Aerial Surveys for Protected Species in the Cape Hatteras and Norfolk Canyon Regions: 2015 Annual Progress Report

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Cover Photo Credit: (*Kogia* sp.). Photo collected by the University of North Carolina Wilmington under NOAA scientific permit # 16473.

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Acronyms and Abbreviations

BSS	Beaufort sea state
EPIRB	emergency position-indicating radio beacon
km	kilometer(s)
m	meter(s)
NMFS	National Marine Fisheries Service
SD	standard deviation
U.S.	United States

1. Introduction

This report details part of a multi-institutional monitoring project intended to provide information on the species composition, population identity, density, and baseline behavior of marine mammals and sea turtles present in United States (U.S.) Navy range complexes along the U.S. Atlantic Coast. This program began in 2007, with baseline aerial and vessel surveys and a passive acoustic monitoring program in Onslow Bay, North Carolina, and has since expanded to include survey areas off Jacksonville, Florida; Cape Hatteras, North Carolina; and Norfolk, Virginia. In Onslow Bay, six years of monitoring have yielded a comprehensive picture of the density, distribution, and abundance of marine mammals and sea turtles and provided new insights into residency patterns among pelagic delphinid cetaceans in this region. More than six years of monitoring in Jacksonville have provided similar information on the density and distribution of marine mammals and sea turtles in this area. In Cape Hatteras, almost five years of surveys have provided preliminary information on the complex patterns of distribution and on the diversity of marine mammals and sea turtles in this highly productive area. This year, the Cape Hatteras survey area has been extended north to include the offshore waters of Virginia, including Norfolk Canyon. The current report builds on this past body of work and describes monitoring activities that occurred between January 2015 and December 2015. Updated statistical analysis of data from this project can be found in Paxton, 2016.

2. Summary Aerial Surveys

This document is an annual progress report to the U.S. Department of the Navy on aerial surveys conducted in the Cape Hatteras, North Carolina survey area between January 2015 and December 2015. To better address the monitoring needs of the Navy's Atlantic Fleet Training and Testing program, the geographic area covered by aerial surveys was expanded in 2015. Sixteen tracklines were added to the northern portion of the survey area to extend into waters off the Virginia coast, including Norfolk Canyon; southern tracklines 20–33 were dropped to balance this shift in effort. The resulting area is composed of 28 equal-length tracklines running from east to west. The goal in 2015 was to conduct two days of effort each month, flying a subset of the 28 tracklines that covered both the Norfolk Canyon and broader Cape Hatteras regions.

Survey effort occurred in 11 of 12 months; unfavorable weather precluded any effort in February. Two survey days were achieved for five of the 11 months (July through November), and a single day of effort occurred in April, May, June, and December. In January and March, surveys were attempted over Norfolk Canyon but only a limited geographic area was available due to closures of restricted areas. A total of 107 tracklines (7531.25 kilometers [km]) over 16 days was covered during this reporting period.

A total of 160 sightings of 5,243 cetaceans was encountered while on effort during the 16 days of aerial surveys. Thirteen species of cetaceans were photo-documented, including bottlenose dolphins (*Tursiops truncatus*; 54 sightings for 1,040 individuals), Atlantic spotted dolphins (*Stenella frontalis*; 24 sightings for 1,407 individuals), short-beaked common dolphins (*Delphinus delphis*; nine sighting for 576 individuals), Risso's dolphins (*Grampus griseus*; nine

sightings for 163 individuals), striped dolphins (*Stenella coeruleoalba,* six sighting for 748 individuals), Clymene dolphins (*Stenella clymene,* three sightings for 465 individuals), short-finned pilot whales (*Globicephala macrorhynchus*; 33 sightings for 795 individuals), Cuvier's beaked whales (*Ziphius cavirostris*; nine sightings for 24 individuals), sperm whales (*Physeter macrocephalus*; three sightings for three individuals), mesoplodont beaked whales (*Mesoplodon* spp; two sightings for eight individuals), kogiid whales (*Kogia* spp.; two sightings for six individuals), humpback whale (*Megaptera novaeangliae*, two sightings for three individuals), minke whales (*Balaenoptera acutorostrata*; two sightings for two individuals), True's beaked whales (*Mesoplodon mirus,* one sighting for two individuals), and a fin whale (*Balaenoptera physalus,* one sighting of one individual).

Fourteen off-effort sightings were also recorded. These included five sightings of Atlantic spotted dolphins (107 individuals), four sightings of bottlenose dolphins (68 individuals), two sightings of Cuvier's beaked whales (eight individuals), and one sighting each of Risso's dolphins (15 individuals), short-finned pilot whales (six individuals), and fin whale (two individuals). These off-effort sightings are included in species sighting maps and tables but are excluded from all other calculations.

One hundred and twenty-two sightings of 163 sea turtles were recorded during this survey period. One hundred and forty-eight individuals were identified as loggerhead (*Caretta caretta*) and ten as leatherback (*Dermochelys coriacea*) sea turtles. No species identification could be established for five individuals, and these were listed as "unidentified sea turtle." Sea turtles were detected during 13 of 16 survey days, with highest abundances observed in August.

While survey conditions were dominated by Beaufort sea state (BSS) 1 to 3, at times surveys were conducted in higher sea states. Other aerial surveys demonstrated that the rate of cetacean sightings is negatively affected by an increase in the BSS (e.g., Gómez de Segura et al. 2006, DeMaster et al. 2001, McAlarney et al. 2014). Effort-corrected cetacean sightings this year off Cape Hatteras dropped from 38.4 to 12.1 sightings per 1,000 km as BSS increased from 1 to 4 respectively.

In addition to cetaceans and sea turtles, other pelagic marine vertebrates were observed, including great white shark (*Caracharodon carcharias*), whale shark (*Rhincodon typus*), basking shark (*Cetorhinus maximus*), manta ray (*Manta birostris*), cownose ray (*Rhinoptera bonasus*), ocean sunfish (*Mola mola*), and unidentified shark. Commercial, military, and recreational vessels were also encountered in the survey area.

All historical data from this project is made publically available through the Ocean Biogeographic Information System Spatial Ecological Analysis of Megavertebrate Populations (OBIS-SEAMAP).

3. Methods

3.1 Survey Design and Logistics

Aerial survey effort was initiated in the waters off Cape Hatteras, North Carolina, in May 2011 to assess the distribution and abundance of offshore cetacean species and sea turtles. These

surveys were included in the U.S. Navy's Atlantic Fleet Training and Testing monitoring program, established to document marine species that could potentially be impacted by naval activities. Beginning this year the survey area was extended north following the shelf break into waters off Virginia to include Norfolk Canyon (**Figure 1**). This expansion resulted in a greater portion of the survey area falling within the airspace of the U.S.Navy's Fleet Area Control and Surveillance Facility (FACSFAC) in Virginia Beach (VACAPES) (**Figure 2**). As this is controlled airspace, pilots were required to contact VACAPES the morning of planned survey flights for information on area closures or restriction. Survey plans were modified to avoid interacting with any area activities.

The survey area covers approximately 15,750-square kilometers spanning continental shelf waters as well as deeper waters beyond the shelf break (**Table 1, Figure 3**). Placement of the survey area was designed to incorporate a large portion of the Cape Hatteras Special Research Area, in support of current research assessing fishery interactions between short-finned pilot whales and the local fisheries. The survey area excludes coastal waters to minimize survey effort in areas where the spatial distribution and relative abundance of coastal bottlenose dolphins has previously been established (Torres et al. 2003, 2005), as well as to focus on areas where navy testing and training activities are most likely to occur. Twenty-eight tracklines, ranging from 73.17 to 75.42 km in length and orientated east to west, are evenly placed across the survey area and divided into the Cape Hatteras and Norfolk Canyon survey regions (**Figure 1**)

The University of North Carolina Wilmington provided experienced aerial observers and contracted Orion Aviation, Siler City, North Carolina, to provide planes and certified pilots. Surveys were conducted using National Oceanic and Atmospheric Administration's Southeast Regional Minimum Aircraft and Crew Provisions Guidelines (NOAA SER 2013), which require that aircraft are Code of Federal Regulations Part 135 certified and that pilots have demonstrated experience working below 305 meters in support of biological observational studies. Surveys were flown in a Cessna 337 Skymaster, at 305-meter (m) altitude and 185-km/hour speed, with a pilot, co-pilot and two observers. Each observer wore a Nomex® fire retardant suit, a Switlik® inflatable life jacket, and a personal emergency position-indicating radio beacon (EPIRB), as well as additional safety equipment. An inflatable life raft, plane EPIRB, and satellite phone were also onboard at all times. All waypoints were collected using a handheld GPS (Garmin 76) that recorded geographic position, date, and local time (Eastern Standard Time or Eastern Daylight Time). A complete list and description of data recorded in the plane can be found in **Appendix B**. Survey flights originated from the Fixed-base Operator in the Dare County Regional Airport in Manteo, North Carolina, or Landmark Aviation in the Norfolk International Airport in Norfolk, Virginia. Utilizing both airports maximized "on-effort" survey time by decreasing transit time to and from the tracklines surveyed.

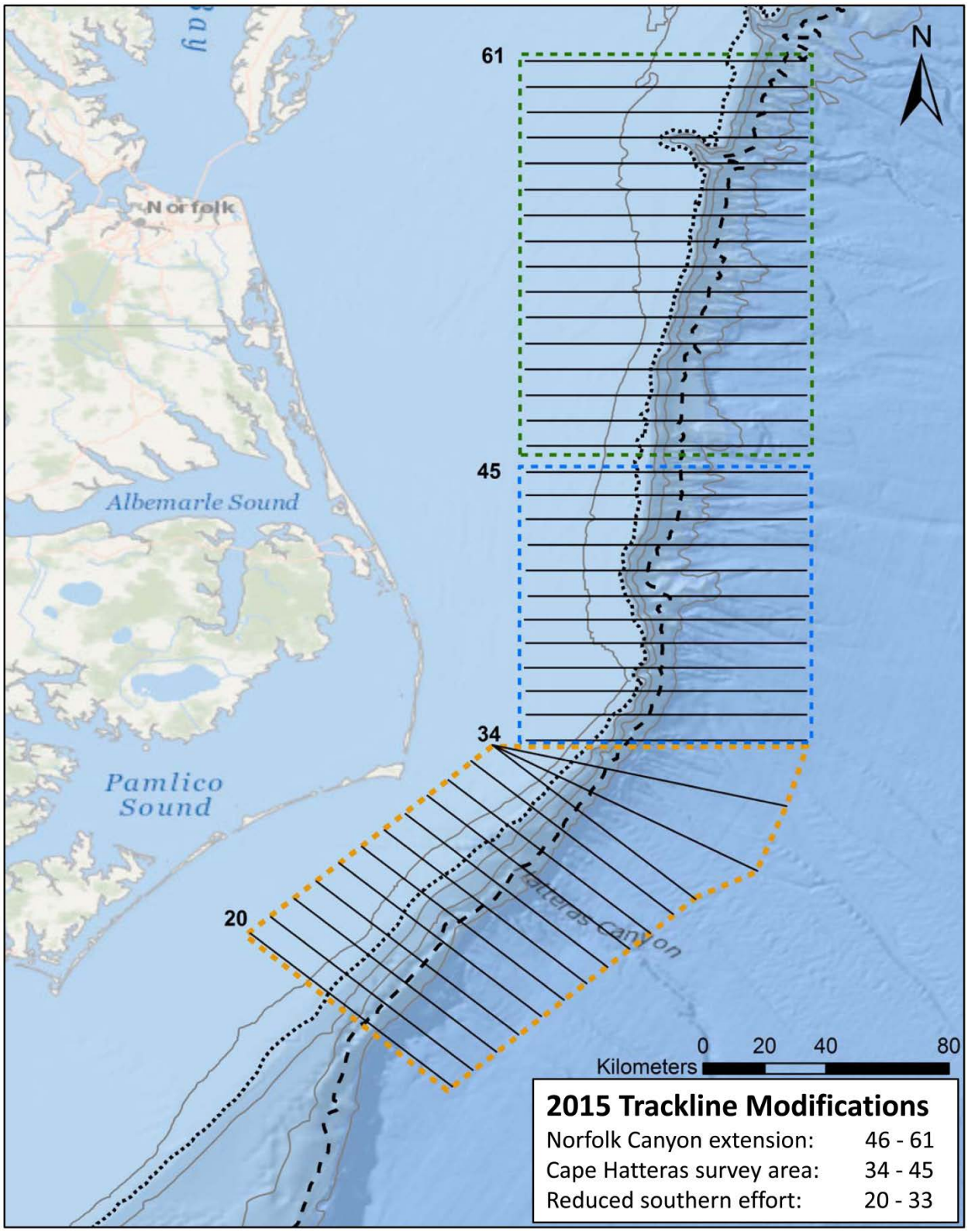


Figure 1. Cape Hatteras and Norfolk Canyon survey area for 2015.

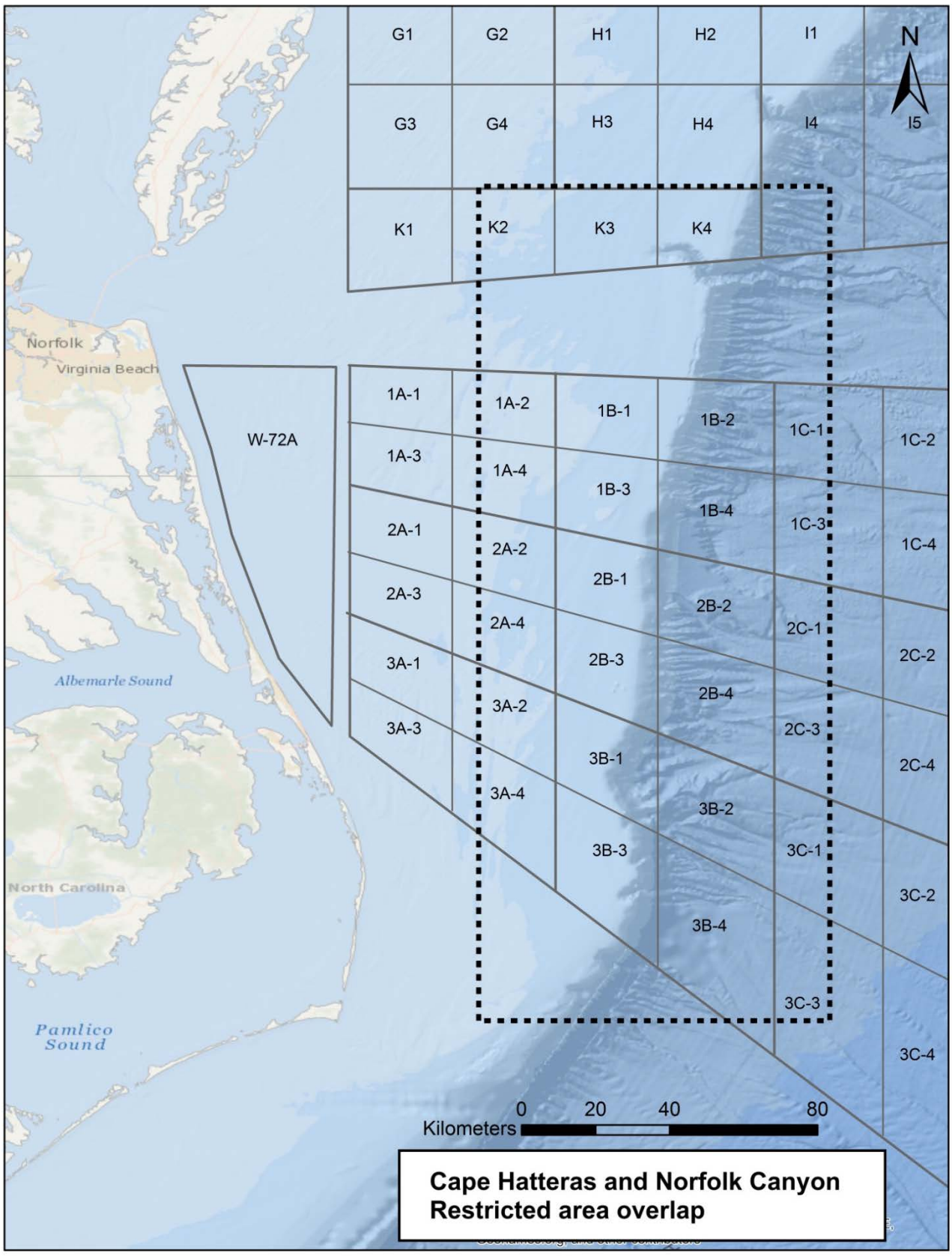
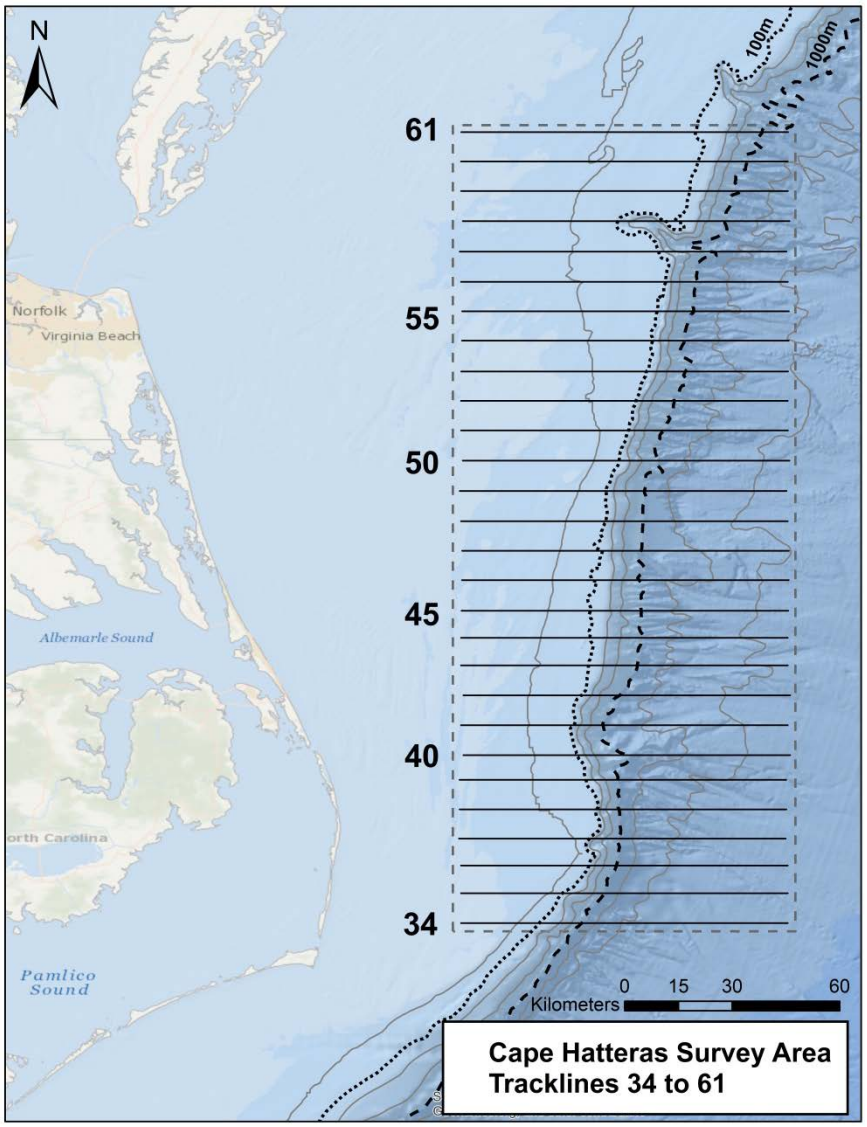


Figure 2. Restricted warning areas that impact the Cape Hatteras and Norfolk Canyon survey area (dotted line).

Table 1. Coordinates for trackline end points for the Cape Hatteras (34-45) and Norfolk Canyon (46-61) survey area.

Transect Line	Western Waypoint		Eastern Waypoint	
	Latitude (N)	Longitude (W)	Latitude (N)	Longitude (W)
61	37.321320	-75.161133	37.321320	-74.333672
60	37.246289	-75.161133	37.246384	-74.333672
59	37.171448	-75.161133	37.171448	-74.333672
58	37.096512	-75.161133	37.096512	-74.333672
57	37.021576	-75.161133	37.021576	-74.333672
56	36.946640	-75.161133	36.946640	-74.333672
55	36.871704	-75.161133	36.871704	-74.333672
54	36.796768	-75.161133	36.796768	-74.333672
53	36.721897	-75.161133	36.721897	-74.333672
52	36.646942	-75.161133	36.646942	-74.333672
51	36.571960	-75.161133	36.571960	-74.333672
50	36.497024	-75.161133	36.497024	-74.333672
49	36.422088	-75.161133	36.422088	-74.333672
48	36.347152	-75.161133	36.347152	-74.333672
47	36.272216	-75.161133	36.272216	-74.333672
46	36.197280	-75.161133	36.197280	-74.333672
45	36.122344	-75.161133	36.122344	-74.333672
44	36.048500	-75.161133	36.048500	-74.333672
43	35.978439	-75.161133	35.978439	-74.333672
42	35.906486	-75.161133	35.906486	-74.333672
41	35.832642	-75.161133	35.832642	-74.333672
40	35.762581	-75.161133	35.762581	-74.333672
39	35.690628	-75.161133	35.690628	-74.333672
38	35.620569	-75.161133	35.620569	-74.333672
37	35.550508	-75.161133	35.550508	-74.333672
36	35.480450	-75.161133	35.480450	-74.333672
35	35.410389	-75.161133	35.410389	-74.333672
34	35.340331	-75.161133	35.340331	-74.333672



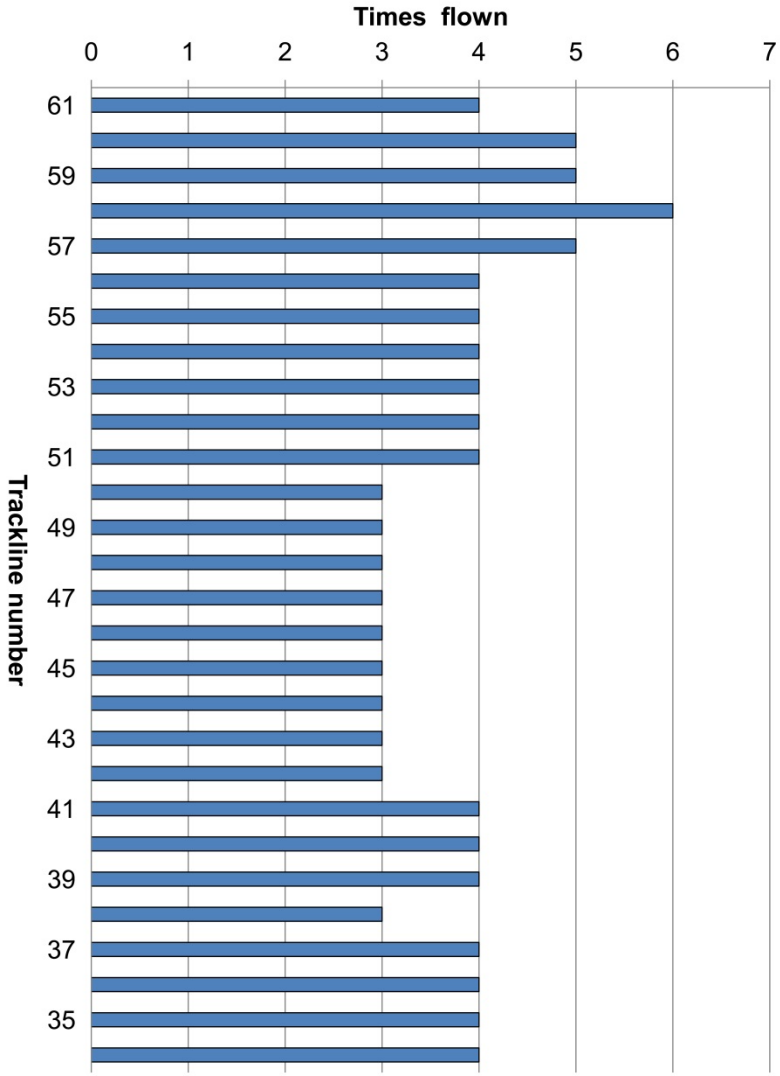


Figure 3. Survey tracklines and realized effort in the Cape Hatteras and Norfolk Canyon survey area.

4. Results

One hundred and seven tracklines totaling 7531 km were surveyed from January 2015 to December 2015 (**Table 2**). Conditions during the 16 survey days ranged from BSS 0 to 6 with nearly 80 percent of effort in sea states of BSS 3 or lower [BSS 0: 2.20 km (<1 percent), BSS 1: 963.65 km (12.80 percent), BSS 2: 2,660.4 km (35.32 percent), BSS 3: 2,373.80 km (31.52 percent), BSS 4: 1159.90 km (15.40 percent), BSS 5: 325.70 km (4.32 percent), BSS 6: 45.60 km (<1 percent) (**Figure 4a and b**). An average BSS value, weighted by distance flown, was calculated for each month as a way to compare conditions across time (**Figure 4c**).

Table 2. Tracklines, km flown, and Hobbs hours (engine-on time) during aerial surveys of the Cape Hatteras and Norfolk Canyon survey area from January 2015 to December 2015. Trackline numbers are listed in the order in which they were flown.

Date	Tracklines Flown AM	Tracklines Flown PM	Total km Flown	Hobbs Hours
21-Jan-2015	58	NA	58.75	1.0
19-Mar-2015	NA	57 to 54	293.75	3.4
7-Apr-2015	58 to 61	50 to 47	573.85	6.4
24-May-2015	46 to 43	39 to 42	562.05	7.3
18-Jun-2015	34 to 37	38 to 41	547.70	5.8
20-Jul-2015	58 to 61, 57, 56	55 to 52	712.55	7.0
21-Jul-2015	51, 50, 42, 41	NA	289.50	3.5
14-Aug-2015	34 to 37	48 to 45	595.05	5.9
15-Aug-2015	44 to 42, 40	49, 51 to 53	593.45	6.3
15-Sep-2015	34 to 37	38, 39, 43, 44	565.20	6.1
16-Sep-2015	52 to 49	48 to 45	551.70	6.1
20-Oct-2015	58 to 61	53 and 52	429.85	5.5
21-Oct-2015	54 and 55	56 to 59	397.20	5.2
16-Nov-2015	51, 53 to 57	60 and 61	564.30	6.3
17-Nov-2015	34 to 39	40 and 41	546.40	6.1
7-Dec-2015	60 to 57	NA	249.95	3.1
16 Days	**107 Tracklines**		**7531.25**	**85.0**

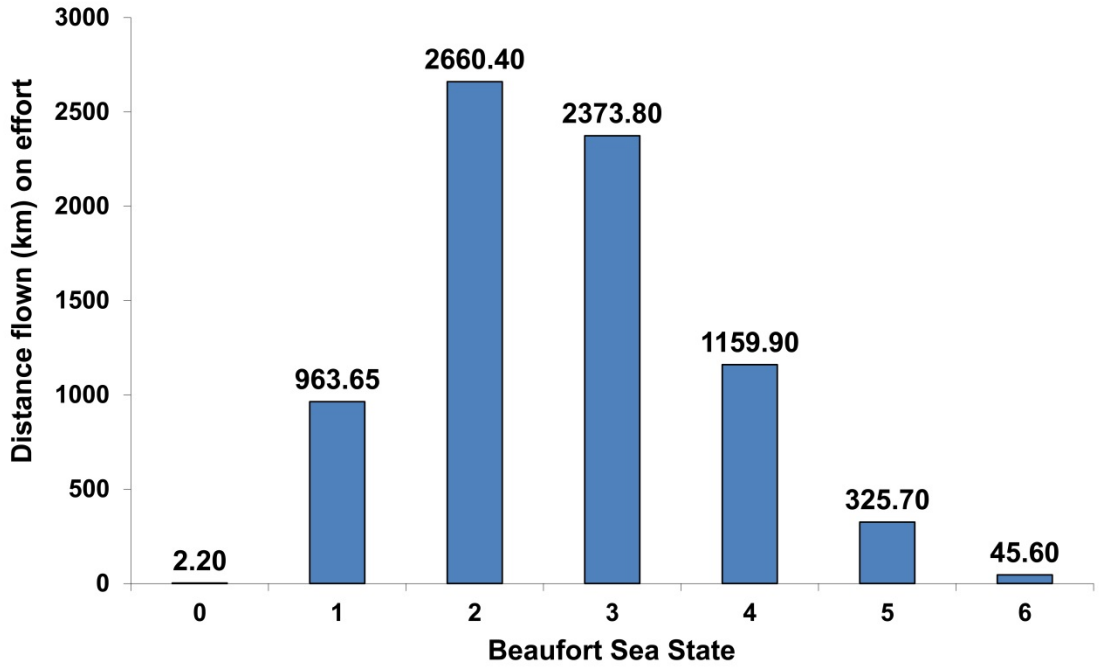


Figure 4a. Total distance surveyed per Beaufort sea state from January 2015 to December 2015 during aerial surveys in the Cape Hatteras and Norfolk Canyon survey area.

