United States Department of the Interior

FISH AND WILDLIFE SERVICE
Raleigh Field Office
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November 15, 2010

Michael B. Murray
Superintendent
Cape Hatteras National Seashore
National Park Service
1401 National Park Drive
Manteo, North Carolina 27954

Subject: Biological Opinion for the Off-road Vehicle Management Plan in Cape Hatteras National Seashore

Dear Sup~~erintendent Murr~~ay: Mike

This transmits the U.S. Fish and Wildlife Service (USFWS) Raleigh Field Office's biological opinion based on our review of the proposed Off-road Vehicle Management Plan for Cape Hatteras National Seashore located in Dare and Hyde Counties, North Carolina. This opinion assesses the effects of the preferred alternative as described in the Draft Environmental Impact Statement of March 2010 and your correspondence dated October 14, 2010, on the piping plover (*Charadrius melodus*) of the Atlantic Coast, Great Lakes and Northern Great Plains populations; seabeach amaranth (*Amaranthus pumilus*); and loggerhead (*Caretta caretta*), green (*Chelonia mydas*), and leatherback (*Dermochelys coriacea*) sea turtles. This opinion is provided in accordance with section 7(a)(2) of the Endangered Species Act of 1973 (Act), as amended (16 U.S.C. 1531 *et seq.*). This document addresses the requirements of the Act but does not address other environmental statutes such as the National Environmental Policy Act or Fish and Wildlife Coordination Act. Your February 17, 2010, request for formal consultation was received at this office on February 18, 2010.

We appreciate the time and effort that went into the preparation of the proposed plan and your cooperation throughout the consultation process. If you have any questions about these opinions, please contact me at (919) 856-4520 extension 11, or via email at Pete_Benjamin@fws.gov.

Sincerely,

Pete Benjamin
Field Supervisor

Attachment

U. S. FISH AND WILDLIFE SERVICE BIOLOGICAL OPINION ON THE OFF-ROAD VEHICLE MANAGEMENT PLAN, CAPE HATTERAS NATIONAL SEASHORE, NORTH CAROLINA NOVEMBER 2010

INTRODUCTION

This document is the U.S. Fish and Wildlife Service (USFWS) Raleigh Field Office's biological opinion based on the National Park Service (NPS) preferred alternative, Alternative F, as described in the Final Off-Road Vehicle (ORV) Management Plan/Environmental Impact Statement (EIS) for Cape Hatteras National Seashore (CAHA; Seashore) in Dare and Hyde Counties, North Carolina (Figure 1). The management actions and environmental impacts of this alternative were provided in the Draft Environmental Impact Statement (DEIS) for the ORV Management Plan, dated March 2010, and updated by correspondence dated October 14, 2010 (M. Murray, NPS, pers. comm. 2010). This opinion assesses the proposed management plan on the piping plover (*Charadrius melodus*) of the Atlantic Coast, Great Lakes and Great Plains populations; seabeach amaranth (*Amaranthus pumilus*); and loggerhead (*Caretta caretta*), green (*Chelonia mydas*), and leatherback (*Dermochelys coriacea*) sea turtles. This opinion is provided in accordance with section 7(a)(2) of the Endangered Species Act of 1973 (Act), as amended (16 U.S.C. 1531 *et seq*.). This document addresses the requirements of the Act but does not address other environmental statutes such as the National Environmental Policy Act or Fish and Wildlife Coordination Act. The Seashore's request for formal consultation, dated February 17, 2010, was received on February 18, 2010.

The DEIS provided a summary of ORV use and management at the Seashore from establishment in the 1930s to the present day (National Park Service [hereafter NPS] 2010a, pp. 16-27). ORV use at the Seashore has historically been managed since the 1970's through various draft or proposed plans, though none were ever finalized or published as a special regulation as required by Executive Orders 11644 and 11989 and 36 CFR 4.10. On December 9, 1999, a petition for rulemaking was submitted to the NPS that requested a ban on the use of all-terrain vehicles (ATVs), dune buggies, sand buggies, and other four-wheel drive vehicles on all off-road areas in the national park system, which included the Seashore. This petition was followed-up by a second petition in 2004. The second petition, specific to the Seashore, was submitted on June 7, 2004, and requested Rulemaking Governing Off-Road Vehicle Use in the Cape Hatteras National Seashore. Petitioners claimed the Seashore's informal authorization of ORV use violated the Act, executive orders and federal regulations regarding ORV use in the national parks, the Organic Act, the General Authorities Act of 1970, the CAHA enabling legislation, and various NPS management policies. Both of these petitions are part of the reason for developing the current ORV plan/EIS.

Following the submission of the two petitions, in 2004 the Seashore issued Superintendent's Order 7, ORV Management, to resolve ORV issues created by Hurricane Isabel. After reviewing the 1984 General Management Plan, the Superintendent decided that parts of the 1978 draft interim ORV Management Plan (permitting sections excluded) would be used as Seashore guidance pending development of a long-term ORV Management Plan and special regulations.

Figure 1. Cape Hatteras National Seashore action area. Source: NPS 2010a, p. 5

To provide guidance for the proper management of protected species and to comply with the Act, while providing for use of the Seashore's recreational resources until an ORV plan/EIS and special regulation could be completed, the Seashore began development of the Interim Strategy in late 2004. The species addressed in the Interim Strategy are those specifically affected by recreational and ORV use within the Seashore that are listed either federally or by the state as threatened, endangered, or species of special concern, or are of special concern to the Seashore.

The Interim Strategy outlined a multifaceted plan (including a program of increased monitoring, recreational and ORV closures, education and enforcement) for minimizing impacts to wildlife, including threatened and endangered species and other protected species, from visitor uses including ORV use. The Seashore published the Interim Strategy for public comment in January 2006. The USFWS prepared a biological opinion on the Interim Strategy (August 14, 2006) in response to a review of the CAHA biological assessment, the Interim Strategy, and other sources of published and unpublished biological information (USFWS 2006b). The biological opinion evaluated the proposed action of the Interim Strategy and its potential impact to protected species at the Seashore. The USFWS concluded that incidental take of protected species would occur from management actions under the Interim Strategy, but the level of anticipated take during the limited period the Interim Strategy would be in effect was not likely to result in jeopardy to the species or destruction or adverse modification of designated or proposed critical habitat (USFWS 2006b).

While the Interim Strategy was being prepared, Defenders of Wildlife issued a notice of intent (NOI) to sue the NPS for alleged violations of the Act at the Seashore in May 2005. In December 2006, after the first season that the Seashore operated under the Interim Strategy and after the USFWS had issued the August 14, 2006, biological opinion, Defenders of Wildlife issued another NOI to sue NPS and USFWS (collectively referred to as Federal Defendants), alleging that the biological opinion did not meet the requirements of the Act and re-asserting the previously stated claims against NPS from the earlier NOI to sue. The NPS issued a Finding of No Significant Impact (FONSI) on the Interim Strategy in July 2007.

In October 2007, Defenders of Wildlife and the National Audubon Society, represented by the Southern Environmental Law Center (collectively referred to as Plaintiffs), filed a lawsuit claiming the Interim Strategy violated the Act and other laws, failed to protect species at CAHA, and failed to comply with the requirements of the ORV executive orders and NPS regulations on ORV use. In December 2007, Dare County, Hyde County, and the Cape Hatteras Access Preservation Alliance, a coalition of ORV/access and fishing groups, were granted Intervenor-Defendant status in the lawsuit.

In April 2008, the Plaintiffs, Federal Defendants, and Intervenor-Defendants jointly submitted to the court a consent decree. This decree was signed by a U.S. District Court Judge on April 30, 2008, to settle the lawsuit. The consent decree, which is enforceable by the court, provided for specific species protection measures and required the NPS to complete the ORV Management Plan/EIS and required special regulation by December 31, 2010, and April 1, 2011, respectively. Consent decree modifications of the Interim Strategy included changes in the size of buffers provided for various species at the Seashore, as well as added restrictions related to night driving. The Seashore currently regulates ORVs under provisions of the Interim Strategy as modified by the consent decree.

This biological opinion is based on information provided in the DEIS (NPS 2010a), as updated by M. Murray, NPS, pers. comm. 2010, and other sources of published and unpublished biological information. A complete administrative record of this consultation is on file in the Raleigh Field Office.

This biological opinion does not rely on the regulatory definition of destruction or adverse modification of critical habitat at 50 Code of Federal Regulations [CFR] 402.02. Instead, the USFWS has relied upon the statutory provisions of the Act to complete the following analysis with respect to critical habitat.

CONSULTATION HISTORY

July 2, 2004 - Staff from the Raleigh Field Office met with staff from CAHA to discuss the need for consultation to include species not consulted on when CAHA's General Management Plan was developed and to address impacts associated with CAHA management and recreational access.

September 1 and 2, 2004 - Staff from the Raleigh Field Office and the USFWS's Atlantic Coast Piping Plover Coordinator met with staff from CAHA to discuss specific areas important to threatened and endangered species, specifically the piping plover.

September 14, 2004 – The USFWS submitted a letter to CAHA, at their request, on recommendations to conserve the piping plover, with a focus on threats from human disturbance.

April 27, 2005 - Staff from the Raleigh Field Office met with staff from the National Park Service (NPS) and scientists from U.S. Geological Survey that were contracted by NPS to prepare protocols for protected species at CAHA.

Summer of 2005 - Staff from the Raleigh Field Office made numerous trips to CAHA and had extensive discussions with CAHA's staff on the management of nesting piping plovers and other shorebirds, including coordination on measures to protect nesting and hatchling plovers.

Fall of 2005 - Staff from the Raleigh Field Office cooperated with NPS's Regional Office staff and others in the development of their alternatives matrix that resulted in the development of the biological assessment for this project.

January 6, 2006 - CAHA submitted a biological assessment for their proposed Strategy and requested consultation under section 7 of the Act.

January 31, 2006 - The Raleigh Field Office responded to CAHA's request and initiated consultation.

February 15, 2006 - CAHA submitted extensive errata to the Interim Protected Species Management Strategy/Environmental Assessment.

March 15, 2006 - Staff from the Raleigh Field Office met with staff from CAHA to discuss issues and concerns regarding CAHA's proposed action. Several changes to the action were proposed by CAHA, and are incorporated below in the description of the proposed action.

March, April, and May, 2006 - The Raleigh Field Office had numerous telephone calls and meetings with staff from CAHA to clarify changes being made to the Strategy.

June 12, 2006 - The USFWS published a proposal to designate four units of critical habitat within CAHA for the wintering population of the piping plover (USFWS, 2006a).

July 10, 2006 - The USFWS submitted a draft biological opinion to CAHA for review.

July 17, 2006 - CAHA submitted their comments back to the USFWS on the draft biological opinion.

July 21, 2006 - Staff from the Raleigh Field Office and CAHA had a conference call to discuss the comments made on the draft biological opinion.

August 14, 2006 - The Raleigh Field Office provided CAHA with the final biological and conference opinions based on our review of the proposed Interim Protected Species Management Strategy (Strategy). These opinions assessed the effects of the Strategy on the piping plover (*Charadrius melodus*) of the Atlantic Coast, Great Lakes and Great Plains populations; seabeach amaranth (*Amaranthus pumilus*); and loggerhead (*Caretta caretta*), green (*Chelonia mydas*), and leatherback (*Dermochelys coriacea*) sea turtles; and proposed critical habitat for wintering populations of piping plovers in North Carolina.

March 30, 2007 - CAHA requested the reinitiation of formal consultation related to the draft Finding of No Significant Impact (FONSI) for the performance measures designed to gauge the success of the implementation of the Strategy on the performance of endangered and threatened species within CAHA. CAHA provides specific performance measures (targets) for piping plovers and sea turtles within the Seashore. If one or more targets are not met, the Seashore would reinitiate consultation with USFWS as part of the annual review process specified in the August 2006 biological opinion.

April 24, 2007 - The Raleigh Field Office provided CAHA with an amended biological opinion (first). The amendment revised the incidental take statement to specify the performance measures developed by the Seashore for the Interim Strategy.

December 10, 2007 - CAHA requested reinitiation of formal consultation based on the inability to meet performance measures implemented in conjunction with the Interim Strategy, specifically that during the 2007 breeding season eleven piping plover nests resulted in four chicks fledged. This level was below the target productivity level of 1.0 fledged chick per nest.

February 20, 2008 - USFWS and CAHA met to discuss the annual reports and any revisions to the Interim Strategy and/or performance measures the Seashore might propose that would form the basis for the consultation.

March 28, 2008 - The Raleigh Field Office provided CAHA with an amended biological opinion (second). The amendment revised performance measures and the amount or extent of anticipated take for piping plovers. The reinitiation notice was revised for both piping plovers and nesting sea turtles.

December 2, 2008 - CAHA requested reinitiation of formal consultation based on the inability to meet performance measures implemented in conjunction with the Interim Strategy, specifically a piping plover fledge rate of 0.64 fledged chick per breeding pair. This level was below the target productivity level of 1.0 fledged chick per breeding pair.

March 13, 2009 - Raleigh Field Office provided CAHA with an amended biological opinion (third). The USFWS did not require any alterations of existing management practices and extended the incidental take statement of the August 2006 biological opinion.

January 6, 2010 - CAHA requested reinitiation of formal consultation based on the inability to meet performance measures implemented in conjunction with the Interim Strategy, specifically the Seashore only achieved a piping plover fledge rate of 0.67 fledged chick per breeding pair. This level was below the target productivity level of 1.0 fledged chick per breeding pair.

February 17, 2010 - CAHA requested formal consultation on Alternative F, the Seashore's preferred alternative, as presented in the Draft Environmental Impact Statement (DEIS) for CAHA Off-Road Vehicle Management Plan, dated March 2010. The USFWS received an advanced copy of the DEIS. The Seashore requested consultation on the piping plover of the Atlantic, Gulf Coast, and Great Plains populations; sea beach amaranth; and the loggerhead, green, and leatherback sea turtles. Based on information in the DEIS, the Seashore determined that Alternative F may affect, and is likely to adversely affect, these species. The preferred alternative was expected to modify, but not likely to adversely modify, designated critical habitat for wintering piping plovers.

March 8, 2010 - the Raleigh Field Office received an official copy of the DEIS. The DEIS contained detailed information of the status of federally protected species within the Seashore and an assessment of the impacts, both beneficial and adverse, that the implementation of Alternative F would produce.

April 19, 2010 - Raleigh Field Office provided CAHA with an amended biological opinion (fourth) for the Interim Strategy. The USFWS did not require any alterations of existing management practices and extended the incidental take statement of the August 2006 biological opinion.

July 6, 2010 - Raleigh Field Office and CAHA met to discuss proposed changes to the NPS preferred alternative, Alternative F, as it would be revised in the Final ORV Management Plan/EIS (FEIS). The proposed changes are based on public and agency comments on the DEIS.

October 14, 2010 - CAHA provided the Raleigh Field Office with additional information regarding the changes made in Alternative F (M. Murray, NPS, pers. comm. 2010).

BIOLOGICAL OPINION

DESCRIPTION OF THE PROPOSED ACTION

The need for action arises from the fact that ORVs have long served as a primary form of access for many portions of the beach in the Seashore, and continue to be the most practical available means of access and parking for many visitors (NPS 2010a, p. 1). This fact must be considered against the fact that the Seashore is home to important habitats created by the Seashore's dynamic environmental processes, including habitats for several federally listed species including the piping plover and three species of sea turtles. These habitats are also home to numerous other protected species, as well as other wildlife. The NPS is required to conserve and protect all of these species, as well as the other resources and values of the Seashore.

The general area at CAHA affected by the proposed Management Plan includes about 67 miles of Atlantic Ocean barrier islands and beaches. The Seashore extends from south of Whalebone Junction, to Ocracoke Inlet. However, the northern 13 miles of Hatteras Island is occupied by Pea Island National Wildlife Refuge (PINWR) under the jurisdiction of the USFWS and is not included in the plan. Therefore, the area affected by the plan would be the southern end of Bodie Island, Hatteras Island south of the refuge, and all of Ocracoke Island. CAHA beaches include the unvegetated sand and mud flats and spits at the southern ends of the three islands and the Cape Hatteras Point, located in the mid-section of Hatteras Island.

The use of ORVs must therefore be regulated in a manner that is consistent with applicable law, and appropriately addresses resource protection (including protected, threatened, and endangered species), potential conflicts among the various Seashore users, and visitor safety (NPS 2010a, p. 1). Section 4.10(b) of the NPS regulations in Title 36 of the Code of Federal Regulations (CFR), which implements Executive Orders 11644 and 11989, prohibits off-road use of motor vehicles except on designated routes or areas. It requires that "routes and areas designated for ORV use shall be promulgated as special regulations" in compliance with other applicable laws.

The purpose of the proposed plan is to "develop regulations and procedures that carefully manage ORV use/access in the Seashore to protect and preserve natural and cultural resources and natural processes, to provide a variety of visitor use experiences while minimizing conflicts among various users, and to promote the safety of all visitors," (NPS 2010a, p. ii) In addition to the overall purpose, the NPS identifies 17 objectives of the plan (NPS 2010a, pp. iii-iv). The USFWS is especially interested in the objective to provide protection for threatened, endangered, and other protected species (e.g., state-listed species) and their habitats, and minimize impacts related to ORV and other uses as required by laws and policies, such as the Endangered Species Act, the Migratory Bird Treaty Act, and NPS laws and management policies. Another objective is to minimize impacts to wildlife species and their habitats related to ORV use. However, other objectives of equal status include managing ORV use to allow for a variety of visitor use experiences and minimizing conflicts between ORV use and other uses.

Chapter 2 of the DEIS (NPS 2010a, pp. 55-146) provides a comprehensive description of the two no-action alternatives (A and B) and the four action alternatives (C-F). Correspondence dated October 14, 2010, (M. Murray, NPS, pers. comm. 2010) provides a comprehensive description of the NPS preferred alternative, Alternative F, as described in the FEIS. There is a discussion of the common elements for all six alternatives (NPS 2010a, pp. 56-59). The basic requirements state that visitors accessing the Seashore by ORV must drive only on marked ORV routes, comply with posted restrictions, not drive or park outside of marked and maintained ORV routes, and not operate a vehicle of any type within resource or safety closures, or within seasonal ORV closures of beaches in front of villages. With regard to protected species management, areas with symbolic fencing (string between posts) would be closed to recreational access, and data would continue to be collected to document breeding and nesting locations. Furthermore, protected species management could: (1) change by location and time; (2) new sites (bars, islands) could require additional management; or, (3) management actions may become inapplicable for certain sites (e.g., habitat changes with vegetation growth, new overwash areas) (NPS 2010a, p. 57).

The common elements of all six alternatives provide insights into the policies and actions available to the Seashore for both public access and protected species management. These include designated ORV routes, the closure of certain areas to recreational use including ORVs, and data collected on protected species usage of the Seashore (NPS 2010a, p. 57).

These policies and actions are developed further in the discussion of the common elements of the four action alternatives (NPS 2010a, pp. 61-74; M. Murray, NPS, pers. comm. 2010). Visitors accessing the Seashore by ORV would be required to use only designated beach access ramps and soundside access routes to enter designated ORV routes and areas (NPS, 2010a, p. 62). Visitors with ORVs must drive only on marked ORV routes and must comply with posted restrictions. Management of protected shorebirds would be accomplished through the designation of ORV routes and vehicle free areas, the identification and protection of suitable breeding and non-breeding shorebird habitat, including the establishment of pre-nesting areas, monitoring, and the use of buffers distances to temporarily close suitable habitat to recreational use when breeding activity is observed. Restrictions on ORV use in these areas would vary between alternatives. Each action alternative would also incorporate various aspects of the 2008 Loggerhead Sea Turtle Recovery Plan (National Marine Fisheries Service and U.S. Fish and Wildlife Service [hereafter NMFS and USFWS] 2008) in developing conservation measures for sea turtles.

The Seashore has chosen Alternative F as the preferred course of action. The action has been revised as described in a meeting between the Raleigh Field Office on July 10, 2010 and in correspondence from CAHA to the Raleigh Field Office dated October 14, 2010 (M. Murray, NPS, pers. comm. 2010). NPS has provided seven maps showing the ORV routes and various restrictions for Alternative F (M. Murray, NPS, pers. comm. 2010). The preferred alternative is designed to provide visitors to the Seashore with a wide variety of access opportunities for both ORV and pedestrian users, including access to the island spits and Cape Point, but often with controls or restrictions in place to limit impacts on sensitive resources. This means that some important shorebird nesting areas, such as Cape Point and South Point, would have designated year-round ORV routes, subject to resource closures as needed during the shorebird breeding season. Bodie Island spit would have a seasonally designated ORV route, open to ORVs September 15 through March 14, and two inlet spits (Hatteras and North Ocracoke) would be designated as vehicle free year-round. Pedestrian access would be enhanced by providing increased parking capacity at various points of access to vehicle-free areas. Such areas would be provided during all seasons so non-ORV users can experience the Seashore without the presence of vehicles. Like the other action alternatives, Alternative F would manage ORV use by identifying areas that historically do not support sensitive resources and areas of lower visitor use. Some of these areas would be designated as ORV routes year-round. Areas of high resource sensitivity and high visitor use would generally be designated as vehicle-free areas year-round or as seasonal ORV routes, with restrictions based on seasonal resource and visitor use. In addition, the pre-nesting areas could reopen to ORV use as early as July 31, which is up to four weeks earlier than under Alternative E (September 1), when the shorebird breeding season is completed at each site (typically in August).

The year-round designation of vehicle-free areas and ORV routes, in conjunction with the revised species management strategies described in Table 10-1 (M. Murray, NPS, pers. comm. 2010) would provide for species protection during both the breeding season and the non-breeding season. Species Management Areas (SMAs), as described for action Alternatives C-E, would not be designated under Alternative F and one set of standard buffers, similar to the ML2 buffers in the other action alternatives, would be utilized. During the shorebird breeding season, pedestrian shoreline access below the high-tide line would be permitted in front of (i.e., seaward of) pre-nesting areas until breeding activity is observed, then standard buffers for breeding activity would apply. Pre-nesting areas would generally be closed March 15 through July 31 (or August 15 if black skimmers are present), or until two weeks after all chicks have fledged and breeding activity has ceased, whichever comes later.

As described in Table 10-1 (M. Murray, NPS, pers. comm. 2010*)*, NPS staff would follow guidance in the North Carolina Wildlife Resources Commission (NCWRC) handbook and USFWS Loggerhead Sea Turtle Recovery Plan, which is to allow sea turtle nests to incubate at their original location if there is any reasonable likelihood of survival. Relocation of a nest would be considered only as an option of last resort. Accommodation of ORV access shall not be a factor in determining whether a nest needs to be relocated. When relocation is determined to be necessary, nests would be moved toward the dunes immediately behind the original nest location (when possible). Narrow beaches or beaches without nearby dunes (i.e. points and spits) may necessitate relocations to adjacent areas above the high tide line that are free of vegetation. If a choice for a relocation site must be made among adjacent areas that are equally suitable biologically, then accommodation of ORV access to a popular location may be considered as a factor in choosing an appropriate relocation site. An adjacent site that is less suitable biologically shall not be selected for a relocated nest to accommodate ORV access.

Bodie Island Spit would be vehicle free March 15 through September 14. Like Alternative E, Alternative F also involves the development of an interdunal pedestrian trail on Bodie Island. The trail would begin at a new parking area near ramp 4 and would provide access to the inlet. This new trail would also be subject to resource-protection closures. Year-round ORV routes would be designated at Cape Point and South Point, with 35-meter-wide (115-foot-wide) ORV corridors during the breeding season. Standard resource-protection buffers would apply to these

ORV corridors. When nests occur near the ORV corridor or when unfledged chicks are present, the probability of being able to provide this access would decrease. Alternative F would include the designation of a short new seasonal ORV route to access a new pedestrian trail to the sound on Ocracoke Island. In addition, the NPS would consider applications for commercial use authorizations to offer beach and water shuttle services and would apply for funding to conduct an alternative transportation study to evaluate the feasibility of alternative forms of transportation to popular sites, such as the inlets and Cape Point (M. Murray, NPS, pers. comm. 2010).

The variety of access methods possible under Alternative F, based on the establishment of year-round and seasonal ORV routes and vehicle-free areas, and increased interdunal roads and parking to support access, would provide the public with ORV and pedestrian access to a greater number of areas within the Seashore. The preferred alternative would afford less predictability than Alternatives C or D, but more predictability than Alternative E, regarding areas available for use, and it would require a comparable level of oversight and management to Alternative E.

Areas that would be seasonally designated as vehicle-free would include the areas in front of Ocracoke Campground and villages, except for Rodanthe north of the pier and Buxton, which would be vehicle free year-round. The ORV open season in front of the seasonally designated villages and Ocracoke Campground would be vehicle free November 1 to March 31 when visitation and rental occupancy is lowest (M. Murray, NPS, pers. comm. 2010).

To facilitate access to ORV routes, Alternative F would add a new ramp 25.5 approximately 2.5 miles south of ramp 23, relocate ramp 59 to 59.5, and add a new ramp 63 across from Scrag Cedar Road. (Note: All action alternatives involve relocating ramp 2 and building a new ramp at 32.5). New interdunal roads would facilitate access to locations that have either seasonal or year-round restrictions on ORV use. Locations for interdunal roads would include: South Beach from ramp 45 to ramp 49, with one new ramp at 47.5 and on Hatteras Inlet Spit extending from the intersection of Pole and Spur Roads southwest toward the inlet, stopping at least 100 meters from the inlet. Existing soundside access points would remain open, with better maintenance than currently occurs. Signage/posts would be installed at the soundside parking areas and boat launch areas to prevent damage to vegetation and other soundside resources. Alternative F also involves the addition of new parking areas to facilitate pedestrian access at a number of locations (M. Murray, NPS, pers. comm. 2010).

ORV routes and vehicle-free areas under Alternative F would still be subject to temporary resource closures established when protected-species breeding behavior warrants and/or if new habitat is created. Outside the breeding season, vehicle-free areas throughout the Seashore would provide relatively less disturbed foraging, resting, and roosting habitat for migrating and wintering birds. These areas would be open to pedestrians for recreational use. In addition, resource closures at spits and points would also be established, based on an annual non-breeding habitat assessment conducted after the breeding season, to provide areas of non-breeding shorebird habitat with reduced human disturbance (M. Murray, NPS, pers. comm. 2010).

STATUS OF SPECIES/CRITICAL HABITAT

STATUS OF SPECIES/CRITICAL HABITAT – PIPING PLOVER

Species /Critical Habitat Description – Piping Plover

The piping plover is a small (6 to 7 inches long, weighing 1.5 to 2.2 ounces), highly camouflaged, sand-colored shorebird endemic to North America. On January 10, 1986, the piping plover was listed under the Act as endangered in the Great Lakes watershed and threatened elsewhere within its range, including migratory routes outside of the Great Lakes watershed and wintering grounds (USFWS 1985). Piping plovers were listed principally because of habitat destruction and degradation, predation, and human disturbance. Protection of the species under the Act reflects the species' precarious status range-wide.

Three separate breeding populations have been identified, each with its own recovery criteria: the Northern Great Plains (threatened), the Great Lakes (endangered), and the Atlantic Coast (threatened). Piping plovers that breed on the Atlantic Coast of the U.S. and Canada belong to the subspecies *C. m. melodus*. The second subspecies, *C. m. circumcinctus*, is comprised of two distinct populations. One population breeds on the Northern Great Plains of the U.S. and Canada, while the other breeds on the Great Lakes. Each of these three entities is demographically independent. Piping plovers spend the winter in coastal areas of the U.S. from North Carolina to Texas, along the coast of eastern Mexico, and on Caribbean islands from Barbados to Cuba and the Bahamas.

The USFWS has designated critical habitat for the piping plover on three occasions. Two of these designations protected different breeding populations. Critical habitat for the Great Lakes breeding population was designated May 7, 2001 (USFWS 2001a), and critical habitat for the Northern Great Plains breeding population was designated September 11, 2002 (USFWS 2002). No critical habitat has been proposed or designated for the Atlantic Coast breeding population, but the needs of all three breeding populations were considered in the 2001 critical habitat designation for wintering piping plovers (USFWS 2001b) and subsequent re-designations (USFWS 2008, 2009a).

The USFWS designated critical habitat for wintering piping plovers on July 10, 2001 (USFWS 2001b). Wintering piping plovers may include individuals from the Great Lakes and Northern Great Plains breeding populations as well as birds that nest along the Atlantic coast. Although all piping plovers are classified as threatened on their shared migration and wintering range outside the watershed of the Great Lakes, USFWS biological opinions prepared under section 7 of the Act recognize that activities affecting wintering and migrating plovers differentially influence the survival and recovery of the three breeding populations.

Designated wintering piping plover critical habitat originally included 142 areas [the rule states 137 units; this is in error] encompassing about 1,793 miles of mapped shoreline and 165,211 acres of mapped areas along the coasts of North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana, and Texas.

Since the designation of wintering critical habitat, 19 units (TX- 3,4,7-10, 14-19, 22, 23, 27,28, and 31-33) in Texas have been vacated and remanded back to the USFWS for reconsideration by Court order (Texas General Land Office v. U. S. Department of Interior (Case No. V-06-CV-00032)). On May 19, 2009, the USFWS published a final rule designating 18 revised critical habitat units in Texas, totaling approximately 139,029 acres (USFWS 2009a).

The Courts vacated and remanded back to the USFWS for reconsideration, four units in North Carolina (Cape Hatteras Access Preservation Alliance v. U.S. Department of Interior (344 F. Supp. 2d 108 (D.D.C. 2004)). The four critical habitat units vacated were NC-l, 2, 4, and 5, and all occurred within Cape Hatteras National Seashore (CAHA). A revised designation for these four units was published on October 21, 2008 (USFWS 2008). On February 6, 2009, Cape Hatteras Access Preservation Alliance and Dare and Hyde Counties, North Carolina filed a legal challenge to the revised designation. On August 18, 2010, a U.S. District Court granted the government’s motion for summary judgment and dismissed the case with prejudice, and the critical habitat designation for these four units remains in effect.

The primary constituent elements (PCEs) for piping plover wintering habitat are those biological and physical features that are essential to the conservation of the species. The primary constituent elements are those habitat components that support foraging, roosting, and sheltering and the physical features necessary for maintaining the natural processes that support these habitat components. These areas typically include those coastal areas that support intertidal beaches and flats and associated dune systems and flats above annual high tide (USFWS 2001b). PCEs of wintering piping plover critical habitat include sand or mud flats or both with no or sparse emergent vegetation. Adjacent unvegetated or sparsely vegetated sand, mud, or algal flats above high tide are also important, especially for roosting piping plovers (USFWS 2001b). Important components of the beach/dune ecosystem include surf-cast algae, sparsely vegetated back beach and salterns, spits, and washover areas. Washover areas are broad, unvegetated zones, with little or no topographic relief, that are formed and maintained by the action of hurricanes, storm surge, or other extreme wave action. The units designated as critical habitat are those areas that have consistent use by piping plovers and that best meet the biological needs of the species. The amount of wintering habitat included in the designation appears sufficient to support future recovered populations, and the existence of this habitat is essential to the conservation of the species. Additional information on each specific unit is available (USFWS 2001b).

Life History – Piping Plover

Nesting

Piping plovers live an average of five years, although studies have documented birds as old as 11 (Wilcox 1959) and 15 years. Breeding activity begins in mid-March when birds begin returning to their nesting areas (Coutu et al. 1990; Cross 1990; Goldin et al. 1990; MacIvor 1990; Hake 1993). Plovers are known to begin breeding as early as one year of age (MacIvor 1990; Haig 1992); however, the percentage of birds that breed in their first adult year is unknown. Piping plovers generally fledge only a single brood per season, but may re-nest several times if previous nests are lost. Plovers depart their breeding grounds for their wintering grounds from July through late August, but southward migration extends through November. Piping plovers spend up to ten months of their life cycle on their migration and winter grounds, generally July 15 through as late as May 15. Piping plovers migrate through and winter in coastal areas of the U. S. from North Carolina to Texas and in portions of Mexico and the Caribbean. Migration routes and habitats overlap breeding and wintering habitats, and, unless banded, migrants passing through a site usually are indistinguishable from breeding or wintering piping plovers.

Piping plovers breed in three discrete areas of North America – the Northern Great Plains, the Great Lakes, and the Atlantic Coast. Northern Great Plains plovers breed from Alberta to Manitoba, Canada and south to Nebraska; although some nesting has recently occurred in Oklahoma. The Northern Great Plains population historically bred from Alberta to Ontario, Canada, south to Kansas and Colorado. Currently the most westerly breeding piping plovers in the United States occur in Montana and Colorado. In the Northern Great Plains, most piping plovers nest on the unvegetated shorelines of alkali lakes, reservoirs, or river sandbars, as described in the recovery plan (USFWS 1988). On occasion, however, they will select non-typical sites for nesting. Great Lakes piping plovers nest on wide, flat, open, sandy or cobble shoreline with very little grass or other vegetation.

The Great Lakes population once ranged throughout the region, but most recent nesting records are limited to Michigan and Wisconsin. Of the 63 breeding pairs found in 2008, 53 pairs were found nesting in Michigan, while ten were found outside the state, including six pairs in Wisconsin and four in Ontario, Canada. The 53 nesting pairs in Michigan represent approximately 50% of the recovery criterion. The ten breeding pairs outside Michigan in the Great Lakes basin, represents 20% of the goal, albeit the number of breeding pairs outside Michigan has continued to increase over the past five years. The single breeding pair discovered in 2007 in the Great Lakes region of Canada represented the first confirmed piping plover nest there in over 30 years, and in 2008 the number of nesting pairs further increased to four.

Atlantic Coast 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; and washover areas cut into or between dunes (USFWS 1996a, p 6). They may also nest on areas where suitable dredge material has been deposited. Nest sites are shallow scraped depressions in substrates ranging from fine grained sand to mixtures of sand and pebbles, shells, or cobble (Bent 1929, Burger 1987a, Cairns 1982, Patterson 1988, Flemming et at. 1992, MacIvor 1990, Strauss 1990). Nests are usually found in areas with little or no vegetation although, on occasion, piping plovers will nest under stands of American beachgrass (*Ammophila breviligulata*) or other vegetation (Patterson 1988, Flemming et at. 1992, MacIvor 1990).

Eggs of Atlantic Coast plovers may be present on the beach from mid-April to late July (USFWS 1996a, p. 7). The birds generally fledge only a single brood per season, but may re-nest several times if previous nests are lost or, infrequently, if a brood is lost within several days of hatching (Wrenn 1991, Goldin 1994, Rimmer 1994). A few extremely rare instances of adults re-nesting following fledging of an early brood have also been observed (J. Victoria, Connecticut Department of Environmental Protection, in litt. 1994; Bottitta et al. 1994).

Clutch size for an initial nest attempt is usually four eggs, one laid every other day. Eggs are pyriform in shape, with variable buff to greenish ground color marked with black or brown spots. Plover nests and eggs are very difficult to detect, especially during the 6-7 day egg laying phase when the birds generally do not incubate (Goldin 1994). Full-time incubation usually begins with the completion of the clutch, averages 27-30 days, and is shared equally by both sexes (Wilcox 1959, Cairns 1977, MacIvor 1990).

For the Atlantic Coast population, eggs in a clutch usually hatch within four to eight hours of each other (USFWS 1996a, p. 8), but the hatching period of one or more eggs may be delayed by up to 48 hours (Cairns 1977, Wolcott and Wolcott 1994). Chicks are precocial, often leaving the nest within hours of hatching (Wilcox 1959, Cairns 1982, Wolcott and Wolcott 1994), but are tended by adults who lead the chicks to and from feeding areas, shelter them from harsh weather, and protect the young from perceived predators. Broods may move hundreds of meters from the nest site during their first week of life. Chicks spend a very high proportion of their time feeding and remain together with one or both parents until they fledge (are able to fly) at 25 to 35 days of age. Depending on date of hatching, flightless chicks on Atlantic Coast beaches maybe present from mid-May until late August, although most fledge by the end of July (Patterson 1988, Goldin 1990, MacIvor 1990, Howard et al. 1993). After fledging, adults and young may congregate on neutral (non-territorial) feeding grounds prior to southward migration (Cairns 1977).

Feeding areas include intertidal portions of ocean beaches, washover areas, mudflats, sandflats, wrack lines, and shorelines of coastal ponds, lagoons, or salt marshes (Gibbs 1986, Coutu et al. 1990, Hoopes et al. 1992, Loegering 1992, Goldin 1993a). Studies have shown that the relative importance of various feeding habitat types may vary by site (Gibbs 1986, Coutu et al. 1990, McConnaughey et al. 1990, Loegering 1992, Goldin 1993a, Hoopes 1993, Elias-Gerken 1994) and by stage in the breeding cycle (Cross 1990). Adults and chicks on a given site may use different feeding habitats in varying proportion (Goldin et al. 1990). During courtship, nesting, and brood-rearing, feeding territories are generally contiguous to nesting territories (Cairns 1977), although instances where brood-rearing areas are widely separated from nesting territories are not uncommon.

Migration and Wintering

While piping plover migration patterns and needs remain poorly understood and occupancy of a particular habitat may involve shorter periods relative to wintering or breeding, information about the energetics of avian migration indicates that this might be a particularly critical time in the species life cycle. The possibility of lower survival rates for Atlantic Coast piping plovers breeding at higher latitudes (based on relationships between population trends and productivity) suggest that migration stress may substantially affect survival rates of this species. In addition, observations suggest that this species exhibits a high degree of wintering site fidelity (Drake et. al. 2001).

Piping plovers migrate through and winter in coastal areas of the U.S. from North Carolina to Texas and in portions of Mexico and the Caribbean (USFWS 2009b, p. 26). While piping plover migration patterns and needs remain poorly understood and occupancy of a particular habitat may involve shorter periods relative to wintering or breeding, information about the energetics of avian migration indicates that this might be a particularly critical time in the species life cycle. The possibility of lower survival rates for Atlantic Coast piping plovers breeding at higher latitudes (based on relationships between population trends and productivity) suggest that migration stress may substantially affect survival rates of this species. In addition, observations suggest that this species exhibits a high degree of wintering site fidelity (Drake et. al. 2001). For the Atlantic Coast breeding population northward migration to the breeding grounds occurs during late February, March and early April, and southward migration to the wintering grounds extends from late July, August, and September (USFWS 1996a, p. 13) with both spring and fall migration routes following a narrow strip along the Atlantic Coast.

Wintering and migrating piping plovers on the Atlantic Coast are generally found at the accreting ends of barrier islands, along sandy peninsulas, and near coastal inlets. Wintering piping plovers appear to prefer sand flats adjacent to inlets or passes, sandy mud flats along prograding spits(areas where the land rises with respect to the water level), and overwash areas as foraging habitats. These substrate types may have a richer infauna than the foreshore of high energy beaches and often attract large numbers of shorebirds. Roosting plovers are generally found along inlet and adjacent ocean and estuarine shorelines and their associated berms and on nearby exposed tidal flats (Nicholls and Baldassarre 1990a,b). Diverse coastal systems may be especially attractive to plovers and may concentrate wintering piping plovers when roosting and feeding areas are adjacent (Nicholls and Baldassarre, 1990a,b). Feeding areas include intertidal portions of ocean beaches, washover areas, mud flats, sand flats, debris lines and shorelines of coastal ponds, and lagoons or salt marshes (Coutu et al., 1990; USFWS, 1996a).

Atlantic Coast and Florida studies highlighted the importance of inlets for non-breeding piping plovers. Almost 90% of observations of roosting piping plovers at ten coastal sites in southwest Florida were on inlet shorelines (Lott et al. 2009). Piping plovers were among seven shorebird species found more often than expected ($p = 0.0004$; Wilcoxon Scores test) at inlet locations versus non-inlet locations in an evaluation of 361 International Shorebird Survey sites from North Carolina to Florida (Harrington 2008).

Recent study results in North Carolina, South Carolina, and Florida complement information from earlier investigations in Texas and Alabama (summarized in the 1996 Atlantic Coast and 2003 Great Lakes Recovery Plans) regarding habitat use patterns of piping plovers in their coastal migration and wintering range. Maddock et al. (2009) observed shifts to roosting habitats and, behaviors during high-tide periods in South Carolina. In South Carolina, exposed intertidal areas were the dominant foraging substrate (accounting for 94% of observed foraging piping plovers; Maddock et al. 2009).

Piping plovers winter along the Atlantic and Gulf Coasts from North Carolina to Texas and in portions of Mexico and the Caribbean. North Carolina is the only state where the piping plover's breeding and wintering ranges overlap and the birds are present year-round.

Wintering piping plovers prefer coastal habitat that include sand spits, islets (small islands), tidal flats, shoals (usually flood tidal deltas), and sandbars that are often associated with inlets (Harrington 2008). Sandy mud flats, ephemeral pools, and overwash areas are also considered primary foraging habitats. These substrate types have a richer infauna than the foreshore of high energy beaches and often attract large numbers of shorebirds (Cohen et al. 2006). Wintering plovers are dependent on a mosaic of habitat patches and move among these patches depending on local weather and tidal conditions (Nicholls and Baldassarre 1990b).

While the majority of wintering birds are likely to be from the Atlantic Coast population, individuals from the Great Lakes and Northern Great Plains populations have been documented on the Southern Atlantic Coast. A high percentage of sightings of banded Great Lakes birds are occurring on the coast of South and North Carolina as well as other areas of the Atlantic coast.

Mean home range size (95% of locations) for 49 radio-marked piping plovers in southern Texas in 1997-98 was 12.6 km^2 (3,113 acres), mean core area (50% of locations) was 2.9 km^2 (717 acres), and mean linear distance moved between successive locations (1.97 ±0.04 days apart), averaged across seasons, was 3.3 km (2.1 miles) (Drake et al. 2001). Seven radio-tagged piping plovers used a 20.1 km^2 (4,967 acres) area (100% minimum convex polygon) at Oregon Inlet in 2005-2006, and piping plover activity was concentrated in 12 areas totaling 2.2 km^2 (544 acres) (Cohen et al. 2008a). Noel and Chandler (2008) observed high fidelity of banded piping plovers to 1-4.5 km (0.62-2.8 miles) sections of beach on Little St. Simons Island, Georgia.

