# United States Department of the Interior

**FISH AND WILDLIFE SERVICE**
Raleigh Field Office
Post Office Box 33726
Raleigh, North Carolina 27636-3726

November 20, 2006

Robert A. Vogel
Superintendent
Cape Lookout National Seashore
National Park Service
131 Charles Street
Harkers Island, North Carolina 28531

Subject: Biological Opinion for Cape Lookout National Seashore's Interim Protected Species Management Plan

Dear Superintendent Vogel:

This transmits the U.S. Fish and Wildlife Service (USFWS) Raleigh Field Office's biological opinion based on our review of the Cape Lookout National Seashore's (CALO) proposed Interim Protected Species Management Plan (Plan) located in Carteret County, North Carolina. This opinion assesses the effects of the 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*), leatherback (*Dermochelys coriacea*), and Kemp's ridley sea turtles (*Lepidochelys kempii*) 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 December 21, 2005 request for formal consultation was received on December 23, 2005.

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

Sincerely,

/signed/

Pete Benjamin
Field Supervisor

Attachment

## INTRODUCTION

This document is the U.S. Fish and Wildlife Service (USFWS) Raleigh Field Office's biological opinion based on our review of the Cape Lookout National Seashore's (CALO) proposed Interim Protected Species Management Plan (Plan), located in Carteret County, North Carolina. This opinion assesses the effects of the 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*), leatherback (*Dermochelys coriacea*), and Kemp's ridley sea turtles (*Lepidochelys kempii*) 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 December 21, 2005 request for formal consultation was received on December 23, 2005.

The USFWS's records are rather inconclusive regarding any formal consultation with CALO on the impacts of recreational access to endangered and threatened species. CALO issued their General Management Plan in December 1982, but no consultation on its effects was found in our files; although, the Park's General Management Plan predated the listing of the piping plover and seabeach amaranth, but not sea turtles. On February 21, 1990, CALO requested the USFWS to review proposed designated off-road vehicle (ORV) routes. In our April 18, 1990, response to CALO, we determined that on-beach ORV routes may adversely affect the piping plover and loggerhead and green sea turtles, and requested the Park initiate formal consultation. No follow-up or additional information is found, though. This biological opinion will address the piping plover, seabeach amaranth, and all five (i.e., green, loggerhead, leatherback, Kemp's ridley, and hawksbill (*Eretmochelys imbricata*)) sea turtle species. Critical habitat has been designated for the piping plover throughout the species' wintering range, and will be considered in the biological opinion.

This biological opinion is based on information provided in your December 21, 2005 biological assessment (CALO, 2005), your March 10, 2006 Interim Protected Species Management Plan/Environmental Assessment (CALO, 2006), 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, we have relied upon the statutory provisions of the Act to complete the following analysis with respect to critical habitat.

### Consultation History

On 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 hired by NPS to prepare protocols for protected species at CALO.

During the 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.

On December 21, 2005, CALO submitted a biological assessment for their proposed Plan and requested consultation under section 7 of the Act.

On January 12, 2006, the Raleigh Field Office responded to CALO's request and initiated consultation.

On March 10, 2006, CALO submitted their environmental assessment for the Interim Protected Species Management Plan.

On October 24, 2006, the USFWS submitted a draft biological opinion to CALO for review.

On November 9, 2006, CALO submitted their comments back to the USFWS on the draft biological opinion.

On November 15, 2006, staff from the Raleigh Field Office and CALO and NPS Regional Office had a conference call to discuss the comments made on the draft biological opinion.

On November 16, 2006, the Raleigh Field Office submitted to CALO a revised draft Incidental Take Statement of the draft biological opinion. CALO returned comments to the Raleigh Field Office on the draft Incidental Take Statement that same day.

## BIOLOGICAL OPINION

## DESCRIPTION OF PROPOSED ACTION

As stated in the BA for this action (CALO, 2005), CALO was established "to preserve for public use and enjoyment an area in the State of North Carolina possessing outstanding natural and recreation values". In addition, NPS Management policies (NPS, 2000:35) state "the NPS will survey for, protect, and strive to recover all species native to national park system units that are listed under the Endangered Species Act" and "will fully meet its obligations under the National Park Service Organic Act and the Endangered Species Act to both pro-actively conserve listed species and prevent detrimental effects on these species."

Furthermore, Executive Order (EO) 11644 of 1972, amended by EO 11989 of 1977, requires certain federal agencies permitting off-road vehicle use on agency lands to publish regulations designating specific trails and areas for this use. Title 36, section 4.10 of the Code of Federal Regulations implements the EOs by providing that routes and areas designated for ORV use shall be promulgated as special regulations. Section 4.10 also provides that the designation of routes and areas shall comply with EO 11644 and with section 1.5 of Title 36 of the Code of Federal Regulations. The obligations under these EOs have not yet been fulfilled with regard to vehicle access and recreational use of the beach at CALO. However, CALO is currently conducting the rulemaking process to develop an ORV Management Plan. The Plan, the action under consultation, is designed to guide management practices for recreational use and protection of species at CALO for the next three to four years until the ORV Management Plan and regulations are completed (currently scheduled for completion in 2009).

The NPS characterizes the purpose of the Plan as the evaluation and implementation of strategies to protect sensitive species (including the federally-listed piping plover, seabeach amaranth, and sea turtles) and provide for year-round recreational use as directed in the CALO enabling legislation, NPS management policies, and other laws and mandates until the long-term ORV Management Plan is developed. The effectiveness of the management actions will be assessed in an ongoing manner to the extent possible in order to assist managers in choosing from among the most effective and feasible management options recommended in the Plan.

The following information, which describes actions NPS may take to protect sensitive species while providing for recreational use, is based on information provided in the BA (CALO, 2005), the environmental assessment (CALO, 2006) and our understanding of the proposed action that NPS is considering. This Biological Opinion is based on the assumptions that NPS implementation of the proposed Plan has flexibility within it that includes, but is not limited to, the following actions:

**Endangered and Threatened Species**

<u>Piping Plovers</u>

*Pre-nesting and Monitoring*

Suitable nesting habitat, both active, historic and newly created habitat for the piping plover (based on last year's of breeding/nesting data) would be closed to the public with symbolic fencing (posts and signs) by April 1$^{st}$ each year. The presence of territorial or courting birds outside of existing closures could further extend these initial closures 150 feet.

Monitoring for piping plovers would begin April 15. Monitoring is to include active and historical nesting areas and potential new habitat as determined appropriate by a qualified biologist. Piping plover monitoring would occur seven days per week on North and South Core Banks and at least one day per week in other areas. Potential new habitat means habitat recently created, usually by storms, e.g. overwash passes, blowouts, etc. A range of observation activities would occur across pre-nesting, nesting, migration, and over-wintering life-stages and include such things as: observing and noting adult behavior, identifying scrapes, nests, eggs, broods, and chicks, and providing outreach and education materials.

*Nesting and Foraging*

When nests are found, park staff would collect data on bird behavior, location of nests, and presence of predators. Park staff would ensure adequate buffers are provided within existing closures or create buffers for the nests that are found outside of existing closures. A 150 foot buffer, from which all recreational uses would be restricted, would be established around any piping plover nests, with additional buffer provided if warranted based on observed bird behavior. Staff would erect predator exclosures directly over piping plover nests when they contain 3-4 eggs. Nesting areas would be monitored for predators.

*Unfledged Chicks*

Park staff will monitor piping plover chicks seven days/week on North and South Core Banks and at least one day per week in other areas. A 600 foot buffer from vehicles will be maintained around all chicks. If chicks move to the ocean beach then this area will be closed to ORV access with the potential for limited escorts in those areas (North Core Banks) where no backroad is present.

Observational data collected would include brood status, behavior, movements, and effects of human presence, predator tracks, or other environmental interactions.

*Migrating/Wintering Piping Plovers*

Park staff will survey the entire seashore non-breeding population once per month. The park will also coordinate with Cape Hatteras National Seashore to conduct simultaneous surveys or receive survey data from Portsmouth Island during winter, since, based on past banding data, wintering birds move across Ocracoke Inlet.

<u>Sea Turtles</u>

Cape Lookout National Seashore follows sea turtle management guidelines defined by the North Carolina Wildlife Resources Commission (NCWRC) in Handbook for Sea Turtle Volunteers in North Carolina (2002) and the USFWS Index Nesting Beach Survey Protocol. An annual permit is issued by NCWRC under the authority of the U.S. Fish and Wildlife Service. Beaches would be patrolled daily between June 1 and August 15 on North and South Core Banks and two to three days per week on Shackleford Banks in search of turtle crawls (tracks left by the turtle when they come ashore to nest). Monitoring for sea turtle nests prior to June 1 would be conducted by piping plover monitoring staff during their normal monitoring routines.

Each located nest is marked with four stakes: two white PVC stakes with orange reflector tape five feet apart spanning nest and perpendicular to shoreline and two wooden stakes at primary dune line a set distance perpendicular to the shoreline so that the nest can be found should the two PVC stakes be lost. Nests laid at or below high tide line or in areas where they are likely to be washed away or are in danger of erosion are relocated according to USFWS and NCWRC recommendations. Fifty days after a nest is laid, a funnel shaped closure is erected from nest to 15 feet below high tide line. The closure is 30 foot wide at nest and 60 feet wide below high tide line, with a minimum 10 foot buffer duneward of the nest. If a 10 foot minimum buffer is not possible, the beach is closed to vehicle access and vehicles will be routed around nest via back road. The beach is reopened after the nest hatches.

Three nest relocation areas (up to 1 mile in length) are designated on SCB and NCB where ORV traffic is prohibited beginning 50 days after first nest relocated to area. Nests that need to be relocated are relocated to the nearest designated area. No ORVs are allowed on Shackleford Banks, nests that need to be relocated here are relocated to the nearest suitable habitat. Nests are relocated within 12 hours after eggs laid or 14 days after the nest was laid.

Camping and campfires are prohibited in nest relocation closures to prevent disturbance of hatchlings by artificial lights. Park encourages concessionaires and people staying in park cabins to minimize use of outdoor lights. For nests in locations deemed vulnerable to light pollution, two foot high plywood barriers will be erected behind and to the sides of the nest 10 days before estimated hatch date.

Seabeach Amaranth

On June 1, begin monitoring habitat outside existing avian closures 1-2 days per week for seedlings/juvenile plants. Conduct annual survey in late July or early August to track plant numbers and distribution and identify areas for closure. Survey covers habitat but concentrates on where plants have been found before (historic sites). Thorough searches conducted in all areas of suitable habitat and results mapped using GIS. Symbolic fencing would be erected around all emergent plants in areas with ORV traffic. These closures would remain in place until the end of the plant’s growing season (late fall/early winter or earlier due to overwash). The size of closure based on best professional judgment but with at least a minimum 30 foot buffer around plants. Bird and turtle closures would be surveyed for seabeach amaranth prior to opening them to ORV traffic.

## Recreation

ORV traffic is allowed in a corridor along the shoreline, as long as there is at least a 150 foot buffer from active piping plover nests. Once chicks are mobile the buffer increases to 600 foot. When a chick is found using the ocean beach, the area would be immediately closed to ORV’s. The closure remains in effect until the chicks move to a different location or are capable of sustained flight. When the beach is closed due to the presence of chicks, pedestrian access is maintained. The full closure around active piping plover nesting sites prohibit ORV and pedestrian access.

ORV's would be prohibited from entering sea turtle nest relocation areas 50 days after first nest laid/relocated until after the last nest has hatched. ORV's must use back road to detour around these areas. Outside of nest relocation areas, ORV's prohibited from entering turtle closures erected 50 days after first nest is laid until after the nest hatched. Where possible, ORV traffic routed around the nest on the duneward side, maintaining a minimum buffer of 10 foot or more based on topography and professional judgment. If sufficient minimum buffer is not possible, then the beach is closed to through traffic and ORV's are required to use the backroad to circumvent nest. This type of total beach closure encompasses area between the nearest access ramps on either side of the nest. Pedestrian access is allowed in turtle closures.

A 30 foot buffer is maintained around seabeach amaranth.

Pets should be leashed and under control of their owners at all times in all areas of the park (36 CFR Sec. 2.15 Pets). Pets prohibited from all active closure areas.

**Outreach and Compliance**

The seashore will station one person at each of the two vehicle ferry landings seven days a week from April 1 to November 31 to relay educational information about species and closures. The park would continue to provide information about endangered species at the visitor's center. Articles would be provided in the park newspaper and on the website. In addition, the public would be notified of closures that would temporarily limit ORV traffic via the park's website, press releases, or through visitor contacts at the vehicle ferry landings.

Annual reports regarding the previous bird breeding season would be published on the park website. A variety of educational materials are available at the park's visitor center regarding the impacts of trash-disposal, wildlife-feeding, fireworks, and pets. These materials will be distributed through ferry operators and community organizations. In addition, interpretive signage is being developed for certain species.

Conservation measures

Conservation measures are action proposed by CALO to avoid or reduce adverse effects to federally-listed species. These measures are implemented to provide an effective monitoring and management program under the Plan. Additionally, information generated from the proposed measures can be used to the development of CALO's long-term ORV Management Plan. Since conservation measures are part of the proposed action, their implementation is required under the terms of consultation.

Piping Plover

- Monitor abundance and distribution of wintering plovers through specific winter surveys.
- Provide monitoring data to the USFWS so that the information may be combined with data from other monitoring efforts to determine the significance of CALO breeding or wintering population segments to the state, region (middle Atlantic coast), or Atlantic coast wide population changes and trends.
- Document violations of bird nesting closures by ORVs, pedestrians, and leashed and unleashed pets.
- Monitor plover breeding activities at nesting sites to identify factors that may be limiting abundance of nesting plovers and/or productivity.
- Monitor the impact of mammalian and avian predators on piping plover breeding productivity.

Seabeach amaranth

- Monitor the effects of nutria grazing on seabeach amaranth at CALO.

Sea turtles

- Monitor the number of nesting females and their reproductive success so that the current contribution of CALO to regional population dynamics can be better understood.
- Monitor the impacts of predators on sea turtle nests.
- Document violations of sea turtle closures by ORVs.

Protection of Habitat Created as a Result of Storms and Other Natural Processes

The Park will allow natural processes to occur unimpeded whenever feasible. Newly-created inlets and overwash areas will be assessed to determine whether alteration of the habitat would lead to effects on plovers or their prey in the present or future.

Action Area

CALO is located in the central coastal area of North Carolina between Beaufort and Ocracoke Inlets (Figure 1). The park is currently divided into five barrier islands. The northernmost island, North Core Banks (NCB) is approximately 19 miles long, extending from Ocracoke Inlet to Old Drum Inlet. From Old Drum Inlet to New Drum Inlet is a three-mile long island of land (formerly connected to NCB) known as Middle Core Banks (MCB). A ¾-mile section of South Core Banks south of New Drum Inlet was isolated with the creation of a new inlet following Hurricane Ophelia. South Core Banks (SCB) extends southward from New Drum Inlet 25 miles to the Cape Lookout bight area. Core Banks have a northeast to southwest orientation and exhibit a low profile landscape. The fifth island, Shackleford Banks (SHACK) is nine miles long and has an east-west orientation with a higher dune system and larger areas of vegetation. All islands in the park are subject to constant and dramatic change by the actions of wind and waves.

The beaches of the park are undeveloped and accessible only by boat. Two concession-operated ferries transport visitors and off-road vehicles to NCB and SCB. Passenger ferries and private boats carry visitors to other locations in the park. Generally, ferries operate on a regular basis between April and November, and closed or operating with limited service during the winter months. Off-road vehicles are permitted on 45 miles of ocean beach and a 30-mile sand road system.

The action area for evaluating direct, indirect, and cumulative effects considered in this Biological Opinion varies by species or groups of species. In determining the action area for sea turtles we combined the species since they have similar reproductive behavioral characteristics. For the sea turtles, we consider the action area to be all ocean facing beaches within CALO. The beach is defined as the area between the mean low tide mark and the seaward edge of first permanent vegetation zone on the dunes. The action area for seabeach amaranth is similar to that of the sea turtles except that it includes all ocean facing beaches between the mean high tide mark and the seaward edge of the first permanent vegetation zone on the dunes and overwash flats at accreting spits or ends of barrier islands. The action area for the piping plover is all ocean or sound-side beaches (e.g., intertidal areas and the upper sandy beach with sparse or no vegetation), sand and mud flats, and overwashes within CALO. These areas are referred to throughout this Biological Opinion as the action area (Figure 1).

## STATUS OF THE SPECIES/CRITICAL HABITAT

### A. Species/critical habitat description

#### *Piping plover*

The piping plover is a small, pale-colored shorebird, about seven inches long with a wingspan of about 15 inches (Palmer, 1967). On January 10, 1986, the piping plover was listed 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). The piping plover winters in coastal areas of the U.S. from North Carolina to Texas, and along the coast of eastern Mexico and on Caribbean islands from Barbados to Cuba and the Bahamas (Haig and Elliott-Smith, 2004). Information from observation of color-banded piping plovers indicates that the winter ranges of the breeding populations overlap to a significant degree.

The recovery objective for the Great Lakes population includes:

> at least 150 pairs (300 individuals), for at least five 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; 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; ensure protection and long-term maintenance of essential breeding and wintering habitat, sufficient in quantity, quality, and distribution to support the recovery goal of 150 pairs (300 individuals); genetic diversity within the population is deemed adequate for population persistence and can be maintained over the long-term; and, agreements and funding mechanisms are in place for long-term protection and management activities in essential breeding and wintering habitat (USFWS, 2003a).

The recovery objective for the northern Great Plains population includes:

> sustaining 2,300 pairs of birds for at least 15 years, meeting recovery objectives for birds in prairie Canada, and providing long term protection of essential breeding and wintering habitat.

The recovery objective for the Atlantic Coast population includes:

> verification of the adequacy of a 2,000-pair population of piping plovers to maintain heterozygosity and allelic diversity over the long term; achieve five-year average productivity of 1.5 fledged chicks per pair in each of the four recovery units; institute long-term agreements among cooperating agencies, landowners, and conservation organizations to assure protection and management sufficient to maintain the target populations in each recovery unit and average productivity; and, ensure long-term maintenance of wintering habitat, sufficient in quantity, quality, and distribution to maintain survival rates for a 2,000-pair population (USFWS, 1996a).

The recovery plan for the Atlantic Coast population of the piping plover (USFWS, 1996a) delineates four recovery units within the population: Atlantic Canada, New England, New York-New Jersey, and Southern (Delaware, Maryland, Virginia, and North Carolina). Extensive efforts to observe and report sightings of greater than 1,400 Atlantic Coast piping plovers color-banded in Virginia, Maryland, Massachusetts, and five Eastern Canadian provinces between 1985 and 2003 have documented many inter-year movements among sites within recovery units, but only four records of plovers breeding outside the recovery unit where they were banded (Loegering, 1992; Cross, 1996; Amirault et al., 2005; Melvin, 2006a, pers. comm.), supporting the premise that immigration and emigration have relatively little influence on abundance trends at the scale of the recovery unit.

