SURVEY PROGRAM ANNUAL REPORT 2024

Maine Department of Marine Resources

Bureau of Science

Division of Marine Mammal Research

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Executive Summary

The Maine Department of Marine Resources Division of Marine Mammal Research established a Survey Program to conduct aerial and vessel surveys for North Atlantic right whales and other marine species in 2023 with funding from the Consolidated Appropriations Act. The primary objectives of the program are to expand research and monitoring efforts to fill data gaps related to right whale distribution in the Gulf of Maine, improve existing risk assessment models and support the development of new risk models, and support the development of management tools that reduce the risk of entanglement in fixed fishing gear. Initial vessel survey efforts were conducted in coordination with Passive Acoustic Monitoring operation in the Spring of 2024, and monthly aerial and vessel surveys began in July of 2024.

Surveys utilize distance sampling methodology and are standardized to allow for the estimation of density and abundance of North Atlantic right whales in the Gulf of Maine. Aerial surveys are conducted along pre-determined transects (track lines) at an altitude of 1000 feet and a groundspeed of 100 knots, while vessel surveys are conducted along randomized transects within about 30 nautical miles of shore at a speed of 10 knots. Sighting data for all marine species (whales, dolphins, porpoises, seals, sea turtles and large fishes) is collected using a custom software template that will allow for the integration of these data with other survey efforts in the region. Both surveys will deviate from transects to collect photographs of North Atlantic right whales for individual identification to obtain demographic and life history information for the individuals sighted.

In 2024, a total of 50 days of standardized surveys were conducted across both aerial and vessel platforms, resulting in 11,986.3km of coverage. An additional seven days of opportunistic vessel surveys were executed and when combined with opportunistic effort from survey transits totaled 13,516.2km. Additionally, 737.03km of effort was conducted aboard the R/V Hugh R. Sharp in the spring. In this first year of survey, a total of 861 sightings were observed during standardized data collection, including sightings of 107 large or medium whales. An additional 59 large whale sightings were observed during opportunistic efforts, and there were eight sightings of large whales on the R/V Hugh R. Sharp in spring. The only detections of North Atlantic right whales occurred during two aerial surveys in November. A single animal was observed in the southern Gulf of Maine and a surface-active group of eight whales was observed near the Bay of Fundy and Canadian Border.

When detections were corrected for effort, both vessel and aerial surveys showed a peak in large and medium whale presence in July, with lower sighting rates August through December. Aerial survey sighting rates ranged (monthly) from about 0.3 – 1.9 sightings per 100 km flown, while vessel surveys ranged from about 0.5 – 4.5. The higher detection rates for large whales from vessel surveys demonstrate that though they cover less area, they can provide further refinement of large whale distribution in the inshore Gulf of Maine. The seasonality and distribution of large whale species changes from year to year, so these data will serve as a baseline for observing spatial and temporal trends and monitor distribution shifts.

The 2024 efforts by this Program are a large undertaking, but the resulting detections of North Atlantic right whales in just six months of survey effort suggest that consistent and frequent survey effort will help to obtain a better understanding of right whale habitat use in the Gulf of Maine. The data collected will be contributed to the pool of data used to develop surface density estimates for North Atlantic right whales in the Gulf of Maine that are currently used in risk

assessment analyses. These data can also be used to inform the development of spatial and temporal management measures with the goal of reducing regulatory impact on the Maine Lobster Fishery by reducing uncertainty when determining areas of entanglement risk. In addition, focusing vessel survey efforts in areas of high gear density will ensure the data collection for regions with high fishing effort is comprehensive. Ongoing visual monitoring from aircraft and vessels may also support the future design and implementation of dynamic management.

List of Terms and Acronyms

Acronym	Definition
AIC	Akaike Information Criterion
ALWTRT	Atlantic Large Whale Take Reduction Team
CCS	Center for Coastal Studies
CI	Co-Investigator
COG	course over ground
CV	Coefficient of Variation
DST	Decision Support Tool
ESA	Endangered Species Act
ft	feet
GOM	Gulf of Maine
m	meters
mm	millimeter
MMPA	Marine Mammal Protection Act
ME DMR	Maine Department of Marine Resources
NEAq	New England Aquarium
NEFSC	Northeast Fisheries Science Center
NOAA	National Oceanic and Atmospheric Administration
NM	nautical miles
NMFS	National Marine Fisheries Service
PAM	passive acoustic monitoring
PI	Principal Investigator
Program	Survey Program
PSD	perpendicular sighting distance
right whale	North Atlantic right whale
SOG	speed over ground

Introduction

Program Establishment and Implementation

Program Establishment

The State of Maine Department of Marine Resources (ME DMR) Bureau of Science established the Division of Marine Mammal Research in 2023, with funding from the Consolidated Appropriation Act, 2023, to expand monitoring efforts for North Atlantic right whales (*Eubalaena glacialis*) in the Gulf of Maine (GOM). The Division of Marine Mammal Research established the Survey Program (hereafter, Program) in November of 2023, to conduct visual surveys for marine mammals from aerial and vessel platforms in the GOM (see Program Objectives, below). Division of Marine Mammal Research staff attended coordination meetings in early 2024 with regional scientists from the National Oceanic and Atmospheric Administration (NOAA) Northeast Fisheries Science Center (NEFSC), The New England Aquarium (NEAq), The Center for Coastal Studies (CCS), and Duke University to establish inter-agency communications between programs and confer on survey designs and methodologies.

Program Implementation

In November of 2023, Marine Resource Scientist III, Sarah Leiter, was brought on to develop and implement the Program. In July of 2024, Marine Resource Scientist II, Paul Nagelkirk, joined the Program as Lead Scientist. In September of 2024, Marine Resource Specialist II, Natasha Telschow, joined the program as a Field Specialist and Marine Resource Scientist III, Julia Stepanuk, joined the Division as the Biological Modeling Program Lead. To provide additional staffing and coordination support, a Request for Proposals (RFP) for Aerial Surveys and Marine Mammal Observers was published in March of 2024, and filled in April 2024 by the selected bidder, Azura Consulting LLC (hereafter, Azura) which operates under a National Marine Fisheries Service (NMFS) Permit (No. 27066).

Initial vessel-based survey work was conducted in conjunction with ME DMR Passive Acoustic Monitoring vessel operations in March and April of 2024, to conduct both opportunistic and standardized line transect surveys and to establish reliable scientific protocols for data collection during vessel survey operations. The Program contracted individual Marine Mammal Observers experienced in regional vessel marine mammal research operations for these surveys, and a post-survey report was disseminated internally.

Inshore vessel surveys and aerial surveys began in July of 2024 and continued monthly through the remainder of the year. During these surveys contractor Azura was responsible for staffing, coordinating, and executing monthly aerial surveys via Aviation Services Provider Aspen Helicopters LLC. who provided a Partenavia aircraft and two pilots for each survey. Vessel surveys were coordinated by ME DMR, and staffed with observers from DMR and Azura, and were conducted aboard the M/V Coastal Explorer or M/V Acadia Explorer crewed and provided by contractor Bar Harbor Whale Watch Company.

In May of 2024, The Division of Marine Mammal Research submitted a NMFS Research Permit application to conduct approaches of North Atlantic right whales and opportunistically study other species from vessels and conduct aerial surveys for marine species in the GOM. The Division of Marine Mammal Research was issued a NMFS Research Permit (No. 27858), valid for five years, in October of 2024. Survey Program Lead, Sarah Leiter, Marine Resource Scientist III, will serve as the Principal Investigator (PI) under this permit, and Division Team Erin Summers, Anita Murray, Paul Nagelkirk, and Julia Stepanuk, and Contracted Scientists Amy Whitt, Lenisa Blair, and K.C. Slivka are listed as Co-Investigators (CI). The Program began utilizing this issued permit in December of 2024 for vessel surveys.

Program Coordination

The Program maintains close coordination with other research agencies conducting similar monitoring efforts in the GOM, particularly with other aerial survey efforts conducted by NOAA, NEFSC, NEAq, CCS, the US Fish & Wildlife Service,

and the Department of Fisheries and Oceans Canada to ensure safety within common airspace. Prior to all aerial surveys and vessel survey windows, a notification is sent to members of the above agencies that includes the anticipated date, platform, departure time, departure location, shore contact, field contact, and methods for communication for each survey. The Program also coordinates with other ME DMR personnel and programs including Marine Patrol and the Division of Marine Mammal Research Passive Acoustic Monitoring (PAM) Program to maximize potential survey platform opportunities, including the coordination and execution of surveys that are a response to key marine mammal sightings.

Program Objectives

The Division of Marine Mammal Research Survey Program conducts research that will support both the conservation of endangered species and the management of Maine's fisheries. The North Atlantic right whale (*Eubalaena glacialis*) is listed as *Endangered* under the Endangered Species Act (ESA) and Depleted under the Marine Mammal Protection Act (MMPA) (US NMFS, 2005). The current population estimate (2023) is approximately 372 (+11/-12) individuals (Linden, 2024). Primary threats to species recovery are vessel strike and entanglement in fixed fishing gear (Knowlton et al., 2022; Pace et al., 2017; Sharp et al., 2019), and an Unusual Mortality Event (UME) has been declared for the species since 2017 (https://www.fisheries.noaa.gov/national/marine-life-distress/2017-2025-north-atlantic-right-whale-unusual-mortality-event). The ESA and MMPA outline requirements for the recovery of North Atlantic right whales. The Atlantic Large Whale Take Reduction Team (ALWTRT) (Atlantic Large Whale Take Reduction Team | NOAA Fisheries) was established in 1997 to develop an Atlantic Large Whale Take Reduction Plan to reduce the risk of North Atlantic right, humpback and fin whale entanglement in fixed fishing gear.

In the context of impending regulatory decisions impacting the Maine Lobster Fishery aimed to reduce right whale entanglement risk, more spatial and temporal species distribution data is necessary to understand areas of high risk in the GOM. Standardized line transect data has not been consistently collected across the entirety of the GOM, as it has in other regions in the northwest Atlantic where right whales have historically aggregated in higher abundance, such as Cape Cod Bay (Mayo et al. 2018, Meyer-Gutbrod et al. 2023). The sheer size of the GOM and the relatively lower number of right whale detections have not prompted regular systematic coverage of the region. The Program developed and implemented by ME DMR aims to improve the understanding of right whale distributions by conducting spatially expansive, year-round surveys to reduce the uncertainties in risk estimates.

The primary objectives of the Survey Program are aligned with those of the overall Division of Marine Mammal Research. Those objectives and the contributions made by the survey program are as follows:

Primary Objective 1
Establish and expand research and monitoring efforts to fill data gaps related to North Atlantic right whale distribution in the Gulf of Maine.

Primary Objective 2
Contribute data layers that improve existing risk assessment models and support the development of new peer-reviewed risk assessment models.

Primary Objective 3
Support the development of management tools, including dynamic management, that reduce North Atlantic right whale entanglement risk.

Due to the nature of survey work, there are many secondary research objectives that can be met through Program data collection and analysis efforts. Other marine mammal species found in the Gulf of Maine that are listed as *Endangered* (ESA) and *Depleted* (MMPA) include the fin whale (*Balaenoptera physalus*), sei whale (*Balaenoptera borealis*), blue whale (*Balaenoptera musculus*), sperm whale (*Physeter macrocephalus*), and leatherback sea turtle (*Dermochelys choriacea*). Data collection for these species will also be prioritized during research efforts. (Reeves et al., 1998; US NMFS & US FWS, 1992; US NMFS, 2010a; US NMFS, 2010b; US NMFS, 2011). Sighting data are collected for other whale species

that are prone to entanglement, apart from those endangered species listed above, including humpback whales (*Megaptera novaeangliae*) and minke whales (*Balaenoptera acutorostrada*). Data are collected for all megafauna species easily visible from aircraft and vessel including small cetaceans, pinnipeds, sharks and other large fishes.

Data Dissemination

North Atlantic right whale sightings are reported to the NOAA Northeast Right Whale Hotline and sightings are uploaded with effort track lines on the day following each survey to Whale Map (www.whalemap.org), and a daily Aerial Survey Report containing a map of survey effort and sightings, sighting totals, and survey details is circulated following each aerial survey to the ME DMR Division of Marine Mammal Research Survey Program Listserv. Individual aerial survey reports are available upon request to sarah.leiter@maine.gov. Photographs of North Atlantic right whales are preliminarily matched to known individuals in the North Atlantic Right Whale Catalog (www.rwcatalog.neaq.org). Data collected during surveys will be submitted to the North Atlantic Right Whale Consortium (NARWC) sighting and photographic databases (www.narwc.org). The Survey Program completes monthly and annual reports, which will be available on the Maine DMR website.

Methods

The Survey Program Primary Objective 1 (above) is to fill gaps and improve existing density estimates of North Atlantic right whales in the Gulf of Maine. To accomplish this, the Program conducts manned visual surveys from two platforms (aerial and vessel) and both platforms utilize distance sampling methodology (Buckland et al., 2015) along predetermined transects (track lines) throughout the Gulf of Maine. Currently, the true density of animals in a given area is calculated using distance sampling theory, where mathematical equations are applied to sightings of animals along a transect to account for factors that could influence the detection of sightings (e.g., visibility, species size or behavior, wave height; outlined in Hedley & Buckland, 2004). Distance sampling methodology relies on standardized data collection methods that cover the following assumptions: animals are distributed independent of the placement of survey transects; every animal directly on the survey line is detected; the distance from the observer to the animal is recorded accurately, and animals do not move prior to detection. These standards are followed during all survey transects (*on effort*) during aerial and vessel surveys. Data collected using line transects and distance sampling methodology can be corrected for calculations of absolute density based on a two-stage process: detection modeling and density surface modeling (Miller et al., 2013). Within detection modeling, there are three components: the detection function, availability bias, and perception bias.

Additional data are collected when both the vessel and aerial platforms are underway, but may not meet the standards for distance sampling analysis, including transits between survey track lines, surveys that are motivated by a response to a sighting, or opportunistic surveys that are conducted when vessels are underway but are unable to maintain the speed and heading requirements for distance sampling (referred to as *opportunistic*).

The aerial and vessel surveys were designed to target accurate data collection for North Atlantic right whale sightings, but secondary species of importance are endangered large whales including fin whales, sei whales, blue whales and sperm whales, as well as endangered leatherback sea turtles. Data for all other marine mammal species, including other species of large and medium whales, small cetaceans, pinnipeds, as well as species of large fishes including tuna, sharks and ocean sunfish (*Mola mola*) are also recorded. Photographs are collected from both platforms for the individual identification (Photo-ID) of individual right whales to obtain demographic information (sex, age, age-class, reproductive status), historical information (sighting history, association history, reproductive history, injuries, entanglements) and health status for the individual(s) (Kraus et al. 1986, Hamilton et al. 2010, Hamilton et al. 2019). Aircraft availability was typically limited to approximately 10 days per

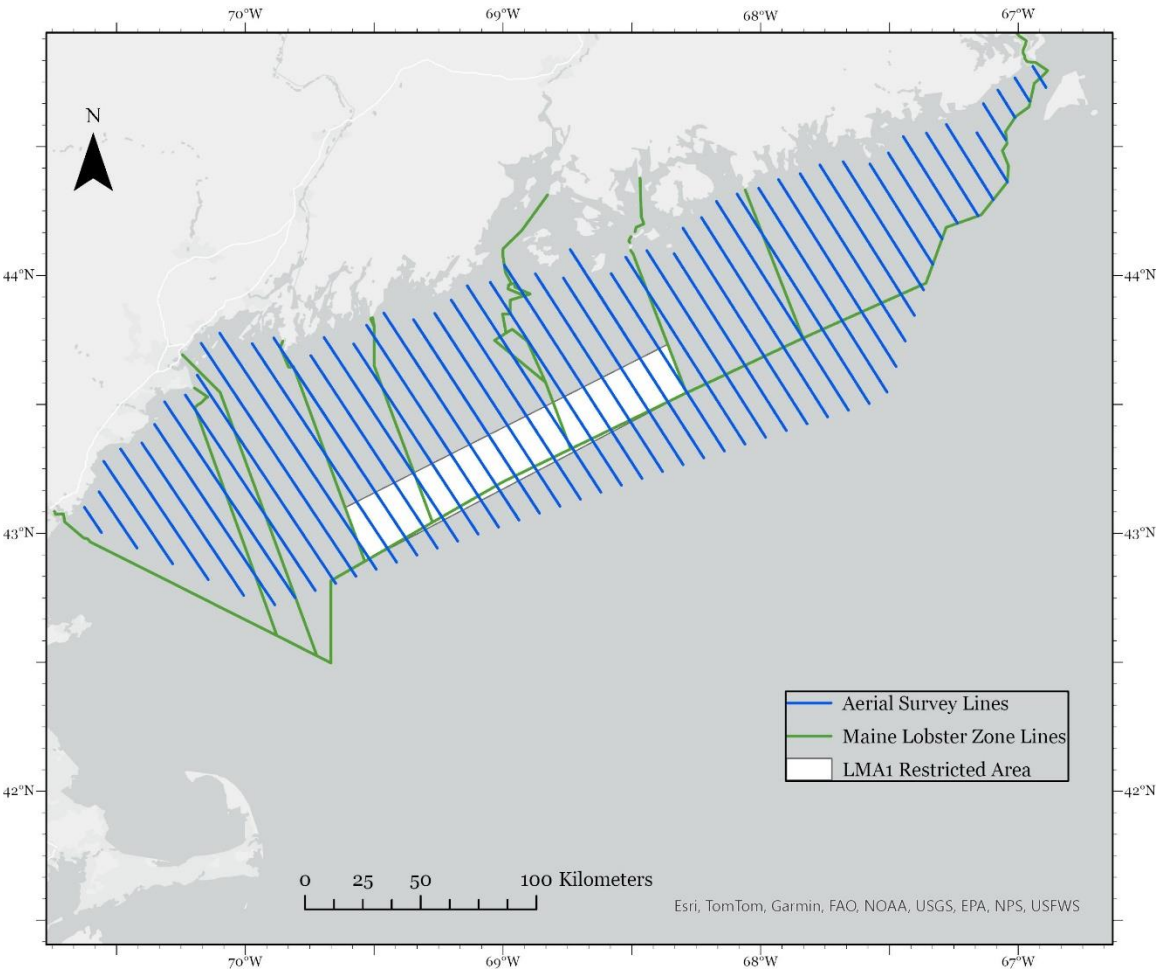
month and vessel survey windows were scheduled for approximately the same number of potential survey days (10).

Aerial Surveys

Monthly aerial surveys are conducted by Azura Consulting LLC from a twin-engine Partenavia (8VA) aircraft owned and operated by Aspen Helicopters LLC at an altitude of 1000 ft (305 m) and a groundspeed of 100 knots. Surveys are conducted along pre-determined transect lines that run perpendicular to the coastline and span the Gulf of Maine from the New Hampshire border to the Canadian border (**Figure 1**).

Within the aircraft, a trained observer is positioned on each side (2) of the aircraft and visually scans the surface of the ocean for marine species from directly beneath the aircraft to a distance of approximately 2 NM. The aircraft is equipped with bubble windows to afford observers a full view of this visual scanning area. During flights for training observers or in summer months when species detections are high, a third observer is positioned in the rear of the aircraft to serve as data recorder and photographer. Nikon Prostaff P3 10x42 binoculars are used to confirm species identification when needed. The survey aircraft deviates from the transect to confirm species identifications for large whales and to collect photographic data for the individual identification of North Atlantic right whales. An attempt is made to confirm that any large whales sighted are non-right whales prior to resuming the transect.

Figure 1. Aerial Survey Transects (Track Lines), Maine Lobster Zone Lines, and LMA 1 Restricted Area



Vessel Surveys

R/V Hugh R. Sharp Survey

A portion of Program vessel survey work in March and April 2024 was conducted aboard the R/V Hugh R. Sharp, with a team of six observers. These operations were conducted in coordination with ME DMR PAM and plankton sampling operations. Visual survey operations were conducted from the observation deck of the vessel (deck height 8.69 m) where two observers scanned from directly in front of the vessel out to 90 degrees with Fujinon 25x150 “big eye” binoculars on either side of the ship (port and starboard). In addition, one observer recorded data and was equipped with handheld Fujinon FMTRC-SX 7x50 binoculars with reticles for scanning for marine species. When observations from the top deck were not feasible due to inclement weather (rain), operations took place from the wheelhouse where two observers, one on either side of the bridge, were equipped with Fujinon FMTRC-SX 7x50 binoculars with reticles and the port observer served as the data recorded.

