



UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Northeast Fisheries Science Center
166 Water Street
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AERIAL SURVEY RESULTS

NOAA DEHAVILLAND TWIN OTTER AIRCRAFT

Northern aerial abundance surveys during spring and fall 2012

SUMMARY

During 28 March – 3 May 2012 and 17 October – 16 November 2012, the Northeast Fisheries Science Center (NEFSC) conducted aerial abundance surveys targeting marine mammals and sea turtles. The southwestern extent of both surveys was New Jersey. The northeastern extent was the southern tip of Nova Scotia, Canada for the spring survey and it was off Halifax, Nova Scotia, Canada for the fall survey. Both surveys 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 4 and less, about 6800 km of on-effort track lines were surveyed in the spring survey and about 7100 km in the fall survey. During spring, over 700 individuals within over 200 groups of 24 species (or species groups) of cetaceans, seals and large fish were detected. The most regularly detected small cetacean species were white-sided dolphins, bottlenose dolphins and harbor porpoises; fin whales were the most common large whale; no sea turtles were detected. During fall, over 1700 individuals within over 240 groups of 28 species (or species groups) of cetaceans, sea turtles, seals, and large fish species were detected. The most regularly detected small cetacean species were common dolphins, white-sided dolphins and bottlenose dolphins; the most common large whales were humpback whales, fin whales and minke whales; and the most common turtle was the loggerhead turtle.

This survey was part of the Atlantic Marine Assessment Program for Protected Species (AMAPPS). During the same general time periods of spring and fall 2012 the Southeast Fisheries Science Center conducted a similar aerial survey covering the southern US Atlantic waters and the US Fish and Wildlife Service conducted an aerial survey targeting seabirds over coastal waters (0 – 30 nmi offshore) along the entire US Atlantic coast.

OBJECTIVES

The objectives of these aerial surveys 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

Spring survey

The spring survey was conducted during 28 March – 3 May 2012. 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 1).

Fall survey

The fall survey was conducted during 17 October – 16 November 2012. The study area extended from New Jersey to Scotia shelf waters off Halifax, Canada, from the coast line to about the 2000 m depth contour (Figure 2). This included broad scale coverage over this entire area and fine scale coverage over the Bureau of Ocean Energy Management (BOEM) wind energy area south of Massachusetts and Rhode Island.

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 below five, 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° is straight down);
- Cue (animal, splash, blow, footprint, birds, vessel/gear, windrows, disturbance, or other);
- Swim direction (0° indicates animal was swimming parallel to the track line in the same direction the plane was flying, 90° 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 the animal was diving (yes or no), 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 (0-359°), where 0° was the track line in the direction of flight and 90° 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 30° 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 (0°) and about 60° up from straight down.

When both teams could not identify the species of a group that was within about 60° 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.

RESULTS

The observers and pilots who collected these data are listed in Table 1.

Spring survey

Nine of the 37 days had sufficiently good weather to conduct the survey. There were about 6806 km of “on-effort” track lines.

On the on-effort track lines, 426 and 734 individual cetaceans within 157 and 198 groups were

detected by the back and front teams, respectively (Table 2). The locations of sightings seen on the on-effort spring transect legs, by species, are displayed in Figures 3 – 9, where harbor porpoises are in Figure 3, dolphins in Figures 4 – 5, whales in Figures 6 – 8, seals in 8, and other species in Figure 9. The sightings included 15 species of identifiable cetaceans: humpback whales, minke whales, fin whales, sei whales, right whales, sperm whales, Cuvier’s beaked whales (goose-beaked), pilot whales, white-sided dolphins, white-beaked dolphins, common dolphins, Risso’s dolphins, bottlenose dolphins, striped dolphins, and harbor porpoises. In addition, basking sharks, sunfish and seals (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, along with one large group of about 100 striped dolphins. Fin whales and whales that were either a fin or sei whale were the most common large whale.

Fall survey

Of the 31 days allocated to this project, 11 days had sufficiently good weather to conduct the survey. There were about 7,134 km of “on-effort” track lines (Figure 2).

On the on-effort track lines, 1173 and 1619 individual cetaceans (from 135 and 154 groups) were detected by the back and front teams, respectively (Table 3). The locations of sightings seen on the on-effort spring transect legs, by species, are displayed in Figures 10 – 17, where harbor porpoises are in Figure 10, dolphins in Figures 11 – 12, whales in Figures 13 – 14, turtles in 15, seals in 16, and other species in Figure 17. These comprised of 14 species of identifiable cetaceans: minke whales, fin whales, sei whales, right whales, sperm whales, humpback whales, pilot whales, Risso’s dolphins, white-sided dolphins, white-beaked dolphins, common dolphins, bottlenose dolphins, striped dolphins, and harbor porpoises. In addition, leatherback turtles, loggerhead turtles, green turtles, basking sharks, great white sharks, ocean sunfishes, and seals (either harbor or gray seals) were seen. The most regularly detected small cetacean species were common dolphins, white-sided dolphins and bottlenose dolphins; the most common large whales were humpback whales, fin whales and minke whales; and the most common turtle was the loggerhead turtle.

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. 775-1875 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 0536-US-2012-10-TC. NEFSC was authorized to conduct these research activities in Canadian airspace under the Species at Risk Permit license number 330996.

ACKNOWLEDGEMENTS

The 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. Staff time was also provided by the NOAA Fisheries Service, Northeast Fisheries Science Center (NEFSC)

and NOAA Aircraft Operations Center (AOC). We would like to thank the pilots and observers involved in collecting the spring and fall 2012 aerial surveys and David Cowan from NOAA Aircraft Operations Center (AOC) who was very helpful preparing for these flights.

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 1. List of observers and pilots that participated in the spring and fall 2012 Northeast aerial surveys, along with their affiliations.

Name	Affiliation	Spring	Fall
OBSERVERS			
Tim Cole	Northeast Fisheries Science Center, Woods Hole, MA	P	P
Peter Duley	Northeast Fisheries Science Center, Woods Hole, MA	P	P
Allison Henry	Northeast Fisheries Science Center, Woods Hole, MA	P	P
Christin Khan	Northeast Fisheries Science Center, Woods Hole, MA	P	
Debra Palka	Northeast Fisheries Science Center, Woods Hole, MA	P	P
Corey Accardo	Integrated Statistics, Inc, Woods Hole, MA		P
Mary Jo Barkaszi	Integrated Statistics, Inc, Woods Hole, MA	P	
Lisa Barry	Integrated Statistics, Inc, Woods Hole, MA	P	
Allison Challiett	Integrated Statistics, Inc, Woods Hole, MA	P	P
Robert DiGiovanni	Integrated Statistics, Inc, Woods Hole, MA	P	P
Marjorie Foster	Integrated Statistics, Inc, Woods Hole, MA		P
Gary Friedrichsen	Integrated Statistics, Inc, Woods Hole, MA		P
Jennifer Gatzke	Integrated Statistics, Inc, Woods Hole, MA	P	P
Joy Hampp	Integrated Statistics, Inc, Woods Hole, MA		P
Rachel Hardee	Integrated Statistics, Inc, Woods Hole, MA		P
Richard Holt	Integrated Statistics, Inc, Woods Hole, MA	P	P
Sarah Mussoline	Integrated Statistics, Inc, Woods Hole, MA		P
PILOTS			
Nicholas Toth	NOAA Aircraft Operations Center, Tampa, FL	P	
Mark Nelson	NOAA Aircraft Operations Center, Tampa, FL	P	
Michael Hirsch	NOAA Aircraft Operations Center, Tampa, FL	P	
Michael Silagi	NOAA Aircraft Operations Center, Tampa, FL		P
Kevin Doremus	NOAA Aircraft Operations Center, Tampa, FL		P

Table 2. Spring 2012 Northeast AMAPPS aerial survey: Number of groups and individuals of species detected while on-effort by the front and back survey teams. Some of the groups seen by the back team were also seen by the front team.

Species		Number of groups		Number of individuals	
		Back	Front	Back	Front
Beaked whales spp.	<i>Mesoplodon spp.</i>	0	3	0	6
Bottlenose dolphin spp.	<i>Tursiops truncatus</i>	14	10	64	107
Common dolphin	<i>Delphinus delphis</i>	4	4	36	36
Common or white-sided dolphin		3	3	10	16
Fin whale	<i>Balaenoptera physalus</i>	13	17	15	26
Fin or sei whale	<i>B. physalus</i> or <i>B. borealis</i>	5	4	6	22
Goose-beaked whale	<i>Ziphius cavirostris</i>	1	0	4	0
Harbor porpoise	<i>Phocoena phocoena</i>	56	76	70	97
Humpback whale	<i>Megaptera novaeangliae</i>	10	9	16	12
Minke whale	<i>B. acutorostrata</i>	3	5	3	5
Right whale	<i>Eubalaena glacialis</i>	2	2	2	2
Risso's dolphin	<i>Grampus griseus</i>	4	8	8	29
Pilot whale spp.	<i>Globicephala spp.</i>	2	2	3	2
Sei whale	<i>Balaenoptera borealis</i>	0	5	0	6
Sperm whale	<i>Physeter macrocephalus</i>	1	2	1	2
Striped dolphin	<i>Stenella coeruleoalba</i>	0	1	0	100
Unid dolphin	<i>Delphinidae</i>	15	15	33	38
Unid whale	<i>Mysticeti</i>	5	11	5	14
White beaked dolphin	<i>Lagenorhynchus albirostris</i>	1	1	7	6
White-sided dolphin	<i>Lagenorhynchus acutus</i>	18	20	143	208
Total cetaceans		157	198	426	734
Basking shark	<i>Cetorhinus maximus</i>	5	8	6	8
Ocean sunfish	<i>Mola mola</i>	1	4	1	4
Hammerhead shark	<i>Sphyrna spp.</i>	1	0	1	0
Gray seal	<i>Halichoerus grypus</i>	1	0	1	0
Unid seal	<i>Pinniped</i>	48	48	3	52
Total all species		213	258	438	798

Table 3. Fall 2012 Northeast AMAPPS aerial survey: Number of groups and individuals of species detected while on-effort by the front and back survey teams. Some of the groups seen by the back team were also seen by the front team.

