Mid-Atlantic Humpback Whale Monitoring, Virginia Beach, Virginia: 2015/16 Annual Progress Report

Submitted to:

Naval Facilities Engineering Command Atlantic under Contract No. N62470-10-3011, Task Orders 03 and 54, and N62470-15-D-8006, Task Order 13, issued to HDR, Inc.

Prepared by

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Cover Photo Credit:

Humpback whale (*Megaptera novaeangliae*) flukes off the coast of Virginia Beach, Virginia with HDR's Research Vessel, *Whale Research,* in the background. Cover photo by Brian Lockwood.

This project is funded by US Fleet Forces Command and managed by Naval Facilities Engineering Command Atlantic as part of the US Navy's marine species monitoring program.

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Acronyms and Abbreviations

BSS	Beaufort sea state
°C	degrees Celsius
km	kilometer(s)
LIMPET	Low Impact Minimally Percutaneous Electronic Transmitter
m	meter(s)
MINEX	Mine Neutralization Exercise
M/V	motor vessel
Photo-ID	photo-identification
SPOT	Smart Position and Temperature
U.S.	United States
VACAPES	Virginia Capes Operating Area
VAQS	Virginia Aquarium and Marine Science Center

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1. Introduction and Background

The endangered North Atlantic humpback whale (*Megaptera novaeangliae*) migrates from six northern feeding grounds in the Gulf of Maine, the Gulf of St. Lawrence, Newfoundland/ Labrador, western Greenland, Iceland, and Norway to Caribbean Sea waters during the winter months (Katona and Beard 1990, Christensen et al. 1992, Palsbøll et al 1997). Understanding the occurrence and behavior of humpback whales in the vicinity of United States (U.S.) Navy training and vessel-transiting activities off the coast of Virginia is important in mitigating potentially harmful impacts on the species.

Humpback whale sighting information off the Virginia Beach area has previously been collected by various methods and sporadic field efforts. Shore-based counts in 1991, vessel-based photo-identification (photo-ID) efforts in 1992 (Swingle et al. 1993), and further cataloging efforts using photographs taken on whale-watching excursions and from stranded whales (Barco et al. 2002), have been the primary data sources. These studies have shown that some individuals return in subsequent years, and it is suggested that the area may act as a supplemental winter feeding ground for the returning whales (Barco et al. 2002). Photographs of whales sighted off Virginia have been matched to cataloged whales from the Gulf of Maine, Newfoundland, and the Gulf of St. Lawrence regions (Barco et al. 2002, Aschettino et al. 2015). Information on the movements of individuals within this region is very limited, and these data are important to assess the potential for disturbance to humpback whales found in U.S. Navy training ranges and high-traffic areas in the Chesapeake Bay and mid-Atlantic coastal waters.

The objective of this project under the U.S. Navy's Marine Species Monitoring Program is to establish baseline information on occurrence and behavior of humpback whales near Naval Station Norfolk and within the Virginia Capes Operational Area (VACAPES OPAREA) by addressing the following questions:

- *What age classes (juveniles, sub-adults, adults) are utilizing the waters within and adjacent to the mouth of the Chesapeake Bay?*
- *Do humpback whales exhibit site fidelity over periods of days to years?*
- *Do humpback whales congregate in specific high-traffic and/or high-use U.S. Navy training areas?*
- *Do humpback whales spend significant time within or move through areas of U.S. Navy live-fire and mine neutralization exercise (MINEX) training (Year 2 and Year 3)?*

Primary objectives of this project include:

- *Collect baseline occurrence data (location, sex, group size, etc.) of humpback whales (and other species of baleen whales opportunistically)*
- *Obtain identification photographs of humpback whales for inclusion in regional and local catalogs.*
- *Conduct focal follows of humpback whales with an emphasis on priority U.S. Navy training areas, such as the W-50 MINEX zone, and shipping channels.*

- *Collect biopsy samples of humpback whales for sex determination, mitochondrial control region sequencing, and microsatellite genotyping of tissue samples, and stable isotope analysis to determine foraging related to prey consumption.*
- *Conduct satellite tagging to document seasonal humpback whale movement patterns in the nearshore waters off Virginia Beach, specifically whether the whales spend significant time in areas of high shipping traffic and/or areas of Navy training exercises.*

2. Methods

The humpback whale field season off Virginia Beach runs from approximately November through March with a small number of sightings occurring outside this timeframe and the majority of sightings between December and February. The first season of dedicated humpback whale surveys (Year 1 of this project) began in January 2015 (see Aschettino et al. 2015) and was completed in May 2015. Additional humpback whale sighting information from bottlenose dolphin density surveys running concurrently off Virginia Beach (see Engelhaupt et al. 2016) was also incorporated in these analyses. The first humpback whale sightings from these density surveys were in December 2014. Therefore, the first field season, encompassing sightings from both the dedicated humpback whale surveys and the bottlenose dolphin density surveys, will herein be referred to as the 2014/2015 field season.

In December 2015, the second season of dedicated humpback whale surveys began (bottlenose dolphin density surveys were no longer being conducted due to the project's completion in August 2015), and this second field season will be referred to as the 2015/2016 field season.

In addition to the nearshore humpback whale field seasons, offshore surveys (occurring 40+ nautical miles from shore) have also been conducted in association with this project from April 2015 through October 2015 and results have been incorporated in this report, although a separate offshore cetacean monitoring project has since been established and will be reported on separately in the future.

Two primary areas of interest in this study were U.S. Navy training areas and commercial shipping lanes. Inbound and outbound shipping lanes were defined by the Traffic Separation Scheme. A "shipping lane study area" was defined for this project as within 100-yards of the Traffic Separation Scheme in the mouth of the Chesapeake Bay (**Figure 1**). U.S. Navy training areas included portions of both the W-50 Mine Neutralization Exercise (MINEX) and VACAPES OPAREA (**Figure 2**).

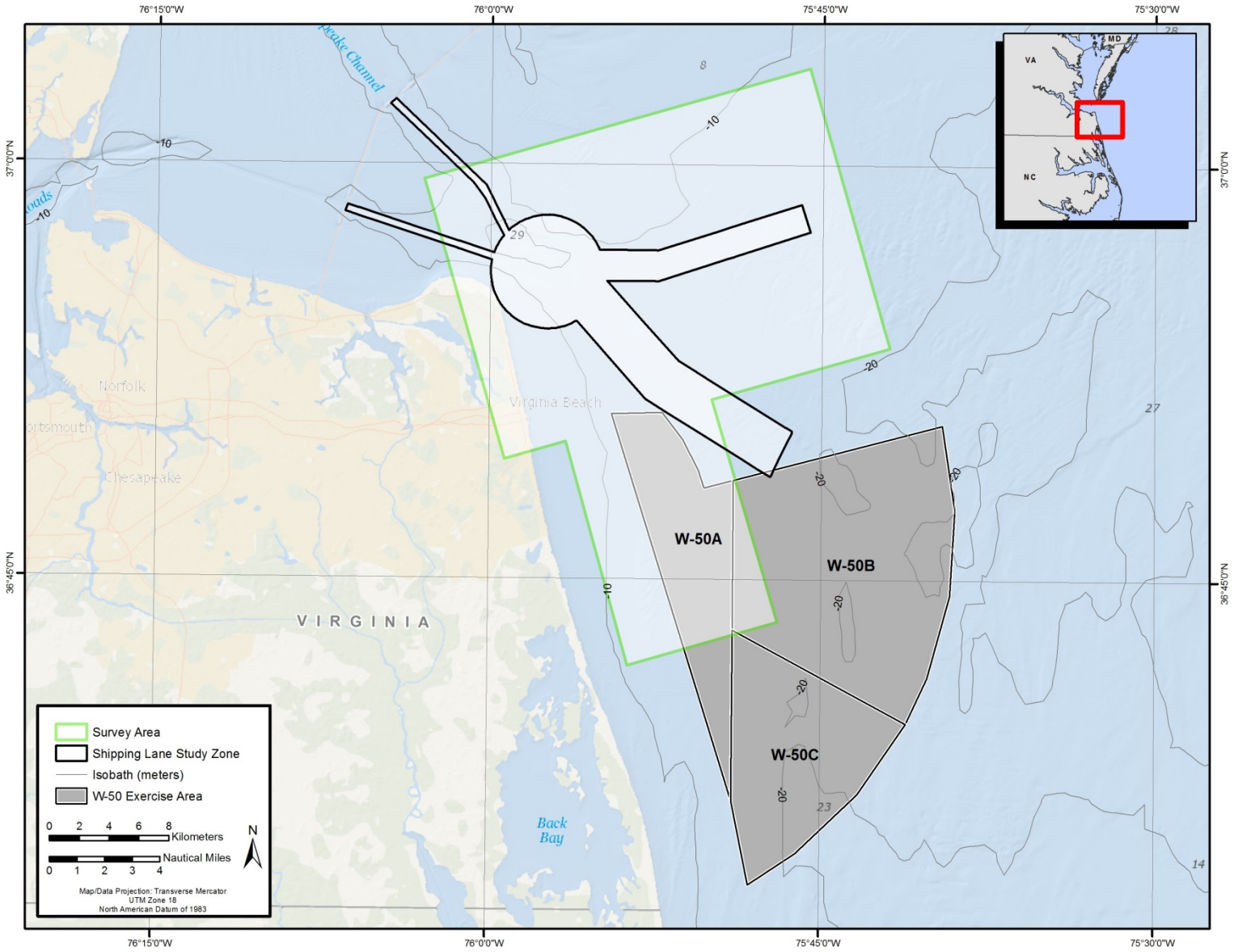

Figure 1. Map of the primary nearshore study area, as outlined by the green boundary, which includes waters in and around the mouth of the Chesapeake Bay as well as the W-50 MINEX region off Virginia Beach.

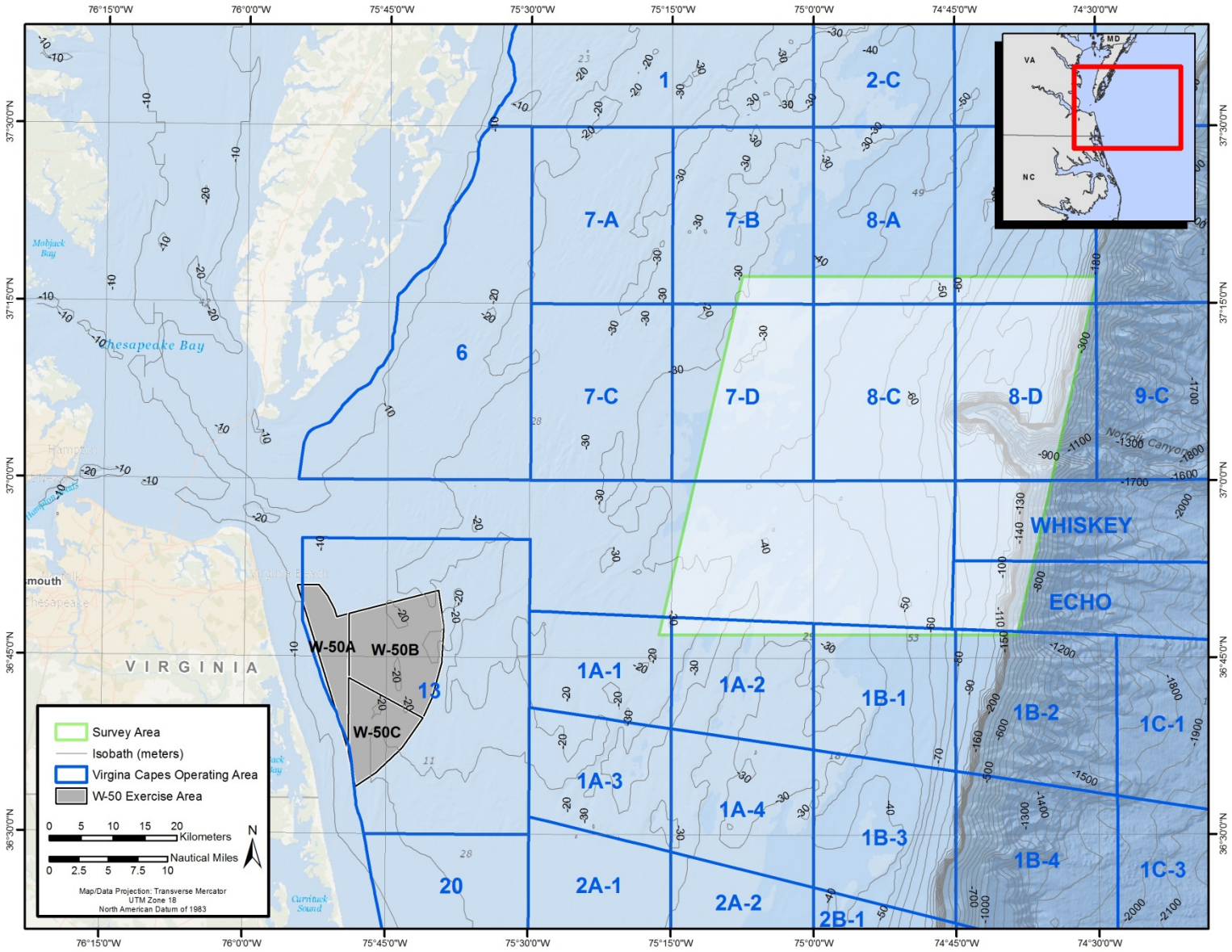

Figure 2. Map of the offshore study area that extends out to the continental shelf break and includes Norfolk Canyon.

The nearshore study zone included waters in and around the mouth of the Chesapeake Bay as well as the W-50 MINEX region off Virginia Beach (**Figure 1**). The offshore study zone extended out over the continental shelf, included much of the VACAPES OPAREA, and included the Norfolk Canyon (**Figure 2**).

The first year of the project included 20 days of nearshore vessel surveys, and 5 days each of offshore vessel and aerial surveys. Fifteen additional nearshore survey days were added in the second year of the project while remaining aerial surveys were converted to additional offshore vessel days. In total, there have been 35 nearshore days, 9 offshore vessel days, and 1 aerial day available under both years of this project.

