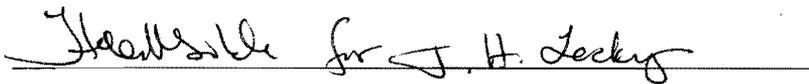


**National Marine Fisheries Service**  
**Endangered Species Act Section 7 Consultation**  
**Biological Opinion**

**Agency:** Permits, Conservation and Education Division of the Office of Protected Resources, National Marine Fisheries Service

**Proposed Action:** Proposal to issue permit No. 14508 to Michael Bressette and No. 14655 to Jane Provancha for studies on sea turtle abundance and distribution in both Lake Worth Lagoon in Palm Beach County, and Mosquito Lagoon in Volusia and Brevard Counties, Florida, pursuant to Section 10(a)(1)(A) of the Endangered Species Act of 1973

**Prepared by:** Endangered Species Division of the Office of Protected Resources, National Marine Fisheries Service

**Approved by:** 

**Date:** June 2, 2010

Section 7(a)(2) of the Endangered Species Act (ESA; 16 U.S.C. 1531 et seq.) requires each federal agency to ensure that any action authorized, funded, or carried out by such agency is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of critical habitat of such species. When an action of a federal agency “may affect” endangered or threatened species or critical habitat, that agency is required to consult with the National Marine Fisheries Service (NMFS) or U.S. Fish and Wildlife Service, depending on the species that may be affected. This biological opinion is the result of an intra-agency consultation between the Permits, Conservation and Education Division and the Endangered Species Division of the NMFS Office of Protected Resources. This opinion describes whether Permits, Conservation and Education Division’s issuance of scientific research permits 14508 (Principal Investigator – Michael Bressette) and 14655 (Principal Investigator – Jane Provancha) would likely jeopardize the existence of the endangered green turtle, Kemp’s ridley turtle, Hawksbill turtle and threatened Loggerhead turtle.

This biological opinion has been prepared in accordance with section 7 of the ESA and regulations promulgated to implement that section of the ESA. This biological opinion is based on information provided in the research permit application, *Draft Environmental Assessment on the Effects of Scientific Research Activities Associated with the issuance of two scientific research permits for sea turtle research in Florida*, published and unpublished scientific

information on the biology and ecology of endangered and threatened turtle, and other sources of information.

A brief account of the consultation history precedes the biological opinion. The biological opinion first describes the proposed permit and research activities, including activities that may affect listed species, and the action areas. Accounts of the various sea turtles, their life histories, population status and trends, and major threats follow. The *Environmental Baseline* section contains a discussion of the past and present activities that have affected these species in the action areas. The *Status of the Species* and the *Environmental Baseline* serve as the context for the analysis of the effects of the proposed action on these species. The *Effects of the Action* section describes the evidence and rationale behind our conclusion that these species are not likely to be jeopardized by issuance of the proposed research permits.

### **Consultation History**

The Permits, Conservation and Education Division requested a consultation under the ESA in a memorandum dated December 11, 2009 for their proposal to issue scientific research permits 14508 and 14655, each for a 5 year period. The applicants would be conducting experiments on various listed sea turtles in Lake Worth Lagoon in Palm Beach County and Mosquito Lagoon in Volusia and Brevard Counties, Florida.

On December 16, 2009 additional information/clarification regarding the sonic tag application (permit No. 14508) and the time required for the epoxy to dry was requested. Upon receiving the additional information on January 5, 2010 consultation was initiated.

## **Biological Opinion**

### **Description of the Proposed Action**

The Permits, Conservation and Education Division of the NMFS Office of Protected Resources proposes to issue two scientific research permits pursuant to section 10(a)(1)(A) of the ESA.

Permit 14508 would authorize Michael Bresette, of Inwater Research Group Inc., to annually capture 50 green (*Chelonia mydas*), 5 loggerhead (*Caretta caretta*), 2 hawksbill (*Eretmochelys imbricata*), and one Kemp's ridley (*Lepidochelys kempii*) sea turtles using a large mesh tangle net.

Animals will be measured, flipper and passive integrated transponder (PIT) tagged, weighed, photographed, blood sampled and released. Dietary samples will also be extracted from a subset of 20 green sea turtles annually using a sampling technique called gastric lavage or stomach flushing. This research will provide long-term data on species comparison, size frequencies, disease rates, seasonal abundance, genetic origin and feeding ecology of sea turtles that use Lake Worth Lagoon in Palm Beach County, Florida. The proposed research would result in collection of baseline data to help determine the decline or recovery of this population. The researches would document the prevalence of fibropapilloma (FP), which is thought to be highly prevalent

in the Lake Worth Lagoon. NMFS proposes to authorize these activities for a 5 year period. The annual take is summarized in take Table 1. that follows.

Table 1: Maximum Annual Takes Under Permit No. 14508			
Number of Individuals	Life Stage	Species	In-water Take Activity(ies)*
30	Juvenile/Subadult	green (Florida Pop)	Capture, measure, weigh, photograph/video, flipper tag, PIT tag, blood and tissue sample, release
20	Juvenile/subadult	green (Florida Pop)	Lavage, capture, measure, weigh, photograph/video, flipper tag, PIT tag, blood and tissue sample, release
5	Adult/subadult/ juvenile	loggerhead	Capture, measure, weigh, photograph/video, flipper tag, PIT tag, blood and tissue sample, release
2	Adult/subadult/ juvenile	hawksbill	Capture, measure, weigh, photograph/video, flipper tag, PIT tag, blood and tissue sample, release
1	Adult/subadult/ juvenile	Kemp's ridley	Capture, measure, weigh, photograph/video, flipper tag, PIT tag, blood and tissue sample, release

\* = Captured by tangle net in the waters of the Lake Worth Lagoon.

The new permit, if issued, would authorize the proposed research over a five-year period starting from the date of approval. The applicant currently holds a permit with NMFS (file no. 1462; with an extended expiration date of August 31, 2010).

Permit 14655 would authorize Jane Provancha , NASA, Ecological Program, Kennedy Space Center to annually capture 40 green (*Chelonia mydas*), 40 loggerhead (*Caretta caretta*), one hawksbill (*Eretmochelys imbricata*), one leatherback (*Dermochelys coriacea*) and one Kemp's ridley (*Lepidochelys kempii*) sea turtles using a large mesh tangle net.

The proposed research project would be a continuation of work that has been conducted by these researchers in this area since 1995. This includes the monitoring of abundance and distribution of sea turtles within the waters of Mosquito Lagoon in Volusia and Brevard Counties, Florida, and comparing it to current sea turtle population structure and distribution to baseline data.

Animals will be measured, flipper and passive integrated transponder (PIT) tagged, weighed, photographed, blood sampled and released. Dietary samples will also be extracted from a subset of 12 green and 10 loggerhead sea turtles annually using gastric lavage or stomach flushing. All equipment coming in contact with the turtles would be cleaned with anti-microbial soap and a

10% Clorox/Betadine solution prior to processing subsequent animals.

In addition, twelve of the 40 captured green and ten of the 40 captured loggerheads would have sonic transmitters glued to the carapace. These turtles would be passively tracked and monitored using moored receivers. The purpose of the research would be to provide a basic understanding of the abundance, location and movement of sea turtles using Mosquito Lagoon.

Researchers would use the data to evaluate seasonal distribution and occurrence of sea turtles (catch per-unit effort, CPUE) in this system; to evaluate distribution patterns relative to resource distribution (submerged aquatic vegetation, water quality, etc.); to provide updated statistical summaries of CPUE to determine regional “importance value” of this lagoon relative to other studied juvenile habitats on the Florida east coast; to monitor sex ratio and genetics of the subadult sea turtles inhabiting Mosquito Lagoon; and to monitor more detailed use of the lagoon by green turtles with fibropapillomas vs. those without evidence of tumors.

The proposed research would result in the collection of baseline data to help determine the decline or recovery of this population. NMFS proposes to authorize these activities for a 5 year period. The annual take is summarized in take Table 2. that follows.

Table 2: Maximum Annual Takes Under Permit No. 14655			
Individuals	Life Stage	Species	In-water Take Activity(ies)*
28	Adult/ subadult/ juvenile	green (Florida Pop)	Capture, measure, weigh, photograph/video, flipper tag, PIT tag, blood and tissue sample, release
12	Adult/ subadult/ juvenile	green (Florida Pop)	Lavage, capture, measure, weigh, epoxy attachment (satellite tag, VHF tag) photograph/video, flipper tag, PIT tag, blood and tissue sample, release
30	Adult/ subadult/ juvenile	loggerhead	Capture, measure, weigh, photograph/video, flipper tag, PIT tag, blood and tissue sample, release
10	Adult/ subadult/ juvenile	loggerhead	Lavage, capture, measure, weigh, epoxy attachment (satellite tag, VHF tag) photograph/video, flipper tag, PIT tag, blood and tissue sample, release
1	Adult/ subadult/ juvenile	Hawksbill	Capture, measure, weigh, epoxy attachment (satellite tag, VHF tag) photograph/video, flipper tag, PIT tag, blood and tissue sample, release
1	Adult/ subadult/ juvenile	Kemp’s ridley	Capture, measure, weigh, epoxy attachment (satellite tag, VHF tag) photograph/video, flipper tag, PIT tag, blood and tissue sample, release

\* = Captured by tangle net in the waters of Mosquito Lagoon, Florida.

Recapture data would be used to measure condition, growth rates, residency, and survival. The new permit, if issued, would authorize the proposed research over a five-year period starting from the date of approval. The applicant held a similar permit with NMFS (file no. 1450; which expired November 30, 2009).

The following provides additional detail on the methodologies that would be used under the proposed actions:

#### Turtle Capture, Experimental Procedures and Minimization of Impacts

The following sections will describe how turtles will be captured and handled as well as the experimental procedures that will be carried out under the proposed action. This section will also note actions that will be taken to minimize the impact of these activities.

*Permit 14508:* Turtles would be captured by a large mesh tangle net during one 3-day period each quarter. The net would be 100 meters long by 5 meters deep and consist of 40 cm stretch (knot to knot) multi-filament mesh. The mesh is suspended from a foam core braided polyethylene top line with fixed buoys spaced 3.5 meters apart. The bottom line consists of a smaller diameter lead core line. Anchors attached to both ends of the net keep it in position and prevent drifting of the lead line.

The net would be deployed by boat and carefully monitored by pulling the lead line hand over hand every 30 minutes. When turtles encounter the net and become entangled, they would be quickly removed from the net and placed on the deck of the boat. Before deployment of the net a careful visual inspection of the area would be made to insure there are no marine mammals present near the study site. In the case where marine mammals are sighted near the netting site, nets will either not be deployed or will be pulled in and netting activity will cease until the area is clear of marine mammals.

Morphometric data would be collected for each turtle captured using forestry calipers and a flexible tape. Thorough out the processing period, the turtles will be kept moist with wet towels and pads on the deck of the boat. Turtles with FP will be kept separate from other turtles and separate sets of measuring and tagging gear will be used. Measurements would include straight carapace length, straight minimum carapace length, straight maximum carapace width, straight midline plastron length, curved standard carapace length, curved maximum carapace width and head width as described by Pritchard *et al.* (1983).

External tagging would involve the application of oxidation and corrosion resistant metal tags (Inconel #681) to the trailing edge of each front flipper, using an applicator. The applicant will make certain that the locking mechanisms are correctly aligned and that the tag locks in place. Care is needed to ensure that the tag is not applied too far into the edge of the flipper. Ideally, 25-33% of the tag should extend beyond the edge of the flipper after application. This is especially important when applying tags to immature turtles that are still growing. A sterile passive integrated transponder (PIT tag) will be subcutaneously inserted to the right front flipper using a 12-gauge needle. PIT tags are encased in glass that protects the electronic components and prevents tissue irritation in the animal. Before insertion of any tags all flippers will be scanned for the presence of any pre-existing PIT tags and the tagging area would be disinfected with a Betadine solution.

Blood samples from all turtles will be taken for genetic analysis, and sex ratios. They will be collected within the first five minutes of capture so as not to bias the samples. Blood will be drawn from the cervical sinus using a sterile vacutainer with no additive (Owens and Ruiz, 1980). The area will be thoroughly sterilized with betadine before needle insertion. A 22 gauge 1" needle will be used on small juveniles, while a 1 ½" would be used on subadults. Researchers will collect approximately 4 ml from each turtle and add a few drops to a lysis buffer (100 mM Tris-HCL, pH 8; 100 mM EDTA, pH 8, 10 mM NaCl; 1.0% SDS) in a 1:10 ratio, gently shake the mixture and store it in a cool dark place. This blood will be used for later mtDNA haplotype analysis to determine the turtles origin (Encalada *et al.* 1996). The remaining blood will be placed in a sterile vacutainer with lithium heparin and spun for ten minutes in an Adams Physician centrifuge. Plasma will then be pipetted into a 1.8 ml vial and be held for future testosterone radioimmunoassay to determine sex.

With small green turtles it is sometimes difficult to obtain a blood sample; therefore, when a blood sample is not obtained researchers would use a 4 mm biopsy punch to extract a tissue sample from the trailing edge of the right rear flipper. The biopsy area would be thoroughly treated with Betadine prior to and after the sample is taken. The sample would then be placed in tissue buffer (ethanol) and stored for future genetic analysis. Date, location and tag numbers of the turtles will be recorded on the collection tube.

Tumors associated with FP, will be measured and recorded on a standardized tumor score sheet. The total tumor score will be used to assign turtles to severity categories (Work and Balazs, 1999). Seasonal rates and severity of FP will be analyzed to evaluate possible correlations. Turtles with FP will be kept separate from other turtles and separate sets of measuring and tagging gear will be used.

Researchers would extract dietary samples from 20 green turtles annually to provide insight into feeding habits, consumption levels, and diet selection. These samples would be compared between other aggregations of green turtles whose diets are also being investigated. Dietary samples would be carefully extracted from the captured green turtles using gastric lavage or stomach flushing. The lavage process flushes food items that are in the esophagus and mouth areas (Legler, 1977; Balazs 1980; Forbes and Limpus, 1993). Turtles would be held on their back with their posterior end slightly elevated. A soft plastic veterinarian's stomach tube would be lubricated with vegetable oil and cautiously inserted into the mouth and throat area. Seawater would be pumped through the tube using a veterinarian's double action pump. The tube would then be gently moved back and forth along the length of the esophagus. The lavage process would be restricted to no more than one minute. Tubes would be selected according to the turtles size and FP condition. Researchers would use 4 tubes; one for smaller size-class green turtles (20-35 cm SCL) with FP, another small tube for green turtles that are clean (FP-free) and two tubes for larger turtles (>35 cm SCL) identified as FP and FP-free. Generally, the lavage process itself lasts under 30 seconds. Food items flushed out of the esophagus and mouth would be collected in a five-gallon plastic bucket. The extracted diet sample would then be strained through a fine mesh net (mesh ~1 mm) and placed into a collection jar. A 4% formalin-seawater solution would preserve the sample for future analysis. Date, location and tag numbers of the turtles would be recorded on the collection jar.

Turtles would be weighed using a netting sling and digital scale hung from a weighing pole, and

subsequently photographed. Turtles would then be released close to the original site after all sampling is complete (25 minutes).

*Permit 14655:* Turtles would be captured seasonally, during a 3-4 day period, using two large mesh tangle nets as described by Provanca *et al.* (1998). Both nets would be 240 m in length by 3.6 m deep and made of no. 18 nylon twine and a mesh size of 22 cm. An extensive bullet and buoy system would be attached to the top line to enhance the visual detect-ability of animals entangled in the net. Two boats would be used to set, tend and process. Boat availability dictates which vessels would be used. Net deployment would be conducted by boat during daylight hours. The net set would be tended throughout operations with a maximum of 20 minutes between complete checks to ensure the safety of captured animals. Environmental parameters, including sea state, water salinity, temperature and depth, would be measured at each net site during sampling events. Start and end times of net sets and net pulls would be recorded for each net deployment.

Researchers would conduct standard morphometrics, evaluation of condition and photographed. Measurements follow standards for reptile measures and would be made with large calipers (straight lengths) and a flexible tape (over the curves). Turtles will be weighed using a netting sling and digital scale hung from a weighing pole.

Epibionts (barnacles) would be removed from turtles that are excessively burdened with them or if the barnacles inhibit proper measurements or tag application. This removal would be accomplished essentially popping them off by gently pressing a “butter-knife” against and wedging under the barnacle.

External tagging would involve a monel tag, attached to the right front flipper. The tag would be generally attached two scales distal to the flipper origin. In addition, a PIT tag would be injected subdermally in the dorsal right front flipper in the region of the radius using a single use, 12 gauge sterile needle. All general equipment that would be in contact with the turtles would be cleaned with anti-microbial soap and an 10% Clorox solution prior to processing subsequent animals. The tag site located on the front flipper would be cleaned with alcohol or betadine (depending on supplies) and the insertion point of the tag would be coated with an antibiotic. Based on NASA IACUC recommendation, researchers ice the tag site prior to insertion as well.

Blood would be collected (ca. approximately 10 cc) from the animals for sex determination and genetic analyses. Samples would be drawn from the dorsal side at the vertebral sinus using standard hematological methods (via vacutainer with 20 gauge, 1.5 inch needles). If blood is not attainable then a small 5 mm biopsy punch taking a 2 mm thick section of posterior flipper tissue can serve to provide genetic samples. The dorsal side of the neck would be cleaned and sanitized prior to blood sampling, generally with alcohol. Betadine may be substituted when alcohol is unavailable.

The applicant has preformed esophageal flushing (lavage) on a subsample of turtles in Mosquito Lagoon over the years as an indication of forage utilization. Lavage may be conducted again on a subset of turtles (12 green and 10 loggerheads) within certain years in relation to ongoing seagrass monitoring within these waters. The proposed method follows the current “standard” and is a modification of that described by Forbes and Limpus (1993). Water transfer tube sizes would vary with the size of the individual turtle to avoid esophageal damage. Samples would be

preserved in buffered formalin. Analyses of the esophageal samples would be determined by relative composition of subsamples that covered the dimensions of a 4 x 4 grid (Holloway-Adkins 2001). Researchers would use separate tubes and gags for FP turtles. Researchers would also clean all tubes, etc. after each use, with detergent and mild clorox. Two sizes of surgical tubes, a set for FP turtles and a set for non-FP turtles. 1) 9 mm outside diameter (OD), 6 mm inside diameter (ID) tube would be used on smaller turtles (35 cm SCL or smaller), and 2) 13 mm OD tube is used for turtles larger than 35 cm SCL.

Sonic tags will be used to compare utilization of the lagoon by healthy green turtles compared to green turtles with evidence of FP. Researchers would attach sonic tags (transmitters) to the carapace of six green turtles with signs of FP (i.e. tumors with class code less than 3) and six green turtles with no signs of the tumors, as well as 10 loggerhead turtles for tracking purposes. The Vemco Inc., sonic tags (V16-transmitter), would be set to operate at a frequency of 69 kHz, and supplies data for approximately 24-60 months. The tags would be approximately four cm long and one cm in diameter and present a weight of less than 1% of the turtle's body mass. Tags would be adhered to the animals using standard application procedures. Researchers would use West Marine epoxy putty sticks as the primary adhering material. Prior to application, the turtle's carapace near the mid-dorsal line would be cleaned with a small, soft brush and lightly sanded with fine sandpaper to improve the surface for the putty adherence.

The precise location is dependent on each turtle's carapace shape and condition. The chosen location (a 20 x 20 cm section of the carapace) would be further cleaned using alcohol applied to a clean cloth. The marine putty would be activated and then shaped into a thick, rectangular "brick" (1 cm x 2 cm x 10 cm) that would allow for contact between the carapace as well as envelope most of the tag. The tag would be lightly roughened with sand paper and is pressed along the top of the putty brick while it is still soft. Then this pairing would be set on the prepared carapace site where the tag would be pressed deeper into the putty/brick and the base of the brick is further pressed onto the carapace. The putty fills any gaps resulting from the shape of the carapace and simultaneously adheres around the tag in all areas except the sonic end. The total surface area under the tag system would be approximately 4 x 13 cm. The application takes about five minutes and is fully dried in one hour.

Turtles would be released at the point of capture after all sampling and tag attachment is complete (about one hour).

### **Mitigation and Monitoring Plan**

The following information outlines the main mitigation measures researchers would employ to minimize the potential for any adverse impacts to the target species (green and loggerhead sea turtles) as well as any additional ESA-listed species in the action area. The research project is designed to minimize the potential of any stress, pain or suffering. All the investigators and personnel involved are experienced in capturing sea turtles and will undertake the following precautions. Netting will be carefully monitored to remove turtles from the net as soon as they are caught. Turtles will be handled carefully so they are not injured during or after capture. Antiseptic methods such as sterilizing equipment with bleach solution and the use of Betadine and or Chlorox solution at tag sites will be standard protocol to prevent the transmittal of disease and prevent infection. Turtles found to have serious injuries will be evaluated for possible transport to a rehabilitation facility. In such cases, the Marine Turtle Stranding Team of the

Florida Fish and Wildlife Conservation Commission will be consulted and will conduct any necessary transfer.

