Mid-Atlantic Baleen Whale Monitoring, Virgina Beach, Virginia

2024/25

Annual Progress Report

PREPARED BY

Jessica Aschettino, Dan Engelhaupt, and Jess Ozog, HDR Inc.

Amy Engelhaupt, Amy Engelhaupt Consulting

Jackie Bort Thornton, Naval Facilities Engineering Systems Command, Atlantic

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A Customized Animal Tracking Solution (CATS) tag is deployed on a North Atlantic right whale (*Eubalaena glacialis*) off the coast of Virginia. Cover photograph taken under National Marine Fisheries Service (NMFS) Scientific Research Permit No. 28184.

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Executive Summary

A total of 22 nearshore and mid-shelf vessel surveys were completed during the 2024/25 field season. In total, 60 baleen whale sightings, including 40 sightings of humpback whales (*Megaptera novaeangliae*) totaling 59 individuals, 10 sightings of North Atlantic right whales (NARWs; *Eubalaena glacialis*) totaling 22 individuals, 7 sightings of fin whales (*Balaenoptera physalus*) totaling 14 individuals, and 3 sightings of individual minke whales (*Balaenoptera acutorostrata*), occurred during the 2024/25 field season. A total of 24 aerial surveys were flown during the 2024/25 field season in association with this effort and the Offshore Cetacean Study (OCS) (A. Engelhaupt et al. 2026); see Ozog and Engelhaupt 2026 for additional details regarding the aerial surveys. Baleen whale sightings from the aerial surveys included humpback (*n*=45), NARWs (*n*=8), fin (*n*=11), and minke (*n*=3) whales (Ozog and Engelhaupt 2026). During the OCS surveys, baleen whale sightings included fin whales (*n*=12), humpback whales (*n*=7), a blue whale (*Balaenoptera musculus*; *n*=1), a minke whale (*n*=1), and an NARW (*n*=1) (A. Engelhaupt et al. 2026). Across this project and the OCS effort, satellite-linked telemetry tags were deployed on one humpback whale, one fin whale, and one NARW. Customized Animal Tracking Solution tags were deployed on two NARWs and two humpback whales. One biopsy sample was collected from the satellite-tagged humpback whale (see **Table 1** in **Section 1**).

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Acronyms and Abbreviations

°N	degrees North
°W	degrees West
Ba	*Balaenoptera acutorostrata* (minke whale)
Bp	*Balaenoptera physalus* (fin whale)
BSS	Beaufort sea state
CATS	Customized Animal Tracking Solution
CMARI	Clearwater Marine Aquarium Research Institute
CLS	Collection & Location by Satellite
CTD	conductivity, temperature, and depth
DMA	Dynamic Management Area
DMON	digital acoustic monitoring instrument
DTAG	Digital Acoustic Recording Tag
Eg	*Eubalaena glacialis* (North Atlantic right whale)
ESA	Endangered Species Act
GOM	Gulf of Maine
GMT	Greenwich Mean Time
GPS	Global Positioning System
hr	hour(s)
ID	identifier/Identification Number/identification
km	kilometer(s)
LFDCS	Low-frequency Detection and Classification System
LIMPET	Low Impact Minimally Percutaneous External-electronics Transmitter
m	meter(s)
MAHWC	Mid-Atlantic Humpback Whale Catalog
max	maximum
min	minute(s)
MINEX	Mine Neutralization Exercise
mm:ss	minutes:seconds
Mn	*Megaptera novaeangliae* (humpback whale)
NAHWC	North Atlantic Humpback Whale Catalog
NARW	North Atlantic right whale
NAVFAC	Naval Facilities Engineering Systems Command
NEFSC	Northeast Fisheries Science Center
nm	nautical mile(s)
No.	Number
NOAA	National Oceanic and Atmospheric Administration

OBIS-SEAMAP	Ocean Biogeographic Information System Spatial Ecological Analysis of Megavertebrate Populations
OCS	Offshore Cetacean Study
OPAREA	Operating Area
PAM	passive acoustic monitoring
photo-ID	photo-identification
SEFSC	Southeast Fisheries Science Center
SMA	Seasonal Management Area
UME	Unusual Mortality Event
U.S.	United States
VACAPES	Virginia Capes
VAQS	Virginia Aquarium & Marine Science Center
VHF	very-high frequency

1 Introduction and Background

Since January 2015, HDR Inc. has been monitoring humpback whales (*Megaptera novaeangliae*) to assess their occurrence, habitat use, and behavior within and near United States (U.S.) Navy training and testing areas off Virginia via the Mid-Atlantic Humpback Whale Monitoring Project (**Table 1**). Vessel surveys focused on photo-identification (photo-ID); biopsy sampling; tagging using medium-resolution satellite-linked telemetry tags and high-resolution suction-cup tags; and using a small drone for behavioral observations, and when properly equipped, for length and body condition assessments. These baseline data are critical for assessing the potential for disturbance to humpback whales within this part of the Mid-Atlantic.

Although humpback whales were initially the focal species for this study, data on other high-priority baleen whale species were also collected opportunistically. Relatively little information exists on how other baleen whale species, including endangered North Atlantic right whales (NARWs; *Eubalaena glacialis*) and fin whales (*Balaenoptera physalus*), use the central Mid-Atlantic waters of the Atlantic Fleet Training and Testing area. Passive acoustic monitoring (PAM) results from autonomous gliders and Marine Autonomous Recording Units confirm that humpback, fin, sei (*Balaenoptera borealis*), minke (*Balaenoptera acutorostrata*), and NARWs regularly use the continental shelf waters off the coasts of Virginia and North Carolina (Stanistreet et al. 2016, Salisbury et al. 2018, Baumgartner 2019). Acoustic detections are supported by visual sighting data collected by the Atlantic Marine Assessment Program for Protected Species (NEFSC and SEFSC 2012, 2013) as well as extensive aerial and vessel baseline surveys previously funded under the Navy's Marine Species Monitoring Program (Mallette et al. 2018, Cotter 2019).

Fin whales, considered a strategic stock given their Endangered Species Act (ESA) status, appear to show a reliable pattern of occurrence near the continental shelf break throughout the Virginia Capes Operating Area (VACAPES OPAREA) (Hayes et al. 2023, Mallette et al. 2018). Satellite-linked telemetry tags, deployed on fin whales within the region by researchers from HDR Inc. between 2016 and 2021, show both localized and extensive movements over all areas of the continental shelf (A. Engelhaupt et al. 2017, 2018, 2019, 2025; Aschettino et al. 2018, 2021, 2022a). Confirmed sightings of endangered NARWs off Virginia have also increased as coverage during surveys has extended farther offshore in recent years (Aschettino et al. 2022a, 2023, 2024a). Movements of satellite-tagged NARWs show extensive use of the mid-shelf region both north and south of the primary study area (Aschettino et al. 2022a, 2023; D. Engelhaupt et al. 2022). Although sightings of blue whales (*Balaenoptera musculus)* off Virginia are infrequent, they have now been documented during HDR Inc. offshore surveys in 2018 (A. Engelhaupt et al. 2019, 2024; D.T. Engelhaupt et al. 2020), 2019 (Cotter 2019, D.T. Engelhaupt et al. 2020), 2021 (A. Engelhaupt et al. 2022), 2022 (A. Engelhaupt et al. 2023a), and 2025 (A. Engelhaupt et al. 2026). Argos location data from satellite-tagged blue whales have shown at least some movements through shallower continental shelf waters (Lesage et al. 2017, A. Engelhaupt et al. 2022, Aschettino et al. 2022b).

Table 1. Summary of field seasons and objectives since project initiation in 2014.

Season	Begin	End	Objectives	Biopsy Samples	Satellite Tags Deployed Mn / Bp / Eg / Ba	Suction Cup Tags Deployed	Report
1 (2014/15[a])	31-Dec-2014	15-May-2015	Collect baseline information	12	—	—	Aschettino et al. 2015; A. Engelhaupt et al. 2015
2 (2015/16)	01-Dec-2015	09-May-2016	Collect baseline information and deploy telemetry tags	11	9 / 0 / 0 / 0	—	Aschettino et al. 2016
3 (2016/17)	01-Nov-2016	21-Mar-2017	Collect baseline information and deploy telemetry tags	29	26 / 0 / 0 / 0	—	Aschettino et al. 2017
4 (2017/18)	01-Oct-2017	01-Mar-2018	Collect baseline information and deploy telemetry tags, expand spatial extent of coverage	3	6 / 2 / 0 / 0	—	Aschettino et al. 2018
5 (2018/19)	12-Nov-2018	20-May-2019	Collect baseline information and deploy telemetry tags, collaborate on behavioral response of humpbacks to large vessels (Shearer et al. 2019, 2020)	9	10 / 0 / 0 / 0	—	Aschettino et al. 2019; Aschettino et al. 2020a; Aschettino et al. 2020b
6 (2019/20)	21-Dec-2019	27-Mar-2020	Collect baseline information, deploy telemetry tags, conduct photogrammetry using a drone, collaborate on behavioral response of humpbacks to large vessels (Shearer et al. 2021)	7	9 / 1 / 0 / 0	—	Aschettino et al. 2021
7 (2020/21)	19-Nov-2020	27-Mar-2021	Collect baseline information, deploy telemetry and acoustic tags, conduct photogrammetry using a drone, expand to mid-shelf region with addition of other baleen whale species, collaborate on behavioral response of humpbacks to large vessel project (Shearer et al. 2022)	6	7 / 2 / 2 / 0	4	Aschettino et al. 2022a
8 (2021/22)	14-Nov-2021	15-Mar-2022	Collect baseline information, deploy telemetry and acoustic tags, conduct photogrammetry using a drone, continue expansion to mid-shelf region with addition of other baleen whale species, collaborate on behavioral response of humpbacks to large vessel project (Shearer et al. 2023)	7	9 / 0 / 1 / 0	2	Aschettino et al. 2023
9 (2022/23)	21-Nov-2022	06-Mar-2023	Collect baseline information, deploy telemetry and acoustic tags, conduct photogrammetry using a drone, continue expansion to mid-shelf region with addition of other baleen whale species, collaborate on behavioral response of humpbacks to large vessel project (Shearer et al. 2024)	1	2 / 0 / 0 / 0	4	Aschettino et al. 2024a; Aschettino et al. 2024b
10 (2023/24)	8-Nov-2023	30-Mar-2024	Collect baseline information, deploy telemetry and acoustic tags, conduct photogrammetry using a drone, continue expansion to mid-shelf region with addition of other baleen whale species	2	0 / 0 / 0 / 1	2	Aschettino et al. 2025a; Aschettino et al. 2025b
11 (2024/25)	18-Nov-2024	19-Mar-2025	Collect baseline information, deploy telemetry and acoustic tags, continue expansion to mid-shelf region with addition of other baleen whale species	1	1 / 1 / 1 / 0	4	Current report

Key: Mn = Humpback whale (*Megaptera novaeangliae*); Bp = Fin whale (*Balaenoptera physalus*); Eg = North Atlantic right whale (*Eubalaena glacialis*); Ba = Minke whale (*Balaenoptera acutorostrata*)

[a] Additional humpback whale sighting information from coastal line-transect surveys for bottlenose dolphins (*Tursiops sp.*) conducted from 2012 through 2015 (see A. Engelhaupt et al. 2016) was also incorporated into these analyses

Building upon the long-term dataset established through the ongoing monitoring of humpback whales, the Mid-Atlantic Nearshore and Mid-Shelf Baleen Whale Monitoring Project expanded the previous study area to encompass mid-shelf waters to approximately 75 kilometers (km) from shore, where the diversity of baleen whale species increases. The goals of this study are to assist the U.S. Navy and regulatory agencies by addressing the following questions:

- What is the baseline ecology and behavior of baleen whales (including NARWs and fin, humpback, sei, minke, and blue whales) within the study area?
- Do individual whales exhibit site fidelity within specific regions of the U.S. Navy OPAREAs over periods of weeks, months, or years?
- What is the seasonal extent of baleen whale movements within and around U.S. Navy OPAREAs?
- Do baleen whales spend significant time within or primarily move through areas of U.S. Navy live-fire or anti-submarine warfare training events?
- Are baleen whale movement patterns affected by U.S. Navy training exercises?
- Are baleen whales likely to be exposed to significant sound levels produced by vessel traffic and/or military training exercises using active sonar?

The core baleen whale field season off Virginia Beach runs from approximately the end of October through March, when humpbacks and NARWs are common visitors—humpbacks most typically December through February, and NARWs into April and occasionally beyond. Eleven field seasons have been dedicated to addressing the above objectives (**Table 1**), starting with collection of basic baseline information using photo-ID, focal-follow, and biopsy-sampling methods. Subsequently, the project evolved to include deployment of satellite-linked telemetry tags, Digital Acoustic Recording Tags (DTAGs), and Customized Animal Tracking Solutions (CATS) tags; collaboration with researchers from Duke University to examine behavioral response of humpbacks to large vessels (Shearer et al. 2020); photogrammetry using a drone; and, more recently, an expansion into the mid-shelf region with the additional focus on other baleen whale species, including fins and NARWs. Therefore, this report presents details for both the nearshore and mid-shelf effort during the 2024/25 season. Additionally, sighting details and tag deployments on baleen whales tagged during the offshore surveys (A. Engelhaupt et al. 2026) as well as all NARW sighting details from the aerial surveys (Ozog and Engelhaupt 2026) are included in this report.

2 Methods

2.1 Vessel Surveys

The study area for this project includes waters within and around the mouth of Chesapeake Bay; the W-50 Mine Neutralization Exercise (MINEX) region off Virginia Beach; and, beginning with the 2020/21 field season, the mid-shelf region of the VACAPES OPAREA (**Figure 1**). Two primary areas of interest within the nearshore study area are U.S. Navy training areas and commercial shipping lanes. Inbound and outbound shipping lanes are defined by the Traffic Separation Scheme. Initially, the "shipping lane study area" was defined by the Traffic Separation Scheme within the mouth of Chesapeake Bay (**Figure 1**). However, as tag locations showed movements outside the defined area but within shipping channels, the area was extended using multiple nautical charts and datasets. This includes using the following guidelines: the Traffic Separation Scheme; Coastal Maintained Channels in U.S. Waters (U.S. Army Corps of Engineers); and Shipping Fairways, Lanes, and Zones for U.S. Waters (National Oceanic and Atmospheric Administration [NOAA]). The U.S. Navy training areas include portions of the W-50 MINEX range. Within the mid-shelf study area, the Dominion Wind Energy Area (not a focus of this study) is shown given interest by other regulatory agencies and stakeholders (**Figure 1**).

Local availability of researchers allowed survey effort to be flexible and take advantage of limited winter weather windows to maximize the ability to achieve project objectives. Optimal weather conditions include good visibility and a Beaufort sea state (BSS) of 3 or lower. Once a survey was underway, if BSS reached 4 to 5, or visibility was reduced to less than 1 nautical mile (nm) because of rain, fog, or snow, the survey was typically aborted and the vessel returned to port. Efforts were coordinated with the W-50 MINEX range, so the research vessel had clearance to operate when training was not being conducted. Because of frequent range closures and limited weather windows, it was not always possible to conduct surveys within the W-50 MINEX range.

The primary survey vessel for the nearshore effort during the 2024/25 season was HDR's 8.8-meter (m), fiberglass, hybrid-foam collar boat. Surveys using this vessel departed Lynnhaven Inlet, Virginia Beach. While working within the mid-shelf area, surveys used the 16.2-m fishing vessel *Top Notch*. Surveys using this vessel departed from Rudee Inlet, Virginia Beach. Given the focus on the mid-shelf with the intent to locate NARWs, more mid-shelf surveys were conducted than nearshore surveys. When working within the mid-shelf region, the vessel would often coordinate with concurrent aerial surveys being conducted in Virginia and North Carolina by HDR, Clearwater Marine Aquarium Research Institute (CMARI), and Azura Consulting LLC, primarily to respond to any sightings of NARWs.