In order to maximize the ability to achieve project objectives, survey departure times were adjusted to maximize weather windows. Local availability of researchers allowed surveys to be planned for days with optimal weather conditions, including good visibility and a Beaufort sea state (BSS) of 3 or lower. Once a survey was underway, if BSS reached 4 or 5, or visibility was reduced to less than one nautical mile due to rain, fog, or snow, the survey was aborted and the vessel returned to port. Efforts were coordinated with the W-50 MINEX range as well as the broader VACAPES OPAREA 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 W-50 MINEX range or VACAPES OPAREA.

The nearshore survey vessel was the 8.2-meter (m) fiberglass hybrid-foam-collar boat, *Whale Research* (**Figure 3**) owned and operated by HDR. Nearshore surveys departed from Marina Shores Marina, located in Lynnhaven Inlet, Virginia Beach. The crew consisted of a minimum of three marine mammal scientists (four after the tagging operations were added during the second field season). One of the science crew also served as the vessel operator. For the nearshore surveys, the vessel would transit to areas where humpback whales were previously seen or reported. If no whales were located in these areas, the vessel would expand the search into waters further offshore, north, or south of the primary study area (see **Figure 1**). Sightings of non-target species in the nearshore survey area (i.e. bottlenose dolphins [*Tursiops truncatus*]) were recorded, however not presented in this report.

Figure 3. Nearshore survey vessel, *Whale Research.* Photo © Brian Lockwood.

For offshore surveys, charter fishing vessels ranging in size from 15.8 to 17.4 m and fully licensed and insured for operation in offshore waters were used (**Figure 4)**. Offshore surveys departed from Rudee Inlet, Virginia Beach. The offshore surveys included three to five scientists in addition to the captain and mate. The survey vessel would transit offshore using VACAPES clearance and availability as a means to select a primary study area for any given survey day. Given the variety of species inhabiting the offshore study area priority was assigned to baleen whale sightings and/or uncommon odontocete sightings.

Figure 4. One of multiple motor vessels (*M/V*) used during offshore surveys, the 16.2 m *M/V Top Notch*.

For both nearshore and offshore surveys, a primary survey team of three individuals visually searched for marine species as the vessel was underway. The team consisted of at least two dedicated observers equipped with 7 × 50 reticled hand-held binoculars or 10 × 30 hand-held image-stabilized binoculars, a third observer (the vessel operator for nearshore surveys), and sometimes fourth and fifth observer, searching only by naked eye.

During a marine mammal sighting, the vessel operator attempted to approach the animal(s) in a slow and safe manner to minimize disturbance. The scientific crew attempted to confirm species, estimate group size, and collect photographs and high-definition video. 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 or 7D Mark ii) with a zoom lens (Canon 100 to 400-millimeter). A laser-photogrammetry system (http://www.abdn.ac.uk/lighthouse) was incorporated beginning in December 2015 as a means to add quantitative data to support age-class identification in the field; however, these data have not yet been incorporated into the results. Photographs of humpback and fin whales were post-processed using ACDSee (Versions 7-9) by cropping the best image of each individual whale's dorsal fin (left and right) and tail flukes (when obtained). Photos were assembled into a catalog managed by HDR where each new whale was assigned an ID number (e.g., HDRVAMn001 or

HDRVABp001) and compared with one another. At the end of the 2014/2015 field season, images of humpback whale flukes were submitted to Allied Whale for comparison to the North Atlantic humpback whale catalog and images of humpback whale dorsal fins and flukes were submitted to the Virginia Aquarium and Marine Science Center (VAQS) for comparisons with the mid-Atlantic humpback whale catalog. Images of fin whales were shared with Duke University and will be shared with other researchers, including the Center for Coastal Studies in Provincetown, Massachusetts.

During the 2014/15 field season, focal follows were attempted based on the known sighting history of individual humpback whales (priority given to whales already in the HDR catalog) and the presence or absence of other baleen whales in the study area (when other baleen whales were in area collecting identification photos took precedent to focal follows). The approximate distance and heading of the animal relative to the research vessel, as well as the behavior of the animal (e.g. breath, fluke up dive, etc.), was recorded via a customized field application created by HDR for use on a tablet (Apple iPad Air 2). Each behavioral observation created a focal follow point with an associated estimated location. Focal follow duration varied but, when possible, approximately 1 hour of observations was attempted. Focal follows were mostly discontinued beginning in December 2015 when the tagging component was added and took priority.

Biopsy samples were collected, when possible, from whales of interest. Biopsies were obtained either using Finn Larsen designed crossbow bolts outfitted with 25-millimeter ethanol sterilized stainless steel tips projected by a 68-kilogram pull Barnett crossbow or via a Paxarms biopsy rifle (www.paxarms.com) using 6 × 20-millimetersterilized dart tips propelled by .22 style blank cartridges. Samples were post-processed by sectioning the skin into three equal-sized pieces. One third of the skin was placed in a cryovial and frozen (-40 degrees Celsius [°C]) for stable isotope analysis by Duke University, one third was placed in a cryovial with a dimethylsufate and sodium chloride solution in preparation for analysis by University of Groningen, and one third was frozen (-40°C) for archival storage for South East Fisheries Science Center. Blubber was wrapped in foil and frozen for archiving for South East Fisheries Science Center. Analysis of these samples is currently in progress.

Beginning in December 2015, a satellite-tagging component was incorporated into the project using Wildlife Computers (Redmond, Washington) Smart Position and Temperature (SPOT-6) Argos-linked satellite tags in the Low Impact Minimally Percutaneous Electronic Transmitter (LIMPET) configuration (Andrews et al. 2008). Tags were remotely deployed using a DAN-INJECT JM25 pneumatic projector (www.dan-inject.com). Two 6.8-centimeter surgical-grade titanium darts with six backwards-facing petals were used to attach tags to the dorsal fin. Given existing information on attachment durations of LIMPET tags on humpback whales, maximum tag attachment duration was expected to be less than 30 days. Therefore, they 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 hours per day with unlimited number of transmissions. Locations of tagged individuals were approximated by the Argos system using the Kalman filtering location algorithm (Argos Users Manual © 2007-2015 CLS), and unrealistic locations were removed via the Douglas Argos-filter version 8.50 (Douglas et al. 2012) using tools provided within Movebank (www.movebank.og). Additional unrealistic locations (i.e., those on

land that the Douglas Argos-filter did not exclude) were also manually removed. Biopsy samples were collected from all tagged whales using the same protocol described above.

The aerial survey plane was a fixed-wing aircraft, owned by Orion Aviation, which followed standard NOAA survey safety guidelines. The observation team included two scientists, and a set of seven transect lines were flown using established tracklines previously surveyed by University of North Carolina, Wilmington for related projects. A single offshore aerial survey was completed during the 2014/15 season in coordination with the first offshore vessel survey to facilitate sighting and localization of humpback whales or other high-priority species, but it was determined to be logistically inefficient and no additional aerial surveys were flown thereafter.

3. Results

3.1 Nearshore Surveys: 2014/15 Field Season

HDR conducted 16 nearshore surveys for humpback whales between 02 January 2015 and 31 May 2015 covering 1,485 kilometers (km) of trackline with over 114 hours of effort (**Table 1**). During these 16 surveys, there were 46 sightings of humpback whales totaling 61 individuals and 3 sightings of fin whales totaling 4 individuals (**Tables 1 and 2; Figure 5**). Another Navy-funded monitoring project (see Engelhaupt et al. 2016) occurring in the same area added an additional 14 humpback whale sightings between 21 December 2014 and 11 April 2015 (**Table 2**). Of the 63 total large whale sightings during the 2014/2015 field season, 33 (55.0%) occurred in the shipping lane study zone and 4 (6.7%) occurred in the W-50 MINEX zone.

Table 1. Summary of nearshore survey efforts off Virginia Beach, Virginia: January— May 2015.

Date	Survey Time (min)	Distance surveyed (km)	# Sightings Mn	# Individual Mn	# Sightings Bp	# Individual Bp
02-Jan-15	339	81.6	2	2	0	0
06-Jan-15	492	72.5	6	6	0	0
11-Jan-15	544	94.5	5	8	0	0
15-Jan-15	427	68.1	3	6	0	0
20-Jan-15	563	86.5	7	10	2	3
22-Jan-15	510	84.0	6	6	1	1
25-Jan-15	441	55.5	7	11	0	0
29-Jan-15	512	62.3	5	7	0	0
06-Feb-15	311	80.0	0	0	0	0
09-Feb-15	292	37.3	2	3	0	0
12-Feb-15	415	56.1	3	2	0	0
22-Feb-15	378	117	0	0	0	0
05-Apr-15	416	168	0	0	0	0
17-Apr-15	480	155	0	0	0	0
15-May-15	519	190	0	0	0	0
31-May-15	208	76.2	0	0	0	0
Total	**6,847**	**1,485**	**46**	**61**	**3**	**4**

Key: min = minute(s); km = kilometer(s); Mn = *Megaptera novaeangliae*; Bp = *Balaenoptera physalus*

Table 2. Sighting history, focal-follows, and biopsy sample collection summary of all humpback, fin, and minke whales off Virginia Beach, Virginia: December 2014—May 2016.

HDR Catalog ID	Density Surveys					Nearshore Humpback Surveys: 02 Jan--31 May 2015																Offshore Surveys			Nearshore Humpback Surveys: 01 Dec 2015--09 May 2016																											Total No. Days Seen	Total No. Focal Follows	Total No. Focal Follow Minutes
	21-Dec-14	31-Dec-14	11-Jan-15	22-Jan-15	11-Apr-15	02-Jan-15	06-Jan-15	11-Jan-15	15-Jan-15	20-Jan-15	22-Jan-15	26-Jan-15	29-Jan-15	06-Feb-15	09-Feb-15	12-Feb-15	22-Feb-15	05-Apr-15	17-Apr-15	15-May-15	31-May-15	12-Apr-15	29-Apr-15	21-Oct-15	01-Dec-15	04-Dec-15	07-Dec-15	09-Dec-15	10-Dec-15	20-Dec-15	21-Dec-15	30-Dec-15	2-Jan-16	09-Jan-16	13-Jan-16	15-Jan-16	20-Jan-16	28-Jan-16	06-Feb-16	08-Feb-16	09-Feb-16	12-Feb-16	17-Feb-16	21-Feb-16	03-Mar-16	05-Mar-16	07-Mar-16	12-Mar-16	22-Mar-16	07-May-16	09-May-16			
Humpback Whales																																																						
HDRVAMn003	x																																																			1	0	-
HDRVAMn004	x																																																			1	0	-
HDRVAMn005		x											x[1,3]																																							2	1	64
HDRVAMn006		x										x[1]																																								2	1	69
HDRVAMn007		x		x								x			x														x[1]																							5	1	60
HDRVAMn008				x		x	x		x			x																																								5	3	215
HDRVAMn009						x[1,3]			x[1]	x[1]	x																																									4	2	112
HDRVAMn010							x[1,3]																					x	x																							3	1	76
HDRVAMn011		x					x[1,3]		x1			x																																								4	1	60
HDRVAMn012								x			x[1]					x																		x		x																5	2	25
HDRVAMn013		x	x	x				x[1,3]		x[1]	x	x	x		x	x[2]																																				10	4	357
HDRVAMn014			x	x				x[1,3]				x	x																							x																6	1	60
HDRVAMn015			x					x[1,3]																																												2	1	58
HDRVAMn016								x																																												1	0	-
HDRVAMn017			x																																																	1	0	-
HDRVAMn018			x																																																	1	0	-
HDRVAMn019			x																																																	1	0	-
HDRVAMn020			x																																																	1	0	-
HDRVAMn021									x			x[1]																																								2	1	78
HDRVAMn022									x				x																																							2	1	85
HDRVAMn023										x[1,3]																																										1	1	80
HDRVAMn024										x	x[1,3]																																									2	1	60
HDRVAMn025											x[1,3]																																									1	1	62
HDRVAMn027				x									x[1,3]														x								x																	4	1	61
HDRVAMn028													x																																							1	0	-
HDRVAMn029															x[1,3]																																					1	1	63

HDR Catalog ID	Density Surveys					Nearshore Humpback Surveys: 02 Jan--31 May 2015																Offshore Surveys			Nearshore Humpback Surveys: 01 Dec 2015--09 May 2016																											Total No. Days Seen	Total No. Focal Follows	Total No. Focal Follow Minutes
	21-Dec-14	31-Dec-14	11-Jan-15	22-Jan-15	11-Apr-15	02-Jan-15	06-Jan-15	11-Jan-15	15-Jan-15	20-Jan-15	22-Jan-15	26-Jan-15	29-Jan-15	06-Feb-15	09-Feb-15	12-Feb-15	22-Feb-15	05-Apr-15	17-Apr-15	15-May-15	31-May-15	12-Apr-15	29-Apr-15	21-Oct-15	01-Dec-15	04-Dec-15	07-Dec-15	09-Dec-15	10-Dec-15	20-Dec-15	21-Dec-15	30-Dec-15	2-Jan-16	09-Jan-16	13-Jan-16	15-Jan-16	20-Jan-16	28-Jan-16	06-Feb-16	08-Feb-16	09-Feb-16	12-Feb-16	17-Feb-16	21-Feb-16	03-Mar-16	05-Mar-16	07-Mar-16	12-Mar-16	22-Mar-16	07-May-16	09-May-16			
Humpback Whales (continued)																																																						
HDRVAMn030					x[1]																		x	x																												**2**	**1**	**62**
HDRVAMn031					x																																															**1**	**0**	**-**
HDRVAMn032					x																																															**1**	**1**	**-**
HDRVAMn033					x[1]																																															**1**	**0**	**63**
HDRVAMn034					x																																															**1**	**0**	**-**
HDRVAMn035																										x	x																									**2**	**0**	**-**
HDRVAMn036																										x	x																									**2**	**0**	**-**
HDRVAMn037																										x	x							x																		**3**	**0**	**-**
HDRVAMn039																											x[3]																									**1**	**0**	**-**
HDRVAMn041																												x																								**1**	**0**	**-**
HDRVAMn042																												x		x	x	x	x			x																**6**	**0**	**-**
HDRVAMn043																													x																							**1**	**0**	**-**
HDRVAMn044																													x[3]																							**1**	**0**	**-**
HDRVAMn045																														x[3]		x				x	x		x						x							**6**	**0**	**-**
HDRVAMn046																														x	x				x	x																**4**	**0**	**-**
HDRVAMn047																														x																						**1**	**0**	**-**
HDRVAMn048																														x[3]	x																					**2**	**0**	**-**
HDRVAMn049																														x	x																					**2**	**0**	**-**
HDRVAMn050																														x				x	x	x[3]																**4**	**0**	**-**
HDRVAMn051																																x	x			x[3]			x	x	x	x	x		x							**9**	**0**	**-**
HDRVAMn052																																	x		x	x[3]																**3**	**0**	**-**
HDRVAMn053																																	x	x																		**2**	**0**	**-**
HDRVAMn054																																	x	x		x[3]			x		x				x	x						**7**	**0**	**-**
HDRVAMn055																																		x			x															**2**	**0**	**-**
HDRVAMn056																																		x	x																	**2**	**0**	**-**
HDRVAMn057																																		x																		**1**	**0**	**-**
HDRVAMn058																																				x																**1**	**0**	**-**
HDRVAMn059																																				x																**1**	**0**	**-**
HDRVAMn060																																				x																**1**	**0**	**-**

