

ENVIRONMENTAL STUDIES PROGRAM: Ongoing Studies

Region: Atlantic

Planning Area(s): North, Mid- and South Atlantic

Title: Atlantic Marine Assessment Program for Protected Species (AMAPPS)

BOEM Cost: \$7.6 million

Period of Performance: FY 2010-2016

Conducting Organization(s): NOAA/NMFS

BOEM Contact: [Brian Hooker](#)

Description:

Background: The primary tools for the assessment of population abundance and spatial distribution are aerial and shipboard line-transect surveys. These surveys typically employ visual detection of animals at the surface, though more recently passive acoustic monitoring has been incorporated into these surveys to improve detection of marine mammals. Within U.S. Atlantic waters, the NOAA Northeast and Southeast Fisheries Science Centers have jointly and independently conducted broad-scale aerial and vessel surveys to support stock assessments. Regional aerial surveys have primarily been used to assess marine mammals and turtles within waters over the continental shelf to just beyond the shelf break. The deeper waters of the continental shelf and the inner continental slope to the U.S. Exclusive Economic Zone (EEZ) are most typically surveyed using large vessels and provide data primarily on marine mammals and sea birds.

For NOAA, both aerial surveys and vessel surveys have primarily been conducted during summer months with occasional surveys in the winter. In general, the goals of the surveys were to provide abundance estimates over large spatial scales, and they have often focused on specific stocks of management interest. These survey programs have provided critical information supporting stock assessment and management of protected species and form the basis for spatially explicit models used in impact assessments. There are critical gaps in the data available for population assessments.

First, there are very limited data available outside of summer months (June-August). The last comprehensive, year round surveys of the Atlantic coast were conducted during the late 1970's and early 1980's in the form of surveys of the southeast and northeast Atlantic coast, respectively. The lack of data, particularly during spring, winter, and fall, severely limits the ability to predict seasonal spatial distribution, especially for seabirds which disperse widely during the "nonbreeding" season. There are large and important differences for seabird use of the marine environment between summer and winter. Therefore, surveys for seabirds need to be uniformly distributed throughout the year.

Second, visual line-transect surveys suffer from known negative biases. Historical surveys typically have not attempted to correct for these biases, limiting the ability to conduct comparative studies to evaluate trends in population size. Most surveys conducted over the last 5-10 years have included approaches to correct for the ability of observers to see animals at the surface. However, in the case of marine turtles, along with deep diving marine mammals, it is particularly important to account for the availability of animals at the surface. Corrections for dive-surface intervals are a critical gap in assessments of population status.

Finally, there has been relatively limited assessment of seabird and pinniped (e.g., harbor seal, gray seal) abundance in U.S. Atlantic Ocean waters. Both of these taxa have the potential to be impacted by offshore energy projects and require dedicated assessment efforts.

Objectives: The objective of this study is to improve the knowledge base of Federal agencies with living marine resource responsibilities through improved surveys of marine mammals, sea turtles, and avian species. This will be accomplished by the following:

- collect broad-scale data over multiple years on the seasonal distribution and abundance of marine mammals (cetaceans and pinnipeds), marine turtles, and sea birds using direct aerial and shipboard surveys of coastal U.S. Atlantic Ocean waters;
- collect similar data at finer scales at several sites of particular interest to NOAA partners using visual and acoustic survey techniques;
- conduct tag telemetry studies within surveyed regions of marine turtles, pinnipeds, seabirds to develop corrections for availability bias in the abundance survey data;
- collect additional data on habitat use and life-history, residence time, and frequency of use;
- explore alternative platforms and technologies to improve population assessment studies; and
- assess the population size of surveyed species at regional scales; and develop models and associated tools to translate these survey data into seasonal, spatially explicit density estimates incorporating habitat characteristics.