Species		Number of groups		Number of individuals	
		Back	Front	Back	Front
Bottlenose dolphin spp.	<i>Tursiops truncatus</i>	20	14	265	187
Common dolphin	<i>Delphinus delphis</i>	34	34	607	663
Common or white-sided dolphin		2	3	19	29
Fin whale	<i>Balaenoptera physalus</i>	10	13	10	14
Fin or sei whale	<i>B. physalus</i> or <i>B. borealis</i>	1	3	1	3
Harbor porpoise	<i>Phocoena phocoena</i>	26	19	35	52
Humpback whale	<i>Megaptera novaeangliae</i>	5	11	7	18
Minke whale	<i>B. acutorostrata</i>	3	7	3	15
Right whale	<i>Eubalaena glacialis</i>	1	0	1	0
Risso's dolphin	<i>Grampus griseus</i>	7	9	15	30
Pilot whale spp.	<i>Globicephala</i> spp.	2	4	8	8
Sei whale	<i>Balaenoptera borealis</i>	0	3	0	9
Sperm whale	<i>Physeter macrocephalus</i>	1	2	1	2
Striped dolphin	<i>Stenella coeruleoalba</i>	3	4	23	188
Unid dolphin	<i>Delphinidae</i>	8	13	30	116
Unid whale	<i>Mysticeti</i>	5	7	5	7
White beaked dolphin	<i>Lagenorhynchus albirostris</i>	1	0	4	0
White-sided dolphin	<i>Lagenorhynchus acutus</i>	6	8	139	278
Total cetaceans		135	154	1173	1619
Basking shark	<i>Cetorhinus maximus</i>	29	34	35	44
Ocean sunfish	<i>Mola mola</i>	18	19	18	19
Great white shark	<i>Carcharodon carcharias</i>	1	0	1	0
Leatherback turtle	<i>Dermochelys coriacea</i>	10	5	10	5
Loggerhead turtle	<i>Caretta caretta</i>	22	16	22	16
Green turtle	<i>Chelonia mydas</i>	0	1	0	1
Unid hardshell turtle	<i>Chelonioidea</i>	0	1	0	1
Harbor seal	<i>Phoca vitulina</i>	1	1	1	1
Gray seal	<i>Halichoerus grypus</i>	0	2	0	2
Unid seal	<i>Pinniped</i>	4	3	4	3
Total all species		220	236	1264	1711

Figure 1. Spring 2012 Northeast AMAPPS aerial survey (28 March – 3 May 2012): completed tracklines.

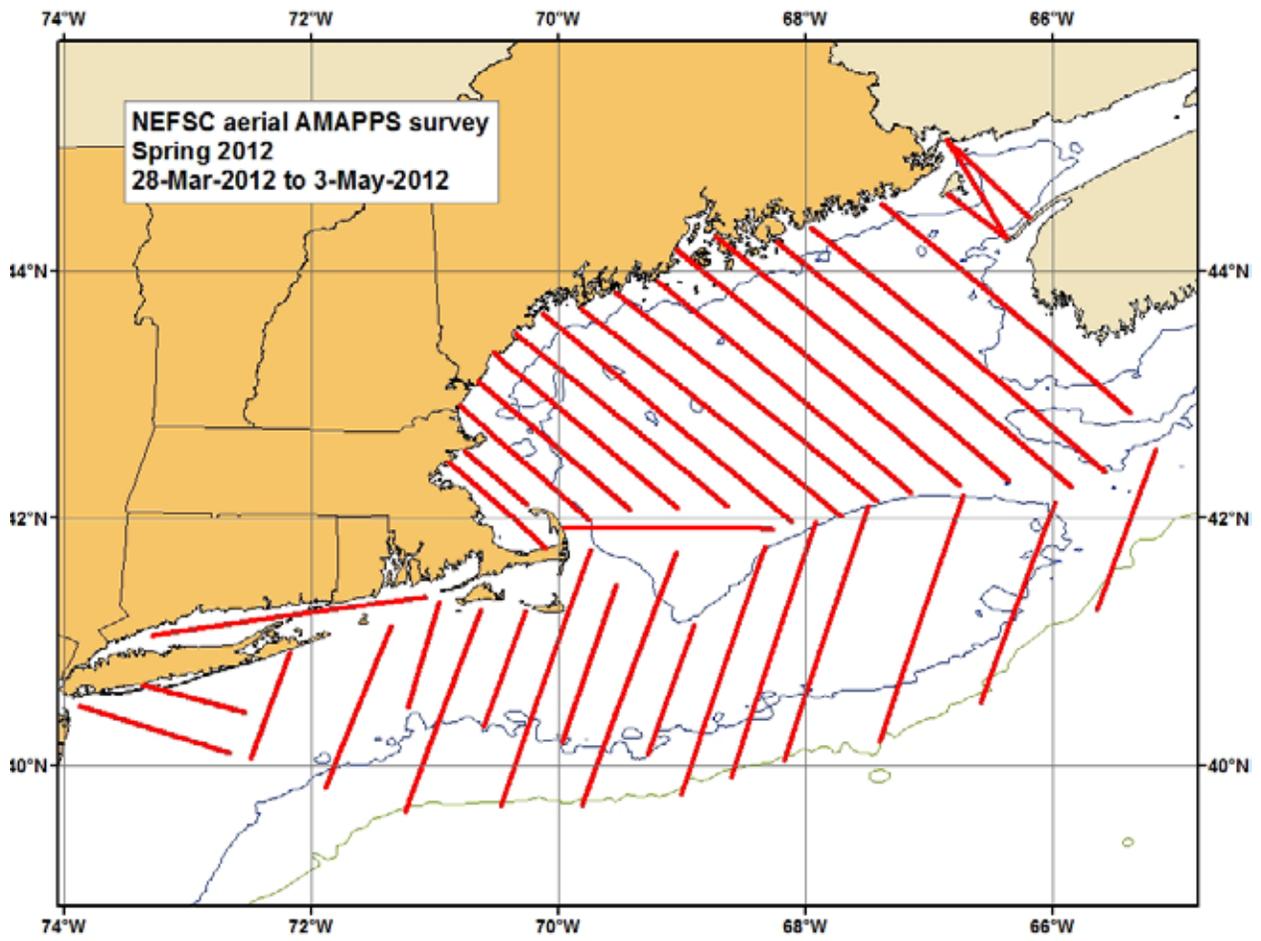


Figure 2. Fall 2012 Northeast AMAPPS aerial survey (17 October – 16 November 2012): completed tracklines.

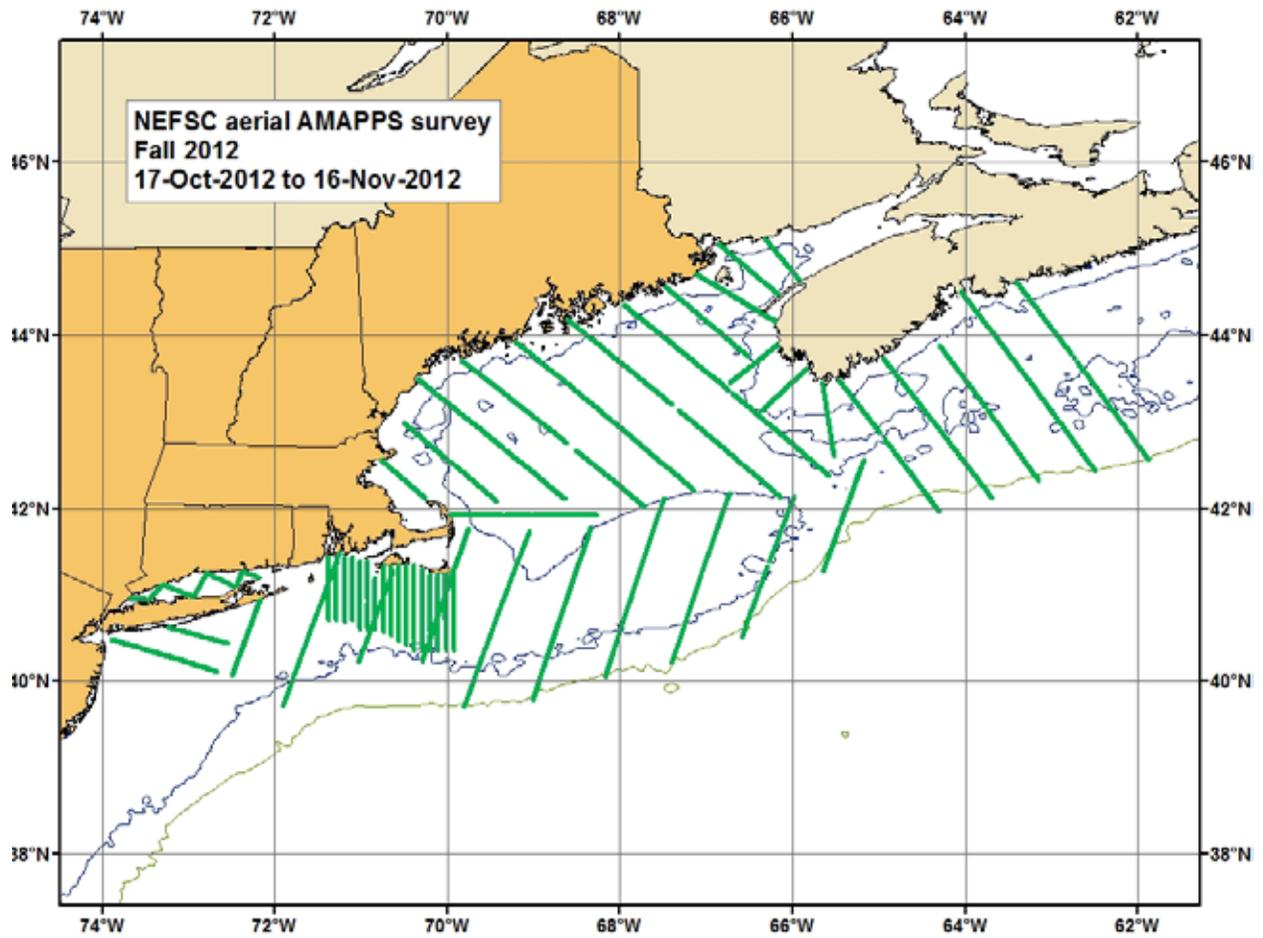


Figure 3. Spring 2012 Northeast AMAPPS aerial survey (28 March – 03 May 2012): Locations of harbor porpoises detected by the front team. Size of circle corresponds to group size. 100 m and 2000 m depth contours shown.

