Wildlife Studies Offshore of Maryland

Waters offshore of Maryland's Atlantic coast are important for many species year-round, including breeding, nonbreeding, and migration periods. Baseline knowledge of wildlife distributions and habitat use is key to understanding conservation and management needs.

Researchers studied the distribution and abundance of prominent wildlife species, including birds, marine mammals, and sea turtles, in relation to environmental factors on the Outer Continental Shelf. These data can be used to identify important habitat areas, inform siting decisions for future development or other activities, and inform environmental permitting requirements and mitigation efforts aimed at minimizing effects from these activities to wildlife.

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Executive Summary

Beginning in 2013, Maryland supported a study to document the distribution and abundance of wildlife off the state's Atlantic coast. This project was undertaken as part of a larger regional effort in the Mid-Atlantic United States, from Delaware to Virginia, that focused on understanding the potential exposure of birds, marine mammals, sea turtles, and other wildlife to future offshore wind energy development (Williams et al. 2015a).

This publication features survey results and case studies on marine mammals, sea turtles, and wintering seabirds, and represents an overview of results from the final technical report for the Maryland-focused study (Williams et al. 2015b). The technical report includes study methods and results that were most relevant to Maryland from both the state-focused effort and the regional Mid-Atlantic Baseline Studies Project (referred to in this publication as the regional study). Data are integrated from multiple study efforts in order to present a comprehensive view of wildlife distribution and abundance patterns offshore of Maryland.

Additional results and case studies can be found in the synthesis report for the Mid-Atlantic regional study (Williams et al. 2015c) as well as related publications (Hatch et al. 2013, Williams et al. 2015a).

GEOGRAPHIC AND TEMPORAL PATTERNS

Species-specific responses to environmental factors in the Mid-Atlantic varied widely, and strong seasonal and interannual variations in community composition and wildlife distributions were observed across the regional study area. Given that the Maryland study included a single year of surveys, with two years for the regional study, the results presented in this report should be interpreted with caution when attempting to identify longer-term (e.g., interdecadal) patterns in wildlife distribution and abundance.

The results of this study indicated that the Mid-Atlantic region was used by many species during breeding or nonbreeding periods. Offshore areas were also important migratory routes for many avian and aquatic taxa.

The highest abundance and diversity of species occurred in nearshore areas. Wintering seabirds, such as scoters, were one driver of this pattern; scoters were highly abundant, and large flocks occurred almost entirely in nearshore areas. Red-throated Loons, Bottlenose Dolphins, and many gull and tern species also tended to be observed in nearshore areas. This pattern was far from universal, however, with many species widely distributed across the study area, including Common Loons, Northern Gannets, and storm-petrels. Species that occurred primarily in offshore areas included Common Dolphins, sea turtles, and alcids (such as Atlantic Puffins, Razorbills, Dovekies, and murres).

Areas near the mouths of Chesapeake Bay and Delaware Bay were "hotspots" with consistently high species diversity and animal abundance throughout the year. These areas were likely attractive to a wide variety of species due to gradients in salinity, water temperature, and primary productivity. Ocean waters off Maryland's northern coast, within roughly 20-30 km of shore, were also a consistent hotspot for many taxa, which may have been partially driven by the density of nearshore surveys in this area.

APPLICATIONS FOR OCEAN DECISION MAKING

This study is an important step towards understanding wildlife populations off Maryland's coast and more broadly in the Mid-Atlantic United States. Collectively, this study and others along the eastern seaboard (e.g., NEFSC and SEFSC 2011, Bailey and Rice 2015) provide important data that may be used to inform future development or other proposed ocean activities. These results may also help to address environmental permitting requirements and inform mitigation efforts aimed at minimizing effects to wildlife.

Marine wind turbine under construction off the coast of Denmark.

