Northern leg of aerial abundance survey during February - March 2014: Northeast Fisheries Science Center

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SUMMARY
During 17 February – 27 March 2014, the Northeast Fisheries Science Center (NEFSC) conducted aerial abundance surveys targeting marine mammals and sea turtles. The southwestern extent was New Jersey and the northeastern extent was the southern tip of Nova Scotia, Canada. This survey covered waters from the coast line to about the 2000 m depth contour. Track lines were flown 183 m (600 ft) above the water surface, at about 200 kph (110 knots). The two-independent team methodology was used to collect the data. In Beaufort sea states of six and less, about 4900 km of on-effort track lines were surveyed. About 430 individuals within 155 groups of 11 species (or species groups) of cetaceans, seals and large fish were detected by one or both teams. The most regularly detected small cetacean species were white-sided dolphins, bottlenose dolphins and harbor porpoises; right whales and minke whales were the most common large whales. No sea turtles were detected.

OBJECTIVES
The objectives of these aerial flights were to collect the data needed to estimate abundance of cetaceans and turtles in the study area, and to investigate how the animal's distribution and abundance relate to their physical and biological ecosystem.

CRUISE PERIOD AND AREA
This survey was conducted during 17 February – 27 March 2014. The study area extended from New Jersey to the southern tip of Nova Scotia, Canada, from the coast line to about the 2000 m depth contour (Figure A1).

METHODS
The aerial surveys were conducted on a DeHavilland Twin Otter DHC-6 aircraft over Atlantic Ocean waters off the east coast of the U.S. and Canada. Track lines were flown 183 m (600 ft) above the water surface, at about 200 kph (110 knots), when Beaufort sea state conditions were six and below, and when there was at least two miles of visibility.

When a cetacean, seal, turtle, sunfish, or basking shark was observed the following data were collected:

- Time animal passed perpendicular to the observer;
- Species identification;
- Species identification confidence level (certain, probable, not sure);
- Best estimate of the group size;
- Angle of declination between the track line and location of the animal group when it passed abeam (measured to the nearest one degree by inclinometers or marks on the windows, where 0^{o} is straight down);
- Cue (animal, splash, blow, footprint, birds, vessel/gear, windrows, disturbance, or other);

- Swim direction (0º indicates animal was swimming parallel to the track line in the same direction the plane was flying, 90º indicates animal was swimming perpendicular to the track line and towards the right, etc.);
- If the animal appeared to react to the plane (yes or no);
- If a turtle was initially detected above or below the surface, and;
- Comments, if any.

Other fish species were also recorded opportunistically. Species identifications were recorded to the lowest taxonomic level possible.

At the beginning of each leg, and when conditions changed the following effort data were collected:

- Initials of person in the pilot seats and observation stations;
- Beaufort sea state (recorded to one decimal place);
- Water turbidity (clear, moderately clear or turbid);
- Percent cloud cover (0-100%);
- Angle glare swath started and ended at (0-359º), where 0º was the track line in the direction of flight and 90º was directly abeam to the right side of the track line;
- Magnitude of glare (none, slight, moderate, and excessive); and
- Subjective overall quality of viewing conditions (excellent, good, moderate, fair, and poor), where data collected in poor conditions indicated conditions were so poor that that part of the track line should not be used in analyses.

In addition, the location of the plane was recorded every two seconds with a GPS that was attached to the data entry program. Sightings and effort data were collected by a computer program called VOR.exe, version 8.75 originally created by Phil Lovell and Lex Hiby.

To help correct for perception bias data were collected to estimate the parameter *g(0)*, the probability of detecting a group on the track line. This was accomplished by using the two independent team data collection method (Laake and Borchers 2004).

Onboard, in addition to two pilots, were six scientists who were divided into two teams. One team, the primary forward team, consisted of a recorder and two observers viewing through the two forward right and left bubble windows. The other team, the independent back team, consisted of one observer viewing through the back belly window, one observer viewing through either the right or left back window (depending on which side the sighting conditions were best), and a recorder. The two observer teams operated on independent intercom channels so that they were not able to cue one another to sightings.

