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Final Report of the Mid-Atlantic Marine Wildlife Surveys, Modeling, and Data: Workshop to Establish Coordination & Communication

July 24-25, 2012

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Final Report

Mid-Atlantic Marine Wildlife Surveys, Modeling, and Data: Workshop to Establish Coordination & Communication

July 24 - 25, 2012

Silver Spring, Maryland

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1. Executive Summary

The U.S. Department of Energy hosted a two-day workshop on July 24-25, 2012 with scientists and regulators engaged in marine ecological survey, modeling, and database efforts pertaining to the waters of the Mid-Atlantic region. The workshop was planned by Federal agency, academic, and private partners to promote collaboration between ongoing offshore ecological survey efforts, and to promote the collaborative development of complementary predictive models and compatible databases. The meeting primarily focused on efforts to establish and predict marine mammal, seabird, and sea turtle abundance, density, and distributions extending from the shoreline to the edge of the Exclusive Economic Zone between Nantucket Sound, Massachusetts and Cape Hatteras, North Carolina.

The first day of the workshop featured an overview of current and recent survey efforts and existing species data, followed by a structured discussion on the potential for coordination of data collection and analyses. The second day was comprised of two additional sessions, one focused on current data storage and distribution systems, data accessibility, and potential avenues for data sharing, and the other on statistical modeling efforts.

Survey Session

During the survey session on the first day of the workshop, presenters summarized fifteen current and recent survey efforts in the Mid-Atlantic coastal region. These survey efforts varied in temporal and geographic scale, focal species, and survey methodologies. While most surveys used aerial and/or shipboard line or strip transect techniques, some surveys utilized avian radar, thermal imaging, passive acoustic detection of marine mammals, telemetry, and acoustic recordings of birds and bats to collect additional data on location and behavior. The objective of the majority of these survey efforts was to inform predictive models of species distribution and abundance.

The desire for data to inform responsible siting of offshore wind energy has driven two of the most intensive studies of ocean space in the region, including state-sponsored marine surveys off Rhode Island and New Jersey. Current efforts are underway to survey the Bureau of Ocean Energy Management's (BOEM) Wind Energy Areas, and ultimately the data collected from these studies will help inform wind farm siting by enhancing understanding of species' presence and use of offshore space.

Assessing spatial and temporal over such large scales is challenging and subsequently, careful interpretation will be necessary to accurately quantify any offshore wind-induced

impacts to wildlife from the background of this natural variability in distributions or abundance. There remain seasonal, geographic, and species-specific data gaps in our understanding of species distributions, movements, abundance and use of Mid-Atlantic waters. Collaborative survey efforts may help minimize such data gaps, by creating nested survey designs and strategically maximizing temporal and geographic coverage, especially in regions and seasons where the largest gaps occur.

Data Session

On the second day of the workshop, presenters highlighted a number of databases and data portals containing biological data for the waters of the Mid-Atlantic coastal region. A number of efforts are underway to aggregate, standardize, and increase access to and awareness of such data. There are also a growing number of systems to facilitate the use and application of this data, including map viewers and portals designed to aid in ocean planning.

Workshop participants suggested that data exchange, along with general data discovery and information sharing, could be promoted through a registry of current data collection activities. Participants also suggested that discussions between data collectors and data providers prior to data collection might help facilitate data dissemination. Such discussions could ensure that standard metadata are collected, that data collection methodologies are as consistent as practicable, and that data are easily comparable. Finally, participants discussed strategies for partnering with and utilizing data collected by private offshore wind developers and suggested that data-use agreements might be formulated to establish parameters to facilitate data sharing.

Modeling Session

During the modeling session, presenters gave talks on modeling efforts underway for marine organisms in the Mid-Atlantic offshore region. Many efforts focus on developing models of species or guild presence and density and on predicting “hotspots,” or geographic areas of aggregation. The modeling efforts currently underway focus on a variety of different species and guilds of species, cover various geographic scales, and use a range of methodologies. Several models have been developed to aid in ocean planning efforts such as siting decisions for offshore wind; these include predictive geospatial models of seabird densities in the New York Bight and predictive and/or geospatial models of seabird, marine mammal, and sea turtle densities in New Jersey’s and Rhode Island’s state and federal waters. Several efforts to model species presence and abundance in the Wind Energy Areas and other areas of the Mid-Atlantic are planned to begin in 2013.

Despite differences among modeling approaches and focus areas, participants identified common challenges. These include integrating data from multiple survey efforts, modeling at different spatial and temporal scales, and clearly identifying study objectives in order to maximize the efficacy of modeling approaches. Additionally, participants discussed future approaches for addressing differences in predictions in species presence and abundance in different model outputs. This includes potential use of a community approach to modeling to create confidence intervals around prediction estimates.

Currently most of the modelers working in this area are creating density models that may help estimate exposure of organisms to wind farm developments. The group suggested that substantial additional work will be needed to incorporate vulnerability and sensitivity into these models to fully model the potential risk to organisms. Participants expressed a desire for clarification from siting and permitting decision-makers as to what risk estimations they would need to judge an offshore wind application.

Conclusions

Over the course of the meeting, participants suggested a number of potential future steps to promote coordination between and among researchers, modelers, and data providers in the Mid-Atlantic region. Individual ideas included:

- Establishing collaborative relationships among researchers and modelers to facilitate technical discussions, provide feedback on models as they are developed, and create a platform for addressing collective challenges.
- Creating a list of points of contact for future communication regarding survey, data, and modeling efforts.
- Creating a map of survey track lines to increase coordination, help ensure flight safety, and identify coverage gaps.
- Creating an online registry of current survey efforts with associated data analysis and aggregation plans to aid in coordination, identification of gaps, and facilitate planning of future survey efforts.
- Holding regular future meetings.
- Developing a community consensus on standards for data, metadata, and to the greatest extent possible, data collection methodologies.
- Developing a community consensus on the highest priority questions regarding the interactions between wildlife and offshore wind installations in the Mid-Atlantic coastal waters.

In response to these ideas, this document contains a list of participants and their contact information; information on current survey, modeling, and data aggregation efforts and associated points of contact; and a map of current and recent survey efforts created by BOEM after the meeting.

2. Workshop Overview and Objectives

The Department of Energy hosted a two-day workshop for scientists and regulators on July 24-25, 2012. The workshop was planned by Federal agency, academic, and private partners, including individuals from the National Oceanic and Atmospheric Administration (NOAA), the Bureau of Ocean Energy Management (BOEM), the U.S. Fish and Wildlife Service (FWS), the United States Geological Survey (USGS), Duke University, North Carolina State University, the University of Rhode Island, the City University of New York, and Biodiversity Research Institute. The meeting was held at NOAA's headquarters in Silver Spring, Maryland. The meeting was open to the public and notice of the meeting was published in the *Federal Register* (Vol. 77, No. 124, June 27, 2012). The Agenda is detailed in Appendix A and the list of participants is in Appendix B.

The goals of the workshop were to improve coordination and collaboration among marine ecological survey, modeling, and database efforts of the offshore waters of the Mid-Atlantic region, and to help ensure that these efforts help meet baseline data-collection and derived product needs for siting and permitting offshore wind facilities. Specifically, this workshop aimed to promote collaboration among offshore ecological survey efforts and the development of complementary predictive models and compatible databases. Due to funding limitations, the workshop was organized as a preliminary gathering among a small number of collaborators. The intended result was a report that gathered information and opened communication channels among those engaged in the broader set of related efforts, including those not participating in this workshop.

The first day of the workshop featured an overview of current and recent survey efforts and existing species data, thus allowing for structured discussions regarding the coordination of survey methodologies. The second day was comprised of two tracks focused on methods and coordination of statistical modeling efforts and on current data storage and distribution systems, data accessibility, and potential avenues for data sharing.

The meeting primarily focused on efforts to establish and predict marine mammal, seabird, and sea turtle abundance, density, and distributions. The primary geographic area of focus was from the shoreline to the edge of the Exclusive Economic Zone and from Nantucket Sound, Massachusetts to Cape Hatteras, North Carolina. Prior to the workshop, many participants provided general information on their survey and modeling efforts. This information on methodologies and objectives and can be found in Appendix C to this report.

3. Session Summaries

This section of the report reflects the proceedings of the first and second days of the workshop. Specifically, Day One (July 24, 2012) was focused on reviewing survey efforts and included structured discussions between all workshop participants. Day Two (July 25, 2012) was divided into two concurrent sessions: one focused on data storage, distribution, and methods of sharing reviewing, and the other focused on biological modeling efforts.

A. Survey Session

The morning session on July 24th was comprised of talks on both current and recently completed survey efforts in the region. The first round of talks focused on recently completed survey efforts and information repositories for data on previous survey efforts. Later talks looked at on on-going survey efforts now in progress, loosely focusing first on projects with a regional geographic scale and then on smaller-scale efforts. Most presentations are included in Appendix D. In addition, prior to the workshop many participants provided more detailed information on their survey methodologies and objectives, which can be found in Appendix C.

This workshop proceedings presents information from the survey session according to the following format:

- Abstracts of talks on survey efforts developed by workshop note takers.
- Table 1: Summary of survey efforts.
- Review of expert discussion and conclusions.
- Table 2: Summary of additional survey efforts identified by workshop participants during the discussions.
- Figure 1: A map of current and recent survey efforts produced by BOEM based on the data provided at the workshop.
- Table 3: List of researchers engaged in BOEM Wind Energy Areas surveys

Survey Talk Abstracts

Existing Data and Recent Survey Efforts

Seabird Survey and Observation Database & Hierarchical Models for Estimating Seabird Distributions in the U.S. Atlantic (**Presenter: Allan O'Connell**, U.S. Geological Survey (USGS) Patuxent Wildlife Research Center, Beth Gardner, North Carolina State University, and Andrew Gilbert, Biodiversity Research Institute)

The U.S. Fish and Wildlife Service (FWS), USGS, and the Bureau of Ocean Energy Management (BOEM) collaborated to catalogue develop a database containing seabird distribution data in the Atlantic. Through this effort the team has catalogued seabird survey and observational datasets, as well as biophysical data for modeling, and conducted hierarchical modeling to predict species distributions. The catalogue includes over 400,000 observations from 70 datasets spanning from the 1900's to the present with most data collected between 1978 and 2010. Modeling efforts, in conjunction with North Carolina State University and NOAA, have produced maps of broad species distributions, community occupancy models, and ongoing efforts to develop statistical guidelines for sampling marine avian populations. More information can be found in Presentation #1 in Appendix D.