Recovery criteria established within the recovery plan defined population and productivity goals for each recovery unit, as well as for the population as a whole. The recovery objective for the Atlantic Coast population is to increase and maintain for five years a total of 2,000 breeding pairs, distributed among the four recovery units – Atlantic Canada, 400 pairs; New England, 625 pairs; New York-New Jersey, 575 pairs; and, Southern, 400 pairs. Attainment of these goals for each recovery unit is an integral part of a piping plover recovery strategy that seeks to reduce the probability of extinction for a population with low rates of inter-regional dispersal by: (1) contributing to the population total, (2) reducing vulnerability to environmental variation (including catastrophes, such as hurricanes, oil spills, or disease), (3) increasing likelihood of genetic interchange among subpopulations, and (4) promoting re-colonization of any sites that experience declines or local extirpations due to low productivity or temporary habitat succession. The plan further states: "A premise of this plan is that the overall security of the Atlantic Coast piping plover population is profoundly dependent upon attainment and maintenance of the minimum population levels for the four recovery units. Any appreciable reduction in the likelihood of survival of a recovery unit will also reduce the probability of persistence of the entire population."

The USFWS has designated critical habitat for the piping plover on three occasions. Two of these designations protected different breeding populations of the piping plover. 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). 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. The three separate designations of piping plover critical habitat demonstrate diversity of constituent elements between the two breeding populations and between the breeding populations and wintering piping plovers.

Designated wintering piping plover critical habitat originally included 137 areas encompassing about 1,793 miles of mapped shoreline and 165,211 acres of mapped area along the coasts of North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana, and Texas (USFWS, 2001b). Four units in North Carolina have been vacated and remanded back to the USFWS for reconsideration by Court order (Cape Hatteras Access Preservation Alliance v. U.S. Department of Interior (344 F. Supp. 2d 108 (D.D.C. 2004)), leaving a total of 133 designated critical habitat units. The four critical habitat units vacated were NC-1, NC-2, NC-4 and NC-5, and all occurred within CAHA. On June 12, 2006, the USFWS proposed to amend and re-designate these four units as critical habitat for the wintering population of the piping plover (USFWS, 2006a). This biological opinion will not consider the proposed units in its analysis. However, we will consider units NC-6, NC-7, and NC-8 that occur within CALO (USFWS, 2001b), and are not affected by the Court's order.

The primary constituent elements for piping plover wintering habitat are those biological and physical features that are essential to the conservation of the species. 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). Primary constituent elements 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). 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 included in the designation can be found at 66 Federal Register 36038 (USFWS, 2001b).

***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).

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.

***Loggerhead sea turtle***

The loggerhead sea turtle, listed as a threatened species on July 28, 1978 (NMFS and USFWS, 1978), inhabits the continental shelves and estuarine environments along the margins of the Atlantic, Pacific, and Indian Oceans. Loggerhead sea turtles nest within the continental U.S. from Louisiana to Virginia. Major nesting concentrations are found on the coastal islands of North Carolina, South Carolina, and Georgia, and on the Atlantic and Gulf coasts of Florida (Hopkins and Richardson, 1984).

Adults and sub-adults have a reddish-brown carapace (top of shell). Scales on the top and sides of the head and top of the flippers are also reddish-brown, but have yellow borders. The neck, shoulders and limb bases are dull brown on top and medium yellow on the sides and bottom. The plastron (underside of shell) is also medium yellow. Adult average size is 36 inches straight carapace length; average weight is 253 pounds. Hatchlings are dull brown in color. Average size at hatching is 1.8 inches long; average weight is 0.7 ounces. Mating takes place from late March to early June, and eggs are laid throughout the summer (NMFS and USFWS, 1991b).

The recovery objectives for the southeastern U.S. population of the loggerhead turtle (NMFS and USFWS, 1991b) include:

> over a period of 25 years, the adult female population in Florida is increasing, and in North Carolina, South Carolina, and Georgia nesting numbers are returning to pre-listing levels. For North Carolina, that equates to 800 nests per year. For South Carolina and Georgia nesting numbers must be 10,000 and 2,000 nests per year, respectively. These above conditions must be met with data from standardized surveys which will continue for at least five years after recovery. Furthermore, at least 25 percent of all available nesting beaches must be in public ownership, distributed over the entire nesting range and encompassing at least 50 percent of the nesting activity within each state. In addition, all

priority one tasks identified in the recovery plan must be successfully implemented (NMFS and USFWS, 1991b).

No critical habitat has been designated for the loggerhead turtle.

***Green sea turtle***

The green sea turtle was federally listed as a protected species on July 28, 1978 (NMFS and USFWS, 1978). Breeding populations of the green turtle in Florida and along the Pacific Coast of Mexico are listed as endangered; all other populations are listed as threatened. The green turtle has a worldwide distribution in tropical and subtropical waters. Major green turtle nesting colonies in the Atlantic occur on Ascension Island, Aves Island, Costa Rica, Suriname, and Trindade Island, Brazil.

Adult green turtles may reach a size of 39 inches in length and weigh 397 pounds. The carapace is smooth and is gray, green, brown, and black. The plastron is yellowish white. Hatchlings weigh about 0.9 ounces, and are about two inches long. Hatchlings are black on top and white on the bottom (NMFS and USFWS, 1991a).

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). Nesting also has been documented along the Gulf coast of Florida from Escambia County through Franklin County in Northwest Florida and from Pinellas County through Collier County in Southwest Florida (Florida Fish and Wildlife Conservation Commission [FFWCC], 2006a). Green turtles have been known to nest in Georgia, but only on rare occasions (Georgia Department of Natural Resources [GDNR], 2004). The green turtle also nests sporadically in North Carolina and South Carolina (Woodson and Webster, 1999; South Carolina Department of Natural Resources [SCDNR], 2004; NCWRC, 2006a). Unconfirmed nesting of green turtles in Alabama has also been reported.

Recovery objectives for the U.S. population of the green turtle (NMFS and USFWS, 1991a) include:

> over a period of 25 years, that the level of nesting in Florida has increased to an average of 5,000 nests per year for at least six years where nesting data are based on standardized surveys; at least 25 percent of all available nesting beaches is in public ownership and encompasses at least 50 percent of the nesting activity; and, a reduction in stage class mortality is reflected in higher counts of individuals on foraging grounds. In addition, all priority one tasks identified in the recovery plan must be successfully implemented (NMFS and USFWS, 1991a).

Critical habitat for the green sea turtle has been designated for the water surrounding Culebra Island, Puerto Rico, and its outlying keys.

***Leatherback sea turtle***

The leatherback sea turtle, listed as an endangered species on June 2, 1970 (USFWS, 1970a), nests on shores of the Atlantic, Pacific and Indian Oceans. 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). Nesting grounds are distributed circumglobally, with the Pacific Coast of Mexico historically supporting the world's largest known concentration of nesting leatherbacks (Pritchard, 1982). The largest nesting colonies in the wider Caribbean region are found in Suriname/French Guiana, Trinidad, Costa Rica, Panama, Colombia and Guyana (NMFS and USFWS, 1992; National Research Council, 1990; Troëng et al., 2004).

The leatherback is the largest living turtle, and is so distinctive as to be placed in a separate taxonomic family, Dermochelyidae. The carapace is distinguished by a rubber-like texture, about 1.6 inches thick, and made primarily of tough, oil-saturated connective tissue. No sharp angle is formed between the carapace and the plastron, resulting in the animal being somewhat barrel-shaped. The average curved carapace length for adult turtles is 61 inches and weight ranges from 441 to 1,543 pounds. Hatchlings are mostly black on top 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. Hatchlings average 2.4 inches long and 1.6 ounces in weight. In the adult, the skin is black and scaleless. The undersurface is mottled pinkish-white and black. The front flippers are proportionally longer than in any other sea turtle, and may span 106 inches in an adult. In both adults and hatchlings, the upper jaw bears two tooth-like projections (NMFS and USFWS, 1992).

The leatherback regularly nests in Puerto Rico, the U.S. Virgin Islands, and along the Atlantic coast of Florida as far north as Georgia (NMFS and USFWS, 1992). Leatherback turtles have been known to nest in Georgia, South Carolina, and North Carolina, but only on rare occasions (Rabon et al., 2003; GDNR, 2004; SCDNR, 2004; NCWRC, 2006a). Leatherback nesting also has been reported on the northwest coast of Florida (LeBuff, 1990; FFWCC, 2006a); a false crawl (non-nesting emergence) has been observed on Sanibel Island (LeBuff, 1990).

The recovery objective for U.S. population of the leatherback turtle include:

> when 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, and nesting habitat encompassing at least 75 percent of nesting activity in the U.S. Virgin Islands, Puerto Rico, and Florida is in public ownership. In addition, all priority one tasks identified in the recovery plan must be successfully implemented (NMFS and USFWS, 1992).

Critical habitat has been designated for the leatherback sea turtle in the U.S. Virgin Islands.

### *Hawksbill sea turtle*

The hawksbill sea turtle was listed as an endangered species on June 2, 1970 (USFWS, 1970a). The hawksbill sea turtle is found in tropical and subtropical seas of the Atlantic, Pacific, and Indian Oceans. The species is widely distributed in the Caribbean Sea and western Atlantic

Ocean. Within the continental U.S., hawksbill sea turtle nesting is rare and is restricted to the southeastern coast of Florida (Volusia through Dade Counties) and the Florida Keys (Monroe County) (Meylan, 1992; Meylan et al., 1995). However, hawksbill tracks are difficult to differentiate from those of loggerheads and may not be recognized by surveyors. Therefore, surveys in Florida likely underestimate actual hawksbill nesting numbers (Meylan et al., 1995). In the U.S. Caribbean, hawksbill nesting occurs on beaches throughout Puerto Rico and the U.S. Virgin Islands (NMFS and USFWS, 1993).

The hawksbill sea turtle is a small to medium-sized sea turtle. In the Caribbean, nesting females average about 24 to 37 inches in straight carapace length. Weight is typically to 176 pounds in the wider Caribbean, with a record weight of 280 pounds. Hatchlings average about 1.6 inches straight carapace length and range in weight from 0.5 to 0.7 ounces. The following characteristics distinguish the hawksbill from other sea turtles: two pairs of prefrontal scales; thick, posteriorly overlapping scutes (plate or scale) on the carapace (shell); four pairs of edge scutes; two claws on each flipper; and a beak-like mouth. The carapace is heart-shaped in very young turtles, and becomes more elongate or egg-shaped with maturity. Its lateral and posterior margins are sharply serrated in all but very old individuals. The top scutes that overlay the bones of the shell are the tortoiseshell of commerce. They are thick, and overlap posteriorly on the carapace in all but hatchlings and very old individuals. These scutes are often richly patterned with irregularly radiating streaks of brown or black on an amber background. The scutes of the belly of Atlantic hawksbills are usually clear yellow, with little or no dark pigmentation. The soft skin on the ventral side is cream or yellow, and may be pinkish-orange in mature individuals. The scales of the head and forelimbs are dark brown or black with sharply defined yellow borders. There are typically four pairs of infra marginal scales. The head is elongate and tapers sharply to a point. The lower jaw is V-shaped (NMFS and USFWS, 1993).

Recovery objectives for the U.S. populations of the hawksbill turtle (NMFS and USFWS, 1993) include:

> over a period of 25 years, that the adult female population is increasing, as evidenced by a statistically significant trend in the annual number of nests on at least five index beaches, including Mona Island and Buck Island Reef National Monument; habitat for at least 50 percent of the nesting activity that occurs in the U.S. Virgin Islands and Puerto Rico is protected in perpetuity; and, numbers of adults, subadults and juveniles are increasing, as evidenced by a statistically significant trend on at least five key foraging areas within Puerto Rico, U.S. Virgin Islands, and Florida. In addition, all priority one tasks identified in the recovery plan must be successfully implemented (NMFS and USFWS, 1993).

Critical habitat has been designated for the hawksbill sea turtle in Puerto Rico for selected beaches and/or waters of Mona, Monito, Culebrita, and Culebra Islands.

***Kemp's ridley sea turtle***

The Kemp's ridley sea turtle was listed as endangered on December 2, 1970 (USFWS, 1970b). The range of the Kemp's ridley includes the Gulf coasts of Mexico and the U.S., and the Atlantic coast of North America as far north as Nova Scotia and Newfoundland, with occasional individuals being swept across the east Atlantic and Mediterranean (Tomás et al., 2003). Most Kemp's ridleys nest on the coastal beaches of the Mexican states of Tamaulipas and Veracruz, although a small number of Kemp's ridleys nest consistently along the Texas coast (Turtle Expert Working Group, 1998). In addition, nesting has been reported in Florida, Alabama, South Carolina, and North Carolina. Hatchlings, after leaving the nesting beach, are believed to become entrained in eddies within the Gulf of Mexico, where they are dispersed within the Gulf and Atlantic by oceanic surface currents until they reach about eight inches in length, at which size they enter coastal shallow water habitats (Ogren, 1989). Outside of nesting, adult Kemp's ridley sea turtles are believed to spend most of their time in the Gulf of Mexico, while juveniles and subadults also regularly occur along the eastern seaboard of the U.S. (USFWS and NMFS, 1992).

The Kemp's ridley sea turtle is one of the two smallest of all extant sea turtles, with the weight of an adult generally being less than 100 pounds and the straight carapace length about 26 inches. Adult Kemp's ridley sea turtle shells are almost as wide as long. Coloration changes significantly during development from the gray-black carapace and plastron of hatchlings to the lighter gray-olive carapace and cream-white or yellowish plastron of adults. Males resemble the females in size and coloration. Hatchlings range from 1.6 to 1.9 inches in straight line carapace length, 1.3 to 1.7 inches in width, and 0.5 to 0.7 ounces in weight (USFWS and NMFS, 1992).

The recovery objectives for Kemp's ridley sea turtles (USFWS and NMFS, 1992) include:

> to continue complete and active protection of the known nesting habitat, and the waters adjacent to the nesting beach and continue the bi-national protection project; essentially eliminate mortality from incidental catch in commercial shrimping in the U.S. and Mexico through use of turtle excluder devices and to achieve full compliance with the regulations requires such devices; and to attain a population of at least 10,000 females nesting in a season. In addition, all priority one tasks identified in the recovery plan must be successfully implemented (USFWS and NMFS, 1992).

No critical habitat has been designated for the Kemp's ridley sea turtle.

## B. Life History

### *Piping plover*

Piping plover breeding activity begins in mid-March when birds begin returning to their nesting areas (Coutu et al., 1990; Cross, 1990; Goldin, 1990; MacIvor, 1990; Hake 1993). Males establish and defend territories and court females (Cairns, 1982). Piping plovers are monogamous, but usually shift mates between years (Wilcox, 1959; Haig and Oring, 1988; MacIvor, 1990), and less frequently between nesting attempts in a given year (Haig and Oring, 1988; MacIvor, 1990; Strauss, 1990). 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. Observations suggest that this species exhibits a high degree of nest site fidelity (Wilcox, 1959; Haig, 1985; Haig and Oring, 1988).

Piping plover nests can be found above the high tide line on coastal beaches, on sand flats at the ends of sand spits and barrier islands, on gently sloping foredunes, in blowout areas behind primary dunes, and in washover areas cut into or between dunes. The birds 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 al., 1990; 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 or other vegetation (Patterson, 1988; Flemming et al., 1990; MacIvor, 1990). Plover nests may be very difficult to detect, especially during the 6- to 7-day egg-laying phase when the birds generally do not incubate (Goldin, 1994).

Eggs may be present on the beach from early April through late July. Clutch size for an initial nest attempt is usually four eggs, one laid every other day. Eggs are pyriform in shape, and variable buff to greenish brown in color, marked with black or brown spots. The incubation period usually lasts 27 to 28 days. Full-time incubation usually begins with the completion of the clutch and is shared equally by both sexes (Wilcox, 1959; Cairns, 1977; MacIvor, 1990). Eggs in a clutch usually hatch within 4 to 8 hours of each other, although the hatching period of one or more eggs may be delayed by up to 48 hours (Cairns, 1977; Wolcott and Wolcott, 1999).

Piping plovers generally fledge only a single brood per season, but may renest several times if previous nests are lost. Chicks are precocial (Wilcox, 1959; Cairns, 1982). They may move hundreds of yards from the nest site during their first week of life (e.g., see Table 1 in USFWS, 1996a), and chicks may increase their foraging range up to 3,000 feet before they fledge (are able to fly) (Loegering, 1992). Chicks remain together with one or both parents until they fledge at 25 to 35 days of age. Depending on date of hatching, flightless chicks may be 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).

Cryptic coloration is a primary defense mechanism for this species; nests, adults, and chicks all blend in with their typical beach surroundings. Chicks sometimes respond to vehicles and/or pedestrians by crouching and remaining motionless (Cairns, 1977; Tull, 1984; Goldin, 1993b; Hoopes, 1993). Adult piping plovers also respond to intruders (avian and mammalian) in their territories by displaying a variety of distraction behaviors, including squatting, false brooding, running, and injury feigning. Distraction displays may occur at any time during the breeding season but are most frequent and intense around the time of hatching (Cairns, 1977).

Plovers feed on invertebrates such as marine worms, fly larvae, beetles, crustaceans, and mollusks (Bent, 1929; Cairns, 1977; Nicholls, 1989). Important feeding areas include intertidal portions of ocean beaches, washover areas, mudflats, sand flats, wrack lines, sparse vegetation, and shorelines of coastal ponds, lagoons, or salt marshes (Gibbs, 1986; Coutu et al., 1990; Hoopes et al., 1992; Loegering, 1992; Goldin, 1993a; Elias-Gerken, 1994). 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, 1990). Feeding activities of chicks are particularly important to their survival. Most time budget studies reveal that chicks spend a high proportion of their time feeding. Cairns (1977) found that piping plover chicks typically tripled their weight during the first two weeks post-hatching; chicks that failed to achieve at least 60 percent of this weight gain by the twelfth day were unlikely to survive.

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 common. Feeding activities of both adults and chicks may occur during all hours of the day and night (Staine and Burger, 1994), and at all stages in the tidal cycle (Goldin, 1993a; Hoopes, 1993).

Both spring and fall migration routes of Atlantic Coast breeders are believed to occur primarily within a narrow zone along the Atlantic Coast (USFWS, 1996a). Some mid-continent breeders travel up or down the Atlantic Coast before or after their overland movements (Stucker and Cuthbert, 2006); use of inland stopovers during migration is also documented (Pompei and Cuthbert, 2004).

