OCCURRENCE, DISTRIBUTION, AND DENSITY OF MARINE MAMMALS NEAR NAVAL STATION NORFOLK & VIRGINIA BEACH, VA

Contract No. N62470-10-3011, Task Orders 31 and 43

2013 ANNUAL PROGRESS REPORT

22 July 2014

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Cover Photo: Bottlenose dolphins (*Tursiops truncatus*) observed on 25 September 2012, east of the Chesapeake Bay Bridge Tunnel. Photographed by D. Spontak. Photo taken under National Marine Fisheries Service permit no. 14451.

Abstract

A combination of visual line-transect survey, photo-identification (photo-ID), and automated acoustic monitoring methods is being used to gather important baseline information on the occurrence, distribution, and density of marine mammals near Naval Station Norfolk (NSN) and adjacent areas. The study area was chosen to cover areas where United States (U.S.) Navy activity is substantial, including Chesapeake Bay waters near Naval Station Norfolk, Joint Expeditionary Base (JEB) Little Creek (LC), and JEB Fort Story, as well as a Mine Exercise (MINEX) Area (W-50) in the Atlantic off the coast of Virginia Beach, Virginia. Twenty-five line-transect surveys were completed in two zones (INSHORE and MINEX) between August 2012 and November 2013, with 2,810 kilometers (km) and 8,942 minutes completed on-effort. The majority of sightings were bottlenose dolphins (*Tursiops truncatus*), although humpback whales (*Megaptera novaeangliae*) and short-beaked common dolphins (*Delphinus delphis*) were also sighted in the study area on occasion. In addition, loggerhead sea turtles (*Caretta caretta*) and leatherback sea turtles (*Dermochelys coriacea*) were sighted during the study period. Conventional line-transect analysis of bottlenose dolphin sightings showed both spatial and seasonal variation in density and abundance, with greatest abundance in the INSHORE zone during summer months. INSHORE densities were calculated as 3.05 individuals per square kilometer (km^2) (N=948) in fall, 0.40 individuals per km^2 (N=123) in winter, 1.09 individuals per km^2 (N=337) in spring, and 3.52 individuals per km^2 (N=1,094) in summer. MINEX densities were calculated as 0.11 individuals per km^2 (N=105) in fall, 0.00 individuals per km^2 (N=0) in winter, 0.10 individuals per km^2 (N=90) in spring, and 0.16 individuals per km^2 (N=148) in summer. A photo-ID catalog was created using photos taken during both dedicated photo-ID and line-transect surveys through July 2013; it contains 308 identified individuals to date. Thirty-three individuals were re-sighted; however, most sightings were less than three months and 15 km apart. Additional survey effort will be required before any clear movement patterns can be determined. C-POD acoustic data loggers (www.chelonia.co.uk) were deployed at four sites throughout the study area to cover areas of high U.S. Navy activity. Harbor porpoises (*Phocoena phocoena*) were detected in low numbers near NSN and JEB-LC during winter and spring deployments, and bottlenose dolphins were detected in each deployment location during all deployments from August 2012 to September 2013. Deployments, however, did not provide consistent coverage due to loss of gear. Further study is required to improve accuracy in seasonal density estimates and allow further stratification of those estimates, and to better describe the movement patterns and site fidelity of the bottlenose dolphins in these waters. Visual surveys and additional C-POD deployments are currently planned through August 2014.

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Acronyms and Abbreviations

°	degree(s)
BSS	Beaufort Sea State
CV	coefficient of variation
DPM	detection positive minutes
EAR	Ecological Acoustic Recorder
FS	Fort Story
GENENC	Generalised Encounter Classifier
hr	hour(s)
ID	identification
JEB	Joint Expeditionary Base
km	kilometer(s)
km^2	square kilometer(s)
LC	Little Creek
m	meter(s)
mm	millimeter(s)
MINEX	Mine Neutralization Exercise
MMO	Marine Mammal Observer
MSM	Marine Species Monitoring
NBHF	Narrow-Band High Frequency
NM	nautical mile
NMFS	National Marine Fisheries Service
NSN	Naval Station Norfolk
NTR	Navy Technical Representative
OPAREA	operating area
PAM	passive acoustic monitoring
Photo-ID	photo-identification
UNDET	underwater detonation
U.S.	United States
VACAPES	Virginia Capes

Section 1 - Introduction

Bottlenose dolphins (*Tursiops truncatus*) are common in Chesapeake Bay and in waters off the Virginia coastline. These individuals are part of both the Western North Atlantic Southern Migratory Coastal Stock of bottlenose dolphins, which ranges in distribution in summer from Cape Lookout, North Carolina, to central Virginia; and the Western North Atlantic Northern Migratory Coastal Stock, which ranges from the Chesapeake Bay mouth to Long Island, New York in the summer (Waring et al. 2011). These two stocks are managed by the National Marine Fisheries Service (NMFS), and total abundance of the Southern Migratory Coastal Stock is estimated at 12,482 dolphins (coefficient of variation [CV]=0.32), and the Northern Migratory Coastal Stock is estimated at 9,604 dolphins (CV=0.36, Waring et al. 2011). Significant seasonal fluctuations in bottlenose dolphin distribution and numbers exist in this area, with peak abundance occurring in late summer/early fall when water temperatures peak (Barco et al. 1999). Although previous work has investigated metrics to estimate bottlenose dolphin abundance in this region (e.g., Blaylock 1988, Barco et al. 1999, Baker 2000), the actual abundance estimated in parts of this area of overlap between stocks is not thoroughly understood. For example, Blaylock (1988) estimated that there were on average 340 bottlenose dolphins in the Chesapeake Bay mouth and southern Virginia coast, but only one of ten surveys used to generate this estimate included the Virginia coastline waters.

The waters off the Virginia coast are heavily utilized by the United States (U.S.) Navy due to the proximity of the world's largest naval base (Naval Station Norfolk [NSN]), as well as Joint Expeditionary Base Little Creek (JEB-LC) and Joint Expeditionary Base Fort Story (JEB-FS), all located adjacent to Chesapeake Bay, and the Virginia Capes (VACAPES) operating area (OPAREA) Mine Neutralization Exercise (MINEX) training area (W-50). The VACAPES MINEX area is located in nearshore Atlantic waters, extending from approximately 6 kilometers (km) (3 nautical miles [NM]) to 27 km (15 NM) from shore.

HDR, Inc., by direction of the U.S. Navy, initiated visual surveys and passive acoustic monitoring in August 2012. The primary goal for the work is to provide a more complete assessment of the seasonal occurrence of bottlenose dolphins in the area (including calculated densities). The information will be used to allow the U.S. Navy to make more informed decisions on proposed training and testing activities in the area. Furthermore, baseline occurrence information can be used to minimize potential effects on the marine mammals utilizing the area. While the project is expected to continue through at least August 2014, this annual summary report describes the data, progress, and results from August 2012 through November 2013.

Project Objectives

The HDR Marine Species Monitoring (MSM) Team was tasked to initiate a monitoring project in coastal waters around NSN, JEB-LC, JEB-FS, and the Virginia Beach waterfront, including the VACAPES MINEX W-50 training area. The main objective is to provide quantitative data and information on the seasonal occurrence, distribution, and density of marine mammals. Effort was dedicated to working with local researchers and employing proven marine mammal monitoring and research techniques to accomplish the following:

1. Conduct monthly systematic line-transect surveys to determine distribution of marine mammals in the vicinity of NSN, JEB-LC, JEB-FS, and the MINEX W-50 area.

2. Conduct monthly photo-identification (photo-ID) surveys during summer months to determine the site fidelity and distributional patterns of marine mammals utilizing the areas listed above.
3. Supplement visual surveys by deploying and retrieving four C-POD acoustic recording devices to monitor for dolphin echolocation clicks in specific locations.

Project Tasks

Task 1 – Vessel Line-transect Surveys. Monthly line-transect surveys were conducted (using NMFS' standard Distance sampling protocols, Jackson 2001) of coastal waters near NSN, outside of JEB-LC and JEB-FS, and along the beaches of Virginia Beach (including the VACAPES MINEX W-50 training area). The study area and zones were determined through coordination with the U.S. Navy Technical Representative (NTR).

Task 2 – Photo-identification Surveys. Monthly photo-ID surveys were completed during summer months in areas near NSN, JEB-LC, and JEB-FS. Priority was given to maximizing representation of individuals near the naval bases to allow for analysis of movement patterns in those areas.

Task 3 – C-POD Automated Acoustic Monitoring. Four C-PODs, automated acoustic monitoring detectors for echolocation clicks, were placed in areas of interest. Final locations were adjusted as advised by interested parties during the Virginia Marine Resources Commission permitting process and by the NTR.

Task 4 – Data Analysis and Reporting. Line-transect survey data were analyzed for bottlenose dolphin density using the software program Distance 6.0 Release 2 (Thomas et al. 2010) to provide density estimates for the study area. An electronic photo-ID catalogue was prepared using images of bottlenose dolphins' dorsal fins to provide insight into stock structure. C-POD acoustic detection data were also analyzed for the relative presence of echolocation clicks.

Section 2 - Materials and Methods

Study Area

Norfolk and Virginia Beach border the southern end of the Chesapeake Bay and the coastline of Virginia Beach extends along the Atlantic Ocean (**Figure 1**). NSN, JEB-LC, JEB-FS, and the VACAPES W-50 MINEX training area (consisting of range boxes A, B, and C) east of Virginia Beach are located within or adjacent to these waters. Within the study area: 1) construction activities are widespread, 2) military, commercial, and recreational vessels transit in large numbers, and 3) U.S. Navy training exercises occur on a regular basis.

There were two primary survey zones established, (see **Figure 1**):

1. *COASTAL/INSHORE* – a 310.4 square kilometer (km^2) area covering a strip extending from shore out to 3.7 km (2.0 nautical miles [NM]). The COASTAL/INSHORE zone includes the Chesapeake Bay waters near NSN, extends past JEB-LC and JEB-FS, and extends down the Atlantic coast towards the Virginia/North Carolina border.
2. *OFFSHORE/MINEX* – a 909.6 km^2 area covering Atlantic waters from 3.7 km (2.0 NM) to 33.3 km (18.0 NM) from shore. The OFFSHORE/MINEX zone includes the entire VACAPES MINEX W-50 training area.

Methods – Vessel Line-transect Surveys

Line-transect surveys were scheduled for two full days (between 8 and 10 hours [hr]) each month (one for each survey zone) beginning in August 2012. Zig-zag transect lines were created to cover the 3.7 km (2.0 NM) INSHORE strip, and 5 parallel transect lines were created to cover the MINEX W-50 range boxes (**Figure 1**). MINEX transect lines are 22 km (12 NM) in length and spaced at a distance of 5.5 km (3 NM). Transect lines were systematically placed with a random start point to adhere to distance sampling survey design. Departures were timed to maximize survey duration in daylight hours (approximately 1 hr after dawn through 1 hr before dusk) and optimal weather conditions (i.e., Beaufort Sea State [BSS] 0–3, no heavy rain, and visibility of greater than 1 NM). Beginning and end times for the survey days were dependent on weather conditions and daylight available.

The HDR MSM Team conducted line-transect surveys using the Research Vessel (R/V) *Ocean Explorer*, Marine Vessel (M/V) *Flat Line*, and M/V *Matador*, which all possess elevated viewing platforms (**Figures 2, 3, and 4**). The height of the observers' eyes above the water's surface was approximately 4 meters (m), or 13 feet (ft). Three observers comprised the on-effort survey team. The vessel transited the survey lines at a constant speed of 15 to 19 km per hour. The port observer searched for marine mammals continuously through Baker Marine 7×50 binoculars in the 100 degree (°) arc from 10° to 270° (all angles are given in relation to the bow, which is defined as 0°). The starboard observer searched for marine mammals continuously through 7×50 marine binoculars from 350° to 90°. The third on-effort observer searched primarily with the naked eye, to avoid missing groups near the trackline. This observer also served as the data recorder, logging data on a laptop computer using specialized software (e.g., Mysticetus and VisVessel), and on hand-written data sheets as a means of back-up. The resulting search area covered by the three-person team included the bearings ahead of the vessel, between 90° and 270°, with a 20° overlap centered on the trackline. To minimize fatigue, observers rotated positions approximately every 30 minutes (min).

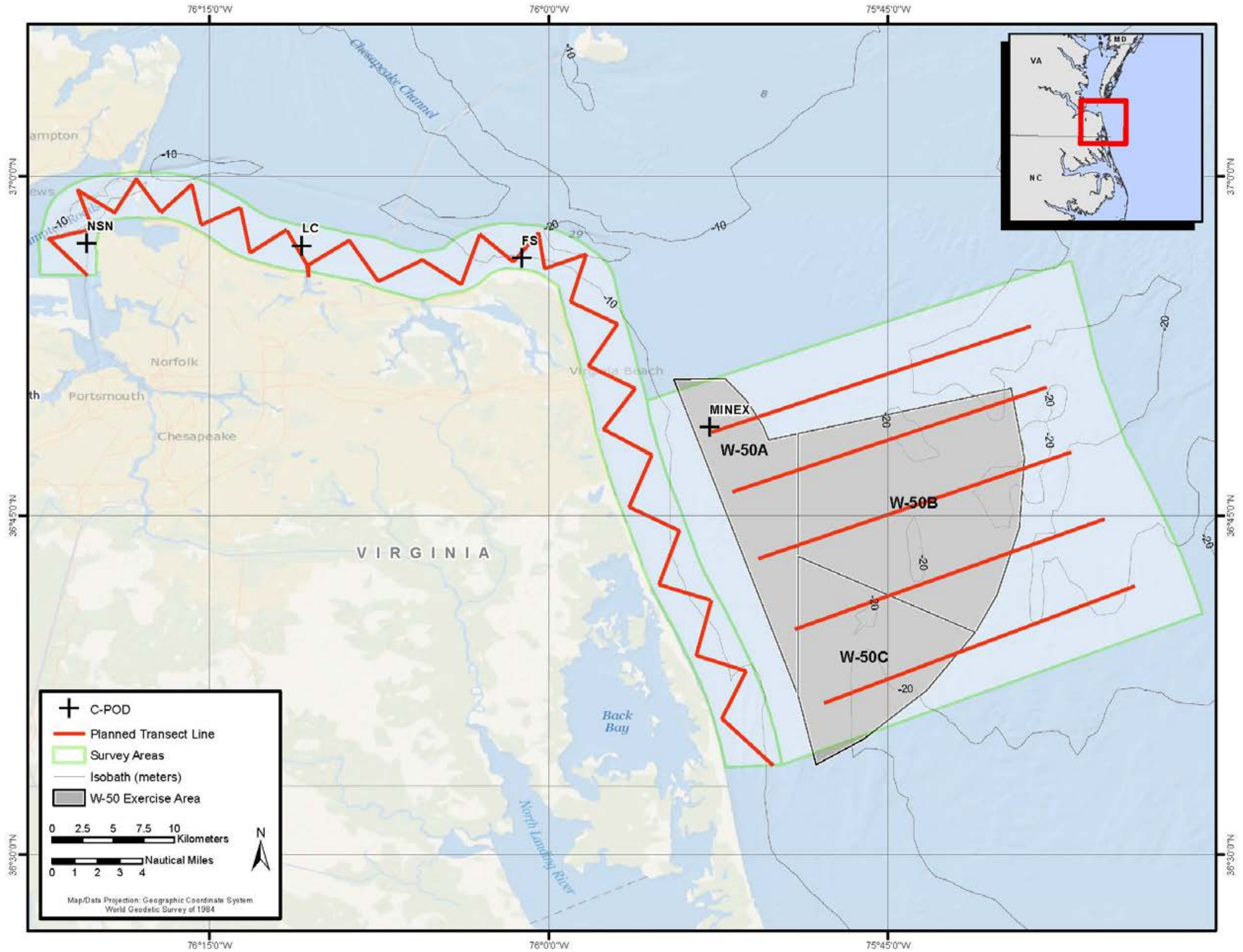

Figure 1. Study area delineated into COASTAL/INSHORE and OFFSHORE/MINEX zones.

Figure 2. Primary MINEX transect survey vessel, the R/V *Ocean Explorer*.

Figure 3. Primary INSHORE transect survey vessel, the M/V *Flat Line*.

Figure 4. Secondary transect survey vessel, the M/V *Matador*.

Effort data collected during on-effort survey periods included time and position for the start and end of search effort, BSS, visibility, presence and percentage of glare, and percent cloud cover. Survey software automatically recorded vessel speed and tracked position at 30-second intervals. When marine mammals were sighted, the monitoring team collected associated sighting data and the vessel diverted from its current course to approach the sighting when necessary to confirm group size estimates and species identification, take photographs, and record behavioral information. In these instances the data recorder would indicate in the software that the team went off-effort. Priority was given to completing the tracklines within the available survey time each day over collecting additional ancillary data. Sighting information collected included data on initial sighting angle and distance, initial sighting position, environmental conditions, group size and composition, and behavior (e.g., response to the survey vessel). Sighting distances were calculated using reticles or by estimation if no horizon was visible. Location data and vessel speed were obtained from a Globalsat BU-353 global positioning system (GPS). Photographs were taken opportunistically during sightings (time permitting) using a Canon 7D digital camera with a 100 to 400-millimeter (mm) lens. Photographs of bottlenose dolphins were added to the photo-ID database described under Task 2; humpback whale photographs were sent to the Virginia Aquarium & Marine Science Center to be contributed to the existing Atlantic catalogs. All sighting data are also uploaded to the Ocean Biogeographic Information System Spatial Ecological Analysis of Megavertebrate Populations (OBIS-SEAMAP) database, managed by Duke University.

Data Analysis

Conventional line-transect methods (also known as Conventional Distance Sampling or CDS) were used to analyze the vessel survey data (Buckland et al. 2001). Estimates of density and abundance (and their associated CV) were calculated using the following formulae:

$$\hat{D} = \frac{n\,\hat{f}(0)\,\hat{E}(s)}{2\,L\,\hat{g}(0)}$$

$$\hat{N} = \frac{n\,\hat{f}(0)\,\hat{E}(s)\,A}{2\,L\,\hat{g}(0)}$$

$$C\hat{V} = \sqrt{\frac{\hat{\mathrm{var}}\,(n)}{n^2} + \frac{\hat{\mathrm{var}}\,[\hat{f}(0)]}{[\hat{f}(0)]^2} + \frac{\hat{\mathrm{var}}\,[\hat{E}(s)]}{[\hat{E}(s)]^2} + \frac{\hat{\mathrm{var}}\,[\hat{g}(0)]}{[\hat{g}(0)]^2}}$$

Where,
D = density (of individuals),
n = number of on-effort sightings,
f(0) = detection function evaluated at zero distance,
E(s) = expected average group size (using size-bias correction in DISTANCE),
L = length of transect lines surveyed on effort,
g(0) = trackline detection probability,
N = abundance,
A = size of the study area,
CV = coefficient of variation, and
var = variance.

Detection function and encounter rates were calculated for bottlenose dolphins using the software DISTANCE 6.0 using all data collected in BSS conditions of 0-3, which was considered good sighting conditions. Estimates were not stratified by BSS or other environmental parameters due to limited sample sizes. Stratified estimates of density and abundance (in terms of sighting rate and group size) were generated for the two main survey zones and four seasons. In other words, we calculated sighting rate and average group size separately for each stratum, and only pooled across strata for estimating the detection function. Due to sample size limitations, data were pooled from all strata to produce a single detection function, f(0). The seasons were defined as spring (March–May), summer (June–August), fall (September–November), and winter (December–February).

To avoid potential overestimation of group size, the size-bias-adjusted estimate of average group size available was calculated in DISTANCE. However, this estimate was only used if it was lower than the arithmetic mean group size. Group size for each estimate was calculated using a stratified approach (i.e., only groups from within a particular stratum were used to calculate average group size for that stratum).

Truncation of the perpendicular sighting distance data excluded the most-distant five percent of the sightings. The data were modeled with half-normal (using hermite polynomial and cosine series expansions), hazard rate (using cosine adjustment), and uniform (using cosine and simple polynomial adjustments) models; the model with the lowest value for Akaike's Information Criterion was selected.

Data is not available to estimate trackline detection probability [g(0)] for this study, thus g(0) was assumed to equal 1.0. While this may not be realistic, the study area is relatively shallow, and bottlenose dolphins do not normally conduct long, deep dives in such habitats. Therefore, if there is any bias resulting from the assumption of g(0) = 1.0, it should be minimal.

Methods – Photo-identification Surveys

A total of seven surveys (one survey day each month) was planned for summer/fall 2012 (August, September, and October) and spring/summer 2013 (May, June, July, and August). Departures by the HDR MSM Survey Team were timed for optimal light conditions for photography and optimal weather conditions (e.g., BSS 0-3, no heavy rain, and visibility of greater than 1 NM).

The HDR MSM Survey Team first attempted systematic coverage of the NSN and JEB-LC nearshore areas using the small vessel M/V *Double OO's*, a 31-ft (9.4-m) center-console vessel (**Figure 5**) to collect data suited for mark-recapture population estimates. After three surveys, it was determined that the seasonal fluctuation of dolphins in the study area violates the assumption of geographic closure for conventional capture-recapture models (Wilson et al. 1999), and would not allow such analysis. As a result it was decided that a more efficient use of time would be to extend the survey area towards JEB-FS and spend more time with dolphin groups rather than focusing on systematic coverage of the NSN and JEB-LC areas for photo identification surveys. The vessel transited the nearshore waters at a speed of 13 to 15 km per hour while observers searched for marine mammals using Canon IS 10 × 30 binoculars and with the naked eye.

Figure 5. Primary photo-ID survey vessel, the *Double OO's*.

Upon sighting a group of dolphins, data were recorded on printed data sheets (see **Appendix A**), including group size estimates, species identification, initial behavioral category, sighting location, bottom depth, sea surface temperature, and frame numbers of photographs taken. Location data were obtained from a handheld Garmin GPS receiver. Photographs were taken during all sightings when possible using a Canon 7D digital camera with 100 to 400-mm lens. Observers adjusted the amount of time spent with each group as necessary to obtain photographs of as many individuals within the group as possible, while allowing additional survey time to encounter other groups.

All photos taken were for identification purposes and the photographer focused on a perpendicular angle of the dolphins' dorsal fins. Unique patterns of nicks and notches on the trailing edge of the dorsal fins were used to identify individuals, a technique utilized by numerous researchers as first described by Würsig and Würsig (1977). Photos went through a process of digital sorting and cataloging, starting with the initial removal of poor-quality photos (i.e., out of focus, obscured fins, fins too far away, non-distinguishable fins). The program ACDSee Pro 3 was used to crop, zoom, and sort the dorsal fin photos within each group sighting by matching up all duplicate photos of the same individual and choosing the best image to proceed to cataloging. The NVB (Norfolk-Virginia Beach) catalog was then created (also using ACDSee) by designating an ID number to each individual in a sighting group. For each subsequent group sighting, the images were first compared to each previously cataloged individual to see if it matched any of those fins before designating as a new individual and assigning an ID number. Image file names include date, sighting number, species, photographer initials, and frame number, so associated sighting data can be found in the database for any matched individuals. As the catalog grows over time and is used for specific purposes, further categorizing, rating, and cataloging techniques and programs will be employed.

Methods – C-POD Automated Acoustic Monitoring

C-PODs (www.chelonia.co.uk) were initially deployed at four locations known as NSN, JEB-LC, JEB-FS, and MINEX (**Figure 1**). Deployment locations were determined based on the likelihood of overlap between dolphin occurrence and Navy activities, including one unit within a relatively high-use portion of the MINEX W-50A area as an additional safety measure, C-POD units were deployed using a vessel platform with deck crane. Each C-POD was connected to a mooring via an Edge Tech acoustic release transponder (**Figure 6**). The initial deployment only used sand bags for moorings but concrete blocks were added for subsequent deployments. The units were recovered by programming the Edge Tech deck unit and associated hydrophone to communicate a release command down to the acoustic release, triggering a sacrificial block to unscrew, and allowing the unit to rise to the surface via attached flotation. Upon recovery, the memory card was extracted and data were sent to Chelonia Limited for analysis. Units that were to be re-deployed were cleaned of extensive marine growth in addition to installing new batteries and blank memory cards.

The C-POD design aims to achieve fast results from a fully automated detection process, produce low false-positive rates (i.e., detection of a signal that was not actually produced), and possess high sensitivity (within approximately 1 km) and long running times of over four months. They act as “energy detectors” and do not make actual acoustic recordings, but trigger the instrument to log events occurring between 20 and 160 kilohertz (kHz). Finely-tuned filters on the processing boards categorize the clicks produced by toothed whales, dolphins, and porpoises.

Automated detections are achieved by identifying trains of echolocation clicks. With custom Chelonia C-POD analysis software, sonar activity from triggered events logged on the C-POD can be identified by characteristic frequency components and signal timing. Features such as click duration, peak frequency, inter-click-interval, and spectral characteristics can all be used to classify clicks and click trains, often times to the species level.

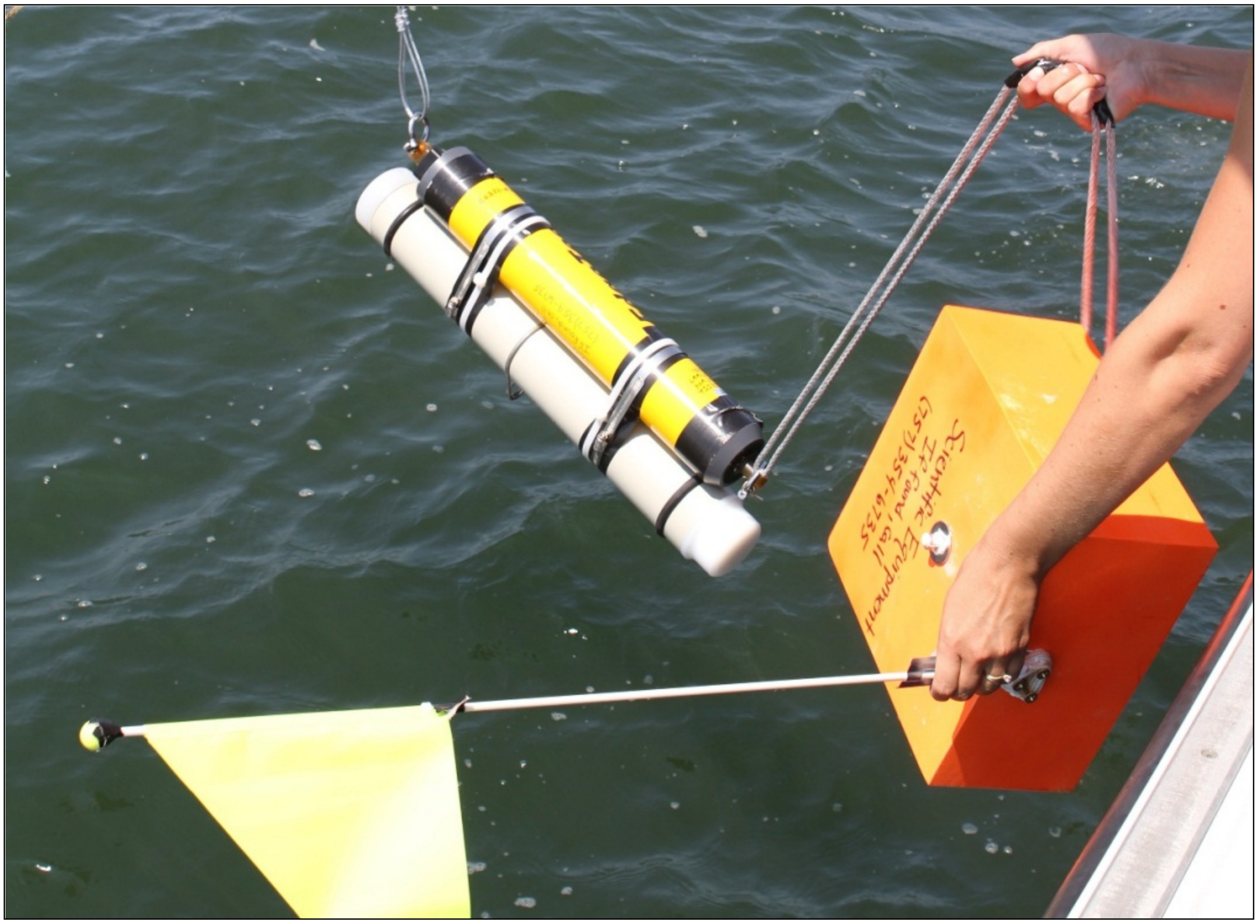

Figure 6. A C-POD unit prepped and in the process of deployment.

Section 3 - Line-transect Survey Results

Visual Survey Effort

Fourteen INSHORE line-transect surveys and 11 MINEX line-transect surveys were completed between August 2012 and November 2013. Surveys covered a total of 2,810 km and 8,942 min on-effort. The total on-effort distance and time spent in the INSHORE zone was 1,685 km and 5,363 min respectively (**Table 1**), while 1,125 km and 3,579 min of on-effort time was spent in the MINEX zone (**Table 2**). Details on each survey day's track and sightings are provided in **Appendix B**.

Table 1. Summary of INSHORE line-transect surveys, August 2012 – November 2013.

Date	Description	Start Time	Stop Time	Total Survey (Minutes*)	Total On-Effort (Minutes)	Trackline On-Effort Distance (km)
7 Sept 2012	INSHORE transect	8:08	15:15	428	313	86.3
3 Oct 2012	INSHORE transect	8:03	15:37	455	428	129.6
27 Nov 2012	INSHORE transect	6:27	16:16	588	384	118.3
9 Jan 2013	INSHORE transect	7:06	16:37	571	331	132.4
22 Feb 2013	INSHORE transect	7:52	16:29	517	373	110.3
1 Apr 2013	INSHORE transect	8:27	16:16	469	400	123.2
28 Apr 2013	INSHORE transect	7:45	15:37	471	416	127.1
9 May 2013	INSHORE transect	9:18	17:46	508	396	124.4
17 Jul 2013	INSHORE transect	6:40	16:01	560	375	124.6
24 Jul 2013	INSHORE transect	6:16	16:52	636	415	129.2
13 Aug 2013	INSHORE transect	6:56	15:54	538	357	111.6
25 Sep 2013	INSHORE transect	7:08	18:22	674	397	121.3
17 Oct 2013	INSHORE transect	7:21	17:18	596	389	123.9
16 Nov 2013	INSHORE transect	6:46	16:40	593	389	123.0
Total				**7,604 (≈127 hr†)**	**5,363 (≈89 hr†)**	**1,685 km**

Note:

* Total Survey Minutes reflect minutes of recording by software, and include both on-effort (systematic) and off-effort (cross-legs between transects, and circling for focal follows or species ID, and some transit) total minutes. Total Survey Minutes may not match the difference between Start Time and Stop Time in the table due to differences in rounding.

† hr is defined as hours.

Table 2. Summary of MINEX line-transect surveys, August 2012 – November 2013.

Date	Description	Start Time	Stop Time	Total Survey (Minutes*)	Total On-Effort (Minutes)	Trackline On-Effort Distance (km)
8 Aug 2012	MINEX transect	7:37	15:46	488	400	111.2
23 Oct 2012	MINEX transect	7:13	14:34	441	343	111.3
10 Nov 2012	MINEX transect	7:10	14:15	426	334	108.2
3 Jan 2013	MINEX transect	7:55	15:44	469	303	94.9
23 Mar 2013	MINEX transect	8:29	16:02	453	330	108.8
31 May 2013	MINEX transect	11:18	16:07	289	204	67.2
22 Jul 2013	MINEX transect	6:16	16:15	559	331	106.0
27 Jul 2013	MINEX transect	6:20	16:26	606	348	112.4
19 Aug 2013	MINEX transect	6:19	14:59	520	256	80.3
28 Oct 2013	MINEX transect	6:57	15:24	507	361	112.0
30 Oct 2013	MINEX transect	7:29	16:18	529	369	112.2
Total				**5,287 (≈88 hr†)**	**3,579 (≈60 hr†)**	**1,125 km**

Note:

* Total Survey Minutes reflect minutes of recording by software, and include both on-effort (systematic) and off-effort (cross-legs between transects, and circling for focal follows or species ID, and some transit) total minutes. Total Survey Minutes may not match the difference between Start Time and Stop Time in the table due to differences in rounding.

† hr is defined as hours.

Sightings

A total of 225 sightings of marine mammals and 42 sightings of sea turtles were recorded during transect surveys from August 2012 through November 2013 (**Figures 7 and 8, Table 3, Appendices C and D**). Sighting locations used are those calculated by VisVessel and Mysticetus software, using the input values for bearing to the individual or group and a measure of distance (either calculated from the reticle reading from the handheld binoculars or estimation of distance when no horizon was visible). The vast majority (97 percent; *n*=219 of 225) of marine mammal sightings were bottlenose dolphins; the other species sighted included four individual humpback whales (*Megaptera novaeangliae*) (**Figure 9**), one group of short-beaked common dolphins (*Delphinus delphis*), and one group of unidentified dolphins. The unidentified dolphins had a similar shape to the short-beaked common dolphins, but the observer team was unable to re-sight the group to confirm species identification. Twelve marine mammal groups were sighted in the MINEX zone and 213 in the INSHORE zone. Twenty of the sea turtles were loggerheads (*Caretta caretta*), 14 were leatherbacks (*Dermochelys coriacea*), and 8 were unidentified hardshell turtles. Thirty-eight sightings were made in the MINEX zone, including all 14 leatherbacks on the same day (27 July 2013), and four in the INSHORE zone.

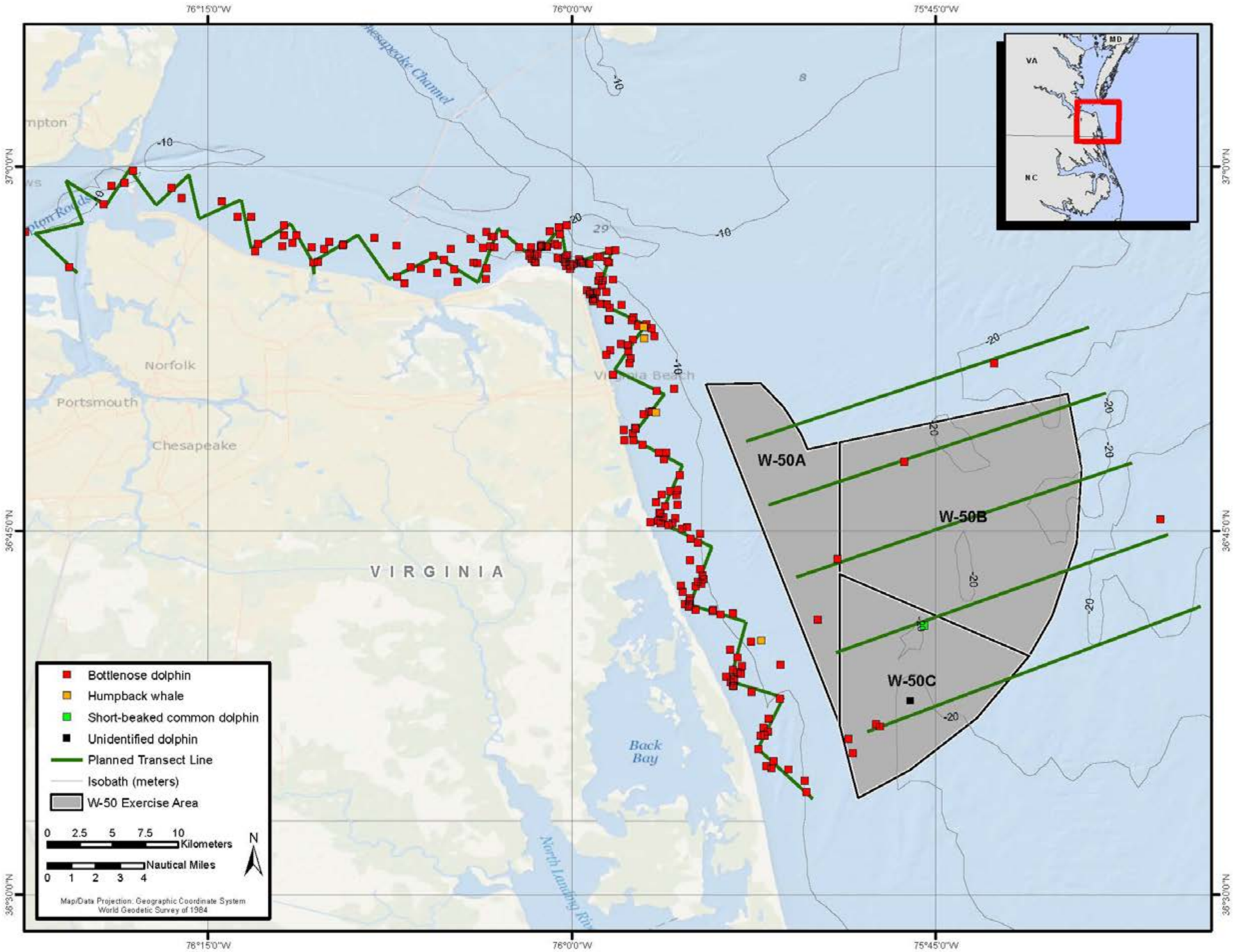

Figure 7. Marine mammal sightings during all line-transect surveys between August 2012 and November 2013.