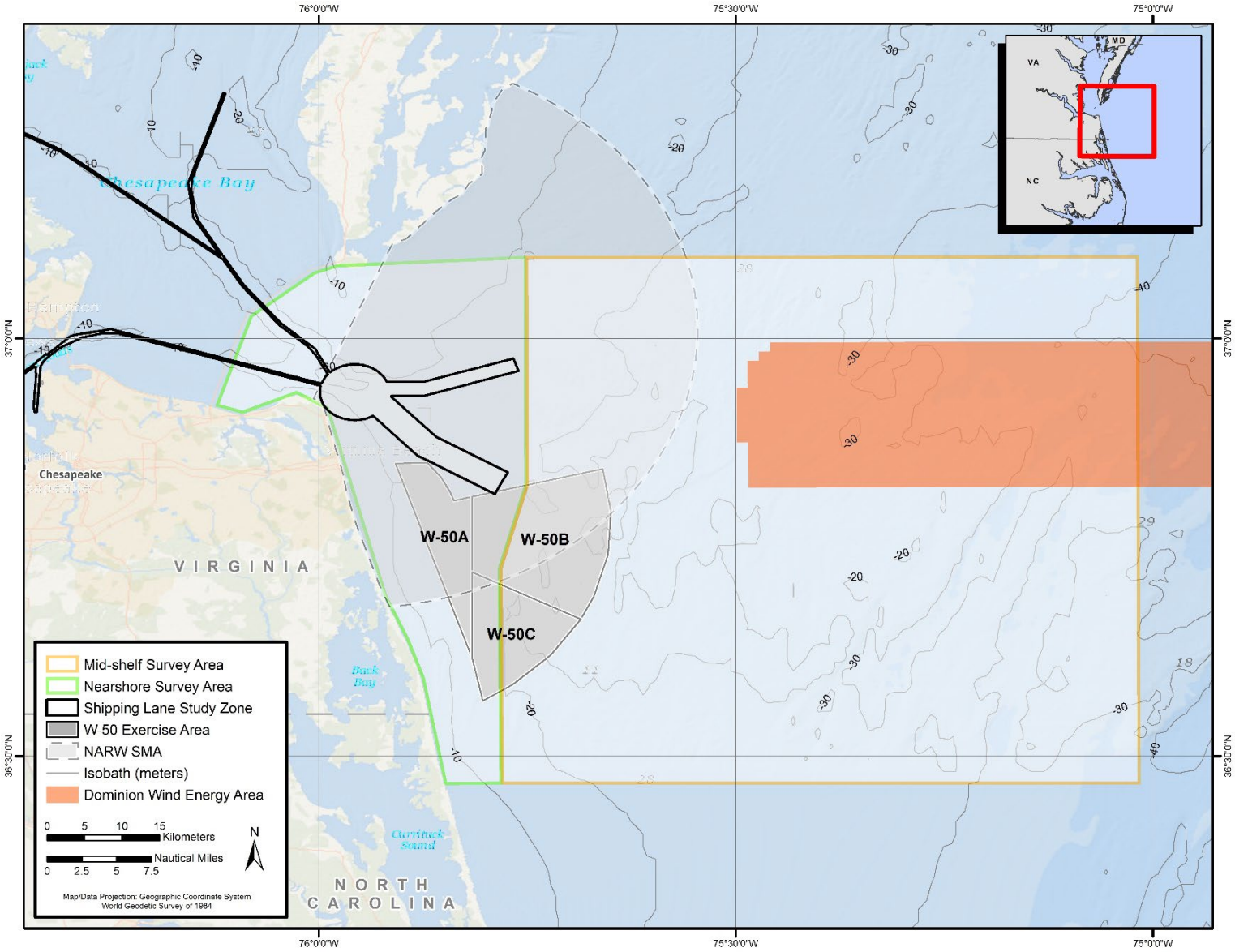

Figure 1. Map of the nearshore and mid-shelf study area, which includes waters within and around the mouth of Chesapeake Bay shipping lanes, the W-50 MINEX region off Virginia Beach, and the Dominion Wind Energy Area.

The crew typically consisted of three or four qualified marine mammal scientists, with one also serving as the vessel operator when working from the nearshore vessel. Survey efforts typically began when the local whale-watch operations and other mariners first started reporting humpback sightings or baleen whales had been detected acoustically on the network of buoys within the survey area. Once departed from the inlet, the vessel would transit to areas where baleen whales were previously seen or reported. If no whales were located within these areas, the vessel would expand the search into waters farther offshore, north, or south of the primary study area (see **Figure 1**). Survey data were collected on an Apple® iPad using COMPASS (see Richlen et al. 2019), a U.S. Navy-funded, marine mammal survey software platform. Sightings of non-target species within the survey area (i.e., bottlenose [*Tursiops* sp.] and common [*Delphinus delphis*] dolphins) were not always recorded and are, therefore, not presented in this report.

2.2 Biopsy Sampling

Biopsy samples were collected using a crossbow. Finn Larsen-designed crossbow bolts outfitted with 25-millimeter, ethanol-sterilized, stainless-steel tips were projected by a 68-kilogram pull Barnett recurve crossbow (Barnett Outdoors, LLC; Tarpon Springs, Florida).

Samples were post-processed by sectioning the skin into three equal-sized pieces. One-third of the skin was placed in a cryovial and frozen (-15 degrees Celsius) for future stable isotope analysis, one-third was placed in a cryovial with a dimethylsulfate and sodium chloride solution in preparation for analysis by University of Groningen, and one-third was frozen (-15 degrees Celsius) for archival storage for the Southeast Fisheries Science Center (SEFSC). Blubber from the samples was wrapped in foil and frozen (-15 degrees Celsius) for archiving for the SEFSC. All baleen whale samples collected through the 2023/24 season were sent to the University of Groningen for processing (Bérubé and Palsbøll 2026). The sample collected in 2024/25 is currently stored and awaiting future processing.

2.3 Satellite Tagging

Satellite-linked telemetry tags have been a primary component of the project since the 2015/16 field season. Wildlife Computers (Redmond, Washington) SPLASH10-F-333 with Fastloc® Global Positioning System (GPS) technology and SPLASH10-292B Argos tags in the Type-A (Andrews et al. 2019) Low Impact Minimally Percutaneous External-electronics Transmitter (LIMPET) configuration (Andrews et al. 2008) were deployed during the 2024/25 season and collect dive-depth data in addition to location. Tags were remotely deployed using a DAN-INJECT JM25 pneumatic projector. The LIMPET tags use two 6.8-centimeter, surgical-grade, titanium darts with six backwards-facing petals to attach tags to or just below the dorsal fin (**Figure 2**).

Figure 2. LIMPET SPLASH10-F tag on a humpback whale immediately after deployment.

Given existing information about attachment durations of LIMPET tags on baleen whales, maximum tag attachment duration was expected to be on the order of days to weeks. Therefore, tags were programmed to maximize the number of transmissions and locations received rather than to extend battery life. Based on satellite availability within the area, tags were programmed to transmit for 18 hours per day and up to 1,100 transmissions per day for the SPLASH10-F tag. A Collection & Location by Satellite (CLS) goniometer was also used as a mobile receiving station to maximize the amount of data (i.e., tag messages) collected that may otherwise be missed by the satellites.

In order to constitute a “dive” for the Wildlife Computers-generated behavior and time-series data outputs of the SPLASH10-F tags, a definition was established in which a submergence needed to be both deeper than 2 m and longer than 120 seconds to be classified as a dive. Locations of tagged individuals were approximated by the Argos system using the Kalman filtering location algorithm (Argos User’s Manual © 2007–2015 CLS), and unrealistic locations (i.e., on land) were manually removed using tools provided within Movebank.

The launching of Argos-capable nanosatellites, known as “Kinéis,” in 2025 allowed for enhanced data access beginning 01 July 2025 (Wildlife Computers 2025). One satellite tag deployed during the 2024/25 season was active during this time frame (see **Section 3.4.3**) and benefited from the enhanced coverage.

Biopsy samples were collected from tagged whales using the protocols described in **Section 2.2**; conductivity, temperature, and depth (CTD) casts were taken following a tag deployment when possible.

2.4 Digital Archival Tagging

Digital archival tagging was added to the project for the 2020/21 season using DTAGs (Johnson and Tyack 2003) within the mid-shelf and/or MINEX region of the study area. CATS tags were incorporated for the 2022/23 season. Both tag types use suction-cup attachments, are deployed using a hand-held carbon fiber pole, and must be retrieved for data recovery. Version 3 DTAGs were equipped with hydrophones and pressure sensors as well as three-axis accelerometer**s** and magnetometers. Audio-sampling rate was set to 120 kilohertz for baleen whales, and programmed release time was set according to conditions and logistics to facilitate the best opportunity retrieval. The CATS tag contains a 4K high-resolution video camera in addition to the diary that records accelerometer, magnetometer, gyroscope, and pressure data as well as a single hydrophone. Both types of tags contain a very-high frequency (VHF) transmitter that allows recovery using Communications Specialists, Inc. R-1000 VHF receivers with hand-held Yagi antennas to direct the vessel to the tag location after release from the animal. The CATS tag also includes a Smart Position and Temperature (SPOT)-6 satellite tag to support recovery.

Tag calibration and data visualization following recovery of all tags was completed using a suite of tools found on animaltags.org and MATLAB. CATS tag calibration steps are outlined in Cade et al. (2021).

2.5 Photo-Identification

Photographs were collected in the field using a digital single-lens reflex camera (Canon 7D, 7D Mark II, or 1DX Mark II) or a mirrorless camera (Canon R5) with a zoom lens (Canon 100- to 400-millimeter or Canon 100- to 500-millmeter). Photographs were post-processed using ACDSee (Versions 7–9) by cropping the best image of each individual whale's dorsal fin (left and right for humpback, fin, and minke whales) and tail flukes (when obtained).

For humpback, fin, minke, and blue whales, photographs were assembled into individual project catalogs managed by HDR Inc., in which new whales are assigned a unique identifier using the naming convention "HDRVA," followed by the two-letter abbreviation for the scientific name of the species, followed by a numerical sequence of three numbers (e.g., HDRVAMn001). Each whale was then compared with the others. At the end of the 2014/15 and 2022/23 field seasons, images of humpback whale flukes were submitted to Allied Whale for comparison to the North Atlantic Humpback Whale Catalog (NAHWC). Prior to the 2021/22 season, images of humpback whale dorsal fins and flukes were submitted to the Virginia Aquarium & Marine Science Center (VAQS) for comparison with the Gulf of Maine (GOM) Humpback Whale Catalog (curated by the Center for Coastal Studies) and integration into the Mid-Atlantic Humpback Whale Catalog (MAHWC) (Mallette and Barco 2019). Subsequent seasons were integrated into the MAHWC by HDR Inc. and Naval Facilities Engineering Systems Command (NAVFAC) Atlantic curators (see **Section 2.5.1**). Images of humpback whales from all seasons were annually compared with images from local whale-watch operation Rudee Tours, and images through the 2021/22 season were compared with Gotham Whale (Brown et al. 2022). Fin whale images through 2017 were shared with the North Atlantic Fin Whale Catalog curated by the Center for Coastal Studies, and will be added to Happywhale and compared to catalog photographs from other regions that have been shared with HDR Inc. Blue whale images were shared with Richard Sears from Mingan Island Cetacean Study to compare with their existing catalog.

When sightings of NARWs were made in the field, a drone was often launched to record overhead videos of all individuals. Because NARWs are best identified using callosity patterns and scarring (Hamilton et al. 2007), the resulting overhead stills were used to compare with an onboard catalog of known reproductive females. If an aerial survey happened to be in progress, they would be tasked with collecting identification photographs of all individuals. If either the vessel or aerial team was within cell-phone range, photographs of the individual NARWs were then shared with Katie Jackson (Florida Fish and Wildlife Conservation Commission) for identification assistance. If not within cell-phone range, images would be sent to Katie Jackson as well as others at the NEFSC and New England Aquarium once back within range. Beginning in February 2025, a Starlink was added to the vessels and planes (see Ozog and Engelhaupt 2026) for real-time photo sharing and communication. At the end of the 2024/25 field season, all photographs and drone data collected from NARWs were submitted to the New England Aquarium for incorporation into the North Atlantic Right Whale Catalog.

2.5.1 Mid-Atlantic Humpback Whale Catalog and Happywhale

The MAHWC was designed as a collaborative tool to facilitate understanding of identity, residency, site fidelity, and habitat use of humpback whales in Mid-Atlantic waters (Mallette and Barco 2017). Organizations and individuals from New York to North Carolina can contribute sighting and photographic information for inclusion in the catalog. The catalog is composed primarily of images and data collected by researchers or organizations focused on photo-ID, as well as information from stranding groups. Contributors are encouraged to provide additional data to the catalog if collected, such as biopsy status, tag status, and gender (if known).

Beginning in 2023, HDR Inc. and NAVFAC Atlantic took on the curator role for the MAHWC and in 2024, a partnership was established with Happywhale.com, a citizen-science platform that allows any user to upload image(s) of whales to gain information on where that whale had been previously seen. An artificial-intelligence-based, automated, image-recognition algorithm was developed for humpback whale flukes and currently, more than 118,000 individuals are in the humpback whale database, of which more than 12,000 are from the North Atlantic and Atlantic Arctic.

To aid researchers in managing their data and images, Ocean Biogeographic Information System Spatial Ecological Analysis of Megavertebrate Populations (OBIS-SEAMAP) hosts an online framework for viewing fin and fluke images, mapping sighting locations, and matching individuals across projects or locations (Halpin et al. 2009). OBIS-SEAMAP and Happywhale have established a data exchange mechanism in which Happywhale's encounter records and associated images are imported into the OBIS-SEAMAP database at a scheduled interval (currently monthly). Any humpback whale fluke photographs entered into the MAHWC can therefore be matched using fast, accurate, automated image recognition (Cheeseman et al. 2022) against a known set of individuals. See Aschettino et al. (2024b; 2025b) for additional information on the MAHWC and Happywhale workflow. So that the known set of individuals is as useful and relevant to the MAHWC as possible, Happywhale hosts and maintains a humpback whale fluke photo-ID catalog containing representative fluke photographs of all available, known, MAHWC individuals as well as fluke images of all available North Atlantic individuals from research collaborators and citizen-science sources.

2.6 Autonomous Real-Time Detection Buoy

An autonomous, real-time reporting, passive acoustic detection buoy (**Figure 3**) developed by the Woods Hole Oceanographic Institute has been maintained off the coast of Cape Charles since October 2023. The buoy has the ability to detect and classify baleen whale vocalizations using a digital acoustic monitoring instrument (DMON) and sophisticated analysis software to listen for whales as well as send notifications and data to researchers in near-real time. A refurbished buoy was deployed on 20 May 2025 to replace a previous buoy that was in the water from 14 July 2024 to 20 May 2025.

Figure 3. DMON buoy deployed off the coast of Cape Charles, Virginia.

Sensor data from the buoy are relayed to shore and posted on the project's publicly accessible website at Robots4Whales. The DMON is programmed with the Low-frequency Detection and Classification System (LFDCS; Baumgartner and Mussoline 2011; Baumgartner et al. 2013) and is capable of detecting NARWs and humpback, fin, and sei whales. Detection data are transmitted in near real time to shore, where they are reviewed daily by trained analysts; the results are posted on the project website; and they are distributed to interested parties by automated email messages, made available on WhaleMap and integrated into NOAA's Passive Acoustic Cetacean Mapper.

This buoy was strategically placed to complement SoundTrap deployments (**Section 2.7**) as well as another real-time detection buoy deployed off southern Virginia by another organization, and to facilitate the HDR Inc. field team efforts within the area. Confirmed detections of NARWs will trigger a temporary "slow zone" for vessels. Slow Zones are a voluntary program NOAA

Fisheries uses to notify vessel operators to slow down to protect NARWs—maintaining speeds of 10 knots or less can help protect NARWs from vessel collisions. Under these programs, NOAA Fisheries provides maps and coordinates to vessel operators indicating areas where NARWs have been detected. For a period of 15 days after a whale is detected, mariners are encouraged to avoid these areas or reduce speeds to 10 knots or fewer while transiting through these areas. Active Slow Zones can be found on NOAA's website as well as WhaleMap.

2.7 SoundTraps

Three arrays of SoundTraps deployed to monitor for the presence of NARWs within the western Mid-Atlantic in collaboration with NOAA Northeast Fisheries Science Center (NEFSC) were serviced in 2025, maintaining near-continuous acoustic coverage since July 2022 (**Figure 4**). The units off the coast of Delaware were serviced in April and November, and the southeastern Virginia and Eastern Shore units were serviced in April and October. This contributes to a multi-agency effort to build out a broader regional long-term PAM network covering the continental shelf break from Maine to Georgia. These archival PAM systems will continue to be serviced and re-deployed approximately twice annually. Current deployment status can be found on the monitoring program's PAM deployment viewer.

Analysis of the data is performed by NEFSC staff and results incorporated into NOAA's Passive Acoustic Cetacean Map. If a day contained the required number of detections for the call types specified, that species was logged as "detected." **Figure 4** shows locations of SoundTrap deployment locations serviced during 2025.

