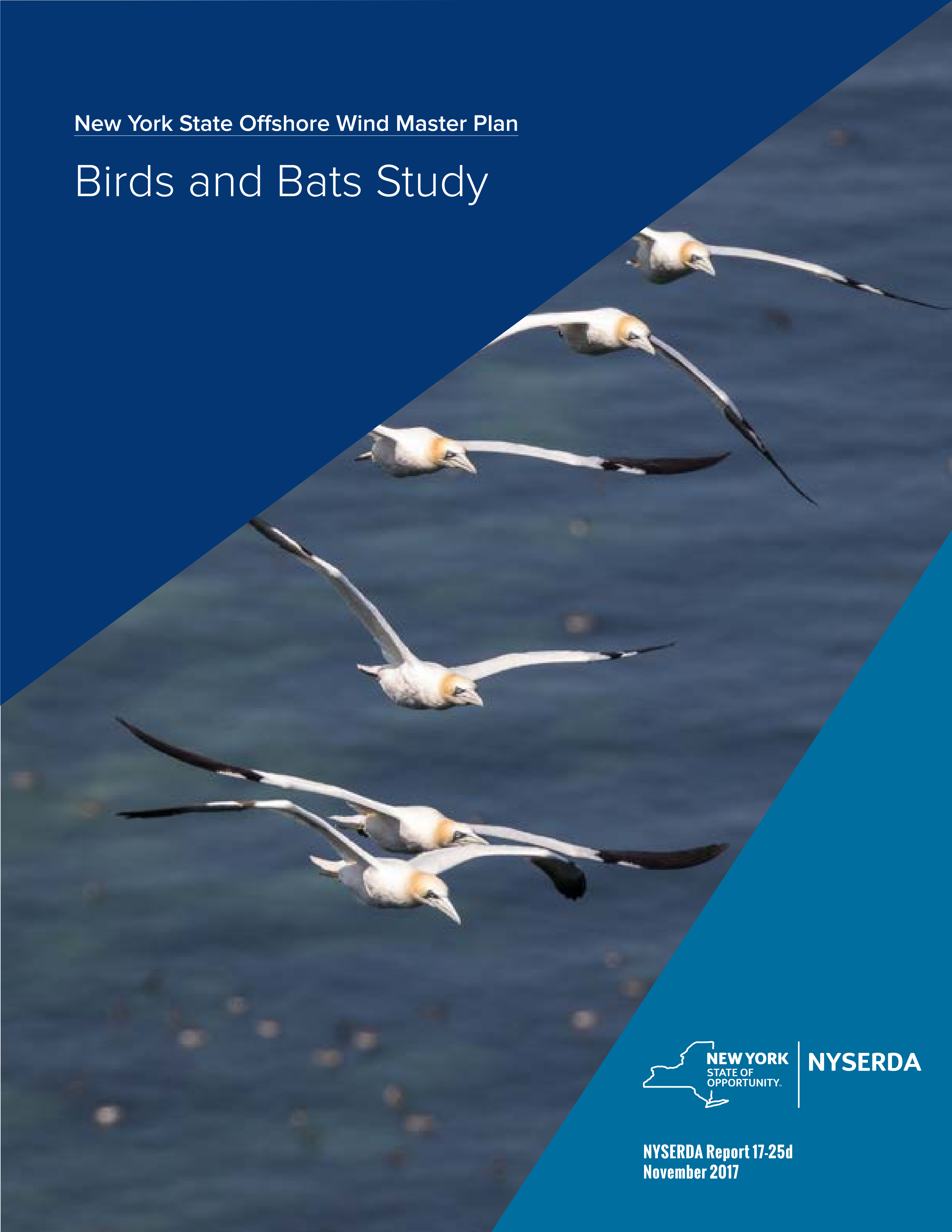
New York State Offshore Wind Master Plan

Birds and Bats Study



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New York State Offshore Wind Master Plan Birds and Bats Study

Final Report

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New York State Energy Research and Development Authority

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New York, New York

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Acronyms and Abbreviations

AoA	Area of Analysis
BCC	Birds of Conservation Concern
BCR	Bird Conservation Region
BGEPA	Bald and Golden Eagle Protection Act
BOEM	Bureau of Ocean Energy Management
DEC	New York State Department of Environmental Conservation
DOS	New York State Department of State
EO	Executive Order
ESA	Endangered Species Act
MBTA	Migratory Bird Treaty Act
NOAA	National Oceanic and Atmospheric Administration
NOAA Fisheries	National Oceanic and Atmospheric Administration Fisheries Service
NYSERDA	New York State Energy Research and Development Authority
OCS	Outer Continental Shelf
OCSLA	Outer Continental Shelf Lands Act
OSA	Offshore Study Area
Study	Birds and Bats Study
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey

Executive Summary

This Birds and Bats Study (Study) used a variety of existing data to examine bird and bat use in the Area of Analysis (AoA), a 14,980-square-mile area of the ocean extending from 15 nautical miles from the coast of Long Island and New York City to the continental shelf break, slope, and into oceanic waters to an approximate maximum depth of 2,500 meters. Another principal objective of the Study was to determine the relative sensitivities of species and species groups to potential offshore wind farm-related impacts. Bird abundance and occurrence within the AoA were largely evaluated using six key sources: Menza et al. 2012, Balderama et al. 2015, Curtice et al. 2016, Kinlan et al. 2016, eBird 2017, and Normandeau 2017. Bird life histories and behavioral information relevant to offshore habitats were obtained from *Birds of North America* (Rodewald 2015), peer-reviewed journal articles, and other reputable sources, while impact sensitivities information primarily came from European research and Robinson Willmott et al. (2013). Data pertaining to use of offshore waters by bats are more limited, and this study primarily discusses information from two sources (Pelletier et al. 2013; Stantec 2016).

Abundance and occurrence data were used to develop a list of species most likely to be observed in the AoA annually (Table 1). Appendix A provides species-specific review of the 39 regularly documented species, including their spatial and temporal occurrence, behavior relative to use of the AoA, and potential impacts associated with offshore wind farms. Species-specific reviews are organized by species groups, which were determined by taxonomy, with one exception—"pelagic birds", which comprise several disparate taxa that spend most of their lives in flight at sea. This study also addresses species groups (e.g., raptors and passerines) that may occur, but are not regularly documented in the AoA. Bats are discussed independently and collectively, given the limited information available.

While birds may occur anywhere in the AoA, data indicate that overall bird use is greatest in three core areas of the AoA: shallower waters along the northern and northwestern boundaries of the AoA, the Hudson Shelf Valley, and the continental shelf break (Figure 3). Regularly occurring species are generally concentrated in one or more of these core areas. For example, Surf Scoter (*Melanitta perspicillata*) (and waterfowl in general) use of the AoA is generally concentrated in shallow waters in the northern AoA and the shallower portions of the Hudson Shelf Valley. Conversely, Wilson's Storm-Petrels (*Oceanites oceanicus*) (and pelagic birds in general) are most commonly observed near the continental shelf breaks. Available data suggest that bird species listed under the Endangered Species Act (ESA) have not been observed to regularly occur within the AoA. However, data show that one state-listed species, Common

Terns (*Sterna hirundo*), regularly occurs within the AoA. Ongoing offshore studies of ESA-listed species, including *rufa* Red Knots (*Calidris canutus rufa*), Roseate Terns (*Sterna dougallii*), Piping Plovers (*Charadrius melodus*), and northern long-eared bats (*Myotis septentrionalis*), and state-listed Common Terns (BOEM 2017a), may provide insight on these species' use of the AoA in the future. There are insufficient data to identify higher use areas for bats in the AoA; based on the data available (Stantec 2016), bat occurrence in offshore waters in general appears to be relatively low and concentrated during migratory periods.

Collisions and displacement are the two principal potential impacts on birds at offshore wind farms, especially during operations. Potential for collisions with turbines and associated structures is greater in areas of higher bird use, during periods of inclement weather or low light, and in species with flight behaviors that put them in rotor-swept areas. Species or individuals that avoid wind farms are less likely to collide with turbines, but may then be displaced from otherwise suitable habitats and exposed to barriers to movement. Section A.1, Table 1, and Table A.1 summarize the relative sensitivities of regularly occurring bird species to collision and displacement risks associated with offshore wind farms. The primary impacts of offshore wind farms on bats, if any, would likely be collision and, to a lesser extent, displacement during operations; however, very little is known about bat use of the AoA.

Guidelines have been developed for measures to avoid or minimize the potential impacts of offshore wind energy development on birds and bats. The recommended measures in these guidelines, which generally include regular consultation with the appropriate resource agencies, data collection, impact assessment, project siting that considers impacts on birds and bats, monitoring, and mitigation, are summarized in this Study. Guidelines evolve over time and new guidance or regulations may arise in the future. Developers should consult BOEM and other State and federal agencies for up-to-date recommendations or requirements.

1 Introduction

This Birds and Bats Study (Study) is one of a collection of studies prepared on behalf of New York State in support of the New York State Offshore Wind Master Plan (Master Plan). These studies provide information on a variety of potential environmental, social, economic, regulatory, and infrastructure-related issues associated with the planning for future offshore wind energy development off the coast of the State. When the State embarked on these studies, it began by looking at a study area identified by the New York State Department of State (DOS) in its two-year Offshore Atlantic Ocean Study (DOS 2013). This study area, referred to as the "offshore study area (OSA)," is a 16,740-square-mile (43,356-square-kilometer) area of the Atlantic Ocean extending from New York City and the south shore of Long Island to beyond the continental shelf break and slope into oceanic waters to an approximate maximum depth of 2,500 meters (Figure 1). The OSA was a starting point for examining where turbines may best be located, and the area potentially impacted. Each of the State's individual studies ultimately focused on a geographic Area of Analysis (AoA) that was unique to that respective study. The AoA for this study is described below in Section 1.1.

The State envisions that its collection of studies will form a knowledge base for the area off the coast of New York that will serve a number of purposes, including: (1) informing the preliminary identification of an area for the potential locating of offshore wind energy areas that was submitted to the Bureau of Ocean Energy Management (BOEM) on October 2, 2017 for consideration and further analysis; (2) providing current information about potential environmental and social sensitivities, economic and practical considerations, and regulatory requirements associated with any future offshore wind energy development; (3) identifying measures that could be considered or implemented with offshore wind projects to avoid or mitigate potential risks involving other uses and/or resources; and (4) informing the preparation of a Master Plan to articulate New York State's vision of future offshore wind development. The Master Plan identifies the potential future wind energy areas that have been submitted for BOEM's consideration, discusses the State's goal of encouraging the development of 2,400 megawatts (MW) of wind energy off the New York coast by 2030, and sets forth suggested guidelines and best management practices that the State will encourage to be incorporated into future offshore wind energy development.

Each of the studies was prepared in support of the larger effort and was shared for comment with federal and State agencies, indigenous nations, and relevant stakeholders, including non-governmental organizations and commercial entities, as appropriate. The State addressed comments and incorporated feedback received into the studies. Feedback from these entities helped to strengthen the quality of the studies, and also helped to ensure that these work products will be of assistance to developers of proposed offshore wind projects in the future. A summary of the comments and issues identified by these external parties is included in the *Outreach Engagement Summary*, which is appended to the Master Plan.

The Energy Policy Act of 2005 amended Section 8 of the Outer Continental Shelf Lands Act (OCSLA) to give BOEM the authority to identify offshore wind development sites within the Outer Continental Shelf (OCS) and to issue leases on the OCS for activities that are not otherwise authorized by the OCSLA, including wind farms. The State recognizes that all development in the OCS is subject to review processes and decision-making by BOEM and other federal and State agencies. Neither this collection of studies nor the State's Master Plan commit the State or any other agency or entity to any specific course of action with respect to offshore wind energy development. Rather, the State's intent is to facilitate the principled planning of future offshore development off the New York coast, provide a resource for the various stakeholders, and encourage the achievement of the State's offshore wind energy goals.

1.1 Scope of Study

The effects of offshore wind farms on birds and, to a lesser extent, bats have been studied in Europe for more than two decades. While offshore wind energy development is in its infancy in the United States, onshore wind farm impacts on birds and bats have been studied in this country for many years. Based on experience with both these areas of wind farm development, in Europe and onshore in the United States, offshore wind farms in the United States will present the potential for two principal impacts on birds: collisions with wind turbines and associated structures, and displacement from otherwise suitable habitats (Furness et al. 2013; Robinson Willmott et al. 2013; Brabant et al. 2015; Vanerman et al. 2015). (Refer to Section 3 for further discussion.)

The AoA for this Study is a 14,980-square-mile area of the ocean extending from 15 nautical miles from the coast of Long Island and New York City to the continental shelf break, slope, and into oceanic waters to an approximate maximum depth of 2,500 meters. It lies within the Atlantic Flyway, which is used by various migratory birds, and the marine and coastal environments of New York and New Jersey provide breeding, wintering, and migration habitat for hundreds of species annually. New York and New Jersey also are home to nine species of bats, eight of which potentially occur in offshore waters (Stegemann and Hicks n.d.; Braun and Grace 2008; Stantec 2016).

This Study summarizes and organizes the results of the best available scientific data and literature on bird and bat use of the AoA and their potential sensitivities to offshore wind energy projects. It identifies the species of birds and bats that use the marine waters within the AoA, evaluates how these species use the area; and identifies higher use areas (where possible) to help inform the State's site selection process. Bird and bat use of the AoA was also a component of the sensitivity model conducted as part of the *Environmental Sensitivity Analysis*, which is appended to the Master Plan. While some information from this Study informs the *Environmental Sensitivity Analysis*, the purpose of this Study is solely as described above. This Study is not intended to model bird and bat use or relative sensitivities to potential impacts, nor is it intended to identify data gaps or draw inferences or develop hypotheses based on existing research.

Section 1 provides an introduction to the scope and objectives of the Study, and the agency and stakeholder engagement conducted during the preparation of the Study. Section 2 details the data and literature review methods and results that summarize bird and bat use of the AoA and surrounding areas. Section 3 discusses the potential impacts associated with offshore wind farms and outlines the relative sensitivities of birds and bats to impacts based on existing research and knowledge. Section 4 outlines current guidelines that developers may consider to avoid or minimize impacts on birds and bats. Feedback from federal and State agencies and non-governmental organizations has been incorporated throughout the final Study. Species group and species-specific summaries, including special status species (defined in Section 2.1), are discussed in Appendix A.

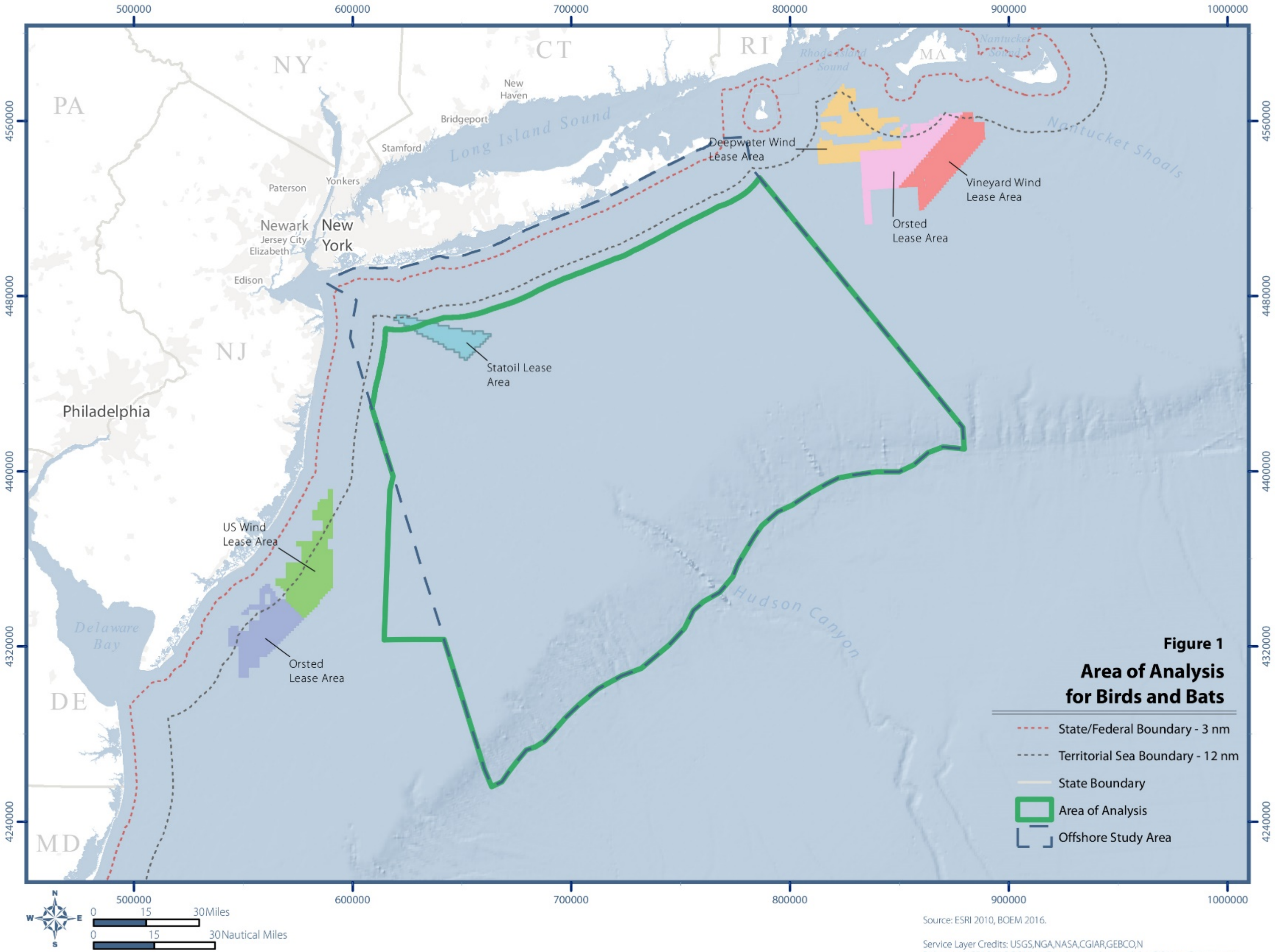
1.2 Study Objectives

The three principal objectives of this Study are to:

1. Summarize bird and bat use, including use by special status species, of the AoA based on the best available data and literature.
2. Review and summarize the existing data and literature regarding the potential adverse impacts of offshore wind farms on birds and bats and their sensitivities to various types of impacts. Special status bird species that regularly occur in the AoA receive species-specific reviews of sensitivity data and literature.
3. Provide guidelines that future offshore wind developers may consider to avoid or minimize project impacts on birds and bats.

Figure 1. Area of Analysis for Birds and Bats.

Souce: ESRI 2010; BOEM 2016



Coordinate System: NAD_1983_UTM_Zone_18N. Projection: Transverse_Mercator

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Source: ESRI 2010, BOEM 2016.

Service Layer Credits: USGS,NGA,NASA,CGIAR,GEBCO,N Robinson,NCEAS,NLS,OS,NMA,Geodatastyrelsen and the GIS User Community

1.3 Agency and Stakeholder Engagement

Agency and stakeholder feedback was an important element of this *Birds and Bats Study* in identifying bird and bat use within the AoA and informing recommended guidelines to site, construct, and operate offshore wind farms in the AoA in a responsible manner. This Study was updated to reflect agency and stakeholder feedback; however, it does not necessarily reflect the commenters' opinions.

The State provided a first draft of this Study to 14 entities for review, including State and federal regulators, nongovernmental organizations, and other stakeholders on July 31, 2017 and afforded these stakeholders the opportunity to submit written comments on the draft's contents. In addition, the State hosted a webinar on August 16, 2017 in which the Study authors gave an overview of the document and fielded questions and concerns from participating State and federal agencies and environmental nongovernmental organizations. In total, the State received 55 written and verbal comments.

The State considered all comments and when appropriate, revised the Study in response to the comments. In some cases, comments required only a written response, whereas others resulted in revisions or additions to the text; and/or modifications to figures, or formatting of the Study. In general, most comments were grouped into one or more of the following categories:

- Requests to include a data gaps section.
- Confusion regarding scope of the Study due to inclusion of an environmental sensitivity modeling section.
- Requests to clarify discussions of background data and to add unreported sources.
- Comments on figures.
- Requests to describe the process for inclusion of future changes to guidelines and inclusion of data from ongoing studies.
- Requests for Study to make inferences or develop hypotheses for results reported by journal articles.
- Requests to add cumulative impacts and adaptive management recommendations.
- General editorial comments.

Revisions and/or additions to the Study largely consisted of one or more of the following types of actions:

- Clarification of text in the Study.
- Addition of information from new sources.
- Improving consistency of terms.
- Restating clearly the scope of the Study.
- Removal of excess environmental sensitivity modeling discussion, which pertains primarily to another Study.

2 Data Review Methods and Summary of Data and Literature Review

2.1 Data Review Methods

As stated in Section 1.2, a principal objective of this Study is to characterize bird and bat occurrence and use of the AoA using the best available literature and data. This section describes the literature and data reviewed to produce the results summarized in Section 2.2 and presented more fully for specific species in Appendix A.

2.1.1 Birds

Numerous research groups have conducted counts and/or collected historical records of birds in the Atlantic Ocean, primarily from boats and airplanes, and several studies have modeled bird use in the Atlantic Ocean in areas overlapping the AoA using various metrics. Modeling this type of data can be a challenge, and studies have used different statistical models. Additionally, the distribution of birds within the marine environment depends on many factors. The location of food may be explained by variables such as bathymetry, water temperature, ocean productivity (i.e., chlorophyll-a concentrations), and currents, among others. These variables may change between seasons and years; for example, in response to changes in fisheries management or the climate (Viet et al. 2015). This Study generally summarizes the results (i.e., relative abundance and occurrence) of the models using bathymetry (water depth) and cardinal directions because there are few other physical points of orientation that can be used to describe locations in the AoA.

This Study considers a variety of sources to evaluate bird use of the AoA. Four key studies were used to present the abundance and occurrence of bird species in the AoA:

- *Marine-life Data and Analysis Team (MDAT) Technical Report on the Methods and Development of Marine-Life Data to Support Regional Ocean Planning and Management* (Curtice et al. 2016).
- *Modeling At-Sea Occurrence and Abundance of Marine Birds to Support Atlantic Marine Renewable Energy Planning: Phase I Report* (Kinlan et al. 2016).
- *Mapping the Distribution, Abundance and Risk Assessment of Marine Birds in the Northwest Atlantic* (Balderama et al. 2015).
- *A Biogeographic Assessment of Seabirds, Deep Sea Corals and Ocean Habitats of the New York Bight: Science to Support Offshore Spatial Planning* (Menza et al. 2012).

Three of these studies modeled bird distribution and abundance using an extensive avian database known as the *Compendium of Avian Occurrence Information for the Continental Shelf Waters along the Atlantic Coast of the U.S.* (O'Connell et al. 2009). This database includes 85 percent of the known seabird occurrence data, representing over 400,000 records, and includes over 30 years of data collected from United States Atlantic waters. Additionally, Curtice et al. (2016) and Kinlan et al. (2016) accessed additional seabird occurrence data for their models, including data from the years 2010 to 2014. The database has limitations such as relatively less survey data within the AoA compared to some other regions (e.g., Cape Cod, the southern New Jersey coast). However, these models are the focus of this Study's bird review because they represent the most recent and comprehensive analyses of birds with coverage of the AoA (Balderama et al. 2015; Curtice et al. 2016; Kinlan et al. 2016).

The Menza et al. (2012) study was prepared specifically to support offshore wind planning in New York. With the exception of approximately 10 miles on the edge of the AoA that represent the furthest offshore waters, the Menza et al. (2012) study area overlaps with the AoA. The Menza et al. (2012) study used an older and abbreviated (1980-1988) Manomet Bird Observatory Seabird and Cetacean Assessment Program dataset in its model. The *Compendium of Avian Occurrence Information for the Continental Shelf Waters along the Atlantic Coast of the U.S.* includes the Manomet Bird Observatory dataset.

For overall bird summary models, this Study focused on Curtice et al. (2016). Curtice et al.'s models are the most current synthesis of a large dataset with the goal of providing summary data for bird use in the offshore area. Summary models for total abundance (or biomass), species richness, and core abundance area richness were created. The models represent indices of occurrence and abundance and are not absolute. Curtice et al. created models of total relative abundance (or biomass) by stacking individual species' predicted annual long-term average relative abundance layers and adding the values in the model grids. Relative species richness was created by stacking if an individual species' was predicted as present and counting the total number of species in each model grid. The core abundance area richness model was prepared by selecting cells that represented 50 percent of the total predicted abundance for a species. This resulted in identifying areas that were "core areas" for specific species. Then, cells were summed for all species to create a count of species richness in a given cell.

These metrics were created for numerous species groups (e.g., offshore species, species with specific feeding strategies, species sensitive to turbine collision, etc.) and an "all birds" group. The all birds group represented 40 abundant species in the dataset and may be the most useful for the initial planning and siting of an offshore wind farm. However, several species were not included in the Curtice et al. (2016) summary models because their maximum prediction values were too large (i.e., Common Eider and Audubon's Shearwater). The summary models were prepared by normalizing the mean values for individual species' abundance models in order to weigh each species equally.

As with all models, there are important caveats and assumptions. The Curtice et al. (2016) models rely on survey data as inputs; areas lacking data should be interpreted cautiously. In the spring, summer, and fall the majority of the AoA contained at least one survey within the study area. Within the AoA, the winter contained many areas for which there were no surveys and, therefore, likely represents the season with the most uncertainty in the model results. For further details on other summary groups and model performance (i.e., the statistical metric of how well suited the model was as a predictor of the data), the Curtice et al. (2016) report should be referenced.

The Menza et al. (2012) study provided summary maps as "hotspots" of seabird abundance, species richness, and diversity. While the Menza et al. (2012) models data from a subset of the data used in the Curtice et al. (2016) study, the Menza et al. (2012) study included the AoA and used a different methodology. This provides an opportunity to compare and contrast results between summary models. The Menza et al. (2012) hotspot maps combined 44 individual species and several species groups. Abundance hotspot maps are concentrations of individual seabirds of any species. Species richness hotspot maps represent the potential relative species richness in a given location. Menza et al. (2012) also prepared maps of species diversity by calculating the Shannon diversity index (Krebs 1989). Species diversity represents the potential relative diversity in a given location. This measure takes into consideration the abundance and dominance of the species at a given location. The species diversity hotspot map predicts areas of diverse bird communities, better accounting for rare species.

Kinlan et al. (2016), Balderama et al. (2015), and Menza et al. (2012) provide abundance and occurrence products for individual bird species. Kinlan et al. (2016) provides seasonal and annual models of relative occurrence and relative abundance. Relative abundance represents the mean number of birds per transect and relative occurrence is the probability of counting at least one bird on a transect. These relative models are useful tools for planning within the AoA, as they support an understanding of where a species or species group may be more likely to occur and where a species or species group may be more abundant.

Relative abundance best provides a broad-scale (i.e., 6 to 60 miles) display of bird distribution and is not suitable for micro-siting. Occurrence models are typically useful for understanding special-status species, where the occurrence of even one bird is relevant because of its regulatory or conservation status.

As the first phase of their research, Kinlan et al. (2016) provided seasonal and annual models of relative occurrence and relative abundance for 40 species. While the Kinlan et al. (2016) study used environmental variables to model bird distributions, the purpose of the study was to determine the distribution of birds and not which environmental variables most influenced the distributions. Similar to Curtice et al. (2016), the Kinlan et al. (2016) models contain important caveats and assumptions. For example, Kinlan et al. (2016) notes that the distribution of survey data is patchy in many areas (i.e., winter season within the AoA) and model predictions should be interpreted cautiously.

In Section 2.2.1, the discussion focuses on the Curtice et al. (2016) and Menza et al. (2012) results. Appendix A provides abundance models for some of the specific species and relative occurrence models for special status species (Kinlan et al. 2016). There were insufficient data to model all species and season models, and some models showed poor performance. As such, only some available models are used in Appendix A to describe bird use for specific species.

The objective of the Balderama et al. (2015) research was to identify potential areas of high use by birds. Balderama et al. (2015) used a different method to model occurrence probability than Kinlan et al. (2016). Balderama et al. (2015) explored statistical methods that model the extreme variability in the bird count data. (For detailed methodology, refer to Balderama et al. 2015.) Their study focused on 24 species using data collected from 2002 through 2010. They modeled bird count data against several environmental variables, including sea surface temperature, chlorophyll-a concentration, ocean depth, and distance to shore. Important assumptions and bias in the Balderama et al. (2015) study that are relevant to this Study include the availability of underlying data within the AoA and poor model performance near the continental shelf due to extreme ocean depths and the distribution of bird observations. For comparison between studies, the monthly results provided by Balderama et al. (2015) are combined into the seasons defined by Kinlan et al. (2016): spring (March through May), summer (June through August), fall (September through November), and winter (December through February).

Menza et al. (2012) used data from seabird surveys along with 11 environmental predictors to map individual seabird presence probability maps for 14 species. These maps were prepared by season and year and represent the probability of a study grid (approximately 0.9 kilometer by 0.8 kilometer) being occupied by a species. The study also identified certainty classes of each species mapped. As available, data from Kinlan et al. (2016), Balderama et al. (2015), and Menza et al. (2012) are used to describe species-specific use in the AoA (see Appendix A).

For information on species-specific bird use within the AoA, preparers of this Study also consulted occurrence data from eBird (2017), Normandeau Associates (Normandeau 2017), and other research and datasets (e.g., Menza et al. 2012; USGS 2013; Viet et al. 2015). The two key sources included:

- Bird Observations: New England/Mid-Atlantic Coast Bird Conservation Region (eBird 2017).
- Digital Aerial Baseline Survey of Marine Wildlife in Support of Offshore Wind Energy (Normandeau 2017).

eBird (2017) is the world's largest repository for bird observation data, currently housing hundreds of millions of bird observations, which are vetted by moderators, with millions more observations arriving each month. Raw data used in this Study have not been adjusted to account for bias such as detectability and location. eBird is useful for describing general trends in bird use within the AoA, especially related to seasonal occurrence, as the data has been accumulated over decades.

Normandeau (2017) is currently conducting a three-year study of seabird use in a survey area that includes the AoA and coastal waters between the northern boundary of the AoA and the shoreline. This Study uses standardized methodology to census bird density using digital aerial cameras. At this time (fall 2017), the results of two survey efforts are available: summer 2016 and fall 2016. While the data from only two surveys are available, it is used to supplement the species summaries in Appendix A, where applicable. Future data from the Normandeau study will be useful for continuing to describe bird use in the AoA.

The abovementioned studies and datasets were used to develop a list of regularly documented species in the AoA. For the purposes of this Study, regularly occurring species are those most likely to be observed in the AoA annually, irrespective of abundance. Refer to Table 1 for a summary of available data on species known to regularly occur in the AoA. More detailed descriptions of those species of birds, including special status species, are provided in Appendix A. In this study, special status species are defined as those protected under the Endangered Species Act (ESA), New York Environmental Conservation Law, and the Bald and Golden Eagle Protection Act, or that are listed as Birds of Conservation Concern by the United States Fish and Wildlife Service (USFWS).

Extensive literature reviews were also conducted to describe bird species and species group occurrence and life histories as they pertain to use of the AoA. Resources included, but were not limited to, peer-reviewed journal articles, government agency and non-governmental organization documents, and print and online bird guides and references, such as *Birds of North America* (Rodewald 2015).

Peer-reviewed journal articles and government agency documents were also used to summarize potential impacts on birds associated with offshore wind farms, many of which are from Europe, and also guidelines developed for avoiding or mitigating these impacts. Section 3 provides a more comprehensive discussion of potential bird impacts associated with offshore wind farms and Section 4 provides a discussion of guidelines. Appendix A presents discussions of species-specific behavior, a brief assessment of the potential impacts on these specific bird species, and the relative sensitivities of these species to those impacts.

Interest in offshore wind energy development in the Atlantic Ocean will likely encourage new environmental investigations and updating of existing studies. Numerous studies are currently underway, many funded by BOEM (2017a) and other regulatory agencies. These studies were not incorporated into this Study, as they were not available prior to its finalization. These studies include, but are not limited to:

- Phase II updates to Kinlan et al. (2016).
- Phase II updates to Curtice et al. (2016).
- Determining Offshore Use by Diving Marine Birds (Surf Scoters [*Melanitta perspicillata*], Red-throated Loons [*Gavia stellata*], and Northern Gannets [*Morus bassanus*]) Using Satellite Telemetry (BOEM 2017a).
- Tracking Movements of Threatened Migratory Rufa Red Knots (*Calidris canutus rufa*) in U.S. Atlantic Outer Continental Shelf Waters (BOEM 2017a).
- Pilot Study Tracking Offshore Occurrence of Common Terns (*Sterna hirundo*) and American Oystercatchers (*Haematopus palliates*) with VHF – extended to include Roseate Terns (*Sterna dougallii*) and Piping Plovers (*Charadrius melodus*; BOEM 2017a).

2.1.2 Bats

While there are many available bird datasets, little research has been conducted on the use of offshore waters of the Atlantic Ocean by bats. In this Study, the discussion focuses on two studies that are currently the most thorough investigations into bat activity in the offshore environment: Pelletier et al. (2013) and Stantec Consulting Services, Inc. (Stantec 2016). These two studies synthesize existing knowledge of the topic and provide additional baseline data for offshore areas in the Gulf of Maine, the Mid-Atlantic, and in parts of the Great Lakes. While the Pelletier et al. (2013) and Stantec (2016) bat surveys were not conducted within the AoA, summaries of their results may be applicable to this Study in the absence of site-specific data. Sjollema et al. (2014), Hatch et al. (2013), and other data also support the bat discussion.

2.2 Data Review Results

The following provides a description of the existing environment in the AoA as it pertains to birds (Section 2.2.1) and bats (Section 2.2.2).

2.2.1 Birds

Within the AoA, higher relative abundance for all bird species generally corresponds with the locations along the Hudson Shelf Valley and the continental shelf break; however, the highest relative abundances in the region occur outside the AoA in the nearshore waters of New York and New Jersey (Curtice et al. 2016; Figure 2). Menza et al. (2012) concludes that overall annual avian relative abundance hotspots within the AoA are generally higher in nearshore areas along the Hudson Shelf Valley. In the winter, overall annual avian relative abundance hotspots were modeled as variable throughout the AoA, with apparent trends of higher relative abundance along the Hudson Shelf Valley, in nearshore waters, and in central portions of the AoA. In the spring, the Menza et al. (2012) overall avian relative abundance hotspot model was similarly variable, with concentrations of use in central portions of the AoA at water depths of 660 feet (200 meters). The Menza et al. (2012) summer overall avian relative abundance hotspot model displays abundance as highest in nearshore waters with depths of 200 feet (60 meters) or less. Similarly, the fall overall avian relative abundance hotspot model displays abundance as higher in waters with depths of 200 feet (60 meters) or less but also along the eastern portion of the AoA. (Modeled distribution or occurrence information for selected individual species is provided in Appendix A.) The Hudson Shelf Valley is an underwater extension of the Hudson River and runs from the New York harbor up to 500 miles offshore. The Hudson Shelf Valley has unique geography that creates upwellings of nutrient-rich water that attract marine wildlife, including birds.