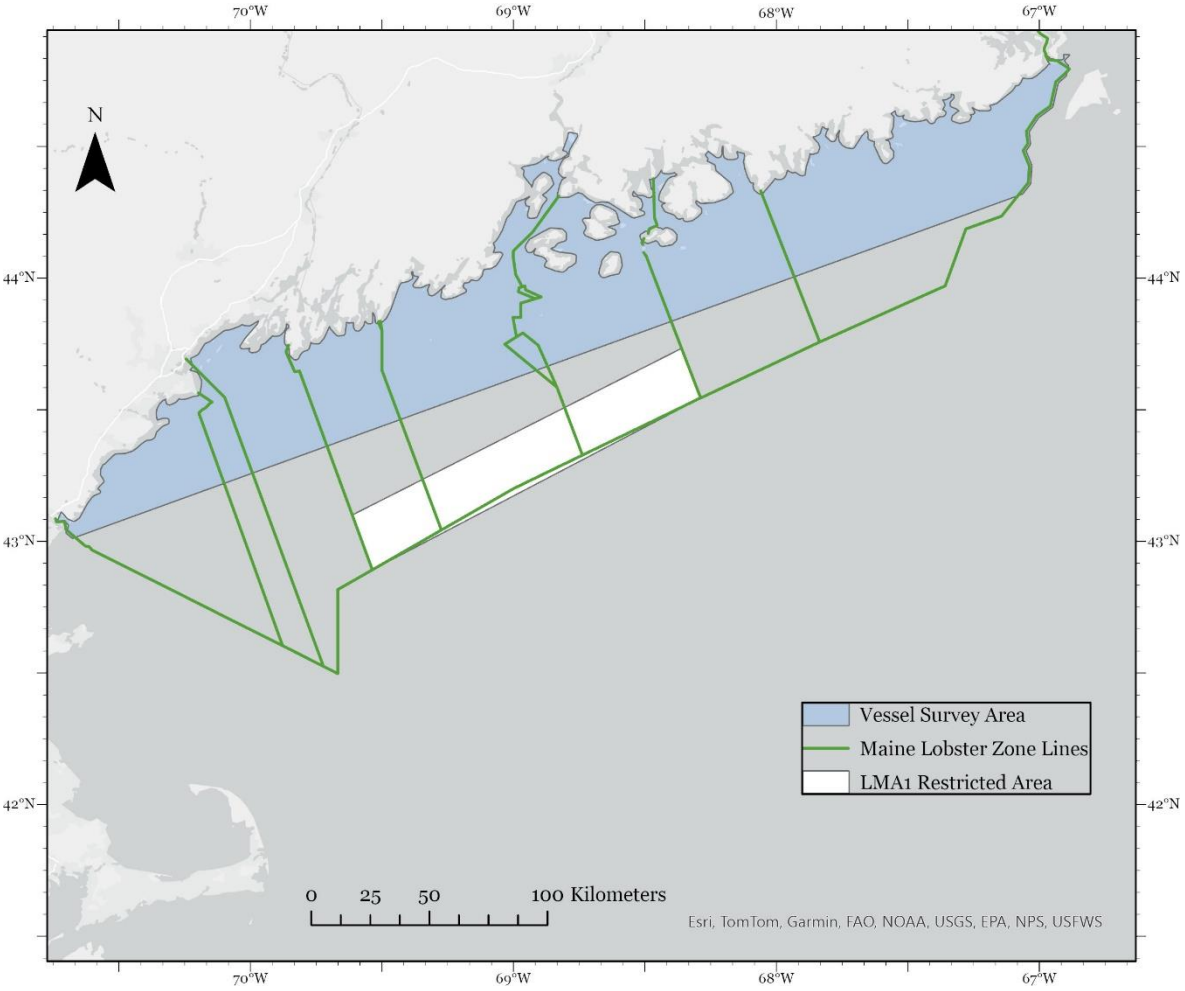
The observation platform height from both the wheelhouse and the observation deck, as well as the addition of big eye binoculars, make the survey methodology significantly different from that utilized for other standardized vessel surveys. For this reason, the sighting and effort analyses for the R/V Hugh R. Sharp survey are reported separately herein.

Monthly Vessel Surveys

Monthly vessel surveys (March and July-December) are conducted aboard a jet-propelled catamaran (M/V Coastal Explorer or M/V Acadia Explorer) with an observation deck height of 19 feet and 6 inches (5.99 m) owned and operated by the Bar Harbor Whale Watch Company. Surveys are conducted along randomized pre-determined transect lines in a sawtooth pattern inside of approximately 30 nm along the Maine coastline within the inshore vessel survey area (**Figure 2**). Survey transects are randomized by selecting new start and end points for each transect within the predetermined inshore survey area. Two observers were stationed on the observation deck and equipped with Fujinon FMTRC-SX 7x50 binoculars with reticles positioned on either side of the vessel. Observers adopted a visual scanning pattern out to about 4 NM from just left of the vessel heading (relative heading -5 degrees) out to 90 degrees relative to the bow of the vessel. A third observer is stationed in either the wheelhouse (with UHF radio communication to the observation platform) or on the observation platform as a data recorder. All three observers alternate between scanning with the naked eye and scanning with binoculars.

The vessel deviates from the transect to confirm species identification for large whales and to collect photographic data for the individual identification of North Atlantic right whales. Whales are always approached from behind their direction of travel or on a converging and parallel course. During an approach, if whales exhibit active avoidance (i.e. change in behavior, change in direction, etc.), the approach is terminated, and the vessel departs from the animal(s).

Figure 2. Vessel Survey Area, Maine Lobster Zone Lines, and LMA1 Restricted Area



Data Collection Protocol

Survey data is recorded on a Dell Toughbook Laptop computer using Mysticetus LLC software with a custom ME DMR Aerial Survey Template (aerial surveys) or ME DMR Vessel Survey Template (vessel surveys) that is connected to a GlobalSat BU-353N USB GPS. The program automatically logs the time, date, position (latitude/longitude), altitude (aircraft only), course over ground (COG) and speed over ground (SOG) of the aircraft at regular (2-3 second) intervals A Logbook within the template is used to record take-off and landing times, survey date, survey number, airport, observer names, pilot names, and other survey details. Effort variables are recorded in accordance with the North Atlantic Right Whale Consortium (NARWC) data submission guidelines periodically throughout each flight, including effort type, visibility distance (in NM), Beaufort sea state, glare, cloud cover, and general weather (**Appendix A, Table 1**). During vessel surveys observers also record windspeed, wind direction and swell height.

For marine mammal, sea turtle, or large fish sightings, observers record the declination angle of the sighting when it is perpendicular to the aircraft using an inclinometer or measured markings on the windows of the aircraft. This declination angle (aerial surveys) or range and bearing (vessel surveys) is used to calculate the distance of the sighting from the transect, or perpendicular sighting distance (PSD), which is required for distance sampling analyses. For each sighting, observers record the species, species identification reliability (**Appendix A, Table 1**), number of animals, confidence interval (+/- count), direction of travel, and behaviors observed. When the species of an animal cannot be determined due to a lack of resighting, distance from the aircraft, or survey

time constraints, the highest possible taxonomic distinction is recorded. For example, because fin and sei whales are sometimes difficult to distinguish between, the species can be recorded as *fin or sei whale*. When a large whale can only be determined to be either a blue, fin, sei, or minke whale, the species can be recorded as *Balaenoptera spp.*, and when a large whale can be determined as a rorqual whale it is recorded as *unidentified rorqual*. This also applies to other species categories (taxonomic groups), such as small cetaceans.

Photographic Identification of North Atlantic Right Whales

For North Atlantic right whale sightings, photographic data that can be utilized for individual identification (photo-ID) is collected. The aircraft/vessel will attempt to approach each individual right whale or group of whales for photography. Photographs are taken using Canon EOS 7D Mark II cameras equipped with either a 70-300 mm or 100-400 mm lens (vessel surveys) or a 300 mm fixed lens (aerial surveys). Ideally, a series of photographs of the whale head, body and flukes of each individual will be collected to maximize the probability of matching the whale to a catalogued individual. Photographs of other species are also collected opportunistically, and photographs of fin whales and humpback whales are also collected for photo-ID.

Data Quality Assessment and Quality Check

Following each vessel and aerial survey, observers in the field perform an initial quality assessment/quality check (QA/QC) of the data collected to ensure that effort and sighting data collected are correctly entered. Additional QA/QC is performed by Program personnel and entry fields are reviewed for completion and accuracy. To ensure accuracy and transferability between surveys, all data for a given year are compiled into a single file that represents the GPS track line, as well as all sightings, effort, and logbook information. Intra- and inter-survey comparisons are made to ensure that fixed fields (e.g., species lists) are streamlined between surveys and that continuous fields (e.g., wind speed) are in the correct units. Post-survey season QA/QC is conducted in R Statistical Software (v4.4.1; R Core Team 2024) using reproducible code to minimize error.

Analyses

Survey effort data was defined as *on effort* when surveys were traveling along a predetermined transect with 2-3 observers on watch, or *opportunistic* when the aircraft or vessel was underway during transits, cross-legs or circling/approaches when at least one observer was surveying. The total effort for each survey platform (vessel and aerial) were calculated as the total distance transited in kilometers.

Species sightings were assessed if the identification reliability was deemed *definite* or *probable*, while sightings with a *possible* confidence level were omitted (**Appendix A, Table 1**). Sightings were included for all Beaufort sea states and visibility conditions, but any species recorded as "unidentified animal" were omitted. For each effort category (on effort and opportunistic), the total number of detections was summed for individual species or species category by platform (aerial or vessel). Species sub-groups were separated by taxonomy and defined as the following:

Large and Medium Whales: whales recorded as fin whale, humpback whale, minke whale, North Atlantic right whale, sei whale, fin or sei whale, unidentified large whale, and unidentified medium whale

Small Cetaceans: Atlantic white-sided dolphin, common dolphin, common or white-sided dolphin, bottlenose dolphin, pilot whale, harbor porpoise, and unidentified dolphin or porpoise

Pinnipeds/Seals: harbor seal, gray seal, harp seal, and unidentified seal

Large Fishes: basking shark, unidentified shark, tuna, and ocean sunfish

Sighting Rates

Sightings per unit of effort (SPUE), also known as Sighting Rates, were calculated as sightings per 100 km of effort by survey platform for individual species and species groups for each survey month

using the formula below. Sightings recorded with an identification reliability of *possible* were excluded, only *definite* and *probable* identifications were included. All species recorded as *unidentified animal* were excluded.

$$SPUE = \frac{number\ of\ detections}{effort\ in\ kilometers}\ x\ 100$$

SPUE was also calculated spatially across the survey area. A gridded surface was created at a resolution of 0.2 decimal degrees, which was intersected with the transect effort and sightings data for the aerial and vessel surveys separately. For each grid cell, the following equation was applied:

$$SPUE_{gs} = \frac{\sum number\ of\ detections_{gs}}{\sum effort\ in\ kilometers_{g}}$$

Where g represents an individual grid cell, and s represents a species or taxonomic group. Spatial SPUE was calculated across all months for each species or taxonomic group that comprised the large, medium, and small whale species sub-groups, and was also calculated by month for the species that comprise the large and medium species sub-groups.

Preliminary Detection Function

Preliminary detection functions were fitted for large whales to the aerial and vessel survey data separately using multi-covariate distance sampling methods in R statistical software (v4.4.1; R Core Team 2024) using the Distance package (MRDS v.2.3.0). Large whales include fin, humpback, sei, and fin or sei whales, as well as unidentified large whales, and North Atlantic right whales. Because the detection sample sizes were low for large whale species individually (**Appendix C, Tables 1 & 3**), a single detection function was fitted for all large whale detections combined for aerial and vessel surveys, respectively. In addition, because the detection function varies by survey platform, the vessel surveys conducted on the R/V Sharp were omitted from this analysis.

To fit the detection function, a half-normal function was applied with no truncation or adjustment for all large whale detections combined for the vessel and aerial surveys. Covariates were derived from the recorded conditions at the time of sighting, including Beaufort sea state (numeric), glare (factor), visibility (numeric), cloud cover (numeric), and a by-species factor. At this time, no group size estimates were included in model fitting. A detection function was fitted based on all combinations of covariates and the detection function with the combination of the lowest Akaike's Information Criterion (AIC) and lowest Coefficient of Variation (CV) was selected.

Results

Effort

The distribution of survey dates and vessel types varied throughout 2024, with initial vessel survey efforts were conducted in coordination with PAM service activities in March and April of 2024 aboard the M/V Acadia Explorer and R/V Hugh R. Sharp, and monthly aerial and vessel surveys beginning in July. (**Appendix A, Table 2**). Total transect effort (km) varied by survey platform and month (**Table 1**) based on weather opportunities during scheduled survey windows.

Table 1. On Effort and Opportunistic Survey Effort in Kilometers by Month and Survey Platform

	Aerial		Vessel		
Month	*On Effort*	*Opportunistic*	*On Effort*	*Opportunistic*	*R/V Sharp*
March	0	0	364.44	542.13	303.7
April	0	0	0	0	433.78
July	509.55	713.34	479.2	827.41	0
August	2127.1	1229.27	293.44	1241.21	0
September	1505.19	1400.73	446.31	474.91	0
October	1371.46	1592.63	365.94	507.11	0
November	2523.57	2204.59	270.3	1178.08	0
December	1379.54	827.49	475.23	777.3	0
Total Distance	**9416.41**	**7968.05**	**2694.86**	**5548.15**	**737.48**

Aerial Surveys

The first aerial survey was conducted by contractor Azura Consulting LLC in July of 2024 (**Appendix A, Table 2**). Subsequent surveys were then conducted by Azura in August, September, October, November and December. Systematic survey effort during aerial surveys (*on effort*) conducted in 2024 from July through December totaled 9218.02 km. An additional 7968.05 km of opportunistic effort was conducted during transits, cross-legs and circling. The greatest amount of aerial survey effort was conducted in November (2523.57 km).

Aerial surveys were primarily conducted in Beaufort sea states 2 or 3 (73%; **Figure 3**). Sea state was slightly higher for surveys conducted during September and November. Most survey effort (81%) was conducted with a visibility range of 10 NM or higher (**Appendix B. Figure 1**). Visibility distance was only reduced to below 10 NM for portions of transect during the months of July, August and September.

Vessel Surveys

Initial vessel surveys conducted during the months of March and April aboard two different vessel platforms (M/V Acadia Explorer and R/V Hugh R. Sharp) which were conducted in coordination with PAM servicing operations for 26 acoustic buoys deployed throughout the Gulf of Maine. Standardized monthly vessel survey efforts began aboard the M/V Acadia Explorer and M/V Coastal Explorer in July of 2024 within the inshore survey area (**Figure 2**).

Total inshore transect effort in 2024 was 2768.28 km, and this effort includes March of 2024 because the same survey platform and general survey area were utilized. The least amount of effort was conducted during the months of August (293.39 km) and November (270.28 km) due to fog and inclement weather. An additional 5548.15 km of opportunistic survey effort was conducted during survey transits and approaches, or during PAM operations conducted both inshore and offshore on the M/V Acadia Explorer in July, August, November and December. Efforts from the R/V Hugh R. Sharp were not separated by effort type (*on effort* vs. *opportunistic*) and totaled 737.03 km.

Inshore vessel survey effort (on effort), March – December, by Beaufort sea state is depicted in **Figure 4**. Overall, the majority of survey effort was conducted in sea state 2-4 (83%). Sea state was highest during the month of March, and lowest during the month of September. Visibility (NM) is depicted annually and by month for inshore vessel surveys in **Appendix B, Figure 2**. Over half (53%) of all survey effort was conducted with full visibility (7 NM), and the only months with any effort in visibility below 2 NM were March, July, August, and September.

Figure 3. On Effort Distance in Kilometers by Beaufort Sea State and Month

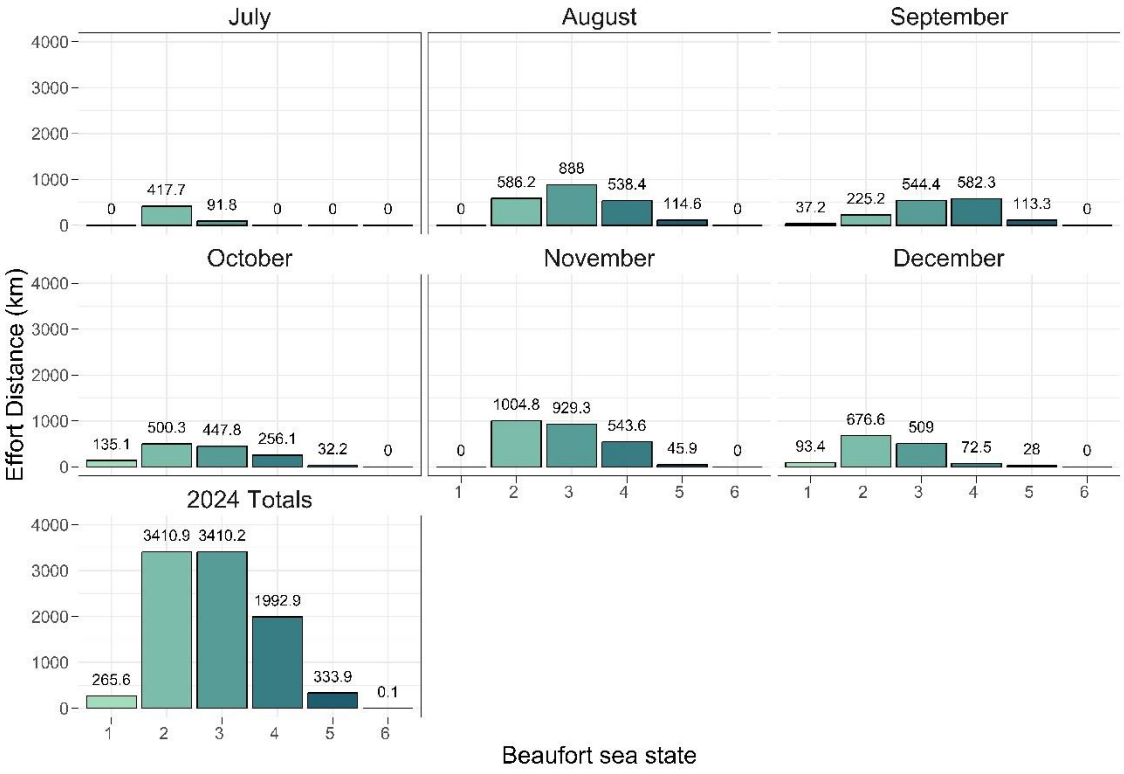
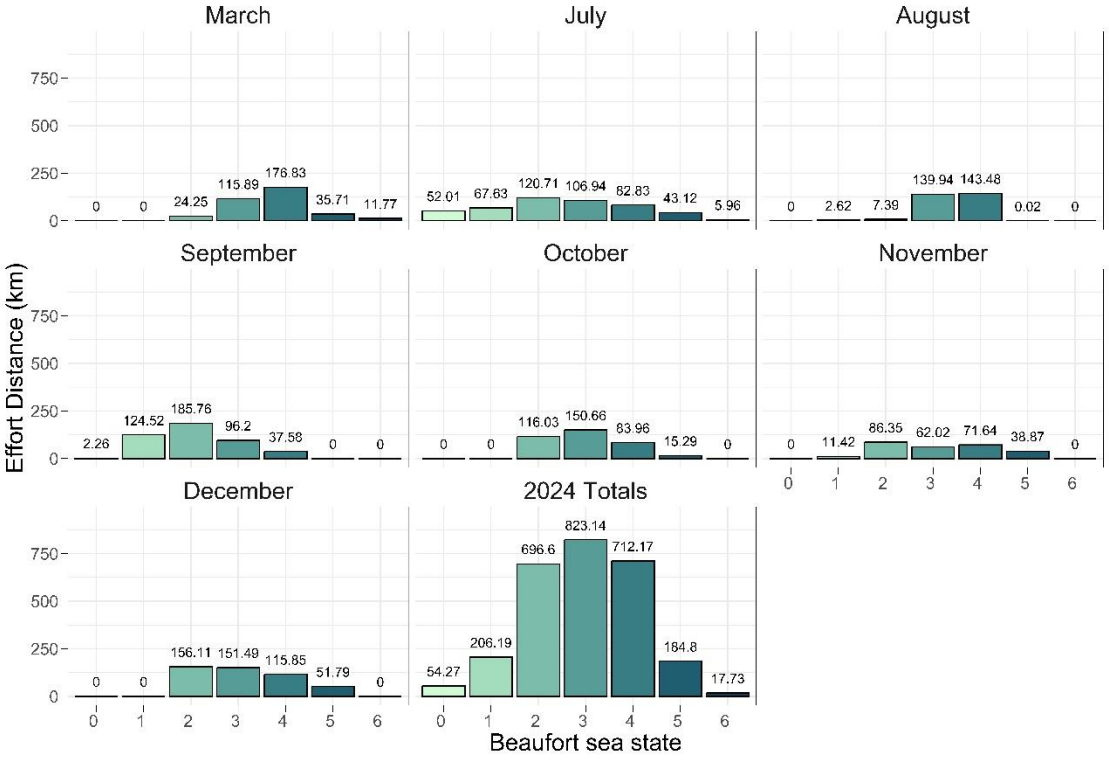


Figure 4. On Effort Distance in Kilometers by Beaufort Sea State and Month



Aerial Survey Sightings

There were 502 sightings of marine species during aerial survey effort (*on effort*) in 2024. The total number of animals sighted was 2532 (+/- 599). Sightings are listed by species and month in **Appendix C: Table 1**. In the table these are also separated by species category (Large and Medium Whales, Small Cetaceans, Seals, and Fishes) and by the seasons *summer* (July, August and September) and *fall* (October, November and December).

Large and Medium Whales

There were 60 sightings of 90 (+/- 1) large and medium whales during aerial survey effort in 2024, with the highest number of sightings in August (n = 14) and September (n = 14) (**Appendix C: Table 1, Figure 5**). The species of whale most sighted in 2024 were fin whale (n = 24) and humpback whale (n = 16). There were 2 sightings of North Atlantic right whales, and both occurred during the month of November. The first sighting was of a single animal, and the second sighting was of a group of 8 right whales. Sighting details for North Atlantic right whales can be found in **Table 3**. Sightings of minke whales (n = 4) and sei whales (n = 1) were also detected, as well as fin or sei whales (n = 3) when the distinction between the two species could not be made. There were also detections of unidentified large and medium whales, which were recorded using the highest possible taxonomic distinction and included unidentified Balaenoptera spp. (n = 3), unidentified rorqual (n = 1), unidentified large whale (n = 5), and unidentified medium whale (n = 1).

Small Cetaceans

There were 186 sightings of 1961 (+/- 574) small cetaceans detected during aerial survey effort in 2024 (**Appendix C: Table 1, Figure 6**). The majority of small cetacean sightings from aerial survey effort were recorded as unidentified dolphin or porpoise (n = 138) The most common species of small cetacean sighted was harbor porpoise (n = 16), followed by common dolphin (n= 13). There were also sightings of Atlantic white-sided dolphins (n=10), pilot whale (n = 8), and bottlenose dolphins (n = 1). The greatest number of small cetacean sightings occurred in December (n = 68).

Seals, Turtles and Fish

There were 30 sightings of 98 (+/- 24) seals from aerial survey effort (*on effort*) in 2024 (**Appendix C: Table 1).** All but one of these sightings was recorded as unidentified seal, with one sighting of a single gray seal. Most seal sightings occurred in December (n = 18). There were no sightings of sea turtles during aerial survey effort in 2024. However, there was an opportunistic sighting of a leatherback sea turtle (see Opportunistic Aerial Sightings, below).

There were 226 sightings of 383 (+/- 0) fish during aerial survey effort in 2024 (**Appendix C: Table 1**). Most of these sightings (n = 163) were ocean sunfish. Basking shark (n = 58), unidentified shark (n = 1) and schools of fish (n = 4) were also recorded.