HDR Catalog ID	Density Surveys					Nearshore Humpback Surveys: 02 Jan--31 May 2015																Offshore Surveys			Nearshore Humpback Surveys: 01 Dec 2015--09 May 2016																											Total No. Days Seen	Total No. Focal Follows	Total No. Focal Follow Minutes
	21-Dec-14	31-Dec-14	11-Jan-15	22-Jan-15	11-Apr-15	02-Jan-15	06-Jan-15	11-Jan-15	15-Jan-15	20-Jan-15	22-Jan-15	26-Jan-15	29-Jan-15	06-Feb-15	09-Feb-15	12-Feb-15	22-Feb-15	05-Apr-15	17-Apr-15	15-May-15	31-May-15	12-Apr-15	29-Apr-15	21-Oct-15	01-Dec-15	04-Dec-15	07-Dec-15	09-Dec-15	10-Dec-15	20-Dec-15	21-Dec-15	30-Dec-15	2-Jan-16	09-Jan-16	13-Jan-16	15-Jan-16	20-Jan-16	28-Jan-16	06-Feb-16	08-Feb-16	09-Feb-16	12-Feb-16	17-Feb-16	21-Feb-16	03-Mar-16	05-Mar-16	07-Mar-16	12-Mar-16	22-Mar-16	07-May-16	09-May-16			
Humpback Whales (continued)																																																						
HDRVAMn061																																							x		x		x[3]									**3**	**0**	**-**
HDRVAMn062																																								x			x		x							**3**	**0**	**-**
HDRVAMn063																																									x[3]	x	x	x[1]								**4**	**1**	**120**
HDRVAMn064																																													x							**1**	**0**	**-**
HDRVAMn065																																													x							**1**	**0**	**-**
HDRVAMn066																																													x				x			**2**	**0**	**-**
HDRVAMn067																																																x				**1**	**0**	**-**
HDRVAMn068																																																		x		**1**	**0**	**-**
Total Mn																																																					**29**	**1951**
Fin Whales																																																						
HDRVABp001										x[1]																																										**1**	**1**	**61**
HDRVABp002										x																																										**1**	**0**	**-**
HDRVABp003											x																																									**1**	**0**	**-**
HDRVABp004																						x[1]																														**1**	**1**	**32**
HDRVABp005																							x[3]																													**1**	**0**	**-**
HDRVABp006																							x																													**1**	**1**	**63**
HDRVABp007																							x[1]																													**1**	**0**	**-**
HDRVABp008																							x																													**1**	**0**	**-**
HDRVABp009																																							x		x											**2**	**0**	**-**
HDRVABp010																																									x	x										**2**	**0**	**-**
HDRVABp011																																										x										**1**	**0**	**-**
Total Bp																																																					**3**	**156**
Minke Whales																																																						
HDRVABa001																						x[1]																														**1**	**1**	**48**
TOTAL ALL																																																					**65**	**4262**

Key: 1 = focal-followed; 2= focal-followed twice; 3=biopsied; min = minutes; Mn = *Megaptera novaeangliae*; Bp = *Balaenoptera physalus*; Ba = *Balaenoptera acutorostrata;* * Only offshore dates where photo-IDs of large whales were collected are included.

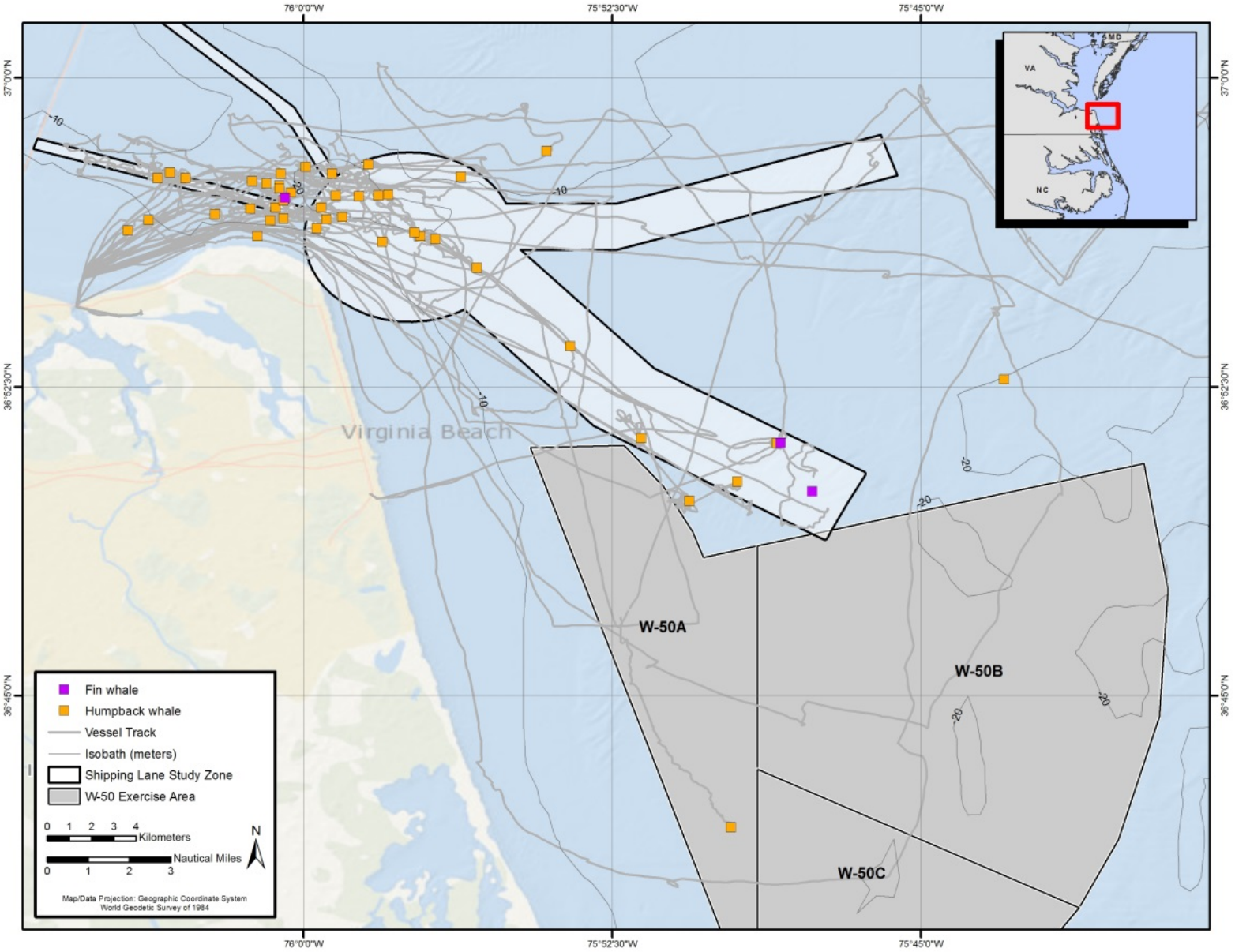

Figure 5. Nearshore survey tracks and locations of all humpback (n=46) and fin whale (n=3) sightings: January–May 2015.

Focal follows were performed on 25 occasions on 17 individual humpback whales and on one fin whale, totaling 1,646 minutes of focal-follow effort (**Table 2; Figure 6**). The other Navy-funded project (Engelhaupt et al. 2016) added 2 additional focal follows on humpback whales, with 125 minutes of focal-follow effort. The distribution of the 27 nearshore focal follow locations was similar to that of the sighting locations (**Figure 6**). The 1,771 total focal follow minutes resulted in 2,133 focal follow locations. Of these, 1,069 (50.1 percent) occurred inside the shipping lane study zone and 169 (7.9 percent) occurred in the W-50 MINEX zone.

There were 31 unique humpback whales identified; 20 of those individuals (64.5 percent) were categorized as juveniles based on size estimates made in the field. Just over half (16/31, 51.6 percent) were seen on multiple occasions, and re-sightings spanned from 2 to 53 days apart (median = 23 days). Of the 16 individuals seen on multiple occasions, half (8/16, 50.0 percent) were seen four or more times. The maximum number of times one individual was seen was 12, which included two same-day re-sightings. Twelve of the 31 (38.7 percent) humpback whales were seen in previous years off Virginia Beach based on comparisons with the Mid-Atlantic humpback whale catalog (Sarah Mallette, VAQS, Virginia Beach, Virginia, pers. comm.), and 10 of the 31 (32.3 percent) were matched to the North Atlantic humpback whale catalog (Peter Stevick, College of the Atlantic, Bar Harbor, Maine, pers. comm.).

Twelve biopsy samples were collected from humpback whales and nine contained sufficient amounts of skin for stable-isotope analysis (**Table 2**).

3.2 Nearshore Surveys: 2015/16 Field Season

Twenty-seven nearshore surveys for humpback whales were conducted from December 2015 through May 2016 covering 2,456 km of trackline with over 164 hours of effort (**Table 3**). There were 96 sightings of humpback whales and 5 sightings of fin whales (**Table 3; Figure 7**), totaling 135 individual humpback whales and 7 individual fin whales. Two focal follows were performed on two individual whales for 60 and 120 minutes, respectively (**Table 2; Figure 6)**. Eleven biopsy samples were collected with enough skin on all samples to also be used for stable isotope analysis (**Table 2**).

Of the 135 total individual humpback whales seen, 103 (76.3 percent) were categorized as juveniles based on their estimated size. There were 37 individual humpback whales identified during the 2015/16 field season. Six of these individuals were seen during the 2014/15 field season.

Nine SPOT-6 satellite tags were deployed (**Figures 8 through 16**) and transmitted between 3.3 and 21.4 days (mean = 13.0 days) (**Table 4**). Argos locations were recorded in the shipping lane study zone and VACAPES OPAREA for all nine whales. Two whales never left the primary nearshore study area for the duration of the satellite tag's transmissions (HDRVA044 and HDRVA045, **Figures 11 and 12**). The remainder of the tagged whales used both the primary nearshore study area, as well as additional offshore areas. Four whales, HDRVA010, HDRVA048, HDRVA061 and HDRVA063 had Argos locations in the W-50 MINEX zone (**Figures 9, 13, 14 and 16)** and HDRVA041, HDRVA048, HDRVA061 and HDRVA063 (**Figures 10, 13, 14 and 16**) had Argos locations along the continental shelf and extending beyond the continental shelf break. HDRVA041 traveled the greatest straight line distance from the initial tagging location (**Figure 9**) with the last Argos location recorded 88 km due south of Martha's Vineyard, Massachusetts.

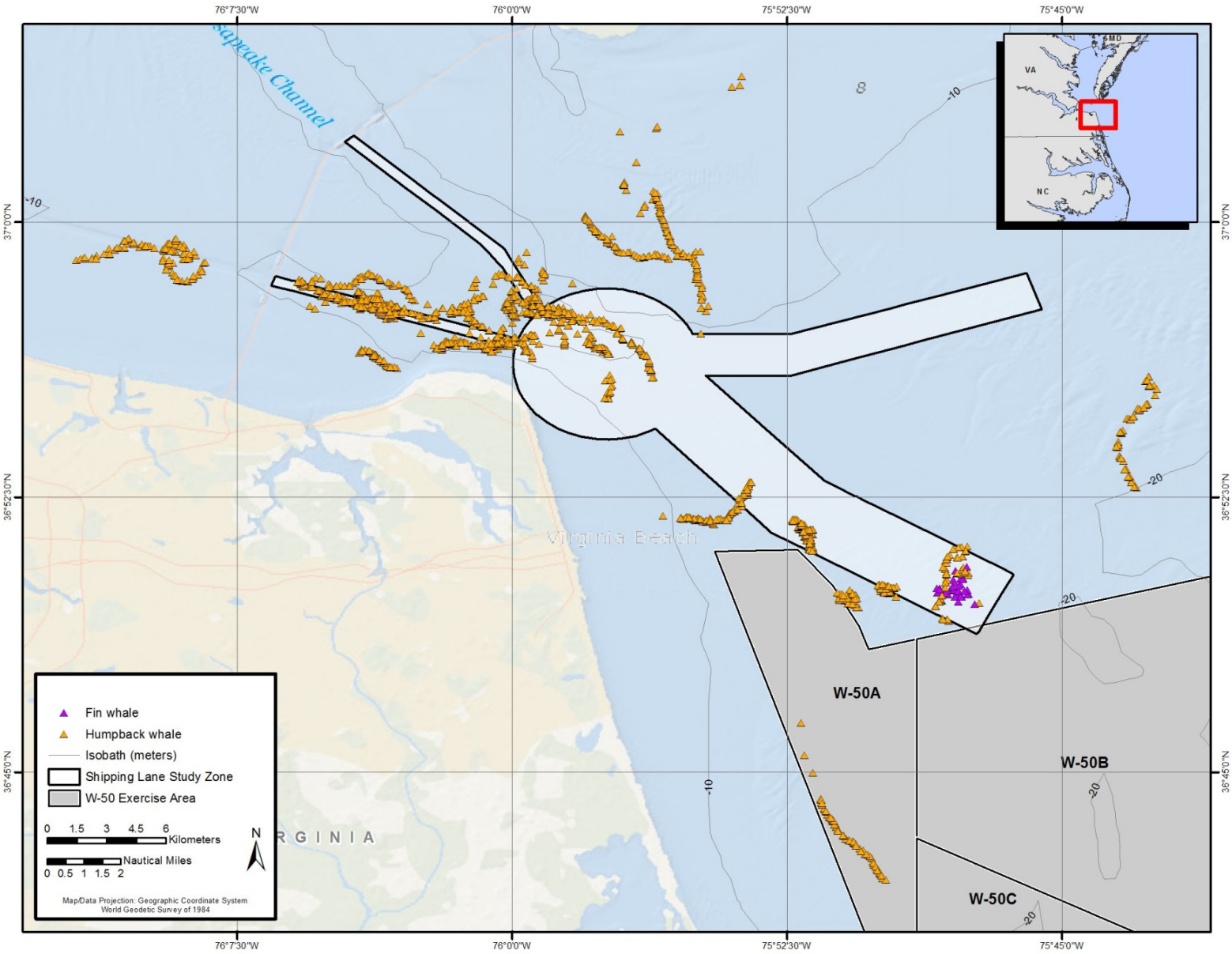

Figure 6. Focal-follow locations for all followed whales in the nearshore study zone from January 2015 through May 2016.