Core abundance area richness for all bird species corresponded with the continental shelf break, the Hudson Shelf Valley, and nearshore areas along the northern and western boundaries of the AoA (Curtice et al. 2016; Figure 3). Species richness is relatively high across all portions of the AoA, but appears to be higher in portions of the AoA where water depth is 200 feet (60 meters) or more compared to nearshore waters. Menza et al. (2012) modeled the predicted annual species richness hotspots as highest along a band through the central and northern portion of the AoA; however, their study noted that there was uncertainty in the results in some areas (the extreme nearshore and offshore portions of the AoA).

Figure 2. Overall Avian Relative Abundance.

Source: ESRI 2010; BOEM 2016; Curtice et al. 2016

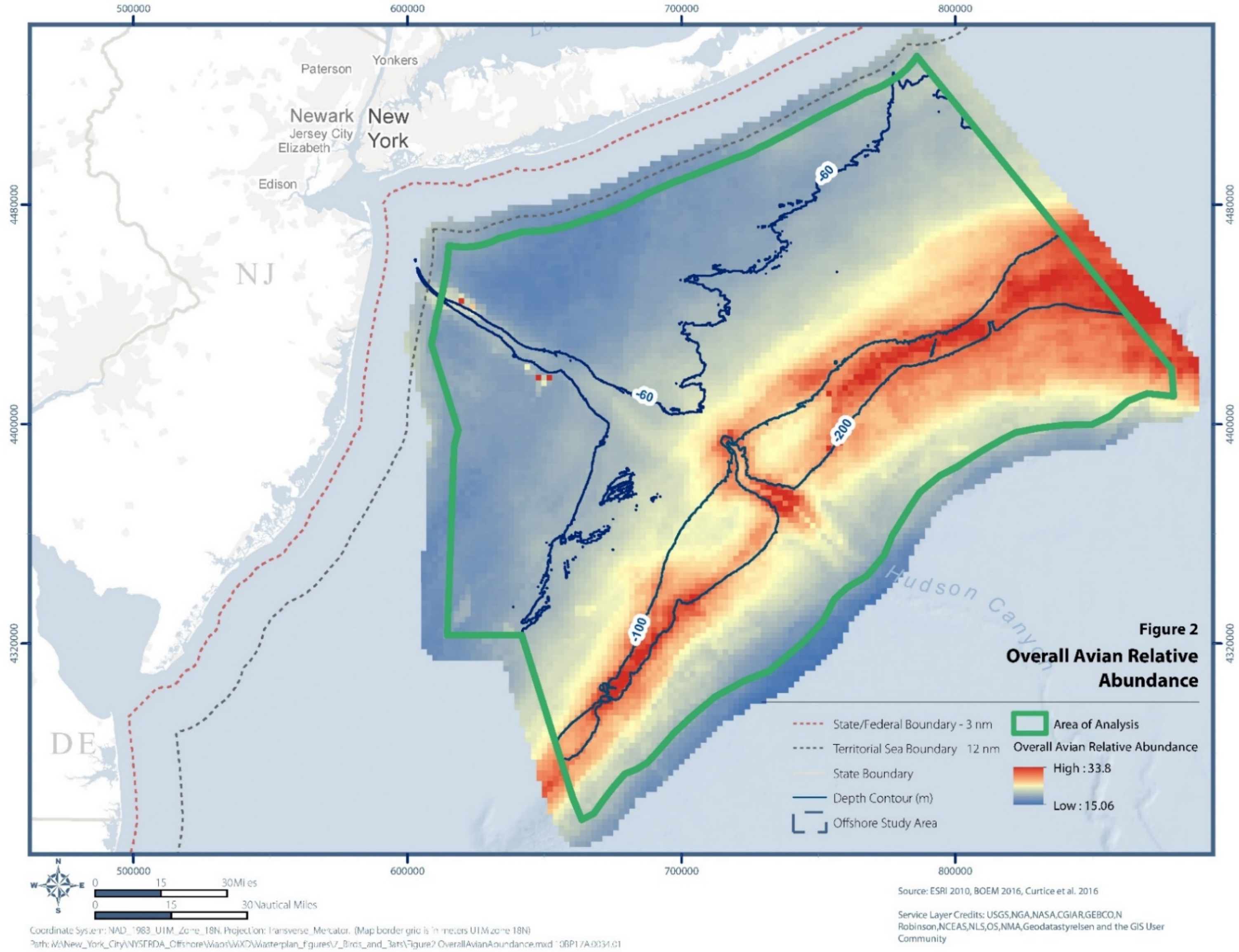
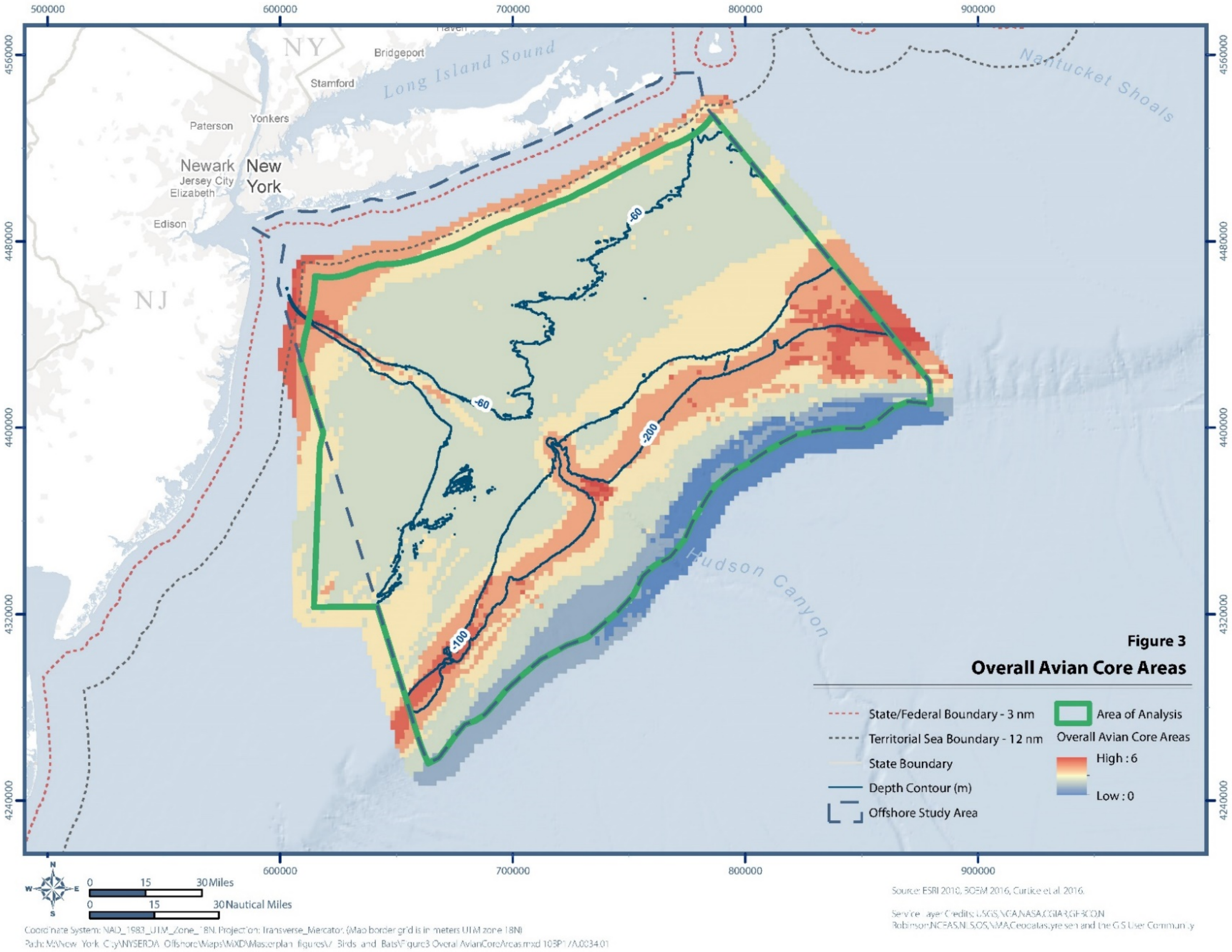


Figure 3. Overall Avian Core Areas.

Source: ESRI 2010; BOEM 2016; Curtice et al. 2016



Coordinate System: NAD_1983_UTM_Zone_18N. Projection: Transverse_Mercator. (Map border grid is in meters UTM zone 18N)
Path: M:\New York City\NYSERDA Offshore\Maps\MXD\Masterplan figures\ Birds and Bats\Figure3 Overal AvianCoreAreas.mxd 10SP17A.0034.01

Source: ESRI 2010, BOEM 2016, Curtice et al. 2016.

Service Layer Credits: USGS,NGA,NASA,CGIAR,GEBCO,N Robinson,NCEAS,NLS,OS,NMA,Geodatastyrelsen and the GIS User Community

The Menza et al. (2012) annual species diversity hotspot model predicted a patchy distribution of high and low diversity throughout the AoA, with hotspots of highest diversity in the northern portion of the AoA (nearest to Long Island) and in the eastern portion of the AoA in deeper waters.

Table 1 provides summary information of the 39 regularly documented species of birds in the AoA, including a summary of the seasonal occurrence of the species, and a sensitivity assessment for collision with and displacement by wind energy development infrastructure, based on existing research. Appendix A provides further information on specific species' seasonal use of the AoA and any behaviors or life history traits of specific species that make them sensitive to wind energy development-related impacts.

2.2.2 Bats

Records of bats in offshore Atlantic waters date back at least 100 years (Pelletier et al. 2013). Stantec (2016) reported that eight species of bats potentially occur over the Atlantic Ocean: the little brown bat (*Myotis lucifugus*), northern long-eared bat (*Myotis septentrionalis*), eastern small-footed bat (*Myotis leibii*), tri-colored bat (*Perimyotis subflavus*), big brown bat (*Eptesicus fucsus*), silver-haired bat (*Lasionycteris noctivagans*), eastern red bat (*Lasiurus borealis*), and hoary bat (*Lasiurus cinereus*). Stantec found that bat species compositions between their Gulf of Maine and the mid-Atlantic coast study areas were similar, observing seven of the abovementioned eight species (excluding eastern small-footed bat) in both study areas. As the AoA is between the Gulf of Maine and the mid-Atlantic, it is reasonable to expect that the AoA would have a similar composition of bat species, although the potential for additional species should not be discounted. Stantec (2016) documented 13 individual bats in the AoA using acoustic detectors mounted on ships; however, they were not able to match the bat calls to specific species.

A number of recent studies documented bat activity in offshore Atlantic waters (Johnson et al. 2011; Hatch et al. 2013; Pelletier et al. 2013; Sjollema et al. 2014; Stantec 2016; Dowling et al. 2017). Stantec (2016) recorded bats up to 100 miles offshore. In the month of September, Hatch et al. (2013) detected eastern red bats 10 to 30 miles offshore in the mid-Atlantic. Sjollema et al. (2014) surveyed for bats in mid-Atlantic offshore waters (up to 100 miles offshore) and documented eastern red bats, big brown bats or silver-haired bats, and hoary bats up to 14 miles from shore. Based on the study design and results, Sjollema et al. (2014) suggested that bat use would be higher closer to shore. Several species of bats have been documented traveling between the mainland and islands in the region of Cape Cod (Dowling et al. 2017) and along barrier islands offshore of Maryland (Johnson et al. 2011).

Table 1. Bird Species that Regularly Occur in the Area of Analysis[a]

Sources: Balderama et al. 2015; Brabant et al. 2015; Dierschke and Garthe 2006; eBird 2017; Furness et al. 2013; Halley and Hopshaug 2007; Johnston et al. 2014; Kinlan et al. 2016; Leopold et al. 2012; Lindeboom et al. 2011; National Audubon Society 2015, 2017; Normandeau 2017; Petersen et al. 2011; Robinson Willmott et al. 2013; USGS 2013; Vanerman et al. 2015.

Common Name	Scientific Name	Seasonal Occurrence[b]	Sensitivity[c]	
			Collision	Displacement
Waterfowl				
Brant	*Branta bernicla*	Winter, Spring, Fall	Low	Low
Common Eider	*Somateria mollissima*	Winter, Spring, Fall	Low to High	High
Surf Scoter	*Melanitta perspicillata*	Winter, Spring, Fall	High	High
White-winged Scoter	*Melanitta fusca*	Winter, Spring, Fall	Low to High	Medium to High
Black Scoter	*Melanitta americana*	Winter, Spring, Fall	Low to High	High
Long-tailed Duck	*Clangula hyemalis*	Winter, Spring, Fall	Low to High	Medium to High
Red-breasted Merganser	*Mergus serrator*	Winter, Spring, Fall	High	Medium
Loons				
Red-throated Loon	*Gavia stellata*	Winter, Spring, Fall	Low to High	High
Common Loon	*Gavia immer*	Winter, Spring, Fall	Low to High	High
Pelagic Birds				
Northern Fulmar	*Fulmarus glacialis*	Winter, Spring, Fall	Low to High	Low to High
Black-capped Petrel	*Pterodroma hasitata*	Summer	High	High
Cory's Shearwater	*Calonectris diomedea*	Summer, Fall	High	Medium
Great Shearwater	*Ardenna gravis*	Summer, Fall	High	Medium
Sooty Shearwater	*Ardenna grisea*	Spring, Summer	Low to High	Low
Manx Shearwater	*Puffinus*	Year-round	Low to High	Low to High
Audubon's Shearwater	*Puffinus lherminieri*	Summer	High	Medium
Wilson's Storm-Petrel	*Oceanites oceanicus*	Spring, Summer	High	Low
Leach's Storm-Petrel	*Oceanodroma leucorhoa*	Spring, Summer	Low to High	Low to Medium
Band-rumped Storm-Petrel	*Oceanodroma castro*	Summer	High	Medium
Northern Gannet	*Morus bassanus*	Winter, Spring, Fall	Low to High	Low to High
Pomarine Jaeger	*Stercorarius pomarinus*	Spring, Summer, Fall	High	Low
Parasitic Jaeger	*Stercorarius parasiticus*	Spring, Fall	High	Low
Long-tailed Jaeger	*Stercorarius longicaudus*	Spring, Fall	High	Low

Table notes are on the next page.

Table 1 continued

Common Name	Scientific Name	Seasonal Occurrence[b]	Sensitivity[c]	
			Collision	Displacement
Cormorants				
Double-crested Cormorant	*Phalacrocorax auritus*	Year-round	High	Medium
Shorebirds				
Red-necked Phalarope	*Phalaropus lobatus*	Spring, Fall	High	Low
Red Phalarope	*Phalaropus fulicarius*	Spring, Fall	High	Medium
Alcids				
Dovekie	*Alle*	Winter, Spring, Fall	Medium	Medium
Common Murre	*Uria aalge*	Winter, Spring	High	High
Razorbill	*Alca torda*	Winter, Spring, Fall	Low to High	Medium to High
Atlantic Puffin	*Fratercula arctica*	Winter, Spring	Low to High	Medium to High
Gulls and Terns				
Black-legged Kittiwake	*Rissa tridactyla*	Winter, Spring, Fall	High	Low
Bonaparte's Gull	*Chroicocephalus philadelphia*	Winter, Spring, Fall	Low	Low
Laughing Gull	*Leucophaeus atricilla*	Spring, Summer, Fall	High	Medium
Ring-billed Gull	*Larus delawarensis*	Winter, Spring, Fall	Medium	Low
Herring Gull	*Larus argentatus*	Winter, Fall	High	Low to High
Iceland Gull	*Larus glaucoides*	Winter, Spring, Fall	High	High
Lesser Black-backed Gull	*Larus fuscus*	Winter, Spring, Fall	High	Low to High
Great Black-backed Gull	*Larus marinus*	Winter, Spring, Fall	High	Low to High
Common Tern	*Sterna hirundo*	Spring, Summer, Fall	Medium to High	Low to Medium

[a] Species likely to occur annually, irrespective of abundance, based on available data.

[b] Seasons in which the species most commonly occurs. Does not indicate that individuals may not appear at other times of the year.

[c] Sensitivity of the species to collision/displacement impacts associated with wind energy development infrastructure, based on existing research. Scale: Low, Medium, or High. Some species received broad categorization of impact risk, based on uncertainty in the best available data.

Bat studies in Atlantic offshore waters suggest that fall migration represents a time when bats are most likely to occur within offshore waters. Hatch et al. (2013) surveyed offshore waters year-round though they recorded all of their bat detections in September. Stantec (2016) focused their surveys in the Gulf of Maine and mid-Atlantic from April to November and March to December, respectively. Bat activity was highest in mid- to late August, but Stantec observed activity in all seasons surveyed. Survey locations on remote islands and offshore buoys revealed that bat activity was low or absent in the summer. Johnson et al. (2011) similarly found bat activity was correlated with spring (mid- February to mid- May) and fall (September to November) migrations along barrier islands in Maryland.

In Europe, where existing offshore wind farms have encouraged the study of bat use and behavior, researchers have documented bats in offshore waters. In Scandinavia, Ahlén et al. (2009) documented bats migrating and foraging in the offshore environment between Sweden and Denmark. They detected individual and small flocks of bats flying at low altitudes (less than 30 feet) over the surface of the water. Ahlén et al. (2007) detailed bat activity around offshore wind turbines in the Baltic Sea near Kalmarsund, Sweden, approximately 10 miles offshore. They observed bats migrating through the area and foraging around the turbines and blades. Ahlén et al. (2007) also observed bats foraging on the abundant invertebrate prey located near or at the water’s surface and using offshore wind turbines as roosts. Boshamer and Bekker (2008) documented bats roosting on offshore oil platforms in the North Sea. Between 1988 and 2007, 34 bats were reported on offshore oil platforms during both the spring and fall migratory seasons. The average distance of bats at offshore oil platforms was 41 miles from shore, with the maximum distance over 100 miles.

3 Potential Impacts and Sensitivity

This section describes potential impacts on birds and bats associated with the development of offshore wind farms and their relative sensitivities to those impacts based on existing research and data.

3.1 Birds

Offshore wind farms are associated with two principal impacts on birds: collisions and displacement. Collison impacts refer to birds striking offshore wind turbines and associated structures resulting in fatalities or injuries during construction or operations. Birds' sensitivities to collision depends on many factors, including dimensions and height of the wind turbines and their placement (i.e., in feeding or breeding areas, along migration corridors; Drewitt and Langston 2008), as well as species-specific flight and feeding behavior, described in further detail in Appendix A. Birds may collide with stationary portions of the wind turbine, or with the moving blades. Birds, especially those that migrate at night, are also apparently disoriented by or attracted to structures that are lit (i.e., lighting to warn aircraft or ships), particularly red and white lights, and this can have significant implications on collision risk (Poot et al. 2008). Probability of collisions can also be influenced by season (e.g., migration period) and weather conditions.

Habitat displacement can result from a variety of offshore wind farm construction activities (e.g., vessel traffic, pile driving, increased human presence) or during operations (e.g., avoidance of the wind turbines). Displacement impacts can be divided into habitat loss and barrier effects. Activities that make habitats unsuitable to birds and cause them to avoid an area indirectly result in habitat loss by displacing the birds. Displacement can also occur in the form of barrier effects, which result when birds avoid wind turbines, affecting migration and other movements (Fox et al. 2006). In general, both collision and displacement impacts can occur during the construction phase of a wind farm development, but these impacts are relatively minor and short term compared to impacts that could occur during the operational life of an offshore wind farm. Existing research focuses primarily on operational impacts; therefore, this section applies a similar focus.

Many bird impact studies have been conducted in Europe, where offshore wind farms have existed for over 20 years (Garthe and Hüppop 2004; Desholm and Kahlert 2005; Desholm 2009; Cook et al. 2012; Band 2011; Furness and Wade 2012; Furness et al. 2013; Johnston et al. 2014; Vanerman et al. 2015; Dierschke et al. 2016). Important variables in determining impacts on birds associated with offshore wind farms include a species' sensitivity to human disturbance, the portion of the population that occurs in the area of interest, adult survival, breeding status, and flight characteristics (i.e., flight altitude, flight maneuverability, percentage of time spent flying, and nocturnal flight activity). Additionally, a species' sensitivity to collision and habitat displacement may depend on their conservation status and population size. Cumulative impacts on birds from offshore wind farms may also be a significant risk to bird populations; for example, increasing the mortality rate of a species across multiple offshore wind farms may lead to population-level effects, especially for bird populations that are already in decline (Brabant et al. 2015).

Many of these studies focus on how a species' flight behavior affects potential for collision (Garthe and Hüppop 2004; Band 2011; Cook et al. 2012; Furness and Wade 2012; Furness et al. 2013). Several flight characteristics can be important when modeling collision risk: flight maneuverability (ability to quickly avoid structures), height of flights, how much time birds spend flying versus resting or foraging on the water surface, and whether birds fly at night (Garthe and Hüppop 2004; Furness and Wade 2012; Furness et al. 2013). Sensitivity models typically assign relative scores (e.g., 1 to 5) as a method to describe collision impacts.

Another important variable in collision impacts is avoidance of offshore wind farms by birds. Studies in Europe show that bird species may avoid offshore wind farms. Reductions in bird use at operational offshore wind farms were documented for several species, including but not limited to Red-throated Loon; Common Eider; Northern Gannet; Common Murre; and Razorbill (Desholm and Kahlert 2005; Petersen et al. 2011; Leopold et al. 2012; Vanerman et al. 2015; Dierschke et al. 2016). Using radar, Desholm and Kahlert (2005) demonstrated that approximately 99 percent of seabirds (i.e., Common Eider and species of geese) did not fly close enough to wind turbines to be at risk of collision, and there was an apparent overall avoidance of the offshore wind farm. Cook et al. (2014) similarly documented an approximately 99 percent wind turbine avoidance rate for gull species. However, some species of birds have demonstrated an attraction to offshore wind farms. Vanerman et al. (2015) found that Lesser Black-backed Gull and Herring Gull counts were significantly higher in the offshore wind development area after construction of the turbines. Dierschke et al. (2016) also determined that Lesser Black-backed Gulls and Herring Gulls exhibited some attraction to offshore wind farms, as did Great Black-backed Gulls, Red-breasted Mergansers, and several species that do not regularly occur in the AoA. Increases in food availability appeared to be an important factor in attracting seabirds to offshore wind farms.

Studies of offshore wind energy development in the United States have built upon the methods and results of European research. Robinson Willmott et al. (2013) used data from existing wind farms in Europe and a literature review to assess a large study area across the Atlantic OCS, which overlaps the AoA, and used three metrics to assess potential sensitivity of bird species to offshore wind turbines: population sensitivity, collision sensitivity, and (habitat) displacement sensitivity. Species identified with the highest population sensitivity were those with small populations, such as Black-capped Petrel, Least Tern, Roseate Tern, and Cory's Shearwater. Species identified as having the highest collision sensitivity occurred most often in offshore waters and had flight characteristics that placed them in the rotor-swept zone of a wind turbine, such as gulls, jaegers, Roseate Tern, Northern Gannet, Black-capped Petrel, and Common Tern. Species identified with the highest displacement sensitivities were those particularly sensitive to disturbance and/or having strong relationships with specific habitat types, such as Common Eider, Roseate Tern, Atlantic Puffin, Razorbill, scoters, and loons. Most sandpipers, passerines, and raptors had low scores in all three categories.

Goodale and Stenhouse (2016) provide a recent conceptual model of factors that should be used when determining sensitivity of wildlife to offshore wind farms: demographic, ethological and biological, population, and sociological. The study suggested that assessing factors using both quantitative (e.g., population viability analysis, field studies) and qualitative (e.g., literature review, consultation with agencies, stakeholders, and working groups) methods were beneficial to understanding the sensitivity of species to offshore wind farms. While their research did not include metrics for a given species, their findings provide useful methods for assessing the potential impact of a proposed offshore wind development site on any wildlife species.

Winiarski et al. (2014) used occurrence and density data of marine birds off the coast of Rhode Island to identify sites with high marine bird conservation priority. Shallow, nearshore waters were the highest ranked conservation priority areas. They found that hypothetical offshore wind farms would significantly reduce the overall distribution of study species if constructed within the conservation priority sites. They also found that proposed wind energy development areas in Rhode Island (at time of publication) would be located in areas of relatively low conservation priority. The Winiarski et al. (2014) study was intended to inform offshore wind farm siting decisions to minimize impacts on marine birds.

The information presented in this section and Appendix A indicates that species with the greatest sensitivities to potential impacts associated with offshore wind energy development in the AoA are regularly occurring (Tables 1 and A-1) and/or special status (Section A.3) species. Potential impacts are also dependent on where offshore wind energy facilities are sited. Based on the available data, areas of the AoA with the highest use by birds appear to be along the length of the Hudson Shelf Valley, in nearshore waters (along the northern boundary of the AoA), and along the continental shelf break.

The National Audubon Society (2015) predicted that climate change will adversely affect 588 species of North American birds and determined that 314 species are either Climate Endangered or Climate Threatened. Climate Endangered species are projected to lose more than 50 percent of their current range by 2050, and Climate Threatened species are projected to lose more than 50 percent of their current range by 2080. Thus, when assessing the potential impact of offshore wind development on birds, it is important to consider how birds may benefit from renewable energy programs, such as offshore wind energy, that reduce carbon emissions. Of the 39 bird species that regularly occur in the AoA, the National Audubon Society identified 17 species as Climate Endangered or Climate Threatened. Although offshore wind turbines present the potential to impact birds and bats, one of the State's key goals in encouraging the development of offshore wind projects in the AoA is to stem climate change, which is impacting—and is projected to continue impacting—many bird and bat species.

3.2 Bats

Bat research in offshore environments is relatively limited, and it is virtually non-existent with regard to offshore wind energy development in the United States. In contrast, bats at onshore wind energy facilities have been well studied. Bats collide with onshore wind turbines at an estimated rate of over 600,000 fatalities per year in the United States (Hayes 2013). Migratory tree-roosting species appear to be most impacted by onshore wind turbines (Kunz et al. 2007). While population-level effects are generally uncertain, new studies suggest onshore wind development may have significant impacts on some species of bats (Frick et al. 2017). Bat collisions with offshore wind facilities would likely be much lower than at onshore facilities, because bat activity is relatively low in offshore environments, based on existing research (Section 2.2.2).

Based on the data available (Stantec 2016), bat occurrence in offshore waters appear to be relatively low and concentrated during migratory periods. Potential impacts on bats may include turbine collisions and possibly displacement from potential offshore migration areas (Pelletier et al. 2013). The northern long-eared bat, which is federally listed as threatened, could be particularly sensitive to these impacts if the species occurs in offshore waters, because its population is already vulnerable. Conversely, bats may benefit from renewable energy development, including offshore wind farms, that combats climate change, which may negatively impact critical foraging and roosting habitats (Sherwin et al. 2012).

4 Guidelines for Avoiding or Minimizing Impacts

This section provides guidelines that developers of offshore wind projects can use to identify and avoid or reduce potential impacts on birds and bats and mitigate impacts that cannot be avoided. These guidelines are derived from agency guidance documents (NYSERDA 2015; BOEM 2017b) and lessons learned from existing onshore and offshore wind farm projects (Bailey et al. 2014; Marques et al. 2014; Klain et al. 2015; Gartman et al. 2016). Guidelines are subject to change over time and new guidance or regulations may also arise after publication of this Study. Developers should consult with BOEM and other federal and state agencies for up-to-date regulatory recommendations or requirements at the time of project planning and development. This Study does not intend to propose changes to existing guidance or to develop new guidance. The State is in the planning phase for offshore wind energy development, the outcome of which will help to inform their next steps, including an approach to develop guidelines.

4.1 Regulatory and Stakeholder Coordination

Begin working early, ideally three years prior to submission of construction and operations plans, with BOEM and regulatory agencies (e.g., USFWS) that manage birds and bats in the offshore environment. Developers can also coordinate with stakeholders (e.g., non-governmental organizations) early in order to understand concerns. Coordination with regulatory agencies and stakeholders can include information sharing (e.g., data portals, fact sheets).

4.2 Identify Potential Impacts

BOEM’s guidelines (BOEM 2017b) require the following steps to be performed during the preconstruction process: identify bird species in the proposed project area and when they occur; establish preconstruction baseline data that will allow bird abundance and distribution to be measured in the post-construction period; fill gaps in existing datasets that are required to make baseline assessments; and develop methods to assess impacts on birds from offshore wind farms. Recommended methods for performing these steps and analyzing the resulting information are summarized below.

4.2.1 Define the Area of Impact

Identify the study area in which impacts on birds and bats from a project may occur. For impact assessments relating to birds, the operational area of impacts may be best defined by potential habitat displacement and avoidance (Desholm and Kahlert 2005). The area of impact should also consider the suite of disturbances related to the offshore wind energy development project and include boat and helicopter traffic in the region. A project's area of impact should also consider the influence of other offshore wind farms in the region.

4.2.2 Define Baseline Information

Within the area of impact, establish baseline information on the bird and bat species present, including their current distribution, abundance, and conservation status. Other demographic data, such as fecundity and survival rates, may also be relevant.

4.2.2.1 Existing Research and Literature Review

Baseline data on species at the regional and population levels should be gathered from existing research and literature review. In the United States, several region-wide studies are underway to support the understanding of the relative abundance and occurrence of birds (Balderama et al. 2015; Curtice et al. 2016; Kinlan et al. 2016). Existing research can be used to support development of conservative estimates. At the site-specific scale, existing research can provide information about behavioral characteristics of birds that will support impact assessments (see Section 4.2.3).

4.2.2.2 Project-Specific Field Studies

Site-specific surveys can provide detailed information about a specific proposed development area. Field surveys should identify the underlying variables that are important to bird habitat in the area of impact (e.g., bathymetry, water temperature, ocean productivity, currents). Field studies should also identify the occurrence of species (e.g., annual, season, day and night), their abundance, their behavior (e.g., flight height), and areas of core activity. Important information needs may also be identified when planning for the preparation of impact assessments (see Section 4.2.3).

Various methods can be used to collect information on birds. Generally, surveys are carried out by observers on boats and airplanes or through the use of high-resolution digital aerial surveillance/ photography. Radar, thermal imaging, satellite tracking, and acoustic monitoring may also be suitable methods of collecting data (Christensen et al. 2004; Farnsworth et al. 2004; Desholm et al. 2006;

Schmaljohann et al. 2008; Plonczkier and Simms 2012; McCafferty 2013; Ronconi et al. 2015). Additionally, BOEM (2017b) recommends preconstruction surveys be conducted for two to three years. Within the AoA, field studies can be designed to supplement or complement, at a more site-specific level, previous and ongoing research efforts (e.g., Normandeau 2017).

While the existing research suggests that bats are relatively rare in the offshore environment (Stantec 2016), research on bat abundance and occurrence is almost entirely lacking for the AoA. As such, field surveys for bats in the AoA should be undertaken during project planning to collect baseline information, such as which species have the potential to occur in a proposed project's area of potential impact. Field studies of bats should consider acoustic monitoring at the height of turbine nacelles, if feasible. Information needed to understand bat movement and corridors within the offshore environment can be obtained using methods such as passive radio telemetry. The potential for the northern long-eared bat to occur in the offshore environment and AoA should be considered when designing bat field studies.

4.2.3 Impact Assessment

Using data collected from existing research and project-specific surveys, developers should prepare impact assessments for species or species groups that have the potential to occur in a proposed project's area of potential impact. Impact assessments consider many variables to understand how sensitive a species may be to impacts from offshore wind development (see Section 3). These studies can identify which species are most sensitive to impacts from offshore wind development and may require monitoring programs (see Section 4.2.4).

4.2.4 Special Status Species

Detailed impact assessments should be undertaken for special status species, such as the federally listed Roseate Tern, Piping Plover, Red Knot, and northern long-eared bat, to the extent they may occur in a proposed project's area of potential impact. Currently, only limited research is available for many special status species. Impact assessments can support an understanding of the potential for "take" to occur and to facilitate compliance with the ESA. At a minimum, species-specific impact assessments should be completed for the project impact area for federally listed species. The results of these assessments will determine permit and regulatory requirements and monitoring programs.

4.3 Micro-Siting of Wind Farm Projects

After the potential impacts have been identified, siting of individual turbines should seek to avoid or minimize impacts on birds and bats to the extent practicable. Proper siting of offshore wind farm infrastructure has the potential to significantly reduce impacts on birds and bats, especially more sensitive species. The number, size, and layout of turbines can be modified to account for risks to birds, bats, and sensitive habitats, as appropriate. There are many variables to consider when siting an offshore wind farm, and different approaches can be taken to weigh important variables (Gartman et al. 2016).

4.4 Monitoring

BOEM (2017b) requires developers to submit plans that outline "proposed measures for avoiding, minimizing, reducing, eliminating, and monitoring environmental impacts." The developer's plans should include developing post-construction monitoring programs that assess the impacts of an offshore wind farm on birds and bats. These impacts include both collision fatalities and displacement. Monitoring programs should be designed in advance. Study methodologies that can detect change and measure response (e.g., before-after-control-impact, generalized additive model [Petersen et al. 2011]) may be different from studies that identify impacts. Study designs must also have the statistical power to measure changes. Monitoring programs should be created with the involvement of stakeholders and regulatory agencies to identify population thresholds or other triggers for when mitigation actions may be needed.

To date, there is no industrywide standard for measuring bird and bat collision fatalities in the offshore environment. Onshore wind developments typically devote considerable effort to documenting bird and bat fatalities as a result of collisions. In the offshore environment, there are many technical obstacles that do not allow for comparable studies. For example, most birds that collide with turbines would fall into the water and be lost to detection. Cameras with thermal imaging and other sound sensors may be used with some success (Desholm et al. 2006; Flowers et al. 2014; Dirksen 2017). Mitigation should be adaptable to unforeseen impacts based on the results of monitoring efforts (NYSERDA 2015).

4.5 Mitigation

Mitigation measures can reduce impacts on birds and bats at offshore wind farms where sensitivities are identified. Several such measures are summarized below.

- Offshore wind turbines may inadvertently create perches and roosts for birds and bats within the structure of the turbine (e.g., decks, wires). Designing turbine structures to minimize the potential for these perch and roosting places may reduce collision impacts.

- Evidence suggests that birds may be attracted to lighted features, especially during migration. Offshore wind turbines are required to be lighted for important safety reasons concerning shipping and aircraft operations, but developers should follow lighting guidelines that minimize impacts on birds. In the offshore environment, preference should be for fewer lights, flashing or strobing lights, lower intensity lights, and lights that are non-white colors (Orr et al. 2013). BOEM is currently drafting Lighting and Marking Guidelines for offshore wind developments.
- Turbine use curtailment has been shown to be effective in some instances at onshore wind farms and may be considered to reduce bird collisions at offshore wind farms during inclement weather, migratory or breeding seasons, or at night during migratory periods, if appropriate (Hüppop et al. 2006; Singh et al. 2015). For bats, onshore wind farms have demonstrated that feathering turbine blades and curtailing operations during seasons when bats are most active is effective at reducing fatalities (Arnett et al. 2011; Stantec 2016). Curtailment and feathering have not been sufficiently tested at offshore wind energy facilities to understand their effectiveness in reducing avian or bat mortality. If collision mortality impacts on bird and bat species are determined to be significant, these methods may be applicable in the offshore environment and deserve further examination.

