Cruise Report

HB1503-Leg 1: Sei whale study during June 2015

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SUMMARY

During 10 – 19 Jun 2015, a shipboard survey was conducted on the NOAA ship *Henry B. Bigelow* around Georges Bank to collect distribution, ecosystem, and acoustic data on cetaceans, in particular sei whales (*Balaenoptera borealis*). To achieve this, two visual teams of data searched for marine mammals, a seabird team searched for birds, a team collected acoustic recordings using a towed array and sonobouys, and another team collected physical and biological data using the ship's sensor system, bongo nets, conductivity, temperature and depth(CTDs) probes, midwater trawls, and backscatter data via a Simrad EK60. In addition, a pilot study was conducted to test the efficacy of a video system, consisting of a high definition video camera and a long wave infrared camera, as compared to corresponding visual and acoustic observations. In total, over 2000 cetaceans and over 2500 birds were detected. Twelve sonobuoys were successfully deployed and over 28 hrs of acoustic data were recorded. CTD data were collected from 20 sites, 22 midwater trawls were conducted and backscatter data were collected during the times of the visual surveys and during some nights. Currently all of these data types are being analyzed.

OBJECTIVES

The overall goal of Leg 1 was to document the relationship between the distribution and abundance of cetaceans, sea turtles and seabirds within the study area relative to their physical and biological environment. This survey focused primarily on sei whales, with the following objectives:

1) Deploy the small boat to collect identification photographs and biopsy samples of as many individuals as possible.
2) Collect passive acoustic data via sonobuoys, dipping hydrophones and towed array.
3) Determine the distribution and relative abundance of plankton and prey species.
4) Develop a better understanding of habitat use and site fidelity for abundance and monitoring of critical areas.
5) Conduct a pilot study to test the efficacy of a video system consisting of a high definition video camera and a long wave infrared camera with corresponding visual and acoustic observations.

CRUISE PERIOD AND AREA

The total cruise period was originally scheduled for 23 days, from 7 June – 2 July 2015, with Leg 1 scheduled for 7 – 19 June 2015 on the NOAA ship *Henry B. Bigelow*. However, due to shortage of shipboard crew members and ongoing repairs needed to be able to deploy the small boat, the first leg of the cruise was delayed three days. Therefore the actual cruise period was 10 – 19 June 2015.

The study area for Leg 1 included the Great South Channel and the perimeter of the Georges Bank region, with limited effort crossing over to Browns Bank. The study region was between 40°N - 43°N latitude, and between 65°W - 70°W. This included waters within the US and Canadian economic exclusive zones (EEZ). See Figure 1.

METHODS

VISUAL MARINE MAMMAL-TURTLE SIGHTING TEAM

A line-transect style survey was conducted during daylight hours (approximately 0600 – 1900) using the two-independent-team procedure. Surveying was conducted in all weather conditions with the exception of rain or fog, while traveling at a survey speed of approximately 10 knots.

Scientific personnel formed two visual marine mammal-sea turtle sighting teams. The teams were stationed on the flying bridge (15.1 m above the sea surface) and anti-roll tank (11.8 m above the sea surface). Each team consisted of four trained observers. On each team, two observers utilized high-powered "big-eye" binoculars (Fujinon, 25x150) to scan from the bow of the ship to 90˚ port or starboard, while one observer scanned the trackline using hand-held binoculars and the naked eye, and recorded the sightings data from all team members. The fourth observer rested, and every 30 minutes the observers rotated positions within the team.

For either team, when an animal group (porpoise, dolphin, whale, seal, turtle or a few large fish species) was detected, the following data were recorded with VisSurv-NE:

1) Time sighting was initially detected, recorded to the nearest second,
2) Species composition of the group,
3) Radial distance between the team's platform and the location of the sighting, estimated either visually when not using the binoculars or by reticles when using binoculars,
4) Bearing between the line of sight to the group and the ship's track line; measured by a polarus mounted near the observer or a polarus at the base of the binoculars,
5) Best estimate of group size,
6) Direction of swim,
7) Number of calves,
8) Initial sighting cue,
9) Initial behavior of the group, and
10) Any comments on unusual markings or behavior.

At times when it was not possible to positively identify a species, survey effort was temporarily suspended ("off-effort") and the ship headed in a manner to intercept the animals in question. When the species identification and group size information were obtained, the ship proceeded back to the point on the track line where effort ended (or close to this point).

Because the focus of the survey was to search for sei whales, in areas of particularly high dolphin density, the visual observers did not record observations of all dolphin groups, as this sometimes became distracting from the primary survey goals. These periods of high dolphin density were noted, and when animal density decreased, all groups were again recorded as usual.

In addition to the sightings data, the following effort data were recorded every 30 minutes or when one of the factors changed:

1) Time of recording

2) Name and position of each observer
3) Weather conditions: swell direction relative to the ship's travel direction and height (in meters), apparent Beaufort sea state in front of the ship, presence of light or thick haze, rain or fog, amount of cloud coverage, visibility (i.e., approximate maximum distance that can be seen), and glare location and strength of glare within the glare swath (none, slight, moderate, severe).

At the same time, the location (latitude and longitude) of the ship when this information was entered was recorded by the ship's GPS via the SCS system which was connected to the data entry computers.

VISUAL SEABIRD SIGHTING TEAM

The seabird observer was also stationed on the flying bridge. For this survey, only a single observer conducted a visual daylight survey for marine birds, from approximately 0600 – 1900 hours with a one hour break at lunchtime and additional rest breaks as needed. Seabird observation effort employed a modified 300 meter strip and line-transect methodology. Data on seabird distribution and abundance were collected by identifying and enumerating all birds seen within a 300 meter arc on one side of the bow. The seabird observer maintained a visual unaided eye watch of the 300 meter survey strip, with frequent scans of the perimeter using hand-held binoculars for difficult-to-detect species. Binoculars (10x42 and 20x60 prism-stabilized) were used for distant scanning and to confirm species identification when needed. Ship-following species were counted once and subsequently carefully monitored to prevent re-counts. All birds, including non-marine species such as passerines, were recorded.

Operational limits are higher for seabird surveys then they are for marine mammal surveys. As a result, seabird survey effort was possible in sea states up to and including Beaufort 7. Seabird survey effort was suspended if the ship's speed over ground fell below five knots.

All data were entered in real time into a Panasonic Toughbook laptop running *Seebird (vers 4.3.6),* a data collection program developed at the Southwest Fisheries Science Center. The software was linked to the ship's navigation system via a serial port. The following data were collected for each sighting: species identification, number of birds within a group, distance between the observer and the group, angle between the track line and the line of sight to the group, behavior, flight direction, flight height, age, sex and, if possible, molt condition. The sighting record received a corresponding time and GPS fix once the observer accepted the record and the software saved it to the laptop's internal hard drive. *Seebird* also added a time and location fix every 5 minutes. *Seebird* incorporates a time synchronization feature that ensures the computer clock matches the GPS clock, thereby facilitating post-processing of the seabird data with the ship's SCS data. All data underwent a quality assurance and data integrity check each evening and were saved to disk and to an external backup dataset.

INFRARED CAMERA TEAM

Seiche Ltd. and CSA Ocean sciences teamed together to test the current state of development and design of a video system to display and visually detect marine mammals. The goal of the pilot project was to test the efficacy of the video system with corresponding visual and acoustic observations. To further this effort NOAA NEFSC agreed to provide facilities to accommodate installation of the camera system and two technicians during HB15-03 Leg 1. The Seiche video system (RAIDS) utilizes a high definition video camera along with a long wave infrared camera.