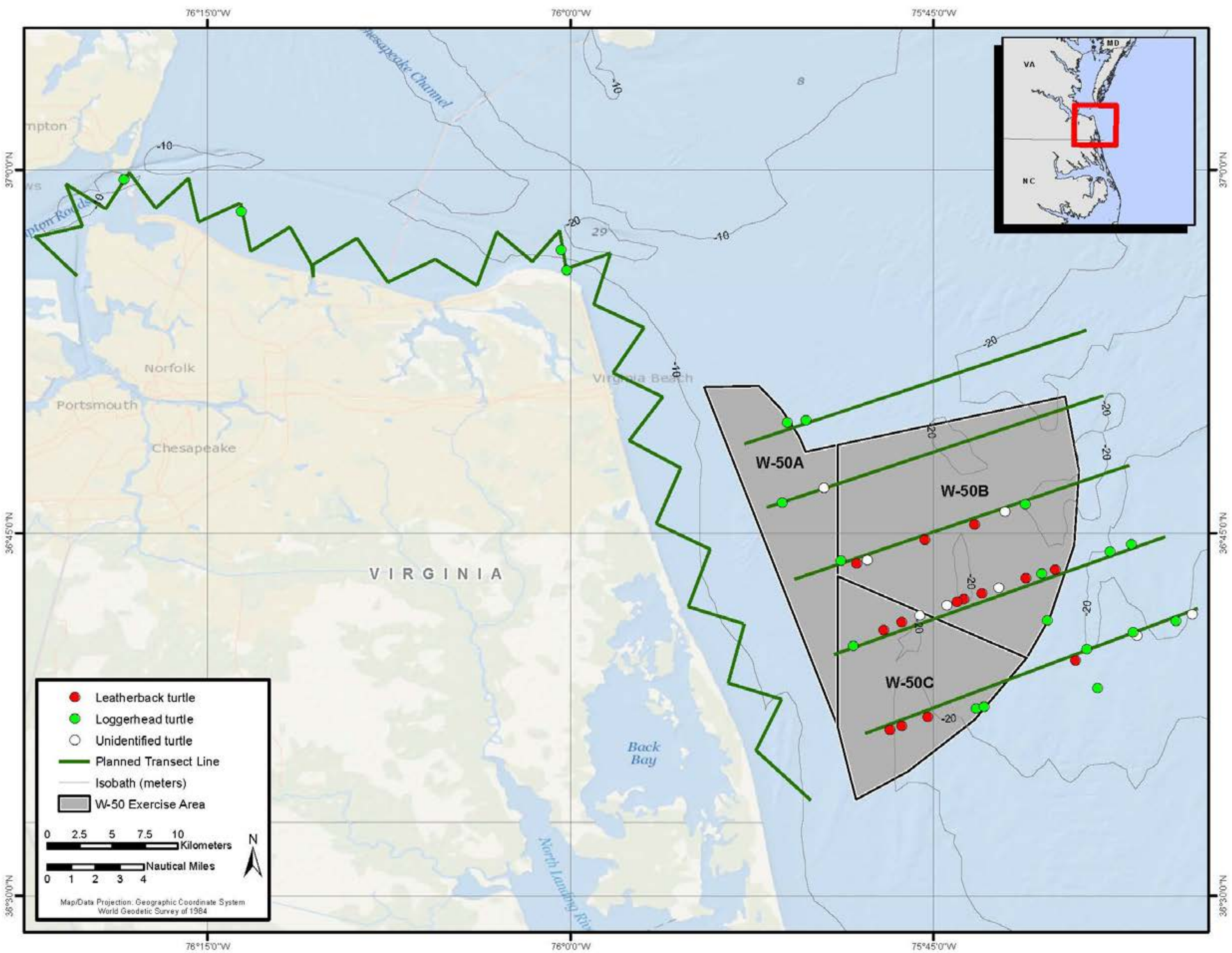

Figure 8. Sea turtle sightings during all line-transect surveys between August 2012 and November 2013.

Table 3. Marine mammal and sea turtle sighting summary.

Zone	Season	No. Survey Days	Distance On-Effort (km)	Total No. Sightings	No. Cetacean Sightings	Total No. Cetacean Individuals*	No. Sea Turtle Sightings
INSHORE	Fall	6	702.4	139	136	1529	3
INSHORE	Winter	2	242.7	10	10	124	0
INSHORE	Spring	3	374.7	16	16	156	0
INSHORE	Summer	3	365.4	52	51	976	1
MINEX	Fall	4	443.7	7	4	15	3
MINEX	Winter	1	94.9	1	1	1	0
MINEX	Spring	2	176.0	7	5	24	2
MINEX	Summer	4	409.9	35	2	81	33

Note:
*Total individuals are sum of Best group size estimate

Figure 9. Photo of humpback whale (*Megaptera novaeangliae*) observed on 25 September 2013 off the Virginia Beach coastline.

Photographs obtained during the 25 Sep 2013 sighting were matched to a known individual, Spinnaker, in the North Atlantic Humpback Whale Catalog, curated by Allied Whale, College of the Atlantic (**Figure 9**). This individual had not previously been documented off the mid-Atlantic states, but is part of a well-known lineage of humpback whales in the Gulf of Maine, first seen as a calf in 2004 and re-sighted there in every subsequent year through 2012 (Jooke Robins, Provincetown Center for Coastal Studies, personal communication, 8 Feb 2014).

Density Estimates

Estimates of density and abundance were calculated for bottlenose dolphins using 199 sightings and 1,644 km of line-transect survey effort in the INSHORE zone, and seven sightings and 1,053 km of effort in the MINEX zone. The detection function was modeled using the hazard rate key function, with a cosine adjustment. The calculated value of f(0) was 5.7062 (CV=0.22), and the effective strip width (1/f(0)) was 175 meters. The histogram of perpendicular sighting distances and fitted model are shown in **Figure 10**. Line-transect parameters and resulting estimates are provided in **Table 4**.

Sightings of humpback whales (*n*=4) and short-beaked common dolphins (*n*=1) were also made during the surveys, but the sample sizes were too small for these species to produce reliable estimates of density or abundance. **Figures 11 through 17** show the sighting locations of all on-effort bottlenose dolphin sightings for each season in which observations occurred.

While the numbers of sightings for the INSHORE zone appear to be adequate to produce reliable estimates of density and abundance, at this point there are too few sightings from the MINEX zone for reliable estimates. As a result, the MINEX estimates should be considered highly preliminary, and we will attempt to refine them with further survey effort in 2014. We will also attempt to further stratify the INSHORE zone if additional data allow densities to be calculated for smaller sections of the area.

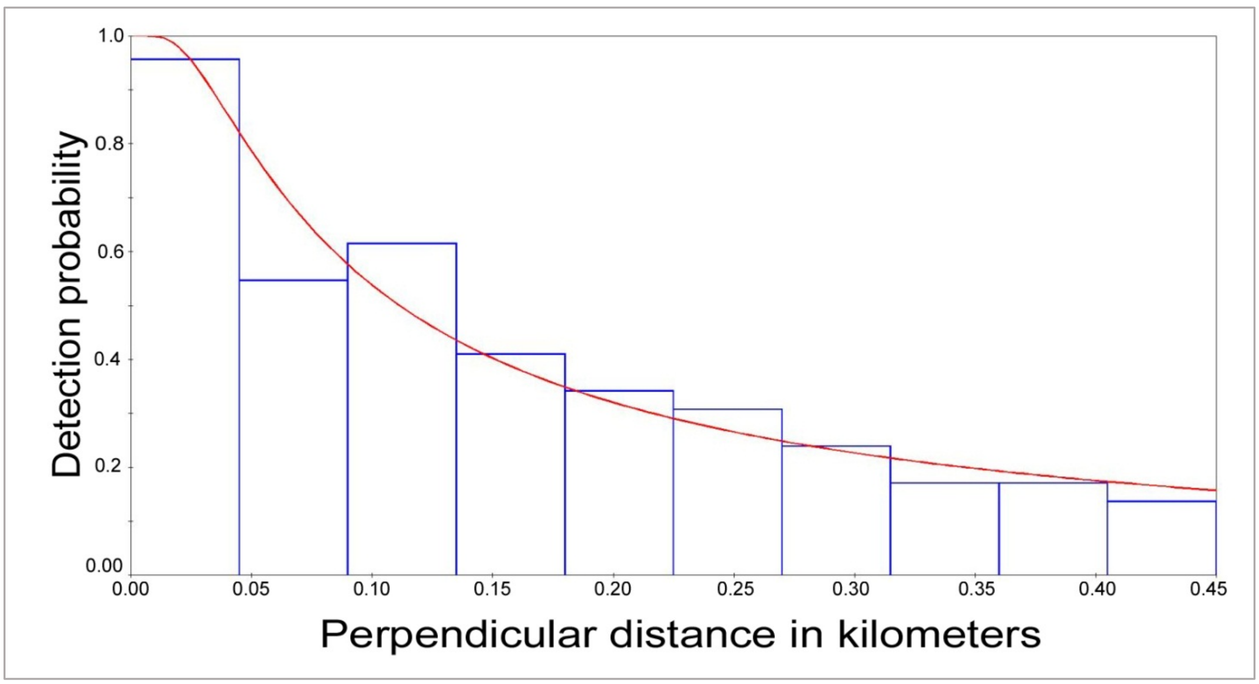

Figure 10. Perpendicular distance histogram and fitted detection function for bottlenose dolphins.

Table 4. Line-transect parameters and estimates of density and abundance for bottlenose dolphins in different zones and seasons.

Zone	Season	No. Stgs.*	Effort (km)	Avg. Grp. Size	Stg. Rate§	Density#	Abundance	% CV†
INSHORE	Fall	121	703	10.0	0.17	3.05	948	34
INSHORE	Winter	8	243	6.8	0.03	0.40	123	73
INSHORE	Spring	12	363	18.5	0.03	1.09	337	72
INSHORE	Summer	48	335	13.9	0.14	3.52	1,094	43
MINEX	Fall	4	442	7.2	0.01	0.11	105	85
MINEX	Winter	0	94	1.0	0.00	0.00	0	n/a
MINEX	Spring	2	125	3.5	0.02	0.10	90	137
MINEX	Summer	1	392	36.0	0.00	0.16	148	96

Note:
*Before truncation
§Measured as individuals per linear km
Measured as individuals per km^2
†Coefficient of Variation

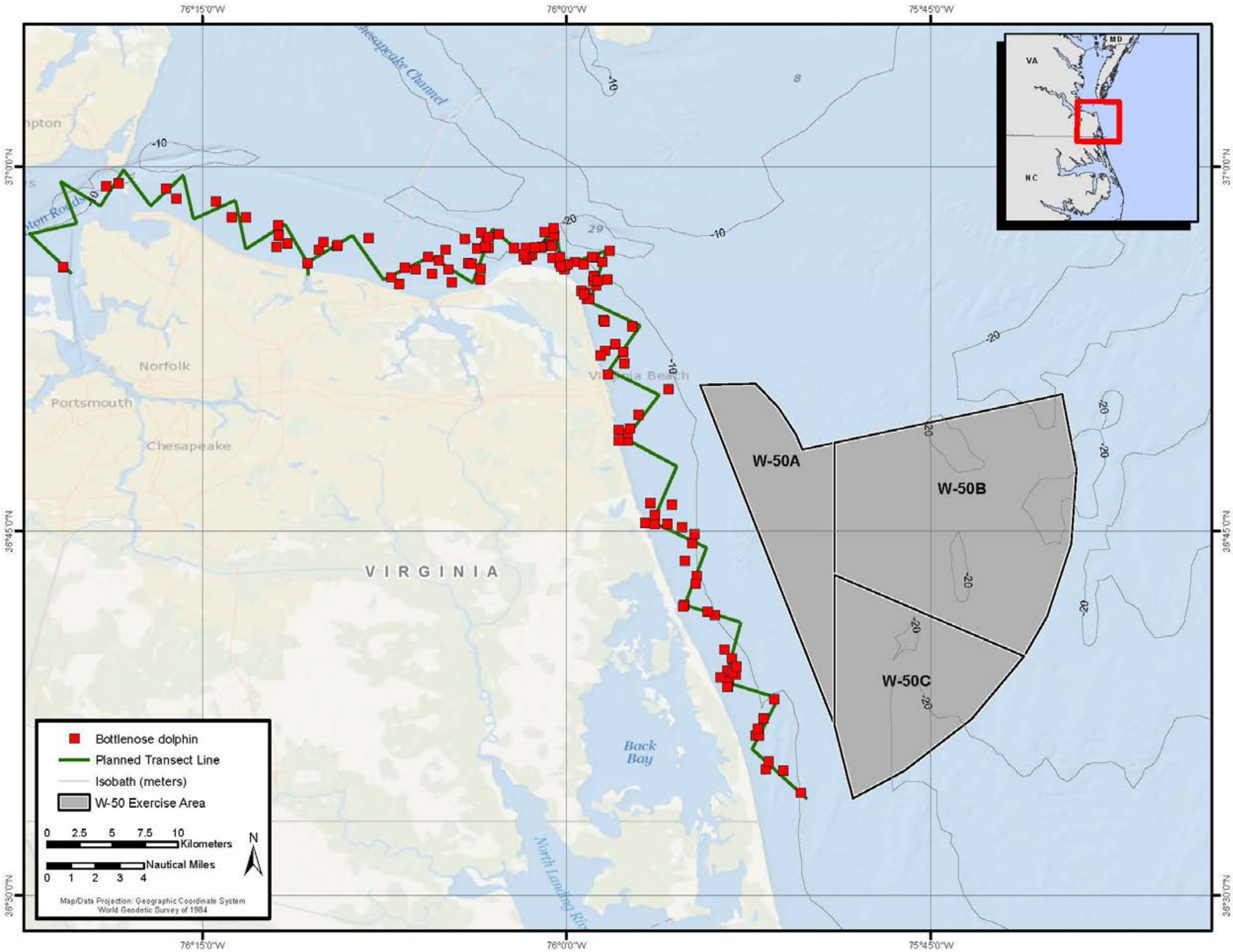

Figure 11. Bottlenose dolphin groups sighted on-effort during fall INSHORE line-transect surveys.

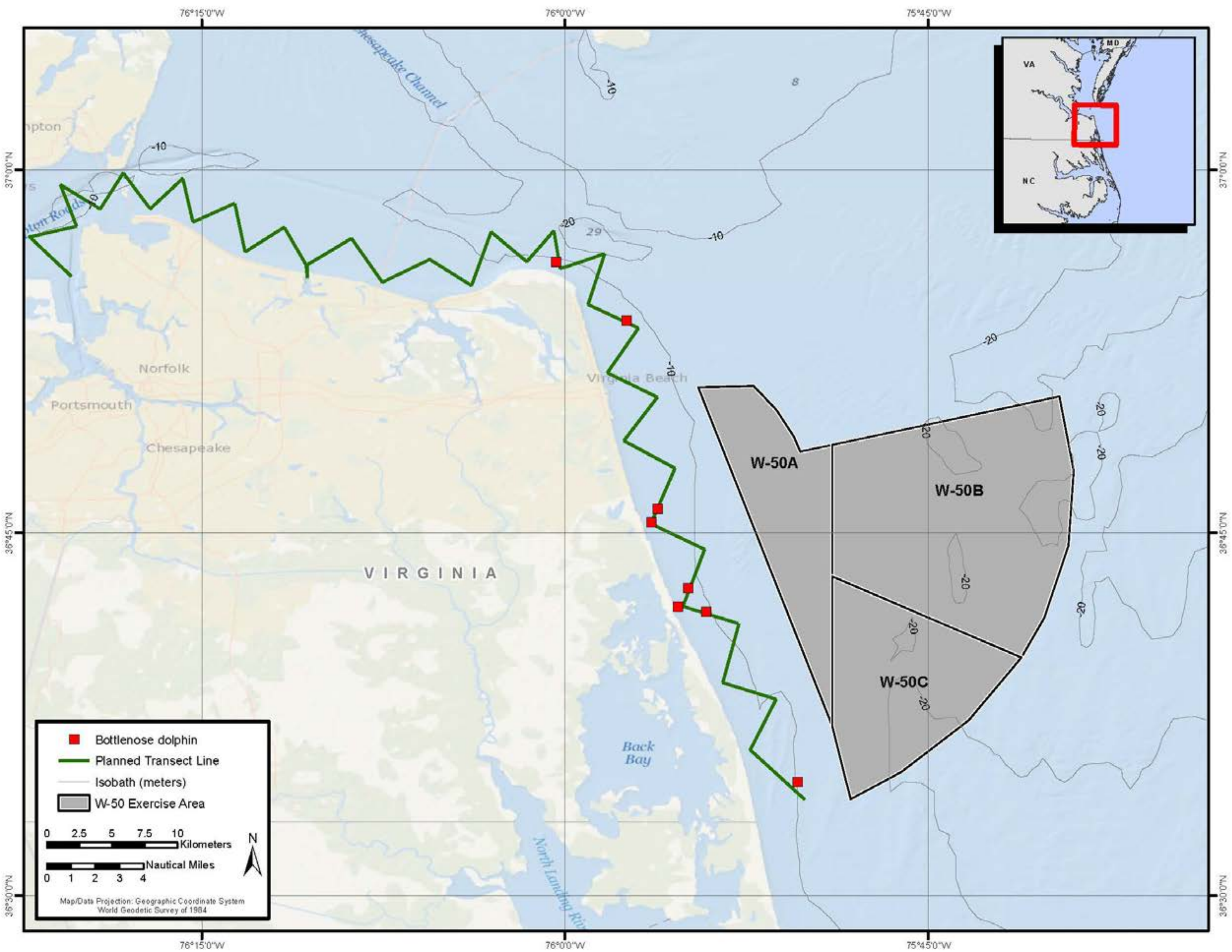

Figure 12. Bottlenose dolphin groups sighted on-effort during winter INSHORE line-transect surveys.

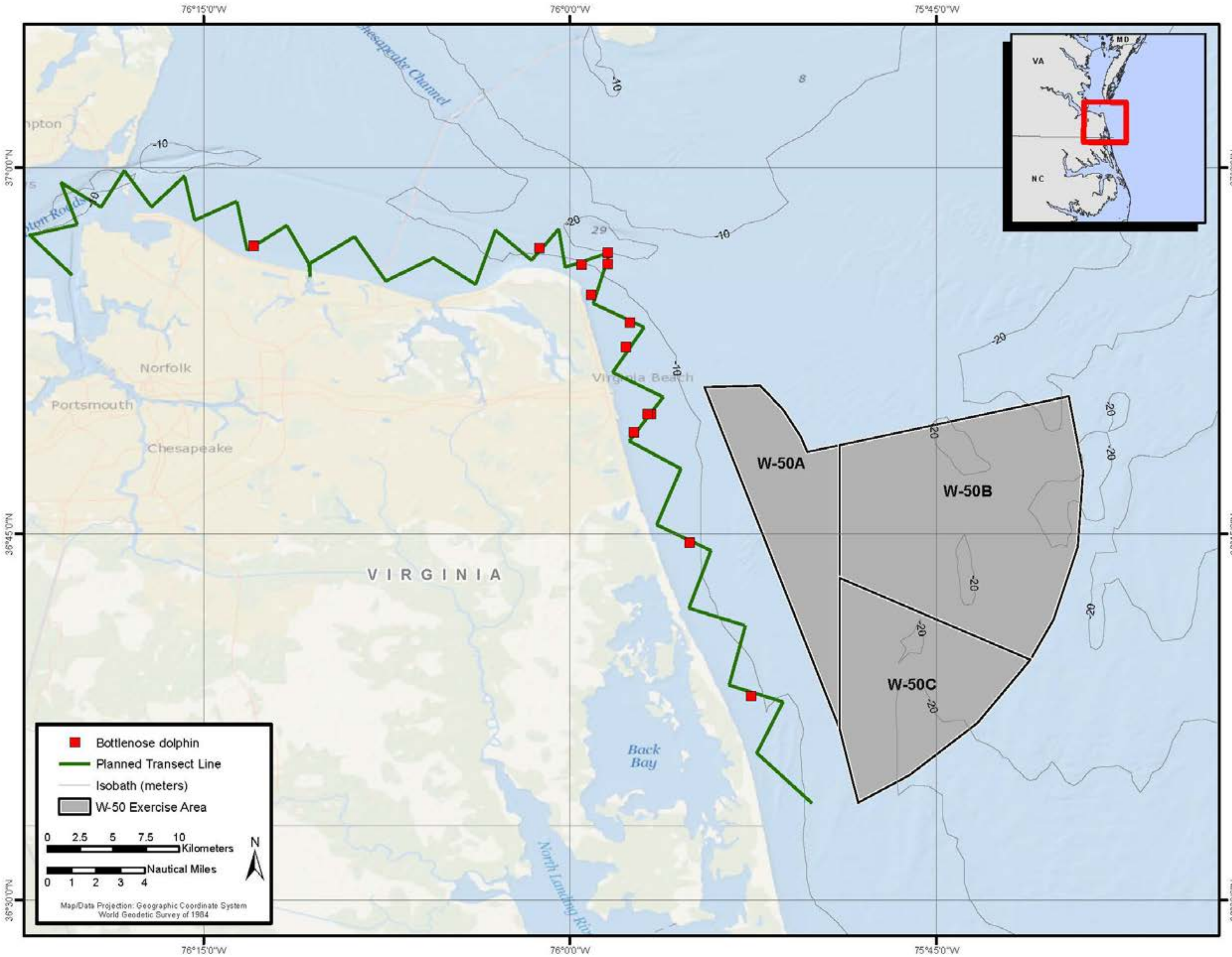

Figure 13. Bottlenose dolphin groups sighted on-effort during spring INSHORE line-transect surveys.

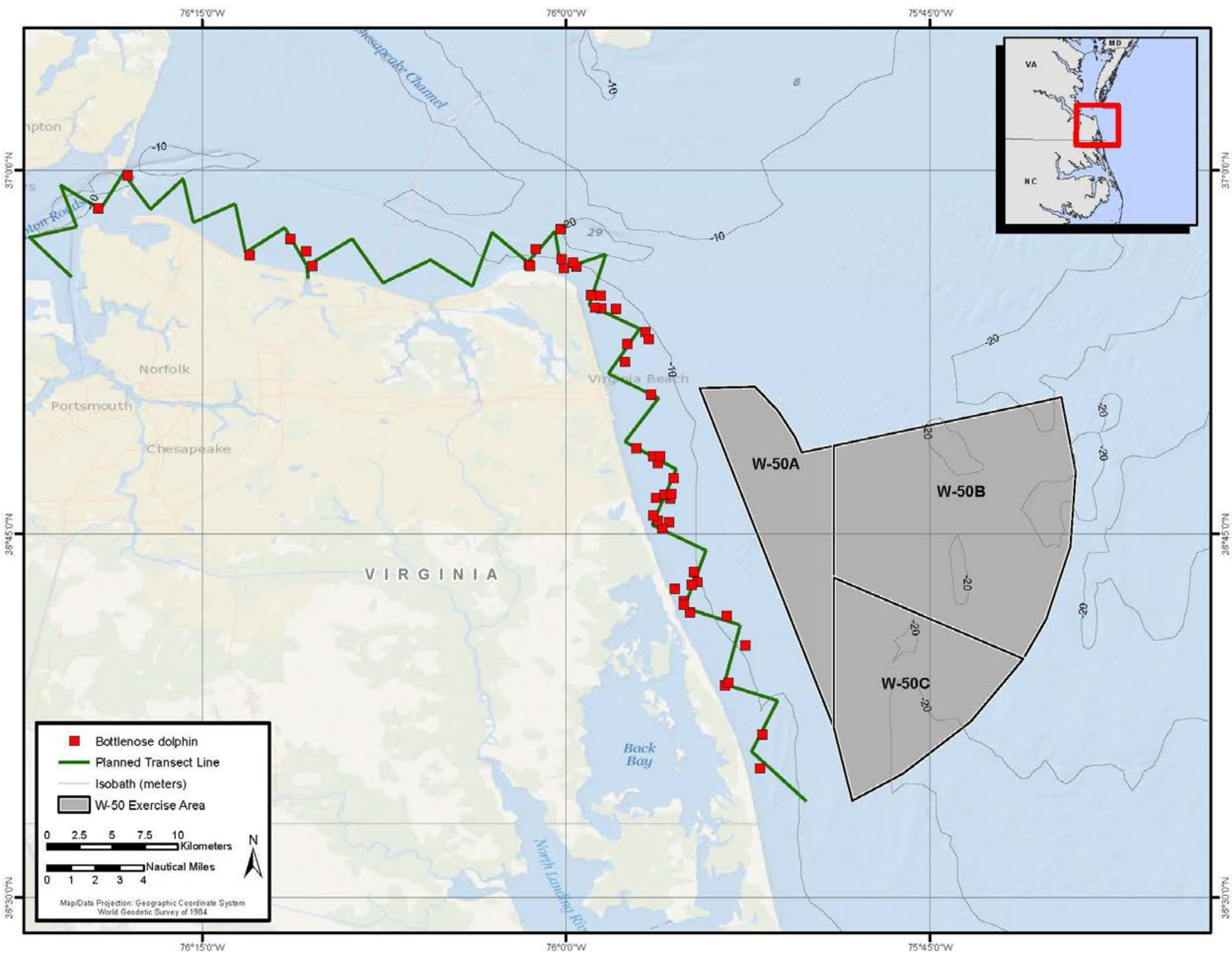

Figure 14. Bottlenose dolphin groups sighted on-effort during summer INSHORE line-transect surveys.

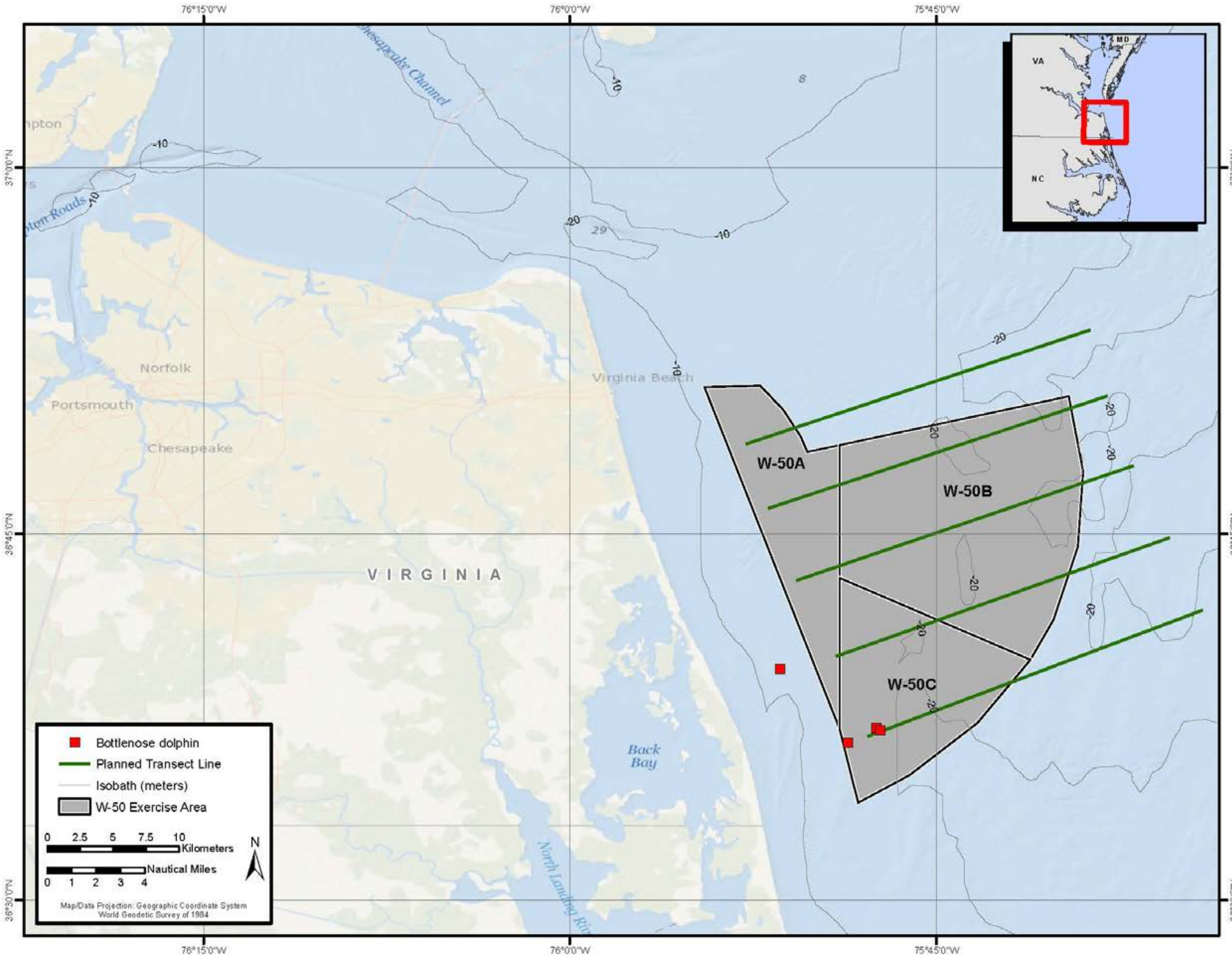

Figure 15. Bottlenose dolphin groups sighted on-effort during fall MINEX line-transect surveys.

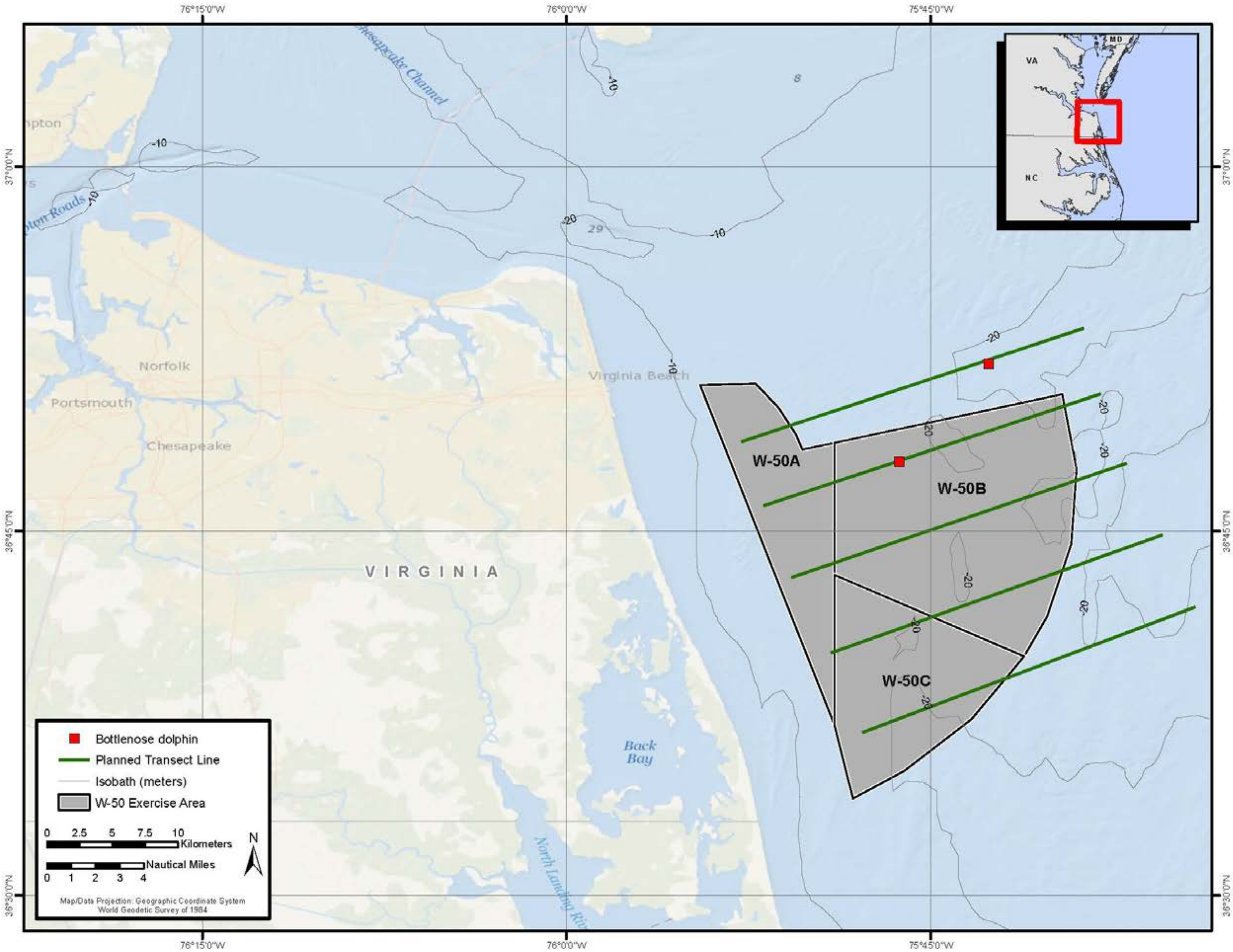

Figure 16. Bottlenose dolphin groups sighted on-effort during spring MINEX line-transect surveys.

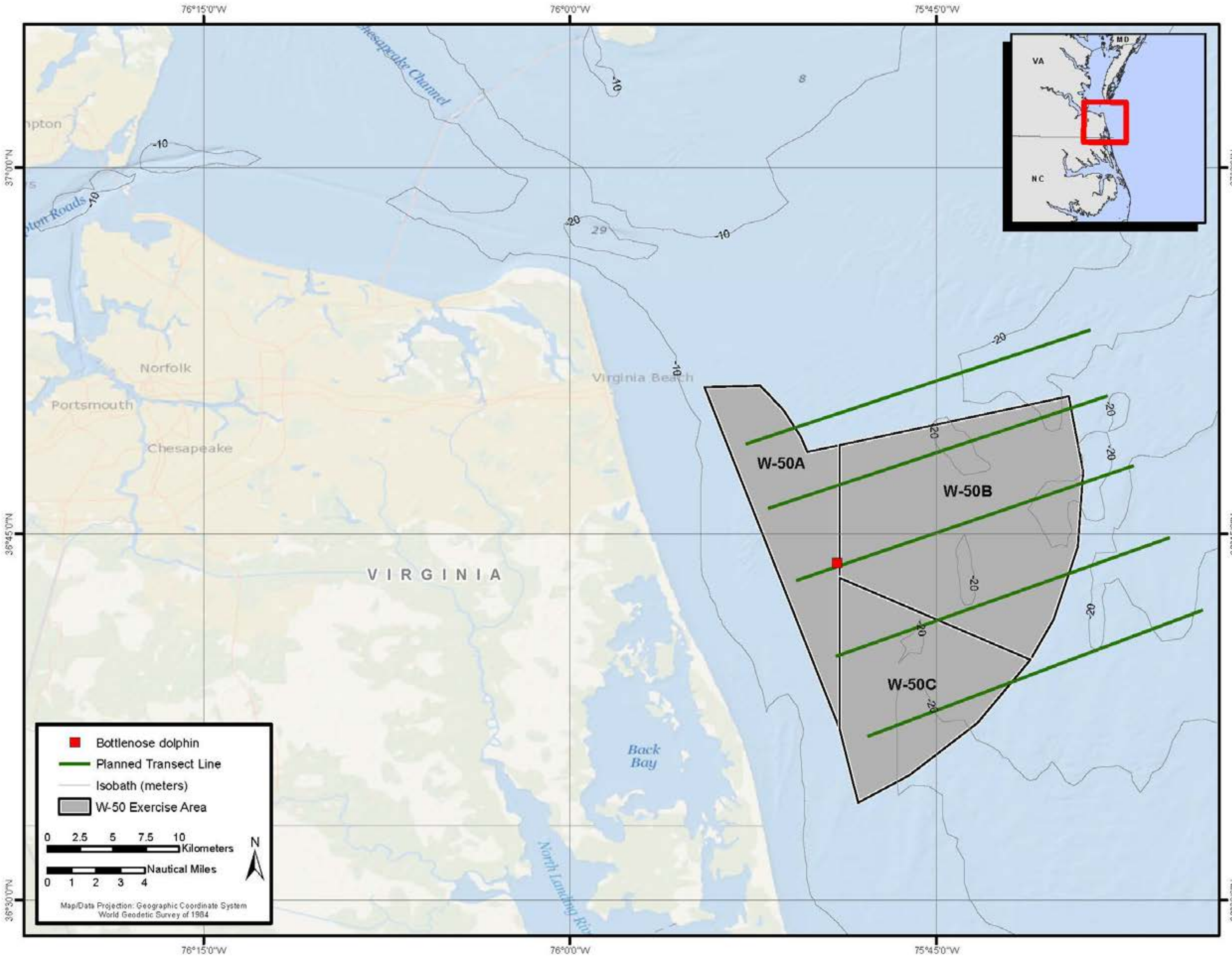

Figure 17. Bottlenose dolphin groups sighted on-effort during summer MINEX line-transect surveys.

Section 4 - Photo-identification Survey Results

Nine photo-ID surveys were completed between August 2012 and November 2013 (**Table 5**). The surveys were not always completed each month as planned due to poor weather conditions. Effort was focused on conducting photo-ID of as many individuals within each encountered group as possible. A catalog was created using both photos taken on photo-ID surveys and photos taken on transect surveys. The cataloging effort is underway and to date includes all photo-ID and transect photographs taken through July 2013. **Figure 18** shows the locations of all sightings used in the catalog. To date, the catalog contains 308 identifiable individuals. The discovery curve (**Figure 19)** shows the addition of new individuals with each month's surveys. Though the curve appears to plateau in the spring months of 2013, then spike in July 2013, it is likely due to the lack of surveys in June of 2013, and it will likely smooth out to a steady rise as more photos are processed.

Table 5. Summary of completed photo-ID surveys August 2012 to November 2013.

