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2016 North Atlantic Right Whale (*Eubalaena glacialis*) Shipboard Survey of the Great South Channel, Jeffreys Ledge, and Howell Swell

by Peter Duley, Mark Baumgartner, and Danielle Cholewiak

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PROJECT DESCRIPTION

This cruise was conducted in collaboration with the WHOI (Woods Hole Oceanographic Institution) to study North Atlantic right whale (*Eubalaena glacialis*) dive behavior as it relates to prey distribution; to obtain photographs for individual North Atlantic right whale identifications, biopsy samples, and acoustic recordings from large whales; and to test new technologies that may allow scientists to survey large areas acoustically with autonomous gliders.

Primary cruise objectives

(1) Collecting biopsies and photographs of large whales from a RHIB (rigid hulled inflatable boat) on all good weather days that whales are present. (2) Apply dermal tags to North Atlantic right (*Eubalaena glacialis*) and sei (*Balaenoptera borealis*) whales from a RHIB on all good weather days that whales are present. (3) Deploy vertical profiling package from NOAA Ship *Gordon Gunter* in the trailing path of tagged whales for the duration of the tagging period (24-72 hr). (4) Conduct visual surveys in proximity to autonomous vehicles equipped with passive acoustic instrumentation. (5) Conduct zooplankton tows near whales from the ship. (6) Collect sei and North Atlantic right whale fecal and respiratory vapor samples for hormone analysis. (7) Deploy sonobuoys to systematically monitor for North Atlantic right whales and sei whales.

METHODS

Watches were conducted on the flying bridge of the *Gordon Gunter* from 0600 to 1800 unless weather conditions precluded observations. Teams of 3 observers used Big-Eye binoculars as well as naked eye to search for large whales, with 1 observer serving as a data recorder. Watch rotations lasted 90 min: 30 min at the port big-eye station, 30 min at the central data recorder position, and 30 min at the starboard big-eye station. Strict line-transect survey protocols were not used on this cruise since the objective was to find concentrations of whales, not to estimate abundance. The surveys were directed over bathymetric features where right whales tend to aggregate in the Great South Channel, Jeffreys Ledge, and on Howell Swell. The Woods Hole Oceanographic Institution (WHOI) had also deployed passive acoustic gliders in the Great South Channel which were monitored in real time by an analyst at the Northeast Fisheries Science Center. Positions of right and sei whales detected on the gliders were relayed to the ship via email.

All marine mammal sightings were recorded. Data recorded included species; number in group (including presence of calves); position; and direction of movement, behavior, and sighting cue. In addition, environmental variables were routinely recorded, and a suite of other information was automatically sampled by the ship's scientific computer system.

When right whales were sighted, the Chief Scientist would break track of the vessel at his discretion in an effort to obtain photographs for individual identification. If the weather conditions were good (usually Beaufort 3 or less, with minimal swell), 1 or both RHIBs would be deployed for photo-identification, biopsy, and dermal tagging attempts.

Where possible, right whales were individually identified in real time by using variations in callosity patterns and scarring. These methods were used to determine if whales needed to be biopsied or resampled. (Kraus et al. 1986).

Fecal samples: No fecal samples were collected during right whale cruise GU1603.

Biopsy samples were taken with a 68-kg draw crossbow and 40mm surgical stainless steel tips (Hunt et al. 2013).

All samples were placed in DMSO for further analysis.

RESULTS

Right whale cruise GU1603 was scheduled to be 30 sea days.

Departure from Woods Hole, Massachusetts for the *Gordon Gunter* was originally scheduled for April 15 2016. The cruise was delayed until April 29 because of technical difficulties: there were initially problems with the ship's sewage treatment system, and then in transit from Pascagoula, MS, to Woods Hole, MA, the main engine caught fire. The ship steamed slowly into Charleston, SC, to repair the main engine and took on stores and fuel. Because of the late departure leg 1 was canceled, and it was agreed to extend the last leg from April 29 – May 17, with a short port call in Boston, MA, on May 4 in order to make a personnel transfer. The ship departed Woods Hole at 16:30 on April 30 and proceeded towards the Great South Channel (GSC).