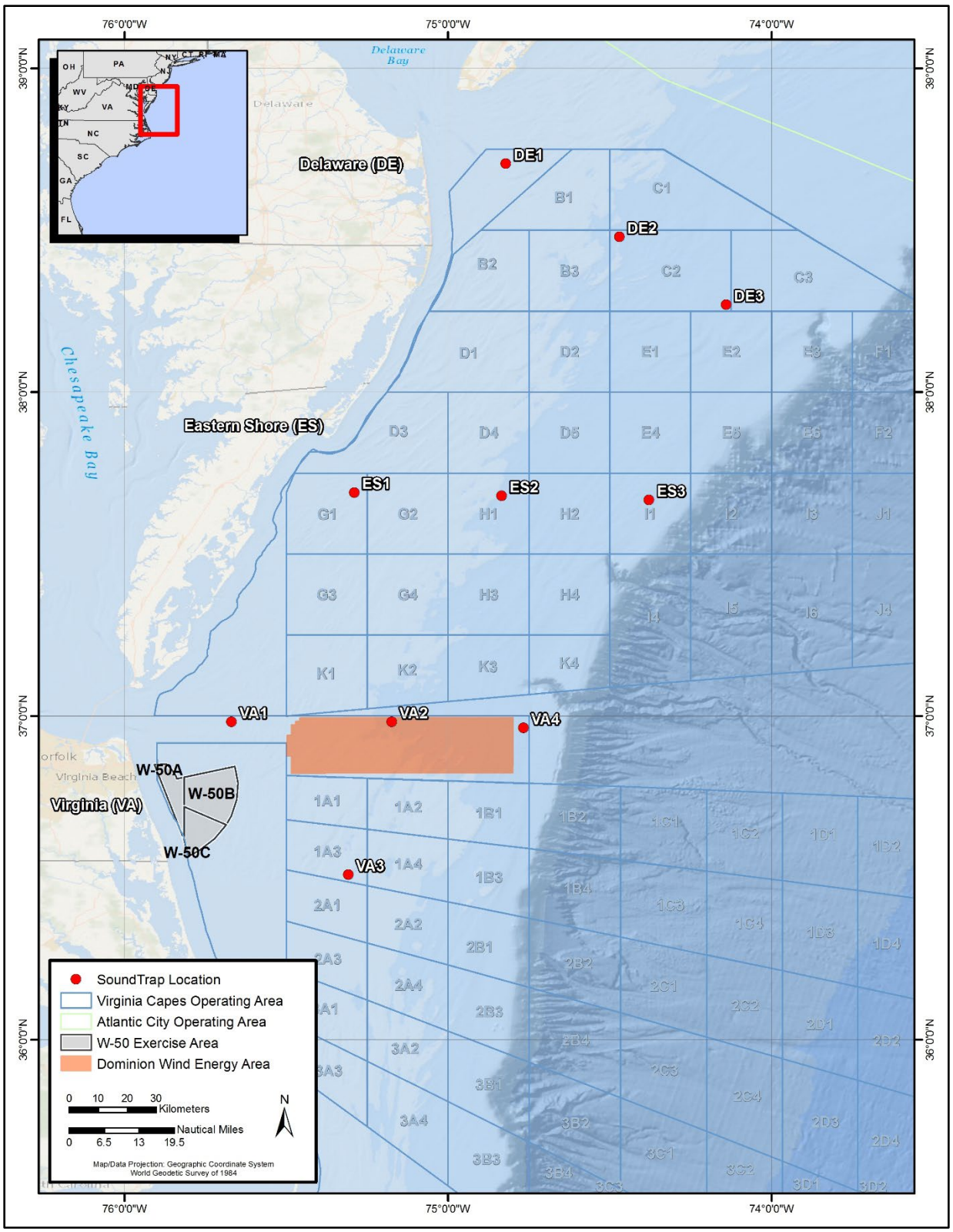

Figure 4. Locations of SoundTrap deployment locations serviced during 2025.

3 Results

3.1 Vessel Surveys

The first survey for the 2024/25 field season occurred on 18 November 2024, and the last survey occurred on 19 March 2025. In total, 22 vessel surveys were conducted during the nearshore and mid-shelf baleen whale field effort, covering 2,719 km of trackline with more than 151 hours of effort (**Table 2**; **Figure 5**). In total, 60 baleen whale sightings, including 40 humpback whale sightings totaling 59 individuals, 10 NARW sightings totaling 22 individuals, 7 fin whale sightings totaling 14 individuals, and 3 sightings of single minke whales occurred during the 2024/25 field season (**Figure 5**; **Table 2**).

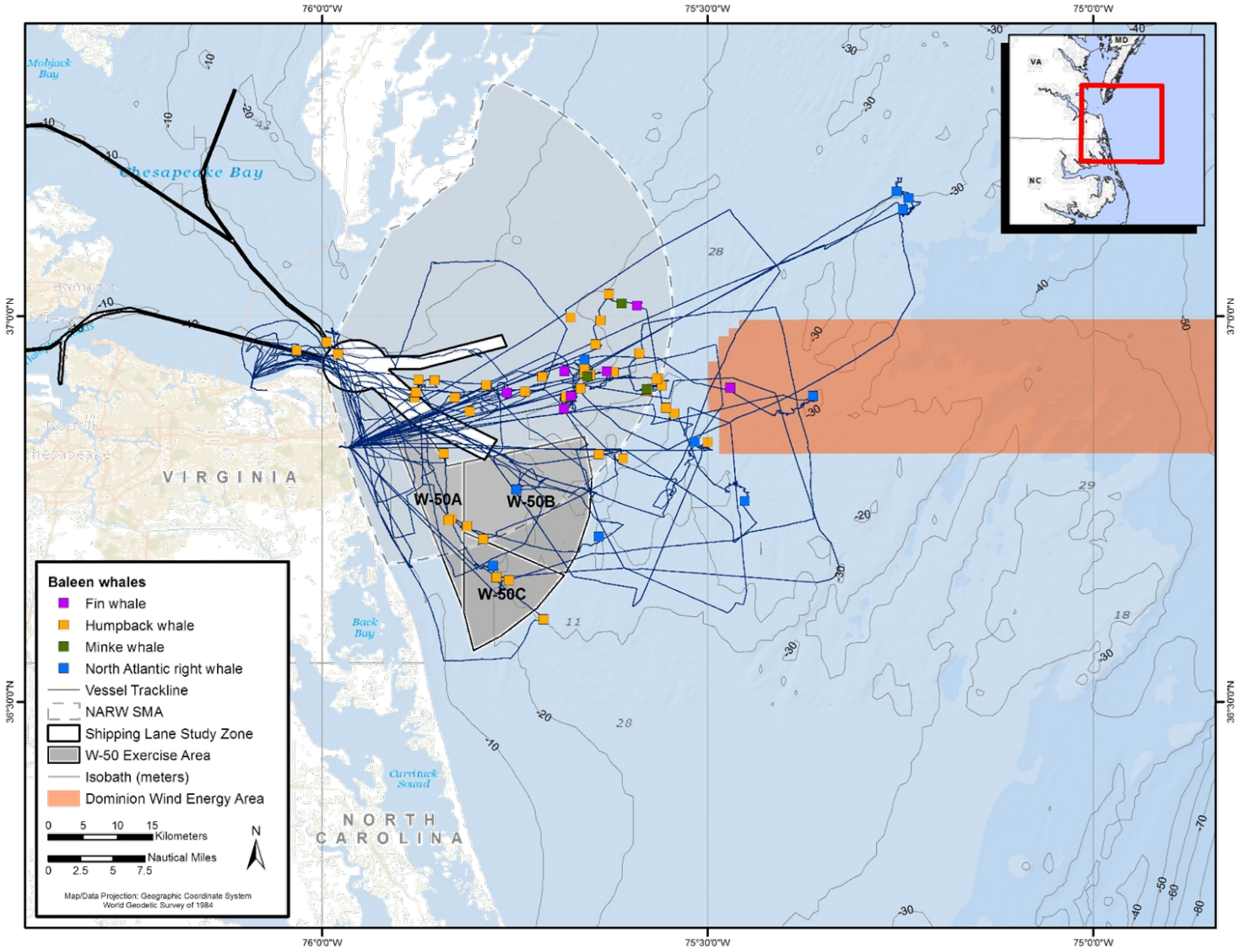

Figure 5. Vessel survey tracks (blue), with locations of all humpback (*n*=40), NARW (*n*=10), fin (*n*=7), and minke (*n*=3) whale sightings for the 2024/25 field season.

Table 2. Summary of nearshore and mid-shelf vessel survey efforts off Virginia Beach, Virginia, for the 2024/25 field season.

Date	Survey Type	Survey Time (min)	Distance Surveyed (km)	# Sightings Mn	# Individual Mn	# Sightings Eg	# Individual Eg	# Sightings Bp	# Individual Bp	# Sightings Ba	# Individual Ba
18-Nov-24	Nearshore	466	159	5	5	0	0	0	0	0	0
19-Nov-24	Nearshore	418	150	0	0	0	0	0	0	0	0
25-Nov-24	Nearshore	446	133	4	5	0	0	0	0	0	0
7-Dec-24	Nearshore	416	122	1	1	1	1	0	0	0	0
10-Dec-24	Nearshore	365	133	1	1	0	0	0	0	0	0
18-Dec-24	Mid-shelf	478	141	1	1	1	2	0	0	0	0
27-Dec-24	Mid-shelf	502	129	2	4	1	1	0	0	0	0
30-Dec-24	Nearshore	331	76	1	2	0	0	0	0	0	0
3-Jan-25	Nearshore	295	100	0	0	0	0	0	0	0	0
17-Jan-25	Mid-shelf	423	93	1	1	1	1	0	0	0	0
24-Jan-25	Mid-shelf	418	149	1	2	0	0	0	0	0	0
25-Jan-25	Mid-shelf	430	129	0	0	2	10	1	1	0	0
27-Jan-25	Mid-shelf	597	155	5	8	1	2	1	1	1	1
30-Jan-25	Mid-shelf	518	179	2	7	0	0	3	8	0	0
3-Feb-25	Nearshore	232	50	0	0	0	0	0	0	0	0
4-Feb-25	Mid-shelf	206	42	2	2	0	0	0	0	0	0
5-Feb-25	Mid-shelf	127	40	0	0	0	0	0	0	0	0
15-Feb-25	Mid-shelf	564	164	1	1	3	5	1	3	0	0
18-Feb-25	Mid-shelf	514	174	3	6	0	0	0	0	0	0
25-Feb-25	Mid-shelf	429	92	6	9	0	0	1	1	2	2
3-Mar-25	Mid-shelf	526	161	3	3	0	0	0	0	0	0
19-Mar-25	Mid-shelf	399	148	1	1	0	0	0	0	0	0
Total	—	**9,100**	**2,719**	**40**	**59**	**10**	**22**	**7**	**14**	**3**	**3**

Key: min = minute(s); Mn = *Megaptera novaeangliae* (humpback whale); Eg = *Eubalaena glacialis* (North Atlantic right whale); Ba = *Balaenoptera acutorostrata* (minke whale); Bp = *Balaenoptera physalus* (fin whale)

3.2 North Atlantic Right Whales

3.2.1 Sightings Summary

Sightings of NARWs from all survey platforms (aerial and vessel) and all survey types (mid-shelf and OCS) are presented in **Table 3** and **Figure 6**. The 10 sightings of NARWs observed during the 2024/25 nearshore and mid-shelf baleen whale season included 22 total individuals (**Table 32**) and resulted in 19 unique NARWs being identified. During the offshore surveys, one sighting of six individual NARWs was made (A. Engelhaupt et al. 2026) and photographs were collected of those six unique NARWs. During the aerial surveys, 8 sightings totaling 23 individuals were made, resulting in 22 unique individuals (Ozog and Engelhaupt 2026). In total, 25 unique NARWs were identified during the 2024/25 season (**Table 3**).

NARW sightings during the 2024/25 season included single animals, pairs, and groups that were traveling. Additionally, milling and some social activity was observed. Only one individual was re-sighted on subsequent survey days (**Table 4**). This differs from previous seasons where larger numbers of surface active groups remained within the area for multiple days (Aschettino et al. 2024a; A. Engelhaupt et al. 2023b).

Table 3. Summary of photo-identified NARWs by platform during the 2024/25 field season, sorted by sighting date and animal identifier and shaded by individuals sighted together. Vessel sightings in black font and aerial sightings in blue font.

Animal ID / Name	Age Class	Sex	Group Size	Behavior	Sighting Date	Survey Type_ Sighting #	Sighting Latitude (°N)	Sighting Longitude (°W)	Unique Sighting Days[1]
#3950	Adult	Male	1	Travel	7-Dec-2024	Midshelf	36.7140	75.6409	1
#3950	Adult	Male	1	Travel	7-Dec-2024	Aerial	36.7052	75.6540	1
#4540 / Cavatappi	Adult	Female	2	Mill	18-Dec-2024	Midshelf	36.6762	75.7786	2
2024Calfof#4540	Yearling	Unknown	2	Mill	18-Dec-2024	Midshelf	36.6762	75.7786	2
#4540 / Cavatappi	Adult	Female	2	Mill	18-Dec-2024	Aerial	36.6775	75.7981	2
2024Calfof#4540	Yearling	Unknown	2	Mill	18-Dec-2024	Aerial	36.6775	75.7981	2
#2024Calfof#3320	Yearling	Unknown	1	Travel	27-Dec-2024	Midshelf	36.8367	75.5167	2
#2024Calfof#3320	Yearling	Unknown	1	Travel	27-Dec-2024	Aerial	36.8241	75.5225	2
#2024Calfof#3320	Yearling	Unknown	1	Travel	17-Jan-2025	Midshelf	36.7750	75.7480	2
#2024Calfof#3320	Yearling	Unknown	1	Travel	17-Jan-2025	Aerial	36.7758	75.7469	2
#1706 / Pencil	Adult	Female	3	Mill	25-Jan-2025	Midshelf	36.8964	75.3633	1
#3934	Adult	Female	3	Mill	25-Jan-2025	Midshelf	36.8964	75.3633	1
#4146	Adult	Female	3	Mill	25-Jan-2025	Midshelf	36.8964	75.3633	1
#1706 / Pencil	Adult	Female	3	Travel	25-Jan-2025	Aerial	36.8887	75.3684	1
#3934	Adult	Female	3	Travel	25-Jan-2025	Aerial	36.8887	75.3684	1
#4146	Adult	Female	3	Travel	25-Jan-2025	Aerial	36.8887	75.3684	1
#3301 / Neptune	Adult	Male	7	Travel	25-Jan-2025	Aerial	36.9951	75.6438	2
#3821 / ZigZag	Adult	Male	7	Travel	25-Jan-2025	Aerial	36.9951	75.6438	3
#4360 / Musketeer	Adult	Male	7	Travel	25-Jan-2025	Aerial	36.9951	75.6438	1
#4523 / Beaker	Adult	Male	7	Travel	25-Jan-2025	Aerial	36.9951	75.6438	5
#5104 / Wall-E	Juvenile	Male	7	Travel	25-Jan-2025	Aerial	36.9951	75.6438	1
#5190	Juvenile	Female	7	Travel	25-Jan-2025	Aerial	36.9951	75.6438	1
#5311 / 2023Calf0f1711	Juvenile	Male	7	Travel	25-Jan-2025	Aerial	36.9951	75.6438	1
#3301 / Neptune	Adult	Male	7	Mill	25-Jan-2025	Midshelf	36.9435	75.6595	2
#3821 / ZigZag	Adult	Male	7	Mill	25-Jan-2025	Midshelf	36.9435	75.6595	3

[1] Number of days individual has been sighted across all survey years 2018-2025

Animal ID / Name	Age Class	Sex	Group Size	Behavior	Sighting Date	Survey Type_ Sighting #	Sighting Latitude (°N)	Sighting Longitude (°W)	Unique Sighting Days[1]
#4360 / Musketeer	Adult	Male	7	Mill	25-Jan-2025	Midshelf	36.9435	75.6595	1
#4523 / Beaker	Adult	Male	7	Mill	25-Jan-2025	Midshelf	36.9435	75.6595	5
#5104 / Wall-E	Juvenile	Male	7	Mill	25-Jan-2025	Midshelf	36.9435	75.6595	1
#5190	Juvenile	Female	7	Mill	25-Jan-2025	Midshelf	36.9435	75.6595	1
#5311 / 2023Calf0f1711	Juvenile	Male	7	Mill	25-Jan-2025	Midshelf	36.9435	75.6595	1
#3903 / Taffy	Adult	Female	2	Travel	27-Jan-2025	Midshelf	36.7601	75.4512	1
#4980 / Coral	Juvenile	Female	2	Travel	27-Jan-2025	Midshelf	36.7601	75.4512	1
#3903 / Taffy	Adult	Female	2	Travel	27-Jan-2025	Aerial	36.7637	75.4470	1
#4980 / Coral	Juvenile	Female	2	Travel	27-Jan-2025	Aerial	36.7637	75.4470	1
#3401 / Tux	Adult	Male	5	Social	15-Feb-2025	Midshelf	37.1383	75.2466	1
#4501	Adult	Male	5	Social	15-Feb-2025	Midshelf	37.1383	75.2466	1
#5012	Juvenile	Male	5	Social	15-Feb-2025	Midshelf	37.1383	75.2466	1
#2406 / Hammer	Adult	Male	6	Travel	10-Mar-2025	Aerial	37.0452	75.2873	1
#2795	Adult	Male	6	Travel	10-Mar-2025	Aerial	37.0452	75.2873	1
#3232 / Lobster	Adult	Female	6	Travel	10-Mar-2025	Aerial	37.0452	75.2873	1
#3423 / Epic	Adult	Male	6	Travel	10-Mar-2025	Aerial	37.0452	75.2873	1
#3545	Adult	Male	6	Travel	10-Mar-2025	Aerial	37.0452	75.2873	2
#4220 / Kermit	Adult	Male	6	Travel	10-Mar-2025	Aerial	37.0452	75.2873	1
#2406 / Hammer	Adult	Male	6	Travel	10-Mar-2025	OCS	36.9731	75.3136	1
#2795	Adult	Male	6	Travel	10-Mar-2025	OCS	36.9731	75.3136	1
#3232 / Lobster	Adult	Female	6	Travel	10-Mar-2025	OCS	36.9731	75.3136	1
#3423 / Epic	Adult	Male	6	Travel	10-Mar-2025	OCS	36.9731	75.3136	1
#3545	Adult	Male	6	Travel	10-Mar-2025	OCS	36.9731	75.3136	2
#4220 / Kermit	Adult	Male	6	Travel	10-Mar-2025	OCS	36.9731	75.3136	1

