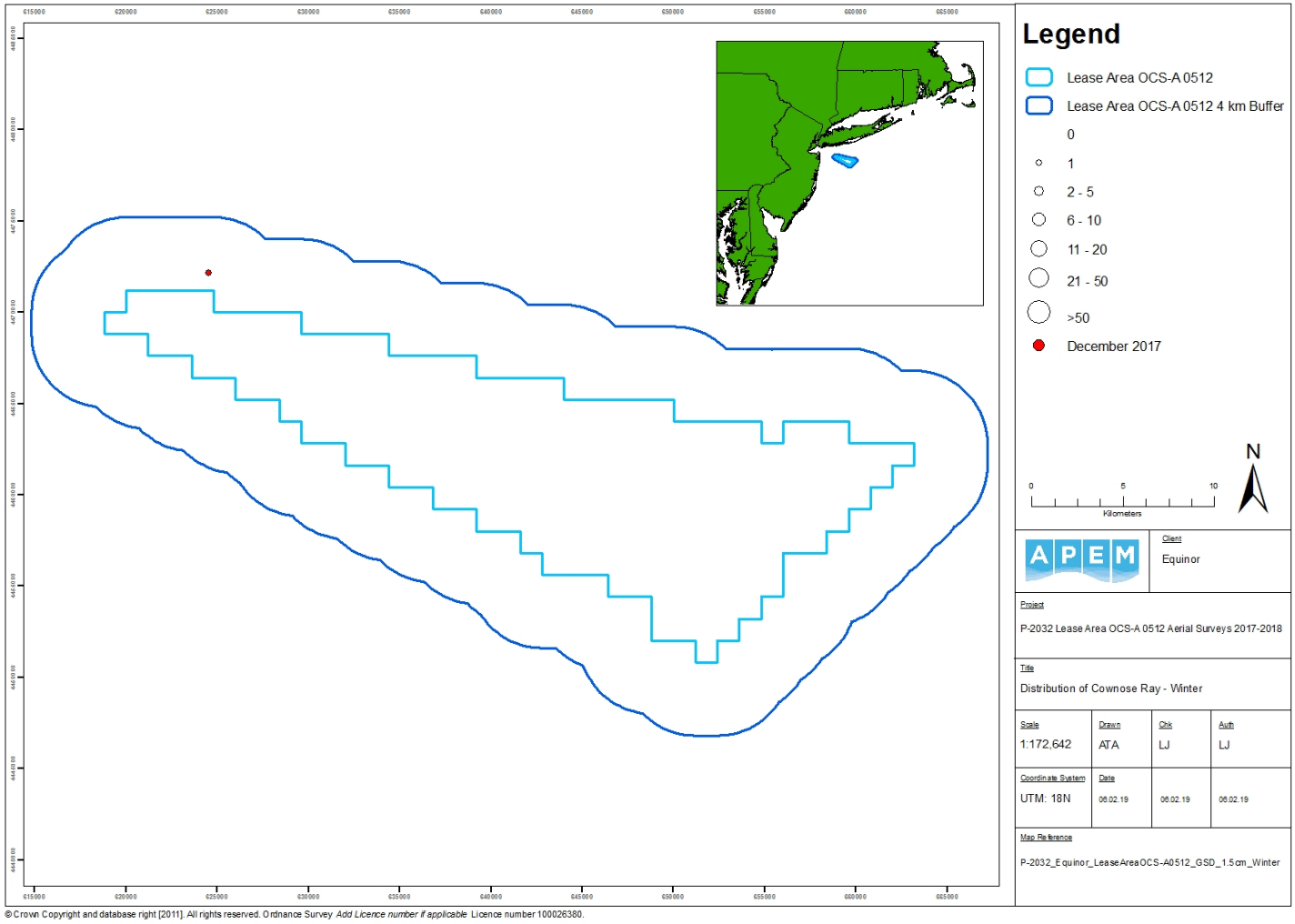


Figure 159 Distribution of cownose rays recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the winter season.

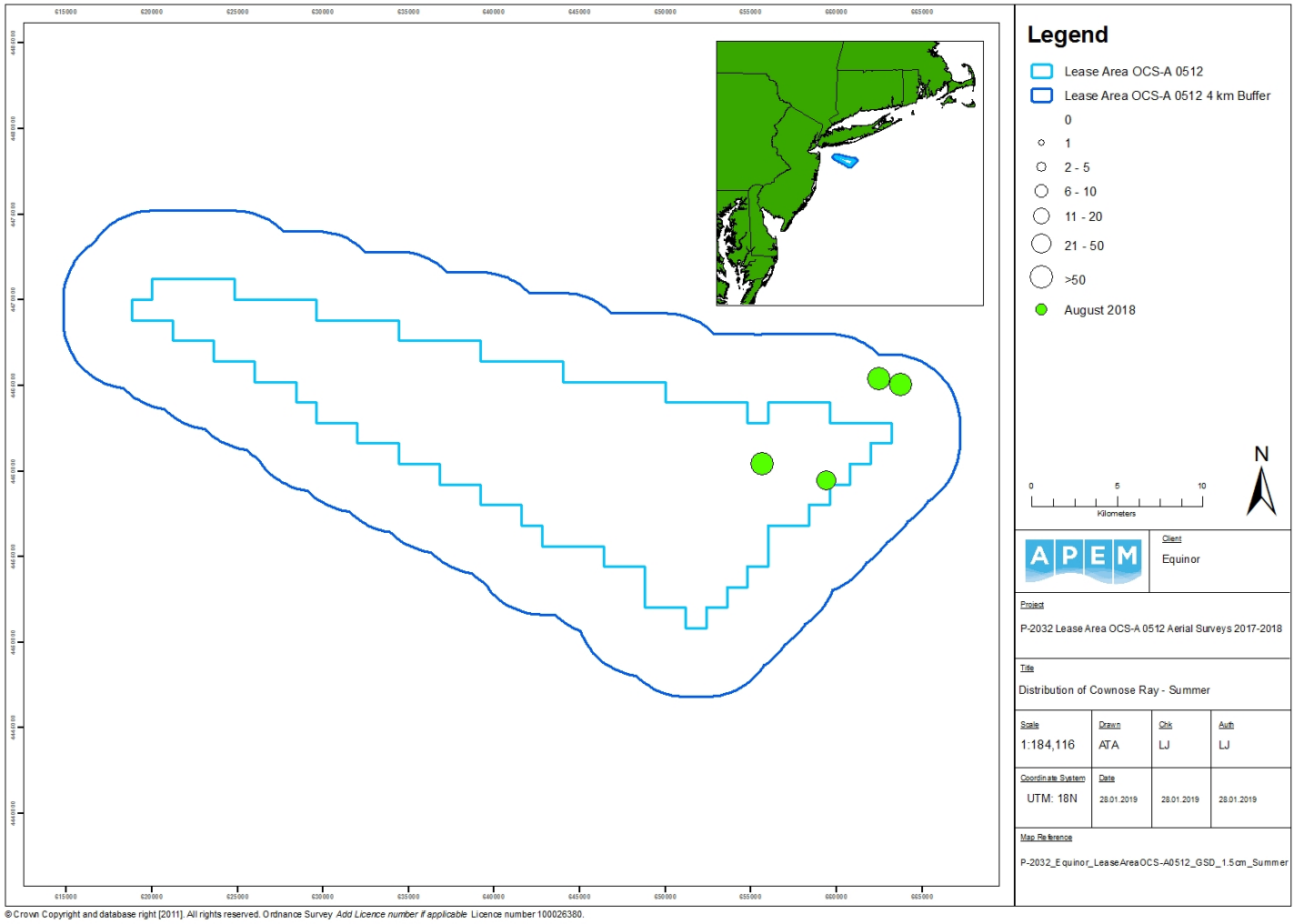


Figure 160 Distribution of cownose rays recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the summer season.

4.67 Ocean Sunfish

Ocean sunfish were recorded in low numbers in seven months throughout the year, with a peak raw count of six in the June survey (**Table 73**). Five of the animals recorded in June were observed in the 4 km buffer, giving an abundance estimate of 41. The peak number recorded within the Lease Area OCS-A 0512 site occurred in October with two individuals resulting in an abundance estimate of 16.

A total of three ocean sunfish were recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the fall. Both individuals recorded in October were located in the Lease Area OCS-A 0512 site, whilst the single individual recorded in September was located in the eastern 4km buffer (**Figure 161**). In winter one ocean sunfish was recorded in December and was located in the center of the wind farm. Two were recorded in February located in the north-west and south-west of the 4 km buffer (**Figure 162**). In spring, two ocean sunfish were recorded in the Lease Area OCS-A 0512 plus 4 km buffer in May. Both individuals were recorded in the Lease Area OCS-A 0512 site, with one in the east and one in the west (**Figure 163**). A total of eight ocean sunfish were recorded in the Lease Area OCS-A 0512 plus 4 km buffer in summer, of which six were recorded in June and two in July. Six individuals were recorded towards the south-east of the Lease Area OCS-A 0512 plus 4 km buffer, of which five were located in the 4 km buffer. Two individuals were recorded in the west of the Lease Area OCS-A 0512 plus 4 km buffer in the 4 km buffer (**Figure 164**).