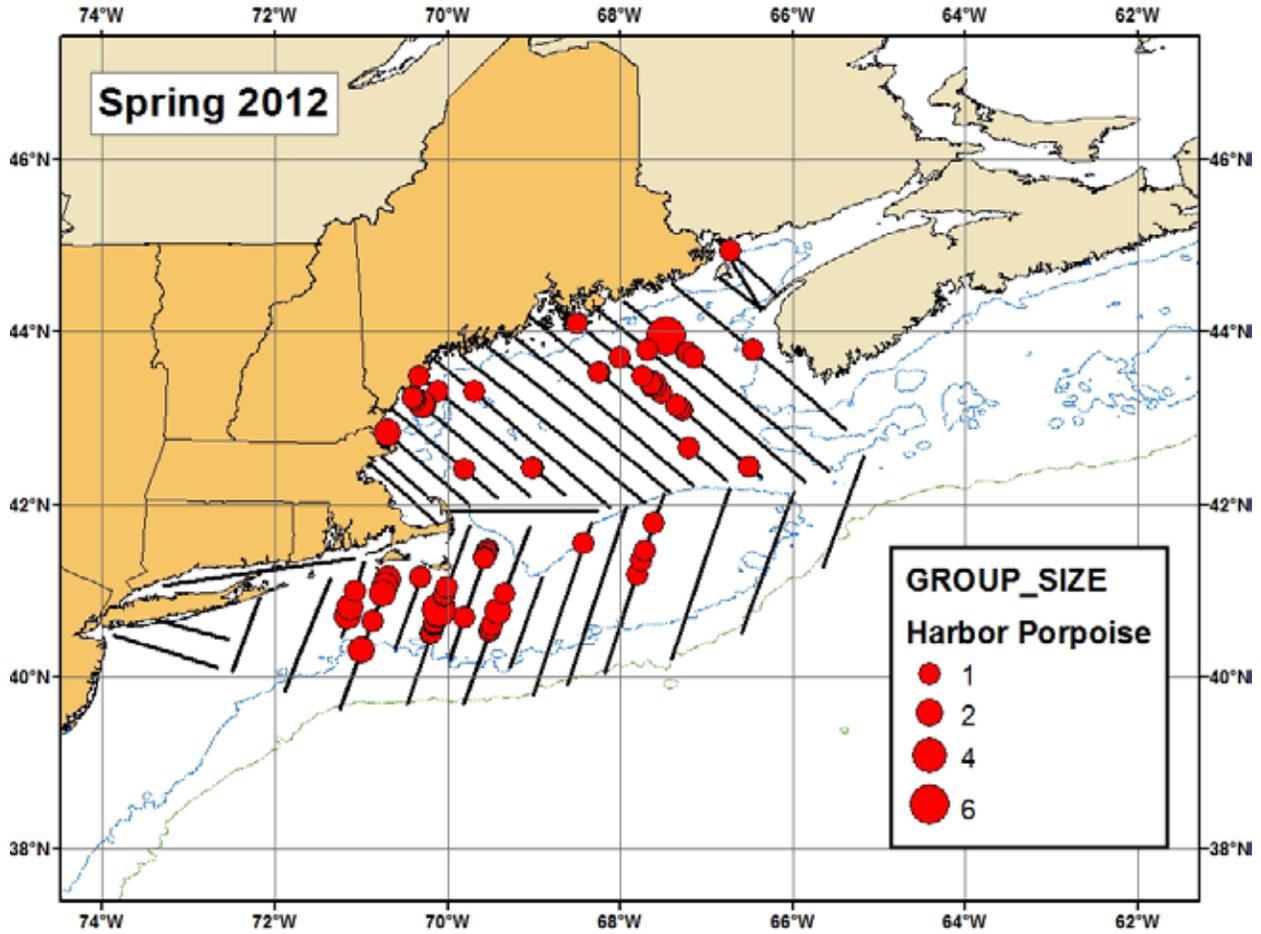


Figure 4. Spring 2012 Northeast AMAPPS aerial survey (28 March – 03 May 2012): Locations of common dolphins (red), white-sided dolphins (beige), common or white-sided dolphins (blue), and bottlenose dolphins (green) detected by the front team. Size of circle corresponds to group size. 100 m and 2000 m depth contours shown.

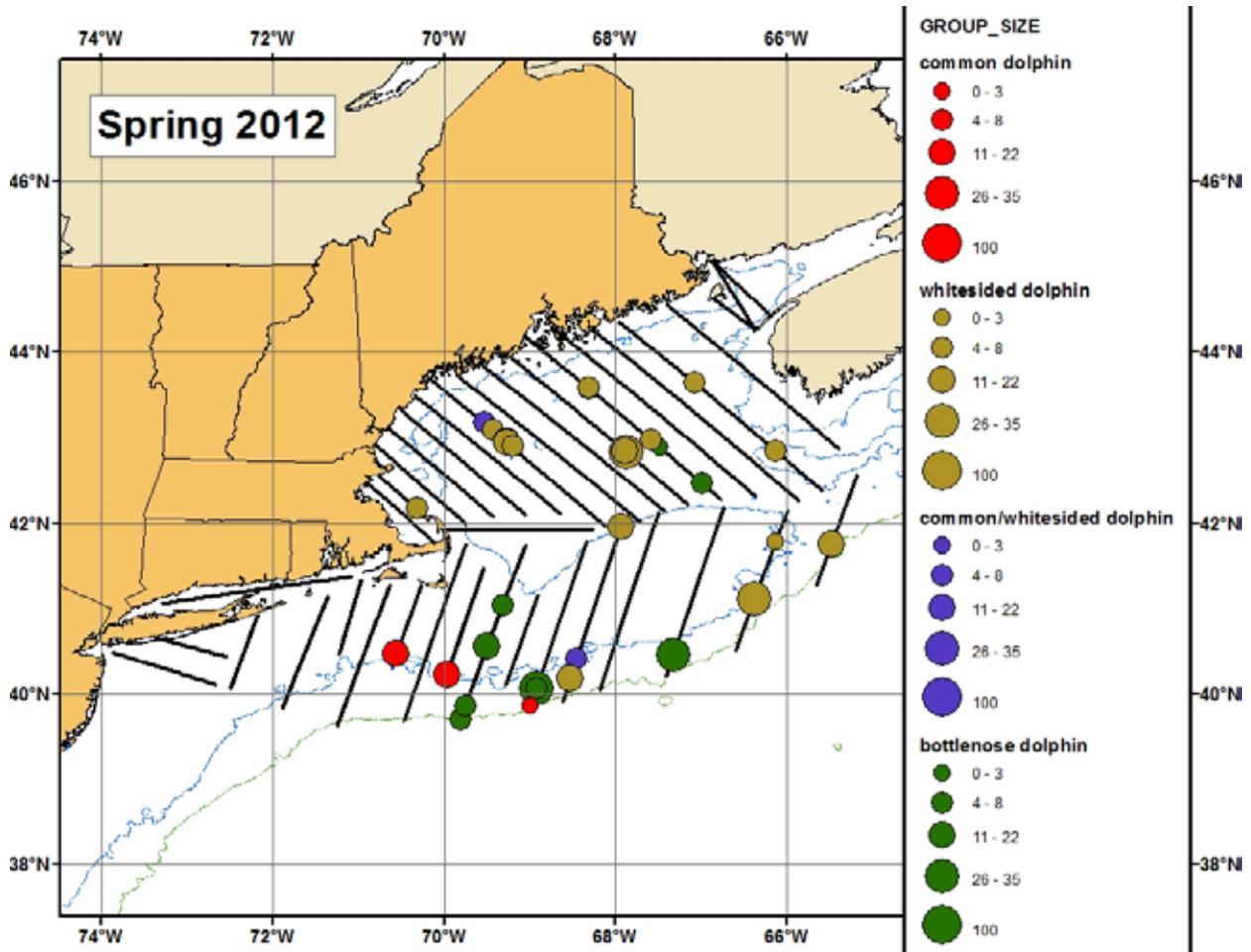


Figure 5. Spring 2012 Northeast AMAPPS aerial survey (28 March – 03 May 2012): Locations of white beaked dolphins (red), Risso’s dolphins (blue), striped dolphins (yellow) and unidentified dolphins (green) detected by the front team. Size of circle corresponds to group size. 100 m and 2000 m depth contours shown.