The following specific research conditions will be placed on the research should both proposed permits (No. 14508 and 14655) be issued to ensure compliance with appropriate research protocols:

1. The Permit Holders would ultimately be responsible for all activities of any individual who is operating under the authority of the proposed permit. The Principal Investigators (PI) would share this responsibility. Individuals operating under the specified Permit and conducting the activities authorized herein, must be approved by NMFS. Alternatively, there must be a NMFS approved individual present to supervise these activities until such time that the other individuals have been approved by NMFS.
2. Accidental Mortality of Authorized Sea Turtles: If a turtle is seriously injured or dies during sampling, the Permit Holder must cease research immediately and notify the Chiefs, Permits, Conservation and Education Division by phone (301-713-2289) as soon as possible, but no later than two days following the event. The Permit Holder must re-evaluate the techniques that were used and those techniques must be revised accordingly to prevent further injury or death. The Permit Holder must submit a written report describing the circumstances surrounding the event. The Permit Holder must send this report to the Chiefs, Permits, Conservation and Education Division, F/PR1, 1315 East-West Highway, Silver Spring, MD 20910. Pending review of these circumstances, NMFS may suspend authorization of research activities or amend the Permit in order to allow research activities to continue. Turtles that are seriously injured or have died will be counted against the total number of animals authorized to be taken under the permit.
3. An annual report would be submitted and reviewed by NMFS for each year the permits are valid. In addition to an account of actual 'take' that occurred, the reports would include detailed descriptions of the animals' reactions, measures taken to minimize disturbance, research plans for the forthcoming year, and an indication as to when or if any results have been published or otherwise disseminated during the year. At the end of each proposed permit, the Permit Holders would submit a final report that includes: (1) a reiteration of the objectives and summary of results of the research and how they pertain to or further the research goals stated in the Permit applications and NMFS conservation plans; and (2) an indication of where and when the research results would be published.
4. Instruments and equipment that are used for invasive procedures must be sterilized or disinfected with an appropriate disinfectant (e.g. mild bleach solution or Betadine) between animals.
5. When handling and/or tagging turtles displaying fibropapilloma tumors and/or lesions, researchers will use the following procedures:
  - Clean all equipment that comes into contact with the turtle (tagging equipment, tape measures, etc.) with a mild bleach solution, between the processing of each turtle, and

- Maintain a separate set of sampling equipment for handling animals displaying fibropapilloma tumors and/or lesions.
6. All turtles shall be examined for existing tags, including PIT tags, before attaching or inserting new ones.
  7. Flipper Tagging with Metal Tags – All tags shall be cleaned (e.g. oil residue) and disinfected before being used.
  8. General Handling and Releasing of Turtles: The Principal Investigators, Co-investigator(s), or Research Assistant(s) acting on the Permit Holder's behalf must use care when handling live animals to minimize any possible injury, and appropriate resuscitation techniques must be used on any comatose turtle prior to returning it to the water. Whenever possible, stressed or injured animals should be transferred to rehabilitation facilities and allowed an appropriate period of recovery before return to the wild. An experienced veterinarian, veterinary technician, or rehabilitation facility must be named for emergencies. All turtles must be handled according to procedures specified in 50 CFR 223.206(d)(1)(i).
  9. Turtles are to be protected from temperature extremes of heat and cold, and kept moist during sampling. The turtle will be placed on pads for cushioning and this surface will be disinfected between turtles. The area surrounding the turtle may not contain any materials that could be accidentally ingested.
  10. During release, turtles shall be lowered as close to the water's surface as possible, to prevent potential injuries.
  11. Blood sampling: Blood samples shall be taken by experienced personnel that have been authorized under this permit. New disposable needles must be used on each animal. Care shall be taken to ensure no injury results from the sampling. If an animal cannot be adequately immobilized for blood sampling, efforts to collect blood must be discontinued. Attempts (needle insertions) to extract blood shall be limited to two on either side of the neck. Sample collection sites shall always be sterilized with alcohol or another antiseptic prior to sampling.
  12. Lavage: The actual lavaging of the turtles shall not exceed three minutes. Once the samples have been collected, water must be turned off and water and food allowed to drain until all flow has stopped. The posterior of the turtles will be elevated slightly to assist in drainage.
  13. Netting Special Conditions
    - Nets used to catch turtles must be of large enough to diminish bycatch of other species.
    - Highly visible buoys shall be attached to the float line of each net such that they are spaced at an interval of every 10 yards or less. Each float shall be attached to the net as it is being deployed.

- Nets must be checked at least every 30 minutes, and more frequently whenever turtles or other bycatch organisms are observed in the net. The float line of all nets shall be observed at all times for movements that indicate an animal has encountered the net. When this occurs the net must be immediately checked. “Net checking” is defined as a complete and thorough visual check of the net either by snorkeling the net in clear water or by pulling up on the top line such that the full depth of the net is viewed along the entire length. If water temperatures are equal to or greater than 30°C, nets must be checked at least every twenty minutes.
- Nets must not be put in the water when marine mammals are observed within the vicinity of the research, and the marine mammals must be allowed to either leave or pass through the area safely before net setting is initiated. Should any marine mammals enter the research area after the nets have been set, the lead line must be raised and dropped in an attempt to make marine mammals in the vicinity aware of the net. If marine mammals remain within the vicinity of the research area, nets must be removed.

14. Transport and Holding (if applicable):

- Turtles are to be transported via a climate-controlled environment, protected from temperature extremes of heat and cold, and kept moist. The turtle will be placed on pads for cushioning. The area surrounding the turtle may not contain any material that could be accidentally ingested.
- Turtles transported to a facility and held (e.g. for rehabilitation) must be maintained and cared for under the “Care and Maintenance Guidelines for Sea Turtles Held in Captivity” issued by the U.S. Fish and Wildlife Service or the State of Florida.

15. In waters where manatee are present: The following conditions to the Permits are to prevent interactions with endangered Florida manatees (*Trichechus manatus*):

- Vessel personnel must be informed that it is illegal to intentionally or unintentionally harm, harass, or otherwise “take” manatees.
- Crew involved in research activities shall wear polarized sunglasses to reduce glare while on the water and keep a look out for manatee. Look for swirls on the water and other signs of manatee.
- Netting activities must cease if a manatee is sighted in the vicinity.
- If a manatee is accidentally captured:
  - i. Devote all research staff efforts to freeing the animal. Remember that a manatee must breathe and surface approximately every 4 minutes
  - ii. As appropriate, turn off the vessel motors or put the engine in neutral. Propellers can seriously injure or kill manatees.
  - iii. Release tension on the net to allow the animal the opportunity to free itself. Exercise caution when attempting to assist the animal in freeing itself. Manatee can thrash violently if captured or entangled in a net. An adult manatee can cause extensive damage to nets while trying to escape

or breathe, so quick action is essential to protect both the manatee and your gear.

- iv. Contact the Florida Fish and Wildlife Conservation Commission, Division of Law Enforcement, 1-888-404-FWCC [3922]. Immediately contact Nicole Adimey of the U.S. Fish and Wildlife Service at 904-232-2580 x 123 (weekdays), fax 904-232-2404, and 904-669-9257 (weekends) to report any gear or vessel interactions with manatees. Also contact NMFS (Chief, Permits, Conservation and Education Division at 301-713-2289) as soon as possible.

16. *Johnson's sea grass and critical habitat.* No research activities will be conducted over, on, or adjacent to Johnson's sea grass or in Johnson's sea grass critical habitat. (This habitat is described in the Johnson's sea grass critical habitat final rule of April 5, 2000)

17. *Other sea grass species.* Researchers will avoid conducting research over or immediately adjacent to any non-listed sea grass species. If these non-listed species can not be avoided, then the following avoidance/minimization measures shall be implemented:

- In order to reduce the potential for sea grass damage, anchors will be set by hand when water visibility is acceptable.
- Researchers will take great care to avoid damaging any sea grass species and if the potential for anchor or net drag is evident researchers will suspend research activities immediately.

### **Approach to the Assessment**

NMFS approaches its section 7 analyses of research permits through a series of steps. The first step identifies those aspects of proposed actions that are likely to have direct and indirect physical, chemical, and biotic effects on listed species or on the physical, chemical, and biotic environment of an action area. As part of this step, we identify the spatial extent of these direct and indirect effects, including changes in that spatial extent over time. The results of this step define the action area for the consultation. The second step of our analyses identifies the listed resources that are likely to co-occur with these effects in space and time and the nature of that co-occurrence (these represent our exposure analyses). In this step of our analyses, we try to identify the number, age (or life stage), and gender of the individuals that are likely to be exposed to an action's effects and the populations or subpopulations those individuals represent. Once we identify which listed resources are likely to be exposed to an action's effects and the nature of that exposure, we examine the scientific and commercial data available to determine whether and how those listed resources are likely to respond given their exposure (these represent our response analyses).

The final steps of our analyses – establishing the risks those responses pose to listed resources – are different for listed species and designated critical habitat (these represent our risk analyses). Our jeopardy determinations must be based on an action's effects on the continued existence of threatened or endangered species as those "species" have been listed, which can include true biological species, subspecies, or distinct populations of vertebrate species. Because the

continued existence of species depends on the fate of the populations that comprise them, the continued existence of these “species” depends on the fate of the populations that comprise them.

Similarly, the continued existence of populations are determined by the fate of the individuals that comprise them; populations grow or decline as the individuals that comprise the population live, die, grow, mature, migrate, and reproduce (or fail to do so).

Our risk analyses reflect these relationships between listed species, the populations that comprise that species, and the individuals that comprise those populations. Our risk analyses begin by identifying the probable risks actions pose to listed individuals that are likely to be exposed to an action’s effects. Our analyses then integrate those individual risks to identify consequences to the populations those individuals represent. Our analyses conclude by determining the consequences of those population level risks to the species those populations comprise.

We measure risks to listed individuals using the individuals’ “fitness,” or the individual’s growth, survival, annual reproductive success, and lifetime reproductive success. In particular, we examine the scientific and commercial data available to determine if an individual’s probable lethal, sub-lethal, or behavioral responses to an action’s effect on the environment (which we identify during our response analyses) are likely to have consequences for the individual’s fitness.

When individual, listed plants or animals are expected to experience reductions in fitness in response to an action, those fitness reductions are likely to reduce the abundance, reproduction, or growth rates (or increase the variance in these measures) of the populations those individuals represent (Stearns 1992). Reductions in at least one of these variables (or one of the variables we derive from them) is a necessary condition for reductions in a population’s viability, which is itself a necessary condition for reductions in a species’ viability. As a result, when listed plants or animals exposed to an action’s effects are not expected to experience reductions in fitness, we would not expect the action to have adverse consequences on the viability of the populations those individuals represent or the species those populations comprise (e.g. Brandon 1978; Mills and Beatty 1979; Stearns 1992; Anderson 2000). As a result, if we conclude that listed plants or animals are not likely to experience reductions in their fitness, we would conclude our assessment.

Although reductions in fitness of individuals are a necessary condition for reductions in a population’s viability, reducing the fitness of individuals in a population is not always sufficient to reduce the viability of the population(s) those individuals represent. Therefore, if we conclude that listed plants or animals are likely to experience reductions in their fitness, we determine whether those fitness reductions are likely to reduce the viability of the populations the individuals represent (measured using changes in the populations’ abundance, reproduction, spatial structure and connectivity, growth rates, variance in these measures, or measures of extinction risk). In this step of our analyses, we use the population’s base condition (established in the *Environmental Baseline* and *Status of the Species* sections of this Opinion) as our point of reference. If we conclude that reductions in individual fitness are not likely to reduce the viability of the populations those individuals represent, we would conclude our assessment.

Reducing the viability of a population is not always sufficient to reduce the viability of the species those populations comprise. Therefore, in the final step of our analyses, we determine if reductions in a population's viability are likely to reduce the viability of the species those populations comprise using changes in a species' reproduction, numbers, distribution, estimates of extinction risk, or probability of being conserved. In this step of our analyses, we use the species' status (established in the *Status of the Species* section of this Opinion) as our point of reference. Our final determinations are based on whether threatened or endangered species are likely to experience reductions in their viability and whether such reductions are likely to be appreciable.

To conduct these analyses, we rely on all of the evidence available to us. This evidence might consist of monitoring reports submitted by past and present permit holders; reports from NMFS Science Centers; reports prepared by natural resource agencies in states, and other countries; reports from domestic and foreign non-governmental organizations involved in marine conservation issues, the information provided by the Permits, Conservation and Education Division when it initiates formal consultation, and the general scientific literature.

During each consultation, we conduct electronic searches of the general scientific literature using *American Fisheries Society*, *Google Scholar*, *ScienceDirect*, *BioOne*, *Conference Papers Index*, *JSTOR*, and *Aquatic Sciences and Fisheries Abstracts* search engines. We supplement these searches with electronic searches of doctoral dissertations and master's theses. These searches specifically try to identify data or other information that supports a particular conclusion (for example, a study that suggests sea turtles will exhibit a particular response to tagging) as well as data that does not support that conclusion. When data are equivocal, or in the face of substantial uncertainty, our decisions are designed to avoid the risks of incorrectly concluding that an action would not have an adverse effect on listed species when, in fact, such adverse effects are likely.

We rank the results of these searches based on the quality of their study design, sample sizes, level of scrutiny prior to and during publication, and study results. Carefully designed field experiments (for example, experiments that control potentially confounding variables) are rated higher than field experiments that are not designed to control those variables. Carefully designed field experiments are generally ranked higher than computer simulations. Studies that produce large sample sizes with small variances are generally ranked higher than studies with small sample sizes or large variances.

### **Action Area**

The action area is defined in 50 CFR 402.2 as "all areas to be affected directly or indirectly by the Federal Action and not merely the immediate area involved in the action." The action area under these proposed activities would be as follows for the next five years:

File No. 14508: The study would be conducted in Lake Worth Lagoon, a 20 mile long body of water along the coast of Palm Beach County, Florida. The research would take place from the northern region adjacent to Little Munyon Island to the area of the lagoon surrounding South Lake Worth Inlet. The study area is about 3 miles long. The lagoon was historically freshwater but two man-made inlets now exist in the lagoon creating an estuarine waterway. Habitat at

these sites consists primarily of seagrass beds interspersed with hard bottom habitat. The action area includes the waters of Lake Worth Lagoon in Florida.

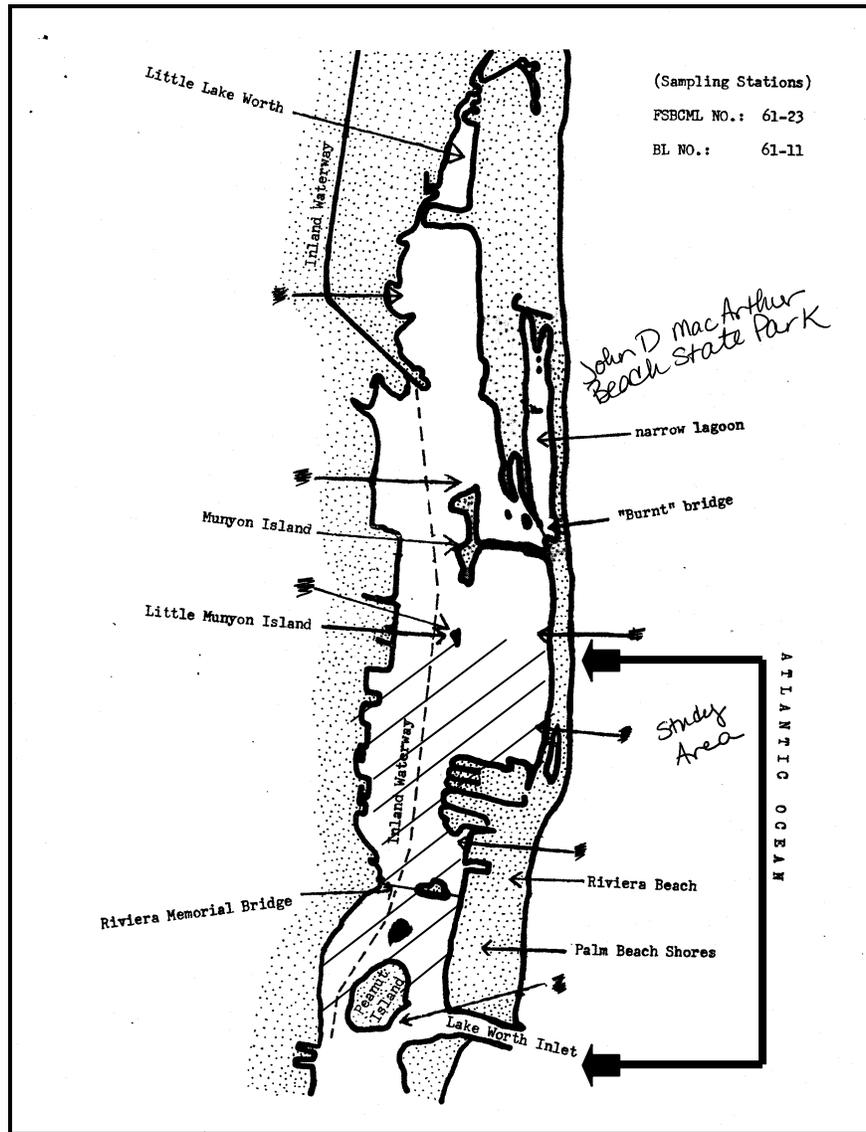


Figure 1. Location of the primary sea turtle netting stations in Lake Worth Lagoon, Florida.

File No. 14655: Mosquito Lagoon is part of the northern Indian River Lagoon complex flowing through Volusia and Brevard Counties, Florida. Three water bodies comprise the Indian River Lagoon complex, the Indian River Lagoon, Banana River Lagoon and Mosquito Lagoon. The research would occur within 3 zones in the Mosquito Lagoon between 28°49.7 N and 28°42.5 N. The landmass to the south and west is Merritt Island, while Canaveral National Seashore separates the lagoon from the Atlantic Ocean on the east. The lagoon is within a biogeographical transition zone, having faunal and floral assemblages derived from both temperate Carolinian and subtropical Caribbean provinces (Provanca *et al.* 1986). The waters are shallow, and primarily Aeolian, with extremely limited tidal influence in the southern portion of Mosquito Lagoon. The water depths average 1 m with maximums of 5 m in dredge channels. The salinity

ranges widely from 25 ppt to 42 ppt, depending on rainfall. Seagrass flats in this lagoon are extensive, covering approximately 70% of the submerged area. The action area includes the waters of Mosquito Lagoon in Florida.

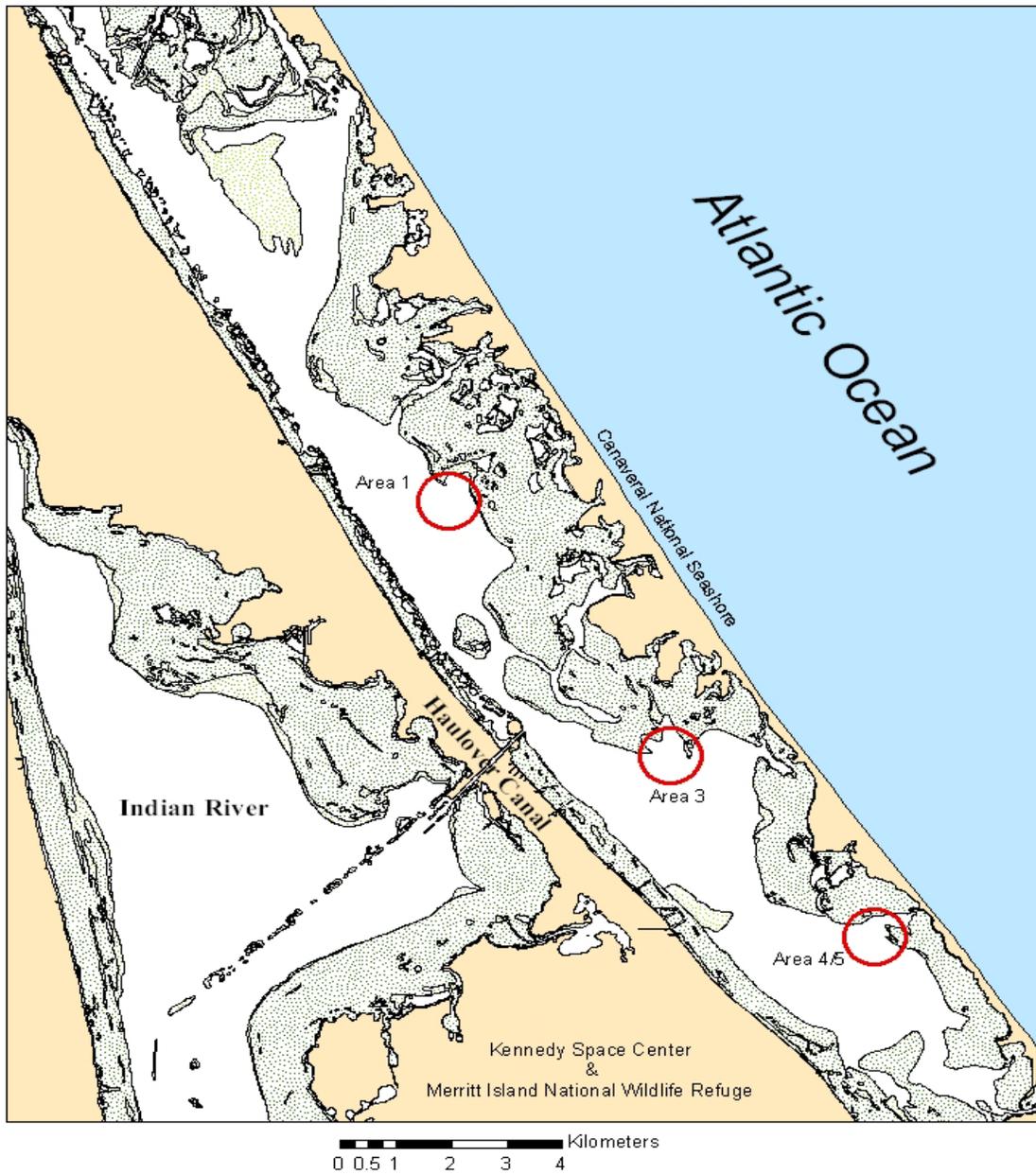


Figure 2. Location of the three primary sea turtle netting stations in Mosquito Lagoon. Open areas are white and represent unvegetated bottom, while the grey stippled areas represent submerged aquatic vegetation.

