NOAA's National Marine Fisheries Service
Endangered Species Act Section 7 Consultation

Biological and Conference Opinion (Corrected)

Agency:	Permits, Conservation, and Education Division of the Office of Protected Resources, NOAA's National Marine Fisheries Service
Activity Considered:	The Proposal to Issue Permit Modification No. 13544-01 to Jeffrey Schmid of the Conservancy of Southwest Florida and Modification No. 13307-02 to Kristen Hart of USGS for Research on Abundance and Distribution Sea Turtles off the Southwest Coast of Florida and Dry Tortugas National Park
Consultation Conducted by:	Endangered Species Division of the Office of Protected Resources, NOAA's National Marine Fisheries Service
Approved by:	
Date:	JAN - 7 2011

Section 7(a)(2) of the Endangered Species Act of 1973, as amended (ESA) (16 U.S.C. 1531 *et seq.*) requires each federal agency to insure 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 a federal agency's action "may affect" listed species or designated critical habitat, that agency is required to consult formally with either NOAA's National Marine Fisheries Service (NMFS) or the U.S. Fish and Wildlife Service (USFWS), depending upon the listed resources that may be affected. Federal agencies are exempt from this requirement if they have concluded that an action "may affect", but is "unlikely to adversely affect" listed species or designated critical habitat, and NMFS and/or USFWS concur with that conclusion (50 CFR 402.14[b]).

For the actions described in this document, the action agency is NMFS' Office of Protected Resources – Permits, Conservation, and Education Division. The consulting agency is NMFS' Office of Protected Resources – Endangered Species Division. This document represents NMFS' Biological and Conference Opinion (Opinion) of the effects of the proposed research activities on listed and proposed threatened and endangered species and designated critical habitat in accordance with section 7 of the ESA. This Opinion is based on information submitted by NMFS' Office of Protected Resources – Permits, Conservation, and Education Division, published and unpublished scientific information on the biology and ecology of the listed species affected, and other relevant sources of information.

CONSULTATION HISTORY

On June 10, 2010, NMFS' Office of Protected Resources – Permits, Conservation, and Education Division requested consultation with NMFS' Office of Protected Resources – Endangered Species Division on a proposed action to issue scientific research permit modification No. 13544-01 to Jeffrey Schmid and modification No. 13307-02 to Kristen Hart to capture and tag sea turtles off the Southwest coast of Florida and Dry Tortugas National Park, respectively. The permits would be valid for five years from the date of issuance. The initiation package included the permit applications from the respective applicants, discussion of the effects of the research on the target species, and drafts of the proposed permits.

Upon reviewing the initiation package, NMFS' Office of Protected Resources – Endangered Species division requested additional information regarding the level of effort expected by the survey team as well as more information on the types of satellite tagging to be employed. Upon receiving the additional information, NMFS' Office of Protected Resources – Endangered Species Division initiated formal consultation on July 7th, 2010.

BIOLOGICAL OPINION (CORRECTED)

DESCRIPTION OF THE PROPOSED ACTION

NMFS' Office of Protected Resources – Permits, Conservation and Education Division proposes to issue permit modifications to Jeffrey Schmid of the Conservancy of Southwest Florida and Kristen Hart of USGWS for harassment of listed sea turtles off the southwest coast of Florida and Dry Tortugas National Park during capture and tagging activities pursuant to section 10(a)(1)(A) of the ESA. These actions may result in "takes"[1] of listed sea turtles including green sea turtles (*Chelonia mydas*), Kemp's ridley sea turtles (*Lepidochelys kempii*), and members of the proposed Northwest Atlantic Ocean distinct population segment of loggerhead sea turtles (*Caretta caretta*). This ESA Section 7 consultation considers the effects of the proposed research studies on endangered and threatened species and designated critical habitat.

<u>Jeffrey Schmid, Permit Modification No. 13544-01</u>
Permit No. 13544 authorizes Jeffrey Schmid of the Conservancy of Southwest Florida to conduct research in the waters of Pine Island Sound, San Carlos Bay, Estero Bay, Charlotte Harbor, and adjacent Gulf of Mexico waters. The current permit authorizes capture of up to 130 Kemp's Ridley, 50 loggerhead, 20 green, and five hawksbill sea turtles annually. Turtles are measured, weighed, and tagged with Iconel tags on the trailing edge of the front flippers and a passive integrated transponder tag inserted in the left front flipper. Tissue samples are collected for genetic and stable isotope analyses. A

1 The ESA defines "take" as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct

subset of Kemp's ridley sea turtles are held for 24-48 hours for fecal sample collection. Another subset of Kemp's Ridley sea turtles receives radio/sonic tags to investigate their movements, home range, and habitat associations. The current permit also authorizes non-lethal incidental take of two smalltooth sawfish during the course of the research activities authorized by Permit No. 13544. Smalltooth sawfish may be incidentally captured while researchers are using nets to capture sea turtles. These authorized takes would remain under the current permit and since their effects were already analyzed under a previous ESA Section 7 consultation, they will not be addressed in this Opinion.

The permit holder is now requesting authorization to satellite tag both Kemp's ridley and loggerhead sea turtles in addition to the activities already authorized under the current permit. Radio/sonic telemetry are useful in documenting short-term, fine-scale movements and behaviors, but satellite telemetry is needed for discerning patterns on larger temporal and/or spatial scales. Turtles would be transported to Mote Marine Laboratory's field station on Demere Key via research vessel for transmitter attachment. The anticipated duration of transport is expected to be 30 minutes or less. During transmitter attachment, turtles would be restrained within a portable wooden box with a towel draped over its head. The towel would reduce optical stimuli that could cause further stress to the turtle in this restrained state. The carapace would be cleaned of epibiota, rinsed with alternating washes of fresh water and ethanol, and then dried prior to transmitter attachment. Depending upon the size of a given turtle, it would be fitted either with a Sirtrack Kiwisat 101 (350 g) or 202 (100 g) or equivalent Wildlife Computer SPOT5 platform transmitter terminals (PTTs). The mass of the transmitter would be less than five percent of the total mass of the turtle. A base of slow cure two-part epoxy adhesive would be applied to attach the transmitter on the second vertebral scute. Additional thin layers of epoxy would be built up along the sides and top extending away from the PTT to provide secure attachment. The procedure is expected to take one to two hours to complete, after which time the turtles would be released near their original capture locations; however, Kemp's Ridley sea turtles that are fitted with transmitters may be held up to 48 hours for fecal sample collection before being released.

Table 1 below lists the additional "take" of listed sea turtles to be authorized in Schmid's permit ammendment. This modification would remain valid for the remainder of duration of the original permit which expires on April 30, 2014. More information on the research activities previously authorized may be found in the original permit and Environmental Assessment documents.

Table 1. Additional Research Activities and Proposed Takes of Listed Species for Permit Modification No. 13544-01

SPECIES (LIFE STAGE)	ACTIVITY	INDIVIDUALS PROPOSED TO BE TAKEN ANNUALLY	INDIVIDUALS PROPOSED TO BE TAKEN OVER REMAINING PERMIT DURATION
Kemp's Ridley Sea Turtle (Subadult)	Strike netting; Epoxy attachment (e.g. satellite tag, VHF tag); Mark, flipper tag; Mark, PIT tag; Measure; Fecal sample; tissue sample; Weigh	15	60
Loggerhead Sea Turtle (Adult/Subadult)	Strike netting; Epoxy attachment (e.g. satellite tag, VHF tag); Mark, flipper tag; Mark, PIT tag; Measure; tissue sample; Weigh	10	40

<u>Kristen Hart, Permit Modification No. 13307-02</u>

Permit No. 13307-01 authorizes Kristen Hart of USGS to conduct research in the Dry Tortugas National Park over five years. Dr. Hart is authorized to capture up to 30 green, 20 hawksbill, and 20 loggerhead sea turtles annually. Turtles are weighed, measured, flipper tagged, PIT tagged, blood sampled, tissue sampled, fecal sampled, and lavaged. A subset of turtles is fitted with a satellite tag or acoustic transmitter or a combination of both. This research addresses fine-scale temporal and spatial patterns of sea turtle habitat use, ecology, and genetic origin within the Dry Tortugas National Park.

Permit No. 13307 was issued on July 7, 2008. On July 21, 2008 the applicant requested the addition of the rodeo capture method as well as marking the turtles with paint and NMFS authorized these activities under a minor permit modification issued on July 30, 2008. Due to the high rate of capture success in the Tortugas using both the rodeo and dipnetting capture techniques, the permit holder now requests authorization to increase the total number of green sea turtles captured annually for tagging, lavage, tissue sampling, blood sampling, and fecal sampling. The "take" associated with these activities will be adjusted from 30 to 60 under the proposed permit modification. Other "take" of green sea turtles associated with satellite and acoustic tagging will remain the same as under the original permit and thus, those effects will not be analyzed in this

Opinion. **Table 2** below displays the additional "take" to be modified under the proposed permit amendment. The modification would be valid for the remainder of the permit, which would expire on June 30, 2013.

Table 2. Additional Research Activities and Proposed Takes of Listed Species for Permit Modification No. 13307-02

SPECIES (LIFE STAGE)	ACTIVITY	INDIVIDUALS PROPOSED TO BE TAKEN ANNUALLY	INDIVIDUALS PROPOSED TO BE TAKEN OVER REMAINING PERMIT DURATION
Green Sea Turtle (Subadult)	Capture (i.e. tangle net, dip net, cast net, or in-water rodeo capture); Lavage; Mark, Carapace (temporary); Mark, flipper tag; Mark, PIT tag; Measure; Photograph/ Video; Blood Sample; Fecal Sample; Tissue Sample; Weigh	60	180

The following is a summary of the research actitivities authorized under the current permit that will be associated with this modified "take":

Capture

Researchers would capture turtles using four different methods (i.e. entanglement net, dip net, cast net, or in-water rodeo capture) depending on the situation and the size of the individual. Entanglement nets (100-250 meters long, 12 inches stretch mesh, 8-16 feet deep) would only be performed during the day and would be set in the water column near known sea grass and sponge habitats (but not on reefs), constantly tended, and retrieved upon capture of a turtle. Researchers may also capture turtles by dipnetting and cast netting when turtles are at or near the surface. Cast netting would involve deploying the net over an individual that is at or near the surface to encircle the individual. The "draw" string that cinches the lead weights together would be pulled, effectively capturing the individual. Because of the researcher's prior success in capturing green sea turtles in the Everglades at night using spotlights and dipnets, researchers request to be permitted to use both dipnetting and cast netting techniques at night as well as during daylight hours. Diver-assisted captures (i.e. rodeo method) would involve slow ascent to ensure no rapid change in depth for either the turtle or the researcher (though all of the capture efforts would be in water at a maximum depth of 6-7 m). Turtles would be grabbed at the nuchal and at the posterior tip of the carapace and guided to the surface.

Handling, Measuring, Weighing, Flipper Tagging, PIT Tagging
Standard carapace and plastron morphometric measurements would be taken from each turtle in addition to being weighed. All turtles would be scanned for previous tags and marked (with internal PIT tags and external flipper tags) if no tags are detected. All turtles would receive two Inconel flipper tags and one Passive Integrated Transponder (PIT) tag. Double tagging minimizes the probability of complete tag loss. Tags would be cleaned prior to use (e.g., to remove oil and other residue) and disinfected with Betadine or alcohol. Applicators would be cleaned and disinfected between animals. The application site would be cleaned and scrubbed with disinfectant before the tag is applied. In order to accommodate future growth in young turtles, flipper tags would be placed with additional space to the edge of the rear flipper. To avoid injury and minimize tag loss, researchers would ensure that the tag is securely folded over.

Prior to insertion, each PIT tag would be sterilized, and tested by scanning it with a PIT tag reader and the corresponding number would be recorded. PIT tagging would be performed by disinfecting the application site with Betadine or alcohol. PIT tags would be applied within the soft, fleshy area dorsal to the wrist bones of the front flipper. All PIT tags and PIT tag needles would remain sterile prior to use. The needle would be inserted at a seam between scales, nearly parallel with the skin of the flipper and with the needle directed proximally. Holding the flipper firmly so that the flipper can not move, the tagging needle would be inserted just beneath the skin. Gauze with antiseptic would be placed with slight pressure over the entry point after the needle has been withdrawn. After insertion, the PIT tag reader would be swiped over the tagged flipper.

Blood and Skin/Tissue Sampling
Blood samples would be obtained for multiple purposes from adult and subadult green turtles from the dorso-cervical sinus. Blood sampling would only be conducted on turtles over 5 kg in weight. Blood samples would not exceed 3 ml per 1 kg of animal. Blood would be sampled for: 1) hormonal radio-immunoassay analysis to investigate the sex of captured individuals; 2) stable carbon and nitrogen isotopic analysis for feeding ecology studies; and 3) genetic analysis to research connectivity. The samples collected may also be tested for additional health-related factors, including ecotoxicology sampling. Sterile techniques would be used at all times. Areas of blood and biopsy collection would be treated with 70 percent ethanol and Betadine or alcohol before the sample is collected. Blood samples would be collected from adults with a 21 gauge, 1-1.5 inch needle and syringe (Owens and Ruiz, 1980) in additive-free (for whole blood) and heparin-containing (for the separation of plasma and red blood cell components) vacutainer tubes. Samples from smaller turtles would be obtained using a smaller needle (e.g. 23 gauge ½ inch needle). To facilitate bleeding of the cervical sinus, turtles would be positioned so that their head is lower than the body. Researchers would also use FTA cards to store blood samples for later analysis. Blood samples in tubes would be kept on ice and in a small cooler for up to 4 hours before being transferred to a lysis buffer (genetic samples) or being centrifuged.

For genetic and feeding ecology sampling, sterile, disposable 6 mm AcuPunch biopsy tools would be used to sample a small biopsy skin sample about 5mm in diameter. Samples would be stored in ethanol or in a 20% DMSO buffer saturated in salt.

