6.0 FUTURE STUDIES AND RECOMMENDATIONS

Future investigations of coastal and offshore birds, marine mammals, and sea turtles in New Jersey will be enriched by the precedent set by the NJDEP EBS. During the course of the surveys, and as a natural result of such an extensive investigation, improvements to methodologies, data collection and storage, and analysis were both identified and implemented. The finalization of this baseline report and its public circulation will mark the onset of further inquiries geared toward establishing wind-power along and off the New Jersey coast. Before-After/Control-Impact (BACI) assessments and other research and resource initiatives will no doubt be heavily reliant on the information we present in addition to addressing new issues concerning avian abundance and distribution in, and utilization of the Study Area. The following recommendations are presented as additional studies or potential improvements to the NJDEP EBS that could be implemented for future monitoring projects.

6.1 AVIAN SURVEYS

Include the Passerine Component of Nocturnal Migration – Although not especially applicable to waterbirds, recent advances in avian acoustic monitoring provide investigators with the capability of assessing the diversity and, potentially, the density of the passerine (songbird) component of nocturnal bird migration. Much is now known on the identification of species of the Eastern North American neotropical and short-distance migrant passerines (Evans and O'Brien 2002; Lanzone et al. 2009). Data collection is accomplished with a relatively simple and cost-effective system of microphone(s), data-storage units, and analysis software. The microphone can be placed to enhance radar units and also be set up in arrays over a specific area to help quantify diversity and density of migrating birds at night. Work has been to done to establish the usefulness of acoustic monitoring to correlate regional migration density data from Doppler radar (Farnsworth et al. 2004). As inexpensive acoustic monitoring methods for bats develops, those for avian monitoring should also expand, specifically when radar or other remote sensing methods are called for in BACI assessments.

Collision Mortality – Site-specific avian and bat collisions with tall structures such as radio towers and high-rise buildings are a concern similar to the potential of wind-turbine collisions. Agencies and developers may seek to enhance their knowledge of collision mortality by also studying these structures. This would help to create a regional and macro-scale picture of the current cumulative impacts, and what they might become with the development of wind power and other construction. Answering this large question would involve behavior and mortality studies involving some or all of the following: carcass searching; radar and acoustic sensing; and visual surveys during the day and night (around well-lit structures or with night-vision optics).

Coastal Fall Waterbird Migration – Localized surveying around known areas of high avian usage and/or potential development areas will now become far more important than larger scale and more randomized survey approaches. The data collected during the NJDEP EBS have greatly added to the overall knowledge of the temporal and local distribution of birdlife within the Study Area. Development that is to be proposed in the coastal zone (approximately ≤ 3 NM from shore) will greatly benefit from further investigation into the macro-phenomenon of coastal fall waterbird migration, that is, a concerted seawatch effort that was initiated in the last season of the project (fall 2009). Determination of waterbird migration density and distance from shore is of vital importance in terms of the largest potential impacts to birds.

Additional Offshore Radar Assessments – The current study provided limited radar data for offshore locations in the Study Area due to survey platforms available, water depth, and safety. Additional pre-construction met-tower or large lift barge-based radar studies and collision risk assessments are recommended to obtain better data on birds moving above, within, and below the rotor swept zone at distances beyond the reach of land-based radar units.

6.2 AVIAN SPATIAL MODELING

Foraging Behavior – The NJDEP Ecological Baseline Studies focused on measuring the spatial variability and response of avian species density to seasonality and geographic-based variables (e.g., distance to shoreline and water depth). Although the study considered flight behavior (e.g., altitude and direction) and sitting on the water as indicators of foraging behavior, it did not utilize tags and/or data loggers to analyze foraging behavior of individual birds. Such information would provide a comprehensive look into how birds make decisions on where to forage or how long they reside in particular locations. Therefore, tracking birds over lengths of time (e.g., months) may provide more insight on residence time and movement behavior within study areas.

Influence of Tidal Fluctuations – The current study did not assess fine-scale (<1 km) spatial variability of avian aggregations that may be attributed to variability in prey resources (e.g., schooling fishes) or related to dynamic tidal variability, which can change markedly along the New Jersey coastline. Such fine scale studies are necessary to understand why and where birds choose to forage and roost, and can yield important parameters to aid future modeling scenarios of avian species in regard to pre- and post construction of offshore wind energy. It is recommended that future studies incorporate tidal fluctuations in models to assess changes in avian spatial distribution.