5 References

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Appendix A. Results of Data Review on Birds, Bats, and Special Status Species

Appendix A describes in more detail the use of the Area of Analysis (AoA) by bird species groups, as described in the available literature identified in Section 6: waterfowl, loons, pelagic birds, cormorants, shorebirds, alcids, gulls and terns, and other bird species groups. The species groups were determined by taxonomy, with one exception: In Section A.1.3 the “pelagic birds” species group comprise several disparate taxa that share similar life history traits. Section A.1.3 describes these taxa and their similarities in more detail. The species groups discussed in Sections A.1 through A.7 represent the 39 regularly documented species in the AoA, which are also identified on Table A-1. (This table is also provided in Section 2.2.1 of the report.) These sections provide species-specific reviews of the regularly documented species. For each species, the following information is summarized, as available: spatial and temporal occurrence, behavior relative to use of the AoA, and potential impacts associated with offshore wind farms. Figures are provided where visual presentation of abundance or occurrence data enhances the reader’s comprehension of the text. Section A.8 discusses species groups that may occur but are not regularly documented in the AoA.

A.1 Birds

A.1.1 Waterfowl

Waterfowl comprise geese, swans, and ducks (family Anatidae), and are mostly gregarious birds that spend much of their time swimming (Kaufman 2001). Despite their shared traits, waterfowl species can exhibit great variability in size, appearance, habitat use, and behavior. More than 30 species of waterfowl occur annually in the marine waters of New York and New Jersey, and many of them may occasionally occur within the AoA. However, data indicate that only six diving duck species and one goose species (Brant) regularly occur within the AoA (Table A-1; USGS 2013; Balderama et al. 2015; Kinlan et al. 2016; eBird 2017).

Table A-1. Bird Species that Regularly Occur in the Area of Analysis[a]

Sources: Balderama et al. 2015; Brabant et al. 2015; Dierschke and Garthe 2006; eBird 2017; Furness et al. 2013; Halley and Hopshaug 2007; Johnston et al. 2014; Kinlan et al. 2016; Leopold et al. 2012; Lindeboom et al. 2011; National Audubon Society 2015, 2017; Normandeau 2017; Petersen et al. 2011; Robinson Willmott et al. 2013; USGS 2013; Vanerman et al. 2015.

Common Name	Scientific Name	Seasonal Occurrence[b]	Sensitivity[c]	
			Collision	Displacement
Waterfowl				
Brant	*Branta bernicla*	Winter, Spring, Fall	Low	Low
Common Eider	*Somateria mollissima*	Winter, Spring, Fall	Low to High	High
Surf Scoter	*Melanitta perspicillata*	Winter, Spring, Fall	High	High
White-winged Scoter	*Melanitta fusca*	Winter, Spring, Fall	Low to High	Medium to High
Black Scoter	*Melanitta americana*	Winter, Spring, Fall	Low to High	High
Long-tailed Duck	*Clangula hyemalis*	Winter, Spring, Fall	Low to High	Medium to High
Red-breasted Merganser	*Mergus serrator*	Winter, Spring, Fall	High	Medium
Loons				
Red-throated Loon	*Gavia stellata*	Winter, Spring, Fall	Low to High	High
Common Loon	*Gavia immer*	Winter, Spring, Fall	Low to High	High
Pelagic Birds				
Northern Fulmar	*Fulmarus glacialis*	Winter, Spring, Fall	Low to High	Low to High
Black-capped Petrel	*Pterodroma hasitata*	Summer	High	High
Cory's Shearwater	*Calonectris diomedea*	Summer, Fall	High	Medium
Great Shearwater	*Ardenna gravis*	Summer, Fall	High	Medium
Sooty Shearwater	*Ardenna grisea*	Spring, Summer	Low to High	Low
Manx Shearwater	*Puffinus*	Year-round	Low to High	Low to High
Audubon's Shearwater	*Puffinus lherminieri*	Summer	High	Medium
Wilson's Storm-Petrel	*Oceanites oceanicus*	Spring, Summer	High	Low
Leach's Storm-Petrel	*Oceanodroma leucorhoa*	Spring, Summer	Low to High	Low to Medium
Band-rumped Storm-Petrel	*Oceanodroma castro*	Summer	High	Medium
Northern Gannet	*Morus bassanus*	Winter, Spring, Fall	Low to High	Low to High
Pomarine Jaeger	*Stercorarius pomarinus*	Spring, Summer, Fall	High	Low
Parasitic Jaeger	*Stercorarius parasiticus*	Spring, Fall	High	Low
Long-tailed Jaeger	*Stercorarius longicaudus*	Spring, Fall	High	Low

Table notes are on the next page.

Table A-1 continued

Common Name	Scientific Name	Seasonal Occurrence[b]	Sensitivity[c]	
			Collision	Displacement
Cormorants				
Double-crested Cormorant	*Phalacrocorax auritus*	Year-round	High	Medium
Shorebirds				
Red-necked Phalarope	*Phalaropus lobatus*	Spring, Fall	High	Low
Red Phalarope	*Phalaropus fulicarius*	Spring, Fall	High	Medium
Alcids				
Dovekie	*Alle*	Winter, Spring, Fall	Medium	Medium
Common Murre	*Uria aalge*	Winter, Spring	High	High
Razorbill	*Alca torda*	Winter, Spring, Fall	Low to High	Medium to High
Atlantic Puffin	*Fratercula arctica*	Winter, Spring	Low to High	Medium to High
Gulls and Terns				
Black-legged Kittiwake	*Rissa tridactyla*	Winter, Spring, Fall	High	Low
Bonaparte's Gull	*Chroicocephalus philadelphia*	Winter, Spring, Fall	Low	Low
Laughing Gull	*Leucophaeus atricilla*	Spring, Summer, Fall	High	Medium
Ring-billed Gull	*Larus delawarensis*	Winter, Spring, Fall	Medium	Low
Herring Gull	*Larus argentatus*	Winter, Fall	High	Low to High
Iceland Gull	*Larus glaucoides*	Winter, Spring, Fall	High	High
Lesser Black-backed Gull	*Larus fuscus*	Winter, Spring, Fall	High	Low to High
Great Black-backed Gull	*Larus marinus*	Winter, Spring, Fall	High	Low to High
Common Tern	*Sterna hirundo*	Spring, Summer, Fall	Medium to High	Low to Medium

[a] Species most likely to occur annually, irrespective of abundance, based on available data.

[b] Seasons in which the species most commonly occurs. Does not indicate that individuals may not appear at other times of the year.

[c] Sensitivity of the species to collision/displacement impacts associated with wind energy development infrastructure, based on existing research. Scale: Low, Medium, or High. Some species received broad categorization of impact risk, based on uncertainty in the best available data.

The seven regularly occurring waterfowl species breed in northern latitudes and overwinter primarily in coastal waters (Kaufman 2001). They are present in the marine waters of New York and New Jersey year-round, but in summer months are limited to low numbers of non-breeding birds close to the shore and outside of the AoA (eBird 2017). All seven species prefer shallower nearshore waters during winter but venture into waters further offshore (i.e., the AoA), often to roost in flocks. The abovementioned species and their use of the AoA are discussed in more detail below.

A.1.1.1 Brant

Brant arrive in the coastal waters of New York and New Jersey for the winter in late October and early November, having mostly traveled nonstop from their fall staging area in James Bay, Canada (Kaufman 2001; Lewis et al. 2013; eBird 2017; National Audubon Society 2017). In March, Brant that spend the winter at points further south on the Atlantic Coast begin a northward movement to the Jamaica Bay area to stage (Lewis et al. 2013). Brant in coastal New York waters leave for their breeding grounds in northern Canada in late May (Levine 1998; Lewis et al. 2013). They are fast fliers that migrate in flocks that can number in the thousands at altitudes typically about 700 to 1,100 feet; however, they may fly at altitudes of several thousand feet (Kaufman 2001; Lewis et al. 2013).

During the winter, Brant prefer intertidal mudflats in shallow, protected marine waters and forage primarily on eelgrass, green algae, and salt marsh grasses (Kaufman 2001; Ladin 2010; Lewis et al. 2013). They will forage in other upland areas, as necessary (Lewis et al. 2013). Brant are gregarious during non-breeding seasons and form large flocks that may number in the thousands (Lewis et al. 2013). Brant may leave inshore areas to roost, especially during disturbances. They frequently take flight during disturbances and during the winter spend about 14 percent of their time flying (Ladin 2010).

Limited data are available regarding the abundance and distribution of Brant in the AoA. Most Brant occurrences in the marine waters of New York and New Jersey are in shallow nearshore waters outside of the AoA, but eBird (2017) records indicate that they regularly occur in smaller numbers in the extreme northwestern portion of the AoA, with a few additional records further offshore along the Hudson Shelf Valley. Within the AoA, data from the U.S. Geological Survey (USGS 2013) contained only one record of a flock of Brant, which was sighted approximately 22 miles offshore. Normandeau (2017) did not report any observations of Brant during surveys in fall 2016. Brant documented in the AoA are likely flocks of resting birds.

Offshore wind-energy impacts on Brant are not well studied; however, they may exhibit low sensitivity to potential impacts. Robinson Willmott et al. (2013) concluded that Brant have “lower” collision sensitivity, in fact, the lowest sensitivity of the species they evaluated for the Atlantic Outer Continental Shelf (OCS). They also found that Brant exhibit a “lower” sensitivity to displacement from offshore wind farms.

A.1.1.2 Common Eider

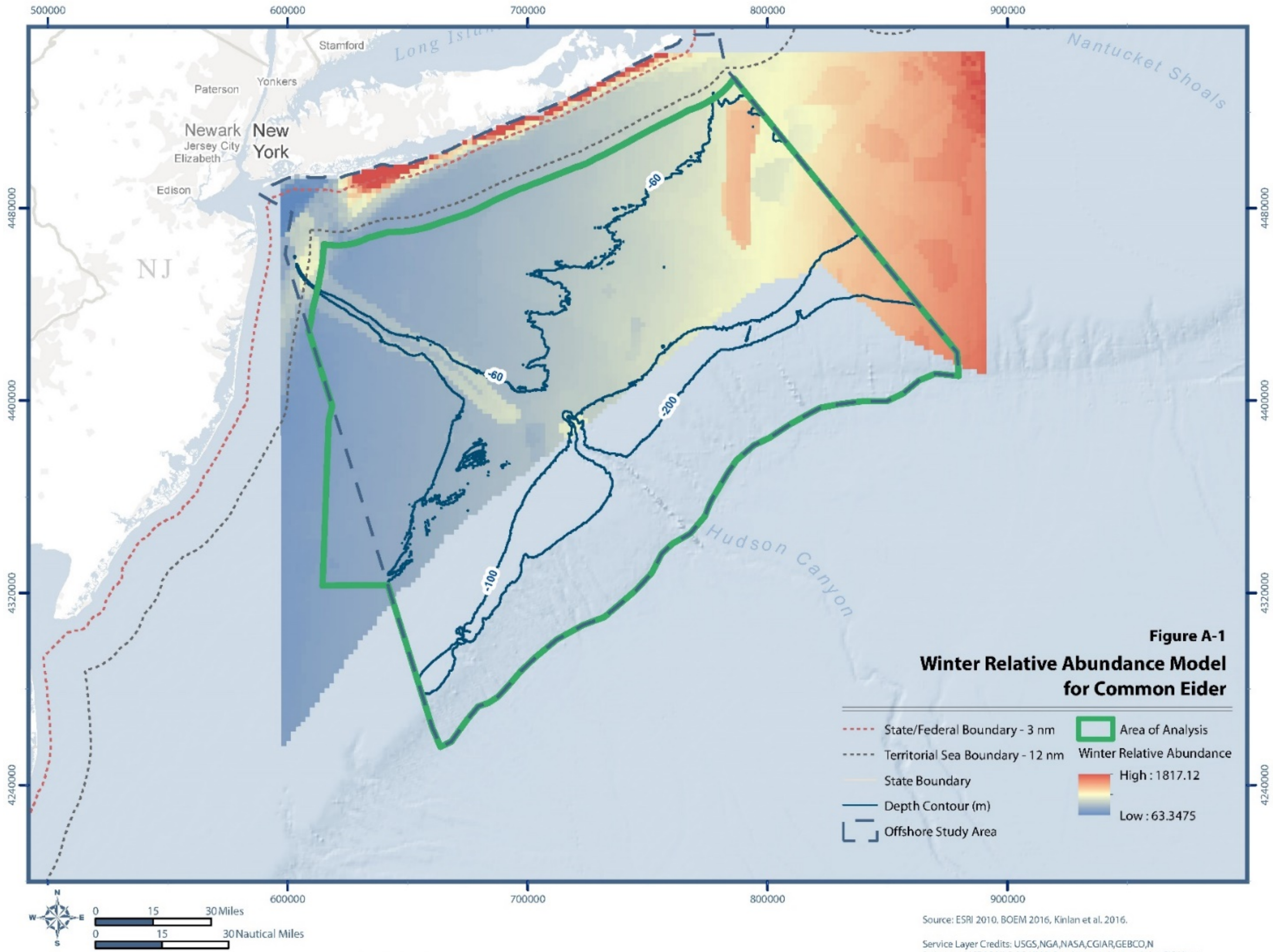
The marine waters of New York and New Jersey lie in the southern portion of the Common Eider non-breeding range (Goudie et al. 2000). Levine (1998) notes that Common Eiders are rare off Long Island from April to mid-November. eBird (2017) reports Common Eiders occur yearly in the AoA, exclusively between November and March. In the winter, Common Eiders are a common bird in the AoA and surrounding areas, with higher relative abundance in the AoA in the eastern portion and along the Hudson Shelf Valley (Kinlan et al. 2016; Figure A-1). Balderama et al. (2015) modeled relative occupancy of Common Eiders as higher within the northern portions of the AoA. Highest use is in nearshore areas outside of the AoA (Balderama et al. 2015; Kinlan et al. 2016).

Common Eiders prefer marine waters less than about 65 feet deep in coastal areas during the winter (Goudie et al. 2000), but they tend to stay very close to coastlines in all seasons (Kaufman 2001; National Audubon Society 2017; eBird 2017). They often form large flocks in non-breeding seasons, ranging from tens to tens of thousands (Guillemette et al. 1993; Goudie et al. 2000; Kaufman 2001). Common Eiders frequently dive for benthic invertebrates in shallow intertidal zones (Guillemette et al. 1993; Goudie et al. 2000), but flocks rest and preen more offshore in winter (Goudie et al. 2000).

Common Eiders migrate in compact flocks ranging from a few to thousands of birds. As they migrate along coastlines, they generally fly low to the water’s surface. In the spring, Common Eiders migrate north to their breeding grounds between March and mid-June. Fall migration occurs primarily during October and November, with most birds arriving in New York and New Jersey wintering areas from mid-November to early December (Levine 1998; Goudie et al. 2000).

Figure A-1. Winter Relative Abundance Model for Common Eider.

Source: ESRI 2010, BOEM 2016; Kinlan et al. 2016



Coordinate System: NAD_1983_UTM_Zone_18N Projection: Transverse_Mercator. (Map border grid is in meters UTM zone 18N

Path: M:\New York City\NYSERDA Offshore\Maps\MXD\Masterplan figures\7 Birds and Bats\FigureA-1 Winter Relative Abundance Model for Common Eider.mxd 10BP1/A.0034.01

Source: ESRI 2010. BOEM 2016, Kinlan et al. 2016.

Service Layer Credits: USGS,NGA,NASA,CGIAR,GEBCO,N Robinson,NCEAS,NLS,OS,NMA,Geodatastyrelsen and the GIS User Community

Larsen and Guillemette (2007) found that Common Eiders avoided flying near or within a wind farm in shallow offshore waters of Denmark, regardless of whether turbines were operating. They contend that this avoidance behavior may reduce available winter habitat for this species. Desholm and Kahlert (2005) observed similar results at another facility in Denmark, where less than 1 percent of Common Eiders flew close enough to turbines to be at risk of collision. Robinson Willmott et al. (2013) also determined that Common Eiders have a "higher" sensitivity for displacement from offshore wind development in the Atlantic Outer Continental Shelf, and Furness et al. (2013) similarly concluded that the species would have a moderate to high sensitivity for displacement relative to other species they studied in Scotland. In contrast to the studies above, Dierschke et al. (2016) reviewed behavioral data from 20 offshore wind farms in Europe and found that Common Eider behavior ranged from weak avoidance to weak attraction, but often exhibited no detectable displacement effects.

In contrast to the Denmark studies, which equated displacement to a low sensitivity to collision, Robinson Willmott et al. (2013) determined that Common Eiders also have a "higher" sensitivity to collisions with offshore wind turbines as well as a "higher" sensitivity for displacement. Conversely, Furness et al. (2013) concluded that Common Eiders would have a low to moderate sensitivity to collisions relative to other species they studied. Johnston et al. (2014) projected that about 26 percent of modeled Common Eider flights at potential offshore wind farm sites around Europe were at heights that put them at risk of collision. Overall, Garthe and Hüppop (2004) modeled seabird sensitivity to wind farms in the North Sea (Europe), and concluded that Common Eiders would have a relatively high sensitivity index value compared to other species they studied.

A.1.1.3 Surf Scoter

Surf Scoters winter in marine waters of New York and New Jersey (Levine 1998; Anderson et al. 2015). In winter, Surf Scoters prefer shallow waters less than 40 feet deep over sandy substrates and flatter slopes, and are often further from shore than Long-tailed Ducks or Common Eiders (Loring et al. 2013; Silverman et al. 2013; Anderson et al. 2015). They may occur up to several miles offshore (Kidwell 2007; Silverman et al. 2013; Anderson et al. 2015). Wintering birds move further offshore at night, where they spend less time feeding and more time sleeping (Lewis et al. 2005; Anderson et al. 2015). Surf Scoters form winter feeding flocks ranging from a few to thousands of individuals (Anderson et al. 2015).

The relative abundance and relative occurrence of Surf Scoters in the AoA is low (Balderama et al. 2015; Kinlan et al. 2016). eBird (2017) records of Surf Scoters within the AoA were documented between late October to early May but are more abundant from November through March. These observations are scattered in the northern and western portions of the AoA, but are largely concentrated along the Hudson Shelf Valley, particularly near the shore in the northwestern portion of the AoA. eBird reports the highest concentrations of Surf Scoter observations in the region outside the AoA along the coasts of New Jersey and Cape Cod.

During spring migration, Surf Scoters wintering along the Atlantic Coast travel north, up the coast to the Bay of Fundy before migrating inland to their summer breeding sites in northern Canada. They typically depart the marine waters of New York and New Jersey from March through mid-May. Fall migration routes occasionally lie offshore. In the fall, Surf Scoters start arriving at winter sites in New Jersey in late September, with winter population numbers peaking in mid- to late October (Anderson et al. 2015). In the fall of 2016, Normandeau (2017) reported 37 Surf Scoters generally in the northern portion of the AoA in shallower waters and outside of the AoA along the shoreline of Long Island. This species flies low over the water during normal activities, but migrating flocks may fly at great heights (Kaufman 2001; Anderson et al. 2015; National Audubon Society 2017). According to Balderama et al. (2015) and Kinlan et al. (2016), the relative abundance and relative occurrence of Surf Scoters in the AoA during spring and fall are low (Balderama et al. 2015; Kinlan et al. 2016).

Surf Scoters fly at low altitudes over water (i.e., at heights closer to turbine blades) and often further offshore at night, a period of low visibility (Lewis et al. 2005; Kidwell 2007; Silverman et al. 2013; Anderson et al. 2015). These behaviors indicate that Surf Scoters could be more sensitive to collisions with wind turbines. Robinson Willmott et al. (2013) determined that Surf Scoters would have a “higher” sensitivity to collision with offshore wind turbines in the Atlantic Outer Continental Shelf and indicated that Surf Scoters would have a “higher” sensitivity to displacement impacts.

A.1.1.4 White-winged Scoter

About 70 percent of the Atlantic White-winged Scoter population winters between Long Island and the Chesapeake Bay (Brown and Frederickson 1997; Sea Duck Joint Venture 2003). In winter, they prefer shallow, coastal waters over shellfish beds and sandy bottoms (Stott and Olson 1973; Sanger and Jones 1981; Brown and Frederickson 1997; Kaufman 2001). They are often found further from shore than Long-tailed Ducks or Common Eiders, but typically remain within 1 mile of shore at water depths less than about 65 feet, and more frequently less than 15 feet (Stott and Olson 1973; Brown and Frederickson 1997; Silverman et al. 2013). White-winged Scoters are gregarious in the non-breeding seasons and may form large flocks in winter, potentially numbering in the hundreds of thousands (Brown and Frederickson 1997).

According to Balderama et al. (2015) and Kinlan et al. (2016), relative abundance and relative occurrence of White-winged Scoters within the AoA are low. The Kinlan et al. (2016) model found that White-winged Scoters exhibited higher relative abundance in shallower nearshore waters outside of the AoA. eBird (2017) records of White-winged Scoters within the AoA occur from late October to early April, but are more abundant from December through March. These observations are scattered in the northern and western portions of the AoA, but are largely concentrated along the Hudson Shelf Valley, particularly near the shore in the northwestern portion of the AoA. Both Balderama et al. (2015) and Kinlan et al. (2016) indicated low relative abundance and relative occurrence for White-winged Scoters during the fall migratory season. However, White-winged Scoters had a higher relative abundance in the spring in the northwest corner of the AoA near the Hudson Shelf Valley (Kinlan et al. 2016).

White-winged Scoters generally leave their wintering areas along the Atlantic Coast for their breeding grounds in Canada and Alaska from March to mid-May (Brown and Frederickson 1997; Levine 1998). During fall migration from their breeding grounds, they begin to arrive at wintering areas in September and reach peak winter numbers by late November (Brown and Frederickson 1997). Minimal reported information exists regarding their migration routes, but they may travel by day or night when migrating over water and typically follow the shorelines when traveling along the coast (Brown and Frederickson 1997; Sea Duck Joint Venture 2003). White-winged Scoters migrate in flocks of up to 100 birds, usually low when over water, and may fly just above the water's surface during periods of high winds (Brown and Frederickson 1997; Kaufman 2001). When flying at higher altitudes, a flock may suddenly drop hundreds of feet (Kaufman 2001).

White-winged Scoter flight behavior over marine waters suggests that this species is sensitive to collisions with wind turbines. Indeed, Robinson Willmott et al. (2013) determined that White-winged Scoters would have a “higher” sensitivity to collision with offshore wind turbines on the Atlantic Outer Continental Shelf. Conversely, Furness et al. (2013) concluded that White-winged Scoters would have a low sensitivity to collisions with offshore wind turbines in Scotland. According to Robinson Willmott et al. (2013), the species would have a “higher” sensitivity to displacement from wind farms, while Furness et al. (2013) projected a moderate sensitivity to displacement impacts relative to other species they studied. Garthe and Hüppop (2004) modeled seabird sensitivity to wind farms in the North Sea (Europe), and concluded that, overall, White-winged Scoters would have a relatively high sensitivity index value compared with other species they studied.

A.1.1.5 Black Scoter

Black Scoters winter in the marine waters of New York and New Jersey (Levine 1998; Bordage and Savard 2011). In winter, Black Scoters prefer shallow marine waters over sandy bottoms (Stott and Olson 1973; Kaufman 2001; Bordage and Savard 2011; Loring et al. 2013; Silverman et al. 2013). Black Scoters are often further from shore than Long-tailed Ducks or Common Eiders, but they typically remain within 1 mile of shore over water depths less than about 30 feet (Stott and Olson 1973; Kaufman 2001; Bordage and Savard 2011; Silverman et al. 2013; Loring et al. 2014). They feed in flocks of varying sizes, but generally roost on water in large groups (Bordage and Savard 2011).

The relative abundance and occurrence of Black Scoters within the AoA were low in the winter (Balderama et al. 2015; Kinlan et al. 2016). eBird (2017) records of Black Scoters within the AoA fall between late October to mid-April, but are more abundant from December through March. These observations are scattered in the northern and western portions of the AoA, but are largely concentrated along the Hudson Shelf Valley, particularly nearer to the shore in the northwestern portion of the AoA. Higher concentrations of Black Scoters occur outside of the AoA in nearshore waters of New York and New Jersey.

Black Scoters begin their spring migration from the Atlantic Coast to breeding grounds in northern Canada in April (Sea Duck Joint Venture 2016). Atlantic winter populations returning from breeding grounds in the fall peak from late October to mid-November (Bordage and Savard 2011). During coastal portions of their spring and fall migrations, Black Scoter flocks typically fly low over the sea and well offshore (Kaufman 2001). During both spring and fall migrations, relative abundance and relative occurrence of Black Scoters are low within the AoA (Balderama et al. 2015; Kinlan et al. 2016). Areas of higher relative abundance and occurrence are generally in waters less than 200 feet (60 meters) deep, most notably in the nearshore waters outside of the AoA along the New Jersey coast.

Black Scoter flight behavior over marine waters suggests that this species could be sensitive to collisions with wind turbines. Indeed, Robinson Willmott et al. (2013) determined that the species would have a "higher" vulnerability to collision with offshore wind turbines in the Atlantic Outer Continental Shelf. However, Furness et al. (2013) concluded that Black Scoters in Scotland would have a low sensitivity to collisions relative to other species they studied. Johnston et al. (2014) also suggests low sensitivity, as they projected that about 0.1 percent of modeled Black Scoter flights at potential offshore wind farm sites around Europe were at heights that put them at risk of collision.

Lindeboom et al. (2011) and Leopold et al. (2012) found evidence that Black Scoters avoided flying in or near offshore wind farms in the Netherlands. Dierschke et al. (2016) reviewed behavioral data from 20 offshore wind farms in Europe and classified Black Scoters as weakly avoiding offshore wind farms. Robinson Willmott et al. (2013) and Furness et al. (2013) concluded that the species would have a higher sensitivity to displacement from wind farms relative other species they studied. Overall, Garthe and Hüppop (2004) modeled seabird sensitivity to wind farms in the North Sea (Europe), and determined that Black Scoters would have a moderately high sensitivity index value compared to other species they studied.

A.1.1.6 Long-tailed Duck

Long-tailed Ducks winter in the marine waters of New York and New Jersey and usually occur between mid-October and early May (Levine 1998; Robertson and Savard 2002). They prefer shallow, coastal waters in winter, but often fly up to several miles offshore to roost in large flocks at night (Jones 1979; Mudge and Allen 1980; Kaufman 2001; Robertson and Savard 2002). During the day, Long-tailed Ducks usually forage in small flocks closer to shore, where they dive for benthic invertebrates and other prey (Robertson and Savard 2002). During winter, Long-tailed Ducks are concentrated in nearshore waters of New York and New Jersey, outside of the AoA (Balderama et al. 2015; Kinlan et al. 2016). The relative abundance and relative occurrence of Long-tailed Ducks within the AoA during winter, as modeled by Balderama et al. (2015) and Kinlan et al. (2016) are low. eBird (2017) records of Long-tailed Ducks within the AoA coincide with the winter period (late October to early April) and are largely concentrated along the Hudson Shelf Valley, particularly nearer to the shore in the northwestern portion of the AoA.

Long-tailed Ducks begin their spring migration to breeding sites in northern Canada in late March or early April. Birds begin to return to wintering sites on the Atlantic Coast in October, with numbers peaking in late November and December (Robertson and Savard 2002; eBird 2017). During both spring and fall, the relative abundance and relative occurrence of Long-tailed Ducks are low within the AoA (Balderama et al. 2015; Kinlan et al. 2016). They typically migrate in small flocks, but flocks also may number in the hundreds. Long-tailed Ducks usually migrate close to shore during the daytime, but may travel further offshore as well (Richardson and Johnson 1981; Kaufman 2001; Robertson and Savard 2002). When traveling over water at any time of the year, they typically fly low above the surface (Kaufman 2001; Robertson and Savard 2002).

Long-tailed Ducks fly at low altitudes over water (i.e., at heights closer to turbine blades) and often to offshore roost areas in the twilight or dark hours (Jones 1979; Mudge and Allen 1980; Kaufman 2001; Robertson and Savard 2002; Allison et al. 2009). Long-tailed Ducks also need to run across water to take flight (Robertson and Savard 2002). These flight behaviors indicate that Long-tailed Ducks could be more sensitive to collisions with wind turbines. Likewise, Robinson Willmott et al. (2013) suggest that the species has a "higher" sensitivity to collision with offshore wind turbines. However, Furness et al. (2013) determined that Long-tailed Ducks would have a relatively low sensitivity to offshore wind turbine collisions in Scotland compared to other species they studied.

Petersen et al. (2011) found that Long-tailed Duck densities were significantly lower within an offshore wind farm in Denmark after construction compared to pre-construction, suggesting they avoid wind farms, indirectly resulting in habitat displacement. Robinson Willmott et al. (2013) also indicated that Long-tailed Ducks have a "higher" sensitivity to displacement from wind farms in the Atlantic Outer Continental Shelf. Furness et al. (2013) determined that Long-tailed Ducks would have moderate sensitivity to displacement impacts associated with offshore wind farms in Scotland compared to other species they studied. Dierschke et al. (2016) reviewed behavioral data from 20 offshore wind farms in Europe and classified Long-tailed Ducks as weakly avoiding offshore wind farms, which showed significant declines at some sites but no effect at others.

A.1.1.7 Red-breasted Merganser

Red-breasted Mergansers winter in the marine waters of New York from October to April (Levine 1998). They prefer sheltered marine waters in winter, often diving for fish in shallow, nearshore waters up to 30 feet deep. Red-breasted Mergansers are gregarious year-round and occur singly or in flocks in marine waters during the winter (Craik et al. 2015). eBird (2017) records within the AoA peak from December through February, and the AoA is absent of records from early May through late October. Scattered Red-breasted Merganser occurrences were reported along the northern and eastern portions of the AoA from November to April, but observations are primarily concentrated along the Hudson Shelf Valley, particularly nearer to the shore in the northwestern portion of the AoA.

Red-breasted Mergansers begin to migrate from their wintering sites to northern breeding grounds in March, and the migration intensifies in April. They begin fall migration to wintering sites in September, and winter numbers begin to peak along the mid-Atlantic Coast in early November (Craik et al. 2015). Red-breasted Mergansers usually migrate in pairs or flocks of five to 15 birds flying in V-formations or lines (Kaufman 2001; Craik et al. 2015). They often migrate along coasts during the day, but will travel at night if going overland (Craik et al. 2015). The USGS (2013) reports only three Red-breasted Mergansers in or near to the AoA, each during migratory periods: One Red-breasted Merganser was recorded in April near the Hudson Shelf Valley in waters approximately 150 feet deep, and two birds were recorded in November near the southern boundary of the AoA in waters approximately 6,600 feet deep.

Red-breasted Mergansers have shown evidence of avoiding offshore wind farms in Europe, although the avoidance behavior was not as strong as seen in some other seabird species (Dierschke and Garthe 2006). Avoiding offshore wind farms indirectly results in habitat displacement. Robinson Willmott et al. (2013) determined that the species would have a “medium” sensitivity to displacement by offshore wind farms on the Atlantic Outer Continental Shelf. In contrast to the studies above, Dierschke et al. (2016) reviewed behavioral data from 20 offshore wind farms in Europe and classified Red-breasted Mergansers as weakly attracted to offshore wind farms. Robinson Willmott et al. (2013) also concluded that Red-breasted Mergansers would have a “higher” vulnerability to collisions with offshore wind turbines.

A.1.2 Loons

The loon family (Gaviidae) comprises five species of waterbirds that forage chiefly for fish by diving from the water’s surface and swimming underwater. They will take other prey opportunistically. Loons nest around lakes in high northern latitudes and spend the winters primarily in coastal northern temperate waters (Kaufman 2001). Two species of loons, Red-throated Loon (*Gavia stellata*) and Common Loon (*Gavia immer*), regularly occur in the AoA during the winter and spring/fall migration periods (Table A-1; eBird 2017). Pacific Loons (*Gavia pacifica*) occasionally occur in the New York Bight area, but records are limited to nearshore waters, outside of the AoA (eBird 2017). Red-throated and Common Loons and their use of the AoA are discussed in more detail below.

Grebes (Family Podicipedidae) are often associated with loons (Kaufman 2001). For this reason, this family was addressed within the loon species group. Grebes rarely occur within the AoA, but several species do regularly inhabit nearshore waters along New York and New Jersey, particularly in the winter and during migrations. The three most commonly occurring species are the Pied-billed Grebe (*Podilymbus podiceps*), Horned Grebe (*Podiceps auritus*), and Red-necked Grebe (*Podiceps grisegena*; eBird 2017). This study does not address grebes further because they do not regularly occur in the AoA.

A.1.2.1 Red-throated Loon

Red-throated Loons are present in the marine waters of New York and New Jersey year-round but are most abundant from November through April (eBird 2017). They arrive in the area for the winter in late October and November (Barr et al. 2000; eBird 2017). During the winter, they loaf and forage singly or in small, loosely aggregated groups, often occurring in shallower marine waters than other loon species (Barr et al. 2000; Kaufman 2001; National Audubon Society 2017). The Kinlan et al. (2016) model shows that both the relative abundance and relative occurrence of Red-throated Loons in winter are highest in nearshore waters, generally less than 200 feet (60 meters) deep. Most eBird (2017) winter records (November through February) of Red-throated Loons occur in nearshore waters. When Red-throated Loons do occur within the AoA, eBird records are largely concentrated along the Hudson Shelf Valley, especially the northern portions of the canyon closer to shore.

The spring migration of adult Red-throated Loons peaks in March and April along the Atlantic Coast (Barr et al. 2000), and by May, Red-throated Loons are largely gone from the AoA (eBird 2017). Sub-adult Red-throated Loons remain in New York and New Jersey marine waters during the summer, but summer abundances are much lower than during non-breeding seasons, and these birds are limited to nearshore waters outside of the AoA along New Jersey and Long Island (Barr et al. 2000; eBird 2017). Barr et al. (2000) noted that during migration, Red-throated Loon are typically recorded up to 2 miles offshore, but they also occur throughout the continental shelf. Fall represents the season in which Red-throated Loons are most widely distributed across the AoA; however, relative abundance remains low (Kinlan et al. 2016). Generally, during migration, eBird (2017) records of Red-throated Loons in the AoA are less common than during winter and are more concentrated in the farthest northwestern portion of the AoA.

During migration, Red-throated Loons fly singly or in small flocks at low altitudes (16 to 230 feet) over coastal waters of the Atlantic Ocean. They usually need a running start of 15 to 130 feet to take off from water (Barr et al. 2000; Kaufman 2001; National Audubon Society 2017). These flight behaviors indicate that Red-throated Loons could be more sensitive to collisions with wind turbines. Likewise, Robinson Willmott et al. (2013) suggest that the species has a “higher” sensitivity to collision with offshore wind turbines. However, Halley and Hopshaug (2007) did not observe any Red-throated Loon mortalities at a wind farm in Norway, but they implied that the species likely avoided the site. Furthermore, Furness et al. (2013) determined that Red-throated Loons would have a low to moderate sensitivity to collisions with offshore wind turbines in Scotland compared to other species they studied. Johnston et al. (2014) projected that about 1 percent of modeled Red-throated Loon flights at potential offshore wind farm sites around Europe were at heights that would make them sensitive to collision.

Halley and Hopshaug (2007) suggest that Red-throated Loons may avoid areas that they previously used prior to the construction of wind farms, which would indirectly result in habitat displacement. Three additional studies support their results. In Scotland, Furness et al. (2013) identified Red-throated Loons as being among the seabirds most sensitive to population-level impacts of displacement at offshore wind farms in Scotland. Dierschke et al. (2016) reviewed behavioral data from 20 offshore wind farms in Europe and determined that Red-throated Loons strongly avoided offshore wind farms. In addition, Robinson Willmott et al. (2013) found that Red-throated Loons would be sensitive to displacement on the Atlantic OCS of the United States.