Date	Start Time	Stop Time	Total Survey Minutes	Number of Bottlenose Dolphin Groups Sighted	Total Number Estimated Individuals
9 Aug 2012	9:12	16:45	453	3	37
25 Sep 2012	7:30	15:37	487	9	136
25 Oct 2012	8:25	16:35	490	2	25
9 Jul 2013	7:06	16:17	551	6	184
16 Jul 2013	7:01	16:22	560	6	160
31 Aug 2013	7:29	15:56	507	8	161
16 Sep 2013	7:10	15:34	504	10	191
2 Oct 2013	7:19	15:41	502	17	395
22 Oct 2013	7:10	14:49	459	7	280

Another sighting and re-sighting of a freeze-branded individual (known as FB405, Kim Urian, Duke University Marine Laboratory, personal communication, 9 Dec 2013) is also included in the catalog, even though the sighting photographs from this date have not yet been cataloged. After the initial sighting in the field, the HDR MSM Survey Team communicated with relevant parties to determine where the animal had been branded. It was confirmed that prior to sightings at Cape Henry, Virginia on 31 August and 16 September 2013, this individual had been photographed in Roanoke Sound, North Carolina, and caught for tagging and freeze-branding at Cape Lookout, North Carolina on 9 November 1999.

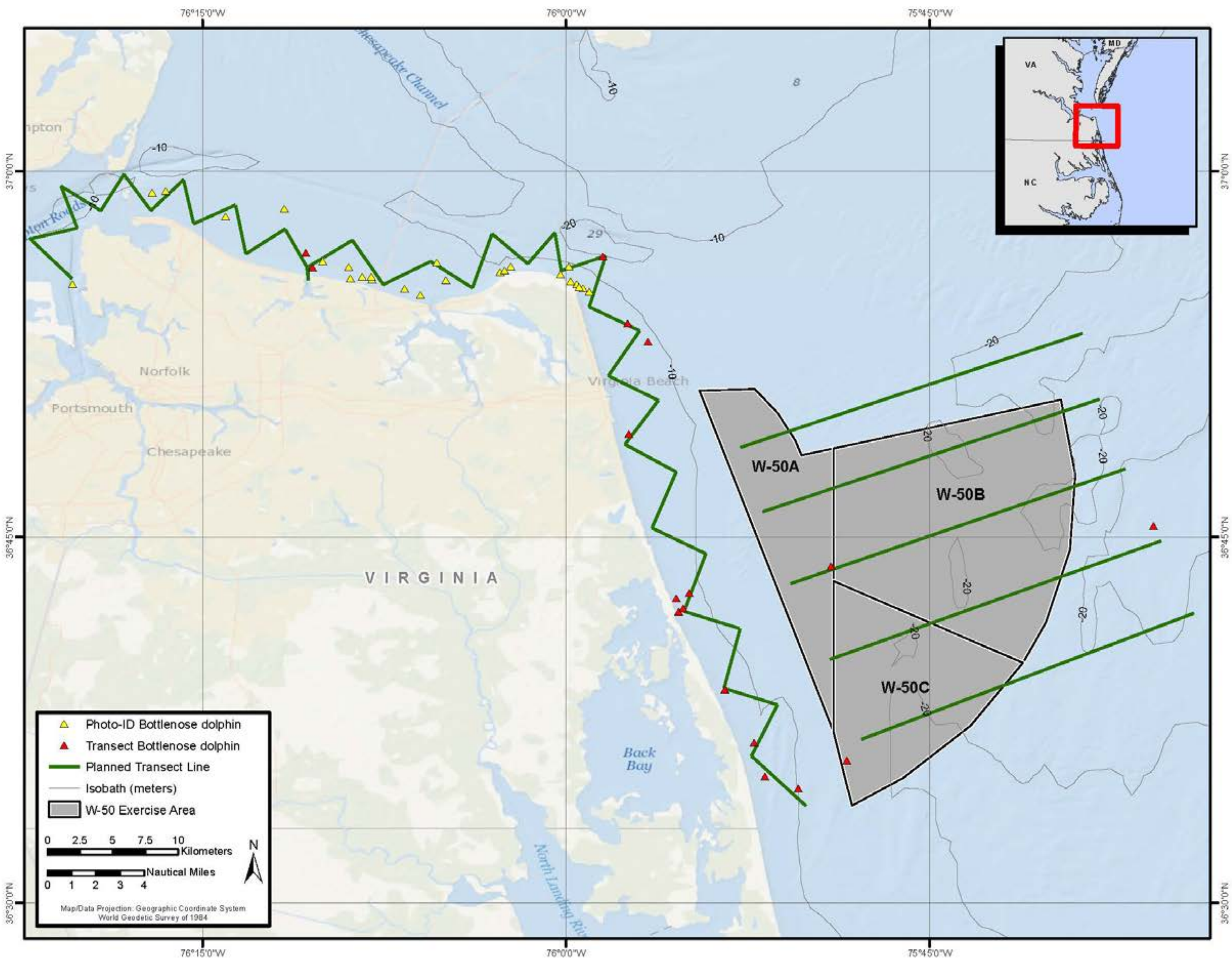

Figure 18. Bottlenose dolphin group sighting locations used in photo-ID catalog. All photo-ID survey locations are shown. For transect surveys, only locations in which identification photos were collected are included.

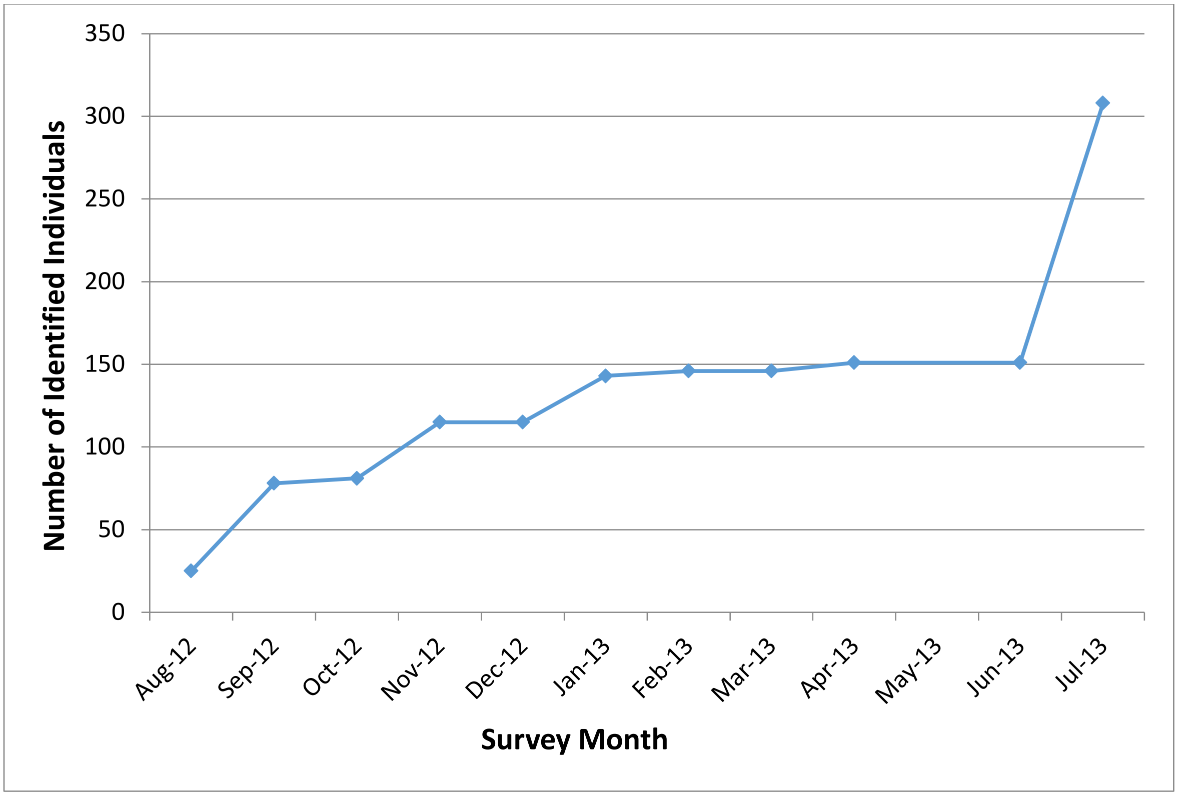

Figure 19. Discovery curve showing the cumulative number of identified dolphins as it increased with each survey month.

Re-sighting rates across surveys were low. Following creation of the catalog, there have been 36 matches of cataloged individuals, which includes a second re-sighting of three individuals (**Table 6**, **Appendix E).** All re-sightings in the study area were recorded less than 15 km from the initial sighting. Dolphins sighted in the Chesapeake Bay were not re-sighted along the Atlantic side of Virginia Beach in the southern portion of the study area. More survey effort and photo-ID are required to discern any clear patterns of site fidelity. Upon completion of cataloging all photographs taken on photo-ID and transect surveys in the study area, images will be contributed and compared to the existing Mid-Atlantic Bottlenose Dolphin Catalog, established by NMFS and curated by Kim Urian of Duke University Marine Laboratory (Urian et al. 1999). The contribution will be made to find matches to other adjacent study areas and piece together information on movement patterns on a larger scale.

Table 6. Sighting details of re-sighted individuals.

Catalog ID No.	Initial Sighting Date/Sighting No./Grp Size			Re-sighting Date/Sighting No./Grp Size			Distance Between Sightings (km)
NVB0006	9 Aug 2012	1	15	9 Aug 2012	5	18	8.9
NVB0008	9 Aug 2012	1	15	9 Aug 2012	5	18	8.9
NVB0009	9 Aug 2012	1	15	9 Aug 2012	5	18	8.9
NVB0010	9 Aug 2012	1	15	9 Aug 2012	5	18	8.9
NVB0011	9 Aug 2012	1	15	9 Aug 2012	5	18	8.9
NVB0012	9 Aug 2012	1	15	9 Aug 2012	5	18	8.9
NVB0014	9 Aug 2012	5	18	25 Sep 2012	1	6	6.6
NVB0020	9 Aug 2012	5	18	25 Sep 2012	9	15	13.0
NVB0003	9 Aug 2012	1	15	25 Sep 2012	9	15	4.0
NVB0033	25 Sep 2012	2	24	16 Jul 2013	1	26	4.2
NVB0111	27 Nov 2012	5	8	9 Jan 2103	1	30	11.2
NVB0115	27 Nov 2012	5	8	9 Jan 2103	1	30	11.2
NVB0083	27 Nov 2012	1	40	9 Jan 2103	2	35	6.4
NVB0084	27 Nov 2012	1	40	9 Jan 2103	2	35	6.4
NVB0084	27 Nov 2012	1	40	9 Jul 2013	1	22	1.0
NVB0086	27 Nov 2012	1	40	9 Jan 2103	2	35	6.4
NVB0133	9 Jan 2103	2	35	22 Feb 2013	5	15	1.2
NVB0152	9 Jul 2013	1	22	16 Jul 2013	3	33	13.8
NVB0155	9 Jul 2013	1	22	16 Jul 2013	3	33	13.8
NVB0164	9 Jul 2013	3	25	9 Jul 2013	4	115	2.0
NVB0164	9 Jul 2013	3	25	16 Jul 2013	4	30	6.4
NVB0165	9 Jul 2013	3	25	16 Jul 2013	4	30	6.4
NVB0172	9 Jul 2013	4	115	24 Jul 2013	2	125	11.8
NVB0175	9 Jul 2013	4	115	16 Jul 2013	1	26	6.6
NVB0179	9 Jul 2013	4	115	16 Jul 2013	4	30	8.2
NVB0183	9 Jul 2013	4	115	16 Jul 2013	3	33	13.8
NVB0188	9 Jul 2013	4	115	16 Jul 2013	3	33	13.8
NVB0189	9 Jul 2013	4	115	16 Jul 2013	4	30	8.2
NVB0193	9 Jul 2013	4	115	16 Jul 2013	3	33	13.8
NVB0195	9 Jul 2013	4	115	16 Jul 2013	1	26	6.5
NVB0199	9 Jul 2013	4	115	16 Jul 2013	6	65	14.2
NVB0211	9 Jul 2013	4	115	16 Jul 2013	1	26	6.5
NVB0211	9 Jul 2013	4	115	16 Jul 2013	4	30	8.2
NVB0212	9 Jul 2013	4	115	16 Jul 2013	1	26	6.6
NVB0214	9 Jul 2013	4	115	16 Jul 2013	4	30	8.2
FB405	31 Aug 2013	3	60	16 Sep 2013	2	75	1.9

Section 5 - C-POD Automated Acoustic Monitoring Results

Four C-PODs were initially deployed in August of 2012 at four different sites off NSN and Virginia Beach (**Table 7, Figure 1**). The MINEX and JEB-LC C-PODs were recovered in October 2012; however, initial mooring systems were inadequate. The instrument deployed at JEB-LC was recovered badly damaged on a nearby beach approximately 6 km from the deployment location and the C-POD deployed at JEB-FS also broke free and was found ashore at Duck, North Carolina (approximately 90 km from its original deployment location). Despite instruments drifting from their mooring and some being significantly damaged, all recovered C-PODs contained usable data. While the JEB-FS unit contained detections, meaningful data comparisons with the other sites cannot be made because it is unknown when the device broke free and if it continued to make detections while it traveled.

In December 2012, the C-PODs were re-deployed at JEB-LC and NSN using more robust mooring systems. These instruments lasted for the duration of the deployment (132 days) and a subsequent deployment was made at JEB-LC for another 152 days. The NSN unit was also deployed in April but not recovered. It is suspected that dredging or fishing activity interfered with the unit, either damaging or moving it out of range for release. In total there were three successful deployments at JEB-LC, one successful deployment each at NSN and MINEX sites, and one moderately successful deployment at JEB-FS (**Table 7, Figure 20**).

Each of the units recovered contained data that were processed using custom software provided by Chelonia Limited (www.chelonia.co.uk). A custom KERNO classifier was used to identify click trains and classify species. A second classifier, GENENC (Generalised Encounter Classifier), was run on the KERNO train details to further confirm species. KERNO looks through the entire dataset and identifies trains likely produced by cetaceans. GENENC takes the KERNO results and identifies likely encounters, with no gap longer than 2 minutes between trains. The GENENC classifier compiles the aggregate detection statistics and reduces the probability of false detections. The program categorizes click trains as ‘Narrow-Band High Frequency’ (NBHF), or ‘Other cetaceans.’ ‘NBHF’ species include all porpoises and any cetaceans in the genus *Cephalorhynchus*, *Kogia*, *Pontoporia*, and some dolphins in the genus *Lagenorhynchus*. ‘Other cetaceans’ species (as classified by the C-POD software) are all non-NBHF toothed whales, with the exception of sperm whales (*Physeter macrocephalus*). Each C-POD had positive detections for both ‘Other cetaceans,’ assumed to be bottlenose dolphins for this study area, and ‘NBHF,’ assumed to be harbor porpoise (*Phocoena phocoena*). Animal occurrence was defined by the number of detection-positive minutes (DPM) determined by the C-POD software output, which is the number of minutes in which one or more detections were made. The metric is not used to estimate the number of animals present.

The C-PODs used in this study were deployed in areas where the most frequently encountered species is bottlenose dolphins. Harbor porpoises are also known to occur in the coastal waters near Virginia Beach (Waring et al. 2011), although they have been reported on rare occasions in the Chesapeake Bay closer to Norfolk (Susan Baker, NOAA’s National Centers for Coastal Ocean Science, personal communication, 31 January 2014). In addition, stranding records of

Table 7. Deployment details of C-POD Automated Acoustic Recorders.

Deployment Date	Location	Coordinates	Total Days Deployed
6 Aug 2012	MINEX	36° 49.905'N, 75° 52.860'W	69
16 Aug 2012	JEB-FS	36° 56.411'N, 76° 01.165'W	53
16 Aug 2012	NSN	36° 57.061'N, 76° 20.444'W	Not recovered
16 Aug 2012	JEB-LC	36° 56.929'N, 76° 10.937'W	59
7 Dec 2012	NSN	36° 57.056'N, 76° 20.498'W	132
7 Dec 2012	JEB-LC	36° 56.940'N, 76° 10.872'W	132
17 Apr 2013	NSN	36° 57.071'N, 76° 20.510'W	Not recovered
17 Apr 2013	JEB-LC	36° 56.936'N, 76° 10.869'W	152

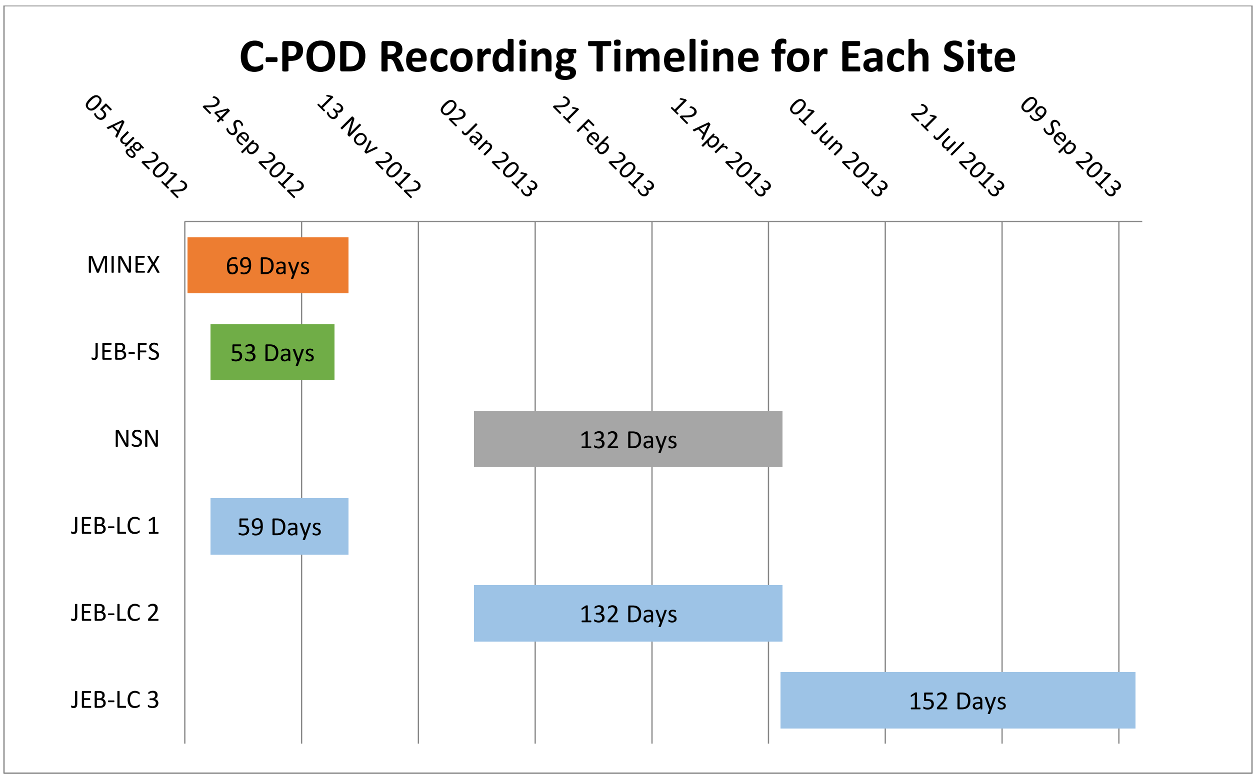

Figure 20. C-POD deployment timeline.

harbor porpoises have been reported on several Chesapeake Bay beaches suggesting limited utilization of the area (Prescott and Fiorelli 1980). The C-POD analysis software is equipped with highly conditioned classifier algorithms and is capable of classifying many distinctive dolphin and porpoise species. Bottlenose dolphins and harbor porpoises produce very distinctive clicks from one another (Au 1993), and C-PODs have been demonstrated to distinguish both species with a high degree of accuracy.

Naval Station Norfolk C-POD

Despite the relatively long deployment at NSN, 132 total days between 7 December 2012 and 17 April 2013, relatively few bottlenose dolphins were detected (*n*=658 total detection positive minutes (DPM), a mean number of 5.0 DPM out of a possible 1,440) (**Table 8; Figure 21**). There was no apparent trend in dolphin presence. There was also no distinct diurnal pattern of occurrence for bottlenose dolphins at the NSN deployment site (**Figure 22**).

A total of 22 DPM was logged for harbor porpoise at the NSN deployment site. All detections were from three different days during the deployment, the majority of which occurred on 16 March 2013 (**Figure 23**).

Table 8. Mean number of Dolphin Detection-Positive Minutes per day for all deployments. Mean values are calculated using full days of recording and may not match number of days deployed.

Location	Total Days Deployed	Mean Dolphin DPM/Day	Mean Porpoise DPM/Day
NSN	132	5.0	0.2
JEB-LC	343	95.6	0.1
JEB-FS	53	765.8	NA
MINEX	69	334.6	NA

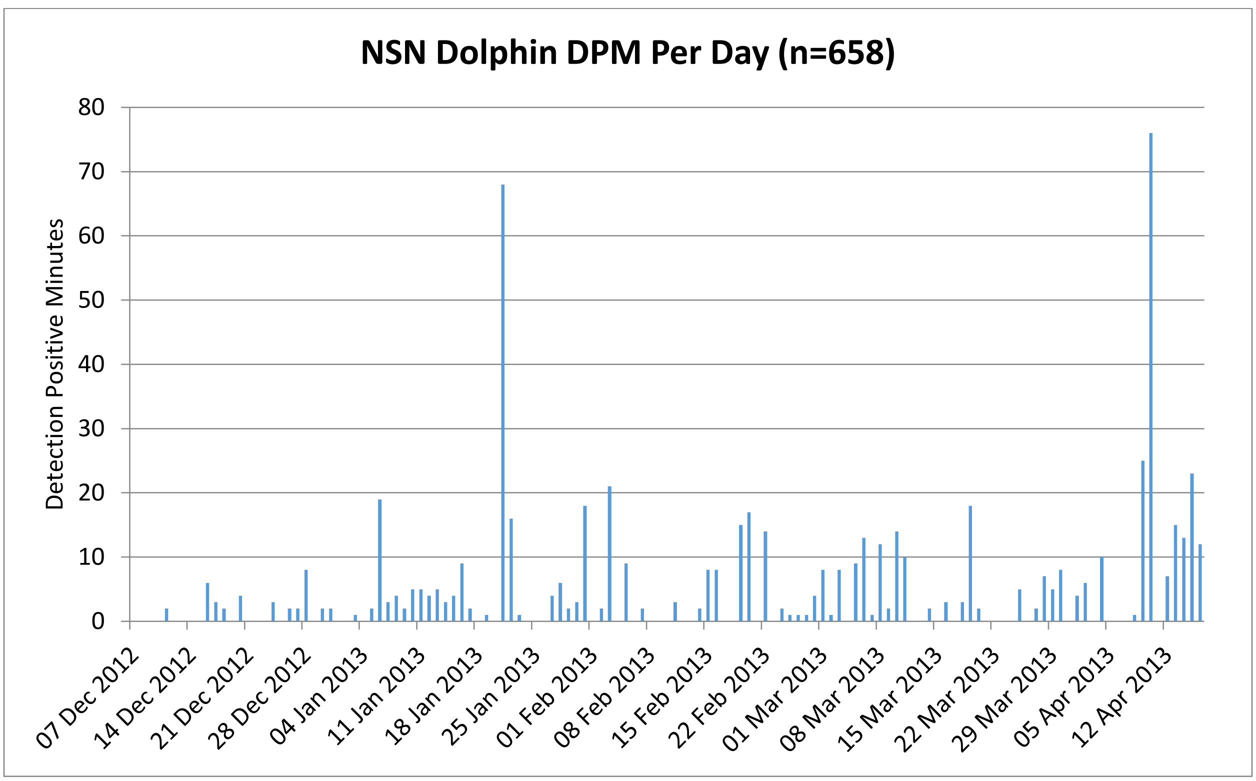

Figure 21. Detection-positive minutes out of a possible 1,440/day logged for bottlenose dolphins at the NSN site.

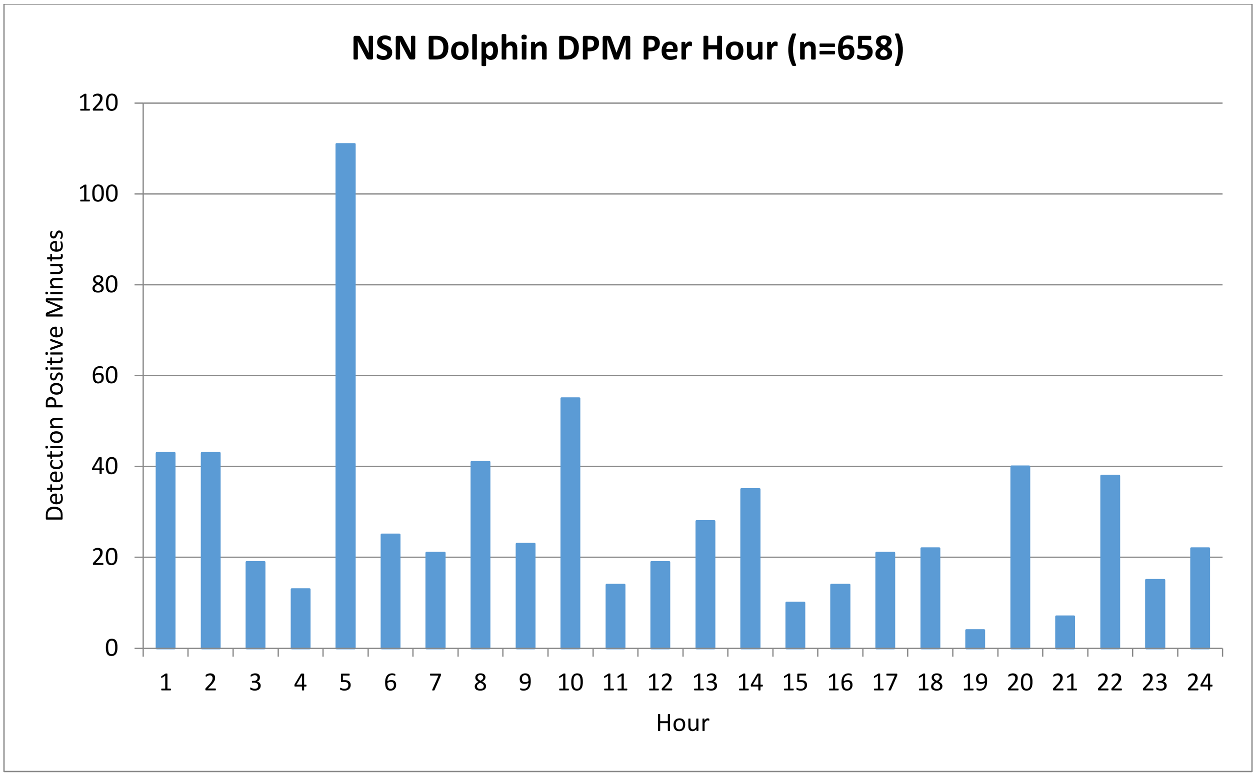

Figure 22. DPM of bottlenose dolphins, binned by hour, to determine diurnal acoustic activity patterns at the NSN site.

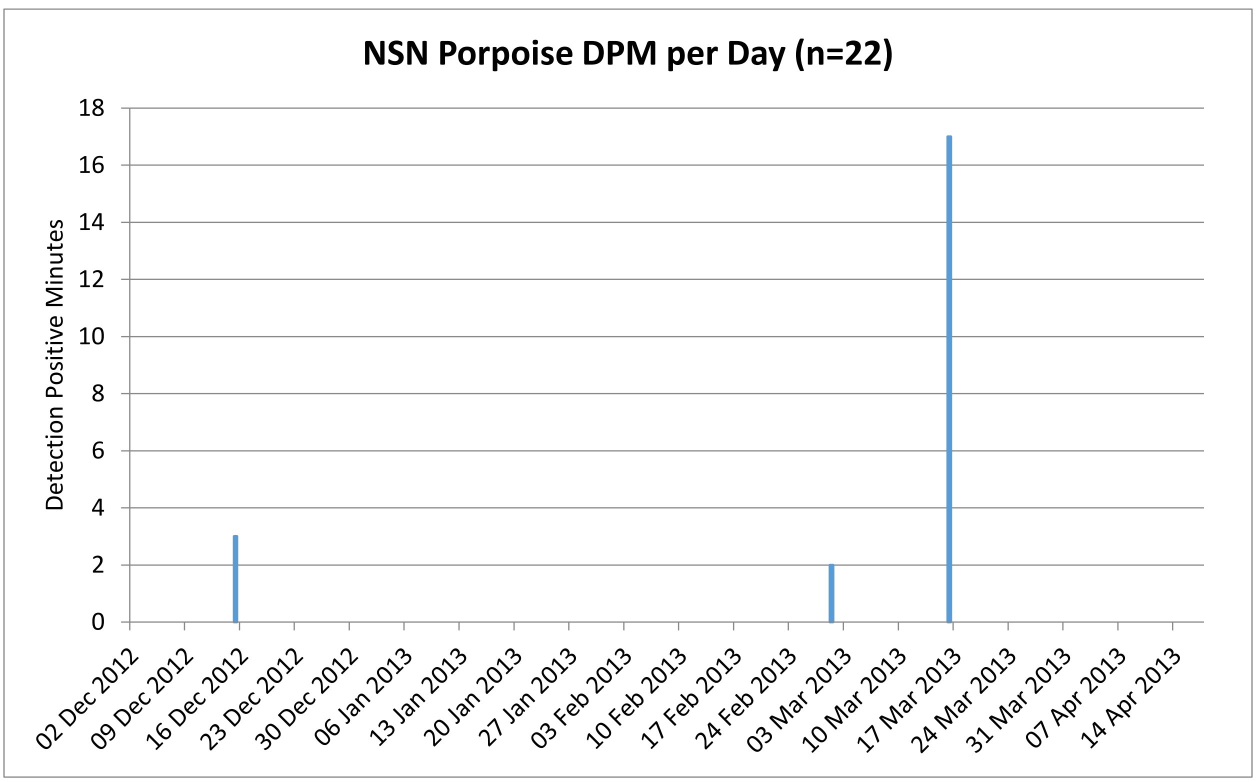

Figure 23. DPM out of a possible 1,440/day logged for harbor porpoise at the NSN site.

JEB-Little Creek C-POD

Although the first C-POD deployed at JEB-LC broke free, it was located within 6 km of the deployment site and assumed to not have traveled for a very long time. Based on this assumption, data collected from the first deployment were included in comparisons. Deployments at JEB-LC spanned nearly a full year, aside from 13 October 2012 to 7 December 2012, when a unit was not in the water. There was a total of 32,901 DPM for bottlenose dolphins throughout the three deployments. In general, there appears to be a trend indicating an increase in detections in the summertime and a decrease in detections in the wintertime (**Figure 24**). A diurnal pattern is also evident for bottlenose dolphins at JEB-LC with the majority of DPM occurring during the nighttime hours (**Figure 25**).

Harbor porpoises were also detected at JEB-LC; there was a total of 21 DPM for all three deployments, 17 on 12 March 2013 and five on 9 March 2013 (**Figure 26**). Due to the low number of detections, there are no discernible patterns to note.

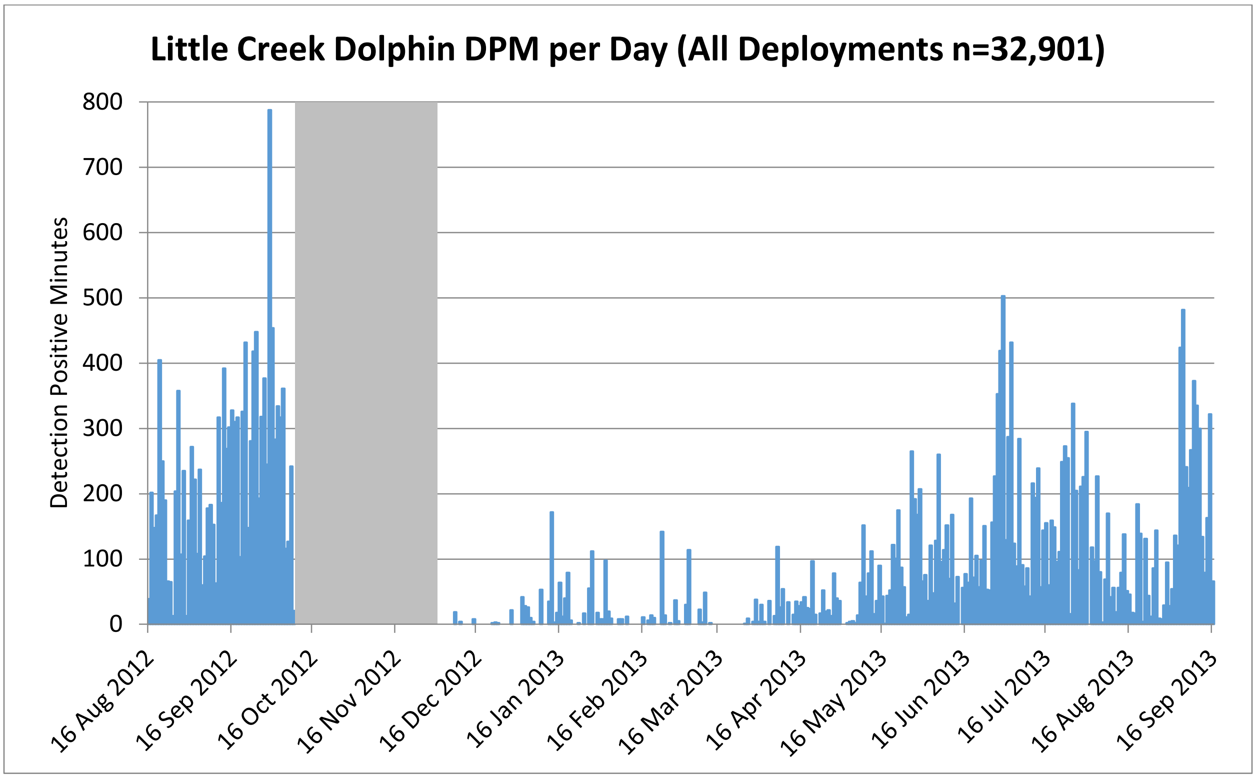

Figure 24. DPM out of a possible 1,440/day logged for bottlenose dolphins at the JEB-LC site. The gray band denotes the period when no C-POD was deployed.

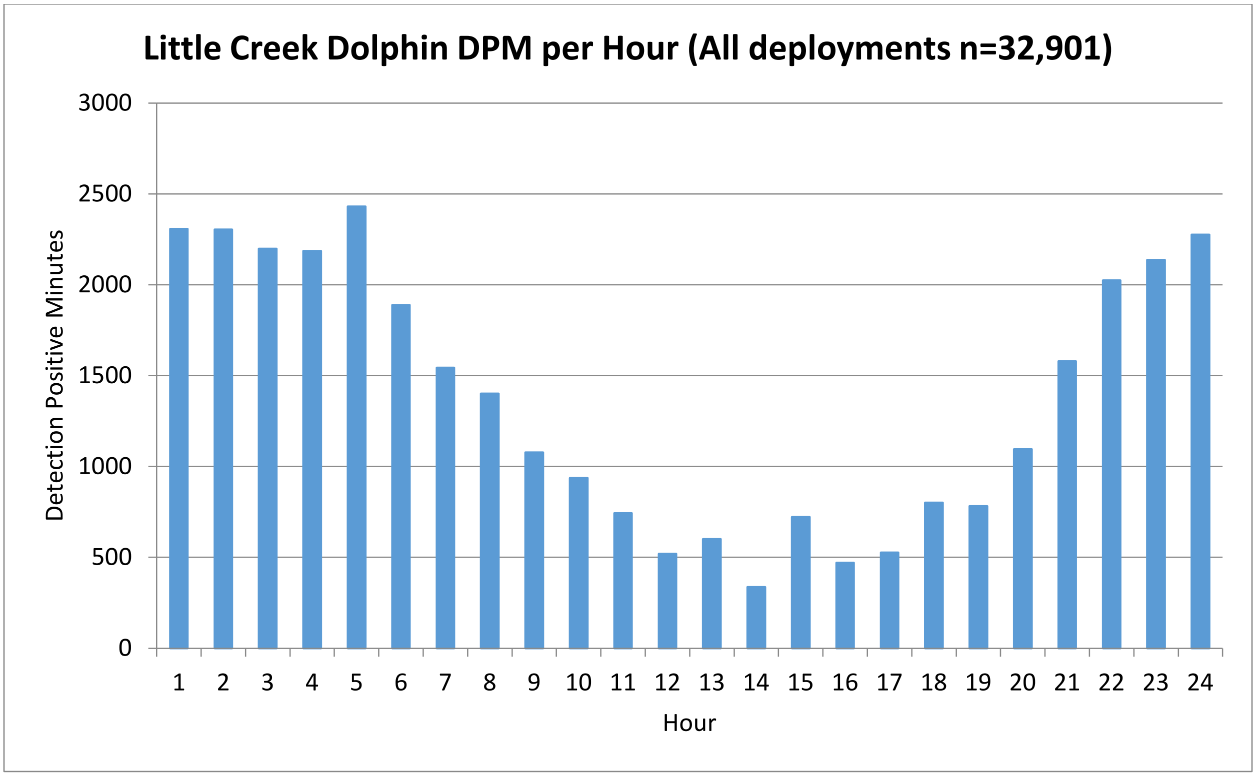

Figure 25. DPM of bottlenose dolphins, binned by hour, to determine diurnal acoustic activity patterns at the JEB-LC site.