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 (Hecht, 2006a, pers. comm.). The pattern of both fall and spring counts at many Atlantic Coast sites demonstrates that many piping plovers make intermediate stopovers lasting from a few days up to one month during their migrations (CALO, 2003; Noel et al., 2005; CAHA, 2006; Stucker and Cuthbert, 2006). In addition, this species exhibits a high degree of both intra- and inter-annual wintering site fidelity (Drake et. al., 2001; Noel et al., 2005; Stucker and Cuthbert, 2006).

A growing body of information shows that overwash-created and -perpetuated habitats, including accessible bayside flats, unstabilized and recently healed inlets, and moist sparsely vegetated barrier flats, are especially important to piping plover productivity and carrying capacity in the New York-New Jersey and Southern recovery units.

In New Jersey, Burger (1994) studied piping plover foraging behavior and habitat use at three sites that offered the birds: ocean, dune, and backbay habitats. The primary focus of this study was on the effect of human disturbance on habitat selection, and it found that both habitat selection and foraging behavior correlated inversely with the number of people present. In the absence of people on an unstabilized beach, plovers fed in ocean and bayside habitats in preference to the dunes. Burger concludes that protection of the entire beach ecosystem with high habitat diversity will help mitigate competition with human beach recreation.

Loegering and Fraser (1995) found that chicks on Assateague Island, Maryland that were able to reach bay beaches and the island interior had significantly higher fledgling rates than those that foraged solely on the ocean beach. Higher foraging rates, percentage of time spent foraging, and abundance of terrestrial arthropods on the bay beach and interior island habitats supported their hypothesis that foraging resources in interior and bayside habitats are key to reproductive rates on that site. Their management recommendations stressed the importance of sparsely vegetated cross-island access routes maintained by overwash, and the need to restrict or mitigate activities that reduce natural disturbance during storms.

Dramatic increases in plover productivity and breeding population on Assateague since the 1991-92 advent of large overwash events corroborate Loegering and Fraser's conclusions. Piping plover productivity, which had averaged 0.77 chicks per pair during the five years before the overwash, posted an average of 1.67 chicks/pair in 1992-96. The nesting population on the northern five miles of the island also grew rapidly, doubling by 1995 and tripling by 1996, when 61 pairs nested there (MacIvor, 1996). Habitat use is primarily on the interior and bayside.

In Virginia, Watts et al. (1996) found that piping plovers nesting on 13 barrier islands between 1986 and 1988 were not evenly distributed along the islands. Beach segments used by plovers had wider and more heterogeneous beaches, fewer stable dunes, greater open access to bayside foraging areas, and in proximity to mudflats. They note that characteristics of beaches selected by plovers are maintained by frequent storm disturbance.

At CALO, 32 to 39 pairs of plovers nested on North and South Core Banks each year between 1992 and 1998. While these unstabilized barrier islands total 47 miles long, nesting distribution is patchy, with all nests clustered on the dynamic ends of the barrier islands, recently closed and sparsely vegetated "old inlets," expansive barrier mudflats, or new ocean-to-bay overwashes. During a 1990 study, 96 percent of brood observations were on bay tidal flats, even though broods had access to both bay and ocean beach habitats (McConnaughey et al., 1990).

At Cape Hatteras National Seashore, distribution of nesting piping plovers is also "clumped," with nesting areas characterized by a wide beach, relatively flat intertidal zone, brackish ponds, and temporary pools formed by rainwater and overwash (Coutu et al., 1990).

Notwithstanding the importance of bayside (soundside) flats, ephemeral pools, and sparsely vegetated barrier flats for piping plover nest site selection and chick foraging, ocean inter-tidal zones are used by chicks of all ages, even in the southern portion of the Atlantic Coast breeding range. Between 1993 and 1996 on the Maryland end of Assateague Island, for example, four to 12 percent of annual observations (n = 368 to 599) of plover broods occurred on the ocean beach (NPS and Maryland DNR, 1993-1996). A three-year study of piping plover chick foraging activity at six sites on four Virginia barrier islands (Cross and Terwilliger, 2000) documented chick use of the ocean intertidal zone at three of six study sites. Furthermore, the total observations at the three sites where chicks were not observed in the ocean intertidal zone had fewer total observations. Intensive observations at Chincoteague National Wildlife Refuge Overwash Zone in 1994, where chicks had unimpeded access to a large, quality undisturbed bayside flat, documented occasional (1 to 5) visits to the ocean intertidal zone by six of eleven broods ranging in age from one to 24 days (Hecht, 2004, in litt.).

*Factors affecting the Piping plover during its life cycle*

Predation has been identified as a major factor limiting piping plover reproductive success at many Atlantic Coast sites (Burger, 1987a; MacIvor, 1990; Cross, 1991; Patterson et al., 1991; Elias-Gerken, 1994). As with other limiting factors, the nature and severity of predation is highly site specific. Predators of piping plover eggs and chicks include foxes, skunks, raccoons, rats, opossums, crows, gulls, grackles, American kestrels, domestic and feral dogs and cats, and ghost crabs.

Substantial evidence exists that human activities are affecting types, numbers, and activity patterns of predators, thereby exacerbating natural predation. Non-native species such as feral cats and rats are considered significant predators on some sites (Goldin et al., 1990; Post, 1991). Humans have also indirectly influenced predator populations; for instance, human activities abetted the expansions in the populations and/or range of other species such as gulls (Drury, 1973; Erwin, 1979). Strauss (1990) found that the density of fox tracks on a beach area was higher during periods of more intensive human use.

Predation and nest abandonment because of predators have been implicated as a cause of low reproductive success (Cooper, 1990; Coutu et al., 1990; Kuklinski et al., 1996). Predator trails (of foxes, dogs, and cats) have been seen around areas of the last known location of piping plover chicks. Predatory birds also are relatively common during their fall and spring migration along the Atlantic Ocean coastline, and there is a possibility they may occasionally take piping plovers.

Piping plover habitats (breeding and non-breeding) are dependent on natural forces of creation and renewal. However, storms and severe cold weather are believed to take their toll on piping plovers. After an intense snowstorm swept the entire North Carolina coast in late December 1989, high mortality of many coastal bird species was noted (Fussell, 1990). Piping plover numbers decreased significantly from about 30 to 40 birds down to 15 birds. While no dead piping plovers were found, circumstantial evidence suggests that much of the decrease was mortality (Fussell, 1990). Hurricanes may also result in direct mortality or habitat loss, and if piping plover numbers are low enough or if total remaining habitat is very sparse relative to historical levels, population responses may be impaired even through short-term habitat losses. Wilkinson and Spinks (1994) suggest that, in addition to the unusually harsh December 1989 weather, low plover numbers seen in South Carolina in January 1990 (11 birds, compared with more than 50 during the same time period in 1991 to 1993) may have been influenced by effects on habitat and food availability caused by Hurricane Hugo which came ashore there in September 1989. Hurricane Elena struck the Alabama Coast in September 1985 and subsequent surveys noted a reduction of foraging intertidal habitat on Dauphin and Little Dauphin Islands (Johnson and Baldassarre, 1988). Birds were observed foraging at Sand Island, a site that was used little prior to the hurricane.

Unrestricted use of motorized vehicles on beaches is a serious threat to piping plovers and their habitats. Vehicles can crush eggs (Wilcox, 1959; Tull, 1984; Burger, 1987b; Patterson et al., 1991; Shaffer and Laporte, 1992) as well as adults and chicks. Plover nests and eggs are particularly vulnerable to destruction during the 6 to 7 day egg-laying phase prior to initiation of full-time incubation. However, the mobility of newly hatched chicks and adults does not lessen the susceptibility to destruction by vehicles. For example, 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; Melvin, 2006b, pers. comm.).

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.

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 1,500 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 (Hecht, 2006b, in litt.). 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 (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 ¼ mile of all unfledged broods (Schroer, 2000, in litt.).

Vehicles also significantly degrade piping plover habitat or disrupt normal behavior patterns. They may harm or harass plovers by crushing wrack into the sand and making it unavailable as cover or a foraging substrate (Hoopes et al., 1992; Goldin, 1993b), by creating ruts that can trap or impede movements of chicks (Jacobs, 1988, in litt.), 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). Vehicular and/or pedestrian disturbance that reduces plover use and/or impairs their foraging efficiency on soundside tidal flats is particularly injurious. Multiple studies have shown that bay tidal flats have relatively high indices of arthropod abundance compared with other microhabitats, that piping plover chick peck rates on bay tidal flats are higher than in other microhabitats, and that piping plovers select these habitats in greater proportion than their availability (Loegering and Fraser, 1995; Cross and Terwilliger, 2000; Elias et al., 2000; Houghton, 2005). Zonick (2000) found that ORV density negatively correlated with abundance of roosting plovers on the ocean beach. Studies elsewhere (e.g., Wheeler, 1979) demonstrate adverse effects of ORV driving on soundside beaches on the abundance of infauna essential to piping plover foraging requirements.

Lighting may also negatively affect piping plovers. While the extent that artificial lighting (including vehicle lights) affects piping plovers is unknown, there is evidence that American oystercatcher (*Haematopus palliatus*) chicks and adults are attracted to vehicle headlights and may move toward areas of ORV activity. During a 2005 study at CALO, adult and chick oystercatchers were observed running or flying directly into the headlights of oncoming vehicles, and two two-day old oystercatcher chicks were run over by an all-terrain vehicle after being observed foraging with the adults near the high tide line at night (Simons et al., 2005).

Pedestrian and non-motorized recreational activities can be a source of both direct mortality and harassment of piping plovers. There are a number of potential sources for pedestrians on the beach, including 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. Essentially, the magnitude of threats to coastal species 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 only.

Pedestrians on beaches may crush eggs (Burger, 1987b; Hill, 1988; Shaffer and Laporte, 1992; CACO, 1993; Collazo et al., 1994), or flush plovers from nests exposing their eggs to predators. Concentrations of pedestrians may also 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 2 acres of beach. Elias-Gerken (1994) found that piping plovers on Jones Beach Island, New York, selected beachfront that had less pedestrian disturbance. Sections of beach at Trustom Pond National Wildlife Refuge in Rhode Island were colonized by piping plovers within two seasons of their closure to heavy pedestrian recreation. 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, exposing eggs to avian predators or excessive temperatures.  Repeated exposure of shorebird eggs on hot days may cause overheating, killing the embryos (Bergstrom, 1991); 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.  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.

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 al., 1992).

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 significantly greater than that caused by pedestrians (Hoopes, 1993).  Unleashed dogs may chase plovers (McConnaughey et al. 1990), destroy nests (Hoopes et al. 1992), and kill chicks (Cairns and McLaren 1980; Boyagian, 1994, in litt.).

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 Massachusetts (Melvin and Gibbs, 1996, cited in Appendix E, USFWS, 1996a), 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; management must focus simultaneously on all sources of stress on the population within management control (predators, ORVs, etc.).

***Seabeach amaranth***

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. 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).

*Factors affecting the Seabeach amaranth during its life cycle*

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 herbivory affects the plant 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.

***Loggerhead sea turtle***

Loggerheads are known to nest on average about four times within a nesting season, ranging from one to seven times (Talbert et al., 1980; Lenarz et al., 1981; Richardson and Richardson, 1982; Murphy and Hopkins, 1984). The interval between nesting varies around a mean of about 14 days (Dodd, 1988). Mean clutch size varies from about 100 to 126 eggs per nest along the southeastern U.S. coast (NMFS and USFWS, 1991b). The loggerhead returns at intervals of two to three years, but the number can vary from one to seven years (Dodd, 1988). Age at sexual maturity is believed to be about 20 to 30 years (Turtle Expert Working Group, 1998).

***Green sea turtle***

Green turtles deposit from one to nine clutches within a nesting season, but the overall average is about 3.3. The interval between nesting 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 to four years intervene between breeding seasons (NMFS and USFWS, 1991a). Age at sexual maturity is believed to be 20 to 50 years (Hirth, 1997).

***Leatherback sea turtle***

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 101 eggs on Hutchinson Island, Florida (Martin, 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).

***Hawksbill sea turtle***

Hawksbills nest on average about 4.5 times per season at intervals of about 14 days (Corliss et al., 1989). In Florida and the U.S. Caribbean, clutch size is about 140 eggs, although records exist of over 200 eggs per nest (NMFS and USFWS, 1993). On the basis of limited information, hawksbills return at intervals of about every two to three years. Hawksbills are recruited into the reef environment at about 13.8 inches in length and are believed to begin breeding about 30 years later. However, the time required to reach 13.8 inches in length is unknown and growth rates vary geographically. As a result, actual age at sexual maturity is not known.

***Kemp's ridley sea turtle***

Nesting occurs from April into July during which time the turtles appear off the Tamaulipas and Veracruz coasts of Mexico. Precipitated by strong winds, the females gather to form mass nesting emergences, known locally as *arribadas* or *arribazones*, to nest during the daylight hours. Clutch size averages 100 eggs (USFWS and NMFS, 1992). Some females breed annually and nest an average of one to four times in a season at intervals of 10 to 28 days. Age at sexual maturity is believed to be between seven and 15 years (Turtle Expert Working Group, 1998).

*<u>Factors affecting sea turtles during portions of their life cycle</u>*

Artificial lighting is one of the most significant impacts on sea turtle survival, especially of post-emergent hatchlings (Mann, 1977; Ehrhart and Witherington, 1987; Witherington, 1992). Visual cues 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 show a tropotactic response to light upon emergence, so that any visual stimulus in the field of vision has some effect on the direction chosen by the hatchlings (Mrosovsky, 1970). Hatchlings instinctively orient to the brightest horizon, which, in the absence of artificial lights, is usually the ocean horizon. It is possible to attract hatchlings out of the surf with a bright light demonstrating the importance of light stimulus in hatchling behavior (Carr and Ogren, 1960; Ehrhart and Witherington, 1987).

Artificial lighting cues can cause misorientation (hatchlings travel along a consistent course toward a light source) or disorientation (hatchlings are not able to set a particular course and wander aimlessly) (Philibosian, 1976; Mann, 1977; Witherington, 1990). Hatchlings are frequently attracted to point source lights on buildings and roadways in urban areas (McFarlane, 1963; Philibosian, 1976; Mann, 1978; Witherington, 1992). Urban areas may also have a non-point source nighttime glow which may disorient hatchlings from otherwise dark sections of beach (Witherington, 1993; Tuxbury and Salmon, 2005). Light intensities from sky measurements taken on the beach can be higher than the ocean horizon (Salmon et al., 1995a).

Once disoriented, turtles often enter conflicting light environments as they head landward. As hatchlings approach buildings and roads (including off-road vehicle corridors), they encounter obstacles that may screen the source of artificial light (Salmon et al., 1995b). They may then re-orient themselves correctly toward the ocean or continue along the obstruction (seawall, deep ruts, buildings) until they can see the original or perhaps another source of artificial light. If the obstructions are high enough and continuous enough to prevent the hatchlings from leaving the beach, the lightening sky as sunrise approaches often becomes a dominant influence and attracts the hatchlings to the surf. Mann (1977) also found that most turtles in artificial light-dominated areas oriented correctly on brightly moonlit nights. On moonless nights, hatchlings were more easily disoriented by artificial lights.

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, ranging from a mild misorientation of a few hatchlings to a strong disorientation of a whole clutch resulting in mortality for many hatchlings (Salmon et al., 1995a; Witherington et al., 1996).

Both Mann (1977) and Ehrhart and Witherington (1987) found high mortality in the emergences where the majority of the hatchlings were strongly disoriented. If the hatchlings do not manage to enter the surf, they may enter the vehicle corridor where they are subject to being run over, trapped in tire ruts and become vulnerable to predators, or become irretrievably lost from finding their way to the surf. The protracted wanderings of disoriented hatchlings also lengthens the time they are susceptible to predation from raccoons, ghost crabs, seabirds, fish crows, night herons and possibly dogs and cats. The prolonged exposure can exhaust and/or dehydrate the turtles to the point of death or limit their chance of survival once in the water. Weakened hatchlings that eventually reach the water may be more vulnerable to marine predators, which are abundant in nearshore waters (Wyneken et al., 1994).

In addition, research has also documented significant reduction in sea turtle nesting activity on beaches illuminated with artificial lights (Witherington, 1992). Therefore, vehicle lights may deter females from coming ashore to nest or disorient females trying to return to the surf after a nesting event. However, artificial lighting does not appear to be as problematic for nesting adult female sea turtles. They seem to use a straight-ahead method to select a nest site. They do not appear to be affected as much by artificial beachfront lights along the beach as they are by bright lights immediately in front of them upon emerging (Salmon et al., 1995b; Witherington, 1992). Distant point sources and urban glow are more likely to affect hatchlings than adult females (Salmon et al., 1995b). The effects of lights on the female's decision of where to emerge (i.e., pre-emergent effects) remain unknown.

Hurricanes, tropical storms, and/or interactions between low and high pressure systems during late summer and fall on the east coast of the U.S. create conditions that often result in beach erosion and the subsequent loss of sea turtle nests. Nests may be washed out or inundated long enough to result in egg mortality. From 1999 to 2004, about 25 (range 1 to 52) nests were lost per year to flooding and/or washout. In the last several years, numerous hurricanes and tropical storms have resulted in substantial impacts to the coastal environment along most of the eastern United States. Erosion resulted in a reduction of beach profile in some areas and an accretion of sand in others. High tides and storm surges from these tropical systems overwashed, washed out, buried, or inundated sea turtle nests. Due to nesting chronology, most of the nests lost to storm events will be loggerhead and a few green sea turtle nests. Leatherback sea turtles typically nest earlier in the season and most, if not all, nests have hatched prior to the peak of the tropical storm season.

The use of ORVs on sea turtle nesting beaches can adversely affect the egg, hatchling, and nesting life stages sea turtles. Vehicles can directly impact sea turtles by running over nesting females and hatchlings making their way to the ocean; crushing nests; deterring females from nesting and approaching nesting beaches; and, changing the beach profile and nesting habitat (e.g., compacting sand making nest excavation difficult, producing ruts in the sand that trap hatchlings, and creating escarpments that prevent females from accessing the beach).

Nesting females and hatchling sea turtles can be killed or nests can be crushed when run over by ORVs. Vehicles on beaches, especially during night hours, run the risk of striking adult females emerging on the beach to nest or hatchlings making their way towards the surf after emerging from the nest (National Research Council, 1990). Both marked and unmarked nests run the risk of being crushed by vehicle use within the nesting areas (typically above the high tide line).

Driving on dune systems alters beach habitat for turtle nesting. Nesting turtles appear to show a preference for their nesting sites (Carr and Carr, 1972; Provancha and Ehrhart, 1987). Vehicles change the character of the beach profile (Hosier and Eaton, 1980), thus increasing the chance of unsuitable nesting habitat for turtles and reducing the number of nests laid and/or hatchlings produced. Erosion can increase in areas with vehicular traffic (National Research Council, 1990), which can create escarpments that prevent females from reaching the nesting area of the beach or act as obstacles to hatchlings trying to reach the ocean. Erosion can also expose nests which are already incubating.