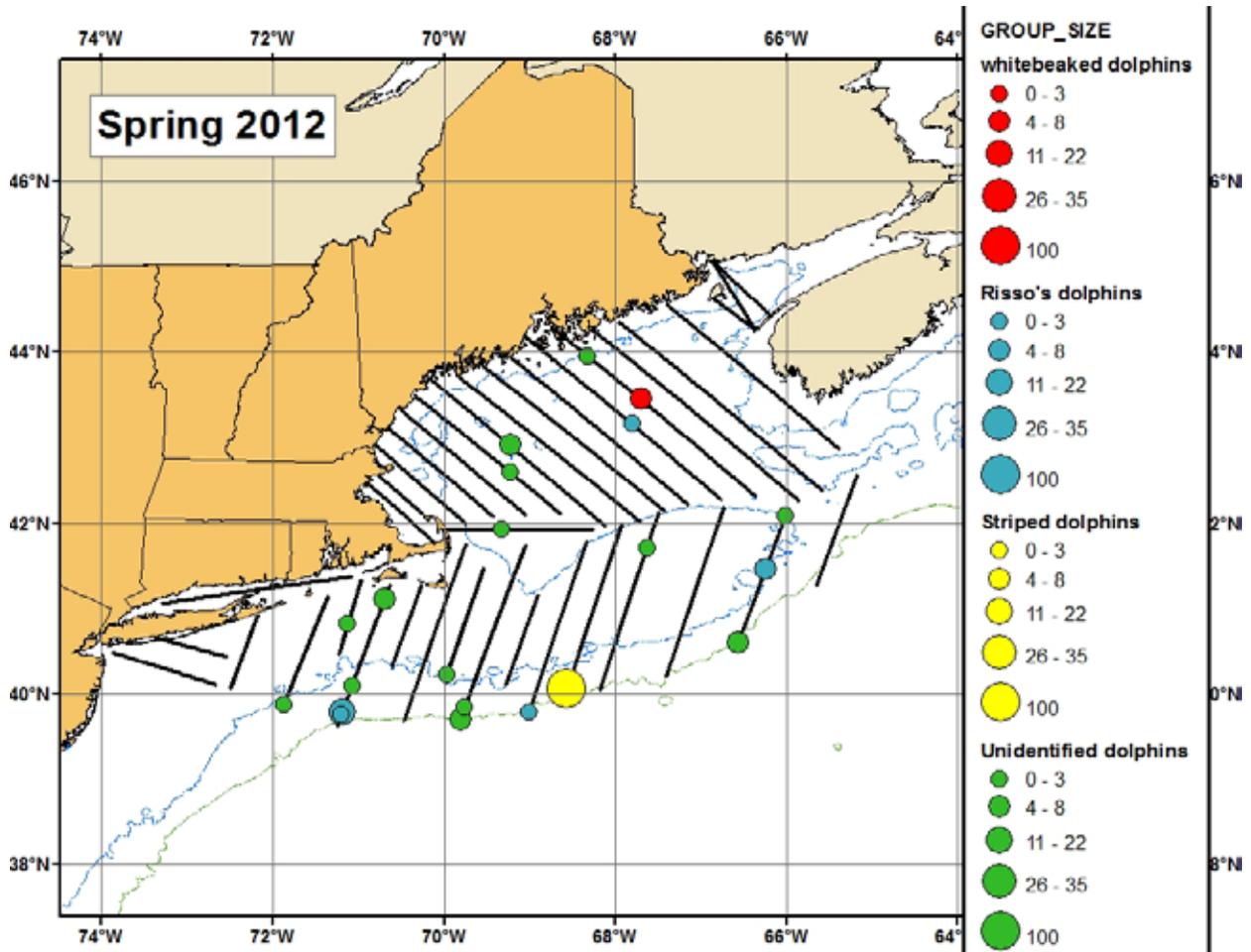


Figure 6. Spring 2012 Northeast AMAPPS aerial survey (28 March – 03 May 2012): Locations of fin whales (green), sei whales (beige) and groups that were either fin or sei whales (blue) as detected by the front team. Size of circle corresponds to group size. 100 m and 2000 m depth contours shown.

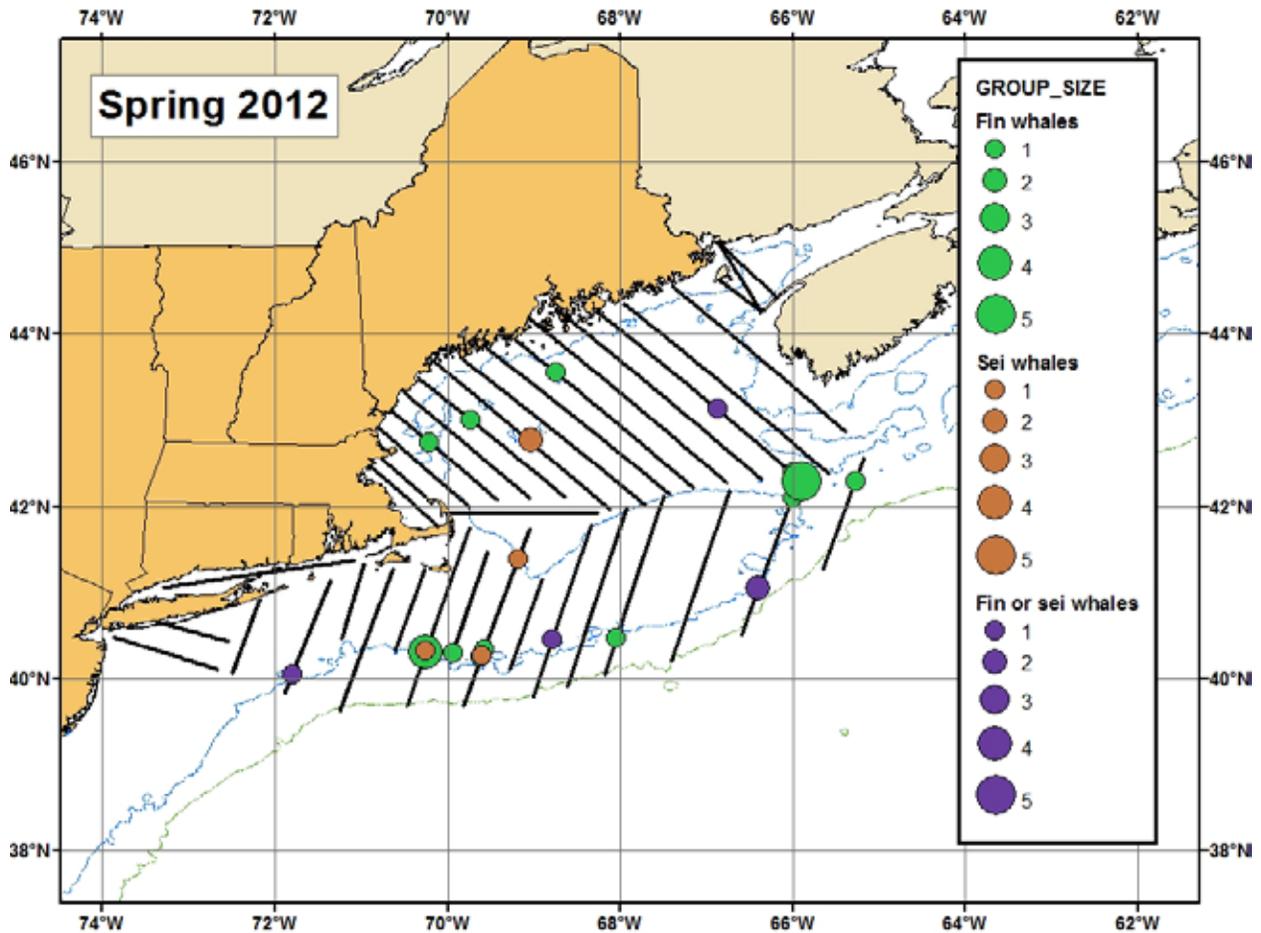


Figure 7. Spring 2012 Northeast AMAPPS aerial survey (28 March – 03 May 2012): Locations of unidentified beaked whales (purple), Cuvier's beaked whales (green), humpback whales (blue), minke whales (beige), right whales (red) and sperm whales (yellow) detected by the front team. 100 m and 2000 m depth contours shown.

