NRR-PMDAPEm Resource

From: Balsam, Briana
Sent: Thursday, April 26, 2012 3:56 PM
To: Gless, Jodie; stacy_foster@fpl.com
Cc: Susco, Jeremy; Logan, Dennis
Subject: St. Lucie: biological opinion from FWS for discharge headwall project
Attachments: St. Lucie biological opinion from FWS dated 4-25-12.pdf

Jodie and Stacy,

NRC received the attached biological opinion from FWS this morning for FPL's discharge headwall project at St. Lucie. Jeff Howe incorporated both NRC's comments and your request to extend the project timeline.

The biological opinion is good for a "one time" take in one of the six take categories listed on page 36. In talking with Jeff on the phone, I understand that this biological opinion will expire once the current construction project is complete, and NRC and FPL would have to reinitiate consultation in the future for any work on the beach that could impact nesting sea turtles.

I don't intend to transmit the biological opinion by formal letter to FPL unless you let me know that you would like me to do so and let me know to whom, specifically, I should address the letter. Otherwise, I will use this email to document that NRC has transmitted the biological opinion to you.

Please let me know if I can help further or if you have any questions about the consultation or biological assessment.

Briana

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Briana A. Balsam
Biologist

Division of License Renewal
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U.S. Nuclear Regulatory Commission

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Hearing Identifier: NRR_PMDA
Email Number: 351

Mail Envelope Properties (Briana.Balsam@nrc.gov20120426155500)

Subject: St. Lucie: biological opinion from FWS for discharge headwall project
Sent Date: 4/26/2012 3:55:57 PM
Received Date: 4/26/2012 3:55:00 PM
From: Balsam, Briana

Created By: Briana.Balsam@nrc.gov

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Post Office:

Files	Size	Date & Time
MESSAGE	1345	4/26/2012 3:55:00 PM
St. Lucie biological opinion from FWS dated 4-25-12.pdf		3922632

Options
Priority: Standard
Return Notification: No
Reply Requested: No
Sensitivity: Normal
Expiration Date:
Recipients Received:

United States Department of the Interior

FISH AND WILDLIFE SERVICE
South Florida Ecological Services Office
1339 20th Street
Vero Beach, Florida 32960

April 25, 2012

Jeremy J. Susco, Acting Chief
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001

Service Federal Activity Code:	41420-2012-CPA-0140
Nuclear Regulatory Commission Docket Nos.:	50-335 and 50-389
Date Received:	March 26, 2012
Formal Consultation Initiation Date:	March 26, 2012
Project:	Seawall installation
Applicant:	Florida Power and Light Company
County:	St. Lucie

Dear Mr. Susco:

This document transmits the U.S. Fish and Wildlife Service's (Service) Biological Opinion based on our review of a proposal to construct a 396 linear foot seawall immediately seaward of the Florida Power and Light Company (Applicant) St. Lucie Nuclear Power Plant cooling water discharge canal located on Hutchinson Island, St. Lucie County, Florida. The U.S. Nuclear Regulatory Commission (NRC) determined in a letter dated March 26, 2012, that the proposed project "may affect" the threatened loggerhead sea turtle (*Caretta caretta*), the endangered leatherback sea turtle (*Dermochelys coriacea*), the endangered green sea turtle (*Chelonia mydas*), the endangered hawksbill sea turtle (*Eretmochelys imbricata*), and the endangered Kemp's ridley sea turtle (*Lepidochelys kempii*). 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*.).

This Biological Opinion is based on information provided in the NRC's letter and biological assessment dated March 26, 2012, and April 17, 2012, respectively, correspondence with the NRC, Florida Fish and Wildlife Conservation Commission (FWC), Taylor Engineering, Incorporated, and the Applicant. A complete administrative record of this consultation is on file at the South Florida Ecological Services Office, Vero Beach, Florida.

CONSULTATION HISTORY

On February 16, 2012, the Service was copied on several e-mail messages between the FWC and the Applicant outlining the Applicant's proposed seawall adjacent to the St. Lucie Nuclear Power Plant cooling water discharge canal.

On February 27, 2012, the Service was copied on several e-mail messages between the FWC and the Applicant. The e-mail messages discussed whether or not the NRC may be able to assist in acting as the Federal nexus for section 7 consultation because the proposed project is located above the mean high water line and a U.S. Army Corps of Engineers' permit is not required. In addition, the Service received a copy of a site visit report conducted by FWC post-construction of approximately 23,000 cubic yards (cy) of sand placed seaward of the proposed sheet pile seawall.

On February 29, 2012, the Service received supplemental documents from the Applicant.

On March 27, 2012, the Service received a letter from the NRC dated March 26, 2012, requesting to initiate formal consultation.

On April 3, 2012, the Service sent an email to the NRC initiating formal consultation concerning the potential effects of the proposed project on nesting sea turtles.

On April 18, 2012, the Service received a biological assessment from the NRC.

BIOLOGICAL OPINION

DESCRIPTION OF THE PROPOSED ACTION

The Applicant proposes to construct a 396 linear foot seawall seaward of the St. Lucie Nuclear Power Plant cooling water discharge canal, located on Hutchinson Island, St. Lucie County, Florida (Figures 1 and 2). A sand dune was constructed seaward of the proposed seawall as of March 1, 2012. Approximately 3,110 cy of beach compatible sand was used to restore the dune with a crest elevation of +15.5 feet North American Vertical Datum and a 1 vertical foot: 2 horizontal feet slope. Prior to seawall installation, minor excavation, less than 4 to 5 feet in depth along the length of the proposed seawall, will be required for work and installation of a concrete tie beam at the top of the seawall. The seawall will be installed using the Giken technology which involves a pressing process and therefore, no vibratory or hammer equipment will be utilized. The sheet pile will be "pressed" into the substrate of the recently restored dune using a sheet pile installer, and will involve excavating and filling trenches on or landward of the dune each day. The sheet pile installer will extend over the dune directly adjacent to the wall. In addition, a small drill rig and wooden cribbing will be necessary landward of the dune for drilling in the tieback rods for the seawall All trenches will be filled to beach elevation before sunset each night. All vehicle access will be from the canal access road, with only foot traffic seaward of the seawall. In addition, the Applicant may install a fence to limit public access, but not sea turtles. After seawall construction has been completed, the dune will be restored to pre-construction condition. The intent of the proposed project is to provide a rigid coastal structure to provide hurricane protection for the St. Lucie Nuclear Plant cooling water discharge canal.

The proposed seawall and anchor installation is scheduled to be completed by May 1, 2012, with the remainder of the work (*i.e.,* concrete cap, anchor tensioning, sheet pile bracing) scheduled to be completed by June 30, 2012. All work conducted after May 1, 2012, will occur landward of the seawall. Because the proposed project will take place during the sea turtle nesting season, monitoring as outlined in the Terms and Conditions of this Biological Opinion and in accordance with the sea turtle protection plan prepared for St. Lucie County Development Review Board, will be required. Construction activities will only take place during daylight hours. Sea turtle nests may be relocated if deposited in the seawall template.

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 approximate 396 linear feet of beach for seawall and concrete cap construction, tieback rod installation, and the upland area adjacent to the proposed seawall footprint where equipment, machinery, and supplies will be operated from and stored. The project is located along the Atlantic Ocean, St. Lucie County, Florida at latitude 27.3518 and longitude -80.2393.

STATUS OF THE SPECIES/CRITICAL HABITAT

Species/critical habitat description

Loggerhead Sea Turtle

The loggerhead sea turtle, which occurs throughout the temperate and tropical regions of the Atlantic, Pacific, and Indian Oceans, was federally listed worldwide as a threatened species on July 28, 1978 (43 Federal Register [FR] 32800). On September 22, 2011, the loggerhead sea turtle's listing under the Act was revised from a single threatened species to nine distinct population segments (DPS) listed as either threatened or endangered. The nine DPSs and their statuses are:

Northwest Atlantic Ocean DPS – threatened
Northeast Atlantic Ocean – endangered
Mediterranean Sea DPS – endangered
South Atlantic Ocean DPS – threatened
North Pacific Ocean DPS – endangered
South Pacific Ocean DPS – endangered
North Indian Ocean DPS – endangered
Southwest Indian Ocean – threatened
Southeast Indo-Pacific Ocean DPS – threatened

The loggerhead sea turtle grows to an average weight of 200 pounds and is characterized by a large head with blunt jaws. Adults and subadults have a reddish-brown carapace. Scales on the top of the head and top of the flippers are also reddish-brown with yellow on the borders. Hatchlings are a dull brown color (NOAA Fisheries 2009a). The loggerhead feeds on mollusks, crustaceans, fish, and other marine animals.

The loggerhead may be found hundreds of miles out to sea, as well as in inshore areas such as bays, lagoons, salt marshes, creeks, ship channels, and the mouths of large rivers. Coral reefs, rocky places, and ship wrecks are often used as feeding areas. Within the Northwest Atlantic, the majority of nesting activity occurs from April through September, with a peak in June and July (Williams-Walls et al. 1983; Dodd 1988; Weishampel et al. 2006). Nesting occurs within the Northwest Atlantic along the coasts of North America, Central America, northern South America, the Antilles, Bahamas, and Bermuda, but is concentrated in the southeastern United States (U.S.) and on the Yucatán Peninsula in Mexico on open beaches or along narrow bays having suitable sand (Sternberg 1981; Ehrhart 1989; Ehrhart et al. 2003; NOAA Fisheries and Service 2008).

No critical habitat has been designated for the loggerhead sea turtle.

Green Sea Turtle

The green sea turtle was federally listed on July 28, 1978 (43 FR 32800). Breeding populations of the green turtle in Florida and along the Pacific Coast of Mexico are listed as endangered; all other populations are listed as threatened. The green sea turtle has a worldwide distribution in tropical and subtropical waters.

The green sea turtle grows to a maximum size of about 4 feet and a weight of 440 pounds. It has a heart-shaped shell, small head, and single-clawed flippers. The carapace is smooth and colored gray, green, brown, and black. Hatchlings are black on top and white on the bottom (NOAA Fisheries 2009b). Hatchling green turtles eat a variety of plants and animals, but adults feed almost exclusively on seagrasses and marine algae.

Major green turtle nesting colonies in the Atlantic occur on Ascension Island, Aves Island, Costa Rica, and Surinam. Within the U.S., green turtles nest in small numbers in the U.S. Virgin Islands and Puerto Rico, and in larger numbers along the east coast of Florida, particularly in Brevard, Indian River, St. Lucie, Martin, Palm Beach, and Broward Counties (NOAA Fisheries and Service 1991a). Nests have been documented, in smaller numbers, north of these Counties, from Volusia through Nassau Counties in Florida, as well as in Georgia, South Carolina, North Carolina, and as far north as Delaware in 2011. Nests have been documented in smaller numbers south of Broward County in Miami-Dade. Nesting also has been documented along the Gulf coast of Florida from Escambia County through Franklin County in northwest Florida and from Pinellas County through Monroe County in southwest Florida (FWC/FWRI 2010a).

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

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

Leatherback Sea Turtle

The leatherback sea turtle was federally listed as an endangered species on June 2, 1970 (35 FR 8491). Leatherbacks have the widest distribution of the sea turtles with nonbreeding animals recorded as far north as the British Isles and the Maritime Provinces of Canada and as far south as Argentina and the Cape of Good Hope (Pritchard 1992). Foraging leatherback excursions have been documented into higher-latitude subpolar waters. In addition, leatherbacks have evolved physiological and anatomical adaptations (Frair et al. 1972; Greer et al. 1973) that allow them to exploit waters far colder than any other sea turtle species would be capable of surviving.

An adult leatherback can reach 4 to 8 feet in length and weigh 500 to 2,000 pounds. The carapace is distinguished by a rubber-like texture, about 1.6 inches thick, and made primarily of tough, oil-saturated connective tissue. Hatchlings are dorsally mostly black and are covered with tiny scales; the flippers are edged in white, and rows of white scales appear as stripes along the length of the back (NOAA Fisheries 2009c). Jellyfish are the main staple of its diet, but it is also known to feed on sea urchins, squid, crustaceans, tunicates, fish, blue-green algae, and floating seaweed. This is the largest, deepest diving of all sea turtle species.

Leatherback turtle nesting grounds are distributed worldwide in the Atlantic, Pacific, and Indian Oceans on beaches in the tropics and subtropics. The Pacific Coast of Mexico historically supported the world's largest known concentration of nesting leatherbacks. The leatherback turtle regularly nests in the U.S. Caribbean in Puerto Rico and the U.S. Virgin Islands. Along the U.S. Atlantic coast, most nesting occurs in Florida (NOAA Fisheries and Service 1992). Leatherback nesting has also been reported on the northwest coast of Florida (LeBuff 1990; FWC 2009a); and in southwest Florida a false crawl (nonnesting emergence) has been observed on Sanibel Island (LeBuff 1990). Nesting has also been reported in Georgia, South Carolina, and North Carolina (Rabon et al. 2003) and in Texas (Shaver 2008).

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

Marine and terrestrial critical habitat for the leatherback sea turtle has been designated at Sandy Point on the western end of the island of St. Croix, U.S. Virgin Islands (50 Code of Federal Regulations (CFR) 17.95).

