United States Department of the Interior

FISH AND WILDLIFE SERVICE
South Florida Ecological Services Office
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February 22, 2013

Colonel Alan M. Dodd
District Commander
U.S. Army Corps of Engineers
Post Office Box 4970
Jacksonville, Florida 32232-0019

Service Federal Activity Code:	41420-2010-CPA-0395
Corps Application No.:	SAJ-1996-02789 (IP-LAE)
Date Received:	June 1, 2010
Formal Consultation Initiation Date:	September 21, 2012
Project:	Clam Pass dredging for estuary ecological improvements
Applicant:	Collier County, Pelican Bay Services Division
County:	Collier

Dear Colonel Dodd:

This document transmits the U.S. Fish and Wildlife Service's (Service) Biological Opinion to the U.S. Army Corps of Engineers (Corps) based on our review of a proposal to dredge the Clam Pass basin and channel for ecological improvement of the estuary, with placement of beach compatible dredge material along the shoreline north and south of Clam Pass, in Collier County, Florida. This document will address potential effects of the proposed project on the threatened piping plover (*Charadrius melodus*), threatened loggerhead sea turtle (*Caretta caretta*), endangered leatherback sea turtle (*Dermochelys coriacea*), endangered green sea turtle (*Chelonia mydas*), endangered hawksbill sea turtle (*Eretmochelys imbricata*), endangered Kemp's ridley sea turtle (*Lepidochelys kempii*), and endangered West Indian manatee (*Trichechus manatus*). This document is provided in accordance with section 7 of the Endangered Species Act of 1973, as amended (Act) (87 Stat. 884; 16 U.S.C. 1531 *et seq.*).

In the Corps' letter dated September 23, 2011, the Corps determined the proposed project "may affect, but is not likely to adversely affect," the piping plover and requested initiation of informal consultation. Although there are no known monitoring efforts conducted specifically for piping plover in the proposed project area, Collier County is a known historic wintering area for piping plover, and suitable foraging and roosting habitat exists within and adjacent to the proposed project area. Thus, the Service did not concur with the Corps' determination and we requested they initiate formal consultation on this species.

This Biological Opinion is based on information provided in the Corps' letter and Public Notice dated June 1, 2010, and April 23, 2010, respectively; a revised project application dated January 25, 2013, and correspondence with the Corps, National Oceanic Atmospheric Administration's National Marine Fisheries Service (NOAA Fisheries), and the Florida Fish and Wildlife Conservation Commission (FWC). A complete administrative record of this consultation is on file at the South Florida Ecological Services Office, Vero Beach, Florida.

FISH AND WILDLIFE RESOURCES

This section is provided in accordance with the Fish and Wildlife Coordination Act of 1958, as amended (48 Stat. 401; 16 U.S.C. 661 et seq.) to address other fish and wildlife resources in the project area.

Hardbottom Reef Habitat and Seagrasses

On August 25, 2009 and June 12 and 19, 2012, Turrell, Hall, and Associates conducted submerged resource surveys within, outside, and through the pass. The surveys covered the shoreline, through the pass, and extended approximately 500 feet offshore from the pass. The objective of the surveys was to locate any submerged resources within or adjacent to the proposed project boundaries. The surveys consisted of a series of transects which were conducted by skin diving, SCUBA diving, or walking. The locations of observed submerged resources were geo-referenced and delineated on an aerial photograph of the proposed project area. Identification and percent coverage of all biological resources were recorded.

Inside Clam Pass

The substrate inside the pass consisted of primarily sand, silt, and small amounts of shell hash; red mangroves (*Rhizophora mangle*) were present along the shoreline. Shoal grass (*Halodule beaudettei*) was observed at 30 to 40 percent coverage between Stations 17+00 and 18+00 in the 2009 survey, but the density varied between 10 to 95 percent. In addition, shoal grass was observed outside of the proposed dredging template. Eight shoots of turtle grass (*Thalassia testudinum*) were observed in the 2009 survey near Station 16+50, which represented less than 1 percent coverage. Turtle grass was not documented in the 2012 survey. A variety of fishes, including mangrove snapper (*Lutjanus griseus*), snook (*Centropomus undecimalis*), striped mullet (*Mugil cephalus*), sheepshead (*Archosargus probatocephalus*), and southern flounder (*Paralichthys lethostigma*), were observed in the water column along the transects inside the pass. Blue crabs (*Callinectes sapidus*), Florida fighting conch (*Strombus alatus*), southern clams (*Mercenaria campechiensis*), and a variety of tritons and welchs were observed in the sand/silt substrate on the south bank inside the pass.

Through Clam Pass

The substrate inside the pass consisted of sand and large quantities of shell hash and shell fragments. Red mangroves were present along the shoreline in the eastern portion of this area and transitioned to a sand shoreline toward the mouth of the pass. Mangrove snapper and striped mullet were observed in the water column. No seagrass, bivalves, or other significant biological resources were observed on or within the substrate in this area in the 2009 survey. During the

2012 survey, a small patch of *Caulerpa prolifera* and a few shoots of *Halodule* spp. were documented. The shoot density of the *Caulerpa prolifera* and *Halodule* was between 1 and 2 percent, and less than 1 percent, respectively.

Outside Clam Pass

The substrate in this area consisted primarily of fine sand with some scattered shell hash. Sand dollars (*Leodia sexiesperforata*) in densities between 25 and 50 percent, and 5 and 15 percent, were documented in the 2009 and 2012 surveys, respectively. Additional biological resources observed in this area included green alga (*Calerpa* spp.) at less than 1 percent cover.

No hardbottom communities (*e.g.,* hard coral, rock outcropping, oysters) were observed within the proposed dredging or sand fill templates. The minimum distance between nearshore hardbottom habitat and the equilibrium toe of fill associated with the proposed north and south fill templates is 160 and 255 feet, respectively.

On June 14, 2010, and August 24, 2012, site visits were conducted by Atkins, the Corps, and the NOAA Fisheries. The NOAA Fisheries determined that no seagrass was present within the proposed dredge template footprint, and that there would be no impact to seagrass. Furthermore, the NOAA Fisheries concluded that any adverse effects that might occur on marine and anadromous fishery resources would be minimal, and therefore, the NOAA Fisheries does not object to issuance of the permit. In addition, Collier County, Pelican Bay Services Division (Applicant) will conduct a seagrass survey within the proposed dredge footprint prior to the proposed dredging event. The Corps will consult with the NOAA Fisheries, who will assess all potential impacts to nearshore hardbottom reef habitat and seagrasses within the dredge template, sand placement fill template, and shoreline downdrift area.

No seagrass or hardbottom reef habitat impacts are anticipated as a result of the proposed project. That said, the Applicant shall be liable for any unauthorized impacts. For any impacts caused by construction activities, seagrass or hardbottom restoration or mitigation may be required, which will be coordinated through the Corps, NOAA Fisheries, and the Service.

Consultation History

On April 26, 2010, the Service received a copy of the Corps' Public Notice dated April 23, 2010, concerning a proposed maintenance dredging, sand placement, and ecological restoration project in and adjacent to Clam Pass, Collier County, Florida.

On June 1, 2010, the Service received a letter dated June 1, 2010, concerning the proposed project outlined in their April 23, 2010, Public Notice.

On June 15, 2010, the Service emailed the Corps a request for additional information.

On May 10, 2011, the Service received additional information from the Corps.

On May 24, 2011, the Service received an email and a copy of the Corps' modified Public Notice dated May 13, 2011. The Public Notice was amended because the Applicant requested to add an additional sand fill template directly north of Clam Pass.

On June 6, 2011, the Service emailed the Corps to inquire whether or not the Corps and Applicant would agree to implement the Reasonable and Prudent Measures and Terms and Conditions in the Statewide Programmatic Biological Opinion (SPBO) (Service 2011) concerning the West Indian manatee and nesting sea turtles.

On August 16, 2011, the Service received an email from the Corps stating that all elements of the project will conform to the Reasonable and Prudent Measures and Terms and Conditions outlined in the SPBO.

On September 21, 2011, the Service emailed the Corps a second request for additional information.

On September 23, 2011, the Service received additional information from the Corps.

On October 3, 2011, the Service sent an email to the Corps verifying that both the Corps and Applicant will comply with all seven commitments to reduce impacts to piping plover as outlined in the SPBO. Later, the Corps sent an email to the Service stating that they agree to fulfill the seven commitments to the extent practicable

On November 30, 2011, the Service sent an email to the Corps informing them that we did not concur with their piping plover determination and requested that they initiate formal consultation concerning the potential effects of the proposed project on piping plovers.

On November 26, 2012, as requested by the Corps and Applicant, a draft copy of the Biological Opinion was provided for their review and comment prior to completing formal consultation.

On December 10, 2012, the Corps provided comments to the Service concerning the draft Biological Opinion via email.

On December 19, 2012, the Corps informed the Applicant that they were withdrawing the current application.

On January 25, 2013, the Applicant reactivated the application and requested a Nationwide 27 permit authorization to conduct a one-time dredging and sand placement event.

BIOLOGICAL OPINION

DESCRIPTION OF THE PROPOSED ACTION

The Applicant proposes to dredge approximately 21,000 cubic yards (cy) of beach compatible sand from Clam Pass basin and channel, Collier County, Florida (Figure 1). The intent of the

proposed dredging project is to aid in tidal flushing and water quality in order to maintain and enhance ecological improvements to the estuary outlined in the July 8, 1998, Clam Bay Restoration and Management Plan.

Using a combination of hydraulic and mechanical dredges, approximately 1,800 linear feet of Clam Pass basin and channel will be dredged between Stations 0+00 and 17+50 (Figure 2). The proposed dredge template elevation is -5.8 feet North American Vertical Datum (NAVD) (Figure 2). A 0.5-foot over-dredge allowance will be authorized. The profile of all dredge cuts will consist of a 1 vertical foot : 1 horizontal foot slope. A 45-foot wide (bottom width) entrance cut will be mechanically dredged, which will allow access for a shallow-draft, barge-mounted hydraulic dredge inside Clam Pass. All excavated and dredged beach compatible material will be loaded into all-terrain dump trucks using front end loaders, deposited within the fill template (Florida Department of Environmental Protection [DEP] reference monument R-39+733 feet to R-41, and R-42+180 feet to R-44+100 feet [total fill template is approximately 0.60 mile]), and graded using bulldozers or other appropriate grading equipment, to the permitted design fill profile (1 vertical foot : 10 horizontal feet slope with an elevation of +6.1 and +6.6 feet NAVD in the north and south fill template, respectively). Construction vehicles will either access the shoreline at one of two beach corridors located approximately 2.4 and 2 miles north and south of Clam Pass, respectively (Figures 3) or may be delivered directly to the site by barge. All sand placed within the fill template must be approved by the DEP and meet all requirements as outlined in the Florida Administrative Code subsection 62B-41.007. Although not anticipated, any non-beach compatible material will be stockpiled on the upland and ultimately disposed of landward of the Coastal Construction Control Line at the Collier County Landfill.

Construction vehicles and equipment may traverse or be stored at the staging areas, stockpile area, and/or within the pipeline corridor. Existing vegetated habitat at these sites and corridors shall be protected to the maximum extent practicable. Any impacted vegetation at each of these sites and corridors shall be restored to preconstruction conditions. In addition, if heavy equipment and vehicles are required to traverse the dry beach above the mean high water line, the path will be tilled to 3 feet to avoid compaction impacts prior to the following sea turtle nesting season.

The proposed estuary improvement event is expected to take approximately 1 to 2 months to complete, and may take place 24 hours a day, 7 days a week.

Action area

The action area is defined as all areas to be affected directly or indirectly by the action and not merely the immediate area involved in the action. The Service identifies the action area to include the dredge template, sand fill template (0.60 mile), beach corridors, pipeline corridors, shoreline downdrift (0.5 mile), staging areas, and the upland disposal site. The project is located along the Gulf of Mexico, in Collier County, Florida, at latitude 26.2197 and longitude -81.8169.

STATUS OF THE SPECIES/CRITICAL HABITAT

Species/critical habitat description

The piping plover is a small, pale sand-colored shorebird, about 7 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 (Service 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). Piping plover subspecies are phenotypically indistinguishable, and most studies in the nonbreeding range report results without regard to breeding origin. Although a recent analysis shows strong patterns in the wintering distribution of piping plovers from different breeding populations, partitioning is not complete and major information gaps persist. Therefore, information summarized here pertains to the species as a whole (*i.e.*, all three breeding populations), except where a particular breeding population is specified.

Critical habitat

The Service has designated critical habitat for the piping plover on three occasions. Two of these designations protected different piping plover breeding populations. Critical habitat for the Great Lakes breeding population was designated May 7, 2001 (66 Federal Register [FR] 22938, Service 2001a), and critical habitat for the northern Great Plains breeding population was designated September 11, 2002 (67 FR 57637, Service 2002). The Service designated critical habitat for wintering piping plovers on July 10, 2001 (66 FR 36038; Service 2001a). 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 as well as diversity of constituent elements between breeding and wintering populations.

Designated wintering piping plover critical habitat originally included 142 areas (the rule states 137 units; this is an error) encompassing approximately 1,793 miles of mapped shoreline and 165,211 acres of mapped areas along the coasts of North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana, and Texas. Since the designation of wintering critical habitat, 19 units (TX-3, 4, 7-10, 14-19, 22, 23, 27, 28, and 31-33) in Texas have been vacated and remanded back to the Service for reconsideration by Court order (*Texas General Land Office vs. U.S. Department of Interior* [Case No. V-06-CV-00032]). On May 19, 2009, the Service published a final rule designating 18 revised critical habitat units in Texas, totaling approximately 139,029 acres (74 FR 23476).

The Courts vacated and remanded back to the Service for reconsideration, four units in North Carolina (*Cape Hatteras Access Preservation Alliance vs. U.S. Department of Interior* [344 F.

Supp. 2d 108 D.D.C. 2004]). The four critical habitat units vacated were NC-1, 2, 4, and 5, and all occurred within Cape Hatteras National Seashore. A revised designation for these four units was published on October 21, 2008 (73 FR 62816). On February 6, 2009, Cape Hatteras Access Preservation Alliance and Dare and Hyde Counties, North Carolina, filed a legal challenge to the revised designation. A final decision has not been made on the North Carolina challenge to date.

The primary constituent elements (PCEs) for piping plover wintering habitat are those biological and physical features that are essential to the conservation of the species. The PCEs are those habitat components that support foraging, roosting, and sheltering, and the physical features necessary for maintaining the natural processes that support these habitat components. PCEs typically include those coastal areas that support intertidal beaches and flats, and associated dune systems and flats above annual high tide (Service 2001b). PCEs of wintering piping plover critical habitat include sand or mud flats or both with no or sparse emergent vegetation. Adjacent unvegetated or sparsely vegetated sand, mud, or algal flats above high tide are also important, especially for roosting piping plovers (Service 2001b). Important components of the beach/dune ecosystem include surf-cast algae, sparsely vegetated back beach and salterns, spits, and washover areas. Washover areas are broad, unvegetated zones, with little or no topographic relief, that are formed and maintained by the action of hurricanes, storm surge, or other extreme wave action. The units designated as critical habitat are those areas that have consistent use by piping plovers and that best meet the biological needs of the species. The amount of wintering habitat included in the designation appears sufficient to support future recovered populations, and the existence of this habitat is essential to the conservation of the species. Additional information on each specific unit included in the designation can be found at 66 FR 36038 (Service 2001b).

