United States Department of the Interior

FISH AND WILDLIFE SERVICE
New England Field Office
70 Commercial Street, Suite 300
Concord, New Hampshire 03301-5087
http://www.fws.gov/northeast/newenglandfieldoffice

Re: Final Biological Opinion, Cape Wind Associates, LLC, Wind Energy Project, Nantucket Sound, Massachusetts
Formal Consultation # 08-F-0323

November 21, 2008

Mr. James Kendall
Chief, Environmental Division
Minerals Management Service
Washington, D.C. 20240

Dear Mr. Kendall:

This document transmits the Fish and Wildlife Service's (Service) biological opinion (BO) based on our review of the Minerals Management Service (MMS) proposed issuance of a lease or easement to Cape Wind Associates, LLC (CWA), to construct, operate and decommission a wind energy project on Horseshoe Shoal in the federal waters of Nantucket Sound, Massachusetts, and the effect on the threatened piping plover *(Charadrius melodus)* and endangered roseate tern *(Sterna dougalli dougalli)*. This document was prepared in accordance with section 7 of the Endangered Species Act of 1973 (ESA), as amended (16 U.S.c. 1531 *et seq.)*.

This BO is based on information provided in the MMS May 2008 biological assessment (BA), subsequently provided supplemental project information, and other sources of information cited herein. A complete administrative record of this consultation is on file at the Service's New England Field Office.

If you have any questions regarding this opinion, please contact Mr. Michael Amaral or Susi von Oettingen of my staff at (603)223-2541, or at the letterhead address.

Sincerely,

Thomas R. Chapman
Supervisor
New England Field Office

Attachment

# Biological Opinion
# for the
# Cape Wind Energy Project
# Nantucket Sound, Massachusetts

This document, dated November 21, 2008, is the U.S. Fish and Wildlife Service's (Service) biological opinion (BO) pursuant to our formal section 7 consultation under the Endangered Species Act of 1973 (ESA), as amended (16 U.S.C. 1531 *et seq*.). Minerals Management Service's (MMS) May 19, 2008 request to initiate formal consultation was received by the Service on May 20, 2008. MMS, the lead federal agency, is also consulting with the Service on behalf of the Army Corps of Engineers (ACOE) and the Environmental Protection Agency, the additional federal agencies with approval or permitting authorities for the Cape Wind Project. Cape Wind Associates, LLC (CWA) proposes to generate electricity from wind energy on the outer continental shelf; some components of the facility are located in waters within three miles of the coast and onshore. The proposal calls for construction of 130 wind turbine generators and associated infrastructure commencing in 2009 and operations beginning in 2010 (as described in the January 2008 Draft Environmental Impact Statement).

The ESA-listed species under the jurisdiction of the Service that are considered in this formal consultation are the threatened Atlantic Coast piping plover (*Charadrius melodus*) population and the endangered northeastern population of the roseate tern (*Sterna dougallii dougallii*). There is no critical habitat designated pursuant to section 4 of the ESA within the Horseshoe Shoal marine environment or elsewhere within the project area for either avian species. Similarly, there are no species currently proposed for ESA listing as threatened or endangered that may be present in the project area. We have also evaluated the potential effect of the project on the threatened northeastern beach tiger beetle (*Cicindela dorsalis dorsalis*), which occurs on the periphery of the project area, and concur with your evaluation, dated October 9, 2008, that the project is not likely to adversely affect this species. We based our concurrence on information provided in your October 9, 2008 letter and an analysis of the probability for an oil spill attributable to the Cape Wind Project (Etkin 2006) to reach a finding of not likely to adversely affect the northeastern beach tiger beetle or its habitat in Nantucket Sound.

The Service underscores that this BO only applies to the roseate tern and piping plover, as listed species under the ESA. Under numerous prior correspondence, the Service submitted comments regarding other avian trust resources, the potential for those resources to be impacted by the project, and MMS's treatment of those species in its draft environmental documentation. The contents of this BO should not be construed or extrapolated to apply to non-listed avian species, which are present in the project area in different numbers and frequency, and which exhibit different life histories, ecology and behaviors. For instance, the Service's conclusions about the level of anticipated effects, the vulnerability to collision, the utility of radar for research and monitoring apply only to the roseate tern and piping plover.

<u>Information Standard</u>
Section 7(a)(2) of the ESA requires that federal agencies undergoing consultation use the best scientific and commercial data available. The regulations implementing this section reiterate that both action agencies and the Service must employ this information standard in carrying out their consultation responsibilities [50 CFR §402.14(d) and (g)(8)].[1] The Service's Policy on Information Standards Under the Endangered Species Act [59 FR 34271 (July 1, 1994)] calls for the review of all scientific and other information to ensure that the information used by the Service to implement the ESA is reliable, credible, and represents the best scientific and commercial data available. The regulations [(50 CFR §402.12(d)(2)] also state that the Service may recommend discretionary studies or surveys that may provide a better information base for the preparation of a biological assessment. However, any recommendation for studies or surveys is not to be construed as the Service's opinion that the federal agency has failed to satisfy the information standard of section 7(a)(2) of the ESA. The Service's Consultation Handbook [section 1.2(D)] states that, where significant data gaps exist, the agencies can agree to extend the due date of the biological opinion until sufficient information is developed for a more complete analysis, or the Service can develop the biological opinion with the available information, giving the benefit of the doubt to the species. The Service's regulations again reiterate this point, noting "if no extension of formal consultation is agreed to, the Director will issue a biological opinion using the best scientific and commercial data available" [50 CFR §402.14(f)].

Uncertainty arising from a lack of information is inherent in biological evaluations and, when significant, can limit confidence in the conclusions drawn from the information or, in some cases, make drawing conclusions at all extremely difficult. Although Service policy regarding significant data gaps calls for giving the benefit of the doubt to the species, the Service cannot forgo addressing uncertainty within certain aspects of a project or its effects, to the best of its abilities. For example, the Service may find that surrogate species information can be used to address uncertainty arising from incomplete or contradictory information. When the scientific literature, surrogate species information, and expert opinion do not support consistent biological determinations, the Service must consider the weight of scientific authority in evaluating expert opinions and the basis for those opinions.

In the course of reviewing and commenting on the Cape Wind Project under all of its applicable authorities, the Service recommended several studies to more fully assess the project's impacts, particularly impacts on migratory birds. Certain information was collected, and some was not. While they would have generated information useful to assessment of migratory birds generally, the unimplemented studies would not necessarily yield information that would have significantly addressed the uncertainties in the analysis of impacts to the roseate tern and piping plover specifically. Other recommended studies (e.g., acoustic monitoring) involve techniques that are relatively untested in the offshore environment, and their potential to yield useful information about roseate terns and piping plovers is, as yet, unproven.

Another ubiquitous issue in ESA decisions is the robustness of available data. More samples over longer time periods increase confidence that natural variability inherent to natural systems

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1 Section 402.14(g)(8) also states that the Service "will give appropriate consideration to any beneficial actions taken by the Federal agency or applicant…"

has been captured. However, while cautious scientists always value additional data, benefit of doubt to the species can be conferred by other means. For example, cushions can be added to best existing estimates, or sensitivity tests can be performed to explore effects of higher or lower values. Information from one location can be compared with larger data sets collected elsewhere and potential reasons for any apparent differences can be evaluated.

This BO contains (among other things) a description of the project, species affected, and anticipated impacts. We based our findings on our independent review of the best scientific and commercial data available. In doing so, we reviewed field reports and investigations by Service staff and others, evaluated information in our files and the scientific literature, and conducted interviews with species and technical experts regarding species ecology, phenology, behavior, and the effects of wind turbines on birds. Service biologists also visited two wind power projects within the North Atlantic breeding range of the endangered roseate tern and threatened piping plover and independently reviewed post-construction avian mortality studies to assess their methodologies, limitations and utility.

Moreover, in preparing this BO, the Service reviewed the results of various models (e.g., collision, population viability, oil spill trajectory models) provided by CWA with respect to the effects of the proposed project on the local and rangewide populations of the roseate tern and piping plover. Models are used to synthesize complex data and assist in the formulation of predictions. Our confidence in a model's projections is determined by a number of factors, such as the amount and quality of the available data and understanding of relevant physical and biological processes; appropriate variance in input estimates and number of model iterations (for stochastic models); use of sensitivity tests to explore effects of changes in parameter estimates; consistency of model projections with those of other related models (or logical explanations for deviations); and comparisons between model projections and empirical evidence from past experience with similar or related questions. In assessing the results of the models used to explore the potential impacts of the Cape Wind Project, we carefully considered these factors and judiciously considered model predictions in the formulation of our findings.

We also considered and independently reviewed information from the following sources: MMS's May 2008 Biological Assessment (BA) for the Cape Wind Energy Project - Nantucket Sound; the January 2008 MMS Draft Environmental Impact Statement (DEIS); the February 15, 2007 final Environmental Impact Report (FEIR); the September 19, 2008 Framework for the Avian and Bat Monitoring Framework for the Cape Wind Proposed Offshore Wind Facility; numerous meetings, conference calls, workshops, and exchanges of information summarized in the Consultation History section (Appendix 1).

<u>Consultation History</u>

There is an extensive consultation history on the Cape Wind Project that spans the time frame from July 2001 to the present, and consists of several hundred articles of correspondence, including letters, telephone conversation records, electronic communications, and meeting summaries. A detailed chronological listing of the consultation history following the passage of the Energy Policy Act of 2005 in August 2005, when MMS assumed permitting and environmental review responsibility from the ACOE, to the present is provided in Appendix 1.

# BIOLOGICAL OPINION

**This BO addresses the effects of all activities associated with Cape Wind Associates' application to lease, construct, operate, maintain, and decommission a wind energy project on Horseshoe Shoal in Nantucket Sound, Massachusetts.**

## DESCRIPTION OF THE ACTION

As described in your letter of May 19, 2008 to the Service's Region 5 Regional Director Marvin Moriarty, the proposed project would consist of the construction of 130 wind turbine generators (WTGs) arranged in an array one-half mile to one-third mile apart across a 25-square-mile area on Horseshoe Shoal in Nantucket Sound. The project is approximately six miles offshore from Hyannis and 19 miles from South Beach, Chatham on the south shore of Cape Cod, 14 miles from Nantucket and nine miles from Edgartown, Massachusetts. The wind energy facility is designed for a maximum energy capacity of 454 megawatts (MW) with an average generation capacity of approximately 182.6 MW. A detailed description of the action and the project area is found in section 2.0 in the BA (pages 2-1 to 2-9), as well as in section 2.0 (pages 2-1 through 2-29) of the DEIS.

The BA concludes, and the Service concurs for the reasons explained in this BO, that the primary impact to ESA-listed birds is from collision injury and mortality with the WTGs, monopoles and electrical service platform (ESP), although there may be minor impacts from potential oil spills and associated construction activities. The following is a brief summary of the salient components of the proposed facility taken from pages 2-3 through 2-5 of the BA and the 2008 Framework for the Avian and Bat Monitoring Plan for the Cape Wind Proposed Offshore Wind Facility (Monitoring Framework):

- WTG Rotor Diameter: 364 ft (111 meters).
- WTG Monopole and Nacelle Hub Height: 275.5 ft (84 m) required to maintain a minimum of 75 ft (23 m) clearance between the rotor blade at the low point in its arc and the surface of the water.
- Overall WTG Height: 440 ft (134 m).
- Rotor-Swept Zone: 75 ft (23 m) to 440 ft (134 m), a circular area equal to 2.4 acres (1 ha) per WTG.
- Generating capacity: ±3.6 MW with a cut-in wind speed of approximately 8 mph (J. Lewandowski, MMS, electronic correspondence, October 1, 2008).
- WTGs have a stated life span of a minimum of twenty years.
- WTGs generate electricity independently of each other.
- Submarine inner array cables from each WTG interconnect within the grid and terminate on the ESP.
- The ESP is a fixed template platform of approximately 100 ft by 200 ft (30.5 m by 61 m), and approximately 39 ft (11.9 m) above mean lowest low water.
- The ESP is located within the approximate center of the WTG array and serves as the common connection point for all WTGs. Circuit breakers and transformers are interconnected with the cable systems in order to transmit power through shore-connected submarine cable systems.

- The shore-connected submarine cable travels northeast in Nantucket Sound into Lewis Bay, making landfall at New Hampshire Avenue in Yarmouth, Massachusetts.
- The proposed onshore transmission cable route to its intersection with the NSTAR Electric right-of-way (ROW) would be located entirely along existing paved underground utilities' ROWs. A portion of the onshore transmission cable route would be located underground within the existing maintained NSTAR Electric ROW.
- Construction equipment, wind turbine components and supplies will be staged at Quonset Point, Rhode Island. Maintenance vessels may be staged out of New Bedford and/or Falmouth, Massachusetts.
- CWA will prepare a Spill Prevention Control and Countermeasure Plan prior to operation of the facility in order to prevent contamination of wildlife and the environment, including roseate terns, piping plovers and their habitats (see 9.3.2 of the DEIS).

**Installation of transmission cable**

Approximately 12.5 circuit miles (20.1 km) of transmission cable will be installed in two circuits. The submarine transmission line will be installed via jet plow embedment over a period of two to four weeks. Installation in Lewis Bay will take one to two days, passing by Egg Island only in a few hours (this will occur twice to complete the circuit) (R. Pachter, electronic correspondence, 2008). Measures to minimize sedimentation resulting from the submarine cable embedment include 1) a turbidity curtain placed near the eelgrass bed near Egg Island, 2) monitoring of staging terns on Egg Island when the cable-laying ship passes by, and 3) to the maximum extent possible, CWA will avoid construction near Egg Island during low tide if construction occurs between mid-July and mid-September.

**Framework for the Avian and Bat Monitoring Plan for the Cape Wind Proposed Offshore Wind Facility**

The Framework for the Avian and Bat Monitoring Plan for the Cape Wind Proposed Offshore Wind Facility (Monitoring Framework) is an outline for developing pre-construction monitoring and post-constructing monitoring protocols for avian and bat presence in the project area and effects to these species from the wind project. The matrix provided in the Monitoring Framework summarizes pre- and post-construction survey methodology (with the exception of the anti-perching monitoring). The Service, MMS and CWA coordinated in the development of the Monitoring Framework with respect to pre- and post-construction monitoring for roseate terns and piping plovers. Monitoring protocols for other avian species and bats were not addressed in great detail during the coordination and review of draft versions of the Monitoring Framework.

This BO comments only on those provisions of the Monitoring Framework that relate specifically to roseate terns and piping plovers. For the roseate tern and piping plover, the Monitoring Framework proposes to:

1. Test the effectiveness of anti-perching devices (see Conservation Measures below) during pre-construction and post-construction. Adjustments to the anti-perching measures will be made in coordination with MMS and the Service based on the pre-construction monitoring results of perching deterrent devices on the met tower and ESP. Anti-perching device monitoring specifics are found on page 15 of the Monitoring Plan.

2. Monitor piping plover and roseate tern movement within the project area using radio telemetry. Pre-construction testing of the methodology would occur on surrogate species (common terns and semipalmated plovers). Post-construction radio tracking of piping plovers and roseate terns would be dependent on the outcome of the pre-construction radio telemetry monitoring effort.
3. Monitor avian use of the project area using acoustic technology. Acoustic monitoring is proposed for pre- and post-construction surveys to determine species' presence and possible passage rates.
4. Conduct visual aerial and boat surveys. For the purposes of endangered species monitoring, the visual surveys will be limited to supplement or ground-truth proposed radio telemetry monitoring (page 4 of the Monitoring Framework) and/or will be used to document and monitor post-construction changes in roseate tern use of the project area (page 16 of the Monitoring Plan).
5. Monitor post-construction collision mortality. A Thermal Animal Detecting System (TADS) consisting of a thermal video camera, data logger and software is tentatively proposed for monitoring the incidence of post-construction avian collisions at the WTGs and ESP. The methodology may be revised after coordination with MMS and the Service if newer technology is developed (e.g., blade collision sensors).
6. Provide monitoring reports at the end of the pre-construction surveys and annually by December 15 once post-construction surveys have been initiated.

**Conservation measures implemented to reduce adverse effects**
Conservation measures, as opposed to conservation recommendations discussed at the end of this BO, represent actions pledged in the project description that the action agency or CWA will implement to minimize adverse effects to roseate terns and piping plovers and to further the recovery of the species under review. As a result of extensive discussions with MMS and CWA during the informal consultation for this action, a number of conservation measures that make the Cape Wind Project less likely to adversely affect threatened and endangered species were incorporated into the project description. Some of these measures are described on pages 8-10 to 8-15 of the BA and in section 5.3.2.4.2 of the DEIS.

The following are conservation measures incorporated into the project proposal:

**Perching Deterrents**
Birds that perch on wind turbines are likely to be at increased risk of collision mortality, particularly if they use the structures for nesting or to initiate courtship displays. Roseate terns could be subjected to avian predation, if raptors opportunistically use the WTGs or ESP as hunting perches. CWA's proposed design, which utilizes monopole or tubular supporting towers for the WTGs, will minimize the likelihood that terns, plovers or other birds will find perching opportunities readily available on the structures. Additional perching deterrent devices (wires, paneling and fencing) will discourage birds from perching on railings and deck areas of the WTGs and the ESP. CWA has committed to field testing anti-perching wire at an alternate location prior to implementation of the project (Appendix B, section 2.2.3 of the BA; 2008 Monitoring Plan, pages 13-15). CWA proposes to monitor the effectiveness of the anti-perching devices for three months (May, June and July) during two years and evaluate the use of alternative or additional devices if warranted. If perching remains an issue based on these

monitoring results, CWA will propose additional anti-perching mechanisms for approval by MMS in coordination with the Service, and then consequently monitor the effectiveness of these new devices during the breeding season from mid-May to late July and the staging season from mid-August to late September.

**Oil Spill Planning and Preparedness**

MMS requires a draft Operation and Maintenance Plan that details standard operating and maintenance protocols to ensure proper operation of offshore facilities. The draft O&M Plan specifies operating guidelines, maintenance schedules, and materials approved for maintenance activities. Within the Operation and Maintenance Plan, CWA would be responsible for developing and implementing an Oil Spill Response Plan (OSRP) covering all phases of the proposed action. The OSRP would be prepared in accordance with the DOI's MMS regulations at 30 CFR §254, "Oil Spill Response Requirements for Facilities Located Seaward of the Coastline."

The Spill Prevention Control and Countermeasure Plan proposed by CWA states that it will meet the requirements of an MMS OSRP by addressing the vessels involved in construction and maintenance of the wind farm, and assessing the different types and amounts of oil products used in the WTGs and the ESP. MMS required that an oil spill risk assessment and fatality study be conducted; these are included in the DEIS (Etkin 2006; Knee *et al*. 2006) and meet the requirements of the OSRP according to MMS. In the event there is an oil spill related to the Cape Wind Project, response activities occurring within roseate tern and piping plover breeding, roosting and foraging habitat shall include measures to avoid adversely affecting these species and their habitats.

**Lighting**

The Cape Wind Project proposes to light 50 WTGs on the perimeter of the array and the eight WTGs adjacent to the ESP at night for aviation safety, each lit with a single flashing red light. The 72 interior WTGs would not be lit with aviation lighting at night. All aviation lights will be synchronized and flashing at 20 flashes per minute. WTG and ESP lighting meets FAA and U.S. Coast Guard requirements (DEIS) and uses a minimum number of lights of medium to low intensity and a minimum number of flashes per minute per the Service's interim guidelines on avoiding and minimizing wildlife impacts from wind turbines (USFWS 2003).

**Bird Island Restoration Project**

Bird Island is the second largest roseate tern nesting colony for the species in the western North Atlantic and is both the largest colony in Massachusetts and the largest colony in proximity to the Horseshoe Shoal project area. It is also consistently one of the most productive breeding sites for the species in the Northeast, with nesting roseate terns producing about 1.2 young per pair [Roseate Tern Recovery Team (RTRT) 2007].

Roseate tern nesting habitat on the 3-acre Bird Island is deteriorating due to erosion and salt water intrusion through the crumbling, 160-year-old revetment that surrounds and protects the island. Presently, only 1.5 acres is above the mean high water spring tide (ACOE 2005). Erosion of the island has lowered ground elevations (from 4-10 ft mean low water), changing portions of the island from sand and gravel to salt marsh and salt pannes (ACOE 2005). These lower areas are unsuitable as nesting habitat and have reduced the extent of the area available on the island for nesting by terns. As a consequence, the island can physically support fewer nesting pairs of terns, leading to crowding between the 1,800 pairs of common terns and ~1,000 pairs of roseate terns that nest there annually. Even without consideration that there may be an accelerated rate of erosion due to the deteriorating condition of the revetment and the potential for sea level rise, another 0.25 acre of tern nesting habitat is projected to be lost in the next 25 years if steps are not taken to "restore" the island (ACOE 2005).

The need to "physically maintain, enhance and expand nesting habitat with dredged material", task 1.3451 in the Roseate Tern Recovery Plan – Northeast Population, is identified as a priority 1 recovery task (USFWS 1998). The Service defines priority 1 recovery tasks as those that must be taken to prevent species extinction or to prevent the species from declining irreversibly in the foreseeable future.

The State of Massachusetts, the Town of Marion, the ACOE, the Service and other interested parties are actively studying alternative ways in which the revetment and tern nesting habitat on the island can be restored (ACOE 2005; DEIR 2002). The alternative recommended by the ACOE (2005) is to restore and repair the existing stone revetment in its current location on the island and to use clean dredged material to raise the elevation of 0.64 acre of habitat landward of the revetment. Re-vegetation of the filled area and the placement of artificial nest boxes will enhance the restored areas' suitability for tern nesting. This will result in about 2.2 acres of habitat suitable for tern nesting on the island. The ACOE (2005) considers the Bird Island restoration project (in planning) to have a 50-year life. On page 8-10 of the BA, MMS states that CWA will contribute $780,000 to the Bird Island restoration project (approximately 21% of the projected cost). Subsequently, the State of Massachusetts clarified that CWA will not directly contribute the funds, but that the state will dedicate $780,000 of Cape Wind-associated lease revenue to support the Bird Island restoration project.

Additional measures were identified as project components in the May 2008 BA. The State of Massachusetts included these measures as mitigation under the Massachusetts Environmental Protection Act (MEPA). However, MMS cannot specify how a state will spend future lease revenues, and subsequently withdrew these measures as part of the proposed action in an electronic transmission to the Service dated September 3, 2008. Despite the benefits that may occur in the long-term, these measures lack specifics and are unquantifiable. Consequently, although we recognize that future benefits may result from state-required measures identified in the BA, we have not incorporated them into our effects analysis and incidental take assessment.

## STATUS OF THE SPECIES

### *Roseate Terns*

The BA provides species description, life history, phenology, survivorship, population dynamics and distribution information on roseate terns on pages 3-35 – 3-40.

The following is a summary of general life history information and distribution information with emphasis on factors pertinent to the proposed Cape Wind Project. Information is excerpted primarily from the Roseate Tern Recovery Plan, Northeastern Population (USFWS 1998), Gochfeld *et al.* (1998), and additional publications as noted.

The roseate tern is a pale, medium-sized, black-capped sea tern [about 15 inches long (38 cm) including tail streamers up to eight inches (20.3 cm)] and weighs about four ounces (Gochfeld *et al.* 1998). Its plumage superficially resembles that of the common tern (*Sterna hirundo*), among which it invariably nests in the Northeast. On November 2, 1987, the Service determined the population that nests in the Northeast to be endangered, and the population that nests in the Caribbean to be threatened.

Historically, the breeding range of roseate terns in the northeastern population extended from Atlantic Canada south to Virginia and North Carolina. In recent decades, the breeding range has contracted and the population has become concentrated in Massachusetts and New York, with smaller colonies in Connecticut, New Hampshire and Maine. The current breeding distribution of roseate terns in the endangered northeastern population is as follows: birds breed from Long Island, New York, east and north to Nova Scotia and Quebec (Iles Madeleines). However, at present, less than 5% of the northeastern North American population nests in Canada (Environment Canada 2006). Approximately 87% of the endangered North Atlantic roseate population nests on just three colonies in Buzzards Bay, Massachusetts (Bird, Ram and Penikese Islands), and one colony off Long Island, New York (Great Gull Island) (RTRT 2007).

The basic breeding biology of the roseate tern is as follows: in spring, roseates make a long distance, northward migration traveling over open ocean. The terns arrive at Nantucket and Martha's Vineyard Islands "in large flocks", and then disperse to nesting colonies northward and westward (Gochfeld *et al.* 1998). Adult roseates arrive at nesting colony sites in late April to early May. Generally, courtship behavior is described as occurring at the breeding colonies and in the surrounding intertidal area (Nisbet 1981; Gochfeld *et al.* 1998). Roseate terns begin egg-laying in mid-to-late May. Typically, two eggs are laid and the incubation period lasts 23 days. Young tern chicks are fed small fish by both adults and grow rapidly. Re-nesting is common if the first clutch of eggs is lost.

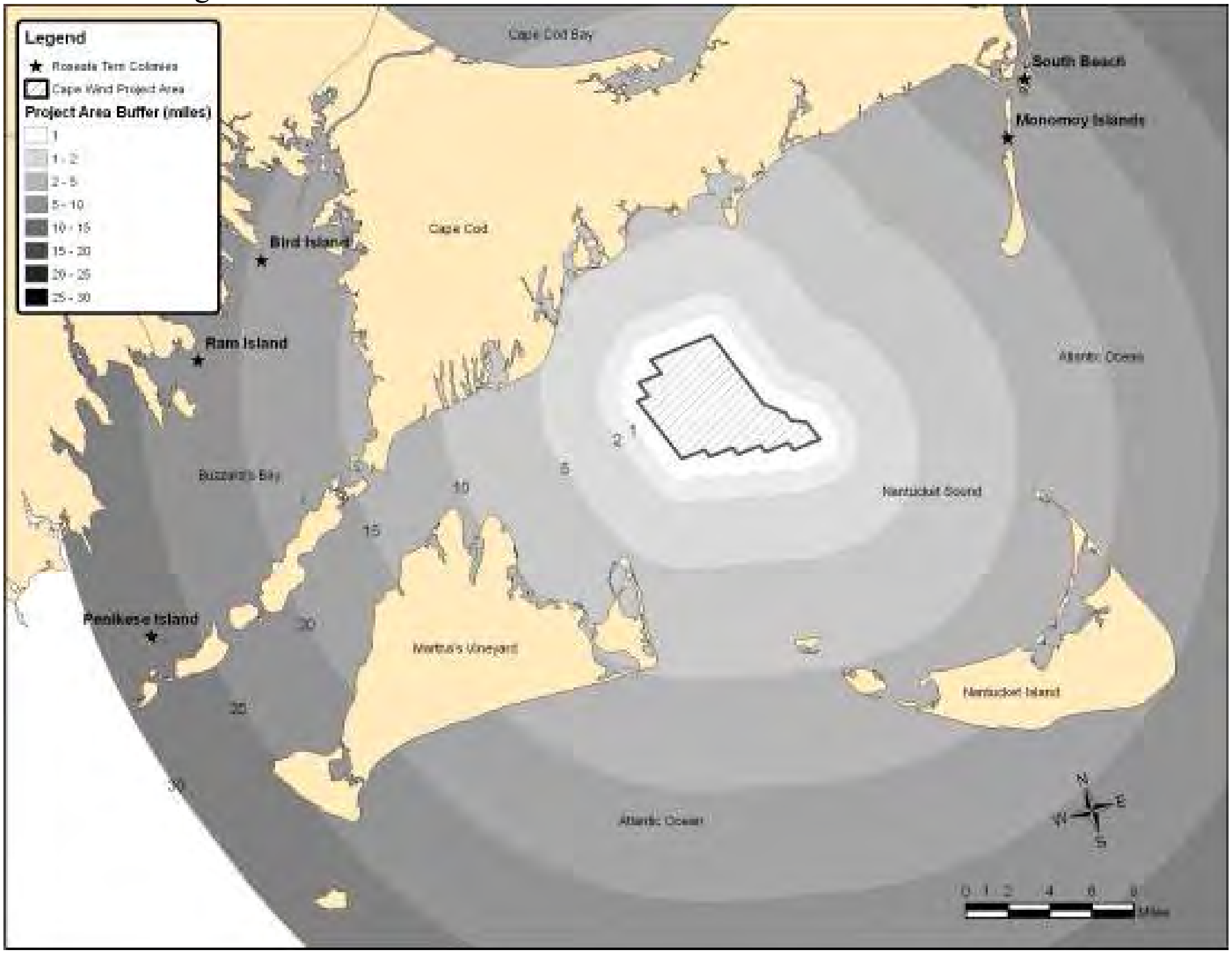
The roseate tern is a marine bird, usually breeding on small islands, but occasionally on sand spits and dunes at the ends of barrier beaches. All recorded nesting in the Northeast is within colonies of common terns. Within these mixed colonies, roseate terns usually select the more densely vegetated areas (Burger and Gochfeld 1988; Gochfeld *et al.* 1998) or other areas that provide dense cover. Unlike most other temperate zone terns, roseate terns usually nest under or adjacent to objects that provide cover or shelter (Nisbet 1981). These objects include clumps of vegetation, rocks, driftwood, or other man-made objects. Plants utilized for cover include beach grass (*Ammophila breviligulata*), seaside goldenrod (*Solidago sempervirens*), lambs quarter (*Chenopodium alba*), beach pea (*Lathyrus japonica*), and mustard (*Brassica* sp.). At some colony sites, vegetation grows to a height of 1-2 meters over the nesting sites during the breeding season, providing concealment for the eggs and chicks, but sometimes impeding access by the adults. At other colony sites, roseate terns nest under rocks, sometimes deep within crevices of rock riprap placed to protect island slopes from erosion. They readily adopt artificial sites such as wooden nest boxes or partially-buried automobile tires (Spendelow 1982, 1994). Nests typically are 24 to 71 inches (60 to 180 cm) apart, although density is sometimes as high as two or three nests per square meter within patches of suitable cover (Nisbet 1981; Burger and Gochfeld 1988).

