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. 14949 to Carlos Diez, which would determine the ecology and population dynamics of hawksbill and green turtles inhabiting the waters surrounding Puerto Rico and the adjacent islands including Mona, Monito, Desecheo, Caja-de-Muertos, Vieques, the Culebra Archipelago, and the Tres Palmas reserve 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: _____

APR 15 2011

Date: _____

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 permit 14949 (Principal Investigator – Carlos Diez) would likely jeopardize the existence of the endangered green, hawksbill turtles.

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on the Effects of the Issuance of a Scientific Research Permit for Sea Turtle Research in Puerto Rico*, published and unpublished scientific information on the biology and ecology of endangered and threatened turtle, and other sources of information.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 permit.

Consultation History

The Permits, Conservation and Education Division requested a consultation under the ESA in a memorandum dated September 14, 2010, on its proposal to issue scientific research permit 14949 for a five-year period. The applicant would be conducting research on listed green and hawksbill sea turtles in the coastal waters of Puerto Rico and its adjacent islands. Consultation was initiated on September 24, 2010.

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 14949 would authorize Carlos Diez, of the Department of Natural and Environmental Resources, San Juan, Puerto Rico, to annually capture 252 green (*Chelonia mydas*) and 320 hawksbill (*Eretmochelys imbricata*) sea turtles within waters surrounding Puerto Rico and the adjacent islands.

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 70 hawksbill sea turtles annually using a sampling technique called gastric lavage or stomach flushing. This research would provide information on the ecology and population dynamics of green and hawksbill turtles inhabiting the waters surrounding Puerto Rico and the adjacent islands including Mona, Monito, Desecheo, Caja-de-Muertos, Vieques, the Culebra Archipelago, and the Tres Palmas reserve.

Figure 1: Location of the principal study areas: 1- Mona and Monito Islands, 2- Desecheo Island, 3- Culebra Archipelago, 4- Tres Palmas marine reserve

The proposed research would result in collection of baseline data to help determine the decline or recovery of this population. In addition, researchers would monitor the prevalence of fibropapillomatosis (FP), a debilitating disease known to occur in green turtle foraging aggregations in Puerto Rico. NMFS proposes to authorize these activities over a five-year period starting from the date of approval. The applicant currently holds a permit with NMFS (file no. 1518-02; with an expiration date of August 31, 2011).

The annual take is summarized in take Table 1. that follows.

Table 1: Maximum Annual Takes Under Permit No. 14949

No. of Individuals	Life Stage	Species	In-water Take Activity(ies)*	Location
190	Adult/subadult/ juvenile	Hawksbill	Mark, flipper tag; Mark, PIT tag; Measure; Sample, tissue; Sample blood; Weigh	Mona and Monito
10	Adult/subadult/ juvenile	hawksbill	Instrument, epoxy attachment (e.g. satellite tag, VHF tag); Mark, flipper tag; Mark, PIT tag; Measure; Sample, tissue; Sample blood; Weigh	Mona and Monito
50	Adult/subadult/ juvenile	hawksbill	Mark, flipper tag; Mark, PIT tag; Measure; Sample, tissue; Sample blood; Weigh	Desecheo
50	Adult/subadult/ juvenile	hawksbill	Lavage; Mark, flipper tag; Mark, PIT tag; Measure; Sample, tissue; Sample blood; Weigh	Desecheo
20	Adult/subadult/ juvenile	hawksbill	Lavage; Mark, flipper tag; Mark, PIT tag; Measure; Sample, tissue; Sample blood; Weigh	Culebra

190	Adult/subadult/ juvenile	green	Mark, flipper tag; Mark, PIT tag; Measure; Sample blood; Ultrasound; Weigh	Culebra
10	Adult/subadult/ juvenile	green	Collect, tumors; Instrument, epoxy attachment (e.g. satellite tag, VHF tag); Mark, flipper tag; Mark, PIT tag; Measure; Sample blood; Ultrasound; Weigh	Culebra
50	Adult/subadult/ juvenile	green	Mark, flipper tag; Mark, PIT tag; Measure; Sample blood; Weigh	Mona, Monito and Desecheo
10*	Adult/subadult/ juvenile	green	Collect, tumors; Intentional (directed) mortality	Culebra, possible euthanasia if a severe case of FP

* Over the lifetime of the permit, no more than 2 green turtles a year.

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.

Hand Capture

Researchers would use hand capture to sample hawksbill turtles, since netting is inappropriate in the reef areas where the researchers survey. Captures would be combined with sighting censuses and generally involve 3-6 persons: three observers in the water and at least one person operating a small motor-powered boat. The observers in the water would swim in a parallel manner along one direction, separated by about 10-20 meters depending on sea conditions and remaining within visual contact of one another. Census sessions generally last one hour. Whenever a turtle is sighted, first it is determined whether capture is necessary, since they try not to capture breeding females (these can be best intercepted on land while laying eggs) or recently caught animals (identifiable by their clean tags). If capture is desirable, one of two strategies would be used: 1) one of the swimmers would dive toward the bottom directly from above the turtle (and perpendicular to the sea-floor) and grab it quickly by the base of the front flippers to bring it to the surface while at least one of the observers stays above to follow the animal in case it escapes; or 2) occasionally, when a turtle is followed, it can go to depths greater than 15 m. In that case, one of the swimmers descends with SCUBA to attempt hand-capture of the turtle (Eckert et al. 1999).

Entanglement Net Capture

The primary method for capturing green turtles is by net, since the animals are generally not approachable for hand-capture. Netting methods are very similar to those applied in the study area by Collazo et al. 1992. Netting involves a 200 meters long, 9 m high nylon twill net (#18 nylon twine, 25 cm stretch mesh) typically deployed parallel to shore for 1 hour sessions in about

6-8 m water depth with highly visible floats attached every 10 meters. At least six swimmers would snorkel continuously along the net to rapidly extract turtles that collide with the net. At least one boat is used for deploying, attending and retrieval of the net.

Captured turtles would be kept in their normal, upright position on the floor of the boat, covered with regularly moistened towels to prevent overheating from sun exposure (SEFSC 2008). Any turtles apparently afflicted with fibropapillomatosis (FP) would be kept separated (e.g. in the rear of the boat or in a separate vessel) from the healthy individuals, and separate sets of measuring, weighing and tagging gear will be used. Upon completion of processing, turtles would be released in close proximity to the point of capture (<200 meteres) within one hour.