OBIS-SEAMAP: Protected Species Information and Analysis System (Jesse Cleary) (**Presenter: Jesse Clearly,** Pat Halpin and Ei Fujioka, OBIS-SEAMAP Team, Marine Geospatial Ecology Lab, Nicholas School of the Environment, Duke University)

The Ocean Biogeographic Information System (OBIS) information network is an international biodiversity archive with OBIS-USA serving as the national component of the network. Within OBIS, the Spatial Ecological Analysis of Megavertebrate Populations (OBIS-SEAMAP) houses data and tools on protected marine species, and is also the network's protected species observation and modeling node. OBIS-USA and OBIS-SEAMAP are working together to advance biogeographic data standards and improve data services, products, and applications. OBIS-SEAMAP provides a spatially referenced online database which aggregates global marine mammal, seabird, and sea turtle data. OBIS-SEAMAP supports ship and aerial surveys, telemetry tracking, acoustic data, species colonies and sites data, as well as models and marine mammal photo identification tools. Observation data are posted with specific information regarding the individual survey efforts, including tracklines, associated metadata, and links to data providers. OBIS-SEAMAP holds data and models that may help inform offshore wind siting including information on seabirds, sea turtles, and marine mammals. More information can be found in Presentation #2 in Appendix D and at http://seamap.env.duke.edu.

Cetacean Density and Distribution Mapping Working Group (CetMap) (**Presenter: Jesse Cleary**, Pat Halpin, Corrie Curtice, and Erin LaBrecque, Marine Geospatial Ecology Lab, Nicholas School of the Environment, Duke University, and the National Oceanic and Atmospheric Administration (NOAA) CetMap Team)

In an effort to improve the tools used by the agency to evaluate the impacts of anthropogenic noise on cetaceans, NOAA instituted two working groups: the Underwater Sound Mapping Working Group (SoundMap) and the Cetacean Density and Distribution Mapping Working Group (CetMap). SoundMap is working to create mapping methods to predict the temporal, spatial, and spectral characteristics of underwater noise, while CetMap is working to create regional cetacean density and distribution maps that are time- and species-specific. These maps utilize survey data and models that estimate density using predictive environmental variables. The CetMap working group is working to analyze existing data sources, identify spatial and temporal data gaps, assess available models, initiate new modeling efforts, and finally, to identify biologically important areas. More information can be found in Presentation #3 in Appendix D and at http://cetsound.noaa.gov.

NJDEP Ocean/Wind Power Ecological Baseline Studies (**Presenter: Gary Buchanan,** Office of Science, New Jersey Department of Environmental Protection)

In 2008-2009, the New Jersey Department of Environmental Protection (NJDEP) undertook a project to help fill data gaps in species distribution in the state's offshore waters to help inform the siting of offshore wind. The study area extended to 20 miles offshore and examined the abundance, distribution, and utilization of the space by birds, marine mammals, and sea turtles. Field studies included aerial line transect surveys and small and large vessel line and strip transect surveys to collect data on birds, marine mammals, and sea turtles, as well as passive acoustic measurements of marine mammal vocalizations, avian radar, thermal imaging for bats and birds, and acoustic recordings. The study also utilized oceanographic, fish, and benthic data. Over bimonthly coastal and offshore surveys, the study observed 153 avian species, eight marine mammal species, and two sea turtle species, including five Federally-designated threatened or endangered species. Marine mammal and sea turtle densities and abundances were estimated using conventional distance sampling and density surface modeling. Bird densities were predicted through interpolation, spatial regression, and additive models to predict the relationship between spatial covariates and birds. Collectively, these maps were combined to create sensitivity maps to predict areas of potential greater and lesser impacts of wind farm development. More information can be found in Presentation #4 in Appendix D and

the full report can be found at http://www.nj.gov/dep/dsr/ocean-wind/report.htm. A summary of the survey efforts is available in Table 1.

Current Regional Scale Survey Efforts

Atlantic Marine Assessment Program for Protected Species (AMAPPS) (**Presenter: Debi Palka,** Northeast Fisheries Science Center, NOAA)

The Atlantic Marine Assessment Program for Protected Species (AMAPPS) is working to collect and analyze data on protected species along the Atlantic coast of the United States. The program is collecting data on whales, dolphins, seals, sea turtles, and seabirds using aerial, shipboard, and acoustic survey efforts, as well as satellite telemetry for sea turtles. These data will be analyzed to model spatially-explicit density estimates using habitat characteristics. The National Marine Fisheries Service (NMFS) is conducting quarterly aerial survey efforts in areas of U.S. coastal waterways that cover the region from the coast line to about the 200-meter depth contour and conducting less frequent shipboard survey efforts from the 200-meter depth contour to the Exclusive Economic Zone. The shipboard survey efforts collect line transect cetacean, turtle, and seabird data, as well as passive and active acoustic data, plankton data, and static and dynamic oceanography data (see Figure 1 for flight coverage). The aerial survey efforts utilize two teams of visual observers using line transect data collection methods flying at an altitude of 180 meters and an airspeed of 110 knots. The U.S. Fish and Wildlife Service (FWS) is simultaneously conducting seasonal fine-scale coastal aerial surveys, with transects that run perpendicular to the coast spaced 5 nautical miles apart. The primary target of the FWS surveys is seabirds with a secondary emphasis on marine mammals and boats. They are flown at a height of 180 meters at 110 knots. More information on project methodology and coverage can be found on the project in Appendix C; the full slide deck can be found in Presentation #5 in Appendix D; a map of the survey areas of coverage can be found in Figure 1; and a summary of the survey efforts can be found in Table 1.

Mid-Atlantic Baseline Studies Project (**Presenter: Kate Williams,** Evan Adams, David Evers, Iain Stenhouse, Biodiversity Research Institute, Beth Gardner, North Carolina State University, Ari Friedlaender, David Johnston, Duke University Marine Lab, and Richard Veit, College of Staten Island / City University of New York)

A team led by Biodiversity Research Institute is working to gather baseline information on the distribution, abundance, and movements of seabirds, marine mammals, and sea turtles on the Mid-Atlantic Outer Continental Shelf. The objective of the study is to produce data to inform siting and permitting processes for offshore wind development in the region. The

project is gathering high-definition video aerial survey data from the southern border of New Jersey to the Virginia - North Carolina border, from three miles offshore to the 30-meter isobath, and is collecting finer scale aerial survey data within the Bureau of Ocean Energy Management's (BOEM) Wind Energy Areas (WEA). Ship-based surveys are also being conducted in about half of this study area, focused in and around the WEAs. Surveys are taking place over a two-year period between March 2012 and April 2014, with seven aerial and eight boat surveys occurring per year. Aerial surveys are flown at ~610 meters over a two day period. Boat surveys transects run perpendicularly from the coast at 10-km intervals with visual observers using combined strip and line transects to record animals, along with passive acoustic detections of nocturnal migrating passerines. The team is also gathering environmental data including sea surface temperature, sea surface salinity, sea state, and biomass density. Data collected through this effort will be used to develop predictive hierarchical abundance or occupancy models. More information on project methodology and coverage can be found on the project in Appendix C; the full presentation can be found in Presentation #6 in Appendix D; a map of the survey areas of coverage can be found in Figure 1; and a summary of survey efforts can be found in Table 1.

Atlantic Coast Wintering Sea Duck Survey, 2008-2011 (Presenters: Emily Silverman and Jeffery Leirness, U.S. Fish and Wildlife Service)

Beginning in 2008, the U.S. Fish and Wildlife Service (FWS) has conducted aerial sea duck surveys during winter months to provide estimates of wintering abundance, with the potential to detect trends, to provide information regarding regional distribution, and to identify crucial wintering areas for sea ducks. These data were used to inform models that predict regional and coast-wide abundance estimates with associated measure of precision. Surveys were conducted from January to March 2008-2011 with some limited additional survey efforts in 2012 and possibly in 2013. The survey area covers the Atlantic coast of the U.S. from the Canadian border to the Georgia - Florida state line. Transects run east-west to the longer of the 9 nautical mile or the 16-meter depth contour with finer resolution surveys in important sea bird habitat and in proposed areas of offshore wind development. The surveys are conducted at a height of ~180 meters at 110 knots using a strip transect methodology. More information on project methodology and coverage can be found on the project in Appendix C; the full slide deck can be found in Presentation #7 in Appendix D; a map of the survey areas of coverage can be found in Figure 1; and a summary of the survey efforts can be found in Table 1.

Broadscale Distribution of Pelagic Birds Off the U.S. East Coast, Maine to North Carolina (**Presenter: Richard Veit**, Timothy White, and Marie-Caroline Martin, Biology Department, College of Staten Island, City University of New York, Melanie Steinkamp, U.S. Fish and Wildlife Service)

With funding from BOEM, NOAA, the College of Staten Island/City University of New York (CSI/SUNY), USGS, Manomet Center for Conservation Sciences, and the FWS have been partnering to collect data on marine bird distribution and abundance in portions of the offshore environment off the U.S. East Coast. The goals of these surveys are to quantify seasonal and yearly variability of seabird abundance and to use these data to identify seabird hotspots and coldspots. These shipboard surveys span the offshore waters from Maine to Cape Hatteras, North Carolina on vessels of opportunity including EcoMon, Herring, and Woods Hole Oceanographic Institute cruises. Researchers use a combination of line and strip transects to count all species of birds and marine mammals encountered as well as environmental data. Data analyses will include time series analysis for bird and plankton co-occurrence. Data are housed at the USGS seabird database. Data collected through these surveys are being compared with historical records to identify trends in use and allow for predictions of change due to climate change. More information on project methodology and coverage can be found on the project in Appendix C; the full slide deck can be found in Presentation #8 in Appendix D; a map of the survey areas of coverage can be found in Figure 1; and a summary of the survey efforts can be found in Table 1.

Update on Offshore Acoustic Bat Research in Atlantic and Great Lakes Regions (**Presenter: Steve Pelletier**, Trevor Peterson, Sarah Boyden, and Joel Perkins, Stantec Consulting Services)

Stantec Consulting Services is working to assess use of offshore space by bats along the Atlantic coast and in the Great Lakes. This project seeks to help offshore wind developers and regulators understand potential effects of offshore wind farms on bats by assessing the frequency of bat occurrence offshore. The current work builds off of survey efforts from 2009-2011 in which acoustic detectors were placed in the Gulf of Maine at coastal locations, on islands, and on one buoy. These initial studies detected bats at all study sites during April through November. Through funding from the Department of Energy, Stantec is expanding the study to cover the Gulf of Maine, the Mid-Atlantic region, and the Great Lakes with an increased emphasis on sites not associated with land. In spring and summer of 2012, the Stantec team successfully deployed twenty bat echolocation detector systems at locations in these regions and is actively collecting data using these systems. By the end of the project, the team aims to obtain regional and multi-year data on seasonal offshore bird and bat activities and to refine equipment, methods, and logistics to aid in the

development of a remote offshore bird and bat migration data collection and monitoring system. More information on project methodology and coverage can be found on the project in Appendix C; the full slide deck can be found in Presentation #9 in Appendix D; and a summary of the survey efforts can be found in Table 1.