Nisbet and Hatch (1999) examined the consequences of an imbalanced sex ratio among breeding-age roseate terns at Bird Island, Massachusetts. At Bird Island, they documented 127 females per 100 males, and found that supernormal clutches were often associated with female-female pairs. Female–female pairs exhibited lower fertility, hatching success and productivity than male-female pairs (Nisbet and Hatch 1999), but the cause of the imbalanced sex ratio remains unknown. Specifically, at Bird Island from 1970-1995, female terns within female-female pairs laid fewer eggs than females mated to males (1.20 versus 1.73), had lower fertility and hatching success (about 46% versus 98%), were less successful at raising young from eggs that did hatch (about 58% versus 73%), and their overall breeding success was 0.34 fledgling per female versus 1.35 (Nisbet and Hatch 1999). As recently as 2008, multi-female associations continue to be observed at many nesting colonies in Massachusetts (C. Mostello, Massachusetts Division of Fisheries and Wildlife, pers. comm. 2008).

Beginning in July and by mid-August, most terns have completed nesting and leave colony sites for pre-migratory staging areas. In August and September, staging birds are reported in large flocks with other species of terns at inlets and islands from Long Island, New York to Maine (Viet and Petersen 1993; Shealer and Kress 1994). From mid-August to mid-September, it is thought that most roseate terns have aggregated in coastal areas of Massachusetts, especially along outer Cape Cod. About 20 post-breeding staging areas have been identified around Cape Cod; South Beach and the Monomoy Islands (Figure 1) appear to be among the most important locations for roseates prior to fall migration (Gochfeld *et al.* 1998; Trull *et al*. 1999). Young-of-the-year roseate terns remain dependent on their parent(s) for at least six weeks after fledging and may remain dependent on parental feeding until after arrival in the winter quarters (Nisbet 1981).

After feeding for a matter of weeks, roseate terns migrate south through the West Indies to winter off the northern and eastern coasts of South America. The winter quarters are not fully known, but work by Hays *et al*. (1997 and 1999) documented concentrations of wintering birds along the Brazilian coast. A roseate tern recovered at Mangue Seco, Bahia, Brazil set a longevity record for the species at 25.6 years (Hays *et al*. 1999). Nearly all 1-year-old and most 2-year-old roseate terns are assumed to remain somewhere in the wintering area, based on banding studies (Nisbet 1984; Spendelow *et al*. 2002) and intensive observations of terns in the breeding grounds (J. Spendelow, U.S. Geological Survey, pers. comm. 2008).

Figure 1.Southern Cape Cod Roseate Tern staging areas and distances from Horseshoe Shoal to nearest breeding colonies.




## Feeding Habits and Foraging Habitat

During the breeding season, roseate terns forage over shallow coastal waters, sometimes near the colony and at other times at distances of over 20 miles (32 km) (Heinemann 1992). Roseates tend to concentrate in places where prey fish are brought close to the surface by the vertical movement of water. Hence, they usually forage over shallow bays, tidal inlets and channels, tide-rips and sandbars over which tidal currents run rapidly (Nisbet 1981; Duffy 1986; Safina 1990; Heinemann 1992; Casey, Kilpatrick and Lima, unpubl. data, 1996 USFWS). Roseate studies strongly suggest that the species is a visual forager (Safina 1990; Heinemann 1992; Casey, Kilpatrick and Lima, unpubl. data, 1996 USFWS; Hatch and Brault 2007; Rock *et al*. 2007). Roseate terns forage mainly by plunge-diving and by contact-dipping or surface dipping over shallow sandbars, reefs or schools of predatory fish (Gochfeld *et al*. 1998). Gochfeld *et al*. (1998) also report that they tend to fly into the wind, hover and dive from a height of 3.3 – 20 ft (1-6 meters), but up to 40 ft (12 meters) at times.

In the only foraging study of roseate terns within the northeastern population that utilized telemetry, Rock *et al.* (2007) found that while roseates nesting at Country Island, Nova Scotia sometimes foraged as far as 7.2 miles (24 km) from the colony, on average they foraged much closer, 2.1 miles (7 km), and especially in locations within six miles (10 km) of the colony, at water depths less than 16.5 ft (5 m). The authors recommended that critical foraging habitat for the roseate terns at County Island, shallow areas (< 5 m depth) within 10 km of the colony, should be protected.

Anecdotal evidence suggests a reduction in provisioning of chicks during foggy conditions, therefore it appears that roseates continue to attempt to forage even when visibility is reduced, but do not venture far from the colony and are less successful in those conditions (S. Hall, National Audubon Soc., pers. comm. 2008; J. Spendelow, pers. comm. 2008). Roseate terns usually feed in clearer and deeper waters than those favored by common terns from the same colony sites (Gochfeld *et al.* 1998).

In recent years, the three most important roseate tern nesting sites in Massachusetts are Bird, Ram and Penikese Islands within Buzzards Bay (Figure 1). The closest edge of the proposed Cape Wind turbine array in Horseshoe Shoal is about 19 miles (31 km) from Bird Island, about 22 miles (35 km) from Ram Island, and 27 miles (43 km) from Penikese Island (BA). Heinemann (1992) studied the foraging behavior of roseate terns nesting at Bird Island during 1990 and 1991, and found that the shoal at Mashnee Flats between Bird Island and the entrance to the Cape Cod Canal was a favored foraging location. Other flats and shoals were also important, including Onset Bay, Buttermilk Bay, W. Falmouth Harbor, Quisset Harbor, Waquoit Bay, Woods Hole, and the extensive shallows between Ram Island and the mainland. Roseate terns from Bird Island were not found foraging any farther east (toward the Horseshoe Shoal project area) than Vineyard Sound (Lake Tashmoo to Vineyard Haven) and the westernmost portion of Nantucket Sound (Heinemann 1992). Presently, the Monomoy Islands (Minimoy and South Monomoy) are the closest locations to the project area (about 18 miles or 29 km) where roseate terns have nested in recent years. About 58 nesting pairs (total season) of roseates were recorded there in 2007. Horseshoe Shoal is close enough to the Monomoy Islands to be within the reported foraging distance for roseate terns (Heinemann 1992; Gochfeld *et al.* 1998).

Roseate terns feed almost exclusively on small, schooling marine fish. In the northeastern United States, they show a preference for sand eels (also called sand lance) (*Ammodytes* spp.). Also taken are various small fish, including bay anchovy (*Anchoa* spp.), juvenile herring (*Clupea* spp.), Atlantic menhaden (*Brevoortia tyannus*), Atlantic mackerel (*Scomber scombrus*), Atlantic silversides (*Menidia menidia*), juvenile bluefish (P*omatomus saltatrix*), and white hake (*Urophycis tenuis*) (Gochfeld *et al.* 1998). Roseates only rarely take insects, squid or small crustaceans.

**Factors Affecting Roseate Terns**

The numbers of roseate terns nesting in the Northeast were greatly reduced in the $19^{th}$ century by commercial hunting for the millinery trade. With the cessation of market hunting, the population recovered, and by the 1930s, there were about 8,500 pairs. However, encroachment onto their nesting islands by increasing populations of gulls, and combined with habitat loss reduced numbers to a low of about 2,500 pairs in 1977.

The primary reasons for listing the northeast population of the roseate tern as endangered in 1987 were the concentration of the population into a small number of breeding sites, and to a lesser extent, a decline in total numbers (USFWS 1998). While roseates are now known to nest at about 20 different sites, they remain vulnerable because only small numbers of pairs occur at most colonies. In 2007, only six nesting colonies supported more than 100 pairs (four had >200 pairs), and more than 90% of the total population in the Northeast breeds on just five islands. Concentrated at so few nesting sites, the endangered northeast population of the roseate tern is susceptible to stochastic events, including erosion of nesting habitat, storms and over-washing of nests, prey food shortages, predation, oil spills and human disturbance. In addition, the roseate tern breeding population remains numerically and geographically reduced from historic levels.

**Rangewide Status and Recovery Objectives**

In the past 20 years (1988-2007), the total estimated breeding population has generally fluctuated in the range of about 3,000 pairs to 4,300 pairs, with a high of 4,926 pairs reached in 2000. During this period, the breeding population has exhibited an approximate 20% increase in the number of nesting pairs. Roseate terns have delayed maturity but are long-lived birds and appear capable of maintaining relatively stable populations from year to year (Spendelow *et al*. 2002; Spendelow *et al.* 2008). The greatest annual fluctuations in roseate breeding pair numbers recorded rangewide in the northeastern United States between 1988-2007 were declines of 17-20% from 1991-1992 and from 2000 to 2001 (Table 1). Preliminary data for the 2008 nesting season indicate another 16-20% decline (from 2007). If final colony census data confirm a 20% decline in 2008, the number of roseate tern pairs will have declined again to the approximate level recorded when the species was listed in 1988.

Table 1. Estimated "total season" nesting pairs of roseate tern in the northeastern United States.

| Year | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 |
|---|---|---|---|---|---|---|---|---|---|---|
| No. pairs | 3332 | 3164 | 3332 | 3718 | 3072 | 3400 | 3527 | 3633 | 3596 | 3980 |
| **Year** | **1998** | **1999** | **2000** | **2001** | **2002** | **2003** | **2004** | **2005** | **2006** | **2007** |
| No. pairs | 4271 | 4284 | 4926 | 4012 | 3781 | 4129 | 3813 | 3435 | 3566 | 4066 |

During the past two decades, total numbers of roseate terns that nested in colonies from Long Island Sound to Buzzards Bay/Nantucket Sound increased about 6% per year (except for a 20% decline from 1991-1992), then decreased at about 4% per year between 2000-2006 (Spendelow *et al.* 2008). The increase noted from 2006 to 2007 may be short-term, as most preliminary colony census data for 2008 suggest a 16-20% decline in the number of breeding pairs. Spendelow *et al.* (2008) report that the annual survival rate (between 0.81-0.85) of the roseate tern population breeding in Massachusetts, Connecticut and New York has been fairly stable for the past 19 years. Fluctuations in the number of breeding pairs are thought to be mainly attributable to changes in the survival rate of juvenile terns and their rate of recruitment into the breeding population (J. Spendelow, pers. comm. 2008).

USFWS (1998) indicates that reclassification of the roseate tern from endangered to threatened should be evaluated when the northeastern nesting population achieves the following criteria:

- increase to 5,000 or more pairs, with high productivity (1.0 young per pair for five years);

- the pairs occur in six or more colonies of > 200 pairs; and
- the six colonies are distributed across the geographic range.

Delisting can be considered when, in addition to the above, the number of roseate tern nesting colonies has been expanded to 30 or more sites and the breeding range has been expanded to include historically-occupied areas south of the current range (USFWS 1998).

Only two prior biological opinions have been prepared involving roseate terns in the North Atlantic. In 1998, the Service submitted a non-jeopardy biological opinion to the ACOE for a shoreline protection project at Falkner Island, Connecticut. An unspecified level of incidental take was identified and phase 1 of the project was completed in 2000. Approximately nine roseate terns (one adult and eight chicks) are suspected of being “taken” (died as a result of entrapment in the revetment) (Spendelow and Kuter 2001). It is currently uncertain whether phase 2 of the project (completion of the revetment around the island periphery) will be built (R. Potvin USFWS, pers. comm. 2008). Completion of phase 2 could include conservation benefits to roseate terns if measures to correct the entrapment issue are included in the scope of work. For example, by filling the interstitial spaces within the revetment with crushed stone, the entrapment of chicks and adults can be greatly reduced. The second biological opinion developed for this species was submitted to the U.S. Coast Guard in October 2004, for the **response** to the 2003 Bouchard No. 120 (B-120) oil spill in Buzzards Bay, Massachusetts. This oil spill resulted in moderate oiling of Ram Island, one of the largest roseate nesting colonies, and slight oiling of Bird and Penikese Islands. Due to the necessity of hazing roseate terns from Ram Island to discourage them from settling into nesting habitat until it was cleaned of oil, many tern pairs moved to other islands, and/or delayed nesting. The Service determined that the take of roseate terns from oil spill response due to their delay in nesting and displacement from Ram Island was 350 chicks not produced (i.e., reduced productivity).

Studies to assess what effect the B-120 oil spill had on the northeastern roseate tern population are ongoing. In addition to the delay in nesting and the movement of pairs away from Ram Island caused by the oil spill response, some terns were oiled and may have been more directly injured. However, Spendelow *et al.* (2008) examined survival rates of roseate terns over a 19-year period and did not detect a lower survival of the birds nesting at the colonies near the spill compared to those nesting at other study sites in New York and Connecticut.

*Piping plovers*

Piping plovers are small, sand-colored shorebirds approximately seven inches long (18 cm) with a wing span of approximately 15 inches (38 cm). The piping plover was listed as threatened and endangered under provisions of the ESA on January 10, 1986. Three distinct populations were identified by the Service during the listing process: Atlantic Coast (threatened), Great Lakes (endangered), and Northern Great Plains (threatened). Protection of all three populations of this species under the ESA reflects its precarious status range-wide. The Atlantic Coast population, which is the focus of this BO, breeds on coastal beaches from Newfoundland to North Carolina (and occasionally in South Carolina), and winters along the Atlantic Coast from North Carolina southward, along the Gulf Coast, and in the Caribbean. In 1996, the Service approved a revised recovery plan for the Atlantic Coast piping plover population (USFWS 1996). No critical habitat, as defined by the ESA, has been designated for the breeding habitat of the Atlantic Coast population.

The following is a summary of general life history information with emphasis on factors pertinent to the proposed Cape Wind Project (e.g., movements during the breeding season, migration) and status. Information is drawn from the revised Atlantic Coast piping plover recovery plan (USFWS 1996), unless otherwise stated.

**Breeding**
Piping plovers begin returning to their Atlantic Coast nesting beaches in early March. By early April, males begin to establish and defend territories and court females. Piping plovers are generally monogamous within a given year, but usually shift mates between years, and only occasionally between nesting attempts in a given year. Plovers are known to breed at one year of age, but the rate at which this occurs is unknown.

Piping plovers nest above the high tide line on coastal beaches, sandflats at the ends of sandspits and barrier islands, gently sloping foredunes, blowout areas behind primary dunes, sparsely vegetated dunes, and washover areas cut into or between dunes. Clutch size is generally four eggs, and eggs are usually incubated for 27-30 days before hatching. Incubation is shared equally by both sexes. As a rule, piping plovers fledge only a single brood per season, but may re-nest several times if previous nests are lost.

Plover foods consist of invertebrates such as marine worms, fly larvae, beetles, crustaceans, and mollusks. Feeding areas include intertidal portions of ocean beaches, washover areas, mudflats, sandflats, wrack lines, and shorelines of coastal ponds, lagoons or salt marshes. Feeding activities of both adults and chicks occur during all hours of the day and night.

Upon hatching, flightless piping plover chicks may walk hundreds of yards from the nest site during their first week of life (Table 1 in USFWS 1996). Adults lead the chicks to and from feeding areas, shelter them from harsh weather and protect young from perceived predators. Jones (1997) studied home ranges of piping plovers at the Cape Cod National Seashore in Massachusetts and observed that most broods moved an average of 500 m (~1,600 ft) from their nests after hatching and before fledging. Two plover families with chicks within 16 to 21 days old were found to forage up to 1,000 m (~3,300 ft) from their nests. Plover broods have also been observed to move up to 1,600 m (~1 mile) from their nest and back in one day, and have moved maximum distances of more than 4,000 m (~2.5 miles) before fledging (Jones 1997).

Chicks remain together with one or both parents until they fledge at 25 to 35 days of age. Depending on the date of hatching, unfledged chicks may be present on beaches from late May through late August, although most have fledged by the end of July.

With the exception of aerial courtship displays performed over breeding territories that include circular or elliptical flights at observed heights up to approximately 35 m (114 ft), adult flights within breeding habitats or between nesting or brood-rearing areas and nearby intertidal sand or mudflats are low to the ground, less than 15 m (<50 ft). During three years of opportunistic observations of plovers crossing a road along Westhampton Island, Houghton (2005) recorded

550 and 913 observations of plovers flying, respectively, below and above truck height. At least two adult plovers were run over by vehicles on the road (Houghton 2005).
Feeding territories are generally contiguous to nesting territories, although adults may forage on the opposite side of small coastal inlets or on nearby bayside intertidal flats (e.g., Cohen 2005). MacIvor *et al.* (1985), however, observed a single plover from a pair breeding at one beach, feeding at another site 23 miles (37 kilometers) away.

Adult piping plovers generally demonstrate nest site fidelity, returning to the same breeding beach or a nearby beach in consecutive years, while fidelity of first-time Atlantic Coast breeders to natal sites is low. In New York, Wilcox (1959) recaptured 39% of the 744 adult plovers that he banded in prior years (many were recaptured during several successive seasons and all but three of them were re-trapped in the same nesting area), but recaptured only 4.7% of 979 plovers that he banded as chicks. He also observed that males exhibited greater fidelity to previous nest sites than females. Strauss (1990) observed individuals that returned to nest in his Massachusetts study area for up to six successive years, but mean distance between natal and breeding sites was 25.3 km (n=6, range 9 - 40 km). Also in Massachusetts, 13 of 16 birds banded on one site were resighted the following season, with 11 nesting on the same beach (MacIvor *et al.* 1987). Of 92 adults banded on Assateague Island, Maryland, and resighted the following year, 91 were seen on the same site, as were 8 of 12 first-year birds (Loegering 1992).

Piping plovers rarely move great distances from one nest site to another after a nest failure. In a four-year study on outer Cape Cod, MacIvor (1990) documented only three adult plovers among 101 uniquely identifiable color-banded breeding pairs that changed beaches between re-nest attempts in the same year. Distances from first nest site to re-nest site ranged from 8 to 23 miles (13 to 37 kilometers). Review of detailed breeding records for an estimated 501 pairs of piping plovers breeding in Massachusetts in 1999 by Melvin and Mostello (2000) included at least 14 pairs suspected of re-nesting at new territories on the same beach or at more than one site.

**Migration**
Both spring and fall migration routes of Atlantic Coast breeding piping plovers are thought to occur primarily within a narrow zone along the Atlantic Coast. Sightings away from the outer beaches, either inland or offshore, are rare (Bull 1964; Barbour *et al.* 1973; Imhoff 1975; Potter *et al.* 1980). Observations of color-marked birds from the Atlantic Coast suggest some crossover to Gulf Coast wintering areas (Haig and Plissner 1993). Occasional sightings of piping plovers at distant islands, such as Bermuda (American Birds 1987, 1990; D. Wingate, Bermuda Aquarium and Natural History Museum, *in litt.* 1988), demonstrate that long-distance migrations are possible.

Northward migration from wintering grounds to breeding grounds occurs during late February, March and early April (USFWS 1996). Reports of earliest arrivals in Massachusetts are concentrated in mid-March (e.g., MacIvor 1990; and Petersen 1993). Cairns (1982) states that most piping plovers arrive in Nova Scotia from mid-to-late April. A few failed breeders may return to their wintering grounds in early July, but the peak of southward migration begins as young plovers fledge in late July and extends through August, trailing off in early September. Transient plovers have been observed following early autumn hurricanes (USFWS 1996).

Relatively little is known about migration behavior, flight altitude or habitat use within the Atlantic Coast breeding range (USFWS 1996), but the pattern of both fall and spring counts at migration sites along the southeastern Atlantic Coast demonstrates that many piping plovers make intermediate stopovers lasting from a few days to one month during their migrations (NPS 2003; Noel *et al*. 2005; Stucker and Cuthbert 2006). Most reports indicate migrants congregating in small groups (e.g., Haig and Elliott-Smith 2004), but flocks of over 100 birds have been observed at Cape Lookout National Seashore in North Carolina during fall migration (Collazo *et al.* 1995). As many as 85 staging piping plovers have been tallied on South Beach in Chatham, Massachusetts (S. Perkins, Massachusetts Audubon Society, *in litt.* 2008), but this likely included adults that bred nearby and their fledged young of the year, as well as migrants from breeding sites farther north.

**Factors affecting piping plovers**

Loss and degradation of habitat due to development and shoreline stabilization have been major contributors to the species' decline. Beaches throughout the plover's range are affected by federal and non-federal actions, including inlet management, beach nourishment, dune construction, and dune stabilization. For example, throughout much of the New York-New Jersey Recovery Unit, periodic beach nourishment has interfered with natural coastal processes by precluding formation of newly-forming inlets, overwash zones, and accreting beach habitats that would create or revitalize piping plover nesting and foraging habitats (USFWS 2005).

Disturbance by humans and pets often reduces the functional suitability of habitat and causes direct and indirect mortality of eggs and chicks. Recreational use of piping plover beaches includes pedestrian and vehicular activities. Pedestrian and non-motorized recreational activities can be a source of both direct mortality and harassment of piping plovers. Pedestrians may disrupt plovers during territory establishment, courting, egg-laying and chick rearing. Intense pedestrian use of plover beaches may also prevent chicks from foraging, separate chicks from adults, and increase chicks' vulnerability to predation. Unmanaged off-road vehicle use will degrade plover nesting and foraging habitat or may crush chicks and occasionally adults. Intensive management, similar to that described in the Environmental Baseline section (below) to minimize the effects of recreational disturbance, is ongoing in most of the piping plover's Atlantic Coast breeding range.

Noncompliant pet owners who allow their dogs off leash have the potential to flush piping plovers, and these flushing events may be more prolonged than those associated with pedestrians or pedestrians with leashed dogs. Unleashed dogs may chase plovers, destroy nests, and kill chicks.

Predation has been identified as a major factor limiting piping plover reproductive success at many Atlantic Coast sites, and substantial evidence shows that human activities are affecting types, numbers, and activity patterns of predators, thereby exacerbating natural predation. Predators of piping plover eggs and chicks include foxes, skunks, raccoons, rats, opossums, crows, gulls, grackles, hawks and falcons, domestic dogs and cats, and ghost crabs (USFWS 1996). As with other limiting factors, the nature and severity of predation is highly site-specific.

Substantial evidence exists that human activities are affecting types, numbers, and activity patterns of predators, thereby exacerbating natural predation. Non-native species such as feral cats and rats are considered significant predators at some sites (Goldin *et al.* 1990; Post 1991). Humans have also indirectly influenced predator populations by abetting the expansions in the populations and/or range of other species such as gulls (Drury 1973). Strauss (1990) found that the density of fox tracks on a beach area was higher during periods of more intensive human use.

A variety of techniques that have been employed to reduce predation on plovers are discussed in the revised recovery plan (USFWS 1996). Most notably, the use of predator exclosures (fences around nests) has been used with demonstrated success to reduce predation on piping plover eggs (Melvin *et al.*, 1992; Rimmer and Deblinger 1990). Regional productivity increases (Melvin and Mostello 2003, 2007) resulting from higher nesting success are credited to the use of predator exclosures. However, these same devices have also been associated with serious problems, including entanglements of birds in the exclosure netting, and attraction of "smart" predators that have "learned" there is potential prey inside. The downside risks may include not only predation or nest abandonment, sometimes at rates exceeding those that might occur without exclosures, but also induced mortality of adult birds (Melvin and Mostello 2003, 2007). Exclosures provide no protection for mobile plover chicks, which generally leave the exclosure within one day of hatching and move extensively along the beach to feed. Selective predator removal at some sites is reducing losses of eggs and chicks and occasionally, adults (B. Clifford, New Hampshire Fish and Game Department, electronic transmission, 2008).

Since the 1986 listing, major oil spills affecting Atlantic Coast piping plovers have included the World Prodigy (RI - 1989), B.T. Nautilus (NY and NJ - 1990), North Cape (RI - 1996) and Anitra (NJ - 1996). Implementation of piping plover restoration plans using funds collected from the responsible party have been completed or are in progress for all of these spills.

In April 2003, the Bouchard No. 120 (B-120) fuel barge apparently struck bottom in Buzzards Bay, Massachusetts and released approximately 55,000 gallons of No. 6 fuel oil. Within 24 hours, an oil slick approximately 10 miles long and two miles wide was observed in the Bay. The spill continued to spread, affecting approximately 90 miles of shoreline in and beyond Buzzards Bay. Approximately 26 extant or historic piping plover beaches were located within the area affected by the B-120 oil spill. Of these 26 beaches, piping plovers were documented to have nested at 13 sites in 2003, of which 12 were oiled and subjected to clean-up activities. Over 60 oiled plovers were documented and up to 55 pairs of plovers could have been affected by the oil and response activities. A natural resources damage assessment is underway that will quantify the injury (oil spill-induced mortality and lost productivity) (S. von Oettingen, USFWS, pers. comm. 2008).

**Rangewide Status and Recovery Objective**

To facilitate an even distribution of the population, the Atlantic Coast piping plover recovery plan established four recovery units (Atlantic Canada, New England, New York-New Jersey, and Southern) and assigned a portion of the population target to each. These units are large enough that their overall carrying capacity should be buffered from changes due to natural habitat formation processes at individual nesting sites, while still assuring a geographically well-distributed population. Current information indicates that most Atlantic Coast piping plovers nest within their natal region and that intensive regional protection efforts contribute to increases in regional piping plover numbers (USFWS 1996).

Since listing under the ESA, the Atlantic Coast population estimate has increased 239%, from approximately 790 pairs to an estimated 1,890 pairs in 2007 (USFWS 2008), while the United States portion of the population has almost tripled, from approximately 550 pairs to an estimated 1,624 pairs. Even discounting apparent increases in New York, New Jersey, and North Carolina between 1986 and 1989, which likely were due in part to increased census effort, the population nearly doubled between 1989 and 2007. Population increases since 1989 have been highest in New England (242%), followed by New York-New Jersey (84%). Most growth in the Southern (DE-MD-VA-NC) recovery unit (67%) has occurred since 2003, while the Atlantic Canada population fluctuates from year to year with increases often quickly eroded in subsequent years (USFWS 2008).

While population growth is heartening, periodic rapid declines in populations at the level of the individual recovery unit raise concerns about the long-term risk of extirpation faced by the Atlantic Coast population. For example, the Atlantic Canada population declined by 21% in just three years (2002 - 2005), and the southern half of the Southern recovery unit population declined by 68% in seven years (1995 - 2001). Pressure on Atlantic Coast beach habitat from development, human disturbance, and predation is widespread and unrelenting. The recovery of the Atlantic Coast piping plover population is occurring in the context of extremely intensive annual management that is implemented on almost all plover beaches, in both the United States and Atlantic Canada (USFWS 1996; RENEW 2003, 2004).

The Revised Recovery Plan for the Atlantic Coast piping plover (USFWS 1996) identified a recovery objective for delisting the species, as well as five criteria for meeting the recovery objective. The overall objective is to ensure the long-term viability of the Atlantic Coast plover population in the wild. Delisting of the Atlantic Coast piping plover population may be considered when the following criteria have been met:

- increase and maintain for five years a total of 2,000 breeding pairs, distributed among four recovery units;
- verify the adequacy of a 2,000-pair population of piping plovers to maintain heterozygosity and allelic diversity over the long term;
- achieve a five-year average productivity of 1.5 fledged chicks per pair in each of the recovery units;
- institute long-term agreements to ensure protection and management are sufficient to maintain the population targets and average productivity in each recovery unit; and
- ensure long-term maintenance of wintering habitat, sufficient in quantity, quality, and distribution to maintain survival rates for a 2,000-pair population.

The New England recovery unit target is a minimum of 625 pairs. In 2007, there were approximately 754 nesting pairs of piping plovers in New England with an average productivity of 1.30 chicks per pair (USFWS 2008). Although the New England recovery unit population has exceeded (or been within two pairs of) the abundance goal since 1998, the average productivity is below the 1.5 chicks/pair threshold needed to maintain a secure population. Inclement weather and increased predation on both adults and young are the primary contributing factors that have been identified as limiting productivity.

The Atlantic Canada recovery unit has experienced the lowest population growth (net change between 1989 and 2007 is +14%), despite higher overall productivity than in the United States (1989-2006 average of 1.61 chicks/pair in Canada versus 1.31 chicks/pair in the United States). Based on estimates of survival derived from recent banding studies from 1998 through 2004, Calvert *et al.* (2006) estimated productivity of 1.63 chicks/pair required to maintain a stationary population at the sites surrounding the Gulf of St. Lawrence, compared with an estimate of 1.24 from banding data collected in Massachusetts in 1985-1988 (Melvin and Gibbs 1994).

The importance of productivity in driving Atlantic Coast piping plover population increases over the last 20 years notwithstanding, demographic models for piping plovers indicate that even small declines in adult and juvenile survival rates will cause substantial increases in extinction risk (Melvin and Gibbs 1994; Wemmer *et al.* 2001; Larson *et al.* 2002; Calvert *et al.* 2006). Elevated mortality of adults or post-fledglings has the potential to quickly undermine the progress toward recovery achieved at breeding sites. Calvert *et al.* (2006) found lower return rates of juvenile (first-year) birds to the breeding grounds than was documented for populations breeding in Massachusetts (Melvin and Gibbs 1994), Maryland (Loegering 1992), and Virginia (Cross 1996) in the late 1980s and early 1990s. This is consistent with low positive and negative growth in the Atlantic Canada population despite very high productivity (relative to other breeding populations) and extremely low rates of dispersal to the United States (Calvert *et al.* 2006). Thus, maximizing productivity does not ensure population increases; management must focus simultaneously on all sources of stress on the population.

Seven non-jeopardy formal consultations have been written for projects within the New England Recovery Unit since 1997. Most of the consultations were with the U.S. Coast Guard for marine event permits for fireworks events in coastal areas of Connecticut and Massachusetts (Table 2). These activities occur once a year and require follow-up reporting to assess take. Due to permit conditions incorporated in marine event permits issued by the U.S. Coast Guard, no plover egg or chick losses have been documented during the fireworks events. One consultation was written for the ACOE for maintenance dredging and disposal of dredged material on plover habitat and ultimately resulted in improved management and long-term benefits to the population utilizing the nourished beach. The B-120 oil spill consultation was based on spill response measures undertaken by the U.S. Coast Guard that resulted in the incidental take of eight eggs due to abandonment. The consultation identified measures to avoid adverse effects from oil spill response activities, thereby providing future protection to piping plovers under similar circumstances.