Lavage

Sample food components for the dietary component of the study would be collected using gastric lavage. Food items collected using this technique are important because they would serve as complementary independent measurements to substantiate or further constrain interpretations of the isotopic evidence. For each oral lavage attempt, the turtle would be placed on their carapace so that its head is positioned lower than the dome of the carapace. This placement facilitates optimal drainage of the food contents. Small turtles would be hand-held in the lap of the researcher. A thin, stainless steel pry bar, cleaned prior to insertion with ethanol, would be used to separate the maxilla and mandible. Pry bars would be rounded and smooth in shape in order to avoid damaging the mouth cavity. The pry bar would then be pressed downward towards the palate in an attempt to provide an irritating pressure, which would cause the turtle to voluntarily open its mouth. A standard veterinary mouth gag is then inserted at the anterior end of the mouth. Care would be taken not to over-expand the gag so as to avoid damaging the soft dermal tissues of the mouth. Two flexible clear plastic tubes would individually be inserted into the esophagus, one on each side of the gag. The ends of each tube would be rounded to reduce damage to the esophagus. The first tube would serve as the retrieval tube that carries the displaced esophagus contents into a mesh collection bag. The second tube would serve as the water injection and have a wall thickness of 1.0-1.5 mm. Smaller water injection tubes would be used for smaller turtle individuals. Researchers would clean all tubes and lavage equipment before sampling additional individuals.

Before insertion, tubes would be thoroughly cleaned with ethanol and water. Markings would be made on both tubes at 10 cm intervals so that researchers can monitor the length of tubing that has been inserted into the esophagus. For example, the distance from the mouth to the junction of the humeral and pectoral scutes typically represents the length of tube necessary to reach the internal location of a food bolus, and would assist researchers in knowing how much tube to insert. After the tip of the retrieval tube has been lubricated with vegetable oil, it would be gently inserted into the esophagus. Extreme care would be made as the tube is inserted in order to avoid damaging the delicate dermal tissues of the esophagus.

After the water insertion tube passes the esophageal muscle groups (but prior to full insertion towards the food bolus) the retrieval tube would be passed in laterally along the water insertion tube. Both tubes would then be slowly advanced down the esophagus until resistance is felt from either the food bolus or the junction of the esophagus and stomach. Saltwater would then be delivered through the injection tube using a hand operated bilge pump. Care would be taken not to deliver water at pressures or volumes greater than what is easily expelled though the retrieval tube. Water return flow should begin within seconds of water entering the turtle. If no water is retrieved, the tube would be withdrawn slightly to allow free entry of water into the tube to be unobstructed. If

water continues to not exit for more than 15-20 seconds, the gastric lavage would be halted and both tubes would be removed, and reinserted.

The lavage procedure would not exceed 3 minutes in order to reduce the chance of the turtle inhaling during the process. After food samples are collected, the use of the bilge pump would be ceased and water and food then allowed to drain until flow ceases. To assist with drainage, the anterior end of the turtle would be placed lower than the rest of the body. The injection tube would be removed first followed by the removal of the retrieval tube. The gag would then be removed rapidly and the head would be elevated to allow for drainage of any remaining water towards the esophagus. Turtles would be held in this position until regular breathing resumes.

Fecal Sampling

Scat samples would be collected from the turtle using digital extraction, or opportunistically from the water when observed floating. A sub-sample would be stored frozen or in 10 percent formalin until analysis. For dietary analysis, scat samples would be analyzed and used as complementary independent measurements to substantiate or further constrain interpretations of the isotopic evidence. Scats collected from recaptured individuals on different days would be considered separate samples.

Mitigation Measures

The following section summarizes the mitigation measures associated with permit modification No. 13544-01 and No. 13307-02 to mitigate effects to targeted and any non-targeted protected species during research activities. More detailed information may be found in the associated permit and Environmental Assessment documents. Conditions are grouped together for this consultation for the two respective permits as many are the same with only a few exceptions. The following conditions are included in the respective researchers' proposed permit modifications:

1. In the event a serious injury or mortality[2] of a protected species occurs, the Researchers must suspend permitted activities and contact the Chief, NMFS Permits, Conservation, and Education Division by phone within two business days. Researchers must also submit a written incident report. The Permits Division may grant authorization to resume permitted activities based on review of the incident report and in consideration of the Terms and Conditions of the permit.

2. If authorized take[3] is exceeded, the Researchers must cease all permitted activities and notify the Chief, NMFS Permits, Conservation, and Education Division by phone as soon as possible but not later than two business days. Researchers must also submit a written incident report within two weeks of the incident. The

2 This permit does not allow for unintentional serious injury and mortality caused by the presence or actions of researchers. This includes, but is not limited to; deaths resulting from infections related to sampling procedures; and deaths or injuries sustained by animals during capture and handling, or while attempting to avoid researchers or escape capture.

3 Under the ESA, a take means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to do any of the preceding.

incident report must include a complete description of the events and identification of steps that will be taken to reduce the potential for additional exceedance of authorized take.

3. Application instruments and equipment must be cleaned and disinfected between animals.

4. When handling, measuring, and/or tagging turtles, researchers must use the following procedures:

    a. All equipment (tagging equipment, tape measures, etc.) that comes in contact with sea turtles must be cleaned and disinfected between the processing of each turtle; and

    b. Maintain a separate set of sampling equipment for handling animals displaying fibropapillomas tumors/or lesions (all equipment that comes in contact with the turtle must be cleaned with a disinfectant between the processing of each turtle).

    c. All turtles must be examined for existing tags, including PIT tags, before attaching or inserting new ones. If existing tags are found, the tag identification numbers must be recorded and included in the annual report. Researchers must have PIT tag readers capable of reading 125, 128, 134.2, and 400 kHz tags.

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

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

5. General handling and releasing of turtles:

    a. The Permit Holder, 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, injured animals should be

transferred to rehabilitation facilities and allowed an appropriate period of recovery before return to the wild. An experienced veterinarian, veterinary technician, or rehabilitation facility must be named for emergencies. If an animal becomes highly stressed, injured, or comatose during the course of the research activities the researchers must contact a veterinarian immediately. Based on the instructions of the veterinarian, if necessary, the animal must be immediately transferred to the veterinarian or to a rehabilitation facility to receive veterinary care. All turtles must be handled according to procedures specified in 50 CFR 223.206(d)(1)(i).

b. Turtles are to be protected from temperature extremes of heat and cold, provided adequate air flow, and kept moist (if appropriate) during sampling. Turtles must be placed on pads for cushioning and this surface must be cleaned and disinfected between turtles. The area surrounding the turtle must not contain any materials that could be accidentally ingested.

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

d. The Permit Holder, Principal Investigator, Co-investigator(s), or Research Assistant(s) acting on the Permit Holder's behalf must carefully observe newly released turtles and record observations on the turtle's apparent ability to swim and dive in a normal manner. If a turtle is not behaving normally within one hour of release, the turtle must be recaptured and taken to a rehabilitation facility.

6. Blood sampling (*exclusive to permit No. 13307-02*): Blood samples must be taken by experienced personnel that have been authorized under this permit. New disposable needles must be used on each animal. Care should be taken to ensure no injury results from the sampling. If an animal cannot be adequately immobilized for blood sampling, efforts to collect blood must be discontinued. Attempts (needle insertions) to extract blood from the neck must be limited to a total of four, two on either side. Sample collection sites must always be scrubbed with alcohol or another antiseptic prior to sampling. No blood sample will be taken should conditions on the boat preclude the safety and health of the turtle.

7. Blood volume limits (standard language):

a. A single sample must not exceed 3 ml per 1 kg of animal.

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

c. Sampling period: Within a 45-day period of time, the cumulative blood volume taken from a single turtle must not exceed the maximum safe limit

described above. If more than 50% of the maximum safe limit is taken, in a single event or cumulatively from repeat sampling events, from a single turtle within a 45-day period that turtle must not be re-sampled for 3 months from the last blood sampling event.

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

8. Biopsy (tissue-skin) sampling:

   a. A new biopsy punch must be used on each turtle.

   b. Turtles brought on-board the vessel for sampling: Sterile techniques must be used at all times. Samples must be collected from the trailing edge of a rear flipper. The tissue surface must be thoroughly swabbed once with both Betadine and alcohol, sampled, and then thoroughly swabbed again with just betadine. The procedure area and hands must be clean.

   c. If the procedure has to involve more tissue (i.e., not just the flipper edge) including skin, fat, and muscle, the biopsy site and surrounding tissue must be treated to a surgical scrub. It must be cleansed with three alternating applications of 70 percent ethanol and a surgical iodine (e.g. Betadine) before the sample is collected. The sample area shall also be swabbed with Betadine after the sample is collected (*Exclusive to permit No. 13544-01*).

   d. If it can be easily determined (through markings, tag number, etc.) that a sea turtle has been recaptured by the fisheries and has been already sampled under the activities authorized by this permit, no further biopsy samples must be collected from the animal.

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

10. Gastric Lavage (*exclusive to permit No. 13307-02*): The actual lavaging of an individual turtle must not exceed three minutes. Once the samples have been collected, water must be turned off and water and food allowed to drain until all flow has stopped. The posterior of the turtles will be elevated slightly to assist in drainage.

a. Equipment (e.g., lavage tubes) that will come in contact with sea turtles must be disinfected between animals. Additionally, a separate set of equipment must be used for infected and non-infected animals. Disinfection can be compromised (incomplete) if items are contaminated with debris and/or have rough or porous surfaces. Researchers shall clean items prior to disinfection and increase the exposure time for rough and/or porous items.

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

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

11. Fecal Sampling (*exclusive to permit No. 13307-02*): Only turtles larger than 50 cm SCL may be subject to digital extraction of feces.

12. Instrument tagging and marking:

a. TDRs, VHF, sonic or satellite tags only.

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

c. Drilling through marginal scutes (*exclusive to permit No. 13544-01*): A separate drill bit shall be used for each turtle. Bits may be reused if sterilized via the autoclave procedure before reuse.

d. Adequate ventilation around the head of the turtle must be provided during the attachment of satellite tags or attachment of radio/sonic tags if attachment materials produce fumes. To prevent skin or eye contact with harmful chemicals used to apply tags, turtles must not be held in water during the application process (*exclusive to permit No. 13307-02*).

e. Painting of Carapace: The applicant must use non-toxic paints that do not contain zylene or toulene, and the paint must be applied without crossing suture lines. Also, the applicant must not use paints with exothermic set-up reactions to avoid any effects from heat that could affect the turtle as the paint cures (*exclusive to permit No. 13307-02*).

13. Entanglement netting:

a. Nets used to catch turtles must be of large enough mesh size to diminish bycatch of other species.

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

c. Nets must be checked at intervals of less than 30 minutes, and more frequently whenever turtles or other organisms are observed in the net. The float line of all nets must be observed at all times for movements that indicate an animal has encountered the net. When this occurs the net must be immediately checked. "Net checking" is defined as a complete and thorough visual check of the net either by snorkeling the net in clear water or by pulling up on the top line such that the full depth of the net is viewed along the entire length. If water temperatures are equal to or greater than 30°C, nets must be checked at less than twenty minute intervals. Researchers must plan for unexpected circumstances or demands of the research activities and have the ability and resources to meet this net checking condition at all times (e.g. if one animal is very entangled and requires extra time and effort to remove from the net, researchers must have sufficient staff and resources to continue checking the rest of the net at the same time).

d. Nets must not be put in the water when marine mammals are observed within the vicinity of the research, and the marine mammals must be allowed to either leave or pass through the area safely before net setting is initiated. Should any marine mammals enter the research area after the nets have been set, the lead line must be raised and dropped in an attempt to make marine mammals in the vicinity aware of the net. If marine mammals remain within the vicinity of the research area, nets must be removed.

14. Hand Capture (*exclusive to permit No. 13307-02*): Researchers must be aware of the increased stress that accompanies hand captures and do their best to minimize stress levels. If there is any question that the research capture event could pose or is posing (during the capture event) a significant risk to the animal's health, the capture event must be discontinued.

15. Transport and Holding:

    a. Turtles must be transported via a climate-controlled environment, protected from temperature extremes and kept moist (if appropriate). The turtles must be placed on pads for cushioning. The area surrounding the turtle must not contain any materials that could be accidentally ingested.

    b. Turtles transported to a facility and held (e.g., for rehabilitation) must be maintained and cared for under the "Care and Maintenance Guidelines for Sea Turtles Held in Captivity" issued by the U.S. Fish and Wildlife Service or if in the State of Florida, following Florida Fish and Wildlife Conservation Commission Sea Turtle Conservation Guidelines, Section 4, Holding Turtles in Captivity.

16. Compromised or Injured Sea turtles: The Permit Holder may conduct the activities authorized by this permit on compromised or injured sea turtles, but only if the activities will not further compromise the animal. Care must be taken to minimize handling time and reduce further stress to the animal. Compromised or injured sea turtles must not be handled or sampled by other permit holders working under separate research permits if their activities would further compromise the animal.

17. In waters where manatees are present: The following conditions to the permit are provided by the United States Fish and Wildlife Service to prevent adverse interactions with endangered Florida manatees (*Trichecus manatus latirostris*):

    a. Vessel personnel must be informed that it is illegal to intentionally or unintentionally harm, harass, or otherwise "take" manatees, and to obey all posted manatee protection speed zones, Federal manatee sanctuary and refuge restrictions, and other similar state and local regulations while conducting in-water activities. Such information shall be provided in writing to all vessel personnel prior to beginning the permitted research.

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

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

    d. Rope attaching floats to nets or traps shall not have kinks or contain slack

that could present an entanglement hazard to manatee.

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

18. If a manatee is accidentally captured:

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

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

c. Release tension on the net to allow the animal the opportunity to free itself. Exercise caution when attempting to assist the animal in freeing itself. Manatee are docile animals but can thrash violently if captured or become entangled in a net. A 1,200 to 3,500 pound manatee can cause extensive damage to nets while trying to escape or breathe, so quick action is essential to protect both the manatee and the net. Ensure that the animal does not escape with net still attached to it.

d. Contact the Florida Fish and Wildlife Conservation Commission, Division of Law Enforcement, 1-888-404-FWCC [3922] immediately to report any incidents. If a manatee is injured, the sooner the animal receives treatment, the better its chance of recovery.

19. The Permit Holder must observe her nets for smalltooth sawfish and disentangle and release them as fast as possible, to the maximum extent practicable and with vigilante consideration of safety. For the safety of both the animals and the researchers, all smalltooth sawfish (especially their gills) must be kept in the water as much as possible. If necessary, researchers must cut the net to free the sawfish to ensure its rapid and safe release.

a. The length of the animal must be measured or estimated. Sawfish should be inspected for tags and any tag recorded.

b. The Permit Holder must report any smalltooth sawfish interactions to Shelley Norton, Protected Resources, Southeast Regional Office, within 14 days of the incident (F/SER3, 263 13th Avenue South, St. Petersburg, FL 33701 (tel: 727/824-5312, fax 727/824-5517)). This report must contain: the description of the take, date and time of take, location, size of animal, habitat type animal was taken in, tag information, sex of animal (if possible), and final disposition of the sawfish (*i.e.*, released in good health, *etc*.). This same information must be reported within 14 days of the incident to the Chief, Permits, Conservation and Education Division, PR1 (National Marine Fisheries Service, Office of Protected Resources, 1315 East West Highway, Silver Spring, MD 20910).