Table 73 **Raw counts and abundance and density estimates (No. estimated individuals per km^2) of ocean sunfish in: a) Lease Area OCS-A 0512 plus 4 km buffer, b) Lease Area OCS-A 0512, and c) the Lease Area OCS-A 0512 4 km buffer only.**

a) Lease Area OCS-A 0512 plus 4 km Buffer					
Survey	**Raw Count**	**Abundance**	**Density**	**Surfacing**	**Submerged**
Dec-17	1	8	0.01	0	1
Feb-18	2	16	0.02	0	2
May-18	2	15	0.02	0	2
Jun-18	6	49	0.06	0	6
Jul-18	2	15	0.02	0	2
Sep-18	1	8	0.01	0	1
Oct-18	2	16	0.02	0	2
b) Lease Area OCS-A 0512					
Survey	**Raw Count**	**Abundance**	**Density**	**Surfacing**	**Submerged**
Dec-17	1	8	0.02	0	1
Feb-18	0	0	-	0	0
May-18	2	15	0.05	0	2
Jun-18	1	8	0.02	0	1
Jul-18	0	0	-	0	0
Sep-18	0	0	-	0	0
Oct-18	2	16	0.05	0	2
c) 4 km Buffer					
Survey	**Raw Count**	**Abundance**	**Density**	**Surfacing**	**Submerged**
Dec-17	0	0	-	0	0
Feb-18	2	16	0.03	0	2

May-18	0	0	-	0	0
Jun-18	5	41	0.08	0	5
Jul-18	2	15	0.03	0	2
Sep-18	1	8	0.02	0	1
Oct-18	0	0	-	0	0

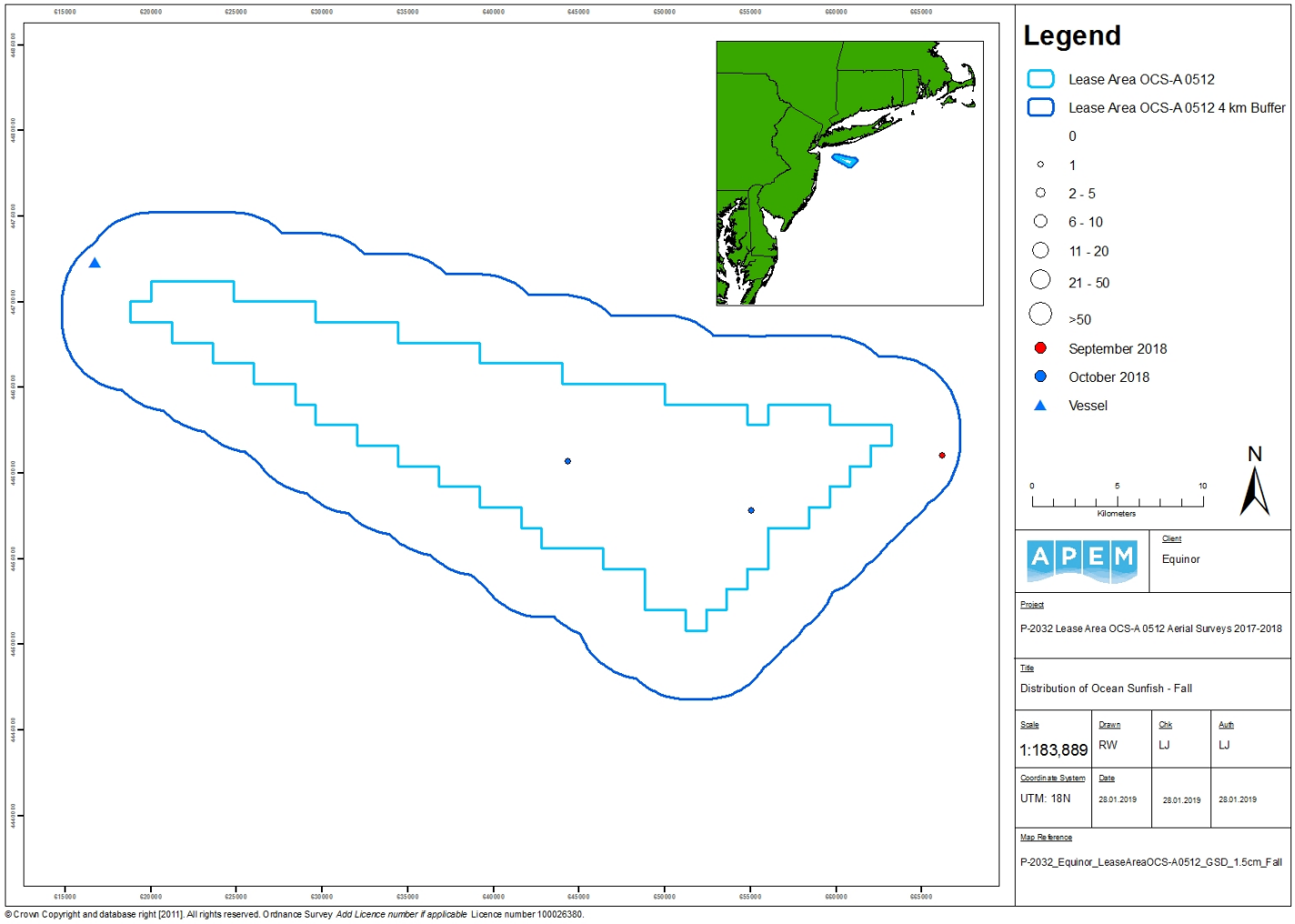


Figure 161 Distribution of ocean sunfish recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the fall season.

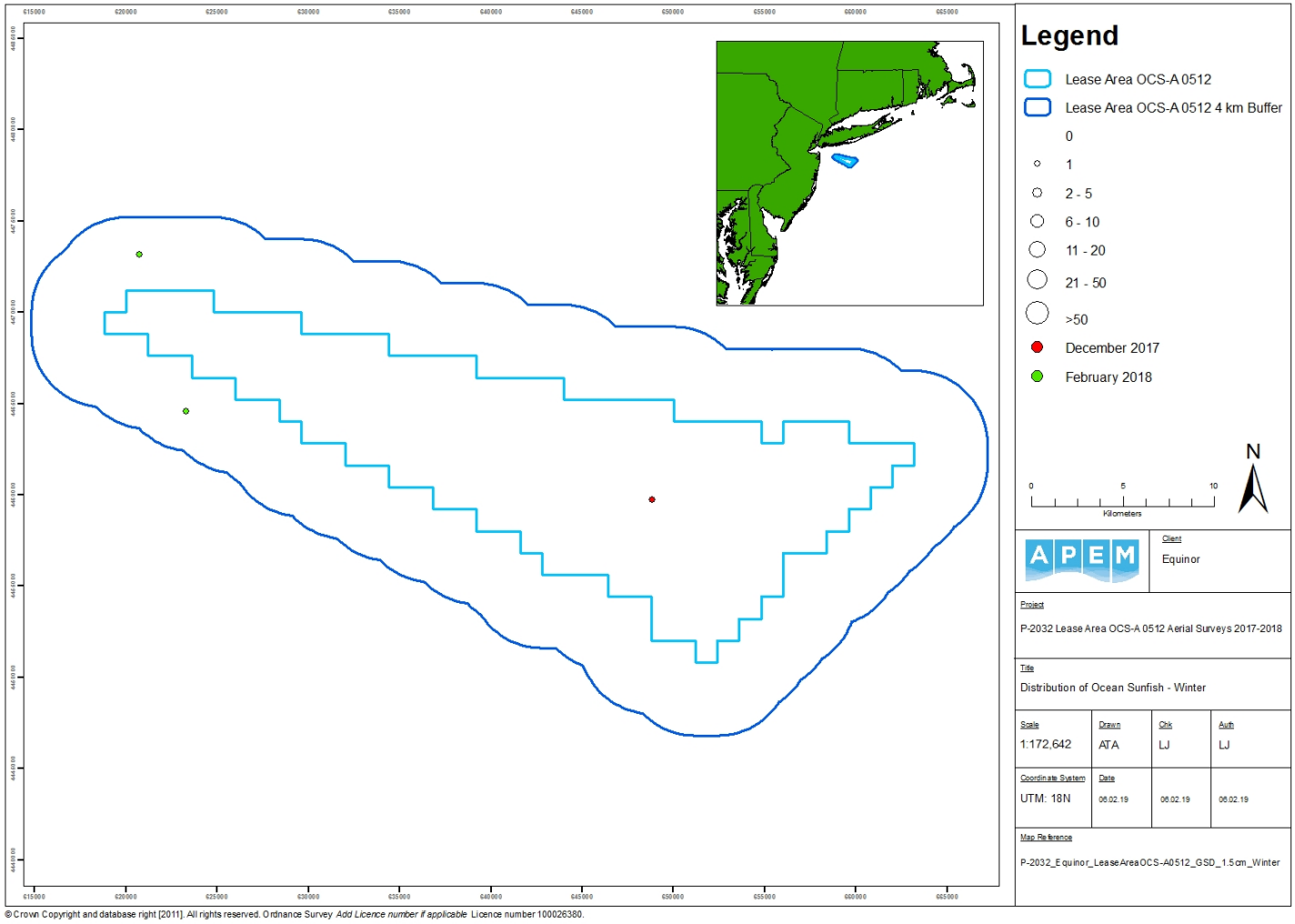


Figure 162 Distribution of ocean sunfish recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the winter season.