Foraging

Plover foods consist of invertebrates such as marine worms, fly larvae, beetles, crustaceans, and mollusks (Bent 1929, Cairns 1977, Nicholls 1989, Gibbs 1986, Shaffer and Laporte 1994). Burger (1994) found more polychaete worms in core samples taken from intertidal areas where plovers were feeding than in random samples.

Behavioral observation of piping plovers on the wintering grounds suggests that they spend the majority of their time foraging (Nicholls and Baldassarre 1990a; Drake et al. 2001). Feeding activities may occur during all hours of the day and night (Staine and Burger 1994; Zonick 1997), and at all stages in the tidal cycle (Goldin 1993a; Hoopes 1993).

Wintering plovers primarily feed on invertebrates such as polychaete marine worms, various crustaceans, fly larvae, beetles, and occasionally bivalve mollusks (Bent 1929; Nicholls 1989). They peck these invertebrates on top of the soil or just beneath the surface. Plovers forage on moist substrate features such as intertidal portions of ocean beaches, washover areas, mudflats, sand flats, algal flats, shoals, wrack lines, sparse vegetation, and shorelines of coastal ponds, lagoons, ephemeral pools and adjacent to salt marshes (Gibbs 1986; Zivojnovich 1987; Nichols 1989; Nicholls and Baldassarre 1990a, 1990b; Coutu et al. 1990; Hoopes et al. 1992; Loegering 1992; Goldin 1993a; Elias-Gerken 1994; Wilkinson and Spinks 1994; Zonick 1997; USFWS 2001b).

Cohen et al. (2006) documented more abundant prey items and biomass on sound islands and sound beaches than the ocean beach. On the wintering grounds, Ecological Associates, Inc. (2009) observed that during piping plover surveys at St. Lucie Inlet, Martin County, Florida, intertidal mudflats and/or shallow subtidal grassflats appear to have greater value as foraging habitat than the unvegetated intertidal areas of a flood shoal.

Roosting

Roosting habitat, sheltered areas for rest or sleep, may be similar for breeding, migrating, and wintering plovers. Roosting plovers are generally found along inlet and adjacent ocean and estuarine shorelines and their associated berms and on nearby exposed tidal flats (Nicholls and Baldassarre 1990a, 1990b). Diverse coastal systems may be especially attractive to plovers and may concentrate wintering piping plovers when roosting and feeding areas are adjacent (Nicholls and Baldassarre 1990a, 1990b). Several studies identified wrack (organic material including seaweed, seashells, driftwood, and other materials deposited on beaches by tidal action) as an important component of roosting habitat for non-breeding piping plovers. In South Carolina, 45% of wintering roosting piping plovers were in old wrack and 18% were in fresh wrack. The remainder of roosting birds used intertidal habitat (22%), backshore (defined as zone of dry sand, shell, cobble and beach debris from mean high water line up to the toe of the dune)(8%), and washover and ephemeral pools at two and one percent, respectively (Maddock et al. 2009).

Population dynamics – Piping Plovers

The 2006 Piping Plover Breeding Census, the last comprehensive survey throughout the breeding grounds, documented 3,497 breeding pairs with a total of 8,065 birds throughout Canada and U.S (Elliott-Smith et al. 2009).

Population Dynamics - Northern Great Plains Breeding Population

The decline of piping plovers on rivers in the Northern Great Plains has been largely attributed to the loss of sandbar island habitat and forage base due to dam construction and operation. Nesting occurs on sand flats or bare shorelines of rivers and lakes, including sandbar islands in the upper Missouri River system, and patches of sand, gravel, or pebbly-mud on the alkali lakes of the Northern Great Plains. Plovers do nest on shorelines of reservoirs created by the dams, but reproductive success is often low and reservoir habitat is not available in many years due to high water levels or vegetation. Dams operated with steady constant flows allow vegetation to grow on potential nesting islands, making these sites unsuitable for nesting. Population declines in alkali wetlands are attributed to wetland drainage, contaminants, and predation.

The Northern Great Plains breeding population is geographically widespread, with many birds in very remote places, especially in the U.S. and Canadian alkali lakes. Thus, determining the number of birds or even identifying a clear trend in the population is a difficult task. The International Piping Plover Census (IPPC) was designed, in part, to help deal with this problem by instigating a large effort every five years in which an attempt is made to survey every area with known or potential piping plover breeding habitat during a two-week window (i.e., the first two weeks of June). The relatively short window is designed to minimize double counting if birds move from one area to another. The recovery (USFWS 1988) plan used the numbers from the IPPC as a major criterion for delisting, as does the 2006 Canadian Recovery Plan (Environment Canada 2006).

Participation in the IPPC has been excellent on the Northern Great Plains, with a tremendous effort put forth to attempt to survey areas during the census window (Elliot-Smith et al. 2009).

The large area to be surveyed and sparse human population in the Northern Great Plains make annual surveys of the entire area impractical, so the IPPC provides an appropriate tool for helping to determine the population trend. Many areas are only surveyed during the IPPC years.

Figure 2 shows the number of adult plovers in the Northern Great Plains (U.S. and Canada) for the four International Censuses. The IPPC shows that the U.S. population decreased between 1991 and 1996, then increased in 2001 and 2006. The Canadian population showed the reverse trend for the first three censuses, increasing slightly as the U.S. population decreased, and then decreasing in 2001. Combined, the IPPC numbers suggest that the population declined from 1991 through 2001, then increased almost 58% between 2001 and 2006 (Elliott-Smith et al. 2009).

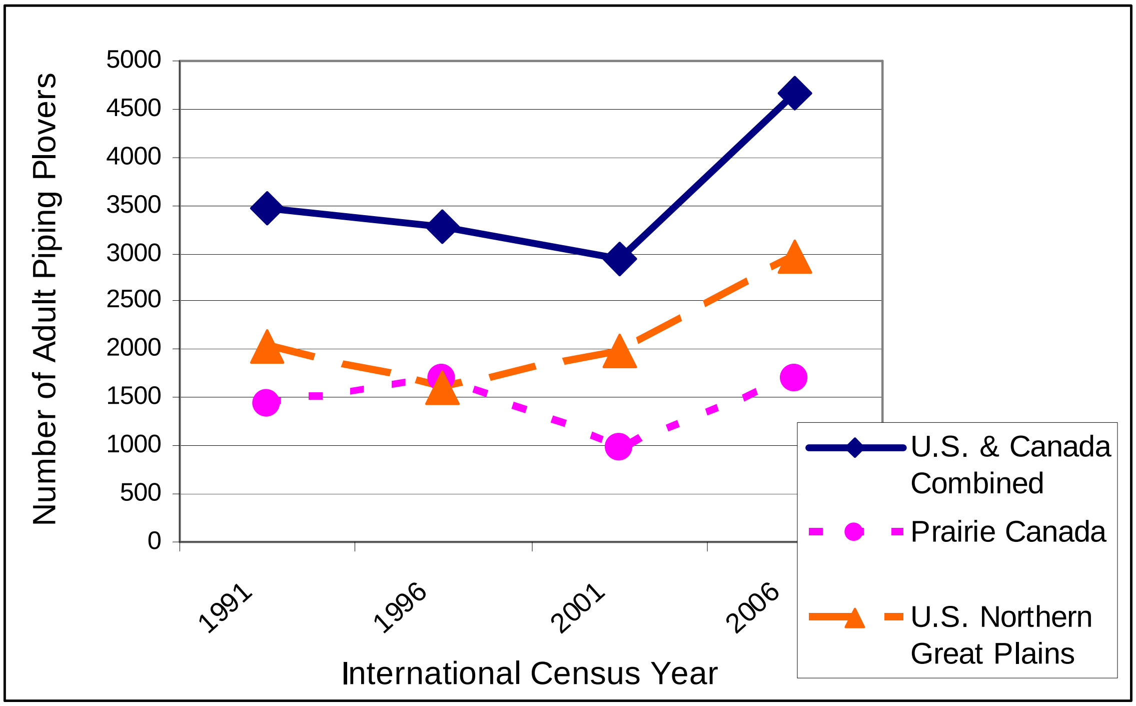

Figure 2. The number of adults reported for the U.S. and Canada Northern Great Plains during the International Censuses compared with the U.S. recovery goal (USFWS 2009b, p. 102).

The increase in 2006 is likely due in large part to a multi-year drought across the much of the region starting in 2001 that exposed thousands of acres of nesting habitat. The U. S. Army Corps of Engineers also began to construct habitat using mechanical means (dredging sand from the riverbed) on the Missouri River in 2004, providing some new nesting and foraging habitat. The drought also caused reservoir levels to drop on many reservoirs throughout the Northern Great Plains (e.g. Missouri River Reservoirs (ND, SD), Lake McConaughey (NE)), providing shoreline habitat. The population increase may also be partially due to more intensive management activities on the alkali lakes, with increased management actions to improve habitat and reduce predation pressures.

While the IPPC provides an index to the piping plover population, the design does not always provide sufficient information to understand the population's dynamics. The five-year time interval between IPPC efforts may be too long to allow managers to get a clear picture of what the short-term population trends are and to respond accordingly if needed. As noted above, the censuses of 1991,1996, and 2001 showed a declining population, while the 2006 census indicated a dramatic population rebound of almost 58% for the combined U.S. and Canada Northern Great Plains population between 2001 and 2006. With only four data points over 15 years, it is impossible to determine if and to what extent the apparent upswing reflects a real population trend versus error(s) in the 2006 census count and/or a previous IPPC. The 2006 IPPC included a detectability component, in which a number of pre-selected sites were visited twice by the same observer(s) during the two-week window to get an estimate of error rate. This study found an approximately 76% detectability rate through the entire breeding area, with a range of between 39% to 78% detectability among habitat types in the Northern Great Plains.

Such a large increase in population reported may indeed indicate a positive population trend, but with the limited data available, it is impossible to determine how much. Furthermore, with the next IPPC not scheduled until 2011, there is limited feedback in many areas on whether this increase is being maintained or if the population is declining in the interim. Additionally, the results from the IPPC have been slow to be released, adding to the time lag between data collection and possible management response.

Population Dynamics - Great Lakes Population

The Great Lakes piping plover breeding population once nested on Great Lakes beaches in Illinois, Indiana, Michigan, Minnesota, New York, Ohio, Pennsylvania, Wisconsin, and Ontario. Great Lakes piping plovers nest on wide, flat, open, sandy or cobble shoreline with very little grass or other vegetation. Reproduction is adversely affected by human disturbance of nesting areas and predation by foxes, gulls, crows and other avian species. Shoreline development, such as the construction of marinas, breakwaters, and other navigation structures, has adversely affected nesting and brood rearing. The Recovery Plan (USFWS 2003a) sets a population goal of at least 150 pairs (300 individuals), for at least 5 consecutive years, with at least 100 breeding pairs (200 individuals) in Michigan and 50 breeding pairs (100 individuals) distributed among sites in other Great Lakes states.

The Great Lakes piping plover population, which has been traditionally represented as the number of breeding pairs, has increased since the completion of the recovery plan in 2003 (Cuthbert and Roche 2006; 2007; Westbrock et al. 2005; Stucker et al. 2003). The Great Lakes piping plover recovery plan documents the 2002 population at 51 breeding pairs (USFWS 2003a). A census conducted in 2008 found 63 breeding pairs, an increase of approximately 23%.

In addition, the number of non-nesting individuals has increased annually since 2003. Between 2003-2008 an annual average of approximately 26 non-nesting piping plovers were observed, based on limited data from 2003, 2006, 2007, and 2008. Although there was some fluctuation in the total population between 2002 and 2008, the overall increase from 51 to 63 pairs combined with the increased observance of non-breeding individuals indicates the population is increasing (Figure 3).

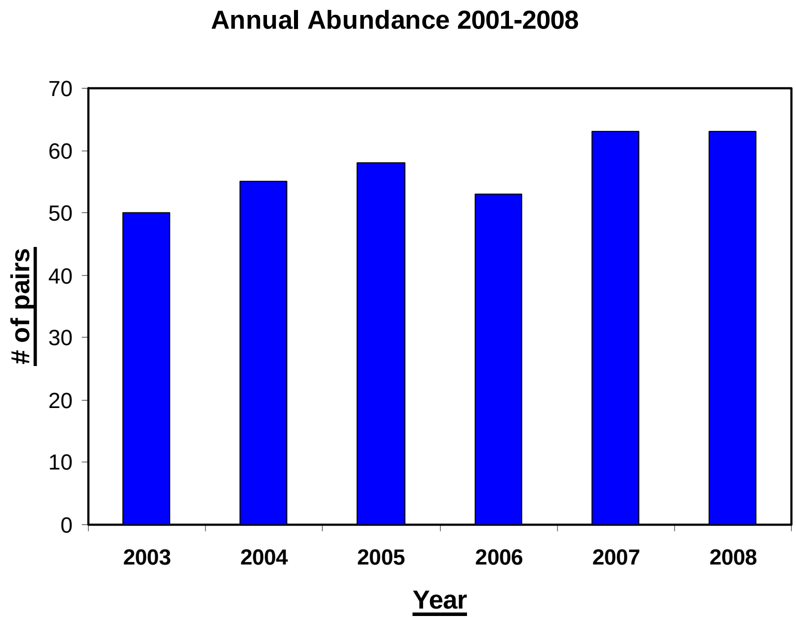

Figure 3. Annual abundance estimates for Great Lakes piping plovers, 2003-2008. Source USFWS 2009b, p. 73.

Population Dynamics - Atlantic Coast Population

The Atlantic Coast piping plover breeding population breeds on coastal beaches from Newfoundland and southeastern Quebec to North Carolina. Historical population trends for the Atlantic Coast piping plover have been reconstructed from scattered, largely qualitative records. Nineteenth-century naturalists, such as Audubon and Wilson, described the piping plover as a common summer resident on Atlantic Coast beaches (Haig and Oring 1987). However, by the beginning of the 20th Century, egg collecting and uncontrolled hunting, primarily for the millinery trade, had greatly reduced the population, and in some areas along the Atlantic Coast, the piping plover was close to extirpation. Following passage of the Migratory Bird Treaty Act (40 Stat. 775; 16 U.S.C. 703-712) in 1918, and changes in the fashion industry that no longer exploited wild birds for feathers, piping plover numbers recovered to some extent (Haig and Oring 1985).

Available data suggest that the most recent population decline began in the late 1940s or early 1950s (Haig and Oring 1985). Reports of local or statewide declines between 1950 and 1985 are numerous, and many are summarized by Cairns and McLaren (1980) and Haig and Oring (1985). While Wilcox (1939) estimated more than 500 pairs of piping plovers on Long Island, New York, the 1989 population estimate was 191 pairs (USFWS 1996a, p. 19). There was little focus on gathering quantitative data on piping plovers in Massachusetts through the late 1960s because the species was commonly observed and presumed to be secure. However, numbers of piping plover breeding pairs declined 50 to 100 percent at seven Massachusetts sites between the early 1970s and 1984 (Griffin and Melvin 1984). Piping plover surveys in the early years of the recovery effort found that counts of these cryptically colored birds sometimes went up with increased census effort, suggesting that some historic counts of piping plovers by one or a few observers may have underestimated the piping plover population. Thus, the magnitude of the species decline may have been more severe than available numbers imply.

Annual estimates of breeding pairs of Atlantic Coast piping plovers are based on multiple surveys at most occupied sites. Sites that cannot be monitored repeatedly in May and June (primarily sites with few pairs or inconsistent occupancy) are surveyed at least once during a standard nine-day count period (Hecht and Melvin 2009).

Since listing under the Act in 1986, the Atlantic Coast population estimate has increased 234%, from approximately 790 pairs to an estimated 1,849 pairs in 2008, and the U.S. portion of the population has almost tripled, from approximately 550 pairs to an estimated 1,596 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 (USFWS 1996a), the population nearly doubled between 1989 and 2008. The largest population increase between 1989 and 2008 has occurred in New England (245%), followed by New York-New Jersey (74%). In the Southern (DE-MD-VA-NC) Recovery Unit, overall growth between 1989 and 2008 was 66%, but almost three-quarters of this increase occurred in just two years, 2003-2005. The eastern Canada population fluctuated from year to year, with increases often quickly eroded in subsequent years; net growth between 1989 and 2008 was 9%.

The overall population growth pattern was tempered by periodic rapid declines in the Southern and Eastern Canada Recovery Units. The eastern Canada population decreased 21% in just three years (2002-2005), and the population in the southern half of the Southern Recovery Unit declined 68% in seven years (1995-2001). The recent 64% decline in the Maine population, from 66 pairs in 2002 to 24 pairs in 2008, following only a few years of decreased productivity, provides another example of the continuing risk of rapid and precipitous reversals in population growth.

Status and Distribution – Piping Plover

On January 10, 1986, the piping plover *(Charadrius melodus)* was listed under the Act as endangered in the Great Lakes watershed and threatened elsewhere within its range, including migratory routes outside of the Great Lakes watershed and wintering grounds (USFWS 1985). The species was listed principally because of habitat destruction and degradation, predation, and human disturbance. Protection of the species under the Act reflects the species' precarious status range-wide.

Status and Distribution - Northern Great Plains Population

The IPPC numbers indicate that the Northern Great Plains population (including Canada) declined from 1991 through 2001, and then increased dramatically in 2006 (Figure 2). This increase corresponded with a multi-year drought in the Missouri River basin that exposed a great deal of nesting habitat, suggesting that the population can respond fairly rapidly to changes in habitat quantity and quality. Despite this recent improvement, the USFWS does not consider the numeric, distributional, or temporal elements of the population recovery criteria achieved.

As the Missouri River basin emerges from drought and breeding habitat is inundated, the population will likely decline. The management activities carried out in many areas during drought conditions have undoubtedly helped to maintain and increase the piping plover population, especially to mitigate for otherwise poor reproductive success during wet years when habitat is limited.

While the population increase seen in recent years demonstrates the possibility that the population can rebound from low population numbers, ongoing efforts are needed to maintain and increase the population. In the U.S., piping plover crews attempt to locate most piping plover nests and take steps to improve their success. This work has suffered from insufficient and unstable funding in most areas.

Emerging threats, such as energy development (particularly wind, oil and gas and associated infrastructure) and climate change are likely to impact piping plovers both on the breeding and wintering grounds. The potential impact of both of these threats is not well understood, and measures to mitigate for them are also uncertain at this time.

In the recently completed status review, the USFWS concluded that the Northern Great Plains piping plover population remains vulnerable, especially due to management of river systems throughout the breeding range (USFWS 2009b). Many of the threats identified in the recovery plan (USFWS 1988), including those affecting Northern Great Plains piping plover population during the two-thirds of its annual cycle spent in the wintering range, remain today or have intensified.

At the time of the recovery plan for the Northern Great Plains breeding population (USFWS 1988) there was little information available concerning how many piping plovers were necessary to secure the population, the reproduction level needed for stability, and the habitat needed to sustain this population level over time. Since that time, substantial new information has become available to inform recovery needs (USFWS 2009b, p. 91).

In addition to numeric population recovery goals, the plan requires that the USFWS provide long-term protection of essential breeding and wintering habitat. This addresses the primary threats to Great Plains piping plovers (USFWS 1988) - habitat alteration and destruction - that are still relevant today. Other threats known at the time of the plan, such as predation, were not addressed in the criteria but are now understood to be important ongoing threats. Potentially important new threats that have emerged since the recovery plan (USFWS 1988) include energy development (oil and gas production and wind production) and climate change.

Modeling strongly suggests that the piping plover population is very sensitive to adult and juvenile survival. Therefore, while there is a great deal of effort extended to improve breeding success, to improve and maintain a higher population over time, it is also necessary to ensure that the wintering habitat, where birds spend most of their time, is secure. On the wintering grounds, the shoreline areas used by wintering piping plovers are being developed, stabilized, or otherwise altered, making them unsuitable. Even in areas where habitat conditions are appropriate, human disturbance on beaches may negatively impact piping plovers' energy budget, as they may spend more time being vigilant and less time in foraging and roosting behavior. In many cases, the disturbance is severe enough that piping plovers appear to avoid some areas altogether. Threats on the wintering grounds may impact piping plovers' breeding success if they start migration or arrive at the breeding grounds with a poor body condition. While the population increase seen in recent years demonstrates the possibility that the population can rebound from low population numbers, ongoing efforts are needed to maintain and increase the population. In the U.S., piping plover crews attempt to locate most piping plover nests and take steps to improve their success. This work has suffered from insufficient and unstable funding in most areas.

The USFWS concluded (USFWS 2009b, p. 129) that the Northern Great Plains piping plover population remains likely to become an endangered species within the foreseeable future throughout all of its range and is correctly classified as a threatened species under the Act. The Northern Great Plains piping plover is not currently in danger of extinction throughout all or a significant portion of its range (i.e., is not an endangered species), because the population has responded dramatically to an increase in habitat during drought years as well as more than 20 years of recovery efforts. However, the population remains vulnerable, especially due to management of river systems throughout the breeding range. Increased understanding and management are also needed to provide for range-wide protection against threats from wind turbine generators and climate change. The status of the Northern Great Plains piping plover is consistent with the definition of a threatened species in the Act.

The recent five-year summary and evaluation provided a discussion of four recovery criteria from the 1988 recovery plan and the extent that they provide useful information on the status and conservation needs of the Northern Great Plains population (USFWS 2009b, pp. 91-99). These recovery criteria were:

Recovery Criterion A. Number of birds in the Northern Great Plains states will increase to 1,300 pairs.

Recovery Criterion B. Essential breeding and winter habitat will be protected.

Recovery Criterion C. The Canadian Recovery Objective of 2,500 birds for the prairie region will be attained.

Recovery Criterion D. The 1,300 pairs will be maintained in the following distribution for 15 years (assuming at least three major censuses will have been conducted during this time): 60 pairs in Montana, 650 pairs in North Dakota (including 550 pairs in the Missouri Coteau and 100 pairs along the Missouri River), 350 pairs in South Dakota (including 250 pairs along the Missouri River below Gavins Point (shared with Nebraska), 75 pairs at other Missouri River sites, 25 pairs at other sites), 465 pairs in Nebraska (including 140 pairs along the Platte River, 50 pairs along the Niobrara River, 250 pairs along the Missouri River (shared with South Dakota), and 25 pairs in Minnesota (Lake in the Woods).

Status and Distribution - Great Lakes Population

The Great Lakes population has shown significant growth, from approximately 17 pairs at the time of listing in 1986, to 63 pairs in 2008 (USFWS 2009b, p. 87). The total of 63 breeding pairs represents approximately 42% of the current recovery goal of 150 breeding pairs for the Great Lakes population. Productivity goals, as specified in the 2003 recovery plan, have been met over the past five years. During this time period the average annual fledging rate has been 1.76, well above the 1.5 fledglings per breeding pair recovery goal. A recent analysis of banded piping plovers in the Great Lakes, however, suggests that after hatch year survival (adult) rates may be declining. Continued population growth will require the long-term maintenance of productivity goals concurrent with measures to sustain or improve important vital rates.

Although initial information considered at the time of the 2003 recovery plan suggested the population may be at risk from a lack of genetic diversity, currently available information suggests that genetic diversity may not pose a high risk to the Great Lakes population. Additional genetic information is needed to assess genetic structure of the population and verify the adequacy of a 150 pair population to maintain long-term heterozygosity and allelic diversity.

Several years of population growth is evidence of the effectiveness of the ongoing Great Lakes piping plover recovery program. Most major threats, however, including habitat degradation, predation, and human disturbance remain persistent and pervasive. Reproduction is adversely affected by human disturbance of nesting areas and predation by foxes, gulls, and crows. Shoreline development, such as the construction of marinas and breakwaters, has adversely affected nesting and brood rearing. Such severe threats remain ubiquitous within the Great Lakes.

Expensive labor-intensive management to minimize the effects of these continuing threats, as specified in recovery plan tasks, are implemented every year by a network of dedicated governmental and private partners. Because threats to Great Lakes piping plovers persist, reversal of gains in abundance and productivity are expected to quickly follow if current protection efforts are reduced.

Emerging potential threats to piping plovers in the Great Lakes basin include disease, wind turbine generators and, potentially, climate change. A recent outbreak of Type E botulism in the Northern Lake Michigan basin resulted in several piping plover mortalities. Future outbreaks in areas that support a concentration of breeding piping plovers could impact survival rates and population abundance. Wind turbine projects, many of which are currently in the planning stages, need further study to determine potential risks to piping plovers and/or their habitat, as well as the need for specific protections to prevent or mitigate impacts. Climate change projections for the Great Lakes include the potential for significant water-level decreases. The degree to which this factor will impact piping plover habitat is unknown, but prolonged water-level decreases are likely to alter habitat condition and distribution.

In the recently completed status review, the USFWS concluded that the Great Lakes population remains at considerable risk of extinction due to its small size, limited distribution, and vulnerability to stochastic events, such as disease outbreak (USFWS 2009b). In addition, the factors that led to the piping plover's 1986 listing remain present.

Two new range-wide threats have emerged since the 2003 recovery plan: wind turbine generators and climate change (USFWS 2009b, p. 68). Both threats merit further evaluation to determine if recovery criteria are needed to address them. Effects of wind turbine generators on piping plovers are expected to be similar across the species' range, although piping plovers may be most vulnerable during the migratory period. The effects of climate change on piping plovers in the Great Lakes are anticipated to be much different than on plovers in other portions of the range, with water level declines being of greatest concern. However, additional information on the effects of wind turbines and climate change is needed before any determination is made regarding revision of existing recovery criteria.

The recovery criteria for the Great lakes breeding population described in the recovery plan for the Great Lakes piping plover (USFWS 2003a) generally reflect the best available information on the biology of this breeding population (USFWS 2009b, p. 68). New information on biology and habitat in the Great Lakes has been very limited. There is increasing concern, however, regarding the adequacy of the population abundance criterion, Criterion 1 given below, of 150 breeding pairs. As the current population has reached only 63 pairs in total, additional demographic, habitat, and genetic data should become available as the population increases. The USFWS anticipates that this criterion will warrant reconsideration if and when the population approaches 100-125 breeding pairs and more information becomes available. The recovery criteria for the Great Lakes population are (USFWS 2009b, pp. 69-72):

Recovery Criterion 1. The population has increased to at least 150 pairs (300 individuals), for at least 5 consecutive years, with at least 100 breeding pairs (200 individuals) in Michigan and 50 breeding pairs (100 individuals) distributed among sites in other Great Lakes states.

Recovery Criterion 2. Five-year average fecundity is within the range of 1.5-2.0 fledglings per pair, per year, across the breeding distribution, and ten-year population projections indicate the population is stable or continuing to grow above the recovery goal.

Recovery Criterion 3. Ensure protection and long-term maintenance of essential breeding habitat in the Great Lakes and wintering habitat, sufficient in quantity, quality, and distribution to support the recovery goal of 150 pairs (300 individuals).

Recovery Criterion 4. Genetic diversity within the population is deemed adequate for population persistence and can be maintained over the long-term.

Recovery Criterion 5. Agreements and funding mechanisms are in place for long-term protection and management activities in essential breeding and wintering habitat.

Piping plover populations, including the Great Lakes population, are inherently vulnerable to even small declines in their most sensitive vital rates, i.e., survival of adults and fledged juveniles. Therefore, ensuring the persistence of the Great Lakes piping plover also requires maintenance and protection of habitat in their migration and wintering range, where the species spends more than two-thirds of its life cycle. Habitat degradation and increasing human disturbance are particularly significant threats to non-breeding piping plovers. Although progress towards understanding and managing threats in this portion of the range has accelerated in recent years, substantial work remains to fully identify and remove or manage migration and wintering threats, which is needed to meet recovery criterion 3.

The USFWS concluded (USFWS 2009b, p. 88) that the Great Lakes piping plover is likely to become extinct throughout its range, and is therefore properly classified as endangered under the Act. Although more than 20 years of intensive recovery efforts have reduced near-term extinction risks, the population remains susceptible to extinction due to its small size, limited distribution, and vulnerability to stochastic events, such as disease outbreak. In addition, the factors that led to the piping plover's 1986 listing are still present, and regulatory mechanisms are needed to ensure long-term conservation of habitat and continuation of intensive annual management activities. Increased understanding of threats and management is also needed to protect the population during the two-thirds of its life cycle spent in the migration and wintering range. The Great Lakes piping plover continues to warrant protection under Act as an endangered species.

Status and Distribution - Atlantic Coast Population

Substantial population growth, from approximately 790 pairs in 1986 to an estimated 1,849 pairs in 2008, has decreased the Atlantic Coast piping plover's vulnerability to extinction since listing. Thus, considerable progress has been made towards the overall goal of 2,000 breeding pairs articulated in recovery criterion 1. As discussed in the 1996 revised recovery plan, however, the overall security of the Atlantic Coast piping plover is fundamentally dependent on even distribution of population growth, as specified in subpopulation targets, to protect a sparsely-distributed species with strict biological requirements from environmental variation (including catastrophes) and increase the likelihood of interchange among subpopulations. Although the New England Recovery Unit has sustained its subpopulation target for the requisite five years, and the New York-New Jersey Recovery Unit reached its target in 2007 (but dipped below again in 2008), considerable additional growth is needed in the Southern and Eastern Canada Recovery Units (recovery criterion 1).

Productivity goals (criterion 3) specified in the 1996 recovery plan must be revised to accommodate new information about latitudinal variation in productivity needed to maintain a stationary population (USFWS 2009b, p. 139). Population growth, particularly in the three U.S. recovery units, provides indirect evidence that adequate productivity has occurred in at least some years. However, overall security of a 2,000 pair population will require long-term maintenance of these revised recovery-unit-specific productivity goals concurrent with population numbers at or above abundance goals.

Twenty years of relatively steady population growth, driven by productivity gains, also evidences the efficacy of the ongoing Atlantic Coast piping plover recovery program. However, all of the major threats (habitat loss and degradation, predation, human disturbance, and inadequacy of other regulatory mechanisms other than the Act identified in the 1986 listing and 1996 revised recovery plan remain persistent and pervasive. Indeed, recent information heightens the importance of conserving the low, sparsely vegetated beaches juxtaposed with abundant moist foraging substrates preferred by breeding Atlantic Coast piping plovers; development and artificial shoreline stabilization pose continuing widespread threats to this habitat. Severe threats from human disturbance and predation remain ubiquitous along the Atlantic Coast. Expensive labor-intensive management to minimize the effects of these continuing threats, as specified in recovery plan tasks, are implemented every year by a network of dedicated governmental and private cooperators. Because threats to Atlantic Coast piping plovers persist and, in many cases have increased since listing, a reduction in current protection efforts would quickly lead to a reversal of gains in abundance and productivity.

The 1985 final rule cited loss of appropriate sandy beaches and other littoral habitats due to recreational and commercial developments and dune stabilization as a factor contributing to the species' decline on the Atlantic Coast. Actions to discourage new structures or other developments, interference with natural inlet processes, and beach stabilization were accorded "priority 1" (actions that must be taken to prevent extinction or to prevent the species from declining irreversibly in the foreseeable future) in the 1996 revised recovery plan.

Habitat loss and degradation remains very serious threats to Atlantic Coast piping plovers, especially in the New York-New Jersey and Southern recovery units. Artificial shoreline stabilization projects perpetuate conditions that reduce carrying capacity and productivity and exacerbate conflicts between piping plovers and human beach recreation.

The USFWS concluded that the Atlantic Coast piping plover remains vulnerable to low numbers in the Southern and Eastern Canada (and, to a lesser extent, the New York-New Jersey) Recovery Units (USFWS 2009b). Furthermore, the factors that led to the piping plover's 1986 listing remain operative range-wide (including in New England), and many of these threats have increased. Interruption of costly, labor-intensive efforts to manage these threats would quickly lead to steep population declines.

Recent research and reports indicate that predation poses a continuing (and perhaps intensifying threat) to Atlantic Coast piping plovers (USFWS 2009b, p. 159). Erwin et al. (2001) found a marked increase in the range of raccoons and foxes on the Virginia barrier islands between the mid-1970s and 1998, and concurrent declines in colonies of beach-nesting terns and black skimmers. Boettcher et al. (2007) identified predation as "the primary threat facing plovers in Virginia." Review of egg losses from natural and artificial nests at Breezy Point, New York, found that gulls, crows, and rats were major predators (Lauro and Tanacredi 2002). Recommendations included removal of crow nests to complement ongoing removal of gull eggs and nests. Modeling by Seymour et al. (2004) using red fox movement data from northern England indicated that risk of fox predation on ground-nesting bird species in long, linear habitats increased with narrowing habitat width, and was sensitive to changes in habitat width of even a few meters.

Disturbance by dogs is a continuing widespread and severe threat to Atlantic Coast piping plovers (USFWS 2009b, p. 163). Sufficiency of restrictions on dogs in piping plovers nesting areas and consistency of enforcement are continuing concerns of biologists monitoring Atlantic Coast piping plovers (e.g., M. Bartlett in litt. 2008; NPS 2008c). Recent literature on closely related beach-nesting plover species provides additional evidence of adverse effects on breeding activities from both leashed and unleashed dogs (Lord et al. 2001, Weston and Elgar 2007). Similarly, free-roaming domestic and feral cats, particularly those associated with human-subsidized feral cat colonies, appear to be an increasing threat to piping plovers and other beach-nesting birds (USFWS 2009b, pp. 159-160).

Unrestricted use of motorized vehicles on beaches is a serious threat to piping plovers and their habitats (USFWS 1996a, p. 40). The magnitude of this threat is particularly significant because vehicles extend impacts to remote stretches of beach where human disturbance would be very slight if access were limited to pedestrians. At Cape Cod National Seashore in 1989, 2,338 off-road vehicle season permits and 290 permits for self-contained camping vehicles were sold.

Vehicles can crush eggs (Wilcox 1959; Tull 1984; Burger 1987b; Patterson et al. 1991; United States of America v. Breezy Point Cooperative, Inc., U.S. District Court, Eastern District of New York, Civil Action No. CV-90-2542, 1991; Shaffer and Laporte 1992) as well as adults and chicks. In Massachusetts and New York, biologists documented 14 incidents in which 18 chicks and two adults were killed by vehicles between 1989 and 1993 (Melvin et al. 1994). Goldin (1993b) compiled records of 34 chick mortalities (30 on the Atlantic Coast and four on the Northern Great Plains) due to vehicles. Biologists that monitor and manage piping plovers believe that many more chicks are killed by vehicles than are found and reported (Melvin et al. 1994). Beaches used by vehicles during nesting and brood-rearing periods generally have fewer breeding plovers than available nesting and feeding habitat can support. In contrast, plover abundance and productivity has increased on beaches where vehicle restrictions during chick-rearing periods have been combined with protection of nests from predators (Goldin 1993b).

Typical behaviors of piping plover chicks increase their vulnerability to vehicles. Chicks frequently move between the upper berm or foredune and feeding habitats in the wrack line and intertidal zone. These movements place chicks in the paths of vehicles driving along the berm or through the intertidal zone. Chicks stand in, walk, and run along tire ruts, and sometimes have difficulty crossing deep ruts or climbing out of them (Eddings et al. 1990, Strauss 1990, Howard et al. 1993). Chicks sometimes stand motionless or crouch as vehicles pass by, or do not move quickly enough to get out of the way (Tull 1984, Hoopes et al. 1992, Goldin 1993b). Wire fencing placed around nests to deter predators (Rimmer and Deblinger 1990, Melvin et al. 1992) is ineffective in protecting chicks from vehicles because chicks typically leave the nest within a day after hatching and move extensively along the beach to feed.

Vehicles also significantly degrade piping plover habitat or disrupt normal behavior patterns (USFWS 1996a, p. 41). They may harm or harass plovers by crushing wrack into the sand and making it unavailable as cover or a foraging substrate (Hoopes et at. 1992, Goldin 1993b), by creating ruts that can trap or impede movements of chicks (J. Jacobs, U. S. Fish and Wildlife Service, in litt. 1988), and by preventing plovers from using habitat that is otherwise suitable (MacIvor 1990, Strauss 1990, Hoopes et al. 1992, Goldin 1993b, Hoopes 1994). Vehicles that drive too close to the toe of the dune may destroy "open vegetation" that may also furnish important piping plover habitat (Elias-Gerken 1994).

Non-motorized recreational activities can be a source of both direct mortality and harassment of piping plovers. Pedestrians on beaches may crush eggs (Burger 1987b, Hill 1988, Shafter and Laporte 1992, Cape Cod National Seashore 1993, Collazo et at. 1994). Unleashed dogs may chase plovers (McConnaughey et al. 1990), destroy nests (Hoopes et at. 1992), and kill chicks (Cairns and McLaren 1980; Z. Boyagian, Massachusetts Audubon Society, pers. comm. 1994).

Concentrations of pedestrians may deter piping plovers from using otherwise suitable habitat. Ninety-five percent of Massachusetts plovers (n = 209) observed by Hoopes (1993) were found in areas that contained less than one person per two acres of beach. Elias-Gerken (1994) found that piping plovers on Jones Beach Island, New York selected beachfront that had less pedestrian disturbance than beachfront where plovers did not nest. Burger (1991, 1994) found that presence of people at several New Jersey sites caused plovers to shift their habitat use away from the ocean front to interior and bayside habitats; the time plovers devoted to foraging decreased and the time spent alert increased when more people were present. Burger (1991) also found that when plover chicks and adults were exposed to the same number of people, the chicks spent less time foraging and more time crouching, running away from people, and being alert than did the adults.

Pedestrians may flush incubating plovers from nests (USFWS 1996a, p. 12, 39), exposing eggs to avian predators or excessive temperatures. Repeated exposure of shorebird eggs on hot days may cause overheating, killing the embryos (Bergstrom 1991), while excessive cooling may kill embryos or retard their development, delaying hatching dates (Welty 1982). Pedestrians can also displace unfledged chicks (Strauss 1990, Burger 1991, Hoopes et al. 1992, Loegering 1992, Goldin 1993b), forcing them out of preferred habitats, decreasing available foraging time, and causing expenditure of energy.

Other recreational activities may be detrimental to successful piping plover reproduction. Fireworks are highly disturbing to piping plovers (Howard et al. 1993). Plovers are also intolerant of kites, particularly as compared to pedestrians, dogs, and vehicles; biologists believe this may be because plovers perceive kites as potential avian predators (Hoopes et at. 1992). Emerging threats include the increasing popularity of “extreme sports,” such as kite-buggies and surf kites (also called “kite boards”), which accidentally land in and near breeding habitat (USFWS 2009b, p. 163). Examples of places where limitations on surf kites have been instituted include Sandy Hook and Stone Harbor in New Jersey, Cape Cod National Seashore in Massachusetts, and Long Beach in Stratford, Connecticut.

The USFWS developed five objective, measurable recovery criteria for the Atlantic Coast breeding population (USFWS 1996a, pp. 57-58). These criteria considered the habitat loss and degradation, disturbance by humans and pets, and increased predation that were important causes of the downward trend that started in the late 1940’s (USFWS 1985) and continued through the mid-1960s in some portions of the Atlantic Coast (USFWS 1996a, p. 33). These criteria given in a recent summary (USFWS 2009b, pp. 140-142) are:

1. Increase and maintain for five years a total of 2,000 breeding pairs, distributed among four recovery units, as shown below:

Recovery Unit	**Minimum subpopulation**
Atlantic (eastern) Canada	400 pairs
New England	625 pairs
New York-New Jersey	575 pairs
Southern (DE-MD-VA-NC)	400 pairs

2. Verify the adequacy of a 2,000 pair population of piping plovers to maintain heterozygosity and allelic diversity over the long term.

3. Achieve a five-year average productivity of 1.5 fledged chicks per pair in each of the four recovery units described in criterion 1, based on data from sites that collectively support at least 90% of the recover unit's population.

4. Institute long-term agreements to assure protection and management sufficient to maintain the population targets and average productivity in each recovery unit.

5. Ensure long-term maintenance of wintering habitat, sufficient in quantity, quality, and distribution to maintain survival rates for a 2,000-pair population.

Status and Distribution – All Populations – Migration and Wintering

Piping plover subspecies are phenotypically indistinguishable, and most studies in the non-breeding range, i.e, wintering and migration range, report results without regard to breeding origin. Although a recent analysis shows strong patterns in the wintering distribution of piping plovers from different breeding populations, partitioning is not complete and major information gaps persist (USFWS 2009b, pp. 26-28). Therefore, status and distribution information for non-breeding piping plovers pertains to the species as a whole (i.e., all three breeding populations), except where a particular breeding population is specified.

Piping plovers spend up to ten months of their life cycle on their migration and winter grounds, generally July 15 through as late as May 15. Piping plover migration routes and habitats overlap breeding and wintering habitats, and, unless banded, migrants passing through a site usually are indistinguishable from breeding or wintering piping plovers. Migration stopovers by banded piping plovers from the Great Lakes have been documented in New Jersey, Maryland, Virginia, and North Carolina (Stucker and Cuthbert 2006). Migrating breeders from eastern Canada have been observed in Massachusetts, New Jersey, New York, and North Carolina (Amirault et al. 2005). As many as 85 staging piping plovers have been tallied at various sites in the Atlantic breeding range (Perkins, S. pers. comm. 2008), but the composition (e.g., adults that nested nearby and their fledged young of the year versus migrants moving to or from sites farther north), stopover duration, and local movements are unknown. In general, distance between stopover locations and duration of stopovers throughout the coastal migration range remains poorly understood.

Review of published records of piping plover sightings throughout North America by Pompei and Cuthbert (2004) found more than 3,400 fall and spring stopover records at 1,196 sites. Published reports indicated that piping plovers do not concentrate in large numbers at inland sites and that they seem to stop opportunistically. In most cases, reports of birds at inland sites were single individuals.

Piping plovers migrate through and winter in coastal areas of the U.S. from North Carolina to Texas and in portions of Mexico and the Caribbean. Gratto-Trevor et al. (2009) reported that six of 259 banded piping plovers observed more than once per winter moved across boundaries of the seven U.S. regions. This species exhibits a high degree of intra- and inter-annual wintering site fidelity (Nicholls and Baldassarre 1990a; Drake et al. 2001; Noel et al. 2005; Stucker and Cuthbert 2006). Of 216 birds observed in different years, only eight changed regions between years, and several of these shifts were associated with late summer or early spring migration periods (Gratto-Trevor et al. 2009). Local movements are more common. In South Carolina, Maddock et al. (2009) documented many cross-inlet movements by wintering banded piping plovers as well as occasional movements of up to 18 km by approximately ten percent of the banded population; larger movements within South Carolina were seen during fall and spring migration.