Hawksbill Sea Turtle

The hawksbill sea turtle was federally listed as an endangered species on June 2, 1970 (35 FR 8491). The hawksbill is found in tropical and subtropical seas of the Atlantic, Pacific, and Indian Oceans. The species is widely distributed in the Caribbean Sea and western Atlantic Ocean.

In the Wider Caribbean adult hawksbills have been reported as typically weighing around 176 pounds or less. Hatchlings average about 1.6 inches, and from 0.5 to 0.7 ounces in length and weight, respectively. The carapace is heart shaped in young turtles, and becomes more elongated or egg-shaped with maturity. The top scutes are often richly patterned with irregularly radiating streaks of brown or black on an amber background. The head is elongated and tapers sharply to a point. The lower jaw is V-shaped (NOAA Fisheries 2009d).

Within the continental U.S., hawksbill sea turtle nesting is rare and is restricted to the southeastern coast of Florida (Volusia through Miami-Dade Counties) and the Florida Keys (Monroe County) (Meylan 1992; Meylan et al. 1995; FWC/FWRI 2010a). However, hawksbill tracks are difficult to differentiate from those of loggerheads and may not be recognized by surveyors. In the U.S. Caribbean, hawksbill nesting occurs on beaches throughout Puerto Rico and the U.S. Virgin Islands (NOAA Fisheries and Service 1993).

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

Kemp's Ridley Sea Turtle

The Kemp's ridley sea turtle was federally listed as endangered on December 2, 1970 (35 FR 18320). The Kemp's ridley, along with the flatback sea turtle (*Natator depressus*), has the most geographically restricted distribution of any sea turtle species. The range of the Kemp's ridley includes the Gulf coasts of Mexico and the U.S., and the Atlantic coast of North America as far north as Nova Scotia and Newfoundland.

Adult Kemp's ridleys and olive ridleys are the smallest sea turtles in the world. The weight of an adult Kemp's ridley is generally between 70 to 108 pounds with a carapace measuring approximately 24 to 26 inches in length (Heppell et al. 2005). The carapace is almost as wide as it is long. The species' coloration changes significantly during development from the grey-black dorsum and plastron of hatchlings, a grey-black dorsum with a yellowish-white plastron as post-pelagic juveniles and then to the lighter grey-olive carapace and cream-white or yellowish plastron of adults. Their diet consists mainly of swimming crabs, but may also include fish, jellyfish, and an array of mollusks.

The Kemp's ridley has a restricted distribution. Nesting is essentially limited to the beaches of the western Gulf of Mexico, primarily in Tamaulipas, Mexico (NOAA Fisheries et al. 2011). Nesting also occurs in Veracruz and a few historical records exist for Campeche, Mexico (Marquez-Millan 1994). Nesting also occurs regularly in Texas and infrequently in a few other U.S. states. However, historic nesting records in the U.S. are limited to south Texas (Werler 1951; Carr 1961, Hildebrand 1963).

Most Kemp's ridley nests located in the U.S. have been found in south Texas, especially Padre Island (Shaver and Caillouet 1998; Shaver 2002, 2005). Nests have been recorded elsewhere in Texas (Shaver 2005, 2006a, 2006b, 2007, 2008), and in Florida (Johnson et al. 1999; Foote and Mueller 2002; Hegna et al. 2006; (FWC/FWRI 2010a), Alabama (NOAA Fisheries et al. 2011), Georgia (Williams et al. 2006), South Carolina (Anonymous 1992), and North Carolina (Marquez et al. 1996), but these events are less frequent. Kemp's ridleys inhabit the Gulf of Mexico and the Northwest Atlantic Ocean, as far north as the Grand Banks (Watson et al. 2004) and Nova Scotia (Bleakney 1955). They occur near the Azores and eastern north Atlantic (Deraniyagala 1938; Brongersma 1972; Fontaine et al. 1989; Bolten and Martins 1990) and Mediterranean (Pritchard and Marquez 1973; Brongersma and Carr 1983; Tomas and Raga 2007; Insacco and Spadola 2010).

Hatchlings, after leaving the nesting beach, are believed to become entrained in eddies within the Gulf of Mexico. Most Kemp's ridley post-hatchlings likely remain within the Gulf of Mexico. Others are transported into the northern Gulf of Mexico and then eastward, with some continuing southward in the Loop Current, then eastward on the Florida Current into the Gulf Stream (Collard and Ogren 1990; Putman et al. 2010). Juvenile Kemp's ridleys spend on average 2 years in the oceanic zone (NOAA Fisheries et al. 2011) where they likely live and feed among floating algal communities. They remain here until they reach about 7.9 inches in length (approximately 2 years of age), at which size they enter coastal shallow water habitats (Ogren 1989); however, the time spent in the oceanic zone may vary from 1 to 4 years or perhaps more (Turtle Expert Working Group [TEWG] 2000; Baker and Higgins 2003; Dodge et al. 2003).

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

Life history

Loggerhead Sea Turtle

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

1. Terrestrial zone (supralittoral) - the nesting beach where both oviposition (egg laying) and embryonic development and hatching occur;
2. Neritic zone - the inshore marine environment (from the surface to the sea floor) where water depths do not exceed 656 feet. The neritic zone generally includes the continental shelf, but in areas where the continental shelf is very narrow or nonexistent, the neritic zone conventionally extends to areas where water depths are less than 656 feet; and
3. Oceanic zone - the vast open ocean environment (from the surface to the sea floor) where water depths are greater than 656 feet.

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

Numbers of nests and nesting females are often highly variable from year to year due to a number of factors including environmental stochasticity, periodicity in ocean conditions, anthropogenic effects, and density-dependent and density-independent factors affecting survival, somatic growth, and reproduction (Meylan 1982; Hays 2000; Chaloupka 2001; Solow et al. 2002). Despite these sources of variation, and because female turtles exhibit strong nest site fidelity, a nesting beach survey can provide a valuable assessment of changes in the adult female population, provided that the study is sufficiently long and effort and methods are standardized (Meylan 1982; Gerrodette and Brandon 2000; Reina et al. 2002). The key life history characteristics for loggerheads nesting in the U.S., is summarized in NOAA Fisheries and Service 2008.

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

The warmer the sand surrounding the egg chamber, the faster the embryos develop (Mrosovsky and Yntema 1980). Sand temperatures prevailing during the middle third of the incubation period also determine the sex of hatchling sea turtles (Mrosovsky and Yntema 1980). Incubation temperatures near the upper end of the tolerable range produce only female hatchlings while incubation temperatures near the lower end of the tolerable range produce only male hatchlings.

Loggerhead hatchlings pip and escape from their eggs over a 1 to 3-day interval and move upward and out of the nest over a 2 to 4-day interval (Christens 1990). The time from pipping to emergence ranges from 4 to 7 days with an average of 4.1 days (Godfrey and Mrosovsky 1997). Hatchlings emerge from their nests en masse almost exclusively at night, and presumably using decreasing sand temperature as a cue (Hendrickson 1958; Mrosovsky 1988; Witherington et al. 1990). Moran et al. (1999) concluded that a lowering of sand temperatures below a critical threshold, which most typically occurs after nightfall, is the most probable trigger for hatchling emergence from a nest. After an initial emergence, there may be secondary emergences on subsequent nights (Carr and Ogren 1960; Witherington 1986; Ernest and Martin 1993; Houghton and Hays 2001).

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

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

Green Sea Turtle

Green sea turtles deposit from one to nine clutches within a nesting season, but the overall average is about 3.3 nests. The interval between nesting events within a season varies around a mean of about 13 days (Hirth 1997). Mean clutch size varies widely among populations. Average clutch size reported for Florida was 136 eggs in 130 clutches (Witherington and Ehrhart

1989). Only occasionally do females produce clutches in successive years. Usually 2 or more years intervene between breeding seasons (NOAA Fisheries and Service 1991a). Age at sexual maturity is believed to be 20 to 50 years (Hirth 1997).

Leatherback Sea Turtle

Leatherbacks nest an average of five to seven times within a nesting season, with an observed maximum of 11 nests (NOAA Fisheries and Service 1992). The interval between nesting events within a season is about 9 to 10 days. Clutch size averages 80 to 85 yolked eggs, with the addition of usually a few dozen smaller, yolkless eggs, mostly laid toward the end of the clutch (Pritchard 1992). Nesting migration intervals of 2 to 3 years were observed in leatherbacks nesting on the Sandy Point National Wildlife Refuge, St. Croix, U.S. Virgin Islands (McDonald and Dutton 1996). Leatherbacks are believed to reach sexual maturity in 13 to 16 years (Dutton et al. 2005; Jones et al. 2011).

Hawksbill Sea Turtle

Hawksbills nest on average about 4.5 times per season at intervals of approximately 14 days (Corliss et al. 1989). In Florida and the U.S. Caribbean, clutch size is approximately 140 eggs, although several records exist of over 200 eggs per nest (NOAA Fisheries and Service 1993). In the U.S. Caribbean, nesting migration intervals of 2 to 3 years appear to predominate (Garduño-Andrade 1999; Richardson et al. 1999; Beggs et al. 2007). Based on data from growth rate studies (Boulon 1983, 1994; Diez and van Dam 2002; Leon and Diez 1999; NOAA Fisheries and Service 2007a), age at sexual maturity has been estimated as 20 or more years in the Caribbean.

Kemp's Ridley

Nesting occurs primarily from April into July. Nesting often occurs in synchronized emergences, known as "arribadas" or "arribazones," which may be triggered by high wind speeds, especially north winds, and changes in barometric pressure (Jimenez et al. 2005). Nesting occurs primarily during daylight hours. Clutch size averages 100 eggs and eggs typically take 45 to 58 days to hatch depending on incubation conditions, especially temperature (Marquez-Millan 1994; Rostal 2007).

Females lay an average of 2.5 clutches within a season (TEWG 1998) and inter-nesting interval generally ranges from 14 to 28 days (Miller 1997; NOAA Fisheries et al. 2011). The mean remigration interval for adult females is 2 years, although intervals of 1 and 3 years are not uncommon (Marquez et al. 1982; TEWG 1998, 2000). Males may not be reproductively active on an annual basis (Wibbels et al. 1991). Age at sexual maturity is believed to be between 10 to 17 years (Snover et al. 2007).

Population dynamics

Loggerhead Sea Turtle

The loggerhead occurs throughout the temperate and tropical regions of the Atlantic, Pacific, and Indian Oceans (Dodd 1988). However, the majority of loggerhead nesting is at the western rims of the Atlantic and Indian Oceans. The most recent reviews show that only two loggerhead nesting beaches have greater than 10,000 females nesting per year (Baldwin et al. 2003; Ehrhart et al. 2003; Kamezaki et al. 2003; Limpus and Limpus 2003; Margaritoulis et al. 2003): Peninsular Florida (U.S.) and Masirah (Oman). Those beaches with 1,000 to 9,999 females nesting each year are Georgia through North Carolina (U.S.), Quintana Roo and Yucatán (Mexico), Cape Verde Islands (Cape Verde, eastern Atlantic off Africa), and Western Australia (Australia). Smaller nesting aggregations with 100 to 999 nesting females annually occur in the Northern Gulf of Mexico (U.S.), Dry Tortugas (U.S.), Cay Sal Bank (Bahamas), Sergipe and Northern Bahia (Brazil), Southern Bahia to Rio de Janerio (Brazil), Tongaland (South Africa), Mozambique, Arabian Sea Coast (Oman), Halaniyat Islands (Oman), Cyprus, Peloponnesus (Greece), Island of Zakynthos (Greece), Turkey, Queensland (Australia), and Japan.

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

The major nesting concentrations in the U.S. are found in South Florida. However, loggerheads nest from Texas to Virginia. Total estimated nesting in the U.S. has fluctuated between 49,000 and 90,000 nests per year from 1999-2010 (NOAA Fisheries and Service 2008; FWC/FWRI 2010b). About 80 percent of loggerhead nesting in the southeast U.S. occurs in six Florida counties (Brevard, Indian River, St. Lucie, Martin, Palm Beach, and Broward). Adult loggerheads are known to make considerable migrations between foraging areas and nesting beaches (Schroeder et al. 2003; Foley et al. 2008). During non-nesting years, adult females from U.S. beaches are distributed in waters off the eastern U.S. and throughout the Gulf of Mexico, Bahamas, Greater Antilles, and Yucatán.

From a global perspective, the U.S. nesting aggregation is of paramount importance to the survival of the species as is the population that nests on islands in the Arabian Sea off Oman (Ross 1982; Ehrhart 1989; Baldwin et al. 2003). Based on standardized daily surveys of the highest nesting beaches and weekly surveys on all remaining island nesting beaches, approximately 50,000, 67,600, and 62,400 nests, were estimated in 2008, 2009, and 2010, respectively (Conant et al. 2009). The status of the Oman loggerhead nesting population, reported to be the largest in the world (Ross 1979), is uncertain because of the lack of long-term standardized nesting or foraging ground surveys and its vulnerability to increasing development pressures near major nesting beaches and threats from fisheries interaction on foraging grounds and migration routes (Possardt 2005). The loggerhead nesting aggregations in Oman and the U.S. account for the majority of nesting worldwide.