Installation of the camera system and monitoring station took place June 5 – 9. The dual camera unit attached to a pan and tilt system that was mounted on a pedestal and secured to the forward rail near the center of the ship's flying bridge (Figure 2). The power and network

distribution unit was attached to the forward mast on the flying bridge where it was easily connected to a nearby power and network access point. The monitoring station was set up in a dry lab across from the passive acoustic monitoring station. The monitoring station consisted of twin monitors, computer, network switch, and a RAID data storage system.

After the system was installed and power and network cables were connected, communication between the monitoring station and the camera system was established through the ship's network by registering the MAC addresses in the ship's network control software. All systems operated normally and numerous tests were performed prior to the ship's departure. Live feed from the camera system was monitoring during all daytime hours and opportunistically during nighttime hours by a rotating team of two observers. For the first three days, the marine mammal visual team reported sightings to the IR team observers so that the image contrast and resolution could be properly calibrated. After that point, the IR team worked independently to detect marine animal for the remainder of the survey.

PASSIVE ACOUSTIC TEAM

Passive acoustic effort on this survey included the deployment of SSQ-53F difar sonobuoys and a towed hydrophone array. This survey did not include a dedicated acoustic team. Instead, three trained acousticians with marine mammal observing experience alternated between visual sightings and passive acoustic monitoring efforts.

Sonobuoys were deployed each evening of the survey in the area where prey sampling was to take place, as well as opportunistically during daytime hours, with the goal of documenting baleen whale acoustic occurrence, particularly sei whale occurrence. Sonobuoys were typically programmed to transmit for 8 hours in difar mode. Sonobuoy signals were received at the ship via a WinRadio receiver and were routed through a Fireface 400 soundcard to a desktop or laptop computer recording the audio data. The software package Pamguard was used to map sonobuoy detections relative to the ship. Recording periods typically lasted from 1 – 8 hrs or as long as the ship was within range to receive the signal from the drifting sonobuoy.

The towed hydrophone array was deployed during daytime hours, only along the shelf break portion of the survey in waters 100 m or greater in depth. The array was comprised of two modular, oil-filled sections (the end-array and in-line array), which were separated by 30 m of cable. The end-array consisted of 3 "mid-frequency" elements (APC International, 42-1021), 2 "high-frequency" elements (Reson, TC 4013), and a depth sensor (Keller America, PA7FLE). The in-line array consisted of 3 "mid-frequency" elements (APC International, 42-1021). The array was towed 300 m behind the ship. Array depth typically varied between 8 – 12 m when deployed at the typical survey speed of 10 kts. Sound speed data at the tow depth of the array were extracted from morning CTD casts.

Acoustic data from the towed hydrophone array were routed to a custom-built Acoustic Recording System that encompassed all signal conditioning, including A/D conversion, filtering, and gain. Data were filtered at 1000 Hz, and variable gain between 20 – 40 dB was added depending on the relative levels of signal and noise. The recording system incorporated two National Instruments soundcards (NI USB-6356). One soundcard sampled the six mid-frequency channels at 192 kHz, the other sampled the two high-frequency channels at 300-500 kHz, both at a resolution of 16 bits. Digitized acoustic data were recorded directly onto laptop and desktop computer hard drives using the software program Pamguard (http://www.pamguard.org/home.shtml), which also recorded simultaneous GPS data, continuous depth data, and allowed manual entry of corresponding notes. Two channels of analog data were also routed to an external RME Fireface 400 soundcard and a separate

desktop computer, specifically for the purpose of real-time detection and tracking of vocal animals using the software packages WhalTrak and Ishmael.

HYDROGRAPHIC/BONGO/PLANKTON SAMPLES

CTD/Bongo Sampling

In addition to the ship's SCS logger system that continuously recorded oceanographic data from the ship's sensors, Conductivity, Temperature, and Depth Profiler (CTD) data were collected to measure water column characteristics. Data were obtained with two Seabird Electronics SBE Model 19+ profiling CTDs and a Seabird Electronics SBE Model 9/11+ CTD. A dissolved oxygen sensor (SBE43-1957) was attached to the 9/11+ CTD as well as a PAR sensor. The CTD was mounted on a 322 conducting core cable allowing the operator to see a real time display of the instrument depth and water column temperature, salinity, density and sound speed on a computer monitor in the ship's Dry Lab. Sea water samples were taken for the purpose of correcting conductivity

A 61 cm bongo plankton net equipped with two 333 μm nets and a CTD mounted on the wire 1 m above the nets was deployed at least twice a day: once before the day's surveying started (about 0500 – 0530) and again after surveying was completed for the day (approximately 1800, depending on weather and the time of sunset), as well as opportunistically at other times. Tows were to within 5 m of the bottom or to 200 m depth, if the bottom depth exceeded 205 m. Upon retrieval, samples were rinsed from the nets using seawater and preserved in 5% formaldehyde and seawater. Samples were transported to the Narragansett, RI National Marine Fisheries Science (NMFS) lab for future identification.

Active Acoustic Sampling with the Simrad EK60

Multifrequency (18, 38, 70, 120, and 200 kHz) Simrad EK60 data were collected continuously throughout the cruise, in either active or passive mode. Data were collected in passive mode during daytime survey hours from 15 – 18 June 2015, when the towed hydrophone array was deployed. At all other times, data were collected in active mode.

RESULTS

Scientific personnel involved in the Leg 1 of this cruise are listed in Table 1.

VISUAL MARINE MAMMAL-TURTLE SIGHTING TEAM

The visual marine mammal and turtle team surveyed about 1228 km while on-effort during 8 sea-days. The first sea day (10 June) was spent in transit to the study area. The vessel initiated their return transit on 18 June, therefore the last "sea day" (19 June) was spent at the dock in Newport, RI.

During the on-effort track lines, the visual teams sighted 19 cetacean species or species groups, 2 turtle species or species groups, and 4 fish species or species groups (Tables 2 and 3). For cetaceans, the upper team detected 346 groups for a total of 2040 individuals. Similarly, the lower team detected 358 groups for a total of 1824 individuals. Note that some of these groups were detected by both teams. Few turtles were sighted, only 1 individual by members of the upper team.

In addition, many ocean sunfish were sighted; 44 groups were sighted by the upper team and 34 by the lower team.

One biopsy sample was collected from a dead and drifting pilot whale.

Distribution maps of sighting locations of the cetaceans, turtles, and fishes are displayed in Figures 3 – 8. Note these are locations of sightings seen by only the upper team.

VISUAL SEABIRD SIGHTING TEAM

The flying bridge of the NOAA ship *Henry B. Bigelow* provided a stable platform and afforded good visibility for the seabird team. Seabird survey effort was conducted on eight days. Nomenclature follows that used in *The Clements Checklist of Birds of the World*. 6th edition, Cornell University Press 2007, with electronic updates to 2014.

A summary of all 2516 birds representing 21 species seen while on effort is presented in Table 4 and Figures 9 – 12. Note that data presented in this table only include detections made within the 300 m survey strip. An additional three species were seen beyond the 300 m survey strip and are included in the summary for the sake of completeness. The four commonest species, listed in order of decreasing abundance were: Great Shearwater (*Puffinus gravis*), Sooty Shearwater (*Puffinus griseus*), Wilson's Storm-Petrel (*Oceanites oceanicus*) and Cory's Shearwater (*Calonectris diomedea*), accounted for almost 79% of all the birds seen. This is typical of early summer seabird distribution and abundance in this area of the northwest Atlantic Ocean. These four species are austral breeders that spend summer in the northwest Atlantic Ocean during their non-breeding season. Throughout the cross-shelf survey lines (e.g., Lines 3, 4, 5, 13, 17 and 18) seabird distribution was patchy yet often predictable. High densities were found along the northern shelf break of Georges Bank, particularly in the vicinity of the Northeast Peak. These concentrations were composed primarily of Cory's and Great Shearwaters. These latter two species, especially the former, were also frequently seen feeding in association with groups of Atlantic white-sided dolphin (*Lagenorhynchus acutus*). Wilson's Storm-Petrel was typically found in areas of upwelling seaward of the shelf break, often in association with Leach's Storm-Petrel (*Oceanodroma leucorhoa*) who is a Northern Hemisphere breeder.