Mid-Atlantic Aerial Surveys for Marine Mammals, Sea Turtles and Other Large Marine Vertebrates 1998-2012 (**Presenter: William McLellan**, University of North Carolina, Wilmington)

A team of researchers from the University of North Carolina, Wilmington; Duke University; the University of St. Andrews; the Virginia Aquarium; and NOAA has been collaborating to conduct aerial surveys on marine mammals, sea turtles, and other large marine vertebrates in sections of the Mid-Atlantic coastal region. The team has conducted multiple survey efforts ranging over a decade in total duration. The surveys are each flown at a height of 305 meters at a speed of 185 km/h with two observers using separate strip surveys. Surveys are flown along track lines; when an organism of interest is observed, the plane breaks from its track line to collect additional data including photos, estimations of group size, species identification, and behavior. Species identification is verified using digital images with 95% of sightings identified to species.

During 2001-2002 and 2005-2008, the team conducted Mid-Atlantic region right whale surveys from Savannah, Georgia to Temperance, Virginia. The goal of these surveys was to document right whale movement patterns across the region including calving data and the identification of individuals. The data were analyzed to determine the frequencies of right whale sightings by month to assess the timing of species movements during their northward migration. In 1998 and1999, the team conducted aerial surveys to estimate the distribution and abundance of sea turtles and cetaceans around Wallops Island, Virginia, and Onslow Bay, North Carolina. Additional surveys were conducted around Onslow Bay from 2007 to 2011. The data were used to create density and abundance estimates.

From 2009 through the present, the team has been conducting similar surveys off of Jacksonville, Florida with funding from the United States Navy through the Atlantic Fleet Active Sonar Training (AFAST) study. Finally, from May 2011 to the present, the team has been conducting surveys off of Cape Hatteras with the same goal of estimating cetacean and sea turtle distributions and abundances in the region. These data are feeding into distribution and abundance analyses conducted by the University of St Andrews in Scotland.

The data from each of these efforts is now available on OBIS SEAMAP. Planned future efforts include surveys at the Virginia Beach wind energy project and continuation of the Cape Hatteras and Jacksonville monthly surveys.

More information on project methodology and coverage for each of these surveys can be found on the project in Appendix C; the full slide deck can be found in Presentation #10 in Appendix D; and a summary of the survey efforts can be found in Table 1.

Current State-Scale & Project-Scale Survey Efforts

Avian Modeling for the Rhode Island Ocean Special Area Management Plan (**Presenter: Kristopher Winiarski**, Peter Paton, Scott McWilliams, and David Miller, University of Rhode Island)

A team of researchers collaborated to assess current spatial and temporal patterns of avian abundance and movement ecology as part of a large marine spatial planning exercise in Rhode Island. The primary objectives of the study were to assess the temporal and spatial distribution and abundance within the ocean Special Area Management Plan (SAMP) study area and to quantify flight behavior of birds in the area.

The survey area included approximately 3,800 km^2 of ocean space and was surveyed using a combination of aerial-based strip and line-transect surveys, ship-based line-transect surveys, land-based radar, and land-based point counts. Eight sawtooth sampling areas were surveyed once per month from June 2009 to August 2010. Observers gathered data on bird abundance, species, bearing, behavior, location, flight elevation, and direction among other variables. A total of 29 aerial strip transect surveys along 24 transects situated perpendicular to the coast were conducted biweekly from December 2009 to August 2010 to quantify abundance of waterbirds. These surveys were flown at a height of ~150 meters and at a speed of 100 knots. Two observers took data on abundance, species, and behavior of birds sighted. A total of 44 aerial line transect surveys were flown from December 2010 to July 2012 along the same transects. Two observers gathered data on abundance, behavior, and sighting bin.

Data collected from the earlier efforts have been incorporated into density surface models. These data were using to inform marine spatial planning for Rhode Island that helped identify optimal sites for offshore wind development. More information on project methodology and coverage for each of these surveys can be found on the project in Appendix C; the full slide deck can be found in Presentation #11 in Appendix D; and a summary of the survey efforts can be found in Table 1.

Massachusetts Clean Energy Center Survey Project, 2011-2012: Birds (**Presenter: Richard Veit**, Simon Perkins, Time White, and Nick Metheny, Biology Department, College of Staten Island /City University of New York)

The Massachusetts Clean Energy Center is funding aerial surveys south of Martha's Vineyard and Nantucket, Massachusetts, including the BOEM Wind Energy Area, the Muskeget Channel tidal turbine area, and the proposed Northeast Ocean Renewable Energy Innovation Zone. A team of researchers collected data on seabird abundance and distribution in a series of 16 aerial surveys between October 2011 and October 2012. Observers collected data on species and behavior using strip transect methodologies. Flights are flown at a height of 90 meters and at a speed of 90-100 knots. Data are used to create species-specific density maps. More information on project methodology and coverage for each of these surveys can be found on the project in Appendix C and a summary of the survey efforts can be found in Table 1.

Massachusetts Clean Energy Center Survey Project, 2011-2012: Field studies of Whales and Sea Turtles for Offshore Alternative Energy Planning in Massachusetts (**Presenter: Jessica Taylor,** Scott Krauss, New England Aquarium, Charles Mayo, Laura Ganley, Pat Hughes, Provincetown Center for Coastal Studies, Robert Kenney, University of Rhode Island, Christopher Clark, and Aaron Rice, Bioacoustics Research Program Cornell Lab of Ornithology, Cornell University)

In addition to the avian surveys described above, the Massachusetts Clean Energy Center is funding aerial surveys and passive acoustic data collection efforts to gather information on large pelagics in the region south of Martha's Vineyard and Nantucket, Massachusetts, focusing on the BOEM Wind Energy Area. Data collection efforts are aimed at estimating density and abundance for large whales and sea turtles, with opportunistic sighting data collected on other large pelagic species. These data are gathered through bi-monthly aerial surveys occurring between October 2011 and October 2012 using line-transect methodology which includes randomized start point selection for each survey. In addition to observer data, automated and opportunistic vertical photographs are also taken. Six Marine Autonomous Recording Units collect passive acoustic data on vocalizations of baleen whales in the vicinity and to assess ambient noise conditions. Data analyses should result in estimations of density and abundance using right-angle-distance sighting probability models, a vertical photography database, and analysis of the temporal and spatial patterns of mysticete whales based on acoustic recordings. More information on project methodology and coverage for each of these surveys can be found on the project in

Appendix C; the full slide deck can be found in Presentation #12 in Appendix D; and a summary of the survey efforts can be found in Table 1.

Documenting Whale Migration off Virginia's Coast for Use in Marine Spatial Planning (**Presenter: Mark Swingle**, Virginia Aquarium and Marine Science Center Foundation)

A team of researchers led by the Virginia Aquarium and Marine Science Center Foundation will be collecting data on large whales in and around the Virginia Wind Energy Area between fall 2012 and spring 2013. The study covers over 10,000 km^2 of ocean space using a combination of aerial and ship-based surveys. Aerial surveys are conducted using standard distance sampling techniques to take data on strip transects and are flown two days per for month for six months at a height of ~300 meters and a speed of 100 knots. Eight vessel days of ship-based survey efforts are planned. Data will be used to generate density estimates which will be incorporated into the Mid-Atlantic Regional Council on the Ocean (MARCO) Mapping and Planning Portal and other regional data bases such as OBIS SEAMAP and will be used to help inform marine spatial planning within the region. More information on project methodology and coverage for each of these surveys can be found on the project in Appendix C; the full slide deck can be found in Presentation #13 in Appendix D; and a summary of the survey efforts can be found in Table 1.

Virginia/Maryland Sea Turtle Research & Conservation Initiative: NOAA Section 6 Species Recovery Grant (**Presenter: Mark Swingle**, Virginia Aquarium and Marine Science Center Foundation)

A team of researchers led by the Virginia Aquarium and Marine Science Center Foundation is working to collect a comprehensive set of data on the life history, health, and abundance of sea turtle species in the Chesapeake Bay and the surrounding coastal waters off Virginia and Maryland. The first goal of this effort is to develop robust seasonal distribution and abundance estimates for loggerhead and Kemp's ridley sea turtles in the study area. The population in the area will be assessed by quantifying surfacing time to determine availability; by conducting aerial abundance surveys to allow for estimations of seasonal and annual abundances; and by making comparisons to previous abundance estimations. The survey area was divided into five strata comprised of 113 east-to-west transects spaced 3.3km apart. Two teams of observers collected data on species, abundance, and angle to sighting from spring 2011 to fall 2012. Observers used the Hiby circle-back technique in fall 2011 and spring 2012. Data will be used to create density and abundance estimations and will be incorporated into the OBIS SEAMAP and MARCO web portals. More information on project methodology and coverage for each of these surveys can be found on the project in

Appendix C; the full slide deck can be found in Presentation #14 in Appendix D; and a summary of the survey efforts can be found in Table 1.

Navy Integrated Comprehensive Monitoring Program (ICMP) (**Presenter: Robert Gisiner**, Office of the Chief of Naval Operations, Energy and Environmental Readiness Division, U.S. Navy)

The United States Navy funds a broad range of biological data collection efforts, including a number of survey efforts in the Mid-Atlantic region. Developed in consultation with regulatory agencies, these data collection efforts are used to inform Navy activities, including monitoring and mitigation activities. The Navy takes an adaptive management approach to reviewing new science and the results of ongoing monitoring activities annually. The Navy funds data collection efforts using a range of methodologies including aerial and ship-based visual surveys, passive acoustic monitoring, behavioral response studies, and photo identification projects. Recent and ongoing data collection efforts in the Mid-Atlantic coastal region include the Duke University-led Cape Hatteras Atlantic Fleet Active Sonar Training (AFAST) study and the AMAPPS survey efforts. Additionally, the Navy is providing funding to OBIS SEAMAP and OBIS-USA and ensuring that their data is archived here. The Navy is working with other agencies to ensure that all survey data is placed in OBIS-USA for common agency and public use. More information on the Navy ICMP can be found in Presentation #15 in Appendix D. A summary of the Cape Hatteras AFAST and AMAPPS survey efforts can be found in Table 1 (refer above to the William McLellan talk).