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

21. Johnson's sea grass and critical habitat: No research activities will be conducted over, on, or immediately adjacent to Johnson's sea grass or in Johnson's sea grass critical habitat.

22. Other sea grass species: Researchers must avoid conducting research over, on, or immediately adjacent to any non-listed sea grass species. If these non-listed species cannot be avoided, then the following avoidance/minimization measures must be implemented:

    a. In order to reduce the potential for sea grass damage, anchors must be set by hand when water visibility is acceptable. Anchors must be placed in unvegetated areas within seagrass meadows or areas having relatively sparse vegetation coverage. Anchor removal must be conducted in a manner that would avoid the dragging of anchors and anchor chains.

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

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

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

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

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

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

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

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

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

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

APPROACH TO THE ASSESSMENT

NMFS approaches its section 7 analyses of agency actions 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 result of this step includes defining 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 establishes the risks those responses pose to listed resources (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 Population Segments (DPSs) of species. 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 (see Stearns, 1992). Reductions in at least one of these variables (or one of the variables we derive from them) is a necessary condition for reductions in a population's viability, which is itself a necessary condition for reductions in a species' viability. As a result, when listed plants or animals exposed to an action's effects are not expected to experience reductions in fitness, we would not expect the action to have adverse consequences on the viability of the populations those individuals represent or the species those populations comprise (e.g., Brandon, 1978; Mills and Beatty, 1979; Stearns, 1992; Anderson, 2000). As a result, if we conclude that listed plants or animals are not likely to experience reductions in their fitness, we would conclude our assessment.

Although reductions in fitness of individuals is 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) as our point of reference. If we conclude that reductions in the fitness of individuals 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) as our point of reference. Our final jeopardy 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 State or Tribal natural resource agencies, reports from 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. We supplement this evidence with reports and other documents – environmental assessments, environmental impact statements, and monitoring reports – prepared by other federal and state agencies like the Minerals Management Service, U.S. Coast Guard and U.S. Navy whose operations extend into the marine environment.

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 a particular tagging procedure) as well as data that does not support that conclusion.

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.

Finally, 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)], when data are equivocal, or in the face of substantial uncertainty, our decisions are designed to avoid the risks associated with incorrectly concluding an action has no adverse effect on a listed species when, in fact, such adverse effects are likely (i.e. avoiding Type II error).

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." Research is authorized to occur in the Dry Tortugas National Park (permit modification No. 13307-02) and Florida waters of Pine Island Sound, San Carlos Bay, Estero Bay, Charlotte Harbor, and adjacent Gulf of Mexico waters (permit modification No. 13544-01). Therefore, the Action Area for this consultation includes the identified nearshore bays and estuaries along the southwest coast of Florida and Gulf of Mexico waters extending down to the Dry Tortugas and lower Florida Keys.

STATUS OF THE SPECIES

NMFS' Office of Protected Resources – Endangered Species Division has determined that the following listed resources provided protection under the ESA or are proposed for listing occur within the action area and may be affected by proposed action:

Common Name	Scientific Name	Listing Status
Loggerhead sea turtle South Atlantic Ocean Distinct Population Segment[4]	*Caretta caretta*	Proposed Threatened
Loggerhead sea turtle Northwest Atlantic Ocean Distinct Population Segment	*Caretta caretta*	Proposed Endangered
Green sea turtle	*Chelonia mydas*	Endangered[5]
Hawksbill sea turtle	*Eretmochelys imbricata*	Endangered
Kemp's ridley sea turtle	*Lepidochelys kempii*	Endangered
Leatherback sea turtle	*Dermochelys coriacea*	Endangered
Smalltooth Sawfish	*Pristis pectinata*	Endangered
Elkhorn Coral	*Acropora palmata*	Threatened
Staghorn Coral	*Acropora cervicornis*	Threatened
Smalltooth Sawfish Critical Habitat		

4 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.

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

Elkhorn Coral Critical Habitat
Staghorn Coral Critical Habitat

Listed Resources Not Likely to be Adversely Affected

Leatherback sea turtles inhabit the waters off the coast of Florida and may therefore be affected by the proposed research activities through net capture. However, given the fact that researchers are experienced in turtle surveys and will restrict their research to the targeted species and the fact that the researchers have never encountered a leatherback sea turtle the past, NMFS believes the probability of this species being exposed to the effects of the research activities to be highly unlikely and therefore the threats posed to this species are discountable. Therefore, the proposed research permit modifications are not likely to adversely affect leatherback sea turtles and this species will not be considered further in this Opinion. Authorized takes of hawksbill sea turtles are already exempted for both researchers under their current permits. Given the highly targeted nature of the research activities and the experience of the researchers, NMFS does not believe that hawksbill sea turtles will be further affected by the proposed permit amendments. Therefore, this species will also not be considered further in this Opinion.

A distinct population segment (DPS) of loggerhead sea turtles is proposed to be listed as endangered under the ESA for the South Atlantic Ocean. However, given that researchers will restrict their research activities to Gulf of Mexico waters, NMFS believes the probability of members of this South Atlantic Ocean DPS being exposed to the effects of the research activities to be highly unlikely and therefore the threats posed to this proposed DPS are discountable. The loggerhead sea turtles encountered over the course of the research are expected to be members of the proposed Northwest Atlantic Ocean DPS. Therefore, the South Atlantic Ocean DPS of loggerhead sea turtles will not be considered further in this Opinion.

Two listed invertebrate species (Elkhorn and Staghorn coral) and their joint critical habitat occur within the action area and could therefore be subjected to physical disturbance from vessels or nets used for turtle capture or from unexpected contaminant or fuel spill pollution under permit modification No 13307-02. However, permit conditions require the researchers to avoid impacting sediment or habitat for coral or other live bottom communities. Specific permit conditions include avoiding setting gear over such areas as well as taking steps to recover lost gear, avoiding anchoring in areas where these communities exist, and avoiding treading or trampling on these areas where in-water work occurs. Also, the research team has experience performing similar types of surveys in these areas and would be expected to take all proper precautions to avoid any physical disturbance or minimizing the impact of an accidental fuel spill. NMFS believes that listed corals as well as their critical habitat are highly unlikely to be exposed to effects from the proposed action and any potential threats are discountable. Therefore, the proposed action is not likely to adversely affect Elkhorn coral, Staghorn coral, or their critical habitat and these listed resources will not be considered further in this Opinion.

Smalltooth sawfish including its critical habitat exist within the action area and therefore may be affected by the proposed research activities. Smalltooth sawfish have the

possibility of being incidentally caught as bycatch in nets used to capture targeted sea turtles. The previous consultations performed for both researchers resulted in determinations that the proposed research was not likely to jeopardize the continued existence of smalltooth sawfish. Previous consultations resulted in incidental take of two smalltooth sawfish authorized under each respective permit. Permit modification No. 13544-01 would not result in a higher level of research effort that would result in additional incidental take of smalltooth sawfish. NMFS also believes that the increased take of green sea turtles associated with permit modification No. 13307-02 is not expected to result in a greater level of incidental take of smalltooth sawfish than what was authorized for the original permit. Therefore, no additional take of smalltooth sawfish is expected with the proposed permit amendments and this species will not be considered further in this Opinion. The authorized take of 2 smalltooth sawfish authorized for the original permits will remain in effect along with the reasonable and prudent measures and terms and conditions established in the original consultations through the duration of the permits.

As stated above, critical habitat designated for the smalltooth sawfish exists in the action area and could be affected by the research activities. The two units of critical habitat designated for the smalltooth sawfish are the Charlotte Harbor Estuary Unit, which comprises approximately 221,459 acres of habitat, and the Ten Thousand Islands/Everglades Unit (TTI/E), which comprises approximately 619,013 acres of habitat. The two units are located along the southwestern coast of Florida between Charlotte Harbor and Florida Bay. These specific areas contain the following physical and biological features that are essential to the conservation of this species: red mangroves and shallow euryhaline habitats characterized by water depths between the Mean High Water Line and 3 ft (0.9 m) measured at Mean Lower Low Water. These essential features are necessary to facilitate recruitment of juveniles into the adult population, because they provide for predator avoidance and habitat for prey in the areas currently being used as juvenile nursery areas. While research activities will occur in designated critical habitat for smalltooth sawfish, permit conditions require the researchers to avoid impacting bottom habitat including those occurring in nearshore waters. Research activities are not expected to impact red mangroves or shallow euryhaline habitats essential for juvenile smalltooth sawfish. The research team has experience performing similar types of surveys in these areas and would be expected to take all proper precautions to avoid any physical disturbance of bottom habitat and/or minimizing the impact of an accidental fuel spill. NMFS believes that constituent elements of the critical habitat are highly unlikely to be exposed to effects from the proposed action and any potential threats are discountable. Therefore, the proposed action is not likely to adversely affect designated critical habitat for the smalltooth sawfish and this listed resource will not be considered further in this Opinion.

Listed Resources Likely to be Adversely Affected

The sections below provide information on the status of listed resources likely to be adversely affected by the proposed action. The biology and ecology of these species as well as their global status and trends are described below, and inform the effects analysis for this Opinion.

Loggerhead Sea Turtle (Northwest Atlantic Ocean DPS)

Species Description, Distribution, and Population Structure

Adult and subadult loggerhead sea turtles (*Caretta caretta*) are characterized as having a light yellow plastron and a reddish brown carapace covered by non-overlapping scutes that meet along seam lines. They typically have 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. Hatchlings lack the reddish tinge and vary from light to dark brown dorsally. Both pairs of appendages are dark brown and have distinct white margins. Hatchling mean body mass is about 20 g and mean straight carapace length is about 45 mm (Dodd, 1988).

The loggerhead sea turtle inhabits continental shelf and estuarine environments and occurs throughout the temperate and tropical regions of the Atlantic, Pacific, and Indian Oceans (Dodd, 1988). The majority of loggerhead nesting occurs at the western rims of the Atlantic and Indian Oceans concentrated in in the north and south temperate zones and subtropics (NRC, 1990).

In the western North Atlantic, the majority of loggerhead nesting is concentrated along the coasts of the United States from southern Virginia to 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), off the southwestern coast of Cuba (Gavilan, 2001), and along the coasts of Central America, Colombia, Venezuela, and the eastern Caribbean Islands. In the eastern Atlantic, the largest nesting population of loggerheads is in the Cape Verde Islands (Abella et al., 2007; Delgado et al., 2008), with some nesting also occuring along the West African coast (Fretey, 2001). From a global perspective, the southeastern U.S. nesting aggregation is critical to the survival of this species as it second in size only to the nesting aggregations in the Arabian Sea off Oman. In addition, shelf waters along the Florida west coast, the Bahamas, Cuba, and the Yucatán Peninsula have been identified as important resident areas for adult female loggerheads that nest in Florida (Foley et al., 2008)

Non-nesting, adult female loggerheads are reported throughout the U.S. and Caribbean Sea. Little is known about the distribution of adult males who are seasonally abundant near nesting beaches although aerial surveys suggest that loggerheads in U.S. waters are distributed as a whole in the following proportions: 54 percent in the southeast U.S. Atlantic, 29 percent in the northeast U.S. Atlantic, 12 percent in the eastern Gulf of Mexico, and 5 percent in the western Gulf of Mexico (Turtle Expert Working Group [TEWG], 1998). 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 while juveniles are also found in enclosed, shallow water estuarine environments not frequented by adults (Epperly et al., 1995a). Further offshore, adults primarily inhabit continental shelf waters, from New England south to Florida, the Caribbean, and Gulf of Mexico (Schroeder et al., 2003). Benthic, immature loggerheads foraging in northeastern U.S. waters are known to migrate southward in the

fall as water temperatures cool and then migrate back northward in spring (Epperly et al., 1995a; Keinath, 1993; Morreale and Sandora, 1998; Shoop and Kenney, 1992).

Currently, there are nine DPS' of loggerhead sea turtles proposed to be listed under the ESA divided geographically: South Atlantic Ocean DPS, Southeast Indian Ocean DPS, Mediterranean Sea DPS, North Indian Ocean DPS, North Pacific Ocean DPS, Northeast Atlantic Ocean DPS, Northwest Atlantic Ocean DPS, South Pacific Ocean DPS, and Southeast Indo-Pacific Ocean DPS.

Life History Information

Loggerhead sea turtles reach sexual maturity between 20 and 38 years of age, although this varies widely among populations (Frazer and Ehrhart, 1985; NMFS, 2001). The annual mating season for loggerhead sea turtles occurs from late March to early June, and eggs are laid throughout the summer months. 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). Mean clutch size varies from 100 to 126 eggs for nests occurring along the southeastern U.S. coast (Dodd, 1988).

Loggerheads originating from the western Atlantic nesting aggregations are believed to lead a pelagic existence in the North Atlantic Gyre for a period as long as 7-12 years (Bolten et al., 1998). Stranding records indicate that when immature loggerheads reach 40-60 cm straight carapace length, they then travel to coastal inshore waters of the continental shelf throughout the U.S. Atlantic and Gulf of Mexico (Witzell et al., 2002). Recent studies, however, have suggested that not all loggerhead sea turtles follow the model of circumnavigating the North Atlantic Gyre as pelagic juveniles, followed by permanent settlement into benthic environments (Laurent et al., 1998; Bolten, 2003). These studies suggest some turtles may either remain in the pelagic habitat in the North Atlantic longer than hypothesized or move back and forth between pelagic and coastal habitats interchangeably (Witzell et al., 2002).

As post-hatchlings, loggerheads hatched on U.S. beaches migrate offshore and become associated with *Sargassum* habitats, driftlines, and other convergence zones (Carr, 1986; Witherington, 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 found in coastal waters and prey on benthic invertebrates such as mollusks and decapod crustaceans in hard bottom habitats.

Listing Status

The loggerhead sea turtle was listed as threatened under the ESA in 1978 throughout its range. At the time of this consultation, nine separate loggerhead sea turtle DPS' are proposed for listing under the ESA with two proposed as endangered (South Atlantic Ocean and Southwest Indian Ocean) and seven proposed as threatened (Mediterranean Sea, North Indian Ocean, North Pacific Ocean, Northeast Atlantic Ocean, Northwest Atlantic Ocean, South Pacific Ocean, and Southeast Indo-Pacific Ocean). Critical habitat has not been designated for this species.