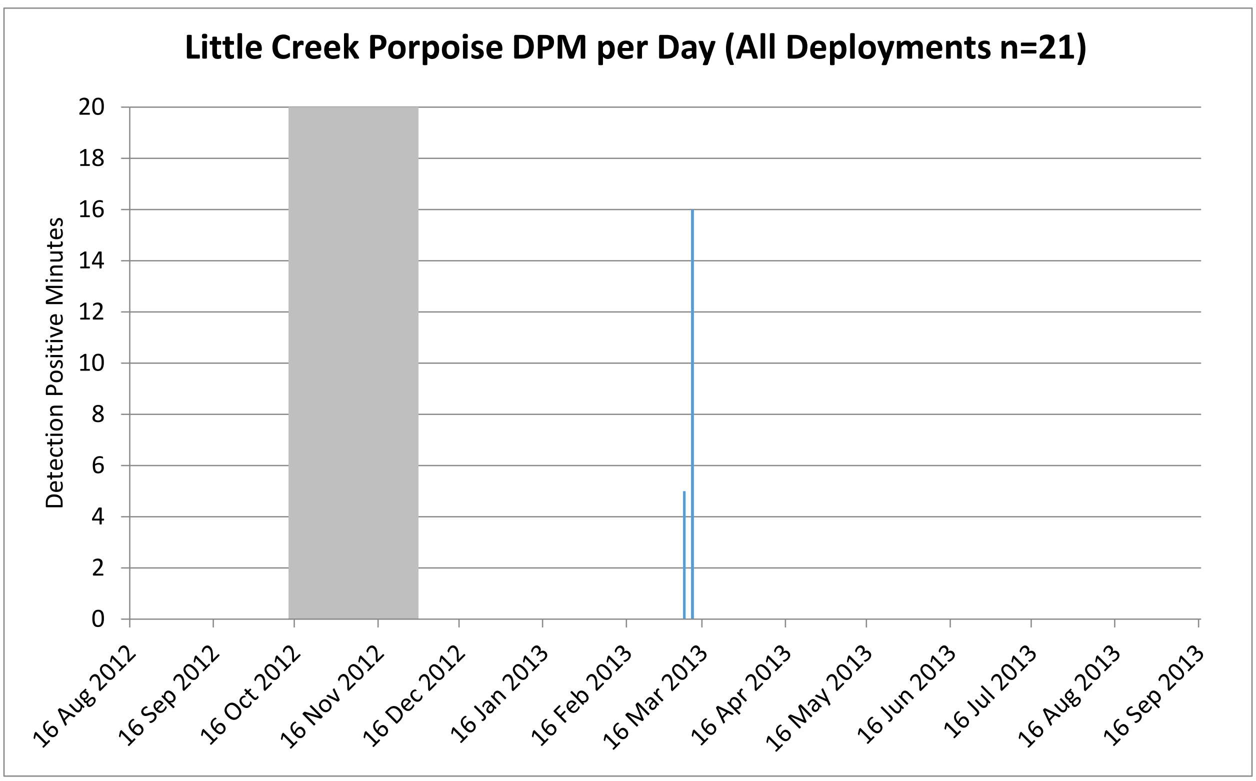

Figure 26. DPM out of a possible 1,440/day logged for harbor porpoise at the JEB-LC site. The gray band denotes the period when no C-POD was deployed.

JEB-Fort Story C-POD

The JEB-FS C-POD was deployed on 16 August 2012 and was recovered on shore near Duck, North Carolina, on 15 October 2012. Lack of knowledge of when the unit broke free from the mooring precludes any meaningful analysis, especially in regards to drawing comparisons from units deployed at the same time in different locations. While adrift, the C-POD was still operational and logged a total of 41,064 DPM for the duration that the unit was functioning (**Figure 27**). While the mean DPM/day for JEB-FS C-POD was highest of all deployment sites at 765.8 (**Table 8**), significance cannot be deduced as the unit was not at a fixed location and thus, dolphin presence was not in relation to location. Despite the inability to note any temporal trends for dolphin presence, the data indicate that bottlenose dolphins were more vocally active in the late afternoon and throughout the night (**Figure 28**). It is interesting to note that this particular C-POD had one of the shortest deployment durations (53 Days) and contained the greatest number of dolphin DPM, nearly 50% of the time.

There were no harbor porpoise detected on the JEB-FS C-POD.

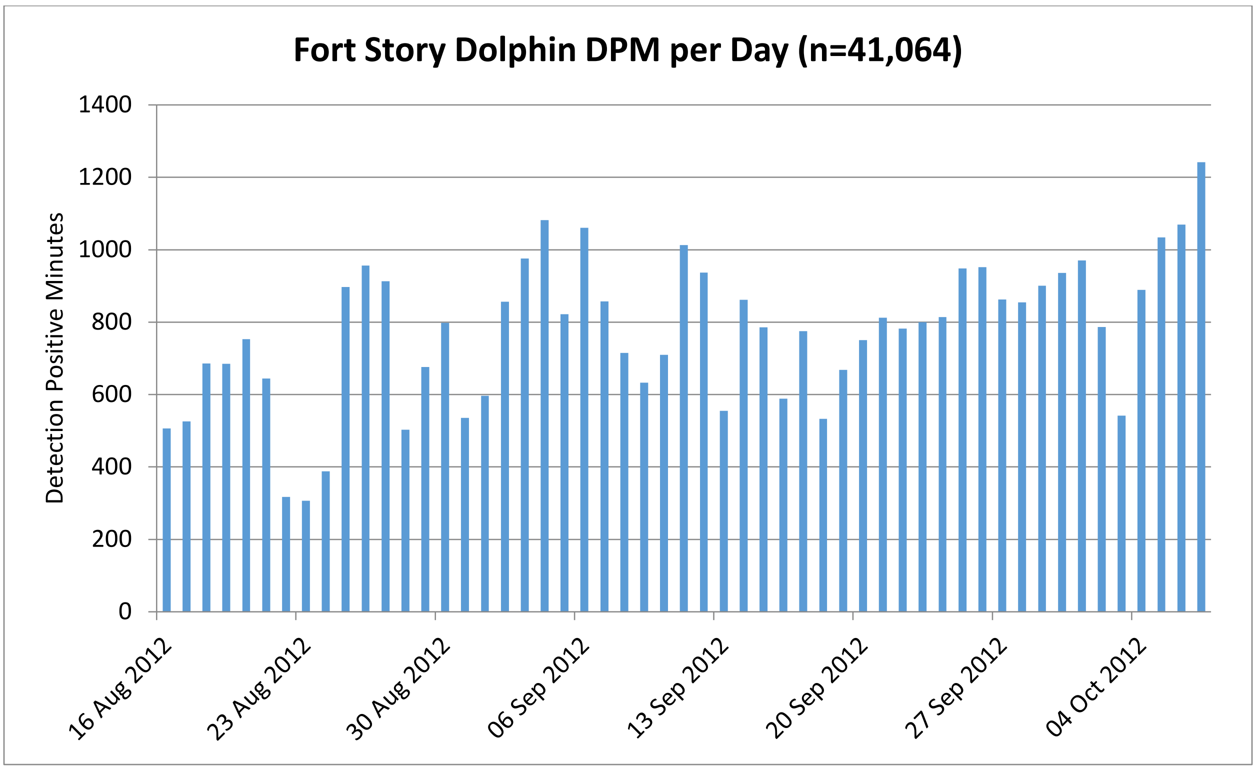

Figure 27. DPM out of a possible 1,440/day logged for bottlenose dolphins at the JEB-FS site*.

*Note: this unit broke free from its mooring on an unknown date and washed ashore in Duck, North Carolina.

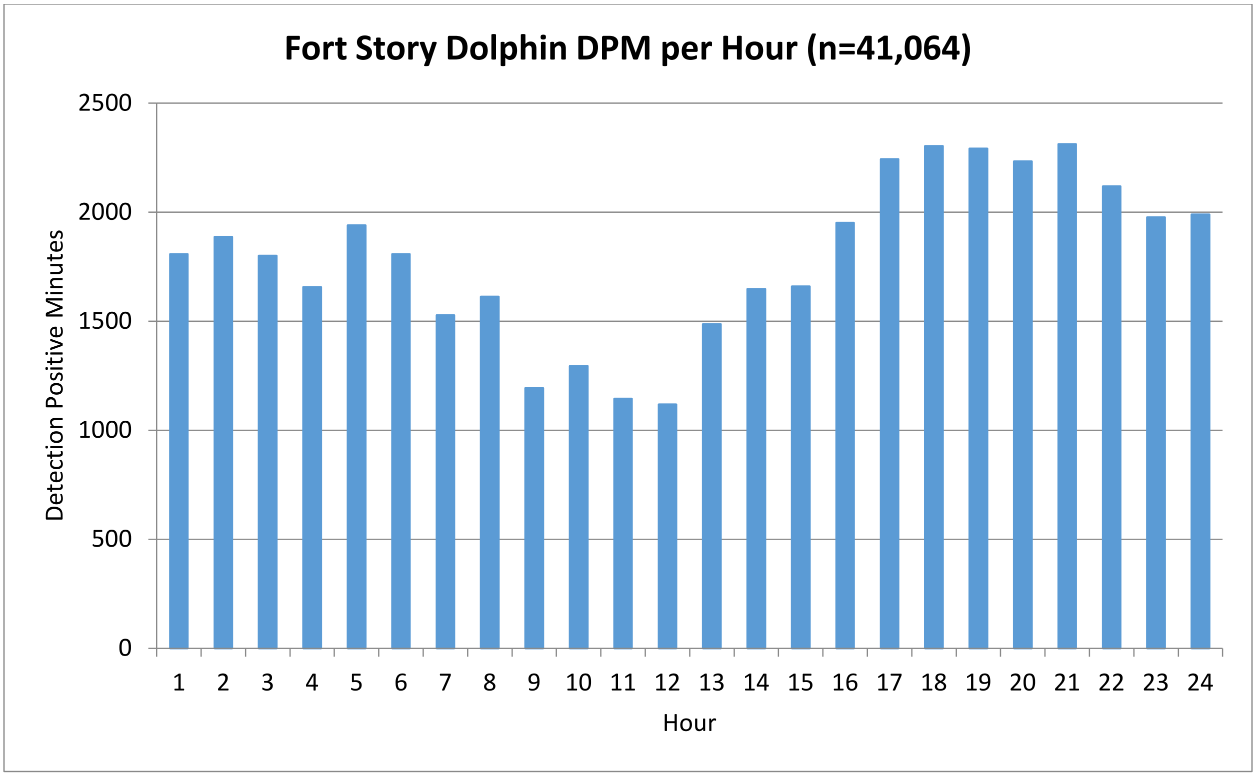

Figure 28. DPM of bottlenose dolphins, binned by hour, to determine diurnal acoustic activity patterns at the JEB-FS site*.

*Note: this unit broke free from its mooring on an unknown date and washed ashore in Duck, North Carolina.

MINEX C-POD

The single deployment at the MINEX site yielded 69 total days of data from 6 August 2012 through 13 October 2012. There was a total of 22,939 DPM for bottlenose dolphins during the deployment with no significant trends evident, aside from a slight increase in DPM in mid-August (**Figure 29**). There was also a diurnal trend with the majority of detections occurring in the nighttime hours (**Figure 30**).

There were no harbor porpoise detections from the MINEX C-POD during the deployment.

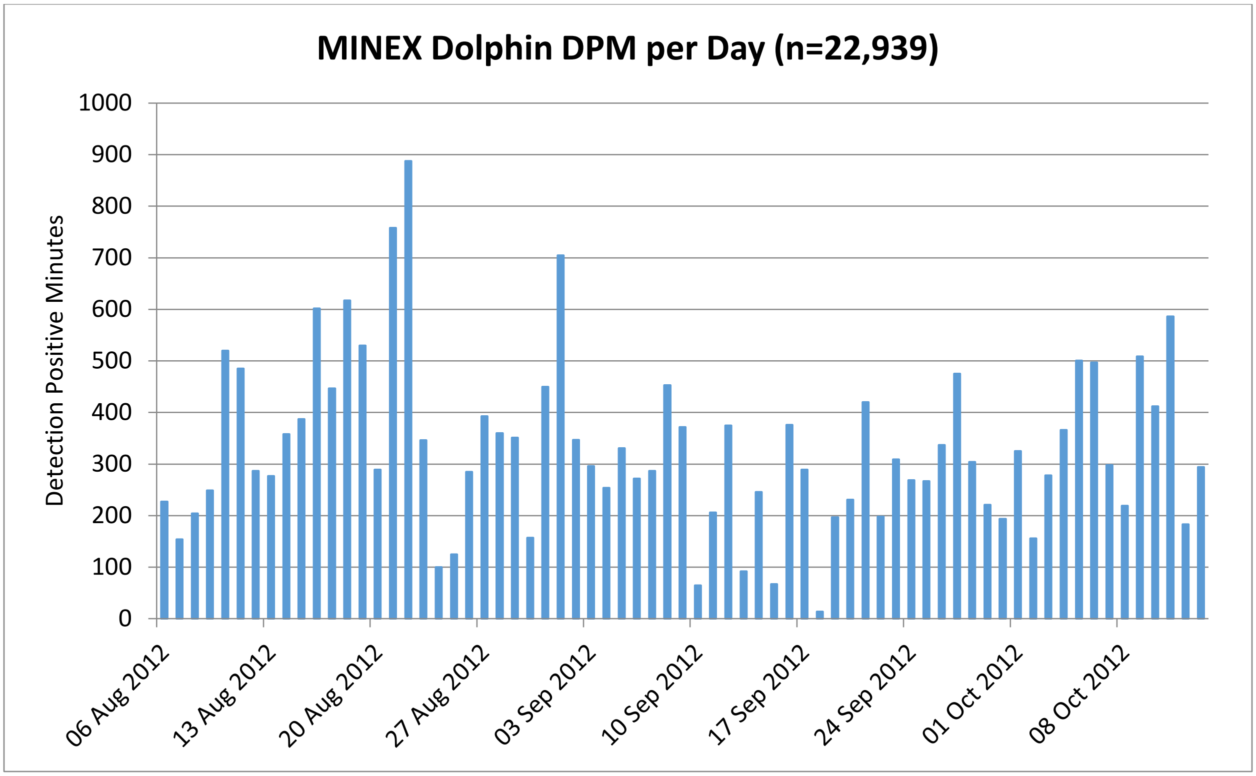

Figure 29. DPM out of a possible 1,440/day logged for bottlenose dolphins at the MINEX site.

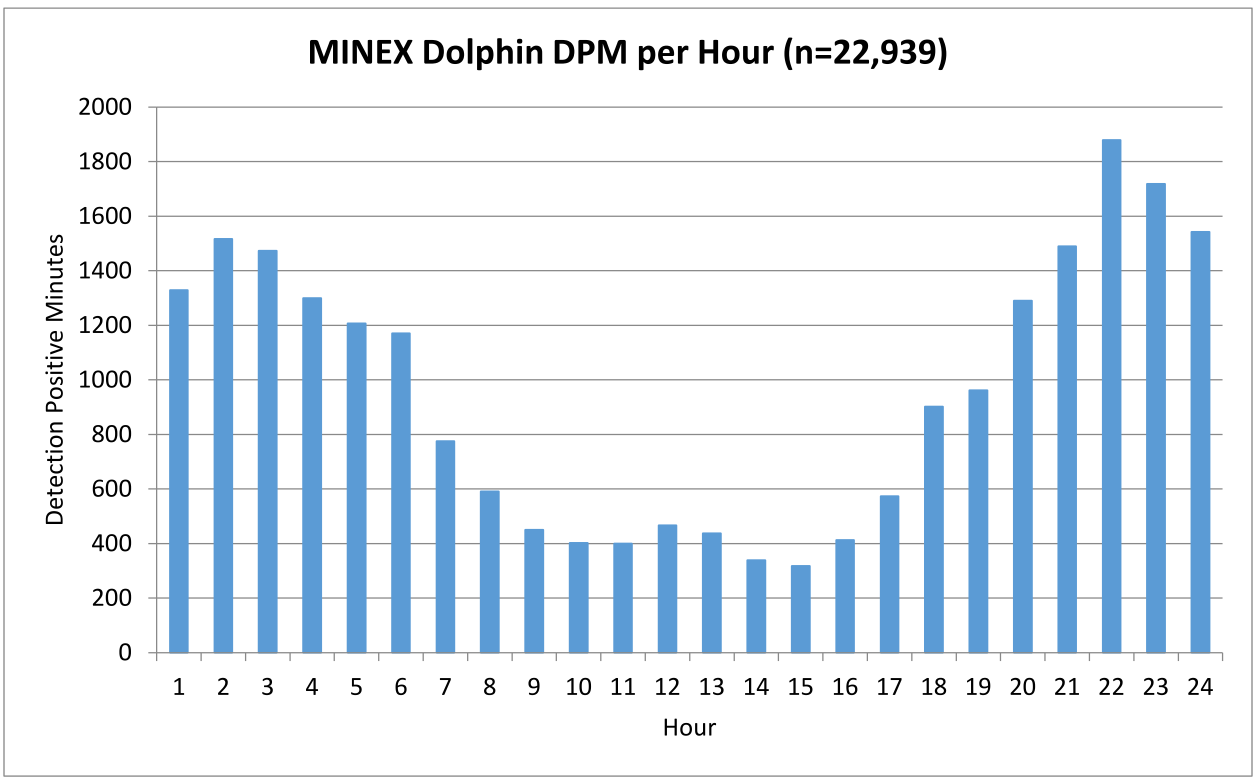

Figure 30. DPM of Atlantic bottlenose dolphins, binned by hour, to determine diurnal acoustic activity patterns at the MINEX site.

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Section 6 - Conclusions

Vessel Line-transect Surveys

Preliminary results demonstrated that bottlenose dolphins are common in the study area, with highest densities in the coastal waters in summer and fall months. Peak estimated abundance in coastal waters of the study area is 1,094 individuals present during the summer (density = 3.52 individuals per km^2), and 948 individuals in fall (density = 3.05 individuals per km^2). However, bottlenose dolphins do not completely move out of these waters in other seasons, with more than 100 individuals still present in winter and spring months. These results agree with previous studies that indicate an increased presence in summer and fall (Barco 1995, Blaylock 1988), but this study furthers the science by measuring the abundance throughout the year. Densities in offshore waters of the MINEX zone are much lower than in the coastal strip, although more data are needed to estimate reliable numbers for all four seasons. Continuing the monthly transect surveys will improve the precision of the estimates and reduce the CV. A more robust dataset will also allow for further analyses, including stratification of the survey area to provide density estimates for sub-areas within the INSHORE zone. This stratification will be useful to narrow down bottlenose dolphin densities in specific areas of U.S. Navy activity within the study area, and allow management to potentially reduce potential impacts.

Transects for both survey areas have been modified to better align with Navy training activity and address potential biases of the original design. The MINEX transect lines have been shifted north and extended inshore to meet the INSHORE survey area.

The initial zig-zag pattern (**Figure 1**) of the INSHORE transects introduces a potential positive bias along the inside corners when compared to the outside of the corners, and the tighter grouping of lines on the Chesapeake Bay side of the area lead to uneven coverage (Thomas et al. 2007). Adjustments have been made with assistance from experts at the Centre for Research into Ecological and Environmental Modeling, using tools in the program DISTANCE 6.0 to reduce potential bias, while using as much existing data as possible in future analyses (**Figure 31**).

Of special interest, given their Endangered Species Act status, were four sightings of humpback whales during line-transect surveys, located within the study area. While the humpback whale sighting locations were within the INSHORE zone, they could easily transit the MINEX area where underwater detonation (UNDET) exercises take place. Further investigation of humpback whale behaviors exhibited in the area (i.e. foraging, migration, etc.) as well as movements of whales within the area would be invaluable towards improving our understanding of potential impacts on this endangered species.

Photo-identification Surveys

Though continued photo-ID effort and analysis is necessary to ascertain the site fidelity and movement patterns of the bottlenose dolphins in the area, early results indicate a very open population, with short-term visits to the area with localized sightings. The re-sighted dolphins were in close proximity (within 15 km) to their original sighting locations, and in most cases these re-sights occurred within a couple months of each other. Only one re-sighting was longer

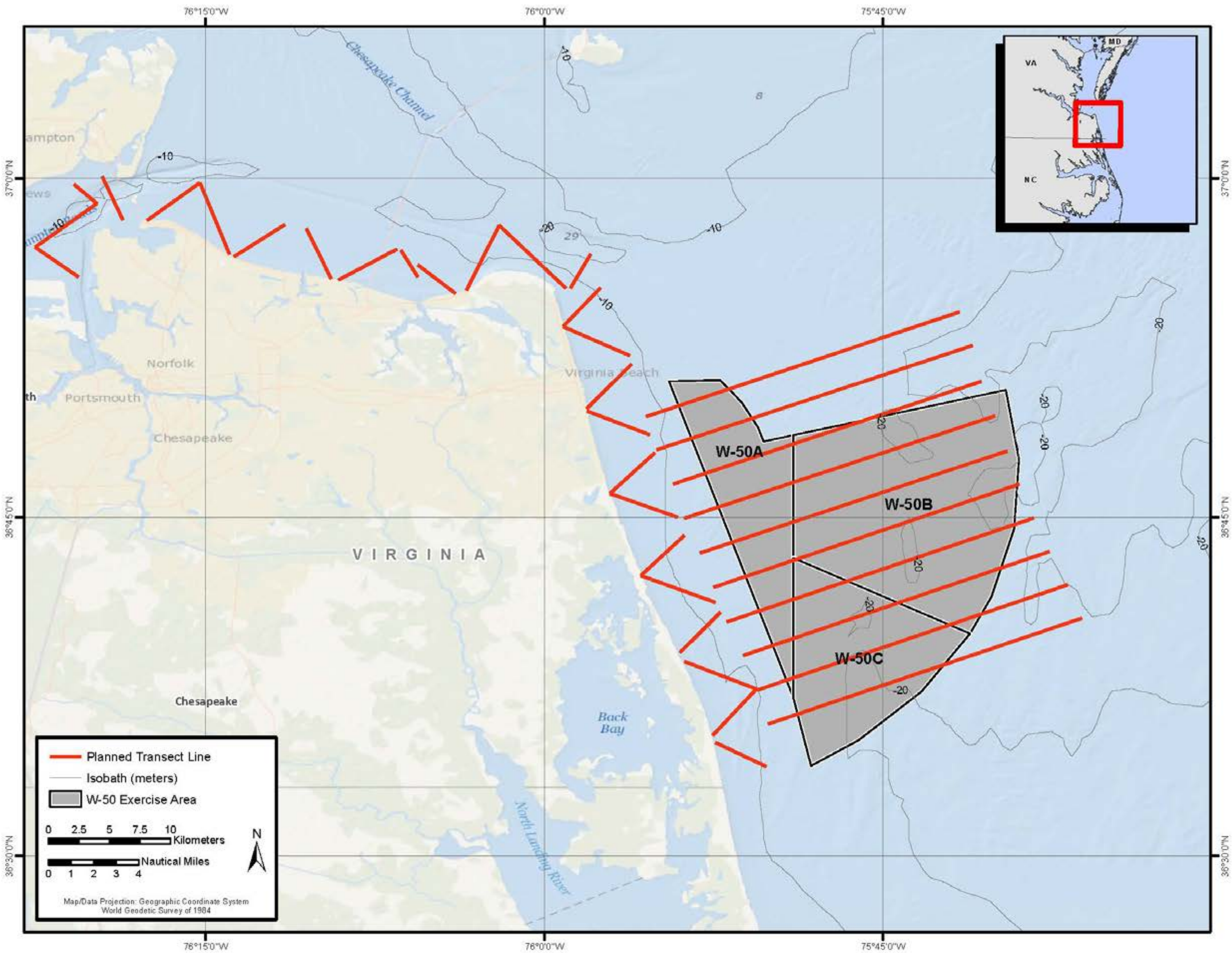

Figure 31. Study area with adjusted transects to be used for future surveys.

than three months apart (NVB0033, first sighted in September of 2012, and re-sighted in July of 2013). As the analysis continues and the catalog grows, we can determine if a seasonal fidelity is evident, which would support previous studies in the area suggesting a seasonal residence (Barco 1995, Blaylock 1984, Swingle 1994). This would suggest the dolphins are migrating through the area, and would also support the described movement of individuals from south to north in the spring and north to south in the fall (Gubbins et al. 2003, Swingle 1994, Waring et al. 2011). Further support of this migration pattern is our sighting of freeze-branded dolphin (FB-405), initially tagged and sighted multiple times in North Carolina. Additional matches found during the planned comparison of this catalog to the existing Mid-Atlantic Bottlenose Dolphin Catalog will likely provide support to these patterns.

There is no evidence thus far of year-round resident dolphins as seen in some other estuarine areas in North Carolina, South Carolina, and Florida (Mazzoil et al. 2008, Wang et al. 1994, Zolman 2002); however, more time and effort is needed for photo-ID comparisons to determine if there are year-round residents. This study area combines estuarine and coastal habitat, and the 2010 National Marine Fisheries Service marine mammal stock assessment considers dolphins inhabiting estuarine waters and those inhabiting coastal waters to be distinct populations for management purposes (Waring et al. 2011). The relationship between the dolphins of estuarine waters, often considered more residential in nature, and the coastal dolphins, often considered more migratory/transient, is poorly understood in this area, possibly complicated by the open nature of the Chesapeake Bay. Therefore, this ongoing study will provide insight into the dynamics of the movements of such groupings in this study area.

C-POD Automated Acoustic Monitoring

The C-POD data provided interesting insight into the occurrence of marine mammals in the study area, though coverage was intermittent for the initial year of the study. Problems with the initial mooring design resulted in loss of gear and prevented the planned coverage of the four sites throughout the year. Now that the method has been improved and moorings are more reliable, future deployments will allow more complete comparisons across deployment sites. However, the risk of gear loss through entanglement is still prevalent. C-PODs are very versatile tools to augment other methods used to determine animal occurrence, distribution, and temporal patterns over short and long periods. Passive acoustic monitoring (PAM) yields valuable data regarding animal occurrence during periods when typical visual surveying methods are not possible. PAM enables data collection in all weather conditions, around the clock, and without biasing animal behavior by vessel approaches. If a signal is detected, a very high level of certainty exists that animals are relatively close to the acoustic sensor. There are, however, some limitations. The C-POD specifications state that the distance of detection is within 1 km but there is no known coverage distance (Chelonia Limited Cetacean Monitoring Systems 2014). Also the number of animals and exact locations cannot be determined from C-PODs alone, and a negative result (no detections) cannot be assumed to mean that animals are not present; they are possibly in the vicinity and not soniferous and detectable by the listening device. Read et al. (2012) conducted a ground-truthing exercise during a similar study at three sites in North Carolina and found that the C-PODs produced very few false positive detections, but were conservative in classifying click trains as a positive detection, therefore reporting a lower number of detections than present in actual recordings. Ground-truthing of the C-POD detections in this study area has not been a part of the work plan for this project to date.

Bottlenose dolphin detections were common throughout the four deployment sites, and supported the visual survey data in many ways, with a few exceptions. The C-POD at the NSN site showed some dolphin detections even in the winter months—in contrast to the visual transect survey results, where no dolphin groups were sighted near the NSN deployment site in January and February (**Figure 12**). The mean DPM logged at this site was the lowest, but the instrument was deployed during winter months when dolphin presence is expected to be low, which partly explains the reduced number of detections. Further deployments at the site will be necessary for a valid comparison to other sites. NSN houses a large portion of the U.S. Navy's fleet, and potential pier construction in the area means this is one of the sites of greatest interest. The high level of vessel activity, construction, and fishing traffic at this site, however, is problematic for keeping PAM gear in place and undisturbed. Further options for deployment coordinates in the NSN area are being pursued.

C-PODs deployed at JEB-LC were the only deployments spanning a time period longer than three months. Aside from 32 days between October and December 2012, a full year of data was collected. In general, bottlenose dolphin presence, measured by DPM, was higher in the summer months. Detections were still made sporadically during the winter, but dolphin presence was only consistent in the summer months. Though the number of dolphins in the area cannot be determined using the C-POD detections, the substantial presence of bottlenose dolphins is noteworthy as this location is also a busy port for the U.S. Navy. The strong diurnal trend that was evident, with more echolocation activity occurring during nighttime hours, is very common for most odontocete species (Klinowska 1986). It is important to note that an increase in acoustic activity at night may not be indicative of an increased number of dolphins, their behavior state (foraging), or group sizes. While whistles are commonly used for interspecific communication and coordination, echolocation is used for navigation and when it is dark and may also be important as animals travel and maintain group communication acoustically. Foraging events can be identified by the occurrence of terminal buzzes (a decrease in the ICI as the animal nears its prey item, Nuuttila et al. 2013), and will be investigated with further data collection.

The JEB-FS data support the large number of bottlenose dolphin sightings near Cape Henry during visual surveys; however, since the data is compromised by the unit breaking free and traveling, a valid comparison cannot be made. Unfortunately these data have to be disregarded since the date that it broke free is unknown and the detections are not indicative of dolphin presence around the fixed location of interest. Interestingly, a strong diurnal pattern was still observed. So, cautiously speaking, these data also indicate more acoustic activity occurring during nighttime hours.

The high number of dolphin detections occurring by the MINEX area C-POD (mean Dolphin DPM/Day = 334.6) is also in contrast to visual survey results, in which the abundance estimates for the MINEX transect coverage area was only 148 for summer and 105 for fall (C-POD monitoring was from 16 August to 13 October 2012). Although a comparison of abundance estimates and acoustic detections is not reasonable, one would expect very few detections from the C-POD when considering the summer and fall bottlenose dolphin sighting maps for the MINEX zone (**Figures 15 and 17**). The INSHORE zone for summer and fall, however, show that in the nearshore waters adjacent to the MINEX zone, there are numerous sightings during transect surveys over those seasons (**Figures 11 and 14**). Another passive acoustic device, an Ecological Acoustic Recorder (EAR – Oceanwide Science Institute), placed in the MINEX area near the C-POD location as part of a separate project also showed fairly constant dolphin detections throughout the deployment from 16 August to 13 October 2012 (Marc Lammers, Oceanwide Sciences Institute, personal communication, 8 December 2013). It is possible that the EARs and C-PODs are recording detections of dolphins within the INSHORE zone.

Of further interest in the C-POD data were the porpoise detections, since none have been sighted during visual surveys. Porpoises were detected only in winter (3 DPM 15 December 2012 at NSN) and early spring (March 2013 at NSN and JEB-LC) at the NSN and JEB-LC sites. The study area falls within their known distribution (Jefferson et al. 1993, Waring et al. 2011); however, they have not been sighted during any visual surveys. While possibly an anomaly, the peak of harbor porpoise detections from both C-PODS recording concurrently was only 4 days apart in March 2013 (JEB-LC recorded 16 DPM on 12 March and NSN recorded 17 DPM on 16 March), suggesting detections were valid and one or more animals were within the area. This finding further substantiates the importance of combining PAM and visual survey techniques to describe marine mammal occurrence in this area. As more complete datasets are obtained with continuous PAM in the high-traffic areas, more trends may become apparent on the occurrence patterns of harbor porpoises.

Overall, this study supports findings from previous research showing substantial presence of bottlenose dolphins throughout the year in areas heavily utilized by the U.S. Navy, with a level of occurrence that fluctuates seasonally. Further study is needed to improve the accuracy of density estimates and to describe the level of site fidelity within the study area. The use of C-PODs is a very practical and cost-effective way to supplement the visual and photo-ID studies, especially to show continuous occurrence on days that visual surveys are not possible, and during nighttime hours. Continued improvement in the seasonal density estimates will allow the U.S Navy to make more informed decisions that may result in minimizing potential impacts on the local bottlenose dolphin populations.

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Section 7 - Recommendations

While this study provides an essential foundation towards determining the occurrence and density of bottlenose dolphins in these areas, logistical (primarily weather and range clearance related) challenges have inhibited the team from achieving even seasonal coverage. With the majority of the U.S. Navy Marine Species Monitoring Program's east coast efforts focusing on Atlantic Fleet Active Sonar Training, this project's aim to monitor marine mammal presence/absence, movements, site fidelity, and distribution patterns associated with UNDET events within and adjacent to MINEX W-50 is of particular interest given the number of exercises, as well as construction activities, and sheer volume of military, commercial, and recreational traffic within the general area.

As discussed in the conclusions, the following are a list of recommendations to further advance the project as a whole:

1. Continue line-transect surveys using newly modified track lines. Additional line-transect surveys expand upon existing coverage as well as attempt to provide coverage for months missed, all of which will serve to produce a more precise density estimate.
2. Continue monthly photo-ID surveys. The overlap of stocks of bottlenose dolphins in the study area is unique and by increasing the photo-ID effort and thus the photo-ID catalog we will gain valuable insight into the movement patterns (both small- and large-scale) and site fidelity of dolphins frequenting U.S. Navy high traffic and training waters. At the moment, the discovery curve of the existing photo-ID catalog shows no sign of a plateau, a result that is highly suggestive of a need for more thorough coverage to fully understand the dynamics of individual movement patterns within the region.
3. Determine a suitable location to re-deploy C-PODs near NSN and continue monitoring at both JEB-LC and NSN. The C-PODs provide a low cost means to detect presence/absence of dolphins and have proven to be a significant complement to the visual surveys. However, the lack of year-round coverage in the primary areas of interest has been disappointing. The placement of C-PODs in more suitable locations near NSN as well as extending coverage at JEB-LC to fill in any coverage gaps throughout the year remains a priority.
4. Initiate a pilot study focused on endangered humpback whales that appear to frequent the area during late fall/winter/early spring months. While only four whales were seen during visual surveys, the amount of time spent and their movements throughout the area is unknown. The whales sighted were in high-traffic areas and likely within hearing range of UNDET and other offshore exercises that occur in and around MINEX W-50. Humpback whales are often seen throughout the broader coastal area from the mouth of the Chesapeake Bay to waters south of Rudee Inlet (Swingle et al. 1993) so our limited transect-based sightings don't portray an accurate picture of habitat use. Understanding more information through 1) photo-ID techniques, 2) biopsy sampling, 3) focal follows to determine behavior (foraging, travel, social, etc.) exhibited within the area, and 4) tagging in subsequent years with FASTLOC GPS technology would provide valuable information about how the animals utilize the area and what the potential impacts on this endangered species may be.

5. Maintain EAR recording package in Site B of the MINEX W-50 area to continue to 1) detail the daily occurrence of marine mammals near the primary location of MINEX activities, 2) detect underwater explosions associated with training events, and 3) quantify the acoustic activity of dolphins in response to underwater explosions.

Section 8 - Acknowledgements

Funding and project management support for this study was provided by U.S. Fleet Forces Command and NAVFAC Atlantic. We would like to thank Anurag Kumar, Joel Bell, and Andrew DiMatteo of NAVAC Atlantic for initial guidance and support, as well as on-going support with methods and exercise information. Thanks also to the numerous boat captains that worked long hours with us over the past year: Jason Ohs, Dave Wolfram, Jeff Thompson, Jake Hiles, and Chris Howlin. Sue Barco of the Virginia Aquarium and Marine Science Center has been extremely helpful in providing background information on the bottlenose dolphins in the area. We also want to thank Sue, Jackie Bort, and others at the Virginia Aquarium Stranding Response Team and Andrew Gowan of REMSA, Inc. for being a part of our observing team. Collaborative efforts by Allied Whale, Bar Harbor Whale Watch, Blue Ocean Society, Brier Island Whale and Seabird Cruises, Provincetown Center for Coastal Studies, Quoddy Link Marine, Virginia Aquarium and Marine Science Center, and the Whale Center of New England provided the background information on the humpback whale sighted and photographed during the study. Dr. Andrew Read and Kim Urian of Duke University Marine Laboratory also provided useful guidance during project design and report review. These data were obtained under NMFS Permits No. 14451 issued to Joseph R. Mobley, Jr. and No. 16239 issued to Dan Engelhaupt.

