VACAPES Offshore Cetacean Study, Virginia Beach, Virginia: 2023 Annual Progress Report

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Cover Photo Credit:

Sperm whales (*Physeter macrocephalus*) off the coast of Virginia. Photographed by Amy Engelhaupt. Photograph taken under National Marine Fisheries Service Scientific Research Permit No. 21482, issued to Dan Engelhaupt.

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Acronyms and Abbreviations

°N	degrees North
°W	degrees West
BSS	Beaufort sea state
COMPASS	Cetacean Observation and Marine Protected Animal Survey Software
DTAG	digital acoustic recording tag
ESA	Endangered Species Act
GMT	Greenwich Mean Time
GPS	Global Positioning System
hr	hour(s)
ID	Identification Number
km	kilometer(s)
LiDAR	Light Detection and Ranging
LIMPET	Low-Impact Minimally Percutaneous Electronic Transmitter
m	meter(s)
Max	maximum
MICS	Mingan Island Cetacean Study
min	minute(s)
mm:ss	minutes:seconds
MMO	marine mammal observer
NAVFAC	Naval Facilities Engineering Systems Command
nm	nautical mile(s)
No.	number
OCS	Offshore Cetacean Study
OPAREA	Operating Area
photo-ID	photo-identification
SPOT	Smart Position and Temperature

U.S.	United States
VACAPES	Virginia Capes
VHF	very high frequency

1. Introduction and Background

The United States (U.S.) Navy routinely conducts training and testing activities within the Virginia Capes (VACAPES) Operating Area (OPAREA) off the Mid-Atlantic and Southeast U.S. The region encompassing the deeper waters of the continental shelf, shelf break, and continental slope has been recognized as an important habitat for multiple species of cetaceans. Kenney and Winn (1986) showed that the shelf edge from Cape Hatteras to Georges Bank was the second-most intensively used cetacean habitat off the northeastern U.S. based on 3 years of surveys conducted by the Cetacean and Turtle Assessment Program (CETAP 1982). More recent, still ongoing, broad-scale surveys by the National Marine Fisheries Service, including the Atlantic Marine Assessment Program for Protected Species, and marine mammal stock-assessment reports (Hayes et al. 2021), continue to show the same pattern.

Cetacean species known to be common seasonally in outer continental shelf, slope, and rise waters include both baleen whales and odontocetes, such as fin whales (*Balaenoptera physalus*), sei whales (*Balaenoptera borealis*), minke whales (*Balaenoptera acutorostrata*), humpback whales (*Megaptera novaeangliae*), sperm whales (*Physeter macrocephalus*), beaked whales (*Ziphius cavirostris*, *Mesoplodo*n spp.), long- and short-finned pilot whales (*Globicephala melas* and *G. macrorhynchus*, respectively), Risso's dolphins (*Grampus griseus*), common bottlenose dolphins (*Tursiops truncatus*), common dolphins (*Delphinus delphis*), Atlantic white-sided dolphins (*Lagenorhynchus acutus*), Atlantic spotted dolphins (*Stenella frontalis*), and striped dolphins (*Stenella coeruleoalba*) (CETAP 1982; Hain et al. 1985, 1992; Kenney and Winn 1986, 1987; Selzer and Payne 1988; Kenney 1990; Payne and Heinemann 1993; Waring et al. 1993, 2001; Northridge et al. 1997; Palka et al. 1997; Mead 2009; NEFSC and SEFSC 2012, 2013; Jefferson et al. 2014; Hayes et al. 2021). Fin, sei, and sperm whales are all listed as endangered under the U.S. Endangered Species Act (ESA).

Recent aerial and vessel surveys as well as passive acoustic monitoring studies for the U.S. Navy Marine Species Monitoring Program (Mallette et al. 2017, 2018a; Salisbury et al. 2018; Foley et al. 2019; Cotter 2019) have provided data confirming the overall distribution patterns and suggesting that the outer shelf area off Virginia in the VACAPES OPAREA would be an ideal location for more focused research on the ecology and behavior of several species of cetaceans. Offshore surveys were first conducted in association with the Mid-Atlantic Humpback Whale Monitoring project from April 2015 through June 2016, and subsequently, a dedicated project focusing on outer continental shelf cetaceans was initiated in July 2016.

Coverage has extended farther offshore as the study has evolved, and considering priority species are often encountered past the continental slope and not over the continental shelf, the project name has changed to Offshore Cetacean Study (OCS). This progress report includes all offshore (i.e. near the shelf break and beyond) monitoring activities conducted in 2023. The goals of this effort continue to focus on addressing fundamental information gaps related to marine mammal occurrence, exposure, and response as primary components of the conceptual framework for the U.S Navy's Marine Species Monitoring Program

In order to address these informational gaps for offshore waters in the VACAPES OPAREA, a combination of techniques is being used, including: (1) photo-identification (photo-ID), photogrammetry, and behavioral data collection from vessels and drones to provide baseline assessments of animal movement patterns, site fidelity, habitat use, life history, and behavior; (2) biopsy sampling for incorporation into existing genetic studies (where opportunities exist) to identify individuals, establish gender, and assist in delineating stock structure; (3) satellite-linked telemetry tagging techniques to provide information about residency patterns, dive profiles, and habitat use across intermediate time scales (weeks to months); and (4) suction-cup tagging to investigate diving and foraging behavior through collection of high-resolution underwater movement and acoustic data.

Residency and movement patterns are of particular interest given the potential for repeated exposure to U.S. Navy training and testing activities known to occur within the area. Findings from work conducted near the continental shelf break off the coast of southeastern Virginia and Cape Hatteras, North Carolina, suggest a year-round presence of several species of cetaceans, including *Ziphius cavirostris* ("Ziphius") and short-finned pilot whales (McAlarney et al. 2018a, 2018b; Waples and Read 2020, 2021, 2022). Tagging efforts for this project provide opportunities to assess movement patterns of additional species, and may identify the extent of overlap between these animals as well as with offshore training and testing activities conducted within the VACAPES OPAREA. Given the duration of the tag attachments and experience from previous tagging studies within waters off Cape Hatteras, North Carolina (Baird et al. 2018), there is potential to track tagged animals more broadly, including through the Cherry Point OPAREA to the south and the Atlantic City OPAREA to the north.

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

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

2. Methods

The primary survey area includes the offshore waters (approximately 90 to 160 kilometers [km] [50 to 85 nautical miles (nm)]) off the coast of Virginia (**Figure 1**). The offshore study area includes the outer continental shelf, shelf break, slope waters, and Norfolk and Washington Canyons. Depths within the core study area range from approximately 50 meters (m) to as much as 2,500 m.

2.1 Survey Operations

The 16.2-m offshore charter sport-fishing vessel *Top Notch* (**Figure 2)** was the primary vessel used in 2023 to support surveys. Other similar charter vessels were used when *Top Notch* was not available. Each vessel is equipped with a Global Positioning System (GPS) receiver, marine radio, emergency beacon, life raft, depth sounder, and emergency equipment. All captains are familiar with the Virginia Beach waterways and unique characteristics of the region, and hold U.S. Coast Guard-approved 100-ton master's licenses. The scientific crew typically consisted of a minimum of three marine mammal observers (MMOs), but no more than five, including (at least) one photographer/drone operator, one tagging specialist, and one biopsy specialist. Roles generally were interchangeable throughout surveys. An aerial survey platform may also be included occasionally to assist as a spotter to identify opportunities for the vessel team to work with animals.

Survey departure times were planned to maximize weather and clearance windows, and to take into account the long transit time to reach the survey area (approximately 3 hours [hr] each way when transiting at 20-plus knots). Survey days were planned to use survey time within the area of interest during optimal weather conditions, including good visibility and a Beaufort sea state (BSS) of 3 or lower when possible, as well as access to the VACAPES OPAREA range boxes within the study area (K3, K4, I4, 1B1, 1B2, 1B3, and 1B4; **Figure 1**) so that the research vessels had clearance to operate when training was not being conducted.

Surveys departed from Rudee Inlet in Virginia Beach, Virginia. In order to maximize achievement of the project's core objectives, departures from the marina were scheduled at approximately sunrise or earlier, and a minimum of 12 hr was allocated for each survey day. Once departing the marina, transit time was approximately 3 hr to reach the study area. MMOs were on-effort during the outbound and inbound transit as long as there was sufficient daylight and a BSS of 4 or lower. Due to the distance from shore and overall effort required to complete each survey day, effort within the primary study area continued until the end of the survey day even if sea states turned unfavorable (BSS 4 to 6), unless conditions were deemed to be unsafe. Every effort was made to avoid such circumstances by following weather forecasts closely before commencing a survey day.

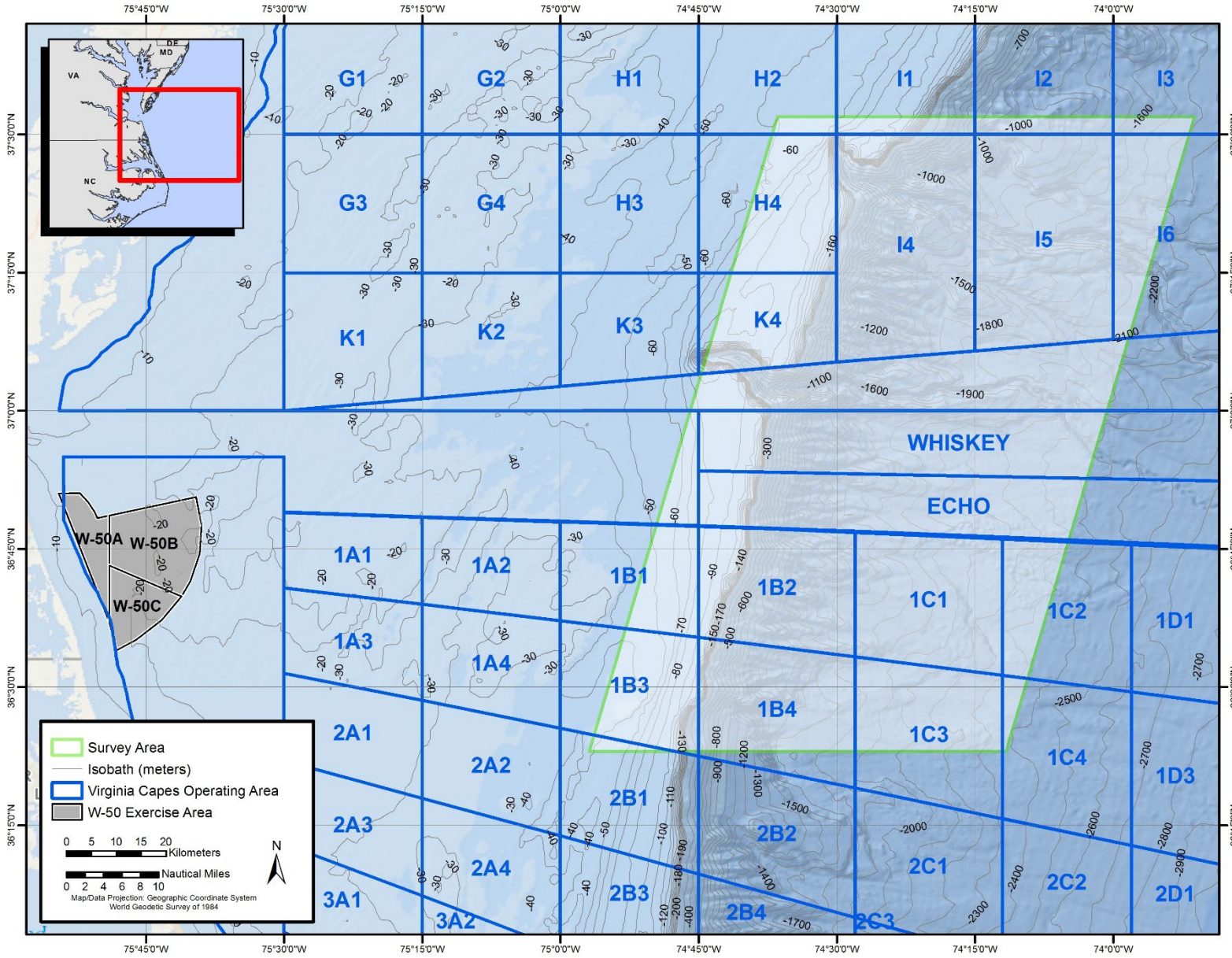

Figure 1. Map of the offshore study area off southeastern Virginia and northern North Carolina, and VACAPES training range surface grid within the region.