Table 2. Previous biological opinions completed for piping plovers in New England.

| Year | Project | Incidental Take | | Project Completed |
|---|---|---|---|---|
| | | Amount/Extent of Take | Documented | |
| 1997 | Fireworks (Connecticut) | 4 pairs of plovers and their broods/Harassment | No mortality or loss of productivity | Yes |
| 1997 | Fireworks (Massachusetts) | 2 pairs of plovers/Harassment | No mortality or loss of productivity | Yes |
| 1999 | Beach nourishment/dredging (Maine) | 2 pairs no productivity/harassment and mortality of young for the life of the project | 1 pair 2002, no young, 1 pair 2003, 1 young | Yes, effects are ongoing |
| 2000 | Fireworks (Massachusetts) | 1 egg /Mortality<br>4 broods/Harassment | No mortality or loss of productivity | Yes |
| 2003 | Fireworks (Connecticut) | 2 pairs of plovers/Harassment | No plovers present during event | Yes |
| 2004 | B-120 Oil Spill Response – post spill consultation | 8 eggs lost to abandonment | Additional unquantifiable take due to harassment | Yes |
| 2005 - 2007 | Fireworks (Massachusetts) | 1 egg lost to temporary abandonment, harassment of chicks younger than 10 days, up to 2 broods | No loss of eggs or chicks documented | Yes |

ENVIRONMENTAL BASELINE

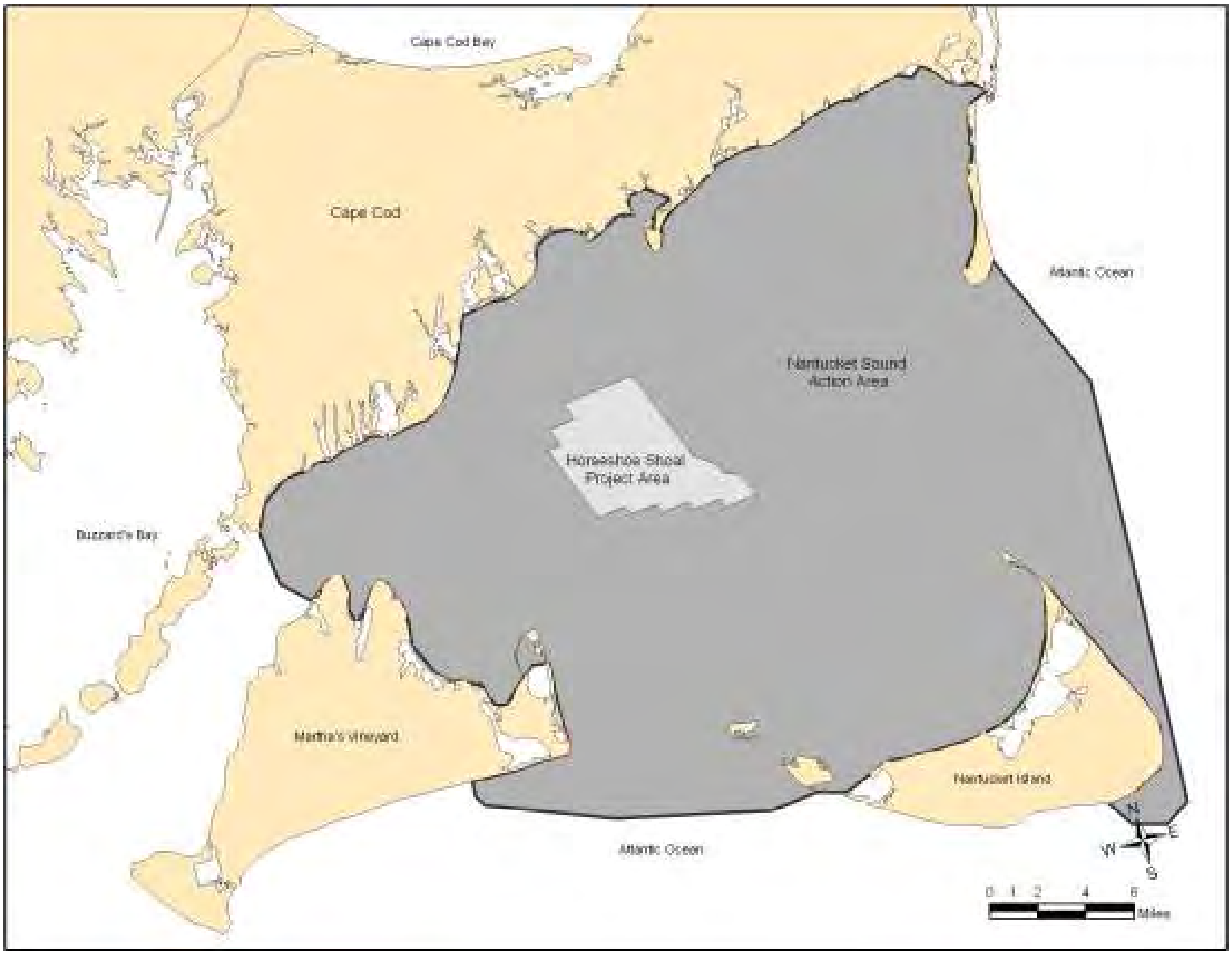
**Status of the species within the action area**

As defined in 50 CFR §402.02, "action" means all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by federal agencies in the United States or upon the high seas. The "action area" is defined as all areas to be affected directly or indirectly by the federal action, and not merely the immediate area involved in the action. The direct and indirect effects of the actions and activities resulting from the federal action must be considered in conjunction with the effects of other past and present federal, state, or private activities, as well as the cumulative effects of reasonably certain future state or private activities within the action area.

Although the primary potential effects are confined to the wind facility at Horseshoe Shoal, the Service considers the action area to encompass all of Nantucket Sound, the east coast of Nantucket and the northeast coast of Martha's Vineyard in order to include the physical facility (WTGs and ESP), maintenance vessel travel lanes, submarine cables and the potential oil spill impact area (Figure 2). The area depicted in Figure 2 was created by the Service as a schematic to highlight the potential area of impact due to an oil spill. The action area boundaries were not drawn specifically to include or exclude certain shore locations; rather, they are an attempt to depict the limits of a possible oil spill based on the oil spill risk and trajectory models provided by CWA (Etkin 2007; Knee *et al*. 2006).

The Bird Island restoration project (Buzzards Bay, MA) is also considered to lie within the roseate tern action area, since the project is considered part of the proposed action. The Service is not including the locations of other proposed beneficial actions (outlined in Section 8 of the BA) because insufficient information regarding the locations and duration of implementation precludes the assessment of their potential beneficial effects in this BO.

Figure 2. General schematic of the Nantucket Sound action area and Horseshoe Shoal project area.




*Roseate Tern*

Roseate terns are present in Massachusetts waters from late April to mid-September, when they depart for their wintering grounds in South America. The species has been studied by ornithologists in the Bay State for more than 70 years (see, for example, reports by C. Floyd from the 1920s cited in Nisbet 1981). Flocks of roseates arriving from the wintering grounds in the spring are reported "in large flocks" in Nantucket Sound before dispersing to breeding sites north, south and west (Gochfeld *et al.* 1998).

Most of the endangered northeastern population of the roseate tern (breeding range is the western North Atlantic) nests in Buzzards Bay, Massachusetts and in Long Island Sound, New York (about 90%), while about 10% migrate north to nest in the Gulf of Maine and Maritime Canada. Prior to the 1970s, many locations around Nantucket Sound, including Monomoy, Nantucket, Muskeget and Tuckernuck Islands, supported from the low hundreds to several thousands of nesting roseate terns (USFWS 1998). Presently, the Monomoy Islands (Minimoy and South Monomoy) are the closest locations to the project area (about 18 miles or 29 km) where roseate terns have nested in recent years. About 58 nesting pairs (total season) of roseates were recorded there in 2007. Despite a multi-year effort (1999 to at least 2007) to restore roseate terns to Muskeget Island (R. Veit, I. Nisbet, pers comm. 2007), roseates have not become re-established there or at the other large historic colonies listed above, except at Monomoy as noted (RTRT 2007; USFWS unpubl. data).

Although roseate terns do not nest at or immediately adjacent to Horseshoe Shoal, foraging activity during the pre-breeding, breeding and pre-migratory fall staging periods could result in roseate tern presence in the project area. Tern presence in the action area was investigated by CWA and by the Massachusetts Audubon Society (MAS) during observational surveys by boat and aircraft during 2002, 2003 and 2004, and by boat off South Beach, Chatham and Monomoy Island in 2006. The results of these studies and a summary of what is generally known about roseate tern presence in and around Nantucket Sound are discussed at length on pages 4-11 to 4-28 in the BA and on pages 2-7 to 2-13 of volume III of the DEIS. An abbreviated summary of the results from those studies is as follows:

During the month of May (pre-breeding and early breeding season) in 2002 and 2003, aerial surveys conducted by CWA estimated that a total of 784 terns (mixed species) were present within the Horseshoe Shoal project area (mean of 392 per survey). During June and July (breeding season months) of 2002-2004, only a combined, annual mean of 21 terns was observed [CWA and MAS surveys, see Hatch and Brault (2007) table 1]. During the post-breeding season (August and September, 2002-2004), a combined, annual mean of 86 terns was observed on Horseshoe Shoal. As a general index of relative occurrence, these data indicate more use of the project area after first arrival in spring, declining with the onset of the breeding season, and then increasing again during the post-breeding season.

From 2002-2006, ESS Group (on behalf of CWA) and MAS flew 125 systematic aerial surveys of Nantucket Sound to document avian species' presence and distribution. More than half of these surveys took place during winter (for waterfowl and sea ducks) when roseate terns and piping plovers are not present in Massachusetts. Fifteen of the surveys were conducted during the nesting season (mid-May to late July), and 37 of the surveys were conducted during fall staging of roseate terns in and around Nantucket Sound (mid-August to late September). ESS Group (2006) reports that surveys were flown at different times of the day, originated from different starting points and directions, at different tides, and in somewhat varying weather, but visibility was good or excellent during every survey. Surveys were not conducted in inclement weather or at night, and several other limitations of the survey methodologies are discussed on pages 2-12 and 2-13 of the DEIS.

The breeding season aerial surveys (mid-May to July) recorded significant common and roseate tern use of Nantucket Sound [e.g., 832 roseates, 4,779 commons and 12,646 mixed common-roseate terns (page 2-10 of the DEIS)]. However, of the total number of terns observed by MAS during the breeding season in 2003, only 1.5% were in the Horseshoe Shoal project area, and in 2004, 0% of the total terns observed by MAS were in Horseshoe Shoal. During aerial surveys conducted by CWA during the breeding season, about 10% of 2,888 total terns (includes both common and roseate terns) observed were in the Horseshoe Shoal project area. Of all terns observed at Horseshoe Shoal during the boat-based surveys by MAS, most (from 33-81%, median = 53%) were travelling across the Shoal (Hatch and Brault 2007), but some terns were actively foraging as well (BA).

The number of (post-breeding) terns staging on outer Cape Cod increases as summer progresses and peaks in mid-August to mid-September (Trull *et al.* 1999). However, staging by non-breeders and failed breeders may begin as early as June (J. Spendelow, pers. comm. 2008). The 37 fall staging period aerial surveys and 36 boat surveys conducted by CWA and MAS recorded relatively minimal tern activity in the Horseshoe Shoal proposed action area during 2002-2004 (DEIS), despite more than 16,500 tern sightings recorded by MAS throughout Nantucket Sound. Tern abundance was higher within a few miles of the south shore of Cape Cod. CWA's fall 2002 and 2003 surveys recorded nearly 3,000 terns (both species) using Nantucket Sound, but the vast majority were near Monomoy, Tuckernuck and Nantucket Islands, with fewer terns encountered over Horseshoe Shoal (BA). Most terns (>90%) that were recorded in Nantucket Sound were using areas other than the Horseshoe Shoal project area.

Combining all systematic survey data available, CWA noted a marked increase in the average densities[2] of terns in areas of Nantucket Sound during spring arrival and the post-breeding, pre-migratory period, when compared to surveys in the nesting season (BA). On Horseshoe Shoal, the average density of terns increased toward the southern boundary of the project area, with densities of 2 to 101-250 terns (mixed species) per square kilometer. These data are for all terns, and common terns are a more abundant species than roseate terns. For example, in nearby Buzzards Bay, common terns outnumber roseates by a factor of 3 to 1 (C. Mostello, pers. comm. 2007); the ratio of common to roseate terns in Nantucket Sound during the fall may be as high as 8:1 (Trull *et al.* 1999).

While we cannot completely discount concerns about difficulties in detecting roseate and common terns during boat and aerial surveys (i.e., they are relatively small light-colored birds that can be difficult to see against a light sky), the Service finds CWA results, based on more than 16,000 tern observations over multiple years, to be credible with respect to presence in the project area. Roseate terns occur with less frequency and regularity in the Horseshoe Shoal project area than in other coastal areas of Nantucket Sound.

For roseate terns across their breeding range in the Northeast, when young become capable of flight, family groups are no longer geographically restricted to the nesting colonies. During the early part of the post-nesting period, roseate terns will leave their nesting colonies (in mid-to-late summer) and may disperse widely to several coastal locations to feed, rest and roost (overnight)

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[2] Average density was based on the count of individual terns observed along the survey transects within 1-mile-square (2.6 km square) grid cells and the number of survey dates within each grid cell.

prior to fall migration. One such fall staging location is reported by Shealer and Kress (1994) at Stratton Island, Maine, where banded birds from eight different colonies were observed. Others occur on Long Island, New York (Gochfeld *et al.* 1998). As the post-nesting period progresses, roseates increase in number in southeastern coastal Massachusetts. The best known and largest fall staging area used by roseate terns in the northeastern population occurs along outer Cape Cod and Nantucket Island (including Nantucket Sound). Here, roseates that have dispersed from their nesting colonies re-aggregate from late July to mid-September and prepare for their southward migration. A study by Trull *et al.* (1999) reported that numbers of roseate terns were staging and roosting at as many as 15 Cape Cod locations but that South Beach, Chatham supported the largest staging/roosting population of roseate terns in eastern North America. Peak numbers of terns were recorded at these outer Cape Cod locations between August 20 and September 10 (Trull 1998); whereas in Trull *et al*. (1999), a multi-year study, the largest roseate numbers were reported between August 26 and September 19 (the 20-25 days before departure). During this three-week period, there is the **potential** that every breeding adult roseate tern in the northeastern population (and their young of that year) will be in Nantucket Sound, within 20 miles of the Cape Wind Project area.

In 2007 and 2008, the post-breeding movement and aggregation of roseate terns in Massachusetts were followed by biologists of MAS and the U.S. Geological Survey (B. Harris, MAS; J. Spendelow, USGS, pers. comm. 2008). In 2007, terns were present in large numbers at Plymouth Beach/Duxbury (south of Boston in Cape Cod Bay), and Black Beach in Falmouth (Buzzards Bay). In 2008, these sites had relatively low use by post-breeding terns, and sites on the outer Cape, such as Provincetown (Cape Cod Bay/Atlantic Ocean) and Nauset/Coast Guard Beach (Atlantic Ocean) were heavily used. Terns that were roosting at night at Plymouth/Duxbury or at Provincetown and were foraging and resting during the day in these areas are less likely than terns staging at Monomoy/South Beach, Chatham to be making daily commuting flights across Nantucket Sound. Importantly, the Service interprets this information to mean that roseates during the post-breeding period do not always concentrate in Nantucket Sound, where they could have exposure to the Cape Wind Project. The observations by MAS and USGS also highlight that there are large within-year and year-to-year differences in tern distribution during this post-breeding period.

During the days and weeks that roseate terns are staging for fall migration on outer Cape Cod, they make daily commuting flights to forage. Some of these flights cross Nantucket Sound, where mixed species flocks of terns are encountered on Horseshoe Shoal, which they use for foraging, resting on the water and to commute back and forth across the Sound to more distant foraging areas (BA).

Hays *et al.* (1999) and Trull *et al.* (1999) are among the only published studies to report roseate terns in flight after dark. Hays *et al.* (1999) reported that at Mangue Seco, Brazil, wintering roseate and common terns came in after dark and left before first light. Trull *et al.* (1999) report that flocks of mixed species of terns arrived at overnight roosting locations from 8 pm to 10 pm and continued to arrive after dark when they could no longer be counted. Prior to the proposal to construct the Cape Wind Project, the dynamics of roseate tern presence (i.e., the location, number and characteristics of roseate tern commuting flights and foraging behavior) on and across Horseshoe Shoal was unstudied and little known. Similar data for nocturnal flights by roseate terns during the pre-breeding and breeding season are unavailable.

In recent years, the three most important roseate tern nesting sites in Massachusetts have been Bird, Ram and Penikese Islands within Buzzards Bay. The closest edge of the proposed WTG array in Horseshoe Shoal is about 19 miles (31 km) from Bird Island, about 22 miles (35 km) from Ram Island, and 27 miles (43 km) from Penikese Island (BA). Roseate terns actively breeding at these colonies are very unlikely to forage as far away as the Horseshoe Shoal project area.

In the five-year period from 2003 to 2007, from 1,480 to over 1,700 pairs, or 43-49% of all roseate terns recorded at breeding colonies in the northeastern United States population, nested at the three Buzzards Bay sites noted above. Accordingly, the Buzzards Bay roseate colonies play a vital role in both the survival and recovery of the species (Table 3). In comparison, the Monomoy Islands in Nantucket Sound have supported from 13-45 peak season pairs (and from 18-58 total season pairs) of nesting roseates during the same time frame.

Table 3. Peak season roseate tern nesting pairs and productivity (chicks fledged per pair) within Buzzards Bay and Monomoy Islands between 2003 and 2007. Peak season counts generally do not include late nesting pairs or re-nests by failed breeders.

| **Location** | **Numbers of pairs/productivity** | | | | |
|---|---|---|---|---|---|
| | **2003** | **2004** | **2005** | **2006** | **2007** |
| Bird Island, Marion, MA | 904 (1.25) | 554 (1.25) | 680 (0.95) | 1111 (1.29) | 919 (1.26) |
| Ram Island, Mattapoisett, MA | 557 (1.12) | 936 (0.92) | 724 (0.93) | 463 (1.00) | 661 (1.16) |
| Penikese Island, Gosnold, MA | 251 (0.87) | 9 (0.97) | 76 (0.79) | 48 (0.44) | 102 (1.54) |
| Monomoy Islands | 18 (1.70) | 27 (1.13) | 31 (0.73 | 29 (1.00) | 58 (1.03) |

Survival and productivity of roseate terns in Buzzards Bay are influenced by a number of factors, including but not limited to weather (particularly storms), predation, competition for nest sites, human disturbance and food availability. Bird and Ram Islands are low elevation islands that have lost upland habitat to erosion and over wash by storms and high tides (ACOE 2005; Ramsey and Osler 2008). Ram Island is estimated to have been reduced in size from 4.9 acres in 1935 to 2.0 acres (2 ha to 0.8 ha) in 2008, and if the current rate of loss is unmitigated, Ram Island will disappear in 40 years (Ramsey and Osler 2008). Bird Island, which has a partial revetment, has been reduced from approximately 3.0 acres (1.2 ha) in size in the 1850s to its present size of 1.5 acres (0.6 ha) (ACOE 2005). Both the ACOE (2005) study and the work of Applied Coastal Research and Engineering (Ramsey and Osler 2008) predict the rate of habitat loss for these islands will increase in coming decades due to erosional forces and sea level rise.

The Buzzards Bay tern colonies are monitored on a nearly daily basis by tern biologists that also serve as island wardens to minimize the loss of terns to predation and disturbance caused by recreational boaters coming ashore. Tern biologists also provide structures for roseate tern use for nesting. These structures sometimes alleviate competition for nest sites with common terns and minimize egg and chick loss due to predation.

**Factors affecting the environment within the action area**

Roseate tern use of the action area within Nantucket Sound is limited to the period of late April to mid-September. In the Monomoy Islands, nesting terns are relatively free from human disturbance, but adverse weather, predators of adults, eggs or chicks (e.g., coyotes, gulls and black-crowned night herons) and rank vegetation are factors influencing nesting success.

At Bird Island, crowding and competition for nesting space with the more abundant common tern is a factor influencing nest site selection and possibly, breeding success. The loss of upland nesting habitat due to erosion and deterioration of the revetment surrounding most of the island also contributes to crowding and competition for nesting sites. More importantly, it reduces the present carrying capacity of the island to below historic levels. Adverse weather and storms resulting in partial over wash of nest sites occasionally reduce hatching success. Sea level rise will exacerbate this factor if not mitigated by repairing the revetment. Predation periodically results in the loss of roseate adults, chicks and eggs. In the recent past, peregrine falcons, mink and gulls (C. Mostello pers. comm.) and Canada geese (J. Hatch pers. comm. 2008) have all caused injury or death of individual roseates at Bird Island.

During the fall staging period, roseate terns will use Nantucket Sound for feeding and travelling and will rest and roost overnight at several outer Cape and Island locations, such as South Beach, Chatham, Eel Point and Smith Point, Nantucket, Katama, Martha's Vineyard, and Tuckernuck Island. Human disturbance by pedestrians, dogs, and fishermen during this time can cause resting and roosting flocks to take flight, resulting in an energetic cost to the birds.

*Piping plover*

Approximately 50 extant piping plover breeding sites are located within the action area of the Cape Wind Energy Project (Table 4). Most of these beaches are intensively managed, although smaller, town-owned or privately-owned beaches may be minimally managed. The Massachusetts Division of Fisheries and Wildlife (MADFW) synthesizes annual estimates of abundance and productivity based on summaries of survey data from local monitors.

Table 4. Abundance of breeding piping plovers and fledged chicks within the action area by site, 2003, 2006, and 2007 (USFWS 2004; 2007; 2008).[3,4]

| | Pairs (chicks) | | |
|---|---|---|---|
| **Plover Breeding Site, Town** | **2003** | **2006** | **2007** |
| **Arruda's Pt./The Jetties, Chappaquiddick** | 1 (0) | 0 (0) | 0 |
| Bank St./Merkel Beach/Wychmere, Harwichport | 4 (10) | 4 (11) | 4 (4) |
| **Cape Pogue Elbow/The Narrows, Chappaquiddick** | 1 (1) | 1 (1) | 4 (2) |
| **Coatue, Nantucket** | 1 (0) | 1 (0) | 5 (10) |
| Cockle Cove/Ridgevale Beach, Chatham | 1 (0) | 1 (0) | 1 (3) |
| **Coskata Beaches, Nantucket** | 1 (2) | 1 (4) | 5 (2) |
| Craigville Beach, Barnstable | ND | 0 | 1 (0) |
| Crosby Landing Beach, Brewster | 1 (1) | 3 (9) | 2 (2) |
| **Dogfish Bar, Aquinnah** | 6 (0) | 4 (3) | 5 (7) |

3 Bold text is used to indicate the sites on Martha's Vineyard and Nantucket.

4 Data for years 2004 and 2005 are still preliminary and incomplete (S. Melvin, pers. comm. 2008).

| Plover Breeding Site, Town | Pairs (chicks) | | |
|---|---|---|---|
| | 2003 | 2006 | 2007 |
| Dowses Beach, Barnstable | 0 | 2 (0) | 1 (4) |
| **Eastville Point Beach, Oak Bluffs** | 1 (0) | 1 (0) | 0 |
| **Edgartown Great Pond/Job's Neck, Crackatuxet Pond, Edgartown** | 3 (0) | 1 (4) | 2 (0) |
| **Eel Point, Nantucket** | 2 (0) | 9 (12) | 9 (9) |
| **Eel Pond/Little Beach/Lighthouse Beach, Edgartown** | 1 (4) | 0 | 0 |
| **Esther Is. / Smith Point, Nantucket** | 5 (2) | 8 (15) | 7 (11) |
| Forest Beach, Chatham | 0 | 1 (3) | 1 (1) |
| Gray's Beach, Yarmouth | 1 (0) | 0 | 0 |
| Great Island, Yarmouth | 3 (0) | 3 (5) | 2 (0) |
| **Great Point, Nantucket** | 0 | 2 (0) | 2 (0) |
| Harding Beach, Chatham | 3 (6) | 2 (4) | 4 (5) |
| **Harthaven, Oak Bluffs** | 2 (0) | 0 | 0 |
| Howes St./Corporation Beach, Dennis | 1 (0) | 0 | 0 |
| **Jetties Beach, Nantucket** | 1 (3) | 3 (4) | 3 (5) |
| Kalmus Park Beach, Barnstable | 7 (0) | 5 (1) | 5 (0) |
| **Leland/East Beaches, Chappaquiddick** | 1 (0) | 4 (4) | 4 (7) |
| **Lobsterville Beach, Aquinnah** | ND[5] | ND | 1 (2) |
| Long Beach, Barnstable | 5 (4) | 5 (5) | 4 (3) |
| Menauhant Yacht Club Beach, Falmouth | 1 (1) | 0 | 0 |
| Minimoy Island, Chatham | 1 (10 | 0 | 0 |
| Miramar Beach (Swan River), Dennis | ND | 6 (8) | 1 (3) |
| **Muskeget Island, Nantucket** | 5 (2) | 4 (5) | 5 (6) |
| New Seabury, Mashpee | 2 (4) | 2 (3) | 2 (3) |
| North Monomoy Island, Chatham | 2 (5) | 1 (4) | 1 (3) |
| **Norton Point Beach, Edgartown** | 5 (0) | 6 (9) | 5 (1) |
| Pleasant St. Beach, Chatham | ND | ND | 1 (2) |
| Popponesset Spit, Mashpee | 3 (6) | 3 (4) | 6 (4) |
| Sampson's Is.-Dead Neck, Barnstable | 16 (22) | 26 (18) | 17 (30) |
| Seagull Beach/Radio City, Yarmouth | 3 (1) | 3 (4) | 4 (3) |
| Sippewisset, Falmouth | 1 (0) | 2 (6) | 3 (7) |
| South Cape Beach, Mashpee | 3 (2) | 4 (0) | 2 (2) |
| South Monomoy Island, Chatham | 29 (44) | 24 (21) | 20 (14) |
| Squaw Island, Barnstable | 2 (2) | 3 (6) | 5 (6) |
| **Sylvia State Beach, Edgartown** | 5 (4) | 3 (6) | 5 (2) |
| **Tashmoo, Tisbury** | 1 (0) | 19 (2) | 2 (5) |
| **The Galls, Nantucket** | 2 (0) | 1 (4) | 2 (3) |
| **Tuckernuck Island, Nantucket** | 2 (4) | 7 (14) | 7 (8) |
| Washburn Island, Falmouth | 4 (1) | 3 (5) | 4 (3) |
| **Wasque, Chappaquiddick** | 2 (3) | 2 (2) | 1 (0) |
| West Dennis Beach, Dennis | 6 (14) | 6 (8) | 6 (7) |
| **Wilfred's Pond and Mink Meadows Beach, Tisbury** | 3 (5) | 1 (3) | 2 (0) |
| **Total pairs in Action Area** | **150** | **168** | **173** |

5 No Data.

Piping plovers migrating north in the spring and south in the fall may pass through or stage in the action area. Table 5 provides information on the number of breeding pairs that nest north of the action area and their productivity. Without allowance for post-breeding mortality of adults or post-fledging mortality of young of the year, the population of plovers migrating south averages 1.7 times that of the number of birds migrating north the previous spring.

Table 5. Abundance of breeding piping plovers and average productivity (chicks/pair) north of the action area, 2003, 2006, and 2007.

| Plover Breeding Site, Town | Pairs[6] (productivity) | | | Average Pairs |
|---|---|---|---|---|
| | 2003 | 2006 | 2007 | |
| Massachusetts north of action area | 300 (1.48) | 283 (1.20) | 349 (1.19) | 311 |
| New Hampshire | 7 (1.00) | 3 (0.67) | 3 (0.33) | 4 |
| Maine | 61 (1.28) | 40 (1.35) | 35 (1.06) | 45 |
| Atlantic Canada | 256 (1.62) | 256 (1.82) | 266 (1.14) | 259 |
| **Total (weighted average productivity)** | **624 (1.51)** | **582 (1.48)** | **653 (1.16)** | **620 (1.38)** |

Known migratory stopover areas within the action area include Chappaquiddick Beaches on Martha's Vineyard, South Beach Island and North and South Monomoy Islands, Chatham, and Great Point, The Galls, Smith Point/Esther's Island, Nantucket (USFWS 1996) (Figure 3). Plovers migrating to and from northern New England and Atlantic Canada may be using these beaches. Observations of banded Atlantic Coast piping plovers indicate that plovers are not non-stop migrants and may use multiple stopover areas along the coast. At least one banded Canadian Atlantic Coast plover was observed during fall migration at Esther's Island, a second banded Canadian migrant was observed at Parker River National Wildlife Refuge in Essex, Massachusetts, north of the project area (D. Amirault, Canadian Wildlife Service, pers. comm. 2008).

Avian surveys conducted by CWA and MAS (2002 – 2006, including 52 non-winter aerial surveys and 44 non-winter boat surveys) detected few shorebirds, and most of these were not identified to species. Shorebird observations included one American oystercatcher (Report No.4.2.4-8), one red knot in a mixed species flock with six unidentified sandpipers, and 20 dunlins observed on Muskeget Island (Report No. 4.2.4-9). Perkins *et al*. (2003, 2004) reported oystercatchers and unknown shorebirds were observed in Nantucket Sound. Most surveys were conducted during the day under good visibility conditions precluding documentation of shorebird or plover use of the project area at night (DEIS 5-85) and during inclement weather. No piping plovers were documented. Paucity of shorebird observations and absence of piping plovers may reflect limitations of survey methods, but it is also plausible that shorebirds (which feed and roost on land) make infrequent use of the surveyed areas or that they tend to transit the ocean at higher elevation during migration.