Influence of Fisheries Resources – Emphasis should be made to better understand the spatial association between fish stocks and avian spatial distribution. There is a wealth of information from the NOAA NMFS that may be compared with avian density and spatial distribution to assess their covariation with fisheries resources. Moreover, future effort should be made to assess how birds and mammals collectively use offshore areas by conducting a comprehensive study of bird-mammal interactions at sea. Such information would increase our ability to identify and predict biologically important areas so that they can receive proper attention through ecosystem-based management plans.

Coordinate the Regional Use of Geospatial Variables – Future studies (i.e., in neighboring states) should conduct similar surveys (vessel-based and radar) using established protocols and consider using the suite of geospatial variables that were identified as important predictors of changes in avian spatial distribution and density. Such information and coordination will likely fill data gaps between states to achieve a more comprehensive view of offshore habitat use by avian species along the eastern U.S. seaboard.

6.3 MARINE MAMMAL AND SEA TURTLE SURVEYS

Increased Survey Time – Future surveys for marine mammals and sea turtles should consider allocating additional survey time in the region during seasons when rough seas are more prevalent. This will ensure that all tracklines are surveyed for the entire Study Area during monthly surveys. Rough seas are prevalent in the OCS region off New Jersey, particularly during fall, winter, and spring. The survey team experienced several delays in survey effort during these seasons. For example, only one survey day was completed during the February 2008 shipboard survey due to rough weather. The least amount of shipboard survey effort was during the spring season when we experienced relatively few days with calm seas.

Regional Surveys – Because many marine mammal and sea turtle species have large ranges of distribution, individuals may only utilize the waters of the Study Area for short periods of time as they migrate or follow prey movements. Therefore, they may not occur in the Study Area long enough to be detected during a monthly survey. To better assess shifts in distribution and abundance, that large-scale surveys are recommended that encompass a broader region, such as the entire Mid-Atlantic Bight. Shipboard and aerial surveys could cover the entire survey region. Specific changes in distribution and abundance may be more evident from these large-scale surveys. For example, this study indicates that the fall season appeared to be a transitional period for some cetacean species in the Study Area. It is likely that most bottlenose dolphins move south of the Study Area, and most short-beaked common dolphins and harbor porpoises are farther north during this time of year. However, no survey data covering these other regions during our survey period exists to verify these shifts in abundance.

Fall Aerial Surveys – It is recommended that future aerial surveys also be conducted during the fall, particularly to collect sightings of turtle species that may be in the region.

Additional Intra-Seasonal Aerial Surveys – In addition, it is recommend more intra-seasonal aerial survey effort during the spring and summer when bottlenose dolphins concentrate in the Study Area. These surveys will help to delineate fine-scale movement patterns of bottlenose dolphins throughout the Study Area which may provide critical information on potential impacts of this species in particular sites of proposed windfarm development. Spring and summer were also the seasons in which sea turtle sightings were greatest. Additional aerial surveys during these seasons will also enable a more thorough assessment of sea turtles including abundance estimates for individual species.

Enhance Acoustic Monitoring Data – Information on the presence of vocalizing cetacean species can be obtained during bad weather conditions via passive acoustic monitoring. A large amount of passive acoustic monitoring data was collected and would have benefited from more time devoted to analyses outside of auto-detection algorithms. That is, a manual review of some of the days of data in relation to survey results for species other than North Atlantic right and fin whales may have shed light on the vocal presence of species with highly variable calls.

Further, the passive acoustic data would be nicely augmented with additional vessel surveys to assess the various species that might be present. Or, adding a towed acoustic array to the vessel surveys would dove-tail nicely with data from the passive acoustic monitoring to provide a monthly snapshot of how the vessel survey data directly compared with acoustic data from both a towed array and the passive recorders. With acoustic monitoring it is possible to collect data during times when observers are not able to survey an area (e.g., during night hours or periods of rough sea conditions or bad weather). Still, when using only passive acoustic monitoring, it is not possible to document the absence of animals because they might simply not be vocalizing. Passive acoustic monitoring is also not an appropriate tool (at least yet) to document abundance or group composition because the recorders only document those individuals who are making vocalizations, not those who are silent.

Shallow-Water Passive Acoustic Recorders – During the course of acoustic monitoring, only a few days of survey had calm seas; most of the weather experienced included a BSS of 3 or 4 or greater with recovery trips more often than not delayed while waiting for better weather. It is possible that the shallow waters of the study area facilitated an increased affect of weather and sea conditions on the particular marine autonomous recording unit (pop-up) used for data collection. That is, at the start of this project, the pop-ups were state-of-the-industry technology. Several additional models of passive acoustic recorder have become available in the last 18 months that might be better suited to the shallow-water environment off the New Jersey coast.