Data examining the potential impacts of displacement on Red-throated Loons are absent; therefore, it is difficult to draw conclusions. Dierschke et al. (2017) indicated that the species would likely be able to find alternative foraging sites after being displaced and are not likely to suffer reduced prey intake from increased competition or interference at suitable sites. Conversely, Red-throated Loons tend to be relatively faithful to winter sites and show strong stress responses. Additional research into the activity and energetic budgets of Red-throated Loons is needed to draw conclusions about the potential effects of displacement. (Dierschke et al. 2017)

While there are mixed results regarding the Red-throated Loon’s collision sensitivity with offshore wind farms, existing research consistently describes displacement as a key impact on the species. Overall, Garthe and Hüppop (2004) concluded that Red-throated Loons would have a high sensitivity to wind farm impacts compared to other modeled seabird species in the North Sea (Europe).

A.1.2.2 Common Loon

Common Loons occur in the AoA year-round, but they are most common between November and April (eBird 2017). In general, Common Loons most often use shallower, nearshore waters outside of the AoA (Balderama et al. 2015; Kinlan et al. 2016; eBird 2017). Within the AoA, eBird (2017) records are more concentrated along the Hudson Shelf Valley, particularly in the northwestern portion of the AoA nearer to shore.

In winter, Common Loons are usually solitary, but they may forage in groups or rest at night in large groups (Evers et al. 2010). Kinlan et al. (2016) found that the relative abundance and relative occurrence of Common Loons in winter are highest in nearshore waters, generally in waters less than 200 feet (60 meters) deep, with peak wintering areas in waters less than about 65 feet deep. Similarly, Balderama et al. (2015) found relative occurrence is higher in the northern portion of the AoA, with highest relative occurrences in nearshore waters off Long Island rather than New Jersey. Common Loon winter occurrence is highest in waters less than 200 feet (60 meters) deep and largely outside of the AoA. Predicted annual abundance mapped by Menza et al. (2012) was also highest in nearshore waters and along the Hudson Shelf Valley. eBird (2017) records are consistent with Kinlan et al. (2016), Balderama et al. (2015), and Menza et al. (2012) in that most occurrences are in nearshore waters outside of the AoA. While uncommon outside of nearshore areas, Common Loons may occur more than 60 miles offshore, but most records occur along the Hudson Shelf Valley in the northwest portion of the AoA (Haney 1990; Evers et al. 2010; eBird 2017).

Spring migration takes place from March through June, but Common Loons begin moving in large numbers in mid-April. During spring, Common Loon relative abundance is highest within shallower waters in the western portion of the AoA, which corresponds to an area of higher activity off the coast of New Jersey (Kinlan et al. 2016). Common Loons are not abundant in the AoA in the summer (Kinlan et al. 2016). Those that are present in the summer are primarily non-breeding birds, specifically individuals one or two years of age. Based on the Balderama et al. (2015) and Kinlan et al. (2016) models, the nearest concentrations of summering Common Loons are in nearshore waters off Long Island, largely outside of the AoA.

Fall migration for Common Loons begins in September, and most birds have arrived at wintering grounds by late November. Common Loons appear to travel non-stop from their breeding areas in the interior northeastern United States to the Atlantic Ocean. If their initial overland migration does not take them directly to their wintering area, they complete their trip by traveling along the coast or offshore waters (Evers et al. 2010). For example, one satellite-tracked Common Loon that bred in the Adirondacks of New York stopped briefly off the southern coast of Long Island before continuing to its wintering area off the New Jersey coast near Atlantic City (Kenow et al. 2009; Evers et al. 2010).

Common Loons are diurnal migrants that fly over open water at altitudes typically ranging from several feet to about 330 feet (100 meters). This species does not generally fly in flocks. As with other loon species, Common Loons require a long take-off, up to about 650 feet, to take flight from water. They initiate flight more often in windy weather, as it reduces the distance necessary for take-off (Evers et al. 2010). These flight behaviors indicate that Common Loons could be sensitive to collisions with wind turbines, which is consistent with the results of Robinson Willmott et al. (2013). However, Furness et al. (2013) determined that Common Loons would have a low to moderate sensitivity to collisions with offshore turbines compared to other birds they studied. Robinson Willmott et al. (2013) also found that Common Loons on the Atlantic Outer Continental Shelf, like Red-throated Loons, would be sensitive to displacement impacts. Their conclusions on displacement impacts are consistent with the research evaluating loon species at European offshore wind farms (Halley and Hopshaug 2007; Furness et al. 2013).

A.1.3 Pelagic Birds

In this study, the term "pelagic birds" refers to seabirds that spend most of their lives at sea, coming to land only to raise young (Kaufman 2001). Pelagic birds are strong fliers and spend a great deal of time flying at sea. Many pelagic bird species undergo long-distance migrations. More specifically, "pelagic birds" refers to the 14 species (Table A-1) that regularly occur within the AoA and belong to the following four families: Procellariidae (shearwaters and petrels), Hydrobatidae (storm-petrels), Sulidae (gannets and boobies), and Stercorariidae (jaegers and skuas). Each regularly occurring pelagic bird species and their use of the AoA is discussed below.

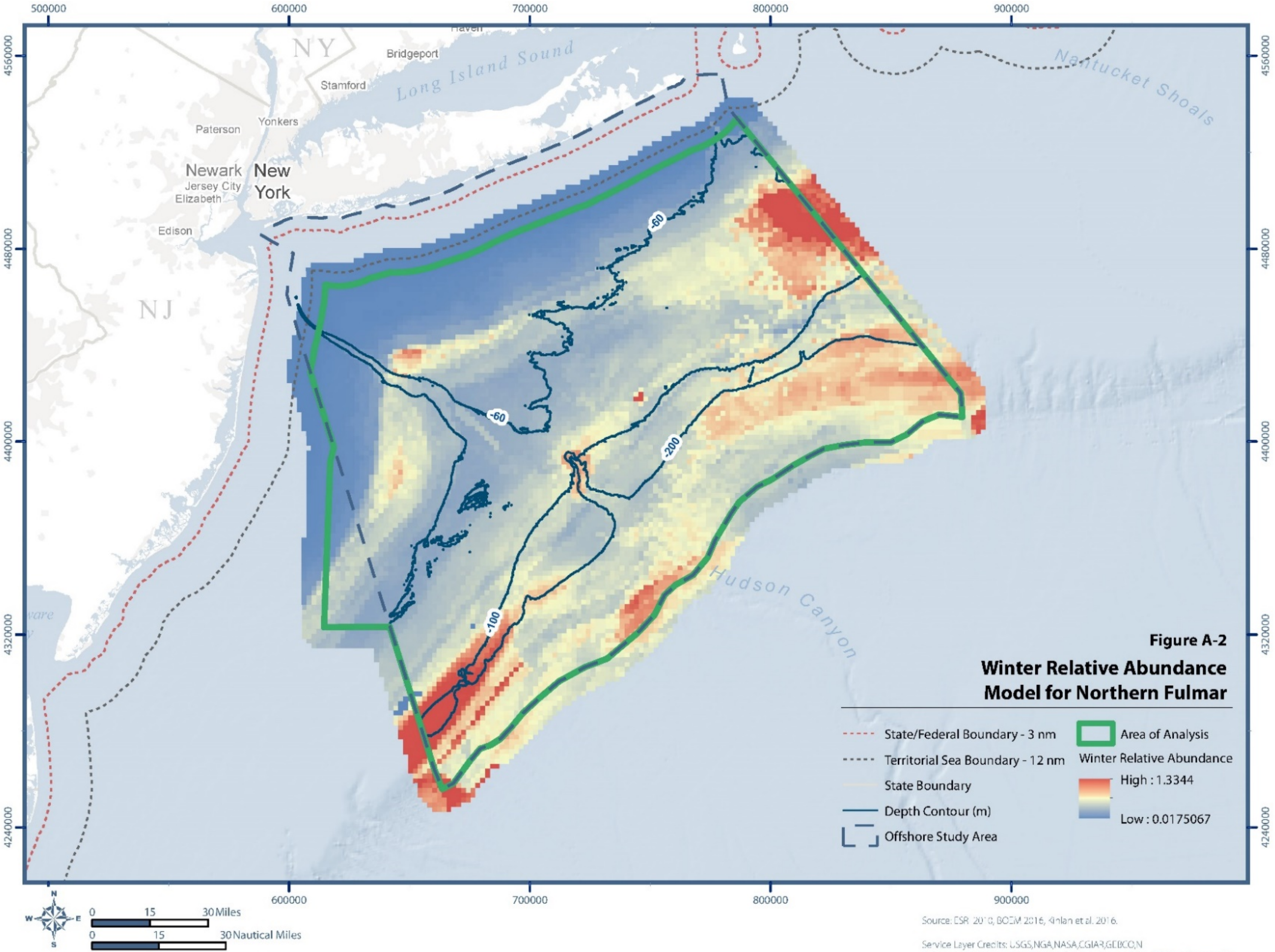
A.1.3.1 Northern Fulmar

Northern Fulmars breed in Arctic and Subarctic latitudes, and disperse into pelagic waters after the breeding season is completed in September and October (Mallory et al. 2008, 2012). Some may disperse south during migration, but winter movements are generally erratic (Mallory et al. 2008). Northern Fulmars remain tens to hundreds of miles offshore during migration and winter (Mallory et al. 2008, 2012). They prefer deep, cold water and often show a preference for continental shelf breaks and upwellings (Kaufman 2001; Mallory et al. 2008, 2012). Northern Fulmars are capable of traveling hundreds of miles per day, but more commonly travel between 20 and 110 miles per day (Mallory et al. 2008). When flying over the ocean, they rarely rise above the wave crests (Mallory et al. 2012).

The AoA lies within the southern portion of the Northern Fulmar's winter range, and numbers here are highly variable from year to year (Kaufman 2001; Mallory et al. 2012; eBird 2017). They primarily occur in the AoA from October to May, but they are occasionally recorded from June through September. The Menza et al. (2012) annual predicted abundance was highest in deep waters within the eastern and southern portions of the AoA. Kinlan et al.'s (2016) winter model of Northern Fulmar similarly showed relative abundance in the AoA as highest near the eastern and southwestern boundaries, and generally in waters deeper than 200 feet (60 meters; Figure A-2). Modeled relative occurrence data show a slightly different trend, in that winter occurrence was concentrated in the central and eastern portions of the AoA, particularly in waters deeper than 200 feet (60 meters; Balderama et al. 2015; Kinlan et al. 2016). eBird (2017) records of Northern Fulmars are scattered throughout the AoA, exhibiting no apparent trends in distribution or density.

Figure A-2. Winter Relative Abundance Model for Northern Fulmar.

Source: CSR 2010; BOEM 2016; Kinlan et al. 2016



Source: CSR 2010, BOEM 2016, Kinlan et al. 2016.

Service Layer Credits: USGS,NGA,NASA,CGIAR,GEBCO,N Robinson,NCEAS,NLS,OS,NMA,Geodatastyrelsen and the GIS User Community

Coordinate System: NAD_1983_UTM_Zone_18N. Projection: Transverse_Mercator. (Map border grid is in meters UTM zone 18N

Path: M:\New_York_City\NYSERDA_Offshore\Maps\MXD\Masterplan_figures\7_Birds_and_Bats\FigureA-2 Winter Relative Abundance Model for Northern Fulmar.mxd 10BP17A.0034.01

During the spring and fall migratory periods, Kinlan et al. (2016) modeled Northern Fulmar relative abundance and relative occurrence in the AoA as low. However, Balderama et al.'s (2015) spring and fall models showed continued higher relative occurrence within the central and eastern portions of the AoA. Normandeau (2017) recorded three Northern Fulmar in fall 2016, all of which were in waters greater than 200 feet (60 meters) deep.

Northern Fulmars are omnivorous, feeding during day or night on fish, squid, zooplankton, offal, and carrion. They feed at or near the surface while swimming, and may dive for short durations at limited depths (Kaufman 2001; Mallory et al. 2012). Birds wintering in southern parts of their range (e.g., the AoA) may consume more fisheries offal than birds that winter further to the north (Phillips et al. 1999; Mallory et al. 2012). This species is gregarious at sea in areas of concentrated food sources (Mallory et al. 2012).

The Northern Fulmar's low-flying flight behavior and gregariousness while feeding of suggests that flocks of birds may be vulnerable to collisions with offshore wind turbines. Robinson Willmott et al. (2013) support this suggestion in determining that Northern Fulmars would have a “higher” sensitivity to turbine collisions compared to other species they studied in the Atlantic Outer Continental Shelf. However, Furness et al. (2013) concluded that Northern Fulmars would have low sensitivity to collision impacts associated with offshore wind energy in Scotland relative to other study species. Johnston et al. (2014) support the work of Furness et al. (2013) in concluding that about 0.2 percent of modeled Northern Fulmar flights at potential offshore wind farm sites around Europe were at heights that make them sensitive to collision.

Robinson Willmott et al. (2013) determined that Northern Fulmars would have a “medium” sensitivity to displacement impacts associated with potential offshore wind farms. Vanerman et al. (2015) suggested that Northern Fulmars avoided an offshore wind energy facility in Belgium, and Furness et al. (2013) concluded that Northern Fulmars would have low sensitivities to displacement impacts relative to other species they studied. Dierschke et al. (2016) reviewed behavioral data from 20 offshore wind farms in Europe and classified Northern Fulmars as weakly avoiding offshore wind farms. Furthermore, Masden et al. (2010) determined that breeding Northern Fulmars would incur lower energetic costs by flying additional distances to avoid wind farms than other seabirds they studied due to the species' efficient gliding flight behavior. This may also apply to non-breeding birds. Overall, Garthe and Hüppop (2004) modeled seabird sensitivity to wind farms in the North Sea (Europe), and Northern Fulmars had the lowest ranked sensitivity index values of the species they analyzed.

A.1.3.2 Black-capped Petrel

Black-capped Petrels breed in the West Indies from mid-October until spring. They regularly occur in the Gulf Stream, well offshore of the southeastern United States, which appears to be their primary non-breeding area (Kaufman 2001; Farnsworth 2010; BirdLife International 2017a; National Audubon Society 2017). Black-capped Petrels prefer warmer waters and typically occur further north only during the warmer summer months (Kaufman 2001; National Audubon Society 2017).

eBird (2017) records appear rare, but regular, along the continental shelf break of the AoA from July through early September. eBird also contains several records of Black-capped Petrels from Montauk Point. Kinlan et al. (2016) included portions of the AoA in their spring and summer models. In both seasons, relative abundance and relative occurrence is very low. The highest relative use is to the south of the AoA in waters 600 feet and deeper. Normandeau (2017) observed 13 Black-capped Petrels in their summer 2016 survey. They observed Black-capped Petrels along the southern boundary of the AoA in waters deeper than 6,000 feet and in the northern portion of the AoA in waters approximately 200 feet (60 meters) deep near Montauk Point.

Black-capped Petrels feed on fish, squid, and crustaceans, often in small, loose, intra-species flocks (Kaufman 2001; Farnsworth 2010; BirdLife International 2017a; National Audubon Society 2017). They forage in flight by dipping to the surface of the water, or by sitting briefly on the water with their wings held upward (Kaufman 2001; National Audubon Society 2017). Black-capped Petrels are nocturnal and crepuscular foragers, as these are periods when some prey items are closer to the surface (Kaufman 2001; Farnsworth 2010; BirdLife International 2017a; National Audubon Society 2017).

Black-capped Petrel foraging behavior puts them at low flight altitudes (i.e., at heights closer to turbine blades) and suggests that they would be sensitive to collisions with wind turbines, particularly at night and during crepuscular periods (Kaufman 2001; Farnsworth 2010; BirdLife International 2017a; National Audubon Society 2017). Robinson Willmott et al. (2013) support this suggestion in determining that Black-capped Petrels would have a “higher” sensitivity to turbine collisions associated with potential offshore wind farms compared to other species they studied. Robinson Willmott et al. also determined that this species would have a “higher” sensitivity to displacement impacts.

A.1.3.3 Cory's Shearwater

Cory's Shearwaters are regular visitors to waters off the East Coast of North America during the late spring, summer, and fall, with numbers peaking from June to November (Kaufman 2001; National Audubon Society 2017). eBird (2017) reports regular records of Cory's Shearwater throughout the AoA from May to October, and occasionally as late as November and early December. This species appears to be observed both from shore and offshore (Kaufman 2001; eBird 2017).

Balderama et al. (2015) and Kinlan et al. (2016) modeled use of the AoA by Cory's Shearwater in spring, summer, and fall. In the spring, the relative abundance and relative occurrence of Cory's Shearwater in the AoA was low (Balderama et al. 2015; Kinlan et al. 2016). In the summer, Kinlan et al. (2016) models identified the areas of higher relative abundance and relative occurrence in the eastern portion of the AoA, an area that corresponds with water depths of around 600 feet. The Balderama et al. (2015) model shows summer relative occurrence is higher throughout the entire southern half of the AoA, in areas that correspond with deeper waters. The Menza et al. (2012) annual predicted abundance model for Cory's Shearwater largely agreed with the results of Kinlan et al. (2016) and Balderama et al. (2015); however, they noted some uncertainties in their model. They noted that Cory's Shearwaters are attracted to fishing vessels, which may impact trends in their distribution. Normandeau (2017) recorded Cory's Shearwater throughout the AoA in the summer of 2016, but the records appear to cluster in the northern portion of the AoA.

Kinlan et al. (2016) modeled Cory's Shearwater use throughout the AoA in the fall as low, but with some relatively higher values in the eastern portion of the AoA. Balderama et al.'s (2015) fall relative occurrence models indicated higher values in deeper waters of the eastern portion of the AoA. The Normandeau (2017) records for Cory's Shearwater from the fall 2016 surveys also were concentrated in the eastern portion of the AoA.

Cory's Shearwaters breed on islands in the Mediterranean Sea and eastern Atlantic from March to October and spend most of the winter at sites off the coasts of Africa and South America (Kaufman 2001; González-Solís et al. 2007; National Audubon Society 2017). Their breeding and wintering habits indicate that individuals documented off North America are immature and non-breeding birds. Cory's Shearwaters occur over the continental shelf and seaward of the shelf, often in search of food. They forage mainly at night by plunging into the water from just above the surface (Kaufman 2001; National Audubon Society 2017). Squid are a large component of their diet, but they also eat fish, crustaceans, and offal (Kaufman 2001; BirdLife International 2017b; National Audubon Society 2017).

Research addressing potential impacts of wind farms on Cory’s Shearwaters is limited. Their foraging behavior puts them at low flight altitudes (i.e., at heights closer to turbine blades) and suggests that they would be vulnerable to collisions with wind turbines, particularly at night (Kaufman 2001; National Audubon Society 2017). Robinson Willmott et al. (2013) support this suggestion in determining that Cory’s Shearwaters would have a “higher” sensitivity to turbine collisions associated with potential offshore wind farms on the Atlantic OCS compared to other study species. In addition, Robinson Willmott et al. (2013) determined that this species would have a “medium” sensitivity to displacement impacts.

A.1.3.4 Great Shearwater

Great Shearwaters breed on islands in the South Atlantic from September to April, at which time they migrate rapidly to the north, mostly to areas in the western Atlantic Ocean. They are common off the Atlantic coast of North America by June and migrate back to their breeding sites in August, although non-breeding birds remain until at least November. Great Shearwaters seldom occur close to shore, except during storms, and they tend to avoid nearshore and mid-ocean areas. (Kaufman 2001; National Audubon Society 2017)

In the AoA, Great Shearwaters are present from late May to mid-December (eBird 2017). According to eBird (2017), occurrences are most frequent in areas along the Hudson Shelf Valley, particularly portions further offshore; along the continental shelf break; and nearer to shore off eastern Long Island. The Menza et al. (2012) annual predicted abundance for Great Shearwater was low within the AoA, with higher abundance values in the central portion of the AoA.

Winter and spring models of Great Shearwaters show low relative abundance and relative occurrence within the AoA (Kinlan et al. 2016). By the summer, Great Shearwaters have higher mean counts of birds and a higher probability of occurrence; however, relative abundance and occurrence in the AoA remained low. Kinlan et al. (2016) modeled summer relative occurrence as higher in the eastern portion of the AoA, particularly in waters 150 feet deep and deeper. In the fall, relative abundance and relative occurrence were similar to the summer model.

Like the Kinlan et al. (2016) model, Balderama et al. (2015) modeled the relative occurrence of Great Shearwaters in the AoA as lowest in the winter. Conversely, the Balderama et al. (2015) models displayed an area of higher relative occurrence in the central and southern portions of the AoA during all other seasons. Normandeau (2017) collected 70 records of Great Shearwaters in the fall of 2016, which were generally concentrated in the northeastern portion of the AoA and at water depths of approximately 150 feet.

Great Shearwaters primarily eat fish and squid but also feed on crustaceans and offal. They commonly feed near fishing boats. Great Shearwaters forage by plunging from the air, diving underwater from the water's surface, or seizing items at the water's surface. They often forage in large flocks during the day and sometimes at night (Kaufman 2001; National Audubon Society 2017).

The flocking and foraging behavior of Great Shearwaters suggest that they would be sensitive to collisions with wind turbines, particularly at night (Kaufman 2001; National Audubon Society 2017). Robinson Willmott et al. (2013) support this suggestion in determining that Great Shearwaters would have a "higher" sensitivity to turbine collisions associated with potential offshore wind farms relative to other species they studied. In addition, Robinson Willmott et al. (2013) determined that this species would have a "medium" sensitivity to displacement impacts.

A.1.3.5 Sooty Shearwater

Sooty Shearwaters nest on islands around Australia, New Zealand, and southern South America from September to May. Adults rapidly migrate in April and May to the northern Pacific and Atlantic Oceans. They are widespread at sea but are most concentrated at upwellings, where cold and warm water masses meet, and over the continental shelf. Sooty Shearwaters may come closer to shore where waters are deep (Kaufman 2001; National Audubon Society 2017).

Sooty Shearwaters occur throughout the AoA from May through August, but according to eBird (2017), occurrences are most frequent along the OCS and shelf break. Occasional records exist throughout the fall, and these are likely non-breeding birds (eBird 2017). In the spring, Sooty Shearwater relative use is highest in the eastern portion of the AoA in waters 200 to 660 feet (60 to 200 meters) deep (Kinlan et al. 2016; Menza et al. 2012). The Balderama et al. (2015) spring relative occurrence model showed higher occurrence in water depths greater than 200 feet (60 meters) throughout the AoA, not just the eastern portion. Higher use in the Balderama et al. (2015) and Kinlan et al. (2016) models appears to correspond with the shelf breaks, similar to the eBird (2017) data.

In the summer, the relative use of the AoA by Sooty Shearwaters decreases (Balderama et al. 2015; Kinlan et al. 2016). Normandeau (2017) recorded two Sooty Shearwaters in the summer of 2016, both of which were in nearshore waters outside of the AoA. In the fall, both the Balderama et al. (2015) and Kinlan et al. (2016) models predict very low relative use, similar to the winter.

Sooty Shearwaters are gregarious at sea and fly low over the ocean. They often occur in flocks of hundreds or thousands, flying in long lines or roosting in rafts on the water. Sooty Shearwaters often forage for fish or crustaceans by plunging into the water from a few feet above the surface, but will also dive from the surface and swim after prey or seize items at surface while sitting on the water (Kaufman 2001; National Audubon Society 2017).

The gregariousness, flight behavior, and plunging style of foraging of Sooty Shearwaters suggest that they would be sensitive to collisions with wind turbines (Kaufman 2001; National Audubon Society 2017). Robinson Willmott et al. (2013) support this suggestion in determining that Sooty Shearwaters would have a “higher” sensitivity to turbine collisions associated with potential offshore wind farms compared to other study species. However, Furness et al. (2013) estimated that Sooty Shearwaters would have a low risk of collisions compared to other species they studied with offshore wind turbines in Scotland. Robinson Willmott et al. (2013) and Furness et al. (2013) both determined that this species would have a low sensitivity to displacement impacts.

A.1.3.6 Manx Shearwater

Manx Shearwaters breed in Europe and Newfoundland and winter primarily off the Atlantic coast of South America (Lee and Haney 1996). The presence of these birds off the Atlantic coast of North America throughout the winter and, in lesser numbers, the summer, makes it difficult to discern the exact timing of migration (Lee 1995; Lee and Haney 1996). In general, Manx Shearwaters migrate past eastern North America from January to March (Lee and Haney 1996). Fall migration is weaker off the coast of eastern North America and typically begins in October and peaks in December. Some non-breeding birds remain off the northern Mid-Atlantic States during spring and summer (Lee 1995; Lee and Haney 1996). Manx Shearwater migration through North American waters is diurnal and typically occurs far out at sea over the continental shelf and shelf breaks. There is little evidence of mass migrations through United States waters, as most Manx Shearwater records are single birds (Lee and Haney 1996).

eBird (2017) reports Manx Shearwaters in low numbers throughout the AoA from May through December, with very few additional records from January to April. The areas where occurrences of

Manx Shearwaters are most frequent in the AoA are along the OCS and shelf break, in the southeastern portion of the AoA. Kinlan et al. (2016) modeled relative use and relative occurrence of Manx Shearwater in the AoA and found that they are very low during the spring, with the Shearweaters typically occurring in offshore waters outside of the AoA (200 nautical miles offshore and greater). In the summer models, relative abundance and relative occurrence are low, but there are pockets of relatively higher use in the AoA, especially in the eastern portion at depths greater than 200 feet (60 meters). Fall relative abundance and relative occurrence are generally low, but higher than in the summer. The fall model also contains variable areas of higher use, particularly in waters 660 feet (200 meters) and greater. Normandeau (2017) did not record Manx Shearwaters in the AoA.

Manx Shearwaters forage primarily on fish but also eat squid, crustaceans, and offal. They mostly forage by plunging from 3 to 7 feet above the water's surface, but they may also dive underwater or seize prey while alighted on the water (Lee and Haney 1996; Kaufman 2001; National Audubon Society 2017). They forage during the day singly or in small groups. Their flight is low over water, but they will make sudden ascents to more than 65 feet above the water's surface in high winds. Manx Shearwaters also change direction often during flight (Lee and Haney 1996).

The Manx Shearwater's flight behavior and plunging style of foraging suggest that they would be sensitive to collisions with wind turbines (Lee and Haney 1996; Kaufman 2001; National Audubon Society 2017). Robinson Willmott et al. (2013) support this suggestion in determining that Manx Shearwaters would have a "higher" sensitivity to turbine collisions associated with potential offshore wind farms. Johnston et al. (2014) stands in contrast to the work of Robinson Willmott et al. (2013) in determining that none of their modeled Manx Shearwater flights at potential offshore wind farm sites around Europe are at heights that make them sensitive to collision. Robinson Willmott et al. (2013) also determined that this species would have a "higher" sensitivity to displacement impacts. On the other hand, Furness et al. (2013) concluded that Manx Shearwaters would have a low sensitivity to collision and displacement impacts associated with offshore wind turbines in Scotland compared to other species they studied. Similarly, Dierschke et al. (2016) reviewed behavioral data from 20 offshore wind farms in Europe and, based on limited data, classified Manx Shearwaters as weakly avoiding offshore wind farms.

A.1.3.7 Audubon's Shearwater

Audubon's Shearwaters nest on islands in warm waters, mostly in the tropics. They are widespread in the Atlantic, Pacific, and Indian Oceans (Kaufman 2001; National Audubon Society 2017). In general, very little is known about their movements (BirdLife International 2017c). Birds nesting in the Caribbean move north along the Gulf Stream in the late summer and fall. In North America, Audubon's Shearwaters occur regularly in the warm waters off the southeastern United States. The northernmost records of this species often coincide with warm summer months (Kaufman 2001; National Audubon Society 2017). Audubon's Shearwaters are very seldom found near land when away from breeding colonies. They forage solitarily or in small groups during the day or night and eat fish and squid, which they acquire by diving or by seizing prey while sitting on the water (Kaufman 2001; BirdLife International 2017c; National Audubon Society 2017).

Based on Kinlan et al.'s (2016) models, the relative abundance and relative occurrence of Audubon's Shearwater in the AoA are extremely low, or absent in the winter and spring. In the summer, the relative abundance and relative occurrence increase compared to the winter and spring, but remain low. Relative use in the summer increases with water depth, with the highest use outside the AoA at approximately 200 miles offshore. eBird (2017) records of Audubon's Shearwaters in the AoA are rare, but regular, and mostly occur further offshore around the Outer Continental Shelf and shelf break. The majority of eBird records within the AoA are from June through September, with August and September representing the peak activity. Normandeau (2017) observed eight Audubon's Shearwater in the summer of 2016, which were in deeper waters approximately 100 miles offshore and possibly correlated with the Hudson Shelf Valley. Relative use of the AoA in the fall is low, with increasing use approximately 150 miles offshore (Kinlan et al. 2016). Normandeau (2017) observed four Audubon's Shearwater in the fall, which, contrary to the Kinlan et al. (2016) model, were in nearshore waters in the western portion of the AoA.

Research addressing potential impacts of wind farms on Audubon's Shearwaters is limited. Robinson Willmott et al. (2013) determined that Audubon's Shearwaters would have a "higher" sensitivity to turbine collisions associated with potential offshore wind farms relative to other species they studied. Robinson Willmott et al. (2013) also determined that this species would have a "medium" sensitivity to displacement impacts.

A.1.3.8 Wilson's Storm-Petrel

Wilson's Storm-Petrels nest on islands and cliffs in the Antarctic region and southern South America from November to May. They move north from March to May, traveling as far north as the Arctic, and are common off eastern North America during the summer. Wilson's Storm-Petrels often are the most common seabird off the Atlantic coast of the United States. In North America, they mostly occur over continental shelfs, and they may concentrate over upwellings or areas where warm and cold waters meet. They are seldom close to land outside of the breeding season (Kaufman 2001; National Audubon Society 2017).

The annual relative abundance of Wilson's Storm-Petrels in the AoA appears to be correlated with the continental shelf break at water depths of 660 feet (200 meters; Figure A-3; Kinlan et al. 2016; Menza et al. 2012). In the spring, the area of highest modeled relative abundance and relative occurrence within the AoA, according to Kinlan et al. (2016), is approximately 90 miles offshore at water depths of 660 feet (200 meters). The Balderama et al. (2015) model is consistent with Kinlan et al. (2016) but also shows areas of relatively higher occurrence in the southern and eastern portions of the AoA.

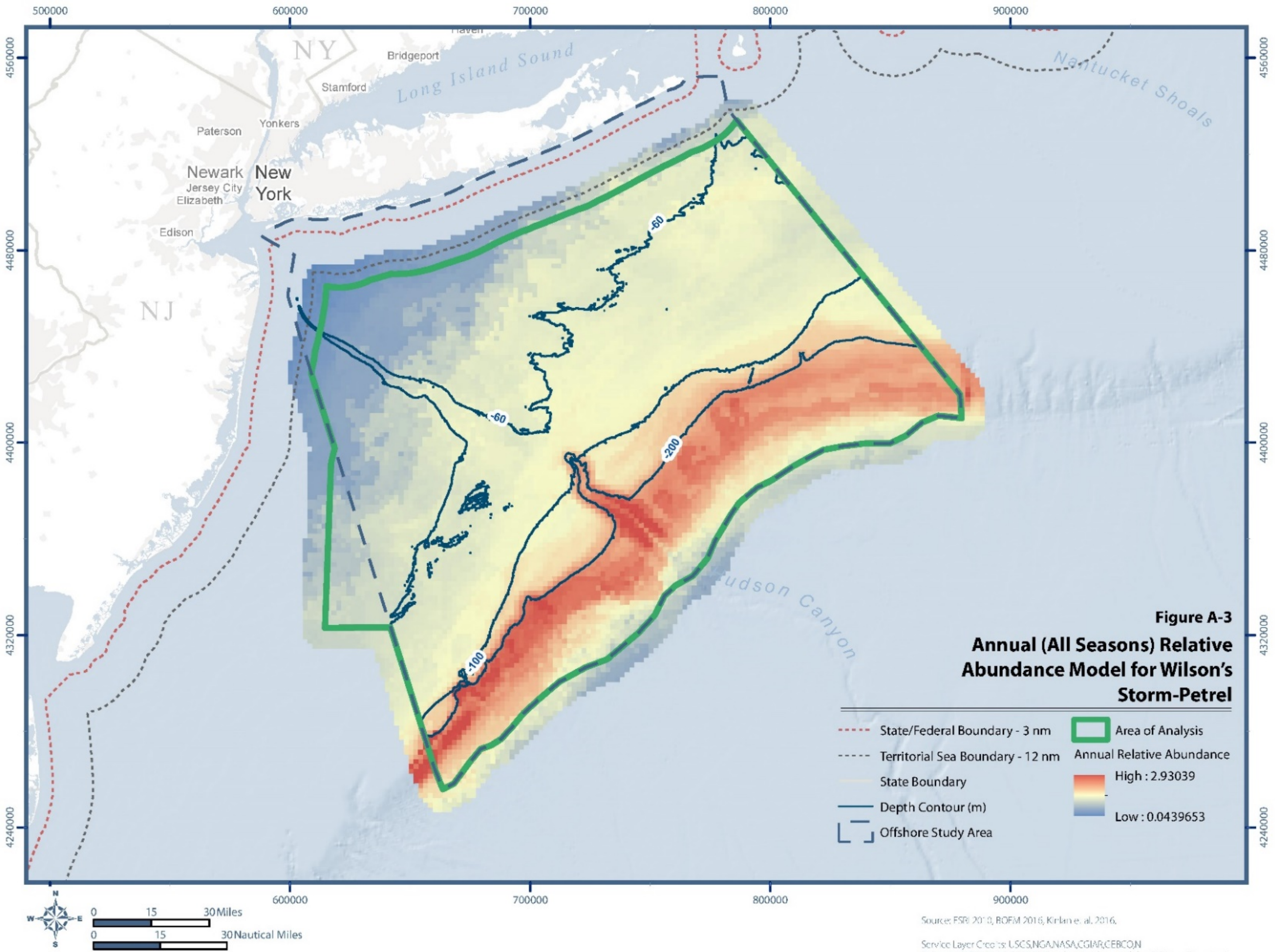
In the summer, relative abundance and relative occurrence are higher throughout the AoA, peaking around the 660-foot isobath (Kinlan et al. 2016). The Balderama et al. (2015) summer model also shows higher relative occurrence than in the spring, but with a similar pattern of higher occurrence in the southern and eastern portions of the AoA. Normandeau (2017) documented 791 Wilson's Storm-Petrels during the summer survey. Their observations occurred throughout the AoA, with apparent concentrations along the Hudson Shelf Valley and along the northern and eastern portions of the AoA.

In the fall, relative abundance and occurrence decrease, but trends of higher use around the 660-foot isobath continue (Kinlan et al. 2016; Balderama et al. 2015). Normandeau (2017) documented one Wilson's Storm-Petrel in the fall of 2016, approximately 70 miles offshore in the eastern portion of the AoA. eBird (2017) records for Wilson's Storm-Petrels occur throughout the AoA, but the areas with the greatest frequencies of occurrence are along the Hudson Shelf Valley. Like the Kinlan et al. (2016) models, eBird (2017) had greater frequencies of occurrence in offshore areas along the continental shelf break and nearer to shore off eastern Long Island. These eBird records are primarily from late April through September, with few records in October and early November.