Table 1: Summary of recent and current survey efforts presented on at the workshop

Effort (Organization)	Area of Coverage	Type of Survey	Methodology of Survey	Species of Emphasis	Timing (Period of coverage, frequency)	Data Products	POC	Data location (if publicly available)
Ocean/Wind Power Ecological Baseline Studies (New Jersey Department of Environmental Protection)	New Jersey Coast to 20 miles offshore	Aerial, shipboard, passive acoustics, avian radar, thermal imaging, acoustic recordings.	Aerial: line transect surveys using visual observers; Shipboard: small and large vessel line and strip transect surveys; Passive acoustics: autonomous monitoring units; Avian radar: Vertically scanning radar (VerCat) and horizontally scanning radar (TracScan) NEXRAD; Thermal imaging: Thermal Imaging-Vertically Pointed Radar.	Seabirds, marine mammals, sea turtles	2008-2009	Density and abundance estimates for sea turtles, marine mammals, and birds.	Gary Buchanan	Final report: http://www.nj.gov/dep/dsr/ocean-wind/report.htm
AMAPPS (NOAA, FWS)	Atlantic Coast from Florida to Nova Scotia, Canada, coverage	Shipboard, aerial, acoustics, satellite telemetry (sea turtles)	Shipboard: line and strip transect; NMFS Aerial: line transect using visual observers; FWS Aerial: strip	Marine mammals, sea turtles, seabirds, ocean sunfish,	Shipboard surveys occur in the summer, aerials occur each	Upcoming seasonal abundance estimates, spatially explicit density	Debi Palka (NMFS) Tim Jones (FWS)	NMFS: OBIS-SEAMAP http://seamap.env.duke.edu/ FWS: USGS Seabird

Effort (Organization)	Area of Coverage	Type of Survey	Methodology of Survey	Species of Emphasis	Timing (Period of coverage, frequency)	Data Products	POC	Data location (if publicly available)
	extends from shoreline to the EEZ.		transect using visual observers.	basking sharks	season	distribution maps		Database
Mid-Atlantic Baseline Studies (BRI, NC State, Duke University, College of Staten Island / CUNY)	Southern border of New Jersey to the Virginia-North Carolina border, from three miles offshore to the 30 m isobath.	Shipboard, aerial, satellite telemetry (birds)	Shipboard: combined strip and line transect; Aerial: high definition video, post-flight ID.	Marine mammals, sea turtles, seabirds	March 2012- April 2014. Seven aerial and eight boat surveys occur per year.	Hierarchal models of animal abundance or occupancy; individual movement data for focal bird species	Kate Williams	Northwest Atlantic Seabird Compendium
Atlantic Coast Wintering Sea Duck Surveys (FWS)	From the Canadian border to the GA/FL state line. Transects run east-west to the longer of the 9 nm/16m depth.	Aerial	Aerial: strip transect using visual observers	Seabirds	Surveys conducted from January-March 2008-2011, with some limited additional survey efforts in 2012, possibly	Models that provide framework for regional and coast-wide abundance estimates, with associated measures of precision	Emily Silverman and Jeffery Leirness	Data maintained by FWS in an Access database and may be made available through the Division Migratory Bird data center

Effort (Organization)	Area of Coverage	Type of Survey	Methodology of Survey	Species of Emphasis	Timing (Period of coverage, frequency)	Data Products	POC	Data location (if publicly available)
					2013			
Broadscale Distribution of Pelagic Birds Off the U.S. East Coast, Maine to North Carolina (College of Staten Island / CUNY and FWS)	Maine to North Carolina	Shipboard, on vessels of opportunity	Combination of line and strip transections using visual observers	Seabirds	Surveys conducted and planned from 2007-2014, with four to seven cruises per year	Analyses of bird and plankton co-occurrence, identification of hotspots and coldspots.	Richard (Dick) Veit	USGS Seabird Database
Offshore Acoustic Bat Research in Atlantic and Great Lakes Regions (Stantec Consulting Services)	Mid-Atlantic, Gulf of Maine, Great Lakes	Acoustic, Radar	Acoustic: remote acoustic detectors placed on offshore islands and buoys; Radar: Offshore X-Band Radar	Bats, seabirds	Spring-early winter 2012-14 in all three regions, additional data from Gulf of Maine 2009-2011	Analysis of presence and variety of bats offshore.	Steve Pelletier	
Wallops Bay and Onslow Island Surveys (Univ. of North Carolina, Wilmington)	Waters around Wallops Island, Virginia, and Onslow Bay,	Aerial	Aerial-based line transect surveys with combination of visual observers and photo documentation for	Cetaceans, sea turtles, other large pelagics	Wallops Bay and Onslow Island 1998-1999, Onslow Bay 2007-2011	Density and abundance estimates	William McLellan	OBIS SEAMAP

Effort (Organization)	Area of Coverage	Type of Survey	Methodology of Survey	Species of Emphasis	Timing (Period of coverage, frequency)	Data Products	POC	Data location (if publicly available)
	North Carolina		species identification confirmation					
Mid-Atlantic Right Whale Surveys (University of North Carolina, Wilmington)	Savannah, Georgia to Temperance, Virginia	Aerial	Aerial-based line transect surveys with combination of visual observers and photo documentation for species identification confirmation	Right whales	2001-2002 and 2005-2008.	Frequencies of right whale sightings by month to assess the timing of species movements during their northward migration	William McLellan	OBIS SEAMAP
Cape Hatteras AFAST Aerial Surveys (University of North Carolina, Wilmington)	Waters off of Cape Hatteras	Aerial	Aerial-based line transect survey with combination of visual observers and photo documentation for species identification confirmation	Cetaceans, sea turtles, other large pelagics	May 2011-current time	Density and Abundance Estimates	William McLellan	OBIS SEAMAP
Avian Modeling for the Rhode Island Ocean Special Area Management Plan	Waters off of Rhode Island	Aerial, Shipboard, Land-based radar, Land-	Aerial-based strip and line-transect surveys using visual observers, ship-	Seabirds	Data collected from January	Density surface models incorporate into the Rhode	Peter Paton	University of Rhode Island Data Center and USGS Seabird

Effort (Organization)	Area of Coverage	Type of Survey	Methodology of Survey	Species of Emphasis	Timing (Period of coverage, frequency)	Data Products	POC	Data location (if publicly available)
(University of Rhode Island)		based point counts	based line transect surveys using visual observers, land-based radar: dual vertical and horizontal X-band, and land-based point counts: visual observation from fixed stations		2009-July 2012, with ocean based surveys occurring from June 2009 on	Island Special Area Management Plan		Database
Massachusetts Clean Energy Center Survey Project, 2011-2012: Birds (College of Staten Island / CUNY)	South of Martha's Vineyard and Nantucket, Massachusetts, including the BOEM Wind Energy Area, the Muskeget Channel tidal turbine area, and the proposed Northeast Ocean Renewable Energy	Aerial	Aerial-based strip transect surveys using visual observers	Seabirds	October 2011-2012	Species-specific density maps	Richard Veit	Data held at USGS Seabird Database, City University of New York, and Massachusetts Clean Energy Center

Effort (Organization)	Area of Coverage	Type of Survey	Methodology of Survey	Species of Emphasis	Timing (Period of coverage, frequency)	Data Products	POC	Data location (if publicly available)
	Innovation Zone							
Massachusetts Clean Energy Center Survey Project, 2011-2012: Field studies of Whales and Sea Turtles for Offshore Alternative Energy Planning in Massachusetts (Provincetown Center for Coastal Studies, University of Rhode Island, and Cornell University)	South of Martha's Vineyard and Nantucket, Massachusetts, focusing on the BOEM Wind Energy Area	Aerial	Aerial-based line transect surveys, with automated and opportunistic photography, passive acoustic recordings	Large whales (focus on right whales) and sea turtles, opportunistic data collected on other large pelagic species	October 2011-2012	Estimations of density and abundance using right-angle-distance sighting probability models, a vertical photography database, and analysis of the temporal and spatial patterns of mysticete whales based on acoustic recordings	Tyler Studds	Right whale images stored in New England Aquarium DIGITS system, sightings in data stored in the North Atlantic Right Whale Consortium dataset housed at the University of Rhode Island

Effort (Organization)	Area of Coverage	Type of Survey	Methodology of Survey	Species of Emphasis	Timing (Period of coverage, frequency)	Data Products	POC	Data location (if publicly available)
Documenting Whale Migration Off Virginia's Coast for Use in Marine Spatial Planning (Virginia Aquarium and Marine Science Center Foundation)	Waters in and around the Virginia Wind Energy Area	Aerial and shipboard	Aerial-based strip transect surveys using visual observers, Shipboard surveys using standard distance sampling techniques	Large whales	Fall 2012-Spring 2013	Density estimates	Susan Barco and Mark Swingle	OBIS SEAMAP and MARCO portals
Virginia/Maryland Sea Turtle Research & Conservation Initiative (Virginia Aquarium and Marine Science Center Foundation)	Chesapeake Bay and surrounding waters off Virginia and Maryland	Aerial	Aerial-based strip transects using visual observers, later surveys used Hiby circle back technique	Sea turtles	Spring 2011-Fall 2012	Density and abundance estimates	Susan Barco and Mark Swingle	OBIS SEAMAP and MARCO portals

Summary of Survey Discussions and Conclusions

The discussion following the survey talks yielded a number of additional efforts not covered in the preceding talks. Table 2 contains a summary of these additional efforts. For purposes of information sharing, Table 2 also captures those studies that are not in the geographic area of concern. Discussion participants referenced a large number of tagging efforts that are underway with the same goal of tracking a wide diversity of organisms. However, the group did not attempt to make an exhaustive list of tagging efforts underway in this region, in particular because the workshop talks had focused primarily on boat and aerial based survey efforts.

During the afternoon of the first day of the workshop, participants discussed survey methodology, design, and coordination in relationship to siting and evaluating the impacts of offshore wind energy facilities. Participants' discussions focused on optimal methodologies and/or best practices for surveying large pelagics in the Mid-Atlantic region coastal waters. Most participants voiced the opinion that survey methodologies should be tailored to the goals of the research endeavor, as different survey methods have different strengths and weaknesses (and all survey methods are subject to some type of bias). An example raised during discussions regarded the advantages and disadvantages of deviating from survey track lines when specific organisms were detected. Such deviations may bias abundance estimates, particularly in areas of high animal densities, but increase researchers' ability to accurately identify species and group sizes. Ultimately, the optimal method of survey depends on which biases the survey is attempting to minimize and the question it is seeking to address. Consequently, participants suggested that it may be less critical to adopt strict standardized methodologies for survey efforts in the Mid-Atlantic region than to focus on ensuring the use of scientifically robust survey designs that are appropriate to address specific research questions. Such care allows for evaluation and understanding of biases associated with each method to ensure accurate data analyses and to facilitate survey inter-comparisons.