### Exposure Analysis

Exposure analyses identify the co-occurrence of ESA-listed species within the action's effects in space and time, and identify the nature of that co-occurrence. They identify as possible, the

number, age or life stage, and gender of the individuals likely to be exposed to the action's effects and the population(s) or subpopulation(s) those individuals represent.

The proposed permits would authorize research activities in site-specific areas within fairly confined water bodies, and since these species are highly mobile, and because the proposed activities are to take place at multiple times of year, individual listed species may suffer repeated exposures.

### Status of the Species

The following listed species under the jurisdiction of NMFS may occur in the action areas that would be covered under the proposed issuance of Section 10 research permits (14508 and 14655) to the applicants and may be affected:

<u>Common Name</u>	<u>Scientific Name</u>	<u>Listing Status</u>
<b><i>Sea Turtles</i></b>		
Green sea turtle*	<i>Chelonia mydas</i>	Endangered/Threatened
Hawksbill sea turtle	<i>Eretmochelys imbricata</i>	Endangered
Kemp's ridley sea turtle	<i>Lepidochelys kempii</i>	Endangered
Leatherback sea turtle	<i>Dermochelys coriacea</i>	Endangered
Loggerhead sea turtle	<i>Caretta caretta</i>	Threatened
<b><i>Sea grass</i></b>		
Johnson's seagrass	<i>Halophilia johnsonii</i>	Threatened

Green sea turtles in U.S. waters are listed as threatened except for the Florida breeding population, which is listed as endangered. Because we are unable to distinguish between the populations away from the nesting beaches, green sea turtles are considered endangered wherever they occur in U.S. waters.

No critical habitat has been designated in the action areas for any listed sea turtles species under NMFS jurisdiction; therefore, no sea turtle critical habitat will be affected.

### Species Not Affected or Not Likely to be Adversely Affected

Leatherback sea turtles (*Dermochelys coriacea*) occur outside the action area and are known to forage in coastal waters (NMFS and USFWS 2007a). The proposed research would focus on direct takes of green and loggerhead sea turtles. Some additional species have a small probability to be caught, however leatherback sea turtles have never been incidentally caught in the net over the various years the applicant has conducted research in the action area. Therefore NMFS does not believe leatherback sea turtles would be directly taken under the proposed action. Therefore, the effects are extremely unlikely and therefore discountable.

Johnson's sea grass (*Halophilia johnsonii*) could be disturbed by the research activities. However no research activities (netting and anchoring) will be conducted over, on, or adjacent to

Johnson's sea grass or in Johnson's sea grass critical habitat. Additionally, researchers would be required to avoid conducting research over, on, or immediately adjacent to any non-listed sea grass species. Therefore NMFS does not believe Johnson's sea grass would be directly affected or result in the destruction or adverse modification of critical habitat. Therefore, the effects are extremely unlikely and therefore discountable. These species are not considered further in this analysis.

### **Species Likely to be Adversely Affected**

The loggerhead, green, Kemp's ridley and hawksbill sea turtles are likely to be adversely affected.

Background information on the range-wide status of these species can be found in a number of published documents including status reviews and recovery plans; Kemp's ridley (NMFS and USFWS 2010), loggerhead (NMFS and USFWS 2009), hawksbill (NMFS and USFWS 2007b), and green (NMFS and USFWS 2007c). Most of these species have circumglobal ranges and are highly migratory, however since the action areas would only affect species that live within the Atlantic Ocean basin, the other oceanic basins, which would not be impacted by the action, have been excluded from further analyses. Summary information on the biology and status of these species is provided below.

#### **Loggerhead Sea Turtle (*Caretta caretta*)**

##### *Listing Status, Description of Species and Critical Habitat.*

The loggerhead was listed as a threatened species in 1978. Critical habitat has not been designated for the loggerhead.

The carapace of adult and subadult loggerheads is reddish-brown. The dorsal and lateral head scales and the dorsal scales of the extremities are also reddish-brown, but with light yellow margins. The plastron is medium to light yellow, and the thick, bony carapace is covered by non-overlapping scutes that meet along seam lines. There usually are 11 or 12 pairs of marginal scutes, five pairs of costals, five vertebrals, and a nuchal (precentral) scute that is in contact with the first pair of costal scutes. Mean straight carapace length of adult southeastern United States loggerheads is about 92 cm and corresponding mean body weight is approximately 113 kg. Hatchlings lack the reddish tinge and vary from light to dark brown dorsally. Both pairs of appendages are dark brown above and have distinct white margins. The plastron is dull yellowish tan. Hatchling mean body mass is about 20 g and mean straight carapace length is about 45 mm (Dodd 1988).

##### *Life History*

Mating takes place in late March-early June, and eggs are laid throughout the summer. Female loggerheads deposit an average of 4.1 nests within a nesting season (Murphy and Hopkins, 1984) and have an average remigration interval of 3.7 years (Tucker 2010). Loggerheads nest on ocean beaches and occasionally on estuarine shorelines. Mean clutch size varies from about 100 to 126 along the southeastern United States coast (Dodd 1988). Loggerheads originating from the western Atlantic nesting aggregations are believed to lead a pelagic existence in the North Atlantic Gyre for as long as 7-12 years (Bolten *et al.*, 1998). Turtles in this life history stage are called "pelagic immatures" and are best known from the eastern Atlantic near the Azores and

Madeira and have been reported from the Mediterranean as well as the eastern Caribbean (Bjorndal *et al.*, 2000). Stranding records indicate that when pelagic immature loggerheads reach 40-60 cm straight carapace length they recruit to coastal inshore waters of the continental shelf throughout the U.S. Atlantic and Gulf of Mexico (Witzell 2002).

Juveniles are omnivorous and forage on crabs, mollusks, jellyfish and vegetation at or near the surface (Dodd 1988). Sub-adult and adult loggerheads are primarily coastal and typically prey on benthic invertebrates such as mollusks and decapod crustaceans in hard bottom habitats.

Studies have suggested that not all loggerhead sea turtles follow the model of circumnavigating the North Atlantic Gyre as pelagic immatures, followed by permanent settlement into benthic environments (Laurent *et al.* 1998; Bolten 2003). Some may not totally circumnavigate the north Atlantic. In addition, some of these turtles may either remain in the pelagic habitat in the north Atlantic longer than hypothesized or they may move back and forth between pelagic and coastal habitats (Witzell 2002).

#### *Range, Distribution, Population Dynamics, Status and Trend of Loggerhead Sea Turtles*

The loggerhead occurs throughout the temperate and tropical regions of the Atlantic, Pacific, and Indian Oceans, and inhabit continental shelves and estuarine environments (Dodd 1988). However, the majority of loggerhead nesting is at the western rims of the Atlantic and Indian Oceans. They concentrate their nesting in the north and south temperate zones and subtropics, but generally avoid nesting in tropical areas of Central America, northern South America, and the Old World (NRC 1990). The most recent reviews show that only two loggerhead nesting aggregations have greater than 10,000 females nesting per year: Peninsular Florida, United States and Masirah Island, Oman (Baldwin *et al.* 2003; Ehrhart *et al.* 2003; Kamezaki *et al.* 2003, Limpus and Limpus 2003; Margaritoulis *et al.* 2003). In contrast to determining population size on nesting beaches, determining population size in the marine environment has been very localized (Bjorndal and Bolten 2000). At present, there are no data on population size in the oceanic habitat. Developmental habitat for small juveniles includes the pelagic waters of the North Atlantic and the Mediterranean Sea.

In the Northwest Atlantic, the majority of loggerhead nesting is concentrated along the coasts of the United States from southern Virginia through Alabama. Additional nesting beaches are found along the northern and western Gulf of Mexico, eastern Yucatán Peninsula, at Cay Sal Bank in the eastern Bahamas (Addison and Morford 1996; Addison 1997), on the southwestern coast of Cuba (Galivan 2001), and along the coasts of Central America, Colombia, Venezuela, and the eastern Caribbean Islands. In the Southwest Atlantic, loggerheads nest in significant numbers only in Brazil. In the eastern Atlantic, the largest nesting population of loggerheads is in the Cape Verde Islands (Abella *et al.* 2007; Delgado *et al.* 2008), and some nesting occurs along the West African coast (Fretey 2001).

As post-hatchlings, Northwest Atlantic loggerheads hatched on U.S. beaches migrate offshore and become associated with *Sargassum* habitats, driftlines, and other convergence zones (Carr 1986; Witherington 2002). The oceanic juvenile stage in the North Atlantic has been primarily studied in the waters around the Azores and Madeira (Bolten 2003). In Azorean waters, satellite telemetry data and flipper tag returns suggest a long period of residency (Bolten 2003), whereas turtles appear to be moving through Madeiran waters (Dellinger and Freitas 2000). Other

concentrations of oceanic juveniles exist in the Atlantic (e.g., in the region of the Grand Banks off Newfoundland). Genetic information indicates the Grand Banks off Newfoundland are foraging grounds for a mixture of loggerheads from all the North Atlantic rookeries (LaCasella *et al.* 2005; Bowen *et al.* 2005), and a large size range is represented (Watson *et al.* 2004, 2005). After departing the oceanic zone, neritic juvenile loggerheads in the Northwest Atlantic inhabit continental shelf waters from Cape Cod Bay, Massachusetts, south through Florida, The Bahamas, Cuba, and the Gulf of Mexico (neritic refers to the inshore marine environment from the surface to the sea floor where water depths do not exceed 200 meters). In the U.S., estuarine waters, including areas such as Long Island Sound, Chesapeake Bay, Pamlico and Core Sounds, Mosquito and Indian River Lagoons, Biscayne Bay, Florida Bay, and numerous embayments fringing the Gulf of Mexico, comprise important inshore habitat. Along the Atlantic and Gulf of Mexico shoreline, essentially all shelf waters are inhabited by loggerheads. Benthic immature loggerhead foraging in northeastern U.S. waters are known to migrate southward in the fall as water temperatures cool (Epperly *et al.* 1995; Keinath 1993; Morreale and Sandora 1998; Shoop and Kenney 1992), and migrate northward in spring. The trend is reversed in the fall as water temperatures cool. The large majority leave the Gulf of Maine by mid-September but some may remain in Mid-Atlantic and Northeast areas until late Fall. By December loggerheads have emigrated from inshore North Carolina waters and coastal waters to the north to waters offshore of North Carolina, particularly off of Cape Hatteras, and waters further south where the influence of the Gulf Stream provides temperatures favorable to sea turtles (Epperly *et al.* 1995). Loggerhead sea turtles are year-round residents of central and south Florida.

Habitat preferences of Northwest Atlantic non-nesting adult loggerheads in the neritic zone differ from the juvenile stage in that relatively enclosed, shallow water estuarine habitats with limited ocean access are less frequently used. Areas such as Pamlico Sound and the Indian River Lagoon in the U.S., regularly used by juveniles, are only rarely frequented by adult loggerheads (Epperly *et al.* 1995). In comparison, estuarine areas with more open ocean access, such as Chesapeake Bay in the U.S. mid-Atlantic, are also regularly used by juveniles, as well as by adults primarily during warmer seasons. Shallow water habitats with large expanses of open ocean access, such as Florida Bay, provide year-round resident foraging areas for significant numbers of male and female adult loggerheads. Offshore, adults primarily inhabit continental shelf waters, from New York south through Florida, The Bahamas, Cuba, and the Gulf of Mexico (Schroeder *et al.* 2003). Seasonal use of mid-Atlantic shelf waters, especially offshore New Jersey, Delaware, and Virginia during summer months (Mendonca and Ehrhart 1982), and offshore shelf waters, such as Onslow Bay (off the North Carolina coast), during winter months has been documented (Hawkes *et al.* 2007). Shelf waters along the west Florida coast, The Bahamas, Cuba, and the Yucatán Peninsula have been identified, using satellite telemetry, as important resident areas for adult female loggerheads that nest in Florida (Foley *et al.* 2008).

Adults have been reported throughout the range of this species in the U.S. and throughout the Caribbean Sea (Meylan *et al.* 1983). As discussed in the beginning of this section, they nest primarily from North Carolina southward to Florida with additional nesting assemblages in the Florida Panhandle and on the Yucatan Peninsula (Addison and Morford 1996; Addison 1997; Foley *et al.* 2008). Non-nesting, adult female loggerheads are reported throughout the U.S. and Caribbean Sea; however little is known about the distribution of adult males who are seasonally abundant near nesting beaches during the nesting season. Aerial surveys suggest that loggerheads (benthic immatures and adults) in U.S. waters are distributed in the following

proportions: 54% in the southeast U.S. Atlantic, 29% in the northeast U.S. Atlantic, 12% in the eastern Gulf of Mexico, and 5% in the western Gulf of Mexico (TEWG 1998, Appendix 3).

From a global perspective, the southeastern U.S. nesting aggregation is critical to the survival of this species. It is second in size only to the nesting aggregations in the Arabian Sea off Oman and represents about 35 and 40 percent of the nests of this species. The status of the Oman nesting beaches has not been evaluated recently, but they are located in a part of the world that is vulnerable to extremely disruptive events (e.g. political upheavals, wars, and catastrophic oil spills), the resulting risk facing this nesting aggregation and these nesting beaches is cause for considerable concern (Meylan *et al.* 1995). Crouse (1999) concluded that relatively small changes in annual survival rates of both juvenile and adult loggerhead sea turtles will adversely affect large segments of the total loggerhead sea turtle population.

### *Threats*

Domestic and international fisheries are known to incidentally capture, injure and kill sea turtles, and they have been and continue to be an important threat to sea turtles. Fishery mortality accounts for a large proportion of annual human-caused mortality outside the nesting beaches. Many of the U.S. fisheries are managed under Federal Fisheries Management Plans (FMPs). The bottom trawl, sink gillnets, hook and line gear, bottom longline managed in the Northeast Multispecies Fishery are known to capture sea turtles (Watson *et al.* 2004; Epperly *et al.* 1995; Lewison *et al.* 2003, 2004; Richards 2007). Turtles can also become entangled in the lines of the pot gear used in the American Lobster Fishery and Red Crab Fishery resulting in injury to flippers, drowning, or increased vulnerability to collision with boats or incidental capture (Lutcavage *et al.* 1997). The gear types included in the Monkfish FMP are large mesh trawls, large mesh beam trawls, large mesh gillnets, and hook gear (e.g. handline, rod-and-reel, and bottom longline). Trawls, gillnets, and scallop dredges are the principal gear types that have historically landed monkfish. All of these gears have been known to take (and kill) sea turtles. The Spiny Dogfish Fishery uses numerous gear types which are known to take sea turtles, including gillnets, the otter trawl, and longline (Wetherall 1997). Summer Flounder, Scup, and Black Sea Bass trawls can adversely impact sea turtles also. The Atlantic Highly Migratory Species (HMS) Fisheries utilize the longline, gillnets, purse seine, and hand gear and are known to incidentally take large numbers of sea turtles. Although loggerhead sea turtles are most vulnerable to pelagic longlines during their pelagic, immature life history stage, there is some evidence that benthic immatures may also be captured, injured, or killed by pelagic fisheries (Lewison *et al.* 2004). The Southeast U.S. Shrimp Fishery (which uses otter trawl gear) has historically been one of the largest fishery threats to sea turtles (Murray 2006), and continues to interact with (and kill) large numbers of turtles each year (refer to the Environmental Baseline for more discussion of some of these fisheries).

Other fisheries operate under state jurisdiction, and some are unmanaged. Little is known about the level of take in fisheries that operate strictly in state waters. Depending on the fishery in question, many state permit holders also hold Federal licenses; therefore, section 7 consultations on Federal action in those fisheries address some state-water activity. NMFS is also actively participating in a cooperative effort with ASMFC to standardize and/or implement programs to collect information on level of effort and bycatch in state fisheries in Atlantic waters. When this information becomes available, it can be used to refine take reduction plan measures in state waters.

In addition to domestic fisheries, sea turtles are subject to direct as well as incidental capture in numerous foreign fisheries. For example, as pelagic immature loggerhead sea turtles circumnavigate the North Atlantic they are exposed to longline fisheries including the Azorean, Spanish, and various other fleets in the Mediterranean Sea (Aguilar *et al.* 1995; Bolten *et al.* 1994; Crouse 1999), and the bottom set lines in the coastal waters of Madeira, Portugal, are reported to take an estimated 500 pelagic immature loggerheads each year (Dellinger and Encarnacao 2000). Reports of incidental takes of turtles are incomplete for many of these nations. Adding up the under-represented observed takes per country per year of over 20 actively fishing countries likely results in an estimate of thousands of animals annually over different life stages. Coastal gillnets from other nations also pose a threat. While good information on specific sea turtle-fishery interaction rates is often unavailable or incomplete, gillnet fishing is occurring in many foreign waters, including (but not limited to) the northwest Atlantic, western Mediterranean, South America, West Africa, Central America, and the Caribbean. Shrimp trawl fisheries are also occurring off the shores of numerous foreign countries and pose a threat to sea turtle species.

There are also many non-fishery impacts affecting the status of sea turtles, both in the marine and terrestrial environment. In the ocean waters of the U.S., the construction and maintenance of Federal navigation channels has been identified as a source of turtle mortality. Hopper dredges, which are frequently used in ocean bar channels and sometimes in harbor channels and offshore borrow areas, move relatively rapidly and can entrain and kill sea turtles (NMFS 1997). Sea turtles entering coastal or inshore areas have been affected by entrainment in the cooling-water systems of electrical generating plants. U.S. rig removal activities (e.g. Army Corps of Engineers) also adversely (injury or mortality) affect sea turtles. Vessel operations and ordnance detonation, can affect listed species of sea turtles (NMFS 1997b). Ingestion of marine debris can also be a serious threat to sea turtles worldwide (Ivar do Sul and Costa 2007). Some types of marine debris may be directly or indirectly toxic, such as oil (Lutcavage *et al.* 1995). Other types of marine debris, such as discarded or derelict fishing gear, may entangle and drown sea turtles (Bugoni *et al.* 2001). Oil and gas exploration, development and transportation, underwater explosions, dredging, offshore artificial lighting, marina and dock construction and operation, boat collisions, and poaching are other threats sea turtles face at sea. Private and commercial vessel operations have the potential to interact (propeller or boat collisions) with sea turtles, resulting in injury or death. Sea turtles are also the focus of research activities worldwide. However, a very small percentage of these result in injury or mortality.

Destruction and modification of loggerhead nesting habitats are occurring worldwide throughout the species range. The main anthropogenic threats impacting loggerhead nesting habitat include coastal development/construction, placement of erosion control structures and other barriers to nesting, beachfront lighting, vehicular and pedestrian traffic, sand extraction, beach erosion, beach sand placement, beach pollution, removal of native vegetation, and planting of non-native vegetation (Baldwin 1992; Margaritoulis *et al.* 2003).

Coastal development can deter or interfere with nesting, affect nest success, and degrade nesting habitats for sea turtles. Structural impacts to nesting habitat include the construction of buildings and pilings, beach armoring and renourishment, and sand extraction (Lutcavage *et al.* 1997;

Bouchard *et al.* 1998). These factors may directly, through loss of beach habitat, or indirectly, through changing thermal profiles and increasing erosion, serve to decrease the amount of nesting area available to nesting females and may evoke a change in the natural behaviors of adults and hatchlings (Acherman 1997; Witherington *et al.* 2003, 2007). In addition, coastal development is usually accompanied by artificial lighting. The presence of lights on or adjacent to nesting beaches alters the behavior of nesting adults (Witherington 1992) and is often fatal to emerging hatchlings as they are attracted to light sources and drawn away from the water (Witherington and Bjorndal 1991). In many countries, coastal development and artificial lighting are responsible for substantial hatchling mortality. Although legislation controlling these impacts does exist (Lutcavage *et al.* 1997), a majority of countries do not have regulations in place.

Predation by species such as fire ants, raccoons (*Procyon lotor*), armadillos (*Dasypus novemcinctus*), opossums (*Didelphus virginianus*), feral pigs, and ghost crabs is a threat to developing nests and emerging hatchlings. Although a rare occurrence on nesting beaches in the U.S., poaching of eggs is reported. Additionally, direct harvest of eggs and adults from beaches in foreign countries continues to be a problem for sea turtle species (NMFS and USFWS 2009).

Loggerheads are highly migratory, which makes them a shared resource among many nations. Therefore, conservation efforts for loggerhead populations in one country may be jeopardized by activities in another. Many countries lack regulations or have inadequate regulations in place to address the impacts of a wide range of anthropogenic activities that directly injure and kill loggerheads, disrupt necessary behaviors, and alter terrestrial and marine habitats used by the species.

A more thorough description of anthropogenic effects and mortality sources is provided in the 2009 Loggerhead sea turtle status review (NMFS and USFWS 2009) as well as in 5-year status review (NMFS and USFWS 2007a), TEWG reports (1998, 2000) and in NMFS SEFSC (2001).