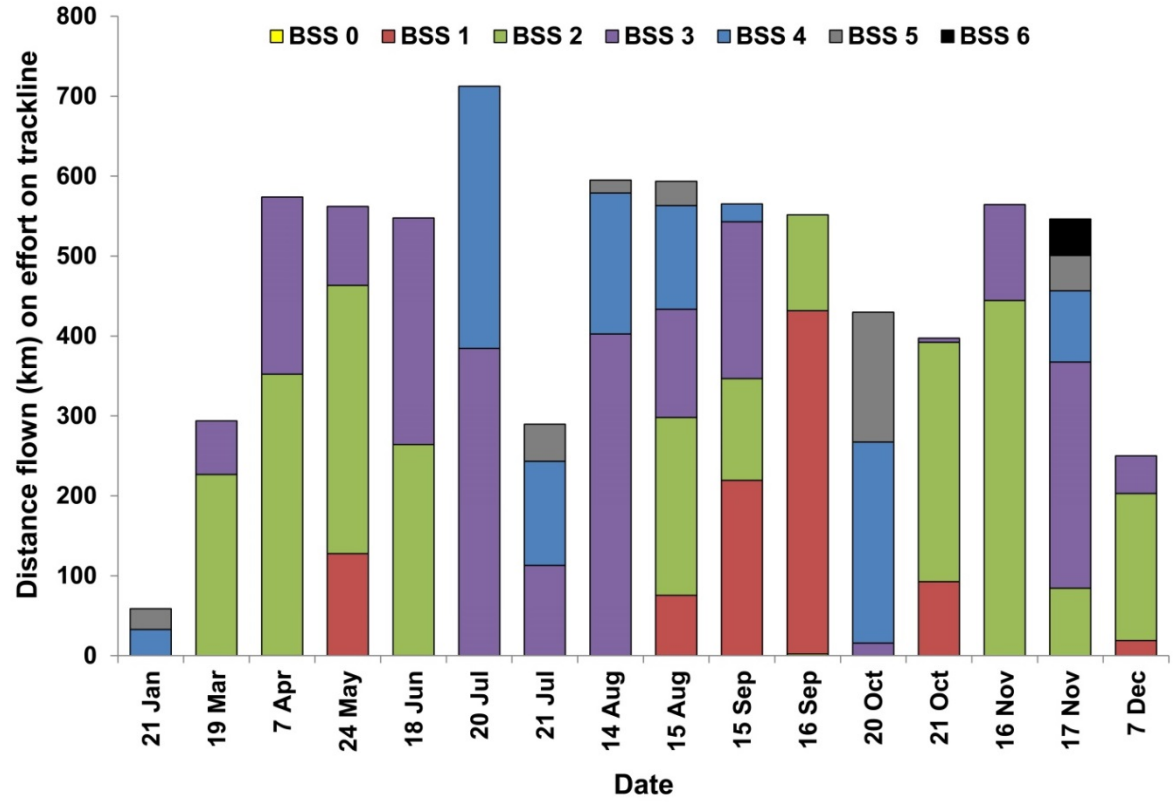


Figure 4b. Effort by Beaufort sea state for each day from January 2015 to December 2015 during aerial surveys in the Cape Hatteras and Norfolk Canyon survey area.

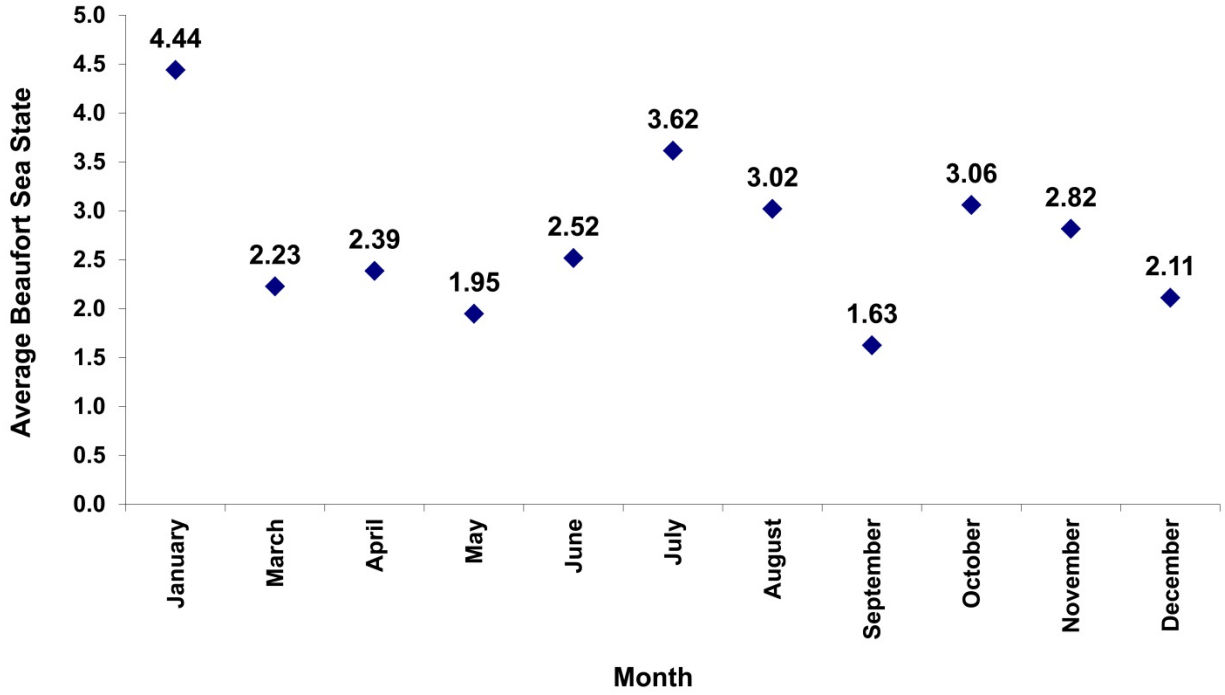


Figure 4c. Average Beaufort sea state for each month from January 2015 to December 2015 during aerial surveys in the Cape Hatteras and Norfolk Canyon survey area. Values are distance-weighted means.

The majority of cetacean sightings (89.5 percent) also occurred in BSS of 3 or less (**Figure 5a**). Cetacean sighting rates decreased as BSS increased, with 38.40 sightings/1,000 km surveyed in BSS 1, 21.05 sightings/1,000 km surveyed in BSS 2, 21.91 sightings/1,000 km surveyed in BSS 3, 12.07 sightings/1,000 km surveyed in BSS 4, and 9.21 sightings/1,000 km surveyed in BSS 5 (**Figure 5b**). Sightings per 1,000 km flown ranged from zero to 48.04 across months surveyed (**Figure 5c**).

Eighty-five percent of the sightings occurred within 1.2 km of the trackline (**Figure 6a**). Mean sighting distance for all cetacean sightings was 0.80 km (standard deviation [SD]=0.45). Sighting distances across sea states varied by just over 0.3 km (**Figure 6b**). Average sighting distances are normally calculated after removing outliers, defined as any value in excess of three SD from the mean (mean=0.80 km, SD=0.45, 0.80+[3x0.45]=2.15 km, outlier >2.15 km). Three sighting distances were identified as outliers during this reporting period (in BSS 2 a 2.25-km sighting; in BSS 3 a 2.26-km sighting; and in BSS 4 a 2.33-km sighting). In addition, six sightings did not have associated sighting distances and were excluded from these calculations. The remaining 153 sighting distances are represented in **Figures 6a** and **b**.

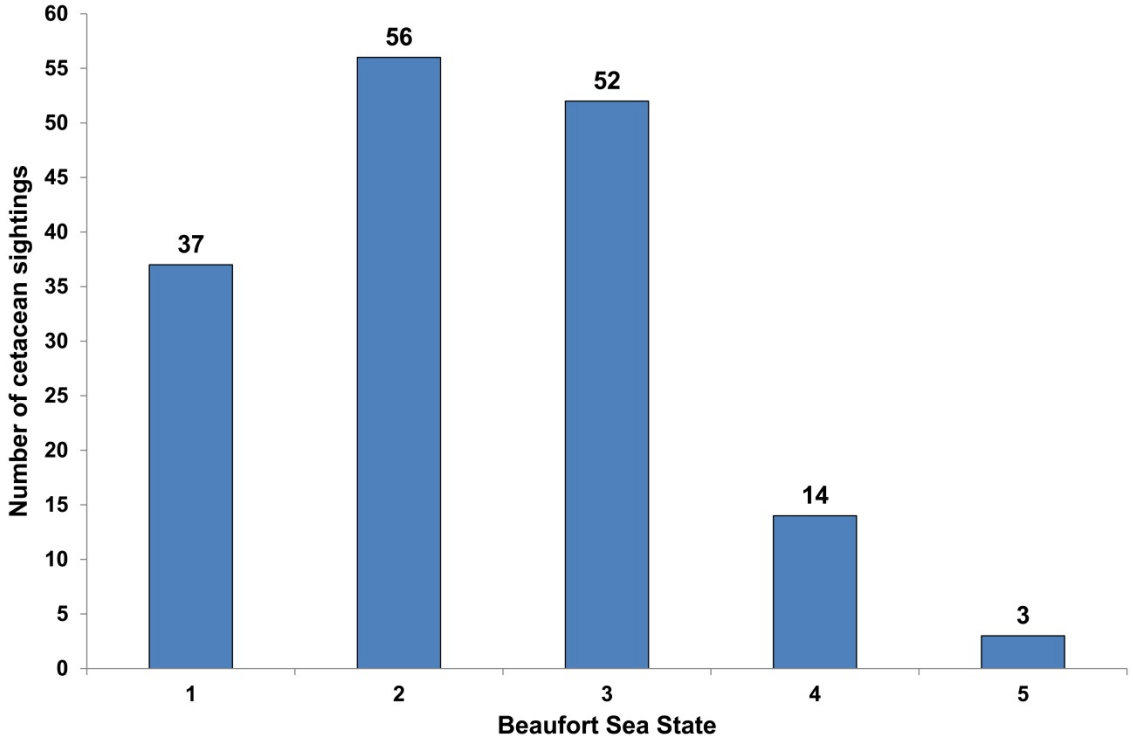


Figure 5a. Number of cetacean sightings per Beaufort sea state from January 2015 to December 2015 during aerial surveys in the Cape Hatteras and Norfolk Canyon survey area.

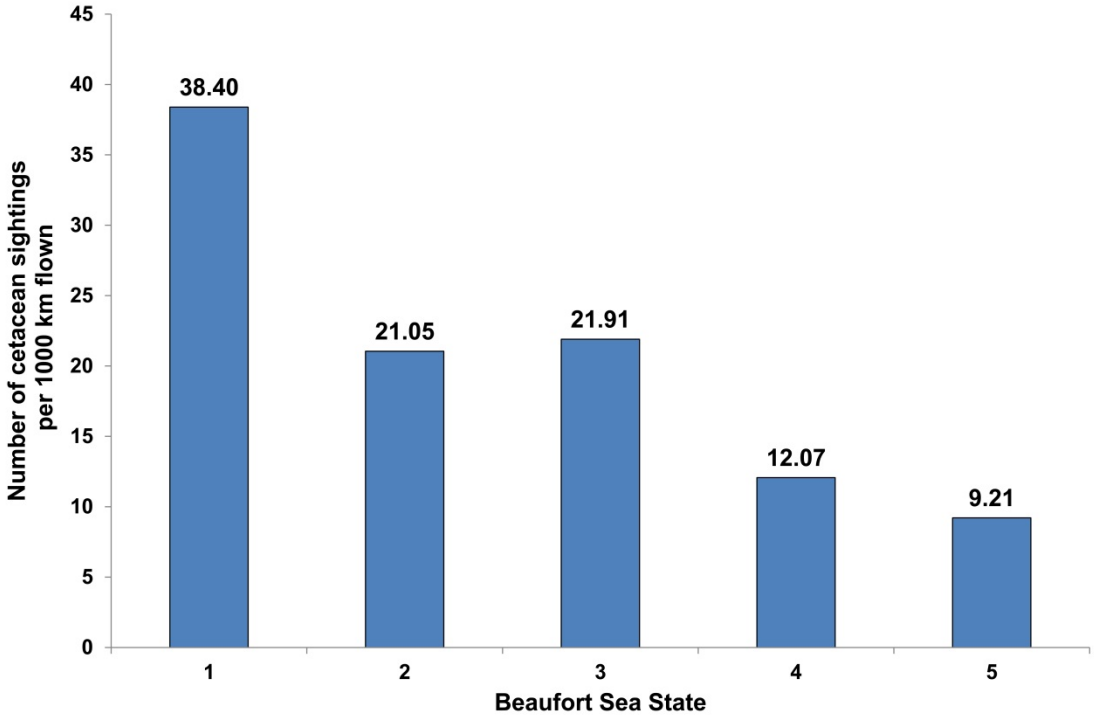


Figure 5b. Cetacean sightings per 1,000 km flown by Beaufort sea state from January 2015 to December 2015 during aerial surveys in the Cape Hatteras and Norfolk Canyon survey area.

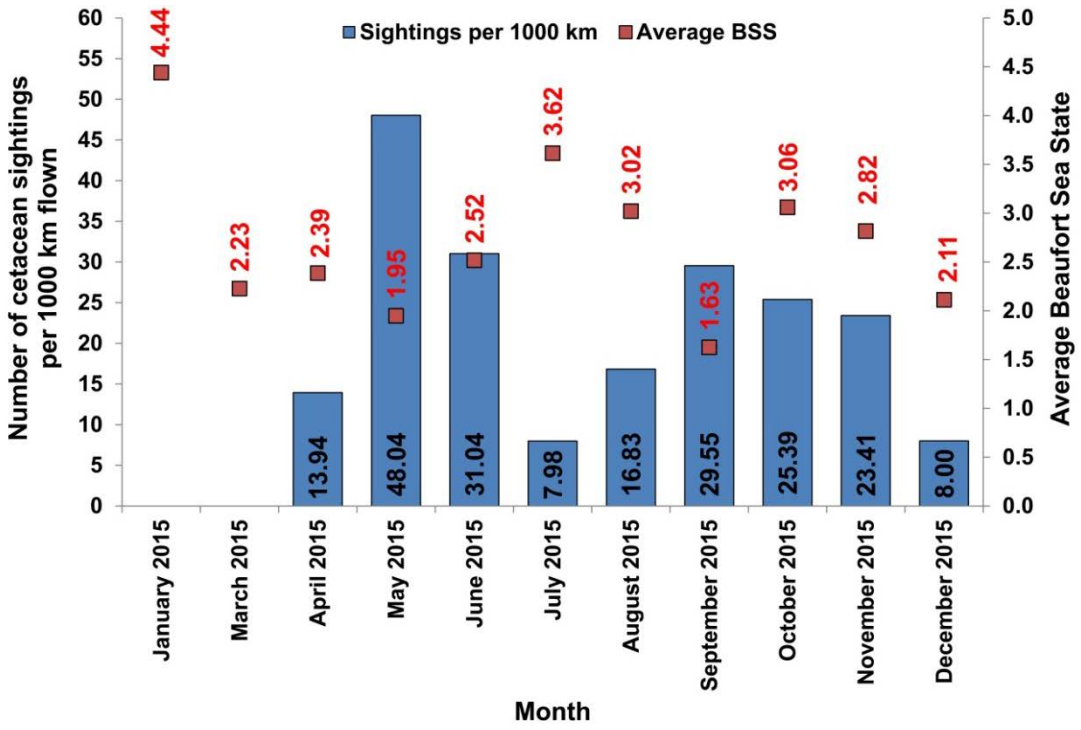


Figure 5c. Cetacean sightings per 1,000 km surveyed and the distance-weighted average Beaufort sea state per month from January 2015 to December 2015 during aerial surveys in the Cape Hatteras and Norfolk Canyon survey area. There were no flights in February.

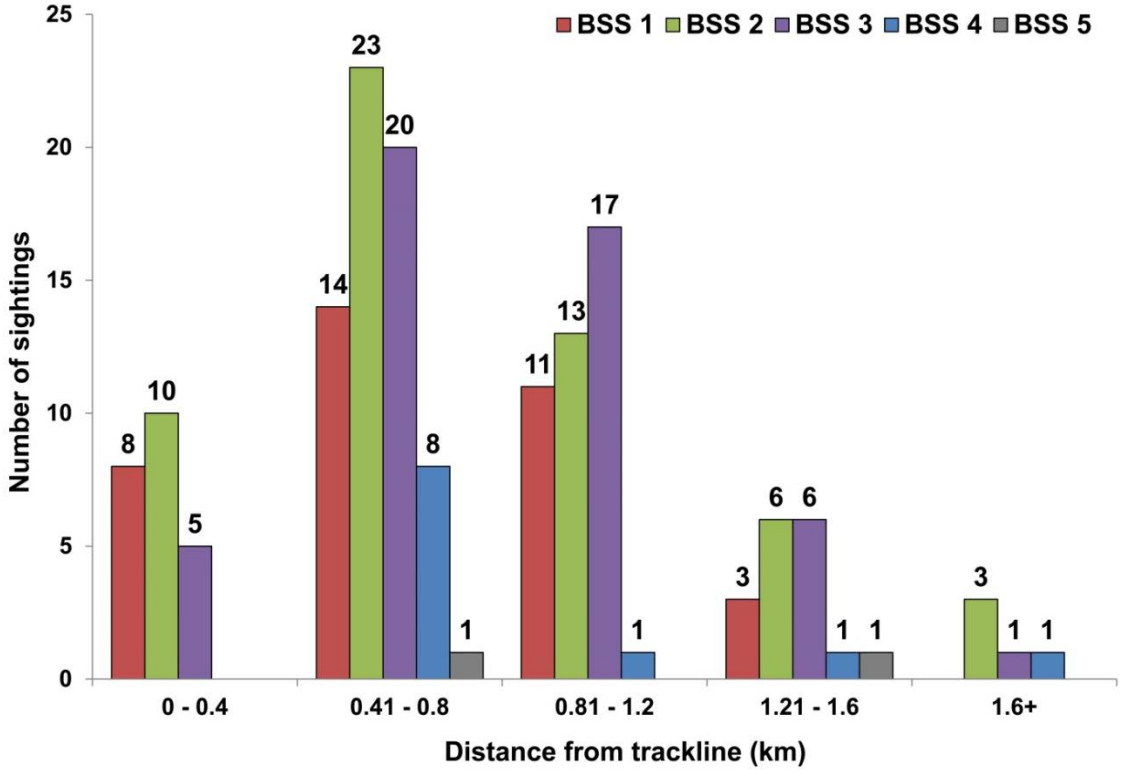


Figure 6a. Sighting distances by Beaufort sea state for 153 of 162 on-effort cetacean sightings from January 2015 to December 2015 during aerial surveys in the Cape Hatteras and Norfolk Canyon survey area.

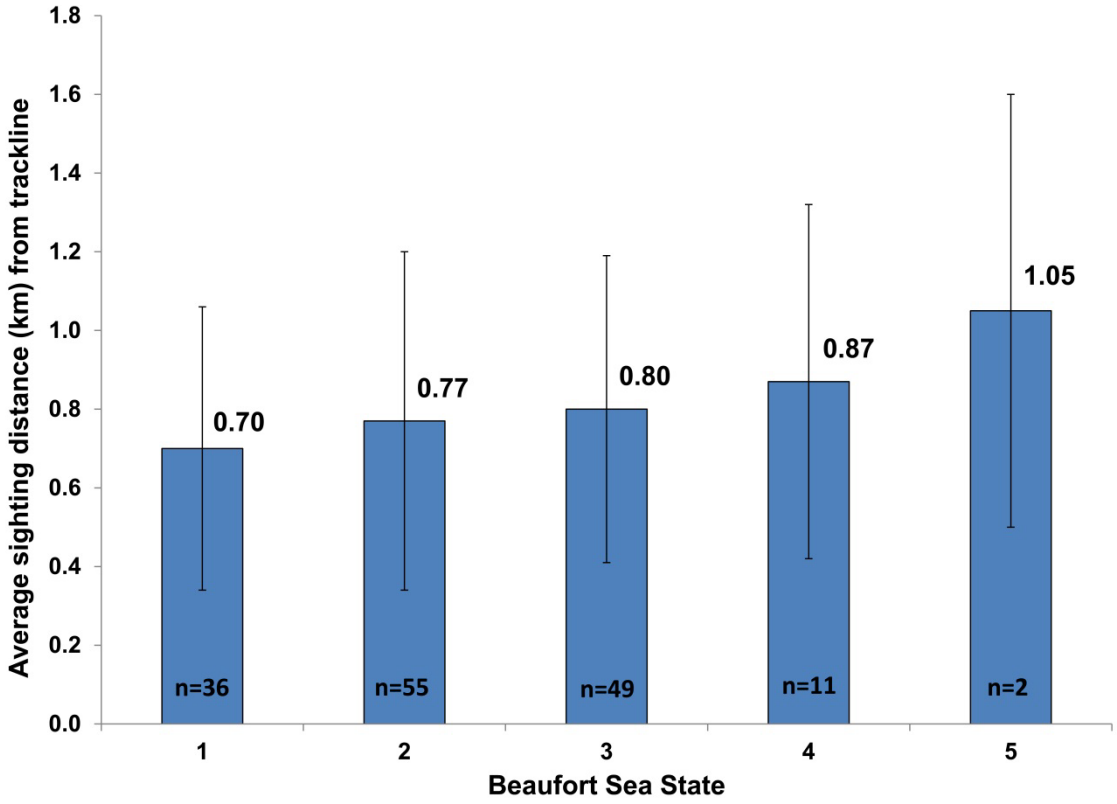


Figure 6b. Average sighting distances by Beaufort sea state for 153 of 162 on-effort cetacean sightings from January 2015 to December 2015 during aerial surveys in the Cape Hatteras and Norfolk Canyon survey area. n=number of sightings in each BSS bin and explains the counter-intuitive increase in sighting distance for increased BSS. Error bars denote standard deviations for each category.

4.1 Marine Mammal Sightings

A total of 160 sightings of 5,243 individual cetaceans representing 14 species or species groups was observed while on effort during the reporting period (**Table 3, Figure 7**). Summary information follows below for each species individually. Three endangered species, the sperm whale, humpback whale, and fin whale, were encountered in the survey area. Six identified cetacean species had additional sightings that were recorded while off effort. A sighting was considered off-effort if it occurred while transiting to or from the survey area or between tracklines. Any cetaceans the survey team encountered while investigating a separate sighting cue were also labeled off-effort. If two species were seen associated with the same sighting cue, both were considered on-effort. The off-effort sightings are included in the tables and maps for each species but are excluded from any calculations. The total number of individuals listed represents the best estimates of group size. Information on individual sighting summaries are in **Appendices A, B, and C**. Daily sightings are summarized in **Appendix D.**

Table 3. Total numbers of on-effort sightings and individuals for each species by month from January 2015 to December 2015 for the Cape Hatteras and Norfolk Canyon survey area.

Species		Month												Total
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Tursiops truncatus	Sightings				1	4	3	1	7	15	10	13		54
	Individuals				58	65	63	8	70	310	268	198		1040
Stenella frontalis	Sightings				1	4	2	1	6	7	3			24
	Individuals				55	159	190	22	265	306	410			1407
Delphinus delphis	Sightings				3	3					1	1	1	9
	Individuals				96	155					95	200	30	576
Grampus griseus	Sightings					5	2		1	1				9
	Individuals					39	62		10	52				163
Stenella coeruleoalba	Sightings				2			1		1	1	1		6
	Individuals				218			325		70	75	60		748
Stenella clymene	Sightings						1			1		1		3
	Individuals						40			250		175		465
Globicephala macrorhynchus	Sightings					8	6	3	4	2	5	4	1	33
	Individuals					110	445	39	28	60	38	25	50	795
Ziphius cavirostris	Sightings					3	2			2		2		9
	Individuals					11	3			6		4		24
Physeter macrocephalus	Sightings						1	1			1			3
	Individuals						1	1			1			3
Mesoplodon spp.	Sightings								2					2
	Individuals								8					8
Kogia spp.	Sightings									1		1		2
	Individuals									3		3		6
Megaptera novaeangliae	Sightings				1							1		2
	Individuals				2							1		3
Balaenoptera acutorostrata	Sightings									1		1		2
	Individuals									1		1		2

Species		Month												Total
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Mesoplodon mirus	Sightings									1				1
	Individuals									2				2
Balaenoptera physalus	Sightings									1				1
	Individuals									1				1
All Cetaceans	***Total sightings***	**0**	**0**	**0**	**8**	**27**	**17**	**7**	**20**	**33**	**21**	**25**	**2**	**160**
	Total individuals	**0**	**0**	**0**	**429**	**539**	**804**	**395**	**381**	**1061**	**887**	**667**	**80**	**5243**
Caretta caretta	Sightings			1	3	12	3	6	30	26	11	16		108
	Individuals			1	4	15	3	7	50	40	11	17		148
Dermochelys coriacea	Sightings					1			1	5	1	2		10
	Individuals					1			1	5	1	2		10
Unidentified Sea Turtle	Sightings				1	1			2					4
	Individuals				1	1			3					5
All Sea Turtles	***Total sightings***	**0**	**0**	**1**	**4**	**14**	**3**	**6**	**33**	**31**	**12**	**18**	**0**	**122**
	Total individuals	**0**	**0**	**1**	**5**	**17**	**3**	**7**	**54**	**45**	**12**	**19**	**0**	**163**

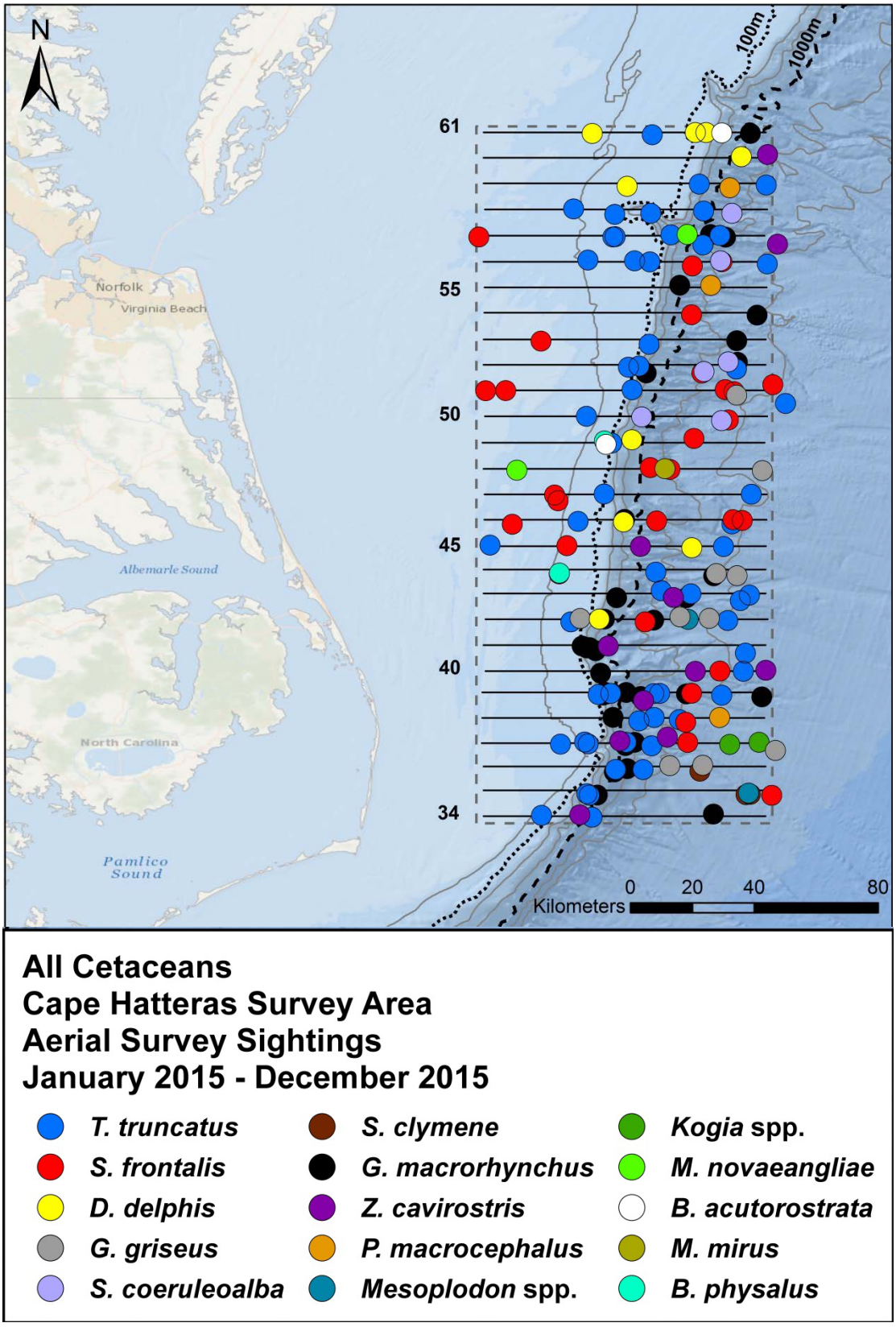


Figure 7. All cetacean sightings during aerial surveys conducted in the Cape Hatteras and Norfolk Canyon survey area from January 2015 to December 2015.