Status and Trends
The most recent reviews show that only two loggerhead nesting aggregations have greater than 10,000 females nesting per year: Peninsular Florida in the 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). Current data reports declines of 26 percent over a recent 20 year period (1989-2008) with a 41 percent decline since 1998 alone (NMFS and USFWS, 2009). The status of the Oman nesting beaches has not been evaluated recently; however, these beaches are located in regions vulnerable to extremely disruptive events (e.g. political upheavals, wars, and catastrophic oil spills), thus resulting in increased risk to loggerhead nesting success in these areas (Meylan et al., 1995). At present, there are no reliable estimates of population size of loggerheads in the pelagic and oceanic environments as studies tend to focus on known nesting populations or are too localized to reveal any reliable large scale estimates (Bjorndal and Bolten, 2000). Heppell et al. (2003) showed that the growth of loggerhead sea turtle populations were particularly sensitive to changes in annual survival of both juvenile and adult sea turtles, and 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, thereby increasing their risk of extinction.

Loggerhead sea turtles face numerous natural and anthropogenic threats that help shape its status and affect the ability of the species to recover. As many of the threats affecting loggerheads are either the same or similar in nature to threats affecting other listed sea turtle species, many of the threats identified in this section below are discussed in a general sense for all listed sea turtles rather than solely for loggerheads. Threats specific to a particular species are then discussed in the corresponding status sections where appropriate.

Sea turtles have been impacted historically by domestic and international fishery operations that often capture, injure, and even kill sea turtles at various life stages. In the U.S., the bottom trawl, sink gillnets, hook and line gear, and bottom longline managed in the Northeast Multispecies Fishery are known to capture sea turtles during normal fishery operations (Watson et al., 2004; Epperly et al., 1995a; Lewison et al., 2003, Lewison et al., 2004; Richards, 2007) while the lines used for pot gear for the U.S. Lobster and Red Crab fisheries can cause entanglement resulting in injury to flippers, drowning, or increased vulnerability to boat collisions (Lutcavage et al., 1997). In addition, various trawl, gillnet, longline, and hook gears used for the Monkfish, Spiny Dogfish, Summer Flounder, Scup, Black Sea Bass, and Atlantic Highly Migratory Species fisheries managed in the U.S. impact sea turtles at various degrees. 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. Although loggerhead sea turtles are most vulnerable to pelagic longlines during their immature life history stage, there is some evidence that benthic juveniles may also be captured, injured, or killed by pelagic fisheries as well (Lewison et al., 2004) (refer to the *Environmental Baseline* section of this Opinion for further information regarding federal and state managed fisheries affecting sea turtles in the action area).

In addition to domestic fisheries, sea turtles are subject to direct as well as incidental capture in numerous foreign fisheries, further exacerbating the ability of sea turtles to survive and recover on a more global scale. For example, pelagic, immature loggerhead sea turtles circumnavigating the Atlantic are exposed to international longline fisheries including the Azorean, Spanish, and various other fleets (Aguilar et al., 1995; Bolten et al., 1994; Crouse, 1999). 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) and gillnet fishing is known to occur 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 significant threat to sea turtles similar to the impacts seen in U.S. waters. In addition to the reported takes, there are many unreported takes or incomplete records by foreign fleets, making it difficult to characterize the total impact that international fishing pressure is having on listed sea turtles. Nevertheless, international fisheries represent a continuing threat to sea turtle survival and recovery throughout their respective ranges.

There are also many non-fishery impacts affecting the status of sea turtle species, both in the marine and terrestrial environment. In nearshore waters of the U.S., the construction and maintenance of Federal navigation channels has been identified as a source of sea 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, 1997a). Sea turtles entering coastal or inshore areas have been affected by entrainment in the cooling-water systems of electrical generating plants. Other neashore threats include harassment and/or injury resulting from private and commercial vessel operations, military detonations and training exercises, and scientific research activities.

Coastal development can deter or interfere with nesting, affect nesting 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 females and may evoke a change in the natural behaviors of both adults and hatchlings (Ackerman, 1997; Witherington et al., 2003; Witherington et al., 2007). In addition, coastal development is usually accompanied by artificial lighting which has been known to alter the behavior of nesting adults (Witherington, 1992) and is often fatal to emerging hatchlings that are drawn away from the water (Witherington and Bjorndal, 1991). Predation by various land predators is a threat to developing nests and emerging hatchlings. Additionally, direct harvest of eggs and adults from beaches in foreign countries continues to be a problem for various sea turtle species throughout their ranges (NMFS and USFWS, 2009).

Multiple municipal, industrial and household sources as well as atmospheric transport introduce various pollutants such as pesticides, hydrocarbons, organochlorides (e.g. DDT and PCBs), and other pollutants that may cause adverse health effects to listed species including sea turtles (Iwata et al., 1993; Grant and Ross, 2002; Garrett, 2004; Hartwell, 2004). Recent efforts have led to improvements in regional water quality in the action area, although the more persistent chemicals are still detected and are expected to endure for years (Mearns, 2001; Grant and Ross, 2002). Also, acute exposure to hydrocarbons from petroleum products released into the environment via oil spills and other discharges may directly injure individuals through skin contact with oils (Geraci, 1990), inhalation at the water's surface and ingesting compounds while feeding (Matkin and Saulitis, 1997). Hydrocarbons also have the potential to impact prey populations, and therefore may affect listed species indirectly by reducing food availability in the action area (for more information on the effects of present and past oil spills affecting populations in the Gulf of Mexico, refer to the *Environmental Baseline* section of this Opinion).

Climate change and variability are identified as major causes of changing marine productivity and may therefore influence sea turtle prey abundance in foraging areas throughout the globe (Mantua et al., 1997; Francis et al., 1998; Beamish et al., 1999; Hare et al., 1999; Benson and Trites, 2002). For example, decade-scale climatic regime shifts have been related to changes in zooplankton in the North Atlantic (Fromentin and Planque, 1996) and decadal trends in the North Atlantic Oscillation (NAO) (Hurrell, 1995) can affect the position of the Gulf Stream (Taylor et al., 1998) and other circulation patterns in the North Atlantic that act as important migratory pathways for various life stages of sea turtles. However, gaps in information and the complexity of climatic interactions complicate the ability to predict the effects that climate variability may have to these species from year to year.

Atmospheric warming creates habitat alteration which may change sex ratios and affect reproductive periodicity for nesting sea turtles. Climate variability may also increase hurricane activity leading to an increase in debris in nearshore and offshore waters, thereby resulting in increased entanglement, ingestion, or drowning as well as increased physical destruction of sea turtle nests. All reptiles including sea turtles have a tremendous dependence on their thermal environment for regulating physiological processes and for driving behavioral adaptations (Spotila et al. 1997). In the case of sea turtles, where many other habitat modifications are documented (beach development, loss of foraging habitat, etc.), the prospects for accentuated synergistic impacts on survival of the species may be even more important in the long-term. Atmospheric warming creates habitat alteration which may change sex ratios, reproductive periodicity, marine habitats, or prey resources such as crabs and other invertebrates. It may increase hurricane activity leading to an increase in debris in nearshore and offshore waters, resulting in increase in entanglement, ingestion, or drowning. Atmospheric warming may change convergence zones, currents and other oceanographic features that are relevant to various sea turtles' life stages.

Green Sea Turtle

Species Description, Distribution, and Population Structure

Green sea turtles (*Chelonia mydas*) have a smooth carapace with four pairs of lateral (or costal) scutes and a single pair of elongated prefrontal scales between the eyes. They typically have a black dorsal surface and a white ventral surface although the carapace of green sea turtles in the Atlantic Ocean has been known to change in color from solid black to a variety of shades of grey, green, brown and black in starburst or irregular patterns (Lagueux, 2001).

Green sea turtles are distributed circumglobally, mainly in waters between the northern and southern 20° C isotherms (Hirth, 1971) and nesting occurs in more than 80 countries worldwide (Hirth, 1997). 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 green sea turtles within the southeastern U.S. includes sandy beaches of mainland shores, barrier islands, coral islands, and volcanic islands between Texas and North Carolina as well as the U.S. Virgin Islands (U.S.V.I.) and Puerto Rico (NMFS and USFWS, 1991). Principal U.S. nesting areas for green sea turtles are in eastern Florida, predominantly Brevard through Broward counties. Regular nesting is also known to occur on St Croix, U.S.V.I., and on Vieques, Culebra, Mona, and the main island of Puerto Rico (Dow et al., 2007). For more information on green sea turtle nesting in other ocean basins, refer to the 1991 Recovery Plan for the Atlantic Green Turtle (NMFS and USFWS, 1991) or the 2007 Green Sea Turtle 5-Year Review (NMFS and USFWS, 2007).

Green sea turtles use mid-Atlantic and northern areas of the western Atlantic coast as important summer developmental habitat. They 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 sea 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 on geographical location.

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, 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, 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).

The genetic substructure of the green sea turtle regional subpopulations shows distinctive mitochondrial DNA properties for each nesting rookery (Bowen et al., 1992) although

turtles from separate nesting origins are commonly found mixed together on foraging grounds.

Life History Information
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 3-4 clutches (Johnson and Ehrhart, 1996). Mean clutch size is highly variable among populations, but averages 110-115 eggs. In Florida, green sea turtle nests contain an average of 136 eggs (Witherington and Ehrhart, 1989), which will incubate for approximately two 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. As adults, they feed almost exclusively on sea grasses and algae in shallow bays, lagoons, and reefs (Rebel, 1974).

Listing Status
The green sea turtle was listed as threatened under the ESA in 1978 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.

Status and Trends
The principal cause of the historical, worldwide decline of the green sea turtle was long-term harvest of eggs and adults on nesting beaches and juveniles and adults on feeding grounds. Seminoff (2004) estimated that analyses of subpopulation changes at 32 Index Sites distributed globally showed a 48 to 67 percent decline in the number of mature females nesting annually over the previous three generations. Of the 23 threatened nesting concentrations analyzed by NMFS and USFWS (2007) for which estimates of current trends was possible, 10 nesting populations appeared to be increasing, 9 appeared to be stable, and 4 appeared to be decreasing. The review did mention that despite some increasing trends in global numbers, these estimates should be viewed cautiously since trend data was only available for about half of the total sites examined. According to the review, the poorest regions in terms of nesting included sites in Southeast Asia, the eastern Indian Ocean, and central Atlantic Ocean (NMFS and USFWS, 2007).

In the western Atlantic, several major nesting assemblages have been identified and studied over time to monitor trends (Bass et al., 2006; Bowen et al., 1992). The largest known nesting assemblage in the western Atlantic, 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 seen each year (Troëng and Rankin, 2005). The estimated number of emergences was reported to be under 20,000 in 1971 and over 40,000 in 1996 with a high estimate of over 100,000 emergences reported in 1995 (Bjorndal et al., 1999). In the continental United States, green turtle nesting occurs along the Atlantic coast, primarily along the central and southeast coast of Florida and present estimates range from 200-1,100 females nesting annually. Occasional nesting has also been documented along the Gulf coast of Florida as well as the beaches on the Florida Panhandle (Meylan et al., 1994; Weishampel et al., 2003). While there appears to be an increasing trend in green sea turtle nesting in the southeast U.S., these numbers only reflect one segment of the population (nesting females) and should be taken with caution.

There are no reliable estimates of the total number of green sea turtles inhabiting foraging areas within the southeast United States; however, localized information is available for a few sites. 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 sea turtles in 1890 (Doughty, 1984). However, Doughty reported that by the year 1902, a significant decline in the fishery was observed. 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 1983-1985 and 1988-1990. An extreme, short-term increase in catch per unit effort of around 300 percent was reported for the years 1995-1996 (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). It is likely that green sea turtles foraging in the region come from multiple genetic stocks.

Currently, anthropogenic impacts to the green sea turtle are similar to those facing other sea turtle species including interactions with domestic and international fisheries, destruction of nesting and foraging habitat, ship strikes, oil spills, and climate change and/or variability (refer to the loggerhead sea turtle status and trends section above for more information on these threats).

Green turtles depend on shallow foraging grounds with sufficient benthic vegetation. Therefore, direct destruction of foraging areas due to dredging, boat anchorage, deposition of spoil, and siltation may have considerable effects on the distribution of foraging green turtles (Coston-Clements and Hoss, 1983; Williams, 1988). 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). Various types of marine debries such as plastics, oil, and tar tends to collect on pelagic drift lines that young green turtles inhabit (Carr, 1987; Moore et al., 2001) and can lead to death through injestion (Balazs, 1985;

Bjorndal et al., 1994). Another major threat from man-made debris is the entanglement of turtles in discarded monofilament fishing line and abandoned netting (Balazs, 1985).

Fibropapillomatosis, an epizootic disease producing lobe-shaped tumors on the soft portion of a turtle's body, has been found to infect green sea turtles, most commonly juveniles (Williams et al., 1994). The occurrence of fibropapilloma tumors may result in impaired foraging, breathing, or swimming ability possibly leading to death in some cases making it a serious threat to the survival and recovery of the species.

Kemp's Ridley Sea Turtle

Species Description, Distribution, and Population Structure
The Kemp's ridley sea turtle (*Lepidochelys kempii)* is among the smallest of all extant sea turtles with adults generally weighing less than 45 kg and having a carapace length of around 65 cm. Adults have an almost circular carapace with a grayish green color while the plastron is often pale yellow. 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 usually grayish-black in color and weigh between 15-20 g.

This species has a very restricted range relative to other sea turtle species with most adults occurring in the Gulf of Mexico in shallow near shore waters, although adult-sized individuals sometimes are found on the eastern seaboard of the United States as well. Nesting is essentially limited to the beaches of the western Gulf of Mexico, primarily in the Mexican state of Tamaulipas, although in recent years nests have also been recorded in Florida and the Carolinas (Meylan et al., 1995). 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 nests in this single locality (Pritchard, 1969).

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). 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., 1995b; Epperly et al., 1995c).

Life History Information
Kemp's ridley sea turtles reach sexual maturity at 7-15 years of age. While some turtles nest annually, the weighted mean remigration rate is approximately two years. Nesting generally occurs from April to July and females lay approximately 2.5 nests per season with each nest containing approximately 100 eggs (Marquez, 1994)

Studies have shown that the time spent in the post-hatchling pelagic stage can vary from 1-4 years time, while the benthic immature stage typically lasts approximately 7-9 years (Schmid and Witzell, 1997). Little is known of the movements of the post-hatching, planktonic stage within the Gulf of Mexico although the turtles during this stage are assumed to associate with floating seaweed (e.g. *Sargassum spp.*) where they would presumably feed on the available sargassum and associated infauna or other epipelagic species found in the Gulf of Mexico. As stated earlier, juveniles are known to migrate northward and southward up the eastern U.S. coast where they frequently forage in submerged aquatic grass beds (Musick and Limpus, 1997). Adult Kemp's ridleys primarily occupy neritic habitats, typically containing muddy or sandy bottoms where prey can be found.