Observers were on watch for a total of 845.83 km of track line see (Figure 1). Survey effort and track lines within the GSC were directed in close association with the WHOI acoustic gliders in an attempt to react to any right or sei whale acoustic detections. Track lines over Jeffreys Ledge were directed over the 50 fathom contour and were drawn up from a report that came into the NEFSC sighting advisory system of 20 right whales on May 1. The survey effort in Howell Swell was directed by an observation by the NEFSC right whale aerial survey team of an aggregation of 10 right whales on May 11.

North Atlantic right whales

A total of 18 different individual North Atlantic right whales were photographed for individual identification. Fifteen of which were matched, (including 1 intermatch code: confirmed as a unique individual but has not yet been given a catalog number) to known individuals in the North Atlantic Right Whale Catalog see (Appendix A). Right whale 2271 was seen at 42.37247N 68.90563W (Figure 2) with a large abscess on the left flank. The observation and images of this individual were sent to staff at the New England Aquarium (NEAq) for health assessment (Pettis et al. 2016).

Tagging and Biopsy

On 1 May 2016 at 10:49 the WHOI team tagged a high skim feeding sei whale in the Great South Channel 41 38.6782N 069 45.2464W (Figure 2). Tag duration for this whale was 30 hours. The animal traveled over 88 nautical miles for the tagging period. The tag was recovered, and the archived data downloaded. On May 11 The WHOI team made 2 attempts to tag sei whales on Jeffreys Ledge but was unsuccessful. The NEFSC obtained good photo documentation of 12 - 15 sei whales and obtained 2 sei whale biopsy samples on May 11.

The WHOI team also made 3 attempts to tag North Atlantic right whales on Howell Swell on May 12 (Figure 2). Right whale 3812 was tagged at 08:23 with tag duration of 4 hours. Six conductivity, temperature, and depth (CTD) casts in the trailing path of the whale were completed before the tag came off the whale. The tag was recovered, and the archived data were downloaded. Right whale 3820 was tagged in the afternoon, but the tag quickly became detached when the corrosion wire broke on impact with the whale. A tagging attempt of right whale 3520 occurred in the evening with fading light. The tag shattered on impact, leaving just the implant needle. Images were obtained by the Northeast Fisheries Science Center (NEFSC) of all right whales tagged, tagging attempts, and tag implant sites.

Entangled whales

Two entangled whales were observed and reported to the Center for Coastal Studies (CCS) disentanglement team see (Figure 2). On May 11 while working with sei whales on Jeffreys Ledge, we encountered a sei whale with a single rostrum wrap of what looked like white line. We obtained some images and assessed the severity of the entanglement. Staff on the ship then notified the CCS disentanglement team and emailed the images to them. Based on the images, they made the decision to attempt to disentangle the animal. The disentanglement team ETA was ~ 2 hours. We stood by the animal for about 40 minutes to an hour, but it soon got too far from the ship and the tagging team. CCS did find the animal and determined the entanglement was a nylon packing strap, but with no trailing line and nothing to grapple onto they were unable to disentangle the animal.

The second entangled animal we documented was a juvenile humpback seen south of Chatham, MA, on the west side of the shipping lanes in the Great South Channel. We notified CCS but soon lost sight of the animal. With deteriorating weather and a 50 mile transit, CCS made the decision not to attempt to disentangle the animal.

Figure 1 shows completed surveys, on effort shipboard track lines and locations of sightings for each species. Figure 2 shows sei and right whale tagging locations the sighting location for right whale 2271 and the location of the 2 entangled whales documented on the cruise. Table 1 summarizes the survey effort and species sighting tallies for the survey. The Appendix lists our preliminary identifications of the right whales we photographed during the survey.