Key: °N = degrees North; °W = degrees West; ID = Identification Number

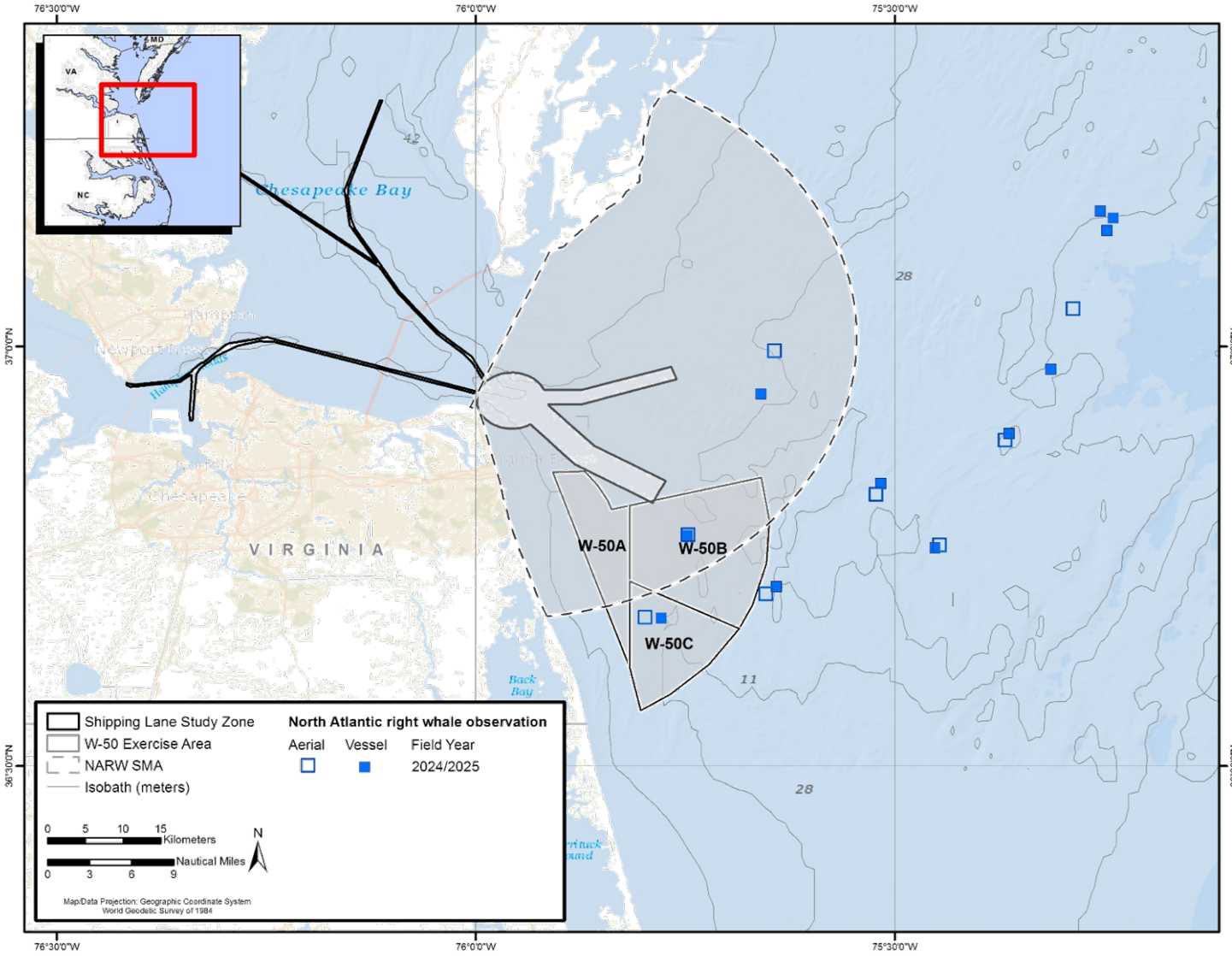

Figure 6. Sighting locations of all NARWs observed during aerial and vessel surveys during the 2024/25 season.

3.2.2 Satellite Tagging Results

One Argos-linked SPLASH10-F-333 satellite tag was deployed on a NARW during the 2024/25 field season (**Table 4**; **Figure 7**) in January 2025. The tag transmitted for 0.7 day after an unexpected rapid battery failure.

Table 4. Satellite-tag deployment on a NARW during the 2024/25 field season.

Animal ID	Estimated Age Class	Tag Type	Argos ID	Deployment Latitude (°N)	Deployment Longitude (°W)	Deployment Date	Last Trans-mission date	Tag Duration (Days)
2024Calfof #3320	Yearling	SPLASH10-F-333	208690	36.7801	75.7406	17-Jan-25	18-Jan-25	0.7

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

2024Calfof#3220 was tagged approximately 10 nm east of Dam Neck, within both the MINEX area and NARW Seasonal Management Area (SMA; **Figure 7**). The tag transmitted for less than 1 day; however, during that timeframe, the yearling initially traveled westward, then eastward before transmissions ended. A re-sighting of 2024Calfof#3220 was made on 15 February 2025 off North Carolina by CMARI, and photographs collected showed that the tag was no longer present (**Figure 8**). Maximum straight-line distance from the initial tagging location to last transmission location was 18.5 km, and mean distance was only 9.9 km (**Table 5**).

Table 5. Summary of results from satellite-tag data for the NARW tagged during the 2024/25 field season.

Animal ID	# Locations Post Filtering	Percent within Shipping Channels	Percent within VACAPES	Maximum Distance from Initial Location (km)	Mean Distance from Initial Location (km)
2024Calfof#3320	15	0.0	100.0	18.5	9.9

Key: ID = identifier

The satellite tag also recorded data on dive depth and duration in addition to the Argos capabilities (**Table 6**). Despite the short duration, the tag recorded a total of 37 dives. Mean dive depth was 18.4 m, with a maximum dive depth of 35.0 m. The mean dive duration was 9.4 minutes (min), with a maximum dive duration of 17.75 min (**Table 6**). While the mean and maximum dive durations are longer than previous tags deployed on NARWs (6:01 & 20:35; 6:42 & 13:55 [Aschettino et al. 2022a]; 4:29 &12:45 [Aschettino et al. 2023]), the short duration of this dataset and low number of dives (*n*=38 compared to *n*=2,250, *n*=110, *n*=1,170) should be taken into consideration as should the water depths in which the whales were diving.

Table 6. Summary of dive depth and duration data collected from tagged NARW during the 2024/25 field season.

Animal ID	# Dives Logged	Mean Dive Depth (m)	Maximum Dive Depth (m)	Mean Dive Duration (mm:ss)	Maximum Dive Duration (mm:ss)
2024Calfof#3320	37	18.4	35.0	9:23	17:45

Key: ID = identifier; mm:ss = minutes:seconds

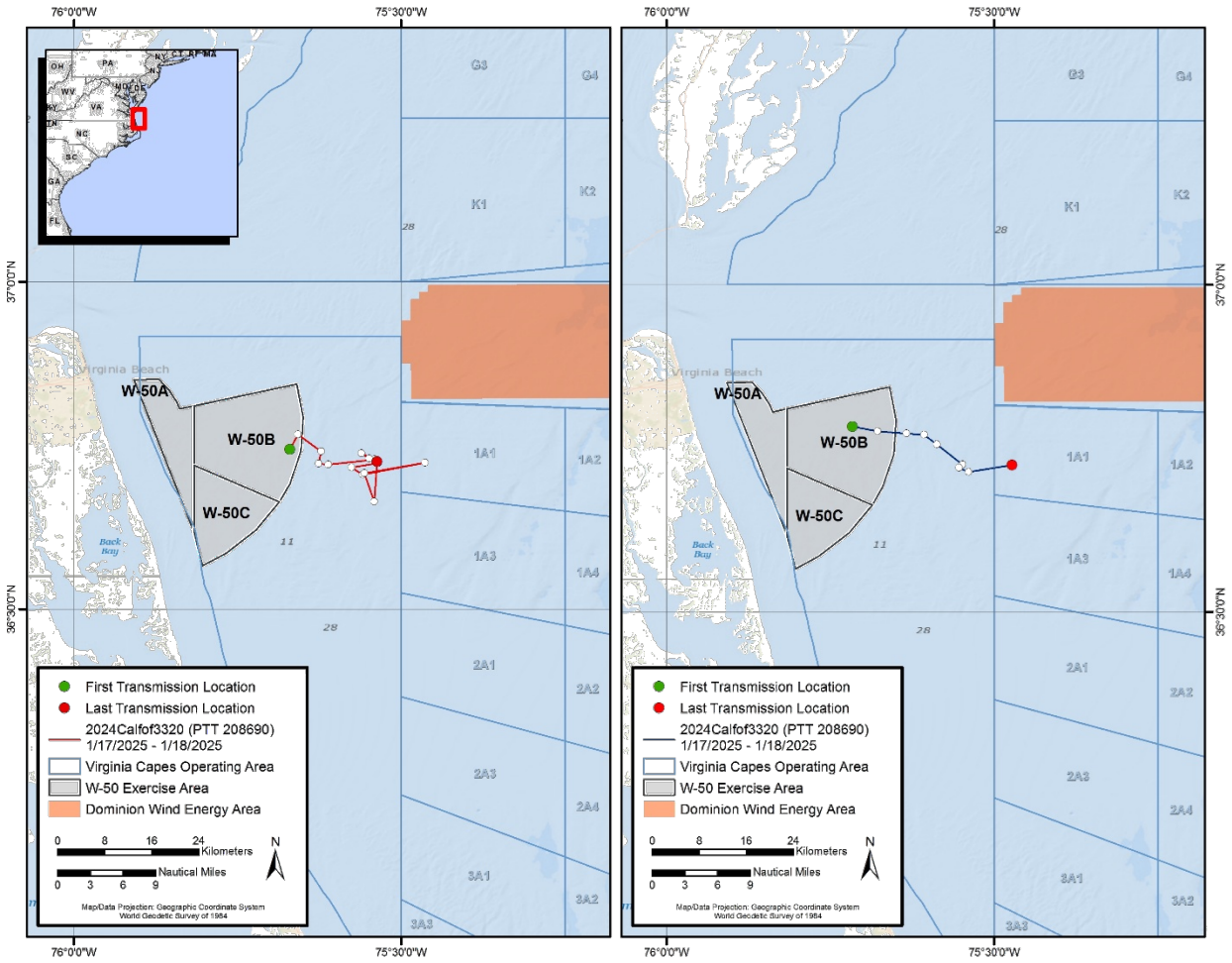

Figure 7. Filtered locations (white dots) and trackline of NARW 2024Calfof#3220, tagged on 17 January 2025, over 0.7 day of tag-attachment duration showing Argos (left) and Fastloc GPS (right) positions.

Photo credit: CMARI, taken under NOAA research permit #26919; aerial survey funded by U.S. Army Corps of Engineers.

Figure 8. 2024Calfof#3320, photographed off North Carolina, on 15 February, 29 days after tagging and with no tag present. Orange circle marks the former tag location.

3.2.3 Digital Archival Tagging Results

Two successful CATS tag deployments occurred during the 2024/25 season on NARWs (**Table 7**).

Figure 9 and **Figure 10** show dive profiles for the suction-cup-tagged NARWs. **Table 8** shows all dives defined using a modified MATLAB script from the animaltags.org toolbox with a dive-depth definition of 2 m and duration of 2 min. Tag durations were brief due to social interactions between individuals, which caused the tags to release prior to the programmed time. A total of 12 dives were logged, and the maximum dive depth recorded was 18 m. Average dive depth for all dives combined was 15.0 m, and the median was 16.3 m. Dive durations ranged from 2.2 to 7.9 min, with a mean of 3.9 min for both individuals; surface durations ranged from 4.6 to 44.7 min. Bottom depths recorded from the vessel echosounder during sightings ranged between 27 and 39 m.

Table 7. Successful NARW CATS tag deployment details.

Animal ID	CATS Tag No./ Deployment ID	Deployment (GMT)	Depth at Tagging (m)	Tag Off Animal (GMT)	Tag Duration (min)	Gender
NARW #4360	CATS 002/ eg250125	2025-Jan-25 20:53	20.1	2025-Jan-25 21:21	27	Male
NARW #4980	CATS 002/ eg250127	2025-Jan-27 16:09	24.4	2025-Jan-27 16:48	39	Female

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

Table 8. Summary of archival tag dive data for all NARWs deployed in 2025.

NARW ID/Name	NARW #4360/Musketeer	NARW #4980/Coral
Age class	Adult	Adult
Sex	Male	Female
Deployment ID	CATS eg250125	CATS eg250127
Tag duration (hr)	0.45	0.65
Number of dives	6	6
Mean dive duration (min)	2.86	4.93
Median dive duration (min)	2.85	4.81
Mean surface duration (min)	2.09	2.10
Median surface duration (min)	2.21	91.00
Mean max dive depth (m)	16.62	13.35
Median max dive depth (m)	16.77	14.76
Maximum max dive depth (m)	18.1	18.3

Notes: hr = hour(s); ID = Identification Number; max = maximum

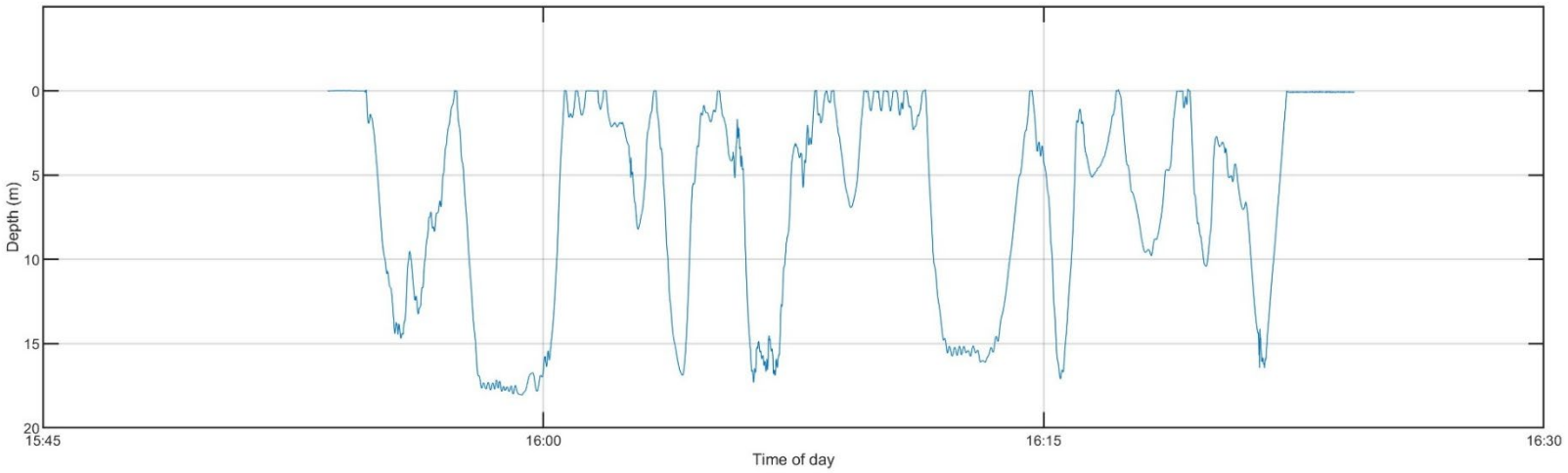

Figure 9. Dive-depth profile (in meters) for NARW 4360 'Musketeer' (CATS eg250125) in local time.