Two Independent Team Approach – A discussion of $g(0)$, factors affecting animal detectability, and methods of accounting for detection bias are discussed in **Volume III**. Estimates of $g(0)$ for shipboard and aerial surveys are used to calculate less biased estimates of abundance. Because $g(0)$ could not be estimated during these surveys, the abundance estimates for each species and group are considered to be underestimated. Estimates of $g(0)$ would greatly improve the accuracy of our abundance estimates. Therefore, we highly recommend the use of the two-independent team approach for future shipboard and aerial surveys. This will require a larger ship that can accommodate two observer platforms and additional observers, and it will also require a larger plane that can accommodate two teams of observers.

6.4 FISH AND FISHERIES ASSESSMENTS

In addition to recommending continued collection of ongoing fisheries monitoring, it is also recommended that the following steps be taken to improve the data available for resource assessments in marine waters:

- Update EFH/HAPC descriptions and their geographical extent. Update ecologically important commercial/recreational closure areas, the status of overfished stock assessments, and federal/state agencies' species management changes as revised or additional amendments and/or FMPs (MAFMC, NEFMC, SAFMC, NMFS, and/or ASMFC).
- Update species of concern, candidate species, proposed T&E species, DPSs, and critical habitats when they are designated by NMFS and/or USFWS.

- Provide a list of recreational fish species and associated habitat type (if available) for each of the 143 fishing hotspot locations within the Study Area.

- Use NEFSC stock assessment reports/workshops and Atlantic Coastal Cooperative Statistics Program (ACCSP) information to prepare figures showing locations of dominant commercial/recreational fisheries within potential wind farm sites.

- Analyze the ocean trawl data collected yearly in the New Jersey Ocean Stock Assessment (OSA) Program (1991 to present) and evaluate the fish/invertebrate species according to landings and economic value within potential wind farm sites.

6.5 OTHER RECOMMENDED STUDIES

6.5.1 Offshore Habitat Utilization of Bats

Aside from the offshore presence/absence assessment of bats completed during this study, very little is known concerning the distribution, abundance, and flight altitudes of bats in offshore environments. Additional studies are recommended for all potential offshore development sites to determine the distribution, abundance, and flight altitudes of bats.

6.5.2 Long-Term Monitoring

Data collected over a time frame exceeding two years would provide larger temporal datasets to more confidently assess seasonal, annual, and interannual variabilities of spatial patterns of avian and marine mammal density/abundance, avian flight migration patterns (altitude, flight direction, passage rates), and oceanographic properties (e.g., SST, surface chlorophyll). While a longer term dataset may allow for extrapolation of observed patterns and to assess whether the data gathered in this study were representative of typical or unusual conditions, the two years of seasonal data gathered during this study allowed for spatial patterns to be associated with an annual "snapshot" of environmental conditions. Although extensive, this two-year dataset does not afford the temporal range to generalize seasonal patterns given that the full effect of known fluctuations in environmental conditions such as the ENSO and the NAO occur on a time scale ranging from three to seven years. Long-term monitoring data would provide additional data to the ESI developed in this study and hence a more precise prediction of sites suitable for offshore wind farm development.

6.5.3 Influence of Natural and Human-Induced Disturbances on the Local Density and Abundance of Birds and Marine Mammals

Large, baseline datasets such as these assist regulators and managers in understanding if local density and abundance patterns of birds and marine mammals are influenced by naturally-occurring events such tropical depressions, nor'easters, changes in current patterns, and river runoff. Also, if these patterns are influenced by positive human-induced changes in the coastal zone such as coastal management and mitigation strategies (pollution cleanup, eutrophication reduction) and negative changes such as oil spills. For example, if coastal cleanup efforts were to be ramped up over a defined time period (e.g., one to two years) over a selected region of the New Jersey coastline, how would this action affect the local density and abundance of birds and marine mammals? How would this potential effect compare to (1) other portions of the coastline not subjected to the management action, (2) offshore locations in proximity of the coastline affected by the management action (i.e., onshore-offshore gradients), and (3) the same area during the years when the management action is not implemented? Although outside the scope of this work, the data collected during this study or other future, similar studies will serve as an important baseline for managers to determine if there are effects on a regional or landscape level due to natural or human-induced disturbances.