Wildlife Densities and Habitat Use Across Temporal and Spatial Scales on the Mid-Atlantic Continental Shelf: 2014 Annual Report

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North Carolina State University
Oregon State University
University of Oklahoma
(Other partners for specific project activities are listed in the acknowledgments section, and are referenced in the relevant chapters of this report).

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Project Scope
This study addresses the “Removal of Market Barriers” objective identified by the Department of Energy’s (DOE) Wind and Water Power Program in “A National Offshore Wind Strategy: Creating an Offshore Wind Energy Industry in the United States” (February 2011). The goal of the study is to provide regulators, developers, and the public with the necessary data to “help identify high-priority areas for protection, existing data gaps, and the best manner by which to efficiently incorporate natural resource considerations into the permitting and siting process.” To address this goal, we are studying bird, sea turtle, and marine mammal distributions, densities, and movements on the mid-Atlantic Outer Continental Shelf (OCS), to determine how these characteristics of animal populations vary with environmental factors and across space and time.

The products developed over the course of this project will provide federal regulators and wind energy developers with two years of high-quality baseline monitoring data for the study area on the mid-Atlantic OCS; identify species at high risk to potential turbine interactions in this area; develop U.S.-based technological resources for future monitoring efforts; and explore technological advancements and assessment methods aimed at simplifying and minimizing the cost of environmental risk assessments.

Project Objectives
The objective of this study is to produce the data required to inform siting and permitting processes for offshore wind energy development in the mid-Atlantic. Data on bird, sea turtle, and marine mammal abundance and movements will be collected and analyzed in scientifically sound ways, using a variety of technologies and methods, and will be presented to stakeholders and regulators in easily accessible formats that are useful for planning and decision-making.

Specific project goals include the following:

- Quantify bird, sea turtle, and marine mammal densities seasonally and annually throughout the study region and develop hierarchical models to examine spatial patterns and trends.
- Use data collected during the project period to predict the combinations of environmental conditions likely to support large densities of birds, turtles, and marine mammals.
- Use individual tracking data from satellite telemetry to provide information on animal movements and site fidelity.
- Compare high definition video aerial and boat-based survey data, and publish results to establish the validity of high definition aerial surveys as a survey method for offshore development in U.S. waters.
• Help overcome the market barrier associated with National Environmental Policy Act (NEPA), Marine Mammal Protection Act, and Endangered Species Act requirements by contributing several years of data and analysis towards future Environmental Impact Statements.
• Disseminate project data to stakeholders and regulators through publicly accessible and readily available technical and summary reports, geospatial map layers, scientific manuscripts, and in-person briefings.

Products and Deliverables
During the third year of the project, Biodiversity Research Institute (BRI) continued wildlife research efforts in coordination with the Bureau of Ocean Energy Management (BOEM), Maryland Department of Natural Resources (MDNR), and other groups that are currently funding or conducting wildlife research within our study area. Several important project milestones occurred in 2014, including the successful completion of all boat and aerial surveys, the finalization of the boat survey dataset, and the completion of aerial survey video review. Additionally, project partners have produced other deliverables or interim products, including web page updates, outreach flyers, analysis and modeling development, scientific manuscripts, and the dissemination of project results. Project partners also continue to develop data deliverables: data produced by project partners include results from 15 aerial and 16 boat surveys; individual tracking data of 149 individuals from four focal bird species; echo sounding data to accompany each day of boat surveys; and a variety of remotely sensed environmental covariate data, among other datasets. A detailed boat survey protocol has been developed (Chapter 5), and written data analysis and QA/QC protocols for aerial survey data are also in development (Chapter 3). Deliverables for the remainder of the project include the submission of a final technical report to the DOE Wind and Water Power Program that includes study results, analyses, and GIS maps; submission of survey data to a publicly accessible database such as the Compendium of Avian Information; and development of outreach and communications documents to assist with the dissemination of project results.

Descriptions of project activities in some instances below include reference to the Maryland Extension Project, which was an expansion of some project activities in the second year of surveys, funded by the Maryland Department of Natural Resources and the Maryland Energy Administration, to cover a larger extent of Maryland’s state and federal waters (Figure 1-1). Most survey datasets presented in this report include the Maryland Extension transects, as well as data funded through DOE for the Mid-Atlantic Baseline Studies Project; however, integration between datasets varied by analysis. We have done our best to note for each chapter and analysis whether the presented dataset includes the Maryland Extension as well as DOE-funded data.

Summary and Task Status
This annual report is structured similarly to the final project report, which will be published later in 2015. This report consists of six parts:

1. A project overview (this section), which includes various status updates required by the funding agency;
2. Examining wildlife distributions and relative abundance from a digital aerial survey platform (Chapters 2-4);
3. Examining wildlife distributions and abundance using boat surveys (Chapters 5-10);
4. Integrating data across survey methods (Chapters 11-13);
5. Individual movements and habitat use for focal bird species (Chapters 14-17); and
6. Nocturnal migration monitoring (Chapters 18-19).

Additional chapters will be added for the final project report later this year, and existing chapters will be revised as data analysis efforts continue. As a result, all data presented in this report should still be regarded as preliminary unless specifically stated otherwise. No part of this report should be considered comprehensive.