### **Green turtle (*Chelonia mydas*)**

#### *Listing Status, Description of Species and Critical Habitat*

The green sea turtle was listed in 1978 as threatened, except for the Florida and Pacific coast of Mexico breeding populations which were listed as endangered. Critical habitat for the green sea turtle has been designated for the waters surrounding Isla Culebra, Puerto Rico and its associated keys.

Adult green turtles commonly reach a meter in carapace length and 150 kg in mass. The mean size of female green turtles nesting in Florida is 101.5 cm (n = 90, SD = 5.8) standard straight carapace length and 136.1 kg (n = 15, SD = 17.7) body mass. Green turtles have a smooth carapace with four pairs of lateral (or costal) scutes and a single pair of elongated prefrontal scales between the eyes. Hatchling green turtles weigh approximately 25 g, and the carapace is about 50 mm long. The dorsal surface is black, and the ventral surface is white. The plastron of Atlantic green turtles remains a yellowish white throughout life, but the carapace changes in color from solid black to a variety of shades of grey, green, brown and black in starburst or irregular patterns (Lagueux 2001).

### *Life History*

Scientists estimate green turtles reach sexual maturity anywhere between 20 and 50 years, at which time females begin returning to their natal beaches (i.e., the same beaches where they were born) every 2-4 years to lay eggs (Balazs 1982, Frazer and Ehrhart 1985), while males may mate every year (Balazs 1983). Adult females migrate from foraging areas to mainland or island nesting beaches and may travel hundreds or thousands of kilometers each way.

Green sea turtle mating occurs in the waters off the nesting beaches. The nesting season varies depending on location. In the southeastern U.S., females generally nest between June and September, while peak nesting occurs in June and July (Witherington and Ehrhart, 1989). During the nesting season, females nest at approximately two week intervals, laying an average of three-four clutches (Johnson and Ehrhart 1996). Mean clutch size is highly variable among populations, but averages 110-115. In Florida, green turtle nests contain an average of 136 eggs (Witherington and Ehrhart, 1989), which will incubate for approximately 2 months before hatching.

After emerging from the nest, hatchlings swim to offshore areas and go through a post-hatchling pelagic stage where they are believed to live for several years, feeding close to the surface on a variety of pelagic plants and animals associated with drift lines of algae and other debris. Once the juveniles reach a certain age/size range, they leave the pelagic habitat and travel to nearshore foraging grounds. Once they move to these nearshore benthic habitats, adult green turtles are almost exclusively herbivores, feeding on sea grasses and algae in shallow bays, lagoons and reefs (Rebel, 1974). However, they also occasionally consume jellyfish and sponges (Bjorndal 1997).

Green turtle foraging areas in the southeast United States include any neritic waters having macroalgae or sea grasses near mainland coastlines, islands, reefs, or shelves, and any open-ocean surface waters, especially where advection from wind and currents concentrates pelagic organisms (Hirth, 1997; NMFS and USFWS 1991b).

In U.S. Atlantic and Gulf of Mexico waters, green turtles are found in inshore and nearshore waters from Texas to Massachusetts. Important feeding areas in Florida include the Indian River Lagoon System, the Florida Keys, Florida Bay, Homosassa, Crystal River, Cedar Key, and St. Joseph Bay, and the Atlantic Ocean off Florida from Brevard through Broward counties (Wershoven and Wershoven 1992; Guseman and Ehrhart 1992). Additional important foraging areas in the western Atlantic include the Culebra archipelago and other Puerto Rico coastal waters, the south coast of Cuba, the Mosquito Coast of Nicaragua, the Caribbean coast of Panama, and scattered areas along Colombia and Brazil (Hirth 1971), and the northwestern coast of the Yucatan Peninsula. Adults of both sexes are presumed to migrate between nesting and foraging habitats along corridors adjacent to coastlines and reefs (Hays *et al.* 2001).

### *Range, Distribution, Population Dynamics, Status and Trend of Green Sea Turtles*

Green turtles are distributed circumglobally, mainly in waters between the northern and southern 20° C isotherms (Hirth 1971). The two largest nesting populations are found at Tortuguero, on the Caribbean coast of Costa Rica, and Raine Island, on the Great Barrier Reef in Australia. The complete nesting range of the green turtle within the southeastern U.S. includes sandy beaches of

mainland shores, barrier islands, coral islands, and volcanic islands between Texas and North Carolina and at the U.S. Virgin Islands (U.S.V.I.) and Puerto Rico (NMFS and USFWS 1991b). Principal U.S. nesting areas for green turtles are in eastern Florida, predominantly Brevard through Broward counties. Regular green turtle nesting also occurs on St Croix, U.S.V.I., and on Vieques, Culebra, Mona, and the main island of Puerto Rico (Dow *et al.* 2007).

In the western Atlantic, several major nesting assemblages have been identified and studied (Bass *et al.* 2006; Bowen *et al.* 1992). The largest, at Tortuguero, Costa Rica, has shown a long-term increasing trend since monitoring began in 1971, with an annual average of 17,402–37,290 nesting females year (Troëng and Rankin 2005). The estimated number of emergences was under 20,000 in 1971 and over 40,000 in 1996 with a high estimate of over 100,000 emergences in 1995 (Bjorndal *et al.* 1999). Trends in nesting at Yucatan beaches cannot be assessed because of irregularity in beach survey methods over time. In the continental United States, green turtle nesting occurs along the Atlantic coast, primarily along the central and southeast coast of Florida; present estimates range from 200-1,100 females nesting annually. Occasional nesting has been documented along the Gulf coast of Florida, at southwest Florida beaches, as well as the beaches on the Florida Panhandle (Meylan *et al.* 1994; Weishampel *et al.* 2003).

There are no reliable estimates of the overall number of green turtles inhabiting foraging areas within the southeast United States, and it is likely that green turtles foraging in the region come from multiple genetic stocks. However, information from some sites is available. A long-term in-water monitoring study in the Indian River Lagoon of Florida has tracked the populations of juvenile green turtles in a foraging environment and noted significant increases in catch-per-unit effort (more than doubling) between the years 1983-85 and 1988-90. An extreme, short-term increase in catch per unit effort of ~300% was seen between 1995 and 1996 (Ehrhart *et al.* 1996). Catches of benthic immature turtles at the St. Lucie Nuclear Power Plant intake canal, which acts as a passive turtle collector on Florida's east coast, have also been increasing since 1992 (Martin and Ernst 2000). During the period of 1977-1999, 2,578 green turtles were documented to be captured at the power plant (Florida Power and Light 2000, Bresette and Gorham 2001). The annual number of immature green turtle (minimum straight-line carapace length < 85 cm) captures has increased significantly during the 23 year period (Florida Power and Light 2005).

Green turtles were once abundant enough in the shallow bays and lagoons of the Gulf to support a commercial fishery, which landed over one million pounds of green turtles in 1890 (Doughty 1984). Doughty reported the decline in the turtle fishery throughout the Gulf of Mexico by 1902. Shaver (1994) live-captured a number of green turtles in channels entering into Laguna Madre in South Texas. She noted the abundance of green turtle strandings in Laguna Madre inshore waters and opined that the turtles may establish residency in the inshore foraging habitats as juveniles. Algae along the jetties at entrances to the inshore waters of South Texas was thought to be important to green turtles associated with a radio-telemetry project (Renaud *et al.* 1995). Transmitter-equipped turtles remained near jetties for most of the tracking period. This project was restricted to late summer months, and therefore may reflect seasonal influences. Coyne (1994) observed increased movements of green turtles during warm water months.

As is the case for loggerhead, green turtles use mid-Atlantic and northern areas of the western Atlantic coast as important summer developmental habitat. Green turtles are found in estuarine

and coastal waters as far north as Long Island Sound, Chesapeake Bay, and North Carolina sounds (Musick and Limpus 1997). Like loggerheads, green turtles that use northern waters during the summer must return to warmer waters when water temperatures drop, or face the risk of cold stunning. Cold stunning of green turtles may occur in southern areas as well (i.e., Indian River, Florida), as these natural mortality events are dependent on water temperatures and not solely geographical location.

### *Threats*

The principal cause of the historical, worldwide decline of the green turtle was long-term harvest of eggs and adults on nesting beaches and juveniles and adults on feeding grounds. Green turtles were traditionally prized for their flesh, fat, eggs, and shell, and fisheries in the United States and throughout the Caribbean contributed to the decline of the species. Although intentional take of green turtles and their eggs is not extensive within the southeast United States, green turtles that nest and forage in the region may spend large portions of their life history outside United States jurisdiction where exploitation is still a threat, which then compromises the efforts to recover this species. Currently, incidental anthropogenic impacts to the green sea turtle are similar to those facing other sea turtle species including interactions with fishery gear, marine pollution, foraging habitat destruction, and threats at nesting beaches, similar to those discussed above under the loggerhead sea turtle (please refer to the loggerhead Threats section above). A more thorough description of anthropogenic mortality sources facing sea turtles is provided in the green turtle 5-year status review (NMFS and USFWS 2007) as well as in previous TEWG reports (1998, 2000) and in NMFS SEFSC (2001). Some of these threats are also discussed in more detail below.

Green turtles depend on shallow foraging grounds with sufficient benthic vegetation. Direct destruction of foraging areas due to dredging, boat anchorage, deposition of spoil, and siltation (Coston-Clements and Hoss 1983; Williams 1988) may have considerable effects on the distribution of foraging green turtles. Eutrophication, heavy metals, radioactive elements, and hydrocarbons all may reduce the extent, quality, and productivity of foraging grounds (Frazier 1980; McKenzie *et al.* 1999; Storelli and Marcotrigiano, 2003).

Pollution also threatens the pelagic habitat of young green turtles. The pelagic drift lines that young green turtles inhabit tend to collect floating debris such as plastics, oil, and tar (Carr 1987; Moore *et al.* 2001). Contact with oil and the ingestion of plastics and tar are known to kill young sea turtles (Carr 1987; Lutcavage *et al.* 1995). Older juvenile green turtles have also been found dead after ingesting seaborne plastics (Balazs 1985; Bjorndal *et al.* 1994). A major threat from man-made debris is the entanglement of turtles in discarded monofilament fishing line and abandoned netting (Balazs 1985), and this entanglement can result in mortality.

Fibropapillomatosis, an epizootic disease producing lobe-shaped tumors on the soft portion of a turtle's body, has been found to infect green turtles, most commonly juveniles (Williams *et al.* 1994). The occurrence of fibropapilloma tumors, may result in impaired foraging, breathing, or swimming ability, leading potentially to death. This has become a serious concern for this species.

### **Kemp's ridley turtle (*Lepidochelys kempii*)**

#### *Listing Status, Description of Species and Critical Habitat*

The Kemp's ridley was listed as endangered on December 2, 1970. There is no designated critical habitat for the Kemp's ridley sea turtle.

This species and its congener, the olive ridley, are the smallest of all extant sea turtles. The weight of an adult is generally less than 45 kg and the straight carapace length around 65 cm. Adults have an almost circular carapace, a grayish green color while the plastron (bottom shell) is pale yellowish to cream in color. There are two pairs of prefrontal scales on the head, five vertebral scutes, and five pairs of costal scutes. In the bridge adjoining the plastron to the carapace, there are four scutes, each of which is perforated by a pore. Hatchlings are grey-black in color on the dorsum and venter. Hatchlings generally range from 42-48 mm in straight line carapace length, 32-44 mm in width, and 15-20 g in weight.

### *Life History*

The age at maturity for Kemp's ridley turtles is estimated to be between 7-15 years. Nesting occurs from April into July in daytime aggregations known as arribadas, with principal nesting beaches found at Rancho Nuevo, a stretch of beach in Tamaulipas, Mexico. However, in recent years nests have also been recorded in Florida and the Carolinas (Meylan *et al.* 1995). While some turtles nest annually, the weighted mean remigration rate is approximately 2 years. Kemp's ridley females lay approximately 2.5 nests per season with about 100 eggs per nest (Marquez 1994).

It appears that adult Kemp's ridley turtles are restricted somewhat to the Gulf of Mexico in shallow near shore waters, although adult-sized individuals sometimes are found on the eastern seaboard of the United States. Juvenile/subadult Kemp's ridleys occur mainly in coastal areas of the Gulf of Mexico and along the eastern seaboard of the United States with sightings extending as far as north as Cape Cod Bay, MA. Atlantic juveniles/subadults travel northward with vernal warming to feed in the productive, coastal waters of Georgia through New England, returning southward with the onset of winter to escape the cold (Lutcavage and Musick 1985; Henwood and Ogren 1987; Ogren 1989). Little is known of the movements of the post-hatching, planktonic stage within the Gulf. Studies have shown the post-hatchling pelagic stage varies from 1-4 or more years, and the benthic immature stage lasts 7-9 years (Schmid and Witzell 1997).

Sub-adult and adult Kemp's ridleys primarily occupy neritic habitats, typically containing muddy or sandy bottoms where prey can be found. In the post-pelagic stages, the ridley is largely cancrivorous (crab eating), with a preference for portunid crabs. Stomach contents of Kemp's ridleys along the lower Texas coast consisted of a predominance of nearshore crabs and mollusks, as well as fish, shrimp and other foods considered to be shrimp fishery discards (Shaver 1991). The pelagic (neonatal) stage are assumed to associate with floating sargassum seaweed, using the area for refuge, rest and presumably feeding on the available sargassum and associated infauna or other epipelagic species found in the Gulf of Mexico.

### *Range, Distribution, Population Dynamics, Status and Trend of Kemp's Ridley Sea Turtle*

Of the seven extant species of sea turtles of the world, the Kemp's ridley has declined to the lowest population level. This species has a very restricted range relative to other sea turtle species. Kemp's ridleys nest in daytime aggregations known as arribadas, primarily at Rancho

Nuevo, a stretch of beach in Mexico. Most of the population of adult females nest in this single locality (Pritchard 1969). When nesting aggregations at Rancho Nuevo were discovered in 1947, adult female populations were estimated to be in excess of 40,000 individuals (Hildebrand 1963). By the early 1970s, the world population estimate of mature female Kemp's ridleys had been reduced to 2,500 5,000 individuals. The population declined further through the mid-1980s. Recent observations of increased nesting suggest that the decline in the ridley population has stopped and there is cautious optimism that the population is now increasing. The number of nests has grown from a low of approximately 702 nests in 1985, to greater than 1,940 nests in 1995, to over 20,000 nests recorded in 2009 (NMFS and USFWS 2010 draft).

The TEWG (2000) developed a population model to evaluate trends in the Kemp's ridley population through the application of empirical data and life history parameter estimates chosen by the TEWG. Model results identified three trends in benthic immature Kemp's ridleys. Benthic immatures are those turtles that are not yet reproductively mature but have recruited to feed in the nearshore benthic environment, where they are available to nearshore mortality sources that often result in strandings. Increased production of hatchlings from the nesting beach beginning in 1966 resulted in an increase in benthic ridleys (defined as 20-60 cm in length and approximately 2-9 years of age) that leveled off in the late 1970s. A second period of increase followed by leveling occurred between 1978 and 1989 as hatchling production was further enhanced by the cooperative program between the U.S. Fish and Wildlife Service and Mexico's Instituto Nacional de Pesca to increase the nest protection and relocation program in 1978. A third period of steady increase, which has not leveled off to date, has occurred since 1990 and appears to be due to the greatly increased hatchling production and an apparent increase in survival rates of immature turtles beginning in 1990 likely due, in part, to the introduction of turtle excluder devices (TEDs) in the United States and Mexican shrimping fleets.

The population growth rate does not appear as steady as originally forecasted by the TEWG, but annual fluctuations, due in part to irregular internesting periods, are normal for other sea turtle populations. Also, as populations increase and expand, nesting activity would be expected to be more variable. The population model used by TEWG (2000) projected that Kemp's ridleys could reach the Recovery Plan's intermediate recovery goal of 10,000 nesters by the year 2015 if the assumptions of age to sexual maturity and age specific survivorship rates used in their model are correct. As noted by TEWG, trends in Kemp's ridley nesting even on the Rancho Nuevo beaches alone suggest that recovery of this population has begun but continued caution is necessary to ensure recovery and to meet the goals identified in the Kemp's Ridley Recovery Plan.

Next to loggerheads, Kemp's ridleys are the second most abundant sea turtle in Virginia and Maryland waters, arriving in these areas during May and June (Keinath *et al.* 1987; Musick and Limpus 1997). The juvenile population of Kemp's ridley sea turtles in Chesapeake Bay is estimated to be 211 to 1,083 turtles (Musick and Limpus 1997). These juveniles frequently forage in submerged aquatic grass beds for crabs (Musick and Limpus 1997). Kemp's ridleys consume a variety of crab species, including *Callinectes spp.*, *Ovalipes spp.*, *Libinia sp.*, and *Cancer spp.* Mollusks, shrimp, and fish are consumed less frequently (Bjorndal 1997). Upon leaving Chesapeake Bay in autumn, juvenile ridleys migrate down the coast, passing Cape Hatteras in December and January (Musick and Limpus 1997). These larger juveniles are joined

there by juveniles of the same size from North Carolina sounds and smaller juveniles from New York and New England to form one of the densest concentrations of Kemp's ridleys outside of the Gulf of Mexico (Musick and Limpus 1997; Epperly *et al.* 1995a; Epperly *et al.* 1995b).

### *Threats*

Like other turtle species, the severe decline in the Kemp's ridley population appears to have been heavily influenced by a combination of exploitation of eggs and impacts from fishery interactions (e.g. the U.S. shrimp trawl fishery). From the 1940's through the early 1960's, nests from Rancho Nuevo, Mexico were heavily exploited but beach protection in 1966 helped to curtail this activity (NMFS and USFWS, 1992). Between the years of 1978 and 1991 only 200 Kemp's ridleys nested annually. Recent observations of increased nesting suggest that the decline in the ridley population has stopped and there is cautious optimism that the population appears to be in the early stages of recovery; however, strandings in some years have increased at rates higher than the rate of increase in the Kemp's population (TEWG 1998). These stranding events illustrate the vulnerability of Kemp's ridley turtles to the impacts of human activities in nearshore Gulf of Mexico waters. Currently, anthropogenic impacts to the Kemp's ridley population are similar to those facing other sea turtle species including interactions with fishery gear, marine pollution, foraging habitat destruction, and threats at nesting beaches (please refer to the loggerhead and green turtle Threats section above). A more thorough description of anthropogenic mortality sources facing sea turtles is provided in the Kemp's ridley Draft Revised Bi-National Recovery Plan (NMFS and USFWS 2010).

### **Hawksbill (*Eretmochelys imbricata*)**

#### *Listing Status, Description of Species and Critical Habitat*

The hawksbill turtle was listed as endangered under the ESA in 1970, and is considered Critically Endangered by the International Union for the Conservation of Nature (IUCN) based on global population declines of over 80% during the last three generations (105 years)(Meylan and Donnelly 1999).

Critical habitat was designated in 1998 for hawksbill turtles in coastal waters surrounding Mona and Monito Islands, Puerto Rico.

The hawksbill turtle is small to medium-sized compared to other sea turtle species. Adults weigh 45 to 68 kg on average, with nesting females weighing up to 80 kg in the Caribbean (Pritchard *et al.* 1983). Hatchlings in the Caribbean range in weight from 13.5 to 19.5 g (Hillis and Mackay 1989; van Dam and Sarti 1989; Eckert 1995).

The carapace (top shell) of an adult ranges from 63 to 90 cm in length and has a "tortoiseshell" coloring, ranging from dark to golden brown, with streaks of orange, red, and/or black. The shells of hatchlings are 42 mm long and are mostly brown and somewhat heart-shaped. The plastron (bottom shell) is clear yellow. The rear edge of the carapace is almost always serrated, except in older adults, and has overlapping "scutes".

The hawksbill turtle's head is elongated and tapers to a point, with a beak-like mouth that gives the species its name. The shape of the mouth allows the hawksbill turtle to reach into holes and

crevices of coral reefs to find sponges, their primary food source as adults, and other invertebrates.

Male hawksbills mature when they are about 69 cm long and females mature at about 75 cm (Limpus 1992; Eckert 1992). The ages at which turtles reach these lengths are unknown (Limpus 1992). Female hawksbills return to their natal beaches every 2-3 years to nest at night approximately every 14-16 days during the nesting season (Witzell 1983; Van Dam *et al.* 1991). A female hawksbill generally lays 3-5 nests per season, (Richardson *et al.* 1999). Hawksbill turtles usually nest high up on the beach under or in the beach/dune vegetation on both calm and turbulent beaches. They commonly nest on pocket beaches, with little or no sand (NFMS and USFWS 1998).

### *Life History*

Hawksbill turtles use different habitats at different stages of their life cycle, but are most commonly associated with healthy coral reefs. Post-hatchlings (oceanic stage juveniles) are believed to occupy the "pelagic" environment, taking shelter in floating algal mats and drift lines of flotsam and jetsam in the Atlantic. In the Pacific, the pelagic habitat of hawksbill juveniles is unknown. After a few years in the pelagic zone, small juveniles recruit to coastal foraging grounds (developmental habitats); their size at recruitment is approximately 20-25 cm in carapace length in the Atlantic and about 38 cm in carapace length in the Pacific (Meylan 1988). This shift in habitat also involves a shift in feeding strategies, from feeding primarily at the surface to feeding below the surface primarily on animals associated with coral reef environments. Here, juveniles begin feeding on a varied diet. In the Caribbean, as hawksbills grow they begin exclusively feeding on only a few types of sponges (Meylan 1988; van Dam and Diez 1997) although other food items, notably corallimorphs and zooanthids, have been documented to be important in some areas of the Caribbean (van Dam and Diez 1997; Mayor *et al.* 1998; Leon and Diez 2000).