The seabird survey effort collected valuable spatial and temporal information in areas that historically have received little systematic observer effort. The sighting of yet another Barolo Shearwater (*Puffinus baroli*) adds to the handful of records from this area. It is generally considered to be very rare anywhere in the northwest Atlantic Ocean. The normal breeding range includes islands off northwest Africa (Canary Islands, Azores, Desertas and Salvage), but its at-sea distribution is less clear. Its status in North American waters, inferred from only a few sightings in the last 100 years, is poorly known. However, at least one has been seen on all previous spring/summer AMAPPS surveys since 2011 and so is perhaps a regular but rare late spring to early fall visitor off New England and Nova Scotia. Additional surveys will no doubt provide further information on this enigmatic species.

Six Audubon's Shearwaters (*Puffinus lherminieri*) were noteworthy for time and location, being unusual this far north so early in the season. In addition to those seen along the shelf break in the vicinity of Powell, Lydonia, and Oceanographer Canyons, two were in Canadian waters where this species is extremely rare. However, this perceived rarity may simply be a result of survey bias. Although Audubon's Shearwater is common during summer in warmer water farther south, its status this far north, particularly in Canadian waters, is less clear; presumably its occurrence is closely related to the presence of warmer sea surface temperatures. Additional surveys will help clarify this species' true status in the northwest Atlantic Ocean.

INFRARED CAMERA TEAM

Observations with the camera system began the morning of 11 June 2015 and despite some fog all systems functioned nominally. Over the course of the first couple days we made several adjustments to the monitoring system which improved marine mammal detectability. Manual and automatic scanning techniques using the pan and tilt system were refined and

occasionally troubleshot. Over the course of the first three days camera observations were coordinated with visual observers to maximize sightings with the camera system and obtain recordings of several species of marine mammals. These recordings will aid to further develop the automatic detection routines for the camera system. The final several days camera observations were conducted independently of visual observers and logs from both will be compared to determine the efficacy of the system.

Overall this test of the twin camera system provided an excellent platform to shake down the system and compare its capabilities to those of visual observers. A few areas that were identified as needing continued development were the network bandwidth compatibilities, user front end controls, and image window adjustment. The sighting ratio compared to an equivalent visual observer will require further analysis to determine; however, post survey conversations suggest the camera system obtained a similar sighting rate as the visual observers.

PASSIVE ACOUSTIC DETECTION TEAM

Over the course of the survey, 15 sonobuoys were deployed, of which 12 were successful (Table 5). In addition, acoustic monitoring effort using the towed hydrophone array was conducted on four sea-days, for nearly 29 hrs. Post-processing of passive acoustic data will be conducted to extract all acoustic events, localize individual groups and compare visual and acoustic detection rates, and evaluate performance of species-specific classifiers.

HYDROGRAPHIC/BONGO/PLANKTON SAMPLES

The types of data collected by the ship's SCS system are listed in Table 6.

CTD/Bongo Data

CTD data were collected from 22 casts at a total of 20 sites; the SBE 9/11+ CTD was deployed at one site (Figure 13). CTD data were collected each morning and evening at the start and end locations of the visual data collection, as well as at the sites of nighttime midwater trawl prey sampling.

Trawl Data

Midwater trawl hauls were conducted during night at opportunistic sites along the cruise track (Table 7; Figure 14). Trawls were set to sample acoustic backscatter locations. Depths, and durations were chosen based on acoustic backscattering patterns observed in the active acoustic multifrequency EK60 echograms, and on areas where marine mammals had been observed during the day.

Trawl haul catches varied depending on the area fished. Trawl catches in the Great South Channel and along the northern edge of Georges Bank predominately consisted of juvenile silver hake (*Merluccius bilinearis*), haddock (*Melanogrammus aeglefinus*), Acadian redfish (*Sebastes fasciatus*), other hake species (e.g., *Urophysis* sp.), spawning Atlantic herring (*Clupea harengus*) on Georges Bank, krill (*Meganyctiphanes norvegica*), and ctenophores and other gelatinous species. Trawl catches off the shelf were dominated by mesopelagic fish species, with myctophid species dominating shallow waters at night and other species (e.g., *Chauliodus* sp., *Nemichthys* sp., hatchetfish sp.) that did not appear to vertically migrate dominating deeper waters (>400 m depth) day and night.

Active Acoustic Data Collection

A trained EK60 expert was on the survey, so the EK60 data were processed daily by removing the echo from the seabed and any electronic, acoustic, or bubble noise. The data

were then stored on a portable hard drive and archived at the NEFSC and additionally will be sent to NOAA's National Geophysical Data Center for permanent archive.

DISPOSITION OF THE DATA

All visual and passive acoustic data collected will be maintained by the Protected Species Branch at the Northeast Fisheries Science Center (NEFSC) in Woods Hole, MA. Visual sightings data will be archived in the NEFSC's Oracle database and later will be submitted to SEAMAP OBIS. Seabird data are also submitted to the Seabird Compendium.

All hydrographic data collected are maintained by the Fishery Oceanography Branch at the NEFSC in Woods Hole, MA. Hydrographic data can be accessed through the Oceanography web site http://www.nefsc.noaa.gov/epd/ocean/MainPage/ioos.html or the NEFSC's Oracle database.

Trawl samples were discarded at sea after positively identified and recorded.

All plankton samples collected are maintained by the Fishery Oceanography Branch at the NEFSC in Narragansett RI. Plankton samples will be sent to Poland for identification. Plankton data can be accessed through the NEFSC's Oracle database after about March 2016.

All active acoustic data are archived and maintained by the NEFSC Data Management Services (DMS) branch at the NEFSC. In addition, all EK60 data are archived and maintained at NOAA's NGDC in Boulder, CO.

PERMITS

NEFSC was authorized to conduct the marine mammal related research activities during this survey under US Permit No. 17355 issued to the NEFSC by the NMFS Office of Protected Resources and SARA Permit No. 330996 issued to the NEFSC by Fisheries and Oceans Canada.

ACKNOWLEDGEMENTS

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Table 1. Scientific personnel involved in the HB15-03 Leg 1 survey. FN = Foreign National.

Personnel	Title	Organization
Danielle Cholewiak	Chief Scientist	Integrated Statistics, Woods Hole, MA
Genevieve Davis	Mammal Observer/ Acoustics	Integrated Statistics, Woods Hole, MA
Peter Duley	Mammal Observer	NOAA NEFSC, Woods Hole, MA
Michael Force (FN)	Seabird Observer	Integrated Statistics, Woods Hole, MA
Julianne Gurnee	Mammal Observer/ Acoustics	Integrated Statistics, Woods Hole, MA
Michael Jech	Oceanographer /Trawl Survey	NOAA NEFSC, Woods Hole, MA
Marjorie Lyssikatos	Mammal Observer	NOAA NEFSC, Woods Hole, MA
Jeff Martin	Infra-red camera Observer	CSA Ocean Sciences
Hilary Moors-Murphy (FN)	Mammal Observer	Department of Fisheries & Oceans, Canada
Christopher Orphanides	Mammal Observer	NOAA NEFSC, Woods Hole, MA
Thomas Savage	Teacher-At-Sea	NOAA Teacher at Sea Program
Lorenzo Scala (FN)	Infra-red Camera Observer	Seiche, Ltd.
Christopher Tremblay	Mammal Observer/ Acoustics	Integrated Statistics, Woods Hole, MA
Melissa Warden	Mammal Observer	Integrated Statistics, Woods Hole, MA
Suzanne Yin	Mammal Observer	Integrated Statistics, Woods Hole, MA

Table 2. Number of groups and individuals of cetacean species detected by the upper and lower marine mammal/turtle visual observer teams during on-effort tracklines. Note that some, but not all, groups detected by one team were also detected by the other team.

