

VACAPES Outer Continental Shelf Cetacean Study, Virginia Beach, Virginia: 2016 Annual Progress Report

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Cover Photo Credit:

Fin whale (*Balaenoptera physalus*) biopsy approach off the coast of Virginia. Photographed by J. Thornton. Photograph taken under National Marine Fisheries Service permit no. 16239.

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Table of Contents

Acronyms and Abbreviations	iii
1. Introduction and Background.....	1
2. Methods.....	2
2.1 SURVEY OPERATIONS.....	4
2.2 PHOTOGRAPHY AND DATA LOGGING	6
2.3 FOCAL FOLLOWS	6
2.4 BIOPSY SAMPLE COLLECTION.....	6
2.5 SATELLITE TAGGING	7
3. Results.....	7
3.1 PHOTO-ID.....	18
3.2 FOCAL FOLLOWS	19
3.3 BIOPSY SAMPLE COLLECTION.....	19
3.4 SATELLITE TAGGING	19
4. Discussion	21
5. Acknowledgements	22
6. References	22

Figures

Figure 1. Map of the offshore study area off southeastern Virginia (green box) and the VACAPES training range surface grid in the region.....	3
Figure 2. One of multiple sport-fishing vessels chartered for use during offshore surveys, the 16.2-m Top Notch.....	4
Figure 3. Offshore survey tracks and locations of all baleen whale (n=9) sightings, April 2015 through 2016.	9
Figure 4. Offshore survey tracks and locations of all toothed whale, dolphin, and porpoise (n=184) sightings, April 2015 through 2016.	10
Figure 5. Offshore survey tracks and locations of all sea turtle (n=35) sightings, April 2015 through 2016.....	11
Figure 6. Filtered locations (white dots) and track of fin whale HDRVABp012 over 13.7 days of tag-attachment duration.....	20

Tables

Table 1. Summary of offshore survey efforts off Virginia Beach, Virginia, from April 2015 through 2016.....	8
Table 2. Summary of marine mammal sightings during 12 offshore vessel surveys from April 2015 through 2016.	12
Table 3. Summary of sea turtle sightings during nine offshore vessel surveys from April 2015 through 2016.	17
Table 4. Summary of photo-identified baleen whale individuals sighted, from April 2015 through 2016.....	18

Acronyms and Abbreviations

BSS	Beaufort sea state
GPS	Global Positioning System
hr	hour(s)
km	kilometer(s)
LIMPET	Low-Impact Minimally Percutaneous Electronic Transmitter
m	meter(s)
min	minute(s)
MMO	marine mammal observer
NAVFAC LANT	Naval Facilities Engineering Command Atlantic
NM	Nautical Miles
NSN	Naval Station Norfolk
OPAREA	Operating Area
PAM	passive acoustic monitoring
photo-ID	photo-identification
SPOT	Smart Position and Temperature
U.S.	United States
VACAPES	Virginia Capes

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1. Introduction and Background

The United States (U.S.) Navy routinely conducts training and testing activities in the Virginia Capes (VACAPES) Operating Area (OPAREA) off the mid-Atlantic. Since 2012, HDR has worked with the U.S. Navy to carry out vessel-based line transect visual surveys, photo-identification (photo-ID) surveys, and focal-follow surveys, with the goal of determining bottlenose dolphin (*Tursiops truncatus*) densities and site fidelity (see Engelhaupt et al. [2014](#), [2015](#), [2016](#)), as well as humpback whale (*Megaptera novaeangliae*) habitat use (see Aschettino et al. [2015](#), [2016](#), [2017](#)) within waters adjacent to Naval Station Norfolk (NSN), Joint Expeditionary Base Little Creek-Fort Story, Naval Air Station Oceana Dam Neck Annex, and within and near the W-50 Mine Neutralization Exercise area.

The region encompassing the deeper waters of the continental shelf, shelf break, and continental slope has been recognized as an important habitat for multiple species of cetaceans. Kenney and Winn (1986) showed that the shelf edge from Cape Hatteras to Georges Bank was the second most intensively used cetacean habitat off the northeastern United States based on 3 years of surveys conducted by the Cetacean and Turtle Assessment Program ([CETAP 1982](#)). More recent, still on-going, broad-scale surveys by the National Marine Fisheries Service, including the [Atlantic Marine Assessment Program for Protected Species](#) (AMAPPS) and marine mammal stock-assessment reports ([Waring et al. 2016](#)) show the same pattern. Cetacean species known to be common in some seasons in outer shelf and slope waters include both baleen whales and odontocetes, including fin whales (*Balaenoptera physalus*), sei whales (*Balaenoptera borealis*), minke whales (*Balaenoptera acutorostrata*), humpback whales, sperm whales (*Physeter microcephalus*), beaked whales (*Ziphius cavirostris*, *Mesoplodon* spp.), long-finned and short-finned pilot whales (*Globicephala melas* and *Globicephala macrorhynchus*, respectively), Risso's dolphins (*Grampus griseus*), bottlenose dolphins, short-beaked common dolphins (*Delphinus delphis*), Atlantic white-sided dolphins (*Lagenorhynchus acutus*), Atlantic spotted dolphins (*Stenella frontalis*), and striped dolphins (*Stenella coeruleoalba*) (CETAP 1982; Hain et al. 1985, 1992; Kenney and Winn 1986, 1987; Selzer and Payne 1988; Kenney 1990; Payne and Heinemann 1993; Waring et al. 1993, 2001, 2016; Northridge et al. 1997; Palka et al. 1997; Mead 2009; NEFSC 2012, 2013; Jefferson et al. 2014). Fin, sei, and sperm whales are all listed as endangered under the U.S. Endangered Species Act. Recent aerial and vessel surveys and passive acoustic monitoring (PAM) studies for the U.S. Navy Marine Species Monitoring Program ([DoN 2013a](#); [McAlarney et al. 2015](#); [Hodge et al. 2016](#); [Malette et al 2016](#); [Aschettino et al. 2016](#), [2017](#)) have provided data confirming the overall patterns, and suggesting that the outer shelf area off Virginia in the VACAPES OPAREA would be a good location for more focused research.

Offshore surveys were first conducted in association with the Mid-Atlantic Humpback Whale Monitoring project from April 2015 through June 2016 ([Aschettino et al. 2016](#)). A separate study focusing on outer continental shelf cetaceans was initiated in July 2016. This progress report includes all offshore data from both projects from April 2015 through December 2016. The goals of this effort focus on addressing fundamental information gaps related to marine mammal occurrence, exposure, and response as identified the U.S. Navy's Integrated Comprehensive Monitoring Program (DoN 2010) and the follow-up Scientific Advisory Group review (DoN 2011).

In order to address these gaps for offshore waters in the VACAPES OPAREA, a combination of techniques are being used, including: (1) photo-ID and behavioral data collection to provide baseline assessments of animal movement patterns, site fidelity, habitat use, life history, and behavior; (2) biopsy sampling for incorporation into existing genetic studies (where opportunities exist) to identify individuals, determine foraging patterns, and assist in delineating stock boundaries; and (3) satellite-linked tagging techniques to provide information on residency patterns and habitat use across intermediate time scales (weeks to months).

Residency and movement patterns are of particular interest given the potential for repeated exposure to U.S. Navy training and testing activities known to occur within the area. Although supporting information is limited, preliminary findings from work conducted off the coast of Cape Hatteras, North Carolina, to the south suggest a year-round presence of several species of cetaceans near the continental shelf break ([Baird et al. 2016](#), [Foley et al. 2016](#)). Tagging efforts will provide longer-term movement patterns to identify extent of overlap with offshore training and testing activities conducted within the VACAPES OPAREA. Given the duration of the tag attachments and experience from previous tagging studies in waters off Cape Hatteras, North Carolina, we would expect the potential to track tagged animals to OPAREAS outside of VACAPES, including the Cherry Point OPAREA to the south and the Atlantic City OPAREA to the north.

Taking into consideration the multiple intermediate scientific objectives in the U.S. [Navy's Strategic Planning Process \(DoN 2013b\)](#), the goals of this study are to assist the U.S. Navy and regulatory agencies with environmental planning and compliance by addressing the following questions:

- Which cetacean species occur over the outer continental shelf to the east of NSN, and how does occurrence fluctuate seasonally?
- What are the baseline behaviors and ecological relationships of offshore cetaceans within the study area?
- Do individual cetaceans exhibit site fidelity within specific regions of the study area over periods of weeks, months, or years?
- What is the seasonal extent of cetacean movements within and around U.S. Navy VACAPES training range boxes?
- Do cetaceans spend significant time within or primarily move through areas of U.S. Navy live-fire or Anti-Submarine Warfare training events?

2. Methods

The primary survey area includes the offshore waters (approximately 90 km (50 nautical miles [NM]) to 160 km (85 NM) off Virginia (**Figure 1**). The offshore study area includes the outer part of the continental shelf, the shelf break, and slope waters, along with Norfolk and Washington Canyons. Depths within the study area range from less than 100 meters (m) to over 2,000 m.

