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

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

Proposed Action: **Proposal to issue permit No. 15552 to Bonnie Ponwith, which would document take of ESA-listed sea turtles at multiple life stages in commercial fisheries in the Southwest Atlantic Ocean, Gulf of Mexico and the Caribbean Sea, and to enhance estimates of sea turtle by-catch in order to characterize the effects on sea turtle sub-populations pursuant to Section 10(a)(1)(A) of the Endangered Species Act of 1973.**

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

Approved by: ______________________

Date: JUL 21 2011

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 and conference opinion (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 15552 (Principal Investigator – Bonnie Ponwith) would likely jeopardize the existence of the endangered green, Kemp's ridley, hawksbill, leatherback turtles, proposed endangered loggerhead sea turtle Northwest Atlantic Ocean Distinct Population Segment (DPS), and threatened olive ridley turtles.

This Opinion has been prepared in accordance with section 7 of the ESA and regulations promulgated to implement that section of the ESA. This 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 File No. 15552 for the Southeast fishery science* *center observer program to conduct Sea Turtle Research from specimens taken in commercial fisheries*, 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 Opinion. The 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 March 2, 2011, on its proposal to issue scientific research permit 15552 for a five-year period. The applicant would conduct research on various listed sea turtles incidentally captured in commercial fisheries in the Southwest Atlantic Ocean, Gulf of Mexico, and the Caribbean Sea. Consultation was initiated on March 9, 2011.

Biological and Conference Opinion

Description of the Proposed Action

The Permits, Conservation and Education Division of the NMFS Office of Protected Resources proposes to issue a scientific research permit pursuant to section 10(a)(1)(A) of the ESA. Permit 15552 would authorize Bonnie Ponwith, of the NMFS Southeast Fisheries Science Center (SEFSC), to annually capture 94 green (*Chelonia mydas*), 731 loggerhead (*Caretta* caretta), 76 hawksbill (*Eretmochelys imbricata*), 255 leatherback (*Dermochelys coriacea*), 163 Kemp's ridley (*Lepidochelys kempii)* and 120 olive ridley/hybrids (*Lepidochelys olivacea*) sea turtles. Activities would occur on commercial fishing vessels or associated vessels within in the Southwest Atlantic Ocean, Gulf of Mexico, and the Caribbean Sea (including embayments and tributaries), and the adjoining state waters that are affected through the regulation of activities of Federal permit holders fishing in those waters. This work would involve determining the size and composition of sea turtle populations found within these commercial fishing areas, and to enhance estimates of sea turtle by-catch in order to characterize the effects on sea turtle sub-populations.

The incidental capture and related impacts to sea turtles would be authorized by incidental take statements (ITS) in section 7 biological opinions or section 10(a)(1)(B) permits for each fishery. However, the takes analyzed in this biological opinion and authorized pursuant to the permit refer only to the effects on the sea turtles of the research activities. No lethal takes are authorized. In certain cases, such as for olive ridley sea turtles for which few fisheries authorize incidental takes, Permit No. 15552 authorizes research activities, as long as the fishery is otherwise in compliance with the terms and conditions of its incidental take statement or its permit.

Specific fisheries that require coverage may change over the five-year permit, but those listed in this permit in which proposed activities would potentially occur through 2015 are:

Trawl Fisheries

Migratory Coastal Pelagic Fisheries – Gulf of Mexico and South Atlantic (trolling/gill nets)
Butterfish, Squid Fish Trawl Fishery (paired/single trawl)
Jellyfish Surface Trawl Fishery (trawl)
Winter Fluke (flounder) Trawl Fishery (trawl)
Gulf of Mexico Pink Shrimp Fishery (beam trawl)
Brown, White, Pink, Seabob and Other Marine Shrimp Fishery (skimmer trawl)

Trap/pot Fisheries

South Atlantic Snapper-grouper (trap)
Lobster Trap Fishery (pot)
Southeastern and Gulf of Mexico Crab Fisheries (crab trap/pot)
Black Sea Bass Pot Fishery (trap/pot)

Gillnet Fisheires

Inshore Gillnet Fishery
North Carolina Coastal Gillnet Fishery in State and Federal Waters

Pound Net/Weir/Seine Fisheries

North Carolina Pound-net Fishery (pound net)
North Carolina Haul/Beach Seine for Striped Bass, Weakfish, Spot, Striped Mullet (multifilament seine; monofilament gillnet/seine)
North Carolina Long-Haul Seines for Sport, Weakfish, and Atlantic Croaker (seine)
North Carolina Stop Nets for Striped Mullet (multifilament anchored net and multifilament beach seine)
Gulf Menhaden Purse-Seine Fishery (purse seine)
Atlantic Menhaden Purse-Seine Fishery (purse seine)
Southeastern Atlantic Croaker and Weakfish Fishery (flynet)
Brown, White, Pink, Seabob and Other Marine Shrimp Fishery (butterfly net)
Brown, White, Pink and Other Marine Shrimp Fishery (cast net)

[*]Recreational Private Boat Fishery

Hook and line
Cast net
Crab pot
Gill net
Rake
Tong
Seine

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

Table 1: Maximum Annual Takes Under Permit No. 15552			
No. of Individuals	Life Stage	Species	In-water Take Activity(ies)[1]
731	Adult/subadult/ juvenile	loggerhead	Carapace mark (temporary); Flipper tag; PIT tag; Measure; Photograph/Video; Tissue biopsy; Salvage (carcass, tissue, parts)
163*	Adult/subadult/ juvenile	Kemp's ridley	Carapace mark (temporary); Flipper tag; PIT tag; Measure; Photograph/Video; Tissue biopsy; Salvage (carcass, tissue, parts)
94*	Adult/subadult/ juvenile	green	Carapace mark (temporary); Flipper tag; PIT tag; Measure; Photograph/Video; Tissue biopsy; Salvage (carcass, tissue, parts)
76*	Adult/subadult/ juvenile	hawksbill	Carapace mark (temporary); Flipper tag; PIT tag; Measure; Photograph/Video; Tissue biopsy; Salvage (carcass, tissue, parts)
255	Adult/subadult/ juvenile	leatherback	Carapace mark (temporary); Flipper tag; PIT tag; Measure; Photograph/Video; Tissue biopsy; Salvage (carcass, tissue, parts)
120	Adult/subadult/ juvenile	Other (Olive Ridley's or hybrids)	Carapace mark (temporary); Flipper tag; PIT tag; Measure; Photograph/Video; Tissue biopsy; Salvage (carcass, tissue, parts)

[1]The number of takes authorized is contingent upon the ITS of fishery or a section 10(a)(1)(B) incidental take permit. Researchers may take turtles up to the amount authorized in the ITS or section 10(a)(1)(B) incidental take permit but may not exceed the upper totals of this permit. If the ITS decreases, researchers may take only the number authorized in the lower ITS.
* Up to an additional 20 turtles for each of these species could be 'taken' since they combined into one category for a few of the fisheries, but not exceed the total of any of the three combined species)

The new permit, if issued, would authorize the proposed research over a five-year period starting from the date of approval. The applicant currently holds a permit with NMFS (file no. 1552; with an expiration date of June 30, 2011).

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

Turtle Capture, Experimental Procedures and Minimization of Impacts

Researchers would not capture turtles. Activities would be conducted on turtles taken legally, incidental to commercial fishing operations. The following sections describe how turtles will be 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.

Southeast Fisheries Observer Program (SEFOP) observers aboard commercial fishing vessels would handle, identify, photograph, measure, weigh, PIT tag, flipper tag, biopsy, and resuscitate sea turtles, and would transport dead or injured turtles that are incidentally taken during commercial fishing operations to shore to be transferred to NMFS approved Sea Turtle Stranding and Salvage Network (STSSN) personnel.

Sea turtles would be handled and resuscitated according to procedures specified in 50 CFR 223.206(d)(1)(i). SEFOP certified observers would be provided and required to follow the Southeast Fisheries Science Center Sea Turtle Research Techniques Manual (NMFS SEFSC 2008, Appendix 1).

Observers will request that all observed sea turtles captured during commercial fishing operations be lowered on to the deck as carefully as possible. Turtles, except leatherbacks, would be turned onto the carapace with plastron facing upwards if assistance is available to the observer. If assistance is not available, the turtle would remain carapace up, with a damp cloth over its head. While onboard the vessel, sea turtles would be protected from temperature extremes, provided adequate air flow, and kept moist during sampling. Attempts to revive comatose or unresponsive turtles would be made by holding turtles onboard for up to 24 hours and elevating the hindquarters to allow for water drainage (NMFS SEFSC 2008).

Morphometric data would be collected for each captured turtle using a flexible tape measure as well as forestry calipers. This would include curved carapace length, carapace width, tail length, straight carapace length (SCL), carapace width, head width and plastron length measurements to the nearest 0.1 cm. Turtles would be weighed to the nearest 0.5kg using a digital hanging scale. Turtles also would be photographed and carefully examined. Turtles with fibropapillomastosis (FP) will be kept separate from other turtles and separate sets of measuring, weighing and tagging gear will be used. Each set of equipment would be used to measure and weigh turtles would be cleaned and disinfected with a mild disinfectant solution before each turtle is measured.

All turtles would be checked for existing flipper tags and scanned for existing internal Passive Integrated Transponders (PIT) tags. If any turtle larger than 26 cm Notch-to-Tip (total length) has not been previously tagged, an oxidation and corrosion resistant metal tag (Inconel) would be applied to the proximal trailing edge of each rear flipper typically in either the first (closest to the body) or second scale on all turtles except leatherbacks. These tags are expected to last up to several years. Leatherback turtles would be tagged along the posterior (trialing) edge of the rear flipper, approximately 5 cm from the base of the tail. If the recommended tagging site is damaged or is unsuitable for tag application, then an alternative site along the trailing edge of the front flipper would be used. Damaged or unreadable flipper tags would be removed using two sets of pliers (needle-nose are preferred). While one set firmly holds the Inconel tag, the other set bends back the cinched end.

Prior to flipper tagging, tags would be cleaned and soaked in alcohol to remove any residue. The tagging site would be swabbed thoroughly with 10% povidone-iodine prior to tagging. Antibiotic ointment would be applied to the cutting tip of each tag just prior to attachment. 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 with alcohol swabs 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.

Should the turtle not have a PIT tag, a tag would be placed using a sterile 12-gauge hypodermic needle, into the dorsal surface of the front flipper in the flexor ulnaris muscle (between the trailing edge scutes of the flipper and the ulna). These tags are expected to last indefinitely. Prior to the insertion of any tag, the skin in the target area would be scrubbed with 10% povidone-iodine. If a previously tagged turtle is missing any of its original tags, replacement tags would be applied.

A temporary, identifying number would be painted on the carapace of each hardshell turtle to enable observers to identify and record recently captured turtles to aid observers in keeping turtles differentiated on deck should multiple turtles be captured. Temporary white gel coat paint would be applied to the scutes with no paint crossing sutures.

Small skin biopsies would be collected for genetic studies from live and dead sea turtles larger than 25 cm Notch-to-Tip (Total Length) carapace length. The ventral and dorsal surface of epidermis would be cleansed with 10% povidone-iodine prior to and after sample collection, and a sterile 6-mm biopsy punch designed for collecting epidermis samples from humans would be used to yield a tissue sample between 0.5 to 2 mm in depth. A new sterile biopsy punch would be used on each animal. Tissue samples would be taken from the trailing edge of each rear flipper just past (away from the body) of the Inconel tag location. Following the biopsy, an additional antiseptic wipe will be used with modest pressure to stop any bleeding. Samples would be preserved in 5 ml vials filled with 20% saturated DMSO, non-toxic preservative.

For turtles that are not boated, a corer attached to a biopsy pole would be used to obtain the sample alongside the vessel. Gear would consist of a 12’ anodized aluminum breakdown biopsy pole or similar biopsy harpoon (NMFS SEFSC 2008). Corers would be stored in ethanol-cleaned vials. The threaded stud on the biopsy pole would be cleaned with an alcohol swab before attaching the corer. For leatherbacks, a ribbon of tissue would be scraped off the carapace with the corer, leaving a gray superficial scar that would heal well over time. If a scrape cannot be obtained, a forceful jab perpendicular to the flipper or at an oblique angle would be employed. Nerve bundles high on the shoulders near the carapace as well as the “armpit” area would be avoided. The corer with the tissue would be stored in a vial of NaCl saturated 20% DMSO buffer. No compromised animals would be biopsied if it would further compromise their health.