Methods: The AMAPPS program will update the available data for marine mammals, turtles, and seabirds, and address critical information gaps in their assessments. The spatial scope of the program includes the U.S. western North Atlantic Ocean coast from the shoreline to the U.S. EEZ. Waters of major estuarine systems (e.g., Delaware Bay, Chesapeake Bay, and Pamlico Sound) may also be covered during aerial surveys. Within the larger area, there are a number of locations where fine-scale visual and/or passive acoustic surveys will be completed to provide enhanced resolution of densities by season. These data will also provide additional information for testing of the density estimation models to be developed under the 6th objective. Fine-scale surveys will be incorporated into the surveys effort, as appropriate. Seabird data will be collected in several ways.

Ongoing coastal aerial sea duck and seabird surveys will be expanded spatially (northward and seaward to -30 nm), and seasonally to provide detailed estimates of seabird abundance and distribution. Seabird observers will also be deployed on NOAA survey vessels conducting marine mammal and turtle line transect surveys as well as on other NOAA fishery cruises as Platforms of Opportunity to obtain data on offshore distribution and abundance of seabirds. For seabird surveys conducted from vessels, surveys should go to the shelf break. Data collection will begin during summer 2010 with aerial surveys in the Northeast and Southeast Atlantic Regions.

Products: The data collected during the shipboard/aerial surveys and tagging data will be incorporated into a comprehensive geospatial database. This will include the *QA/QC'd* sighting and telemetry data, survey effort, visual detections, passive acoustic detections, and ancillary habitat data collected during each

survey. This comprehensive ORACLE database will be available within NOAA firewalls to its partners. Limited sightings information will also be made available outside the NOAA firewall to online data access systems such as OBIS-SEAMAP. The goal of these data management systems will be to provide ready access to the collected data for both public users and government agencies in support of environmental assessments. For seabirds, data will also be incorporated into the seabird database presently housed by U.S.G.S. at Patuxent Wildlife Research Center. The spatial modeling efforts will also be integrated into online or distributed products. In addition, the collected data will be incorporated into modeling efforts in an interactive manner to allow users to develop customized models for times and areas of interest. This effort will build off the Strategic Decision Support System developed jointly by NOAA and Duke University and funded by the Navy SERDP program. Paper products expected to be produced by the project include at a minimum: annual updates to the *Atlantic Ocean and Gulf of Mexico Marine Mammal Stock Assessment Report*, annual reports of survey results, and a peer reviewed journal manuscript describing the model development and results.

Importance to BOEM: Exploration, usually in the form of seismic surveys, occurs in an area prior to drilling and production. The seismic surveys provide information used by the offshore energy industry and government to evaluate the potential for offshore oil, gas, and methane hydrate resources and geologic hazards. BOEM and industry need accurate data on the location, extent, and properties of hydrocarbon resources, as well as information on shallow geologic hazards and seafloor geotechnical properties in order to explore develop, produce and transport hydrocarbons safely and economically. In addition to potential oil and gas exploration and production, there has been a global movement to develop marine-based renewable energy sources. Wind farms, tidal and ocean wave turbine systems are in various stages of planning for U.S. Atlantic coastal and offshore waters. Seismic surveys may be used to appropriately site structures for wind energy projects. Pile driving to place structures has also been identified as a source of potential impacts to biological resources. Sand and gravel operations also utilize seismic profiles to locate and identify resources. Though the potential impact-producing activities from the production of wind, wave or tidal energy, or the development of sand and gravel resources, may differ from those presented by oil and gas exploration and development, detailed information on the affected resources will be required for appropriate analysis and mitigation of any of the activities.

Current Status: The contract was awarded on June 22, 2010. Surveys were conducted in 2010, 2011, 2012, 2013, and 2014. Surveys conducted after 2014 are part of AMAPPS II. Draft density models were received and are under Agency review.

Final Report Due: March 2016.

Publications: See product list below.