Ruts caused by ORVs reduce the number of hatchlings that make it to the ocean (Lamont et al., 2002). The ruts act as barriers which trap hatchlings making them prone to desiccation and predation. Live and desiccated turtles have been observed in deep vehicle ruts (LeBuff, 1990). The ruts can also act as pathways, leading hatchlings away from the ocean. Upon encountering a vehicle rut, hatchlings may be disoriented along the vehicle track, rather than crossing over it to reach the water. Apparently, hatchlings become diverted not necessarily because they cannot physically climb out of the rut (Arianoutsou, 1988; 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). If hatchlings are detoured along vehicle ruts, they are at greater risk to vehicles, predators, fatigue, and desiccation. However, hatchling turtles also have a greater probability of overturning when they have to maneuver over ruts in the sand (Hosier, 1981; Hosier et al., 1981), which can expose them to desiccation and predation. 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.

Sand compaction resulting from ORVs may increase the length of time required for female sea turtles to excavate nests. 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). This may cause increased physiological stress to the animals (Nelson and Dickerson, 1988a; 1988b). Compression of sand by vehicles also causes reduced hatching success of loggerhead turtle nests (Mann, 1977). Nesting areas with vehicle traffic have a lower hatchling emergence due to egg chamber cave-ins, making it harder for hatched turtles to emerge to the surface (Mann, 1977). Mortality while hatching out of eggs is also higher on beaches open to public access than beaches with restricted access (Kudo et. al., 2003). In addition, gas exchange within the nest and eggs may be a factor in reducing nest success in compacted areas (Ackerman, 1980). Hatching success was reduced on beaches with beach cleaning/raking machinery (Mann, 1977); sand compaction and nest exposure resulting from beach cleaning/raking were thought to be the main causes for the decline.

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, 2005a). 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). Our 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, 2005a), 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. Thus, while the results of the combined area comparison of nesting success may lead us to conclude sand compaction does not affect nesting success, we remain cautious of these results considering the lack of control over other obviously important variables. Available data are insufficient to draw meaningful conclusions on the effects of sand compaction resulting from vehicle use of the beach on sea turtle nesting success.

Average hatching success (hatchlings produced from a nest) and emerging success (hatchlings making it to the beach surface) 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, 2005a). 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, we 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, 2005a). Thus, from this analysis we can conclude 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.

Pedestrian traffic on the beach can have a wide variety of adverse affects on sea turtles. People often walk on beaches at night seeking encounters with nesting female sea turtles. These interactions can intentionally or unintentionally interfere with the successful excavation of a nest chamber and/or deposition of eggs and may result in abandonment of nesting attempts (Johnson et al., 1996; McFarlane, 1963). Once a turtle leaves the beach, she may return to the same location or select a new site later that night or the following night. However, repeated interruption of nesting may cause a turtle to construct her nest in a sub-optimum incubation environment, postpone nesting for several days, prompt movement many miles from the original chosen nesting site, and bring about the turtle shedding her eggs at sea (Murphy, 1985). Additionally, pedestrians may also walk over deposited nests. Studies of pedestrian impacts on loggerhead sea turtle nests in Japan have shown that beaches with full pedestrian access have significantly lower emergence success, compared to nests laid on beaches with restricted pedestrian access (Kudo et al., 2003). The full extent to which nighttime beach use by humans may affect sea turtles and their nesting habitat is not known.

Increased pedestrian use increases the amount of trash left behind on the beach. This waste becomes a threat to hatchlings and adult turtles on the beach and in the water. Sea turtles ingest waste products, especially plastics, due to their resemblance of jellyfish, a turtle food source (National Research Council, 1990). Bugoni et al. (2001) found as much as 60 percent of the turtles investigated had ingested marine debris. Between five and 10 percent of stranded sea turtles in North Carolina whose gastro-intestinal tracts were investigated had ingested some anthropogenic debris (NCWRC, 2006a). Beach trash can also impede the movement of hatchlings to the ocean.

Dogs running freely on beaches have been identified as potential predators of eggs, hatchlings and even adult sea turtles (Dodd, 1988; Santos and Godfrey, 2001). Unleashed dogs have been observed digging into nests (NCWRC, 2006a).

## C. Population dynamics

### *Piping plover*

#### Great Lakes Population

The Great Lakes plovers once nested on Great Lakes beaches in Illinois, Indiana, Michigan, Minnesota, New York, Ohio, Pennsylvania, Wisconsin, and Ontario, Canada. Russell (1983) reviewed historical records to estimate the pre-settlement populations of the plover throughout this range. While estimates may be high for some Great Lakes states, no other historic estimates are available. Total population estimates ranged from 492 to 682 breeding pairs in the Great Lakes region; Michigan alone may have had the most with as many as 215 pairs.

Northern Great Plains Population

The Northern Great Plains plover breeds from Alberta to Manitoba, Canada and south to Nebraska; although some nesting has recently occurred in Oklahoma. Currently the most westerly breeding piping plovers in the United States occur in Montana and Colorado.

The decline the Northern Great Plains population has been attributed to the construction and operations of dams on rivers that result in the loss of sandbar habitat. Reservoirs created by the dams have flooded much of the rivers' natural sandbar habitats, although birds can use shorelines of reservoirs where appropriate substrates exist. However, unless reservoirs are managed to preclude vegetation in some years nesting habitat is minimized. Dam operations for purposes other than plover nesting may cause sandbar/island habitat inundation or flooding of nests. Too much water in the spring floods nests; whereas, dams operated with steady constant flows over a long period allows grasses and other vegetation to grow on the prime nesting islands, making these sites unsuitable for successful nesting. Population declines in alkali wetlands are attributed to wetland drainage, contaminants, and predation.

Atlantic Coast Population

The Atlantic Coast piping plover breeds on coastal beaches from Newfoundland and southeastern Quebec, Canada to North Carolina. The Atlantic Coast population has increased from 790 pairs since listing to a preliminary estimation of 1,632 pairs in 2005 (USFWS, 2006). However, it is important to note that the increase is unevenly distributed, with most pairs occurring in New England, and can be partially attributed to increased survey efforts, especially in the southern half of the species range (Service, 1996a). From 1986 to 1994, the Southern recovery unit increased from 158 to 217 nesting pairs, and then declined to 182 pairs in 1999. The Southern recovery unit is currently estimated to include 300 nesting pairs. The recovery objective for the Atlantic Coast population and the Southern recovery unit is 2,000 and 400 breeding pairs, respectively (Service, 1996a).

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 (e.g., see Table 4, USFWS, 1996a). 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). Further, recent experience of biologists surveying piping plovers has shown that counts of these cryptically colored birds sometimes go up with increased census effort; suggesting that some historic counts of piping plover numbers by one or a few observers, who often recorded occurrences of many avian species simultaneously, may have underestimated the piping plover population. Thus, the magnitude of the species decline may have been more severe than available numbers imply.

Species as a whole

As of 2001, census results indicate that 5,938 breeding pairs are distributed from Alberta, Canada to the Atlantic Coast. Total population numbers have fluctuated over time with some areas experiencing increases and others decreases. Fluctuations are predominately due to the location, quality, and extent of suitable breeding and foraging habitat that may vary over time due to regional rainfall and anthropogenic hydrologic manipulation. Fluctuations could also represent unequal survey efforts or localized conditions during surveys. For example, the apparent increase in numbers of pairs in the Atlantic Coast population between 1986 and 1989 is thought, at least partially, to reflect the effects of increased survey efforts following the proposed listing in 1985.

***Seabeach amaranth***

The USFWS has sporadic survey data for seabeach amaranth going back to 1987. However, systematic range-wide surveys for seabeach amaranth surveys only began in 2000, and since then, we have a fairly complete data set from New York, New Jersey, Delaware, Maryland, Virginia, North Carolina, and South Carolina. Furthermore, we have 10 consecutive years of data from two states, New York and North Carolina. We anticipate systematic surveys to continue in all states within the species current extant range, and occasional surveys in Rhode Island and Massachusetts incidental to beach-nesting bird management. In general, seabeach amaranth total numbers for all states have been higher since the species was listed in 1993, than before listing. This could be attributed to increased awareness about the rarity of this species, additional people recognizing the plant and reporting locations to Natural Heritage Programs and the USFWS, additional surveys specifically targeting seabeach amaranth, the initiation of measures to protect natural populations, section 7 consultations requiring protection of the species, and reintroduction and habitat restoration projects.

Given the fugitive nature of the species and the constantly changing environment where it occurs, it is difficult to make determinations about population size or trends based limited data from annual surveys. For example, total seabeach amaranth numbers reported in 2004 rangewide surveys were lower than reports from any year since 1999. However, because seabeach amaranth is an annual species and it occurs exclusively in a constantly changing environment, the number of individual plants may increase or decrease greatly from year to year.

***Loggerhead sea turtle***

Total estimated nesting in the southeastern U.S. is about 68,000 to 90,000 nests per year (FFWCC, 2006a; GDNR, 2006; NCWRC, 2006a; SCDNR, 2006). In 1998, 85,988 nests were documented in Florida alone. However, in 2001, 2002, 2003, 2004, and 2005, this number dropped to 69,657, 62,905, 56,852, 47,173, and 52,467, respectively. An analysis of nesting data from the Florida Index Nesting Beach Survey (INBS) Program from 1989 to 2005, a period encompassing index surveys that are more consistent and more accurate than surveys in previous years, detected no significant trend in annual loggerhead nesting in Florida (FFWCC, 2006b). Of some concern, however, is the fact that a similar analysis of data from 1989-2000 indicated an increasing trend in loggerhead nesting. The disparity between these findings suggests that declines in nesting over the past five years have been substantial, but not of sufficient magnitude to result in a downward trend in the long-term dataset.

Standardized monitoring of nearly all ocean facing beaches in North Carolina was implemented in the mid-1990s. Data collected to date on annual numbers of nests in North Carolina are insufficient to detect a trend. An analysis of a longer-term dataset available for several nesting beaches in the southern reach of North Carolina showed that there was no increasing or decreasing trend in annual nest numbers (Hawkes et al., 2005). The implications of the recent declines in loggerhead nesting in the conservation and recovery of this species are not known. Additional, long-term nesting data are needed to determine whether current declines in nesting are part of the inherent variability in sea turtle nesting patterns or the result of other factors.

From a global perspective, the southeastern U.S. nesting aggregation is of importance to the survival of the species and is second in size only to that which nests on islands in the Arabian Sea off Oman (Ross, 1982; Ehrhart, 1989; NMFS and USFWS, 1991b). 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 interactions on foraging grounds and migration routes (Possardt, 2005, in litt.). The loggerhead nesting aggregations in Oman, the southeastern U.S., and Australia have been estimated to account for about 88 percent of nesting worldwide (NMFS and USFWS, 1991b). About 80 percent of loggerhead nesting in the southeastern U.S. occurs in six Florida counties (Brevard, Indian River, St. Lucie, Martin, Palm Beach, and Broward Counties) (NMFS and USFWS, 1991b).

***Green sea turtle***

About 150 to 2,750 females nest on beaches in the continental U.S. annually. In the U.S. Pacific, over 90 percent of nesting throughout the Hawaiian archipelago occurs at the French Frigate Shoals, where about 200 to 700 females nest each year (NMFS and USFWS, 1998a). Elsewhere 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 tens of 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).

***Leatherback sea turtle***

Recent estimates of global nesting populations indicate 26,000 to 43,000 nesting females annually (Spotila et al., 1996). The largest nesting populations at present occur in the western Atlantic Ocean in Trinidad and Suriname/French Guiana (4,500 to 7,500 females nesting/year) and in the eastern Atlantic Ocean in Gabon (Billes et al., 2000). In the U.S., small nesting populations occur on the Florida east coast (100 to 170 females/year) (FFWCC, 2006a), Sandy Point, U.S. Virgin Islands (100 to 190 females/year) (Alexander et al., 2004; Dutton et al., 2005; West Indies Marine Animal Research and Conservation Service, 2005), and Puerto Rico (100 to 200 females/year).

***Hawksbill sea turtle***

About 15,000 females are estimated to nest each year throughout the world with the Caribbean accounting for 20 to 30 percent of the world's hawksbill population. Only five regional populations remain with more than 1,000 females nesting annually (Seychelles, Mexico, Indonesia, and two in Australia) (Meylan and Donnelly, 1999). Mexico is now the most important region for hawksbills in the Caribbean with about 3,000 nests per year (Meylan, 1999). Other significant but smaller populations in the Caribbean still occur in Guadeloupe, Martinique, Jamaica, Guatemala, Nicaragua, Grenada, Dominican Republic, Turks and Caicos Islands, Cuba, Puerto Rico, and U.S. Virgin Islands. In the U.S. Caribbean, about 150 to 500 nests per year are laid on Mona Island, Puerto Rico, and 70 to 130 nests per year on Buck Island Reef National Monument, U.S. Virgin Islands. In the U.S. Pacific, hawksbills nest primarily on main-island beaches in Hawaii, mostly along the east coast of the island of Hawaii. Hawksbill nesting has also been documented in American Samoa and Guam (NMFS and USFWS, 1998b).

***Kemp's ridley sea turtle***

The 40,000 nesting females estimated from a single mass nesting emergence in 1947 reflected a much larger total number of nesting turtles in that year than exists today (Carr, 1963; Hildebrand, 1963). However, nesting in Mexico has been steadily increasing in recent years, from 702 nests in 1985 to more than 10,000 nests in 2005 (USFWS, 2005b). Despite protection for the nests, turtles have been and continue to be lost to incidental catch by shrimp trawls (USFWS and NMFS, 1992).

## D. Status and distribution

***Piping plover***

Piping plovers breed in three discrete areas of North America – the northern Great Plains, Great Lakes, and the Atlantic Coast. The northern Great Plains population historically bred from Alberta to Ontario, Canada, south to Kansas and Colorado. The Great Lakes population once ranged throughout the region, but recent nesting records are limited to Michigan and Wisconsin. Atlantic coast breeding sites are found from Newfoundland, Canada, south to North Carolina. Breeding sites are typically found on islands, lakeshores, coastal shorelines, and river margins (USFWS, 1996a; 2003a). Atlantic Coast piping plovers nest on barrier islands and coastal beaches including sand flats at the ends of sand spits, gently sloped foredunes, sparsely vegetated dunes, and washover areas cut into or between dunes.

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 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, 1990). 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, 1990). 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).

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).

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.

Populations of piping plovers have declined from historic numbers. Unregulated hunting drove plovers to near extinction in the early 1900s, but protective legislation resulted in population recovery by the mid-1920s. However, piping plover numbers declined again in the 1940s and 1950s due to shoreline development. River flow alteration, channelization, and reservoir construction also contributed to declines during this period. When listed, the Great Lakes population numbered only 17 known breeding pairs that nested in northern Michigan. Gradual increases in this population have been documented since listing and these birds are now known to have expanded to the south and west (USFWS, 2003a). The Atlantic Coast breeding population has also experienced an overall increase since listing, but these increases are regionally variable with some areas continuing to experience population declines (USFWS, 1996a). The northern Great Plains breeding population continues to decline.

The endangered Great Lakes population is at a low level. From an all-time low of 12 nesting pairs in 1990, the population has increased to 58 nesting pairs in 2005. During this period most nesting occurred in Michigan, but in at least one pair has nested along the Lake Superior shoreline in Wisconsin. 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, and crows. Shoreline development, such as the construction of marinas and breakwaters, has adversely affected nesting and brood rearing.

The birds of the Northern Great Plains population nest from Alberta to Manitoba in Canada southward to Nebraska. Nesting occurs on sand flats or bare shorelines of rivers and lakes, including bare areas on islands in the upper Missouri River system, and patches of sand, gravel, or pebbly-mud on the alkali lakes of the northern Great Plains. Breeding surveys in the early 1980s reported 2,137 to 2,684 adult plovers in the northern Great Plains/Prairie region (Haig and Oring, 1985). In 1991, 2,032 adult plovers were observed in the U.S. portion of the northern Great Plains (Haig and Plissner, 1993). The number declined to 1,599 in 1996 (Plissner and Haig, 1997), a reduction of 21 percent from 1991. Part of this reduction was likely an artifact of increased numbers of plovers nesting in Canada in 1996, due to high water levels in the U.S. (Plissner and Haig, 1997). Overall there were an estimated 1486 northern Great Plains nesting pairs in the U.S. and Canada in 1991. In 2001, 1,981 adult plovers were observed from the U.S. portion of the northern Great Plains. The fluctuations in numbers between 1996 and 2001 appear to reflect a relationship with the birds in prairie Canada, but this time the relationship was inverse. Overall, there were an estimated 1291 northern Great Plains nesting pairs in the U.S. and Canada in 2001. Current estimates of piping plover survival rates are limited, but most mortality was thought to occur during migration or on wintering grounds (Root et al., 1992). The decline of this population has been attributed to the construction of reservoirs that result in the loss of sandbar habitat. Plovers also can be harmed by artificial changes in water level due to dams and other water control structures. Too much water in the spring floods nests. Too little water over a long period allows grasses and other vegetation to grow on the prime nesting beaches, making these sites unsuitable for successful nesting. Population declines in alkali wetlands are contributed to wetland drainage, contaminants, and cattle grazing.

The Atlantic Coast population of piping plovers has increased from 790 nesting pairs in 1986 to

1,668 nesting pairs in 2004 (preliminary estimates; USFWS, 2006). However, it is important to note that the increase is very unevenly distributed (mostly in New England), and can be partially attributed to increased survey effort in two states. While rapid overall Atlantic Coast population growth between 1991 and 1995, driven largely by the New England subpopulation, was encouraging, growth in the later half of the decade was more modest, with an essentially flat population trend from 1996 to 2000. Since 1986 (through the 2005 nesting season), the New England recovery unit has increased 446 pairs, while the New York-New Jersey recovery unit gained 271 pairs. The Southern recovery unit gained 142 pairs (Virginia and Maryland alone accounted for 138 of the pairs), while the Atlantic Canada recovery unit has gained only 5 pairs (through the 2004 nesting season). Substantially higher productivity rates have been observed in New England than elsewhere in the population's range. The Southern subpopulation has averaged about 198 pairs per year (range 158 to 300 pairs) between 1986 and 2005, which is only 49.5 percent of the recovery objective. Recovery of the Atlantic Coast population is occurring but appears to be dependent on an extremely intensive annual protection and monitoring effort.