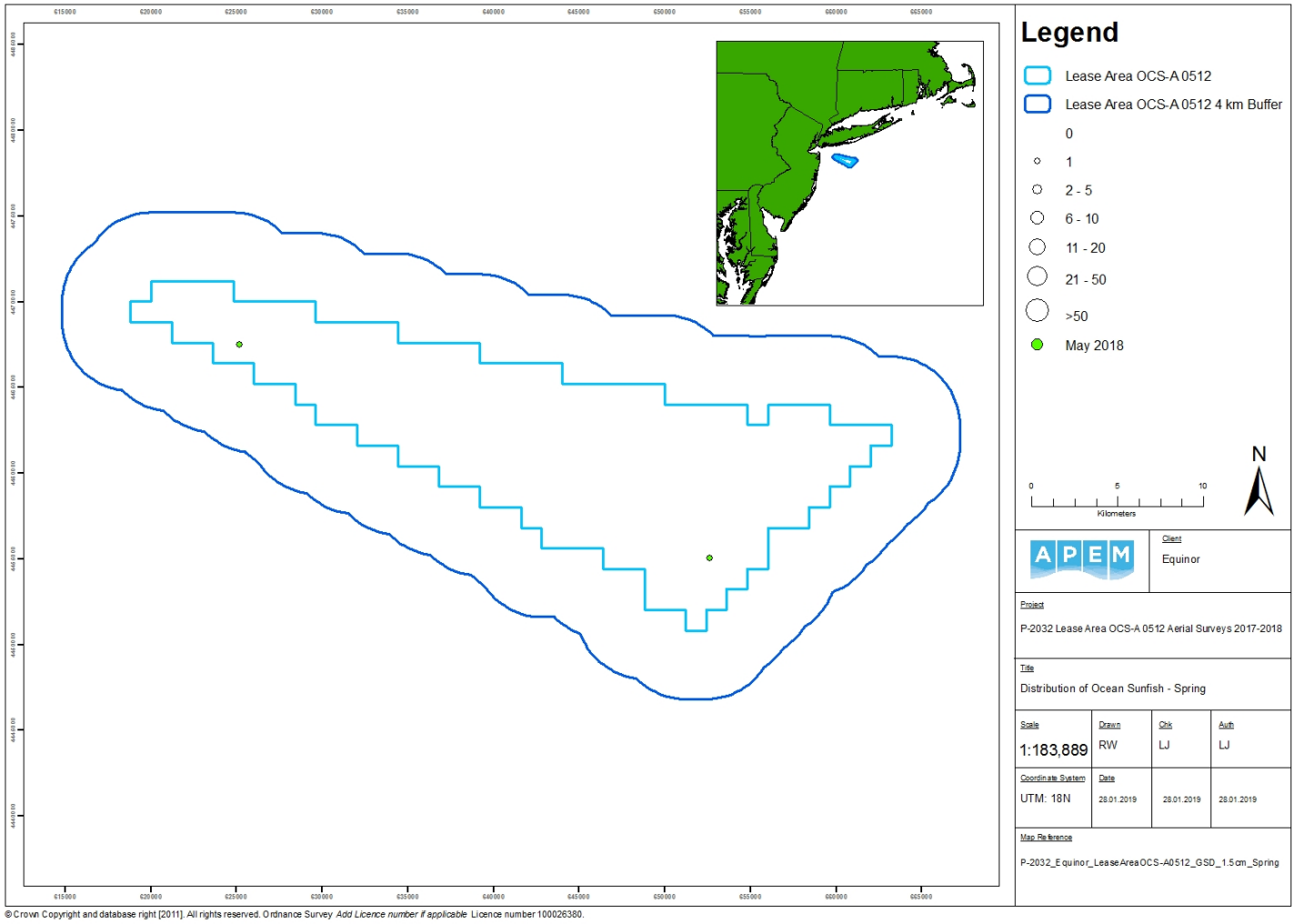


Figure 163 Distribution of ocean sunfish recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the spring season.

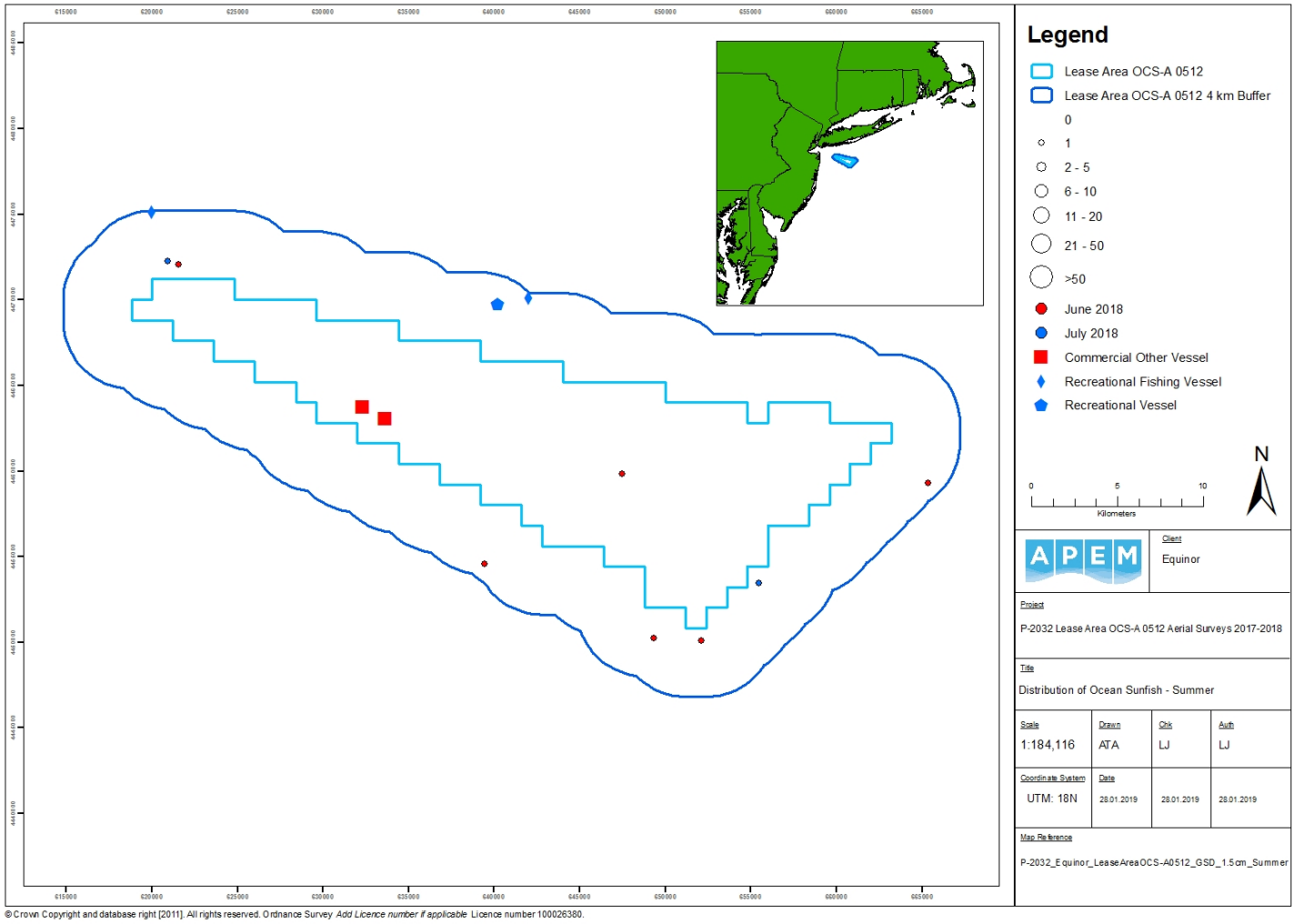


Figure 164 Distribution of ocean sunfish recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the summer season.

4.68 Mahi-mahi

Mahi-mahi were recorded in the May survey only, with 131 individuals being recorded. All animals were recorded in the Lease Area OCS-A 0512 site, giving an abundance estimate of 976 (**Table 74**).

Four separate groups of mahi-mahi were recorded throughout the Lease Area OCS-A 0512 plus 4 km buffer. (**Figure 165**).