In the post-pelagic stages, Kemp's ridley sea turtles are largely cancrivorous (crab eating), with a preference for portunid crabs (Bjorndal, 1997). 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 bycatch discards from the shrimping industry (Shaver, 1991).

Listing Status

The Kemp's ridley sea turtle was listed as endangered under the ESA on December 2, 1970. This species is also protected by CITES and is listed as "critically endangered" under the IUCN Red List of Threatened Species (IUCN, 1996). No critical habitat has been designated for the species.

Status and Trends

Of the seven extant species of sea turtles of the world, the Kemp's ridley has declined to the lowest global population level. 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 reduced to 2,500-5,000 individuals and this trend continued through the mid-1980s. The severe decline in the Kemp's ridley population in the past 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.

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 investigators. Model results identified three trends over time in benthic immature Kemp's ridley sea turtles. Increased production of hatchlings from the nesting beach beginning in 1966 resulted in an increase in the population of benthic Kemp's 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 nest protection and relocation. A third period of steady increase has occurred since 1990 likely due to increased hatchling production and survival of immature turtles The introduction of turtle excluder devices (TEDs) in the United States and Mexican shrimping fleets has likely influenced this trend. The model projected that population levels could theoretically 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 are correct; however, the TEWG did emphasize caution in these estimates.

Other recent nesting data has also suggested the population may be showing signs of recovery as the number of nests grew from a low of 702 nests in 1985, to 1,940 nests in 1995, to over 20,000 nests in 2009 (NMFS and USFWS, 2010). However, preliminary nesting data for 2010 indicate a dramatic drop in the number of nests (Conant, pers. comm. 2010) and recent impacts to foraging and nesting habitat as a result of the *Deep Horizon* oil spill in the Gulf of Mexico may further impact nesting success and slow down recovery of the species. According to the preliminary data available from NMFS at the time of this consultation, there are 465 confirmed deaths of Kemp's ridley sea turtles in the vicinity of the *Deep Horizon* oil spill site and this number is considered a conservative one (NMFS, 2010). While the cause of death is not certain for many of the carcasses recovered, these numbers represent the highest total mortality by far of any of the extant sea turtle species occurring in the Gulf since the blowout first occurred. It is expected that the acute and chronic events of the *Deep Horizon* oil spill as well as other historical spills will continue to threaten the survival and recovery of the Kemp's ridley sea turtle for years to come (see the *Environmental Baseline* section of this Opinion for more information on oil spill effects to sea turtles).

In addition to effects from oil spills, other anthropogenic impacts to the Kemp's ridley population are similar to those facing other sea turtle species including interactions with fishing gear, marine pollution, foraging habitat destruction, threats at nesting beaches, and effects of climate change and/or variability (see status and trends section for the loggerhead sea turtle above). Strandings events observed over the years illustrate the vulnerability of Kemp's ridley turtles to the impacts of human activities in nearshore Gulf of Mexico waters and these threats are expected to continue for years to come (TEWG, 1998).

ENVIRONMENTAL BASELINE

By regulation, environmental baselines for biological opinions include the past and present impacts of all state, federal or private actions and other human activities in the action area, the anticipated impacts of all proposed federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of state or private actions that are contemporaneous with the consultation in process (50 CFR §402.02).

The purpose of the *Environmental Baseline* section is to step down from the species level discussion in the *Status of the Species* section and establish the current and projected

viability or fitness of individuals and populations within the action area so that the effects of the proposed research activities can be measured and assessed. The following sections summarize the natural phenomena as well as the anthropogenic activities that have affected and continue to affect listed listed sea turtles within the action area.

Natural Sources of Stress and Mortality

Diseases, Parasites, and Biotoxins

A disease known as fibropapilloma is a major threat to listed turtles in many areas of the world including the action area. The disease 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). It 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 as well as other sea turtle species, such as loggerheads (Huerta et al., 2002). In Florida, many immature green turtles captured in the Indian River Lagoon are infected, and there are similar reports from other sites in Florida, including Florida Bay. More research needs to be done to determine the cause of the disease as well as the possibly long term effects to sea turtle populations.

Oceanographic Features and Climatic Variability

Naturally occurring climatic patterns, such as the Pacific Decadal Oscillation and the El Niño and La Niña events, as well as longer time-scale climate variability are identified as major causes of changing marine productivity and may therefore influence listed species' prey abundance in the action area (Mantua et al., 1997; Francis et al., 1998; Beamish et al., 1999; Hare et al., 1999; Benson and Trites, 2002). For example, decade-scale climatic regime shifts have been related to changes in zooplankton in the North Atlantic (Fromentin and Planque, 1996) and decadal trends in the North Atlantic Oscillation (NAO) (Hurrell, 1995) can affect the position of the Gulf Stream (Taylor et al., 1998) and other circulation patterns in the North Atlantic that act as important migratory pathways for various life stages of sea turtles. However, gaps in information and the complexity of climatic interactions complicate the ability to predict the effects that climate variability may have to these species from year to year.

Anthropogenic Sources of Stress and Mortality

Habitat Degradation

A number of human activities may be directly or indirectly affecting listed sea turtle species in the action area through habitat degradation. Anthropogenic activities such as discharges from wastewater systems, dredging, ocean dumping and disposal, aquaculture, and additional impacts from coastal development are known to degrade coastal waters utilized by sea turtles in the action area. The construction and maintenance of federal navigation channels has been identified as a source of sea turtle mortality as hopper dredges move relatively rapidly and can entrain and kill sea turtles located in the dredge area.

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) although omnivorous loggerhead turtles have been observed to have the highest organochlorine contaminant concentrations in sampled tissues (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). Although these contaminant concentrations do not likely affect pelagic waters, the species of turtles analyzed in this biological opinion travel between near shore and offshore habitats and may be exposed to and accumulate these contaminants during their life cycles.

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 sea turtle adults as well as hatchlings in the action area. 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 located in the action area. 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 and Witherington, 1995).

Habitat in the action area may also be degraded by various sources of marine debris such as plastics, glass, metal, polystyrene foam, rubber, and derelict fishing gear. Marine debris is introduced into the marine environment through ocean dumping, littering, or hydrologic transport of these materials from land-based sources. 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., juvenile loggerheads and juvenile green turtles). 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.

Atmospheric warming creates habitat alteration which may change sex ratios and affect reproductive periodicity for nesting sea turtles. Alteration of climate due to anthropogenic activities may also increase hurricane activity within the Gulf of Mexico leading to an increase in debris in nearshore and offshore waters, thereby resulting in increased entanglement, ingestion, or drowning as well as increased physical destruction of sea turtle nests in the action area.

Oil Spills

Sea turtles in the Gulf of Mexico are located in an area of high-density offshore oil extraction with chronic, low-level spills and occasional massive spills (such as the current *Deep 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). Oil spills can impact sea turtles and other 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 pre-dive 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; Keller et al., 2006). In addition, chronic exposure may impair a turtle’s overall fitness so that it is less able to withstand other stressors throughout the species life history (Milton et al., 2003).

The earlier life stages are usually at greater risk from an oil spill than adults since they usually spend a greater portion of their time at the sea surface, thereby increasing their risk of exposure to floating oil slicks (Lutcavage et al., 1995). Most reports of oiled hatchlings originate from convergence zones where currents meet to form collection points for material at or near the surface of the water. For example, 65 of 103 post-hatchling loggerhead sea turtles 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 percent had tar caked in their jaws (Witherington, 1994). 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. Lutz and Lutcavage (1989) reported hatchlings found with their beaks and esophagi blocked with tarballs, apparently dying of starvation.

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).

Oil cleanup activities, such as the use of dispersants, may also be harmful to sea turtles although 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 and interfere with digestion, respiration, excretion, and/or salt-gland function which can be similar to effects deriving from the oil itself (Hoff and Shigenaka, 2003). Other oil cleanup activities such as the use of earth-moving equipment on beaches can dissuade females from nesting and destroy nests while the use of containment booms has the possibly of entrapping young hatchlings (Witherington, 1999).

At the time of this consultation, NMFS has reported that 64 loggerheads, 27 green, and 465 Kemp's Ridley sea turtles have been found dead in the vicinity of the *Deep Horizon* spill although the cause of death is not immediately certain for all caracasses recovered (NMFS, 2010). Kemp's Ridley sea turtles appear to be the most affected due to their high death totals since the blowout occurred, their low population numbers to begin with, and their limited range compared with other sea turtle species. More research will need to be done to determine the short and long term effects that oil spills such as the *Deep Horizon* oil spill in the Gulf of Mexico has on Kemp's ridleys and other sea turtle populations in the years to come.

Ocean Noise
Increases in underwater sound generated from various man-made sources such as commercial shipping and recreational vessels, seismic exploration, offshore construction (e.g. for offshore wind farms), and sonars of various types have the potential to affect listed species (including sea turtles) in the action area at various times throughout the year. Acoustic impacts to sea turtles can include temporary or permanent injury, habitat exclusion, habituation, and disruption of other normal behavior patterns (NMFS-SEFSC, 2001).

Seismic surveys using towed airguns occur within the action area and are the primary exploration technique for oil and gas deposits and for fault structure and other geological hazards. Airguns generate intense low-frequency sound pressure waves capable of penetrating the seafloor and are fired repetitively at intervals of 10-20 seconds for extended periods (NRC, 2003). Most of the energy from the guns is directed vertically downward, but significant sound emission also extends horizontally. Very little data exists on the effects of seismic surveys on sea turtles; however, NMFS anticipates incidental takes of sea turtles from vessel strikes, noise, marine debris, and the use of explosives during seismic surveys and during removal of oil and gas structures. Short-term exposure to high-energy sound sources such as underwater explosions, pile driving and other marine construction have the potential to result in direct injury or even death to listed species located near the sound source.

U.S. Military Activities
Sea turtles in the action area are affected by military activities including vessel operations and various training operations. NMFS has and will continue to establish conservation measures for all federal agency vessel operations to avoid or minimize interaction with listed sea turtles in the Gulf of Mexico. At the present time, however, they present the potential for some level of interaction including short term behaviorial harassment and the possibility of vessel strikes. Past and ongoing U.S. Navy aerial bombing training in the ocean off the southeast U.S. coast, involving drops of live ordnance (e.g. 500 and 1,000 lb bombs) has the potential to annually injure or kill listed sea turtles (NMFS, 1997b). NMFS and the U.S. Navy have been working cooperatively to establish a policy for monitoring and managing acoustic impacts from anthropogenic sound sources in the marine environment including any future operations occurring in the Gulf of Mexico.

Fishing Activities
Entrapment and entanglement in fishing gear is a frequently documented source of human-caused mortality in listed sea turtles located within and in the vicinity of the action area (NMFS-SEFSC, 2001; Dietrich et al., 2007). These entanglements also make listed species more vulnerable to additional dangers (e.g., predation and ship strikes) by restricting agility and swimming speed. There is concern that many sea turtles that die from entanglement in commercial fishing gear tend to sink rather than strand ashore thus making it difficult to accurately determine the extent of such mortalities.

Listed sea turtles are adversely affected by several types of fishing gears used in 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. Formal ESA Section 7 consultations have been conducted on the following fisheries occurring within or in the vicinity of the action area that affect listed sea turtle species: Atlantic bluefish, Atlantic herring, Atlantic mackerel/squid/butterfish, Atlantic sea scallop, Atlantic swordfish/tuna/shark/ billfish, coastal migratory pelagic, dolphin-wahoo, Gulf of Mexico reef fish, monkfish, Northeast multispecies, South Atlantic snapper-grouper, Southeast shrimp trawl, spiny dogfish, red crab, skate, commercial directed shark, summer flounder/scup/black sea bass fisheries, tilefish, Atlantic highly migratory species fishery, Gulf of Mexico/South Atlantic spiny lobster, and Gulf of Mexico stone crab. For each of the aforementioned fisheries, an Incidental Take Statement (ITS) has been issued for the take of sea turtles during normal fishery operations. Entanglements or entrapments of sea turtles have been recorded in one or more of these gear types including trawl, hook and line, pot/trap, dredge, and net gear. In addition, pelagic longline, pelagic driftnet, bottom longline, and/or purse seine gear have also been documented taking sea turtles for pelagic-based fisheries. In the Gulf of Mexico, hook-and-line, gillnet, and cast net gears are often 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 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 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.

Other fisheries operate under state jurisdiction, and some are unmanaged. While little is known about the level of take in fisheries that operate strictly in state waters many state permit holders also hold Federal licenses; therefore, ESA Section 7 consultations on Federal action in those fisheries address some state-water activity. NMFS is also actively participating in a cooperative effort with the Atlantic States Fisheries Management Commission 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.

Ship Strikes and Other Vessel Interactions
In addition to noise effects described earlier, vessels operating in the action area adversely affect listed sea turtles through direct ship strikes and/or other physical and behavioral disturbance. Turtles swimming or feeding at or just beneath the surface of the water are vulnerable to boat and vessel strikes, potentially resulting in serious propeller injuries and even 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 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. Vessel avoidance may cause sea turtles in the action area to move away from important feeding areas or potential mates, both of which can affect the ability of the species to recover.

Scientific Research
Sea turtles in the action area have been the subject of numerous scientific research activities (mostly non-lethal), as authorized by NMFS permits. Research activities for sea turtles range from photographing, weighing, and tagging sea turtles incidentally taken in fisheries, blood sampling, biopsy sampling, and performing laparoscopy on intentionally captured turtles. At the time of this consultation, there are currently 24 active permits directed towards sea turtles located in the Gulf of Mexico or in areas close to the action area along the coast of Florida. The number of authorized takes varies widely depending on the research and species involved. 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. Authorized "takes" by harassment represent substantial research effort relative to species abundance in the action area with repeated disturbances of individuals likely to occur each year. However, all permits for sea turtles contain conditions requiring the permit holders to coordinate their activities with the NMFS regional offices and other permit holders and, to the extent possible, share data to avoid unnecessary duplication of research.