4.2 Dolphins

4.2.1 Bottlenose dolphin (*Tursiops truncatus*)

This species was the most commonly observed cetacean species, with 54 on-effort sightings totaling 1,040 individuals (**Table 4, Figure 8**). Bottlenose dolphins were observed in nine of eleven months in which survey effort was conducted this reporting period, with groups ranging in size from three to 93 individuals (mean=19.3, SD=19.48). In addition, on two occasions, bottlenose dolphins were observed while circling on other cetaceans and were therefore off-effort. Two sightings were also recorded on the offshore end of our survey area and considered off-effort. The majority of sightings occurred greater than 37 km from shore and in waters beyond the 100-m isobath. Based on the distance from shore, most of these bottlenose dolphins were likely the offshore ecotype (Torres et al. 2003).

Table 4. Bottlenose dolphin (*Tursiops truncatus*) sightings in the Cape Hatteras and Norfolk Canyon survey area from January 2015 to December 2015. Asterisk denotes an off-effort sighting.

Date	Time	Way Point	Latitude	Longitude	Track Number	BSS	Angle out	Degree Forward	Best #	Off-Effort (*)
19-Mar-2015	14:12:43	10	36.947403	-74.675339	56	2	1	90°	17	*
7-Apr-2015	13:32:56	29	36.499389	-74.859739	50	2	3	45°	58	
24-May-2015	9:10:56	7	36.194357	-74.884176	46	1	2	60°	7	
24-May-2015	11:00:55	58	35.964485	-74.412471	43	3	2	60°	30	
24-May-2015	13:46:29	94	35.695181	-74.646687	39	3	2	60°	25	
24-May-2015	15:23:28	131	35.906561	-74.449133	42	3	1	60°	3	
18-Jun-2015	11:57:38	39	35.543105	-74.670428	37	2	3	90°	10	
18-Jun-2015	14:29:13	56	35.625020	-74.662708	38	3	1	90°	18	
18-Jun-2015	15:57:30	99	35.812217	-74.397800	41	3	2	110°	35	
21-Jul-2015	10:27:41	12	35.902838	-74.904886	42	4	2	100°	8	
14-Aug-2015	11:51:00	27	35.473906	-74.695227	36	3	1	90°	8	
14-Aug-2015	12:21:56	33	35.553136	-74.744325	37	3	1	90°	8	
14-Aug-2015	15:52:22	59	36.187031	-74.437124	46	3	1	90°	10	
14-Aug-2015	16:28:00	65	36.125481	-75.139761	45	3	1	90°	8	
15-Aug-2015	13:14:56	38	36.421906	-74.786418	49	2	2	90°	25	
15-Aug-2015	13:43:18	50	36.536684	-74.281328		2	3	100°	18	*
15-Aug-2015	14:52:25	90	36.636294	-74.423977	52	2	3	90°	2	
15-Aug-2015	15:11:33	96	36.708275	-74.677672	53	2	2	120°	9	
15-Sep-2015	9:27:51	7	35.341306	-74.990148	34	3	2	100°	3	
15-Sep-2015	10:22:41	23	35.404064	-74.858372	35	3	3	110°	7	
15-Sep-2015	11:43:02	44	35.548784	-74.854525	37	2	1	90°	18	
15-Sep-2015	14:31:22	64	35.694816	-74.663836	39	1	2	90°	3	
15-Sep-2015	14:48:19	71	35.691992	-74.825483	39	1	2	110°	55	
15-Sep-2015	15:21:13	83	35.993432	-74.642365	43	1	3	90°	50	

Date	Time	Way Point	Latitude	Longitude	Track Number	BSS	Angle out	Degree Forward	Best #	Off-Effort (*)
15-Sep-2015	15:29:45	87	35.984059	-74.556350	43	1	2	90°	15	
15-Sep-2015	15:38:18	91	35.980404	-74.386079	43	1	1	90°	5	
15-Sep-2015	15:58:09	100	36.047113	-74.658229	44	2	1	100°	50	
16-Sep-2015	9:23:00	7	36.641869	-74.737737	52	1	2	90°	6	
16-Sep-2015	9:25:21	12	36.645302	-74.707102	52	1	2	60°	50	
16-Sep-2015	10:08:47	33	36.576236	-74.727048	51	1	1	60°	4	
16-Sep-2015	14:20:05	91	36.273294	-74.380753	47	1	1	60°	40	
16-Sep-2015	14:35:17	95	36.274023	-74.808052	47	1	1	90°	2	
16-Sep-2015	15:35:15	121	36.121418	-74.461323	45	1	1	75°	2	
20-Oct-2015	11:17:42	7	37.170815	-74.337405		4	2	90°	30	*
20-Oct-2015	11:36:07	11	37.173383	-74.531764	59	5	1	60°	7	
21-Oct-2015	13:06:43	35	36.952899	-74.855591	56	1	3	90°	9	
21-Oct-2015	13:11:55	41	36.950644	-74.720019	56	2	2	45°	18	
21-Oct-2015	13:33:45	55	36.941347	-74.334222	56	2	2	90°	7	
21-Oct-2015	13:40:52	60	37.023941	-74.471550	57	2	2	90°	5	
21-Oct-2015	13:47:07	64	36.996685	-74.521325	57	2	4	100°	3	*
21-Oct-2015	13:56:43	71	37.019916	-74.782799	57	2	2	90°	30	
21-Oct-2015	14:19:27	85	37.101471	-74.897061	58	1	1	90°	6	
21-Oct-2015	14:25:05	89	37.085338	-74.777397	58	1	2	60°	93	
21-Oct-2015	14:29:32	93	37.088597	-74.672561	58	1	2	60°	48	
21-Oct-2015	14:35:02	97	37.095375	-74.519407	58	1	1	90°	45	
16-Nov-2015	11:10:43	34	37.026115	-74.614506	57	2	1	90°	8	
16-Nov-2015	11:17:45	38	37.020493	-74.776110	57	2	1	60°	4	
16-Nov-2015	14:38:56	59	37.316475	-74.668403	61	2	2	100°	25	
17-Nov-2015	9:19:36	9	35.335780	-74.843764	34	3	3	90°	5	
17-Nov-2015	10:00:20	22	35.399869	-74.851099	35	3	4	70°	50	
17-Nov-2015	10:22:33	28	35.474397	-74.774602	36	3	1	10°	5	
17-Nov-2015	11:43:04	54	35.554091	-74.864945	37	3	1	45°	8	
17-Nov-2015	11:49:35	58	35.547740	-74.934854	37	3	4	120°	3	
17-Nov-2015	12:11:00	68	35.615415	-74.707483	38	2	1	60°	8	
17-Nov-2015	12:19:02	72	35.618991	-74.589700	38	2	4	90°	30	
17-Nov-2015	12:34:03	78	35.690007	-74.466879	39	3	1	90°	20	
17-Nov-2015	12:51:00	86	35.695315	-74.788946	39	3	2	60°	14	
17-Nov-2015	15:08:02	95	35.759210	-74.403821	40	3	2	90°	18	

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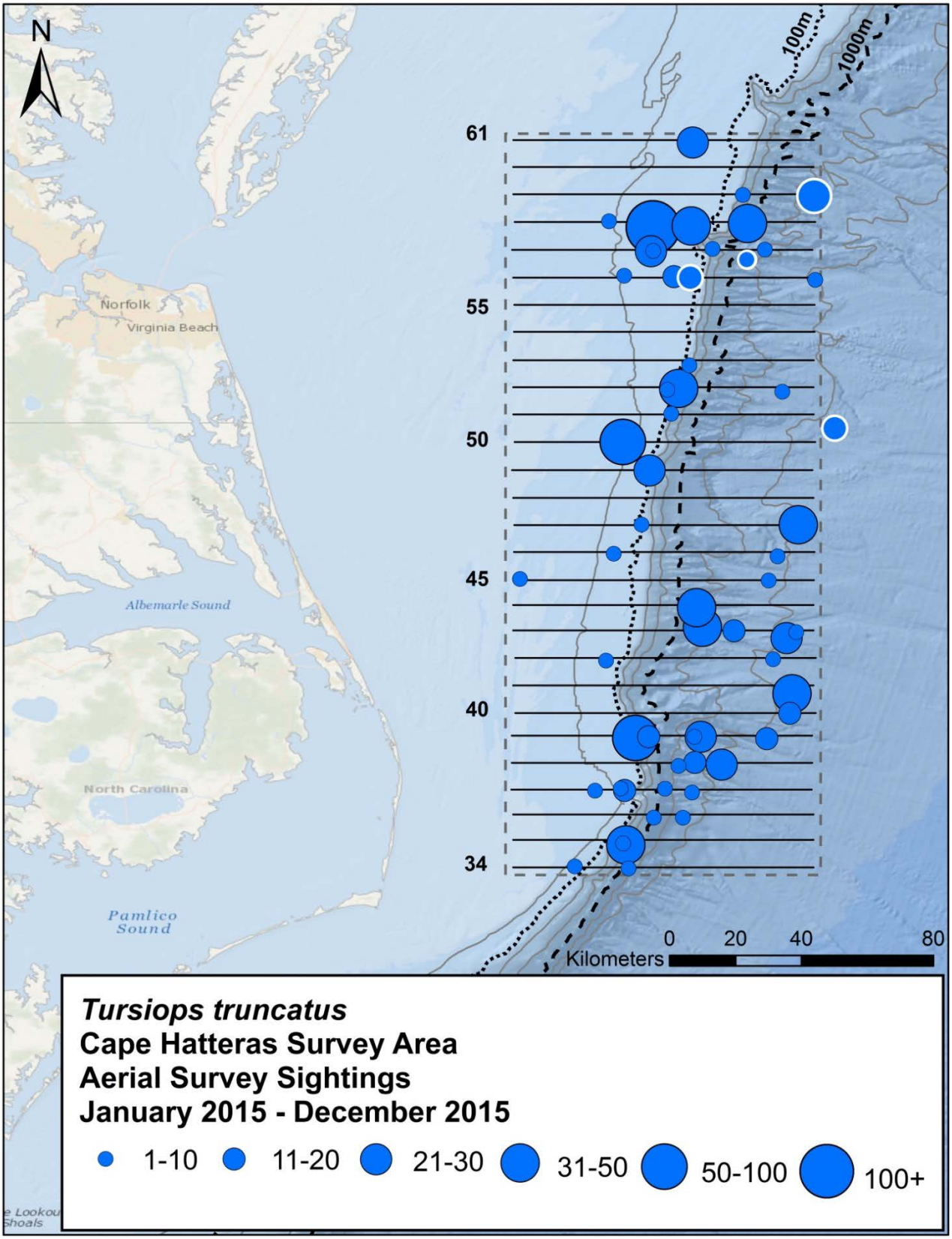

Figure 8. Bottlenose dolphin (*Tursiops truncatus*) sightings. White outlines denote off-effort sightings; symbol size indicates group size.

4.2.2 Atlantic spotted dolphin (*Stenella frontalis*)

Twenty-four sightings of 1,407 individuals were observed while on effort in the Cape Hatteras, North Carolina survey area. Group size ranged between 18 and 250 (mean=58.6, SD=46.48) (**Table 5, Figure 9**). Two additional off-effort sightings occurred inside the survey area, and three off-effort sightings occurred between tracklines. There are two distinct forms, or ecotypes, of the Atlantic spotted dolphin in the western North Atlantic: a heavily spotted, larger form that typically occurs on the continental shelf and is most often encountered around the 200-m isobath or in shallower water, and a less spotted and smaller form that occurs farther offshore and around islands (Perrin et al. 1987, 1994). Examination of photos collected during each sighting suggests that both ecotypes are present within the survey area.

Table 5. Atlantic spotted dolphin (*Stenella frontalis)* sightings in the Cape Hatteras and Norfolk Canyon survey area from January 2015 to December 2015. Asterisk denotes an off-effort sighting.

Date	Time	Way Point	Latitude	Longitude	Track Number	BSS	Angle out	Degree Forward	Best #	Off-Effort (*)
7-Apr-2015	15:30:32	62	36.254298	-74.942319	47	2	3	120°	55	
24-May-2015	9:29:51	17	36.197265	-74.406728	46	2	2	90°	22	
24-May-2015	10:04:46	34	36.123977	-74.916302	45	1	1	45°	32	
24-May-2015	13:50:48	98	35.695812	-74.554402	39	2	3	100°	75	
24-May-2015	14:24:31	107	35.759844	-74.472039	40	3	3	100°	30	
18-Jun-2015	10:30:17	6	35.399552	-74.321092		3	3	90°	20	*
18-Jun-2015	11:49:28	35	35.552893	-74.565527	37	2	1	90°	100	
18-Jun-2015	14:35:02	60	35.611375	-74.571552	38	3	2	90°	90	
20-Jul-2015	14:53:33	50	36.717749	-74.991921	53	3	3	60°	22	
14-Aug-2015	15:05:49	49	36.270871	-74.951956	47	3	3	100°	40	
14-Aug-2015	15:36:10	55	36.195457	-74.655875	46	3	1	90°	50	
15-Aug-2015	10:13:01	19	35.902747	-74.688928	42	4	1	90°	25	
15-Aug-2015	13:25:55	44	36.435012	-74.547426	49	2	3	90°	45	
15-Aug-2015	14:09:52	64	36.573820	-75.152326	51	1	2	45°	60	
15-Aug-2015	14:41:52	86	36.625205	-74.524049	52	2	3	60°	45	
15-Sep-2015	16:11:08	105	36.042200	-74.938906	44	1	1	90°	18	
16-Sep-2015	9:45:15	23	36.591131	-74.318273		1	2	90°	11	*
16-Sep-2015	9:51:17	27	36.570835	-74.430896	51	1	2	45°	45	
16-Sep-2015	9:54:29	30	36.576834	-74.456559	51	1	2	60°	50	
16-Sep-2015	10:19:06	40	36.574182	-75.094301	51	1	1	90°	26	*
16-Sep-2015	10:45:19	50	36.488688	-74.447280	50	1	3	110°	53	
16-Sep-2015	13:42:37	75	36.350666	-74.674343	48	1	2	60°	45	
16-Sep-2015	13:57:08	81	36.345235	-74.617188	48	1	1	90°	30	*
16-Sep-2015	14:52:01	103	36.185961	-75.075028	46	1	3	60°	30	
16-Sep-2015	15:25:31	115	36.199293	-74.433438	46	1	3	90°	65	
21-Oct-2015	9:58:57	10	36.794192	-74.554355	54	2	2	90°	250	

Date	Time	Way Point	Latitude	Longitude	Track Number	BSS	Angle out	Degree Forward	Best #	Off-Effort (*)
21-Oct-2015	13:18:00	46	36.935664	-74.551795	56	2	2	60°	85	
21-Oct-2015	13:26:39	50	36.948071	-74.465892	56	2	2	45°	75	
21-Oct-2015	14:09:48	79	37.019694	-75.172183		2	2	90°	20	*

1

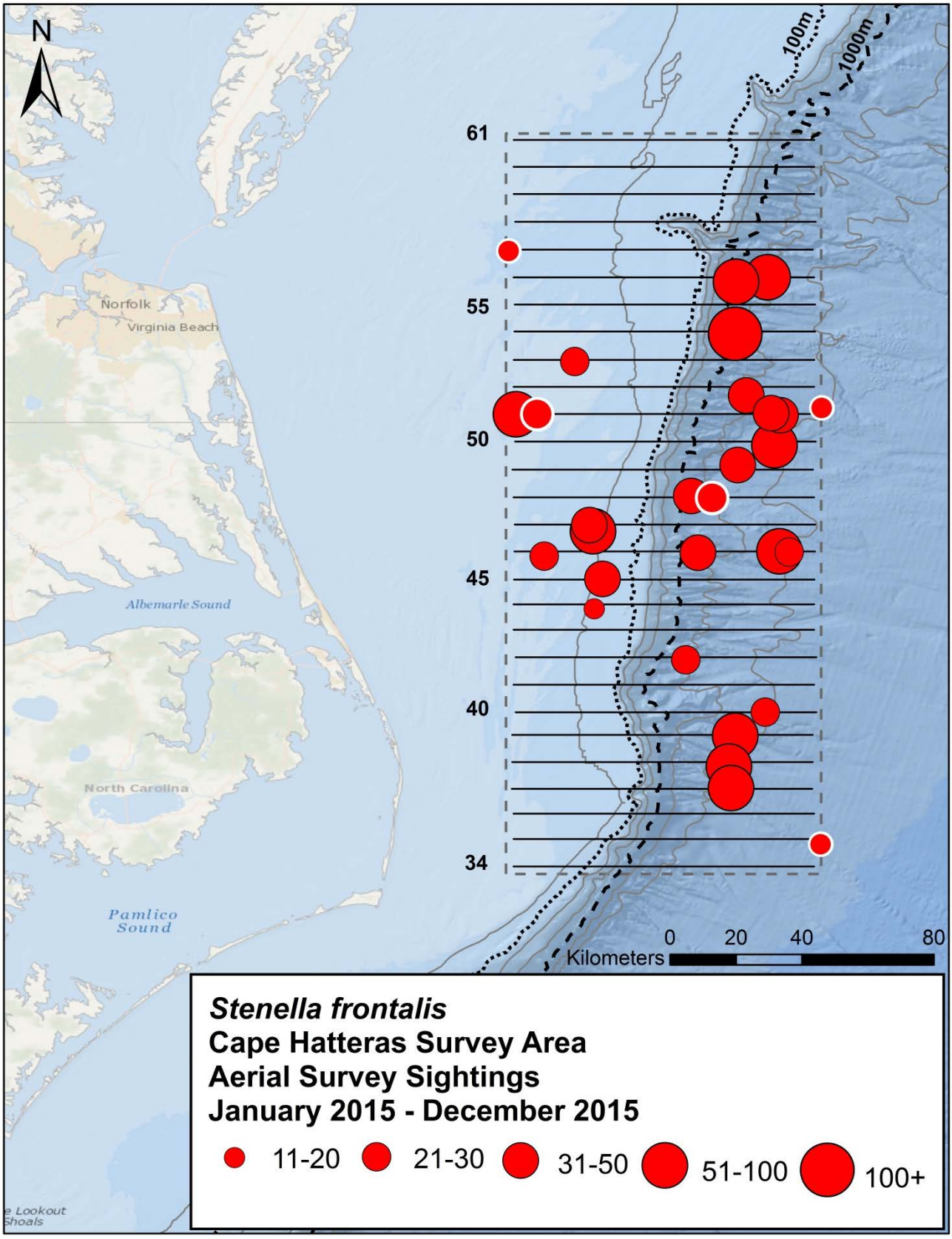

Figure 9. Atlantic spotted dolphin (*Stenella frontalis*) sightings. White outline denotes off-effort sightings; symbol size indicates group size.

4.2.3 Short-beaked common dolphin (*Delphinus delphis*)

Nine sightings of 576 individuals (mean=64, SD=63.02) were observed from inshore of the 50-m isobath to seaward of the 1,500-m isobath (**Table 6, Figure 10**). Group sizes were highly variable; two groups had fewer than 25 animals, while two other groups contained more than 100 individuals.

Table 6. Short-beaked common dolphin (*Delphinus delphis*) sightings in the Cape Hatteras and Norfolk Canyon survey area from January 2015 to December 2015.

Date	Time	Way Point	Latitude	Longitude	Track Number	BSS	Angle out	Degree Forward	Best #	Off-Effort (*)
7-Apr-2015	9:52:37	11	37.166830	-74.741402	59	2	2	90°	32	
7-Apr-2015	10:51:32	21	37.320238	-74.843045	61	2	1	90°	4	
7-Apr-2015	14:15:31	47	36.431352	-74.727354	49	3	2	90°	60	
24-May-2015	9:19:32	12	36.193046	-74.751774	46	1	3	90°	115	
24-May-2015	9:46:15	23	36.117753	-74.553665	45	2	2	60°	25	
24-May-2015	15:50:21	147	35.910812	-74.822434	42	2	2	90°	15	
20-Oct-2015	12:29:28	22	37.323036	-74.543398	61	4	1	90°	95	
16-Nov-2015	14:25:35	55	37.323072	-74.512258	61	2	2	90°	200	
7-Dec-2015	9:36:58	5	37.252723	-74.409651	60	2	2	60°	30	

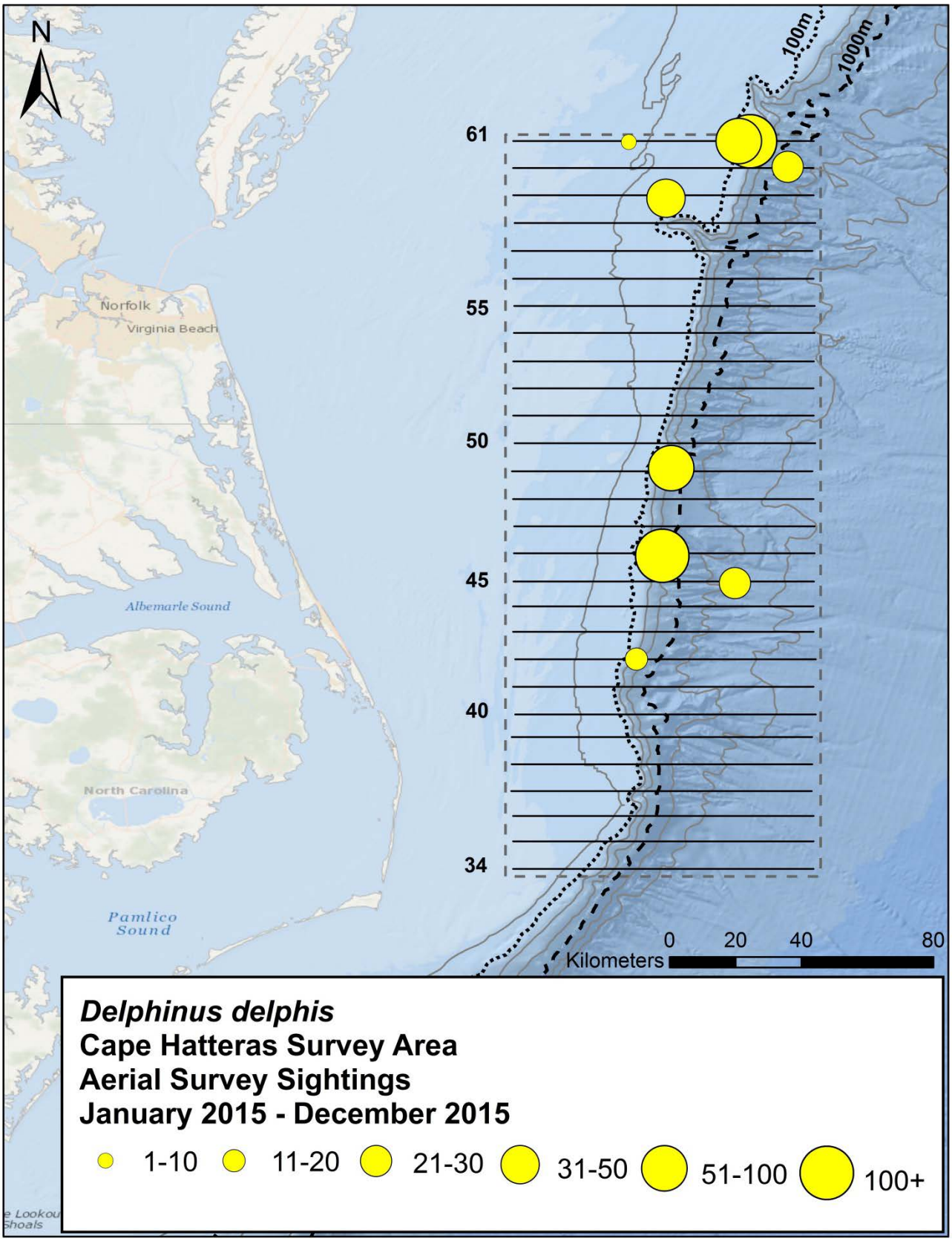

Figure 10. Short-beaked common dolphin (*Delphinus delphis*) sightings; symbol size indicates group size.

4.2.4 Risso's dolphin (*Grampus griseus*)

This species was encountered nine times (for 163 individuals) while on effort, with one additional off-effort sighting. Group sizes were generally less than 20 individuals although two larger groups of 50 or more animals were also observed (mean=18.1, SD=18.89) (**Table 7, Figure 11**). The majority of sightings occurred beyond the 1,500-m isobath.

Table 7. Risso's dolphin (*Grampus griseus*) sightings in the Cape Hatteras and Norfolk Canyon survey area from January 2015 to December 2015. Asterisk denotes off-effort sighting.

Date	Time	Way Point	Latitude	Longitude	Track Number	BSS	Angle out	Degree Forward	Best #	Off-Effort (*)
24-May-2015	10:40:20	47	36.042967	-74.482209	44	2	2	30°	14	
24-May-2015	10:48:11	52	36.036701	-74.422220	44	1	3	60°	7	
24-May-2015	15:35:51	136	35.913114	-74.502859	42	2	2	75°	7	
24-May-2015	15:39:31	140	35.917175	-74.587937	42	2	3	75°	7	
24-May-2015	15:57:44	151	35.912696	-74.878069	42	2	2	90°	4	
18-Jun-2015	11:21:10	22	35.485392	-74.617609	36	2	3	90°	12	
18-Jun-2015	11:29:53	26	35.486635	-74.521904	36	2	3	90°	50	
15-Aug-2015	13:49:32	54	36.560547	-74.423398	51	2	2	60°	10	
16-Sep-2015	14:12:06	85	36.341600	-74.348554	48	1	1	45°	52	
18-Jun-2015	11:39:24	31	35.529509	-74.310493		2	4	90°	15	*

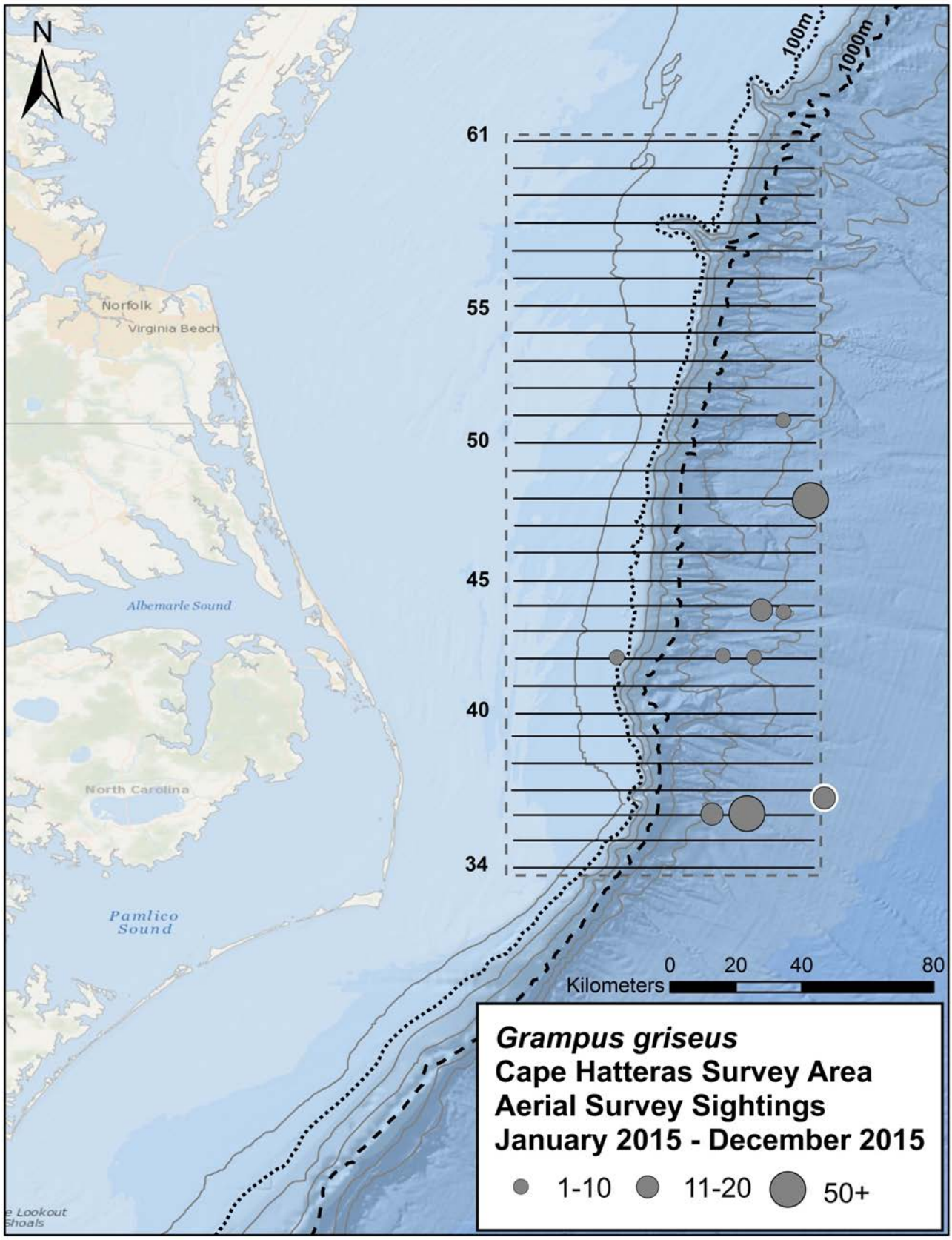

Figure 11. Risso's dolphin (*Grampus griseus*) sightings. White outline denotes off-effort sighting; symbol size indicates group size.