The North Atlantic right whale images we collected have been submitted to the North Atlantic Right Whale Catalog at the New England Aquarium in Boston, MA. Copies of the survey data and right whale images are available from Peter Duley at NOAA's Northeast Fisheries Science Center.

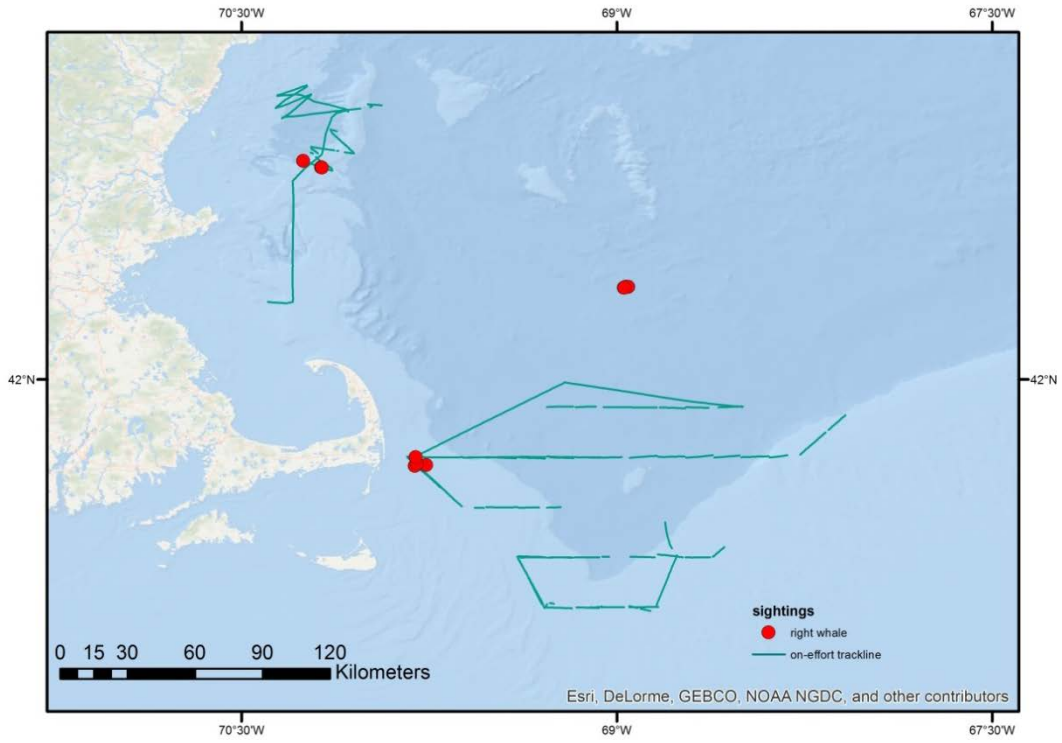
ACKNOWLEDGEMENTS:

The officers and deck crew of the NOAA ship *Gordon Gunter* for their skill in safe deployment and retrieval of the small boats for large whale photo id, biopsy, and tagging operations during the 2016 right whale cruise. All the scientists that participated in this year's cruise: Mark Baumgartner, Hansen Johnson, Suzanne Yin, Steven Thornton, Jenn Gatzke, Leah Crowe, Barbara Beblowski, Nicole Brandt, Marina Cucuzza, Danielle Cholewiak, and Delphine Durette-Morin. The NEFSC right whale aerial survey team: Tim Cole, Allison Henry, Christin Khan. The NOAA Twin otter pilots Brad Fritzler, Frank Centinello, and David Keith. Elizabeth Josephson prepared the figures and tables for the cruise report.