Feeding areas

Plovers forage on moist substrate features such as intertidal portions of ocean beaches, washover areas, mudflats, sand flats, algal flats, shoals, wrack lines, sparse vegetation, and shorelines of coastal ponds, lagoons, and ephemeral pools, and adjacent to salt marshes (Gibbs 1986; Zivojnovich 1987; Nicholls 1989; Coutu et al. 1990; Nicholls and Baldassarre 1990a; Nicholls and Baldassarre 1990b; Hoopes et al. 1992; Loegering 1992; Goldin 1993a; Elias-Gerken 1994; Wilkinson and Spinks 1994; Zonick 1997; Service 2001b). 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). Cohen et al. (2008) documented more abundant prey items and biomass on sound island and sound beaches than the ocean beach. Ecological Associates Incorporated [EAI] (2009) observed that, during piping plover surveys conducted at St Lucie Inlet, Martin County, Florida, intertidal mudflats and/or shallow subtidal grassflats appeared to have greater value as foraging habitat than the unvegetated intertidal areas of a flood shoal.

Foraging/food

Behavioral observations of piping plovers on the wintering grounds suggest that they spend the majority of their time foraging (Nicholls and Baldassarre 1990a; Drake 1999a, 1999b). Feeding activities may occur during all hours of the day and night (Staine and Burger 1994; Zonick

1997), and at all stages in the tidal cycle (Goldin 1993a; Hoopes 1993). Wintering plovers primarily feed on invertebrates such as polychaete marine worms, various crustaceans, fly larvae, beetles, and occasionally bivalve mollusks (Bent 1929; Cairns 1977; Nicholls 1989; Zonick and Ryan 1996) found on top of the soil or just beneath the surface.

Habitat

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

Recent study results in North Carolina, South Carolina, and Florida complement information from earlier investigations in Texas and Alabama (summarized in the 1996 Atlantic Coast and 2003 Great Lakes Recovery Plans) regarding habitat use patterns of piping plovers in their coastal migration and wintering range. As documented in Gulf Coast studies, nonbreeding piping plovers in North Carolina primarily used sound (bay or bayshore) beaches and sound islands for foraging and ocean beaches for roosting, preening, and being alert (Cohen et al. 2008). The probability of piping plovers being present on the sound islands increased with increasing exposure of the intertidal area (Cohen et al. 2008). Maddock et al. (2009) observed shifts to roosting habitats and behaviors during high-tide periods in South Carolina.

Seven years of surveys, two to three times per month, along 8 miles of Gulf of Mexico (ocean-facing) beach in Gulf County, Florida, cumulatively documented nearly the entire area used at various times by roosting or foraging piping plovers. Birds were reported using the midbeach to the intertidal zone. Numbers ranged from 0 to 39 birds on any given survey day (Eells unpublished data).

As observed in Texas studies, Lott et al. (2009) identified bay beaches (bay shorelines as opposed to ocean-facing beaches) as the most common landform used by foraging piping plovers in southwest Florida. However in northwest Florida, Smith (2007) reported landform use by foraging piping plovers about equally divided between Gulf of Mexico (ocean-facing) and bay beaches. Exposed intertidal areas were the dominant foraging substrate in South Carolina (accounting for 94 percent of observed foraging piping plovers; Maddock et al. 2009) and in northwest Florida (96 percent of foraging observations; Smith 2007). In southwest Florida, Lott et al. (2009) found approximately 75 percent of foraging piping plovers on intertidal substrates.

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

There are no routine shorebird monitoring efforts conducted in the proposed action area; however, some data exists based on a beach nourishment project conducted along portions of Vanderbilt Beach, Park Shore Beach, and Naples City Beach in 2006. These surveys were conducted by the Conservancy of Southwest Florida between February 10 and May 30, 2006, (construction phase) and from June 1, 2006, to September 30, 2008 (post-construction). The bi-monthly surveys documented a total of 25 species and a total of 5,410 birds (Addison 2008). Although no piping plovers were observed during these surveys, piping plover PCEs are present throughout the proposed action area.

Recent geographic analysis of piping plover distribution on the upper Texas coast noted major concentration areas at the mouths of rivers, washover passes (low, sparsely vegetated barrier island habitats created and maintained by temporary, storm-driven water channels), and major bay systems (Arvin 2008). Earlier studies in Texas have drawn attention to washover passes, which are commonly used by piping plovers during periods of high bayshore tides and during the spring migration period (Zonick 1997; Zonick 2000). Elliott-Smith et al. (2009) reported piping plover concentrations on exposed seagrass beds and oyster reefs during seasonal low water periods in 2006.

The effects of dredge material deposition merit further study. Drake et al. (2001) concluded conversion of southern Texas mainland bayshore tidal flats to dredged material impoundments results in a net loss of habitat for wintering piping plovers because impoundments eventually convert to upland habitat not utilized by piping plovers. Zonick et al. (1998) reported dredged material placement areas along the intracoastal waterway in Texas were rarely used by piping plovers, and noted concern that dredge islands block wind-driven water flows which are critical to maintaining important shorebird habitats. By contrast, most of the sound islands used by foraging piping plovers at Oregon Inlet were created by the Corps through deposition of dredged material in the subtidal bay bottom, with the most recent deposition ranging from 28 to less than 10 years prior to the study (Cohen et al. 2008).

Mean home range size (95 percent of locations) for 49 radio-tagged piping plovers in southern Texas in 1997 through 1998 was 3,113 acres, mean core area (50 percent of locations) was 717 acres, and the mean linear distance moved between successive locations (1.97 $\pm$ 0.04 days apart) averaged across seasons, was 2.1 miles (Drake 1999a; Drake et al. 2001). Seven radio-tagged piping plovers used a 4,967-acre area (100 percent minimum convex polygon) at Oregon Inlet in 2005 and 2006, and piping plover activity was concentrated in 12 areas totaling 544 acres (Cohen et al. 2008). Noel and Chandler (2008) observed high fidelity of banded piping plovers along a 0.62 and 2.8 mile section of beach on Little St. Simons Island, Georgia.

Migration

Plovers depart their breeding grounds for their wintering grounds between July and late August, but southward migration extends through November. Piping plovers use habitats in Florida primarily from July 15 through May 15. Both spring and fall migration routes of Atlantic Coast breeders are believed to occur primarily within a narrow zone along the Atlantic Coast (Service 1996). The pattern of both fall and spring counts at many Atlantic Coast sites demonstrates

many piping plovers make intermediate stopovers lasting from a few days up to 1 month during their migrations (Noel and Chandler 2005; Stucker and Cuthbert 2006). Some midcontinent 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). The source breeding population of a given wintering individual cannot be determined in the field unless it has been banded or otherwise marked. Information from observation of color-banded piping plovers indicates that the winter ranges of the breeding populations overlap to a significant degree. See the *Status and Distribution* section for additional information pertaining to population distribution on the wintering grounds. While piping plover migration patterns and needs remain poorly understood and occupancy of a particular habitat may involve shorter periods relative to wintering, information about the energetics of avian migration indicates that this might be a particularly critical time in the species' life cycle.

Natural protection

Cryptic coloration is a primary defense mechanism for piping plovers where nests, adults, and chicks all blend in with their typical beach surroundings. Piping plovers on wintering and migration grounds respond to intruders (*e.g.*, pedestrian, avian, and mammalian) usually by squatting, running, and flushing (flying).

Roosting

Several studies identified wrack (organic material including seaweed, seashells, driftwood, and other materials deposited on beaches by tidal action) as an important component of roosting habitat for nonbreeding piping plovers. Lott et al. (2009) found greater than 90 percent of roosting piping plovers in southwest Florida in old wrack with the remainder roosting on dry sand. In South Carolina, 18 and 45 percent of roosting piping plovers were in fresh and old wrack, respectively. The remainder of roosting birds used intertidal habitat (22 percent), backshore (defined as the zone of dry sand, shell, cobble and beach debris from the mean high water line up to the toe of the dune; 8 percent), washover (2 percent), and ephemeral pools (1 percent) (Maddock et al. 2009). Thirty percent of roosting piping plovers in northwest Florida were observed in wrack substrates, with 49 percent roosting on dry sand and 20 percent using intertidal habitat (Smith 2007). In Texas, seagrass debris (bayshore wrack) was an important feature of piping plover roosting sites (Drake 1999a). Mean abundance of two other plover species in California, including the listed western snowy plover, was positively correlated with an abundance of wrack during the nonbreeding season (Dugan et al. 2003).

Life history

Piping plovers live an average of 5 years, although studies have documented birds as old as 11 (Wilcox 1959) and 15 years. Piping plover breeding activity begins in mid-March when birds begin returning to their nesting areas (Coutu et al. 1990; Cross 1990; Goldin et al. 1990; MacIvor 1990; Hake 1993). Plovers are known to begin breeding as early as 1 year of age (MacIvor 1990; Haig 1992); however, the percentage of birds that breed in their first adult year is unknown. Piping plovers generally fledge only a single brood per season, but may re-nest several times if previous nests are lost.

The most consistent finding in the various population viability analyses conducted for piping plovers (Ryan et al. 1993; Melvin and Gibbs 1996; Plissner and Haig 2000; Wemmer et al. 2001; Larson et al. 2002; Amirault et al. 2005; Calvert et al. 2006; Brault 2007) indicates even small declines in adult and juvenile survival rates will cause increases in extinction risk. A banding study conducted between 1998 and 2004 in Atlantic Canada concluded lower return rates of juvenile (first year) birds to the breeding grounds than was documented for Massachusetts (Melvin and Gibbs 1994), 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 in abundance despite 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). This suggests maximizing productivity does not ensure population increases.

Efforts to partition survival within the annual cycle are beginning to receive more attention, but current information remains limited. Drake et al. (2001) observed no mortality among 49 radio-tagged piping plovers (total of 2,704 transmitter days) in Texas in 2007 and 2008. Cohen et al. (2008) documented no mortality of 7 radio-tagged wintering piping plovers at Oregon Inlet from December 2005 to March 2006. They speculate their high survival rate was attributed to plover food availability much of the day as well as the low occurrence of days below freezing and infrequent wet weather. Analysis of South Carolina resighting data for 87 banded piping plovers (78 percent Great Lakes breeders) in 2006 and 2007, and 2007 and 2008, found 100 percent survival from December to April (Cohen 2009). However, of those birds, one unique and one nonuniquely banded piping plover were seen in the first winter and resighted multiple times in the second fall at the same location, but not seen during the second winter. Whether these two birds died in the fall or shifted their wintering location is unknown (Maddock et al. 2009). Noel et al. (2007) inferred two winter (November to February) mortalities among 21 banded (but not radio-tagged) overwintering piping plovers in 2003 through 2004, and 9 mortalities among 19 overwintering birds during the winter of 2004 through 2005 at Little St. Simons Island, Georgia. Noel et al. (2007) inferred mortality if a uniquely banded piping plover with multiple November to February sightings on the survey site disappeared during that time and was never observed again in either its nonbreeding or breeding range. Note that most of these birds were from the Great Lakes breeding population, where detectability during the breeding season is very high. LeDee (2008) found higher apparent survival rates during breeding and southward migration than during winter and northward migration for 150 adult (*i.e.*, after-hatch year) Great Lakes piping plovers. "Apparent survival" does not account for permanent emigration. If marked individuals leave a survey site, apparent survival rates will be lower than true survival. If a survey area is sufficiently large, such that emigration out of the site is unlikely, apparent survival will approach true survival.

Mark-recapture analysis of resightings of uniquely banded piping plovers from seven breeding areas by Roche et al. (2009) found apparent adult survival declined in four populations and did not increase over the life of the studies (data were analyzed for 3 to 11 years per breeding area between 1998 and 2008). Some evidence of correlation in year-to-year fluctuations in annual survival of Great Lakes and eastern Canada populations, both of which winter primarily along the southeastern U.S. Atlantic Coast, suggests shared over-wintering and/or migration habitats may influence annual variation in survival. Further concurrent mark-resighting analysis of color-banded individuals across piping plover breeding populations has the potential to shed light on threats that affect survival in the migration and wintering range.

Population dynamics

The 2006 International Piping Plover Breeding Census, the last comprehensive survey throughout the breeding grounds, documented 3,497 breeding pairs with a total of 8,065 birds throughout Canada and the U.S, and a total of 454 in Florida (Elliott-Smith et al. 2009). The surveys covered approximately 760.5 miles and included 186 sites (Elliott-Smith et al 2009). As the Atlantic Coast is not included in the action area, the breakdown for the Gulf Coast of Florida is: 321 piping plovers at 117 sites covering approximately 522 miles of suitable habitat (Elliott-Smith et al 2009).

Numbers for Florida can be further broken down into 3 regions along the Gulf Coast. The northwest Florida census area in the panhandle extends from the Alabama line to Jefferson County, the north Florida census area from Taylor County south to Manatee County, and southwest Florida from Sarasota County south to Key West National Wildlife Refuge. Northwest Florida numbers for the 2006 International Piping Plover Census were 111, with an increased survey effort from previous years. This represents an increase from the 53 piping plovers sighted in the 2001 effort. North Florida reported 96 birds and estimated an additional 40 from missing data sheets. There were 74 piping plovers located in southwest Florida as compared to 50 in the 2001 effort (Elliott-Smith et al 2009). The mainland portion of Monroe County is, technically, on the Gulf Coast of Florida; however, the predominant habitat is mangrove shoreline and no piping plovers were sighted at the survey location on Pavilion Key.

Atlantic Coast population

The Atlantic Coast piping plover breeds on coastal beaches from Newfoundland and southeastern Quebec to North Carolina. Historical population trends for the Atlantic Coast piping plover have been reconstructed from scattered, largely qualitative records. Nineteenth-century naturalists, such as Audubon and Wilson, described the piping plover as a common summer resident on Atlantic Coast beaches (Haig and Oring 1987). However, by the beginning of the twentieth 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 (MBTA) 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 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 (Service 1996). There was little focus on gathering quantitative data on piping plovers in Massachusetts through the late 1960s because the species was commonly observed and presumed to be secure. However, numbers of piping plover breeding pairs declined 50 to 100 percent at seven Massachusetts sites between the early 1970s and 1984 (Griffin and Melvin 1984). Piping plover surveys in the early years of the recovery effort found counts of these cryptically colored birds sometimes increased with increased census effort, suggesting some historic counts of piping plovers by one or more observers may have underestimated the piping plover population. Thus, the magnitude of the species decline may have been more severe than available numbers imply.