Wilson's Storm-Petrels feed mainly on crustaceans and fish, foraging at the water's surface by hovering and picking at the surface with their bills. They may also drop into water briefly or seize items while swimming (Kaufman 2001; National Audubon Society 2017). Wilson's Storm-Petrels may form large rafts on the water, and their flight is fairly low over the water (Drucker 2013).

Figure A-3. Annual (All Seasons) Relative Abundance Model for Wilson's Storm-Petrel.

Source: ESRI 2010; BOEM 2016; Kinlan et al. 2016



Coordinate System: NAD_1983_UTM_Zone_18N. Projection: Transverse_Mercator. (Map border grid is in meters UTM zone 18N)

Path: M:\New_York_City\NYSERDA_Offshore\Maps\MXD\Masterplan_figures\7_Birds_and_Bats\FigureA 3 Annual (All Seasons) Relative Abundance Model for Wilson's Storm Petrel.mxd 10BP17A.0034.01

Source: ESRI 2010, BOEM 2016, Kinlan et. al. 2016.

Service Layer Credits: USGS,NGA,NASA,CGIAR,GEBCO,N Robinson,NCEAS,NLS,OS,NMA,Geodatastyrelsen and the GIS User Community

The flight behavior of Wilson's Storm-Petrels put them at altitudes closer to turbine blades and suggests that they would be sensitive to collisions with wind turbines (Drucker 2013). Hull et al. (2013) reported one collision-related mortality of this species over nearly 13,000 turbine visits at two coastal, land-based wind farms in Tasmania, Australia. Robinson Willmott et al. (2013) determined that Wilson's Storm-Petrels would have a "higher" sensitivity to turbine collisions associated with potential offshore wind farms relative to other species they studied. However, Robinson Willmott et al. (2013) determined that this species would have a "lower" sensitivity to displacement impacts.

A.1.3.9 Leach's Storm-Petrel

Leach's Storm-Petrels nest on islands in northern latitudes and may also nest off Massachusetts, which is more than 200 miles south of the next closest nesting area (Huntington et al. 1996; Mass Audubon 2017). They winter in tropical Atlantic waters, mostly off Africa and Brazil (Huntington et al. 1996; Pollet et al. 2014). Leach's Storm-Petrels are also widespread in temperate waters throughout the winter. Some birds, likely non-breeders, remain on wintering grounds or in the mid-ocean through breeding season. In migration, they are found where suitable food occurs between breeding and wintering areas and often concentrate at upwellings, continental shelf breaks, and where cold and warm waters meet, but also far out to sea (Huntington et al. 1996; Kaufman 2001; National Audubon Society 2017). Leach's Storm-Petrels rarely come near land outside the breeding season (BirdLife International 2017d).

In the spring, summer, and fall, the relative abundance and relative occurrence of Leach's Storm-Petrels is very low throughout the AoA, according to Kinlan et al. (2016). The Balderama et al. (2015) model, while also showing relatively low occurrence nearshore, showed higher relative occurrence during the spring, summer, and fall in areas of the AoA further offshore. eBird (2017) records similarly show low but regular numbers of Leach's Storm-Petrels in the AoA from late April through September. The area of greatest frequency of occurrence, according to eBird, is along the continental shelf break. Normandeau (2017) did not detect any Leach's Storm-Petrels in the AoA during their summer and fall surveys in 2016.

Leach's Storm-Petrels forage by hovering at the water's surface and pecking at prey, which include fish, crustaceans, squid, and other invertebrates. They seldom forage while sitting on water, but presumably sleep on the water. They forage singly or in small flocks by day or at night (Huntington et al. 1996; Kaufman 2001; National Audubon Society 2017).

The foraging behavior of Leach's Storm-Petrels suggests that they would be sensitive to collisions with wind turbines (Huntington et al. 1996; Kaufman 2001; National Audubon Society 2017). Robinson

Willmott et al. (2013) support this suggestion in determining that Leach's Storm-Petrels would have a "higher" sensitivity to turbine collisions associated with potential offshore wind farms. Conversely, Furness et al. (2013) concludes that this species would have a relatively low sensitivity to collision with offshore wind turbines in Scotland relative to other species they studied. Furness et al. (2013) also concludes that Leach's Storm-Petrels would have a low sensitivity to displacement impacts associated with offshore wind farms, while Robinson Willmott et al. (2013) determined that this species would have a "medium" sensitivity to displacement impacts.

A.1.3.10 Band-rumped Storm-Petrel

In the Atlantic Ocean, Band-rumped Storm-Petrels nest on islands off southern Europe and Africa. Their movements outside of the breeding season are not well studied (Slotterback 2002). They are visitors off the east coast of North America, primarily from April to September, with fewer records northward. Band-rumped Storm-Petrels prefer warm, deep waters (3,000 feet and greater) and do not approach land unless blown there by storms (Lee 1984; Haney 1985; Slotterback 2002). They may concentrate at upwellings (Haney 1985; Slotterback 2002).

In the summer, relative abundance and relative occurrence of Band-rumped Storm-Petrels in the AoA is very low according to the Kinlan et al. (2016) models. Their relative use increases along the continental shelf break at water depths of 660 feet (200 meters). eBird (2017) records of Band-rumped Storm-Petrels in the AoA also occur in low numbers and are concentrated along the continental shelf break from July through September. Normandeau (2017) did not detect any Band-rumped Storm-Petrels in the AoA during their summer and fall surveys in 2016.

Band-rumped Storm-Petrels eat fish and squid that they catch by hovering just above the water's surface and seizing prey with their bills. They forage day or night, singly or in small groups, although they may occur in larger flocks in areas of high food concentration (Lee 1984; Haney 1985; Slotterback 2002). Band-rumped Storm-Petrels frequently fly 3 to 10 feet above the water's surface (Lee 1984).

The foraging and flight behaviors of Band-rumped Storm-Petrels put them at altitudes between the water surface and turbine blades and suggest that they would be sensitive to collisions with wind turbines (Lee 1984; Haney 1985; Slotterback 2002). Robinson Willmott et al. (2013) support this suggestion in determining that Band-rumped Storm-Petrels would have a "higher" sensitivity to turbine collisions associated with potential offshore wind farms relative to other species they studied. Robinson Willmott et al. (2013) also determined that this species would have a "medium" sensitivity to displacement impacts.

A.1.3.11 Northern Gannet

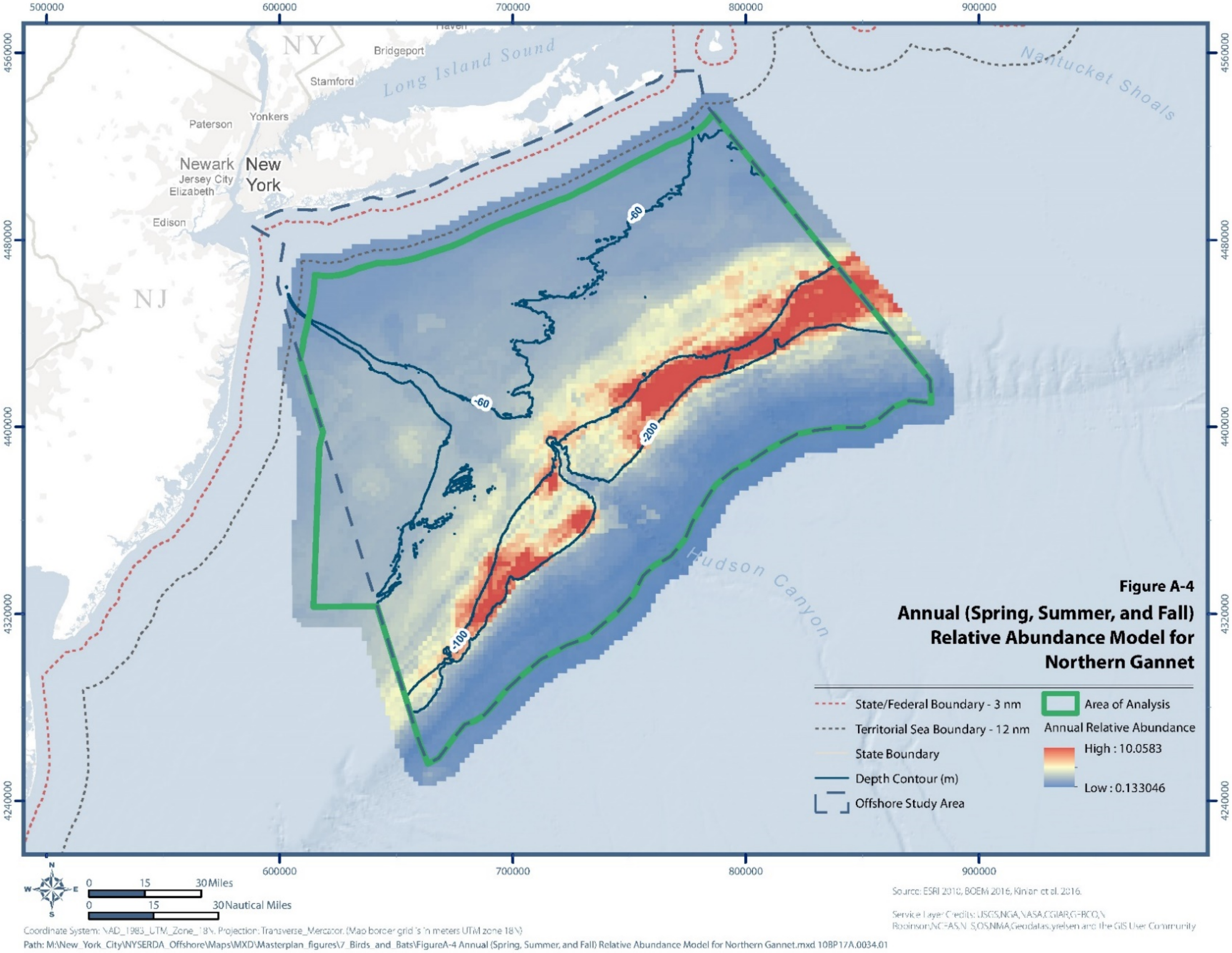
Northern Gannets breed on cliffs and islands in northern Canada and Europe from March through November (Mowbray 2002). They winter at sea where they prefer cold waters overlying the continental shelf (Kaufman 2001; Mowbray 2002; National Audubon Society 2017). Northern Gannets depart breeding sites to points south between late September and November, and begin the return migration to their breeding grounds from February to April. They migrate largely over the waters of the continental shelf and shelf break, coming toward land only in pursuit of fish or during inclement weather. They infrequently travel greater than 125 miles from land. Immature Northern Gannets remain at sea year-round during their first three years (Mowbray 2002).

Annually, Northern Gannets are a relatively abundant species in the AoA, especially in the region of the continental shelf break (Figure A-4; Kinlan et al. 2016). In the winter, modeled relative abundance and relative occurrence of Northern Gannets in the AoA is high, particularly in waters less than 660 feet (200 meters) deep and around the Hudson Shelf Valley. In the spring, modeled relative abundance and relative occurrence in the AoA remains high, with areas of highest use near the continental shelf in water 660 feet (200 meters) deep. The summer represents the lowest relative use in the AoA (Kinlan et al. 2016). Normandeau's (2017) data support the Kinlan et al. (2016) summer model, as they did not observe Northern Gannet in the AoA during the summer of 2016. In the fall, Kinlan et al.'s (2016) relative abundance and occurrence is similar to the spring models; however, fall use is relatively higher in nearshore waters along the coasts of New Jersey and Long Island. Normandeau (2017) collected 2,953 observations of Northern Gannet throughout the AoA in the fall of 2016.

Balderama et al.'s (2015) models exhibit trends of relative occurrence similar to those of Kinlan et al. (2016) in each season. However, their models show the highest relative occurrence in the AoA is near the Hudson Shelf Valley, at water depths of 200 feet (60 meters) and near the Long Island coast, which is not evident in the Kinlan et al. (2016) models. eBird (2017) data generally support the Kinlan et al. (2016) models, in that Northern Gannet records occur throughout the AoA, except in the waters furthest from shore. However, the eBird (2017) records indicate that the area of greatest frequency of occurrence is along the Hudson Shelf Valley, particularly in the northwestern corner of the AoA. According to eBird (2017), Northern Gannets are present in the AoA year-round but occur in the lowest numbers during June and July. The Menza et al. (2012) study also mapped Northern Gannet as one of the most abundant and widespread species within the AoA, but noted this species is attracted to fishing vessels, which may impact trends.

Figure A-4. Annual (Spring, Summer, and Fall) Relative Abundance Model for Northern Gannet.

Source: ESRI 2010; BOEM 2016; Kinlan et al. 2016



Northern Gannets may fly low over the waves or up to great altitudes (Mowbray 2002). They plunge dive for schooling fish from altitudes generally ranging from 30 to 130 feet. This species feeds diurnally and may be solitary or occur in small, loose flocks, but they sometimes forage in large flocks of up to 1,000 birds around concentrated food sources. Northern Gannets may sometimes fish while swimming with their heads submerged and will steal food from other birds (Kaufman 2001; Mowbray 2002; National Audubon Society 2017).

The Northern Gannet's flight behavior and plunging style of foraging suggest that they would be sensitive to collisions with wind turbines (Kaufman 2001; Mowbray 2002; National Audubon Society 2017). Robinson Willmott et al. (2013) support this suggestion in determining that Northern Gannets would have a "higher" sensitivity to turbine collisions associated with potential offshore wind farms. Furness et al. (2013) also determined that Northern Gannets would have a high vulnerability to offshore wind turbine collisions in Scotland compared to other study species. However, Brabant et al. (2015) concluded that Northern Gannets would incur a relatively low number of collision mortalities in the North Sea (Europe). Johnston et al. (2014) concluded that about 7 percent of modeled Northern Gannet flights at potential offshore wind farm sites around Europe were at heights that make them sensitive to collision.

Robinson Willmott et al. (2013) determined that Northern Gannets would have a "higher" sensitivity to displacement impacts. Vanerman et al. (2015) found that Northern Gannets avoided an offshore wind energy facility in Belgium. Dierschke et al. (2016) reviewed behavioral data from 20 offshore wind farms in Europe and determined that Northern Gannets strongly avoid offshore wind farms. Conversely, Furness et al. (2013) determined that this species would have a low sensitivity to displacement impacts. Masden et al. (2010) concluded that breeding Northern Gannets would incur lower energetic costs by flying additional distances to avoid wind farms than other seabirds they studied due to the species' efficient gliding flight behavior. This may also apply to non-breeding birds. Finally, Garthe and Hüppop (2004) modeled seabird sensitivity to wind farms in the North Sea and concluded that Northern Gannets would have a moderately high sensitivity index value compared to other study species.

A.1.3.12 Pomarine Jaeger

Pomarine Jaegers breed on the Arctic tundra and winter at sea in tropical and subtropical waters (Wiley and Lee 2000). They migrate over all zones of the continental shelf, but are less common in shallower waters and sometimes occur in the mid-ocean (Rowlett 1980; Wiley and Lee 2000; Kaufman 2001; National Audubon Society 2017). Pomarine Jaegers are most numerous off the coast of the northeastern

United States in late April and May and in October (Rowlett 1980; Wiley and Lee 2000). Most migrants travel far from shore, alone or in small groups during the day (Wiley and Lee 2000). They often fly 30 feet or more above the water's surface and may settle on the water during periods of high wind or low visibility (Davenport 1975; Wiley and Lee 2000).

eBird (2017) records of Pomarine Jaegers are regular in low numbers in the AoA from May to December, with an apparent peak in observations in August and September. The outer continental shelf is the area of greatest frequency of occurrence. Kinlan et al.'s (2016) model results indicated low relative abundance and relative occurrence of Pomarine Jaeger in the AoA in spring and summer. Relative abundance and relative occurrence of Pomarine Jaegers is highest in the AoA during the fall, particularly at water depths of 660 feet (200 meters; Kinlan et al. 2016; Menza et al. 2012). Normandeau (2017) recorded one Pomarine Jaeger in the fall, which was approximately 90 miles offshore in the southern portion of the AoA.

Pomarine Jaegers alight on the water or dip to the water's surface from the air to catch fish or eat scraps from ships. They also take smaller birds in flight or steal food from other birds (Wiley and Lee 2000; Kaufman 2001; National Audubon Society 2017). Pomarine Jaegers concentrate over upwellings and the boundaries of currents while foraging (Kaufman 2001; National Audubon Society 2017). After feeding, they may gather in groups to rest on the sea surface, often mixing with other seabirds (Wiley and Lee 2000).

The flight and foraging behavior of Pomarine Jaegers suggest that they would be sensitive to collisions with wind turbines (Davenport 1975; Wiley and Lee 2000; Kaufman 2001; National Audubon Society 2017). Conversely, if they do suspend flight during periods of high winds or low visibility, then that risk would be reduced (Davenport 1975; Wiley and Lee 2000). Robinson Willmott et al. (2013) determined that Pomarine Jaegers would have a "higher" sensitivity to turbine collisions associated with potential offshore wind farms compared to other birds they studied. However, Robinson Willmott et al. (2013) determined that this species would have a "lower" sensitivity to displacement impacts.

A.1.3.13 Parasitic Jaeger

Parasitic Jaegers breed in Arctic and Subarctic tundra and winter at sea in tropical and Southern temperate oceans (Wiley and Lee 1999; Kaufman 2001; National Audubon Society 2017). During spring migration, Parasitic Jaegers pass through the North Atlantic in May. In the fall, they migrate through the North Atlantic between late August and November (Wiley and Lee 1999). Parasitic Jaegers typically migrate within a few miles of land, but they may also occur far out to sea or over land (Wiley and Lee 1999; Kaufman 2001; National Audubon Society 2017). They fly close to the water's surface in headwinds; otherwise, they fly about 15 to 30 feet above the surface (Wiley and Lee 1999). Non-breeding birds remain at sea year-round (Kaufman 2001; National Audubon Society 2017).

eBird (2017) observers documented most Parasitic Jaegers from the coasts of Long Island and New Jersey. Within the AoA, records are scattered and in low numbers from late April to early December; however, no October records exist. The numbers of observations peak in May and September. USGS (2013) records of Parasitic Jaeger are consistent with eBird (2017) in that they are scattered throughout the AoA with no apparent trend and occur primarily during the spring and fall. Normandeau (2017) did not record any Parasitic Jaegers during their 2016 summer and fall surveys.

Parasitic Jaegers primarily obtain food at sea by harassing other seabirds and stealing fish from them. They may also take smaller birds in flight, dip down to the water's surface to catch fish, or eat scraps from ships (Wiley and Lee 1999; Kaufman 2001; National Audubon Society 2017). They typically forage singly or in small groups (Wiley and Lee 1999).

The flight and foraging behavior of Parasitic Jaegers suggest that they would be sensitive to collisions with wind turbines (Wiley and Lee 1999; Kaufman 2001; National Audubon Society 2017). Robinson Willmott et al. (2013) determined that Parasitic Jaegers would have a "higher" sensitivity to turbine collisions associated with potential offshore wind farms compared to other species they studied. However, Robinson Willmott et al. (2013) determined that this species would have a "lower" sensitivity to displacement impacts.

A.1.3.14 Long-tailed Jaeger

Long-tailed Jaegers breed on the Arctic tundra and winter in southern temperate oceans. They typically migrate well offshore, often beyond the continental shelf (Wiley and Lee 1998; Kaufman 2001; National Audubon Society 2017). Long-tailed Jaegers fly in flocks as high as about 800 feet above the water's surface in calm weather, but typically fly at altitudes between 25 and 65 feet (Wiley and Lee 1998). This species is seldom within sight of land during non-breeding seasons, but migrants are occasionally observed near the coasts, mostly as single birds (Wiley and Lee 1998; Kaufman 2001; National Audubon Society 2017). Long-tailed Jaegers travel by day or night (Sittler et al. 2011).

eBird (2017) records of Long-tailed Jaegers within the AoA are rare but regular during May, August, and September. A few records exist for June and July as well. USGS (2013) reported one record of a Long-tailed Jaeger within the AoA in the summer near the Hudson Shelf Valley, approximately 100 miles offshore. Normandeau (2017) did not record any Long-tailed Jaegers during their 2016 summer and fall surveys.

At sea, Long-tailed Jaegers feed on fish, invertebrates, and offal from the surface of the water by hovering and dipping or by swimming. They also hunt smaller birds in flight and steal food from other seabirds (Wiley and Lee 1998; Kaufman 2001; National Audubon Society 2017). As many as 100 birds may congregate to forage around fishing vessels (Wiley and Lee 1998).

The flight and foraging behavior of Long-tailed Jaegers suggest that they would be sensitive to collisions with wind turbines (Wiley and Lee 1998; Kaufman 2001; National Audubon Society 2017). Robinson Willmott et al. (2013) determined that Long-tailed Jaegers would have a "higher" sensitivity to turbine collisions associated with potential offshore wind farms compared to other species they studied. However, Robinson Willmott et al. (2013) determined that this species would have a "lower" sensitivity to displacement impacts.

A.1.4 Cormorants

Cormorants (family Phalacrocoracidae) are social diving birds that pursue fish and other prey underwater. Their feathers waterlog while foraging, so they must dry them out between feedings. As such, cormorants spend little time in water outside of feeding (Kaufman 2001). Two cormorant species regularly occur in marine waters of New York and New Jersey; however, only the Double-crested Cormorant regularly occurs within the AoA (Table A-1). Great Cormorants occur within the AoA irregularly during the winter, and more often inhabit coastal areas and nearshore waters (Kaufman 2001; eBird 2017). Double-crested Cormorants and their use of the AoA are discussed below.

A.1.4.1 Double-crested Cormorant

Double-crested cormorants are abundant year-round along coastal New York and New Jersey (eBird 2017). They nest onshore or on islands and are highly migratory; therefore, many of the local breeding birds may move south for the winter, while breeders from other regions may move through and/or winter in the area (Kaufman 2001; Dorr et al. 2014; eBird 2017). During migration, Double-crested Cormorants follow the Atlantic coastline, river systems, or travel overland (Kaufman 2001; Dorr et al. 2014). Spring migration is generally during March and April, while fall migration occurs between August and November (Dorr et al. 2014). Migratory flocks of Double-crested Cormorants along coasts may number in the thousands. Migrants usually fly low over water during daylight hours (Kaufman 2001; Dorr et al. 2014).

In all seasons, Double-crested Cormorants need suitable places (e.g., perches) for nighttime roosts and daytime roosting and loafing (Kaufman 2001; Dorr et al. 2014). They use shallow aquatic habitats, often in waters less than 35 feet deep, to forage for fish and other prey. Most foraging occurs within 1.5 miles of the shore (Custer and Bunck 1992; Stapanian et al. 2002; Coleman et al. 2005; Dorr et al. 2014). Double-crested Cormorants usually forage individually, but may form loosely coordinated flocks when feeding on schooling fish (Dorr et al. 2014).

Double-crested Cormorant relative abundance and relative occurrence within the AoA is low in all seasons, as most use of marine waters of New York and New Jersey is concentrated near the shoreline (Balderama et al. 2015; Kinlan et al. 2016; eBird 2017). Within the AoA, Double-crested Cormorant records are most numerous in the northwestern corner, albeit still in low numbers (eBird 2017).

The low-flying flight behavior of Double-crested Cormorants suggests that they would be sensitive to collisions with wind turbines (Kaufman 2001; Dorr et al. 2014; National Audubon Society 2017); however, their tendency to remain close to shore mitigates some of the collision risk (Custer and Bunck 1992; Stapanian et al. 2002; Coleman et al. 2005; Dorr et al. 2014). Robinson Willmott et al. (2013) determined that Double-crested Cormorants would have a “higher” sensitivity to turbine collisions associated with potential offshore wind farms relative to other species they studied. In addition, Robinson Willmott et al. (2013) determined that this species would have a “medium” sensitivity to displacement impacts.

A.1.5 Shorebirds

Shorebirds in the United States comprise four families of the order Charadriiformes: Recurvirostridae (stilts and avocets), Haematopodidae (oystercatchers), Charadriidae (plovers), and Scolopacidae (sandpipers and allies). In general, shorebirds have relatively long legs and thin bills, and most forage for invertebrates in open, shoreline habitats (USFWS n.d.). While more than 30 species of shorebirds occur annually along the coasts of New York and New Jersey, most species remain onshore or in very shallow waters (eBird 2017). Data indicate that two species regularly occur within the AoA, Red-necked

Phalarope and Red Phalarope (Table A-1). The habits and limited occurrence records of other shorebird species suggest that they may occur only rarely within the AoA in transit. Phalaropes, unlike other sandpiper species, feed while swimming and spend their winters in offshore waters. The Red-necked Phalarope and Red Phalarope and their use of the AoA are discussed below.

A.1.5.1 Red-necked Phalarope

Red-necked Phalaropes breed on the low Arctic and Subarctic tundra and winter at sea, primarily in tropical waters. They migrate offshore and overland, although the latter is less common in eastern North America (Rubega et al. 2000; Kaufman 2001; National Audubon Society 2017). Spring migration through coastal and offshore waters of New York and New Jersey is generally from late April through early June, while fall migration is from August through October. Red-necked Phalaropes are highly gregarious and frequently fly in tightly coordinated flocks that may number in the thousands (Rubega et al. 2000). At sea, Red-necked Phalaropes are associated with continental shelf breaks, fronts, upwellings, and other geographic features that concentrate submerged prey near the surface (Briggs et al. 1984; Kaufman 2001; National Audubon Society 2017).

Kinlan et al. (2016) provided model results for summer in the AoA and determined that relative abundance and relative occurrence are extremely low. Normandeau (2017) did not record any observations of Red-necked Phalaropes within the AoA during the summer of 2016. Kinlan et al. (2016) produced varying results for relative abundance and relative occurrence during the fall. In summary, there are apparent pockets of relatively higher use throughout the AoA without distinguishable trends. Likewise, fall data collected by Normandeau (2017) did not show apparent trends within the AoA, although observations generally occurred within the southern and western portions of the AoA. eBird (2017) records indicate that Red-necked Phalaropes are regular in low numbers within the AoA during May, August, and September.

Red-necked Phalaropes fly offshore in large flocks during migration, which suggests that they would be sensitive to collisions with wind turbines (Rubega et al. 2000; Kaufman 2001; National Audubon Society 2017). Robinson Willmott et al. (2013) determined that Red-necked Phalaropes would have a “higher” sensitivity to turbine collisions associated with potential offshore wind farms compared to other species they studied. However, Robinson Willmott et al. (2013) determined that this species would have a “lower” sensitivity to displacement impacts.

A.1.5.2 Red Phalarope

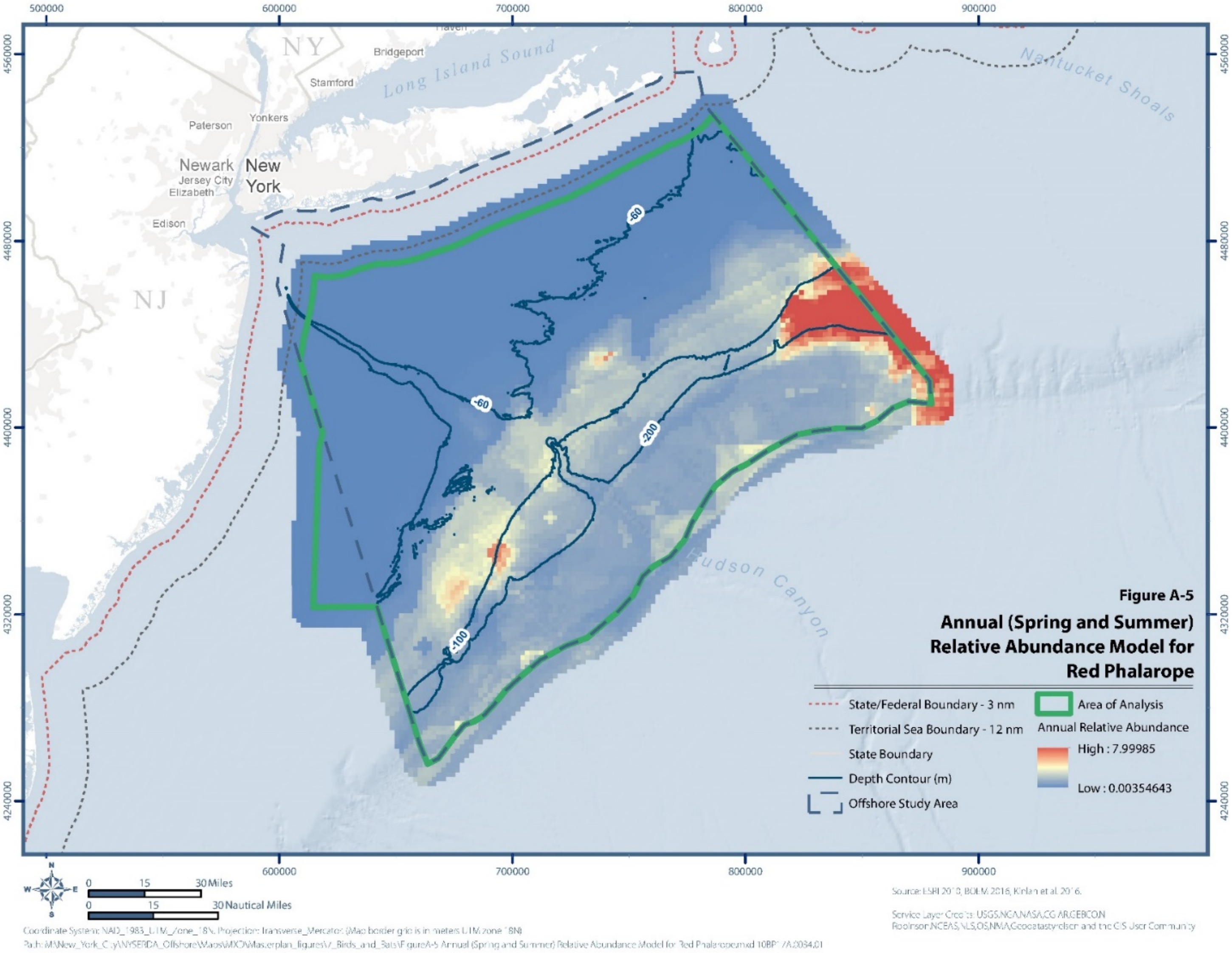
Red Phalaropes breed on Arctic tundra and winter at sea in tropical and subtropical waters. They migrate offshore along the continental shelf break of eastern North America in April and May during spring migration and October to December during fall migration (Kaufman 2001; Tracy et al. 2002; National Audubon Society 2017). Red Phalaropes form flocks of up to several hundred individuals in flight and while foraging (Tracy et al. 2002). They tend to concentrate at ocean fronts, upwellings, and continental shelf breaks approximately 6 to 45 miles offshore when foraging (Briggs et al. 1984; Brown and Gaskin 1988; Tracy et al. 2002).

Red Phalaropes are a seasonally common bird in the AoA, particularly in waters deeper than 330 feet (100 meters) along the eastern boundary (Figure A-5; Kinlan et al. 2016; eBird 2017; Normandeau 2017). As expected, Red Phalaropes exhibit low relative occurrence and relative abundance in the summer. In the spring, Red Phalaropes have high relative occurrence and relative abundance in portions of the AoA with deep waters (generally greater than 200 feet [60 meters]), and they exhibit an apparent concentration of high use in the eastern portion of the AoA (Kinlan et al. 2016). eBird (2017) reports low numbers of observations within the AoA during spring (i.e., May). Normandeau (2017) documented Red Phalaropes throughout the AoA in all water depths during fall 2016. eBird (2017) records for the AoA are regular in low numbers from August to mid-December.

Red Phalaropes fly offshore in large flocks during migration, which suggests that they would be sensitive to collisions with wind turbines (Kaufman 2001; Tracy et al. 2002; National Audubon Society 2017). Robinson Willmott et al. (2013) determined that Red Phalaropes would have a “higher” sensitivity to turbine collisions associated with potential offshore wind farms compared to other species they studied. In addition, Robinson Willmott et al. (2013) determined that this species would have a “medium” sensitivity to displacement impacts.

Figure A-5. Annual (Spring and Summer) Relative Abundance Model for Red Phalarope.

Source: ESRI 2010; BOEM 2016; Kinlan et al 2016



Coordinate System: NAD_1983_UTM_Zone_18N, Projection: Transverse_Mercator (Map border grid is in meters UTM zone 18N)

Path: M:\New_York_City\NYSERDA_Offshore\Maps\MXD\Masterplan_figures\7_Birds_and_Bats\FigureA-5 Annual (Spring and Summer) Relative Abundance Model for Red Phalarope.mxd 10BP17A0034.01

Source: ESRI 2010, BOEM 2016, Kinlan et al. 2016.

Service Layer Credits: USGS,NOAA,NASA,CGIAR,GEBCO,N Robinson,NCEAS,NLS,OS,NMA,Geodatastyrelsen and the GIS User Community

A.1.6 Alcids

Alcids are seabirds of the family Alcidae and are largely associated with cold, northern waters. Their wings function well for swimming, providing great speed and agility, but flight appears to require great effort (Kaufman 2001). There are 22 living species in this family, of which four regularly occur within the AoA (Table A-1). In general, alcids occur in low numbers in the AoA, as this area lies at or near the southern extent of their winter ranges (Ainley et al. 2002; Lowther et al. 2002; Montevecchi and Stenhouse 2002; Lavers et al. 2009). The Dovekie, Common Murre, Razorbill, and Atlantic Puffin are discussed below.