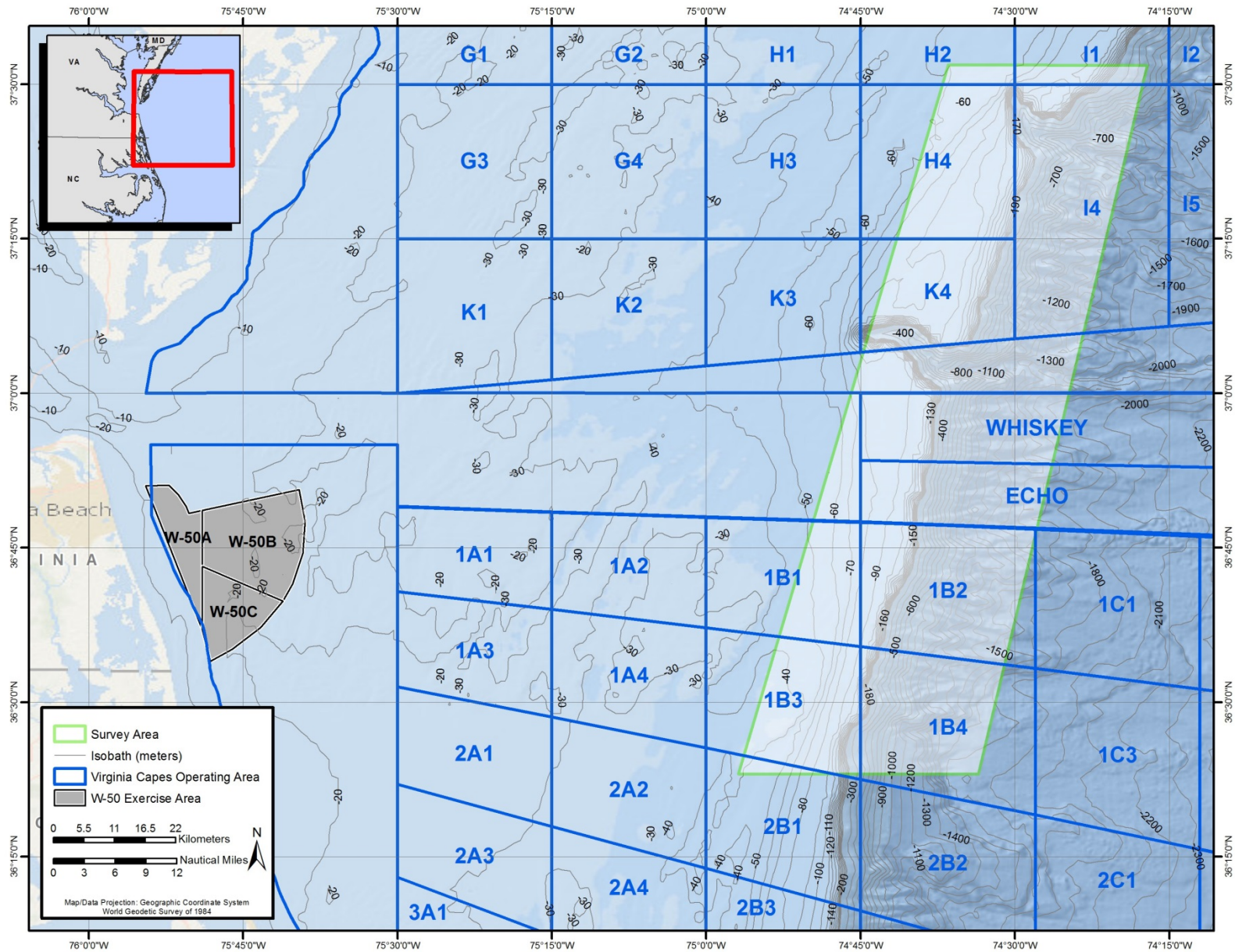


Figure 1. Map of the offshore study area off southeastern Virginia (green box) and the VACAPES training range surface grid in the region.

2.1 Survey Operations

Survey departure times were adjusted to maximize weather and clearance windows, and to take into account the long transit time to reach the survey area (approximately 3 hours [hr] each way). Survey days were planned to utilize survey time within the area of interest during optimal weather conditions, including good visibility and a Beaufort sea state (BSS) of 3 or lower when possible, as well as access to the VACAPES OPAREA range boxes within the study area (K3, K4, 1B1, 1B2, 1B3, and 1B4; **Figure 1**) so that the research vessels had clearance to operate when training was not being conducted. However, due to frequent range closures and limited weather windows, it was not always possible to conduct surveys within the desired VACAPES OPAREA boxes.

Multiple vessels were utilized to support surveys. Charter fishing boats have proven to be effective for reaching the study area and therefore have been the primary vessels used. The 17.4-m *Capt. Cheryl*, 16.2-m *Top Notch* (**Figure 2**), and 17.1-m *Knot Tell'n* were the primary vessels used in 2016. Each vessel was equipped with a Global Positioning System (GPS) receiver, marine radio, emergency beacon, a life raft, depth sounder, and emergency equipment. All captains are familiar with the Virginia Beach waterways and the unique characteristics of the region and hold U.S. Coast Guard-approved 100-ton master's licenses.



Figure 2. One of multiple sport-fishing vessels chartered for use during offshore surveys, the 16.2-m *Top Notch*.

Charter vessels departed from Rudee Inlet in Virginia Beach, Virginia. Efforts were coordinated with the VACAPES range so that the vessel would have clearance in the primary study area as often as possible. The K3 and K4 range boxes, which encompass Norfolk Canyon, require clearance to be obtained on the day of surveys, and therefore there were times that area was

unavailable. Coordination with aerial survey teams was also attempted, whenever possible, in order to maximize sightings potential.

The scientific crew consisted of a minimum of four marine mammal observers (MMOs), including (at least) one photographer, one data recorder, one tagging specialist, and one biopsy specialist. Roles were interchangeable throughout surveys.

In order to maximize achieving the project objectives, surveys commenced around sunrise. Up to 12 hr were allocated for each survey day. Once departing the marina, transit time was approximately 3 hr to reach the study area. A limited MMO team was on effort during the outbound transit; the full MMO team was deployed on reaching the primary survey area. Due to the distance from shore and overall effort required to complete each survey day, even if sea states were unfavorable (BSS 4 to 6), effort continued until the end of the survey day, unless conditions were deemed to be unsafe. Every effort was made to avoid such circumstances by following weather forecasts closely before commencing a survey day.

The survey area for each day was chosen depending on weather conditions, clearance, and reports of high-priority species (e.g., information from recent aerial or vessel surveys). Areas of high naval use, such as the Norfolk Canyon area (**Figure 1**) were a priority. The survey vessel often followed pre-determined tracks that covered high-priority regions; however, because these surveys were intended to maximize the potential for making observations, surveys did not follow line-transect distance-sampling protocols. The vessel maintained a survey speed of approximately 18-22 km/hr (10-12 knots) during search efforts that followed a zig-zag pattern to waypoints chosen on the day of survey that would optimize coverage across the depth gradient in the areas that could be accessed that day.

The on-effort MMOs used both 10 × 30 hand-held image-stabilized binoculars and unaided eyes. MMOs covered a 180-degree swath of observation area in front of the survey vessel. Once a sighting was made, one MMO focused on entering data into a data-recording application running on an Apple iPad tablet (see **Appendix A**) while others focused on visually tracking and obtaining photo-ID images of the individual or group. In addition to photo-ID, some species were targeted for biopsy, satellite tagging, and/or digital video-recording. Baleen whales, sperm whales, and beaked whales were given highest priority in terms of time and effort spent collecting information and attempting to deploy tags and collect samples. Species not frequently seen in the area, such as killer whales (*Orcinus orca*), false killer whales (*Pseudorca crassidens*), melon-headed whales (*Peponocephala electra*), and pygmy killer whales (*Feresa attenuata*) were also defined to be high-priority if encountered. Pilot whales and Risso's dolphins were considered medium-priority species and were worked in the event that higher-priority species were not encountered. Other delphinid species were the lowest priority and effort spent collecting data and photographs was limited to group size, initial behavior, and confirmation of species identification.

During a priority marine mammal sighting, or when in the vicinity of a suspected sighting, the research vessel would attempt to approach the animal(s) for the purpose of photographs, biopsy sampling, focal-follow data collection, or tagging. The approach was done in a manner to minimize disturbance to the animals and to maximize the crew's abilities to confirm species, obtain group size estimates, and collect photo-IDs and video. The decision on when to end data

collection efforts on a priority species or to switch to a different sighting was made by the Chief Scientist.

2.2 Photography and Data Logging

Once a sighting was made, one observer focused on data recording, while the others focused on obtaining photo-ID images of the individual(s) using a digital SLR camera (Canon 7D, 7D Mark II, or 1DX Mark II) with a zoom lens (Canon 100- to 400-millimeter). Every effort was made to obtain good quality identification photos of the flukes and/or dorsal fins of high-priority species encountered. Following each survey day, photos were cropped and compiled in a format suitable for data sharing with other catalogs. HDR will share their images with known regional and local catalogs, including the Gulf of Maine Humpback Whale Catalog curated by the Center for Coastal Studies, the North Atlantic Humpback Whale Catalog curated by Allied Whale, College of the Atlantic, the Mid-Atlantic Humpback Whale Catalog maintained by the Virginia Aquarium, and multiple cetacean catalogs maintained by Duke University.

During surveys, the data recorder maintained a log of observers, environmental conditions, and sighting information in a tablet-based data-recording application (**Appendix A**). Environmental data were updated whenever sighting conditions changed. When a sighting was made, information regarding the distance and bearing to the sighting, species identification, speed and direction of the animals, group size, photographs, and videos was logged when available.

Sighting distances were estimated visually, although laser range finders were used when possible. Location data and vessel speed were obtained from a GPS unit feeding directly into the iPad and logging a location every 30 seconds.