Much of the plover's historic habitat along the Atlantic Coast has already been destroyed or permanently degraded by development and human use. The construction of houses and commercial buildings on and adjacent to barrier beaches directly removes plover habitat and results in increased human disturbance. Additional disturbance comes in the form of recreational use of beach habitats. The impacts of shoreline development are often greatly expanded by the attendant concerns for protecting access roads, which often provide greater access for recreationists. While legal restrictions on coastal development may slow the future pace of physical habitat destruction, the trend in habitat availability for this species is inexorably downward. Furthermore, habitat availability for the species is compromised by the ever increasing human access to, and recreational use of, these coastal habitats. The decrease in habitat availability, especially with regard to the dynamic nature of these coastal areas, may force birds to nest in suboptimal habitats, the effects of which could manifest itself in poor future reproductive success.

The decrease in the functional suitability of the plover's habitat due to accelerating recreational activity on the Atlantic Coast may impact productivity. Functional habitat loss occurs when suitable nesting sites are made unusable because high human and/or animal use precludes the birds from successfully nesting. Population growth along both the U.S. and Canadian coasts fosters an ever increasing demand for beach recreation. In 2004, about 30 percent of the U.S. Atlantic Coast population of piping plovers nested on federally owned beaches where at least some protection can be afforded under section 7 of the Endangered Species Act. The remaining 70 percent of the birds nested on state, town, or privately-owned beaches where they face increasing disturbance from recreationists and development. Unfortunately for the piping plover, recreational activities and public use of federally owned beaches have also increased. Pressure on Atlantic Coast beach habitat from development and human disturbance continues (USFWS, 1996a).

Piping plovers winter in coastal areas of the U.S. from North Carolina to Texas and in portions of Mexico and the Caribbean. Birds from the three breeding populations overlap in their use of wintering habitat. In 2001, 2,389 piping plovers were located during a winter census, accounting for only 40 percent of the known breeding birds recorded during a breeding census (Ferland and Haig, 2002). About 89 percent of birds that are known to winter in the U.S. do so along the Gulf Coast, while eight percent winter along the Atlantic coast. The status of wintering piping plovers is difficult to assess, but threats to piping plover wintering habitat 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 wintering areas. Conservation efforts at some locations have likely resulted in the enhancement of wintering habitat.

We are aware of the following site-specific conditions that affect the status of several wintering piping plover habitats, 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. In Florida, land acquisition has been initiated within portions of one critical habitat unit in the panhandle. The USFWS remains in a contractual agreement with the U.S. Department of Agriculture for predator control within limited coastal areas in the panhandle, including portions of some critical habitat units. Continued removal of potential terrestrial predators is likely to enhance survivorship of wintering 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.

***Seabeach amaranth***

Seabeach amaranth historically occurred along the east coast of the U.S. from Massachusetts to South Carolina. It is currently known from seven states within its historic range (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, they are still threatened by off-road vehicle traffic on National Park Service, military bases, and state park lands.

***Loggerhead sea turtle***

Genetic research involving analysis of mitochondrial DNA has identified five different loggerhead subpopulations/nesting aggregations in the western North Atlantic:

(1) the Northern subpopulation occurring from North Carolina to around Cape Canaveral, Florida (about 29$^{o}$ N.);
(2) South Florida subpopulation occurring from about 29$^{o}$ N. on Florida's east coast to Sarasota on Florida's west coast;
(3) Dry Tortugas, Florida, subpopulation,
(4) Northwest Florida subpopulation occurring at Eglin Air Force Base and the beaches near Panama City; and
(5) Yucatán subpopulation occurring on the eastern Yucatán Peninsula, Mexico (Bowen, 1994, in litt.; 1995, in litt; Bowen et al., 1993; Encalada et al., 1998; Pearce, 2001).

These data indicate that maternally based gene flow between these five regions is very low. If nesting females are extirpated from one of these regions, regional dispersal will not be sufficient to rapidly replenish the depleted nesting subpopulation.

The Northern subpopulation has declined substantially since the early 1970s. Recent estimates of loggerhead nesting trends from standardized daily beach surveys showed significant declines ranging from 1.5 percent to 2.0 percent annually (Dodd, 2006, in litt.). Nest totals from aerial surveys conducted by the South Carolina Department of Natural Resources showed a 3.3 percent annual decline in nesting since 1980. Although long-term data are not available for all beaches in North Carolina, an analysis of annual nest totals on beaches in the southern part of NC showed no discernable increasing or decreasing trend (Hawkes et al., 2005). Overall, there is strong statistical evidence to suggest the Northern subpopulation has sustained a long-term decline.

Data from all beaches where nesting activity has been recorded indicate that the South Florida subpopulation has shown significant increases over the last 25 years. However, an analysis of nesting data from the Florida INBS Program is inconclusive. Declines in nesting in recent years are of concern, but implications for conservation and recovery are uncertain.

A near census of the Florida Panhandle subpopulation undertaken from 1989 to 2002 reveals a mean of 1,028 nests per year, which equates to about 251 females nesting per year (FFWCC, 2006a). Evaluation of long-term nesting trends for the Florida Panhandle subpopulation is difficult because of changed and expanded beach coverage. However, there are six years of INBS data for the Florida Panhandle subpopulation, but the time series is too short to detect a trend (Witherington, 2003, in litt.).

A near census of the Dry Tortugas subpopulation undertaken from 1995 to 2001 reveals a mean of 213 nests per year, which equates to about 50 females nesting per year (FFWCC, 2006a). The trend data for the Dry Tortugas subpopulation are from beaches that are not part of the Florida INBS program, but have moderately good monitoring consistency. There are seven years of data for this subpopulation, but the time series is too short to detect a trend (Witherington, 2003, in litt.).

Nesting surveys in the Yucatán subpopulation have been too irregular to date to allow for a meaningful trend analysis (Turtle Expert Working Group, 1998; 2000).

Threats include loss or degradation of nesting habitat from coastal development and beach armoring; confusion of hatchlings by beachfront lighting; excessive nest predation by native and non-native predators; degradation of foraging habitat; marine pollution and debris; watercraft strikes; disease; and incidental take from channel dredging and commercial trawling, longline, and gill net fisheries. There is particular concern about the extensive incidental take of juvenile loggerheads in the eastern Atlantic by longline fishing vessels from several countries (Lutcavage et al., 1997; Lewison et al., 2004).

***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, in Florida, where the majority of green turtle nesting in the southeastern U.S. occurs, estimates range from 150 to 2,750 females nesting (FFWCC, 2006a). Populations in Tortuguero, Costa Rica and Ascension Island appear to be increasing (Troëng and Rankin, 2005; Broderick et al., 2006), while for other populations there are insufficient data to confirm a trend.

A major factor contributing to the green turtle's decline worldwide has been commercial harvest for eggs and food. Fibropapillomatosis, a disease of sea turtles characterized by the development of multiple tumors on the skin and internal organs, is also a mortality factor and has seriously impacted green turtle populations in Florida, Brazil, Hawaii, and other parts of the world. The tumors interfere with swimming, eating, breathing, vision, and reproduction, and heavy tumor burdens are fatal to the turtles (Herbst, 1994). Other threats include loss or degradation of nesting habitat from coastal development and beach armoring; confusion of hatchlings by beachfront lighting; excessive nest predation by native and non-native predators; degradation of foraging habitat; marine pollution and debris; watercraft strikes; and incidental take from channel dredging and commercial fishing operations (Lutcavage et al., 1997).

***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. He 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 (Pritchard, 1982). Leatherbacks are less common in the Indian Ocean and in very low numbers in the western Pacific Ocean. The largest populations are in the Atlantic, in Suriname/French Guiana, Gabon, Trinidad and Costa Rica/Panama (Troëng et al., 2004). 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. They concluded that leatherbacks are on the road to extinction and further population declines can be expected unless we take action to reduce adult mortality and increase survival of eggs and hatchlings.

The crash of the Pacific leatherback population is believed primarily to be the result of exploitation by humans for the eggs and meat, as well as incidental take in numerous commercial fisheries of the Pacific (Spotila et al., 2000). Other factors threatening leatherbacks globally include loss or degradation of nesting habitat from coastal development; confusion of hatchlings by beachfront lighting; excessive nest predation by native and non-native predators; degradation of foraging habitat; marine pollution and debris; and watercraft strikes (Lutcavage et al., 1997).

***Hawksbill sea turtle***

The hawksbill sea turtle has experienced global population declines of 80 percent or more during the past century, and continued declines are projected (Meylan and Donnelly, 1999). Hawksbills were previously abundant, as evidenced by high-density nesting at a few remaining sites and by trade statistics. The decline of this species is primarily due to human exploitation for tortoiseshell. While the legal hawksbill shell trade ended when Japan agreed to stop importing shell in 1993, a significant illegal trade continues (Meylan and Donnelly, 1999). It is believed that individual hawksbill populations around the world will continue to disappear under the current regime of exploitation for eggs, meat, and tortoiseshell, loss of nesting and foraging habitat, incidental capture in fishing gear, ingestion of and entanglement in marine debris, oil pollution, and boat collisions. Additionally, hawksbills are closely associated with coral reefs, one of the most endangered of all marine ecosystem types (Meylan and Donnelly, 1999).

***Kemp's ridley sea turtle***

The decline of this species was primarily due to human activities, including the direct harvest of adults and eggs and incidental capture in commercial fishing operations. Today, under strict protection, the population appears to be in the early stages of recovery (USFWS, 2003b; Marquez et al., 2005). The recent nesting increase can be attributed to full protection of nesting females and their nests in Mexico resulting from a bi-national effort between Mexico and the U.S. to prevent the extinction of the Kemp's ridley, and the requirement to use turtle excluder devices in shrimp trawls in both the U.S. and Mexico.

The Mexico government also prohibits harvesting and is working to increase the population through more intensive law enforcement, by fencing nest areas to diminish natural predation, and by relocating all nests into corrals to prevent poaching and predation. While relocation of nests into corrals is currently a necessary management measure, this relocation and concentration of eggs into a safe area is of concern since it makes the eggs more susceptible to reduced viability due to movement-induced mortality, disease vectors, catastrophic events like hurricanes, and marine predators once the predators learn where to concentrate their efforts.

## E. Analysis of the 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 CALO 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.

The proposed action also has the potential to adversely affect designated critical habitat for the wintering population of the piping plover. North Carolina Units 6, 7, and 8 all occur within the boundaries of CALO. Unit NC-6, Portsmouth Island, consists of about 7,873 acres and includes all land from mean lower low water (MLLW) on Atlantic Ocean to MLLW on Pamlico Sound, from Ocracoke Inlet extending west to the western end of Pilontary Islands. This unit includes the islands of Casey, Sheep, Evergreen, Portsmouth, Whalebone, Kathryne Jane, and Merkle Hammock. This unit also extends west from the eastern side of Old Drum Inlet to 1.0 miles west of New Drum Inlet and includes all lands from MLLW on Atlantic Ocean to MLLW on Core Sound. Unit NC-7, South Core Banks, consists of about 1,364 acres, extending south from Cape Lookout Lighthouse, along Cape Lookout, to Cape Point and northwest to the northwestern peninsula. This unit includes all lands from MLLW on the Atlantic Ocean, Onslow Bay, and Lookout Bight up to where densely vegetated habitat begins. Unit NC-8 at Shackleford Banks is in two parts and totals about 1,769 acres. The eastern end of Shackleford Banks extends from MLLW of Barden Inlet west 1.5 miles, including Diamond City Hills, Great Marsh Island, and Blinds Hammock. The western end of Shackleford Banks extends from MLLW at Beaufort Inlet east 2.0 miles. The unit includes all land from MLLW to where densely vegetated habitat begins, and includes emergent sandbars within Beaufort Inlet. This unit is bordered by Onslow Bay, Shackleford Slue, and Back Sound. The effects of vehicle access on the beaches and recreational beach use of CALO has the potential to destroy or degrade piping plover foraging and roosting habitats.

***Seabeach amaranth***

The proposed action 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 CALO 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.

***Sea turtles - all species***

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 subpopulation, as well as the southeastern U.S. population as a whole.

Potential effects of vehicle access and recreational activities on the beaches of CALO 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 CALO, vehicle lights and driving related markers and signs on the beach, and fires on the beach.

## 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 CALO include beach driving and recreational activities such as fishing, beach combing, sun bathing, birding, etc. The public may drive vehicles on ocean beaches and the interdunal road at CALO. Driving is not permitted within any temporary resource closures, two permanent beach closures on South Core Banks, and Shackleford Banks, and access is limited at Middle Core Banks. Maintenance, management, and emergency service vehicles may operate within these areas, though. Dogs are allowed on a leash within CALO, except in designated areas where no dogs are allowed (such as bird closure areas); however, the leash law is rarely enforced. Pedestrians may use all portions of CALO at any time, except in designated areas (e.g., 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 CALO has increased since implementation of the Park's 1982 General Management Plan.

## A. Status of the species within the action area

### *Piping plover*

Piping plover habitat within CALO is an area affected by dynamic coastal processes and ongoing human uses. Suitable piping plover habitat appears to be present at all the inlet and overwash areas within CALO, as well as along the ocean shoreline.

The breeding activity of piping plovers at CALO began with a baseline study in 1989; however, regular monitoring began in 1992. Table 1 summarizes the number of breeding piping plovers observed between 1989 and 2005, but data are not available for all years. CALO's breeding population varied between 32 and 39 pairs (in 1994) until 1999 when the population began to decline. The population bottomed out at only 13 pairs in 2004, but rebounded in 2005 and 2006 with 27 and 33 pairs, respectively. CALO accounts for about two-thirds of the piping plover breeding activity in North Carolina. While the nesting numbers of piping plovers appears to be rebounding, the declining population and potential extirpation of piping plovers at Cape Hatteras National Seashore may decrease the likelihood of sustaining the Southern recovery unit nesting population at CALO and points further south.

The number of piping plovers at CALO during the winter and migration is more difficult to assess. Regular monitoring for non-breeding piping plovers at CALO began in 2000 with monthly surveys. An average of 45 piping plovers was found during these monthly counts. The greatest number of piping plovers at CALO was found during the spring and fall migrations. Although the entire park is not surveyed, several sites have been identified as important non-breeding areas. The area from Ocracoke Inlet to Mile 4 on NCB had the highest number of non-breeding piping plovers in the park. Furthermore, while the important sites were not surveyed daily, a conservative estimate of the maximum number of plovers using these sites between September and March was nearly 120 individuals during one monthly count (CALO 2005), and as many as 136 individual plovers were reported during a single day count (Collazo et al., 1994).

### *Seabeach amaranth*

Biologists from the NPS, the North Carolina Natural Heritage Program, and East Carolina University have conducted various surveys for seabeach amaranth at CALO. Park staff perform annual surveys for seabeach amaranth in late July and early August. Most seabeach amaranth plants are found on the ocean facing beaches of Shackleford Banks and the area between Cape Point and Power Squadron Spit, which are closed to ORVs.

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. Table 2 summarizes the number of plants counted during growing season surveys (1993 to 2005).

***Loggerhead sea turtle***

Loggerhead turtles usually nest from late April or early May through mid-September (Meylan et al., 1995). From 1996 to 2005, the average annual nesting rate in CALO was about 145 nests. However, the available data suggest that there is no discernable trend in loggerhead sea turtle nesting at CALO.

Dead and live stranded loggerhead turtles are found in CALO. From 1998 to 2005, 321 loggerhead turtles were found stranded in CALO. Loggerhead turtles represent about 53 percent of all stranded turtles.

***Green sea turtle***

In CALO and elsewhere in North Carolina, green turtles usually nest from late May or early June to early or mid-September (Woodson and Webster, 1999; NCWRC, 2006a). CALO supports about five percent of all green turtle nesting in North Carolina (NCWRC, 2006a).

From 1996 to 2005, green turtle nesting in CALO averaged about one nest (range 0 to 4) per year. In addition, 188 green sea turtles were reported stranded in CALO between the years 1998 to 2005. Green turtles represent about 31 percent of all sea turtles found stranded at CALO.

***Leatherback sea turtle***

Nesting by leatherback turtles is rare within CALO, with only nine nests documented since 2000; five of these nests were in 2005. Leatherback nests in CALO account for at about 17 percent of all sea turtle nests documented in North Carolina. Although the numbers of nests laid in the action area are small relative to the loggerhead, the lack of observed nests prior to 1998 suggests that leatherback nests in CALO and the rest of North Carolina is increasing.

Sixteen leatherback turtles have been reported stranded (dead or live) from 1998 to 2005 at CALO. Leatherback turtles account for less than three percent of sea turtles found stranded at CALO.

***Hawksbill sea turtle***

No hawksbill sea turtle nests have been observed in the action area (NCWRC, 2006a). However, four stranded hawksbill sea turtles have been recovered at CALO. Hawksbill sea turtles account for less than one percent of sea turtles found stranded at CALO.

*Kemp’s ridley sea turtle*

Only one nest of the Kemp’s ridley turtle has been documented in CALO, although dead Kemp's ridley turtles are known to wash up on the beaches of the action area. Sixty-seven Kemp’s ridley turtles (about 11 percent of all sea turtles found stranded at CALO) have been reported from CALO between the years 1998 and 2005.

***Summary of the status of sea turtles at CALO***

As cited above, the total extent of sea turtle nesting on CALO beaches account for 20 percent of all loggerhead, five percent of all green, and 17 percent of all leatherback sea turtle nesting in North Carolina. Although the USFWS recognizes sea turtles can occur and will nest within the geographic extent of CALO’s beaches, the total number of turtle nests potentially affected is relatively small when compared to the recovery and survival needs of each species. Table 3 summarizes the sea turtle nesting and hatching data from 1990 to 2005 at CALO.

About 606 dead or live sea turtles (including 10 individuals in which the species could not be identified) have been reported stranded on CALO. About half of these animals (n = 304) have been located on the ocean side of CALO. Loggerheads (n = 321) have been the most numerous species found stranded on CALO, followed by green (n = 188) and Kemp’s ridley (n = 67) sea turtles. Sea turtles of all species are found stranded throughout the year at CALO. However, the months between December and January (n = 201) and between May and June (n = 139) recorded the highest numbers of strandings.

**B. Factors affecting species environment within the action area**

A number of ongoing anthropogenic and natural factors may affect the species addressed in this biological opinion. Many of these effects have not been evaluated with respect to biological impacts on the species. In addition, some are interrelated and the effects of one cannot be separated from others. Known or suspected factors affecting the species addressed in this biological opinion are discussed below.

***Lighting***

The extent that lighting affects piping plovers is unknown. However, there is evidence that American oystercatcher (*Haematopus palliatus*) chicks and adults are attracted to vehicle headlights and may move toward areas of ORV activity. During a 2005 study at CALO, adult and chick oystercatchers were observed running or flying directly into the headlights of oncoming vehicles, and two two-day old oystercatcher chicks were run over by an all-terrain vehicle after being observed foraging with the adults near the high tide line at night (Simons et al., 2005).