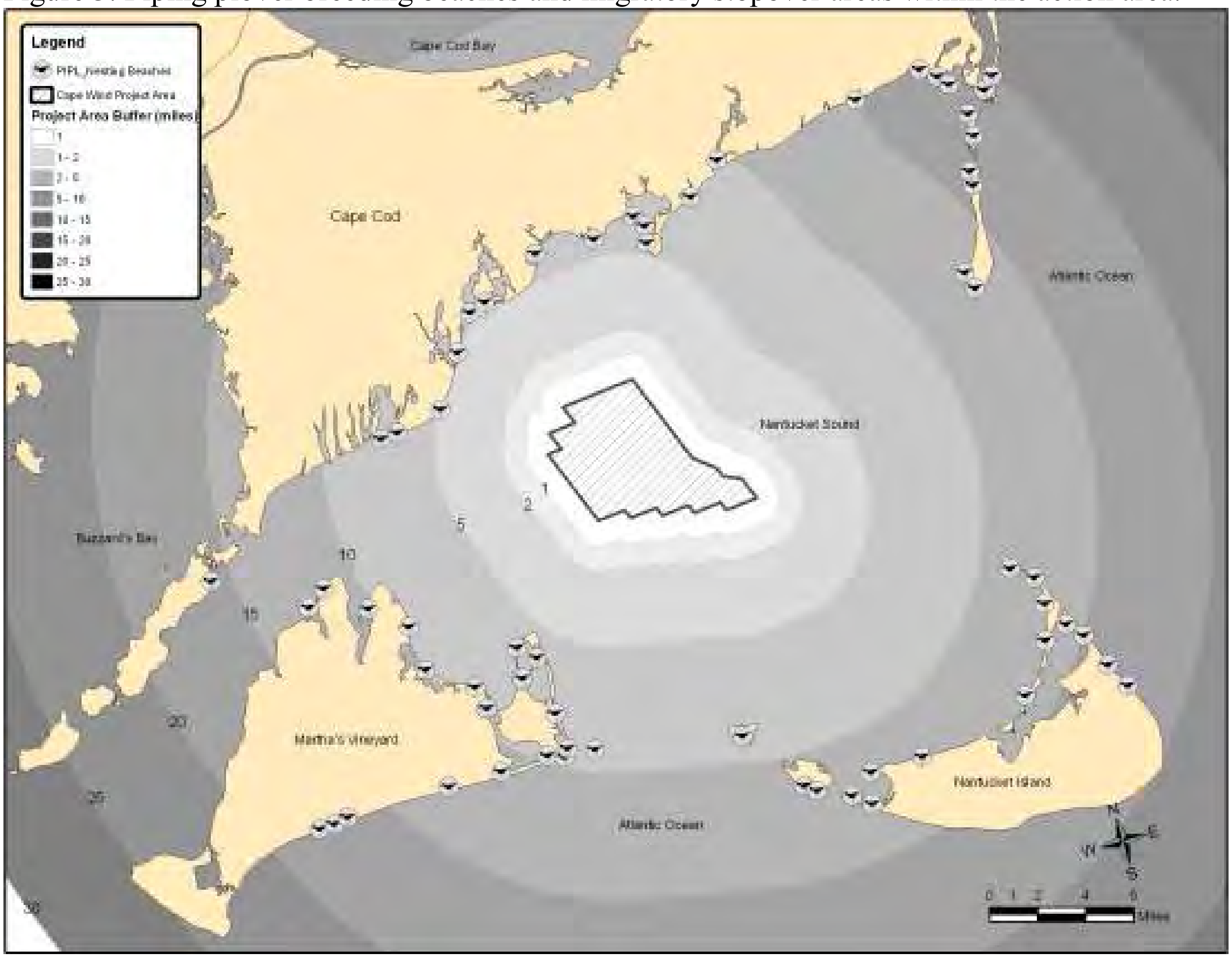
**Factors affecting the environment within the action area**

Male piping plovers first arrive in Massachusetts in mid-March to establish territories and begin nesting. Females generally arrive later, although plovers continue to arrive through April and

[6] Total number of pairs observed.

into May. Egg-laying commences by mid-to-late April and chicks may begin to hatch shortly before Memorial Day weekend. Chicks fledge between late June and late August, with the peak in mid-to-late July. In Massachusetts, adult plovers may begin to stage and migrate shortly after their chicks have fledged. Plovers continue to stage and migrate throughout August and into early September.

Figure 3. Piping plover breeding beaches and migratory stopover areas within the action area.




Within the action area, piping plovers nest on private- and government (municipal, state and federal)-owned beaches in Nantucket and Vineyard Sounds. Most of these beaches are heavily used for recreation during the summer months when plovers are present and breeding.

Massachusetts state guidelines (MADFW 1993) for managing piping plovers have been in place since 1993, although intensive management of beaches was initiated prior to their publication. In 1994, the Service developed guidelines (USFWS 1994) for managing recreational activities on piping plover habitat and avoiding violations of the ESA.

Management at most sites in the state now conforms to both state and federal guidelines. All current nesting beaches and most historical or potential sites are censused each year, and more

than 80% of the major sites are monitored at least three times per week during periods of nesting and brood-rearing (Appendix C, USFWS 1996). Since 1995, estimates of productivity were obtained for more than 95% of all breeding pairs in the state.
On most Massachusetts beaches where nests are potentially threatened by pedestrian activities, nests are protected with buffers delineated by symbolic fencing and warning signs. Additionally, some nests are protected with wire predator exclosures. Within the action area, a number of nests are not exclosed at locations where predators have keyed into exclosures in the past and caused increased predation of eggs, chicks, and occasionally adults. Management of off-road vehicles at major beaches in Massachusetts conforms to most components of state and federal guidelines. Beginning in early April, and extending until the first egg hatches, off-road vehicles are restricted per guideline recommendations to discrete travel corridors along the outer edges of suitable plover nesting habitat. The guidelines call for sections of beach where unfledged plover chicks are present to be completely closed to recreational vehicles until chicks reach 35 days of age or are observed in flight. By requiring Orders of Conditions avoiding short- and long-term adverse effects on the habitat of listed species, the Massachusetts Wetlands Protection Act provides an effective regulatory tool to protect plover habitat from degradation caused by off-road vehicles and dune building activities.

Dog control is a continuing management problem on many Massachusetts plover beaches. Dogs disturb plovers and often prevent successful nesting by chasing adults and chicks and crushing eggs. Enforcement of town and state leash laws or dog prohibitions has been minimal at best. MAS manages plovers on more than 40 state and private beaches, and consistently reports dogs off-leash harassing plovers (E. Jedrey, Massachusetts Audubon Society, pers. comm. 2008). Some dogs are brought to beaches by owners; others swim a short distance from the mainland to barrier island plover nesting sites (e.g., Sampson’s Island) and periodically disrupt breeding terns and plovers (B. Harris, Massachusetts Audubon Society, pers. comm. 2008).

Additional management challenges include increasing predation pressure, particularly from coyote, fox, cats, and avian predators, including crows and gulls. Predator control measures have not been implemented to a large extent due to restrictive state regulations, limited funding, or lack of support by the landowners. However, targeted predator management recently implemented at two beaches north of the action area (Plymouth Long Beach, Plymouth, Massachusetts and Crane Beach, Ipswich, Massachusetts) resulted in immediate increased productivity, although long-term benefits to productivity from targeted predator removal are unknown.

EFFECTS OF THE ACTION

The Service's evaluation of the effects of the federal action under consideration in this consultation is governed by its regulations and policies implementing the ESA. For instance, the Service is required to evaluate the direct, indirect and cumulative effects of the action on the species.[7] We conclude that construction, operation and decommissioning of offshore wind turbines may affect birds in several ways, including 1) risk of mortality from collision with the rotors and monopole or from turbulence behind the rotors (rotor wash), 2) short-term habitat loss or displacement during construction, 3) longer-term habitat loss or displacement due to the presence of the turbines and maintenance activities, 4) formation of barriers on migration routes (Exo *et al.* 2003), and 5) increased predation. Lighting of the facility could confuse or attract birds, potentially exacerbating the primary effects enumerated above, especially in poor weather or visibility conditions. Since the vessels involved in the construction, operation and decommissioning of the Cape Wind Project contain diesel and other oils, and the individual WTGs and the ESP contain cooling oil (some 40,000 gallons within the ESP), there is also the potential threat of an oil spill caused by a vessel accident, leakage or catastrophic failure of the ESP or one or more WTGs.

The ESA defines take to include the wounding and killing of listed species [16 USC 1532(19)]. Although both may occur with respect to this project, the Service has determined that it is highly unlikely that any plover or tern that collides with any part of the WTG or ESP would survive if injured. For example, injured birds would have a compromised ability to feed, defend against predation and complete a migration necessary for survival. As such, we refer to mortality as encompassing injury for the purpose of this BO.

The Service considered the effects to both species over 20 years, the anticipated project duration based upon CWA's estimate of a minimum 20-year life expectancy of the WTGs. Nevertheless, with respect to the beneficial effects that the Bird Island restoration project is anticipated to provide roseate terns, we examine it over 50 years, which is the designed life-expectancy of the restored revetment and re-nourishment operation (ACOE 2005).

As explained earlier, in applying the "best scientific and commercial data available" information standard in evaluating project impacts on listed species, the Service must carefully assess and address uncertainty. Uncertainty associated with evaluating the impacts of the Cape Wind Project on roseate terns and piping plovers arises largely from the fact that there are limited data for roseate tern presence within the project area in Horseshoe Shoal and no empirical data for

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[7] 50 CFR §402.02 provides that: Effects of the action refers to the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated or interdependent with that action, that will be added to the environmental baseline. The environmental baseline includes the past and present impacts of all federal, state, or private actions and other human activities in the action area, the anticipated impacts of all proposed federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of state or private actions which are contemporaneous with the consultation in process. Indirect effects are those that are caused by the proposed action and are later in time, but still are reasonably certain to occur. The Service concludes that "when effects on listed species are expected to be discountable, insignificant, or completely beneficial," it is appropriate to conclude that the action will not likely adversely affect the species. It defines those terms as follows: "Beneficial effects are contemporaneous positive effects without any adverse effects to the species. Insignificant effects relate to the size of the impact and should never reach the scale where take occurs. Discountable effects are those extremely unlikely to occur. Based on best judgment, a person would not: (1) be able to meaningfully measure, detect, or evaluate insignificant effects; or 2) expect discountable effects to occur."

piping plover presence within the action area other than at breeding sites on the periphery. Limited surveys for roseate tern presence at Horseshoe Shoal conducted by MAS and CWA documented use of the area by foraging, resting and travelling roseate terns. Avian surveys conducted sporadically over a five-year period were unable to conclusively document piping plover flights over Horseshoe Shoal, although breeding locations and productivity information are well documented for coastal beaches. The Service acknowledges these data gaps exist, but nevertheless is required to evaluate the project with the information that is available. We do so as transparently as possible, identifying the limitations of the methodologies used, the data assembled, and their resulting utility.

Given the limited data available concerning roseate tern and piping plover use of the project area, we depend to varying degrees on information collected from other wind projects where interaction with, or proximity to roseate terns, piping plovers, and similar species has been documented. In addition, where data is lacking, results are of questionable utility, or comparisons with other projects are not directly applicable, we account for this in the risk modeling upon which we have largely based our conclusions about the levels of anticipated take. For example, as is discussed below, the Service adjusted many of the factors in the model of collision risk (e.g., where information on the nighttime flights of terns is unavailable, we assumed some level of presence and incorporated a more conservative value).

*Roseate Tern*

**Collision Risk**

<u>*Other Wind Facilities*</u>
Some literature exists on offshore and onshore coastal wind projects of varying sizes and effects on bird species, including other tern and plover species that breed or roost in, forage within, or fly (during migration or commuting) through wind turbine fields. The Service evaluated information from what it considers to be the most relevant of these, given their proximity to known tern species and plover occurrences. Of these, the Service focused on one wind power facility in Belgium and three facilities within the western North Atlantic breeding range of the roseate tern and piping plover. These projects are not identical in design, size or location to Cape Wind. In fact, they differ in some notable respects, which we discuss in detail. Also, we recognize that the methodologies used to obtain data, particularly carcass searches used to obtain mortality data, in the studies of these other facilities have certain limitations. For these reasons, the data collected at these sites are not necessarily directly transferrable to our analyses. However, they do yield useful information about the species' behaviors and tendencies. We therefore thoroughly discuss the results, their utility, and how we apply the information to our modeling efforts.

<u>Zeebrugge</u>
The Zeebrugge commercial wind power facility in Belgium consists of 25 turbines located in a linear array on a breakwater (not in open water) between tern nesting habitat and foraging habitat. Fourteen of the turbines are directed at the sea and 11 are land-directed.

Everaert and Stienen (2006) recorded collision mortality at the Zeebrugge facility for three species of terns, common terns, sandwich terns (*S. sandvicensis*), and little terns (*S. albifrons*). They were not able to study roseate tern response to this facility because roseate terns do not nest or otherwise occur there. These studies showed that the Zeebrugge facility had an important negative effect on a tern colony due to collision mortality.

At Zeebrugge, over 6,000 pairs of terns nested between 100 ft (30 m) and 1,320 ft (400 meters) from the turbine array in 2004 and about 4,000 pairs nested between 165 ft (50 m) and 1,320 ft (400 m) from the turbines in 2005. Everaert and Stienen (2006) reported that an estimated 168 terns died from collisions with the turbines in 2004 (primarily the 14 turbines closest to the sea) and 161 were estimated to have died in 2005. This amounts to about 6.7 terns killed per turbine per year for the entire wind facility, and about 11 terns killed per turbine per year for the 14 turbines closest to the colony. Even within the 14 sea-directed turbine group, during 2004-2005, the four turbines closest to the tern colony caused the vast majority (90-92%) of the observed tern mortality. The authors attribute the recorded mortality of terns (and gulls) at Zeebrugge to the high number of daily crossings (>10,000 flights per day for common and sandwich terns) through the linear wind turbine array by the birds moving about the colony and travelling (commuting) from nesting habitat to their feeding grounds at sea.

The data from Everaert and Stienen imply little to no risk for adults and young terns at Zeebrugge during the post-fledging period and during migration, when passage rates through the turbine array are presumably much reduced. All tern mortality occurred between May and mid-August; no terns were found to have collided with the turbines the rest of the year (Everaert and Stienen 2006).

In a more recent finding from this study, Stienen *et al.* (2008) report strong evidence of a male bias among common tern collision fatalities at Zeebrugge during the egg-laying and incubation phases of the breeding season. The authors attribute the cause to behavioral differences between the sexes, and not to any morphological differences between the sexes, such as size, that could influence vulnerability to collision mortality. Specifically, female common terns spend more time in the colony defending their nests, incubating eggs and defending against kleptoparasitism, while males allocate more time to foraging and delivering food to their mates (Stienen *et al.* 2008). As a result, males were at greater risk of colliding with the turbines because as they foraged at sea and then returned to the colony, they made many more commuting flights past the turbine array than did females.

Among the limited studies that have been conducted to date, the tern mortality rate (6-11 terns per turbine per year) at Zeebrugge is the highest for those species reported in the scientific literature (e.g., Erickson *et al.* 2001; Perrow *et al.* 2006; Everaert and Kuijken 2007) and underscores the importance of site selection. Based on the Zeebrugge case study, the Service determines that placing wind turbines within or in very close proximity to tern nesting colonies is poor site selection that could result in high levels of mortality. It is similarly ill advised to encourage terns to nest in close proximity to turbines, as was the case at Zeebrugge.

However, the Service finds that there are substantial differences between the Zeebrugge facility and the Cape Wind Project. The Cape Wind Project is located > 19 miles (31 km) from the nearest major roseate tern colonies, while common, sandwich, and little terns nested between 100 ft (~30 m) and 1,320 ft (400 m) of wind turbines at the Zeebrugge facility (Everaert and Stienen 2006). Also, the small-to-medium-sized turbines at Zeebrugge are shorter with a smaller rotor-swept zone closer to the water surface, 52.5 to 164 ft (16 to 50 m) above water than those proposed for the Cape Wind Project, 75 to 440 ft (23 to 134 m) above water. In addition, the turbines at Zeebrugge are much more closely spaced, about 500 to 600 ft apart, than those proposed for the Cape Wind Project, which will be 0.33 to 0.5 mile apart.

Western North Atlantic

Presently, there are three small-to-mid-sized wind turbine projects within the breeding range of the roseate tern in the western North Atlantic. These are located at Sable Island and Pubnico Peninsula, Nova Scotia, and at the Massachusetts Maritime Academy (MMA) in Buzzards Bay, Massachusetts. The Sable Island wind generating station consists of five smaller, lattice tower mounted turbines 78 to 98 ft high (24 to 30 meters) with guy wires, the Pubnico Peninsula project consists of 17 large turbines (a 30 MW project), and the MMA single turbine is a Vestas V47-660kW model, 164-foot monopole with a blade tip height of 241 ft (50-meter monopole, blade tip height of 73.5 m). These projects differ in numerous and significant ways from the Cape Wind proposal. For example, they are much smaller in size and in the number of turbines, and they are land-based. However, because these wind facilities are all located closer to roseate tern nesting colonies than Horseshoe Shoal is to colonies in Nantucket Sound (the Monomoy Islands), they are pertinent to this analysis.

Sable Island: The Sable Island wind turbines were erected near the island's meteorological station but in a site used by nesting common and arctic terns (*S. paradisaea*) (Andrew Boyne, Canadian Wildlife Service, pers. comm. 2008). The few roseate tern pairs that are present on the island (four pairs were recorded in 2007) are apparently "on the other side of the island", but several hundred common and arctic terns nest within the scope of the supporting guy wires for the turbines (A. Boyne, pers. comm. 2008). Little information is available on this recently constructed project, however, approximately 10 terns may have been killed as a result of collisions and none were roseates (A. Boyne, pers. comm. 2008). A. Boyne (pers. comm. 2008). Photo-documentation found at www.greenhorsesociety.com/wind-energy/windfarm suggest that brightly colored flagging was added to the guy wires to reduce bird strike mortality at the structures. Indeed, A. Boyne (pers. comm. 2008) recently indicated that the turbine rotors are not spinning due to mechanical problems, thus tern mortality is almost certainly associated with strikes of the guy wires or possibly of other stationary parts of the latticed structures.

Pubnico Peninsula: The 17-turbine Pubnico Peninsula project was constructed in 2004 and 2005 and was visited by the Service and members of the United States and Canadian Roseate Tern Recovery Teams in October 2004. The project is located about 2.5 miles (4 km) from North and South Brothers Islands, the site of the largest roseate tern colony in Atlantic Canada. The turbines are land-based and are constructed on a peninsula adjacent to Pubnico Sound. About 50-75 pairs of roseate terns typically nest at the Brothers Islands (T. D'eon, c/o www.geocities.com/teddeon509/tern07), and, including common and arctic terns, the islands support from 450-750+ pairs of terns. Matkovich (2007) conducted two years of post-construction monitoring for avian and bat mortality from April 2005 to April 2007, and documented the mortality of 16 birds; all but one (a herring gull) were passerines. Mortality estimates adjusted for scavenger removal and searcher efficiency suggest 1-2.5 birds killed per turbine per year. No bats were found. All bird mortality was associated with periods of fog or overcast/windy weather, and most was associated with spring and fall passerine migration. Mr. Ted D'eon, Canadian Roseate Tern Recovery Team member and tern colony steward of the Brothers Islands, states, "I have no concerns with the wind farm disturbing the tern colony. I have seen no effect of the wind farm (negative or otherwise) on the tern colony" (T. D'eon, electronic correspondence 2008).

Massachusetts Maritime Academy: The single-wind turbine at the MMA in Buzzards Bay is a useful pilot project to examine the behavior of travelling and foraging common and roseate terns in proximity to a commercial scale WTG. Although the MMA turbine is land-based, its location on Taylors Point, a peninsula on the northern edge of Buzzards Bay, is useful because both common and roseate terns are present along the Cape Cod Canal on one side and along Buttermilk Bay on the other. Terns frequently cross the MMA campus in the area of the turbine to travel between these water bodies. Moreover, it is located much closer to the action area than any of the other projects we considered.

The Service recognizes the difficulty of extrapolating results from a one turbine project to a proposed 130-turbine facility. However, despite the small size of the MMA project, researchers studying tern behavior were able to obtain useful information about tern flight behavior, ecology and reactions to the turbine. Also, because there is only one turbine and it is land-based, monitoring (including post-construction collision mortality) could be more comprehensive and results therefore more accurate.

From April to November in both 2006 and 2007, Vlietstra (2008) recorded the abundance and flight altitude of common and roseate terns flying within 165 ft (50 m) of the MMA WTG. Although both tern species were present in the study area, common terns far outnumbered roseate terns. However, small numbers of roseate terns were present during mid-June to mid-to-late August in both years. Vlietstra observed 254 terns (both species) in 2006 and 294 terns in 2007 that were flying within 165 ft of the WTG.

An avian and bat mortality study was also conducted at the MMA during 2006 and 2007. No bat carcasses were found at the site but three birds (a laughing gull, an osprey and a great black-backed gull) were found and were likely casualties of a collision with the WTG. In July 2008, the Service (unpubl. data) observed a herring gull carcass that was also likely a collision fatality. Vlietstra (pers. comm. 2008) reported that European starlings were the only bird species observed to have briefly perched on the nacelle of the WTG.

The MMA WTG is lit by a flashing white aviation safety light. The light on the wind turbine is visible from the Bird Island tern colony, 7.5 miles (11 km) away. From the observations at the site, neither anecdotal nor empirical evidence suggests that the flashing light on the MMA WTG is an attractive nuisance to the common or roseate terns traveling through the area, although no specific study was undertaken to assess the effects of lighting on those birds. Similar to the Pubnico Peninsula wind power project, there is no evidence that the MMA wind turbine has had any adverse effect on the roseate tern (Matkovich 2007; T. D'eon, pers. comm. 2008; Vlietstra 2008).

To date, there is no evidence that any of the three wind power projects within the coastal breeding range of the roseate tern in the western North Atlantic have caused injury or mortality to roseate terns.

*Collision Risk Exposure*

Spring arrival and pre-migration fall staging

In the weeks when roseate terns first return to their northeast breeding range in late April and early May, they may be present in and around Nantucket Sound "in large flocks" (Gochfeld *et al.* 1998). During the post-breeding period, late July to September (to the date of departure when the North Atlantic population may congregate en masse and begin their migration to the wintering area), particularly a 21-25 day period in late August to mid-September, there is the potential that every breeding adult roseate tern in the North Atlantic population, and their young of that year, (e.g., about 8,000 adults and 4,000 young for the year 2007) will be in Nantucket Sound, within 20 miles of the Cape Wind Project area. During these times of year, roseate terns may enter the project area and be exposed to collision risk (See Collision Risk Assessment) from the Cape Wind Project as they forage or commute between foraging and staging habitats. Based on this information, the Service determines that the time of year when most roseate terns may be exposed to collision risk is during the few weeks in late April-mid-May and during the last three weeks of the post-breeding staging period (approximately August 20-September 15), when peak numbers of terns are reported along outer Cape Cod and in Nantucket Sound (Trull 1998; Trull *et al.* 1999).

Courtship

In courtship, roseate terns perform spectacular aerial displays at 9-91 ft (30-300 m). Courtship behavior is described as generally occurring at the breeding colonies and in the surrounding intertidal area (Nisbet 1981; Gochfeld *et al*. 1998). However, there is a remote possibility that some roseate terns might conduct courtship flights in the project area. Should this occur, the roseate terns could potentially fly within the rotor zones. The likelihood of courtship occurring in the project area is more remote if perching deterrents are installed, discouraging resting terns from gathering and possibly initiating courtship.

MMS and CWA have committed to field-test proposed perching deterrent measures during the pre-construction phase of the project (e.g., by using them on the meteorological tower already in place), to monitor the anti-perching measures post-construction with remote, motion-detecting cameras, and to alter methods if MMS and CWA, in coordination with the Service, find them unacceptable (BA). Based on roseate tern courtship primarily occurring at breeding colonies or adjacent intertidal areas and the CWA commitment to develop effective perching deterrent devices to further minimize the likelihood of courtship occurring in the project area, the Service finds that roseate terns are unlikely to collide with the WTGs or the ESP as a result of courtship flights.

<u>Foraging</u>

During the nesting season, roseate terns may be exposed to collision risk if they enter the project area to forage. The foraging range for nesting roseates is reported to be up to 30 km from the colony (Spendelow in Gochfeld. *et al.* 1998; Heineman 1992), although they often feed much closer [within 6.2 miles (10 km)] to the colony (Rock *et al.* 2007), depending on the availability of food (Nisbet 1981). Data collected in and around Cape Cod also suggest this to be the case. For instance, Nisbet (1981) and Heinemann (1992) reported on the feeding areas used by roseate terns nesting at Bird Island, the largest roseate colony in Massachusetts. Roseate terns nesting at Bird Island forage within Buzzards Bay and along the Elizabethan Island archipelago to Woods Hole and Vineyard Sound, but were not reported to venture farther east than the westernmost portion of Nantucket Sound. It is generally thought that what makes Bird and Ram Islands so attractive and productive for nesting terns is their proximity to nearby foraging locations at Mashnee Flats and the shallows surrounding Ram Island (Heinemann 1992; J. Spendelow, pers. comm. 2008). Heinemann (1992) states that the shoal at Mashnee Flats, and other feeding sites nearby, constitute the single-most important foraging area for the roseate terns nesting at Bird Island. The Service concludes that relatively few roseate terns will forage on Horseshoe Shoal during the breeding season due to its distance ($\geq$ 18 miles, 31 km) from the large nesting colonies in Buzzards Bay.

A male-biased mortality factor for roseate terns would be a very important concern, as the endangered northeast population already exhibits an imbalanced adult sex ratio skewed toward females (Nisbet and Hatch 1999; Arnold 2007). However, male-biased mortality of roseate terns from the Cape Wind Project is not anticipated, since unlike at Zeebrugge (for common terns), the Horseshoe Shoal project area is not within the foraging range of any major nesting colony for roseate terns, and likely only within the outer foraging area of terns nesting in the Monomoy Islands, 15+ miles (24 km) away.

Muskeget Island [8.6 miles (13.8 km) from Horseshoe Shoal] is historically the site of a large roseate tern colony. If Muskeget were to be re-occupied by nesting terns during the expected life of the project, there could be a future concern for overall and male-biased mortality of roseate terns. However, unlike at Zeebrugge, where terns nest immediately adjacent to the wind farm and pass through the turbine array as they commute to foraging areas, terns at Muskeget would be miles away from the nearest turbines and have alternative foraging locations along Nantucket Island and Tuckernuck Island that would not require crossing Horseshoe Shoal. The re-occupancy of Muskeget Island by large numbers of roseate terns is not reasonably certain to occur within the 20-year life of the Cape Wind Project.

<u>Day versus night</u>

In a comparison of collision risk by day or night, Everaert (2004) refers to a Dutch study in which it was reported that, in contrast to gulls, terns do not migrate much at night and therefore the chance for collision should be lower. Although roseate terns in Nantucket Sound are known to occasionally fly at night (Trull *et al.* 1999), what is known about roseate tern life history (e.g., Gochfeld *et al.* 1998) supports the conclusion that the species is diurnal and their use of the project area will primarily occur during daylight hours.

<u>Juvenile roseate terns</u>
For any particular year, there will be no exposure to collision mortality for about 18-20% of the individuals in the northeastern population of the roseate tern. Virtually all the one- and most of the two-year-old roseate terns do not migrate north to the breeding range, but rather are assumed to remain in the wintering grounds until their third year of age (Spendelow *et al.* 2002). Spendelow *et al.* (2002) report no cases where one- or two-year-old birds were detected breeding in their 10-year study of nesting roseates at Falkner Island. In examining the effect of Hurricane Bob, which struck the Cape Cod area on August 19, 1991, the authors found little impact of the storm on the survival of young from the two preceding years. They report that virtually no young from 1990 and relatively few from 1989 were expected to have been present around Cape Cod in August 1991 (Nisbet 1984), and these two cohorts showed no sign of less than typical survival (Spendelow *et al.* 2002). Spendelow (pers. comm. 2008) estimates that a small number of one-year-olds (~5%), and perhaps as many as 40% of the two-year-olds do migrate north in their first and second years, respectively. Spendelow *et al.* (2002) estimated that annualized survival probabilities for immature, pre-breeding roseate terns at Falkner Island were 0.53-0.57. Accordingly, in any given year, some 2,100 one-year-old roseate terns (4,000 X 0.55 survival rate X 95%) and another 726 two-year-old (4,000 X 0.55 X 0.55 X 60%), or ~2,800 pre-breeding roseate terns, will have no exposure to collision mortality from the proposed action, because they will not occur in the project area. Accordingly, subsequent discussions regarding the effects of the action on the roseate tern apply only to those birds that migrate north to the breeding range, and to their young of the year, that may stage in Nantucket Sound prior to their first migration south.

<u>*Collision Risk Factors*</u>

<u>Flight height above water</u>
Since the primary threat of injury and mortality to birds is the collision hazard posed by the spinning rotors and to a lesser extent to the vortex or turbulence effects behind the rotors (Desholm *et al.* 2004), the height of the rotors above the water and the flight altitude of roseate terns as they cross the project area is information essential to assess risk. For the Cape Wind Project, the rotor-swept zone is 75 ft (23 m) to 440 ft (134 m), an area of about 2.4 acres (1 ha) above the water surface. Birds flying below 75 ft at any given time are at no risk from the rotors but must avoid colliding with the monopole support towers. Birds flying above 440 ft should be at no risk.

In order to assess the presence of terns and their flight altitude above Horseshoe Shoal, CWA and MAS conducted aerial, boat and radar surveys. In 2003 and 2004, MAS observed more than 560 terns (both roseate and common) during boat surveys in Nantucket Sound. Of terns in flight (some were resting on the water), the average flight height was 29 ft (about 9 m), and 90% of the terns in flight were below 70 ft (21 m) [Perkins *et al.* 2004 and Sadoti *et al.* (2005a; 2005b) cited in BA]. During CWA's 2002 and 2003 aerial surveys, the flight heights of over 900 terns (both species) were categorized and 94% were at altitudes below the rotor-swept zone (RSZ); 6% were at heights within the RSZ. One roseate tern was among the terns identified to species that were flying at the height of the RSZ (page 4-22 of the BA). As summarized in the BA, CWA's breeding season surveys from 2002-2004 recorded 100 terns (both species) flying at altitudes within the RSZ (one was a roseate tern), but the majority of terns were flying below 39 ft (12 m).

During MAS boat surveys on Horseshoe Shoal in 2003 and 2004, 3% of about 450 terns (both species) flew within the rotor zone. Considering that common terns likely outnumber roseate terns in Nantucket Sound as they do in Buzzards Bay (perhaps by a ratio between 2:1 and 8:1) (Trull *et al.* 1999), very few of the terns observed in flight travelling through the Horseshoe Shoal project area within the rotor zone were likely to be roseate terns.

The difficulties of estimating flight height of small, fast moving birds during aerial and boat surveys over open water are discussed on pages 4-17 and 4-18 of the BA. In addition, the similarity of appearance between roseate and common terns, particularly when observed from an aircraft or boat at a distance, often prevented positive identification to species during CWA and MAS surveys. Other limitations of the CWA and MAS studies are discussed on pages 4-15 to 4-20 of the BA. We agree with MMS'ss assessment of the methodological limitations and resulting difficulties posed by studies that were of insufficient duration to capture seasonal and year-to-year variability. In summary, the most important limitations were that the aerial and boat surveys only obtained data during daylight hours, on days with light to moderate winds, and with good visibility. Accordingly, information about tern flight behavior over Horseshoe Shoal during night and other periods of low visibility (e.g., in fog or during inclement weather) when roseate terns and other birds may be at greatest risk to collision mortality remains unavailable. The Service further addresses these concerns when evaluating the assumptions and values employed in the collision risk model. However, based on the fact that the roseate tern is primarily a diurnal species and a visual forager, the Service concludes that during times when there is decreased visibility, roseate tern occurrence on Horseshoe Shoal will similarly decrease.