The New England recovery unit population has exceeded (or been within three pairs of) its 625-pair abundance goal since 1998, attaining a postlisting high of 711 pairs in 2008. The New York-New Jersey recovery unit reached 586 pairs in 2007, surpassing its 575-pair goal for the first time; however, in 2008, abundance dipped to 554 pairs. The Southern recovery unit, which attained 333 and 331 pairs in 2007 and 2008, respectively, has not yet reached its 400-pair goal.

The Eastern Canada recovery unit has experienced the lowest population growth (9 percent net increase between 1989 and 2008), despite higher overall productivity than in the U.S. The highest postlisting abundance estimate was 274 pairs in 2002, with a 2008 estimate of 253 pairs, placing this recovery unit furthest from its goal (400 pairs).

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. Great Lakes piping plovers nest on wide, flat, open, sandy or cobble shoreline with very little grass or other vegetation. Reproduction is adversely affected by human disturbance of nesting areas and predation by foxes, gulls, crows and other avian species. Shoreline development, such as the construction of marinas, breakwaters, and other navigation structures, has adversely affected nesting and brood rearing.

The Recovery Plan (Service 2003a) set a population goal of at least 150 pairs (300 individuals), for at least 5 consecutive years, with at least 100 breeding pairs (200 individuals) in Michigan and 50 breeding pairs (100 individuals) distributed among sites in other Great Lakes states. In 2008, the current Great Lakes piping plover population was estimated at 63 breeding pairs (126 individuals). Of these, 53 pairs were found nesting in Michigan, while 10 were found outside the state, including 6 pairs in Wisconsin and 4 in Ontario. The 53 nesting pairs in Michigan represent approximately 50 percent of the recovery criterion. The 10 breeding pairs outside Michigan in the Great Lakes basin represent 20 percent of the goal, albeit the number of breeding pairs outside Michigan has continued to increase over the past 5 years. The single breeding pair discovered in 2007 in the Great Lakes region of Canada represented the first confirmed piping plover nest there in over 30 years, and in 2008 the number of nesting pairs further increased to four.

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

The International Piping Plover Census, conducted every 5 years, also estimates the number of piping plover pairs in the Northern Great Plains. None of the International Piping Plover Census estimates suggest that the Northern Great Plains population has yet satisfied the recovery criterion of 2,300 pairs (Table 1).

The International Piping Plover Census results in prairie Canada reported 1,703 adult birds in 2006, well short of the goal of 2,500 adult piping plover as stated in the Service's Recovery Plan (Service 1988).

Status and distribution

Nonbreeding (migrating and wintering)

Piping plovers spend up to 10 months of their life cycle on their migration and at wintering grounds, generally July 15 through as late as May 15. Piping plover migration routes and habitats overlap breeding and wintering habitats, and, unless banded, migrants passing through a site usually are indistinguishable from breeding or wintering piping plovers. Migration stopovers by banded piping plovers from the Great Lakes have been documented in New Jersey, Maryland, Virginia, and North Carolina (Stucker and Cuthbert 2006). Migrating breeders from eastern Canada have been observed in Massachusetts, New Jersey, New York, and North Carolina (Amirault et al. 2005). As many as 85 staging piping plovers have been tallied at various sites in the Atlantic breeding range (Perkins 2008), but the composition (*e.g.,* adults that nested nearby and their fledged young of the year versus migrants moving to or from sites farther north), stopover duration, and local movements are unknown. In general, distance between stopover locations and duration of stopovers throughout the coastal migration range remains poorly understood.

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

Piping plovers migrate through and winter in coastal areas of the U.S. from North Carolina to Texas and in portions of Mexico and the Caribbean. Data based on four rangewide mid-winter (late January to early February) population surveys, conducted at 5-year intervals starting in 1991, show that total numbers have fluctuated over time, with some areas experiencing increases and others decreases (Table 2). Regional and local fluctuations may reflect the quantity and quality of suitable foraging and roosting habitat, which vary over time in response to natural coastal formation processes as well as anthropogenic habitat changes (*e.g.,* inlet relocation, dredging of shoals and spits). Fluctuations may also represent localized weather conditions (especially wind) during surveys, or unequal survey coverage. For example, airboats facilitated first-time surveys of several central Texas sites in 2006 (Elliott-Smith et al. 2009). Similarly, the increase in the 2006 numbers in the Bahamas is attributed to greatly increased census efforts; the extent of additional habitat not surveyed remains undetermined (Elliott-Smith et al. 2009). Changes in wintering numbers may also be influenced by growth or decline in the particular

breeding populations that concentrate their wintering distribution in a given area. Opportunities to locate previously unidentified wintering sites are concentrated in the Caribbean and Mexico (Elliott-Smith et al. 2009). Further surveys and assessment of seasonally emergent habitats (*e.g.,* seagrass beds, mudflats, oyster reefs) within bays lying between the mainland and barrier islands in Texas are also needed.

Midwinter surveys may underestimate the abundance of nonbreeding piping plovers using a site or region during other months. In late September 2007, 104 piping plovers were counted at the south end of Ocracoke Island, North Carolina (National Park Service [NPS] 2007), where none were seen during the 2006 International Piping Plover Winter Census (Elliott-Smith et al. 2009). Noel et al. (2007) observed up to 100 piping plovers during peak migration at Little St. Simons Island, Georgia, where approximately 40 piping plovers wintered in 2003 to 2005. Differences among fall, winter, and spring counts in South Carolina were less pronounced, but inter-year fluctuations (*e.g.,* 108 piping plovers in spring 2007 versus 174 piping plovers in spring 2008) at 28 sites were striking (Maddock et al. 2009). Even as far south as the Florida Panhandle, monthly counts at Phipps Preserve in Franklin County ranged from a midwinter low of four piping plovers in December 2006, to peak counts of 47 in October 2006 and March 2007 (Smith 2007). Pinkston (2004) observed much heavier use of Texas Gulf Coast (ocean-facing) beaches between early September and mid-October (approximately 16 birds per mile) than during December to March (approximately 2 birds per mile).

Local movements of non-breeding piping plovers may also affect abundance estimates. At Deveaux Bank, one of South Carolina's most important piping plover sites, 5 counts at approximately 10-day intervals between August 27 and October 7, 2006, oscillated from 28 to 14 to 29 to 18 to 26 (Maddock et al. 2009). Noel and Chandler (2008) detected banded Great Lakes piping plovers known to be wintering on their Georgia study site in 73.8 $\pm$ 8.1 percent of surveys over 3 years.

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

Gratto-Trevor et al. (2009) found strong patterns (but no exclusive partitioning) in winter distribution of uniquely banded piping plovers from four breeding populations (Figure 4). All eastern Canada and 94 percent of Great Lakes birds wintered from North Carolina to southwest Florida. However, eastern Canada birds were more heavily concentrated in North Carolina, and a larger proportion of Great Lakes piping plovers were found in South Carolina and Georgia. Northern Great Plains populations were primarily seen farther west and south, especially on the Texas Gulf Coast. Although the great majority of Prairie Canada individuals were observed in Texas, particularly southern Texas, individuals from the U.S. Great Plains were more widely distributed on the Gulf Coast from Florida to Texas.

The findings of Gratto-Trevor et al. (2009) provide evidence of differences in the wintering distribution of piping plovers from these four breeding areas. However, the distribution of birds

by breeding origin during migration remains largely unknown. Other major information gaps include the wintering locations of the U.S. Atlantic Coast breeding population (banding of U.S. Atlantic Coast piping plovers has been extremely limited) and the breeding origin of piping plovers wintering on Caribbean islands and in much of Mexico.

Banded piping plovers from the Great Lakes, Northern Great Plains, and eastern Canada breeding populations showed similar patterns of seasonal abundance at Little St. Simons Island, Georgia (Noel et al. 2007). However, the number of banded plovers originating from the latter two populations was relatively small at this study area.

This species exhibits a high degree of intra- and interannual wintering site fidelity (Nicholls and Baldassarre 1990a; Drake et al. 2001; Noel and Chandler 2005; Stucker and Cuthbert 2006). Gratto-Trevor et al. (2009) reported that 6 of 259 banded piping plovers observed more than once per winter moved across boundaries of the seven U.S. regions. Of 216 birds observed in different years, only 8 changed regions between years, and several of these shifts were associated with late summer or early spring migration periods (Gratto-Trevor et al. 2009). Total number of individuals observed on the wintering grounds was 46 for Eastern Canada, 150 for the U.S. Great Lakes, 169 for the U.S. Great Plains, and 356 for Prairie Canada.

Local movements are more common. In South Carolina, Maddock et al. (2009) documented many cross-inlet movements by wintering banded piping plovers as well as occasional movements of up to 11.2 miles by approximately 10 percent of the banded population. Larger movements within South Carolina were seen during fall and spring migration. Similarly, eight banded piping plovers that were observed in two locations during 2006 and 2007 surveys in Louisiana and Texas were all in close proximity to their original location (Maddock 2008).

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 (Texas to Florida), while 8 percent winter along the Atlantic Coast (North Carolina to Florida).

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

The 2004 and 2005 hurricane seasons affected a substantial amount of habitat along the Gulf Coast. Habitats such as those along Gulf Islands National Seashore have benefited from increased washover events which created optimal habitat conditions for piping plovers. Conversely, hard shoreline structures are put into place following storms throughout the species range to prevent such shoreline migration (see *Factors Affecting the Species Habitat within the Action Area*). Four hurricanes between 2002 and 2005 are often cited in reference to rapid erosion of the Chandeleur Islands, a chain of low-lying islands in Louisiana where the 1991

International Piping Plover Census tallied more than 350 piping plovers. Comparison of imagery taken 3 years before and several days after Hurricane Katrina found that the Chandeleur Islands lost 82 percent of their surface area (Sallenger et al. in review), and a review of aerial photography prior to the 2006 Census suggested little piping plover habitat remained (Elliott-Smith et al. 2009). However, Sallenger et al. (in review) noted that habitat changes in the Chandeleurs stem not only from the effects of these storms, but rather from the combined effects of the storms, long-term (greater than 1,000 years) diminishing sand supply, and sea level rise relative to the land.

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

Recovery criteria

Northern Great Plains population (Service 1988, 1994)

1. Increase the number of birds in the U.S. northern Great Plains states to 2,300 pairs (Service 1994).
2. Increase the number of birds in the prairie region of Canada to 2,500 adult piping plovers (Service 1988).
3. Secure long term protection of essential breeding and wintering habitat (Service 1994).

Great Lakes population (Service 2003a)

1. At least 150 pairs (300 individuals), for at least 5 consecutive years, with at least 100 breeding pairs (200 individuals) in Michigan and 50 breeding pairs (100 individuals) distributed among sites in other Great Lakes states.
2. Five-year average fecundity within the range of 1.5 to 2.0 fledglings per pair, per year, across the breeding distribution, and 10-year population projections indicate the population is stable or continuing to grow above the recovery goal.
3. Protection and long-term maintenance of essential breeding and wintering habitat is ensured, sufficient in quantity, quality, and distribution to support the recovery goal of 150 pairs (300 individuals).

4. Genetic diversity within the population is deemed adequate for population persistence and can be maintained over the long-term.
5. Agreements and funding mechanisms are in place for long-term protection and management activities in essential breeding and wintering habitat.

Atlantic Coast population (Service 1996)

1. Increase and maintain for 5 years a total of 2,000 breeding pairs, distributed among four recovery units.

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

2. Verify the adequacy of a 2,000 pair population of piping plovers to maintain heterozygosity and allelic diversity over the long term.
3. Achieve a 5-year average productivity of 1.5 fledged chicks per pair in each of the four recovery units described in criterion 1, based on data from sites that collectively support at least 90 percent of the recover unit's population.
4. Institute long-term agreements to assure protection and management sufficient to maintain the population targets and average productivity in each recovery unit.
5. Ensure long-term maintenance of wintering habitat, sufficient in quantity, quality, and distribution to maintain survival rates for a 2,000-pair population.

Threats to piping plovers

In the following sections, threats to piping plovers in their migration and wintering range is provided. This information has been updated since the 1985 listing rule, the 1991 status review, and the three breeding population recovery plans. Previously identified and new threats are discussed. With minor exceptions, this analysis is focused on threats to piping plovers within the continental U.S. portion of their migration and wintering range. Threats in the Caribbean and Mexico remain largely unknown.

Present or threatened destruction, modification, or curtailment of its habitat or range

The 1985 final rule stated the number of piping plovers on the Gulf of Mexico coastal wintering grounds might be declining, as indicated by preliminary analysis of the Christmas Bird Count data. Independent counts of piping plovers on the Alabama coast indicated a decline in numbers between the 1950s and early 1980s. At the time of listing, the Texas Parks and Wildlife Department stated that 30 percent of wintering habitat in Texas had been lost over the previous 20 years. The final rule also stated, in addition to extensive breeding area problems, the loss and modification of wintering habitat was a significant threat to the piping plover.

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

Priority 1 actions in the 1996 Atlantic Coast and 2003 Great Lakes Recovery Plans identify tasks to protect natural processes that maintain coastal ecosystems and quality wintering piping plover habitat, and to protect wintering habitat from shoreline stabilization and navigation projects. The 1988 Northern Great Plains Plan states as winter habitat is identified, current and potential threats to each site should be determined.

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

Any assessment of threats to piping plovers from loss and degradation of habitat must recognize that up to 24 shorebird species migrate or winter along the Atlantic Coast and almost 40 species of shorebirds are present during migration and wintering periods in the Gulf of Mexico region (Helmers 1992). Continual degradation and loss of habitats used by wintering and migrating shorebirds may cause an increase in intra-specific and inter-specific competition for remaining food supplies and roosting habitats. For example, in Florida approximately 825 miles of coastline and parallel bayside flats (unspecified amount) were present prior to the advent of high human densities and beach stabilization projects. We estimate only about 35 percent of the Florida coastline continues to support natural coastal formation processes, thereby concentrating foraging and roosting opportunities for all shorebird species and forcing some individuals into suboptimal habitats. Thus, intra- and interspecific competition most likely exacerbates threats from habitat loss and degradation.

Exotic/invasive vegetation

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

Beach vitex (*Vitex rotundifolia*) is a woody vine introduced into the southeastern U.S. as a dune stabilization and ornamental plant (Westbrooks and Madsen 2006). It currently occupies a very

small percentage of its potential range in the U.S.; however, it is expected to grow well in coastal communities throughout the southeastern U.S. from Virginia to Florida, and west to Texas (Westbrooks and Madsen 2006). In 2003, the plant was documented in New Hanover, Pender, and Onslow counties in North Carolina, and at 125 sites in Horry, Georgetown, and Charleston counties in South Carolina. One Chesapeake Bay site in Virginia was eradicated, and another site on Jekyll Island, Georgia, is about 95 percent controlled (Suiter 2009). Beach vitex has been documented from two locations in northwest Florida, but one site disappeared after erosional storm events. The landowner of the other site has indicated an intention to eradicate the plant, but follow through is unknown (Farley 2009). Task forces formed in North and South Carolina in 2004 and 2005 have made great strides to remove this plant from their coasts. To date, about 200 sites in North Carolina have been treated, with 200 additional sites in need of treatment. Similar efforts are underway in South Carolina.