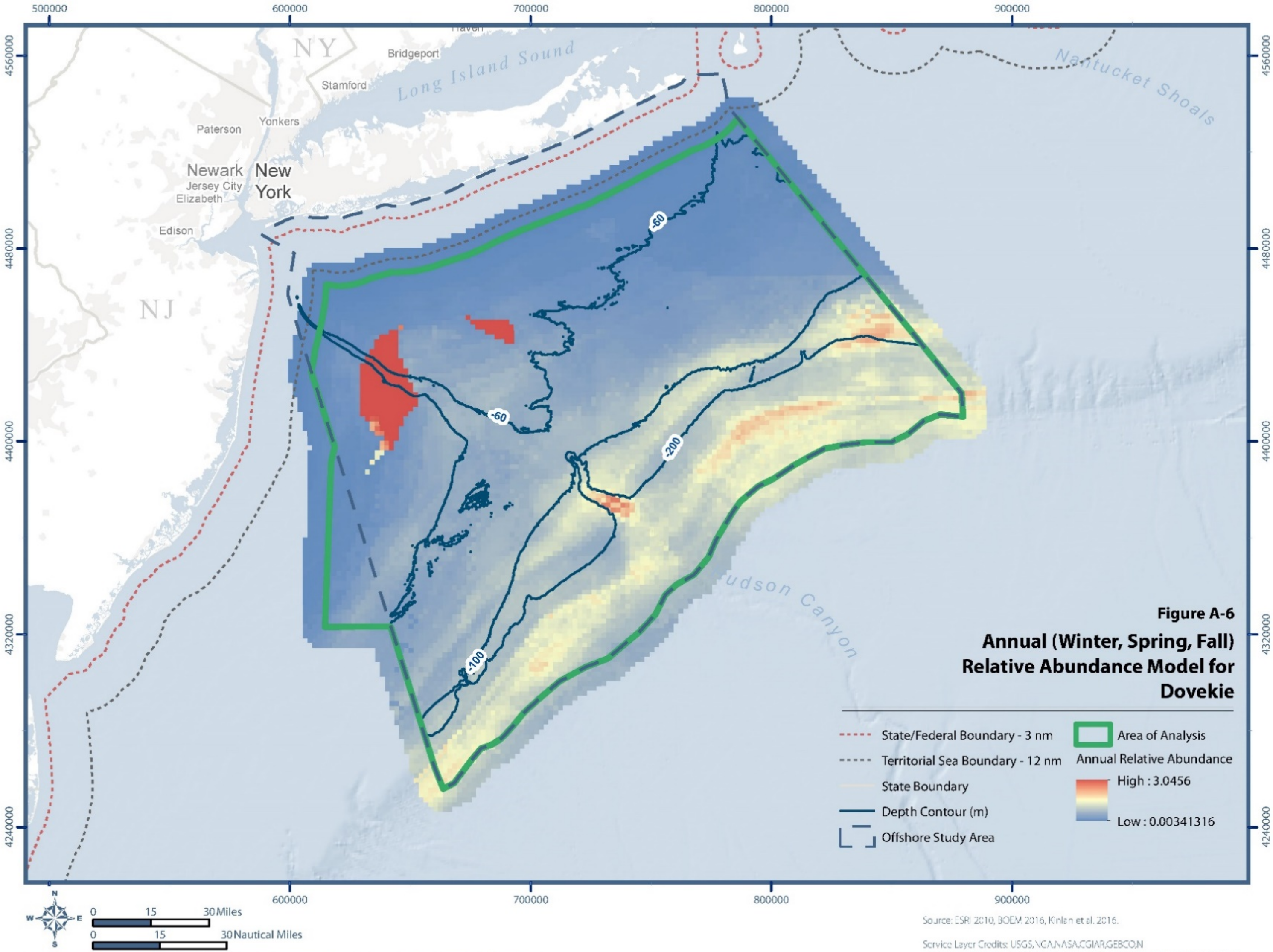
A.1.6.1 Dovekie

Dovekies breed in the Arctic and winter at sea in the North Atlantic. Most Dovekies winter in cold, Subarctic waters south to New England, but some individuals occur as far south as Florida. They generally winter near continental shelf breaks but occasionally occur in shallower waters during inclement weather. Dovekie flocks fly low over the waves (Kaufman 2001; Montevecchi and Stenhouse 2002; National Audubon Society 2017). They feed primarily on crustaceans, but they occasionally feed on mollusks and small fish over banks, upwellings, and oceanographic fronts (Brown 1988; Kaufman 2001; Montevecchi and Stenhouse 2002; National Audubon Society 2017).

Kinlan et al.’s (2016) models indicated that Dovekies are relatively abundant in the winter, spring, and fall in the AoA (Figure A-6). The annual model showed a higher relative abundance in waters deeper than 300 feet and an apparent concentration of use near the Hudson Shelf Valley in the northwestern portion of the AoA. The Menza et al. (2012) similarly mapped annual predicted abundance for Dovekie as highest along the Hudson Shelf Valley and in central portions of the AoA. In the winter, Dovekie relative abundance and relative occurrence in the AoA increased at depths above 200 feet (60 meters), including in the Hudson Shelf Valley (Balderama et al. 2015; Kinlan et al. 2016). These models are consistent with eBird (2017), for which Dovekie records are regular in the AoA in low numbers from December to early March, and are largely concentrated along the Hudson Shelf Valley. In the spring, Dovekie relative abundance and relative occurrence are higher in deeper waters, concentrating in waters around 660 feet (200 meters) deep (Balderama et al. 2015; Kinlan et al. 2016). Relative to other seasons, Kinlan et al. (2016) found low fall use of the AoA, while Balderama et al. (2015) indicated relatively high occupancy in deeper waters of the AoA.

Figure A-6. Annual (Winter, Spring, Fall) Relative Abundance Model for Dovekie.

Source: ESRI 2010; BOEM 2016; Kinlan et al. 2016



Source: ESRI 2010, BOEM 2016, Kinlan et al. 2016.

Service Layer Credits: USGS,NGA,NASA,CGIAR,GEBCO,N Robinson,NCEAS,NLS,OS,NMA,Geodatastyrelsen and the GIS User Community

Coordinate System: NAD_1983_UTM_Zone_18N. Projection: Transverse_Mercator. (Map border grid is in meters UTM zone 18N)

Path: M:\New_York_City\NYSERDA_Offshore\Maps\MXD\Masterplan_figures\7_Birds_and_Bats\FigureA-6 Annual (Winter, Spring, Fall) Relative Abundance Model for Dovekie.mxd 103P17A.0034.01

Dovekies are gregarious, oceanic birds that fly low over the water, which suggests that they would be sensitive to collisions with wind turbines (Kaufman 2001; Montevecchi and Stenhouse 2002; National Audubon Society 2017). Robinson Willmott et al. (2013) determined that Dovekies would have a "medium" sensitivity to turbine collisions and a "medium" sensitivity to displacement impacts associated with potential offshore wind farms relative to other study species.

A.1.6.2 Common Murre

In eastern North America, Common Murres nest on islands and coasts in Canada and winter at sea from Newfoundland south to Cape Cod, and rarely south to Virginia (Kaufman 2001; Ainley et al. 2002; National Audubon Society 2017). Most birds winter more than 30 miles from shore (McFarlane Tranquilla et al. 2013). Populations that nest at higher latitudes migrate south to escape winter sea ice (Kaufman 2001; Ainley et al. 2002; National Audubon Society 2017). In the fall, Common Murres first move from coastal areas out to the continental shelf and then move further south by December. Spring migration typically occurs in March and April (Ainley et al. 2002).

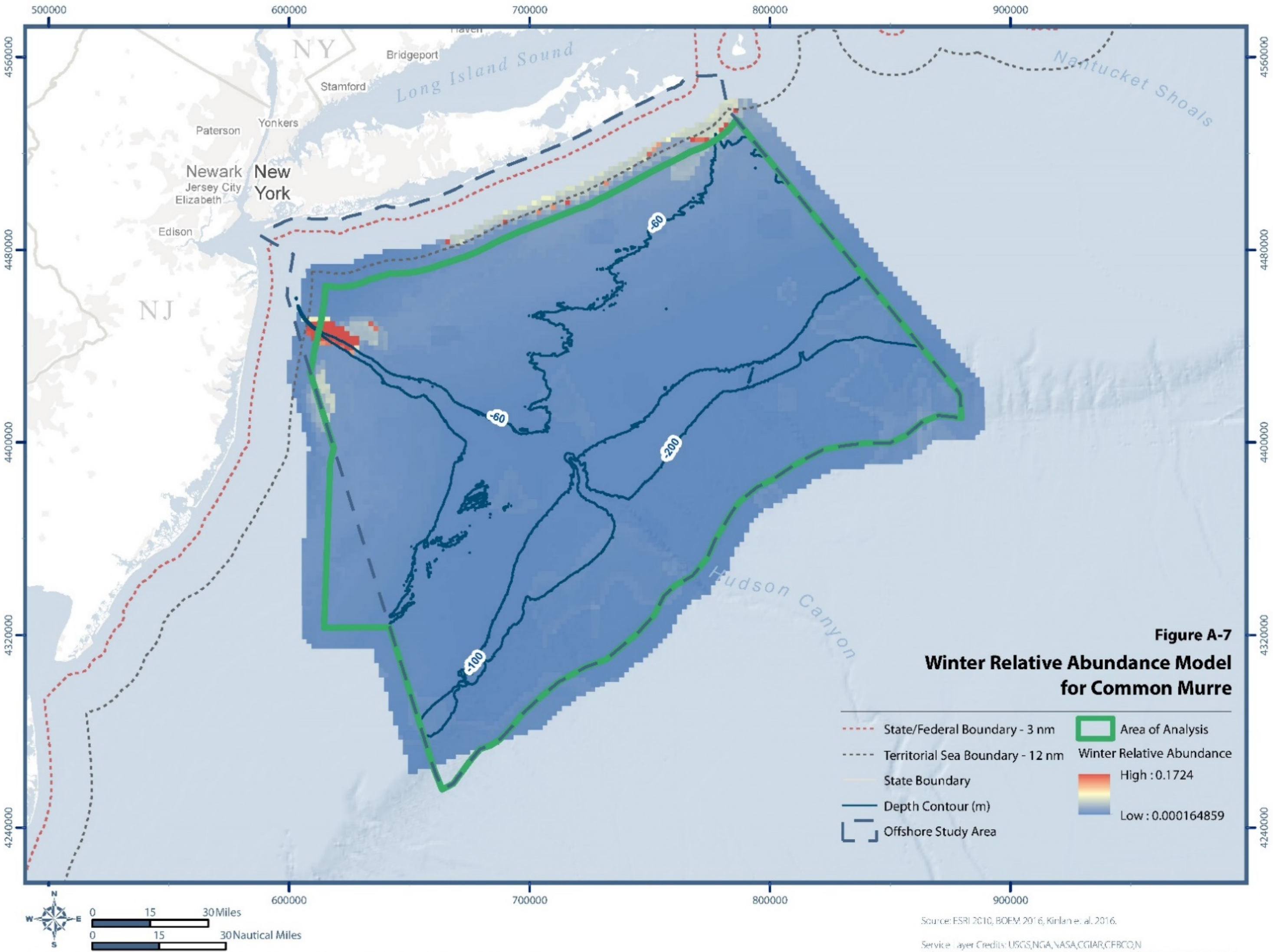
Common Murres dive and swim underwater for fish, squid, and other invertebrates during daylight and crepuscular periods (Kaufman 2001; Ainley et al. 2002; National Audubon Society 2017). They typically form foraging flocks at sea, often mixing with other species that can number in the thousands (Ainley et al. 2002).

According to eBird (2017), Common Murre records are regular in the AoA in low numbers from December to early April, and are largely concentrated along the Hudson Shelf Valley. In the winter, Kinlan et al. (2016) modeled relative abundance and relative occurrence within the AoA as highest between the northern boundary of the AoA and waters approximately 5 miles offshore, and along the Hudson Shelf Valley near the northwestern boundary of the AoA (Figure A-7). Normandeau (2017) recorded 11 Common Murres in the fall of 2016 along the northern boundary of the AoA at water depths of approximately 200 feet (60 meters).

There are no reported Common Murre flight heights, but the gregariousness and offshore presence of the species suggests that they could be sensitive to collisions with wind turbines (Kaufman 2001; Ainley et al. 2002; National Audubon Society 2017). Robinson Willmott et al. (2013) determined that Common Murres would have a "higher" sensitivity to turbine collisions associated with potential offshore wind farms compared to other species they studied. In addition, Robinson Willmott et al. (2013) determined that this species would have a "higher" sensitivity to displacement impacts.

Figure A-7. Winter Relative Abundance Model for Common Murre.

Source: ERSI 2010; BOEM 2016; Kinlan et al. 2016



Coordinate System: NAD_1983_UTM_Zone_18N Projection: Transverse_Mercator (Map border grid is in meters UTM zone 18N)
Path: M:\New_York_City\NYSERDA_Offshore\Maps\MXD\Masterplan_figures\7_Birds_and_Bats\FigureA-7 Winter Relative Abundance Model for Common Murre.mxd 10BP17A.0034.01

Source: ESRI 2010, BOEM 2016, Kinlan et. al. 2016.

Service Layer Credits: USGS,NGA,NASA,CGIAR,GEBCO,N Robinson,NCEAS,NLS,OS,NMA,Geodatastyrelsen and the GIS User Community

A.1.6.3 Razorbill

Razorbills breed on coasts and islands in the North Atlantic and winter at sea primarily in coastal waters south to Long Island and, in lower numbers, New Jersey (Kaufman 2001; Lavers et al. 2009; National Audubon Society 2017). In New York, Razorbills are most common from mid-December through March, but they have occurred from November through mid-May (Levine 1998; Lavers et al. 2009). At sea, flocks fly low over the water (Kaufman 2001; National Audubon Society 2017). They primarily feed on schooling fish during the day in waters less than 200 feet (60 meters) deep and often concentrate over shoals and ledges (Kaufman 2001; Clarke 2009; National Audubon Society 2017).

According to eBird (2017), Razorbill records are regular in the AoA from November to early April and are concentrated along the Hudson Shelf Valley, particularly in the northwestern portion of the AoA. Kinlan et al.'s (2016) winter models indicated low relative abundance and relative occurrence within the AoA. Spring models indicated higher relative abundance and relative occurrence within the AoA than winter models. Razorbill use was concentrated in nearshore waters at depths less than 200 feet (60 meters), including around the northwestern portion of the AoA. Normandeau (2017) documented 24 Razorbills in the fall 2016 and, consistent with Kinlan et al. (2016) and eBird (2017), observations occurred in the northwestern portion of the AoA near the Hudson Shelf Valley.

The low-flying behavior of Razorbill flocks suggests that the species could be sensitive to collisions with wind turbines (Kaufman 2001; National Audubon Society 2017). Robinson Willmott et al. (2013) determined that Razorbills would have a "higher" sensitivity to turbine collisions associated with potential offshore wind farms relative to other species they studied. Conversely, Furness et al. (2013) concluded that Razorbills had a low sensitivity to collision impacts with potential offshore wind farms in Scotland compared to other study species. Johnston et al. (2014) support the work of Furness et al. (2013) in projecting that about 0.8 percent of modeled Razorbill flights at potential offshore wind farm sites around Europe were at heights that make them sensitive to collision.

In terms of potential displacement impacts, Robinson Willmott et al. (2013) determined that Razorbills would have a "higher" sensitivity, while Furness et al. (2013) indicated a moderate sensitivity relative to other species in their respective studies. Vanerman et al. (2015) found that Razorbills avoided an operational offshore wind farm in Belgium. Dierschke et al. (2016) reviewed behavioral data from 20 offshore wind farms in Europe and classified Razorbills as weakly avoiding offshore wind farms, which showed significant declines at some sites, but showed no effect or even increased at others.

Overall, Garthe and Hüppop (2004) estimated that Razorbills would have a moderate overall sensitivity to wind farm impacts compared to other modeled seabird species in the North Sea (Europe).

A.1.6.4 Atlantic Puffin

In North America, Atlantic Puffins breed on small offshore islands from Maine to Nunavut and winter at sea south to Massachusetts, with low numbers migrating as far south as Virginia (Kaufman 2001; Lowther et al. 2002). They occur in New York from December through April (Levine 1998; Lowther et al. 2002). Atlantic Puffins migrate to offshore areas, mostly seaward of the continental shelf, primarily by flight, but also by passively drifting in currents or actively swimming (Kaufman 2001; Lowther et al. 2002; National Audubon Society 2017). They are flightless while molting, which generally occurs between January and March (Lowther et al. 2002). Atlantic Puffins are often solitary in winter, but may also occur in flocks (Kaufman 2001; Lowther et al. 2002; National Audubon Society 2017).

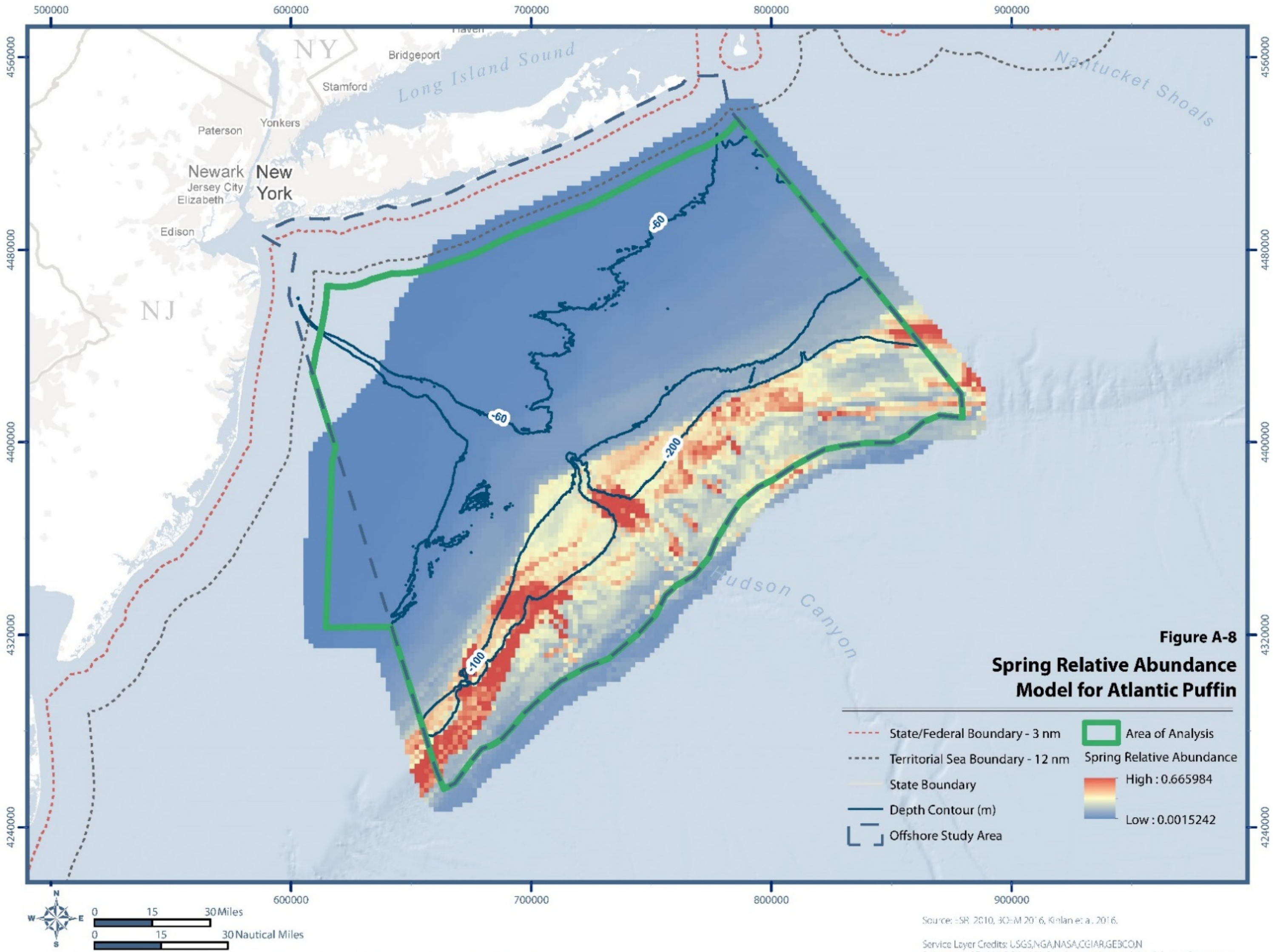
According to eBird (2017), Atlantic Puffin records are regular in low numbers in the AoA from December to March, with additional records occurring in May. Kinlan et al.'s (2016) winter models of relative abundance and relative occurrence were highest along the OCS at depths greater than 330 feet (100 meters). Spring models produced higher relative use in the AoA than the winter models but with similar locational trends (Figure A-8).

Robinson Willmott et al. (2013) determined that Atlantic Puffins would have a "higher" sensitivity to turbine collisions associated with potential offshore wind farms compared to other species they studied. Conversely, Furness et al. (2013) concluded that Atlantic Puffins had a low sensitivity to collision impacts with potential offshore wind farms in Scotland relative other study species. Johnston et al. (2014) support the work of Furness et al. (2013) in revealing that none of their modeled Atlantic Puffin flights at potential offshore wind farm sites around Europe were at heights that make them sensitive to collision.

In terms of potential displacement impacts, Robinson Willmott et al. (2013) determined that Atlantic Puffins would have a "higher" sensitivity, while Furness et al. (2013) indicated a relatively moderate sensitivity. Masden et al. (2010) estimated that breeding Atlantic Puffins would incur higher energetic costs than other study seabirds by flying additional distances to avoid wind farms. This may also apply to non-breeding birds. Finally, Garthe and Hüppop (2004) estimated that Atlantic Puffins would have a moderate overall sensitivity to wind farm impacts compared to other modeled seabird species in the North Sea (Europe).

Figure A-8. Spring Relative Abundance Model for Atlantic Puffin.

Source: ESRI 2010; BOEM 2016; Kinlan et al. 2016



Coordinate System: NAD_1983_UTM_Zone_18N, Projection: Transverse_Mercator. (Map border grid is in meters UTM zone 18N)
Path: M:\New_York_City\NYSERDA_Offshore\Maps\MXD\Masterplan_figures\7_Birds_and_Bats\FigureA 8 Spring Relative Abundance Model for Atlantic Puffin.mxd 18BP17A.0034.01

Source: ESRI 2010, BOEM 2016, Kinlan et al. 2016.

Service Layer Credits: USGS,NGA,NASA,CGIAR,GEBCO,N Robinson,NCEAS,NLS,OS,NMA,Geodatastyrelsen and the GIS User Community

A.1.7 Gulls and Terns

The family Laridae comprises about 100 species of gulls, terns, and skimmers (Kaufman 2001). Species from this family breed on every continent, and more than a dozen species regularly occur annually in New York and New Jersey (Kaufman 2001; eBird 2017). Within the AoA, eight species of gulls and one tern species regularly occur (Table A-1). Gulls are often associated with coastal areas and lakes, as well as developed areas. They are gregarious year-round and breed in colonies. Terns also generally breed in colonies in aquatic environments, but they are not as gregarious at foraging sites. Terns are smaller, more agile fliers than gulls and spend less time swimming (Kaufman 2001). Gulls and terns regularly occurring in the AoA are discussed below. Refer to Section A.3 for discussions of additional special status tern species.

A.1.7.1 Black-legged Kittiwake

Black-legged Kittiwakes breed on coasts and islands in Artic and Subarctic latitudes and winter at sea along banks, upwellings, continental shelf breaks, and deeper waters (Kaufman 2001; Hatch et al. 2009; National Audubon Society 2017). In eastern North America, some Black-legged Kittiwakes from Europe join wintering birds, which may occur as far south as Florida (Barrett and Bakken 1997; Hatch et al. 2009). This species typically occurs off the East Coast of the United States from late October to April (Powers 1984; Hatch et al. 2009). Black-legged Kittiwakes rarely come to land, but immature birds are more prone to do so.

Black-legged Kittiwakes forage in flocks, primarily for fish, using a variety of methods, including plunge diving from 3 to 20 feet above the water (Bayer 1983; Kaufman 2001; Hatch et al. 2009; National Audubon Society 2017). Foraging occurs mostly during the day (Hatch et al. 2009; McKnight et al. 2011).

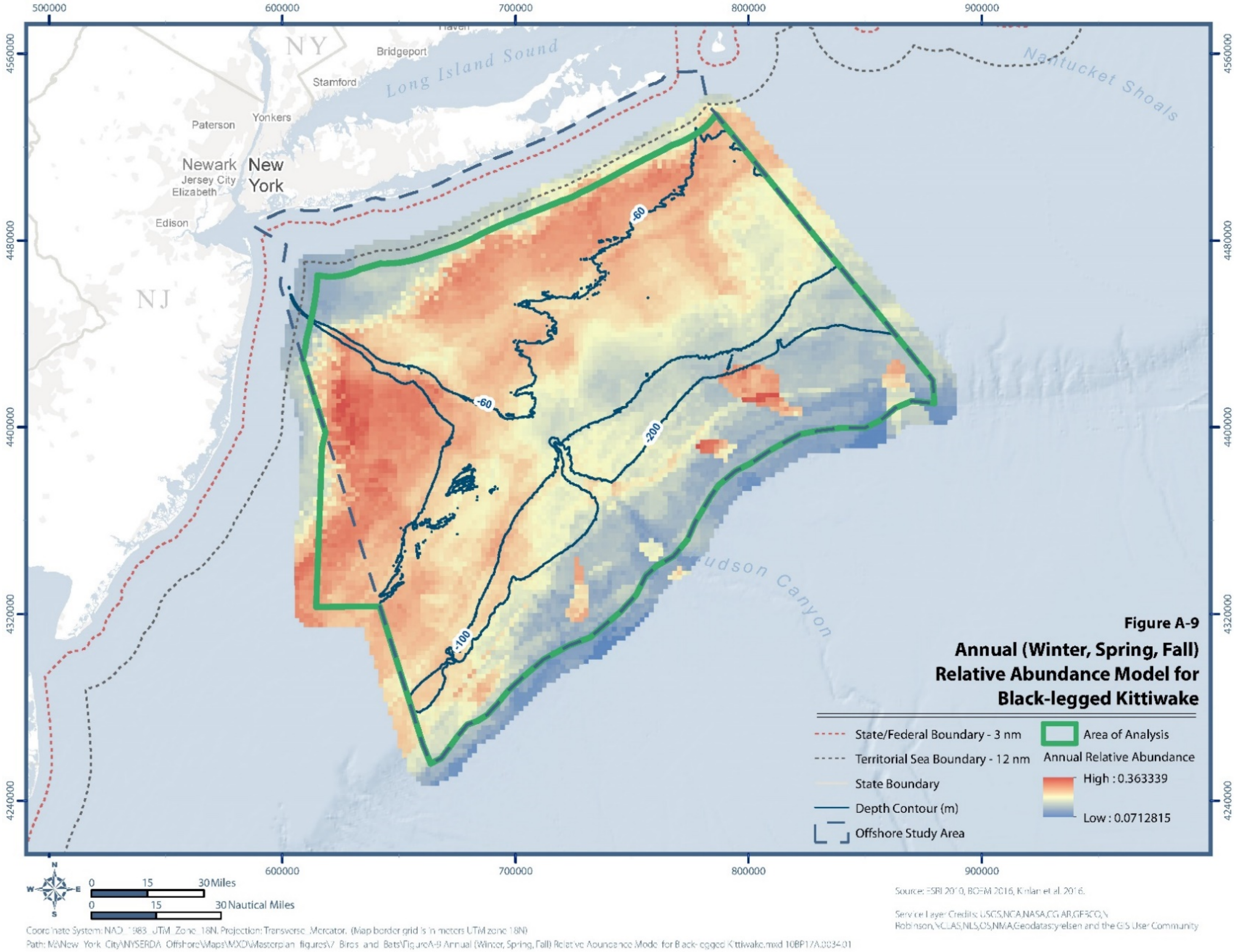
Annually, the modeled relative abundance and relative occurrence of Black-legged Kittiwakes are relatively high in many areas throughout the AoA, with the winter and spring comprising most use (Figure A-9; Kinlan et al. 2016; Menza et al. 2012). Balderama et al. (2015) modeled the highest use by Black-legged Kittiwakes in the winter, with an apparent trend for higher occurrence in the eastern portions of the AoA. The Menza et al. (2012) map showed predicted abundance in similar areas across the fall, winter, and spring; abundance was highest in the eastern and central portions of the AoA. Normandeau (2017) documented 230 Black-legged Kittiwakes throughout the AoA in fall 2016, with somewhat higher concentrations in the northern half of the AoA and along the Hudson Shelf Valley. According to eBird (2017), Black-legged Kittiwake records are regular in the AoA in low numbers from late October through March and are largely concentrated along the Hudson Shelf Valley.

The foraging behavior of Black-legged Kittiwakes, which includes flocking and plunge diving, suggests that the species could be sensitive to collisions with wind turbines (Bayer 1983; Kaufman 2001; Hatch et al. 2009; National Audubon Society 2017). Robinson Willmott et al. (2013) support this suggestion in determining that Black-legged Kittiwakes would have a “higher” sensitivity to turbine collisions associated with potential offshore wind farms relative to other species they studied. Likewise, Furness et al. (2013) and Brabant et al. (2015) predicted higher sensitivities to collision with offshore wind farms in Europe for this species relative to other species in their respective studies. Johnston et al. (2014) estimated that about 7 percent of modeled Black-legged Kittiwake flights at potential offshore wind farm sites around Europe were at heights that make them sensitive to collision.

Displacement from suitable habitat does not appear to be a substantial impact for Black-legged Kittiwakes at offshore wind farms. Vanerman et al. (2015) found that Black-legged Kittiwake abundance increased with the construction of a wind farm at a site in Belgium. Likewise, Robinson Willmott et al. (2013) and Furness et al. (2013) determined that Black-legged Kittiwakes would have a relatively low displacement sensitivity. Dierschke et al. (2016) reviewed behavioral data from 20 offshore wind farms in Europe and also found that Black-legged Kittiwakes behavior ranged from weak avoidance to weak attraction, but often exhibited no detectable displacement effects. Overall, Garthe and Hüppop (2004) estimated that Black-legged Kittiwakes would have a low sensitivity to wind farm impacts compared to other modeled seabird species in the North Sea (Europe).

Figure A-9. Annual (Winter, Spring, Fall) Relative Abundance Model for Black-legged Kittiwake.

Source: ESRI 2010; BOEM 2016; Kinlan et al. 2016



A.1.7.2 Bonaparte's Gull

Bonaparte's Gulls breed in Alaska and Canada and, on the Atlantic Coast, winter from New Brunswick south to Florida. During migration, they follow rivers toward the Atlantic and Pacific Coasts in flocks that may reach into the thousands. They migrant primarily by day but also occasionally at night (Burger and Gochfield 2002).

During winter, Bonaparte's Gulls may occupy a variety of aquatic habitats along the Atlantic Coast and may forage for fish and invertebrates to at least 12 miles offshore (Kaufman 2001; Burger and Gochfield 2002; National Audubon Society 2017). Bonaparte's Gulls forage in flocks using various methods, but plunge diving from the air and dipping to the water's surface in flight are the most common (Kaufman 2001; Burger 1988; Burger and Gochfield 2002; National Audubon Society 2017).

eBird (2017) records of Bonaparte's Gulls within the AoA are regular in low numbers from November to April and are concentrated along the Hudson Shelf Valley, particularly in the northwestern portion of the AoA. Kinlan et al.'s (2016) models are consistent with eBird (2017) in revealing low relative abundance and relative occurrence of Bonaparte's Gull in the winter, with relatively higher use in the Hudson Shelf Valley. Relative use of the AoA was higher in spring models than in winter, with higher use in the western portion of the AoA. Fall models showed low relative abundance and relative occurrence in the AoA, with higher use in the western portion of the AoA. However, Bonaparte's Gull was one of the most abundant birds documented by Normandeau (2017) in fall 2016. They recorded more than 1,000 individuals, mostly in the northeastern portion of the AoA and near the Hudson Shelf Valley at depths of 200 feet (60 meters). Annually, Balderama et al. (2015) also showed a trend for occupancy in the northeastern portion of the AoA.

The gregariousness and foraging behavior of Bonaparte's Gulls suggest that they would be sensitive to collisions with wind turbines (Burger 1988; Kaufman 2001; Burger and Gochfield 2002; National Audubon Society 2017). However, Robinson Willmott et al. (2013) determined that Bonaparte's Gulls would have a "lower" sensitivity to turbine collisions associated with potential offshore wind farms relative to other species they studied. Likewise, Robinson Willmott et al. (2013) determined that this species would have a "lower" sensitivity to displacement impacts.

A.1.7.3 Laughing Gull

Laughing Gulls breed along the Atlantic Coast from Maine to Georgia. Coastal North Carolina is generally the northern extent of their winter range, but they do rarely occur further north in winter. Laughing Gulls leave their breeding colonies in mid- to late July and coalesce into larger flocks along the coast in September and October before migrating south (Burger 2015). They return to their breeding colonies between March and May (Belant and Dolbeer 1993; Burger 2015). Migration is primarily along the coast and the continental shelf, during which they roost on inland lakes, sheltered marine waters, and the open ocean (Burger 2015).

eBird (2017) records of Laughing Gulls in New York and New Jersey are most common in nearshore waters and coastal sites, particularly from April to October. Laughing Gulls are regular in low numbers from mid-March to December in the AoA, and are concentrated along the Hudson Shelf Valley, particularly in the northwestern portion of the AoA. In the summer and fall, Laughing Gulls are relatively abundant within the AoA compared to other species of birds; however, the highest areas of Laughing Gull use are nearshore waters along the northern and western portions of the AoA (Balderama et al. 2015; Kinlan et al. 2016; Menza et al. 2012). Normandeau (2017) recorded 776 Laughing Gulls in fall 2016, primarily in nearshore waters outside of the AoA. They documented 15 Laughing Gulls in the summer outside of the AoA in nearshore waters.

Laughing Gulls have a generalist diet and normally feed at the water's edge or in wrack, but they also feed abundantly up to 18 miles offshore (Wickliffe and Jodice 2010; Burger 2015). They are diurnal and use a variety of methods to capture food, among them plunge diving from the air (Kaufman 2001; Burger 2015; National Audubon Society 2017). When feeding, Laughing Gulls may form flocks that number in the hundreds (Burger 2015).

The gregariousness and foraging behavior of Laughing Gulls suggest that they would be vulnerable to collisions with wind turbines (Wickliffe and Jodice 2010; Burger 2015). Robinson Willmott et al. (2013) support this suggestion in determining that Laughing Gulls would have a "higher" sensitivity to turbine collisions relative to other species they studied. Robinson Willmott et al. (2013) also determined that this species would have a "medium" sensitivity to displacement impacts.

A.1.7.4 Ring-billed Gull

In eastern North America, Ring-billed Gulls breed in Canada, Maine, and Upstate New York. Many eastern-breeding Ring-billed Gulls overwinter between December and February in coastal marine habitats from the Canadian Maritimes south to Florida (Pollet et al. 2012). Ring-billed Gulls rarely occur in pelagic waters. During migration, Ring-billed Gulls may fly up to altitudes of 1,300 feet in flocks ranging in size from a few to several hundred individuals.

Ring-billed Gulls forage primarily during the day using a variety of methods, including dipping to the water's surface or plunge diving from the air. They often forage in flocks, sometimes numbering in the thousands, but also forage singly (Kaufman 2001; Pollet et al. 2012; National Audubon Society 2017).

Ring-billed Gulls are common year-round along the coasts and nearshore waters of New York and New Jersey, but particularly during winter months (eBird 2017). Records exist in low numbers in the AoA in all months except April and July, with peak occurrence in December. eBird (2017) records are concentrated along the Hudson Shelf Valley, particularly in the northwestern portion of the AoA. Modeled relative abundance and relative occurrence of Ring-billed Gulls in the AoA were low to moderate in the AoA during winter, spring, and fall, but the areas of highest use were along the coast and outside of the AoA (Kinlan et al. 2016). Normandeau (2017) recorded 92 Ring-billed Gulls in fall 2016; while most occurrences were outside of the AoA and along the coast, many were located throughout the AoA, including in deep offshore waters.

Robinson Willmott et al. (2013) determined that Ring-billed Gulls would have a "medium" sensitivity to turbine collisions relative to other species they studied. They also determined that this species would have a "lower" sensitivity to displacement impacts.

A.1.7.5 Herring Gull

Herring Gulls are year-round residents of coastal New York and New Jersey (Kaufman 2001; eBird 2017; National Audubon Society 2017; Nisbet et al. 2017). They breed in a variety of habitats near open water, including on islands, barrier beaches, and in salt marshes (Kaufman 2001; National Audubon Society 2017; Nisbet et al. 2017). Herring Gulls on the Atlantic Coast disperse from their breeding sites from July to September, but adults and some juveniles tend to remain within a few hundred miles of breeding sites during the winter. Some juveniles migrate south in October and November and return in March and April.