Hawksbills show fidelity to their foraging areas over periods of time as great as several years (van Dam and Diez 1998). The ledges and caves of coral reefs provide shelter for resting hawksbills both during the day and at night. Hawksbills are known to inhabit the same resting spot night after night. Hawksbills are also found around rocky outcrops and high energy shoals, which are also optimum sites for sponge growth. They are also known to inhabit seagrass pastures in mangrove-fringed bays and estuaries, particularly along the eastern shore of continents where coral reefs are absent (Bjorndal 1997, van Dam and Diez 1998).

Hawksbills may undertake developmental migrations (migrations as immatures) and reproductive migrations that involve travel over hundreds or thousands of kilometers (Meylan 1999). Reproductive females undertake periodic (usually non-annual) migrations to their natal beach to nest. Movements of reproductive males are less well known, but are presumed to involve migrations to the nesting beach or to courtship stations along the migratory corridor. Females nest an average of 3-5 times per season with some geographic variation in this parameter (Richardson *et al.* 1999). Clutch size is higher on average (up to 250 eggs) than that of green turtles (Hirth 1980). Reproductive females may exhibit a high degree of fidelity to their nest sites. This, plus the tendency of hawksbills to nest at regular intervals within a season, make them vulnerable to capture on the nesting beach.

*Range, Distribution, Population Dynamics, Status and Trend of Hawksbill Sea Turtles*

Hawksbill turtles are circumtropical, usually occurring from 30° N to 30° S latitude in the Atlantic, Pacific, and Indian Oceans and associated bodies of water. Hawksbills are widely distributed throughout the Caribbean Sea and western Atlantic Ocean, regularly occurring in southern Florida and the Gulf of Mexico (especially Texas), in the Greater and Lesser Antilles, and along the Central American mainland south to Brazil (Groombridge and Luxmoore 1989, NMFS and USFWS 1998).

Within the U.S., hawksbills are most common in Puerto Rico and its associated islands and in the U.S. Virgin Islands. In the continental U.S., the species is recorded from all the Gulf States and along the east coast as far north as Massachusetts, but sightings north of Florida are rare (Meylan and Donnelly 1999). Hawksbills are observed in Florida on the reefs off Palm Beach, Broward, Miami-Dade, and Monroe Counties, where the warm Gulf Stream current passes close to shore, and in the Florida Keys (Lund 1985). Texas is the only other U.S. state where hawksbills are sighted with any regularity (Plotkin and Amos 1988,1990; Amos 1989). Most sightings involve post-hatchlings and juveniles. These small turtles are believed to originate from nesting beaches in Mexico (Hildebrand 1987, Amos 1989).

Only five regional nesting populations remain with more than 1,000 females nesting annually (Seychelles, Mexico, Indonesia, and two in Australia) (Meylan and Donnelly 1999). Most populations are declining, depleted, or remnants of larger aggregations. Research indicates adult hawksbill turtles are capable of migrating long distances between nesting beaches and foraging areas, which are comparable to migrations of green and loggerhead turtles. In the Atlantic, a female hawksbill tagged at Buck Island Reef National Monument in the U.S. Virgin Islands traveled 1,160 miles (1,866 km) to the Miskito Cays in Nicaragua (Spotila 2004).

Hawksbills are solitary nesters and, thus, determining population trends or estimates on nesting beaches is difficult. The largest nesting population of hawksbills appears to occur in Australia. Approximately 2,000 hawksbills nest on the northwest coast of Australia and about 6,000 to 8,000 off the Great Barrier Reef each year (Spotila 2004). Additionally, about 2,000 hawksbills nest each year in Indonesia and 1,000 in the Republic of Seychelles (Spotila 2004).

The most significant nesting within the U.S. occurs in Puerto Rico and the U.S. Virgin Islands, specifically on Mona Island and Buck Island, respectively. Each year, about 500-1000 hawksbill nests are laid on Mona Island, Puerto Rico (Diez and van Dam 2006) and another 100-150 nests on Buck Island Reef National Monument off St. Croix in the U.S. Virgin Islands (Meylan 1999b). Nesting also occurs on other beaches in St. Croix and on St. John, St. Thomas, Culebra Island, Vieques Island, and mainland Puerto Rico. Within the continental U.S., nesting is restricted to the southeast coast of Florida and the Florida Keys, but nesting is rare in these areas. No nesting occurs on the west coast of the U.S. mainland. 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.

In addition to nesting beaches in the U.S. Caribbean, the largest hawksbill nesting population in the Western Atlantic, occurs in the Yucatán Península of Mexico, where several thousand nests are recorded annually in the states of Campeche, Yucatán, and Quintana Roo (Spotila 2004;

Garduño-Andrade *et al.* 1999). Lutz *et al.* (2003) estimate the number of adult hawksbills living in the Caribbean today is 27,000.

### *Threats*

Although hawksbills are subject to the suite of threats on both nesting beaches and in the marine environment that affect other sea turtles, the decline of the species is primarily attributed to centuries of exploitation for tortoise shell, the beautifully patterned scales that cover the hawksbill's shell (Parsons 1972). The current primary global threat to hawksbills is habitat loss of coral reef communities. Hawksbill turtles rely on coral reefs and sea grass beds for food resources and habitat. As these communities continue to decline in quantity and quality, hawksbills will have reduced foraging opportunities and limited habitat options.

Coral reefs are vulnerable to destruction and degradation caused by human activities. Humans can alter coral reefs either gradually (i.e., pollution can degrade habitat quality) or catastrophically (e.g., toxic spills and vessel groundings). These habitats can be affected by eutrophication, sedimentation, chemical poisoning, collecting-gleaning, trampling (by fishermen and divers), anchoring, etc. (NMFS and USFWS 1998). Chemical pollutants, such as petroleum, sewage, pesticides, solvents, industrial discharges, and agricultural runoff are responsible for an unquantifiable level of sea turtle mortality each year (NMFS and USFWS 1998). The entanglement in and ingestion of marine debris threatens the survival of hawksbill sea turtles. Such debris includes not only discarded or abandoned fishing gear (lines, ropes, nets), but also plastic bags, plastic sheets, "6-pack" rings, and other discarded debris. Turtles can die from ingested garbage, such as plastic or tar (NMFS and USFWS 1998). Recent evidence also suggests that global climate change is negatively impacting coral reefs by causing higher incidences of coral diseases, which can ultimately kill entire coral reef communities (Crabbe 2008).

Throughout the Atlantic and Gulf of Mexico, problems at nesting beaches such as domestic animals, beach driving, litter, beach erosion, beach mining, beach replenishment, and recreational use of beaches have presented problems for nesting hawksbill turtles. In addition, beach front lights appear to pose a serious problem for hatchling hawksbill turtles in U.S. coastal areas (USFWS 1999).

The continuing demand for the hawksbill's shell as well as other products (leather, oil, perfume, and cosmetics), constitutes an important threat to this species. The British Virgin Islands, Cayman Islands, Cuba, Haiti, and the Turks and Caicos Islands (U.K.) all permit some form of legal take of hawksbill turtles. In the northern Caribbean, hawksbills are directly harvested primarily for their commercially valuable carapace, which is often carved into hair clips, combs, jewelry, and other trinkets (Marquez 1990; Stapleton and Stapleton 2006). Additionally, hawksbills are harvested for their eggs and meat while whole stuffed turtles are sold as curios in the tourist trade. Hawksbill products are openly available in the Dominican Republic and Jamaica despite a prohibition on harvesting hawksbills and eggs (Fleming 2001). While the international trade in the shell of this species is prohibited between those countries that have signed the Convention on International Trade in Endangered Species (CITES), illegal trade remains a problem.

In addition to anthropogenic threats, hawksbill turtles are also threatened by natural causes including hurricanes (NMFS and USFWS 2007) and predation by exotic species (fire ants, raccoons (*Procyon lotor*) and opossums (*Didelphus virginiana*))(USFWS 1999).

Hawksbill sea turtles are the focus of research activities worldwide. Research on sea turtles in the U.S. is carefully controlled and managed so that it does not operate to the disadvantage of the species. A very small percentage of the takes related to these activities results in injury or mortality.

### **Environmental Baseline**

The environmental baseline for this opinion includes the effects of several activities that affect the survival and recovery of threatened and endangered species and its habitat (including designated critical habitat), and ecosystem, within the action area. As noted above, sea turtles found in the action areas may travel widely throughout the Atlantic, Gulf of Mexico, and Caribbean Sea. Therefore, individuals found in an action area can potentially be affected by activities anywhere within this wide range.

The environmental baseline includes the past and present impacts of all state, tribal, local, private, and other human activities in the action area, including impacts of these activities which will occur contemporaneously with this consultation. Unrelated Federal actions affecting the same species or critical habitat that have completed formal or informal consultation are also part of the environmental baseline, as are Federal and other actions within the action area that may benefit listed species or critical habitat. It clearly identifies how actions affect the status and trend of the listed species or critical habitat of the opinion. To provide the reader with a more comprehensive discussion of the all the activities affecting the species found in the action area, we have included activities occurring in areas to which these species could migrate during the course of their life cycle.

A number of human activities have contributed to the current status of listed sea turtle species in the action area. Some of those activities, (e.g. commercial harvesting of individuals as well as eggs) no longer occur in the U.S., yet are still a problem in other countries. Other human activities are ongoing and appear to be directly or indirectly affecting these species. Additionally, unrelated factors may be acting together to affect listed species, such as global warming.

Taken together, the components of the environmental baseline for the action area include sources of natural mortality as well as influences from natural oceanographic and climatic features in the action areas. Circulation and productivity patterns influence food distribution and habitat quality for listed species. The effects of climatic variability on these species in the action areas and the availability of food remain largely undetermined; however, it is likely that any changes in weather and oceanographic conditions resulting in effects on population dynamics (i.e. sex-ratios) as well as food availability would have dire consequences for sea turtle species.

The most significant activities affecting sea turtles in the Atlantic are fisheries and conservation activities directed at fisheries. Other environmental impacts to turtles may result from vessel

operations, discharges, dredging, military activities, oil and gas development activities, industrial cooling water intake, aquaculture, recreational fishing, coastal development, habitat degradation, directed take, marine debris, as well as scientific research and conservation efforts.

### ***Federal Activities***

*Fisheries.* Threatened and endangered sea turtles are adversely affected by several types of fishing gears used throughout the action area. Gillnet, longline, other types of hook-and-line gear, trawl gear, and pot fisheries have all been documented as interacting with sea turtles. Available information suggests sea turtles can be captured in any of these gear types when the operation of the gear overlaps with the distribution of sea turtles. For all fisheries for which there is an FMP or for which any federal action is taken to manage that fishery, impacts have been evaluated under section 7. Formal section 7 consultation have been conducted on the following fisheries, occurring at least in part within the action area, found likely to adversely affect threatened and endangered sea turtles: Atlantic bluefish, Atlantic herring, Atlantic mackerel/squid/butterfish, Atlantic sea scallop, Atlantic swordfish/tuna/shark/billfish, coastal migratory pelagic, dolphin-wahoo, Gulf of Mexico (GOM) reef fish, monkfish, Northeast multispecies, South Atlantic snapper-grouper, Southeast shrimp trawl, spiny dogfish, red crab, skate, commercial directed shark, summer flounder/scup/black sea bass fisheries, tilefish, Atlantic highly migratory species (HMS) fishery, GOM/South Atlantic spiny lobster, and GOM stone crab. An Incidental Take Statement (ITS) has been issued for the take of sea turtles in each of the fisheries (Appendix 1). A brief summary of each consultation is provided below but more detailed information can be found in the respective biological opinions.

NMFS found the operation of the *Atlantic bluefish fishery* was likely to adversely affect Kemp's ridley and loggerhead sea turtles, but not likely to jeopardize their continued existence (NMFS 1999a). The majority of commercial fishing activity in the North and Mid-Atlantic occurs in the late spring to early fall, when bluefish (and sea turtles) are most abundant in these areas (NEFSC 2005a).

NMFS' consultation on the *Atlantic Herring fishery* FMP concluded that the federal herring fishery may adversely affect loggerhead, leatherback, Kemp's ridley, and green sea turtles as a result of capture in gear used in the fishery (NFMS 1999b). NMFS currently authorizes the use of trawl, purse seine, and gillnet gear in the commercial herring fishery (64 FR 4030). There is no direct evidence of takes of ESA-listed species in the herring fishery from the NMFS sea sampling program. However, observer coverage of this fishery has been minimal. Sea turtles have been captured in comparable gear used in other fisheries that occur in the same area as the herring fishery.

The *Atlantic mackerel/squid/butterfish fisheries* are managed under a single FMP that includes both the short-finned squid (*Illex illecebrosus*) and long-finned squid (*Loligo pealei*) fisheries. The most recent biological concluded that the continued authorization of the FMP was likely to adversely affect sea turtles, but not jeopardize their continued existence (NMFS 1999c). Trawl gear is the primary fishing gear for these fisheries, but several other types of gear may also be used, including hook-and-line, pot/trap, dredge, pound net, and bandit gear. Entanglements or entrapments of sea turtles have been recorded in one or more of these gear types.

It was previously believed that the *Atlantic Sea Scallop fishery* was unlikely to take sea turtles given differences in depth and temperature preferences for sea turtles and the optimal areas where the fishery occurs. However, after the reopening of a closed area in the mid-Atlantic, and the accumulation of more extensive observer effort, NMFS conducted a formal section 7 consultation on the fishery (NMFS 2009). NMFS concluded that operation of the fishery may adversely affect loggerhead, Kemp's ridley, green, and leatherback sea turtles as a result of capture in scallop dredge and/or trawl gear.

The *Atlantic HMS pelagic fisheries for swordfish, tuna, and billfish* are known to incidentally capture large numbers of sea turtles, particularly in the pelagic longline component (NMFS 2004). Pelagic longline, pelagic driftnet, bottom longline, and/or purse seine gear have all been documented taking sea turtles. A permanent prohibition on the use of driftnet gear in the swordfish fishery was published in 1999.

NMFS recently completed a consultation on the continued authorization of the *coastal migratory pelagic* fishery in the Gulf of Mexico and South Atlantic (NMFS 2007). In the Gulf of Mexico, hook-and-line, gillnet, and cast net gears are used. Gillnets are the primary gear type used by commercial fishermen in the South Atlantic regions as well, while the recreational sector uses hook-and-line gear. The hook-and-line effort is primarily trolling. The biological opinion concluded that green, hawksbill, Kemp's ridley, leatherback, and loggerhead sea turtles may be adversely affected by operation of the fishery. However, the proposed action was not expected to jeopardize the continued existence of any of these species.

The South Atlantic FMP for the *dolphin-wahoo fishery* was approved in December 2003. NMFS's consultation concluded that green, hawksbill, Kemp's ridley, leatherback, and loggerhead sea turtles may be adversely affected by the longline component of the fishery, but it was not expected to jeopardize their continued existence (NMFS 2003). In addition, pelagic longline vessels can no longer target dolphin-wahoo with smaller hooks because of hook size requirements in the pelagic longline fishery.

The incidental take for sea turtles specified in the February 2005 biological opinion on the *Gulf of Mexico reef fish fishery* was substantially exceeded in 2008 by the bottom longline component of the fishery. In May 2009, NMFS published an emergency rule, which was intended to reduce the number of sea turtle takes by the reef fish fishery in the short-term while the Gulf of Mexico Fishery Management Council develops long-term measures in Amendment 31 to the Reef Fish Fishery Management Plan (RFFMP). The new biological opinion, which considered the continued authorization of reef fish fishing under the RFFMP, including any measures proposed in Amendment 31, was completed October 2009.

The federal *monkfish fishery* occurs from Maine to the North Carolina/South Carolina border and is jointly managed by the New England Fishery Management Council (NEFMC) and Mid-Atlantic Fishery Management Council (MAFMC), under the Monkfish FMP (NEFSC 2005b). The current commercial fishery operates primarily in the deeper waters of the Gulf of Maine, Georges Bank, and southern New England, and effort has recently increased dramatically in the mid-Atlantic. The monkfish fishery uses several gear types that may entangle sea turtles,

including gillnet, trawl gear and scallop dredges, which are the principal gear types that have historically landed monkfish. Monkfish (also known as “goosefish” or “angler”) are found in inshore and offshore waters from the northern Gulf of St. Lawrence to Florida, although primarily distributed north of Cape Hatteras. As fishing effort moves further south, there is a greater potential for interactions with sea turtles.

Following an event in which over 200 sea turtle carcasses washed ashore in an area where large-mesh gillnetting had been occurring, NMFS published new restrictions for the use of gillnets with larger than 8-inch stretched mesh, in the EEZ off of North Carolina and Virginia (67 FR 71895, December 3, 2002). This rule was in response to a direct need to reduce the impact of this fishery on sea turtles. The rule was subsequently modified on April 26, 2006, by modifying the restrictions to the use of gillnets with greater than or equal to 7-inch stretched mesh when fished in federal waters from the North Carolina/South Carolina border to Chincoteague, Virginia.

Multiple gear types are used in the *Northeast Multispecies fishery FMP*, which manages 15 different commercial fisheries. Data indicated that gear type of greatest concern is the sink gillnet gear, which has taken loggerhead and leatherback sea turtles (*i.e.*, in buoy lines and/or net panels). The Northeast multispecies sink gillnet fishery has historically occurred from the periphery of the Gulf of Maine to Rhode Island in water as deep as 360 feet. In recent years, more of the effort in the fishery has occurred in offshore waters and into the Mid-Atlantic. Participation in this fishery has declined because extensive groundfish conservation measures have been implemented; the latest of these occurring under Amendment 13 to the Multispecies FMP. Consultation on the Northeast Multispecies fishery was reinitiated on April 2, 2008, based on new information on the capture of loggerhead sea turtles in this fishery.

The *South Atlantic snapper-grouper fishery* (NMFS 2006a) uses spear and powerhead, black sea bass pot, and hook-and-line gear. Hook-and-line gear used in the fishery includes commercial bottom longline gear and commercial and recreational vertical line gear (e.g., handline, bandit gear, and rod-and-reel). The consultation found only hook-and-line gear likely to adversely affect, green, hawksbill, Kemp's ridley, leatherback, and loggerhead sea turtles.

The *Southeast shrimp trawl fishery* affects more sea turtles than all other activities combined (NRC 1990). Revisions to the TED regulations (68 FR 8456, February 21, 2003), requiring larger openings in TEDs enhanced the TED effectiveness in reducing sea turtle mortality resulting from trawling. This determination was based, in part, on the opinion's analysis that shows the revised TED regulations are expected to reduce shrimp trawl related mortality by 94 percent for loggerheads and 97 percent for leatherbacks. Interactions between sea turtles and the shrimp fishery may also be declining because of reductions of fishing effort unrelated to fisheries management actions. In recent years, low shrimp prices, rising fuel costs, competition with imported products, and the impacts of recent hurricanes in the Gulf of Mexico have all impacting the shrimp fleets; in some cases reducing fishing effort by as much as 50 percent for offshore waters of the Gulf of Mexico (GMFMC 2007).

Indirect effects of shrimp trawling on sea turtles would include the disturbance of the benthic habitat by the trawl gear. The effect bottom trawls have on the seabed is mainly a function of

bottom type. In areas where repeated trawling occurs, fundamental shifts in the structure of the benthic community have been documented (Auster *et al.* 1996) which may affect the availability of prey items for foraging turtles. The overall effects to benthic communities that may result from long-term and chronic disturbance from shrimp fishing needs further evaluation.

The primary gear types for the *Spiny dogfish fishery* are sink gillnets, otter trawls, bottom longline, and driftnet gear (NEFSC 2003). Spiny dogfish are landed in every state from Maine to North Carolina, throughout a broad area with the distribution of landings varying by area and season. During the fall and winter months, spiny dogfish are captured principally in Mid-Atlantic waters from New Jersey to North Carolina. During the spring and summer months, spiny dogfish are landed mainly in northern waters from NY to ME. Sea turtles can be incidentally captured in all gear sectors of this fishery. Although there have been delays in implementing the FMP (NMFS 2001b), quota allocations are expected to be substantially reduced over the 4.5-year rebuilding schedule; this should result in a substantial decrease in effort directed at spiny dogfish. The reduction in effort should be of benefit to protected turtle species by reducing the number of gear interactions that occur.

The *Red crab fishery* is a pot/trap fishery that occurs in deep waters along the continental slope. There have been no recorded takes of ESA-listed species in the red crab fishery. However, given the type of gear used in the fishery, takes of loggerhead and leatherback sea turtles may be possible where gear overlaps with the distribution of ESA-listed species. The red crab commercial fishery has traditionally been composed of less than six vessels fishing trap gear. The fishery appears to have remained small (approximately two vessels) through the mid-1990's. But between 1995 and 2000 there were as many as five vessels with the capacity to land an average of approximately 78,000 pounds of red crab per trip. Following concerns that red crab could be overfished, an FMP was developed and became effective on October 21, 2002.

Traditionally, the main gear types used in the *Skate fishery* include mobile otter trawls, gillnet gear, hook and line, and scallop dredges, although bottom trawling is by far the most common gear type with gillnet gear is the next most common gear type. The Northeast skate complex is comprised of seven different skate species. The seven species of skate are distributed along the coast of the northeast U.S. from the tide line to depths exceeding 700m (383 fathoms). There have been no recorded takes of ESA-listed species in the skate fishery. However, given that sea turtles interactions with trawl and gillnet gear have been observed in other fisheries, sea turtle takes in gear used in the skate fishery may be possible where the gear and sea turtle distribution overlap.

