United States Department of the Interior

U. S. FISH AND WILDLIFE SERVICE

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IN REPLY REFER TO:

FWS Log No. 41910-2009-F-0087

November 18, 2008

[redacted]
Commander, 45th Space Wing, 45 CES/CEVP
1224 Edward H. White II Street, MS-7100
Patrick AFB, Florida 32925-3299
(ATTN: Robin Sutherland)

FWS Log No. 41910-2009-F-0087

Dear [redacted]:

This document transmits the U.S. Fish and Wildlife Service's (Service) final biological opinion (BO) based on our review of historical and anticipated future light management activities by the 45th Space Wing (45th SW) of the U.S. Air Force at the Cape Canaveral Air Force Station (CCAFS) and Patrick Air Force Base (PAFB) in Brevard County, Florida, and their effects on nesting and hatchling loggerhead (*Caretta caretta*), green (*Chelonia mydas),* leatherback (*Dermochelys coriacea*), hawksbill (*Eretmochelys imbricata*), and Kemp's ridley (*Lepidochelys kempii*) sea turtles in accordance with section 7 of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 *et seq*.). A complete administrative record of this consultation is on file at this office.

CONSULTATION HISTORY

On April 13, 1988, [redacted] the Southeastern Sea Turtle Coordinator for the Service, met with several representatives of the Air Force to discuss a security upgrade lighting for Launch Complex (LC) 17, 40, and 41 and the sea turtle hatchling disorientations at this installation. During the 1987 – 1990 sea turtle nesting season, there were between 2236 loggerhead nests and 26-78 green turtle nests on CCAFS. For the 1988 sea turtle nesting season, 69 nests at CCAFS and 4 nests at PAFB were disoriented or misoriented due to CCAFS lighting. On August 15, 1988, the Service sent a letter to the 45th SW reiterating the concern for the number of disorientations at CCAFS and the need for compliance with Section 7 of the Act, as amended. The Air Force replied with a letter to the Service on September 19, 1988 indicating their desire to resolve the lighting issues at CCAFS. Following this letter, it was agreed that the Air Force would develop light management plans (LMP) in cooperation with the Service, for its launch complexes and other facilities at CCAFS. On October 17, 1989, LMPs were provided to the Service for the following areas: Industrial Area, Vertical Integration Building (VIB), Port Area, LC 17, LC 40, and LC 41. On February 28, 1990, revised LMPS were provided to the Service for LC 17 and LC 41. For the 1990 sea turtle nesting season, 160 nests at CCAFS and 12 nests at PAFB were disoriented or misoriented due to CCAFS lights.

On February 9, 1990, the Service issued a Biological Opinion (BO) for the LMP for LC 36. On January 17, 1991, a revised LMP was provided to the Service for the Port Area. On April 9, 1991, the Service issued their BO authorizing an incidental take of hatchlings from 75 loggerhead and 2 green turtle nests at CCAFS and hatchlings from 2 loggerhead nests at PAFB. In subsequent years, the authorized level of incidental take was to reduce by 50% each year following the implementation of the LMPs. The Air Force developed seven LMPs, eliminated 293 incandescent, high pressure sodium, mercury vapor fixtures and quartz lights. Four hundred and seventy-seven incandescent lights were replaced with yellow buglights. Eight hundred and forty-four incandescent, high pressure sodium, mercury vapor, quartz, and metal halide lights were changed to low pressure sodium. Four hundred and forty-nine high pressure sodium lights were shielded. Lights not in use were shut off and compliance was recorded ensuring routine security inspection and patrols. Annual notices to all complex personnel were issued prior to sea turtle nesting season.

On September 9, 1991, the Service received a letter from the Air Force to report that CCAFS had exceeded the incidental take for sea turtle hatchlings authorized by the Service in the April 9, 1991, BO. The Air Force has exceeded its authorized incidental take by 61 loggerhead nests. On October 10, 1991, the Service's Southeastern Sea Turtle Coordinator, Mr. Earl Possardt, met with representatives of CCAFS to discuss the implementation of the LMPs and additional measures to minimize the number of hatchling disorientations. The exceeded take was due to a higher number of nests and more comprehensive nesting and lighting surveys. To minimize further disorientations, 280 susceptible nests were screened. The BO written on April 9, 1990 was modified to include all hatchlings from nests disoriented and misoriented during the 1991 nesting and hatching season. Incidental take for subsequent years was authorized for hatchlings from four percent of the nests at CCAFS during the 1992 nesting season and reduced to two percent for subsequent years. The Service amended their BO on May 2, 2000 to authorize an incidental take of two percent of hatchlings and two percent of nesting females at CCAFS.

Patrick Air Force Base: On August 30, 2004, the Service received an email from an Air Force, 45th SW representative of PAFB, [redacted] to inform us that the 2% incidental take of sea turtles given in the BO dated May 2, 2000 was exceeded. The email contained information with precautions that were being conducted to reduce the number of disorientation events; such as reducing/shielding the safety/security lighting at a few facilities and planting more dune vegetation in the areas from the Officers' Club to the north Distinguished Visitors beach housing. [redacted] stated that the traffic lights on State Road (SR) A1A for the Main Gate and the former Officers' Club/Blockhouse (including public beach access lights) appeared to be the cause of the majority of the disorientation events. Modifications to the lights were being researched to attempt to develop a solution by next nesting season, but it would be low on the Brevard County Traffic Engineering's (BTE) list as repairs to other traffic lights destroyed by the hurricanes in 2004 would be top priority. In the interim, funding would be obtained by the Air Force and coordination with the Florida Department of Transportation (FDOT) and BTE would occur to strive for retrofitting before the next nesting season.

In 2005, two lighting surveys were conducted at PAFB by the University of Central Florida Marine Turtle Research Group and a representative of the 45th SW, [redacted] The surveys included patrolling the beach at night to determine sources of light that could potentially cause disorientations of sea turtles. The surveys identified the traffic lights at the Main Gate and Officers' Club as light sources likely to cause sea turtle disorientations during the 2005 sea turtle nesting season. On July 28, 2005, the Service received an email from [redacted] to discuss the traffic lights at the Main Gate and Officers' Club. Emails were exchanged with [redacted] of PAFB, [redacted] of the Florida Fish and Wildlife Conservation Commission, [redacted] of BTE, and the Service as to a possible solution for the traffic lights. On July 28, 2005, the Service received an email from [redacted] stating that the solution reached through discussions with FDOT) and BTE was for installation of shielding louvers on the traffic lights. The lighting from the traffic signals would still be visible on the beach but reduced. In the interim, while waiting for the Air Force funds and BTE scheduling, the Air Force agreed to use silt fencing to temporarily shield any nests laid on the dune that were likely to be affected by the traffic lights.

Louvers were installed at the traffic lights at the Main Gate and former Officer's Club/Blockhouse at PAFB in January 2006. BTE readjusted the louvers, installed new mounting hardware, and added new signal heads to increase visibility for motorists. Strong winds in February and March of 2006 caused significant sway of these traffic lights, which, in combination with the louvers, reduced the ability of motorists to see the traffic signal. In March 2006, FDOT ordered the louvers from the Main Gate to be removed due to safety concerns and public complaints. The pedestrian and beach access signal louvers at the former Officer's Club/Blockhouse were opened to three times their original configuration. Other alternatives for the traffic lights were discussed at a meeting held on April 13, 2006 with [redacted], the Service, [redacted] [redacted] representatives of FDOT, and OJ Oujevolk of BTE. Options for removing the traffic signal at the former Officer's Club/Blockhouse were discussed as well as rerouting traffic and turning off lights during the nesting season. Discussions are on-going between the 45th SW, FDOT, BTE, and the Service to minimize impacts to sea turtles from the traffic lights.

On October 21, 2004, the Service received a letter from [redacted], a representative of CCAFS, to inform us that the incidental take of 2% for sea turtles given in the May 2, 2000 BO, was also exceeded at this location. On June 27, 2005, the Service conducted a site visit and met with representatives of the 45th SW, including [redacted] and [redacted]. The possible lighting sources causing the sea turtle hatchling disorientations and misorientations were discussed.
On August 23, 2006, the Service issued an interim BO for the 2006 and 2007 nesting seasons. The "Terms and Conditions" provided in the interim BO were assessed and amended "Terms and Conditions" were discussed. Disorientation is defined as a nesting female's or hatchling's loss of orientation, being unable to maintain constant directional movement. Misorientation is defined as orientation in the wrong direction. This BO represents the final BO with an allowable percentage of incidental take from lighting disorientations and misorientations.

On September 17, 2008, a representative of CCAFS provided the Service with the 2007 Sea Turtle Hatchling Disorientation Report for CCAFS and PAFB. The Service had sufficient information to complete the final BO.