Gratto-Trevor et al. (2009) found strong patterns (but no exclusive partitioning) in winter distribution of uniquely banded piping plovers from four breeding populations. All eastern Canada and 94% of Great Lakes birds wintered from North Carolina to southwest Florida. However, eastern Canada birds were more heavily concentrated in North Carolina, and a larger proportion of Great Lakes piping plovers were found in South Carolina and Georgia. Northern Great Plains populations were primarily seen farther west and south, especially on the Texas Gulf Coast. Although the great majority of Prairie Canada individuals were observed in Texas, particularly southern Texas, individuals from the Great Plains population were more widely distributed on the Gulf Coast from Florida to Texas.

The findings of Gratto-Trevor et al. (2009) provide evidence of differences in the wintering distribution of piping plovers from these four breeding areas. However, the distribution of birds by breeding origin during migration remains largely unknown. Other major information gaps include the wintering locations of the U.S. Atlantic Coast breeding population (banding of U.S. Atlantic Coast piping plovers has been extremely limited) and the breeding origin of piping plovers wintering on Caribbean islands and in much of Mexico. Banded piping plovers from the Great Lakes, Northern Great Plains, and eastern Canada breeding populations showed similar patterns of seasonal abundance at Little St. Simons Island, Georgia (Noel et al. 2007). However, the number of banded plovers originating from the latter two populations was relatively small at that study area.

Four, range-wide, mid-winter (late January to early February) population surveys, conducted at five-year intervals starting in 1991, are summarized in Table 1. Total numbers have fluctuated over time, with some areas experiencing increases and others decreases. Regional and local fluctuations may reflect the quantity and quality of suitable foraging and roosting habitat, which vary over time in response to natural coastal formation processes as well as anthropogenic habitat changes (e.g., inlet relocation, dredging of shoals and spits). Fluctuations may also represent localized weather conditions (especially wind) during surveys, or unequal survey coverage. Changes in wintering numbers may also be influenced by growth or decline in the particular breeding populations that concentrate their wintering distribution in a given area.

Mid-winter surveys may substantially underestimate the abundance of non-breeding piping plovers using a site or region during other months. In late September 2007, 104 piping plovers were counted at the south end of Ocracoke Island, North Carolina (NPS 2008a), where none were seen during the 2006 International Piping Plover Winter Census (Elliott-Smith et al. 2009).

Table 1. Results of the 1991, 1996, 2001, and 2006 International Piping Plover Winter Censuses (Haig et al. 2005, Elliott-Smith et al. 2009).

Location	**1991**	**1996**	**2001**	**2006**
Virginia	not surveyed (ns)	ns	ns	1
North Carolina	20	50	87	84
South Carolina	51	78	78	100
Georgia	37	124	111	212
Florida	551	375	416	454
-Atlantic	*70*	*31*	*111*	*133*
-Gulf	*481*	*344*	*305*	*321*
Alabama	12	31	30	29
Mississippi	59	27	18	78
Louisiana	750	398	511	226
Texas	1,904	1,333	1,042	2,090
Puerto Rico	0	0	6	Ns
U.S. Total	**3,384**	**2,416**	**2,299**	**3,355**
Mexico	27	16	Ns	76
Bahamas	29	17	35	417
Cuba	11	66	55	89
Other Caribbean Islands	0	0	0	28
GRAND TOTAL	**3,451**	**2,515**	**2,389**	**3,884**
Percent of Total International Piping Plover Breeding Census	62.9%	42.4%	40.2%	48.2%

Noel et al. (2007) observed up to 100 piping plovers during peak migration at Little St. Simons Island, Georgia, where approximately 40 piping plovers wintered in 2003-2005. Differences among fall, winter, and spring counts in South Carolina were less pronounced, but inter-year fluctuations (e.g., 108 piping plovers in spring 2007 versus 174 piping plovers in spring 2008) at 28 sites were striking (Maddock et al. 2009). Even as far south as the Florida Panhandle, monthly counts at Phipps Preserve in Franklin County ranged from a mid-winter low of four piping plovers in December 2006 to peak counts of 47 in October 2006 and March 2007 (Smith 2007). Pinkston (2004) observed much heavier use of Texas Gulf Coast (ocean-facing) beaches between early September and mid-October (approximately 16 birds per mile) than during December to March (approximately two birds per mile).

Local movements of non-breeding piping plovers may also affect abundance estimates. At Deveaux Bank, one of South Carolina's most important piping plover sites, five counts at approximately 10-day intervals between August 27 and October 7, 2006, oscillated from 28 to 14 to 29 to 18 to 26 (Maddock et al. 2009). Noel and Chandler (2008) detected banded Great Lakes piping plovers known to be wintering on their Georgia study site in 73.8 ± 8.1 % of surveys over three years.

Abundance estimates for non-breeding piping plovers may also be affected by the number of surveyor visits to the site. Preliminary analysis of detection rates by Maddock et al. (2009) found 87% detection during the mid-winter period on core sites surveyed three times a month during fall and spring and one time per month during winter, compared with 42% detection on sites surveyed three times per year (Cohen 2009 pers. communication).

The 2004 and 2005 hurricane seasons affected a substantial amount of habitat along the Gulf Coast. Habitats such as those along Gulf Islands National Seashore have benefited from increased washover events, which created optimal habitat conditions for piping plovers. Conversely, hard shoreline structures put into place following storms throughout the species range to prevent such shoreline migration prevent habitat creation. Four hurricanes between 2002 and 2005 are often cited in reference to rapid erosion of the Chandeleur Islands, a chain of low-lying islands in Louisiana where the 1991 International Piping Plover Census tallied more than 350 piping plovers. Comparison of imagery taken three years before and several days after Hurricane Katrina found that the Chandeleur Islands lost surface area and a review of aerial photography prior to the 2006 Census suggested little piping plover habitat remained (Elliott-Smith et al. 2009).

The USFWS is aware of the following site-specific conditions that benefit several habitats piping plover use while wintering and migrating, including critical habitat units. In Texas, one critical habitat unit was afforded greater protection due to the acquisition of adjacent upland properties by the local Audubon chapter. In another unit in Texas, vehicles were removed from a portion of the beach decreasing the likelihood of automobile disturbance to plovers. Exotic plant removal that threatens to invade suitable piping plover habitat is occurring in a critical habitat unit in South Florida. The USFWS and other government agencies remain in a contractual agreement with the U.S. Department of Agriculture for predator control within limited coastal areas in the Florida panhandle, including portions of some critical habitat units. Continued removal of potential terrestrial predators is likely to enhance survivorship of wintering and migrating piping plovers. In North Carolina, one critical habitat unit was afforded greater protection when the local Audubon chapter agreed to manage the area specifically for piping plovers and other shorebirds following the relocation of the nearby inlet channel.

The status of piping plovers on winter and migration grounds is difficult to assess, but threats to piping plover habitat used during winter and migration identified by the USFWS during its designation of critical habitat continue to affect the species. Unregulated motorized and pedestrian recreational use, inlet and shoreline stabilization projects, beach maintenance and nourishment, and pollution affect most winter and migration areas. Conservation efforts at some locations have likely resulted in the enhancement of wintering habitat.

The three recovery plans stated that shoreline development throughout the wintering range poses a threat to all populations of piping plovers. The plans further stated that beach maintenance and nourishment, inlet dredging, and artificial structures, such as jetties and groins, could eliminate wintering areas and alter sedimentation patterns leading to the loss of nearby habitat.

Important components of ecologically sound barrier beach management include perpetuation of natural dynamic coastal formation processes. Structural development along the shoreline or manipulation of natural inlets upsets the dynamic processes and results in habitat loss or degradation (Melvin et al. 1991). Throughout the range of migrating and wintering piping plovers, inlet and shoreline stabilization, inlet dredging, beach maintenance and nourishment activities, and seawall installations continue to constrain natural coastal processes. Dredging of inlets can affect spit formation adjacent to inlets and directly remove or affect ebb and flood tidal shoal formation. Jetties, which stabilize an island, cause island widening and subsequent growth of vegetation on inlet shores. Seawalls restrict natural island movement and exacerbate erosion. As discussed in more detail below, all these efforts result in loss of piping plover habitat. Construction of these projects during months when piping plovers are present also causes disturbance that disrupts the birds' foraging efficiency and hinders their ability to build fat reserves over the winter and in preparation for migration, as well as their recuperation from migratory flights.

Continual degradation and loss of habitats used by wintering and migrating shorebirds may cause an increase in intra-specific and inter-specific competition for remaining food supplies and roosting habitats. In Florida, for example, approximately 825 miles of coastline and parallel bayside flats (unspecified amount) were present prior to the advent of high human densities and beach stabilization projects. The USFWS estimates that only about 35% of the Florida coastline continues to support natural coastal formation processes, thereby concentrating foraging and roosting opportunities for all shorebird species and forcing some individuals into suboptimal habitats. Thus, intra- and inter-specific competition most likely exacerbates threats from habitat loss and degradation.

Sand placement projects

In the wake of episodic storm events, managers of lands under public, private, and county ownership often protect coastal structures using emergency storm berms. Such berms are frequently followed by beach nourishment or renourishment activities (nourishment projects are considered "soft" stabilization versus "hard" stabilization such as seawalls).

Past and ongoing stabilization projects fundamentally alter the naturally dynamic coastal processes that create and maintain beach strand and bayside habitats, including those habitat components that piping plovers rely upon. Although impacts may vary depending on a range of factors, stabilization projects may directly degrade or destroy piping plover roosting and foraging habitat in several ways. Front beach habitat may be used to construct an artificial berm that is densely planted in grass, which can directly reduce the availability of roosting habitat. Over time, if the beach narrows due to erosion, additional roosting habitat between the berm and the water can be lost. Berms can also prevent or reduce the natural overwash that creates roosting habitats by converting vegetated areas to open sand areas. The vegetation growth caused by impeding natural overwash can also reduce the maintenance and creation of bayside intertidal feeding habitats. In addition, stabilization projects may indirectly encourage further development of coastal areas and increase the threat of disturbance.

At least 668 of 2,340 coastal shoreline miles (29% of beaches throughout the piping plover winter and migration range in the U.S.) are bermed, nourished, or renourished, generally for recreational purposes and to protect commercial and private infrastructure. However, only approximately 54 miles or 2.31% of these impacts have occurred within critical habitat. In Louisiana, sediment placement projects are deemed environmental restoration projects by the USFWS, because without the sediment, many areas would erode below sea level.

Inlet stabilization/relocation

Many navigable mainland or barrier island tidal inlets along the Atlantic and Gulf of Mexico coasts are stabilized with jetties, groins, or by seawalls and/or adjacent industrial or residential development. Dredged material may be placed on the islands which subsequently widen. Once

Table 2. Summary of the extent of nourished beaches in piping plover wintering and migrating habitat within the conterminous U.S. from unpublished data (project files, gray literature, and field observations). Source: USFWS 2009b, p. 33.

State	**Sandy beach shoreline miles available**	**Sandy beach shoreline miles nourished to date (within critical habitat units)**	**Percent of sandy beach shoreline affected (within critical habitat units)**
North Carolina	301[1]	117[5] (unknown)	39 (unknown)
South Carolina	187[1]	56 (0.6)	30 (0.003))
Georgia	100[1]	8 (0.4)	8 (0.004)
Florida	825[2]	404 (6)[6]	49 (0.007)
Alabama	53[1]	12 (2)	23 (0.04)
Mississippi	110[3]	≥6 (0)	5 (0)
Louisiana	397[1]	Unquantified (usually restoration-oriented)	Unknown
Texas	367[4]	65 (45)	18 (0.12)
Overall Total	2,340 (does not include Louisiana)	≥668 does not include Louisiana (54 in critical habitat)	29% (≥.02% in critical habitat)

the island becomes stabilized, vegetation encroaches on the bayside habitat, thereby diminishing and eventually destroying its value to piping plovers. Accelerated erosion may compound future habitat loss, depending on the degree of sea-level rise. Unstabilized inlets naturally migrate, re-forming important habitat components, whereas jetties often trap sand and cause significant erosion of the downdrift shoreline. These combined actions affect the availability of piping plover habitat (Cohen et al. 2008b).

Using Google Earth© (accessed April 2009), USFWS biologists visually estimated the number of navigable mainland or barrier island tidal inlets throughout the wintering range of the piping plover in the conterminous U.S. that have some form of hardened structure (USFWS 2009b, p. 34). This includes seawalls or adjacent development, which lock the inlets in place (Table 3).

Table 3. Number of hardened inlets by state. Asterisk (*) represents an inlet at the state line, in which case half an inlet is counted in each state. Source: USFWS 2009b, p. 34.

State	Visually estimated number of navigable mainland and barrier island inlets per state	Number of hardened inlets	% of inlets affected
North Carolina	20	2.5*	12.5%
South Carolina	34	3.5*	10.3%
Georgia	26	2	7.7%
Florida	82	41	50%
Alabama	14	6	42.9%
Mississippi	16	7	43.8%
Louisiana	40	9	22.5%
Texas	17	10	58.8%
Overall Total	249	81	32.5%

Tidal inlet relocation can cause loss and/or degradation of piping plover habitat; although less permanent than construction of hard structures, effects can persist for years. The USFWS is aware of at least seven inlet relocation projects (two in North Carolina, three in South Carolina, two in Florida), but this number likely under-represents the extent of this activity.

Sand mining/dredging

Sand mining, the practice of extracting (dredging) sand from sand bars, shoals, and inlets in the nearshore zone, is a less expensive source of sand than obtaining sand from offshore shoals for beach nourishment. Sand bars and shoals are sand sources that move onshore over time and act as natural breakwaters. Inlet dredging reduces the formation of exposed ebb and flood tidal shoals considered to be primary or optimal piping plover roosting and foraging habitat. Exposed shoals and sandbars are also valuable to piping plovers, as they tend to receive less human recreational use (because they are only accessible by boat) and therefore provide relatively less disturbed habitats for birds. The USFWS does not have a good estimate of either the amount of sand mining that occurs across the piping plover wintering range or the number of inlet dredging projects that occur. This number is likely greater than the number of total inlets with hardened structures shown in Table 3, since most jettied inlets need maintenance dredging, but non-hardened inlets are often dredged as well.

Groins

Groins (structures made of concrete, rip rap, wood, or metal built perpendicular to the beach in order to trap sand) are typically found on developed beaches with severe erosion. Although groins can be individual structures, they are often clustered along the shoreline. Groins can act as barriers to longshore sand transport and cause downdrift erosion, which prevents piping plover habitat creation by limiting sediment deposition and accretion. These structures are found throughout the southeastern Atlantic Coast, and although most were in place prior to the piping plover's 1986 listing under the Act, installation of new groins continues to occur. Table 4 tallies recent groin installation projects in wintering and migration habitat, as estimated by USFWS biologists.

Table 4. Number of recent groin installation projects in two states, as reported by USFWS staff. Source: USFWS 2009b, p. 36

State	**Timeframe**	**# Projects**
South Carolina	2006–2009	1
Florida	2000–2009	11

Seawalls and revetments

Seawalls and revetments are vertical hard structures built parallel to the beach in front of buildings, roads, and other facilities to protect them from erosion. However, these structures often accelerate erosion by causing scouring in front of and downdrift from the structure which can eliminate intertidal foraging habitat and adjacent roosting habitat. Physical characteristics that determine microhabitats and biological communities can be altered after installation of a seawall or revetment, thereby depleting or changing composition of benthic communities that serve as the prey base for piping plovers. At four California study sites, each comprised of an unarmored segment and a segment seaward of a seawall, Dugan and Hubbard (2006) found that armored segments had narrower intertidal zones, smaller standing crops of macrophyte wrack, and lower shorebird abundance and species richness. Geotubes (long cylindrical bags made of high-strength permeable fabric and filled with sand) are softer alternatives, but act as barriers by preventing overwash. The USFWS did not find any sources that summarize the linear extent of seawall, revetment, and geotube installation projects that have occurred across the piping plover's wintering and migration habitat.

Exotic/invasive vegetation

A recently identified threat to piping plover habitat, not described in the listing rule or recovery plans, is the spread of coastal invasive plants into suitable piping plover habitat. Like most invasive species, coastal exotic plants reproduce and spread quickly and exhibit dense growth habits, often outcompeting native plant species. If left uncontrolled, invasive plants cause a habitat shift from open or sparsely vegetated sand to dense vegetation, resulting in the loss or degradation of piping plover roosting habitat, which is especially important during high tides and migration periods.

Beach vitex *(Vitex rotundifolia)* is a woody vine introduced into the southeastern U.S. as a dune stabilization and ornamental plant (Maddox et al. 2007). In 2003, the plant was documented in New Hanover, Pender, and Onslow counties in North Carolina, and at 125 sites in Horry, Georgetown, and Charleston counties in South Carolina. One Chesapeake Bay site in Virginia was eradicated, and another site on Jekyll Island, Georgia, is about 95% controlled (Suiter 2009 pers. communication). Beach vitex has been documented from two locations in northwest Florida, but one site disappeared after erosional storm events. Task forces formed in North and South Carolina in 2004-05 have made great strides to remove this plant from their coasts. To date, about 200 sites in North Carolina have been treated, with 200 additional sites in need of treatment. Similar efforts are underway in South Carolina.

Unquantified amounts of crowfoot grass *(Dactyloctenium aegyptium)* grow invasively along portions of the Florida coastline. It forms thick bunches or mats that may change the vegetative structure of coastal plant communities and alter shorebird habitat.

The Australian pine *(Casuarina equisetifolia)* changes the vegetative structure of the coastal community in south Florida and islands within the Bahamas. Shorebirds prefer foraging in open areas where they are able to see potential predators, and tall trees provide good perches for avian predators. Australian pines potentially impact shorebirds, including the piping plover, by reducing attractiveness of foraging habitat and/or increasing avian predation. The propensity of these exotic species to spread, and their tenacity once established, make them a persistent threat, partially countered by increasing landowner awareness and willingness to undertake eradication activities.

Wrack removal and beach cleaning

Wrack on beaches and baysides provides important foraging and roosting habitat for piping plovers (Smith 2007; Maddock et al. 2009; Lott et al. 2009) and many other shorebirds on their winter, breeding, and migration grounds. Because shorebird numbers are positively correlated with wrack cover and biomass of their invertebrate prey that feed on wrack (Dugan et al. 2003), grooming will lower bird numbers (Defreo et al. 2009).

There is increasing popularity in the Southeast, especially in Florida, for beach communities to carry out "beach cleaning" and "beach raking" actions. Beach cleaning occurs on private beaches, where piping plover use is not well documented, and on some municipal or county beaches that are used by piping plovers. Most wrack removal on state and federal lands is limited to post-storm cleanup and does not occur regularly.

Man-made beach cleaning and raking machines effectively remove seaweed, fish, glass, syringes, plastic, cans, cigarettes, shells, stone, wood, and virtually any unwanted debris (Barber Beach Cleaning Equipment 2010). These efforts remove accumulated wrack, topographic depressions, and sparse vegetation nodes used by roosting and foraging piping plovers. Removal of wrack also eliminates a beach's natural sand-trapping abilities, further destabilizing the beach. In addition, sand adhering to seaweed and trapped in the cracks and crevices of wrack is removed from the beach. Although the amount of sand lost due to single sweeping actions may be small, it adds up considerably over a period of years (Nordstrom et al. 2006). Beach cleaning or grooming can result in abnormally broad unvegetated zones that are inhospitable to dune formation or plant colonization, thereby enhancing the likelihood of erosion (Defreo et al. 2009).

Predation

The 1996 Atlantic Coast Recovery Plan summarized evidence that human activities affect types, numbers, and activity patterns of some predators, thereby exacerbating natural predation on breeding piping plovers. The impact of predation on migrating or wintering piping plovers remains largely undocumented.

Recreational Disturbances

Intense human disturbance in shorebird winter habitat can be functionally equivalent to habitat loss if the disturbance prevents birds from using an area (Goss-Custard et al. 1996), which can lead to roost abandonment and local population declines (Burton et al. 1996). Disturbance, i.e., human and pet presence that alters bird behavior, disrupts piping plovers as well as other shorebird species. Disturbance can cause shorebirds to spend less time roosting or foraging and more time in alert postures or fleeing from the disturbances (Johnson and Baldassarre 1988; Burger 1991; Burger 1994; Elliott and Teas 1996; Lafferty 2001a, 2001b; Thomas et al. 2003), which limits the local abundance of piping plovers (Zonick 2000). Shorebirds that are repeatedly flushed in response to disturbance expend energy on costly short flights (Nudds and Bryant 2000).

Shorebirds are more likely to flush from the presence of dogs than people, and birds react to dogs from farther distances than people (Lafferty 2001a, 2001b; Thomas et al. 2003). Dogs off leash are more likely to flush piping plovers from farther distances than are dogs on leash; nonetheless, dogs both on and off leashes disturb piping plovers (Hoopes 1993). Pedestrians walking with dogs often go through flocks of foraging and roosting shorebirds; some even encourage their dogs to chase birds.

Off-road vehicles can significantly degrade piping plover habitat (Wheeler 1979) or disrupt the birds' normal behavior patterns (Zonick 2000). The 1996 Atlantic Coast recovery plan cites tire ruts crushing wrack into the sand, making it unavailable as cover or as foraging substrate (Hoopes 1993; Goldin 1993b). The plan also notes that the magnitude of the threat from off-road vehicles is particularly significant, because vehicles extend impacts to remote stretches of beach where human disturbance will otherwise be very slight. Zonick (2000) found that the density of off-road vehicles negatively correlated with abundance of roosting piping plovers on the ocean beach. Cohen et al. (2008a) found that radio-tagged piping plovers using ocean beach habitat at Oregon Inlet in North Carolina were far less likely to use the north side of the inlet where off-road vehicle use is allowed, and recommended controlled management experiments to determine if recreational disturbance drives roost site selection. Ninety-six percent of piping plover detections were on the south side of the inlet even though it was farther away from foraging sites (1.8 km from the sound side foraging site to the north side of the inlet versus 0.4 km from the sound side foraging site to the north side of the inlet (Cohen et al. 2008a).

Based on surveys with land managers and biologists, knowledge of local site conditions, and other information, the USFWS has estimated the levels of eight types of disturbance at sites in the U.S with wintering piping plovers (USFWS 2009b, p. 46). There are few areas used by wintering piping plovers that are devoid of human presence, and just under half have leashed and unleashed dog presence (Smith 2007; Lott et al. 2009). Table 5 summarizes the disturbance analysis results. Data are not available on human disturbance at wintering sites in the Bahamas, other Caribbean countries or Mexico.

Table 5. Percent of known piping plover winter and migration habitat locations, by state, where various types of anthropogenic disturbance have been reported. Source: USFWS 2009b, p.46.

	Percent by State							
Disturbance Type	**AL**	**FL**	**GA**	**LA**	**MS**	**NC**	**SC**	**TX**
Pedestrians	67	92	94	25	100	100	88	54
Dogs on leash	67	69	31	25	73	94	25	25
Dogs off leash	67	81	19	25	73	94	66	46
Bikes	0	19	63	25	0	0	28	19
ATVs	0	35	0	25	0	17	25	30
ORVs	0	21	0	25	0	50	31	38
Boats	33	65	100	100	0	78	63	44
Kite surfing	0	10	0	0	0	33	0	0

Although the timing, frequency, and duration of human and dog presence throughout the wintering range are unknown, studies in Alabama and South Carolina suggest that most disturbances to piping plovers occurs during periods of warmer weather, which coincides with piping plover migration (Johnson and Baldassarre 1988; Lott et al. 2009; Maddock et al. 2009). Smith (2007) documents varying disturbance levels throughout the non-breeding season at northwest Florida sites.

In South Carolina, 33% (13 out of 39) of sites surveyed during the 2007-2008 season had ≥ 2:5 birds. Of those 13 sites, 46.2% (6 out of 13) had ≥10 people present during surveys, and 61.5% (8 out of 13) allow dogs, indicating that South Carolina sites with the highest piping plover density are exposed to disturbance.

LeDee (2008) collected survey responses in 2007 from 35 managers (located in seven states) at sites that were designated as critical habitat for wintering piping plovers. Ownership included federal, state, and local governmental agencies and non-governmental organizations managing national wildlife refuges; national, state, county, and municipal parks; state and estuarine research reserves; state preserves; state wildlife management areas; and other types of managed lands. Of 44 reporting sites, 40 allowed public beach access year-round and four sites were closed to the public. Of the 40 sites that allow public access, 62% of site managers reported>10,000 visitors during September-March, and 31% reported >100,000 visitors. Restrictions on visitor activities on the beach included automobiles (at 81% of sites), all-terrain vehicles (89%), and dogs during the winter season (50%). Half of the survey respondents reported funding as a primary limitation in managing piping plovers and other threatened and endangered species at their sites. Other limitations included "human resource capacity" (24%), conflicting management priorities (12%), and lack of research (3%).

Disturbance can be addressed by implementing recreational management techniques such as vehicle and pet restrictions and symbolic fencing (usually sign posts and string) of roosting and feeding habitats. In implementing conservation measures, managers need to consider a range of site-specific factors, including the extent and quality of roosting and feeding habitats and the types and intensity of recreational use patterns. In addition, educational materials such as informational signs or brochures can provide valuable information so that the public understands the need for conservation measures.

In sum, although there is some variability among states, disturbance from human beach recreation and pets poses a moderate to high and escalating threat to migrating and wintering piping plovers. Systematic review of recreation policy and beach management across the non-breeding range will assist in better understanding cumulative impacts. Site-specific analysis and implementation of conservation measures should be a high priority at piping plover sites that have moderate or high levels of disturbance, and the USFWS and state wildlife agencies should increase technical assistance to land managers to implement management strategies and monitor their effectiveness.

Climate Change (sea-level rise)

Over the past 100 years, the globally-averaged sea level has risen approximately 10-25 centimeters (Rahmstorf et al. 2007), a rate that is an order of magnitude greater than that seen in the past several thousand years (Douglas et al. 2001 as cited in Hopkinson et al. 2008). The IPCC suggests that by 2080 sea-level rise could convert as much as 30% of the world's coastal wetlands to open water (IPCC 2007a). Although rapid changes in sea level are predicted, estimated time frames and resulting water levels vary due to the uncertainty about global temperature projections and the rate of ice sheets melting and slipping into the ocean (IPCC 2007a, Climate Change Science Program [hereafter CCSP] 2008).

Potential effects of sea-level rise on coastal beaches may vary regionally due to subsidence or uplift as well as the geological character of the coast and nearshore (CCSP 2009; Galbraith et al. 2002). In the last century, for example, sea-level rise along the U.S. Mid-Atlantic and Gulf Coasts exceeded the global average by 13-15 cm (five to six inches), because coastal lands there are subsiding (U. S. Environmental Protection Agency [hereafter USEPA] 2010). Sediment compaction and oil and gas extraction compound tectonic subsidence (Morton et al. 2003; Hopkinson et al. 2008). Low elevations and proximity to the coast make all non-breeding coastal piping plover foraging and roosting habitats vulnerable to the effects of rising sea level. Furthermore, areas with small astronomical tidal ranges are more vulnerable to loss of coastal lands such as salt marsh and other tidal wetlands (USEPA 2010). Portions of the U. S. Gulf Coast where intertidal range is <1 meter are the most vulnerable to loss of intertidal wetlands and flats induced by sea-level rise. Sea-level rise was cited as a contributing factor in the 68% decline in tidal flats and algal mats in the Corpus Christi area (i.e., Lamar Peninsula to Encinal Peninsula) in Texas between the 1950s and 2004 (Tremblay et al. 2008). Mapping by Titus and Richman (2001) showed that more than 80% of the lowest land along the Atlantic and Gulf coasts was in Louisiana, Florida, Texas, and North Carolina, where 73.5% of all wintering piping plovers were tallied during the 2006 International Piping Plover Census (Elliott-Smith et al. 2009).

Inundation of piping plover habitat by rising seas could lead to permanent loss of habitat if natural coastal dynamics are impeded by numerous structures or roads, especially if those shorelines are also armored with hardened structures. Without development or armoring, low undeveloped islands can migrate toward the mainland, pushed by the overwashing of sand eroding from the seaward side and being re-deposited in the bay (Scavia et al. 2002). Overwash and sand migration are impeded on developed portions of islands. Instead, as sea level increases, the ocean-facing beach erodes and the resulting sand is deposited offshore. The buildings and the sand dunes then prevent sand from washing back toward the lagoons, and the lagoon side becomes increasingly submerged during extreme high tides (Scavia et al. 2002), diminishing both barrier beach shorebird habitat and protection for mainland developments.

Modeling for three sea-level rise scenarios (reflecting variable projections of global temperature rise) at five important U.S. shorebird staging and wintering sites predicted loss of 20-70% of current intertidal foraging habitat (Galbraith et al. 2002). These authors estimated probabilistic sea-level changes for specific sites partially based on historical rates of sea-level change (from tide gauges at or near each site); they then superimposed this on projected 50% and 5% probability of global sea-level changes by 2100 of 34 cm and 77 cm (13.4 and 30.3 inches), respectively. The 50% and 5% probability sea level change projections were based on assumed global temperature increases of 2° C (50% probability) and 4.70° C (5% probability). The most severe losses were projected at sites where the coastline is unable to move inland due to steep topography or seawalls.

The Galbraith et al. (2002) Gulf Coast study site, Bolivar Flats, Texas, is a designated critical habitat unit known to host high numbers of piping plovers during migration and throughout the winter; e.g., 275 individuals were tallied during the 2006 International Piping Plover Census (Elliott-Smith et al. 2009). Under the 50% likelihood scenario for sea-level rise, Galbraith et al. (2002) projected approximately 38% loss of intertidal flats at Bolivar Flats by 2050; however, after initially losing habitat, the area of tidal flat habitat was predicted to slightly increase by the year 2100, because Bolivar Flats lacks armoring, and the coastline at this site can thus migrate inland. Although habitat losses in some areas are likely to be offset by gains in other locations, Galbraith et al. (2002) noted that time lags may exert serious adverse effects on shorebird populations. Furthermore, even if piping plovers are able to move their wintering locations in response to accelerated habitat changes, there could be adverse effects on the birds' survival rates or reproductive fitness.

Table 6 displays the potential for adjacent development and/or hardened shorelines to impede response of habitat to sea-level rise in the eight states supporting wintering piping plovers. Although complete linear shoreline estimates are not readily obtainable, almost all known piping plover wintering sites in the U.S. were surveyed during the 2006 International Piping Plover Census. To estimate effects at the census sites, as well as additional areas where piping plovers have been found outside of the census period, USFWS biologists reviewed satellite imagery and spoke with other biologists familiar with the sites. Of 406 sites, 204 (50%) have adjacent structures that may prevent the creation of new habitat if existing habitat were to become inundated. These threats will be perpetuated in places where damaged structures are repaired and replaced, and exacerbated where the height and strength of structures are increased. Data do not exist on the amount or types of hardened structures at wintering sites in the Bahamas, other Caribbean countries, or Mexico.

Table 6. Number of sites surveyed during the 2006 winter International Piping Plover Census with hardened or developed structures adjacent to the shoreline. An asterisk (*) indicates additional piping plovers sites not surveyed in the 2006 Census. Source: USFWS 2009b, p. 52.

State	**Number of sites surveyed during the 2006 winter Census**	**Number of sites with some armoring or development**	**Percent of sites affected**
North Carolina	37 (+2)*	20	51
South Carolina	39	18	46
Georgia	13	2	15
Florida	188	114	61
Alabama	4 (+2)*	3	50
Mississippi	16	7	44
Louisiana	25 (+2)*	9	33
Texas	78	31	40
Overall Total	406	204	50

Asterisk (*) indicates additional piping plovers sites not surveyed in the 2006 Census.

Sea-level rise poses a significant threat to all piping plover populations during the migration and wintering portion of their life cycle (USFWS 2009b, p. 52). Ongoing coastal stabilization activities may strongly influence the effects of sea-level rise on piping plover habitat. Improved understanding of how sea-level rise will affect the quality and quantity of habitat for migrating and wintering piping plovers is an urgent need.

Storm events

Although coastal piping plover habitats are storm-created and maintained, the 1996 Atlantic Coast Recovery Plan also noted that storms and severe cold weather may take a toll on piping plovers, and the Great Lakes Recovery Plan (USFWS 2003a) postulated that loss of habitats such as overwash passes or wrack, where birds shelter during harsh weather, poses a threat. Storms are a component of the natural processes that form coastal habitats used by migrating and wintering piping plovers, and positive effects of storm-induced overwash and vegetation removal have been noted in portions of the wintering range. Hurricane Katrina (2005) overwashed the mainland beaches of Mississippi, creating many tidal flats where piping plovers were subsequently observed (N.Winstead in litt. 2008).

Following Hurricane Ike in 2008, Arvin (2009) reported decreased numbers of piping plovers at some heavily eroded Texas beaches in the center of the storm impact area and increases in plover numbers at sites about 100 miles to the southwest. However, piping plovers were observed later in the season using tidal lagoons and pools that Ike created behind the eroded beaches (Arvin 2009).

The adverse effects on piping plovers attributed to storms are sometimes due to a combination of storms and other environmental changes or human use patterns. Other storm-induced adverse effects include post-storm acceleration of human activities such as beach nourishment, sand scraping, and berm and seawall construction. Such stabilization activities can result in the loss and degradation of feeding and resting habitats. Storms also can cause widespread deposition of debris along beaches. Removal of debris often requires large machinery, which can cause extensive disturbance and adversely affect habitat elements such as wrack.

Recent climate change studies indicate a trend toward increasing hurricane numbers and intensity (Emanuel 2005; Webster et al. 2005). When combined with predicted effects of sea-level rise, there may be increased cumulative impacts from future storms.

In sum, storms can create or enhance piping plover habitat while causing localized losses elsewhere in the wintering and migration range. Available information suggests that some birds may have resiliency to storms and move to unaffected areas without harm, while other reports suggest birds may perish from storm events. Significant concerns include disturbance to piping plovers and habitats during cleanup of debris, and post-storm acceleration of shoreline stabilization activities, which can cause persistent habitat degradation and loss.

Summary

Habitat loss and degradation on winter and migration grounds from shoreline and inlet stabilization efforts, both within and outside of designated critical habitat, remain a serious threat to all piping plover populations. Modeling strongly suggests that the population is very sensitive to adult and juvenile survival. Therefore, while there is a great deal of effort extended to improve breeding success, to improve and maintain a higher population over time, it is also necessary to ensure that the wintering habitat, where birds spend most of their time, is secure. On the wintering grounds, the shoreline areas used by wintering piping plovers are being developed, stabilized, or otherwise altered, making it unsuitable. Even in areas where habitat conditions are appropriate, human disturbance on beaches may negatively impact piping plovers' energy budget, as they may spend more time being vigilant and less time in foraging and roosting behavior. In many cases, the disturbance is severe enough, that piping plovers appear to avoid some areas altogether. Threats on the wintering grounds may impact piping plovers' breeding success if they start migration or arrive at the breeding grounds with a poor body condition.

Finally, two emerging potential threats, wind turbine generators and climate change (especially sea-level rise) are likely to affect Atlantic Coast piping plovers throughout their life cycle. These two threats must be evaluated to ascertain their effects on piping plovers and/or their habitat, as well as the need for specific protections to prevent or mitigate impacts that could otherwise increase overall risks the species.

Analysis of Species/Critical Habitat Likely to be Affected – Piping Plovers

Piping plovers from the Atlantic Coast population are the focus of this biological opinion when referencing breeding birds. Since recovery units have been established in an approved recovery plan for the piping plover (USFWS, 1996a), this biological opinion will also consider the effects of the proposed project on piping plovers in the Southern recovery unit. Piping plovers from all three breeding populations are referenced when discussing effects of the proposed action on migrating and wintering plovers.

The proposed action has the potential to adversely affect nesting and non-nesting adults, eggs, chicks, and juveniles during the nesting season, and adults and juveniles during the migrating and wintering seasons within the proposed project area. Potential effects of vehicle access on the beaches and recreational beach use of CAHA include vehicles hitting nesting adult piping plovers or chicks and crushing eggs; vehicles hitting migrating and wintering adults and juveniles; vehicles and pedestrians harming or disturbing nesting and non-nesting plovers during courtship, nest establishment, foraging, and roosting; pedestrians (and their pets) harming or disturbing nesting and non-nesting plovers or killing adults, chicks, and crushing eggs; tire ruts trapping chicks exposing them to predators, extreme temperatures or being run over by vehicles; human activity attracting predators such as gulls and raccoons that may kill or disturb plover adults, chicks, and eggs; and degradation of nesting habitat.

STATUS OF THE SPECIES/CRITICAL HABITAT – SEA TURTLES

Species/Critical Habitat Description – All Sea Turtles

The USFWS has responsibility for implementing recovery of sea turtles when they come ashore to nest. This BO addresses nesting sea turtles, their nests and eggs, and hatchlings as they emerge from the nest and crawl to the sea. The National Oceanic and Atmospheric Administration's National Marine Fisheries Service (NMFS) has jurisdiction over sea turtles in the marine environment. Although five threatened or endangered sea turtle species occur in the waters of North Carolina, only three species, the loggerhead, green, and leatherback, are known to nest at the Seashore (NPS 2010a, p. 368). The other two species, Kemp’s ridley (*Lepidochelys kempi*) and hawksbill (*Eretmochelys imbricata*) are only known to occur at the Seashore through occasional stranding, usually due to either prior death or incapacitation from hypothermia. Three species of sea turtles are analyzed in this biological opinion: the threatened loggerhead sea turtle (*Caretta caretta*), the endangered green sea turtle (*Chelonia mydas*), and the endangered leatherback sea turtle (*Dermochelys coriacea*).

Species/Critical Habitat Description - Loggerhead Sea Turtle

The loggerhead sea turtle was federally listed as a threatened species on July 28, 1978 (NMFS and USFWS 1978). This species occurs throughout the temperate and tropical regions of the Atlantic, Pacific, and Indian Oceans. No critical habitat has been designated for the loggerhead sea turtle.

The loggerhead sea turtle grows to an average weight of about 200 pounds and is characterized by a large head with blunt jaws. Adults and subadults have a reddish-brown carapace. Scales on the top of the head and top of the flippers are also reddish-brown with yellow on the borders. Hatchlings are a dull brown color (NMFS 2010a). The loggerhead feeds on mollusks, crustaceans, fish, and other marine animals.

The loggerhead occurs throughout the temperate and tropical regions of the Atlantic, Pacific, and Indian Oceans. It may be found hundreds of miles out to sea, as well as in inshore areas such as bays, lagoons, salt marshes, creeks, ship channels, and the mouths of large rivers. Coral reefs, rocky places, and ship wrecks are often used as feeding areas.

Within the Northwest Atlantic, the majority of nesting activity occurs from April through September, with a peak in June and July (Williams-Walls et al. 1983, Dodd 1988, Weishampel et al 2006). Nesting occurs within the Northwest Atlantic along the coasts of North America, Central America, northern South America, the Antilles, Bahamas, and Bermuda, but is concentrated in the southeastern U.S. and on the Yucatan Peninsula in Mexico on open beaches or along narrow bays having suitable sand (Sternberg 1981, Ehrhart 1989, Ehrhart et al 2003, NMFS and USFWS 2008).

Species/Critical Habitat Description- Green Sea Turtle

The green sea turtle was federally listed on July 28, 1978, (NMFS and USFWS 1978). Breeding populations of the species in Florida and along the Pacific Coast of Mexico are listed as endangered; all other populations are listed as threatened. The green sea turtle has a worldwide distribution in tropical and subtropical waters. Critical habitat for the species has been designated for the waters surrounding Culebra Island, Puerto Rico, and its outlying keys.

The green sea turtle grows to a maximum size of about four feet and a weight of 440 pounds. It has a heart-shaped shell, small head, and single-clawed flippers. The carapace is smooth and colored gray, green, brown and black. Hatchlings are black on top and white on the bottom (NMFS 2010b). Hatchling green turtles eat a variety of plants and animals, but adults feed almost exclusively on seagrasses and marine algae.

Major green sea turtle nesting colonies in the Atlantic occur on Ascension Island, Aves Island, Costa Rica, and Surinam. Within the U.S., green turtles nest in small numbers in the U.S. Virgin Islands and Puerto Rico, and in larger numbers along the east coast of Florida, particularly in Brevard, Indian River, St. Lucie, Martin, Palm Beach, and Broward Counties (NMFS and USFWS 1991a).

Green sea turtles are generally found in fairly shallow waters (except when migrating) inside reefs, bays, and inlets. The green turtle is attracted to lagoons and shoals with an abundance of marine grass and algae. Open beaches with a sloping platform and minimal disturbance are required for nesting.

Species/Critical Habitat Description - Leatherback Sea Turtle

The leatherback sea turtle was federally listed as an endangered species on June 2, 1970 (USFWS 1970). Leatherbacks have the widest distribution of the sea turtles with non-breeding animals have been recorded as far north as the British Isles and the Maritime Provinces of Canada and as far south as Argentina and the Cape of Good Hope (Pritchard 1992). Foraging leatherback excursions have been documented into higher-latitude subpolar waters. They have evolved physiological and anatomical adaptations (Frair et al. 1972, Greer et al. 1973) that allow them to exploit waters far colder than any other sea turtle species would be capable of surviving. Marine and terrestrial critical habitat for the species has been designated at Sandy Point on the western end of the island of St. Croix, U.S. Virgin Islands (USFWS 1978).

The adult leatherback can reach four to eight feet in length and weigh 500 to 2,000 pounds. The carapace is distinguished by a rubber-like texture, about 1.6 inches thick, made primarily of tough, oil-saturated connective tissue. Hatchlings are dorsally mostly black and are covered with tiny scales; the flippers are edged in white, and rows of white scales appear as stripes along the length of the back (NMFS 2010c). Jellyfish are the main staple of its diet, but it is also known to feed on sea urchins, squid, crustaceans, tunicates, fish, blue-green algae, and floating seaweed. This is the largest, deepest diving of all sea turtle species.