Green Sea Turtle

There are an estimated 150,000 females that nest each year in 46 sites throughout the world (NOAA Fisheries and Service 2007b). In the U.S. Atlantic, there are about 100 to 1,000 females estimated to nest on beaches in Florida annually (FWC 2009b). In the U.S. Pacific, over 90 percent of nesting throughout the Hawaiian archipelago occurs at the French Frigate Shoals, where about 200 to 700 females nest each year (NOAA Fisheries and Service 1998a). Elsewhere in the U.S. Pacific, nesting takes place at scattered locations in the Commonwealth of the Northern Marianas, Guam, and American Samoa. In the western Pacific, the largest green turtle nesting aggregation in the world occurs on Raine Island, Australia, where thousands of females nest nightly in an average nesting season (Limpus et al. 1993). In the Indian Ocean, major nesting beaches occur in Oman where 30,000 females are reported to nest annually (Ross and Barwani 1995).

Leatherback Sea Turtle

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

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

However, the most recent population size estimate for the North Atlantic alone is a range of 34,000 to 94,000 adult leatherbacks (TEWG 2007). During recent years in Florida, the total number of leatherback nests counted as part of the Statewide Nesting Beach Survey (SNBS) program ranged from 540 to 1,797 from 2006-2010 (FWC/FWRI 2010b). Assuming a clutch frequency (number of nests/female/season) of 4.2 in Florida (Stewart 2007), these nests were produced by a range of 128 to 428 females in a given year.

Nesting in the Southern Caribbean occurs in the Guianas (Guyana, Suriname, and French Guiana), Trinidad, Dominica, and Venezuela. The largest nesting populations at present occur in the western Atlantic in French Guiana with nesting varying between a low of 5,029 nests in 1967 to a high of 63,294 nests in 2005, which represents a 92 percent increase since 1967 (TEWG 2007). Trinidad supports an estimated 6,000 leatherbacks nesting annually, which represents more than 80 percent of the nesting in the insular Caribbean Sea. Leatherback nesting along the Caribbean Central American coast takes place between Honduras and Colombia. In Atlantic Costa Rica, at Tortuguero, the number of nests laid annually between 1995 and 2006 was estimated to range from 199 to 1,623. Modeling of the Atlantic Costa Rica data indicated that the nesting population has decreased by 67.8 percent over this time period.

In Puerto Rico, the main nesting areas are at Fajardo (Northeast Ecological Corridor) and Maunabo on the main island of Puerto Rico and on the islands of Culebra and Vieques. Between 1993 and 2010, the number of nests in the Fajardo area ranged from 51 to 456. In the Maunabo area, the number of nests recorded between 2001 and 2010 ranged from a low of 53 in 2002 to a high of 260 in 2009 (Diez 2011). On the island of Culebra, the number of nests ranged from a low 41 in 1996 to a high of 395 in 1997 (Diez 2011). On beaches managed by the Commonwealth of Puerto Rico on the island of Vieques, the Puerto Rico Department of Natural and Environmental Resources recorded annually 14-61 leatherback nests between 1991 and 2000; 145 nests in 2002; 24 in 2003; and 37 in 2005 (Diez 2011). The number of leatherback sea turtle nests recorded on Vieques Island beaches managed by the Service ranged between 13 and 163 during 2001-2010. Using the numbers of nests recorded in Puerto Rico between 1984 and 2005, the TEWG (2007) estimated a population growth of approximately 10 percent per year. Recorded leatherback nesting on the Sandy Point National Wildlife Refuge on the island of St. Croix, U.S. Virgin Islands, between 1982 and 2010, ranged from a low of 82 in 1986 to a high of 1,008 in 2001 (Garner and Garner 2010). Using the number of observed females at Sandy Point from 1986 to 2004, the TEWG (2007) estimated a population growth of approximately 10 percent per year. In the British Virgin Islands, annual nest numbers have increased in Tortola from zero to six nests per year in the late 1980s to 35 to 65 nests per year in the 2000s (TEWG 2007).

The most important nesting beach for leatherbacks in the eastern Atlantic lies in Gabon, Africa. It was estimated there were 30,000 nests along 60 miles of Mayumba Beach in southern Gabon during the 1999-2000 nesting season (Billes et al. 2000). Some nesting has been reported in Mauritania, Senegal, the Bijagos Archipelago of Guinea-Bissau, Turtle Islands and Sherbro Island of Sierra Leone, Liberia, Togo, Benin, Nigeria, Cameroon, Sao Tome and Principe, continental Equatorial Guinea, Islands of Corisco in the Gulf of Guinea and the Democratic Republic of the Congo, and Angola. In addition, a large nesting population is found on the island of Bioko (Equatorial Guinea) (Fretey et al. 2007).

Hawksbill Sea Turtle

About 21,212 to 28,138 hawksbills are estimated to nest each year at 83 nesting concentrations among 10 ocean regions around the world (NOAA Fisheries and Service 2007c). Only four populations remain with more than 1,000 females nesting annually (Indonesia, and three in Australia) (Limpus 1997, 2002, 2004; NOAA Fisheries and Service 2007c). Mexico is now likely the most important region for hawksbills in the Caribbean with 534 to 891 nesting females recorded per year during 2001-2006 (NOAA Fisheries and Service 2007c). In the U.S. Pacific, hawksbills nest only on main island beaches in Hawaii, primarily along the east coast of the island of Hawaii. Hawksbill nesting has also been documented in American Samoa and Guam (NOAA Fisheries and Service 1998b).

Kemp's Ridley Sea Turtle

Most Kemp's ridleys nest on the beaches of the western Gulf of Mexico, primarily in Tamaulipas, Mexico. Nesting also occurs in Veracruz and Campeche, Mexico, although a small number of Kemp's ridleys nest consistently along the Texas coast (NOAA Fisheries et al. 2011). In addition, rare nesting events have been reported in Alabama, Florida, Georgia, South Carolina, and North Carolina. Historical information indicates that tens of thousands of Kemp's ridleys nested near Rancho Nuevo, Mexico, during the late 1940s (Hildebrand 1963). The Kemp's ridley population experienced a devastating decline between the late 1940s and the mid 1980s. The total number of nests per nesting season at Rancho Nuevo remained below 1,000 throughout the 1980s, but gradually began to increase in the 1990s. In 2009, 16,273 nests were documented along the 18.6 miles of coastline patrolled at Rancho Nuevo, and the total number of nests documented for all the monitored beaches in Mexico was 21,144 (Service 2010). In 2011, a total of 20,570 nests were documented in Mexico, 81 percent of these nests were documented in the Rancho Nuevo beach (Burchfield and Peña. 2011). In addition, 153 and 199 nests were recorded during 2010 and 2011, respectively, primarily in Texas.

Status and distribution

Loggerhead Sea Turtle

Five recovery units have been identified in the Northwest Atlantic based on genetic differences and a combination of geographic distribution of nesting densities, geographic separation, and geopolitical boundaries (NOAA Fisheries and Service 2008). Recovery units are subunits of a listed species that are geographically or otherwise identifiable and essential to the recovery of the species. Recovery units are individually necessary to conserve genetic robustness, demographic robustness, important life history stages, or some other feature necessary for long-term sustainability of the species. The five recovery units identified in the Northwest Atlantic are:

1. Northern Recovery Unit (NRU) - defined as loggerheads originating from nesting beaches from the Florida-Georgia border through southern Virginia (the northern extent of the nesting range);
2. Peninsula Florida Recovery Unit (PFRU) - defined as loggerheads originating from nesting beaches from the Florida-Georgia border through Pinellas County on the west coast of Florida, excluding the islands west of Key West, Florida;
3. Dry Tortugas Recovery Unit (DTRU) - defined as loggerheads originating from nesting beaches throughout the islands located west of Key West, Florida;
4. Northern Gulf of Mexico Recovery Unit (NGMRU) - defined as loggerheads originating from nesting beaches from Franklin County on the northwest Gulf coast of Florida through Texas; and
5. Greater Caribbean Recovery Unit (GCRU) - composed of loggerheads originating from all other nesting assemblages within the Greater Caribbean (Mexico through French Guiana, Bahamas, Lesser Antilles, and Greater Antilles).

The mtDNA analyses show that there is limited exchange of females among these recovery units (Ehrhart 1989; Foote et al. 2000; NOAA Fisheries 2001; Hawkes et al. 2005). Based on the number of haplotypes, the highest level of loggerhead mtDNA genetic diversity in the Northwest Atlantic has been observed in females of the GCRU that nest at Quintana Roo, Mexico (Encalada et al. 1998; Nielsen 2010).

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

Historically, the literature has suggested that the northern U.S. nesting beaches (NRU and NGMRU) produce a relatively high percentage of males and the more southern nesting beaches (PFRU, DTRU, and GCRU) a relatively high percentage of females (*e.g.*, Hanson et al. 1998; NOAA Fisheries 2001; Mrosovsky and Provancha 1989). The NRU and NGMRU were believed to play an important role in providing males to mate with females from the more female-dominated subpopulations to the south. However, in 2002 and 2003, researchers studied loggerhead sex ratios for two of the U.S. nesting subpopulations, the northern and southern subpopulations (NGU and PFRU, respectively) (Blair 2005; Wyneken et al. 2005). In 2002, the northern beaches produced more females and the southern beaches produced more males than previously believed. However, the opposite was true in 2003, with the northern beaches producing more males and the southern beaches producing more females in keeping with prior literature. Wyneken et al. (2005) speculated that the 2002 result may have been anomalous; however, the study did point out the potential for males to be produced on the southern beaches. Although this study revealed that more males may be produced on southern recovery unit beaches than previously believed, the Service maintains that the NRU and NGMRU play an important role in the production of males to mate with females from the more southern recovery units.

The NRU is the second largest loggerhead recovery unit within the Northwest Atlantic Ocean DPS. Annual nest totals from northern beaches averaged 5,215 nests from 1989-2008, a period of near-complete surveys of NRU nesting beaches, representing approximately 1,272 nesting females per year (4.1 nests per female, Murphy and Hopkins 1984) (NOAA Fisheries and Service 2008). In 2008, nesting in Georgia reached what was a new record at that time (1,646 nests), with a downturn in 2009, followed by yet another record in 2010 (1,760 nests). South Carolina had the two highest years of nesting in 2009 (2,183 nests) and 2010 (3,141 nests). The previous high for that 11-year span was 1,433 nests in 2003. North Carolina had 847 nests in 2010, which is above the average of 715. The Georgia, South Carolina, and North Carolina nesting data come from the seaturtle.org Sea Turtle Nest Monitoring System, which is populated with data input by the State agencies. The loggerhead nesting trend from daily beach surveys was declining significantly at 1.3 percent annually from 1983 to 2007 (NOAA Fisheries and Service, 2008). Nest totals from aerial surveys conducted by the South Carolina Department of Natural Resources showed a 1.9 percent annual decline in nesting in South Carolina from 1980-2007. Overall, there is strong statistical data to suggest the NRU has experienced a long-term decline (NOAA Fisheries and Service 2008). Currently, nesting for the NRU is showing possible signs of stabilizing.

The PFRU is the largest loggerhead recovery unit within the Northwest Atlantic Ocean DPS and represents approximately 87 percent of all nesting effort in the DPS (Ehrhart et al. 2003). A near-complete nest census of the PFRU undertaken from 1989 to 2007, revealed a mean of 64,513 loggerhead nests per year, representing approximately 15,735 females nesting per year (4.1 nests per female, Murphy and Hopkins 1984) (FWC 2008; NOAA Fisheries and Service 2008). This near-complete census provides the best statewide estimate of total abundance, but because of variable survey effort, these numbers cannot be used to assess trends. Loggerhead nesting trends are best assessed using standardized nest counts made at the Index Nesting Beach Survey (INBS) sites surveyed with constant effort over time. In 1979, the SNBS program was initiated to document the total distribution, seasonality, and abundance of sea turtle nesting in Florida. In 1989, the INBS program was initiated in Florida to measure seasonal productivity, allowing comparisons between beaches and between years (FWC 2009c). Of the 190 SNBS surveyed areas, 33 participate in the INBS program (representing 30 percent of the SNBS beach length).

Using INBS nest counts, a significant declining trend was documented for the PFRU Florida Recovery Unit, where nesting declined 26 percent over the 20-year period from 1989–2008, and declined 41 percent over the period 1998–2008 (NOAA Fisheries and Service 2008; Witherington et al. 2009). However, with the addition of nesting data through 2010, the nesting trend for the PFRU did not show a nesting decline statistically different from zero.

The NGMRU is the third largest nesting assemblage among the four U.S. recovery units. Nesting surveys conducted on approximately 186 miles of beach within the NGMRU (Alabama and Florida only) were undertaken between 1995 and 2007 (statewide surveys in Alabama began in 2002). The mean nest count during this 13-year period was 906 nests per year, which equates to about 221 females nesting per year (4.1 nests per female, Murphy and Hopkins 1984) (FWC 2008; NOAA Fisheries and Service 2008). Evaluation of long-term nesting trends for the NGMRU is difficult because of changed and expanded beach coverage. Loggerhead nesting trends are best assessed using standardized nest counts made at INBS sites surveyed with constant effort over time. Using Florida INBS data for the NGMRU (FWC 2008), a log-linear regression showed a significant declining trend of 4.7 percent annually from 1997-2008 (NOAA Fisheries and Service 2008).