Information for this final BO was obtained by email correspondence, meetings, several site visits, telephone conversations and other sources of information. A complete administrative record of this consultation is on file at the Service's Jacksonville Field Office.

BIOLOGICAL OPINION

DESCRIPTION OF THE PROPOSED ACTION

The area involved in this biological opinion is the entirety of CCAFS and PAFB in Brevard County, Florida. The CCAFS has approximately 21 km of nesting beach and PAFB approximately 7 km of beach. At CCAFS, Light Management Plans (LMP) were previously developed for CCAFS and at PAFB, a Light Management Plan was developed for the base and approved by the Service in 1993, in an attempt to reduce or eliminate sea turtle hatchling disorientation/misorientation events. Facility custodians and managers are responsible for ensuring compliance of site personnel with operational constraints. The 45th SW Civil Engineering Squadron/Civil Engineering Environmental Protection (CES/CEVP) office conducts lighting inspections and records noncompliance, and the person responsible for the lights is notified. In addition, facility managers are required to report noncompliant lights. The 45th SW issues annual notices to all personnel prior to the sea turtle nesting season reminding tenants of light use requirements and responsibilities.

The previously issued May 2, 2000, BO requires the 45th SW to develop LMPs for all new construction and all facilities that currently do not have an LMP at CCAFS and PAFB for submittal to the Service for review and approval. The purpose of reinitiating consultation due to authorized incidental take being exceeded, is to reevaluate the level of anticipated incidental take as a result of disorientation and misorientation, modify the Service's minimization measures, review the 45th SW lighting guidelines, retrofit where feasible the lighting sources that are potentially causing the disorientations/misorientations, and re-evaluate the need for individual facility LMPs.

STATUS OF THE SPECIES/CRITICAL HABITAT

Species/critical habitat description

Loggerhead Sea Turtle

The loggerhead sea turtle was listed as a threatened species on July 28, 1978 (43 FR 32800). The loggerhead occurs throughout the temperate and tropical regions of the Atlantic, Pacific, and Indian Oceans.

Within the continental U.S., loggerheads nest from Texas to Virginia with major nesting concentrations found in South Florida. Additional nesting concentrations occur on coastal islands of North Carolina, South Carolina, and Georgia, and on the Atlantic and Gulf coasts of Florida (NMFS and Service 1991b). Within the western Atlantic, loggerheads also nest in Mexico and the Caribbean.

The loggerhead sea turtle grows to an average weight of about 200 pounds and is characterized by a large head with blunt jaws. Adults and subadults have a reddish-brown carapace. Scales on the top of the head and top of the flippers are also reddish-brown with yellow on the borders. Hatchlings are a dull brown color (NMFS 2002a). The loggerhead feeds on mollusks, crustaceans, fish, and other marine animals.

The loggerhead occurs throughout the temperate and tropical regions of the Atlantic, Pacific, and Indian Oceans. However, the majority of loggerhead nesting is at the western rims of the Atlantic and Indian Oceans. The species is widely distributed within its range. It may be found hundreds of miles out to sea, as well as in inshore areas such as bays, lagoons, salt marshes, creeks, ship channels, and the mouths of large rivers. Coral reefs, rocky places, and ship wrecks are often used as feeding areas. Nesting occurs mainly on open beaches or along narrow bays having suitable sand, and often in association with other species of sea turtles.

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

On November 16, 2007, the Service and NMFS received a petition from Oceana and the Center for Biological Diversity requesting that loggerhead turtles in the western North Atlantic Ocean be reclassified as a Distinct Population Segments (DPS) with endangered status and that critical habitat be designated. A DPS is a population segment that is discrete in relation to the remainder of the species to which it belongs, and significant to the species to which it belongs.

NMFS took the lead on the petition response and issued a 90–day finding on March 5, 2008 in the Federal Register, that the petition presents substantial scientific information indicating that the petitioned action may be warranted. NMFS has initiated a review of the status of the species to determine whether the petitioned action is warranted and to determine whether any additional changes to the current listing of the loggerhead turtle are warranted and solicited public comment that ended on May 5, 2008 (73 FR 11849).

Green Sea Turtle

The green sea turtle was federally listed as a protected species 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. 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 (NMFS and Service 1991a). Nesting also has been documented along the Gulf coast of Florida from Escambia County through Franklin County in northwest Florida and from Pinellas County through Collier County in southwest Florida (FWC Statewide Nesting Beach Survey database). Green turtles have been known to nest in Georgia, but only on rare occasions (Georgia Department of Natural Resources statewide nesting database). The green turtle also nests sporadically in North Carolina and South Carolina (North Carolina Wildlife Resources Commission statewide nesting database; South Carolina Department of Natural Resources statewide nesting database). Unconfirmed nesting of green turtles in Alabama has also been reported (Bon Secour National Wildlife Refuge nesting reports).

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.

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 (NMFS 2002b). Hatchling green turtles eat a variety of plants and animals, but adults feed almost exclusively on seagrasses and marine algae.

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, listed as an endangered species on June 2, 1970 (35 FR 8491), nests on shores of the Atlantic, Pacific and Indian Oceans. Leatherbacks have the widest distribution of the sea turtles with nesting on beaches in the tropics and sub-tropics and foraging excursions into higher-latitude sub-polar waters. They have evolved physiological and anatomical adaptations (Frair et al. 1972, Greer et al. 1973) that allow them to exploit waters far colder than any other sea turtle species would be capable of surviving. Non-breeding animals have been recorded as far north as the British Isles and the Maritime Provinces of Canada and as far south as Argentina and the Cape of Good Hope (Pritchard 1992). Nesting grounds are distributed worldwide, with the Pacific Coast of Mexico historically supporting the world's largest known concentration of nesting leatherbacks. The largest nesting colony in the wider Caribbean region is found in French Guiana, but nesting occurs frequently, although in lesser numbers, from Costa Rica to Columbia and in Guyana, Surinam, and Trinidad (NMFS and Service 1992; National Research Council 1990a).

The leatherback regularly nests in the U.S., in Puerto Rico, the U.S. Virgin Islands, and along the Atlantic coast of Florida as far north as Georgia (NMFS and Service 1992). Leatherback turtles have been known to nest in Georgia, South Carolina, and North Carolina, but only on rare occasions (North Carolina Wildlife Resources Commission; South Carolina Department of Natural Resources; and Georgia Department of Natural Resources statewide nesting databases). Leatherback nesting has also been reported on the northwest coast of Florida (LeBuff 1990; FWC Statewide Nesting Beach Survey database); and in southwest Florida a false crawl (non-nesting emergence) has been observed on Sanibel Island (LeBuff 1990).

This is the largest, deepest diving of all sea turtle species. The 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, made primarily of tough, oil-saturated connective tissue. Hatchlings are dorsally mostly black and are covered with tiny scales; the flippers are edged in white, and rows of white scales appear as stripes along the length of the back (NMFS 2002c). 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.

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 CFR 17.95).

Hawksbill Sea Turtle

The hawksbill sea turtle was 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.

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

Hawksbills typically weigh around 176 pounds or less in the wider Caribbean; hatchlings average about 1.6 inches straight length and range in weight from 0.5 to 0.7 ounces. 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 (NMFS 2002d).

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 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. The majority of nesting for the entire species occurs on the primary nesting beach at Rancho Nuevo (Marquez-M. 1994).

Outside of nesting, adult Kemp's ridleys are believed to spend most of their time in the Gulf of Mexico, while juveniles and subadults also regularly occur along the eastern seaboard of the U.S. (Service and NMFS 1992). There have been rare instances when immature ridleys have been documented making transatlantic movements (Service and NMFS 1992). It was originally speculated that ridleys that make it out of the Gulf of Mexico might be lost to the breeding population (Hendrickson 1980), but data indicate that many of these turtles are capable of moving back into the Gulf of Mexico (Henwood and Ogren 1987). In fact, there are documented cases of ridleys captured in the Atlantic that migrated back to the nesting beach at Rancho Nuevo (Schmid and Witzell 1997, Schmid 1998, Witzell 1998).

Hatchlings, after leaving the nesting beach, are believed to become entrained in eddies within the Gulf of Mexico, where they are dispersed within the Gulf and Atlantic by oceanic surface currents until they reach about 7.9 inches in length, at which size they enter coastal shallow water habitats (Ogren 1989).

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 (200 meters). 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 (200 meters).
3. Oceanic zone - the vast open ocean environment (from the surface to the sea floor) where water depths are greater than 656 feet (200 meters).

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 basic life cycle of the loggerhead turtle in the western North Atlantic consists of seven life stages (**Figure 1**) that are based on the size of the sea turtles at different ages (Bolten 2003, Crouse et al. 1987).