2.3 Focal Follows

Focal follows were conducted on priority species prior to the addition of satellite tagging to the project. The process involved frequently recording the approximate distance and bearing to the animal relative to the research vessel, as well as the behavior of the animal (e.g., breath, fluke-up dive, etc.) via the customized iPad field application. Each behavioral observation created a focal-follow point with an associated estimated location. Due to unpredictable dive times of the priority species, the focal-follow entries were collected at each surfacing and not at a specific time interval. Focal-follow duration varied but, when possible, approximately 1 hr of observations was attempted.

2.4 Biopsy Sample Collection

Biopsy samples were collected from priority species after the survey team finished collecting identification photographs. Biopsy samples were collected with a sampling dart fired from a Paxarms MK24c projector (Paxarms New Zealand Ltd., Cheviot, New Zealand) or Barnett Recurve crossbow (Barnett Outdoors, LLC, Tarpon Springs, FL). Skin samples were placed in a Whirl-Pak® bag after collection and stored in an ice cooler on the vessel. At the end of the day, samples were cross-sectioned, placed in the appropriate Cryovial® storage tube, and stored in a freezer until ready for shipment. Samples for stable-isotope analysis, genetic analysis, and pollutant studies were sent to Duke University, the University of Groningen, and Southeast

Fisheries Science Center (National Marine Fisheries Service), respectively. Analysis of these samples is currently in progress.

2.5 Satellite Tagging

Low-Impact Minimally Percutaneous Electronic Transmitter (LIMPET) tags with Argos-linked location-only Smart Position and Temperature (SPOT-6) transmitters (Wildlife Computers, Redmond, WA) were deployed on priority species. Tags were deployed remotely with a DAN-INJECT JM.SP.25 CO₂ projector (DAN-INJECT ApS, Børkop, Denmark; www.dan-inject.com). Two surgical-grade titanium darts (either 6.8-centimeter or 4.5-centimeter) with six or three backwards-facing petals were used to attach tags to the dorsal fin. Due to expected attachment durations of LIMPET tags on baleen whales (and sperm whales) of less than 30 days, tags were programmed to maximize the number of transmissions and locations received during attachment rather than to extend battery life. Based on satellite availability in the area, tags were programmed to transmit for 22 hr per day with unlimited numbers of transmissions. Locations of tagged individuals were approximated by the Argos system using the Kalman filtering location algorithm (Argos User's Manual © 2007-2015 Collective Location Services). Unrealistic locations (i.e., those on land) were manually removed using tools provided within Movebank (www.movebank.org).

3. Results

HDR conducted 12 offshore vessel surveys from April 2015 through 2016, covering 4,003 km of trackline during more than 143 hr of effort (**Table 1**).

The vessel surveys resulted in 193 marine mammal sightings and 35 sea turtle sightings (**Figures 3 through 5; Tables 2 and 3**). Thirteen cetacean taxa were identified (in order of decreasing frequency): unidentified pilot whale (*Globicephala* sp.) ($n=69$), bottlenose dolphin ($n=52$), Atlantic spotted dolphin ($n=12$), short-finned pilot whale ($n=14$), short-beaked common dolphin ($n=14$), Risso's dolphin ($n=5$), fin whale ($n=5$), striped dolphin ($n=1$), minke whale ($n=1$), humpback whale ($n=2$), sperm whale ($n=1$), Cuvier's beaked whale (*Ziphius cavirostris*) ($n=1$), long-finned pilot whale ($n=1$), and harbor porpoise (*Phocoena phocoena*) ($n=1$). In addition, there were 14 sightings of unconfirmed species: unidentified delphinid ($n=6$), unidentified cetacean ($n=4$), unidentified medium whale ($n=2$), unidentified large whale ($n=1$), and probable sperm whale ($n=1$). Loggerhead turtle (*Caretta caretta*) were the most frequently sighted turtle species ($n=29$), followed by unidentified hard-shell sea turtle ($n=4$), and leatherback turtle (*Dermochelys coriacea*) ($n=2$).

Table 1. Summary of offshore survey efforts off Virginia Beach, Virginia, from April 2015 through 2016.

Date	Survey Time (min)	Distance surveyed (km)	# Sightings	# Individuals	# Sightings Baleen Whales	# Individuals Baleen Whales	# Sightings Odontocetes	# Individuals Odontocetes	# Sightings Sea Turtles	# Individuals Sea Turtles
12-Apr-15	725	237	15	813	2	2	10	807	3	4
29-Apr-15	724	319	17	452	2	3	10	444	5	5
10-Jun-15	721	349	27	335	0	0	18	312	9	23
26-Aug-15	724	337	10	90	0	0	10	90	0	0
02-Sep-15	708	342	29	766	0	0	26	762	3	4
21-Oct-15	722	340	15	772	1	1	13	770	1	1
12-Mar-16	680	317	17	313	2	2	15	311	0	0
27-Jun-16	703	328	19	379	2	2	13	364	4	13
11-Jul-16	791	358	27	542	0	0	22	534	5	8
27-Jul-16	708	393	15	752	0	0	13	750	2	2
21-Oct-16	689	334	16	412	0	0	16	412	0	0
02-Nov-16	701	349	21	589	0	0	18	586	3	3
Total	8,596	4,003	228	6,215	9	10	184	6,142	35	63

Key: min = minute(s); km = kilometer(s)

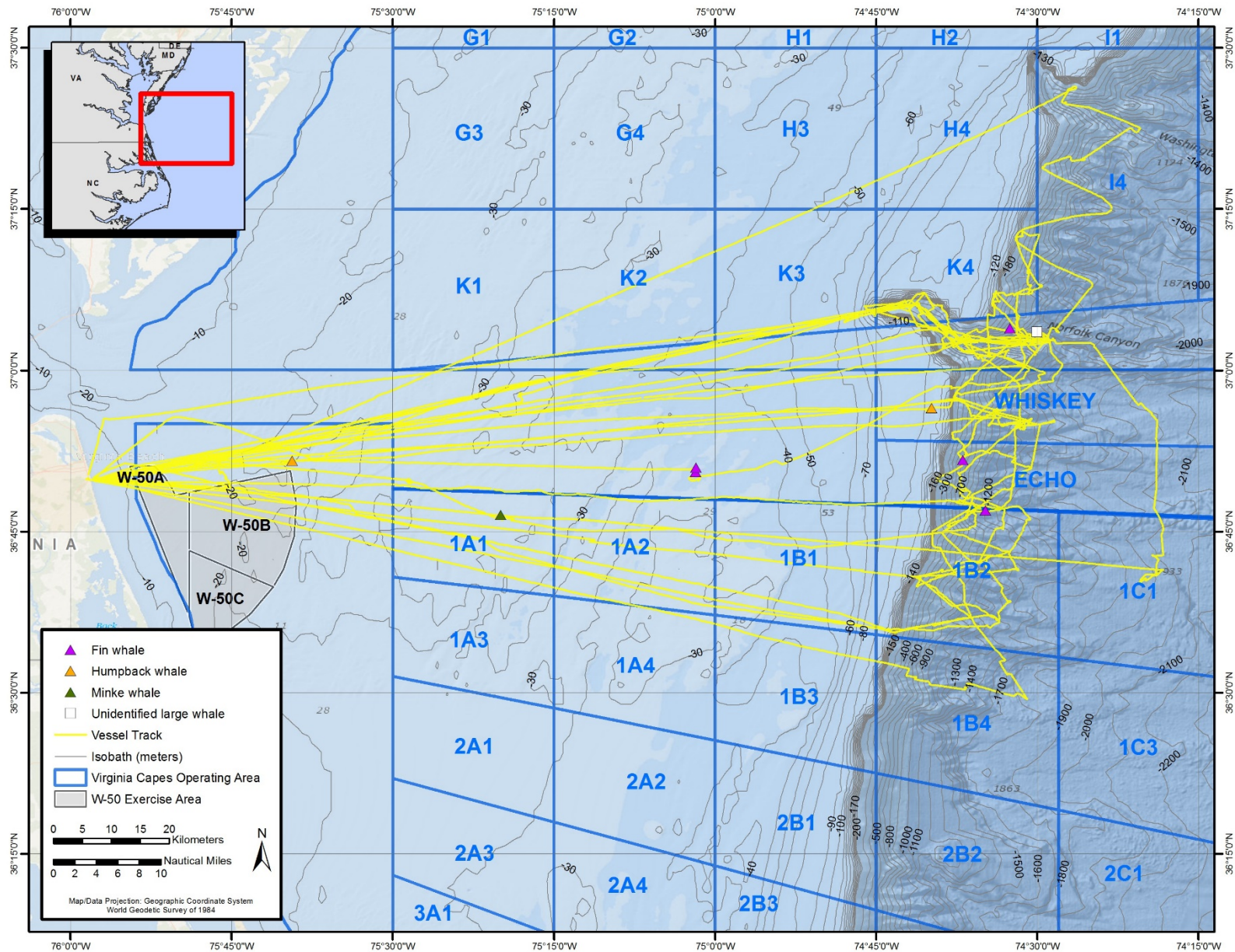


Figure 3. Offshore survey tracks and locations of all baleen whale ($n=9$) sightings, April 2015 through 2016.