Species Name		Number of groups		Number of individuals	
		lower	upper	lower	upper
Bottlenose dolphin, common	*Tursiops truncatus*	7	5	57	74
Common dolphin, short-beaked	*Delphinus delphis*	14	25	132	408
Cuvier's beaked whale	*Ziphius cavirostris*	2	1	3	1
Fin whale	*Balaenoptera physalus*	15	15	25	25
Fin/sei whales	*B. physalus or B. borealis*	1	6	1	10
Humpback whale	*Megaptera novaeangliae*	39	30	68	48
Lagenorhynchus sp.	*Lagenorhynchus sp.*	2	7	36	96
Minke whale	*B. acutorostrata*	25	14	25	16
Pilot whales spp.	*Globicephala spp.*	33	26	123	121
Right whale	*Eubalaena glacialis*	1	1	1	1
Risso's dolphin	*Grampus griseus*	10	9	66	48
Rough-toothed dolphin	*Steno bredanensis*	0	1	0	2
Sei whale	*Balaenoptera borealis*	1	4	2	5
Sowerby's beaked whale	*Mesoplodon bidens*	2	4	7	11
Sperm whale	*Physeter macrocephalus*	12	10	19	15
Striped dolphin	*Stenella coeruleoalba*	1	1	20	15
Unid. dolphin	*Delphinidae*	62	68	352	460
Unid. whale	*Mysticeti/Odontoceti*	59	76	76	112
Unid. ziphiid	*Ziphiidae*	3	1	5	3
White-sided dolphin	*Lagenorhynchus acutus*	69	42	806	569
TOTAL CETACEANS		**358**	**346**	**1824**	**2040**

Table 3. Number of groups and individuals of large fish and turtles detected by the marine mammal/turtle visual teams during on-effort track lines. Note, some, but not all, groups detected by one team were also detected by the other team.

Species		Number of groups		Number of individuals	
		lower	upper	lower	upper
Basking shark	*Cetorhinus maximus*	10	8	11	8
Manta rays spp.	*Manta spp.*	0	2	0	2
Ocean sunfish	*Mola mola*	34	44	35	50
Shark spp.		1	1	1	1
Leatherback turtle	*Dermochelys coriacea*	0	1	0	1
Unid hardshell turtle	*Chelonioidea*	0	1	0	1
TOTAL ALL SPECIES		**45**	**57**	**47**	**63**

Table 4. Number of groups and individual birds detected within the 300 m strip during the NOAA ship *Henry B. Bigelow* survey.

Species		**Total Individuals***	**Relative Abundance (%)**	**IUCN status (2015.2)**
Red-throated Loon	*Gavia stellata*	1	0.04	Least Concern
Northern Fulmar	*Fulmarus glacialis*	188	7.47	Least Concern
Cory's Shearwater	*Calonectris diomedea*	260	10.33	Least Concern
Great Shearwater	*Puffinus gravis*	614	24.39	Least Concern
Sooty Shearwater	*Puffinus griseus*	601	23.88	Near Threatened
Manx Shearwater	*Puffinus puffinus*	15	0.6	Least Concern
Audubon's Shearwater	*Puffinus lherminieri*	6	0.24	Least Concern
Wilson's Storm-Petrel	*Oceanites oceanicus*	512	20.34	Least Concern
Leach's Storm-Petrel	*Oceanodroma leucorhoa*	212	8.42	Least Concern
Northern Gannet	*Morus bassanus*	4	0.16	Least Concern
Red Phalarope	*Phalaropus fulicarius*	2	0.08	Least Concern
South Polar Skua	*Stercorarius maccormicki*	8	0.32	Least Concern
Pomarine Jaeger	*Stercorarius pomarinus*	5	0.2	Least Concern
Parasitic Jaeger	*Stercorarius parasiticus*	2	0.08	not assessed
Long-tailed Jaeger	*Stercorarius longicaudus*	4	0.16	Least Concern
Dovekie	*Alle alle*	1	0.04	Least Concern
Common Murre	*Uria aalge*	1	0.04	Least Concern
Thick-billed Murre	*Uria lomvia*	1	0.04	Least Concern
Atlantic Puffin	*Fratercula arctica*	1	0.04	Least Concern
Herring Gull	*Larus argentatus*	40	1.59	Least Concern
Great Black-backed Gull	*Larus marinus*	38	1.51	Least Concern
		2516		
* Off transect species not included in the totals				
Addititional species seen off transect:				
Barolo Shearwater	*Puffinus baroli*	1	N/A	not assessed
Lesser Black-backed Gull	*Larus fuscus*	6	N/A	Least Concern
Barn Swallow	*Hirundo rustica*	1	N/A	Least Concern

Table 5. Summary of passive acoustic recording effort

SONOBUOYS	Number of sonobuoys deployed	15
	Successful sonobuoy deployments	*12*
	Failed sonobuoy deployments	*3*
TOWED ARRAY	Days with acoustic effort	4
	Daytime recording time (hh:mm)	28:27

Table 6. SCS data collected once /second during the survey and stored in a user created file.

Date (MM/DD/YYYY)	
Time (hh:mm:ss)	TSG-Conductivity (s/m)
EK60-38kHz-Depth (m)	TSG-External-Temp (ºC)
EK60-18kHz-Depth (m)	TSG-InternalTemp (ºC)
ADCP-Depth (m)	TSG-Salinity (PSU)
ME70-Depth (m)	TSG-Sound-Velocity (m/s)
ES60-50kHz-Depth (m)	MX420-Time (GMT)
Doppler-Depth (m)	MX420-COG (º)
Air-Temp (ºC)	MX420-SOG (Kts)
Barometer-2 (mbar)	MX420-Lat (DDMM.MM)
YOUNG-TWIND-Direction (º)	MX420-Lon (DDMM.MM)
YOUNG-TWIND-Speed (Kts)	Doppler-F/A-BottomSpeed (Kts)
Rel-Humidity (%)	Doppler-F/A-WaterSpeed (Kts)
Rad-Case-Temp (ºC)	Doppler-P/S-BottomSpeed (Kts)
Rad-Dome-Temp (ºC)	Doppler-P/S-WaterSpeed (Kts)
Rad-Long-Wave-Flux (W/m^2)	High-Sea Temp (ºC)
Rad-Short-Wave-Flux (W/m^2)	POSMV – Time (hhmmss)
ADCP-F/A – GroundSpeed (Kts)	POSMV – Elevation (m)
ADCP-F/A – WaterSpeed (Kts)	POSMV – Heading (º)
ADCP-P/S – GroundSpeed (Kts)	POSMV – COG (Kts)
ADCP-P/S – WaterSpeed (Kts)	POSMV – SOG (Kts)
Gyro (º)	POSMV – Latitude (DDMM.MM)
POSMV – Quality (1=std)	POSMV – Longitude (DDMM.MM)
POSMV – Sats (none)	POSMV – hdops (none)

Table 7. Midwater trawl begin date, time, and locations for HB15-03 Leg 1 (NEFSC ESB Survey code: 201505).