Measure, weigh and photograph

Morphometric data would be collected for each captured turtle using both calipers (SCL) and a flexible tape measure (CCL) (SEFSC 2008). Straight and curved measurements to the nearest 0.1 cm would be taken from all the turtles caught. Turtles would be weighed using spring scales to the nearest 0.1kg. Each set of equipment used to measure and weigh turtles would be cleaned and disinfected with a mild disinfectant solution before each turtle is measured. To minimize inter-observer measurement errors, whenever possible the same observer as in prior survey sessions would take all measurements. Turtles would also be photographed and carefully examined. Saturation tagging and capture-recapture methods conducted at various times throughout the year for the next several years would allow researchers to obtain many population parameters such as patterns of turtle aggregation density, rate of recruitment, somatic growth rates, and turtle migration between survey sites.

Flipper and PIT tag

Medical exam gloves would be worn during all sampling procedures. All turtles would be checked for existing flipper tags or internal Passive Integrated Transponders (PIT tags). If any turtle larger than 25 cm SCL has not been previously tagged, an oxidation and corrosion resistant tag (Monel, Inconel, or plastic Roto tags) would be applied to the proximal trailing edge of each front flipper typically in either the first (closest to the body) scale or between the first and second scale on all turtles, before being released (SEFSC 2008). If the recommended tagging site is damaged or is unsuitable for tag application, then an alternative site along the trailing edge of the back flipper would be used. If a previously tagged turtle is missing any of its original tags, replacement tags would be applied. Damaged or unreadable flipper tags would be removed using two sets of pliers (needle-nose are preferred).

Prior to tagging, tags would be cleaned and disinfected to remove any residue. The tagging site would be swabbed thoroughly with a disinfectant prior to tagging. These tags are expected to last up to several years. A separate set of applicators will be used with turtles afflicted with FP. The applicant will make certain that the locking mechanisms are correctly aligned and that the tag locks in place. However, care should be taken to ensure tags are not cinched too tight against the flipper without room to move freely, and 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. Tag applicators (pliers) would be cleaned and disinfected between turtles to avoid cross contamination. Tag applicators would be washed in fresh water after use, the spring and pivot surface sprayed with WD40, and stored in a sealed plastic bag.

Additionally, turtles smaller than 35 cm would be tagged with AVID PIT tags. 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. Prepackaged sterile PIT tag will be subcutaneously inserted into the dorsal surface of the front flipper in the flexor carpi ulnaris muscle (between the trailing-edge scutes of the flipper and the ulna) using a 12-gauge hypodermic needle. Prior to the insertion of any tag, the skin in the target area would be scrubbed with an antiseptic. PIT tags are encased in glass that protects the electronic components and prevents tissue irritation in the animal.

Blood and tissue sample

Blood samples from all turtles will be taken for genetic analysis, and sex ratios. Blood would be drawn from the dorsal cervical sinus using a sterile vacutainer (Owens and Ruiz 1980). New sterile disposable needles would be used on each animal. A 5-10 ml blood sample (dependent on size) would be drawn from each turtle immediately following capture using a 21-guage, vacutainer needle and a heparinized vacutainer tube. The blood sample would be immediately centrifuged and the plasma and blood cells placed separately into cryotubes and stored frozen in an on-board liquid nitrogen tank for later analysis. Attempts to extract blood (needle insertions) would be limited to a total of four, two on either side of the neck. The collection sites will be thoroughly sterilized with alcohol or another antiseptic prior to needle insertion. During blood sampling, precautions would be taken to prevent a back and forth, or rocking movement of the needle once it is inserted. No blood sample would be taken should conditions on the boat preclude the safety and health of the turtle. No more than 3mL of blood per 1kg of animal would be collected (SEFSC 2008).

Small tissue samples would be collected from turtles for genetic characterization and/or pathological studies. Skin or FP tumors from the shoulder area would be biopsied using a 6-mm diameter biopsy punch. The biopsy site would be cleaned with an antiseptic wipe prior to and after sample collection, and a sterile biopsy punch designed for collecting epidermis samples from humans would be used. Following the biopsy, an additional antiseptic wipe will be used with modest pressure to stop any bleeding. A new sterile biopsy punch would be used on each animal. Tissue samples would be placed in 10% buffered formalin for 12-24 hours, then cut in half and placed in diethyl pyrocarbonate (DEPC) treated phosphate-buffered saline (PBS, pH7.6) and kept at 4oC. After transportation to the laboratory (1-2 weeks), they are kept there at -80oC until assayed (SEFSC 2008).

Lavage

Researchers would extract dietary samples from 70 hawksbill turtles annually to provide insight into feeding habits, consumption levels, and diet selection (Legler 1977). Dietary samples would be carefully extracted from the captured green turtles using gastric lavage or stomach flushing as described by van Dam and Diez (1997). 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. After the turtle's mouth was opened, a standard veterinary canine oral speculum or similar mouth gag (small or medium, depending on the size of the turtle) would be inserted just posterior to the anterior tip of the rhamphotheca to keep the jaws from closing. A soft plastic veterinarian's stomach tube would be lubricated with vegetable oil and cautiously inserted into the mouth and down the length of the esophagus. Tube sizes would vary with the size of the individual turtle to avoid esophageal damage. Two sizes of surgical tubes would be available, as well as a set for FP

turtles and a set for non-FP turtles. Seawater would be pumped through the tube using a hand pump or water from a ~10m high cistern. The tube would then be gently moved back and forth along the length of the esophagus. The returning flow or t he injected water out of the mouth carrying food particles would be collected in a sampling container held below. Samples would be preserved in a 10% buffered formalin solution, with sponges transferred to 70% ethanol (SEFSC 2008).

Generally, the lavage process itself lasts under 30 seconds. The lavage process would be restricted to no more than 45 seconds. After completion of lavage, the water flow would be stopped and the posterior of the turtle would be slightly elevated to allow the tube to drain. Once drained, the tube would be removed first, followed by the mouth gag or PVC pipe. The anterior part of the turtle's body would then be slightly elevated relative to the posterior to allow any remaining water to drain into the esophagus, away from the glottis, so that the turtle could take a breath. Only one sample would be obtained per individual. All lavage equipment would be disinfected between animals.

Satellite Tag

Researchers would attach satellite tags (transmitters) to the carapace of ten green and ten hawksbill turtles. Turtles selected for satellite transmitter application would be either healthy adults (male or female) or large (>60 cm carapace length) immatures. Turtles would be detained for transmitter application either on the beach in a custom wooden box after oviposition (females) or after hand capture at sea lifted and kept confined in a small boat (males and immature). Transmitteres used would be Wildlife Computers model Spot5, measuring approximately 5 x 4 x 2 cm (LxWxH), and weighs 30 grams. The weight of the transmitters would not exceed five percent of the turtle's body mass.