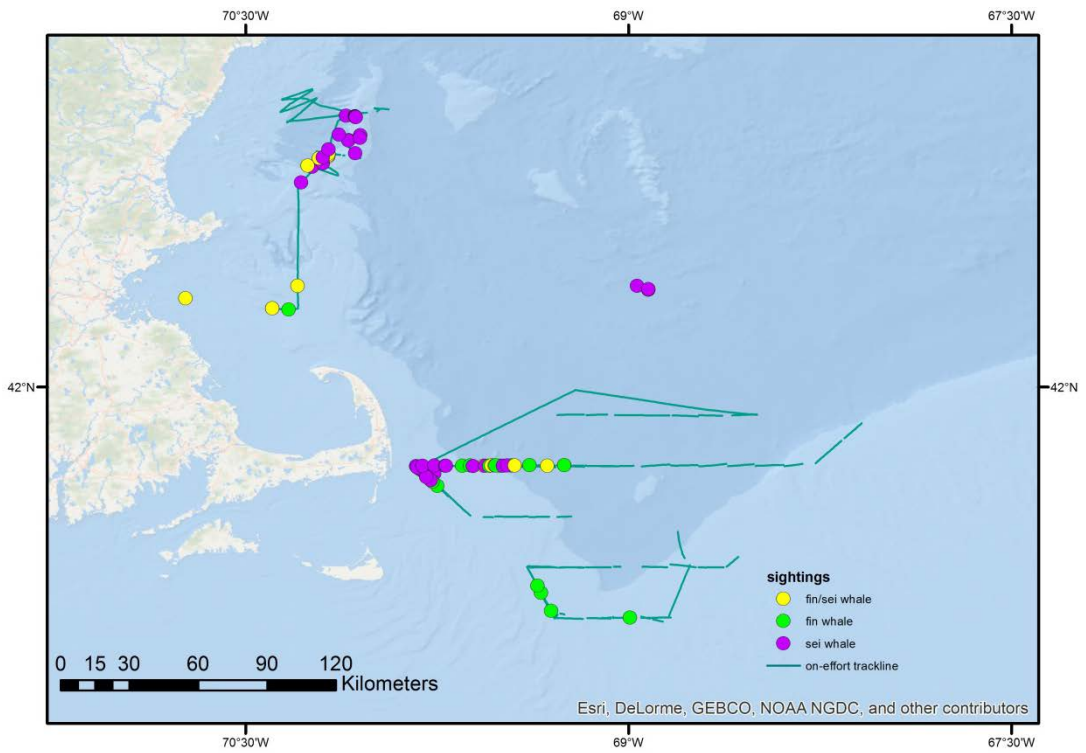
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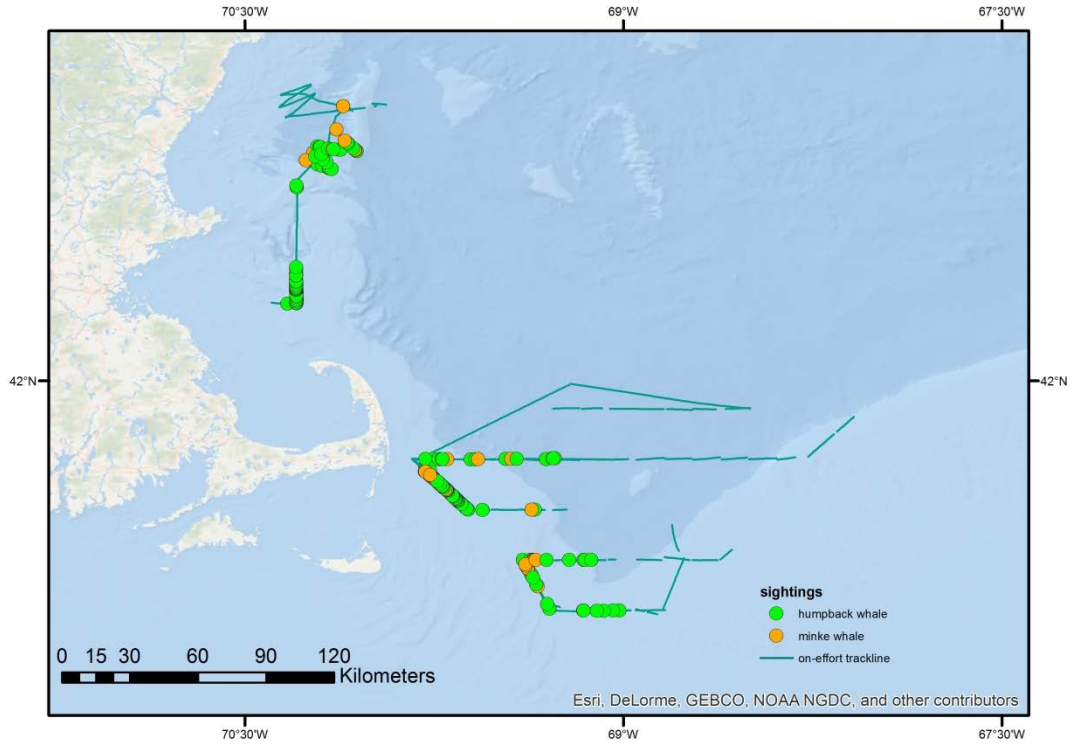