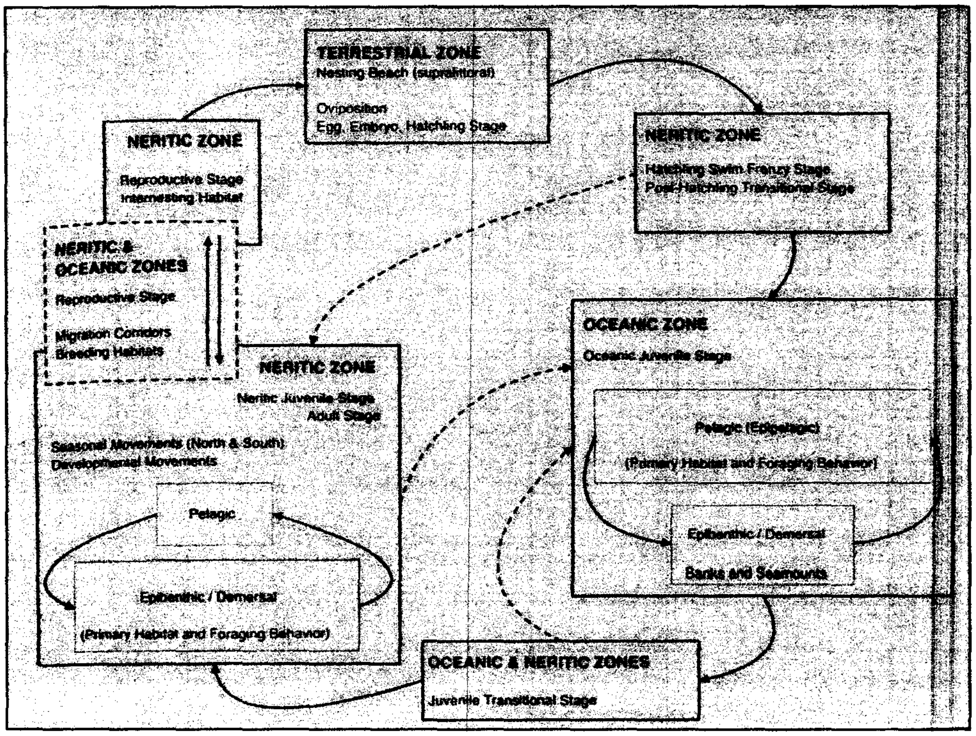

Figure 1. Life history stages of a loggerhead turtle. The boxes represent life stages and the corresponding ecosystems, solid lines represent movements between life stages and ecosystems, and dotted lines are speculative (Bolten 2003).

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, 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).

Life History Trait	**Data**
Clutch size (mean)	100-126 eggs[1]
Incubation duration (varies depending on time of year and latitude)	Range = 42-75 days[2,3]
Juvenile (<87 cm CCL) sex ratio	65-70% female[4]
Pivotal temperature (incubation temperature that produces an equal number of males and females)	29.0°C[5]

Nest productivity (emerged hatchlings/total eggs) x 100 (varies depending on site specific factors)	Range = 45-70%[2,6]
Clutch frequency (number of nests/female/season)	3-4 nests[7]
Internesting interval (number of days between successive nests within a season)	12-15 days[8]
Remigration interval (number of years between successive nesting migrations)	2.5-3.7 years[9]
Nesting season	late April-early September
Hatching season	late June-early November
Age at sexual maturity	32-35 years[10]
Life span	>57 years[11]

1 Dodd 1988.
2 Dodd and Mackinnon (1999, 2000, 2001, 2002, 2003, 2004).
3 B. Witherington, FWC, pers. comm. 2006 (information based on nests monitored throughout Florida beaches in 2005, n=865).
4 National Marine Fisheries Service (2001); A. Foley, FWC, pers. comm. 2005.
5 Mrosovsky (1988); Marcovaldi et al. (1997).
6 B. Witherington, FWC, pers. comm. 2006 (information based on nests monitored throughout Florida beaches in 2005, n=1,680).
7 Murphy and Hopkins (1984); Frazer and Richardson (1985); Ehrhart, unpublished data.
8 Caldwell (1962), Dodd (1988).
9 Richardson et al. (1978); Bjorndal et al. (1983); Ehrhart, unpublished data.
10 M. Snover, NMFS, pers. comm. 2005.
11 Dahlen et al. (2000).

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. 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).

Sea turtle eggs require a high-humidity substrate that allows for sufficient gas exchange for development (Miller 1997, Miller et al. 2003). Loggerhead nests incubate for variable periods of time. The length of the incubation period (commonly measured from the time of egg deposition to hatchling emergence) is inversely related to nest temperature, such that between 26°C and 32°C, a change of 1°C adds or subtracts approximately 5 days (Mrosovsky 1980).

The warmer the sand surrounding the egg chamber, the faster the embryos develop (Mrosovsky and Yntema 1980). Sediment 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. The pivotal temperature (i.e., the incubation temperature that produces equal numbers of males and females) in loggerheads is approximately 29°C (Limpus et al. 1983, Mrosovsky 1988, Marcovaldi et al. 1997). However, clutches with the same average temperature may have different sex ratios depending on the fluctuation of temperature during incubation (Georges et al. 1994). Moisture conditions in the nest similarly influence incubation period, hatching success, and hatchling size (McGehee 1990, Carthy et al. 2003).

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 1968, Witherington et al. 1990). Moran et al. (1999) concluded that a lowering of sand temperatures below a critical threshold, which most typically occurs after nightfall, is the most probable trigger for hatchling emergence from a nest. After an initial emergence, there may be secondary emergences on subsequent nights (Carr and Ogren 1960, Witherington 1986, Ernest and Martin 1993).
Hatchlings use a progression of orientation cues to guide their movement from the nest to the marine environments where they spend their early years (Lohmann and Lohmann 2003). Hatchlings first use light cues to find the ocean. On naturally lighted beaches without artificial lighting, ambient light from the open sky creates a relatively bright horizon compared to the dark silhouette of the dune and vegetation landward of the nest. This contrast guides the hatchlings to the ocean (Daniel and Smith 1947, Limpus 1971, Salmon et al. 1992, Witherington 1997, Witherington and Martin 1996).

Green Sea Turtle

Green turtles deposit from one to nine clutches within a nesting season, but the overall average is about 3.3 nests. The interval between nesting events within a season varies around a mean of about 13 days (Hirth 1997). Mean clutch size varies widely among populations. Average clutch size reported for Florida was 136 eggs in 130 clutches (Witherington and Ehrhart 1989). Only occasionally do females produce clutches in successive years. Usually two, three, four or more years intervene between breeding seasons (NMFS 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 (NMFS 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 6 to 10 years (Zug and Parham 1996).

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 (NMFS and Service 1993). On the basis of limited information, nesting migration intervals of 2 to 3 years appear to predominate. Hawksbills are recruited into the reef environment at about 14 inches in length and are believed to begin breeding about 30 years later. However, the time required to reach 14 inches in length is unknown and growth rates vary geographically. As a result, actual age at sexual maturity is unknown.

Kemp's Ridley Sea Turtle

Nesting occurs from April into July during which time the turtles appear off the Tamaulipas and Veracruz coasts of Mexico. Precipitated by strong winds, the females swarm to mass nesting emergences, known as *arribadas* or *arribazones*, to nest during daylight hours. The period between Kemp's ridley arribadas averages approximately 25 days (Rostal et al. 1997), but the precise timing of the arribadas is highly variable and unpredictable (Bernardo and Plotkin 2007). Clutch size averages 100 eggs and eggs typically take 45 to 58 days to hatch depending on temperatures (Marquez-M. 1994, Rostal 2007).

Some females breed annually and nest an average of 1 to 4 times in a season at intervals of 10 to 28 days. Analysis by Rostal (2007) suggested that ridley females lay approximately 3.075 nests per nesting. Interannual remigration rate for female ridleys is estimated to be approximately 1.8 (Rostal 2007) to 2.0 years (Marquez Millan et al. 1989, TEWG 2000). Age at sexual maturity is believed to be between 10 to 17 years (Snover et al. (2007).