When at the end of track lines or about every 30-40 minutes, scientists rotated between the observations positions. The belly window observer was limited to approximately a 30º view on both sides of the track line. The bubble window and back side observers searched from straight down to the horizon, with a concentration on waters between straight down (0º) and about 60º up from straight down.

When both teams could not identify the species of a group that was within about 60º of the track line and there was a high chance that the group could be relocated, sighting effort was broke off, and the plane returned to the group to confirm the species identification and group size. The

marine mammal and turtle data will be reviewed at a later time to identify duplicate sightings made by the two teams based upon time, location, and position relative to the trackline.

In addition, to determine the approximate area that a species can be detected, when possible the front team also collected the time a group was initially seen and then also collected the time and angle of declination of that same group when it was perpendicular to the observers position. The initial time a group was seen was identified in the sightings data by a species identification of "FRST".

RESULTS

The observers and pilots who collected these data are listed in Table A1.

Twelve of the 39 days had sufficiently good weather and a working plane to conduct the survey. There were about 4900 km of "on-effort" track lines, where 72% of the track lines were surveyed in Beaufort 2 and 3 (Table A2).

On the on-effort portions of the track lines, 243 and 264 individual cetaceans within 58 and 71 groups were detected by the back and front teams, respectively (Table A3). The locations of sightings seen on the on-effort transect legs, by species, are displayed in Figures A2 – A5, where harbor porpoises are in Figure A2, dolphins in Figures A3, whales in Figures A4, and seals and other species in Figure A5. The sightings included six species of identifiable cetaceans: minke whales, fin whales, right whales, white-sided dolphins, bottlenose dolphins, and harbor porpoises. In addition, sunfish and seals (most likely either harbor or gray seals) were also seen. No sea turtles were detected. The most regularly detected small cetacean species were white-sided dolphins, bottlenose dolphins and harbor porpoises. Right whales and minke whales were the most common large whales.

DISPOSITION OF DATA

All data collected during this survey will be maintained by the Protected Species Branch at NEFSC in Woods Hole, MA and are available from the NEFSC's Oracle database.

PERMITS

NEFSC was authorized to conduct these research activities during this survey under US Permit No. 17355 issued to the NEFSC by the NMFS Office of Protected Resources. The NOAA aircraft was granted diplomatic overflight clearance in Canadian airspace with the overflight clearance number 0039-US-2014-02-TC. NEFSC was authorized to conduct these research activities in Canadian airspace under the Species at Risk Permit license number 330996.

ACKNOWLEDGEMENTS

Funds for this project came from the Bureau of Ocean Energy Management (BOEM) and the US Navy through the respective Interagency Agreements for the AMAPPS project. Flight time and other aircraft costs were funded by NOAA Aircraft Operations Center (AOC). Staff time was also provided by the NOAA Fisheries Service, Northeast Fisheries Science Center (NEFSC) and NOAA AOC. We would like to thank the pilots and observers involved in collecting these data.

REFERENCES CITED

Laake JL, Borchers DL. 2004. Methods for incomplete detection at distance zero, In: Advanced distance sampling, edited by S. T. Buckland, D. R. Andersen, K. P. Burnham, J. L. Laake, and L. Thomas, pp. 108–189, Oxford University Press, New York.

Table A1. List of observers and pilots that participated in the spring 2014 Northeast AMAPPS aerial survey, along with their affiliations.

