SUMMARY OF 2014 AMAPPS ACTIVITIES

(taken from draft 2014 annual report)

During 2014 under the AMAPPS program, NOAA Fisheries Service conducted field studies to collect cetacean, sea turtle, seal, and sea bird seasonal distribution and abundance data and studies to collect sea turtle and seal telemetry and biological data (Table 1). In addition, NOAA Fisheries Service continued analyzing past and present data collected under AMAPPS (Table 2). Two papers related to AMAPPS were published in 2014, one was in review, and eleven more were in progress during 2014 (Tables 3 and 4). A summary of the 2014 projects follows.

Field activities

During February – April 2014 the NEFSC amd SEFSC conducted two aerial and one shipboard surveys. The aerial line transect abundance surveys used NOAA Twin Otter airplanes targeting marine mammals and sea turtles in Atlantic continental shelf waters from Nova Scotia to South Carolina, from the shore to about the 100 m or 2000 m depth contour, depending on the location (Figure 1; Table 1). The shipboard habitat survey used the NOAA ship *Gordon Gunter* targeting marine mammals, sea turtles, and sea birds in addition to their biotic and abiotic habitat in waters from Virginia to Massachussetts, from the coast to the 2000 m depth contour. The aerial surveys completed about 12,700 km of track lines, while the shipboard survey completed about 4000 km of track lines, with about 150 hrs of passive acoustic monitoring using towed hydrophone arrays. During these surveys there were about 800 groups of 29 detected species or species groups of cetaceans and sea turtles, where the most commonly detected species were common dolphins (*Delphinus delphis*) and loggerhead turtles (*Caretta caretta*), with fin whales (*Balaenoptera physalus*) and humpback whales (*Megaptera novaeangliae*) being the most commonly detected large whales (Table 5). On the shipboard survey, in addition to the marine mammals and turtles, about 6940 birds within 2491 groups of 62 species (or species groups) were detected while on-effort, where the most common were Herring Gull (*Larus argentatus*), Northern Gannet (*Morus bassanus*) and Dovekie (*Alle alle*). Also, to sample the biotic and abiotic habitat, active acoustic backscatter data from a Simrad EK60 were collected nearly 24 hrs per day and physical and biological oceanographic data were sampled from over 510 collection stations. This included 64 casts of conductivity, temperature and depth profilers (CTDs), 127 bongo deployments, 13 visual plankton recorder (VPR) deployments, 2 Isaac-Kidd midwater trawl (IKMT) deployments, 3 Multiple Opening Closing Net Environmental Sensing System (MOCNESS) deployments, 70 beam trawl deployments and 233 bottom sediment grabs. To assist in documenting spring-time distributions of whales, 10 bottom-mounted marine autonomous recording units (MARUs) were deployed during this cruise, of which 9 were retrieved in September 2014.

During 25 – 30 July 2014, the NEFSC conducted a short shipboard surveys to document the relationships between the distribution and abundance of cetaceans, sea tutles and sea birds relative to their physical and biological environment, focusing on beaked whales on Georges Bank (Figure 1; Table 1). During over 800 km of surveyed track lines, there were 43 hours of passive acoustic recordings, and the visual observers detected over 1800 cetaceans and 800 birds and tracked six groups of Sowerby's beaked whales (*Mesoplodon bidens*) to document their dive time patterns, where the longest track was about 23 minutes. To document the physical and biological habitat, 11 bongo nets+CTD, 3 rosettes+CTD, 1 water only CTD, 1 IKMT and 3

midwater trawls were deployed, in addition to continuously recording data from various ship sensors and the Simrad EK60.

NEFSC started a winter aerial abundance survey 4 Dec 2014 which ended 19 Jan 2015 and so will be reported in the 2015 annual report.

NEFSC participated in loggerhead and leatherback turtle tagging studies that were in collaboration with Coonamessett Farm Foundation. The focus was centered on filling the data gap in the Northeastern portion of the loggerhead turtle range. These studies deployed 20 satellite relayed data loggers on loggerhead sea turtles, and one temporary suction cup video and time-depth recorder on a leatherback turtle north of Martha's Vineyard. In addition, while tracking the leatherback trutle three CTD casts were deployed to collect data on the physical structure of the water column and video profiles were collected to determine the species identification and distribution of gelatinous zooplankton in the vicinity of the leatherback. The time/depth data from this study will be used to establish dive time correction factors for the proportion of turtles that were in the study area but were underwater and therefore, not available to be detected at the surface during the abundance surveys. In addition, all of these data will provide information on turtle habitat use, behavior, and life history. The satellite tag data are archived in the Northeast Sea Turtle Collaborative Oracle database, maintained by the NEFSC and displayed on their website http://www.nefsc.noaa.gov/psb/turtles/turtleTracks.html. Photographs and other computerized data are stored on NEFSC servers. Biological samples are stored in freezers at the NEFSC and the NOAA Fisheries Service Southwest Fisheries Science Center.