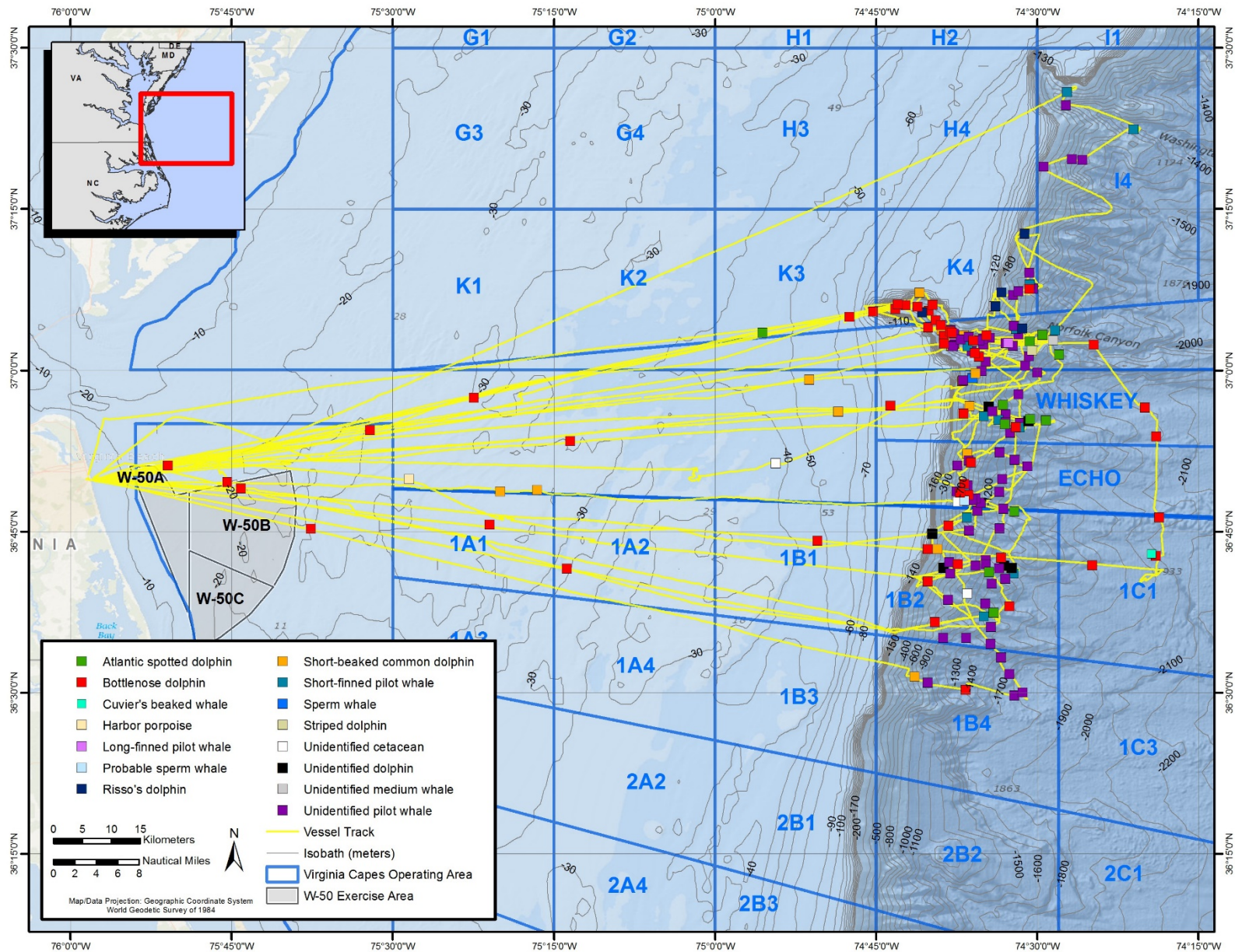


Figure 4. Offshore survey tracks and locations of all toothed whale, dolphin, and porpoise (n=184) sightings, April 2015 through 2016.

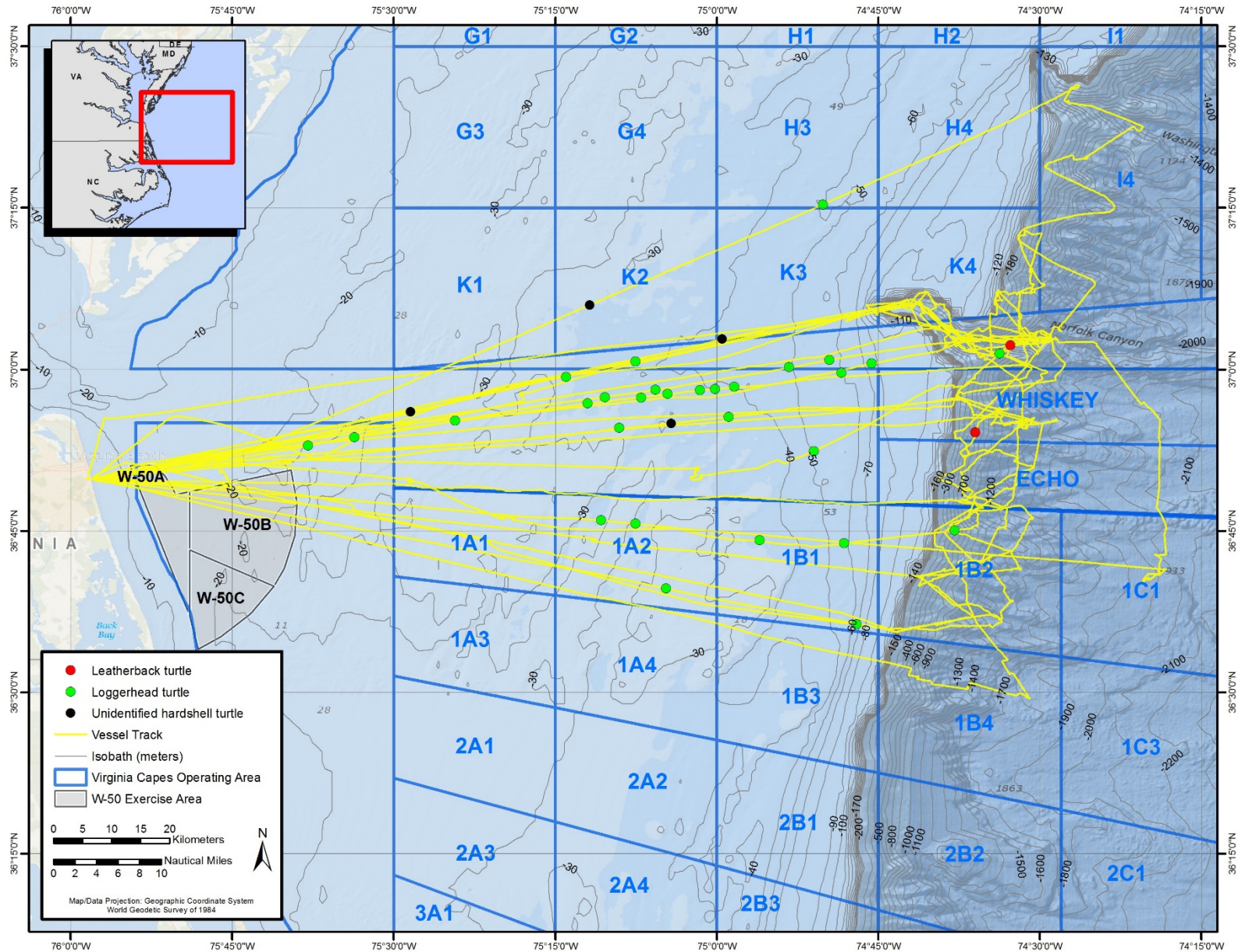


Figure 5. Offshore survey tracks and locations of all sea turtle ($n=35$) sightings, April 2015 through 2016.

Table 2. Summary of marine mammal sightings during 12 offshore vessel surveys from April 2015 through 2016.

Date	Sighting Time (local)	Scientific Name	Common Name	Group Size	Latitude (°N)	Longitude (°W)
12-Apr-15	7:51	<i>Tursiops truncatus</i>	Bottlenose dolphin	600	36.8220	75.7534
12-Apr-15	7:52	<i>Tursiops truncatus</i>	Bottlenose dolphin	100	36.8242	75.7535
12-Apr-15	9:28	<i>Phocoena phocoena</i>	Harbor porpoise	4	36.8305	75.4742
12-Apr-15	10:35	<i>Balaenoptera acutorostrata</i>	Minke whale	1	36.7724	75.3433
12-Apr-15	10:37	<i>Tursiops truncatus</i>	Bottlenose dolphin	15	36.7702	75.3381
12-Apr-15	14:44	<i>Globicephala</i> sp.	Unidentified pilot whale	60	36.7530	74.6116
12-Apr-15	14:58	<i>Globicephala</i> sp.	Unidentified pilot whale	11	36.7684	74.5962
12-Apr-15	15:05	<i>Balaenoptera physalus</i>	Fin whale	1	36.7811	74.6025
12-Apr-15	15:26	<i>Globicephala</i> sp.	Unidentified pilot whale	6	36.7852	74.5882
12-Apr-15	15:54		Unidentified cetacean	1	36.7960	74.6237
12-Apr-15	17:22	<i>Delphinus delphis</i>	Short-beaked common dolphin	5	36.8141	75.2758
12-Apr-15	17:40	<i>Delphinus delphis</i>	Short-beaked common dolphin	5	36.8139	75.3324
29-Apr-15	10:24	<i>Balaenoptera physalus</i>	Fin whale	2	36.8488	75.0297
29-Apr-15	10:27	<i>Balaenoptera physalus</i>	Fin whale	2	36.8419	75.0303
29-Apr-15	12:33		Unidentified dolphin	4	36.8557	74.9057
29-Apr-15	13:26	<i>Delphinus delphis</i>	Short-beaked common dolphin	320	36.9827	74.6158
29-Apr-15	14:32	<i>Tursiops truncatus</i>	Bottlenose dolphin	1	37.0662	74.6694
29-Apr-15	15:24	<i>Grampus griseus</i>	Risso's dolphin	4	37.0897	74.6783
29-Apr-15	15:52	<i>Delphinus delphis</i>	Short-beaked common dolphin	60	37.0539	74.6135
29-Apr-15	16:05		Unidentified dolphin	3	37.0482	74.5894
29-Apr-15	16:05	<i>Tursiops truncatus</i>	Bottlenose dolphin	25	37.0543	74.5783
29-Apr-15	17:01	<i>Globicephala</i> sp.	Unidentified pilot whale	6	37.0393	74.5834
29-Apr-15	17:07	<i>Tursiops truncatus</i>	Bottlenose dolphin	18	37.0457	74.5988
29-Apr-15	17:42	<i>Delphinus delphis</i>	Short-beaked common dolphin	3	36.9854	74.8535
10-Jun-15	7:05	<i>Tursiops truncatus</i>	Bottlenose dolphin	16	36.9069	75.5354
10-Jun-15	9:04	<i>Stenella frontalis</i>	Atlantic spotted dolphin	60	37.0828	74.7910
10-Jun-15	10:05	<i>Globicephala macrorhynchus</i>	Short-finned pilot whale	18	37.0374	74.6076
10-Jun-15	10:41	<i>Globicephala</i> sp.	Unidentified pilot whale	12	37.0377	74.5380
10-Jun-15	10:59	<i>Stenella coeruleoalba</i>	Striped dolphin	30	37.0307	74.5077
10-Jun-15	11:29	<i>Grampus griseus</i>	Risso's dolphin	7	37.0990	74.5646
10-Jun-15	11:55	<i>Grampus griseus</i>	Risso's dolphin	3	37.1209	74.5555
10-Jun-15	12:04	<i>Globicephala</i> sp.	Unidentified pilot whale	16	37.1168	74.5374
10-Jun-15	12:16	<i>Tursiops truncatus</i>	Bottlenose dolphin	7	37.1261	74.5123
10-Jun-15	12:18	<i>Globicephala</i> sp.	Unidentified pilot whale	8	37.1265	74.5061
10-Jun-15	13:09	<i>Grampus griseus</i>	Risso's dolphin	8	37.2116	74.5195
10-Jun-15	13:39	<i>Globicephala</i> sp.	Unidentified pilot whale	12	37.1512	74.5123
10-Jun-15	13:51	<i>Globicephala macrorhynchus</i>	Short-finned pilot whale	9	37.1328	74.5113