4.2.5 Striped dolphin (*Stenella coeruleoalba*)

Six sightings of 748 individuals (mean=124.66, SD=108.60) were observed during this reporting period. All sightings occurred in the northern portion of our survey area either near or beyond the 1,000-m isobath **(Table 8, Figure 12).**

Table 8. Striped dolphin (*Stenella coeruleoalba*) sightings in the Cape Hatteras and Norfolk Canyon survey area from January 2015 to December 2015.

Date	Time	Way Point	Latitude	Longitude	Track Number	BSS	Angle out	Degree Forward	Best #	Off-Effort (*)
7-Apr-2015	13:39:31	34	36.497501	-74.698788	50	2	2	45°	43	
7-Apr-2015	13:52:53	40	36.486937	-74.467230	50	3	2	60°	175	
20-Jul-2015	15:26:21	58	36.629258	-74.518201	52	3	3	60°	325	
16-Sep-2015	9:35:39	18	36.657402	-74.447666	52	1	3	60°	70	
21-Oct-2015	14:40:19	101	37.088272	-74.436856	58	2	1	90°	75	
16-Nov-2015	10:37:28	22	36.950672	-74.469969	56	2	1	90°	60	

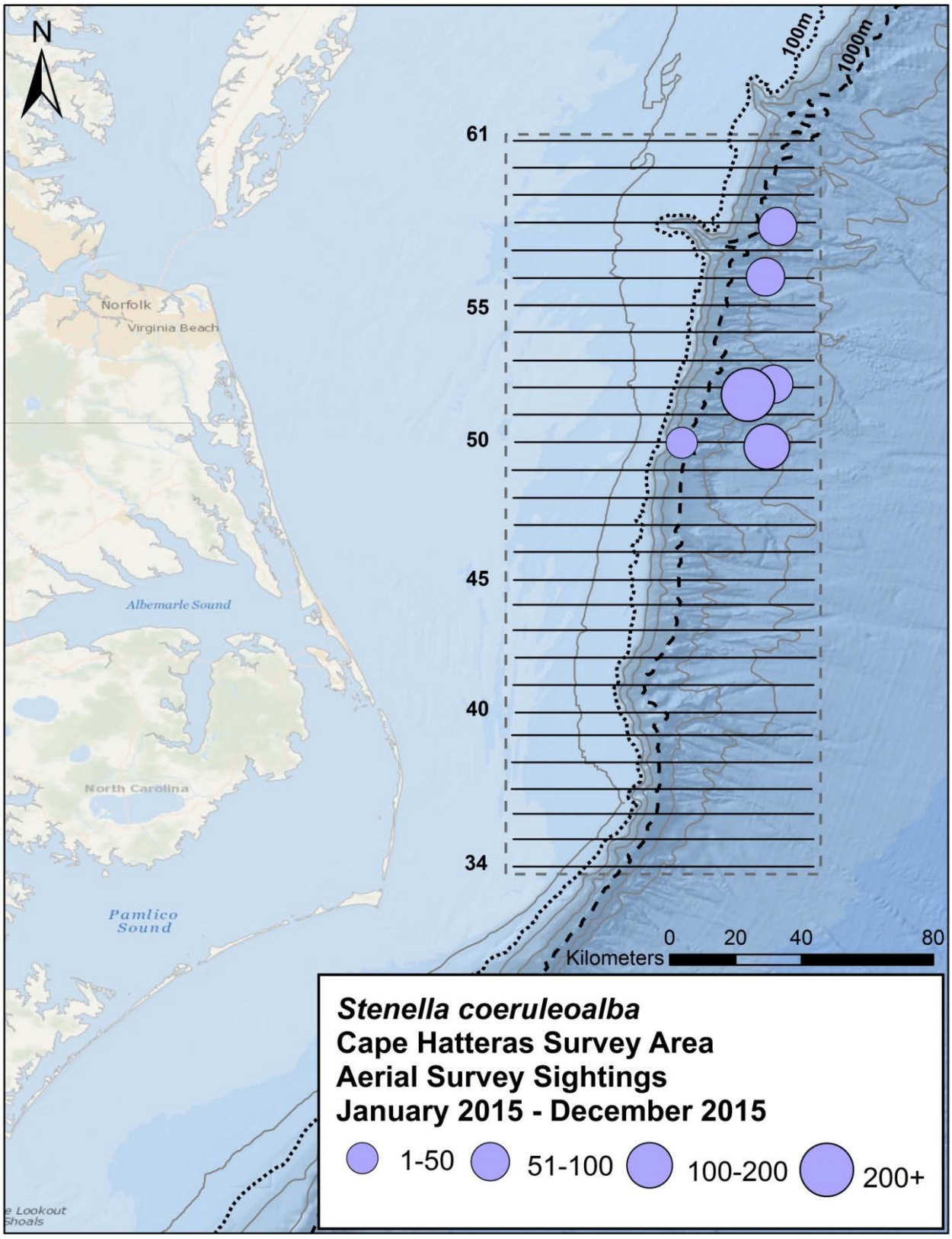

Figure 12. Striped dolphin (*Stenella coeruleoalba*) sightings; symbol size indicates group size.

4.2.6 Clymene dolphin (*Stenella clymene*)

Three sightings of 465 individuals were observed seaward of the 2,000-m isobath in the southern portion of the survey area. Group size ranged between 40 and 250 (mean=155, SD=106) (**Table 9, Figure 13**).

Table 9. Clymene dolphin (*Stenella clymene*) sightings in the Cape Hatteras and Norfolk Canyon survey area from January 2015 to December 2015.

Date	Time	Way Point	Latitude	Longitude	Track Number	BSS	Angle out	Degree Forward	Best #	Off-Effort (*)
18-Jun-2015	10:40:28	10	35.401172	-74.395817	35	3	2	90°	40	
15-Sep-2015	10:03:47	19	35.402519	-74.383268	35	3	1	100°	250	
17-Nov-2015	10:47:37	36	35.469600	-74.529738	36	3	1	100°	175	

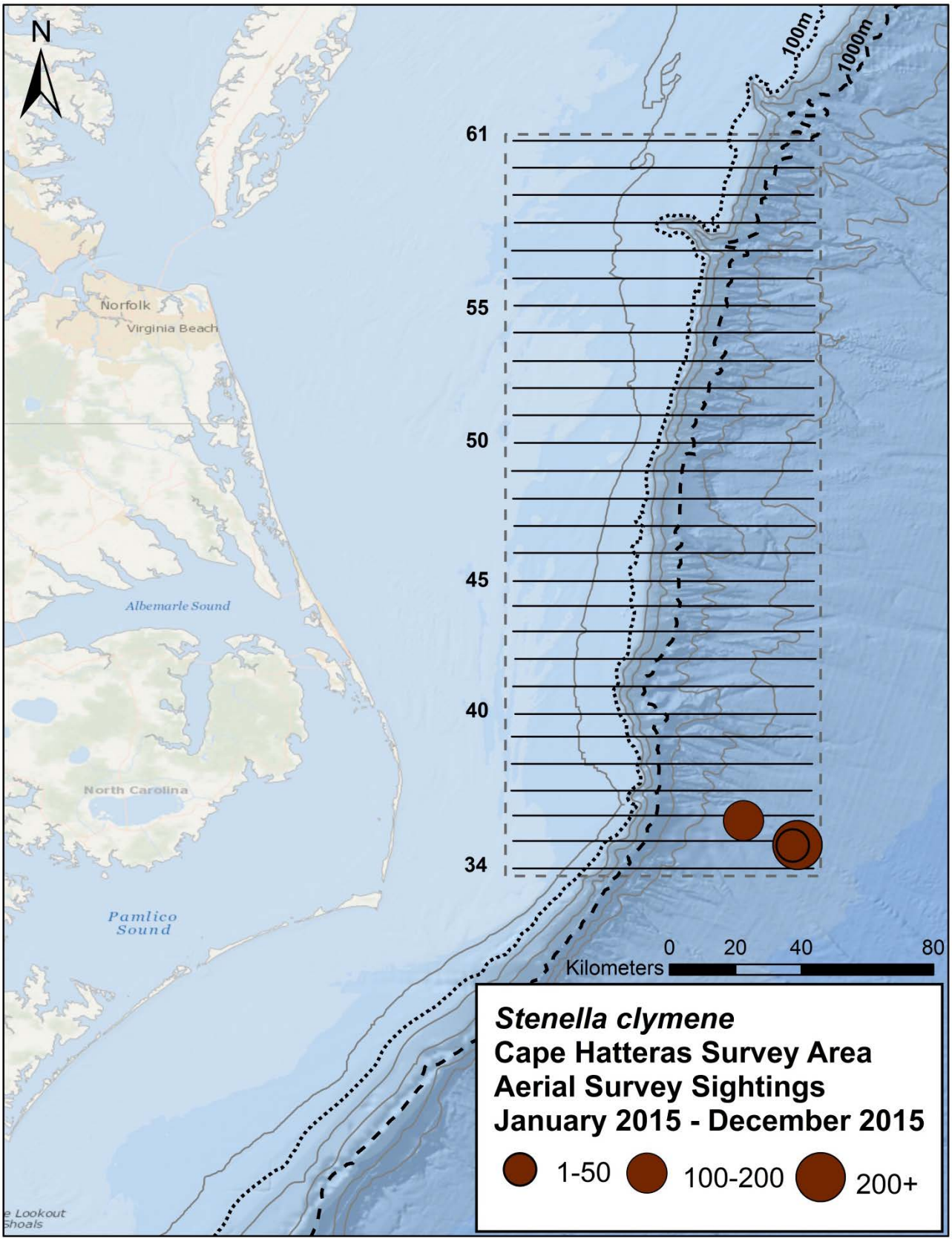

Figure 13. Clymene dolphin (*Stenella clymene*) sightings; symbol size indicates group size.

4.3 Whales

4.3.1 Short-finned pilot whale (*Globicephala macrorhynchus*)

This species was observed on effort 33 times for a total of 795 individuals, and was seen in eight of the 11 months in which surveys were conducted. Group sizes ranged from one to 210 individuals (mean=24.09, SD=38.70) (**Table 10**). One off-effort sighting of six individuals was observed while transiting between tracklines. Pilot whales were observed from the 100-m isobath to waters greater than 2,000 m in bottom depth (**Figure 14**). A careful examination of all photos suggests that all sightings were of short-finned pilot whales.

Table 10. Short-finned pilot whale (*Globicephala macrorhynchus)* sightings in the Cape Hatteras and Norfolk Canyon survey area from January 2015 to December 2015. Asterisk denotes on off-effort sighting.

Date	Time	Way Point	Latitude	Longitude	Track Number	BSS	Angle out	Degree Forward	Best #	Off-Effort (*)
24-May-2015	10:40:41	48	36.036386	-74.490075	44	2	2	30°	8	
24-May-2015	11:05:39	63	35.972954	-74.569118	43	1	2	45°	42	
24-May-2015	11:25:40	72	35.972772	-74.772129	43	2	2	90°	11	
24-May-2015	13:31:41	85	35.690433	-74.810956	39	2	2	60°	20	
24-May-2015	13:37:36	89	35.686080	-74.701848	39	2	2	60°	7	
24-May-2015	14:11:31	102	35.685122	-74.350336	39	3	1	60°	4	
24-May-2015	14:58:53	119	35.832518	-74.872009	41	1	2	90°	13	
24-May-2015	15:43:05	143	35.907715	-74.664152	42	2	1	90°	5	
18-Jun-2015	14:21:30	52	35.625456	-74.782216	38	3	2	90°	30	
18-Jun-2015	15:01:33	76	35.697957	-74.744274	39	3	2	60°	60	
18-Jun-2015	15:08:31	80	35.698852	-74.807166	39	3	3	100°	12	
18-Jun-2015	15:30:10	87	35.753910	-74.818624	40	3	2	90°	73	
18-Jun-2015	16:11:30	103	35.819086	-74.832829	41	3	1	90°	60	
18-Jun-2015	16:15:31	107	35.827101	-74.859014	41	3	1	90°	210	
20-Jul-2015	10:27:14	11	37.320319	-74.383165	61	4	2	90°	5	
20-Jul-2015	11:18:11	19	37.026785	-74.499318	57	4	1	90°	15	
21-Jul-2015	11:03:49	19	35.828201	-74.850372	41	4	2	90°	19	
14-Aug-2015	10:44:29	7	35.344832	-74.490557	34	5	2	90°	12	
14-Aug-2015	11:18:04	17	35.400208	-74.828039	35	4	1	90°	13	
14-Aug-2015	12:23:37	34	35.543858	-74.745997	37	3	1	90°	1	
15-Aug-2015	9:54:11	15	35.910747	-74.807453	42	4	2	90°	2	
15-Sep-2015	14:39:48	68	35.692667	-74.804169	39	1	3	90°	52	
16-Sep-2015	15:04:45	110	36.200278	-74.748740	46	1	2	100°	8	
20-Oct-2015	15:55:50	33	36.718802	-74.422857	53	4	1	90°	2	
20-Oct-2015	16:11:38	38	36.656126	-74.420885	52	4	2	100°	6	
20-Oct-2015	16:19:24	41	36.625176	-74.685948	52	4	2	120°	14	

Date	Time	Way Point	Latitude	Longitude	Track Number	BSS	Angle out	Degree Forward	Best #	Off-Effort (*)
21-Oct-2015	10:09:18	15	36.793070	-74.363763	54	2	1	45°	6	
21-Oct-2015	10:23:14	23	36.879712	-74.588462	55	3	3	90°	10	
17-Nov-2015	10:27:34	29	35.467152	-74.778705	36	3	1	10°	4	
17-Nov-2015	10:31:05	32	35.476591	-74.741063	36	3	4	120°	3	
17-Nov-2015	11:32:48	50	35.553343	-74.719337	37	3	2	90°	14	
17-Nov-2015	12:43:00	82	35.693834	-74.569298	39	3	2	90°	4	
7-Dec-2015	10:56:03	24	37.019093	-74.455490	57	2	1	60°	50	
7-Dec-2015	9:56:04	10	37.258846	-74.333488			3	60°	6	*

1

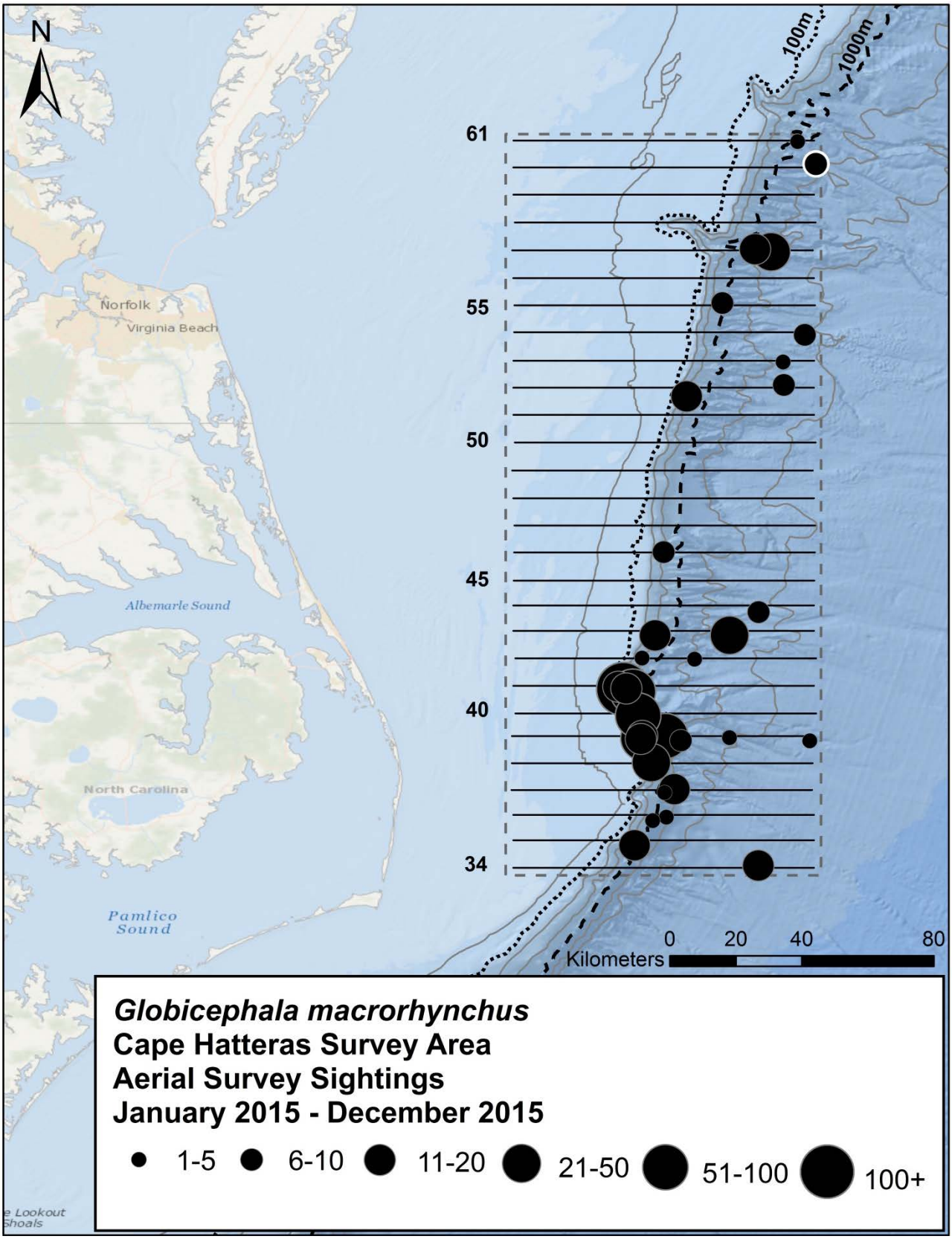

Figure 14. Short-finned pilot whale (*Globicephala macrorhynchus*) sightings. White outlines denote off-effort sighting; symbol size indicates group size.

4.3.2 Cuvier's beaked whale (*Ziphius cavirostris*)

Nine sightings of 24 individuals occurred while on effort in the Cape Hatteras survey area, and this species was observed in five of the 11 months in which surveys were conducted (**Table 11, Figure 15**). Group sizes ranged from single animals up to groups of 7 individuals. Two additional, off-effort sightings, totaling 8 individuals, were recorded in the northern portion of the survey area. Sightings occurred from just inside the 1000-m isobath to beyond the 2,000-m isobath.

Table 11. Cuvier's beaked whale (*Ziphius cavirostris)* sightings in the Cape Hatteras and Norfolk Canyon survey area from January 2015 to December 2015. Asterisk denotes an off-effort sighting.

Date	Time	Way Point	Latitude	Longitude	Track Number	BSS	Angle out	Degree Forward	Best #	Off-Effort (*)
24-May-2015	9:54:07	27	36.121638	-74.702764	45	3	1	90°	3	
24-May-2015	11:12:07	67	35.973728	-74.606720	43	2	4	120°	7	
24-May-2015	15:04:53	123	35.832549	-74.796478	41	1	2	100°	1	
18-Jun-2015	14:58:03	72	35.674469	-74.693698	39	3	4	100°	1	
18-Jun-2015	15:37:25	91	35.759349	-74.543164	40	3	1	90°	2	
15-Sep-2015	9:31:11	12	35.342735	-74.879061	34	4	1	100°	5	
15-Sep-2015	11:33:40	39	35.556851	-74.762349	37	2	3	90°	1	
17-Nov-2015	11:29:07	46	35.568265	-74.624694	37	3	3	45°	3	
17-Nov-2015	15:19:01	100	35.762163	-74.338429	40	3	3	90°	1	
16-Nov-2015	10:48:11	27	36.998784	-74.304312	56	2	3	45°	1	*
7-Dec-2015	9:56:04	10	37.258846	-74.333488			3	60°	7	*

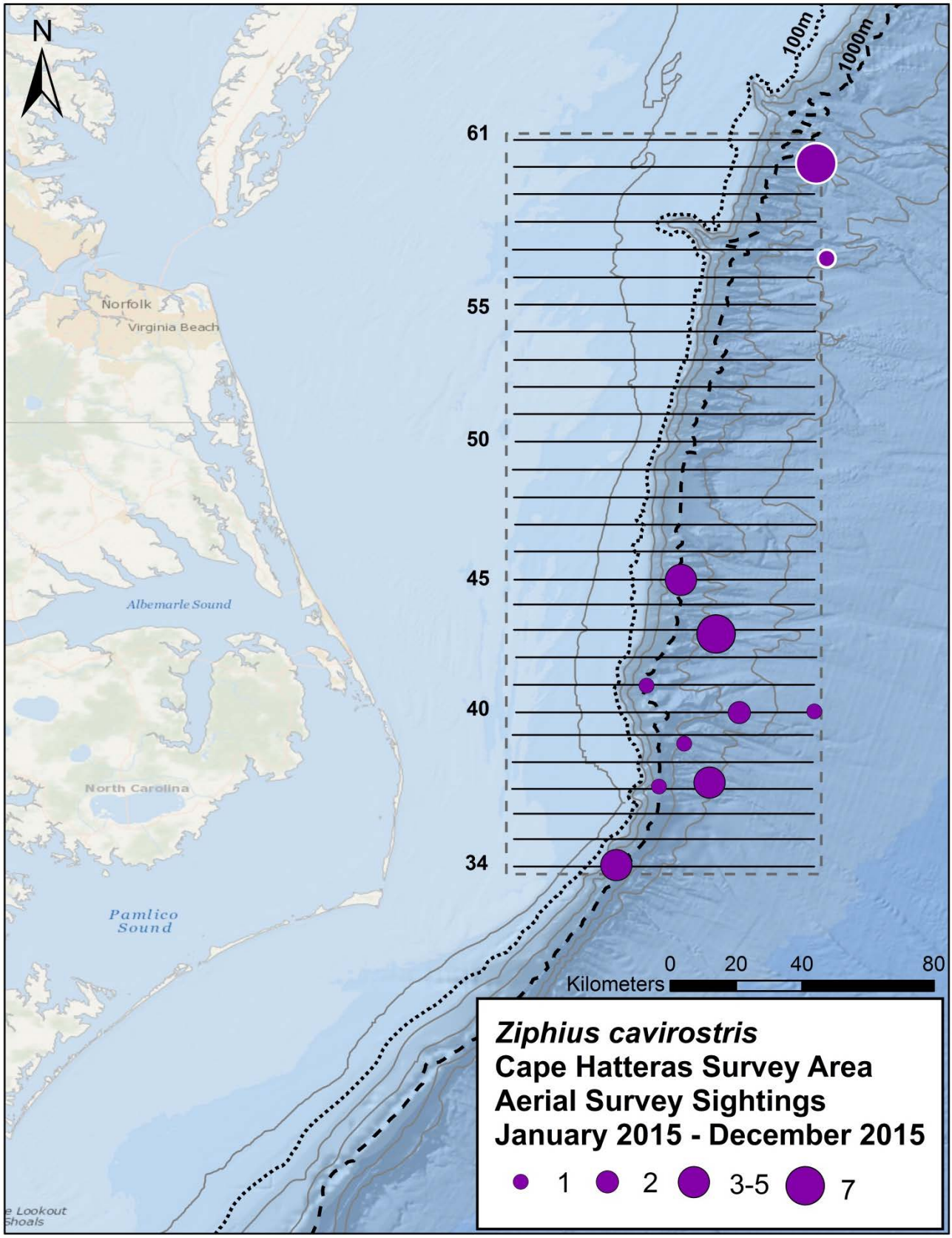

Figure 15. Cuvier's beaked whale (*Ziphius cavirostris*) sightings. White outline denotes off-effort sightings; symbol size indicates group size.

4.3.3 Sperm whale (Physeter macrocephalus)

On three occasions, lone sperm whales were observed beyond the 1,000-m isobath in the northern and southern portion of the Cape Hatteras, North Carolina survey area (**Table 12, Figure 16**).

Table 12. Sperm whale (*Physeter macrocephalus*) sightings in the Cape Hatteras and Norfolk Canyon survey area from January 2015 to December 2015.

Date	Time	Way Point	Latitude	Longitude	Track Number	BSS	Angle out	Degree Forward	Best #	Off-Effort (*)
18-Jun-2015	14:39:52	65	35.625089	-74.472827	38	2	3	45°	1	
20-Jul-2015	14:09:09	34	36.879489	-74.498237	55	4	2	90°	1	
21-Oct-2015	14:53:14	107	37.162577	-74.443163	59	2	2	90°	1	

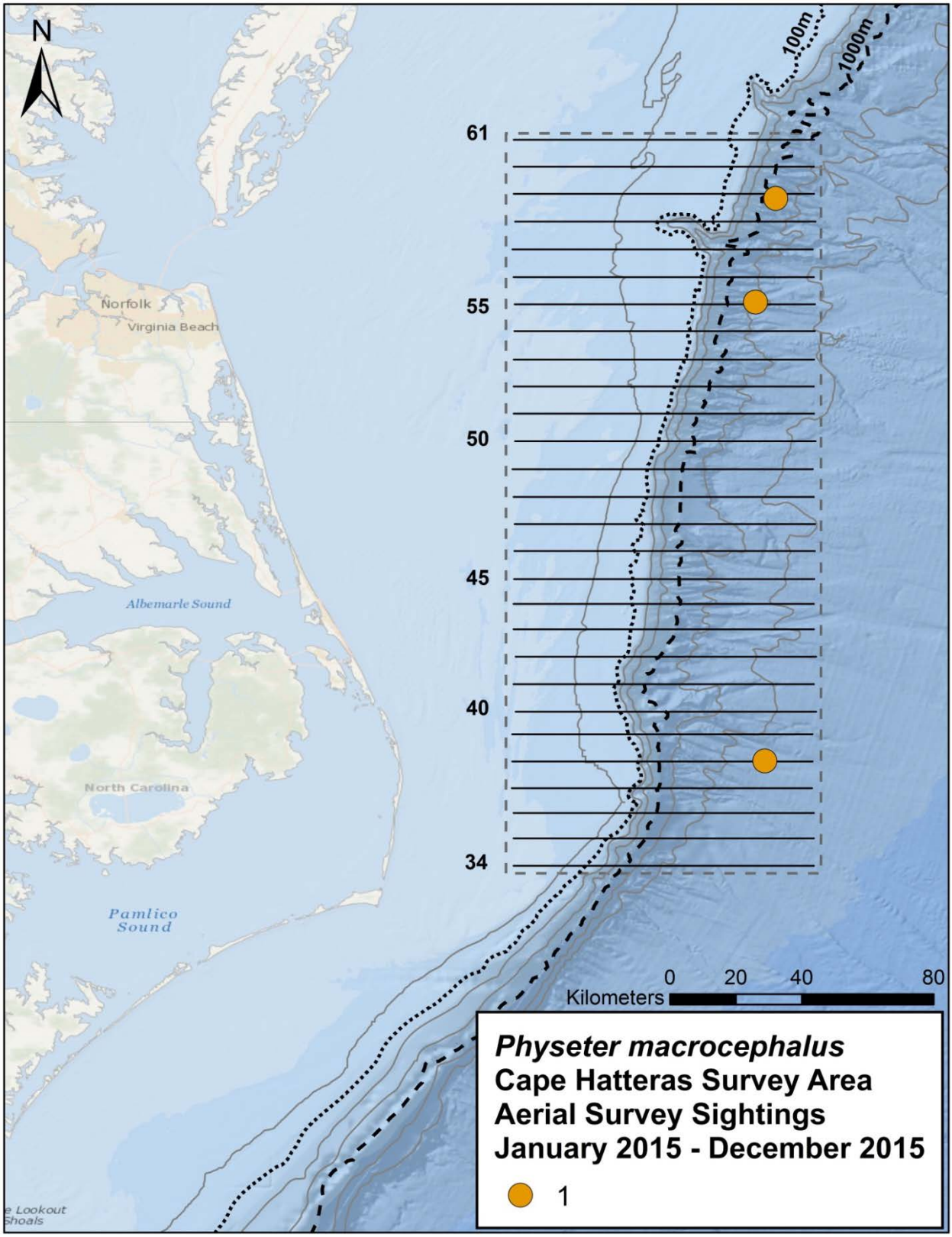

Figure 16. Sperm whale (*Physeter macrocephalus*) sightings.