The DTRU, located west of the Florida Keys, is the smallest of the identified recovery units. A near-complete nest census of the DTRU was undertaken from 1995 to 2004, excluding 2002, (9 years surveyed) revealed a mean of 246 nests per year, which equates to about 60 females nesting per year (4.1 nests per female, Murphy and Hopkins 1984) (FWC 2008, NOAA Fisheries and Service 2008). The nesting trend data for the DTRU are from beaches that are not part of the INBS program, but are part of the SNBS program. A simple linear regression of 1995-2004 nesting data, accounting for temporal autocorrelation, revealed no trend in nesting numbers. Because of the annual variability in nest totals, it was determined a longer time series is needed to detect a trend (NOAA Fisheries and Service 2008).

The GCRU is composed of all other nesting assemblages of loggerheads within the Greater Caribbean and is the third largest recovery unit within the Northwest Atlantic Ocean DPS, with the majority of nesting at Quintana Roo, Mexico. Statistically valid analyses of long-term nesting trends for the entire GCRU are not available because there are few long-term standardized nesting surveys representative of the region. Additionally, changing survey effort at monitored beaches and scattered and low-level nesting by loggerheads at many locations currently precludes comprehensive analyses. The most complete data are from Quintana Roo and Yucatán, Mexico, where an increasing trend was reported over a 15-year period from 1987-2001 (Zurita et al. 2003). However, TEWG (2009) reported a greater than 5 percent annual decline in loggerhead nesting from 1995-2006 at Quintana Roo.

Recovery Criteria (only the Demographic Recovery Criteria are presented below; for the Listing Factor Recovery Criteria, see NOAA Fisheries and Service 2008)

1. Number of Nests and Number of Nesting Females
   a. Northern Recovery Unit
      i. There is statistical confidence (95 percent) that the annual rate of increase over a generation time of 50 years is 2 percent or greater resulting in a total annual number of nests of 14,000 or greater for this recovery unit. The approximate distribution of nests in North Carolina = 14 percent (2,000 nests), South Carolina = 66 percent (9,200 nests), and Georgia = 20 percent (2,800 nests).
      ii. This increase in the number of nests must be a result of corresponding increases in the number of nesting females (estimated from nests, clutch frequency, and remigration interval).

   b. Peninsular Florida Recovery Unit
      i. There is statistical confidence (95 percent) that the annual rate of increase over a generation time of 50 years is statistically detectable (1 percent) resulting in a total annual number of nests of 106,100 or greater for this recovery unit.
      ii. This increase in the number of nests must be a result of corresponding increases in the number of nesting females (estimated from nests, clutch frequency, and remigration interval).

   c. Dry Tortugas Recovery Unit
      i. There is statistical confidence (95 percent) that the annual rate of increase over a generation time of 50 years is 3 percent or greater resulting in a total annual number of nests of 1,100 or greater for this recovery unit.
      ii. This increase in the number of nests must be a result of corresponding increases in the number of nesting females (estimated from nests, clutch frequency, and remigration interval).

   d. Northern Gulf of Mexico Recovery Unit
      i. There is statistical confidence (95 percent) that the annual rate of increase over a generation time of 50 years is 3 percent or greater resulting in a total annual number of nests of 4,000 or greater for this recovery unit. The approximate distribution of nests (2002-2007) is Florida = 92 percent (3,700 nests) and Alabama = 8 percent (300 nests).
      ii. This increase in the number of nests must be a result of corresponding increases in the number of nesting females (estimated from nests, clutch frequency, and remigration interval).

   e. Greater Caribbean Recovery Unit
      i. The total annual number of nests at a minimum of three nesting assemblages, averaging greater than 100 nests annually (*e.g.*, Yucatán, Mexico; Cay Sal Bank, Bahamas) has increased over a generation time of 50 years.
      ii. This increase in number of nests must be a result of corresponding increases in the number of nesting females (estimated from nests, clutch frequency, and remigration interval).

2. Trends in Abundance on Foraging Grounds

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

3. Trends in Neritic Strandings Relative to In-water Abundance

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

Green Sea Turtle

Annual nest totals documented as part of the Florida SNBS program from 1989-2010 have ranged from 435 nests laid in 1993 to 13,225 in 2010. Nesting occurs in 26 counties with a peak along the east coast, from Volusia through Broward Counties. Although the SNBS program provides information on distribution and total abundance statewide, it cannot be used to assess trends because of variable survey effort. Therefore, green turtle nesting trends are best assessed using standardized nest counts made at INBS sites surveyed with constant effort over time (1989-2010). Green sea turtle nesting in Florida is increasing based on 22 years (1989-2010) of INBS data from throughout the state ((FWC/FWRI 2010a). The increase in nesting in Florida is likely a result of several factors including:

1. A Florida statute enacted in the early 1970s that prohibited the killing of green turtles in Florida;
2. The species listing under the Act afforded complete protection to eggs, juveniles, and adults in all U.S. waters;
3. The passage of Florida's constitutional net ban amendment in 1994 and its subsequent enactment, making it illegal to use any gillnets or other entangling nets in State waters;
4. The likelihood that the majority of Florida green turtles reside within Florida waters where they are fully protected;
5. The protections afforded Florida green turtles while they inhabit the waters of other nations that have enacted strong sea turtle conservation measures (*e.g.*, Bermuda); and
6. The listing of the species on Appendix I of Convention on International Trade in Endangered Species of Wild Fauna and Flora, which stopped international trade and reduced incentives for illegal trade from the U.S (NOAA Fisheries and Service 2007b).

Recovery Criteria

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

1. The level of nesting in Florida has increased to an average of 5,000 nests per year for at least 6 years. Nesting data must be based on standardized surveys;
2. At least 25 percent (65 miles) of all available nesting beaches (260 miles) is in public ownership and encompasses at least 50 percent of the nesting activity;

3. A reduction in stage class mortality is reflected in higher counts of individuals on foraging grounds; and
4. All priority one tasks identified in the recovery plan have been successfully implemented.

Leatherback Sea Turtle

Pritchard (1982) estimated 115,000 nesting females worldwide, of which 60 percent nested along the Pacific coast of Mexico. Declines in leatherback nesting have occurred over the last 2 decades along the Pacific coasts of Mexico and Costa Rica. The Mexican leatherback nesting population, once considered to be the world's largest leatherback nesting population (historically estimated to be 65 percent of the worldwide population), is now less than 1 percent of its estimated size in 1980. Spotila et al. (1996) estimated the number of leatherback sea turtles nesting on 28 beaches throughout the world from the literature and from communications with investigators studying those beaches. The estimated worldwide population of leatherbacks in 1995 was about 34,500 females on these beaches with a lower limit of about 26,200, and an upper limit of about 42,900. This is less than one-third the 1980 estimate of 115,000. Leatherbacks are rare in the Indian Ocean and in very low numbers in the western Pacific Ocean. The population size for the North Atlantic range from 34,000 to 94,000 adult leatherbacks (TEWG 2007). The largest population is in the western Atlantic. Using an age-based demographic model, Spotila et al. (1996) determined that leatherback populations in the Indian Ocean and western Pacific Ocean cannot withstand even moderate levels of adult mortality and that the Atlantic populations are being exploited at a rate that cannot be sustained. They concluded that leatherbacks are on the road to extinction and further population declines can be expected unless action is taken to reduce adult mortality and increase survival of eggs and hatchlings.

In the western Atlantic, the U.S., nesting populations occur in Florida, Puerto Rico, and the U.S. Virgin Islands. In Florida, the SNBS program documented an increase in leatherback nesting numbers from 98 nests in 1989 to between 453 and 1,747 nests per season in the early 2000s (Stewart and Johnson 2006; FWC 2009a). Although the SNBS program provides information on distribution and total abundance statewide, it cannot be used to assess trends because of variable survey effort. Therefore, leatherback nesting trends are best assessed using standardized nest counts made at INBS sites surveyed with constant effort over time (1989-2010). Under the INBS program, approximately 30 percent of Florida's SNBS beach length is surveyed. The INBS nest counts represent approximately 34 percent of known leatherback nesting in Florida. An analysis of the INBS data has shown an exponential increase in leatherback sea turtle nesting in Florida since 1989. From 1989 through 2010, the annual number of leatherback sea turtle nests at the core set of index beaches ranged from 27 to 615 (FWC 2010b). Using the numbers of nests recorded from 1979 through 2009, Stewart et al. (2011) estimated a population growth of approximately 10.2 percent per year. In Puerto Rico, the main nesting areas are at Fajardo on the main island and on the island of Culebra and Vieques. Nesting ranged from 51 to 882 nests between 2001 and 2010 (Diez 2011). In the U.S. Virgin Islands, leatherback nesting on Sandy Point National Wildlife Refuge on the island of St. Croix, estimated a range of 143 to 1,008 nests between 1990 and 2005 (TEWG 2007; NOAA Fisheries and Service 2007c).

Recovery Criteria

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

1. The adult female population increases over the next 25 years, as evidenced by a statistically significant trend in the number of nests at Culebra, Puerto Rico, St. Croix, U.S. Virgin Islands, and along the east coast of Florida;
2. Nesting habitat encompassing at least 75 percent of nesting activity in U.S. Virgin Islands, Puerto Rico, and Florida is in public ownership; and
3. All priority one tasks identified in the recovery plan have been successfully implemented.

Hawksbill Sea Turtle

The hawksbill sea turtle has experienced global population declines with about 70 percent of the sites examined showing a decrease in nesting abundance over time (NOAA Fisheries and Service 2007a). Most populations are declining, depleted, or remnants of larger aggregations. Hawksbills were previously abundant, as evidenced by high-density nesting at a few remaining sites and by trade statistics. The decline of this species is primarily due to human exploitation for tortoiseshell. While the legal hawksbill shell trade ended when Japan agreed to stop importing shell in 1993, a significant illegal trade continues. It is believed that individual hawksbill populations around the world will continue to disappear under the current regime of exploitation for eggs, meat, and tortoiseshell, loss of nesting and foraging habitat, incidental capture in fishing gear, ingestion of and entanglement in marine debris, oil pollution, and boat collisions. Hawksbills are closely associated with coral reefs, one of the most endangered of all marine ecosystem types.

Recovery Criteria

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

1. The adult female population is increasing, as evidenced by a statistically significant trend in the annual number of nests on at least five index beaches, including Mona Island and Buck Island Reef National Monument;

2. Habitat for at least 50 percent of the nesting activity that occurs in the U.S. Virgin Islands and Puerto Rico is protected in perpetuity;

3. Numbers of adults, subadults, and juveniles are increasing, as evidenced by a statistically significant trend on at least five key foraging areas within Puerto Rico, U.S. Virgin Islands, and Florida; and

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

Kemp's Ridley Sea Turtle

Nesting aggregations of Kemp's ridleys at Rancho Nuevo were discovered in 1947, and the adult female population was estimated to be 40,000 or more individuals based on a film by Andres Herrera (Carr 1963; Hildebrand 1963). Within approximately three decades, the population had declined to 924 nests and reached the lowest recorded nest count of 702 nests in 1985. Since the mid-1980s, the number of nests observed at Rancho Nuevo and nearby beaches has increased 15 percent per year (Heppell et al. 2005), allowing cautious optimism that the population is on its way to recovery. This increase in nesting can be attributed to full protection of nesting females and their nests in Mexico resulting from a bi-national effort between Mexico and the U.S. to prevent the extinction of the Kemp's ridley, the requirement to use Turtle Excluder Devices in shrimp trawls both in the U.S. and Mexico, and decreased shrimping effort (Heppell et al. 2005; NOAA Fisheries et al. 2011).

Recovery Criteria (only the Demographic Recovery Criteria are presented below; for the Listing Factor Recovery Criteria, see NOAA Fisheries et al. 2011)

The recovery goal is to conserve and protect the Kemp's ridley sea turtle so that protections under the Act are no longer necessary and the species can be removed from the List of Endangered and Threatened Wildlife. Biological recovery criteria form the basis from which to gauge whether the species should be reclassified to threatened (*i.e.*, downlisted) or delisted, whereas the listing factor criteria ensure that the threats affecting the species are controlled or eliminated.

Downlisting Criteria

1. A population of at least 10,000 nesting females in a season (as estimated by clutch frequency per female per season) distributed at the primary nesting beaches (Rancho Nuevo, Tepehuajes, and Playa Dos) in Mexico is attained. Methodology and capacity to implement and ensure accurate nesting female counts have been developed.

2. Recruitment of at least 300,000 hatchlings to the marine environment per season at the three primary nesting beaches (Rancho Nuevo, Tepehuajes, and Playa Dos) in Mexico is attained to ensure a minimum level of known production through *in situ* incubation, incubation in corrals, or a combination of both.

Delisting Criteria

1. An average population of at least 40,000 nesting females per season (as measured by clutch frequency per female per season and annual nest counts) over a 6-year period distributed among nesting beaches in Mexico and the U.S. is attained. Methodology and capacity to ensure accurate nesting female counts have been developed and implemented.

Ensure average annual recruitment of hatchlings over a 6-year period from *in situ* nests and beach corrals is sufficient to maintain a population of at least 40,000 nesting females per nesting season distributed among nesting beaches in Mexico and the U.S into the future. This criterion may rely on massive synchronous nesting events (*i.e.*, arribadas) that will inundate predators as well as rely on supplemental protection in corrals and facilities.

