

Introduction to Part III

Examining wildlife distributions and abundance using boat surveys

Report structure

The chapters in this report represent a broad range of study efforts focused on understanding wildlife population distributions in Atlantic waters offshore of Maryland (and elsewhere in the Mid-Atlantic United States). Some chapters are purely methodological in nature, while others present a variety of analyses and results (Figure I). Part I of this report (the Executive Summary and Chapters 1-2) summarizes and synthesizes project results. The 12 subsequent chapters and their relationships to each other are shown in Figure I. In Parts II (Chapters 3-5) and III (Chapters 6-9), we describe methods and results for high resolution digital video aerial surveys and boat-based surveys, respectively. Part IV of this report (Chapters 10-14) combines data from both survey approaches to develop a comprehensive understanding of marine wildlife populations that use the Mid-Atlantic study area.

Part III: Examining wildlife distributions and abundance using boat surveys

Standardized boat-based surveys with distance estimation are a widely used and well-established method of obtaining density data for birds, sea turtles, and marine mammals. There are four chapters in Part III of this report, focused on the use of boat surveys to examine wildlife distributions and abundance:

- Chapter 6. Protocol for conducting boat surveys for wildlife.
- Chapter 7. Basic summary of boat survey observation data.
- Chapter 8. Scientific echo sounding study to obtain aquatic biomass data (includes data management and analysis protocols as well as a basic data summary).
- Chapter 9. Prediction of seabird densities across the study area by season, based on an incorporation of environmental data into a multi-species modeling approach.

The survey protocol (Chapter 6) explains our boat survey study design in detail, and is referenced throughout the following chapters (also see Figure II). Surveys were particularly optimized for avian species, and detected a wide variety of seabird species as well as raptors, passerines, shorebirds, and

other avian taxa. Boat surveys also recorded marine mammals, sea turtles, rays, sharks, fish, and bats (Chapter 7). Data collected on boat surveys provided some substantial advantages in species identification over digital data collected from aircraft. Species-specific information can be important, as even closely related species often have differences in their conservation status, ecology, and habitat requirements.

While conducting surveys, we collected environmental covariate data in order to assess fine-scale patterns of environmental variables in relation to wildlife densities. In particular, fisheries sonar (a scientific echo sounder) was used to estimate relative biomass of aquatic prey in the same areas as boat survey observations (Chapter 8). Identifying the spatial and temporal associations and lags between aquatic biomass and seabird behavior can be helpful for understanding how these birds are making decisions in the marine environment, and the simultaneous collection of in situ data on seabirds and their prey can allow for a better understanding of the ecological drivers of seabird distributions (e.g., by allowing analysis of co-occurrence at very fine geographic and temporal scales, or linking predator distributions to specific prey species; Veit et al. 1993, Santora et al. 2010).

A broader geographic and temporal scale of analysis is required to develop wildlife data appropriate for siting future development projects, however, or to fully assess exposure to wildlife from proposed projects. These goals also require correction of certain biases associated with boat survey data, such as distance bias, in which observers are less likely to see animals located farther from the survey vessel. Hierarchical Bayesian statistical approaches, as applied to survey data in Chapter 9, allow distribution models to be chosen to fit the observed data (Gardner et al. 2008, Zipkin et al. 2010), and incorporate distance estimation and environmental covariates into the model structure, in order to predict animal distributions and abundance on a broad geographic scale. Project collaborators first focused on the development of a community distance sampling (CDS) model for seabirds, using data from the first boat survey in April 2012 (Sollmann et al. 2015). This was a novel multi-species approach for estimating seabird abundance and distributions that explicitly estimates detection as well as abundance parameters. By sharing information across species, this community model allowed for inference 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, Chapter 9 examines survey data from 15 boat surveys to develop geospatial models that predict seabird densities by season. By incorporating remotely collected environmental covariate data into the hierarchical modeling structure in this expanded analysis, we predict seabird abundance throughout the study area, including areas that were not directly surveyed. The seasonal abundance maps presented in this chapter, for both seabird communities and individual species, predict animal distributions and abundance on a broad geographic scale and are useful for identifying important habitat use areas and seasonal patterns. Unlike several chapters in Part IV of this report, which utilize approaches for combining boat and digital aerial survey data, Chapter 9 focuses on using data from a single, well understood survey method to do the best possible job of describing patterns of abundance.