Opportunistic Aerial Survey Sightings

Additional sightings were detected during transits, cross legs and circling events that did not constitute systematic survey effort and were therefore categorized as opportunistic data (**Appendix C: Table 2**). These include sightings of large and medium whales (n = 17) (**Appendix C: Figure 1**), small cetaceans (n = 22) (**Appendix C: Figure 2**), seals (n = 1), turtles (n = 2), and fish (n = 36). Sightings are mapped without one leatherback turtle and one unidentified turtle, which were the only two turtle sightings from aerial surveys in 2024.

Figure 5. Large and Medium Whale Sightings and Survey Transects (Track Lines) from Aerial Surveys July – December2024

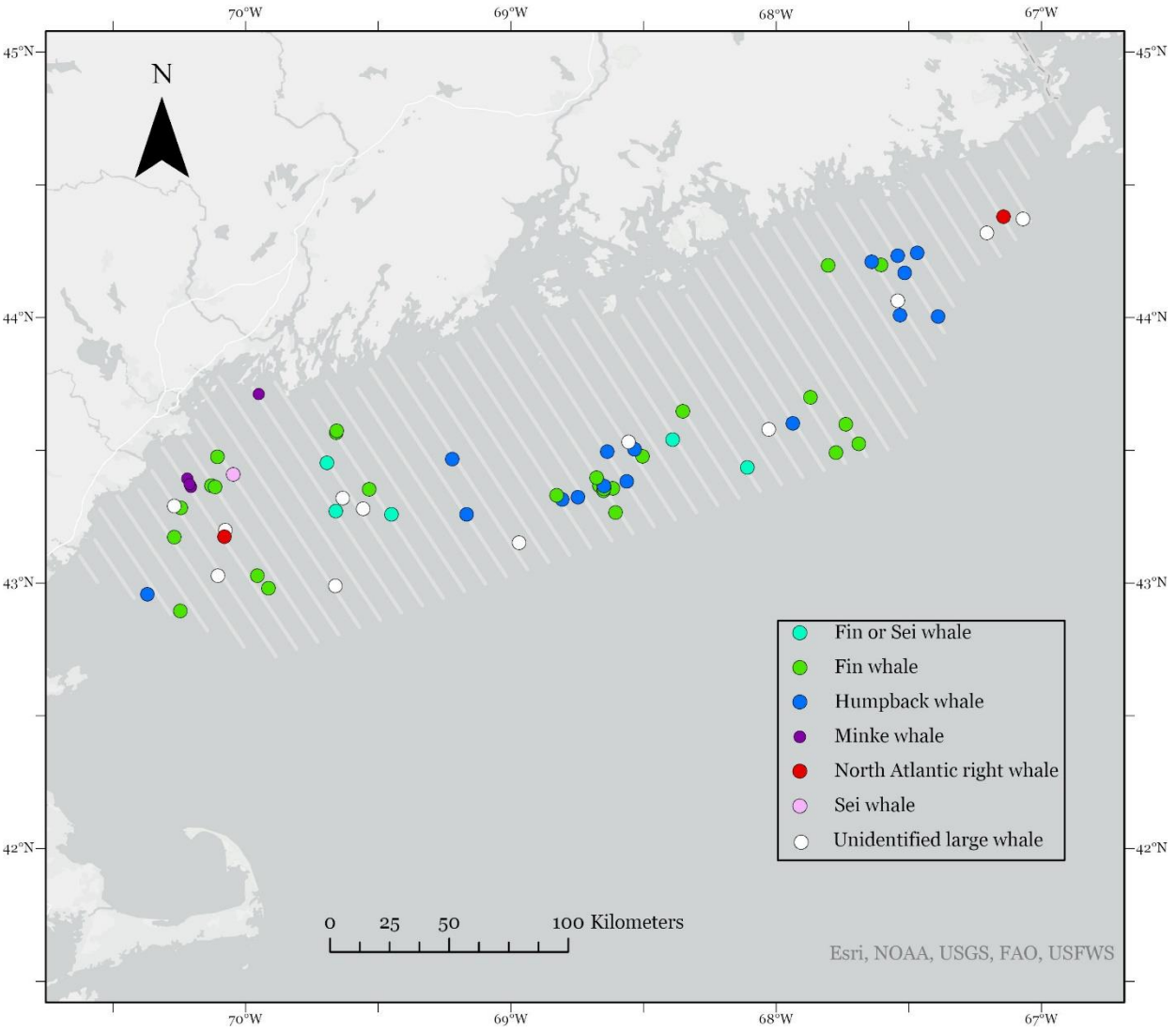
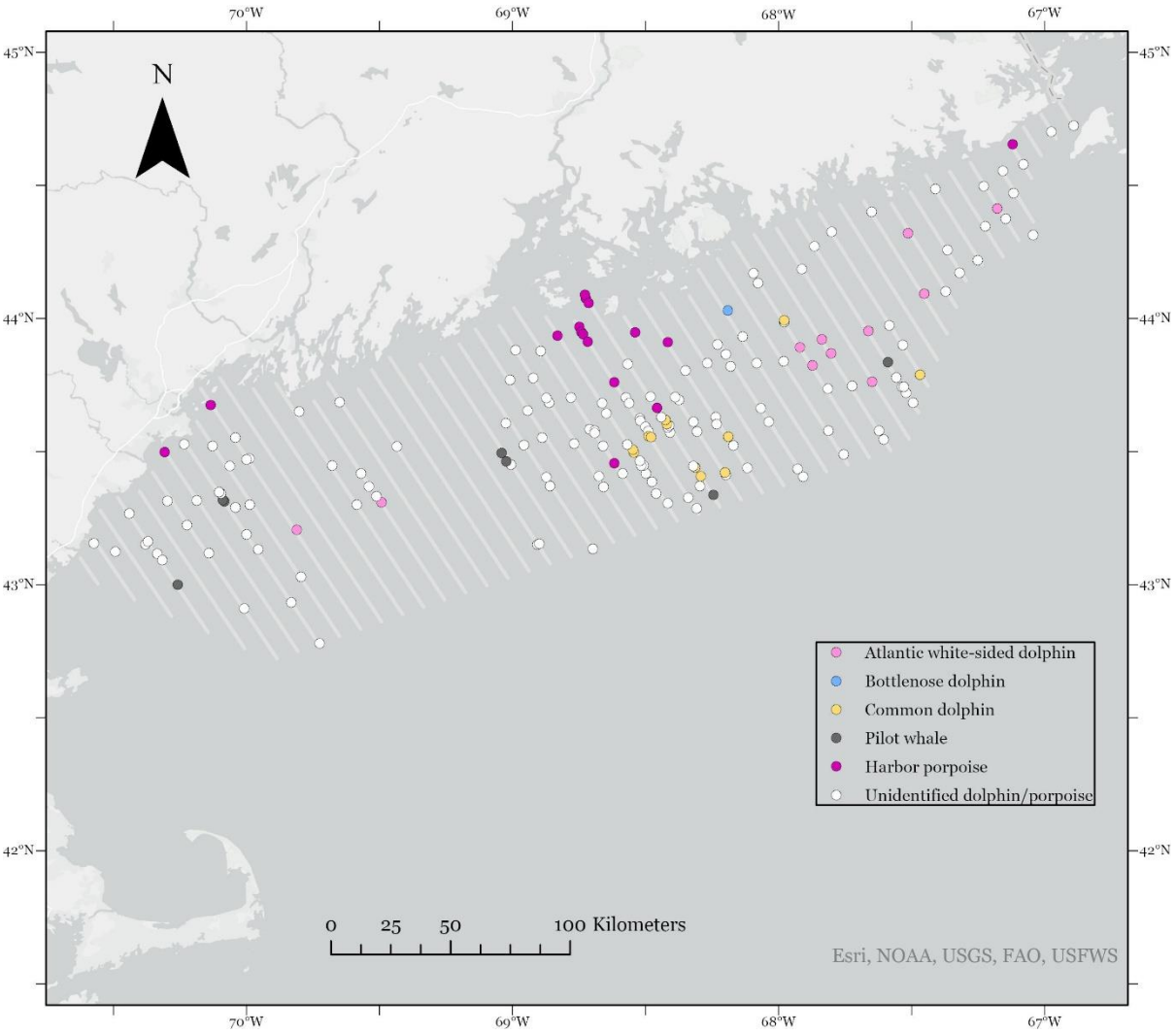


Table 3. North Atlantic Right Whale Sightings from Aerial Surveys in 2024 with Date, Number of Animals, Position and Preliminary Identifications (EGNO) and Associated Demographics

Date	Number	Latitude	Longitude	Platform	EGNO	Name	Sex	Age Class	Calving Female	Behavior
11/03/2024	1	43.17409	-70.08531	Aerial	NA	NA	NA	NA	NA	NA
11/04/2024	8	44.37869	-67.15010	Aerial	3951	Domino	M	Adult	NA	SAG
					4343		M	Adult	NA	SAG
					3623	Bongo	M	Adult	NA	SAG
					3830	Garlic	M	Adult	NA	SAG
					4145		M	Adult	NA	SAG
					3832		M	Adult	NA	SAG
					4423	Nebula	M	Adult	NA	SAG
					3712		M	Adult	NA	SAG

Figure 6. Small Cetacean Sightings and Survey Transects (Track Lines) from Aerial Surveys July – December 2024



Vessel Survey Sightings

There was a total of 359 sightings of marine species from vessel survey effort (*on effort*) in 2024. The total number of animals sighted was 1143 (+/- 213). Sightings are listed by species and month in **Appendix C: Table 3**. In the table these are also separated by species category (Large and Medium Whales, Small Cetaceans, Seals, and Fishes) and by the seasons *winter* (March) *summer* (July, August and September) and *fall* (October, November and December). Additional sightings collected from the research platform R/V Hugh R. Sharp during PAM operations in March and April are listed by species category, month and season in **Table 5**.

Large and Medium Whales

There were 47 sightings of 66 (+/- 18) large and medium whales sighted during vessel survey effort in 2024, and the greatest number of sightings (n = 21) were detected in July (**Appendix C: Table 3**, **Figure 7**). The species of whale most sighted were humpback whale (n = 13), minke whale (n = 12), and fin whale (n = 11). There were also sightings of sei whale (n = 3), and fin or sei whale (n = 2) when a distinction between the two species could not be made. Some whales could not be identified to species and were recorded to the highest taxonomic distinction possible and included unidentified Balaenoptera spp. (n = 1), unidentified rorqual (n = 2), unidentified large whale (n = 2), and unidentified medium whale (n = 1).

Small Cetaceans

There were 177 sightings of 887 (+/- 163) small cetaceans sighted during vessel survey effort in 2024, with the greatest number of sightings occurring in July (**Appendix C: Table 3, Figure 8**). The most sighted species of small cetacean were harbor porpoise (n = 72), followed by unidentified dolphin or porpoise (n = 43), common dolphin (n = 33) and Atlantic white-sided dolphin (n = 23). There were also sightings of pilot whales (n = 4), bottlenose dolphin (n = 1) and common or white-sided dolphin (n = 1) when the distinction between the two species could not be made.

Seals, Turtles and Fish

There were 53 sightings of 69 (+/- 0) seals during vessel survey effort in 2024 (**Appendix C: Table 3**), with the greatest number of sightings occurring in July (n = 19). The most sighted species of seal was harbor seal (n = 34), followed by gray seal (n = 10) and unidentified seal (n = 9). There were no turtle sightings during vessel survey effort (*on effort*) in 2024. There were 82 sightings of 121 (+/- 32) sightings of fish during vessel survey effort in 2024 (**Appendix C: Table 3**). Most of these sightings were of ocean sunfish (n = 61). Basking shark (n = 10), tuna (n = 7) and unidentified shark (n = 4).

Opportunistic Vessel Sightings

Additional sightings were detected during transits or PAM servicing operations that did not constitute systematic survey effort and were therefore categorized as opportunistic data (**Appendix C: Table 4**). These sightings are a substantial contribution of opportunistic sightings data given the great distance traveled during PAM servicing operations. Opportunistic data collection during vessel operations contributed an additional 204 sightings of 1126 (+/- 240) marine species. These include sightings of large and medium whales (n = 42) (**Appendix C: Figure 3**), small cetaceans (n = 111) (**Appendix C: Figure 4**), seals (n = 32), turtles (n = 1), and fish (n = 18). Species observed during opportunistic data collection that were not detected during systematic vessel survey efforts included harp seal (n = 1), leatherback turtle (n = 1), and blue shark (n = 2).

R/V Hugh R. Sharp Sightings

During the months of March and April 2024, observations conducted aboard the R/V Hugh R. Sharp collected 63 sightings of 103 (+/- 76) marine species (**Appendix C: Table 5**). These included large and medium whales (n = 8), small cetaceans (n = 33), seals (n = 21), and fish (n = 1). Marine mammal species observed during this survey effort included fin whale, unidentified Balaenoptera spp., unidentified large whale, Atlantic white-sided dolphin, common dolphin, harbor porpoise, common or white-sided dolphin, unidentified dolphin or porpoise, gray seal, harbor seal, harp seal, and unidentified seal.

Figure 7. On Effort Large and Medium Whale Sightings and Survey Transects from Vessel Surveys in 2024

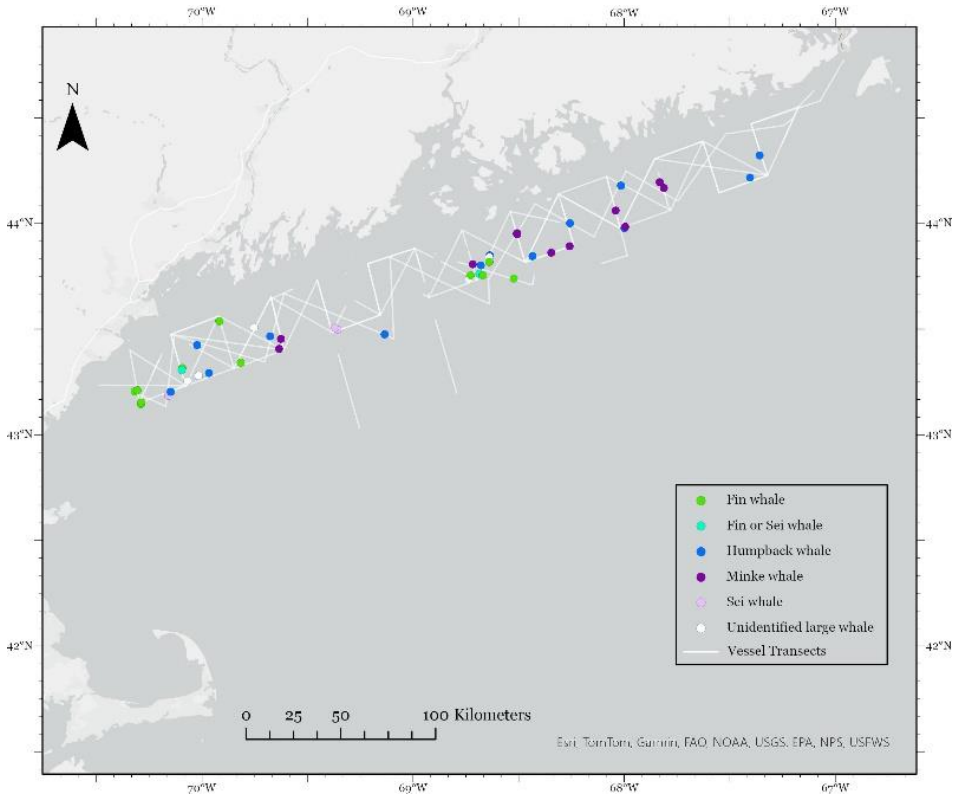
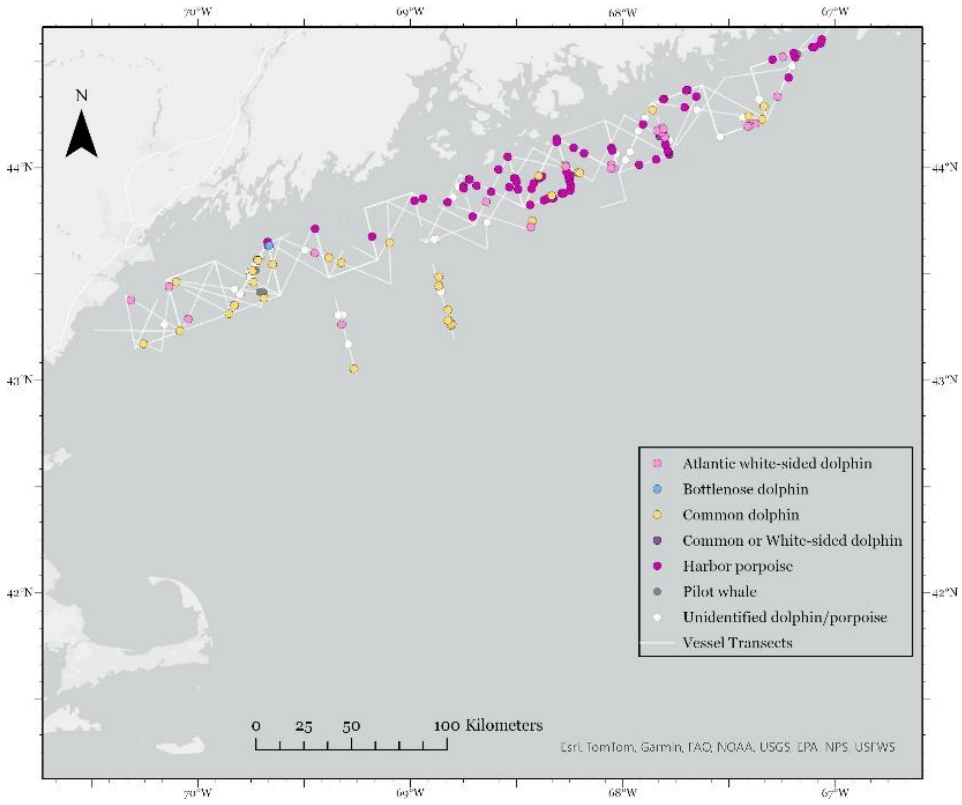


Figure 8. On Effort Small Cetacean Sightings and Survey Transects from Vessel Surveys in 2024



Sighting Rates

Sighting rates, also known as sightings per unit of effort (SPUE), were calculated for each species by month and overall, as sightings per 100 km of survey effort (opportunistic sightings and effort excluded). Large and medium whales include fin whale, humpback whale, minke whale, North Atlantic right whale, sei whale, fin or sei whale, and unidentified whale. Small cetaceans include Atlantic white-sided dolphin, bottlenose dolphin, common dolphin, harbor porpoise, pilot whale, and unidentified dolphin or porpoise.

Sighting Rates of Large and Medium Whales

Sighting Rates of Large and Medium Whales from Aerial Surveys

For large and medium whales, sighting rates from aerial surveys are depicted by month and species and for all whales in **Figure 9**. Sighting rates for fin whales, sei whales and minke whales were highest in July, while humpback whale sighting rates were consistent throughout the summer and fall, with the highest sighting rate in December. The only North Atlantic right whale sighting rate was in November, the month with the only sightings of right whales. Overall, the sighting rates for large and medium whales from aerial surveys were highest in July and lowest in November. The SPUE map for large and medium whale species detected

from aerial surveys (all months combined) demonstrates a similar spatial pattern for humpback and fin whales with the majority of detections occurring further from shore (**Figure 10**). When the SPUE for all large and medium whale species combined is depicted by month, a trend of detections occurring further from shore during the months of September and December can be observed (**Figure 11**).