Table 74 **Raw counts and abundance and density estimates (No. estimated individuals per km^2) of mahi-mahi in: a) Lease Area OCS-A 0512 plus 4 km buffer, b) Lease Area OCS-A 0512, and c) the Lease Area OCS-A 0512 4 km buffer only.**

a) Lease Area OCS-A 0512 plus 4 km Buffer					
Survey	Raw Count	Abundance	Density	Surfacing	Submerged
May-18	131	990	1.21	0	131
b) Lease Area OCS-A 0512					
Survey	Raw Count	Abundance	Density	Surfacing	Submerged
May-18	131	976	3.04	0	131
c) 4 km Buffer					
Survey	Raw Count	Abundance	Density	Surfacing	Submerged
May-18	0	0	-	0	0

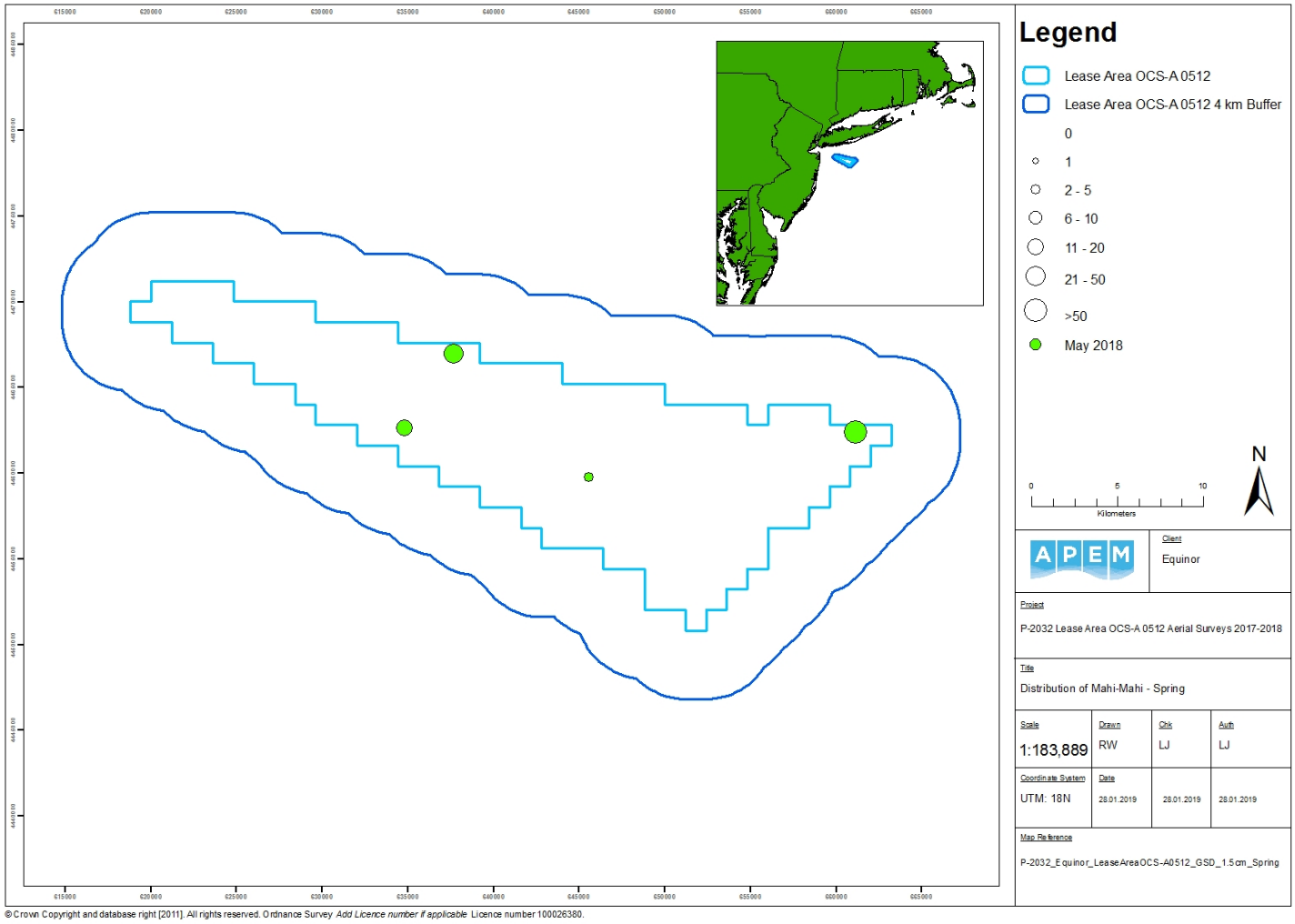


Figure 165 Distribution of mahi-mahi recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the spring season.

4.69 Atlantic Bluefin Tuna

Seven Atlantic bluefin tuna were recorded in the 4 km buffer in the May survey, giving an abundance estimate of 53 individuals (**Table 75, Figure 166**).

Table 75 **Raw counts and abundance and density estimates (No. estimated individuals per km^2) of Atlantic bluefin tuna in: a) Lease Area OCS-A 0512 plus 4 km buffer, b) Lease Area OCS-A 0512, and c) the Lease Area OCS-A 0512 4 km buffer only.**

a) Lease Area OCS-A 0512 plus 4 km Buffer					
Survey	**Raw Count**	**Abundance**	**Density**	**Surfacing**	**Submerged**
May-18	7	53	0.06	0	7
b) Lease Area OCS-A 0512					
Survey	**Raw Count**	**Abundance**	**Density**	**Surfacing**	**Submerged**
May-18	0	0	-	0	0
c) 4 km Buffer					
Survey	**Raw Count**	**Abundance**	**Density**	**Surfacing**	**Submerged**
May-18	7	53	0.11	0	7

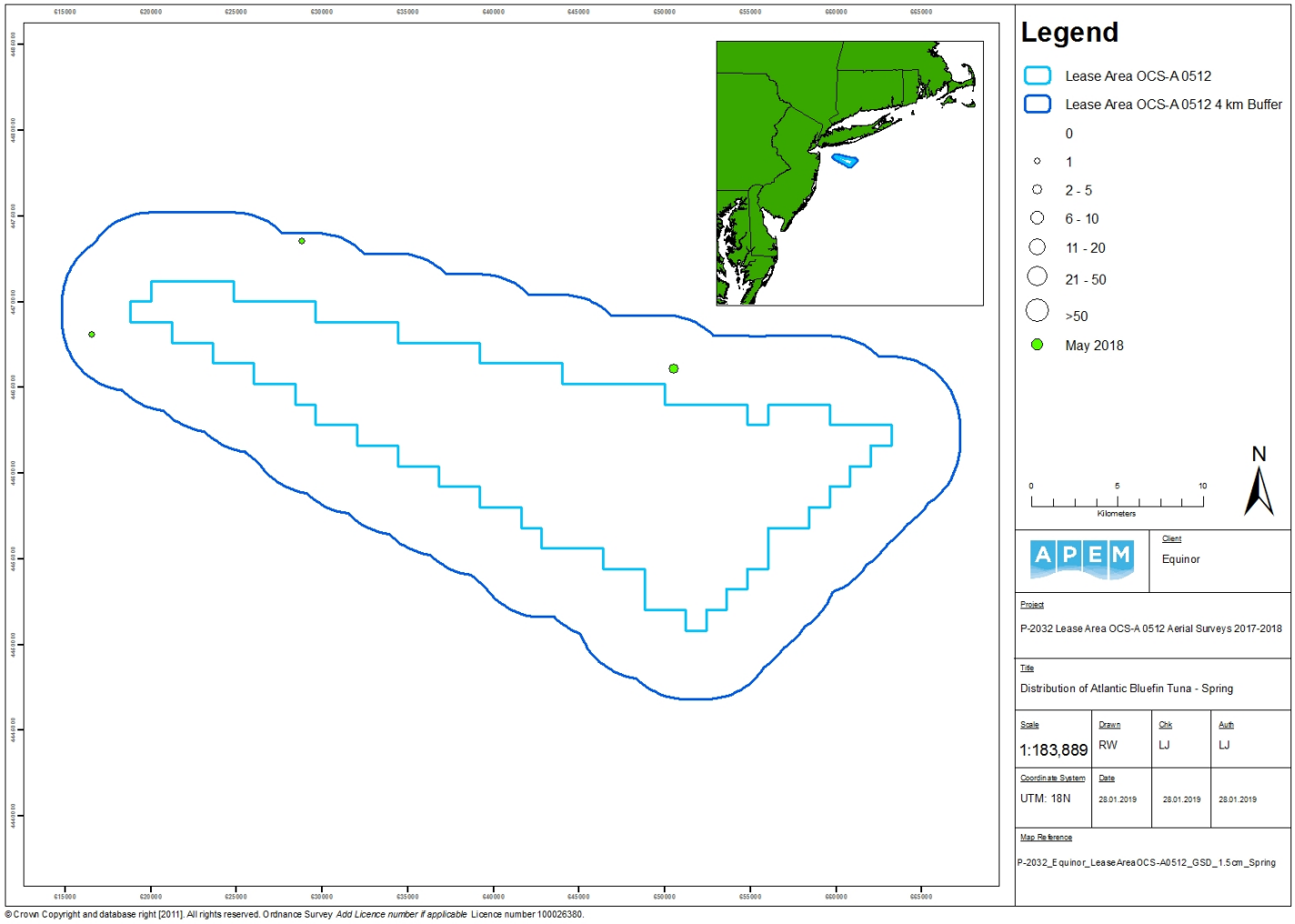


Figure 166 Distribution of Atlantic bluefin tuna recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the spring season.