Name	Affiliation
OBSERVERS	
Tim Cole	Northeast Fisheries Science Center, Woods Hole, MA
Peter Duley	Northeast Fisheries Science Center, Woods Hole, MA
Allison Henry	Northeast Fisheries Science Center, Woods Hole, MA
Christin Khan	Northeast Fisheries Science Center, Woods Hole, MA
Val Sherlock	Integrated Statistics, Inc, Woods Hole, MA
Robert DiGiovanni	Integrated Statistics, Inc, Woods Hole, MA
Rachel Hardee	Integrated Statistics, Inc, Woods Hole, MA
Richard Holt	Integrated Statistics, Inc, Woods Hole, MA
PILOTS	
Dave Gothan	NOAA Aircraft Operations Center, Tampa, FL
Francisco Fuenmayor	NOAA Aircraft Operations Center, Tampa, FL
Mike Marino	NOAA Aircraft Operations Center, Tampa, FL
Sandor Silagi	NOAA Aircraft Operations Center, Tampa, FL

Table A2. Length of on-effort track lines (in km) surveyed by Beaufort sea state.

	Beaufort sea state						
	1	2	3	4	5	6	Total
track length (km)	130.6	1406.9	2097.8	949.7	215.6	103.9	4904.5
% of total	3	29	43	19	4	2	100

Table A3. Spring 2014 Northeast AMAPPS aerial survey: Number of groups and individuals of species detected while on-effort by the front and back teams. Some of the groups seen by the back team were also seen by the front team.

		Number of groups		Number of individuals	
Species		**Back**	**Front**	**Back**	**Front**
Bottlenose dolphin spp.	*Tursiops truncatus*	3	3	75	35
Common or white-sided dolphin		4	2	14	7
Fin whale	*Balaenoptera physalus*	0	2	0	2
Harbor porpoise	*Phocoena phocoena*	25	28	30	51
Minke whale	*B. acutorostrata*	1	3	1	4
Right whale	*Eubalaena glacialis*	1	6	1	6
Unid dolphin	*Delphinidae*	9	9	61	27
Unid large whale	*Mysticeti*	1	1	1	1
White-sided dolphin	*Lagenorhynchus acutus*	14	17	60	131
Total cetaceans		58	71	243	264
Ocean sunfish	*Mola mola*	2	2	2	2
Unid seal	*Pinniped*	23	26	23	26
Total all species		83	99	268	292

Figure A1. Spring 2014 Northeast AMAPPS aerial survey (17 February – 27 March 2014): completed on-effort track lines. The 100 m and 2000 m depth contours and the US economic exclusion zone (EEZ) are shown.