The group discussed the value of and challenges associated with identification of "hotspots" and "coldspots," particularly in the context of using these identified areas to inform the siting of offshore wind energy facilities. Participants articulated the view that the definition of hotspots and coldspots is fluid and lacks standardization, and noted definitions ranging from percentage of a specific species present to total species density in the area. Since hotspots and coldspots have geographic, population, and temporal contexts to consider, it was suggested that they are best described as hotspots/coldspots of the target species, relative to geographic area and averaged over unit time. To identify hotspots and coldspots, participants stressed the importance of both survey consistency – that is, replication in timing and location of survey effort – as well as high sampling intensity and meaningful duration, to ensure data are collected on species presence under a range of conditions.

In siting wind energy facilities, some participants suggested that the verification of coldspots may be more important than detailed evaluation of hotspots. Further, verification of coldspots might be easier than verification of hotspots; however, others argued that verification of organism absence will always be challenging. Additionally, some suggested that hotspots and coldspots matter less in siting wind farms than the assessment of risk to animals during construction and subsequently during operation. However, participants had varied opinionsregarding what data and subsequent analyses are needed to fully assess risk. In the case of birds, some participants noted that risk assessment topics that arose for the Cape Wind project included flight height and patterns of daily and seasonal use, and suggested that these variables be used in siting evaluation.

More broadly, it was suggested that it would be optimal to understand what organisms are in an area, when, how frequently, and how they are utilizing the space. These data should then be considered within the context of regional and population-level data. Participants also discussed that the mechanisms of risk posed by construction and operations are different, and therefore data should be collected that specifically addresses risks from both these activities. Some suggested that the optimal strategy for assessing wind farm risk might be to design surveys around the species of greatest concern, predict risk to that species, and then establish go/no-go levels of risk for those species.

Some of the researchers present at the workshop articulated a desire for regulatory guidance regarding type and amount of data required for the siting and permitting of wind farms and guidance on the analyses that regulators require to support decisions regarding acceptable levels of risk. Others expressed the view that it is difficult to anticipate these data needs in advance of construction of wind farms, since impacts in this environment have not been evaluated.

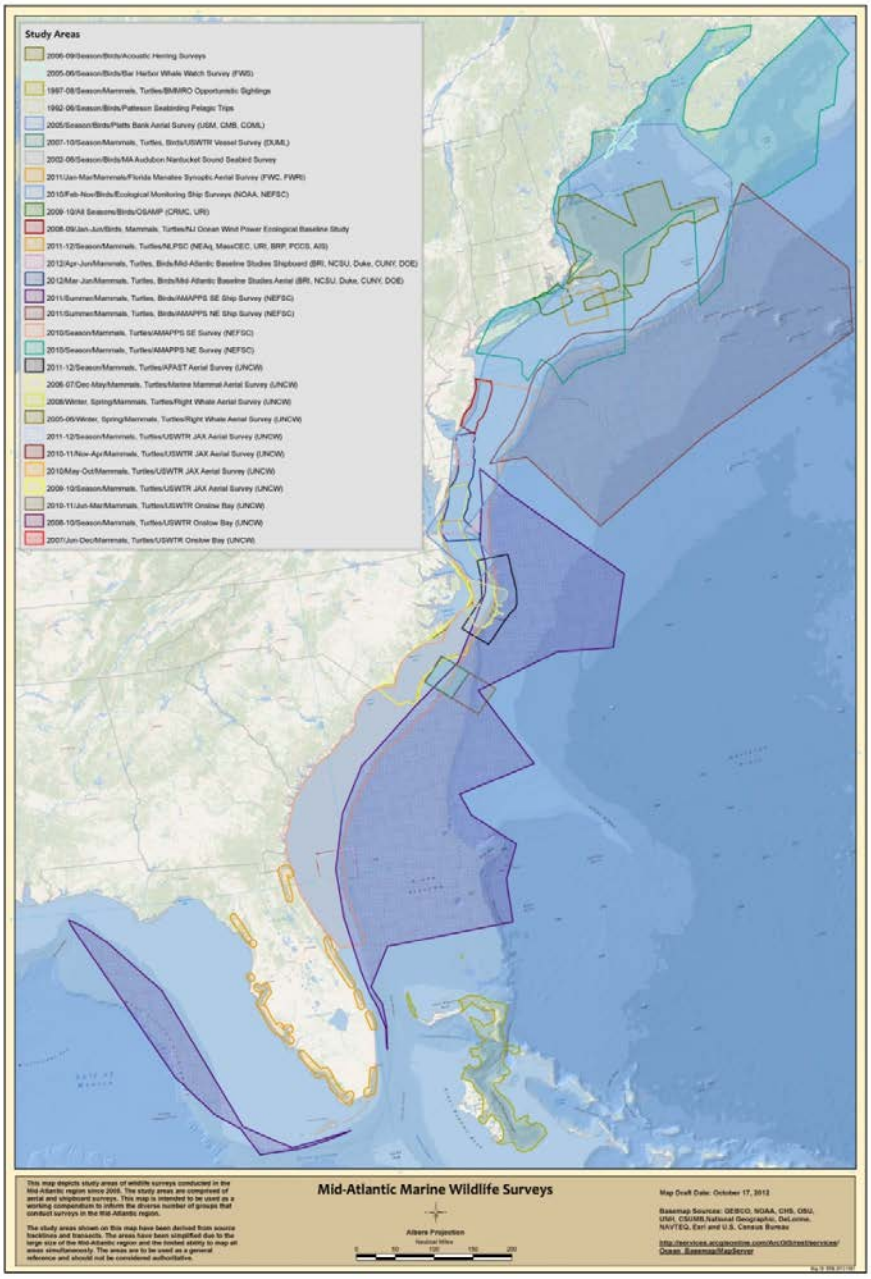
Participants suggested that coordination of survey efforts could allow for inter-comparisons of results and increased value of combined efforts. Additionally, coordination of aerial survey efforts could help increase the safety of flights. In response to this suggestion, BOEM worked to develop a map of recent and current survey efforts in the region following the workshop (Figure 1). This map is posted on the Multipurpose Marine Cadastre (MMC) http://csc.noaa.gov/mmcviewer/. While the map shows the regions of coverage of the survey efforts, the MMC also shows the survey track lines and will contain metadata on each survey that provides more detailed information on the effort, including how to access the data. In order to help facilitate coordination among researchers collecting and utilizing data in the Wind Energy Areas (WEAs), the group also compiled lists of researchers working in the WEAs. This list is provided in Table 3 of this report.

Table 2: Additional current survey efforts identified by workshop participants during meeting discussions

Organization	Location	Type	Focal Taxa	Contact	Other
Provincetown Center for Coastal Studies	Cape Cod Bay*	Aerial and ship-based	North Atlantic right whales	ccs@coastalstudies.org	
NavFac Atlantic	Norfolk, Virginia	Small boat and passive acoustic	Bottlenose dolphin	Anu Kumar	
NOAA NEFSC	Maine* and Massachusetts	Aerial and tagging	Harbor seal, grey seal surveys upcoming	Debra Palka, Gordon Waring	2011/2012
NOAA NEFSC	Rhode Island to Maine*	Aerial line transect and photo-id	North Atlantic right whales	Debra Palka/Tim Cole	Data available in OBIS SEAMAP
Duke University, U.S. Marine Corps	Camp LeJeune, North Carolina	Visual Surveys	Marine mammals (primarily bottlenose and spotted dolphin	Andy Read	
State of Maryland Dept. of Natural Resources Chesapeake and Coastal Service	Maryland	Baseline biological surveys and geophysical surveys	Birds/mammals	Gwynne Schultz	2013-2014
Numerous tagging studies	Throughout region	Cetaceans, seabirds, sea turtles, other			

**Indicates efforts that fall outside of the geographic area of coverage of the meeting. These were included in this report for information sharing purposes, though the coverage of survey efforts occurring in these regions is likely not exhaustive.*

Figure 1: Map of areas of coverage for recent and current survey efforts compiled by BOEM



A larger version of the map can be viewed on the Multi-Purpose Marine Cadastre at http://csc.noaa.gov/mmcviewer/. *Under the ocean uses and planning areas category, there are two layers: Atlantic Wildlife Survey Track Lines and Atlantic Wildlife Survey Study Areas. The raw survey information is available for download at:* http://www.boem.gov/Renewable-Energy-Program/Mapping-and-Data/index.aspx.

Table 3: Researchers engaged in recent or current survey efforts in the BOEM Wind Energy Areas (WEAs)

Virginia Wind Energy Area
James Bail Offshore Aerial Imagery Company
Robert DiGiovanni Jr. Riverhead Foundation for Marine Research and Preservation
Tim Jones U.S. Fish and Wildlife Service
Anu Kumar NAVFAC Atlantic
Laura McKay Virginia Coastal Zone Management Program
William (Bill) McLellan University of North Carolina, Wilmington
Debra (Debi) Palka Northeast Fisheries Science Center National Oceanographic and Atmospheric Administration Fisheries
Steve Pelletier Stantec Consulting Services
Andrew Read Duke University
Mark Swingle Virginia Aquarium & Marine Science Center
Dick Veit College of Staten Island, City University of New York
Andy Webb HiDef Aerial Surveying
Kate Williams Biodiversity Research Institute
Maryland Wind Energy Area
James Bail Offshore Aerial Imagery Company
Tim Jones U.S. Fish and Wildlife Service

Anu Kumar NAVFAC Atlantic
Debra (Debi) Palka Northeast Fisheries Science Center National Oceanographic and Atmospheric Administration Fisheries
Steve Pelletier Stantec Consulting Services
Gwynne Schultz Maryland Dept. of Natural Resources
Mark Swingle Virginia Aquarium & Marine Science Center
Dick Veit College of Staten Island, City University of New York
Kate Williams Biodiversity Research Institute
Delaware Wind Energy Area
James Bail Offshore Aerial Imagery Company
Tim Jones U.S. Fish and Wildlife Service
Anu Kumar NAVFAC Atlantic
Debra (Debi) Palka Northeast Fisheries Science Center National Oceanographic and Atmospheric Administration Fisheries
Steve Pelletier Stantec Consulting Services
Kate Williams Biodiversity Research Institute
New Jersey Wind Energy Area
James Bail Offshore Aerial Imagery Company
Gary Buchanan New Jersey Department of Environmental Protection
Tim Jones U.S. Fish and Wildlife Service

Anu Kumar NAVFAC Atlantic
Debra (Debi) Palka Northeast Fisheries Science Center National Oceanographic and Atmospheric Administration Fisheries
Rhode Island Wind Energy Area
Robert DiGiovanni Jr. Riverhead Foundation for Marine Research and Preservation
Tim Jones U.S. Fish and Wildlife Service
Kris Winiarski Department of Natural Resources, University of Rhode Island
Debra (Debi) Palka Northeast Fisheries Science Center National Oceanographic and Atmospheric Administration Fisheries

B. Data Session

This section contains information presented at the data session during Day Two of the workshop. Presentations and discussion included such topics as data storage, distribution, and accessibility and sharing efforts. Table 4 contains a list of databases and data portals with marine biological information for waters of the Mid-Atlantic region.