Date	Sighting Time (local)	Scientific Name	Common Name	Group Size	Latitude (°N)	Longitude (°W)
10-Jun-15	14:06	<i>Globicephala</i> sp.	Unidentified pilot whale	19	37.1224	74.5292
10-Jun-15	14:33	<i>Globicephala macrorhyncus</i>	Short-finned pilot whale	12	37.0640	74.5330
10-Jun-15	14:46	<i>Globicephala</i> sp.	Unidentified pilot whale	11	37.0552	74.5292
10-Jun-15	14:55	<i>Globicephala</i> sp.	Unidentified pilot whale	4	37.0214	74.5123
10-Jun-15	14:57	<i>Stenella coeruleoalba</i>	Striped dolphin	60	37.0219	74.5144
26-Aug-15	9:47	<i>Tursiops truncatus</i>	Bottlenose dolphin	5	36.6087	74.6588
26-Aug-15	10:23	<i>Globicephala</i> sp.	Unidentified pilot whale	5	36.6433	74.6381
26-Aug-15	11:03		Unidentified dolphin	4	36.6935	74.6450
26-Aug-15	12:24	<i>Tursiops truncatus</i>	Bottlenose dolphin	3	36.7586	74.6375
26-Aug-15	12:39	<i>Globicephala macrorhyncus</i>	Short-finned pilot whale	14	36.7711	74.6091
26-Aug-15	13:46	<i>Tursiops truncatus</i>	Bottlenose dolphin	24	36.9115	74.5333
26-Aug-15	14:01	<i>Globicephala</i> sp.	Unidentified pilot whale	5	36.9626	74.5290
26-Aug-15	14:23	<i>Globicephala</i> sp.	Unidentified pilot whale	11	37.0135	74.5799
26-Aug-15	14:37	<i>Globicephala</i> sp.	Unidentified pilot whale	10	37.0296	74.6012
26-Aug-15	14:47	<i>Globicephala</i> sp.	Unidentified pilot whale	9	37.0409	74.6281
02-Sep-15	9:05	<i>Tursiops truncatus</i>	Bottlenose dolphin	8	36.9446	74.7279
02-Sep-15	9:28	<i>Tursiops truncatus</i>	Bottlenose dolphin	23	36.9324	74.6140
02-Sep-15	9:42	<i>Globicephala macrorhyncus</i>	Short-finned pilot whale	15	36.9284	74.5824
02-Sep-15	9:56	<i>Globicephala macrorhyncus</i>	Short-finned pilot whale	18	36.9224	74.5601
02-Sep-15	9:58	<i>Globicephala</i> sp.	Unidentified pilot whale	12	36.9315	74.5489
02-Sep-15	10:13	<i>Stenella frontalis</i>	Atlantic spotted dolphin	50	36.9164	74.5498
02-Sep-15	10:21	<i>Globicephala</i> sp.	Unidentified pilot whale	15	36.9180	74.5269
02-Sep-15	10:33	<i>Globicephala</i> sp.	Unidentified pilot whale	22	36.9028	74.5418
02-Sep-15	10:58	<i>Tursiops truncatus</i>	Bottlenose dolphin	15	36.8567	74.6023
02-Sep-15	11:05	<i>Tursiops truncatus</i>	Bottlenose dolphin	30	36.8236	74.6130
02-Sep-15	11:08	<i>Globicephala</i> sp.	Unidentified pilot whale	11	36.8208	74.6081
02-Sep-15	11:24	<i>Physeter macrocephalus</i>	Probable sperm whale	1	36.7974	74.6132
02-Sep-15	11:27	<i>Tursiops truncatus</i>	Bottlenose dolphin	25	36.8063	74.6067
02-Sep-15	11:49	<i>Stenella frontalis</i>	Atlantic spotted dolphin	130	36.7806	74.5352
02-Sep-15	11:50	<i>Globicephala</i> sp.	Unidentified pilot whale	9	36.7851	74.5522
02-Sep-15	12:28		Unidentified dolphin	8	36.6931	74.5398
02-Sep-15	12:32	<i>Globicephala macrorhyncus</i>	Short-finned pilot whale	17	36.6845	74.5366
02-Sep-15	12:32		Unidentified dolphin	20	36.6963	74.5514
02-Sep-15	12:45	<i>Globicephala</i> sp.	Unidentified pilot whale	10	36.6926	74.5590
02-Sep-15	12:52	<i>Globicephala</i> sp.	Unidentified pilot whale	10	36.6684	74.5704
02-Sep-15	12:54	<i>Stenella frontalis</i>	Atlantic spotted dolphin	60	36.6867	74.5747
02-Sep-15	13:12	<i>Globicephala</i> sp.	Unidentified pilot whale	18	36.6841	74.6348
02-Sep-15	14:00	<i>Stenella frontalis</i>	Atlantic spotted dolphin	200	36.6238	74.5672
02-Sep-15	14:14	<i>Globicephala</i> sp.	Unidentified pilot whale	17	36.6014	74.5718
02-Sep-15	14:27	<i>Globicephala</i> sp.	Unidentified pilot whale	10	36.5846	74.6100
02-Sep-15	14:40	<i>Globicephala</i> sp.	Unidentified pilot whale	8	36.5846	74.6455