The transmitters would be affixed to the uppermost central section of the turtles' carapace using silicone elastomer and epoxied fiberglass, following Balazs (1996) and Van Dam et al. (2007). Silicone elastomer (a splinting agent used in human medicine that does not generate heat) would be used to create a stable base beneath the transmitter (and on top of the carapace) and would allow the transmitter to be removed (or fall off) without damage to the carapace at a later date. Once the silicone elastomer has cured, three layers of polyester resin over fiberglass cloth strips would be applied to encase the transmitter onto the carapace. The layers of resin would be very thin and generate very little heat. The anterior portion of the carapace would be cleaned of sediment and algae. Researchers would thoroughly clean with a scrub brush the first, second and part of the third vertebral plus the first and second coastal scutes on both sides, avoiding the seams between scutes, rinse with fresh water, dry with a towel, and then lightly sand with sandpaper. The location would be further cleaned using an alcohol pad. Each attachment would be made as hydrodynamic as possible, so that there is no risk of entanglement. Tag attachment would be conducted in a well-ventilated area and extreme care would be taken to ensure that no silicone elastomer or epoxied fiberglass comes in contact with the skin of the turtle. The attachment would take approximately one to two hours to fully dry, depending on ambient air temperature. Turtles are then released at the location of capture (recorded by GPS receiver).

Tumor Removal Surgery

The methodology for the determination of surgical candidates, surgical procedures and post-operative care would all follow the same protocol as determined in the applicant's previous permit (File No. 1518). Fibropapilloma tumors would be removed from selected candidate

animals. The main goal of the surgeries is to understand the pathogenesis / disease course of the FP in the wild. Not every tumor in each animal would be removed by the researchers, doing so would lose information on how existing tumors in the same animal grow and if the removal of tumors triggers any immune response that could cause existing tumors to regress (as it happens in other tumors, which may not be the case with fibropapillomatosis, but scant information is available). In addition, removing massive numbers of tumor in one animal may compromise its health.

A status of "possible surgical candidate" would be assigned by wildlife veterinarians to animals measuring less than 70 cm in carapace length, with overall adequate to acceptable body weight/body mass, no evidence of visceral tumors as demonstrated by ultrasonography, and in which the external FP to be excised exhibit the following characteristics: 1) size that interferes with proper vision, motility, or any other body function/activity necessary for the short-term survival of the animal in the wild, or 2) those that may not be interfering with proper body function/activity but are infected or necrotic and therefore represent an immediate threat to the health of the animal. In cases of massive spread, only the tumors in worst shape would be removed.

The ideal surgery candidate would be a turtle that has an overall good body condition (based on comparative biometric data that has been collected at this site), has no obvious ultrasonographic evidence of internal FP, and hematology values (hematocrit, total solids, white blood cell count) that are within the reference range. A "possible surgical candidate" would be upgraded to "surgical candidate" if the hematology and blood biochemistry results permit. Animals with marked leucopenia (lower than the normal amount of white blood cells), hypoproteinemia (abnormally low level of protein in the blood), anemia (deficiency in the oxygen-carrying component of the blood), and electrolyte imbalances would not be subjected to surgery.

The depth of anesthesia would be assessed by monitoring limb withdrawal, ocular reflexes, and jaw tone. These diminish as the depth of anesthesia increases. Anesthesia would be induced with propofol (3 mg/ kg, IV). Turtles would be intubated and anesthesia maintained with isoflurane gas. Lidocaine would be used in cases where the tumors are small and superficial. The researchers would use a Doppler to monitor the carotid pulse.

In general, surgical excision of these cutaneous masses is minimally invasive and uncomplicated. The surgical site would be prepared by scrubbing with chlorhexidine (long-lasting liquid antiseptic) solution (Nolvassan®, Fort Dodge Animal Health, Fort Dodge, Iowa). The animals would receive butorphanol (1 mg/kg) prior to the removal of large tumors. Small tumors would be removed using local anesthetics, such as lidocane. Tumor(s) would be removed with the use of electrosurgery (Surgitron, Ellman International, Hewlett, New York). This technique allows coagulation of the blood vessels as the tissue is dissected, resulting in minimal blood loss. A veterinary ophthalmologist would evaluate ocular tumors for surgical resection. FPs that are interfering with eyelid function and vision would be removed from the eyelid or conjunctiva if the procedure does not require extended rehabilitation (>48 hours). The eyelids, conjunctiva and cornea would be prepped with a 1:50 povidine-iodine solution before surgical removal of the FP. After three 1-minute cleaning periods the eye would be flushed with 0.9% sterile saline. Conjunctival fibropapillomas would be removed using dissection with tenotomy scissors and bipolar ophthalmic cautery forceps. If the mass is less than or equal to 1/3 the palpebral length it would be removed by a four-sided incision and if greater than1/3, a plasty procedure would be

used for removal of the mass. Conjunctival fibropapillomas that extend into the underlying sclera would not be surgically removed. Similarly, ocular fibropapillomas that invade into the deep corneal stroma (greater than ½ the deep) as determined by biomicroscopy and ocular ultrasound, and tumors that extend in to the orbit as determined by ocular ultrasound would not be treated surgically.

A long lasting absorbable nylon suture would be used in any procedure that requires suturing. After surgery, the turtles would be recovered in an environmental temperature of 80-85°F. They would be placed in a container with foam padding at the bottom and would be kept moist throughout the recovery period. The turtles would be returned to the water within 48 hours or less after complete recovery from anesthesia. Full recovery from anesthesia would be determined by the turtle's ability to raise it head to breathe and the return of normal reflexes. The turtle would be held for 24 hours following recovery from anesthesia to ensure that the anesthetic agent is completely metabolized. Animals would be held in the holding facilities at DNER/USFWS headquarters (Culebra Island). The turtle would not be released until its overall condition has been deemed acceptable by a veterinarian.

Health Assessment

All health related assessments would be conducted by an experienced certified veterinarian (Dr. Samuel Rivera). Due to the high prevalence of FP tumors on green turtles in the Culebra Archipelago, special attention would be given to those animals captured at Manglar and Culebrita. All turtles captured at these sites would be physically examined in detail to determine the presence of fibropapilloma tumors or other abnormal features. Ultrasonic examination would be performed to green turtles captured at these sites.