Data Talk Abstracts

The intent of these talks was to provide participants with an understanding of the major data aggregation efforts underway for species distribution and abundance information in Mid-Atlantic waters, and to provide a basis for later discussion of potential coordination and collaboration efforts. Presentations are included in Appendix D.

Multipurpose Marine Cadastre (**Presenter: Daniel Martin**, NOAA Coastal Services Center)
Website: http://www.marinecadastre.gov/default.aspx

NOAA and BOEM are co-leading the development of the Multipurpose Marine Cadastre, an integrated information system which compiles offshore geographic information on a variety of components including energy resources, biota, fisheries, shipping, and other natural and human use variables. The Cadastre (or MMC) includes a map viewer with data visualization and mapping tools to support planning and permitting, and a sortable data registry that provides data available for download and links to data sources. The Cadastre has a federated distributed system that allows for the distribution of data from multiple parties. The system uses ESRI Flex Library and ArcGIS as its mapping platform. The Cadastre is linked with Ocean.data.gov and members of the Cadastre team are helping with the development of the Ocean.data.gov site (http://www.data.gov/communities/ocean.) All data in the Cadastre system are available through API/Web Services and available upon request.

During the next year, the Cadastre team will be working to develop new data products, map viewers, and other data tools. The team is also working to expand its regional support capabilities to help assist in regional planning activities, and finally, it is working to provide direct assistance to the BOEM State Task Forces and other groups to meet their specific needs. More information on the Multipurpose Marine Cadastre can be found in Presentation #16 in Appendix D.

Atlantic Seabird Survey Compendium (**Presenter: Mark Wimer**, USGS)

The Atlantic Seabird Survey Compendium[1] ("the Compendium") is a multi-agency effort involving the USGS, NOAA, and BOEM. For an overview of the data housed in the Compendium, see the talk entitled *Seabird Survey and Observation Database & Hierarchical Models for Estimating Seabird Distributions in the U.S. Atlantic* in the Survey section of this report.

The primary goal of the Compendium is to support research and modeling. As a secondary goal, the team is also working to provide derived products to aid in management and planning decisions. A tertiary goal of the system is to provide a platform for data sharing; however, the team focuses primarily on supporting products which interpret/display/visualize the data rather than providing raw data.

As part of its efforts, the team is working to share data with the Multipurpose Marine Cadastre and others; however, it recognizes there is a tension between the specificity of purpose for which individual data sets are collected and the broad uses for which others might want to utilize them. In the data lifecycle, portions of data not relevant to the study at hand may not be archived and therefore, data sets may evolve over this cycle to be less useful to the general user. To address these issues, the Compendium developers are working with data providers to ensure that data and metadata are captured in ways that enhance future usability for researchers and decision makers.

The Compendium is currently owned by USGS but at present there are only two years of funding available for the system. Ideally, the team hopes to move towards a shared resource that will be available freely online. Currently, the Compendium team is focusing on communication and coordination of database usage rather than solely on data archiving, and it is helping support a full lifecycle of data use including the development of analytical and derived tools for marine planning purposes. More information on the Atlantic Seabird Survey Compendium can be found in Presentation #17 in Appendix D.

[1] As of March 2013, the Atlantic Seabird Compendium is referred to as the Northwest Atlantic Seabird Compendium.

National Oceanographic Data Center: An Ocean of Data and Information (**Presenter: Krisa Arzayus**, NOAA)
Website: http://www.nodc.noaa.gov/

The National Oceanographic Data Center (NODC) is one of three national data centers. Collectively the National Geophysical Data Center, the National Climatic Data Center, and the NODC work to curate the nation's environmental data, promoting access to and stewardship of these data. The NODC manages the world's largest collection of publicly available physical, chemical, and biological oceanographic data.

Over the last fifty years, NODC evolved from a disparate collection of databases into a unified Archive Management System, and it is now working to incorporate a wide range of internationally accepted data tools and services including data discovery, data access and use, and metadata services, as well as online browsing, visualization, and analysis systems. The NODC has a flexible and open archival information system, which serves as a link between the data provider and consumer. The Center houses over 678 data accessions from Cape Hatteras to the Scotian Shelf, as well as a large number of data sets from other regions.

The NODC team strives to make data useable, accessible, discoverable, and the team works to ensure that tools are available for data integration. Additionally, it ensures datasets have appropriate associated metadata. The Center works to provide long term preservation of data, tailored access to these data, improved quality control, and derived data products. More information on the National Oceanographic Data Center can be found in Presentation #18 in Appendix D.

Virginia and Mid-Atlantic Ocean Planning (**Presenter: Laura McKay**, Virginia Coastal Zone Management Program)
Website: www.midatlanticocean.org

The Mid-Atlantic Regional Council on the Ocean (MARCO) is one of five existing regional ocean partnerships in the United States. MARCO was established in 2009 with the goals of protecting key ocean habitats, improving water quality, adapting to climate change, promoting renewable offshore energy, and ocean planning. To aid in ocean planning, the Virginia Coastal Zone Management Program provided funds to the Nature Conservancy to develop a data portal in 2009 that was launched in 2010. With the establishment of the National Ocean Council and the associated formation of Regional Planning Bodies - charged with developing Coastal and Marine Spatial Plans - the portal is expected to aid in this planning process. Virginia received a five year grant to aid in marine spatial planning efforts and these funds will partially support data access and are actively working to address

identified needs. More information on Virginia and Mid-Atlantic ocean planning efforts can be found in Presentation #19 in Appendix D.

MARCO Portal: Data and Tool Development (**Presenter: Jay Odell,** The Nature Conservancy)
Website: http://portal.midatlanticocean.org/portal/

The purpose of the MARCO Portal is to support marine planning in the Mid-Atlantic coastal region. The portal provides geographic data including physical, biological, and human use variables as downloadable files and web mapping tools. The portal also contains themes preloaded with sector-specific data, including energy, which provides a spatial filter, allowing users to select areas that meet their specific criteria and generate reports on the results of their efforts. For offshore wind energy, the portal allows users to identify areas of specified depths, wind speed, proximity to transmission, and human use variables such as distance from shipping lanes and military use. Moving forward the team hopes to enhance the portal by incorporating more data, improving spatial filters, incorporating stakeholder data and values, and undergoing a peer review process. More information on the data and tool development for Virginia and Mid-Atlantic ocean planning efforts can be found in Presentation #20 in Appendix D.

OBIS-USA Data Management: Standards, Applications and Life Cycle (**Presenters: Mark Fornwall**, USGS, **Philip Goldstein**, University of Colorado, and **Jesse Cleary**, Duke University)
Websites: www.usgs.gov/obis-usa/, http://seamap.env.duke.edu/

The Ocean Biogeographic Information System (OBIS) – USA is the US node of a global network to provide marine biological data in a standardized format, including providing standardized metadata. OBIS-USA is a component of the Federal data architecture, gathering data from Federal, academic, state, and other entities, applying data standards and services, and providing access to data to ultimately support the development of products. Data housed in OBIS-USA are taxonomically, spatially, and temporally resolved and International Organization for Standardization (ISO) compliant. The system uses set semantics to standardize data under the Marine Biogeographic Data Terminology, and data records contain a standard set of record details, such as geo-reference points. OBIS-USA has relationships with a variety of web services to make data readily available and useable and is currently working to integrate physical data, as well as absence, quantification, tracking, sampling methodology, and transect data.

The Ocean Biogeographic Information System - Spatial Ecological Analysis of Megavertebrate Populations (OBIS-SEAMAP) is another component of the Federal data

architecture, serving as a spatially referenced online database that aggregates marine mammal, seabird, and sea turtle observation data from across the world and serves as the OBIS protected species observation and modeling node. OBIS-SEAMAP acts as a liaison between data users and data providers to offer customized applications including data exploration tools and modeling development. OBIS-SEAMAP includes the U.S. Navy cetacean monitoring data which allows users to view all monitoring data through a single web portal. OBIS-SEAMAP also provide GIS web services for data view, as well as tools that integrate mixed data types for exploration, that aggregates tag data, acoustic data, photo ID, and genetic datasets, including BOEM Gulf of Mexico sperm whale data.

OBIS-SEAMAP holds potential for future use in marine spatial planning and energy planning purposes. More information on OBIS-USA and OBIS-SEAMAP can be found in Presentation #21 in Appendix D.

Summary of Data Discussions and Conclusions

Following the presentations on current data systems and aggregation efforts, participants discussed mechanisms to improve data exchanges. The group discussed whether there was a need to expedite data access by creating systems and mechanisms for data sharing prior to public release, to provide modelers and decision makers with the most up-to-date data possible. Participants discussed the tension between the proximate need for current data to inform offshore wind siting decisions (i.e., accurate pre- and post-construction comparisons) and the simultaneous need to protect the scientific process (i.e., assuring adequate time for data quality control and publication prior to data release). They also cautioned that raw data made accessible can be vulnerable to misuse, leading researchers instead to prefer sharing derived products.

Participants suggested that data exchanges, along with general data discovery and information sharing, could be promoted by creating a registry of current projects. Such a registry might include a contact list and listserv with information on topics such as survey locations and timing, modelers seeking to utilize marine species data, and data availability dates and points of contact. Some participants suggested that such a project registry would be most effective if it were centralized, leveraged existing data systems, and fed into the regional portals. This repository might also provide a platform for on-going discussions between research groups and encourage researchers collecting field data to consider data sharing and standards during the survey design process.

Participants suggested that such discussions between data collectors and data providers prior to data collection can help facilitate data dissemination after it is collected, by

ensuring that standard metadata is collected, data collection methodologies are as consistent as possible, and that data are easily comparable. Collecting and describing data using designated standards also helps manage uncertainty in data quality by ensuring confidence in data, differentiating between data quality, and helping users understand the level of uncertainty associated with data sets. Participants recognized that the data community needs to work towards ensuring that there is clear guidance to researchers regarding data standards. They suggested that the development of tools to help researchers capture and standardize their own metadata could make data entry more efficient and could enhance compatibility between data sets. Participants also suggested that incentives and rationales for data sharing need to be established to encourage these activities. Additionally, they proposed that future in-person meetings (potentially annually) could help promote and enhance coordination efforts.

Finally, the group discussed strategies for partnering with and utilizing data collected by private offshore wind developers. Participants suggested that data-use agreements might be formulated that establish parameters for such data use. Others suggested that developers could be assured that geospatial anonymity would be granted to their data in exchange for use in meta-analyses.