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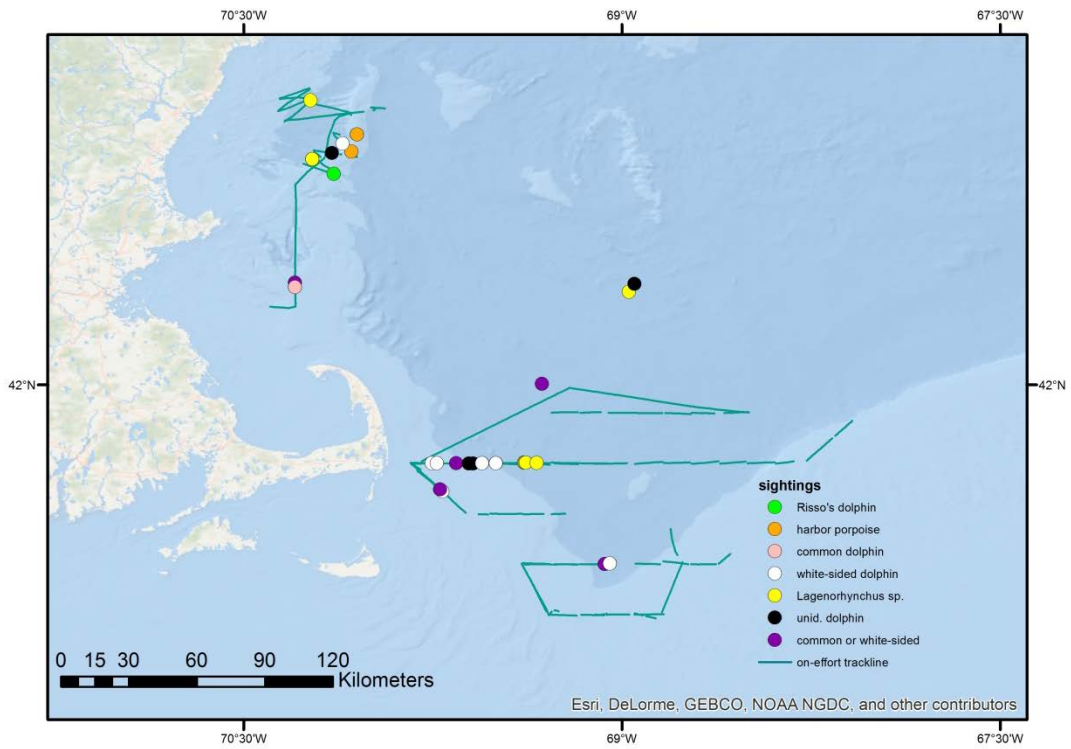
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C.