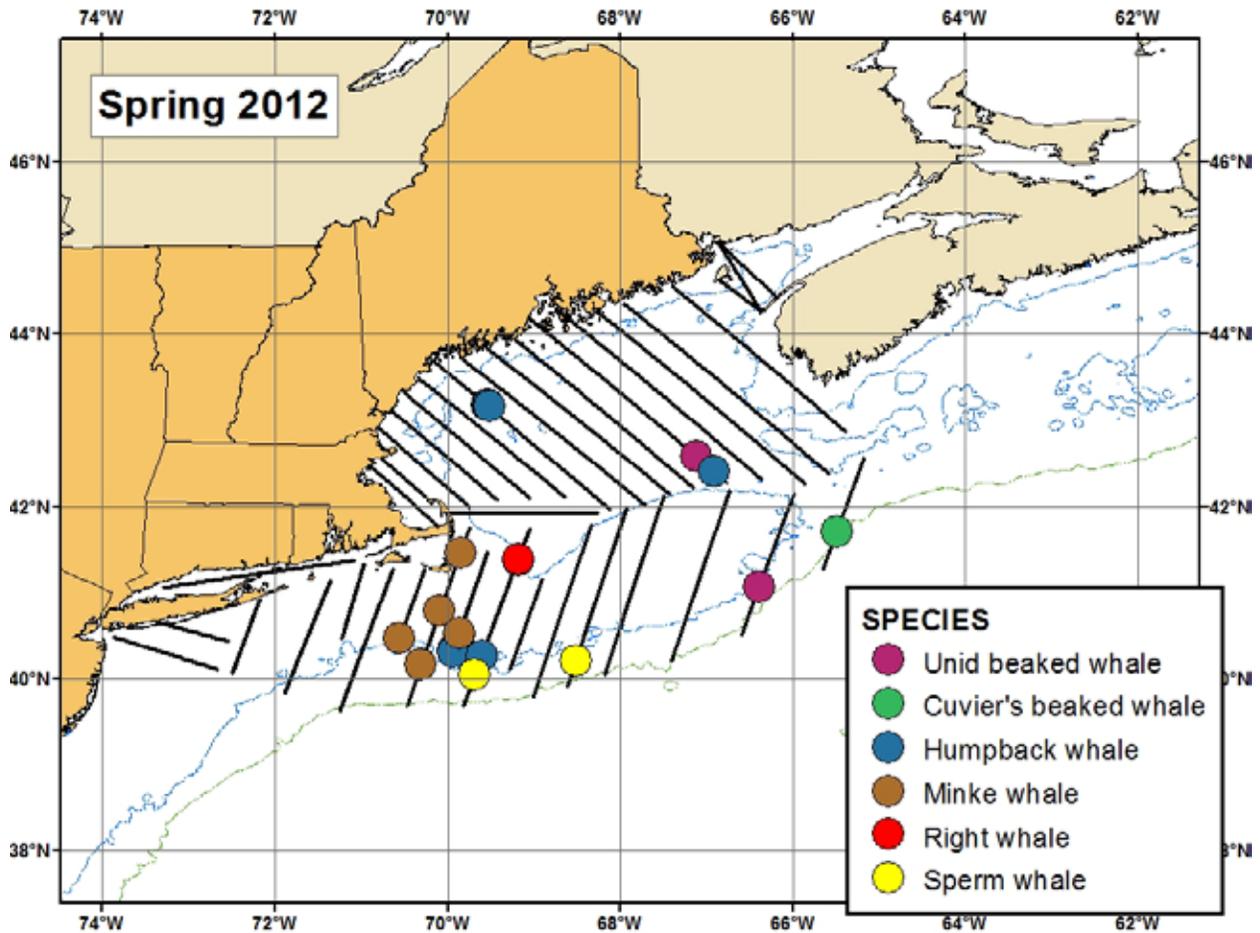


Figure 8. Spring 2012 Northeast AMAPPS aerial survey (28 March – 03 May 2012): Locations of pilot whales (green) and unidentified seals (purple) detected by the front team. 100 m and 2000 m depth contours shown.

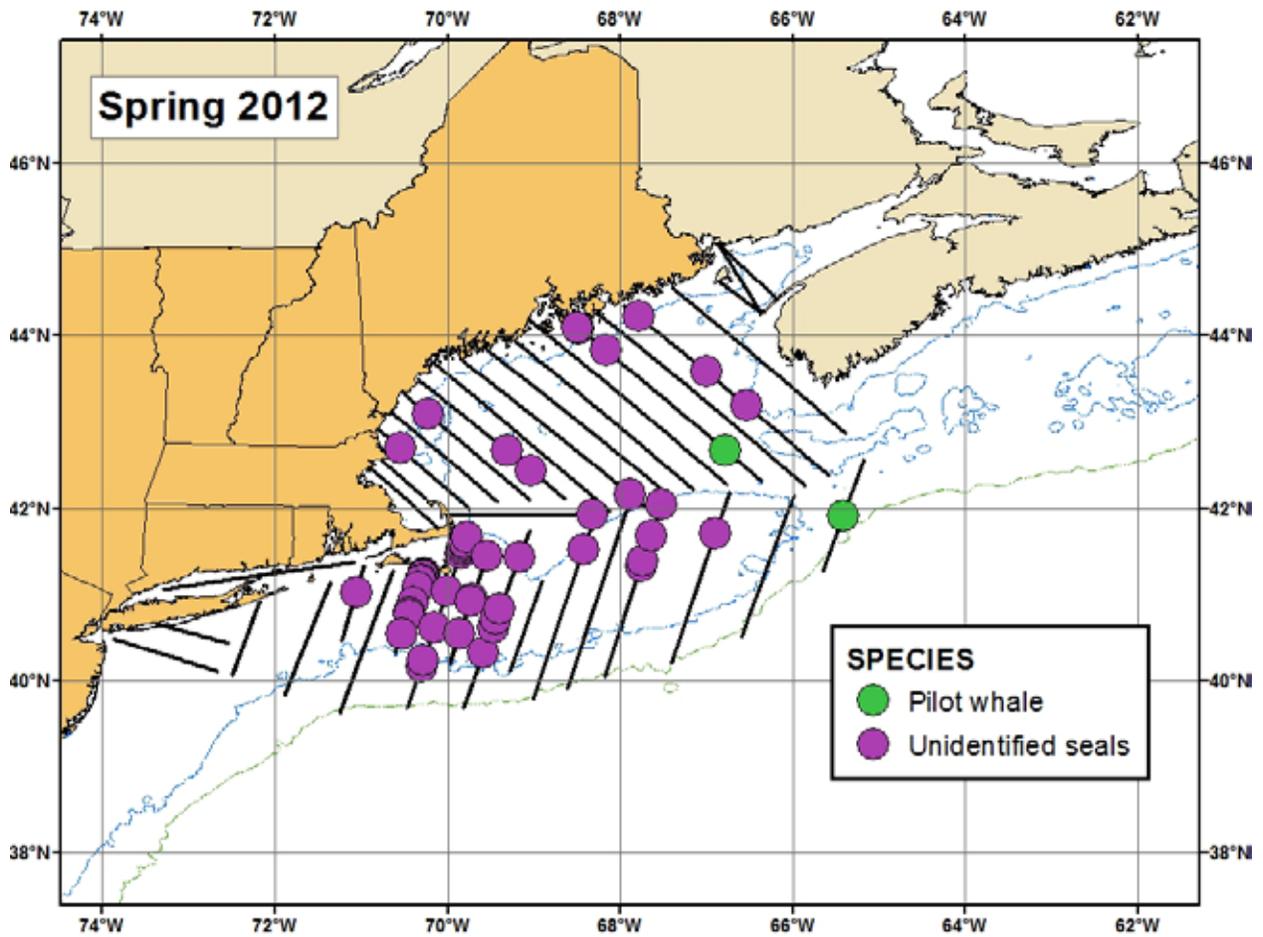


Figure 9. Spring 2012 Northeast AMAPPS aerial survey (28 March – 03 May 2012): Locations of basking sharks (beige) and ocean sun fish (purple) detected by the front team. 100 m and 2000 m depth contours shown.

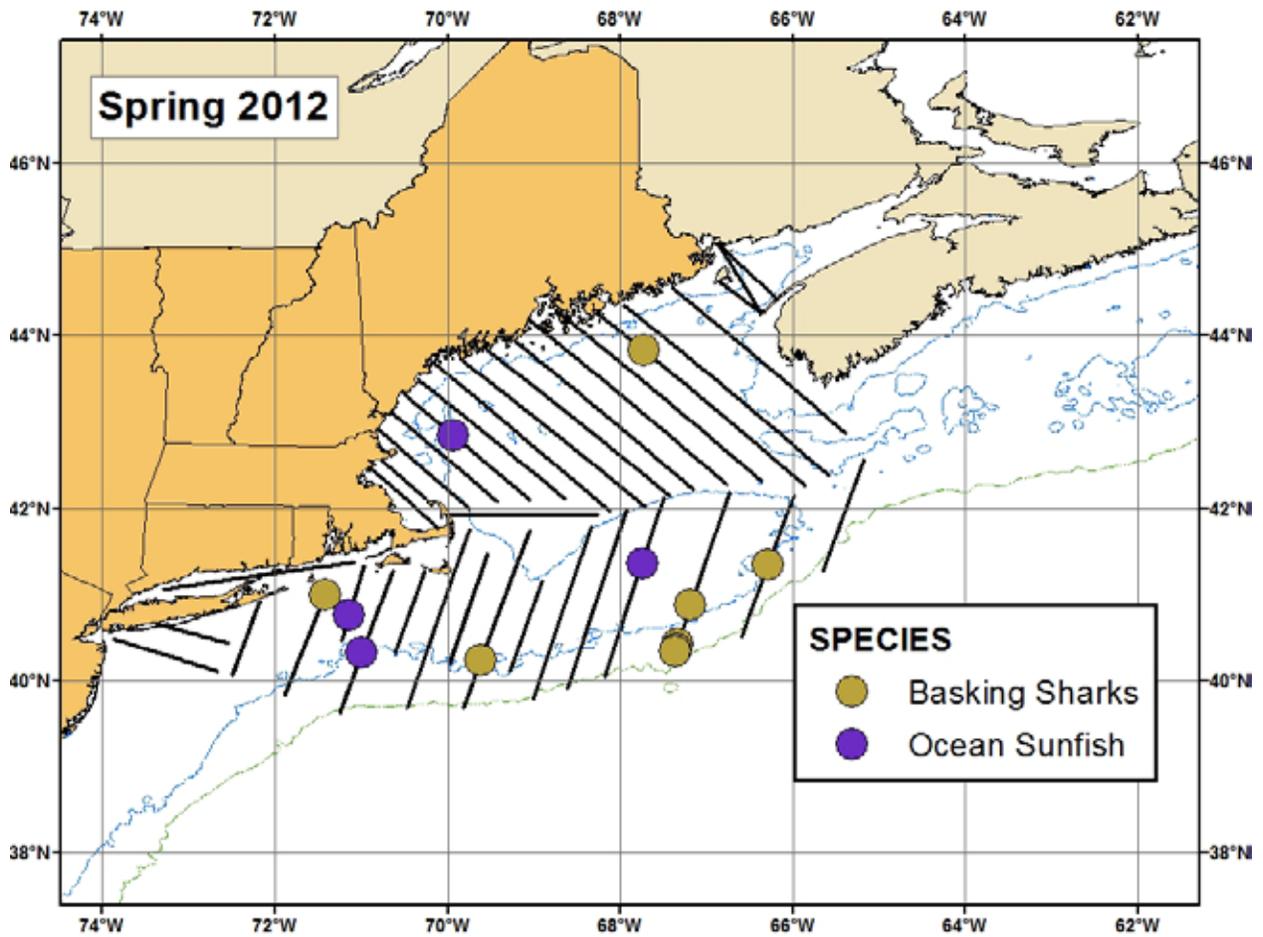


Figure 10. Fall 2012 Northeast AMAPPS aerial survey (17 October – 16 November 2012): Locations of harbor porpoises (red) detected by the front team. 100 m and 2000 m depth contours shown.