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

The Australian pine (*Casuarina equisetifolia*) changes the vegetative structure of the coastal community in south Florida and islands within the Bahamas. Shorebirds prefer foraging in open areas where they are able to see potential predators, and tall trees provide good perches for avian predators. Australian pines potentially affect shorebirds, including the piping plover, by reducing attractiveness of foraging habitat and/or increasing avian predation.

The propensity of these exotic species to spread, and their tenacity once established, make them a persistent threat, partially countered by increasing landowner awareness and willingness to undertake eradication activities.

Groins

Groins (structures made of concrete, rip rap, wood, or metal built perpendicular to the beach in order to trap sand) are typically found on developed beaches with severe erosion. Although groins can be individual structures, they are often clustered along the shoreline. Groins act as barriers to longshore sand transport and cause downdrift erosion, which prevents piping plover habitat creation by limiting sediment deposition and accretion (Hayes and Michel 2008). These structures are found throughout the southeastern Atlantic Coast, and, although most were in place prior to the piping plover's 1986 Act listing, installation of new groins continues to occur.

Inlet stabilization/relocation

Many navigable mainland or barrier island tidal inlets along the Atlantic and Gulf of Mexico coasts are stabilized with jetties, groins, seawalls, and/or adjacent industrial or residential development. Jetties are structures built perpendicular to the shoreline that extend through the entire nearshore zone and past the breaker zone (Hayes and Michel 2008) to prevent or decrease sand deposition in the channel. Inlet stabilization with rock jetties and associated channel dredging for navigation alter the dynamics of longshore sediment transport and affect the location and movement rate of barrier islands (Camfield and Holmes 1995), typically causing downdrift erosion. Sediment is then dredged and added back to islands which are subsequently

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

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

Tidal inlet relocation can cause loss and/or degradation of piping plover habitat, although less permanent than construction of hard structures where effects can persist for years. For example, a project on Kiawah Island, South Carolina, degraded one of the most important piping plover habitats in the State by reducing the size and physical characteristics of an active foraging site, changing the composition of the benthic community, decreasing the tidal lag in an adjacent tidal lagoon, and decreasing the exposure time of the associated sand flats (Service and Town of Kiawah Island unpublished data). In 2006, preproject piping plover numbers in the project area recorded during four surveys conducted at low tide averaged 13.5 piping plovers. This contrasts with a postproject average of 7.1 plovers during eight surveys (four in 2007 and four in 2008) conducted during the same months (Service and Town of Kiawah Island unpublished data). Service biologists are aware of at least seven inlet relocation projects (two in North Carolina, three in South Carolina, two in Florida), but this number likely under represents the extent of this activity.

Sand mining/dredging

Sand mining, the practice of dredging sand from sand bars, shoals, and inlets in the nearshore zone, is a less expensive source of sand than obtaining sand from offshore shoals for beach nourishment. Sand bars and shoals are sand sources that move onshore over time and act as natural breakwaters. Inlet dredging reduces the formation of exposed ebb and flood tidal shoals considered to be primary or optimal piping plover roosting and foraging habitat. Removing these sand sources can alter depth contours and change wave refraction as well as cause localized erosion (Hayes and Michel 2008). Exposed shoals and sandbars are also valuable to piping plovers, as they tend to receive less human recreational use (because they are only accessible by boat) and therefore provide relatively less disturbed habitats for birds. An accurate estimate of the amount of sand mining that occurs across the piping plover wintering range, or the number of inlet dredging projects that occur is not available. This number is likely greater than the number of total jettied inlets shown in Table 3, since most jettied inlets need maintenance dredging, but non-hardened inlets are often dredged as well.

Sand placement projects

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

nourishment projects deposit substantial amounts of sand along Gulf of Mexico and Atlantic beaches to protect local property in anticipation of preventing erosion and what otherwise will be considered natural processes of overwash and island migration (Schmitt and Haines 2003).

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

Lott et al. (in review) documented an increasing trend in sand placement events in Florida (Figure 5). Approximately 358 miles of 825 miles (43 percent) of Florida's sandy beach coastline were nourished from 1959 to 2006 (Table 4), with some areas being nourished multiple times. In northwest Florida, the Service consulted on first time sand placement projects along 46 miles of shoreline in 2007 to 2008, much of which occurred on public lands (Gulf Islands National Seashore [Service 2007a], portions of St. Joseph State Park [Service 2007b], and Eglin Air Force Base ([Service 2008a]).

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

Seawalls and revetments

Seawalls and revetments are vertical hard structures built parallel to the beach in front of buildings, roads, and other facilities to protect them from erosion. However, these structures often accelerate erosion by causing scouring in front of and downdrift from the structure (Hayes and Michel 2008), which can eliminate intertidal foraging habitat and adjacent roosting habitat. Physical characteristics that determine microhabitats and biological communities can be altered after installation of a seawall or revetment, thereby depleting or changing composition of benthic communities that serve as the prey base for piping plovers. At four California study sites, each comprised of an unarmored segment and a segment seaward of a seawall, Dugan and Hubbard (2006) found armored segments had narrower intertidal zones, smaller standing crops of macrophyte wrack, and lower shorebird abundance and species richness. Geotubes (long cylindrical bags made of high strength permeable fabric and filled with sand) are softer alternatives, but act as barriers by preventing overwash.

Wrack removal and beach cleaning

Wrack on beaches and baysides provides important foraging and roosting habitat for piping plovers (Drake 1999a; Smith 2007; Lott et al. 2009; Maddock et al. 2009) and many other shorebirds on their winter, breeding, and migration grounds. Because shorebird numbers are positively correlated with wrack cover and biomass of their invertebrate prey that feed on wrack (Tarr and Tarr 1987; Dugan et al. 2003; Hubbard and Dugan 2003), beach grooming will lower bird abundance (Defreo et al. 2009).

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

Manmade beach cleaning and raking machines effectively remove seaweed, fish, glass, syringes, plastic, cans, cigarettes, shells, stone, wood, and virtually any unwanted debris (Barber Beach Cleaning Equipment 2011). These efforts remove accumulated wrack, topographic depressions, and sparse vegetation nodes used by roosting and foraging piping plovers. Removal of wrack also eliminates a beach's natural sand trapping abilities, further destabilizing the beach. In addition, sand adhering to seaweed and trapped in the cracks and crevices of wrack is removed from the beach. Although the amount of sand lost due to single sweeping actions may be small, it adds up considerably over a period of years (Nordstrom et al. 2006; Neal et al. 2007). Beach cleaning or grooming can result in abnormally broad unvegetated zones that are inhospitable to dune formation or plant colonization, thereby enhancing the likelihood of erosion (Defreo et al. 2009). Tilling beaches to reduce soil compaction, as sometimes required by the Service for sea turtle protection after beach nourishment activities, has similar effects. Recently, the Service improved sea turtle protection provisions in Florida. These provisions now require tilling, when needed, to be conducted above the primary wrack line, not within it.

Currently, the DEP's Beaches and Coastal Management Systems section has issued 117 permits for beach raking or cleaning to multiple entities. The Service estimates that 240 of 825 miles (29 percent) of sandy beach shoreline in Florida are cleaned or raked on various (*i.e.*, daily, weekly, monthly) schedules (Teich 2009). Service biologists estimate South Carolina mechanically cleans approximately 34 of its 187 shoreline miles (18 percent), and Texas mechanically cleans approximately 20 of its 367 shoreline miles (5.4 percent). The percentage of mechanical cleaning that occurs in piping plover critical habitat is unknown.

Overutilization for commercial, recreational, scientific or educational purposes

The 1985 final listing rule found no evidence to suggest this factor is a threat to piping plovers while on migration or winter grounds. The various recovery plans state hunting in the late 1800s may have severely reduced piping plover numbers. The plans did not identify hunting as an existing threat to piping plovers wintering in the U.S., as take is prohibited pursuant to the MBTA. No credible information indicates hunting is a threat in the U.S. or in other countries. Based on the current information, overutilization is not a threat to piping plovers on their wintering and migration grounds.

Disease and predation

Disease

Neither the final listing rule nor the recovery plans state disease is an issue for piping plover, and no plan assigns recovery actions to this threat factor. Based on information available to date, West Nile virus and avian influenza are a minor threat to piping plovers (Service 2009).

Predation

The effect of predation on migrating or wintering piping plovers remains largely undocumented. Except for one incident involving a cat in Texas (NY Times 2007), no predation of piping plovers during winter or migration has been noted. Avian and mammalian predators are common throughout the species' wintering range. Predatory birds are relatively common during fall and spring migration, and it is possible raptors occasionally take piping plovers (Drake et al. 2001). It has been noted, however, the behavioral response of crouching when in the presence of avian predators may minimize avian predation on piping plovers (Morrier and McNeil 1991; Drake 1999b; Drake et al. 2001). The 1996 Atlantic Coast Recovery Plan summarized evidence that human activities affect types, abundance, and activity patterns of some predators, thereby exacerbating natural predation on breeding piping plovers. Nonbreeding piping plovers may reap some collateral benefits from predator management conducted for the primary benefit of other species. In 1997, the U.S. Department of Agriculture implemented a public lands predator control partnership in northwest Florida that included the Department of Defense, NPS, the State of Florida (state park lands), and the Service (National Wildlife Refuges and Ecological Services). The program continues with all partners except Florida. In 2008, lack of funding precluded inclusion of Florida state lands; however, DEP staff do occasionally conduct predator trapping on state lands, although trapping is not implemented consistently.

The NPS and individual state park staff in North Carolina participate in predator control programs (Rabon 2009). The Service issued permit conditions for raccoon eradication to Indian River County staff in Florida as part of a coastal Habitat Conservation Plan (HCP) (Adams 2009). Destruction of turtle nests by dogs or coyotes in Indian River County justified the need to amend the permit to include an education program targeting dog owners regarding the appropriate means to reduce affects to coastal species caused by their pets. The Service partnered with Texas Audubon and the Coastal Bend Bays and Estuaries Program in Texas to implement predator control efforts on colonial waterbird nesting islands (Cobb 2009). Some of these predator control programs may provide very limited protection to piping plovers should they use these areas for roosting or foraging (Table 5). The Service is not aware of any current predator control programs targeting protection of coastal species in Georgia, Alabama, Mississippi, or Louisiana.

Regarding predation, the magnitude of this threat to non-breeding piping plovers remains unknown, but given the pervasive, persistent, and serious effects of predation on other coastal reliant species, it remains a potential threat. Focused research to confirm these effects as well as to ascertain effectiveness of predator control programs may be warranted, especially in areas frequented by Great Lakes birds during migration and wintering months. The Service considers predator control on their wintering and migration grounds to be a low priority at this time. The threat of direct predation should be distinguished from the threat of disturbance to roosting and feeding piping plovers posed by dogs off leash.

Other natural or manmade factors affecting its continued existence

Accelerating sea-level rise

Over the past 100 years, the globally-averaged sea level has risen approximately 3.9 to 9.8 inches (Rahmstorf 2007), a rate that is an order of magnitude greater than that seen in the past several thousand years (Hopkinson et al. 2008). The Intergovernmental Panel of Climate Change (IPCC) suggests by 2080 sea level rise could convert as much as 33 percent of the world's coastal wetlands to open water (IPCC 2007). Although rapid changes in sea level are predicted, estimated time frames and resulting water levels vary due to the uncertainty about global temperature projections and the rate of ice sheets melting and slipping into the ocean (IPCC 2007; Climate Change Science Program [CCSP] 2008).

Potential effects of sea level rise on coastal beaches may vary regionally due to subsidence or uplift as well as the geological character of the coast and nearshore (Galbraith et al. 2002; CCSP 2009). For example, in the last century sea level rise along the U.S. Gulf Coast exceeded the global average by 5.1 to 5.9 inches because coastal lands west of Florida are subsiding (U.S. Environmental Protection Agency [EPA] 2009). Low elevations and proximity to the coast make all nonbreeding coastal piping plover foraging and roosting habitats vulnerable to the effects of rising sea level. Furthermore, areas with small astronomical tidal ranges (*e.g.,* portions of the Gulf Coast where intertidal range is greater than 3.2 feet) are the most vulnerable to loss of intertidal wetlands and flats induced by sea level rise (EPA 2009). Sea level rise was cited as a contributing factor in the 68 percent decline in tidal flats and algal mats in the Corpus Christi area (*i.e.,* Lamar Peninsula to Encinal Peninsula) in Texas between the 1950s and 2004 (Tremblay et al. 2008). Mapping by Titus and Richman (2001) showed that more than 80 percent of the lowest land along the Atlantic and Gulf coasts was in Louisiana, Florida, Texas, and North Carolina, where 73.5 percent of all wintering piping plovers were tallied during the 2006 International Piping Plover Census (Elliott-Smith et al. 2009).

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

Modeling for three sea level rise scenarios (reflecting variable projections of global temperature rise) at five important U.S. shorebird staging and wintering sites predicted a loss of 20 to 70 percent of current intertidal foraging habitat (Galbraith et al. 2002). These authors estimated probabilistic sea level changes for specific sites partially based on historical rates of sea level change (from tide gauges at or near each site) which were then superimposed on projected 50 percent and 5 percent probability of global sea level changes by 2100 of 13.4 inches and 30.3 inches, respectively. The 50 percent and 5 percent probability sea level change projections were based on assumed global

temperature increases of 35.6° F (50 percent probability) and 40.5° F (5 percent probability). The most severe losses were projected at sites where the coastline is unable to move inland due to steep topography or seawalls. The Galbraith et al. (2002) Gulf Coast study site, Bolivar Flats, Texas, is a designated critical habitat unit known to host high numbers of piping plovers during migration and throughout the winter (*e.g.*, 275 individuals were tallied during the 2006 International Piping Plover Census; Elliott-Smith et al. 2009). Under the 50 percent likelihood scenario for sea level rise, Galbraith et al. (2002) projected approximately 38 percent loss of intertidal flats at Bolivar Flats by 2050; however, after initially losing habitat, the area of tidal flat habitat was predicted to increase slightly by the year 2100, because Bolivar Flats lacks armoring, and the coastline at this site can thus migrate inland. Although habitat losses in some areas are likely to be offset by gains in other locations, Galbraith et al. (2002) noted time lags may exert serious adverse effects on shorebird populations. Furthermore, even if piping plovers are able to move their wintering locations in response to accelerated habitat changes, there could be adverse effects on the birds' survival rates or reproductive fitness.

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

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

Contaminants

Contaminants have the potential to cause direct toxicity to individual birds or negatively affect their invertebrate prey base (Rattner and Ackerson 2008). Depending on the type and degree of contact, contaminants can have lethal and sub-lethal effects on birds, including behavioral impairment, deformities, and impaired reproduction (Rand and Petrocelli 1985; Gilbertson et al. 1991; Hoffman et al. 1996).