Additional questions remain concerning the proportion of terns in flight over the project area that will be at altitudes within the rotor zone; the Service nevertheless finds that the available data provide reasonable approximations if due allowances are made for inherent biases. Data obtained through radar were of little value to this evaluation because species identification for radar "targets" traversing the project area was not determined; no flight behavior of roseate terns or piping plovers was obtained from the radar data.

In the MMA post-construction monitoring study, Vlietstra (2008) reported that the flight altitude of about 550 common, roseate and unidentified terns that flew within 165 ft (50 m) of the MMA WTG averaged 63 ft (19.2 m), indicating that most terns flew below the rotor-swept zone, which occurs at this turbine between 86 ft (26.2 m) and 242 ft (73.8 m). Overall, the MMA study found that 85% of terns flew below the height of the rotor-swept zone, about 3% flew above the rotor zone and about 13% flew at the height of the rotor zone. When roseate terns were considered separately (n=8), all flew below the rotor zone. Roseates were found to pass through wind turbine airspace at a median height of 43 ft (13 m) (range 26-69 ft, 8-21 meters). Vlietstra noted that the likelihood of terns flying within 165 ft of the turbine was dependent on the operational status of the turbine rotors. During 2006, terns were 4-5 times less abundant when rotor velocity was > 1 rpm than when rotor velocity was < 1 rpm, leading her to conclude that when the rotor was operating, "terns seemed to avoid rotor-swept altitudes". Vlietstra (2008) concluded that when the rotor was operating, terns usually flew either below or above rotor-swept altitudes, whereas when the turbine was at rest, they flew at a variety of altitudes, including the height of the rotor.

At the MMA and nearby waters, Vlietstra (2008) found that in general, terns fly low to the water, about 3 to 39 ft (from 1-12 meters) when foraging, and it appears that they generally fly low when travelling short distances over land and water. When travelling, terns fly lower into the wind than when they fly with a tailwind (Hatch and Brault 2007; Nisbet 2008). This is important because when roseate terns on Horseshoe Shoal are foraging or flying into a head wind, they will likely be well under the RSZ and in no danger of collision mortality, but when they are travelling downwind, they are more likely to be flying higher and may be within the RSZ.

CWA and MAS also recorded flight heights of terns over Nantucket Sound during 37 aerial surveys and 36 boat surveys during the fall staging period (discussed on pages 4-22 to 4-27 of the BA). These studies suggest that from 0 – 31% (average about 6%) of travelling and foraging terns observed in the study area occurred at flight heights within the rotor zone (Hatch and Brault 2007). MAS boat surveys within Horseshoe Shoal found that 95% of terns flew below the rotor zone. In a recent study of visible bird migration during daytime in Helgoland, Germany, Exo *et al.* (2003) report less than 10% of divers (loons), grebes, ducks, mergansers, skuas, terns, gulls and auks were observed in flight at altitudes above 165 ft (50 m). Based on this information (from MMA, CWA and MAS), the Service finds that a large majority of terns of both species can be expected to fly below the rotor zone.

<u>Visibility</u>

Birds in flight, including roseate terns, are assumed to be at increased risk of colliding with WTGs when travelling during low visibility conditions. While terns could collide with the structures during different weather conditions, it is generally believed that birds are at greatest risk at night (Exo *et al.* 2003) and during other periods of limited visibility (Chamberlain *et al.* 2006). Roseates are generally considered a diurnal species, but they continue to forage during foggy weather (S. Hall, pers. comm. 2008; J. Spendelow, pers. comm. 2008), perhaps staying closer to the breeding colonies, and are known to fly at night during migration and during the post-breeding period (Hays *et al.* 1999, Trull *et al.* 1999) as they arrive and depart from overnight roosting locations.

The Service concurs with the discussion in the BA that terns are expected to regularly avoid collisions with the proposed WTGs, including the monopoles, on Horseshoe Shoal during favorable visibility and weather, because they are agile and maneuverable flyers (Gochfeld *et al.* 1998). At Zeebrugge, no dead terns were found beneath a disabled turbine which had no blades (Everaert pers. comm. cited in Hatch and Brault 2007). Unlike some birds, terns generally avoid colliding with man-made structures such as lighthouses (FWS unpublished data). Although researching the response of terns to a single onshore turbine, Vlietstra (2008) reports observing more than 550 tern flights past the MMA turbine, and none of the terns collided with either the rotors or the monopole.

The greatest potential for roseate terns to collide with the WTGs is during crossings of the Horseshoe Shoal project area during fog and rain, during nighttime and other low light conditions, or when the terns are flying in a downwind direction within the rotor-swept zone. As noted in the BA, there is a lack of observational data on tern occurrence in the project area during low visibility conditions. However, as previously noted, the Service believes that tern occurrence in the project area will decrease as visibility decreases.

The Service finds that the time of year when roseate terns are most exposed to collision risk is during the few weeks in late April-mid-May and during the last three weeks of the post-breeding staging period (approximately August 20-September 15) when peak numbers of terns are reported along outer Cape Cod and in Nantucket Sound (Trull 1998; Trull *et al.* 1999).

Weather data on visibility obtained from the Nantucket, Martha's Vineyard and Barnstable Airports for the years 2004 and 2005 were recently summarized by ESS Group on behalf of CWA (Table 6). At the Service's request, ESS analyzed what proportion of time (during daylight hours) for the month of May and for August/September visibility was recorded as being less than 0.25 mile. Combining two years (2004 and 2005) of data for these periods indicates that low visibility conditions for the two periods during the year when peak numbers of roseate terns were found in Nantucket Sound were very rare (only 3.67% of daylight hours during May and 1.63% of daylight hours during August/September). In view of this information, the Service concludes that when peak numbers of roseate terns are anticipated to be present in Nantucket Sound during daylight hours,[8] visibility will exceed 0.25 mile the vast majority of time, increasing the probability that terns and other birds will see and avoid the WTGs at Horseshoe Shoal.

Table 6. Visibility data from airports around Nantucket Sound.[9]

| | Nantucket Airport | | | | Martha's Vineyard Airport | | | | Barnstable Airport | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daylight hours[10] | April/ May 2004 | April/ May 2005 | Aug/ Sept 2004 | Aug/ Sept 2005 | April/ May 2004 | April/ May 2005 | Aug/ Sept 2004 | Aug/ Sept 2005 | April/ May 2004 | April/ May 2005 | Aug/ Sept 2004 | Aug/ Sept 2005 |
| No. hours visibility ≤0.25 miles | 27 | 24 | 10 | 14 | 17 | 13 | 6 | 5 | 1 | 5 | 3 | 1 |
| No. daylight hours in data set | 383 | 383 | 430 | 430 | 382 | 381 | 431 | 431 | 383 | 383 | 431 | 431 |
| % of daylight hours with visibility ≤0.25 miles | 7.0% | 6.3% | 2.3% | 3.3% | 4.5% | 3.4% | 1.4% | 1.2% | 0.3% | 1.3% | 0.7% | 0.2% |

*Review and Evaluation of Cape Wind Collision Risk Assessment*

Models are frequently used as a tool in risk assessment when uncertainty prevents the prediction of an outcome (or outcomes) with accuracy. For the Cape Wind Project, the number of terns or plovers that will actually collide with the WTGs and ESP is not known, thus Hatch and Brault (2007) used a geometric model in which a series of factors (specific to roseate terns and piping plovers where available) are either measured, extrapolated from studies of closely related species or estimated from the scientific literature. Multiplying these factors together within the model provides a transparent way to develop an estimated probability of collision mortality to roseate terns and piping plovers from the project.

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8 Data from the 2006 ESS Group, Inc. study for CWA indicate that the majority of incoming and outgoing flights of the ±1,200 roseate terns observed over a four-day period occurred after sunrise and before sunset.

9 Data Source: Nantucket, Martha's Vineyard and Barnstable Airport weather records, 2004-2005. Available at www.ncdc.noaa.gov/oa/ncdc.html.

10 Daylight hours in April and May are from civil dawn to civil twilight; daylight hours in August and September are one hour before sunrise to one hour after sunset.

Hatch and Brault (2007), consultants for CWA, utilized tern passage rates, numbers flying at rotor height and other factors, and collision mortality data from sites such as Zeebrugge, Belgium to develop a collision risk assessment model for roseate terns occurring in or crossing the Cape Wind Project area. Collision probability at the Zeebrugge wind farm was believed to be influenced by a number of factors, including **flight behaviors**, e.g., irregular flight paths and circling around the colony, **flight height** as they commuted from nest sites to foraging locations and returned, **numbers of pairs nesting** at close range (most terns nested from 50-100 meters to 400 meters from the turbine array) and most importantly, **passage rates**, the number of terns flying past the turbines. An **avoidance rate** is the proportion of birds that could collide with a wind turbine generator but do not because they take effective avoiding action (Chamberlain *et al*. 2006). These and other factors for roseate terns at Horseshoe Shoal were similarly considered by Hatch and Brault to formulate an estimate of the number of terns that may collide with the WTGs of the Cape Wind Project.

It is important to note that tern mortality recorded at Zeebrugge included any and all collisions with the turbines (rotors and the monopoles) as well as any birds killed due to vortex (turbulence) effects of the rotors. Thus, estimated avoidance rates for common and sandwich terns at Zeebrugge take into consideration all potential causes of collision mortality. Accordingly, the collision risk assessment model developed by Hatch and Brault (2007) for this project, which utilized and adapted avoidance rates exhibited by common and sandwich terns at Zeebrugge, similarly accounts for any form of collision mortality with the wind turbines.

Hatch and Brault ran two versions of their geometric collision risk model for roseate terns in the Horseshoe Shoal project area (Hatch and Brault 2007; Appendix A of the BA). The result of the 2007 model estimated 0.3 to 2.3 (median of 0.8) roseate terns will be killed per project per year from collisions with the WTGs. Each of the parameters used in estimating the number of roseate tern collisions contains some uncertainty, due to variation in species presence/absence, numbers, or flight behavior and sampling variation. It is useful to know the range of this uncertainty because it can indicate what deviations from expected outcomes are possible and how likely they are. An uncertainty analysis was conducted by Hatch and Brault (2007) using a combination of Monte Carlo and data re-sampling methods to estimate the range of uncertainty surrounding the parameters of the model and to develop a probability distribution for the annual number of roseate tern collisions. Results of 5,000 simulations indicated a median mortality of 0.83 roseate tern per year with large uncertainty (5% to 95% probabilities: 0.01 to 8.2 roseate tern mortalities per year).

In the 2008 version of the model, the authors considered different parameter inputs, partially based on the comments of Nisbet (2008), and estimated that two roseate terns will be killed from collisions with the WTGs per year. Because inputs for many of the parameters used in both the 2007 and 2008 models, as well as those recommended by Nisbet (2008), were estimates or approximations, the authors acknowledge that the uncertainty surrounding the model inputs has a large impact on the variance of the mortality estimates. Using all the recommended revisions to the model suggested by Nisbet (2008) resulted in a mortality estimate of 17.5 roseate tern deaths per year. According to Nisbet (2008), 95% confidence limits for a "central" mortality estimate of 18 are 0.2 to 180 terns killed per year.

In review of the avian collision risk assessment for roseate terns presented in the DEIS and the BA, the Service is persuaded by some (but not all) of the revised collision risk model inputs recommended by Nisbet (2008). The Service independently reviewed all of the factors presented in Hatch and Brault's revised collision model and Nisbet (2008) as follows and estimates that, for a number of reasons described below, four to five roseate terns will be taken each year:

Factor A. Numbers of terns (mixed species) present in the Horseshoe Shoal project area. The Service has reviewed the model inputs suggested by Hatch and Brault in the BA and those by Nisbet (2008) and finds that factor A, "numbers of terns", was underestimated in the BA but not likely by as much as 25% as suggested by Nisbet (2008). Nisbet's contention that the aerial surveys appear to have missed most of the high flying birds is based on questions about a large number of high flying targets detected in radar studies (and allegedly missed in aerial surveys) during 2002. The Service is persuaded by the discussion in Appendix A of the BA, that explains why more high flying targets were detected during the radar survey than during the aerial survey [different (larger) radar sampling area and longer duration]. However, the Service concludes that terns flying at dusk, night, dawn or otherwise in poor visibility would have been missed by CWA and MAS boat and aerial surveys. Therefore, although we disagree with Nisbet's proposed correction factor value, we find that a smaller correction factor of 10% is appropriate to account for undetected terns flying at night, dawn or in poor visibility, because the detectability issue he raised is addressed in part in Appendix A (BA). A=1.10

Factor B. Proportion of total terns that were roseate terns. The Service agrees with Nisbet (2008) that the proportion of mixed species of terns recorded during surveys on Nantucket Sound that were ascribed by Hatch and Brault (2007) to be roseate terns, 3.2% and 10%, was too low. Trull *et al.* (1999) reports that common terns outnumbered roseate terns in ratios of 2:1 to 8:1 (33% to 11%) on outer Cape Cod during the post-breeding season. Trull (1998) reported that subsamples of roosting terns during this period showed an average of 35% roseates overall, but cautioned that because roseates call more frequently than do common terns at this time, observers can be misled if they rely on vocalizations alone to identify proportions between the species. CWA and MAS surveys during the pre-breeding and breeding seasons report the proportion of terns being roseates as from 2.4% to 20%. The Service finds that the roseate tern proportion estimated by Hatch and Brault (2007) and Appendix A (BA) (3.2% to 10%) does not sufficiently represent the range of variability for this factor, and finds that a correction factor of 15-20% is reasonable because it is intermediate between more historical estimates, for example Trull *et al.* (1999) and data from more contemporary CWA studies. B=1.15-1. 20

Factor C is simply factor A multiplied by factor B. AXB=1.265–1.32

Factor D is the fraction of roseate terns observed on Horseshoe Shoal that were travelling. As opposed to when terns rest on the water or forage from low flight heights, a proportion of terns using the Horseshoe Shoal project area will be travelling, which could, in certain circumstances, place them at the height of the rotors and in greater risk of collision. Nisbet (2008) argues that Hatch and Brault (2007), as cited in the DEIS and the BA, underestimate not only the number of terns in Horseshoe Shoal but also the proportion of roseate terns in “travelling” flight that could be within the rotor-swept zone. Hatch and Brault (2007) analyzed tern flight height and wind direction data from the CWA and MAS surveys and found a clear effect of wind direction and speed on flight altitude. Notably, terns in flight with a tailwind will fly at higher altitudes. Based on that finding, Nisbet recommends that most or all terns travelling with a tailwind (within 45 degrees of the birds’ heading) are likely to fly at rotor height. However, Hatch and Brault (2007) analyzed the height of terns in flight with a downwind and report that 40% were at rotor height, and not most or nearly all as Nisbet contends. Further, they dispute the detection questions raised by Nisbet, and contend that for the applicant’s aerial surveys, all birds for the complete width of the transect to the height of the plane were recorded because “terns are relatively conspicuous and were detected over a wide area”.

Nisbet (2008) accurately points out that no data were obtained on travelling terns or the height of their flight after dark. Nisbet (2008) argues that Hatch and Brault’s estimate for this parameter, 5% travelling, was low and should be increased to 30%. However, this higher estimate is based on the assumption that the best available information underestimates that proportion by 600%. The Service is persuaded that a smaller correction factor is more reasonable because the detectability question has been partially addressed (see above).

Table 3 in Hatch and Brault (2007) indicates that from 0 to 31% of terns observed in flight from boat surveys were at heights in the rotor-swept zone, and an overall average is 6.2% of flying terns were at rotor zone height. However, there is additional uncertainty resulting from the lack of surveys conducted during low light and strong wind conditions. As discussed previously, although tern use of the project area is expected to decrease as visibility decreases, the Service nevertheless finds that some additional caution is warranted to account for uncertainty. Therefore, the Service determines that 6.2% is too low and that a correction factor of 10%-15%, should be applied to this factor. D=1.10-1.15

<u>Factor E</u> is the number of tern crossings of the project area. For this factor, Nisbet (2008) contends that Hatch and Brault (2007) underestimated the number of crossings by about one third (recommending a correction factor of 1.32). The Service does not concur with the correction factor recommended by Nisbet (2008) for the estimated number of roseate tern crossings of the project area per year. Nisbet reasons, in part, that the estimated number used by Hatch and Brault is too low and should be increased by about one third because terns flying at night were missed. Observations of terns departing South Beach, Chatham and Monomoy during four days in 2006 found that most tern flight activity occurred between 10 minutes of sunrise to 20 minutes after sunset (ESS 2006). Hatch and Brault (2007) report that these first and last birds were outliers, and that most tern flights occurred after sunrise and well before (~ 50 minutes) sunset. Although this study only occurred over the span of four days, it is supportive of Hatch and Brault’s finding that day length (sunrise to sunset) provides a conservative measure of the period during which terns are active.

With due caution, the Service determines that reliance on limited data is preferable to findings of a speculative basis. The Service partially concurs with the discussion in Appendix A of the BA that Hatch and Brault's estimate is unlikely to underestimate the number of terns by 33% because although some terns do continue to arrive at night roosts after dark, this is a highly seasonal behavior restricted to several weeks in August through mid-September. Furthermore, roseate distribution on outer Cape Cod varies considerably from year to year. Recent roseate tern post-breeding distribution observations in 2007 and 2008 by MAS (B. Harris, pers. comm. 2008) and the U.S. Geological Survey (J. Spendelow, pers. comm. 2008) suggest that in some years, roseate terns were using Cape Cod Bay and the Atlantic Ocean more frequently than previously suspected. The Service interprets this to mean that in certain years, roseate terns may have less presence (i.e., fewer tern crossings) in Nantucket Sound than indicated by earlier fall staging period studies. A smaller correction factor, 10-15%, is therefore appropriate. E=1.10-1.15

<u>Factor F</u> is the fraction of travelling terns flying at rotor height. The uncertainty surrounding this factor is discussed above in factor A (i.e., detectability of high flying terns) and in particular, factor D above (% of terns flying downwind that were observed within the rotor zone). For reasons specified in those sections, the Service is not persuaded by Nisbet (2008) that a correction factor of 5 is appropriate. While Nisbet (2008) speculates that most or all of terns flying downwind fly at rotor height, Hatch and Brault (2007) rely on an empirical data set that includes 60% of downwind (day time) flyers observed not at rotor height. However, Hatch and Brault's (2007) estimate of 5% does not account for the range of uncertainty around this factor (e.g., terns that may have commuted back to an overnight roost at rotor zone height after dusk were not counted in the boat and aerial surveys because surveys only occurred during daylight hours). A higher proportion of the terns flying after dark may be at higher altitudes because unlike day time terns in flight, none of the birds after dark would be actively foraging (foraging terns generally fly low to the water). The Service concludes an appropriate correction factor for F is 3.0.

<u>Factor G</u> is number of rotors encountered. The figure used by Hatch and Brault (2007) is not in dispute, although the Service notes that some foraging terns may enter the turbine array, quickly catch a fish, and depart the wind project area. Terns behaving in this manner will not encounter as many turbines as estimated in the model. No correction factor is applied. G=1.0

<u>Factor H</u> is the species-specific probability of collision. Since no data for avoidance rates exist for roseate terns transiting WTGs, Hatch and Brault (2007) utilized common tern and sandwich tern data from the Zeebrugge, Belgium wind facility. Hatch and Brault then adjusted the common tern and sandwich tern avoidance rate based on the differences between Zeebrugge (a tern nesting colony) and Horseshoe Shoal (an area periodically used by foraging and travelling terns). Nisbet (2008) disputes the avoidance rate (0.953-0.983) for roseates used by Hatch and Brault (2007), and recommends a lower value based on the roseate tern being intermediate in size and flight characteristics between the two species.

> The Service is persuaded that the major differences between the Zeebrugge facility and the Cape Wind Project proposed for Horseshoe Shoal go beyond the size and flight speed of the birds, and support an avoidance rate in the range used by Hatch and Brault (2007; see also Appendix A of the BA). In particular, Everaert and Stienen (2006) report that while sandwich terns at Zeebrugge mainly flew a straight line (past the turbine array) to the feeding grounds and back, common terns flew more irregular flight paths and performed more circling movements around the colony (and presumably the turbine array). The flight patterns exhibited by common terns at Zeebrugge are associated with the breeding colony located nearby and resulted in increased collision mortality. Roseate terns flying across Nantucket Sound are not expected to fly in a similar manner, because Horseshoe Shoal is more than 15 miles from the nearest nesting colony. For the above reasons and other differences between the projects as previously discussed, the Service disagrees with the overly conservative avoidance rates recommended by Nisbet (2008) that are based on collision rates for common terns (in particular) and sandwich terns at the Zeebrugge facility in Belgium. Rather, the Service concludes that roseate terns will have a higher avoidance rate (and lower collision) rate through the Cape Wind Project area, compared to terns at Zeebrugge. No correction factor is applied. H=1.0

As described above, the Service has evaluated the input parameters for the collision model in light of rationale presented by Hatch and Brault (2007), Nisbet (2008), and Appendix A of the BA (2008), and exercised an abundance of caution by providing a reasonable but generous allowance for uncertainty around each parameter. Multiplication of our revised factors (A=1.1, B=1.15–1.2, D=1.1–1.15, E=1.1–1.15, F=3) yields a multiplier of 4.59 (using lower bounds for factors B, D, and E) and a multiplier of 5.24 (using the higher bounds). The multipliers applied to Hatch and Brault's (2007) estimate of 0.83 tern per year for the project yields an estimate of 3.8 – 4.3 roseate tern collisions per year for the proposed project. To further observe caution in our estimate, we rounded the estimate of 3.8 to 4.3 to four to five roseate tern collisions per year.

*Indirect mortality to dependent juvenile roseate terns*

Juvenile roseate terns remain dependent on their parent(s) for at least six weeks after fledging (Shealer and Kress 1994 in Gochfeld *et al.* 1998) and may remain dependent on parental feeding until after arrival in the winter quarters (Nisbet 1981). The loss of adults in late summer/fall may reduce the survival rate of their young. In this regard, the mortality of adults during the fall staging period may indirectly lead to the mortality of their dependent young, increasing the level of incidental take. If the take were to occur in May, prior to the breeding season, then no additional take (of dependent young) is anticipated. If the take were to consist of juveniles, non-breeders or failed breeders, then no additional indirect take of dependent young is anticipated. Accordingly, the Service acknowledges that a small number of dependent young, equal to but not exceeding the number of successful adult breeders taken during the post-breeding period, could also be taken as a result of the project.

*Collision Risk Conclusion*

After careful consideration of all available scientific literature, project-specific environmental documents, avian survey data, and known life history attributes of the roseate tern, the Service determines that the collision risk assessment [Hatch and Brault (2007), Appendix A in the BA, and Nisbet (2008)] should be adjusted to better represent the best available information. Accordingly, we adjusted the correction factors recommended by Nisbet (2008) and arrived at a collision mortality estimate of on average, four to five roseate terns per year for the Cape Wind Project. Some of these individuals may be adult breeding birds with dependent young, and their loss would reduce the survival rate of those young.

In light of concerns stemming from studies in Belgium, (Everaert and Kuijken 2007) concluding that wind farms can have a negative (population level) impact on birds, the Service reiterates that there are important differences between the proposed action and its likely effect on the roseate tern and effects on terns noted at the Zeebrugge, Belgium wind facility. The most important differences are:

1. At Zeebrugge, there are several thousands of pairs of terns, some nesting as close as ~100 ft (30 m) from the nearest turbine. Because thousands of terns nest nearby, tens of thousands of daily tern flights occur past the linear array of turbines during the breeding season. In addition, flight patterns near colonies can be more irregular and circling, placing more birds at altitudes within the rotor zone. At Horseshoe Shoal, the nearest roseate tern colony occurs at Minimoy Island (~18 miles or 29 km distant), and fewer than 60 pairs of roseates have nested there recently. Passage rates of roseate terns through the Horseshoe Shoal project area are much smaller than the passage rates for common and sandwich terns noted past the turbines at Zeebrugge.
2. The Zeebrugge WTGs are shorter and the rotor-swept zone is closer to the surface of the water than the Cape Wind Project WTGs. Zeebrugge WTGs are much more closely spaced, about 500 to 600 ft apart, vs. 0.33 mile to 0.5 mile apart for WTGs for the Cape Wind Project.

Even though the size of the rotor zone is much larger for the turbines proposed for the Cape Wind Project than the Zeebrugge turbines, more terns are likely to fly within the rotor zone at Zeebrugge because of low flight altitudes above water generally exhibited by terns in Nantucket Sound and the higher altitude of the rotor zone proposed by CWA. The wider spacing of turbines at Horseshoe Shoal will allow for more passive avoidance by terns transiting the project site. Based on the above, the Service concludes that the Cape Wind Project is unlike the Zeebrugge case study in many fundamental ways and therefore, is not likely to result in population level effects to the roseate tern.

**Habitat Loss and Disturbance**
Approximately 0.67 acre (0.003 square kilometer) of submerged land would be permanently occupied by the 130 WTGs and ESP, comprising less than 0.0042% of the project area and 0.0002% of Nantucket Sound (Table 5.3.2-2 in the DEIS). Rock armoring and scour mats would be placed underwater to protect the WTGs and ESP from scour, altering an additional 50.4 acres (20.4 ha) (MMS electronic transmission, accessed November 6, 2008). The total acreage affected by the WTGs, ESP, rock armoring and scour mats would be approximately 0.014% of Nantucket Sound. The Service finds that this amount of habitat loss, approximately 51.07 acres of 358,400 acres in Nantucket Sound, will have insignificant effects on the roseate tern due to the large amount of tern foraging habitat in the project area and throughout Nantucket Sound that will remain unaffected by the project. Moreover, studies conducted by CWA and MAS on tern travel

corridors within Nantucket Sound do not suggest the existence of a foraging concentration site in the vicinity of Horseshoe Shoal that would be impacted by habitat disturbance or displacement. As such, aside from a coarse comparison regarding habitat availability, we find that these effects cannot be meaningfully measured, detected or evaluated.

The proposed landfall site for the submarine cable bringing power from the project to the onshore electrical distribution system is on the northeastern side of Lewis Bay in Yarmouth (BA). A cable laid along this route will pass near Egg Island, periodically used by roseate terns during the fall staging period in 2007 (B. Harris, *in litt*. 2008). The State of Massachusetts issued a 401 Water Quality Certificate (#W133633: finalized August 15, 2008) that established time-of-year restrictions relative to cable laying operations. In-water silt producing work is prohibited from January 15 to May 30. Jet plowing is only permitted from June 1 to January 14.

Short-term disturbance and reduced water clarity affecting roseate tern foraging activity or fall staging at Egg Island could result from this activity if the work occurred between July and mid-September. Disturbance during placement of the cable within the entire project area is likely to occur over a number of weeks, although water clarity in a particular area should quickly return to normal shortly after construction is concluded. Should roseate terns be foraging in the immediate vicinity of the jet plow, they may be briefly disturbed, although it is anticipated that the disturbance would not be any different than that of other construction vessels (barges or dredges) occurring in Nantucket Sound. Jet plow installation of the submarine cable near Egg Island is anticipated to be completed within several hours and suspended sediments should return to ambient conditions within two hours of disruption by the jet plow (MMS electronic transmission, accessed November 6, 2008). To further reduce adverse impacts, CWA proposes to avoid construction near Egg Island during low tide (when Egg Island is exposed) from mid-July to mid-September when roseate terns might be staging.

In summary, the Service concludes that foraging habitat loss and alteration from the Cape Wind Project in Horseshoe Shoal is not likely to adversely affect roseate terns due to the insignificant amount of foraging habitat that will be affected (<0.014%) within Nantucket Sound. Short-term disturbance and water quality effects from placement of the submarine cable to foraging or fall staging roseate terns are also not likely to adversely affect roseate terns due to the short-term duration of disturbance and water column sedimentation from submarine cable construction activities. The Service finds it unlikely that these activities will significantly alter tern breeding, foraging or others behaviors.

**Piers as Fish Attractant Devices**

During informal consultation on this project, the Service raised the concern that the WTG underwater monopole support structures will accumulate algae and be colonized by marine invertebrates and over time may serve to attract fish. If these prey species are present, the area around the WTGs may be utilized by marine birds such as terns, potentially putting them at greater risk of collision fatality. The potential for the monopole supports to become fish attractant devices is discussed in the DEIS on pages 5-16 and 5-17. The Service notes that the fish species likely attracted to these new underwater surfaces (for example, Atlantic cod, black sea bass, cunner, tautog and scup) are not those species commonly fed on (and fed to chicks) by roseate terns at breeding colonies (e.g., sand lance and silversides) (USFWS 1998).

The monopole foundations may, however, create tide rips as incoming and outgoing tidal currents surge past the structures. Roseate terns will feed in tide rips if the current brings schooling sand lance or silversides to the water's surface. Accordingly, the presence of the WTGs on Horseshoe Shoal may result in an increase in foraging opportunities and could increase their risk of collisions. However, because roseate terns feed predominantly by plunge-diving from 3.3-20 ft (1-6 m) and occasionally up to 40 ft (12 m) (Gochfeld *et al.* 1998), they are unlikely to be at risk of collision from the rotors when foraging. Furthermore, the presence of the monopoles may have the positive effect of increasing food availability in the project area.