These survey results on the geographic distributions and relative abundance of wildlife in the Mid-Atlantic are expected to be useful for minimizing impacts to wildlife populations from anthropogenic activities in that they:

- Inform the siting of future projects, by incorporating wildlife patterns into marine spatial planning and decision making, and by using exposure data as a first step towards defining relative risk by location
- Inform the permitting process for projects, by contributing data towards National Environmental Protection Act (NEPA) and other regulatory requirements, and by helping to define target taxa or research priorities on which to focus on during site-specific monitoring studies
- Inform mitigation, by presenting temporal data on community composition, distributions, and abundance that can be used to time certain activities to coincide with reduced potential for exposure of certain populations.

Boat survey data and analyses can also be used to assess changes to wildlife populations as a result of offshore wind energy development, climate change, and other factors. Results from this project represent a baseline that can be used for comparison with compatible future surveys, and to assess changes due to development or other causes. Future research to fill data gaps on hazards and vulnerability can be targeted towards species with high levels of exposure, as well as species most likely to be impacted due to their conservation status or life history.

Acknowledgments: This material is based upon work supported by the Maryland Department of Natural Resources and the Maryland Energy Administration. Additional funding support came from the Department of Energy under Award Number DE-EE0005362. Capt. Brian Patteson made significant contributions toward the completion of this study.

Disclaimers: The statements, findings, conclusions, and recommendations expressed in this report are those of the author(s) and do not necessarily reflect the views of the Maryland Department of Natural Resources or the Maryland Energy Administration. Mention of trade names or commercial products does not constitute their endorsement by the State.

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

Literature cited

- Gardner, B., P. J. Sullivan, S. Epperly, and S. J. Morreale. 2008. Hierarchical modeling of bycatch rates of sea turtles in the western North Atlantic. *Endangered Species Research* 5:279–289. doi: 10.3354/esr00105.
- Mordecai, R. S., B. J. Mattsson, C. J. Tzilkowski, and R. J. Cooper. 2011. Addressing challenges when studying mobile or episodic species: hierarchical Bayes estimation of occupancy and use. *Journal of Applied Ecology* 48:56–66. doi: 10.1111/j.1365-2664.2010.01921.x.
- Santora, J. A., C. S. Reiss, V. J. Loeb, and R. R. Veit. 2010. Spatial association between hotspots of baleen whales and demographic patterns of Antarctic krill *Euphausia superba* suggests size-dependent predation. *Marine Ecology Progress Series* 405:255–269. doi: 10.3354/meps08513.
- Sollmann, R., B. Gardner, A. Gilbert, K. Williams, and R. Veit. 2015. A community distance sampling model to investigate the abundance and distribution of seabirds. (K. Williams, E. Connelly, S. Johnson, and I. Stenhouse, Eds.) *Wildlife Densities and Habitat Use Across Temporal and Spatial Scales on the Mid-Atlantic Outer Continental Shelf: Final Report to the Department of Energy EERE Wind & Water Power Technologies Office*. Biodiversity Research Institute, Portland, ME.
- Veit, R. R., E. D. Silverman, and I. Everson. 1993. Aggregation Patterns of Pelagic Predators and Their Principal Prey, Antarctic Krill, Near South Georgia. *Journal of Animal Ecology* 62:551–564. doi: 10.2307/5204.
- Zipkin, E. F., B. Gardner, A. T. Gilbert, A. F. O’Connell, J. A. Royle, and E. D. Silverman. 2010. Distribution patterns of wintering sea ducks in relation to the North Atlantic Oscillation and local environmental characteristics. *Oecologia* 163:893–902. Retrieved March 28, 2012, from <http://www.ncbi.nlm.nih.gov/pubmed/20364388>.