Date	Sighting Time (local)	Scientific Name	Common Name	Group Size	Latitude (°N)	Longitude (°W)
21-Oct-15	9:32	<i>Tursiops truncatus</i>	Bottlenose dolphin	6	37.0912	74.7546
21-Oct-15	9:46	<i>Tursiops truncatus</i>	Bottlenose dolphin	30	37.0950	74.7200
21-Oct-15	10:16	<i>Tursiops truncatus</i>	Bottlenose dolphin	50	37.0924	74.6679
21-Oct-15	10:39	<i>Tursiops truncatus</i>	Bottlenose dolphin	8	37.0529	74.6449
21-Oct-15	10:42	<i>Tursiops truncatus</i>	Bottlenose dolphin	4	37.0414	74.6445
21-Oct-15	11:47	<i>Stenella frontalis</i>	Atlantic spotted dolphin	235	37.0243	74.4660
21-Oct-15	13:12	<i>Stenella frontalis</i>	Atlantic spotted dolphin	110	36.9461	74.5526
21-Oct-15	13:50	<i>Stenella frontalis</i>	Atlantic spotted dolphin	50	36.9237	74.5110
21-Oct-15	14:03	<i>Stenella frontalis</i>	Atlantic spotted dolphin	175	36.9218	74.4861
21-Oct-15	14:21		Unidentified dolphin	45	36.9208	74.5129
21-Oct-15	14:27	<i>Globicephala macrorhynchus</i>	Short-finned pilot whale	25	36.9109	74.5273
21-Oct-15	15:00	<i>Globicephala</i> sp.	Unidentified pilot whale	12	36.9190	74.5489
21-Oct-15	16:53	<i>Tursiops truncatus</i>	Bottlenose dolphin	20	36.8902	75.2248
21-Oct-15	17:48	<i>Megaptera novaeangliae</i>	Humpback whale	1	36.8596	75.6567
12-Mar-16	10:49	<i>Tursiops truncatus</i>	Bottlenose dolphin	6	37.1006	74.7044
12-Mar-16	11:09	<i>Tursiops truncatus</i>	Bottlenose dolphin	5	37.0775	74.6574
12-Mar-16	11:27	<i>Delphinus delphis</i>	Short-beaked common dolphin	110	37.0378	74.6330
12-Mar-16	11:30	<i>Globicephala</i> sp.	Unidentified pilot whale	52	37.0371	74.6305
12-Mar-16	11:54	<i>Tursiops truncatus</i>	Bottlenose dolphin	30	37.0208	74.5902
12-Mar-16	12:40		Unidentified medium whale	1	37.0990	74.5671
12-Mar-16	13:17	<i>Globicephala</i> sp.	Unidentified pilot whale	33	37.0687	74.5362
12-Mar-16	13:28	<i>Balaenoptera physalus</i>	Fin whale	1	37.0655	74.5427
12-Mar-16	13:41	<i>Grampus griseus</i>	Risso's dolphin	4	37.0648	74.5232
12-Mar-16	14:34	<i>Globicephala melas</i>	Long-finned pilot whale	25	37.0425	74.5450
12-Mar-16	15:02	<i>Globicephala</i> sp.	Unidentified pilot whale	15	36.9984	74.5860
12-Mar-16	15:05	<i>Delphinus delphis</i>	Short-beaked common dolphin	12	36.9932	74.5914
12-Mar-16	15:11	<i>Physeter macrocephalus</i>	Sperm whale	1	36.9876	74.6002
12-Mar-16	15:16	<i>Globicephala</i> sp.	Unidentified pilot whale	7	36.9838	74.6146
12-Mar-16	15:39	<i>Megaptera novaeangliae</i>	Humpback whale	1	36.9414	74.6639
12-Mar-16	16:07	<i>Delphinus delphis</i>	Short-beaked common dolphin	5	36.9358	74.8090
12-Mar-16	18:14	<i>Tursiops truncatus</i>	Bottlenose dolphin	5	36.8523	75.8494
27-Jun-16	9:06	<i>Tursiops truncatus</i>	Bottlenose dolphin	1	36.6724	74.6699
27-Jun-16	9:25	<i>Tursiops truncatus</i>	Bottlenose dolphin	45	36.6987	74.6232
27-Jun-16	9:58	<i>Globicephala macrorhynchus</i>	Short-finned pilot whale	4	36.7547	74.5583
27-Jun-16	10:29	<i>Globicephala</i> sp.	Unidentified pilot whale	5	36.8015	74.5954
27-Jun-16	10:41	<i>Tursiops truncatus</i>	Bottlenose dolphin	6	36.8101	74.6195
27-Jun-16	10:44	<i>Globicephala macrorhynchus</i>	Short-finned pilot whale	10	36.8141	74.6130

Date	Sighting Time (local)	Scientific Name	Common Name	Group Size	Latitude (°N)	Longitude (°W)
27-Jun-16	10:52	<i>Globicephala</i> sp.	Unidentified pilot whale	6	36.8119	74.6251
27-Jun-16	11:18	<i>Globicephala</i> sp.	Unidentified pilot whale	12	36.8520	74.6236
27-Jun-16	11:21	<i>Balaenoptera physalus</i>	Fin whale	1	36.8607	74.6155
27-Jun-16	11:46	<i>Delphinus delphis</i>	Short-beaked common dolphin	50	36.8607	74.6155
27-Jun-16	12:45		Unidentified dolphin	2	36.9437	74.5749
27-Jun-16	13:09	<i>Globicephala</i> sp.	Unidentified pilot whale	15	37.0076	74.5177
27-Jun-16	13:33		Unidentified large whale	1	37.0520	74.5197
27-Jun-16	14:03	<i>Globicephala</i> sp.	Unidentified pilot whale	8	37.0498	74.5750
27-Jun-16	14:07	<i>Globicephala</i> sp.	Unidentified pilot whale	200	37.0406	74.5884
11-Jul-16	6:35	<i>Tursiops truncatus</i>	Bottlenose dolphin	12	36.9574	75.3741
11-Jul-16	7:54	<i>Tursiops truncatus</i>	Bottlenose dolphin	7	37.0825	74.7915
11-Jul-16	8:23	<i>Tursiops truncatus</i>	Bottlenose dolphin	25	37.0984	74.6854
11-Jul-16	8:35	<i>Tursiops truncatus</i>	Bottlenose dolphin	8	37.0697	74.6491
11-Jul-16	8:38	<i>Tursiops truncatus</i>	Bottlenose dolphin	80	37.0604	74.6355
11-Jul-16	8:42	<i>Globicephala</i> sp.	Unidentified pilot whale	18	37.0564	74.6290
11-Jul-16	8:55	<i>Globicephala</i> sp.	Unidentified pilot whale	60	37.0475	74.6185
11-Jul-16	9:03	<i>Globicephala</i> sp.	Unidentified pilot whale	20	37.0463	74.5896
11-Jul-16	9:13	<i>Globicephala</i> sp.	Unidentified pilot whale	23	37.0420	74.5487
11-Jul-16	9:22	<i>Stenella frontalis</i>	Atlantic spotted dolphin	50	37.0447	74.5117
11-Jul-16	9:31	<i>Stenella frontalis</i>	Atlantic spotted dolphin	65	37.0547	74.4914
11-Jul-16	9:44		Unidentified medium whale	3	37.0464	74.4752
11-Jul-16	10:11	<i>Tursiops truncatus</i>	Bottlenose dolphin	30	37.0352	74.4096
11-Jul-16	10:45	<i>Tursiops truncatus</i>	Bottlenose dolphin	13	36.9173	74.3415
11-Jul-16	11:07	<i>Tursiops truncatus</i>	Bottlenose dolphin	22	36.8969	74.3153
11-Jul-16	11:39	<i>Tursiops truncatus</i>	Bottlenose dolphin	35	36.7714	74.3103
11-Jul-16	12:01	<i>Tursiops truncatus</i>	Bottlenose dolphin	15	36.7120	74.3157
11-Jul-16	12:08	<i>Ziphius cavirostris</i>	Cuvier's beaked whale	5	36.7150	74.3219
11-Jul-16	14:52	<i>Tursiops truncatus</i>	Bottlenose dolphin	25	36.6971	74.4143
11-Jul-16	15:11	<i>Tursiops truncatus</i>	Bottlenose dolphin	5	36.7087	74.5558
11-Jul-16	15:27	<i>Tursiops truncatus</i>	Bottlenose dolphin	7	36.7225	74.6697
11-Jul-16	15:50	<i>Tursiops truncatus</i>	Bottlenose dolphin	6	36.7354	74.8412
27-Jul-16	10:24	<i>Tursiops truncatus</i>	Bottlenose dolphin	3	37.1017	74.7091
27-Jul-16	10:32	<i>Delphinus delphis</i>	Short-beaked common dolphin	200	37.1199	74.6829
27-Jul-16	10:41	<i>Tursiops truncatus</i>	Bottlenose dolphin	80	37.1006	74.6983
27-Jul-16	10:56	<i>Globicephala</i> sp.	Unidentified pilot whale	90	37.0622	74.6340
27-Jul-16	11:00	<i>Tursiops truncatus</i>	Bottlenose dolphin	25	37.0581	74.6323
27-Jul-16	11:12	<i>Globicephala</i> sp.	Unidentified pilot whale	75	37.0516	74.6059
27-Jul-16	11:46	<i>Globicephala macrorhynchus</i>	Short-finned pilot whale	45	37.0616	74.4726
27-Jul-16	13:33	<i>Globicephala</i> sp.	Bottlenose dolphin	12	37.3158	74.4899
27-Jul-16	13:48	<i>Globicephala</i> sp.	Unidentified pilot whale	8	37.3277	74.4460
27-Jul-16	13:54	<i>Globicephala</i> sp.	Unidentified pilot whale	25	37.3266	74.4298