Figure 2. The primary sport-fishing vessel chartered for use during offshore surveys, the 16.2-m *Top Notch*.

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

The on-effort MMOs used both unaided eyes and 10x30 hand-held, image-stabilized binoculars. MMOs covered a 270-degree swath of observation area in front and to the sides of the survey vessel. Once in deep water (more than 400 m), a directional hydrophone was also used to listen for sperm whales periodically. If clicks were heard, every effort was made to localize the detections and maneuver the vessel toward where the whales were heard. If no clicks were heard, the vessel would continue transiting before stopping approximately 20 to 30 minutes (min) later to listen within a different area.

Once a sighting was made, one MMO focused on data entry using Cetacean Observation and Marine Protected Animal Survey Software (COMPASS; Richlen et al. 2019) running on an Apple iPad tablet (see **Appendix A**), while others focused on visual tracking and obtaining photo-ID images of the individual or group. In addition to photo-ID, some species were targeted for drone data collection, biopsy sampling, satellite tagging, and/or suction-cup tagging. Baleen, sperm, and beaked whales were given highest priority in terms of time and effort spent

collecting information and attempting to deploy tags and collect samples. Species not frequently seen within the area, such as killer whales (*Orcinus orca*), false killer whales (*Pseudorca crassidens*), melon-headed whales (*Peponocephala electra*), and pygmy killer whales (*Feresa attenuata*) are also considered high-priority if encountered. Pilot whales and Risso's dolphins were generally medium-priority species and only approached if higher-priority species were not encountered; however, because of the high number of pilot whale sightings, groups were not always approached for identification to species and photo-ID documentation. Other delphinid species were low priority, and effort spent collecting data and conducting photo-ID was limited to confirming species identification, estimating group size, and determining initial behavior if time allowed.

During a high-priority marine mammal sighting, the research vessel would attempt to approach the animal(s) for photo-ID, biopsy sampling, focal-follow data collection, drone video collection, and/or tagging. The approach was done in a manner to minimize disturbance to the animals and maximize the crew's abilities to confirm species, estimate group size, and collect photo-IDs and video. The decision on when to end data-collection efforts on a priority species or switch to a different sighting was made by the Chief Scientist.

2.2 Photography, Photogrammetry, and Data Logging

Photo-ID images were collected using a digital single-lens reflex camera (Canon 7D Mark II, 1DX Mark II, or R5) with a zoom lens (Canon 100- to 400-millimeter). Every effort was made to obtain good-quality photographs of the flukes and/or dorsal fins of high-priority species encountered. Following each survey day, photographs were cropped and compiled in a format suitable for data sharing with other catalogs. HDR shares images with known regional and local catalogs, including the North Atlantic Fin Whale Catalog curated by the Center for Coastal Studies, North Atlantic and Mediterranean Sperm Whale Catalog curated by Whale Watch Azores, Mid-Atlantic Humpback Whale Catalog curated jointly by HDR and Naval Facilities Engineering Systems Command (NAVFAC) Atlantic (Mallette et al. 2018b; Mallette and Barco 2019; Aschettino et al. 2024), Gotham Whale Humpback Whale Catalog (Brown et al. 2022), Mingan Island Cetacean Study (MICS) Blue Whale Catalog, and Cape Hatteras Short-finned Pilot Whale and Cuvier's Beaked Whale Catalogs maintained by Duke University (Waples and Read 2024).

During surveys, the data recorder maintained a log of observers, environmental conditions, and sighting information in COMPASS (**Appendix A**). Environmental data were updated whenever sighting conditions changed. When a sighting was made, information regarding the distance and bearing to the sighting, species identification, speed and direction of the animal(s), group size, photographs, and videos was logged when available. Sighting distances were estimated visually. Location data and vessel speed were obtained from a GPS unit feeding directly into the iPad and logging a location every 30 seconds.

The use of a drone was incorporated into the field effort beginning in 2019. A DJI Phantom 4 Pro V2.0 was used to collect morphometric data and assess overall body condition. Data were typically collected at flight heights between 15 and 30 m, depending on the behavior of the focal animal during the time of the encounter. The drone collected 4K ultra-high-definition video at 30 frames per second. Initial measurements were made from data using altitude values from the

stock barometer (DJI Phantom 4 Pro); however HDR recently assembled and installed a custom Light Detection and Ranging (LiDAR) precision altimeter on the drone (described in Dawson et al. 2017) to increase precision. This upgrade improves accuracy of reading to ±5 centimeters. Open-source software developed by researchers at Duke University (Torres and Bierlich 2020) was used to calculate animal lengths from the video. Attribute grading criteria for images from Christiansen et al. (2018) were used to assess drone still images for seven attributes, including camera focus, body straightness, body roll, body arch, body pitch, body length measurability, and body width measurability. Each attribute was scored as either a 1 (good), 2 (medium), or 3 (poor). Any image receiving a score of 3 for any of the seven attributes or a 2 for both roll/arch, roll/pitch, or arch/pitch was still used to calculate an estimated length but excluded from further analysis.

2.3 Biopsy Sample Collection

Biopsy samples were collected from priority species after the survey team finished collecting photo-ID images. Biopsy samples were collected with a sampling dart fired from a Paxarms MK24c projector (Paxarms New Zealand Ltd., Cheviot, New Zealand) or Barnett Recurve crossbow (Barnett Outdoors, LLC, Tarpon Springs, Florida). Skin samples were placed in a Whirl-Pak® bag after collection and stored in an ice cooler on the vessel. Samples were then cross-sectioned, placed in the appropriate Cryovial® storage tube, and stored in a freezer until ready for shipment. Samples for fin whale genetic analyses were collected for the University of Groningen, and samples for sperm whale genetic analyses were collected for Oregon State University.

2.4 Satellite Tagging

Three types of tags from Wildlife Computers (Redmond, Washington)—Argos-linked, location-only, Smart Position and Temperature (SPOT-365); Argos-linked time-depth archival (SPLASH10-333); and Argos-linked, time-depth archival with Fastloc® GPS technology (SPLASH10-F-333), all in the Low-Impact Minimally Percutaneous External-electronics Transmitter (LIMPET) configuration (Andrews et al. 2008)—were deployed on priority species. Tags were deployed remotely with a DAN-INJECT J.M.SP.25 CO_2 projector (DAN-INJECT ApS, Børkop, Denmark).

The LIMPET design uses two surgical-grade titanium darts, measuring 6.8 centimeters long and containing six backwards-facing petals, to attach tags to or just below the dorsal fin. Tags were programmed to maximize the number of transmissions and locations received during attachment rather than to extend battery life, which was based on expected LIMPET tag attachment durations of less than 60 days on baleen and sperm whales. Based on satellite availability within the area, tags were programmed to transmit for 16 hr per day and were limited to 600 transmissions per day.

In order to constitute a “dive” for the behavior and time-series data outputs of the SPLASH10 tags, a dive definition was established for sperm whales in which a submergence needs to be both deeper than 5 m and longer than 5 min. Locations of tagged individuals were tracked by GPS, or estimated by the Argos system using the Kalman filtering location algorithm (Argos User’s Manual© 2007–2015 Collective Location Services). Using tools provided within

Movebank, unrealistic locations (e.g., on land) were manually removed prior to a further final Douglas Argos filtering step. Additional dive-data results were obtained using the statistical software R (R Core Team 2018).

2.5 Digital Acoustic Recording Tag Methods

Suction-cup tag deployments for short-duration, high-resolution, dive data collection were added to the project beginning in the 2021 season. Digital acoustic recording tags (DTAGs; Johnson and Tyack 2003) are the only available suction-cup tags rated for deep water, and can be deployed on sperm whales and used to assess their fine-scale diving and foraging behavior in the Mid-Atlantic region, specifically in the VACAPES OPAREA. Version 3 DTAGs were deployed using a hand-held carbon fiber pole. DTAGs are equipped with hydrophones and pressure sensors as well as a three-axis accelerometer and magnetometer. The audio sampling rate was set to 240 kilohertz for sperm whales. Programmed release time was set according to conditions and logistics to facilitate best opportunity for tag retrieval. Each tag also contained a very high frequency (VHF) transmitter that facilitates recovery of the tag using Communications Specialists, Inc. R-1000 VHF receivers with hand-held Yagi antennas (www.com-spec.com) to direct the vessel to the tag location after release from the animal.

Tag calibration and data visualization following recovery was completed using a suite of tools found on animaltags.org using MATLAB R2023a.

3. Results

Nine offshore vessel surveys were conducted between March and December 2023, covering 2,727 km of trackline during more than 107 hrs of effort (**Table 1; Figure 3**).

Surveys in 2023 resulted in 74 marine mammal sightings and 11 sea turtle sightings (**Figures 4** through **7; Appendices B** and **C**). Nine cetacean taxa were identified (in order of decreasing frequency): pilot whale (*n* = 27), common bottlenose dolphin (*n* = 23), sperm whale (*n* = 8), common dolphin (*n* = 6), Atlantic spotted dolphin (n = 3), Risso's dolphin (*n* = 3), humpback whale (*n* = 2), blue whale (*n* = 1), and fin whale (*n* = 1). Two sea turtle species were identified: loggerhead turtle (*Caretta caretta*; *n* = 9) and leatherback turtle (*Dermochelys coriacea*; *n* = 2). Because both short- and long-finned pilot whales may occur within this region, most sightings of the genus *Globicephala* were not assigned a species unless they were closely approached and could be definitively identified, which was not typically the case.

3.1 Photo-identification and Photogrammetry

Photo-ID images were collected from 36 of the 74 marine mammal sightings. All photographs of baleen and sperm whales were added to HDR's existing catalogs (**Appendix D**). One fin whale was identified during OCS surveys in 2023 and added to the fin whale catalog, which now contains 118 individuals. Of the 118 fin whales identified to date, 18 (15.3 percent) have been re-sighted, with 14 (11.9 percent) occurring during different years, ranging from 248 to 2,530 days between first and last sightings. The individual identified in 2023 had not been previously sighted during this study.

Seventeen unique sperm whales were identified in 2023 and added to the sperm whale catalog, which now contains 141 individuals. Of all cataloged individuals, 22 (15.6 percent) were sighted on more than 1 day, ranging from 1 to 2,185 days between first and last sightings (mean = 801, median = 564). Five of the sperm whales photographed in 2023 were sighted previously in this study: HDRVAPm007, first documented March 2017; HDRVAPm010 and 012, first documented June 2017; HDRVAPm062, first documented March 2019; and HDRVAPm096, first documented April 2021.

Sperm whale drone video data from April 2021 through July 2022 were analyzed to calculate the lengths of 18 individuals (**Table 2**). Measured sperm whales ranged in size from 6.97 to 14.34 m in total length, with a mean length of 10.17 m and a median length of 9.81 m.