Researchers have established normal ultrasonographic anatomy of the eyes, liver, kidneys, urinary bladder, esophagus, intestinal loops, and heart. These images are used to compare turtles affected with FP that may have internal organ involvement. A manuscript describing the normal ultrasonographic appearance of green sea turtle internal organs is in preparation. Ultrasound examinations would be performed using a portable Micromaxx ultrasound system (SonoSite, Inc., Bothell, WA 98021, USA). Smaller sea turtles would be imaged using an 8-12 MHz transducer, while larger animals require a 1-2 MHz transducer to allow for better visualization of deeper organs. Researchers can image esophagus, liver, gall bladder, stomach, heart, intestines, urinary bladder, and kidneys. Eye involvement in FP is very common and would be determined during a complete eye examination of all animals from Manglar bay. Researchers have established normal ophthalmologic parameters and standardized ocular ultrasonographic techniques. The ophthalmic examination would consist of: palpebral examination and length measurements, fluorescein staining (if applicable), degree of retropulsion, intraocular pressures, slit-lamp biomicroscopy (eyelids, conjunctiva, cornea, and anterior chamber), direct and indirect ophthalmoscopy, and ocular ultrasonogram.

Euthanasia

FP afflicts some juvenile green turtles at the Culebra study site and it is possible that during the surveys individuals would be captured that are so severely debilitated by the disease that euthanasia would be the most humane option.

The decision to euthanize an animal will be based on the physical condition of the animal and the prognosis for long-term survival. Turtles that are severely emaciated, unable to swim or eat, or

have ultrasonographic evidence of severe internal tumors would be considered for humane euthanasia. Euthanasia would be performed by a qualified veterinarian following the guidelines on humane euthanasia set by the American Veterinary Medical Association panel on euthanasia. Euthanasia, to relieve suffering, would be reserved for those cases where the prognosis for long-term survival is grave. Based on past experience, the applicant anticipates that euthanasia could apply for up to two juvenile green turtles per year over the course of the permit.

The selected turtle(s) would be euthanized by lethal injection, using beuthanasia® solution. Four ml per Kg of body weight would be injected intravenously. Euthanized turtles would be necropsied. The lack of a heart rate would be evaluated via ultrasonography prior to performing a thorough necropsy. After the completion of the necropsy the carcasses would be taken to a veterinary facility for incineration.

Permit Conditions

The following information outlines the main mitigation measures researchers would employ to minimize the potential for any adverse impacts to the target species (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. Turtles will be handled carefully so they do not incur additional injury during or after research procedures. 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 or euthanasia.

The following specific research conditions will be placed on the research should permit (No. 14949) be issued to ensure compliance with appropriate research protocols:

1. The Permit Holder would ultimately be responsible for all activities of any individual who is operating under the authority of the proposed permit. The Principal Investigator (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 Chief, 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 Chief, 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.

3. An annual report would be submitted and reviewed by NMFS for each year the permit is 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 the proposed permit, the Permit Holder 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 application and NMFS conservation plan; 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, and shall be the appropriate weight/size ratio to the receiving animal.

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. Researchers must have PIT tag readers capable of reading 125, 128, 134.2, and 400 kHz tags.

7. Flipper Tagging with Metal Tags – All tags must be cleaned (e.g., to remove oil residue) and disinfected before being used. Applicators must be cleaned (and disinfected when appropriate, e.g., contaminated with fluids) between animals. The application site must be cleaned and then scrubbed with a disinfectant (e.g. Betadine) before the tag pierces the animal's skin.

8. PIT Tagging – New, sterile tag applicators (needles) must be used. The application site must be cleaned and then scrubbed with a disinfectant (e.g. Betadine) before the applicator pierces the animal's skin. The injector handle must be disinfected if it has been exposed to fluids from other animals.

9. General Handling and Releasing of Turtles: The Principal Investigator, 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. If an animal becomes highly stressed, injured, or comatose during the course of the research activities the researchers must contact a veterinarian

immediately. Based on the instructions of the veterinarian, if necessary, the animal must be immediately transferred to the veterinarian or to a rehabilitation facility to receive veterinary care. All turtles must be handled according to procedures specified in 50 CFR 223.206(d)(1)(i).

10. 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.

11. During release, turtles shall be lowered as close to the water's surface as possible, to prevent potential injuries.

12. Blood sampling: Blood samples must be taken by experienced personnel that have been authorized under this permit. New disposable needles must be used on each animal. Care should 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 from the neck must be limited to a total of four, two on either side. Sample collection sites must always be scrubbed with alcohol or another antiseptic prior to sampling. No blood sample will be taken should conditions on the boat preclude the safety and health of the turtle.

13. Blood volume limits (standard language):
    - A single sample must not exceed 3 ml per 1 kg of animal.

    - Turtles that are severely injured or compromised: Severely compromised or injured turtles must not be sampled unless specifically authorized by NMFS or during treatment by a veterinarian for a specific health problem.

    - Sampling period: Within a 45-day period of time, the cumulative blood volume taken from a single turtle must not exceed the maximum safe limit described above. If more than 50% of the maximum safe limit is taken, in a single event or cumulatively from repeat sampling events, from a single turtle within a 45-day period that turtle must not be re-sampled for three months from the last blood sampling event.

    - Research coordination: Researchers must, to the maximum extent practicable, attempt to determine if any of the turtles they blood sample may have been sampled within the past three months or will be sampled within the next 3 months by other researchers. The permit holder must contact the other researchers working in the area that could capture the same turtles to ensure that none of the above limits are exceeded.

14. Tissue sampling: Tissue samples shall be taken by experienced personnel that have been authorized under this permit. A new disposable biopsy punch 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 tissue sampling, efforts to collect it must be discontinued. Attempts shall be limited to one on either side of the trailing edge of each

rear flipper. Sample collection sites shall always be sterilized with alcohol or another antiseptic prior to sampling. If it can be easily determined (through markings, tag number, etc.) that a sea turtle has been recaptured by the fisheries and has been already sampled under the activities authorized by this permit, no further biopsy samples must be collected from the animal.

15. Transfer of Biological Samples: The transfer of any biological samples from the Permit Holder to researchers other than those specifically identified in the application requires written approval from NMFS. The terms and conditions concerning any samples collected under this authorization remain in effect as long as the Permit Holder maintains authority and responsibility of the material taken.

16. Gastric Lavage: The actual lavaging of an individual turtle must not exceed 45 seconds. 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.
    - Equipment (e.g., lavage tubes) that will come in contact with sea turtles must be disinfected between animals. Additionally, a separate set of sampling equipment for handling animals displaying fibropapilloma tumors and/or lesions. Disinfection can be compromised (incomplete) if items are contaminated with debris and/or have rough or porous surfaces. Researchers shall clean items prior to disinfection and increase the exposure time for rough and/or porous items.