D.



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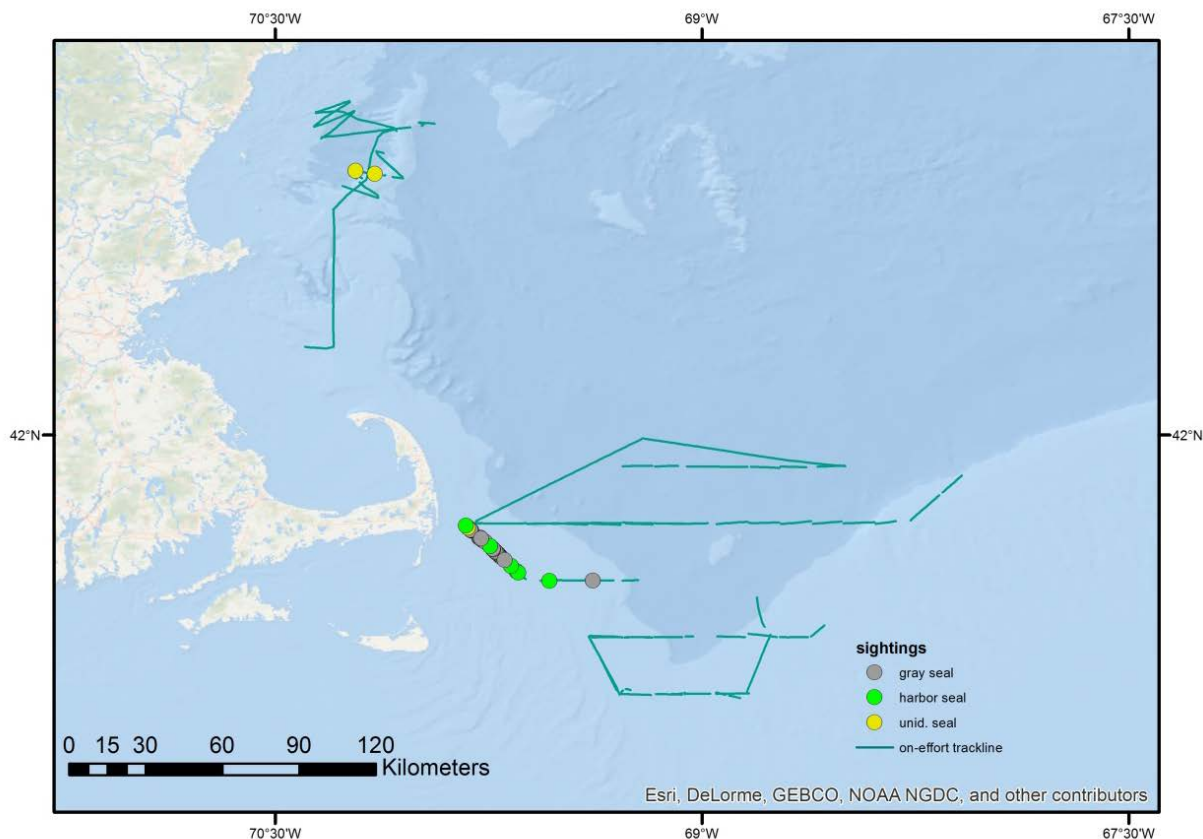


Figure 1. Showing completed surveys, on effort shipboard track lines (in green) and sighting locations for (A) North Atlantic right whales (*Eubalaena glacialis*); (B) Fin (*Balaenoptera physalus*), and Sei whales (*B. borealis*), (C) Humpback (*Megaptera novaeangliae*) and Minke (*B. acutorostrata*) whales, (D) small Odontocetes: Risso's dolphin (*Grampus griseus*), Harbor porpoise (*Phocoena phocoena*), Common dolphin (*Delphinus delphis*), and white-sided dolphin (*Lagenorhynchus acutus*) (E) Phocid seals: Harbor (*Phoca vitulina*) and gray (*Halichoerus grypus*) seals. There were no track lines recorded in Howell Swell just north of the Great South Channel (GSC), because the ship transited there during the night, and the small boats were deployed at the right whale aggregation reported to us by the NOAA twin otter crew.