Leatherback turtle nesting grounds are distributed worldwide in the Atlantic, Pacific and Indian Oceans on beaches in the tropics and sub-tropics. The Pacific Coast of Mexico historically supporting the world's largest known concentration of nesting leatherbacks. The leatherback turtle regularly nests in the U.S., Puerto Rico, and the U.S. Virgin Islands. Along the Atlantic coast of most nesting is in Florida to Georgia (NMFS and USFWS 1992). Leatherback nesting has also been reported on the northwest coast of Florida (LeBuff 1990); and in southwest Florida a false crawl (non-nesting emergence) has been observed on Sanibel Island (LeBuff 1990).

Adult females require sandy nesting beaches backed with vegetation and sloped sufficiently so the distance to dry sand is limited. Their preferred beaches have proximity to deep water and generally rough seas.

Life History – Sea Turtles

Life History - Loggerhead Sea Turtle

Loggerheads are long-lived, slow-growing reptiles that use multiple habitats across entire ocean basins throughout their life history. This complex life history encompasses terrestrial, nearshore, and open ocean habitats. The three basic ecosystems in which loggerheads live are the:

1. Terrestrial zone (supralittoral) - the nesting beach where both oviposition (egg laying) and embryonic development and hatching occur.

2. Neritic zone - the inshore marine environment (from the surface to the sea floor) where water depths do not exceed 656 feet. The neritic zone generally includes the continental shelf, but in

areas where the continental shelf is very narrow or nonexistent, the neritic zone conventionally extends to areas where water depths are less than 656 feet.

3. Oceanic zone - the vast open ocean environment (from the surface to the sea floor) where water depths are greater than 656 feet.

Maximum intrinsic growth rates of sea turtles are limited by the extremely long duration of the juvenile stage and fecundity. Loggerheads require high survival rates in the juvenile and adult stages, common constraints critical to maintaining long-lived, slow-growing species, to achieve positive or stable long-term population growth (Congdon et al. 1993, Heppell 1998, Crouse 1999, Heppell et al. 1999, 2003, Musick 1999).

Numbers of nests and nesting females are often highly variable from year to year due to a number of factors including environmental stochasticity, periodicity in ocean conditions, anthropogenic effects, and density-dependent and density-independent factors affecting survival, somatic growth, and reproduction (Hays 2000, Chaloupka 2001, Solow el al. 2002). Despite these sources of variation, and because female turtles exhibit strong nest site fidelity, a nesting beach survey can provide a valuable assessment of changes in the adult female population, provided that the study is sufficiently long and effort and methods are standardized (Gerrodette and Brandon 2000, Reina el al. 2002).

Loggerheads nest on ocean beaches and occasionally on estuarine shorelines with suitable sand. Nests are typically laid between the high tide line and the dune front (Routa 1968, Witherington 1986, Hailman and Elowson 1992). Wood and Bjorndal (2000) evaluated four environmental factors (slope, temperature, moisture, and salinity) and found that slope had the greatest influence on loggerhead nest-site selection on a beach in Florida. Loggerheads appear to prefer relatively narrow, steeply sloped, coarse-grained beaches, although nearshore contours may also play a role in nesting beach site selection (Provancha and Ehrhart 1987).

The warmer the sand surrounding the egg chamber, the faster the embryos develop (Mrosovsky and Yntema 1980). Sand temperatures prevailing during the middle third of the incubation period also determine the sex of hatchling sea turtles (Mrosovsky and Yntema 1980, Vogt and Bull 1982) making them vulnerable to environmental conditions that influence incubation temperatures.

Loggerhead hatchlings pip and escape from their eggs over a one to three day interval and move upward and out of the nest over a two to four day interval (Christens 1990). The time from pipping to emergence ranges from four to seven days with an average of 4.1 days (Godfrey and Mrosovsky 1997). Hatchlings emerge from their nests en masse almost exclusively at night, and presumably using decreasing sand temperature as a cue (Hendrickson 1958, Mrosovsky 1968, Witherington et al. 1990). Moran et al. (1999) concluded that a lowering of sand temperatures below a critical threshold, which most typically occurs after nightfall, is the most probable trigger for hatchling emergence from a nest. After an initial emergence, there may be secondary emergences on subsequent nights (Carr and Ogren 1960, Witherington 1986, Ernest and Martin 1993, Houghton and Hays 2001).

Hatchlings use a progression of orientation cues to guide their movement from the nest to the marine environments where they spend their early years (Lohmann and Lohmann 2003). Hatchlings first use light cues to find the ocean. On naturally lighted beaches without artificial lighting, ambient light from the open sky creates a relatively bright horizon compared to the dark silhouette of the dune and vegetation landward of the nest. This contrast guides the hatchlings to the ocean (Daniel and Smith 1947, Limpus 1971, Salmon et al. 1992, Witherington 1997, Witherington and Martin 1996, Stewart and Wyneken 2004).

Loggerheads in the Northwest Atlantic display complex population structure based on life history stages. Based on mitochondrial deoxyribonucleic acid (mtDNA), oceanic juveniles show no structure, neritic juveniles show moderate structure and nesting colonies show strong structure (Bowen et al. 2005). In contrast, a survey using microsatellite (nuclear) markers showed no significant population structure among nesting populations (Bowen et al. 2005), indicating that while females exhibit strong philopatry, males may provide an avenue of gene flow between nesting colonies in this region.

Life History - Green Sea Turtles

Nesting habits for the green turtle are very similar to those of the loggerhead turtle, with only slight differences (NPS 2010a, p. 215). Green sea turtles deposit from one to nine clutches within a nesting season, but the overall average is about 3.3 nests. The interval between nesting events within a season varies around a mean of about 13 days (Hirth 1997). Mean clutch size varies widely among populations. Average clutch size reported for Florida was 136 eggs in 130 clutches (Witherington and Ehrhart 1989). Only occasionally do females produce clutches in successive years. Usually two or more years intervene between breeding seasons (NMFS and USFWS 1991a). Age at sexual maturity is believed to be 20 to 50 years (Hirth 1997).

Life History - Leatherback Sea Turtles

Leatherback nesting grounds are distributed circumglobally, with the largest known nesting area occurring on the Pacific Coast of southern Mexico. Nesting in the United States occurs primarily in Puerto Rico, the U.S. Virgin Islands, and southeastern Florida (NMFS and USFWS 1992).

Leatherbacks nest an average of five to seven times within a nesting season, with an observed maximum of 11 (NMFS and USFWS 1992). The interval between nesting is about nine to ten days. Clutch size averages 80 to 85 yolked eggs, with the addition of usually a few dozen smaller, yolkless eggs, mostly laid toward the end of the clutch (Pritchard 1992). Most leatherbacks return at two to three-year intervals based on data from the Sandy Point National Wildlife Refuge, St. Croix, U.S. Virgin Islands (McDonald and Dutton 1996). Leatherbacks are believed to reach sexual maturity in six to ten years (Zug and Parham 1996).

Population Dynamics – Sea Turtles

Population Dynamics - Loggerhead Sea Turtle

The loggerhead occurs throughout the temperate and tropical regions of the Atlantic, Pacific, and Indian Oceans. The loggerhead is commonly found throughout the North Atlantic including the Gulf of Mexico, the northern Caribbean, the Bahamas archipelago, and eastward to West Africa, the western Mediterranean, and the west coast of Europe.

The majority of loggerhead nesting is at the western rims of the Atlantic and Indian Oceans. The most recent reviews show that only two loggerhead nesting beaches have greater than 10,000 females nesting per year (Baldwin et al. 2003, Ehrhart et al. 2003, Kamezaki et al. 2003, Limpus and Limpus 2003, Margaritoulis et al. 2003): South Florida (U.S.) and Masirah (Oman). Those beaches with 1,000 to 9,999 females nesting each year are Georgia through North Carolina (U.S.), Quintana Roo and Yucatan (Mexico), Cape Verde Islands (Cape Verde, eastern Atlantic off Africa), and Western Australia (Australia). Smaller nesting aggregations with 100 to 999 nesting females annually occur in the Northern Gulf of Mexico (U.S.), Dry Tortugas (U.S.), Cay Sal Bank (Bahamas), Sergipe and Northern Bahia (Brazil), Southern Bahia to Rio de Janerio (Brazil), Tongaland (South Africa), Mozambique, Arabian Sea Coast (Oman), Halaniyat Islands (Oman), Cyprus, Peloponnesus (Greece), Island of Zakynthos (Greece), Turkey, Queensland (Australia), and Japan.

The major nesting concentrations in the U.S. are found in South Florida. However, loggerheads nest from Texas to Virginia. Total estimated nesting in the U.S. has fluctuated between 49,000 and 90,000 nests per year from 1999-2008 (NMFS and USFWS 2008). About 80 percent of loggerhead nesting in the southeast U.S. occurs in six Florida counties (Brevard, Indian River, St. Lucie, Martin, Palm Beach, and Broward Counties). Adult loggerheads are known to make considerable migrations between foraging areas and nesting beaches (Schroeder et al. 2003, Foley et al. 2008). During non-nesting years, adult females from U.S. beaches are distributed in waters off the eastern U.S. and throughout the Gulf of Mexico, Bahamas, Greater Antilles, and Yucatan.

From a global perspective, the U.S. nesting aggregation is of paramount importance to the survival of the species as is the population that nests on islands in the Arabian Sea off Oman (Ross 1982, Ehrhart 1989). The status of the Oman loggerhead nesting population, reported to be the largest in the world (Ross 1979), is uncertain because of the lack of long-term standardized nesting or foraging ground surveys and its vulnerability to increasing development pressures near major nesting beaches and threats from fisheries interaction on foraging grounds and migration routes (Possardt 2005). The loggerhead nesting aggregations in Oman and the U.S. account for the majority of nesting worldwide.

Population Dynamics - Green Sea Turtle

About 100 to 1,000 females are estimated to nest on beaches in Florida annually (Florida Fish and Wildlife Conservation Commission 2010). In the U.S. Pacific, nesting takes place at scattered locations in the Commonwealth of the Northern Marianas, Guam, and American

Samoa. In the western Pacific, the largest green turtle nesting aggregation in the world occurs on Raine Island, Australia, where thousands of females nest nightly in an average nesting season (Limpus et al. 1993). In the Indian Ocean, major nesting beaches occur in Oman where 30,000 females are reported to nest annually (Ross and Barwani 1995).

Average clutch sizes range from 110 to 115 eggs, although this varies by population, and females produce clutches in successive years only occasionally. Usually two to four years or more occur between breeding seasons (NMFS and USFWS 1991a).

Population Dynamics - Leatherback Sea Turtle

A dramatic drop in nesting numbers has been recorded on major nesting beaches in the Pacific. Spotila et al. (2000) have highlighted the dramatic decline and possible extirpation of leatherbacks in the Pacific.

The East Pacific and Malaysia leatherback populations have collapsed. Spotila et al. (1996) estimated that only 34,500 females nested annually worldwide in 1995, which is a dramatic decline from the 115,000 estimated in 1980 (Pritchard 1982). In the eastern Pacific, the major nesting beaches occur in Costa Rica and Mexico. At Playa Grande, Costa Rica, considered the most important nesting beach in the eastern Pacific, numbers have dropped from 1,367 leatherbacks in 1988-1989 to an average of 188 females nesting between 2000-2001 and 2003-2004. In Pacific Mexico, 1982 aerial surveys of adult female leatherbacks indicated this area had become the most important leatherback nesting beach in the world. Tens of thousands of nests were laid on the beaches in 1980s, but during the 2003-2004 seasons a total of 120 nests were recorded. In the western Pacific, the major nesting beaches lie in Papua New Guinea, Papua, Indonesia, and the Solomon Islands. These are some of the last remaining significant nesting assemblages in the Pacific. Compiled nesting data estimated approximately 5,000 to 9,200 nests annually with 75 percent of the nests being laid in Papua, Indonesia.

However, the most recent population size estimate for the North Atlantic alone is a range of 34,000 to 94,000 adult leatherbacks (Turtle Expert Working Group (TEWG) 2007). In Florida, an annual increase in number of leatherback nests at the core set of index beaches ranged from 27 to 498 between 1989 and 2008. Under the Core Index Nesting Beach Survey (INBS) program, 198.8 miles of nesting beach have been divided into zones, known as core index zones, averaging one-half mile in length. Annually, between 1989 and 2008, these core index zones were monitored daily during the 109-day sea turtle index nesting season (May 15 to August 31). On all index beaches, researchers recorded nests and nesting attempts by species, nest location, and date.

Nesting in the Southern Caribbean occurs in the Guianas (Guyana, Suriname, and French Guiana), Trinidad, Dominica, and Venezuela. The largest nesting populations at present occur in the western Atlantic in French Guiana with nesting varying between a low of 5,029 nests in 1967 to a high of 63,294 nests in 2005, which represents a 92 percent increase since 1967 (TEWG 2007). Trinidad supports an estimated 6,000 leatherbacks nesting annually, which represents more than 80 percent of the nesting in the insular Caribbean Sea. Leatherback nesting along the Caribbean Central American coast takes place between Honduras and Colombia. In Atlantic

Costa Rica, at Tortuguero, the number of nests laid annually between 1995 and 2006 was estimated to range from 199 to 1,623. Modeling of the Atlantic Costa Rica data indicated that the nesting population has decreased by 67.8 percent over this time period.

In Puerto Rico, the main nesting areas are at Fajardo on the main island of Puerto Rico and on the island of Culebra. Between 1978 and 2005, nesting increased in Puerto Rico with a minimum of nine nests recorded in 1978 and a minimum of469 to 882 nests recorded each year between 2000 and 2005. Recorded leatherback nesting on the Sandy Point National Wildlife Refuge on the island of St. Croix, U.S. Virgin Islands between 1990 and 2005, ranged from a low of 143 in 1990 to a high of 1,008 in 2001. In the British Virgin Islands, annual nest numbers have increased in Tortola from zero to six nests per year in the late 1980s to 35 to 65 nests per year in the 2000s.

The most important nesting beach for leatherbacks in the eastern Atlantic lies in Gabon, Africa. It was estimated there were 30,000 nests along 60 miles of Mayumba Beach in southern Gabon during the 1999-2000 nesting season. Some nesting has been reported in Mauritania, Senegal, the Bijagos Archipelago of Guinea-Bissau, Turtle Islands and Sherbro Island of Sierra Leone, Liberia, Togo, Benin, Nigeria, Cameroon, Sao Tome and Principe, continental Equatorial Guinea, Islands of Corisco in the Gulf of Guinea and the Democratic Republic of the Congo, and Angola. In addition, a large nesting population is found on the island of Bioko (Equatorial Guinea).

Status and Distribution - Loggerhead Sea Turtle

Five recovery units (subpopulations) have been identified in the Northwest Atlantic based on genetic differences and a combination of geographic distribution of nesting densities and geographic separation (NMFS and USFWS 2008). These recovery units are:

1. Northern Recovery Unit (NRU) - defined as loggerheads originating from nesting beaches from the Florida-Georgia border through southern Virginia (the northern extent of the nesting range);

2. Peninsula Florida Recovery Unit (PFRU) - defined as loggerheads originating from nesting beaches from the Florida-Georgia border through Pinellas County on the west coast of Florida, excluding the islands west of Key West, Florida;

3. Dry Tortugas Recovery Unit (DTRU) - defined as loggerheads originating from nesting beaches throughout the islands located west of Key West, Florida;

4. Northern Gulf of Mexico Recovery Unit (NGMRU) - defined as loggerheads originating from nesting beaches from Franklin County on the northwest Gulf coast of Florida through Texas; and,

5. Greater Caribbean Recovery Unit (GCRU) - composed of loggerheads originating from all other nesting assemblages within the Greater Caribbean (Mexico through French Guiana, The Bahamas, Lesser Antilles, and Greater Antilles).

The mt(mitochrondial)DNA analyses show that there is limited exchange of females among these recovery units (Ehrhart 1989, Foote et al. 2000, Hawkes et al. 2005). Based on the number of haplotypes, the highest level of loggerhead mtDNA genetic diversity in the Northwest Atlantic has been observed in females of the GCRU that nest at Quintana Roo, Mexico (Encalada et al. 1999, Nielsen el al. in press).

Nuclear DNA analyses show that there are no substantial subdivisions across the loggerhead nesting colonies in the southeastern U.S. Male-mediated gene flow appears to be keeping the subpopulations genetically similar on a nuclear DNA level (Francisco-Pearce 2001).

Historically, the literature has suggested that the northern U.S. nesting beaches (NRU and NGMRU) produce a relatively high percentage of males and the more southern nesting beaches (PFRU, DTRU, and GCRU) a relatively high percentage of females (e.g., Hanson el al. 1998). The NRU and NGMRU were believed to play an important role in providing males to mate with females from the more female-dominated subpopulations to the south. However, in 2002 and 2003, researchers studied loggerhead sex ratios for two of the U.S. nesting subpopulations, the northern and southern subpopulations (NGU and PFRU, respectively) (Blair 2005, Wyneken et al. 2005). The study produced interesting results. In 2002, the northern beaches produced more females and the southern beaches produced more males than previously believed. However, the opposite was true in 2003 with the northern beaches producing more males and the southern beaches producing more females in keeping with prior literature. Wyneken et al. (2005) speculated that the 2002 result may have been anomalous; however, the study did point out the potential for males to be produced on the southern beaches. Although this study revealed that more males may be produced on southern recovery unit beaches than previously believed, the USFWS maintains that the NRU and NGMRU play an important role in the production of males to mate with females from the more southern recovery units.

The NRU is the second largest loggerhead nesting aggregation in the Northwest Atlantic. Annual nest totals from northern beaches averaged 5,215 nests from 1989-2008, a period of near-complete surveys of NRU nesting beaches (NMFS and USFWS 2008), representing approximately 1,272 nesting females per year (4.1 nests per female, Murphy and Hopkins 1984). The loggerhead nesting trend from daily beach surveys showed a significant decline of 1.3 percent annually. Nest totals from aerial surveys conducted by the South Carolina Department of Natural Resources showed a 1.9 percent annual decline in nesting in South Carolina since 1980. Overall, there is strong statistical data to suggest the NRU has experienced a long-term decline.

The PFRU is the largest loggerhead nesting assemblage in the Northwest Atlantic. A near-complete nest census of the PFRU undertaken from 1989 to 2007 reveals a mean of 64,513 loggerhead nests per year representing approximately 15,735 females nesting per year (4.1 nests per female, Murphy and Hopkins 1984). This near-complete census provides the best statewide estimate of total abundance, but because of variable survey effort, these numbers cannot be used to assess trends. Loggerhead nesting trends are best assessed using standardized nest counts made at Index Nesting Beach Survey (INBS) sites surveyed with constant effort over time. In 1979, the Statewide Nesting Beach Survey (SNBS) program was initiated to document the total distribution, seasonality and abundance of sea turtle nesting in Florida. In 1989, the INBS program was initiated in Florida to measure seasonal productivity, allowing comparisons between beaches and between years (Florida Fish and Wildlife Conservation Commission 2010). Of the 190 SNBS surveyed areas, 33 participate in the INBS program (representing 30 percent of the SNBS beach length).

An analysis of these data has shown a decline in nesting from 1989-2008 (Witherington et al. 2009). The analysis that reveals this decline uses nest-count data from 345 representative Atlantic-coast index zones (total length = 187 miles) and 23 representative zones on Florida's southern Gulf coast (total length = 14.3 miles). The spatial and temporal coverage (annually, 109 days and 368 zones) accounted for an average of 70 percent of statewide loggerhead nesting activity between 1989 and 2008. Negative binomial regression models that fit restricted cubic spline curves to aggregated nest-counts were used in trend evaluations. Results of the analysis indicated that there had been a decrease of 26 percent over the 20-year period and a 41 percent decline since 1998. The mean annual rate of decline for the 20-year period was 1.6 percent.

The NGMRU is the third largest nesting assemblage among the four U.S. recovery units. Nesting surveys conducted on approximately 186 miles of beach within the NGMRU (Alabama and Florida only) were undertaken between 1995 and 2007 (statewide surveys in Alabama began in 2002). The mean nest count during this 13-year period was 906 nests per year, which equates to about 221 females nesting per year (4.1 nests per female, Murphy and Hopkins 1984). Evaluation of long-term nesting trends for the NGMRU is difficult because of changed and expanded beach coverage. Loggerhead nesting trends are best assessed using standardized nest counts made at INBS sites surveyed with constant effort over time. A log-linear regression showed a significant declining trend of 4.7 percent annually.

The DTRU, located west of the Florida Keys, is the smallest of the identified recovery units. A near-complete nest census of the DTRU undertaken from 1995 to 2004, excluding 2002, (nine years surveyed) reveals a mean of 246 nests per year, which equates to about 60 females nesting per year (4.1 nests per female, Murphy and Hopkins 1984). Surveys after 2004 did not include principal nesting beaches within the recovery unit (i.e., Dry Tortugas National Park). The nesting trend data for the DTRU are from beaches that are not part of the INBS program, but are part of the SNBS program. There are nine years of data for this recovery unit. A simple linear regression accounting for temporal auto-correlation revealed no trend in nesting numbers. Because of the annual variability in nest totals, a longer time series is needed to detect a trend.

The GCRU is composed of all other nesting assemblages of loggerheads within the Greater Caribbean. Statistically valid analyses of long-term nesting trends for the entire GCRU are not available because there are few long-term standardized nesting surveys representative of the region. Additionally, changing survey effort at monitored beaches and scattered and low-level nesting by loggerheads at many locations currently precludes comprehensive analyses. The most complete data are from Quintana Roo and Yucatan, Mexico, where an increasing trend was reported over a 15-year period from 1987-2001 (Zurita et al. 2003). However, since 2001, nesting has declined and the previously reported increasing trend appears not to have been sustained (NMFS and USFWS 2008). Other smaller nesting populations have experienced declines over the past few decades (e.g., Amorocho 2003).

Recovery Criteria- Loggerhead Sea Turtles

The three broad recovery criteria for loggerhead sea turtles and the specific nesting criteria by recovery unit are:

1. Number of Nests and Number of Nesting Females

a. Northern Recovery Unit

i. There is statistical confidence (95 percent) that the annual rate of increase over a generation time of 50 years is 2 percent or greater resulting in a total annual number of nests of 14,000 or greater for this recovery unit (approximate distribution of nests is North Carolina =14 percent [2,000 nests], South Carolina = 66 percent [9,200 nests], and Georgia =20 percent [2,800 nests]); and,

ii. This increase in number of nests must be a result of corresponding increases in number of nesting females (estimated from nests, clutch frequency, and remigration interval).

b. Peninsular Florida Recovery Unit

i. There is statistical confidence (95 percent) that the annual rate of increase over a generation time of 50 years is statistically detectable (one percent) resulting in a total annual number of nests of 106,100 or greater for this recovery unit; and,

ii. This increase in number of nests must be a result of corresponding increases in number of nesting females (estimated from nests, clutch frequency, and remigration interval).

c. Dry Tortugas Recovery Unit

i. There is statistical confidence (95 percent) that the annual rate of increase over a generation time of 50 years is three percent or greater resulting in a total annual number of nests of 1,100 or greater for this recovery unit; and,

ii. This increase in number of nests must be a result of corresponding increases in number of nesting females (estimated from nests, clutch frequency, and remigration interval).

d. Northern Gulf of Mexico Recovery Unit

i. There is statistical confidence (95 percent) that the annual rate of increase over a generation time of 50 years is three percent or greater resulting in a total annual number of nests of4,000 or greater for this recovery unit (approximate distribution of nests (2002-2007) is Florida= 92 percent [3,700 nests] and Alabama =8 percent [300 nests]); and,

ii. This increase in number of nests must be a result of corresponding increases in number of nesting females (estimated from nests, clutch frequency, and remigration interval).

e. Greater Caribbean Recovery Unit

i. The total annual number of nests at a minimum of three nesting assemblages, averaging greater than 100 nests annually (e.g., Yucatan, Mexico; Cay Sal Bank, Bahamas) has increased over a generation time of 50 years; and,

ii. This increase in number of nests must be a result of corresponding increases in number of nesting females (estimated from nests, clutch frequency, and remigration interval).

2. A network of in-water sites, both oceanic and neritic across the foraging range is established and monitoring is implemented to measure abundance. There is statistical confidence (95 percent) that a composite estimate of relative abundance from these sites is increasing for at least one generation.

3. Stranding trends are not increasing at a rate greater than the trends in in-water relative abundance for similar age classes for at least one generation.

Status and Distribution - Green Sea Turtle

Total population estimates for the green turtle are unavailable, and trends based on nesting data are difficult to assess because of large annual fluctuations in numbers of nesting females. For instance, nesting data collected as part of the Florida INBS program (1989 and 2008) show a range of approximately 267 and 12,752 nests laid in Florida, where the majority of green turtle nesting in the southeastern U.S. occurs. Populations in Surinam and Tortuguero, Costa Rica, may be stable, but there are insufficient data for other areas to confirm a trend.

Recovery Criteria – Green Sea Turtle

The U.S. Atlantic population of green sea turtles can be considered for delisting when, over a period of 25 years the following conditions are met:

1. The level of nesting in Florida has increased to an average of 5,000 nests per year for at least six years. Nesting data shall be based on standardized surveys;

2. At least 25 percent (65 miles) of all available nesting beaches (260 miles) are in public ownership and encompass at least 50 percent of the nesting activity;

3. A reduction in stage class mortality is reflected in higher counts of individuals on foraging grounds; and,

4. All priority one tasks identified in the recovery plan have been successfully implemented.

The Recovery Plans for the U.S. Atlantic, Pacific, and East Pacific populations of green turtles were completed in 1991, 1998, and 1998 respectively.

Status and distribution - Leatherback Sea Turtle

Declines in leatherback nesting have occurred over the last two decades along the Pacific coasts of Mexico and Costa Rica. The Mexican leatherback nesting population, once considered to be the world's largest leatherback nesting population (historically estimated to be 65 percent of worldwide population), is now less than one percent of its estimated size in 1980. Spotila et al. (1996) estimated the number of leatherback sea turtles nesting on 28 beaches throughout the world from the literature and from communications with investigators studying those beaches. The estimated worldwide population of leatherbacks in 1995 was about 34,500 females on these beaches with a lower limit of about 26,200, and an upper limit of about 42,900. This is less than one-third the 1980 estimate of 115,000. Leatherbacks are rare in the Indian Ocean and in very low numbers in the western Pacific Ocean. The largest population is in the western Atlantic. Using an age-based demographic model, Spotila et al. (1996) determined that leatherback populations in the Indian Ocean and western Pacific Ocean cannot withstand even moderate levels of adult mortality and that the Atlantic populations are being exploited at a rate that cannot be sustained. They concluded that leatherbacks are on the road to extinction and further population declines can be expected unless action is taken to reduce adult mortality and increase survival of eggs and hatchlings.

In the U.S., nesting populations occur in Florida, Puerto Rico, and the U.S. Virgin Islands. In Florida, the SNBS program documented an increase in leatherback nesting numbers from 1988 to the early 2000s (Stewart and Johnson 2006). Although the SNBS program provides information on distribution and total abundance statewide, it cannot be used to assess trends because of variable survey effort. Therefore, leatherback nesting trends are best assessed using standardized nest counts made at INBS sites surveyed with constant effort over time (1989-2009). An analysis of the INBS data has shown a substantial increase in leatherback nesting in Florida since 1989 (Turtle Expert Working Group (TEWG) 2007). The annual number of leatherback nests at the core set of index beaches in Florida ranged from 27 to 615 between 1989 and 2010 (Florida Fish and Wildlife Conservation Commission 2010).

Recovery Criteria

The U.S. Atlantic population of leatherbacks can be considered for delisting when the following conditions are met:

1. The adult female population increases over the next 25 years, as evidenced by a statistically significant trend in the number of nests at Culebra, Puerto Rico, St. Croix, U.S. Virgin Islands, and along the east coast of Florida;

2. Nesting habitat encompassing at least 75 percent of nesting activity in U.S. Virgin Islands, Puerto Rico, and Florida is in public ownership; and,

3. All priority one tasks identified in the recovery plan have been successfully implemented.

The current Recovery Plan for the leatherback turtles in the U.S. Caribbean, Atlantic, and Gulf of Mexico was implemented in 1992 (NMFS and USFWS 1992) and for the U.S. Pacific populations in 1998 (NMFS and USFWS 1998).

Threats to Sea Turtles – All Species

Anthropogenic (human) factors that impact hatchlings and adult female turtles on land, or the success of nesting and hatching include: beach erosion, armoring and nourishment; artificial lighting; beach cleaning; increased human presence; recreational beach equipment; beach driving; coastal construction and fishing piers; exotic dune and beach vegetation; and poaching. An increased human presence at some nesting beaches or close to nesting beaches has led to secondary threats such as the introduction of exotic fire ants, feral hogs, dogs, and an increased presence of native species (e.g., raccoons, armadillos, and opossums), which raid and feed on turtle eggs. Although sea turtle nesting beaches are protected along large expanses of the western North Atlantic coast, other areas along these coasts have limited or no protection.

Anthropogenic threats in the marine environment include oil and gas exploration and transportation; marine pollution; underwater explosions; hopper dredging, offshore artificial lighting; power plant entrainment and/or impingement; entanglement in debris; ingestion of marine debris; marina and dock construction and operation; boat collisions; poaching and fishery interactions.

The April 2010 explosion and sinking of British Petroleum's Deep Water Horizon drilling rig resulted in a massive flow of oil into the Gulf of Mexico. The effects of this massive oil spill have yet to be determined, but numerous adverse impacts on sea turtles may occur. Sea turtles may be exposed to chemicals in oil or to chemicals in products such as dispersants used in two ways: internally (eating or swallowing oil, consuming prey containing oil based chemicals, or inhaling of volatile oil related compounds) and externally (swimming in oil or dispersants). Oil and other chemicals on skin and body may result in skin and eye irritation, burns to mucous membranes of eyes and mouth, and increased susceptibility to infection. Inhalation of volatile organics from oil or dispersants may result in respiratory irritation, tissue injury, and pneumonia. Ingestion of oil or dispersants may result in gastrointestinal inflammation, ulcers, bleeding, diarrhea, and maldigestion. Absorption of inhaled and ingested chemicals may damage organs such as the liver or kidney, result in anemia and immune suppression, or lead to reproductive failure or death.

Several aspects of sea turtle behavior put them at risk including the importance to turtles of surface convergence areas, typically highly productive areas where ocean currents converge and where oil has been found. These areas provide feeding and sheltering habitat to sea turtles in the Gulf of Mexico. Sea turtles are air breathers and all must come to the surface frequently to take a breath of air. In a large oil spill, these animals may be exposed to volatile chemicals during inhalation. Additionally, sea turtles may experience oiling impacts on nesting beaches when they come ashore to lay their eggs, and their eggs may be exposed during incubation potentially resulting in increased egg mortality and/or possibly developmental defects in hatchlings. Hatchlings emerging from their nests may encounter oil on the beach and in the water as they begin their lives at sea.

In order to reduce the risk of sea turtle hatchling crawling into oiled water, several state and federal agencies are cooperating to excavate remove hundreds of sea turtle nests on beaches from Alabama across the Florida panhandle and moved the eggs to Florida's East Coast. A private company is providing specialized transportation and will move hundreds of other nests to Florida's east coast adjacent to the Kennedy Space Center for final incubation and hatchling release. Dozens of nest relocations are expected to take place over the summer nesting season.

Fibropapillomatosis, a disease of sea turtles characterized by the development of multiple tumors on the skin and internal organs, is also a mortality factor, particularly for green turtles. This disease has seriously impacted green turtle populations in Florida, Hawaii, and other parts of the world. The tumors interfere with swimming, eating, breathing, vision, and reproduction, and turtles with heavy tumor burdens may die.

Coastal Development

Loss of nesting habitat related to coastal development has had the greatest impact on nesting sea turtles in Florida. Beachfront development may create a need to protect upland structures and infrastructure by armoring, groin placement, beach emergency berm construction and repair, and beach nourishment which cause changes in, additional loss or impact to the remaining sea turtle habitat.

The DEIS discussed some of the problems for nesting sea turtles associated with the human presence resulting from coastal development (NPS 2010a, pp. 216-217). The greatest threat posed by humans on the beach at night is disturbance of female turtles before they have finished nesting. From the time a female exits the surf until she has begun covering her nest, she is highly vulnerable to disturbance, especially prior to and during the early stages of egg laying. Females that abort a nesting attempt may attempt to nest again at or near the same location or select a new site later that night or the following night. However, repeated interruption of nesting attempts may cause a turtle to construct her nest in a sub-optimum incubation environment, postpone nesting for several days, prompt movement many kilometers from the originally chosen nesting site, or result in the shedding of eggs at sea. Direct harassment may also cause adult turtles to reduce the time spent covering the nest. In addition, heavy pedestrian traffic may compact sand over unmarked nests, although the effect of this compaction has not been determined and may be negligible. Depending on the nesting substrate, pedestrian traffic over nests near the time of emergence can cause nests to collapse and result in hatchling mortality.

Coastal development may generate beach debris that interferes with nesting females and hatchlings (NPS 2010a, p. 219). Hatchlings often must navigate through a variety of obstacles before reaching the ocean. These include natural and human-made debris. Debris on the beach may interfere with a hatchling's progress toward the ocean. Research has shown that travel times of hatchlings from the nest to the water may be extended when traversing areas of heavy foot traffic or vehicular ruts; the same is true of debris on the beach. Hatchlings may be upended and spend both time and energy in righting themselves. Some beach debris may have the potential to trap hatchlings and prevent them from successfully reaching the ocean. In addition, debris over the tops of nests may impede or prevent hatchling emergence.

Hurricanes

Periodic, short-term, weather-related erosion events (e.g., atmospheric fronts, Nor'easter storms, tropical storms, and hurricanes) are common phenomena throughout the loggerhead nesting range and may vary considerably from year to year. Hurricanes were probably responsible for maintaining coastal beach habitat upon which sea turtles depend through repeated cycles of destruction, alteration, and recovery of beach and dune habitat. Hurricanes generally produce damaging winds, storm tides and surges, and rain, which can result in severe erosion of the beach and dune systems. Overwash and blowouts are common on barrier islands. Hurricanes and other storms can result in the direct or indirect loss of sea turtle nests, either by erosion or washing away of the nests by wave action, inundation or "drowning" of the eggs or hatchlings developing within the nest or indirectly by loss of nesting habitat. Depending on their frequency, storms can affect sea turtles on either a short-term basis (nests lost for one season and/or temporary loss of nesting habitat) or long term, if frequent (habitat unable to recover). How hurricanes affect sea turtle nesting also depends on its characteristics (winds, storm surge, rainfall), the time of year (within or outside of the nesting season), and where the northeast edge of the hurricane crosses land.

Because of the limited remaining nesting habitat, frequent or successive severe weather events could threaten the ability of certain sea turtle populations to survive and recover. Sea turtles evolved under natural coastal environmental events such as hurricanes. The extensive amount of predevelopment coastal beach and dune habitat allowed sea turtles to survive even the most severe hurricane events. It is only within the last 20 to 30 years that the combination of habitat loss to beachfront development and destruction of remaining habitat by hurricanes has increased the threat to sea turtle survival and recovery. On developed beaches, typically little space remains for sandy beaches to become reestablished after periodic storms. While the beach itself moves landward during such storms, reconstruction or persistence of structures at their pre-storm locations can result in a major loss of nesting habitat.

Erosion

A critically eroded area is a segment of shoreline where natural processes or human activity have caused or contributed to erosion and recession of the beach or dune system to such a degree that upland development, recreational interests, wildlife habitat, or important cultural resources are threatened or lost. Critically eroded areas may also include peripheral segments or gaps between identified critically eroded areas which, although they may be stable or slightly erosional now, their inclusion is necessary for continuity of management of the coastal system or for the design integrity of adjacent beach management projects (Florida Department of Environmental Protection (FDEP) 2010).

Natural beach erosion events may influence the quality of nesting habitat (NPS 2010a, p. 218). Nesting females may deposit eggs at the base of an escarpment formed during an erosion event where they are more susceptible to repeated tidal inundation. Erosion, frequent or prolonged tidal inundation, and accretion can negatively affect incubating egg clutches. Short-term erosion events are common phenomena nesting beach of the South Atlantic Coast and may vary considerably from year to year. Sea turtles have evolved a strategy to offset these natural events by laying large numbers of eggs and by distributing their nests both spatially and temporally.

Thus, the total annual hatchling production is never fully affected by storm generated beach erosion and inundation, although local effects may be high. For example, storm-induced mortality in the Dry Tortugas Recovery Unit has been high during years of high tropical storm activity and may limit recovery. However, human activities along coastlines can accelerate erosion rates, interrupt natural shoreline migration, and reduce both the quantity and quality of available nesting habitat. During erosion events, some nests may be uncovered or completely washed away. Nests that are not washed away may suffer reduced reproductive success as the result of frequent or prolonged tidal inundation. Eggs saturated with seawater are susceptible to embryonic mortality. However, in spite of the potential for reduced hatching success, loggerhead eggs can successfully survive periodic tidal inundation. Studies have shown that although frequent or prolonged tidal inundation resulted in fewer emergent hatchlings, occasional overwash of nests appeared to have minimal effect on reproductive success. Accretion of sand above incubating nests may also result in egg and hatchling mortality (NMFS and USFWS 2008).

Artificial Light on the Beach

Both nesting and hatchling sea turtles are adversely affected by the presence of artificial lighting on or near the beach. Research has documented significant reduction in sea turtle nesting activity on beaches illuminated with artificial lights (Witherington 1992).

A 1986 study noted that loggerheads aborted nesting attempts at a greater frequency in lighted areas. Because adult females rely on visual brightness cues to find their way back to the ocean after nesting, those turtles that nest on lighted beaches may become disoriented (unable to maintain constant directional movement) or misoriented (able to maintain constant directional movement but in the wrong direction) by artificial lighting and have difficulty finding their way back to the ocean. In some cases, misdirected nesting females have crawled onto coastal highways and have been struck and killed by vehicles.

Artificial beachfront lighting is a documented cause of hatchling disorientation (loss of bearings) and misorientation (incorrect orientation) on nesting beaches (Philibosian 1976, Mann 1977, Witherington and Martin 1996). The most critical periods of a sea turtle’s life are the emergence from the nest and crawl to the sea. Hatchlings exhibit a robust sea-finding behavior guided by visual cues, and direct and timely migration from the nest to sea is critical to their survivorship. Visual signs are the primary sea-finding mechanism for hatchlings (Mrosovsky and Carr 1967, Mrosovsky and Shettleworth 1968, Dickerson and Nelson 1989, Witherington and Bjorndal 1991). Hatchlings that do not make it to the sea quickly become food for ghost crabs, birds, and other predators, or become dehydrated and may never reach the sea. Although the mechanism involved in sea-finding is complex, involving cues from both brightness and shape, it is clear that strong brightness stimuli can override other competing cues. Hatchlings have a tendency to orient toward the brightest direction as integrated over a broad horizontal area. On natural undeveloped beaches, the brightest direction is commonly away from elevated shapes (e.g., dune, vegetation, etc.) and their silhouettes and toward the broad open horizon of the sea. On developed beaches, the brightest direction is often away from the ocean and toward lighted structures. Hatchlings unable to find the ocean, or delayed in reaching it, are likely to incur high mortality from dehydration, exhaustion, or predation. Hatchlings lured into lighted parking lots or toward streetlights are often crushed by passing vehicles. Uncommonly intense artificial lighting can draw hatchlings back out of the surf.

Although the attributes that can make a light source harmful to sea turtles are complex, a simple rule has proven useful in identifying lights that pose potential problems for sea turtles. Some types of beachfront lighting attract hatchlings away from the sea while some lights cause adult turtles to avoid stretches of brightly illuminated beach.

Researchers propose that artificial light sources are “likely to cause problems for sea turtles if light from the source can be seen by an observer standing anywhere on the beach.” This visible light can come directly from any glowing portion of a luminaire, including the lamp, globe, or reflector, or indirectly by reflection from buildings or trees that are visible from the beach. Bright or numerous light sources, especially those directed upward, will illuminate sea mist and low clouds, creating a distinct sky glow visible from the beach. Field research suggests hatchling orientation can be disrupted by the sky glow from heavily lighted coastal areas even when no direct lighting is visible. The ephemeral nature of evidence from hatchling disorientation and mortality makes it difficult to accurately assess how many hatchlings are misdirected and killed by artificial lighting.

Reports of hatchling disorientation events in Florida describe several hundred nests each year and are likely to involve tens of thousands of hatchlings. Exterior and interior lighting associated with condominiums had the greatest impact causing approximately 42 percent of documented hatchling disorientation/misorientation. Other causes included urban sky glow and street lights (Florida Fish and Wildlife Conservation Commission 2007). However, this number calculated from disorientation reports is likely a vast underestimate. Independent of these reports, researchers surveyed hatchling orientation at nests located at 23 representative beaches in six counties around Florida in 1993 and 1994 and found that, by county, approximately 10 to 30 percent of nests showed evidence of hatchlings disoriented by lighting. From this survey and from measures of hatchling production, the number of hatchlings disoriented by lighting in Florida is calculated in the range of hundreds of thousands per year (NMFS and USFWS 2008, p. I-43).

Predation

Predation of sea turtle eggs and hatchlings by native and introduced species occurs on almost all nesting beaches. Predation by a variety of predators can considerably decrease sea turtle nest hatching success. The most common predators in the southeastern U.S. are ghost crabs (*Ocypode quadrata*), raccoons (*Procyon lotor*), feral hogs (*Sus scrofa*), foxes (*Urocyon cinereoargenteus* and *Vulpes vulpes*), coyotes (*Canis latrans*), armadillos (*Dasypus novemcinctus*), and red fire ants (*Solenopsis invicta*) (Dodd 1988, Stancyk 1995). In the absence of nest protection programs in a number of locations throughout the southeast U.S., raccoons may depredate up to 96 percent of all nests deposited on a beach (Davis and Whiting 1977, Hopkins and Murphy 1980, Stancyk et al. 1980, Talbert et al. 1980, Schroeder 1981, Labisky et al. 1986).