The fact that multiple permitted "takes" of listed sea turtles is already permitted and is expected to continue to be permitted in the future, means that short term behavioral harassment expected to listed sea turtles from similar research activities has the ability to contribute to or even exacerbate the non-lethal stress responses generated from other threats occurring in the action area. The point at which this leads to a measurable cumulative impact on the survival and recovery of listed sea turtles, however, is uncertain. Our ability to detect long-term effects from research activities will depend on several factors including our ability to better detect sub-lethal effects from research actions as well as funding and prioritizing long-term studies investigating survival and

reproductive abilities of listed species targeted by similar types of research in the past. This may lead to statistically significant trends showing whether or not repeated non-lethal disturbances by research activities are affecting the ability of sea turtles to survive and recover in the wild to an appreciable degree. More information on anticipated effects from similar research actions is included in the *Effects of the Proposed Action* section of this Opinion.

Conservation and Management Efforts

Several conservation and management efforts have been undertaken for listed sea turtles to aid in recovery efforts. NMFS implements conservation and management activities for these species through its Regional Offices and Fishery Science Centers in cooperation with states, conservation groups, the public, and other federal agencies.

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 the Atlantic Highly Migratory Species Fishery, Gulf of Mexico reef fish, and South Atlantic snapper-grouper fishery, and TED requirements for Southeast shrimp trawl 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. 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 (Watson et al., 2005; Read, 2007).

NMFS has 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. 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).

In March 2002, NMFS published new restrictions for the use of gillnets with larger than 8-inch stretched mesh operating 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. 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.

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. Those 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. There is also 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 sea turtle mortality, but also rescue and rehabilitate any live stranded sea turtles that are encountered.

EFFECTS OF THE PROPOSED ACTION

Pursuant to Section 7(a)(2) of the ESA, federal agencies are directed to insure 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. 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, and the probable responses of those individuals (given probable exposures) based on the best scientific and commercial evidence available. 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. The purpose of this assessment is to determine if it is reasonable to expect the proposed research activites to have effects on listed species that could appreciably reduce their likelihood of surviving and recovering in the wild.

For this consultation, we are particularly concerned about behavioral disruptions that may result in animals 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 permits would authorize non-lethal "takes" by harassment of listed sea turtles by way of net/hand capture, PIT and satellite tagging, lavage, blood and tissue sampling, and fecal sampling. For this Opinion, we define harassment as an intentional or unintentional human act or omission that creates the probability of injury to an individual animal by disrupting one or more behavioral patterns that are essential to the animal's life history or its contribution to the population the animal represents.

Exposure Analysis

Exposure analyses identify the co-occurrence of ESA-listed species with the action's effects in space and time, and identify the nature of that co-occurrence. The exposure analysis identifies, 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. For the exposure analysis conducted for this consultation, we estimated the number of individual sea turtles likely to be exposed to the effects of the proposed research activities using the best information available to us including recent population estimates, expected growth rates over the life of the permits, the maximum survey effort expected from the researchers over the life of the permits, and past take numbers reported from permits authorizing similar types of research within or near the action area.

While annual reports detailing prior "takes" are useful in estimating exposure levels, it must be noted that the frequency, duration, area, and focus of research activities often vary on an annual basis due to factors such as weather, funding, opportunistic events, and evolving research goals and needs. Also, the threshold for reporting whether an actual "take" occurred has evolved over the years, thus possibly introducing some level of human error or bias into numbers reported in prior annual reports (e.g. some researchers may have reported a "take" only if the animal somehow reacted to an approach while other researchers may have assumed a "take" whether the animal exhibited a visible reaction or not). Thus, past annual reports introduce some level of uncertainty as to their accuracy for predicting future activities, levels of effort, and expected "takes" of listed species. Despite this uncertainty, annual reports remain one of the most valuable resources to NMFS Office of Protected Resources – Endangered Species Division for estimating exposure levels of future permit actions and were thus utilized in this consultation. NMFS Office of Protected Resources – Permits, Conservation, and Education Division has made an effort to standardize reporting of "takes" resulting from research activities which should lead to more accurate and informative annual reports in future years and hopefully reduce the level of error and uncertainty associated with the number of "takes" reported.

For permit modification No. 13544-01, the researcher requested to satellite tag both Kemp's ridley and loggerhead sea turtles in addition to carrying out the activities already exempted under the original permit. Rather than sampling additional individuals, the researcher requests to add a satellite tag to a proportion of the individuals already captured for other research purposes. Therefore, NMFS analyzed the exposure at the requested levels (15 Kemp's ridley and 10 loggerhead individuals). For permit modification No. 13307-02, the researcher has requested to sample additional subadult green sea turtles than what was exempted under the original permit. NMFS reviewed the justification by the researcher along with annual reports and found these numbers to be reasonable based on the amount of green sea turtle captures recorded in the first year of sampling. Therefore, NMFS analyzed the exposure at the requested levels (60 subadult green sea turtles). 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 under both permits.

Response Analysis

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, 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.

Response to Vessels

Vessel interactions have the potential to disturb listed sea turtle species by inducing behavioral and possibly physiological stress to animals observed in the vicinity of the survey vessel. 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 et al., 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).

Detection of vessel noise is dependent on several factors, including weather, vessel engine type and size, habituation, and other ambient noise. However, since the vessels are below 50 ft in length for the proposed research activities, the sound generated is expected to be at higher frequencies than larger vessels such as supply ships, container/cargo ships, and cruise vessels in terms of contributing to overall marine ambient noise in the action area. So, while there is the potential for vessels to contribute to marine ambient noise in the action area, the effects to sea turtles who hear and vocalize at lower frequencies than those generated by the proposed survey vessel is sufficiently low and therefore discountable.

The probability of a vessel collision during transit depends, in part, on the size and speed of the vessel. However, because the personnel involved would be trained observers and the research vessels would operate at relatively slow speeds, the probability of sea turtles being struck by research vessels is extremely unlikely and, therefore, discountable.

Response to Capture

Any capture of a turtle by netting methods (i.e. entanglement net, dipnet, or cast net) or by hand (i.e. rodeo capture) could result in stresses to sea turtle individuals, and drowning could potentially occur as a result of forced submergence. Sea turtles are particularly prone to entanglement as a result of their body configuration and behavior. Records of stranded or entangled sea turtles reveal that fishing debris can wrap around the neck or flipper and severely restrict swimming or feeding. Sea turtles may also experience constriction of appendages as a result of the entanglement. Constriction may cut off blood flow, causing deep gashes, some severe enough to remove an appendage. Sea turtles that are forcibly submerged undergo respiratory and metabolic stress that can lead

to severe disturbance of their acid-base balance. While most voluntary dives by sea turtles appear to be aerobic, showing little if any increases in blood lactate and only minor changes in acid-base status (pH level of the blood) (Lutz and Bentley, 1985), sea turtles that are stressed as a result of being forcibly submerged through entanglement consume oxygen stores, triggering an activation of anaerobic glycolysis, and subsequently disturbing their acid-base balance. 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).

Larger sea turtles are capable of longer voluntary dives than small turtles, so juveniles may be more vulnerable to the stress due to capture and handling than adults. With each forced submergence, lactate levels increase and require a long (as much as 20 hours) time to recover to normal levels. Therefore, sea turtles are likely 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 (Lutcavage and Lutz, 1997). Capture and handling activities may markedly affect metabolic rate (St. Aubin and Geraci, 1988) and hormone levels (Gregory et al., 1996).

Hoopes et al. (2000) found that entanglement netting produced notable changes in blood chemistry in wild Kemp's ridley sea turtles, with plasma lactate concentrations at capture elevated up to 6-fold above those measured 6-10 hours post capture. However, they note that the lactate response resulting from the stress of capture in entanglement netting was relatively slight compared with that reported from trawl capture of sea turtles. Although it appears that net capture can result in temporary changes in blood chemistry of sea turtles, it appears that animals that are immediately placed back into a marine environment after removal from the gear can recover from the short-term stress of capture (Hoopes et al., 2000). Based on the literature, sea turtles are expected to respond to net and hand capture with increased respiratory and metabolic stress; however, individuals are expected to return to normal levels once released and no mortality or serious injury should occur.

Response to Measuring, Weighing, Flipper Tagging, PIT Tagging
Handling, measuring, photographing and weighing can result in raised levels of stressor hormones in sea turtles. The additional on-board holding time imposes an additional stressor on already acidotic turtles (Hoopes et al., 2000). It has been suggested that the muscles used by sea turtles for swimming might also be used during lung ventilation (Butler et al., 1984). Thus, an increase in breathing effort in negatively buoyant animals may have heightened lactate production. However, the handling, measuring, photographing and weighing procedures are generally short in duration and are non-invasive. Therefore, NMFS expects that individual turtles would experience short-term stresses as a result of these activities but would return to normal behaviors when released.

Flipper tagging activities are minimally invasive although sea turtles can experience some discomfort during the application of the tag. The discomfort is usually short and highly variable between individuals based on past observations (Balazs, 1999). NMFS expects the stresses associated with flipper tags to be minimal and short-term and that the

small wound-site resulting from a tag should heal relatively quickly and not be expected to lead to any long term consequences.

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). 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 relatively short period of time. The proposed tagging methods have been regularly employed in sea turtle research in the past with little lasting impact on the individuals tagged (Balazs, 1999).

Response to Satellite Tagging

Carapace mounted transmitters would be attached to Kemp's ridley and loggerhead sea turtles under permit modification No. 13544-01. Transmitters, as well as biofouling of the tag, attached to the carapace of turtles increase hydrodynamic drag and affect lift and pitch. For example, Watson and Granger (1998) performed wind tunnel tests on a full-scale juvenile green turtle and found that at small flow angles representative of straight-line swimming, a transmitter mounted on the carapace increased drag by 27-30 percent, reduced lift by less than 10 percent and increased pitch moment by 11-42 percent. Therefore, attachment of transmitter terminal could affect the swimming ability of sea turtles fitted with this attachment although the researcher will make sure the transmitter is less than five percent of the mass of the turtle to minimize this effect. During a study of sonic tracked turtles by Seminoff et al. (2002), green turtles returned to areas of initial capture, suggesting that the transmitters and the tagging experience left no lasting effect on habitat use patterns. During previous tracking sessions in San Diego Bay by the NMFS Southwest Fisheries Science Center, both telemetered and nontelemetered turtles were seen in the same areas exhibiting roughly similar surface behavior suggesting negligible effects of the transmitter packages. Attachment of satellite, sonic, or radio tags with epoxy is a commonly used and permitted technique by NMFS. These tags are unlikely to become entangled due to their streamlined profile and would typically be shed after about one year, posing no long-term risks to the turtle.

Response to Blood and Tissue Sampling

Effects to sea turtles of drawing blood samples with syringes and taking tissue samples include minimal discomfort and pain as well as possible hemorrhage or infection at the site of penetration. To mitigate these effects, the needle would be slowly advanced while applying gentle negative pressure to the syringe until blood freely flows into the syringe.

Once the blood is collected, direct pressure would be applied to the site to ensure clotting and prevent subsequent blood hemorrhaging (Stoskopf, 1993). Also, during the more than five years of tissue biopsying using sterile techniques, NMFS Southeast Fisheries Science Center researchers have encountered no infections or mortality resulting from this procedure (NMFS-SEFSC, 2006). 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.

Response to Lavage

The feeding habits of wild turtles can be determined by a variety of methods, but the preferred technique is gastric lavage or stomach flushing. This comparatively simple and reliable technique has been used to successfully sample the gut contents of various vertebrate animals groups without seriously injuring or scarring to the subject animal (Forbes, 1999). This technique has been successfully used on green, hawksbill, olive ridley and loggerhead turtles ranging in size from 25 to 115 curved carapace length (CCL). Forbes (1999) reported that many individual turtles have been lavaged multiple times without any known long term detrimental effect. Individuals have been recaptured from the day after the procedure up to three years later and appeared healthy and exhibiting normal feeding behaviors. Laproscopic examination of the intestines following the procedure has not detected any swelling or damage to the intestines. While individual turtles are likely to experience discomfort during this procedure, NMFS does not expect individual turtles to experience more than short-term stress with no threat of serious injury or mortality expected given permit conditions and the experience of the researchers.

Response to Fecal Sampling

Permit modification No. 13544-01 would authorize the passive collection of fecal samples for Kemp's ridely sea turtles transported for transmitter and tag attachment. No invasive sampling would occur. Samples would be collected from the holding tanks after the animals have defecated. Given the precautions that would be taken by the researchers to ensure the safety of the turtles and the permit conditions relating to transport and holding, NMFS expects the transport would have minimal and insignificant effects on the Kemp's ridely sea turtles temporarily held for fecal samples. For example, during the many years that the NMFS Southeast Fisheries Science Center has been conducting sea turtle research, they have not observed any serious injuries or mortalities to turtles as a result of their handling protocol including transport and holding for fecal samples (NMFS-SEFSC, 2006).

Permit modification No. 13307-02 would involve digital extraction of fecal samples for captured sea turtles. Only sufficiently large turtles would be subject to digital extraction of feces. NMFS does not expect that individual turtles would experience more than short-term stresses and possibly some minor discomfort as a result of this activity. No injury or lasting effects are expected from this procedure. NMFS Beaufort Laboratory conducted digital fecal sampling, and turtles exhibited normal behavior upon being released (NMFS-SEFSC, 2006).

Risk Analysis

Our risk analyses reflect 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.

For our risk analysis, this Opinion treats the proposed Northwest Atlantic Ocean DPS of loggerhead sea turtles separate from other proposed DPS' occurring in other ocean basins as this approach is supported by interagency policy on the recognition of distinct vertebrate populations (61 Federal Register 4722). As stated earlier, green sea turtles in U.S. waters are listed as threatened except for the Florida breeding population, which is listed as endangered. Due to difficulties in distinguishing between individuals from the Florida breeding population from other populations, green sea turtles are considered endangered wherever they occur in U.S. waters and thus, our evaluation of risk to this species is consistent with this approach. Also, the loss of green sea turtle populations in the Atlantic basin would result in a significant gap in the distribution of the species as a whole throughout its range given its ability to migrate between ocean basins; therefore, loss of green sea turtle populations in the Atlantic basin would, by itself, appreciably reduce the entire species' likelihood of surviving and recovering in the wild. The same approach is applied for evaluating risk to Kemp's ridley sea turtles although given that this species' range is limited to the Atlantic Ocean, loss of Kemp's ridley populations in the Atlantic would, by default, appreciably reduce the species' likelihood of surviving and recovering in the wild.