4.70 Species Unknown - Tuna

There were 24 unknown tuna species recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the May survey, all of which were observed in the 4 km buffer (**Table 76, Figure 167**). This resulted in an abundance estimate of 183.

Table 76 **Raw counts and abundance and density estimates (No. estimated individuals per km^2) of unknown tuna species in: a) Lease Area OCS-A 0512 plus 4 km buffer, b) Lease Area OCS-A 0512, and c) the Lease Area OCS-A 0512 4 km buffer only.**

a) Lease Area OCS-A 0512 plus 4 km Buffer					
Survey	Raw Count	Abundance	Density	Surfacing	Submerged
May-18	24	181	0.22	0	24
b) Lease Area OCS-A 0512					
Survey	Raw Count	Abundance	Density	Surfacing	Submerged
May-18	0	0	-	0	0
c) 4 km Buffer					
Survey	Raw Count	Abundance	Density	Surfacing	Submerged
May-18	24	183	0.37	0	24

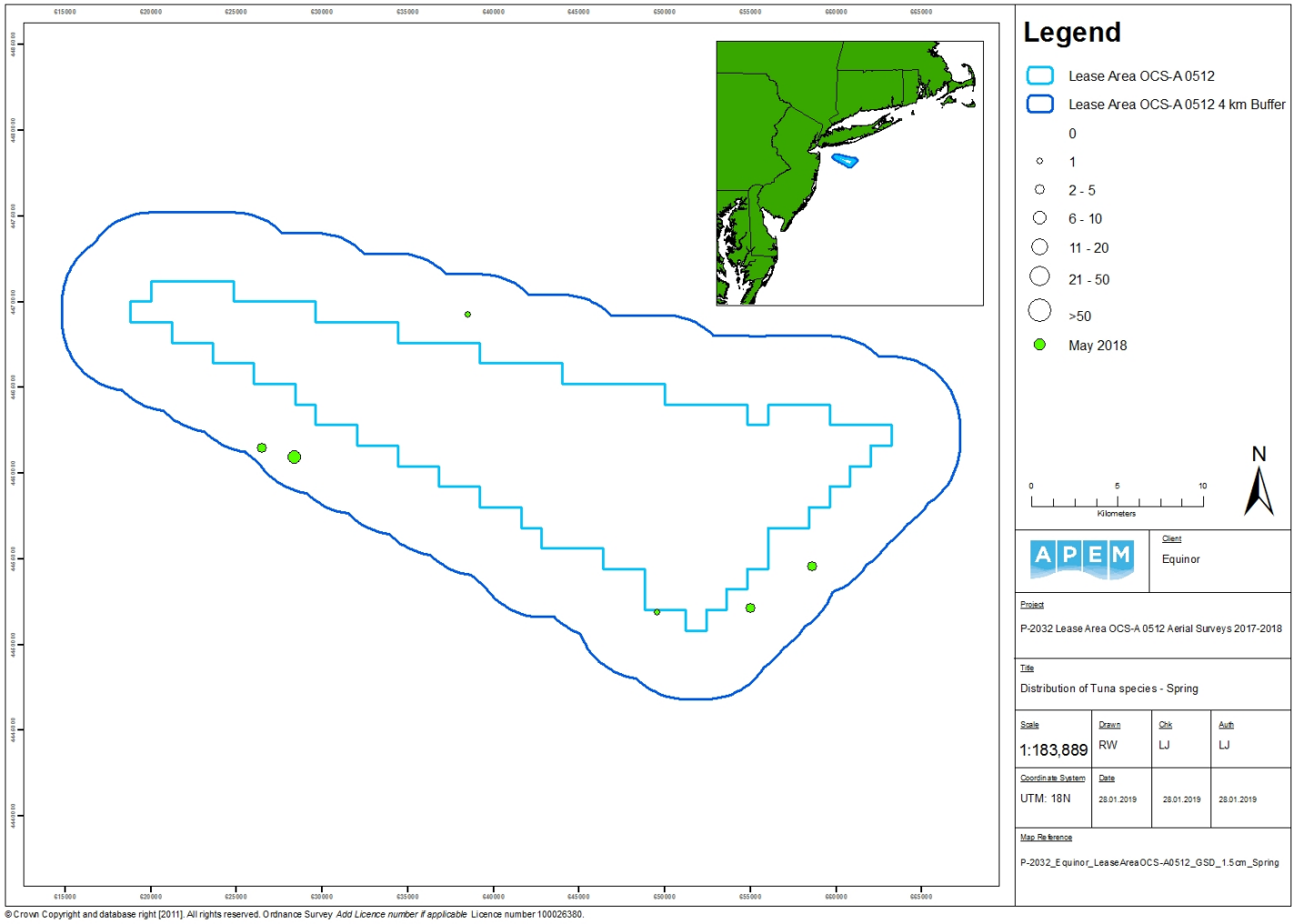


Figure 167 Distribution of unknown tuna species recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the spring season.

4.71 Species Unknown – Fish

Unknown fish species were recorded in the January and October surveys only, with a peak raw count of 11 in October (**Table 77**), of which 10 were recorded in the Lease Area OCS-A 0512 site. A peak abundance estimate of 78 was recorded. In January, a single unknown fish species was recorded in the 4 km buffer.

In the fall, a total of eleven unknown fish species were recorded in the Lease Area OCS-A 0512 plus 4 km buffer. All individuals were recorded in the east, with ten located in the Lease Area OCS-A 0512 site and one in the 4 km buffer (**Figure 168**). In winter, a single unknown fish species was recorded in January and was located in the south-west region of the 4 km buffer (**Figure 169**).

Table 77 **Raw counts and abundance and density estimates (No. estimated individuals per km^2) of unknown fish species in: a) Lease Area OCS-A 0512 plus 4 km buffer, b) Lease Area OCS-A 0512, and c) the Lease Area OCS-A 0512 4 km buffer only.**

a) Lease Area OCS-A 0512 plus 4 km Buffer					
Survey	**Raw Count**	**Abundance**	**Density**	**Surfacing**	**Submerged**
Jan-18	1	8	0.01	0	1
Oct-18	11	87	0.11	0	11
b) Lease Area OCS-A 0512					
Survey	**Raw Count**	**Abundance**	**Density**	**Surfacing**	**Submerged**
Jan-18	0	0	-	0	0
Oct-18	10	78	0.24	0	10
c) 4 km Buffer					
Survey	**Raw Count**	**Abundance**	**Density**	**Surfacing**	**Submerged**
Jan-18	1	8	0.02	0	1
Oct-18	1	8	0.02	0	1