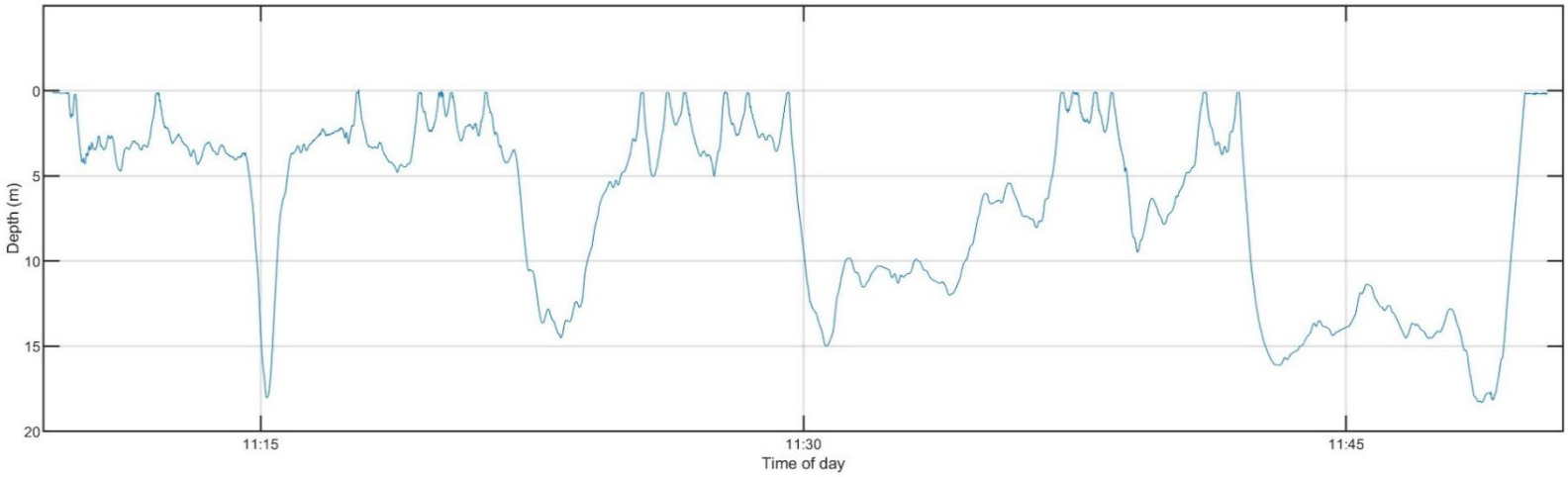

Figure 10. Dive-depth profile (in meters) for NARW 4980 'Coral' (CATS eg250127) in local time.

3.2.4 Photo-Identification

Researchers from the New England Aquarium maintain the publicly accessible NARW Catalog; therefore, age classes and sexes of NARWs observed during the survey effort could be readily accessed and are provided herein. Of the 25 unique NARWs seen during the 2024/25 season, 18 (72.0 percent) were known adults, 5 (20.0 percent) were juveniles, and 2 (32.0 percent) were yearlings. Approximately 60 percent (*n*=15) were known males, 8 (32.0 percent) were known females, and sex was unknown for the remaining 2 (8.0 percent) individuals. All individuals were matched to the NARW Catalog except for two individuals where only poor-quality photographs were obtained. One individual was sighted twice within the season (yearling #2024Calfof#3320, 21 days apart).

HDR Inc. has now encountered 98 known individual NARWs off southern Virginia and northern North Carolina since 2018. Individuals have represented both sexes and all age classes. Nine individuals have been sighted during more than one season, 285 to 2,242 days following initial sighting.

3.3 Humpback Whales

3.3.1 Sightings Summary

Humpback whales were observed on 40 occasions during the mid-shelf vessel surveys. An additional 7 sightings occurred during the OCS effort (see A. Engelhaupt et al. 2026), and 45 sightings occurred during the aerial survey effort (see Ozog and Engelhaupt 2026) (**Figure 11**).

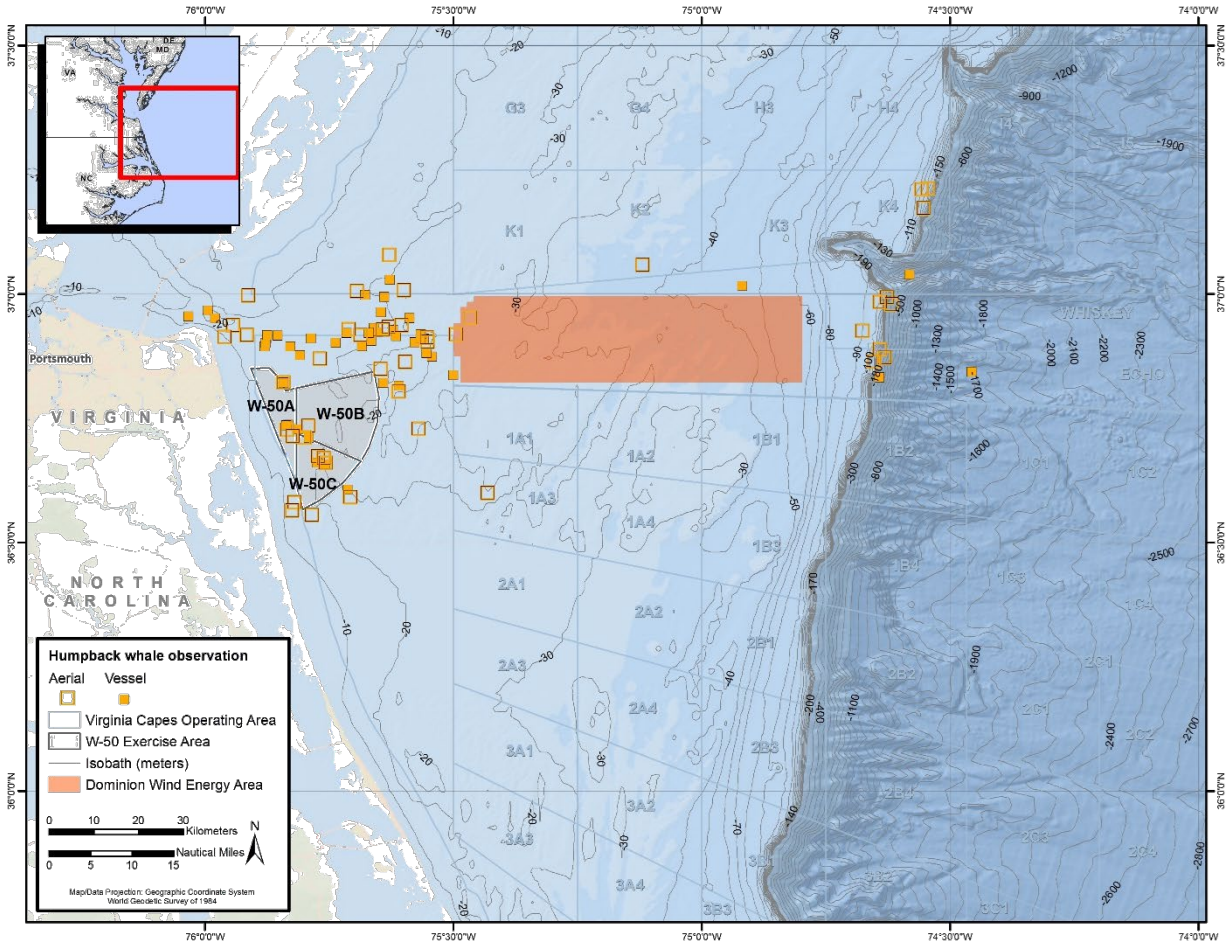

Figure 11. Sighting locations of all humpback whales observed during aerial and vessel surveys during the 2024/25 season.

3.3.2 Biopsy Results

One biopsy sample was collected from a tagged humpback whale HDRVAMn375 during the OCS effort (see A. Engelhaupt et al. 2026) and is awaiting analysis. This sample will eventually be compared to the larger NAHWC managed by the University of Groningen.

Twenty-nine humpback samples collected between 2014 and 2016 were previously processed for stable-isotope analyses ($\delta^{13}C$ and $\delta^{15}N$) (Waples 2017). Sixty-three humpback samples (inclusive of the samples analyzed for stable isotopes) were previously provided to the University of Groningen for genetic analysis, with humpback samples being integrated into a larger North Atlantic humpback whale population study. Gender results from the full set of samples show roughly equal sex ratios of humpback whales (32 males and 31 females) (Bérubé and Palsbøll 2022, Bérubé and Palsbøll 2026). Genetic matching to the larger NAHWC, which at the time of this report contains more than 10,200 samples of 6,771 individuals, showed that 29 samples matched to samples collected elsewhere along the eastern U.S., and no duplicate humpback whale samples occurred in the HDR Inc. dataset. All samples matched 100 percent on all loci genotyped in both samples in each pair (i.e., no mismatching genotypes were detected).

3.3.3 Satellite Tagging Results

One Argos-linked SPLASH10-F-333 satellite tag was deployed on a humpback whale during an OCS survey (A. Engelhaupt et al. 2026) (Table 9, Table 10; Figure 12) in May 2025. The tag transmitted for 4.3 days.

Table 9. Satellite-tag deployment on a humpback whale during the 2024/25 field season.

Animal ID	Estimated Age Class	Tag Type	Argos ID	Deployment Latitude (°N)	Deployment Longitude (°W)	Deployment Date	Last Trans-mission date	Tag duration (days)
HDRVA Mn375	Juvenile	SPLASH 10-F-333	240216	36.0077	74.9270	25-May-25	30-May-25	4.3

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

HDRVAMn375 was tagged approximately 95 km east northeast of Rudee Inlet, within the VACAPES OPAREA (**Figure 11**). This individual remained close to the location it was tagged (mean distance from initial tagging location was 5.6 km; **Table 10**) for the 4.3 days that the tag transmitted.

Table 10. Summary of results from satellite-tag data for the humpback whale tagged during the 2024/25 field season.

Animal ID	# Locations Post Filtering	Percent within Shipping Channels	Percent within VACAPES	Maximum Distance from Initial Location (km)	Mean Distance from Initial Location (km)
HDRVAMn375	102	0.0	30.4	13.3	5.6

Key: ID = identifier

The satellite tag also recorded data on dive depth and duration in addition to the Argos capabilities (**Table 11**). This tag recorded a total of 335 dives. Mean dive depth was 37.5 m, with a maximum dive depth of 50.0 m. The mean dive duration was 3.2 min, with a maximum dive duration of 8.3 min (**Table 11**).

Table 11. Summary of dive depth and duration data collected from tagged humpback whale during the 2024/25 field season.

Animal ID	# Dives Logged	Mean Dive Depth (m)	Maximum Dive Depth (m)	Mean Dive Duration (mm:ss)	Maximum Dive Duration (mm:ss)
HDRVAMn375	335	37.5	50.0	3:13	8:18

Key: ID = identifier; mm:ss = minutes:seconds

The dive duration of HDRVAMn375 was similar to that of humpbacks tagged during previous seasons, despite the mean dive duration being higher. For all 27 depth recording tags deployed on humpback whales to-date, the mean dive duration was 3.17 min and mean dive depth was 19.6 m (HDR Inc. unpublished data). HDRVAMn375 was one of the humpback whales tagged farthest from shore (although still over outer shelf waters) and one of only four tags deployed during the month of May across all project years. Most humpback whales tagged closer to shore are limited to much shallower depths in comparison.

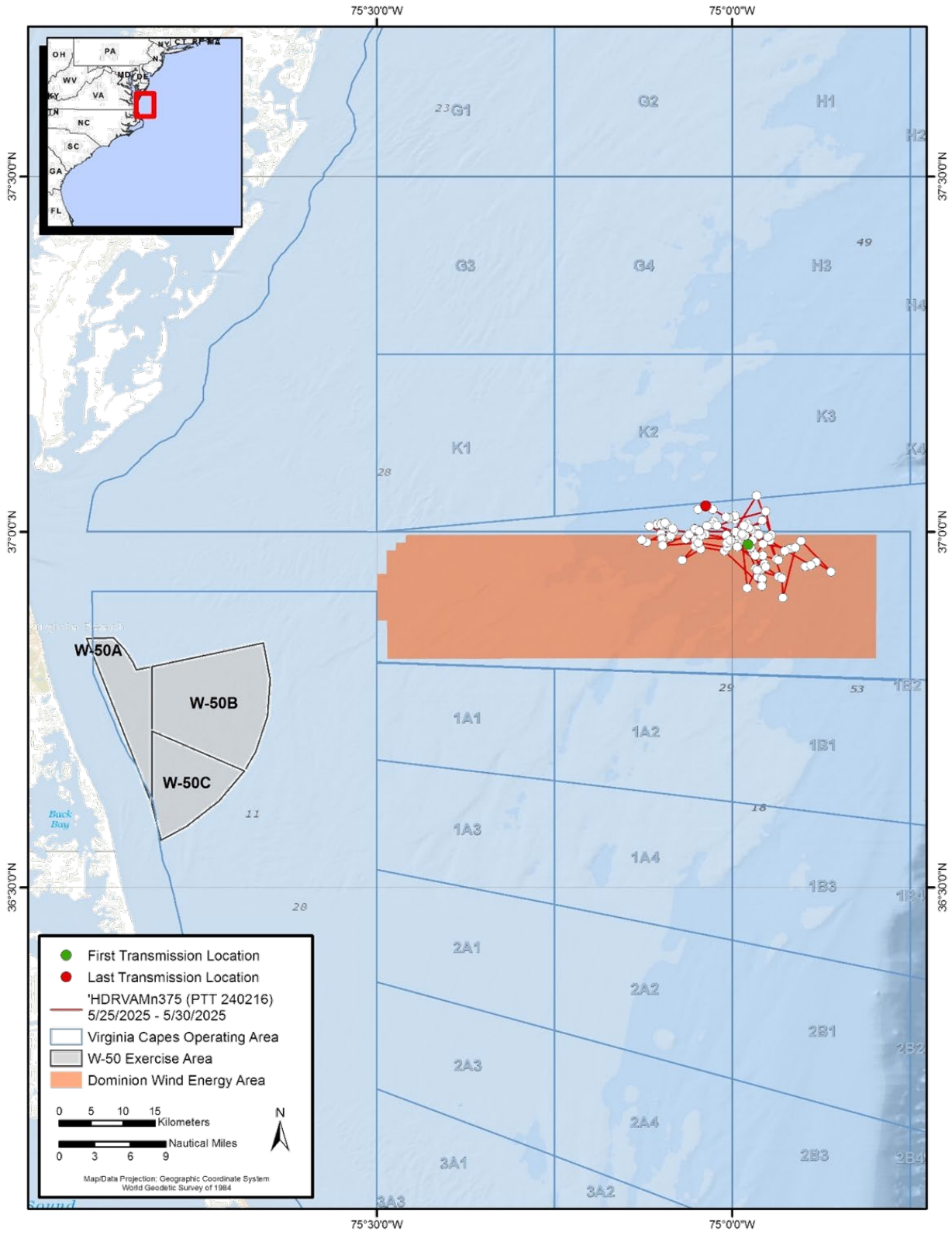

Figure 12. Filtered Argos locations (white dots) and trackline of HDRVAMn375, tagged on 25 May 2025, over 4.3 days of tag-attachment duration.

3.3.4 Digital Archival Tagging Results

Two CATS suction-cup tags were deployed on humpback whales during the 2024/25 field season (**Table 12**). The tags were recovered the following day and recorded a total of approximately 8.5 hours of three-dimensional movement, acoustic, and video data (**Table 12**). **Table 13** summarizes the dive statistics calculated using the find-dive MATLAB script from the toolbox posted to the animaltags.org site, with a dive-depth definition of deeper than 2 m and longer than 2 min. A total of 45 dives and 43 surfacing bouts were recorded during the tags' deployments. Dive duration ranged from 2.0 to 6.4 min (mean = 3.52 min). Maximum dive depth was 20.3 m (mean = 10.34 m; **Table 13**). **Figure 13** and **Figure 14** shows the dive profile of each individual.

Table 12. CATS tag deployments on humpback whales during the 2024/25 field season.

Animal ID	Species	Deployment ID	Tag ID	Deployment (GMT)	Depth at Tagging (m)	Tag Off Animal (GMT)	Tag Duration (min)
HDRVAMn300	Humpback whale	mn250204	CATS 001	2025-Feb-04 16:11	11.0	2025-Feb-04 21:25	313
HDRVAMn291	Humpback whale	mn250223	CATS 001	2025-Feb-23 22:15	21.0	2025-Feb-24 01:34	198

Key: ID = identifier; GMT = Greenwich Mean Time

Table 13. Summary of dive depth and duration data collected from CATS tagged humpback whales.