The Great Lakes plan states concentration levels of polychlorinated biphenol detected in Michigan piping plover eggs have the potential to cause reproductive harm. They further state analysis of prey available to piping plovers at representative Michigan breeding sites indicated breeding areas along the upper Great Lakes region are not likely the major source of contaminants to this population.

In 2000, mortality of large numbers of wading birds and shorebirds occurred following the County's aerial application of the organophosphate pesticide Fenthion for mosquito control purposes, including one piping plover at Audubon's Rookery Bay Sanctuary on Marco Island, Florida, (Williams 2001). Fenthion, a known toxin to birds, was registered for use as an avicide by Bayer chemical manufacturer. Subsequent to a lawsuit filed against the EPA in 2002, the manufacturer withdrew Fenthion from the market, and the EPA declared all uses were to end by November 30, 2004 (American Bird Conservancy 2011). All other counties in the U.S. now use less toxic chemicals for mosquito control. It is unknown whether pesticides are a threat for piping plovers wintering in the Bahamas, other Caribbean countries, or Mexico.

Petroleum products are the contaminants of primary concern, as opportunities exist for petroleum to pollute intertidal habitats that provide foraging substrate. Beach-stranded 55-gallon barrels and smaller containers, which may fall from moving cargo ships or offshore rigs and are not uncommon on the Texas coast, contain primarily oil products (gasoline or diesel), as well as other chemicals such as methanol, paint, organochlorine pesticides, and detergents (Lee 2009). Federal and state land managers have protective provisions in place to secure and remove the barrels, thus reducing the likelihood of contamination. Effects to piping plovers from oil spills have been documented throughout their life cycle (Chapman 1984; Service 1996; Burger 1997; Massachusetts Audubon 2003; Amirault-Langlais et al. 2007; Amos 2009). This threat persists due to the high volume of shipping vessels (from which most documented spills have originated) traveling offshore and within connected bays along the Atlantic Coast and the Gulf of Mexico. Additional risks exist for leaks or spills from offshore oil rigs, associated undersea pipelines, and onshore facilities such as petroleum refineries and petrochemical plants. Lightly oiled piping plovers have survived and successfully reproduced (Chapman 1984; Amirault-Langlais et al. 2007; Amos 2009). Chapman (1984) noted shifts in habitat use as piping plovers moved out of spill areas. This behavioral change was believed to be related to the demonstrated decline in benthic infauna (prey items) in the intertidal zone and may have decreased the direct effects to the species. To date, no plover mortality has been attributed to oil contamination outside the breeding grounds, but latent effects would be difficult to identify.

The Deepwater Horizon oil spill, which started April 20, 2010, discharged into the Gulf of Mexico through July 15, 2010. According to government estimates, the leak released between 100 and 200 million gallons of oil into the Gulf. The U.S. Coast Guard estimates that more than 50 million gallons of oil have been removed from the Gulf, or roughly a quarter of the spill amount. Additional effects to natural resources may be attributed to the 1.84 million gallons of dispersant applied to the spill. As of July 2010, approximately 625 miles of Gulf Coast shoreline was oiled (approximately 360 miles in Louisiana, 105 miles in Mississippi, 66 miles in Alabama and 94 miles in Florida) (Join Information Center 2010). These numbers reflect a daily snapshot of shoreline that experienced effects from oil; however, they do not include cumulative effects to date, or shoreline that has already been cleaned.

Piping plovers have continued to winter within the Gulf of Mexico shorelines. Researchers have and continue to document oiled piping plovers stemming from this spill. Oiling of designated piping plover critical habitat has been documented. Effects to the species and its habitat are expected, but their extent remains difficult to predict. The U.S. Coast Guard, the states, and responsible parties that comprise the Unified Command, with advice from Federal and State

natural resource agencies, initiate protective and cleanup efforts per prepared contingency plans to deal with petroleum and other hazardous chemical spills for each state's coastline. The contingency plans identify sensitive habitats, including all federally listed species' habitats, which receive a higher priority for response actions. Those plans allow for immediate habitat protective measures for cleanup activities in response to large contaminant spills. While such plans usually ameliorate the threat to piping plovers, it is yet unknown how much improvement will result in this case given the breadth of the effects associated with the Deepwater Horizon incident.

Based on all available data prior to the Deepwater Horizon oil spill, the risk of effects from contamination to piping plovers and their habitat was recognized, but the safety contingency plans were considered adequate to alleviate most of these concerns. The Deepwater Horizon incident has brought heightened awareness of the intensity and extent of impacts to fish and wildlife habitat from large-scale releases. In addition to potential direct habitat degradation from oiling of intertidal habitats and retraction of stranded boom, effects to piping plovers may occur from the increased human presence associated with boom deployment and retraction, cleanup activities, wildlife response, and damage assessment crews working along shorelines. Research studies are documenting the potential expanse of effects to the piping plover.

Military actions

Twelve coastal military bases are located in the Southeast (Table 7). To date, five bases have consulted with the Service under the Act, on military activities on beaches and baysides that may affect piping plovers or their habitat (Table 7). In 2002, Camp Lejeune in North Carolina consulted formally with the Service on troop activities, dune stabilization efforts, and recreational use of Onslow Beach. The permit conditions require bi-monthly (twice-monthly) piping plover surveys, use of buffer zones, and work restrictions within buffer zones.

Naval Station Mayport in Duval County, Florida, consulted with the Service on U.S. Marine Corps training activities that included beach exercises and use of amphibious assault vehicles. The affected area was not considered optimal for piping plovers and the consultation was concluded informally. Similar informal consultations have occurred with Tyndall Air Force Base (Bay County) and Eglin Air Force Base (Okaloosa and Santa Rosa Counties) in northwest Florida. Both consultations dealt with occasional use of motorized equipment on the beaches and associated baysides. Tyndall Air Force Base has minimal on-the-ground use, and activities, when conducted, occur on the Gulf of Mexico beach, which is not considered the optimal area for piping plovers within this region. Eglin Air Force Base conducts bi-monthly (twice-monthly) surveys for piping plovers, and habitats consistently documented with piping plover use are posted with avoidance requirements to minimize direct disturbance from troop activities. A 2001 consultation with the Navy for training exercises on the beach and retraction operations on Peveto Beach, Cameron Parish, Louisiana, concluded informally.

Overall, project avoidance and minimization actions currently reduce threats from military activities to wintering and migrating piping plovers to a minimal threat level. However, prior to removal of the piping plover from protection of the Act, Integrated Resource Management Plans or other agreements should clarify if and how a change in legal status would affect plover protections.

Recreational disturbance

Intense human disturbance in shorebird winter habitat can be functionally equivalent to habitat loss if the disturbance prevents birds from using an area (Goss-Custard et al. 1996), which can lead to roost abandonment and local population declines (Burton et al. 1996). Pfister et al. (1992) implicated anthropogenic disturbance as a factor in the long-term decline of migrating shorebirds at staging areas. Disturbance (*i.e.,* human and pet presence) that alters bird behavior can disrupt piping plovers as well as other shorebird species. Disturbance can cause shorebirds to spend less time roosting or foraging and more time in alert postures or fleeing from the disturbances (Johnson and Baldassarre 1988; Burger 1991, 1994; Elliott and Teas 1996; Lafferty 2001a, 2001b; Thomas et al. 2002), which limits the local abundance of piping plovers (Zonick and Ryan 1996; Zonick 2000). Shorebirds that are repeatedly flushed in response to disturbance expend energy on costly short flights (Nudds and Bryant 2000). Shorebirds are more likely to flush from the presence of dogs than people, and birds react to dogs from farther distances than people (Lafferty 2001a, 2001b; Thomas et al. 2002). Dogs off leash are more likely to flush piping plovers from farther distances than dogs on leash. Nonetheless, dogs both on and off leashes disturb piping plovers (Hoopes 1993). Pedestrians walking with dogs often go through flocks of foraging and roosting shorebirds; some even encourage their dogs to chase birds.

Off-road vehicles can significantly degrade piping plover habitat (Wheeler 1979) or disrupt the birds' normal behavior patterns (Zonick 2000). The 1996 Atlantic Coast recovery plan cites tire ruts crushing wrack into the sand, making it unavailable as cover or as foraging substrate (Goldin 1993b; Hoopes 1993). The plan also notes the magnitude of the threat from off-road vehicles is particularly significant because vehicles extend the effects to remote stretches of beach where human disturbance would otherwise be very slight. Lamont et al. (1997) postulated vehicular traffic along the beach may compact the substrate and kill marine invertebrates that are food for the piping plover. Zonick (2000) found the density of off-road vehicles negatively correlated with abundance of roosting piping plovers on the ocean beach. Cohen et al. (2008) found radio-tagged piping plovers using ocean beach habitat at Oregon Inlet in North Carolina were far less likely to use the north side of the inlet where off-road vehicle use is allowed, and recommended controlled management experiments to determine if recreational disturbance drives roost site selection. Ninety-six percent of piping plover detections were on the south side of the inlet even though it was farther away from foraging sites (1.1 miles from the sound side foraging site to the north side of the inlet versus 0.2 mile from the sound side foraging site to the north side of the inlet; Cohen et al. 2008).

Based on surveys with land managers and biologists, knowledge of local site conditions, and other information, the Service estimated the levels of eight types of disturbance at sites in the U.S. with wintering piping plovers. There are few areas used by wintering piping plovers that are devoid of human presence, and just under half have leashed and unleashed dog presence (Smith 2007; Lott et al. 2009; Maddock and Bimbi unpublished data; Table 8). Data are not available on human disturbance at wintering sites in the Bahamas, other Caribbean countries, or Mexico.

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

In South Carolina, 33 percent (13 out of 39) of sites surveyed during the 2007 and 2008 season had ≥ 5 birds. Of those 13 sites, 46.2 percent (6 out of 13) had ≥ 10 people present during surveys, and 61.5 percent (8 out of 13) allow dogs, indicating that South Carolina sites with the highest piping plover density are exposed to disturbance. Only 25.7 percent (9 out of 35) of sites in South Carolina prohibit dogs and restrict public access to the entire site or sections of sites used by piping plovers (Maddock and Bimbi unpublished data). Compliance with the restrictions at these sites is unknown.

LeDee (2008) collected survey responses in 2007 from 35 managers (located in seven states) at sites that were designated as critical habitat for wintering piping plovers. Ownership included Federal, State, and local governmental agencies and nongovernmental organizations managing National Wildlife Refuges; national, State, county, and municipal parks; State and estuarine research reserves; state preserves; state wildlife management areas; and other types of managed lands. Of 44 reporting sites, 40 allowed public beach access year-round and 4 sites were closed to the public. Of the 40 sites that allow public access, 62 percent of site managers reported greater than 10,000 visitors during September through March, and 31 percent reported greater than 100,000 visitors. Restrictions on visitor activities on the beach included automobiles (81 percent), all-terrain vehicles (89 percent), and dogs (50 percent) during the winter season. Half of the survey respondents reported funding as a primary limitation in managing piping plovers and other threatened and endangered species at their sites. Other limitations included "human resource capacity" (24 percent), conflicting management priorities (12 percent), and lack of research (3 percent).

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

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

Storm events

Although coastal piping plover habitats are storm-created and maintained, the 1996 Atlantic Coast Recovery Plan also noted that storms and severe cold weather may take a toll on piping plovers, and the 2003 Great Lakes Recovery Plan postulated that loss of habitats such as overwash passes or wrack, where birds shelter during harsh weather, poses a threat.

Storms are a component of the natural processes that form coastal habitats used by migrating and wintering piping plovers, and positive effects of storm-induced overwash and vegetation removal have been noted in portions of the wintering range. For example, Gulf Islands National Seashore habitats in Florida benefited from increased washover events that created optimal habitat conditions during the 2004 and 2005 hurricane seasons, with biologists reporting piping plover use of these habitats within 6 months of the storms (Nicholas 2005). In 2005, Hurricane Katrina overwashed the mainland beaches of Mississippi, creating many tidal flats where piping plovers were subsequently observed (Winstead 2008). Hurricane Katrina also created a new inlet and improved habitat conditions on some areas of Dauphin Island, Alabama (LeBlanc 2009). Conversely, localized storms, since Katrina, have induced habitat losses on Dauphin Island (LeBlanc 2009).

Noel and Chandler (2005) suspect that changes in habitat caused by multiple hurricanes along the Georgia coastline altered the spatial distribution of piping plovers and may have contributed to winter mortality of three Great Lakes piping plovers. Following Hurricane Ike in 2008, Arvin (2009) reported decreased numbers of piping plovers at some heavily eroded Texas beaches in the center of the storm affected area and increases in plover numbers at sites about 100 miles to the southwest. However, piping plovers were observed later in the season using tidal lagoons and pools that Ike created behind the eroded beaches (Arvin 2009).

The adverse effects on piping plovers attributed to storms are sometimes due to a combination of storms and other environmental changes or human use patterns. For example, four hurricanes between 2002 and 2005 are often cited in reference to rapid erosion of the Chandeleur Islands, a chain of low-lying islands in Louisiana where the 1991 International Piping Plover Census tallied more than 350 piping plovers. Comparison of imagery taken 3 years before and several days after Hurricane Katrina found the Chandeleur Islands lost 82 percent of their surface area (Sallenger et al. in review), and a review of aerial photography prior to the 2006 Census suggested little piping plover habitat remained (Elliott-Smith et al. 2009). However, Sallenger et al. (in review) noted habitat changes in the Chandeleur Islands stem not only from the effects of these storms, but rather from the combined effects of the storms, long-term (greater than 1,000 years) diminishing sand supply, and sea level rise relative to the land.

Other storm-induced adverse effects include poststorm acceleration of human activities such as beach nourishment, sand scraping, and berm and seawall construction. Such stabilization activities can result in the loss and degradation of feeding and resting habitats. Storms can also cause widespread deposition of debris along beaches. Removal of debris often requires large machinery, which can cause extensive disturbance and adversely affect habitat elements such as wrack. Another example of indirect adverse effects linked to a storm event is the increased access to Pelican Island (LeBlanc 2009) due to merging with Dauphin Island following a 2007 storm (Gibson et al. 2009).

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

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

Summary

Habitat loss and degradation on winter and migration grounds from shoreline and inlet stabilization efforts, both within and outside of designated critical habitat, remains a serious threat to all piping plover populations. In some areas, beaches that abut private property are needed by wintering and migrating piping plovers. However, residential and commercial developments that typically occur along private beaches may pose significant challenges for efforts to maintain natural coastal processes. The threat of habitat loss and degradation, combined with the threat of sea level rise associated with climate change, raise serious concerns regarding the ability of private beaches to support piping plovers over the long term.

Future actions taken on private beaches will determine whether piping plovers continue to use these beaches or whether the recovery of piping plovers will principally depend on public property. As Lott (2009) concludes, "The combination of development and shoreline protection seems to limit distribution of non-breeding piping plovers in Florida. If mitigation or habitat restoration efforts on barrier islands fronting private property are not sufficient to allow plover use of some of these areas, the burden for plover conservation will fall almost entirely on public land managers."