Beach Driving

The operation of motor vehicles on the beach affects sea turtle nesting by interrupting a female turtle approaching the beach. Vehicle lights and vehicle movement on the beach after dark can deter females from nesting. Vehicles driving on beaches at night may run over females attempting to nest and cause death or injury. One nesting loggerhead was struck and killed on Ocracoke Island within the action area in June 2010. Night driving could result in death or injury of stranded sea turtles of both sexes. Sand compaction due to vehicles on the beach may hinder nest construction.

Driving directly above incubating egg clutches can cause sand compaction, which may decrease hatching success. Driving directly above or over incubating egg clutches or on the beach can cause sand compaction which may result in adverse impacts clutch viability, emergence by hatchlings, decreasing nest success, and directly killing pre-emergent hatchlings (Mann 1977, Nelson and Dickerson 1987, Nelson 1988).

Driving on sea turtle nesting beaches may directly or indirectly harm hatchlings. Headlights may disorient or misorient emergent hatchlings. Vehicles may run over and crush hatchlings attempting to reach the ocean. Vehicle tracks traversing the beach can interfere with hatchlings crawling to the ocean. Ruts left by vehicles in the sand may prevent or impede hatchlings from reaching the ocean following emergence from the nest. Hatchlings appear to become diverted not because they cannot physically climb out of the rut (Hughes and Caine 1994), but because the sides of the track cast a shadow and the hatchlings lose their line of sight to the ocean horizon (Mann 1977). The extended period of travel required to negotiate tire tracks and ruts may increase the susceptibility of hatchlings to fatigue, dehydration, predation, strikes from other vehicles during migration to the ocean.

Additionally, vehicle traffic on nesting beaches may contribute to erosion, especially during high tides or on narrow beaches where driving is concentrated on the high beach and foredune (NMFS and USFWS 2008). The physical changes and loss of plant cover caused by vehicles on dunes can lead to various degrees of instability, and therefore encourage dune migration. As vehicles move either up or down a slope, sand is displaced downward, lowering the trail. Since the vehicles also inhibit plant growth, and open the area to wind erosion, dunes may become unstable, and begin to migrate. Unvegetated sand dunes may continue to migrate across stable areas as long as vehicle traffic continues. If beach driving is necessary, the area where the least amount of impact occurs is the beach between the low and high tide water lines. Vegetation on the dunes can quickly reestablish provided the mechanical impact is removed.

Climate Change

The varying and dynamic elements of climate science are inherently long term, complex and interrelated. Regardless of the underlying causes of climate change, glacial melting and expansion of warming oceans are causing sea level rise, although its extent or rate cannot as yet be predicted with certainty. At present, the science is not exact enough to precisely predict when and where climate impacts will occur. Although the direction of change may be known, it may not be possible to predict the precise timing or magnitude of such change. The impacts of climate change may take place gradually or episodically in major leaps.

Climate change is evident from observations of increases in average global air and ocean temperatures, widespread melting of snow and ice, and rising sea level, according to the Intergovernmental Panel on Climate Change Report (IPCC 2007a). The IPCC Report (2007a) describes changes in natural ecosystems with potential widespread effects on many organisms, including marine mammals and migratory birds. The potential for rapid climate change poses a significant challenge for fish and wildlife conservation. Species' abundance and distribution are dynamic, relative to a variety of factors, including climate. As climate changes, the abundance and distribution of fish and wildlife will also change. Highly specialized or endemic species are likely to be most susceptible to the stresses of changing climate.

Climatic changes could amplify current land management challenges involving habitat fragmentation, urbanization, invasive species, disease, parasites, and water management. Global warming will be a particular challenge for endangered, threatened, and other "at risk" species. It is difficult to estimate, with any degree of precision, which species will be affected by climate change or exactly how they will be affected. The USFWS will use Strategic Habitat Conservation planning, an adaptive science-driven process that begins with explicit trust resource population objectives, as the framework for adjusting our management strategies in response to climate change. As the level of information increases concerning the effects of global climate change on sea turtles and its designated critical habitat, the USFWS will have a better basis to address the nature and magnitude of this potential threat and will more effectively evaluate these effects to the range-wide status of sea turtles.

Temperatures are predicted to rise from 1.6^{o}F to 9^{o}F for North America by the end of this century (IPCC 2007a, b). Alterations of thermal sand characteristics could result in highly female-biased sex ratios because sea turtles exhibit temperature dependent sex determination (e.g., Glen and Mrosovsky 2004). Studies have already documented earlier nesting and warmer nest incubation temperatures (Hays et al. 2003, Glen and Mrosovsky 2004, Weishampel et al. 2004, Pike et al. 2006, Hawkes et al. 2007).

Climate change will likely compound existing threats, such as limited suitable nesting habitat and increased inundation risk (Fish et al. 2005). Along developed coastlines, and especially in areas where shoreline protection structures have been constructed to limit shoreline movement, rising sea levels will cause severe effects on nesting females and their eggs. Erosion control structures can result in the permanent loss of dry nesting beach or deter nesting females from reaching suitable nesting sites (National Research Council 1990). Nesting females may deposit eggs seaward of the erosion control structures potentially subjecting them to repeated tidal inundation or washout by waves and tidal action.

Based on the present level of available information concerning the effects of global climate change on the status of sea turtles and their designated critical habitat, the USFWS acknowledges the potential for changes to occur in the Action Area, but presently has no basis to evaluate if or how these changes are affecting sea turtles. Nor does our present knowledge allow the USFWS to project what the future effects from global climate change may be or the magnitude of these potential effects.

Research and Management

The DEIS considered (NPS 2010a, pp. 217-218) the often unrecognized threat to sea turtles by research and management. Such activities (e.g., nesting surveys, tagging of nesting females, nest manipulation) are tools to advance the recovery of the sea turtles. However, they have the potential to adversely affect nesting females, hatchlings, and developing embryos if not properly conducted. Research and conservation management activities should be carefully evaluated to determine their potential risks and conservation benefits.

These issues are being addressed by permitting programs to ensure that proposed research and conservation activities are necessary for recovery, carried out by appropriately trained persons, non-duplicative, the least manipulative possible, and carried out in such a way to minimize chances of mortality. A low level of lethal take is authorized annually for research and conservation purposes. Under conditions where the conservation benefits (e.g., embryo survivorship, hatchling survivorship, conservation knowledge gained) are forecast to substantially outweigh the potential conservation risks, certain activities can be considered beneficial to loggerhead recovery. Most research and conservation management activities are likely to have minimal effects on nesting turtles, hatchlings, and developing embryos when conducted in accordance with established protocols designed to minimize disturbance and risk. On many beaches, surveyors use small, four-wheeled all-terrain vehicles with low-pressure (<5 psi) tires that minimally impact nesting habitat. In addition, almost all surveys to count nests are conducted after sunrise when encounters with nesting turtles and emergent hatchlings are unlikely.

One management activity, nest relocation, has received increased scrutiny in recent years. Such relocation is a management technique for protecting nests that are predicted to be destroyed by environmental factors, such as erosion or repeated tidal inundation, or permitted human activities, such as beach nourishment during the nesting season. However, the unnecessary relocation of nests may result in negative impacts to eggs and hatchlings. Historically, the relocation of sea turtle nests to higher beach elevations or into hatcheries was a regularly recommended conservation management activity throughout the southeast United States. However, advances in our knowledge of the incubation environment have provided important information to guide nest management practices. Nests located where there are threats from beachfront lighting, foot traffic, and mammalian predators can be effectively managed by addressing the threat directly or by protecting the nest in situ rather than by moving the nest. In situ protection, which addresses the root causes of egg and hatchling mortality, is in keeping with Frazer's (1992) call to move away from "halfway technology." Increased understanding of the potential adverse effects associated with nest relocation, restraint of hatchlings, and concentrated hatchling releases has resulted in less manipulative management strategies to protect nests and hatchlings. The Florida Fish and Wildlife Conservation Commission's sea turtle conservation guidelines consider nest relocation to be a management technique of last resort. At training workshops, nest monitors are advised to relocate nests only if they are certain that the nest will otherwise be lost, and if this certainty is based on extensive experience at the specific beach. Recovery Action 6111 describes development of protocols by which managers could identify threatened nests with greater precision, thereby minimizing the number of nests that are relocated (NMFS and USFWS 2008).

Threats to Loggerhead Sea Turtles

As noted, anthropogenic (human) factors that impact hatchlings and adult female turtles on land, or the success of nesting and hatching include: beach erosion, armoring and nourishment; artificial lighting; beach cleaning; increased human presence; recreational beach equipment; beach driving; coastal construction and fishing piers; exotic dune and beach vegetation; and poaching. An increased human presence at some nesting beaches or close to nesting beaches has led to secondary threats such as the introduction of exotic fire ants, feral hogs, dogs, and an increased presence of native species (*e.g.*, raccoons, armadillos, and opossums), which raid and feed on turtle eggs. Although sea turtle nesting beaches are protected along large expanses of the western North Atlantic coast, other areas along these coasts have limited or no protection.

Loggerhead turtles are affected by a completely different set of anthropogenic threats in the marine environment. These include oil and gas exploration and transportation; marine pollution; underwater explosions; hopper dredging, offshore artificial lighting; power plant entrainment and/or impingement; entanglement in debris; ingestion of marine debris; marina and dock construction and operation; boat collisions; poaching, and fishery interactions. In the oceanic environment, loggerheads are exposed to a series of longline fisheries that include the U.S. Atlantic tuna and swordfish longline fisheries, an Azorean longline fleet, a Spanish longline fleet, and various fleets in the Mediterranean Sea (Aguilar et al. 1995; Bolten et al. 1994; Crouse 1999). There is particular concern about the extensive incidental take of juvenile loggerheads in the eastern Atlantic by longline fishing vessels. In the neritic environment in waters off the coastal U.S., loggerheads are exposed to a suite of fisheries in Federal and State waters including trawl, purse seine, hook and line, gillnet, pound net, longline, dredge, and trap fisheries (NMFS and USFWS 2007a).

Threats to Green Sea Turtles

Threats to nesting and marine habitats continue to affect threatened green turtle populations. Continuing human population expansion into coastal areas is expected to increase the severity of existing threats and is therefore cause for major concern. Green turtles are also highly vulnerable to anthropogenic impacts during all life-stages, and three of the biggest threats result from harvest for commercial and subsistence use (e.g. egg harvest, the harvest of females on nesting beaches, and directed hunting of green turtles in foraging areas), diseases, particularly fibropapillomatosis, threaten a large number of existing subpopulations. Fisheries bycatch in artisanal and industrial fishing gear (drift-netting, long-lining, set-netting, pound netting, and trawl fisheries) is also a major impact. In addition, increasing incidence of exposure to heavy metals and other contaminants in the marine environment is of concern in some areas. Additional factors affecting green turtles include boat traffic and its modification of green turtle behavior in coastal areas, boat strikes as a major mortality source in some areas, the ingestion of and entanglement in marine debris that can reduce food intake and digestive capacity, and the interaction with oil spills (NMFS and USFWS 2007b).

While endangered green turtle populations have increased, threats to nesting beaches and the marine environment have also increased. Among the most significant threats to nesting habitat in Florida are the structural impacts (e.g. construction of buildings, beach armoring, and beach nourishment) and beachfront lighting. These activities result in direct habitat destruction and degradation decreasing the extent and suitability of nesting sites on Florida beaches (e.g. increased erosion, altered thermal profiles). The high incidence of fibropapillomatosis disease among some foraging populations is a serious concern. Within U.S. waters, fisheries bycatch of Florida green turtles remains a threat. Human threats (e.g. directed killing, fisheries bycatch) outside of Florida may have profound impacts on the Florida breeding population because of the dispersal of Florida green turtles to juvenile foraging areas throughout the wider Caribbean and GOM. Vessel strikes are a growing concern and, as human populations increase in coastal areas, vessel strikes are likely to increase (NMFS and USFWS 2007b).

Threats to Leatherback Sea Turtles

Both natural and anthropogenic threats to nesting and marine habitats continue to affect leatherback populations, including the 2004 tsunami in the Indian Ocean as well as development and tourism impacts on beaches in several countries. Egg collection continues to occur in many countries around the world and has been attributed to catastrophic declines in some areas. In addition, the killing of nesting females still remains a matter of concern on many nesting beaches. Despite relatively large numbers of female turtles nesting in certain regions of the western Pacific, hatchling production remains low (Hitipeuw et al. 2007). A wide variety of species depredate leatherback nests worldwide (e.g. feral pigs and dogs, raccoons, mongoose, civets, genets, armadillos, monitor lizards, ghost crabs, mole crickets, and dipteran larvae). Incidental bycatch in artisanal and commercial fishing operations, including longline, gillnet, and trawl fisheries, is a major impact that is far from being resolved. Additional factors affecting leatherbacks include boat strikes, the ingestion of and entanglement in marine debris, and exposure to heavy metals and other contaminants in the nesting and marine environments (NMFS and USFWS 2007c).

ANALYSIS OF THE SPECIES/CRITICAL HABITAT LIKELY TO BE AFFECTED – SEA TURTLES

The proposed action has the potential to adversely affect nesting females, nests, hatchlings, post-hatchling washbacks, and stranded live turtles within the proposed project area. The effects of the proposed action on sea turtles will be considered further in the remaining sections of this biological opinion. For loggerhead turtles, specifically, the focus of this biological opinion will consider the effects of the proposed action on nesting loggerheads from North Carolina and the Northern Recovery Unit, as well as the southeastern U.S. population as a whole.

Potential effects of vehicle access and recreational activities on the beaches of CAHA include vehicles hitting nesting adult sea turtles, hatchlings, post-hatchling washbacks, and stranded live turtles; vehicles crushing eggs; tire ruts trapping hatchlings; degradation of nesting habitat through compaction of sand and grading of access ramps; harm and disturbance to nesting and hatchling sea turtles due to fires on the beach; disturbance to nesting and hatchling sea turtles due to lighting from concessionaire facilities and other structures within CAHA, vehicle lights and driving related markers and signs on the beach, and fires on the beach.

STATUS OF SPECIES/CRITICAL HABITAT – SEABEACH AMARANTH

Species/Critical Habitat Description - Seabeach Amaranth

Seabeach amaranth is an annual plant that grows on Atlantic barrier islands and ocean beaches currently ranging from South Carolina to New York. It was listed as threatened under the Act on April 7, 1993 (USFWS 1993) because of its vulnerability to human and natural impacts and the fact that it had been eliminated from two-thirds of its historic range (USFWS 1996b).

Seabeach amaranth stems are fleshy and pink-red or reddish, with small rounded leaves that are 0.5 to 1.0 inches in diameter. The green leaves, with indented veins, are clustered toward the tip of the stems, and have a small notch at the rounded tip. Flowers and fruits are relatively inconspicuous, borne in clusters along the stems.

Seabeach amaranth will be considered for delisting when the species exists in at least six states within its historic range and when a minimum of 75 percent of the sites with suitable habitat within each state are occupied by populations for 10 consecutive years (USFWS, 1996b). The recovery plan states that mechanisms must be in place to protect the plants from destructive habitat alterations, destruction or decimation by off-road vehicles or other beach uses, and protection of populations from debilitating webworm predation.

There is no designation of critical habitat for seabeach amaranth.

Life History - Seabeach Amaranth

Germination occurs over a relatively long period, generally from April to July. Upon germinating, this plant initially forms a small unbranched sprig, but soon begins to branch profusely into a clump. This clump often reaches one foot in diameter and consists of five to 20 branches. Occasionally, a clump may get as large as three feet or more across, with 100 or more branches.

Flowering begins as soon as plants have reached sufficient size, sometimes as early as June, but more typically commencing in July and continuing until the death of the plant in late fall. Seed production begins in July or August and peaks in September during most years, but continues until the death of the plant. Weather events, including rainfall, hurricanes, and temperature extremes, and predation by webworms have strong effects on the length of the reproductive season of seabeach amaranth. Because of one or more of these influences, the flowering and fruiting period can be terminated as early as June or July. Under favorable circumstances, however, the reproductive season may extend until January or sometimes later (Radford et al., 1968; Bucher and Weakley, 1990; Weakley and Bucher, 1992).

Population Dynamics - Seabeach Amaranth

The most serious threats to the continued existence of seabeach amaranth are construction of beach stabilization structures, natural and man-induced beach erosion and tidal inundation, fungi (i.e., white wilt), beach grooming, herbivory by insects and mammals, and off-road vehicles.

Seabeach amaranth is dependent on natural coastal processes to create and maintain habitat. However, high tides and storm surges from tropical systems can overwash, bury, or inundate seabeach amaranth plants or seeds, and seed dispersal may be affected by strong storm events. In September of 1989, Hurricane Hugo struck the Atlantic Coast near Charleston, South Carolina, causing extensive flooding and erosion north to the Cape Fear region of North Carolina, with less severe effects extending northward throughout the range of seabeach amaranth. This was followed by several severe storms that, while not as significant as Hurricane Hugo, caused substantial erosion of many barrier islands in the seabeach amaranth's range.

Surveys for seabeach amaranth revealed that the effects of these climatic events were substantial (Weakley and Bucher, 1992). In the Carolinas, populations of amaranth were severely reduced. In South Carolina, where the effects of Hurricane Hugo and subsequent dune reconstruction were extensive, amaranth numbers declined from 1,800 in 1988 to 188 in 1990, a reduction of 90 percent. A 74 percent reduction in amaranth numbers occurred in North Carolina, from 41,851 plants in 1988 to 10,898 in 1990. Although population numbers in New York increased in 1990, range-wide totals of seabeach amaranth were reduced 76 percent from 1988 (Weakley and Bucher 1992). The extent stochastic events have on long-term population trends of seabeach amaranth has not been assessed.

Herbivory by webworms, deer, feral horses, and rabbits is a major source of mortality and lowered fecundity for seabeach amaranth. However, the extent to which herbivory affects the species as a whole is unknown.

Potential effects to seabeach amaranth from vehicle use on the beaches include vehicles running over, crushing, burying, or breaking plants, burying seeds, degrading habitat through compaction of sand and the formation of seed sinks caused by tire ruts. Seed sinks occur when blowing seeds fall into tire ruts, then a vehicle comes along and buries them further into the sand preventing germination. If seeds are capable of germinating in the tire ruts, the plants are usually destroyed before they can reproduce by other vehicles following the tire ruts. Those seeds and their reproductive potential become lost from the population.

Pedestrians also can negatively affect seabeach amaranth plants. Seabeach amaranth occurs on the upper portion of the beach which is often traversed by pedestrians walking from parking lots, hotels, or vacation property to the ocean. This is also the area where beach chairs and umbrellas are often set up and/or stored. In addition, resorts, hotels, or other vacation rental establishments usually set up volleyball courts or other sporting activity areas on the upper beach at the edge of the dunes. All of these activities can result in the trampling and destruction of plants.

Pedestrians walking their dogs on the upper part of the beach, or dogs running freely on the upper part of the beach, may result in the trampling and destruction of seabeach amaranth plants. The extent of the effects that dogs have on seabeach amaranth is not known.

Status and Distribution - Seabeach Amaranth

The species historically occurred in nine states from Rhode Island to South Carolina (USFWS 2003b). By the late 1980s, habitat loss and other factors had reduced the range of this species to North and South Carolina. Since 1990, seabeach amaranth has reappeared in several states that had lost their populations in earlier decades, and some states have seen dramatic increases in numbers of plants. However, threats like habitat loss have not diminished, and populations are declining in other states. It is currently found in New York, New Jersey, Delaware, Maryland, Virginia, North Carolina, and South Carolina.

The typical habitat where this species is found includes the lower foredunes and upper beach strands on the ocean side of the primary sand dunes and overwash flats at accreting spits or ends of barrier islands. Seabeach amaranth has been and continues to be threatened by destruction or adverse alteration of its habitat. As a fugitive species dependent on a dynamic landscape and large-scale geophysical processes, it is extremely vulnerable to habitat fragmentation and isolation of small populations. Further, because this species is easily recognizable and accessible, it is vulnerable to taking, vandalism, and the incidental trampling by curiosity seekers. Seabeach amaranth is afforded legal protection in North Carolina by the General Statutes of North Carolina, Sections 106-202.15, 106- 202.19 (N.C. Gen. Stat. section 106 (Supp. 1991)), which provide for protection from intrastate trade (without a permit).

Some of the largest remaining populations are located on publicly owned land, including five National Seashores and Recreation Areas (Assateague Island; Cape Lookout; Cape Hatteras; Fire Island; and, Gateway), four National Wildlife Refuges (Cape May; Cape Romain; Chincoteague; and, Forsythe), two military bases (Camp Lejeune Marine Corps Base, NC, and New Jersey Army National Guard Training Center, NJ) and 12 state parks (Corson Inlet, NJ; Cape May Point, NJ; Island Beach, NJ; Strathmore Natural Area, NJ; Delaware Seashore, DE; Fenwick Island, DE; Cape Henlopen, DE; Assateague Island State Park, MD; False Cape, VA; Hammocks Beach, NC; Myrtle Beach, SC; and, Huntington Beach, SC). The plants are being protected from beach armoring and shoreline stabilization at these parks, refuges and military bases. However, plants are still threatened by off-road vehicle traffic on National Seashores, military bases, and state park lands.

Analysis of the Species Likely to be Affected - Seabeach Amaranth

Since 2000, locations where seabeach amaranth has been found within the Seashore include the upper, dry-sand flats at Cape Hatteras Point (Cape Point and South Beach), in a line of small dunes adjacent to the flats at Hatteras Inlet Spit, at Bodie Island Spit, and at the base of dunes on the beach on the northern half of Ocracoke Island (NPS 2010a, p. 223). Most areas where the plants have been found were either in established bird closures or other areas closed to vehicular traffic (NPS 2001b, 2001c, 2005a). Despite continuous protection (through the establishment of summer and winter resource closures) of the area on Bodie Island Spit where the plants were found in 2004 and 2005, as well as the area on Cape Point where the plant was historically found, no plants have been found in the Seashore since 2005. Additionally, large portions of the historic range of the plant at Hatteras Inlet Spit no longer exist due to continued erosion. While it is thought that the plant may possibly be extirpated from the Seashore (NPS 2009a), it should be noted that since plants are not evident every year, but may survive in the seed bank, populations of seabeach amaranth may still be present even though plants are not visible for several years.

The predominant threat to seabeach amaranth is the destruction or alteration of suitable habitat, primarily because of beach stabilization efforts and storm-related erosion (USFWS 1993). Other important threats to the plant include beach grooming and some forms of "soft" beach stabilization, such as sand fencing and planting of beach-grasses; vehicular traffic, which can easily break or crush the fleshy plant and bury seeds below depths from which they can germinate; and predation by webworms (caterpillars of small moths) (USFWS 1993). Webworms feed on the leaves of the plant and can defoliate the plants to the point of either killing them or at least reducing their seed production. Beach vitex (*Vitex rotundifolia*) is another threat to seabeach amaranth, as it is an aggressive, invasive, woody plant that can occupy habitat similar to seabeach amaranth and outcompete it (Invasive Species Specialist Group (ISSG) 2010).

The implementation of Alternative F has the potential to adversely affect seabeach amaranth plants and seeds within the proposed project area. The effects of the proposed action on seabeach amaranth will be considered further in the remaining sections of this biological opinion. Potential effects of vehicle access on the beaches of CAHA include vehicles running over, crushing, burying, or breaking plants, burying seeds, degrading habitat through compaction of sand and the formation of seed sinks caused by tire ruts. Access provided by vehicles may lead to higher than normal trampling by pedestrians.

ENVIRONMENTAL BASELINE

This section is an analysis of the effects of past and ongoing human and natural factors leading to the status of the species, its habitat (including designated and/or proposed critical habitat), and ecosystems within the action area. The environmental baseline is a "snapshot" of a species' health at a specified point in time. It does not include the effects of the action under review in this consultation.

Ongoing human uses within CAHA include beach driving and recreational activities such as fishing, beach combing, sun bathing, birding, etc. The public may drive vehicles throughout CAHA except on Pea Island National Wildlife Refuge, in front of the villages during the summer, and in temporary resource closure areas. Maintenance, management, and emergency service vehicles may operate within this same area. Dogs are allowed on a leash within CAHA, except in designated areas where no dogs are allowed. Pedestrians may use all portions of CAHA at any time, except in designated areas (some resource closure areas). However, violations of these areas occur and enforcement is difficult because of the limited number of NPS staff. Human and pet use of CAHA has increased substantially since implementation of the Park's 1984 General Management Plan.

Environmental Baseline – Piping Plovers – General

North Carolina is currently the only state on the Atlantic Coast that hosts piping plovers during all phases of their annual cycle, including the establishment and holding of territories, courtship and copulation, nest scraping and nest building, egg laying and incubation, chick rearing and fledging, and migration and wintering (Cohen et al. 2010a). Band sightings indicate that plovers from all three North American breeding populations depend on Cape Hatteras during migration and/or the winter. Plovers from the endangered Great Lakes population have been observed in fall and spring migration and during the wintering period (Cohen et al. 2010a). Early nesting records indicate that plovers were nesting at Pea Island in 1901 and 1902 (Golder 1986). The first published account of breeding piping plovers in North Carolina is from 1960, when a young bird was photographed in early June on Ocracoke Island (Golder 1985).

Status within the Action Area – Piping Plovers - Breeding

The DEIS (NPS 2010a, pp. 192-201) and recent correspondence (M. Murray, NPS, pers. comm. 2010) provide detailed information on the breeding chronology and performance of piping plovers within CAHA. Locally breeding piping plovers arrive at the Seashore in mid-March, begin courting and pairing in April, and begin to scrape and/or build nests by the third week of April. Bodie Island Spit, Cape Point, South Beach, Hatteras Inlet Spit, North Ocracoke Spit, and South Point Ocracoke (South Point) all contain potential nesting habitat.

Records of piping plover breeding activity have been maintained since 1984. Four nests and one brood were observed in 1984, and five chicks were confirmed to have fledged that year. All four nests were located adjacent to least tern (*Sterna antillarum*) colonies on wide, open, sandy flats (Golder 1985). Nine pairs were counted in 1985 (Golder 1986), and 10 pairs in the summer of 1987 (Cooper 1990). The piping plover population reached a high of 15 pairs at the Seashore in 1989, and subsequently varied between 11 and 14 pairs through 1996, after which a sharp decline began (NPS 2010a, Fig. 3, p. 187). The population at the Seashore reached a low of two breeding pairs in 2002 and 2003, with only three breeding pairs reported in 2004 and 2005 (NPS 2009b). The population increased to six pairs in 2006 and 2007 and to 11 pairs by 2008 (NPS 2009b). The Seashore recorded nine piping plover breeding pairs during the 2009 season (NPS 2010b) and 16 nests were observed in the 2010 season (NPS 2010c, M. Murray, NPS, pers. comm. 2010).

Under the Interim Strategy, Seashore personnel would generally begin monitoring for piping plover arrival and pre-nesting behavior in late March and early April. Monitoring and surveys of these sites were conducted a minimum of three times per week. However, the 2008 consent decree required staff to begin monitoring these sites on March 15, and monitor every two days from March 15 to April 15, and daily from April 16 to July 15. Bodie Island Spit had to be monitored daily from March 15 to July 15. All known nests are protected by predator exclosures, which have been in use at the Seashore since 1994. Once nests are located, they are briefly approached once a week to inspect the exclosure, count eggs, and search for predator tracks. Morning and evening observations begin when clutches are expected to hatch. Monitors observe from a distance for evidence of hatching or chicks. After hatching, in areas not open to ORV use, the broods are monitored a few hours in the morning and a few hours in the afternoon until the chicks have fledged or are lost. Seashore personnel document brood status, behavior, individual bird and/or brood movements, human disturbance, predator interactions, and other significant environmental events.

From 1987 through 2009 the numbers of breeding pairs of piping plovers at six known nesting sites has ranged from two (2002 and 2003) to 15 (1989) (NPS 2010a, Table 15, p. 193). While six breeding pairs were observed during the first two years of the Interim Strategy (2006-2007), the number increased during 2008 and 2009 to 11 and nine pairs, respectively. The 11 nesting pairs identified in 2008 marks an 83% increase from the 6 pairs identified in 2007 and the 12 breeding pairs identified in 2010 (Muiznieks, NPS, pers. comm.2010a) marks a 100% increase from 2007. In 2010, 15 plover chicks successfully fledged, which represents the greatest number of fledged chicks ever documented at the Seashore (NPS 2010c; M. Murray, NPS, pers. comm. 2010).

The DEIS and recent correspondence (M. Murray, NPS, pers. comm. 2010) provide data on piping plover hatching and fledging success at the Seashore from 1992 through 2010 (NPS 2010a, Table 16, p. 194; M. Murray, NPS, pers. comm. 2010). Fledge rate (or reproductive rate) is defined as the number of chicks that survive until fledging age per breeding pair. Since 1989, reproductive rates at the Seashore have ranged from 0.00 to 2.00 chicks per breeding pair, with an average rate over the 18 years from 1992 through 2009 of 0.64 fledged chicks per breeding pair (NPS 2010b). During 2009, a total of nine breeding pairs fledged 6 chicks (a rate of 0.67 fledged chicks per pair) (NPS 2010b). However, a rate of 1.25 fledged chicks per breeding pair annually would be needed to sustain the population (USFWS 1996a), and the recovery goal set by the USFWS is 1.50 fledged chicks per breeding pair. Although a fledge rate of 1.25 chicks per breeding pair (15/12) was achieved at the Seashore in 2010, the fledge rate at the Seashore has averaged less than half the recovery goal since 1992. The decline in the local breeding population from 1995 to 2003 is likely a reflection of the low reproductive rate (NPS 2005a) and resultant lack of recruitment (NPS 2010a, p. 195).

Status within the Action Area – Piping Plovers - Non-breeding

In addition to supporting a local breeding population, the Seashore also hosts migrating and wintering piping plovers from all three of the North American breeding populations (the threatened Atlantic Coast and Great Plains populations and the endangered Great Lakes population). The Outer Banks is an important stopover area for migrating shorebirds along the Atlantic Coast. Fall migrants arrive at the Outer Banks in July, peak in August and September, and depart by November (Dinsmore et al. 1998). The distribution and abundance of non-breeding populations at the Seashore are less well documented than the local breeding population. Documenting and protecting non-breeding piping plovers and their habitats are priorities articulated in the recovery plans for all three North American breeding populations (USFWS 1996a; 2003a). Recognizing the importance of the Outer Banks to wintering piping plovers, the USFWS designated 2,043 acres of critical habitat in Dare and Hyde counties in November 2008 (USFWS 2008).

Wintering piping plovers on the Atlantic Coast select wide beaches in the vicinity of inlets that are associated with a high percentage of moist substrate habitat (Nicholls and Baldassarre 1990a, Wilkinson and Spinks 1994). Because tidal regimes and fall and winter storm patterns often cause piping plovers to move among habitat patches, a diversity of habitat patches may be important to wintering populations (Burger 1994; Nicholls and Baldassarre 1990a). Cohen et al. (2010) studied non-breeding piping plovers at the Seashore from 2000 to 2005. The results of this study indicated that the greatest number of non-breeding piping plovers at the Seashore occurs during the fall migration, which begins in July and peaks between July and September (NPS 2010a, Table 23, p. 203). The fall migration counts were highest at South Point, followed by Oregon Inlet (Bodie Island Spit, Pea Island NWR, and, formerly, Green Island, which is now largely unusable for plovers because of vegetation growth), then Hatteras Inlet Spit, and finally Cape Point (Cohen et al. 2010).

Seashore staff documented non-breeding piping plovers' use of the Seashore throughout 2006. Migratory birds appeared to peak in August and September, with a high count of 93 birds at South Point on August 10 (NPS 2010a, Table 24, p. 204). South Point revealed the highest counts during fall migration.

Seashore staff also documented non-breeding plovers' use of the Seashore beginning at the end of the breeding season in August 2007 through March 2008 and from August 2008 to March 2009 (NPS 2010a, p. 205), although surveys were limited to the points and spits. In 2007, migratory birds peaked in September, with a high of 33 counted on September 7, 2007, on South Point (NPS 2008a). After the migrants passed through the area in September 2007, plover numbers appeared to stabilize over the winter months except in February 2008, when there was an unexplained drop in numbers. In 2008, the number of migratory plovers peaked in August and numbers declined in September to a level similar to the previous year. The number of birds at the Seashore continued to decline until February 2009, when the migrants started passing through the Seashore again.

Seashore staff documented the habitat type in which migratory and wintering piping plovers were observed from August 2007 to March 2008 and from August 2008 to March 2009 (NPS 2010a, Figure 8, p. 205). Of the 717 observations, 458 were in mudflat/algal flat, 157 were in sand flat, 67 were in foreshore, and 26 were in wrack line habitat (NPS 2009b).

In addition to the monitoring being conducted by Cohen et al. (2010) and Seashore staff, the Southeast Coast Network (SECN) Inventory and Monitoring Program conducted a comprehensive study on wintering shorebirds at the Seashore. Pilot implementation of a long-term shorebird monitoring protocol began in mid-July 2006 and the first report was published in March 2009. The study found that the fall migration appeared to peak in August (NPS 2010a, p. 206) and the spring migration likely peaked in May, but nest initiation by piping plover and logistical issues precluded consistent sampling later than April in any given year. The three highest single-day counts during the pilot study (for sampled areas only) were 24 in July 2006, 50 in August 2006, and 14 in April 2007.

Status within the Action Area – Piping Plovers – Designated Critical Habitat

All piping plover breeding sites at the Seashore were designated as critical habitat for wintering birds, as defined by the Act (Federal Register 66:50 CFR 36038-36143, July 10, 2001).

However, in 2004 a court decision vacated the designation for Oregon Inlet, Cape Point, Hatteras Inlet, and Ocracoke Island (*Cape Hatteras National Seashore Access Preservation Alliance versus U.S. Dept. of the Interior*, 344 F. Supp. 2d 108 [D.D.C. 2004]). A rule to revise designated critical habitat for the wintering population of the piping plover in North Carolina was proposed in 2006 (71 FR 33703). That proposed rule described four coastal areas (named Units NC-1, NC-2, NC-4, and NC-5), totaling approximately 739 hectares (1,827 acres) entirely within the Seashore, as critical habitat for the wintering population of the piping plover. The USFWS also proposed to add 87 hectares (215 acres) of critical habitat to two previously proposed units. As a result, the proposed revised critical habitat designation for the species now includes four revised critical habitat units totaling approximately 826 hectares (2,042 acres). The final rule for the revised critical habitat designation became effective on November 20, 2008 (Federal Register 73:50 CFR 62815-62841, October 21, 2008). On February 6, 2009, Cape Hatteras Access Preservation Alliance and Dare and Hyde Counties, North Carolina filed a legal challenge to the revised designation. On August 18, 2010, a U.S. District Court granted the government's motion for summary judgment and dismissed the case with prejudice, and the critical habitat designation for these four units remains in effect.

Critical habitat identifies specific areas that are essential to the conservation of a listed species, or that contain physical and biological features that are essential to the species and that may require special management considerations or protection. Approximately 2,043 acres in Dare and Hyde counties are designated as critical habitat for the wintering population of the piping plover. Activities that may destroy or adversely modify critical habitat include those that alter the primary constituent elements (PCEs) to an extent that the value of critical habitat for both the survival and recovery of the species is appreciably reduced.

Of the 2,043 acres of designated critical habitat in Dare and Hyde counties, approximately 1,827 acres are located within the boundaries of the Seashore and are located at Bodie Island Spit, Cape Point, Hatteras Inlet Spit, Ocracoke Inlet Spit, and South Point. The DEIS provided a detailed description of the four units of designated critical habitat (NPS 2010a, pp. 190-191).

Factor Affecting the Species within the Action Area – Piping Plovers

Rates and sources of mortality and disturbance, and the responses of piping plovers to disturbance in the non-breeding season, have not been specifically assessed at the Seashore (NPS 2010a, p. 208). However, it is known that piping plover foraging and roosting habitats at Cape Hatteras are used by pedestrians and ORVs outside of the breeding season (Cohen et al. 2010). Where such activity is allowed, studies conducted at several beaches in Massachusetts and New York have shown that there is the potential for piping plovers to be killed by being run over by ORVs (Melvin et al. 1994) or taken by domestic pets. Studies along the Atlantic and Gulf coasts (including one at the Seashore) have shown that the density of wintering plovers is higher in areas with limited human presence or disturbance (Cohen et al. 2008a; Nicholls and Baldassarre 1990a). Furthermore, disturbance to roosting and foraging birds by ORVs, unleashed pets, and pedestrians may reduce foraging efficiency or alter habitat use, thereby increasing the risk of nutritional or thermal stress (Zonick 2000).

The DEIS considered three factors that are affecting piping plovers within the Seashore (NPS 2010a, pp. 208-212). First, weather and tides influence the number of piping plovers and productivity. Hurricanes may reduce predator populations and create suitable habitat. Hurricanes and other ocean storms can lead to unusually high tides, and subsequent flooding can overwash piping plover nests (Cohen et al. 2010). In May 2000, a three-day storm produced high winds, heavy rain, and ocean overwash. One clutch at Cape Point was buried under windblown sand and abandoned, while a second was lost to flooding at Hatteras Inlet Spit (NPS 2001a). Wave action and erosion caused the abandonment of a nest in 2002 when waves undermined a protective dune, resulting in the nest being flooded by ocean overwash. The eggs were scattered from the nest and the adults did not return to them (NPS 2003a). In 2009 a four-egg nest discovered on June 8 on South Point, Ocracoke, was overwashed by spring tides on June 23 (NPS 2010b).

Indeed, some piping plovers that nest too close to mean high tide may lose their nests on normal high tides (Cohen et al. 2010). Storms can also result in widespread mortality of chicks (Houghton 2005). Besides these direct effects of storms on piping plover nests, flooding from extreme high tides or storm surges may alter habitat enough to render it unsuitable for nesting. This may lead to the abandonment of habitat within or between breeding seasons (Haig and Oring 1988).

The second existing factor is predation (NPS 2010a, p. 209-210). Predation, especially by mammalian predators, continues to be a major factor affecting the reproductive success of the piping plover (Elliott-Smith and Haig 2004). The impact of predation has been postulated to be greater on beaches with high human use because the presence of pets and trash (which may attract wild predators) is correlated with the presence of humans (USFWS 1996a).

Fox activity was recorded at all active plover nesting areas in 2001 and one late nest initiation and two nest abandonments were linked to this activity (NPS 2002a). No direct evidence of predation was observed through 2006, although the presence or tracks of crows, grackles (*Quiscalus* spp.), gulls, ghost crabs (*Ocypode quadrata*), Virginia opossum, mink, raccoon, red fox, gray fox, and domestic cats and dogs were documented within many plover breeding territories (NPS 2009b). In 2009, two chicks at Cape Point were lost to suspected opossum predation (NPS 2010b). In addition to causing direct mortality, predators in piping plover habitat can also lead to piping plovers' abandoning territories within and between breeding seasons (Cohen 2005).

Ghost crabs have occasionally been implicated in the loss of nests (Watts and Bradshaw 1995) and chicks (Loegering et al. 1995). Research on ghost crabs conducted in the lab and at a breeding site at Assateague Island in Virginia suggests that crab predation is generally uncommon. However, this study indicated that the presence of ghost crabs could have a more indirect effect on plover survival. Adult plovers may shepherd their broods away from the foreshore, where the best forage normally exists, due to the abundance of ghost crabs at that location (Wolcott and Wolcott 1999). Poor forage was found to be a more likely contributor to chick mortality than predation by ghost crabs (Wolcott and Wolcott 1999). However, anecdotal records indicate that ghost crabs may be more of a problem in North Carolina than at sites farther north (Cohen et al. 2010). In 2007, one egg in an exclosed nest was lost to a ghost crab (NPS

2008a) and in 2008, ghost crab predation was suspected in the loss of three piping plover nests because ghost crab holes were found inside and around the nests and predator exclosures (NPS 2009b).

The third existing factor affecting piping plovers is human activities (NPS 2010a, pp. 210-212). Human disturbance, both direct and indirect, can adversely affect piping plovers at the Seashore. Studies on piping plovers have demonstrated that reproductive success is lower in areas with high human disturbance (Burger 1991, 1994). Research has also shown that plover behavior is altered by the presence of humans, which ultimately results in chicks exhibiting less time feeding, brooding, and conserving energy. Plovers that are subject to human disturbance spend less than 50% of their foraging time searching for prey and feeding, where undisturbed plovers can spend up to 90% of that time feeding (Burger 1994). These human-caused behavioral changes result in depleted energy reserves, which could leave chicks more susceptible to predation or other stresses (Flemming et al. 1988; Loegering and Fraser 1995). At other sites, it was documented that fledging success did not differ between areas with and without recreational ORV use (Patterson et al. 1991), although pedestrians caused a decrease in brood foraging behavior in New Jersey (Burger 1994).

Pedestrian and non-motorized recreational activities can be a source of both direct mortality and harassment of piping plovers. Potential pedestrians on the beach include those individuals driving and subsequently parking on the beach, those originating from off-beach parking areas (hotels, motels, commercial facilities, beachside parks, etc.), and those from beachfront and nearby residences. Vehicle impacts can extend to remote stretches of beach where human disturbance would be very slight if access were limited to pedestrians only (USFWS 1996a).

Disturbance from vehicles, pedestrians, and pets can cause incubating birds to be flushed from their nests. Flushing can affect plover behavior and viability in a number of ways. Flushing of incubating plovers from nests can expose eggs to avian predators or excessive temperatures. Repeated exposure of eggs to direct sunlight on hot days can cause overheating, which can kill avian embryos (Bergstrom 1989). In Texas, piping plovers avoided foraging on sand flats close to areas of high human use (Drake et al. 2001). Zonick (2000) found that the number of piping plovers was lower on disturbed bayside flats than on undisturbed flats, and piping plovers experienced lower foraging efficiency when disturbed.