Although extensive monitoring of the effects of lighting on sea turtles has not been conducted at CALO, staff reports indicate that the effects of artificial lighting pose risks to nesting and hatchling sea turtles at CALO. Since 1997, an unknown number of hatchlings from at least nine different nests were disoriented or misdirected by artificial lighting.

***Predation/Herbivory***

Predation and nest abandonment because of predators have been implicated as a cause of low reproductive success (Cooper, 1990; Coutu et al., 1990; Kuklinski et al., 1996). Predation of piping plover eggs and chicks by raccoons, feral cats, gulls, crows, grackles, and ghost crabs has been observed at CALO. Predatory birds also are relatively common at CALO during their fall and spring migration, and there is a possibility they may occasionally take piping plovers.

Herbivory of seabeach amaranth is suspected by nutria and webworms at CALO. However, predation has been difficult to detect.

Predation of sea turtle nests and hatchlings at CALO has been documented. From 1997 to 2004, raccoons accounted for the loss of 12 to 28 (mean = 12) sea turtle nests annually. Ghost crabs have also been associated with about four nests annually.

***Stochastic (Random) Events***

The impacts of tropical storms and associated coastal erosion on piping plovers at CALO has occurred, but the full effects have not been assessed.

The extent stochastic events have had on the seabeach amaranth population at CALO has not been assessed.

From 1990 to 2004, about 22 (range 1 to 90) sea turtle nests at CALO were lost per year to flooding and/or washout. In the last several years, numerous hurricanes and tropical storms have resulted in substantial impacts to the coastal environment along most of CALO. Erosion resulted in a reduction of beach profile in some areas and an accretion of sand in others. High tides and storm surges from these tropical systems overwashed, washed out, buried, or inundated sea turtle nests. Due to nesting chronology at CALO, most of the nests lost to storm events will be loggerhead sea turtle nests.

***Habitat Acquisition and Protection***

The coastline of CALO is under public ownership. Public ownership confers some conservation benefit to listed species, but land use decisions by the public entities managing these lands ultimately determines the extent of conservation value these areas will have for threatened or endangered species.

In all cases, public ownership removes some threats that might otherwise be present if the properties were owned by private landowners and subsequently developed according to existing zoning regulations. In most cases, public ownership precludes the need for coastal armoring or beach nourishment, since these activities on public lands are rarely deemed appropriate. Thus, adverse impacts to sea turtles, piping plovers, and seabeach amaranth associated with these activities are avoided or minimized on public lands and adjacent shorelines. Public ownership also minimizes the likelihood that light pollution from homes and other development will become a significant problem since no commercial and residential development will occur on public lands. Therefore, along the shoreline of public parcels, disorientation of adult or hatchling sea turtles or piping plovers due to artificial lighting of homes or businesses will have been avoided or greatly reduced with public ownership.

***Vehicle Use on the Beach***

Vehicles significantly degrade piping plover habitat and disrupt normal behavior patterns of the birds, but the extent of their effects on piping plovers at CALO is unknown. Information on vehicles entering the closure areas of piping plovers is incomplete. CALO reports that threats to nesting success from "human disturbance, predators and flooding" were found to be a problem within the park following a 1989 study (CALO, 2005; 2006). They conclude that "through improved compliance of closed areas, human impact has been reduced." This implies, however, that violations still occur albeit at some reduced level. The prospect of finding a small sand-colored bird that has been crushed in a tire rut is unlikely. Similarly, the chances of finding a crushed chick are very small; 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 at CALO 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. Lighting from vehicles may also negatively affect piping plovers, but the extent of those effects on piping plovers is unknown. However, there is evidence at CALO that American oystercatcher chicks and adults are attracted to vehicle headlights and may move toward areas of ORV activity resulting in mortality (Simons et al., 2005).

Potential effects of vehicle use on the beaches of CALO to seabeach amaranth 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, but the extent of impacts at CALO is unknown. Historically, most seabeach amaranth plants at CALO are found in areas closed to vehicles; however, this does not imply that the plants do not/cannot occur in areas open to vehicles.

The use of ORVs on sea turtle nesting beaches can adversely affect the egg, hatchling, and nesting life stages sea turtles. All nests located during surveys at CALO are conspicuously marked and presumed to be avoided by vehicles. However, vehicles (or vehicle tracks) have been reported within closure areas at CALO 10 to 70 times (mean = 37) per year during the period from 1999 to 2005. During the 2006 nesting season, a vehicle was reported to have entered a sea turtle nest closure area and run over at least one sea turtle hatchling (the event is still under investigation). While there are no specific records of vehicles colliding with nesting turtles at CALO, 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. In addition, data from a 1994 study at CALO showed a slight positive correlation between an increase in the number of vehicles operating at night on the seashore and an increase in the number of false crawls. However, from 1998 to 2005, the ratio of nests to false crawls has ranged from 1:1.8 (1997) to 1.6:1 (2004). The average annual ratio of 1:1.1 at CALO is very near the normal 1:1 ratio of nests to false crawls expected for undisturbed conditions. A study scheduled to begin in 2006 will assess nighttime use of the seashore to determine the extent the use might have on nesting sea turtles.

It has been reported that vehicular ruts create obstacles for hatchlings moving from the nest to the ocean. On at least four occasions at CALO, hatchlings were documented to have crawled inland from the nests. While these events are not necessarily the result of tire ruts, they were described as being attributed to the topography confusing the hatchlings (CALO, 2006). Unfortunately, sub-lethal or lethal effects to hatchlings may have occurred that were not witnessed (nocturnal land predators, weakened individuals dying at sea or made more vulnerable to predators, etc.). However, data from CALO do not exist to quantify the extent of take anticipated due to these interactions.

A potential indirect effect of vehicular traffic is compaction of beach sediments under the weight of cars, trucks, and heavy equipment. However, there are no known data that quantify the extent sediment compaction derives from long-term vehicle use versus natural processes.

***Pedestrian Use of the Beach***

Pedestrians are prohibited in all resource closures at CALO, but we expect that when human and piping plover use of unprotected sections of the beach overlap, disturbance to nesting, resting or foraging plovers will occur. Information on pedestrians entering the closure areas of piping plovers is incomplete. CALO reports that threats to nesting success from “human disturbance, predators and flooding” were found to be a problem within the park following a 1989 study (CALO, 2005; 2006). They conclude that “through improved compliance of closed areas, human impact has been reduced.” This implies, however, that violations still occur albeit at some reduced level. Data do not exist to quantify the extent of take anticipated due to these interactions.

Seabeach amaranth occurs on the upper portion of the beach at CALO, which is often traversed by pedestrians walking along the ocean shoreline. The extent to which pedestrian use of the beach at CALO may affect seabeach amaranth is not known.

Pedestrian traffic on the beach at CALO can have a wide variety of adverse affects on sea turtles. The full extent to which nighttime beach use by humans at CALO may affect sea turtles and their nesting habitat is not known.

***Dog Use on the Beach***

Dogs are allowed on the beaches at CALO, but must be under physical restraint (leashed) and responsive to the commands of their owner and only use portions of the beach designated for pedestrian and pet use. The extent of the effects that free-running dogs have on piping plovers or seabeach amaranth at CALO is not known.

Dogs running freely on beaches have been identified as potential predators of eggs, hatchlings and even adult sea turtles, and unleashed dogs have been observed digging into nests. However, the extent of the effects from these actions to sea turtles at CALO is unknown.

## 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 Plan and the uncertainty of the specifics of how it will be implemented on-the-ground, we are 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 CALO rest with the NPS. However, the overall implementation of the Plan is fully expected to be carried out in accordance with NPS management policies, the enabling legislation for CALO 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 this biological opinion. As such, under the worst case scenario, we expect 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 CALO ecosystem.

### A. Factors to be considered

***Piping plovers***

<u>Proximity of the action</u>: The proposed action occurs within the nesting range of the Atlantic Coast piping plover breeding population. Following 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 and the entire species. 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. Additionally, the proposed action would occur within three critical habitat units (NC-6, NC-7, and NC-8) for the wintering piping plover.

<u>Distribution</u>: 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 be unlimited, affecting the species throughout the year. The USFWS expects that year-round recreational access will affect the piping plover and its habitat 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 disturbances that may affect 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.

Figures 2 and 3 compare population trends in NPS units and by State, respectively. Piping plover abundance in some of the other States and National Seashores has grown substantially and a few have remained relatively low. The biologically appropriate measure of population impact is not the size of the current remnant population, but rather the potential pairs and productivity foregone. Demonstrated population growth elsewhere in the range provides evidence that the potential contributions of CALO are greater than their current number (e.g., 33 pairs in 2006). The USFWS estimated carrying capacity for CALO to be 70 pairs (See USFWS, 1996a, appendix B).

Vehicle-related activities that may affect breeding and non-breeding piping plovers addressed in this biological opinion includes 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 includes 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. Finally, we considered the potential affects of the proposed action on the primary constituent elements of wintering piping plover habitat within the three critical habitat units, including the potential for ORV and pedestrian recreational use to alter those habitat features.

Duration: The effects of the proposed action are likely to continue until an ORV Management Plan is completed (expected in 2009). The proposed measures to protect the piping plover may not be considered part of the ORV Management Plan or continue during implementation of the ORV Management Plan because it will have a different scope from the proposed Plan. For the purposes of this consultation, we are considering the proposed Plan to be in effect until the end of calendar year 2009, and thus the impacts are temporary.

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

CALO 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 high and result in the greatest impacts on the spits at the inlets 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 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 four individually identifiable Great Lakes piping plovers at North Core Banks/Ocracoke Inlet, two at South Core Banks, and six at Shackleford Banks (Stucker and Cuthbert, 2006). Stucker and Cuthbert (2006:8) also note that "the magnitude of change [in the annual survival rate] from previous annual and cumulative estimates suggests that adult mortality during winter 2004-2005 and spring migration 2005 was higher than normal." Furthermore, expected growth in Great Lakes breeding pair abundance projected from fledging success in the previous two seasons failed to materialize in 2004 and 2005, and scarcity of females appears to have been a contributing factor (Stucker and Cuthbert, 2006:12).

***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 (defined above). The USFWS expects 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: Vehicular traffic, pedestrians, and pets may crush, bury and/or destroy existing plants, resulting in mortality of the plant. Vehicular traffic, pedestrians, and pets 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 CALO may be reduced.

Duration: The effects of the proposed action are likely to continue until an ORV Management Plan is completed (expected in 2009). The proposed measures to protect seabeach amaranth may not be considered part of the ORV Management Plan or continue during implementation of the ORV Management Plan because it will have a different scope from the proposed Plan. For the purposes of this consultation, we are considering the proposed Plan to be in effect until the end of calendar year 2009, and thus the impacts temporary.

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 CALO 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 CALO.

***Sea turtles – all species***

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 (defined above).

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. Direct impacts to live stranded turtles may occur year round. Because routine sea turtle nesting surveys typically are not initiated until June, early nesting events may be overlooked. These early-laid nests, therefore, will not be marked or located by the measures implemented by CALO and are at risk.

Nature of the effect: Vehicle-related activities that may affect sea turtles addressed in this biological opinion includes 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 includes 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, we expect that about 99 percent of beach access impacts will involve loggerhead sea turtles (adults, eggs and hatchlings) and one percent will involve leatherback, green, and .or Kemp's ridley 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, we have 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: The effects of the proposed action are likely to continue until an ORV Management Plan is completed (expected in 2009). The proposed measures to protect the sea turtles may not be considered part of the ORV Management Plan or continue during implementation of the ORV Management Plan because it will have a different scope from the proposed Plan. For the purposes of this consultation, we are considering the proposed Plan to be in effect until the end of calendar year 2009, and thus the impacts temporary.

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 (NCWRC, 2006a). At least three nesting activities have been reported at CALO prior to May 1, and the lack of regular daily patrols prior to June may have impeded observations of early nests.

Similarly, sea turtle nests laid late in the summer result in hatchlings emerging in the fall. The latest loggerhead nest at CALO was laid on September 2 (NCWRC, 2006a), which would predict hatching in early November. The latest recorded green turtle nest at CALO was laid on August 14 (NCWRC, 2006a). Leatherback nests tend to be laid earlier than green or loggerhead turtles, and the latest nesting date at CALO for leatherbacks is July 24 (NCWRC, 2006a).

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 hatchling sea turtles over several years may result in population declines as the number of sea turtles nesting on the beaches at CALO or the number of hatchlings surviving to reach the ocean are reduced. The resulting population decline may lead to a significant reduction in the number of sea turtles nesting on CALO and the contribution that those sea turtles have (especially the northern nesting subpopulation of loggerheads) on the larger sea turtle population.

## B. Analysis for effects of the action

Beneficial effects:

Beneficial effects to listed species can be found in the discussion of minimization and mitigation measures proposed by CALO. 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; potential reduction in the disturbance of proposed wintering piping plover critical habitat; germinating seabeach amaranth; and nesting sea turtles and their nests, eggs, and hatchlings.

***Piping plover***

Direct effects:

*Vehicles altering adult nesting behavior or colliding with an adult plover during the night or day*

Vehicles are present on the beaches at CALO 24 hours a day, seven days a week, except during the winter when the entire park is closed to vehicles (CALO, 2005). Under the proposed Plan, vehicles, pedestrians and pets may be restricted from plover nesting areas beginning April 1 of each year. However, keeping vehicles, pedestrians, and pets out of the symbolically fenced areas designed to protect nesting plovers has been less than fully successful. CALO reports that "through improved compliance of closed areas, human impact has been reduced" (CALO, 2005), but violations still occur at some level. The unknown/unreported number of incidents is concerning for the potential adverse effects these violations might have on breeding piping plovers. The number of violations (e.g., vehicles entering closure areas) would provide 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. Lighting from vehicles may also negatively affect piping plovers, but the extent of those effects on piping plovers is unknown. However, there is evidence at CALO that American oystercatcher chicks and adults are attracted to vehicle headlights and may move toward areas of ORV activity resulting in mortality (Simons et al., 2005).

*Collision between vehicles and plover chicks during the night and day.*

Under the proposed Plan, vehicular traffic will continue to be allowed on CALO beaches 24 hours a day, except for certain areas designated as resource closures and during the winter when the entire park is closed to vehicles. Because of their small size, high mobility, and the high volume of traffic in areas of CALO known for plover nesting, plover chicks on the beach during the day and night are vulnerable to being run over. While no collisions with piping plover chicks are reported to have occurred at CALO, 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. Furthermore, there have been several instances were American oystercatchers (which are considerably larger that piping plovers) were run over by vehicles at CALO. For example, five chicks were run over in 2003, at least three chicks from three nests were run over in 2004, and a fourth chick was struck by a vehicle after fledging that same year, and two chicks were found run over by an all-terrain vehicle in 2005. Chick mortality at CALO was determined primarily by extensive surveying and monitoring of these chicks, including the use of radio telemetry (Simons et al., 2005). There are no reports of plover chicks being struck by vehicles at CALO; however, monitoring of piping plover chicks has not been conducted at the level that oystercatcher chicks are monitored.

*Vehicles running over undetected piping plover nests*

Nests located during surveys will be buffered by symbolic fencing and presumed to be avoided by vehicles, pedestrians, and pets. While there were no specific records provided of vehicles running over piping plover nests at CALO, violations of these closure areas are presumed to occur (CALO, 2005). The potential for vehicles running over plover nests also exists when those nests are constructed outside of the closure areas and remain undetected. Risks to undetected nests (especially those with incomplete clutches, which are not incubated) at CALO is high in light of vehicles operating 24 hours a day, seven days a week.

*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 seen running or flying directly into headlights of oncoming vehicles at CALO (Simons et al., 2005), resulting in mortality.

*Vehicular ruts and impacts to hatchling plovers fledging the nests*

Under the proposed Plan, beach vehicular traffic would be required to occur on the upper beach within a corridor between the mean high tide line and typically the toe of the dune. No mortality of piping plover chicks has been reported due to tire ruts at CALO; however, 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 when vehicles are allowed to operate on the beaches at CALO.

*Disturbance by vehicles, pedestrians, and pets*

CALO reports that "through improved compliance of closed areas, human impact has been reduced" (CALO, 2005), but violations still occur at some level. As a result, vehicle access may kill or flush piping plovers at CALO. Vehicles can obliterate scrapes, 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.

Pedestrians have access to portions of piping plover habitat at CALO, and we expect 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.

The biological effects of flushing are difficult to quantify. In general, however, we know that plovers require food and shelter. Any actions that limit their ability to feed or 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 there are other factors that 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 in order to attempt to quantify the effects of flushing. We are aware of no such long term and statistically robust studies.

The biological effects of disturbance that prevents nesting are more easily quantified, though. 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. 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. CALO proposes to erect pre-nesting closures by April 1; therefore, human disturbances should play a diminished role in territorial establishment, courting and nest establishment.

*Effects to piping plover habitat*

Concerning critical habitat for wintering piping plovers, the three units 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.

Within the action area there is an overlap between the breeding and non-breeding seasons. As such, 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.

Interrelated and Interdependent Effects:

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 that is part of the proposed action and depends on the proposed action for justification. An interdependent activity is an activity that has no independent utility apart from the action under consultation. The USFWS does not anticipate any interrelated or interdependent effects.

Indirect Effects:

Indirect effects are caused by or result from the proposed action, are later in time, and are reasonably certain to occur.

Predators may follow ORV tracks or pedestrians (e.g., recreationists that have discarded bait or catch from fishing) into piping plover nesting habitat and destroy nests, disturb or kill adults, eggs, or fledglings.

***Seabeach amaranth***

Direct Effects:

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 may also bury seeds to a depth that would prevent future germination, resulting in reduced numbers of plants.

Interrelated and Interdependent Effects:

The USFWS does not anticipate any interrelated or interdependent effects.

Indirect Effects:

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.

***Sea turtles - all species***

Direct Effects:

*Vehicles altering adult nesting behavior or colliding with an adult turtle during the night and 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). Vehicles are present on the beaches at CALO 24 hours a day, although, nighttime vehicle use is thought to remain relatively low. A 1994 study found 4 to 13 vehicles on the ocean beach during the night on South Core Banks during the sea turtle nesting season. A study scheduled to begin in 2006 will examine the current nighttime vehicle use within CALO.

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. 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. A study mentioned above may address in the analysis some of these factors.

Vehicles (or vehicle tracks) have been reported within closure areas at CALO 10 to 70 times (mean = 37) per year during the period from 1999 to 2005. During the 2006 nesting season, a vehicle was reported to have entered a sea turtle nest closure area and run over at least one sea turtle hatchling (the event is still under investigation). While there are no specific records of vehicles colliding with nesting turtles at CALO, 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*

Under the proposed Plan, vehicular traffic will continue be allowed on CALO beaches 24 hours a day, except for certain areas designated as resource closures. Routine daily patrols for sea turtles by CALO personnel are planned between June 1 and August 15 of each year. In addition, monitoring for sea turtles may also be conducted as part of other species' surveys and management actions (e.g., piping plover). However, with unlimited access, the potential for collisions to occur remain high during the day and night. During the 2006 nesting season, a vehicle was reported to have entered a sea turtle nest closure area and run over at least one sea turtle hatchling (the event is still under investigation).