Background and Methods

THE MARYLAND AND MID-ATLANTIC BASELINE STUDIES PROJECTS

The regional Mid-Atlantic Baseline Studies Project was funded by the U.S. Department of Energy in 2011 to identify important wildlife areas and data gaps, and to collect natural resource data that could be incorporated into decision making.

Study activities that occured in federally designated wind energy areas (WEAs; Figure 1) and elsewhere on the Outer Continental Shelf included:

1. Two years of high resolution digital video aerial surveys and boat surveys to assess wildlife distribution and abundance patterns (conducted by HiDef Aerial Surveying, Ltd., City University of New York, and Biodiversity Research Institute);
2. Development of statistical models to identify ecological drivers of these patterns and predict important habitat and aggregation areas (North Carolina State University, Duke University, Oregon State University, and Biodiversity Research Institute); and
3. Identification of species likely to be exposed to offshore wind energy development or other anthropogenic activities.

During the second year of the regional study, in 2013, the Maryland Department of Natural Resources and the Maryland Energy Administration provided funds to support the expansion of existing boat-based surveys into Maryland state waters, and existing video aerial surveys into areas west and south of the Maryland WEA. An additional aerial survey in Maryland waters was also conducted in August 2013. Results presented in this report include data from both projects.

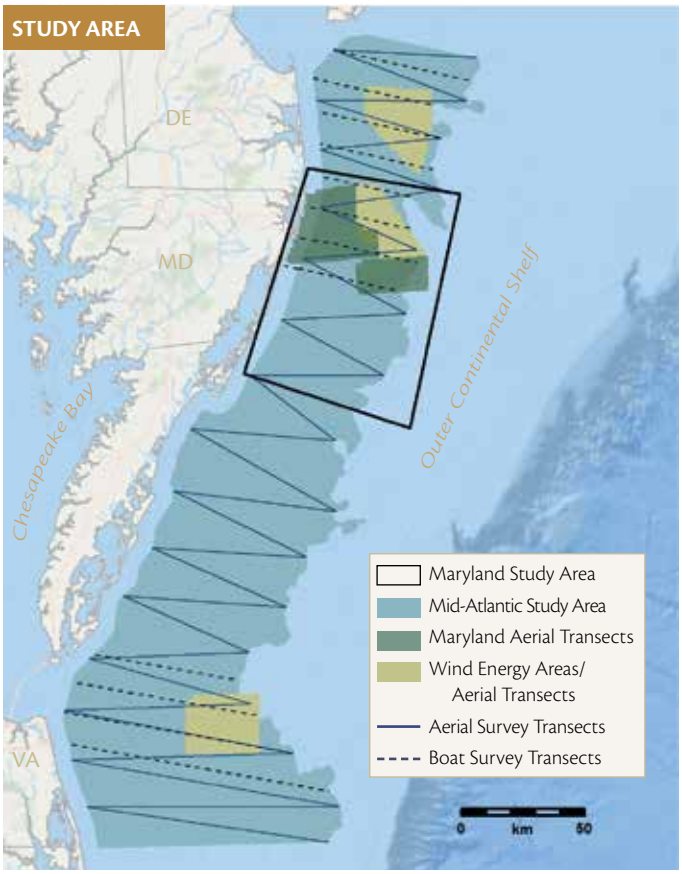

Figure 1. The study areas for the Maryland and Mid-Atlantic Baseline Studies projects, including Wind Energy Areas (WEAs) and aerial and boat survey transects. The Maryland study area includes data from both the regional and state-focused projects. Fine-scale aerial transects (20% coverage) were carried out within the WEAs, as well as offshore of Maryland as part of the state-focused study.

THE MID-ATLANTIC BIGHT

Maryland's marine waters are dominated by shallow sandy shoals that are important resources for many species of marine wildlife. This area forms part of the oceanic region known as the Mid-Atlantic Bight, and is used by a broad range of species throughout the year, largely due to a relatively high level of primary productivity (growth of phytoplankton) and the region's central location in a major migratory corridor.