Each whale had previously been assigned an age-class based on subjective size assessments from the research vessel, which is shown next to the calculated lengths in **Table 2**. Whales estimated as older calf/juvenile (*n* = 2) measured below 8 m. Those estimated as immature male/adult female (*n* = 13) measured between 8 and 12 m, with the exception of one individual that measured 7.98 m. One additional whale measured in the 8 and 12 m range was estimated as large immature/small subadult. Another classified as large immature/small subadult (*n* = 1) and subadult (*n* = 1) measured 12 m or longer. These classifications highlight the difficulty of assigning an age-class for whales that may be of intermediate length and/or transitioning from one age-class to another.

Blue whale photographs collected from the one individual sighted during 2023 were sent to MICS colleagues, who ran them through their North Atlantic Blue Whale Catalog and found no matches. There are now eight identified blue whales in the project catalog. Two humpback whales were identified during these offshore surveys in 2023 and added to HDR's humpback whale catalog, which is summarized in that project's report (Aschettino et al. 2024).

Pilot whale photographs have been provided to Duke University, and comparisons of individuals through October 2023 with their Cape Hatteras catalog have been completed (Waples and Read 2024). Waples and Read (2024) added an additional 25 individuals to the pilot whale catalog for this project, including 1 re-sighting of an individual previously matched to Cape Hatteras. Three new matches were also made between the Norfolk and Hatteras catalogs, including an individual first documented off Hatteras in May 2015 and re-sighted off Norfolk Canyon in August 2023. Our catalog now contains 320 unique pilot whales, and the updated total of matches between Virginia and North Carolina is 15 percent (47 of 320). Images of the remaining odontocete species have been archived for future processing.

Table 1. Summary of 2023 offshore survey effort and sightings within the VACAPES OCS study area.

Date	Survey Duration (min)	Distance surveyed (km)	No. Sightings	No. Individuals	Baleen Whales No. Sightings/ No. Individuals	Deep Diving Whales[a] No. Sightings/ No. Individuals	Dolphins No. Sightings/ No. Individuals	Sea Turtles No. Sightings/ No. Individuals
20-Mar-23	739	249	5	15	2/2	3/13	0/0	0/0
05-May-23	672	328	8	146	0/0	2/17	6/129	0/0
06-May-23	748	322	9	137	1/1	4/12	3/123	1/1
29-Jun-23	729	308	7	79	0/0	6/71	1/8	0/0
07-Jul-23	754	344	10	263	0/0	3/169	6/93	1/1
03-Aug-23	707	330	13	189	0/0	7/154	4/33	2/2
12-Oct-23	686	314	14	375	0/0	3/152	7/218	4/5
19-Oct-23	673	265	15	220	0/0	5/76	7/141	3/3
23-Dec-23	719	267	4	65	1/1	2/44	1/20	0/0
Totals	**6,427**	**2,727**	**85**	**1,489**	**4/4**	**35/708**	**35/765**	**11/12**

Key: No. = number

[a] Sperm, pilot, and beaked whales

Table 2. Drone length measurements for all images of sperm whales that were assessed and calculated.

Animal ID	Flight Date	Sighting No.	Calculated Length (m)	Age-Class Estimated in Field	Gender
HDRVAPm122	29-Jun-22	13	6.97	Older calf/juvenile	Unknown
HDRVAPm124	8-Jul-22	2	7.16	Older calf/juvenile	Unknown
HDRVAPm099	1-Jun-21	14	7.98	Immature male or adult female	Female
HDRVAPm105	1-Jun-21	14	8.35	Immature male or adult female	Unknown
HDRVAPm123	8-Jul-22	2	8.63	Immature male or adult female	Unknown
HDRVAPm101	1-Jun-21	14	8.73	Immature male or adult female	Female
HDRVAPm121	29-Jun-22	13	8.82	Immature male or adult female	Unknown
HDRVAPm108	16-Aug-21	8	9.25	Immature male or adult female	Unknown
HDRVAPm050	20-Apr-21	6	9.35	Immature male or adult female	Unknown
HDRVAPm103	1-Jun-21	14	9.36	Immature male or adult female	Unknown
HDRVAPm116	8-Jul-22	2	9.63	Immature male or adult female	Unknown
HDRVAPm097	20-Apr-21	7	9.81	Immature male or adult female	Unknown
HDRVAPm107	16-Aug-21	8	10.98	Immature male or adult female	Unknown
HDRVAPm114	16-Mar-22	6	11.18	Immature male or adult female	Unknown
HDRVAPm115	21-Apr-22	5	11.75	Large immature/small subadult	Male
HDRVAPm096	18-Apr-21	18	11.76	Immature male or adult female	Unknown
HDRVAPm100	1-Jun-21	14	13.02	Subadult	Unknown
HDRVAPm117	23-Apr-22	8	14.43	Large immature/small subadult	Male

Key: ID = Identification Number; No. = number

[a] Blue highlighted cells are those that contain a score of 2 or 3 for two or more attributes; they have been included for reference to individual age-class field estimates but have been excluded from mean and median length calculations.

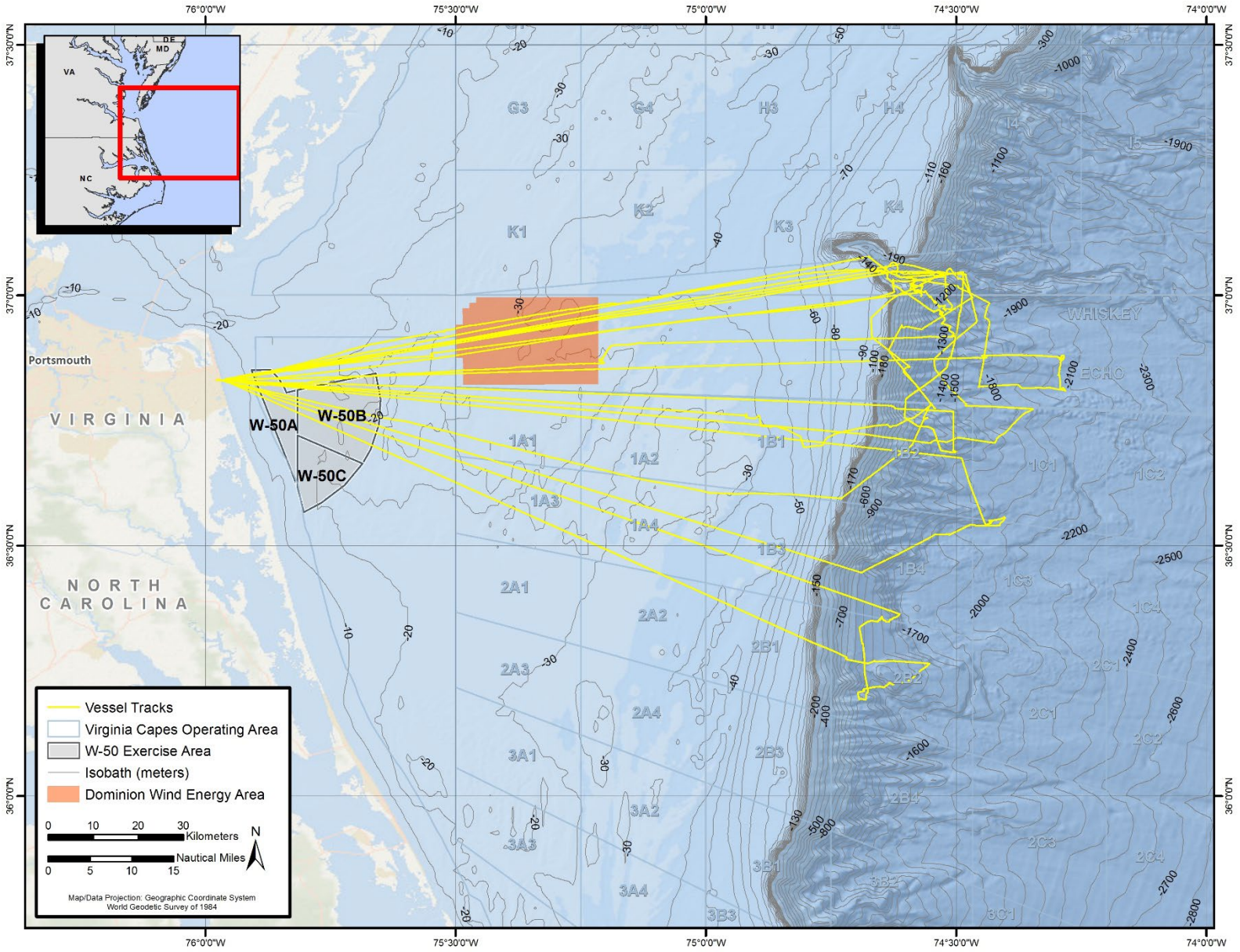

Figure 3. Offshore survey tracks for all surveys conducted in 2023.

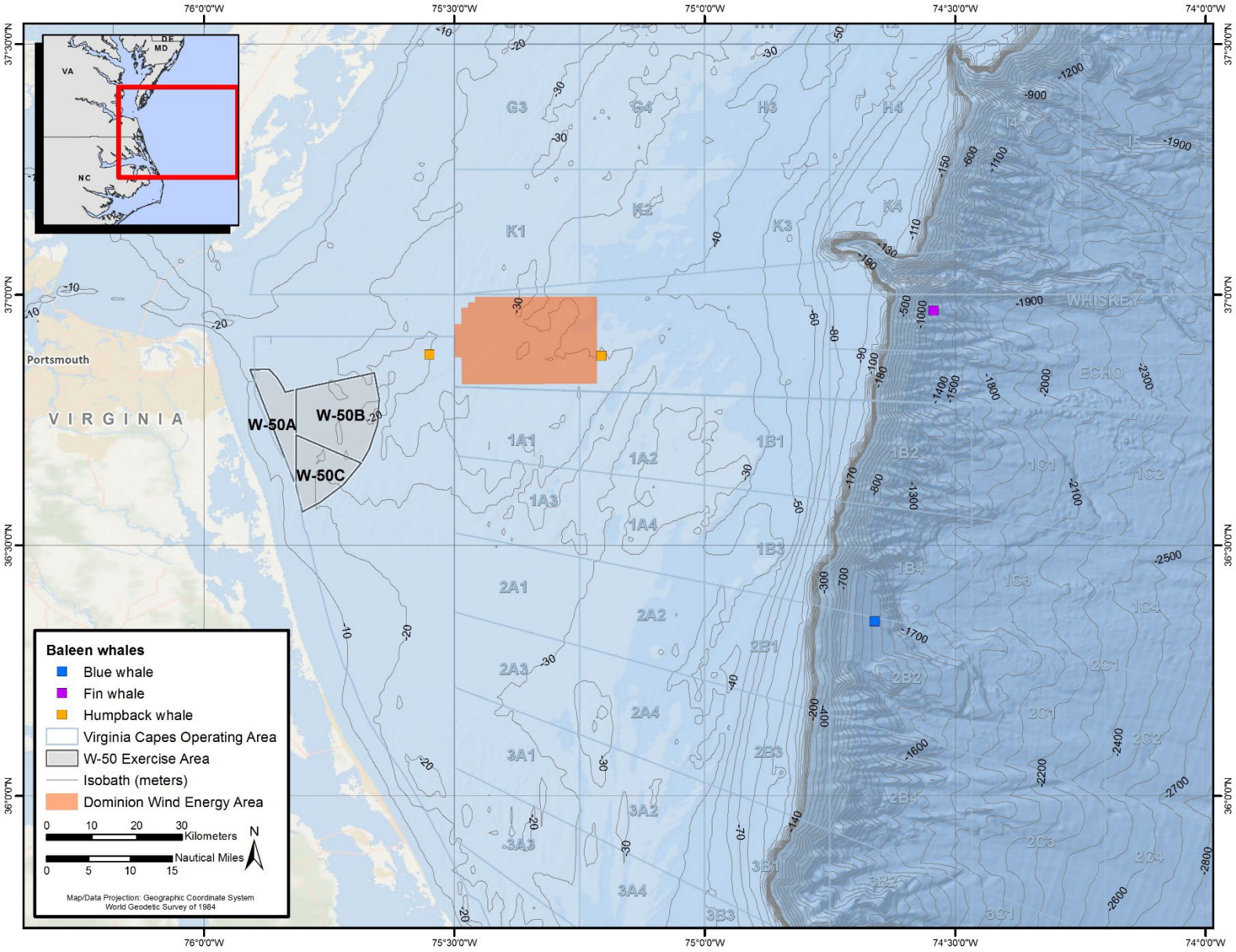

Figure 4. Locations of all baleen whale sightings (*n* = 4) in 2023.