Figure 9. Monthly Sighting Rates by Large and Medium Whale Species from Aerial Surveys in 2024

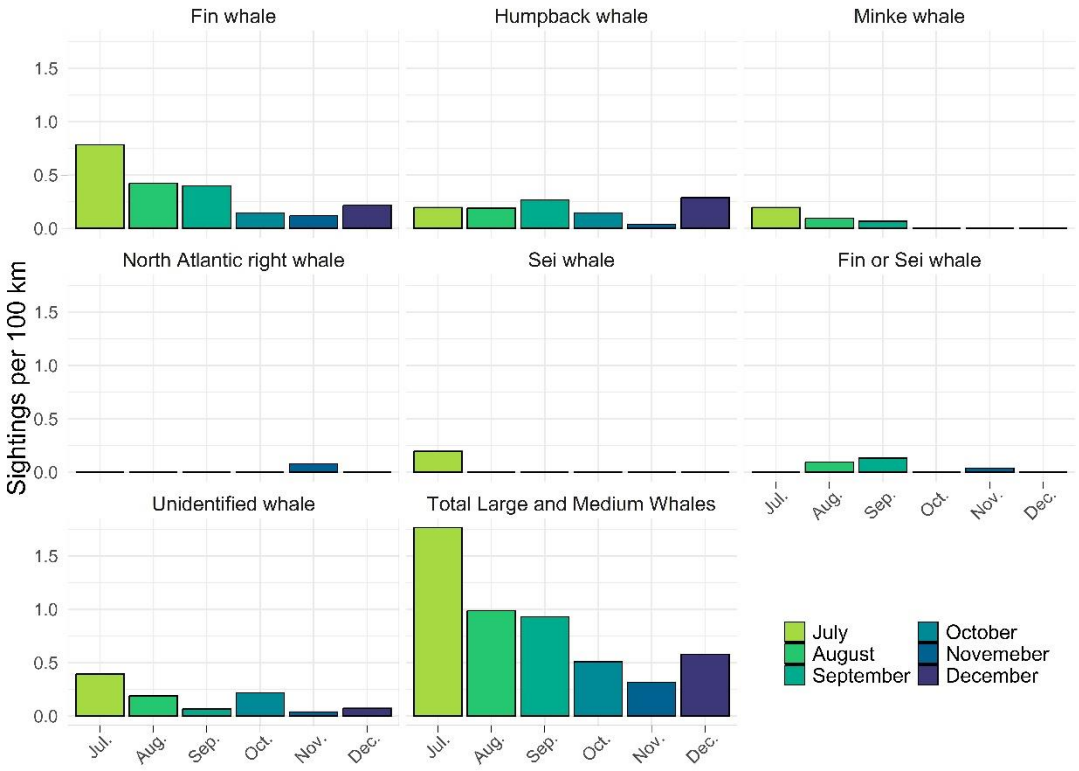


Figure 10. Sightings Per Unit Effort (SPUE) by Species from Aerial Surveys in 2024

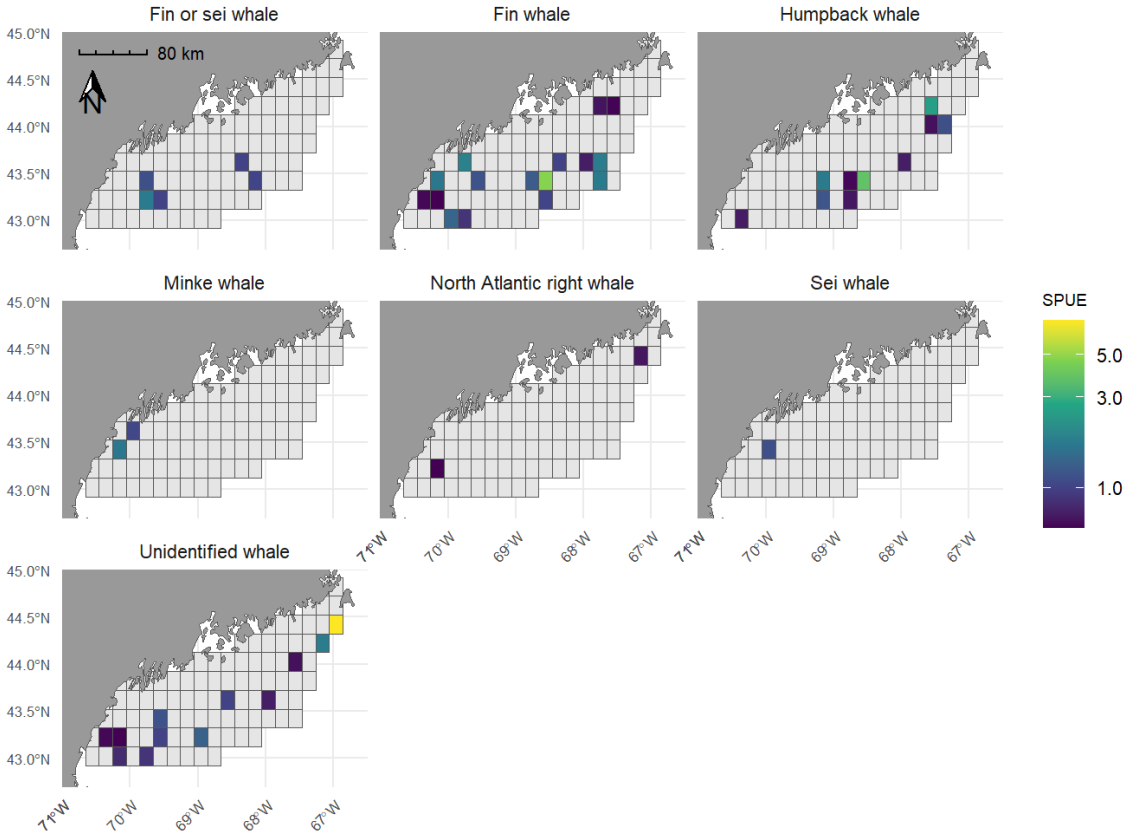
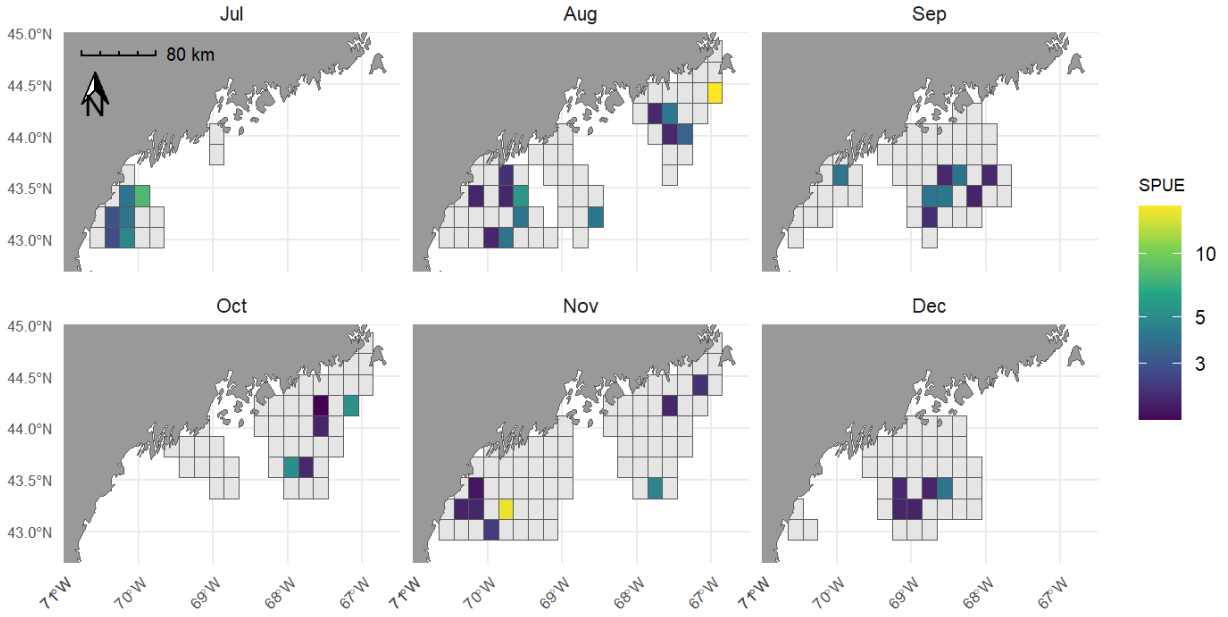


Figure 11. Sightings Per Unit Effort of Large and Medium Whales from Aerial Surveys by Month



Sighting Rates of Large and Medium Whales from Vessel Surveys

Sighting rates calculated for large and medium whales from vessel surveys are depicted by month and species and for all whales in **Figure 12**. Sighting rates for fin, minke and sei whales were also highest from the vessel in July, and humpback whales demonstrated a similar consistency in sighting rate, with their lowest sighting rate in September. There were no North Atlantic right whales sighted from vessel surveys therefore no sighting rate was calculated. Overall, the sighting rates for large and medium whales from vessel surveys were highest in July and lowest in September. The vessel survey SPUE map for large and medium whale species (all months combined) demonstrates that humpback and minke whales were distributed throughout the survey area, detection rates were higher from the Mid-coast Maine region to Southern Maine for fin whales, and sei whales were only detected in Southern Maine (**Figure 13**). When all species of large and medium whales sighted from vessel surveys were combined by month, the most widely dispersed distribution of whales occurred in July (**Figure 14**).

Figure 12. Monthly Sighting Rates by Large and Medium Whale Species from Vessel Surveys in 2024

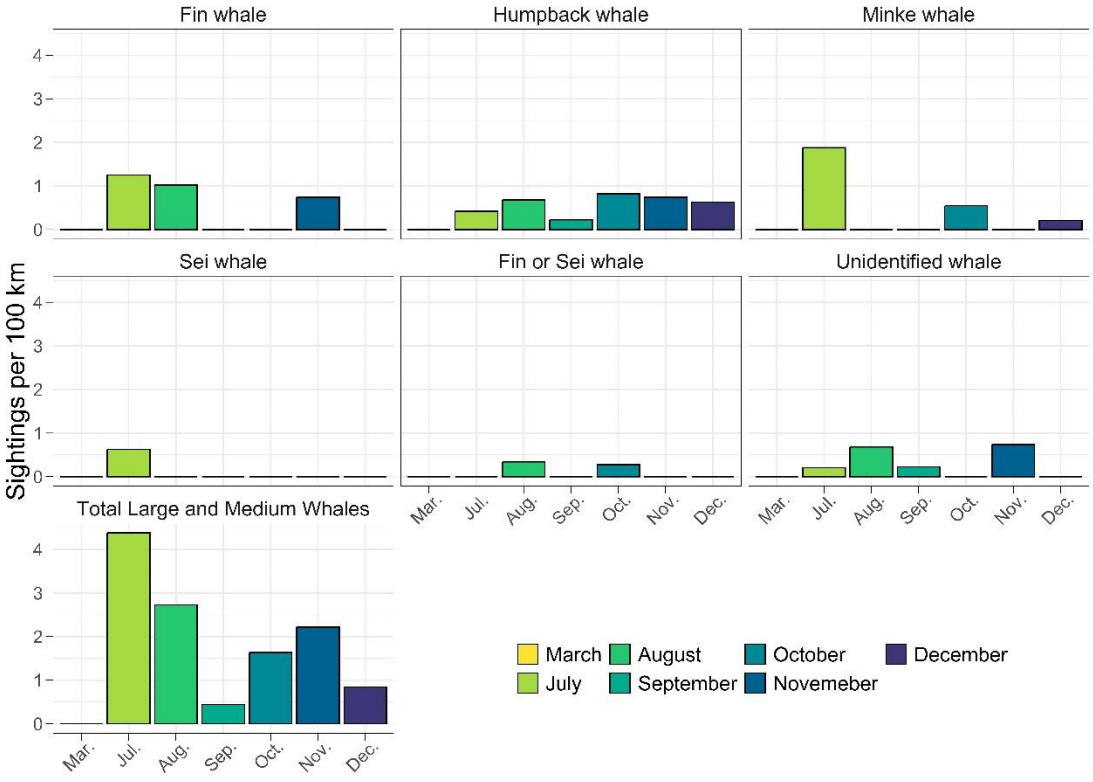


Figure 13. Large Whale Sightings Per Unit Effort (SPUE) by Species from Vessel Surveys in 2024

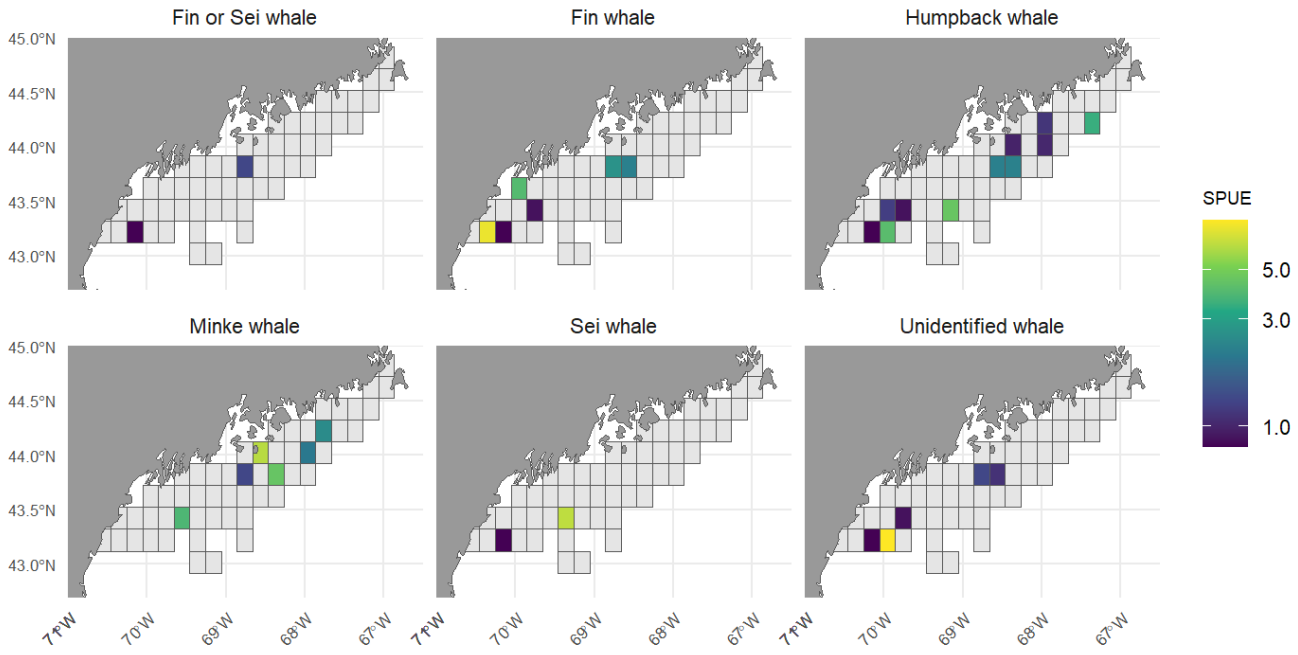
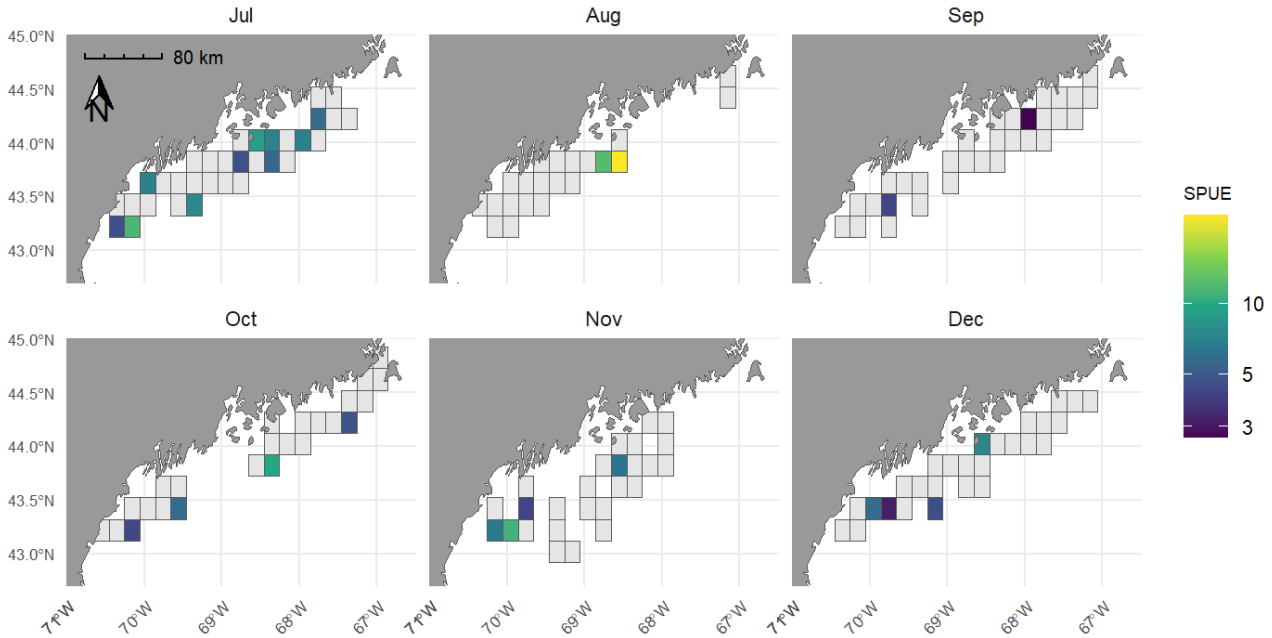


Figure 14. Large and Medium Whale Sightings Per Unit Effort (SPUE) by Month from Vessel Surveys in 2024



Sighting Rates of Small Cetaceans

Sighting Rates of Small Cetaceans from Aerial Surveys

For small cetaceans, sighting rates from aerial surveys are depicted monthly by species, and overall, in **Figure 15**. Most small cetacean sightings from aerial surveys were recorded as unidentified dolphin or porpoise, therefore sighting rates for species are small. There were two species that peaked in sighting rate in December: common dolphin and harbor porpoise. Pilot whale sighting rates peaked in September and decreased throughout the fall. Overall, the sighting rates for both unidentified dolphins or porpoise and small cetaceans increased over the course of the summer and fall months, except for November, and the highest sighting rates were in December. The SPUE map for species of small cetaceans (all months combined) demonstrates that common dolphins and Atlantic white-sided dolphins were most frequently sighted in waters east of the Mid-coast Maine region, while pilot whales tended to be sighted further from shore and harbor porpoises were sighted closer to shore (**Figure 16**). Since most small cetaceans were not identified to species from the air, the plot depicting unidentified small cetaceans demonstrates the wide dispersal of small cetacean detections throughout the survey area.

Sighting Rates of Small Cetaceans from Vessel Surveys

For small cetaceans, sighting rates from aerial surveys are depicted monthly by species and overall, in **Figure 17**. Small cetaceans are more likely to be identified to species from vessel surveys, and sighting rates were highest for harbor porpoise and common dolphin. Both harbor porpoise and Atlantic white-sided dolphin sighting rates peaked in July, while common dolphin sighting rates peaked in November. Pilot whales were only detected in September and October. Overall, the highest sighting rates for small cetaceans were in July and November, and the lowest sighting rates were in March. The SPUE map of small cetacean sighting rates during vessel surveys (all months combined) shows that Atlantic white-sided dolphins, common dolphin and unidentified small cetaceans were widely dispersed throughout the survey area, while harbor porpoise distribution favored toward the easternmost portion of survey area (**Figure 18**).

Sighting Rates for Seals, Turtles and Fish

Sighting rates from aerial and vessel surveys are depicted monthly by species, and overall, for seals and turtles & fish in **Figures 5-8 in Appendix C**. Sighting rates for seals were highest overall in July from vessel surveys and in December from aerial surveys. Most fish sightings were of ocean sunfish, and these were highest from aerial surveys in September, and highest from vessel surveys in July and August.

Figure 15. Small Cetacean Sightings Rates from Aerial Surveys in 2024 by Species

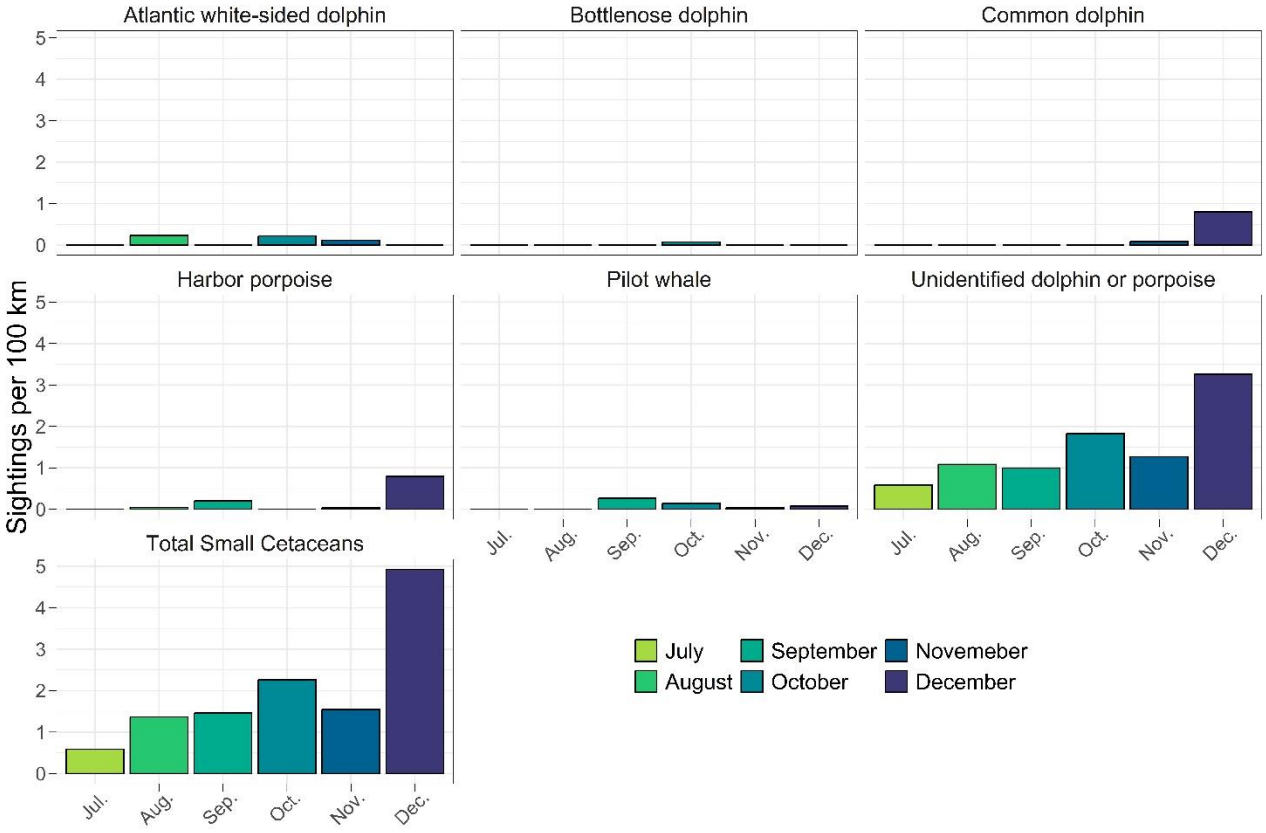


Figure 16. Small Cetacean Sightings Per Unit Effort (SPUE) from Aerial Surveys in 2024 by Species