Overall, the Bight is characterized by a broad expanse of gently sloping, sandy bottomed continental shelf that extends up to 150 km to the shelf edge and has waters reaching about 200 m deep. The region exhibits strong seasonal cycles in sea surface temperature and salinity, and the largest and most persistent phytoplankton blooms occur in late fall and winter. Influxes of fresh water from Chesapeake and Delaware Bays deliver nutrients that boost primary productivity in coastal waters.

Phytoplankton blooms are followed by pulses in secondary productivity (zooplankton species that forage on the phytoplankton), providing food for larger predators. Waters offshore of Maryland are generally rich with small schooling fishes, known as "forage fish" due to their critical importance for many piscivorous (fish-eating) predators, and their pivotal role in driving ecosystems worldwide. These large forage fish populations are likely partly responsible for the high density of predators and other species that use the area.

Geographic and Temporal Patterns

Researchers found that the Outer Continental Shelf offshore of Maryland was characterized by strong seasonal variation in habitat characteristics, as well as in species presence and distributions. During spring and fall migration, a variety of taxa used this region (Figure 2). Many of these species were also part-time or year-round residents that used the area for foraging during the breeding season, or for foraging, roosting, and other activities during nonbreeding periods.

SEASONAL PATTERNS

Fall: Seabird species composition shifted in fall as summer residents, including shearwaters, storm-petrels, and terns, left the region. Winter residents such as the Northern Gannet, Red-throated Loon, Common Loon, and scoters migrated south from their breeding grounds. Researchers observed Cownose Rays in dense migratory aggregations in early fall. Songbirds, shorebirds, and Eastern Red Bats also migrated over open waters across the Outer Continental Shelf. Offshore of Maryland, Laughing Gulls were most abundant during this period, as were sea turtles. Large schools of forage fish were observed along the coast. Bottlenose Dolphins remained nearshore through late fall, while Common Dolphins mostly arrived in the area in November.

Winter: Avian abundance was highest offshore of Maryland during winter. Seabirds occupied habitat throughout the regional study area, with variation in distribution patterns among species. For example, Northern Gannets were broadly distributed, while scoters were highly aggregated in nearshore areas.

Researchers observed small numbers of baleen whales across the region. Common Dolphins were most abundant during this season, while most Bottlenose Dolphins and sea turtles had left the study area for warmer waters.

Spring: Wintering seabirds migrated out of the region in spring, while summer resident seabirds arrived. Sea turtles also began to arrive in the study area at this time. Predicted abundance of Common Terns was high in the spring, especially offshore, corresponding to the migration season. Songbirds and shorebirds were also observed migrating over the ocean.

Summer: Overall abundance of avian species was lowest in the Maryland study area during the summer, though federal