Extra care would be used when handling, sampling, and releasing leatherback turtles. Very large leatherbacks would typically not be boarded. They would be sampled alongside the vessel and then released at the water’s surface. Only in the rare case when a vessel is equipped with a large turtle hoist apparatus to retrieve the turtle from the water would a large leatherback be brought on deck. In longline fisheries, smaller leatherbacks and other sea turtle species would be brought onboard when a dipnet is available. Live, healthy sea turtles would be held for no more than 20 minutes, and would be released close to the original capture site after all sampling is complete. During release, engines would be in neutral and turtles released away from fishing gear and as close to the surface of the water as possible (NMFS SEFSC 2008).

Sea turtle carcasses, tissues, or parts would be collected (when possible) from dead animals--incidental lethal takes would have been authorized by the commercial fishing operations or other activities. Samples would be stored on ice or frozen and subsequently used for scientific studies. Carcasses would be bagged and shipped on ice to NMFS facilities for necropsy to determine cause of death. Tissue samples from non-frozen animals would be examined for histopathology and contaminant analyses. Hard parts would be salvaged for aging and life history studies. Tissue biopsies would be collected for genetic studies. Gut contents would be salvaged for diet studies. The applicant also holds a CITES permit to import salvaged sea turtle carcasses, parts, and tissue samples from live animals from the high seas.

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 10% povidone-iodine 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. The following specific research conditions will be placed on the research should permit (No. 15552) 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 Chiefs, Permits, Conservation and Education Division by phone (301-713-2289) as soon as possible, but no later than two days following the event. The Permit Holder must re-evaluate the techniques that were used and those techniques must be revised accordingly to prevent further injury or death. The Permit Holder must submit a written report describing the circumstances surrounding the event. The Permit Holder must send this report to the Chiefs, Permits, Conservation and Education Division, F/PR1, 1315 East-West Highway, Silver Spring, MD 20910. Pending review of these circumstances,

NMFS may suspend authorization of research activities or amend the Permit in order to allow research activities to continue.

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 10% povidone-iodine) 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.

7. Flipper Tagging with Metal Tags – All tags shall be cleaned (e.g. oil residue) and disinfected before being used.

8. General Handling and Releasing of Turtles: The Principal 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. All turtles must be handled according to procedures specified in 50 CFR 223.206(d)(1)(i).

9. Turtles are to be protected from temperature extremes of heat and cold, and kept moist during sampling. The turtle will be placed on pads for cushioning and this surface will be disinfected between turtles. The area surrounding the turtle may not contain any materials that could be accidentally ingested.

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

11. 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.

12. Transport and Holding (if applicable):
    - Turtles are to be transported via a climate-controlled environment, protected from temperature extremes of heat and cold, and kept moist. The turtle will be placed on pads for cushioning. The area surrounding the turtle may not contain any material that could be accidentally ingested.

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. 15552: The study would be conducted within the U.S. Exclusive Economic Zone of the southeastern Atlantic coast, Gulf of Mexico, and the Caribbean Sea (including embayments and tributaries) and the adjoining state waters that are affected through the regulation of activities of Federal permit holders fishing in those waters.

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 (15552) to the applicant and may be affected:

Common Name	Scientific Name	Listing Status
Sea Turtles		
Green sea turtle	*Chelonia mydas*	Endangered/Threatened[1]
Hawksbill sea turtle	*Eretmochelys imbricata*	Endangered
Kemp's ridley sea turtle	*Lepidochelys kempii*	Endangered
Olive ridley sea turtle	*Lepidochelys olivacea*	Endangered[2]/Threatened
Leatherback sea turtle	*Dermochelys coriacea*	Endangered
Loggerhead sea turtle	*Caretta caretta*	Endangered NW Atlantic DPS [3]

Critical Habitat

- In 1979, NMFS designated critical habitat for leatherback turtles to include the coastal waters adjacent to Sandy Point, St. Croix, U.S. Virgin Islands (44 FR 17710).
- On January 5, 2010, NMFS proposed and sought comments on the expansion of critical habitat to include approximately 70,600 square miles (182,854 square km) of marine habitat in the Pacific Ocean off the U.S. coast, east of a line approximating the 2,000-meter depth contour (75 FR 319).
- On May 5, 2011, NMFS accepted the petition to revise critical habitat off the coast of Puerto Rico (76 FR 25660).
- In 1998 critical habitat was designated for hawksbill turtles in coastal waters surrounding Mona and Monito Islands, Puerto Rico and for green turtles in coastal waters around Culebra Island, Puerto Rico (63 FR 46693).
- On February 17, 2010, NMFS and USFWS were jointly petitioned to designate critical habitat for Kemp's ridley sea turtles for nesting beaches along the Texas coast and marine habitats in the Gulf of Mexico and Atlantic Ocean. NMFS is currently reviewing the petition.
- Critical habitat has not been designated for loggerhead turtles.

No critical habitat will be affected by the research, since the incidental capture and related impacts (including those to critical habitat) would be authorized by the section 7 biological opinions or section 10(a)(1)(B) permits for each fishery.

Species Likely to be Adversely Affected

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

Background information on the range-wide status of these species can be found in a number of published documents including status reviews and recovery plans; Kemp's ridley (NMFS and

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[1] Green sea turtles in U.S. waters are listed as threatened except for the Florida breeding population, which is listed as endangered. Because we are unable to distinguish between the populations away from the nesting beaches, green sea turtles are considered endangered wherever they occur in U.S. waters.
[2] Mexico's Pacific coast breeding colonies are listed as endangered.
[3] A distinct population segment, 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.

USFWS 2010), loggerhead (NMFS and USFWS 2009), hawksbill (NMFS and USFWS 2007a), green (NMFS and USFWS 2007b), leatherback (NMFS and USFWS 2007c) and olive ridley (NMFS and USFWS 2007d). 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.

Loggerhead Sea Turtle (*Caretta caretta)*

Listing Status, Description of Species and Critical Habitat.

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

Currently, there are 9 distinct population segments (DPS) of loggerhead sea turtles proposed to be listed under the ESA divided geographically: South Atlantic Ocean DPS (Threatened), Southwest Indian Ocean DPS (Threatened), Mediterranean Sea DPS (Endangered), North Indian Ocean DPS (Endangered), North Pacific Ocean DPS, Northeast Atlantic Ocean DPS (Endangered), Northwest Atlantic Ocean DPS (Endangered), South Pacific Ocean DPS (Endangered), and Southeast Indo-Pacific Ocean DPS (Endangered). A final determination will be made by September 2011.

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

Life History

Mating takes place in late March-early June, and eggs are laid throughout the summer. Female loggerheads deposit an average of 4.1 nests within a nesting season (Murphy and Hopkins, 1984) and have an average remigration interval of 3.7 years (Tucker 2010). Loggerheads nest on ocean beaches and occasionally on estuarine shorelines. Mean clutch size varies from about 100 to 126 along the southeastern United States coast (Dodd 1988). Loggerheads originating from the western Atlantic nesting aggregations are believed to lead a pelagic existence in the North Atlantic Gyre for as long as 7-12 years (Bolten *et al.*, 1998). Turtles in this life history stage are called “pelagic immatures” and are best known from the eastern Atlantic near the Azores and Madeira and have been reported from the Mediterranean as well as the eastern Caribbean (Bjorndal et al., 2000). Stranding records indicate that when pelagic immature loggerheads reach 40-60 cm straight carapace length they recruit to coastal inshore waters of the continental shelf throughout the U.S. Atlantic and Gulf of Mexico (Witzell 2002).

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

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

Range, Distribution, Population Dynamics, Status and Trend of Loggerhead Sea Turtles
The loggerhead occurs throughout the temperate and tropical regions of the Atlantic, Pacific, and Indian Oceans, and inhabit continental shelves and estuarine environments (Dodd 1988). However, the majority of loggerhead nesting is at the western rims of the Atlantic and Indian Oceans. They concentrate their nesting in the north and south temperate zones and subtropics, but generally avoid nesting in tropical areas of Central America, northern South America, and the Old World (NRC 1990). The most recent reviews show that only two loggerhead nesting aggregations have greater than 10,000 females nesting per year: Peninsular Florida, United States and Masirah Island, Oman (Baldwin *et al.* 2003; Ehrhart *et al.* 2003; Kamezaki *et al.* 2003, Limpus and Limpus 2003; Margaritoulis *et al.* 2003). Trends indicate that Florida's loggerhead nest counts have declined significantly between 1989 and 2006 and have shown a steep decline within the most recent period, 1998–2006 (Witherington *et al*. 2009). Results of the analysis indicated that there has been a decrease of 26% over the 20-year period from 1989-2008 and a 41% decline since 1998 (NMFS and USFWS 2009). In contrast to determining population size on nesting beaches, determining population size in the marine environment has been very localized (Bjorndal and Bolten 2000). At present, there are no data on population size in the oceanic habitat. Developmental habitat for small juveniles includes the pelagic waters of the North Atlantic and the Mediterranean Sea.

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

As post-hatchlings, Northwest Atlantic loggerheads hatched on U.S. beaches migrate offshore and become associated with *Sargassum* habitats, driftlines, and other convergence zones (Carr 1986; Witherington 2002). The oceanic juvenile stage in the North Atlantic has been primarily studied in the waters around the Azores and Madeira (Bolten 2003). In Azorean waters, satellite telemetry data and flipper tag returns suggest a long period of residency (Bolten 2003), whereas turtles appear to be moving through Madeiran waters (Dellinger and Freitas 2000). Other concentrations of oceanic juveniles exist in the Atlantic (e.g., in the region of the Grand Banks off Newfoundland). Genetic information indicates the Grand Banks off Newfoundland are foraging grounds for a mixture of loggerheads from all the North Atlantic rookeries (LaCasella *et al.* 2005; Bowen *et al.* 2005), and a large size range is represented (Watson *et al.* 2004, 2005). After departing the oceanic zone, neritic juvenile loggerheads in the Northwest Atlantic inhabit continental shelf waters from Cape Cod Bay, Massachusetts, south through Florida, The Bahamas, Cuba, and the Gulf of Mexico (neritic refers to the inshore marine environment from the surface to the sea floor where water depths do not exceed 200 meters). In the U.S., estuarine waters, including areas such as Long Island Sound, Chesapeake Bay, Pamlico and Core Sounds, Mosquito and Indian River Lagoons, Biscayne Bay, Florida Bay, and numerous embayments fringing the Gulf of Mexico, comprise important inshore habitat. Along the Atlantic and Gulf of Mexico shoreline, essentially all shelf waters are inhabited by loggerheads. Benthic immature loggerhead foraging in northeastern U.S. waters are known to migrate southward in the fall as water temperatures cool (Epperly *et al.* 1995; Keinath 1993; Morreale and Sandora 1998; Shoop and Kenney 1992), and migrate northward in spring. The trend is reversed in the fall as water temperatures cool. The large majority leave the Gulf of Maine by mid-September but some may remain in Mid-Atlantic and Northeast areas until late Fall. By December loggerheads have emigrated from inshore North Carolina waters and coastal waters to the north to waters offshore of North Carolina, particularly off of Cape Hatteras, and waters further south where the influence of the Gulf Stream provides temperatures favorable to sea turtles (Epperly *et al.* 1995). Loggerhead sea turtles are year-round residents of central and south Florida.

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

Adults have been reported throughout the range of this species in the U.S. and throughout the Caribbean Sea (Meylan *et al.* 1983). As discussed in the beginning of this section, they nest primarily from North Carolina southward to Florida with additional nesting assemblages in the Florida Panhandle and on the Yucatan Peninsula (Addison and Morford 1996; Addison 1997; Foley *et al.* 2008). Non-nesting, adult female loggerheads are reported throughout the U.S. and Caribbean Sea; however little is known about the distribution of adult males who are seasonally abundant near nesting beaches during the nesting season. Aerial surveys suggest that loggerheads (benthic immatures and adults) in U.S. waters are distributed in the following proportions: 54% in the southeast U.S. Atlantic, 29% in the northeast U.S. Atlantic, 12% in the eastern Gulf of Mexico, and 5% in the western Gulf of Mexico (TEWG 1998).