Figure 2. Showing locations for tagged sei (*B. borealis*) and right whales (*Eubalaena glacialis*), the observation of right whale 2271 and the 2 entangled whales documented during GU1603

Table 1. Summary of survey effort and species tallies for the entire cruise GU1603.

GU1602 Search Effort by Beaufort Seastate					Species	# Groups	individuals
Seastate	Km effort						
0	12.16				Common Dolphin (<i>Delphinus delphis</i>)	1	1
1	61.15				Common or White-sided Dolphin	5	32
2	234.95				Risso's Dolphin, (<i>Grampus griseus</i>)	1	4
3	243.80				Dolphin, Unid. <i>Lagenorhynchus</i>	5	60
4	235.18				White-sided Dolphin (<i>Lagenorhynchus acutus</i>)	7	936
5	48.08				unid Dolphin	1	50
6	10.52				Harbor Porpoise (<i>Phocoena phocoena</i>)	1	5
Total	845.83				Gray Seal (<i>Halichoerus grypus</i>)	22	153
					Harbor Seal (<i>Phoca vitulina</i>)	5	8
					unid.Seal	3	5
					Leatherback Turtle (<i>Dermodochelys coriacea</i>)	1	1
					Unknown	2	2
					Finback Whale (<i>Balaenoptera physalus</i>)	11	16
					Fin or Sei Whale	13	19
					Humpback Whale (<i>Megaptera novaeangliae</i>)	123	199
					Minke Whale (<i>Balaenoptera acutorostrata</i>)	36	39
					Right Whale (<i>Eubalaena glacialis</i>)	4	18
					Sei Whale (<i>Balaenoptera borealis</i>)	32	58
					Unid. Baleen Whale	3	3
					Unid. Large Whale	39	44
					Unid. Medium Whale	4	4

APPENDIX A. Preliminary identifications (catalog number) of photographed right whales (*Eubalaena glacialis*), from the 2016 North Atlantic right whale shipboard surveys in the Great South Channel (GSC), Jeffreys Ledge, and Howell Swell.

Date	Location	Catalog #	Gender	Notes
1-May	GSC	1970	F	
1-May	GSC	3714	M	
1-May	GSC	1250	M	
12-May	Howell Swell	3812	M	Tagged, tag duration 4 hours
12-May	Howell Swell	1627	M	
12-May	Howell Swell	3820	F	Tagging attempt. Tag quickly became detached when corrosion wire broke on impact w/whale
12-May	Howell Swell	3296	M	
12-May	Howell Swell	2135	M	
12-May	Howell Swell	4041	F	
12-May	Howell Swell	1243	F	
12-May	Howell Swell	3992	M	
12-May	Howell Swell	2271	M	abscess on left flank/ images sent to NEAq for health assessment
12-May	Howell Swell	1616	M	
12-May	Howell Swell	4045	F	
12-May	Howell Swell	3520	F	Tag attempt shattered on impact

APPENDIX B. SONOBUOY DEPLOYMENTS

Methods

Directional Frequency and Ranging (DIFAR) sonobuoys (model AN/SSQ-53F) were deployed throughout the GU16-03 survey, in addition to visual surveys conducted by marine mammal observers. Sonobuoys were deployed systematically as acoustic sampling stations, several miles prior to predetermined conductivity, temperature, and depth (CTD) stations, as well as opportunistically, when sighting conditions were poor. Sonobuoys were also deployed for acoustic prospecting when the ship transited overnight to Howell Swell, where North Atlantic right whales had been previously sighted, and for targeted recordings.

Sonobuoy signals were received with an omnidirectional Diamond X30A base antenna mounted to the mast of the vessel. Signals were routed through a WinRadio receiver and to a desktop computer running the software package Pamguard, including the DIFAR processing module. When vocalizations were detected on the spectrogram, calls were selected and localized to provide the bearing of vocalizing animals in relation to the vessel. In most cases, sonobuoys were deployed as single acoustic stations. However, on several occasions 2 or more buoys were deployed to facilitate localization of calling animals.