Table 3. Summary of nearshore survey efforts off Virginia Beach, Virginia from December 2015 through May 2016

Date	Survey Time (min)	Distance surveyed (km)	# Sightings Mn	# Individual Mn	# Sightings Bp	# Individual Bp
01-Dec-15	321	105	0	0	0	0
04-Dec-15	270	81.5	1	3	0	0
07-Dec-15	447	116	6	8	0	0
09-Dec-15	456	72.3	4	4	0	0
10-Dec-15	536	187.3	5	6	0	0
20-Dec-15	335	57.2	4	11	0	0
21-Dec-15	282	96.6	5	6	0	0
30-Dec-15	252	60.3	3	4	0	0
02-Jan-16	335	61.4	7	10	0	0
09-Jan-16	405	89.6	9	9	0	0
13-Jan-16	255	85.8	1	5	0	0
15-Jan-16	568	78.0	14	17	0	0
20-Jan-16	322	115	3	2	0	0
28-Jan-16	383	129	0	0	0	0
06-Feb-16	565	80.8	7	10	1	1
08-Feb-16	249	50.5	1	2	0	0
09-Feb-16	366	37.3	5	6	2	3
12-Feb-16	425	118	4	6	2	3
17-Feb-16	435	101	5	5	0	0
21-Feb-16	242	52.7	1	1	0	0
03-Mar-16	388	51.2	7	7	0	0
05-Mar-16	339	115	1	1	0	0
07-Mar-16	405	127	1	1	0	0
12-Mar-16	338	135	0	0	0	0
22-Mar-16	467	132	1	1	0	0
07-May-16	286	54.1	1	1	0	0
09-May-16	205	66.3	0	0	0	0
Total	**9,877**	**2,456**	**96**	**135**	**5**	**7**

Key: min = minute(s); km = kilometer(s); Mn = *Megaptera novaeangliae*; Bp = *Balaenoptera physalus*

Table 4. Summary of satellite tag deployments for the 2015/16 season.

Animal ID	Tag Type	Argos ID	Deployment (GMT)	Last Transmission (GMT)	Days Transmitted
HDRVA039	SPOT-6	157916	07-Dec-2015 18:06	21-Dec-2015 23:25	14.2
HDRVA010	SPOT-6	157915	09-Dec-2015 14:05	20-Dec-2015 03:09	10.5
HDRVA041	SPOT-6	157917	09-Dec-2015 15:42	21-Dec-2015 17:56	12.1
HDRVA044	SPOT-6	157918	12-Dec-2015 21:01	16-Dec-2015 12:37	5.6
HDRVA045	SPOT-6	157919	20-Dec-2015 18:14	01-Jan-2016 07:43	11.6
HDRVA048	SPOT-6	157920	20-Dec-2015 21:30	07-Jan-2016 11:40	17.6
HDRVA061	SPOT-6	157921	06-Feb-2016 11:36	28-Feb-2016 00:16	21.4
HDRAV054	SPOT-6	157922	06-Feb-2016 13:20	09-Feb-2016 23:53	3.3
HDRVA063	SPOT-6	157923	09-Feb-2016 16:15	01-Mar-2016 09:46	20.7

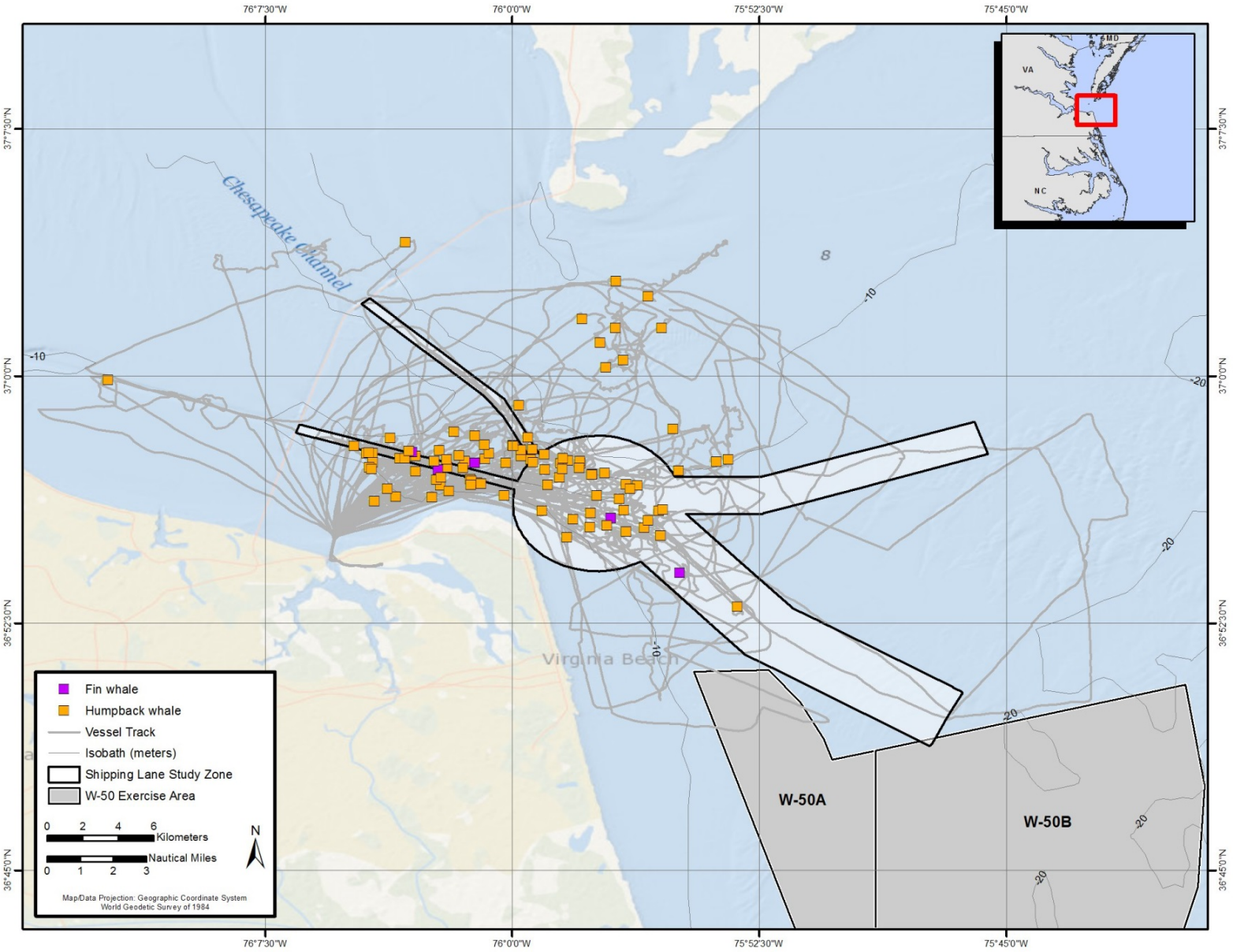

Figure 7. Nearshore survey tracks and locations of all humpback (n=96) and fin (n=5) whale sightings: December 2015 – May 2016.

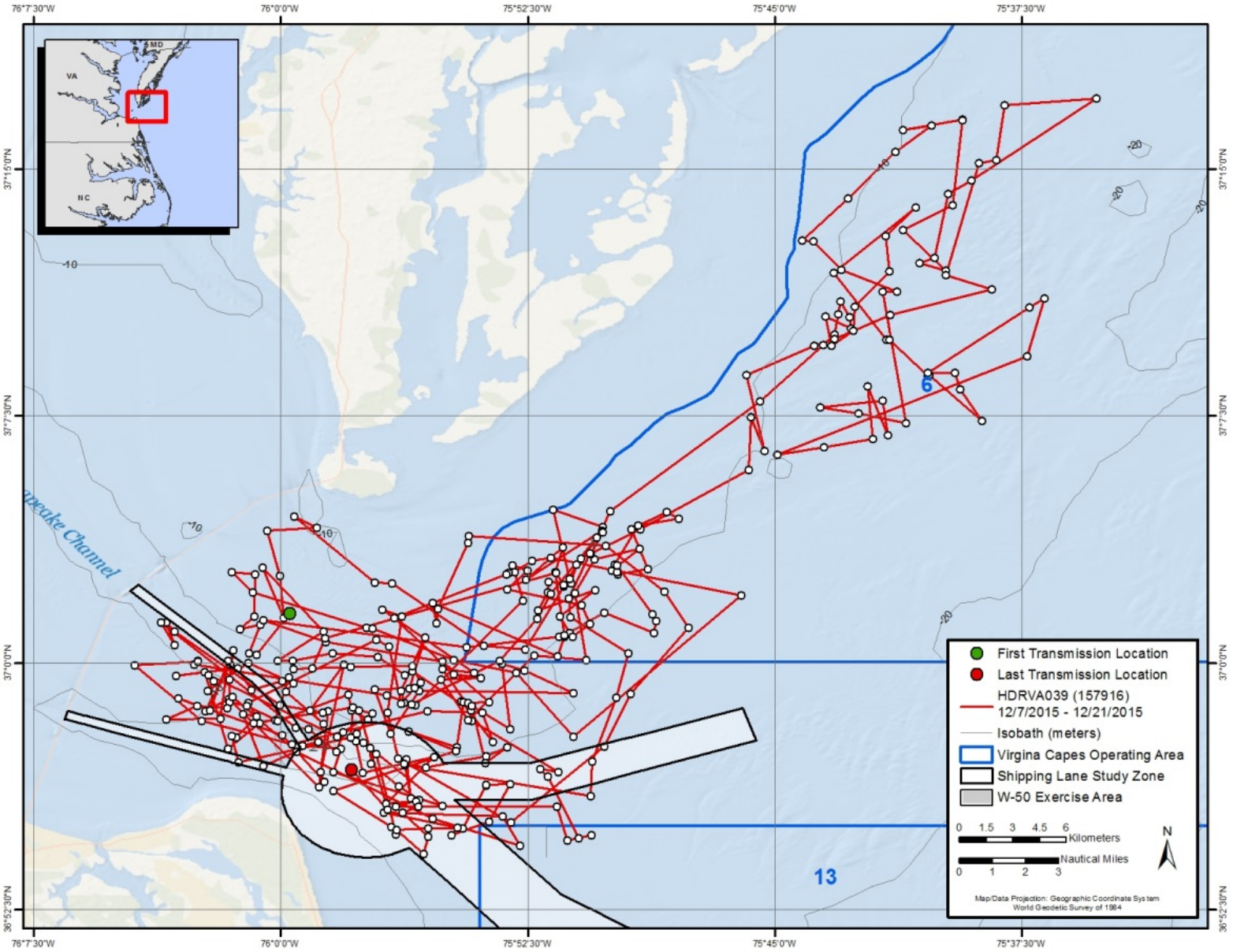

Figure 8. Filtered locations (white dots) of humpback whale HDRVA039 over 14.2 days of tag-attachment duration, with consecutive locations joined by a line.