<u>Population dynamics</u>

Loggerhead Sea Turtle

The loggerhead occurs throughout the temperate and tropical regions of the Atlantic, Pacific, and Indian Oceans. 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): South Florida (U.S.) and Masirah (Oman). Those beaches with 1,000 to 9,999 females nesting each year are Georgia through North Carolina (U.S.), Quintana Roo and 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 47,000 and 90,000 nests per year over the last decade (FWC, unpublished data; GDNR, unpublished data; SCDNR, unpublished data; NCWRC, unpublished data). About 80% of loggerhead nesting in the southeast U.S. occurs in six Florida counties (Brevard, Indian River, St. Lucie, Martin, Palm Beach, and Broward Counties). Adult loggerheads are known to make considerable migrations between foraging areas and nesting beaches (Schroeder et al. 2003, Foley et al. in press). 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 and is second in size only to that which nests on islands in the Arabian Sea off Oman (Ross 1982, Ehrhart 1989). The status of the Oman loggerhead nesting population, reported to be the largest in the world (Ross 1979), is uncertain because of the lack of long-term standardized nesting or foraging ground surveys and its vulnerability to increasing development pressures near major nesting beaches and threats from fisheries interaction on foraging grounds and migration routes (E. Possardt, Service, personal communication 2005). The loggerhead nesting aggregations in Oman, the U.S., and Australia account for about 88% of nesting worldwide (NMFS and Service 1991b).

Green Sea Turtle

About 150 to 3,000 females are estimated to nest on beaches in the continental U.S. annually (FWC 2005). In the U.S. Pacific, over 90 percent of nesting throughout the Hawaiian archipelago occurs at the French Frigate Shoals, where about 200 to 700 females nest each year (NMFS and 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 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, in 1982 through aerial surveys of adult female leatherbacks this area became 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 was 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 5,000-9,200 nests annually with 75% of the nests being laid in Papua, Indonesia.

However, the most recent population size estimate for the North Atlantic alone is a range of 34,000-94,000 adult leatherbacks (Turtle Expert Working Group 2007). In Florida, an increase in leatherback nesting numbers from 98 nests in 1989 to between 800 and 900 nests in the early 2000s has been documented.

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 approximately 5,029 and 63,294 nests between 1967 and 2005 (Turtle Expert Working Group 2007). Trinidad supports an estimated 6,000 leatherbacks nesting annually, which represents more than 80% of the nesting in the insular Caribbean Sea. Leatherback nesting along the Caribbean Central American coast takes place between the Honduras and Colombia. In Atlantic Costa Rica, at Tortuguero the number of nests laid annually between 1995 and 2006 was estimated to range from 199-1,623; modeling of these data indicated that the nesting population has decreased by 67.8% over this time period.

In Puerto Rico, the main nesting areas are at Fajardo on the main island of Puerto Rico and on the island of Culebra. Between 1978 and 2005, nesting increased in Puerto Rico with a minimum of 9 nests recorded in 1978 and a minimum of 469-882 nests recorded each year between 2000 and 2005. Recorded leatherback nesting on the Sandy Point National Wildlife Refuge on the island of St. Croix, U.S. Virgin Islands between 1990 and 2005, ranged from a low of 143 in 1990 to a high of 1,008 in 2001. In the British Virgin Islands, annual nest numbers have increased in Tortola from 0-6 nests per year in the late 1980s to 35-65 nests per year in the 2000s.

The most important nesting beach for leatherbacks in the eastern Atlantic lies in Gabon, Africa. It was estimated there were 30,000 nests along 60 miles (96.5 km) of Mayumba Beach in southern Gabon during the 1999 - 2000 nesting season. Some nesting has been reported in Mauritania, Senegal, the Bijagos Archipelago of Guinea-Bissau, Turtle Islands and Sherbro Island of Sierra Leone, Liberia, Togo, Benin, Nigeria, Cameroon, Sao Tome and Principe, continental Equatorial Guinea, Islands of Corisco in the Gulf of Guinea and the Democratic Republic of the Congo, and Angola. A larger nesting population is found on the island of Bioko (Equatorial Guinea).

Hawksbill Sea Turtle

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

Kemp's Ridley Sea Turtle

Most Kemp's ridleys nest on the coastal beaches of the Mexican states of Tamaulipas and Veracruz, although a small number of Kemp's ridleys nest consistently along the Texas coast (Turtle Expert Working Group 1998). In addition, rare nesting events have been reported in Alabama, Florida, Georgia, South Carolina, and North Carolina. Historic information indicates that tens of thousands of 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 2007, 11,268 nests were documented along the 18.6 miles (30 km) of coastline patrolled at Rancho Nuevo, and the total number of nests documented for all the monitored beaches in Mexico was 15,032 (Service 2007c). During the 2007 nesting season, an arribada with an estimated 5,000 turtles was recorded at Rancho Nuevo from May 20 to May 23. In addition, 128 nests were recorded during 2007 in the U.S., primarily in Texas.

Status and Distribution

Loggerhead Sea turtle

Genetic research involving analysis of mitochondrial DNA has identified five different loggerhead subpopulations/nesting aggregations in the western North Atlantic: (1) the Northern Subpopulation occurring from North Carolina to around Cape Canaveral, Florida (about 29° N.); (2) South Florida Subpopulation occurring from about 29° N. on Florida's east coast to Sarasota on Florida's west coast; (3) Dry Tortugas, Florida, Subpopulation, (4) Northwest Florida Subpopulation occurring at Eglin Air Force Base and the beaches near Panama City; and (5) Yucatán Subpopulation occurring on the eastern Yucatán Peninsula, Mexico (Bowen 1994, 1995; Bowen et al. 1993; Encalada et al. 1998; Pearce 2001). These data indicate that gene flow between these five regions is very low. If nesting females are extirpated from one of these regions, regional dispersal will not be sufficient to replenish the depleted nesting subpopulation.
The Northern Subpopulation had an average of 5,151 nests per year from 1989-2005 (Georgia Department of Natural Resources, unpublished data; North Carolina Wildlife Resources Commission, unpublished data; South Carolina Department of Natural Resources, unpublished data). Standardized ground surveys of 11 North Carolina, South Carolina, and Georgia nesting beaches showed a significant declining trend of 1.9% annually in loggerhead nesting from 1983-2005 (M. Dodd, Georgia Department of Natural Resources, personal communication 2006; M. Godfrey, North Carolina Wildlife and Marine Resources Commission, personal communication 2006; S. Murphy, South Carolina Department of Natural Resources, personal communication 2006). In addition, standardized aerial nesting surveys in South Carolina have shown a significant annual decrease of 3.1% from 1980-2002 (South Carolina Department of Natural Resources, unpublished data).

An analysis of Florida's long-term loggerhead sea turtle nesting data, carried out as part of the FWC's Index Nesting Beach Survey (INBS) program (its purpose is to measure seasonal productivity, allowing comparisons between beaches and between years.), reveals a decline in loggerhead nest numbers around the state. Nest counts have decreased nearly 50 percent from 1998 to 2007. The precipitous decline in loggerhead nest numbers has followed a modest increase that occurred between 1989 and 1998. Between 1989 and 2007, the overall trend in loggerhead nesting is down approximately 37 percent. Data collected during the 2007 Statewide Nesting Beach Survey (SNBS) program (its purpose is to document the total distribution, seasonality and abundance of sea turtle nesting in Florida) indicate the lowest nesting levels in Florida in the 19-year history of this monitoring program (45,084 nests).

A near complete census of the Florida Panhandle Subpopulation undertaken from 1995 to 2006 reveals a mean of 910 nests per year, which equates to about 222 females nesting per year

(FWC Statewide Nesting Beach Survey database). However, preliminary analysis for 11 years (1995 to 2005) of INBS data for the Florida Panhandle subpopulation shows a declining trend (B. Witherington, FWC, personal communication 2007).

A near complete census of the Dry Tortugas Subpopulation undertaken from 1995 to 2004, excluding 2002 (9 years surveyed), reveals a mean of 246 nests per year, which equates to about 60 females nesting per year (FWC Statewide Nesting Beach Survey database). The trend data for the Dry Tortugas Subpopulation are from beaches that are not included in Florida's INBS program, but have moderately good monitoring consistency. There are 9 years of data for this Subpopulation, but the time series is too short to detect a trend (B. Witherington, FWC, personal communication 2007).

The Yucatán Nesting Subpopulation (occurring in the eastern Yucatán Peninsula in Mexico) had a range of 903-2,331 nests from 1987-2001 along the central coast of Quintana Roo (Zurita *et al.* 2003). Zurita *et al.* (2003) reported a statistically significant increase in the number of nests laid on seven of the beaches in Quintana Roo, Mexico, from 1987-2001 where survey effort was consistent during the period. However, nesting since 2001 has declined and the previously reported increasing trend appears to have not been sustained (J. Zurita, personal communication 2006).

Recovery Criteria

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

1. The adult female population in Florida is increasing and in North Carolina, South Carolina, and Georgia, it has returned to pre-listing levels (NC - 800, SC - 10,000, and GA - 2,000 nests per season). The above conditions shall be met with the data from standardized surveys, which would continue for at least five years after delisting.