Mortality and serious injury under the research as described under the proposed actions is not expected for loggerhead, green, or Kemp's ridley sea turtles. Based on observations from prior sampling efforts and in the literature on the expected responses of sea turtles to similar types of research, the proposed netting, handling, tagging, measuring, weighing, photographing, blood/tissue sampling, fecal sampling and lavage procedures have the potential to elicit short-term changes in sea turtle behavior, but are not likely to result in long-term consequences. Based on the best scientific information available, we expect that the research permit modifications as proposed are not likely to cause a reduction in ESA listed or ESA proposed sea turtles' growth, survival, annual reproductive success, or lifetime reproductive success (i.e. fitness). As a result, we do not expect activities authorized by the proposed permits to have an appreciable effect on the extinction risk of the population(s) these individuals represent or the species those populations comprise.

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. Future cumulative effects from these and other types of federal actions will be investigated in future consultations, most notably in the *Status of the Species* and *Environmental Baseline* sections of Opinions which inform the effects analyses for specific federal actions. Other possible effects that may be acting in conjunction with federal actions and could possibly contribute to a cumulative impact on listed species are described below.

NMFS expects the natural phenomena in the action area (e.g., oceanographic features, storms, natural mortality) will continue to influence listed species as described in the *Environmental Baseline* section of this Opinion. Climatic variability has the potential to affect listed species in the action area in the future; however, the prediction of any specific effects leading to a decision on the future survival and recovery of listed species is currently speculative. Nevertheless, possible effects of climatic variability for listed sea turtles include the alteration of community composition and structure, changes to migration patterns or community structure, changes to species abundance, increased susceptibility to disease and contaminants, alterations to prey composition and altered timing of breeding. Atmospheric warming creates habitat alteration which may change sex ratios and affect reproductive periodicity for nesting sea turtles. Also, climate variability may increase hurricane activity leading to an increase in debris in nearshore and offshore waters, thereby resulting in increased entanglement, ingestion, or drowning as well as increased physical destruction of sea turtle nests.

We also expect anthropogenic effects described in the *Environmental Baseline* will continue, including habitat degradation, vessel traffic and risk of ship strikes, and interactions with fishing gear. Expected increases in vessel traffic would further increase collision risks for sea turtles by the increased traffic itself and/or through habituation of animals to the sounds of oncoming traffic making them more prone to being struck. The number of vessels and tonnage of goods shipped by the U.S. fleet are increasing (e.g. there has been nearly a 30 percent increase in volume between 1980 and 2000) (NRC, 2003) and will lead to more vessel traffic throughout the action area in the future.

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. Due to insufficient information on future management regimes associated with commercial and recreational fisheries, we cannot estimate the probability of future injuries or deaths of listed sea turtles due to interactions with these fisheries. However, given interactions with fisheries in the action area during the recent past, such interactions remains a major threat to the survival and recovery of sea turtles globally.

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 that result in increased discharge of sediments and pollution into the marine

environment. These activities are expected to continue to degrade the habitat of listed species as well as that of the prey on which they depend. Pollutants may also affect prey populations which could impact food and habitat availability for other listed sea turtle species in the future.

Additionally, unrelated factors may be acting together to affect listed species. For example, vessel effects combined with the stresses of reduced prey availability or increased contaminant loads may reduce foraging success and lead to chronic energy imbalances and poorer reproductive success which all may work to lower an animal's ability to suppress disease (Williams et al., 2002; NMFS, 2008). The net effect of these disturbances is dependent on the size and percentage of the population affected, the ecological importance of the disturbed area to the animals, the parameters that influence an animal's sensitivity to disturbance or the accommodation time in response to prolonged disturbance (Geraci and St. Aubin, 1980). More studies need to be done to identify the long term effects to listed sea turtles from current stressors as well as the potential additive effect that multiple stressors acting in conjunction over time will have on the survival and recovery of these species.

After reviewing the available information, NMFS is not aware of any additional future non-federal activities or potential stressors reasonably certain to occur in the action area that could contribute to a cumulative impact to ESA listed or ESA proposed species affected by the proposed action.

INTEGRATION AND SYNTHESIS OF EFFECTS

The following text integrates and synthesizes the *Status of the Species*, the *Environmental Baseline* and the *Effects of the Proposed Action* sections of this Opinion. This information, in addition to any known or expected cumulative effects, was used to assess the risk the proposed research activities pose to the future survival and recovery of green sea turtles, Kemp's ridley sea turtles, and members of the proposed Northwest Atlantic Ocean DPS of loggerhead sea turtles.

As explained in the *Approach to the Assessment* section, risks to listed individuals are measured using changes to an individual's "fitness." When listed plants or animals exposed to an action's effects are not expected to experience reductions in fitness, we would not expect the action to have adverse consequences on the viability of the populations those individuals represent or the species those populations comprise (e.g., Brandon, 1978; Mills and Beatty, 1979; Stearns, 1992; Anderson, 2000). When individuals of listed plants or animals are expected to experience reductions in fitness in response to an action, those fitness reductions can reduce the abundance, reproduction, or growth rates of the populations that those individuals represent (see Stearns, 1992). If we determine that reductions in individual plants' or animals' fitness reduce a population's viability, we consider all available information to determine whether these reductions are likely to appreciably reduce the viability of the species as a whole.

NMFS Office of Protected Resources - Permits, Conservation, and Education Division proposes to issuance permit modification No. 13544-01 to Jeffrey Schmid and permit modification No. 13307-02 to Kristen Hart that would authorize direct "takes" of green sea turtles, Kemp's ridley sea turtles, and members of the proposed Northwest Atlantic Ocean DPS of loggerhead sea turtles in the Gulf of Mexico from the southwest coast of Florida south to Dry Tortugas National Park. Permit modification No. 13544-01 would authorize the researcher to attach satellite transmitters to a portion of loggerhead (10 individuals) and Kemp's ridley (15 individuals) sea turtles that would already be captured for other research objectives while permit modification No. 13307-02 would authorize additional "take" of 60 green sea turtles that would undergo various research activities including net and/or hand capture, flipper and PIT tagging, tissue and blood sampling, fecal sampling, and lavage. The permit amendments would be valid for the duration of the original permits and would exempt "take" of listed sea turtles by way of harassment during research activities. In addition, no direct mortality of listed species is to be authorized.

Sea turtles have been impacted historically by domestic and international fishery operations that often capture, injure, and even kill sea turtles at various life stages. Other significant threats include habitat modification, dredging operations, contaminant pollution including effects of oil spills, destruction of nesting beaches, and effects from research activities.

Taken together, the components of the environmental baseline for the action area include sources of natural mortality – such as predation, disease, and parasites – as well as influences from natural oceanographic and climatic features in the action area. Circulation and productivity patterns may influence prey distribution and habitat quality for listed species at present and in the future. The baseline also includes human activities resulting in disturbance, injury, or mortality of individuals. These activities include the direct commercial harvest, habitat degradation (e.g., due to contaminants and noise), vessel traffic and risk of ship strikes, entrapment or entanglement in fishing gear, and harassment from other permitted scientific research activities. Conservation and management efforts are ongoing and have a positive effect on the status of listed species found within the action area.

The assessment for this consultation identified several possible stressors as a result of the proposed research activities that would be measured and evaluated against the stressors already occurring in the *Environmental Baseline* section. These stressors included vessel disturbance, capture, measuring and weighing, tagging, satellite transmitter attachment, blood and tissue sampling, fecal sampling, and lavage.

Mortality and serious injury under the research as described under the proposed actions is not expected for loggerhead, green, or Kemp's ridley sea turtles. Based on observations from prior sampling efforts and in the literature on the expected responses of sea turtles to similar types of research, the proposed netting, handling, tagging, measuring, weighing, photographing, blood/tissue sampling, fecal sampling and lavage procedures have the potential to elicit short-term changes in sea turtle behavior, but are not likely to

result in long-term consequences. Based on the best scientific information available, we expect that the research permit modifications as proposed are not likely to cause a reduction in ESA listed or ESA proposed sea turtles' growth, survival, annual reproductive success, or lifetime reproductive success (i.e. fitness). As a result, we do not expect activities authorized by the proposed permits to have an appreciable effect on the extinction risk of the population(s) these individuals represent or the species those populations comprise.

NMFS expects the natural phenomena in the action area (e.g., oceanographic features, storms, natural mortality) will continue to influence listed species as described in the *Environmental Baseline*. Climatic variability has the potential to affect listed species in the action area through alteration of community composition and structure, changes to migration patterns or community structure, changes to species abundance, increased susceptibility to disease and contaminants, alterations to prey composition and altered timing of breeding.

We also expect anthropogenic effects described in the *Environmental Baseline* will continue, including habitat degradation, vessel traffic and risk of ship strikes, increases in background ocean noise levels, and interactions with fishing gear. The net effect of these disturbances is dependent on the size and percentage of the population affected, the ecological importance of the disturbed area to the animals, the parameters that influence an animal's sensitivity to disturbance, or the accommodation time in response to the prolonged disturbance (Geraci and St. Aubin, 1980). More studies need to be done to identify the long term effects to listed sea turtles from current stressors as well as the potential additive effect that multiple stressors acting in conjunction over time have on the survival and recovery of these species in the future.

Based on the best scientific information available, we expect that responses to the research activities as proposed are not likely to cause a reduction in any ESA listed or ESA proposed species' individual growth, survival, annual reproductive success, or lifetime reproductive success (i.e. fitness) or contribute to a significant cumulative effect. As a result, we do not expect activities authorized by the proposed permits to have an appreciable effect on the extinction risk of the population(s) these individuals represent or the species those populations comprise.

CONCLUSION

After reviewing the current status of listed species affected by the proposed action, the environmental baseline for the action area, the anticipated effects of the proposed research activities and the possible cumulative effects, it is NMFS Office of Protected Resources – Endangered Species Division's opinion that the NMFS Office of Protected Resources – Permits, Conservation and Education Division's proposed action of issuing permit modification No. 13544-01 to Jeffrey Schmid and permit modification No. 13307-02 to Kristen Hart, as proposed, are not likely to jeopardize the continued existence of green sea turtles, Kemp's ridley sea turtles, or the proposed Northwest Atlantic Ocean

DPS for loggerhead sea turtles. In addition, no designated critical habitat under NMFS' authority would be affected.

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 the 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. 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 Sections 7(b)(4) and 7(o)(2), taking that is incidental 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. However, as discussed in the accompanying Opinion, only the species targeted by the proposed research activities will be significantly harassed as part of the intended purpose of the proposed action.

Previous consultations resulted in incidental take of two smalltooth sawfish authorized under each respective permit. Permit modification No. 13544-01 would not result in a higher level of research effort that would result in additional incidental take of smalltooth sawfish. NMFS also believes that the increased take of green sea turtles associated with permit modification No. 13307-02 is not expected to result in a greater level of incidental take of smalltooth sawfish than what was authorized for the original permit. Therefore, no additional take of smalltooth sawfish is expected with the proposed permit amendments. The authorized take of 2 smalltooth sawfish authorized for the original permits will remain in effect along with the reasonable and prudent measures and terms and conditions established in the original consultations through the duration of the permits.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA directs federal agencies to use their authorities to further the purposes of the ESA 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.

No additional Conservation Recommendations have been placed on these permit modifications.

REINITIATION NOTICE

This concludes formal consultation and conference on the proposal to issue scientific research permit modification No. 13544-01 and No. 13307-02 for research on ESA listed and ESA proposed sea turtles in the Gulf of Mexico. 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.

LITERATURE CITED

Abella, E., Marco, A., and L.F. Lopez-Jurado. 2007. Success of Delayed Translocation of Loggerhead Turtle Nests. The Journal of Wildlife Management 71, 2290-2296.

Ackerman, R.A. 1997. The nest environment and the embryonic development of sea turtles. Pages 83-106 in Lutz, P.L. and J.A. Musick (editors). The Biology of Sea Turtles. CRC Press, Boca Raton, Florida.

Ackerman, R.A. 1980. Physiological and ecological aspects of gas exchange by sea turtle eggs. American Zoologist 20: 575-583.

Addison, D.S. 1997. Sea turtle nesting on Cay Sal, Bahamas, recorded June 2-4, 1996. Bahamas Journal of Science 5:34-35.

Addison, D.S. and B. Morford. 1996. Sea turtle nesting activity on the Cay Sal Bank, Bahamas. Bahamas Journal of Science 3:31-36.

Aguilar, R., J. Mas, and X. Pastor. 1995. Impact of Spanish swordfish longline fisheries on the loggerhead sea turtle Caretta caretta population in the western Mediterranean. Pages 1-6 in Richardson, J.I. and T.H. Richardson (compilers). Proceedings of the Twelfth Annual Sea Turtle Workshop on Sea Turtle Biology and Conservation. NOAA Technical Memorandum NMFS-SEFSC-361.

Aguirre, A. A., Balazs, G. H., Zimmerman, B. and F.D. Galey. 1994. Organic Contaminants and Trace Metals in the Tissues of Green Turtles (Chelonia mydas) Afflicted with Fibropapillomas in the Hawaiian Islands. Marine pollution bulletin 28: 109.

Aguirre A.A., R.K. Bonde, and J.A. Powell. 2002. Biology, movements and health assessment of free-ranging manatees in Belize. In: 51st Annual Wildlife Disease Association Conference, Humboldt State University, Arcata, CA, p. 135.

Anderson, J.J. 2000. A vitality-based model relating stressors and environmental properties to organism survival. Ecological Monographs, 70: 445-470.

Auster, P.J., R.J. Malastesta, R.W. Langton, L. Watling, P.C. Valentine, C.L.S. Donaldson, E.W. Langton, A.N. Shepard, and I.G. Babb. 1996. The impacts of mobile fishing gear on the sea floor habitats in the Gulf of Maine (Northwest Atlantic): Implications for conservation of fish populations. Reviews in Fisheries Science 4:185-200.

Balazs, G.H. 1982. Growth rates of immature green turtles in the Hawaiian Archipelago. In: Bjorndal, K.A. (Ed.), Biology and Conservation of Sea Turtles. Smithsonian Institution Press, Washington, D.C., pp. 117-125.

Balazs, G.H. 1983. Recovery records of adult green turtles observed or originally tagged at French Frigate Shoals, northwestern Hawaiian Islands. p. 47 pp.

Balazs, G. H. 1985. Impact of ocean debris on marine turtles: entanglement and ingestion. In: Proceedings of the workshop on the fate and impact of marine debris, 27-29 November, 1984, Vol. 54 (Shomura, R. S. and Yoshida, H. O., eds.). pp. 367-429. U.S. Department of Commerce NOAA Technical

Memorandum, NMFS-SWFC.