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

Threats

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

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

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

There are also many non-fishery impacts affecting the status of sea turtles, both in the marine and terrestrial environment. In the ocean waters of the U.S., the construction and maintenance of Federal navigation channels has been identified as a source of turtle mortality. Hopper dredges, which are frequently used in ocean bar channels and sometimes in harbor channels and offshore borrow areas, move relatively rapidly and can entrain and kill sea turtles (NMFS 1997). Sea turtles entering coastal or inshore areas have been affected by entrainment in the cooling-water systems of electrical generating plants. U.S. rig removal activities (e.g. Army Corps of Engineers) also adversely (injury or mortality) affect sea turtles. Vessel operations and ordnance detonation, can affect listed species of sea turtles (NMFS 1997b). Ingestion of marine debris can also be a serious threat to sea turtles worldwide (Ivar do Sul and Costa 2007). Some types of marine debris may be directly or indirectly toxic, such as oil (Lutcavage *et al.* 1995). Other types of marine debris, such as discarded or derelict fishing gear, may entangle and drown sea turtles (Bugoni *et al.* 2001). Oil and gas exploration, development and transportation, underwater explosions, dredging, offshore artificial lighting, marina and dock construction and operation, boat collisions, and poaching are other threats sea turtles face at sea. Private and commercial vessel operations have the potential to interact (propeller or boat collisions) with sea turtles, resulting in injury or death. Sea turtles are also the focus of research activities worldwide. However, a very small percentage of these result in injury or mortality.
Destruction and modification of loggerhead nesting habitats are occurring worldwide throughout the species range. The main anthropogenic threats impacting loggerhead nesting habitat include coastal development/construction, placement of erosion control structures and other barriers to nesting, beachfront lighting, vehicular and pedestrian traffic, sand extraction, beach erosion, beach sand placement, beach pollution, removal of native vegetation, and planting of non-native vegetation (Baldwin 1992; Margaritoulis *et al.* 2003).

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

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

Loggerheads are highly migratory, which makes them a shared resource among many nations. Therefore, conservation efforts for loggerhead populations in one country may be jeopardized by activities in another. Many countries lack regulations or have inadequate regulations in place to address the impacts of a wide range of anthropogenic activities that directly injure and kill loggerheads, disrupt necessary behaviors, and alter terrestrial and marine habitats used by the species.
A more thorough description of anthropogenic effects and mortality sources is provided in the 2009 Loggerhead sea turtle status review (NMFS and USFWS 2009) as well as in 5-year status review (NMFS and USFWS 2007a), TEWG reports (1998, 2000) and in NMFS SEFSC (2001).

Green turtle (*Chelonia mydas*)

Listing Status, Description of Species and Critical Habitat

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

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

Life History

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

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

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

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

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

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

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

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

In the western Atlantic, several major nesting assemblages have been identified and studied (Bass et. al 2006; Bowen et 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.

Kemp's ridley turtle (*Lepidochelys kempii*)

Listing Status, Description of Species and Critical Habitat

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

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

Life History

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

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

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

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

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

Nuevo, a stretch of beach in Mexico. Most of the population of adult females nest in this single locality (Pritchard 1969). When nesting aggregations at Rancho Nuevo were discovered in 1947, adult female populations were estimated to be in excess of 40,000 individuals (Hildebrand 1963). By the early 1970s, the world population estimate of mature female Kemp's ridleys had been reduced to 2,500-5,000 individuals. The population declined further through the mid-1980s. Recent observations of increased nesting suggest that the decline in the ridley population has stopped and there is cautious optimism that the population is now increasing. The number of nests has grown from a low of approximately 702 nests in 1985, to greater than 1,940 nests in 1995, to over 20,000 nests recorded in 2009 (NMFS and USFWS 2010 draft). However, preliminary nesting data for 2010 indicate a dramatic drop in the number of nests (T. Conant NMFS, pers. comm. 2010).

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

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

Next to loggerheads, Kemp's ridleys are the second most abundant sea turtle in Virginia and Maryland waters, arriving in these areas during May and June (Keinath *et al.* 1987; Musick and Limpus 1997). The juvenile population of Kemp's ridley sea turtles in Chesapeake Bay is estimated to be 211 to 1,083 turtles (Musick and Limpus 1997). These juveniles frequently forage in submerged aquatic grass beds for crabs (Musick and Limpus 1997). Kemp's ridleys consume a variety of crab species, including *Callinectes spp*., *Ovalipes spp*., *Libinia sp*., and *Cancer spp*. Mollusks, shrimp, and fish are consumed less frequently (Bjorndal 1997). Upon leaving Chesapeake Bay in autumn, juvenile ridleys migrate down the coast, passing Cape Hatteras in December and January (Musick and Limpus 1997). These larger juveniles are joined there by juveniles of the same size from North Carolina sounds and smaller juveniles from New York and New England to form one of the densest concentrations of Kemp's ridleys outside of the Gulf of Mexico (Musick and Limpus 1997; Epperly *et al.* 1995a; Epperly *et al.* 1995b).

Threats

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

Leatherback (*Dermochelys coriacea*)

Listing Status, Description of Species and Critical Habitat

The leatherback sea turtle was listed as endangered throughout its global range on June 2, 1970. Critical habitat was designated in 1998 for leatherback turtles in coastal waters adjacent to Sandy Point, St. Croix, U.S. Virgin Islands. In 2009, NMFS proposed to revise the critical habitat to include areas off of the U.S. west coast.

The leatherback is the largest turtle and the largest living reptile in the world. Mature males and females can be as long as six and a half feet (2 m) and weigh almost 2000 lbs. (900 kg). The leatherback is the only sea turtle that lacks a hard, bony shell. A leatherback's carapace is approximately 1.5 inches (4 cm) thick and consists of leathery, oil saturated connective tissue overlaying loosely interlocking dermal bones. The ridged carapace and large flippers are characteristics that make the leatherback uniquely equipped for long distance foraging migrations.

Leatherbacks lack the crushing chewing plates characteristic of sea turtles that feed on hard-bodied prey (Pritchard 1971). Instead, they have pointed tooth-like cusps and sharp edged jaws that are perfectly adapted for a diet of soft-bodied pelagic (open ocean) prey, such as jellyfish and salps. A leatherback's mouth and throat also have backward-pointing spines that help retain such gelatinous prey.

Life History

Leatherbacks are a long-lived species, living for well over 30 years. It has been thought that they reach sexual maturity somewhat faster than other sea turtles (except Kemp's ridley), with an estimated range from 3-6 years (Rhodin 1985) to 13-14 years (Zug and Parham 1996). However, some recent research using sophisticated methods of analyzing leatherback ossicles has cast doubt on the previously accepted age to maturity figures, with leatherbacks in the western North Atlantic possibly not reaching sexual maturity until as late as 29 years of age (Avens and Goshe 2007). Continued research in this area is vitally important to understanding the life history of leatherbacks and has important implications in management of the species.

Female leatherbacks nest from the southeastern United States to southern Brazil in the western Atlantic and from Mauritania to Angola in the eastern Atlantic. The most significant nesting beaches in the Atlantic, and perhaps in the world, are in French Guiana and Suriname (NMFS SEFSC 2001). Female leatherbacks nest frequently (up to 10 nests per year) during a nesting season and nest about every 2-3 years on sandy, tropical beaches. During each nesting, they produce 100 eggs or more in each clutch and, thus, can produce 700 eggs or more per nesting season (Schultz 1975). However, a significant portion (up to approximately 30 percent) of the eggs can be infertile. Thus, the actual proportion of eggs that can result in hatchlings is less than this seasonal estimate. After 60-65 days, leatherback hatchlings with white striping along the ridges of their backs and on the margins of the flippers emerge from the nest. Leatherback hatchlings are approximately 50-77 cm (2-3 inches) in length, with fore flippers as long as their bodies, and weigh approximately 40-50 grams (1.4-1.8 ounces).

Previous genetic analyses of leatherbacks using only mitochondrial DNA (mtDNA) resulted in an earlier determination that within the Atlantic basin there are at least three genetically different nesting populations: the St. Croix nesting population (U.S. Virgin Islands), the mainland nesting Caribbean population (Florida, Costa Rica, Suriname/French Guiana), and the Trinidad nesting population (Dutton et al. 1999). Further genetic analyses using microsatellite markers in nuclear DNA along with the mtDNA data and tagging data has resulted in Atlantic Ocean leatherbacks now being divided into seven groups or breeding populations: Florida, Northern Caribbean, Western Caribbean, Southern Caribbean/Guianas, West Africa, South Africa, and Brazil (TEWG 2007). General differences in migration patterns and foraging grounds may occur between the seven nesting assemblages, but data is limited.

Based on a review of all sightings of leatherback sea turtles of <145 cm curved carapace length (ccl), Eckert (1999) found that leatherback juveniles remain in waters warmer than 26ºC until they exceed 100 ccl. Although leatherbacks forage in coastal waters, they appear to remain primarily pelagic through all life stages (Heppell et al. 2003). The location and abundance of prey, including medusae, siphonophores, and salpae, in temperate and boreal latitudes likely has a strong influence on leatherback distribution in these areas (Plotkin 1995).

Range, Distribution, Population Dynamics, Status and Trend of Leatherback Sea Turtles
Adult leatherbacks forage in temperate and subpolar regions from 71ºN to 47ºS latitude in all oceans and undergo extensive migrations to and from their tropical nesting beaches. In the Atlantic Ocean, leatherbacks have been recorded as far north as Newfoundland, Canada, and Norway, and as far south as Uruguay, Argentina, and South Africa (NMFS SEFSC 2001). Estimates of total population size for Atlantic leatherbacks are difficult to ascertain due to the

inconsistent nature of the available nesting data. In 1980, the leatherback population was estimated at approximately 115,000 adult females globally (Pritchard 1982). The most recent population estimate for leatherback sea turtles from just the North Atlantic breeding groups is a range of 34,000-90,000 adult individuals (20,000- 56,000 adult females) (TEWG 2007).

The Southern Caribbean/Guianas stock is the largest known Atlantic leatherback nesting aggregation (TEWG 2007). This area includes the Guianas (Guyana, Suriname, and French Guiana), Trinidad, Dominica, and Venezuela, with the vast majority of the nesting occurring in the Guianas and Trinidad. Past analyses had shown that the nesting aggregation in French Guiana had been declining at about 15 percent per year since 1987 (NMFS SEFSC 2001). However, from 1979-1986, the number of nests was increasing at about 15 percent annually which could mean that the current decline could be part of a nesting cycle which coincides with the erosion cycle of Guiana beaches described by Schultz (1975). It is thought that the cycle of erosion and reformation of beaches has resulted in shifting nesting beaches throughout this region. This was supported by the increased nesting seen in Suriname, where leatherback nest numbers have shown large recent increases concurrent with declines elsewhere (with more than 10,000 nests per year since 1999 and a peak of 30,000 nests in 2001), and the long-term trend for the overall Suriname and French Guiana population was thought to possibly show an increase (Hilterman and Goverse 2003). In the past many sea turtle scientists have agreed that the Guianas (and some would include Trinidad) should be viewed as one population and that a synoptic evaluation of nesting at all beaches in the region is necessary to develop a true picture of population status (Reichart et al. 2001). Genetics studies have added support to this notion and have resulted in the designation of the Southern Caribbean/Guianas stock. Using both Bayesian modeling and regression analyses, the TEWG (2007) determined that the Southern Caribbean/Guianas stock had demonstrated a long-term, positive population growth rate (using nesting females as a proxy for population). This positive growth was seen within major nesting areas for the stock, including Trinidad, Guyana, and the combined beaches of Suriname and French Guiana (TEWG 2007).

The Western Caribbean stock includes nesting beaches from Honduras to Colombia. The most intense nesting in that area occurs in Costa Rica, Panama, and the Gulf of Uraba in Colombia (Duque et al. 2000). The Caribbean coast of Costa Rica and extending through Chiriquí Beach, Panama, represents the fourth-largest known leatherback rookery in the world (Troëng et al. 2004). Examination of data from three index nesting beaches in the region (Tortuguero, Gandoca, and Pacuare, in Costa Rica) using various Bayesian and regression analyses indicated that the nesting population was likely not growing over the 1995-2005 time series of available data (TEWG 2007), though modeling of the nesting data for Tortuguero indicates a possible 67.8 percent decline between 1995 and 2006 (Troëng et al. 2007).

Nesting data for the Northern Caribbean stock is available from Puerto Rico, the U.S. Virgin Islands (St. Croix), and the British Virgin Islands (Tortola). In Puerto Rico, the primary nesting beaches are at Fajardo and on the island of Culebra. Nesting between 1978 and 2005 has ranged between 469-882 nests, and the population has been growing since 1978, with an overall annual growth rate of 1.1 percent (TEWG 2007). At the primary nesting beach on St. Croix, the Sandy Point National Wildlife Refuge, nesting has fluctuated from a few hundred nests to a high of 1008 in 2001, and the average annual growth rate has been approximately 1.1 percent from

1986-2004 (TEWG 2007). Nesting in Tortola is limited, but has been increasing from 0-6 nests per year in the late 1980s to 35-65 per year in the 2000s, with an annual growth rate of approximately 1.2 percent between 1994 and 2004 (TEWG 2007).