2. At least 25 percent (348 miles) of all available nesting beaches (1,400 miles) are in public ownership, distributed over the entire nesting range and encompassing at least 50 percent of the nesting activity in each state.

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

The Recovery Plan for the loggerhead sea turtle is currently under revision. An initial recovery plan for the loggerhead turtle was approved on September 19, 1984. This initial plan was a multi-species plan for all six species of sea turtles occurring in the U.S. On December 26, 1991, a separate recovery plan for the U.S. Atlantic population of the loggerhead turtle was approved. Since approval of the first revised plan in 1991, significant research has been accomplished and important conservation and recovery activities have been undertaken. As a result, we have a greater knowledge of the species and its status. Thus, a revision of the Recovery Plan was drafted and distributed for public comment on May 30, 2008 (73 FR 31066). Comments are requested by July 29, 2008.

The Service and NMFS completed a five-year status review of the loggerhead sea turtle in August 2007 (NMFS and Service 2007a). A recommendation has been made to determine the application of the Distinct Population Segment (DPS) policy for the species. A DPS is a population segment that is discrete in relation to the remainder of the species to which it belongs, and significant to the species to which it belongs. NMFS and the Service have established a Biological Review Team to assess the loggerhead population structure globally to determine whether DPSs exist and assess the status of each DPS. The Biological Review Team is in the process of reviewing and synthesizing information and will ultimately render an expert opinion in a written report. This report is anticipated to be completed in 2009.

Green Turtle

Nesting data collected as part of the Florida SNBS program (2000-2006) show that a mean of approximately 5,600 nests are laid each year in Florida. Nesting occurs in 26 counties with a peak along the east coast, from Volusia through Broward Counties. The green turtle nesting population of Florida appears to be increasing based on 19 years (1989-2007) of INBS data from throughout the state. 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 ESA in 1973, affording 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 adult 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 CITES, which stopped international trade and reduced incentives for illegal trade from the U.S.

Recovery Criteria

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

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

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

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

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

The current "Recovery Plan for the U.S. Population of Atlantic Green Turtle (*Chelonia mydas*)" was completed in 1991, the Recovery Plan for U.S. Pacific Populations of the Green Turtle (*Chelonia mydas*)" was completed in 1998, and the "Recovery Plan for U.S. Pacific Populations of the East Pacific Green Turtle (*Chelonia mydas*)" was completed in 1998. The recovery criteria contained in the plans, while not strictly adhering to all elements of the Recovery Planning Guidelines (Service and NOAA), are a viable measure of the species status.

The Service and NMFS completed a five-year status review of the green sea turtle in August 2007 (NMFS and Service 2007b). A recommendation has been made to conduct an analysis and review of the species to determine the application of the Distinct Population Segment (DPS) policy for the species. A DPS is a population segment that is discrete in relation to the remainder of the species to which it belongs, and significant to the species to which it belongs. Since the species' listing, a substantial amount of information has become available on population structure (through genetic studies) and distribution (through telemetry, tagging, and genetic studies). The data has not been fully assembled or analyzed; however, at a minimum, these data appear to indicate a possible separation of populations by ocean basins.

Leatherback Sea Turtle

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

In the U.S., nesting populations occur in Florida, Puerto Rico, and the U.S. Virgin Islands. In Florida, the SNBS program has documented an increase in leatherback nesting numbers from 98 nests in 1988 to between 800 and 900 nests per season in the early 2000s (FWC SNBS; Stewart and Johnson 2006). Although the SNBS program provides information on distribution and total abundance statewide, it cannot be used to assess trends because of variable survey effort. Therefore, leatherback nesting trends are best assessed using standardized nest counts made at INBS sites surveyed with constant effort over time (1989-2007). An analysis of the INBS data has shown a substantial increase in leatherback nesting in Florida since 1989 (FWC INBS; Turtle Expert Working Group 2007).

Recovery Criteria

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

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

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

The current "Recovery Plan for the Leatherback Turtles (*Dermochelys coriacea*)" in the U.S. Caribbean, Atlantic, and Gulf of Mexico" was signed in 1992 and the "Recovery Plan for U.S. Pacific Populations of the Leatherback Turtle (*Dermochelys coriacea*)" was signed in 1998. The recovery criteria contained in the plans, while not strictly adhering to all elements of the Recovery Planning Guidelines (Service and NOAA), are a viable measure of the species status.

The Service and the National Marine Fisheries Service completed a five-year status review of the leatherback sea turtle in August 2007 (NMFS and Service 2007c). A recommendation has been made to conduct an analysis and review of the species to determine the application of the Distinct Population Segment (DPS) policy for the species. A DPS is a population segment that is discrete in relation to the remainder of the species to which it belongs, and significant to the species to which it belongs. Since the species' listing, a substantial amount of information has become available on population structure (through genetic studies) and distribution (through telemetry, tagging, and genetic studies). The data has not been fully assembled or analyzed; however, at a minimum, these data appear to indicate a possible separation of populations by ocean basins.

Hawksbill Sea Turtle

The hawksbill sea turtle has experienced global population declines of 80 percent or more during the past century and continued declines are projected (Meylan and Donnelly 1999). 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.

Recovery Criteria

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

1. The adult female population is increasing, as evidenced by a statistically significant trend in the annual numbers of nests on at least five index beaches, including Mona Island and Buck Island Reef National Monument (BIRNM).
2. Habitat for at least 50 percent of the nesting activity that occurs in the U.S. Virgin Islands (USVI) 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, USVI, and Florida.
4. All priority one tasks identified in the recovery plan have been successfully implemented.

Kemp's Ridley Sea Turtle

Today, under strict protection, the population appears to be in the early stages of recovery. The recent nesting increase can be attributed to full protection of nesting females and their nests in Mexico resulting from a bi-national effort between Mexico and the U.S. to prevent the extinction of the Kemp's ridley, and the requirement to use Turtle Excluder Devices (TEDs) in shrimp trawls both in the United States and Mexico.

The Mexico government also prohibits harvesting and is working to increase the population through more intensive law enforcement, by fencing nest areas to diminish natural predation, and by relocating most nests into corrals to prevent poaching and predation. While relocation of nests into corrals is currently a necessary management measure, this relocation and concentration of eggs into a "safe" area is of concern since it makes the eggs more susceptible to reduced viability.

Recovery Criteria

The goal of the recovery plan is for the species to be reduced from endangered to threatened status. The Recovery Team members feel that the criteria for a complete removal of this species from the endangered species list need not be considered now, but rather left for future revisions of the plan. Complete removal from the federal list would certainly necessitate that some other instrument of protection, similar to the Marine Mammal Protection Act, be in place and be international in scope. Kemp's ridley can be considered for reclassification to threatened status when the following four criteria are met:

1. Protection of the known nesting habitat and the water adjacent to the nesting beach (concentrating on the Rancho Nuevo area) and continuation of the bi-national project.

2. Elimination of the mortality from incidental catch from commercial shrimping in the U.S. and Mexico through the use of TEDs and full compliance with the regulations requiring TED use.

3. Attainment of a population of at least 10,000 females nesting in a season.

4. All priority one recovery tasks in the recovery plan are successfully implemented.

The current Recovery Plan for the Kemp's Ridley Sea Turtle (*Lepidochelys kempii*) was signed in 1992. Significant new information on the biology and population status of Kemp's ridley has become available since 1992. Consequently, a full revision of the recovery plan has been undertaken by the Service and NMFS and is nearing completion. The revised plan will provide updated species biology and population status information, objective and measurable recovery criteria, and updated and prioritized recovery actions. The Service and NMFS completed a five-year status review of the Kemp's ridley sea turtle in August 2007 (NMFS and Service 2007d). Recommendations provided in the five-year review focused on the protection of the species both in the water (enforcement of TED use) and on land (nesting habitat).

Common threats to sea turtles in Florida

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

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

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

Coastal Development

Loss of nesting habitat related to coastal development has had the greatest impact on nesting sea turtles in Florida. Beachfront development 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 1990b). 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 which cause changes in, additional loss or impact to the remaining sea turtle habitat.

Hurricanes

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 and can result in severe erosion of the beach and dune systems. Overwash and blowouts are common on barrier islands. Hurricanes and other storms can result in the direct or indirect loss of sea turtle nests, either by erosion or washing away of the nests by wave action or inundation or "drowning" of the eggs or hatchlings developing within the nest or indirectly by loss of nesting habitat. Depending on their frequency, storms can affect sea turtles on either a short-term basis (nests lost for one season and/or temporary loss of nesting habitat) or long term, if frequent (habitat unable to recover). How hurricanes affect sea turtle nesting also depends on its characteristics (winds, storm surge, rainfall), the time of year (within or outside of the nesting season), and where the northeast edge of the hurricane crosses land.