Table 4: Databases and data portals containing marine biological data for the Mid-Atlantic region

Name	Web Address	Geographic Coverage	Primary Function	Data Emphasis	POC
OBIS-USA	www.usgs.gov/obis-usa/	U.S. waters and oceanic regions	Provide access to marine biological data and metadata to meet research and management needs.	Primarily marine biological occurrence data	Mark Fornwall, mark_fornwall @usgs.gov
OBIS-SEAMAP	http://seamap.env.duke.edu/	Global	Provided spatially referenced database with global marine mammal, seabird and sea turtle observation data.	Marine mammal, sea turtle, and seabird data	Andrew Read and Patrick Halpin mgel-tech@env.duke.edu
Multipurpose Marine Cadastre	http://www.marinecadastre.gov/default.aspx	U.S. waters and oceanic regions	Provide access to marine data and map viewer to aid in ocean planning and management decisions.	Primarily boundary, geophysical, human use, and biological data	Brian Smith and Daniel Martin nos.csc.mmc@noaa.gov
National Oceanographic Data Center	http://www.nodc.noaa.gov/	Global	Provide access to, maintains and update national ocean environmental data	Primarily physical, biological and chemical oceanographic data and ocean	Krisa Arzayus NODC.Services @noaa.gov

			archive.	model simulations	
Data.Ocean.gov*	http://www.data.gov/ocean	U.S. waters and oceanic regions	Serve as the National Ocean Council's portal for data, information, and tools to support people engaged ocean planning.	Seeking all relevant Federal geospatial datasets	http://www.data.gov/contact-us
U.S. IOOS Data Catalog*	http://www.ioos.gov/catalog/	Global, emphasis on U.S. Waters	Providing data to track, predict, manage, and adapt to changes in ocean, coastal and Great Lakes environments.	Primarily physical oceanographic data	noaa.ioos.web master@noaa.gov
Northwest Atlantic Seabird Compendium	Not publicly available	Western Atlantic	Aggregate seabird observation datasets from the Atlantic Outer Continental Shelf for the purposes of research and informing planning activities.	Seabird distribution data and biophysical covariate data	Allan O'Connell and Mark Wimer, aoconnell@usgs.gov, mwimer@usgs.gov
MARCO Portal	http://portal.midatlanticoce	Mid-Atlantic ocean	Provide an online toolkit, resource center,	Primarily	Jay Odell

	an.org/portal/	waters	and map viewer that consolidates available data to aid in ocean planning.	boundary, human use, and biological data	jodell@tnc.org
Maryland Coastal Atlas: Ocean*	http://www.dnr.state.md.us/ccp/coastalatlas/ocean.asp	Maryland ocean waters	Provide mapping tool to view ocean data and access to ocean planning tools.	Human use and biological data	Chris Cortina ccortina@dnr.state.md.us
New York Ocean and Great Lakes Data Portal and Atlas*	http://portal.oglecc.ny.gov/geoportal/catalog/main/home.page	New York ocean and Great Lakes waters	Data portal and mapping tool to locate and display data.	Human use and biological data	http://portal.oglecc.ny.gov/geoportal/catalog/identity/feedback.page
Virginia Coastal Geospatial and Educational Mapping System (GEMS)*	http://www.deq.virginia.gov/Programs/CoastalZoneManagement/CoastalGEMSGeospatialData.aspx	Virginia ocean waters	Mapping tool to view ocean data and access ocean planning tools.	Human use and biological data	Nick Meade Nick.Meade@deq.virginia.gov

**Databases or portals that were not presented on at the workshop.*

C. Modeling Session

The intent of this session was to review current regional marine wildlife modeling efforts and establish a basis for later discussions addressing modeling challenges and coordination efforts. The session started with a series of overview talks on existing, ongoing, and future modeling efforts in the region. The talks are summarized below and the slides are included in Appendix D. The abstracts to each of these sets of talks are presented in this section.

Modeling Talk Abstracts

Existing Modeling Efforts

NOAA/NCCOS Biogeography Statistical Modeling of Seabird Distributions (**Presenter: Brian Kinlan**, NOAA, Chris Caldow, NOS/NCCOS/CCMA Biogeography Branch, Allan O'Connell, Elise Zipkin, Mark Wimer, and Allison Sussman, USGS Patuxent Wildlife Research Center)

The mission of NOAA's Biogeography Branch is to develop informational and analytical products through research, monitoring, and assessment on the distribution and ecology of living marine resources and their associated habitats. The Branch works to conduct integrated biogeographic analyses of spatial data layers to develop products, including spatial models, which aid in management decisions. Currently, the Branch is involved in several modeling projects aimed at providing spatially-explicit information to aid in offshore wind site selection and environmental assessments. These models build off of the premise that risk is a function of hazard, vulnerability, and exposure.

The Branch recently completed a climatological model of seabirds, shorebirds, and waterfowl in the New York Bight. This predictive model was created through collaboration with the New York Department of State to provide ecological information to help site renewable energy projects while protecting crucial offshore habitats. The model primarily utilized data from the Manomet Bird Observatory Cetacean and Seabird Assessment Program (1980-1987), which was collected using timed shipboard strip-transects to create estimates of sightings per unit effort. Where possible, the team created seasonal models by species, and otherwise modeled by taxonomic group or by groups of ecologically similar species. Species presence and abundance were modeled with environmental predictor data using a two stage regression-kriging approach. In the first stage, data were analyzed using binomial generalized linear models (GLM) to predict probability of presence and then used Gaussian GLM to predict abundance. The model's predictive skill was then assessed using cross validation. The model predicted abundance hotspots, which were defined areas of predicted high abundance using data from all species and groups. The team also predicted

uncertainty for their abundance estimates by using half of the data to create an independent assessment of error.

Through funding from BOEM, the team is currently working with the USGS Patuxent Wildlife Research Center to develop a predictive spatial model of long-term average patterns of seabird abundance and occurrence in the Mid-Atlantic Bight to aid in offshore wind siting. Working with data in the Atlantic Seabird Compendium, the team aims to incorporate environmental predictors; to standardize surveys to a common unit of effort; to incorporate different error terms and weights for different surveys; and to incorporate detectability from small-scale model results.

The final project that Dr. Kinlan discussed is an ongoing sampling design/power analysis project to develop methodology for determining sampling intensity needed to detect hotspots and coldspots of occurrence and abundance at the scale of lease block grids. The technique involves selecting appropriate statistical distribution models for data sets and then simulating a distribution curve to predict number of surveys required for adequate statistical power. More information on these modeling efforts can be found in Appendix C and in Presentation #22 in Appendix D.

Avian Modeling for the Rhode Island Ocean Special Area Management Plan (**Presenter: Kris Winiarski**, Peter Paton, Scott McWilliams, and David Miller, Department of Natural Resources, University of Rhode Island)

To inform Rhode Island's ocean planning decision process, a team of scientists at the University of Rhode Island modeled seasonal surface density and depicted foraging areas for a large number (>80) of bird species using ship-based transect and aerial-based strip-transect survey data. The multi-step modeling process included fitting a detection function to the data to control for imperfect detection, and dividing transects into unique segments with environmental covariates identified at the midpoint of each segment. The best-fitting models were included distance to land and depth as predictors. Finally, a predictive model was created and abundance in the study area for each species and season was predicted. These were used to develop predictive density maps, as well as uncertainty regarding these predictions. The models indicated that waters with depths of less than 20 meters were important foraging areas.

The team is also working to address the question of how modeling output can best be incorporated into offshore wind siting decisions. Using Zonation, a conservation planning software program which aids in the identification of optimal conservation areas, abundance predictions were used to identify areas of high ecological value. Preliminary results

suggested that nearshore areas were important, as well as some offshore areas. Future work will include analysis of the newer aerial-based line-transect data with the potential incorporation of additional environmental covariates in the model. More information on these modeling efforts can be found in Appendix C and Presentation #23 in Appendix D.

Existing and Upcoming Modeling Efforts

Cetacean Distribution and Density Modeling Efforts at Duke (**Presenter: Jesse Cleary**, Patrick Halpin, Ben Best, Jason Roberts, and Ei Fujioka, Marine Geospatial Ecology Lab, Duke University)

Researchers at the Marine Geospatial Ecology Lab at Duke University are currently working on numerous cetacean modeling efforts for both the Atlantic Coast of the U.S. and the Gulf of Mexico. The team of researchers at Duke, in conjunction with NOAA's Southwest Fisheries Science Center, worked to develop the Strategic Environmental Research and Development Program (SERDP) cetacean probability of occurrence models, and to use these models to develop an online Spatial Decision Support System (SDSS) that provides spatiotemporally-explicit predictions of density and probability of occurrence of cetaceans in order to minimize risk to protected species from potentially harmful human interactions. Occurrence probabilities were predicted using GAM models of density and both static and time-varying environmental variables for 16 cetacean species guilds. Presence/absence maps were generated using receiver operator characteristic curves to minimize false positives and negative error rates. The maps have been integrated into OBIS-SEAMAP where users can query regions of interest, and the predictive density models of cetaceans by season are also housed on the Multipurpose Marine Cadastre. The team is currently working to update these models, incorporating a wider range of remotely-sensed ocean observations, identifying more ecologically-important model parameters from these observations through the development of novel algorithms, exploring the possibility of creating near-real-time now-cast and forecast capabilities, and finally publishing a GIS-integrated tool box which includes key algorithms.

The team at Duke, in conjunction with the Navy and NOAA NMFS, is also beginning to model cetaceans in the U.S. Navy Atlantic Fleet Training and Testing Area in the Western Atlantic. Through this effort, the team will investigate new statistical methods to improve density estimates and will update "pier side" data. These models will feed into the Navy Marine Species Density Database (NMSDD) and the Navy Acoustic Effects Models (NAEMO).

Finally, the team is working with the cetacean density and distribution mapping (CetMap) working group to map cetacean density and abundance through an analysis of available

data, novel modeling efforts, and finally identification of biologically important areas. The team is working to develop a cetacean data and model discovery tool. Through their OBIS-SEAMAP and modeling efforts, the group is working to provide a data system span from data provision to model development to information discovery to decision support.

The team is interested in collaborating on Mid-Atlantic data and modeling efforts. More information on these modeling efforts can be found in Appendix C and in Presentation #24 in Appendix D.