Date	Sighting Time (local)	Scientific Name	Common Name	Group Size	Latitude (°N)	Longitude (°W)
27-Jul-16	14:29	<i>Globicephala macrorhynchus</i>	Short-finned pilot whale	22	37.3734	74.3504
27-Jul-16	15:10	<i>Globicephala</i> sp.	Unidentified pilot whale	15	37.4113	74.4554
27-Jul-16	15:24	<i>Globicephala macrorhynchus</i>	Short-finned pilot whale	150	37.4316	74.4533
21-Oct-16	11:18	<i>Tursiops truncatus</i>	Bottlenose dolphin	20	36.7539	75.6270
21-Oct-16	13:52	<i>Delphinus delphis</i>	Short-beaked common dolphin	45	36.5244	74.6904
21-Oct-16	14:01	<i>Globicephala</i> sp.	Unidentified pilot whale	17	36.5150	74.6695
21-Oct-16	14:18	<i>Tursiops truncatus</i>	Bottlenose dolphin	65	36.5038	74.6107
21-Oct-16	14:47	<i>Globicephala</i> sp.	Unidentified pilot whale	8	36.4950	74.5352
21-Oct-16	15:02	<i>Globicephala</i> sp.	Unidentified pilot whale	5	36.4997	74.5227
21-Oct-16	15:16	<i>Globicephala</i> sp.	Unidentified pilot whale	6	36.5284	74.5431
21-Oct-16	15:32	<i>Globicephala</i> sp.	Unidentified pilot whale	10	36.5541	74.5556
21-Oct-16	15:42	<i>Globicephala</i> sp.	Unidentified pilot whale	11	36.5728	74.5706
21-Oct-16	16:06		Unidentified cetacean	3	36.6534	74.6085
21-Oct-16	16:24	<i>Globicephala</i> sp.	Unidentified pilot whale	24	36.7020	74.6363
21-Oct-16	16:35	<i>Delphinus delphis</i>	Short-beaked common dolphin	150	36.7226	74.6543
21-Oct-16	16:44		Unidentified dolphin	4	36.7460	74.6628
21-Oct-16	17:05	<i>Globicephala</i> sp.	Unidentified pilot whale	12	36.7983	74.6010
21-Oct-16	17:25	<i>Globicephala</i> sp.	Unidentified pilot whale	12	36.8312	74.5541
21-Oct-16	18:32	<i>Delphinus delphis</i>	Short-beaked common dolphin	20	36.9444	74.6050
02-Nov-16	8:29	<i>Tursiops truncatus</i>	Bottlenose dolphin	6	36.6921	75.2298
02-Nov-16	10:14	<i>Globicephala macrorhynchus</i>	Short-finned pilot whale	14	36.6180	74.5828
02-Nov-16	10:15	<i>Globicephala</i> sp.	Unidentified pilot whale	5	36.6375	74.5806
02-Nov-16	10:28	<i>Tursiops truncatus</i>	Bottlenose dolphin	75	36.6337	74.5427
02-Nov-16	10:45	<i>Globicephala</i> sp.	Unidentified pilot whale	15	36.6759	74.5492
02-Nov-16	10:59	<i>Globicephala</i> sp.	Unidentified pilot whale	8	36.7056	74.5799
02-Nov-16	11:00	<i>Globicephala</i> sp.	Unidentified pilot whale	6	36.6990	74.5799
02-Nov-16	11:14	<i>Globicephala</i> sp.	Unidentified pilot whale	7	36.6965	74.5953
02-Nov-16	12:02	<i>Globicephala</i> sp.	Unidentified pilot whale	14	36.8113	74.5585
02-Nov-16	12:27	<i>Globicephala</i> sp.	Unidentified pilot whale	2	36.8511	74.5148
02-Nov-16	12:36	<i>Globicephala</i> sp.	Unidentified pilot whale	5	36.8610	74.5349
02-Nov-16	12:45	<i>Globicephala</i> sp.	Unidentified pilot whale	30	36.8725	74.5579
02-Nov-16	12:58	<i>Globicephala</i> sp.	Unidentified pilot whale	11	36.8599	74.6059
02-Nov-16	13:33	<i>Globicephala</i> sp.	Unidentified pilot whale	8	36.9363	74.5695
02-Nov-16	13:58	<i>Globicephala</i> sp.	Unidentified pilot whale	20	36.9964	74.4996
02-Nov-16	14:44	<i>Tursiops truncatus</i>	Bottlenose dolphin	80	37.0320	74.6030
02-Nov-16	14:59	<i>Delphinus delphis</i>	Short-beaked common dolphin	250	37.0623	74.6481
02-Nov-16	15:56	<i>Stenella frontalis</i>	Atlantic spotted dolphin	30	37.0580	74.9264

Table 3. Summary of sea turtle sightings during nine offshore vessel surveys from April 2015 through 2016.

Date	Sighting Time (local)	Scientific Name	Common Name	Group Size	Latitude (°N)	Longitude (°W)
12-Apr-15	13:34	<i>Caretta caretta</i>	Loggerhead sea turtle	2	36.73528	74.93357
12-Apr-15	14:07	<i>Caretta caretta</i>	Loggerhead sea turtle	1	36.73060	74.80337
12-Apr-15	14:39	<i>Caretta caretta</i>	Loggerhead sea turtle	1	36.75032	74.63203
29-Apr-15	12:42	<i>Caretta caretta</i>	Loggerhead sea turtle	1	36.87331	74.84967
29-Apr-15	14:09	<i>Caretta caretta</i>	Loggerhead sea turtle	1	37.02431	74.56249
29-Apr-15	16:53	<i>Dermochelys coriacea</i>	Leatherback sea turtle	1	37.03731	74.54522
29-Apr-15	17:30	<i>Caretta caretta</i>	Loggerhead sea turtle	1	37.00906	74.76048
29-Apr-15	17:36	<i>Caretta caretta</i>	Loggerhead sea turtle	1	36.99458	74.80701
10-Jun-15	16:04	<i>Caretta caretta</i>	Loggerhead sea turtle	1	36.97295	74.97305
10-Jun-15	16:07	<i>Caretta caretta</i>	Loggerhead sea turtle	2	36.96951	75.00287
10-Jun-15	16:10	<i>Caretta caretta</i>	Loggerhead sea turtle	5	36.96750	75.02605
10-Jun-15	16:16	<i>Caretta caretta</i>	Loggerhead sea turtle	2	36.96168	75.07619
10-Jun-15	16:21	<i>Caretta caretta</i>	Loggerhead sea turtle	3	36.95616	75.11699
10-Jun-15	16:31	<i>Caretta caretta</i>	Loggerhead sea turtle	7	36.94751	75.20039
10-Jun-15	16:55	<i>Caretta caretta</i>	Loggerhead sea turtle	1	36.92020	75.40500
10-Jun-15	17:13	<i>Caretta caretta</i>	Loggerhead sea turtle	1	36.89465	75.56130
10-Jun-15	17:22	<i>Caretta caretta</i>	Loggerhead sea turtle	1	36.88179	75.63332
02-Sep-15	8:08	<i>Caretta caretta</i>	Loggerhead sea turtle	2	36.90911	75.15100
02-Sep-15	8:19		Unidentified hard-shell sea turtle	1	36.91602	75.07056
02-Sep-15	8:31	<i>Caretta caretta</i>	Loggerhead sea turtle	1	36.92591	74.98177
21-Oct-15	9:00		Unidentified hard-shell sea turtle	1	37.04699	74.99186
27-Jun-16	14:53	<i>Caretta caretta</i>	Loggerhead turtle	1	37.01215	74.9007
27-Jun-16	15:01	<i>Caretta caretta</i>	Loggerhead turtle	1	37.00321	74.8879
27-Jun-16	15:39	<i>Caretta caretta</i>	Loggerhead turtle	7	36.96814	75.0953
27-Jun-16	15:39	<i>Caretta caretta</i>	Loggerhead turtle	4	36.95657	75.1734
11-Jul-16	6:21		Unidentified hard-shell turtle	1	36.93439	75.4743
11-Jul-16	6:54	<i>Caretta caretta</i>	Loggerhead turtle	4	36.98827	75.2333
11-Jul-16	7:08	<i>Caretta caretta</i>	Loggerhead turtle	1	37.01186	75.1258
11-Jul-16	16:27	<i>Caretta caretta</i>	Loggerhead turtle	1	36.76063	75.1261
11-Jul-16	16:34	<i>Caretta caretta</i>	Loggerhead turtle	1	36.76616	75.179
27-Jul-16	16:35	<i>Caretta caretta</i>	Loggerhead turtle	1	37.25529	74.8355
27-Jul-16	17:22		Unidentified hard-shell sea turtle	1	37.09892	75.1994
02-Nov-16	8:50	<i>Caretta caretta</i>	Loggerhead turtle	1	36.66021	75.0789
02-Nov-16	9:30	<i>Caretta caretta</i>	Loggerhead turtle	1	36.60517	74.7835
02-Nov-16	13:18	<i>Dermochelys coriacea</i>	Leatherback turtle	1	36.90213	74.5994

3.1 Photo-ID

Photo-ID images were collected from 129 of the 193 marine mammal sightings. Images collected during pilot whale encounters are being shared with Duke University for comparisons with their existing catalog of pilot whales from Cape Hatteras, and matching is on-going. Photos of other species of odontocetes have been archived for future processing. All photos of baleen whales were added to HDR's existing catalogs (**Table 4**). With the addition of these photos, the HDR fin whale catalog now contains 12 unique individuals, the minke whale catalog contains 4 individuals, and the sei whale catalog contains 2 individuals. The first humpback whale observed during the offshore vessel survey on 21 October 2015 matched to an individual in the HDR humpback whale catalog, HDRVAMn030, last seen near shore 193 days prior (on 11 April 2015), and the second was new to the catalog (HDRVAMn067).

Table 4. Summary of photo-identified baleen whale individuals sighted, from April 2015 through 2016.

HDR ID #	Species	Sighting Date	Focal Follow?, Duration (min)	Biopsy?	Satellite Tag?
HDRVABa001	<i>Balaenoptera acutorostrata</i>	12-Apr-15	Yes, 48	No	No
HDRVABp004	<i>Balaenoptera physalus</i>	12-Apr-15	Yes, 32	No	No
HDRVABp005	<i>Balaenoptera physalus</i>	29-Apr-15	Yes, 63	Yes	No
HDRVABp006	<i>Balaenoptera physalus</i>	29-Apr-15	No	No	No
HDRVABp007	<i>Balaenoptera physalus</i>	29-Apr-15	No	No	No
HDRVABp008	<i>Balaenoptera physalus</i>	29-Apr-15	No	No	No
HDRVABp013	<i>Balaenoptera physalus</i>	03-Mar-16	No	No	No
HDRVABp012	<i>Balaenoptera physalus</i>	27-Jun-16	No	No	Yes
HDRVAMn030	<i>Megaptera novaeangliae</i>	21-Oct-15	No	No	No
HDRVAMn067	<i>Megaptera novaeangliae</i>	12-Mar-16	No	No	No

3.2 Focal Follows

Three focal follows were performed totaling 163 minutes before the satellite tagging component of the project was added (**Table 3**). Two were completed on 12 April 2015 on a single fin whale and a single minke whale, and one was on 29 April 2015 on a pair of fin whales. Focal-follow data will be examined for any emerging patterns of habitat utilization and primary behaviors.