*Collisions between vehicles and strandings of live or weakened juveniles, adults, and post-hatchling washback sea turtles*

Strandings are juvenile or adult sea turtles that wash onto the beach dead, injured, ill, or weak. Five species of turtles have stranded on CALO beaches. From 1998 to 2005, about 606 sea turtles were stranded along the coastline of CALO (NCWRC, 2006a). About 3.3 percent of all stranded turtles were alive at the time of stranding. There were no reports of stranded turtles being run over.

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 volume of traffic in some areas of CALO, live post-hatchlings on the beach during the day and night are vulnerable to being run over. However, there are no reports of post-hatchling washbacks being struck by vehicles at CALO.

*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 hatchlings, and eggs may result due to physical crushing or collapse of the nest chamber. 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 15) are conspicuously marked and presumed to be avoided by vehicles. However, vehicles (or vehicle tracks) have been reported within closure areas at CALO 10 to 70 times (mean = 37) per year during the period from 1999 to 2005. No information has been provided on specific analyses conducted to determine the extent of any potential damage (e.g., effects of compaction on 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, experienced sea turtle nest surveyors can misidentify about seven percent of the nests as false crawls.

To estimate the number of missed nests potentially affected by vehicles, we back calculated from documented nesting rates to approximate the number of nests missed during surveys that may be impacted due to vehicle traffic. Assuming an error rate of six to eight percent, the average number of nests that go undetected each year at CALO is between nine and 12 (based on an average of 147 nests per year). This is a conservative estimate because the error rate is likely higher earlier in the season (prior to June 1) before regular monitoring begins, and because tracks from ORVs on the beach prior to daily monitoring can obscure fresh sea turtle tracks.

A more accurate calculation may be conducted by calculating the number of nests laid (from all NC beaches) for the whole season in the month of May. Using sea turtle nesting data from 1997 to 2004, about 7 percent (range 3 to 16 percent) of all nests laid for the whole season are laid in the month of May. Given that CALO has reported 135 nest found in the month of May (1990-2005), then that means that they have missed between four and 22 nests that were laid prior to June. This accounts for about 0 to 2 nests missed per year (actual 0.3 to 1.5). Add that to the nine to 12 nests missed due to monitoring error (i.e., six to eight percent missed during regular daily monitoring), and an estimated 9 to 14 nests are missed overall at CALO. Given that there was at least three known nests laid prior to May 1 and at least two known nest laid after August 31, you can add at least five additional nests that may be missed, totaling an estimated 14 to 19 nests missed per year. Also considering that 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 indeterminate number of nests. However, CALO reports that since 1990 less than one percent of all nests were known to be missed and hatched without protection (CALO, 2006).

No quantitative studies have been conducted at CALO 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. Additionally confounding this analysis is 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; 1993). 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., 1995a; Witherington et al., 1996).

Disorientation of hatchlings resulting from artificial lighting has been documented at CALO (CALO, 2006). To minimize the likelihood of misorientation or disorientation of hatchlings, plywood light barriers are erected around nests to shield the nests and emerging hatchlings from vehicle lights or other artificial lighting.

*Vehicular ruts and impacts to hatchling sea turtles emerging from nests*

It is reported that vehicular ruts create obstacles for hatchlings moving from the nest to the ocean. Upon encountering a vehicle rut, hatchlings may be disoriented 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), but because the sides of the track cast a shadow and the hatchlings lose their line of sight to the ocean horizon. If hatchlings are detoured along vehicle ruts, they are at greater risk to vehicles, predators, fatigue, and desiccation.

Under the proposed Plan, all beach vehicular traffic may occur on the soft sandy upper beach between the mean high tide line and typically the toe of the dune. When a sea turtle nest is found, stakes will be placed marking the nest. As the hatching date approaches (day 50 of incubation), a funnel shape ORV closure will be erected around the nest. The funnel will provide a minimum of a 30-foot buffer at the nest expanding to 60-foot at the ocean. The buffer behind the nest, between the dune and the nest, may be reduced to 10 feet to allow for ORV traffic.

Mortality of sea turtle hatchlings due to vehicles has not been documented at CALO; although, vehicles (or vehicle tracks) have been reported within closure areas an average of 37 times per year, and on at least four occasions hatchlings were disoriented and crawled inland as a result of topography (CALO, 2006). It is not clear whether the confusion of hatchlings from "topography" refers to tire ruts or some other unnatural feature or natural geomorphic feature in the landscape misdirecting the hatchlings. Similarly, it is not clear what effects, if any, occurred to the nests and/or hatchlings because of the closure violations. Regardless, sub-lethal or lethal effects may have occurred to hatchlings that were not witnessed. However, data do not exist to quantify the extent of take anticipated due to these interactions.

Despite the measures of nest protection to minimize impacts to hatchling sea turtles, incidental take is likely to occur. This take is expected because implementation of nest protection measures will miss some nests because: (1) daily surveys are only conducted from June 1 through August 15; (2) vehicles obscure nesting tracks; and, (3) workloads preclude the removal of ruts from nests nearing hatching.

*Compaction of beach sediments and impacts on adults and/or hatchling sea turtles*

A potential indirect effect of vehicular traffic is compaction of beach sediments under the weight of cars, trucks, and heavy equipment. There are no known data that quantify the extent sediment compaction derives from long-term vehicle use versus natural processes.

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 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.

Beach driving likely contributes to sand compaction in CALO, but the additive effects of sand compaction due to vehicle traffic on nesting and reproductive success are not well understood.

Interrelated and Interdependent Effects:

The USFWS does not anticipate any interrelated or interdependent effects.

Indirect Effects:

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

## C. Species' response to proposed action

### *Piping plover*

Numbers of individuals/populations in the action area affected: The number of piping plover nests found at CALO has varied over the years. An all time high of 66 nests was reported in 1994, and an all time low of 13 nests in 2004. However, the number of nests is not necessarily a good indicator of the number of pairs. For example, in 1994, the 66 nests were laid by 39 plover pairs; whereas, in 2004, 13 nests were laid by 13 plover pairs. Regardless, the past annual number of piping plover pairs at CALO has fallen below the estimated carrying capacity of 70 pairs for CALO (USFWS, 1996a). The number of non-breeding plovers is more difficult to assess. However, as many as 136 individual plovers have been reported at CALO during a single day count (Collazo et al., 1994), and more than 40 plovers have been recorded during mid-winter surveys (CALO, 2005). Our interpretation of the Plan's stated goal of protecting listed species means to improve productivity until the long-term ORV Management Plan is in place that will afford enhanced protections, enabling the population to recover to historic levels and, ultimately, build to a level the habitat appears capable of supporting.

Sensitivity to change: Piping plovers are sensitive to negative impacts during the breeding and non-breeding periods. 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 CALO (Stucker and Cuthbert, 2006).

Resilience: Under the proposed management Plan, the piping plover population at CALO is likely to remain unchanged. Declines in the CALO population or even maintaining current population levels could prevent achieving the stated recovery goals for the Southern recovery unit. For example, CALO has never had a year in which the productivity of plover chicks was above the minimum level required to maintain a stable population (i.e., 1.24 chicks per pair), or that exceeded the recovery criteria of 1.5 chicks per pair (USFWS, 1996a). However, increases in productivity and non-breeding survival through improved protective measures and substantial decreases in disturbance could potentially reverse the low productivity seen in this population over the last 15 years. The response may not be immediate (e.g., population increases after one breeding season), but as evidenced from the 2005 breeding season at CAHA (2.0 chicks per pair), productivity can be substantially increased with the appropriate protective measures. Non-breeding protections are also warranted and attainable to promote population increases 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 70 pairs is an estimate of the potential breeding population at CALO. Under the currently proposed management, the CALO population is likely to remain at its current level (about 13 to 39 pairs per year). 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 CALO 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 the proposed action will adversely affect migrating and wintering piping plovers. Reduced ability to rest (roosting) and decreased food abundance could reduce survivorship of migrating and wintering birds. 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.

In terms of the effects of ORV use on critical habitat for wintering piping plover, reduced ability to rest (roosting) and decreased food abundance resulting from ORV traffic could reduce the suitability of habitat for migrating and wintering birds. If this is the case, the suitability of the habitat would be expected to continue to decline as the amount of human use and ORV traffic increases. Conversely, any actions the NPS implement as part of the Interim Plan that have the effect of limiting ORV use in wintering piping plover habitat would be expected to improve the suitability of the habitat.

***Seabeach amaranth***

Numbers of individuals/populations in the action area affected: The number of seabeach amaranth plants recorded from CALO have ranged from four to 2,265. While surveys for seabeach amaranth have been conducted regularly at CALO since 1993, the low number of plants recorded in recent years may not be an indicator of the total population size at CALO, nor the potential population. The extent of the effect of human access on seabeach amaranth, especially in areas that do not offer protection to this species or other resources, is unknown. The Interim Plan proposes to continue annual surveys of potential habitat in late July and early August.

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. Further, ORV use may bury seeds to a depth that would prevent 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.

***Sea turtles – all species***

Numbers of individuals/populations in the action area affected: Approximately 146 sea turtle nests (all species) are laid each year on the shores of CALO, and represents about 20 percent of the state's nesting population. The total extent of sea turtle nesting on CALO beaches account for 20 percent of all loggerhead, 5 percent of all green, and 17 percent of all leatherback sea turtle nesting in North Carolina.

Approximately 20 live sea turtles have been reported stranded on CALO. Loggerheads account for about 65 percent of the sea turtles found live stranded. Green and leatherback sea turtles account for about 25 percent and 10 percent, respectively, of live stranded turtles at CALO.

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 will likely remain at the current level with repeated (or increasing) disturbance at CALO. Similarly, the number of hatchling turtles surviving to reach the ocean will remain at the current level. If nesting numbers, and subsequently the number of hatchlings produced, continues at the same rate or declines, then the population may fail to reach recovery levels. For example, loggerhead nests on North Carolina beaches (and in the Northern subpopulation) 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 (e.g., through fewer nests laid or anthropogenic factors altering the nesting environment) 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 CALO) do not reach sexual maturity until 20 to 50 years of age. If there is a reduction in the number of nests laid at CALO, 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 CALO 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 this biological opinion. 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 opinion includes Federal property owned and operated by CALO. Therefore, we anticipate 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 coastal development or other activities occurring near or adjacent to CALO may occur without Federal authorization. Continued coastal development may increase the number of visitors to CALO (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 vehicles 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 nearby coastal development are not reasonably certain to occur. As such, we do not anticipate any cumulative effects.

## CONCLUSION

After reviewing the current status of the breeding population of the Atlantic Coast population of the piping plover, wintering population of the Atlantic Coast population of the piping plover, the wintering population of the Great Lakes population of the piping plover, the wintering population of the Great Plains population of the piping plover, seabeach amaranth, and loggerhead, green, leatherback, hawksbill, and Kemp’s ridley sea turtles, the environmental baseline for the action area, the effects of the proposed action and the cumulative effects, it is the USFWS’s biological opinion that implementation of the Plan, as proposed, is not likely to jeopardize the continued existence of these species. Specific rationale for the non-jeopardy determination for each species is provided below.

No critical habitat has been designated for seabeach amaranth; therefore, none will be affected. 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.

### *Piping plover*

The Atlantic Coast nesting population of piping plover is a component of the entity listed as threatened which encompasses all breeding piping plovers except the Great Lakes breeding population. Of this listed entity, the Atlantic Coast population experienced a 71 percent increase in the number of breeding pairs between 1989 and 2004, while the Great Plains populations experienced a decline of about 13 percent between 1991 and 2001. As such, the overall status of the listed entity is likely to be increasing. Within the Atlantic Coast population, most of the population growth has been in the New England and New York/New Jersey sub-populations; although the Southern recovery unit experienced a 48 percent increase between 2003 and 2005 due to population increases in Maryland and Virginia.  The recovery goal for the Atlantic Coast population is (in part) 2,000 breeding pairs and our most recent estimate indicates that there were 1,668 pairs in 2004.

The current number of breeding piping plovers using CALO is a relatively small part of the breeding population of the Southern recovery unit and the overall Atlantic Coast breeding population.  However, the breeding population at CALO is a substantial part of the North Carolina population.  While CALO's breeding population declined somewhat since the 1990s, it appears to be increasing again.  The breeding population at CALO, however, has not contributed to population growth in recent years in the overall Atlantic Coast range, including other parts of the Southern recovery unit, that was facilitated by sustained intensive management.

The current number of piping plovers using CALO during migration and over winter is relatively large compared to the overall population of Atlantic Coast non-breeding piping plovers.  As many as 136 individual plovers have been seen using sites at CALO during a single day count during migration (Collazo et al., 1994), and as many as 45 to 60 during monthly counts during the winter months (CALO, 2005).  CALO is an important migratory stopover site and over winter destination.

Assuming a worst case scenario for NPS implementation of the protective measures described in the Plan, the Plan will conserve the piping plover at CALO.  However, it may not result in an increase in nesting plovers at CALO.  This, coupled with continued intensive management of other management units within the range of the Atlantic population and the status of this listed entity rangewide, leads us to conclude that implementation of the Plan will not jeopardize the continued existence 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 CALO during the non-breeding season.  This population is currently increasing, but remains at very low levels.  The current number of Great Lakes piping plovers using CALO during migration and over winter is unknown; however, CALO is an important migratory stopover site and over winter destination.  Harm and harassment of migrating and wintering piping plovers may reduce the fitness of individuals, which will have an unknown affect on the listed entity.  Assuming a worst case scenario for NPS implementation of the protective measures described in the Plan, the Plan may result in the incidental take of individuals.  However, this coupled with continued intensive management in the breeding range of the Great Lakes population and the status of the listed entity rangewide, leads us to conclude that implementation of the Plan will not jeopardize the continued existence of the listed entity.

Concerning critical habitat for wintering piping plover, the three units continue to support primary constituent elements essential for the conservation of the species with the current levels of human use and existing management.  Continued increases in the amount of human use and ORV traffic within these three units may reduce the suitability of the habitat for wintering piping plover.  Assuming a worst case scenario for NPS implementation of the protective measures described in the Plan, it may result in a slight improvement in the condition of wintering habitat.

Considering the effects of the Plan on the three units together with the effects on the other designated units, the overall effect on designated piping plover wintering habitat is expected to be slight. For this reason it is our opinion that the proposed action is not likely to destroy or adversely modify critical habitat.

***Seabeach amaranth***

The current number of seabeach amaranth plants on CALO is relatively small compared to the overall population. It appears that higher populations of seabeach amaranth are possible at CALO given that population numbers reported in the past exceeded 2,000 individual plants. In addition, while no data exists to suggest beach driving is having an adverse effect on seabeach amaranth numbers at CALO, there is evidence that restricted access may protect plants and result in a larger population. For example, seabeach amaranth numbers are higher in areas protecting other resources, or where there are fewer vehicles on the beaches or no vehicle driving is allowed. Alternatively, these areas may have more available habitat and thus more room for seabeach amaranth to germinate than other areas with greater vehicle and pedestrian access.

Impacts to seabeach amaranth at CALO 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.

Assuming a worst case scenario for NPS implementation of the protective measures at CALO, we expect its implementation to afford a reasonable opportunity for at least a minimal amount of successful germination annually at CALO. This, coupled with continued intensive management at other seabeach amaranth sites (particularly State and federal properties) in North Carolina, leads us to conclude that implementation of the Plan will not jeopardize the continued existence of the species.

***Sea turtles***

The number of sea turtles nesting on the shores of CALO represents about 20 percent of North Carolina's total nesting population. The total extent of sea turtle nesting on CALO beaches account for 20 percent of all loggerhead, five percent of all green, and 17 percent of all leatherback sea turtle nesting in North Carolina. While the loggerhead nesting numbers are relatively small compared to the overall nesting populations, the loggerhead nesting numbers are important to the Northern subpopulation specifically because these beaches produce a greater proportion of males to the population.

Although there is little data on the extent of the effects the proposed Plan will have on sea turtle populations, evidence suggests that the actions proposed to be authorized have the potential to result in mortality/injury to nesting turtles and nests, eggs, hatchlings, post-hatchling washbacks, and stranded live turtles.

Assuming a worst case scenario for NPS implementation of the protective measures at CALO, we expect its implementation may afford a reasonable opportunity for successful nesting of sea turtles annually. This would potentially produce a slight increase in the number of sea turtle nests protected at CALO over the near term. This, coupled with continued intensive management at other nesting beaches (particularly State and federal properties) in North Carolina, leads us to conclude that implementation of the Plan will not jeopardize the continued existence of any sea turtle 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 CALO for the exemption in section 7(o)(2) to apply. CALO has a continuing duty to regulate the activity covered by this incidental take statement. If CALO (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, CALO 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

***Piping plovers***

1) Breeding Piping Plovers: The USFWS expects incidental take of breeding piping plover will be difficult to detect for the following reasons: breeding adults may be

scared away from or prevented from forming a nest at CALO; the nests are cryptic; the hatchlings are small and sand colored; dead young are easily covered by sand; or waves and predators may carry away young. However, this undetected level of take of this species can be anticipated along the 56 miles of CALO by the disturbance of suitable plover nesting habitat from recreational activities, implementation of protective measures and implementation of monitoring measures. Assuming a worst case scenario for NPS implementation of the protective measures described in the Plan, the undeterminable level of incidental take is expected to be a proportion of all the abandoned and existing nests at CALO. The proposed monitoring will provide data that will allow the NPS to adjust the protective measures to enhance conservation of the plover the following year. Additionally, the monitoring information may allow the USFWS to better quantify the amount of incidental take in subsequent consultations (e.g., regarding the ORV Management Plan regulations).

Incidental take for the proposed action is anticipated during each nesting season (i.e., April 1 to August 31 of each year) until a long-term ORV Management Plan is developed (anticipated 2009) or December 31, 2009, whichever comes first.

2) Migrating and Wintering Piping Plovers: The USFWS expects incidental take of the piping plover 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 56 miles of CALO 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 the protective measures described in the Plan, the undeterminable level of incidental take is expected to be a proportion of all wintering plovers at CALO. The proposed monitoring will provide data that will allow the NPS to adjust the protective measures to enhance conservation of the plover the following year. Additionally, the monitoring information may allow the USFWS to better quantify the amount of incidental take in subsequent consultations (e.g., regarding the ORV Management Plan regulations).