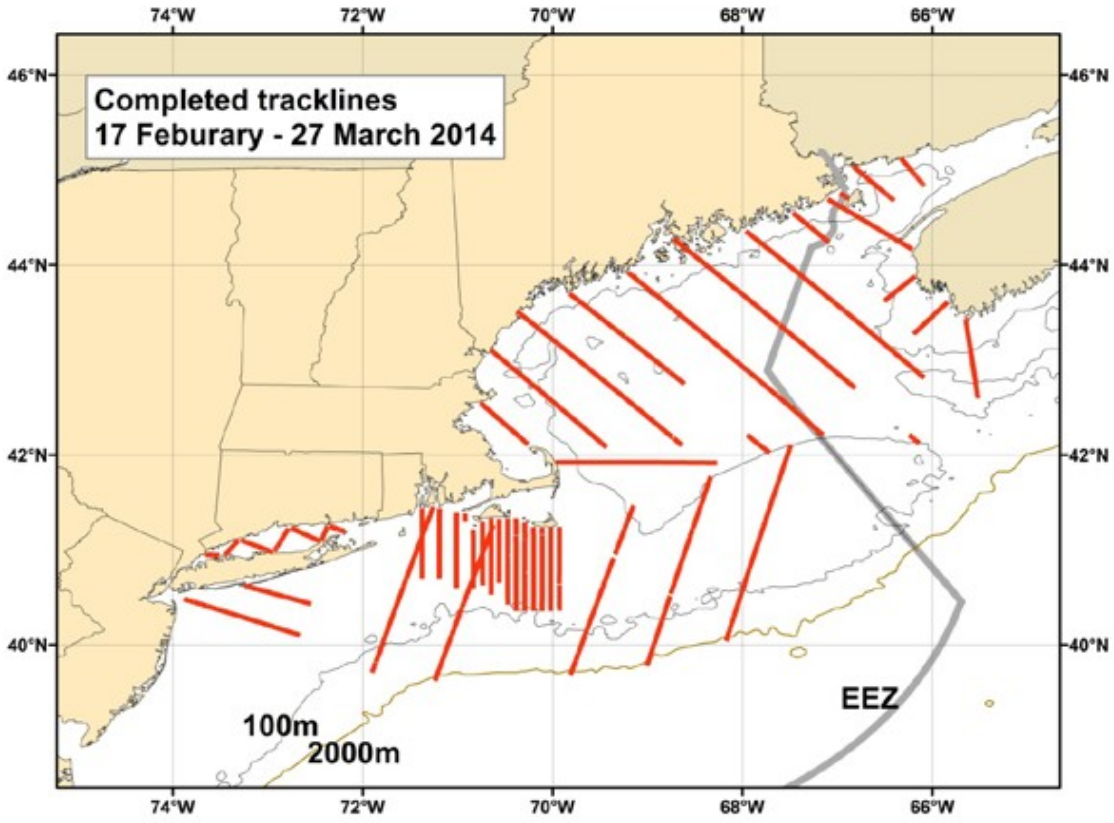

Figure A2. Spring 2014 Northeast AMAPPS aerial survey (17 February – 27 March 2014): Locations of harbor porpoises detected by either one or both teams. The 100 m and 2000 m depth contours and the US economic exclusion zone (EEZ) are shown.