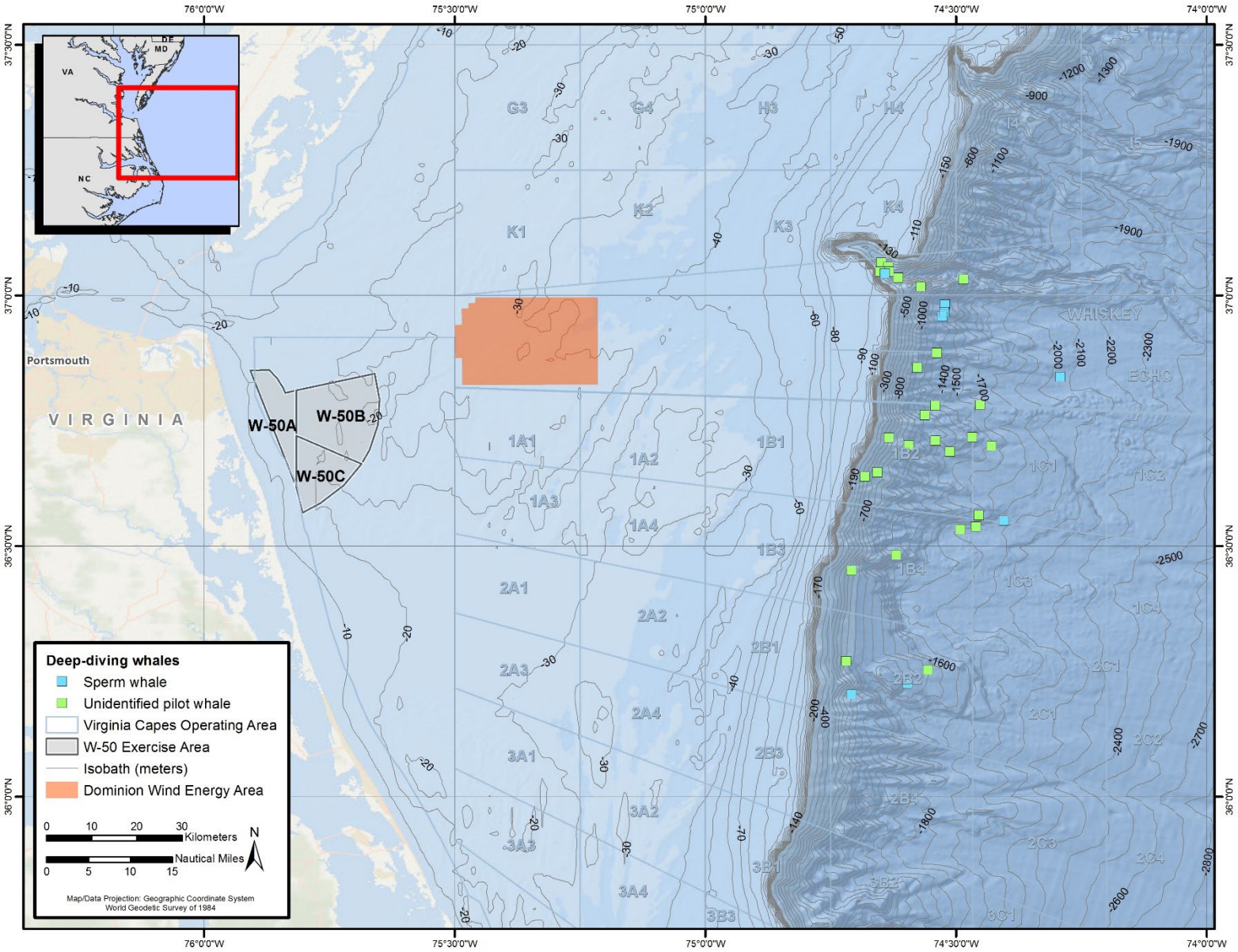

Figure 5. Locations of all deep diving whale sightings (*n* = 35) in 2023.

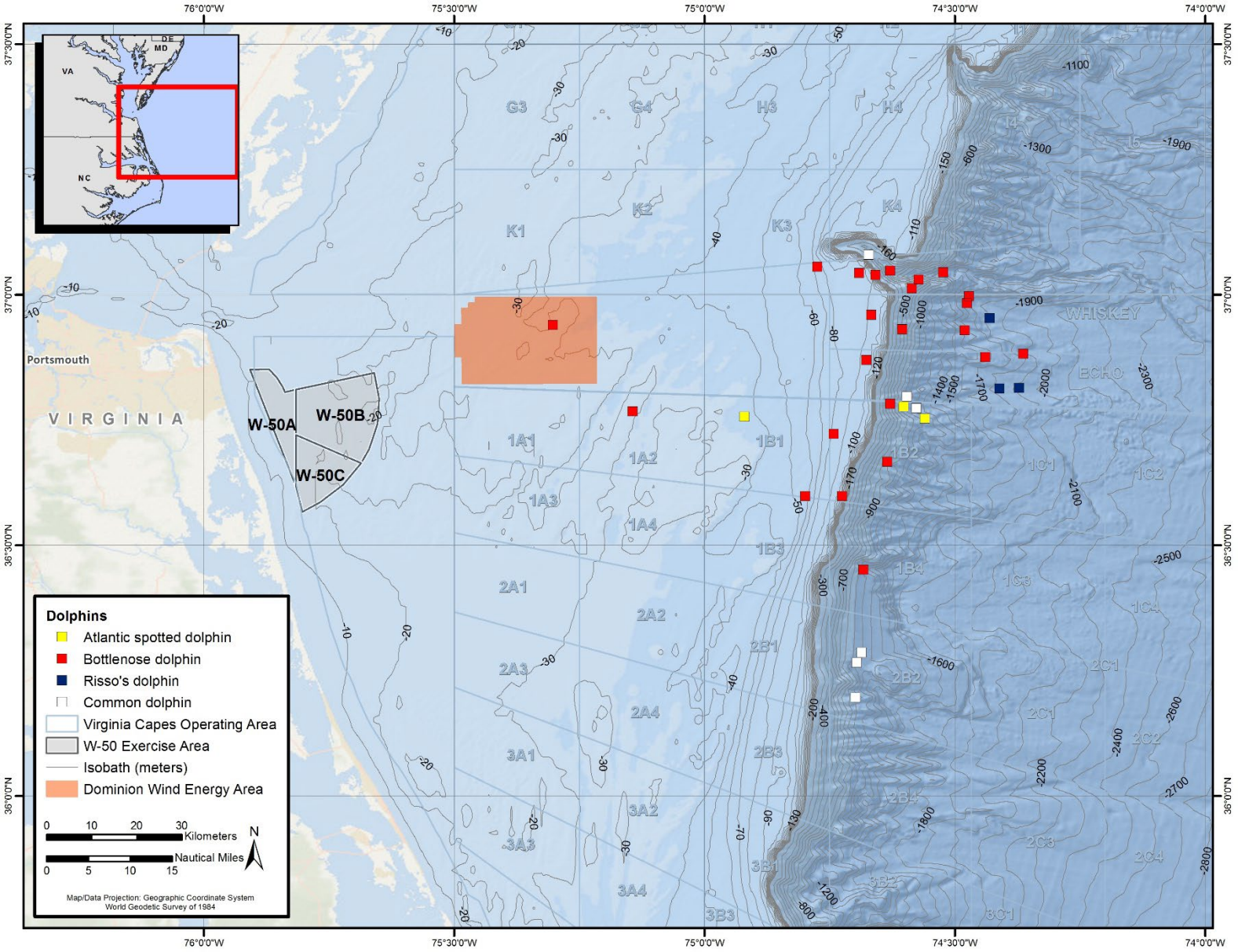

Figure 6. Locations of all dolphin sightings (*n* = 35) in 2023.

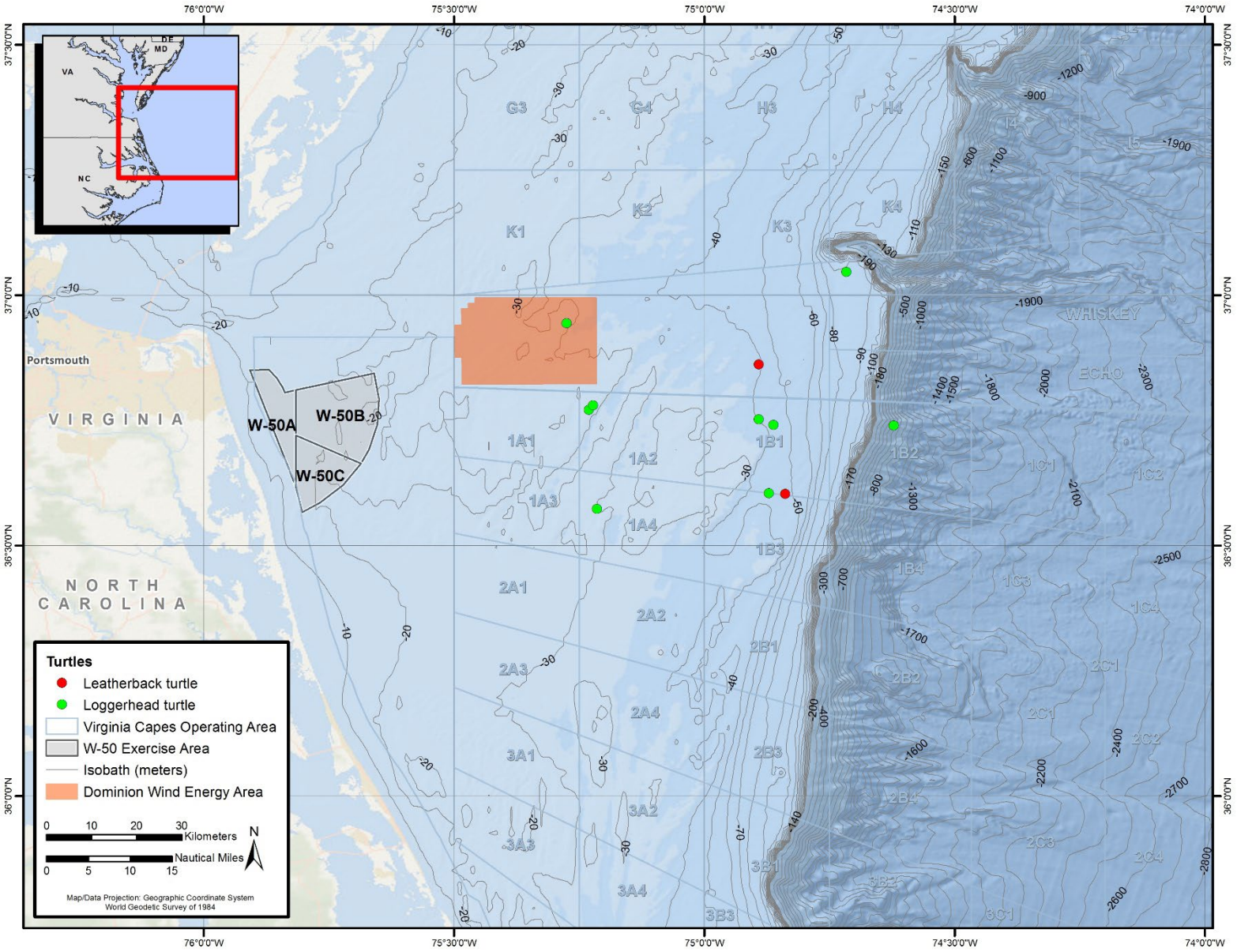

Figure 7. Locations of all sea turtle sightings (*n* = 11) in 2023.