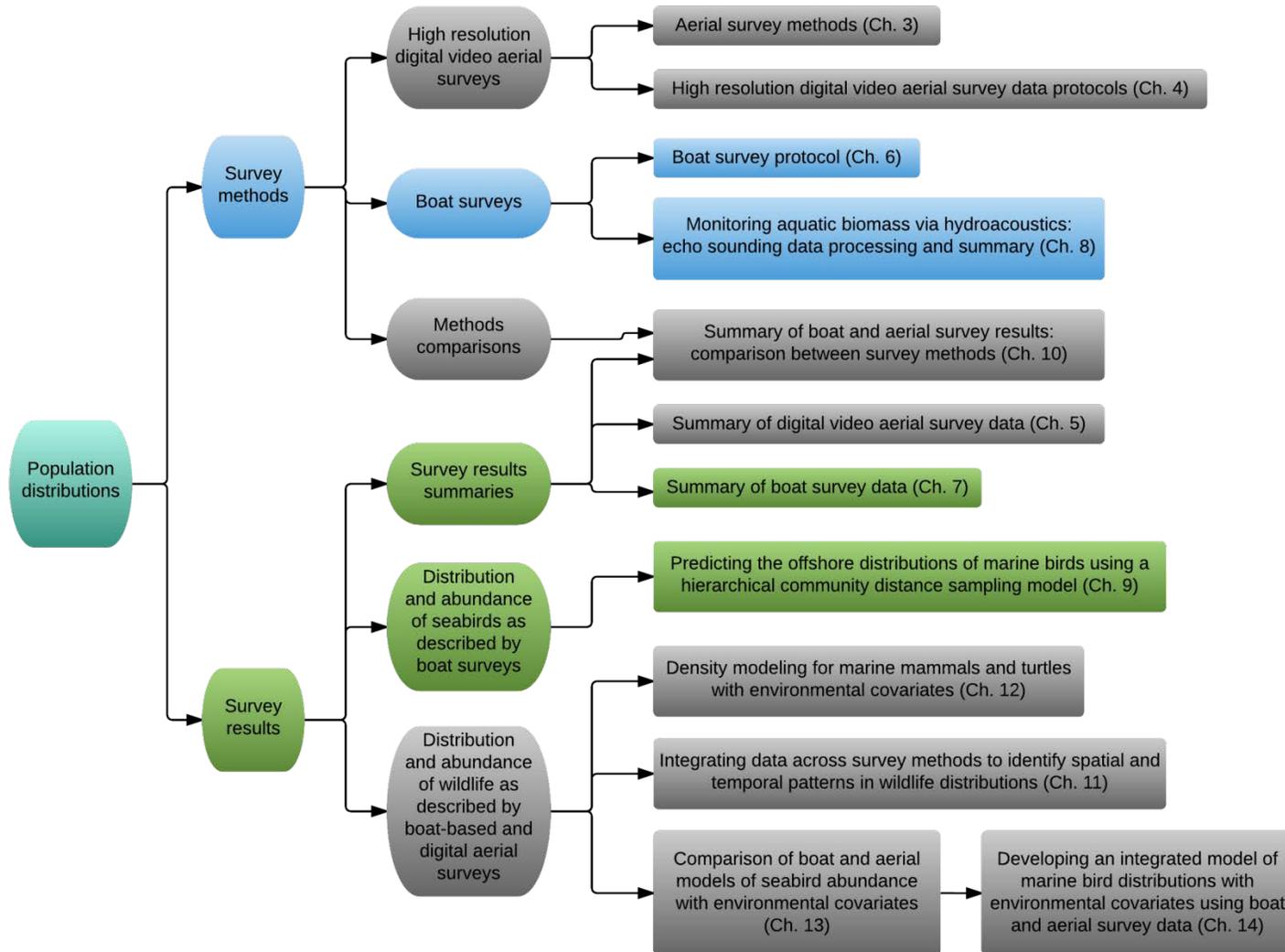


Figure I. Organization of chapters within this final report.