The Florida nesting stock nests primarily along the east coast of Florida. This stock is of growing importance, with total nests between 800-900 per year in the 2000s following nesting totals fewer than 100 nests per year in the 1980s (Florida Fish and Wildlife Conservation Commission, unpublished data). Using data from the index nesting beach surveys, the TEWG (2007) estimated a significant annual nesting growth rate of 1.17 percent between 1989 and 2005. In 2007, a record 517-leatherback nests were observed on the index beaches in Florida, with 265 in 2008 (FWCC Index Nesting Beach database). The reduction in nesting from 2007 to 2008 is thought to be a result of the cyclical nature of leatherback nesting, similar to the biennial cycle of green turtle nesting.

The West African nesting stock of leatherbacks is a large, important, but mostly unstudied aggregation. Nesting occurs in various countries along Africa's Atlantic coast, but much of the nesting is undocumented and the data is inconsistent. However, it is known that Gabon has a very large amount of leatherback nesting, with at least 30,000 nests laid along its coast in one season (Fretey et al. 2007). Fretey et al. (2007) also provide detailed information about other known nesting beaches and survey efforts along the Atlantic African coast. Because of the lack of consistent effort and minimal available data, trend analyses were not possible for this stock (TEWG 2007).

Two other small but growing nesting stocks utilize the beaches of Brazil and South Africa. For the Brazilian stock, the TEWG (2007) analyzed the available data and determined that between 1988 and 2003 there was a positive annual average growth rate of 1.07 percent using regression analyses, and 1.08 percent using Bayesian modeling. The South African stock has an annual average growth rate of 1.06 based on regression modeling and 1.04 percent using the Bayesian approach (TEWG 2007).

Threats

Zug and Parham (1996) pointed out that the main threat to leatherback populations in the Atlantic is the combination of fishery-related mortality (especially entanglement in gear and drowning in trawls) and the intense egg harvesting on the main nesting beaches. Other important ongoing threats to the population include pollution, loss of nesting habitat, and boat strikes.
Of sea turtle species, leatherbacks seem to be the most vulnerable to entanglement in fishing gear. This susceptibility may be the result of their body type (large size, long pectoral flippers, and lack of a hard shell), their attraction to gelatinous organisms and algae that collect on buoys and buoy lines at or near the surface, possibly their method of locomotion, and perhaps their attraction to the lightsticks used to attract target species in longline fisheries. They are also susceptible to entanglement in gillnets and pot/trap lines (used in various fisheries) and capture in trawl gear (e.g., shrimp trawls). From 1990-2000, 92 entangled leatherbacks were reported from New York through Maine (Dwyer et al. 2002). Additional leatherbacks stranded wrapped in line of unknown origin or with evidence of a past entanglement (Dwyer et al. 2002). Because many entanglements of this typically pelagic species likely go unnoticed, entanglements in fishing gear may be much higher. Leatherbacks also interact with the Gulf of Mexico shrimp

fishery. For many years, TEDs required for use in these fisheries were less effective at excluding leatherbacks than the smaller, hard-shelled turtle species. To address this problem, on February 21, 2003, the NMFS issued a final rule to amend the TED regulations. Modifications to the design of TEDs are now required in order to exclude leatherbacks and large and sexually mature loggerhead and green turtles.

Leatherback sea turtles may be more susceptible to marine debris ingestion than other species due to their pelagic existence and the tendency of floating debris to concentrate in convergence zones that adults and juveniles use for feeding areas and migratory routes (Lutcavage et al. 1997; Shoop and Kenney 1992). Investigations of the stomach contents of leatherback sea turtles revealed that a substantial percentage (44 percent of the 16 cases examined) contained plastic (Mrosovsky 1981). The presence of plastic debris in the digestive tract suggests that leatherbacks might not be able to distinguish between prey items and plastic debris (Mrosovsky et al. 2009). Balazs (1985) speculated that the object might resemble a food item by its shape, color, size or even movement as it drifts about, and induce a feeding response in leatherbacks.

Global climate change is likely to influence the distribution and abundance of jellyfish, the primary prey item of leatherbacks (NMFS and USFWS 2007c). Several studies have shown leatherback distribution is influenced by jellyfish abundance (e.g., Houghton et al. 2006; Witt et al. 2006; Witt et al. 2007). How these changes in jellyfish abundance and distribution will affect leatherback sea turtle foraging behavior and distribution is currently unclear (Witt et al. 2007).

Currently, anthropogenic impacts to the leatherback population are similar to those facing other sea turtle species including interactions with the above mentioned fishery gear, marine pollution, foraging habitat destruction, and threats at nesting beaches please refer to the loggerhead and green turtle Threats section above). A more thorough description of anthropogenic mortality sources facing sea turtles is provided in the leatherback turtle 5-year status review (NMFS and USFWS 2007c) as well as in the TEWG (2007) report.

Hawksbill (*Eretmochelys imbricata*)

Listing Status, Description of Species and Critical Habitat

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

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

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

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

The hawksbill turtle's head is elongated and tapers to a point, with a beak-like mouth that gives the species its name. The shape of the mouth allows the hawksbill turtle to reach into holes and crevices of coral reefs to find sponges, their primary food source as adults, and other invertebrates.

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

Life History

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

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

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

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

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

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

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

The most significant nesting within the U.S. occurs in Puerto Rico and the U.S. Virgin Islands, specifically on Mona Island and Buck Island, respectively. Each year, about 500-1000 hawksbill nests are laid on Mona Island, Puerto Rico (Diez and van Dam 2006) and another 100-150 nests on Buck Island Reef National Monument off St. Croix in the U.S. Virgin Islands (Meylan 1999b). Nesting also occurs on other beaches in St. Croix and on St. John, St. Thomas, Culebra

Island, Vieques Island, and mainland Puerto Rico. Within the continental U.S., nesting is restricted to the southeast coast of Florida and the Florida Keys, but nesting is rare in these areas. No nesting occurs on the west coast of the U.S. mainland. In the U.S. Pacific, hawksbills nest only on main island beaches in Hawaii, primarily along the east coast of the island of Hawaii. Hawksbill nesting has also been documented in American Samoa and Guam.

In addition to nesting beaches in the U.S. Caribbean, the largest hawksbill nesting population in the Western Atlantic, occurs in the Yucatán Península of Mexico, where several thousand nests are recorded annually in the states of Campeche, Yucatán, and Quintana Roo (Spotila 2004; Garduño-Andrade *et al.* 1999). Lutz *et al.* (2003) estimate the number of adult hawksbills living in the Caribbean today is 27,000.

Threats

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

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

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

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

In addition to anthropogenic threats, hawksbill turtles are also threatened by natural causes including hurricanes (NMFS and USFWS 2007d) 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.

Olive Ridley (*Lepidochelys olivacea*)

Listing Status, Description of Species and Critical Habitat

Except for the Mexico breeding stock (endangered), olive ridley sea turtles were listed as threatened under the ESA on July 28, 1978 (43 FR 32800). The olive ridley is the most abundant sea turtle in the world (Pritchard 1997). Worldwide, abundance of nesting female olive ridleys is estimated at two million (Spotila 2004). There is no designated critical habitat for the olive ridley sea turtle.

The olive ridley was named for the olive color of its heart-shaped shell and is one of the smallest of the sea turtles, with adults reaching 2 to 2½ feet in length and weighing 80 to 110 pounds. The species may be identified by the uniquely high and variable numbers of vertebral and costal scutes. Although some individuals have only five pairs of costals, in nearly all cases some division of costal scutes occurs, so that as many as six to nine pairs may be present. In addition, the vertebral scutes also show frequent division, as do the scales on the dorsal surface of the head. The prefrontal scales, however, typically number two pairs. Olive ridleys typically forage offshore and feed on a variety of benthic and pelagic species, such as jellyfish, squid, salps, red crabs, acorn and gooseneck barnacles, mollusks, and algae (Márquez 1990; Carr 1961, Caldwell 1969, Fritts 1981, Cornelius and Robinson 1986, Mortimer 1982 - as cited in NMFS 2004a).

Life History

The olive ridley is most noted for its massive nesting aggregations, known as arribadas or arribazones, with literally thousands of females nesting in large simultaneous waves over small stretches of beach. Arribadas may be precipitated by climatic events, such as a strong offshore wind, or by certain phases of the moon and tide, but there is a major element of unpredictability at all arribada sites. Although not every adult female participates in these arribadas, the vast majority do. Olive ridleys typically nest 1 to 3 times per season, producing about 100 to110 eggs on each occasion. The internesting interval is variable, but for most localities it is approximately 14 days for solitary nesters and 28 days for arribada nesters. Incubation takes about 50 to 60 days.

Little is known about olive ridley growth or reproduction. However, some beaches, such as Ostional Beach on the Pacific coast of Costa Rica, is known to have extremely low hatching success, particularly at the onset of the dry season onward, at least partly due to the high temperatures of nests (Valverde et al. 2010). Post-hatching survivorship is unknown and there is no information available on recruitment rates. Presumably, like other sea turtles, olive ridleys experience high mortality in their early life stages. Juveniles are believed to occur in similar habitats as the adults (i.e., pelagic waters) where they forage on gelatinous prey such as jellyfish, salps, and tunicates (Kopitsky *et al.* 2005).

Female olive ridleys attain sexual maturity at an age similar to its congener, the Kemp's ridley. Based on samples collected in the north-central Pacific Ocean, Zug *et al.* (2006) recently confirmed this and estimated the median age of sexual maturity for the olive ridley is 13 years with a range of 10 to 18 years. Reproductively active males and females migrate toward the coast and aggregate at nearshore breeding grounds near nesting beaches (Cornelius 1986; Hughes and Richard 1974; Kalb et al. 1995; Plotkin et al. 1991; Plotkin et al. 1996; Plotkin et al. 1997; Pritchard 1969). Other males and females may not migrate to nearshore breeding aggregations at all (Kopitsky et al. 2000; Pitman 1991). Some males appear to remain in oceanic waters, are non-aggregated, and mate opportunistically as they intercept females *en route* to near shore breeding grounds and nesting beaches (Kopitsky et al. 2000; Plotkin 1994; Plotkin et al. 1994b; Plotkin et al. 1996). Their migratory pathways vary annually (Plotkin 1994), there is no spatial and temporal overlap in migratory pathways among groups or cohorts of turtles (Plotkin et al. 1994a; Plotkin et al. 1995), and no apparent migration corridors exist. Olive ridleys may use water temperature more than any other environmental cue during migrations (Spotila 2004). Post-nesting migration routes from Costa Rica traverse more than 3,000 km out into the central Pacific (Plotkin et al. 1993; Plotkin et al. 1994a).

Range, Distribution, Population Dynamics, Status and Trend of Olive Ridley Sea Turtles
Olive ridleys are globally distributed in tropical regions (>20º C) of the Pacific (southern California to Peru, and rarely in the Gulf of Alaska Hodge and Wing 2000), Indian (eastern Africa and the Bay of Bengal), and Atlantic oceans (Grand Banks to Uruguay and Mauritania to South Africa Foley et al. 2003; Fretey 1999; Fretey et al. 2005; Stokes and Epperly 2006). Olive ridleys are uncommon in the western Pacific and western Indian Oceans, and most of the North Atlantic (Spotila 2004).

Olive ridley distribution in the western North Atlantic occurs mostly along the northern coast of South America and adjacent waters. In the Caribbean, non-nesting individuals occur regularly near Isla Margarita, Trinidad, and Curacao, but are rare further west, such as in Puerto Rico, the Dominican Republic, and Cuba. In rare cases, olive ridleys are known to occur as far north as Puerto Rico, the Dominican Republic, and Cuba and as far south as Brazil (Moncada-G. 2000 as cited in NMFS 2004a). Regular nesting occurs only in Guyana, Suriname, and French Guiana, with most foraging grounds likely nearby (Reichart 1989 as cited in LGL Ltd. 2007). Nesting occurs along the north coast of Venezuela (Sternberg 1981). Olive ridleys likely occur in low numbers along western Africa.

Olive ridleys are highly migratory and may spend most of their non-breeding life cycle in deep-ocean waters, but occupy the continental shelf region during the breeding season (Arenas and

Hall 1991; Beavers and Cassano 1996; Cornelius and Robinson 1986; Pitman 1991; Pitman 1993; Plotkin 1994; Plotkin et al. 1994a; Plotkin et al. 1995). Olive ridleys from different populations may occupy different oceanic habitats (Polovina et al. 2004; Polovina et al. 2003). Unlike other marine turtles that migrate from a breeding ground to a single feeding area, where they reside until the next breeding season, olive ridleys are nomadic migrants that swim hundreds to thousands of kilometers over vast oceanic areas (Plotkin 1994; Plotkin et al. 1994a; Plotkin et al. 1995). Olive ridleys may associate with flotsam, which could provide food, shelter, and/or orientation cues (Arenas and Hall 1991b). In the oceanic eastern tropical Pacific, olive ridley sea turtles are far more common than any other cheloniid (Pitman 1990).