3.2 Biopsy Sample Collection and Genetic Analysis

In 2023, two biopsies were collected from sperm whales (**Appendix D**). These samples will be held at HDR and sent to Oregon State University for processing. Of the 27 unique sperm whale samples collected within the study area through 2022, totals include 5 females and 22 males. Mitochondrial DNA results also provided by Oregon State University for 26 sperm whale samples (1 did not have a clear result) and included the three most common haplotypes (haplotype A = 16, haplotype B = 5, haplotype C = 5). Microsatellite techniques have not yet been completed to search for genetic matches to other sperm whales sampled in this study or elsewhere.

3.3 Satellite Tagging

Two satellite tags were successfully deployed on sperm whales in 2023 (**Tables 3** and **4**). Both tags were SPLASH-10 tags, which collected location and dive depth/duration information (**Table 5**).

Tag durations for the two sperm whales were 18.0 and 30.7 days. Locations from satellite-tagged sperm whales showed movements through multiple U.S. Navy OPAREAS, mostly along the continental shelf break or beyond the slope. One of the tagged sperm whales first moved to the south and spent time in the Cherry Point OPAREA before turning back to the north through VACAPES and Atlantic City OPAREAs and into the Narragansett Bay OPAREA for the last tag transmissions (**Figure 8**). The other tagged sperm whale moved north throughout the tag duration along the continental shelf break through VACAPES, Atlantic City, and Narragansett Bay OPAREAs, and continued northward past Georges Bank before transmissions stopped (**Figure 9**).

Tagged sperm whales traveled up to 1,045 km from initial tag deployment locations, and 39.1 and 8.2 percent of their locations were within the VACAPES OPAREA (**Table 4**). Maximum dive depths were 1,823 and 1,695 m, and maximum dive durations were 69 and 64 min (**Table 5**).

Table 3. Summary of tag deployment details for all sperm whale tags deployed in 2023.

Animal ID	Tag Type	Argos ID	Deployment (GMT)	Deployment Latitude (°N)	Deployment Longitude (°W)	Depth at Tagging Location (m)	Last Transmission (GMT)	Tag Duration (days)
HDRVAPm137	SPLASH-10	202810	2023-May-06 16:11	36.209339	74.684540	1,226	2023-May-24 22:52	18.0
HDRVAPm138	SPLASH-10	202811	2023-May-06 16:47	36.194059	74.686549	1,089	2023-Jun-06 00:16	30.7

Key: ID = Identification Number; °N = degrees North; °W = degrees West; GMT = Greenwich Mean Time

Table 4. Summary of results from satellite-tag data for all sperm whale tags deployed in 2023.

Animal ID	Argos ID	No. of Locations Post Filtering	% Within VACAPES OPAREA	Max Distance from Initial Location (km)	Mean Distance from Initial Location (km)
HDRVAPm137	202810	184	39.1	466.2	167.8
HDRVAPm138	202811	281	8.2	1045.8	665.4

Key: ID = Identification Number; Max = maximum; No. = number

Table 5. Summary of dive data for all sperm whale SPLASH-10 tags deployed in 2023.

Animal ID	Argos ID	No. Dives Logged	Mean Dive Depth (m)	Max Dive Depth (m)	Mean Dive Duration (mm.ss)	Max Dive Duration (mm.ss)
HDRVAPm137	202810	255	837.1	1,823	50.70	69.68
HDRVAPm138	202811	816	481.1	1,695	34.26	63.95

Key: ID = Identification Number; Max = maximum; mm.ss = minutes.seconds; No. = number

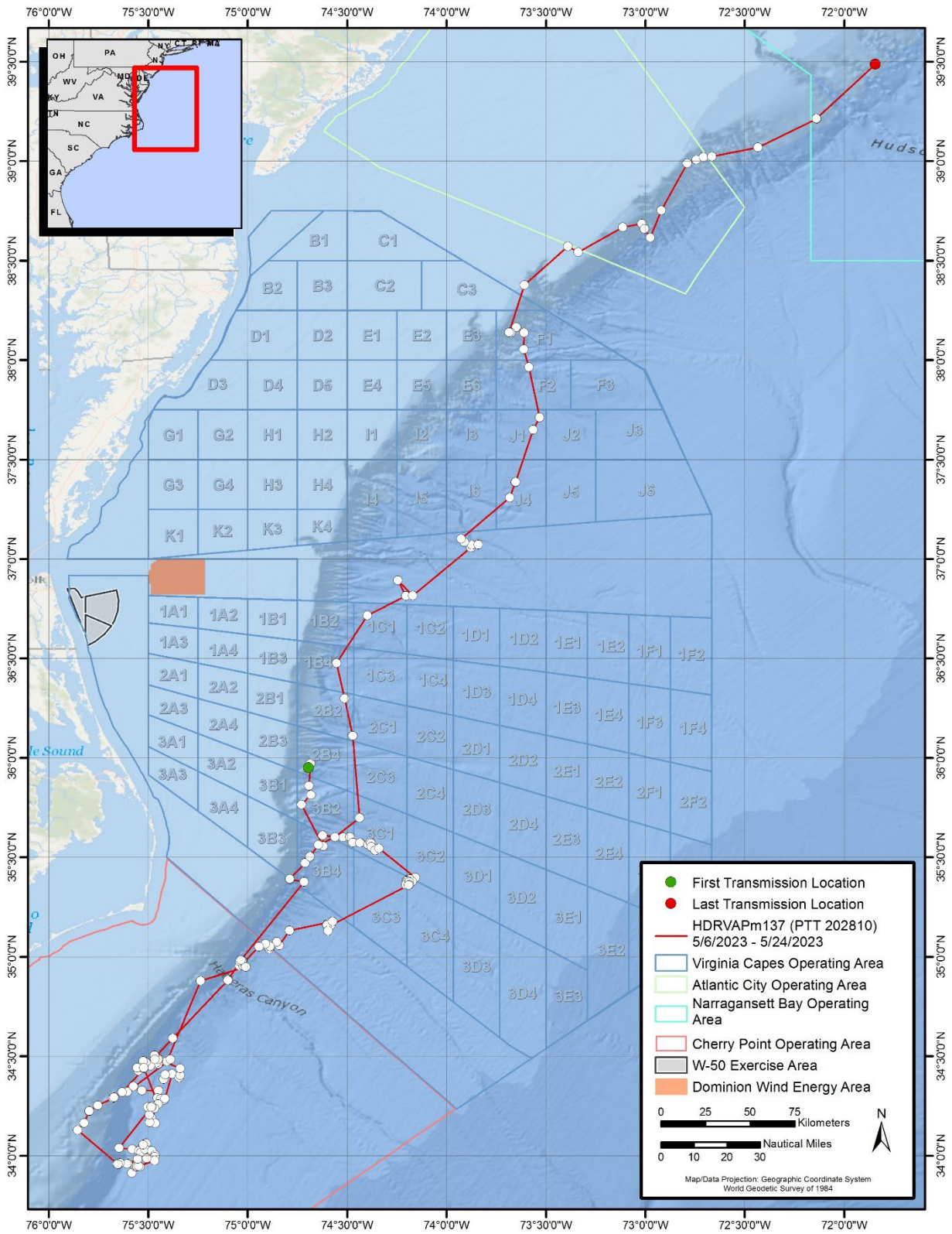

Figure 8. Filtered locations (white dots) and track of sperm whale HDRVAPm137 over 18.0 days.

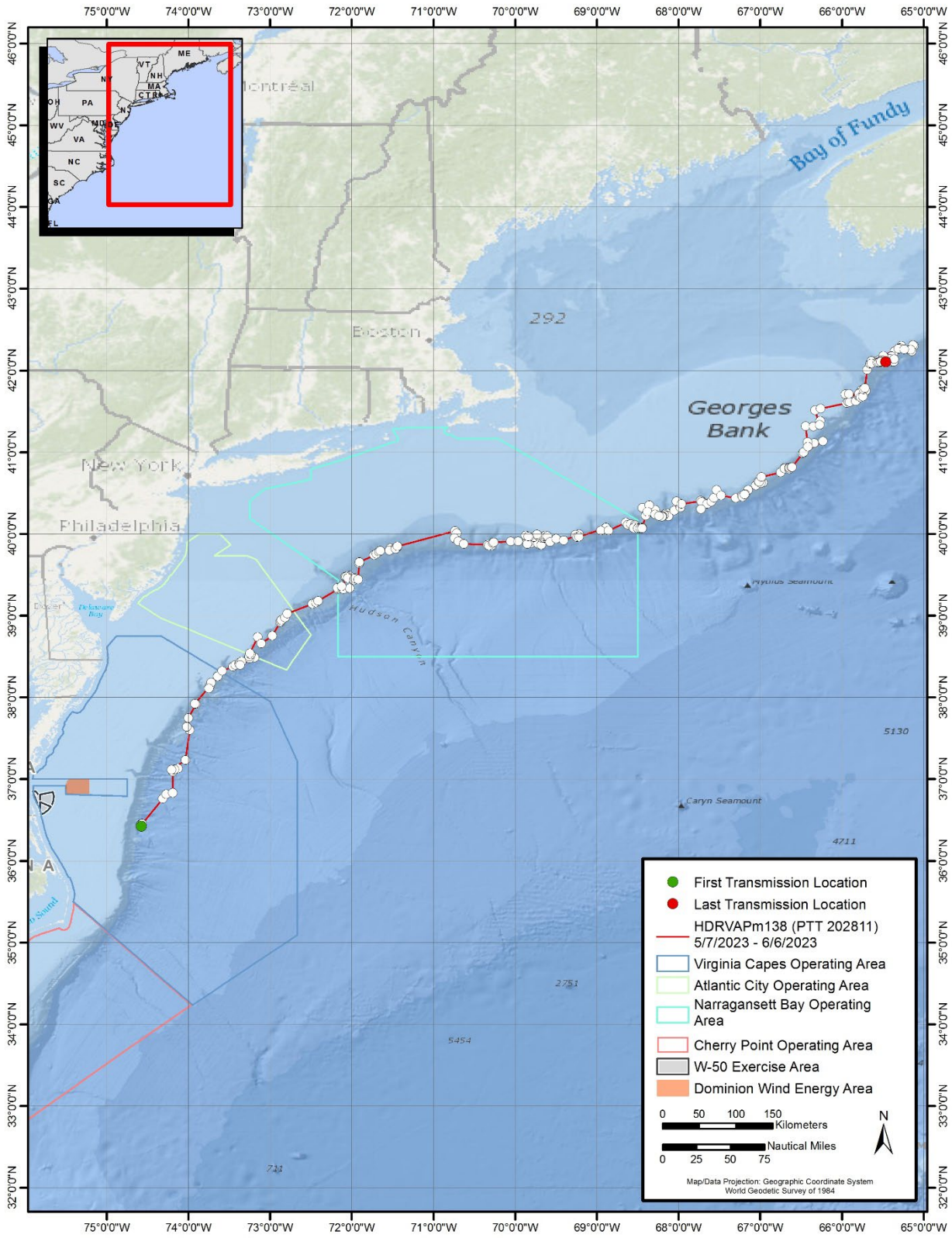

Figure 9. Filtered locations (white dots) and track of sperm whale HDRVAPm138 over 30.7 days.