**Examining wildlife distributions and relative abundance from a digital aerial survey platform**

One of the primary goals of this study is to quantify bird, sea turtle, and marine mammal densities seasonally and annually throughout the study region, in order to be able to examine spatial patterns and trends. Several survey approaches were used to reach this goal, including wildlife surveys from both boat and aerial platforms.

Aerial surveys were conducted using high definition digital video; though digital aerial surveys have become standard practice for offshore wind energy development in Europe, this study represents the first time this type of technology was deployed on a large spatial scale in the United States. Chapter 2 describes the study design and methods for these aerial surveys, and Chapter 3 consists of detailed video data analysis and management protocols, including the Quality Assurance and Quality Control (QA/QC) protocol used by the Biodiversity Research Institute to audit survey results. Completed analysis provided data on the number of target organisms in the video, the species or species grouping of organisms, the approximate flight height for flying birds and bats, and geospatial data for all objects that may be used in modeling efforts. A short summary of the aerial dataset is included in Chapter 4; final geoprocessing of the data has been completed, and more intensive analysis and modeling activities will be conducted in 2015.

**Examining wildlife distributions and abundance using boat surveys**

To accompany (and compare with) data from digital aerial surveys, we also conducted two years of boat surveys for wildlife on the continental shelf (Figure 1-1). Standardized boat-based surveys are a widely used method of obtaining density data for birds, sea turtles, and marine mammals. The 16 boat surveys for the project concluded in April of 2014; including the extension of several transects into Maryland state waters, which began in March 2013, total transect length for each survey was at least 570 km (often more, as observers remained “on transect” and observed animals while traveling between most transects, further extending the total effort). These boat surveys counted all observed animals in at least a 90 degree arc to one side of the ship, and also estimated distance and angle to individuals whenever possible (Chapter 5). Final processing of observational data was completed in 2014, including data management, QA/QC, and georeferencing of sightings based on GPS vessel tracks; summaries of this dataset are presented in Chapter 6.
The final data have been sent to co-PIs to initiate modeling efforts, and several scientific manuscripts are in development. Hierarchical Bayesian approaches are useful for situations where distribution patterns or resource use vary with scale, and where species of interest are highly mobile and may be periodically unavailable for detection (Mordecai et al. 2011); they can allow for the calculation of posterior model probabilities (which provide an easily interpretable measure of uncertainty), allow distribution models to be chosen to fit the observed data (Gardner et al. 2008, Zipkin et al. 2010), and incorporate environmental covariates into the model structure. Project collaborators first focused on the development of a community distance sampling (CDS) model for seabirds, a multi-species approach for estimating seabird abundance and distributions that explicitly estimates detection as well as abundance parameters (Chapter 7). By sharing information across species, this community model allowed us to make inferences about abundance, distribution, and response to environmental variables of rare species for which there would not be enough data to run individual models. Building on the CDS model (which was initially developed using only data from the first boat survey), we incorporated the second year of surveys as well as remotely collected environmental covariate data, and developed geospatial models that predict seabird densities across larger spatial areas by season in relation to environmental covariates (Chapter 8). In addition to collaborators at North Carolina State University, collaborators at Duke University and Oregon State University are working to analyze sea turtle and marine mammal data in tandem with the seabird analysis efforts (Chapter 9).

While conducting surveys, we also collected environmental covariate data in order to assess fine-scale patterns of these environmental variables in relation to wildlife densities. In particular, fisheries sonar (scientific echo sounder) was used to estimate fish and biomass abundance in the same areas as boat survey observations (Chapter 10).

**Integrating data across survey methods**

In order to test the utility of high definition aerial video surveys on the Atlantic coast, and to integrate new aerial survey data with historical data, we compared the digital aerial data to boat-based surveys using experimentally controlled methods (Chapter 11). This comparison occurred in March of 2013 off the coast of Virginia Beach; the boat completed two of its normal transects on this date, and the plane completed each of the same transects six times during the same period. Analyses of abundance, species identification rates, and disturbance from the survey vessel are all ongoing. In addition to this formal methods comparison study, project collaborators are also pursuing other methods of comparing and contrasting the two survey datasets (Chapter 12). Analysis and data visualization methods are in development that will incorporate both survey datasets and allow them to be reviewed and visualized in tandem. These efforts include persistent hotspot analysis, to identify geographic areas with consistently high numbers of animals through time (Santora and Veit 2013), as well as graphical visualizations that illustrate change in species relative abundance by time of year. The boat and aerial datasets have provided data on several specific taxa of interest, including large cetaceans (Chapter 12) and bats (Chapter 13).
Individual movements and habitat use for focal bird species

We tracked the movements of three focal avian taxa: seabirds (the Red-throated Loon, *Gavia stellata*, and Northern Gannet, *Morus bassanus*); sea ducks (the Surf Scoter, *Melanitta perspicillata*); and raptors (the Peregrine Falcon, *Falco peregrinus*). The project team used several methods to track known individuals from these focal species, with goals of providing an improved understanding of migratory speed, effects of weather patterns on movements, and seasonal use of space on the OCS. Project partners and collaborators for this project component included the U.S. Fish and Wildlife Service (USFWS) Region 5 Migratory Bird Program, the Bureau of Ocean Energy Management (BOEM), Sea Duck Joint Venture (SDJV), the U.S. Geological Survey (USGS), the Canadian Wildlife Service, and Memorial University of Newfoundland, among others. Total deployments of satellite transmitters exceeded original expectations, due to the contribution of additional transmitters by project collaborators (including BOEM, USFWS, SDJV, and BRI) and collaborators’ willingness to share data funded through other means.