Threats

Sea turtles face predation primarily by sharks and to a lesser extent by killer whales. Natural predators of olive ridleys also include crabs, garrabos, iguanas, crocodiles, black vultures, coyotes, raccoons, and coatis (Aprill 1994). All sea turtles except leatherbacks can undergo "cold stunning" if water temperatures drop below a threshold level, which can pose lethal effects.

Collection of eggs as well as adult turtles has historically led to species decline (NMFS and USFWS 2007d). Harvests remain a concern for olive ridley recovery. In some locations, takes are now regulated or banned (with varying compliance), while harvests remain uncontrolled in other areas. Adult harvests are now largely banned, except along African coasts.

High levels of adult mortality due to harvesting are believed to be the reason why rapid and large nesting population declines occurred in Mexico (Cornelius et al. 2007). The nationwide ban on commercial sea turtles harvest in Mexico, enacted in 1990, has greatly aided olive ridley conservation, but the population is still seriously decremented and threatened with extinction (Groombridge 1982). Several solitary and arribada nesting beaches experience (although banned) egg harvesting, which is causing declines (Cornelius et al. 2007). Approximately 300,000-600,000 eggs were seized each year from 1995-1998 (Trinidad and Wilson 2000).

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. In the Northeast Region (Maine through Virginia), ESA section 7 consultations have been conducted on the American lobster, Atlantic herring, Atlantic mackerel/squid/butterfish, Atlantic sea scallop, monkfish, northeast multispecies, red crab, skate, spiny dogfish, summer flounder/scup/black sea bass, and tilefish fisheries. The Incidental Take Statement (ITS) reflects the incidental take of sea turtles and other ESA-listed species anticipated from the date of the ITS and forward in time. In the Southeast Region (North Carolina through Texas), ESA section 7 consultations have been conducted on the coastal migratory pelagics, swordfish/tuna/sharklbillfish, snapper/grouper, dolphin/wahoo, southern flounder gillnet, and the Southeast shrimp trawl fisheries. An Incidental Take Statement (ITS) has been issued for the take of sea turtles in each of the fisheries (Appendix 2).

The only fishery that has been determined by NMFS to reduce the reproduction, numbers, or distribution of ESA-listed sea turtles, and thereby reduce appreciably their likelihood of survival and recovery, is the pelagic longline component of the Atlantic highly migratory species fishery. On June 14, 2001, NMFS released an Opinion that found that the continued operation of the Atlantic pelagic longline fishery was likely to jeopardize the continued existence of both loggerhead and leatherback sea turtles. To avoid jeopardy to these species, a Reasonable and

Prudent Alternative (RPA) was developed. The RPA required the closure of the Northeast Distant (NED) Statistical Area of the Atlantic Ocean to pelagic longlining and the enactment of a research program to develop or modify fishing gear and techniques to reduce sea turtle interactions and mortality associated with such interactions. On June 1, 2004, NMFS released another Opinion on the Atlantic pelagic longline fishery which stated that the fishery was still likely to jeopardize the continued existence of leatherback sea turtles. Another RPA was then developed to attempt to remove jeopardy. The RPA required that NMFS (1) reduce post-release mortality of leatherbacks, (2) improve monitoring of the effects of the fishery, (3) confirm the effectiveness of the hook and bait combinations that are required as part of the proposed action, and (4) take management action to avoid long-term elevations in leatherback takes or mortality. NMFS stated in the Opinion that this RPA must be implemented in its entirety to avoid jeopardy. 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 2010a). 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 existence. 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.

Consultation on the Atlantic herring fishery was reinitiated on March 23, 2005 due to new information on the effects of the fishery on the Gulf of Maine DPS of Atlantic salmon and sea turtles. That consultation was completed in February 2010 and determined that the herring fishery is not likely to adversely affect any ESA-listed species, including sea turtles. Based on analysis of VTR data, Murray (2008) estimated zero sea turtle takes in trawl gear by the Atlantic herring fishery. In addition, over the 5 year period from 2004-2008, higher than normal observer coverage occurred in the herring fishery, without any observed takes of sea turtles.

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 2010b). 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 reef fish fishery* was substantially exceeded in 2008 by the bottom longline component of the fishery. In May 2009, NMFS published an emergency rule, which was intended to reduce the number of sea turtle takes by the reef fish fishery in the short-term while the Gulf of Mexico Fishery Management Council develops long-term measures in Amendment 31 to the Reef Fish Fishery Management Plan (RFFMP). The new biological opinion, which considered the continued authorization of reef fish fishing under the RFFMP, including any measures proposed in Amendment 31, was completed October 2009.

The federal *monkfish fishery* (NMFS 2010c) 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 2010). 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 (NMFS 2010d).

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 (NMFS 2010e). 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* (NMFS 2010f) 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* (NMFS 2010g) 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 *American lobster trap fishery* has been identified as a source of gear causing injuries and mortality of loggerhead and leatherback sea turtles as a result of entanglement in buoy lines of the pot/trap gear (NMFS 2010h). Loggerhead or leatherback sea turtles caught/wrapped in the buoy lines of lobster pot/trap gear can die as a result of forced submergence or incur injuries leading to death as a result of severe constriction of a flipper from the entanglement. Given the seasonal distribution of loggerhead sea turtles in Mid-Atlantic and New England waters and the operation of the lobster fishery, loggerhead sea turtles are expected to overlap with the placement of lobster pot/trap gear in the fishery during the months of May through October in waters off of New Jersey through Massachusetts. Compared to loggerheads, leatherback sea turtles have a similar seasonal distribution in Mid-Atlantic and New England waters, but with a more extensive distribution in the Gulf of Maine (Shoop and Kenney 1992; James *et al.* 2005a). Therefore, leatherback sea turtles are expected to overlap with the placement of lobster pot/trap gear in the fishery during the months of May through October in waters off of New Jersey through Maine.

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. Potential sources of adverse effects to sea turtles from Federal vessel operations in the action area include operations of the U.S. Navy (USN), U.S. Coast Guard (USCG), Environmental Protection Agency (EPA), Army Corps of Engineers (ACOE), and NOAA to name a few. NMFS has previously conducted formal consultations with the USN, USCG, and NOAA on their vessel-based operations. NMFS has also conducted section 7 consultations with the Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE), Federal Energy Regulatory Commission (FERC), and Maritime Administration (MARAD) on vessel traffic related to energy projects in the Northeast Region and has implemented conservation measures. Through the section 7 process, where applicable, NMFS has and will continue to identify conservation measures for all these agency vessel operations to avoid or minimize adverse effects to listed species.

Several Opinions for the USN activities (NMFS 1996, 1997, 2006b, 2008c, 2009a,b) and USCG (NMFS 1995, 1998c) contain details on the scope of vessel operations for these agencies and the conservation measures that are being implemented as standard operating procedures. In the U.S. Atlantic, the operation of USCG boats and cutters is not expected to jeopardize the continued existence of the ESA-listed species while operating with an estimated take of no more than one individual sea turtle, of any species, per year (NMFS 1995, 1998c).

In June 2009, NMFS prepared an Opinion on USN activities in each of their four training range complexes along the U.S. Atlantic coast-Northeast, Virginia Capes, Cherry Point, and Jacksonville (NMFS 2009b). That Opinion found that the Virginia Capes Range Complex and Jacksonville Range Complex were attributed with potential harassment of leatherback sea turtles and hard shell turtles and the Virginia Capes Range Complex has been characterized as having the potential to harm loggerhead and Kemp's ridley turtles.

Military activities such as ordnance detonation also affect ESA-listed species. A section 7 consultation was conducted in 1997 for USN aerial bombing training in the ocean off the Southeast U.S. coast, involving drops of live ordnance (500 and 1,000-lb bombs). The resulting Opinion for this consultation determined that the activity was likely to adversely affect ESA listed sea turtles in the action area, but would likely not jeopardize their continued existence. In the ITS included within the Opinion, these training activities were estimated to have the potential to injure or kill, annually, loggerheads, leatherbacks, greens and Kemp's ridleys (NMFS 1997).

NMFS has also conducted more recent section 7 consultations on USN explosive ordnance disposal, mine warfare, sonar testing (e.g., AFAST, SURTASS LFA), and other major training exercises (e.g., bombing, Naval gunfire, combat search and rescue, anti-submarine warfare, and torpedo and missile exercises) in the Atlantic Ocean. These consultations have determined that the proposed USN activities may adversely affect but would not jeopardize the continued existence of ESA-listed sea turtles (NMFS 2008c, 2009a,b). NMFS estimated that five loggerhead and six Kemp's ridley sea turtles are likely to be harmed as a result of training activities in the Virginia Capes Range Complex from June 2009 to June 2010, and that nearly 1,500 sea turtles, including 10 leatherbacks, are likely to experience harassment (NMFS 2009b).

Similarly, operations of vessels by other Federal agencies within the action area (NOAA, EPA, and ACOE) may adversely affect ESA-listed sea turtles. However, vessel activities of those agencies are often 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.

Navigation Channel Dredging and Maintenance. The construction and maintenance of federal navigation channels has also been identified as a source of sea turtle mortality. Entrainment is the most imminent danger for sea turtles during hopper dredging operations. The National Research Council's Committee on Sea Turtle Conservation (1990) estimated that dredging mortalities, along with boat strikes, were second only to fishery interactions as a source of probable lethal takes of sea turtles. Experience has shown that injuries sustained by sea turtles entrained in hopper dredge dragheads are usually fatal. Mortality in hopper dredging operations most often occurs when turtles are sucked into the dredge draghead, pumped through the intake pipe and then killed as they cycle through the centrifugal pump and into the hopper.

Sea turtles have been killed in hopper dredge operations along the East and Gulf coasts of the US. Documented turtle mortalities during dredging operations in the ACOE South Atlantic Division (SAD; i.e., south of the Virginia/North Carolina border) are more common than in the ACOE North Atlantic Division (NAD; Virginia-Maine) probably due to the greater abundance of turtles in these waters and the greater frequency of hopper dredge operations. For example, in the ACOE SAD, over 400 sea turtles have been entrained in hopper dredges since 1980 and in the Gulf Region over 160 sea turtles have been killed since 1995. Records of sea turtle entrainment in the ACOE NAD began in 1994. Since this time, at least 66 sea turtles deaths related to hopper dredge activities have been recorded in waters north of the North Carolina/Virginia border (ACOE Sea Turtle Database[4]).

Official records of sea turtle mortality in dredging activities in the ACOE NAD begin in the early 1990s. Before this time, endangered species observers were not required on board hopper dredges and dredge baskets were not inspected for sea turtles or sea turtle parts. The majority of sea turtle takes in the NAD have occurred in the Norfolk district. This is largely a function of the large number of loggerhead and Kemp's ridley sea turtles that occur in the Chesapeake Bay each summer and the intense dredging operations that are conducted to maintain the Chesapeake Bay entrance channels and for beach nourishment projects at Virginia Beach. However, since 1992, the take of 10 sea turtles (all loggerheads) has been recorded during hopper dredge operations in the Philadelphia, Baltimore and New York Districts. Hopper dredging is relatively rare in New England waters where sea turtles are known to occur, with most hopper dredge operations being completed by the specialized Government owned dredge Currituck which operates at low suction and has been demonstrated to have a very low likelihood of entraining or impinging sea turtles.

[4] The USACE Sea Turtle Data Warehouse is maintained by the ACOE's Environmental Laboratory and contains information on ACOE dredging projects conducted since 1980 with a focus on information on interactions with sea turtles.

To date, no hopper dredge operations (other than the Currituck) have occurred in the New England District in areas or at times when sea turtles are likely to be present.

The number of interactions between dredge equipment and sea turtles seems to be best associated with the volume of material removed, which is closely correlated to the length of time dredging takes, with a greater number of interactions associated with a greater volume of material removed and a longer duration of dredging. The number of interactions is also heavily influenced by the time of year dredging occurs (with more interactions correlated to times of year when more sea turtles are present in the action area) and the type of dredge plant used (sea turtles are apparently capable of avoiding pipeline and mechanical dredges as no takes of sea turtles have been reported with these types of dredges). The number of interactions may also be influenced by the terrain in the area being dredged, with interactions more likely when the draghead is moving up and off the bottom frequently. Interactions are also more likely at times and in areas when sea turtle forage items are concentrated in the area being dredged, as sea turtles are more likely to be spending time on the bottom while foraging.