Analysis of the species/critical habitat likely to be affected

The proposed action has the potential to adversely affect nesting sea turtles, their nests, and hatchlings within the action area. The effects of the proposed action on sea turtles will be considered further in the remaining sections of this Biological Opinion. Potential effects include destruction of nests deposited within the boundaries of the proposed project, harassment in the form of disturbing or interfering with female turtles attempting to nest within the construction area or on adjacent beaches as a result of construction activities, disorientation of hatchling turtles adjacent to the construction area as they emerge from the nest and crawl to the water as an altered beach system and adjacent artificial lighting, and behavior modification of nesting females due to escarpment formation within the project area during a nesting season resulting in false crawls or situations where they choose marginal or unsuitable nesting areas to deposit eggs. The quality of the habitat in front of the structure could affect the ability of female turtles to nest, the suitability of the nest incubation environment, and the ability of hatchlings to emerge from the nest.

Critical habitat has not been designated for any sea turtle in the continental U.S.; therefore, the proposed action would not result in an adverse modification to critical habitat.

ENVIRONMENTAL BASELINE

Climate Change

According to the Intergovernmental Panel on Climate Change Report (IPCC 2007), warming of the earth's climate is unequivocal, as is now evident from observations of increases in average global air and ocean temperatures, widespread melting of snow and ice, and rising sea level. The IPCC Report (2007) describes changes in natural ecosystems with potential widespread effects on many organisms, including marine mammals, reptiles, and migratory birds. The potential for rapid climate change poses a significant challenge for fish and wildlife conservation. Species abundance and distribution are dynamic, relative to a variety of factors, including climate. As climate changes, the abundance and distribution of fish and wildlife will also change. Highly specialized or endemic species are likely to be most susceptible to the stresses of changing climate. Based on these findings and other similar studies, the Department of the Interior requires agencies under its direction to consider potential climate change effects as part of their long-range planning activities (Service 2008).

Climate change at the global level drives alterations in weather at the regional level, although weather is also strongly affected by season and local effects (*e.g.*, elevation, topography, latitude, proximity to the ocean). Average temperature is predicted to rise from 36°F to 41°F for North America by the end of this century (IPCC 2007). Other processes to be affected by this projected warming include rainfall (amount, seasonal timing, and distribution), storms (frequency and intensity), and sea level rise. However, the exact magnitude, direction, and distribution of these changes at the regional level are not well understood or easy to predict. Seasonal change and local geography make prediction of the effects of climate change at any location variable. Climatic changes in south Florida could amplify current land management challenges involving habitat fragmentation, urbanization, invasive species, disease, parasites, and water management (Pearlstine 2008).

Air Temperature

Current models predict changes in mean global temperature in the range of 4°F to 8°F by 2100. How this manifests at the regional and local scale is uncertain. A change of just a couple degrees can have profound effects, particularly at temperature extremes. For example, in Florida, winter frost, a 2-degree transition from 33°F to 31°F, greatly affects vegetation. While predicted changes in average annual temperature appear small, local and seasonal temperature variation may be greater. It is also important to consider that an increase in the temperature of the global atmosphere may manifest as an increase or a decrease in local means and extremes. We do not currently know either the direction or anticipated size of temperature change in Florida, but the following possibilities at the local level should be considered:

1. Changes (likely small) in mean annual temperature;
2. Greater extremes of temperature in summer (average highs) and winter (average lows);
3. More prolonged and seasonally extended frosts;
4. Shifts in the distribution of temperature regimes (*e.g.*, isotherms and growing zones);
5. Changes in the seasonal onset of temperature changes (*e.g.*, earlier spring);
6. Changes in the duration of temperature regimes (*e.g.*, longer and warmer summers); and
7. Changes in both air and water (lake, river, ocean) temperature.

Most organisms have preferred ranges of temperature and lethal temperature limits they cannot survive. Many organisms require temperature signals or suitable temperature regimes to successfully complete life cycle activities such as nesting and winter dormancy. Some organisms are sensitive to temperature for incubation, sex determination (*e.g.*, sea turtles, alligators), or seed germination. The oxygen content of water (affecting fish) and the water content of vegetation (affecting fire combustion) are temperature-dependent. Some noxious or undesirable organisms may proliferate under different temperature regimes (*e.g.*, blue green algae in lakes and exotic species). Changes in temperature will likely affect fish and wildlife resources in many ways depending on the direction, amount, timing, and duration of the changes.

Rainfall

Ecosystems in Florida are sensitive to variation in rainfall. Well-drained soils, rapid runoff, and high plant transpiration quickly redistribute water available to organisms. Despite a high average rainfall, much of Florida experiences seasonal drought that profoundly affects fish and wildlife resources. Florida's rain depends on both global and regional climate factors (*e.g.*, jet stream, El Niño, frontal progression, storms and hurricanes) and local weather (*e.g.*, thunderstorms, sea breezes, lake effects and local circulation) that are likely affected by climate change. The following possibilities at the local level should be considered:

1. Changes in average annual rainfall (*e.g.*, higher or lower);
2. Changed seasonal distribution of rainfall (*e.g.*, when rain falls);

3. Changed regional distribution of rainfall (*e.g.*, where rain falls); and
4. Changed intensity (*e.g.*, more severe storm rain, or dispersed "misty" rain).

Rainfall changes are affected by temperature. The effects of changes in rainfall will likely be mediated through responses by vegetation and the changed availability of surface water (*e.g.*, lakes, ponds, rivers, swamps, and wet prairies) on which many organisms depend. In the longer term, changes in deposition or recharge to surficial and deep aquifers may affect spring flow. Florida has an unusually large area of wetland habitats supporting wildlife. If climate change reduces rainfall, then desertification of much of Florida is possible and it may come to resemble "desert islands" such as much of the Bahamas that occur at the same latitude. Rainfall changes may have the most profound effects on Florida's fish and wildlife resources.

Sea Level Rise

All current predictions suggest sea level will rise due to melting of continental and glacial ice and thermal expansion of the oceans. Florida, with its extensive coastline and low topography is highly vulnerable to sea level rise. The magnitude of the predicted rise is currently unknown and estimates vary from a few inches to yards. Modeled predictions using median consensus sea level rise estimates indicate that significant portions of Florida's coastline will be inundated and a major redistribution of coastal habitats is likely. However, to put this in context, Florida's coast currently experiences sea level fluctuations of 2 to 6 feet twice daily tides and is exposed to storm surges of 10 to 16 feet during hurricanes. Sea level changes will be superimposed on these normal, larger fluctuations. While these changes will likely be disastrous to human structures and activities, the effect on wildlife and its habitat may be less damaging. In essence, coastal habitats will migrate inland and Florida's flat coastal topography, a result of previous sea level changes, will mitigate the effect. Current coastal forests, dunes, and beaches will migrate inland and be displaced by marsh, while current marsh will become sea grass, barrier islands will become sandbars and new barrier islands arise. The primary effect for wildlife will be redistribution, and possibly increase in some habitats at the expense of others.

More profound changes in the coastal and marine environment may be driven by the temperature and rainfall effects that may promote the distribution of mangroves and coral reefs into the expanded coastal zone. The main hazard to wildlife from sea level rise will arise from efforts to protect human structures from these changes by dikes, seawalls, dredging, beach nourishment and similar engineering responses. Changes in temperature regimes in the ocean may cause shifts in distribution of marine species, and profound but entirely unpredictable effects may be generated if climate changes cause large scale change in ocean circulation such as the Florida Current. The following possibilities at the local level should be considered:

1. Transient but damaging effects on vulnerable coastal species (*e.g.*, beach nesting shorebirds, and sea turtles);
2. Redistribution of coastal habitats with disruptions of productivity;
3. Sedimentation effects during the transition;
4. Interactive synergy with other climate effects (*e.g.*, temperature, and storm frequency) to generate unanticipated second order effects;

5. Disruption of coastal migration patterns, particularly "passive" migrations of larvae driven by local water movement effects;
6. Secondary effects of protection of human structures; and
7. Migration zones and corridors available to allow changes in distribution.

To summarize, effects of climate change on wildlife in Florida are likely to be widespread and profound, and occur over a variety of dimensions and variables. As these effects cannot be prevented or delayed under current circumstances, a practical response will be to identify key areas and key species and habitats that are vulnerable to irreversible change and develop policy and planning to mitigate effects on these vulnerable entities.

Global warming will be a particular challenge for endangered, threatened, and other "at risk" species. It is difficult to estimate, with any degree of precision, which species will be affected by climate change or exactly how they will be affected. However, as it relates to nesting sea turtles, if predictions about global warming are realized, increased storms and rising sea levels could damage or destroy nests and nesting habitat, and temperature changes could skew sex ratios. Consequently, the Service shall use Strategic Habitat Conservation planning, an adaptive science-driven process that begins with explicit trust resource population objectives, as the framework for adjusting our management strategies in response to climate change (Service 2006).

Storms

Another predicted effect of climate change is to increase the frequency and intensity of severe storms, particularly tropical cyclones (hurricanes). Higher sea temperatures and high atmosphere conditions generate energy and conditions suitable for storms. There is some controversy about whether this effect is already discernible against the background of natural variation and cycles of hurricane occurrence.

Hurricanes are generally considered detrimental to human interests and may directly cause wildlife mortality. However, their effect in natural systems is generally transient; plants and animals tend to rapidly recover. Hurricanes do have significant secondary effects, reshaping coastal habitat structure (barrier islands, beaches, salt/freshwater intrusion to marshes, and estuaries), replenishing water bodies and aquifers and renewing plant succession, which are not completely negative for wildlife. Hurricane effects will interact with rainfall and sea level changes, possibly exacerbating coastal flooding. Hurricanes also redistribute organisms, particularly plants, by spreading seeds and other propagules. The following possibilities at the local level should be considered:

1. Changes in storm intensity and frequency;
2. Changes in the possibility of more concentrated storm tracks leading to more frequent storm landfall;
3. Interaction of surge and sea level for more severe coastal and adjacent inland effects; and
4. Distribution of invasive species.

Hurricanes were probably responsible for maintaining coastal beach habitat upon which sea turtles depend through repeated cycles of destruction, alteration, and recovery of beach and dune habitat. Hurricanes generally produce damaging winds, storm tides and surges, and rain, which can result in severe erosion of the beach and dune systems. Overwash and blowouts are common on barrier islands. Hurricanes and other storms can result in the direct loss of sea turtle nests, either by erosion or washing away of the nests by wave action and inundation or "drowning" of the eggs or pre-emergent hatchlings within the nest, or indirectly by causing the loss of nesting habitat. Depending on their frequency, storms can affect sea turtles on either a short-term basis (nests lost for one season and/or temporary loss of nesting habitat) or long term, if frequent (habitat unable to recover). The manner in which hurricanes affect sea turtle nesting also depends on their characteristics (winds, storm surge, rainfall), the time of year (within or outside of the nesting season), and where the northeast edge of the hurricane crosses land.

Because of the limited remaining nesting habitat in a natural state with no immediate development landward of the sandy beach, frequent or successive severe weather events could threaten the ability of certain sea turtle populations to survive and recover. Sea turtles evolved under natural coastal environmental events such as hurricanes. The extensive amount of predevelopment coastal beach and dune habitat allowed sea turtles to survive even the most severe hurricane events. It is only within the last 20 to 30 years that the combination of habitat loss to beachfront development and destruction of remaining habitat by hurricanes has increased the threat to sea turtle survival and recovery. On developed beaches, typically little space remains for sandy beaches to become reestablished after periodic storms. While the beach itself moves landward during such storms, reconstruction or persistence of structures at their pre-storm locations can result in a loss of nesting habitat.

Coastal Development

Loss of nesting habitat related to coastal development has had the greatest impact on nesting sea turtles in Florida. Beachfront development not only causes the loss of suitable nesting habitat, but can result in the disruption of powerful coastal processes accelerating erosion and interrupting the natural shoreline migration (National Research Council 1990). This may in turn cause the need to protect upland structures and infrastructure by armoring, groin placement, beach emergency berm construction and repair, and beach nourishment, all of which cause changes in, additional loss of, or impact to the remaining sea turtle habitat.

Erosion

A critically eroded area is a segment of shoreline where natural processes or human activity have caused or contributed to erosion and recession of the beach or dune system to such a degree that upland development, recreational interests, wildlife habitat, or important cultural resources are threatened or lost. Critically eroded areas may also include peripheral segments or gaps between identified critically eroded areas because, although they may be stable or slightly erosional now, their inclusion is necessary for continuity of management of the coastal system or for the design integrity of adjacent beach management projects (DEP 2009). It is important to note that for an erosion problem area to be critical there must be an existing threat to or loss of one of four specific interests – upland development, recreation, wildlife habitat, or important cultural resources.

Status of the species/critical habitat within the action area

Sea Turtles

During the 2011 nesting season, St. Lucie County accounted for approximately 8 percent of the overall nesting along Florida's Atlantic coast. From 2008 to 2011, there was an average of 4,918 loggerhead, 348 green, and 202 leatherback sea turtle nests laid within St. Lucie County (Table 1).

Loggerhead Sea Turtle

Of the counties along the east coast of Florida, St. Lucie County supported the third highest nesting of loggerhead sea turtles, with 5,763 nests or 269 nests per mile in 2011 (FWC 2011; Table 1). In 2011, loggerhead sea turtles laid 543 nests along 1.24 miles adjacent to shoreline in the project area (Table 2). In 2011, loggerhead sea turtles made 5,651 false crawls in St. Lucie County (Table 1). Along 1.24 miles of shoreline adjacent to the project area, loggerhead turtles made 542 false crawls in 2011 (Table 2).