A multi-agency team conducted a project on weaned gray seal (*Halichoerus grypus grypus*) pups on Muskeget Island, MA. During 14 – 18 January 2014 researchers conducted live captures, tagging, and biological sampling. One hundred and three pups (37 female; 62 male, 4 gender not noted) were captured. A suite of biological measurements and samples (e.g., weight, lengths, girth, blood, hair, skin, whisker, and mucous swabs) were collected and small ear tags were attached to hind flippers. Electronic versions of the photos and the capture and samplings logs are archived at NEFSC.

Analyses

In collaboration, the United State Navy, Coonamessett Farm Foundation, Virginia Aquarium & Marine Science Center, NEFSC, SEFSC, and University of St. Andrews (Scotland) completed an analysis of tag data from loggerhead turtles to estimate spatially- and temporally- explicit availability corrections.

Existing leatherback Wildlife Computer satellite telemetry data collected by the Large Pelagics Research Center between 2008 and 2010 were examined to determine if the existing data can be useful to inform AMAPPS leatherback availability estimates. Unfortunately, it appears that about 18% of the records from our study area, the Northeast US shelf, showed no surface intervals and so will probably not be usable.

Existing *in situ* video data collected from ROVs during 2007 – 2014 are currently being analyzed to describe offshore juvenile and adult loggerhead behavior by depth and to identify predator-prey relationships.

To model the spatial/temporal distribution of marine mammals and sea turtles using data collected since 2010, two frameworks are being developed that use the same input data but

different types of statistical models: Bayesian Hierarchical models and Generalized Linear and Additive models. During 2014, survey data from the ship and plane surveys conducted by the NEFSC and SEFSC were further QA/QC'd, formatted similarly, and summarized by grid cells that are 10x10 km and 8-day averages. Additional environmental variables were compiled and divided into the grid cells. Dive and surface times are being derived from DTAG data collected by other researchers to be used to address availability bias. The two statistical models were expanded to be more flexible, double checked for accuracy, goodness-of-fit statistics derived, measures of uncertainity developed, and code was expanded to use a derived model to create seasonal spatial maps of the animal density.

In addition, to collecting passive acoustic data collected on the 2014 Northeast AMAPPS shipboard surveys, there are five primary ongoing projects related to passive acoustic data: (1) estimating the abundance of sperm whales (*Physeter macrocephalus*) using acoustics, where the ultimate goal is to integrate these with visual abundance estimates to account for availability bias; (2) quantifying acoustic detection rates for beaked whales, with the goals of comparing to visual detection rates and estimating acoustic abundance for this taxon, if possible; (3) testing the performance of a newly-developed Atlantic version of the Real-time Odontocete Call Classification Algorithm (ROCCA), where the ultimate goal is to determine which delphinid species may be confidently identified acoustically in the absence of visual species identification; (4) documenting the offshore spring/summer occurrence of baleen whales in the Great South Channel and Georges Bank regions to supplement visual sighting data, and (5) assessing geographic variation in the echolocation clicks of Risso's dolphins (*Grampus griseus*). Both the NEFSC and SEFSC also continue to collaborate with other Science Centers and Scripps for the development of a standardized acoustic database system (Tethys).

The models and density maps are correlative models describing species distributions as a function of physical environmental variables (e.g., bottom depth and sediment type) and potential proxies to biological environmental variables that are readily available (e.g., sea surface temperature and surface chlorophyll). However, these efforts do not explicitly account for biological processes that may be a more direct driver of the target species' distributions. To investigate this, the distribution and density patterns of marine mammals, sea turtles and sea birds will be compared with the distribution patterns of species in other trophic levels, in addition to the patterns of the physical environment variables. To start this investigation the physical oceanographic and lower trophic-level data collected during the shipboard surveys are being processed to be used in this comparison. During 2014, most of the physical data from the 2009 – 2014 surveys have been post-processed and most of the biological samples collected have been enumerated. During 2015, the post-processing should be completed which will then allow a more thorough comparison between distributions of predators (marine mammals, sea turtles and sea birds) and their prey as documented in the EK60, VPR and other sampling devices.

The AMAPPS ORACLE database that stores the data collected during the field activities and the associated environmental variables that were derived from other sources was updated in 2014, additional datasets were added, queries for combining and outputting the data were developed, and data collection methods and data structures across the NEFSC and SEFSC are being standardized when possible.