Station	Begin Date-Time	Begin Lat	Begin Lon
2	12/06/2015-02:38:50	41 17.290 N	69 07.447 W
3	12/06/2015-05:47:45	41 20.287 N	69 01.197 W
4	13/06/2015-01:16:22	41 56.679 N	68 03.200 W
5	13/06/2015-03:10:36	41 56.266 N	67 50.363 W
6	13/06/2015-05:53:25	41 57.227 N	67 59.656 W
7	14/06/2015-00:01:14	42 13.003 N	67 24.239 W
8	14/06/2015-02:15:00	42 09.770 N	67 26.130 W
9	14/06/2015-04:36:30	42 04.323 N	67 27.113 W
10	14/06/2015-06:51:28	42 09.159 N	67 23.941 W
12	15/06/2015-01:20:51	42 14.472 N	66 24.226 W
14	15/06/2015-03:59:23	42 16.908 N	66 24.188 W
15	15/06/2015-06:07:49	42 10.346 N	66 25.160 W
16	15/06/2015-07:53:04	42 12.355 N	66 25.349 W
17	16/06/2015-01:45:42	42 12.185 N	65 13.296 W
18	16/06/2015-06:40:53	42 02.653 N	65 42.900 W
19	17/06/2015-00:06:15	41 08.742 N	66 12.497 W
20	17/06/2015-03:49:24	41 09.265 N	66 13.133 W
21	17/06/2015-05:37:50	41 07.755 N	66 13.568 W
22	18/06/2015-01:18:52	40 16.986 N	67 19.371 W
23	18/06/2015-04:17:58	40 24.730 N	67 16.722 W
24	18/06/2015-06:41:11	40 23.277 N	67 14.922 W

Figure 1. Survey tracklines covered by the marine mammal /sea turtle visual team during HB15-03 Leg 1. The US exclusive economic zone (EEZ) and the 100 m, 200 m, 1000 m and 2000m depth contours are also displayed.

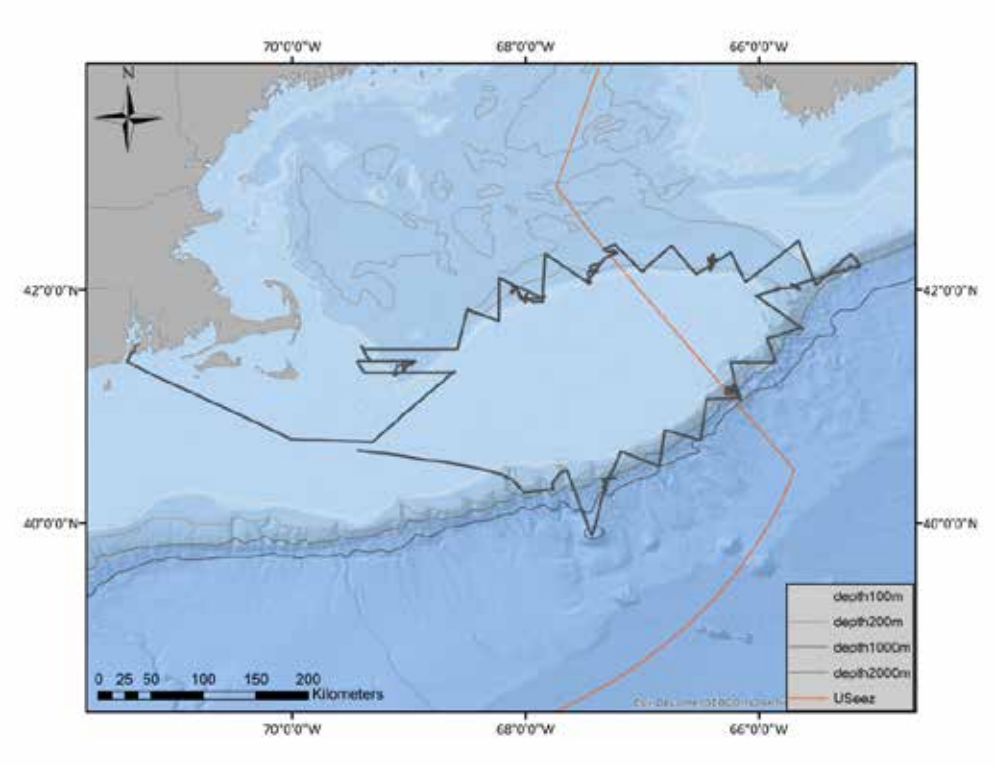

Figure 2. Photograph of infrared camera setup on the flying bridge for HB15-03 Leg 1.

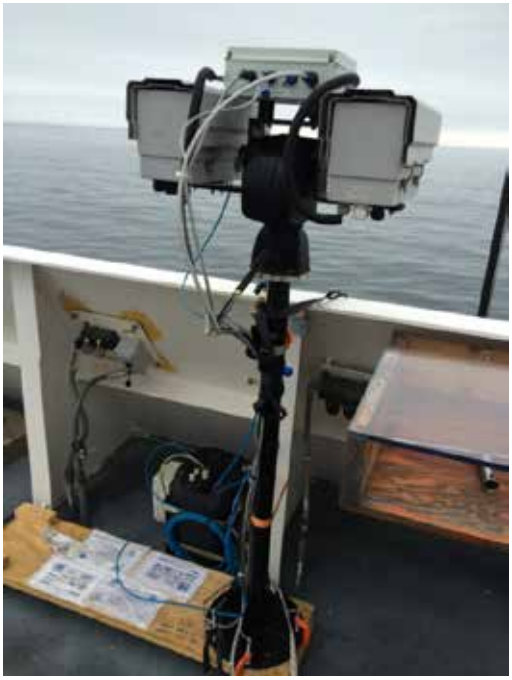

Figure 3. Location of fin and sei whale sightings during HB15-03 Leg 1.

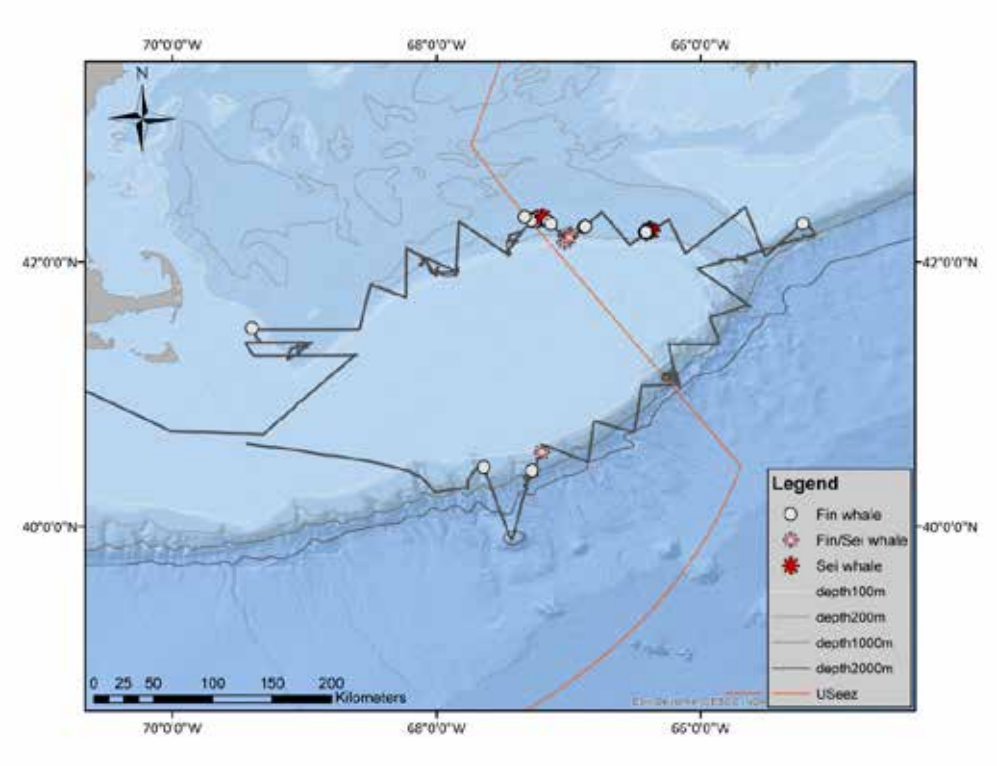

Figure 4. Location of humpback, minke and north atlantic right whale sightings during HB15-03 Leg 1.