Results

A total of 41 sonobuoys were deployed throughout the survey. Of these, 36 were successful, and 5 failed immediately or shortly after deployment. Vocalizations from 5 large whale species were detected: humpback (*Megaptera novaeangliae*), sei (*Balaenoptera borealis*), minke (*Balaenoptera acutorostrata*), fin (*Balaenoptera physalus*), and North Atlantic right whales (*Eubalaena glacialis*).

Large whales were acoustically detected at 30 of the sonobuoy stations (Figure AppB1); in addition, unidentified delphinids were detected at several sites. The most predominant species detected acoustically was humpback whales; humpback song or social sounds were heard at 22 sites and were possibly detected at an additional 7 sites. Sei whales were heard at 9 sites, primarily in the Jeffrey's Ledge area, though they were also detected at both the eastern and western edges of the Great South Channel (GSC) and possibly in the middle of the GSC. Fin whales and minke whales were only detected at 2-3 sites each, both near the western edge of the GSC. North Atlantic right whales were only acoustically detected at Howell Swell, in the same area where they were visually detected in high numbers and where tagging attempts occurred. Both up-calls and gunshots were recorded in this area at night, prior to the deployment of the small boats. Two sonobuoys were deployed in close proximity (several km) for localization testing. Right whales were not acoustically detected in 2 other areas where they were sighted during visual surveying.

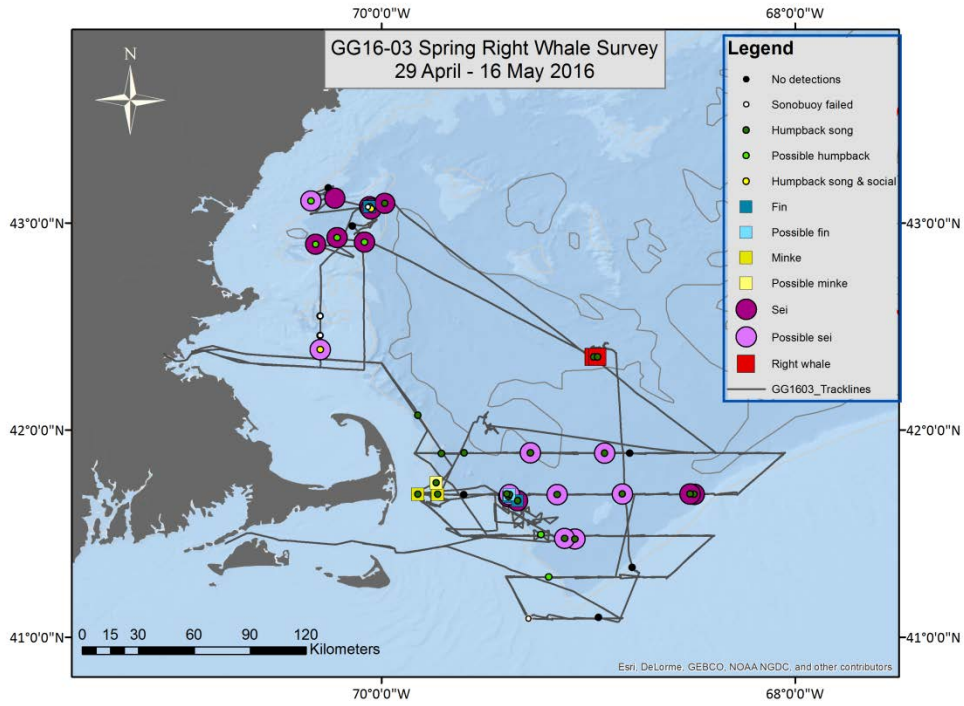


Figure B1. Map showing locations of 41 sonobuoy deployments, overlaid on the trackline for the GU16-03 survey. Sonobuoys failed at 5 sites (gray dots), and no cetacean vocalizations were detected at 6 sites (black dots). At the remaining 30 sites, 1 or more large whale species were detected.

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