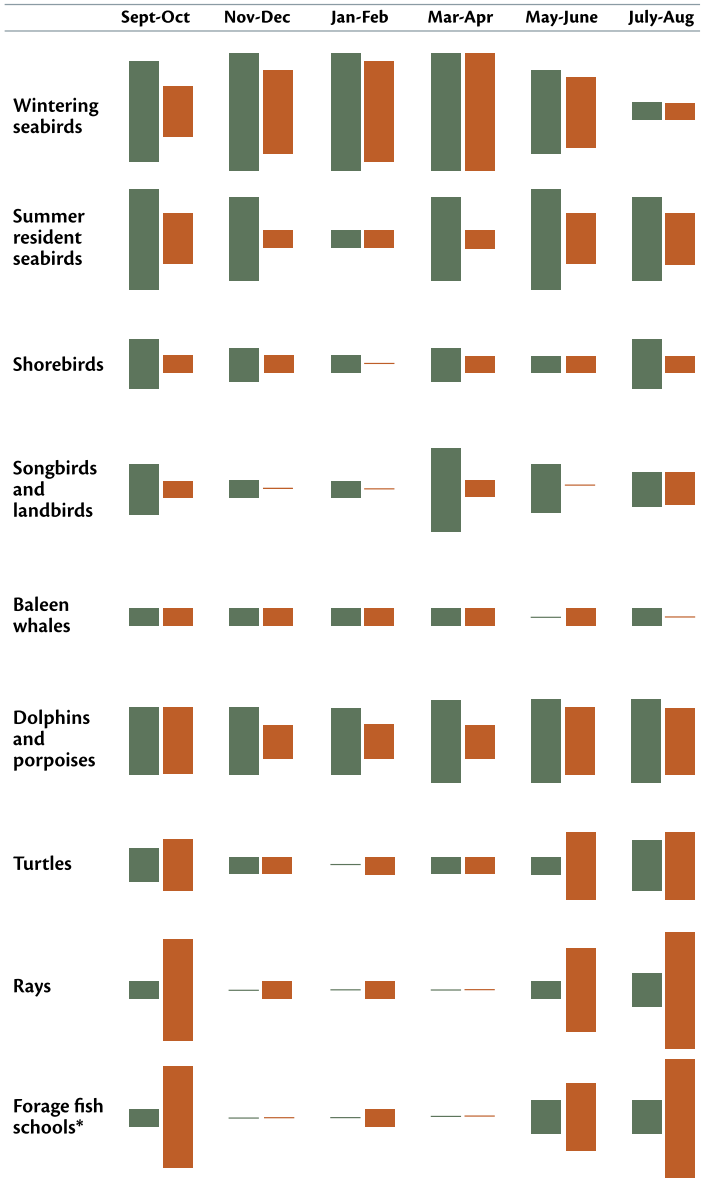

Figure 2: Temporal changes in relative abundance for major taxonomic groups. Data are from the boat-based surveys (■, *left*) and high resolution digital aerial video surveys (■, *right*) for the regional and Maryland studies (2012-2014). Species included in each category are listed in Williams et al. (2015a). Labels refer to seasons in the Northern Hemisphere.

* *Forage fish were counted as schools, not as individuals, unlike the other animal groups.*

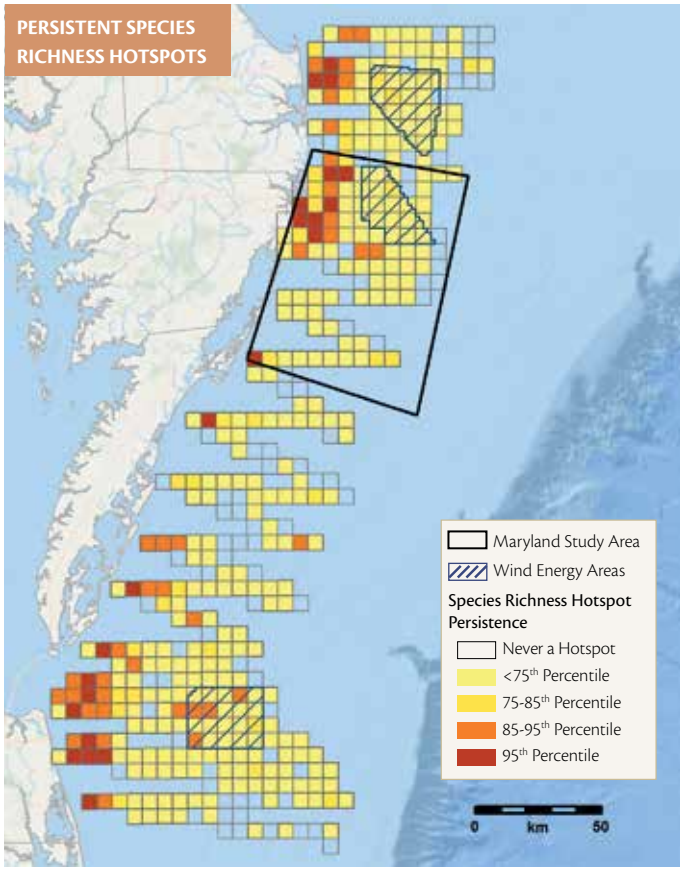

Figure 3. Persistent species richness hotspots—areas with consistently greater numbers of species across all surveys.