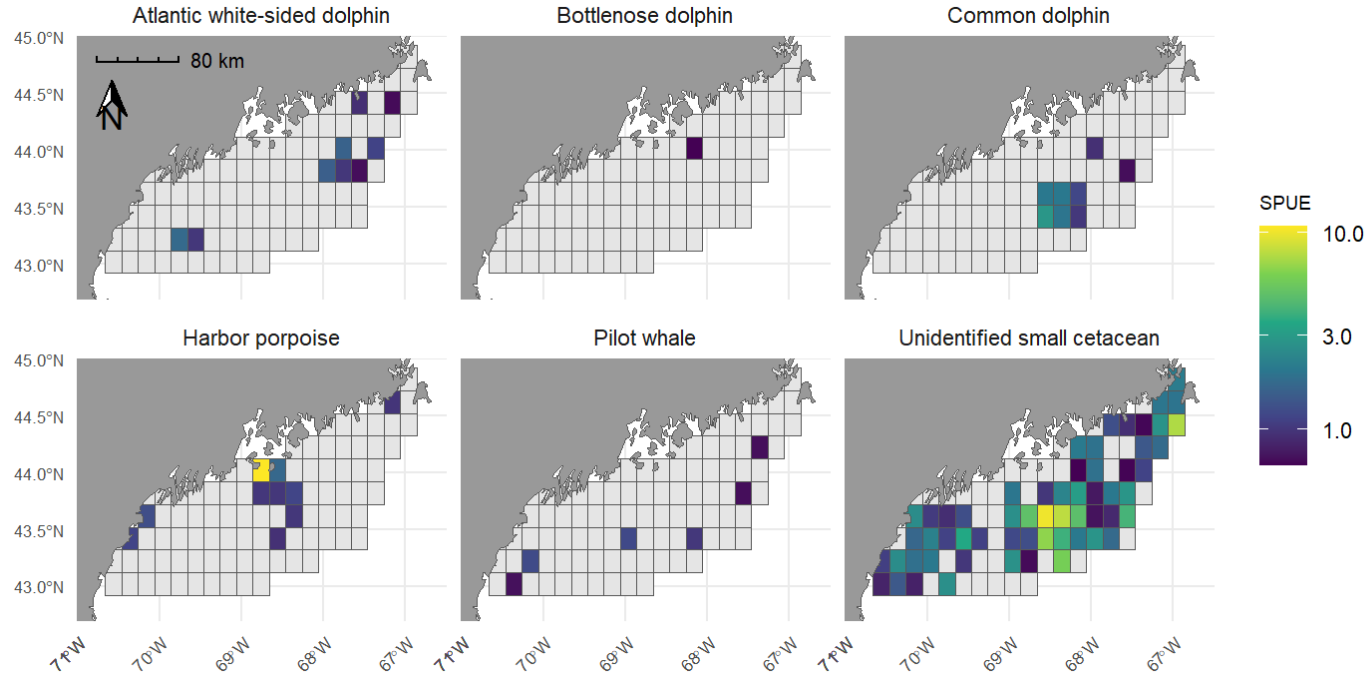


Figure 17. Small Cetacean Sightings Rates from Vessel Surveys in 2024 by Species

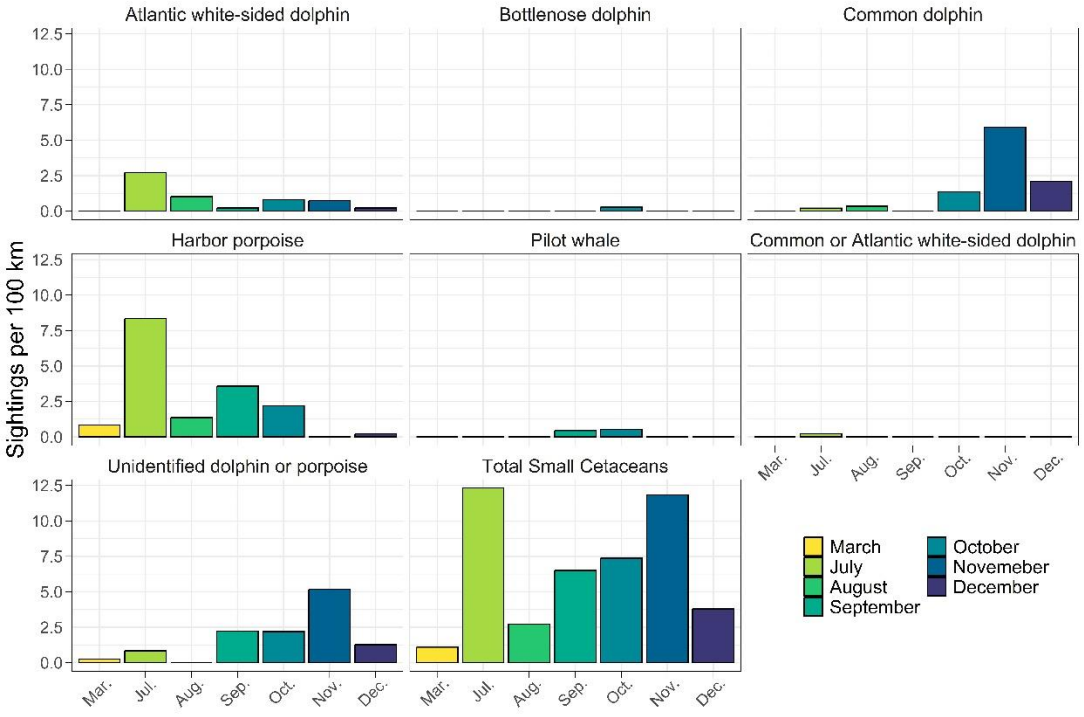
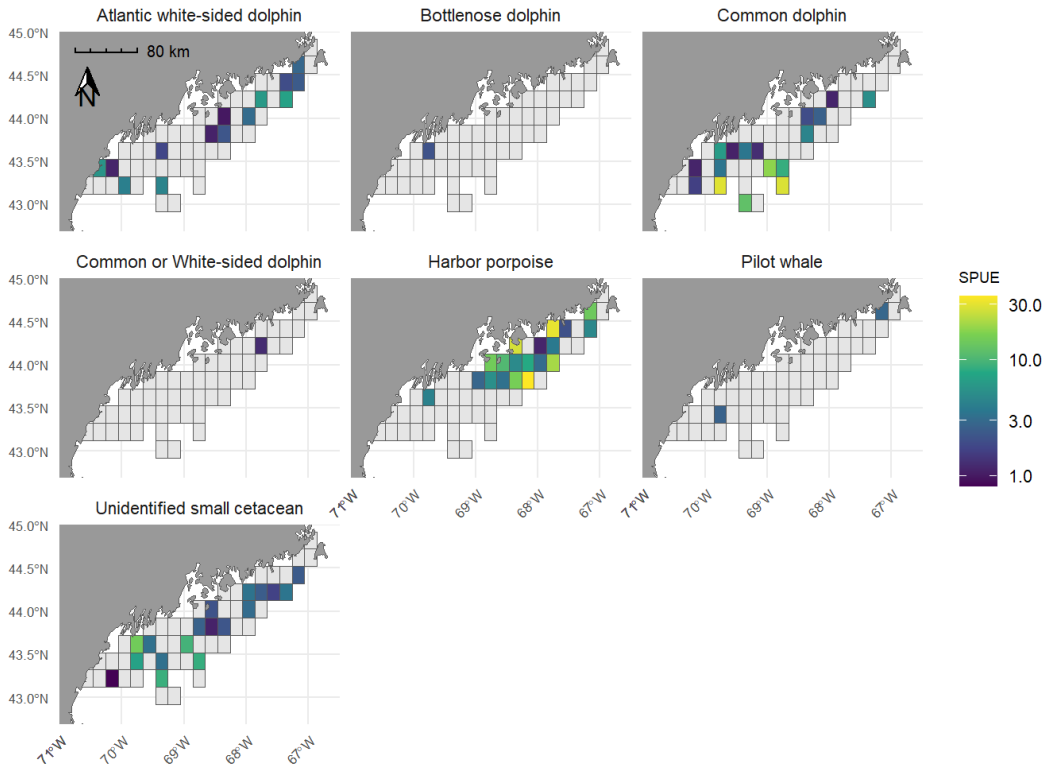


Figure 18. Small Cetacean Sightings Per Unit Effort (SPUE) from Vessel Surveys in 2024 by Species

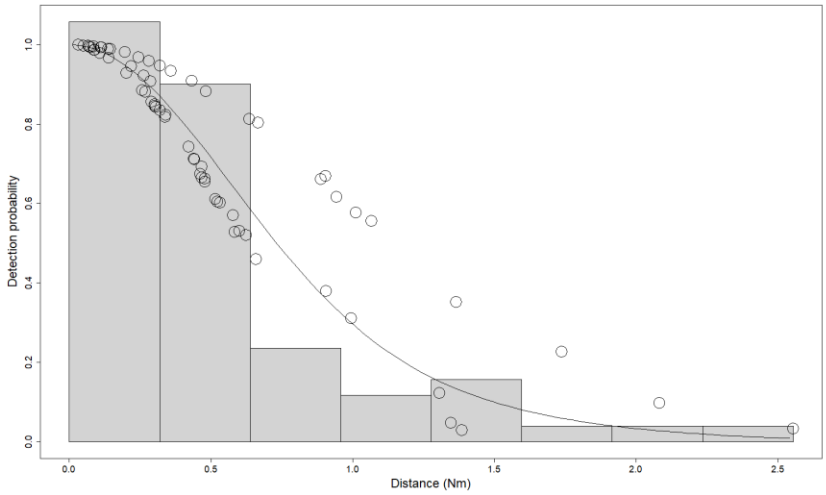


Detection Functions for Large Whales

Aerial Surveys

A total of 33 detection functions were fitted across all possible covariate combinations (**Figure 19**). The distance of the 57 observations included in the aerial modeling ranged from 0.03NM to 2.55NM. The detection function that included glare as a factor and visibility as a continuous variable was the model with the lowest AIC (46.12) and CV (0.129). In this model, the Cramér–von Mises goodness of fit test value was 0.978 and the probability of detection was 0.319 (+/- 0.04 standard error).

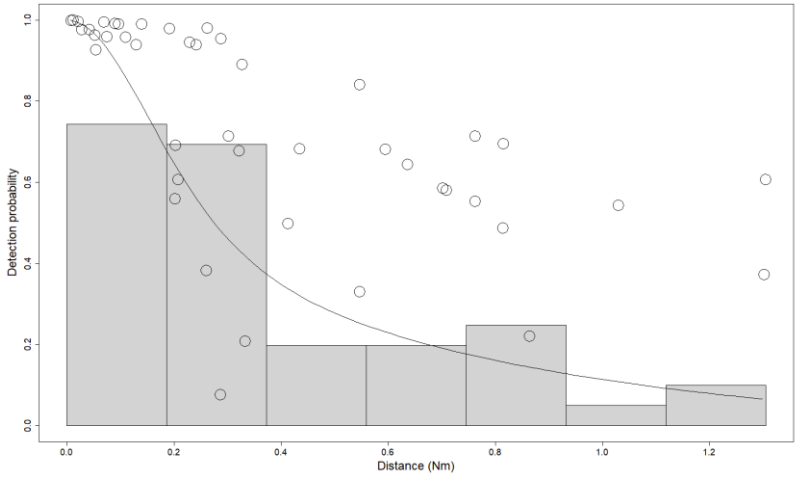
Figure 19. Detection Function, 2024 Aerial Surveys



Vessel Surveys

A total of 28 detection functions were fitted across all possible covariate combinations (**Figure 20**). The distance of the 46 observations included in the aerial modeling ranged from 0.008NM to 1.31NM. The detection function that included glare as a factor and Beaufort sea state as a continuous variable was the model with the lowest AIC (669.97) and CV (0.157). In this model, the Cramér–von Mises goodness of fit test value was 0.471 and the probability of detection was 0.318 (+/- 0.05 standard error).

Figure 20. Detection Function, 2024 Vessel Surveys



Discussion

The Program began efforts to fulfill *Primary Objective 1* by conducting visual surveys from vessel and aerial platforms to collect sightings data for North Atlantic right whales and other marine species in the Gulf of Maine in 2024. The successful completion of the vessel and aerial surveys was a result of substantial coordination between MEDMR and collaborators, the development of protocols and acquisition of equipment, and the mobilization of a successful field team. In total, 50 days of standardized surveys were conducted in 2024 across both aerial and vessel platforms, resulting in 11,986.3km of coverage (**Table 1**). An additional seven days of opportunistic vessel surveys were executed and when combined with opportunistic effort from survey transits totaled 13,516.2km. Additionally, 737.03km of effort was conducted aboard the R/V Hugh R. Sharp in the spring. In this first year of survey, a total of 861 sightings were observed during standardized data collection, including sightings of 107 large or medium whales. An additional 59 large whale sightings were observed during opportunistic efforts, and there were eight sightings of large whales on the R/V Hugh R. Sharp in spring. In the first year of survey, the members of the MEDMR Program successfully initiated and executed survey efforts that have, and will continue to, benefit the research community and improve the understanding of North Atlantic right whale habitat use in the Gulf of Maine.

The only detections of North Atlantic right whales occurred during aerial surveys in November (2): a single animal was observed in the southern Gulf of Maine and a SAG of 8 whales was observed near the Bay of Fundy and Canadian Border (**Table 3**). There were additional detections of North Atlantic right whales in the Gulf of Maine in nearby Canadian waters over Grand Manan Banks by a whale watching vessel in late September (pers comms J. Taylor, Bar Harbor Whale Watch Company). The Northeast Fisheries Science Center followed up on these initial detections with aerial and vessel surveys conducted in Canadian waters. Documented changes to the oceanographic structure in the Gulf of Maine have been observed in recent years (Pershing et al., 2015; Record et al., 2019), and North Atlantic right whales have not been observed as often in the northern Gulf of Maine as in previous years, suggesting a change in distribution (Meyer-Gutbrod et al., 2021; Meyer-Gutbrod et al., 2023). An ocean regime shift in sea surface temperature, which impacted the density and distribution of key North Atlantic right whale prey, was a likely driver of distribution changes out of the Gulf of Maine (Record et al., 2019). However, there is evidence of colder conditions in the Gulf of Maine (Record et al., 2024), indicating the possibility of continued changes in North Atlantic right whale presence in the Gulf of Maine. The sightings observed by the MEDMR surveys, particularly the sighting of 8 whales observed near the Bay of Fundy, are reflective of historical habitat use of North Atlantic right whales in the Gulf of Maine (Baumgartner et al., 2003; Davies et al. 2019). In addition, the central GOM has been evidenced as a potential winter mating ground (Cole et al., 2013), though preliminary individual identifications of the 8 whales indicate that they are all male. Though there were only two sightings of North Atlantic right whales by the Program in the Gulf of Maine, standardized data collection by the Program over time will enable monitoring for distribution shifts.

Large and medium whale detections were lowest from vessel surveys in September, though it appears that the large whale

detections from aerial surveys in September were located offshore and outside of the vessel survey area (**Figure 2**, **Figure 5**). This reduction of sightings in September could be explained by the vessel survey area proximity to shore, as it does not encompass all of the large whale habitat in the Gulf of Maine. The continued data collection by the survey program will allow for observations of interannual variability, as well as monthly and seasonal variability in large whale sightings between years.

When detections were corrected for effort (SPUE), both vessel and aerial surveys showed a peak in large and medium whale presence in July, with lower sighting rates August through December. Aerial survey sighting rates ranged (monthly) from about 0.3 – 1.9 sightings per 100 km flown, while vessel surveys ranged from about 0.5 – 4.5 (**Figures 9 & 12**). The higher detection rates for large whales from vessel surveys demonstrate that though they cover less area, they can provide further refinement of large whale distribution in the inshore Gulf of Maine. Spatially, sighting rates of large and medium whales from aerial surveys were generally further from shore (**Figure 10**), and in the outermost portion of the survey area during vessel surveys (**Figure 13**). Sighting rates depicted monthly from both platforms show some trends in distribution (**Figures 11 & 12**). The seasonality and distribution of large whale species changes from year to year, so these data will serve as a baseline for observing spatial and temporal trends.

On-effort detections of small cetaceans from aerial surveys increased with each month throughout the fall, and on-effort vessel survey detections followed a somewhat similar trend, except for July (**Figures 15 & 17**). Although small cetaceans were clearly easier to identify to species from the vessel, many of the unidentified small cetaceans from aerial surveys could likely be attributed to those most seen from the vessel (harbor porpoise, common dolphin and Atlantic white-sided dolphin). The steady increase in small cetacean sightings with the highest sightings per unit effort in December depicted by aerial survey data seemed unusual when related to the expected seasonal abundance of these animals in the Gulf of Maine. Common dolphins seemed to be high in numbers throughout Maine waters longer than typically observed.

The success of data collection was limited by poor conditions in some months. For vessel surveys, inshore efforts were reduced significantly during the month of August due to heavy fog in the Mid-coast to Downeast regions of the State, which is a well-known challenge in the summer season in the Gulf of Maine. In addition, the surveys that were executed during August had a relatively high Beaufort sea state (3-4). Vessel surveys executed in March, July, and August also exhibited reduced visibility for a portion of the survey effort. For aerial surveys, the total effort was lower in July compared to other months due to limitations in aircraft availability. Surveys were difficult to execute, and the distance covered was limited, in October and December for aerial surveys and August and November for vessel surveys. There was also reduced visibility when surveys could be executed in July, August, and September. The seasonal variation in conditions, particularly fog and sea state, lead to variability in the area covered by surveys between months and seasons. The collection of subsequent data in coming years will improve the range of conditions in which data are collected within and between months and years.

The data collected by the Program will be analyzed to better understand the distribution of North Atlantic right whales in the Gulf of Maine, particularly to identify

high use habitats and temporal variability within and between years. To date, the primary marine mammal models of distribution are based on measures of true density, or the number of animals per a given area, typically because risk to marine mammals is measured as the number of impacted animals, per the MMPA (i.e., a measure of "take"). The first modeling objective was to assess the value and success of the vessel and aerial on effort survey data by developing large whale detection functions. Though the eventual goal is to develop functions for each large whale species, the sample size of large whale sightings included in the detection function in both the vessel (N = 46) and aerial (N = 57) surveys only permitted the development of preliminary multi-species, grouped detection functions, as Buckland et al. (2001) recommends 60-80 detections to build a detection function for line transect data. The histogram of sighting distances for the aerial surveys was an excellent representation of successful distance sampling, with many sightings on, or near, the survey line, with decreasing detections at further distances. The resulting detection function fit the data well. In contrast, the histogram of sightings distances for large whales from the vessel surveys exhibited less variation in sighting numbers by distance, resulting in a more homogeneous distribution. The best fit detection function did a poorer job capturing the distribution of sighting distances in the vessel data compared to the aerial data. This suggests that the detection of animals is relatively similar at near and far distances and could be a result of low sample sizes. Alternatively, some detections close to the track line could have been missed, or there were characteristics of detection between the large whale species that led to a more homogeneous distribution. The model fits will be improved by increasing the sample size of on effort detections in coming years, and by focusing on the development of species-specific detection functions.

Substantial data collection efforts were also undertaken when distance sampling line transect surveys were not doable, due to the prioritization of PAM sampling, poor weather conditions, or response survey efforts. Data were still collected opportunistically, and these data (*opportunistic*) will be incorporated into an integrated model to investigate North Atlantic right whale distributions in the Gulf of Maine using multiple data collection efforts, rather than just the *on effort* distance sampling data. The opportunistic data collected may also be useful for future model validation or for opportunistic-only model development.

The data collected by the Program will be contributed to the pool of data used to develop surface density estimates for North Atlantic right whales in the Gulf of Maine that are currently used in risk assessment analyses to support *Primary Objective 2*. In Southeastern New England, surveys have been conducted since 2011 to further describe the seasonal importance of previously understudied right whale habitats (Leiter et al., 2017; Quintanna-Rizzo et al., 2021; O'Brien et al., 2022). The recent efforts by this Program and others in the Gulf of Maine are a large undertaking, but the resulting detections of NARW in just a few months of survey effort suggests that consistent and frequent survey effort will help us obtain a better understanding of right whale habitat use in the GOM.

The most recent density surface model utilized 20 years of survey data totaling 459,000 km of effort in the GOM (Roberts et al., 2024), and this Program has collected more than 11,000 km of new standardized survey effort over 7 months that can be incorporated into future modeling efforts. Regarding *Primary Objective 3*, data collected by the Program can be used to

inform the development of spatial and temporal management measures with the goal of reducing regulatory impact on the Maine Lobster Fishery by reducing uncertainty when determining areas of entanglement risk. In addition, focusing vessel survey efforts in areas of high gear density will ensure the data collection for regions with high fishing effort is comprehensive. Ongoing visual monitoring from aircraft and vessels by the Program may also support the future design and implementation of dynamic management.

There is no shortage of challenges in the attempt to survey the vast GOM and active footprint of the Maine lobster fishery. The weather in this region is unpredictable nearly year-round due to immense tides, seasonal storms, high winds, and temperature fluctuations. To maximize survey efforts considering these challenges, the Program will issue an RFP for Aviation Services in the spring of 2025 to secure an aircraft for at least half of each month. The Program will also seek to enlist a staff of locally based observers to ensure the team is nimble and can respond to weather opportunities, reported sightings or near real-time acoustic detections with ease. The Program will continue to seek feedback from the research and fishing communities to improve data collection efforts.

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Appendix A. Data Variables & Survey Dates

Table 1. Data Variables, Options and Definitions for Effort Type, Visibility, Glare Angles (Vessel Surveys) and Identification Reliability

Survey Variables	Variable Options	Definition
Effort Type		
	Transit	Travel to/from survey transects
	Start Track	Begin a trackline
	On Track	Continuing on a trackline
	Break - Transit	Break trackline and start Transit
	Break - Approach	Break trackline and investigate sighting in vessel data
	Break - Circling	Break trackline and investigate sighting in aerial data
	Break - Hazard	Break trackline due to a hazzard
	Break - Off Watch	Break trackline and go Off Watch
	Resume Track	Proceed on a previously broken trackline
	End Track - Transit	End a survey trackline and start Transit
	End Track - Crossleg	End a survey trackline and start a Crossleg
	End Track - PAM	End a survey trackline and service a PAM station
	Off Watch	Observers are not keeping watch
Visibility		
	0-7 nm, in 0.5 steps	Used in vessel surveys as the possible sighting distance of the blow of a large whale
	0.5 nm, 1-10 nm in whole steps, 15 nm, 20 nm, 25 nm, 30 nm	Used in aerial surveys as the possible sighting distance of a large whale
Glare angles	0-360°	The absolute compass bearing of the sun's glare on the water surface during a vessel survey. The bearing is taken at both the left and right edge of the glare patch
ID reliability		Confidence of the Observer in a sighting's species identification
	Definite	Indicates a 100% positive species ID
	Probable	Indicates a 'most-likely' species ID
	Possible / Unsure	Indicates a plausible species ID. Removed from reported sightings and all analyses

For more information on data collection variables, see the NARWC database user and contributor guide.