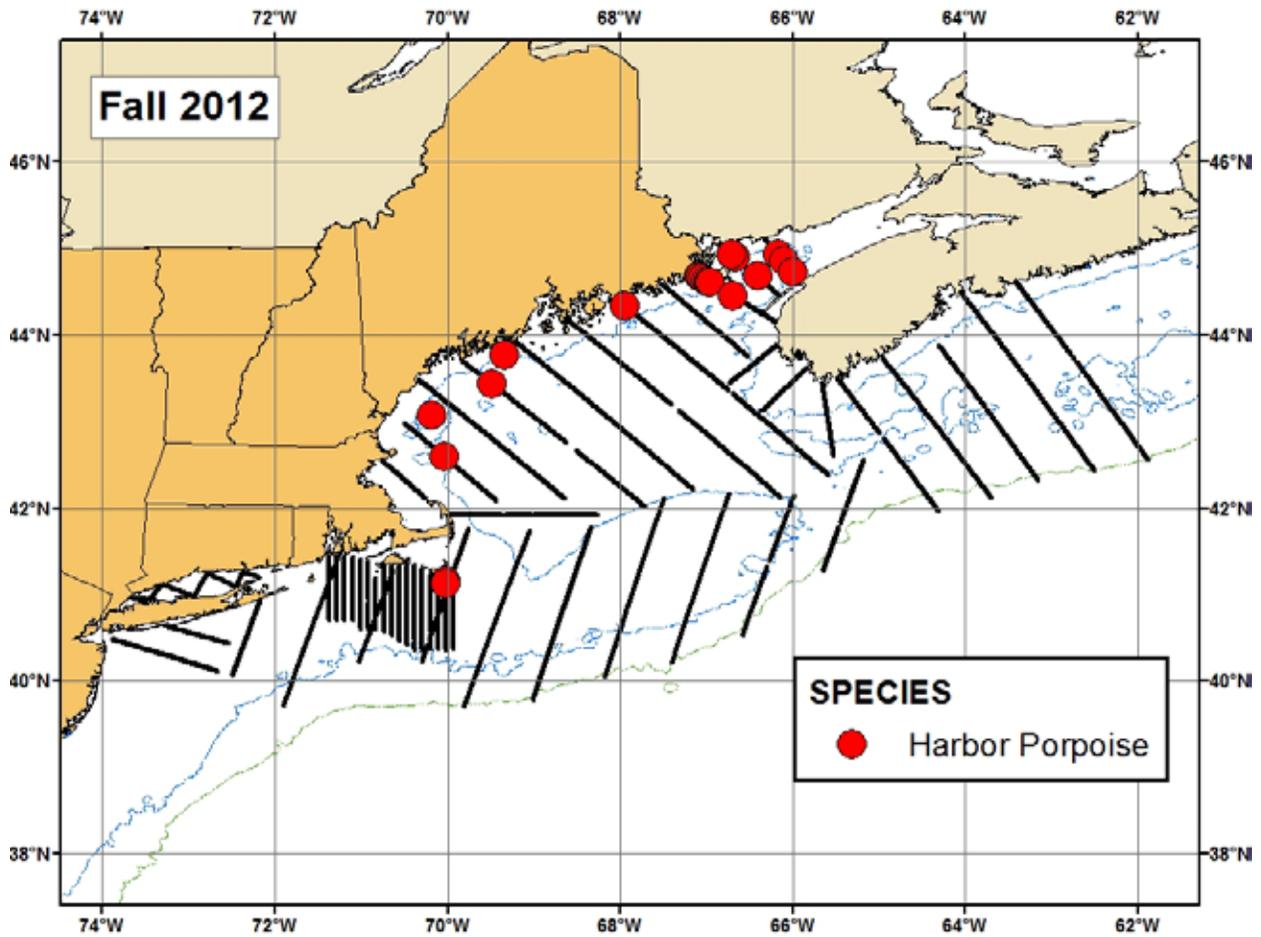


Figure 11. Fall 2012 Northeast AMAPPS aerial survey (17 October – 16 November 2012): Locations of common dolphins (purple), white-sided dolphins (brown), bottlenose dolphins (yellow) and groups that were either common or white-sided dolphins (green) as detected by the front team. 100 m and 2000 m depth contours shown.

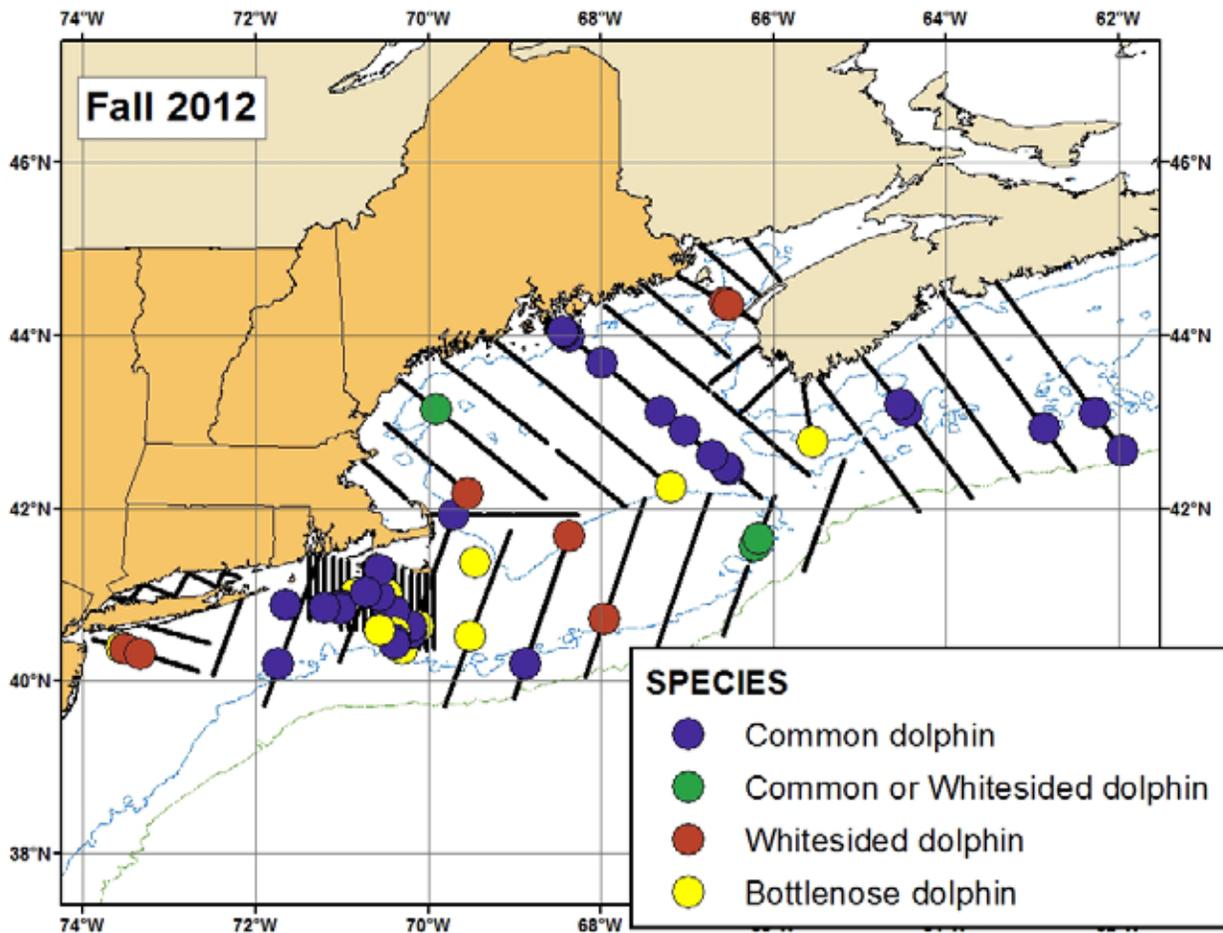


Figure 12. Fall 2012 Northeast AMAPPS aerial survey (17 October – 16 November 2012): Locations of Risso's dolphins (yellow), pilot whales (green) and striped dolphins (red) detected by the front team. 100 m and 2000 m depth contours shown.