Green Sea Turtle

Of the counties along the east coast of Florida, St. Lucie County supported the fourth highest nesting of green sea turtles with 398 nests or 19 nests per mile in 2011 (FWC 2011; Table 1). In 2011, green sea turtles laid 68 nests along 1.24 miles adjacent to shoreline in the project area (Table 2). In 2011, green sea turtles made 586 false crawls in St. Lucie County (Table 1). Along 1.24 miles of shoreline adjacent to the project area, green sea turtles made 53 false crawls in 2011 (Table 2).

Leatherback Sea Turtle

Of the counties along the east coast of Florida, St. Lucie County supported the second highest nesting of leatherback sea turtles with 254 nests or 12 nests per mile in 2011 (FWC 2011; Table 1). In 2011, leatherback sea turtles laid 12 nests along 1.24 miles adjacent to shoreline in the project area (Table 2). In 2011, leatherback sea turtles made 48 false crawls in St. Lucie County (Table 1). Along 1.24 miles of shoreline adjacent to the project area, leatherback turtles made six false crawls in 2011 (Table 2).

Hawksbill Sea Turtle

No occurrences of hawksbill nesting have been documented in the action area or St. Lucie County. The majority of nesting surveys conducted in Florida occur during the morning hours and are based on interpretation of the tracks left by the turtles as they ascend and descend the beach; the turtles themselves are rarely observed. Because hawksbill and Kemp's ridley turtle tracks are difficult to discern from loggerhead tracks, it is likely that nesting by both species is underreported (Meylan et al. 1995).

Kemp's Ridley Sea Turtle

No nesting has been reported in St. Lucie County for Kemp's ridley turtles. The majority of nesting surveys conducted in Florida occur during the morning hours and are based on interpretation of the tracks left by the turtles as they ascend and descend the beach; the turtles themselves are rarely observed. Because hawksbill and Kemp's ridley turtle tracks are difficult to discern from loggerhead tracks, it is likely that nesting by both species is underreported (Meylan et al. 1995).

Factors affecting the species habitat within the action area

In 2004, hurricanes Francis and Jeanne caused significant dune erosion adjacent to the project area. In the winter of 2005, the dune was restored with approximately 180,000 cy of sand. Later that year, Hurricane Wilma caused additional erosion resulting in the potential for breaching of the cooling water canal. In the spring of 2006, the dune was once again restored using approximately 10,000 cy of sand. In the fall of 2008, Tropical Storm Kyle produced large escarpments in excess of 6 feet along the project area.

Beach Maintenance and Pollution

No regular beach maintenance in the form of tractor tilling that may disrupt or impact deposited nests and nesting females takes place adjacent to the project area. Plastics, styrofoam, and fishing line are pollutants that may negatively impact nesting success and nearshore foraging.

Lighting

Artificial beachfront lighting may cause disorientation (loss of bearings) and misorientation (incorrect orientation) of sea turtle hatchlings. Visual signs are the primary sea-finding mechanism for hatchlings (Mrosovsky and Carr 1967; Mrosovsky and Shettleworth 1968; Dickerson and Nelson 1989; Witherington and Bjorndal 1991). Artificial beachfront lighting is a documented cause of hatchling disorientation and misorientation on nesting beaches (Philibosian 1976; Mann 1977; Witherington and Martin 1996). The emergence from the nest and crawl to the sea is one of the most critical periods of a sea turtle's life. Hatchlings that do not make it to the sea quickly become food for ghost crabs, birds, and other predators, or become dehydrated and may never reach the sea. In addition, research has documented significant reduction in sea turtle nesting activity on beaches illuminated with artificial lights (Witherington 1992). During the 2010 sea turtle nesting season, 141 sea turtle disorientations were recorded in St. Lucie County (Schanzle 2012) and over 47,000 throughout Florida (FWC/FWRI 2011).

The Applicant has a Sea Turtle Protection Plan that contains several required sea turtle monitoring parameters including lighting impacts an order to document the number of disorientated adult and hatchling sea turtles. In addition, the proposed project will not be conducted at night, includes no beachfront lighting, no plans to construct lighting, and no existing sources of light exist in the project area.

Predation

Predation of sea turtle eggs and hatchlings by native and introduced species occurs on almost all nesting beaches. Predation by a variety of predators can considerably decrease sea turtle nest hatching success. The most common predators in the southeastern U.S. are ghost crabs

(*Ocypode quadrata*), raccoons (*Procyon lotor*), feral hogs (*Sus scrofa*), foxes (*Urocyon cinereoargenteus* and *Vulpes vulpes*), coyotes (*Canis latrans*), armadillos (*Dasypus novemcinctus*), and fire ants (*Solenopsis invicta*) (Dodd 1988, Stancyk 1995). In the absence of nest protection programs in a number of locations throughout the southeast U.S., raccoons may depredate up to 96 percent of all nests deposited on a beach (Davis and Whiting 1977; Hopkins and Murphy 1980; Stancyk et al. 1980; Talbert *et al.* 1980; Schroeder 1981; Labisky et al. 1986).

EFFECTS OF THE ACTION

The analysis of the direct and indirect effects of the proposed action on sea turtles and the interrelated and interdependent activities of those effects was based on beneficial and detrimental factors.

Factors to be considered

The proposed action has the potential to adversely affect nesting sea turtles and their nests, and hatchlings within the proposed action area during the seawall construction activities and for the life of the seawall along St. Lucie County, Florida. Potential effects include an increase in clutch mortality due to nest inundation or erosion, and loss of nesting habitat if the dune seaward of the seawall is not maintained or lost due to erosion, behavior modification of nesting females due to seawall presence within the project area during the nesting season that could result in false crawls or situations where they choose marginal or unsuitable nesting areas to deposit eggs, and the seawall could act as a barrier to both nesting female and hatchling sea turtles if exposed or insufficiently covered by sand.

Proximity of action

Seawall construction will occur within and adjacent to sea turtle nesting habitat and dune habitat that ensure the stability and integrity of the nesting beach. Specifically, the project has the potential to impact loggerhead, green, leatherback, hawksbill, and Kemp's ridley nesting females, their nests, and hatchlings.

Timing

Although dune restoration and dune planting were completed by March 1 and March 31, respectively, seawall construction could directly and indirectly impact nesting female sea turtles, their nests, and hatchlings when conducted between May 1 and June 30. The presence of the seawall on the nesting beach has the potential to impact sea turtle nesting for the life of the project.

Nature of the effect

The effects of the seawall may change the nesting behavior of adult female sea turtles, diminish nesting success, and cause reduced hatching and emerging success. Any decrease in productivity and/or survival rates would contribute to the vulnerability of the sea turtles nesting in the southeastern U.S.

Duration

Seawall construction is a one-time activity thus; the direct effects would be expected to be short-term in duration. A continued effect from the activity has the potential to impact nesting and hatchling sea turtles and sea turtle nests in subsequent nesting seasons.

Analyses for effects of the action

Beneficial effects

Construction of the proposed seawall has no benefit to nesting sea turtles.

Adverse Effects

It has been documented that seawalls can have adverse effects on nesting and hatchling sea turtles and sea turtle nests. Results of monitoring sea turtle nesting and seawall presence provide additional information regarding sea turtle response, effectiveness of minimization measures, and other factors that influence nesting, hatching, and emerging success.

Direct effects

Construction

Significant negative effects to sea turtles may result if protective measures are not incorporated during project construction. Seawall construction during the nesting season, particularly on or near high density nesting beaches, can cause increased loss of eggs and hatchlings and, along with other mortality sources (*e.g.*, inundation of nests), may significantly impact the long-term survival of the species. Construction of the proposed seawall is expected to directly affect approximately 396 linear feet of nesting shoreline. In addition, placement of sand on a beach in and of itself may not provide suitable nesting habitat for sea turtles. Although sand placement activities may increase the potential nesting area, significant negative impacts to sea turtles may result if protective measures are not incorporated during project construction. Sand placement activities during the nesting season, particularly on or near high density nesting beaches, can cause increased loss of eggs and hatchlings and, along with other mortality sources, may significantly impact the long-term survival of the species. For instance, construction conducted during the early nesting and hatching season could result in the loss of sea turtles through disruption of adult nesting activity and by burial or crushing of nests or hatchlings. In addition, while a nest monitoring and egg relocation program would reduce these impacts, nests may be inadvertently missed (when crawls are obscured by rainfall, wind, or tides) or misidentified as false crawls during daily patrols. Even under the best of conditions, about 7 percent of the nests can be misidentified as false crawls by experienced sea turtle nest surveyors (Schroeder 1994). Potential adverse effects during the project construction phase include disturbance of existing nests, which may have been missed, and disturbance of females and hatchlings attempting to nest and emerge, respectively.

Changes in the physical environment

Sand placement in the dune creation may result in changes in sand density (compaction), beach shear resistance (hardness), beach moisture content, beach slope, sand color, sand grain size, sand grain shape, and sand grain mineral content if the placed sand is dissimilar from the original beach sand (Nelson and Dickerson 1988a). These changes could result in adverse impacts on nest site selection, digging behavior, clutch viability, and hatchling emergence (Nelson and Dickerson 1987, Nelson 1988).

Beach compaction and unnatural beach profiles resulting from sand placement could negatively impact sea turtles regardless of the timing of projects. Very fine sand or the use of heavy machinery can cause sand compaction on nourished beaches (Nelson et al. 1987; Nelson and Dickerson 1988a). Significant reductions in nesting success (*i.e.*, false crawls occurred more frequently) have been documented on severely compacted nourished beaches (Fletemeyer 1980; Raymond 1984; Nelson and Dickerson 1987; Nelson et al. 1987), and increased false crawls may result in increased physiological stress to nesting females. Sand compaction may increase the length of time required for female sea turtles to excavate nests and cause increased physiological stress to the animals (Nelson and Dickerson 1988b). Nelson and Dickerson (1988c) concluded that, in general, beaches nourished from offshore borrow sites are harder than natural beaches, and while some may soften over time through erosion and accretion of sand, others may remain hard for 10 years or more.

These impacts can be minimized by using suitable sand and by tilling (minimum depth of 36 inches) compacted sand after project completion. The level of compaction of a beach can be assessed by measuring sand compaction using a cone penetrometer (Nelson 1987). Tilling of a nourished beach with a root rake may reduce the sand compaction to levels comparable to unnourished beaches. However, a pilot study by Nelson and Dickerson (1988c) showed that a tilled nourished beach will remain uncompacted for only up to 1 year. Thus, multi-year beach compaction monitoring and, if necessary, tilling would help to ensure that project impacts on sea turtles are minimized.

A change in sediment color on a beach could change the natural incubation temperatures of nests in an area, which, in turn, could alter natural sex ratios. To provide the most suitable sediment for nesting sea turtles, the color of the nourished sediments should resemble the natural beach sand in the area. Natural reworking of sediments and bleaching from exposure to the sun would help to lighten dark nourishment sediments; however, the timeframe for sediment mixing and bleaching to occur could be critical to a successful sea turtle nesting season.

Escarpment formation

For sand placement, steep escarpments may develop along their water line interface as they adjust from an unnatural construction profile to a more natural beach profile (Coastal Engineering Research Center 1984; Nelson et al. 1987). Escarpments can hamper or prevent access to nesting sites (Nelson and Blihovde 1998). Researchers have shown that female sea turtles coming ashore to nest can be discouraged by the formation of an escarpment, leading to situations where they choose marginal or unsuitable nesting areas to deposit eggs (*e.g.*, in front of the escarpments, which often results in failure of nests due to prolonged tidal inundation). This impact can be minimized by leveling any escarpments prior to the nesting season.

Nest relocation

Besides the risk of missing nests during a nest relocation program, there is a potential for eggs to be damaged by their movement, particularly if eggs are not relocated within 12 hours of deposition (Limpus et al. 1979). Nest relocation can have adverse impacts on incubation temperature (and hence sex ratios), gas exchange parameters, hydric environment of nests, hatching success, and hatchling emergence (Limpus et al. 1979; Ackerman 1980; Parmenter 1980; Spotila et al. 1983; McGehee 1990). Relocating nests into sands deficient in oxygen or moisture can result in mortality, morbidity, and reduced behavioral competence of hatchlings.

Nest moisture content is known to influence the incubation environment of the embryos and hatchlings of turtles with flexible-shelled eggs, which has been shown to affect nitrogen excretion (Packard et al. 1984), mobilization of calcium (Packard and Packard 1986), mobilization of yolk nutrients (Packard et al. 1985), hatchling size (Packard et al. 1981; McGehee 1990), energy reserves in the yolk at hatching (Packard et al. 1988), and locomotory ability of hatchlings (Miller et al. 1987). In a 1994 Florida study comparing loggerhead hatching and emergence success of relocated nests with *in situ* nests, Moody (1998) found hatching success was lower in relocated nests at 9 of 12 beaches evaluated and emergence success was lower in relocated nests at 10 of 12 beaches surveyed in 1993 and 1994.