REFERENCES CITED

Waring GT, Josephson E, Maze-Foley K, Rosel, PE, editors. 2014. U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments -- 2013. NOAA Tech Memo NMFS NE 228; 464 p. Available from: National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543-1026, or online at http://www.nefsc.noaa.gov/nefsc/publications/

Table 1. General information on the AMAPPS NOAA Fisheries Service field data collection projects that occurred during 2014: the project name (NOAA Fisheries Service principal investigating center), platforms used, dates and general location of the field study.

Note, the NEFSC aerial survey conducted during 4 Dec 2014 – 19 Jan 2015 will be reported in the 2015 annual report.

2014 field collection projects	Platform(s)	Dates in 2014	Location
Spring abundance survey (NEFSC)	NOAA Twin Otter aircraft	17 Feb - 27 Mar	Shelf waters from New Jersey to Nova Scotia
Spring abundance survey (SEFSC)	NOAA Twin Otter aircraft	24 Mar - 28 Apr	Shelf waters from New Jersey to Florida
Spring abundance survey (NEFSC)	NOAA ship Gordon Gunter	11 Mar - 1 May	North Carolina to Massachesetts, near coast to 2000 m depth contour
Summer abundance survey (NEFSC)	NOAA ship Henry B. Bigelow	25-30 July	Shelf break Massachesetts to Georges Bank
Northern sea turtle tagging (NEFSC)	F/V Kathy Ann	27 May - 1 Jun; 3 - 5 Sep	Offshore of Cheaspeake Bay; Offshore of Rhode Island and Massachusetts
Gray seal tagging (NEFSC)	small boats	14 - 18 Jan	Muskeget Island, MA

Table 2. A brief description of the purpose of the AMAPPS NOAA Fisheries Service analyses projects that occurred during 2014.

2014 analysis projects	Purpose
Availability of loggerhead turtles	Use tag data to estimate spatially- and temporally-explicit estimates of the percent of time loggerheads are available to be seen by the survey platforms
Availability estimates for leatherback turtle	Using existing telemetry data for leatherback turtles determine if it can be useful to inform AMAPPS leatherback turtle availability estimates
Offshore loggerhead turtle behavior	Using existing video data collected via ROVs during 2007 - 2014 identify predator-prey relationships and classify behaviors into behavior-depth categories
Enviormental time-series	Collalate and calculate time series for environmental variables from available NOAA, satellite and ocean model databases
Spatially- and temporally-explicit density models and maps	Develop Bayesian hierarchical and generalized linear/additive models to quantify relationship between marine mammals and sea turtles and habitat
Availability estimates for cetaceans using DTAGs	Estimate dive patterns to be used to account for availability bias using data from DTAGs on a variety of cetaceans collected by other researcher
Acoustic and visual abundance estimate of sperm whales	Use the acoustic and visual detection rates collected in AMAPPS surveys to estimate a more accurate abundance estimate of sperm whales
Beaked whale acoustics	Quantify acoustic detection rate of beaked whales and compare with visual detection rates
Whistle and echolocation classification	Test the performance of a newly-developed Atlantic version of the Real-time Odontocete Call Classification Algorithm (ROCCA)
Offshore occurrence of baleen whales on Georges Bank	Using bottom-mounted recorders to document presence of baleen whale calls during Apr - Sep 2014
Geogrphic variation in echolocation clicks of Risso's dolphins	Characterize the spectral banding patterns of Risso's dolphins from around the world and determine if geographic differences indicate population structure
Process and compare EK60 active acoustic backscatter data	Process active acoustic backscatter data (represents middle level trophic level taxa), then compare with distributions of marine mammals and sea turtles

2014 analysis projects	Purpose
Process and compare the Visual Plankton Recorder images	Process images of plankton from the Visual Plankton Recorder, then compare with distributions of marine mammals, sea turtles and sea birds
Process and compare the organisms in net tows	Enumerate samples from bongo nets, MOCNESS and midwater trawls, then compare with distributions of marine mammals, sea turtles and birds
Expand database to include the AMAPPS data	Build on the existing NEFSC Oracle databases to store and process the data collected under the various AMAPPS projects

Table 3. New papers (completed and in review) that document aspects of the AMAPPS research.

Completed in 2014
Scott-Hayward, L.A.S., D.L. Borchers, M.L. Burt, S. Barco, H.L.Hass, C.R. Sasso and R.J. Smolowitz. 2014. Use of Zero and One-Inflated Beta Regression to Model Availability of Loggerhead Turtles off the East Coast of the United States. Final Report. Prepared for U.S. Fleet Forces Command. Submitted to Naval Facilities Engineering Command (NAVFAC) Atlantic, Norfolk, Virginia, under Contract No. N62470-10-D-3011, Task Order 40, issued to HDR Inc., Norfolk, Virginia. Prepared by CREEM, University of St. Andrews, St. Andrews, Scotland. July 2014.
Waring GT, Josephson E, Maze-Foley K, Rosel, PE, editors. 2014. U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments -- 2013. NOAA Tech Memo NMFS NE 228; 464 p. Available from: National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543-1026, or online at http://www.nefsc.noaa.gov/nefsc/publications/
In review
Gilbert JR, Waring GT, DiGiovanni, R, Josephson E. Gulf of Maine harbor seal abundance estimate. In review as a NOAA Tech Memo NMFS NE

Table 4. Papers currently in progress that document aspects of the AMAPPS research.