Because of the limited remaining nesting habitat, frequent or successive severe weather events could threaten the ability of certain sea turtle populations to survive and recover. Sea turtles evolved under natural coastal environmental events such as hurricanes. The extensive amount of pre-development 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 re-established after periodic storms. While the beach itself moves landward during such storms, reconstruction or persistence of structures at their pre-storm locations can result in a major loss of nesting habitat.

The 2004 hurricane season was the most active storm season in Florida since weather records began in 1851. Hurricanes Charley, Frances, Ivan, and Jeanne, along with Tropical Storm Bonnie, damaged the beach and dune system, upland structures and properties, and infrastructure in the majority of Florida's coastal counties. The cumulative impact of these storms exacerbated erosion conditions throughout the state.

The 2005 hurricane season was a record-breaking season with 27 named storms. Hurricanes Dennis, Katrina, Ophelia, Rita, and Wilma, and Tropical Storms Arlene and Tammy impacted Florida. The cumulative impact of these storms exacerbated erosion conditions in south and northwest Florida.

Erosion

The designation of a Critically Eroded Beach is a planning requirement of the State's Beach Erosion Control Funding Assistance Program. A segment of beach shall first be designated as critically eroded in order to be eligible for State funding. A critically eroded area is a segment of the shoreline where natural processes or human activity have caused or contributed to erosion and recession of the beach or dune system to such a degree that upland development, recreational interests, wildlife habitat, or important cultural resources are threatened or lost. Critically eroded areas may also include peripheral segments or gaps between identified critically eroded areas which, although they may be stable or slightly erosional now, their inclusion is necessary for continuity of management of the coastal system or for the design integrity of adjacent beach management projects (FDEP 2005). It is important to note, that for an erosion problem area to be critical, there shall exist a threat to or loss of one of four specific interests – upland development, recreation, wildlife habitat, or important cultural resources. The total of critically eroded beaches statewide in Florida for 2007 is 388 miles of 497 miles of shoreline. Seventy-eight (78) percent of the State's shoreline is considered to be critically eroded.

Beachfront 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; FWC 2006). 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. Some types of beachfront lighting attract hatchlings away from the sea while some lights cause adult turtles to avoid stretches of brightly illuminated beach. Research has documented significant reduction in sea turtle nesting activity on beaches illuminated with artificial lights (Witherington 1992). During the 2007 sea turtle nesting season in Florida, over 64,000 turtle hatchlings were documented as being disoriented **(Table 4)** (FWC/FWRI 2007, http://www.myfwc.com/seaturtle/Lighting/Light_Disorient.htm). Exterior and interior lighting associated with condominiums had the greatest impact causing approximately 42 percent of documented hatchling disorientation/misorientation. Other causes included urban sky glow and street lights (http://www.myfwc.com/seaturtle/Lighting/Light_Disorient.htm).

Table 1. Documented Disorientations along the Florida coast.

Year	Total Number of Hatchling Disorientation Events	Total Number of Hatchlings Involved in Disorientation Events	Total Number of Adult Disorientation Events
2001	743	28,674	19
2002	896	43,226	37
2003	1,446	79,357	18
2004	888	46,487	24
2005	976	41,521	50
2006	1,521	71,798	40
2007	1,410	64,433	25

Predation

Depredation of sea turtle eggs and hatchlings by natural and introduced species occurs on almost all nesting beaches. Depredation by a variety of predators can considerably decrease sea turtle nest hatching success. The most common predators in the southeastern United States are ghost crabs (*Ocypode quadrata*), raccoons (*Procyon lotor*), feral hogs (*Sus scrofa*), foxes (*Urocyon cinereoargenteus* and *Vulpes vulpes*), coyotes (*Canis latrans*), armadillos (*Dasypus novemcinctus*), cats (*Felis catus)*, and fire ants (*Solenopsis* spp.) (Dodd 1988, Stancyk 1995). Raccoons are particularly destructive on the Atlantic coast and may take 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). As nesting habitat dwindles, it is essential that nest production be naturally maximized so the turtles may continue to exist in the wild.

In response to increasing depredation of sea turtle nests by coyote, fox, hog, and raccoon, multi-agency cooperative efforts have been initiated and are ongoing throughout Florida, particularly on public lands.

Driving on the Beach

The operation of motor vehicles on the beach affects sea turtle nesting by: interrupting a female turtle approaching the beach; headlights disorienting or misorienting emergent hatchlings; vehicles running over hatchlings attempting to reach the ocean; and vehicle tracks traversing the beach which interfere with hatchlings crawling to the ocean. Hatchlings appear to become diverted not because they cannot physically climb out of the rut (Hughes and Caine 1994), but because the sides of the track cast a shadow and the hatchlings lose their line of sight to the ocean horizon (Mann 1977). The extended period of travel required to negotiate tire tracks and ruts may increase the susceptibility of hatchlings to dehydration and depredation during migration to the ocean (Hosier et al. 1981). Driving directly above or over incubating egg clutches or on the beach can cause sand compaction which may result in adverse impacts on nest site selection, digging behavior, clutch viability, and emergence by hatchlings, decreasing nest success and directly killing pre-emergent hatchlings (Mann 1977, Nelson and Dickerson 1987, Nelson 1988).

The physical changes and loss of plant cover caused by vehicles on dunes can lead to various degrees of instability, and therefore encourage dune migration. As vehicles move either up or down a slope, sand is displaced downward, lowering the trail. Since the vehicles also inhibit plant growth, and open the area to wind erosion, dunes may become unstable, and begin to migrate. Unvegetated sand dunes may continue to migrate across stable areas as long as vehicle traffic continues. Vehicular traffic through dune breaches or low dunes on an eroding beach may cause accelerated rate of overwash and beach erosion (Godfrey et al. 1978). If driving is required, the area where the least amount of impact occurs is the beach between the low and high tide water lines. Vegetation on the dunes can quickly re-establish provided the mechanical impact is removed.

In 1985, the Florida Legislature severely restricted vehicular driving on Florida's beaches, except that which is necessary for cleanup, repair, or public safety. This legislation also allowed an exception for five counties to continue to allow vehicular access on coastal beaches due to the availability of less than 50 percent of its peak user demand for off-beach parking. The counties affected by this exception are Volusia, St. Johns, Gulf, Nassau, and Flagler Counties, as well as limited vehicular access on Walton County beaches for boat launching.

Analysis of the species/critical habitat likely to be affected

The presence of artificial lighting on CCAFS and PAFB has the potential to adversely affect nesting female and hatchling sea turtles. The effects of the proposed action on sea turtles will be considered further in the remaining sections of this biological opinion. Potential effects of the presence of artificial lighting on CCAFS and PAFB include the deterrence of female sea turtles from coming onto the beach to dig nests; harassment of nesting females that results in aborted nesting attempts; harassment in the form of misdirection of females attempting to return to sea after nesting; mortality of nesting females that are misdirected and end up on coastal highways where they may be struck by vehicles; harassment in the form of misdirection of hatchling turtles as they emerge from the nest and attempt to crawl to the water; and mortality of hatchling turtles that are misdirected and made more vulnerable to predators, desiccation, exhaustion, and automobiles.

Critical habitat has not been designated in the continental United States; therefore, the proposed action would not result in an adverse modification.

ENVIRONMENTAL BASELINE

Status of the species within the action area

Loggerhead Sea Turtle

The loggerhead sea turtle nesting and hatching season for southern Florida Atlantic beaches extends from March 15 through November 30. Incubation ranges from about 45 to 95 days. Between 889 and 1,579 loggerhead nests were deposited annually on PAFB beach from 2000 through 2007. Between 1,195 and 3,395 nests were deposited annually on CCAFS beach from 2000 through 2007.

Green Sea Turtle

The green sea turtle nesting and hatching season for southern Florida Atlantic beaches extends from May 1 through November 30. Incubation ranges from about 45 to 75 days. Between 0 and 51 green turtle nests were deposited annually on PAFB beach from 2000 through 2007. Between 4 and 163 nests were deposited annually on CCAFS beach from 2000 through 2007.

Leatherback Sea Turtle

The leatherback sea turtle nesting and hatching season for Southern Florida Atlantic beaches extends from February 15 through November 15. Incubation ranges from about 55 to 85 days. Between 0 and 3 leatherback turtle nests were deposited annually on PAFB beach from 2000 through 2007. Between 0 and 8 nests were deposited annually on CCAFS beach from 2000 through 2007.