4.3.4 Mesoplodont beaked whale (*Mesoplodon* spp.)

On two occasions, a total of 8 beaked whales was observed, which were determined not to be Cuvier's beaked whales, but could not be positively identified to species (**Table 13, Figure 17**). Since no species identification could be established, they are listed here as *Mesoplodon* spp. Sightings occurred in 2,000 m water depth.

Table 13. Unidentified *Mesoplodon* sightings in the Cape Hatteras and Norfolk Canyon survey area from January 2015 to December 2015.

Date	Time	Way Point	Latitude	Longitude	Track Number	BSS	Angle out	Degree Forward	Best #	Off-Effort (*)
14-Aug-2015	11:03:17	13	35.405863	-74.388501	35	5	2	90°	6	
15-Aug-2015	10:38:27	23	35.909878	-74.564267	42	4	2	90°	2	

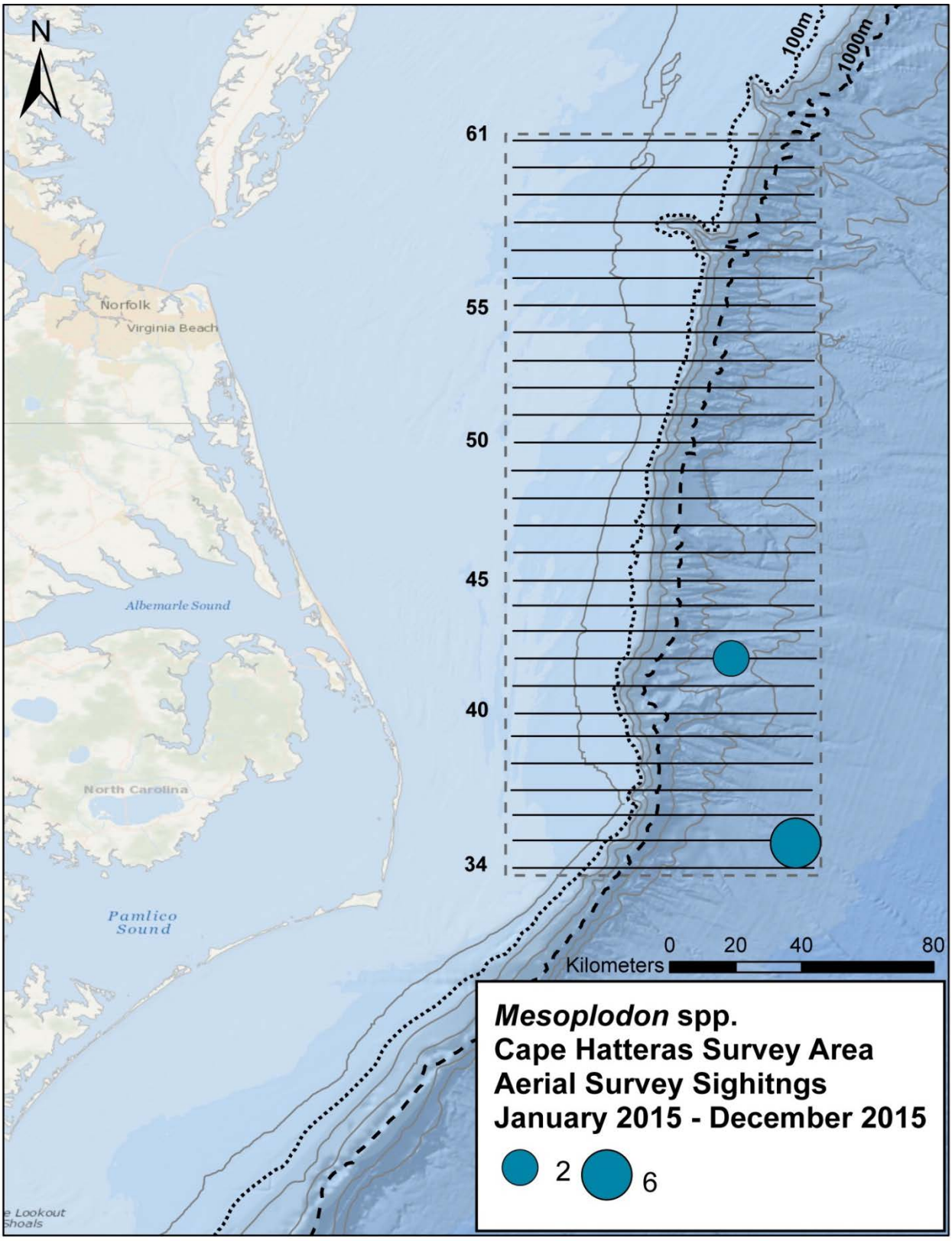

Figure 17. Unidentified *Mesoplodon* sightings; symbol size indicates group size.

4.3.5 Kogiid whales (*Kogia* spp.)

On two occasions, groups of three kogiid whales were observed beyond the 2,000-m isobath in the southern portion of the survey area. One group consisted of three animals of roughly equivalent size. The second group contained one individual that was obviously smaller than the other two, which was presumed to be a calf. There is a distinct difference in the external "false gill slit" pigmentation pattern between the two species of whale in the genus *Kogia*, which is a useful character to distinguish between kogiid species in the field (Keenan-Bateman et al. 2016). In both species of *Kogia*, the dorso-cranial tip of the "false gill slit" pigmentation pattern marks the opening of the external auditory meatus. However, the pygmy sperm whale (*Kogia breviceps*), possesses a dark pigmentation pattern that extends the ventral portion of the "false gill slit" pigmentation cranially to form a "bracket" between the eye and the pectoral flipper. The ventro-cranial extension of the "false gill slit" pigmentation pattern is absent in the dwarf sperm whale (*Kogia sima*), and therefore does not form a "bracket." Instead, the ventral margin of the "false gill slit" pigmentation in *K. sima* extends ventro-caudally and terminates near to the level of the insertion of the pectoral flipper. While photos were collected of each sighting, the ventral portion of the "false gill slit" pigmentation pattern was not able to be visualized from above. Thus, species specific distinction could not be made with 100 percent certainty. Thus, both sightings are identified as *Kogia* spp. (**Table 14, Figure 18**).

Table 14. Unidentified kogiid (*Kogia* sp.) sighting in the Cape Hatteras and Norfolk Canyon survey area from January 2015 to December 2015.

Date	Time	Way Point	Latitude	Longitude	Track Number	BSS	Angle out	Degree Forward	Best #	Off-Effort (*)
15-Sep-2015	11:17:42	34	35.547243	-74.443543	37	3	3	90°	3	
17-Nov-2015	11:04:58	42	35.553249	-74.358230	37	3	2	100°	3	

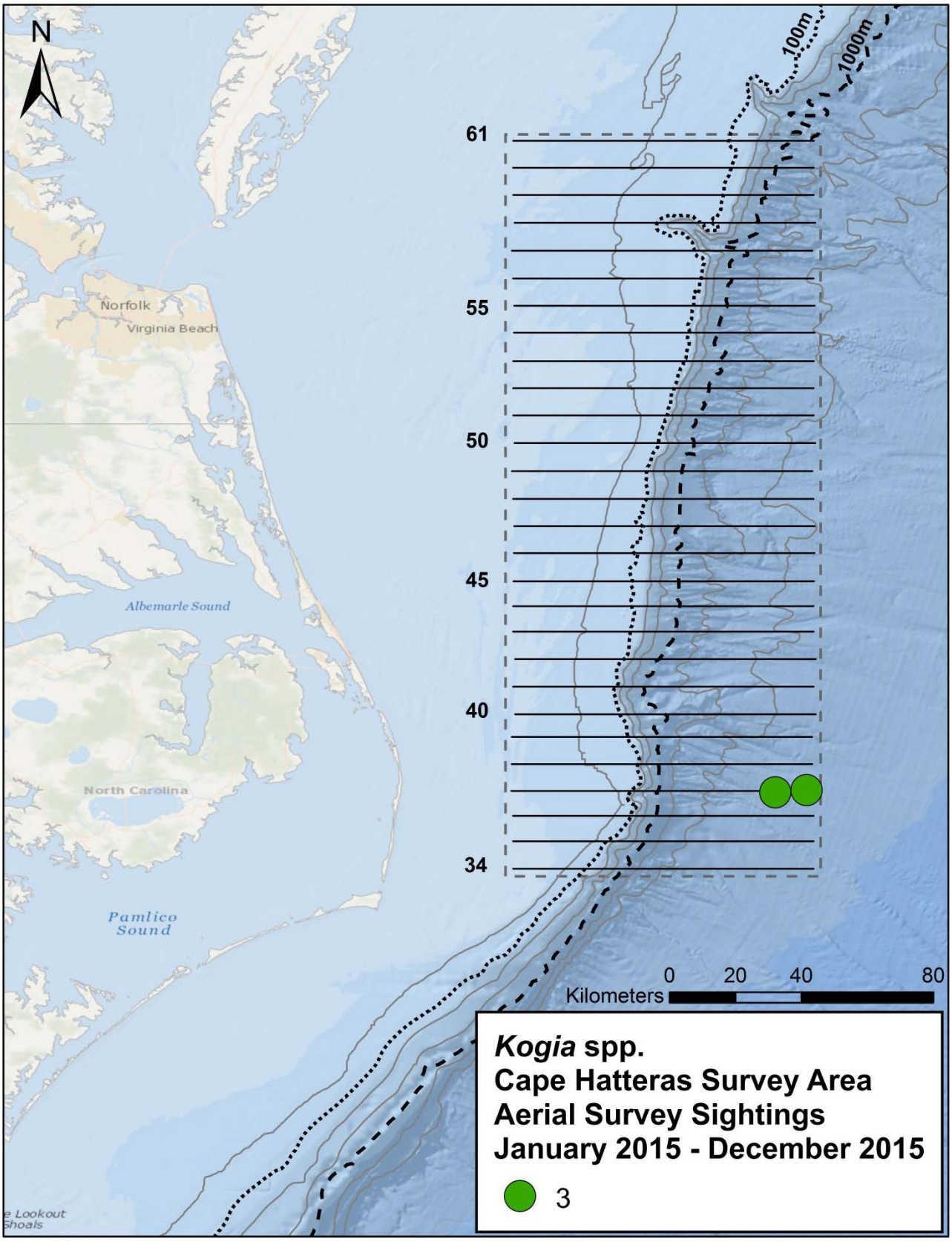

Figure 18. Kogiid whale (*Kogia* spp.) sightings.

4.3.6 Humpback whale (*Megaptera novaengliae*)

Humpback whales were observed inside the survey area on two occasions this year (**Table 15, Figure 19**). On 7 April a pair of animals was observed on the inshore portion of trackline 48. While circling the pair to collect photographs, one individual was documented feeding at the surface. On 16 November a single, heavily scarred animal was observed in the northern offshore portion of the survey area over Norfolk Canyon. Since this species has been the focus of current and past photo identification ID work, all efforts were made to document any features on the animals that could aid in identifying the individual. Images collected from each sighting were shared with teams responsible for maintaining Atlantic humpback whale catalogues.

Table 15. Humpback whale (*Megaptera novaeangliae*) sightings in the Cape Hatteras and Norfolk Canyon survey area from January 2015 to December 2015.

Date	Time	Way Point	Latitude	Longitude	Track Number	BSS	Angle out	Degree Forward	Best #	Off-Effort (*)
7-Apr-2015	14:35:36	53	36.342966	-75.061886	48	2	2	60°	2	
16-Nov-2015	10:55:27	30	37.027035	-74.567014	57	2	3	60°	1	

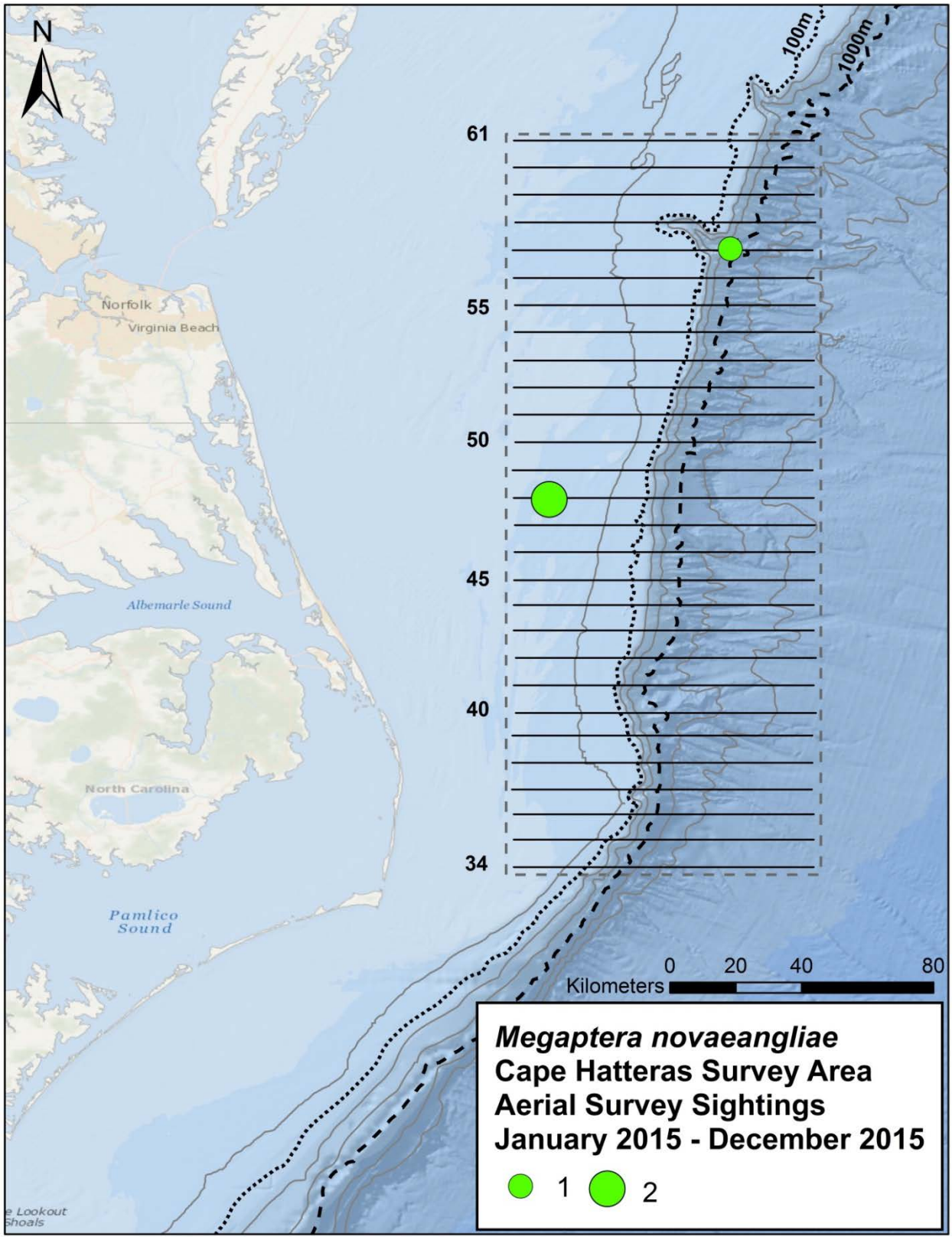

Figure 19. Humpback whale (*Megaptera novaeangliae*) sightings; symbol size indicates group size.

4.3.7 Minke whale (*Balaenoptera acutorostrata*)

On two occasions, lone minke whales were observed along the 100-m shelf break (**Table 16, Figure 20**). This species has not been observed during aerial surveys off Cape Hatteras since 2013.

Table 16. Minke whale (*Balaenoptera acutorostrata*) sightings in the Cape Hatteras and Norfolk Canyon survey area from January 2015 to December 2015.

Date	Time	Way Point	Latitude	Longitude	Track Number	BSS	Angle out	Degree Forward	Best #	Off-Effort (*)
16-Sep-2015	11:07:14	60	36.417897	-74.802906	49	2	2	90°	1	
16-Nov-2015	14:15:07	51	37.321911	-74.466343	61	2	3	90°	1	

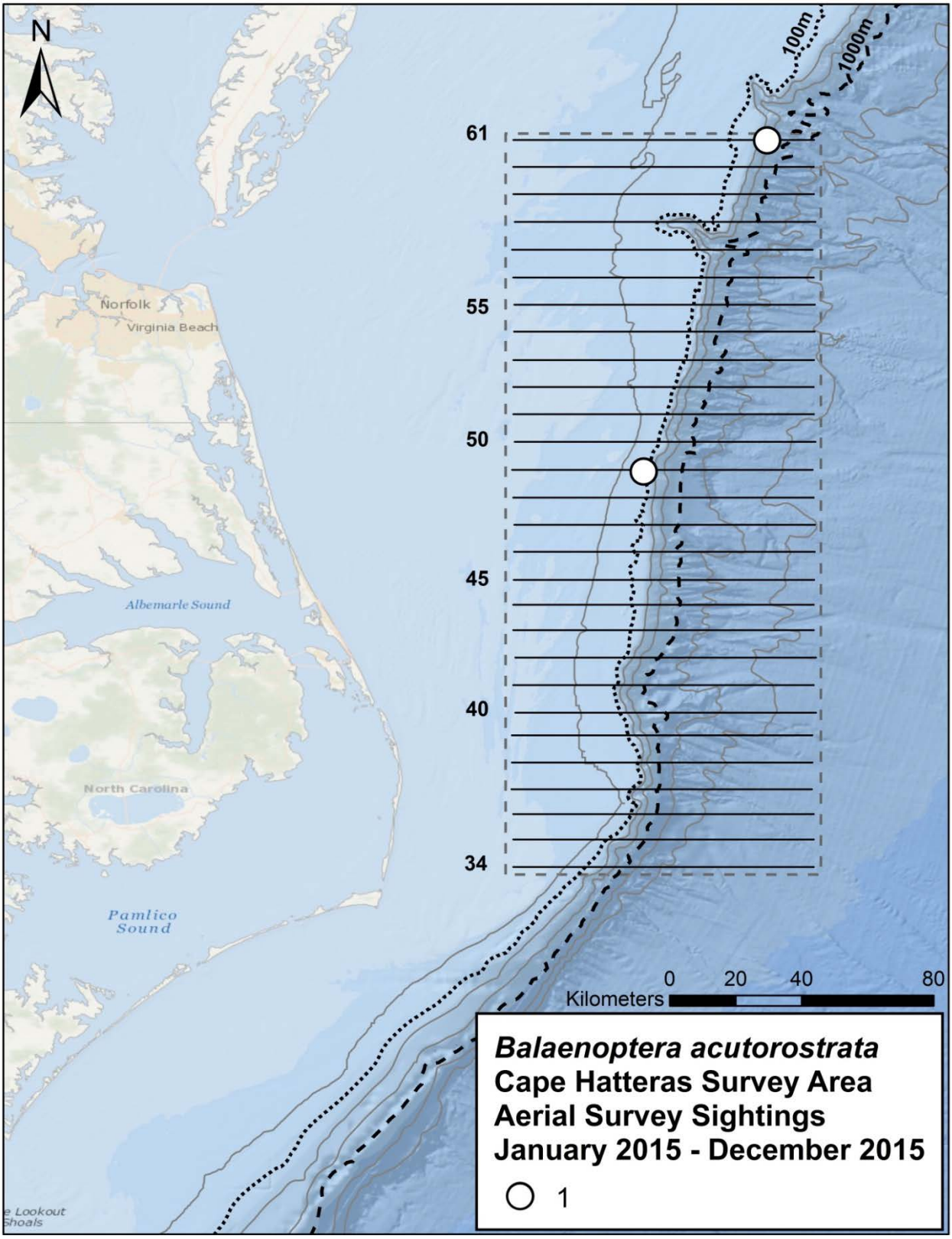

Figure 20. Minke whale (*Balaenoptera acutorostrata*) sightings.

4.3.8 True's beaked whale (*Mesoplodon mirus*)

As part of the ongoing effort to establish species-specific characters for beaked whales, all images of beaked whales were examined and compared to published works and to our own growing inventory of sightings. This process continues to be refined with each new sighting. On 16 September, two mesoplodont whales were observed in one sighting event. Careful review of photos back in the lab revealed the presence of erupted teeth at the tip of the rostrum of one individual (**Table 17, Figure 21**). The placement and size of teeth can be used to identify beaked whales to species (Mead 1989). We compared these images to both published images and stranding photos for which definitive species identification had been established, and determined that the aerial survey images were of True's beaked whale.

Table 17. True's beaked whale (*Mesoplodon mirus*) sighting in the Cape Hatteras and Norfolk Canyon survey area from January 2015 to December 2015.

Date	Time	Way Point	Latitude	Longitude	Track Number	BSS	Angle out	Degree Forward	Best #	Off-Effort (*)
16-Sep-2015	13:48:56	79	36.347591	-74.631713	48	1	2	60°	2	

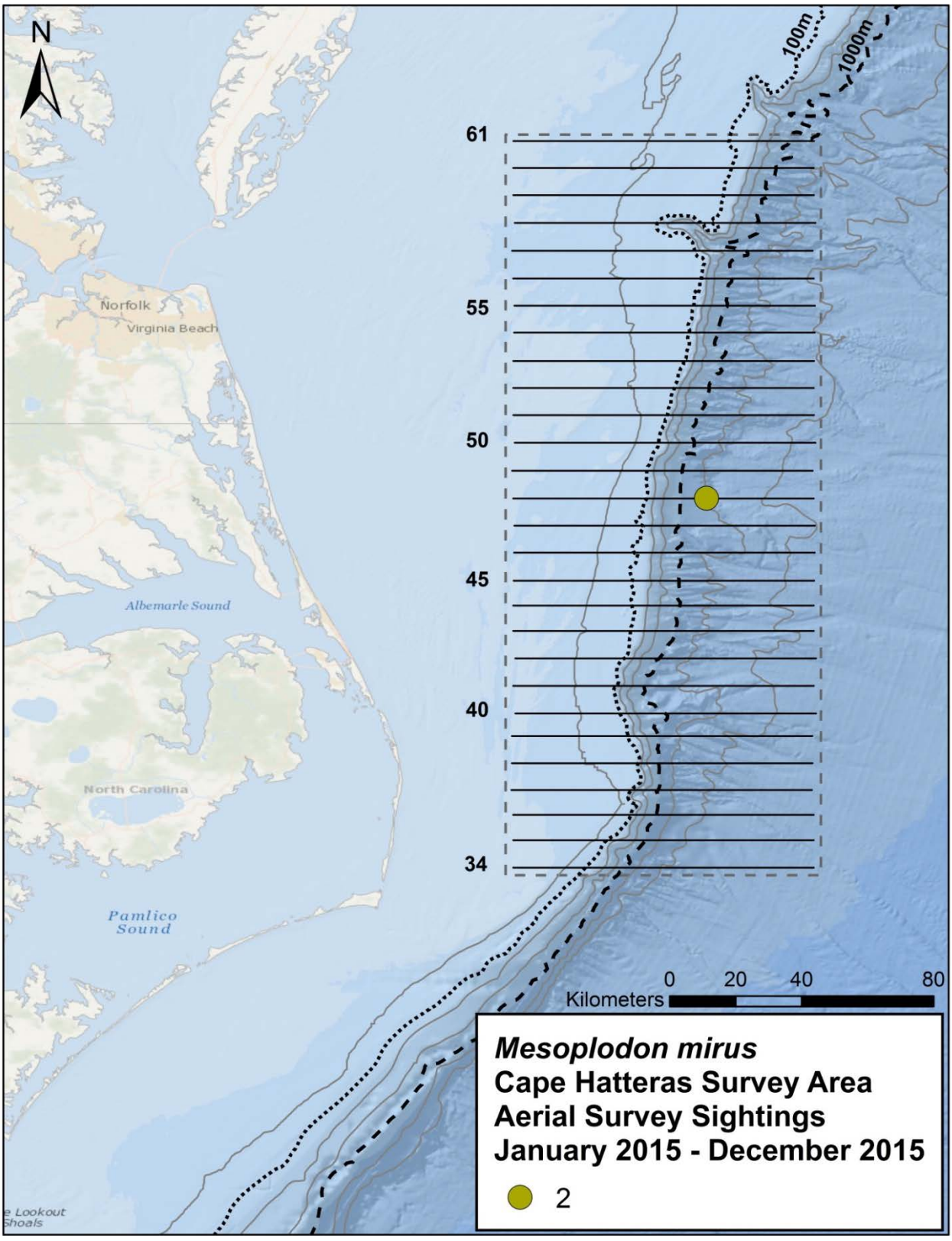

Figure 21. True's beaked whale (*Mesoplodon mirus*) sighting indicating group size.

4.3.9 Fin whale (*Balaenoptera physalus*)

During September surveys, two sightings of fin whales were recorded in the shallow waters of the survey area (**Table 18, Figure 22**). On 15 September a lone fin whale was observed inshore of the 100-m isobath. The following day on 16 September, a large, actively healing propeller wound was noted on the mid-dorsal region of one of the two fin whales sighted. This sighting was recorded while investigating another sighting and is listed as off-effort. The injury was photographed and images passed to responsible individuals at the National Marine Fisheries Service's Greater Atlantic Regional Fisheries Office and Southeast Regional Office, who monitor large whale injuries along the Atlantic coast.

Table 18. Fin whale (*Balaenoptera physalus*) sightings in the Cape Hatteras and Norfolk Canyon survey area from January 2015 to December 2015. Asterisk denotes an off-effort sighting.

Date	Time	Way Point	Latitude	Longitude	Track Number	BSS	Angle out	Degree Forward	Best #	Off-Effort (*)
15-Sep-2015	16:11:13	106	36.044416	-74.938153	44	1	1	90°	1	
16-Sep-2015	11:16:20	62	36.427849	-74.807350	49	2	2	90°	2	*

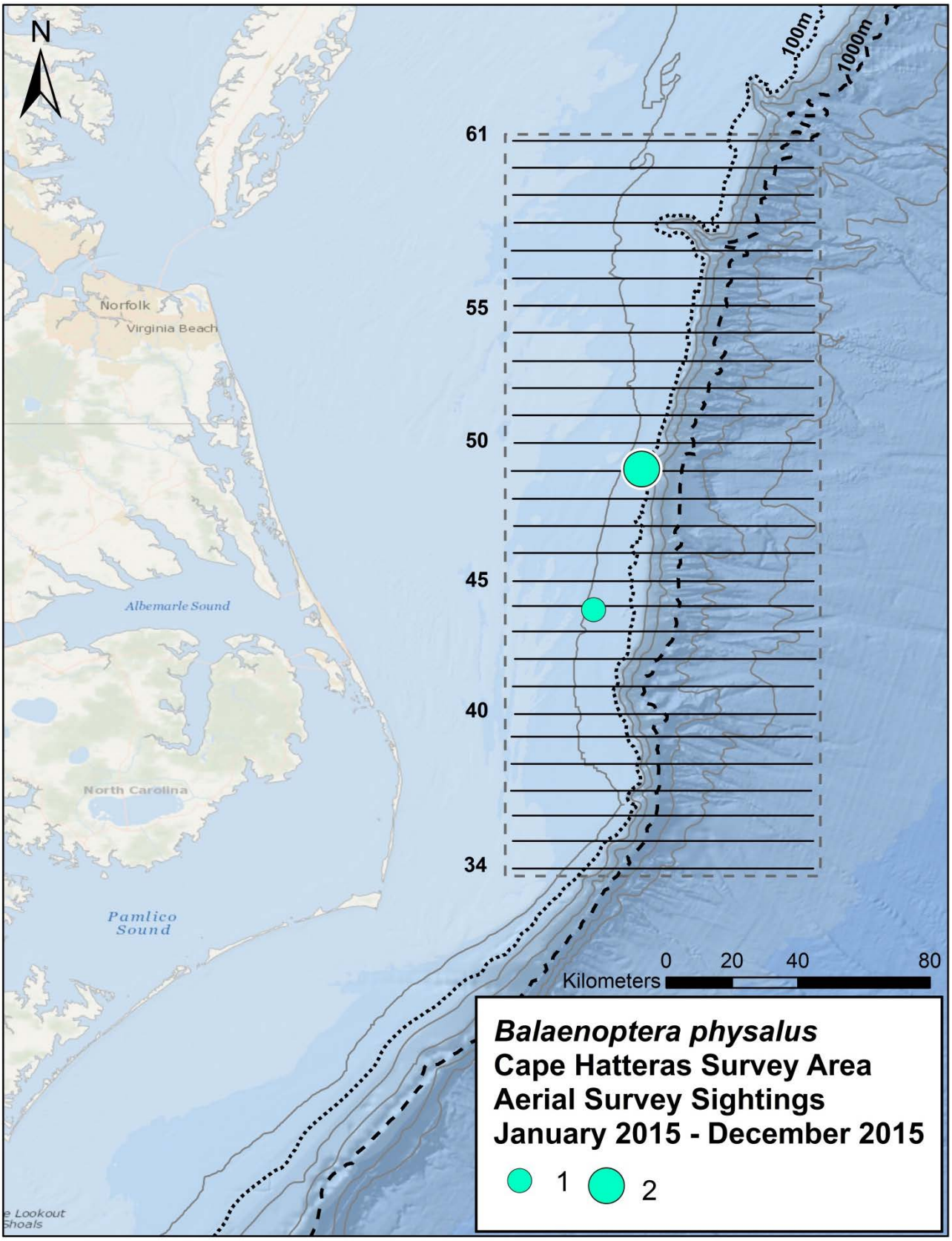

Figure 22. Fin whale (*Balaenoptera physalus*) sightings. White outline denotes off-effort sighting; symbol size indicates group size.