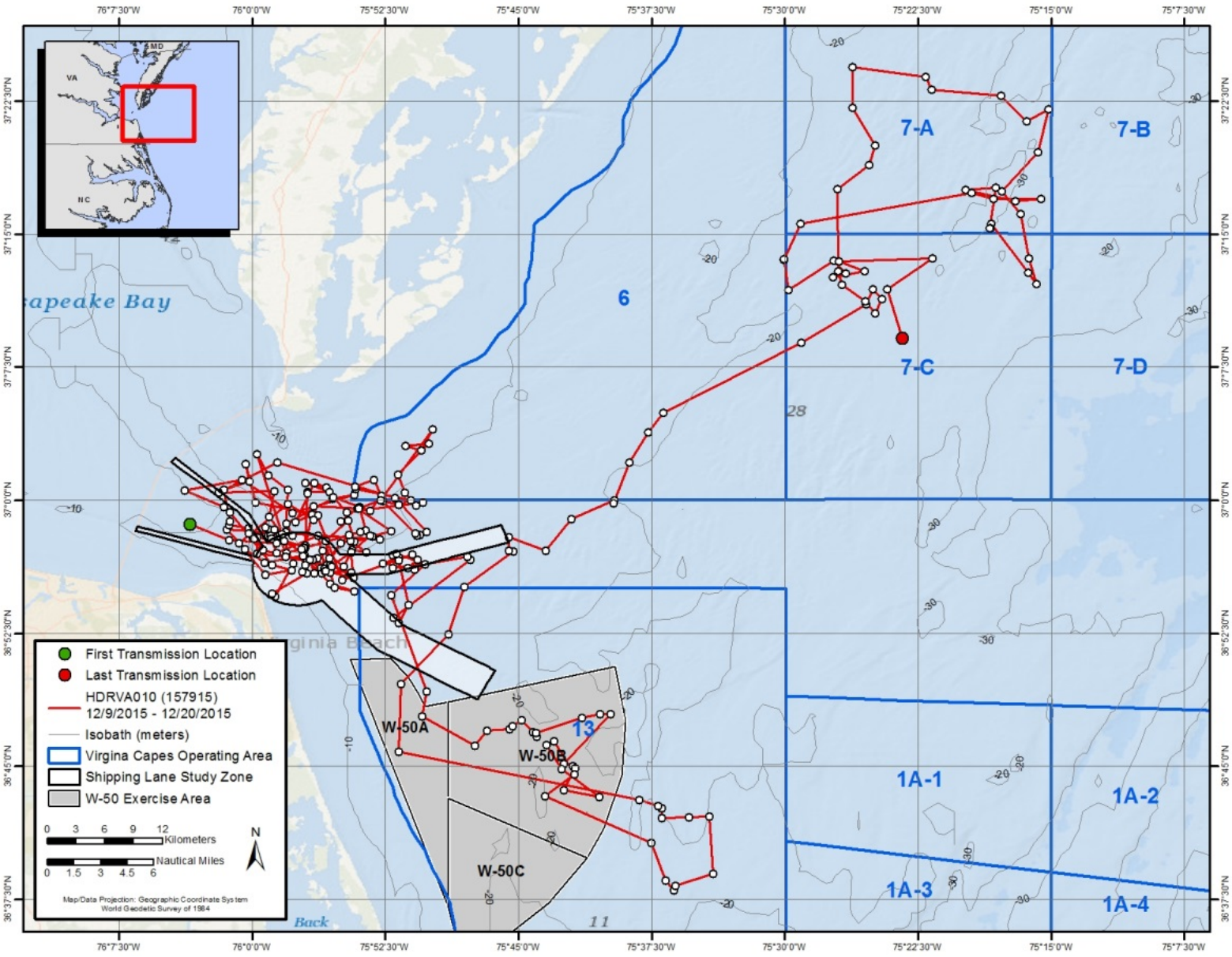

Figure 9. Filtered locations (white dots) of humpback whale HDRVA010 over 10.5 days of tag-attachment duration, with consecutive locations joined by a line.

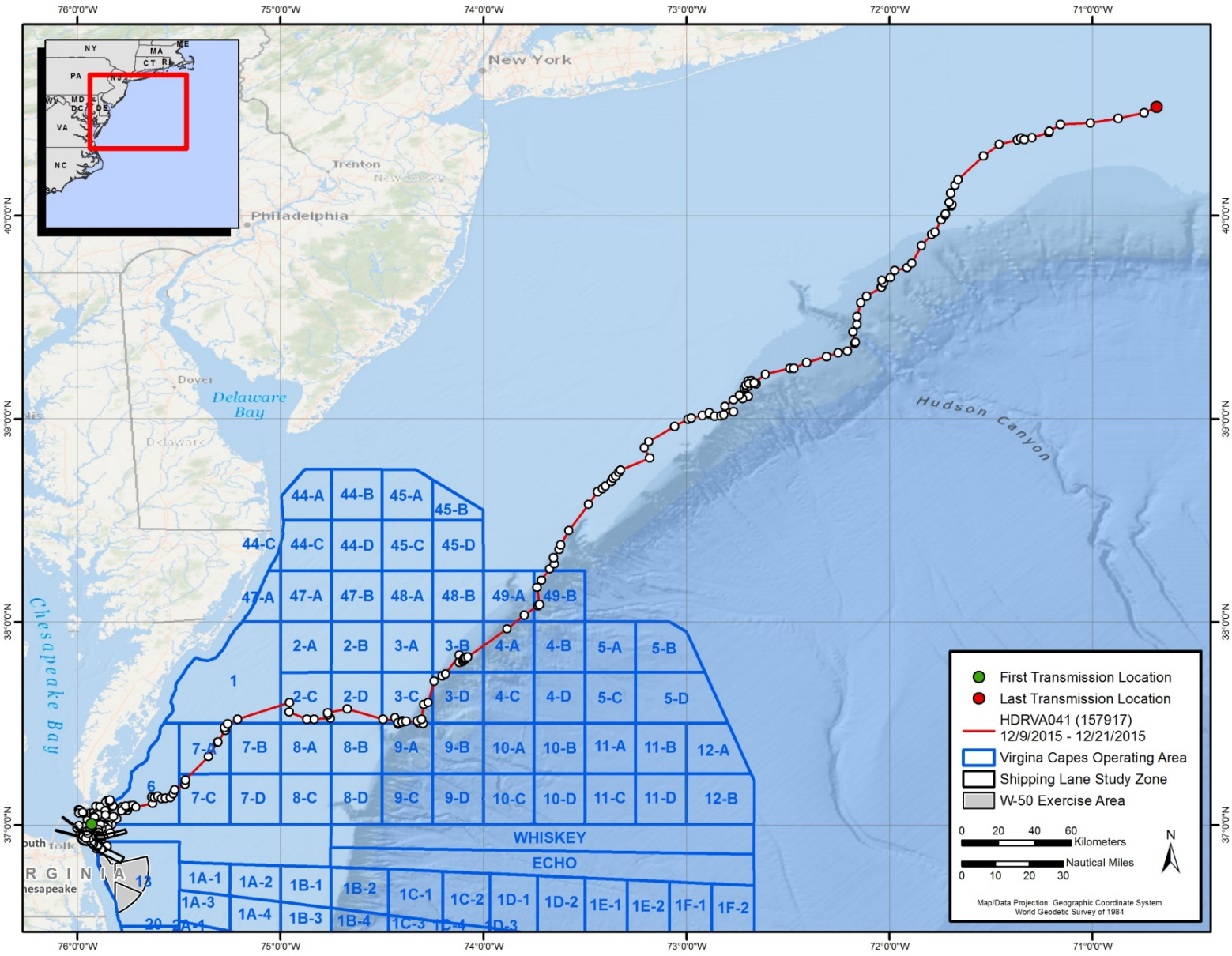

Figure 10. Filtered locations (white dots) of humpback whale HDRVA041 over 12.1 days of tag-attachment duration, with consecutive locations joined by a line.

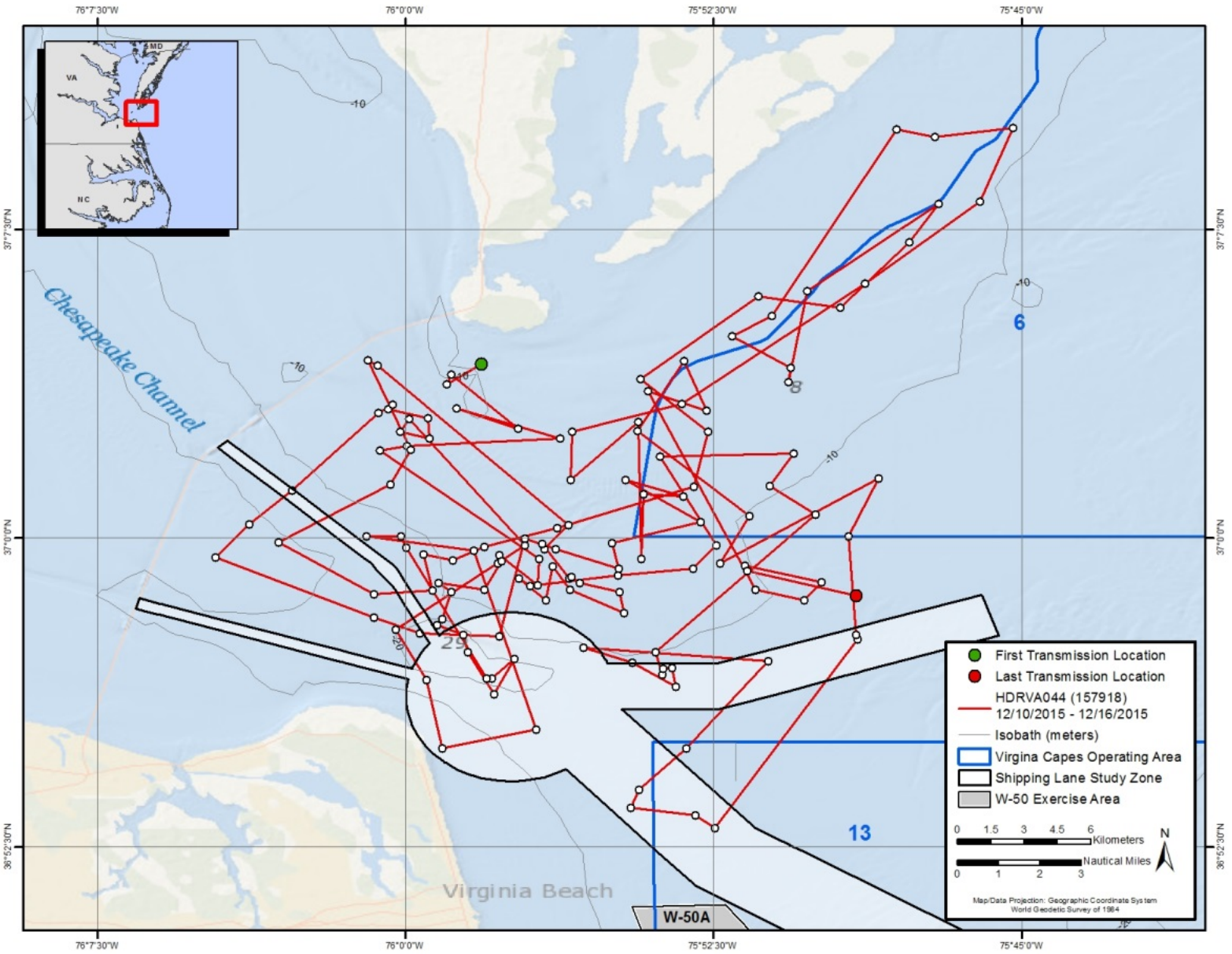

Figure 11. Filtered locations (white dots) of humpback whale HDRVA044 over 5.6 days of tag-attachment duration, with consecutive locations joined by a line.

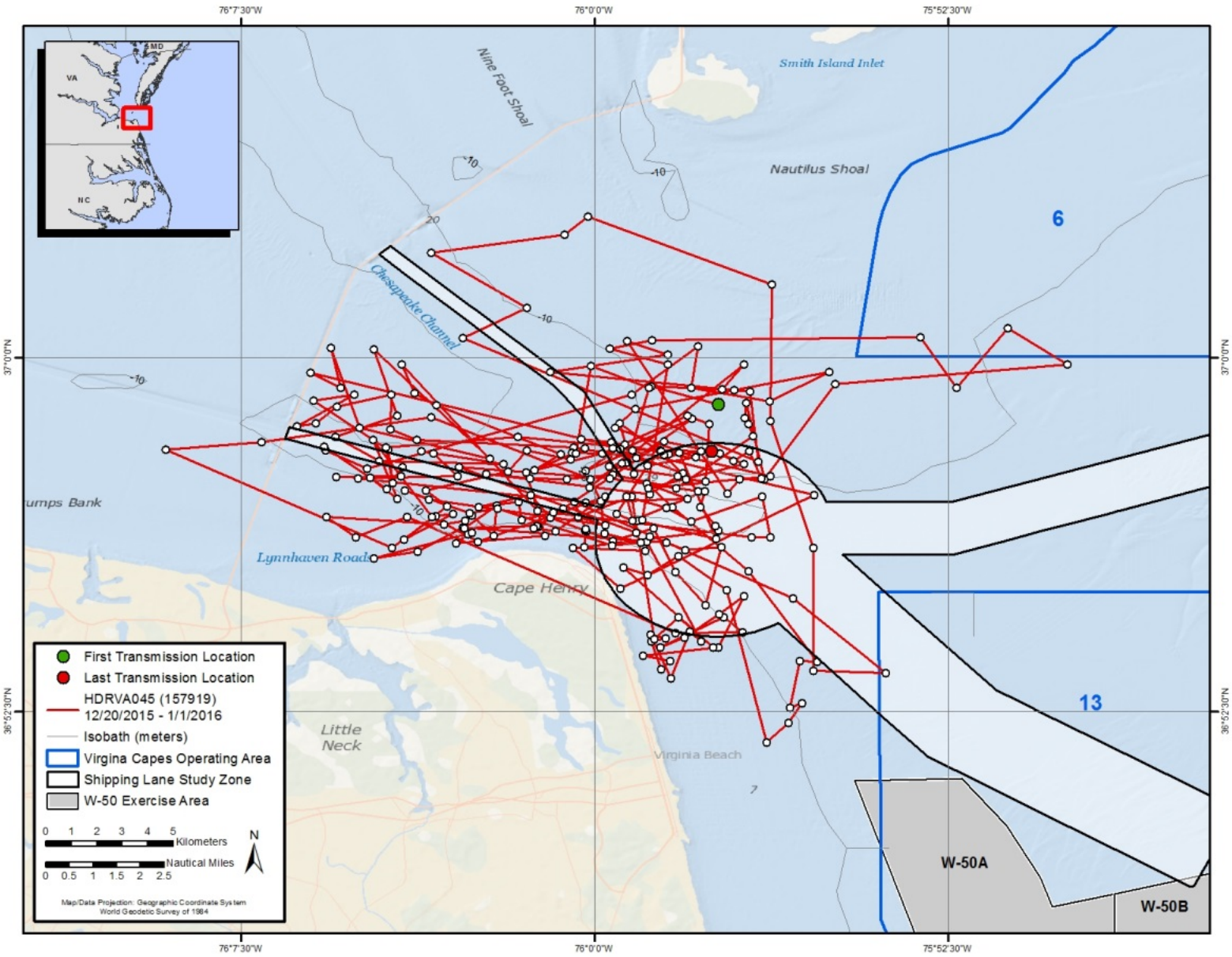

Figure 12. Filtered locations (white dots) of humpback whale HDRVA045 over 11.6 days of tag-attachment duration, with consecutive locations joined by a line.