Deployment ID	Animal ID	# Dives Logged	Mean Dive Depth (m)	Maximum Dive Depth (m)	Mean Dive Duration (mm:ss)	Maximum Dive Duration (mm:ss)
mn250204	HDRVAMn300	37	8.8	13.6	3:45	6:26
mn250223	HDRVAMn291	8	17.6	20.3	02:24	3:22

Key: ID = identifier; mm:ss = minutes:seconds

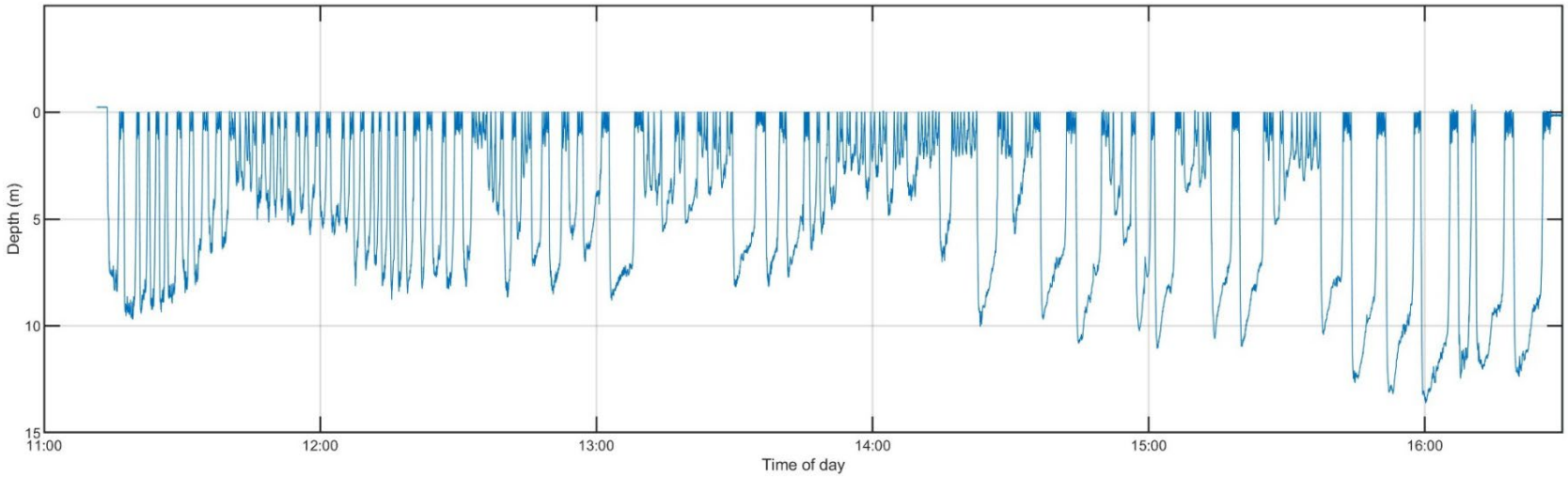

Figure 13. Dive-depth profile (in meters) for HDRVAMn300 (CATS mn250204).

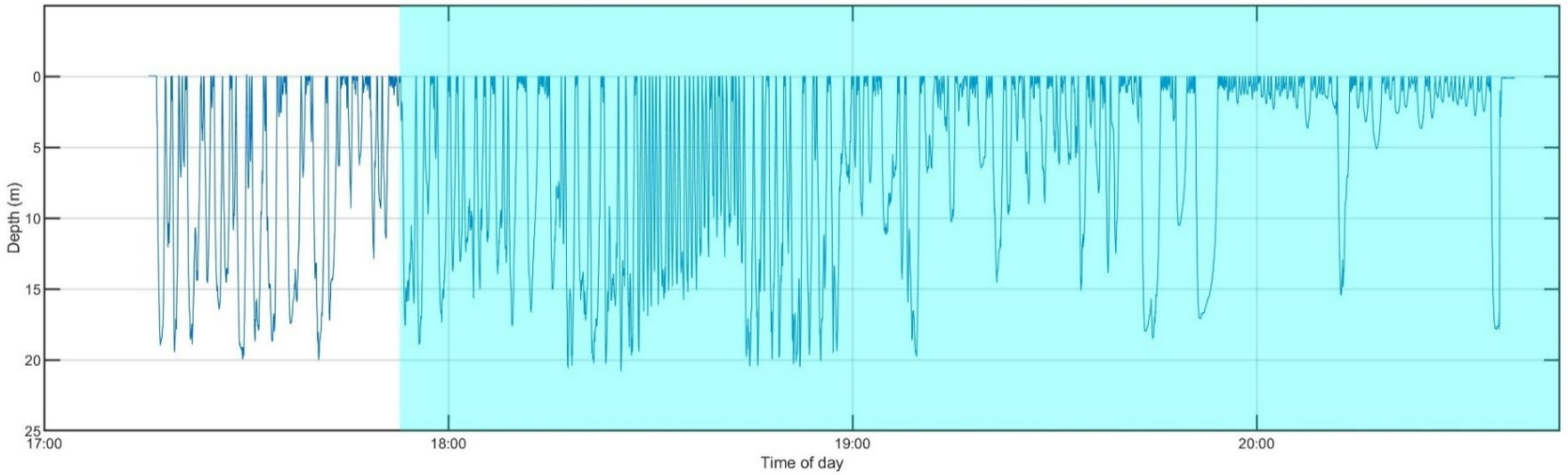

Figure 14. Dive-depth profile (in meters) for HDRVAMn291 (CATS mn250223) with sunset through sunrise shaded blue in local time.

3.3.5 Photo-Identification

3.3.5.1 CATALOGING

The 40 sightings of humpback whales observed during the 2024/25 nearshore and mid-shelf baleen whale season included 59 total individuals and resulted in identifications of 37 unique humpback whales. During the offshore survey effort, 7 sightings of humpback whales totaled 18 individuals (A. Engelhaupt et al. 2026) and resulted in 7 unique humpback whales. Humpback whales photographed from the aerial surveys (Ozog and Engelhaupt 2026) were not included in the cataloging effort. In total, 43 unique humpback whales were identified during the 2024/25 season (**Figure 15**).

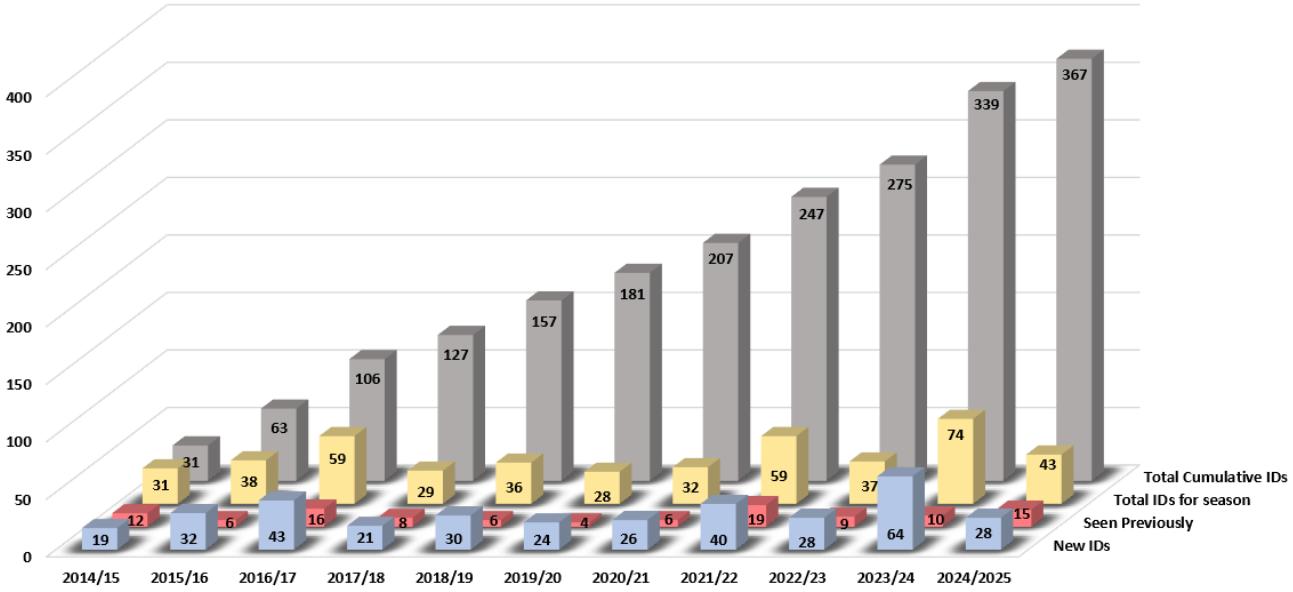

Figure 15. Humpback whale identifications (ID) over 11 field seasons within the Virginia study area (yellow bars = total number of IDs each season; red bars = number of those IDs seen in previous seasons; blue bars = number of new IDs added to catalog; and gray bars = total number of cumulative unique IDs).

Of the 43 unique humpback whales seen during the 2024/25 season, 18 (41.9 percent) were categorized as juveniles based on their estimated size in the field, 9 (20.1 percent) were classified as sub-adults/adults, 6 (14.0 percent) were classified as adults, 4 (9.3 percent) were classified as sub-adults, 3 (7.0 percent) were classified as juveniles/sub-adults, and 1 individual (2.3 percent) seen on 5 occasions was classified as either juvenile, juvenile/sub-adult, or sub-adult, reinforcing the difficultly and subjectivity of assessing age class in field. Fifteen (34.9 percent) of the 43 individuals were re-sights to HDR Inc.'s catalog; the additional 28 whales were new individuals added to the growing project catalog, which, to date, includes 369 unique humpback whales, inclusive of identifications added from previous bottlenose dolphin surveys (2012–2015) (A. Engelhaupt et al. 2016) and the Outer Continental Shelf Break/VACAPES Offshore Cetacean Study (ongoing since 2016) [A. Engelhaupt et al. 2017, 2018, 2019, 2020, 2022, 2023a, 2024, 2025]) (**Figure 15**). Two individuals, HDRVAMn001 and HDRVAMn002, seen only once each in 2013 are not included in **Figure 15**.

Of the 43 unique humpback whales seen during the 2024/25 season and excluding same day resights, 10 (23.3 percent) were seen on more than 1 occasion, and 5 (11.6 percent) were seen on 3 or more occasions. Within-season re-sightings spanned 1.8 to 34.7 days apart (mean = 31.0 days; median = 19.0 days).

For all humpback whales sighted since the beginning of this project, 192 individuals (52.0 percent) have only been seen on 1 occasion, whereas the remaining 177 individuals (48.0 percent) have been observed on 2 or more occasions (**Table 14**). The majority of humpback whales (*n*=311, 84.5 percent) were only seen during 1 field season (**Table 14**). However, 53 individuals (14.5 percent) were seen for 2 or more field seasons (**Table 15**). Including all years of data, individuals that were re-sighted within the same season (excluding same-day re-sightings) were seen 0.7 to 98.9 days from the initial sighting (mean = 23.2 days; median = 18.9 days).

Table 14. Frequency distribution of the number of sightings of photo-identified humpback whales since 2014.

Number of Sightings	Number of Individuals
1	190
2	80
3	33
4	25
5	12
6	8
7	3
8	6
9	2
11	3
12	1
15	1
17	1
18	1
21	1
Total	**367**

Table 15. Frequency distribution of the number of seasons photo-identified humpback whales were seen since 2014.

Number of Seasons Seen	Number of Individuals
1	311
2	36
3	10
4	5
5	4
6	1
Total	**367**

Evidence of human interaction, either presumed line-entanglement scars (**Figure 16**) or propeller scars (**Figure 17**), was documented on one new humpback whale during the 2024/25 season and is apparent on at least 29 of the total 366 (7.9 percent) cataloged humpback whales. Eight individuals are known to be deceased.

Figure 16. Cataloged humpback whale HDRVAMn179 with an apparent line entanglement scar in front of the leading dorsal hump.

Figure 17. Cataloged humpback whale HDRVAMn222 with apparent propeller scarring along the body's right side.

3.3.5.2 MID-ATLANTIC HUMPBACK WHALE CATALOG DEVELOPMENT AND HAPPYWHALE RESULTS

During the study year, HDR Inc. and NAVFAC Atlantic continued all curator efforts, including coordinating with data providers, reviewing and processing data submissions, managing both the Microsoft Access database and OBIS-SEAMAP platform, and assigning dorsal fin and fluke attributes to cataloged individuals.

The MAHWC was updated with all HDR Inc.'s sighting records and humpback whale images through May 2025, and currently contains 369 individuals (**Table 16**). Images included the best dorsal fin and fluke image, comprehensive of every sighting of a given whale. Additionally, the Duke University Marine Lab catalog was updated with 2023 images and sighting information provided by Kim Urian and now contains 44 individuals (**Table 16**). A new contributor catalog was created with a submission by Kristin Rayfield from Rudee Tours and now contains 299 individuals (**Table 16**). Matching between catalogs is ongoing.

Table 16. All catalogs created and/or updated within the MAHWC since 2024, including the years of data collection and number of unique individuals.

Organization/Research Team	Location	Point(s) of Contact	Years	Number of Individuals
HDR Inc.	Virginia	Jessica Aschettino, Jess Ozog	2013–2025	369
Duke University Marine Lab	Virginia, North Carolina	Kim Urian	2017; 2019–2024	44
Cape May Whale Watch and Research Center	Delaware, New Jersey	Melissa Laurino	2011–2023	232
Rudee Tours	Virginia	Kristin Rayfield	2009–2025	299

Additionally, all fluke images within the HDR Inc. catalog from 2013 through 2023 were previously compiled and submitted to the NAHWC for matching in January 2024, and results are still pending.

Previously, only the best fluke image available for each of HDR Inc.'s cataloged whales and associated metadata were uploaded to Happywhale in order to make publicly available all of the whales sighted during survey efforts. However, Happywhale has now developed an additional dorsal fin matching algorithm. This development has allowed HDR Inc. to upload images and sighting histories of all individuals, inclusive of individuals and sightings that only have representative dorsal fin images.

The HDR Inc. Happywhale catalog was updated with individuals and images from the 2024/25 winter field season. Additionally, the catalog underwent quality review, and full sighting histories and images of individuals were uploaded from 2013 onward. In total, HDR Inc.'s Happywhale humpback whale catalog contains 367 individuals, and 191 of these individuals yielded match records. Whales were matched to feeding grounds in waters off the northeastern U.S., Canada, Iceland, and Svalbard, and were also matched to breeding grounds off the Dominican Republic as well as the Turks and Caicos Islands (**Figure 17**). Matches within the Mid-Atlantic, including Virginia, Delaware, New Jersey, and New York, were also made; in fact, some whales were only matched within Virginia and not to outside areas.

Both the GOM and NAHWC recently began a partnership with Happywhale, and comparisons of individuals between Happywhale and both catalogs are ongoing (**Table 17**). If an individual has a sighting history in one or both catalogs and is also currently in Happywhale, identification information was added to the individual's page for the respective catalog. The GOM group has a long-standing naming process, and 69 humpback whales in HDR Inc.'s Happywhale catalog have been named to date. **Table 17** includes matches to other maintained catalogs; however, this table does not include sightings added by individuals (rather than organizations), such as photographs collected on a whale-watch tour by a customer. Within Happywhale, all users maintain rights to their data; however, the data are openly accessible to view and explore. Within the HDR homepage on Happywhale, all individual humpback whales observed during HDR Inc. surveys are viewable. The user can click on any given whale to see whether that individual has been seen within other areas.

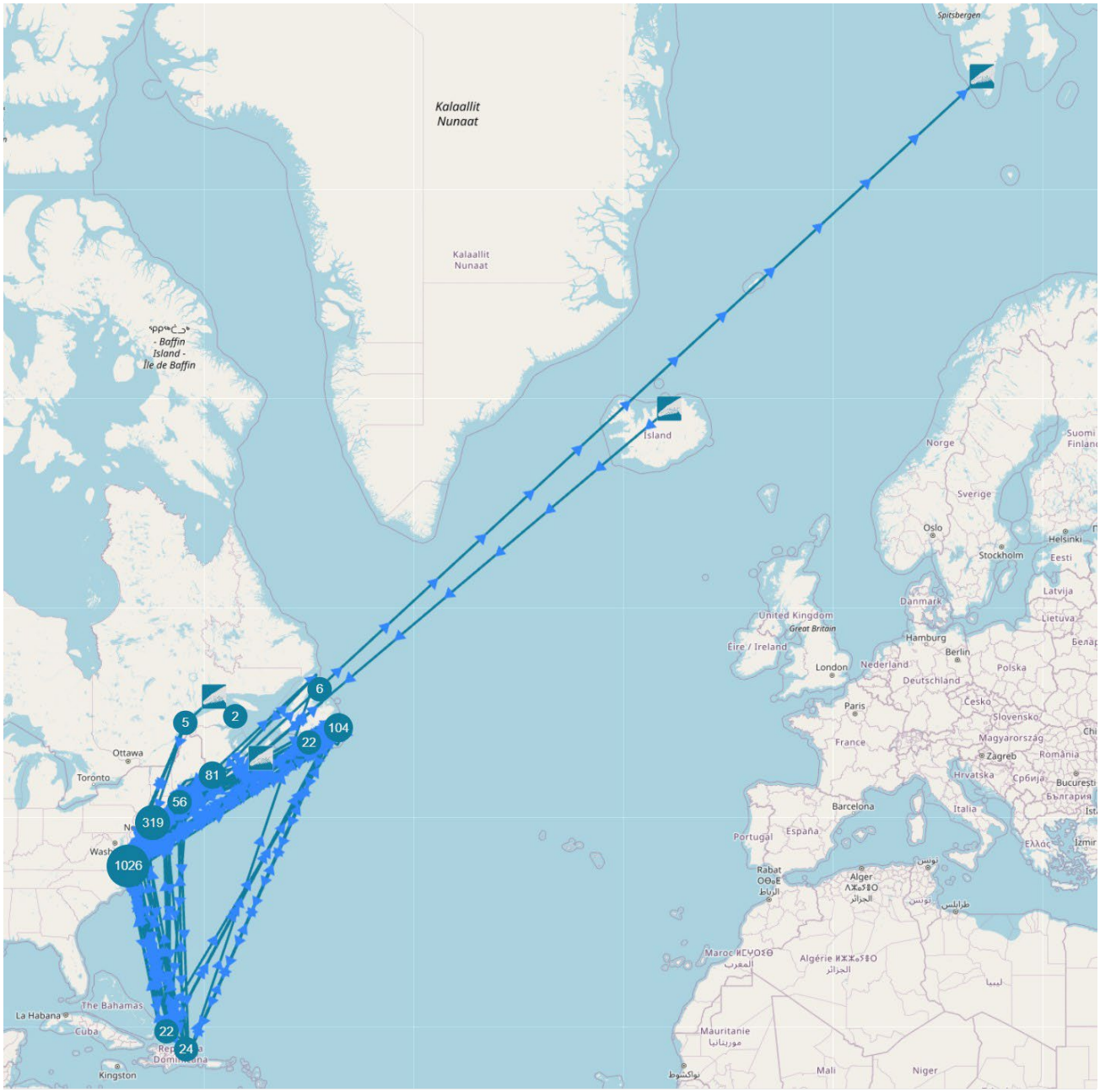

Figure 18. Happywhale connections of all humpback whales observed during HDR Inc.'s surveys. Note sightings to feeding and breeding grounds, as far northeast as Svalbard.