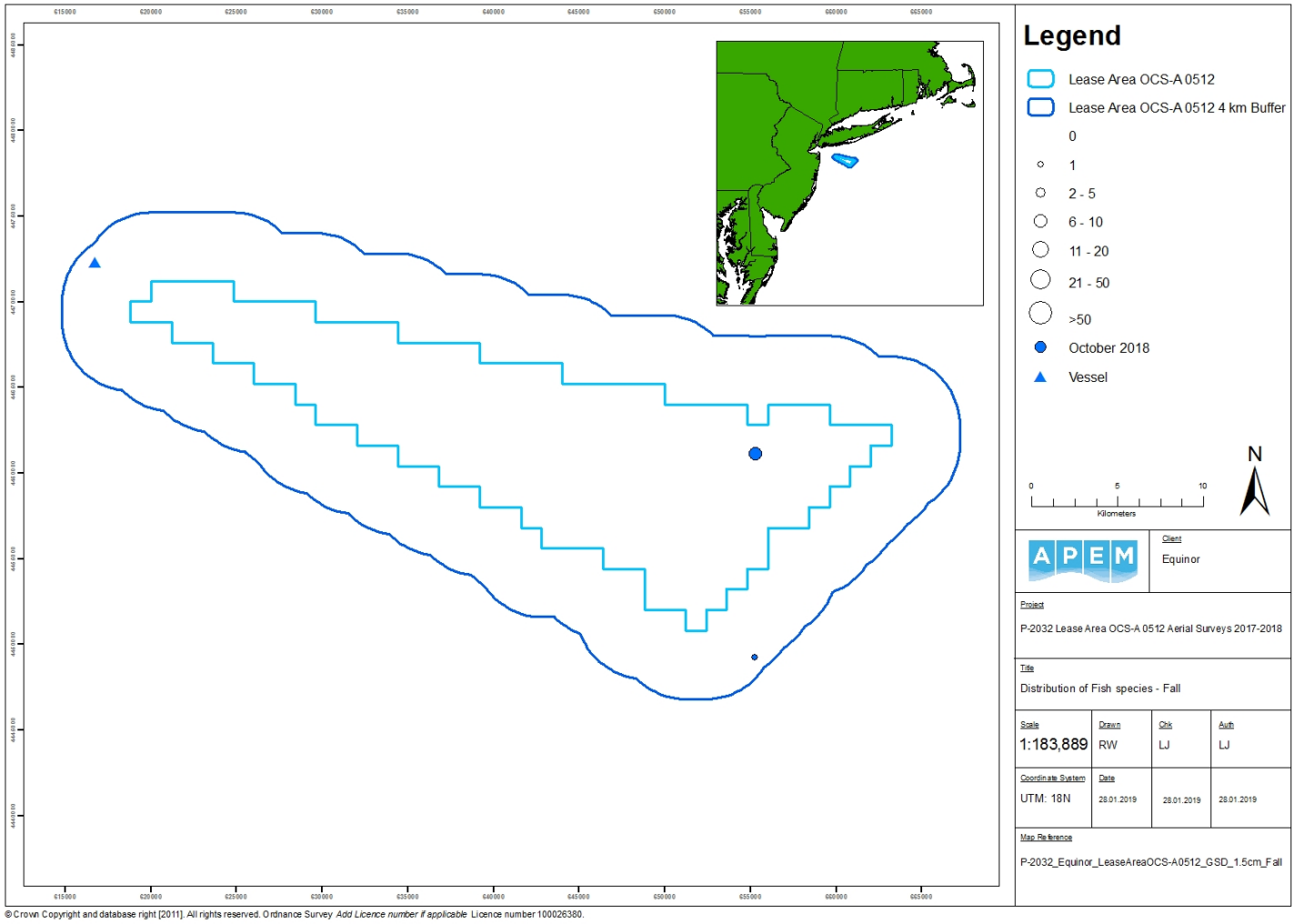


Figure 168 Distribution of unknown fish species recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the fall season.

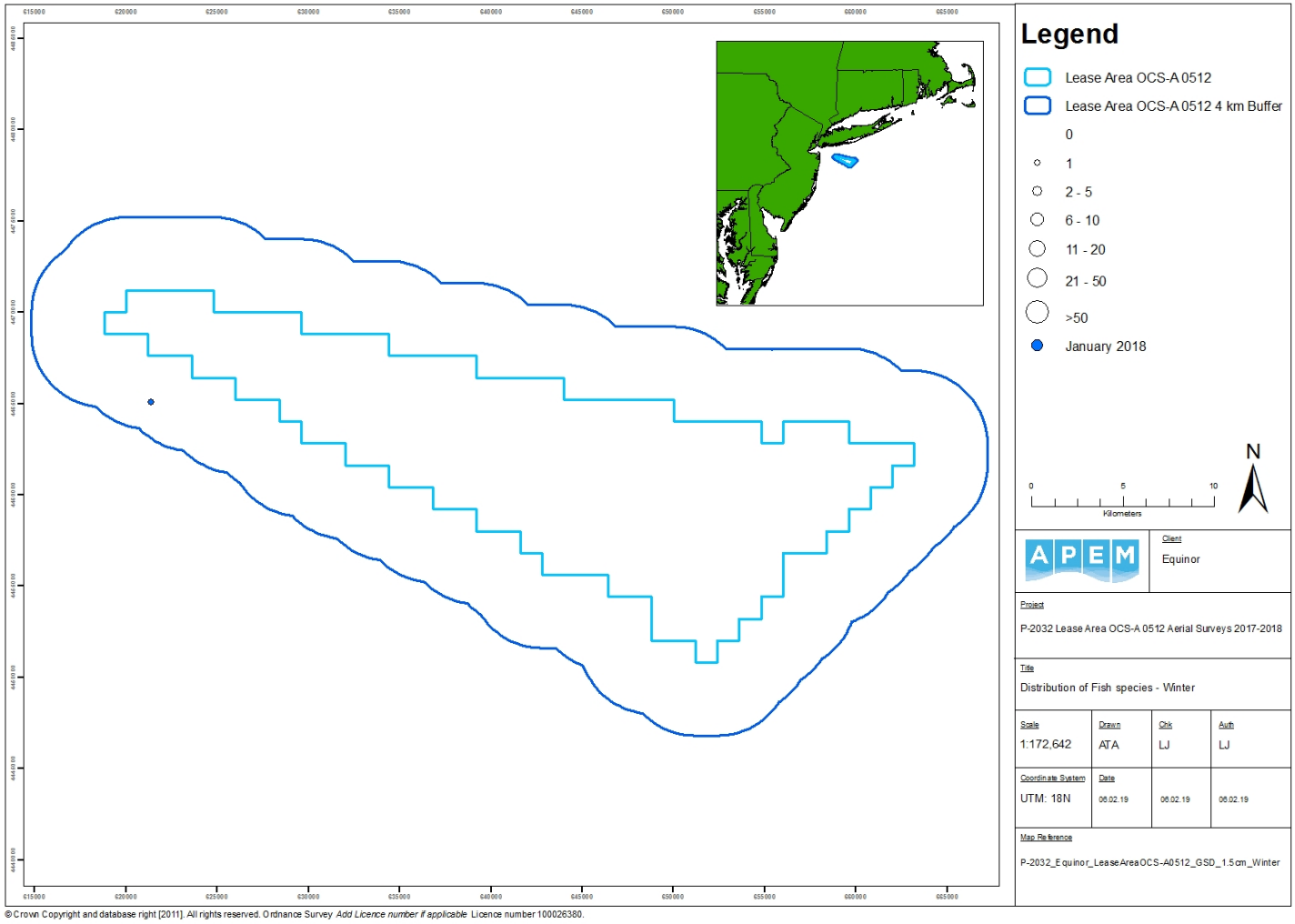


Figure 169 Distribution of unknown fish species recorded in the Lease Area OCS-A 0512 plus 4 km buffer in the winter season.

5. Anecdotal Observations

In November 2017, one tanker (with a south-eastern bearing) and one trawler (with a south south-western bearing) were observed visually from the aircraft on the 28th November 2017. No vessels were recorded visually during the flight on the 29th November. No vessels were recorded in the imagery on either of the survey days.

In December 2017, one small fishing vessel (with a south-westerly bearing) and one small craft (stationary) were observed visually from the aircraft on the 15th December 2017. No vessels were recorded visually during the flight on the 16th December. No vessels were recorded in the imagery.

In January 2018, two small fishing vessels (with a north-easterly bearing) and one cargo vessel (with a northerly bearing) were observed visually from the aircraft on the 25th January 2018. No vessels were recorded visually during the flight on the 26th January. No vessels were recorded in the imagery.

In February 2018, five tankers (with an easterly bearing) were observed visually from the aircraft. No vessels were recorded in the imagery.

No vessels were recorded visually or in the imagery in the March 2018.

No vessels were recorded visually or in the imagery in April 2018.

In May 2018, two vessels identified as trawlers were recorded visually from the aircraft, one with a westerly bearing and the second with a southerly bearing. No vessels were recorded in the imagery. Twelve fish shoals were recorded in the May 2018 imagery.

In June 2018, two vessels identified as a survey boat and personnel water craft were recorded visually from the aircraft. Both of the vessels had a north westerly bearing. Two vessels were captured in the imagery classified as commercial (other) vessel types.

In July 2018, seven vessels were observed visually from the aircraft. These were recorded as one fishing vessel, one speedboat, two yachts, one ferry, and two trawlers. Three vessels were captured in the imagery classified as two recreational fishing vessels and one recreational vessel.

In August 2018, no vessels were recorded visually during the flight on the 16th August 2018. One small fishing vessel was recorded stationary (Latitude 40.25, Longitude -073.28) observed from the aircraft on the 17th August 2018. No vessels were recorded in the imagery.

In September 2018, two vessels were visually observed from the aircraft on the 27th September 2018. These were both recorded as fishing vessels and both had a northerly bearing. Three vessels were observed visually from the aircraft on the 29th September 2018. The first was classified as a fishing vessel with a north-easterly bearing. The remaining two were classified as small speedboats with a south-easterly bearing. Sixteen fish shoals were recorded in the imagery in September 2018.

No vessels were recorded visually or in the imagery in October 2018.

6. Discussion

6.1 Ducks

Ducks included mallard, long-tailed ducks, American black ducks, and all three scoter species. A total of six duck species and two unidentified species of duck were recorded during the survey period, recorded in all four seasons (n=544), with a peak abundance

estimate in the fall. The most abundant duck species recorded was black scoter, with a peak abundance estimate of 1,001 in October 2018. In the summer only a single unidentified duck was recorded.

In contrast, only one duck species (black scoters) was recorded in the quarterly Year 1 surveys (APEM, 2019), which were recorded exclusively in the fall.