In the event that the tidal flows around the turbine bases increase prey availability (a potential benefit) and attract roseate terns, the Service concludes that incremental collision risks are very low due to roseate tern foraging behavior occurring below the rotor-swept zone. Therefore, an increase in the prey availability within the project area is not likely to adversely affect roseate terns and may be considered a beneficial effect.[11]

**Barrier or Displacement Effect**

The Horseshoe Shoal project area is not a nesting location for roseate terns, and it is unlikely that during the nesting season, roseate terns from the large Buzzards Bay colonies would visit the project area on a daily basis when foraging for food for themselves or for their chicks. However, roseate terns that are travelling and feeding during early spring, small numbers of breeders (about 50 pairs) associated with the Monomoy Islands colonies, non-breeding roseate terns that may occur in Nantucket Sound and roseate terns staging in preparation for fall migration do use or commute through Horseshoe Shoal each year**.**

Some studies have shown that disturbance by operating wind turbines can displace birds from suitable breeding, roosting and feeding habitats (Exo *et al.* 2003). Exo *et al.* (2003) summarized studies undertaken at offshore and onshore wind facilities in Europe and identified a number of species that appeared to be especially sensitive to the presence of wind farms and that could be affected by habitat loss. These species included divers (loons), scoter, geese and waders. Exo *et al*. (2003) suggested that the degree of disturbance to these species could be determined by a number of factors, including availability of suitable foraging habitat, time of year and layout of the wind farm, among others.

The single turbine constructed at the MMA in Buzzards Bay, Massachusetts provided the first opportunity to examine this potential barrier effect for roseate terns. Vlietstra (2008) and the Service (unpubl. data, 2008) found no evidence that common and roseate terns crossing the MMA campus (>575 tern flights observed) were displaced from the area of the WTG (barrier effect). Common and roseate terns continued to forage along the shore of Buttermilk Bay, at its closest point about 330 ft (100 m) from the turbine. Terns using Buttermilk Bay exhibited no disturbance or displacement effect due to the presence of the turbine, its shadow, or noise it creates (Service, unpubl data, 2008). The Service acknowledges the disparity in the turbine size,

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[11] As noted in the preface to this BO, this conclusion only applies to the roseate tern; the Service previously expressed concern about potential risks that the monopole supports may pose to other avian species, e.g., waterfowl, that forage in the project area.

number of turbines, and areal extent of the wind turbine array proposed for the Cape Wind facility; nevertheless, we find these observations informative for our analysis.
Studies by Everaert (2004) on the Zeebrugge wind facility found that gulls and terns undertake thousands of local migration flights for feeding at sea and back. Gulls and terns at Zeebrugge crossed the dam (breakwater) where the turbines were located, adjusting their courses as needed to fly between the turbines. Everaert concluded that the turbines did not act as a barrier for these birds. Furthermore, the Service notes that roseates are known to nest on several islands with lighthouses, for example, Falkner Island, Bird Island, White Island, New Hampshire, and Petit Manan, Maine (USFWS unpublished data) and do not appear disturbed by the tall lighthouse structures, their flashing, rotating lights or their fog horns.

Langston and Pullan (2003) reviewed available literature and "on the basis of 10 years experience by the BirdLife partners…", developed a matrix of potential effects (disturbance/displacement, barrier to movement, collision, and direct habitat loss/damage), and evaluated sensitive bird groups. In this study, Langston and Pullan (2003) determined that among the four categories of potential effects, the *Sternidae* (terns) were sensitive to collision risk, and less so to the other potential effects of wind farms. Band *et al.* (2007) point out that post-construction disturbance (resulting in habitat avoidance or displacement) and collision risk are antagonistic processes that are spatially mutually exclusive. In other words, if birds stay away from a wind farm area, they are not at risk of colliding with the turbine rotors. They note that some bird species may avoid the area of a wind farm at first (no exposure to collision mortality), but then become habituated to its presence (introducing some exposure to collision mortality over time). It is important to note that short-term post-construction monitoring studies may miss detecting this dynamic.

In light of the available scientific literature discussed above, and observed roseate behavior around lighthouses and at the Zeebrugge facility, the Service concludes that the Cape Wind Project will not displace roseate terns from periodic and seasonal use of Horseshoe Shoal for foraging, resting on the water, or commuting from overnight roosting locations (i.e., South Beach) to feeding sites across Nantucket Sound. Therefore, the Service finds that the Cape Wind Project is unlikely to cause adverse effects by creating barriers for foraging or commuting roseate terns, or displacing roseate terns from foraging habitat. The Service will require that monitoring be designed to validate our reasoning during project construction and operation, so that we can revisit the attendant risks and develop minimization measures if necessary.

**Increased Predation**

The potential for the ESP and WTGs to act as opportunistic hunting perches for birds of prey is discussed on pages 5-60 to 5-61 in the BA. Some raptors such as the peregrine falcon (*Falco peregrinus*) are known to prey on terns, and their presence has been noted at roseate tern colonies in Connecticut, Massachusetts and Maine (J. Spendelow, pers. comm. 2008; C. Mostello pers. comm. 2008; L. Welch, USFWS unpubl. data).

If the anti-perching measures on the ESP and WTGs are ineffective, avian predators such as peregrine falcons could intercept roseate terns travelling across Horseshoe Shoal, resulting in occasional mortality of individuals. The presence of avian predators can also cause terns to take quick evasive flights, which could expose them to collision with the rotors. If anti-perching measures are effective, the effects from increased predation risk will be discountable. It remains unclear how the helipad on the ESP can be "bird proofed" while permitting unobstructed access to rotary aircraft. However, MMS and CWA have committed to field-test proposed perching deterrent measures during the pre-construction phase of the project (e.g., by using them on the meteorological tower already in place and an alternative location closer to tern activity), to monitor the measures with remote, motion-detecting cameras, and to alter methods if they are not acceptable as outlined in the 2008 Monitoring Framework.

The Service notes that predation is a much more important factor for communal nesting species such as roseate terns if it occurs at the breeding colonies, where predators can take multiple birds or eggs in a short time period and cause disruption or even colony abandonment. Predation in the project area (if it occurs at all) is likely to involve only the occasional, individual bird or birds. On this basis, the Service finds that the loss of roseate terns crossing Horseshoe Shoal to avian predators using the WTGs or the ESP as a hunting perch of opportunity will be a very rare event. The Service concludes that increased predation resulting from the Cape Wind Project is not likely to adversely affect roseate terns due to discountable effects.

*Piping Plovers*

**Collision Risk**

Of the limited studies conducted in the offshore or near-shore setting, review of available literature provides few documented observations of shorebird collisions with offshore wind generating facilities. Most studies investigating the effects of onshore and offshore wind generating facilities in Europe identify impacts to terns, seabirds, raptors, gulls and passerines (Chamberlain *et al*. 2006; Desholm *et al*. 2006; Hüppop *et al*. 2006; Petersen *et al*. 2006; Everaert and Kuijken 2007). Petersen *et al.* (2006) conducted extensive surveys and analyses of the impact of two wind generating facilities in Denmark and documented avoidance behavior and collisions for seabirds and passerines. On one occasion, four bar-tailed godwits were documented at a buoy-transect east of the Nysted offshore wind farm during fall migration (Petersen *et al*. 2006). At the onshore Belgian wind generating facilities of Zeebrugge and Brugge, the most common birds that collided with WTGs were gulls, ducks, pigeons and passerines (thrushes and pipits). Three shorebird species (common oystercatcher, black-tailed godwit and redshank) were documented collision fatalities, but numbers and season have not been reported (Everaert and Kuijken 2007). Everaert (Research Institute for Nature and Forest, Belguim, 21 and 22 October 2008 electronic correspondence to S. von Oettingen) reported finding one Kentish plover (*Charadrius alexandrinus*) in 2004 "that most likely collided with one of the turbines" at Zeebrugge, where 17 pairs of Kentish plovers and five pairs of ringed plovers (*Charadrius hiaticula*) bred nearby and foraged "very frequently near and even under the turbines." Everaert also noted that he and his colleagues have "only observed 1 ringed plover migrating at low height (below 30 m) during monitoring at sea."

The three onshore coastal North American wind generating facilities described under Roseate Tern Effects (Sable Island and Pubnico Peninsula facilities in Nova Scotia and the MMA facility) are located within the breeding range of piping plovers. Two piping plover nesting areas are within two miles of the MMA single wind generating turbine. Piping plovers have been observed on Sable Island, Nova Scotia during migration, although they are not known to nest on the island (D. Amirault-Langlais, Canadian Wildlife Service, electronic correspondence 2008). Post-construction surveys have not documented plover mortality or other shorebird fatalities attributed to wind generating turbines at any of these facilities (Matkovich 2007; Vlietstra 2008; Amirault-Langlais electronic correspondence 2008).

*Collision Risk Exposure*

Although piping plovers nest and forage on beaches encircling the project area, potential opportunities for plovers to cross the wind generating facility in Horseshoe Shoal include, to varying degrees discussed below: adults and young of the year during spring and fall migration, adults prospecting for breeding sites around Nantucket Sound in the early spring, breeding adults changing sites between nesting attempts, and adults foraging away from their nesting sites.

Non-migrating plovers

The Service finds that risks to plovers from crossings of Horseshoe Shoal not associated with migration are very low. Fidelity of adult plovers (especially males) to nest sites (MacIvor 1990; Strauss 1990; Loegering 1992) is consistent with low incidence of pre-breeding movements among potential nesting sites, although there may be more movements associated with first-year breeders prospecting for sites. Although a few plovers change sites between nest attempts within a season [three instances reported by MacIvor (1990), 14 suspected cases among 501 Massachusetts pairs in 1999], the vast majority of re-nests occur on the same site. Likewise, observations of adults foraging on beaches or intertidal flats away from their nest sites (MacIvor *et al*. 1985) within the range of possible movements between the mainland of Cape Cod and Nantucket and Martha's Vineyard are rare. Non-incubating adults are typically observed near the nest site, which facilitates their availability for nest-defense. Furthermore, foraging flights between the mainland and islands would be extremely inefficient compared with movements along the coastline over potential foraging habitats. While the Service has not completely discounted the potential for non-migrating piping plovers flying across Horseshoe Shoal, available data and basic piping plover breeding biology support an overall assessment of very low incidence and therefore, very low risk.

Migrating Plovers

There is no information regarding the altitude at which plovers migrate and whether they migrate over open water, close to the shore, over land or a combination of shore, water and land. Richardson (1979) conducted a radar study of shorebird migration over Nova Scotia and New Brunswick and documented shorebirds flying at a mean height of 1.2 mi (2 km). However, many of the shorebirds detected by Richardson are described as long-distance, non-stop migrants and their flight altitudes have little utility in understanding behaviors of piping plovers that appear to migrate shorter distances and make more frequent stops.

South Beach in Chatham, Massachusetts is located at the northeastern periphery of the action area (see Figure 1) and may be an important stop-over area for plovers in spring and fall migration. MAS recorded up to 85 piping plovers at one time on South Beach in August and up to 61 plovers in September (Perkins S., electronic correspondence 2008) between 1995 and 2005. Although there are no topographical features to funnel piping plovers through Horseshoe Shoal (BA), it is plausible that migrating piping plovers staging at South Beach, Monomoy Islands, or other migration stop-over sites within the action area (see Environmental Baseline section, Piping Plover) could cross the project area if they travel in a straight line to (or from) the south shore of Long Island. Absence of piping plover observations during aerial and boat surveys conducted by CWA and MAS may reflect limitations on the methodology to detect piping plovers (and other small shorebirds), infrequent flights of piping plovers through the area, or a combination of both. While it is possible that additional boat or aerial surveys might identify piping plovers transiting Nantucket Sound, the general paucity of small shorebird observations during past surveys suggests additional visual surveys are very unlikely to be informative.

Although reports of piping plovers in migration flights are non-existent, widespread observations of plovers roosting and foraging on beaches throughout their Atlantic Coast range during both the spring and fall support the idea that migration routes follow the coastline (USFWS 1996). Notwithstanding the lack of substantial evidence that piping plovers migrate over open water in Nantucket Sound, the Service contends that some migrating piping plovers may cross the Horseshoe Shoal project area. We base this conclusion on our independent review of the other information, including that referenced above, coupled with our understanding of the species ecology and its occurrence in the vicinity of the proposed project area.

*Collision Risk Factors*

Flight height is a significant factor in the assessment of collision risk; however, flight height has only been observed for breeding, courting or foraging plovers over and near their coastal shoreline habitat. Accordingly, there are no reported observations of piping plover flight height over offshore waters of Nantucket Sound, unlike the reports provided for roseate terns. If piping plovers migrate at high altitudes, then weather could be a factor in assessing the likelihood that a bird may fly at the height of the rotor-swept zone. The Service has considered information about general avian response to weather to assess the potential effects of weather on piping plovers.

Weather

Weather may be a factor in where and how plovers migrate, as with many other migrants (Chamberlain *et al*. 2006). Numerous studies indicate that the risk of bird collisions with turbines increases as weather conditions worsen and visibility decreases (Exo *et al*. 2003; Drewitt *et al*. 2006; Hüppop *et al*. 2006). The effect of weather on migrating birds' flight altitudes has been well documented through the use of radar and thermal imagery. During migration, birds may remain grounded during inclement weather; this is especially likely if, as commonly held, migrating piping plovers make relatively short flights along the coast. However, if birds are migrating at high altitudes and suddenly encounter fog, precipitation or strong head winds, they may be forced to fly at lower altitudes, exposing them to wind turbine collisions if they fly in the rotor-swept zone. (Drewitt *et al*. 2006). Hüppop *et al*. (2006) investigated year-round bird migration over the North Sea in Germany and the potential collision risk with offshore wind farms. The authors correlated weather factors with migrating bird flight altitudes or changes in flight altitude. For example, they found that tailwinds and light head winds were associated with higher flight altitudes, while a greater percentage of birds migrated below 200 m (600 ft) during nighttime rain events than on nights without rain. Based on the general assumption that piping plovers would respond to inclement weather and strong head winds similarly to other avian species, the Service finds that any high altitude migrating piping plovers encountering inclement weather or strong head winds while they are flying through the Horseshoe Shoal project area may be forced to fly below or within the rotor-swept zone.

Review and Evaluation of Cape Wind Collision Risk Assessment

The discussion in the BA relative to the collision probability assessment conducted by Hatch and Brault (2007) correctly states that "the numbers, height and course of [plover] flights are unknown." In the absence of empirical data, Hatch and Brault (Table 5) explore the ramifications of several hypothetical flight heights and avoidance rates for postulated 200 annual piping plover crossings of Horseshoe Shoal by analyzing a number of factors, including annual number of plovers migrating to breeding sites north of and in the action area, number of plovers crossing the Horseshoe Shoal project area, avoidance risk estimates and flight height. The Service independently reviewed all of the factors and found that some of the model inputs warranted revision. We therefore revised the collision assessment as discussed below, and estimate that, under a "worst plausible case scenario," collisions will not cause take of more than 10 piping plovers over the 20-year life of the project:

1. *Annual number of plovers migrating to and from breeding sites north of and in the action area***.** The Service concludes that Hatch and Brault's estimate that annually 2,458 piping plovers "cross the Massachusetts coastline" is too low for the purposes of this analysis. A post-breeding population of 260 pairs in Canada fledging 1.6 chicks/pair, for example, would yield an estimate of 1,456 combined northward and southward migrants (260 x 5.6, assuming no mortality between fledging and southward migration to Massachusetts), while approximately 525 pairs in Maine, New Hampshire, Massachusetts in and north of the project area (Tables 4 and 5) fledging 1.4 chicks/pair yield an estimate of 2,835 (525 x 5.4) northward and southward migration flights. Thus, the Service estimates approximately 4,300 northward and southward migration flights by piping plovers currently breeding or fledging in and north of the action area.

   Attainment of the 400-pair recovery objective in Atlantic Canada during the life of the proposed project would increase the post-fledging population to almost 1,450 piping plovers (400 X 3.6), assuming productivity of 1.6 chicks/pair to support a stationary population (Calvert *et al.* 2006). Thus, the Service finds that up to 5,000 migration flights per year (925 pairs x 5.5) to and from breeding sites north of, and in the action area could be attained during the life of the proposed project.

2. *Number of plovers annually crossing the Horseshoe Shoal project area*. Since the number of piping plover crossings through the Horseshoe Shoal project area is unknown, Hatch and Brault postulated 200 annual crossings discussed in a hypothetical example offered in a February 24, 2005 letter from the MADFW. The inference by Hatch and Brault that this is 10% of total migration flights is not consistent with our estimate in #1 (above). Furthermore, it seems plausible that greater than ten percent of plovers migrating to and from nesting sites north of Horseshoe Shoal might follow the relatively direct route across Nantucket Sound. Accordingly, the Service has evaluated ramifications of estimated crossings of up to 20% of 5,000 migration flights, or up to 1,000 annual crossings. This figure also provides an allowance for some crossings associated with non-migration activities such as within-season changes in breeding site,

first-year breeders looking for nesting sites, or birds traveling to post-breeding staging areas at South Beach or Monomoy from nesting sites in the southern or western parts of the action area. The Service also notes that current migration flights are estimated to be 4,300 per year, not 5,000, which provides additional leeway for within-season crossings.

3. *Avoidance rate estimates.*[12] In the absence of values specific to plovers, Hatch and Brault considered four avoidance rate values from Chamberlain *et al.* (2005)[13] for piping plovers (0.91, 0.95, 0.98 and 0.99). Notwithstanding the likelihood that low visibility (poor weather conditions, nighttime flights) decreases avoidance rates, the Service finds it highly probable that avoidance rates for piping plovers are toward the higher end of this range. We rely on the following factors in reaching this conclusion: evidence of good night vision inferred by nocturnal foraging behavior [albeit with lower peck rates than during the daytime (Staine and Burger 1994)], agility of adult plovers observed in distraction displays (including abrupt flights to escape the potential predator) on beaches[14], and the fact that any plovers in flight over Horseshoe Shoal will not be distracted by concurrent foraging or courting activities. Furthermore, several factors make it relatively unlikely that piping plover flights over Horseshoe Shoal will occur during periods of poor visibility in fog or storms often associated with low avoidance rates. Because plovers do not forage over water, the need to provision themselves or their young is not a factor compelling them to fly through the wind farm during periods of adverse weather. If, as is commonly held, migrating piping plovers make relatively short flights along the coast, they are likely to select good weather and land if they encounter poor conditions. A high altitude migration flight scenario, discussed under Collision Risk Factors (above), could entail occasional descents to rotor height during sudden periods of inclement weather. However, the frequency and duration of such poor weather (coinciding with one or more migrating plovers) is likely to affect only a very small fraction of the population and, therefore, exert only a small effect on the average avoidance rate.[15] Although avoidance rates as low as 0.91 cannot be completely discounted, the Service finds that 0.95 is a more likely lower bound for this parameter (even though the higher avoidance rates of 0.99 or 0.98 may be the most realistic for piping plovers over Horseshoe Shoal).

4. *Flight height estimates*. Hatch and Brault also evaluated three different height distributions: at or below the rotor-swept zone at approximately 0 to 100 ft [0 to 30 m] above sea level (asl), within the rotor-swept zone at 73 to 440 ft (23 to 134 m) asl and a

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[12] The Service is very mindful of the sensitivity of collision estimates to avoidance rates, as well as strong cautions pertinent to hazards associated with application of avoidance rates derived from one site or species to another (Chamberlain *et al*. 2005). We note, however, the impracticability of obtaining site-specific turbine avoidance rates <u>before</u> a project is constructed. Even the monitoring of a "test-turbine" will have difficulty capturing effects of long-term variability in bird behaviors under different conditions and suffer limitations due to small sample size.

[13] Chamberlain *et al*.'s Appraisal of Scottish Natural Heritage's Wind Farm Collision Risk Model and its Application (British Trust for Ornithology Research Report 401) provides a particularly thorough evaluation of avoidance rate estimates and their effect on collision risk.

[14] Although evidence of good nocturnal vision and agility are drawn from onshore behaviors, we know of no reason why fundamental physiological characteristics enabling these behaviors would change in flight or over water.

[15] We further note that a high altitude migration strategy would decrease the number of piping plovers likely to fly at rotor height (see *Flight height estimates* section, below).

range within and above the rotor-swept zone 100 to 2,000 ft (30 to 600 m) asl. Although Hatch and Brault's worst-case scenario (all birds flying at rotor height) cannot be completely discounted, the Service finds it is highly unlikely. Except for courtship displays, piping plover flights observed in and near beach habitats are low to the ground (well below rotor height). It also seems plausible that migrating plovers would seek high altitudes (above rotor height) for longer flights, as has been documented for other migrating shorebirds (Richardson 1979; Able 1999; Langston and Pullen 2003; Petersen *et al*. 2006). Under a "high altitude migration scenario," piping plovers could be forced into the rotor-swept zone during migration as a result of the sudden onset of unfavorable weather conditions such as strong head winds, precipitation, fog or low cloud ceiling (Able 1999; Exo *et al*. 2003; Drewitt and Langston 2006; Hüppop *et al*. 2006). Plovers taking off from or landing at staging and migratory stop-over beaches around Nantucket Sound may pass through altitudes that include the rotor height; however, this seems likely to occur closer to land than at Horseshoe Shoal. Furthermore, a high altitude migration strategy would also suggest relatively longer migration flight paths between piping plover wintering and breeding areas that would avoid the action area altogether (radically reducing the estimate of plover crossings of the wind facility). The Service finds that the more likely upper bound of collision risk within the project area is that associated with distribution of flight heights between 30 and 600 meters (the middle range evaluated by Hatch and Brault, Table 5).

We note that the risk assessment model does not account for the risk to piping plovers posed by the monopoles. The Service finds the risk of collision with these stationary structures is highly unlikely and therefore discountable. The stationary, 16.75- to 18-foot-wide monopoles are fundamentally different from the WTGs, that have a circular area equal to 2.4 acres (1 ha). We are not aware of instances of piping plovers colliding with the many human-made structures on and immediately adjacent to nesting beaches. The most ubiquitous structures are relatively short houses (many located in the flight paths of adults commuting between bayside foraging flats and oceanside nesting areas on barrier islands and spits, especially in New York and New Jersey). However, lighthouses are prominent features at a number of important piping plover breeding sites, many at the ends of sandspits and other promontories. Suggestions of collision hazards from lighthouses are notably absent from the piping plover literature.

Based on the above, we recalculated the risk and anticipated take to be caused by collisions. Using an avoidance rate of 0.91 and all piping plovers flying within the rotor-swept zone, Hatch and Brault projected 244 crossings per collision, which translates into 0.8 collision per year if there are 200 annual piping plover flights through the wind farm (Hatch and Brault incorrectly calculated 1.2 collisions per year for this scenario). Doubling the estimate of annual migration flights by piping plovers breeding or fledging in and north of the action area (the Service's revision explained under #1, above) during the life of the Cape Wind Project, and adjusting the estimate of annual crossings through the wind facility accordingly (to 400 per year), increases the collision estimate to 1.6 per year. As noted under discussion points #3 and #4, however, the Service finds that an avoidance rate of 0.95 and flight altitudes distributed between 30 and 600 meters provides a more reasonable upper bound estimate of one collision per 2,273 crossings. Therefore, the Service calculates that <u>four hundred estimated annual crossings of the wind farm</u>

result in 0.18 collisions per year. Increasing annual crossings to 1,000 (20% of 5,000 migration flights), with crossings distributed between 30 and 600 meters and an avoidance rate of 0.95, yields an estimate of 0.44 collision per year. Notwithstanding considerable uncertainty regarding all parameters, the Service finds that more than 0.5 piping plover collision per year (approximately 10 piping plovers averaged over the life of the project) is extremely unlikely. Indeed, we conclude that collisions may be much more infrequent.

**Habitat Loss and Disturbance**
Piping plovers nest on beaches and forage in the intertidal zone, on wrack at the high tide line, in ephemeral pools or sparsely vegetated dune grass on Cape Cod, Nantucket and Martha's Vineyard beaches. The Cape Wind Project and land-based components will not be situated in or near piping plover nesting, resting, or foraging habitat; therefore, the Service anticipates no adverse effects to plovers as a result of long- or short-term habitat loss.

The proposed submarine cable route through Lewis Bay is greater than 300 m (985 ft) from piping plover nesting habitat at Kalmus Beach, Hyannis to the west and Smiths Point, Yarmouth to the east. A cable vessel with jet plow equipment is expected to pass through the area in a matter of a few hours as it lays down cable. This equipment is similar to existing boat traffic (not noted in the piping plover literature as a source of direct disturbance) and will not adversely affect breeding piping plovers. The submarine cable landfall is not near breeding piping plovers.

Based on the sufficient distance of the cable laying activities from nesting piping plovers and disturbance effects no greater than existing marine vessel traffic, the Service anticipates no adverse effects as a result of disturbance from the installation of the submarine cable.

**Barrier or Displacement Effects**
There is no piping plover breeding or feeding habitat within Horseshoe Shoal, and within-season crossings are anticipated to be infrequent at best. The number of migrating piping plovers crossing Horseshoe Shoal in the vicinity of the proposed wind park is unknown. It is likely that most piping plovers migrate along the outer coastal beaches (USFWS 1996) since almost all observations are at stop-over locations along the coast. As discussed under Collision Risk (above), the most likely piping plover activity in the project area is by transiting northward or southward migrants.

Research indicates that some birds may fly around a wind farm instead of through, although avoidance could be dependent on the distance between turbines, the size of the wind farm and the extent of the displacement (Langston and Pullen 2003). Avoidance reactions to offshore and near-shore wind farms have been documented for some European birds, including divers, scoters, geese and waders (Drewitt and Langston 2006; Exo *et al.* 2003). As previously stated in the Roseate Tern section for Barrier and Displacement Effects, avoidance behavior, although it may increase the energetic requirements as a bird deviates from a routine flight path, will decrease the likelihood of collision with wind turbines. The Service anticipates that the greatest likelihood of plovers crossing Horseshoe Shoal will be during migration; should plovers perceive the wind farm as a barrier, we anticipate that the slight increase in the migratory distance would only marginally add to the overall energetic requirements of migration. Although longer migrations may contribute to patterns of lower survival rates of Atlantic Coast piping plovers

breeding at higher latitudes (Calvert *et al.* 2006), the contributing factors (e.g., foraging resources at stop-over locations, weather, predation by raptors) are unknown.
On the basis of the best available information, the Service finds that displacement effects of the proposed project on piping plovers are very likely to be inconsequential. Therefore, the Service concludes that the Cape Wind Project is not likely to adversely affect piping plovers through the creation of barriers for migration and commuting. There will be no adverse effects from displacement of plovers, since Horseshoe Shoal is not breeding or foraging habitat.

*Roseate terns and piping plovers*

**Lighting**
The effects of FAA lighting of the WTGs and the potential that lighting may become an attractive nuisance and cause disorientation of migrating plovers or terns at night or under poor visibility is discussed on pages 8-13 and 8-14 of the BA. The lighting proposed for 50 of the 130 WTGs and the ESP addresses Service interim guidelines to minimize and avoid impacts to migratory birds, by minimizing the use and intensity of lights and number of flashes per minute (USFWS 2003); the lighting scheme also complies with current FAA and U.S. Coast Guard requirements (see Project Description). The ESP and a portion of the WTGs will be lit with a single flashing red light. The 72 interior WTGs will not be lit with aviation lighting at night. All aviation lights will flash synchronously.

Studies cited in the BA, Gehring *et al.* (2007) and Shire *et al.* (2000) found that steady burning FAA obstruction lighting and some other types of lighting on mainly land-based tall structures [generally communication towers at heights of 1,000 ft (305 m)] can attract or disorient night migrating birds, resulting in collisions with those structures. In a Michigan study, Gehring *et al.* (2006, 2007) reported that where red, continuous lights were extinguished and replaced with flashing or strobe lights, there was a 71% reduction in avian collision mortality on communication towers. Jones and Francis (2003) reported a dramatic reduction in birds reported killed during a 41-year study of night-migrating bird mortality at a lighthouse in Canada, comparing number and species of birds killed before and after a change in the light signature. The reported bird mortality dropped significantly as a result of altering the intensity and nature of the light beam. Longcore *et al.* (2008) conducted a comprehensive review of research on the effects of lights from tall structures on night migrating birds and concluded that the use of synchronously flashing lights would reduce avian mortality at tall structures.

The Service concurs with the conclusion in the BA that the best information available does not support the hypothesis that terns are attracted to refracted light, and thus have an increased risk to collision mortality. Additionally, as previously noted, several contemporary roseate tern nesting colonies occur on (or near) islands with lighthouses. Examples include Falkner Island, Bird Island, White Island, and Petit Manan. Tern biologists have not reported that the lights at these locations are adversely affecting the terns that nest there (USFWS unpubl. data). In spite of the line-of-sight presence of the MMA turbine to the breeding colony at Bird Island and the Pubnico Peninsula wind turbines to the roseate tern colony at The Brothers Islands, no tern mortality has been detected at these facilities.

Despite the prevalence of artificial lighting from coastal developments, including beach homes and a lengthy history of lighthouses on offshore islands, promontories, and low-lying sandspits, attraction or disorientation of migrating piping plovers due to refracted light has never been reported as an actual or potential threat. During a 2005 study at Cape Lookout National Seashore, American oystercatchers (*Haematopus palliatus*) were observed running or flying directly into the headlights of vehicles transiting their beach foraging territories at night (Simons *et al.* 2005). However, neither USFWS (1994) nor MADFW (2003) guidelines for managing recreational vehicles in Atlantic Coast piping plover breeding habitats indicate that vehicle headlights are a hazard to adult or fledged juvenile piping plovers (even in close proximity to nesting and foraging habitats), nor has it been suggested that headlights or other artificial lights are a potential threat warranting further investigation.

Research demonstrates that some bird species are attracted to or confused by artificial lights. The Cape Wind proposed lighting incorporates flashing lights of low to medium intensity, which is consistent with recommended methods for avoiding or minimizing avian mortality from tall lighted structures (Jones and Francis 2003; Longcore *et al.* 2008). In view of the above, the Service finds that lighting of the WTGs and the ESP is not likely to adversely affect foraging, commuting or fall staging roseate terns or migrating or commuting piping plovers. We base our conclusion on the available literature, our current understanding of the species' reactions to artificial lights, and the implementation of synchronized, flashing lights per published recommendations and the interim Service guidelines.

**Oil Spill Risk Assessment**

The DEIS, BA and the supplementary report 5.2.1-1 (Etkin 2006) review the potential for an oil spill associated with about 500 marine vessel trips to Horseshoe Shoal during construction and maintenance of the proposed project. The possibility that other vessels (non-Cape Wind-related) may collide with the WTGs or the ESP and spill oil, or the catastrophic failure of the ESP (which will contain more than 40,000 gallons of mineral oil and 2,000 gallons of diesel), or one or more of the WTGs (each contain about 215 gallons of lubricating oil) is also considered in the oil spill probability analysis by Etkin (2006). There is no oil in the submarine interconnecting cables.