Table 2. 2024 Aerial Survey Dates by Survey Type and Platform

Month	Day	Survey Type	Aircraft or Vessel
March	02	Vessel	M/V Acadia Explorer
March	04	Vessel	M/V Acadia Explorer
March	05	Vessel	M/V Acadia Explorer
March	06	Vessel	M/V Acadia Explorer
March	27	Vessel	R/V Sharp
March	28	Vessel	R/V Sharp
March	31	Vessel	R/V Sharp
April	01	Vessel	R/V Sharp
April	02	Vessel	R/V Sharp
July	07	Aerial	Partenavia AHF8VA
July	08	Aerial	Partenavia AHF8VA
July	17	Vessel	M/V Acadia Explorer
July	18	Vessel	M/V Acadia Explorer
July	19*	Vessel	M/V Acadia Explorer
July	23	Vessel	M/V Acadia Explorer
July	24	Vessel	M/V Acadia Explorer
August	02*	Vessel	M/V Acadia Explorer
August	03*	Vessel	M/V Acadia Explorer
August	11	Aerial	Partenavia AHF8VA
August	13	Aerial	Partenavia AHF8VA
August	14	Aerial	Partenavia AHF8VA
August	17	Aerial	Partenavia AHF8VA
August	22	Vessel	M/V Acadia Explorer
August	23	Vessel	M/V Acadia Explorer
August	27*	Vessel	M/V Acadia Explorer
August	28	Vessel	M/V Acadia Explorer
September	12	Vessel	M/V Acadia Explorer
September	13	Vessel	M/V Acadia Explorer
September	16	Aerial	Partenavia AHF8VA
September	17	Aerial	Partenavia AHF8VA
September	18	Aerial	Partenavia AHF8VA
September	24	Aerial	Partenavia AHF8VA
September	27	Vessel	M/V Acadia Explorer
September	28	Vessel	M/V Acadia Explorer
October	02	Aerial	Partenavia AHF8VA
October	03	Aerial	Partenavia AHF8VA
October	09	Aerial	Partenavia AHF8VA
October	13	Vessel	M/V Acadia Explorer
October	19	Vessel	M/V Acadia Explorer
October	20	Vessel	M/V Acadia Explorer
November	02	Aerial	Partenavia AHF8VA
November	03*	Vessel	M/V Coastal Explorer
November	03	Aerial	Partenavia AHF8VA
November	04	Vessel	M/V Coastal Explorer
November	04	Aerial	Partenavia AHF8VA
November	07	Vessel	M/V Coastal Explorer
November	07	Aerial	Partenavia AHF8VA
November	18	Vessel	M/V Coastal Explorer
November	20*	Vessel	M/V Coastal Explorer
December	02	Vessel	M/V Coastal Explorer
December	03	Vessel	M/V Coastal Explorer
December	09*	Vessel	M/V Coastal Explorer
December	09	Aerial	Partenavia AHF8VA
December	14	Aerial	Partenavia AHF8VA
December	15	Aerial	Partenavia AHF8VA
December	16	Vessel	M/V Coastal Explorer
December	18	Vessel	M/V Coastal Explorer

* Opportunistic Effort Only

Appendix B. Effort by Visibility Distance Figures

Figure 1. 2024 Aerial Survey Effort (On Effort) Distance in Kilometers by Visibility Distance and Month

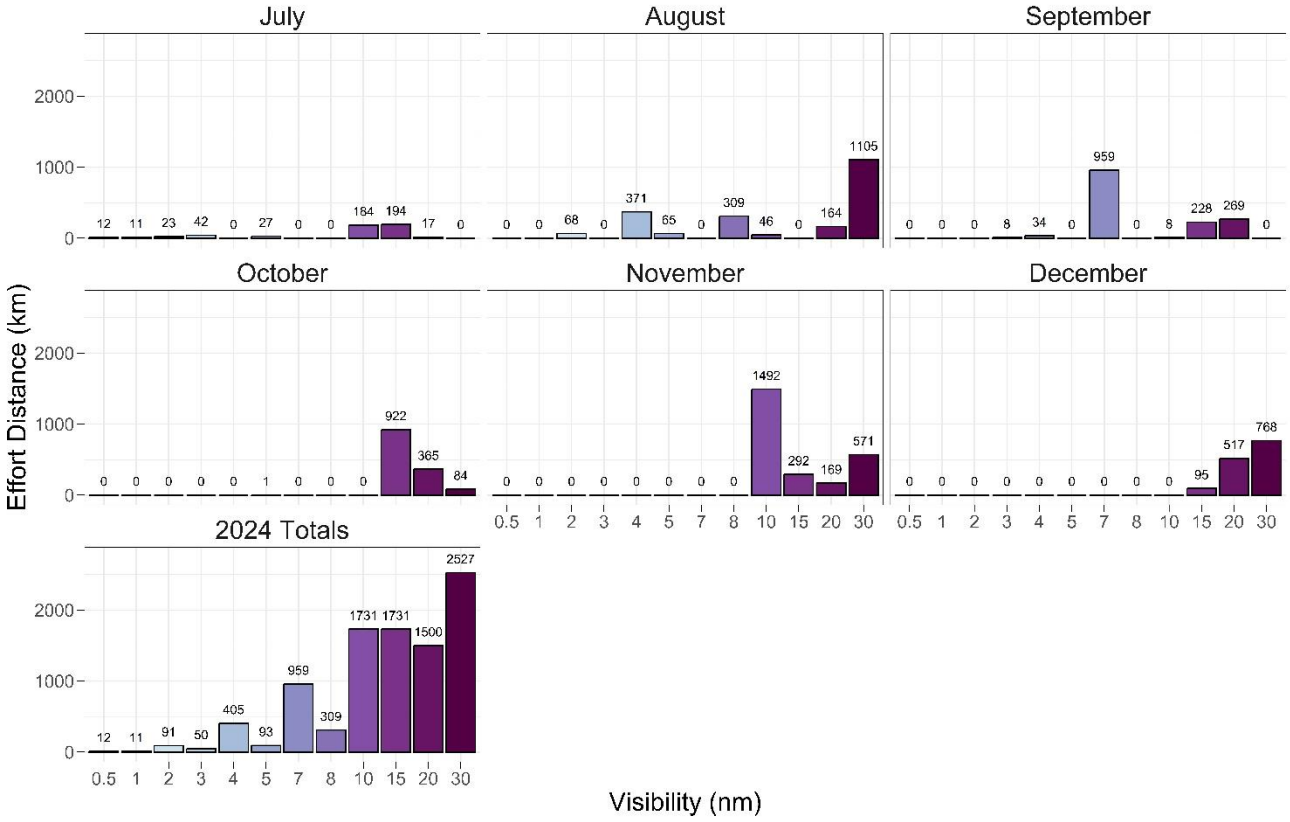
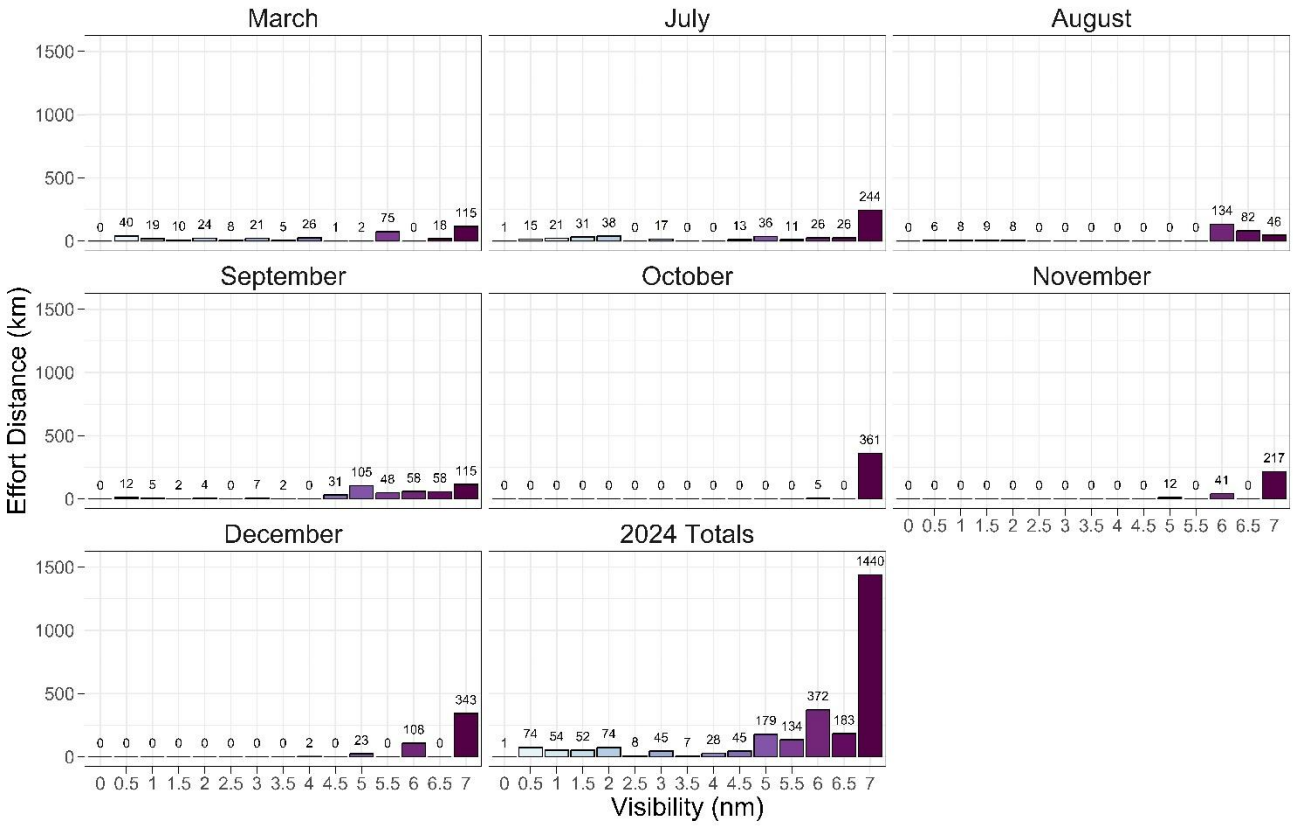


Figure 2. 2024 Vessel Survey Effort (On Effort) Distance in Kilometers by Visibility Distance and Month



Appendix C. Sightings Tables and Figures

Table 1. Aerial Survey *On Effort* Sightings of Species, Number of Animals, and Confidence (+/-) by Month and Season

	July			August			September			October			November			December			2024 Totals		
Species	*Sightings*	*#*	*Conf.*	*Sightings*	*#*	*Conf.*	*Sightings*	*#*	*Conf.*	*Sightings*	*#*	*Conf.*	*Sightings*	*#*	*Conf.*	*Sightings*	*#*	*Conf.*	*Sightings*	*#*	*Conf.*
										Large and Medium Whales											
Fin whale	4	7	+/- 0	9	17	+/- 1	6	8	+/- 0	2	2	+/- 0	3	4	+/- 0	3	6	+/- 0	27	44	+/- 1
Humpback whale	1	2	+/- 0	4	9	+/- 0	4	4	+/- 0	2	3	+/- 1	1	1	+/- 0	4	6	+/- 0	16	25	+/- 1
Minke whale	1	1	+/- 0	2	2	+/- 0	1	1	+/- 0	0	0	+/- 0	0	0	+/- 0	0	0	+/- 0	4	4	+/- 0
North Atlantic right whale	0	0	+/- 0	0	0	+/- 0	0	0	+/- 0	0	0	+/- 0	2	9	+/- 0	0	0	+/- 0	2	9	+/- 0
Sei whale	1	1	+/- 0	0	0	+/- 0	0	0	+/- 0	0	0	+/- 0	0	0	+/- 0	0	0	+/- 0	1	1	+/- 0
Fin or Sei whale	0	0	+/- 0	2	2	+/- 0	2	2	+/- 0	0	0	+/- 0	1	1	+/- 0	0	0	+/- 0	5	5	+/- 0
Unidentified Balaenoptera spp.	1	1	+/- 0	0	0	+/- 0	0	0	+/- 0	2	2	+/- 0	0	0	+/- 0	0	0	+/- 0	3	3	+/- 0
Unidentified large whale	0	0	+/- 0	4	4	+/- 0	1	1	+/- 0	1	1	+/- 0	0	0	+/- 0	1	1	+/- 0	7	7	+/- 0
Unidentified medium whale	0	0	+/- 0	0	0	+/- 0	0	0	+/- 0	0	0	+/- 0	1	1	+/- 0	0	0	+/- 0	1	1	+/- 0
Unidentified rorqual	1	1	+/- 0	0	0	+/- 0	0	0	+/- 0	0	0	+/- 0	0	0	+/- 0	0	0	+/- 0	1	1	+/- 0
Total Large and Medium Whales	**9**	**13**	**+/- 0**	**21**	**34**	**+/- 1**	**14**	**16**	**+/- 0**	**7**	**8**	**+/- 1**	**8**	**16**	**+/- 0**	**8**	**13**	**+/- 0**	**67**	**100**	**+/- 2**
										Small Cetaceans											
Atlantic white-sided dolphin	0	0	+/- 0	5	232	+/- 55	0	0	+/- 0	3	120	+/- 30	3	75	+/- 20	0	0	+/- 0	11	427	+/- 105
Bottlenose dolphin	0	0	+/- 0	0	0	+/- 0	0	0	+/- 0	1	5	+/- 2	0	0	+/- 0	0	0	+/- 0	1	5	+/- 2
Common dolphin	0	0	+/- 0	0	0	+/- 0	0	0	+/- 0	0	0	+/- 0	2	15	+/- 7	11	51	+/- 9	13	66	+/- 16
Harbor porpoise	0	0	+/- 0	1	1	+/- 0	3	17	+/- 4	0	0	+/- 0	1	55	+/- 0	11	18	+/- 2	16	91	+/- 6
Pilot whale	0	0	+/- 0	0	0	+/- 0	4	27	+/- 4	2	17	+/- 4	1	25	+/- 10	1	9	+/- 2	8	78	+/- 20
Unidentified dolphin or porpoise	3	10	+/- 3	23	206	+/- 70	15	128	+/- 37	25	381	+/- 104	32	361	+/- 166	45	246	+/- 59	143	1332	+/- 439
Total Small Cetaceans	**3**	**10**	**+/- 3**	**29**	**439**	**+/- 125**	**22**	**172**	**+/- 45**	**31**	**523**	**+/- 140**	**39**	**531**	**+/- 203**	**68**	**324**	**+/- 72**	**192**	**1999**	**+/- 588**
										Seals											
Gray seal	0	0	+/- 0	0	0	+/- 0	0	0	+/- 0	0	0	+/- 0	0	0	+/- 0	1	1	+/- 0	1	1	+/- 0
Unidentified seal	1	1	+/- 0	7	63	+/- 22	3	3	+/- 0	0	0	+/- 0	1	2	+/- 0	17	28	+/- 2	29	97	+/- 24
Total Seals	**1**	**1**	**+/- 0**	**7**	**63**	**+/- 22**	**3**	**3**	**+/- 0**	**0**	**0**	**+/- 0**	**1**	**2**	**+/- 0**	**18**	**29**	**+/- 2**	**30**	**98**	**+/- 24**
										Fish											
Basking shark	8	8	+/- 0	17	17	+/- 0	23	23	+/- 0	15	15	+/- 0	0	0	+/- 0	1	1	+/- 0	64	64	+/- 0
Ocean sunfish	6	6	+/- 0	48	110	+/- 0	77	182	+/- 0	43	43	+/- 0	0	0	+/- 0	0	0	+/- 0	174	341	+/- 0
School of fish	3	3	+/- 0	1	6	+/- 0	0	0	+/- 0	0	0	+/- 0	0	0	+/- 0	0	0	+/- 0	4	9	+/- 0
Unidentified shark	0	0	+/- 0	0	0	+/- 0	0	0	+/- 0	0	0	+/- 0	0	0	+/- 0	1	1	+/- 0	1	1	+/- 0
Total Fish	**17**	**17**	**+/- 0**	**66**	**133**	**+/- 0**	**100**	**205**	**+/- 0**	**58**	**58**	**+/- 0**	**0**	**0**	**+/- 0**	**2**	**2**	**+/- 0**	**243**	**415**	**+/- 0**
Monthly Total	***30***	***41***	***+/- 3***	***123***	***669***	***+/- 148***	***139***	***396***	***+/- 45***	***96***	***589***	***+/- 141***	***48***	***549***	***+/- 203***	***96***	***368***	***+/- 74***	***532***	***2612***	***+/- 614***

Seasons: Summer | Fall

Table 2. Aerial Survey *Opportunistic* Sightings of Species, Number of Animals, and Confidence (+/-) by Month and Season

	July			August			September			October			November			December			2024 Totals		
Species	*Sightings*	*#*	*Conf.*	*Sightings*	*#*	*Conf.*	*Sightings*	*#*	*Conf.*	*Sightings*	*#*	*Conf.*	*Sightings*	*#*	*Conf.*	*Sightings*	*#*	*Conf.*	*Sightings*	*#*	*Conf.*
								Large & Medium Whales												
Fin whale	3	4	+/- 0	0	0	+/- 0	0	0	+/- 0	1	1	+/- 0	1	1	+/- 0	1	2	+/- 0	6	8	+/- 0
Humpback whale	0	0	+/- 0	1	1	+/- 0	2	3	+/- 0	0	0	+/- 0	1	1	+/- 0	0	0	+/- 0	4	5	+/- 0
Sei whale	1	1	+/- 0	0	0	+/- 0	0	0	+/- 0	0	0	+/- 0	0	0	+/- 0	0	0	+/- 0	1	1	+/- 0
Fin or Sei whale	1	1	+/- 0	0	0	+/- 0	1	1	+/- 0	0	0	+/- 0	0	0	+/- 0	0	0	+/- 0	2	2	+/- 0
Unidentified large whale	1	1	+/- 0	0	0	+/- 0	0	0	+/- 0	0	0	+/- 0	1	2	+/- 0	1	1	+/- 0	3	4	+/- 0
Unidentified medium whale	1	1	+/- 0	0	0	+/- 0	0	0	+/- 0	0	0	+/- 0	0	0	+/- 0	0	0	+/- 0	1	1	+/- 0
Total Large and Medium Whales	**7**	**8**	**+/- 0**	**1**	**1**	**+/- 0**	**3**	**4**	**+/- 0**	**1**	**1**	**+/- 0**	**3**	**4**	**+/- 0**	**2**	**3**	**+/- 0**	**17**	**21**	**+/- 0**
								Small Cetaceans												
Atlantic white-sided dolphin	0	0	+/- 0	1	7	+/- 2	0	0	+/- 0	0	0	+/- 0	1	15	+/- 10	0	0	+/- 0	2	22	+/- 12
Bottlenose dolphin	0	0	+/- 0	0	0	+/- 0	1	7	+/- 2	0	0	+/- 0	0	0	+/- 0	0	0	+/- 0	1	7	+/- 2
Pilot whale	0	0	+/- 0	0	0	+/- 0	2	28	+/- 7	0	0	+/- 0	0	0	+/- 0	1	8	+/- 0	3	36	+/- 7
Common or Atlantic white-sided dolphin	1	30	+/- 10	0	0	+/- 0	0	0	+/- 0	0	0	+/- 0	0	0	+/- 0	0	0	+/- 0	1	30	+/- 10
Unidentified dolphin or porpoise	1	10	+/- 5	3	80	+/- 29	5	85	+/- 20	0	0	+/- 0	4	145	+/- 22	2	3	+/- 0	15	323	+/- 76
Total Small Cetaceans	**2**	**40**	**+/- 15**	**4**	**87**	**+/- 31**	**8**	**120**	**+/- 29**	**0**	**0**	**+/- 0**	**5**	**160**	**+/- 32**	**3**	**11**	**+/- 0**	**22**	**418**	**+/- 107**
								Seals												
Unidentified seal	0	0	+/- 0	0	0	+/- 0	1	6	+/- 0	0	0	+/- 0	0	0	+/- 0	0	0	+/- 0	1	6	+/- 0
Total Seals	**0**	**0**	**+/- 0**	**0**	**0**	**+/- 0**	**1**	**6**	**+/- 0**	**0**	**0**	**+/- 0**	**0**	**0**	**+/- 0**	**0**	**0**	**+/- 0**	**1**	**6**	**+/- 0**
								Turtles												
Leatherback turtle	1	1	+/- 0	0	0	+/- 0	0	0	+/- 0	0	0	+/- 0	0	0	+/- 0	0	0	+/- 0	1	1	+/- 0
Unidentified turtle	1	1	+/- 0	0	0	+/- 0	0	0	+/- 0	0	0	+/- 0	0	0	+/- 0	0	0	+/- 0	1	1	+/- 0
Total Turtles	**2**	**2**	**+/- 0**	**0**	**0**	**+/- 0**	**0**	**0**	**+/- 0**	**0**	**0**	**+/- 0**	**0**	**0**	**+/- 0**	**0**	**0**	**+/- 0**	**2**	**2**	**+/- 0**
								Fish												
Basking shark	2	2	+/- 0	1	1	+/- 0	5	5	+/- 0	0	0	+/- 0	0	0	+/- 0	0	0	+/- 0	8	8	+/- 0
Ocean sunfish	3	3	+/- 0	3	3	+/- 0	7	13	+/- 0	0	0	+/- 0	0	0	+/- 0	0	0	+/- 0	13	19	+/- 0
School of fish	13	26	+/- 0	1	15	+/- 10	0	0	+/- 0	0	0	+/- 0	0	0	+/- 0	0	0	+/- 0	14	41	+/- 10
Unidentified shark	1	1	+/- 0	0	0	+/- 0	0	0	+/- 0	0	0	+/- 0	0	0	+/- 0	0	0	+/- 0	1	1	+/- 0
Total Fish	**19**	**32**	**+/- 0**	**5**	**19**	**+/- 10**	**12**	**18**	**+/- 0**	**0**	**0**	**+/- 0**	**0**	**0**	**+/- 0**	**0**	**0**	**+/- 0**	**36**	**69**	**+/- 10**
Monthly Total	***30***	***82***	***+/- 15***	***10***	***107***	***+/- 41***	***24***	***148***	***+/- 29***	***1***	***1***	***+/- 0***	***8***	***164***	***+/- 32***	***5***	***14***	***+/- 0***	***78***	***516***	***+/- 117***

Seasons: Summer | Fall

Figure 1. *Opportunistic* Large and Medium Whale Sightings from Aerial Surveys July – December, 2024