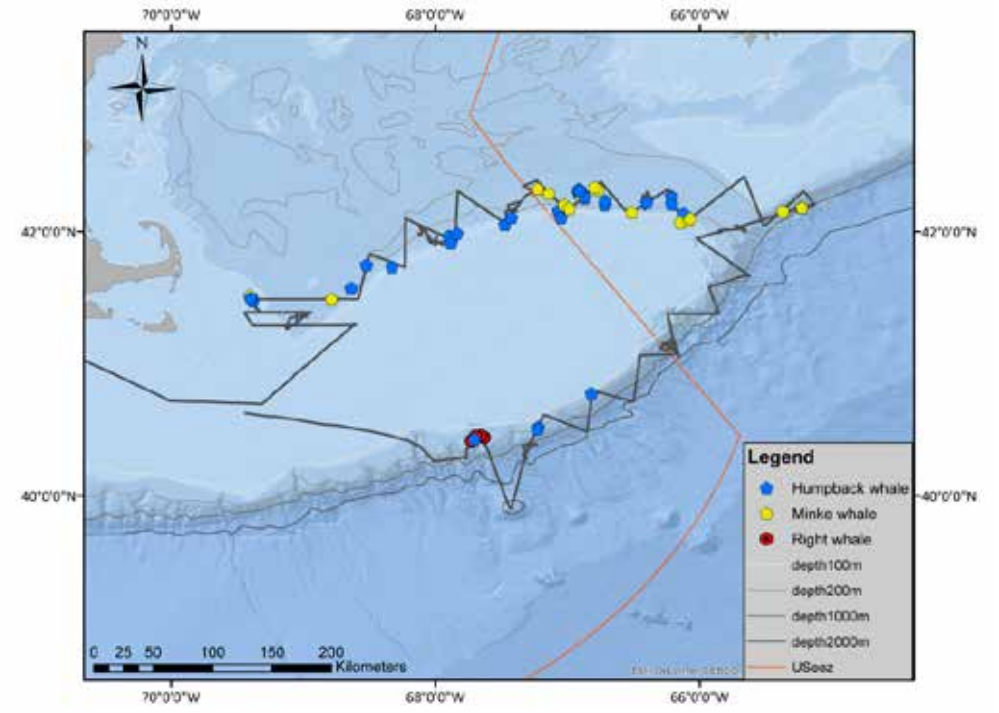

Figure 5. Location of delphinid sightings during HB15-03 Leg 1.

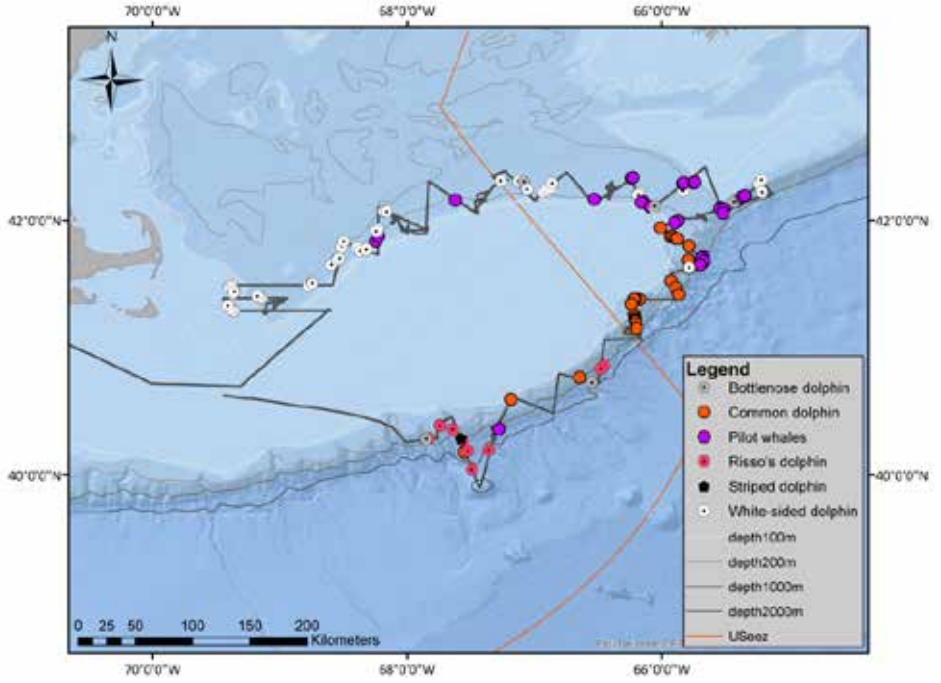

Figure 6. Location of beaked and sperm whale sightings during HB15-03 Leg 1.

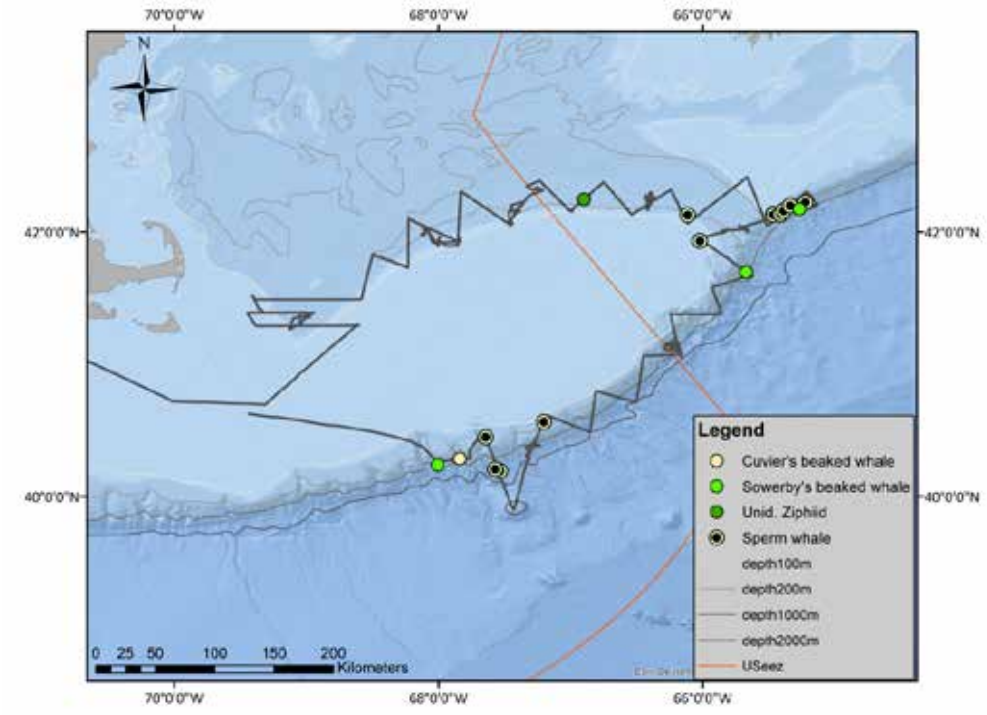

Figure 7. Location of unidentified dolphins, as well as large and small whales, sighted during HB15-03 Leg 1.