Oil and Gas Exploration. The COE and the Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE) 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. The impacts of oil contamination on the environment are further discussed under *Environmental Contamination* to the *Baseline.*

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).

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

The Gulf of Mexico is an area of high-density offshore oil extraction with chronic, low-level spills and occasional massive spills (such as the April 20, 2010 Deep Water Horizon oil spill, Ixtoc I oil well blowout and fire in the Bay of Campeche in 1979, and the explosion and destruction of a loaded supertanker, the Mega Borg, near Galveston in 1990). As ESA listed species (e.g., loggerhead and Kemp's ridley sea turtles) are known to migrate through, forage, and/or nest along the coastal waters of the Gulf of Mexico, the Deep Water Horizon oil spill is likely to affect their populations; however, because all the information on sea turtle and other ESA-listed species' stranding, deaths, and recoveries has not yet been finalized, the long-term effects of the oil spill on the their populations has not been determined at this time. As of February 15, 2011 the turtle species totals that have been documented as either strandings or collected via directed captures offshore due to the Deep Water Horizon oil spill were as follows:

Turtle Species	***Alive***	***Dead***	***Total***
Green turtle (*Chelonia mydas*)	172	29	201
Hawksbill turtle (*Eretmochelys imbricata*)	16	0	16
Kemp's ridley turtle (*Lepidochelys kempii*)	328	481	809
Loggerhead turtle (*Caretta caretta*)	21	67	88
Unknown turtle species	0	32	32
TOTAL	**537**	**609**	**1146**

NOTE: All data is preliminary. This data is continually being updated and will be considered preliminary until all necropsies have been completed.

Oil spills can impact wildlife directly through three primary pathways: ingestion – when animals swallow oil particles directly or consume prey items that have been exposed to oil, absorption – when animals come into direct contact with oil, and inhalation – when animals breath volatile organics released from oil or from “dispersants” applied by response teams in an effort to increase the rate of degradation of the oil in seawater. Several aspects of sea turtle biology and behavior place them at particular risk, including the lack of avoidance behavior, indiscriminate feeding in convergence zones, and large predive inhalations (Milton *et al.* 2003). When large quantities of oil enter a body of water, chronic effects such as cancer, and direct mortality of wildlife becomes more likely (Lutcavage *et al.* 1997). Oil spills in the vicinity of nesting beaches just prior to or during the nesting season could place nesting females, incubating egg clutches, and hatchlings at significant risk (Fritts and McGehee 1982; Lutcavage *et al*. 1997; Witherington 1999). Continuous low-level exposure to oil in the form of tarballs, slicks, or elevated background concentrations also challenge animals facing other natural and anthropogenic stresses. Types of trauma can include skin irritation, altering of the immune system, reproductive or developmental damage, and liver disease (Keller *et al.* 2004, 2006). Chronic exposure may not be lethal by itself, but it may impair a turtle's overall fitness so that it is less able to withstand other stressors (Milton *et al.* 2003).

The earlier life stages of living marine resources are usually at greater risk from an oil spill than adults, especially true for hatchlings, since they spend a greater portion of their time at the sea surface than adults, their risk of exposure to floating oil slicks is increased (Lutcavage *et al*. 1995). One of the reasons might be the simple effects of scale: for example, a given amount of oil may overwhelm a smaller immature organism relative to the larger adult. The metabolic machinery an animal uses to detoxify or cleanse itself of a contaminant may not be fully developed in younger life stages. Also, in early life stages, animals may contain proportionally higher concentrations of lipids, to which many contaminants such as petroleum hydrocarbons bind. Most reports of oiled hatchlings originate from convergence zones, ocean areas where currents meet to form collection points for material at or near the surface of the water. Sixty-five of 103 post-hatchling loggerheads in convergence zones off Florida's east coast were found with tar in the mouth, esophagus or stomach (Loehefener *et al*. 1989). Thirty-four percent of post-hatchlings captured in Sargassum off the Florida coast had tar in the mouth or esophagus and more than 50% had tar caked in their jaws (Witherington 1994). These zones aggregate oil slicks, such as a Langmuir cell, where surface currents collide before pushing down and around, and represents a virtually closed system where a smaller weaker sea turtle can easily become trapped (Witherington 2002; Carr 1987). Lutz (1989) reported that hatchlings have been found apparently starved to death, their beaks and esophagi blocked with tarballs. Hatchlings sticky with oil residue may have a more difficult time crawling and swimming, rendering them more vulnerable to predation.

Frazier (1980) suggested that olfactory impairment from chemical contamination could represent a substantial indirect effect in sea turtles, since a keen sense of smell apparently plays an important role in navigation and orientation. A related problem is the possibility that an oil spill impacting nesting beaches may affect the locational imprinting of hatchlings, and thus impair their ability to return to their natal beaches to breed and nest (Milton *et al.* 2003). Whether hatchlings, juveniles, or adults, tarballs in a turtle's gut are likely to have a variety of effects – starvation from gut blockage, decreased absorption efficiency, absorption of toxins, effects of general intestinal blockage (such as local necrosis or ulceration), interference with fat metabolism, and buoyancy problems caused by the buildup of fermentation gases (floating prevents turtles from feeding and increases their vulnerability to predators and boats), among others. Also, trapped oil can kill the seagrass beds that turtles feed upon.

Unfortunately, little is known about the effects of dispersants on sea turtles, and such impacts are difficult to predict in the absence of direct testing. While inhaling petroleum vapors can irritate turtles' lungs, dispersants can interfere with lung function through their surfactant (detergent) effect. Dispersant components absorbed through the lungs or gut may affect multiple organ systems, interfering with digestion, respiration, excretion, and/or salt-gland function—similar to the empirically demonstrated effects of oil alone (Hoff and Shigenaka 2003). Oil cleanup activities can also be harmful. Earth-moving equipment can dissuade females from nesting and destroy nests, containment booms can entrap hatchlings, and lighting from nighttime activities can misdirect turtles (Witherington 1999).

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 midsummer, 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).

Global climate change. There is a large and growing body of literature on past, present, and future impacts of global climate change induced by human activities. Some of the likely effects commonly mentioned' are sea level rise, increased frequency of severe weather events, and change in air and water temperatures. The EPA's climate change webpage provides basic background information on these and other measured or anticipated effects (see www. epa.gov/climatechange/index.html). Activities in the action area that may have contributed to global warming include the combustion of fossil fuels by vessels.

The effects of global climate change on sea turtles is typically viewed as being detrimental to the species (NMFS and USFWS 2007a; 2007b; 2007c; 2007d). It is believed that increases in sea level, approximately 4.2 mm per year until 2080, have the potential to remove available nesting beaches, particularly on narrow low lying coastal and inland beaches and on beaches where coastal development has occurred (Church *et al.* 2001; IPCC 2007; Nicholls 1998; Fish *et al.* 2005; Baker *et al.* 2006; Jones *et al.* 2007; Mazaris *et al.* 2009). Additionally, global climate change may affect the severity of extreme weather (e.g., hurricanes), with more intense storms expected, which may result in the loss/erosion of or damage to shorelines, and therefore, the loss of potential sea turtle nests and/or nesting sites (Goldenburg *et al.* 2001; Webster *et al. 2005;* IPCC 2007). The cyclical loss of nesting beaches resulting from extreme storm events may then result in a decrease in hatching success and hatchling emergence (Martin 1996; Ross 2005; Pike and Stiner 2007; Prusty *et al.* 2007; Van Houton and Bass 2007). However, there is evidence that, depending on the species, sea turtles species with lower nest site fidelity (i.e., leatherbacks) would be less vulnerable to storm related threats than those with a higher site fidelity (i.e., loggerheads). In fact, it has been reported that sea turtles in Guiana are able to maintain successful nesting despite the fact that between nesting years some beaches they once nested on have disappeared, suggesting that sea turtle species may be able to behavioral adapt to such changes (Pike and Stiner 2007; Witt *et al.* 2008; Plaziat and Augustinius 2004; Girondot and Fretey 1996; Rivalan *et al.* 2005; Kelle *et al. 2007).*

Changes in water temperature are also expected as a result of global climate change. Changes in water temperature are expected affect water circulation patterns perhaps even to the extent that the Gulf Stream is disrupted, which would have profound effects on every aspect of sea turtle life history from hatching success, oceanic migrations at all life stages, foraging, and nesting. (Gagosian 2003; NMFS and USFWS 2007a; 2007b; 2007c; 2007d; Rahmstorf 1997, 1999; Stocker and Schmittner 1997). Thermocline circulation patterns are expected to change in intensity and direction with changes in temperature and freshwater input at the poles (Rahmstorf 1997; Stocker and Schmittner 1997), which will potentially affect not only hatchlings, which rely on passive transport in surface currents for migration and dispersal but also pelagic adults (i.e., leatherbacks) and juveniles, which depend on current patterns and major frontal zones in obtaining suitable prey, such as jellyfish (Hamann *et al.* 2007; Hawkes *et al. 2009).*

Changes in water temperature may also affect prey availability for species of sea turtles. Herbivorous species, such as the green sea turtle, depend primarily on seagrasses as their forage base. Seagrasses could ultimately be negatively affected by increased temperatures, salinities, and acidification of coastal waters (Short and Neckles 1999; Bjork *et al.* 2008), as well as increased runoff due the expected increase in extreme storm events as a result of global climate change. These alterations of the marine environment due to global climate change could ultimately affect the distribution, physiology, and growth rates of seagrasses, potentially eliminating them from particular areas. However, the magnitude of these effects on seagrass beds, and therefore green sea turtles, are difficult to predict, although some populations of green sea turtles appear to specialize in the consumption of algae (Bjorndal 1997) and mangroves (Limpus and Limpus 2000) and as such, green sea turtles may be able to adapt their foraging behavior to the changing availability of seagrasses in the future. Omnivorous species, such as Kemp's ridley and loggerhead sea turtles, may face changes to benthic communities as a result of changes to water temperature; however, these species are probably less likely to suffer shortages of prey than species with more specific diets (i.e., green sea turtles) (Hawkes *et al. 2009).*

Several studies have also investigated the effects of changes in sea surface temperature and air temperatures on turtle reproductive behavior. For loggerhead sea turtles, warmer sea surface temperatures in the spring have been correlated to an earlier onset of nesting (Weishampel *et al.* 2004; Hawkes *et al.* 2007), shorter internesting intervals (Hays *et al.* 2002), and a decrease in the length of the nesting season (Pike *et al.* 2006). Green sea turtles also exhibited shorter internesting intervals in response to warming water temperatures (Hays *et al.* 2002*).*

Air temperatures also play a role in sea turtle reproduction. In marine turtles, sex is determined by temperature in the middle third of incubation with female offspring produced at higher temperatures and males at lower temperatures within a thermal tolerance range of 25-35° C (Ackerman 1997). Based on modeling done of loggerhead sea turtles, a 2° C increase in air temperature is expected to result in a sex ratio of over 80% female offspring for loggerhead nesting beaches in the vicinity of Southport, NC. Farther to the south at Cape Canaveral, Florida, a 2°C increase in air temperature would likely result in production of 100% females while a 3°C increase in air temperature would likely exceed the thermal threshold of turtle clutches (i.e., greater than 35° C) resulting in death (Hawkes *et al.* 2007). Glen et al. (2003) also reported that, for green sea turtles, incubation temperatures also appeared to affect hatchling size with smaller turtles produced at higher incubation temperatures; however, it is unknown whether this effect is species specific and what impact it has on the survival of the offspring. Thus changes in air temperature as a result of global climate change may alter sex ratios and may reduce hatchling production in the most southern nesting areas of the U.S. (Hawkes et al. 2007; Hamann *et al.* 2007). Given that the south Florida nesting group is the largest loggerhead nesting group in the Atlantic (in terms of nests laid), a decline in the success of nesting as a result of global climate change could have profound effects on the abundance and distribution of the loggerhead species in the Atlantic, however; variation of sex ratios to incubation temperature between individuals and populations is not fully understood and as such, it is unclear whether sea turtles will (or can) adapt behaviorally to alter incubation conditions to counter potential feminization or death of clutches associated with water temperatures (e.g., choosing nest sites that are located in cooler areas, such as shaded areas of vegetation or higher latitudes; nesting earlier or later during cooler periods of the year) (Hawkes *et al. 2009*).