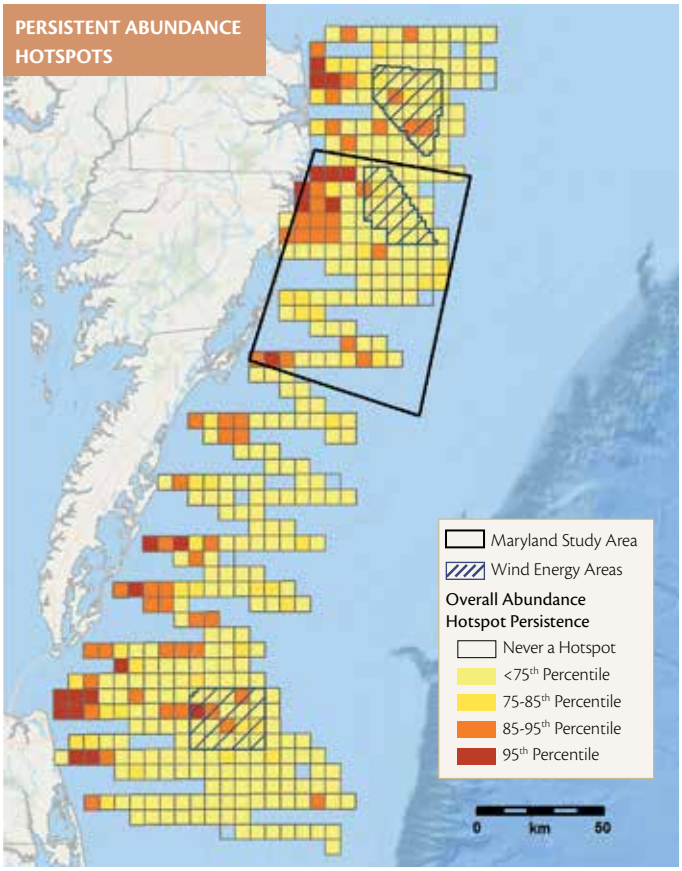

Figure 4. Persistent abundance hotspots—areas with consistently greater numbers of individuals across all taxa and surveys.

and state-listed species were observed in nearshore regions, including Roseate Terns, Least Terns, Common Terns, and Royal Terns. Nonbreeding species, such as storm-petrels, were more broadly distributed across the continental shelf. The highest predicted abundances of Wilson's Storm-Petrels and Royal Terns occurred within the regional study area. Large numbers of Cownose Rays migrated through the area, and Bottlenose Dolphins were most abundant and broadly distributed offshore of Maryland during this season.

PERSISTENT PATTERNS

Several taxa showed persistent hotspots of abundance within the Maryland study area, including Red-throated Loons, Common Loons, Northern Gannets, storm-petrels, alcids, gulls and terns, rays, sea turtles, and dolphins. In general, many species exhibited a nearshore distribution, concentrated within about 30 km of shore. Species more commonly distributed further offshore included alcids (such as Dovekies), sea turtles, and Wilson's Storm-Petrels.

Areas near the mouths of Chesapeake Bay and Delaware Bay showed consistently high species diversity and animal abundance throughout the year (Figures 3 and 4). These areas had high primary productivity relative to the rest of the Mid-Atlantic region. Since primary productivity supports the pelagic ecosystem, these areas likely provided important and reliable foraging habitat for many species.

Ocean waters off Maryland's northern coast, within roughly 20-30 km of shore, were also consistent hotspots of biodiversity and abundance for many taxa. While we expect that these were real hotspots for many species, this result may have been partially driven by the more nearshore study design implemented in this location as compared to elsewhere in the regional study area.