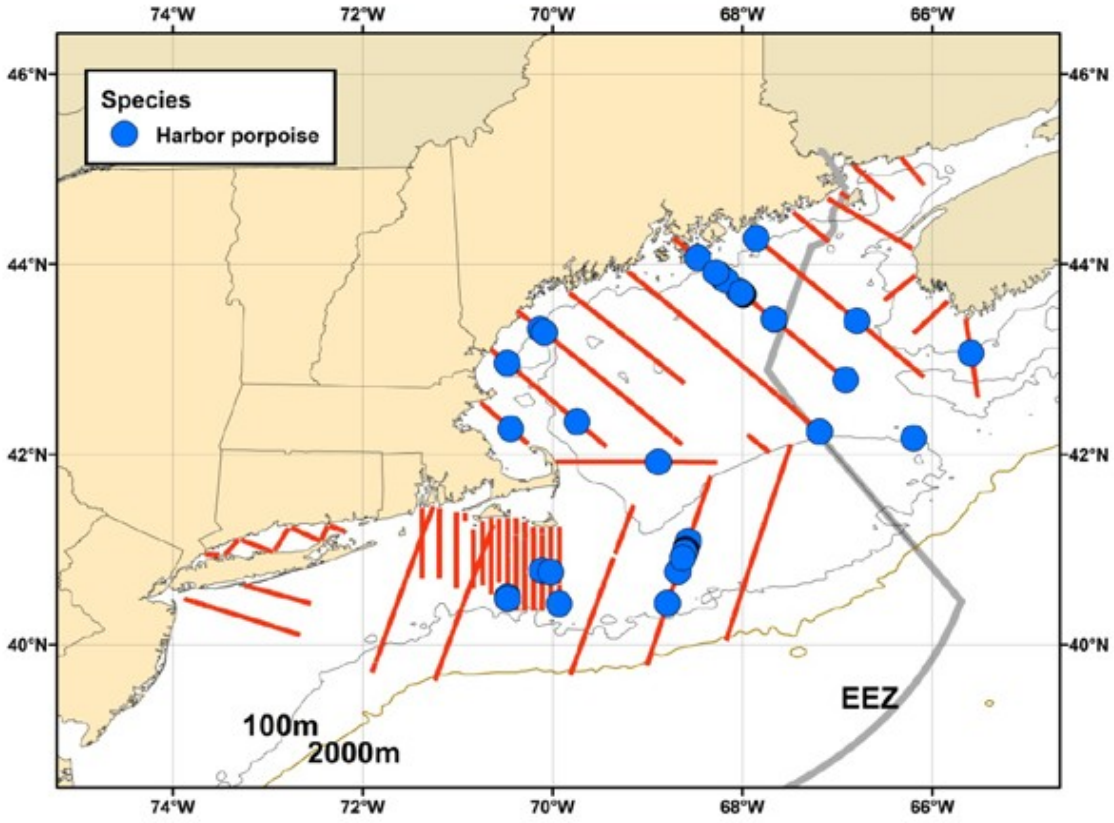

Figure A3. Spring 2014 Northeast AMAPPS aerial survey (17 February – 27 March 2014): Locations of bottlenose dolphins (red circles), white-sided dolphins (green square), common or white-sided dolphins (blue triangle), and unidentified dolphins (black cross) detected by either one or both teams. The 100 m and 2000 m depth contours and the US economic exclusion zone (EEZ) are shown.

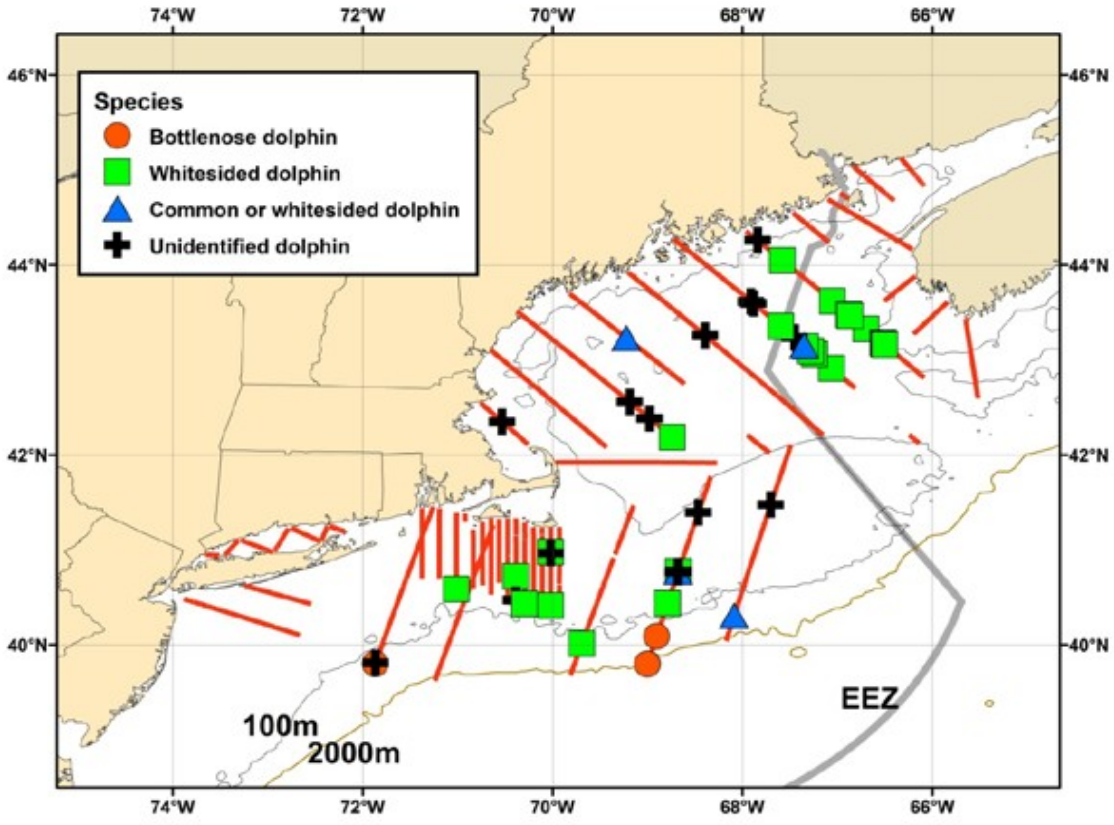

Figure A4. Spring 2014 Northeast AMAPPS aerial survey (17 February – 27 March 2014): Locations of fin whales (green square), minke whales (blue triangle), right whales (red circle) and unidentified large whales (black cross) detected by either one or both teams. The 100 m and 2000 m depth contours and the US economic exclusion zone (EEZ) are shown.