The earlier description of the baseline included discussions of numerous crude oil spills that impacted roseate terns and piping plovers. It is important to underscore that the type of oil maintained in the WTGs and ESP is different from crude oil in many important respects. For example, the majority of the oil that will be in the ESP is mineral oil. Mineral oil is light, floats on water and is generally non-persistent (rapidly breaks up into small droplets in the water column); about 12% of it is estimated to remain on the water surface after 36 hours post-spill (Etkin 2006).

The Service concurs with the assessment made in the BA that the potential impacts to plovers and terns from oil spills associated with the proposed action would depend on the season, the size and location of the spill, and the wind direction. It will also be influenced by oil spill planning and preparedness, the response action, and the type of oil that was spilled.

Roseate terns forage at the sea surface and frequently loaf and bathe in near-shore areas around their nesting colonies. As a result, they are vulnerable to oil spills in the marine environment. Piping plovers nest above the high tide line and forage along the wrack line and intertidal areas; an oil spill reaching piping plover foraging and breeding habitat would adversely affect them. Oil robs bird feathers of their insulating capacity and may cause oiled birds to die of exposure or of starvation if they are unable to fly. It may also cause hatching failure if the oil from an incubating bird spreads to its nest and eggs. Oil can be toxic to roseate terns and piping plovers if ingested when feeding or during preening.

Etkin (2006) analyzed the probability that an oil spill might occur at the wind energy complex. The analysis estimated the probability of a theoretical occurrence of an instantaneous release of 40,000 gallons (151,000 liters) of electric insulating oil and other oils from the ESP and the WTGs for a total worst case of 68,000 gallons (257,000 liters) of oil—an extremely unlikely scenario. Such a worst-case discharge event would only occur if something damaged the ESP *and* all 130 of the WTGs to the extent that the entire contents of all four electrical transformer insulating oil tanks, as well as the oil in each of the WTGs, would be released almost instantaneously. The analysis involved two major components: 1) determining the probability that any spill might occur from the ESP and WTGs: and 2) analyzing the range of spill sizes (and associated probabilities) that might be expected if a spill were to occur from the ESP and WTGs. The analysis involved a four-step process:

1. Evaluate and describe the events that might cause damage to the ESP and/or WTGs (e.g., extreme weather events, earthquakes, accidents, structural failures, oil transfers, etc.).
2. Estimate or qualitatively analyze the probability of each of these events occurring.
3. Estimate or qualitatively analyze the probability that for each of these events that damage occurs to the ESP and/or WTGs.
4. Estimate or qualitatively analyze the probability for each of these events to cause damage sufficient to cause an oil spill from the ESP and/or WTGs.

Etkin (2006) performed quantitative analyses for those events using previous spill/accident data records, and other events to the extent possible. Where quantitative analyses were not possible or practicable, Etkin performed qualitative evaluations. Once these probabilities were analyzed, the potential spill sizes that might occur (if a spill were to occur) were then analyzed using data from comprehensive oil spill databases. From this analysis, the probability that a worst-case discharge from the ESP and WTGs would occur was determined, as well as the probability of the smaller spill volumes.

Etkin's oil spill probability analysis concluded that the highest possibility of an oil spill occurring in the area in and around Nantucket Sound is related to vessels transiting the area, regardless of the presence of the Cape Wind facility and related work vessels, and that only 7% (two spills) of all spills expected in Nantucket Sound during a 30-year period (an estimated 29 spills) could be attributed to the addition of the Cape Wind facility. Of the two spills, there is a 90% chance that they would involve volumes of 50 gallons or less, and a 1% chance that they would involve volumes of 10,000 gallons or more. The probability of a spill in the same 30-year period involving the entire volume of 68,000 gallons of oil contained in the ESP and the 130 WTGs is less than one in a million.

In addition to estimating the probability of an oil spill associated with the proposed action, consultants for CWA also modeled the likely trajectories of oil released from the ESP and calculated probable estimates of its area coverage and travel time (Knee *et al.* 2006). The study used two models: HYDROMAP to calculate currents, and OILMAP to calculate oil spill trajectories and resulting oiled areas and travel times.

The OILMAP model was used to simulate spill trajectories and determine probabilities of areas being oiled and oil travel times for a instantaneous release of 40,000 gallons (151,000 liters) of electrical insulating oil at the ESP site in Nantucket Sound. This scenario (instantaneous release of entire tank contents) is highly unlikely and therefore conservative. The analysis estimates (not unexpectedly) that areas closest to the release site have the highest probability of surface water oiling and that lower probabilities generally spread radially outward from the site. While there is a >90% probability of oil impacting the shoreline somewhere in the action area within 12 hours, by the time the oil reaches the shoreline, 100 simulations of the model predicted that the probability of water surface oiling occurring within 10 days of a spill is generally reduced to 1-10%. Figure 4.6 in Knee *et al.* (2006, p. 21) shows that during the months of March-May, the model predicted a 1-10% probability of water surface oiling along the south shore of Cape Cod, eastern shore of Martha's Vineyard and western reaches of Nantucket; the Monomoy Islands are predicted to receive zero oiling. For the months of June-August, Figure 4.7 (p. 22) depicts both 1-10% and 10-20% oiling probability contours reaching the central Cape Cod (south coast) shoreline, with eastern Martha's Vineyard and western Nantucket being within the 1-10% contour. Nantucket Island is predicted to receive zero oiling. During September to November (Figure 4-8, p. 22), the model predicts 1-10% probability of water surface oiling along most of the Nantucket Sound shoreline, except for the Monomoy Islands and Nantucket, which have zero to very low probability of any surface water oiling.

The model projections of Knee *et al.* (2006) indicate the areas with highest probability of water surface oiling associated with an accidental release from the ESP in May through September occur in and near the project area, which coincides with roseate tern foraging habitat. As with collision risks, the peak potential exposure of the roseate tern population to any accidental oil spills occurs in May and then again in late August through mid-September. Piping plovers are also present in the action area from late March to September, but only a small subset of breeding sites are in areas with >10% probability of water surface oiling occurring within 10 days of a spill, and most sites known or suspected to receive concentrated plover use during migration (i.e., South Beach, Monomoy, Great Point, The Galls, Smiths Point and Esther's Island) have 1-10% or no probability of water surface oiling.

Although the oil spill trajectory modeling performed by Knee *et al.* (2006) implies some vulnerability to piping plovers along the Nantucket Sound shoreline and to the roseate terns using the waters of the Sound, consideration of these findings along with those of Etkin (2006) and the habitat use patterns and chronology of roseate terns and piping plovers support an overall assessment indicating very low risk to these bird species:

- 7% of all spills in Nantucket Sound in the next 30 years (two spills) will be attributable to Cape Wind;

- there is a 90% chance that these spills will be of 50 gallons or less;
- there is a 1% chance that these two spills will be >10,000 gallons;
- piping plovers are present in the action area less than half of the year and most of their habitat, including most known migratory stop-over concentration sites, is located in areas with <10% probability of contact with even the smallest amount of water surface oil dispersing from the ESP;
- roseate terns are present in the action area less than half of the year. Although they may forage close to sources of oil dispersing from a potential spill at the ESP, relatively small numbers of terns have been observed foraging on Horseshoe Shoal compared with other portions of Nantucket Sound.

In summary, there is a likelihood of at least two spills occurring during the life of the project as predicted by Etkin (2006) and the amount, time of occurrence and location are not predictable. The Service anticipates that should a spill occur as predicted by the model, there may be adverse effects to a few foraging roseate terns from oiling or displacement from their foraging habitat, but the likelihood of this occurrence is remote. Traveling roseate terns will not be adversely affected. The amount of oil from a spill most likely to occur (50 gallons or less) is unlikely to reach piping plover habitat. Accordingly, the Service finds that the effects to the roseate tern and piping plover from an oil spill associated with the proposed action are, for the purposes of this section 7 consultation, anticipated to be discountable.

In the unlikely event that an oil spill of a magnitude to affect piping plover beaches, or affect piping plover and roseate tern staging areas, and/or significantly affect roseate tern foraging habitat were to occur in Nantucket Sound, either project-related or independent of Cape Wind, the Service reserves the right under the Oil Pollution Act of 1990 (33 U.S.C. 2701 *et seq*.) to pursue damage claims for natural resources lost or injured.

We conclude our discussion by noting that MMS regulations at 30 CFR §254, "Oil Spill Response Requirements for Facilities Located Seaward of the Coastline", require owners/operators of oil handling, storage, or transportation facilities located seaward of the coastline to submit a spill response plan to MMS for approval prior to facility operation. In the event of a release of oil to the ocean, the applicant's employees, its contractors, and its responders would refer to the OSRP to ensure that the appropriate spill response actions are taken in a timely manner to minimize impacts to sensitive receptors and the environment. The OSRP (see Project Description - Conservation Measures) proposed in accordance with the Department of the Interior's regulations will minimize and avoid adverse impacts from possible oil spills to the maximum extent possible if appropriately implemented. Since the OSRP was unavailable to review prior to the completion of the BO, the Service will condition the BO on the development of measures that are protective of roseate terns and piping plovers.

The U.S. Coast Guard is the federal agency responsible for oil spill response in the coastal zone. The Massachusetts Department of Environmental Protection has developed a Geographic Response Plan (GRP) (http://grp.nukaresearch.com/CIgroup.htm), a component of which includes Nantucket Sound, the south shore of Cape Cod and the islands of Martha's Vineyard and Nantucket, to protect specific sensitive areas from impacts within 24 to 48 hours following a spill. However, adverse effects from the oil spill response on roseate terns and piping plovers must be balanced with the adverse effects from the oil spill. Therefore, there is a potential for unavoidable adverse effects, including harm and harassment, from oil spill response measures. These adverse effects will be addressed in a post-spill emergency consultation under section 7 of the ESA.

**Short-term Effects from Pre- and Post-Construction, Routine Maintenance Activities and Decommissioning Activities**

*Roseate tern*

The DEIS (Chapter 5) describes the various activities associated with the development, operation and decommissioning of the Cape Wind Project and the potential impacts on biological resources, including roseate terns and piping plovers (pages 5-172 through 5-175). These activities may occur during the construction, decommissioning and operation of the project and may incur short-term effects, primarily by disturbing foraging roseate terns or by the temporary displacement from preferred foraging habitat.

Activities that may temporarily affect roseate terns include increased vessel and helicopter traffic, and noise and vibrations from construction equipment. Roseate terns may be disturbed while foraging or temporarily displaced from foraging habitat as a result of increased boat traffic and sporadic helicopter flights during the construction, operation and decommissioning phases of the project. The DEIS also predicts that increased recreational fishing may occur in the Horseshoe Shoal project area if fish populations increase around the foundations of the wind turbines. Currently, there is considerable vessel traffic as well as helicopter and small plane traffic in Nantucket Sound. The additional increase in vessel and helicopter traffic from the Cape Wind Project is not anticipated to cause adverse effects that rise to the level of take. The disturbance and displacement of foraging roseate terns is anticipated to be negligible and of very short duration.

Since roseate terns are absent from Massachusetts waters each year from mid-September to mid-April, many of the activities described above will likely occur when roseate terns are not present in Nantucket Sound. During the breeding season, disturbance to foraging or traveling roseate terns from vibrations and noise resulting from construction of the WTGs, ESP and associated infrastructure is anticipated to be localized, of short duration, and result in insignificant and discountable effects. The area over which the noise and vibrations may occur is a fraction of the overall foraging habitat available to roseate terns in Nantucket Sound. Therefore, the Service has determined that these activities will not significantly alter essential roseate tern behaviors, and therefore will not cause harm or harassment, as those terms are defined by the ESA.

*Piping plovers*

The Service anticipates no adverse effects to breeding piping plovers from increased vessel or helicopter traffic or noise and vibration, since piping plovers are not found in the Horseshoe Shoal project area (with the possible exception of during migration or commuting), the center of most of this activity. Vessel and helicopter traffic will occur primarily in and over open water, well away from breeding and foraging piping plovers. Helicopters are expected to depart from local airports, none of which are located adjacent to breeding piping plovers, and fly directly to the Horseshoe Shoal project area.

**Beneficial Effects to Roseate Terns from Bird Island Restoration**

The preferred alternative recommended by the ACOE (2005) for the Bird Island restoration project is to restore and repair the existing stone revetment in its current location on the island and to use clean dredged material to raise the elevation of 0.64 acre of habitat landward of the revetment. The 0.64 acre of habitat to be filled is currently unsuitable for nesting by either common or roseate terns. Re-vegetation of the filled area and the placement of artificial nest boxes will further enhance the restored area's suitability for tern nesting. This will result in about 2.2 total acres of habitat suitable for tern nesting on the island for the projected 50-year life of the project.

Restoration of nesting habitat on Bird Island will benefit both common terns and roseate terns and is likely to result in measurable increases in the number of pairs of both species nesting there in the future and for the projected 50-year lifetime of the restored habitat (ACOE 2005). The following projection of the increase in the number of nesting pairs for both tern species that will be possible from the restoration work is based on the density of terns per unit of habitat present on the island now and the anticipated space available after an additional 0.64 acre is provided. Common tern pairs will have sufficient habitat to increase from about 1,800-1,900 pairs in 2007 to 2,890 pairs after the island is restored. Roseate tern pairs may increase from about 750 pairs in 2008 to over 1,150 pairs after the island is restored, an increase of 400 pairs. It is likely that contributions provided by Massachusetts from CWA's lease revenues will fill a critical gap (approx. 21%) in the funding needed for this project.

Since roseate terns nesting at Bird Island frequently exhibit higher productivity than roseate terns nesting at other Buzzards Bay colonies (an average of 1.17 chicks per pair at Bird Island, versus 1.03 at Ram and 0.92 at Penikese Islands during 2000-2007 (RTRT 2007), this aspect of the project is a substantial benefit to this endangered species. This benefit is realized even if roseate nesting pairs drawn to Bird Island after the habitat is restored are not "new" recruits to the regional population but rather are immigrants from Ram or Penikese Islands, because at Bird Island, they will likely breed more successfully and annually produce, on average, 12%-21% more young. Lastly, the Bird Island restoration project is critical in a more fundamental way. It is necessary to protect the habitat that exists there now. Without repairs to the revetment, the extent of suitable tern nesting habitat currently available on the island will continue to decline due to erosion and storm over wash, and the carrying capacity for both common and roseate terns will decline. For these reasons, should the restoration be undertaken, the Service concludes that all effects to roseate terns from the restoration of Bird Island will be beneficial. The design, scheduling and implementation of the Bird Island restoration plan is being closely coordinated among the Service, the ACOE and the State of Massachusetts.

The Bird Island restoration project is likely to have measurable beneficial effects for the roseate tern by preventing the further loss of existing essential nesting habitat, by creating additional suitable nesting habitat, and by increasing the carrying capacity of the island which is the most productive breeding site for the species in Buzzards Bay. The Service assumes that this project may not be completed and thus the benefits to terns may not accrue until some point after the

Cape Wind Project is constructed (and some take of terns may occur). However, the benefits will be long-term (50 years) and will persist even after the adverse effects of turbine mortality cease.

**Population Level Implications of the Cape Wind Project on the Roseate Tern and Piping Plover**

Effects of changes in vital rates (e.g., survival, fecundity) on the northeastern population of the roseate tern and the Atlantic Coast piping plover population vary with factors such as duration of the impact, age-class of the affected individuals, sex of the affected individuals (especially for roseates), or distribution of affected individuals in the breeding population (particularly for piping plovers). For the purposes of considering population level implications, the duration of the project and its impacts are presumed to continue for the indefinite future following construction. Although the projected life of the WTGs is 20 years, the Service recognizes that they may remain operational beyond that time span. Furthermore, while an ongoing activity with a short (e.g., five-year or even 10-year) life may have different population level implications than a 20-year project, our ability to reliably distinguish among population level effects due to varying duration diminishes markedly beyond the 20-year horizon. Therefore, it is appropriate (and errs on the side of the species) to assume that duration of the impact will continue for the indefinite future.

A Population Viability Analysis (PVA) is a method of estimating extinction probabilities using time series data of vital rates (e.g., survival, productivity, etc.) and/or population counts. Accordingly, a PVA may be useful in evaluating whether a range of potential additional mortalities (incidental take due to collisions with turbines) will have population level effects over time. Another value of PVAs is that sensitivity analyses can be evaluated to see what vital rate parameter is most important to changing the model's predicted outcome.

During this consultation, CWA's consultants made several attempts to model population level effects of hypothesized roseate tern mortality from the Cape Wind Project (Brault and Arnold 2004; Arnold 2007; PVA addendum of the BA), and did so once for the piping plover (Brault 2007). However, numerous reviews (e.g., Fieberg and Ellner 2000; Ralls *et al*. 2002; McCarthy *et al*. 2003) caution against over-reliance on the use of PVAs for assessing extinction risk, even when such models incorporate robust estimates of vital demographic rates, age structure, and habitat availability.

*Roseate Tern*

The roseate tern PVA model developed for CWA by Arnold (2007) is most sensitive to changes in adult survival rate followed by immature survival rate and population sex ratio. In it, the western North Atlantic roseate tern population exhibited a 95% probability of quasi-extinction (when the population of adult males drops below 500 individuals) within 50 years, even in the absence of any additional mortality due to the Cape Wind Project. Arnold (2007) estimated that the take of 1-5 males per year from collision mortality did not change the quasi-extinction probability, and the take of 10-15 males per year changed it 1%, from 95% to 96%. A take of 20 males per year increased the probability 2%, to 97%, and the take of 50 males per year brought it to 98% in 50 years. Essentially, the simulations run by Arnold (2007) suggest that the western

North Atlantic population of endangered roseate terns is likely to drop below a quasi-extinction threshold of 500 adult male breeders, with or without hypothesized mortality from Cape Wind.

The PVA addendum (BA) describes 12 new model runs and incorporates comments from Nisbet (2008), the Service and others, refined estimates of the number of young produced, adult survival and other vital rates, and current population estimates. It also incorporated “no take” scenarios, and different collision distribution estimates based on a 20- and 30-year project life. The PVA addendum also includes simulations run with and without the benefit of the Bird Island restoration project, which is estimated to provide additional nesting habitat for 300-400 nesting pairs of roseate terns. In summary, the 2008 PVA addendum model results deviate markedly from Arnold (2007). These alternative models find a quasi-extinction risk at 50 years of only 3.2% if there is no additional take from Cape Wind, and despite a range of collision probabilities, the quasi-extinction risk never exceeds 4%. More detail on the roseate tern PVA is provided on pages 5-56 to 5-60, and Appendix C of the BA.

Fieberg and Ellner (2000) found that even under optimistic assumptions (vital rate data are free from measurement error), the data requirements for estimates of extinction risk are overwhelming. Their analyses indicate further that estimates of extinction probabilities from time series data of vital rates or population counts will be unreliable measures of true extinction risk. They offer, however, that it may be possible to estimate short-term probability, but the predictive time period is only equal to 10-20% as long as the period over which the population has been monitored. Reliable population estimates for the endangered roseate tern in the western North Atlantic are only available for approximately 20 years, 1988-2007 (USFWS unpubl. data; RTRT 2007). Vital rates such as adult survival (Spendelow *et al.* 2008) are estimated from a similar time frame (19 years). Spendelow (pers. comm. 2008) notes that while some vital rates for the northeastern population of the roseate tern are reasonably well known, i.e., adult survival and annual productivity, other demographic parameters necessary for a PVA model, such as juvenile survival and recruitment of juvenile birds into the breeding population, are not well known. For roseate terns, juvenile survival and recruitment rates are not only less well known, they are also likely to be more variable than demographic parameters like adult survival and productivity (Monticelli *et al.* 2008). Because juvenile survival and recruitment rates can have a dramatic effect on population growth rate, predictions about long-term population trends when these parameters are not well studied must be made with extreme caution.

Given the above, as well as observed trends in abundance and productivity, the Service concludes that the above population viability analyses have limited value with regard to evaluating whether the Cape Wind Project is likely to reduce appreciably the likelihood of both the survival and recovery of the roseate tern in the western North Atlantic population by reducing its reproduction, numbers or distribution in the wild. Accordingly, the Service is not relying on the PVA to determine whether the proposed action will jeopardize the continued existence of the species. Instead, the Service is persuaded by the following summary which we find to be the best information available to assess population level effects of the project on the species:

First and foremost, the anticipated level of take, four to five roseate terns (and depending on the time of year and breeding status, possibly their dependent young), is very small in relation to the size of the northeast population. For example, the fall 2007 roseate population, including breeding age adults, their young of the year, and one- and two-year-old birds, is estimated at about 14,600 individuals (3,900 adults x 2, + approximately 4,000 young of the year, + 2,800 = 14,600). Even 10 birds taken per year is a very small fraction of a population that is estimated to number well over 10,000, even during periodic population lows (e.g., 2005, when only about 3,100 breeding pairs were recorded). In addition, for any given year, hatch-year roseate terns migrating to the wintering areas in Brazil will have virtually no exposure to collision mortality from the Cape Wind Project, as one-year-olds and most (~60%) of these birds will have no exposure as two-year-olds. Accordingly, in any given year, there will be two age classes of roseate terns that will have minimal exposure to collision mortality from the project or to other stochastic events that may occur during the fall staging period, such as Hurricane Bob in 1991.

In addition, the northeastern roseate tern population has exhibited resiliency during the past 20 years. Adult survival was lowered following a severe hurricane in August 1991, after which the breeding population at five key colonies south of Cape Cod (comprising more than 90% of the entire population) declined from 3,259 pairs in 1991 to 2,590 pairs in 1992 (Spendelow *et al.* 2008). The population then rebounded over the next several years to 3,623 pairs in 1998. Spendelow *et al.* (2008) report that for almost two decades, the annual survival rate of the roseate terns at these key colonies has been relatively stable in the range of 0.81-0.85. During this time, the population sustained the known loss of adult roseate terns to predators at several sites, including five at Bird Island in 1991 and five in 1993, 20 at Ram Island in 1997 and 20 in 2005, and 34 at Great Gull in 2004 and six in 2005 (Spendelow *et al.* 2008). Spendelow *et al.* (2008) concluded that despite the loss of these adult birds, the overall annual survival rate for the Long Island Sound and Massachusetts sub-population was little affected.

There are no recovery units identified for the endangered northeastern population, and terns from any of the colonies from Long Island, New York to Nova Scotia are equally at risk to collision mortality from the project. This is because the peak numbers of roseate terns were recorded in Nantucket Sound during the pre-breeding period of arrival in spring and the post-breeding period in late summer and fall, when terns from throughout the breeding range may have occurred in the Sound. As a result, the Service does not find that there will be any effects on the distribution of roseate terns as a result of the take of four to five individuals (and potentially their dependent young). Similarly, the loss of four to five terns will not appreciably reduce the likelihood of survival and recovery of the roseate tern because it is such a small fraction of the total northeastern population.

*Piping Plover*

The primary anticipated effect of the proposed project is mortality due to collisions during migration and, to a much lesser extent, collisions from non-migration flights by plovers breeding or fledging within the action area. Cape Wind Project-related mortality during migration could affect piping plovers breeding or fledging anywhere from Newfoundland south to the action area. However, it is reasonable to expect that piping plovers breeding on outer Cape Cod, Martha's Vineyard and Nantucket are the most likely to transit the project area while moving to or from their breeding grounds, while only a small portion of the population breeding at sites north of the project area will take migratory routes through Nantucket Sound. Furthermore, the potentially exposed population breeding in Canada is currently about one-third of the total number of pairs breeding in and north of the action area (even under a full-recovery scenario of 400 pairs, the Atlantic Canada population would be smaller than the New England population breeding in and north of the project). While we consider that quantitatively parsing the small number of projected collisions between breeding populations in New England and Atlantic Canada stretches the limits of available data, we estimate that markedly lower exposure will limit mortality of Canadian breeders to only one or two during the 20-year life of the project. Although it is plausible that young of the year on their southward migrations are likely the least skilled flyers with lowest avoidance rates, each adult has twice as many annual migration opportunities to transit the project area. The Service therefore projects that expected collision-induced mortality is about equally divided between adults and young of the year.

Unlike the situation for the roseate tern, previously published PVAs for the piping plover were available for use by consultants for CWA in examining the effects of potential mortality from the Cape Wind Project (Brault 2007). Brault's model assumptions and results provided to the Service appear appropriate, reasonable, and largely consistent with previous PVAs for piping plovers (Ryan *et al.* 1993; Melvin and Gibbs 1994; Plissner and Haig 2000; Wemmer *et al.* 2001; Larson *et al.* 2002; Calvert *et al*. 2006), as well as observed trends in abundance and productivity. The Service finds that Brault's PVA provides a useful framework for qualitative discussion of population level implications of the proposed project, but has not relied on its quantitative extinction risk estimates in formulating its conclusions in this BO.

The most consistent finding of all of the PVAs for piping plovers, including Brault (2007), is the sensitivity of extinction risk to even small declines in adult and/or juvenile survival rates. Changes in adult survival in Brault's model exert 2.25 times the effect on population growth than an equal change in productivity. In other words, a 1% reduction in annual adult survival would need to be offset by a 2.25% increase in fledglings produced, likely a formidable task given the baseline protection effort ongoing on the breeding grounds. Unsurprisingly, Brault's simulations indicated that the New England population is less sensitive to annual fatalities under intermediate growth (7%/year) than when the population is stationary. The smaller Atlantic Canada population is below-stationary growth, and Brault found that low numbers of fatalities (one to five birds/year) had large effects on extinction probabilities over 25-50 years.

Collision-induced mortality will exert the most significant population level effects if fatalities involve adults (birds >1 year old), especially from the Atlantic Canada breeding population (Brault 2007; Melvin and Gibbs 1994). This should not be construed as dismissing fatalities involving young of the year or plovers breeding in New England. Furthermore, relatively small numbers of sustained annual fatalities can exert noticeable effects on probabilities of population persistence, especially in a stationary or declining population. Relatively smaller demographic benefits from increasing piping plover productivity and the ongoing intensive recovery activities pose challenges to efforts to off-set mortalities that might be caused by the proposed project.

Notwithstanding potential demographic effects of small numbers of fatalities described above and the >20-year potential duration of exposure from the wind farm project, we return to the estimate of 0.44 collision-induced fatality per year, distributed across all age classes of piping plovers in the New England and Atlantic Canada recovery units, and emphasize the high likelihood that actual collision rates will be much lower. Demographic effect of any mortality is not trivial, but we find that mortality on the scale of one every two years will not rise to the level of an appreciable effect on probabilities of persistence of the Atlantic Coast piping plover population, which numbered 1,890 breeding pairs in 2007. The New England piping plover population has exceeded (or been within two pairs of) its 625 pair abundance goal for 10 years. While the Atlantic Canada breeding population remains more vulnerable, the Service finds that only a small proportion of the very limited mortality projected from the proposed project is likely to affect that portion of the population.

CUMULATIVE EFFECTS

Cumulative effects include the effects of future state, tribal, local or private actions that are reasonably certain to occur in the action area considered in this BO (50 CFR §402.02). Future federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA.

Human disturbance and domestic animals are generally not factors adversely affecting roseate tern breeding success, due to their nesting on offshore islands and the near daily presence of tern biologists that act as island stewards. However, what was once a summer tourist season is now extended into September and fall, and pedestrian and vehicular traffic on beaches, and unleashed dogs have been noted as having a disturbing effect on roseate terns (and piping plovers) present in the Plymouth area (S. Hecker pers. comm. 2008) and the Cape Cod area during the roseate pre-migratory, fall staging period (Trull *et al.* 1999). Indeed, Trull *et al*. (1999) report that staging flocks of terns were disturbed by human activities at 16 of the 20 sites they observed. Roseate terns that are repeatedly flushed from favored feeding, resting and overnight roosting areas may be unable to accumulate the necessary energy reserves needed for their long distance migration over water to their wintering grounds.

Commercial and recreational fishing activity may indirectly affect roseate terns if commercial herring harvest reduces the availability of juvenile herring used as food by terns. Commercial and recreational fishing may indirectly affect food availability for terns which often feed over schools of bluefish and striped bass, if harvest of those species diminishes their distribution or abundance in Nantucket Sound. There is a potential for an oil spill to occur unrelated to the Cape Wind Project that could adversely affect terns and plovers if it occurs at a time when the birds are present or at a location that impacts breeding, feeding, resting or roosting habitat.

Piping plover beaches in the action area are a mixture of publicly- and privately-owned land. On public beaches, recreational activity is expected to increase annually, as residential units are expanded and tourism of the area is promoted. Furthermore, ongoing disturbance and predation (resulting from human activities attracting predators to the area) are likely to continue throughout the action area. With the escalating numbers of beachgoers and their pets, disturbance to breeding piping plovers is expected to increase. Currently, most sites have effective management plans in place, although smaller, privately-owned or town-owned beaches lack specific management plans or agreements with qualified management entities such as MAS, and there is little-to-no enforcement of dog ordinances or leash laws. Therefore, it is expected that plover productivity may suffer some adverse effects due to increasing use of some beaches within the action area. Dredging and subsequent beach nourishment actions that may affect piping plovers will be addressed in future biological opinions.

Other wind energy projects (offshore, near shore and onshore) in the early planning stages in Massachusetts are not considered a cumulative effect because they are either outside of the action area or they will be the subject of future federal review under the ESA.

CONCLUSION

After reviewing the current status of the Atlantic Coast piping plover and the northeastern population of the roseate tern, the environmental baseline for the action area, and all effects of the proposed Cape Wind Project, it is the Service's biological opinion that the project is not likely to jeopardize the continued existence of these species. No critical habitat has been designated for the Atlantic Coast breeding ranges of these species; therefore, none will be affected.

"Jeopardize the continued existence of" is defined (50 CFR §402.02) to mean "to engage in an action that would be expected, directly or indirectly to reduce appreciably the likelihood of both survival and recovery of a listed species in the wild by appreciably reducing the reproduction, numbers, and distribution of that species."

In making this determination, the Service analyzed the potential impacts from collisions, habitat loss and disturbance, prey species attraction, barriers and displacement, increased predation, lighting, oil spills, pre- and post-construction activities, routine maintenance activities, and decommissioning activities. In analyzing these potential impacts, the Service determined that, in all cases except collisions, the effects were insignificant or discountable and would not result in take (mortality) of roseate terns and piping plovers. The Service estimates that the mortality of roseate terns due to collisions to be four to five roseate terns per year on average. Some of these individuals may be adult breeding birds with dependent young, and their loss would reduce the survival rate of those young. The Service also determines that mortality of piping plovers due to collisions is extremely unlikely to be more than 0.5 piping plover per year on average.