Table 17. HDR Inc. humpback whale matches to other organizations within Happywhale.

Organization	Number of Matches
Rudee Flipper Dolphin and Whale Watching Tours	118
Gotham Whale New York City	70
GOM Catalog	69
NAHWC	60
Turks and Caicos Islands Whale Project	15
Coastal Research & Education Society of Long Island	10
Saint Pierre and Miquelon	10
Witless Bay Reserve Humpback Whale Catalog	9
Trinity Bay Newfoundland – Kris Prince	5
Marine and Coastal Ecology Research Center	2
Mingan Island Cetacean Study	2
Husavik Research Centre	1

3.4 Fin Whales

3.4.1 Sightings Summary

Fin whales were observed on seven occasions during the mid-shelf vessel surveys. An additional 12 sightings occurred during the OCS effort (see A. Engelhaupt et al. 2026), and 11 sightings occurred during the aerial survey effort (see Ozog and Engelhaupt 2026) (**Figure 19**).

3.4.2 Biopsy Results

No fin whale biopsy samples were collected during the 2024/25 season; however, 13 samples previously collected were processed during this reporting season. Two samples were poor quality and unable to be analyzed and two samples were genetic duplicates of the same individual. When the remaining samples were matched to the 1,773 samples contained in the North Atlantic fin whale genetic archive, 1 sample matched to an individual sampled by the Center for Coastal Studies (Bérubé and Palsbøll 2022, 2026). In total, six males and four females were identified.

3.4.3 Satellite Tagging Results

One Argos-linked SPLASH10-F-333 satellite tag was deployed on a fin whale during an OCS survey (A. Engelhaupt et al. 2026) (**Table 18**, **Table 19**; **Figure 20**). The tag transmitted for 7.7 days and was the first tag deployed with the new Kinéis system in place.

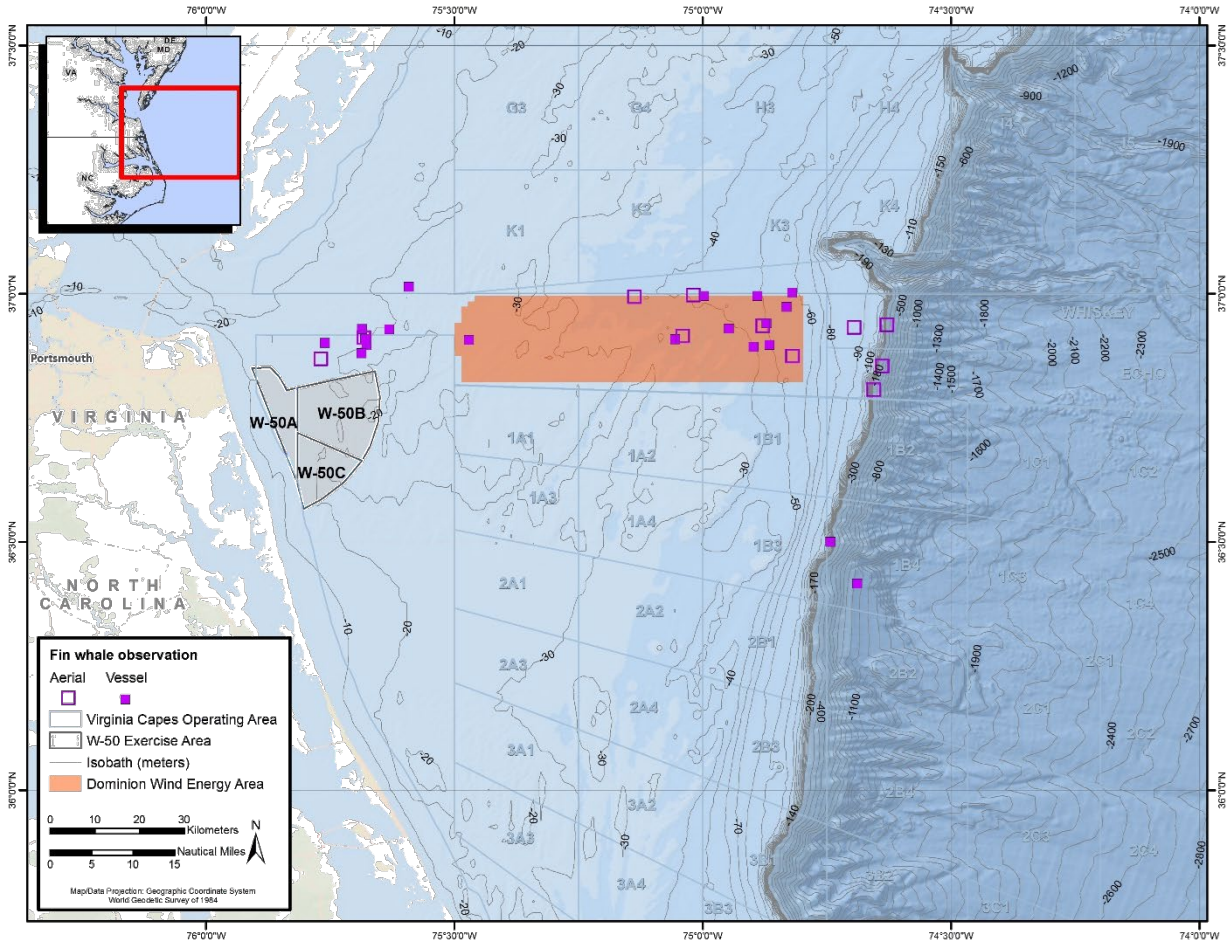

Figure 19. Sighting locations of all fin whales observed during aerial and vessel surveys during the 2024/25 season.

Table 18. Satellite-tag deployment on a fin whale during the 2024/25 field season.

Animal ID	Estimated Age Class	Tag Type	Argos ID	Deployment Latitude (°N)	Deployment Longitude (°W)	Deployment Date	Last Trans-mission Date	Tag Duration (days)
HDRVABp172	Sub-adult	SPLASH 10-F-333	282238	36.9043	74.9126	14-Jul-25	22-Jul-25	7.7

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

Table 19. Summary of results from satellite-tag data for the fin whale tagged during the 2024/25 field season.

Animal ID	# Locations Post Filtering	Percent within Shipping Channels	Percent within VACAPES	Maximum Distance from Initial Location (km)	Mean Distance from Initial Location (km)
HDRVABp172	87	0.0	34.5	58.9	18.3

Key: ID = identifier

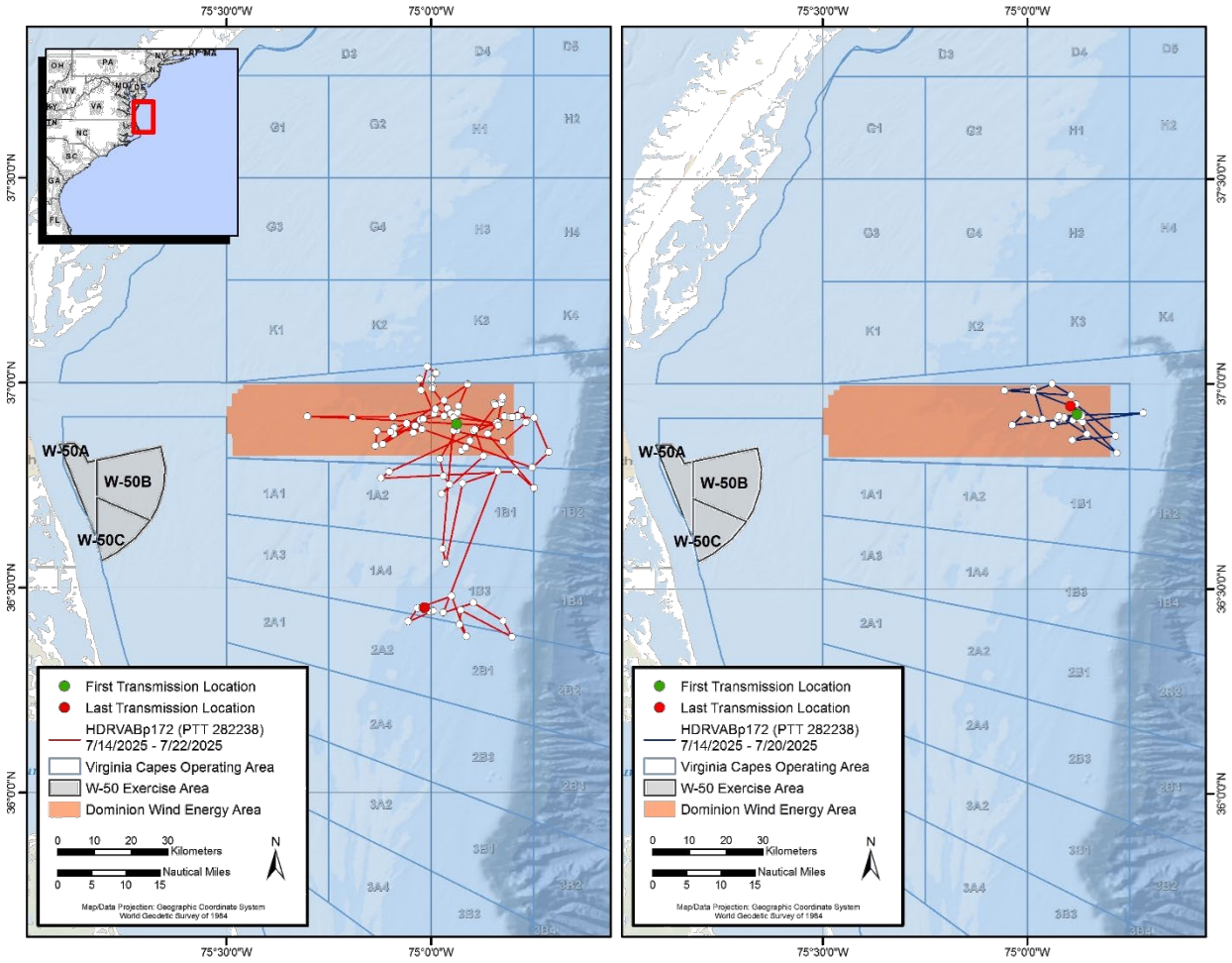

Figure 20. Filtered locations (white dots) and trackline of HDRVABp172, tagged on 14 July 2025, over 7.7 days of tag-attachment duration showing Argos (left) and Fastloc (right) positions.

HDRVABp172 was tagged approximately 101 km offshore of Virginia Beach (**Figure 20**). This individual remained within the primary study area and relatively close to the deployment location for the first 5 days of the tag deployment before beginning to move southward, just past the Virginia/North Carolina border. No Argos locations occurred within shipping channels; however, 34.5 percent were located within the VACAPES OPAREA (**Figure 20**; **Table 19**). Maximum straight-line distance from the initial tagging location was 58.9 km, and mean distance was only 18.3 km (**Table 19**).

The satellite tag also recorded data on dive depth and duration in addition to the Argos capabilities (**Table 20**). This tag recorded a total of 485 dives. Mean dive depth was 28.6 m, with a maximum dive depth of 84.0 m. The mean dive duration was 3.4 min with a maximum dive duration of 14.0 min (**Table 20**).

Table 20. Summary of dive depth and duration data collected from tagged fin whale during the 2024/25 field season.

Animal ID	# Dives Logged	Mean Dive Depth (m)	Maximum Dive Depth (m)	Mean Dive Duration (mm:ss)	Maximum Dive Duration (mm:ss)
HDRVABp172	485	28.6	84.0	3:25	14:01

Key: ID = identifier; mm:ss = minutes:seconds

The dive depths and durations of HDRVABp172 were similar to one of the fin whales tagged the prior season in May 2024, who also stayed relatively close (15.5 m) to the original tagging location (HDRVABp142; see A. Engelhaupt et al. 2025) and whose mean dive depth was 22.5 m and mean dive duration was 3.1 minutes. In contrast, the other three fin whales tagged in May and June 2024 exhibited more widespread movement patterns and logged deeper (mean = 33.9, 88.5, 96.1 m) and longer (mean = 3.6, 3.6, 5.0) dives (A. Engelhaupt et al. 2025).

3.4.4 Photo-Identification

Seven sightings of 14 individual fin whales were made during the 2024/25 nearshore and mid-shelf baleen whale season (**Table 21**), with photographs of 6 unique individuals collected. During the offshore surveys, 12 sightings of fin whales totaled 22 individuals (A. Engelhaupt et al. 2026) and resulted in 20 uniquely identified fin whales. Fin whales photographed from the aerial surveys (Ozog and Engelhaupt 2025) were not included in the cataloging effort. Four individuals were sighted on 2 or 3 survey days during the season, resulting in a total of 20 unique fin whales identified during the 2024/25 season.

Table 21. Frequency distribution of the number of sightings of photo-identified fin whales since 2015.

Number of Sightings	Number of Individuals
1	144
2	17
3	8
4	5
5	1
6	—
7	1
Total	**176**

Of the 20 unique fin whales seen during the 2024/25 season, 17 (85.0 percent) were classified as adults or sub-adults based on their estimated sizes in the field, 2 (10.0 percent) were categorized as juveniles, and 1 (5.0 percent) was categorized as a calf. Eight (40.0 percent) of the 20 individuals were re-sights to HDR Inc.'s catalog, 3 individuals were initially sighted in August 2017 (HDRVABp028, HDRVABp029, and HDRVABp033), 1 individual has been seen multiple times since its initial sighting in 2021 (HDRVABp093), and the remaining re-sighted individuals were first added to HDR's catalog during the 2023/24 season (HDRVABp119, HDRVABp128, HDRVABp158, and HDRVABp166). The additional 12 whales were new individuals added to the growing project catalog, which, to date, contains 176 unique fin whales.

Of the 20 unique fin whales seen during the 2024/25 season, 4 (20.0 percent) were seen on more than 1 occasion within the season, and 1 (5.0 percent) was seen on 3 occasions. Within-season re-sightings spanned 4.5 to 27.1 days apart (mean = 15.4 days; median = 14.9 days).

For all fin whales included in the catalog dating back to 2015, 144 individuals (81.8 percent) have only been seen on 1 occasion, whereas the remaining 32 individuals (18.2 percent) have been observed on 2 or more occasions (**Table 21**). The majority of fin whales (*n*=153, 86.9 percent) were only seen during one field season (**Table 21**). However, 23 individuals (13.1 percent) were seen for 2 or more field seasons (**Table 22**). Including all years of data, individuals that were re-sighted within the same season (excluding same-day re-sightings) were seen between 2 and 257 days from the initial sighting (mean = 37.5 days; median = 11.9 days).

Table 22. Frequency distribution of the number of seasons photo-identified fin whales were seen since 2015.

Number of Seasons Seen	Number of Individuals
1	153
2	15
3	6
4	2
Total	**176**

3.5 Minke Whales

3.5.1 Sightings Summary

Minke whales were observed on three occasions during the mid-shelf vessel surveys. One additional sighting occurred during the OCS effort (see A. Engelhaupt et al. 2026), and three sightings occurred during the aerial survey effort (see Ozog and Engelhaupt 2026) (**Figure 21**).