Affiliated Web Sites: http://www.wildlifetracking.org/index.shtml?project_id=537
<http://www.nefsc.noaa.gov/psb/AMAPPS/>

Revised Date: December 1, 2015

ESPIS: Environmental Studies Program Information System

All completed ESP studies can be found here:

http://www.data.boem.gov/homepg/data_center/other/espis/espisfront.asp

Products resulting from Atlantic Marine Assessment Program for Protected Species (AMAPPS): 2010 – 2014

3 December 2013

A. NEW ABUNDANCE ESTIMATES:

1. *Abundance estimates of cetaceans in US Atlantic and Canadian Scotian shelf waters*; accounting for perception bias for the following species: Atlantic spotted dolphins, common bottlenose dolphin, common dolphin, Cuvier's beaked whale, false killer whale, fin whale, harbor porpoise, humpback whale, Kogia spp, Mesoplodonts spp., minke whale, pantropical spotted dolphin, pilot whale spp., Risso's dolphin, rough-toothed dolphin, sei whale, sperm whale, striped dolphin, and white-sided dolphin.
2. *Preliminary abundance estimate for loggerhead turtles in US Atlantic waters*; accounting for perception and availability bias using aerial visual sightings and tagging data.
3. *Abundance estimate of harbor seals* using counts of seals on haul out sites photographed from NOAA aircraft and locations of VHF tagged seals located from FWS aircraft which were used to account for availability bias.

B. REFEREED PAPERS/TECHNICAL REVIEWS (authors working on AMAPPS in bold):

1. **Avens L**, Goshe LR, Pajuelo M, Bjorndal KA, MacDonald BD, Lemons GE, Bolten AB, Seminoff JA. 2013. Complementary skeletochronology and stable isotope analyses offer new insight into juvenile loggerhead sea turtle oceanic stage duration and growth dynamics. *Marine Ecology Progress Series* 491: 235-251.
2. **Cholewiak D**, Baumann-Pickering S, **Van Parijs SM**. Description of sounds associated with Sowerby's beaked whales (*Mesoplodon bidens*) in the western North Atlantic. *Journal of the Acoustical Society of America* 134(5): 3905-3912.
3. **Cholewiak D**, Risch D, Valtierra R, **Van Parijs SM**. Methods for passive acoustic tracking of marine mammals: estimating calling rates, depths and detection probability for density estimation. Chapter 6 in Adam, O. (ed) *Detection, Classification and Localization of marine mammals*, pp. 107 - 145.
4. **Goodman Hall A**, Belskis LC. 2012. Guide to the aerial identification of sea turtles in the US Atlantic and Gulf of Mexico. NOAA Technical Memorandum NMFS-SEFSC-633, 24 pp. or online at http://www.nefsc.noaa.gov/read/protssp/mainpage/AMAPPS/docs/TM_633_Goodman-Hall_Belskis_Aerial_ID.pdf
5. **Northeast Fisheries Science Center**. 2011. Preliminary summer 2010 regional abundance estimate of loggerhead turtles (*Caretta caretta*) in northwestern Atlantic Ocean continental shelf waters. US Dept Commer, Northeast Fish Sci Cent Ref Doc. 11-03; 33 p. Available from National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543-1026, or online at <http://www.nefsc.noaa.gov/publications/crd/crd1103/>
6. **Palka D**. 2012. Cetacean abundance estimates in US northwestern Atlantic Ocean waters from summer 2011 line transect survey. US Dept Commer, Northeast Fish Sci Cent Ref Doc. 12-29; 37 p. Available from: National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543-1026, or online at <http://nefsc.noaa.gov/publications/crd/crd1103/>
7. Silverman ED, **Leirness JB**, **Saalfeld DT**, Koneff MD, Richkus KB. 2012. Atlantic Coast Wintering Sea Duck Survey, 2008-2011. Division of Migratory Bird Management U.S. Fish & Wildlife Service, 11510 American Holly Drive, Laurel, MD 20708. Online at <http://seaduckjv.org/studies/pro3/pr109.pdf>