***Sea turtles - all species***

The USFWS expects incidental take of all species of sea turtles will be difficult to detect for the following reasons:

(1) the turtles nest primarily at night and all nests are not found because (a) natural factors, such as rainfall, wind, and tides may obscure crawls and (b) human-caused factors, such as pedestrian and vehicular traffic, may obscure crawls, and result in nests being destroyed because they were missed during a nesting survey and egg relocation program;

(2) the total number of hatchlings per undiscovered nest is unknown;

(3) the reduction in percent hatching and emerging success per relocated nest over the natural nest site is unknown;
(4) an unknown number of females may avoid the project beach and be forced to nest in a less than optimal area;
(5) lights may misdirect an unknown number of hatchlings and cause death; and
(6) escarpments may form and cause an unknown number of females from accessing a suitable nesting site.

However, the level of take of all sea turtles can be anticipated along the 56 miles of CALO by the disturbance of suitable turtle nesting beach habitat from recreational activities, implementation of protective measures and implementation of monitoring measures. Assuming a worst case scenario for NPS implementation of the protective measures described in the Plan, the undeterminable level of incidental take is expected to be a limited proportion of all sea turtles and their nests (including hatchlings) at CALO. The proposed monitoring will provide data that will allow the NPS to adjust the protective measures to enhance conservation of sea turtles the following year.

## EFFECT OF THE TAKE

In the accompanying biological opinion, the USFWS determined that this level of anticipated take is not likely to result in jeopardy to the species, or destruction or adverse modification of designated critical habitat.

## 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, leatherback, hawksbill, and Kemp's ridley sea turtles.

The responsibility to manage CALO rests with the NPS and it is up to the NPS to make specific management decisions on public use and resource conservation for their Plan. The role of the USFWS relates to resource conservation and is strictly advisory. While we are 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 the Plan. The following reasonable and prudent measures, and terms and conditions represent monitoring procedures to determine the effectiveness of the Plan in conserving the species.

### *Piping Plover*

1. The NPS must monitor the effects of management actions on nesting, foraging, and roosting piping plovers at all sites within the park boundaries.

2. The NPS must ensure that park users, concessionaires, and contractors are aware of the piping plover protection measures implemented within the park boundaries.

***Sea turtles – all species***

1. The NPS must monitor the effects of management actions on nesting, hatching, and stranded sea turtles on specified beaches within the park boundaries.

2. The NPS must ensure that park users, concessionaires, and contractors are aware of the sea turtle protection measures implemented within the park boundaries.

## TERMS AND CONDITIONS

In order to be exempt from the prohibitions of section 9 of the Act, CALO must comply with the following terms and conditions, which implement the reasonable and prudent measures described above and outline required reporting/monitoring requirements. While these terms and conditions are non-discretionary, they are in keeping with the adaptive management approach outlined in the Plan.

***Piping Plover***

1. The NPS must monitor for piping plover arrival and pre-nesting behavior beginning March 15, with at least one survey per week. Beginning on April 1, monitoring of breeding areas must be increased to three times per week (or every other day). Additionally, monitoring reports must include descriptions of management measures in place and document piping plover behavior sufficient to evaluate the effects of management actions in place at the site.

   The NPS should make observations in the following categories as a means of providing them with an early indication that the management measures in place may not be having the desired effect as described in the Plan. If any of these actions are detected, the NPS should immediately evaluate whether implementation of additional protective measures are warranted.

   Nest Initiation

   In each breeding season (i.e., April 1 through August 31), the NPS must monitor and obtain data on pairs observed courting for three or more days without subsequent detection of a nest (including scrapes) by June 1. The monitoring must include descriptions of the management measures in place and human activity observed in the area(s) where courting behavior occurred.

   The NPS should monitor and obtain data on the number of observations of plovers performing territorial defense or courtship displays outside the symbolic fencing; and, making nest scrapes outside the symbolic fencing; and the numbers of vehicles, pedestrians, or pets within the symbolic fencing and/or in which tracks are observed crossing into posted habitat. This monitoring should also include a description of the management measures in place where these behaviors are observed.

Nest Abandonment

The NPS should monitor and obtain data on the location of all identified nests relative to different management measures (e.g., inside/outside posted areas).

During the monitoring sessions, data should be collected on interactions between people and plovers including instances where vehicles, pedestrians, or pets are observed within the symbolic fencing and the type of response exhibited by nesting plovers. Additionally observations should be made at each session on vehicle, pedestrian and pet tracks in posted habitat; any signs of predators, including species; and specific management measures in place at the time of the observation. Monitoring must describe the fate (e.g., abandoned, successful, lost to predators, etc.) of each identified nest relative to the specific management measures implemented.

Chicks

During the monitoring sessions, data should be collected on interactions between people and plovers including instances where vehicles, pedestrians, or pets are observed within the symbolic fencing and the type of response exhibited by the plovers. Additionally observations should be made at each session on vehicle, pedestrian and pet tracks in posted habitat; any signs of predators, including species; and specific management measures in place at the time of the observation. Monitoring must describe the fate (e.g., survived, fledged, lost to predators, exposure, etc.) of each brood relative to the specific management measures implemented.

Additional monitoring for nesting and wintering piping plovers

The NPS must monitor presence, abundance, and behavior of migrating and wintering piping plovers from August 1 to March 31 of each year. Specific observations should be made relative to the above parameters with respect to the level and types of human activity in the area.

A log must be maintained that records the date, time, and purpose of each official vehicle trip through areas where unfledged chicks are present.

Monitors, law enforcement personnel, and other CALO staff should record all observations of violations of dog leashing requirements in plover breeding areas, both inside and outside posted habitat.

Monitors should maintain contemporaneous field notes and daily summaries including time and duration of all habitat surveys. For each territorial bird or pair, a daily record should be maintained of its location and status (number of adults seen, observed behaviors, status of nest, number of chicks seen, unusual behaviors, reactions to disturbance by pedestrians, pets, or vehicles).

2. Procedures must be developed and implemented by CALO to ensure that all concessionaires and contractors doing any work on or near the beach fully understand and comply with the plover protection measures implemented by the NPS, including any measures related to lighting.

***Sea turtles – all species***

1 Daily early morning sea turtle nesting surveys at North Core Banks and South Core Banks will be required from May 1 through September 15 or later if there is a known late nest still incubating. The purpose of the monitoring is to document and evaluate the response of sea turtles, their nests, and young to various management measures sufficient to determine the effectiveness of those measures. Periodic monitoring (e.g., every two to three days) for unknown nesting and emerging hatchlings should continue, especially in areas of CALO that are not surveyed regularly or that receive high visitor use, through November 15. Monitoring should also occur for post-hatchling washbacks during periods when there are large quantities of seaweed washed ashore or following severe storm events.

2. Procedures must be developed and implemented by CALO to ensure that all concessionaires and contractors doing any work on or near the beach fully understand and comply with the sea turtle protection measures implemented by the NPS, including any measures related to lighting.

The annual report will include the number of nests laid and their date and location; the specific management measures implemented with respect to each nest; the number of false crawls, their date, location, and specific management measures in place at the location; nest hatching success, hatchling emerging success, the number of stranded turtles (alive and dead) identified by species, and in relation to management measures implemented; any incidents of take (e.g., light disturbance, mortality, harassment, etc.); and any other information regarding sea turtles at CALO that may be relevant to evaluating the response of sea turtles to different management actions.

***Reporting Requirements***

An annual report detailing the information requested above 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, with the first report due by January 31, 2007. In addition, any information or data related to a conservation measure or recommendation that is implemented should be included in the annual report. A meeting between CALO and the USFWS must be scheduled within 30 days of the annual report to discuss the data and any changes in the management or monitoring action proposed by the NPS for the next season. Additionally, the level of incidental take will be reevaluated to comply with any project modification and new data. The annual report should be sent to the address below:

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 that appears to have been impacted as the result of an action occurring at CALO (e.g., run over by a vehicle), initial notification must be made to the Fish and Wildlife Service Law Enforcement Office below. Additional notification must be made to the Fish and Wildlife Service 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.

Andrew Aloise, Resident Agent in Charge
U.S. Fish and Wildlife Service
Post Office Box 33096
Raleigh, North Carolina 27636-3096
(919) 856-4786

**Coordination of Incidental Take Statements with Other Laws, Regulations, and Policies**

The USFWS will not refer the incidental take of the piping plover 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.

## 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.

***Piping Plover***

1. CALO should implement a level of protection for breeding piping plovers that contributes to recovery, including increases in productivity and population growth. The combined efforts of the NPS and other managed lands will help insure recovery within the Southern recovery unit. In addition, CALO should implement protective measures for non-breeding piping plovers. For example, areas with foraging and roosting habitat should be fenced off and protected by symbolic fencing at a distance sufficient to avoid disturbance

to the birds. The NPS should coordinate with the USFWS to develop and implement measures to protect non-breeding piping plovers.

2. CALO should implement a protocol to monitor potential take due to predators that are attracted to human-supplied trash, fish offal, or human presence. For example, the number of tracks of each potential predator species should be counted along transects perpendicular to the shoreline at 750 foot intervals in the early morning hours two days prior to the expected reopening of any brood/chick area that has been closed for 10 days or more. Sampling along the same transects at the same time of day should be repeated one week following re-opening. The resulting data may provide information on the association of predators and people and their effects on piping plover nesting.

***Seabeach amaranth***

1. During its annual survey in late July or early August, CALO should systematically record the following population information: number of plants; general distribution (GPS coordinates of general areas where the plants occur); general proportions of seedlings, medium and large plants at the time of survey; and, overall health (signs of stress, damage, disease or herbivory, etc). A report compiling the survey data should be provided to the USFWS's Raleigh Field Office by December 31 of the year in which the data were collected. The report should include the number of miles of beach surveyed, the survey dates, and the number of person hours invested in the survey.

2. The NPS should conduct research on the effects of ORV use on seabeach amaranth recruitment, germination, growth and reproduction. Control areas where ORV use is not allowed could be compared to similar habitat where ORV use occurs.

***Sea Turtles***

1. The National Park Service should coordinate with the USFWS and the North Carolina Wildlife Resources Commission to develop and implement measures to further minimize beach lighting threats.

2. CALO should explore developing a permit program to manage and monitor vehicle use of the beaches. Such a program, if limited in the number of permits issued and the type of activity allowed, could substantially reduce the frequency and intensity of disturbance to federally protected species while possibly allowing greater access.

3. The NPS should conduct research on the effects of ORV use on sea turtles, such as nesting success and hatching success. Control areas where ORV use is not allowed could be compared to similar habitat where ORV use occurs. CALO should coordinate with the USFWS and the North Carolina Wildlife Resources Commission in the development of a study to explore such effects.

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

## REINITIATION NOTICE

This concludes formal consultation on the action(s) outlined in the December 21, 2005 request for formal consultation. As provided in 50 CFR §402.16, reinitiation of formal consultation is required where discretionary NPS involvement or control over the action has been retained (or is authorized by law) and if:

(1) the amount or extent of incidental take, which will be monitored by the NPS's implementation of the Plan, is exceeded;

(2) new information reveals effects of the NPS's action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion;

(3) the NPS's action is later modified in a manner that causes an effect to the listed species or critical habitat not considered in this opinion; or,

(4) a new species is listed or critical habitat designated that may be affected by the action.

In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending reinitiation.

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Table 1. Number of breeding pairs of piping plovers observed at CALO between 1992 and 2005.

| | 1992 | 1993 | 1994 | 1995 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ocracoke Inlet | 2 | 0 | 2 | 2 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| Portsmouth Flats | 8 | 9 | 7 | 8 | 17 | 15 | 9 | 11 | 9 | 8 | 6 | 4 | 6 |
| Kathryn-Jane Flats | 11 | 9 | 12 | 11 | 10 | 8 | 2 | 1 | 1 | 2 | 1 | 1 | 2 |
| Old Drum Inlet | 2 | 1 | 1 | 2 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |
| New Drum Inlet (NCB) | 5 | 9 | 10 | 6 | 3 | 2 | 3 | 1 | 2 | 2 | 2 | 2 | 3 |
| New Drum Inlet (SCB) | 3 | 4 | 5 | 4 | 2 | 3 | 3 | 2 | 3 | 2 | 2 | 2 | 2 |
| Plover Inlet (Mile 23.6) | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 4 | 8 |
| Cape Point | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 4 |
| Power Squadron Spit | 2 | 3 | 2 | 2 | 1 | 2 | 1 | 0 | 0 | 0 | 1 | 0 | 1 |
| Shackleford Banks | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| **CALO Total** | **33** | **35** | **39** | **35** | **36** | **32** | **21** | **16** | **16** | **15** | **14** | **13** | **27** |

Table 2. Number of seabeach amaranth plants recorded from CALO.

| Year | North Core Banks | South Core Banks | Shackleford Banks | **CALO Total** |
|---|---|---|---|---|
| 1993 | 82 | 1208 | 975 | **2265** |
| 1994 | 63 | 641 | 948 | **1652** |
| 1995 | 30 | 45 | 1155 | **1230** |
| 1996 | 1 | 0 | 3 | **4** |
| 1997 | 2 | 0 | 51 | **53** |
| 1998 | 121 | 4 | 369 | **494** |
| 1999 | 2 | 0 | 9 | **11** |
| 2000 | 0 | 4 | 13 | **17** |
| 2001 | 8 | 43 | 126 | **177** |
| 2002 | 2 | 69 | 261 | **332** |
| 2003 | 1 | 205 | 1354 | **1560** |
| 2004 | 1 | 78 | 58 | **137** |
| 2005 | 0 | 284 | 669 | **953** |

Table 3. Sea turtle nesting and hatching summary from CALO (1990 to 2005).

| Year | No. Nests | No. Relocated | No. Excavated | Avg. Clutch | No. Flooded | Avg. Incubation (days) | No. Eggs | No. Eggs Emerged | EMR % |
|---|---|---|---|---|---|---|---|---|---|
| 1990 | 99 | 68 | 89 | 115 | 1 | 57 | 10,376 | 7,369 | 71% |
| 1991 | 89 | 56 | 74 | 115 | 6 | 62 | 8,393 | 5,197 | 62% |
| 1992 | 90 | 39 | 84 | 114 | 4 | 63 | 9,419 | 6,791 | 73% |
| 1993 | 99 | 54 | 89 | 115 | 9 | 59 | 10,365 | 7,544 | 74% |
| 1994 | 124 | 98 | 119 | 120 | 3 | 62 | 14,459 | 11,296 | 79% |
| 1995 | 119 | 66 | 103 | 115 | 38 | 57 | 12,357 | 6,157 | 51% |
| 1996 | 95 | 69 | 85 | 115 | 16 | 65 | 10,091 | 5,602 | 57% |
| 1997 | 124 | 92 | 120 | 122 | 3 | 63 | 14,824 | 10,740 | 73% |
| 1998 | 198 | 117 | 169 | 114 | 39 | 62 | 19,672 | 13,315 | 69% |
| 1999 | 242 | 123 | 191 | 116 | 90 | 62 | 23,224 | 11,751 | 53% * |
| 2000 | 190 | 120 | 176 | 111 | 2 | 67 | 19,527 | 13,471 | 69% |
| 2001 | 119 | 60 | 106 | 113 | 5 | 65 | 12,358 | 9,555 | 79% |
| 2002 | 123 | 56 | 115 | 119 | 7 | 61 | 13,657 | 10,758 | 79% |
| 2003 | 161 | 66 | 138 | 119 | 45 | 65 | 16,440 | 10,067 | 61%** |
| 2004 | 77 | 34 | 75 | 104 | 36 | 64 | 7,309 | 3,139 | 43% |
| 2005 | 142 | 49 | 112 | 111 | 54 | 60 | 12,423 | 6,569 | 53% |

*does not include 37 nests washed away with unknown egg totals

**does not include 20 nests washed away with unknown egg totals

Figure 1.  Map of CALO, inclusive of the action areas as defined for the species evaluated in this biological opinion.

Figure 2.  Abundance of breeding pairs of piping plovers at Atlantic Coast National Park Service Units, including CALO, for 1989, 2003, 2004, and 2005.

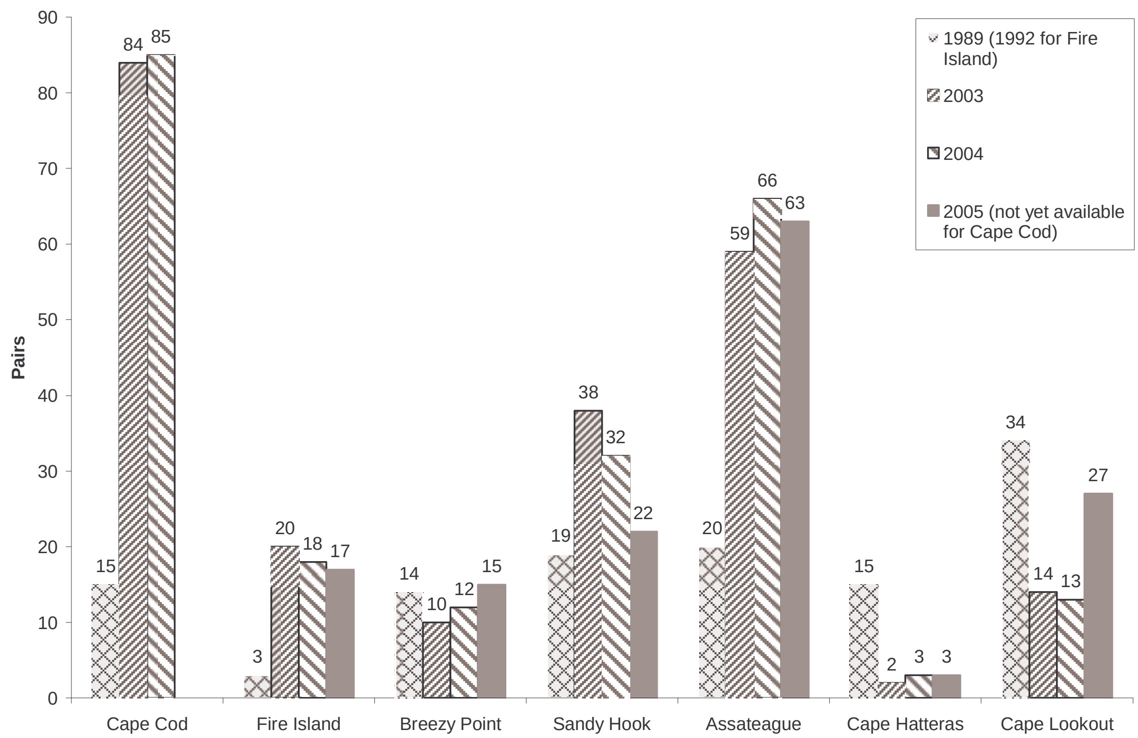

Figure 3. Abundance of breeding pairs of piping plovers by Atlantic Coast States for 1989, 2004, and 2005.