3.3 Biopsy Sample Collection

One biopsy of a fin whale was collected on 29 April 2015 (**Table 3**). HDR has completed the necessary paperwork and is waiting for CITES to issue an export permit before genetic samples can be shipped to the University of Groningen in the Netherlands for processing.

3.4 Satellite Tagging

One SPOT-6 satellite tag (Argos ID 15867) was deployed on a fin whale (HDRVABp012) sighted on 27 June 2016 (**Table 4, Figure 6**). The tag stopped transmitting on 11 July, for a total duration of 13.7 days. Argos locations (**Figure 5**) show the individual's movements along and beyond the continental shelf break, as well as some time spent over the continental shelf. Movements were through VACAPES range boxes 1B2, 1B3, 1B4, 2B1, 2B2, and 2B3.

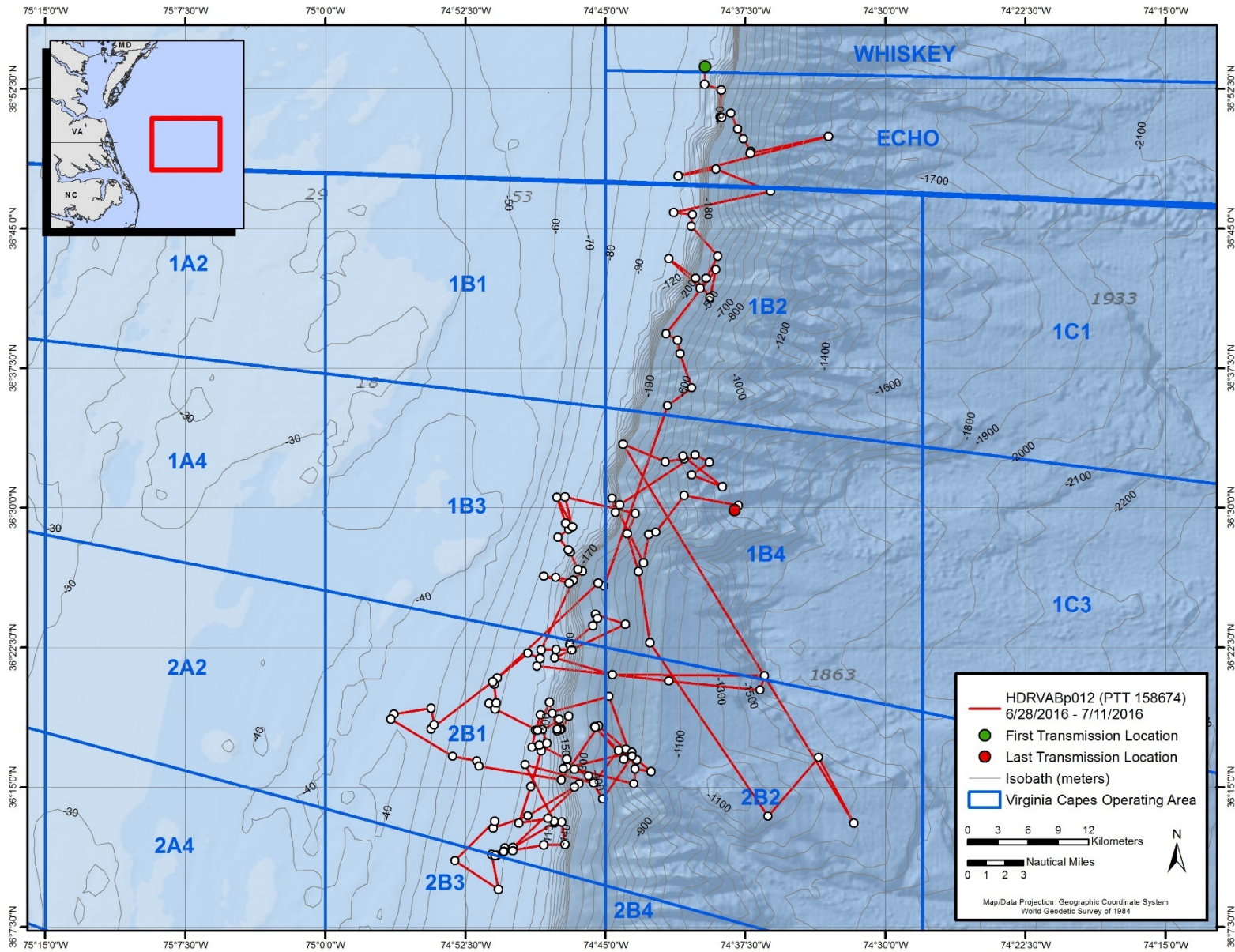


Figure 6. Filtered locations (white dots) and track of fin whale HDRVABp012 over 13.7 days of tag-attachment duration.

4. Discussion

Analysis and collection of data for this project are still in the early stages; however, preliminary results show high diversity in the study area for marine mammals in an important high-use area by the U.S. Navy. Two hundred and forty sightings of 14 identified species of marine mammals and 2 species of sea turtles were made over 13 surveys, showing a wide distribution throughout the study area. Sightings from this project coincide with those species expected to be present based on information collected through aerial surveys (McAlarney et al. 2016) and PAM (Hodge et al. 2016). Overlaying sighting information with PAM data would be a useful method to validate acoustic detections with species identifications. There are still some species recorded through PAM that have not yet been visually detected; however, with continued effort in this region additional validations will hopefully be determined.

As expected, there was a concentration of sightings near and offshore of the shelf break, especially for pilot whales, but baleen whale sightings were made both on and off the shelf. Locations from the satellite-tagged fin whale show movements through both shelf and slope waters, which include VACAPES range boxes 1B2, 1B3, 1B4, 2B1, 2B2, and 2B3 (**Figure 6**).

Range boxes in and around the Norfolk Canyon (K3 and K4) were often closed due to Navy training and testing exercises; however, sightings of marine species in this area were numerous, showing the potential for overlap between these species and naval activities. Norfolk Canyon is also an area heavily used by recreational fishing charter vessels. Those species most frequently observed in this area were bottlenose dolphins, followed by pilot whales, suggesting that these animals may be the least disturbed by frequently occurring activities in this area. The absence of other species, including beaked whales, is of interest; however, additional effort is needed in this area to make further conclusions about the species composition for this area. Additionally, satellite-tag data would be especially useful to see whether some species are using this area and simply have not yet been observed.

This study area can be challenging to survey, mainly because of the difficulty in finding suitable weather windows that match up with access to restricted Navy exercise areas. Each survey day, however, adds useful data once completed. As more surveys are completed and the HDR team is able to spread more coverage across each season, a high priority will be given to conducting analyses to better document seasonal occurrence patterns. Better and more detailed information will allow the U.S. Navy to make more informed decisions for training within the survey area to minimize potential impacts on marine mammals and sea turtles.

HDR will continue to coordinate data sharing with other local and regional researchers and agencies. To date, the largest of our offshore photo-ID catalogs, the fin whale catalog, has been compared to that of the Center for Coastal Studies but did not yield any matches. Further comparisons will occur as the catalogs grow and additional data become available. Such comparisons, along with the processing of photo-ID data collected to date, will allow for a better understanding of residency in the area by some species. Additional tag deployments will be a priority for future surveys, and as technology progresses and Fastloc® GPS is integrated into Wildlife Computer's LIMPET tags, HDR will be able to add high-resolution data logging to better document the whales' movements within the study area.

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A

Data Fields to be Recorded



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Data fields to be recorded

Placement	Field / Attribute
Survey/ Environmental	<ul style="list-style-type: none"> • Date / Time • Platform • Survey ID • Beaufort Scale • Visibility • Wind Direction • Swell • Percent Cloud Cover • Effort Status • Personnel • Leg Notes
Sighting	<ul style="list-style-type: none"> • Sighting Number • Date/Time • Latitude/Longitude • Relative Bearing • Angle to Sighting • Distance to Animal • Animal's Heading • Species Name (Common) • Species Name (Scientific) • Min Group Size • Max Group Size • Best Group Size • Count (Calves) • Count (Juveniles) • Behavior State • Multiple Sightings • Recorder • Observer • Reaction • Depth • Temperature • Navy Ship within 500m? (Y/N) • Cargo Ship within 500m? (Y/N) • Fishing/Rec Boat within 500m? (Y/N) • Within 500m of Shipping Channel? (Y/N) • Notes • Photos Taken (Y/N) (If Yes - Frame numbers, camera, photographer) • Video (Y/N) (If Yes - Frame numbers, camera, photographer) • Biopsy (Y/N) (If Yes – Shooter, hit/miss, sample location, reaction, others present/reacting, sample, sample name, comments) • Tagging (Y/N) (If Yes – Shooter, hit/miss, tag location, reaction, others present/reacting, tag number, tag type, comments) • Maximum Distance between Nearest Neighbor • Minimum Distance between Nearest Neighbor
Focal (Related to Focal Individual Only)	<ul style="list-style-type: none"> • Date / Time • Latitude / Longitude • Group ID • Behavioral State (Travel; Feed; Mill; Social; Rest; Log; Unknown) • Behavioral Event (Blow; Dive/Peduncle arch; FUD; FDD; Side fluke; Lunge; Tail slap; Pec slap; Spy hop; Breach; Bubbles; Start follow; Stop follow; Footprint WP; First surfacing; Head slap; Peduncle slap; Chase; Brood side display; Head lunge; Linear bubble trail; charge) • Bearing • Distance to Sighting • Heading of the Animal • Relative Movement of Vessel and Animal's Bearing • Sighting Notes

* Upon each entry and time stamp and GPS coordinate is recorded for the position of the vessel. Variables may be modified as deemed necessary by the Chief Scientist.

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