3.4 Digital Acoustic Recording Tag Results

No successful DTAG deployments occurred during 2023, but analysis of data from previously deployed tags continued. **Table 6** details all successful DTAG deployments for sperm whales to date. Two of the individuals were also satellite tagged and biopsied: HDRVAPm117 and HDRVAPm119. HDRVAPm117 was a solitary male, and the DTAG (pm22_113a) collected data during three dives, which included two dives to depths deeper than 1,000 m and one dive closer to 600 m. An acoustic audit was completed (**Figure 10)**, with sustained periods of clicking when at depths approximately 400 m and greater, and buzzes at the maximum depth of the dive bout. HDRVAPm119 was also male and seen in a group of three. The tag (pm22_150a) was programmed for an overnight deployment but released slightly more than 300 minutes into the deployment. The dive profile shows that the individual remained at or near the surface for more than 4 hrs before it dove (the tag released before that dive was complete). The acoustic audit of this deployment (**Figure 11**) shows times where codas were detected from both the tagged whale and from conspecifics. For more than 1.5 hr of the four-hr surface event, codas were noted. **Figure 12** shows the acoustic audit of pm22_189a, of unknown gender (not sampled), seen with one other small whale. For the first dive, the individual dove to approximately 500 m and continued clicking when deeper than 200 m; for the second dive to nearly 1,600 m, clicking began immediately but stopped during the ascent near 900 m depth. Many buzzes were detected at the deepest part of the deep dive, and codas were detected when at or near the surface.

Table 6. Successful sperm whale DTAG deployment details.

Animal ID	Species	DTAG No./ Deployment ID	Deployment (GMT)	Depth at Tagging (m)	Tag Off Animal (GMT)	Tag Duration (min)	SPLASH Tag No.	Gender
HDRVAPm117	Sperm whale	321/ pm22_113a	2022-Apr-23 15:36	1,288	2022-Apr-23, 18:55	198	183922	Male
HDRVAPm119	Sperm whale	321/ pm22_150a	2022-May-30 16:02	1,947	2022-May-30, 20:41[a]	280[a]	183924	Male
HDRVAPm116	Sperm whale	346/ pm22_189a	2022-Jul-08 14:56	1,779	2022-Jul-08, 17:08[a]	135[a]	n/a	Unknown

Key: ID = Identification Number; No. = number; GMT = Greenwich Mean Time

[a] Research team was not present during tag release; the tag-off time and tag duration are estimated

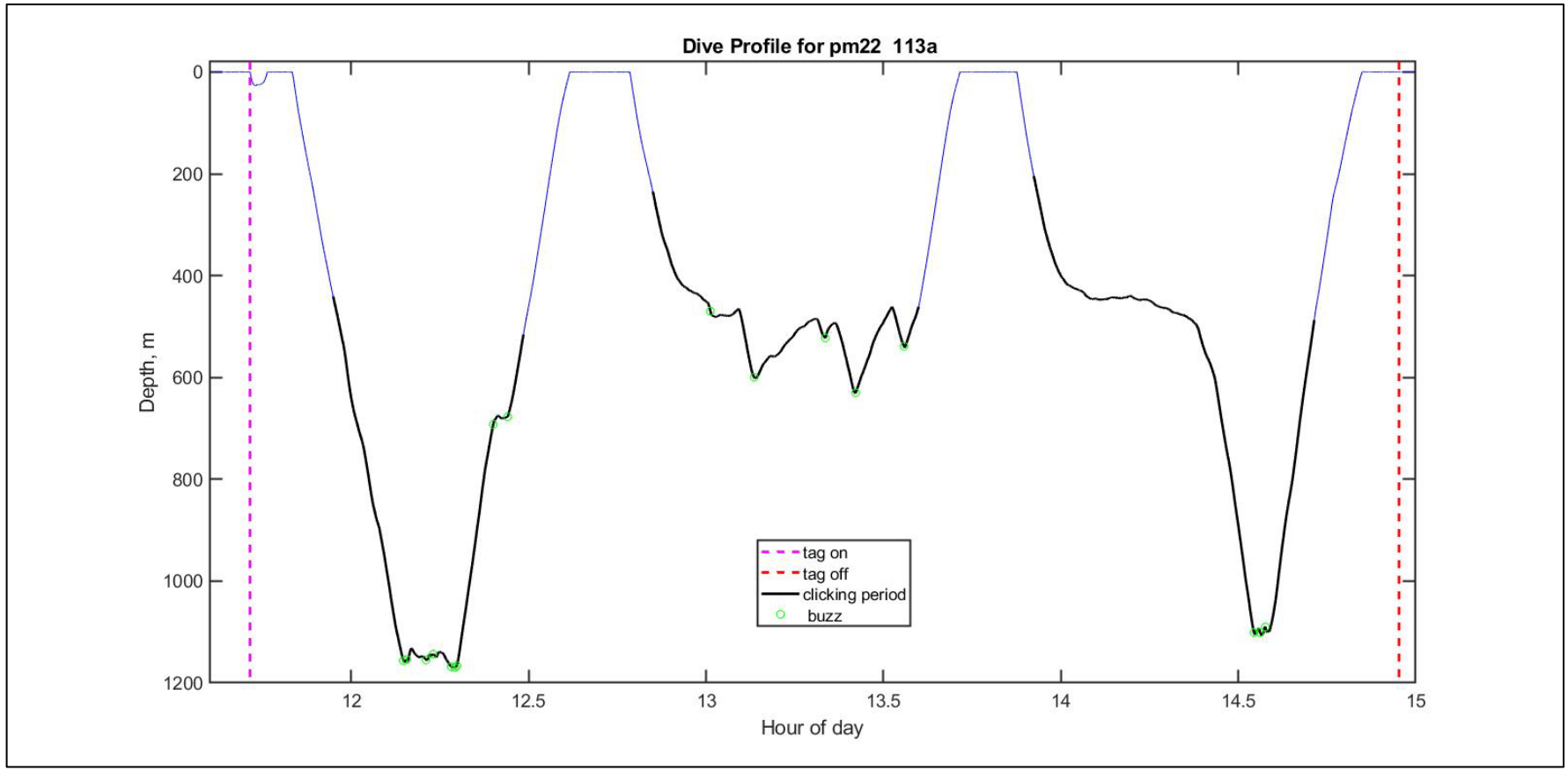

Figure 10. Acoustic audit results for DTAG dataset pm22_113a plotted with the dive profile. The black lines indicate clicking and green circles indicate buzzing from the tagged animal. The pink dashed line marks the tag on animal time, and the red dashed line marks the tag off animal.

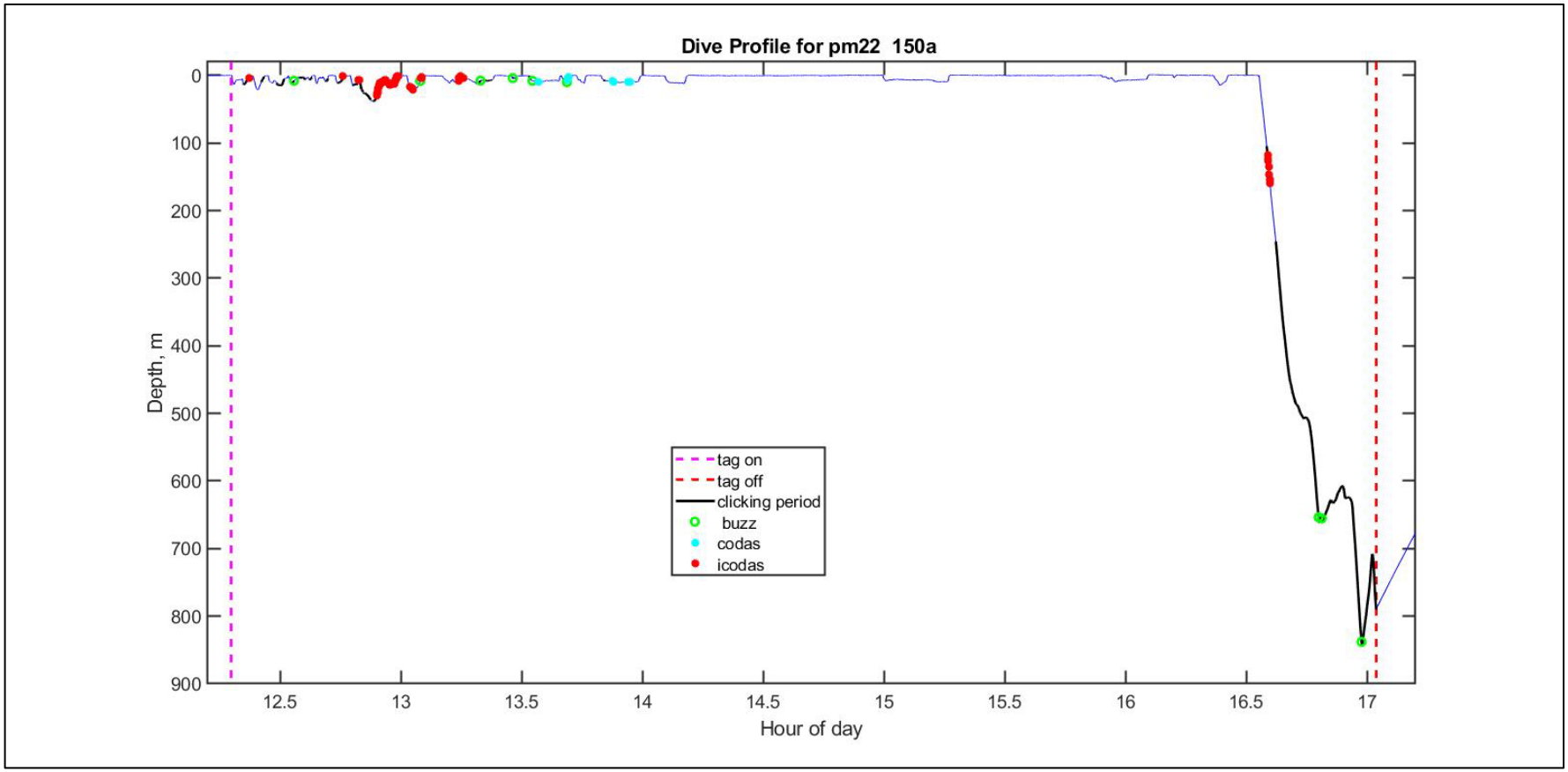

Figure 11. Acoustic audit results for DTAG dataset pm22_150a plotted with the dive profile. The black lines indicate clicking, green circles indicate buzzing, blue circles are codas from the tagged animal, and red circles indicate codas that cannot be determined whether they came from the tagged whale or other whales. The pink dashed line marks the tag on animal time, and the red dashed line marks the tag off animal.