Herring Gulls nesting in northern latitudes are more migratory, and many follow the Atlantic Coast to wintering sites, some traveling over the OCS (Nisbet et al. 2017).

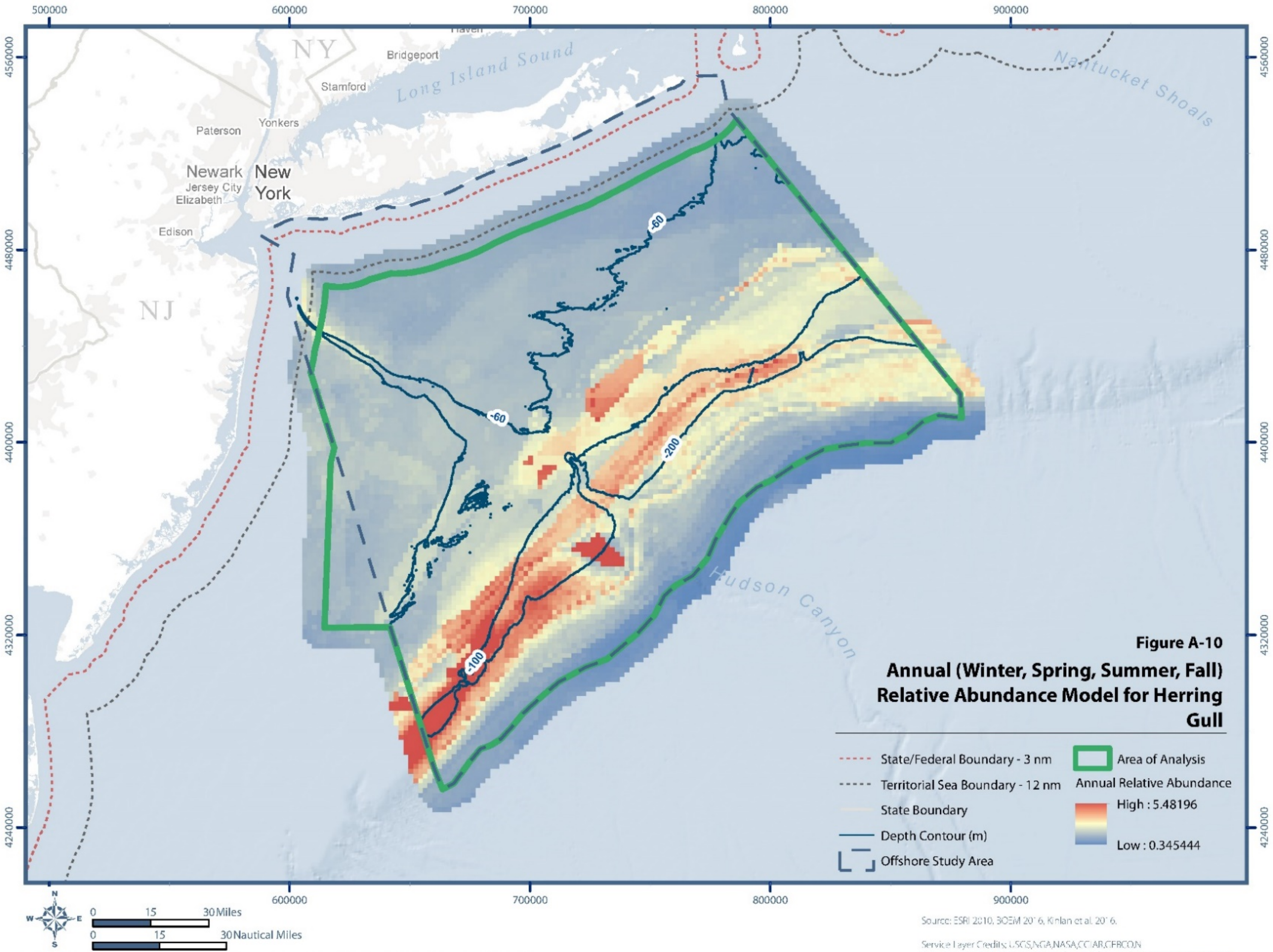
According to eBird (2017), Herring Gulls may occur in the AoA year-round, but occur more frequently from August through February, primarily along the Hudson Shelf Valley. Kinlan et al.'s (2016) models of relative abundance and relative occurrence showed that Herring Gulls were relatively common in the AoA, particularly in the winter, spring, and fall. Across all seasons, Herring Gull relative abundance appeared to be highest along the OCS (Figure A-10). The Menza et al. (2012) map for annual predicted abundance also showed Herring Gulls as abundant within the AoA with trends of higher abundance in nearshore waters and along the Hudson Shelf Valley. Relative abundance and relative occurrence were lowest during the summer, when Herring Gull use was greater in nearshore waters and generally outside of the AoA (Menza et al. 2012; Kinlan et al. 2016).

Herring Gulls are scavengers and generalist predators that use a variety of foraging habitats, including the open ocean (Kaufman 2001; National Audubon Society 2017; Nisbet et al. 2017). At sea, they occur as far out as the OCS and typically concentrate around fishing vessels, feeding on offal and by-catch (Powers 1984; Nisbet et al. 2017). They may also concentrate around upwellings, submarine features, and tide rips. Herring Gull foraging flocks at sea may number in the tens of thousands (Nisbet et al. 2017). They employ several methods of food capture at sea, including hovering and plunge diving from less than 3 feet above the water's surface and dipping to the surface for floating items. Herring Gulls also harass other seabirds in flight and steal their food (Kaufman 2001; National Audubon Society 2017; Nisbet et al. 2017).

Herring Gulls often fly low over water while foraging or transiting, which suggests that they may be sensitive to collisions with offshore wind turbines (Nisbet et al. 2017). Robinson Willmott et al. (2013) and Furness et al. (2013) both estimated that Herring Gulls had the highest sensitivity to collisions with offshore wind farms of all their respective study species. Brabant et al. (2015) also predicted that Herring Gulls would be sensitive to collisions with offshore wind turbines in Belgium. Johnston et al. (2014) projected that about 19 percent of modeled Herring Gull flights at potential offshore wind farm sites around Europe were at heights that make them sensitive to collision.

Figure A-10. Annual (Winter, Spring, Summer, Fall) Relative Abundance Model for Herring Gull.

Source: ESRI 2010;, BOEM 2016; Kinlan et al 2016



Source: ESRI 2010, BOEM 2016, Kinlan et al. 2016.

Service Layer Credits: USGS,NGA,NASA,CGIAR,GEBCO,N Robinson,NCEAS,NLS,OS,NMA,Geodatastyrelsen and the GIS User Community

Coordinate System: NAD_1983_UTM_Zone_18N. Projection: Transverse_Mercator. (Map border grid is in meters UTM zone 18N)

Path: M:\New_York_City\NYSERDA_Offshore\Maps\MXD\Masterplan_figures\7_Birds_and_Bats\FigureA-10 Annual (Winter, Spring, Summer, Fall) Relative Abundance Model for Herring Gull.mxd 10BP17A.0034.01

Research has produced varying results regarding potential displacement impacts on Herring Gulls associated with offshore wind farms. Vanerman et al. (2015) found that Herring Gulls exhibited a significant attraction to an offshore wind farm in Belgium. Dierschke et al. (2016) reviewed behavioral data from 20 offshore wind farms in Europe and classified Herring Gulls as weakly attracted to offshore wind farms, but noted that more often no effects have been found. Conversely, Robinson Willmott et al. (2013) and Furness et al. (2013) predicted that Herring Gulls would have "medium" and low sensitivities, respectively, to displacement impacts compared to other species in their respective studies. Overall, Garthe and Hüppop (2004) estimated that Herring Gulls would have a low sensitivity to wind farm impacts compared to other modeled seabird species in the North Sea (Europe).

A.1.7.6 Iceland Gull

Iceland Gulls breed in Greenland and northern Canada and, in the eastern United States, winter in the Great Lakes and along the Atlantic Coast (Kaufman 2001; Snell 2002; National Audubon Society 2017). They occur along the Atlantic Coast primarily from January to March (Snell 2002). Iceland Gulls may occur well off shore, but they forage most commonly at the surface of shallow coastal waters while flying. They feed opportunistically, mainly on fish, but also carrion, offal, invertebrates, and the eggs or young of other birds (Kaufman 2001; Snell 2002; National Audubon Society 2017).

eBird (2017) records of Iceland Gulls in the AoA are regular in low numbers from November through March, peaking from December to February. The Hudson Shelf Valley is the area of greatest frequency of occurrence, particularly in the northwestern portion of the AoA. The USGS (2013) reported seven Iceland Gull records within the AoA from February to April, all of which were at least 70 miles offshore.

Little information about Iceland Gull use of wintering areas is reported, and research addressing potential impacts of wind farms on the species also is limited. Robinson Willmott et al. (2013) determined that Iceland Gulls would have a "higher" sensitivity to turbine collisions and displacement impacts associated with offshore wind farms in the Atlantic OCS compared to other species they studied.

A.1.7.7 Lesser Black-backed Gull

Lesser Black-backed Gulls were once a rare vagrant from Europe, but they have become an increasingly more common visitor in North America, particularly along the Atlantic Coast, over the last century (Kaufman 2001; Hallgrimsson et al. 2011; National Audubon Society 2017). They occur in North America during any month of the year, but are most common during the winter (Kaufman 2001;

National Audubon Society 2017). Migration occurs primarily during the day at altitudes less than 820 feet (Klaassen et al. 2011). They migrate singly or in small flocks of less than ten individuals; however, they may forage in flocks of hundreds at concentrated food sources (BirdLife International 2017e). Lesser Black-backed Gulls typically occur in protected marine waters, beaches, coastal islands, inland lakes, and garbage dumps. They are omnivorous and capture food by dipping to the water's surface in flight and picking at items while swimming, wading, or walking. Lesser Black-backed Gulls may also harass other birds and steal their food (Kaufman 2001; National Audubon Society 2017).

eBird (2017) records of Lesser Black-backed Gulls in the AoA are regular in low numbers in every month except July, and peak occurrence is from December to February. The Hudson Shelf Valley is the area of greatest frequency of occurrence, particularly in the northwestern portion of the AoA. Normandeau (2017) recorded nine Lesser Black-backed Gulls in the fall throughout the eastern portion of the AoA. The USGS (2013) reported two winter records of Lesser Black-backed Gulls in the AoA along the western boundary over water depths of approximately 200 feet (60 meters).

Like other gulls, Lesser Black-backed Gulls have a high sensitivity to collision with offshore wind turbines. Robinson Willmott et al. (2013) and Furness et al. (2013) both estimated that Lesser Black-backed Gulls had high sensitivity to collisions with offshore wind farms compared to other species in their respective studies. Brabant et al. (2015) also determined that Lesser Black-backed Gulls would be sensitive to collisions with offshore wind turbines in Belgium. Johnston et al. (2014) projected that about 26 percent of modeled Lesser Black-backed Gull flights at potential offshore wind farm sites around Europe were at heights that make them sensitive to collision.

Research has produced varying results regarding the potential displacement impacts on Lesser Black-backed Gulls associated with offshore wind energy development. Vanerman et al. (2015) found that Lesser Black-backed Gulls exhibited a significant attraction to an offshore wind farm in Belgium. Dierschke et al. (2016) reviewed behavioral data from 20 offshore wind farms in Europe and classified Lesser Black-backed Gulls as weakly attracted to offshore wind farms, but noted that more often no effects have been found. Lesser Black-backed Gulls exhibited a significant attraction to an offshore wind farm in Belgium. Robinson Willmott et al. (2013) and Furness et al. (2013) predicted that Lesser Black-backed Gulls would have "medium" and low sensitivities, respectively, to displacement impacts relative to other species in their respective studies. Masden et al. (2010) estimated that breeding Lesser Black-backed Gulls would incur relatively lower energetic costs than other study seabirds in flying additional distances to avoid wind farms. Overall, Garthe and Hüppop (2004) estimated that Lesser

Black-backed Gulls would have a low to moderate sensitivity to wind farms compared to other modeled seabird species in the North Sea (Europe).

A.1.7.8 Great Black-backed Gull

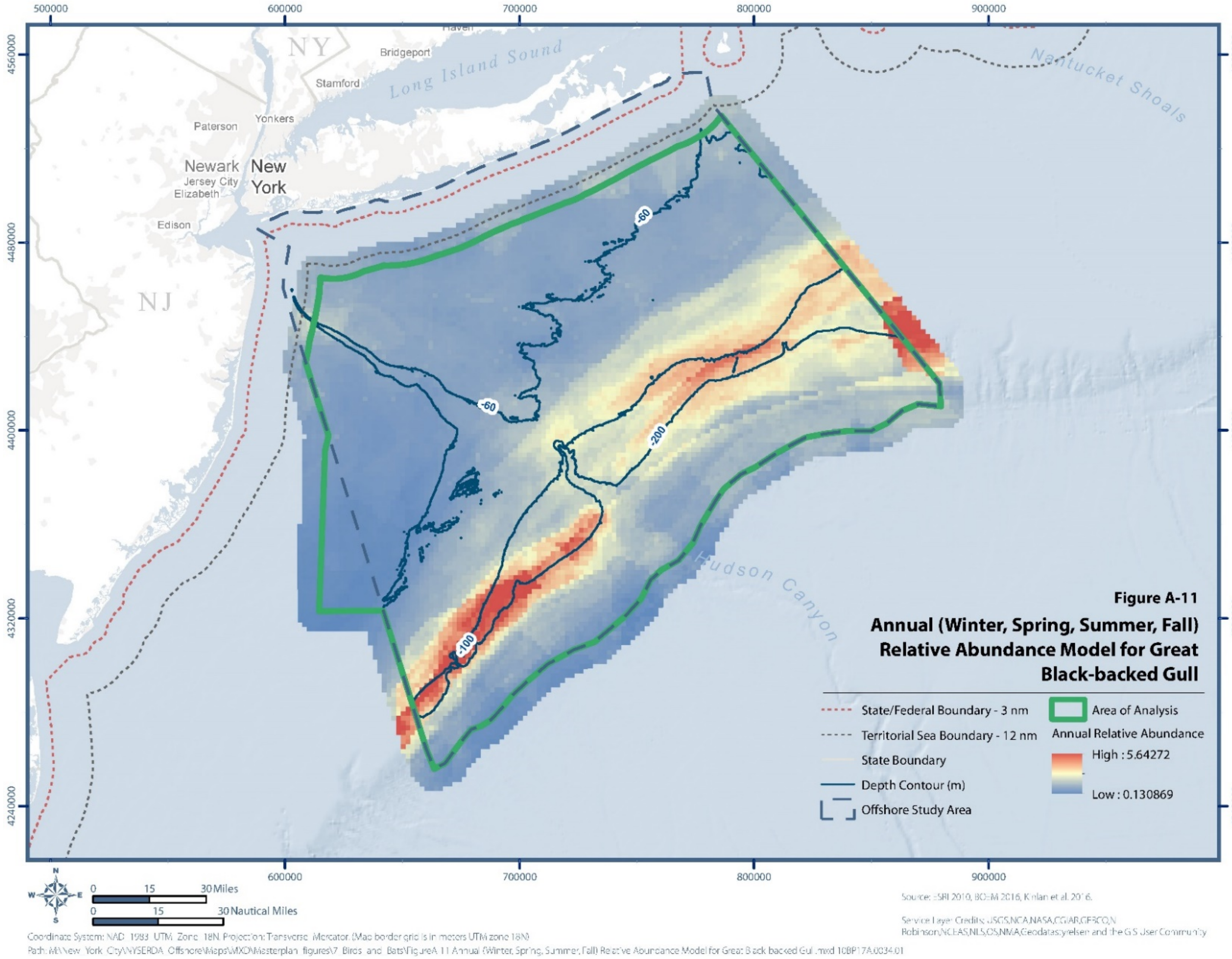
Great Black-backed Gulls are year-round residents of coastal New York and New Jersey, where they breed on islands, beaches, and salt marshes (Good 1998; Kaufman 2001; eBird 2017; National Audubon Society 2017). Some breeding birds may migrate further south along the coast, while birds breeding at northern sites may migrate to and winter in coastal New York and New Jersey (Good 1998). Great Black-backed Gulls remain close to the coast much of the year, but will forage far offshore in the winter (Kaufman 2001; National Audubon Society 2017). In the spring, immature and sub-adult birds are common over the continental shelf (Good 1998).

eBird (2017) observations indicate that Great Black-backed Gulls may occur in the AoA year-round, but their greatest frequencies of occurrence are from December through February along the Hudson Shelf Valley. In all seasons, Greater Black-backed Gulls are most likely to occur in shallow coastal waters outside the AoA (eBird 2017). According to Kinlan et al. (2016), Great Black-backed Gulls are relatively common in the AoA in the winter, spring, and fall. In addition to nearshore waters, Great Black-backed Gull relative abundance across all seasons was also highest along the OCS (Figure A-11). Menza et al. (2012) mapped annual predicted abundance as highest in nearshore waters, along the Hudson Shelf Valley, and generally across the eastern half of the AoA. In the summer, relative abundance and relative occurrence were low, and Great Black-backed Gull generally occurred in nearshore waters outside of the AoA. Balderama et al.'s (2015) models showed relative occurrence of Great Black-backed Gulls were similar across all seasons, with an overall trend for higher occurrence in nearshore waters. In fall 2016, Normandeau (2017) recorded 56 Great Black-backed Gulls throughout the AoA, with an apparent concentration along the Hudson Shelf Valley. In summer 2016, they recorded 370 Great Black-backed Gulls, most of which were in coastal waters outside of the AoA.

Great Black-backed Gulls are generalist predators and opportunistic scavengers (Good 1998; Kaufman 2001; National Audubon Society 2017). At sea, they feed at or near the water's surface around mounts, banks, and upwellings by swimming, dipping to the surface from flight, and plunge diving from 6 to 10 feet above the surface (Good 1998; Kaufman 2001; National Audubon Society 2017). They forage in widely scattered flocks at sea, often mixed with other sea birds and marine mammals (Good 1998). Great Black-backed Gulls also harass and steal food from other birds (Kaufman 2001; National Audubon Society 2017).

Figure A-11. Annual (Winter, Spring, Summer, Fall) Relative Abundance Model for Great Black-backed Gull.

Source: ESRI 2010; BOEM 2016; Kinlan et al. 2016



Like the Herring Gull, Great Black-backed Gulls have one of the highest sensitivities to collision with offshore wind turbines, as estimated by Robinson Willmott et al. (2013) and Furness et al. (2013). Brabant et al. (2015) also predicted that Great Black-backed Gulls would be sensitive to collisions with offshore wind turbines in Belgium. Johnston et al. (2014) projected that about 37 percent of modeled Great Black-backed Gull flights at potential offshore wind farm sites around Europe were at heights that make them sensitive to collision.

Robinson Willmott et al.'s (2013) estimation that Great Black-backed Gulls would have a "higher" risk of displacement impacts stands in contrast to research in Europe. Furness et al. (2013) predicted that Great Black-backed Gulls would have low sensitivity to displacement impacts compared to other study species. Vanerman et al. (2015) noted a possible attraction effect to an operational wind farm in Belgium. Dierschke et al. (2016) reviewed behavioral data from 20 offshore wind farms in Europe and classified Great Black-backed Gulls as weakly attracted to offshore wind farms, but noted that more often no effects have been found. Overall, Garthe and Hüppop (2004) estimated that Great Black-backed Gulls would have a moderate sensitivity to wind farm impacts compared to other modeled seabird species in the North Sea (Europe).

A.1.7.9 Common Tern

Common Terns, listed as Threatened in New York, occur in coastal New York and New Jersey as summer breeding residents and migrants. They nest on islands, barrier beaches, and salt marshes, usually within 300 feet of the water's edge. After nesting and raising young, Common Terns disperse throughout their breeding area and then congregate at staging sites before migrating south to winter in coastal areas in the subtropics and tropics (Kaufman 2001; Nisbet 2002; National Audubon Society 2017). They may migrate directly over the Atlantic to Caribbean islands from mid-August to mid-October, and return to breeding colonies from late April to mid-May (Levine 1998; Nisbet 2002). Migratory flocks may number in the thousands and appear to fly at high altitudes (>3,000 feet) at night (Nisbet 2002). Common Terns rarely occur more than 6 miles offshore during migration, but they may occur in small numbers out to the edge of the continental shelf (Powers et al. 1980; Nisbet 2002).

Within the AoA, Common Tern relative abundance was low; they are most likely to occur in shallow coastal waters outside the AoA, particularly along the coasts of New Jersey and Long Island (Figure A-12; Balderama et al. 2015; Kinlan et al. 2016; Menza et al. 2012; eBird 2017). According to eBird (2017), Common Terns primarily occur in the AoA from May to September, and their greatest frequencies of occurrence are along the Hudson Shelf Valley and off eastern Long Island in the northeastern portion of the AoA. Kinlan et al.'s (2016) models showed the highest relative abundance and relative occurrence in summer, particularly in shallower waters near the northeastern and northern boundaries of the AoA. Menza et al. (2012) mapped predicted annual abundance as highest in nearshore waters in the northern portions of the AoA, nearest to Long Island.

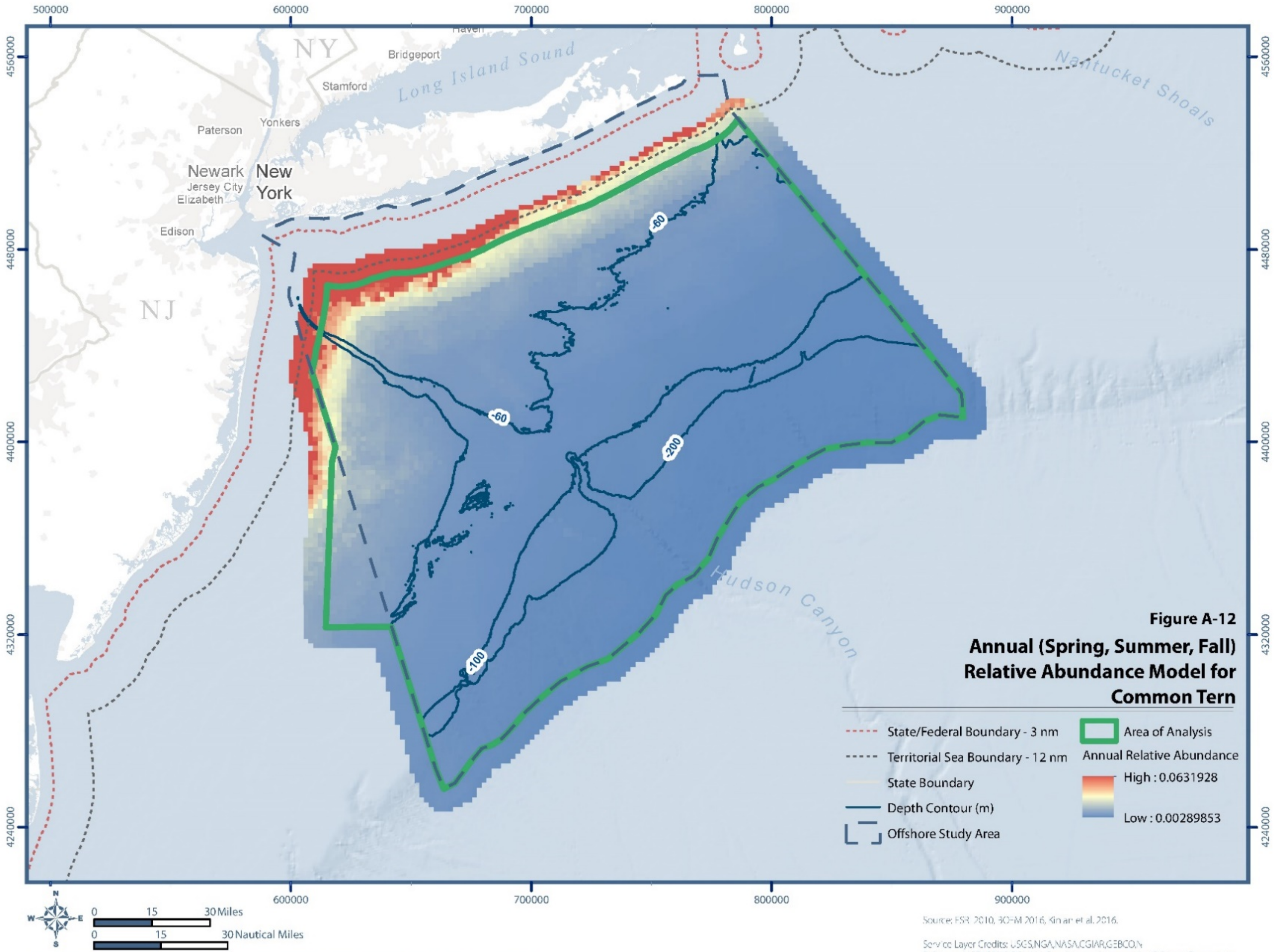
Normandeau (2017) did not record any Common Terns in the AoA in summer or fall of 2016. However, in the summer, Normandeau collected a number of observations of unknown terns and terns in the genus *Sterna* that could not be identified to species. These observations were primarily within the northern portion of the AoA, within approximately 25 miles of shore.

Common Terns forage mainly for fish, usually within 0.6 miles of the shore (Kaufman 2001; Nisbet 2002; National Audubon Society 2017). They often feed singly or in small groups, but may concentrate in large numbers over schooling predatory fish (Duffy 1986; Nisbet 2002). Common Terns forage from flight, typically by plunge diving from heights of 3 to 20 feet, but also by dipping to the surface (Kaufman 2001; Nisbet 2002; National Audubon Society 2017). When commuting with fish, they fly low to the water up to 100 feet above the surface (Nisbet 2002).

The foraging behavior of Common Terns suggests they may be sensitive to collisions with wind turbines (Kaufman 2001; Nisbet 2002; National Audubon Society 2017); however, they are more likely to fly through the AoA during migration, during which they fly at high altitudes (Nisbet 2002). Robinson Willmott et al. (2013) determined that Common Terns would have a "higher" sensitivity to collisions with offshore wind farms, and Furness et al. (2013) estimated a moderate to high sensitivity to collisions compared to other species in their respective studies. In Belgium, Everaert and Stienen (2007) found that Common Tern collisions with wind turbines located in close proximity to a breeding colony significantly impacted the breeding population with an additional 3.0 to 4.4 percent mortality. Johnston et al. (2014) estimated that about 3 percent of modeled Common Tern flights at potential offshore wind farm sites around Europe were at heights that make them susceptible to collision.

Figure A-12. Annual (Spring, Summer, Fall) Relative Abundance Model for Common Tern.

Source: ESRI 2010; BOEM 2016; Kinlan et al. 2016



Coordinate System: NAD_1983_UTM_Zone_18N. Projection: Transverse_Mercator. (Map border grid is in meters UTM zone 18N)

Path: M:\New_York_City\NYSERDA_Offshore\Maps\MXD\Masterplan_Figures\7_Birds_and_Bats\FigureA-12 Annual (Spring, Summer, Fall) Relative Abundance Model for Common Tern.mxd 10BP17A0034.01

Source: ESRI 2010, BOEM 2016, Kinlan et al. 2016.

Service Layer Credits: USGS,NGA,NASA,CGIAR,GEBCO,N Robinson,NCEAS,NLS,OS,NMA,Geodatastyrelsen and the GIS User Community

Everaert and Stienen (2007) found no evidence of displacement impacts on Common Terns. Dierschke et al. (2016) reviewed behavioral data from 20 offshore wind farms in Europe and also found that Common Tern behavior ranged from weak avoidance to weak attraction, but often exhibited no detectable displacement effects. Likewise, Furness et al. (2013) estimated the sensitivity to displacement impacts to be low to moderate relative to other species they studied. However, Robinson Willmott et al. (2013) determined that Common Terns would have "medium" sensitivity to displacement impacts compared to their other study species. Masden et al. (2010) demonstrated that breeding Common Terns would incur the highest rates of energetic cost increase of their study species in flying additional distances to avoid wind farms, largely because Common Terns fly a relatively high number of foraging trips per day. Overall, Garthe and Hüppop (2004) estimated that Common Terns would have a moderate sensitivity to wind farm impacts compared to other modeled seabird species in the North Sea (Europe).

A.1.8 Other Bird Species Groups

This section addresses other bird species groups that may occur but are not regularly documented in the AoA. These species groups generally do not forage or breed in offshore environments, and the potential for these species to occur in the AoA is primarily during migrations. Birds may fly over offshore waters, some at great distances, between their breeding or wintering grounds. These migrating birds cannot stop to feed or rest on the surface of the water; therefore, their flight heights and migratory or commuting paths are of importance. Summaries of occurrence by species group are provided below.

A.1.8.1 Raptors

Raptors are birds of prey represented by vultures (family Cathartidae); ospreys (family Pandionidae); hawks, eagles, and allies (family Accipitridae); Owls (families Tytonidae and Stigidae); and falcons (family Falconidae). In all seasons, raptors generally forage over onshore environments. Two raptor species in New York, Osprey (*Pandion haliaetus*) and Bald Eagle (*Haliaeetus leucocephalus*), feed primarily on fish; however, they typically feed in shallower waters and not in the offshore environment (Vana-Miller 1987; USFWS 2002). Ospreys in coastal areas prefer shallow waters generally within 9 miles of their nests (Prevost 1979; Flemming and Smith 1990; Hagan and Walters 1990). (Refer to Section A.3.3 for more information about Bald Eagles.)

Many raptors migrate long distances between their winter and summer habitats. Raptors are diurnal migrants and typically require onshore thermal currents to complete their migratory flights efficiently (Kerlinger et al. 1982). The Atlantic Coast is a "diversion line" that concentrates migrating raptors towards onshore or coastal areas, and many raptors appear to be reluctant to cross water when distances are greater than 12 miles (Goodrich and Smith 2008). However, some raptor species, including Ospreys and Peregrine Falcons (*Falco peregrinus*), are more routinely documented migrating over offshore waters than other species. For example, Kerlinger et al. (1982) documented 95 raptors (i.e., Osprey, Sharp-shinned Hawk [*Accipiter striatus*], Peregrine Falcon, Merlin [*Falco columbarius*], and American Kestrel [*Falco sparverius*]) migrating in offshore environments. In the study, Kerlinger et al. (1982) observed Ospreys furthest from shore, with a mean distance of 118 miles from land.

Desorbo et al. (2015) studied Peregrine Falcon migration in the offshore environment from 2012 to 2014 using satellite-tracking devices. They tracked 16 Peregrine Falcon migrations between Block Island, Rhode Island, and Monhegan Island, Maine, and southern Florida. Based on their data, Peregrine Falcons undertook long-distance migrations over offshore waters, including within the AoA, with flights up to 930 miles from the shore. When flying over water, Peregrine Falcons flew an average of 1,280 feet above the water surface. The authors suggested that offshore migration is potentially significant for the Peregrine Falcon.

Ospreys will also undertake significant long-distance migrations in offshore waters; however, when possible, they tend to stay over land (Martell et al. 2014). Ospreys that bred on Long Island migrated primarily over land and generally followed similar migratory pathways in the spring and fall (Martell et al. 2001, 2014). However, Horton et al. (2014) documented significant offshore migrations of juvenile Ospreys, which averaged 1,340 miles of non-stop travel when migrating over the Atlantic Ocean.

Robinson Willmott et al. (2013) estimated that the collision sensitivity associated with offshore wind farms on the Atlantic OCS for five raptor species—Osprey, Northern Harrier (*Circus cyaneus*), Peregrine Falcon, American Kestrel, and Merlin—was “lower” to “medium” compared to other species they studied. In addition, Robinson Willmott et al. (2013) estimated that all five species would have a “lower” risk of displacement impacts.

A.1.8.2 Passerines and Other Bird Taxa

Like raptors, passerines (songbirds of the order Passeriformes) and many other taxonomic families of primarily coastal and terrestrial birds (e.g., hummingbirds, woodpeckers, herons) generally forage over onshore or coastal environments and would not occur in the AoA. However, many species in these groups migrate long distances from breeding grounds in northern latitudes to winter sites in warmer climates of the southern United States, Caribbean, and Central and South America. As birds travel between their winter and summer breeding grounds, they funnel up and down the shorelines of New York and New Jersey, including urban centers such as New York City (USFWS 1997). While many birds stay in onshore and coastal areas during migration, others will also use offshore waters. The North Atlantic Ocean is a major route for birds as they move between the eastern United States and their winter range to the south, particularly during fall migration (McClintock et al. 1978). Many passerines and other bird taxa migrate at night (Alerstam et al. 2011).

Radar studies have revealed that passerines typically fly at heights greater than 3,300 feet during migration; however, flight heights can vary with weather conditions (Kerlinger and Moore 1989; Gauthreaux 1991). Robinson Willmott et al. (2013) reported that when migrating over offshore waters, passerines spend less than 5 percent of their time flying within the heights (65 to 656 feet) that correlate to a wind turbine's rotor-swept zone. As such, Robinson Willmott et al. (2013) gave most passerines low collision sensitivity scores. Three passerines received a "medium" collision sensitivity score. They determined that all studied passerines were at low risk of displacement impacts associated with offshore wind farms.

Herons, egrets, bitterns (family Ardeidae), and rails (family Rallidae) migrate at much lower heights than passerines (Wright et al. 2012). For study species in these groups, Robinson Willmott et al. (2013) assigned the highest rank for potential to occur within a wind turbine's rotor-swept zone. However, Robinson Willmott et al. (2013) estimated that herons, egrets, bitterns, and rails would have "lower" to "medium" sensitivities to collisions with offshore wind farms on the Atlantic OCS compared to other study species because of their low potential to occur within offshore environments. In addition, they determined that herons, egrets, bitterns, and rails have a "lower" risk of displacement impacts.

A.2 Bats

Records of bats in offshore Atlantic waters date back at least 100 years (Pelletier et al. 2013). Stantec (2016) reported that eight species of bats potentially occur over the Atlantic Ocean: the little brown bat (*Myotis lucifugus*), northern long-eared bat, eastern small-footed bat (*Myotis leibii*), tri-colored bat (*Perimyotis subflavus*), big brown bat (*Eptesicus fucsus*), silver-haired bat (*Lasionycteris noctivagans*), eastern red bat (*Lasiurus borealis*), and hoary bat (*Lasiurus cinereus*). Stantec found that bat species compositions between their Gulf of Maine and the mid-Atlantic coast study areas were similar, observing seven of the abovementioned eight species (excluding eastern small-footed bat) in both study areas. As the AoA is between the Gulf of Maine and the mid-Atlantic, it is reasonable to expect that the AoA would have a similar composition of bat species, although the potential for additional species should not be discounted. Stantec (2016) documented 13 individual bats in the AoA using acoustic detectors mounted on ships; however, they were not able to match the bat calls to specific species.

A number of recent studies documented bat activity in offshore Atlantic waters (Hatch et al. 2013; Pelletier et al. 2013; Sjollema et al. 2014; Stantec 2016). Stantec (2016) recorded bats up to 100 miles offshore. In the month of September, Hatch et al. (2013) detected eastern red bats in waters 10 to 30 miles offshore in the mid-Atlantic. Sjollema et al. (2014) surveyed for bats in mid-Atlantic offshore waters (up to 100 miles offshore) and documented eastern red bats, big brown bats or silver-haired bats, and hoary bats up to 14 miles from shore. Based on the study design and results, Sjollema et al. (2014) suggested that bat use would be higher in nearshore waters versus offshore waters.