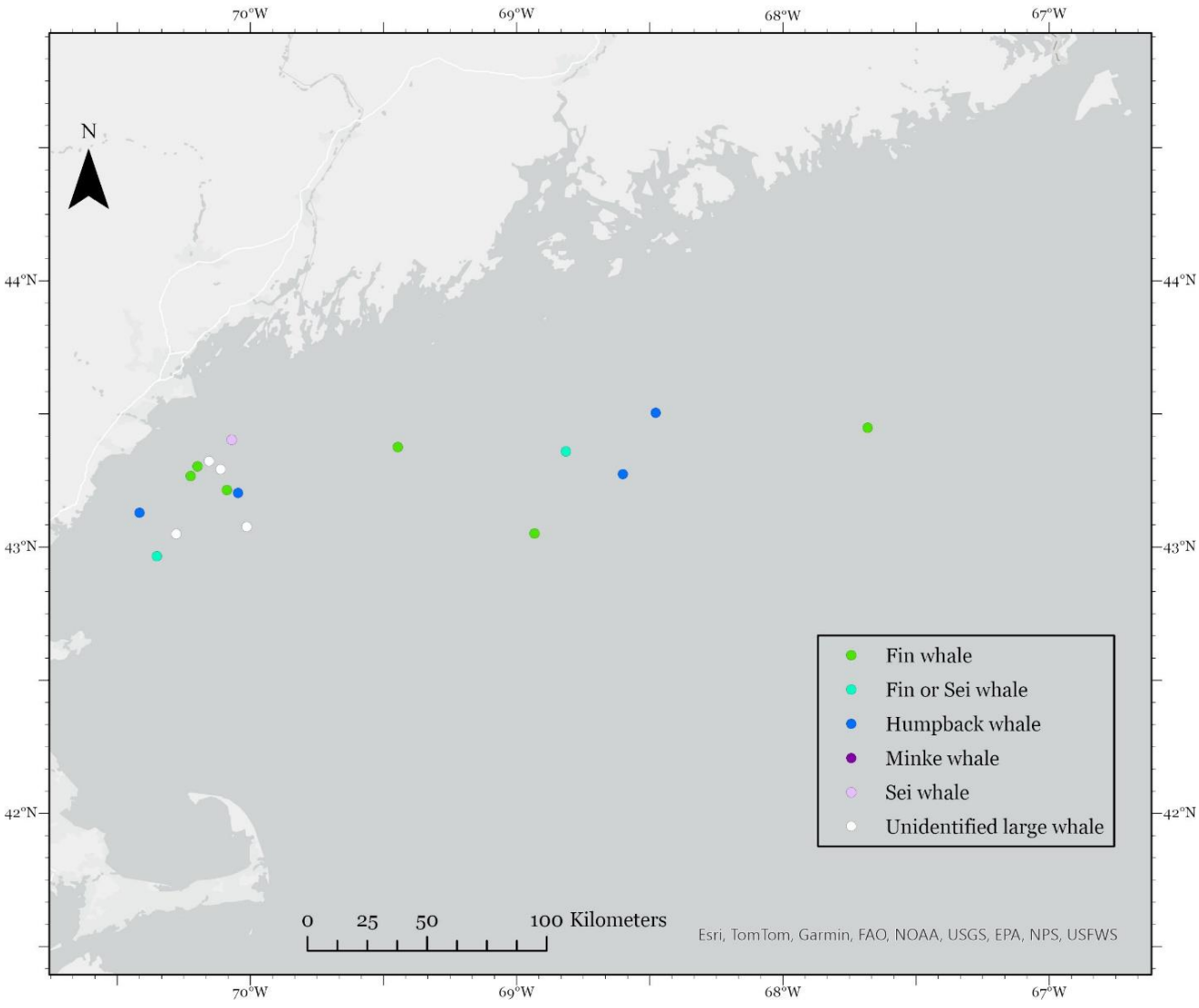


Figure 2. *Opportunistic* Small Cetacean Sightings from Aerial Surveys July – December, 2024

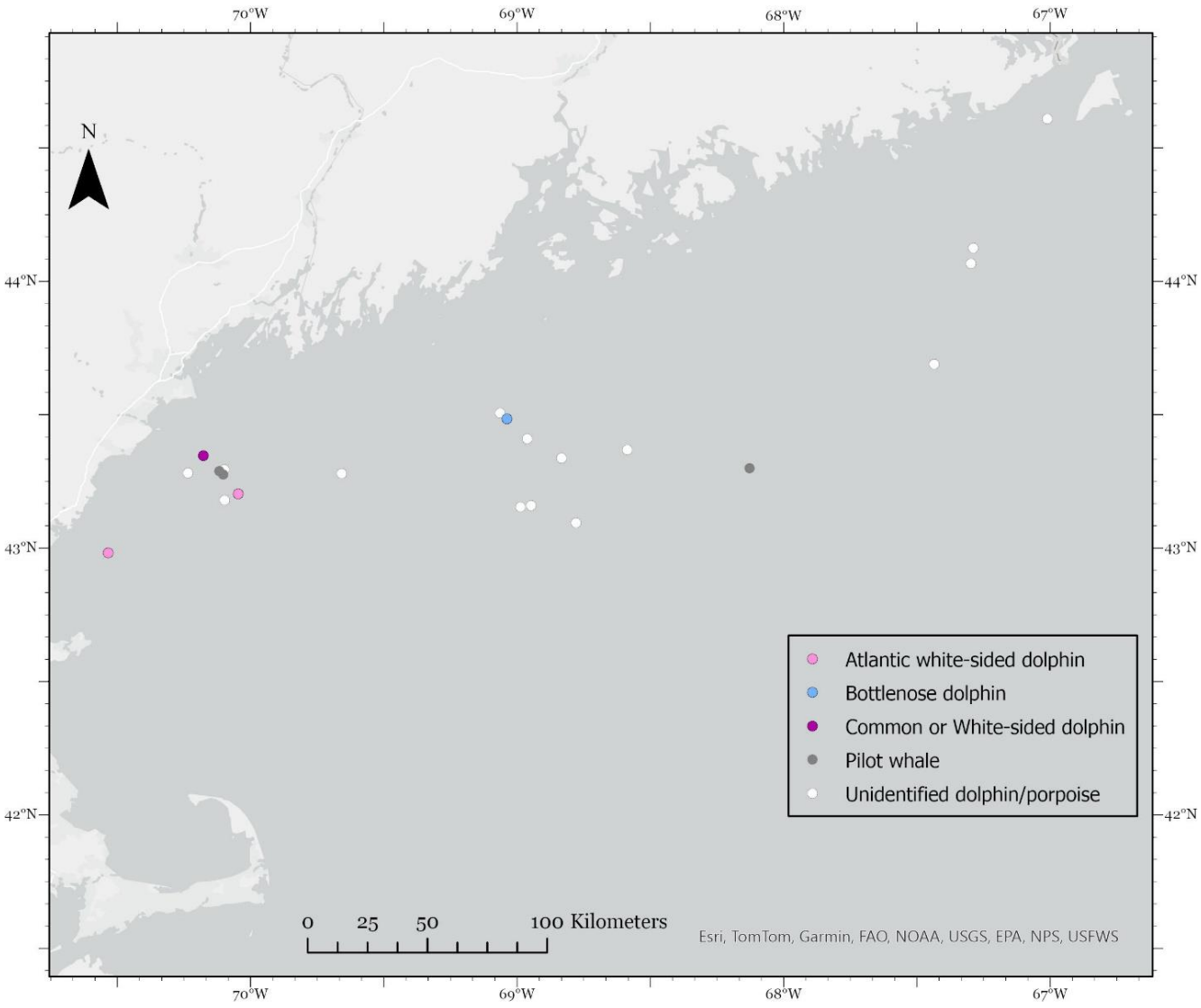


Table 3. Vessel Survey *On Effort* Sightings of Species, Number of Animals, and Confidence (+/-) by Month and Season

	March			July			August			September			October			November			December			2024 Totals		
Species	*Sightings*	*#*	*Conf.*	*Sightings*	*#*	*Conf.*	*Sightings*	*#*	*Conf.*	*Sightings*	*#*	*Conf.*	*Sightings*	*#*	*Conf.*	*Sightings*	*#*	*Conf.*	*Sightings*	*#*	*Conf.*	*Sightings*	*#*	*Conf.*
										Large & Medium Whales													
Fin whale	0	0	+/- 0	6	11	+/- 11	3	7	+/- 2	0	0	+/- 0	0	0	+/- 0	2	3	+/- 1	0	0	+/- 0	11	21	+/- 14
Humpback whale	0	0	+/- 0	2	2	+/- 0	2	2	+/- 1	1	1	+/- 0	3	5	+/- 0	2	6	+/- 0	3	4	+/- 0	13	20	+/- 1
Minke whale	0	0	+/- 0	9	9	+/- 0	0	0	+/- 0	0	0	+/- 0	2	2	+/- 0	0	0	+/- 0	1	1	+/- 0	12	12	+/- 0
Sei whale	0	0	+/- 0	3	4	+/- 1	0	0	+/- 0	0	0	+/- 0	0	0	+/- 0	0	0	+/- 0	0	0	+/- 0	3	4	+/- 1
Fin or Sei whale	0	0	+/- 0	0	0	+/- 0	1	1	+/- 0	0	0	+/- 0	1	1	+/- 0	0	0	+/- 0	0	0	+/- 0	2	2	+/- 0
Unidentified Balaenoptera spp.	0	0	+/- 0	0	0	+/- 0	1	1	+/- 0	0	0	+/- 0	0	0	+/- 0	0	0	+/- 0	0	0	+/- 0	1	1	+/- 0
Unidentified large whale	0	0	+/- 0	0	0	+/- 0	0	0	+/- 0	0	0	+/- 0	0	0	+/- 0	2	3	+/- 0	0	0	+/- 0	2	3	+/- 0
Unidentified medium whale	0	0	+/- 0	0	0	+/- 0	0	0	+/- 0	1	1	+/- 0	0	0	+/- 0	0	0	+/- 0	0	0	+/- 0	1	1	+/- 0
Unidentified rorqual	0	0	+/- 0	1	1	+/- 2	1	1	+/- 0	0	0	+/- 0	0	0	+/- 0	0	0	+/- 0	0	0	+/- 0	2	2	+/- 2
Total Large and Medium Whales	**0**	**0**	**+/- 0**	**21**	**27**	**+/- 14**	**8**	**12**	**+/- 3**	**2**	**2**	**+/- 0**	**6**	**8**	**+/- 0**	**6**	**12**	**+/- 1**	**4**	**5**	**+/- 0**	**47**	**66**	**+/- 18**
										Small Cetaceans													
Atlantic white-sided dolphin	0	0	+/- 0	13	71	+/- 12	3	70	+/- 12	1	10	+/- 5	3	14	+/- 6	2	19	+/- 0	1	1	+/- 0	23	185	+/- 35
Bottlenose dolphin	0	0	+/- 0	0	0	+/- 0	0	0	+/- 0	0	0	+/- 0	1	2	+/- 1	0	0	+/- 0	0	0	+/- 0	1	2	+/- 1
Common dolphin	0	0	+/- 0	1	8	+/- 1	1	35	+/- 10	0	0	+/- 0	5	58	+/- 16	16	128	+/- 9	10	83	+/- 23	33	312	+/- 59
Harbor porpoise	3	3	+/- 0	40	87	+/- 10	4	8	+/- 2	16	42	+/- 13	8	23	+/- 7	0	0	+/- 0	1	1	+/- 1	72	164	+/- 33
Pilot whale	0	0	+/- 0	0	0	+/- 0	0	0	+/- 0	2	12	+/- 0	2	4	+/- 1	0	0	+/- 0	0	0	+/- 0	4	16	+/- 1
Common or Atlantic white-sided dolphin	0	0	+/- 0	1	4	+/- 0	0	0	+/- 0	0	0	+/- 0	0	0	+/- 0	0	0	+/- 0	0	0	+/- 0	1	4	+/- 0
Unidentified dolphin or porpoise	1	1	+/- 0	4	5	+/- 0	0	0	+/- 0	10	68	+/- 11	8	38	+/- 15	14	72	+/- 8	6	20	+/- 0	43	204	+/- 34
Total Small Cetaceans	**4**	**4**	**+/- 0**	**59**	**175**	**+/- 23**	**8**	**113**	**+/- 24**	**29**	**132**	**+/- 29**	**27**	**139**	**+/- 46**	**32**	**219**	**+/- 17**	**18**	**105**	**+/- 24**	**177**	**887**	**+/- 163**
										Seals														
Gray seal	1	1	+/- 0	4	4	+/- 0	0	0	+/- 0	3	3	+/- 0	0	0	+/- 0	1	1	+/- 0	1	1	+/- 0	10	10	+/- 0
Harbor seal	1	1	+/- 0	13	13	+/- 0	5	7	+/- 0	10	24	+/- 0	2	2	+/- 0	2	2	+/- 0	1	1	+/- 0	34	50	+/- 0
Unidentified seal	2	2	+/- 0	2	2	+/- 0	1	1	+/- 0	1	1	+/- 0	0	0	+/- 0	2	2	+/- 0	1	1	+/- 0	9	9	+/- 0
Total Seals	**4**	**4**	**+/- 0**	**19**	**19**	**+/- 0**	**6**	**8**	**+/- 0**	**14**	**28**	**+/- 0**	**2**	**2**	**+/- 0**	**5**	**5**	**+/- 0**	**3**	**3**	**+/- 0**	**53**	**69**	**+/- 0**
										Fish														
Basking shark	0	0	+/- 0	6	6	+/- 0	3	3	+/- 0	1	1	+/- 0	0	0	+/- 0	0	0	+/- 0	0	0	+/- 0	10	10	+/- 0
Ocean sunfish	0	0	+/- 0	40	58	+/- 2	20	31	+/- 0	1	1	+/- 0	0	0	+/- 0	0	0	+/- 0	0	0	+/- 0	61	90	+/- 2
Tuna	0	0	+/- 0	4	12	+/- 30	3	5	+/- 0	0	0	+/- 0	0	0	+/- 0	0	0	+/- 0	0	0	+/- 0	7	17	+/- 30
Unidentified shark	0	0	+/- 0	1	1	+/- 0	1	1	+/- 0	1	1	+/- 0	1	1	+/- 0	0	0	+/- 0	0	0	+/- 0	4	4	+/- 0
Total Fish	**0**	**0**	**+/- 0**	**51**	**77**	**+/- 32**	**27**	**40**	**+/- 0**	**3**	**3**	**+/- 0**	**1**	**1**	**+/- 0**	**0**	**0**	**+/- 0**	**0**	**0**	**+/- 0**	**82**	**121**	**+/- 32**
Monthly Total	***8***	***8***	***+/- 0***	***150***	***298***	***+/- 69***	***49***	***173***	***+/- 27***	***48***	***165***	***+/- 29***	***36***	***150***	***+/- 46***	***43***	***236***	***+/- 18***	***25***	***113***	***+/- 24***	***359***	***1143***	***+/- 213***

Seasons: Winter | Summer | Fall

Table 4. Vessel Survey *Opportunistic* Sightings of Species, Number of Animals, and Confidence (+/-) by Month and Season

	March			July			August			September			October			November			December			2024 Totals		
Species	*Sightings*	*#*	*Conf.*	*Sightings*	*#*	*Conf.*	*Sightings*	*#*	*Conf.*	*Sightings*	*#*	*Conf.*	*Sightings*	*#*	*Conf.*	*Sightings*	*#*	*Conf.*	*Sightings*	*#*	*Conf.*	*Sightings*	*#*	*Conf.*
										Large & Medium Whales													
Fin whale	0	0	+/- 0	4	4	+/- 0	0	0	+/- 0	0	0	+/- 0	0	0	+/- 0	3	3	+/- 0	1	1	+/- 0	8	8	+/- 0
Humpback whale	0	0	+/- 0	3	4	+/- 0	4	10	+/- 0	0	0	+/- 0	0	0	+/- 0	2	3	+/- 1	4	6	+/- 0	13	23	+/- 1
Minke whale	0	0	+/- 0	0	0	+/- 0	2	2	+/- 0	0	0	+/- 0	1	1	+/- 0	3	3	+/- 0	0	0	+/- 0	6	6	+/- 0
Sei whale	0	0	+/- 0	1	2	+/- 1	1	1	+/- 0	0	0	+/- 0	0	0	+/- 0	0	0	+/- 0	0	0	+/- 0	2	3	+/- 1
Fin or Sei whale	0	0	+/- 0	0	0	+/- 0	0	0	+/- 0	1	2	+/- 1	0	0	+/- 0	2	3	+/- 0	0	0	+/- 0	3	5	+/- 1
Unidentified Balaenoptera spp.	0	0	+/- 0	0	0	+/- 0	0	0	+/- 0	0	0	+/- 0	0	0	+/- 0	1	1	+/- 0	0	0	+/- 0	1	1	+/- 0
Unidentified large whale	0	0	+/- 0	2	2	+/- 0	1	3	+/- 2	2	3	+/- 1	0	0	+/- 0	1	2	+/- 0	3	3	+/- 0	9	13	+/- 3
Total Large and Medium Whales	**0**	**0**	**+/- 0**	**10**	**12**	**+/- 1**	**8**	**16**	**+/- 2**	**3**	**5**	**+/- 2**	**1**	**1**	**+/- 0**	**12**	**15**	**+/- 1**	**8**	**10**	**+/- 0**	**42**	**59**	**+/- 6**
										Small Cetaceans													
Atlantic white-sided dolphin	0	0	+/- 0	2	5	+/- 0	3	34	+/- 10	0	0	+/- 0	0	0	+/- 0	6	26	+/- 8	0	0	+/- 0	11	65	+/- 18
Common dolphin	0	0	+/- 0	0	0	+/- 0	3	106	+/- 37	0	0	+/- 0	0	0	+/- 0	18	215	+/- 52	5	101	+/- 14	26	422	+/- 103
Harbor porpoise	0	0	+/- 0	9	16	+/- 4	5	12	+/- 3	5	17	+/- 1	5	18	+/- 7	7	16	+/- 2	3	4	+/- 0	34	83	+/- 17
Pilot whale	0	0	+/- 0	0	0	+/- 0	1	18	+/- 5	1	10	+/- 2	0	0	+/- 0	1	40	+/- 10	1	8	+/- 1	4	76	+/- 18
Common or Atlantic white-sided dolphin	0	0	+/- 0	0	0	+/- 0	0	0	+/- 0	0	0	+/- 0	0	0	+/- 0	0	0	+/- 0	5	28	+/- 5	5	28	+/- 5
Unidentified dolphin or porpoise	0	0	+/- 0	1	3	+/- 0	7	43	+/- 3	0	0	+/- 0	1	3	+/- 1	18	119	+/- 27	4	8	+/- 0	31	176	+/- 31
Total Small Cetaceans	**0**	**0**	**+/- 0**	**12**	**24**	**+/- 4**	**19**	**213**	**+/- 58**	**6**	**27**	**+/- 3**	**6**	**21**	**+/- 8**	**50**	**416**	**+/- 99**	**18**	**149**	**+/- 20**	**111**	**850**	**+/- 192**
										Seals														
Gray seal	0	0	+/- 0	1	1	+/- 0	2	2	+/- 0	0	0	+/- 0	0	0	+/- 0	2	2	+/- 0	4	73	+/- 25	9	78	+/- 25
Harbor seal	3	3	+/- 0	2	2	+/- 0	3	27	+/- 5	1	1	+/- 0	0	0	+/- 0	3	3	+/- 0	2	11	+/- 0	14	47	+/- 5
Harp seal	1	1	+/- 0	0	0	+/- 0	0	0	+/- 0	0	0	+/- 0	0	0	+/- 0	0	0	+/- 0	0	0	+/- 0	1	1	+/- 0
Unidentified seal	*0*	*0*	*+/- 0*	*1*	*1*	*+/- 0*	*6*	*55*	*+/- 10*	*0*	*0*	*+/- 0*	*0*	*0*	*+/- 0*	*0*	*0*	*+/- 0*	*1*	*1*	*+/- 0*	*8*	*57*	*+/- 10*
Total Seals	**4**	**4**	**+/- 0**	**4**	**4**	**+/- 0**	**11**	**84**	**+/- 15**	**1**	**1**	**+/- 0**	**0**	**0**	**+/- 0**	**5**	**5**	**+/- 0**	**7**	**85**	**+/- 25**	**32**	**183**	**+/- 40**
										Turtles														
Leatherback turtle	0	0	+/- 0	1	1	+/- 0	0	0	+/- 0	0	0	+/- 0	0	0	+/- 0	0	0	+/- 0	0	0	+/- 0	1	1	+/- 0
Total Turtles	**0**	**0**	**+/- 0**	**1**	**1**	**+/- 0**	**0**	**0**	**+/- 0**	**0**	**0**	**+/- 0**	**0**	**0**	**+/- 0**	**0**	**0**	**+/- 0**	**0**	**0**	**+/- 0**	**1**	**1**	**+/- 0**
										Fish														
Basking shark	0	0	+/- 0	1	1	+/- 0	4	5	+/- 0	0	0	+/- 0	0	0	+/- 0	0	0	+/- 0	0	0	+/- 0	5	6	+/- 0
Blue shark	0	0	+/- 0	0	0	+/- 0	2	2	+/- 0	0	0	+/- 0	0	0	+/- 0	0	0	+/- 0	0	0	+/- 0	2	2	+/- 0
Ocean sunfish	0	0	+/- 0	2	2	+/- 0	5	18	+/- 2	0	0	+/- 0	0	0	+/- 0	0	0	+/- 0	0	0	+/- 0	7	20	+/- 2
Tuna	0	0	+/- 0	1	1	+/- 0	3	4	+/- 0	0	0	+/- 0	0	0	+/- 0	0	0	+/- 0	0	0	+/- 0	4	5	+/- 0
Total Fish	**0**	**0**	**+/- 0**	**4**	**4**	**+/- 0**	**14**	**29**	**+/- 2**	**0**	**0**	**+/- 0**	**0**	**0**	**+/- 0**	**0**	**0**	**+/- 0**	**0**	**0**	**+/- 0**	**18**	**33**	**+/- 2**
Monthly Total	***4***	***4***	***+/- 0***	***31***	***45***	***+/- 5***	***52***	***342***	***+/- 77***	***10***	***33***	***+/- 5***	***7***	***22***	***+/- 8***	***67***	***436***	***+/- 100***	***33***	***244***	***+/- 45***	***204***	***1126***	***+/- 240***

Seasons: Winter | Summer | Fall

Table 5. R/V Sharp Vessel Survey Sightings of Species, Number of Animals, and Confidence (+/-) by Month and Season