[CASE STUDY]
Wintering Seabirds

Wintering seabirds in the Mid-Atlantic region include scoters, loons, gannets, alcids, and gulls, all of which migrate from their breeding grounds to spend the cooler months on the Mid-Atlantic Outer Continental Shelf. In this study, these taxa showed considerable variation in distribution and abundance. Overall abundance was notably higher during the second winter of the study than the first (Figure 5).

Scoters were the most abundant seabirds; large flocks were often observed within about 30 km of shore, particularly at the mouth of Chesapeake Bay and along the northern shore of Maryland. Loons were more commonly observed individually or in small groups. Of these, Red-throated Loons tended to occur closer to shore than Common Loons. Northern Gannets and wintering gulls were widely distributed across the study area, though gannets were consistently abundant within about 30 km of shore, while Bonaparte's Gulls tended to be located farther offshore. Alcids were also most consistently observed farther from shore.

To predict the abundance and distributions of wintering seabirds across the study area and to make inferences about the habitat used by different species, we paired boat-based survey data with remotely sensed environmental data (from satellites) from the same time periods. During both years of the study, scoters used nearshore waters with high primary productivity. The rest of the wintering seabird community showed more variable relationships with environmental covariates between years (Figure 5).

During the first winter, distance to shore, water temperature, and primary productivity were significant environmental predictors of seabird community distributions, although specific relationships varied by species. Distance to shore was less significant during the second winter (Figure 5), while seafloor characteristics were predictors for several species. This high level of interannual variability in seabird distributions suggests that seabird prey may have been responding to different environmental conditions between the two winters.

Because seabirds have varied life histories, distributions, and habitat requirements, future development may influence each species uniquely. Some species may be more likely to be affected by collisions with turbines; for other species, displacement from wind facility areas may result in habitat loss (Fox et al. 2006). Species distributed in offshore areas that overlap with WEAs may have a greater chance of displacement or collision than those with nearshore ranges.