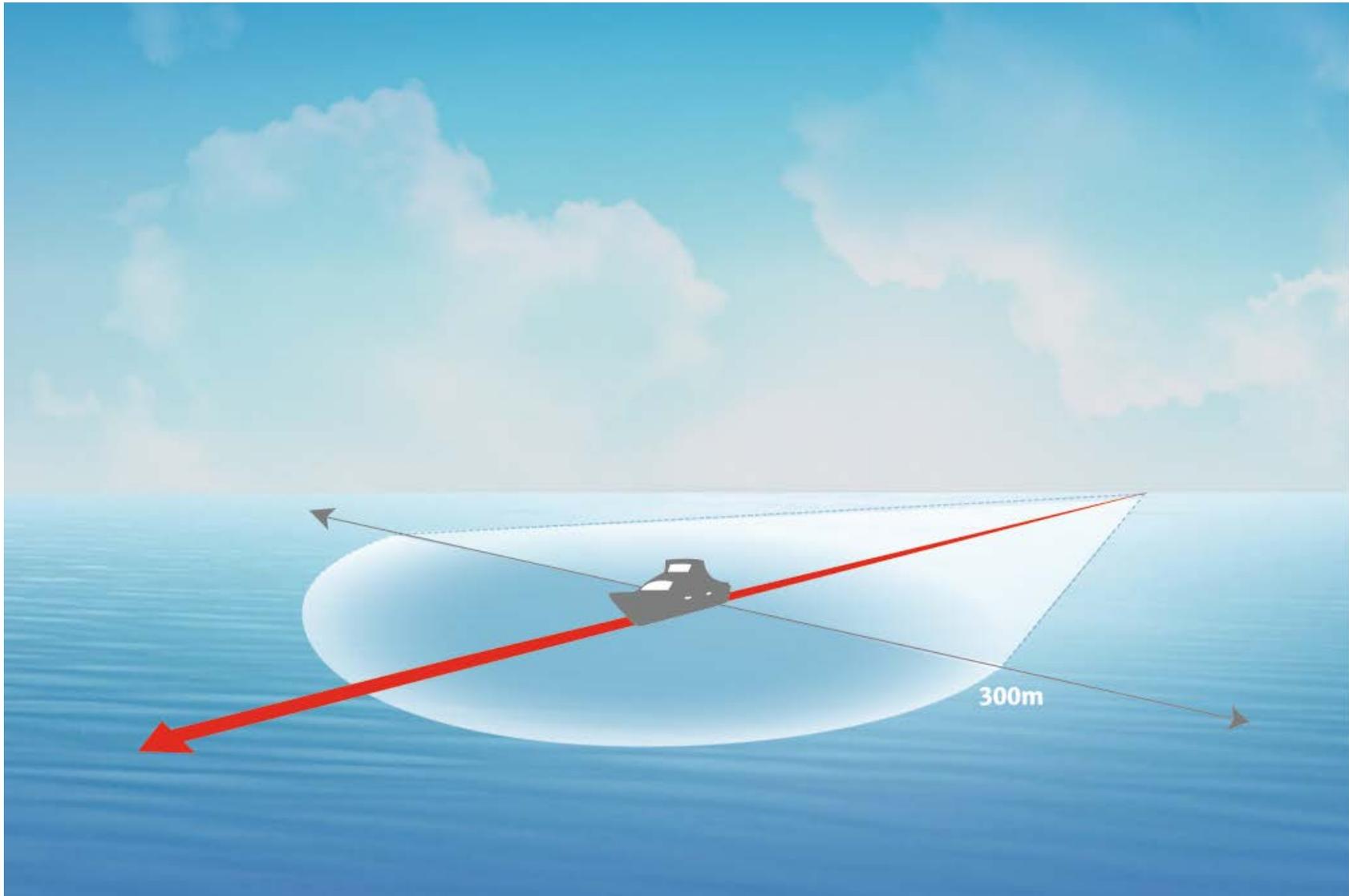


Figure II. Diagram showing the field of view available during boat surveys. The boat transect had an intended minimum strip width of 300 m on one side of the vessel, although observations of animals were generally recorded from both sides of the vessel and up to 1,000 m away.