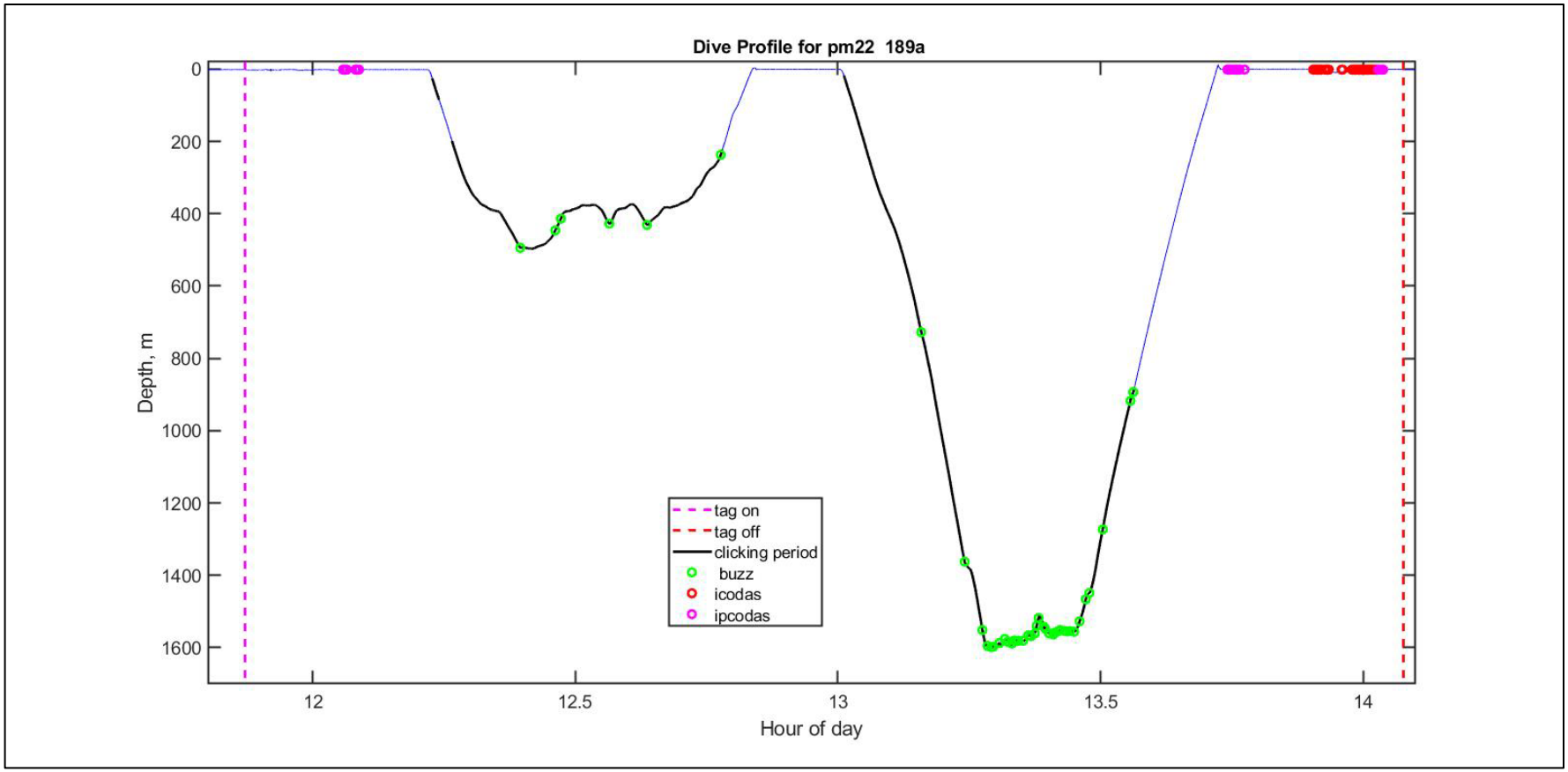

Figure 12. Acoustic audit results for DTAG dataset pm22_189a plotted with the dive profile. The black lines indicate clicking, green circles indicate buzzing, red circles indicate codas that cannot be determined whether they came from the tagged whale or other whales, and pink circles indicate *possible* codas that cannot be determined whether they came from the tagged whale or other whales. The pink dashed line marks the tag on animal time, and the red dashed line marks the tag off animal.

4. Discussion

Data collection and analyses for this project are ongoing; however, results to date show a high degree of marine-mammal diversity within the study area with notable habitat use by important ESA-listed species: sperm, fin, and blue whales. Surveys conducted in 2023 continued coverage to the east of Norfolk Canyon and to the southern extent of the study area, continuing to survey waters deeper than 1,500 m to increase chances for detections of deep-diving cetaceans and using a directional hydrophone to increase success of finding sperm whales. Sightings of nine species of marine mammals and two species of sea turtles were made over nine surveys, showing a wide distribution throughout the study area. All species encountered during 2023 had previously been sighted during this study, keeping the total number of marine mammal species encountered within the study area over the project duration to 20. Previous aerial survey and passive acoustic monitoring data from the region show similar species diversity (McAlarney et al. 2018a, 2018b; Rafter et al. 2018; Cotter 2019;).

Sightings of deep-diving species, including sperm and pilot whales, were concentrated beyond the shelf break and into deeper offshore waters during the 2023 surveys, similar to previous years. Baleen whales were encountered both over the shelf and past the shelf break, also similar to previous seasons. Dolphin species were sighted throughout the core study and transit areas, and with the exception of one loggerhead turtle, all sea turtle sightings were over the shelf.

The numbers of individuals in the photo-ID catalogs continue to increase for baleen and sperm whales. This valuable tool requires a multi-year commitment to accumulate sufficient data to produce meaningful insights into site-fidelity and ultimately to address population consequences. However, results are already becoming evident for some species, with 15.6 percent (22 of 141) of cataloged sperm whale individuals being re-sighted up to nearly 6 years (2,185 days) after the initial encounter.

Additionally, the importance of the Norfolk Canyon to ESA-listed sperm whales has become evident through re-sightings and tagged whale movements. To date, comparison of the catalog to existing sperm whale catalogs within the Atlantic Ocean and Gulf of Mexico have not yielded any matches, but as additional catalogs are added to photo-ID sharing websites, valuable matches may emerge. Re-sightings within the study area and outside regions will continue to address questions of seasonal variation and social affiliations, and may eventually address questions related to population-level consequences of disturbance.

Sightings of blue whales within the study area continue to significantly add to the limited knowledge of this ESA-listed species. Eight blue whales have been identified within the study area to date, which includes one sighting during 2023. Data collected during 2021 and 2022 support the previously published records of sightings off Virginia documented by this study (D.T. Engelhaupt et al. 2020), providing unique insight into the movements of the species. Tag location and dive data also further support the potential for overlap between both species and U.S. Navy training activities (Aschettino et al. 2022, Engelhaupt et al. 2022).

The addition of drone video collection has proven valuable to the overall project, not only in collecting data to improve age-class assessments, assess body condition, and document

associations of priority species, but has often proven valuable in improving the success rate of satellite-tagging efforts by informing the research team of animal movements before they could be detected from the vessel. Calculated length estimates for sperm whales showed a mean length of approximately 10 m, supporting field estimates of mostly immature male/adult female sized sperm whales sighted.

Satellite-tagged whales again showed movements through VACAPES beyond the continental slope **(Figures 8** and **9**). Sperm whales tagged this year showed a lower percentage of locations within the VACAPES OPAREA than in previous years, and although both individuals initially spent time in the VACAPES OPAREA, they continued out of the area and through multiple other OPAREAs. HDRVAPm138, traveled over 1,000 km to the north from the tagging location.

Progress made on the analysis of sperm whale DTAG datasets has shown depths at which clicking and buzzes were detected (**Figures 10** through **12**), which provides insight into feeding behavior within this region. The detection of codas during surface bouts by small groups of juvenile sperm whales is also of interest. The combination of methods used over time, including length estimates from drone images, genetic sexing from biopsies, re-sightings discovered though photo-ID, and acoustic and movement behavior recorded by satellite and suction-cup tags, has begun to show the study area as an important habitat for juvenile male sperm whales. The need for communication and social interaction of these individuals that return to the area in subsequent years or seasons is an important consideration when addressing potential of exposure and consequence within an area of crucial U.S. Navy use.

Working 60 to 90 nm from shore requires exploiting short and infrequent weather-window opportunities as well as limited access to restricted U.S. Navy training areas. With every survey completed, this project provides a more comprehensive understanding of how numerous species (including ESA-listed ones) use this important offshore habitat.

As more surveys are conducted and tags are deployed, the research team continues to expand their coverage across multiple seasons, which allows us to explore questions of intra- and inter-seasonal species occurrence and variation. Providing a more detailed understanding of both fine- and medium-scale foraging ecology of sperm and beaked whales is now the priority. And with the implementation of suction-cup tag deployments on deep-diving species, researchers will work to better detail fine-scale movement, dive patterns, foraging behavior, and acoustic activity to add to the existing medium-duration telemetry dataset. Understanding fine-scale baseline data and recording subtle changes in behavior (including acoustic activity) will provide valuable insights on animal behavior and potential impacts from anthropogenic stressors. The results of this multi-year effort are expected to provide the U.S. Navy with the level of detailed information required to make informed decisions with regard to future training and testing planning and mitigation measures within the survey area as a means to minimize potential impacts on protected marine species.

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A

Data Fields Recorded in COMPASS

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Data Fields to be Recorded

Placement	Field/Attribute	
Survey/ Environmental	• Date/Time • Platform • Survey ID • Beaufort Scale • Visibility • Wind Direction	• Swell • Percent Cloud Cover • Effort Status • Personnel • Leg Notes
Sighting	• Sighting Number • Date/Time • Latitude/Longitude • Relative Bearing • Angle to Sighting • Distance to Animal • Animal's Heading • Species Name (Common) • Species Name (Scientific) • Minimum Group Size • Maximum Group Size • Best Group Size • Count (Calves) • Count (Juveniles) • Behavior State • Multiple Sightings • Recorder • Observer • Reaction • Depth • Temperature	• Navy Ship within 500 m? (Y/N) • Cargo Ship within 500 m? (Y/N) • Fishing/Recreation Boat within 500 m? (Y/N) • Within 500 m of Shipping Channel? (Y/N) • Notes • Photographs Taken (Y/N) (If Yes – frame numbers, camera, photographer) • Video (Y/N) (If Yes – frame numbers, camera, photographer) • Biopsy (Y/N) (If Yes – shooter, hit/miss, sample location, reaction, others present/reacting, sample, sample name, comments) • Tagging (Y/N) (If Yes – shooter, hit/miss, tag location, reaction, others present/reacting, tag number, tag type, comments) • Maximum Distance between Nearest Neighbor • Minimum Distance between Nearest Neighbor
Focal (Related to Focal Individual Only)	• Date/Time • Latitude/Longitude • Group ID • Behavioral State (Travel, Feed, Mill, Social, Rest, Log, Unknown) • Behavioral Event (Blow, Dive/Peduncle Arch, FUD, FDD, Side fluke, Lunge, Tail Slap, Pec Slap, Spy Hop, Breach, Bubbles, Start Follow, Stop Follow, Footprint WP, First Surfacing, Head Slap, Peduncle Slap, Chase, Brood Side Display, Head Lunge, Linear Bubble Trail, Charge)	• Bearing • Distance to Sighting • Heading of the Animal • Relative Movement of Vessel and Animal's Bearing • Sighting Notes

Key: ID = Identification; m = meter(s); Y = Yes; N = No; FUD = Fluke Up Dive; FDD = Fluke Down Dive; Pec = Pectoral; WP = Waypoint

Note: Upon each entry, time stamp and Global Positioning System coordinate is recorded for the position of the vessel. Variables may be modified as deemed necessary by the Chief Scientist.