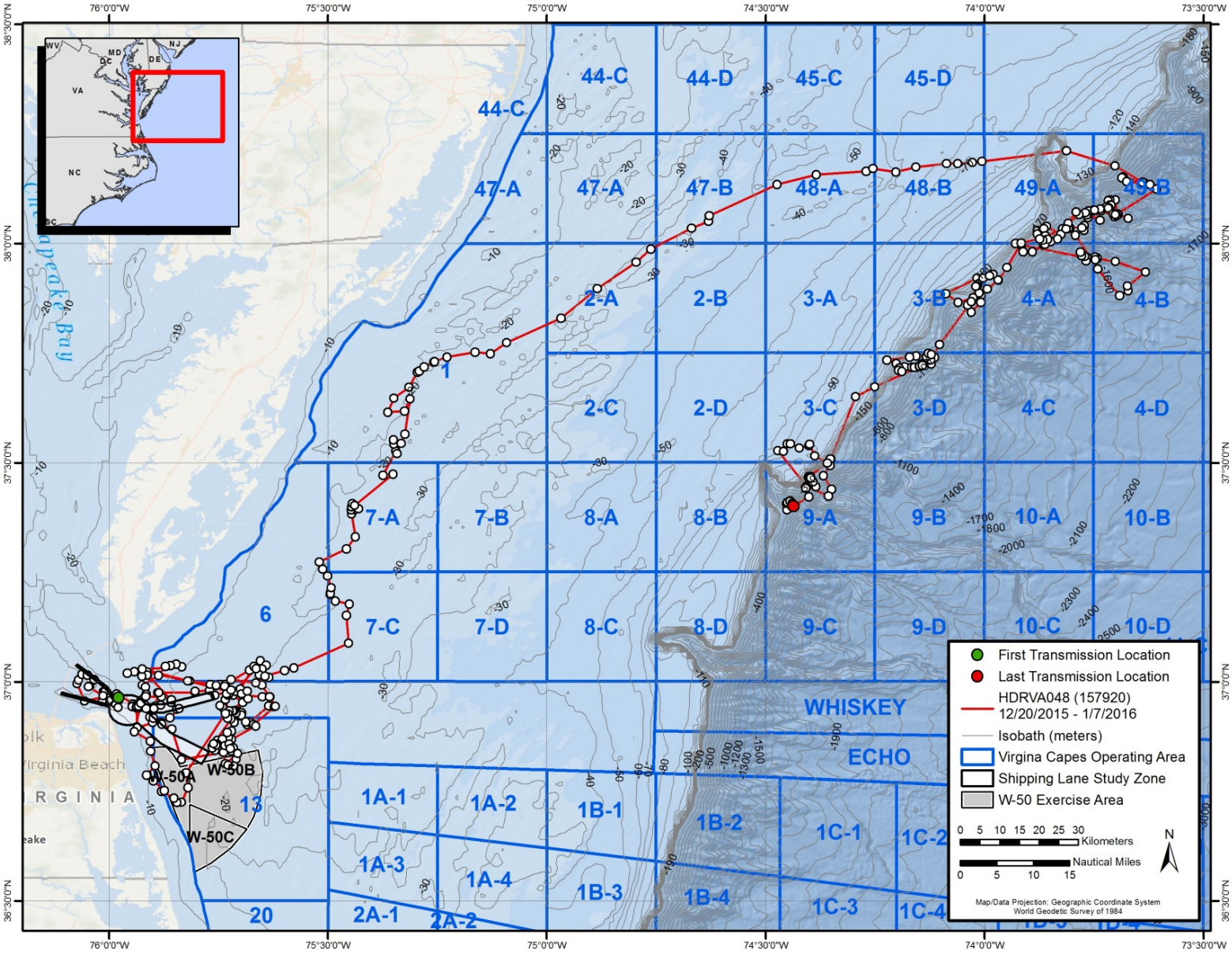

Figure 13. Filtered locations (white dots) of humpback whale HDRVA048 over 17.6 days of tag-attachment duration, with consecutive locations joined by a line.

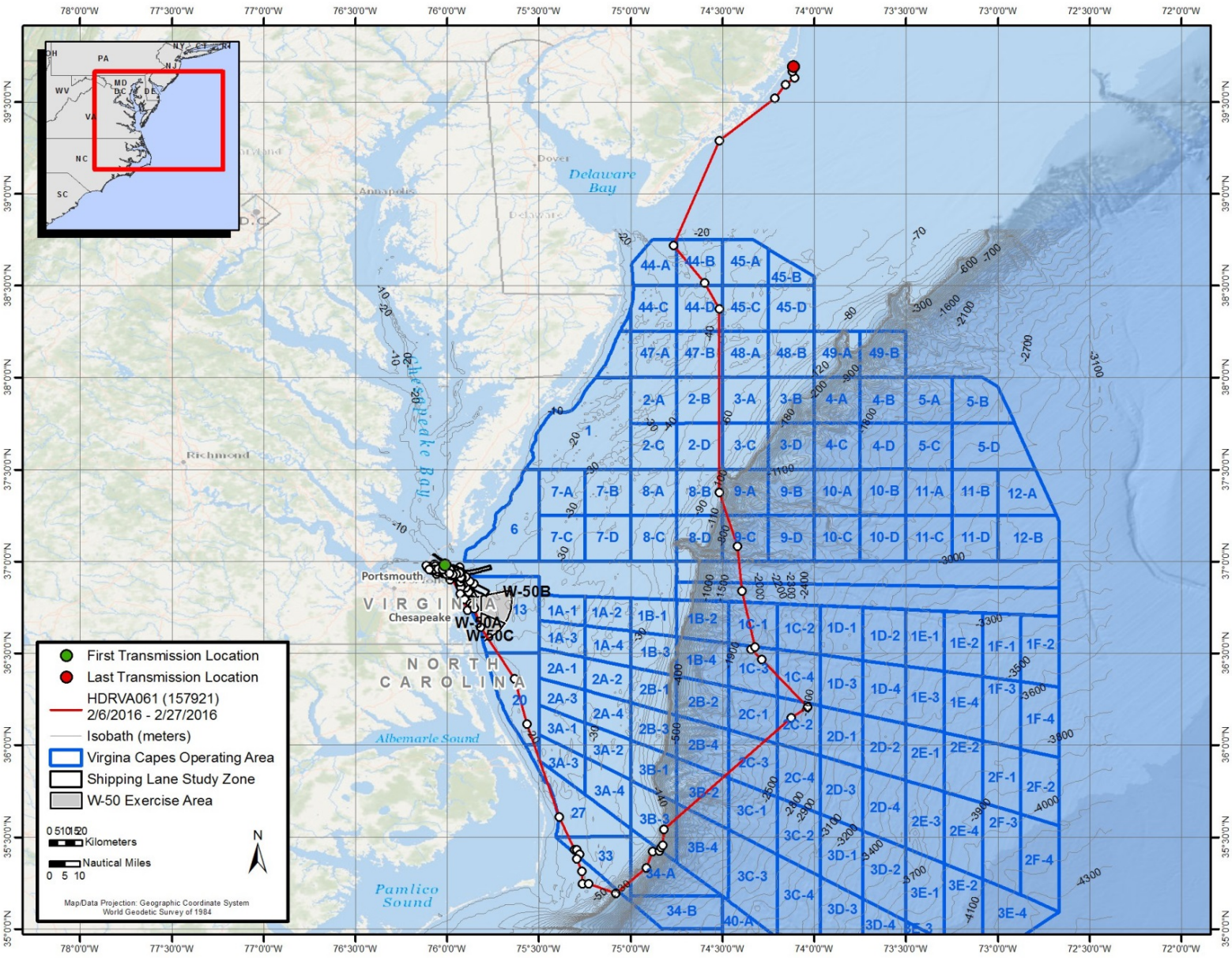

Figure 14. Filtered locations (white dots) of humpback whale HDRVA061 over 21.4 days of tag-attachment duration, with consecutive locations joined by a line.

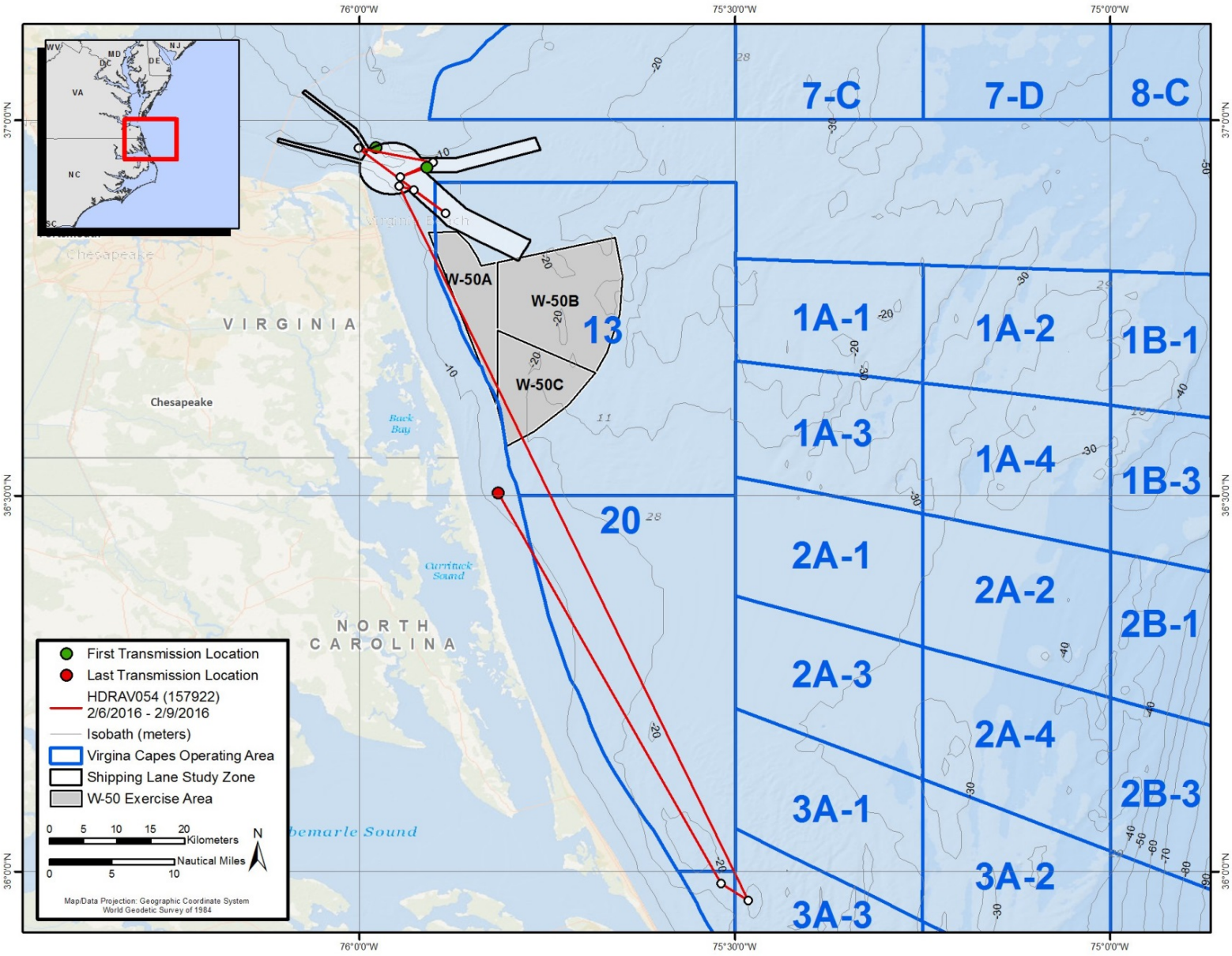

Figure 15. Filtered locations (white dots) of humpback whale HDRVA054 over 3.3 days of tag-attachment duration, with consecutive locations joined by a line.