The commercial *HMS Atlantic shark fisheries* (NMFS 2008) uses bottom longline and gillnet gear. The recreational sector of the fishery uses only hook-and-line gear. To protect declining shark stocks the proposed action seeks to greatly reduce the fishing effort in the commercial component of the fishery. These reductions are likely to greatly reduce the interactions between the commercial component of the fishery and sea turtles.

The *Summer Flounder, Scup and Black Sea Bass fisheries* are known to interact with sea turtles. Otter trawl gear is used in the commercial fisheries for all three species. Floating traps and pots/traps are used in the scup and black sea bass fisheries, respectively (MAFMC 2007).

Significant measures have been developed to reduce the take of sea turtles in summer flounder trawls and trawls that meet the definition of a summer flounder trawl (which would include fisheries for other species like scup and black sea bass). TEDs are required throughout the year for trawl nets fished from the North Carolina/South Carolina border to Oregon Inlet, North Carolina, and seasonally (March 16-January 14) for trawl vessels fishing between Oregon Inlet, North Carolina, and Cape Charles, Virginia.

The North Carolina inshore fall *southern flounder gillnet fishery* was identified as a source of large numbers of sea turtle mortalities in 1999 and 2000, especially loggerhead sea turtles. In 2001, NMFS issued an ESA section 10 permit to North Carolina with mitigative measures for the southern flounder fishery. Subsequently, the sea turtle mortalities in these fisheries were drastically reduced. The reduction of sea turtle mortalities in these fisheries reduces the negative effects these fisheries have on the environmental baseline.

The management unit for the *Tilefish FMP* is all golden tilefish under U.S. jurisdiction in the Atlantic Ocean north of the Virginia/North Carolina border. Tilefish have some unique habitat characteristics, and are found in a warm water band (8-18° C) approximately 250 to 1200 feet deep on the outer continental shelf and upper slope of the U.S. Atlantic coast. Because of their restricted habitat and low biomass, the tilefish fishery in recent years has occurred in a relatively small area in the Mid-Atlantic Bight, south of New England and west of New Jersey.

The *Atlantic Highly Migratory Species (HMS)* and Associated Fisheries are known to take sea turtles via pelagic longline, pelagic driftnet, bottom longline, hand line (including bait nets), and/or purse seine gear. The opinion analyzed the effects of proposed regulatory modifications to the HMS FMP that address the impacts of the HMS pelagic longline fishery on endangered green, hawksbill, Kemp's ridley, and leatherback sea turtles and on threatened loggerhead and olive ridley sea turtles. However, the proposed action was not expected to jeopardize the continued existence of any of these.

Based on limited observer data available, NMFS also anticipates that continued operation of the U.S. shark drift gillnet portion of the fishery would result in the capture of loggerhead sea turtles, leatherbacks, Kemp's ridley sea turtles, and hawksbill sea turtles. NMFS anticipates that continued operation of the bottom longline fishery component would result in the capture of loggerhead sea turtles, leatherback, Kemp's ridley, green, and hawksbill sea turtles. Since potential for take in other HMS fisheries is low, NMFS anticipated that the proposed action was not expected to jeopardize the continued existence of any of these.

The commercial *Gulf of Mexico/South Atlantic spiny lobster fishery* (NMFS 2009a) consists of diving, bully net and trapping sectors; recreational fishers are authorized to use bully net and hand-harvest gears. The consultation determined that, although evidence that the commercial trap sector of the fishery adversely affects these species, the continued authorization of the fishery would not jeopardize the continued existence of green, hawksbill, Kemp's ridley leatherback, and loggerhead sea turtles.

The *Gulf of Mexico stone crab fishery* (NMFS 2009b) is unique in that only the claws of the crab are harvested (Muller *et al.* 2006). The fishery operates primarily nearshore and fishing

techniques have changed little since the implementation of the federal Stone Crab Fishery Management Plan. The commercial and recreational fishery consists of trap/pot, and recreational hand harvest. Stone crab traps are known to adversely affect sea turtles via entanglement and forced submergence. The fishery is currently management through spatio-temporal closures, effort limitations, harvest limitations, permit requirements, trap construction requirements, and a passive trap limitation program managed by the State of Florida. Recreational fishers must follow the same guidelines as commercial fishers unless otherwise noted. The consultation determined the continued authorization of the fishery would not jeopardize the continued existence of green, hawksbill, Kemp's ridley leatherback, and loggerhead sea turtles.

*Vessel Activities.* Potential sources of adverse effects from federal vessel operations in the action area and throughout the range of sea turtles include operations of the U.S. Navy (USN) and Coast Guard (USCG), which maintain the largest Federal vessel fleets, the Environmental Protection Agency, the National Oceanic and Atmospheric Administration (NOAA), and the Army Corps of Engineer (COE). NMFS has conducted formal consultations with the USCG, the USN, and NOAA on their vessel operations. Through the section 7 process, where applicable, NMFS has and will continue to establish conservation measures for all these agency vessel operations to avoid or minimize adverse effects to listed species. At the present time, however, they present the potential for some level of interaction.

Since the USN consultation only covered operations out of Mayport, Florida, potential still remains for USN vessels to adversely affect sea turtles when they are operating in other areas within the range of these species. Similarly, operations of vessels by other Federal agencies within or near the action area (NOAA, EPA, COE) may adversely affect sea turtles. However, the in-water activities of those agencies are limited in scope, as they operate a limited number of vessels or are engaged in research/operational activities that are unlikely to contribute a large amount of risk.

Private and commercial vessel operations also have the potential to interact with sea turtles. For example, shipping traffic in Massachusetts Bay is estimated at 1,200 ship crossings per year with an average of three per day. Similar traffic may exist in many other areas where sea turtles occur. The invention and popularization of new technology resulting in high speed catamarans for ferry services and whale watch vessels operating in congested coastal areas contributes to the potential for impacts from privately-operated vessels. In addition to commercial traffic and recreational pursuits, private vessels participate in high speed marine events concentrated in the southeastern United States that are a particular threat to sea turtles. The magnitude of these marine events is not currently known. The sea turtle stranding network (STSSN) also reports many records of vessel interaction (propeller injury) with sea turtles off coastal states such as New Jersey and Florida, where there are high levels of vessel traffic.

*Other Military Activities.* In addition to vessel operations, other military activities including training exercises and ordnance detonation also affect listed species of sea turtles. Past and ongoing USN aerial bombing training in the ocean off the southeast U.S. coast, involving drops of live ordnance (500 and 1,000 lb. bombs) is estimated to have the potential to injure or kill, annually listed sea turtle species (NMFS 1997b). A consultation evaluating the impacts from USAF search-and-rescue training operations in the Gulf of Mexico (NMFS 1999c) determined

that the training operations would adversely affect sea turtles but would not jeopardize their continued existence. Consultations on individual activities have been completed, but no formal consultation on overall USCG or USN activities in any region has been completed at this time.

*Dredging.* The construction and maintenance of federal navigation channels has also been identified as a source of sea turtle mortality. Hopper dredges move relatively rapidly (compared to sea turtle swimming speeds) and can entrain and kill sea turtles.

*Oil and Gas Exploration.* The COE and the Minerals Management Service (MMS) authorize oil and gas exploration, well development, production, and abandonment/rig removal activities that may adversely affect sea turtles. Both of these agencies have consulted numerous times with the NMFS on these types of activities. These activities include the use of seismic arrays for oil and gas exploration in the Gulf of Mexico, the impacts of which have been analyzed in opinions for individual and multi-lease sales. NMFS anticipates incidental takes of sea turtles from vessel strikes, noise, marine debris, and the use of explosives to remove oil and gas structures.

*Electrical Generating Plants.* Another action with federal oversight (the Federal Energy Regulatory Commission and the Nuclear Regulatory Agency) impacting sea turtles is the operation of electrical generating plants. Sea turtles entering coastal or inshore areas have been affected by entrainment in the cooling-water systems of electrical generating plants, though it is important to note that almost all of the turtles are caught and released alive; NMFS estimates the survival rate at 98.5% or greater (NMFS 1997).

*Navigation Channel Construction and Maintenance.* The construction and maintenance of Federal navigation channels and sand mining ("borrow") has also been identified as a source of turtle mortality. Hopper dredges, which are frequently used in ocean bar channels and sometimes in harbor channels and offshore borrow areas, move relatively rapidly and can entrain and kill sea turtles, presumably as the drag arm of the moving dredge overtakes the slower moving turtle.

### ***State or Private Actions***

*State Fisheries.* Various fishing methods used in state fisheries, including trawling, pot fisheries, fly nets, and gillnets are known to incidentally take listed species, but information on these fisheries is sparse (NMFS SEFSC 2001). Although few of these state regulated fisheries are currently authorized to incidentally take listed species, several state agencies have approached NMFS to discuss applications for a section 10(a)(1)(B) incidental take permit. Since NMFS' issuance of a section 10(a)(1)(B) permit requires formal consultation under section 7 of the ESA, the effects of these activities are considered in section 7 consultation. Any fisheries that come under a section 10(a)(1)(B) permit in the future will likewise be subject to section 7 consultation. Although the past and current effects of these fisheries on listed species is currently not determinable, NMFS believes that ongoing state fishing activities may be responsible for seasonally high levels of observed strandings of sea turtles on both the Atlantic and Gulf of Mexico coasts. Most of the state data are based on extremely low observer coverage or sea turtles were not part of data collection; thus, these data provide insight into gear interactions that could occur but are not indicative of the magnitude of the overall problem. In addition to the lack of interaction data, there is another issue that complicates the analysis of impacts to sea

turtles from these fisheries. Certain gear types may have high levels of sea turtle takes, but very low rates of serious injury or mortality. For example, the hook and line takes rarely result in death, but trawls and gillnets frequently do. Leatherbacks seem to be susceptible to a more restricted list of fisheries, while the hard shelled turtles, particularly loggerheads, seem to appear in data on almost all of the state fisheries.

Other state bottom trawl fisheries that are suspected of incidentally capturing sea turtles are the horseshoe crab fishery in Delaware (Spotila *et al.* 1998) and the whelk trawl fishery in South Carolina and Georgia. In South Carolina, the whelk trawling season opens in late winter and early spring when offshore bottom waters are > 55°F. One criterion for closure of this fishery is water temperature: whelk trawling closes for the season and does not reopen throughout the state until six days after water temperatures first reach 64°F in the Fort Johnson boat slip. Based on the South Carolina Department of Natural Resources Office of Fisheries Management data, approximately six days will usually lapse before water temperatures reach 68°F, the temperature at which sea turtles move into state waters. From 1996-1997, observers onboard whelk trawlers in Georgia reported a total of three Kemp's ridley, two green, and two loggerhead sea turtles captured in 28 tows for a CPUE of 0.3097 turtles/100 ft net hour. As of December 2000, TEDS are required in Georgia state waters when trawling for whelk. Trawls for cannonball jellyfish and Florida try nets may also be a source of interactions.

A detailed summary of the gillnet fisheries currently operating along the mid- and southeast U.S. Atlantic coastline, which are known to incidentally capture loggerheads, can be found in the TEWG reports (1998, 2000). Although all or most nearshore gillnetting is prohibited by state regulations in state waters of South Carolina, Georgia, Florida, Louisiana, and Texas, gillnetting in other states' waters and in federal waters does occur. Of particular concern are the nearshore and inshore gillnet fisheries of the mid-Atlantic operating in Rhode Island, Connecticut, New York, New Jersey, Delaware, Maryland, Virginia, and North Carolina state waters and/or federal waters. Incidental captures in these gillnet fisheries (both lethal and non-lethal) of loggerhead, leatherback, green and Kemp's ridley sea turtles have been reported. In addition, illegal gillnet incidental captures have been reported in South Carolina, Florida, Louisiana and Texas (NMFS SEFSC 2001).

Georgia and South Carolina prohibit gillnets for all but the shad fishery. This fishery was observed in South Carolina for one season by the NMFS SEFSC (McFee *et al.* 1996). No takes of protected species were observed. Florida banned all but very small nets in state waters, as has the state of Texas. Louisiana, Mississippi and Alabama have also placed restrictions on gillnet fisheries within state waters such that very little commercial gillnetting takes place in southeast waters, with the exception of North Carolina. Gillnetting activities in North Carolina associated with the southern flounder fishery had been implicated in large numbers of sea turtle mortalities. The Pamlico Sound portion of that fishery was closed and has subsequently been reopened under a section 10(a)(1)(B) permit.

Pound nets are a passive, stationary gear that are known to incidentally capture loggerhead sea turtles in Massachusetts, Rhode Island, New Jersey, Maryland, New York (Morreale and Standora 1998), Virginia (Bellmund *et al.* 1987) and North Carolina (Epperly *et al.* 2000). Although pound nets are not a significant source of mortality for loggerheads in New York

(Morreale and Standora 1998) and North Carolina (Epperly *et al.* 2000), they have been implicated in the stranding deaths of loggerheads in the Chesapeake Bay from mid-May through early June (Bellmund *et al.* 1987). The turtles were reported entangled in the large mesh (>8 inches) pound net leads (NMFS SEFSC 2001).

Incidental captures of loggerheads in fish traps set in Massachusetts, Rhode Island, New York, and Florida have been reported. Although no incidental captures have been documented from fish traps set in North Carolina and Delaware (Anon. 1995), they are another potential anthropogenic impact to loggerheads and other sea turtles. Lobster pot fisheries are prosecuted in Massachusetts (Prescott 1988), Rhode Island (Anon. 1995), Connecticut (Anon. 1995) and New York. Although they are more likely to entangle leatherback sea turtles, lobster pots set in New York are also known to entangle loggerhead sea turtles. No incidental capture data exist for the other states. Long haul seines and channel nets in North Carolina are known to incidentally capture loggerhead and other sea turtles in the sounds and other inshore waters. No lethal takes have been reported (NMFS SEFSC 2001).

Recreational fishermen have reported hooking turtles when fishing from boats, piers, and beach, banks, and jetties. Commercial fishermen fishing for reef fish and for sharks with both single rigs and bottom longlines have also reported hooked turtles (NMFS 2001). A detailed summary of the known impacts of hook and line incidental captures to loggerhead sea turtles can be found in the TEWG reports (1998, 2000).

*Vessel Traffic.* Commercial traffic and recreational pursuits can adversely effect sea turtles through propeller and boat strikes. Private vessels participate in high speed marine events concentrated in the southeastern United States and are a particular threat to sea turtles. The magnitude of these marine events is not currently known. The Sea Turtle Stranding and Salvage Network (STSSN) also reports many records of vessel interaction (propeller injury) with sea turtles off coastal states such as New Jersey and Florida, where there are high levels of vessel traffic.

### **Other Potential Sources of Impacts in the Baseline**

Significant anthropogenic impacts threaten nesting populations of all species in areas within as well as outside of the U.S. These impacts include poaching of eggs, immatures and adults as well as beach development problems. The impacts from these activities are difficult to measure.

*Habitat Loss.* Loss or degradation of nesting habitat resulting from erosion control through beach nourishment and armoring, beachfront development, artificial lighting, and non-native vegetation is a serious threat affecting nesting females and hatchlings. Although beach nourishment, or placing sand on beaches, may provide more sand, the quality of that sand, and hence the nesting beach, may be less suitable than pre-existing natural beaches. Sub-optimal nesting habitat may cause decreased nesting success, place an increased energy burden on nesting females, result in abnormal nest construction, and reduce the survivorship of eggs and hatchlings (Mann 1977; Ackerman 1980; Mortimer 1990).

Beach armoring (e.g., bulkheads, seawalls, soil retaining walls, rock revetments, sandbags, and geotextile tubes) can impede a turtle's access to upper regions of the beach/dune system, thereby

limiting the amount of available nesting habitat (Mazaris et al. 2009). Impacts also can occur if structures are installed during the nesting season. For example, unmarked nests can be crushed or uncovered by heavy equipment, nesting turtles and hatchlings can get caught in construction debris or excavations, and hatchlings can get trapped in holes or crevices of exposed riprap and geotextile tubes. In many areas of the world, sand mining (removal of beach sand for upland construction) seriously reduce or degrade/destroy sea turtle nesting habitats or interfere with hatchling movement to sea (NMFS 2003).

Artificial lighting on or near the beach adversely affects both nesting and hatchling sea turtles. Specifically, artificial lighting may deter adult female turtles from emerging from the ocean to nest and can disorient or misorient emerging hatchlings away from the ocean (Ehrhart 1983, Salmon and Witherington 1995). Hatchlings have a tendency to orient toward the brightest direction, which on natural, undeveloped beaches is commonly toward the broad open horizon of the sea. However, on developed beaches, the brightest direction is often away from the ocean and toward lighted structures. Hatchlings unable to find the ocean, or delayed in reaching it, are likely to incur high mortality from dehydration, exhaustion, or predation (Peters and Verhoeven 1994; Salmon et al. 1995). Hatchlings lured into lighted parking lots or toward streetlights can get crushed by passing vehicles. The extent to which these activities reduce sea turtle nesting and hatchling production is unknown. However, more and more coastal counties are adopting stringent protective measures to protect hatchling sea turtles from the disorienting effects of beach lighting.

*Marine Debris.* Ingestion of marine debris can be a serious threat to sea turtles. Sea turtles living in the pelagic (open ocean) environment commonly ingest or become entangled in marine debris (e.g., tar balls, plastic bags, plastic pellets, balloons, and ghost fishing gear) as they feed along oceanographic fronts, where debris and their natural food items converge (Bugoni *et al.* 2001; Pichel *et al.* 2007; Mrosovsky *et al.* 2009). This is especially problematic for turtles that spend all or significant portions of their life cycle in the pelagic environment (e.g., leatherbacks, juvenile loggerheads, and juvenile green turtles). Some types of marine debris may be directly or indirectly toxic to sea turtles on their migration to (and potentially within) the action area, such as oil. Turtles can become entangled in derelict gillnets, pound nets, and the lines associated with longline and trap/pot fishing gear. Turtles entangled in these types of fishing gear may drown and often suffer serious injuries to their flippers from constriction by the lines or ropes.

*Environmental Contamination.* Coastal runoff, marina and dock construction, dredging, aquaculture, oil and gas exploration and extraction, increased under water noise and boat traffic can degrade marine habitats used by sea turtles (Colburn *et al.* 1996). The development of marinas and docks in inshore waters can negatively impact nearshore habitats. Fueling facilities at marinas can sometimes discharge oil, gas, and sewage into sensitive estuarine and coastal habitats. An increase in the number of docks built may also increase boat and vessel traffic. Turtles swimming or feeding at or just beneath the surface of the water are particularly vulnerable to boat and vessel strikes, which can result in serious propeller injuries and death (Hazel *et al.* 2007). Although these contaminant concentrations do not likely affect the more pelagic waters, the species of turtles analyzed in this biological opinion travel between near

shore and offshore habitats and may be exposed to and accumulate these contaminants during their life cycles.

There are studies on organic contaminants and trace metal accumulation in green and leatherback sea turtles (Aguirre *et al.* 1994; Caurant *et al.* 1999; Corsolini *et al.* 2000). McKenzie *et al.* (1999) measured concentrations of chlorobiphenyls and organochlorine pesticides in sea turtle tissues collected from the Mediterranean (Cyprus, Greece) and European Atlantic waters (Scotland) between 1994 and 1996. Omnivorous loggerhead turtles had the highest organochlorine contaminant concentrations in all the tissues sampled, including those from green and leatherback turtles (Storelli *et al.* 2008). It is thought that dietary preferences were likely to be the main differentiating factor among species. Decreasing lipid contaminant burdens with turtle size were observed in green turtles, most likely attributable to a change in diet with age. Sakai *et al.* (1995) found the presence of metal residues occurring in loggerhead turtle organs and eggs. Storelli *et al.* (1998) analyzed tissues from twelve loggerhead sea turtles stranded along the Adriatic Sea (Italy) and found that characteristically, mercury accumulates in sea turtle livers while cadmium accumulates in their kidneys, as has been reported for other marine organisms like dolphins, seals and porpoises (Law *et al.* 1991). No information on detrimental threshold concentrations are available, and little is known about the consequences of exposure of organochlorine compounds to sea turtles. Research is needed on the short- and long-term health and fecundity effects of chlorobiphenyl, organochlorine, and heavy metal accumulation in sea turtles.

Nutrient loading from land-based sources, such as coastal communities and agricultural operations, are known to stimulate plankton blooms in closed or semi-closed estuarine systems. The effects on larger embayments are unknown. An example is the large area of the Louisiana continental shelf with seasonally-depleted oxygen levels (<2mg/l) is caused by eutrophication from both point and non-point sources. Most aquatic species cannot survive at such low oxygen levels and these areas are known as “dead zones.” The oxygen depletion, referred to as hypoxia, begins in late spring, reaches a maximum in mid summer, and disappears in the fall. Since 1993, the average extent of mid-summer bottom-water hypoxia in the northern GOM has been approximately 16,000 km<sup>2</sup>, approximately twice the average size measured between 1985 and 1992. The hypoxic zone attained a maximum measured extent in 2002, when it was about 22,000 km<sup>2</sup> which is largest than the state of Massachusetts (U.S. Geological Service, 2005). The hypoxic zone has impacts on the animals found there, including sea turtles, and the ecosystem-level impacts continue to be investigated.