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APPENDIX A
Data Sheets

Event : Norfolk Dolphin Density - Transects   Vessel Name: ______________________   Page ________ of ________

Date: ______________________   Misc. : ______________________   Location: ______________________

Sighting Data

Sighting Number	Time (Start & Stop)	WP	Animal Bearing & Distance	Species	Group Size (min/max/best) # of Calves	Ship Latitude and Longitude	Ship Bearing	Behavior	Reaction to Vessel	Observer Name	Sighting cue	Water Temp	Photos? frames	Effort	Comments
	: : : :		° m/r		/ / ___ calves	Lat: Lon:	°		Positive Negative None Uncertain				Y/N	On Off	
	: : : :		° m/r		/ / ___ calves	Lat: Lon:	°		Positive Negative None Uncertain				Y/N	On Off	
	: : : :		° m/r		/ / ___ calves	Lat: Lon:	°		Positive Negative None Uncertain				Y/N	On Off	
	: : : :		° m/r		/ / ___ calves	Lat: Lon:	°		Positive Negative None Uncertain				Y/N	On Off	
	: : : :		° m/r		/ / ___ calves	Lat: Lon:	°		Positive Negative None Uncertain				Y/N	On Off	
	: : : :		° m/r		/ / ___ calves	Lat: Lon:	°		Positive Negative None Uncertain				Y/N	On Off	

Event : Norfolk Dolphin Density - Transect   Vessel Name: ______________________   Page ________ of ________

Date: ______________________   Misc. : ______________________   Start Location: ______________

Effort Log

Time	Line/WP	Effort	Ship Latitude and Longitude	Comments
: :			Lat: Lon:	
: :			Lat: Lon:	
: :			Lat: Lon:	
: :			Lat: Lon:	
: :			Lat: Lon:	
: :			Lat: Lon:	
: :			Lat: Lon:	
: :			Lat: Lon:	
: :			Lat: Lon:	

Event : Norfolk Dolphin Density - Photo-ID   Vessel Name: ______________________   Page ________ of ________

Date: ______________________   Misc. : ______________________   Start Location: ______________

Sighting Data

Sighting Number	Time (Start & Stop)	WP	Species	Group Size (min/max/best) # of Calves	Ship Latitude and Longitude	Behavior	Depth	Observer Name	Water Temp	Photos? Frames	Comments
	: : : :			/ / ___ calves	Lat: Lon:					Y/N	
	: : : :			/ / ___ calves	Lat: Lon:					Y/N	
	: : : :			/ / ___ calves	Lat: Lon:					Y/N	
	: : : :			/ / ___ calves	Lat: Lon:					Y/N	

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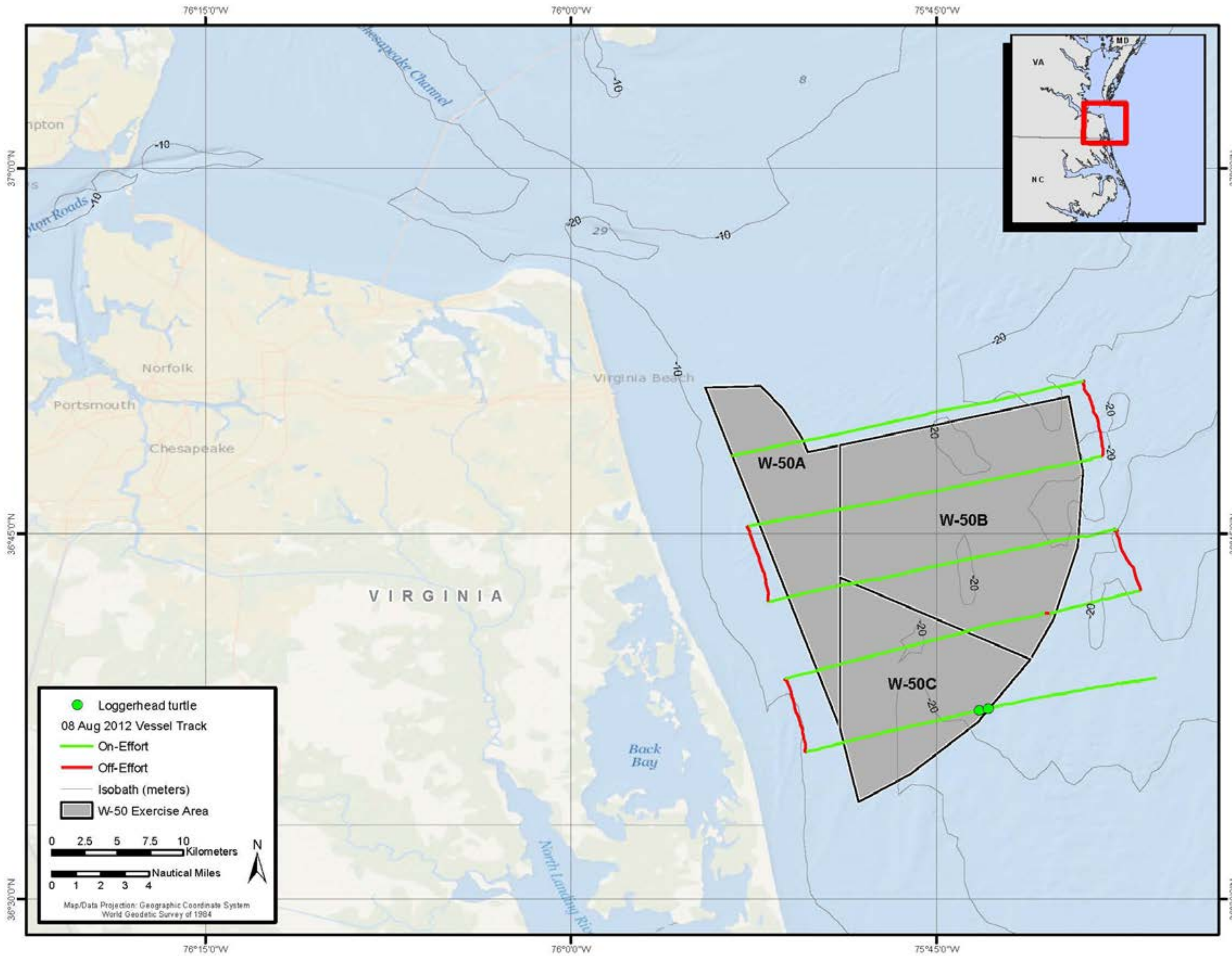
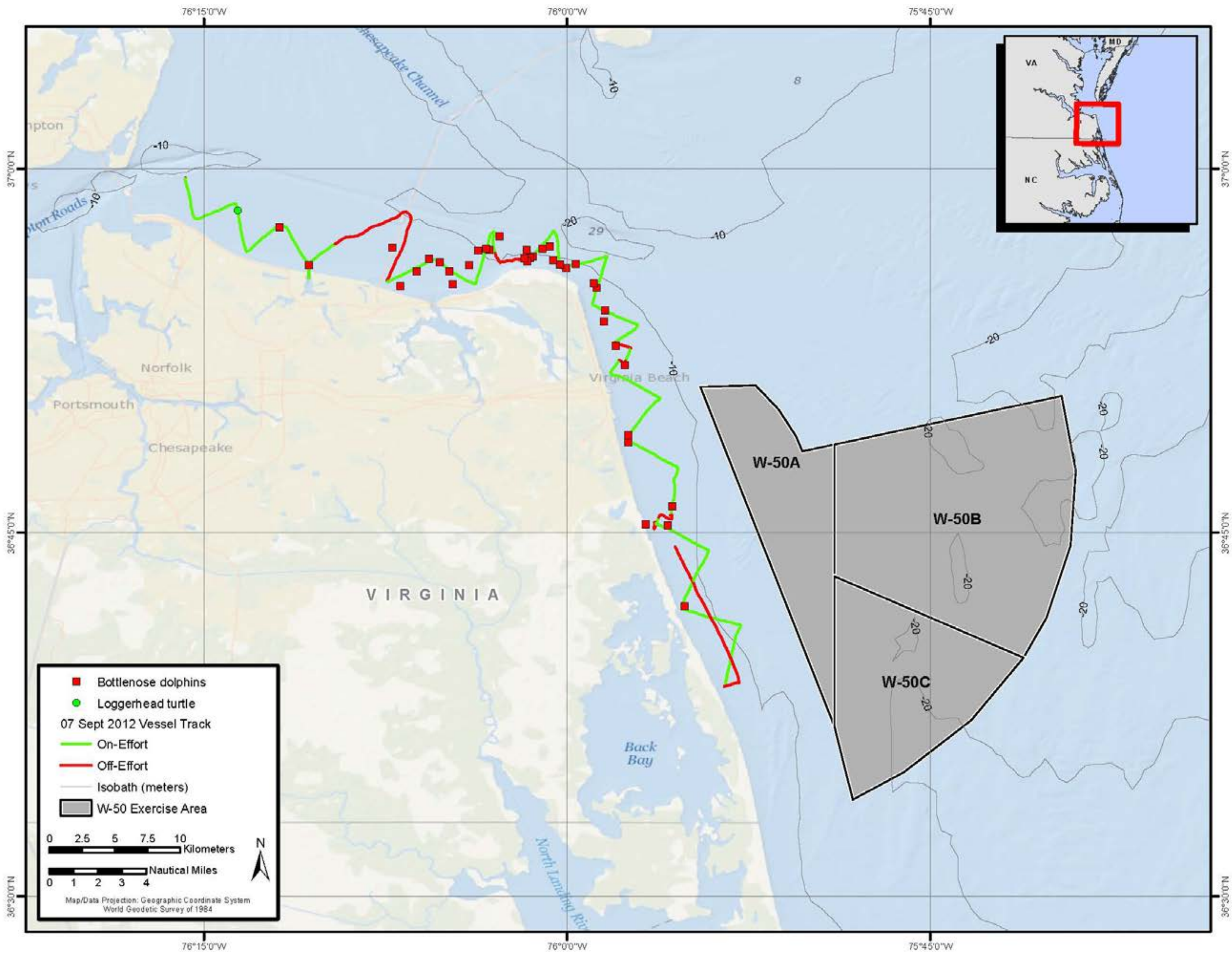
APPENDIX B
Transect Survey Tracks and Sightings

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VA
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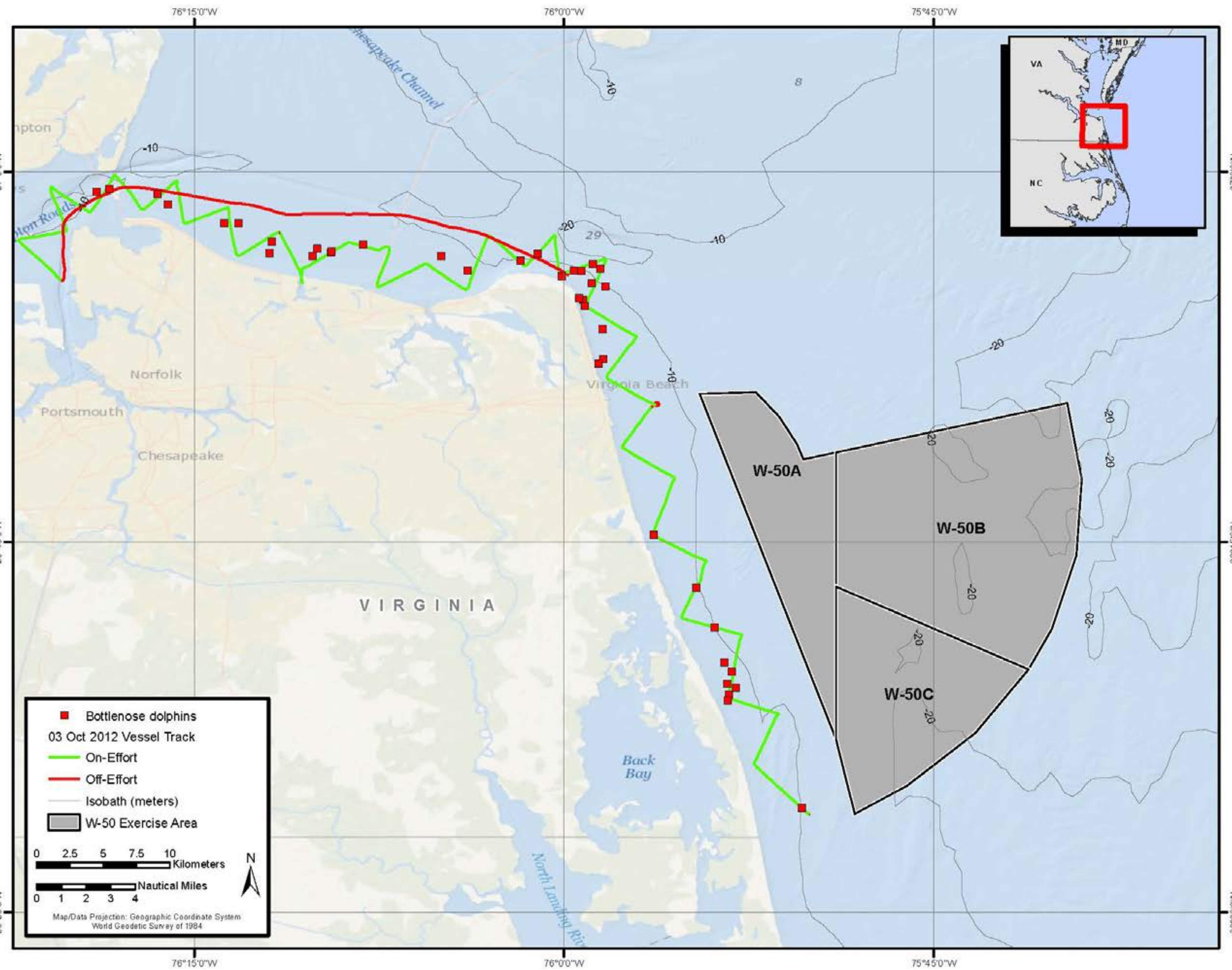
NC
Chesapeake Channel
Norfolk
Portsmouth
Chesapeake
Virginia Beach
VIRGINIA
Back Bay
North Landing River
W-50A
W-50B
W-50C
Bottlenose dolphins
Loggerhead turtle
07 Sept 2012 Vessel Track
On-Effort
Off-Effort
Isobath (meters)
W-50 Exercise Area
0 2.5 5 7.5 10 Kilometers
0 1 2 3 4 Nautical Miles
N
Map/Data Projection: Geographic Coordinate System
World Geodetic Survey of 1984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Portsmouth
Chesapeake
Virginia Beach
VIRGINIA
Back Bay
W-50A
W-50B
W-50C
VA
MD
NC
Bottlenose dolphins
03 Oct 2012 Vessel Track
On-Effort
Off-Effort
Isobath (meters)
W-50 Exercise Area
0 2.5 5 7.5 10 Kilometers
Nautical Miles
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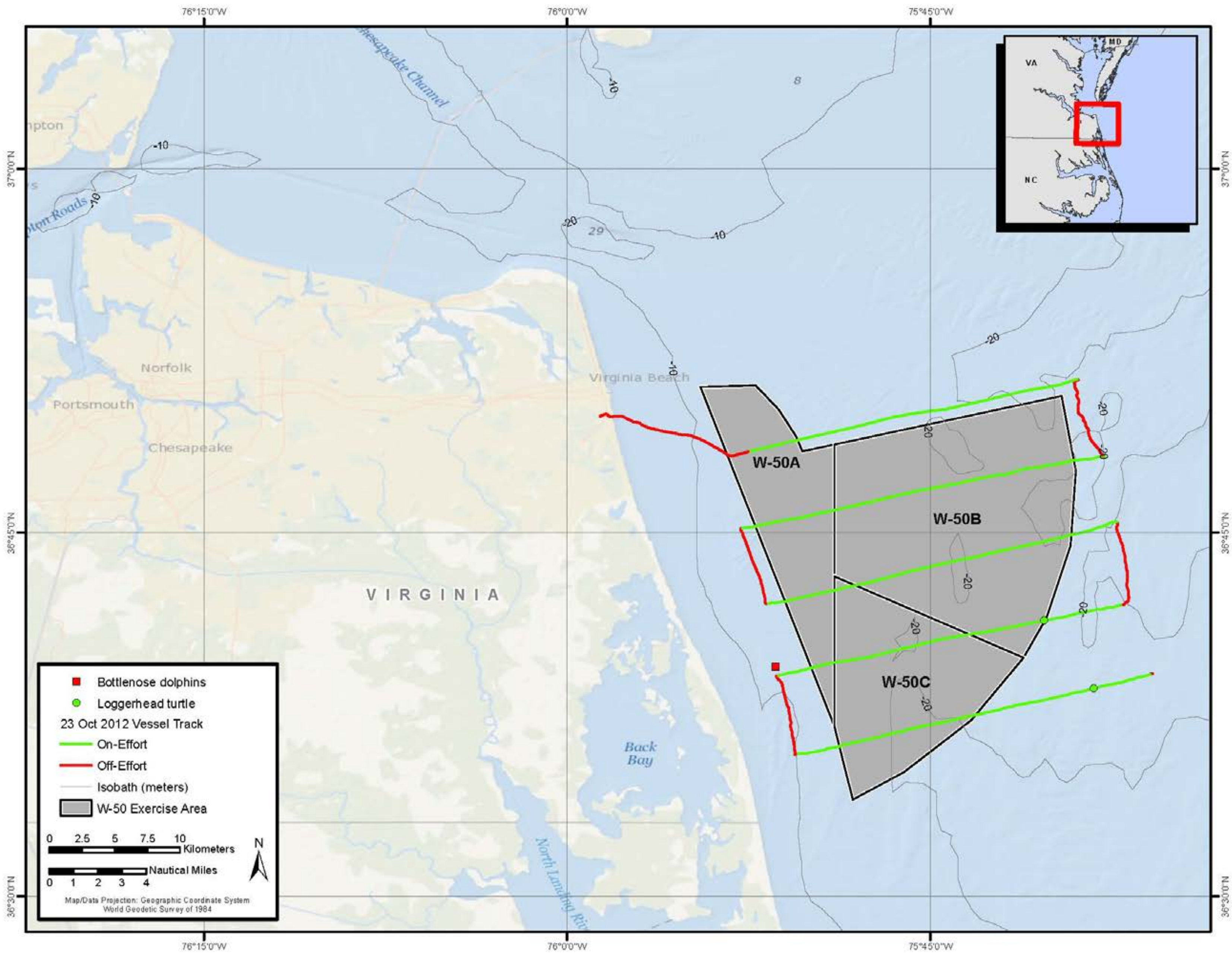
Map/Data Projection: Geographic Coordinate System
World Geodetic Survey of 1984