4.4 Sea Turtles

One hundred twenty-two sightings of 163 individual sea turtles occurred during the reporting period (**Tables 19 and 20, Figures 23 and 24**). Sighting rates were negatively correlated with BSS, and rates sharply declined at BSS higher than 2 (**Figures 25a-b**). Sea turtles were recorded in every month surveyed except for January, with highest sightings per 1,000 km flown in August and September (**Figure 25c**). Loggerhead sea turtles represented the majority (90 percent) of total sea turtles sighted. The only other sea turtle species identified in the Cape Hatteras and Norfolk Canyon survey area was the leatherback sea turtle (6.1 percent of total sea turtles sighted). For the remaining 4 percent of sightings, species identification could not be made with 100 percent certainty; these are listed as "unidentified sea turtles."

4.4.1 Loggerhead sea turtle (*Caretta caretta*)

Sightings of loggerhead sea turtles occurred in nine of 11 months surveyed, for a total of 148 animals (**Table 19, Figure 23**). The vast majority of sightings were over the continental shelf inshore of the 100-m isobath.

4.4.2 Leatherback sea turtle (*Dermochelys coriacea*)

Ten sightings of lone leatherback sea turtles were observed from the inshore waters out to beyond the 2000-m isobath (**Table 20, Figure 24**).

Table 19. Loggerhead sea turtle (*Caretta caretta)* sightings in the Cape Hatteras and Norfolk Canyon survey area from January 2015 to December 2015.

Date	Time	Way Point	Latitude	Longitude	Track Number	BSS	Angle out	Degree Forward	Best #	Off-Effort (*)
19-Mar-2015	15:25:44	23	36.796550	-74.746673	54	2	1	90°	1	
7-Apr-2015	9:47:59	8	37.171090	-74.663112	59	3	2	90°	1	
7-Apr-2015	14:25:25	38	36.421992	-75.016717	49	2	1	90°	2	
7-Apr-2015	15:40:20	50	36.271645	-75.012416	47	2	2	90°	1	
24-May-2015	9:03:14	3	36.195371	-75.126932	46	1	3	90°	1	
24-May-2015	9:04:11	4	36.198258	-75.090073	46	1	1	90°	1	
24-May-2015	9:04:30	3	36.198381	-75.077628	46	1	3	90°	1	
24-May-2015	9:06:18	4	36.198413	-75.006205	46	1	1	90°	1	
24-May-2015	9:08:26	5	36.198371	-74.922705	46	1	1	60°	1	
24-May-2015	10:14:57	25	36.121916	-75.061635	45	2	4	45°	1	
24-May-2015	11:31:54	48	35.973631	-75.031371	43	2	1	90°	1	
24-May-2015	13:23:07	81	35.698351	-75.123545	39	2	2	90°	3	
24-May-2015	13:23:49	55	35.698527	-75.094737	39	2	2	60°	1	
24-May-2015	13:24:24	82	35.698367	-75.071788	39	2	3	90°	2	
24-May-2015	14:40:52	114	35.752910	-74.926357	40	1	3	90°	1	
24-May-2015	16:04:45	155	35.905830	-75.125805	42	2	1	90°	1	
18-Jun-2015	11:05:52	17	35.475492	-75.071090	36	2	2	100°	1	

Date	Time	Way Point	Latitude	Longitude	Track Number	BSS	Angle out	Degree Forward	Best #	Off-Effort (*)
18-Jun-2015	14:17:18	35	35.620563	-74.870943	38	3	3	90°	1	
18-Jun-2015	16:24:22	110	35.825527	-75.079122	41	3	1	90°	1	
20-Jul-2015	9:18:13	3	37.091129	-75.041772	58	4	1	90°	1	
20-Jul-2015	10:46:31	15	37.319104	-74.956336	61	3	2	90°	2	
20-Jul-2015	11:46:09	26	36.940726	-74.952184	56	3	2	90°	1	
20-Jul-2015	11:47:32	27	36.940492	-75.007600	56	3	3	90°	1	
20-Jul-2015	11:48:34	28	36.940845	-75.048818	56	3	3	90°	1	
20-Jul-2015	14:39:13	37	36.789954	-75.076722	54	3	2	90°	1	
14-Aug-2015	14:28:03	41	36.358458	-74.958632	48	3	1	90°	1	
14-Aug-2015	14:30:06	42	36.358388	-74.876803	48	3	2	100°	1	
14-Aug-2015	15:13:17	34	36.275868	-75.022981	47	3	2	90°	1	
14-Aug-2015	15:26:50	38	36.194815	-74.884214	46	3	1	90°	1	
15-Aug-2015	9:43:52	12	35.904495	-75.061129	42	4	2	90°	1	
15-Aug-2015	12:57:46	31	36.426618	-75.033577	49	2	2	90°	1	
15-Aug-2015	13:08:46	35	36.427481	-74.892757	49	2	3	90°	1	
15-Aug-2015	13:09:13	36	36.427968	-74.874102	49	2	3	90°	1	
15-Aug-2015	14:01:32	42	36.564627	-74.845865	51	2	1	90°	1	
15-Aug-2015	14:02:05	43	36.565487	-74.868621	51	2	2	90°	2	
15-Aug-2015	14:02:34	44	36.565985	-74.888230	51	2	1	90°	4	
15-Aug-2015	14:05:29	46	36.568298	-75.005452	51	1	2	90°	2	
15-Aug-2015	14:06:27	61	36.569051	-75.044946	51	1	3	90°	1	
15-Aug-2015	14:07:27	47	36.569762	-75.085802	51	1	2	60°	3	
15-Aug-2015	14:18:58	70	36.642578	-75.079437	52	1	2	90°	1	
15-Aug-2015	14:19:08	52	36.642576	-75.072531	52	1	2	60°	3	
15-Aug-2015	14:20:11	71	36.642703	-75.028588	52	1	2	90°	1	
15-Aug-2015	14:21:46	73	36.642693	-74.963131	52	1	2	90°	1	
15-Aug-2015	14:22:03	53	36.642652	-74.951264	52	1	1	60°	1	
15-Aug-2015	14:22:33	75	36.642566	-74.929786	52	1	1	120°	1	
15-Aug-2015	14:23:15	76	36.642502	-74.899648	52	1	1	90°	2	
15-Aug-2015	14:24:03	54	36.642485	-74.866956	52	1	2	90°	4	
15-Aug-2015	14:25:02	78	36.642428	-74.827511	52	1	1	90°	1	
15-Aug-2015	14:25:12	79	36.642384	-74.821368	52	1	1	90°	1	
15-Aug-2015	15:17:17	68	36.719341	-74.840769	53	2	2	90°	3	
15-Aug-2015	15:19:53	70	36.719367	-74.951347	53	1	2	90°	3	
15-Aug-2015	15:23:47	71	36.721863	-74.999472	53	1	2	90°	3	
15-Aug-2015	15:24:43	104	36.719697	-75.037094	53	1	1	90°	1	
15-Aug-2015	15:25:36	105	36.719069	-75.073983	53	1	1	90°	1	
15-Aug-2015	15:27:41	74	36.722561	-75.121266	53	1	1	90°	2	
15-Sep-2015	11:54:18	31	35.549479	-75.131245	37	2	2	90°	1	

Date	Time	Way Point	Latitude	Longitude	Track Number	BSS	Angle out	Degree Forward	Best #	Off-Effort (*)
15-Sep-2015	14:53:00	51	35.690300	-74.976738	39	1	3	90°	1	
15-Sep-2015	14:54:04	52	35.690156	-75.018623	39	1	2	90°	1	
15-Sep-2015	15:06:35	78	35.978388	-75.136596	43	1	1	90°	1	
15-Sep-2015	15:08:10	56	35.979296	-75.072128	43	1	2	90°	2	
15-Sep-2015	15:55:12	98	36.048627	-74.593056	44	2	1	90°	1	
16-Sep-2015	9:12:10	3	36.649491	-75.037566	52	1	2	90°	1	
16-Sep-2015	9:15:41	5	36.646742	-74.896984	52	1	1	60°	2	
16-Sep-2015	9:17:49	6	36.646837	-74.812004	52	1	2	90°	2	
16-Sep-2015	10:10:45	25	36.571898	-74.797478	51	2	1	90°	1	
16-Sep-2015	10:15:28	36	36.571719	-74.981284	51	1	1	90°	1	
16-Sep-2015	10:16:19	37	36.571550	-75.014430	51	1	2	90°	1	
16-Sep-2015	10:16:45	28	36.571604	-75.031395	51	2	2	90°	1	
16-Sep-2015	10:18:08	38	36.571345	-75.085859	51	1	2	90°	1	
16-Sep-2015	10:27:01	33	36.497862	-75.122946	50	2	1	90°	2	
16-Sep-2015	10:33:22	46	36.498292	-74.873140	50	1	2	90°	2	
16-Sep-2015	10:34:12	47	36.498271	-74.840152	50	1	2	90°	3	
16-Sep-2015	11:25:52	64	36.421684	-75.016094	49	2	2	90°	1	
16-Sep-2015	13:32:47	69	36.347985	-75.012680	48	1	2	90°	1	
16-Sep-2015	13:35:04	71	36.348245	-74.926756	48	1	2	90°	1	
16-Sep-2015	14:37:51	65	36.272003	-74.900416	47	1	2	90°	2	
16-Sep-2015	14:38:12	99	36.271881	-74.914194	47	1	2	90°	1	
16-Sep-2015	14:38:27	66	36.272168	-74.923742	47	1	2	90°	4	
16-Sep-2015	14:43:05	67	36.271771	-75.096672	47	1	3	90°	3	
16-Sep-2015	14:58:36	108	36.198583	-74.911012	46	1	2	90°	1	
16-Sep-2015	15:57:23	87	36.122024	-74.981419	45	1	1	90°	2	
20-Oct-2015	12:56:20	18	37.320546	-74.905230	61	5	1	90°	1	
20-Oct-2015	16:27:09	44	36.640850	-74.814448	52	4	2	110°	1	
21-Oct-2015	9:43:09	3	36.792723	-75.110107	54	2	2	90°	1	
21-Oct-2015	9:46:30	4	36.792980	-74.972057	54	2	2	90°	1	
21-Oct-2015	9:50:34	4	36.792945	-74.80349	54	2	2	90°	1	
21-Oct-2015	10:37:39	27	36.884350	-75.074101	55	2	1	90°	1	
21-Oct-2015	13:02:00	33	36.942946	-74.952635	56	1	1	60°	1	
21-Oct-2015	13:50:19	41	37.018821	-74.61567	57	1	1	90°	1	
21-Oct-2015	14:14:22	51	37.092730	-75.05231	58	2	2	90°	1	
21-Oct-2015	15:04:53	71	37.167618	-74.87101	59	2	2	90°	1	
21-Oct-2015	15:08:34	72	37.166825	-75.01983	59	2	2	90°	1	
16-Nov-2015	9:18:56	8	36.719856	-74.852225	53	2	1	90°	1	
16-Nov-2015	9:22:08	9	36.719524	-74.985730	53	2	1	90°	1	
16-Nov-2015	9:32:16	10	36.792760	-75.018250	54	2	3	90°	1	

Date	Time	Way Point	Latitude	Longitude	Track Number	BSS	Angle out	Degree Forward	Best #	Off-Effort (*)
16-Nov-2015	9:33:35	11	36.792975	-74.964312	54	2	4	80°	1	
16-Nov-2015	10:10:31	15	36.884973	-75.097962	55	2	2	60°	1	
16-Nov-2015	11:31:28	28	37.018752	-74.971225	57	2	3	90°	1	
16-Nov-2015	11:33:03	29	37.018520	-75.039114	57	2	2	90°	1	
16-Nov-2015	13:45:13	45	37.243038	-74.963681	60	2	3	90°	1	
16-Nov-2015	13:48:47	46	37.243111	-74.806788	60	2	2	90°	2	
16-Nov-2015	15:00:39	45	37.319962	-74.950277	61	2	2	60°	1	
17-Nov-2015	9:16:55	5	35.339287	-74.895524	34	3	2	80°	1	
17-Nov-2015	9:17:57	7	35.339421	-74.853617	34	3	3	90°	1	
17-Nov-2015	9:25:04	12	35.338364	-74.796400	34	3	3	90°	1	
17-Nov-2015	9:25:59	13	35.338578	-74.760054	34	3	4	70°	1	
17-Nov-2015	9:37:54	18	35.338681	-74.585520	34	3	4	60°	1	
17-Nov-2015	11:53:05	38	35.552381	-75.042784	37	2	2	90°	1	

Table 20. Leatherback sea turtle (*Dermochelys coriacea)* sightings in the Cape Hatteras and Norfolk Canyon survey area from January 2015 to December 2015. Asterisk denotes off-effort sighting.

Date	Time	Way Point	Latitude	Longitude	Track Number	BSS	Angle out	Degree Forward	Best #	Off-Effort (*)
24-May-2015	9:15:39	10	36.198467	-74.778116	46	1	3	90°	1	
14-Aug-2015	16:20:34	45	36.122619	-75.020559	45	3	2	90°	1	
15-Sep-2015	9:30:33	11	35.341665	-74.904944	34	4	1	90°	1	
15-Sep-2015	13:54:11	51	35.621799	-75.125405	38	1	1	90°	1	
15-Sep-2015	13:58:58	53	35.621733	-74.943438	38	1	1	90°	1	
15-Sep-2015	14:22:14	44	35.687659	-74.377068	39	3	2	90°	1	*
16-Sep-2015	13:33:23	70	36.348209	-74.990219	48	1	1	90°	1	
16-Sep-2015	14:05:07	55	36.348337	-74.481218	48	1	2	90°	1	
20-Oct-2015	12:05:45	17	37.243501	-74.704450	60	4	2	120°	1	
16-Nov-2015	11:34:24	30	37.018578	-75.097403	57	2	1	90°	1	
17-Nov-2015	11:46:14	36	35.553584	-74.922910	37	2	2	90°	1	

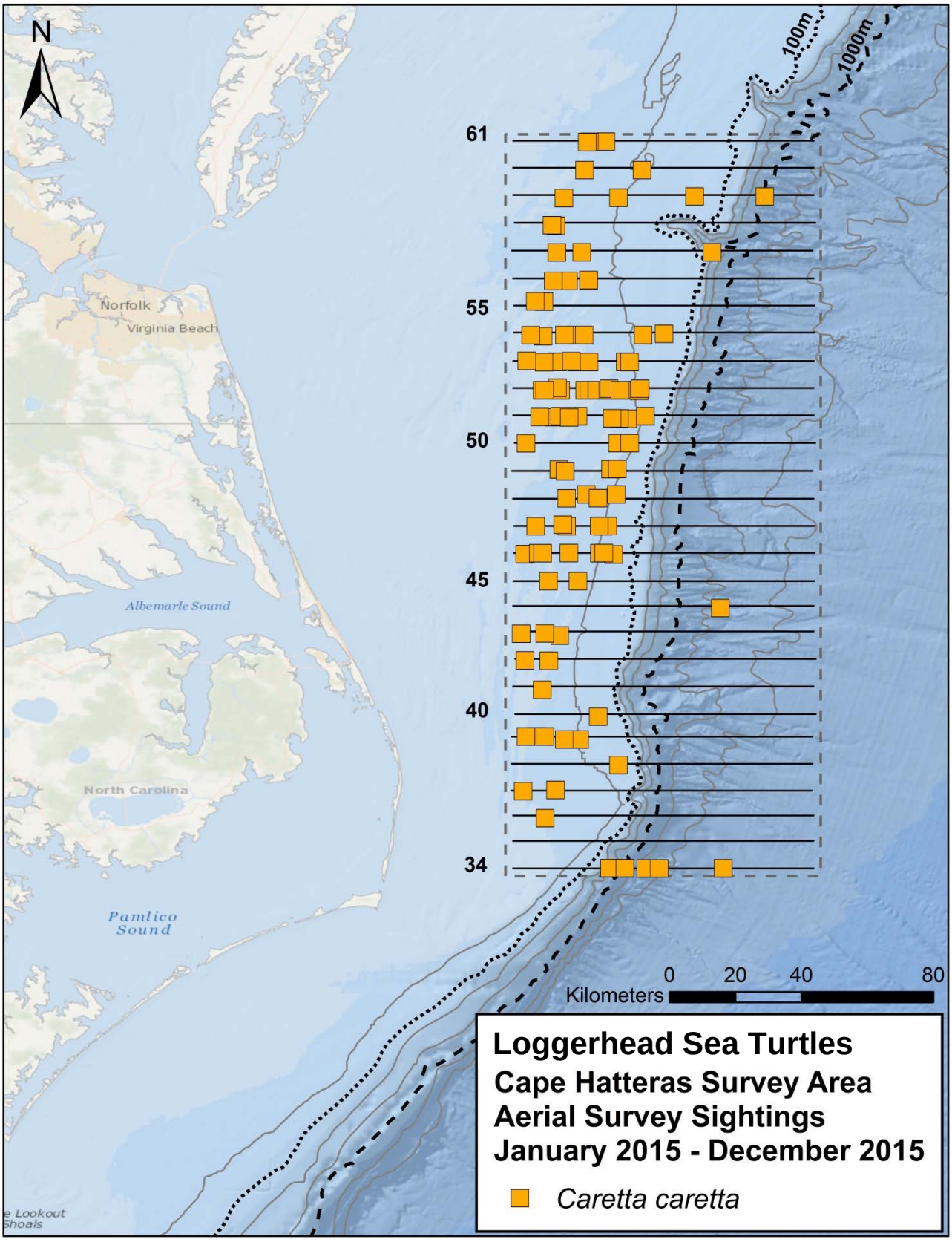

Figure 23. Loggerhead sea turtle (*Caretta caretta*) sightings.

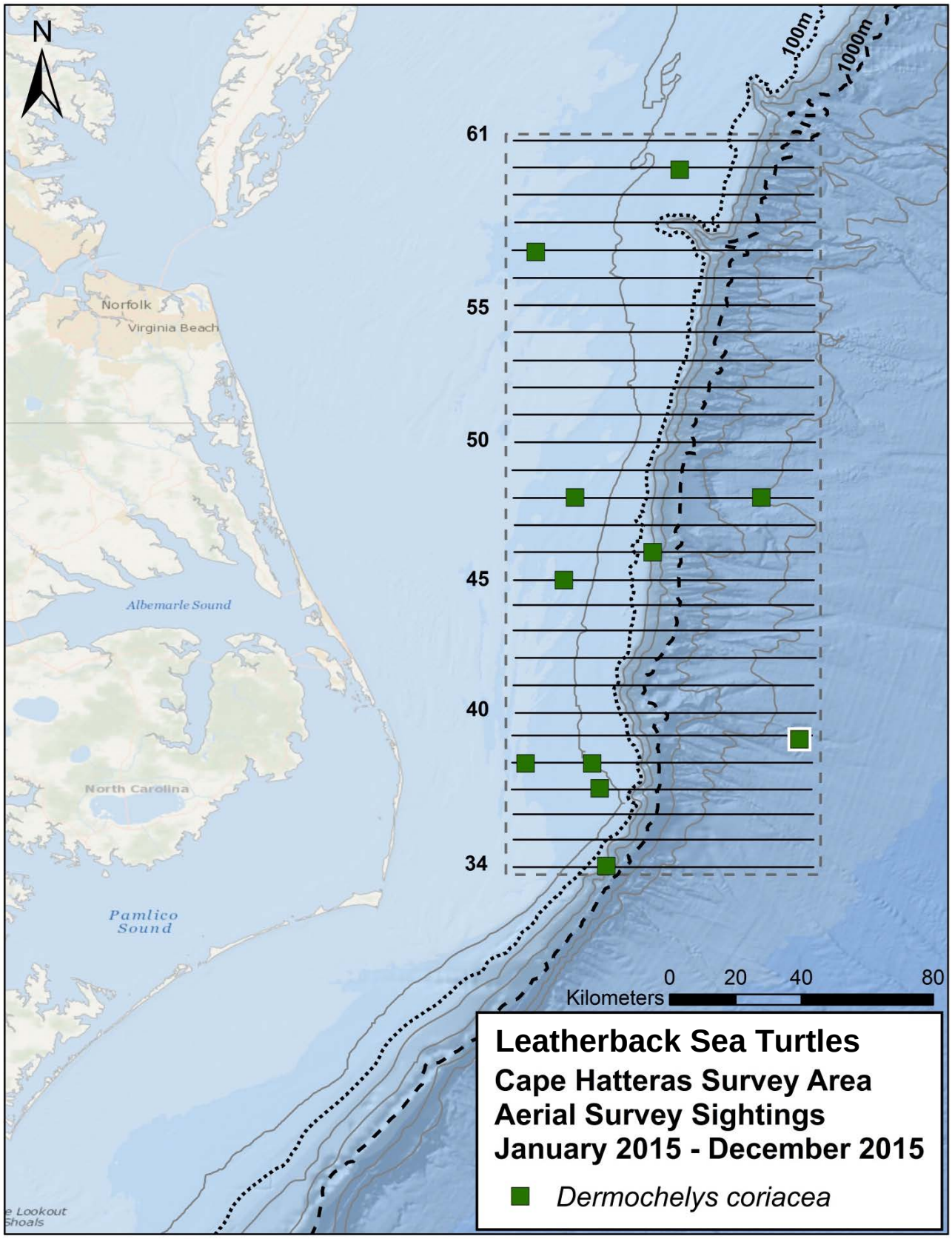

Figure 24. Leatherback sea turtle (*Dermochelys coriacea)* sightings. White outline denotes off-effort sighting.

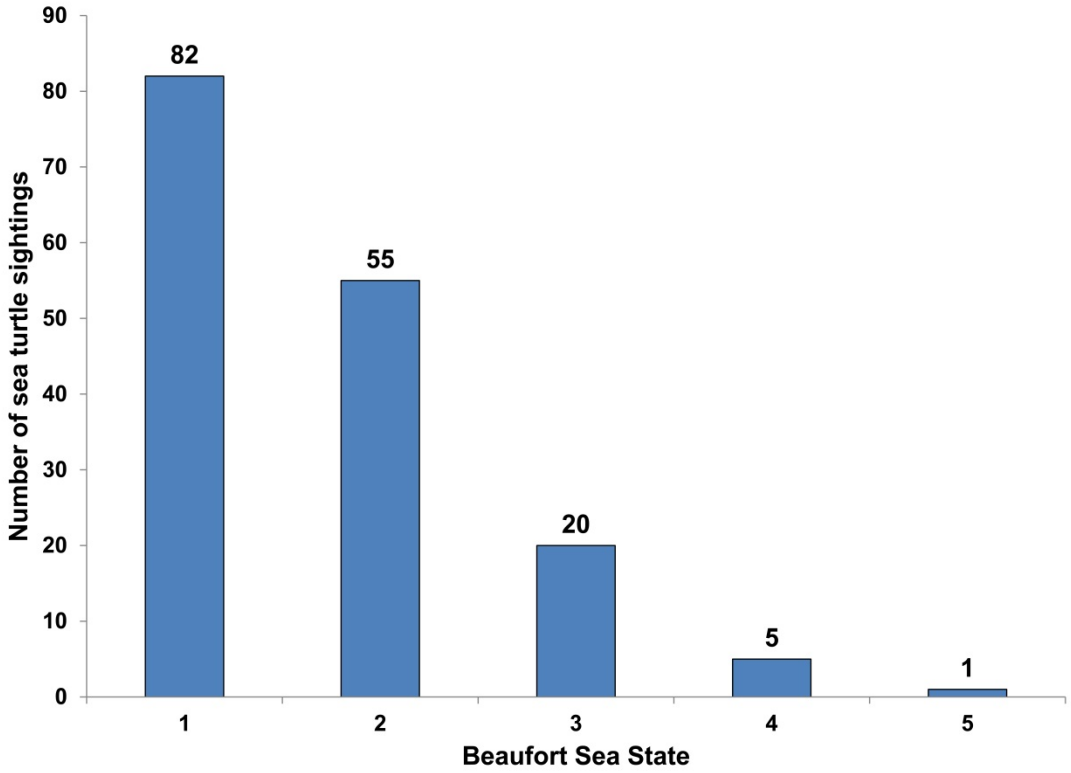

Figure 25a. Total number of sea turtle sightings by Beaufort sea state in the Cape Hatteras and Norfolk Canyon survey area from January 2015 to December 2015.

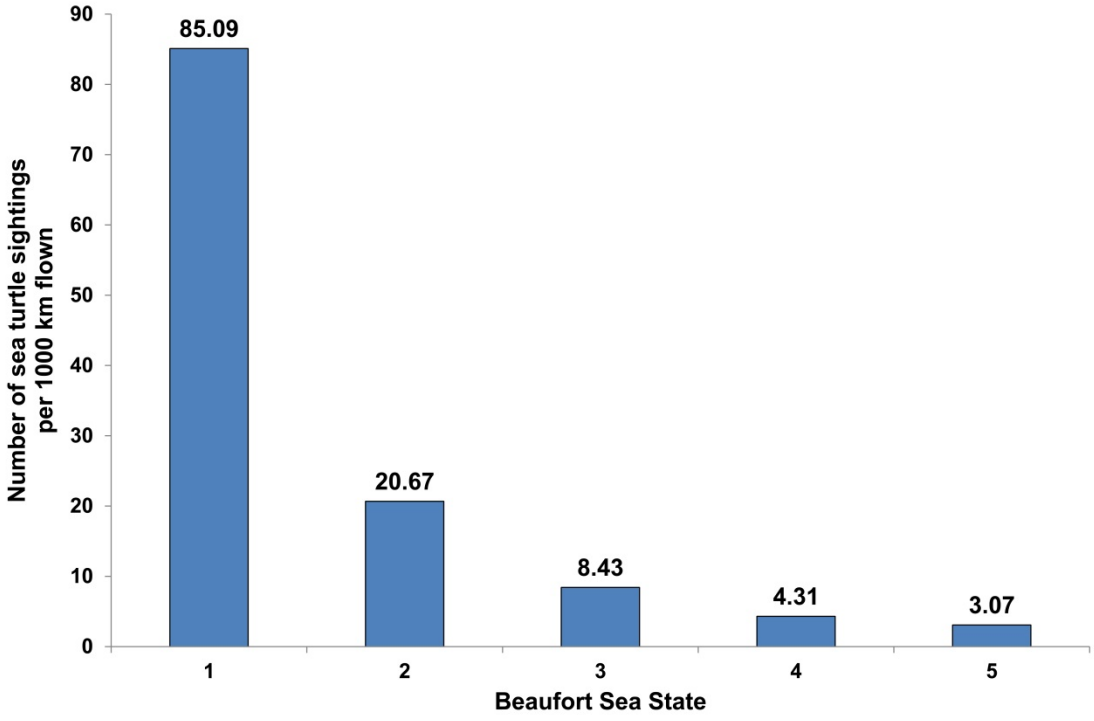

Figure 25b. Sea turtle sightings per 1,000 km flown by Beaufort sea state in the Cape Hatteras and Norfolk Canyon survey area from January 2015 to December 2015.