Unleashed pets have the potential to flush piping plovers, and these flushing events may be more prolonged than those associated with pedestrians or pedestrians with dogs on leash. A study conducted on Cape Cod, Massachusetts, found that the average distance at which piping plovers were disturbed by pets was 46 meters (151 feet), compared with 23 meters (75 feet) for pedestrians (Hoopes 1993). Birds flushed by pets moved farther (an average of 57 meters [187 feet]) than plovers reacting to pedestrians (an average of 25 meters [82 feet]). Duration of observed disturbance behaviors stimulated by pets was significantly greater than that caused by pedestrians (USFWS 1996a). In 2002, there was evidence that a dog may have been responsible for the loss of a piping plover chick at Bodie Island (NPS 2010a, p. 211). When a plover brood could not be found, large canine tracks were documented in the area where the brood was often seen foraging and resting.

Vehicles have been documented running over nests (Patterson et al. 1991) and birds on Assateague Island in Maryland and Virginia. In Massachusetts and New York, biologists found that 18 chicks and 2 adults were killed by vehicles between 1989 and 1993, even on beaches with only five to ten vehicles passes per day (Melvin et al. 1994). Piping plover chicks often move from the foredune area to forage along the wrack line and intertidal zone, which places them in the paths of vehicles. Chicks can end up in or near tire ruts, and sometimes have difficulty crossing or climbing out of them. The normal response of plover chicks to disturbance could increase their vulnerability to vehicles. Chicks sometimes stand motionless or crouch as vehicles approach, and their lack of rapid movement could lead to mortality (USFWS 1996a).

Off-road vehicle use may also affect the beach through sand displacement and compaction (Anders and Leatherman 1987), which may lead to steeper dune profiles. This, in turn, may prove less suitable for piping plover nesting. Degradation of the wrack line is possible from as little as one vehicle pass (Leatherman and Godfrey 1979), and may negatively impact reproductive success due to the loss of important habitat used by foraging plovers. Also, the wrack line provides habitat for many beach invertebrates, which are a staple of the plover diet.

Beach and dune renourishment projects can alter the profile of beaches, causing increased erosion and habitat loss (Leatherman 1985). Numerous dune-creation projects have been carried out along most of the Seashore, beginning in the 1930s. These may be affecting the ability of the Seashore to support piping plovers (Harrison and Trick pers. comm. 2005). A recent study theorized that beach nourishment projects may negatively impact plover habitat because the resulting dredge spoil is often fine-grained, reducing the availability of pebbles and cobbles, which are a preferred substrate for nesting plovers (Cohen et al. 2008b). Furthermore, beach stabilization prevents normal storm processes, such as overwash fan formation, thereby leading to long-term loss of moist substrate habitat and to accelerated vegetative succession in potential nesting habitat (Dolan et al. 1973). Construction of artificial structures on beaches eliminates breeding territories and may result in an increased level of predation on and human disturbance of remaining pairs (Houghton 2005).

ENVIRONMENTAL BASELINE – SEA TURTLES

Environmental Baseline – Sea Turtles -General

The Seashore staff has been consistently monitoring for sea turtle nests since 1987 (NPS 2010a, p. 212). However, over the years both monitoring and managing techniques have changed, making data comparison difficult; therefore, only nesting data from 2000 to 2010 are presented, for these data are known to be accurate. The number of nests recorded at the Seashore from 2000 to 2010 has fluctuated greatly, with only 43 nests recorded in 2004 and 153 nests recorded in 2010 (M. Murray, NPS, pers. comm.. 2010), which was the highest number on record (NPS 2010a, p. 214). Of the three species that nest at the Seashore, the loggerhead turtle is by far the most numerous, comprising approximately 95% of the known nests between 2000 and 2010 (NPS 2005b, 2007, 2008b; 2009c; 2010a, p. 212; Baker pers. comm. 2009b). Green turtles and leatherbacks breed primarily in the tropics, with only small numbers nesting at higher latitudes. Green turtles have nested regularly at Cape Hatteras, but in fewer numbers, comprising only about 5% of the nests between 2000 and 2010, while leatherback turtles have nested infrequently at the Seashore, comprising only about 1% of the nests (NPS 2005b, 2007, 2008b, 2009c, 2010a, p. 216; Baker pers. comm. 2009b). The vast majority of sea turtle nests occur on Hatteras and Ocracoke islands, with turtles occasionally nesting on Bodie Island (NPS 2000, 2001b, 2002b, 2003b, 2005b, 2007, 2008b, 2009c, 2010a, p. 212).

Status of Species within the Action Area – Loggerhead Sea Turtle

Between 2000 and 2009 there was an average of 79 loggerhead nests per year at the Seashore, with the lowest number of nests (40) occurring in 2004 and the highest number (108) of nests occurring in 2008 (NPS 2010a, Figure 13, p. 214; Baker pers. comm. 2009b). However, as of October 14, 2010, a record-breaking 146 loggerhead nests were laid at the Seashore (M. Murray, NPS, pers. comm. 2010). No additional nesting is expected for 2010. While only 40 loggerhead nests were laid in 2004, it was a poor nesting year for the entire southeast Atlantic Coast (NPS 2005b).

Loggerhead turtles spend the majority of their life at sea, with only mature females coming ashore to nest every two to three years, on average (Schroeder et al. 2003). The first turtle nests (all turtle species included) typically begin to appear at Cape Hatteras in mid-May, and the last nests are usually deposited in late August (NPS 2000b, 2001b, 2002b, 2003b, 2005b, 2006b, 2007, 2008b, 2009c). Although three nests were found prior to May 15 (two of which were leatherback nests), and 4 nests have been found after September 1, it is important to note that prior to 2008, nest patrols were conducted only from June 1 through August 31 (2001–2005), or May 15 through September 15 (2006 and 2007). Any nests laid outside of that timeframe had a greater likelihood of not being found and protected by resource management staff.

Status of the Species within the Action Area – Green Sea Turtles

Nesting habits for the green turtle are very similar to those of the loggerhead turtle, with only slight differences. In CAHA and elsewhere in North Carolina, green turtles usually nest from late May or early June to early or mid-September (Woodson and Webster, 1999). The Seashore supports about 35.7% percent of all green turtle nesting in North Carolina (Godfrey, M.H., NCWRC, pers. comm. 2010). From 2000 to 2009, there was an annual average of four green turtle nests at the Seashore, with a peak of nine nests in 2005 (Baker pers. comm. 2009a). Through October 14, 2010, seven green turtle nests were laid at the Seashore during the year (Muiznieks pers. comm. 2010b). No additional nesting is expected for 2010.

Status of Species within the Action Area – Leatherback Sea Turtle

Leatherback nesting at the Seashore was first documented in 1998 and has subsequently been documented in 2000, 2002, 2007, and 2009, totaling six nests since 2000 (NPS 2001b, 2008b, 2009c, 2010a; p. 216; Baker pers. comm. 2009b). During 2010, no leatherback nests were documented within the Seashore as of October 14, 2010 (M. Murray, NPS, pers. comm. 2010) and no additional nesting is expected this year. Since the species has a minimum of two years between nesting cycles, it is not known if more than one female of the species uses the Seashore as a nesting ground. Through mid-2006, leatherback nests in CAHA accounted for at least 39 percent of all nests for the species documented in North Carolina (n = 18). Although the numbers of nests laid in the action area are small relative to the loggerhead and green sea turtles, the lack of observed nests prior to 1998 suggests that leatherback nests in CAHA and the rest of North Carolina may be increasing.

Until 2009 the Seashore was the northernmost nesting location on record for this species (Rabon et al. 2003). However, in 2009 a leatherback nested in Kill Devil Hills, North Carolina, directly north of CAHA. This nesting currently represents the northernmost nest ever found from this species (Baker pers. comm. 2009a).

Leatherback nesting habits are very similar to those of the loggerhead turtle, although they tend to begin and end nesting earlier in the year than the loggerhead (NMFS and USFWS 1992). Since 1999, the only two nests laid in April at the Seashore have been leatherbacks (NPS 2000, 2008b). Leatherbacks are thought to migrate to their nesting beach about every two to three years (NMFS and USFWS 1992; Miller 1997). Clutch size averages 116 eggs, and the incubation period averages 55 to 75 days. It is also reported that leatherback turtles nest an average of five to seven times per year, with an average interval of nine to ten days between nesting (NMFS and USFWS 1992).

Factor Affecting Species Environment within the Action Area – All Sea Turtles

Threats to the loggerhead turtle on nesting grounds, as outlined in their recovery plan (NMFS and USFWS 2008), are representative of those also faced by green and leatherback turtles. The DEIS considers (NPS 2010a, pp. 220-221) data from the Seashore's annual sea turtle reports (all species) from 1999 to 2008 in discussing the threats to sea turtles within the action area.

The majority of turtle nest losses at the Seashore from 1999 to 2007 were weather related, particularly due to hurricanes and other storms (NPS 2010a, p. 220). Nest losses resulted from storms washing them away, burying them under feet of sand, or drowning them in the flooding tides. During this time period, seven hurricanes made landfall and impacted nests. In 2003, 34 of 87 nests hatched before Hurricane Isabel hit. Afterward, none of the remaining 52 nests (60%) could be found, and the water and sand movement along the beaches left no evidence of their previous existence. In 2006, 30% of the nests (23 of 76 nests) were either lost to heavy seas or drowned by flooding tides. In 2007, five nests (6%) were lost; in 2008, six nests (5%) were lost and another 16 nests experienced decreased nest success due to two tropical storms. In 2009, six nests (6%) were lost to storms and another 25 experienced a severe decrease in nest success due to individual storms. Additionally, many other nests over the years have experienced reduced hatching success due to storm overwash that could not be correlated to any one particular storm event.

Foxes were first seen at the Seashore in 1999 and on Hatteras Island in the winter of 2001–2002. Foxes disturbed or destroyed turtle nests in 5 of the 11 years between 1999 and 2009, with the number of nests disturbed or destroyed ranging from one to nine nests per year. Ghost crab predation has been reported sporadically from 1999 to 2009, with 0 to 27 nests per year recorded as having either ghost crab holes burrowed deep into the nest cavity and/or eggshell fragments found on top of the sand in association with crab tracks.

Pedestrian tracks have been recorded inside closures, with counts ranging from 8 to 92 intrusions per year (NPS 2010a, p. 220). Pedestrians disturbed or destroyed two to six nests per year from 1999 to 2008 by digging at the nest site; however, no pedestrian disturbances occurred in 2003, and no data were available for 2005.

Many, but not all, ORV users respect sea turtle nest protection areas. Since 1999, recorded violations of sea turtle nest protection areas by ORVs have generally ranged annually from 13 to 45 sets of tracks inside closures, though a total of 130 sets of tracks were documented in 2000 and 102 sets of tracks were documented in 2001 (NPS 2010a, p. 220). Most, but not all, of these ORV violations occurred when ORVs drove in front of nest areas during periods of low tide. Incidents of ORVs causing property damage to signs, posts, and twine marking the sea turtle nest protection areas have also been documented. From 1999 to 2009, the number of incidents where ORVs caused property damage generally ranged from 3 to 9 incidents annually, although a total of 28 incidents were recorded in 2000 and a total of 146 incidents were recorded in 2001. ORVs drove over four to five nests per year from 2000 to 2002; however, the nests survived. Two nests in 2007 and one nest in 2008 were known to have been run over by ORVs before they were found during the morning turtle patrol and fenced off. Of these three nests, the 2008 nest and one of the 2007 nests appeared undamaged; however, four eggs were crushed in the second 2007 nest. In 2004, a total of ten hatchlings were killed by vehicles in two separate incidents. In 2009, despite operating under the consent decree, requiring expanded buffers be implemented after acts of deliberate closure violations/vandalism, two occurrences of deliberate violations were recorded (NPS 2010a, p. 220).

During the night-time hours between June 23 and June 24, 2010, a nesting female loggerhead turtle that was struck and killed by an off-road vehicle (ORV). The turtle had crawled out of the ocean and attempted to lay a nest between Ramps 70 and 72 on Ocracoke Island. The turtle was hit by an ORV and dragged approximately 12 feet, causing fatal injuries to the turtle. It is believed to be the first time a nesting sea turtle has been killed by an ORV at the Seashore. The incident is believed to have occurred during the early morning hours of June 24 in violation of the posted night-driving restriction. The vehicle that struck and killed the turtle is likely to have been a four-wheel drive sport utility vehicle (SUV) or pick-up truck.

Dogs disturbed or destroyed two nests in 2000, and five to 60 sets of dog tracks per year have been recorded inside closures (NPS 2010a, p. 220). In 2008, cats were documented preying on emerging hatchlings at several nests, all within the villages (NPS 2010a, pp. 220-221). This was the first year in which this was documented. However, ten to 50 sets of cat tracks per year were counted inside turtle closures from 2000 to 2002. In 2009 cat tracks were found within at least 20 turtle closures, most commonly in the village areas.

The total number of pedestrian, vehicle, and pet violations are conservative estimates, for often the actual numbers could not be determined. Footprints and tracks are often recorded as a single violation, when an undeterminable number of tracks through an area may actually represent multiple violations. Also, tracks below the expanded nest closures are often washed out by the tide before being discovered by the turtle patrol.

Documented beach fires totaled 174 in 2000 and 773 in 2001. Such fires may misdirect adults and emergent hatchlings (NPS 2010a, p. 221). In 2006, an adult turtle crawl was discovered going into the coals of a beach fire, and in 2007, a turtle approached a beach fire, which visitors quickly extinguished prior to the turtle laying her nest about 2 feet from the fire site. In 2008, several hatchlings were found entering a fire and were recovered and released. It was unknown how many died prior to the hatchlings being noticed. The misdirection of hatchlings by lights from villages and other human structures is a common occurrence at the Seashore. In 2009, documented tracks indicated a nesting female crawled up to a still-warm fire pit, turned around, and went back into the water.

There have also been documented reports in 2000, 2001, 2007, 2008, and 2009 and an unconfirmed report in 2006, of adult turtles aborting nesting attempts when visitors approached the turtles with flashlights, vehicle lights, or flash photography (NPS 2010a, p. 221). Because the beaches are not patrolled 24 hours a day, it is likely that more disturbances of this nature occur but go undocumented.

Since 2001, Seashore staff members have been tying notices to personal property found on the beach after dawn, advising owners of the threats to nesting sea turtles, and then removing the items, when possible, if they remain on the beach 24 hours after tagging (NPS 2008b).

At the Seashore, between 2000 and 2009 (excluding 2005 data that cannot be verified), on average, 25% of the nests found (all turtle species included) were relocated from their original location by Seashore staff (Muiznieks, NPS, pers. comm. 2010b). Of those nests, 81% were relocated for natural causes (e.g., in areas prone to flooding [below the high tide line], in an area prone to erosion, etc.), 13% were relocated because of potential human disturbance, primarily because they were within one mile of a lighted fishing pier, 3% were relocated due to both environment and human disturbance issues, and 3% were moved during storm events later into incubation.

Information provided to the Seashore and USFWS by members of the Cape Hatteras Access Preservation Alliance in response to the DEIS indicated that between 2006 and 2009 the nest relocation rate decreased to 18% of all nests laid. This document advocates greater use of nest relocation as a management tool (Larry Hardham and Bob Davis, unpubl. data. 2010).

Stranded sea turtles, i.e., juvenile or adult turtles that wash onto the beach dead, injured, ill, or weak, have been found within CAHA. From 1998 to 2005, about 1,346 dead or living sea turtles (including 23 individuals in which the species could not be identified) were reported stranded on CAHA. The majority of these animals (n = 777) have been located on the ocean side of CAHA. Loggerheads (n = 841) have been the most numerous species found stranded on CAHA, followed by green (n = 255) and Kemp's ridley (n = 203) sea turtles. Sea turtles of all species are found stranded throughout the year at CAHA. However, the months between November and January (n = 541) and between May and July (n = 516) recorded the highest numbers of strandings. Twenty-one leatherback turtles were reported stranded (dead or alive) at CAHA during these years. Leatherback turtles accounted for less than two percent of sea turtles found stranded at CAHA. Three stranded hawksbill sea turtles were recovered on the inshore side of CHHA during the 1998-2005 period. The "Seaturtle.org" website (<

http://www.seaturtle.org/strand/summary/index.shtml?program=1&year=2009 >) states that 293 sea turtle strandings were recorded on Hatteras and Ocracoke Islands during 2009 (Seaturtle.org 2010). Strandings for loggerhead, greens, and Kemp's ridleys were 50 (17.1%), 184 (62.8%), and 57 (19.4%), respectively. There was one leatherback and one unknown stranding. No stranded hawksbills were reported. While there have been no reports of stranded turtles being run over, direct impacts to live stranded turtles may occur year-round (NPS 2010a, p. 368).

ENVIRONMENTAL BASELINE – SEABEACH AMARANTH

Status of Species within Action Area - Seabeach Amaranth

This species is listed as threatened by the State of North Carolina (North Carolina Natural Heritage Program 2010). Within North Carolina, from 2002 to 2003, the number of plants increased from 5,700 to 9,300 along 112 miles of beach, only a fraction of the approximately 40,000 plants reported in the late 1980s and 1995 (Cohen et al. 2010, NPS 2010a, p. 221).

Biologists from the USFWS, NPS, the North Carolina Natural Heritage Program, and East Carolina University have conducted various surveys for seabeach amaranth at CAHA since 1987. Most survey efforts were concentrated around Bodie Island spit, Cape Point and South Beach, Hatteras Island spit, north Ocracoke and the south Ocracoke spit. Since seabeach amaranth is an annual species and it occurs in a habitat that is constantly changing, it is difficult to calculate the actual population size. Annual numbers of seabeach amaranth reported represent an estimate of the population size based on the number of individual plants visible during a brief window when surveys are conducted during the growing season.

Since 2000, locations where seabeach amaranth has been found within the Seashore include the upper, dry-sand flats at Cape Hatteras Point (Cape Point and South Beach), in a line of small dunes adjacent to the flats at Hatteras Inlet Spit, at Bodie Island Spit, and at the base of dunes on the beach on the northern half of Ocracoke Island (NPS 2010a, p. 223). Most areas where the plants have been found were either in established bird closures or other areas closed to vehicular traffic (NPS 2001b, 2001c, 2005a).

Within the Seashore, seabeach amaranth numbers ranged from 550 to nearly 16,000 plants between 1985 and 1990 (NPS 2010a, p. 222). However, in the last 10 years a maximum of only 93 plants was observed in 2002. More recently, only one plant was found in 2004 and two plants in 2005. Despite continuous protection (through the establishment of summer and winter resource closures) of the area on Bodie Island Spit where the plants were found in 2004 and 2005, as well as the area on Cape Point where the plant was historically found, no plants have been found in the Seashore since 2005. Additionally, large portions of the historic range of the plant at Hatteras Inlet Spit no longer exist due to continued erosion. While it is thought that the plant may possibly be extirpated from the Seashore (NPS 2009a), it should be noted that since plants are not evident every year, but may survive in the seed bank, populations of seabeach amaranth may still be present even though plants are not visible for several years (USFWS 2007).

Factors Affecting Species within the Action Area - Seabeach Amaranth

The predominant threat to seabeach amaranth is the destruction or alteration of suitable habitat, primarily because of beach stabilization efforts and storm-related erosion (USFWS 1993). Other important threats to the plant include beach grooming and some forms of "soft" beach stabilization, such as sand fencing and planting of beach-grasses; vehicular traffic, which can easily break or crush the fleshy plant and bury seeds below depths from which they can germinate; and predation by webworms (caterpillars of small moths) (USFWS 1993). Webworms feed on the leaves of the plant and can defoliate the plants to the point of either killing them or at least reducing their seed production. Beach vitex (*Vitex rotundifolia*) is another threat to seabeach amaranth, as it is an aggressive, invasive, woody plant that can occupy habitat similar to seabeach amaranth and outcompete it (Invasive Species Specialist Group (ISSG) 2010).

EFFECTS OF THE ACTION

This section includes an analysis of the direct and indirect effects of the proposed action on the species and/or critical habitat (designated and proposed) and its interrelated and interdependent activities. An interrelated activity is an activity that is part of the proposed action and depends on the action for its justification. An interdependent activity is an activity that has no independent utility apart from the action under consideration.

Because of the flexibility inherent in the adaptive management approach of the ORV Management Plan and the uncertainty of the specifics of how it will be implemented on-the-ground, and the possibility that the alternative selected may vary somewhat from the preferred alternative described in the DEIS, the USFWS is analyzing a worst case situation for the plan. This worst case scenario recognizes that the NPS may or may not implement specific management actions based on the particular circumstances of a given situation. It further recognizes that the responsibility for specific management decisions at CAHA rest with the NPS. However, the overall implementation of the ORV Management Plan is fully expected to be carried out in accordance with NPS management policies, the enabling legislation for CAHA and the NPS Organic Act; all of which mandate the conservation of fish and wildlife resources including the federally listed species and their habitats addressed in these biological and conference opinions. As such, under the worst case scenario, the USFWS expects the NPS to implement the elements of the plan such that its overall effect is to ensure the continued existence of these species as a functioning component of the CAHA ecosystem.

FACTORS TO BE CONSIDERED

Factors to be Considered - Piping Plovers

Proximity of the action

The proposed action occurs within the nesting range of the Atlantic Coast piping plover breeding population. In accordance with the Endangered Species Consultation Handbook (USFWS and

NMFS 1998), since recovery units have been established in an approved recovery plan, this biological opinion considers the effects of the proposed project on piping plovers in the Southern recovery unit, as well as the Atlantic Coast population as a whole. The proposed action also occurs within the migrating and overwintering range of all three breeding populations (including the endangered Great Lakes breeding population) of the piping plover.

Distribution

The expected disturbance from the proposed action is likely to occur throughout the action area (defined above). Potential impacts to breeding and non-breeding piping plovers will affect the species throughout the year, but be limited by the extent to which protected areas are established for breeding and non-breeding piping plovers. The USFWS expects the magnitude of impact to be inversely proportional to the extent to which year-round recreational access is controlled in areas used by the piping plover during all phases of its life-cycle (i.e., nesting, migrating, and wintering).

Timing

The proposed action will occur throughout the year. Specifically, the proposed action will occur during the breeding, migrating and wintering seasons of the piping plover.

Nature of the effect

The most obvious and well-documented effects on the Atlantic Coast population are attributable to inadequate protection of breeding activity. Vehicles on the beach can have significant effects on piping plover breeding activities as well as non-breeding activities. Vehicles on the beach also greatly compound the full suite of public use impacts by extending high levels of human and pet activity to a much larger section of the beach than would occur if all access were pedestrian. Although public use management alone is not sufficient to assure high plover productivity and population growth (predator management and habitat protection are also required), it is essential. Evidence suggests that without such management, the CAHA piping plover population will again become unproductive and small, and may become functionally extirpated. Conversely, experience elsewhere in the species' Atlantic Coast range and at CAHA during the 2005-2010 breeding seasons demonstrate that well-protected piping plovers can be highly productive.

The effects of current public access (specifically ORV) management at CAHA may be reflected in the trends in number of breeding pairs recorded in several southern states (NPS 2010a, p. 186), including North Carolina, from 1986 through 2009 and the number of breeding pairs recorded on CAHA (NPS 2010a, p. 187; M. Murray, NPS, pers. comm.. 2010) from 1987 through 2010. While plover abundance in Virginia grew substantially, breeding in other areas remained relatively low (Delaware). However, no state experienced the sustained declines seen at CAHA from 1995-1996 through 2002-2003. The biologically appropriate measure of population impact is not the size of the population as it existed in 2004, prior to implementation of the Interim Strategy, but rather the potential pairs and productivity foregone. The 15 pairs documented at CAHA in 1989, the rapid growth in the breeding population since implementation of the Interim Strategy and Consent Decree, and comparison of current habitat with 1989 aerial photos furnish empirical evidence of potential for a breeding population size greater than that which currently exists at CAHA. Further, demonstrated population growth in similar habitats elsewhere in the range provides strong evidence that the potential contributions of CAHA are two to four times historic numbers (i.e., 30 to 60 pairs). Indeed, a very simple exercise conducted at the time of the recovery plan revision resulted in an estimated carrying capacity for CAHA of 30 pairs (USFWS 1996a, Appendix B). Actual population growth at many of the sites in other states has exceeded the projections made in this exercise.

Vehicle-related activities that may affect breeding and non-breeding piping plovers addressed in this biological opinion include collisions with cars; vehicles disturbing or harassing nesting; foraging, or roosting plovers; tire ruts trapping, herding, or impeding movements of piping plover chicks; and similar impacts associated with beach maintenance and other recreational activities. Pedestrian-related activities that may affect piping plovers addressed in this biological opinion include disturbing or harassing nesting piping plovers and chicks; crushing eggs or nests; attracting predators to plover nests or chicks; and similar impacts associated with pedestrian recreational use of the beach. Lights from vehicles, pedestrians (including beach fires), or structures that may result in disturbance or disruption of nesting, foraging, or migrating piping plovers is also considered.

Duration

The effects of the proposed action are likely to continue until throughout the life of the ORV Management Plan.

Disturbance frequency

The frequency of disturbance will be continuous throughout the action area as piping plovers may be present throughout the year and recreational access to plover habitats will be persistent throughout the year. Although recreational access will likely decline during the winter months, concentrated impacts from disturbance will likely be greatest within the Seashore at the inlet spits where plovers are likely to concentrate in higher numbers.

Disturbance intensity

The potential for disturbance to the piping plover populations throughout the action area is high, but the intensity of the disturbance is expected to be very high and result in the greatest potential impacts on the spits at the inlets and Cape Point where the highest number of piping plovers are reported. The intensity of disturbance will likely be greatest for nesting piping plovers (April 1 through August 31) since they are tied to a point on the landscape with a nest, or when rearing young that have not yet fledged. The intensity of disturbance will also be high during the nesting, migrating, and wintering periods for foraging and roosting plovers. Disturbance can occur to the adults, chicks, and nests during the day or night by vehicles, pedestrians, or their pets, especially if those nests are not marked for protection, access is not restricted from closure areas, and disturbance in the general vicinity of plovers is not avoided. Increased predator activity from human use could also increase disturbance to piping plovers. In the presence of disturbance, adult and young plovers ultimately expend more energy being alert and avoiding impacts, and are potentially more susceptible to predation. Disturbance intensity may decrease through time with implementation of the Adaptive management components of the ORV Management Plan.

Disturbance severity

Impacts to migrating and wintering piping plovers described above are of particular concern for the endangered Great Lakes population. Surveys to date have detected at least seven individually identifiable Great Lakes piping plovers at Hatteras Inlet, four at North Core Banks/Ocracoke Inlet, and one at Bodie Spit/Pea Island National Wildlife Refuge (Stucker and Cuthbert, 2006). The Great Lakes population is inherently vulnerable to even small declines in its most sensitive vital rates, i.e., survival of adults and fledged juveniles (USFWS 2009b, p. 88). Therefore, ensuring the persistence of the Great Lakes piping plover also requires maintenance and protection of habitat in their migration and wintering range, where the species spends more than two-thirds of its life cycle. Habitat degradation and increasing human disturbance are particularly significant threats to non-breeding piping plovers. Although progress towards understanding and managing threats in this portion of the range has accelerated in recent years, substantial work remains to fully identify and remove or manage migration and wintering threats.

Factors to be Considered – All Sea Turtles

Proximity of the action

The proposed action occurs within the northern nesting range of the loggerhead, green, and leatherback sea turtles. Specifically, the proposed action occurs within the range of the Northern subpopulation of the loggerhead turtle.

Distribution

The expected disturbance from the proposed action is likely to occur on all ocean facing beaches throughout the action area.

Timing

The proposed action will occur throughout the year. The majority of direct and indirect effects of vehicular access to the beach on sea turtles, and their nests, eggs, and hatchlings are anticipated to occur primarily during the sea turtle nesting and hatching seasons from May 1 through November 15 and during summer and fall storm events through about November 30 when post-hatchlings may wash ashore.

Nature of the effect

Vehicle-related activities that may affect sea turtles addressed in this biological opinion include collisions with cars, vehicles disturbing or harassing nesting sea turtles or hatchlings, tire ruts impeding hatchling sea turtle migration to the sea, sand compaction of sea turtle nest sites, and impacts to turtles associated with beach maintenance and recreational activities. Pedestrian-related activities that may affect sea turtles addressed in this biological opinion include disturbing or harassing nesting sea turtles or hatchlings, attracting predators to sea turtle nests or hatchlings, and impacts to turtles associated with pedestrian recreational use of the beach. Lights from vehicles, pedestrians (including beach fires), or structures that may result in disturbance or disruption of nesting or hatchling sea turtles is also considered.

Differences in specific sea turtle species' behaviors may lead to slightly different impacts; although these differences are not expected to be measurable. Wherever possible, the USFWS has based its assessment on information that gives the benefit of the doubt to the species. In terms of a qualitative assessment of the impact of the actions described below on each of the three sea turtle species that nest in the action area, the USFWS believes that impacts are equally likely to affect each adult, nest, and hatchling. With this reasoning, the proportion of nests occurring in the action area may accurately predict impacts to each species. Using this rationale, the USFWS expects that about 95 percent of beach access impacts will involve loggerhead sea turtles (adults, eggs and hatchlings) and five percent will involve leatherback and green sea turtles, their eggs and hatchlings.

The USFWS is also considering the effects of beach access on sea turtles during periods not specifically within the typical sea turtle nesting season. Thus, the USFWS has incorporated analyses of potential impacts to nests, hatchlings, and adults throughout the year, where warranted, as well as post-hatchling washbacks and live stranded turtles.

Duration

When implemented, the ORV Management Plan will guide the management and control of ORVs on CAHA for the next 10 to 15 years (NPS 2010a, p. 1). The plan will form the basis for a special regulation to manage ORV use at the Seashore. Efforts to achieve the desired future conditions for sea turtles (NPS 2010a, p. 8) in both the short-term (two, five-year periods) and long-term (four, five-year periods) will be ongoing while the plan is in effect.

As stated earlier, the majority of direct and indirect effects of vehicular access to the beach on sea turtles, their nests, their eggs, and hatchlings are anticipated to occur primarily during the sea turtle nesting and hatching seasons from May 1 through November 15 and during summer and fall storm events through about November 30, when post-hatchlings may wash ashore. Some early nests are occasionally laid prior to May 1. The earliest leatherback nest on record was laid on April 16 (Godfrey, M.H., NCWRC, pers. comm. 2010). No green or loggerhead nests have been reported as being laid prior to May 1 in the action area, although the lack of regular patrols may have impeded observations of early nests.

Similarly, sea turtle nests laid late in the summer result in hatchlings emerging in the fall after November 1. The latest loggerhead nest was laid on September 5. The latest recorded green turtle nest in CAHA was laid on August 28 (Godfrey, M.H., NCWRC, pers. comm. 2010). Leatherback nests tend to be laid earlier than green or loggerhead turtles, and the latest nesting date for leatherbacks within CAHA occurred on July 26, 1998 (Godfrey, M.H., NCWRC, pers. comm. 2010).

Disturbance frequency

The frequency of disturbance will be continuous throughout the sea turtle nesting and hatching seasons as nesting females, nests, and hatchling sea turtles may be present from April through mid-November throughout the action area.

Disturbance intensity

The potential for disturbance to the sea turtle populations throughout the action area is high. Disturbance can occur at night when females are emerging to lay a nest or when hatchlings are leaving the nest to return to the ocean. Disturbance can also occur to the nests during the day or night by vehicles, pedestrians, or their pets, especially if those nests are not marked for protection. Increased predator activity from human use could also increase disturbance to sea turtle nests and hatchlings.

Disturbance severity

Disturbance may appear relatively small on a day to day basis. However, the effects of constant disturbance to nesting sea turtles, their nests, and hatchlings over several years may result in population declines due to a reduction in the number of sea turtles nesting on the beaches at CAHA and/or the number of hatchlings surviving to reach the ocean. If realized, the resulting population decline could lead to a significant reduction in the number of sea turtles nesting on CAHA and the contribution that those sea turtles have (especially the northern nesting subpopulation of loggerheads) on the larger sea turtle population.

Factors to be Considered– Seabeach Amaranth

Proximity of the action

The proposed action occurs within the historic and extant range of seabeach amaranth.

Distribution

The expected disturbance from the proposed action is likely to occur throughout the action area. The USFWS expects the potential magnitude of impact to be high considering that the year-round recreational access will affect seabeach amaranth during all phases of its life-cycle and the seeds during the winter.

Timing

The effects of the proposed action will occur throughout the year; although, the direct effects will primarily occur during the germination, growth and flowing period for seabeach amaranth.

Nature of the effect

The proposed action may crush, bury and/or destroy existing plants, resulting in mortality of the plant. The proposed action may also bury seeds. If mortality occurs before the plants produce fruit, or if the seeds are buried to a depth that would prevent germination, the overall population at CAHA may be reduced.

Duration

When implemented, the ORV Management Plan will guide the management and control of ORVs on CAHA for the next 10 to 15 years (NPS 2010a, p. 1). The plan will form the basis for a special regulation to manage ORV use at the Seashore. Efforts to achieve the desired future conditions for seabeach amaranth (NPS 2010a, p. 9) in both the short-term (two, five-year periods) and long-term (four, five-year periods) will be ongoing while the plan is in effect.

Disturbance frequency

The frequency of disturbance will be continuous as seeds may be present throughout the winter and plants, if able to germinate, will be growing during the summer months throughout the action area.

Disturbance intensity

The potential for disturbance to the seabeach amaranth population throughout the action area is high, but the intensity of the disturbance is not expected to be very high because not all plants on CAHA will likely be harmed at the same time.

Disturbance severity

Disturbance may appear relatively small on a day to day basis; however, the effects of constant disturbance over several years may result in population declines as seed are lost from the population (seed sinks) or plants are destroyed before reproducing. The resulting population decline may lead to extirpation of seabeach amaranth from CAHA.

ANALYSES FOR EFFECTS OF THE ACTION

Beneficial Effects

Beneficial effects of implementing Alternative F to listed species can be found in the discussion of minimization and mitigation measures proposed by the Seashore. These beneficial effects can be categorized as measures to limit the interaction of vehicles, pedestrians, and their pets with nesting, migrating, and wintering piping plovers and their nests, hatchling and juvenile piping plovers (NPS 2010a, pp. 356-358), germinating seabeach amaranth (NPS 2010a, pp. 415-418), and nesting sea turtles and their nests, eggs, and hatchlings (NPS 2010a, pp. 392-396).

Analyses for Effects of the Action– Piping Plovers

Direct effects

Vehicles altering adult nesting behavior or colliding with an adult plover during the night or day - Under Alternative F, suitable piping plover nesting habitat would be protected as pre-nesting areas and restricted for vehicles, pedestrians and pets from March 15 through July 31, or two weeks after all chicks in the area have fledged (whichever come later). Alternative F would designate approximately 26 miles of vehicle-free areas (VFAs) which would be closed to ORVs year round, and would include Hatteras Inlet Spit and North Ocracoke Spit. ORV corridors would be provided at Cape Point and South Point, with the corridor being reduced from 50 meters (164 feet) to 35 meters (115 feet) during the breeding season, with standard resource protection buffers in effect once breeding activity is documented. Alternative F also provides for a seasonal VFA on Bodie Island spit which is closed to ORV use from March 15 through September 14. Within these areas, as well as throughout other areas of the Seashore, buffers for the protection of piping plover would be established as a 75 meter buffer for nests, and a 1000 meter ORV buffer and a 300 meter pedestrian buffer for unfledged chicks. Piping plovers would likely experience long-term moderate benefits from the size of the resource closures under Alternative F and the fact that buffers would be adjusted in response to chick mobility, as these actions would be expected to improve the sustainability of the species at the Seashore. Use of ORVs at night would restricted between May 1 and November 15. An annual habitat assessment would be conducted prior to the breeding season to identify suitable pre-nesting areas and such areas would be subject to periodic review, which would have long-term moderate beneficial impacts.

While there are no specific records of vehicles colliding with breeding piping plovers at CAHA, the prospects of finding a small sand-colored bird that has been crushed in a tire rut is unlikely. However, the number of violations (e.g., vehicles entering closure areas) provides some indication of the potential for vehicles altering the breeding behavior of plovers or vehicles colliding with breeding plovers to occur and go unreported. The potential for vehicles hitting a plover also exists on the ocean beach outside of closure areas during the nesting and non-nesting periods.

Collision between vehicles and plover chicks during the night and day - Under the proposed ORV Management Plan, the threat of vehicle collisions with piping plover chicks remains due to the creation of ORV access corridors near breeding areas. Because of their small size, high mobility, and the high volume of traffic in areas of the Seashore known for plover nesting, plover chicks on the beach during the day and night are vulnerable to being run over.

Vehicles have been documented running over nests (Patterson et al. 1991) and birds on Assateague Island in Maryland and Virginia. In Massachusetts and New York, biologists found that 18 chicks and 2 adults were killed by vehicles between 1989 and 1993, even on beaches with only five to ten vehicles passes per day (Melvin et al. 1994). Piping plover chicks often move from the foredune area to forage along the wrack line and intertidal zone, which places them in the paths of vehicles. Jones (1997) studied piping plovers on Cape Cod National Seashore in Massachusetts, and observed that unfledged chicks ranged over 600 feet of beach length on average and that vehicle closures would need to encompass at least 1500 feet from nest sites in order to protect 95 percent of broods until fledging. Rapid chick movements are possible, with downy chicks observed crossing 81 feet in 12 seconds and 10-day old chicks capable of moving 180 feet in 26 seconds (Wilcox, 1959). Three out of 14 incidents in which plover chicks were killed by vehicles between 1989 and 1993 in Massachusetts and New York occurred despite the presence of monitors stationed on the beach to guide vehicles past (Melvin et al. 1994). In a 1996 incident on Long Island, New York, a chick darted in front of a vehicle and was killed in full view of two monitors who had just informed the driver that it was safe to proceed (A. Hecht, USFWS, pers. comm. 2006). Despite continuous daylight monitoring of nests and broods at the Overwash Zone, Chincoteague National Wildlife Refuge in Virginia in 1999, an experienced plover biologist traveling along the oceanside beach enroute to another site spotted four chicks from a previously undetected nest standing in vehicle ruts in an area open to ORV travel. Absent the fortuitous presence of this biologist, these chicks would likely have been killed without anyone ever being aware of their existence (A. Hecht 2000, in litt.). Following a 2000 incident when a brood of four chicks moved to the ocean intertidal zone before veteran monitors could alert and remove vehicles, the Chincoteague Refuge manager instituted ocean to bay closures within one quarter mile of all unfledged broods (J. Schroer, USFWS, in litt. June 2000).

Chicks can end up in or near tire ruts, and sometimes have difficulty crossing or climbing out of them. The normal response of plover chicks to disturbance could increase their vulnerability to vehicles. Chicks sometimes stand motionless or crouch as vehicles approach, and their lack of rapid movement could lead to mortality (USFWS 1996a).

While the DEIS does not document any vehicle collisions with piping plover chicks within CAHA (NPS 2010a, p. 210), the chances of finding a crushed chick are very small, and the potential for collisions to occur remain extremely high during the day and night. In fact, the majority of piping plover chicks at CAHA are lost within the first ten days after hatching.

At Cape Lookout National Seashore, where vehicles operate on the beach under similar rules as CAHA, there have been several instances were American oystercatchers (*Haematopus palliates*), which are considerably larger that piping plovers, were run over by vehicles (NPS 2010a, p. 234). Direct mortality of oystercatcher chicks from vehicles has been documented since 1995, when three chicks were found crushed in a set of vehicle tracks at the Seashore (Simons and Schulte 2008). Similar events have been documented at neighboring Cape Lookout National Seashore, where studies documented five chick deaths related to vehicles in 1995 (Davis 1999), and one chick and two clutches lost in 1997 when they were run over by vehicles (Davis et al. 2001). Three oystercatcher chicks were killed during the 2003 and 2004 breeding seasons at Cape Hatteras by being run over by vehicles (NPS 2004b, 2005c), as documented by Seashore resource protection staff.

Vehicles running over undetected piping plover nests – All action alternatives would incorporate the Piping Plover Recovery Plan, Appendix G: Guidelines for Managing Recreational Activities in Piping Plover Breeding Habitat on the U.S. Atlantic Coast to Avoid Take Under Section 9 of the ESA, which provides that all suitable piping plover nesting habitat should be identified by a qualified biologist and delineated with posts and warning signs or symbolic fencing on or before April 1 each year (NPS 2010a, p. 66). All vehicular access into or through posted nesting habitat should be prohibited. Furthermore, on beaches where pedestrians, joggers, sun-bathers, picnickers, fishermen, boaters, horseback riders, or other recreational users are present in numbers that could harm or disturb incubating plovers, their eggs, or chicks, areas of at least 50 meter-radius around nests above the high tide line should be delineated with warning signs and symbolic fencing (NPS 2010a, p. 65). Only persons engaged in rare species monitoring, management, or research activities should enter posted areas.

However, about 50 to 60 occurrences of ORVs entering protected areas in the Seashore were recorded each year from 2000 to 2002 (NPS 2010a, p. 210). In 2003, 13 bird closure posts/signs were driven over by an ORV, and several instances of ORVs within the protected area were observed (NPS 2003a, 2004a, 2005a). A total of 105 occurrences of ORVs entering posted bird closures were recorded in 2003. This number represents a substantial increase compared to 52 recorded in 2001 and 63 in 2002 (NPS 2004a). In 2004, 227 pedestrians and 65 vehicle tracks were reported within posted bird resource closures, including those for piping plovers.

While there are no specific records of vehicles disturbing piping plover nests or the loss of chicks within CAHA (NPS 2010a, p. 210), the number of violations (e.g., vehicles entering closure areas) provides some indication of the potential for vehicles destroying nests. The potential for vehicles running over plover nests also exists when those nests are constructed outside of the closure areas and remain undetected.

Mobile and stationary lights and impacts on adult and/or hatchling piping plovers - The extent that mobile or stationary lighting affects piping plovers is unknown. However, there is evidence that American oystercatcher chicks and adults are attracted to vehicle headlights and may move toward areas of ORV activity. Oystercatcher adults and chicks were regularly seen running or flying directly into headlights of oncoming vehicles at Cape Lookout National Seashore (Simons et al. 2005), resulting in mortality.