The Service assessed the population-level effects for roseate terns and piping plovers arising from the effects of the action, including the estimated collision mortality, and determined that these losses will not appreciably reduce the likelihood of survival and recovery of either species.

*Roseate terns*
No effect is anticipated on the distribution of roseate terns in the northeastern population, other than an increase in breeding pairs at Bird Island following the restoration of the habitat there (Beneficial Effects section). No effect on roseate tern breeding success is anticipated, because there is minimal use of the Horseshoe Shoal project area during the breeding season. There will be no measurable effects on roseate tern reproductive rates, although any collisions with the WTGs will foreclose future breeding of birds that are killed.

The population trend for roseate terns in the Northeast for the past two decades is characterized by fluctuations in the number of adult breeding pairs from about 3,000 – 4,300+ pairs. Short periods of population increase are followed by several years of decline. Although the loss of even a small number of birds per year due to the Cape Wind Project is a concern, particularly during periods of population decline, the take of even 10 individuals is a very small fraction of a population that is estimated to number well over 10,000, even during periodic population lows.

*Piping Plovers*

The Service's analysis finds that the greatest risk to piping plovers comes from potential collisions by migrating piping plovers that breed or fledge in or north of the action area (see Effects section). Although not entirely discountable, the best available information supports the Service's judgment that potential adverse effects of barriers, displacement, and collisions during flights not associated with migration, and oil spills are negligible, not rising to the level of "take". Thus, the primary potential effects of the proposed project will take the form of reductions in numbers of piping plovers incurred during northward and southward migration. The distribution of the potential mortality is among piping plovers that breed in the New England and Atlantic Canada recovery units. There will be no effects on reproductive rates, although it is axiomatic that any collisions will foreclose future breeding of the birds that are killed.

Although no piping plovers have been detected in the project area, this negative occurrence data is insufficient to discount potential risks. The Service has evaluated Hatch and Brault's deconstruction of collision risk to formulate its own reasoned upper bound estimate of <0.5 piping plover mortality per year. The Service recognizes more serious demographic implications if project-induced mortality involves adults and/or plovers breeding in Atlantic Canada. However, given that the total upper bound estimate is much less than one per year, the Service finds that it is not meaningful to attempt to parse quantitative mortality estimates by age class or breeding distribution. The Service cannot completely discount risks to the Atlantic Coast piping plover from the proposed project, but we emphasize that only 0.5 mortality per year is anticipated, even with conservative modeling. Notwithstanding the duration of potential exposure anticipated over 20 years or more, the Service determines that the proposed project will not appreciably reduce the likelihood of survival and recovery of the Atlantic Coast piping plover or populations breeding in the New England or Atlantic Canada recovery units.

## INCIDENTAL TAKE STATEMENT

Section 9 of the ESA and federal regulations pursuant to Section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, collect, or attempt to engage in any such conduct. Harm is further defined to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns including breeding, feeding, or sheltering. Harass is defined as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of Section 7(b)(4) and Section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the ESA provided that such taking is in compliance with the terms and conditions of an Incidental Take Statement.

**Amount and Extent of Take**

*Roseate Tern*

The Service estimates that on average, four to five roseate terns per year (80-100 terns over the 20-year life of the project) are likely to be taken (injured or killed) as a result of collisions with the WTGs on Horseshoe Shoal. If any of the four or five individuals are successful adult breeders with dependent young of the year, the survival rate of their young will be reduced, adding to the level of take. The Service bases this estimate on an independent review of the various collision modeling discussed previously and the modifications that reflect our full consideration of the best available scientific information and understanding of the species.

*Piping Plover*

The Service anticipates that a maximum of 10 piping plovers will be taken over the life of the Cape Wind Energy Project, based on our upper bound estimate of one piping plover collision every two years with the WTGs in the Horseshoe Shoal project area. As for roseate terns, the Service bases this estimate on an independent review of the various collision modeling discussed previously and includes our full consideration of the best available scientific information and understanding of the species. Because the formulation of mortality estimates is very complex, new empirical information demonstrating one or more of the following circumstances will constitute evidence that estimated take of piping plovers has been exceeded:

1. Annual flights across the project area exceed the total number of pairs breeding in and north of the action area. This is equivalent to approximately 18% of migration flights by adults and young of the year (pairs x 5.5).
2. More than 20% of flights occur at rotor height.
3. Avoidance rates <0.95.

**Effect Of The Take**

In this BO, the Service determined that the level of take is not likely to have jeopardized the continued existence of the piping plover and roseate tern. Furthermore, the Service estimates that implementation of the Bird Island restoration project will offset any potential roseate tern mortality that may occur from the Cape Wind Project.

REASONABLE AND PRUDENT MEASURES

Pursuant to Section 7(b)(4) of the Endangered Species Act, the Service finds the following reasonable and prudent measures are necessary and appropriate to minimize incidental take of roseate terns and piping plovers. In order to be exempt from prohibitions of Section 9 of the

ESA, MMS and CWA must comply with the following terms and conditions which implement the reasonable and prudent measures and outline reporting/monitoring requirements. These terms and conditions are non-discretionary. The term "reasonable and prudent measures" is defined by the Service's ESA implementing regulations (50 CFR §402.02) to mean "those actions that the [Service] believes are necessary to minimize the impacts of take, i.e., amount or extent, of incidental take". The Service's Section 7 Consultation Handbook (March 1998) further explains that measures are considered reasonable and prudent when they are consistent with the proposed action's basic design, location, scope, duration, or timing of the project" [Handbook at 4-50 (illustrations excluded)]. The Handbook also states that "the test of reasonableness is whether the proposed measure would cause more than a minor change to the project" and that RPMs can include only actions that occur within the action area.

*1. Pre- and post-construction monitoring to assess the effects and incidental take of the Cape Wind Project*
The MMS and CWA Monitoring Framework is a preliminary framework of methodologies for pre- and post-construction monitoring of the potential impacts of the Cape Wind Project on roseate terns and piping plovers. MMS, CWA and the Service will coordinate in the development of more detailed protocols to determine the extent of roseate tern and piping plover presence in the project area, the effects of the WTGs on roseate tern foraging and other use of Horseshoe Shoal and/or the level of incidental take as a result of the project.

*2. Oil Spill Response Plan*
Although MMS requires an oil spill response plan in the event of a spill related to the Cape Wind Project, specific response measures shall be identified for roseate tern and piping plover habitat in order to avoid or minimize take. Some adverse effects and possible take (primarily in the form of harm or harassment) may be unavoidable during an emergency response. These effects will be addressed in a post-spill emergency consultation as described in the BO.

*3. Review of pre- and post-construction monitoring activities, perching deterrents and operational adjustments.*
The Service, MMS and CWA will review the efficiency and efficacy of pre- and post-construction monitoring activities, and the implementation of perching deterrents to determine their effectiveness and/or make adjustments as needed, in order to continue or enhance avoidance and minimization of take.

*4. Reporting requirements*
Post-construction monitoring may not be able to sufficiently document take of roseate terns and piping plovers resulting from collisions with WTGs or the ESP. Nevertheless, MMA and CWA must report roseate tern and piping plover injury or mortality associated with the Cape Wind Project to the Service within 24 hours.

*Operational adjustments*
The Service also considered as a reasonable and prudent measure, an operational adjustment to the wind facility that would require the temporary and seasonal shut down of the WTGs through the feathering of the rotors. Feathering of the rotors causes them to face the wind and stop spinning, and would reduce the risk of collision by roseate terns and, to a limited extent,

migrating piping plovers transiting the Horseshoe Shoal project area. Although the Service considered that result in this "operational adjustment" would be based on weather and day light parameters that reduce visibility, and would be limited in time to seasons when plovers and peak numbers of roseate terns are expected to be present (a few weeks in early to mid-May and a few weeks in late August to mid-September), it was determined by MMS and CWA (J. Lewandowski, MMS electronic correspondence including Bennett *in litt*. as attachment, November 20, 2008) to **not** be reasonable and prudent based on the following:

The operational adjustment (shut down of turbine rotors to a neutral position) is not reasonable because it does not meet the RPM regulatory definition as a "reasonable measure" as it modifies the scope of the project in a manner that is adverse to the project's stated purpose and need, that is to make a substantial contribution to enhancing the region's electrical reliability and achieving the renewable energy requirements under the Massachusetts and regional renewable portfolio standards (DEIS 2008 at E-1). MMS considers that this may involve more than a "minor change" (50 C.F.R. § 402.14(i)(2).

MMS has also determined that the RPM is not reasonable because the uncertainty regarding the project's ability to generate electricity during the two time frames (late April to mid-May and late August to mid-September) reduces the project's predicted potential electrical output in a significant enough way to have a deleterious affect on anticipated revenues, financing and power purchasing agreements.

Furthermore, MMS indicates that the proposed timeframes for the operational adjustment, although limited by season, visibility and time of day, constitute peak period hours, when the energy supplied to the ISO New England (the regional transmission organization) has greater market value (see DEIS 2008 at 3-32). Therefore, the RPM may not be prudent because the economic cost makes this measure not feasible for project proponents to implement.

**Terms and Conditions**

In order to be exempt from the prohibitions of section 9 of the ESA, MMS and CWA must comply with the following terms and conditions to implement the reasonable and prudent measures described above. These terms and conditions are non-discretionary.

1. Monitoring:
    a. MMS, CWA and the Service will coordinate in the development of specific pre- and post-construction monitoring protocols discussed in the Framework for the Avian and Bat Monitoring Framework for the Cape Wind Proposed Offshore Wind Facility.

    b. Prior to implementation, monitoring protocols should be peer-reviewed, including at least one European scientist currently conducting similar monitoring efforts at off-shore wind projects. Peer review could allow data collection and analysis to be comparable with other ongoing off-shore monitoring efforts.

c. To the greatest extent practicable, all protocols shall incorporate methods to assess detectability and sufficiency of negative data. Examples might include double observer protocols for aerial and boat surveys, testing the range of radio transmitter reception and effects of flight altitude using transmitters affixed to small planes or boats, and use of recorded play-backs to evaluate acoustic monitoring in the project area.

d. Components of the Monitoring Framework, such as radio telemetry, that entail take (i.e., capture, some risk of injury) to roseate terns and/or piping plovers will be contingent on recovery permits under section 10(a)(1)(A) of the ESA.

e. The monitoring framework shall be adaptable and incorporate to the maximum extent practicable, new remote sensing technologies or other new technologies that will enhance data collection on avian use and collision risk in the project area.

2. Oil Spill Response Plan
    a. MMS and CWA will coordinate with the Service to develop an oil spill response plan (or section within CWA's proposed OSRP) that specifically addresses response activities that could occur in roseate tern and piping plover habitat (including breeding, foraging and resting habitat).

3. Review of pre- and post-construction monitoring activities, perching deterrents and operational adjustments.
    a. The Service, MMS and CWA will coordinate annually (or as needed) to review the results of pre- and post-construction monitoring efforts, and monitor the effectiveness of operational adjustments and perching deterrents.

    b. Based on the results of the reviews, adjustments to monitoring protocols and redesign of perching deterrents may be required. If operational adjustments are determined to be unnecessary, they may be discontinued.

4. Reporting requirements
    a. MMS and/or CWA shall report within 24 hours any roseate tern or piping plover mortality attributable to the Cape Wind Project to the Supervisor, New England Field Office, 70 Commercial St., Suite 300, Concord, NH 03301 or telephone 603-223-2541.

    b. MMS or CWA shall provide an annual summary report of pre- and post-constructing monitoring efforts to the Supervisor, New England Field Office, 70 Commercial St., Suite 300, Concord, NH 03301 or telephone 603-223-2541 no later than December 15 of each year.

## CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA directs federal agencies to use their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of endangered and threatened species. The following conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or proposed critical habitat, to help implement recovery plans, or to develop information.

1. MMS should develop and test technology to facilitate *pre-project* assessments of roseate tern and piping plover abundance in off-shore areas proposed for future WTG projects. Each additional project along these species' Atlantic Coast migration routes has potential to compound mortality risks from collisions, and extinction risks for both of these species are highly sensitive to increased mortality. Serious effects on piping plover extinction risk at relatively low sustained kill/year thresholds modeled by Brault (2007) underscore the importance of responding to this issue before off-shore wind projects proliferate, especially since piping plovers from the relatively precarious Atlantic Canada recovery unit are potentially exposed to every U.S. Atlantic off-shore wind generation proposal. The current dearth of information reflects the absence (until the advent of off-shore wind energy proposals) of perceived off-shore threats to these species.

   State-of-the-art radar technology is unable to identify birds to species. Off-shore visual surveys (boat and aerial) have only limited ability to identify flying terns to species and are virtually incapable of identifying small shorebirds such as piping plovers in flight. Acoustic monitoring and telemetry in the Cape Wind post-project Monitoring Framework have potential to refine assessments of risks to these species, but it is essential that planning and consultations for future projects have the benefit of pre-project assessments. The Service urges MMS to foster development of cost-effective means of stationing acoustic and telemetry receivers in off-shore areas where future wind energy projects may be proposed. Advances in other technology (e.g., harmonic radar) that might provide important pertinent information on the off-shore activities of these species (e.g., time of year, time of day, altitude, behaviors, effects of weather) are also needed. Every effort should be made to develop protocols for each technology that support assessments of detectability and sufficiency of negative data.

2. MMS should encourage CWA and its partners to fully implement all measures identified as state-required "compensatory mitigation" in section 8.2.1 of the BA. As a result of the Massachusetts Environmental Policy Act (MEPA) Certificate, CWA was required to establish a $10 million fund to compensate for unavoidable impacts to affected wildlife and habitat. The fund would come from anticipated lease revenues generated by Cape Wind. A portion of this fund is proposed for use in the following conservation measures:

   a. Predator Management: Predation on beach nesting piping plovers and terns has been a significant factor for reduced productivity at a number of Massachusetts beaches. Professional management of predators at carefully selected sites has yielded demonstrable benefits for piping plovers and terns in recent years. Successful implementation of predator management on select plover sites in Massachusetts should increase productivity and offset potential losses as a result of plover or tern collisions with WTGs (page 8-11 of the BA).

b. Population Monitoring, Site Protection and Management (Breeding Season): MADFW proposes to use mitigation funds to sustain and/or augment current statewide efforts to monitor and manage piping plovers and terns in Massachusetts. Priority locations where additional monitoring and protection is needed are identified on page 8-11 of the BA.

c. Identification and Protection of Piping Plover and Tern Post-Breeding Staging and Migration Areas: MADFW proposes to hire seasonal staff to identify post-breeding staging and migratory stopover areas for terns and piping plovers, and to develop and implement site management plans for high priority areas. Identification and evaluation of conservation needs at piping plover migration stop-over habitats is a heretofore rarely implemented and potentially beneficial action.

d. Coastal Waterbird Conservation Assistant: A permanent Coastal Waterbird Conservation Assistant may be hired by MADFW to oversee statewide conservation efforts for piping plovers and roseate terns. Augmentation of MADFW staff will enhance training of and coordination with local shorebird monitors and improve responsiveness to requests for assistance with the many unique and sometimes devastating problems that arise during a very short annual breeding window.

3. MMS should find mechanisms to implement the conservation measures for piping plovers discussed in section 8.2.1 of the BA in Atlantic Canada, Maine, and New Hampshire. It is the nature of off-shore wind generation facilities that they can affect birds breeding at locations far distant from the project area. Furthermore, any mortality of plovers that breed at higher latitudes will result in more serious demographic effects.

In order for the Service to be kept informed of actions minimizing or avoiding adverse effects or benefiting listed species or their habitats, the Service requests notification of the implementation of any conservation recommendations.

## REINITIATION NOTICE

This concludes formal consultation regarding the MMS proposal to lease a portion of the outer continental shelf in Nantucket Sound, Massachusetts to Cape Wind Associates LLC, for development of a commercial wind energy facility. As provided in 50 CFR §402.16, reinitiation of formal consultation is required where discretionary federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending reinitiation.

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Appendix 1. Consultation History

November 17, 2005 – Initial meeting between Minerals Management Service staff and U.S. Fish and Wildlife Service (FWS) Regional Office and New England Field Office staff to discuss environmental issues relative to the proposed Cape Wind project. The MMS briefed FWS on the upcoming NEPA review process and ESA consultation between the FWS and MMS.

December 27, 2005 – Electronic correspondence from MMS to the FWS requesting initiation of informal consultation on the Cape Wind project and FWS information needs required for consultation.

January 5, 2006. Conference call between MMS and FWS discussing the need to redo the Draft EIS and the desirability of conducting additional studies on terns and plovers.

February 22, 2006. Email from MMS to the FWS and others regarding establishing a date and time for a conference call to discuss avian studies in Nantucket Sound.

March 6, 2006. Notes from conference call between the MMS, FWS, U.S. Geological Survey USGS, Massachusetts Audubon Society (MAS), Cape Wind Associates (CWA) and consultants. Stated purpose of call was to close communication gaps, to discuss present body of avian studies conducted by Mass Audubon and the CWA, and work on-going on the population and viability analyses (PVA) for plovers and terns.

April 7, 2006. Protocol for Marine Radar Surveys of Birds. Geo-marine, Inc and ESS Group, Inc. for CWA.

April 12, 2006. Conference call between the MMS, FWS, USGS, CWA and consultants to discuss potential research for understanding plover and tern migratory routes within the project area.

April 27, 2006. Conference call between the MMS, FWS, Massachusetts Department of Fish and Wildlife (MADFW), CWA and consultants to discuss the roseate tern PVA.

April 27, 2006. Email from Jennifer Arnold USGS providing follow-up information and suggested changes for the roseate tern PVA.

June 26, 2006. Conference call between the MMS, FWS, MADFW, CWA and consultants regarding revision of the PVA for piping plovers.

July 10, 2006. Email from Anne Hecht FWS to MMS providing a research paper on movements, habitat use and survival rates of piping plovers and discussing need for research on piping plover migration.

December 6, 2006. Email correspondence from MMS to the FWS and others to coordinate a meeting to assimilate existing data on piping plover and roseate tern presence at two proposed off-shore wind energy projects and to discuss potential research avenues to assess plover and/or tern presence in the proposed sites.

January 5, 2007. Letter from FWS to ESS Group, Inc., providing an updated endangered species list for the HSS project area and transmission line corridor. Updated species distribution information was also provided.

January 8, 2007. Email correspondence from MMS to FWS and USGS regarding the purpose for a meeting on January 30, 2007.

January 30, 2007. Agenda, various notes, and copies of power point slides presented at the January 30th meeting at MMS offices in Herndon, VA., at which FWS, USGS, ESS Group, MADFW, Virginia Tech and several consultants were in attendance.

February 1, 2007. Email correspondence from USGS regarding the August 28-31 tern observations made by ESS Group near Monomoy Island.

February 15, 2007. Cape Wind Energy Project Final EIR/Development of Regional Impact.

February 16, 2007. Email correspondence from FWS to Woodlot Alternatives (consultant for MMS), MADFW and others, regarding four published PVAs for piping plovers for MMS and Woodlot review.

February 16, 2007. Woodlot Alternatives, summary of topics for Cape Wind biological assessment with notes from a conference call between MMS, FWS and Woodlot.

March 12, 2007. Email correspondence from MMS to FWS and Woodlot Alternatives, regarding a March 15, 2007 conference call to discuss issues relevant to the MMS'ss biological assessment.

March 15, 2007. Email correspondence from Woodlot Alternatives to MMS and FWS with several attachments, including the most recent versions of the PVAs and collision risk models and a list of the literature cited to date for the MMS draft biological assessment.

March 15, 2007. Notes from a meeting with Woodlot Alternatives, MMS and FWS staff regarding preparation of the biological assessment, particularly with respect to assumptions and inputs to roseate tern PVA.

March 16, 2007. Email correspondence from FWS to MMS reconfirming species list.

March 20, 2007. Email correspondence from Woodlot Alternatives to FWS and MMS containing a copy of the recommendations from MADFW regarding model assumptions for piping plovers, as requested by FWS on the March 15 call and again by email correspondence from FWS on March 19.

March 21, 2007. I. Nisbet comments on the Final EIR for the Cape Wind Project: Avian Impacts.

March 21, 2007. MADFW comments on tern sections of Cape Wind Final EIR.

March 22, 2007. Letter from MADFW to Secretary, Executive Office of Energy and Environmental Affairs' comments on the Cape Wind FEIR.

March 22, 2007. Multiple email correspondence from FWS to MMS staff and FWS staff about interagency communications regarding the Cape Wind project, the Long Island project and the programmatic EIS. Second email from FWS discussing designation of a non-federal representative, suggesting that the candidate species, red knot, be included in the species list for the Cape Wind project area and responding to questions from Woodlot Alternatives on the piping plover.

March 23, 2007. Email correspondence from FWS to Woodlot Alternatives in reply to a March 16 Woodlot Alternatives to FWS staff discussing information sources and assumptions for the PVAs and collision risk assessments.

March 24, 2007. Follow-up email correspondence from FWS to MMS with final feedback related to March 22, 2007 correspondences noted above.

March 29, 2007. The Commonwealth of Massachusetts, Certificate of the Secretary of Environmental Affairs on the Final EIR. Includes identification of ($780,000) from CWA lease revenues for the Bird Island restoration.

April 9, 2008. Email exchanges between MMS and FWS staff regarding interagency communications and ESA consultations for wind power.

April 10, 2007. Email correspondence from FWS to MMS providing follow-up answers to 15 questions from MMS regarding model inputs to the collision risk assessment to roseate terns. An April 10, 2007 email from USGS is appended.

April 2007. Roseate Tern Recovery Team c/o C. Mostello (MADFW), Final figures for roseate tern abundance, Northeast U.S. 1988-2006. Includes a table showing census estimates for all breeding colonies in the U.S.

April 27, 2007. Conference call between consultant to ESS Group, Inc., and roseate tern recovery team members, Ian Nisbet and Jeff Spendelow, regarding inputs and assumptions to the roseate tern PVA.

April 27, 2007. USGS electronic correspondence providing a summary of the April 27 roseate tern PVA conference call.

May 31, 2007. FWS electronic correspondence to MMS outlining preliminary questions regarding Appendices 3.6-I and 3.6-K in the Cape Wind FEIR as discussion points for the informal Section 7 consultation on piping plovers.

June 2007. Cape Wind Associates response to data requested by MMS regarding inputs to collision risk assessment models for plovers and terns.

June 20, 2007. Conference call between several MMS staff, FWS staff, CWA and consultants. Discussions focused on bird collision risk assessments derived from European projects and studies, and their application to the Cape Wind project and a bird monitoring plan.

August 7, 2007. Email from MMS to FWS staff coordinating a meeting date in Boston in September, 2007.

August 9, 2007. Telephone correspondence between FWS (red knot recovery team leader) and MMS regarding current status of red knot and potential for occurrence in the proposed action area.

September 13, 2007. Meeting in Boston between several MMS staff, several FWS staff, MADFW, consultants and CWA. Working MMS draft of existing recommendations for mitigation, monitoring and impact avoidance for birds and wind farms.

September 14, 2007. Email and fax correspondences from FWS to MMS, providing section 7 ESA guidance materials as follow-up to September 13 meeting.

October 9, 2007. Letter from MMS to FWS, requesting concurrence on the list of threatened and endangered species and critical habitat to be considered in the consultation for the Cape Wind project.

October 22, 2007. Email correspondence from MMS to FWS with update on progress of draft MMS biological assessment and request for one more piping plover call and a separate roseate tern call specifically addressing monitoring/mitigation issues.

November 12, 2007. Email from MMS to FWS staff, MADFW, USGS and Roseate tern recovery team member and others, regarding a conference call meeting to discuss the first draft of avian monitoring, mitigation and reporting requirements for the Cape Wind project.

November 12, 2007. Email from MMS to FWS staff, MADFW and piping plover recovery team member and others, regarding a November 14 conference call meeting to discuss the first draft of avian monitoring, mitigation and reporting requirements for the Cape Wind project.

November 12, 2007. Email from MMS to FWS staff, MADFW and piping plover recovery team member and others, regarding a November 20 conference call meeting to discuss the first draft of avian monitoring, mitigation and reporting requirements for the Cape Wind project.

November 16, 2007. Letter from FWS to MMS responding to concurrence request for the Cape Wind species list.

November 26, 2007. Outcome (meeting summary notes) from MMS Technical Meeting on ESA-Listed Bird Species and the Cape Wind Proposal held September 13, 2007 in Boston.

December 3, 2007. Email correspondence from FWS to MMS notifying of new article in Journal of Wildlife Management (Kuvlesky *et al.*, 2007) on Wind Energy Development and Wildlife Conservation.

December 4, 2007. Email correspondence from MMS to FWS, USGS and I. Nisbet with attached preliminary draft biological assessment seeking an initial review on completeness of information. Several additional emails between recipients of draft biological assessment during mid-December providing preliminary comments or questions.

January 2008. MMS provides latest version of draft MMS biological assessment for more extensive FWS review and comment.

February 5, 2008. FWS provided comments on the draft BA, comments of an anonymous reviewer and those of Dr. Ian Nisbet, roseate tern recovery team member.

April 21, 2008. Letter from FWS to MMS conveying FWS comments on the January 2008 draft EIS.

May 19, 2008. Biological Assessment and letter requesting initiation of formal section 7 consultation from MMS to FWS.

June 9-11, 2008. Several email correspondences between FWS and MMS on whether to post the biological assessment on line. Assessment was ultimately posted on the MMS website on June 16.

June 17, 2008. Letter from FWS to MMS acknowledging receipt of request to initiate formal section 7 consultation and anticipating completion date of October 2, 2008 for the consultation.

June 23, 2008. Notes from conference call between MMS staff, FWS staff and consultants. Discussion focused on on-going coordination MMS is having with multiple federal regulatory agencies [FAA, USCG, Army Corps of Engineers (ACOE), etc.] Discussion also addressed the FWS's comments on the DEIS and the research proposals for additional bird studies that MMS is reviewing.

July 17, 2008. Email from FWS to MMS and others, discussing FWS availability to assist MMS with bird study research proposals MMS has received.

July 21 and 23, 2008. Emails and notes to files to and from the FWS and MMS regarding FWS availability to participate in a panel to review and revise the avian monitoring plan.

August 15, 2008. Email correspondence from FWS to MMS requesting additional monitoring and mitigation information and confirmation of proposed action components for ongoing formal section 7 consultation.

August 18, 2008. Letter from FWS to MMS requesting extension of consultation period to October 16, 2008, with a complete biological opinion issued by December 1, 2008.

August 19 – 25, 2008. Conference call and email correspondence between MMS and FWS discussing development of draft avian monitoring plan.

August 20, 2008. Multiple email correspondence between FWS to ACOE to discuss Bird Island restoration project.

August 27, 2008. Conference call between MMS, FWS and consultants discussing post-construction monitoring options and methodologies.

September 3 4, 2008. Multiple email correspondence between MMS and FWS discussing submission of draft avian monitoring plan and timeline for completing ESA consultation and review of draft avian monitoring plan.

September 5, 2008. MMS electronically submitted draft avian monitoring plan to FWS for review and comment.

September 10, 2008. FWS requests missing draft avian monitoring plan references and methodology matrix from MMS.

September 11, 2008. Multiple email correspondence between MMS and FWS discussing missing references and timeline for ESA consultation.

September 12, 2008. FWS electronically submitted comments on the MMS draft avian monitoring plan.

September 15, 2008. Conference call between MMS, FWS and consultants to discuss draft avian monitoring plan.

September 19, 2008. MMS electronically submitted the final Framework for the Avian and Bat Monitoring Plan for the Cape Wind Proposed Offshore Wind Facility.

September 30, 2008. Letter from FWS (electronic) to MMS regarding the presence of the federally-threatened Northeastern beach tiger beetle within the periphery of the proposed Cape Wind project action area.

October 1, 2008. Multiple electronic correspondence between MMS and FWS discussing wind cut-in speed of the Cape Wind project wind generating turbines.

October 3 and 6, 2008. Multiple electronic correspondence between MMS and FWS discussing a potential Reasonable and Prudent Measure for the FWS biological opinion.

October 6, 2008. Letter from MMS to FWS responding to the Service's request for an extension on the formal consultation.

October 8, 2008. Telephone communication with MMS, FWS and representatives of CWA discussing draft RPMs.

October 9, 2008. Letter from MMS to FWS amending the Biological Assessment to include an effects analysis for the northeastern beach tiger beetle.

October 16, 2008. Additional telephone communication with MMS, FWS and representatives of CWA discussing draft RPMs.

October 21, 2008. Telephone conference with MMS, representatives of CWA and FWS to discuss availability of weather data for Nantucket Sound to clarify how often low visibility conditions (e.g., fog) occur on the sound during periods when tern numbers are highest.

October 22, 2008. Email transmittal from FWS to ESS Group, MMS and CWA requesting clarification of selected parameters of the roseate tern collision risk model.

October 23, 2008. Email correspondence from Jeremy Hatch, U. Mass Boston (ESS Group) to FWS, providing clarification on the Band *et al.* (2006) collision model adapted for use in the BA.

October 29, 2008. Telephone and email correspondence between FWS, and Jeff Spendelow, USGS, discussing the strengths and weaknesses of the roseate tern population viability analyses, and recent papers published in the scientific literature useful to the Service's on-going consultation with MMS.

October 31, 2008. Transmittal of FWS draft Biological Opinion, with appendices, to MMS.

November 6, 2008. Electronic submittal of MMS comments on the draft Biological Opinion to the FWS.

November 7, 2008. One additional comment on the draft Biological Opinion electronically submitted by MMS to FWS.

November 10, 2008. Conference call between MMS, FWS, CWA and consultants to discuss comments provided by MMS and CWA on the draft Biological Opinion.

November 12, 2008 Electronic submittal from MMS to FWS outlining MMS timeline and requesting FWS final Biological Opinion by November 21, 2008.

November 12, 2008. Electronic submittals relative to the Biological Opinion's Reasonable and Prudent Measures and consultation history.

November 13, 2008. Telephone call between MMS and FWS discussing additional information needs relative to the Reasonable and Prudent Measures.

November 18, 2008. Electronic transmittal from MMS to FWS relaying additional comments on the draft biological opinion regarding the collision model and oil spill risk analysis.

November 20, 2008. Electronic transmittal from MMS to FWS relaying MMS's response to a proposed Reasonable and Prudent Measure.