8. Silverman ED, **Saalfeld DT**, **Leirness JB**, Koneff MD. 2013. Wintering Sea Duck Distribution along the Atlantic Coast of the United States. *Journal of Fish and Wildlife Management*. <http://fwsub.org/doi/full/10.3996/122012-JFWM-107>
9. Valtierra, R. D., Holt, R. G., **Cholewiak, D.**, **Van Parijs, S. M.** 2013. Calling depths of baleen whales from single sensor data: Development of an autocorrelation method using multipath localization. *Journal of the Acoustical Society of America* 143(3): 2571-2581.
10. **Waring GT**, **Josephson E**, Maze-Foley K, Rosel, PE, editors. 2013. U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments -- 2012. NOAA Tech Memo NMFS NE 223; 419 p. Available from: National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543-1026, or online at <http://www.nefsc.noaa.gov/publications/tm/tm223/>
11. Zipkin EF, **Leirness JB**, Kinlan BL, O'Connell AF, Silverman ED. *in press*. Fitting statistical distributions to sea duck count data: implications for survey design and abundance estimation. *Statistical Methodology*.

C. PAPERS IN REVIEW:

1. **Waring GT**, **Josephson E**, Maze-Foley K, Rosel, PE, editors. In review. U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments – 2013. Will be submitted as a NOAA Tech Memo NMFS NE.

D. PAPERS IN PREPARATION:

1. **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.
2. Gilbert JR, **Waring GT**, DiGiovanni, R, **Josephson E**. 2012. Gulf of Maine harbor seal abundance estimate 2012. Will be submitted as a NOAA Tech Memo NMFS NE.
3. 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.
4. **Leirness JB**, Silverman ED. Loon and northern gannet distribution along the Atlantic coast of the United States. To be submitted as peer-reviewed journal article. Journal: TBD.
5. **Leirness JB**, Silverman ED. Estimating abundance of individual scoter species when observations are not all identified to species. Journal: TBD.
6. **Waring GT**, **Josephson E**, Maze-Foley K, Rosel, PE, editors. In review. U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments – 2014. Will be submitted as a NOAA Tech Memo NMFS NE.

E. CONFERENCE PRESENTATIONS:

1. **Cholewiak D**, **Valtierra R**, Baumann-Pickering S, **Van Parijs SM**. 2013. Towed arrays and beaked whales: detection and three-dimensional localization of Sowerby's beaked whales (*Mesoplodon bidens*) on large vessel surveys. Presentation at the Detection, Classification, Localization, and Density Estimation (DCLDE) of Marine Mammals using Passive Acoustics conference in St. Andrews, 12 – 15 June 2013.

2. **Cholewiak D, Valtierra R**, Baumann-Pickering S, **Van Parijs SM, Palka D**. 2013. Towed arrays and beaked whales: detection and three-dimensional localization of Sowerby's beaked whales (*Mesoplodon bidens*) on large vessel surveys. Abstract submitted to Biennial Conference on the Biology of Marine Mammals, 9 – 13 Dec 2013.
3. **Jones MT, Steinkamp MJ**. 2012. Northwest Atlantic Marine Bird Cooperative Meeting. AMAPPS and Sea Duck Survey. Sturbridge, MA. February 2013. http://acjv.org/Marine_Bird_page/marine_bird_meeting_2012/jones_2012.pdf
4. **Jones MT, Steinkamp, MJ**. 2013. Northwest Atlantic Marine Bird Cooperative Meeting. Preliminary Results for AMAPPS Seabird Surveys. Charleston, SC, April 2013.
5. **LaBrecque E**, Lawson G, Jech M, **Palka D**, Halpin P. 2013. Use of opportunistically collected active acoustic data from marine mammal surveys: What can we learn about a marine mammal's environment? Abstract submitted to Biennial Conference on the Biology of Marine Mammals, 9 – 13 Dec 2013.
6. Oswald JN, **Cholewiak D**, Hodge L, Soldevilla, M, **Van Parijs SM**, Martinez A, Read A, Norris TF. Man versus machine: a comparison of whistle classifiers developed using auto-detector data and manually analyzed data. Abstract submitted to Biennial Conference on the Biology of Marine Mammals, 9 – 13 Dec 2013.
7. **Palka DL**. 2012. 2011 AMAPPS NEFSC abundance surveys. Northwest Atlantic Marine Bird Cooperative Meeting. AMAPPS and Sea Duck Survey. Sturbridge, MA. February 2013. http://acjv.org/Marine_Bird_page/marine_bird_meeting_2012/palka_2012.pdf
8. Roch MA, Baumann-Pickering S, Hwang D, Batchelor H, Berchok C, **Cholewiak D**, Munger LM, Oleson EM, **Van Parijs SM.**, Rankin S, Risch D, Širović A, Soldevilla MS. The Tethys Metadata System. Accepted presentation at the DCLDE conference in St. Andrews, 12 – 15 June 2013.
9. Soldevilla MS, Baumann-Pickering S, Olseon EM, **Cholewiak D, Van Parijs SM**. Ranking, geographic variability in spectral features of Risso's dolphin echolocation clicks. Abstract submitted to Biennial Conference on the Biology of Marine Mammals, 9 – 13 Dec 2013.
10. **Sasso CR**, Epperly S. Annual survival of juvenile loggerheads in the North Atlantic Ocean. Baltimore 2013.
11. **Van Parijs SM**. Using passive acoustic technologies for management, mitigation and conservation of North Atlantic Right whales. Keynote Speaker at the DCLDE conference in St. Andrews, 12 – 15 June 2013.