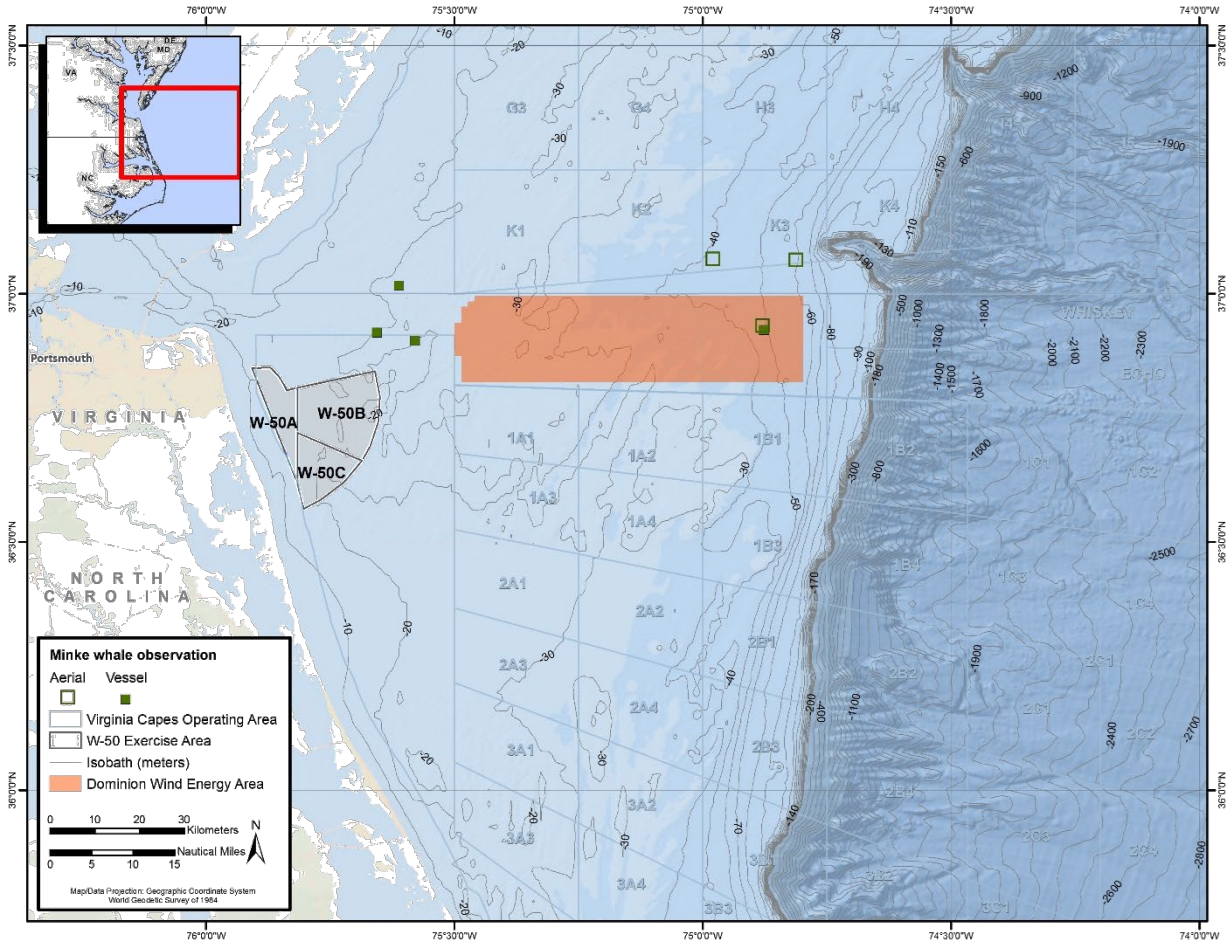

Figure 21. Sighting locations of all minke whales observed during aerial and vessel surveys during the 2024/25 season.

3.5.1 Biopsy Results

No minke whale biopsy samples were collected during the 2024/25 season; however, one sample previously collected from the 2023/24 season was analyzed this season. The minke whale sample did not yield a match when compared to the 868 samples contained in the North Atlantic minke whale genetic archive (Bérubé and Palsbøll 2026). The individual was identified as a female.

3.5.2 Photo Identification

Minke whales are occasionally encountered within the study area; however, minimal effort is spent trying to work with or photograph them given that they are not a priority species for these projects. Across all years and projects, the minke whale catalog currently contains 18 individuals. No re-sights between years have been made (**Appendix A**, **Table A-4**).

3.6 Blue Whales

3.6.1 Sightings Summary

A blue whales was only observed on one occasion during the OCS effort (see A. Engelhaupt et al. 2026) (**Figure 22**).

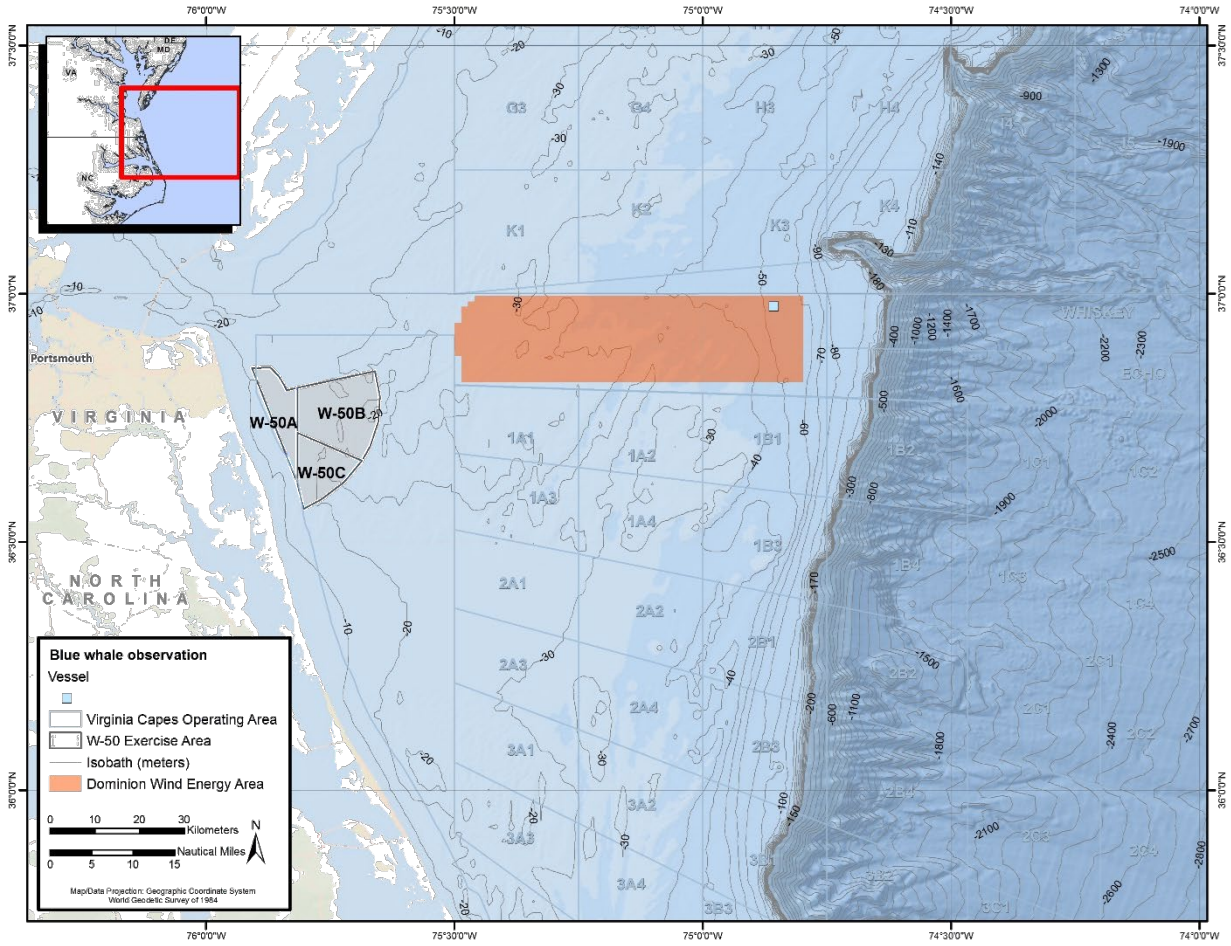

Figure 22. Sighting location of a blue whale observed during the 2024/25 season.

3.6.2 Biopsy Results

No blue whale biopsy samples were collected during the 2024/25 season; however, two samples previously collected from prior seasons were analyzed during this season. The blue whale samples did not yield any matches when compared to the 322 samples contained in the North Atlantic blue whale genetic archive (Bérubé and Palsbøll 2026). One individual was identified as a female and one as a male.

3.6.3 Photo-Identification

Blue whales are sighted occasionally within the study area in mid-shelf or offshore waters. During the 2024/25 season, one blue whale was sighted and photographed during an OCS survey (A. Engelhaupt et al. 2026) and added as a new individual to HDR's blue whale catalog, bringing the total unique individuals documented across all years (2018 to 2026) to nine.

3.7 Autonomous Real-Time Detection Buoy

During the period of September 2024 to August 2025, fin whales were the most commonly detected species, followed by humpback whales (**Figure 23**). From December 2024 to March 2025, the Cape Charles buoy had 22 confirmed detections of NARWs, which led to a slow zone within the area surrounding the buoy for a total of 87 days—nearly continuously from mid-December through the end of February. There were also 10 additional possible NARW detections that did not meet the criteria to be officially confirmed as "detected." The last NARW detection for the season occurred on 10 March 2025, while fin and humpback whale detections continued through the beginning of May 2025. From 20 May to 19 July 2025, there were only sporadic "possible detections" of both fin and humpback whales. On 19 July 2025, there were humpback whale calls confirmed as detected on this single day. Fin whale calls began being regularly detected in early August. There are no data from 15 August 2025 through the end of August due to a failure with the urethane used to encapsulate the hydrophones to protect them from seawater.

Up to date daily detections are available at the project's page on Robots4Whales: July 2024 to May 2025 and May 2025 through August 2025 (ongoing buoy).

Figure 23. Plot showing daily detections (yellow = possible, red = confirmed) of baleen whales from the DMON buoy deployed off the coast of Cape Charles, Virginia, from September 2024 through August 2025.

3.8 SoundTraps

Analysis of SoundTrap data by the NEFSC staff is nearing completion, and most SoundTraps deployed from June 2022 to April 2024 have been processed with the LFDCS and analyzed for daily presence for NARW upcalls, fin whale pulses, blue whale song, humpback whale song, and sei whale downsweeps following the methods described in Davis et al. (2017, 2020). Only the first deployment off Virginia (three sites: CB01, CB02, and CB03) have been analyzed for humpback whales so far.

4 Discussion

Continued analysis of data from this multi-year project is ongoing; however, each season of data helps build a more comprehensive picture of how baleen whales use the waters within and around the mouth of Chesapeake Bay and the surrounding area. Shipping channels, U.S. Navy OPAREAs, and wind energy development areas all overlap with the habitat that these whales use seasonally. Results continue to show a high level of occurrence of high-priority species within areas that are heavily used by the U.S. Navy; commercial shipping, recreational, and commercial fishing vessels; and future wind energy programs. These findings are supported by information collected during the past 11 years of this study, including photo-ID, focal follow, and tagging results.

Interactions with vessels, both large and small, are a significant cause for concern for humpback whales as well as endangered fin whales and NARWs within the study area. In April 2017, the National Marine Fisheries Service declared an Unusual Mortality Event (UME) for humpback whales within the Atlantic Ocean, from Maine to Florida, based on elevated mortalities of this species since January 2016. As of February 2026, 263 humpback whales are included in this UME, and 71 (27.0 percent) of those have occurred along the shore or in waters off the coast of Virginia or North Carolina (NOAA 2026a). Given this designation, a group of subject matter experts, the UME working group, aim to further investigate what is causing or contributing to the increased number of deaths of humpback whales within this area. Although the UME investigation process is ongoing, of the approximately 129 whales that were examined, an estimated 45 percent showed evidence of human interaction via vessel strike or entanglement. While the UME working group will look at humpback whales of all age classes, approximately two-thirds of the humpback whales identified during the 11 years of survey effort on this project appear to be juveniles (Aschettino et al. 2024a) that are spending more time within the study area than larger animals, presumed to be adults, and may be at greater risk for injury. Sightings of sub-adult-sized humpback whales are highest early in the field season or farther from shore within the mid-shelf region, and those individuals are often re-sighted less frequently, suggesting that sightings early in the season may be whales passing through the area rather than whales remaining within the nearshore study area for longer durations. The large percentage of juveniles observed in this study matches both historic stranding (e.g., Wiley et al. 1995) and observational (e.g., Swingle et al. 1993) data for the area.

A UME for NARWs was also declared in 2017, with 150 instances of mortality, serious injury, and morbidity as of February 2026, primarily from rope entanglements and vessel strikes (NOAA 2026b). The first vessel-related death of a NARW in 2023 was reported in February 2023 in Virginia Beach, and highlights the potential for serious injuries and fatalities within this area. In a statement released by NOAA regarding the results of the necropsy, it states that "the whale suffered a catastrophic blunt force traumatic injury, impacting a large portion of the vertebral column. The injuries, consistent with vessel strike, included multiple vertebral fractures and separations that would have resulted in death shortly after the injury" (NOAA 2023). In March 2024, another fatality was recorded off Virginia Beach, with this sighting first observed by the HDR Inc. aerial team; adult female #1950 (Ozog and Engelhaupt 2025) had last been seen with her calf off Florida. Because her calf was a dependent, both were included in the UME.

The large number of sightings of individual NARWs over the last three field seasons is likely a result of the increased survey effort in the mid-shelf area and in association with aerial survey support, although the presence of relatively large groups such as those observed during the 2022/23 season (Aschettino et al. 2023) had not previously been observed within the area. The persistence of individuals to remain within the same general area over the duration of up to 14 days suggests those individuals were not simply passing through, and are at an increased risk of vessel strike and other anthropogenic activities within the area (Aschettino et al. 2024c; A. Engelhaupt et al. 2023b).

From November through April, a ship-speed reduction rule is in effect at the mouth of Chesapeake Bay as part of the SMA set up to protect ESA-listed NARWs. These speed restrictions require all vessels 65 feet (19.8 m) or longer to travel at 10 knots (18.5 km/hour) or less. A proposed rule to extend those restrictions to smaller vessels within a wider area ultimately failed. One problem with the current SMA is that the areas where NARWs and humpback whales frequently occur are not within these boundaries. For instance, eight of nine sightings of NARW groups occurred outside the SMA during the 2022/23 (Aschettino et al. 2024a) field season, and all sightings of NARWs occurred outside the SMA during the 2023/24 field season (see **Figure 3** and **Figure 4** Aschettino et al. 2025a). For the 2024/25 season, only 4 out of the 19 NARW sightings were within the SMA (**Figure 6**).

Dynamic Management Areas (DMAs) are created when three or more NARWs are visually observed together. For a period of 15 days after a grouping is detected, NOAA uses these DMAs to notify vessel operators of the presence of NARWs within a given area and urge mariners to reduce speed to 10 knots or fewer when traveling through these areas (NOAA 2024). Right Whale Slow Zones, which are similar to DMAs, can be triggered by either visual or acoustic triggers, such as by the DMON buoys. During the 2024/25 season, five sightings would have yielded a DMA (if no active DMAs were already in place). These are voluntary requirements, however, and therefore do not guarantee additional protection to whales using those areas. When whales are socializing or milling, as is often the case with aggregations of NARWS, individuals may be at increased risk for vessel strikes while they spend more time at the surface and may be distracted while engaging with other whales.

Tag deployments during the 2024/25 season were relatively short, both for satellite tags deployed and CATS tags; therefore, inferences made from these data should be cautioned. The data, however, combined with the prior 10-year datasets, build a much stronger picture of baleen whale presence and habitat use off Virginia and within surrounding areas. For whales tagged closer to shore, the mouth of Chesapeake Bay and shipping lanes, in particular, have remained a heavily used area. SMAs that provide protection to baleen whales within specific areas during specific months fail to protect whales outside those areas and timeframes. Future work on the satellite-tag data will focus on overlapping environmental data and other covariates for the larger datasets.

Future work on the suction-cup tag data will include acoustic audits of archival tag data, track plot visualization of pitch-roll-heading archival tag data, and modeling sighting data and satellite-tag location data with environmental data.

Efforts for the 2025/26 field season will continue to focus on pushing farther into mid-shelf waters as well as continuing humpback photo-ID and body-condition assessment efforts within nearshore waters. During the upcoming 2025/26 field season, the study team will also continue to deploy DTAGs and CATS tags on baleen whales, with a focus on the W-50 MINEX and mid-shelf areas. A National Defense Authorization Act-compliant drone, equipped with a customized tag drop system, will also be used to deploy DTAGs and CATS tags. This will allow the team to continue to better detail fine-scale movement, dive patterns, and foraging behavior as well as record acoustic activity to add to the existing medium-duration dataset.

The numbers of sightings of NARWs and humpback, fin, and minke whales, as well as the level of interaction between whales and vessel traffic detailed to date, support previous recommendations to continue this study using the same techniques to better understand movement patterns and habitat use. Continued photo-ID efforts will build a more complete picture of inter-annual site fidelity to this region. The inclusion of SPLASH10-F tags with Fastloc® GPS technology, capable of providing high-resolution data logging, will provide superior quality with respect to accuracy of locations. The launching of Argos-capable nanosatellites, known as “Kinéis,” in 2025 will greatly improve Argos coverage globally (Wildlife Computers 2025); based on preliminary findings (see Southall et al. 2026), this yielded 3.1 to 5.7 times the number of Argos positions, which will greatly enhance the number of locations obtained from future tag deployments. Coupled with the use of DTAGs and CATS tags, which can examine the three-dimensional movements of baleen whales within and around high-traffic shipping channels, the entirety of these data will provide a better understanding of the occurrence and behavior of large whales within this area and further support future mid-Atlantic behavioral response studies.

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