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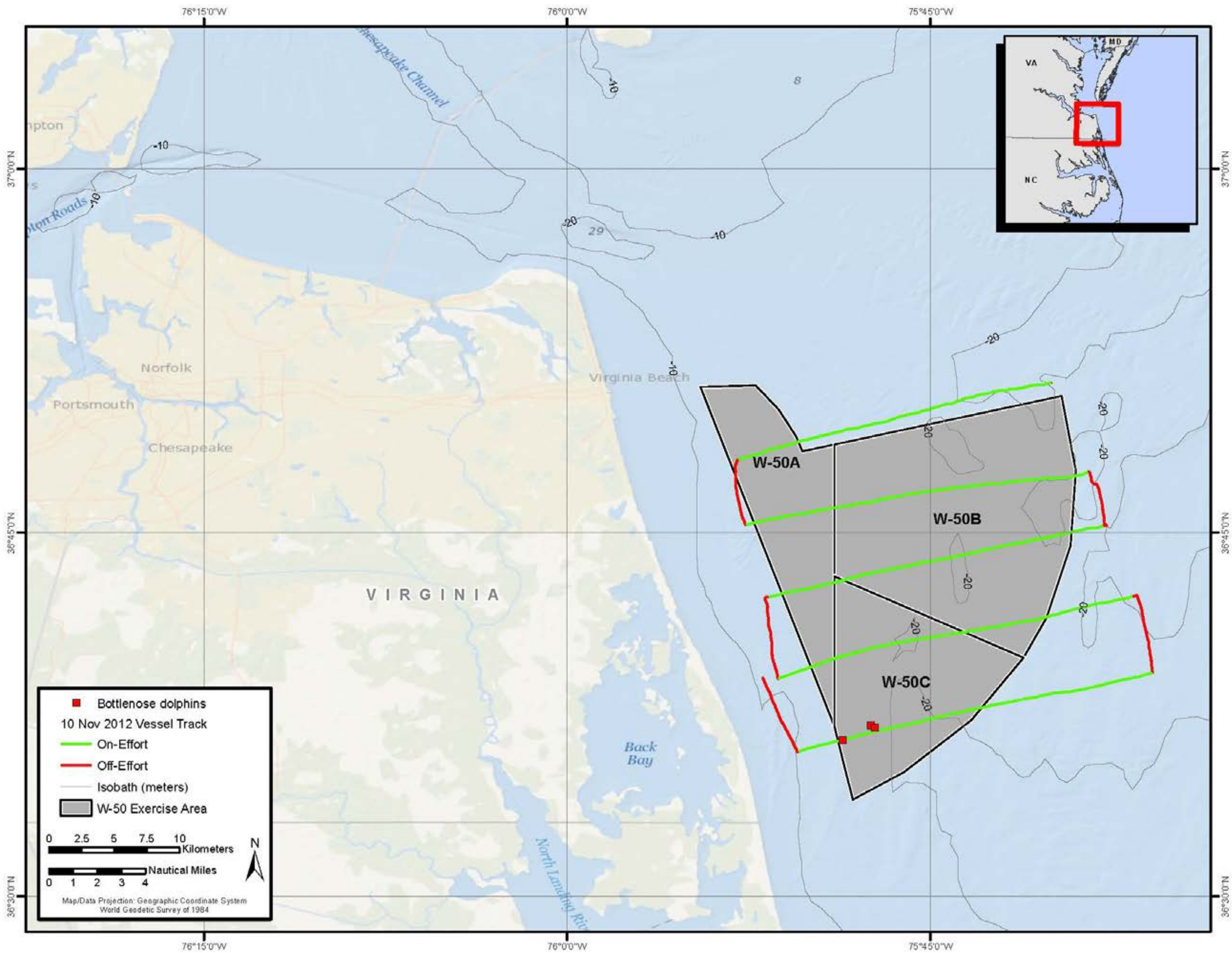
Norfolk
Portsmouth
Chesapeake
Virginia Beach
VIRGINIA
Back Bay
North Landing Riv
W-50A
W-50B
W-50C
Bottlenose dolphins
Loggerhead turtle
23 Oct 2012 Vessel Track
On-Effort
Off-Effort
Isobath (meters)
W-50 Exercise Area
0 2.5 5 7.5 10 Kilometers
Nautical Miles
0 1 2 3 4
N
Map/Data Projection: Geographic Coordinate System
World Geodetic Survey of 1984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Chesapeake Channel
Norfolk
Portsmouth
Chesapeake
Virginia Beach
VIRGINIA
Back Bay
North Landing River
W-50A
W-50B
W-50C
Bottlenose dolphins
10 Nov 2012 Vessel Track
On-Effort
Off-Effort
Isobath (meters)
W-50 Exercise Area
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Nautical Miles 0 1 2 3 4
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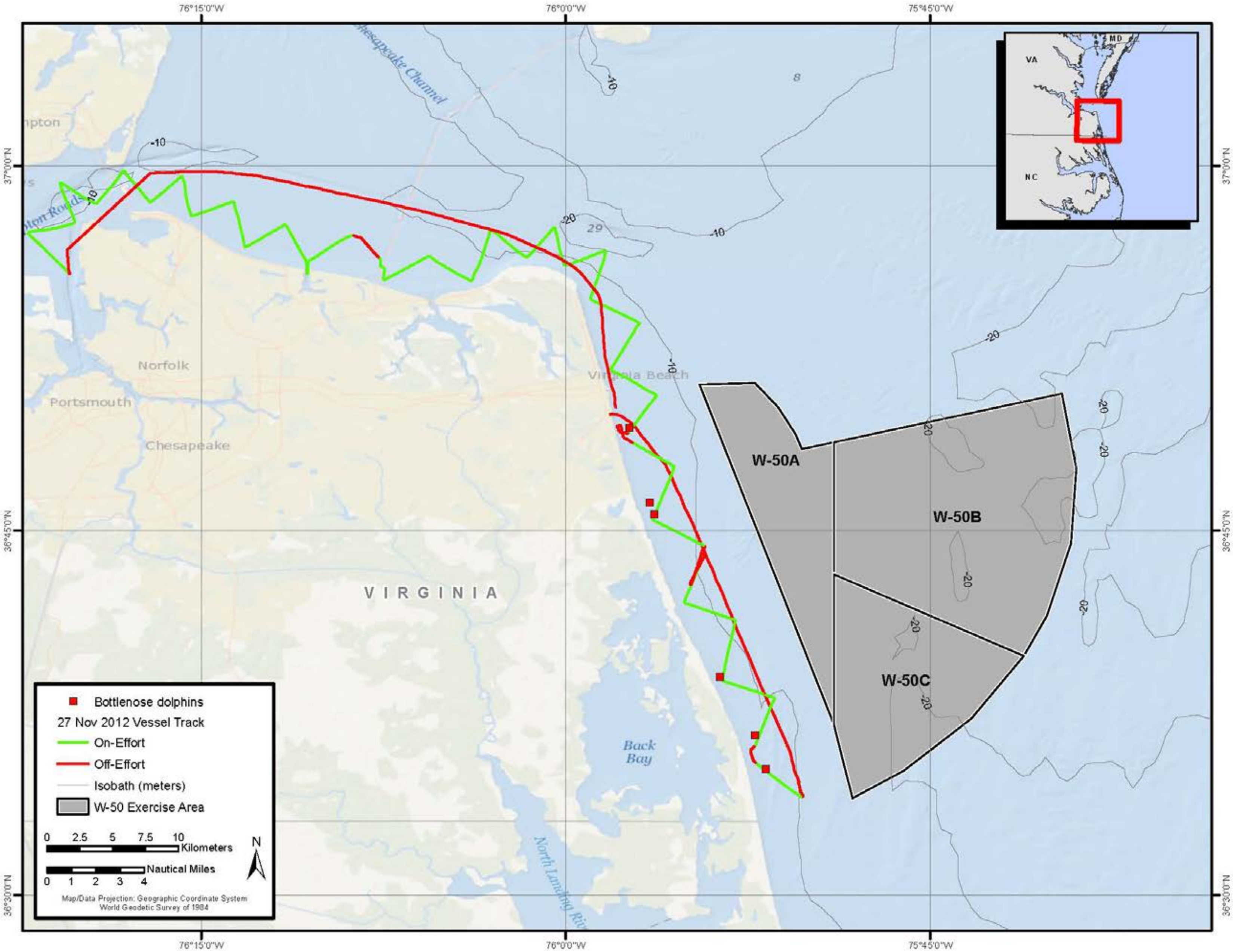
Map/Data Projection: Geographic Coordinate System
World Geodetic Survey of 1984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Chesapeake
Virginia Beach
VIRGINIA
Back Bay
North Landing River
Chesapeake Channel
W-50A
W-50B
W-50C
Bottlenose dolphins
27 Nov 2012 Vessel Track
On-Effort
Off-Effort
Isobath (meters)
W-50 Exercise Area
0 2.5 5 7.5 10 Kilometers
0 1 2 3 4 Nautical Miles
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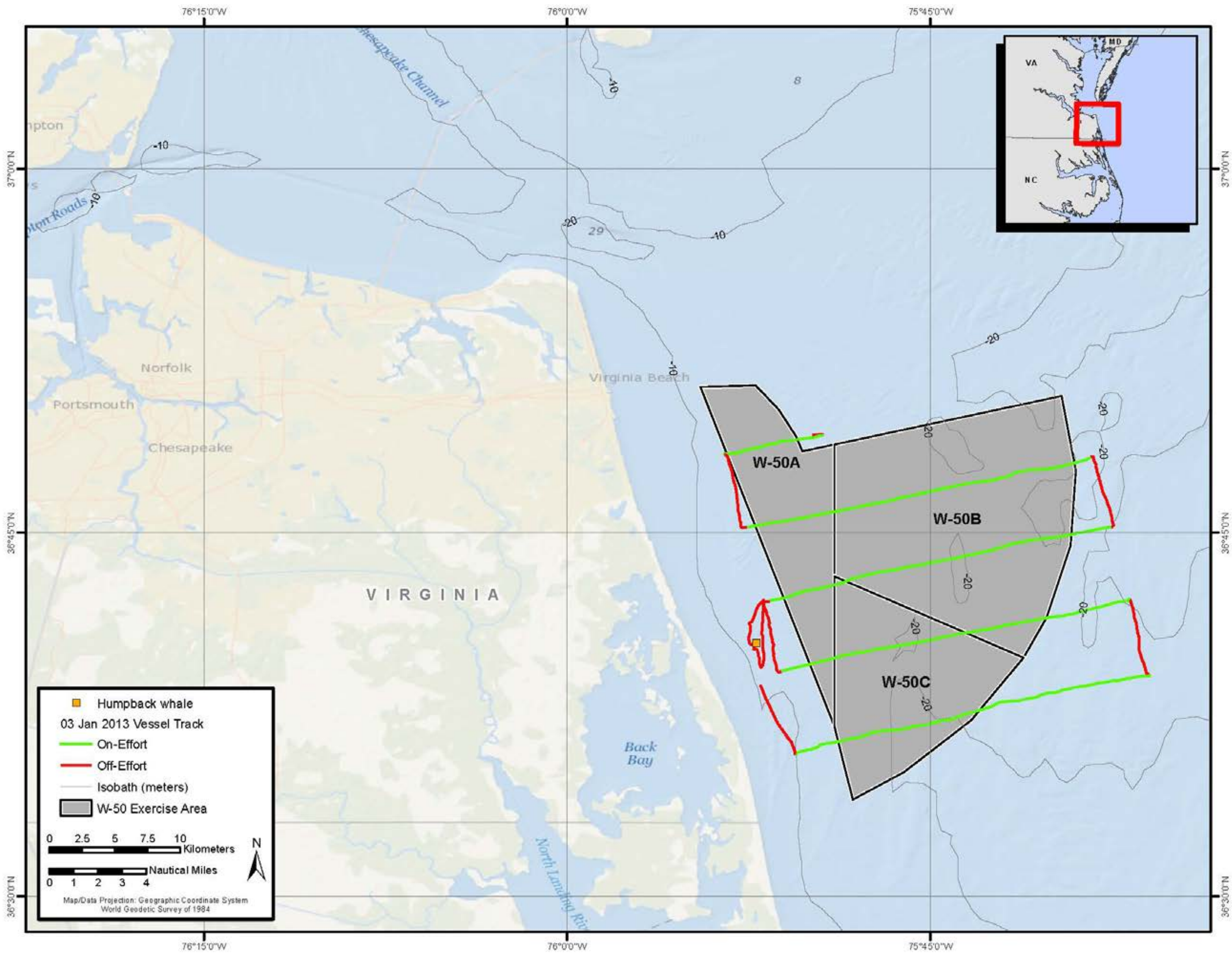
Map/Data Projection: Geographic Coordinate System
World Geodetic Survey of 1984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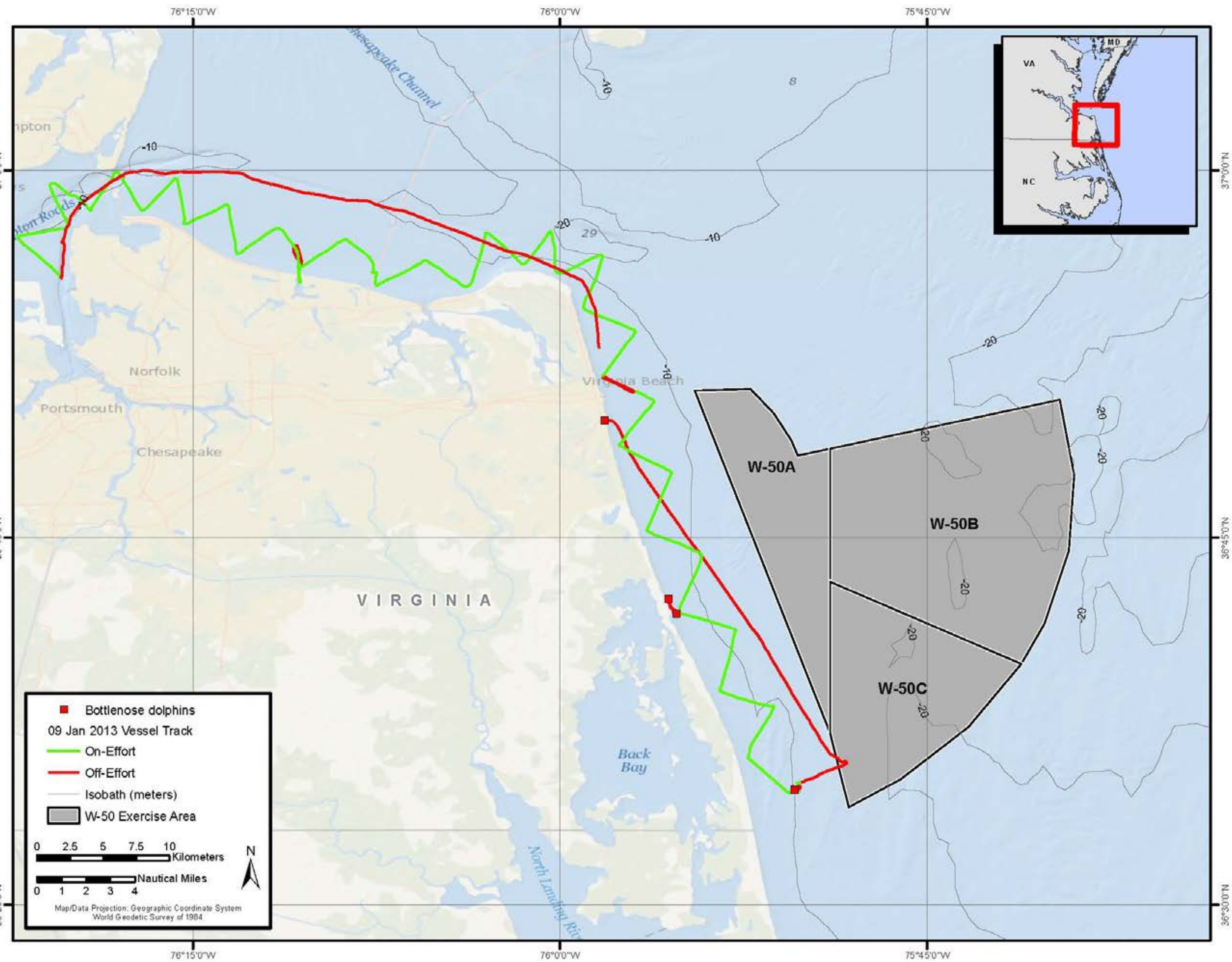
75°45'0"W
37°0'0"N
36°45'0"N
36°30'0"N
VA
MD
NC
Chesapeake Channel
Norfolk
Portsmouth
Chesapeake
Virginia Beach
VIRGINIA
Back Bay
North Landing River
W-50A
W-50B
W-50C
Humpback whale
03 Jan 2013 Vessel Track
On-Effort
Off-Effort
Isobath (meters)
W-50 Exercise Area
0 2.5 5 7.5 10 Kilometers
0 1 2 3 4 Nautical Miles
N
Map/Data Projection: Geographic Coordinate System
World Geodetic Survey of 1984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Portsmouth
Chesapeake
Virginia Beach
VIRGINIA
Back Bay
North Landing River
W-50A
W-50B
W-50C
VA
MD
NC
Bottlenose dolphins
09 Jan 2013 Vessel Track
On-Effort
Off-Effort
Isobath (meters)
W-50 Exercise Area
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0 1 2 3 4 Nautical Miles
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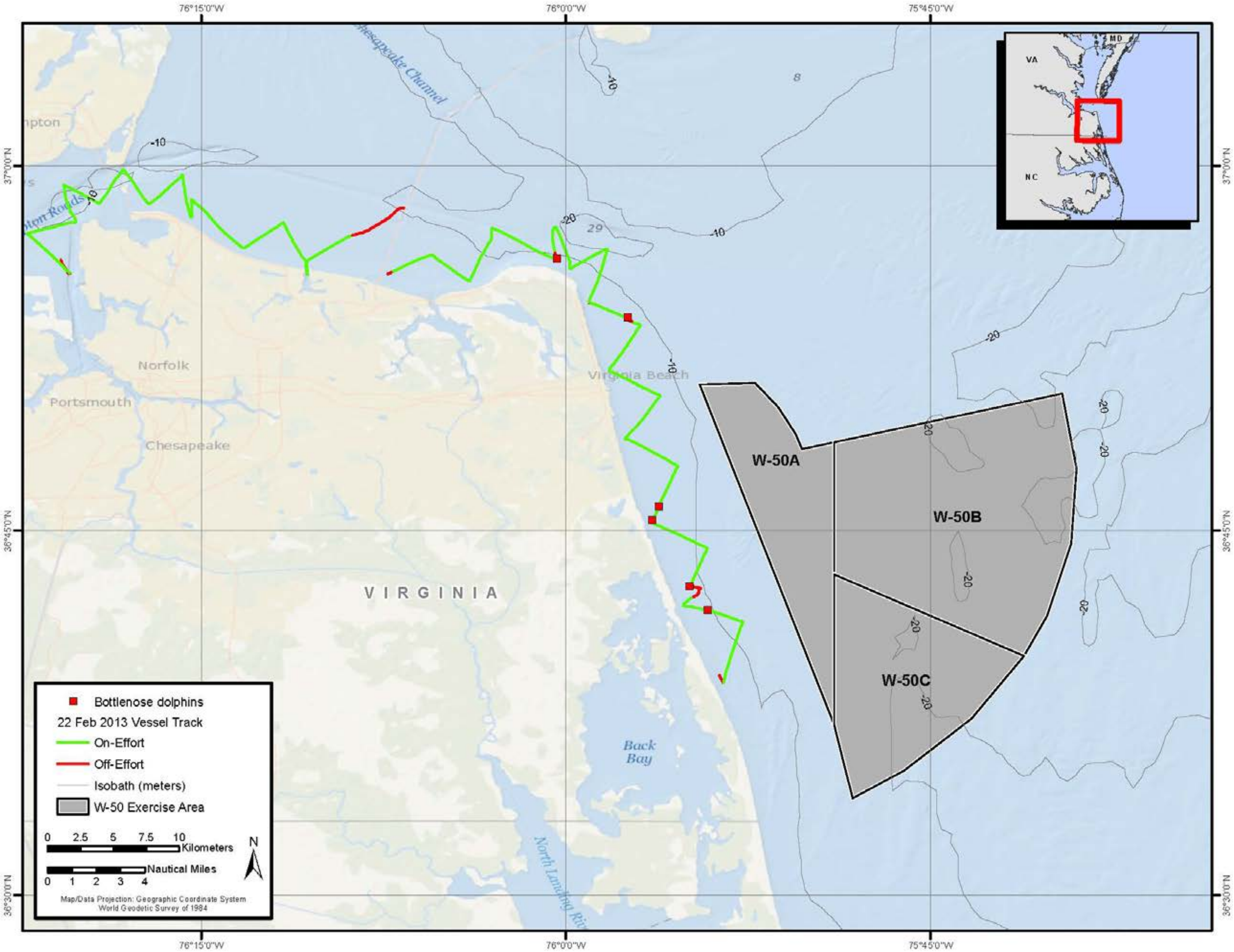
Map/Data Projection: Geographic Coordinate System
World Geodetic Survey of 1984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Norfolk
Portsmouth
Chesapeake
Virginia Beach
VIRGINIA
Back Bay
North Landing Riv
W-50A
W-50B
W-50C
VA
MD
NC
Bottlenose dolphins
22 Feb 2013 Vessel Track
On-Effort
Off-Effort
Isobath (meters)
W-50 Exercise Area
0 2.5 5 7.5 10 Kilometers
0 1 2 3 4 Nautical Miles
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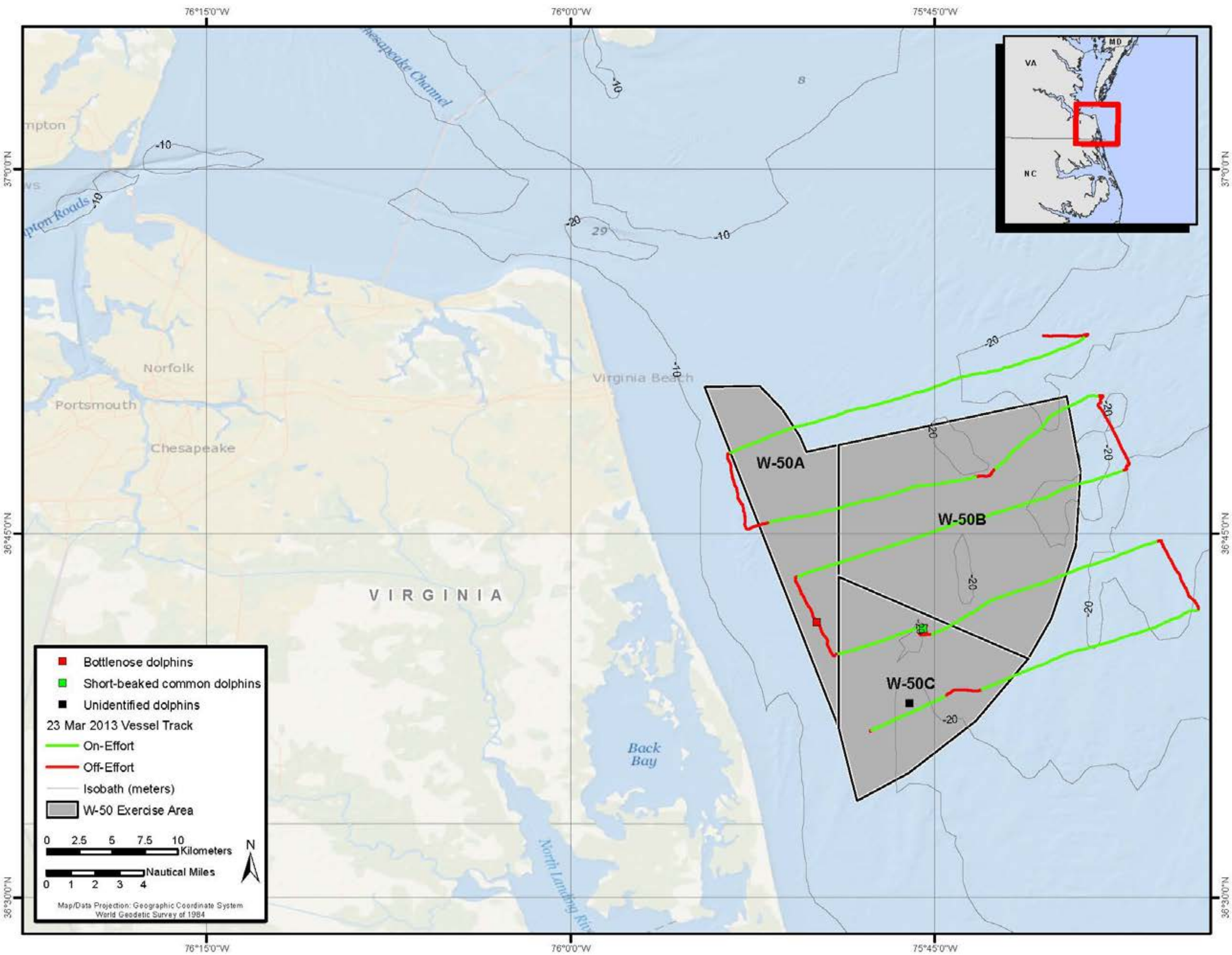
Map/Data Projection: Geographic Coordinate System
World Geodetic Survey of 1984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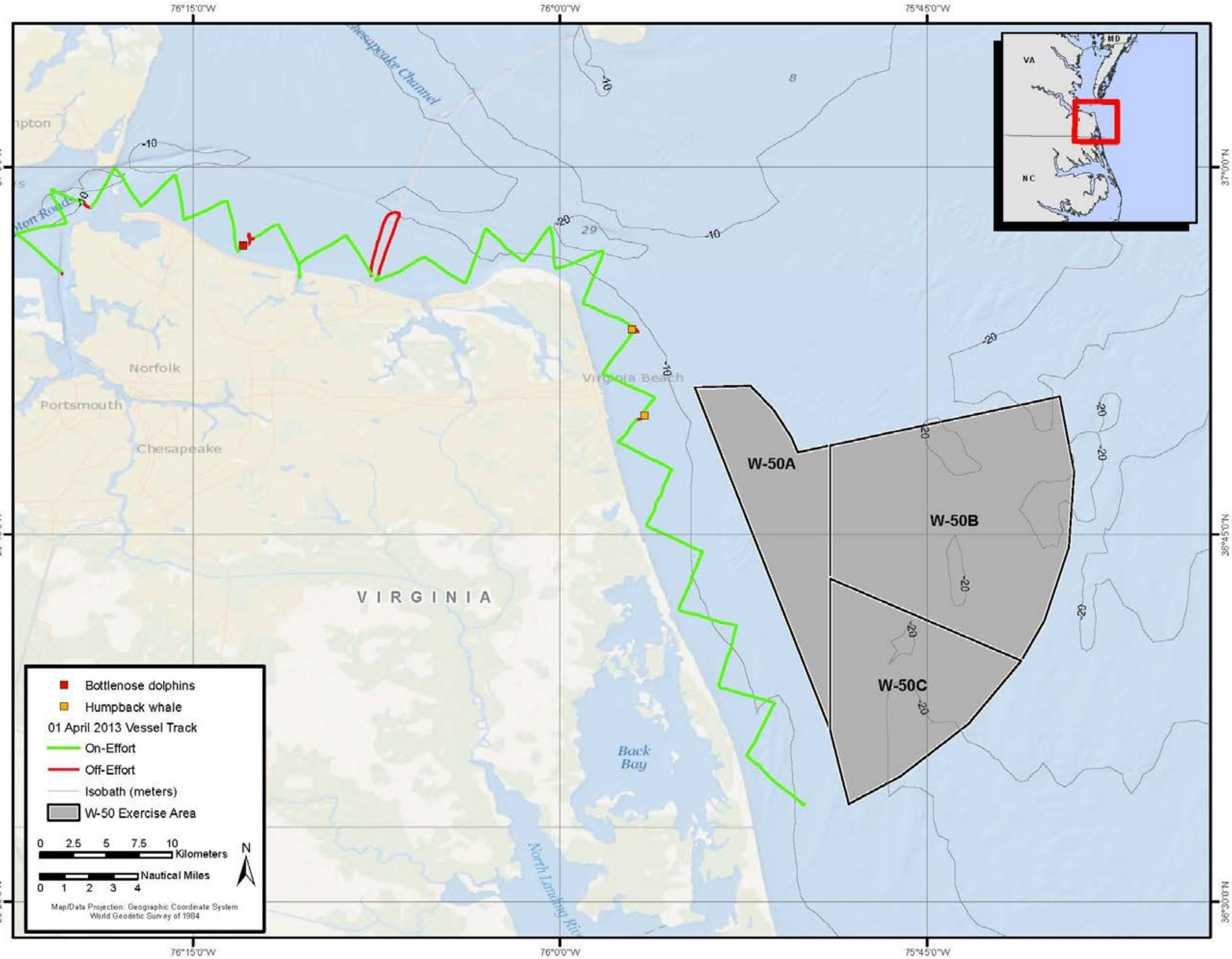
Norfolk
Portsmouth
Chesapeake
Virginia Beach
VIRGINIA
Back Bay
North Landing River
W-50A
W-50B
W-50C
VA
MD
NC
Bottlenose dolphins
Short-beaked common dolphins
Unidentified dolphins
23 Mar 2013 Vessel Track
On-Effort
Off-Effort
Isobath (meters)
W-50 Exercise Area
0 2.5 5 7.5 10 Kilometers
0 1 2 3 4 Nautical Miles
N
Map/Data Projection: Geographic Coordinate System
World Geodetic Survey of 1984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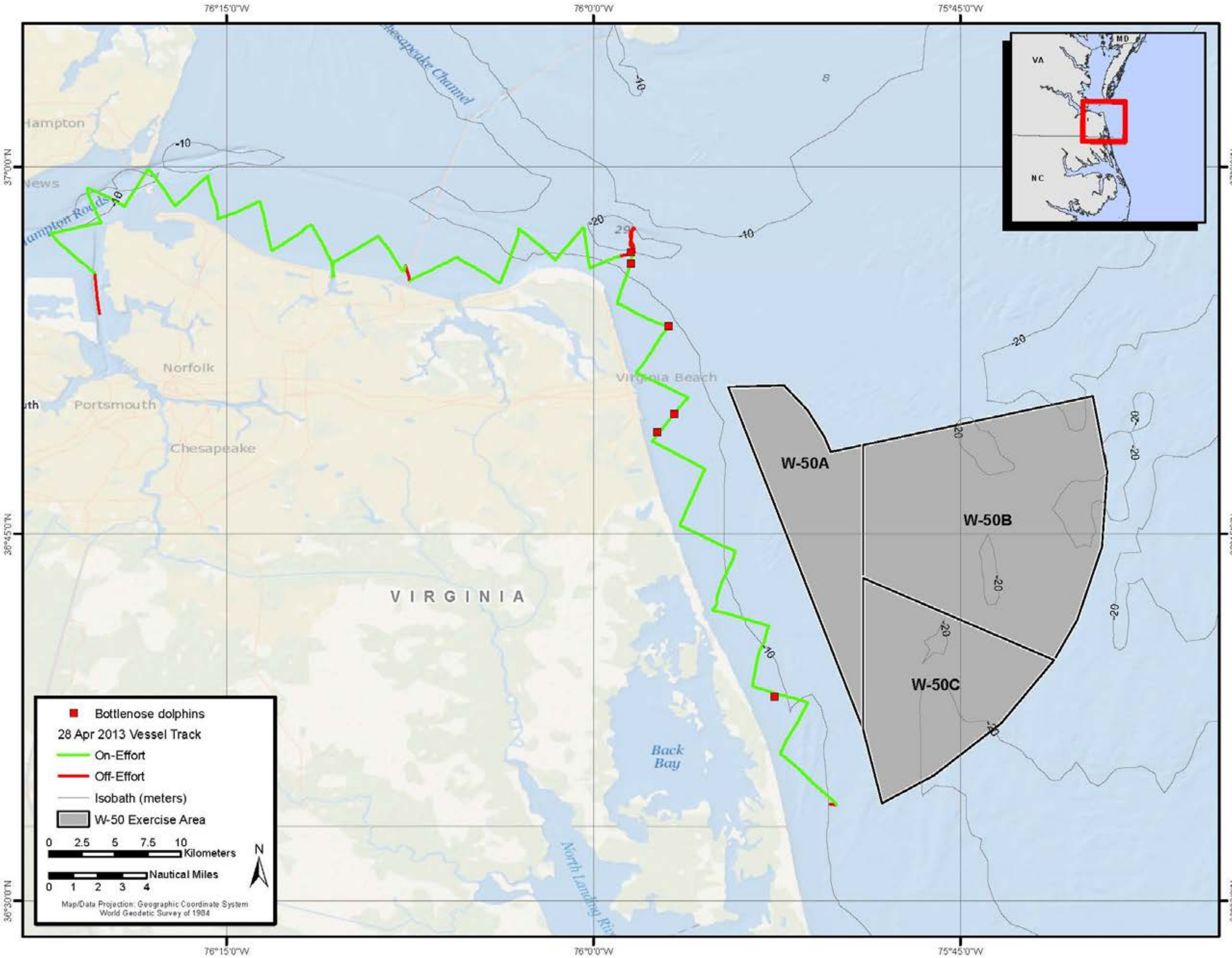
NC
Chesapeake Channel
Norfolk
Portsmouth
Chesapeake
Virginia Beach
VIRGINIA
Back Bay
North Landing River
W-50A
W-50B
W-50C
Bottlenose dolphins
Humpback whale
01 April 2013 Vessel Track
On-Effort
Off-Effort
Isobath (meters)
W-50 Exercise Area
0 2.5 5 7.5 10 Kilometers
0 1 2 3 4 Nautical Miles
N
Map/Data Projection: Geographic Coordinate System
World Geodetic Survey of 1984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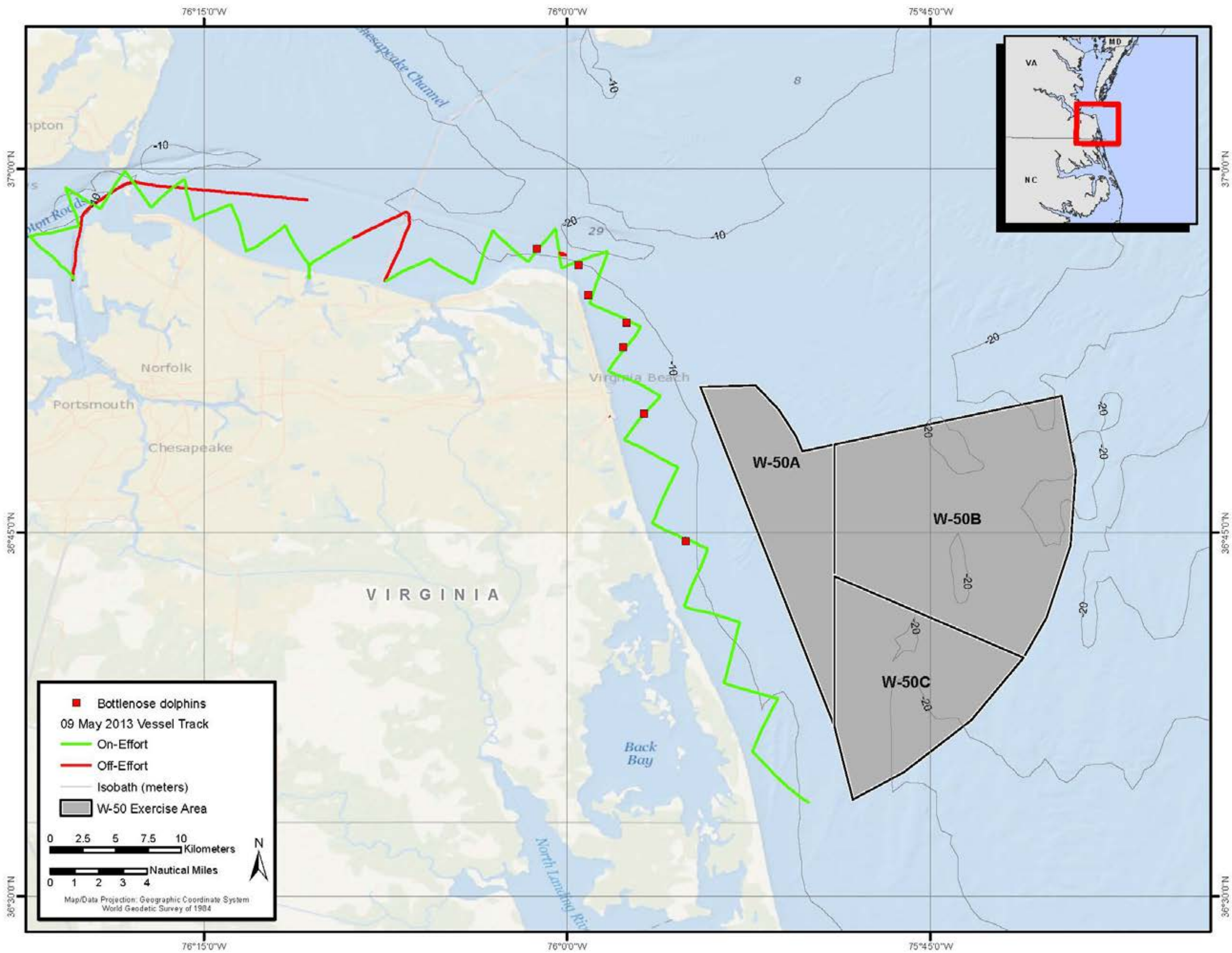
36°30'0"N
VA
MD
NC
Hampton
News
Hampton Roads
Chesapeake Channel
Norfolk
Portsmouth
Chesapeake
Virginia Beach
VIRGINIA
Back Bay
North Landing Riv
W-50A
W-50B
W-50C
-10
-20
8
29
Bottlenose dolphins
28 Apr 2013 Vessel Track
On-Effort
Off-Effort
Isobath (meters)
W-50 Exercise Area
0 2.5 5 7.5 10 Kilometers
0 1 2 3 4 Nautical Miles
N
Map/Data Projection: Geographic Coordinate System
World Geodetic Survey of 1984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MD
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Chesapeake Channel
Norfolk
Portsmouth
Chesapeake
Virginia Beach
VIRGINIA
Back Bay
North Landing River
W-50A
W-50B
W-50C
Bottlenose dolphins
09 May 2013 Vessel Track
On-Effort
Off-Effort
Isobath (meters)
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0 1 2 3 4 Nautical Miles
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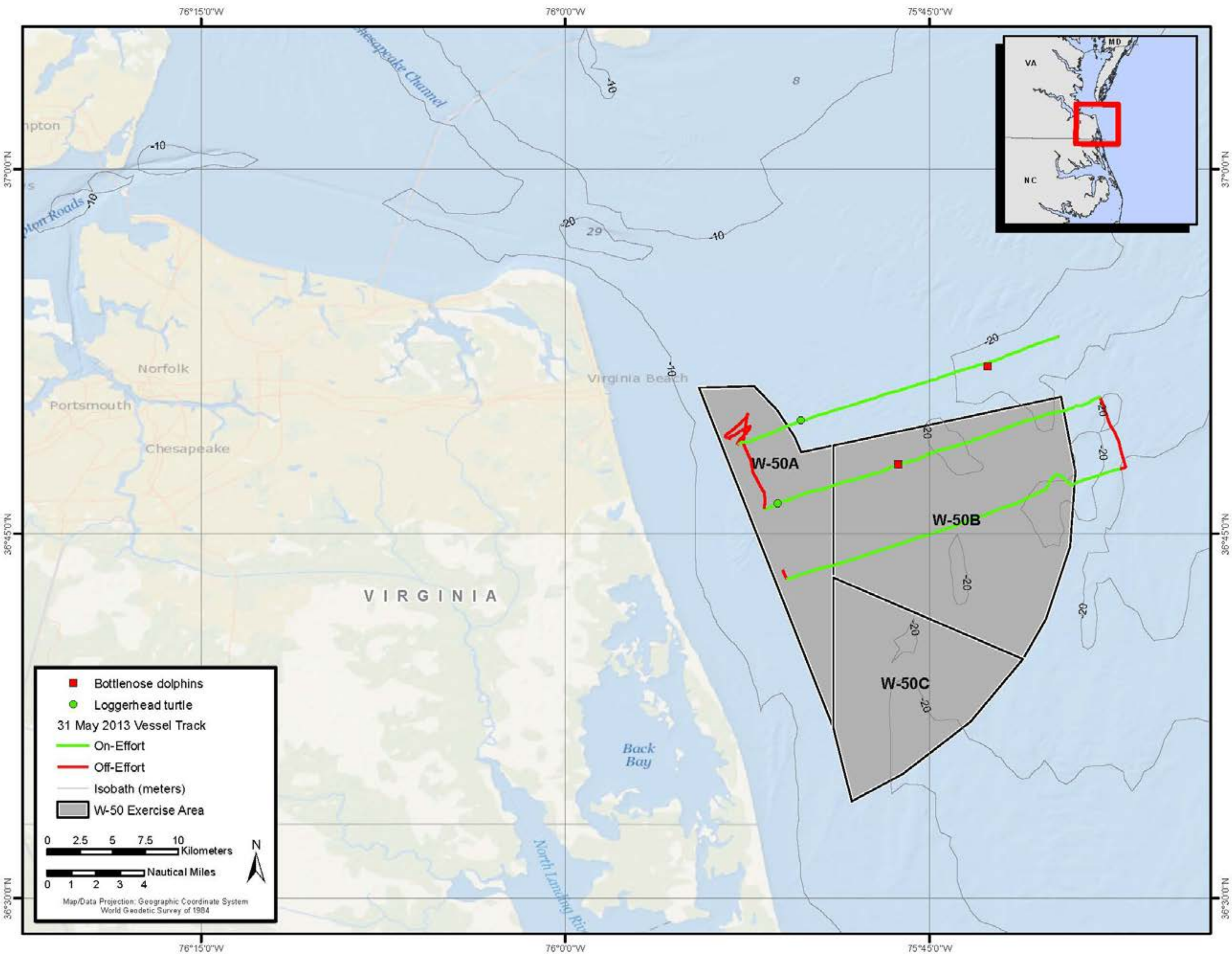
Map/Data Projection: Geographic Coordinate System
World Geodetic Survey of 1984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NC
Norfolk
Portsmouth
Chesapeake
Virginia Beach
VIRGINIA
Back Bay
Chesapeake Channel
W-50A
W-50B
W-50C
Bottlenose dolphins
Loggerhead turtle
31 May 2013 Vessel Track
On-Effort
Off-Effort
Isobath (meters)
W-50 Exercise Area
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0 1 2 3 4 Nautical Miles
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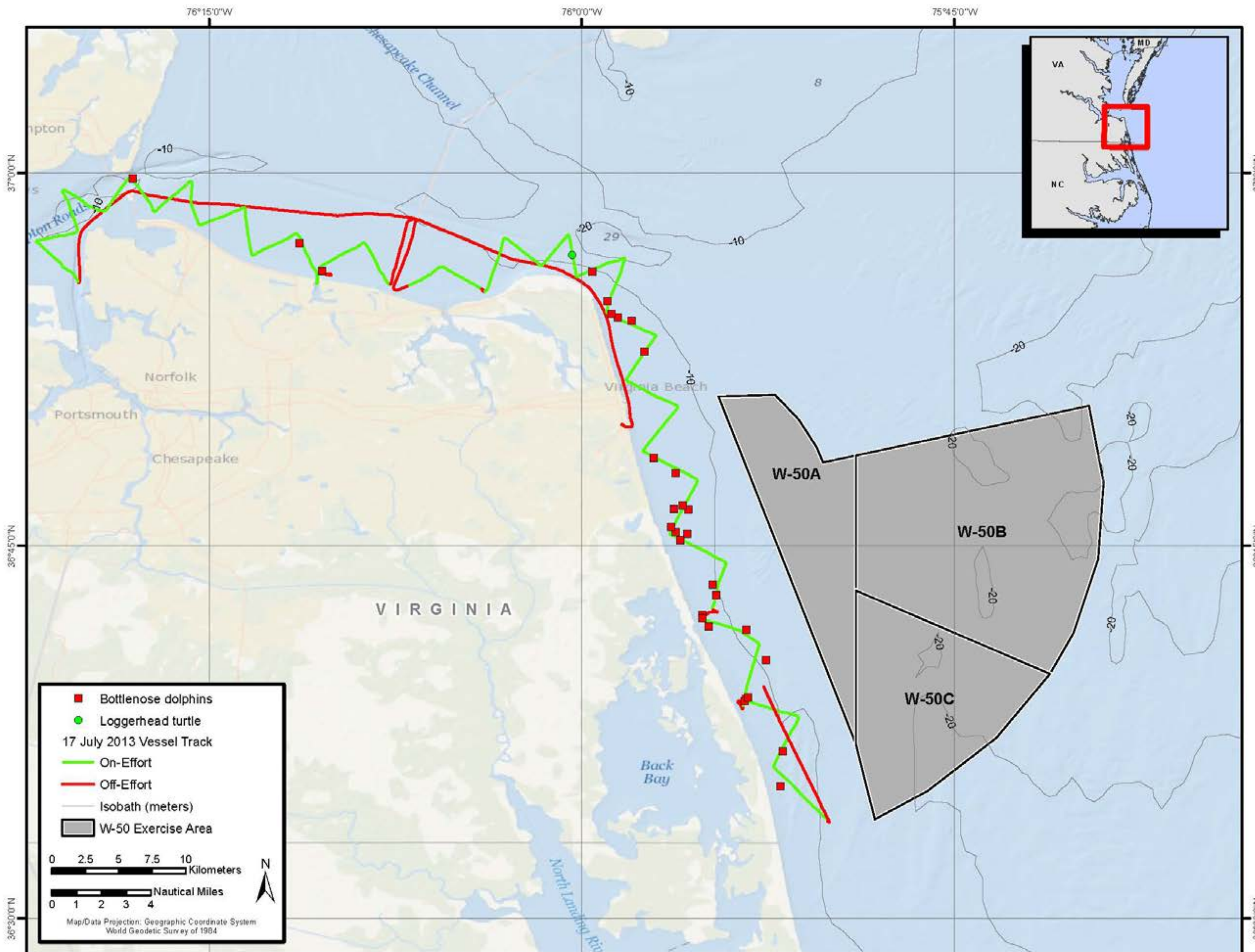
Map/Data Projection: Geographic Coordinate System
World Geodetic Survey of 1984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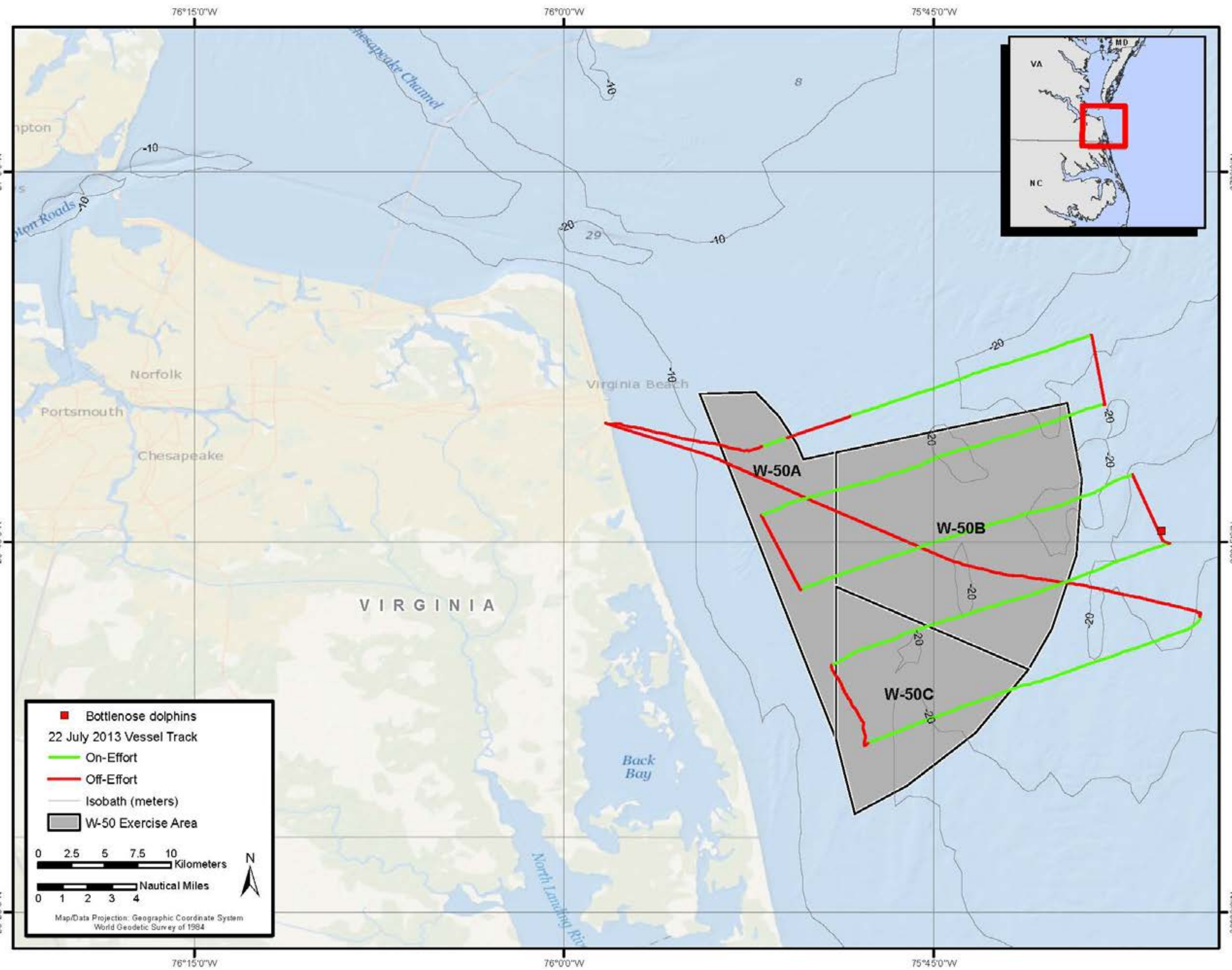
MD
NC
Chesapeake Channel
Norfolk
Portsmouth
Chesapeake
Virginia Beach
VIRGINIA
Back Bay
North Landing Riv
W-50A
W-50B
W-50C
Bottlenose dolphins
Loggerhead turtle
17 July 2013 Vessel Track
On-Effort
Off-Effort
Isobath (meters)
W-50 Exercise Area
0 2.5 5 7.5 10 Kilometers
0 1 2 3 4 Nautical Miles
N
Map/Data Projection: Geographic Coordinate System
World Geodetic Survey of 1984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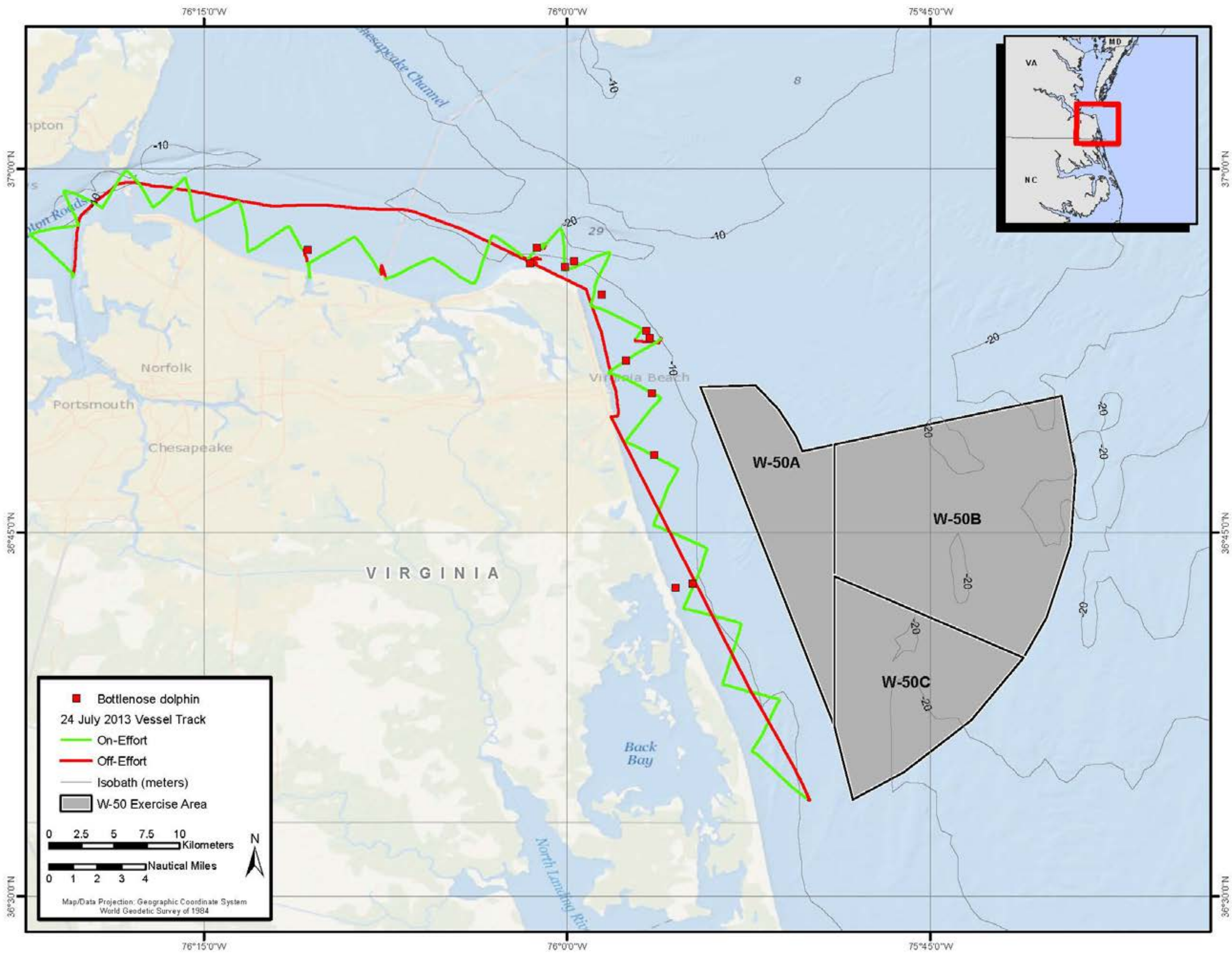
VA
MD
NC
Chesapeake Channel
Norfolk
Portsmouth
Chesapeake
Virginia Beach
VIRGINIA
Back Bay
North Landing River
W-50A
W-50B
W-50C
Bottlenose dolphins
22 July 2013 Vessel Track
On-Effort
Off-Effort
Isobath (meters)
W-50 Exercise Area
0 2.5 5 7.5 10 Kilometers
0 1 2 3 4 Nautical Miles
N
Map/Data Projection: Geographic Coordinate System
World Geodetic Survey of 1984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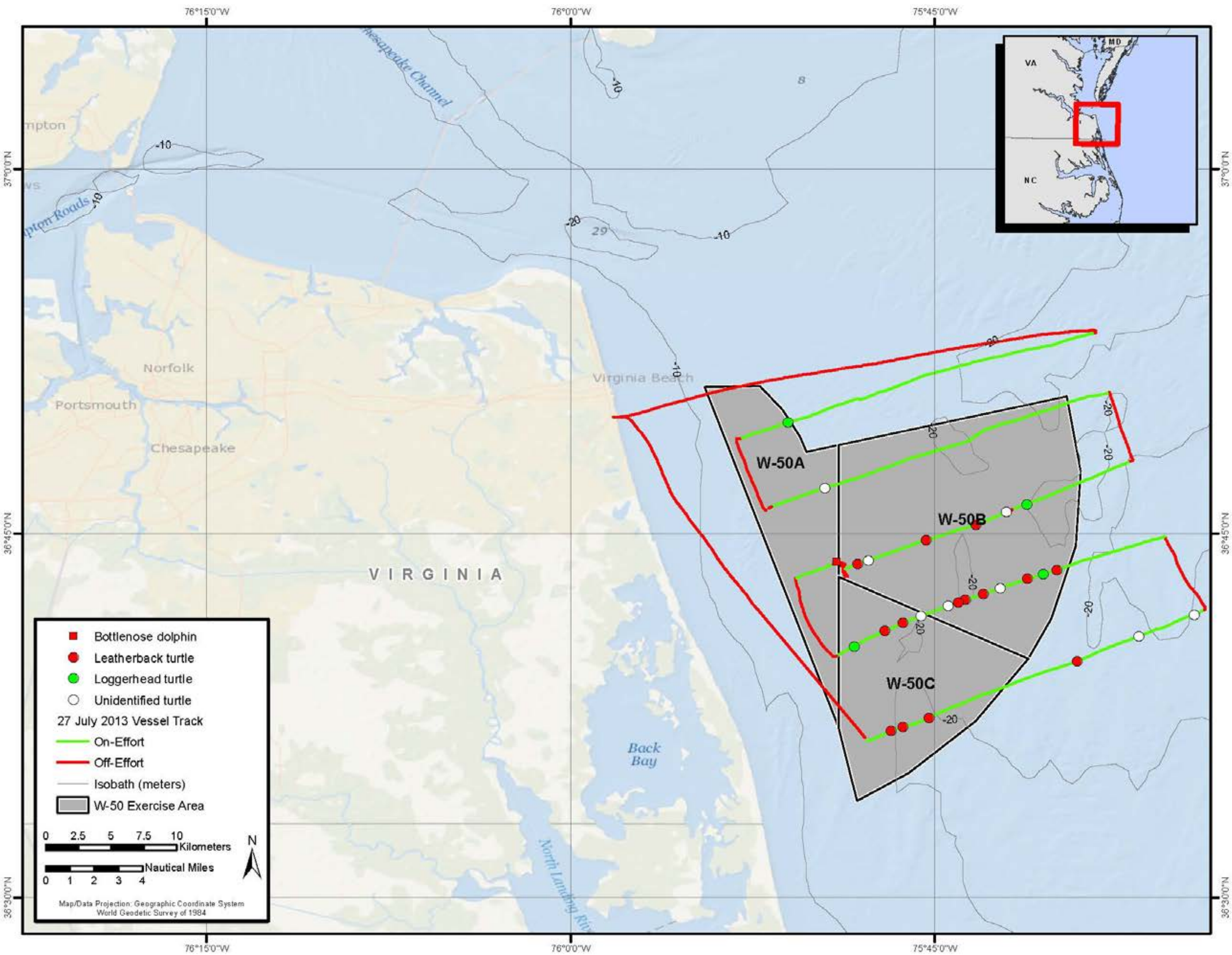
76°0'0"W
75°45'0"W
37°0'0"N
36°45'0"N
36°30'0"N
VA
MD
NC
Chesapeake Channel
Norfolk
Portsmouth
Chesapeake
Virginia Beach
VIRGINIA
Back Bay
North Landing River
W-50A
W-50B
W-50C
Bottlenose dolphin
24 July 2013 Vessel Track
On-Effort
Off-Effort
Isobath (meters)
W-50 Exercise Area
0 2.5 5 7.5 10 Kilometers
0 1 2 3 4 Nautical Miles
N
Map/Data Projection: Geographic Coordinate System
World Geodetic Survey of 1984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36°30'0"N
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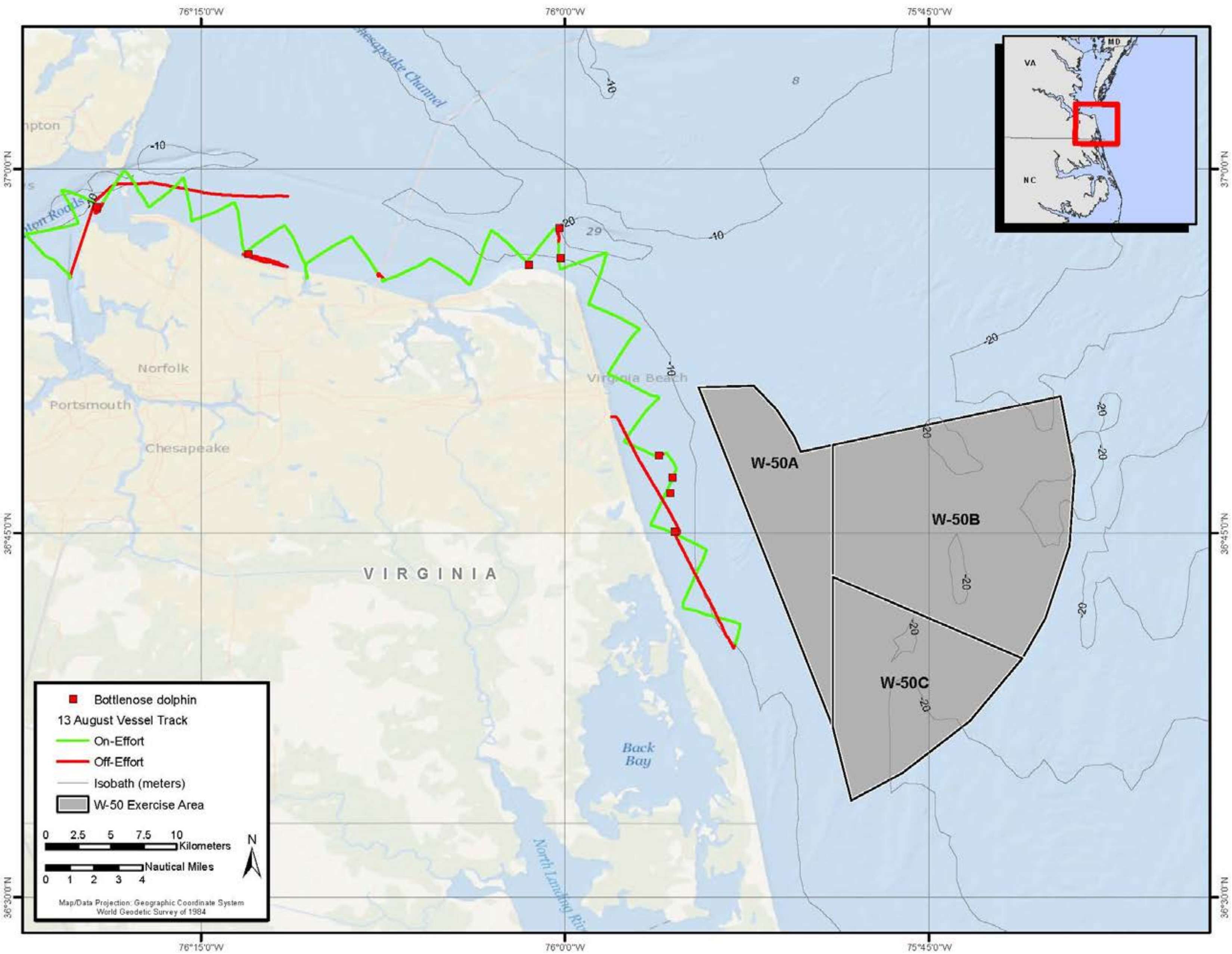
MD
NC
Chesapeake Channel
Norfolk
Portsmouth
Chesapeake
Virginia Beach
VIRGINIA
Back Bay
North Landing River
W-50A
W-50B
W-50C
-10
-20
29
8
Bottlenose dolphin
Leatherback turtle
Loggerhead turtle
Unidentified turtle
27 July 2013 Vessel Track
On-Effort
Off-Effort
Isobath (meters)
W-50 Exercise Area
0 2.5 5 7.5 10 Kilometers
Nautical Miles
0 1 2 3 4
N
Map/Data Projection: Geographic Coordinate System
World Geodetic Survey of 1984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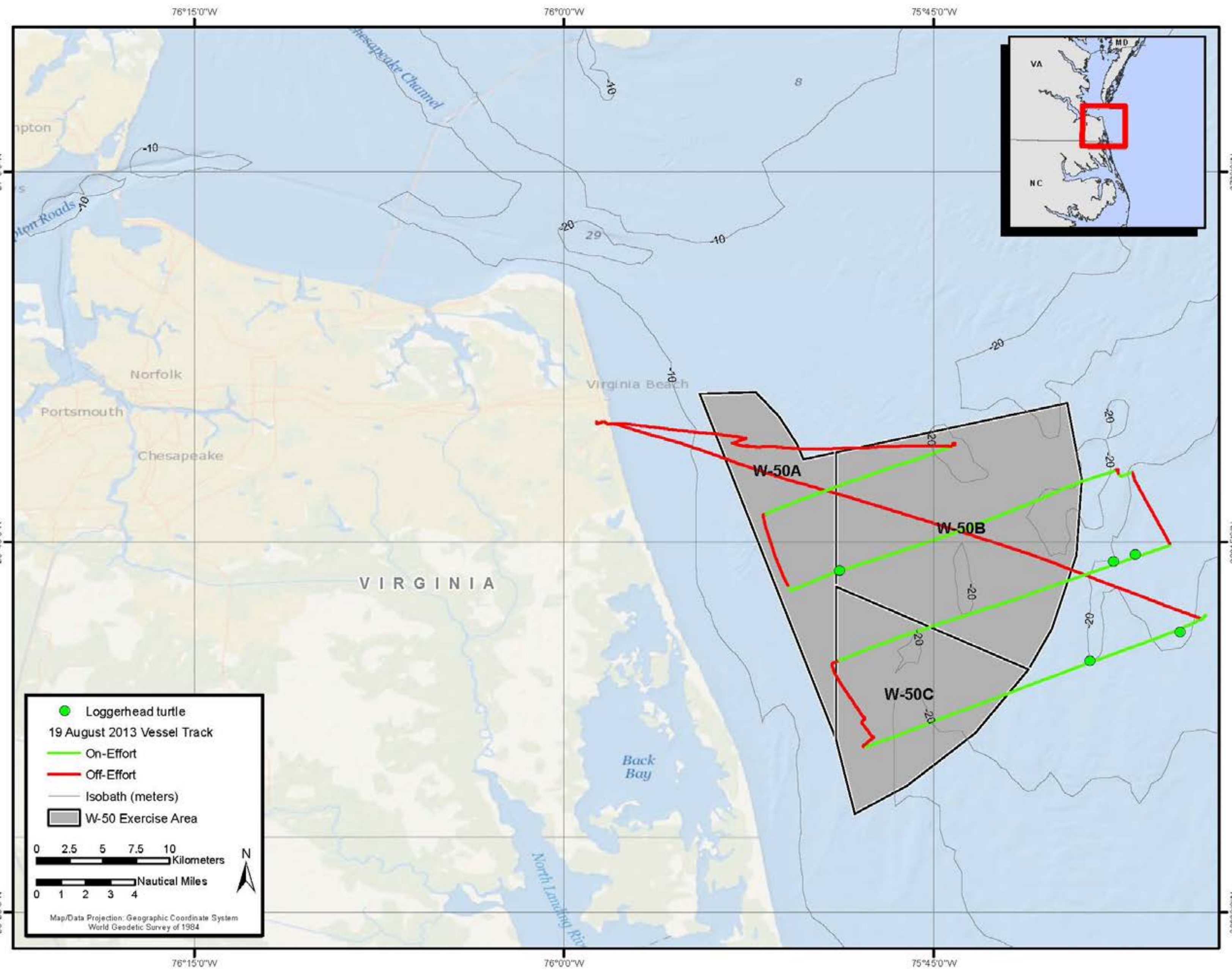
36°30'0"N
Chesapeake Channel
Norfolk
Portsmouth
Chesapeake
Virginia Beach
VIRGINIA
Back Bay
North Landing River
W-50A
W-50B
W-50C
VA
MD
NC
Bottlenose dolphin
13 August Vessel Track
On-Effort
Off-Effort
Isobath (meters)
W-50 Exercise Area
0 2.5 5 7.5 10 Kilometers
0 1 2 3 4 Nautical Miles
N
Map/Data Projection: Geographic Coordinate System World Geodetic Survey of 1984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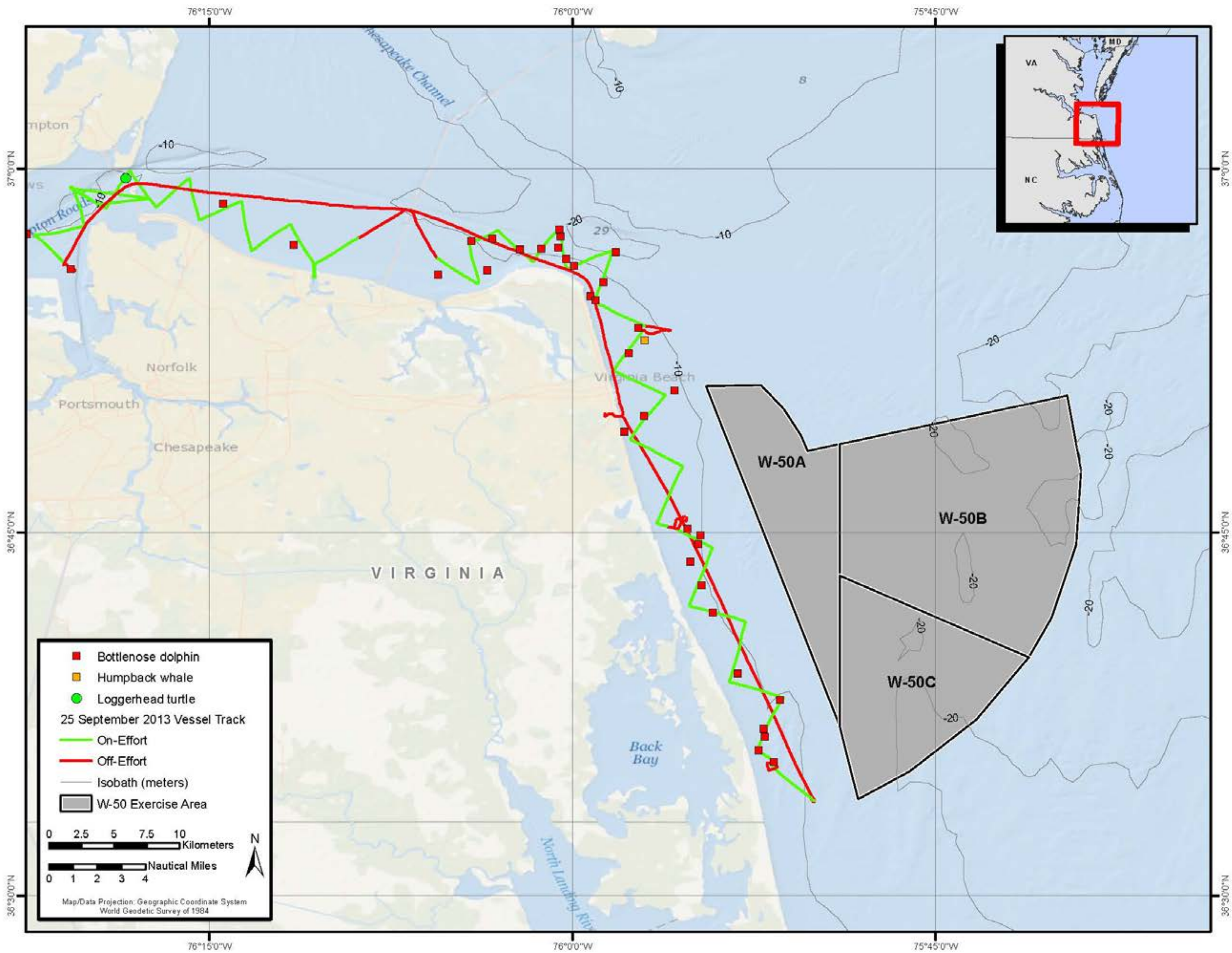
36°30'0"N
VA
MD
NC
Chesapeake Channel
Norfolk
Portsmouth
Chesapeake
Virginia Beach
VIRGINIA
Back Bay
North Landing Riv
W-50A
W-50B
W-50C
Loggerhead turtle
19 August 2013 Vessel Track
On-Effort
Off-Effort
Isobath (meters)
W-50 Exercise Area
0 2.5 5 7.5 10 Kilometers
0 1 2 3 4 Nautical Miles
N
Map/Data Projection: Geographic Coordinate System
World Geodetic Survey of 1984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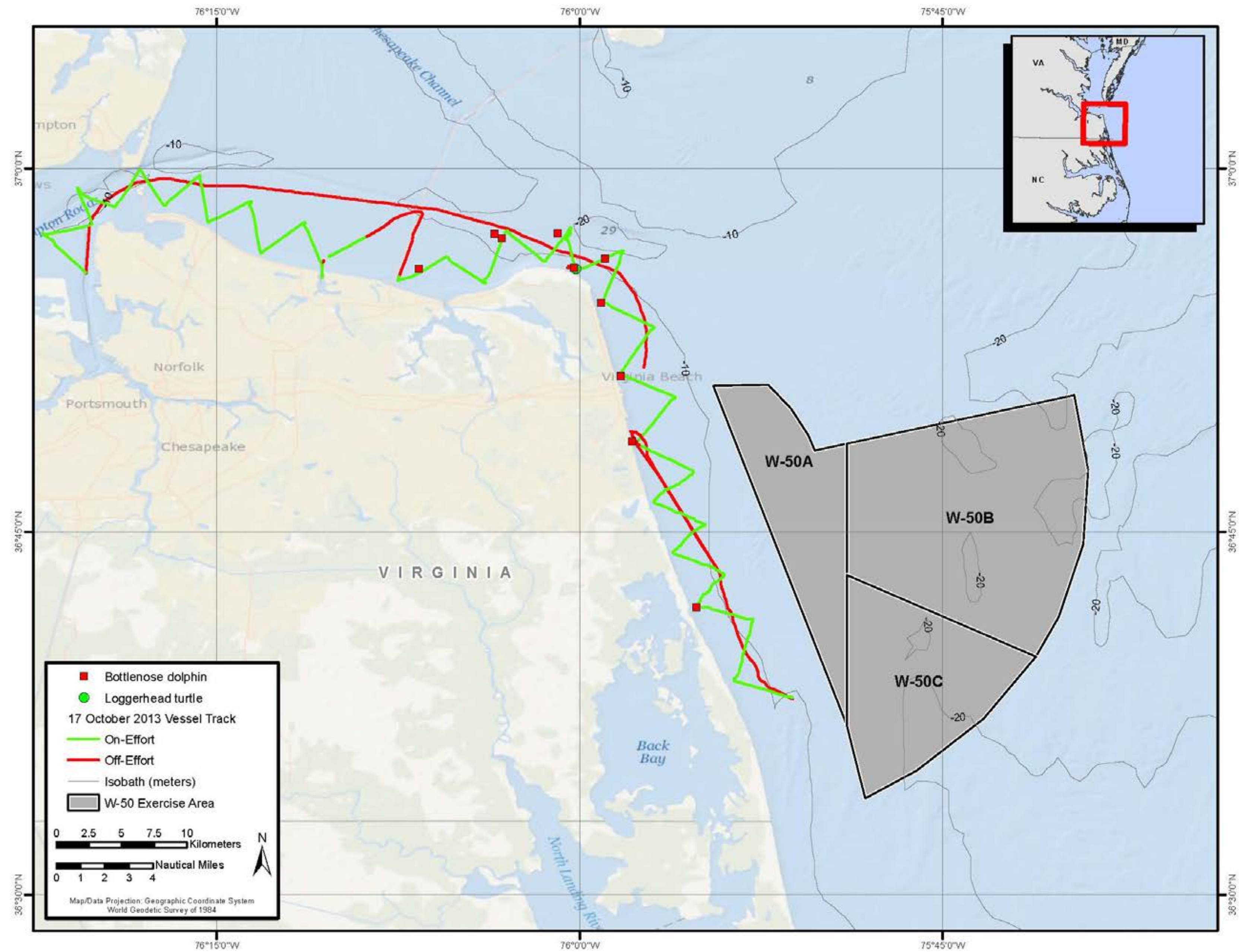
76°0'0"W
75°45'0"W
37°0'0"N
36°45'0"N
36°30'0"N
Chesapeake Channel
Norfolk
Portsmouth
Chesapeake
Virginia Beach
VIRGINIA
Back Bay
W-50A
W-50B
W-50C
VA
MD
NC
Bottlenose dolphin
Humpback whale
Loggerhead turtle
25 September 2013 Vessel Track
On-Effort
Off-Effort
Isobath (meters)
W-50 Exercise Area
0 2.5 5 7.5 10 Kilometers
Nautical Miles
0 1 2 3 4
N
Map/Data Projection: Geographic Coordinate System
World Geodetic Survey of 1984