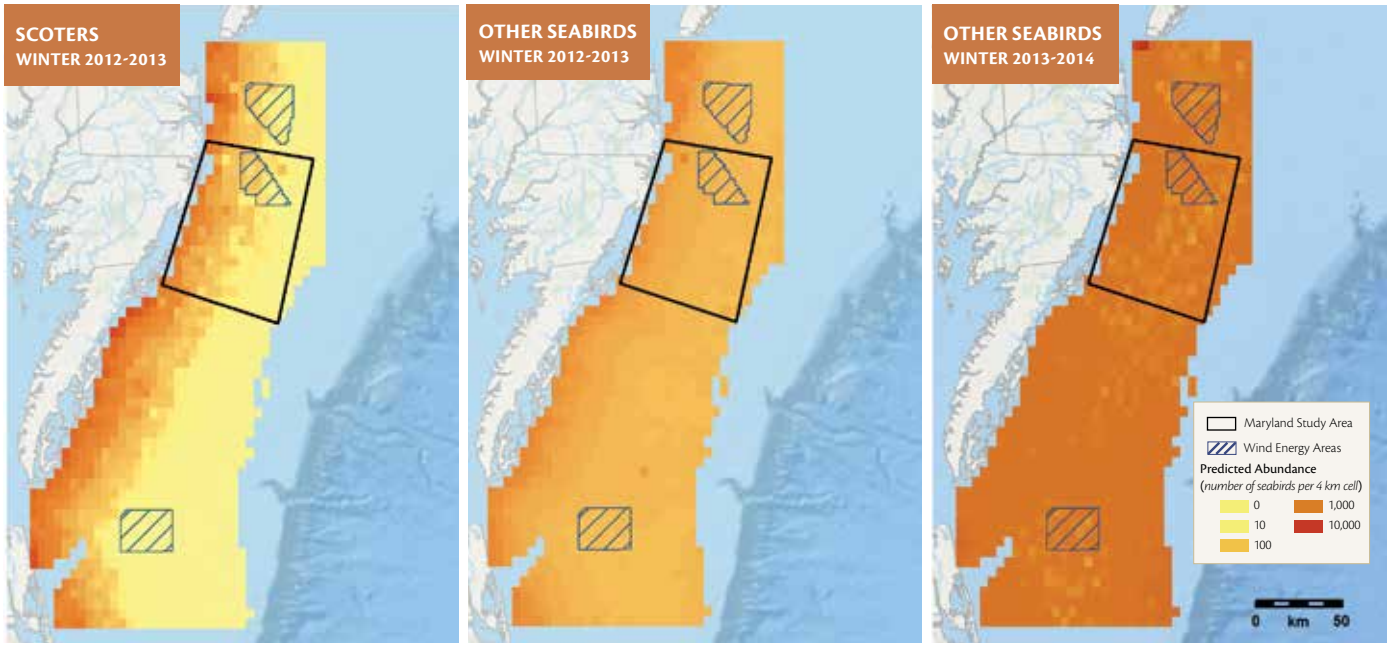

Figure 5. Predicted abundance of scoters and other wintering seabirds for a given date during winters of 2012-2013 and 2013-2014. Model outputs combine observation data from boat-based surveys with environmental data to predict wintering seabird abundance across the regional study area. Scoter patterns were similar in both winters surveyed, while other seabirds showed notable interannual variation in distributions.

[CASE STUDY]
Sea Turtles

Sea turtles are long-lived animals with a worldwide oceanic distribution. Turtles migrate seasonally, as their body temperatures vary considerably with their environment, limiting them to waters in specific temperature ranges (Gardner et al. 2008, Epperly et al. 1995). Five species occur in the Mid-Atlantic study area: Leatherback, Loggerhead, Kemp's Ridley, Hawksbill, and Green Sea Turtles. All are listed as Threatened or Endangered under the Endangered Species Act.

Although relatively large populations of a high diversity of turtles are found in the Mid-Atlantic, there are many existing threats in the region that could cause population declines. These threats include mortality from bycatch in fishing nets, collisions with vessels, loss of nesting habitat, and disturbance of nests on coastal beaches (Hazel et al. 2007, Wallace et al. 2011, Murray and Orphanides 2013). In addition to vessel traffic, potential concerns related to offshore development include the effects of noise and vibrations, particularly during construction activities (Read 2013).

Sea turtles were more easily detected during digital video aerial surveys than in boat-based surveys, likely in part because the turtles could be detected even when they were fully submerged. Because of these high detection rates, we used only the aerial survey results to develop predictive models of sea turtle distributions.

Hundreds of sea turtles were observed offshore of Maryland in the two years of surveys. Loggerhead and Leatherback Sea Turtles were most frequently observed, though all five species occurred in the Maryland study area. Sea turtles were most abundant from May to October (Figure 2), with very few individuals present in the study area in winter.

Models predicted that most turtles were located far from shore off of Virginia in spring, in areas with warmer sea surface temperatures. In summer, sea turtles were predicted to be distributed across a broader range (Figure 6), as females moved to shore to lay eggs on sandy beaches. By fall, models suggested that sea turtles were widely distributed offshore across the regional study area (Figure 6). Sea turtle abundance and species diversity was highest in the Maryland study area during this season.

Due to their offshore habitat use, there was substantial overlap between sea turtle distributions and areas of planned wind energy development, particularly during autumn and in southern sections of the regional study area.