F. TECHNOLOGICAL DEVELOPMENTS:

1. Completed – *Built new towed hydrophone arrays* that are compatible and interchangeable across NMFS Science Centers have been constructed for shipboard surveys. Similar recording equipment and approaches to passive acoustic data collection are underway.
2. Ongoing – *Developing a prototype of an electronic range finder* to be used to estimate distance between shipboard observer and a group of animals. This can be used in place of reticles in big eye (25x150) binoculars.

G. METHODOLOGICAL DEVELOPMENTS:

Data/ data processing

1. Ongoing – *Developing decision tree for selecting the most accurate Sea Surface Temperature (SST) data* from multiple satellite sources at different temporal and spatial scales. Data to be linked to AMAPPS data to aid in habitat models development.
2. Ongoing – *Developing methods to create time series of oceanographic fronts* to be linked to AMAPPS data to aid habitat model development.
3. Ongoing – *Developing a template to implement algorithms to clean the EK60 5-frequency backscatter data* via collaboration with student at Duke University.
4. Ongoing – *Developing methods for determining calling rates, depths and detection probabilities from passive acoustic tracking of marine mammals.*
5. Ongoing – *Developing real-time processors of the visual plankton recorder data* via collaboration of Oceanography Branch within the Northeast Fisheries Science Center.

Components of density estimation

6. Ongoing – *Evaluating different passive acoustic approaches* to decide on which is most applicable to different management and mitigation requirements.
7. Ongoing – *Developing methods to estimate abundance of sperm whales and beaked whales* accounting for perception and availability bias using shipboard visual sightings and passive acoustic detections.
8. Ongoing – *Investigating ways to improve definition of sea turtle availability bias* to be used with line transect survey data via collaborations with the US Navy and University of St. Andrews.
9. Ongoing – *Developing ways to integrate other data sources into density estimate* of loggerhead turtles. Other sources include, for example, bycatch estimates, tag location data.
10. Ongoing – *Developing Bayesian hierarchical modeling framework* that uses double observer line transect data and habitat factors to estimate habitat-density relationships and estimate spatially-temporally explicit density estimates.
11. Ongoing – *Developing generalized linear and generalized additive methods* to estimate density of cetaceans when accounting for habitat.
12. Ongoing – *Exploring non-parametric multiplicative regression methods* to estimate spatially-explicit density estimates that account for habitat or to estimate habitat-density relationships.
13. Ongoing – *Fitting statistical distributions to marine bird count data.*
14. Ongoing – *Mapping the Distribution, Abundance and Risk Assessment of Marine Birds in the Northwest Atlantic: Phase 1.*
15. Ongoing – *Improving methodology to estimate seabird density estimates:* Use double observer data to better understand overall detection probability, probability of identifying to species (e.g., identifying a black scoter as such vs. identifying as a generic scoter), variation in how observers count flocks, as well as other variation introduced by the observation process.