Bottlenose dolphin
Loggerhead turtle
17 October 2013 Vessel Track
On-Effort
Off-Effort
Isobath (meters)
W-50 Exercise Area
0 2.5 5 7.5 10 Kilometers
Nautical Miles
0 1 2 3 4
N
Map/Data Projection: Geographic Coordinate System
World Geodetic Survey of 1984
W-50A
W-50B
W-50C
Norfolk
Portsmouth
Chesapeake
VIRGINIA
Virginia Beach
Back Bay
Chesapeake Channel
North Landing River
76°15'0"W
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75°45'0"W
37°0'0"N
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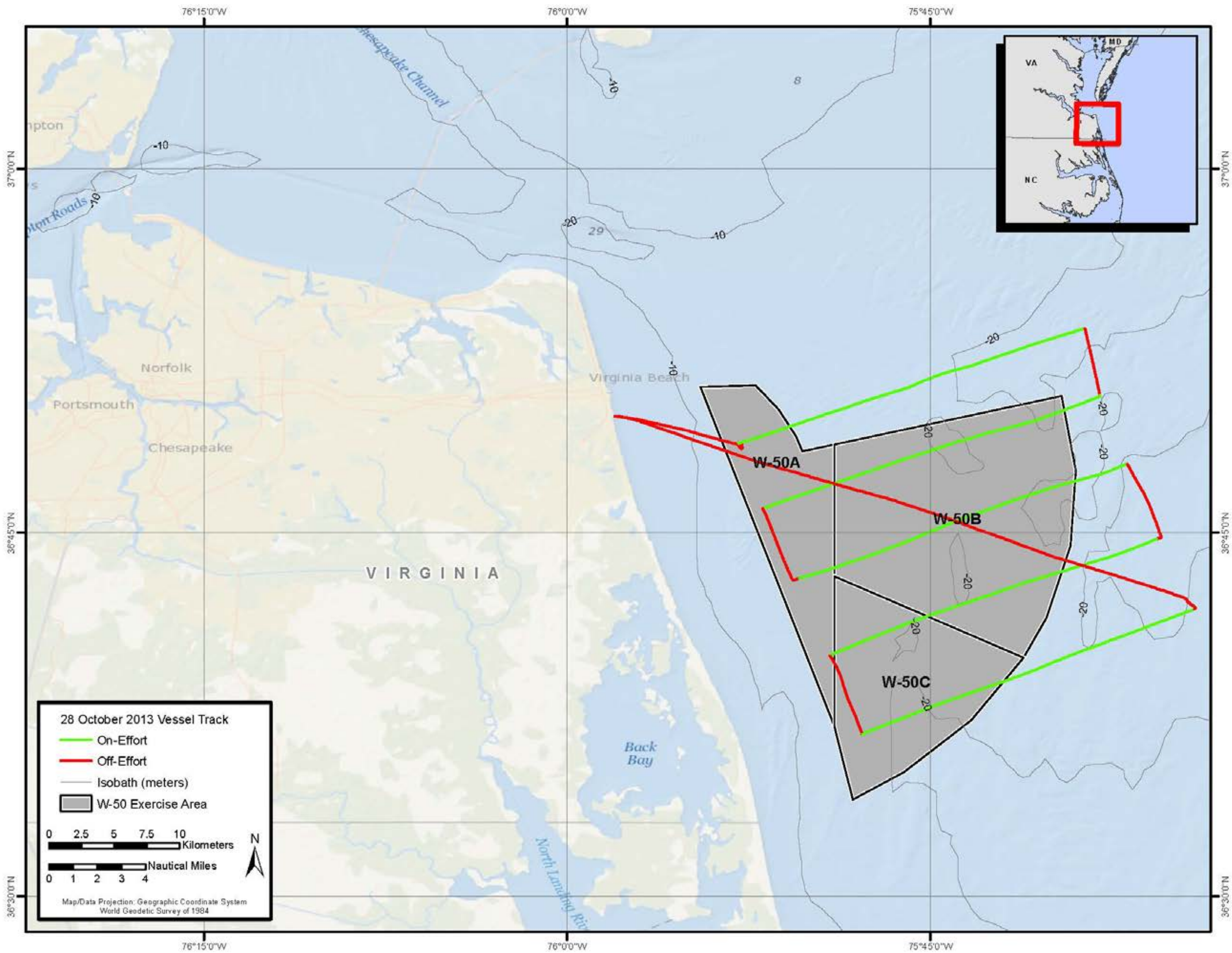
VA
MD
NC



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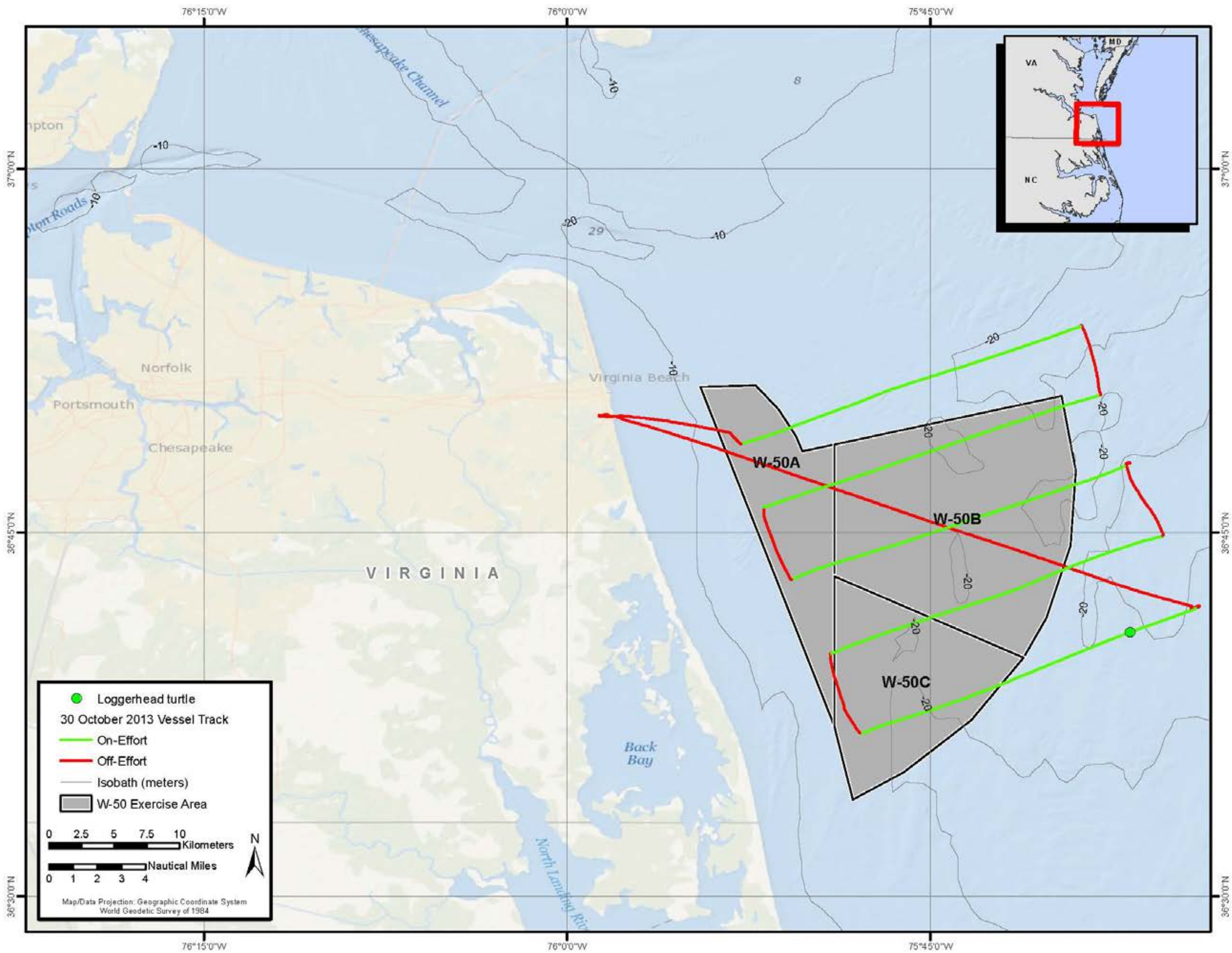
Chesapeake Channel
Norfolk
Portsmouth
Chesapeake
Virginia Beach
VIRGINIA
Back Bay
North Landing Riv
W-50A
W-50B
W-50C
VA
MD
NC
28 October 2013 Vessel Track
On-Effort
Off-Effort
Isobath (meters)
W-50 Exercise Area
0 2.5 5 7.5 10 Kilometers
0 1 2 3 4 Nautical Miles
N
Map/Data Projection: Geographic Coordinate System
World Geodetic Survey of 1984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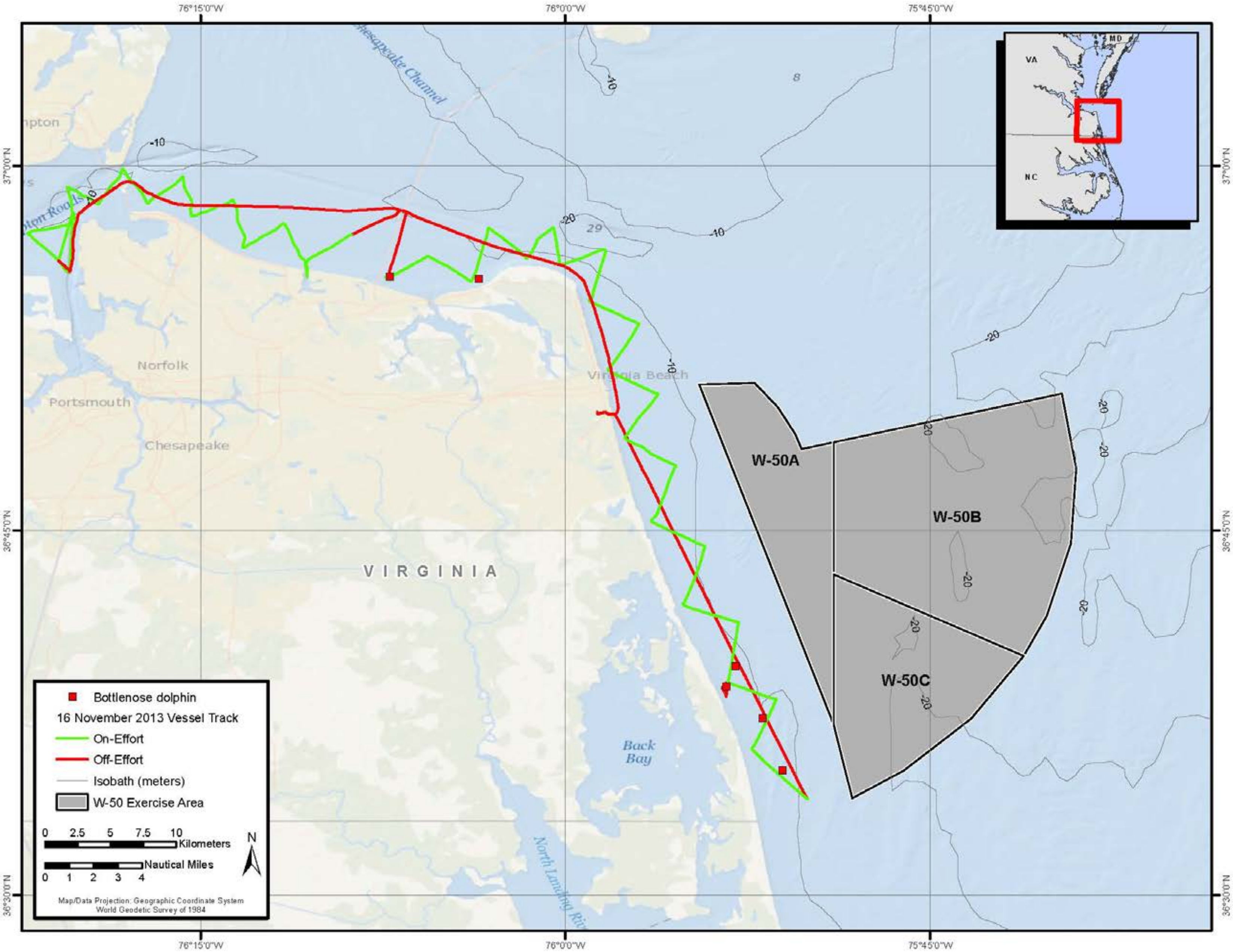
VA
MD
NC
Chesapeake Channel
Norfolk
Portsmouth
Chesapeake
Virginia Beach
VIRGINIA
Back Bay
W-50A
W-50B
W-50C
Loggerhead turtle
30 October 2013 Vessel Track
On-Effort
Off-Effort
Isobath (meters)
W-50 Exercise Area
0 2.5 5 7.5 10 Kilometers
0 1 2 3 4 Nautical Miles
N
Map/Data Projection: Geographic Coordinate System
World Geodetic Survey of 1984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Portsmouth
Chesapeake
Virginia Beach
VIRGINIA
Back Bay
North Landing River
W-50A
W-50B
W-50C
VA
MD
NC
Bottlenose dolphin
16 November 2013 Vessel Track
On-Effort
Off-Effort
Isobath (meters)
W-50 Exercise Area
0 2.5 5 7.5 10 Kilometers
0 1 2 3 4 Nautical Miles
N
Map/Data Projection: Geographic Coordinate System
World Geodetic Survey of 1984

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APPENDIX C
INSHORE Transect Survey Marine Mammal and Sea Turtle Sightings

Sighting No.	Date	Time	Species	Group Size Best/High/Low			Calves	Sighting Latitude	Sighting Longitude	Effort	Bearing Angle	PSD[†] (m)	BSS*	Bottom Depth (m)	SST[§] (°F)	Photos Taken
07 September 2012 INSHORE transect																
1	7 Sep 2012	8:46	Tt	2	2	2	0	36.699	-75.919	On	15	31	3	7	80	No
2	7 Sep 2012	9:19	Tt	2	2	2	0	36.756	-75.946	On	304	580	3	8	80	No
3	7 Sep 2012	9:29	Tt	4	5	4	0	36.755	-75.931	On	70	364	3	10	80	No
4	7 Sep 2012	9:36	Tt	3	3	3	0	36.768	-75.928	On	354	31	3	9	80	No
5	7 Sep 2012	10:00	Tt	4	4	4	0	36.812	-75.958	On	315	177	3	9	80	No
6	7 Sep 2012	10:04	Tt	1	1	1	0	36.817	-75.958	On	330	50	3	9	80	No
7	7 Sep 2012	10:36	Tt	5	5	3	0	36.865	-75.960	On	90	267	3	9	80	No
8	7 Sep 2012	10:46	Tt	5	6	3	0	36.878	-75.966	On	292	927	3	8	80	No
9	7 Sep 2012	11:00	Tt	4	4	4	0	36.895	-75.975	On	296	809	3	7	80	No
10	7 Sep 2012	11:03	Tt	10	10	7	0	36.903	-75.974	Off	12	6	3	7	80	No
11	7 Sep 2012	11:13	Tt	4	4	4	0	36.918	-75.980	On	0	0	3	8	80	No
12	7 Sep 2012	11:14	Tt	8	9	4	0	36.922	-75.982	On	274	299	3	7	80	No
13	7 Sep 2012	11:29	Tt	3	3	3	0	36.935	-75.994	On	0	0	3	13	80	No
14	7 Sep 2012	11:30	Tt	25	30	10	0	36.932	-76.001	On	336	325	3	11	80	No
15	7 Sep 2012	11:35	Tt	5	5	3	0	36.934	-76.005	On	35	143	3	10	80	No
16	7 Sep 2012	11:38	Tt	5	5	3	0	36.937	-76.010	On	280	201	3	16	80	No
17	7 Sep 2012	11:41	Tt	6	6	4	0	36.947	-76.012	On	270	500	3	21	80	No
18	7 Sep 2012	11:51	Tt	3	3	3	0	36.945	-76.017	On	335	211	3	19	80	No
19	7 Sep 2012	11:53	Tt	1	1	1	0	36.940	-76.024	On	355	17	3	16	80	No
20	7 Sep 2012	11:55	Tt	2	2	2	0	36.939	-76.026	On	21	72	3	15	80	No
21	7 Sep 2012	11:57	Tt	25	30	5	1	36.937	-76.028	On	325	123	3	15	80	No
22	7 Sep 2012	12:02	Tt	7	7	4	0	36.938	-76.030	Off	35	57	3	16	80	No
23	7 Sep 2012	12:03	Tt	8	8	4	1	36.944	-76.028	Off	90	387	3	16	80	No
24	7 Sep 2012	12:42	Tt	3	3	3	0	36.944	-76.061	On	280	98	2	14	80	No
25	7 Sep 2012	12:44	Tt	8	8	4	0	36.954	-76.047	On	35	222	2	14	80	No
26	7 Sep 2012	12:50	Tt	3	3	3	1	36.944	-76.053	On	344	152	2	13	80	No
27	7 Sep 2012	12:53	Tt	12	14	5	1	36.945	-76.056	On	90	100	2	11	80	No

Sighting No.	Date	Time	Species	Group Size Best/High/Low			Calves	Sighting Latitude	Sighting Longitude	Effort	Bearing Angle	PSD† (m)	BSS*	Bottom Depth (m)	SST§ (°F)	Photos Taken
07 September 2012 INSHORE transect (continued)																
28	7 Sep 2012	12:56	Tt	2	2	2	0	36.934	-76.068	On	90	387	2	11	80	No
29	7 Sep 2012	13:04	Tt	7	7	7	0	36.921	-76.079	On	272	750	2	10	80	No
30	7 Sep 2012	13:06	Tt	13	15	6	0	36.929	-76.081	On	337	117	2	10	80	No
31	7 Sep 2012	13:09	Tt	8	8	3	0	36.936	-76.088	On	346	48	2	9	80	No
32	7 Sep 2012	13:11	Tt	10	12	8	0	36.938	-76.095	On	45	84	2	9	80	No
33	7 Sep 2012	13:13	Tt	2	2	2	0	36.930	-76.104	On	332	282	2	9	80	No
34	7 Sep 2012	13:20	Tt	3	3	3	0	36.920	-76.115	On	90	650	2	5	80	No
35	7 Sep 2012	13:28	Tt	35	43	28	-	36.946	-76.121	Off	316	347	2	8	80	No
36	7 Sep 2012	14:03	Tt	6	4	4	0	36.934	-76.178	On	0	0	2	9	80	No
37	7 Sep 2012	14:32	Tt	32	35	10	2	36.960	-76.198	On	45	32	3	8	80	No
38	7 Sep 2012	14:54	Cc	1	1	1	-	36.971	-76.227	On	300	-	3	-	80	No
03 October 2012 INSHORE transect																
1	3 Oct 2012	8:54	Tt	1	1	1	0	36.987	-76.316	On	298	441	1	4	72	No
2	3 Oct 2012	8:56	Tt	5	5	4	0	36.989	-76.308	On	18	83	1	7	72	No
3	3 Oct 2012	9:15	Tt	4	4	4	0	36.985	-76.275	On	328	212	1	5	72	No
4	3 Oct 2012	9:27	Tt	3	3	3	0	36.978	-76.268	On	90	800	1	7	72	No
5	3 Oct 2012	9:39	Tt	6	6	3	0	36.965	-76.230	On	85	996	1	8	72	No
6	3 Oct 2012	9:46	Tt	2	2	2	0	36.965	-76.220	On	285	258	2	7	72	No
7	3 Oct 2012	9:55	Tt	3	3	3	0	36.953	-76.198	On	8	167	2	9	72	No
8	3 Oct 2012	9:58	Tt	7	8	4	1	36.945	-76.199	On	76	970	2	7	72	No
9	3 Oct 2012	10:34	Tt	3	3	3	0	36.943	-76.170	On	288	451	2	3	73	No
10	3 Oct 2012	10:36	Tt	6	8	6	0	36.948	-76.167	On	270	387	2	3	73	No
11	3 Oct 2012	10:38	Tt	1	1	1	0	36.946	-76.158	On	0	0	2	3	73	No
12	3 Oct 2012	10:38	Tt	1	1	1	0	36.946	-76.157	On	270	50	2	3	73	No
13	3 Oct 2012	10:46	Tt	3	3	3	0	36.951	-76.136	On	286	115	2	8	73	No
14	3 Oct 2012	11:13	Tt	12	15	10	0	36.943	-76.083	On	0	0	2	11	72	No
15	3 Oct 2012	11:29	Tt	10	11	8	0	36.934	-76.065	On	288	194	2	10	72	No
16	3 Oct 2012	11:47	Tt	5	5	4	0	36.940	-76.030	On	350	35	2	7	72	No
17	3 Oct 2012	11:49	Tt	7	8	4	0	36.945	-76.018	On	280	693	2	5	72	No
18	3 Oct 2012	12:08	Tt	8	8	6	0	36.930	-76.001	On	90	300	1	3	72	No
19	3 Oct 2012	12:10	Tt	10	10	5	0	36.933	-75.988	On	20	132	1	3	72	No
20	3 Oct 2012	12:11	Tt	12	15	8	0	36.933	-75.994	Off	125	43	1	5	72	No