Physical Barrier/Obstruction

The proposed seawall has the potential to interfere with the egress and ingress of adult female sea turtles at nesting sites where they may abort nesting for that night, or move to another section of beach to nest. All of these activities may cause an increase in energy expenditure. In addition, the seawall may adversely affect sea turtle hatchlings by serving as a barrier or obstruction thereby delaying offshore migration, and depleting or increasing expenditure of the "swim frenzy" energy critical to reach the relative safety of offshore development areas (Salmon and Wyneken 1987; Wyneken et al. 1990; Witherington 1991). The first hour of a hatchling's life is precarious and predation is high, but threats decrease as hatchlings distance themselves from the natal beach (Stancyk 1995; Pilcher et al. 2000). Delays in hatchling migration (both on the beach and in the water) can cause added expenditures of energy and an increase of time spent in predator rich nearshore water.

Indirect effects

Many of the direct effects of a seawall may persist over time and become indirect effects. These indirect effects include changes in the physical habitat, behavioral modification, mortality, decreased nest viability, increased need for armoring, increased susceptibility of relocated nests to catastrophic events during the construction period, increased erosion, and impact of debris on the beach from seawall deterioration.

Changes in the Physical Habitat

Most property owners invest substantially in the construction of temporary armoring structures and in many cases they subsequently petition the Florida Department of Environmental Protection (DEP) for a permit to authorize the structure as a permanent armoring device. As a result, the Service anticipates armoring authorized by the DEP and the NRC will subsequently remain in place with modifications to meet the DEP requirements. Consequently, any adverse effects to sea turtles due to the presence of an armoring structure are expected to occur throughout the life of the structure.

Due to the extreme erosion events that are necessary to require construction of emergency armoring, it is likely that most structures will be placed within the tidal zone of the sea. In addition to the fact an armoring structure creates a physical obstacle to nesting sea turtles, the interaction between an armoring structure and the hydrodynamics of tide and current often results in the alteration of the beach profile seaward and in the immediate vicinity of the structure (Pilkey and Wright 1988; Terchunian 1988; Tait and Griggs 1990; Plant and Griggs 1992) including increased erosion seaward of structures, increased longshore currents that move sand away from the area, loss of interaction between the dune and ocean, and concentration of wave energy at the ends of an armoring structure (Schroeder and Mosier 1996). These changes or combination of changes can have various detrimental effects on sea turtles and their nesting habitat.

Hard shoreline stabilization structures may be effective in stabilizing the beach and adjacent infrastructure; however, these structures, especially seawalls, usually result in creating a narrower dry beach and therefore, a loss in potential sea turtle nesting habitat (Rizkalla and Savage 2011).

Behavioral Modification

Coastal armoring can hinder nesting females from reaching suitable nesting sites and result in increased false crawls where female turtles return to the water without nesting (Mosier 1998). Threats to nesting sea turtles posed by armoring may include a reduction of nesting habitat, displacement of turtles into nesting habitat that is sub-optimal (*e.g.,* a lower beach elevation where eggs would drown; Murphy 1985), an increase in the physiological cost of nesting, a possible decrease in nesting activity (Mosier 1998), and potentially even entrapment of nesting turtles. Also as armoring structures age and subsequently fail and break apart, they spread debris on the beach, which may further impede access to suitable nesting sites and trap hatchlings and nesting turtles. For example, hatchlings have been found trapped in holes or crevices of exposed riprap and geotextile tubes. Both nesting turtles and hatchlings have been found entangled or entrapped in the debris of failed structures.

Mortality

There have been reports of injury and mortality of nesting turtles that have been able to climb onto an armoring structure via adjacent unarmored properties and have subsequently fallen off and died from injuries incurred during the fall.

Decreased Nest Viability

Schroeder and Mosier (1996) indicated sea turtle nests seaward of armoring are more prone to mortality due to inundation or exacerbated erosion.

Increased Need for Armoring

The placement of armoring structures within areas of tidal influence results in changes to natural beach processes. These changes can result in accelerated erosion seaward of the armoring structure and adjacent to the structure, especially on the downdrift side (Pilkey and Wright 1988; Tait and Griggs 1990). Thus, additional armoring may be necessary downdrift of the proposed project.

Increased Susceptibility to Catastrophic Events

Relocation of sea turtle nests may concentrate eggs in an area making them more susceptible to catastrophic events. Hatchlings released from concentrated areas may also be subject to greater predation rates from both land and marine predators, because the predators learn where to concentrate their efforts (Glenn 1998; Wyneken et al. 1998).

Erosion

Erosion control structures (*e.g.*, seawalls, terminal groins, T-groins, and breakwaters), in conjunction with beach nourishment, can help stabilize U.S. Gulf and Atlantic coast barrier island beaches (Leonard et al. 1990). However, seawalls often result in accelerated beach erosion due to an increase in longshore currents, a steep beach profile due to the lack of sand exchange between dune and beach, a steeper offshore profile, and corresponding degradation of suitable sea turtle nesting habitat (NOAA Fisheries and Service 1991a, 1991b, 1992; Rizkalla and Savage 2011). Initially, the greatest changes are observed close to the structures, but effects may eventually extend significant distances along the coast (Komar 1983). Beach nourishment only partly alleviates impacts of seawall construction on downdrift beaches (Komar 1983).

Erosion Control Structure Breakdown

If the seawall fails and breaks apart, debris may spread upon the beach, which may further impede nesting females from accessing suitable nesting sites (resulting in a higher incidence of false crawls) and trapping hatchlings and nesting turtles (NOAA Fisheries and Service 1991a, 1991b).

Species' response to a proposed action

The Service believes there is a potential for long-term adverse effects on sea turtles, including nesting females, eggs, and hatchlings, as a result of seawall construction.

Placement of the seawall has the potential to result in behavior modification of nesting females due to the presence of the armoring structure, resulting in false crawls and their return to the water without nesting; displacement of female turtles into nesting habitat that is sub-optimal (*e.g.*, a lower beach elevation where eggs would drown); an increase in the physiological cost of nesting; a possible decrease in nesting activity; potential entrapment and mortality of nesting turtles and hatchlings; and destruction of nests from washout or inundation due to the effects of the armoring structure and shoreline processes (*i.e.*, exacerbated erosion).

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 seawall construction event outlined in this Biological Opinion. In addition, the Service does not have any knowledge of any plans by other agencies, municipalities, or private parties, to conduct activities that could affect federally-listed species within the action area.

CONCLUSION

It is the Service's biological opinion that the project, as proposed, is not likely to jeopardize the continued existence of loggerhead, green, leatherback, hawksbill, and Kemp's ridley sea turtles. This conclusion is based on the following:

1. The proposed seawall will directly impact approximately 396 linear feet of shoreline. This represents 0.005 and 0.006 percent of the approximately 1,400 and 1,166 miles of available sea turtle nesting habitat in the southeastern U.S, and within the PFRU, respectively;

2. Take of sea turtles will be minimized by implementation of the Reasonable and Prudent Measures, and Terms and Conditions outlined below. These measures have been shown to help minimize adverse impacts to sea turtles;

3. Long-term adverse effects to adult and hatchling sea turtles and sea turtle eggs are anticipated as a result of the seawall. The principle long-term effects of the seawall are expected to affect hatchling success within a minimum of 396 linear feet of shoreline adjacent to the project area and possibly approximately 750 feet due to downdrift erosion and/or escarpments for the duration of the seawall's existence. Although a variety of factors, including some that cannot be controlled, can influence how an erosion control structure will perform from an engineering perspective, measures can be implemented to minimize adverse impacts to sea turtles;

4. The Service has taken into account the current status of sea turtles, the environmental baseline for the action area, the effects of the proposed seawall, and the cumulative effects; and

5. No critical habitat has been designated for the loggerhead, green, leatherback, Kemp's ridley, and hawksbill sea turtles in the continental U.S.; therefore, none 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, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined by the 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 NRC so they become binding conditions of any permit issued, as appropriate, for the exemption in section 7(o)(2) to apply. The NRC has a continuing duty to regulate the activity covered by this incidental take statement. If the NRC (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 impact of incidental take, the NRC must report the progress of the action and its impacts on the species to the Service as specified in the incidental take statement [50 CFR §402.14(i)(3)].

AMOUNT OR EXTENT OF TAKE

Sea Turtles

The Service anticipates approximately 396 linear feet of nesting beach habitat could be taken as a result of the proposed action; however, incidental take of sea turtles will be difficult to detect for the following reasons:

1. Turtles nest primarily at night and all nests are not located because:
   a. Natural factors, such as rainfall, wind, and tides may obscure crawls and
   b. Human-induced factors, such as pedestrian and vehicular traffic, may obscure crawls, and result in nests being destroyed because they were missed during a nesting survey and egg relocation program.
2. The total number of hatchlings per undiscovered nest is unknown;
3. The reduction in percent hatching and emerging success per relocated nest over the natural nest site is unknown;

4. An unknown number of females may avoid the project beach and be forced to nest in a less than optimal area; and
5. The number of nests lost due to erosion, washout, and inundation adjacent to the seawall is unknown.

However, the level of take of these species can be anticipated by the disturbance of suitable turtle nesting beach habitat because of the following:

1. Turtles nest within the project area;
2. Project construction may occur during a portion of the nesting season; and
3. Seawall construction may modify the beach profile and topography.

Take is expected to be in the form of:

1. Destruction of all sea turtle nests that may be constructed and eggs that may be deposited and missed by a nest survey and egg relocation program within the boundaries of the proposed project;
2. Destruction of all sea turtle nests deposited during the period when a nest survey and egg relocation program is not required to be in place within the boundaries of the proposed project;
3. Reduced hatching success due to egg mortality during relocation and adverse conditions at the relocation site;
4. Harassment in the form of disturbing or interfering with sea turtles attempting to nest within the project area or on adjacent beaches as a result of construction activities;
5. Destruction and loss of nests from erosion, inundation, and washout events due to the presence of the seawall; and
6. Behavior modification of nesting females or hatchlings due to the presence of the seawall which may act as a barrier to movement, or cause disorientation.

The amount or extent of incidental take for sea turtles will be considered exceeded if the project results in more than a one-time seawall construction event along approximately 396 linear feet of beach identified for seawall construction. This incidental take statement will be in effect for the life of the project. 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 NRC 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

Sea Turtles

In this accompanying Biological Opinion, the Service determined that this level of anticipated take is not likely to result in jeopardy to the loggerhead, green, leatherback, hawksbill, or Kemp's ridley sea turtles. Critical habitat has not been designated in the project area; therefore, the project will not result in destruction or adverse modification of critical habitat for any of the sea turtle species.

Incidental take of nesting and hatchling sea turtles is anticipated to occur during project construction and during the life of the project. Take will occur on nesting habitat along approximately 396 linear feet of beach within the project area.

REASONABLE AND PRUDENT MEASURES

The Service believes the following reasonable and prudent measures are necessary and appropriate to minimize take of loggerhead, green, leatherback, hawksbill, and Kemp's ridley sea turtles in the proposed action area.

1. All seawall construction activities shall be completed by June 30, 2012.
2. Agencies will be contacted immediately if a sea turtle emergence event occurs in the project area.
3. If seawall construction activities are conducted during the period from March 1 through June 30, surveys for early nesting sea turtles and hatchlings shall be conducted. If nests are constructed in the seawall template, the eggs shall be relocated.
4. During seawall construction, the natural beach profile will be maintained to the maximum extent possible.
5. If seawall or dune integrity is compromised, remedial action may be warranted.
6. The NRC shall ensure that contractors performing the seawall construction work fully understand the sea turtle protection measures detailed in this incidental take statement.
7. During the early (March 1 through April 30) and late (November 1 through November 30) portions of the nesting season, construction equipment and supplies shall be stored in a manner that will minimize impacts to sea turtles to the maximum extent practicable.
8. A vegetated dune must be maintained in front of the proposed seawall. The placement and design of the dune must emulate the natural dune system to the maximum extent practicable, including the dune configuration and shape. An exemption to this may occur through coordination with the Service and FWC if it is found that the constructed dune continually erodes away.
9. Beach quality sand suitable for sea turtle nesting, successful incubation, and hatchling emergence must be used for the constructed and maintained dune.
10. Daily nesting surveys shall be conducted 2 years postconstruction.
11. The sea turtle permit holder shall be notified if a sea turtle nest is excavated.
12. All reports shall be submitted to the FWC and the Service.
13. State and Federal agencies shall be notified immediately upon locating a dead, injured, or sick sea turtle.

TERMS AND CONDITIONS

In order to be exempt from the prohibitions of section 9 of the Act, the NRC 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.

Protection of sea turtles

1a. As of March 1, but not later than April 30, the Applicant may conduct work on the beach seaward of the proposed seawall based on the following guidelines:

- i. All nests within the ongoing construction survey area (600 feet) shall be marked with a protective barrier;
- ii. If a nest occurs in zones 0 or N, specific marking requirements will be determined on a case-by-case basis through consultation with FWC and the Service;
- iii. FWC and the Service shall be contacted if a sea turtle emergence occurs in the project area during the construction period, including final dune planting activities;
- iv. If the Applicant chooses to construct a fence to limit public access to the work area, the fence will include posts imbedded in the sand (including no concrete or other similar post support material) spaced approximately 8 to 10 feet apart. The fence material will comprise orange plastic fencing or chain link fencing. At sundown the fencing bottom elevation must occur no less than 3 feet above the surface of the beach/dune. The fence should be removed, rolled up, or otherwise modified to ensure night access to nesting sea turtles; and
- v. The work area will be surveyed in accordance with the Sea Turtle Protection Plan prepared for St. Lucie County Development Review Board and provided as part of the permit application package. Night time turtle monitoring will be performed as requested by the FWC.