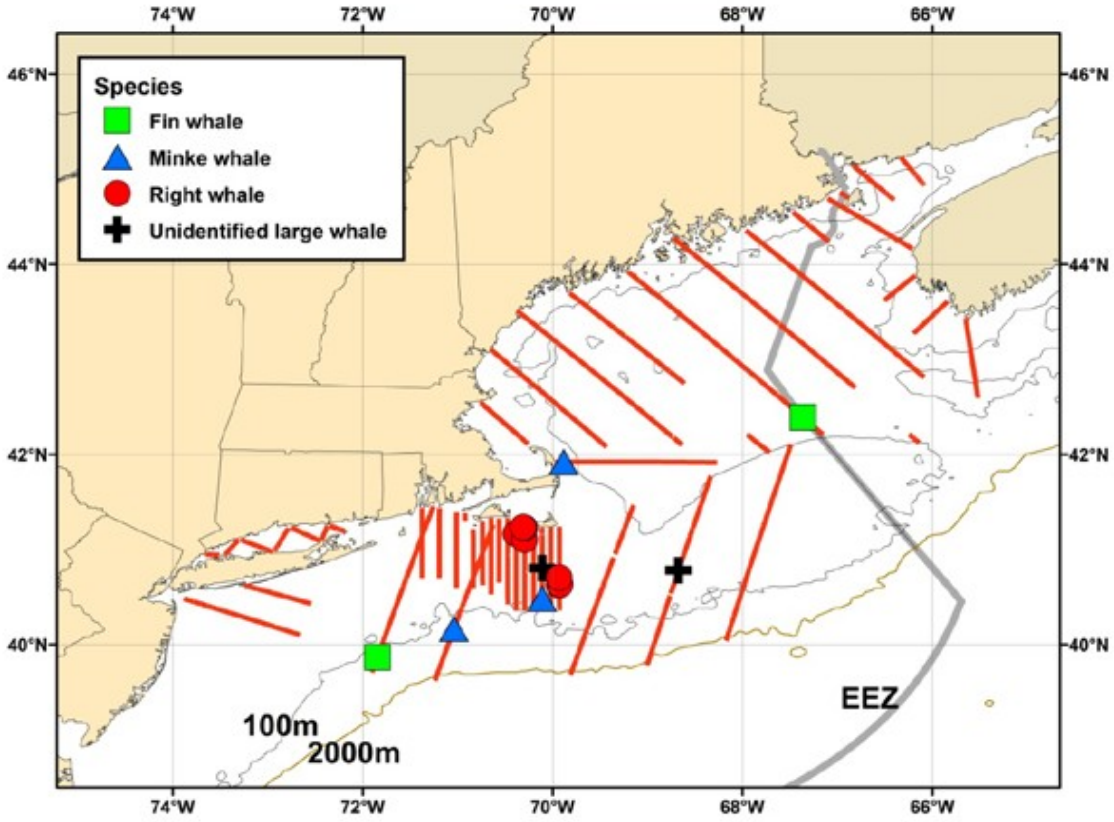

Figure A5. Spring 2014 Northeast AMAPPS aerial survey (17 February – 27 March 2014): Locations of sunfish, *Mola mola* (black circle), and unidentified seals (blue square) detected by either one or both teams. The 100 m and 2000 m depth contours and the US economic exclusion zone (EEZ) are shown.