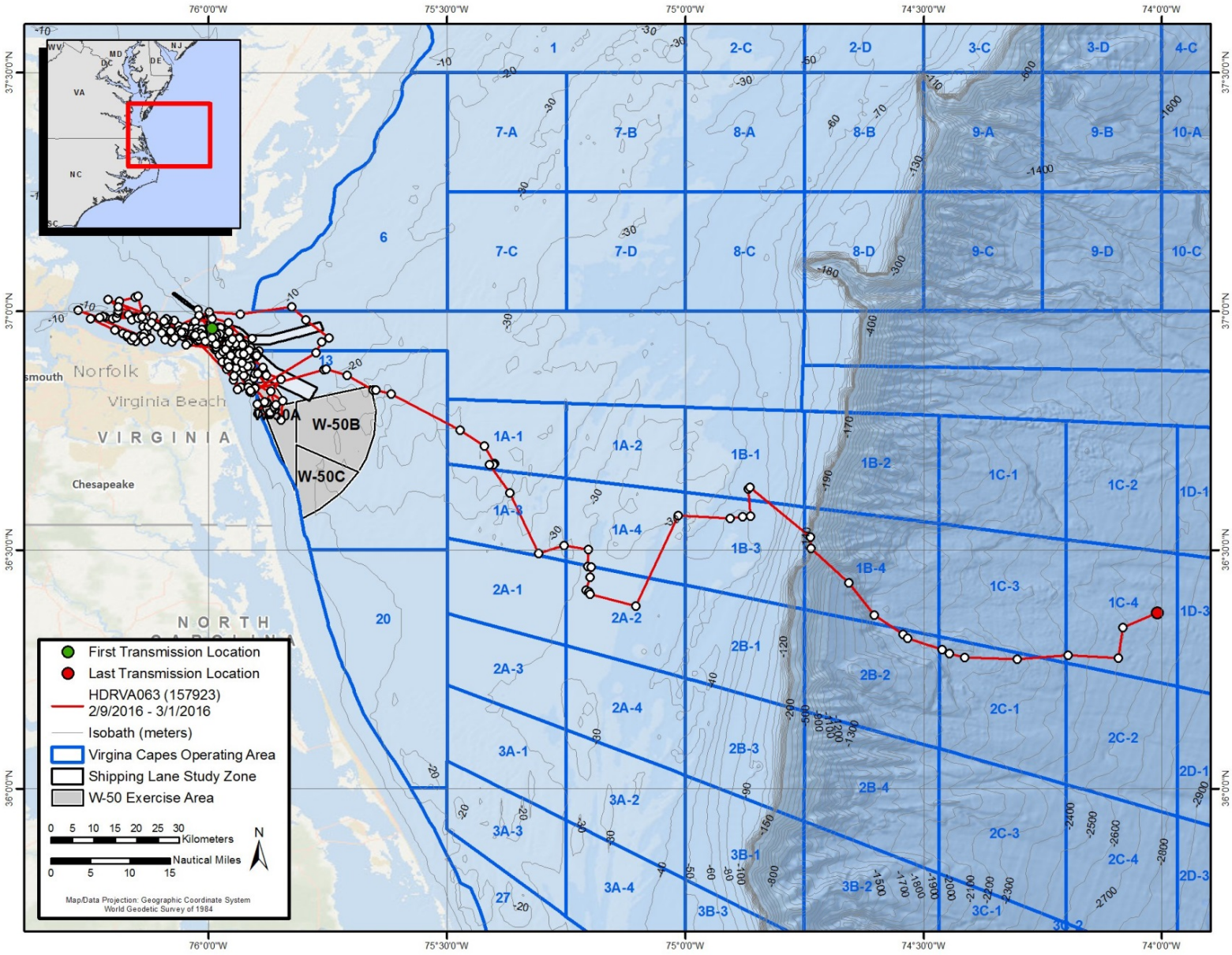

Figure 16. Filtered locations (white dots) of humpback whale HDRVA063 over 20.7 days of tag-attachment duration, with consecutive locations joined by a line.

3.3 Offshore Surveys: April–October 2015

Six offshore vessel surveys and one offshore aerial survey were conducted from April through October 2015. The vessel surveys resulted in 82 marine mammal sightings and 21 sea turtle sightings (**Figure 17 and 18; Table 5 and 6**). Ten cetacean taxa were identified (in order of decreasing frequency): unidentified pilot whale (*Globicephala* sp.) (n=23), bottlenose dolphin (n=19), Atlantic spotted dolphin (*Stenella frontalis*) (n=9), short-finned pilot whale (*Globicephala macrocephalus*) (n=7), short-beaked common dolphin (*Delphinus delphis*) (n=5), Risso's dolphin (*Grampus griseus*) (n=4), fin whale (n=3), striped dolphin (*Stenella coeruleoalba*) (n=2), minke whale (*Balaenoptera acutorostrata*) (n=1), humpback whale (n=1), and harbor porpoise (*Phocoena phocoena*) (n=1). In addition, there were unconfirmed species: unidentified delphinid (n=5), unidentified cetacean (n=1), and probable sperm whale (n=1). Loggerhead sea turtle (*Caretta caretta*) were the most frequently sighted turtle species (n=19), followed by unidentified hard shell sea turtle (n=2), and leatherback sea turtle (*Dermochelys coriacea*) (n=1). During the one day of aerial survey effort there were eight marine mammal sightings (**Table 7**), including bottlenose dolphin (n=7) and humpback whale (n=1).

During the vessel surveys, three focal follows were performed (two fin whales and one minke whale) totaling 163 minutes (**Table 2**). Two fin whale biopsies were also collected.

Photo-ID images were collected from 64 of the 82 marine mammal sightings. All images collected during pilot whale encounters (n=25) were shared with Duke University for comparisons with their existing catalog of pilot whales from Cape Hatteras, North Carolina, 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. With the addition of these photos, the HDR fin whale catalog now contains eight unique individuals and the minke whale catalog contains a single individual (**Table 2**). The lone humpback whale observed during the offshore vessel survey on 21 October 2015 matched to an individual in the HDR humpback whale catalog, HDRVA030, last seen near shore 193 days prior (on 11 April 2015).

Offshore surveys have been discontinued as a specific component of this humpback whale monitoring project but are continuing as part of a new dedicated offshore monitoring effort that will be reported separately in the future (see VACAPES Continental Shelf Break Cetacean Study project profile on the US Navy Marine Species Monitoring Program web portal).

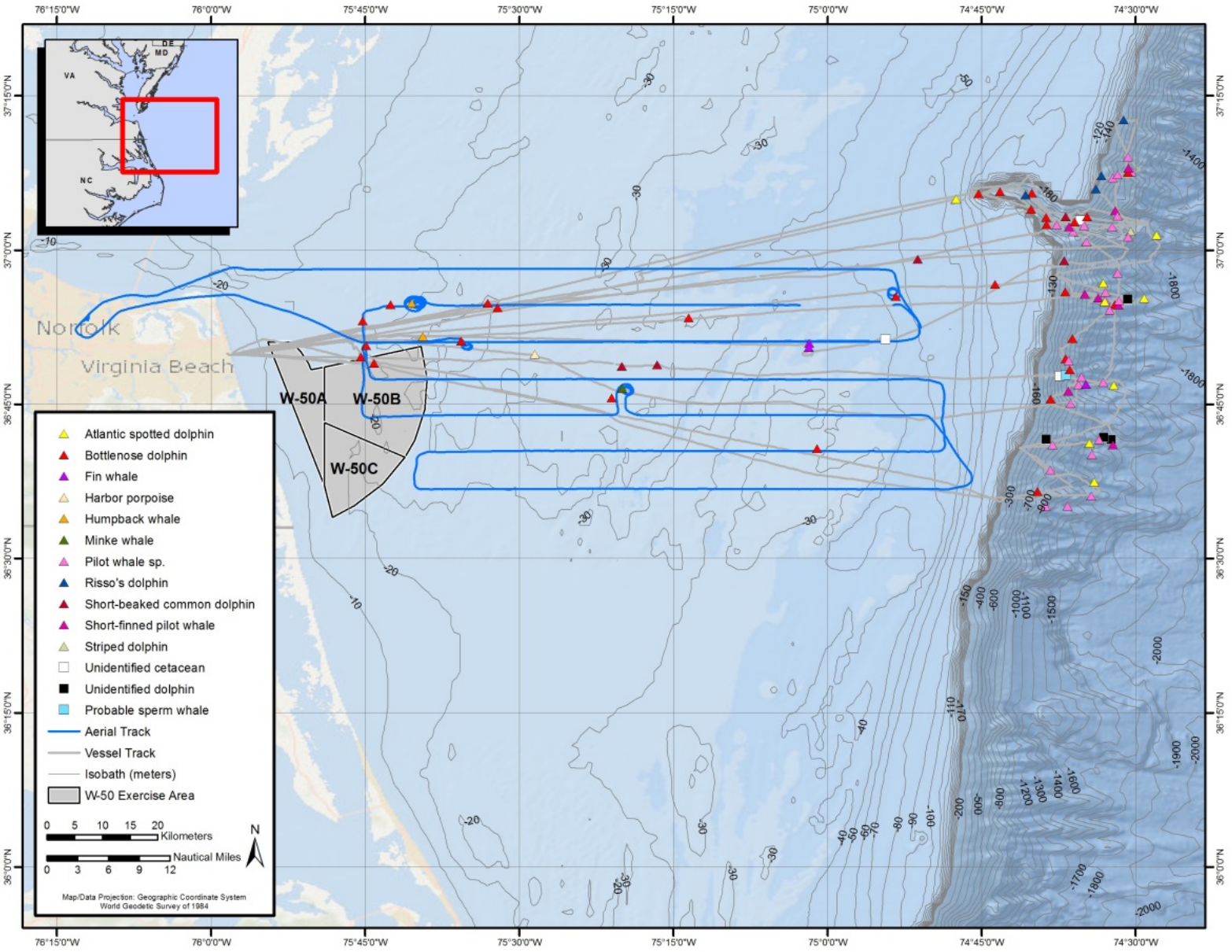

Figure 17. Sightings of marine mammals from six offshore vessel surveys and one aerial survey from April through October 2015.

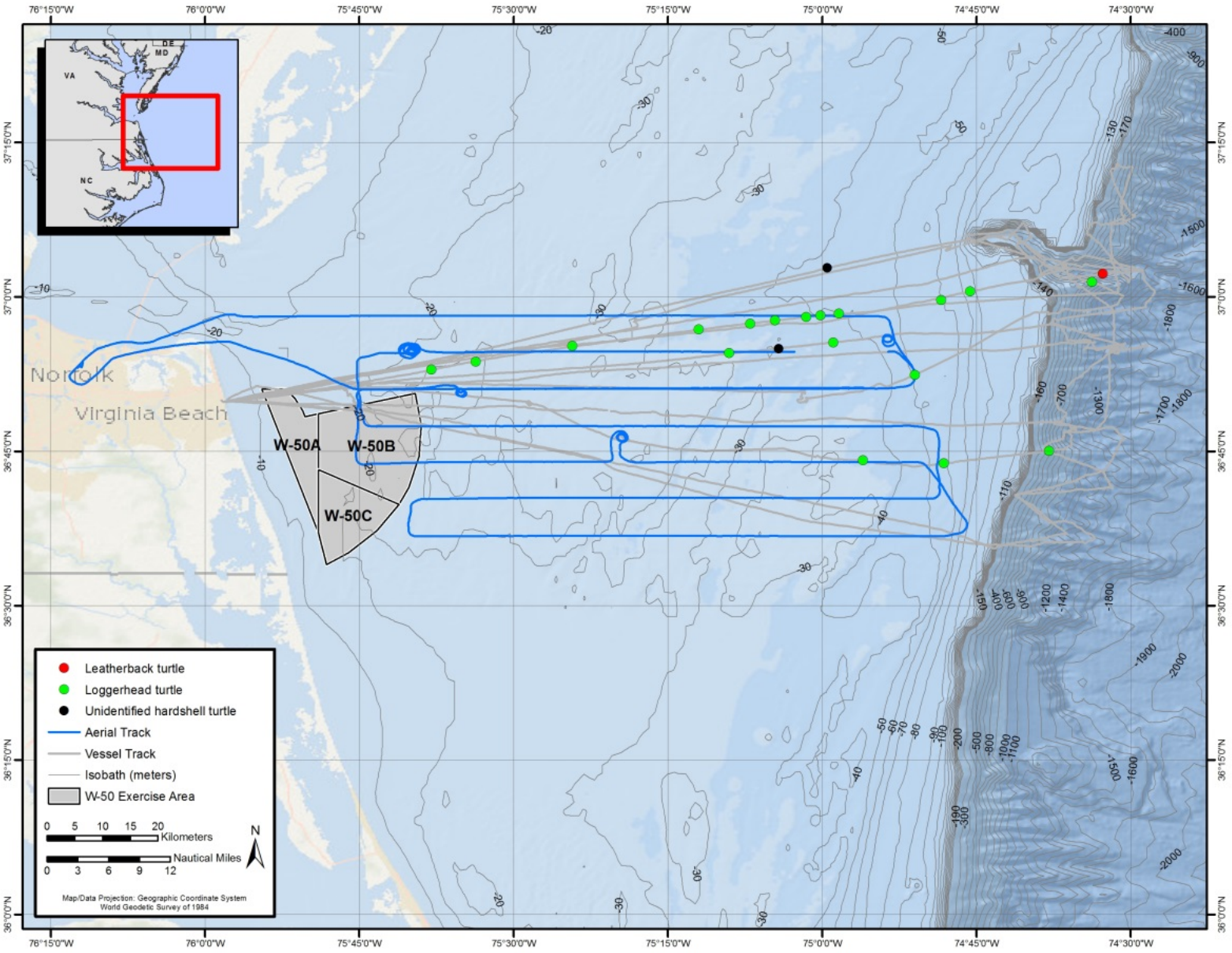

Figure 18. Sightings of sea turtles from six offshore vessel surveys from April through October 2015.

Table 5. Summary of marine mammal sightings during six offshore vessel surveys from April through October 2015.