    - Disinfectants shall be used according to directions, however researchers shall ensure that contact time with disinfectant is sufficient (according to label directions; a dip and rinse is not sufficient) and lavage tubes shall be thoroughly physically cleaned prior to disinfection (viruses can remain protected in organic matter, the disinfectant can't get to them if they're protected in this matter).

    - Care shall be taken that disinfecting solutions are clean and active and that proper rinsing occurs after disinfection.

17. Instrument tagging and marking:
    - TDRs, VHF, sonic or satellite tags only.

    - Total weight of transmitter attachments must not exceed 5% of the body mass of the animal. Each attachment must be made so that there is no risk of entanglement. The transmitter attachment must either contain a weak link (where appropriate) or have no gap between the transmitter and the turtle that could result in entanglement. The lanyard length (if used) must be less than 1/2 of the carapace length of the turtle. It must include a corrodible, breakaway link that will corrode and release the tag-transmitter after the tag-transmitter life is finished. Researchers must make attachments as hydrodynamic as possible.

18. Entanglement netting:
    - Nets used to catch turtles must be of large enough mesh size to diminish bycatch of other species.

- Highly visible buoys must be attached to the float line of each net and spaced at intervals of every 10 yards or less.

- Nets must be checked at intervals of less than 30 minutes, and more frequently whenever turtles or other organisms are observed in the net. The float line of all nets must 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 30oC, nets must be checked at less than twenty minute intervals. Researchers must plan for unexpected circumstances or demands of the research activities and have the ability and resources to meet this net checking condition at all times (e.g. if one animal is very entangled and requires extra time and effort to remove from the net, researchers must have sufficient staff and resources to continue checking the rest of the net at the same time).

- 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.

19. Hand Capture: Researchers must be aware of the increased stress that accompanies hand captures and do their best to minimize stress levels. If there is any question that the research capture event could pose or is posing (during the capture event) a significant risk to the animal's health, the capture event must be discontinued.

20. Transport and Holding (if applicable):
    - Turtles must be transported via a climate-controlled environment, protected from temperature extremes and kept moist (if appropriate). The turtles must be placed on pads for cushioning. The area surrounding the turtle must not contain any materials 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 if in the State of Florida, following Florida Fish and Wildlife Conservation Commission Sea Turtle Conservation Guidelines, Section 4, Holding Turtles in Captivity.

21. Compromised or Injured Sea turtles: The Permit Holder may conduct the activities authorized by this permit on compromised or injured sea turtles, but only if the activities will not further compromise the animal. Care must be taken to minimize handling time

and reduce further stress to the animal. Compromised or injured sea turtles must not be handled or sampled by other permit holders working under separate research permits if their activities would further compromise the animal.

22. In waters where manatees are present: The following conditions to the permit are provided by the United States Fish and Wildlife Service to prevent adverse interactions with endangered West Indian manatees (Trichecus manatus manatus):
    - Vessel personnel must be informed that it is illegal to intentionally or unintentionally harm, harass, or otherwise "take" manatees, and to obey all posted manatee protection speed zones, Federal manatee sanctuary and refuge restrictions, and other similar state and local regulations while conducting in-water activities. Such information shall be provided in writing to all vessel personnel prior to beginning the permitted research.

    - Crew involved in research activities must wear polarized sunglasses to reduce glare while on the water and keep a look out for manatee. The crew shall include at least one member experienced in and dedicated to watching for manatee during all in-water activities.

    - All vessels engaged in netting and trapping shall operate at the slowest speed consistent with those activities. All netting and trapping shall be restricted to the hours between one-half hour after sunrise to one-half hour before sunset.

    - Rope attaching floats to nets or traps shall not have kinks or contain slack that could present an entanglement hazard to manatee.

    - All nets must be continuously monitored. Netting activities must cease if a manatee is sighted within a 100-foot radius of the research vessel or the net, and may resume only when the animal is no longer within this safety zone, or 30 minutes has elapsed since the manatee was last observed within the safety zone.

23. If a manatee is accidentally captured:
    - Devote all research staff efforts to freeing the animal. Remember that a manatee must breathe and surface approximately every 4 minutes. The Permit Holder or PI must brief all research participants to ensure that they understand that freeing a manatee can be dangerous. This briefing will caution people to keep fingers out of the nets, that no jewelry should be worn, that they be careful to stay away from the manatee's paddle, and that they give the animal adequate time and room to breathe as they are freeing it.

    - As appropriate, turn off the vessel motors or put the engine in neutral. Propellers can seriously injure or kill manatees.

    - 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 are docile animals but can thrash violently if captured or become entangled in a net. A 1,200 to

3,500 pound manatee can cause extensive damage to nets while trying to escape or breathe, so quick action is essential to protect both the manatee and the net. Ensure that the animal does not escape with net still attached to it.

- Contact Jan Paul Zegarra, USFWS-Caribbean Ecological Services Field Office, 787-851-7297 ext. 220 immediately to report any incidents. If a manatee is injured, the sooner the animal receives treatment, the better its chance of recovery.

24. Submerged Aquatic Vegetation, Coral Communities, Live or Hard Bottom Ecosystems: Researchers must take all practicable steps to identify submerged aquatic vegetation (SAV), coral communities, and live/hard bottom habitats and avoid setting gear in such areas. Researchers must use strategies to identify SAV, coral, and live or hard bottom types and avoid adverse impacts to EFH, including the use of tools such as charts, GIS, sonar, fish finders, or other electronic devices to help determine characteristics and suitability of bottom habitat prior to using gear. If research gear is lost, diligent efforts must be made to recover the lost gear to avoid further damage to benthic habitat and impacts related to "ghost fishing."

25. Sea grass species: Researchers must avoid conducting research over, on, or immediately adjacent to any sea grass species. If these species cannot be avoided, then the following avoidance/minimization measures must be implemented:
    - In order to reduce the potential for sea grass damage, anchors must be set by hand when water visibility is acceptable. Anchors must be placed in unvegetated areas within seagrass meadows or areas having relatively sparse vegetation coverage. Anchor removal must be conducted in a manner that would avoid the dragging of anchors and anchor chains.

    - Researchers must take great care to avoid damaging any sea grass species and if the potential for anchor or net drag is evident researchers must suspend research activities immediately.

    - Researchers must be careful not to tread or trample on seagrass and coral reef habitat.

26. No gear may be set, anchored on, or pulled across coral or hard/live bottom habitats.

27. Bycatch: All incidentally captured species (e.g., fishes) must be released alive as soon as possible. Researchers must document bycatch and the condition of the bycatch upon release. This information must be included in the annual report.

28. Individuals conducting permitted activities must possess qualifications commensurate with their roles and responsibilities.