While public lands may not be at risk of habitat loss from private development, significant threats to piping plover habitat remain on many municipal, state, and federally owned properties. These public lands may be managed with competing missions that include conservation of imperiled species, but this goal frequently ranks below providing recreational enjoyment to the public, readiness training for the military, or energy development projects.

Public lands remain the primary places where natural coastal dynamics are allowed. Of recent concern are requests to undertake beach nourishment actions to protect coastal roads or military infrastructure on public lands. If project design does not minimize impediments to shoreline overwash, which are necessary to help replenish bayside tidal flat sediments and elevations, significant bayside habitat may become vegetated or inundated, thereby exacerbating the loss of preferred piping plover habitat. Conversely, if beach fill on public lands is applied in a way that allows for "normal" system overwash processes, and sediment is added back to the system, projects may be less injurious to barrier island species that depend on natural coastal dynamics.

Maintaining wrack for food and cover in areas used by piping plovers may help offset effects that result from habitat degradation due to sand placement associated with berm and beach

nourishment projects and ensuing human disturbance. Leaving wrack on private beaches may improve use by piping plovers, especially during migration when habitat fragmentation may have a greater effect on the species. In addition, using recreation management techniques, Great Lakes recovery action 2.14 may minimize the effects of habitat loss. Addressing off-road vehicles and pet disturbance may increase the suitability of existing piping plover habitat.

Analysis of the species/critical habitat likely to be affected

In a letter dated June 1, 2010, the Corps determined the proposed project "may affect" the threatened loggerhead sea turtle, endangered leatherback sea turtle, endangered green sea turtle, endangered hawksbill sea turtle, and endangered Kemp's ridley sea turtle, and "may affect, but is not likely to adversely affect", the endangered West Indian manatee.

On August 22, 2011, the Service issued a SPBO to the Corps to address potential adverse effects to nesting sea turtles, their nests and eggs, and hatchlings as they emerge from the nest and crawl to the sea, and the West Indian manatee as a result of sand placement activities proposed along the coast of Florida (Service 2011). The SPBO includes avoidance and minimization measures, Reasonable and Prudent Measures, and Terms and Conditions to ensure adverse effects to the covered species are avoided and minimized to the maximum extent practicable. Although the purpose of dredging Clam Pass basin and channel is for ecological improvements of the estuary, the dredging and sand placement activities associated with the proposed project are covered in the SPBO. The Applicant has agreed to implement the protection measures described in the SPBO. Therefore, the Service has determined the proposed project is consistent with the SPBO and the Service concurs with the Corps' determinations. The Reasonable and Prudent Measures and Terms and Conditions in section A of the SPBO will apply to the Corps and Applicant. This concludes our consultation for nesting sea turtles and West Indian manatees. Beach mice are not present in the action area. Based on this information, the Service concurs with the Corps' determinations listed above.

The proposed action has the potential to adversely affect wintering and migrating piping plovers and their habitat from all three populations that may use the action area. The Atlantic and Gulf Coast nesting population of piping plover is a component of the entity listed as threatened, which encompasses all breeding piping plovers (Great Plains and Atlantic) except the Great Lakes breeding population. Therefore, this Biological Opinion considers the potential effects of this project on this species and its designated critical habitat.

ENVIRONMENTAL BASELINE

Status of the species/critical habitat within the action area

There are no routine shorebird monitoring efforts conducted in the proposed action area; however, some data exists based on a beach nourishment project conducted along portions of Vanderbilt Beach, Park Shore Beach, and Naples City Beach in 2006. These surveys were conducted by the Conservancy of Southwest Florida between February 10 and May 30, 2006, (construction phase) and from June 1, 2006, to September 30, 2008 (post-construction). The bi-monthly surveys documented a total of 25 species and a total of 5,410 birds (Addison 2008). Although no piping plovers were observed during these surveys, piping plover PCEs are present throughout the proposed action area.

Efforts to avoid and reduce adverse effects

The Service often requests postproject surveys and eradication of coastal exotic plant species in Florida as permit conditions for beach berm or nourishment projects to reduce effects to piping plover habitat. Four recent Biological Opinions for sand placement events in Florida included requirements that restricted the removal of wrack to minimize project effects (Service 2007b, 2008c, 2008d, 2008e). A statewide consultation with the Federal Emergency Management Agency to minimize emergency berm repair and construction projects in Florida was completed in 2008 (Service 2008c).

Section 10(a)(2)(A) of the Act requires an applicant for an incidental take permit to submit a conservation plan that specifies, among other things, the effects that are likely to result in the taking and the measures the applicant will undertake to minimize and mitigate such effects.

Coordinated efforts for several large projects are currently underway. Florida Service field offices are engaged in statewide programmatic consultations on Florida coastal Corps projects and permitting (dredging, jetty maintenance, and nourishment). Also, DEP and FWC are drafting a statewide HCP for coastal actions permitted through the DEP. The primary purpose of this plan is to minimize or mitigate habitat effects associated with wrack removal, seawall installation, and geotube placement.

As noted above, some project sponsors have incorporated recommended avoidance and minimization measures. Nonetheless, considerable challenges remain. Other project sponsors have declined to implement Service conservation recommendations, citing financial costs and engineering restrictions.

Several projects have resulted in formal consultation for piping plovers or their designated critical habitat in Florida (Table 9).

Factors affecting the species environment within the action area

Prior to the development of the 1998 Clam Bay Restoration and Management Plan, Clam Pass was dredged in 1996 and 1997. In accordance with the Clam Bay Restoration and Management Plan adopted in 1998, DEP permit 0128463-001-JC and Corps permit 199602789 (IP-CC) authorized numerous channel maintenance dredging events in 1999, 2002, and 2007.

- 1996 - Clam Pass inlet and interior channel dredged by Collier County under DEP JCP Permit No. 112859039, issued on March 28, 1996.
- 1997 - Clam Pass dredged under a modification of the 1996 DEP permit 112859039.
- 1997 - Clam Bay Restoration and Management Plan Report submitted to DEP.
- 1998 - Maintenance dredging of the inlet completed to the 1996 specifications.
- 1998 - DEP permit 0128463-001-JC is granted.
- 1999 - Clam Pass dredged under DEP permit 0128463-001-JC, as part of the Clam Bay Restoration and Management Plan.
- 2002 - Maintenance dredging of the flood shoals completed to improve tidal circulation.
- 2007 - Maintenance dredging completed according to the 1999 specification, plus the entrance channel.

Based on dredging and sand placement activities, piping plovers have the potential to be affected due to habitat loss, sand placement, wrack removal, predation, contaminants, recreational disturbance, and storm events within the action area.

EFFECTS OF THE ACTION

Factors to be considered

Beach topography and morphology

The geomorphic characteristics of barrier islands, peninsulas, beaches, dunes, overwash fans, and inlets are critical to a variety of natural resources, and the geomorphic characteristics influence a barrier beach's ability to respond to wave action, including storm overwash and sediment transport. However, the protection or persistence of these important natural land forms, processes, and wildlife resources is often in conflict with shoreline projects. The manufactured berms and sand fill may impede overwash, thereby causing successional advances in the habitat that will reduce sand flat formation, and, therefore, its use by piping plovers in the project area.

Distribution

The Applicant proposes dredging and sand placement activities within Clam Pass basin and channel, and along 0.60 mile of shoreline, respectively, with the former to provide ecological improvement to the estuary. The Service expects the proposed construction activities could directly and indirectly affect the distribution of migrating and wintering piping plovers to roosting and foraging habitat within the action area.

Disturbance frequency and intensity

The proposed action has the potential to adversely affect piping plovers within the proposed action area during dredging and sand placement activities. The Service anticipates construction activities to have short-term and temporary effects on the piping plover populations. Piping plovers located within the action area are expected to move outside of the construction zone due to disturbance.

Duration

The timeframe associated with completion of the proposed dredging and excavation event is expected to be approximately 1 to 2 months, although this timeframe may vary depending on the amount of work necessary, weather conditions, and equipment mobilization and maintenance. Commencement of the proposed event is scheduled to occur in 2013.

Nature of the effect

Although the Service expects short-term effects from disturbance during project construction, it is anticipated the action will result in direct, indirect, and long term effects to piping plovers. The Service expects that there may be morphological changes to piping plover habitat due to the effects to loafing and foraging habitat, and optimal habitat within the action area. Activities that affect or alter the use of optimal habitat or increase disturbance to the species may decrease the survival and recovery potential of the piping plover.

Timing

The timing of the proposed dredging and sand placement project may occur completely or partially during the migration and wintering period for piping plovers (July 15 to May 15). The Service expects indirect effects to occur later in time.

Analyses for effects of the action

The proposed project includes dredging approximately 1,800 linear feet of Clam Pass basin and channel for ecological improvement of the estuary, and placing the beach compatible material along 0.60 mile of shoreline north and south of the Pass. If the dredged material is placed on the beach, it has the potential to elevate the beach berm and widen the beach, providing storm protection and increasing recreational space. Sand placement may occur in and adjacent to habitat that appears suitable for roosting and foraging piping plovers or that will become more optimal with time. Project construction may overlap with portions of piping plover winter and migration seasons. Short-term and temporary construction effects to piping plovers will occur if the birds are roosting and feeding in the area during a migration stopover. The deposition of sand may temporarily deplete the intertidal food base along the shoreline and temporarily disturb roosting birds during project construction. Tilling to loosen compaction of the sand (required to minimize sea turtle effects) may affect wrack that has accumulated on the beach. This affects feeding and roosting habitat for piping plovers since they often use wrack for cover and foraging.

Direct effects

The construction window (*i.e.,* sand placement, dredging) will extend through a portion of one piping plover migration and winter season. If the dredged material is placed on the beach, heavy machinery and equipment (*e.g.,* trucks and bulldozers), location of the dredge pipeline, and sand placement, may adversely affect migrating and wintering piping plovers in the action area by disturbing and disrupting normal activities such as roosting and feeding, and possibly forcing birds to expend valuable energy reserves to seek available habitat in adjacent areas along the shoreline. In addition, suffocation of invertebrate species will occur. Impacts will affect the entire fill template (0.60 mile) in the project area. Timeframes projected for benthic recruitment and re-establishment following sand placement are between 6 months and 2 years, depending on actual recovery rates. Effects will occur even if sand placement activities occur outside the piping plover migration and wintering seasons.

Indirect effects

The proposed project includes placing beach-compatible material dredged from Clam Pass basin and channel along 0.60 mile of shoreline. Indirect effects of reducing the potential for the formation of optimal habitats, especially along the shoreline, pose a concern to piping plover survival and recovery within the action area.

Eventually the shoreline within the fill template will reestablish and provide some feeding habitat for piping plovers, but these feeding areas are considered inferior to natural overwash and emergent shoal habitat that is likely to form within sections of the action area absent the proposed project.

Natural barrier islands need storms and overwash in order to maintain the physical and biological environments they support (Young et al. 2006). The removal of overwash processes will accelerate the successional state of the flats such that they will likely become vegetated within a few years (Leatherman 1988), thereby reducing the area's value to foraging and roosting piping plovers. The proposed project will perpetuate and contribute to the widespread activities that prevent the formation of these preferred early successional overwash habitats. The piping plover's rapid response to habitats formed by washovers from the hurricanes in 2004 and 2005 in the Florida panhandle at Gulf Islands National Seashore and Eglin Air Force Base's Santa Rosa Island, and similar observations of their preferences for overwash habitats at Phipps Preserve and Lanark Reef in Franklin County, Florida, and elsewhere in their range, demonstrate the importance of optimal habitats for wintering and migrating piping plovers.

At the same time the proposed project limits the creation of optimal foraging and roosting habitat, it increases recreational pressures within the project area. Recreational activities that have the potential to adversely affect piping plovers include disturbance by increased pedestrian use, often with dogs. Long-term effects could include a decrease in piping plover use of habitat due to increased disturbance levels.

Dredging Clam Pass basin and channel may potentially allow for an increase in boat traffic. Boating related activities, and the associated pedestrian and possible domestic canine presence, may adversely affect the foraging and roosting behavior of piping plovers.

Beneficial effects

There are no known beneficial effects to piping plovers or piping plover habitat from the proposed project.

Species' response to the proposed action

The Service bases this Biological Opinion on anticipated direct and indirect effects to piping plovers (wintering and migrating) as a result of dredging Clam Pass basin and channel, and sand placement, which prevents the maintenance or formation of habitat that piping plovers consider optimal for foraging and roosting. Heavy machinery and equipment, the placement of the dredge pipeline along the beach, and sand disposal may adversely affect migrating and wintering piping plovers in the project area by causing disturbance and disruption of normal activities such as roosting and foraging, and possibly forcing piping plovers to expend valuable energy reserves to seek available habitat elsewhere. In addition, foraging in suboptimal habitat by migrating and wintering piping plovers may reduce the fitness of individuals.

CUMULATIVE EFFECTS

Cumulative effects include the effects of future State, Tribal, local, or private actions that are reasonably certain to occur in the action area considered in this 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 Applicant does not anticipate conducting additional activities in the project action area that could affect federally listed species other than the dredging and sand placement events outlined in this Biological Opinion. Any other activities in the Action Area would require a Corps permit. Therefore, no cumulative effects are expected.

CONCLUSION

The 0.60 mile of shoreline represents approximately 0.03 percent of the 2,340 miles of sandy beach shoreline miles available (although not necessarily suitable) throughout the piping plover wintering range within the conterminous U.S. The Service estimates 29 percent (668 miles preproject) have permits for sand placement events.

After reviewing the current status of the northern Great Plains, Great Lakes, and Atlantic Coast wintering piping plover populations, the environmental baseline for the dredging, sand placement, associated construction activities, and the cumulative effects, it is the Service's biological opinion that implementation of the project, as proposed, is not likely to jeopardize the continued existence of the piping plover, and no critical habitat will be affected.

INCIDENTAL TAKE STATEMENT

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

The measures described below are nondiscretionary, and must be implemented by the Corps so they become binding conditions of any permit issued, as appropriate, for the exemption in section 7(o)(2) to apply. The Corps has a continuing duty to regulate the activity covered by this incidental take statement. If the Corps (1) fails to assume and implement the Terms and Conditions or, (2) fails to adhere to the Terms and Conditions of the incidental take statement through enforceable terms that are added to the permit, the protective coverage of section 7(o)(2) may lapse. In order to monitor the effects of incidental take, the Corps must report the progress of the action and its effects on the species to the Service as specified in the incidental take statement [50 CFR §402.14(i)(3)].

AMOUNT OR EXTENT OF TAKE

It is difficult for the Service to estimate the exact number of piping plovers that could be migrating through or wintering within the proposed action area at any one point in time or place during project construction. Therefore, the Service considers the disturbance to shoreline miles as a measurable way to estimate take because disturbance to suitable habitat within the action area would affect the ability of any given number of piping plovers to find foraging and roosting habitat throughout the migrating and wintering periods of any given year. The Service

anticipates that, directly and indirectly, an unspecified number of piping plovers occupying 0.60 mile of shoreline within the sand fill template north and south of Clam Pass, and 1,800 linear feet within Clam Pass basin and channel, could be taken in the form of harm (*e.g.*, death, injury) and harassment as a result of the proposed project.