A Consistent Approach to Using Density Estimates for Use in Navy Acoustic Effects Modeling (Presenter: Anu Kumar, NAVFAC Atlantic)

The Navy requires marine mammal density estimates to help inform their ocean use activities and enable quantitative estimations of impacts. Specifically, during the compliance processes under the Marine Mammal Protection Act and the Endangered Species Act, the Navy is asked to quantify their acoustic effects on protected species. The Navy is currently in the second phase of the environmental review process which will cover a broader geographic area than the Environmental Impact Statements covered in Phase I. Collectively, these analyses involve the incorporation of many data layers and data derived from a variety of sources. To systematically rank and incorporate these disparate data sources, the Navy developed a density hierarchy which stratifies density derivations based on the amount of survey data effort from which they were derived and the robustness of the analysis by which they were produced. At the top of this hierarchy are density spatial models, followed by design-based/stratified density estimates derived from primary literature, then by density based on Relative Environmental Suitability models, and lastly, extrapolation from any of these sources. Using this hierarchy, the Navy creates combined density estimates in the Navy Marine Species Density Database for use in Navy Acoustic Effects Models. In the future, the Navy plans to incorporate new data from CetMap, AMAPPS, and other sources; to work with Duke to update the density data models for Atlantic Fleet Training and Testing; to update the database; to work to make the results available to the public; and to collaborate with other modelers. The full slide deck can be found in Presentation #25 in Appendix D.

Modeling Distribution and Abundance of Sea Birds in the Western North Atlantic (**Presenter: Beth Gardner**, North Carolina State University)

Beth Gardner from North Carolina State University is collaborating with numerous parties to develop a range of seabird models in the western North Atlantic. These models typically are hierarchical and are analyzed using a Bayesian mode of inference. They also typically

incorporate information on effort and heterogeneity based on survey type; utilize spatially and/or temporally referenced covariates; handle zero-inflated data; and incorporate explicit spatial auto-correlation.

One such modeling effort involved a collaboration with Tufts University to model baseline information on beached seabirds using Seabird Ecological Assessment Network data collected by trained volunteers. These data will help provide a baseline for comparison with stranding numbers associated with human and natural impact activities and events. The data was zero-heavy, survey lengths were variable, and sampling was non-random with poor coverage. The team used a zero-inflated Poisson model that included beach orientation, sea surface temperature, month, and wind vector variables, with beach length as an offset term.

A second modeling effort drew upon the Atlantic Seabird Database to create a broad-scale model of seabird distributions using a spatial Poisson Regression approach to model species distribution patterns with spatial correlation and estimates of uncertainty. The effort identified covariates that affect distributional patterns and in the future the team plans to combine individual species maps to determine if they can identify community patterns.

Dr. Gardner is also working with the scientists at the University of Rhode Island and Massachusetts Audubon Society to develop community dynamic occupancy models. By comparing areas with repeated aerial surveys, models will allow for an assessment of the probability of detection. Using the Cape Wind area data and the Rhode Island SAMP data, the team is working to address questions such as consistency in regional occupancy patterns, variability in detection, and variations in species communities between these two areas. Additionally, Dr. Gardner will be working with the baseline boat-based and high definition video data collected by the Biodiversity Research Institute in the Mid-Atlantic region. These models will predict species abundance and distribution and will consider detectability and availability. Finally, Dr. Gardner is modeling the distribution and abundance, and evaluating risk to seabirds in the northwest Atlantic (also known as the Best Darn Bird Map Project) in conjunction with a large collaborative team.

More information on these modeling efforts can be found in Appendix C and in Presentation #26 in Appendix D.

AMAPPS Modeling (**Presenter: Debi Palka**, NOAA's Northeast Fisheries Science Center)

Using the data collected through the AMAPPS survey efforts, the AMAPPS team plans to develop spatial-temporal fine scale density maps of cetaceans, sea turtles, and sea birds

within U.S. Atlantic waters using environmental covariates and detection factors. They also plan to investigate trends, hotspots, and potential climate effects, as well as trophic ecosystem relationships. The effort will result in density maps that account for seasonal temporal patterns and variability, covariate dependent detection probabilities, group size, encounter rates, availability, and (if present) spatial autocorrelation. The team will likely analyze some species individuals and pool others and plans to use a Bayesian hierarchical framework. More information on these modeling efforts can be found in Appendix C and in Presentation #27 in Appendix D.

Summary of Modeling Discussion

Participants discussed challenges associated with modeling marine species in the Mid-Atlantic region, approaches to address those challenges, and potential future coordination opportunities. Additionally, participants discussed the need for standardization of data from different survey efforts and cross-platform data gathering methods. Methodological differences between survey efforts raise challenges for treatment of data in models; for example, there may be differences in the altitude at which aerial surveys are conducted based both on safety and focal species of interest, and these differences will affect detectability. Furthermore, there are large differences in the behavioral responses of organisms based on survey platform (e.g., boat vs. aerial) and subsequently in organism availability. Participants suggested complete standardization among survey techniques is likely not possible (nor even desirable) because of the need for methodologies that address diverse end goals. However, it was suggested that documentation of methodology is critical and should be reported in detail for all survey efforts, especially for variables that affect detectability of organisms (e.g., glare). A common modeling currency might be developed to help address this issue in the absence of survey standardization.

The group also discussed modeling approaches for addressing offshore wind wildlife impacts. Participants noted that models of different scales may be required for broad-scale siting purposes versus evaluation of construction and operation impacts at specific projects; regional-scale models with rough temporal resolution may be sufficient to inform broad-scale ocean planning and siting decisions. In such a case, detection of hotspots and coldspots could be informative in identifying potential sites for development or avoidance. Site-specific risk questions will likely require data at finer temporal and spatial scales, including behavioral data. It was recognized that most modelers are currently creating density and abundance models which help estimate exposure, and that substantial additional work will be needed to incorporate vulnerability and sensitivity into these models. Only then will it be possible to fully model the risk of potential wind farm effects on species of concern. Participants also expressed the view that in order to model risk

effectively, clear direction is needed on the types of risk of greatest concern. Participants suggested that model development should progress first from species density estimates to eventually creating more complex risk models that incorporate a variety of variables. Participants also discussed potential steps for further model coordination and collaboration, and ranked those steps based on their perceived feasibility and the level of interest the group had in pursuing them. The results of this discussion are presented in Table 5.

The group had the greatest interest in continuing information sharing efforts, perhaps via mechanisms such as webinars, Wikipedia sites, or other forms of interactive websites. Participants also suggested that presentations on model development efforts with regular input from community members would be helpful, although participants stressed that such efforts would be most effective when based upon a well-defined goal. The group also discussed the possibility of sharing environmental predictor data, including the possibility of creating or choosing an existing central repository for data sharing and storage.

Participants discussed the possibility of engaging in coordinated efforts to evaluate and address variability in model outputs to address the likely event that different models will produce somewhat different predictions of species density and distribution, even with the same input data. Different predictions could be an issue for decision makers seeking to base decisions off of those model results. While participants emphasized that currently there does not appear to be a large amount of overlap in species and geographic model output, they discussed approaches through which models and results could be compared. The possibility of using an ensemble approach to modeling such as is used in hurricane predictions was discussed. There were not any major objections to this possibility; however, it was recognized that such efforts would need additional resources to implement. Participants also suggested the possibility of conducting model comparisons by selecting a single species, running various models using the same data, creating a range of results, and using these as a way to compare models.

Finally, the group discussed the possibility of data sharing among modelers, including the potential to use such data as independent validation data sets. This suggestion was ranked lowest by the group based on issues with the proprietary nature of data and the large data storage needs associated with this suggestion.

In addition to the suggestion by some participants that researchers conducting surveys collect as much metadata regarding detectability as possible, the group also suggested that data systems employ biologists in their quality assurance and quality control (QA/QC) processes. Participant processes echoed the data group's articulation of the need for data

standards and suggested that enhanced metadata on the scale of survey efforts, both temporal and spatial, would aid in modeling efforts.

Participants in the modeling group expressed a desire for clarification from decision-makers involved with offshore wind siting and permitting regarding the types of modeling outputs they would need to judge an offshore wind application. It was felt by several participants that such input from regulators and decision makers would help determine the direction of future modeling efforts.

Table 5: Potential modeling coordination efforts discussed at workshop

Option	Requirements	Level of Interest/ Feasibility
Information sharing	• Develop community for communication: -Webinars -Website -Wikipedia site • Presentation of model development with participant input; regular (annual) update from community members on current modeling efforts.	1
Coordinate and Share Environmental Predictor Data	• Repository for storage, sharing; • Efficient means of data gathering (scripts, tools); • Possibly a dedicated worker.	2
Model Inter-comparison Project	• Standardized data set; • Possible ensemble of model outputs approach; • Addressing different model foci (species scale, etc.); • Likely requires funding to drive effort.	3
Data Sharing	• Modelers share their data sets (possibly as independent validation data sets); • Repository for data (with ability to handle proprietary data).	4

4. Potential Future Coordination Efforts

Over the course of the workshop, participants suggested a number of potential future steps to address challenges identified during discussions. Such steps included the promotion of coordination between researchers, modelers, and data providers in the Mid-Atlantic coastal region, and ranged from relatively static or simple suggestions to long-term, complex efforts.

Ideas included creating a list of points of contact for future communication regarding survey, data collection, and modeling efforts. Such a list would provide a tool for communication among and between researchers engaged in these efforts. The group also suggested the creation of a map of survey track lines to increase coordination and flight safety. If focal species were included, this map could also be of use in helping facilitate the identification of spatial and temporal gaps in survey coverage. Additionally, the group suggested creating an on-line registry of current survey efforts with associated data analysis and aggregation plans to aid in coordination, identification of gaps, and in the planning of future survey efforts. Participants also suggested regular future meetings would be useful to promote discussions. The modeling group expressed interest in the possibility of establishing ongoing technical conversations among modelers to provide feedback on models as they are developed and to provide a platform for addressing modeling challenges faced by multiple researchers.

Building from such efforts, participants suggested that the group could work towards developing a community consensus on standards for data, metadata, and to some extent data collection methodologies. Finally, participants suggested working towards a community consensus on what questions are the most pressing and critical ones to ask and to answer regarding the interactions between wildlife and offshore wind in the Mid-Atlantic coastal region.

In response to these ideas, this report contains a compendium of information from the workshop. It includes a list of participants and their contact information; technical information on current survey, modeling, and data aggregation efforts and associated points of contact; and a map of current and recent survey efforts created by BOEM after the meeting. It also contains appendices including a comprehensive set of answers provided by workshop participants after the meeting and the slides from the talks.

The development of offshore wind off of the Atlantic Coast raises new questions for the region regarding interactions with marine organisms during construction and operation. Determining what data and analyses are needed to fully answer these questions will likely

be an iterative process further shaped and driven by numerous factors, including the articulated information needs of regulators, data collection abilities and limitations, analyses used for modeling risk, and finally, by our evolving understanding of the species-specific variables that drive risk in this region as wind farms are constructed and monitored.

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