Cholewiak D, Haver S, Gurnee J, Van Parijs SM. Acoustic abundance estimates for sperm whales (Physeter macrocephalus) in the northeast U.S. EEZ based on line-transect surveys.
Garrison L, Ortega-Ortiz J. Spatially explicit density-habitat models of cetaceans and sea turtles using a generalized additive model with data from 2010 - 2014.
Garrison LP, Barry K, Mullin KD. Abundance of cetaceans along the southeastern U.S. coast from aerial and vessel based visual line transect surveys. Will be submitted as a NOAA Tech Memo NMFS SE.
Gilbert JR, Waring GT, DiGiovanni, R, Josephson E. Gulf of Maine harbor seal abundance estimate. In review as a NOAA Tech Memo NMFS NE.
Gilbert JR, Waring GT. Aerial survey design proposal for 2011 New England harbor seal abundance survey. Will be submitted as a NOAA Tech Memo NMFS NE.
LaBrecque E, Lawson G, Jech JM, Halpin P. Distribution of acoustic regions of interested derived from multi-frequency data in a dynamic shelfbreak system.
LaBrecque E, Lawson G, Palka D, and Halpin P. Fine scale cetacean habitat classification in a dynamic shelfbreak system.
Palka D, Chavez S, Josephson E, Orphanides C, Hatch J, Murray K. Collation and processing of data collected during AMAPPS shipboard and aerial surveys and associated habitat data from NOAA, satellite and ocean model databases: 2010 - 2014.
Palka D, Jech M, Lawson G, Broughton E. Northwestern Atlantic spatial-temporal relationships between cetaceans and lower trophic levels.
Sigourney D, Chavez S, Palka D, Josephson E. Spatially explicit density-habitat models of cetaceans using a Bayesian hierarchical framework with data from 2010 - 2014.
Sigourney D, Cholewiak D, Palka D. Integrating passive acoustic information with visual surveys in a Bayesian hierarchical model to predict the spatial distribution of sperm whales in the Atlantic Ocean.
Soldevilla MS, Garrison L, Baumann-Pickering S, Cholewiak D, Van Parijs S, Hodge LEW, Read A, Oleson EM, and Rankin S. Geographic variation in Risso's dolphin echolocation click spectral features. .
Warden M, Palka D. plus others. Estimates of availability of cetaceans using DTAG data.

Table 5. Approximate number of groups detected during the aerial and shipboard spring (February – April 2014) 2014 AMAPPS surveys.

Species		ship	planes
Atlantic spotted dolphin	*Stenella frontalis*	1	1
Blue whale	*Balaenoptera musculus*	1	
Bottlenose dolphin spp.	*Tursiops truncatus*	24	70
Bottlenose whale	*Hyperoodon ampullatus*	0	
Common dolphin	*Delphinus delphis*	84	31
Cuvier's beaked whale	*Ziphius cavirostris*	3	2
False killer whale	*Pseudorca crassidens*		1
Fin whale	*Balaenoptera physalus*	40	4
Fin/sei whales	*B. physalus or B. borealis*	22	
Harbor porpoise	*Phocoena phocoena*	13	30
Humpback whale	*Megaptera novaeangliae*	41	3
Killer whale	*Orcinus orca*	1	
Minke whale	*B. acutorostrata*	11	5
Pilot whales spp.	*Globicephala spp.*	44	4
Right whale	*Eubalaena glacialis*	18	8
Risso's dolphin	*Grampus griseus*	19	3
Sei whale	*Balaenoptera borealis*	4	
Sowerby's beaked whale	*Mesoplodon bidens*	1	
Sperm whale	*Physeter macrocephalus*	32	2
Striped dolphin	*Stenella coeruleoalba*	7	
True's beaked whale	*Mesoplodon mirus*	1	
White-sided dolphin	*Lagenorhynchus acutus*	20	17
Unid. Dolphin	*Delphinidae*	52	33
Unid. Whale	*Mysticeti*	121	5
Unid. Mesoplodon	*Mesoplodon spp.*	17	
Total cetaceans		577	219
Unid. Hardshell turtle		1	172
Kemp's Ridley			10
Leatherback turtle	*Dermochelys coriacea*		7
Loggerhead turtle	*Caretta caretta*	1	335
Total turtles		2	524

Figure 1. Tracklines completed during the February – April 2014 AMAPPS aerial and shipboard surveys.