Ocean acidification related to global warming would also reasonably be expected to negatively affect sea turtles. The term "ocean acidification" describes the process of ocean water becoming corrosive as a result of carbon dioxide ($C0_2$) having been absorbed from the atmosphere. The absorption of atmospheric CO_2 into the ocean lowers the pH of the waters. Evidence of corrosive water caused by the ocean's absorption of $C0_2$ was found less than 20 miles off the West coast of North America during a field study from Canada to Mexico in the summer of 2007 (Feely *et al.* 2008). This was the first time "acidified" ocean water was found on the continental shelf of western North America. While the ocean's absorption of $C0_2$ provides a great service to humans by significantly reducing the amount of greenhouse gases in the atmosphere and decreasing the effects of global warming, the resulting change in ocean chemistry could adversely affect marine life, particularly organisms with calcium carbonate shells such as corals, mussels, mollusks, and small creatures in the early stages of the food chain (*e.g.,* plankton). A number of these organisms serve as important prey items for sea turtles.

Although potential effects of climate change on sea turtle species are currently being addressed, fully understanding the effects of climate change on listed species of sea turtles will require development of conceptual and predictive models of the effects of climate change on sea turtles, which to date are still being developed and will depend greatly on the continued acquisition and maintenance of long-term data sets on sea turtle life history and responses to environmental changes. Until such time, the type and extent of effects to sea turtles as a result of global climate change are will continue to be speculative and as such, the effects of these changes on sea turtles cannot, for the most part, be accurately predicted at this time.

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

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

Sea turtles are the focus of research activities authorized by a Section 10 permit under the ESA. As of May 2011, there were 25 active scientific research permits directed toward sea turtles that are applicable to the action area of this 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 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 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. The NMFS Southeast Fishery Science Center has requested authorization to annually sample a combined total of 731 loggerhead, 163 Kemp's ridley, 76 hawksbill, 94 green, 255 leatherbacks, and 120 olive ridleys or hybrid turtles within state waters and the U.S. Exclusive Economic Zone from North Carolina, south throughout the Gulf of Mexico and the Caribbean. Animals will be measured, carapace marked (temporarily), flipper tagged, checked for PIT tags, PIT tagged, weighed, 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
Although this permit does not entail any actual capture, since it is incidental to commercial fishing operations and permitted, it does result in stress due to being. 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 additional mortalities or injuries are expected as a result of this research.

Measuring, Photographing, Weighing, Carapace Painting and Tagging
Handling, measuring, photographing, weighing and carapace painting 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, carapace painting 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.

Tissue Sampling
NMFS does not expect that individual turtles will experience more than short-term stresses during tissue sampling. 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. 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 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 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.

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 during the Pound Net portion of the permit. 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.

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

Species' Response to Effects of the Proposed Action

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

Mortality and serious injury under the research as described under the proposed actions are not expected. The effects of the proposed handling, tagging, measuring, weighing, photographing, 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 loggerhead, green, leatherback, Kemp's ridley, and hawksbill sea turtles. There are known cumulative effects (i.e., from future state, local, tribal, or private actions) that fold into our risk assessment for this species. This section provides an integration and synthesis of the information presented in the Status of the Species, Environmental Baseline, Cumulative Effects, and Effects of the Action sections of this Opinion. The intent of the following discussion is to provide a basis for determining the additive effects of the take authorized in the permit on loggerhead, green, leatherback, Kemp's ridley, 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 loggerhead, green, leatherback, Kemp's ridley and hawksbill sea turtle populations considered in this Opinion to maintain or increase their numbers by limiting the number of individuals in these populations, the loss of reproductive adults results in reductions in future reproductive output. Species with delayed maturity such as sea turtles are demographically vulnerable to increases in mortality, particularly of juveniles and subadults, those stages with higher reproductive value. The potential for an egg to develop into a hatchling, into a juvenile, and finally into a sexually mature adult sea turtle varies among species, populations, and the degree of threats faced during each life stage. Each juvenile that does not survive to 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 15552 are not expected to result in mortality or injury to any of the sea turtles. The capture, handling, tagging, measuring, photographing, weighing, tissue sampling activities will only result in temporary stress to the animal and are not expected to have more than short-term effects on individual loggerhead, green, Kemp's ridley, olive ridleys, leatherback, 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, loggerhead, hawksbill, leatherback, olive ridley or Kemp's ridley sea turtles likelihood of survival and recovery in the wild by adversely affecting their birth rates, death rates, or recruitment rates. In particular, NMFS does not expect the proposed research 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, loggerhead, hawksbill, leatherback, olive ridley or Kemp's ridley sea turtles.

The proposed actions are not expected to have more than short-term effects on loggerhead, green, olive ridley, Kemp's ridley, leatherback 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 Gulf of Mexico, Caribbean and Atlantic Ocean populations of green, loggerhead, hawksbill, leatherback, olive ridley and Kemp's ridley sea turtles.

Conclusion

After reviewing the current status of the loggerhead, green, hawksbill, leatherback, olive ridley and Kemp's ridley 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 and conference 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.

Proposed Rule to List Loggerhead Sea Turtles

As explained in *Status of Listed Species* section of this Opinion, on March 16, 2010, NMFS published a proposed rule to list two DPSs of loggerhead sea turtles as threatened and seven DPSs of loggerhead sea turtles as endangered. This rule, when finalized, would replace the existing listing for loggerhead sea turtles. Currently, the species is listed as threatened range wide. Once a species is proposed for listing, the conference provisions of the ESA apply. As stated at 50 CFR 402.10, "Federal agencies are required to confer with NMFS on any action which is likely to jeopardize the continued existence of any proposed species or result in the destruction or adverse modification of proposed critical habitat. The conference is designed to assist the Federal agency and any applicant in identifying and resolving potential conflicts at an early stage in the planning process."

As explained in the Opinion, the takes caused by the proposed action are all likely to include turtles from the Northwest Atlantic DPS, one of the seven DPSs proposed to be listed as endangered in the proposed rule.

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 and conference on the proposal to issue scientific research permit 15552. 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 proposed take is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this Opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this Opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of authorized take is exceeded, NMFS Office of Protected Resources – Permits, Conservation, and Education Division must immediately request reinitiation of section 7 consultation.

You may ask NMFS to confirm the conference opinion as a biological opinion issued through formal consultation if the Northwest Atlantic Ocean DPS for loggerhead sea turtles is listed. The request must be in writing. If NMFS reviews the proposed action and finds that there have been no significant changes in the action as planned or in the information used during the conference, NMFS will confirm the conference opinion as the biological opinion on the project and no further section 7 consultation will be necessary.

After the Northwest Atlantic Ocean DPS for loggerhead sea turtles is listed and any subsequent adoption of this conference opinion, the Federal agency shall request reinitiation of consultation if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may affect the species or critical habitat in a manner or to an extent not considered in this conference opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the species or critical habitat that was not considered in this conference opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of take is exceeded, section 7 consultation must be reinitiated immediately.

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Appendix 1. Examples of handouts provided to observers.

Conditions of ESA Sea Turtle Permit #15552

The Endangered Species Act Permit authorizes SEFOP staff and observers to handle and conduct the following activities with protected sea turtles:

- Photograph
- Measure
- Biopsy
- Inconel Tag
- Scan for PIT Tags
- Release
- Resuscitate (when needed)
- Transport for rehabilitation (when needed)
- Bring dead turtles in for further investigation

These activities shall **only** be conducted following the established protocols here and in the Observer Program and Biological Sampling manuals.

The following conditions also apply:

- Observers must not intentionally kill or cause any sea turtle to be killed.
- Care must be taken when handling live turtles to minimize injury to turtles and the observer.
- Observers will request that all sea turtles captured by a fishery be lowered to the deck as carefully as possible.
- All sea turtles brought on board will be protected from any weather or fishing activity that may cause injury. The area surrounding the turtle will be free of any material that the turtle might ingest.
- Healthy, active turtles will not be kept on board longer than 30 minutes.
- Appropriate resuscitation techniques must be used on any comatose turtle prior to returning it to the water.
- During release, engines should be in neutral and turtles shall be released away from fishing gear and as close to the surface of the water as possible.
- The observer will observe the newly released animal and record the behavior on the Marine Mammal, Sea Turtle and Sea Bird Incidental Take Log.
- When possible, observers should coordinate with the Sea Turtle Stranding and Salvage Network (STSSN) to transfer stressed or injured animals to rehabilitation facilities ashore. The easiest and quickest way to do this might be through the Area Coordinator.

It is understood that several of these requirements are out of the observer’s control. In those cases, it is incumbent upon the observer to work with the crew to meet these requirements. If the vessel operator is unable or unwilling to meet a request, then the observer should provide comments on the Marine Mammal, Sea Turtle and Sea Bird Incidental Take Log. Observers are responsible for their actions only, not for those of the crew.

Safe Sea Turtle Handling Guidelines

- Sea turtles have powerful jaws. Always keep clear of the head and wear durable foot wear when working around them on deck.
- Sea turtles of all species, except leatherbacks, have claws on their flippers. Keep clear of flapping flippers, especially if the animal is on its back (carapace). Avoid straddling animals when you are working with them.
- Never pick up sea turtles by the flippers, head or tail. For all turtles except leatherbacks, pick them up by placing one hand at the front and one hand at the back of the carapace.
- Placing a clean, damp cloth over an agitated turtles head can sometimes have a calming effect.
- Wear gloves when possible and clean and disinfect any cuts or abrasions incurred when handling sea turtles.
- Turtles brought on deck should be protected from adverse weather conditions as much as possible. If it is sunny and hot, turtles should be covered with a clean damp cloth/towel and kept in the shade. If it is cold, turtles should be insulated with available clean material and kept out of the weather.
- Extra care should be taken when handling leatherback turtles since they are covered with skin. Leatherback turtles should never be turned over on their carapace and should always be picked by their plastron, i.e., by supporting their underneath instead of just picking up by their carapace. Since leatherback turtles can be large, you will need assistance when moving them - do not try to drag or push them.

Handling and Resuscitation Requirements

Any live sea turtle incidentally taken during the course of commercial fishing or scientific research activities must be handled with due care to prevent injury. Incidentally taken sea turtles should be observed for activity and then returned to the water according to the following procedures:

1. Sea turtles that are alive or dead must be released over the stern of the boat.[1] In addition, they must be released only when fishing gear is not in use, when the engine gears are in neutral position, and in areas where they are unlikely to be recaptured or injured by fishing gear or vessels.[2]

2. Resuscitation must be attempted on sea turtles that are comatose or inactive but not dead by placing the turtle right side up (on plastron) and elevating the hindquarter six inches for a period of 4 up to 24 hours. The amount of the elevation depends on the size of the turtle; greater elevations are needed for larger turtles. Periodically rock the turtle from side to side by holding the outer edge of the carapace and lifting one side about 3 inches. Alternate lifting from one side

to the other. This allows the lungs to drain off water. Sea turtles being resuscitated must be protected from the elements at all times. If it is sunny and warm then shade the turtle and keep it moist using clean sea water or clean damp towels. If it is cold then keep the turtle out of the weather and warm by insulating with clean rags or other suitable material. Gently touch the upper eyelid and pinch the tail (reflex test) periodically to see if there is a response. Those that revive and become active must be released over the stern of the boat only when fishing gear is not in use, when the engine gears are in neutral position, and in areas where they are unlikely to be recaptured or injured by fishing gear or vessels. Sea turtles that fail to respond to the reflex test or fail to move within several hours (up to 24, if possible) must be returned to the water in the same manner.

[1] Follow the above release guidelines for dead turtles only when it is not possible to salvage the dead animal and bring it in.

[2] Live and resuscitated animals should be released as close to the water surface as possible

Important: Do not assume that an inactive turtle is dead. The onset of rigor mortis or the rotting of flesh is often the only definitive indication that a turtle is dead. Otherwise the turtle is determined to be comatose or inactive and resuscitation attempts are necessary. There are three methods that may elicit a reflex response from an inactive animal:

1. Cloaca or tail reflex. Stimulate the tail with a light touch. This may cause a retraction or side movement of the tail.
2. Eye reflex. Lightly touch the upper eyelid. This may cause an inward pulling of the eyes, flinching or blinking response.
3. Nose reflex. Press the soft tissue around the nose which may cause a retraction of the head or neck region or an eye reflex response.

Genetic Sampling Protocols for Live, Comatose or Dead Turtles

Genetic samples provide valuable information on stock structure. Small skin biopsies provide a simple method to obtain tissue samples for genetic studies from live and dead sea turtles. For turtles **larger than 25 cm Notch-to-Tip (Total Length) carapace length**, tissue samples large enough for genetic analysis can be obtained using a 6mm disposable biopsy punch.

This tool consists of a plastic handle that supports a sharp circular blade. Tissue samples are preserved in 5 ml vials filled with 20% saturated DMSO. This preservative is non-toxic, however it can soak into the skin rapidly and cause a garlic-like taste and breath odor. Given that, and the fact that DMSO can pick up any chemical already on your hands, use latex gloves throughout the sampling process.