6.2 Loons

Loons were primarily recorded in fall, winter and spring, with only a single bird recorded outside of these seasons, a single common loon in the summer. The most abundant loon species recorded was common loon (n=217), followed by red-throated loon (n=104) and unknown loon species (n=1). The peak abundance estimate was of 525 for red-throated loons in November, whilst for common loons the peak abundance estimate was of 393 in May. Loons were generally recorded in higher numbers in the fall (n=127), before gradually declining during the winter (n=81), and then experiencing a brief, sharp increase in late spring (n=113).

Similarly, the quarterly Year 1 surveys (APEM, 2019) also found common loons to be more abundant than red-throated loons, with an increase in numbers during the spring.

Both common and red-throated loons winter off the coast, before migrating to the inland areas of Canada and Alaska to breed (Audubon Society 2019[ef], Birdlife International, 2018[bc]). The presence of loons in fall to spring can therefore be explained by this migratory behavior.

6.3 Grebes

A single unknown grebe species was recorded in the Lease Area OCS-A 0512 site in December, resulting in an abundance estimate of eight individuals. There were no grebes recorded during the quarterly Year 1 surveys (APEM, 2019).

Some grebe species winter off the east coast of America, similarly to loons, before migrating inland and further north to Canada and Alaska to breed. However, grebe species have a tendency to prefer nearshore rather than offshore areas to forage, which may potentially explain the presence of only a single unidentified grebe in December throughout the survey programme.

6.4 Fulmars

Fulmars were recorded in low numbers in the fall (n=2) and spring (n=1), with a peak abundance estimate of 16 in November. All fulmars were recorded either within or close to the border of the 4 km buffer.

Fulmars are more numerous in the eastern north Atlantic, in European waters, than in the western north Atlantic, though breeding birds do occur during the summer months in Alaska and northern Canada. Additionally, fulmars tend to be found over the open ocean (Audubon Society 2019[d]).

6.5 Gannets

Gannets were recorded in all four seasons, with a peak count in the October survey (n=179), resulting in a peak abundance estimate of 1,411. Fewer were recorded in the summer (n=3). Year 1 surveys also demonstrated a decline of gannets in the summer months, with no gannets recorded.

In all but the summer months, northern gannets showed a similar distribution within each season. In the fall and spring surveys, gannets were mostly distributed towards the north-west of the Lease Area OCS-A 0512 plus 4 km buffer, whilst during the winter survey, gannets were mostly distributed towards the south-east.

Like many other species, northern gannets migrate to more northern areas of the East Atlantic in the summer months to breed, but spend time further south during the winter off the eastern coast of the United States (Audubon Society 2019[h]).

6.6 Phalaropes

Phalarope abundances peaked in November, with both red phalaropes (n=50) and red / red-necked phalaropes (n=10) recorded, resulting in abundance estimates of 397 and 79, respectively. Red / red-necked phalaropes were also recorded in winter (n=5) and spring (n=1).

In the fall, phalaropes were more distributed towards the north-east of the Lease Area OCS-A 0512 plus 4 km buffer, whilst in winter; there was no clear distribution pattern.

While red phalaropes may winter offshore further south than the Lease Area OCS-A 0512 plus 4 km buffer, red-necked phalaropes winter south of the equator. Both species, however, are commonly sighted off the east coast of America whilst migrating north to the Arctic tundra to breed (Audubon Society 2019[i j]).

6.7 Cormorants

Unknown cormorants were recorded in the spring (n=32), the summer (n=2) and the fall (n=7) 2018. With the exception of the single cormorant recorded in May, all cormorants were recorded in groups. The peak abundance estimate was of 235 recorded in the April survey.

In May and October, all cormorants were recorded within the Lease Area OCS-A 0512 site, whilst in April and June, cormorants were recorded in the 4 km buffer.

6.8 Alcids

Alcids included Atlantic puffins, dovekies, common murres, thick-billed murres and razorbills. Alcids were recorded in low numbers in the fall (n=3), before increasing during the winter (n=190). Peak counts were reached during the spring (n=371), before declining in the summer (n=1).

During the winter and the spring, alcids were primarily distributed towards the east of the Lease Area OCS-A 0512 plus 4 km buffer. Due to the low counts in fall and summer, no distribution patterns were noticeable.

In contrast, very low numbers of alcids were recorded during the quarterly Year 1 surveys (APEM, 2019), and were only recorded during the winter months.

Both murres and razorbills winter off the east coast of the northern United States and breed off the north-east Canadian coast. It would therefore be expected for numbers to be at a peak in winter, and at their lowest in summer (Sibley, 2000).

6.9 Small gulls

Small gull species included black-legged kittiwake, Bonaparte's gulls, ring-billed gull and laughing gull. The most abundant small gull species recorded was Bonaparte's gulls, with peak counts in December (n=330), followed by November (n=101), resulting in abundance estimates of 2,557 and 803, respectively. Black-legged kittiwakes were the second most abundant small gull species recorded, with peak counts in fall (n=26). Ring-billed gulls and laughing gulls were seen in considerably fewer numbers, with a peak count of n=2 in any one month. Unknown small gulls were recorded at a peak in December (n=11).

In spring, small gulls appeared to be distributed further towards the east than in other seasons.

The quarterly Year 1 surveys also found Bonaparte's gulls to be the most abundant small gull species (APEM, 2019).

Peak abundances of each small gull species are likely related to their migratory habits. Black-legged kittiwakes, Bonaparte's gulls and ring-billed gulls mostly winter off the eastern United States, whilst for laughing gulls, the Lease Area OCS-A 0512 plus 4 km buffer is within their breeding range (Sibley, 2000).

6.10 Large gulls

Large gulls included herring gull, lesser black-backed gull and great black-backed gull. Herring gulls were the most abundant large gull species recorded, with records in all but July and August. A peak count was recorded in October (n=46), contributing to a peak abundance estimate in fall of 362. Great black-backed gulls also peaked in fall, while lesser black-backed gulls and unknown large gulls recorded in considerably fewer numbers in spring and summer.

There did not appear to be any noticeable distribution patterns of large gulls in any season.

Both herring gulls and great black-backed gulls winter off the eastern United States, and may be found year-round off the south-eastern Canadian coast (Sibley, 2000). The lesser black-backed gull, however, is a vagrant from Europe (Audubon Society, 2019[g]), and would therefore be expected to occur in lower numbers.

6.11 Terns

With the exception of a single unknown tern species, all terns were recorded in May. The most abundant species recorded was 'Commic' / Forster's terns (n=170) with an abundance estimate of 1,284, followed by sterna tern species (n=60), with an abundance estimate of 453.

Whilst there were no clear distribution patterns amongst terns, the majority were recorded in the 4 km buffer.

Forster's terns, common terns and least terns may all breed along the coastlines closest to the Lease Area OCS-A 0512 plus 4 km buffer (Audubon's Society, 2019[mno]). The presence of terns almost exclusively in the month of May is likely related to both the migratory and breeding habits of terns.

6.12 Small Shearwaters

Manx shearwaters were recorded in June (n=2), resulting in an abundance estimate of 16, while Sooty shearwaters were recorded in both May (n=1) and June (n=15), resulting in a peak abundance estimate of 124 in June. Unknown small shearwaters were recorded in May (n=5) and June (n=3). There was no clear distribution pattern, in part owning to the low numbers of small shearwaters recorded.

Manx shearwaters are less common in North America than other species, and their movements are less studied in the western Atlantic than around Europe (Audubon's Society, 2019[l]). There are however several breeding colonies off the coast of Newfoundland and Massachusetts (Birdlife International, 2018[d]). Sooty shearwaters are seen more regularly off the Pacific coast, but is a non-breeder in this area (Audubon Society, 2019[b]).

6.13 Large Shearwaters

Large shearwaters were recorded in peak numbers in the summer, with great shearwaters (n=18), Cory's shearwaters (n=62) and unknown large shearwaters (n=25) all peaking in June, leading to abundance estimates of 148, 511 and 206, respectively. Large shearwaters were also recorded in the spring and / or the fall.

Large shearwaters did not seem to show any particular distribution patterns.

Great shearwaters and Cory's shearwaters are both seen regularly off the North American coast in the summer months, neither species breeds in this area, and these birds are therefore non-breeders (Audubon's Society, 2019[ac], Birdlife International, 2018[a]).

6.14 Petrels

A total of three petrels were recorded; black-capped petrels (n=1) and unknown petrel species (n=2). The single black-capped petrel (recording in August) was recorded in the 4 km buffer, whilst both unknown petrel species one recorded in each of August and October) were recorded in the Lease Area OCS-A 0512 site.

Black-capped petrels breed only in the West Indies, and are generally found off the coast of the southern United States towards the warmer waters of the Gulf Stream (Audubon Society, 2019[k]). It is likely that the individual recorded in August would have been a vagrant.

6.15 Storm Petrels

Unknown storm petrel species were recorded in spring (n=1) and summer (n=37). In the summer, storm petrels appeared to be primarily distributed towards the east of the Lease Area OCS-A 0512 plus 4 km buffer, with a greater number of individuals in the 4 km buffer.