*Disease.* A disease known as (FP), is a major threat to green turtles in some areas of the world. FP is characterized by tumorous growths, which can range in size from very small to extremely large, and are found both internally and externally. Large tumors can interfere with feeding and essential behaviors, and tumors on the eyes can cause permanent blindness (Foley *et al.* 2005). FP was first described in green turtles in the Florida Keys in the 1930s. Since then it has been recorded in many green turtle populations around the world, most notably present in green turtles of Hawaii, Florida, and the Caribbean. In Florida, up to 50% of the immature green turtles captured in the Indian River Lagoon are infected, and there are similar reports from other sites in Florida, including Florida Bay, as well as from Puerto Rico and the U.S. Virgin Islands. In addition, scientists have documented FP in populations of loggerhead, olive ridley, and flatback

turtles (Huerta *et al.* 2002). The effects of FP at the population level are not well understood and could be a serious threat to their recovery. The cause of the disease remains unknown. Research to determine the cause of this disease is a high priority and is underway.

*Impacts from non-native species introductions.* 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. Non-native vegetation has invaded many coastal areas and often outcompetes native species. Non-native vegetation is usually less-stabilizing and can lead to increased erosion and degradation of suitable nesting habitat. Non-native vegetation may also form impenetrable root mats that can prevent proper nest cavity excavation, invade and desiccate eggs, or trap hatchlings. In light of these issues, conservation and long-term protection of sea turtle nesting and foraging habitats is an urgent and high priority need.

*Acoustic impacts.* NMFS and the USN have been working cooperatively to establish a policy for monitoring and managing acoustic impacts from anthropogenic sound sources in the marine environment. Acoustic impacts to sea turtles can include temporary or permanent injury, habitat exclusion, habituation, and disruption of other normal behavior patterns. There are other more indirect factors; for a complete list refer to NMFS SEFSC (2001).

*International.* For sea turtle species in the Atlantic, international activities, particularly fisheries, are significant factors impacting populations. NMFS estimates that, each year, thousands of sea turtles of all species are incidentally caught and a proportion of them killed incidentally or intentionally by international activities. The impact of international fisheries is a significant factor in the baseline inhibiting sea turtle recovery. Additional information on the impacts of international fisheries is found in NMFS SEFSC (2001) and Lewison *et al.* (2004).

***Southeast Area Monitoring and Assessment Program-South Atlantic Shallow Water Trawl Survey (SEAMAP-SASWTS).***

This research is on-going and has conducted over 4,123 otter trawling tows in or adjacent to the action area and taken over 270 turtles since 1987, with no reported mortalities. Indirect effects of this trawling in the action area on sea turtles are as those discussed under shrimp trawling above (disturbance of benthic habitat). Also, captured turtles are forcibly submerged in trawls and undergo respiratory and metabolic stress. While no mortalities have been reported since 1987, risk of mortality remains possible under this activity.

***Other ESA Section 10 Sea Turtle Permits.***

Regulations developed under the ESA allow for the issuance of permits allowing take of certain ESA-listed species for the purposes of scientific research under Section 10(a)(1)(a) of the ESA. In addition, the ESA allows for the NMFS to enter into cooperative agreements with states developed under Section 6 of the ESA, to assist in recovery actions of listed species. Prior to issuance of these authorizations, the proposal must be reviewed for compliance with Section 7 of the ESA.

Sea turtles are the focus of research activities authorized by a Section 10 permit under the ESA. As of January 2009, there were 23 active scientific research permits directed toward sea turtles that are applicable to the action area of this biological opinion. Authorized activities range from photographing, weighing, and tagging sea turtles incidentally taken in fisheries, blood sampling, tissue sampling (biopsy) and performing laparoscopy on intentionally captured turtles. The number of authorized takes varies widely depending on the research and species involved but may involve the taking of hundreds of turtles annually. Most of takes authorized under these permits are expected to be non-lethal. Before any research permit is issued, the proposal must be reviewed under the permit regulations (i.e., must show a benefit to the species). In addition, since issuance of the permit is a federal activity, issuance of the permit by the NMFS must also be reviewed for compliance with section 7(a)(2) of the ESA to ensure that issuance of the permit does not result in jeopardy to the species. However, despite these safeguards research activity may result in cumulative effects on sea turtle populations.

### **Conservation and Recovery Actions Shaping the Environmental Baseline**

NMFS has implemented a series of regulations aimed at reducing potential for incidental mortality of sea turtles from commercial fisheries in the action area. These include sea turtle release gear requirements for Atlantic HMS, Gulf of Mexico reef fish, and South Atlantic snapper-grouper fishery, and TED requirements for Southeast shrimp trawl fishery. In addition to regulations, outreach programs have been established and data on sea turtle interactions with recreational fisheries has been collected through the Marine Recreational Fishing Statistical Survey (MRFSS). The summaries below discuss all of these measures in more detail.

#### *Reducing Threats from Pelagic Longline and Other Hook-and-Line Fisheries*

On May 1, 2009 NMFS published an emergency rule (74 FR 20229), effective from May 18, 2009 through October 28, 2009, prohibiting bottom longlining for Gulf reef fish east of 85°30'W longitude (near Cape San Blas, Florida) and in the portion of the EEZ shoreward of the 50-fathom depth contour. The emergency rule was intended to reduce sea turtle takes in the short-term while the Gulf of Mexico Fishery Management Council developed long-term protective measures through Amendment 31 to the Fishery Management Plan for Reef Fish Resources in the Gulf of Mexico.

NMFS published the final rule to implement sea turtle release gear requirements and sea turtle careful release protocols in the Gulf of Mexico reef fish fishery on August 9, 2006 (71 FR 45428). These measures require owners and operators of vessels with federal commercial or charter vessel/headboat permits for Gulf reef fish to comply with sea turtle release protocols and have on board specific sea turtle release gear. NMFS is currently conducting rulemaking to implement similar release gear and handling requirements for the South Atlantic snapper-grouper fishery.

NMFS published a final rule on July 6, 2004, to implement management measures to reduce bycatch and bycatch mortality of Atlantic sea turtles in the Atlantic pelagic longline fishery (69 FR 40734). The management measures include mandatory circle hook and bait requirements, and mandatory possession and use of sea turtle release equipment to reduce bycatch mortality. The current reduction in turtle interactions, seems to corroborate the rulemaking. In the Hawaii-

based longline swordfish fishery which required vessels to switch from using a J-shaped hook with squid bait to a wider circle-shaped hook with fish bait has reduced capture rates of leatherback and loggerhead turtles significantly by 83% and 90% respectively (Gilman *et al.* 2007). There was also a highly significant reduction in the proportion of turtles that swallowed hooks (versus being hooked in the mouth or body or entangled) and a highly significant increase in the proportion of caught turtles that were released after removal of all terminal tackle, which could lead to the likelihood of turtles surviving the interaction (Read 2006; Watson *et al.* 2005)

#### *Revised Use of Turtle Excluder Devices in Trawl Fisheries*

NMFS has also implemented a series of regulations aimed at reducing potential for incidental mortality of sea turtles in commercial shrimp trawl fisheries. In particular, NMFS has required the use of TEDs in southeast United States shrimp trawls since 1989 and in summer flounder trawls in the Mid-Atlantic area (south of Cape Charles, Virginia) since 1992. It has been estimated that TEDs exclude 97 percent of the sea turtles caught in such trawls (Cox *et al.* 2007). These regulations have been refined over the years to ensure that TEDs are properly installed and used where needed to minimize the impacts on sea turtles.

Significant measures have been developed to reduce the take of sea turtles in summer flounder trawls and trawls that meet the definition of a summer flounder trawl (which would include fisheries for other species like scup and black sea bass) by requiring TEDs in trawl nets fished from the North Carolina/South Carolina border to Cape Charles, Virginia. However, the TED requirements for the summer flounder trawl fishery do not require the use of larger TEDs that are used in the shrimp trawl fishery to exclude leatherbacks, as well as large, benthic, immature and sexually mature loggerheads and green sea turtles.

NMFS has also been working to develop a TED, which can be effectively used in a type of trawl known as a flynet, which is sometimes used in the Mid-Atlantic and Northeast fisheries to target sciaenids and bluefish. Limited observer data indicate that takes can be quite high in this fishery. A top-opening flynet TED was certified this summer, but experiments are still ongoing to certify a bottom-opening TED.

#### *Placement of Fisheries Observers to Monitor Sea Turtle Takes*

On August 3, 2007, NMFS published a final rule required selected fishing vessels to carry observers on board to collect data on sea turtle interactions with fishing operations, to evaluate existing measures to reduce sea turtle takes, and to determine whether additional measures to address prohibited sea turtle takes may be necessary (72 FR 43176). This rule also extended the number of days NMFS observers placed in response to a determination by the Assistant Administrator that the unauthorized take of sea turtles may be likely to jeopardize their continued existence under existing regulations, from 30 to 180 days.

#### *Final Rules for Large-Mesh Gillnets*

In March 2002, NMFS published new restrictions for the use of gillnets with larger than 8-inch stretched mesh, in federal waters (3-200 nautical miles) off North Carolina and Virginia. These restrictions were published in an interim final rule under the authority of the ESA (67 FR 13098) and were implemented to reduce the impact of the monkfish and other large-mesh gillnet fisheries on ESA-listed sea turtles in areas where sea turtles are known to concentrate. Following

review of public comments submitted on the interim final rule, NMFS published a final rule on December 3, 2002, that established the restrictions on an annual basis. As a result, gillnets with larger than 8-inch stretched mesh were not allowed in federal waters (3-200 nautical miles) in the areas described as follows: (1) north of the North Carolina/South Carolina border at the coast to Oregon Inlet at all times; (2) north of Oregon Inlet to Currituck Beach Light, North Carolina, from March 16-January 14; (3) north of Currituck Beach Light, North Carolina, to Wachapreague Inlet, Virginia, from April 1-January 14; and (4) north of Wachapreague Inlet, Virginia, to Chincoteague, Virginia, from April 16-January 14. On April 26, 2006, NMFS published a final rule (71 FR 24776) that included modifications to the large-mesh gillnet restrictions. The new final rule revised the gillnet restrictions to apply to stretched mesh that is greater than or equal to 7 inches. Federal waters north of Chincoteague, Virginia, remain unaffected by the large-mesh gillnet restrictions. These measures are in addition to Harbor Porpoise Take Reduction Plan measures that prohibit the use of largemesh gillnets in southern Mid-Atlantic waters (territorial and federal waters from Delaware through North Carolina out to 72° 30'W longitude) from February 15-March 15, annually.

#### *Sea Turtle Handling and Resuscitation Techniques*

NMFS published a final rule (66 FR 67495, December 31, 2001) detailing handling and resuscitation techniques for sea turtles that are incidentally caught during scientific research or fishing activities. Persons participating in fishing activities or scientific research are required to handle and resuscitate (as necessary) sea turtles as prescribed in the final rule. These measures help to prevent mortality of hard-shelled turtles caught in fishing or scientific research gear.

#### *Outreach and Education, Sea Turtle Entanglements, and Rehabilitation*

There is an extensive network of Sea Turtle Stranding and Salvage Network participants along the Atlantic and Gulf of Mexico coasts who not only collect data on dead sea turtles, but also rescue and rehabilitate any live stranded sea turtles.

A final rule (70 FR 42508) published on July 25, 2005, allows any agent or employee of NMFS, the USFWS, the U.S. Coast Guard, or any other federal land or water management agency, or any agent or employee of a state agency responsible for fish and wildlife, when acting in the course of his or her official duties, to take endangered sea turtles encountered in the marine environment if such taking is necessary to aid a sick, injured, or entangled endangered sea turtle, or dispose of a dead endangered sea turtle, or salvage a dead endangered sea turtle that may be useful for scientific or educational purposes. NMFS already affords the same protection to sea turtles listed as threatened under the ESA [50 CFR 223.206(b)].

#### *Other Actions*

A recovery plan for the loggerhead sea turtle was published December 2008 (74 FR 2995). A draft revised recovery plan for the Kemp's ridley sea turtle was published March 2010 (75 FR 12496). Recovery teams comprised of sea turtle experts have been convened and are currently working towards revising these plans based upon the latest and best available information. Five-year status reviews have been completed for green, hawksbill, Kemp's ridley, leatherback, and loggerhead sea turtles. These reviews were conducted to comply with the ESA mandate for periodic status evaluation of listed species to ensure that their threatened or endangered listing status remains accurate. Each review determined that no delisting or reclassification of a species

status (i.e., threatened or endangered) was warranted at this time. However, further review of species data for the green, hawksbill, and leatherback was recommended, to evaluate whether distinct population segments (DPS) should be established for these species (NMFS and USFWS 2007a-e). The proposed rule to list nine distinct population segments (DPSs) of Loggerhead sea turtles under the ESA was published March 1020 (75 FR 12598).

### **Effects of the Proposed Action**

Pursuant to Section 7(a)(2) of the ESA, federal agencies are directed to ensure that their activities are not likely to jeopardize the continued existence of any listed species or result in the destruction or adverse modification of critical habitat. Direct adverse effects of the permitted activities on listed species that are within the action area would include disruption of feeding, breeding, resting and other behaviors. Some displacement may result from these activities. The duration of the behavioral disruptions and displacements are expected to vary by species and type of disturbance.

In this section, we describe the potential physical, chemical, or biotic stressors associated with the proposed action, the probability of individuals of listed species being exposed to these stressors based on the best scientific and commercial evidence available, and the probable responses of those individuals (given probable exposures) based on the available evidence. As described in the *Approach to the Assessment* section, for any responses that would be expected to reduce an individual's fitness (i.e., growth, survival, annual reproductive success, and lifetime reproductive success), the assessment would consider the risk posed to the viability of the population(s) those individuals comprise and to the listed species those populations represent.

For this consultation, we are particularly concerned about behavioral disruptions that may result in listed sea turtles that fail to feed or breed successfully or fail to complete their life history because these responses are likely to have population-level consequences. The proposed permit would authorize non-lethal "takes" by harassment of listed species during activities. The ESA does not define harassment nor has NMFS defined the term pursuant to the ESA through regulation. For this Opinion, we define harassment as an intentional or unintentional human act or omission that creates the probability of injury to an individual animal by disrupting one or more behavioral patterns that are essential to sea turtles' life history or its contribution to the population the animal represents.

The purpose of this assessment is, then, to determine if it is reasonable to expect that the research, as conducted under the permits, can be expected to have direct or indirect effects on threatened and endangered sea turtle species that appreciably reduce their likelihood of surviving and recovering in the wild or result in destruction or adverse modification of critical habitat. Including assessing the direct and indirect effect of the proposed action on threatened and endangered species or critical habitat, together with the effects of other activities that are interrelated or interdependent (50 CFR 402.02). Indirect effects are those that are caused later in time, but are still reasonably certain to occur. Interrelated actions are those that are part of a larger action and depend upon the larger action for their justification. Interdependent actions are those that have no independent utility apart from the action under consideration (50 CFR 402.02). Jeopardy analyses compare reductions in a species' likelihood of surviving and

recovering in the wild associated with a *specific* action with the species' likelihood of surviving and recovering in the wild that was established in the *Status of the Species* section of an Opinion. Jeopardy analyses also consider the importance of the action area to a listed species and the effects of other human actions and natural phenomena (that were summarized in the *Environmental Baseline*) on a species' likelihood of surviving and recovering in the wild. As a result, jeopardy analyses in biological opinions distinguish between the effects of a specific action on a species' likelihood of surviving and recovering in the wild and a species' background likelihood of surviving and recovering given the full set of human actions and natural phenomena that threaten a species.

This section will assess the types of effects that are expected from the proposed action, the extent of those effects, and the overall impact of those effects on sea turtle populations.

#### *Standards Used in Effects Analysis*

The analyses in this Opinion are based on an implicit understanding that the listed sea turtle species considered in this Opinion are threatened or endangered with local or global extinction by a wide array of human activities and natural phenomena. We have outlined many of those activities in the *Status of the Species* section of this Opinion. NMFS also recognizes that some of these other human activities and natural phenomena pose serious threats to the survival of these listed species (and other flora and fauna). Further, NMFS recognizes that such species will not recover without addressing the full range of human activities and natural phenomena such as patterns of beach erosion, predation on turtle eggs, and turtle captures, injuries, and deaths in other domestic and international fisheries and other State, federal, and private activities that could cause these animals to become extinct in the foreseeable future.

Nevertheless, this Opinion focuses solely on whether the direct and indirect effects of the proposed action can be expected to appreciably reduce the listed sea turtles' likelihood of surviving and recovering in the wild by reducing their reproduction, numbers, or distribution or would result in a direct or indirect alteration that appreciably diminishes the value of critical habitat for both the survival and recovery of a listed species. Jeopardy analyses in biological opinions distinguish between the effects of a specific action on a species' likelihood of surviving and recovering in the wild and a species' background likelihood of surviving and recovering given the full set of human actions and natural phenomena that threaten a species.

This biological opinion treats sea turtle populations in the Atlantic Ocean as distinct from the Pacific Ocean populations for the purposes of this consultation. This approach is supported by interagency policy on the recognition of distinct vertebrate populations (61 Federal Register 4722). This approach is also consistent with traditional jeopardy analyses: the loss of sea turtle populations in the Atlantic basin would result in a significant gap in the distribution of each turtle species, which makes these populations biologically significant. Finally, the loss of these sea turtle populations in the Atlantic basin would dramatically reduce the distribution and abundance of these species and would, by itself, appreciably reduce the entire species' likelihood of surviving and recovering in the wild.

#### *Conservative Decisions- Providing the Benefit of the Doubt to the Species*

The analysis in this section is based upon the best available commercial and scientific data on sea turtle biology and the effects of the proposed action. However, there are instances where there is limited information upon which to make a determination. In those cases, in keeping with the direction from the U.S. Congress to provide the “benefit of the doubt” to threatened and endangered species [House of Representatives Conference Report No. 697, 96th Congress, Second Session, 12 (1979)], we will generally make determinations which provide the most conservative outcome for listed species.

## **Response Analyses**

As discussed in the *Approach to the Assessment* section of this Opinion, response analyses determine how listed resources are likely to respond after being exposed to an action’s effects on the environment or directly on listed animals themselves. For the purposes of consultation, the assessments try to detect potential lethal, sub-lethal, physiological or behavioral responses that might reduce the fitness of individuals. The proposed activities have the potential to produce disturbances that may affect listed sea turtles.

The responses by animals to human disturbance are similar to their responses to potential predators (Harrington and Veitch, 1992; Lima, 1998; Gill and Sutherland, 2001; Frid and Dill, 2002; Frid, 2003; Beale and Monaghan, 2004; Romero, 2004). These responses include interruptions of essential behavior and physiological processes such as feeding, mating, resting, digestion etc. This can result in stress, injury and increased susceptibility to disease and predation (Frid and Dill, 2002; Romero, 2004; Walker *et al.*, 2006).

Risks to listed individuals are measured in terms of changes to an individual’s “fitness.” Fitness is defined as the individual’s growth, survival, annual reproductive success and lifetime reproductive success. When listed plants or animals exposed to an action’s effects are not expected to experience reductions in fitness, we would not expect the action to have adverse consequences on the viability of the populations those individuals represent or the species those populations comprise (Brandon, 1978; Mills and Beatty, 1979; Stearns, 1992; Anderson, 2000). As a result, if the assessment indicates that listed plants or animals are not likely to experience reductions in their fitness, we conclude our assessment. If possible reductions in individuals’ fitness are likely to occur, the assessment considers the risk posed to populations to which those individuals belong, and then to the species those populations represent.

The proposed actions may expose listed sea turtle species to disturbance from boat, capture, sampling and collection activities. In addition, there is a minimal potential for boat strikes to occur. These animals may undergo changes in behavior in response to disturbances from the proposed activities.

## **Effects of Research Activities**

The applicants have requested authorization to annually capture a combined total of 80 green, 45 loggerhead, 3 hawksbill, and 2 Kemp’s ridley turtles using large mesh tangle nets in the waters of the Lake Worth and Mosquito Lagoons of Florida. Animals will be measured, flipper and passive integrated transponder (PIT) tagged, sonic tagged, weighed, blood sampled and released.

Dietary samples will also be extracted from a subset of 32 green, and 10 loggerhead sea turtles annually using a sampling technique called lavage.

### *Capture*

The capture could result in stresses due to interaction with the tangle net gear. Turtles can be affected by entanglement in the nets and/or drowning as a result of the forced submergence (Sasso and Epperly 2006). Sea turtles are particularly prone to entanglement as a result of their body configuration and behavior. Records of stranded or entangled sea turtles reveal that fishing debris can wrap around the neck or flipper, or body of a sea turtle and severely restrict swimming or feeding. Sea turtles may also experience constriction of appendages as a result of the entanglement. Constriction may cut off blood flow, causing deep gashes, some severe enough to remove an appendage. Sea turtles that are forcibly submerged undergo respiratory and metabolic stress that can lead to severe disturbance of their acid-base balance. While most voluntary dives by sea turtles appear to be aerobic, showing little if any increases in blood lactate and only minor changes in acid-base status (pH level of the blood)(Lutz and Bentley 1985), sea turtles that are stressed as a result of being forcibly submerged through entanglement consume oxygen stores, triggering an activation of anaerobic glycolysis, and subsequently disturbing their acid-base balance, sometimes to lethal levels. It is likely that the rapidity and extent of the physiological changes that occur during forced submergence are functions of the intensity of struggling as well as the length of submergence (Lutcavage and Lutz, 1997). Other factors to consider in the effects of forced submergence include the size of the turtle, ambient water temperature, and multiple submergences. Larger sea turtles are capable of longer voluntary dives than small turtles, so juveniles may be more vulnerable to the stress due to entanglement. During the warmer months, routine metabolic rates are higher, so the impacts of the stress due to entanglement may be magnified. With each forced submergence, lactate levels increase and require a long (even as much as 20 hours) time to recover to normal levels. Turtles are probably more susceptible to lethal metabolic acidosis if they experience multiple captures in a short period of time, because they would not have had time to process lactic acid loads (*in* Lutcavage and Lutz 1997). Capture and handling activities may markedly affect metabolic rate (St. Aubin and Geraci 1988), reproduction (Mahmoud and Licht 1997), and hormone levels (Gregory *et al.* 1996). Understanding the physiological effects of capture methodology is essential to conducting research on endangered sea turtles, since safe return to their natural habitat is required. However, literature pertaining to the physiological effects of capture on sea turtles is scarce.