Sighting No.	Date	Time	Species	Group Size Best/High/Low			Calves	Sighting Latitude	Sighting Longitude	Effort	Bearing Angle	PSD† (m)	BSS*	Bottom Depth (m)	SST§ (°F)	Photos Taken
03 October 2012 INSHORE transect (continued)																
21	3 Oct 2012	12:13	Tt	6	6	4	0	36.938	-75.981	On	5	23	1	6	72	No
22	3 Oct 2012	12:20	Tt	18	21	10	2	36.935	-75.976	On	73	96	1	6	72	No
23	3 Oct 2012	12:24	Tt	7	7	6	2	36.922	-75.972	On	292	359	1	7	72	No
24	3 Oct 2012	12:24	Tt	9	14	9	0	36.925	-75.981	On	83	248	1	3	72	No
25	3 Oct 2012	12:28	Tt	2	2	2	0	36.914	-75.987	On	32	265	1	3	72	No
26	3 Oct 2012	12:29	Tt	6	6	5	0	36.915	-75.990	On	82	545	1	3	72	No
27	3 Oct 2012	12:30	Tt	3	3	3	0	36.909	-75.986	On	12	31	1	2	72	No
28	3 Oct 2012	12:37	Tt	1	1	1	0	36.894	-75.974	On	90	750	1	2	72	No
29	3 Oct 2012	12:49	Tt	3	4	3	0	36.874	-75.974	On	42	803	1	3	72	No
30	3 Oct 2012	12:53	Tt	8	10	6	0	36.871	-75.977	On	84	895	1	5	72	No
31	3 Oct 2012	14:03	Tt	1	1	1	0	36.755	-75.939	On	2	3	2	3	73	No
32	3 Oct 2012	14:21	Tt	7	12	7	0	36.719	-75.910	On	358	10	2	4	73	No
33	3 Oct 2012	14:36	Tt	11	13	10	0	36.692	-75.898	On	0	0	2	4	73	No
34	3 Oct 2012	14:50	Tt	18	20	15	2	36.668	-75.892	On	90	650	2	3	73	No
35	3 Oct 2012	14:52	Tt	5	5	5	0	36.663	-75.886	On	85	99	2	3	73	No
36	3 Oct 2012	14:53	Tt	5	5	4	0	36.647	-75.889	On	2	42	2	3	73	No
37	3 Oct 2012	14:54	Tt	5	5	5	0	36.654	-75.890	On	72	238	2	3	73	No
38	3 Oct 2012	14:55	Tt	3	3	3	0	36.651	-75.884	On	72	238	2	3	73	No
39	3 Oct 2012	14:57	Tt	4	4	4	0	36.643	-75.889	On	270	165	2	3	73	No
40	3 Oct 2012	15:35	Tt	6	6	3	0	36.570	-75.839	On	355	52	3	4	73	No
27 November 2012 INSHORE transect																
1	27 Nov 2012	12:35	Tt	40	50	40	6	36.820	-75.957	On	032	159	3	5-15	49	Yes
2	27 Nov 2012	13:18	Tt	18	25	15	0	36.769	-75.942	On	085	598	2	5-15	50	No
3	27 Nov 2012	13:20	Tt	7	8	5	0	36.761	-75.939	On	025	42	2	5-15	50	No
4	27 Nov 2012	14:31	Tt	3	3	3	0	36.650	-75.894	On	048	186	1	5-15	50	No
5	27 Nov 2012	14:50	Tt	8	10	7	1	36.609	-75.870	On	012	208	2	5-15	50	Yes
6	27 Nov 2012	15:07	Tt	8	9	7	0	36.586	-75.863	On	340	70	1	5-15	51	Yes
09 January 2013 INSHORE transect																
1	9 Jan 2013	13:52	Tt	30	40	30	6	36.699	-75.923	On	023	277	2	5-15	47	Yes
2	9 Jan 2013	14:07	Tt	35	35	35	12	36.708	-75.924	Off	000	268	2	5-15	47	Yes
3	9 Jan 2013	15:20	Tt	4	5	3	0	36.578	-75.840	On	328	200	2	5-15	47	Yes

Sighting No.	Date	Time	Species	Group Size Best/High/Low			Calves	Sighting Latitude	Sighting Longitude	Effort	Bearing Angle	PSD[†] (m)	BSS*	Bottom Depth (m)	SST[§] (°F)	Photos Taken
09 January 2013 INSHORE transect (continued)																
4	9 Jan 2013	15:48	Tt	23	25	20	0	36.597	-75.807	Off	000	-	2	5-15	47	Yes
22 February 2013 INSHORE transect																
1	22 Feb 2013	12:50	Tt	4	4	4	1	36.937	-76.006	On	346	23	2	5-15	43	No
2	22 Feb 2013	13:49	Tt	3	3	3	0	36.896	-75.958	On	279	55	2	5-15	43	Yes
3	22 Feb 2013	15:03	Tt	3	3	3	0	36.767	-75.936	On	303	19	2	5-15	43	No
4	22 Feb 2013	15:08	Tt	5	5	5	1	36.757	-75.941	On	000	0	2	5-15	43	No
5	22 Feb 2013	15:33	Tt	15	15	12	1	36.712	-75.915	On	054	42	2	5-15	43	Yes
6	22 Feb 2013	16:04	Tt	2	2	2	0	36.695	-75.903	On	002	0	3	5-15	43	No
01 April 2013 INSHORE transect																
1	1 Apr 2013	10:17	Tt	1	1	1	0	36.95	-76.22	On	324	110	2	5-15	47	No
2	1 Apr 2013	13:12	Mn	1	1	1	0	36.89	-75.95	On	032	140	2	9	49	Yes
3	1 Apr 2013	14:08	Mn	1	1	1	0	36.83	-75.94	On	321	139	2	9	50	No
28 April 2013 INSHORE transect																
1	28 Apr 2013	12:02	Tt	68	75	60	4	36.942	-75.975	On	316	80	3	15	57	Yes
2	28 Apr 2013	12:33	Tt	7	8	6	0	36.934	-75.975	On	331	80	3	5-15	57	No
3	28 Apr 2013	12:56	Tt	4	4	4	0	36.892	-75.949	Off	180	5	3	5-15	59	No
4	28 Apr 2013	13:27	Tt	4	4	3	0	36.832	-75.945	On	339	8	3	5-15	59	No
5	28 Apr 2013	13:31	Tt	3	4	2	0	36.820	-75.956	On	042	110	3	5-15	59	No
6	28 Apr 2013	14:59	Tt	9	10	8	0	36.639	-75.877	On	042	250	4	5-15	59	No
09 May 2013 INSHORE transect																
1	9 May 2013	10:48	Tt	1	1	1	0	36.744	-75.919	On	271	200	2	11	62	No
2	9 May 2013	11:34	Tt	5	7	3	0	36.832	-75.947	On	002	10	2	11	63	No
3	9 May 2013	11:56	Tt	26	30	25	2	36.877	-75.962	On	346	160	2	8	61	No
4	9 May 2013	12:09	Tt	3	3	3	0	36.894	-75.959	On	316	243	2	10	62	No
5	9 May 2013	12:20	Tt	8	9	7	0	36.913	-75.986	On	296	269	2	7	63	No
6	9 May 2013	12:37	Tt	8	10	7	0	36.934	-75.992	On	305	287	2	14	64	No
7	9 May 2013	13:06	Tt	7	7	5	0	36.945	-76.021	On	030	80	2	14	64	No
17 July 2013 INSHORE transect																
1	17 Jul 2013	7:15	Tt	8	10	6	0	36.588	-75.867	On	277	645	2	9	79	No
2	17 Jul 2013	7:22	Tt	3	3	3	0	36.612	-75.865	On	042	105	2	9	79	No
3	17 Jul 2013	7:40	Tt	5	5	5	0	36.646	-75.891	On	352	59	2	5-15	79	Yes

Sighting No.	Date	Time	Species	Group Size Best/High/Low			Calves	Sighting Latitude	Sighting Longitude	Effort	Bearing Angle	PSD† (m)	BSS*	Bottom Depth (m)	SST§ (ºF)	Photos Taken
17 July 2013 INSHORE transect (continued)																
4	17 Jul 2013	7:41	Tt	14	18	7	0	36.648	-75.889	On	056	211	2	5-15	79	Yes
5	17 Jul 2013	8:11	Tt	3	3	3	0	36.673	-75.877	On	063	600	2	5-15	79	No
6	17 Jul 2013	8:19	Tt	2	2	2	0	36.693	-75.890	On	065	645	2	5-15	79	No
7	17 Jul 2013	8:24	Tt	7	10	5	0	36.696	-75.915	On	275	105	2	5-15	79	No
8	17 Jul 2013	8:27	Tt	35	40	30	0	36.704	-75.919	On	061	59	2	5-15	84	No
9	17 Jul 2013	8:27	Tt	50	60	45	0	36.701	-75.919	On	285	211	2	7	84	Yes
10	17 Jul 2013	8:44	Tt	2	2	2	0	36.717	-75.910	On	033	600	2	7	84	No
11	17 Jul 2013	8:46	Tt	12	15	10	1	36.724	-75.912	On	309	181	2	5-15	80	No
12	17 Jul 2013	9:00	Tt	2	2	2	0	36.758	-75.929	On	063	418	2	5-15	80	No
13	17 Jul 2013	9:00	Tt	2	2	2	0	36.754	-75.934	On	000	350	2	5-15	80	No
14	17 Jul 2013	9:02	Tt	4	5	2	0	36.759	-75.937	On	054	97	2	5-15	80	No
15	17 Jul 2013	9:04	Tt	32	35	30	1	36.762	-75.940	On	347	54	2	5-15	80	No
16	17 Jul 2013	9:08	Tt	14	20	10	0	36.775	-75.938	On	306	272	2	5-15	80	No
17	17 Jul 2013	9:09	Tt	2	2	2	0	36.774	-75.928	On	090	623	2	5-15	80	No
18	17 Jul 2013	9:10	Tt	2	2	2	0	36.777	-75.933	On	271	0	2	5-15	80	No
19	17 Jul 2013	9:19	Tt	7	9	5	0	36.799	-75.937	On	338	323	3	5-15	82	No
20	17 Jul 2013	9:25	Tt	8	10	6	1	36.809	-75.952	On	329	72	3	5-15	81	No
21	17 Jul 2013	9:58	Tt	1	1	1	0	36.881	-75.958	On	322	70	3	5-15	81	No
22	17 Jul 2013	10:08	Tt	3	3	3	0	36.905	-75.966	On	076	65	3	5-15	81	No
23	17 Jul 2013	10:10	Tt	4	4	4	0	36.905	-75.976	On	000	193	3	5-15	75	No
24	17 Jul 2013	10:12	Tt	5	5	5	0	36.906	-75.980	On	056	41	3	5-15	75	No
25	17 Jul 2013	10:15	Tt	24	25	22	2	36.914	-75.983	On	335	74	3	5-15	75	No
26	17 Jul 2013	10:32	Tt	9	10	6	0	36.934	-75.993	On	318	134	3	5-15	81	No
27	17 Jul 2013	11:41	Cc	1	1	1	-	36.945	-76.007	On	063	-	2	5-15	81	No
28	17 Jul 2013	12:22	Tt	5	6	4	0	36.934	-76.175	On	314	108	2	5-15	81	Yes
29	17 Jul 2013	12:45	Tt	11	12	10	0	36.953	-76.189	On	283	146	2	5-15	81	No
30	17 Jul 2013	13:42	Tt	1	1	1	0	36.997	-76.302	On	032	106	2	5-15	81	No
24 July 2013 INSHORE transect																
1	24 Jul 2013	9:36	Tt	5	7	5	1	36.944	-76.179	On	118.9	191	2	9	78	Yes
2	24 Jul 2013	11:14	Tt	125	140	110	6	36.935	-76.026	On	152.8	109	2	4	77	Yes
3	24 Jul 2013	11:45	Tt	11	15	8	0	36.946	-76.021	On	17.0	33	2	18	77	No
4	24 Jul 2013	12:19	Tt	6	6	6	0	36.936	-75.995	On	131.3	200	1	12	80	No

Sighting No.	Date	Time	Species	Group Size Best/High/Low			Calves	Sighting Latitude	Sighting Longitude	Effort	Bearing Angle	PSD[†] (m)	BSS*	Bottom Depth (m)	SST[§] (°F)	Photos Taken
24 July 2013 INSHORE transect (continued)																
5	24 Jul 2013	12:21	Tt	22	25	16	1	36.933	-76.002	On	178.4	36	1	9	80	No
6	24 Jul 2013	12:41	Tt	18	18	18	0	36.914	-75.976	On	152.9	179	1	5	78	No
7	24 Jul 2013	12:57	Tt	3	3	3	0	36.889	-75.946	On	135.4	13	2	9	73	No
8	24 Jul 2013	12:58	Tt	100	110	90	3	36.884	-75.943	On	127.0	241	2	9	73	Yes
9	24 Jul 2013	13:28	Tt	3	3	3	0	36.868	-75.960	On	250.2	7	2	8	73	No
10	24 Jul 2013	13:42	Tt	6	6	6	0	36.846	-75.942	On	223.3	75	2	9	78	No
11	24 Jul 2013	14:04	Tt	2	2	2	0	36.803	-75.940	On	102.5	50	2	9	73	No
12	24 Jul 2013	14:43	Tt	10	12	6	1	36.715	-75.914	On	217.8	97	2	10	77	No
13	24 Jul 2013	14:46	Tt	8	8	8	0	36.712	-75.925	On	287.7	978	2	9	77	No
13 August 2013 INSHORE transect																
1	13 Aug 2013	8:12	Tt	4	4	3	0	36.974	-76.322	On	165.7	117	3	2	81	Yes
2	13 Aug 2013	9:28	Tt	40	45	35	2	36.942	-76.218	On	159.8	249	2	3	81	Yes
3	13 Aug 2013	12:03	Tt	10	12	7	0	36.934	-76.025	On	169.1	137	3	16	80	No
4	13 Aug 2013	12:12	Tt	90	100	80	4	36.960	-76.004	On	81.7	199	3	24	80	Yes
5	13 Aug 2013	12:26	Tt	9	13	3	0	36.939	-76.003	On	180.0	87	3	24	80	No
6	13 Aug 2013	13:48	Tt	2	2	2	0	36.803	-75.935	On	76.5	76	3	9	77	No
7	13 Aug 2013	14:02	Tt	3	3	3	0	36.788	-75.926	On	0.0	35	3	12	77	No
8	13 Aug 2013	14:05	Tt	68	75	65	0	36.778	-75.928	On	123.9	252	3	12	77	No
9	13 Aug 2013	15:21	Tt	150	100	175	3	36.751	-75.924	Off	-	320	2	12	77	Yes
25 September 2013 INSHORE transect																
1	25 Sep 2013	9:10	Tt	175	180	150	0	36.592	-75.861	On	358.1	241	2	10	72	Yes
2	25 Sep 2013	9:37	Tt	6	6	6	0	36.600	-75.872	Off	0.0	0	2	10	72	No
3	25 Sep 2013	9:40	Tt	9	15	12	0	36.609	-75.868	On	48.6	103	2	10	72	No
4	25 Sep 2013	9:42	Tt	5	7	5	0	36.614	-75.869	On	6.2	137	2	11	71	No
5	25 Sep 2013	9:49	Tt	30	35	20	0	36.635	-75.857	On	17.0	137	2	11	71	No
6	25 Sep 2013	10:05	Tt	1	1	1	0	36.653	-75.886	On	104.5	362	2	11	71	No
7	25 Sep 2013	10:24	Tt	3	3	3	0	36.694	-75.903	On	289.1	56	2	10	72	No
8	25 Sep 2013	10:33	Tt	7	7	5	0	36.714	-75.911	On	46.6	239	1	10	72	No
9	25 Sep 2013	10:40	Tt	3	3	3	0	36.729	-75.919	On	300.9	975	1	12	72	No
10	25 Sep 2013	10:46	Tt	3	3	3	0	36.742	-75.914	On	279.4	266	1	10	72	No
11	25 Sep 2013	10:47	Tt	4	5	4	0	36.748	-75.912	On	3.1	362	1	10	72	No

Sighting No.	Date	Time	Species	Group Size Best/High/Low			Calves	Sighting Latitude	Sighting Longitude	Effort	Bearing Angle	PSD[†] (m)	BSS*	Bottom Depth (m)	SST[§] (°F)	Photos Taken
25 September 2013 INSHORE transect (continued)																
12	25 Sep 2013	10:53	Tt	145	160	120	6	36.752	-75.921	On	348.3	411	1	10	72	Yes
13	25 Sep 2013	11:47	Tt	6	7	5	0	36.819	-75.964	On	306.3	600	1	9	73	No
14	25 Sep 2013	11:52	Tt	3	4	3	0	36.830	-75.951	On	0.0	139	1	9	73	No
15	25 Sep 2013	11:59	Tt	55	60	45	0	36.847	-75.930	On	66.7	447	1	9	73	No
16	25 Sep 2013	12:15	Tt	7	10	7	0	36.873	-75.961	On	97.9	160	1	8	73	No
17	25 Sep 2013	12:20	Tt	30	35	25	0	36.890	-75.955	On	8.8	354	2	12	73	No
18	25 Sep 2013	12:22	Mn	1	1	1	0	36.882	-75.950	On	195.7	496	2	12	73	Yes
19	25 Sep 2013	12:49	Tt	3	3	3	0	36.909	-75.984	On	341.1	176	2	11	71	No
20	25 Sep 2013	12:50	Tt	15	20	12	0	36.912	-75.988	On	302.9	383	2	11	71	No
21	25 Sep 2013	12:53	Tt	5	5	5	0	36.922	-75.979	On	43.6	95	2	11	71	No
22	25 Sep 2013	12:59	Tt	18	25	15	0	36.942	-75.970	On	35.0	199	2	11	72	No
23	25 Sep 2013	13:12	Tt	13	15	8	0	36.933	-75.999	On	252.1	12	2	11	72	No
24	25 Sep 2013	13:17	Tt	8	10	8	0	36.938	-76.004	On	59.5	114	2	11	72	No
25	25 Sep 2013	13:19	Tt	4	4	4	0	36.946	-76.010	On	312.4	280	2	11	72	No
26	25 Sep 2013	13:22	Tt	8	10	7	0	36.953	-76.008	On	357.7	51	2	11	72	No
27	25 Sep 2013	13:24	Tt	5	5	5	0	36.958	-76.009	On	345.3	107	2	11	72	No
28	25 Sep 2013	13:30	Tt	21	25	21	0	36.945	-76.022	On	226.1	42	2	10	72	No
29	25 Sep 2013	13:38	Tt	1	1	1	0	36.944	-76.036	On	350.7	57	2	10	72	No
30	25 Sep 2013	13:44	Tt	6	6	5	0	36.952	-76.055	On	242.4	680	2	10	72	No
31	25 Sep 2013	13:46	Tt	42	35	50	0	36.950	-76.070	On	255.9	260	2	10	72	No
32	25 Sep 2013	13:55	Tt	9	10	8	0	36.930	-76.059	On	143.0	671	2	10	73	No
33	25 Sep 2013	14:05	Tt	2	2	2	0	36.927	-76.093	On	278.6	964	2	10	73	No
34	25 Sep 2013	14:45	Tt	6	8	5	0	36.948	-76.192	On	307.2	436	2	6	74	No
35	25 Sep 2013	15:11	Tt	2	2	2	0	36.976	-76.241	On	313.0	1149	2	7	74	No
36	25 Sep 2013	15:53	Cc	1	1	1	0	36.993	-76.308	On	251.6	500	2	21	74	No
37	25 Sep 2013	16:34	Tt	28	30	25	2	36.955	-76.376	On	282.4	104	2	7	74	No
38	25 Sep 2013	16:49	Tt	40	45	35	4	36.931	-76.346	On	152.8	70	2	7	74	Yes
17 October 2013 INSHORE transect																
1	17 Oct 2013	11:59	Tt	3	4	3	0	36.931	-76.111	On	340.0	275	2	7	70	No
2	17 Oct 2013	12:26	Tt	8	10	4	0	36.955	-76.059	On	321.0	570	1	12	70	No
3	17 Oct 2013	12:28	Tt	2	2	2	0	36.952	-76.054	On	299.0	250	1	12	70	No
4	17 Oct 2013	12:46	Tt	5	8	4	0	36.955	-76.015	On	306.0	525	3	21	70	No

Sighting No.	Date	Time	Species	Group Size Best/High/Low			Calves	Sighting Latitude	Sighting Longitude	Effort	Bearing Angle	PSD[†] (m)	BSS*	Bottom Depth (m)	SST[§] (°F)	Photos Taken
17 October 2013 INSHORE transect (continued)																
5	17 Oct 2013	12:59	Tt	54	60	45	2	36.932	-76.004	On	215.0	26	3	4	70	Yes
6	17 Oct 2013	13:23	Cc	1	1	1	-	-	-	Off	-	-	-	7	70	No
7	17 Oct 2013	13:28	Tt	1	1	1	0	36.938	-75.983	On	32.0	11	3	17	69	No
8	17 Oct 2013	13:45	Tt	12	15	8	0	36.907	-75.985	On	280.0	94	3	4	69	No
9	17 Oct 2013	14:13	Tt	20	24	16	0	36.857	-75.972	On	264.0	122	3	7	69	No
10	17 Oct 2013	14:39	Tt	36	41	29	4	36.812	-75.964	On	236.0	61	3	5	70	Yes
11	17 Oct 2013	16:17	Tt	5	8	4	0	36.698	-75.920	On	237.0	20	3	6	69	No
16 November 2013 INSHORE transect																
1	16 Nov 2013	8:03	Tt	5	7	3	0	36.586	-75.851	On	60.9	366	2	11	58	No
2	16 Nov 2013	8:19	Tt	4	5	3	0	36.621	-75.865	On	302.4	299	2	11	57	No
3	16 Nov 2013	8:35	Tt	22	25	16	0	36.643	-75.890	On	213.8	300	2	4	56	Yes
4	16 Nov 2013	8:54	Tt	3	4	2	0	36.657	-75.883	On	65.0	259	2	5	54	No
5	16 Nov 2013	12:14	Tt	9	12	6	0	36.923	-76.059	On	139.5	334	2	5	54	No
6	16 Nov 2013	12:34	Tt	4	4	3	1	36.924	-76.120	On	259.0	23	2	3	53	Yes

Note:
* BSS = Beaufort Sea State
[†] PSD = Perpendicular Sighting Distance
§ SST = Sea Surface Temperature

Key:
Cc = Loggerhead turtle (*Caretta caretta*)
Mn = Humpback whale (*Megaptera novaeangliae*)
Tt = Bottlenose dolphin (*Tursiops truncatus*)

APPENDIX D
MINEX Transect Survey Marine Mammal and Sea Turtle Sightings

Sighting No.	Date	Time	Species	Group Size Best/High/Low			Calves	Sighting Latitude	Sighting Longitude	Effort	Bearing Angle	PSD† (m)	BSS*	Bottom Depth (m)	SST§ (°F)	Photos Taken
08 August 2012 MINEX transect																
1	8 Aug 2012	15:09	Cc	1	1	1	-	36.629	-75.721	On	280	157	180	12	78	No
2	8 Aug 2012	15:10	Cc	1	1	1	-	36.630	-75.715	On	090	194	140	12	78	No
23 October 2012 MINEX transect																
1	23 Oct 2012	12:02	Cc	1	1	1	-	36.754	-75.658	On	000	0	2	10-20	65	No
2	23 Oct 2012	13:03	Tt	5	6	4	0	36.658	-75.857	On	043	682	2	10-20	66	No
3	23 Oct 2012	14:23	Cc	1	1	1	-	36.643	-75.636	On	355	267	1	10-20	66	No
10 November 2012 MINEX transect																
1	10 Nov 2012	7:33	Tt	5	5	3	0	36.607	-75.810	On	010	60	2	14	55	No
2	10 Nov 2012	7:39	Tt	3	3	3	0	36.617	-75.791	On	278	500	2	14	56	No
3	10 Nov 2012	7:40	Tt	2	2	2	0	36.616	-75.788	On	000	250	2	14	56	No
03 January 2013 MINEX transect																
1	3 Jan 2013	11:35	Mn	1	1	1	0	36.674	-75.870	Off	308	394	3	15	45	Yes
23 March 2013 MINEX transect																
1	23 Mar 2013	13:13	Tt	5	5	5	0	36.689	-75.831	Off	025	55	2	10-20	41	No
2	23 Mar 2013	13:38	Dd	5	8	5	1	36.685	-75.758	On	085	298	2	10-20	41	No
3	23 Mar 2013	15:37	Unid	7	12	5	0	36.633	-75.767	On	041	751	2	10-20	41	No
31 May 2013 MINEX transect																
1	31 May 2013	11:31	Tt	4	5	3	0	36.865	-75.710	On	344	221	3	21	68	No
2	31 May 2013	12:11	Cc	1	1	1	-	36.828	-75.838	On	089	20	3	10-20	68	No
3	31 May 2013	13:35	Cc	1	1	1	-	36.771	-75.854	On	326	17	4	10-20	68	No
4	31 May 2013	14:00	Tt	3	3	3	0	36.797	-75.772	On	337	105	4	18	68	No
22 July 2013 MINEX transect																
1	22 Jul 2013	11:34	Tt	45	50	40	1	36.75762	-75.5959	Off	290	650	2	22	74	Yes
27 July 2013 MINEX transect																
1	27 Jul 2013	7:39	Dc	1	1	1	-	36.615	-75.780	On	0.0	44	1	22	72	No
2	27 Jul 2013	7:42	Dc	1	1	1	-	36.617	-75.771	On	53.1	37	1	23	72	No
3	27 Jul 2013	7:47	Dc	1	1	1	-	36.625	-75.754	On	34.6	83	1	20	72	No

Sighting No.	Date	Time	Species	Group Size Best/High/Low			Calves	Sighting Latitude	Sighting Longitude	Effort	Bearing Angle	PSD† (m)	BSS*	Bottom Depth (m)	SST§ (°F)	Photos Taken
27 July 2013 MINEX transect (continued)																
4	27 Jul 2013	8:19	Dc	1	1	1	-	36.662	-75.652	On	100.9	20	1	21	72	No
5	27 Jul 2013	8:32	UnidST	1	1	1	-	36.678	-75.608	On	134.0	211	1	21	72	No
6	27 Jul 2013	8:44	UnidST	1	1	1	-	36.693	-75.570	On	128.3	145	1	20	72	No
7	27 Jul 2013	9:28	Dc	1	1	1	-	36.725	-75.667	On	326.8	86	1	23	74	No
8	27 Jul 2013	9:31	Cc	1	1	1	-	36.721	-75.676	On	198.1	22	1	19	74	No
9	27 Jul 2013	9:34	Dc	1	1	1	-	36.719	-75.687	On	243.9	29	1	18	74	No
10	27 Jul 2013	9:40	UnidST	1	1	1	-	36.713	-75.707	On	304.5	89	1	20	74	No
11	27 Jul 2013	9:44	Dc	1	1	1	-	36.707	-75.718	On	200.2	97	1	20	74	No
12	27 Jul 2013	9:47	Dc	1	1	1	-	36.704	-75.731	On	249.7	27	1	23	74	No
13	27 Jul 2013	9:49	Dc	1	1	1	-	36.702	-75.735	On	242.2	22	1	20	74	No
14	27 Jul 2013	9:51	UnidST	1	1	1	-	36.699	-75.740	On	166.6	160	1	19	74	No
15	27 Jul 2013	9:56	UnidST	1	1	1	-	36.693	-75.760	On	167.9	9	1	19	74	No
16	27 Jul 2013	10:00	Dc	1	1	1	-	36.689	-75.773	On	344.0	120	1	19	74	No
17	27 Jul 2013	10:04	Dc	1	1	1	-	36.685	-75.786	On	338.0	240	1	19	74	No
18	27 Jul 2013	10:10	Cc	1	1	1	-	36.673	-75.809	On	300.0	259	1	20	74	No
19	27 Jul 2013	10:41	Tt	36	36	13	3	36.729	-75.820	On	68	4	2	15	74	Yes
20	27 Jul 2013	11:06	Dc	1	1	1	-	36.730	-75.803	On	24.6	60	2	16	72	No
21	27 Jul 2013	11:08	UnidST	1	1	1	-	36.731	-75.795	On	119.1	79	2	16	72	No
22	27 Jul 2013	11:20	Dc	1	1	1	-	36.743	-75.755	On	170.8	320	2	16	72	No
23	27 Jul 2013	11:30	Dc	1	1	1	-	36.756	-75.721	On	97.8	30	2	18	72	No
24	27 Jul 2013	11:37	UnidST	1	1	1	-	36.765	-75.702	On	339.7	60	2	20	72	No
25	27 Jul 2013	11:43	Cc	1	1	1	-	36.769	-75.686	On	128.4	57	2	22	72	No
26	27 Jul 2013	13:20	UnidST	1	1	1	-	36.780	-75.826	On	205.5	42	2	17	73	No
27	27 Jul 2013	14:02	Cc	1	1	1	-	36.826	-75.851	On	349.3	70	2	17	73	No
19 August 2013 MINEX transect																
1	19 Aug 2013	7:55	Cc	1	1	1	-	36.689	-75.583	On	210.3	193	3	25	79	No
2	19 Aug 2013	8:14	Cc	1	1	1	-	36.670	-75.645	On	275.6	125	3	26	78	No
3	19 Aug 2013	10:24	Cc	1	1	1	-	36.737	-75.629	On	348.8	252	3	20	73	No
4	19 Aug 2013	10:27	Cc	1	1	1	-	36.742	-75.614	On	57.4	282	3	20	73	No
5	19 Aug 2013	12:00	Cc	1	1	1	-	36.731	-75.814	On	275.6	51	2	14	72	No
28 October 2013 MINEX transect																
No Sightings																

Sighting No.	Date	Time	Species	Group Size Best/High/Low			Calves	Sighting Latitude	Sighting Longitude	Effort	Bearing Angle	PSD† (m)	BSS*	Bottom Depth (m)	SST§ (°F)	Photos Taken
30 October 2013 MINEX transect																
1	30 Oct 2013	8:57	Cc	1	1	1	-	36.683	-75.614	on	345.4	193	1	16	63	No

Note:
* BSS = Beaufort Sea State
† PSD = Perpendicular Sighting Distance
§ SST = Sea Surface Temperature

Key:
Cc = Loggerhead turtle (*Caretta caretta*)
Dc = Leatherback turtle (*Dermochelys coriacea*)
Dd = Short-beaked common dolphin (*Delphinus delphis*)
Mn = Humpback whale (*Megaptera novaeangliae*)
Tt = Bottlenose dolphin (*Tursiops truncatus*)
UnidST = unidentified sea turtle
Unid = unidentified dolphin

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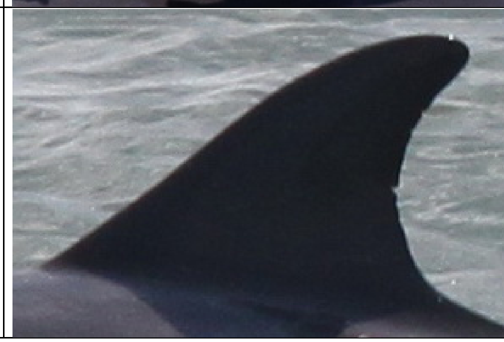
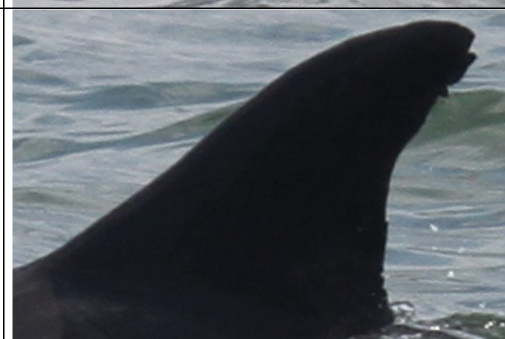
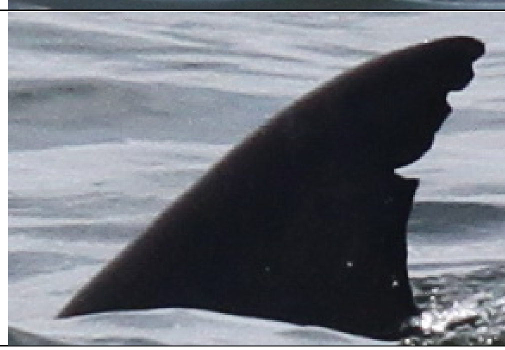
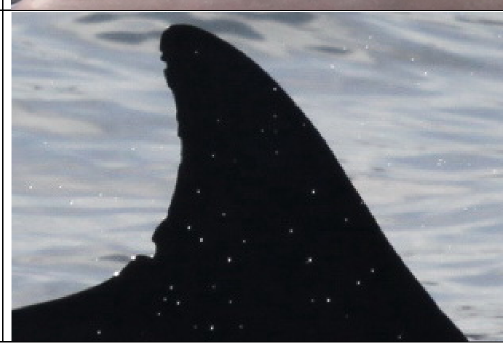
APPENDIX E
Identification Photos of Re-sighted Individuals

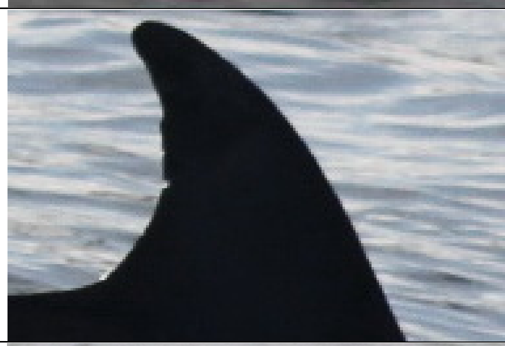
Catalog ID No.	Initial Sighting Photo	First Matched Re-sighting Photo	Second Matched Re-sighting Photo
NVB0003			
NVB0006			

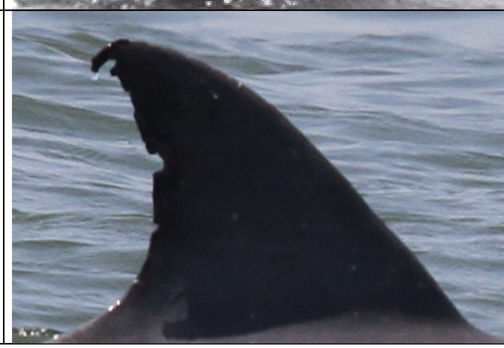
Catalog ID No.	Initial Sighting Photo	First Matched Re-sighting Photo	Second Matched Re-sighting Photo
NVB0008			
NVB0009			
NVB0010			

Catalog ID No.	Initial Sighting Photo	First Matched Re-sighting Photo	Second Matched Re-sighting Photo
NVB0011			
NVB0012			
NVB0014			

Catalog ID No.	**Initial Sighting Photo**	**First Matched Re-sighting Photo**	**Second Matched Re-sighting Photo**
NVB0020			
NVB0033			
NVB0083			

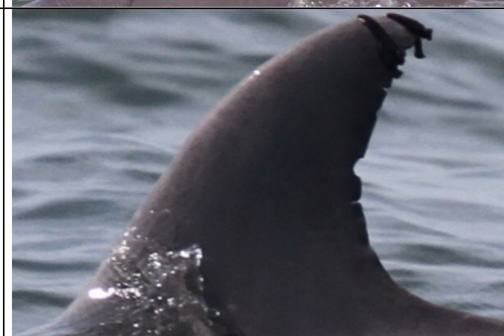
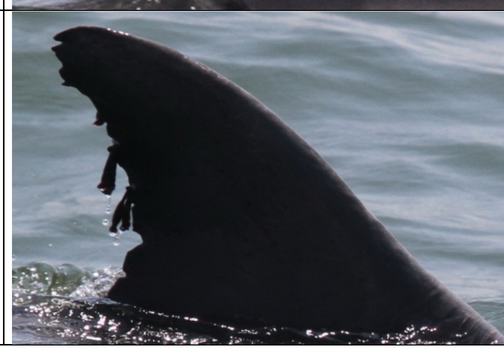
Catalog ID No.	Initial Sighting Photo	First Matched Re-sighting Photo	Second Matched Re-sighting Photo
NVB0084			
NVB0086			
NVB0111			

Catalog ID No.	Initial Sighting Photo	First Matched Re-sighting Photo	Second Matched Re-sighting Photo
NVB0115			
NVB0133			
NVB0152			

Catalog ID No.	Initial Sighting Photo	First Matched Re-sighting Photo	Second Matched Re-sighting Photo
NVB0155			
NVB0164			
NVB0165			

Catalog ID No.	Initial Sighting Photo	First Matched Re-sighting Photo	Second Matched Re-sighting Photo
NVB0172			
NVB0175			
NVB0179			

Catalog ID No.	Initial Sighting Photo	First Matched Re-sighting Photo	Second Matched Re-sighting Photo
NVB0183			
NVB0188			
NVB0189			

Catalog ID No.	Initial Sighting Photo	First Matched Re-sighting Photo	Second Matched Re-sighting Photo
NVB0193			
NVB0195			
NVB0199			

Catalog ID No.	Initial Sighting Photo	First Matched Re-sighting Photo	Second Matched Re-sighting Photo
NVB0211			
NVB0212			
NVB0214			

Catalog ID No.	Initial Sighting Photo	First Matched Re-sighting Photo	Second Matched Re-sighting Photo
FB405