The amount or extent of incidental take for piping plovers will be considered exceeded if the frequency of Clam Pass basin and channel dredging, and sand placement events exceeds one event. All future events will be based on our review and approval of a revised Clam Bay Restoration and Management Plan to assure the health and viability of the estuary. If, during the course of the action, this level of incidental take is exceeded, such incidental take represents new information requiring reinitiation of consultation and review of the reasonable and prudent measures provided. The Corps must immediately provide an explanation of the causes of the taking and review with the Service the need for possible modification of the reasonable and prudent measures.

EFFECT OF THE TAKE

In this Biological Opinion, the Service determined the proposed project is not likely to result in jeopardy to piping plovers or result in destruction or adverse modification of critical habitat.

REASONABLE AND PRUDENT MEASURES

The Service believes the following reasonable and prudent measures are necessary and appropriate to minimize take of nonbreeding piping plovers in the proposed action area.

1. The Applicant shall minimize and monitor the effects of the proposed project on piping plovers.
2. After project completion, the Applicant shall protect wrack and inlet shorelines for roosting and foraging piping plovers.
3. Preconstruction project information collected in Term and Condition #1 shall be submitted to the South Florida Ecological Services Office.
4. The Applicant shall provide aerial surveys to monitor changes in piping plover optimal habitat in the project area.
5. Prior to construction, avoidance signs shall be installed around optimal piping plover habitat features.
6. Driving on the beach shall be limited to that necessary and within a travel corridor.
7. Postconstruction signage will be placed within the action area to protect piping plover habitat features.
8. The Applicant shall educate the public to minimize disturbance to piping plovers.
9. The Applicant shall comply with the MBTA and FWC's shorebird guidelines.
10. The Applicant shall minimize the presence of predators.

11. The Applicant shall ensure communication between all parties is carried out.

12. The Applicant will revise the 1998 Clam Bay Restoration and Management Plan for long-term management of the estuary.

TERMS AND CONDITIONS

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

1. For 3 months prior to construction and for the 3 years following the proposed dredging and sand placement event, the Applicant must conduct bi-monthly (twice-monthly) surveys for piping plovers in the beach fill and dredging templates within the action area covering the nonbreeding season for plovers (July 15 to May 15 of each year) to monitor and quantify the level of take associated with the project and to evaluate the potential effects of future projects of similar nature. At least one of the bi-monthly surveys should be conducted on a weekend during each of the months of October, November, March and April.

   Piping plover identification, especially when in non-breeding plumage, can be difficult. Qualified professionals with shorebird/habitat survey experience must conduct the required field work.

   The following will be collected and reported:
   a. Negative and positive survey data;
   b. The amount and type of recreational use (*e.g.*, people, dogs on-off leash, vehicles, kite-boarders);
   c. Piping plover locations with a Global Positioning System (decimal degrees preferred);
   d. Habitat feature(s) used by piping plovers when observed (*e.g.*, intertidal, fresh wrack, old wrack, dune, mid-beach, vegetation);
   e. Landscape feature(s) where piping plovers are located (*e.g.*, inlet spit, tidal creek, shoals, lagoon shoreline);
   f. Substrate used by piping plovers (*e.g.*, sand, mud/sand, mud, algal mat);
   g. Behavior of piping plovers (*e.g.*, foraging, roosting, preening, bathing, flying, aggression, walking);
   h. Color bands observed on piping plovers; and
   i. All other shorebirds/waterbirds seen within the survey area.

All information shall be incorporated into a database. Submit pre-and postconstruction piping plover monitoring results (datasheets, maps, database) on standard electronic media (*e.g.*, CD, DVD) to the FWC, and to the Service's South Florida Ecological Services Office (1339 20th Street, Vero Beach, Florida 32960-3559; 772-562-3909). All reports will be due by December 1 following the end of the nonbreeding season for plovers (July 15) of each year.

2. To preserve piping plover feeding and roosting habitat, the Applicant shall limit mechanical cleaning of the dry sand portion of the beach to areas landward of the primary wrack (organic material) line as reasonable determined by the Applicant for the life of the project. This has been identified as important foraging and roosting habitat by piping plovers as well as an abundance of other shorebirds for wintering and migrating. Trash and litter within the wrack line area may be manually removed. Mechanical removal of wrack may be authorized when the Applicant documents a fish kill event, or when the health of humans may be affected. The Applicant will notify the Service via phone or electronic mail when wrack removal is necessary.

3. Prior to construction, the Applicant shall submit to the South Florida Ecological Services Office a project design which incorporates the information collected in Term and Condition #1 documenting how project impacts have been minimized to the maximum extent practicable.

4. The Applicant shall provide high resolution true color aerial imagery taken at mean low water or topographic surveys to quantify the pre- and postdredging area of piping plover optimal habitat. The Applicant will use the above outlined information to determine the acreage of optimal habitat lost which may be offset during future maintenance dredging events. Data will be provided in GIS format and submitted electronically to the FWC and the Service 3 months postphotography on standard electronic media (e.g., CD, DVD) as outlined in the Service's Spatial Data Requirements (Service 2008b).

5. Prior to construction, the Applicant shall post avoidance signs around any optimal piping plover habitat features identified in Term and Condition #1 within the project area, and protect these areas from sediment fill to the maximum extent practicable. Obvious identifiers (*e.g.*, pink flagging tape on metal poles) shall be used to clearly mark the boundaries to prevent accidental impacts to these areas.

6. If project construction requires driving on the beach outside of the project area, driving on the beach for construction shall be limited to the minimum necessary within a travel corridor established above the primary wrack line.

7. Postconstruction signage shall be placed within the action area to protect the habitat features documented as used by piping plovers. When County pet ordinances are in place, that information shall be integrated into the signage. If possible, warnings and citations will be issued when appropriate to minimize harassment of piping plovers and other shorebirds protected under the MBTA.

8. The Applicant shall produce piping plover and wrack-oriented educational materials to be placed on the County's website and television channel. The goal of these outreach activities is to educate the public about piping plover optimal habitat, the role of natural coastal processes in creating and maintaining piping plover habitat, and the importance of wrack. Some of the educational information will be included in a preconstruction news release.

9. Due to the potential for the proposed project to affect piping plovers, the Applicant shall comply with the MBTA and follow FWC's standard guidelines to protect against effects to nesting shorebirds during implementation of the proposed project from February 15 to August 31. In part, these guidelines include the establishment of buffer zones in locations where shorebirds have been engaged in nesting behavior, including territory defense.

10. The Applicant shall ensure the contractors conducting the work provide predator proof trash receptacles for all construction workers. All contractors and their employees shall be briefed on the importance of not littering and keeping the project area trash and debris free. Predator proof trash receptacles shall be installed and maintained at all access points, eating areas, and restroom areas.

11. The Applicant shall submit a report describing the actions taken to implement the terms and conditions of this incidental take statement to the FWC, Imperiled Species Management Section, Tallahassee office and the Service's South Florida Ecological Services Office, Vero Beach, Florida, within 60 days postconstruction of each event.

    11a. The Applicant must arrange a meeting between representatives of the contractor, the Service, the FWC, and the shorebird surveyor(s) prior to the commencement of the project and prior to each future event.

12. All revisions to the 1998 Clam Bay Restoration and Management Plan shall be coordinated with the Service to insure performance criteria and maintenance components reflect the long-term ecological management of the estuary.

Upon locating a dead, injured, or sick threatened or endangered specimen, initial notification must be made to the Service's Office of Law Enforcement (20501 Independence Boulevard, Groveland, Florida 34736; 352-429-1037). Additional notification must be made to FWC at 1-888-404-3922 and the Service's South Florida Ecological Services Office (1339 20th Street, Vero Beach, Florida 32960-3559; 772-562-3909). Care should be taken in handling sick or injured specimens to ensure effective treatment and care and in handling dead specimens to preserve biological materials in the best possible state for later analysis of cause of death. In conjunction with the care of sick or injured endangered or threatened species or preservation of biological materials from a dead animal, the finder has the responsibility to ensure evidence intrinsic to the specimen is not unnecessarily disturbed.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the Act directs Federal agencies to utilize 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.

- To further protect piping plover habitat and reduce beach erosion, the Applicant should consider protecting the wrack throughout the project area in perpetuity.

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

THE MIGRATORY BIRD TREATY ACT

The MBTA implements various treaties and conventions between the U.S., Canada, Japan, Mexico, and the former Soviet Union for the protection of migratory birds. Under the provisions of the MBTA, it is unlawful "by any means or manner to pursue, hunt, take, capture or kill any migratory bird except as permitted by regulations issued by the Service." The term "take" is not defined in the MBTA, but the Service has defined it by regulation to mean to pursue, hunt, shoot, wound, kill, trap, capture or collect any migratory bird, or any part, nest or egg or any migratory bird covered by the conventions or to attempt those activities.

In order to comply with the MBTA, and due to the potential for this project to affect nesting shorebirds, the Corps and Applicant should follow FWC's standard guidelines to protect against effects to nesting shorebirds during implementation of this project during the periods from February 15 to August 31.

The Service will not refer the incidental take of piping plover for prosecution under the MBTA of 1918, as amended (16 U.S.C. 703-712), if such take is in compliance with the terms and conditions specified in the incidental take statement above.

REINITIATION NOTICE

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

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

2. New information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion;

3. The agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this opinion; or

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

Thank you for your cooperation in the effort to protect fish and wildlife resources. Should you have additional questions or require clarification, please contact Jeff Howe at 772-469-4283.

Sincerely yours,

Larry Williams
Field Supervisor
South Florida Ecological Services Office

cc: electronic only
Corps, Fort Myers, Florida (Bill DeFrance, Linda Elligott)
DEP, Tallahassee, Florida (Lanie Edwards)
EPA, West Palm Beach, Florida (Ron Miedema)
FWC, Tallahassee, Florida (Robbin Trindell)
NOAA Fisheries, St. Petersburg, Florida (Mark Sramek)
Service, Panama City, Florida (Patty Kelly)
Service, St. Petersburg, Florida (Anne Marie Lauritsen)
Service, Atlanta, Georgia (Ken Graham)
USGS, Gainesville, Florida (Susan Walls)

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Table 1. The number of adult piping plovers and breeding pairs reported in the U.S. Northern Great Plains by the International Piping Plover Census efforts.

Year	Adults	Pairs Reported by the Census
1991	2,023	891
1996	1,599	586
2001	1,981	899
2006	2,959	1,212

Source: Plissner and Haig 1997; Ferland and Haig 2002; Elliot-Smith et al. 2009.

Table 2. Results of the 1991, 1996, 2001, and 2006 International Piping Plover Winter Censuses (Haig et al. 2005; Elliott-Smith et al. 2009).

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

Table 3. Number of hardened inlets by state as of 2009. An asterisk (*) represents an inlet at the state line, in which case half an inlet is counted in each state.

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

Table 4. Summary of the extent of nourished beaches in piping plover wintering and migrating habitat within the conterminous U.S. From Service unpublished data.

State	Sandy beach shoreline miles available	Sandy beach shoreline miles nourished to date (within critical habitat units)	Percent of sandy beach shoreline affected (within critical habitat units)
North Carolina	301[1]	117[5] (unknown)	39 (unknown)
South Carolina	187[1]	56 (0.6)	30 (0.32))
Georgia	100[1]	8 (0.4)	8 (0.40)
Florida	825[2]	404 (6)[6]	49 (0.72)
Alabama	53[1]	12 (2)	23 (3.77)
Mississippi	110[3]	≥6 (0)	5 (0)
Louisiana	397[1]	Unquantified (usually restoration-oriented)	Unknown
Texas	367[4]	65 (45)	18 (12.26)
Overall Total	2,340 (does not include Louisiana)	≥ 668 does not include Louisiana (54)	29 (≥2.31)

Data from [1]www.50states.com; [2] Clark 1993; [3]Winstead 2008; [4] www.surfrider.org; [5] Hall 2009; [6] partial data from Lott et al. (in review).

Table 5. Summary of predator control programs that may benefit piping plovers on winter and migration grounds.

State	Entities with Predator Control Programs
North Carolina	State Parks, Cape Lookout and Cape Hatteras National Seashores.
South Carolina	As needed throughout the state-targets raccoons and coyotes.
Georgia	No known programs.
Florida	Merritt Island NWR, Cape Canaveral AFS, Indian River County, Eglin AFB, Gulf Islands NS, northwest Florida state parks (up until 2008), St. Vincent NWR, Tyndall AFB.
Alabama	Late 1990's Gulf State Park and Orange Beach for beach mice, none current.
Mississippi	No known programs.
Louisiana	No known programs.
Texas	Aransas NWR (hog control for habitat protection). Audubon (mammalian predator control on colonial waterbird islands that have occasional piping plover use).

Table 6. Number of sites surveyed during the 2006 winter International Piping Plover Census with hardened or developed structures adjacent to the shoreline.

State	Number of sites surveyed during the 2006 winter Census	Number of sites with some armoring or development	Percent of sites affected
North Carolina	37 (+2)[1]	20	51
South Carolina	39	18	46
Georgia	13	2	15
Florida	188	114	61
Alabama	4 (+2)[1]	3	50
Mississippi	16	7	44
Louisiana	25 (+2)[1]	9	33
Texas	78	31	40
Overall Total	406	204	50

[1] Indicates additional piping plovers sites not surveyed in the 2006 Census.

Table 7. Military bases that occur within the wintering/migration range of piping plovers and contain piping plover habitat. Five bases (indicated with an asterisk [*]) conduct activities that may affect piping plovers or their habitat.

State	Coastal Military Bases
North Carolina	Camp Lejeune*
South Carolina	No coastal beach bases
Georgia	Kings Bay Naval Base
Florida	Key West Base, Naval Station Mayport*, Cape Canaveral Air Force Station, Patrick AFB, MacDill AFB, Eglin AFB*, Tyndall AFB*
Alabama	No coastal beach bases
Mississippi	Keesler AFB
Louisiana	U.S. Navy* operations on Peveto Beach
Texas	Corpus Christi Naval Air Station

Table 8. Percent of known piping plover winter and migration habitat locations, by state, where various types of anthropogenic disturbance have been reported.

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

Table 9. Biological Opinions issued for all projects that had adverse effects to the piping plovers on non-breeding grounds in Florida.