1. The best way to biopsy a sea turtle is to gently place the turtle on its carapace with plastron facing up (except leatherbacks). This is best done with assistance from a crew member as turtles that are placed on their carapace tend to flap their flippers aggressively. Always exercise caution around the head and jaws.

If you are working alone then the best method might be to leave the turtle carapace up, with a damp cloth over its head.

2. Put on a pair of latex gloves and thoroughly wipe the ventral and dorsal surfaces of the rear flipper with a Betadine wipe. This area is along the posterior edge (trailing) of the flipper and is just past (away from the body) the Inconel tag location, which is the first scale closest to the body.

3. Use an alcohol swab to wipe the hard surface (plastic dive slate, biopsy vial cap or other available clean surface) that will be used under the flipper, and place this surface underneath the Betadine treated flipper.

4. Holding a new biopsy punch by the thumb and index finger, press the biopsy punch firmly into the flesh. The punch should actually be aligned a little past the flipper edge, creating a 3/4 crescent shaped biopsy. This technique promotes quicker healing. Rotate the punch one or two complete turns to make a cut all the way through the flipper. The biopsy tool has a sharp cutting edge so exercise caution at all times. Wipe the punched area with a Betadine swab.

5. Repeat the procedure to the other rear flipper using the same biopsy punch (if not too dull). You will now have two samples from this turtle in the same biopsy punch.

6. Remove the tissue plugs by using a pair of tweezers cleaned with alcohol wipes, a clean tooth pick or by tapping the punch on the edge of the vial. Place the plugs directly into a vial containing 20% saturated DMSO. It is important that tissue samples do not come into contact with any other surface or materials during collection.

7. Secure the vial cap. Using a fine point permanent marker (Sharpie) label the vial with the same consecutive identification number (PSID) used on your Sea Turtle Biological Sample Log and the trip number. Then cover the writing with a piece of clear tape to prevent smearing. Tightly wrap a piece of Parafilm around the vial cap and place it in a Whirl-pak. Label the Whirl-pak with trip number, collection date and species. Record all pertinent information on the Sea Turtle Biological Sample Log and the Marine Mammal, Sea Turtle and Sea Bird Incidental Take Log.

9. Be sure to indicate that a biopsy sample was taken on the Sea Turtle Biological Sample Log.

10. Dispose of the used biopsy punch. It is very important to use a new punch for each turtle.

11. Submit the vial with your data.

Protocols for Inconel Flipper Tagging Sea Turtles

1. All turtles should be examined for existing external and/or PIT tags prior to applying new Inconel tags. All existing tags should be recorded accurately. PIT tags are recorded on the Sea Turtle Biological Sample Log. Inconel and other external tags are recorded on the Marine Mammal, Sea Turtle and Sea Bird Incidental Take Log. Any damaged or unreadable tags should

be removed. Prior to release, each turtle **larger than 26 cm** Notch-to-Tip (Total Length) carapace length should have two well attached and clearly legible external Inconel tags.

2. Inconel tags should be cleaned of the protective oil coat they are shipped with and stored in a sealed plastic bag.
Remove one at a time as needed. Inconel tags are expensive. Take care of them and don=t pass on to other observers.

3. Due to tag loss, double tagging is standard procedure, with one Inconel tag placed proximal to the first scale (scale closest to the body) of the trailing edge of each rear flipper for all turtles except leatherback.

Leatherback turtles should be tagged along the posterior (trailing) edge of the rear flipper. The preferred site is approximately 5 cm (~ 2 inches) out from the base of the tail (leatherback turtles do not have flipper scales).

Only Inconel tag turtles that are **larger than 26 cm** Notch-to-Tip (Total Length) carapace length. If the recommended tagging site is damaged or is for some reason unsuitable for tag application, then an alternative site along the trailing edge of the front flipper may be used.

4. The best way to tag the rear flippers of a turtle, except leatherbacks, is to first turn the turtle over onto its carapace with plastron (underside) facing upwards. This is best done with assistance from a crew member, as turtles that are placed on their carapace tend to flap their flippers aggressively. Always exercise caution around the head and jaws.
If you are working alone then the best method might be to leave the turtle carapace up, with a damp cloth over its head.

5. To prepare the rear flippers for tagging thoroughly swab the areas with betadine. If someone is available to help, have them hold the flipper to improve leverage while you are applying the Inconel tag. Record the tag identification number prior to placing it into the applicator. Place the pointed (piercing) side of the tag up and place the end of your index finger inside the tag against the bend. Pull the tag straight back into the open jaws of the applicator, aligning the pointed side of the tag opposite to the side of the pliers that has the small depression. It can be helpful to mark one jaw of the applicator with colored paint as a reminder of the correct way to insert the tag. Do not squeeze the pliers before you are ready to tag or the tag will fall out.

6. Position the Inconel tag so that it extends slightly past (approx. 1/3 the length of the tag) the trailing edge of the rear flipper. It should not be cinched in too tight against the flipper without room to move freely. Also avoid positioning the tag close to edge of the flipper where it can rip out or catch on fishing gear.

7. There are two distinct motions involved in applying Inconel tags. The first step is to squeeze the applicator so the tag point pierces the flipper. The second step, a moment later, involves applying greater force to drive the point through the tag hole and make it bend over completely. Use both hands and squeeze in a firm, steady manner to ensure that the tag will fully lock. The handles of the applicator should always be gripped as far back as possible to gain maximum

leverage. The tag point should pierce the flipper and lock into place with the tip bending securely over by 3-5 mm. After attachment, feel the tag with your finger and visually inspect to make sure the point has bent over into a fully locked position. Repeat the procedure and apply a second tag on the other rear flipper. All turtles should be double tagged in this manner. If possible use consecutive tag numbers on the same turtle.

8. In the event that the Inconel tag does not lock, fit the pliers back around the tag and apply greater pressure. Tags that fail to lock when applied to a turtle are difficult, frustrating and sometimes impossible to properly correct, even when using additional tools. Improperly applied tags can be shed quickly. A tag that malfunctions should be removed, recorded as being destroyed and replaced with a new tag. If you are having persistent problems when attempting to apply Inconel tags please contact the SEFOP staff for additional training.

9. When you have finished working with one turtle clean and disinfect the applicator (plier) to avoid cross contamination between turtles. Maintain the tag applicators so they continue to work properly by washing them in fresh water after use, spraying the spring and pivot surface with WD40, and storing them in a sealed plastic bag.

Photographic Documentation of Sea Turtle Takes

Observers are required to photograph **all** sea turtles that are observed taken during commercial fishing operations. Although a properly completed Sea Turtle Biological Sample Log should provide all identifying characteristics used for species determination, it is imperative that the observer also provide photographic documentation to verify this identification for **every live or dead turtle reported**. Photographs should be taken of the head, flippers, carapace, and plastron. Photographs should also be taken of any injuries, healed scars or unusual markings. Cameras should be sent in with the data at the soonest opportunity, regardless of whether the roll has been completely used. Additional photographic instructions are given in the Photo Log section of the SEFOP Program Manual.

Protocol for Measuring Turtles

Accurate and precise measurements are critical. All measurements should be recorded to the nearest 0.1 cm. The following guidelines apply to over the curve (curvilinear) measurements using a flexible tape. The standard measure of carapace length is **Notch-to-Tip**. This is measured along the centerline from the center of the carapace nuchal notch to the longest posterior tip. Because the posterior tips are frequently broken in juveniles, or worn away in adults, it is recommended that a nuchal notch to posterior notch measurement also be taken. This is known as a **Notch-to-Notch** length. Carapace width is measured perpendicular to the centerline of the carapace at the widest point. If epibiota is present do not include it, if possible, when taking measurements. If it is unavoidable and your measurements do include epibiota please be sure to include detailed comments in your Marine Mammal, Sea Turtle and Sea Bird Incidental Take Log.

Pit Tag Scanning Guidelines

All turtles should be scanned for PIT tags. Many turtle research projects now routinely use PIT tags in addition to external tags.

1. Keep your PIT tag scanner inside a plastic ziplock bag whenever you use it. PIT tag scanners are expensive and since they are **not** waterproof this will help protect them from water or slime. Even the smallest amount of water will destroy a PIT tag scanner, so please be careful when using or storing the scanner. Placing the scanner in a plastic bag will not affect its performance. Some scanners are issued with a nylon case. If your scanner has a nylon case then it is not necessary for you to also use a plastic bag. It is not recommended that a scanner be stored in a plastic bag since condensation may develop inside the plastic bag.

2. Scan the provided (attached) sample tag to verify that the batteries are good and that the PIT tag scanner is working properly. Be sure to hold/keep the sample tag well out of the way when you are scanning a sea turtle. Test the scanner periodically. Establish if your scanner uses AA or AAA batteries and always keep extra batteries on hand. Avoid situations where you are unable to properly scan turtles because of dead batteries.

3. Place the PIT tag reader scanning surface directly on the skin of the turtle and **SLOWLY** scan the dorsal (top) surface of both front flippers, including the shoulder, armpit and neck areas. For the scanner to work properly, you will need to hold the button down while scanning. It is important to move the reader slowly since it cycles through different tag types (Avid, Destron, Trovan) and frequencies (125 and 400 kHz). An overlapping circular scanning motion has been shown to increase tag detection over a straight swiping motion. Scan the entire area multiple times to ensure that you have not missed a tag. Repeat the same procedure for both rear flippers.

4. For all turtles, **except** leatherbacks, gently place the turtle on its carapace and scan the ventral (bottom) surface of all flippers following the procedures outlined above. Also check the area of plastron between the front and rear flippers. This may require assistance from a crew member since turtles can be difficult to handle when on their backs. Leatherback turtles should not be turned on their back since this may damage their skin.

5. If a PIT tag is detected, record the identification code exactly as it appears on the PIT tag scanner display on the Sea Turtle Biological Sample Log. You can take your finger off the button for this and the identification code will stay on the display screen. I.D. codes may be all numbers or alpha numeric. Record all hyphens which may appear as part of the code. Double check to make sure you have recorded the code exactly as it appears on the reader display. Please be especially careful with the letters and numbers which are easily confused.

6. Please retain the turtle and notify the Incidental Take Team Lead at SEFOP if a tag is detected. We will be able to learn more about the history of the PIT tag. If the tag involved is from a dead animal, **do not dispose of the carcass** until given permission do so, since additional valuable information may be obtained from the PIT tagged turtle.

Appendix 2. 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*	GOM: 28,095 – No more than 778 lethal S. Atlantic: 33,204 – No more than 673 lethal	GOM: 623 – No more than 18 lethal S. Atlantic: 378 – No more than 8 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	202 – No more than 67 lethal	25 – No more than 15 lethal	19 – No more than 8 lethal	39 – No more than 14 lethal	4 – No more than 3 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- ALL GEAR COMBINED	205 – No more than 85 lethal	6 – Lethal or non-lethal	4 – Lethal or non-lethal	5 – 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	3 – YEAR	33 – Lethal takes	2 – Lethal takes	4 – Lethal takes	14 – Lethal takes	2 – Lethal takes
ATLANTIC BLUEFISH	ANNUAL	**Trawl gear**: 3 – no more than 2 lethal/yr over 5yr avg. **Gillnet:** 79 – no more than 32 lethal/yr over a 5yr avg	4 – Lethal or non-lethal	4 – Lethal or non-lethal	5 – Lethal or non-lethal	None
ATLATIC MACKEREL/SQUID/ BUTTERFISH	ANNUAL	62 – no more than 27 lethal/yr over 5yr avg.	2 – Lethal or non-lethal	2 – Lethal or non-lethal	2 – Lethal or non-lethal	None
MONKFISH	ANNUAL	**Gillnet:** 171– no more than 69 lethal/yr over 5yr avg. **Trawl gear:**	4 – Lethal or non-lethal	4 – Lethal or non-lethal	5– Lethalor non-lethal	None

		2 – no more than 1 lethal/yr over a 5yr avg.				
Spiny Dogfish	Annual	**Trawl gear**: 1– Lethal or non-lethal over 5yr avg. **Gillnet:** 1– Lethal or non-lethal over 5yr avg	4 – Lethal or non-lethal	4 – Lethal or non-lethal	5 – 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	1 – Lethal or non-lethal	5 – Lethal or non-lethal (biennially)	None	None	None
Northeast Multispecies	Annual	**Trawl gear**: 43 – no more than 19 lethal/yr over 5yr avg. **Gillnet:** 3 – no more than 2 lethal/yr over a 5yr avg.	4 – Lethal or non-lethal	4 – Lethal or non-lethal	5– Lethalor non-lethal	None

* Revised as of 12/22/2010 per the updated Shrimp by-catch Memo.