29. Persons who require state or Federal licenses to conduct activities authorized under the permit (e.g. veterinarians, pilots) must be duly licensed when undertaking such activities.

30. The Permit holder must submit annual reports to the Chief, NMFS Permits, Conservation, and Education Division and a final report must be submitted within 180 days after expiration of the permit, or, if the research concludes prior to permit expiration, within 180 days of completion of the research.

31. Research results must be published or otherwise made available to the scientific community in a reasonable period of time.

32. The Permit Holder must provide written notification of planned field work to the appropriate Assistant Regional Administrator(s) for Protected Resources. Such notification must be made at least two weeks prior to initiation of a field trip/season and must include the locations of the intended field study and/or survey routes, estimated dates of research, and number and roles of participants.

33. To the maximum extent practicable, the Permit Holder must coordinate permitted activities with activities of other Permit Holders conducting the same or similar activities on the same species, in the same locations, or at the same times of year to avoid unnecessary disturbance of animals.

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. Mills and Beatty 1979; Anderson 2000; Brandon 1978; Stearns 1992). 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. 14949: The study would be conducted within the waters surrounding Puerto Rico and the adjacent islands including Mona, Monito, Desecheo, Caja-de-Muertos, Vieques, the Culebra Archipelago, and the Tres Palmas reserve.

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 permit (14949) to the applicant and may be affected:

Common Name	Scientific Name	Listing Status
Sea Turtles		
Green sea turtle[1]	*Chelonia mydas*	Endangered/Threatened
Hawksbill sea turtle	*Eretmochelys imbricate*	Endangered
Leatherback sea turtle	*Dermochelys coriacea*	Endangered
Loggerhead sea turtle[2]	*Caretta caretta*	Threatened
Corals		
Elkhorn Coral	*Acropora palmata*	Threatened
Staghorn Coral	*Acropora cervicornis*	Threatened

Listed Resources Not Likely to be Adversely Affected

Leatherback sea turtles inhabit the waters off the coast of Puerto Rico and may therefore be affected by the proposed research activities through net capture. However, given the fact that researchers are experienced in turtle surveys and will restrict their research to the targeted species and the fact that the researchers have never encountered a leatherback sea turtle the past, NMFS believes the probability of this species being exposed to the effects of the research activities to be highly unlikely and therefore the threats posed to this species are discountable. Therefore, the proposed research permit modifications are not likely to adversely affect leatherback sea turtles and this species will not be considered further in this Opinion.

A distinct population segment (DPS) of loggerhead sea turtles is proposed to be re-listed as endangered under the ESA for the Northwest Atlantic Ocean. Benthic immature loggerheads foraging in waters off the northeast coast of the U.S. may travel southward in the fall as temperatures cool (Epperly et al. 1995; Keinath, 1996; Morreale and Sandora, 1998; Shoop and Kenney, 1992) and non-nesting adults may spend a portion of their time in Gulf of Mexico waters (Schroeder et al., 2003) meaning that some individuals from this proposed distinct population segment may be affected by the proposed research activities. However, given that researchers will restrict their research activities to waters off the coast of Puerto Rico and its sister islands, NMFS believes the probability of members of this Northwest Atlantic Ocean DPS being exposed to the effects of the research activities to be highly unlikely and therefore the

1 Green sea turtles in U.S. waters are listed as threatened except for the Florida breeding population, which is listed as endangered. Due to difficulties in distinguishing between individuals from the Florida breeding population from other populations, green sea turtles are considered endangered wherever they occur in U.S. waters.

2 . Loggerhead turtles are currently proposed to be listed as distinct population segments. DPS is a vertebrate population or group of populations that is discrete from other populations of the species and significant in relation to the entire species. The ESA provides for listing species, subspecies, or distinct population segments of vertebrate species.

threats posed to this proposed DPS are discountable. The loggerhead sea turtles encountered over the course of the research are expected to be members of the proposed South Atlantic Ocean DPS, these could be disturbed by the research activities (netting); however they are not the targeted species and would be quickly released from the net. Therefore, the proposed research permit modifications are not likely to adversely affect loggerhead sea turtles (both the Northwest Atlantic Ocean DPS and South Atlantic Ocean DPS) and this species will not be considered further in this Opinion.

Two listed invertebrate species (Elkhorn and Staghorn coral) and their joint critical habitat occur within the action area and could therefore be subjected to physical disturbance from vessels or nets used for turtle capture or from unexpected contaminant or fuel spill pollution under this permit. However, permit conditions require the researchers to avoid impacting sediment or habitat for coral or other live bottom communities. Specific permit conditions include avoiding setting gear over such areas as well as taking steps to recover lost gear, avoiding anchoring in areas where these communities exist, and avoiding treading or trampling on these areas where in-water work occurs. Also, the research team has experience performing similar types of surveys in these areas and would be expected to take all proper precautions to avoid any physical disturbance or minimizing the impact of an accidental fuel spill. NMFS believes that listed corals as well as their critical habitat are highly unlikely to be exposed to effects from the proposed action and any potential threats are discountable. Therefore, the proposed action is not likely to adversely affect Elkhorn coral, Staghorn coral, or their critical habitat and these listed resources will not be considered further in this Opinion.

Designated Critical Habitat

Research would be conducted in the waters surrounding Culebra Island (green sea turtle critical habitat) and the waters of Mona and Monito Islands (hawksbill critical habitat).

In designating critical habitat, NMFS must consider the requirements of the species, including (1) Space for individual and population growth, and for normal behavior; (2) food, water, air, light, minerals, or other nutritional or physiological requirements; (3) cover or shelter; (4) sites for breeding, reproduction, or rearing of offspring; and, generally, (5) habitats that are protected from disturbance or are representative of the historic geographical and ecological distributions of the species (see 50 CFR 424.12(b)).

Critical habitat for the green sea turtle is listed under 50 CFR 226.208. It includes the waters surrounding the island of Culebra, Puerto Rico from the mean high water line seaward to 3 nautical miles (5.6 km). These waters include Culebra's outlying Keys including Cayo Norte, Cayo Ballena, Cayos Geniqui, Isla Culebrita, Arrecife Culebrita, Cayo de Luis Pena, Las Hermanas, El Mono, Cayo Lobo, Cayo Lobito, Cayo Botijuela, Alcarraza, Los Gemelos, and Piedra Steven. Sea grasses are the principal dietary component of juvenile and adult green turtles. The Culebra archipelago is important green sea turtle developmental and feeding habitat (e.g. sea grasses such as *Thalassia testudinum*). The coral reefs and other topographic features within these waters provide green turtles with shelter during interforaging periods (USOFR 1998).