Vehicular ruts and impacts to hatchling plovers fledging the nests – Alternative F would have buffers for unfledged chicks that extend 1,000 meters for ORVs (or 300 meters for pedestrians) on each side of a line drawn through the nest site and perpendicular to the long axis of the beach (NPS 2010a, p. 123; M. Murray, NPS, pers. comm.. 2010). The resulting area (2,000 meters wide for ORVs or 600 meters wide for pedestrians) of protected habitat for piping plover chicks would extend from the oceanside low water line to the soundside low water line or to the farthest extent of dune habitat if no soundside intertidal habitat exists. However, vehicles may be allowed to pass through portions of the protected area that are considered inaccessible to plover chicks because of steep topography, dense vegetation, or other naturally-occurring obstacles (NPS 2010a, p. 67;M. Murray, NPS, pers. comm.. 2010). Unfledged chicks outside of designated protected areas would be at risk of being run over by vehicles or trapped in tire ruts. While no mortality of piping plover chicks has been documented due to tire ruts at CAHA, chicks trapped in tire ruts would be difficult to detect even if regular surveys of the ruts were conducted. In addition, sub-lethal or lethal effects associated with chicks in tire ruts may have occurred that were not witnessed (animals buried in ruts, nocturnal land predators, weakened individuals dying or made more vulnerable to predators, etc.). Data do not exist to quantify the extent of take anticipated due to these interactions.

Despite the measures of symbolic fencing and nest protection to minimize impacts to fledgling piping plovers, incidental take is likely to occur. This level of take is expected because implementation of nest protection: (1) cannot account for highly mobile chicks that wander outside of the fenced areas; (2) broods are difficult to monitor during the day; and, (3) broods cannot be monitored at night.

Disturbance by vehicles, pedestrians, and pets – Vehicles used by park visitors, as well as by Seashore management and emergency service vehicles, operate throughout CAHA, except seasonally in front of the villages and within established resource closures. However, violations of the closures have been reported. During the 2009 breeding season, Seashore staff documented 192 pedestrian, eight ORVs, 19 dog, three horse and three boat violations in the pre-nesting closures (NPS 2010a, p. 210, NPS 2010b). Most illegal entries were not witnessed but documented based on vehicle, pedestrian, or dog tracks left behind.

Vehicles entering closure areas may kill or flush piping plovers throughout CAHA. However, the greatest potential for flushing piping plovers exists where there is the highest number of vehicles using the beach, which generally corresponds to the inlet areas. Vehicles can obliterate scraps, crush eggs as well as adults and chicks, and can disturb adults or chicks subjecting them to other lethal and sub-lethal conditions. Vehicles also degrade piping plover habitat or disrupt normal behavior patterns. Typical behaviors of piping plover chicks increase their vulnerability to vehicles, for example, by attempting to cross vehicle use areas when moving between upper beach areas and foraging areas of intertidal zones, and hiding from predators or traveling in tire ruts. Lighting from vehicles may also negatively affect piping plovers by attracting them resulting in disturbance or mortality.

Unrestricted use of motorized vehicles on beaches is a serious threat to piping plovers and their habitats. The magnitude of these threats is particularly significant because vehicles extend impacts to remote stretches of beach where human disturbance would be very slight if access were limited to pedestrians. Pedestrian and non-motorized recreational activities can be a source of both direct mortality and harassment of piping plovers. Pedestrians on beaches may crush eggs or deter piping plovers from using otherwise suitable habitat for nesting, foraging, or roosting. Pedestrians may flush incubating plovers from nests, exposing eggs to avian predators or excessive temperatures. Pedestrians can also displace unfledged chicks, forcing them out of preferred habitats, decreasing available foraging time, and causing expenditure of energy. Most time budget studies (see Table 2 in USFWS 1996a) reveal that piping plover chicks spend a very high proportion of their time feeding. Cairns (1977) found that piping plover chicks typically triple their weight during the first two week of hatching; chicks that failed to achieve at least 60 percent of this weight gained by day 12 were unlikely to survive.

Pedestrians have access to portions of piping plover habitat at CAHA and the USFWS expects that when human and plover use of the beach overlap, disturbance to nesting resting or foraging plovers will occur. 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 dogs on leash. A study conducted on Cape Cod, Massachusetts found that the average distance at which piping plovers were disturbed by pets was 150 feet, compared with 75 feet for pedestrians. Furthermore, the birds reacted to the pets by moving an average of 187 feet, compared with 82 feet when the birds were reacting to a pedestrian, and the duration of the disturbance behavior stimulated by pets was also significantly greater than that caused by pedestrians (Hoopes 1993). Unleashed dogs are known to chase piping plovers, destroy nests, and kill chicks (USFWS, 1996a).

The biological effects of flushing are difficult to quantify. However, since plovers require food and shelter, any actions that limit their ability to feed or find shelter probably have adverse effects on individual birds because flushed birds expend energy to avoid disturbance. The degree that piping plovers are adversely affected depends largely on how much time they are precluded from feeding or sheltering in relation to the amount of time they would feed or shelter if they were not flushed. To evaluate the biological effects of flushing, the identity of individual piping plovers would have to be known (e.g., leg banded) and the amount and extent of flushing would need to be documented consistently over time for each bird. Furthermore, these individual birds would need to be followed throughout the year to determine if their survival rates or nesting success were lower than other birds not subjected to flushing. Given that there are numerous other factors that may affect the survival or reproductive success of piping plovers (predation, weather, food availability and quality, etc.), it would be difficult to isolate the effects of flushing. A large number of individual birds would have to be studied over a relatively long period of time in order to attempt to quantify the effects of flushing. The USFWS is aware of no such long term and statistically robust studies.

The biological effects of disturbance that prevents nesting are more easily quantified. If adequate pre-nesting closures are not established by April 1 when spring migrants begin arriving and displaying breeding behavior (i.e., territorial establishment, courting, etc.), nesting by these birds may be delayed or preempted. Prior to 2005, pre-nesting closures were not consistently applied at CAHA, and while other factors (weather, predation, etc.) may play a role in the success of nest establishment, disturbance is as likely the leading cause of failure to construct a nest as any other factor.

Effects on piping plover habitat - The four units of designated piping plover wintering habitat currently support the primary constituent elements essential for the conservation of the species and do support consistent use by wintering piping plovers with the existing level of human use. However, as noted in the proposed rule to designate these four areas (71 FR 33703) the overall number of piping plovers observed at the proposed Oregon Inlet unit has declined since the species was listed in 1986, which corresponds to increases in the number of human users and off-road vehicles. This may be an indication that the increased use of the area by ORVs is adversely affecting the primary constituent elements of the habitat or it may be an indication of disturbance of wintering and migrating birds.

The proposed ORV plan, Alternative F (NPS 2010a, p. 80; M. Murray, NPS, pers. comm. 2010), states that areas of high resource sensitivity and high visitor use would generally be designated as vehicle-free areas year-round or as seasonal ORV routes, with restrictions based on seasonal resource and visitor use. In addition to the breeding season conservation measures, resource closures and/or vehicle-free areas would be established, based on an annual non-breeding habitat assessment conducted after the breeding season, to provide areas of non-breeding shorebird habitat with reduced human disturbance (NPS 2010a, p. 81; M. Murray, NPS, pers. comm.. 2010).

Alternative F would establish pre-nesting areas to close suitable nesting habitat to ORV use from March 15 through July 31, or two weeks after all the chicks in the area have fledged (whichever comes later. Alternative F would designate approximately 26 miles of vehicle-free areas (VFAs) which would be closed to ORVs year round, and would include Hatteras Inlet Spit and North Ocracoke Spit. ORV corridors would be provided at Cape Point and South Point, with the corridor being reduced from 50 meters (164 feet) to 35 meters (115 feet) during the breeding season, with standard resource protection buffers in effect once breeding activity is documented. Alternative F also provides for a seasonal VFA on Bodie Island spit which would be closed to ORV use from March 15 through September 14 (M. Murray, NPS, pers. comm. 2010). Since there is an overlap between the breeding and non-breeding seasons of piping plovers at the Seashore, measures to protect piping plover broods may still be in place when non-breeding plovers begin to arrive in late July, and these measures would potentially result in a slight increase in the suitability of the habitat for these early arriving non-breeding birds.

As shown on maps for Alternative F (M. Murray, NPS, pers. comm. 2010), the designated VFAs would provide for additional areas for non-breeding species to utilize. Also, an annual habitat assessment would be conducted at the points and spits after all birds have fledged from the area. Prior to removing the pre-nesting closures, resource closures would be established in the most sensitive portions of non-breeding shorebird habitat in these areas, based on habitat used by winter piping plovers in more than one (i.e., two or more) of the past five years. People and pets would be prohibited within these closures.

Interrelated and Interdependent Effects – Piping Plover

The effects of the action under consultation are analyzed together with the effects of other activities that are interrelated to, or interdependent with, that action. An interrelated activity is an activity

Analyses for Effects of the Action – All Sea Turtles

Direct Effects – Sea Turtles

Vehicles altering adult nesting behavior or colliding with an adult turtle during the night or day - While most sea turtle nesting activities are at night, some females may nest during daylight hours, or may be caught in the morning hours on the beach at some stage of nesting (oviposition, covering the nest, and exiting and returning to ocean). Alternative F provides (NPS 2010a, p. 82; M. Murray, NPS, pers. comm. 2010), that from May 1 through November 15, all potential sea turtle nesting habitat (ocean intertidal zone, ocean backshore, and dunes) would be closed to non-essential ORV use from 9:00 p.m. until 7:00 a.m. to provide for sea turtle protection and allow enforcement staff to concentrate their resources during the daytime. Therefore, there would be a reduced risk of nesting females being struck by ORVs during most hours of darkness, but some risk of collision during periods of twilight before 9 PM or after 7

AM. Visitor non-compliance with the night driving restrictions could put some nesting females would be at risk of collision with vehicles.

Isolating the effects of vehicular traffic on sea turtle nesting behavior, particularly the behavior of females either in oviposition or attempting to nest, is complicated. Other anthropogenic factors, geomorphic characteristics of the beach and nearshore waters and atmospheric conditions all influence the behavior of nesting sea turtles to some extent. However, it appears that areas with higher human recreational use have a higher number of false crawls than do areas with lower human use. For example, of all turtle crawls reported, about 80 percent were found on beaches open to vehicles or pedestrian use areas (such as life-guarded beaches or beaches serviced with parking lots), as compared to about 18 percent on beaches with lower human activity. This analysis, however, is confounded by the fact that many other factors could have affected nesting behavior in areas where driving or heavy pedestrian use was permitted. Higher numbers of pedestrians, greater light pollution, and different beach morphology may have also adversely affected nesting behavior in this area. Thus, without more data that allow for an analysis of correlation between variables potentially affecting sea turtle nesting behavior, it is not possible to definitively identify the effects that vehicles have on nesting sea turtle behavior.

Vehicles (or vehicle tracks) have been reported within closure areas at CAHA 29 to 109 times per year during the period from 1999 to 2004. While prior to June 2010 there were no specific records of vehicles colliding with nesting turtles at CAHA, the number of violations (e.g., vehicles entering closure areas) provides some indication of the potential for vehicles altering nesting sea turtle behavior or vehicles colliding with nesting sea turtles to occur and go unreported.

Collisions between vehicles and hatchling sea turtles during the night and day – From September 16 through November 15, Alternative F allows selected ORV routes with no turtle nests remaining (as determined by the NPS) to reopen for night driving, subject to the terms and conditions established under the ORV permit (NPS 2010a, p. 82; M. Murray, NPS, pers. comm.. 2010). During this period, incubation and emergence would be occurring on the Seashore.

Regular patrols for sea turtle nests would begin on May 1 unless leatherback nests have been reported within the state, in which case, the Seashore will follow the direction of NCWRC. Patrols will continue until September 15, or two weeks after the last sea turtle nest or crawl is found, whichever is later (M. Murray, NPS, pers. comm. 2010, Table 10-1). Following the end of the generally accepted nesting season, a cadre of trained volunteers would be established to watch nests that have reached their hatch windows in order to monitor hatchling emergence success and success reaching the water, and to provide for the minimization of negative impacts from artificial lighting, predation, and human disturbance (M. Murray, NPS, pers. comm.. 2010, Table 10-1). Depending on the number of nests that may be ready to hatch and the availability of volunteers, it may be necessary for NPS turtle staff to prioritize which nests are watched on any particular night. Priority will be given to watching the nests that are most likely to be negatively impacted by manageable factors.

Aside from the potential for hatchlings from unrecorded nests to be struck by vehicles, staff limitations for observing incubating nest creates the possibility of harm for the emerging hatchlings. Vehicle collisions with sea turtle hatchlings during the daytime have been reported (e.g., 2004), as have collisions with hatchlings that crawled over the dune and onto the highway at night (also 2004). The potential for collisions to occur remain high during the day and night.

Collisions between vehicles and strandings of live or weakened juvenile and adults and post-hatchling washback sea turtles – As noted, stranded sea turtles of the five species that occur in North Carolina waters have been reported. While there have been no reports of stranded turtles being run over, direct impacts to live stranded turtles may occur year-round (NPS 2010a, p. 368).

Post-hatchlings are commonly stranded in seaweed washed in by late summer and fall storm events (these post-hatchlings are often referred to as washbacks). Post-hatchling washbacks are often found dead or in a weakened state; however, efforts are made to revive or maintain live post-hatchlings for subsequent release when ocean conditions are calmer. Because of their size and the high volume of traffic in some areas of the Seashore, live post-hatchlings on the beach during the day are vulnerable to being run over. However, there are no reports of post-hatchling washbacks being struck by vehicles.

Vehicles running over undetected sea turtle nests - Impacts from vehicles running over sea turtle nests are reported in the literature. Mann (1977) reported that driving directly above incubating egg clutches can cause sand compaction which may decrease nest success and directly kill pre-emergent hatchlings. Subsequent injury and/or death of pre-emergent hatchling, and eggs may result due to physical crushing or collapse of the nesting chamber.

In the recent past, nests that have been missed during surveys and occurring in areas where beach driving is proposed are susceptible to being run over. All nests located during surveys (June 1 through August 31) were conspicuously marked and presumed to be avoided by vehicles. However, 12 of 102 sea turtle nests identified in CAHA in 2002 were subject to impacts by ORVs. These 12 nests were either run over by ORVs prior to the morning sea turtle survey or their enclosures were breached by ORVs after being marked off by CAHA staff. In fact, ORVs (or vehicle tracks) have been reported in closed areas 29 to 109 times per year during the years 2000-2002 (Cohen et al. 2010, p. 76). Vehicles were reported to have driven over four to five sea turtle nests per year during the 2000 to 2002 nesting seasons (Cohen et al. 2010, p. 76). While the nests were reported to survive, no specific analysis was conducted to determine the extent of any potential damage (e.g., effects of compaction or hatching success).

In two separate monitoring programs on the east coast of Florida where hand digging was performed to confirm the presence of nests, trained observers still missed about six to eight percent of the nests (Martin 1992; Ernest and Martin 1993). This must be considered a conservative number, because missed nests are not always accounted for. In another study, Schroeder (1994) found that even under the best of conditions, about seven percent of the nests can be misidentified as false crawls by experienced sea turtle nest surveyors.

The number of sea turtle nests that are not detected by Seashore monitors and that may be affected by vehicles on the beach can be estimated. During 2008 and 2009, there were 108 and 100 loggerhead nests, respectively, reported within the Seashore (NPS 2010a, p. 214. During

2010 a record 146 loggerhead nests were reported (M. Murray, NPS, pers. comm. 2010). The three year total for the dominant sea turtle species nesting in the project area was 354, or an average of 118 nests per season. Assuming an error rate of six to eight percent, the average number of nests that are undetected each year in CAHA when regular nest surveys are conducted (i.e., May 1 through September 15) would be between 7.1 and 9.4. Among the three species that nest at the Seashore, the loggerhead turtle is by far the most numerous, comprising approximately 95% of the known nests between 2000 and 2010 (NPS 2005b, 2007, 2008b; 2009c; 2010a; p. 212; Baker pers. comm. 2009b; M. Murray, NPS, pers. comm. 2010). Using the percentage for other species over the longer period, the number of nests not detected could be between 7.5 and 9.9 per year. Under Alternative F, monitoring would begin on May 1 and continue through September 15, or two weeks after the last turtle nest is laid, whichever is later (M. Murray, NPS, pers. comm. 2010), which reduces the possibility of missing nests.

However, this is a conservative estimate because other factors can obscure fresh turtles nest tracks. The weather, tides, and ORV tracks can and do obscure sea turtle tracks during the night when no surveys are conducted and before the surveys are conducted in the morning, there is a potential to miss an additional number of nests. While beach driving would be more regulated with the implementation of Alternative F, natural factors could results in approximately 19 to 22 sea turtle nests being undetected within the Seashore over the course of the nesting season.

No quantitative studies have been conducted at CAHA to evaluate the effects of vehicles driving over nests. Many factors, including the speed, weight, and size of the vehicle, the timing of the event with respect to the incubation period, the depth of the eggs/hatchlings (below grade) at the time of impact, and the physical characteristics of the nest itself, will influence whether or not, and the extent to which, mortality/injury occurs. Further, there is no established relationship between the cumulative number of times a particular nest has been run over and the extent and duration of a mortality/injury event. This analysis is further confounded by the fact that other factors may affect the viability of any particular sea turtle nest. For example, tidal inundation, storm events, predation, accretion/erosion of sand could negatively influence a sea turtle nest deposited in areas where beach driving will continue (NMFS and USFWS 1991a; 1991b; 1992). For these reasons, it is not possible to quantify the impacts beach driving will have on the undetected nests deposited annually in areas where beach driving will occur.

Mobile and stationary lights and impacts on adult and/or hatchling sea turtles - The USFWS recognizes that mobile and stationary lights have the potential to disorient both hatchlings and nesting females. Artificial lighting can cause misorientation or disorientation (Philibosian 1976; Mann 1977; Witherington 1990). Misdirection from crawling straight to the ocean may result in fatigue, dehydration, and increased likelihood of predation (Witherington et al. 1996). The correlation between level of light-caused disruption and survivorship has not, however, been identified. It has been demonstrated that there are relative degrees of sub-lethal and lethal effects (Salmon et al. 1995, Witherington et al. 1996).

Disorientation of hatchlings resulting from lights from villages and other human structures has been documented at CAHA. As part of the current plan, by May 1, 2012, the Seashore proposes to install, turtle-friendly lighting fixtures on all Seashore structures visible from the ocean beach (except where prevented by other overriding lighting requirements, such as lighthouses, which serve as aids to navigation) and fishing piers operated by NPS concessioners (NPS 2010a, p. 125). Portable lanterns, auxiliary lights, and powered fixed lights of any kind shining for more than 5 minutes at a time would be prohibited on Seashore ocean beaches from May 1 through Nov 15 (NPS 2010a, p. 125).

However, beach campfires can also misdirect adult and emerging hatchlings. In 1998, visitors reported hatchlings crawled into their campfire. In 2008, hatchlings emerging from a nest crawled approximately 984 feet (300 meters) into a campfire to the south of the nest (NPS 2009c). The Preferred Alternative allows for beach fires from 6:00 AM to midnight in front of the villages and Coquina Beach and the Ocracoke Day Use Area during the sea turtle nesting season, although it requires that in areas where fires are permitted, they would be prohibited within 100 meters of turtle nest protection areas (NPS 2010a, p. 112; M. Murray, NPS, pers. comm.. 2010).

Vehicular ruts and impacts to hatchling sea turtles emerging from nests - Vehicular ruts can create obstacles for hatchlings moving from the nest to the ocean. Upon encountering a vehicle rut, hatchlings may be disoriented and move along the vehicle track, rather than crossing over it to reach the water. Apparently, hatchlings become diverted not because they cannot physically climb out of the rut (Hughes and Caine 1994; Arianoutsou 1988), but because the sides of the track cast a shadow and the hatchlings lose their line of sight to the ocean horizon (Mann 1977). If hatchlings are detoured along vehicle ruts, they are at greater risk to vehicles, predators, fatigue, and desiccation.

At least two studies have confirmed hatchling disorientation by vehicular ruts (Cox et al. 1994; Hosier et al. 1981). In one study, tire ruts were found to cause nearly 21 percent of hatchling turtles to invert. Live and desiccated turtles have also been observed in deep vehicle ruts (LeBuff 1990).

The variety of access methods possible under Alternative F, based on the establishment of year-round and seasonal ORV routes and vehicle-free areas, and increased interdunal roads and parking to support access, would provide the public with ORV and pedestrian access to a greater number of areas within the Seashore (NPS 2010a, p. 81; M. Murray, NPS, pers. comm. 2010). A buffer approximately 10 × 10 meters will be established with symbolic fencing and signage around nest. Closure size may be modified depending on environmental conditions at the nest site. Approximately 50–55 days into incubation, closures will be expanded to the surf line. The width of the closure will be based on the type and level of use in the area of the beach where the nest was laid (NPS 2010a, p. 125; M. Murray, NPS, pers. comm.. 2010):

1. Vehicle-free areas with little or no pedestrian traffic - 25 meters wide (total). (i.e., 12.5 meters on either side of the nest);

2. Village beaches or other areas with high levels of pedestrian and other non-ORV use - 50 meters wide (total) (i.e., 25 meters on either side of the nest); and,

3. Areas with ORV traffic - 105 meters wide (total) (i.e., 52.5 meters on either side of the nest).

On the landward side of the nest, the closed area will be expanded to 15 meters from the nest where possible, but no less than 10 meters landward from the nest. If appropriate, traffic detours behind the nest area will be established and clearly marked with signs and reflective arrows.

The DEIS acknowledged (NPS 2010a, p. 217) that the ruts left by vehicles in the sand may prevent or impede hatchlings from reaching the ocean following emergence from the nest. In addition, sub-lethal or lethal effects may occur that are not observed (nocturnal land predators, weakened individuals dying at sea or made more vulnerable to predators, etc.). However, data do not exist to quantify the extent of take anticipated due to these interactions.

Despite the measures of nest protection and rut removal to minimize impacts to hatchling sea turtles, incidental take is likely to occur. This take is expected because implementation of nest protection and rut removal measures will miss some nests due to: (1) daily surveys are only conducted from May 1 through September 15 and nests laid prior to or after those dates may be missed; (2) vehicles obscure nesting tracks and the nests are missed; and, (3) high workloads that preclude the Seashore staff's ability to remove ruts from all nests nearing hatching.

Compaction of beach sediments and impacts on adults and/or hatchling sea turtles – Sand compaction due to vehicles on the beach may hinder nest construction and hatchling emergence from nests (NPS 2010a, p. 217). Driving directly above incubating egg clutches can cause sand compaction, which may decrease hatching success and directly kill pre-emergent hatchlings. Additionally, vehicle traffic on nesting beaches may contribute to erosion, especially during high tides or on narrow beaches where driving is concentrated on the high beach and foredune (USFWS and NMFS 2008). However, there are no known data that quantify the extent to which sediment compaction on beaches derives from long-term vehicle use versus natural processes.

If sediments become too compacted, a female turtle may have difficulty excavating an egg chamber of adequate depth or dimensions (Raymond 1984; Ryder 1990; Carthy 1994). Females may have more digging attempts before finally constructing a suitable egg chamber or they may simply be unable to dig a typical egg chamber. Increased energy expenditures during the course of nesting may place a higher reproductive cost on that individual. Additionally, if the chamber is poorly constructed, egg viability may be affected. For example, if the chamber is too shallow, eggs are more susceptible to erosion, predation, extreme temperatures, and disturbance from activities on the beach.

Sediments surrounding the egg chamber largely influence the incubation environment of the clutch. Temperature, moisture content, and gas exchange, all extremely important factors in the development of sea turtle embryos, are strongly influenced by sediment characteristics (Ackerman et al. 1985). Thus, hatching success, emerging success, sex ratios, and hatchling fitness (size and vitality) may be different in compact sediments than in more loosely configured sediments of comparable grain size.

Sand compaction has been shown to negatively impact sea turtles, particularly concerning beach nourishment projects. Research has shown that placement of very fine sand and/or the use of heavy machinery can cause sand compaction on nourished beaches (Nelson et al. 1987; Nelson and Dickerson 1988a). Significant reductions in nesting success (i.e., false crawls occurred more frequently) have been documented on severely compacted nourished beaches (Fletemeyer, 1980; Raymond 1984; Nelson and Dickerson 1987; Nelson et al. 1987), and increased false crawls may result in increased physiological stress to nesting females. Sand compaction may also increase the length of time required to excavate nests and result in increased physiological stress (Nelson and Dickerson, 1988b).

Beach driving likely contributes to sand compaction in CAHA. However, the additive effects of sand compaction due to vehicle traffic on nesting and reproductive success is not understood. Analyses of nesting data collected from Volusia County, Florida suggest that the effects of sand compaction may have negative effects on nests. However, these results were likely confounded by other uncontrolled, unmeasured variables that are known or suspected to also result in negative impacts to nesting and reproductive success (USFWS 2005). Therefore, the analyses described below, could not isolate the effects of sand compaction due to vehicles from other potential negative factors affecting sea turtles.

Data gathered from Volusia County, Florida, were analyzed to determine if sea turtle nesting success (number of emergences resulting in deposition of eggs) and reproductive success (number of nests with one or more eggs that hatched) were different between areas of the beach where public access was allowed (driving areas) and areas of beach where public access was not allowed (non-driving areas). The USFWS hypothesis was that sand compaction resulting from vehicle use would negatively affect both nesting and reproductive success. Analyses were conducted only on loggerhead sea turtles and their nests each year from 1997 to 2001.

Nesting success was nearly identical between driving areas and non-driving areas when data were combined for all driving and non-driving areas. However, when analyzed by area, the lowest and highest nesting success rates were found in non-driving areas (USFWS 2005), suggesting that other factors affect sea turtle nesting success. These factors, none of which were quantified or controlled, include: (1) presence and density of coastal armoring, (2) extent and magnitude of nocturnal human activity on the beach, (3) light pollution, and (4) beach profile characteristics. While the results of the combined area comparison of nesting success may lead the USFWS to conclude sand compaction does not affect nesting success, cautious regarding this conclusion is necessary due to the lack of control over other obviously important variables. Generally speaking, available data are insufficient to draw meaningful conclusions on the effects of sand compaction resulting from vehicle use of the beach on sea turtle nest success.

Average hatching (hatchlings produced from a nest) and emerging (hatchlings making it to the beach surface) success for driving areas was 73.6 and 68.9 percent, respectively, whereas average hatching and emerging success for non-driving areas was 80.4 and 75.6 percent, respectively (USFWS 2005). Hatching and emerging success was higher in non-driving areas. However, as with nesting success, other factors likely affect both hatching and emerging success. In an attempt to isolate the effects of sand compaction, the USFWS evaluated the emergence ratio (number of emerged hatchlings divided by the number of hatched eggs). On average, nests in driving areas had an emergence ratio of 0.924 and non-driving areas had an emergence ratio of 0.931 and were not statistically different (USFWS 2005). Thus, from this analysis the USFWS concluded that this difference resulted from proportionately fewer eggs hatching in driving areas rather than from proportionately fewer hatchlings emerging from nests. It is not known whether this difference is due to sand compaction (and the effects that sand compaction may have on oxygen content, moisture content, sand temperature regimes, etc.) or from other unrelated factors such as contamination of the sand.

Interrelated and Interdependent Effects – Sea Turtles

The USFWS does not anticipate any interrelated or interdependent effects.

Indirect Effects – Sea Turtles

Predators may follow ORV tracks or pedestrians to sea turtle nests and destroy the nests, eggs, or hatchlings.

Analyses for Effects of the Action -– Seabeach Amaranth

Direct Effects – Seabeach Amaranth

ORV use and associated activities (i.e., pedestrians and pets) in seabeach amaranth habitat may crush, bury and/or destroy existing plants, resulting in mortality. Beach driving can easily break or crush the fleshy plant and bury seeds below depths from which they can germinate, resulting in reduced numbers of plants.

Interrelated and Interdependent Effects – Seabeach Amaranth

The USFWS does not anticipate any interrelated or interdependent effects.

Indirect Effects- Seabeach Amaranth

Vehicle use of the beach may result in pedestrians and their pets accessing areas that otherwise would not be visited or would be visited less frequently because access would be difficult. The increased foot traffic from pedestrians and their pets can destroy existing plants by trampling or breaking the plants.

SPECIES' RESPONSE TO PROPOSED ACTION

Species' Response to Proposed Action - Piping plover

Numbers of individuals/populations in the action area affected - Over the last 11 years (2000-2010) the annual number of piping plover nests found at CAHA has varied from 15 (2010) to two (2003 through 2005) (NPS 2010a, p. 194; M. Murray, NPS, pers. comm. 2010). However, the number of nests is not necessarily a good indicator of the number of breeding plovers at CAHA. For example, in 2006, at least six pairs of plovers were seen exhibiting territorial behaviors indicative of breeding, but only four nests were ever found.

The estimated carrying capacity of piping plovers for CAHA conducted during the revision of the Recovery Plan for the species is 30 pairs. However, many other locations throughout the species' range have demonstrated population growth that exceeded their predicted number.

The number of non-breeding plovers, generally the months of July through April, utilizing CAHA is more difficult to assess. Three surveys on both sides of Ocracoke Inlet during 2006 observed totals that ranged from 100 (August 10) to 31 (October 2) (NPS 2010a, p. 204). Combined monthly data during the period of 2000 to 2005 at four sites within CAHA found total non-breeding plovers ranging from 12 (March) to 72 (August) (NPS 2010a, p. 203).

In order to stabilize the breeding piping plover population at CAHA and achieve the desired future conditions, the ORV Management Plan must provide the opportunity to successfully fledge young each year at each of the primary nesting locations (Bodie Island, Cape Point, Hatteras Inlet, and Ocracoke Island). Broadly speaking, implementation of Alternative F would represent a continuation of the types of management actions that have produced increases in the number of nesting pairs and number of fledglings at the Seashore over the past six years. The protection provided by the plan should enable the population to continue to recover to historic levels and, ultimately, build to a level the habitat appears capable of supporting. The continued breeding population growth anticipated to occur with implementation of Alternative F may not be as rapid or consistent as would be expected to occur under a more protective management regime, such as described under Alternative D. However, the primary difference between the two alternatives is the slightly higher potential under Alternative F that piping plovers may attempt to nest outside protected areas and be subject to disturbance until protective measures are implemented. The extent to which this potential effect will actually occur cannot be estimated at this time; however, such effects have not been noted under the Interim Strategy or Consent decree, and the proposed monitoring and adaptive management plans should enable to NPS to detect any such effects and adjust management accordingly.

Sensitivity to change - Piping plovers are sensitive to negative impacts during the breeding and non-breeding periods. Demographic models for piping plovers indicate that even small declines in adult and juvenile survival rates will cause very substantial increases in extinction risk (Melvin and Gibbs 1994; Amirault et al. 2005). Furthermore, insufficient protection of non-breeding piping plovers has the potential to quickly undermine the progress toward recovery achieved at other sites. For example, a banding study conducted between 1998 and 2004 in Atlantic Canada found lower return rates of juvenile (first year) birds to the breeding grounds than was documented for Maryland (Loegering 1992) and Virginia (Cross, 1996) breeding populations in the mid-1980s and very early 1990s. This is consistent with failure of the Atlantic Canada population to increase abundance despite very high productivity (relative to other breeding populations) and extremely low rates of dispersal to the U.S. over the last 15 plus years (Amirault et al. 2005). Simply stated, this suggests that maximizing productivity does not ensure population increases. This further illustrates that management must focus simultaneously on all sources of stress on the population within management control (predators, ORVs, etc.). These effects could be even more detrimental for non-breeding plovers from the endangered Great Lakes population, in which at least 12 identifiable individuals (10 percent of that population's breeding adults) have been observed at CAHA (Stucker and Cuthbert 2006).

Resilience - The breeding piping plover population at CAHA faced extirpation prior to implementation of the Interim Strategy. However, consistent with experience throughout the Atlantic Coast breeding range, the species has demonstrated an ability to respond positively to reasonable management actions. Continued increases in productivity through improved protective measures and substantial decreases in disturbance should produce continued progress toward the desire future conditions. The response may not be immediate or consistent (e.g., factors beyond management control such as weather will continue to affect annual productivity), but as evidenced from the most recent breeding season, productivity can be substantially increased with the appropriate protective measures. Non-breeding protections are also warranted and attainable to reverse the declines seen in juvenile return rates and overwinter survival to promote population increase in other parts of the species' range.

Recovery rate - Piping plover habitat is inherently dynamic and carrying capacity fluctuates accordingly, but the available information suggests that 30 breeding pairs is a conservative estimate of the potential breeding population at CAHA. An average of eight breeding pairs have been observed over the last four years (2006-2009) (NPS 2010a, p. 194). At these low population levels, extirpation may occur for any number of reasons, including factors unrelated to the proposed action. While extinction probabilities are less sensitive to initial population size, this does not diminish the importance of population size to population survival. Increasing population size will delay time to extinction, allowing implementation of measures to improve survival and productivity rates. The larger and more dispersed the Atlantic Coast population is, the less will be the overall effects of environmental stochasticity, catastrophes, or inconsistent management. While the specific recovery rate of piping plovers at CAHA is unknown, the recovery rate is expected to be moderate if the birds are protected from all stressors. For example, several areas within the Atlantic Coast breeding population have doubled and quadrupled their population size without a loss of productivity in as few as two to four years (USFWS, 1996a).

Although the specific effects of ORV use on non-breeding piping plovers are less well understood than those described above, there are several lines of evidence that indicate that adverse impacts on migrating and wintering piping plovers will compound the damage to the Atlantic Coast population. Zonick (2000) found that ORV density negatively correlated with abundance of roosting plovers on the ocean beach. Studies elsewhere demonstrate adverse effects of ORV driving on soundside beaches on the abundance of infauna essential to piping plover foraging requirements. The implications for survival and recovery of the species due to insufficient protections during non-breeding periods are serious. Every demographic model for piping plovers, including two Atlantic Coast studies (Melvin and Gibbs 1994; Amirault et al. 2005) shows that even small declines in adult and juvenile survival rates will cause very substantial increases in extinction risk. Furthermore, a banding study conducted between 1998 and 2004 in Atlantic Canada found lower returns to the breeding grounds of juvenile (1 year old) birds than those observed in a similar Massachusetts study in the late 1980s. Insufficient protection of non-breeding piping plovers has the potential to quickly undermine hard-earned progress towards recovery.

Effects of the proposed action at CAHA must also be considered in the context of the species' status elsewhere in its Atlantic Coast range. While inadequate protection at CAHA resulted in a steep population decline through 2004, hard-earned productivity and population growth elsewhere has improved the species' range-wide status. Failure to implement the same level of protection at CAHA that has contributed to recovery elsewhere shifted the burden of the additional gains necessary to fully secure this species to the other landowners in the Southern recovery unit who had already made substantial contributions. Furthermore, it is likely that the incremental effort to realize additional progress at these sites would be much greater than that which will be required at CAHA. Simply put, the land managers and user groups that have already contributed to the recovery effort would be called upon to do even more to cover the deficiencies of management at CAHA if actions similar to those in the preferred alternative were not implemented.

Species Response to Proposed Action -Sea Turtles

Numbers of individuals/populations in the action area affected - The number of nests (all species) recorded at the Seashore from 2000 to 2010 has fluctuated greatly, with only 43 nests recorded in 2004 and 153 nests recorded through October 14, 2010, and no additional nesting expected for the year. The 2010 total was the highest number on record (NPS 2010a; Muiznieks pers. comm. 2010b (NPS 2010a, p. 212; M. Murray, NPS, pers. comm. 2010). Among the three species that nest at the Seashore, the loggerhead turtle is by far the most numerous, comprising approximately 95% of the known nests between 2000 and 2010 (NPS 2005b, 2007, 2008b; 2009c; 2010a, p. 212; Baker pers. comm. 2009b; M. Murray, NPS, pers. comm. 2010). Green turtles and leatherbacks breed primarily in the tropics, with only small numbers nesting at higher latitudes. Green turtles have nested regularly at Cape Hatteras, but in fewer numbers, comprising only about 5% of the nests between 2000 and 2010, while leatherback turtles have nested infrequently at the Seashore, comprising only about 1% of the nests (NPS 2005b, 2007, 2008b; 2009c, 2010a, p. 212; Baker pers. comm. 2009b; M. Murray, NPS, pers. comm. 2010). The vast majority of sea turtle nests occur on Hatteras and Ocracoke islands, with turtles occasionally nesting on Bodie Island (NPS 2000, 2001b, 2002b, 2003b, 2005b, 2007, 2008b, 2009c, 2010a, p. 212).

Sea turtles of the five species that occur in North Carolina are found stranded throughout the year at CAHA. Aside from the loggerhead, green and leatherback sea turtles that nest on the Seashore, strandings may include the Kemp's ridley and hawksbill sea turtles. Strandings are usually due to death or incapacitation due to hypothermia. Data from seaturtle.org (available at < http://www.seaturtle.org/strand/summary/index.shtml?program=1&year=2009 >) for Hatteras and Ocracoke Islands (but excluding Bodie Island) gave 293 strandings during 2009. This total represented approximately 46 percent (293/638) of all strandings reported in North Carolina. This total was composed on 50 loggerheads (17.1%), 184 greens (62.8%), 57 Kemp's ridleys (19.4%), one leatherback (0.3%), and one unknown (0.3%).

Sensitivity to change - Sea turtles are relatively sensitive to changes in the nesting environment. The ratio of false crawls to nests increases in beach areas with higher vehicle use than in areas with limited or no vehicle access. The ratio of nests to false crawls on undisturbed beaches is about 1:1 (Dodd, 1988). Sea turtle eggs are also sensitive to the nesting environment. The sex of an embryonic sea turtle is determined by the temperature of the nest environment. Vehicle use on the beach may change the nest environment by altering sand compaction and gas diffusion, which may in turn affect temperature.

Resilience - Sea turtle nesting would likely decline with repeated disturbance at CAHA. Similarly, the number of hatchling turtles surviving to reach the ocean would decline with reduced nests. If nesting numbers and subsequently the number of hatchlings produced decline, then the population may suffer. For example, loggerhead nests on North Carolina beaches (and in the Northern Recovery Unit) produce a greater proportion of males than do beaches in the southern part of the species' range. A reduction in the number of males contributed to the greater population may have adverse affects on future reproduction in the population. However, the extent of this effect is unknown.

Recovery rate - Sea turtles reach sexual maturity at different ages depending on the species. Leatherback and Kemp's ridley turtles can reach sexual maturity as early as six or seven years of age. However, loggerhead and green sea turtles (the majority of sea turtles found on CAHA) do not reach sexual maturity until 20 to 50 years of age. If there is a reduction in the number of nests laid at CAHA, and subsequently the number of hatchlings produced, then it may take decades before those hatchlings are contributing reproductively to the population. The general recovery rate of sea turtles is slow, but the specific recovery rate at CAHA is unknown.

Species Response to Proposed Action – Seabeach Amaranth

Numbers of individuals/populations in the action area affected - The number of seabeach amaranth plants recorded from CAHA from 1985 through 2008 have ranged from 0 to 15,828 (NPS 2010a, p. 222; M. Murray, NPS, pers. comm. 2010). The five latest surveys, 2006 through 2010, did not find the plant on the Seashore. The low number of plants recorded in recent years may not be an indicator of the total population size at CAHA or the potential population.

Sensitivity to change - There is no information available on the sensitivity of seabeach amaranth to change. However, it will take longer for seabeach amaranth to rebound from low population numbers if seed banks are being continually used or destroyed and seeds are not allowed to set for the next seasons' populations.

Resilience - Seabeach amaranth will not rebound from low population numbers if seed banks are being continually used or destroyed and seeds are not allowed to set for the next seasons' populations. However, the extent of this effect is not known.

Recovery rate - The use of ORVs on the beach could result in the crushing, burying or destruction of existing plants. Furthermore, ORVs may bury seeds to a depth that prevents germination. The recovery rate of seabeach amaranth is expected to be moderate to fast in the appropriate habitat since it is an annual species and produces many seeds; however, the specific recovery rate is unknown.

CUMULATIVE EFFECTS

Cumulative effects include the effects of future State, local, or private actions that are reasonably certain to occur in the action area considered in these biological and conference opinions. 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 Act. The action area for the species evaluated in this biological and conference opinions includes federal property owned and operated by CAHA. Therefore, the USFWS anticipates that any action that occurs within the action area will be subject to federal approval or authorization, and would require a separate consultation under section 7 of the Act.

Additional development or other activities occurring within the villages adjacent to CAHA may occur without federal authorization. Continued development may increase the number of visitors to CAHA (e.g., increasing ORVs, pedestrians, pets, and predators) which will have associated effects to federally-listed species within the action area. Such actions include increased lighting from development in the villages that may affect the sea turtle nesting habitat of the beachfront, or increased predators associated with people that may affect nesting areas of the piping plover. While the resultant effects of such actions are evaluated in this opinion, the incremental effects of additional development within the villages are not reasonably certain to occur. As such, the USFWS does not anticipate any cumulative effects.

CUMULATIVE EFFECTS – PIPING PLOVERS

State, local, or private actions that may influence piping plovers within the Seashore include increased development (and increased recreational use of CAHA) in the villages imbedded in the Seashore and the success or failure of non-federal predator management activities. The cumulative impacts for Alternative F would be the same as those for Alternative A (NPS 2010a, p. 358) and the DEIS concluded (NPS 2010a, p. 328) that the overall cumulative impacts of these past, current, and future actions would be long-term negligible to minor, depending on the intensity and duration of unpredictable factors such as storm events, with long-term moderate beneficial impacts from actions such as increased interpretive programs as part of the long-range interpretive plan and predator management within the Seashore. Many of these actions do not directly impact piping plover habitat in the area, as most of this habitat is located within the Seashore and is impacted by NPS management actions more than any of the aforementioned past, present, and future actions. These impacts, combined with the long-term minor to moderate adverse, as well as minor to moderate beneficial impacts of Alternative F, would be long-term minor to moderate adverse, as actions within the Seashore would act as a driver for overall cumulative impacts (NPS 2010a, p. 359; M. Murray, NPS, pers. comm.. 2010). To the extent that the ORV Management Plan facilitates progress toward the proposed desired future conditions, the action would reduce adverse cumulative impacts.