H. DATABASE DEVELOPMENT:

1. Ongoing – *Oracle database* (housed at NEFSC) will hold or link to the marine mammal, turtle, seal, seabird, and environmental data collected in the NEFSC and SEFSC AMAPPS surveys.
2. Ongoing – *TETHYS: Acoustic database* developed by Scripps Institution of Oceanography and the NOAA Science Centers will hold acoustic data (including that collected in AMAPPS funded surveys) in a standardized format.
3. Ongoing – *Marine bird Compendium database* originally developed by FWS and currently housed at USGS will hold seabird data collected by NMFS and FWS AMAPPS surveys.
4. Ongoing – *Updating existing databases of environmental variables*: sea surface temperature (sst), chlorophyll, fronts from sst and chlorophyll, bottom depth, bottom slope, rugosity, sediment, benthic classification, position relative to a bathymetric feature. Updating existing ocean model data: mixed layer depth, salinity at depth, temperature at depth, sea surface height, potential density, current velocity. Obtain new satellite data: sea surface height, upwelling, vorticity, eddy probability, and wave height.

I. WEB PRESENCE OF DATA

1. Webpage with locations of satellite-tagged loggerhead turtles: <http://www.nefsc.noaa.gov/psb/turtles/turtleTracks.html>.
2. Webpage with locations of satellite-tagged harbor seal and information on tagging adventures: <http://www.nefsc.noaa.gov/psb/seals/GraySealCapture2013.html>
3. Website with general information on AMAPPS: <http://www.nefsc.noaa.gov/read/protsp/mainpage/AMAPPS/>
4. Passive Acoustic Research, papers and updates: <http://www.nefsc.noaa.gov/psb/acoustics/>
5. CETSOUND: Website containing currently available cetacean density information (using Atlantic data collected before 2010) and biologically important area information. As new updates are finalized they will be added to cetsound.noaa.gov/
6. Ongoing – *Developing ArcMap geodatabases* to facilitate mapping products.

J. ONGOING AND PLANNED WORK: Distribution and abundance

1. Ongoing – *Preparing all survey data collected by NMFS and FWS for storage in the appropriate database.*
2. Ongoing – *Developing spatially and temporally explicit fine scale density estimates and maps of cetaceans, sea birds, and turtles* of at least the recent years (2010 to the current) which incorporate perception bias (using two team sightings data), availability bias (using tag or passive acoustic data collected within AMAPPS or from the literature), spatial autocorrelation (if applicable), and other factors that are species or platform specific (for example, account for responsive movement to the sighting platform, deal with extremely large and rare group sizes).
3. Ongoing – *Examining seasonal movement patterns and dive behavior of adult and sub-adult loggerhead turtles based on tag telemetry data.* Based upon satellite telemetry tags deployed on loggerhead turtles captured between Delaware and Cape Canaveral, FL, examine large scale seasonal movement patterns including investigation of potential foraging areas. Quantify the spatial and temporal variability in dive-surface behaviors to provide appropriate corrections for turtle abundance estimates derived from aerial surveys.

4. Ongoing – *Estimating abundance for loggerheads turtles* accounting for perception bias (using aerial visual sightings data), surface availability bias (using tagging data), and percent of population not currently in US Atlantic surveyed waters (using survival rates of oceanic juveniles not yet using US Atlantic waters and estimates of the number of young age classes that have not yet entered the habitats along the east coast of the US).
5. Ongoing – *Developing Atlantic-wide spatially explicit distribution maps of seabirds* in collaboration with the NOAA Biography branch.
6. Ongoing – *Compare acoustic detections of bottom mounted MARUs to line transect results*. MARU's deployed May – July/August 2013. Line-transect and passive acoustic results collected on shipboard abundance survey July – August 2013.
7. Planning – *Shipboard ecosystem survey in Feb – Apr 2014* in waters from North Carolina to Massachusetts, focusing on wind energy planning areas and surrounding, targeting marine mammals, seabirds, turtles, and large fish and sharks. Including passive and active acoustic monitoring, collection of hydrographic and plankton information, collection of cetacean biopsies and photographs.
8. Planning – *Aerial abundance surveys during spring 2014, winter 2015, and fall 2015* conducted by NMFS (targeting marine mammals, turtles, and large fish and sharks) and FWS (targeting sea birds and other species).
9. Planning – *Winter time data collection using passive acoustic towed array* on the NEFSC ECOMON (Oceanography) surveys.
10. Planning – *Document distribution changes and abundance trends of cetaceans and sea turtles*.
11. Planning – *Deployment of satellite telemetry packages on Razorbills* across all four known breeding colonies in the Northeastern US.