Critical habitat for the hawksbill turtle is designated under 50 CFR 226.209. It includes the waters surrounding the islands of Mona and Monito, Puerto Rico from the mean high water line seaward to 3 nautical miles (5.6 km). The coral reefs of Mona and Monito provide foraging habitat (e.g. sponges) for hawksbill sea turtles, and the ledges and caves of the reefs provide shelter for resting and refuge from predators (USOFR 1998). The proposed permit would authorize activities in critical habitat areas for green and hawksbill sea turtles, but activities are not expected to adversely affect any of the physical, chemical, or biotic features that form the critical habitat. As a result, the proposed activities are not likely to adversely affect the conservation value of the designated critical, and so it is not addressed further in this Opinion**.**

Critical habitat for elkhorn and staghorn corals is designated under 50 CFR 226.216. It includes all waters in the depths of 98 ft (30 m) and shallower to the mean low water line in Puerto Rico and associated Islands. Within these specific areas, the essential feature consists of natural consolidated hard substrate or dead coral skeleton that are free from fleshy or turf macroalgae cover and sediment cover.

The proposed permit would authorize activities in critical habitat areas of elkhorn and staghorn corals, but activities are not expected to adversely affect any of the physical, chemical, or biotic features that form the critical habitat. The proposed activities would not affect the substrate of suitable quality and availability, in water depths of 30 meters or less, to support successful recruitment and population growth of these corals. As a result, the proposed activities are not likely to adversely affect the conservation value of the designated critical habitat for elkhorn and staghorn corals, and so their critical habitat is not addressed further in this Opinion**.**

Species Likely to be Adversely Affected

The sections below provide information on the status of listed resources likely to be adversely affected by the proposed action. The green 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; green (NMFS and USFWS 2007) and hawksbill (NMFS and USFWS 2007b). Most of these species have circumgobal 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.

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 1991).

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 1991). 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 a. 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.

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 1998b).

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 1998b).

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 1998b). 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 1998b). 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 1998b). 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 2007b) 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 (NMFS 1999b), but not jeopardize their continued existance. 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 opinion 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 (NFMS 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 reeffish 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 (8-18º 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 1997a). 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 (NMFS 1997b).

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 numerously 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 > 55ºF. 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 64ºF 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 68ºF, 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, kemps and green 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). Pound net leaders with greater than or equal to 12 inches (30.5 cm) stretched mesh and leaders with stringers have been documented to incidentally take sea turtles (Bellmund et al., 1987, 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. 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). 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. An increase in the number of docks built increases boat and vessel traffic. Fueling facilities at marinas can sometimes discharge oil, gas, and sewage into sensitive estuarine and coastal habitats. 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 turtles 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/i) 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 km2, 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^2 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 fibropapilloma (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 lead 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).

Climate change at normal rates (thousands of years) was not historically a problem for sea turtles species since they have shown unusual persistence over a scale of millions of years. However, there is a 90% probability that warming of the earth's atmosphere since 1750 is due to human activities resulting in atmospheric increases in carbon dioxide, methane, and nitrous oxide (IPCC 2007). All reptiles including sea turtles have a tremendous dependence on their thermal environment for regulating physiological processes and for driving behavioral adaptations (Spotila et al. 1997). In the case of sea turtles, where many other habitat modifications are documented (beach development, loss of foraging habitat, etc.), the prospects for accentuated synergistic impacts on survival of the species may be even more important in the long-term. Atmospheric warming creates habitat alteration which may change sex ratios, reproductive periodicity, marine habitats, or prey resources such as crabs and other invertebrates. It may increase hurricane activity leading to an increase in debris in nearshore and offshore waters, resulting in increase in entanglement, ingestion, or drowning. Atmospheric warming may change convergence zones, currents and other oceanographic features that are relevant to various sea turtles' life stages.

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 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 November 2010, there were 25 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 72º 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, 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 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.

Exposure Analyses

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. Individuals exposed may be of either sex or of any age.

The proposed action will expose listed sea turtle species to disturbance from boat, capture, sampling and collection activities. Carlos Diez of the Department of Natural and Environmental Resources of Puerto Rico has requested authorization to annually sample a combined total of 252 green and 320 hawksbill sea turtles within the waters surrounding Puerto Rico and the adjacent islands including Mona, Monito, Desecheo, Caja-de-Muertos, Vieques, the Culebra Archipelago and the Tres Palmas reserve. Animals will be measured, weighed, flipper tagged, checked for PIT tags, PIT tagged, satellite tagged, lavaged, blood and tissue sampled and released. 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.

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, our assessments try to detect potential lethal, sub-lethal (or physiological), or behavioral responses that might reduce the fitness of individuals. Ideally, response analyses would consider and weigh evidence of adverse consequences as well as evidence suggesting the absence of such consequences. 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 (Beale and Monaghan, 2004; Frid, 2003; Frid and Dill, 2002; Gill and Sutherland, 2001; Harrington and Veitch, 1992; Lima, 1998; 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).

Capture

The capture could result in stresses due to being entangled in nets (green) or handled by the snorkelers and/or divers (hawksbill). 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 handling. During the warmer months, routine metabolic rates are higher, so the impacts of the stress 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. 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 provided 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.

Ultrasonic Examination

Ultrasonography is a noninvasive technique (Owens, 1999) commonly used in human medicine, that assists in determining the presence of FP tumors or other abnormal features using a portable ultrasound machine on board the research vessel and takes a maximum of 10 minutes per turtle. Turtles remain largely impassive while inverted. A clear, water-based gel would be applied to the inguinal area of the turtle and smooth-ended transducer would then be pushed up against the skin and used to visualize the area. Since this procedure is non-invasive, we do not expect this method to have sub-lethal effects.

FP Tumor Removal Surgery
The main disadvantage is that this procedure is invasive and potentially hazardous to the turtle. Moreover, it is logistically difficult and should not be attempted without proper veterinary training. Complete familiarization with sea turtle anatomy is essential prior to doing surgery. It is also important to use aseptic techniques at all times to prevent infections. Tumor(s) would be removed with the use of electrosurgery, which allows coagulation of the blood vessels as the tissue is dissected, resulting in minimal blood loss.

Effects of surgery could include pain, handling discomfort, possible hemorrhage at the site with a risk of infection. Particular caution is necessary to avoid an entry that is too deep; striking vital organs during surgery has the potential of inducing severe bleeding and mortality. It is currently common practice to avoid the use of general anesthetics (with veterinary approval) whenever possible, since a local anaesthetic incurs less risk of mortality, is adequate for reducing apparent pain, and allows a much shorter post-operative observation period (Wood *et al.*, 1982; Wibbels *et al.*, 1990). Turtles will be held for 24 hours following recovery from anesthesia and closely monitored to evaluate breathing and diving capability and released once normal buoyancy has been confirmed.