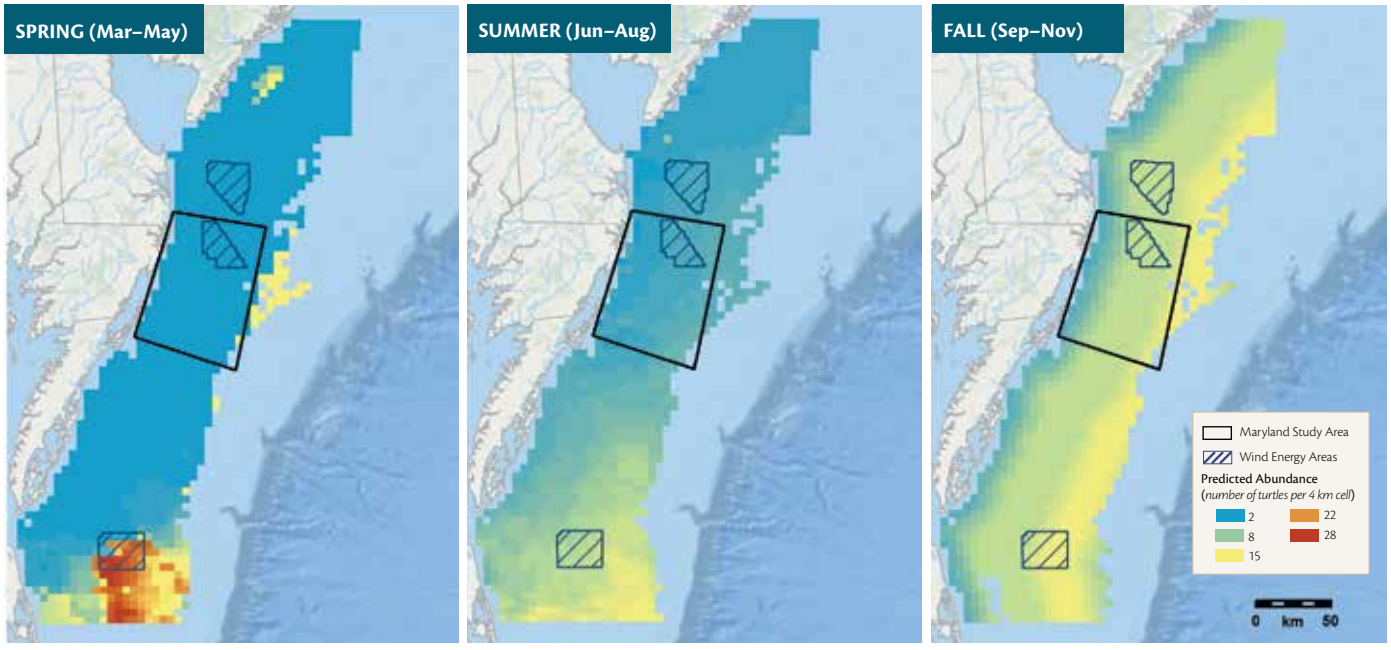

Figure 6. Predicted relative abundance of sea turtles by season, based on two years of digital video aerial survey data (2012-2014). Models used observation data from aerial surveys and remotely sensed environmental covariate data to predict abundance across the regional study area. Turtles had a dense southerly distribution in the spring, and were dispersed more broadly in the summer. By the fall, they were distributed fairly evenly across the Mid-Atlantic in offshore areas.

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SUGGESTED CITATION FOR THIS REPORT

Williams KA, Stenhouse IJ, Connelly EE, Johnson SM (2015) Baseline Wildlife Studies Offshore of Maryland. Biodiversity Research Institute. Portland, Maine. Science Communications Series BRI 2015-20. 8 pp

For final reports and more information on the Maryland and Mid-Atlantic Baseline Studies projects, visit: www.briloon.org/mabs

COLLABORATING AND FUNDING ORGANIZATIONS

This material is based upon work supported by the Maryland Department of Natural Resources (MDNR) and the Maryland Energy Administration under Contract Number 14-13-1653 MEA. Additional funding support came from the Department of Energy under Award Number DE-EE0005362.

This study was completed in collaboration with researchers from North Carolina State University, City University of New York, Duke University, and Oregon State University.

Investigators would like to thank Gwynne Schultz (MDNR), HiDef Aerial Surveying, Ltd., Capt. Brian Patteson, Inc., and Aquacoustics, Inc., and to acknowledge the many BRI staff members who contributed towards this project's success.

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