SPECIES Piping plover	YEAR	Habitat Impacted (miles or acres)	PROJECT STATUS
East Pass re-opening	2001	2.0 miles	Completed
Amended Biological Opinion for south jetty extension in Ponce De Leon Navigation Inlet.	2003	Shoal habitat	Completed
Terminal groin and nearshore breakwater on the south end of Amelia Island, Nassau, Florida.	2004	Shoal habitat	Completed
Navarre beach nourishment emergency consultation and amendments 1-6.	2005	4.1 miles	Project completed, consultation incomplete.
Eglin AFB INRMP	2007-2011	17 miles (disturbance/ monitoring)	Completed
Tyndall AFB INRMP	2007-2011	18 miles (disturbance/ monitoring)	Completed
St. Joseph Peninsula beach restoration	2007	7.5 miles	Consultation complete, project completed.
Alligator Point beach nourishment	2007	2.9 nourished, add 1.5 disturbed (miles)	Consultation complete, project cancelled.
NAS Pensacola pass dredging and spoil placement	2007	10.6 miles	Consultation ongoing.
FEMA emergency berm repair for Florida coast	2008	50 miles (statewide)	Consultation complete.
Eglin AFB nourishment	2008	7.3 miles	Consultation complete, project pending.
Perdido Key beach nourishment; Escambia County.	2008	6.5 miles	Consultation complete, project pending.
Beach nourishment, Walton County	2008	14.1 miles	Consultation complete, project pending.
East Pass Destin Navigation Project	2009	Inlet dredge and 2.1 miles of shoreline.	Consultation complete, project pending.
Matanzas Pass Re-opening	2009	3.6 acres of Critical Habitat Unit FL-25.	Consultation complete, project pending.
Hideaway Beach Erosion Control Project	2009	2.5 acres of Critical Habitat Unit FL-27.	Consultation and project completed.
St. Lucie Inlet Dredging and Sand Placement	2011	3.8 acres of Critical Habitat Unit FL-33, and 8.5 miles.	Consultation complete.
Panama City Beach Erosion Control and Storm Damage Reduction	2012	18.5 miles of shoreline	Consultation and project completed.
Walton County Beach Hurricane and Storm Damage Reduction Project	2012	26.0 miles of shoreline	Consultation complete.
Matanzas Pass Dredging	2012	3.2 acres of Critical Habitat Unit FL-25 and 1.1 miles of shoreline.	Consultation complete.
Sailfish Point Channel Dredging and Sand Placement		0.95 mile of shoreline.	Consultation complete.
Captiva & Sanibel Islands Sand Placement	2012	6.4 miles of shoreline.	Consultation complete.
Clam Pass Dredging and Sand Placement		0.60 mile of shoreline.	Consultation ongoing.
Wiggins Pass M&O			Consultation ongoing.
Hideaway Beach Sand Placement and Groin Construction			Consultation ongoing.
Sebatian Inlet Sand Trap Dredging and Sand Placement			Consultation ongoing.
Lovers Key & Little Hickory Island Sand Placement		1.85 miles of shoreline.	Consultation ongoing.

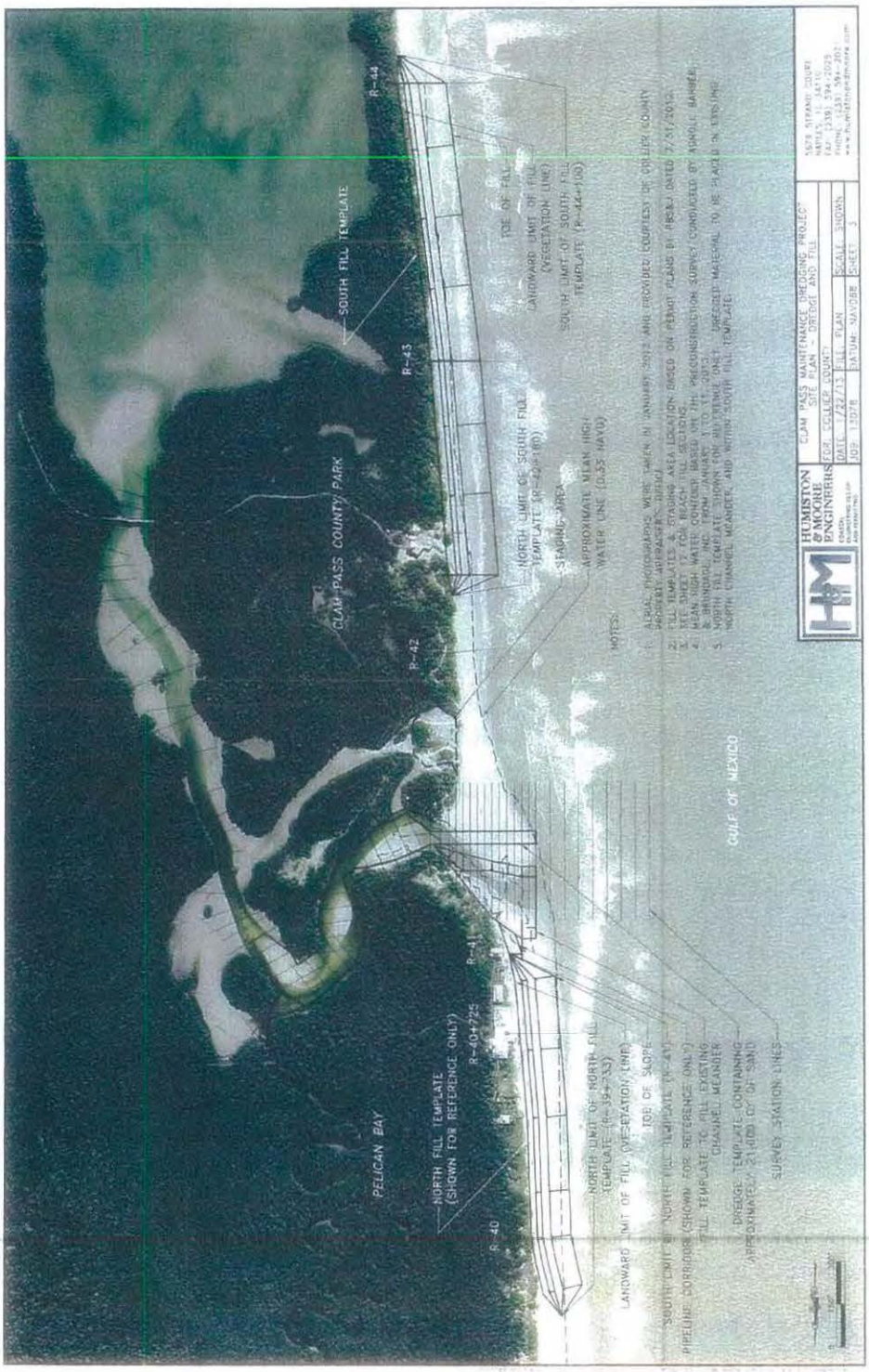

Figure 1. Location of the dredging template, sand fill templates, and staging areas, Clam Pass, Collier County, Florida.

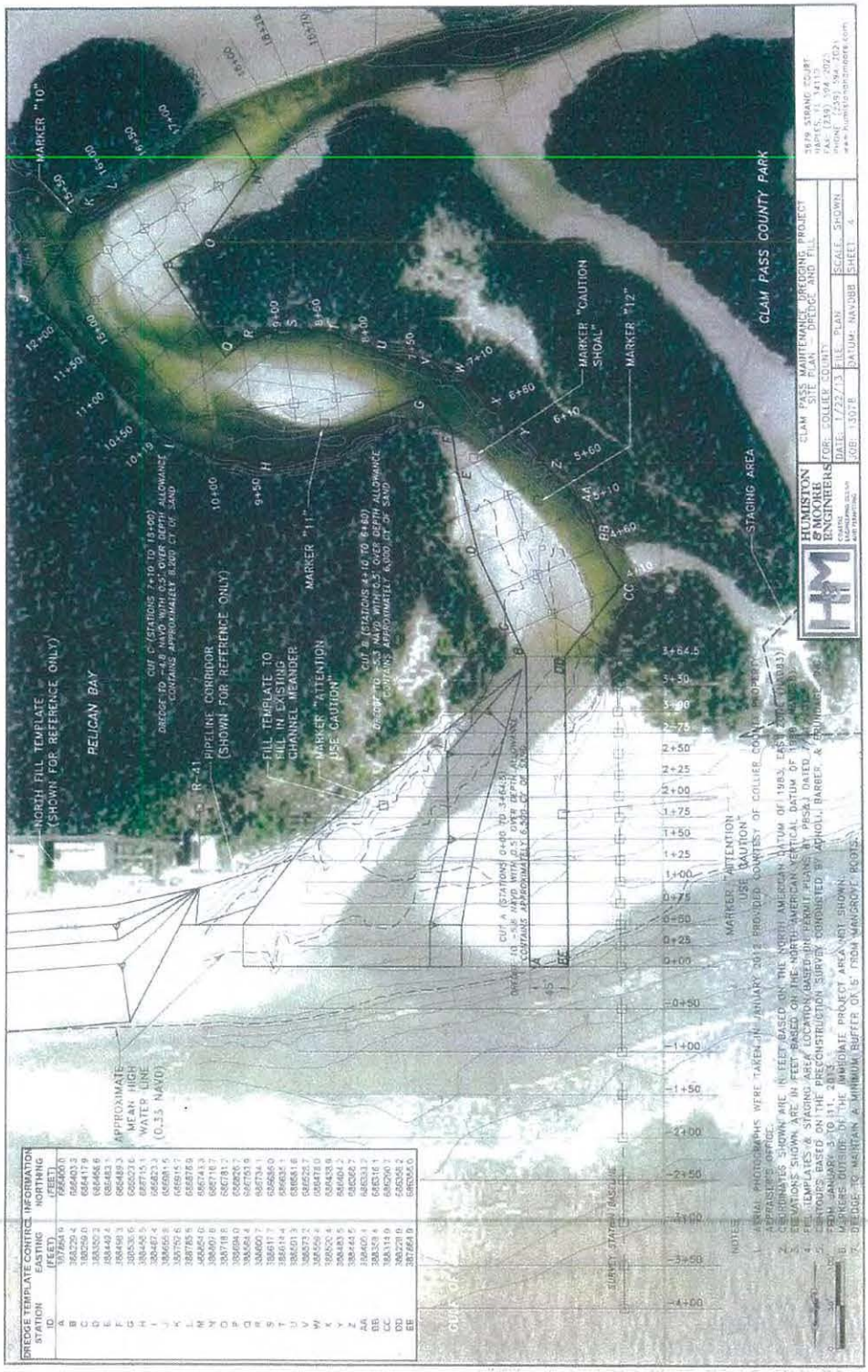

Figure 2. Proposed dredging template and elevations in Clam Pass, Collier County, Florida.

Figure 3. Beach access corridors north and south of Clam Pass, Collier County, Florida.

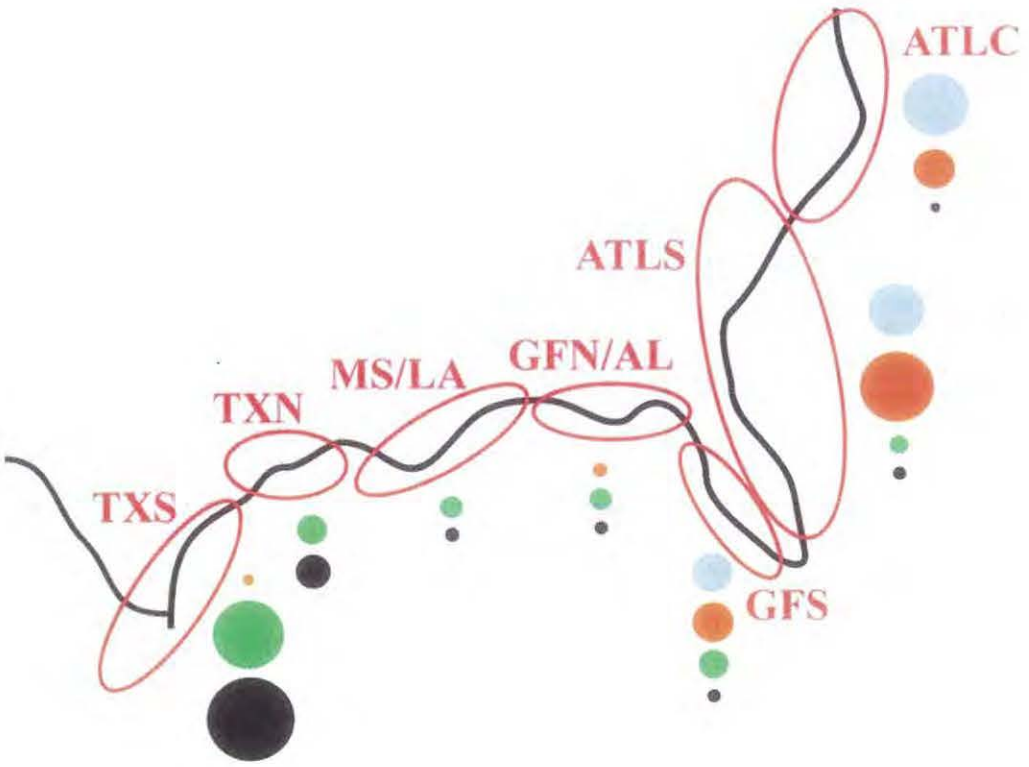

Figure 4. Breeding population distribution in the wintering/migration range. Grey circles represent Eastern Canada birds, Orange U.S. Great Lakes, Green U.S. Great Plains, and Black Prairie Canada. ATLC=Atlantic (eastern) Canada; GFS=Gulf Coast of southern Florida; GFN=Gulf Coast of north Florida; AL=Alabama; MS/LA=Mississippi and Louisiana; TXN=northern Texas; and TXS=southern Texas. From Gratto-Trevor et al. 2009; reproduced by permission.

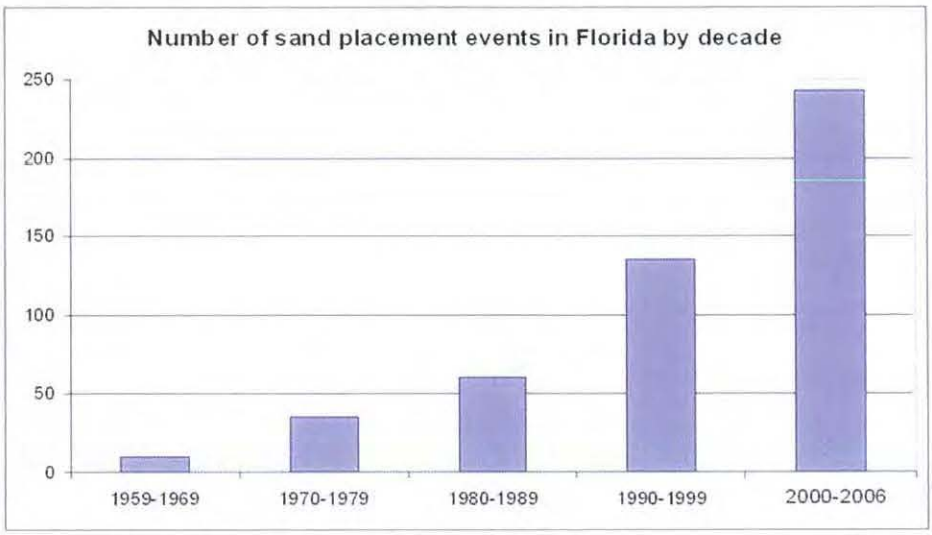

Figure 5. Number of sand placement events in Florida between 1959 and 2006.