Boat Strikes, Noise and Visual Disturbance
There is a potential for boat strikes, noise and visual disturbance to listed species resulting from the proposed activities. However, because of the trained research personnel, maneuverability and slow operating speeds of the research vessels, boat strikes are extremely unlikely and noise and visual disturbance would be discountable. As a result, any risk of boat related disturbances to listed species is highly unlikely and no reduction in the fitness of any individual listed sea turtle is expected.

Euthanasia
Euthanasia will be used to relieve suffering, and will be reserved for those cases where the prognosis (by a qualified veterinarian) for long-term survival is exceptionally grave. Although this would remove two juvenile green turtles per year over the course of the permit, these deaths would have no overall effect to the population since the probability of these individual turtles contributing through reproduction to the respective population is negligible, should they not be euthanized.

Summary of Effects
The short-term stresses resulting from capture, handling, measuring, photographing, weighing, flipper tagging, blood and tissue sampling, and FP tumor removal 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 (other than humane euthanasia) and serious injury under the research as described under the proposed actions are not expected. The effects of the proposed handling, measuring, weighing, photographing, tagging, lavaging, blood and tissue sampling 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, leatherback, 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 (Anderson, 2000; Brandon, 1978; Mills and Beatty, 1979; Stearns, 1992). 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 green 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 green and hawksbill sea turtles, in light of their present and anticipated future status.

While the loss of any turtles, including eggs, has likely adversely affected the ability of all green 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 reproduce 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 contributed 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 Permit 14949 are not expected to result in mortality or injury to any of the sea turtles. The capture, handling, tagging, measuring, photographing, weighing, tissue and blood sampling activities will only result in temporary stress to the animal and are not expected to have more than short-term effects on individual green 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 and tissue sampling 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 and hawksbill 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 Permit 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 and hawksbill sea turtles.

The proposed actions are not expected to have more than short-term effects on green and hawksbill sea turtle populations. The data generated by the applicant regarding these populations over the duration of these studies 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 Atlantic Ocean populations of green and hawksbill sea turtles.

Conclusion

After reviewing the current status of the green and hawksbill sea turtles, the environmental baseline for the action area, the effects of the take authorized in this permit, and probable cumulative effects, it is NMFS' biological opinion that issuance of the permit, 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)(1)(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.* 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."* 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.

RENITIATION NOTICE

This concludes formal consultation on the NMFS' proposed issuance of scientific research permit 14949. 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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Appendix 1. The anticipated annual incidental take of loggerhead, leatherback, Kemp's ridley, green, and hawksbill sea turtles as outlined in the most recent opinions on NMFS-authorized federal fisheries.

FISHERY	SEA TURTLE SPECIES					
	TAKE PERIOD	LOGGERHEAD	LEATHERBACK	KEMP'S RIDLEY	GREEN	HAWKSBILL
SOUTHEASTERN U.S. SHRIMP	ANNUAL	163,160 – No more than 3,948 lethal	3,090 – No more than 80 lethal	155,503 – No more than 4,208 lethal	18,757 – No more than 514 lethal	640 – All lethal
ATLANTIC HMS-PELAGIC LONGLINE	3 – YEAR	1,905 – No more than 339 lethal	1,764 – No more than 252 lethal	105 – All species in combination; no more than 18 lethal		
ATLANTIC HMS-SHARK FISHERIES	3 – YEAR	679 – No more than 113 lethal	74 – No more than 47 lethal	2 – No more than 1 lethal	2 – No more than 1 lethal	2 – No more than 1 lethal
SOUTH ATLANTIC SNAPPER-GROUPER	3 – YEAR	68 – No more than 23 lethal	9 – No more than 5 lethal	7 – No more than 3 lethal	13 – No more than 5 lethal	2 – No more than 1 lethal
GULF OF MEXICO REEF FISH	3 – YEAR	68 – No more than 26 lethal	7 – No more than 3 lethal	1 – Lethal or non-lethal	17 – No more than 7 lethal	15 – No more than 5 lethal
SUMMER FLOUNDER/SCUP/ BLACK SEA BASS	ANNUAL	19 – No more than 5 lethal (total – either loggerheads or Kemp's ridley	None	See loggerhead entry	2 – lethal or non-lethal	None
GOM STONE CRAB	3 – YEAR	16 – No more than 4 lethal	1 – Lethal or non-lethal	3 – No more than 1 lethal	4 – No more than 1 lethal	1 – Lethal or non-lethal
DOLPHIN-WAHOO		12 – No more than 2 lethal	12 – No more than 2 lethal	3 – All species in combination; no more than 1 lethal take		
COASTAL MIGRATORY PELAGICS	ANNUAL	11 – Lethal takes	2 – Lethal takes for leatherbacks, hawksbill, and Kemp's ridley- both lethal take	14 – Lethal takes	2 – Lethal takes for leatherbacks, hawksbill, and Kemp's ridley- both lethal take	
ATLANTIC BLUEFISH	ANNUAL	6 – No more than 3 lethal	None	6 – Lethal or non-lethal	None	None
ATLATIC MACKEREL/SQUID/ BUTTERFISH	ANNUAL	6 – No more than 3 lethal	1 – Lethal or non-lethal	2 – Lethal or non-lethal	2 – Lethal or non-lethal	None
MONKFISH (GILLNET)		3 – Loggerhead (no more than 5 lethal loggerhead takes by all monkfish gear over 5 yrs)	1 – Leatherback, Kemp's ridley or green			None
MONKFISH		1 – Leatherback, leatherback, Kemp's ridley or green				None

(TRAWL)						
SPINY DOGFISH		3 – No more than 2 lethal	1 – Lethal or non-lethal	1 – Lethal or non-lethal	1 – Lethal or non-lethal	None
GOM/SOUTH ATLANTIC SPINY LOBSTER	3 – YEAR	3 – Lethal or non-lethal	1 – Leatherback, Kemp's ridley or hawksbill		3 – lethal or non-lethal	See leatherback entry
NORTHEAST LOBSTER TRAP	ANNUAL	2 – Lethal or non-lethal	9 – Lethal or non-lethal (biennially)	None	None	None
NORTHEAST MULTISPECIES		1 – Lethal or non-lethal	1 – Lethal or non-lethal	1 – Lethal or non-lethal	1– Lethalor non-lethal	None