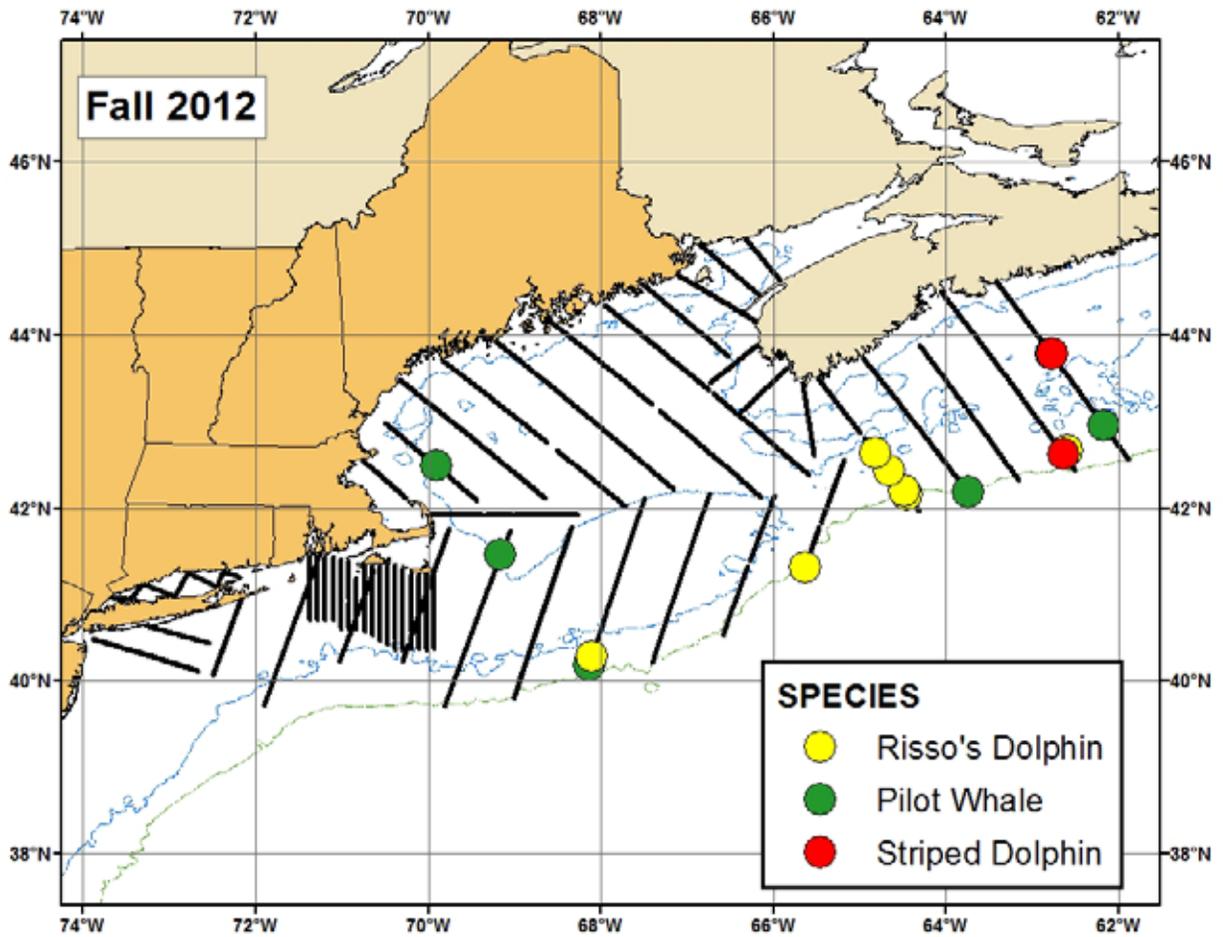


Figure 13. Fall 2012 Northeast AMAPPS aerial survey (17 October – 16 November 2012): Locations of fin whales (blue), sei whales (brown) and groups that were either a fin or sei whale (green) detected by the front team. 100 m and 2000 m depth contours shown.

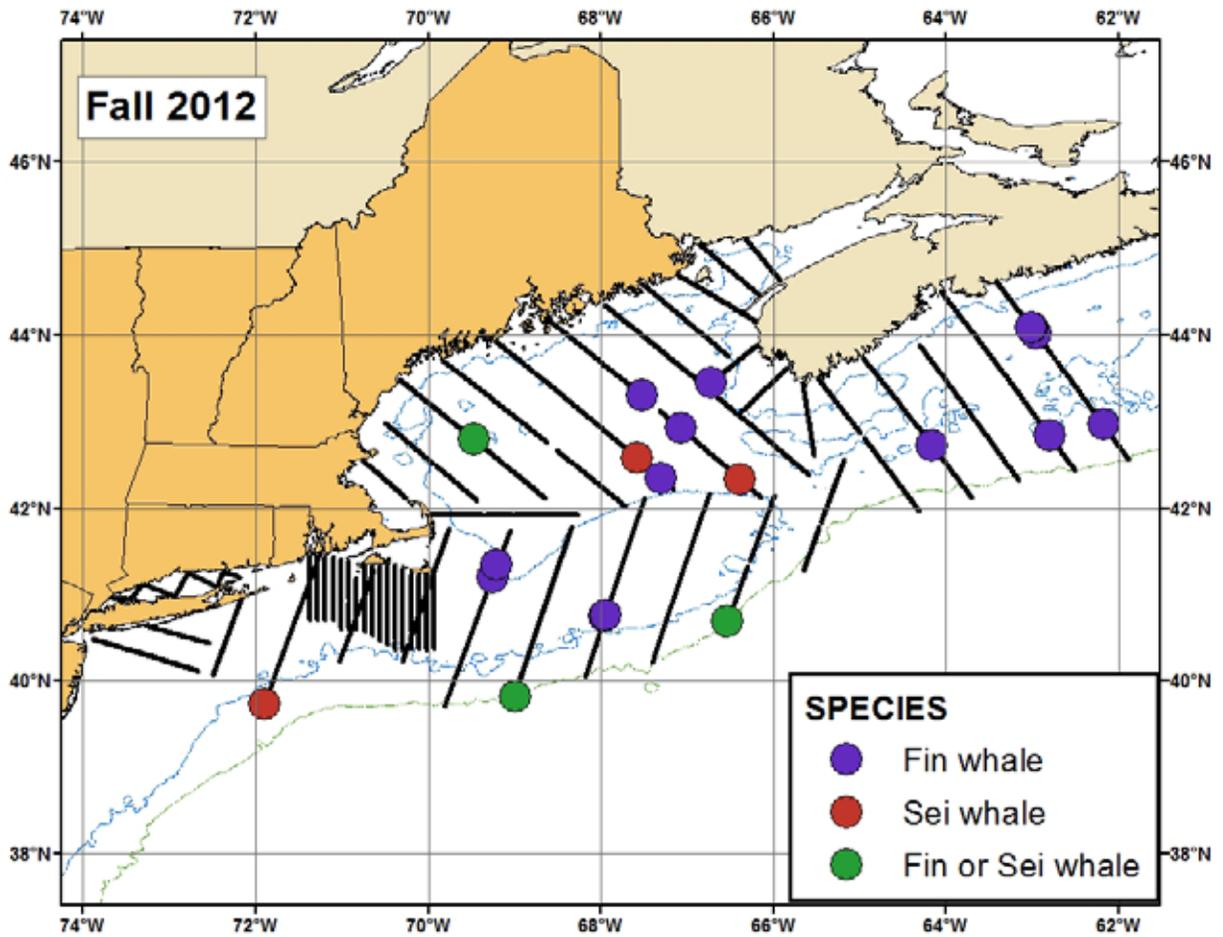


Figure 14. Fall 2012 Northeast AMAPPS aerial survey (17 October – 16 November 2012): Locations of humpback whales (blue), minke whales (red), sperm whales (yellow) and unidentified whales (green) detected by the front team. 100 m and 2000 m depth contours shown.