	March			April			2024 Totals		
Species	*Sightings*	*#*	*Conf.*	*Sightings*	*#*	*Conf.*	*Sightings*	*#*	*Conf.*
				Large and Medium Whales					
Fin whale	0	0	+/- 0	2	6	+/- 0	2	6	+/- 0
Unidentified Balaenoptera spp.	1	1	+/- 0	4	5	+/- 1	5	6	+/- 1
Unidentified large whale	1	1	+/- 1	0	0	+/- 0	1	1	+/- 1
Total Large and Medium Whales	**2**	**2**	**+/- 1**	**6**	**11**	**+/- 1**	**8**	**13**	**+/- 2**
				Small Cetaceans					
Atlantic white-sided dolphin	0	0	+/- 0	3	8	+/- 2	3	8	+/- 2
Common dolphin	2	19	+/- 26	0	0	+/- 0	2	19	+/- 26
Harbor porpoise	5	14	+/- 29	12	12	+/- 2	17	26	+/- 31
Common or Atlantic white-sided dolphin	1	2	+/- 1	0	0	+/- 0	1	2	+/- 1
Unidentified dolphin or porpoise	3	4	+/- 2	7	9	+/- 7	10	13	+/- 9
Total Small Cetaceans	**11**	**39**	**+/- 58**	**22**	**29**	**+/- 11**	**33**	**68**	**+/- 69**
				Seals					
Gray seal	1	1	+/- 0	1	1	+/- 0	2	2	+/- 0
Harbor seal	6	6	+/- 0	1	1	+/- 1	7	7	+/- 1
Harp seal	1	1	+/- 0	0	0	+/- 0	1	1	+/- 0
Unidentified seal	6	6	+/- 2	5	6	+/- 2	11	12	+/- 4
Total Seals	**14**	**14**	**+/- 2**	**7**	**8**	**+/- 3**	**21**	**22**	**+/- 5**
				Fish					
Ocean sunfish	1	NA	NA	0	0	+/- 0	1	0	+/- 0
Total Fish	**1**	**NA**	**NA**	**0**	**0**	**+/- 0**	**1**	**0**	**+/- 0**
Monthly Total	***28***	***55***	***+/- 61***	***35***	***48***	***+/- 15***	***63***	***103***	***+/- 76***

Seasons: Winter | Spring

Figure 3. *Opportunistic* Large and Medium Whale Sightings from Aerial Surveys July – December, 2024

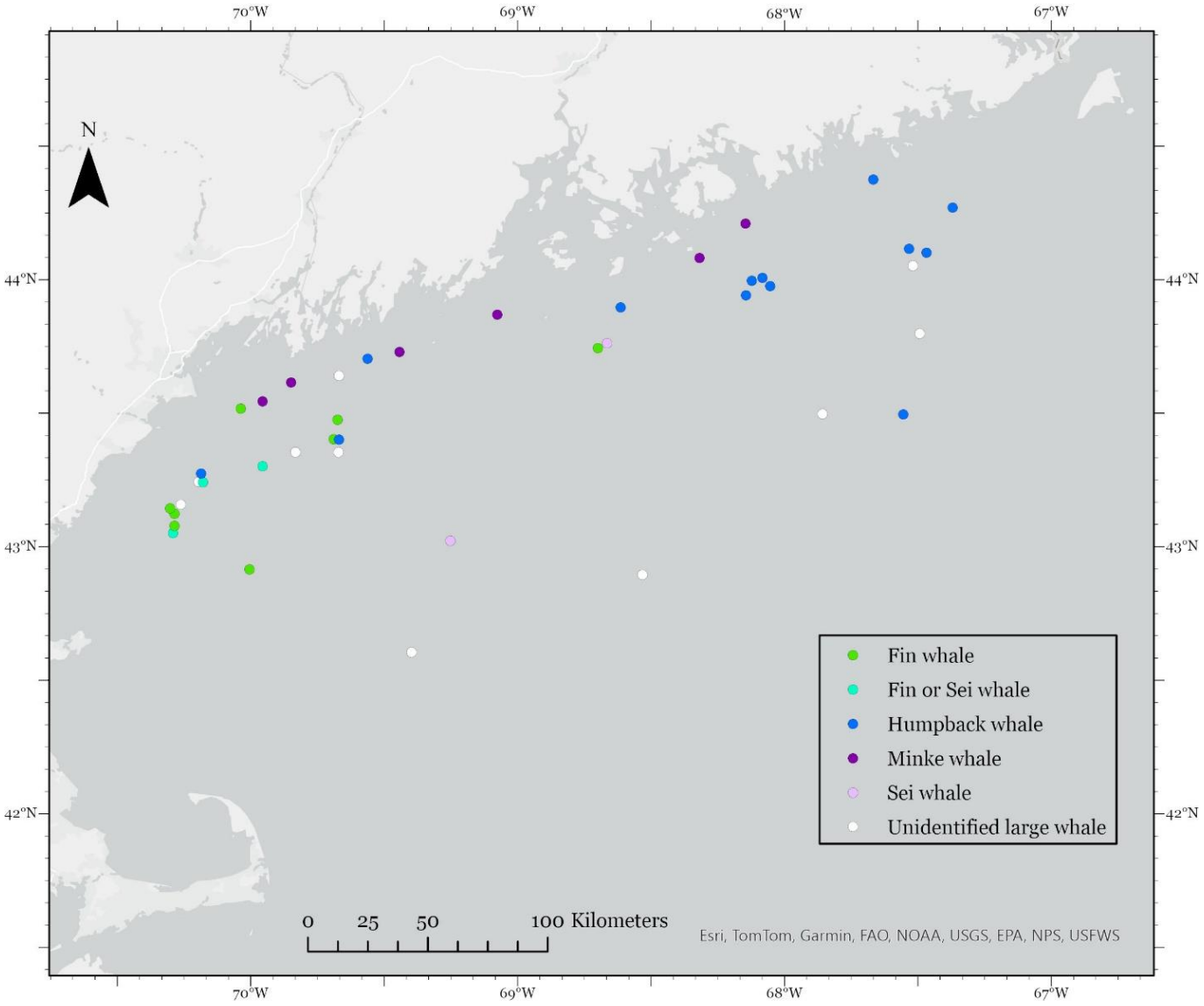


Figure 4. Opportunistic Small Cetacean Sightings from Aerial Surveys July – December 2024

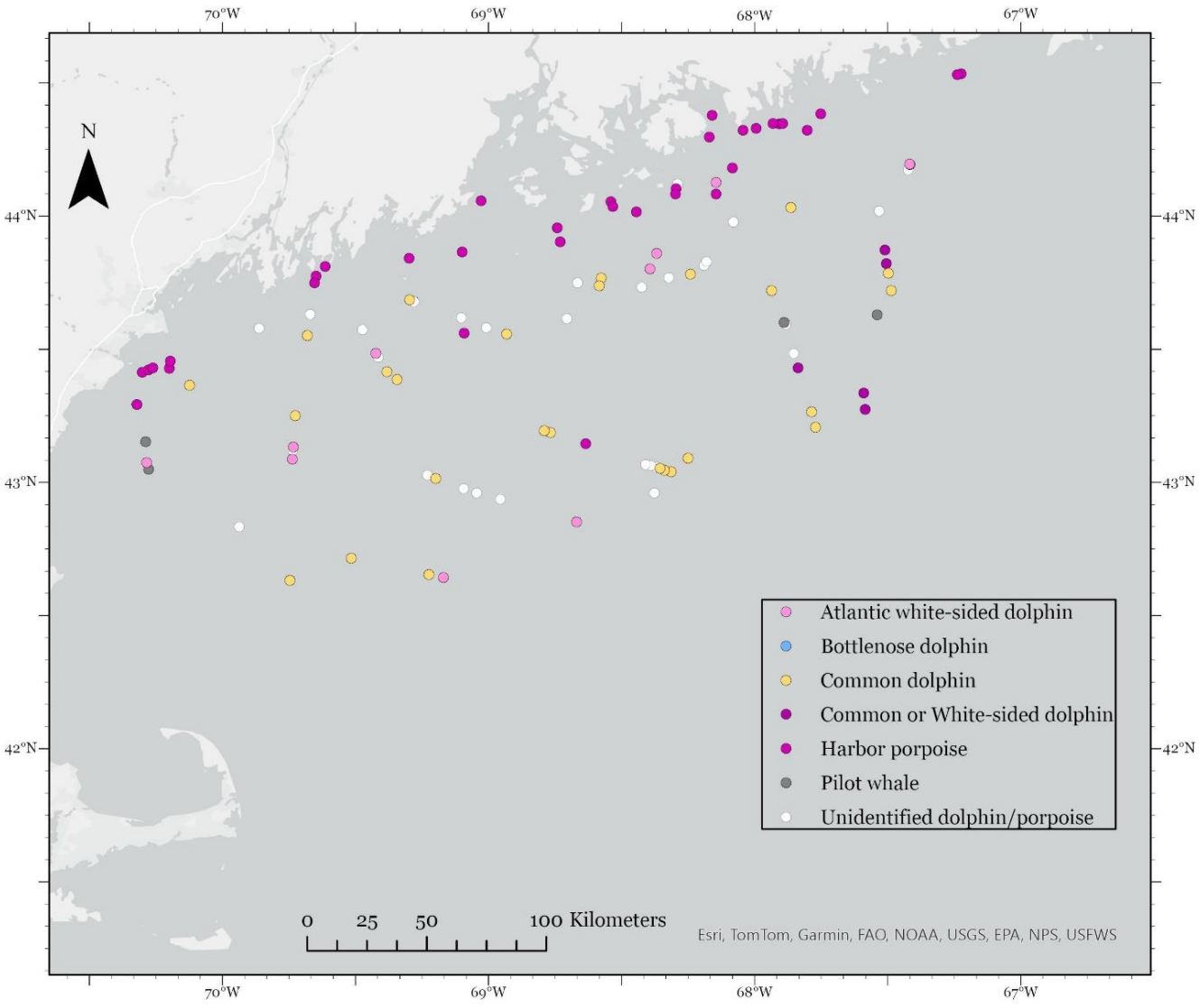


Figure 5. Sighting Rates of Seals from Aerial Surveys July – December 2024

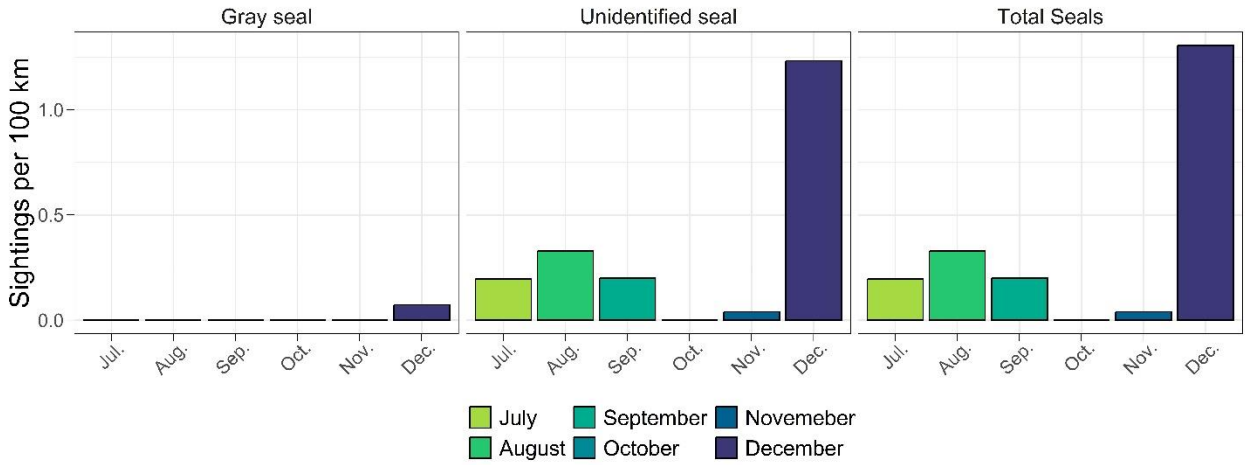


Figure 6. Sighting Rates of Seals from Vessel Surveys in 2024

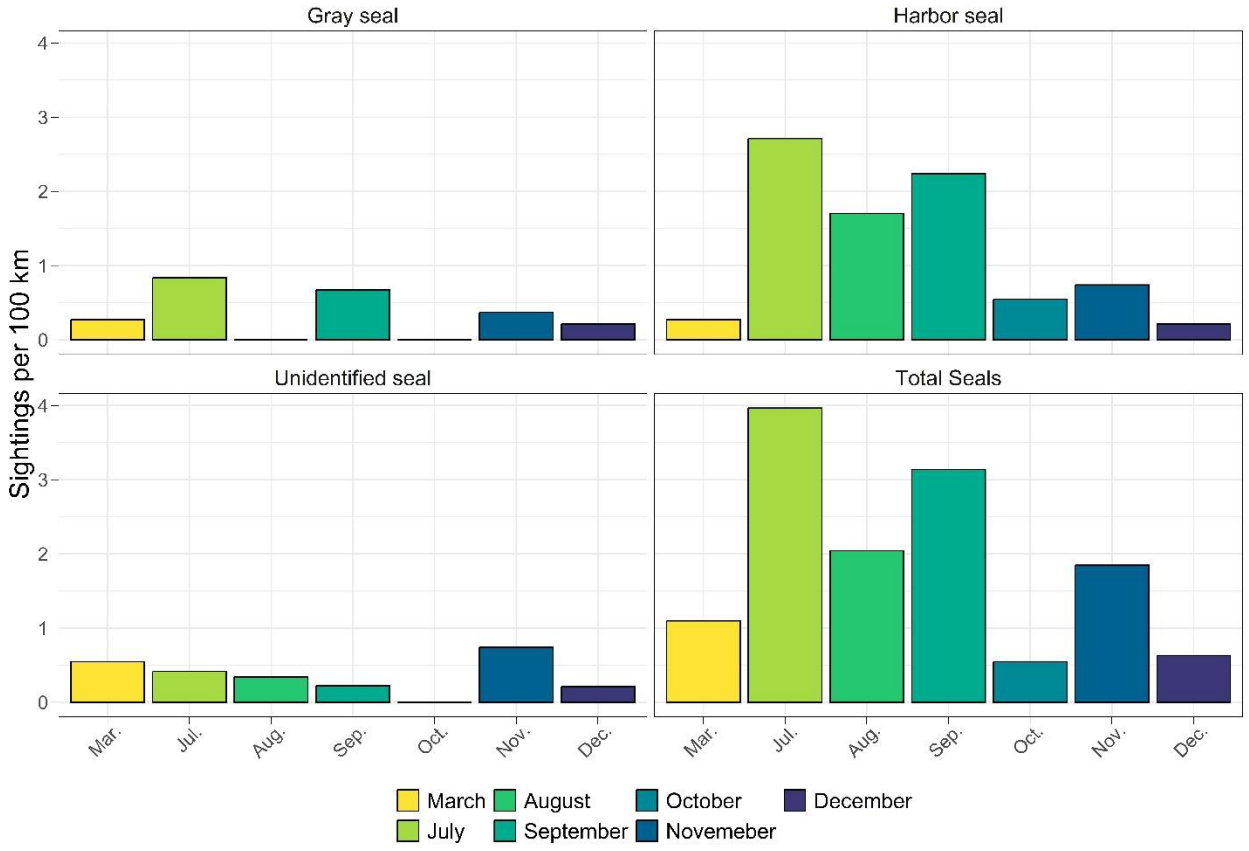


Figure 7. Sighting Rates of Fish and Turtles from Aerial Surveys July – December 2024

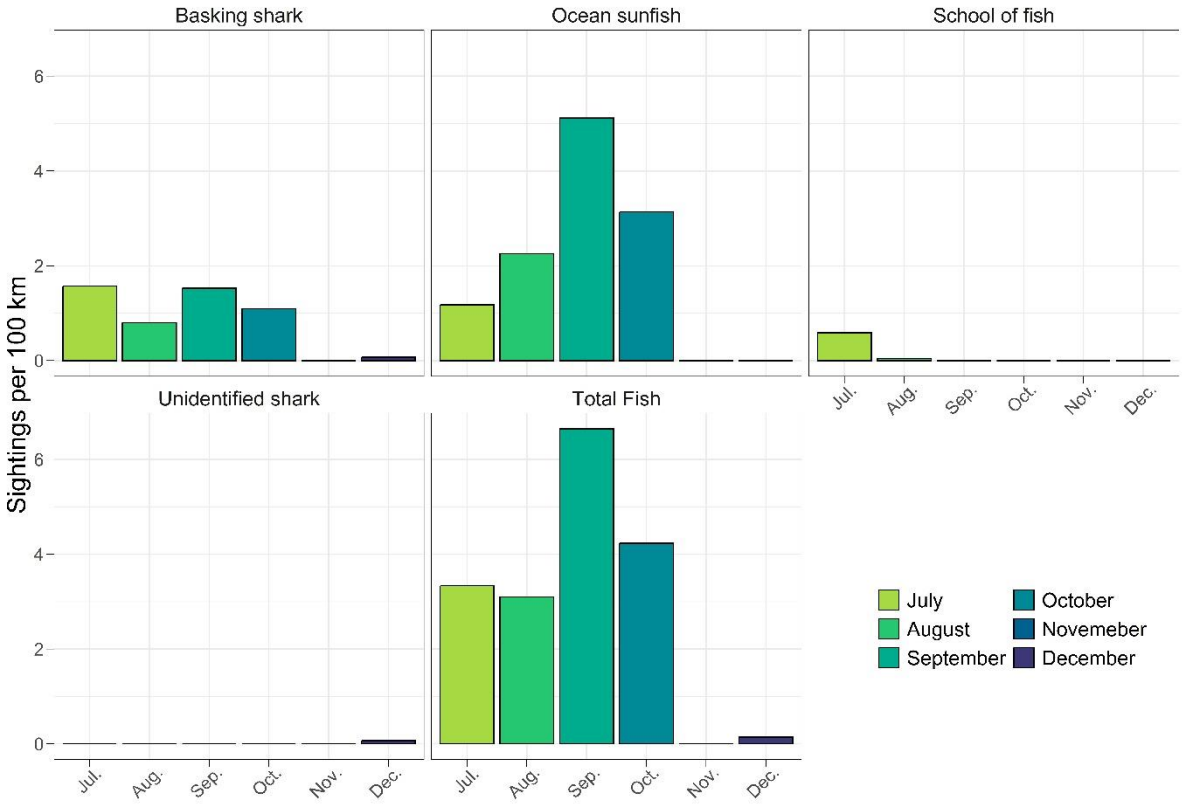
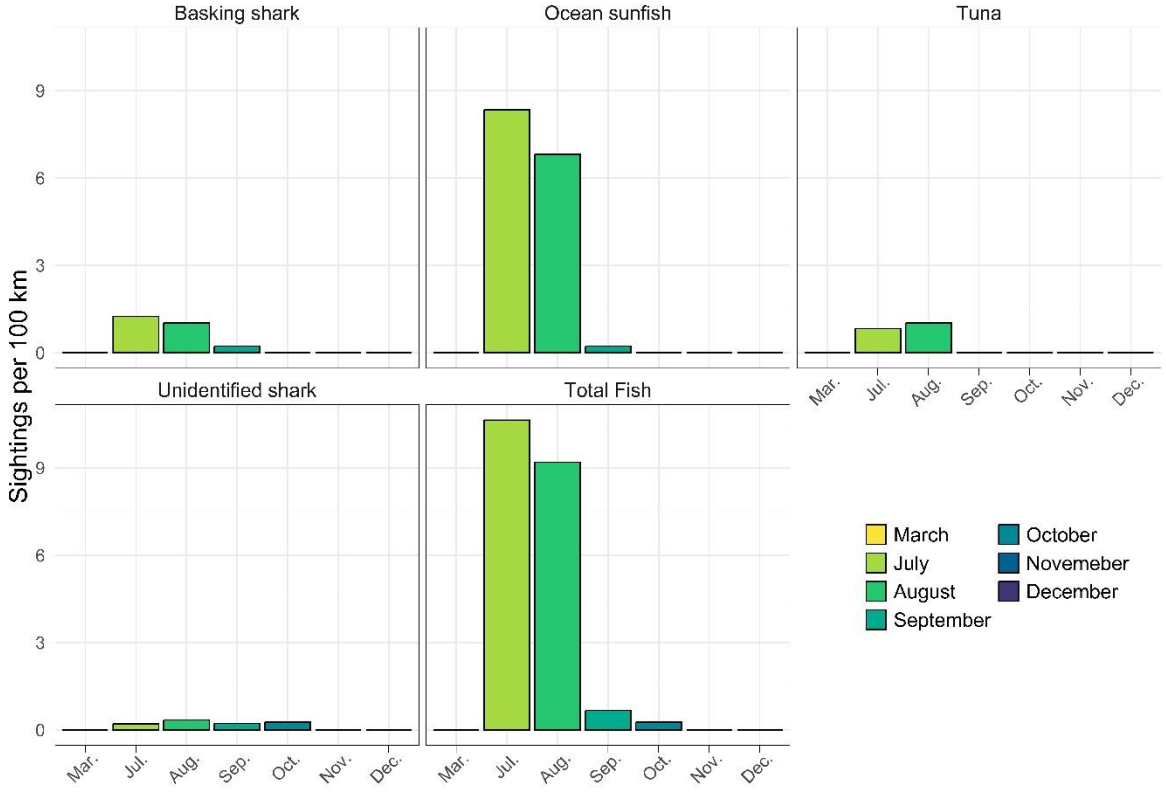


Figure 8. Sighting Rates of Fish and Turtles from Vessel Surveys in 2024



Appendix D. Select Photographs of Marine Species

Figure 1. Common dolphin (*Delphinus delphis*), photographed by S. Leiter, MEDMR, Permit No. 27066

Figure 2. Pilot whales (*Globicephalia spp.*), photographed by S. Leiter, MEDMR, Permit No. 27066

Figure 3. Fin whale (*Balaenoptera physalus*), photographed by A. Whitt, Azura Consulting LLC., Permit No. 27066

Figure 4. Common dolphin (*Delphinus delphis*), photographed by N. Telschow, MEDMR, Permit No. 27066

Figure 5. North Atlantic right whale (*Eubalaena glacialis*), photographed by L. Blair, Azura Consulting LLC., Permit No. 27066

Figure 6. North Atlantic right whales (*Eubalaena glacialis*), photographed by L. Blair, Azura Consulting LLC., Permit No. 27066