1b. As of May 1, no work will occur seaward of the seawall except as described below. Work may continue without restriction landward of the seawall:

- i. As of May 1, but not later than May 30, excavation may occur up to 2 feet seaward of the installed sheet pile to allow for construction of the seawall cap. All excavation shall be done by hand, and all pits/trenches shall be filled to grade by hand no later than sunset each day;
- ii. The Applicant shall instruct the contractor to finish the more seaward sections of cap (those sections of the seawall cap parallel to the shoreline) first, then complete cap work on the wing walls extending landward. All excavation work for cap construction shall be completed by May 30;
- iii. After May 30 only dune planting may occur seaward of the seawall;
- iv. If a nest occurs in zones O and N, specific marking requirements will be determined on a case-by-case basis through consultation with the FWC and the Service;
- v. All nests within the ongoing construction survey area (600 feet) shall be marked with a protective barrier;

vi. If a nest occurs in zones 0 or N, specific marking requirements will be determined on a case-by-case basis through consultation with FWC and the Service; and

vii. The work area will be surveyed in accordance with the Sea Turtle Protection Plan prepared for St. Lucie County Development Review Board and provided as part of the permit application package. Night time turtle monitoring will be performed as requested by the FWC.

2. The Service and FWC shall be contacted if a sea turtle emergence event occurs in the project area during the construction period, including final dune planting activities;

3. Daily early morning surveys for sea turtles shall be required if any portion of the seawall construction occurs during the period from March 1 through June 30. Nesting surveys shall be initiated 65 days prior to seawall construction activities, or by March 1, whichever is later. Nesting surveys shall continue through the end of the project or through September 30, whichever is earlier. If nests are constructed in areas where they may be affected by seawall construction activities, eggs shall be relocated per the following requirements:

3a. Nesting surveys and egg relocations shall only be conducted by personnel with prior experience and training in nesting survey and egg relocation procedures. Surveyors shall have a valid FWC Permit. Nesting surveys shall be conducted daily between sunrise and 9 a.m. The contractor shall not initiate work until daily notice has been received from the sea turtle permit holder that the morning survey has been completed. Surveys shall be performed in such a manner so as to ensure that seawall construction activities do not occur in any location prior to completion of the necessary sea turtle protection measures;

3b. Only those nests that may be affected by seawall construction activities shall be relocated. Nests requiring relocation shall be moved no later than 9 a.m. the morning following deposition to a nearby self-release beach site in a secure setting where artificial lighting will not interfere with hatchling orientation. Nest relocations in association with seawall construction activities shall cease when these activities no longer threaten nests; and

3c. Nests deposited within areas where seawall construction activities have ceased or will not occur for 65 days shall be marked and left *in situ* unless other factors threaten the success of the nest. The sea turtle permit holder shall install an on-beach marker at the nest site and a secondary marker at a point landward as possible to assure the future location of the nest will be possible should the on-beach marker be lost. A series of stakes and highly visible survey ribbon or string shall be installed to establish a 10-foot radius around the nest. No activity will occur within this area nor will any activity occur which could result in impacts to the nest. Nest sites shall be inspected daily to assure nest markers remain in place and that the nest has not been disturbed by seawall construction;

4. During March 1 through June 30, all excavations and temporary alteration of beach topography resulting from seawall construction will be filled or graded to the natural beach profile prior to 9:00 p.m. each day. No open trenches shall be left unattended. In the event that scarps form at the seaward edge of the armoring structure prohibiting access by sea turtles, the NRC must contact the Service to determine if remedial action is required to ensure that female turtles are able to access nesting habitat behind the armoring structure and that hatchlings may move across the armoring structure to the water safely;

5. In the event a portion of the seawall fails or begins to disintegrate, all debris and structural material must be removed from the nesting beach area and deposited off site immediately. If maintenance of the seawall or dune is required during the period from May 1 to October 31, no work will be initiated without prior coordination with the NRC and Service;

6. The NRC shall arrange a meeting between representatives of the contractor, the Service, the FWC, and the sea turtle permit holder responsible for egg relocation prior to commencement of work on this project. This will provide an opportunity for explanation or clarification of the sea turtle protection measures;

7. From March 1 through April 30, and November 1 through November 30, staging areas for construction equipment shall be located off the beach to the maximum extent possible. Nighttime storage of construction equipment not in use shall be off the beach to minimize disturbance to sea turtle nesting and hatching activities;

8. To the extent feasible, dune restoration or creation included in the profile design (or project) should have a slope of 1.5:1 followed by a gradual slope of 4:1 for approximately 20 feet seaward on a high erosion beach. If another slope is more feasible in this high erosion area, the Applicant will meet with the Service to discuss this new slope. If it is found that the dune in front of the seawall is continually washed away, the Applicant must meet with the Service and the FWC to discuss other options;

9. Only beach compatible fill shall be used in the construction of the dune system, and shall not contain any toxic material, construction debris, or other foreign matter. Beach compatible fill is material that maintains the general character and functionality of the material occurring on the beach and in the adjacent dune and coastal system. Beach compatible fill must be sand that is similar to a native beach in the vicinity of the site that has not been affected by prior sand placement activity. The fill material must be similar in both coloration and grain size distribution to that native beach. All fill material shall comply with the DEP requirements pursuant to the Florida Administrative Code (FAC) subsection 62B-41.005(15). A Quality Control Plan shall be implemented pursuant to FAC Rule 62B-41.008(1)(k)4.b.;

10. Daily nesting surveys shall be conducted for two nesting seasons in accordance with the FWC's SNBS Protocol by the NRC or the Applicant following construction. Post construction year-one surveys shall record the number of nests, nesting success, reproductive success, and lost nests due to erosion and/or inundation. Post construction, year-two surveys shall only need to record nest numbers and nesting success. This information will be used to periodically assess the cumulative effects of these projects on sea turtle nesting and hatchling production and monitor suitability of post construction beaches for nesting;

11. In the event a sea turtle nest is excavated during construction activities, the sea turtle permit holder responsible for egg relocation for the project shall be notified so the eggs can be moved to a designated relocation site;

Reporting

12. A report describing the actions taken to implement the terms and conditions of this incidental take statement shall be submitted to the NRC and the FWC, Imperiled Species Management Section, Tallahassee office and the Service's South Florida Ecological Services Office, Vero Beach, Florida within 60 days postconstruction. This report shall include the dates of actual construction activities, names and qualifications of personnel involved in nest surveys and relocation activities, descriptions and locations of self-release beach sites, nest survey and relocation results, and hatching success of nests.

    All reports shall be submitted electronically to the NRC, FWC, and the Service on standard electronic media (*e.g.*, compact disc); and

13. Upon locating a dead, injured, or sick endangered or threatened sea turtle specimen, initial notification shall be made to the Service's Office of Law Enforcement (10426 NW 31st Terrace, Miami, Florida 33172; 305-526-2610). Additional notification shall 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.

- Educational signs should be placed where appropriate at beach access points explaining the importance of the area to sea turtles and/or the life history of sea turtle species that nest in the area.

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

REINITIATION NOTICE

This concludes formal consultation 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;
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 Biological 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 Biological Opinion; and
4. A new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending reinitiation.

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

Sincerely yours,

for Craig Aubrey

Larry Williams
Field Supervisor
South Florida Ecological Services Office

cc: electronic only
DEP, Tallahassee, Florida (Michael Wetherington)
EPA, West Palm Beach, Florida (Ron Miedema)
FWC, Tallahassee, Florida (Robbin Trindell)
NOAA Fisheries, West Palm Beach, Florida (Jocelyn Karazsia)
NRC, Washington, D.C. (Briana Balsam)
Service, Atlanta, Georgia (David Flemming)
Service, St. Petersburg, Florida (Anne Marie Lauritsen)
USGS, Gainesville, Florida (Susan Walls)

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Table 1. Summary of sea turtle nesting data along 21.4 miles of coastline in St. Lucie County, Florida from 2008 to 2011 (provided by FWC).

Year	Loggerhead Nests	Loggerhead False Crawls	Green Nests	Green False Crawls	Leatherback Nests	Leatherback False Crawls
2008	4,514	4,515	297	335	115	33
2009	3,936	4,044	212	338	235	62
2010	5,459	6,705	486	519	203	32
2011	5,763	5,651	398	586	254	48
Mean	**4,918**	**5,229**	**348**	**444**	**202**	**44**

Table 2. Summary of sea turtle nesting data along approximately 1.24 miles of shoreline adjacent to the proposed project in St. Lucie County, Florida from 2008 to 2011 (provided by FWC and the Applicant).

Year	Loggerhead Nests	Loggerhead False Crawls	Green Nests	Green False Crawls	Leatherback Nests	Leatherback False Crawls
2008	324	452	18	41	11	0
2009	293	370	18	18	25	7
2010	401	679	26	45	8	1
2011	543	542	68	53	12	6
Mean	**390**	**533**	**32**	**39**	**14**	**4**

Figure 1. Location of the proposed seawall project adjacent to the St. Lucie Nuclear Power Plant cooling water discharge canal, Hutchinson Island, St. Lucie County, Florida.

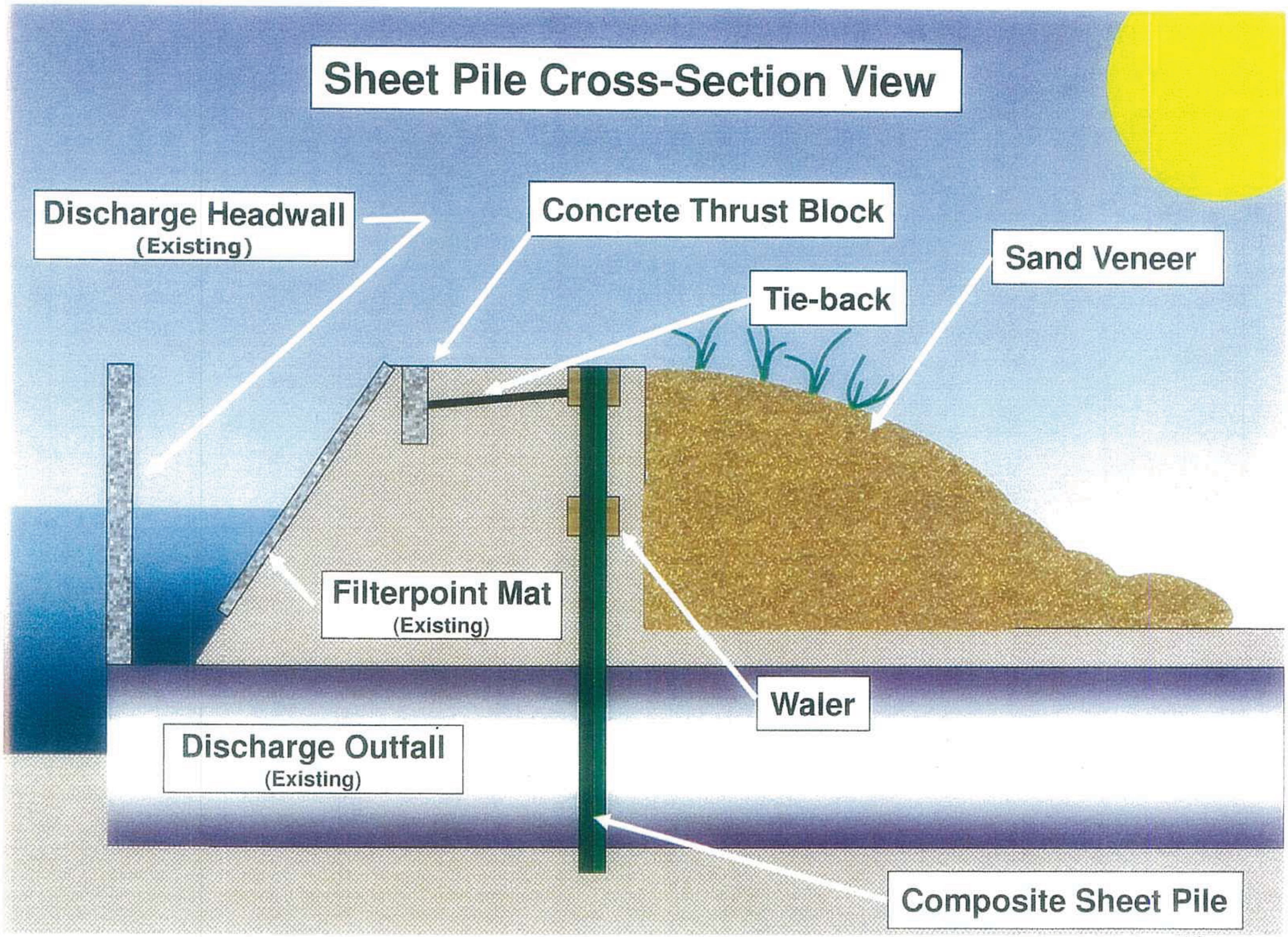

Figure 2. Sheet pile seawall cross-section.