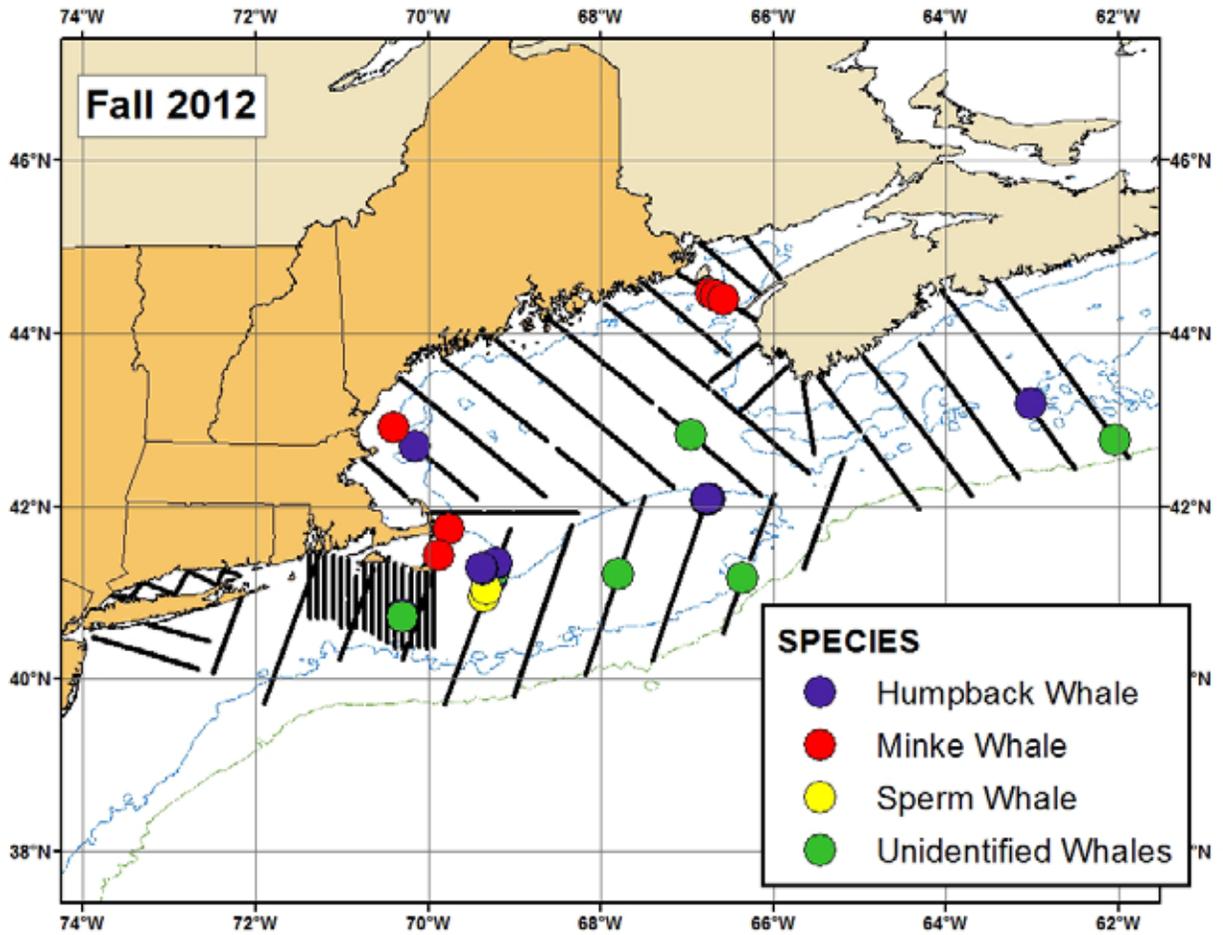


Figure 15. Fall 2012 Northeast AMAPPS aerial survey (17 October – 16 November 2012): Locations of loggerhead turtles (brown), leatherback turtles (purple), green turtles (green) and unidentified hard shell turtles (blue) detected by the front team. 100 m and 2000 m depth contours shown.

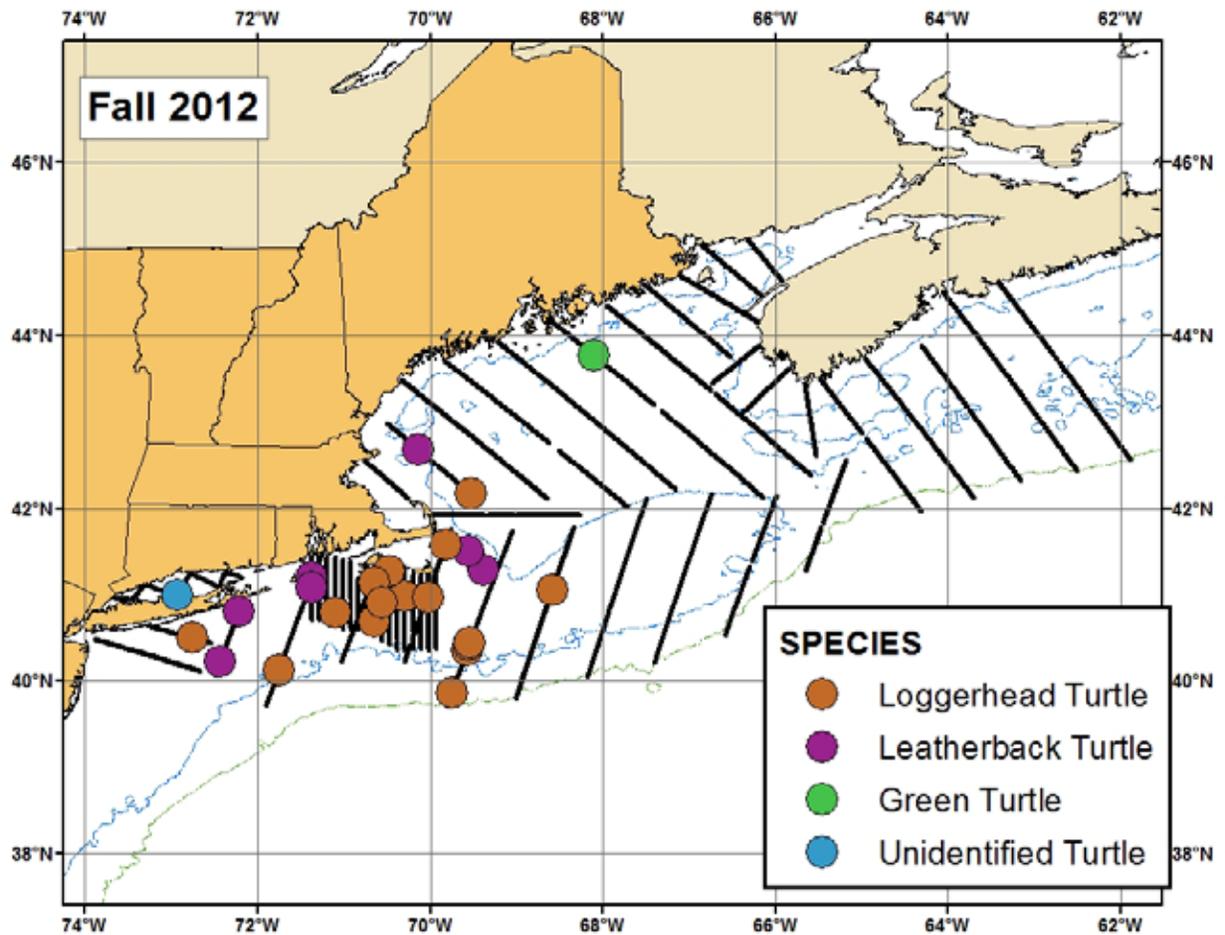


Figure 16. Fall 2012 Northeast AMAPPS aerial survey (17 October – 16 November 2012): Locations of grey seals (blue), harbor seals (red) and unidentified seals (yellow) detected by the front team. 100 m and 2000 m depth contours shown.

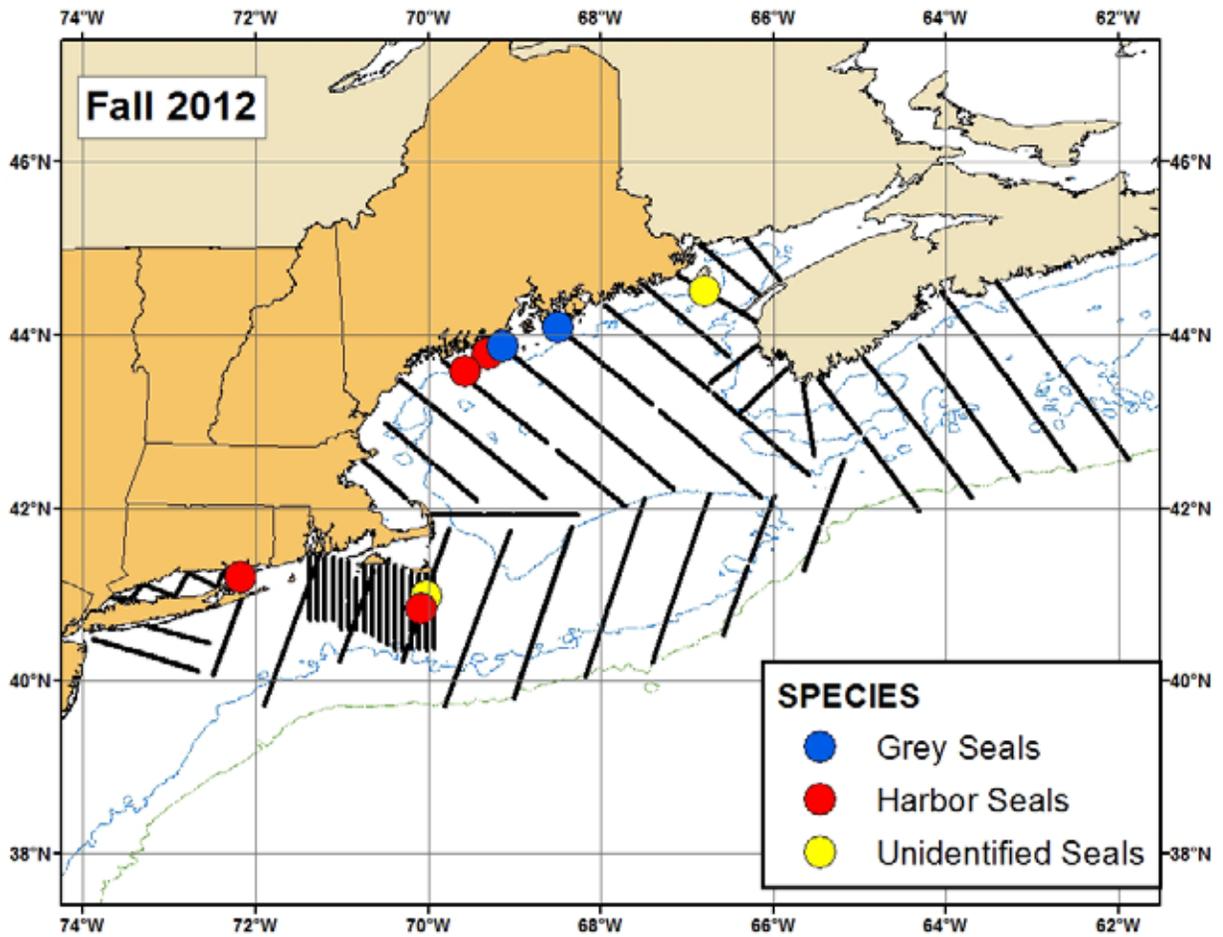


Figure 17. Fall 2012 Northeast AMAPPS aerial survey (17 October – 16 November 2012): Locations of basking sharks (red) and ocean sunfishes (blue) detected by the front team. 100 m and 2000 m depth contours shown.