K. ONGOING AND PLANNED WORK: Life history parameters of North Atlantic loggerhead turtles (needed for accurate abundance estimates)

1. Completed – *Estimated duration of oceanic stage duration, somatic growth rates, and straight line carapace length-at-age relationships of loggerheads* that have not yet entered the habitat covered by the aerial abundance surveys using combined skeleto-chronological and stable isotope analyses of annually formed skeletal growth marks in humeri.
2. Ongoing – *Estimating survival rate of oceanic stage loggerheads* using pop-off archival transmitting tags that were deployed on the Canadian Grand Banks in 2011.

L. ONGOING AND PLANNED WORK: Trophic investigations

1. Ongoing – *Comparing hydrographic characteristics of the water column relative to patterns of distribution and density of middle and lower level trophic taxa* (2 mm – 5 cm size range) as determined from 2011 active acoustic and visual plankton recorder data.
2. Planning – *Simultaneously collect active acoustic data and sample plankton/fish* from bongos, visual plankton recorders, and MOCNESS to determine taxa types and trophic levels of active acoustic data during spring 2014 survey shipboard survey (like that done in summer 2013 survey).
3. Planning – *Comparing/modeling hydrographic, active acoustic and plankton density relationships to the marine mammal and seabird distribution patterns*.
4. Planning – *Investigating potential effects of climate change on cetaceans, sea turtles, and sea birds*.

M. SUMMARY OF AMAPPS DATA COLLECTED DURING 2010 - 2013

1. Abundance aerial surveys (NMFS)

- a. Time periods:
 - i. Jul – Aug 2010 (summer)
 - ii. Jan – Mar 2011 (winter/spring)
 - iii. Jun – Aug 2011 (summer)
 - iv. Mar – May 2012 (spring)
 - v. Sep – Nov 2012 (fall)
 - vi. Feb – Mar 2013 (winter/spring)
- b. Types of data:
 - i. Sightings of marine mammals, turtles, large fish and sharks (species, locations, group size, etc).
 - ii. Effort (time and locations of on-effort searching, who is working, sighting conditions, etc.)
 - iii. Photographs for species id verification

2. Abundance aerial surveys (FWS)

- a. Time Periods:
 - i. February 2010 (full coast, sea ducks)
 - ii. August 2010 (Florida)
 - iii. December 2010 (mid-Atlantic)
 - iv. February 2011 (full coast, sea ducks)
 - v. August 2011 (full coast)
 - vi. March 2012 (full coast)
 - vii. Sept – Oct 2012 (full coast)
- b. Types of data:
 - i. Sightings of seabirds, marine mammals, turtles, sharks and rays (species, locations, flock size)
 - ii. Effort (time, distance from transect, survey conditions)

3. Abundance shipboard surveys (NMFS)

- a. Time periods:
 - i. Jul – Aug 2011 (summer)
 - ii. Jul – Sep 2013 (summer)
- b. Types of data:
 - i. Sightings of marine mammals, turtles, birds, large fish and sharks (species, locations, group size, etc).
 - ii. Sightings Effort (time and locations of on-effort searching, who is working, sighting conditions, etc.)
 - iii. Passive acoustic detections (species, location, acoustic signature)