CUMULATIVE EFFECTS – SEA TURTLES

Cumulative impacts to sea turtles under Alternative F would be very similar to those described for Alternative A. Although Alternative F would provide additional protection that would be beneficial to the regional sea turtle population, the adverse effects on sea turtles from other actions occurring in the region would still exist. Therefore, the overall cumulative impact of these past, current, and future actions-added to the effects of actions under Alternative F would result in long-term minor to moderate adverse cumulative impacts.

Several local past, current, and future planning efforts can also affect sea turtles (NPS 2010a, p. 375). For example, past development that has occurred in Dare and Hyde counties under their land use plans had increased the residential housing and related services in the areas within the Seashore. Also, new development might result from the County Land Use Development Plan for Dare and Hyde counties. Although the details are lacking, additional development within the Seashore's boundaries that may result from implementing the land use plan may have long-term minor to moderate adverse impacts by increasing the amount of light pollution on the beaches causing adult turtles to abort nesting attempts and hatchlings to be disoriented when trying to make their way to the sea. Development might also increase the recreational use of the beaches and the impacts that recreation has on sea turtles.

Cumulative impacts from combining the effects of Alternative F with effects of other past, present, and future planned actions in and around the Seashore would likely result in infrequent or occasional occurrences of disturbance to some nesting females with negative effects to reproduction affecting local population levels, infrequent or occasional complete or partial nest loss due to human activities, and occasional disorientation or disruption of hatchling movement or direct hatchling mortality from human activities (NPS 2010a, p. 395). Even with these adverse effects, large declines in population numbers would not result and sufficient population numbers and functional habitat would remain to maintain a sustainable population in the Seashore.

Overall, Alternative F would provide additional protection that would be beneficial to the regional sea turtle population, but the adverse effects on sea turtles from other actions occurring in the region would still exist (NPS 2010a, p. 393; M. Murray, NPS, pers. comm.. 2010). Therefore, the overall cumulative impact of these past, current, and future actions, when added to the effects of actions under Alternative F, would result in long-term minor to moderate adverse cumulative impacts (NPS 2010a, pp. 393-394; M. Murray, NPS, pers. comm. 2010).

CUMULATIVE EFFECTS – SEABEACH AMARANTH

Other past, present, and future planned actions within and around the Seashore have the potential to impact seabeach amaranth (NPS 2010a, p. 401). As with other species dependent on beach habitat, e.g., sea turtles and shorebirds, seabeach amaranth could be adversely affected by changes in local land use policies. The overall impacts of these past, current, and future actions, in combination with the effects of ORV Management Plan, would result in long-term moderate adverse cumulative impacts to seabeach amaranth within the Seashore and throughout the plant's habitat range in North Carolina (NPS 2010a, p. 416; M. Murray, NPS, pers. comm. 2010).

CONCLUSION

CONCLUSION – PIPING PLOVER

An assessment of the effects of ORV management at CAHA on the survival and recovery of piping plovers as a whole, and on the Atlantic Coast, Great Lakes and Great Plains populations individually turns on three primary factors: breeding population size at CAHA (expressed as the number of breed pairs), productivity (expressed as fledging rate per pair), and non-breeding survival and fitness (expressed as migrating and wintering survival rates). Breeding population size and productivity apply specifically to the Atlantic Coast population and the species as a whole, whereas non-breeding survival applies to all populations and the species as a whole.

In reviewing the status of the Atlantic Coast population and the wintering populations of the Northern Great Plains and Great Lakes, the environmental baseline and the effects of the action the following conclusions can be drawn. Regarding breeding population size and productivity, the current number of breeding piping plovers using CAHA is a relatively small percentage of the breeding population of the Southern recovery unit and the overall Atlantic Coast breeding population. While the total breeding pairs in the southern unit (Delaware, Maryland, Virginia, North Carolina, and South Carolina) ranged from 300 to 333 pairs during the period of 2005 through 2008 (NPS 2010a, p. 186), the breeding pairs within CAHA ranged from three (2005) to 11 (2008) during these four years (NPS 2010a, p. 187). However, breeding pairs have increased from only two pairs (2002 and 2003) to eleven, nine, and twelve during 2008, 2009, and 2010, respectively (M. Murray, NPS, pers. comm. 2010).

The overall size of the Atlantic Coast breeding population has shown an increasing trend toward the recovery goal; although the Southern Recovery Unit has been growing at a slower rate. The size of the breeding population at CAHA has fluctuated over the years and reached historically low levels in 2002 and 2003. Since that time the breeding population has shown an increasing trend. Regardless of these population fluctuations, the recorded size of the CAHA breeding population as always been well below the projected carrying capacity described in Appendix B of the Piping Plover, Atlantic Coast Population, Revised Recovery Plan (1996), although we note that the area was subject to relatively uncontrolled human activity throughout the period over which reasonably accurate records have been kept regarding the number of breeding pairs at CAHA. This leads us to believe that habitat suitability and availability are not currently limiting factors to the size of the breeding population. And although we do not have a full understanding of the combination of factors that determine the size of the breeding population in any given year, we do know that factors subject to management control (e.g., human disturbance and predation) are significant contributors. In regard to the increasing population trend at CAHA since 2003 we note that the only known factors to have changed noticeably during that time period are the extent of management of human disturbance and the increased control of mammalian predators; both of which occurred over the past few years. As such, we conclude that the management actions implemented through the Interim Strategy and the Consent Decree in conjunction with predator management activities have positively affected the size of the breeding population at CAHA. Further, while the preferred alternative for the ORV management plan varies from the Interim Strategy and Consent Decree in certain details, the overall approach to protected species management is generally consistent. As such, it is reasonable to conclude that implementation of the proposed ORV management plan will allow the breeding population of piping plovers to continue to grow at CAHA, barring events such as major changes in habitat conditions due to storms. Under the proposed management plan breeding piping plovers will continue to be exposed to potential human disturbance that may cause the population to grow at a slower rate than would occur in the complete absence of disturbance, and may cause the breeding population size to stabilize at a level below that which the available habitat could support in the absence of disturbance. Because we do not have a means of estimating the population growth rate at a particular locale (without or without disturbance), or the actual carrying capacity of the habitat within CAHA, the magnitude of these effects is unknown.

With regard to breeding piping plover productivity, there has historically been considerable annual variation in the fledging rate at CAHA; and the fledging rate has generally been well below the 1.5 fledglings/pair benchmark established in the Atlantic Coast piping plover recovery plan. This is also true for breeding piping plovers in North Carolina as a whole. Additionally, while the absolute number of fledglings produced per year has increased since 2003 (as the size of the breeding population has increased) there has been no identifiable trend in the fledging rate (fledglings/breeding pair) over this period. Many factors affecting fledging success are highly variable on an annual basis, including timing and severity of storms that may cause overwash or flooding of nesting sites, and variations in weather patterns that may affect habitat conditions and/or the availability of food, water or shelter. A single storm event during the nesting season can significantly affect local productivity.

While the reasons for this low productivity are not fully understood it is very likely that stressors subject to management control (e.g., predation and human disturbance) are contributing factors. Nonetheless, because the causes of nest loss or chick mortality are often unknown or not recorded, we do not know which factors have the greatest influence on productivity at CAHA, or the extent to which productivity may change in response to implementation of the preferred alternative. Elements of the preferred alternative that would be expected to contribute positively to productivity include the delineation and protection of suitable nesting habitat prior to the breeding season, careful monitoring of nesting activity and timely adjustment of protected areas based on breeding bird behavior, provision of sufficient buffers around piping plover broods, and control of predators. Elements of the preferred alternative that would be expected to negatively affect productivity include the provision of ORV corridors at Cape Point and South Point Ocracoke, the possible exclusion of some suitable habitat from pre-nesting closures, and potential disturbance that would occur prior to implementation of additional protective measures (e.g., broods moving out of protected areas and being subject to disturbance until protected area boundaries are adjusted). On balance, we anticipate that the preferred alternative combined with continued control of mammalian predators will have an overall positive effect on piping plover productivity; though the magnitude of this effect is uncertain, as is the ability to achieve the desired future conditions described in the ORV Management Plan. To ensure that CAHA does not act as a sink in terms of piping plover productivity, it will be important to carefully study the factors affecting productivity at CAHA and to continually adjust management based on the results of those evaluations, as part of the Adaptive Management Plan. In that way the NPS can optimize management of those factors that are subject to management control through time.

In terms of non-breeding piping plover survival and fitness we know that adult survival is a critically important factor in overall population health and viability. We also know that piping plovers spend the majority of their annual life cycle in migration and on wintering grounds, and as such factors that affect the survival and fitness of non-breeding piping plovers are very important to the survival and recovery of the species. We further know that CAHA provides migratory stop-over and wintering habitat for all three populations of piping plovers. We do not know the relative proportion of each population that migrates through or winters at CAHA, so we cannot quantitatively describe the importance of CAHA as migration and wintering habitat. Nonetheless, given the role of CAHA in providing migratory and wintering habitat to all three piping plover populations, the importance of non-breeding survival and fitness to the overall survival and recovery of the species, and the fact that North Carolina is the only place where breeding and non-breeding ranges for this species overlap, it is clear that effective management of non-breeding piping plovers at CAHA is an important consideration. On balance, we anticipate that the preferred alternative combined with continued control of mammalian predators will have an overall positive effect on non-breeding piping plover survival and fitness; though the magnitude of this effect is uncertain. The proposed plan does not articulate desired future conditions for non-breeding piping plovers. Also lacking is a means to objectively determine the effectiveness of any measures implemented on non-breeding piping plovers. The Adaptive Management Plan will need to focus on reducing the uncertainty regarding the effects of management on non-breeding piping plovers.

In light of the above, and after reviewing the current status of the Atlantic Coast piping plover, the environmental baseline for the proposed ORV Management Plan, it is the biological opinion of the USFWS that implementation of Alternative F, as described (M. Murray, NPS, pers. comm. 2010), is not likely to jeopardize the continued existence of Atlantic Coast subpopulation of the piping plover.

The Great Lakes population of piping plovers is a separate listed entity, classified as endangered. Piping plovers from this population occur at CAHA during the non-breeding season. This population is currently increasing, but remains at very low levels. As mentioned above, the current number of Great Lakes piping plovers using CAHA during migration and over winter is unknown; however, CAHA is an important migratory stopover site and overwintering destination. Harm and harassment of migrating and wintering piping plovers may reduce the fitness of individuals, which will have an unknown effect on the listed entity. However, considering the effects of the proposed ORV management plan together with continued intensive management in the breeding range of the Great Lakes population and the status of the listed entity range-wide, leads the USFWS to conclude that implementation of Alternative F will not jeopardize the continued existence of the listed entity.

Critical habitat for wintering piping plovers has been designated within the project area and the Action Area (NC-1, NC-2, NC-4, and NC-5). Alternative F would designate approximately 26 miles of vehicle-free areas that would result in the closure of approximately 26 miles of shoreline to ORV use year round (M. Murray, NPS, pers. comm. 2010). These closures would provide less-disturbed foraging, resting, and roosting areas for migrating and wintering shorebirds and would protect the primary constituent elements of intertidal sand beaches and ocean backshores. These year-round VFAs along the ocean shoreline would be managed to allow for pedestrian use. Non-breeding resource closures would also be established at the points and spits based on an annual habitat assessment, which would provide protection for wintering plover habitat. There would be some benefit to the critical habitat from the implementation of seasonal night-driving restrictions although these restrictions would only apply between May 1 and November 15, which would not cover the majority of time when the wintering population of piping plover is present at the Seashore (M. Murray, NPS, pers. comm. 2010). Construction of ORV access ramps, parking areas, and interdunal roads would not impact any of the primary constituent elements of designated critical habitat for wintering piping plover (NPS 2010a, p. 361; M. Murray, NPS, pers. comm. 2010). Since the management plan seeks to reduce disturbances to non-breeding plovers and by extension their habitat, it is the biological opinion of the USFWS that the project is not likely to destroy or adversely modify designated critical habitat units within CAHA.

CONCLUSION – SEA TURTLES

The number of sea turtles nesting on the shores of CAHA represents about 10 percent of North Carolina's total nesting population. While the loggerhead nesting numbers are relatively small compared to the overall nesting populations, the loggerhead nesting numbers are important to the Northern Recovery Unit specifically because these beaches produce a greater proportion of males to the population. Alternative F presents a number of conservation measures that contribute to achieving the short- and long-term goals of CAHA (NPS 2010a, pp. 125; (M. Murray, NPS, pers. comm. 2010). Management activities include nest closures/buffers, nest watch program, response to stranded sea turtles, light restrictions, light management, and night-driving restrictions. Table 10-1 (M. Murray, NPS, pers. comm. 2010) outlines management activities related to sea turtle conservation and also outlines plans for nest surveys, data collection, research and implementation of adaptive management for these important resource categories (NPS 2010a, p. 126; M. Murray, NPS, pers. comm. 2010).

Despite the continued potential for some adverse effects, the USFWS expects implementation of Alternative F should afford a reasonable opportunity for successful nesting of sea turtles annually. The proposed management activities would contribute to achieving the desired future conditions for nesting sea turtles (NPS 2010a, p 8), which provides four goals. First, from an average of 77.2 loggerhead nests during the 2004-2008 period, a short-term target (ten years) of an average annual rate of two percent increase to 94 nests. With a similar base and rate of increase, the long-term target (20 years) is 115 nests. Second, both the short- and long-term targets would be to a five-year average of ten percent of all sea turtle nests within North Carolina on CAHA. Third, both the short- and long-term targets would be a five-year average ratio of false crawls to nests of 1:1 or less. Fourth, both the short- and long-term targets would be a five-year average of less than 30% relocation of nests. This effort would seek to reduce the relocation of nests for reasons other than risk associated with daily overwash or well-documented risk of erosion. This would potentially produce a slight increase in the number of sea turtle nests protected at CAHA over the near term. The establishment of an adaptive management framework, clearly defined resource goals, and the 5-year periodic review process to adjust management policies should allow continued science-based improvement of sea turtle management within CAHA over time. This management framework coupled with continued intensive management at other nesting beaches (particularly state and federal properties) in North

Carolina, leads the USFWS to conclude that implementation of Alternative F as the ORV Management Plan will not jeopardize the continued existence of any sea turtle species.

Marine and terrestrial critical habitat for the leatherback sea turtle has been designated for Sandy Point on St. Croix, U.S. Virgin Islands; for the hawksbill sea turtle for waters of Mona, Monito, Culebrita, and Culebra Islands, Puerto Rico; and for the green turtle for the waters surrounding Culebra Island, Puerto Rico, and its outlying keys; however, this action does not affect those areas, and no destruction or adverse modification of that critical habitat is anticipated. No critical habitat has been designated for the loggerhead and Kemp's ridley sea turtles; therefore, none will be affected.

CONCLUSION – SEABEACH AMARANTH

There have not been any documented plants on the Seashore since 2005. The cause for the most recent disappearance from the Seashore is not known. In 1988 the Seashore supported a population in excess of 15,000 individual plants and rapidly declined to zero plants in 1993. The plant numbers appear to be cyclical and no plants have been documented in the last five years (NPS 2010a, p. 222; M. Murray, NPS, pers. comm. 2010).

While no data exists to suggest beach driving is having an adverse effect on seabeach amaranth numbers at CAHA, there is evidence that restricted access may protect plants and could result in a larger population. For example, seabeach amaranth numbers are higher at Cape Lookout National Seashore where there are fewer vehicles on the beaches and especially on Shackleford Banks where no vehicle driving is allowed. Alternatively, Cape Lookout National Seashore may have more available habitat and thus more room for seabeach amaranth to germinate than CAHA.

Impacts to seabeach amaranth at CAHA include vehicles crushing, burying, or breaking plants, burying seeds, degrading habitat through compaction of sand and the formation of seed sinks caused by tire ruts. Pedestrians and their pets may also crush, bury, or break plants and bury seeds.

Management activities related to seabeach amaranth conservation are provided in Table 10-1 (M. Murray, NPS, pers. comm. 2010). These activities would contribute to achieving the desired future conditions for the recovery of the species on the Seashore (NPS 2010a, p. 9). The short-term goal (10 years) for the species is developing a seabeach amaranth restoration plan for four suitable sites. These sites include Bodie Island Spit, Cape Point, Hatteras Inlet Spits (Hatteras Island Spit and North Ocracoke Spit) and Ocracoke Inlet Spits (Southern Ocracoke Island Spit). The long-term goal (20 years) is for three of the four suitable sites to be occupied for five consecutive years.

The preferred alternative presents a number of management activities that contribute to achieving the short- and long-term goals of CAHA (NPS 2010a, pp. 126). These activities include Seashore-wide annual survey in August for seabeach amaranth in all potential habitat; identifying prior to June 1 suitable seabeach amaranth habitat at points and spits where plants have been observed within the last 5 years and delineated with symbolic fencing if such areas are not already protected within existing shorebird resource closures; erecting symbolic fencing with signage to create a 10- × 10-meter buffer around the plant, if a plant/seedling is found outside of an existing closure; expanding the enclosure to protect several plants, if plants are located next to one another; and protecting plants found during the survey prior to reopening a bird closure to ORV and pedestrian use by creating a closure area to protect the plant as described above and reopen the portions of the bird closure where seabeach amaranth plants do not exist. If seabeach amaranth is not present by September 1, seabeach amaranth buffers will be removed. If seabeach amaranth is present, buffers will remain until after the plants have senesced, which is typically around December 1.

The USFWS expects implementation of Alternative F to afford a reasonable opportunity for at least a minimal amount of successful germination annually at CAHA's most significant sites (Bodie Island, Cape Point, Cape Hatteras spit and Ocracoke spit). This is expected to potentially produce a slight population increase of seabeach amaranth over the near term. Furthermore, the establishment of an adaptive management framework, clearly defined resource goals, and the 5-year periodic review process to adjust management policies would benefit seabeach amaranth within CAHA. This management framework coupled with continued intensive management at other seabeach amaranth sites (particularly State and federal properties) in North Carolina, leads the USFWS to conclude that implementation of Alternative F will not jeopardize the continued existence of this species.

INCIDENTAL TAKE STATEMENT

Section 9 of the Act and federal regulation pursuant to section 4(d) of the Act prohibit take of endangered and threatened species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, capture or collect, or to 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 behavioral patterns such as breeding, feeding, or sheltering. Harass is defined as 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 any take of listed animal species that results from, but is not the purpose of, carrying out an otherwise lawful activity conducted by the federal agency or the applicant. 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 a prohibited taking provided that such taking is in compliance with the terms and conditions of this incidental take statement.

The measures described below are non-discretionary, and must be undertaken by CAHA for the exemption in section 7(o)(2) to apply. CAHA has a continuing duty to regulate the activity covered by this incidental take statement. If CAHA (1) fails to assume and implement the terms and conditions or (2) fails to require adherence to the terms and conditions of the incidental take statement through enforceable terms, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, CAHA must report the progress of the action and its impact on the species to the USFWS as specified in the incidental take statement. [50 CFR §402.14(i)(3)]

Sections 7(b)(4) and 7(o)(2) of the Act generally do not apply to listed plant species. However, limited protection of listed plants from take is provided to the extent that the Act prohibits the removal and reduction to possession of federally-listed endangered plants or the malicious damage of such plants on areas under federal jurisdiction, or the destruction of endangered plants on non-federal areas in violation of state law or regulation or in the course of any violation of a State criminal trespass law. The NPS should follow the provisions of the North Carolina Plant Protection and Conservation Act (GS 106-202.12 to 202.22).

AMOUNT OR EXTENT OF TAKE ANTICIPATED

AMOUNT OR EXTENT OF TAKE ANTICIPATED – PIPING PLOVERS

The USFWS anticipates nesting piping plovers, eggs, and chicks within the Seashore's boundaries will be taken as a result of the proposed action. Based on the review of the biological information and considering the effects of implementing Alternative F, incidental take is anticipated to be in the form of: (1) harm to chicks and adults that may result in mortality (e.g., being crushed or run over) as a result of vehicle and pedestrian use of the beach; (2) the loss of nesting opportunities due to disturbances associated with vehicle use on the beach; (3) the loss of resting and foraging opportunities due to disturbances associated with vehicle use on the beach; (4) harm in the form of disturbing or interfering with piping plovers attempting to court, nest, defend territories, feed, rest, or roost within CAHA as a result of vehicle use of the beach; (5) harassment in the form of disturbing or interfering with piping plovers attempting to court, nest, defend territories, feed, rest, or roost within CAHA as a result of vehicle use of the beach; (6) harm in the form of disturbing or interfering with piping plovers attempting to court, nest, defend territories, feed, rest, or roost within CAHA as a result of pedestrian or animal (domestic, feral, and wild) use of the beach; (7) harassment in the form of disturbing or interfering with piping plovers attempting to court, nest, defend territories, feed, rest, or roost within the Seashore as a result of pedestrian or animal (domestic, feral, and wild) use of the beach; (8) behavior modification of piping plovers due to disturbances associated with vehicle, pedestrian, pet activities within CAHA during the nesting season, resulting in failed nest attempts or situations where they choose marginal or unsuitable nesting areas; and, (9) behavior modification of piping plovers due to disturbances associated with vehicle, pedestrian, pet activities within CAHA during the migrating or overwintering seasons.

The amount of take anticipated at various stages in the breeding cycle is interdependent. For example, disturbance to courtship that results in failure to establish pair bonds or abandonment prior to nest establishment will preclude opportunities for nest destruction or nest failure due to disturbance. Nests that are crushed by vehicles or abandoned prior to hatch will result in less mortality of chicks due to direct mortality or to increased susceptibility of less fit individuals to starvation, predation, or adverse weather conditions. The net demographic effect of failure to produce fledged chicks is the same regardless of the stage at which breeding failure occurs. Loss of adult birds, however, would carry an even higher demographic cost. The amount of anticipated annual take is also partly contingent on productivity of the CAHA population (and to a lesser extent, productivity of piping plovers elsewhere in the Southern recovery unit) in the preceding two years because it will affect the number of prospecting adult breeders.

Detecting mortality or injury of piping plovers (especially chicks), particularly on beaches where vehicles are being operated, is extremely difficult. Cryptic coloration is the species' primary defense mechanism, evolved to cope with natural predators; nests, adults, and chicks all blend with their typical beach surroundings. Nests and eggs are particularly difficult to detect during the 6 to 7 day egg-laying stage. Adults are about seven inches tall and pale colored, camouflaging them against the surrounding beach habitats. Newly hatched chicks stand only 2.5 inches high, weigh less than a quarter ounce, blend with the beach substrate, and often respond to approaching vehicles, pedestrians, and perceived predators by "freezing" in place to take advantage of their natural camouflage. Dead adults and chicks may be covered by wind-blown sand, ground into the sand by other passing vehicles, washed away by high tides, or consumed by scavengers. Finally, harm and harassment that results in effects such as loss of nesting opportunities or reduced fitness due to disruption of foraging are inherently difficult to observe and quantify. Thus, actual take may be substantially higher than the take that is detected.

As described above, the USFWS anticipates that actual take under the proposed action will be proportional to the population attaining each life stage. Furthermore, detection of take will be limited by the species' natural crypsis, life history, and the likelihood that on-going public use will obliterate evidence of piping plover deaths and injuries. Therefore, the USFWS has characterized the extent of anticipated take as a proportion of observed plover activity and has also provided a detectable measure of each type of take.

The USFWS anticipates take in the form of harm and harassment of any territorial males or breeding pairs that attempt to establish territories and nests near the boundaries of or outside protected areas. This take is likely to occur until the birds are observed during routine surveys and appropriate management actions are implemented, as described in the preferred alternative. Some breeding behavior occurs in flight, so determining if this behavior is occurring inside or outside an established closure can be difficult. Though scraping and/or nesting has not been reported outside of protected areas during implementation of the Interim Strategy or Consent Decree it is likely that such behavior will occur with increasing frequency as the population continues to expand to occupy the available habitat. The USFWS does not anticipate this to exceed two territorial males or breeding pairs in any single breeding season over the first five years of implementation of the proposed plan.

Complete or partial failure of known nests due to the proposed action is not anticipated. Take will be presumed, however, if one or more eggs is cracked or crushed by a pedestrian, pet, or vehicle or if three or more observations of incubating plovers flushing from a nest in response to a pedestrian (other than a monitor), vehicle, or pet.

The USFWS believes that half the chicks for which adequate disturbance-free foraging and resting opportunities are not provided will die from direct crushing or from disturbance-induced starvation, predation, or susceptibility to adverse weather (heat, cold, high wind, or precipitation). Detectable measures of such take will include the observation of any pre-fledged chick for any time outside of protected areas, or observation of plover chick tracks outside the symbolic fencing. Although such behavior has not been reported during implementation of the Interim Strategy or Consent Decree it is likely that such behavior will occur with increasing frequency as the population continues to expand to occupy the available habitat. The USFWS does not anticipate this to exceed one brood in any single breeding season over the first five years of implementation of the proposed plan.

The USFWS expects incidental take of migrating and wintering piping plovers will be difficult to detect for the following reasons: the harm may only be apparent on the breeding grounds the following year; dead plovers may be carried away by waves or predators; or it is difficult to locate dead plovers in dune areas. However, this undetected level of take of this species can be anticipated along the 67 miles of CAHA by the disturbance of suitable plover feeding or roosting habitat from recreational activities, implementation of protective measures and implementation of monitoring measures. Assuming a worst case scenario for NPS implementation of Alternative F, as described (M. Murray, NPS, pers. comm. 2010), the undeterminable level of incidental take is expected to be a proportion of all wintering plovers at CAHA. The proposed monitoring will provide data that will allow the NPS to adjust the protective measures to enhance conservation of the plover in subsequent years. Additionally, the monitoring information may allow the USFWS to better quantify the amount of incidental take in subsequent consultations.

AMOUNT OR EXTENT OF TAKE ANTICIPATED – SEA TURTLES

The USFWS anticipates sea turtles/sea turtle eggs along about 67 miles of nesting beach habitat in CAHA will be taken as a result of the proposed action. Based on the review of biological information and considering the effects of implementing Alternative F, incidental take is anticipated to be in the form of: (1) harm or harassment to nesting sea turtles from vehicles, pedestrians, and pets; (2) harm and harassment to hatchling sea turtles emerging from nests by vehicles, pedestrians, and pets; (3) harm and harassment to hatchling sea turtles emerging nests and subsequently caught in vehicle ruts in areas where no rut removal has taken place; (4) harm to sea turtle eggs and/or hatchlings resulting from vehicles driving over unmarked/unprotected sea turtle nests located within the action area; (5) harm and harassment to adult, hatchling, stranded, or post-hatchling washback sea turtles resulting from collisions with vehicles operating within the action area; such vehicles may also disorient/harass adults and/or hatchling sea turtles with headlights while in motion or at rest, or harass adult sea turtles during nesting activity; (6) harm or harassment to adult female sea turtles attempting to nest resulting in false crawls; (7) harm and harassment to sea turtle eggs and/or nests laid outside the period when sea turtle patrols and daily surveys are conducted, May 1 through September 15 or two weeks after the last sea turtle nest or crawl is found (NPS 2010, p. 124; M. Murray, NPS, pers. comm. 2010), a period when a nest monitoring/marking program would not be in place; (8) harm and harassment of sea turtles and/or hatchlings resulting from contact with any pole, post, sign, or other moveable or unmovable object placed on the beach; and, (9) harm and harassment of sea turtles and their eggs and hatchlings resulting from any activity necessary to implement the ORV plan not specifically addressed above.

The types of anticipated take described above are expected to occur primarily as a result of adult females attempting to nest at times and in areas of CAHA where vehicular access is permitted, and in the case of nests and hatchlings in those instances where nests are not detected and appropriately protected. Additional incidental take could result from CAHA visitors unintentionally failing to abide by rules established for protection of sea turtles, such as the inadvertent entry into protected areas. Take associated with willful violations of CAHA rules is not considered incidental to the proposed activity and is not covered by this incidental take statement.

The number of sea turtles that are unable to come ashore to nest is not knowable. Also, the USFWS can only estimate the number of nests not detected by daily surveys from the literature. As such, the amount of actual take is unquantifiable. Nonetheless, it is anticipated that take due to ORV, pedestrian, and pet activity under the proposed action is failure to locate and protect four (4) sea turtles nests and the disturbance of sea turtles that results in no more than a 1:1 nest to false crawl ratio per breeding season. Incidental take for the proposed action is limited to a single nesting season (i.e., May 1 to November 15 of each year).

EFFECT OF THE TAKE

EFFECT OF THE TAKE – PIPING PLOVERS

In the accompanying biological opinion, the USFWS determined that this level of anticipated take is not likely to result in jeopardy to the piping plover species or destruction or adverse modification of designated critical habitat Units NC-1, NC-2, NC-4, and NC-5. Incidental take of piping plovers is anticipated to occur in suitable breeding, foraging, and roosting habitat that are impacted, directly or indirectly, by ORVs.

While incidental take related to the proposed action could occur in all the forms described above, take of piping plovers during the breeding season is most likely to occur in the form of harm and harassment in those situations when adult plovers attempt to establish territories or nests outside of protected areas, or when broods or single chicks wander outside protected areas, and before such behaviors are observed by NPS staff. Given the recent size of the piping plover population relative to the extent and configuration of habitat, and current staffing levels at CAHA, these types of events would be most likely to occur under Alternative F near the pedestrian corridor at Bodie Island spit, and the ORV corridors at Cape Point and South Point Ocracoke. Based on our observations of implementation of similar management practices at CAHA over the past few years, the USFWS expects the effects of any such take to be a minor reduction of the population growth rate over that which could be achieved in the absence of human disturbance. As the breeding population at CAHA increases toward the desired future conditions, such effects may become more pronounced as plovers fully occupy the best available habitat and begin to utilize other available habitat that is not as readily identified by NPS staff during the pre-nesting season habitat surveys.

EFFECT OF THE TAKE – SEA TURTLES

In the accompanying biological opinion, the USFWS determined that this level of anticipated take is not likely to result in jeopardy to the loggerhead, green, or leatherback sea turtle species. Critical habitat has not been designated in the project area; therefore, the project will not result in destruction or adverse modification of critical habitat for any sea turtle species. Incidental take of nesting and hatchling sea turtles is anticipated to occur on ocean beaches of CAHA. While incidental take related to the proposed action could occur in all the forms described above, take of sea turtles is most likely to occur in the form of harm and harassment of nests not discovered by NPS staff (including any subsequent hatchlings from such nests), harm and harassment of nesting females due to vehicles operating on the beaches during the early evening and morning hours, and harm and harassment as a result of beach fires authorized during the nesting season in the limited areas described in Alternative F. Based on our observations of implementation of similar management practices at CAHA over the past few years, the USFWS expects the effects of any such take to be a minor reduction of the population growth rate over that which could be achieved in the absence of human disturbance.

REASONABLE AND PRUDENT MEASURES

The USFWS believes the following reasonable and prudent measures are necessary and appropriate to minimize impacts of incidental take of the piping plover, and loggerhead, green, and leatherback sea turtles.

The responsibility to manage CAHA rests with the NPS that must make specific management decisions on public use and resource conservation under the ORV Management Plan. The role of the USFWS relates to resource conservation and is strictly advisory. While the USFWS is available to provide technical assistance, that assistance is but one piece of information the NPS should weigh in making final management decisions. The level of incidental take anticipated above is that which is expected to occur as the NPS implements Alternative F as the basis for a special regulation to guide the management and control of ORVs within CAHA for the next five years. The following reasonable and prudent measures, and terms and conditions primarily represent monitoring procedures to determine the effectiveness of the plan in conserving the species.

REASONABLE AND PRUDENT MEASURES - PIPING PLOVERS

There are several factors at CAHA that require highly assiduous protection of pre-nesting habitats in order to reduce take in the form of disruption and abandonment of piping plover courtship behaviors, obliteration of scrapes, and destruction of undetected nests. First, piping plover numbers at CAHA in recent years were so low that Allee effects (e.g., inability to find and court mates) likely made courtship difficult and required that the few remaining/prospecting birds be afforded every possible opportunity to form pair-bonds. Under such conditions courtship may be protracted and initial pair bonds may be unusually tenuous.

Second, wide spits and interspersion of nesting habitat “islands” with foraging habitats require plovers to establish courtship territories that often encompass moist sediment habitats that are less frequently used for this purpose at other Atlantic Coast sites. Strategies for protecting upper beach courtship habitat at sites with well-defined primary dunes where nests are more predictably situated are inadequate to prevent disruption of essential piping plover courtship behaviors (including aerial displays, tilt displays, and scraping) at CAHA.

Third, topographic relief that provides visual screening for plovers on the landward side at many Atlantic Coast nesting areas, especially in the northern portions of the range, is absent at many sites in the Southern recovery unit, and particularly throughout much of CAHA. Flushing distances documented in Maryland (Loegering, 1992) and Virginia (Cross, 1990; Cross and Terwilliger, 1993) were substantially larger than those observed at study sites in Massachusetts (Hoopes, 1993) and New York (Goldin, 1993). On the basis of data from an intensive three-year study (Loegering, 1992), for example, Assateague National Seashore in Maryland established 200 meter buffer zones around most piping plover nest sites and primary foraging areas (NPS, 1993).

Fourth, the intensity of human activity at CAHA plover nesting areas, especially during the early phases of the breeding cycle, is much higher than that at most sites in the plover's Atlantic Coast range. Unlike areas with harsher weather in April and May and/or where land managers limit the density of vehicles allowed on the beach at any one time, in the past CAHA plover nesting sites have been regularly subjected to large numbers of vehicles during periods when piping plovers are attempting courtship. Access by large numbers of vehicles at CAHA created a potential intensity of disturbance rarely present during plover courtship and nest establishment at sites from Virginia to Maine.

In light of the above conditions, the keys to minimizing the effect of incidental take on piping plovers include the provision of sufficient protected areas to afford undisturbed nesting, brood-rearing, and non-breeding habitat; and the careful monitoring of bird behavior for signs of disturbance with implementation of appropriate management responses. As such, the reasonable and prudent measures necessary and appropriate to minimize the take of piping plovers within the action area are:

1. The NPS must monitor the effects of management actions on breeding piping plovers at all sites within the park boundaries, and take corrective action as appropriate to minimize effects on productivity.

2. The NPS must monitor non-breeding PIPL through the implementation of the non-breeding shorebird surveys and monitoring studies. The NPS will provide protection to non-breeding plovers by providing year-round, vehicle free areas on some ocean and inlet shorelines within the Seashore.

REASONABLE AND PRUDENT MEASURES – SEA TURTLES – ALL SPECIES

The reasonable and prudent measures that are necessary and appropriate to minimize the take of sea turtles within the action area are:

1. The NPS must provide protection to sea turtles that have come ashore to nest, provide protection and monitor incubating nests, and provide protection to emerging hatchlings from ORVs on all beaches within the boundaries of CAHA.

2. Proposed activities and access to nesting sea turtles, incubating turtle nests, and hatching events must be timed and conducted to minimize impacts on sea turtles and sea turtle productivity.

3. The NPS must respond to stranded sea turtles and coordinate the transport and delivery of live strandings to appropriate care facilities.

TERMS AND CONDITIONS

In order to be exempt from the prohibitions of section 9 of the Act, the Seashore must comply with the following terms and conditions, which implement the reasonable and prudent measures described above and outline required reporting/monitoring requirements. These terms and conditions are non-discretionary.

TERMS AND CONDITIONS – ALL SPECIES

The ORV Management Plan must result in progress toward achieving the short- and long-term targets identified as the desired future conditions (NPS 2010a, pp. 8-9) for federal protected species within CAHA. The Seashore proposes (NPS 2010a, p. 74; M. Murray, NPS, pers. comm. 2010) a systematic periodic review of data, annual reports, and other information every five years, after storms or events that Seashore management determines to be a major modification of habitat quantity or quality, or if necessitated by a significant change in protected species status (e.g., listing or de-listing), in order to evaluate the effectiveness of management actions in making progress toward the accomplishment of stated objectives and desired future conditions. As part of each five-year review, the NPS must reinitiate consultation on the ORV Management Plan.

Each periodic review could result in changes to the management actions in order to improve effectiveness of resource protection. Each review should evaluate progress toward achieving the desired future conditions and state, as precisely as possible, when these future conditions are likely to be met. When desired future conditions for resources are met or exceeded, periodic review and adaptive management may allow for more flexible management of recreational use, provided adverse impacts of such use are effectively managed and wildlife populations remain stable (NPS 2010a, p. 74; M. Murray, NPS, pers. comm. 2010). However, where progress is not being made toward the attainment of desired future conditions, periodic review and adaptive management may provide for additional management including increased restrictions on recreational use (M. Murray, NPS, pers. comm. 2010). If the condition of any federally protected species has deteriorated over the review period, there should be an explanation of the factors that contributed, or may have contributed, to the deteriorated condition.

TERMS AND CONDITIONS – PIPING PLOVER

1. Following the pre-nesting habitat surveys each year, the NPS will provide their intended pre-nesting closures to the USFWS for review and comment. This opportunity for review and comment will not impede the timely implementation of pre-nesting closures as described in the FEIS.

2. In addition to the survey and monitoring data to be collected as described in Alternative F (NPS 2010a, p. 123; M. Murray, NPS, pers. comm. 2010), the following information must be collected and reported;

a. any sightings of breeding adult piping plovers consistently observed outside protected areas between March 15 and July 15 of each nesting season;
b. any unfledged chicks observed outside protected areas during each nesting season;
c. any piping plovers observed outside protected areas during non-breeding season surveys;
d. any behavioral observations indicating disturbance of breeding adult or unfledged piping plovers in response to human activities (e.g., flushing, leaving nests, etc.) inside protected areas not related to monitoring efforts;
e. any indications of unauthorized entry to protected areas by humans or pets; and
f. management or enforcement actions taken in response to any of the above observations.

3. In accordance with the procedures described in Alternative F, NPS must carefully monitor behavior of nesting piping plovers and broods for indications of disturbance and increase protective buffers if signs of disturbance are observed. In the case of disturbance resulting from Kite flying, the NPS will increase the protective buffer to 200 meters around breeding piping plovers.

4. The NPS will work with the USFWS Raleigh Field Office to develop a methodology for objectively determining the effects of management actions on non-breeding piping plovers. The agencies will work together such that the agreed upon methodology could be implemented immediately following the 2011 nesting season.

TERMS AND CONDITIONS – SEA TURTLES

1. In addition to the survey and monitoring data to be collected as described in Alternative F (NPS 2010a, p. 123; M. Murray, NPS, pers. comm. 2010), the following information must be collected and reported;

a. the annual number of nests and false crawls along with their dates and locations;
b. any incidences of violations of protective measures or incursions into protected areas and any actions taken in response; and,
c. the annual number of nest relocations, including reasons for relocation and fate of relocated nests.

REPORTING REQUIREMENTS

An annual report detailing the monitoring and survey data collected during the proceeding breeding season (as described in Alternative F, in addition to the additional information required in the above Terms and Conditions) and summarizing all piping plover, seabeach amaranth, and sea turtle data must be provided to the Raleigh Field Office by January 31 of each year for review and comment. In addition, any information or data related to a conservation measure or recommendation that is implemented should be included in the annual report. The contact for these reporting requirements is:

Pete Benjamin, Supervisor
Raleigh Field Office
U.S. Fish and Wildlife Service
Post Office Box 33726
Raleigh, North Carolina 27636-3726
(919) 856-4520

Upon locating a dead, injured, or sick individual of an endangered or threatened species, initial notification must be made to the USFWS Law Enforcement Office below. Additional notification must be made to the USFWS Ecological Services Field Office identified above. Care should be taken in handling sick or injured individuals and in the preservation of specimens in the best possible state for later analysis of cause of death or injury.

Sandra Allred
U.S. Fish and Wildlife Service
Post Office Box 33096
Raleigh, North Carolina 27636-3096
(919) 856-4786

COORDINATION OF INCIDENTAL TAKE STATEMENT WITH OTHER LAWS, REGULATIONS, AND POLICIES

The USFWS will not refer the incidental take of any migratory bird for prosecution under the Migratory Bird Treaty Act of 1918, as amended (16 USC § 703-712), if such take is in compliance with the terms and conditions (including amount and/or number) specified herein. Take resulting from activities that are not in conformance with the ORV Management Plan (e.g., intrusions into protected area, deliberate harassment of wildlife, etc.) are not considered part of the proposed action and are not covered by this incidental take statement and may be subject to enforcement action against the individual responsible for the act.

CONSERVATION RECOMMENDATIONS

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

The USFWS recommends and encourages the NPS to actively pursue development of a robust adaptive management framework to help inform and guide management actions associated with this plan. In addition to those adaptive management initiatives outlined in Alternative F, the USFWS recommends that NPS further investigate the effects of lighting (stationary and vehicle) on the wildlife resources of the Seashore. Additionally, special attention should be paid to identifying factors impairing nesting, hatchling, and fledgling success in piping plovers, sea turtles and other species of concern. The USFWS further encourages the NPS to continue predator control efforts. Finally, the USFWS encourages the NPS to continue to investigate factors affecting wintering piping plovers and shorebirds. The NPS should coordinate these activities with the USFWS, North Carolina Wildlife Resources Commission and other interested parties.

REINITIATION – CLOSING STATEMENT

This concludes formal consultation on the action outlined in your February 17, 2010, request for formal consultation. 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.

Section 9 of the Act and federal regulation pursuant to section 4(d) of the Act prohibit the take of endangered or threatened species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined by the USFWS 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 by the USFWS 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, carrying out an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(0)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited under the Act provided that such taking is in compliance with the terms and conditions of this incidental take statement. Incidental take of an undetermined number of young or eggs of sea turtles and piping plovers has been exempted from the prohibitions of section 9 by this opinion.

For this biological opinion, each five-year review will constitute new information requiring the reinitiation of consultation. If a periodic review is initiated after storms or events that Seashore management determines to be a major modification of habitat quantity or quality, or if necessitated by a significant change in protected species status (e.g., listing or de-listing), the USFWS should be contacted to determine whether new consultation is required based on the degree of changes to the ORV Management Plan. Consultation must be reinitiated between planned five-year reviews if the level of incidental take is exceeded.

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