Hawksbill Sea Turtle

The hawksbill sea turtle nesting and hatching season for Southern Florida Atlantic beaches extends from June 1 through December 31. Incubation lasts approximately 60 days. Hawksbill sea turtle nesting is rare and restricted to the southeastern coast of Florida (Volusia through Dade Counties) and the Florida Keys (Monroe County) (Meylan 1992, Meylan *et al.* 1995). However, hawksbill tracks are difficult to differentiate from those of loggerheads and may not be recognized by surveyors. Therefore, surveys in Florida likely underestimate actual hawksbill nesting numbers (Meylan *et al.* 1995). Although no hawksbill nests have ever been recorded in Brevard County, one was reported at the Canaveral National Seashore in Volusia County in 1982 (Meylan *et al.* 1995). Therefore, the potential exists for such an occurrence at CCAFS and PAFB.

EFFECTS OF THE ACTION

Factors to be considered

Direct effects

Artificial lighting can be detrimental to sea turtles in several ways. Field observations have shown a correlation between lighted beaches and reduced loggerhead and green sea turtle nesting (Mortimer 1982, Raymond 1984, Mattison *et al.* 1993). Experimental field work by Witherington (1992a) directly implicated artificial lighting in deterring sea turtles from nesting. In these experiments, both green and loggerhead turtles showed a significant tendency to avoid stretches of beach with artificial lights that have predominantly blue and green wavelengths. Because adult females rely on visual brightness cues to find their way back to the ocean after nesting, those turtles that nest on lighted beaches may be disoriented by artificial lights and have difficulty finding their way back to the ocean. In the lighted-beach experiments described by Witherington (1992a), few nesting turtles returning to the sea were misdirected by lighting; however, those that were, spent a large portion of the night wandering in search of the ocean. In some cases, nesting females have ended up on coastal highways and been struck by vehicles. However, turtles returning to the sea after nesting are not misdirected nearly as often as hatchlings emerging on the same beaches (Witherington and Martin 1996).

Under natural conditions, hatchling sea turtles, which typically emerge from nests at night, move toward the brightest, most open horizon, which is over the ocean. However, when bright light sources are visible on the beach, they become the brightest spot on the horizon and attract hatchlings in the wrong direction, making them more vulnerable to predators, desiccation, entrapment in debris or vegetation, and exhaustion, and often luring them onto roadways and parking lots where they are run over. Artificial lights can also disorient hatchlings once they reach the water. Hatchlings have been observed to exit the surf onto land where lighting is nearby (Daniel and Smith 1947, Carr and Ogren 1960, Witherington 1986). Artificial beachfront lighting from buildings and streetlights is a well documented cause of hatchling disorientation (loss of bearings) and misorientation (incorrect orientation) on nesting beaches (McFarlane 1963, Philibosian, 1976, Mann 1978, Florida Fish and Wildlife Conservation Commission unpubl. data).

Extensive research has demonstrated that visual cues are the primary sea finding mechanism for hatchlings (Carr and Ogren 1960, Ehrenfeld and Carr 1967, Mrosovsky and Carr 1967, Mrosovsky and Shettleworth 1968, Dickerson and Nelson 1989, Witherington and Bjorndal 1991). Loggerhead, green and hawksbill hatchlings demonstrate a strong preference for short-wavelength light (Witherington and Bjorndal 1991, Witherington 1992b). Green and hawksbill turtles were most strongly attracted to light in the near-ultraviolet to yellow region of the spectrum and were weakly attracted or indifferent to orange and red light. Loggerheads were most strongly attracted to light in the near-ultraviolet to green region and showed differing responses to light in the yellow region of the spectrum depending on light intensities. At intensities of yellow light comparable to a full moon or a dawn sky, loggerhead hatchlings showed an aversion response to yellow light sources, but at low, nighttime intensities, loggerheads were weakly attracted to yellow light.

Although the attributes that can make a light source harmful to sea turtles are complex, a simple rule has proven useful in identifying problem lighting: "An artificial light source is likely to cause problems for sea turtles if light from the source can be seen by an observer standing anywhere on the beach" (Witherington and Martin 1996). If any glowing portion of a luminaire (including the lamp, globe or reflector) is directly visible on the beach, then this source of light is likely to be a problem for sea turtles. But light may also reach the beach indirectly by reflecting off buildings or trees that are visible from the beach. Bright or numerous sources of lights, especially those directed upward, will illuminate sea mist and low clouds, creating a distinct sky glow visible from the beach. Field research suggests natural hatchling dispersal patterns may be disrupted by the glow from heavily lighted coastal areas (Witherington 1991).

Hatchling disorientation and misorientation incidents are well documented on CCAFS and PAFB. A few surveys may be missed during the course of the nesting and hatching season. Since the tracks of hatchlings are easily obscured by rain or windblown sand, the actual number of hatchling disorientation/misorientation incidents may be higher than what is actually observed and reported. Use of a standard monitoring and reporting protocol for disorientations/misorientations and estimating the percentage of all nests laid that produce hatchlings that are misdirected on an annual basis can be useful in assessing the success of light management activities.

Prior to implementation of approved LMPs and an internal light management policy, hatchlings from 4.4 percent of nests laid on CCAFS and Kennedy Space Center/Merritt Island National Wildlife Refuge in 1988 and 0.6 percent in 1989 were estimated to have been disoriented or misoriented by CCAFS lights. Hatchling disorientation and misorientation incidents recorded at PAFB in 1988 and 1989 were 0 and 0 percent, respectively, of all nests laid on PAFB.

Following implementation of approved LMPs and an internal light management policy, hatchlings from 0.005 percent of nests laid on CCAFS and Kennedy Space Center/Merritt Island National Wildlife Refuge in 1998 and 0.007 percent in 1999 were estimated to have been disoriented or misoriented by CCAFS lights. Hatchling disorientation and misorientation incidents recorded at PAFB in 1998 and 1999 were 0 and 0 percent, respectively, of all nests laid on PAFB. In 2005, hatchling and adult disorientation and misorientation incidents recorded at PAFB and CCAFS were 2.3% and 3.3% respectively. In 2006, using the marked sample hatchling disorientation calculation, disorientation recorded at PAFB and CCAFS was 0% and 3% respectively, and in 2007 it was 0% and 2.5% for PAFB and CCAFS respectively.

Prior to implementation of approved LMPs and an internal light management policy, over 4,000 artificial lights were associated with the facilities described above and contributed to the illumination of the nesting beach and light glow affecting CCAFS, PAFB, and adjacent nesting beaches. Incandescent, high pressure sodium, quartz, and mercury vapor lights were commonly used lights at CCAFS and PAFB facilities. These types of lights emit high levels of blue and green wavelengths and consequently present the greatest potential for deterring nesting activities and causing hatchling disorientations and misorientations. Light management at CCAFS and PAFB has resulted in a significant number of lights being converted to low pressure sodium lights, which are monochromatic and emit only yellow wavelengths. Although these lights could still cause some hatchling disorientations or misorientations if they are close to the beach and their lamps, globes, or reflectors are visible from the beach, they are much less likely to adversely impact nesting activities or hatchlings, particularly if they are shielded. In addition, many lights have been eliminated, replaced with cutoff shoebox fixtures, and/or shielded.

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 Service is not aware of any cumulative effects in the project area.

CONCLUSION

After reviewing the current status of the loggerhead, green, leatherback and hawksbill sea turtles, the environmental baseline for the action area, the effects of the proposed project, and the cumulative effects, it is the Service's biological opinion that the project, as proposed, is not likely to jeopardize the continued existence of these species and is not likely to destroy or adversely modify designated critical habitat. No critical habitat has been designated for the sea turtles in the continental United States; therefore, none will be affected.

It is our opinion that considering the measures the 45th SW has implemented and will be implementing to minimize direct lighting of the nesting beaches and background lighting glow at CCAFS and PAFB, the proposed project is not likely to jeopardize the continued existence of listed sea turtles. We do, however, believe that adverse impacts to sea turtles will continue from lighting sources essential for human safety and national security at CCAFS and PAFB. We believe the reasonable and prudent measures provided with the incidental take statement below will effectively reduce the take of sea turtles.

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 non-discretionary, and must be implemented by the Air Force's 45th SW so that they become binding conditions of any grant or permit issued to the applicant, as appropriate, for the exemption in section 7(o)(2) to apply. The 45th SW has a continuing duty to regulate the activity covered by this incidental take statement. If the 45th SW (1) fails to assume and implement the terms and conditions or (2) fails to require the applicant to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or grant document, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, the 45th SW 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

The Service has determined that incidental take of hatchlings will be described as the actual number of hatchlings that disoriented/misoriented from surveyed nests (based on hatchling track counts) divided by total number of hatchlings potentially emerging from surveyed nests based on an average hatchling emerging success rate from 2001 through 2005 (72 hatchlings per CCAFS and PAFB).