- iv. Passive acoustic effort (time and locations of on-effort searching, who is working, etc.)
- v. Active acoustic effort (frequency, time, location, ping rate, max depth data recorded)
- vi. Active acoustic multi-frequency Simrad EK60 echosounder data (backscatter at 18, 38, 60, 120, and 200 kHz)
- vii. CTD (location, time, depth, temperature, salinity)
- viii. XBT (location, time, depth, temperature)
- ix. Bongo (location, time, depth spanned, species (or species group) ided and quantity of)
 - x. Visual plankton recorder data (location, time, depth spanned, species (or species group) ided and relative quantity of)
- xi. Biopsies (location, species identification)
- xii. Photographs (location, species identification)
- xiii. Hydrographic and environmental data collected from ship's flow-through sampling systems and other ship sensors (location, time, bottom depth, sea temperature, chlorophyll concentrations, wind speed and direction, ship's speed and direction, current direction and speed, etc.).

4. **Loggerhead turtle tagging projects**

- a. NE (50 – 80 nmi off Delaware – Virginia) deployment time periods:
 - i. Aug – Sep 2010
 - ii. Jun 2011
 - iii. May – Jun 2012
 - iv. May – Jun 2013
- b. SE (off South Carolina – Florida) deployment time periods:
 - i. May – Jul 2010
 - ii. May 2013
- c. Types of data:
 - i. Deployment effort data (location and time of deployment)
 - ii. Biological data (always length, width, biopsies, flipper and PIT tagging, photograph; since 2011 also weight, tail length, body depth, internal temperature, respiration, heart beats, blood chemistry, stable isotopes, and sex, etc.)
 - iii. Satellite tag data (location, time, time spent in depth categories, etc.)

5. **Loggerhead turtle life history projects**

- a. Types of data:
 - i. 246 calibrated (4x magnification), digital images of entire, histologically-processed (decalcified, thin-sectioned, stained) humerus cross-sections from 246 oceanic and neritic juvenile loggerheads used for skeletochronological analysis of age and growth.
 - ii. 246 sectioned humeri from oceanic and neritic juvenile loggerheads
 - iii. 109 annual skeletal growth increment-specific $\delta_{15}\text{N}$ isotope values used to infer trophic level and shift from oceanic to neritic habitat for 15 juvenile loggerheads.

- iv. Straight-line carapace length (SCL)-at-age data for 246 oceanic and neritic stage juvenile loggerheads.
- v. 1877 annual somatic growth rates (cm SCL/yr) spanning 1984 to 2009 for oceanic and neritic juvenile loggerheads (as calculated through validated conversion of every measurable skeletal growth mark to an estimate of SCL and calculating the difference in SCL between sequential SCL estimates).
- vi. Estimates of mean and range for juvenile loggerhead oceanic stage duration.

6. Seal tagging projects

- a. Deployment time periods (off Massachusetts and Maine):
 - i. Apr – May 2011 (harbor seals)
 - ii. Mar – Apr 2012 (harbor seals)
 - iii. Dec 2012 (harbor seals)
 - iv. Jun 2013 (gray seals)
- b. Types of data:
 - i. Deployment effort data (location and time of deployment)
 - ii. Biological data (length and weight, photographs, blood, mucous swabs, skin, etc.)
 - iii. Tag data (location, time, etc.)

7. Harbor seal abundance survey

- a. Time periods:
 - i. May 2011
 - ii. May – Jun 2012
- b. Types of data:
 - i. Flight effort data (location and time of plane, sighting conditions, etc.)
 - ii. Flight sightings data (photograph frames taken at each haul-out location, number of seals and species of each seal detected in the photos, location of VHF tagged seals, etc.)

8. Sea bird tagging project

- a. Time period: August 2013 – May 2015
- b. Species tagged: Razorbill
- c. Types of data: location and time

9. Environmental data products to be associated with AMAPPS data

- a. Static (bottom depth, bottom slope, rugosity, benthic classification, sediment)
- b. Satellite derived (SST, chlorophyll, fronts from SST and chlorophyll, turbidity, productivity, sea surface height, eddy probability, wave height)
- c. Ocean model derived (mixed layer depth, salinity at depth, temperature at depth, current velocity)