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B

Marine Mammal Sightings
2023

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Date	Sighting Time (local)	Scientific Name	Common Name	Group Size	Latitude (°N)	Longitude (°W)
20-Mar-23	10:39	*Physeter macrocephalus*	Sperm whale	3	37.043837	74.642598
20-Mar-23	11:53	*Balaenoptera physalus*	Fin whale	1	36.968295	74.542913
20-Mar-23	12:29	*Physeter macrocephalus*	Sperm whale	2	36.957409	74.527709
20-Mar-23	12:46	*Physeter macrocephalus*	Sperm whale	8	36.966814	74.523330
20-Mar-23	16:21	*Megaptera novaeangliae*	Humpback whale	1	36.878194	75.206059
05-May-23	7:28	*Tursiops truncatus*	Bottlenose dolphin	30	37.055558	74.774789
05-May-23	7:43	*Delphinus delphis*	Short-beaked common dolphin	25	37.079890	74.672371
05-May-23	7:50	*Globicephala* sp.	Unidentified pilot whale	5	37.065283	74.649282
05-May-23	10:58	*Delphinus delphis*	Short-beaked common dolphin	8	36.796700	74.596279
05-May-23	11:14	*Stenella frontalis*	Atlantic spotted dolphin	11	36.777013	74.602356
05-May-23	12:11	*Globicephala* sp.	Unidentified pilot whale	12	36.687867	74.512121
05-May-23	13:24	*Delphinus delphis*	Short-beaked common dolphin	30	36.773772	74.577135
05-May-23	13:48	*Tursiops truncatus*	Bottlenose dolphin	25	36.782058	74.629170
06-May-23	8:24	*Globicephala* sp.	Unidentified pilot whale	5	36.270241	74.719602
06-May-23	8:40	*Delphinus delphis*	Short-beaked common dolphin	18	36.266145	74.696309
06-May-23	9:44	*Globicephala* sp.	Unidentified pilot whale	5	36.252871	74.556361
06-May-23	10:16	*Physeter macrocephalus*	Sperm whale	1	36.225654	74.597568
06-May-23	12:01	*Physeter macrocephalus*	Sperm whale	1	36.204313	74.709029
06-May-23	12:30	*Delphinus delphis*	Short-beaked common dolphin	35	36.196029	74.698697
06-May-23	13:43	*Delphinus delphis*	Short-beaked common dolphin	70	36.285922	74.686867
06-May-23	14:13	*Balaenoptera musculus*	Blue whale	1	36.348175	74.660623
29-Jun-23	8:19	*Globicephala* sp.	Unidentified pilot whale	25	36.450867	74.708688
29-Jun-23	8:23	*Tursiops truncatus*	Bottlenose dolphin	8	36.451177	74.683103
29-Jun-23	9:06	*Globicephala* sp.	Unidentified pilot whale	12	36.482522	74.619562
29-Jun-23	10:11	*Globicephala* sp.	Unidentified pilot whale	20	36.533726	74.491443
29-Jun-23	10:25	*Globicephala* sp.	Unidentified pilot whale	2	36.538460	74.460795
29-Jun-23	11:11	*Physeter macrocephalus*	Sperm whale	4	36.550131	74.404894
29-Jun-23	12:40	*Globicephala* sp.	Unidentified pilot whale	8	36.561307	74.455053
07-Jul-23	8:21	*Globicephala* sp.	Unidentified pilot whale	150	37.056820	74.635874
07-Jul-23	8:49	*Globicephala* sp.	Unidentified pilot whale	18	37.035356	74.615325
07-Jul-23	10:10	*Grampus griseus*	Risso's dolphin	15	36.953082	74.430656
07-Jul-23	11:27	*Grampus griseus*	Risso's dolphin	25	36.812942	74.411105
07-Jul-23	11:40	*Grampus griseus*	Risso's dolphin	12	36.813858	74.372394
07-Jul-23	12:34	*Physeter macrocephalus*	Sperm whale	1	36.837490	74.292788
07-Jul-23	14:10	*Tursiops truncatus*	Bottlenose dolphin	10	36.882010	74.363719
07-Jul-23	14:22	*Tursiops truncatus*	Bottlenose dolphin	25	36.875715	74.439074
07-Jul-23	14:54	*Tursiops truncatus*	Bottlenose dolphin	6	36.869620	74.676942
03-Aug-23	8:48	*Globicephala* sp.	Unidentified pilot whale	50	37.047864	74.634493
03-Aug-23	8:59	*Tursiops truncatus*	Bottlenose dolphin	10	37.047456	74.629499
03-Aug-23	10:01	*Tursiops truncatus*	Bottlenose dolphin	12	36.996474	74.471730

Date	Sighting Time (local)	Scientific Name	Common Name	Group Size	Latitude (°N)	Longitude (°W)
03-Aug-23	10:31	*Tursiops truncatus*	Bottlenose dolphin	6	36.929043	74.480254
03-Aug-23	10:52	*Globicephala* sp.	Unidentified pilot whale	17	36.885115	74.538250
03-Aug-23	11:54	*Globicephala* sp.	Unidentified pilot whale	7	36.781160	74.452418
03-Aug-23	13:05	*Globicephala* sp.	Unidentified pilot whale	10	36.699793	74.429339
03-Aug-23	13:22	*Globicephala* sp.	Unidentified pilot whale	40	36.717274	74.467889
03-Aug-23	13:44	*Globicephala* sp.	Unidentified pilot whale	18	36.710234	74.541316
03-Aug-23	14:23	*Globicephala* sp.	Unidentified pilot whale	12	36.716051	74.634334
03-Aug-23	15:39	*Tursiops truncatus*	Bottlenose dolphin	5	36.766983	75.143364
12-Oct-23	7:17	*Tursiops truncatus*	Bottlenose dolphin	35	36.939457	75.302664
12-Oct-23	8:38	*Tursiops truncatus*	Bottlenose dolphin	11	37.039318	74.658477
12-Oct-23	8:40	*Globicephala* sp.	Unidentified pilot whale	130	37.047901	74.651147
12-Oct-23	9:23	*Tursiops truncatus*	Bottlenose dolphin	65	37.044289	74.523663
12-Oct-23	9:50	*Globicephala* sp.	Unidentified pilot whale	12	37.031890	74.485411
12-Oct-23	10:27	*Tursiops truncatus*	Bottlenose dolphin	10	36.982797	74.475754
12-Oct-23	11:07	*Tursiops truncatus*	Bottlenose dolphin	55	36.931046	74.605086
12-Oct-23	12:23	*Globicephala* sp.	Unidentified pilot whale	10	36.780381	74.541872
12-Oct-23	13:36	*Tursiops truncatus*	Bottlenose dolphin	2	36.722350	74.741963
12-Oct-23	14:46	*Stenella frontalis*	Atlantic spotted dolphin	40	36.756683	74.920386
19-Oct-23	8:23	*Tursiops truncatus*	Bottlenose dolphin	3	36.598117	74.798631
19-Oct-23	8:35	*Tursiops truncatus*	Bottlenose dolphin	22	36.598207	74.725056
19-Oct-23	8:53	*Globicephala* sp.	Unidentified pilot whale	12	36.638207	74.682140
19-Oct-23	9:00	*Globicephala* sp.	Unidentified pilot whale	24	36.646865	74.657611
19-Oct-23	9:10	*Tursiops truncatus*	Bottlenose dolphin	20	36.666328	74.635098
19-Oct-23	9:26	*Globicephala* sp.	Unidentified pilot whale	18	36.701049	74.594730
19-Oct-23	9:58	*Stenella frontalis*	Atlantic spotted dolphin	31	36.752669	74.560296
19-Oct-23	10:10	*Globicephala* sp.	Unidentified pilot whale	18	36.760995	74.562766
19-Oct-23	11:18	*Globicephala* sp.	Unidentified pilot whale	4	36.855877	74.577424
19-Oct-23	12:05	*Tursiops truncatus*	Bottlenose dolphin	10	36.959899	74.667381
19-Oct-23	12:34	*Tursiops truncatus*	Bottlenose dolphin	5	37.012586	74.586228
19-Oct-23	13:54	*Tursiops truncatus*	Bottlenose dolphin	50	37.043156	74.691348
23-Dec-23	10:06	*Tursiops truncatus*	Bottlenose dolphin	20	37.029887	74.572723
23-Dec-23	10:49	*Physeter macrocephalus*	Sperm whale	4	36.982046	74.522052
23-Dec-23	14:21	*Globicephala* sp.	Unidentified pilot whale	40	37.017650	74.570695
23-Dec-23	16:43	*Megaptera novaeangliae*	Humpback whale	1	36.880816	75.549521

Key: °N = degrees North; °W = degrees West

C

Sea Turtle Sightings 2023

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Date	Sighting Time (local)	Scientific Name	Common Name	Group Size	Latitude (°N)	Longitude (°W)
06-May-23	16:33	*Caretta caretta*	Loggerhead turtle	1	36.573058	75.214802
07-Jul-23	15:23	*Dermochelys coriacea*	Leatherback turtle	1	36.861959	74.891817
03-Aug-23	15:03	*Caretta caretta*	Loggerhead turtle	1	36.741251	74.862466
03-Aug-23	15:50	*Caretta caretta*	Loggerhead turtle	1	36.770786	75.230876
12-Oct-23	7:20	*Caretta caretta*	Loggerhead turtle	1	36.944167	75.275667
12-Oct-23	13:00	*Caretta caretta*	Loggerhead turtle	1	36.739519	74.622272
12-Oct-23	14:35	*Caretta caretta*	Loggerhead turtle	2	36.751772	74.891375
12-Oct-23	15:33	*Caretta caretta*	Loggerhead turtle	1	36.780262	75.222516
19-Oct-23	8:14	*Caretta caretta*	Loggerhead turtle	1	36.604856	74.871150
19-Oct-23	8:18	*Dermochelys coriacea*	Leatherback turtle	1	36.602923	74.838930
19-Oct-23	14:06	*Caretta caretta*	Loggerhead turtle	1	37.046583	74.716844

Key: °N = degrees North; °W = degrees West

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D

Photo-identified Individuals, Priority Species 2023

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HDR ID	Species	Sighting Date	Biopsy?	Satellite Tag?/Argos ID
HDRVAPm007	*Physeter macrocephalus*	20-Mar-23	No	No
HDRVABp117	*Balaenoptera physalus*	20-Mar-23	No	No
HDRVAPm010	*Physeter macrocephalus*	20-Mar-23	No	No
HDRVAPm012	*Physeter macrocephalus*	20-Mar-23	No	No
HDRVAPm096	*Physeter macrocephalus*	20-Mar-23	No	No
HDRVAPm130	*Physeter macrocephalus*	20-Mar-23	No	No
HDRVAPm131	*Physeter macrocephalus*	20-Mar-23	No	No
HDRVAPm132	*Physeter macrocephalus*	20-Mar-23	No	No
HDRVAPm133	*Physeter macrocephalus*	20-Mar-23	No	No
HDRVAPm134	*Physeter macrocephalus*	20-Mar-23	No	No
HDRVAPm135	*Physeter macrocephalus*	20-Mar-23	No	No
HDRVAPm136	*Physeter macrocephalus*	20-Mar-23	No	No
HDRVAMn283	*Megaptera novaeangliae*	20-Mar-23	No	No
HDRVAPm137	*Physeter macrocephalus*	06-May-23	Yes	SPLASH-10/202810
HDRVAPm138	*Physeter macrocephalus*	06-May-23	Yes	SPLASH-10/202811
HDRVABm008	*Balaenoptera musculus*	06-May-23	No	No
HDRVAPm139	*Physeter macrocephalus*	29-Jun-23	No	No
HDRVAPm140	*Physeter macrocephalus*	29-Jun-23	No	No
HDRVAPm062	*Physeter macrocephalus*	07-Jul-23	No	No
HDRVAMn293	*Megaptera novaeangliae*	23-Dec-23	No	No
HDRVAPm141	*Physeter macrocephalus*	23-Dec-23	No	No

Key: ID = Identification