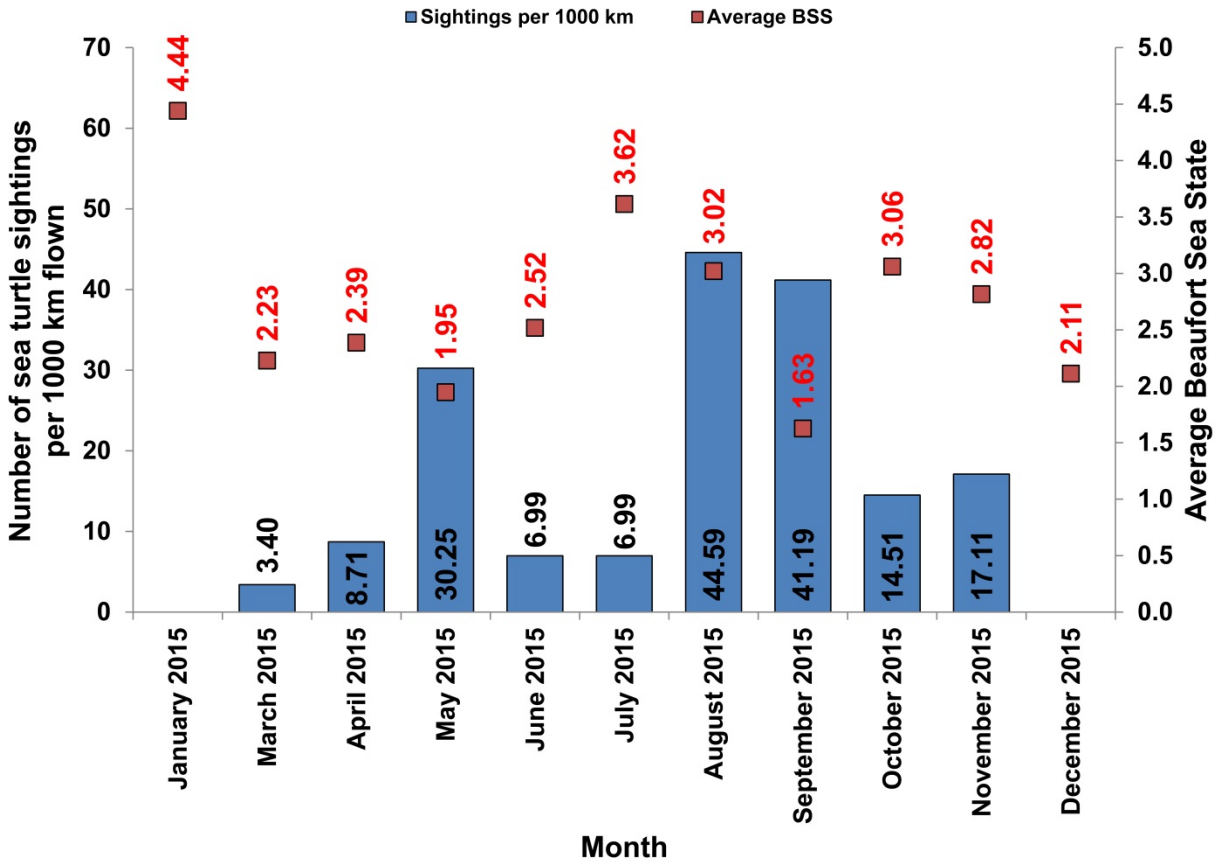

Figure 25c. Sea turtle sightings per 1,000 km surveyed and the distance-weighted average Beaufort sea state per month in the Cape Hatteras and Norfolk Canyon survey area from January 2015 to December 2015.

4.5 Other Marine Vertebrate Sightings

4.5.1 Cartilaginous Fishes (Chondrichthyes)

Forty-one unidentified sharks or rays were recorded during the reporting period largely inshore of the 1000-m isobath (**Tables 21**). Three species of sharks could be identified from the air: a great white shark (**Table 22**), four basking sharks (**Table 23**) and one whale shark (**Table 24**). Two species of rays were identified: 48 manta rays (**Table 25**) and over 4,000 cownose rays (**Table 26**). All sightings are represented in **Figure 26**.

Table 21. Unidentified chondrichthyan fish sightings in the Cape Hatteras and Norfolk Canyon survey area from January 2015 to December. 2015.

Date	Time	Way Point	Latitude	Longitude	Track Number	BSS	Angle out	Degree Forward	Best #	Comments
24-May-2015	9:22:00	11	36.198538	-74.658769	46	2	1	90°	1	Hammerhead
24-May-2015	10:00:47	21	36.121498	-74.789019	45	3	1	90°	1	Hammerhead
24-May-2015	11:20:40	45	35.972781	-74.754444	43	2	1	90°	1	Shark
24-May-2015	14:38:18	77	35.753333	-74.826499	40	2	1	90°	1	Hammerhead
15-Aug-2015	8:59:07	4	36.043997	-74.957104	44	3	1	90°	1	Shark
15-Sep-2015	15:13:53	79	35.974998	-74.880182	43	1	2	90°	1	Hammerhead
15-Sep-2015	15:14:28	58	35.977652	-74.854901	43	1	2	90°	1	Shark
15-Sep-2015	16:08:10	72	36.049287	-74.896894	44	1	1	90°	3	Hammerhead
16-Sep-2015	10:41:51	48	36.498105	-74.541125	50	1	1	90°	1	Shark
16-Sep-2015	13:39:36	73	36.348609	-74.749670	48	1	1	90°	4	Large rays
16-Sep-2015	15:46:06	124	36.122343	-74.766698	45	1	2	90°	1	Large ray
16-Sep-2015	15:46:57	125	36.122413	-74.802022	45	1	2	90°	1	Shark
20-Oct-2015	11:03:38	3	37.092122	-74.514689	58	4	2	90°	1	Hammerhead
20-Oct-2015	11:04:57	4	37.091909	-74.460530	58	4	1	90°	1	Shark
20-Oct-2015	11:39:17	9	37.169445	-74.651284	59	4	1	90°	1	Hammerhead
20-Oct-2015	15:39:18	31	36.720932	-74.586060	53	4	3	90°	1	Large ray
21-Oct-2015	9:48:47	6	36.793092	-74.877069	54	2	2	90°	1	Hammerhead
21-Oct-2015	13:14:44	44	36.943108	-74.634939	56	2	1	90°	12	Hammerhead
21-Oct-2015	14:17:03	83	37.092965	-74.941908	58	1	2	90°	1	Hammerhead
16-Nov-2015	13:49:47	47	37.243125	-74.762933	60	2	2	90°	1	Hammerhead
17-Nov-2015	9:15:36	6	35.338998	-74.948499	34	3	2	100°	1	Shark
17-Nov-2015	9:17:45	6	35.339487	-74.861794	34	3	4	70°	1	Shark
17-Nov-2015	11:39:11	33	35.553075	-74.844616	37	2	2	90°	3	Hammerhead

Table 22. Great white shark (*Carcharodon carcharias)* sighting in the Cape Hatteras and Norfolk Canyon survey area from January 2015 to December 2015.

Date	Time	Way Point	Latitude	Longitude	Track Number	BSS	Angle out	Degree Forward	Best #	
7-Apr-2015	9:42:21	7	37.171093	-74.472110	59	3	1	90°	1	

Table 23. Basking shark (*Cetorhinus maximus*) sightings in the Cape Hatteras and Norfolk Canyon survey area from January 2015 to December 2015.

Date	Time	Way Point	Latitude	Longitude	Track Number	BSS	Angle out	Degree Forward	Best #	
19-Mar-2015	14:04:55	8	36.938477	-74.435851	56	3	1	90°	1	
19-Mar-2015	15:11:34	18	36.792721	-74.494407	54	2	1	90°	1	
7-Apr-2015	10:42:54	16	37.320781	-74.681213	61	3	1	90°	1	
7-Apr-2015	14:13:48	34	36.431136	-74.702984	49	2	2	90°	1	

Table 24. Whale shark (*Rhincodon typus*) sighting in the Cape Hatteras and Norfolk Canyon survey area from January 2015 to December 2015.

Date	Time	Way Point	Latitude	Longitude	Track Number	BSS	Angle out	Degree Forward	Best #	
21-Oct-2015	13:50:58	42	37.019323	-74.64254	57	1	3	90°	1	

Table 25. Manta Rays (*Manta birostris*) sightings in the Cape Hatteras and Norfolk Canyon survey area from January 2015 to December 2015.

Date	Time	Way Point	Latitude	Longitude	Track Number	BSS	Angle out	Degree Forward	Best #	
24-May-2015	10:30:44	41	36.048577	-74.815578	44	2	2	90°	2	
24-May-2015	11:04:05	40	35.973230	-74.540942	43	2	1	90°	1	
24-May-2015	13:30:20	83	35.696432	-74.832808	39	2	2	90°	1	
24-May-2015	13:30:46	57	35.696400	-74.814982	39	2	2	45°	1	
24-May-2015	14:37:18	76	35.753370	-74.788411	40	2	2	90°	3	
24-May-2015	14:39:06	78	35.753241	-74.857289	40	2	1	90°	3	
24-May-2015	14:41:17	80	35.752472	-74.942894	40	2	2	90°	1	
24-May-2015	15:53:16	103	35.906769	-74.837829	42	2	1	90°	3	
18-Jun-2015	15:36:58	90	35.759416	-74.563465	40	3	2	90°	1	
14-Aug-2015	11:13:48	15	35.405888	-74.799956	35	4	1	90°	1	
15-Aug-2015	9:24:44	7	35.973469	-74.609538	43	4	2	90°	2	
15-Aug-2015	11:01:54	22	35.757519	-74.854612	40	4	1	90°	1	
15-Aug-2015	14:00:10	59	36.563441	-74.788214	51	2	2	130°	1	

Date	Time	Way Point	Latitude	Longitude	Track Number	BSS	Angle out	Degree Forward	Best #	
15-Aug-2015	14:20:48	72	36.642857	-75.003044	52	1	1	90°	1	
15-Aug-2015	14:26:33	55	36.642393	-74.767181	52	1	1	90°	1	
15-Aug-2015	14:34:48	84	36.638887	-74.661431	52	2	2	90°	1	
15-Sep-2015	14:00:06	54	35.621818	-74.900298	38	1	2	90°	1	
15-Sep-2015	15:13:52	57	35.975032	-74.880622	43	1	3	90°	1	
15-Sep-2015	15:16:18	80	35.979848	-74.783235	43	1	2	90°	2	
15-Sep-2015	15:16:28	59	35.979867	-74.777095	43	1	1	90°	2	
15-Sep-2015	16:03:26	71	36.048465	-74.720854	44	1	2	90°	1	
15-Sep-2015	16:05:13	103	36.049083	-74.787462	44	1	2	90°	1	
16-Sep-2015	10:12:02	35	36.571663	-74.848616	51	1	1	90°	1	
16-Sep-2015	10:14:17	27	36.571876	-74.935398	51	2	1	90°	1	
16-Sep-2015	11:03:28	57	36.421998	-74.689106	49	1	2	90°	1	
16-Sep-2015	13:39:30	50	36.348606	-74.753543	48	1	1	60°	3	
16-Sep-2015	14:43:39	68	36.271654	-75.118863	47	1	1	90°	1	
16-Sep-2015	15:41:18	83	36.122209	-74.579464	45	1	1	90°	1	
16-Sep-2015	15:46:30	84	36.122162	-74.783066	45	1	2	90°	3	
21-Oct-2015	10:04:39	13	36.790728	-74.492728	54	2	1	90°	2	
17-Nov-2015	9:09:18	3	35.338814	-75.128588	34	3	1	90°	1	
17-Nov-2015	12:57:14	58	35.686946	-74.934173	39	4	1	90°	1	
17-Nov-2015	12:58:23	59	35.686960	-74.987428	39	4	1	90°	1	

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Table 26. Cownose ray (*Rhinoptera bonasus*) sightings in the Cape Hatteras and Norfolk Canyon survey area from January 2015 to December 2015.

Date	Time	Way Point	Latitude	Longitude	Track Number	BSS	Angle out	Degree Forward	Best #	
24-May-2015	10:26:57	28	36.045315	-74.956987	44	2	3	90°	60	
24-May-2015	11:30:03	75	35.973782	-74.955340	43	2	2	90°	50	
24-May-2015	11:30:56	76	35.973729	-74.991483	43	2	2	90°	50	
24-May-2015	14:37:35	113	35.753764	-74.799765	40	1	3	90°	100	
24-May-2015	14:44:56	82	35.752006	-75.084790	40	2	1	90°	100	
24-May-2015	16:00:33	106	35.906389	-74.956265	42	2	1	90°	220	
24-May-2015	16:01:15	107	35.906338	-74.984065	42	2	1	90°	200	
24-May-2015	16:01:17	154	35.906433	-74.985471	42	2	2	90°	80	
20-Jul-2015	14:39:24	44	36.789987	-75.084234	54	3	1	100°	50	
20-Jul-2015	14:46:40	48	36.721900	-75.045196	53	3	1	90°	350	
20-Jul-2015	15:55:53	65	36.640350	-74.916667	52	3	1	90°	550	
21-Jul-2015	9:09:27	2	36.570275	-75.012746	51	3	2	90°	450	
15-Aug-2015	15:20:31	101	36.719309	-74.977659	53	1	2	90°	450	
16-Sep-2015	9:14:15	3	36.647439	-74.954038	52	1	3	90°	65	
16-Sep-2015	9:14:48	4	36.647043	-74.932338	52	1	1	90°	110	
16-Sep-2015	9:14:58	4	36.647102	-74.925364	52	1	2	90°	900	
16-Sep-2015	9:15:21	5	36.646853	-74.910216	52	1	2	90°	100	
16-Sep-2015	10:29:05	45	36.497980	-75.042030	50	1	1	90°	200	
16-Sep-2015	10:29:05	45	36.497980	-75.042030	50	1	1	90°	200	

4.5.2 Other fishes

Eighteen ocean sunfish were recorded, with the majority offshore of the 100-m isobath (**Table 27, Figure 26**).

Table 27. Ocean sunfish (*Mola mola)* sightings in the Cape Hatteras and Norfolk Canyon survey area from January 2015 to December 2015

Date	Time	Way Point	Latitude	Longitude	Track Number	BSS	Angle out	Degree Forward	Best #	
7-Apr-2015	13:37:54	32	36.488281	-74.725091	50	2	1	90°	1	
7-Apr-2015	13:49:50	37	36.498349	-74.568154	50	2	2	90°	1	
7-Apr-2015	15:00:11	56	36.348634	-74.766707	48	2	1	90°	1	
14-Aug-2015	12:19:00	21	35.552686	-74.700869	37	3	1	90°	1	
15-Aug-2015	15:25:01	72	36.719345	-75.049634	53	1	1	60°	1	

Date	Time	Way Point	Latitude	Longitude	Track Number	BSS	Angle out	Degree Forward	Best #	
15-Sep-2015	11:53:15	30	35.549848	-75.087556	37	2	2	90°	1	
16-Sep-2015	11:05:36	40	36.421984	-74.772835	49	2	2	60°	1	
16-Sep-2015	14:56:06	106	36.196401	-75.010405	46	1	1	90°	1	
16-Sep-2015	15:01:25	73	36.198547	-74.805793	46	1	1	90°	3	
16-Sep-2015	15:13:50	76	36.198604	-74.587109	46	1	3	90°	1	
21-Oct-2015	9:46:36	5	36.792946	-74.968309	54	2	2	90°	2	
21-Oct-2015	13:30:31	53	36.942953	-74.419248	56	2	2	90°	1	
21-Oct-2015	13:59:12	74	37.019636	-74.821279	57	2	1	90°	1	
16-Nov-2015	9:09:01	5	36.719653	-74.442734	53	3	1	90°	1	
17-Nov-2015	12:47:09	54	35.687576	-74.641301	39	3	1	90°	1	

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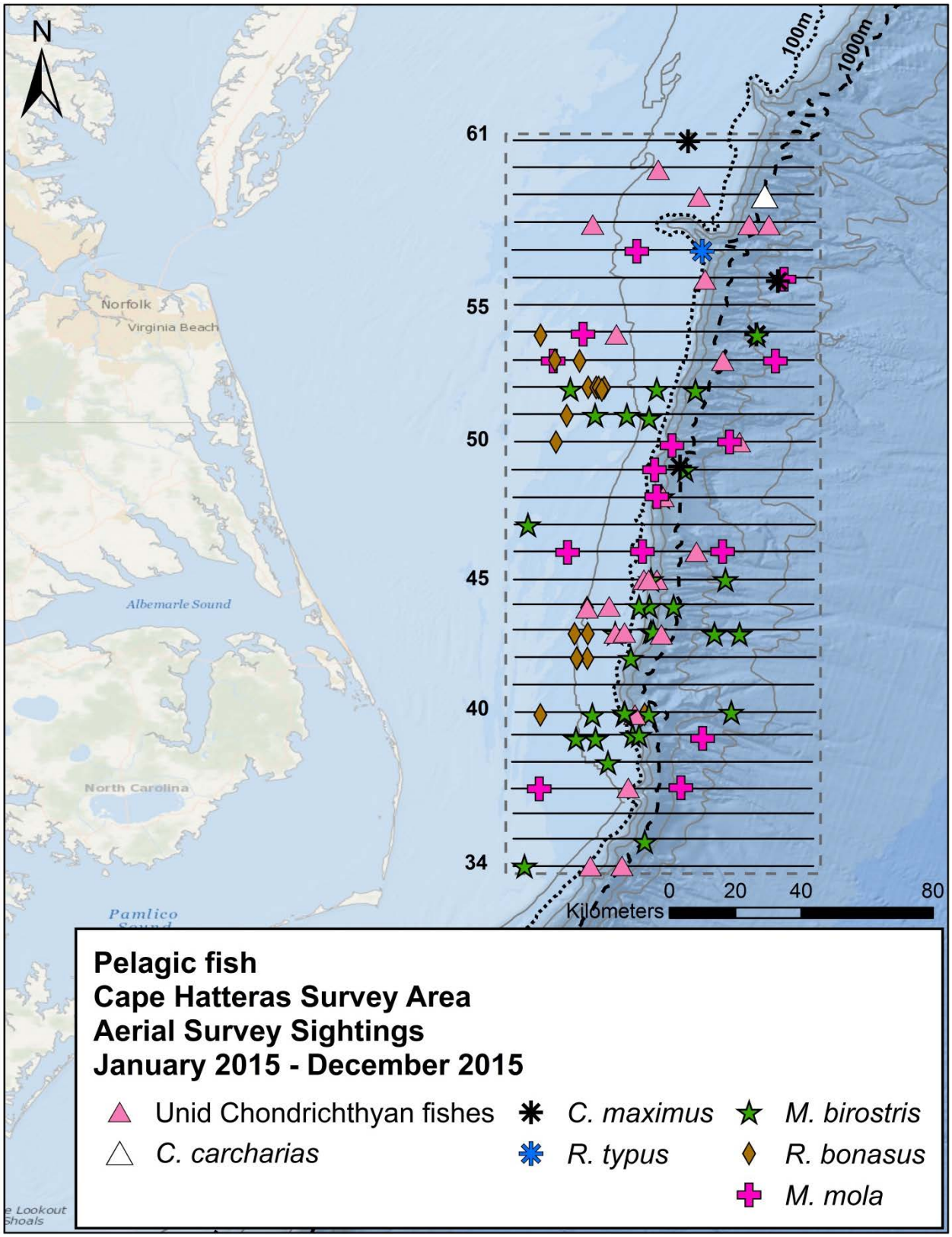

Figure 26. Great white shark (*Carcharodon carcharias*), basking shark (*Cetorhinus maximus*), whale shark (*Rhincodon typus*), manta ray (*Manta birostris*), cownose ray (*Rhinoptera bonasus),* ocean sunfish (*Mola mola*), and unidentified chondrichthyan fish sightings.

4.6 Vessel Sightings

4.6.1 Commercial

A total of 54 commercial vessels (e.g., tankers, car carriers, and container vessels) was observed in the survey area (**Table 28, Figure 27**).

Table 28. Commercial vessel sightings in the Cape Hatteras and Norfolk Canyon survey area from January 2015 to December 2015.

Date	Time	Way Point	Latitude	Longitude	Track Number	BSS	Angle out	Degree Forward	Best #	Comments
19-Mar-2015	14:44:56	16	36.873026	-74.671920	55	2	4	90°	1	Cargo vessel
19-Mar-2015	14:49:27	17	36.872856	-74.506717	55	2	3	90°	1	Cargo vessel
7-Apr-2015	14:24:14	37	36.422113	-74.973982	49	2	3	60°	1	Cargo vessel
24-May-2015	10:02:10	31	36.121757	-74.844276	45	3	3	45°	1	Cargo vessel
24-May-2015	10:33:05	43	36.049671	-74.726988	44	3	1	90°	1	Cargo vessel
24-May-2015	15:09:29	126	35.833493	-74.620253	41	1	2	90°	1	Car carrier
18-Jun-2015	10:17:11	4	35.339063	-74.664856	34	2	4	90°	1	Cargo vessel
18-Jun-2015	11:10:12	14	35.475867	-74.895516	36	2	1	90°	1	Cargo vessel
18-Jun-2015	11:48:15	24	35.552683	-74.552917	37	2	3	45°	1	Cargo vessel
20-Jul-2015	11:07:25	18	37.021218	-74.824222	57	3	2	60°	1	Cargo vessel
20-Jul-2015	15:38:29	61	36.639279	-74.643917	52	3	4	60°	1	Cargo vessel
21-Jul-2015	9:37:19	7	36.490434	-74.676712	50	3	2	60°	1	Cargo vessel
21-Jul-2015	9:38:44	8	36.490410	-74.735158	50	3	2	45°	1	Cargo vessel
14-Aug-2015	11:35:36	22	35.476289	-75.051265	36	3	3	45°	1	Commercial fishing vessel
15-Aug-2015	13:20:49	42	36.428412	-74.704314	49	2	4	90°	3	Commercial fishing vessels
15-Aug-2015	13:22:08	32	36.428616	-74.649792	49	2	4	45°	1	Cargo vessel
15-Aug-2015	13:54:34	57	36.558110	-74.552056	51	2	4	70°	1	Cargo vessel
15-Aug-2015	13:58:29	58	36.561946	-74.717252	51	2	4	90°	1	Recreational fishing vessel
15-Aug-2015	15:06:37	65	36.719482	-74.674168	53	2	3	45°	1	Research vessel
15-Aug-2015	15:27:05	107	36.718231	-75.096315	53	1	4	100°	1	Commercial vessel
15-Sep-2015	9:20:14	3	35.340807	-75.135612	34	2	3	90°	1	Car carrier
15-Sep-2015	9:21:10	4	35.341005	-75.100159	34	2	4	45°	1	Car carrier
15-Sep-2015	11:06:52	32	35.550038	-74.411011	37	3	3	45°	1	Commercial fishing vessel
15-Sep-2015	13:56:10	52	35.621586	-75.049620	38	1	4	90°	1	Tanker
15-Sep-2015	14:55:17	75	35.689973	-75.066681	39	1	4	90°	1	Car carrier

Date	Time	Way Point	Latitude	Longitude	Track Number	BSS	Angle out	Degree Forward	Best #	Comments
15-Sep-2015	15:19:00	81	35.979679	-74.680010	43	1	4	90°	1	Research vessel
15-Sep-2015	15:51:48	96	36.048263	-74.464349	44	2	2	90°	2	Commercial fishing vessel
15-Sep-2015	15:52:36	97	36.048415	-74.495017	44	2	2	60°	2	Commercial fishing vessel
16-Sep-2015	13:36:25	48	36.348522	-74.873461	48	1	4	45°	1	Cargo vessel
16-Sep-2015	15:12:48	113	36.198592	-74.626693	46	1	2	60°	1	Yacht
20-Oct-2015	11:23:51	6	37.170280	-74.419141	59	4	3	45°	1	Tanker
20-Oct-2015	12:08:41	13	37.242107	-74.588031	60	5	3	60°	1	Commercial fishing vessel
20-Oct-2015	12:09:19	18	37.243209	-74.561487	60	4	3	90°	2	Trawl vessel
21-Oct-2015	9:51:40	7	36.793115	-74.758117	54	2	4	45°	1	Tanker
21-Oct-2015	9:52:46	8	36.792989	-74.713877	54	2	4	60°	1	Tanker
21-Oct-2015	10:17:37	20	36.871380	-74.430717	55	2	2	90°	1	Commercial fishing vessel
21-Oct-2015	12:57:06	20	36.942693	-75.148974	56	2	4	60°	1	Cargo vessel
21-Oct-2015	13:09:44	39	36.942920	-74.762875	56	2	1	60°	1	Commercial fishing vessel
21-Oct-2015	13:30:31	32	36.942932	-74.419114	56	1	3	90°	1	Cargo vessel
21-Oct-2015	13:50:17	67	37.018813	-74.614373	57	2	2	90°	1	Commercial fishing vessel
21-Oct-2015	14:15:50	82	37.092860	-74.992135	58	1	4	60°	1	Tanker
21-Oct-2015	14:58:35	70	37.165693	-74.616677	59	2	1	90°	1	Cargo vessel
16-Nov-2015	8:46:44	3	36.567939	-74.903794	51	3	4	20°	1	Commercial vessel
16-Nov-2015	9:14:20	6	36.719352	-74.661036	53	3	2	50°	1	Commercial fishing vessel
16-Nov-2015	9:18:27	7	36.719813	-74.831691	53	2	4	90°	1	Cargo vessel
16-Nov-2015	9:34:38	12	36.792986	-74.921537	54	2	1	40°	1	Cargo vessel
16-Nov-2015	10:19:19	18	36.942260	-74.949589	56	2	3	90°	1	Commercial fishing vessel
16-Nov-2015	13:40:59	35	37.242749	-75.146473	60	2	4	20°	1	Cargo vessel
16-Nov-2015	14:04:24	38	37.318444	-74.383931	61	2	1	90°	2	Tug and barge
7-Dec-2015	10:26:16	16	37.169534	-75.115593	59	2	3	90°	1	Cargo vessel

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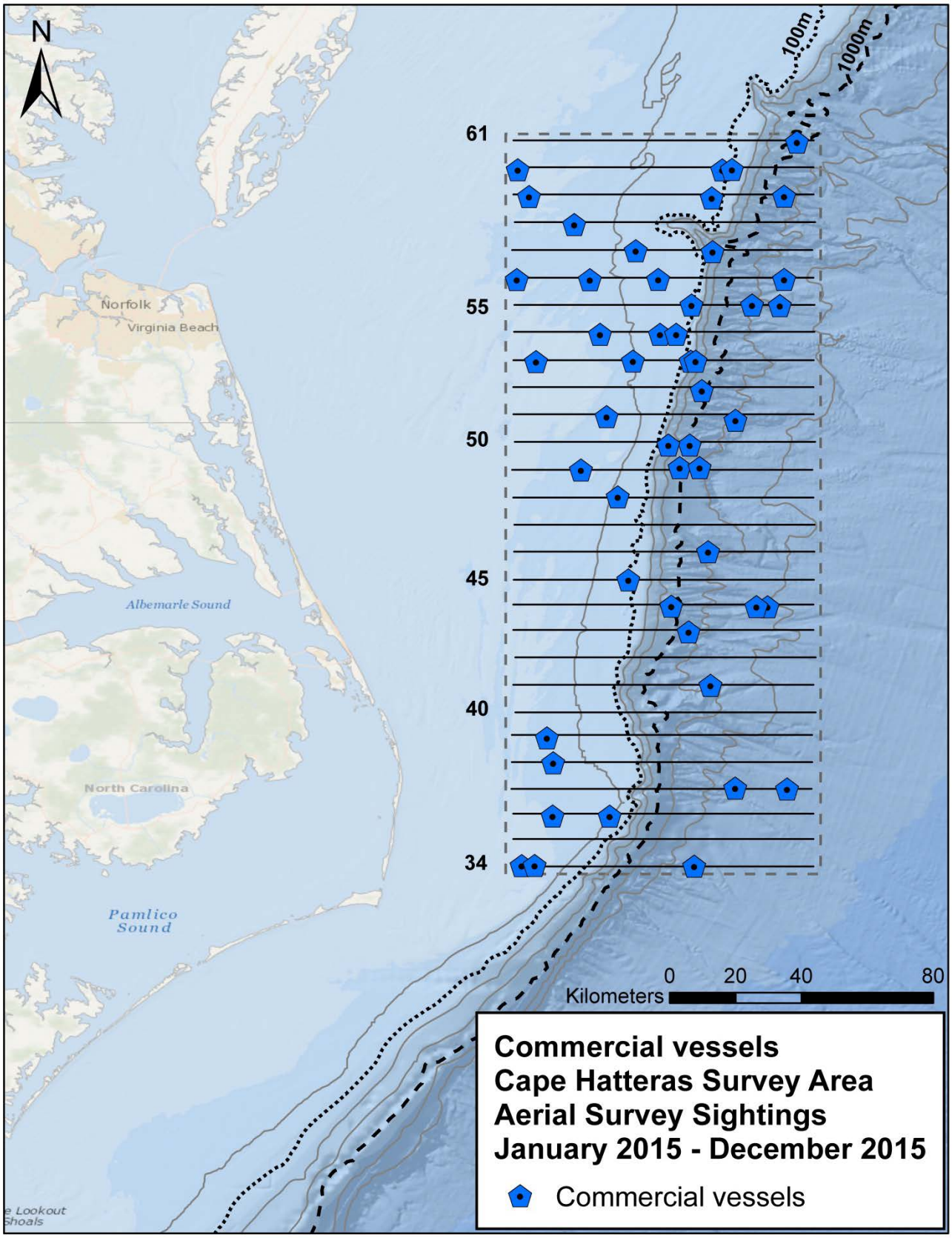

Figure 27. Commercial vessel sightings.