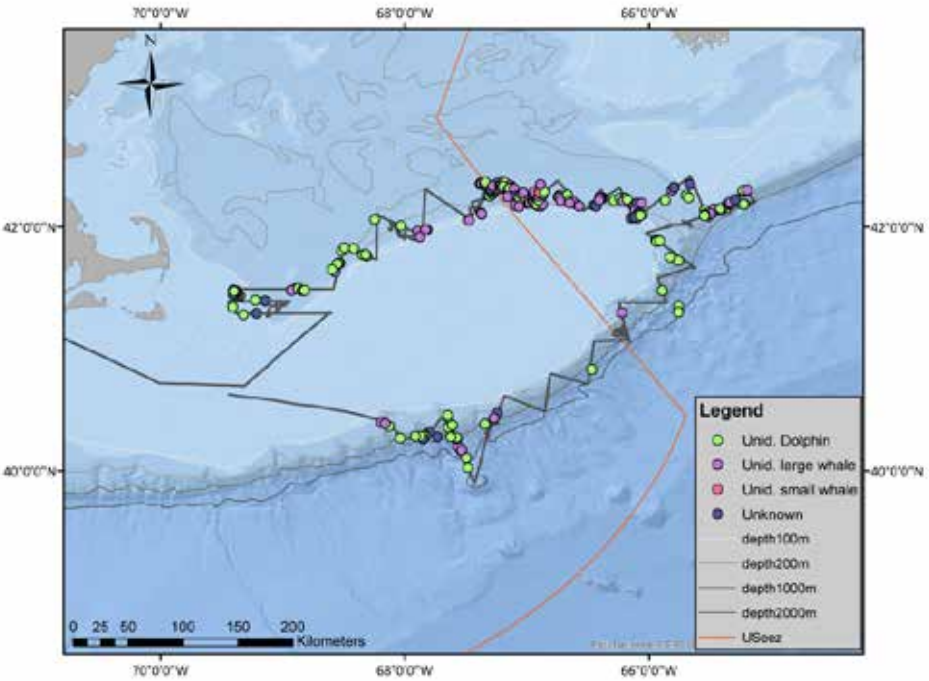

Figure 8. Location of sharks, rays and turtles sighted during HB15-03 Leg 1.

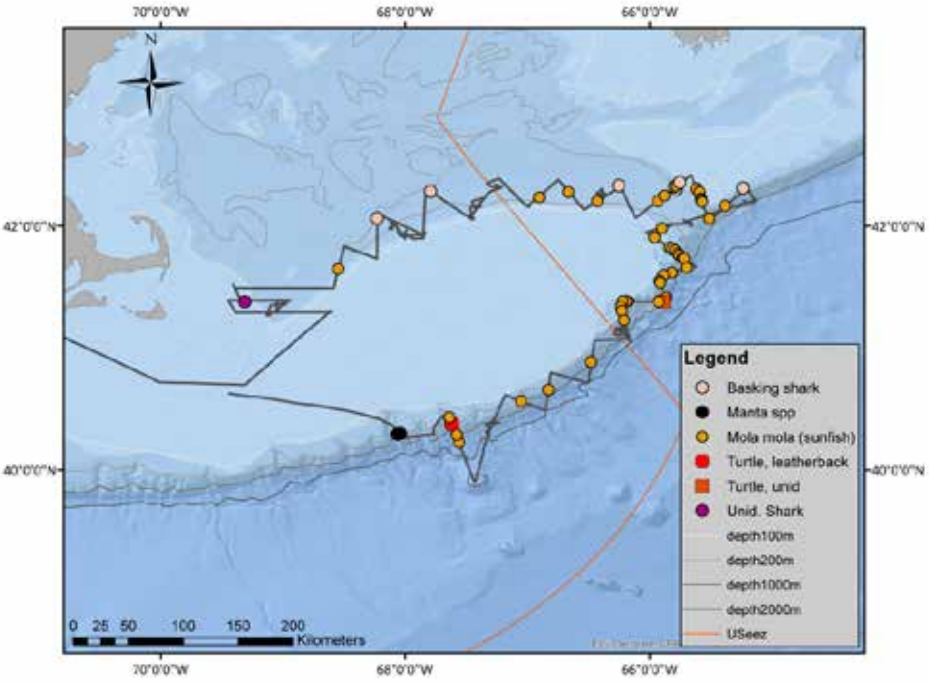

Figure 9. Location of shearwaters sighted during HB15-03 Leg 1. The trackline effort in this and subsequent seabird maps shows only the periods when the seabird observer was "on effort". Shearwater sightings include 6 Audubon's and 15 Manx shearwaters.

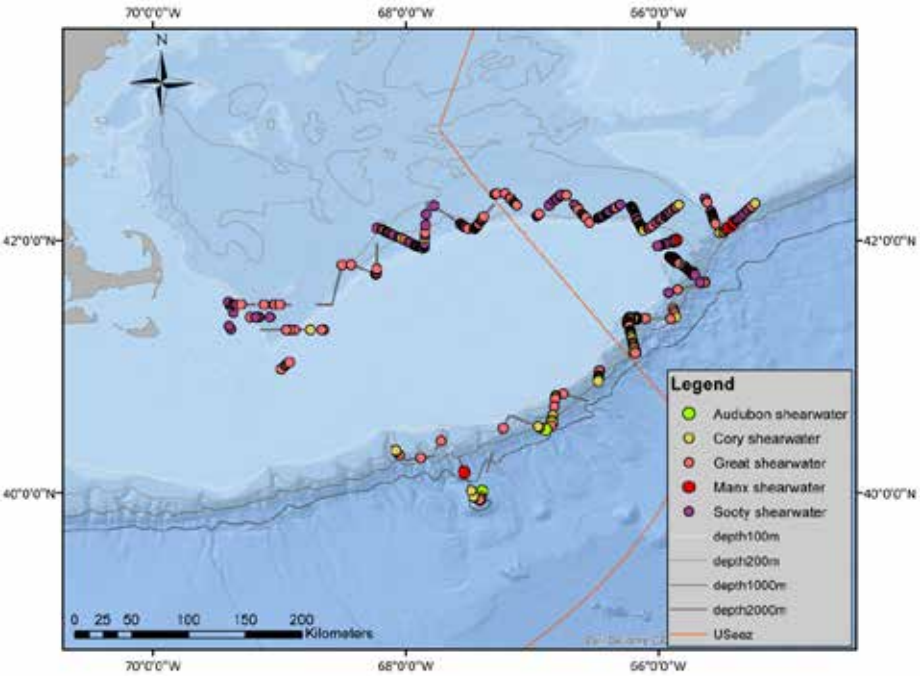

Figure 10. Map of storm petrel sightings during HB15-03 Leg 1. Two species were sighted, least storm petrel (LESP) and Wilson's storm petrel (WISP).

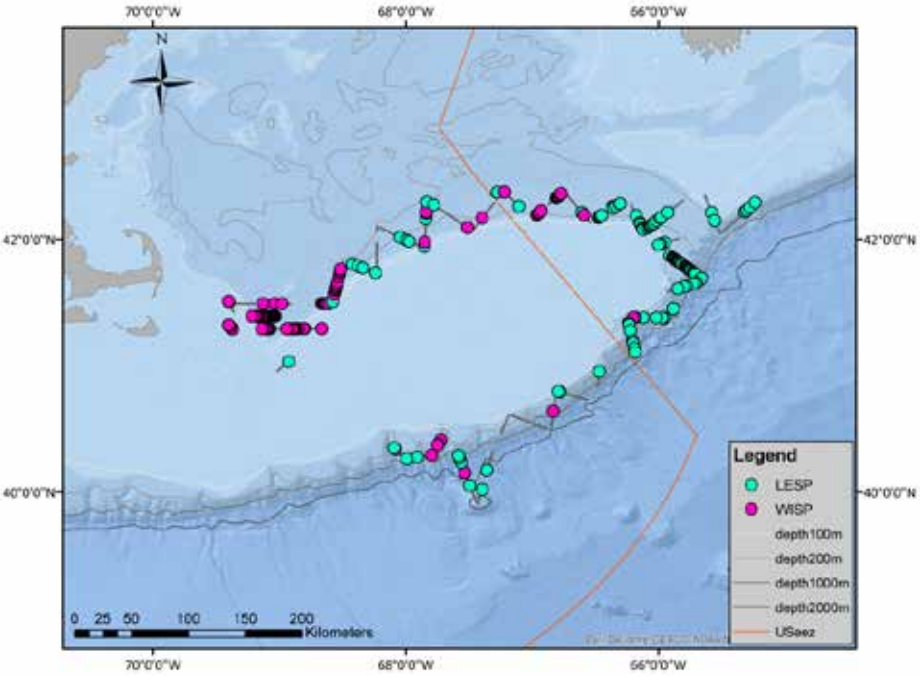

Figure 11. Map of gulls and jaegers sighted during HB15-03 Leg 1. Six species are shown: Great black-backed gull (GBBG), herring gull (HERG), lesser black-backed gull (LBBG), long-tailed jaeger (LTJA), parasitic jaeger (PAJA), pomerine jaeger (POJA), and south polar skuas (SPSK).