Peak numbers of storm petrels in the summer is in contrast to the results of the quarterly surveys in Year 1 (APEM, 2019), in which a single storm petrel was recorded in a spring, but no other individuals were recorded throughout the year.

6.16 Other avian species

Of the other avian species recorded, unknown shorebird species (n=16) in July was the most abundant. An unknown hawk species in May (n=1) and a great blue heron in August (n=1) were also recorded. All individuals were recorded towards the west of the Lease Area OCS-A 0512 plus 4 km buffer in the 4 km buffer.

6.17 Marine Mammals

Common dolphins were the most abundant marine mammal species recorded, with a peak count (n=68) in the May survey, giving an abundance estimate of 514. This was followed by bottlenose dolphins, with a peak raw count (n=22) in the June survey, giving an abundance estimate of 181. Harbor porpoises, common minke whales and a single humpback whale were also recorded, as were three unidentified dolphins and three unidentified marine mammals. Marine mammals were recorded in peak numbers in spring.

Whilst the dolphin species recorded can be resident, and therefore may potentially be recorded year-round, common minke whales may migrate north in the summer months (Shirihai & Jarrett, 2006). The single humpback whale, recorded in June, would likely have been migrating north to the summer feeding grounds off the coast of Canada and Greenland.

6.18 Turtles

The most abundant turtle species recorded was loggerhead turtles, with a peak count (n=7) in the June survey, giving an abundance estimate of 58. Numbers then gradually decreased until October (n=2). Turtles were only recorded in summer and early fall. There were no clear distribution patterns amongst turtles in any season. Similarly, turtles were only recorded in summer and fall in the Year 1 surveys.

6.19 Sharks

Sharks were recorded in low numbers in the summer months only. Blue sharks and unknown sharks were the most abundant shark species recorded (n=6), followed by scalloped hammerheads (n=2), unknown hammerheads (n=2), great white sharks (n=1), tiger sharks (n=1) and unknown Carcharhinidae species (n=1). A peak abundance estimate of 49 was recorded for blue sharks in the June survey.

The majority of sharks were recorded in the 4 km buffer. Blue sharks appeared to be mostly distributed towards the east of the Lease Area OCS-A 0512 plus 4 km buffer, but otherwise, there were no clear distribution patterns.

6.20 Rays

Cownose rays were the only species of ray recorded, with a peak raw count in August (n=502), resulting in an abundance estimate of 3,749. Cownose rays were also recorded in September (n=3) and December (n=1). The peak abundance in August suggests the rays were migrating at that time.

In August, cownose rays were distributed towards the north-east of the Lease Area OCS-A 0512 plus 4 km buffer, in four groups located both in the Lease Area OCS-A 0512 site and the 4 km buffer.

6.21 Sunfish

Ocean sunfish were recorded in low numbers throughout the year, with a peak raw count in June 2018 (n=6), giving an abundance estimate of 49. In all seasons, ocean sunfish were loosely distributed across the Lease Area OCS-A 0512 plus 4 km buffer, with a majority of individuals recorded in the 4 km buffer.

6.22 Large bony fish

With the exception of unknown fish species, all large bony fish were recorded in May. Mahi-mahi were the most abundant species recorded (n=131), giving an abundance estimate of 990. Atlantic bluefin tuna (n=7) and unknown tuna species (n=24) were also recorded in May. Unknown fish species were recorded in January (n=1) and October (n=11).

All Mahi-mahi and ten of the unknown fish species were recorded in the Lease Area OCS-A 0512 site; however all of the tuna were recorded in the 4 km buffer. Otherwise, there were no clear distribution patterns.

These results contrast significantly from the Year 1 surveys, in which the most abundant species group recorded was Cobia, of which none were recorded in the present survey. Additionally, only a single Mahi-mahi was recorded.

7. Conclusions

A programme of 12 monthly aerial digital surveys of Equinor's Lease Area OCS-A 0512 in the New York Bight were conducted between November 2017 and October 2018 using APEM Inc.'s high-resolution camera system to capture digital still imagery.

In the fall months, gulls, loons and ducks were the most abundant species group recorded. During the winter, gulls and alcids were the most numerous, whilst alcids and terns were the most numerous in the spring. In the summer months, shearwaters and petrels were more numerous with marine fauna such as marine mammals, sharks and rays also increased in abundance (with rays being the most numerous species) recorded in the summer.

The results obtained in this survey programme (monthly surveys in Year 2) differed from those in the quarterly surveys in Year 1. In the fall in Year 1, ducks (n=34), shearwaters (n=24) and gulls (n=20) were the most numerous species groups recorded. In winter in Year 1, only 36 birds and one large bony fish were seen, with gannets (n=18) being the most abundant species. During the spring in Year 1, terns were the most numerous, which is similar to the results of one of the Year 2 spring surveys in May 2018. In the Year 1 summer survey, rays and sharks were especially numerous, as were rays during the Year 2 summer surveys in August 2018.

On the whole, marine animals were considerably more numerous during the Year 2 survey programme than the Year 1 surveys. It should be noted however that only one survey per season took place in the first year of surveys, whilst in the Year 2 programme, surveys were monthly.

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Appendix I Scientific Names and Taxonomy of Marine Fauna

Common Name	Scientific Name	Family	Class
Mallard	*Anas platyrhynchos*	Anatidae	Aves
American Black Duck	*Anas rubripes*	Anatidae	Aves
Long-tailed Duck	*Clangula hyemalis*	Anatidae	Aves
Surf Scoter	*Melanitta perspicillata*	Anatidae	Aves
White-winged Scoter	*Melanitta fusca*	Anatidae	Aves
Black Scoter	*Melanitta americana*	Anatidae	Aves
Red-throated Loon	*Gavia stellata*	Gaviidae	Aves
Common Loon	*Gavia immer*	Gaviidae	Aves
Cory's Shearwater	*Calonectris diomedea*	Procellariidae	Aves
Great Shearwater	*Ardenna gravis*	Procellariidae	Aves
Sooty Shearwater	*Ardenna grisea*	Procellariidae	Aves
Manx Shearwater	*Puffinus puffinus*	Procellariidae	Aves
Northern Fulmar	*Fulmarus glacialis*	Procellariidae	Aves
Northern Gannet	*Morus bassanus*	Sulidae	Aves
Red Phalarope	*Phalaropus fulicarius*	Scolopacidae	Aves
Red-necked Phalarope	*Phalaropus lobatus*	Scolopacidae	Aves
Common Murre	*Uria aalge*	Alcidae	Aves
Thick-billed Murre	*Uria lomvia*	Alcidae	Aves
Dovekie	*Alle alle*	Alcidae	Aves
Razorbill	*Alca torda*	Alcidae	Aves
Black-legged Kittiwake	*Rissa tridactyla*	Laridae	Aves
Bonaparte's Gull	*Chroicocephalus philadelphia*	Laridae	Aves
Laughing Gull	*Leucophaeus atricilla*	Laridae	Aves
Ring-billed Gull	*Larus delawarensis*	Laridae	Aves
Herring Gull	*Larus argentatus*	Laridae	Aves
Lesser black-backed Gull	*Larus fuscus*	Laridae	Aves
Great Black-backed Gull	*Larus marinus*	Laridae	Aves
Common Tern	*Sterna hirundo*	Laridae	Aves
Least Tern	*Sternaula antillarum*	Laridae	Aves
Forster's Tern	*Sterna forsteri*	Laridae	Aves
Black-capped Petrel	*Pterodroma hasitata*	Procellariidae	Aves
Great Blue Heron	*Ardea herodias*	Ardeidae	Aves
Common Dolphin	*Delphinus delphis*	Delphinidae	Mammalia
Bottlenose Dolphin	*Tursiops truncates*	Delphinidae	Mammalia
Harbour Porpoise	*Phocoena phocoena*	Phocoenidae	Mammalia
Humpback Whale	*Megaptera novaeangliae*	Balaenopteridae	Mammalia
Loggerhead Turtle	*Caretta caretta*	Cheloniidae	Reptilia
Kemp's Ridley Turtle	*Lepidochelys kempii*	Cheloniidae	Reptilia
Mahi-mahi	*Coryphaena hippurus*	Coryphaenidae	Actinopterygii

Common Name	Scientific Name	Family	Class
Atlantic Bluefin Tuna	*Thunnus thynnus*	Scombridae	Actinopterygii
Ocean Sunfish	*Mola mola*	Molidae	Actinopterygii
Cownose Ray	*Rhinoptera bonasus*	Rhinopteridae	Chondrichthyes
Blue Shark	*Prionace glauca*	Carcharhinidae	Chondrichthyes
Tiger Shark	*Galeocerdo cuvier*	Carcharhinidae	Chondrichthyes
Great White Shark	*Carcharodon carcharias*	Lamnidae	Chondrichthyes
Scalloped Hammerhead	*Sphyrna lewini*	Sphyrnidae	Chondrichthyes