Since the nets will be manned at all times and turtles will be immediately removed, the risks to the turtles are expected to be greatly reduced and the effects of the entanglement and forced submergence are expected to dissipate within a day (Stabenau and Vietti 1999). No mortalities or injuries are expected as a result of the capture.

### *Measuring, Photographing, Weighing and Tagging*

Handling, measuring, photographing and weighing can result in raised levels of stressor hormones in sea turtles. The additional on-board holding time imposes an additional stressor on these already acidotic turtles (Hoopes *et al.* 2000). It has been suggested that the muscles used by sea turtles for swimming might also be used during lung ventilation (Butler *et al.* 1984). Thus, an increase in breathing effort in negatively buoyant animals may have heightened lactate

production. However, the handling, measuring, photographing and weighing procedures are simple, non-invasive, with a relatively short time period and NMFS does not expect that individual turtles would normally experience more than short-term stresses as a result of these activities. No injury is expected from these activities, and turtles will be worked up as quickly as possible to minimize stresses resulting from their capture.

Tagging activities are minimally invasive and all tag types have negatives associated with them, especially concerning tag retention. Plastic tags can become brittle, break and fall off underwater, and titanium tags can bend during implantation and thus not close properly, leading to tag loss. Tag malfunction can result from rusted or clogged applicators or applicators that are worn from heavy use (Balazs 1999). Turtles that have lost external tags must be re-tagged if captured again at a later date, which subjects them to additional effects of tagging. Turtles can experience some discomfort during the tagging procedures and these procedures will produce some level of pain. The discomfort is usually short and highly variable between individuals (Balazs 1999). Most barely seem to notice, while a few others exhibit a marked response. However, NMFS expects the stresses to be minimal and short-term and that the small wound-site resulting from a tag applied to the flipper should heal completely in a short period of time. Similarly, turtles that must be re-tagged should also experience minimal short-term stress and heal completely in a short period of time. Re-tagging is not expected to appreciably affect these turtles.

PIT tags have been used with a wide variety of animal species that include fish (Clugston 1996; Skalski *et al.* 1998; Dare 2003), amphibians (Thompson 2004), reptiles (Cheatwood *et al.* 2003; Germano and Williams 2005), birds (Boisvert and Sherry 2000; Green *et al.* 2004), and mammals (Wright *et al.* 1998; Aguirre *et al.* 2002). PIT tags have the advantage of being encased in glass, which makes them inert, and are positioned inside the turtle where loss or damage due to abrasion, breakage, corrosion or age over time is virtually non-existent (Balazs 1999). Also with PIT tagging, there is a lower rate of loss than with conventional methods, possibly leading to less retagging, and hence reduced interference as well as data of increased reliability and scientific value (Broderick and Godley 1999). When PIT tags are inserted into animals that have large body sizes relative to the size of the tag, empirical studies have generally demonstrated that the tags have no adverse effect on the growth, survival, reproductive success, or behavior of individual animals (Skalski *et al.* 1998, Hockersmith *et al.* 2003).

NMFS expects the stresses to be minimal and short-term, and that the small wound resulting from the insertion of the tag would heal completely in a short period of time. NMFS does not expect that individual turtles would experience more than short term stresses during the application of the PIT tags. The proposed tagging methods have been regularly employed in sea turtle research with little lasting impact on the individuals tagged and handled (Balazs 1999). No problems with tagging have been reported by any of the NMFS permit holders. In the many years that the NMFS Southeast Fisheries Science Center has been PIT-tagging turtles, turtle discomfort was observed to be temporary, as the turtles exhibit normal behavior shortly after tagging and swim normally after release. The applicant will also be required to follow procedures designed to minimize the risk of either introducing a new pathogen into a population or amplifying the rate of transmission from animal to animal of an endemic pathogen when handling animals.

In previous studies, the actual attachment of the sonic tags has shown that that turtles would likely experience some small additional stress from attaching the transmitters, but not significant increases in stress or discomfort to the turtle beyond what was experienced during other research activities. The energetic costs of swimming for an instrumented turtle may be increased, resulting in major effects on activity, behavior, metabolism, habitat selection, and other key aspects of the animals' life history. Transmitters, as well as biofouling of the tag, attached to the carapace of turtles increase hydrodynamic drag and affect lift and pitch. For example, Watson and Granger (1998) performed wind tunnel tests on a full-scale juvenile green turtle and found that, at small flow angles representative of straight-line swimming, a transmitter mounted on the carapace increased drag by 27 to 30 percent, reduced lift by less than 10 percent, and increased pitch moment by 11 to 42 percent. It is likely that this type of transmitter attachment would negatively affect the swimming energetics of the turtle. However, based on the results of hardshell sea turtles equipped with this tag setup, NMFS is unaware of transmitters resulting in any serious injury to these species. Attachment of satellite, sonic, or radio tags with epoxy is a commonly used and permitted technique by NMFS. These tags are unlikely to become entangled due to their streamlined profile and will typically be shed after about 1 year, posing no long-term risks to the turtle. The permit, if issued, would require the tag attachment occur so that there would be no risk of entanglement. There would be no gap allowed between the transmitter and the turtle. All tags would be attached in the most hydrodynamic manner possible.

Sonic tags emit an acoustic signal that can be received underwater with a hydrophone. Triangulation of the acoustic signal allows researchers to determine turtle locations. The sonic transmitters would have a frequency of approximately 50 to 80 kHz. This frequency level is not expected to adversely affect turtles. Sea turtles have low-frequency hearing sensitivity and are potentially affected by sound energy in the band below 1,000 Hz (Lenhardt 2003). Bartol *et al.* (1999) found the effective bandpass of the loggerhead sea turtle to be between at least 250 and 1,000 Hz. Ridgeway *et al.* (1969) found the maximum sensitivity of green sea turtle hearing to fall within 300- 500 Hz with a sharp decline at 750 Hz. Since the sonic tags authorized for sea turtle tracking research would be well above this hearing threshold, these tags would not be heard by the turtles. NMFS would not expect the transmitters to interfere with turtles' normal activities after they are released.

Another important consideration is whether the sounds emitted by the sonic transmitters would attract potential predators, primarily sharks. Unfortunately, hearing data on sharks is limited. Casper and Mann (2004) examined the hearing abilities of the nurse shark (*Ginglymostoma cirratum*), and results showed that this species detects low-frequency sounds from 100 to 1,000 Hz, with best sensitivity from 100 to 400 Hz. Myrberg (2000) explained that audiograms have been published on elasmobranchs. Although we do not have hearing information for all the sharks that could potentially prey on sea turtles, estimates for hearing sensitivity in available studies provided ranges of 25 to 1,000 Hz. In general, these studies found that shark hearing is not as sensitive as in other tested fishes, and that sharks are most sensitive to low-frequency sounds (Nelson 1967; Casper *et al.* 2003). Thus, it appears that the sonic transmitters would not attract potential shark predators to the turtles, because the frequency of the sonic tags is well above the 1,000-Hz threshold.

### *Lavage*

The feeding habits of wild turtles can be determined by a variety of methods, but the preferred technique is gastric lavage or stomach flushing. This comparatively simple and reliable technique has been used to successfully sample the gut contents of various vertebrate animals groups without harm to the animal (Forbes 1999). Gastric lavage can provide information on diets and how they relate to seasonal foraging and habitat use (Witherington 2000; Mayor *et al.* 1998) and can provide useful information aiding to the designation of critical habitat. This technique has been successfully used on green, hawksbill, olive ridley and loggerhead turtles ranging in size from 25 to 115 curved carapace length (CCL). Forbes (1999) states that many individual turtles have been lavaged more than three times without any known detrimental effect. Individuals have been recaptured from the day after the procedure up to three years later and appear healthy and feeding normally. Laproscopic examination of the intestines following the procedure has not detected any swelling or damage to the intestines. While individual turtles are likely to experience discomfort during this procedure, NMFS does not expect individual turtles to experience more than short-term distress. Injuries are not anticipated. The applicant will also be required to follow procedures designed to minimize the risk of either introducing a new pathogen into a population or amplifying the rate of transmission from animal to animal of an endemic pathogen when handling animals, including having separate lavage equipment for the sampling of turtles with and without FP, as well as on the size of the turtles.

### *Blood & Tissue Sampling*

NMFS does not expect that individual turtles will experience more than short-term stresses during blood or tissue sampling. Taking a blood sample from the sinuses in the dorsal side of the neck is now a routine procedure (Owens 1999), is a non-lethal and is not expected to have any sub-lethal effects. According to Owens (1999), with practice, it is possible to obtain a blood sample 95% of the time and the sample collection time should be about 30 seconds in duration. During the more than 5 years of tissue biopsying using sterile techniques, NMFS Southeast Fisheries Science Center researchers have encountered no infections or mortality resulting from this procedure (NMFS 2006). Sample collection sites are always sterilized with alcohol or other antiseptic, prior to sampling and attempts will be limited.

Effects of drawing blood samples with syringes from the dorsal side of the neck of turtles, could include pain, handling discomfort, possible hemorrhage at the site or risk of infection. To mitigate these effects, the needle would be slowly advanced while applying gentle negative pressure to the syringe until blood freely flows into the syringe. Once the blood is collected, direct pressure would be applied to the site to ensure clotting and prevent subsequent blood hemorrhaging (Stoskopf 1993). Bjorndal *et al.* (2010) found that turtles exhibited rapid healing at the tissue sampling site with no infection or scarring, and that the sampling did not adversely impact turtle physiology or health. The blood or tissue sample site would then be disinfected and checked again after recovery prior to release. Additionally, all of the researchers responsible for obtaining these samples will have received extensive experience in the procedure.

As stated above, this procedure is non-lethal and we do not expect this method to have sub-lethal effects. We acknowledge that pain, handling discomfort, possible hemorrhage at the site or risk of infection could occur, but procedure mitigation efforts (such as pressure and disinfection) lessen those possibilities. We believe that drawing blood or tissue biopsy in the manner

described appears to have little probability of harming or producing sub-lethal effects as long as the procedure is conducted by an experienced biologist.

### *Summary of Effects*

The short-term stresses resulting from capture, handling, measuring, photographing, weighing, flipper tagging, PIT tagging, lavage and blood sampling are expected to be minimal. The Permit would contain conditions to mitigate adverse impacts to turtles from these activities. As discussed above, turtles would be worked up as quickly as possible to minimize stresses resulting from the research and the applicant would also be required to follow procedures designed to minimize the risk of either introducing a new pathogen into a population or amplifying the rate of transmission from animal to animal of an endemic pathogen when handling animals. The applicant would be required to exercise care when handling animals to minimize any possible injury. An experienced veterinarian or veterinarian technician would be named by the applicant for emergencies. During release, turtles would be lowered as close to the water's surface as possible, to prevent potential injuries.

### **Species' Response to Effects of the Proposed Action**

Actions that result in mortality affect listed species through the impact of the loss of individual turtles and also through the loss of the reproductive potential of each turtle to its respective population. Similarly, serious injuries to listed species due to an action that result in an animal's inability to reproduce affects a listed species due to the loss of that animal's reproductive potential. These effects have the potential to reduce the likelihood of survival and recovery of species.

Mortality and serious injury under the research as described under the proposed action is not expected. The effects of the proposed netting, handling, tagging, measuring, weighing, photographing, blood sampling and lavage (and for which we have experience from other existing permits) have been determined to have the potential to elicit short-term changes in sea turtle behavior, but are not likely to result in long-term effects on these individuals or populations. Therefore, NMFS does not expect the research procedures that would be authorized under the proposed action to result in more than short-term effects on individual animals due to the conditions concerning research procedures and placed on the applicant. In addition, NMFS does not expect any delayed mortality of turtles following their release as a direct result of the research based on past research efforts by other researchers and adherence to certain protocols identified in the proposed action. The data generated by the applicant over the duration of this study will provide beneficial information that will be important to the management and recovery of threatened and endangered species. The information collected as a direct result of permit issuance will be available to implement the goals identified in the Recovery Plans for sea turtles. Based on the above, NMFS believes it is reasonable to assume that issuance of the proposed permit will have beneficial effects for sea turtles. Issuance of this permit is not likely to appreciably reduce the numbers, distribution, or reproduction of loggerhead, Kemp's ridley, green or hawksbill sea turtles in the wild that would appreciably reduce the likelihood of survival and recovery of these species.

## **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 Opinion. Future Federal actions, including research authorized under ESA Section 10(a)1(A), that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA. After reviewing available information, NMFS is not aware of effects from any additional future non-federal activities in the action area that would not require federal authorization or funding and are reasonably certain to occur during the foreseeable future.

NMFS expects the natural phenomena in the action area (e.g., oceanographic features, storms, and natural mortality) will continue to influence listed sea turtles as described in the *Environmental Baseline*. We also expect current anthropogenic effects will also continue, including vessel traffic and scientific research. Potential future effects from climate change on sea turtles in the action area are not definitively known. However, climatic variability has the potential to affect these species in the future, including indirectly by affecting sex ratios.

As the size of human communities increase, there is an accompanying increase in habitat alterations resulting from an increase in housing, roads, commercial facilities and other infrastructure. This results in increased discharge of sediments and pollution into the marine environment. These activities are expected to continue to degrade the habitat of sea turtles as well as that of the food items on which they depend. However, it is the combination and extent to which these natural and human-induced phenomena will affect sea turtles that remains unknown.

## **Integration and Synthesis of Effects**

As explained in the Approach to the Assessment section, risks to listed individuals are measured using changes to an individual's "fitness" – i.e., the individual's growth, survival, annual reproductive success, and lifetime reproductive success. When listed plants or animals exposed to an action's effects are not expected to experience reductions in fitness, we would not expect the action to have adverse consequences on the viability of the population(s) those individuals represent or the species those populations comprise (Stearns 1992, Anderson 2000). As a result, if the assessment indicates that listed plants or animals are not likely to experience reductions in their fitness, we conclude our assessment.

The narrative that follows integrates and synthesizes the information contained in the Status of the Species, the Environmental Baseline, and the Effects of the Action sections of this Opinion to assess the risk the proposed activities pose to loggerhead, green, Kemp's ridley, and hawksbill sea turtles. There are known cumulative effects (i.e., from future state, local, tribal, or private actions) that fold into our risk assessment for this species. This section provides an integration and synthesis of the information presented in the Status of the Species, Environmental Baseline, Cumulative Effects, and Effects of the Action sections of this Opinion. The intent of the following discussion is to provide a basis for determining the additive effects of the take authorized in the permit on loggerhead, green, Kemp's ridley, and hawksbill sea turtles, in light of their present and anticipated future status.

While the loss of all these turtles, including eggs, has likely adversely affected the ability of all loggerhead, green, Kemp's ridley and hawksbill sea turtle populations considered in this Opinion to maintain or increase their numbers by limiting the number of individuals in these populations, the loss of reproductive adults results in reductions in future reproductive output.

Species with delayed maturity such as sea turtles are demographically vulnerable to increases in mortality, particularly of juveniles and subadults, those stages with higher reproductive value. The potential for an egg to develop into a hatchling, into a juvenile, and finally into a sexually mature adult sea turtle varies among species, populations, and the degree of threats faced during each life stage. Each juvenile that does not survive to produce will be unable to contribute to the maintenance or improvement of the species' status. Reproducing females that are prematurely killed due the threats mentioned in the above sections, while possibly having contributing something before being removed from the population, will not be allowed to realize their reproductive potential. Similarly, reproductive males prematurely removed from the population will be unable to make their reproductive contribution to the species' population.

As described in the Effects of the Action section of this Opinion, the research activities that would take place under the permit are not expected to result in mortality or injury to any of the sea turtles. The capture, handling, tagging, measuring, photographing, weighing, blood sampling and lavage activities will only result in temporary stress to the animal and are not expected to have more than short-term effects on individual loggerhead, green, Kemp's ridley, and hawksbill sea turtles. These non-lethal interactions will not affect the turtle's ability to reproduce and contribute to the maintenance or recovery of the species. These effects are expected to be short-term because the take is non-lethal and previous experience with the type of proposed research activities has demonstrated that it is reasonable to expect that effects will be minimal. This research will affect the turtles by harassing individual turtles during the research thus raising levels of stressor hormones, and the turtle may experience some discomfort during capture, tagging, blood sampling and lavage procedures. Based on past observations of similar research, these effects are expected to dissipate within approximately a day. Based on this prior information and experience, and conditions placed on the Permit Holder, NMFS does not expect the applicant's proposal to conduct the research as described above to result in more than short-term effects on the individual animals. NMFS also does not expect any delayed mortality of any turtles following their release as a direct result of the research based on past research efforts by other researchers and adherence to certain protocols identified in the proposed action.

Although some degree of stress or pain is likely for individual turtles captured, handled and tagged, and while tagging and tissue sampling will result in tissue injuries, none of the research procedures are expected to result in mortality or reduced fitness of individuals. The proposed permit is not expected to affect the population's reproduction, distribution, or numbers. Because the proposed action is not likely to reduce the particular population's likelihood of surviving and recovering in the wild, it is not likely to reduce the species' likelihood of surviving and recovering in the wild.

NMFS does not expect the proposed research activities to appreciably reduce the green, loggerhead, hawksbill, or Kemp's ridley sea turtles likelihood of survival and recovery in the

wild by adversely affecting their birth rates, death rates, or recruitment rates. In particular, NMFS does not expect the proposed research Permits to affect adult, female turtles in a way that appreciably reduces the number of animals born in a particular year; the reproductive success of adult female turtles; the survival of young turtles; or the number of young turtles that annually recruit into the adult, breeding populations of any population of green, loggerhead, hawksbill, or Kemp's ridley sea turtles.

The proposed action is not expected to have more than short-term effects on loggerhead, green, Kemp's ridley, and hawksbill sea turtle populations. The data generated by the applicant regarding these populations over the duration of this study will provide beneficial information that will be important to the management and recovery of threatened and endangered species. The information collected as a direct result of Permit issuance will be used to implement the goals identified in the Recovery Plans for the U.S. Atlantic Populations of sea turtles. As discussed above, NMFS believes it is reasonable to assume that issuance of the proposed Permit will have beneficial effects for the Gulf of Mexico/Atlantic Ocean populations of green, loggerhead, hawksbill, and Kemp's ridley sea turtles.

## **Conclusion**

After reviewing the current status of the loggerhead, green, hawksbill, and Kemp's ridley sea turtles, the environmental baseline for the action area, the effects of the take authorized in these permits, and probable cumulative effects, it is NMFS' biological opinion that issuance of these permits, as proposed, will not reduce the likelihood of the survival and recovery of their populations in the wild by reducing their numbers, distribution, or reproduction, and therefore is not likely to jeopardize the continued existence of these species and is not likely to destroy or adversely modify designated critical habitat.

## **INCIDENTAL TAKE STATEMENT**

Section 9 of the ESA and Federal regulation pursuant to section 4(d) of the ESA prohibit the take of endangered and 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 NMFS 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 USFWS as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of 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 taking under the ESA provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

## **Amount or Extent of Take**

The permit is for the directed take, for research purposes, of listed sea turtles; no incidental take of other listed species is anticipated or authorized.

This opinion does not authorize any take of other listed species or immunize any actions from the prohibitions of section 9(a) of the ESA. Take is authorized by section 10(a) as specified in the permit.

## **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.

The following conservation recommendations would provide information that would improve the level of protections afforded in future consultations involving proposals to issue permits for research on the listed sea turtle species:

1. *Cumulative Impact Analysis.* Before authorizing any additional permits for activities similar to those contained in the proposed permits, F/PR1 should work with the sea turtle recovery team and the research community to develop protocols that would have sufficient power to determine the cumulative impacts (that is, includes the cumulative lethal, sub-lethal, and behavioral consequences) of existing levels of research on individuals populations of sea turtles.
2. *Estimation of actual levels of “take.”* Before authorizing any additional permits for activities similar to those contained in the proposed permits, F/PR1 should review the annual reports and final reports submitted by researchers that have conducted research on sea turtles as well as any data and results that can be obtained from the permit holders. This should be used to estimate the numbers of sea turtles killed and harassed by these investigations, and how the harassment affects the life history of individual animals. The results of the study should be provided to F/PR3 for use in the consultations of future research activities.

## **REINITIATION NOTICE**

This concludes formal consultation on the NMFS’ proposed issuance of scientific research permits 14508 and 14655. 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 take, specified in the permit, is exceeded; (2) new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not previously considered; (3) the identified action is subsequently modified in a manner that causes an effect to listed species or critical habitat that was not considered in the biological opinion; (4) a new species is listed or critical habitat designated that may be affected by the identified action. In instances where the amount or extent of take is exceeded, section 7 consultation must be reinitiated immediately.

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