Little is known about the heights at which bats fly over the offshore environment, especially in relation to the rotor-swept zone of offshore wind turbines. The Stantec (2016) and Sjollema et al. (2014) studies collected data at 330 feet (100 meters) or less. Hatch et al. (2013) recorded bats flying at heights of 330 feet (100 meters) to 660 feet (200 meters) above sea level, which represented the first study to document bats flying at higher altitudes in the offshore environment.

Bat studies in Atlantic offshore waters suggest that fall migration represents a time when bats are most likely to occur over offshore waters. Hatch et al. (2013) surveyed offshore waters year-round though they recorded all of their bat detections in September. Stantec (2016) focused their surveys in the Gulf of Maine and mid-Atlantic from April to November and March to December, respectively. Bat activity was highest in mid- to late August, but Stantec observed activity in all seasons surveyed. Survey locations on remote islands and offshore buoys revealed that bat activity was low or absent in the summer.

Offshore bat studies typically rely on acoustic detection that cannot provide a metric of density or abundance. Sjollema et al. (2014) detected relatively few bats in offshore waters compared to coastal areas. They proposed that bat mortality at offshore wind farms may not be as significant as at onshore wind farms. Stantec (2016) suggested that, despite unknown density and abundances, impacts on bats could be managed because the occurrence of bats in the offshore environment is relatively brief and offshore wind turbines would not provide suitable refuge.

In Europe, where existing offshore wind farms have encouraged the study of bat use and behavior, researchers have documented bats in offshore waters. In Scandinavia, Ahlén et al. (2009) documented bats migrating and foraging in the offshore environment between Sweden and Denmark. They detected individual and small flocks of bats flying at low altitudes (less than 30 feet) over the surface of the water. Ahlén et al. (2007) detailed bat activity around offshore wind turbines in the Baltic Sea near Kalmarsund, Sweden, approximately 10 miles offshore. They observed bats migrating through the area and foraging around the turbines and blades. Ahlén et al. (2007) observed bats foraging on the abundant invertebrate prey located near or at the water's surface and using offshore wind turbines as roosts. Boshamer and Bekker (2008) documented bats roosting on offshore oil platforms in the North Sea. Between 1988 and 2007, 34 bats were reported on offshore oil platforms during both the spring and fall migratory seasons. The average distance of bats at offshore oil platforms was 41 miles from shore, with the maximum distance over 100 miles.

Bat research in offshore environments is relatively limited, and is virtually non-existent in association with offshore wind energy development in the United States. In contrast, bats at onshore wind energy facilities have been well studied. Bats collide with onshore wind turbines at an estimated rate of over 600,000 fatalities per year in the United States (Hayes 2013). Migratory tree-roosting species appear to be most impacted by onshore wind turbines (Kunz et al. 2007). Bat collisions with offshore wind facilities would likely be much lower than at onshore facilities, but it is useful to examine bat interactions with onshore facilities in lieu of data from offshore facilities.

A.3 Special Status Species

This section identifies species that may occur in the AoA that are subject to federal and state laws and summarizes each species potential use of the AoA and their sensitivity to offshore wind farms, if applicable.

A.3.1 Endangered Species Act

The Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531 et seq.) provides a program for the conservation of threatened and endangered species of animals and plants and the habitats in which they occur. Under the ESA, the United States Fish and Wildlife Service (USFWS) may list species as either endangered or threatened based upon the species' biological status and threats to the species existence. The ESA prohibits the take of any threatened or endangered species except under federal permit. As defined in the ESA, "take" means "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to engage in any such conduct." Section 7 of the ESA directs federal agencies to consult with the USFWS, or the National Oceanic and Atmospheric Administration, Fisheries Service (NOAA Fisheries) for marine species, to ensure that any actions carried out under that agency's jurisdiction will not jeopardize the existence of any listed species or their habitat (USFWS 2013a).

The ESA requires the USFWS, or NOAA Fisheries, to designate "critical habitat" to help ensure the protection of habitat for listed species. Critical habitat includes those areas that contain the features needed to support the conservation of a listed species and that also may require special protection. The ESA mandates that federal agencies avoid any adverse impacts on designated critical habitat in actions undertaken, including activities funded or permitted by that action agency (USFWS 2013a).

This section describes the potential use of the AoA by species listed under the ESA as endangered, threatened, or candidate. The USFWS's (2017) Information for Planning and Conservation tool identified three bird species and one bat species listed under the ESA that may occur within the AoA: the Piping Plover, Red Knot, Roseate Tern, and northern long-eared bat. All four species may occur within the AoA during migration, but Roseate Terns may also occur in the AoA while foraging during breeding periods. No designated critical habitat for any ESA-listed species occurs within the AoA.

A.3.1.1 Piping Plover

Piping Plovers are a migratory shorebird that winter from North Carolina to the Caribbean and breed in the summer along the mid-Atlantic coast north into Canada (USFWS 1996). Piping Plovers nest on coastal beaches and barrier islands where they forage on marine invertebrates in the intertidal zone and mudflats. As such, Piping Plovers would not likely occur in offshore waters of the AoA during the breeding season. During migration, Piping Plovers fly along a narrow strip of coastline between breeding and wintering grounds, and records of Piping Plovers over offshore waters are rare (USFWS 1996; USGS 2013; eBird 2017; Normandeau 2017).

Burger et al. (2011) provided a sensitivity evaluation for Piping Plovers within a study area along the Atlantic OCS. The study area ranged from 3.4 miles offshore to waters 980 feet in depth, which covers a portion of the AoA. Burger et al. (2011) acknowledged that migratory flight heights are generally unknown, but noted that migratory flights over offshore waters are infrequent and, therefore, Piping Plover sensitivity to collisions with turbines remained unlikely. In addition, Burger et al. (2011) found that offshore wind energy development was unlikely to result in loss or modification of habitat.

A.3.1.2 Red Knot

The Red Knot is a long-distance migratory shorebird that may occur in the AoA and surrounding areas during spring or fall migrations. Red Knots winter between the mid-Atlantic coast (south of the AoA) and South America (Niles et al. 2010; Burger et al. 2012) and breed in the high Arctic (Niles et al. 2010). Burger et al. (2012) studied the migration and wintering habitats of Red Knots along the Atlantic coast and found that Red Knots had a high variation in their migration routes and stopover and wintering habitats. Red Knots often made multiple stops along the Atlantic Coast during spring and fall migrations and were capable of flying long distances, including over waters of the OCS. Burger et al. (2012) identified the coast of Long Island as a high use area. Additionally, the Niles et al. (2010) research proposed that the OCS between North Carolina and Cape Cod, Massachusetts, may be critical for Red Knot migration. Normandeau (2017) and USGS (2013) do not report records of Red Knot within the AoA, but eBird (2017) reports one individual over deeper waters of the Hudson Shelf Valley in 1997.

Burger et al. (2011) provided a sensitivity evaluation for Red Knots within a study area along the Atlantic OCS. The study area ranged from 3.4 miles offshore to waters 980 feet deep, which covers a portion of the AoA. They suggested that Red Knots are most sensitive to collision with offshore wind turbines when migrants travel northbound in the spring, but note that data are lacking on these movements. Southbound (fall) migrants are believed to fly further offshore and may not be as sensitive to offshore wind turbines. Burger et al. (2011) concluded that Red Knot migratory flights were greater than 3,300 feet in height, and this may reduce their sensitivity to collision with offshore wind turbines.

Gordon and Nations (2016) completed a collision sensitivity model for Red Knots for a project-specific study area in Nantucket Sound, Massachusetts. While modeling collision sensitivity is challenging and relies on many assumptions, their model relied on a number of known characteristics about Red Knot behavior and use of the offshore environment in their study area. Similar to Burger et al. (2011), Gordon and Nations' (2016) compilation of research suggested that Red Knots fly at heights of 1,640 to 6,560 feet above the water, sometimes as high as 9,840 feet (Alerstam et al. 1990; Piersma and Jukema 1990; Green 2004; Petersen et al. 2006). These flight heights are above the rotor-swept zone of offshore wind turbines. In addition, Red Knots do not feed or rest in offshore waters (Robinson Willmott et al. 2013). Gordon and Nations' (2016) model predicted that Red Knots were still sensitive to collisions from offshore wind energy development, and up to 16 Red Knots may collide with offshore wind turbines in their study area over a 100-year period. Robinson Willmott et al. (2013) estimated that Red Knots would have a "medium" collision sensitivity and a "lower" sensitivity to potential displacement impacts associated with offshore wind farms compared to other species they studied.

A.3.1.3 Roseate Tern

The Roseate Tern is a migratory seabird that breeds along the Atlantic Coast between eastern Long Island and Maritime Canada (Nisbet et al. 2014). In the winter, Roseate Terns migrate south to the West Indies and South America. Great Gull Island, situated in the Long Island Sound approximately 50 miles to the north of the AoA, contains the largest breeding colony of Roseate Terns in the western hemisphere and the only currently active breeding colony in New York (Eisenstein 2017; Papa 2017). During the 2016 breeding season, 1,858 nests were reported (Macleod-Nolan 2017).

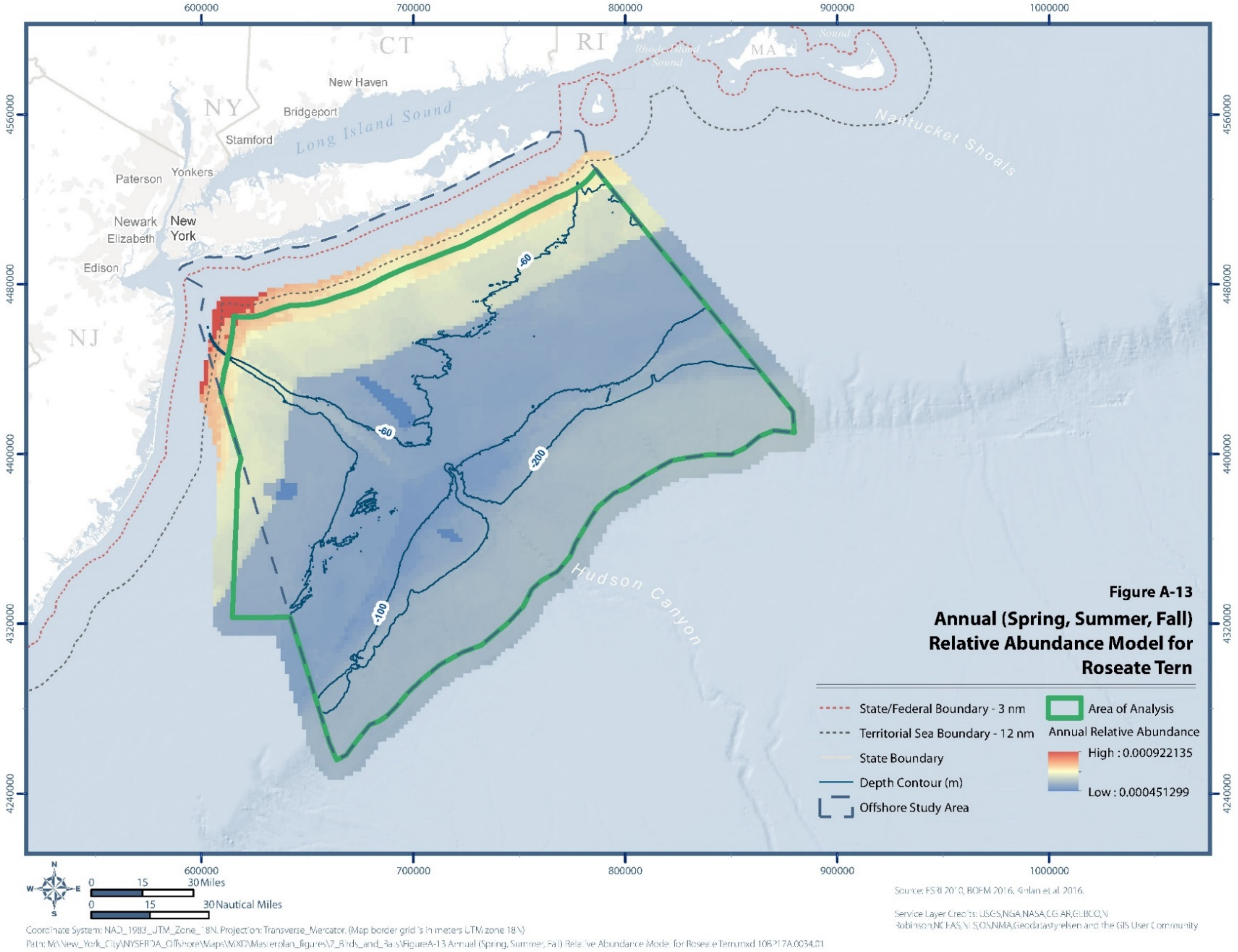
In the Long Island Sound, Roseate Terns foraged at a mean distance of 3.4 miles from their breeding colonies, with maximum distances of up to 13.6 miles (Duffy 1986). In other breeding colonies on the northeastern Atlantic Coast, Roseate Terns foraged at similar distances near shore and up to approximately 20 miles from their colonies (Heinemann 1992; Rock et al. 2007). Given that Great Gull Island, the only known active breeding colony in New York, is about 50 miles north of the AoA, it is unlikely that Roseate Terns from that colony are foraging within the AoA during the breeding season.

Before migrating south, Roseate Terns disperse from their breeding colonies and stage in large congregations (Shealer and Kress 1994; Trull et al. 1999; Nisbet et al. 2014; Loring 2016). Cape Cod and Nantucket represent the largest staging grounds for Roseate Terns, with at least 75 percent of the entire breeding population in the northeastern Atlantic using this area (Trull et al. 1999; National Park Service 2015a). From these staging grounds, it is believed that Roseate Terns migrate in offshore waters, up to 300 miles from land, directly to their wintering habitat (Nisbet 1984; Burger et al. 2011). Roseate Terns begin their migration at dusk and fly at heights above 3,280 feet (Viet and Petersen 1993 as cited by Burger et al. 2011).

The Kinlan et al. (2016) model displayed very low relative abundance and relative occurrence of Roseate Terns in the spring, summer, and fall within the AoA (Figure A-13). The highest estimated use is outside of the AoA and in the region of Cape Cod and Nantucket. The Balderama et al. (2015) model is consistent with Kinlan et al. (2016). eBird (2017) reports several records of Roseate Terns in the northern portion of the AoA, near Long Island. These records are from May and August. Roseate Terns are more abundant along the coastlines (eBird 2017). USGS (2013) reports one record of a Roseate Tern in the AoA, approximately 40 miles from the coast in the western portion of the AoA. Normandeau (2017) did not document Roseate Terns within their study area or the AoA in the spring or fall. However, in the summer Normandeau collected a number of observations of unknown terns and terns in the genus *Sterna* that could not be identified to species; it is possible that some of these observations were Roseate Terns.

Figure A-13. Annual (Spring, Summer, Fall) Relative Abundance Model for Roseate Tern.

Source: ESRT 2010; BOEM 2016; Kinlan et al. 2016



These observations were primarily within the northern portion of the AoA, within approximately 25 miles of the shore.

Burger et al. (2011) used the known characteristics about Roseate Tern's breeding habitat, migratory paths, and flight heights to provide a sensitivity evaluation for Roseate Tern within a study area along the Atlantic OCS from 3.4 miles offshore to waters 980 feet deep, which partially overlaps the AoA. Burger et al. (2011) determined that sensitivity of Roseate Terns associated with offshore wind farms was low.

In contrast, Robinson Willmott et al. (2013) estimated that collision sensitivity for Roseate Terns is "higher" compared to other species they studied. They based their score, in part, on the Roseate Tern's low population numbers, sensitivity to population-level impacts, and flight characteristics that put them at higher likelihood of being within a wind turbine's rotor-swept zone. Robinson Willmott et al. (2013) also estimated that Roseate Terns would have a high sensitivity to displacement impacts.

A.3.1.4 Northern Long-eared Bat

Stantec (2016) determined that the northern long-eared bat had the potential to occur within the offshore regions to the north and south of the AoA; therefore, this species presumably has the potential to occur in the AoA as well. The northern long-eared bat is within the *Myotis* genus, and studies that use acoustic detection often cannot reliably distinguish between species in this genus. As such, an unknown number of individuals identified in offshore areas as *Myotis* species may potentially be northern long-eared bats. In Stantec's (2016) Gulf of Maine and mid-Atlantic study areas, *Myotis* sp. were the most frequently detected species group over coastal and offshore areas.

Northern long-eared bats have been documented on coastal islands: Mount Desert Island, Maine (2 miles off mainland; Zimmerman 1998 as cited by Pelletier et al. 2013); Martha's Vineyard, Massachusetts (4 miles from the mainland; Buresch 1999 as cited by Pelletier et al. 2013); and various locations in and around Nova Scotia, Canada (a peninsula largely separated from the mainland by 30 to 50 miles; Broders et al. 2003). Their presence on these islands indicates that they must be able and willing to traverse offshore areas. Dowling et al. (2017) studied the movement of nano-tagged northern long-eared bats on the island of Martha's Vineyard (Massachusetts). However, they did not observe offshore movement by the five northern long-eared bats in their study and it appeared the bats may have hibernated on the island.

A.3.2 Migratory Bird Treaty Act

The Migratory Bird Treaty Act of 1918 (MBTA), 16 U.S.C. 703-718, prohibits the take of a migratory bird or its parts, nests, or eggs unless specifically permitted to do so by regulation (USFWS 2014). Per the MBTA and its implementing regulations, "take" is defined as "pursue, hunt, shoot, wound, kill, trap, capture, or collect (50 CFR §10.12)." Migratory birds, as defined by the MBTA, include nearly all species that may occur in the United States (1,026 in total) with the exceptions of some upland game birds and non-native species (e.g., Mute Swan [*Cygnus olor*]) that occur in the United States by way of human introduction (USFWS 2013b).

The MBTA does not explicitly include provisions for permits to authorize incidental take of migratory birds that result from an otherwise legal activity, where take is not the purpose of the activity. Instead, the USFWS encourages individuals, companies, and industries to use "best practices" established to help reduce and avoid the unpermitted take of MBTA-protected species. The USFWS may exercise their discretion to prosecute individuals, companies, or industries that are aware of a situation or activity resulting in the take of MBTA-protected species and fail to work to remedy the situation (USFWS 2013c). The USFWS may also prosecute individuals, companies, or industries that fail to employ conservation measures or minimize adverse impacts on MBTA-protected species. Although the MBTA does not specifically protect habitat, the alteration or disturbance of habitat during the course of project construction or operations that results in the take of an MBTA-protected species would constitute a violation of the MBTA.

Executive Order (EO) 13186, Responsibilities of Federal Agencies to Protect Migratory Birds (January 10, 2001), requires that all federal agencies undertaking activities that may negatively impact migratory birds take a prescribed set of actions to further implement the MBTA. EO 13186 directs federal agencies to develop a Memorandum of Understanding with the USFWS that promotes the conservation of migratory birds. In accordance with the development of the Memorandum of Understanding and to the extent practicable given legal and budgetary considerations, EO 13186 encourages agencies to implement a series of conservation measures aimed at reinforcing and strengthening the MBTA. The conservation measures may include provisions that require agencies to (1) support migratory bird conservation, (2) minimize and mitigate the effects on and take of migratory birds, (3) restore and enhance habitat, (4) prevent pollution, (5) incorporate conservation principles into agency plans and ensure their consistency with and support of existing migratory bird planning efforts, and (6) properly evaluate migratory birds in the National Environmental Policy Act process.

The MBTA and EO 13186 afford protection for all migratory birds, but EO 13186 requires prioritization of Birds of Conservation Concern (BCC) when considering impacts on migratory birds. BCCs are a subset of MBTA-protected species identified by the USFWS as those in the greatest need of additional conservation action to avoid future listing under the ESA. The USFWS designated BCCs at three distinct geographic scales: national, USFWS regions, and Bird Conservation Regions (BCRs). BCRs are the smallest geographic scale at which the USFWS identified BCCs, and the USFWS expects BCR-level BCC species to be the most useful for resource management agencies to comply with the MBTA and EO 13186. The AoA lies within BCR 30 (New England/Mid-Atlantic Coast; USFWS 2008).

There are 45 BCCs within BCR 30. Table A-2 provides the habitats, seasonal occurrence, and likelihood of occurrence within the AoA for each species. The table also provides references to species accounts in other sections of this Study, where appropriate. Many of the BCCs may occur in the AoA as possible migrants. Refer to Section A.1.8 for a general discussion of raptors, passerines, and other bird taxa and their use of the AoA.

A.3.3 Bald and Golden Eagle Protection Act

Bald Eagles and Golden Eagles (*Aquila chrysaetos*) are protected under the Bald and Golden Eagle Protection Act (BGEPA; 16 U.S.C. 668-668c). The BGEPA prohibits anyone without a federal permit to “take, possess, sell, purchase, barter, offer to sell, purchase or barter, transport, export or import, at any time or any manner, any bald eagle . . . [or any golden eagle], alive or dead, or any part, nest, or egg thereof.” “Take” is defined as “pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest or disturb.” The BGEPA defines “disturb” as “to agitate or bother a bald or golden eagle to a degree that causes, or is likely to cause, based on the best scientific information available, injury to an eagle, a decrease in productivity by substantially interfering with the eagle’s normal breeding, feeding or sheltering behavior, or nest abandonment by substantially interfering with the eagle’s normal breeding, feeding or sheltering behavior.” Under the BGEPA, a federal permit may be issued to authorize specific activities that include the take, possession, and transportation of specimens for scientific or exhibition purposes, for the religious purposes of Indian tribes, or when a take is necessary to protect wildlife or agriculture in a particular area (USFWS 2016).

Golden Eagles migrate through and winter in very low numbers in New York. There is no indication that they use offshore waters during migration or winter (Katzner et al. 2012; eBird 2017). As such, Golden Eagles would not occur in the AoA and are not discussed further.

Table A-2. Birds of Conservation Concern from Bird Conservation Region 30 that May Occur in the Offshore Study Area

Sources: eBird 2017; Rodewald 2015; USFWS 2008

Common Name	Scientific Name	Habitat(s)	Seasonal Occurrence	Likelihood of Occurrence[a]	Species-specific Account
Red-throated Loon	*Gavia stellata*	Marine habitat in sheltered shallow waters	Winter, spring, and summer	Likely	Section A.1.2
Pied-billed Grebe	*Podilymbus podiceps*	Dense stands of emergent vegetation or aquatic vegetation close to the surface	Winter, spring, and summer	Possible	No
Horned Grebe	*Podiceps auritus*	Large bodies of fresh water and, more commonly, salt water	Winter, spring, and summer	Possible	No
Great Shearwater	*Ardenna gravis*	Marine species with a large range covering most of the Atlantic	Spring, summer, and fall	Likely	Section A.1.3
Audubon's Shearwater	*Puffinus lherminieri*	Open ocean, almost exclusively over warm waters; nests on islands	Spring, summer, and fall	Likely	Section A.1.3
American Bittern	*Botaurus lentiginosus*	Wetlands dominated by tall, emergent vegetation	Spring and fall	Possible	No
Least Bittern	*Ixobrychus exilis*	Freshwater and brackish marshes with dense, tall growths of aquatic or semiaquatic vegetation	Spring and fall	Possible	No
Snowy Egret	*Egretta thula*	Along Atlantic and Gulf coasts and in Florida; generally prefers shallow estuarine sites	Spring and fall	Possible	No
Bald Eagle	*Haliaeetus leucocephalus*	Trees in forest adjacent to bodies of water	Spring, summer, and fall	Possible	Section A.3.3
Black Rail	*Laterallus jamaicensis*	High in palustrine and estuarine emergent wetlands	Spring and fall	Possible	No
Wilson's Plover	*Charadrius wilsonia*	Coastal areas of high salinity and sparse vegetation	Spring and fall	Possible	No
American Oystercatcher	*Haematopus palliatus*	Sand and shell beaches, dunes, salt marshes, and occasionally rock or other surfaces	Spring and fall	Possible	No
Solitary Sandpiper	*Tringa solitaria*	Freshwater lakes and ponds in areas of muskeg bogs and spruce trees.	Spring and fall	Possible	No

Table notes are at the end of table.

Table A-2 continued

Common Name	Scientific Name	Habitat(s)	Seasonal Occurrence	Likelihood of Occurrence[a]	Species-specific Account
Lesser Yellowlegs	*Tringa flavipes*	Wide range of wetlands, usually with shallow, vegetation-filled water and mud flats	Spring and fall	Possible	No
Upland Sandpiper	*Bartramia longicauda*	Obligate grassland, native prairie	Spring and fall	Possible	No
Whimbrel	*Numenius phaeopus*	Dunes, meadows, short grass fields, and tidal flats	Spring and fall	Possible	No
Hudsonian Godwit	*LimAoA haemastica*	Variable coastal and inland wetland and estuarine habitats	Spring and fall	Possible	No
Marbled Godwit	*LimAoA fedoa*	Variable coastal and inland wetland and estuarine habitats	Spring and fall	Possible	No
Red Knot	*Calidris canutus rufa*	Marine coasts, intertidal zones, inlets, estuaries, and bays	Spring and fall	Possible	Section A.3.1.3
Semipalmated Sandpiper	*Calidris pusilla*	Shallow fresh or salt water with little vegetation, muddy intertidal zones, or along edges of lakes	Spring and fall	Possible	No
Purple Sandpiper	*Calidris maritima*	Rocky shorelines and jetties/breakwaters, including rocky islets and peninsulas	Spring and fall	Possible	No
Buff-breasted Sandpiper	*Calidris subruficollis*	Dry grasslands (usually short grass), pastures, plowed fields and, rarely, mudflats	Spring and fall	Possible	No
Short-billed Dowitcher	*Limnodromus griseus*	Coastal mud flats and brackish lagoons	Spring and fall	Possible	No
Least Tern	*Sternula antillarum*	Bare or sparsely vegetated sand or dried mudflats along coasts or rivers; sandy or shell islands and gravel and sand pits	Spring, summer, and fall	Possible	Section A.3.4.2
Gull-billed Tern	*Gelochelidon nilotica*	Along Atlantic and Gulf coasts; most pairs nest on sandy beaches or on sandy barrier islands	Spring, summer, and fall	Possible	No
Black Skimmer	*Rynchops niger*	Open sandy areas or gravel or shell bars with sparse vegetation or broad mats of sea wrack	Spring, summer, and fall	Possible	No

Table notes are at the end of table.

Table A-2 continued

Common Name	Scientific Name	Habitat(s)	Seasonal Occurrence	Likelihood of Occurrence[a]	Species-specific Account
Short-eared Owl	*Asio flammeus*	Large open areas within woodlots, stubble fields, and fresh- and saltwater marshes	Spring and fall	Unlikely	No
Eastern Whip-poor-will	*Antrostomus vociferus*	Deciduous or mixed forests with little or no underbrush	Spring and fall	Possible	No
Red-headed Woodpecker	*Melanerpes erythrocephalus*	Variety of treed habitats, typically with a certain degree of openness and presence of dead limbs or snags for nesting purposes	Spring and fall	Possible	No
Peregrine Falcon	*Falco peregrinus*	Broad range of natural and artificial habitats	Spring and fall	Possible	Section A.1.8
Loggerhead Shrike	*Lanius ludovicianus*	Open country with short vegetation: pastures with fence rows, agricultural fields, riparian areas, open woodlands, etc.	Spring and fall	Possible	No
Brown-headed Nuthatch	*Sitta pusilla*	AoA is outside of species range.	n/a	Unlikely	No
Sedge Wren	*Cistothorus platensis*	Tall growths of sedges in palustrine and estuarine emergent wetlands	Spring and fall	Possible	No
Wood Thrush	*Hylocichla mustelina*	Interior and edges of deciduous and mixed forests, especially upland forest	Spring and fall	Possible	No
Worm-eating Warbler	*Helmitheros vermivorum*	Mature deciduous or mixed deciduous-coniferous forest overlapping with hillsides and smaller patches of shrubs	Spring and fall	Possible	No
Golden-winged Warbler	*Vermivora chrysoptera*	Dense patches of herbs and shrubs with some taller trees. Trees often form the territorial border	Spring and fall	Possible	No
Blue-winged Warbler	*Vermivora cyanoptera*	Early to mid-successional habitat, patches of dense herbaceous growth	Spring and fall	Possible	No
Kentucky Warbler	*Geothlypis formAoA*	Bottomland forests at lower elevation with dense understory	Spring and fall	Possible	No

Table notes are at the end of table.

Table A-2 continued

Common Name	Scientific Name	Habitat(s)	Seasonal Occurrence	Likelihood of Occurrence[a]	Species-specific Account
Cerulean Warbler	*Setophaga cerulea*	Old-growth deciduous forest with preference for broad-leaf species	Spring and fall	Possible	No
Prairie Warbler	*Setophaga discolor*	Early successional, open-canopied plant communities	Spring and fall	Possible	No
Henslow's Sparrow	*Ammodramus henslowii*	Open field habitats such as marsh, swamp, pocosin, and prairie	Spring and fall	Possible	No
Nelson's Sparrow	*Ammodramus nelsoni*	Coastal cordgrass marshes	Spring and fall	Possible	No
Saltmarsh Sparrow	*Ammodramus caudacutus*	Inland prairies, freshwater marshes, and meadows	Spring and fall	Possible	No
Seaside Sparrow	*Ammodramus maritimus*	Varied vegetation structures in tidal marshes	Spring and fall	Possible	No
Rusty Blackbird	*Euphagus carolinus*	Swamps, wet woodlands, and pond edges	Spring and fall	Possible	No

Notes:

[a] Likelihood of occurrence was determined based on available suitable habitat and documented observations in Project counties (eBird 2017).

Likelihood of Occurrence category definitions:

Likely – Project area lies within the species' range, suitable habitat is available, and data suggest the species regularly occurs in the area.

Possible – Project area lies within the species' range, contains some suitable habitat, and/or data suggest the species may occur, but not regularly.

Unlikely – Project area is outside of species' range, suitable habitat does not occur, and/or rare/no occurrence records in vicinity.

Bald Eagles occur year-round in southeastern New York (Nye 2010). There are approximately 100 breeding pairs and hundreds of wintering birds in the area. While not numerous, there are records of nesting Bald Eagles on the shorelines of Long Island and New Jersey (National Park Service 2015b; Smith and Clark 2016). Bald Eagles forage in a variety of aquatic habitats, including over marine waters; however, they restrict foraging to habitats near shore and typically forage within 1 mile of their nests (Livingston et al. 1990). Bald Eagles also typically hunt over shallow waters, often less 13 feet deep (Watson et al. 1991; Thompson et al. 2005). As such, Bald Eagles would not likely occur within the AoA while foraging.

During migration, Bald Eagles use coastal and inland routes, and offshore migration routes have not been documented (Wood et al. 1998; Mojica et al. 2008; Mojica et al. 2016; Smith and Clark 2016; Conserve Wildlife Foundation of New Jersey 2017). Mojica et al. (2016) tagged Bald Eagles migrating in the northern United States with satellite trackers. Their utilization models revealed that Bald Eagles exhibit low use in nearshore waters; however, Mojica et al. only modeled nearshore portions of the AoA. Other portions of the AoA also would likely be characterized as having low or no use because Mojica et al. (2016) did not document Bald Eagles in deeper waters. eBird (2017) does not report any records of Bald Eagles within the AoA.

A.3.4 New York State Endangered and Threatened

New York Environmental Conservation Law § 11-0535 prohibits, except under license or permit from the New York State Department of Environmental Conservation (DEC), “the taking, importation, transportation, possession or sale of any endangered or threatened species of fish, shellfish, crustacea or wildlife.” The DEC designates species that they deem seriously threatened with extinction as “endangered,” and species as “threatened” if they “are likely to become endangered species within the foreseeable future throughout all or a significant portion of their range.” The DEC also designates “species of special concern,” which are species they deem to be at risk of becoming threatened. Species of special concern are not subject to the same prohibitions under New York Environmental Conservation Law § 11-0535 as endangered and threatened species, but the law does allow the DEC to institute regulations to prohibit the taking, importation, transportation, possession or sale of any species of special concern as they deem necessary for the proper protection of those species.

Six state-listed bird species and one bat species may occur within the AoA: Piping Plover, Least Tern (*Sternula antillarum*), Black Tern (*Chlidonias niger*), Roseate Tern, Common Tern, Peregrine Falcon, and northern long-eared bat. Five of these species are discussed in previous sections and will not be discussed further here: Piping Plover (Section A.3.1.1), Roseate Tern (Section A.3.1.3), Common Tern (Section A.1.7), Peregrine Falcon (Section A.1.8), and northern long-eared bat (A.3.1.4). Black Tern and Least Tern are discussed below.

A.3.4.1 Black Tern

Black Terns are state-listed as endangered in New York. They breed in freshwater wetlands in the northern United States and Canada, but do not breed on Long Island or coastal New Jersey (Shuford 1999; DEC 2017). Black Terns winter in Mexico and South America (Shuford 1999). Their potential to occur within the AoA is limited to spring and fall migration periods. They primarily migrate inland or along the coasts but may occur offshore. During migrations, Black Terns typically fly singly or in small flocks, but they may form larger flocks over concentrated food sources in coastal or marine habitats (Heath et al. 2009). Black Terns commonly fly over offshore waters up to 6,500 feet deep in the Gulf of Mexico, but similar data are not available for their use of Atlantic offshore waters (Fritts and Reynolds 1981; Heath et al. 2009).

eBird (2017) reports low numbers of Black Terns records within the AoA, with sighting occurring primarily in August and September and with two sightings in May. The areas of greatest frequency of occurrence are in shallower waters of eastern Long Island and along the Hudson Shelf Valley, particularly in deeper waters. Normandeau (2017) did not detect Black Terns in their summer or fall 2016 surveys. Likewise, USGS (2013) did not report records of Black Terns in the AoA.

Robinson Willmott et al. (2013) estimated that Black Terns would have a “higher” collision sensitivity and “medium” sensitivity to displacement impacts associated with offshore wind farms compared to other species they studied.

A.3.4.2 Least Tern

The Least Tern is state-listed as threatened in New York. They breed in the summer on coastal beaches, islands, and wetland habitats on Long Island and coastal New Jersey and forage over shallow waters and, occasionally, offshore waters (Erwin 1981; Thompson et al. 1997). They feed while plunge diving from 3 to 35 feet above the water (Thompson et al. 1997; Kaufman 2001). Least Terns migrate south in the winter to Central and South America, primarily following rivers and coastlines. They may cross open water for more direct routes, but known offshore routes are limited to the Caribbean, Gulf of Mexico, and off the Pacific coast of Mexico (Thompson et al. 1997).

Kinlan et al. (2016) modeled Least Tern relative abundance and relative occurrence throughout the AoA as very low during the summer. Within the region, Least Terns are primarily located in nearshore waters of New Jersey and New York. Normandeau (2017) recorded 36 Least Terns in summer of 2016; however, most were in nearshore waters outside of the AoA. One Least Tern was located in the southern portion of the AoA in waters deeper than 200 feet (60 meters). eBird (2017) reports several records of Least Terns within the AoA, all of which are from May through August.

Robinson Willmott et al. (2013) estimated that Least Terns would have a "medium" collision sensitivity and "lower" sensitivity to displacement impacts associated with offshore wind farms compared to other species they studied.

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