Approaches toward understanding wintering movements and habitat use in the mid-Atlantic study area are still in development, and vary by species. Kernel-based utilization distributions and resource selection functions have proved fruitful for examining Black Scoter (*Melanitta americana*) habitat use (Loring et al. 2014). A similar effort is underway for Surf Scoters in our study area (Chapter 14). Modifications to this approach using different resource selection methods and environmental covariates are being applied to Red-throated Loons (Chapter 15) and Northern Gannets (Chapter 16). Unlike these seabird species, Peregrine Falcons migrate through the project study area but seldom winter in or near the mid-Atlantic. As a result, different methodological approaches are being pursued to understand falcon movements and use of space within the project study area during fall migration (Chapter 17).

Nocturnal migration monitoring

Limited information is available on nocturnal avian migrants in the offshore environment. The project team investigated the species composition, general spatial patterns, and weather-dependent and seasonal variation in offshore bird migration through a combination of acoustic and radar data collection. Both the nocturnal passive acoustic avian monitoring from the boat (Chapter 18) and the analysis of WSR-88 radar data, also known as NEXt generation RADar (NEXRAD, Chapter 19) were undertaken to determine the utility of these approaches for examining avian migration in the offshore environment, and to improve our understanding of migratory patterns in the offshore environment on the Atlantic coast of the U.S.

Dissemination of project results

In addition to the above-mentioned efforts by the project team, we have worked to communicate project updates to developers, regulators, and the scientific community via several approaches. First, we presented project results at several relevant conferences during the past year: project collaborators recently presented preliminary results for the boat-aerial comparison study at the American Ornithological Conference in Estes Park, Colorado (September 25th); via poster at the AWEA Offshore Expo in Atlantic City, New Jersey (October 7th); and at the National Wind Coordinating Collaborative
Wildlife working group meeting in Broomfield, Colorado (December 4th). A general overview of major project activities was also presented at AWEA and NWCC. Project collaborators presented the CDS model at the International Statistical Ecology Conference 2014, in Montpellier France in July, and the NEXRAD study was presented at a meeting of the European Network for the Radar Surveillance of Animal Movement (ENRAM), focused on algorithm development for use with weather radar to extract biological information.

BRI has expanded the Baseline Studies Project web page (www.briloon.org/mabs) with additional information and descriptions of study methods for the project. This web page will undergo continued development and expansion in 2015, as more finalized project results become available.

The first manuscript to come out of the Baseline Studies project was published in PLoS ONE in December 2013 (Hatch et al.), and a second manuscript focused on the CDS model was recently submitted for publication. Several additional manuscripts are currently in development and are expected to be submitted for publication in 2015.

Incorporation of project data into public databases

All data generated from this project will become publicly available. The Compendium of Avian Information is a relational database that contains hundreds of thousands of data points and associated survey effort across a broad spatial scale in the northwest Atlantic (O’Connell et al. 2009), including data on marine mammals, sea turtles, and other wildlife, as well as seabirds. Andrew Gilbert of BRI and U.S. Geological Survey staff oversaw the inclusion of this project’s boat survey data into the Compendium in 2014, though additional quality assurance processes since its uploading have led to this version of the dataset being slightly outdated. As of January 2015, the database was not being actively managed, and none of the high definition video aerial survey data has been included in the Compendium at this time. If the Compendium remains inactive in 2015, datasets will be incorporated into other public databases, such as the Mid-Atlantic Regional Ocean Council’s (MARCO) Data Portal (http://midatlanticocean.org/data-portal/).

Acknowledgments

Project partners would like to thank the DOE Energy Efficiency and Renewable Energy Program, the BOEM Division of Environmental Sciences, the USFWS Region 5 Migratory Bird Program, Sea Duck Joint Venture, the Maryland Energy Administration, the Maryland Dept. of Natural Resources, and The Bailey Wildlife Foundation for funding the research efforts discussed in this report. Other project collaborators include HiDef Aerial Surveying, Ltd., Memorial University of Newfoundland, the U.S. Geological Survey, and Capt. Brian Patteson, Inc.

BRI investigators would also like to acknowledge the many staff members who are contributing towards this project’s success, particularly the biologists who conducted aerial video review, and the diving bird and falcon telemetry teams.
Literature Cited


Figures and Tables

Figure 1-1. Map of aerial and boat survey transects for the Mid-Atlantic Baseline Studies and Maryland Extension Projects. Mid-Atlantic Baseline Studies transects are shown in gray (aerial surveys) and pink (boat surveys), while boat transects for the Maryland extension are in red, and aerial transects are in black.