In addition, the previous method of assessing disorientations/misorientations will be calculated and provided to the Service as well. The previous method was the percentage of disoriented nests (more than four hatchlings tracks were observed disoriented/misoriented) divided by the total number of nests during the nesting season.

The Service anticipates that up to a total of 3 percent of all hatchlings disoriented/misoriented from a representative sample of all surveyed nests (marked) nests (based on hatchling track counts) divided by total number of hatchlings potentially emerging from marked nests based on an average hatchling emerging success rate each hatching season (72 hatchlings per CCAFS and PAFB) and 3 percent of females nesting at each installation (CCAFS and PAFB) during each nesting seasons could be taken as a result of this proposed action. The incidental take is expected to be in the form of hatchling and nesting female disorientations and misorientations. The 45th SW will be held responsible for disorientation or misorientation incidents caused by 45th SW lighting only, including those disorientation and misorientation incidents that might occur on Kennedy Space Center /Merritt Island National Wildlife Refuge as a result of CCAFS lighting. Areas south of kilometer 8 will be attributed to the glow produced by lights at Port Canaveral and nearby towns. Sky glow at PAFB from Cocoa Beach and Satellite beach may account for some disorientations and misorientations at PAFB. PAFB will be held responsible for disorientation or misorientation incidents that might occur on PAFB as a result of PAFB lighting.

EFFECT OF THE TAKE

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

REASONABLE AND PRUDENT MEASURES

The Service believes the following reasonable and prudent measures are necessary and appropriate to minimize take of sea turtles.

1. Compliance monitoring shall be conducted to ensure operational constraints of approved LMPs at CCAFS and PAFB and the light management policies at CCAFS and PAFB are being followed.

2. All new CCAFS and PAFB facilities shall follow the 45th SW Instruction 32-7001. LMPs will be developed, in accordance with the respective light management policies at CCAFS and PAFB for all new facilities that are in close proximity to the beach.

3. Exterior lighting to be replaced at CCAFS and PAFB will use the best available light management technology to minimize sea turtle disorientations.

4. Operational constraints will preclude use of any noncompliant exterior lights between 9 p.m. and dawn from May 1 through October 31, unless essential to support launch-related activities at active launch complexes, safety/security lighting or night operations training.

5. The LC 41 door should be kept closed at night during the sea turtle nesting and hatching season.

6. Nesting surveys and monitoring of beaches for hatchling disorientation or misorientation incidents will continue at CCAFS and PAFB.

7. A minimum of five nighttime lighting surveys will be conducted at CCAFS and five at PAFB during the peak nesting and hatching period (May 1 through October 31) to ensure compliance with the LMPs and existing light management policies.

8. PAFB will continue to work with the Florida Department of Transportation and Brevard County Traffic Authority to minimize impacts from the traffic lights.

9. CCAFS will conduct a sea turtle lighting workshop once every two-years.

10. Calculations of disorientation/mosorientation events must be reported on an annual basis following the sea turtle nesting and hatching season.

TERMS AND CONDITIONS

In order to be exempt from the prohibitions of section 9 of the Act, the 45th SW must comply with the following terms and conditions, which implement the reasonable and prudent measures, described above and outline required reporting/monitoring requirements. These terms and conditions are non-discretionary.

1. The 45th SW Environmental staff will inspect and record noncompliance and will also be notified of lighting violations by facility managers. Personnel responsible for rectifying violations will be notified by 45th SW Environmental staff on the current procedure, the 45th SW Instruction 32-7001, Exterior Lighting Management, will be followed.

2. All new CCAFS and PAFB facilities shall follow the 45th SW Instruction 32-7001. LMPs will be developed, in accordance with the respective light management policies at CCAFS and PAFB for all new facilities that are in close proximity to the beach.

LMPs must be reviewed and approved by the Service. Lighting directly visible from anywhere on the beach must be shielded and/or recessed so that the point source of light is not directly visible from the beach. No fixtures producing lighting visible from the beach and uplighting will be approved except in mission-critical applications. A letter of justification must be submitted to the 45th SW Environmental Staff with the request for this variance.

3. Exterior lighting at CCAFS and PAFB requiring replacement must be replaced with lighting that is in accordance with the 45 SW Instruction 32-7001. Exterior lighting that is producing lighting/glow visible from the beach will be replaced will full cut off/shielded fixtures to produce downward directed light that does not allow uplighting and minimizes lateral light spread. No fixtures producing lighting/glow visible from the beach and uplighting will be approved except in mission-critical applications. In cases where white lights, visible from the beach, are required for safety and/or security, and color reindition, these lights must be reviewed and approved by the 45th SW Environmental Branch.

4. Operational constraints will preclude use of any noncompliant exterior lights between 9 p.m. and dawn from May 1 through October 31, unless essential to support launch-related activities at active launch complexes, safety/security lighting or night operations training. If incubating nests are still present on the beach after October 31 that could be impacted by particular noncompliant light sources, the 45th SW Environmental Staff will notify facility managers of the visible lighting source. Lighting must be corrected to prevent potential disorientation/ misorientation events in those particular cases.

5. The LC 41 door should be kept closed at night during the nesting and hatching season (May 1 through October 31) except for brief periods as necessary for those periods of time required to support launch activities. If incubating nests are still present on the beach after October 31 that could be impacted by particular noncompliant light sources, the 45th SW Environmental Staff will notify facility managers of the visible lighting source. Lighting must be corrected to prevent potential disorientation/ misorientation events in those particular cases.

6. Surveys will continue annually at CCAFS and PAFB to record nesting activities and hatchling disorientation and misorientation events to evaluate the effectiveness of the LMPs and lighting management policies and identify needed modifications. Survey personnel must be experienced and trained in survey methodology and hold a valid Florida Fish and Wildlife Conservation Commission marine turtle permit.

7. A minimum of five nighttime lighting surveys will be conducted at CCAFS and five at PAFB during the peak nesting and hatching period (May 1 through October 31) to ensure compliance with the LMPs and existing light management policies. Additional lighting surveys will be conducted, as needed, to ensure any lighting violations observed are brought into compliance and to confirm sources of hatchling disorientation that cannot be identified during hatchling disorientation surveys.

8. PAFB will continue to work with the Florida Department of Transportation and Brevard County Traffic Authority to minimize impacts from the traffic lights at the Main Gate and the former Officers' Club/Blockhouse.

9. CCAFS will conduct a sea turtle lighting workshop once every two-years for the engineers, launch complex managers and any other representatives that design and/or enforce lighting at CCAFS and PAFB.

10. Both methods of calculating disorientation/mosorientation events must be reported on an annual basis following the sea turtle nesting and hatching season. These methods are as follows:

    i. <u>Number of hatchlings that disoriented from surveyed nests</u>
       Total number of potential hatchlings from surveyed nests

    ii. <u>Number of surveyed nests that had disorientation hatchling events</u>
        Total number of surveyed nest

In the event disoriented or misoriented hatchlings are discovered, the following procedures shall be followed:

1. Live hatchlings shall be maintained in covered, rigid walled containers on moist sand in a building protected from extremes of heat or cold. Hatchlings shall be released after dark on the first night subsequent to the disorientation/misorientation event if their health status permits.

2. A Florida Fish and Wildlife Conservation Commission "Marine Turtle Hatchling Disorientation Incident Report Form" shall be completed for each disorientation/misorientation incident. These forms shall be submitted to the Service's Jacksonville Field Office on a monthly basis.

The Service has determined that up to a total of 3 percent of all disoriented/misoriented from surveyed nests (based on hatchling track counts) divided by total number of hatchlings potentially emerging from surveyed nests based on an average hatchling emerging success rate from each hatching season (72 hatchlings per CCAFS and PAFB) and 3 percent of all females nesting at each installation (CCAFS and PAFB) for each nesting season will be incidentally taken as a result of the proposed action. The reasonable and prudent measures, with their implementing terms and conditions, are designed to minimize the impact of incidental take that might otherwise result from the proposed action. 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 Federal agency 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.

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.

1. The 45^{th} SW should request budgetary funding for dune enhancement and native vegetation plantings to provide additional light screening of beach areas with a history of hatchling disorientation and/or misorientation incidents.

2. Educational information should be provided to personnel 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 for reinitiation. As provided in 50 CFR §402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending reinitiation. The Service appreciates the cooperation of the Air Force during this consultation. We would like to continue working with you and your staff regarding the lighting at PAFB and CCAFS. For further coordination please contact [redacted] at (904) 525-0661.

Sincerely,

[redacted]

Field Supervisor

cc: [redacted], Florida Fish and Wildlife Conservation Commission, Tequesta, FL
[redacted] Merritt Island National Wildlife Refuge, Titusville, FL

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