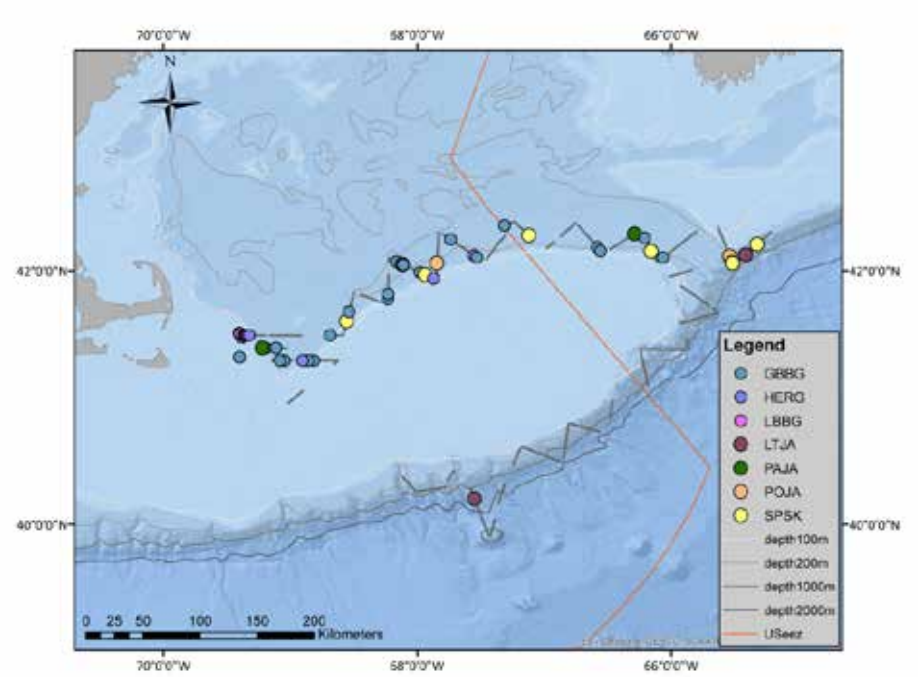

Figure 12. Map of alcids and other avian species sighted during HB15-03 Leg 1, including Atlantic puffin (ATPU), common murre (COMU), dovekie (DOVE), northern fulmar (NOFU), northern gannet (NOGA), unidentified passerine (PASS), red pharalope (REPH), red-throated loon (RTLO), and thick-billed murre (TBMU).

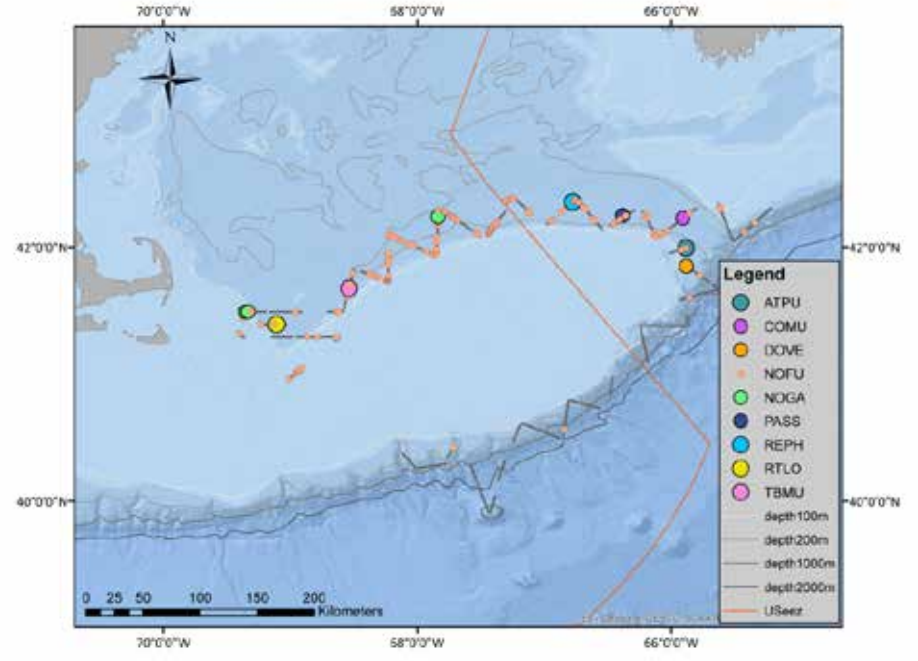

Figure 13. Locations of the deployment of CTD and bongo (green dots) and SBE 9/11+ (yellow dot) during HB15-03 Leg 1.

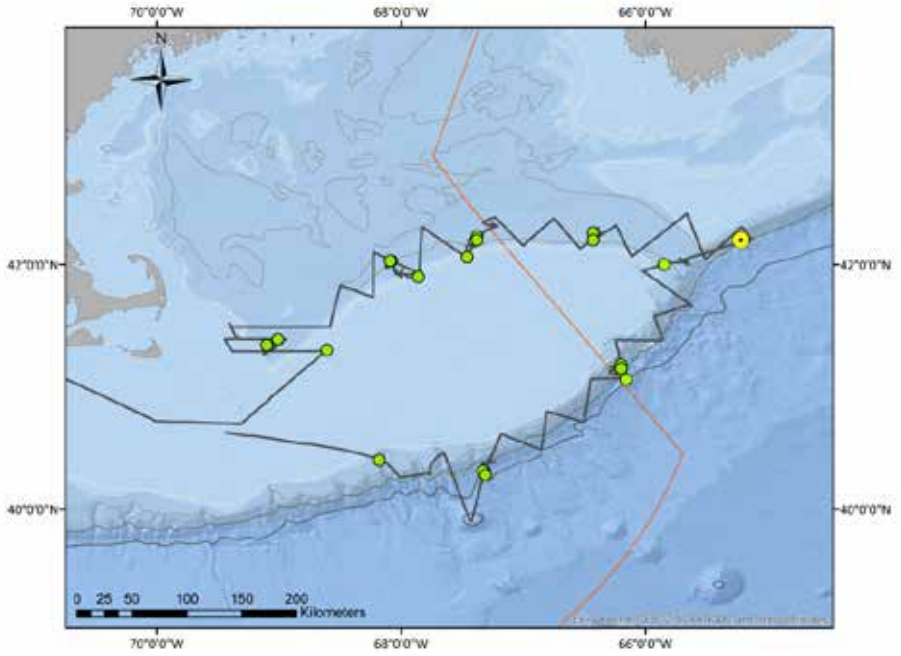

Figure 14. Locations of midwater trawls conducted at nighttime during HB15-03 Leg 1.