Date	Sighting Time (EDT)	Scientific Name	Common Name	Group Size	Latitude (N)	Longitude (W)
12-Apr-15	7:51:02	*Tursiops truncatus*	Bottlenose dolphin	600	36.82197	75.75341
12-Apr-15	7:52:20	*Tursiops truncatus*	Bottlenose dolphin	100	36.82416	75.75348
12-Apr-15	9:28:48	*Phocoena phocoena*	Harbor porpoise	4	36.83048	75.47416
12-Apr-15	10:35:00	*Balaenoptera acutorostrata*	Minke whale	1	36.77242	75.34332
12-Apr-15	10:37:32	*Tursiops truncatus*	Bottlenose dolphin	15	36.77020	75.33806
12-Apr-15	14:44:53	*Globicephala* sp.	Unidentified pilot whale	60	36.75299	74.61163
12-Apr-15	14:58:44	*Globicephala* sp.	Unidentified pilot whale	11	36.76839	74.59619
12-Apr-15	15:05:55	*Balaenoptera physalus*	Fin whale	1	36.78107	74.60251
12-Apr-15	15:26:41	*Globicephala* sp.	Unidentified pilot whale	6	36.78515	74.58819
12-Apr-15	15:54:08		Unidentified cetacean	1	36.79597	74.62365
12-Apr-15	17:22:48	*Delphinus delphis*	Short-beaked common dolphin	5	36.81412	75.27577
12-Apr-15	17:40:27	*Delphinus delphis*	Short-beaked common dolphin	5	36.81390	75.33236
29-Apr-15	10:24:26	*Balaenoptera physalus*	Fin whale	2	36.84883	75.02966
29-Apr-15	10:27:35	*Balaenoptera physalus*	Fin whale	2	36.84186	75.03027
29-Apr-15	12:33:34		Unidentified dolphin	4	36.85569	74.90574
29-Apr-15	13:26:35	*Delphinus delphis*	Short-beaked common dolphin	320	36.98271	74.61578
29-Apr-15	14:32:23	*Tursiops truncatus*	Bottlenose dolphin	1	37.06615	74.66939
29-Apr-15	15:24:26	*Grampus griseus*	Risso's dolphin	4	37.08970	74.67827
29-Apr-15	15:52:07	*Delphinus delphis*	Short-beaked common dolphin	60	37.05394	74.61353
29-Apr-15	16:05:06		Unidentified dolphin	3	37.04823	74.58940
29-Apr-15	16:05:26	*Tursiops truncatus*	Bottlenose dolphin	25	37.05426	74.57834
29-Apr-15	17:01:27	*Globicephala* sp.	Unidentified pilot whale	6	37.03925	74.58339
29-Apr-15	17:07:12	*Tursiops truncatus*	Bottlenose dolphin	18	37.04566	74.59881
29-Apr-15	17:42:31	*Delphinus delphis*	Short-beaked common dolphin	3	36.98538	74.85349
10-Jun-15	7:05:08	*Tursiops truncatus*	Bottlenose dolphin	16	36.90693	75.53539
10-Jun-15	9:04:07	*Stenella frontalis*	Atlantic spotted dolphin	60	37.08279	74.79099
10-Jun-15	10:05:28	*Globicephala macrorhyncus*	Short-finned pilot whale	18	37.03738	74.60755

Date	Sighting Time (EDT)	Scientific Name	Common Name	Group Size	Latitude (N)	Longitude (W)
10-Jun-15	10:41:27	*Globicephala* sp.	Unidentified pilot whale	12	37.03767	74.53797
10-Jun-15	10:59:40	*Stenella coeruleoalba*	Striped dolphin	30	37.03065	74.50771
10-Jun-15	11:29:47	*Grampus griseus*	Risso's dolphin	7	37.09903	74.56464
10-Jun-15	11:55:32	*Grampus griseus*	Risso's dolphin	3	37.12085	74.5555
10-Jun-15	12:04:29	*Globicephala* sp.	Unidentified pilot whale	16	37.11678	74.53737
10-Jun-15	12:16:00	*Tursiops truncatus*	Bottlenose dolphin	7	37.12612	74.51229
10-Jun-15	12:18:12	*Globicephala* sp.	Unidentified pilot whale	8	37.12647	74.50613
10-Jun-15	13:09:37	*Grampus griseus*	Risso's dolphin	8	37.21161	74.51948
10-Jun-15	13:39:16	*Globicephala* sp.	Unidentified pilot whale	12	37.15119	74.51228
10-Jun-15	13:51:16	*Globicephala macrorhyncus*	Short-finned pilot whale	9	37.13278	74.51127
10-Jun-15	14:06:54	*Globicephala* sp.	Unidentified pilot whale	19	37.12241	74.5292
10-Jun-15	14:33:04	*Globicephala macrorhyncus*	Short-finned pilot whale	12	37.06396	74.53299
10-Jun-15	14:46:06	*Globicephala* sp.	Unidentified pilot whale	11	37.05524	74.5292
10-Jun-15	14:55:52	*Globicephala* sp.	Unidentified pilot whale	4	37.02143	74.51234
10-Jun-15	14:57:54	*Stenella coeruleoalba*	Striped dolphin	60	37.02190	74.51443
02-Sep-15	9:05:12	*Tursiops truncatus*	Bottlenose dolphin	8	36.94460	74.72786
02-Sep-15	9:28:26	*Tursiops truncatus*	Bottlenose dolphin	23	36.93241	74.61396
02-Sep-15	9:42:18	*Globicephala macrorhyncus*	Short-finned pilot whale	15	36.92842	74.58244
02-Sep-15	9:56:18	*Globicephala macrorhyncus*	Short-finned pilot whale	18	36.92242	74.56005
02-Sep-15	9:58:45	*Globicephala* sp.	Unidentified pilot whale	12	36.93152	74.54894
02-Sep-15	10:13:52	*Stenella frontalis*	Atlantic spotted dolphin	50	36.91636	74.54977
02-Sep-15	10:21:57	*Globicephala* sp.	Unidentified pilot whale	15	36.91800	74.52689
02-Sep-15	10:33:35	*Globicephala* sp.	Unidentified pilot whale	22	36.90275	74.54177
02-Sep-15	10:58:02	*Tursiops truncatus*	Bottlenose dolphin	15	36.85671	74.60232
02-Sep-15	11:05:44	*Tursiops truncatus*	Bottlenose dolphin	30	36.82361	74.61302
02-Sep-15	11:08:21	*Globicephala* sp.	Unidentified pilot whale	11	36.82082	74.60811
02-Sep-15	11:24:44	*Physeter macrocephalus*	Probable sperm whale	1	36.79740	74.6132
02-Sep-15	11:27:46	*Tursiops truncatus*	Bottlenose dolphin	25	36.80626	74.60668

Date	Sighting Time (EDT)	Scientific Name	Common Name	Group Size	Latitude (N)	Longitude (W)
02-Sep-15	11:49:36	*Stenella frontalis*	Atlantic spotted dolphin	130	36.78056	74.53519
02-Sep-15	11:50:53	*Globicephala* sp.	Unidentified pilot whale	9	36.78511	74.55215
02-Sep-15	12:28:26		Unidentified dolphin	8	36.69308	74.53975
02-Sep-15	12:32:15	*Globicephala macrorhyncus*	Short-finned pilot whale	17	36.68453	74.53659
02-Sep-15	12:32:54		Unidentified dolphin	20	36.69633	74.55143
02-Sep-15	12:45:47	*Globicephala* sp.	Unidentified pilot whale	10	36.69261	74.55904
02-Sep-15	12:52:03	*Globicephala* sp.	Unidentified pilot whale	10	36.66838	74.5704
02-Sep-15	12:54:22	*Stenella frontalis*	Atlantic spotted dolphin	60	36.68671	74.57467
02-Sep-15	13:12:33	*Globicephala* sp.	Unidentified pilot whale	18	36.68411	74.63476
02-Sep-15	14:00:53	*Stenella frontalis*	Atlantic spotted dolphin	200	36.62375	74.56724
02-Sep-15	14:14:52	*Globicephala* sp.	Unidentified pilot whale	17	36.60136	74.57178
02-Sep-15	14:27:54	*Globicephala* sp.	Unidentified pilot whale	10	36.58464	74.61002
02-Sep-15	14:40:45	*Globicephala* sp.	Unidentified pilot whale	8	36.58456	74.64552
21-Oct-15	9:32:18	*Tursiops truncatus*	Bottlenose dolphin	6	37.09117	74.75455
21-Oct-15	9:46:39	*Tursiops truncatus*	Bottlenose dolphin	30	37.09496	74.71996
21-Oct-15	10:16:53	*Tursiops truncatus*	Bottlenose dolphin	50	37.09239	74.66789
21-Oct-15	10:39:29	*Tursiops truncatus*	Bottlenose dolphin	8	37.05289	74.64488
21-Oct-15	10:42:32	*Tursiops truncatus*	Bottlenose dolphin	4	37.04135	74.64449
21-Oct-15	11:47:55	*Stenella frontalis*	Atlantic spotted dolphin	235	37.02425	74.46603
21-Oct-15	13:12:16	*Stenella frontalis*	Atlantic spotted dolphin	110	36.9461	74.55263
21-Oct-15	13:50:20	*Stenella frontalis*	Atlantic spotted dolphin	50	36.92372	74.51096
21-Oct-15	14:03:35	*Stenella frontalis*	Atlantic spotted dolphin	175	36.92182	74.48607
21-Oct-15	14:21:25		Unidentified dolphin	45	36.92079	74.51294
21-Oct-15	14:27:04	*Globicephala macrorhyncus*	Short-finned pilot whale	25	36.91086	74.52728
21-Oct-15	15:00:15	*Globicephala* sp.	Unidentified pilot whale	12	36.91903	74.54888
21-Oct-15	16:53:12	*Tursiops truncatus*	Bottlenose dolphin	20	36.89017	75.22482
21-Oct-15	17:48:00	*Megaptera novaeangliae*	Humpback whale	1	36.85957	75.65665

Table 6. Summary of sea turtle sightings during six offshore vessel surveys from April through October 2015.

Date	Sighting Time (EST)	Scientific Name	Common Name	Group Size	Latitude (N)	Longitude (W)
12-Apr-15	13:34:09	*Caretta caretta*	Loggerhead sea turtle	2	36.73528	74.93357
12-Apr-15	14:07:32	*Caretta caretta*	Loggerhead sea turtle	1	36.73060	74.80337
12-Apr-15	14:39:58	*Caretta caretta*	Loggerhead sea turtle	1	36.75032	74.63203
29-Apr-15	12:42:43	*Caretta caretta*	Loggerhead sea turtle	1	36.87331	74.84967
29-Apr-15	14:09:12	*Caretta caretta*	Loggerhead sea turtle	1	37.02431	74.56249
29-Apr-15	16:53:59	*Dermochelys coriacea*	Leatherback sea turtle	1	37.03731	74.54522
29-Apr-15	17:30:01	*Caretta caretta*	Loggerhead sea turtle	1	37.00906	74.76048
29-Apr-15	17:36:03	*Caretta caretta*	Loggerhead sea turtle	1	36.99458	74.80701
10-Jun-15	16:04:04	*Caretta caretta*	Loggerhead sea turtle	1	36.97295	74.97305
10-Jun-15	16:07:58	*Caretta caretta*	Loggerhead sea turtle	2	36.96951	75.00287
10-Jun-15	16:10:25	*Caretta caretta*	Loggerhead sea turtle	5	36.96750	75.02605
10-Jun-15	16:16:22	*Caretta caretta*	Loggerhead sea turtle	2	36.96168	75.07619
10-Jun-15	16:21:16	*Caretta caretta*	Loggerhead sea turtle	3	36.95616	75.11699
10-Jun-15	16:31:06	*Caretta caretta*	Loggerhead sea turtle	7	36.94751	75.20039
10-Jun-15	16:55:35	*Caretta caretta*	Loggerhead sea turtle	1	36.92020	75.40500
10-Jun-15	17:13:49	*Caretta caretta*	Loggerhead sea turtle	1	36.89465	75.56130
10-Jun-15	17:22:26	*Caretta caretta*	Loggerhead sea turtle	1	36.88179	75.63332
02-Sep-15	8:08:55	*Caretta caretta*	Loggerhead sea turtle	2	36.90911	75.15100
02-Sep-15	8:19:47		Unidentified hard shell sea turtle	1	36.91602	75.07056
02-Sep-15	8:31:34	*Caretta caretta*	Loggerhead sea turtle	1	36.92591	74.98177
21-Oct-15	9:00:13		Unidentified hard shell sea turtle	1	37.04699	74.99186

Table 7. Summary of HDR's marine mammal sightings during offshore aerial survey in April 2015.

Date	Sighting Time (EST)	Scientific Name	Common Name	Group Size	Latitude (N)	Longitude (W)
12-Apr-15	14:31:22	*Tursiops truncatus*	Bottlenose dolphin	30	36.92061	74.89037
12-Apr-15	14:54:12	*Tursiops truncatus*	Bottlenose dolphin	100	36.84979	75.58840
12-Apr-15	16:21:57	*Tursiops truncatus*	Bottlenose dolphin	30	36.67421	75.01295
12-Apr-15	16:56:18	*Tursiops truncatus*	Bottlenose dolphin	40	36.84290	75.75059
12-Apr-15	16:57:36	*Tursiops truncatus*	Bottlenose dolphin	30	36.88252	75.75359
12-Apr-15	16:59:27	*Tursiops truncatus*	Bottlenose dolphin	13	36.90935	75.70648
12-Apr-15	17:07:10	*Megaptera novaeangliae*	Humpback whale	1	36.91618	75.67056
12-Apr-15	17:11:47	*Tursiops truncatus*	Bottlenose dolphin	15	36.91083	75.54788

4. Discussion

Analyses of data from this project are on-going; however, preliminary results show site fidelity in the study area for some individuals and a high level of occurrence within the shipping channels—an important high-use area by both the U.S. Navy and commercial shipping traffic. These findings are supported by photo-ID, focal follows, and initial satellite-tagging results. A smaller number of animals are also spending time close to, or within, the W-50 MINEX box as well as in the offshore VACAPES range complex and are presumably within hearing range of underwater detonation training exercises. Interactions with vessels, both large and small, are a significant cause for concern for humpback whales in the study area. During the 2015/16 season three individual humpback whales were observed with boat injuries (as observed by HDR, Rudee Flippers Tours, and VAQS) ranging from non-life threatening to likely fatal injuries (Mallette et al. 2016, unpublished report) (**Figure 19**). In total, eight of the 60 (8.3 percent) individual humpback whales in the HDR humpback whale catalog have scars or injuries indicative of propeller or vessel strikes. More than half of the humpback whales seen during the two years of effort on this project appear to be juveniles that are spending more time in the study area than larger animals, presumed to be adults, and may be at greater risk for injury.

Figure 19. Humpback whale HDRVA053 observed with severe vessel strike injuries on 09 January 2016. Photo by Todd Pusser, collected under National Marine Fisheries permit no. 16239.

HDR will continue to coordinate data sharing with other local and regional researchers and agencies, such as the VAQS and Center for Coastal Studies. Focal-follow data will be examined for any emerging patterns of habitat utilization and primary behaviors. With analysis of the tagging data expected to occur during the summer/fall of 2016, preliminary movement patterns and other related results will be provided in the 2016/17 Annual Reporting efforts.

The numbers of sightings of humpback whales and other species, as well as the level of interaction between whales and vessel traffic to date, support the previous recommendation to

continue this study including the use of satellite tagging. As technology progresses and Fastloc GPS is integrated into Wildlife Computer's LIMPET tags, there will be an increased benefit of high-resolution data logging to better document the whales' movements within the study area (as well as when they leave the study area). Such information will better demonstrate the occurrence and behavior of humpback whales in this area and provide a baseline for behavioral response studies in the future.

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