4.6.2 Military Vessels

Seven military vessels were observed in the survey area (**Table 29, Figure 28**).

Table 29. Military vessel sightings in the Cape Hatteras and Norfolk Canyon survey area from January 2015 to December 2015.

Date	Time	Way Point	Latitude	Longitude	Track Number	BSS	Angle out	Degree Forward	Best #	Comments
19-Mar-2015	13:27:16	3	37.022226	-75.112172	57	2	3	45°	1	Military
19-Mar-2015	14:34:50	15	36.872417	-75.036157	55	2	4	110°	1	Military
20-Jul-2015	14:39:52	45	36.789814	-75.102764	54	3	4	90°	1	Military
14-Aug-2015	12:05:20	18	35.510649	-74.308323	37	3	1	90°	1	Military
16-Sep-2015	10:57:45	38	36.421544	-74.462613	49	2	3	45°	1	Military
20-Oct-2015	15:33:08	29	36.720916	-74.839558	53	3	2	60°	1	Military
20-Oct-2015	16:34:27	32	36.639946	-75.115764	52	5	4	45°	1	Military

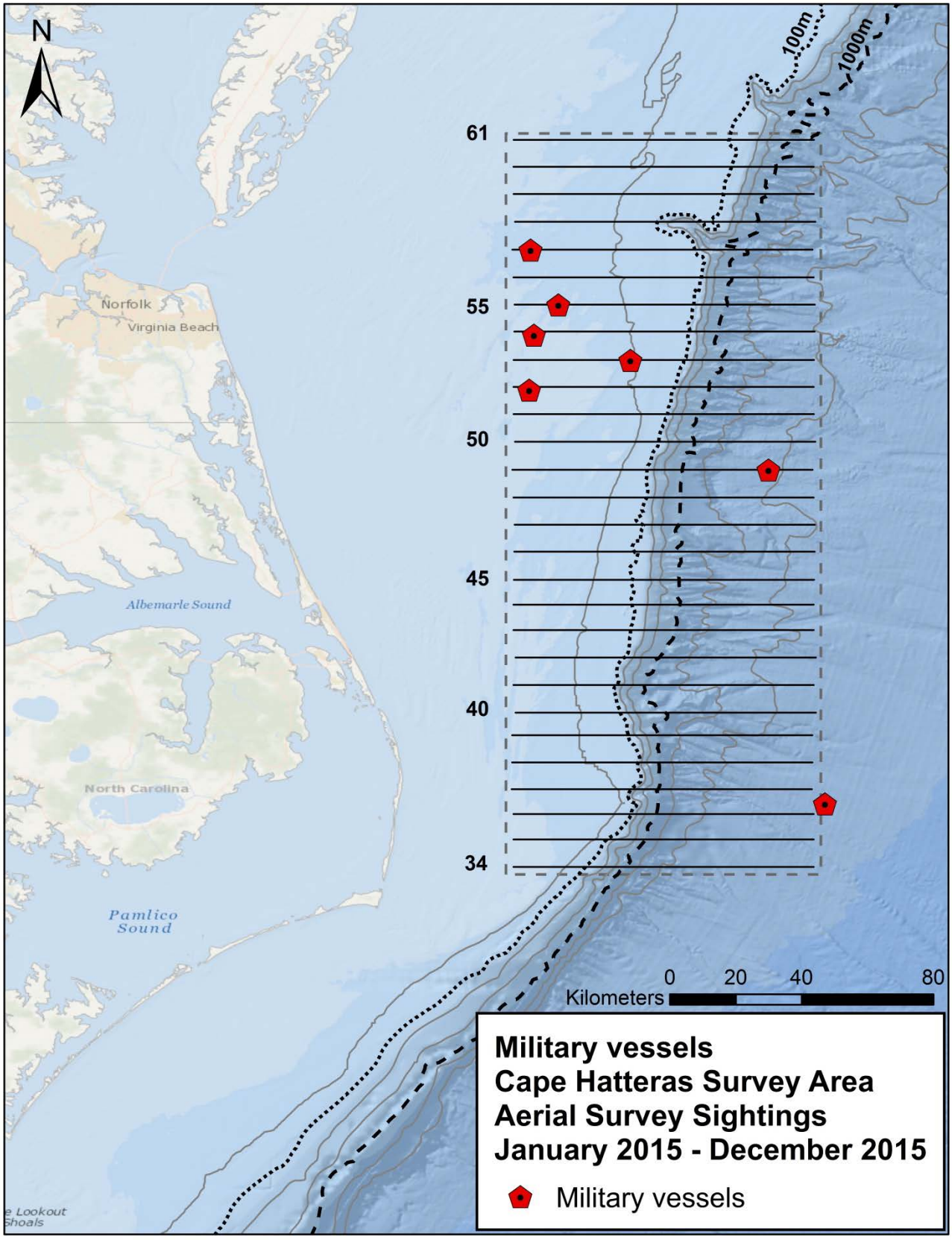

Figure 28. Military vessel sightings.

4.6.3 Other Vessels

A total of 177 other vessels was recorded in the survey area (**Table 30, Figure 29**). These included one sailboat, and recreational sport-fishing vessels.

Table 30. Other vessel sightings in the Cape Hatteras and Norfolk Canyon survey area from January 2015 to December 2015.

Date	Time	Way Point	Latitude	Longitude	Track Number	BSS	Angle out	Degree Forward	Best #	Comments
24-May-2015	9:08:20	5	36.198258	-74.926453	46	1	3	60°	1	Sailboat
24-May-2015	14:37:00	112	35.753853	-74.777583	40	1	3	90°	1	Recreational fishing vessel
24-May-2015	14:46:18	115	35.752257	-75.138116	40	1	3	90°	5	Recreational fishing vessel
15-Aug-2015	13:58:29	58	36.561946	74.717252	51	2	4	90°	1	Recreational fishing vessel
15-Aug-2015	14:07:49	62	36.570084	-75.101253	51	1	4	80°	1	Recreational fishing vessel
15-Aug-2015	14:22:18	74	36.642605	-74.940352	52	1	4	90°	1	Recreational fishing vessel
15-Aug-2015	14:25:40	80	36.642342	-74.802400	52	1	3	90°	1	Recreational fishing vessel
15-Sep-2015	14:02:01	36	35.621874	-74.826791	38	1	2	30°	4	Recreational fishing vessel
15-Sep-2015	14:02:38	55	35.621929	-74.802746	38	1	2	45°	2	Recreational fishing vessel
15-Sep-2015	14:53:18	74	35.690225	-74.988039	39	1	3	90°	2	Recreational fishing vessel
15-Sep-2015	14:55:29	53	35.689945	-75.074677	39	1	3	90°	1	Recreational fishing vessel
15-Sep-2015	15:56:18	68	36.048803	-74.635169	44	1	2	90°	1	Recreational fishing vessel
15-Sep-2015	16:18:50	75	36.049516	-75.024894	44	1	2	90°	1	Recreational fishing vessel
16-Sep-2015	9:24:36	10	36.651677	-74.708008	52	1	2	90°	1	Recreational fishing vessel
16-Sep-2015	13:36:50	49	36.348614	-74.856984	48	1	3	60°	13	Recreational fishing vessel
16-Sep-2015	13:37:22	72	36.348458	-74.836438	48	1	3	60°	1	Recreational fishing vessel
16-Sep-2015	14:36:04	98	36.272102	-74.829070	47	1	1	90°	1	Recreational fishing vessel
16-Sep-2015	14:36:07	64	36.272092	-74.831131	47	1	2	90°	2	Recreational fishing vessel

Date	Time	Way Point	Latitude	Longitude	Track Number	BSS	Angle out	Degree Forward	Best #	Comments
16-Sep-2015	14:56:30	107	36.197364	-74.994759	46	1	1	45°	1	Recreational fishing vessel
21-Oct-2015	13:14:58	26	36.943176	-74.625662	56	1	2	90°	2	Recreational fishing vessel
21-Oct-2015	13:16:16	27	36.943057	-74.574423	56	1	1	90°	2	Recreational fishing vessel
24-May-2015	13:30:24	56	35.696515	-74.829642	39	2	3	90°	1	Recreational fishing vessel
24-May-2015	13:41:57	62	35.693393	-74.675729	39	2	4	90°	15	Recreational fishing vessel
24-May-2015	13:48:14	65	35.694012	-74.580091	39	2	3	90°	4	Recreational fishing vessel
24-May-2015	14:40:06	79	35.752914	-74.896519	40	2	3	45°	1	Recreational fishing vessel
24-May-2015	14:44:06	81	35.752195	-75.052113	40	2	3	60°	1	Recreational fishing vessel
24-May-2015	14:54:50	85	35.833194	-74.994564	41	2	4	90°	1	Recreational fishing vessel
18-Jun-2015	10:08:01	3	35.339746	-75.020063	34	2	4	60°	1	Recreational fishing vessel
18-Jun-2015	10:54:42	14	35.406278	-74.907876	35	2	1	90°	1	Recreational fishing vessel
18-Jun-2015	12:01:04	29	35.552828	-74.768919	37	2	3	60°	3	Recreational fishing vessel
18-Jun-2015	12:01:25	42	35.552879	-74.782208	37	2	1	90°	1	Recreational fishing vessel
18-Jun-2015	12:01:51	43	35.552874	-74.799211	37	2	4	90°	3	Recreational fishing vessel
15-Aug-2015	13:57:58	40	36.561469	-74.695268	51	2	4	90°	4	Recreational fishing vessel
15-Aug-2015	14:01:06	41	36.564134	-74.827570	51	2	4	90°	5	Recreational fishing vessel
15-Aug-2015	15:17:45	99	36.719493	-74.860943	53	2	2	90°	1	Recreational fishing vessel
15-Sep-2015	10:48:44	28	35.481402	-74.889204	36	2	3	90°	1	Recreational fishing vessel
15-Sep-2015	11:41:11	42	35.552243	-74.814115	37	2	1	90°	1	Recreational fishing vessel
16-Sep-2015	10:11:51	26	36.571844	-74.841636	51	2	3	45°	2	Recreational fishing vessel
16-Sep-2015	11:05:00	39	36.422103	-74.749559	49	2	4	90°	4	Recreational fishing vessel

Date	Time	Way Point	Latitude	Longitude	Track Number	BSS	Angle out	Degree Forward	Best #	Comments
16-Sep-2015	11:06:00	41	36.421996	-74.788934	49	2	3	90°	1	Recreational fishing vessel
21-Oct-2015	9:43:06	3	36.792369	-75.112558	54	2	2	90°	1	Recreational fishing vessel
21-Oct-2015	10:27:08	13	36.878165	-74.633925	55	2	3	90°	1	Recreational fishing vessel
21-Oct-2015	14:16:49	52	37.092979	-74.951355	58	2	3	60°	1	Recreational fishing vessel
21-Oct-2015	14:56:41	110	37.168885	-74.537268	59	2	3	90°	1	Recreational fishing vessel
16-Nov-2015	9:30:08	12	36.792697	-75.106249	54	2	2	45°	1	Recreational fishing vessel
16-Nov-2015	10:24:20	20	36.942415	-74.741623	56	2	3	40°	1	Recreational fishing vessel
24-May-2015	10:37:36	44	36.046907	-74.557171	44	3	1	90°	1	Recreational fishing vessel
18-Jun-2015	14:16:24	49	35.620519	-74.908772	38	3	4	90°	1	Recreational fishing vessel
18-Jun-2015	14:18:48	50	35.620512	-74.810092	38	3	3	90°	6	Recreational fishing vessel
18-Jun-2015	15:12:25	53	35.686787	-74.903582	39	3	2	60°	1	Recreational fishing vessel
18-Jun-2015	15:14:52	54	35.686443	-75.005174	39	3	1	90°	2	Recreational fishing vessel
18-Jun-2015	15:17:48	83	35.686597	-75.127587	39	3	1	45°	1	Recreational fishing vessel
18-Jun-2015	15:21:26	57	35.756193	-75.125399	40	3	2	60°	3	Recreational fishing vessel
20-Jul-2015	11:11:14	19	37.021206	-74.649971	57	3	2	60°	3	Recreational fishing vessel
20-Jul-2015	11:13:46	20	37.021078	-74.534134	57	3	2	90°	1	Recreational fishing vessel
20-Jul-2015	14:01:55	31	36.880137	-74.725704	55	3	4	60°	1	Recreational fishing vessel
14-Aug-2015	12:34:28	24	35.558630	-75.135453	37	3	2	90°	1	Recreational fishing vessel
14-Aug-2015	14:30:27	29	36.358776	-74.863188	48	3	3	60°	1	Recreational fishing vessel
14-Aug-2015	14:54:48	46	36.275761	-74.652690	47	3	4	60°	9	Recreational fishing vessel
14-Aug-2015	14:57:00	47	36.275300	-74.743777	47	3	2	90°	3	Recreational fishing vessel

Date	Time	Way Point	Latitude	Longitude	Track Number	BSS	Angle out	Degree Forward	Best #	Comments
14-Aug-2015	15:25:10	37	36.194852	-74.953000	46	3	1	90°	8	Recreational fishing vessel
15-Aug-2015	8:58:22	3	36.044143	-74.986705	44	3	2	45°	2	Recreational fishing vessel
15-Aug-2015	8:58:40	3	36.044112	-74.974882	44	3	2	90°	1	Recreational fishing vessel
15-Aug-2015	9:02:09	5	36.043767	-74.837909	44	3	3	90°	2	Recreational fishing vessel
15-Aug-2015	9:30:28	9	35.973415	-74.840907	43	3	3	90°	7	Recreational Fishing fleet
15-Aug-2015	9:47:41	12	35.904986	-74.912449	42	3	3	90°	6	Recreational Fishing fleet
15-Sep-2015	10:13:25	11	35.410026	-74.549762	35	3	3	60°	1	Larger fishing vessel
15-Sep-2015	11:30:37	23	35.550512	-74.668256	37	3	2	90°	1	Recreational fishing vessel
16-Nov-2015	9:18:37	7	36.719814	-74.838907	53	3	2	80°	1	Recreational fishing vessel
21-Jul-2015	11:14:17	18	35.825437	-75.001788	41	4	1	90°	1	Recreational fishing vessel
14-Aug-2015	11:41:12	24	35.476785	-74.833354	36	4	3	45°	1	Recreational fishing vessel
15-Aug-2015	9:48:29	13	35.904929	-74.881033	42	4	3	90°	9	Recreational fishing vessel
20-Oct-2015	12:09:19	18	37.243209	-74.561487	60	4	3	90°	2	Trawl vessel

1

2

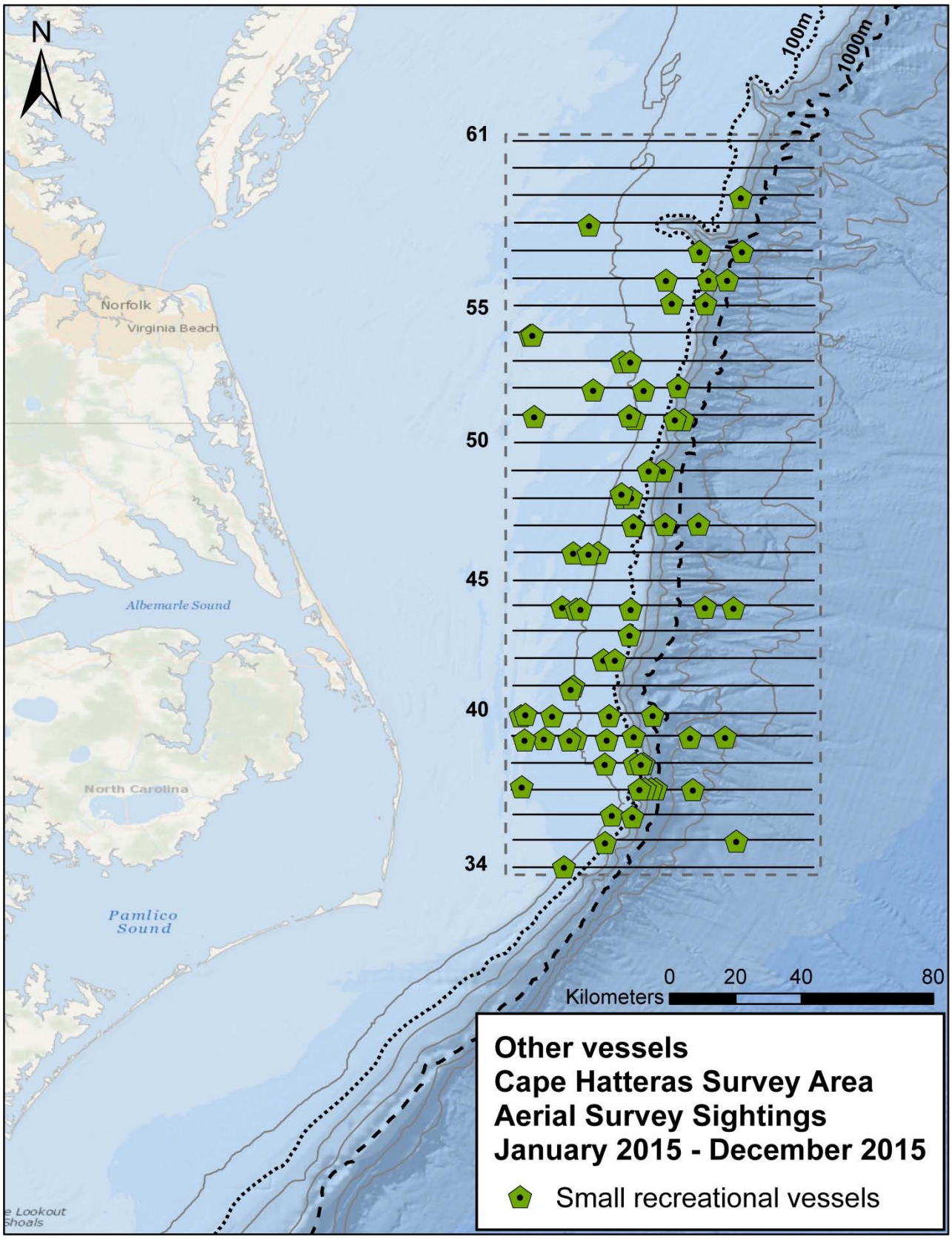

Figure 29. Other vessel sightings.

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A

Aerial Daily Sheet

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Appendix A

AERIAL SURVEY DATA SHEET

Date:_____ **Observer Side:**_____ **GPS#:**_____ **Page**__ **of**___

Pilot/Co-Pilot_____ **Observers Left/Right:**_____ **Hobbs:**_____

Time	Waypoint #	Event	Heading	Track #	Observer R / L	Visibility	BSS	Cloud	Glare L	Glare R	Vertical Angle	Horizontal degree	Sighting Cue	Species	Reliability	Min #	Max #	Best Est	Comments

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B

Event Codes and Species List

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Codes for Variables on USWTR Aerial Survey Data Sheet

Date: Month, Day, Year

Track#: opportunistic track line=99

Event:

1.1 = On effort/on track
1.2 = Off effort

3.1 = Change in environmental conditions

10.0 = Opportunistic sighting(s)
PF = Preflight
XB = Cross Beach
WU = Wheels Up
WD = Wheels Down
TE = Transit Leg on Effort

2.0 = Sighting-breaking track/off effort (real time)
2.3 = Vessel sighting

2.4 = Sighting of marine mammal (real location)
2.41 = Location of Sighting Cue, No Animals sighted
2.42 = Break from sighting

2.7 = Sighting of sea turtle (real location)
2.8 = Sighting of large vessel (Military, commercial, etc.)
2.9 = Unidentified sighting, requires comments

Confidence of cue

1 = definite
2 = probable
3 = possible/unsure

Beaufort Sea State:

0 = slick, calm, mirror-like
1 = small waves
2 = whitecaps 0-33%, waves 1-2 feet
3 = whitecaps 33-50%, waves 2-3 feet
4 = whitecaps 50-65%, waves 3-5 feet
5 = whitecaps >65%, waves >5 feet
6 = too rough too survey

Cloud Cover:

01 = clear
02 = partly cloudy
03 = continuous layer of clouds
04 = rain
05 = haze
99 = other, requires comments

Glare

0 = No glare
1 = 0-25 %
2 = 25 -50 %
3 = >50%

Visibility:

1 = clear to horizon
2 = half the distance to the horizon
3 = less than half the distance to the horizon

Sighting Cues:

1 = Blow
2 = Splash
3 = Body Part
4 = Breach
5 = Other (needs comments)

Vertical Angle is given in rough increments of 20 degrees with 1 being directly on the trackline and 4 being anything outside of survey wide to horizon

Horizontal Angle is given assuming the nose of the plane is 0 degrees and directly off the wing is 90 degrees – measurements are taken from 1-180 on each side of the plane.

Species List for Aerial Surveys		
Common Name	**Scientific Name**	**Species Code**
Cetaceans		
North Atlantic right whale	*Eubalaena glacialis*	Egl
Minke whale	*Balaenoptera acutorostrata*	Bac
sei whale	*Balaenoptera borealis*	Bbo
fin whale	*Balaenoptera physalus*	Bph
Brydes whale	*Balaenoptera edeni*	Bed
humpback whale	*Megaptera novaeangliae*	Mno
unidentified balaenopterid	Family *Balaenopteridae*	BALA
sperm whale	*Physeter macrocephalus*	Pma
pygmy sperm whale	*Kogia breviceps*	Kbr
dwarf sperm whale	*Kogia sima*	Ksi
unidentified Kogia	*Kogia* spp.	KOGI
Northern bottlenose whale	*Hyperoodon ampullatus*	Ham
Cuvier's beaked whale	*Ziphius cavirostris*	Zca
Mesoplodon beaked whale	Genus *Mesoplodon*	MESO
unidentified beaked whale	Family *Ziphiidae*	ZIPH
harbor porpoise	*Phocoena phocoena*	Pph
killer whale	*Orcinus orca*	Oor
melon-headed whale	*Peponocephala electra*	Pel
pygmy killer whale	*Feresa attenuata*	Fat
false killer whale	*Pseudorca crassidens*	Pcr
Risso's dolphin	*Grampus griseus*	Ggr
long-finned pilot whale	*Globicephala melas*	Gme
short-finned pilot whale	*Globicephala macrorhynchus*	Gma
unidentified pilot whale	Genus *Globicephala*	GLOB
rough-toothed dolphin	*Steno bredanensis*	Sbr
Atlantic white-sided dolphin	*Lagenorhynchus acutus*	Lac
Fraser's dolphin	*Lagenodelphis hosei*	Lho
common dolphin	*Delphinus delphis*	Dde
bottlenose dolphin	*Tursiops truncatus*	Ttr
spotted dolphin	*Stenella frontalis*	Sfr
striped dolphin	*Stenella coeruleoalba*	Sco
spinner dolphin	*Stenella longirostris*	Scl
unidentified *Stenella*	Genus *Stenella*	STEN
unidentified delphinid	Family *Delphinidae*	DELP
unidentified cetacean		CETA
Pinnipeds		
gray seal	*Halichoerus grypus*	Hgr
harbor seal	*Phoca vitulina*	Pvi
harp seal	*Phoca groenlandica*	Pgr
hooded seal	*Cystophora cristata*	Ccr
unidentified phocid	Family *Phocidae*	PHOC
Sea Turtles		
loggerhead	*Caretta caretta*	Cca
leatherback	*Dermochelys coriacea*	Dco
green	*Chelonia mydas*	Cmy
Kemp's ridley	*Lepidochelys kempii*	Lke
hawksbill	*Eretmochelys imbricata*	Eim
unidentified sea turtle		TURT
Other interesting sightings		
ocean sunfish	*Mola mola*	Mmo
basking shark	*Cetorhinus maximus*	Cma
whale shark	*Rhincodon typus*	Rty
manta ray	*Manta birostris*	Mbi
cownose rays	*Rhinoptera bonasus*	Rbo

C

Notes on Sighting Summary Sheets

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The Sighting Summary Sheet

The Sighting Summary, adapted from the Sighting Data Sheet used in the field, integrates data gathered in the field with results from lab analyses to provide a full summary of each marine mammal sighting (note – this sheet only deals with marine mammal sightings). A Sighting Summary is to be completed for all sightings, including sightings made while off-effort during transits between survey legs, as well as sighting cues that never led to a sighting that was relocated.

The Sighting Summary sheet is broken into four sections; "Initial Sighting on Track", "Time and Position of Sighting", "Final Time and Position of Sighting", and "Behavior and Additional Comments". Each section and sub-heading will be detailed below.

Initial Sighting on Track

Time*:* The time the "break track" GPS way-point was taken.
WP#: GPS way-point number of the break track.
Lat/Long: The latitude and longitude associated with the break track way-point.
Track Line: The track line surveyed when the sighting was made.
On/Off Effort: Whether the sighting was made during an active survey track line (*i.e.* on effort) or during transit BETWEEN track lines (*i.e.* off effort). Sightings made during off effort transit to and from the range are included in the sighting summaries.
Sighting Cue: Whether the initial sighting was a splash, a breach or body part.
Vertical Angle: Vertical "angle" is given in rough increments of 20 degrees with 1 being directly on the trackline and 4 being anything outside of beyond the survey track width
Horizontal Bearing in Degrees: Is given assuming the nose of the plane is 0 degrees and directly off the wing is 90 degrees – measurements are taken from 1-180 on each side of the plane.
Observer: Three lettered initial of the observer who made the sighting.
Observer Side: On which side of the plane in the direction of travel the sighting occurred.

Time and Position of Sighting

Time*:* The time the GPS way-point was taken while relocating animals and circling above.
WP#: GPS way-point number of the sighting.
Lat/Long: The latitude and longitude associated with the way point obtained while circling over animals.
Beaufort Sea State: The sea state observed during the sighting.
Species: Scientific binomial name of the marine mammal species involved in the sighting. When species identity could not be established unequivocally, the next higher taxonomic level to which identity could be established was used. If a cetacean was identified as a dolphin but images obtained during the encounter were not sufficient to establish species ID, the designation "unidentified delphinid" is used. If the animal could be ID'd as a cetacean only, then "unidentified cetacean" is used. If a large body was observed but it could not be established whether a cetacean, fish/shark or turtle was involved in the sighting, the designation "unidentified marine vertebrate" is used.
Criteria used to identify species: Which species specific diagnostic features were used in classifying a sighting to species (see information on diagnosis of species).
Best images used for species ID: The images obtained during the sighting that best displayed the features used to establish species.
Numbers (Low/ High/ Best): Low, high, and best estimate of number of animals involved in the sighting.
Calves observed? Whether any calves were observed during the encounter. A conservative measure is used, in that only animals roughly half the size of the associated larger animal (the presumed mother) are designated as calves.
Calculated Distance from Track Line: The distances between the break track waypoint (2.0) and the initial position of each sighting (2.4) is calculated using the online software Scripts Movable Type (http://www.movable-type.co.uk/scripts/latlong.html). Since there is a bias in estimating the location of a

group of mobile marine mammals from a fast moving airplane, the distances calculated between break track and sighting are rounded to 0.1 km.
Photographer: Three lettered initials of observer seated in the right camera seat.
Card #: Memory card on which the photos from the particular sighting was made.
Frame Numbers: Starting and ending frame number.
Spacer: Image used to separate sighting to clarify when one sighting ends and the next begins. Image typically of interior of plane or a 45 degree angle shot of the horizon. If taking a shot of the interior of the plane, put the camera focus setting on "manual", take the picture, then immediately set it back to "automatic".

Final Time and Position of Sighting

Time: WP#: Lat: Long: Calculated Distance traveled: ➔ see section above.

Behavior and Additional Comments

Any behavioral notes obtained during the sighting (*e.g.* group formation, relative travel speed, feeding events or presumed copulation attempts, presence of other cetaceans or sharks in or around the animal(s) in the sighting, interaction with inanimate objects such marine debris). This section also includes notes on altitude of the survey plane during the encounter as well as any indications (or lack thereof) of the animal(s) reacting to the presence of the plane.

D

Sighting Summary Sheets

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