Balazs, G.H. 1999. Factors to Consider in the Tagging of Sea Turtles *in* Research and Management Techniques for the Conservation of Sea Turtles. K.L. Eckert, K.A. Bjourndal, F.A. Abreu-Grobois and M. Donnelly (editors). IUCN/SSC Marine Turtle Specialist Group Publication No 4, 1999.

Baldwin, R., G.R. Hughes, and R.I.T. Prince. 2003. Loggerhead turtles in the Indian Ocean. Pages 218-232 in Bolten, A.B. and B.E. Witherington (editors). Loggerhead Sea Turtles. Smithsonian Institution Press, Washington, D.C.

Bass, A.L., S.P. Epperly, and J. Braun-McNeill. 2006. Green turtle (Chelonia mydas) foraging and nesting aggregations in the Caribbean and Atlantic: impact of currents and behavior on dispersal. J Hered. 97:346–354.

Beale, C.M. and P. Monaghan. 2004. Human disturbance: people as predation-free predators? Journal of Applied Ecology 41: 335-343.

Beamish, R.J., Noakes, D.J., McFarlane, G.A., Klyashtorin, L., Ivanov, V.V., Kurashov, V. 1999. The regime concept and natural trends in the production of Pacific salmon. Can. J. Fish. Aquat. Sci., 56: 516-526.

Benson, A.J. and A.W. Trites. 2002. Ecological effects of regime shifts in the Bering Sea and eastern North Pacific Ocean. Fish and Fisheries, 9: 95-113.

Bjorndal, K.A. 1997. Foraging ecology and nutrition of sea turtles. In: Lutz, P.L., Musick, J.A. (Eds.). The Biology of Sea Turtles. CRC Press, Boca Raton, Florida, pp. 199–231.

Bjorndal, K. A., A. B. Bolten and C. J. Lagueux. 1994. Ingestion of Marine Debris by Juvenile Sea Turtles in Coastal Florida Habitats. Marine Pollution Bulletin, Vol. 28, No. 3, pp. 154-158.

Bjorndal, K.A. and A.B. Bolten (editors). 2000. Proceedings of a workshop on assessing abundance and trends for in-water sea turtle populations. NOAA Technical Memorandum NMFS-SEFSC-445. 83 pages.

Bjorndal, K.A., K.J. Reich, and A.B. Bolten. 2010. Effect of repeated tissue sampling on growth rates of juvenile loggerhead turtles *Caretta caretta.* Diseases of Aquatic Organisms 88: 271-273.

Bjorndal, K.A., J.A. Wetherall, A.B. Bolten, and J.A. Mortimer. 1999. Twenty-Six Years of Green Turtle Nesting at Tortuguero, Costa Rica: An Encouraging Trend. Conservation Biology 13, 126-134.

Boisvert, M.J. and D.F. Sherry. 2000. A system for the automated recording of feeding behavior and body weight. Physiology and Behavior 71: 147-151.

Bolten, A.B. 2003. Active swimmers - passive drifters: the oceanic juvenile stage of loggerheads in the Atlantic system. Pages 63-78 in Bolten, A.B. and B.E. Witherington (editors). Loggerhead Sea Turtles. Smithsonian Books, Washington D.C.

Bolten, A.B., K.A. Bjorndal, and H.R. Martins. 1994. Life history model for the

loggerhead sea turtle (Caretta caretta) population in the Atlantic: potential impacts of a longline fishery. Pages 48-55 in Balazs, G.H. and S.G. Pooley (editors). Research Plan to Assess Marine Turtle Hooking Mortality: Results of an Expert Workshop Held in Honolulu, Hawaii, November 16-18, 1993. NOAA Technical Memorandum NOAA-TM-NMFS-SWFSC-201.

Bolten, A.B., K.A. Bjorndal, H.R. Martins, T. Dellinger, M.J. Biscoito, S.E. Encalada, and B.W. Bowen. 1998. Transatlantic developmental migrations of loggerhead sea turtles demonstrated by mtDNA sequence analysis. Ecol. Appl., 8, 1–7

Bouchard, S., K. Moran, M. Tiwari, D. Wood, A. Bolten, P. Eliazar, and K. Bjorndal. 1998. Effects of Exposed Pilings on Sea Turtle Nesting Activity at Melbourne Beach, Florida. Journal of Coastal Research 14, 1343-1347.

Bowen, B.W., A.B. Meylan, J.P. Ross, C.J. Limpus, G.H. Balazs, and J.C. Avise. 1992. Global Population Structure and Natural History of the Green Turtle (Chelonia mydas) in Terms of Matriarchal Phylogeny. Evolution 46, 865-881.

Brandon, R. 1978. Adaptation and evolutionary theory. Studies in the History and Philosophy of Science, 9: 181-206.

Bugoni, L., L. Krause, and M. Virgínia Petry. 2001. Marine Debris and Human Impacts on Sea Turtles in Southern Brazil. Marine Pollution Bulletin 42, 1330-1334.

Butler, P. J., W.K. Milsom, and A.J. Woakes. 1984. Respiratory, cardiovascular and metabolic adjustments during steady state swimming in the green turtle, Chelonia mydas. J. comp. Phvsiol. 154B: 167-174.

Carr, A.F. 1986. RIPS, FADS, and little loggerheads. Bioscience 36(2):92-100.

Carr, A.F. 1987. Impact of nondegradable marine debris on the ecology and survival outlook of sea turtles. Marine Pollution Bulletin 18(6B):352-356.

Caurant, F., P. Bustamante, M. Bordes, and P. Miramand. 1999. Bioaccumulation of cadmium, copper and zinc in some tissues of three species of marine turtles stranded along the French atlantic coasts. Marine Pollution Bulletin 38, 1085–1091.

Cheatwood, J.L., E.R. Jacobson, P.G. May, T.M. Farrell, B.L. Homer, D.A. Samuelson, and J.W. Kimbrough. 2003. An outbreak of fungal dermatitis and stomatitis in a free-ranging population of pigmy rattlesnakes (Sistrurus miliarius barbouri) in Florida. J Wildl Dis 39: 329-337.

Clugston, J.P. 1996. Retention of T-bar anchor tags and passive integrated transponder tags by Gulf sturgeons. North American Journal of Fisheries Management 16: 4.

Conant, T. 2010. Personal communication. NMFS Office of Protected Resources, Silver Spring, MD.

Corsolini, S., S. Aurigi, and S. Focardi. 2000. Presence of polychlobiphenyls (PCBs) and coplanar congeners in the tissues of the Mediterranean loggerhead turtle Caretta caretta. Marine Pollution Bulletin 40: 952–960.

Coston-Clements, L. and D.E. Hoss. 1983. Synopsis of Data on the Impact of Habitat

Alteration on Sea Turtles around the Southeastern United States. pp. 57 pp.

Cox, T.M., R.L. Lewison, R. Zydelis, L. Crowder, C. Safina, and J. Read. 2007. Comparing effectiveness of experimental and implemented bycatch reduction measures: the ideal and the real. Conserv Biol 21: 1155–1164.

Crouse, D.T. 1999. The consequences of delayed maturity in a human-dominated world. In: Musick, J.A. (Ed.), Life in the Slow Lane: Ecology and Conservation of Long-Lived Marine Animals, American Fisheries Society Symposium, pp. 195-202.

Dare, M.R. 2003. Mortality and Long-Term Retention of Passive Integrated Transponder Tags by Spring Chinook Salmon. North American Journal of Fisheries Management 23: 1015-1019.

Delgado C, T. Dellinger, N. Varo, and L.F. Lopez-Jurado. 2008. Preliminary approach to the hatchlings sex-ratio of a population of Caretta caretta of Boa Vista Island, Cape Verde Archipelago (Western Africa)—an update for 2004 season. In: Kalb H, Rohde AS, Gayheart K, Shanker Kc (eds) Proceedings of the twenty-fifth annual symposium on sea turtle biology and conservation. NOAA Technical Memorandum NMFS-SEFSC-582, pp 166–167.

Dellinger, T. and H. Encarnaçâo. 2000. Accidental capture of sea turtles by the fishing fleet based at Madeira Island, Portugal. Page 218 in Kalb, H.J. and T. Wibbels (compilers). 180 Proceedings of the Nineteenth Annual Symposium on Sea Turtle Biology and Conservation. NOAA Technical Memorandum NMFS-SEFSC-443.

Dietrich, K.S., V.R. Cornish, K.S. Rivera, and T.A. Conant. 2007. Best practices for the collection of longline data to facilitate research and analysis to reduce bycatch of protected species. NOAA Technical Memorandum NMFS-OPR-35. 101p. Report of a workshop held at the International Fisheries Observer Conference Sydney, Australia.

Dodd, C.K., Jr. 1988. Synopsis of the biological data on the loggerhead sea turtle Caretta caretta (Linnaeus 1758). U.S. Fish and Wildlife Service Biological Report 88(14). 110 pages.

Doughty, R. W. 1984. Sea turtles in Texas: a forgotten commerce. Southwestern Historical Quarterly 88: 43-70.

Dow, W., K. Eckert, M. Palmer and P. Kramer. 2007. An Atlas of Sea Turtle Nesting Habitat for the Wider Caribbean Region. The Wider Caribbean Sea Turtle Conservation Network and The Nature Conservancy. WIDECAST Technical Report No. 6. Beaufort, North Carolina. 267 pp.

Ehrhart, L.M. 1983. Marine turtles of the Indian River Lagoon System. Florida Sci. 46: 337-346.

Ehrhart, L. M., W.E. Redfoot, and D.A. Bagley. 1996. A study of the population ecology of in-water marine turtle populations on the east-central Florida coast from 1982-96. Vol. . pp. 164 pp. Department of Biology, University of Central Florida, Orlando.

Ehrhart, LM., D.A. Bagley, and W.E. Redfoot. 2003. Loggerhead turtles in the Atlantic Ocean: geographic distribution, abundance, and population status. Pages 157-174 in Bolten, A.B. and B.E. Witherington (editors). Loggerhead Sea Turtles. Smithsonian Institution Press, Washington, D.C.

Epperly, S. P., J. Braun, A.J. Chester, F.A. Cross, J.V. Merriner, and P.A. Tester. 1995a. Winter distribution of sea turtles in the vicinity of Cape Hatteras and their interactions with the summer flounder trawl fishery. Bulletin of Marine Science 56: 547-568.

Epperly, S.P., J. Braun, and A.J. Chester. 1995b. Aerial surveys for sea turtles in North Carolina inshore waters. Fishery Bulletin 93:254.

Epperly, S.P., J. Braun, and A. Veishlow. 1995c. Sea turtles in North Carolina waters. Conserv. Biol. 9: 384-394

Foley, A, A. Schroeder, A. Redlow, K. Fick-Child, and W. Teas. 2005. Fibropapillomatosis in stranded green turtles (Chelonia mydas) from the eastern United States (1980–98): trends and associations with environmental factors. J Wildl Dis 41:29–41

Foley, A., B. Schroeder, and S. MacPherson. 2008. Post-nesting migrations and resident areas of Florida loggerheads. Pages 75-76 in Kalb, H., A. Rohde, K. Gayheart, and K. Shanker (compilers). Proceedings of the Twenty-fifth Annual Symposium on Sea Turtle Biology and Conservation. NOAA Technical Memorandum NMFS-SEFSC-582.

Forbes, G.A. 1999. Diet Sampling and Diet Component Analysis in Research and Management Techniques for the Conservation of Sea Turtles. K.L. Eckert, K.A. Bjourndal, F.A. Abreu-Grobois and M. Donnelly (editors). IUCN/SSC Marine Turtle Specialist Group Publication No 4, 1999.

Francis, R.C., S.R. Hare, A.B. Hollowed, and W.S. Wooster. 1998. Effects of interdecadal climate variability on the oceanic ecosystems of the NE Pacific. Fisheries Oceanography, 7: 1-21.

Frazer, N.B. and L.M. Ehrhart. 1985. Preliminary growth models for green, Chelonia mydas, and loggerhead, Caretta caretta, turtles in the wild. Copeia 1985:73-79.

Frazier, J. G. 1980. Marine turtles and problems in coastal management. In: Coastal Zone '80: Proceedings of the Second Symposium on Coastal and Ocean Management 3, (Edge, B. C., ed.). pp. 2395-2411. American Society of Civil Engineers, Washington, D.C.

Fretey, J. 2001. Biogeography and conservation of marine turtles of the Atlantic coast of Africa. CMS Technical Series Publication No. 6, UNEP/CMS Secretariat, Bonn, Germany. 429 pp.

Frid, A. 2003. Dall's sheep responses to overflights by helicopter and fixed-wing aircraft. Biological Conservation 110: 387-399.

Frid, A. and L. Dill. 2002. Human-caused disturbance stimuli as a form of predation risk. Conservation Ecology, (6): 11.

Fritts, T.H. and M.A. McGehee. 1982. Effects of petroleum on the development and survival of marine turtle embryos. U.S. Fish and Wildlife Service report FWS/OBS-82/37. 41 pp.

Fromentin, J.M. and B. Planque. 1996. Calanus and environment in the eastern North Atlantic. II. Influence of the North Atlantic Oscillation on C. finmarchicus and C. helgolandicus. Marine Ecology Progress Series, 134: 111- 118.

Garrett, C. 2004. Priority Substances of Interest in the Georgia Basin - Profiles and background information on current toxics issues. Technical Supporting Document. Canadian Toxics Work Group Puget Sound/Georgia Basin International Task Force: 402.

Gavilan, F.M. 2001. Status and distribution of the loggerhead turtle, Carettacaretta, in the wider Caribbean region. In Marine turtle conservation in the widerCaribbean region: a dialogue for effective regional management. Pp 36-40.Eckert,K.L. & Abreu Grobois, F.A. (Eds). St. Croix, U.S. Virgin Is.

Geraci, J.R. 1990. Physiological and toxic effects on cetaceans. Pp. 167-197 In: Geraci, J.R. and D.J. St. Aubin (eds), Sea Mammals and Oil: Confronting the Risks. Academic Press, Inc.

Geraci, J.R. and D.J. St. Aubin. 1980. Offshore petroleum resource development and marine mammals: A review and research recommendations. Mar. Fish. Rev., 42: 11:1-12.

Germano, D.J. and D.F. Williams. 2005. Population Ecology of Blunt-Nosed Leopard Lizards in High Elevation Foothill Habitat. Journal of Herpetology 39: 1-18.

Gill, J. A., K. Norris, and W. J. Sutherland. 2001. Why behavioural responses may not reflect the population consequences of human disturbance. Biological Conservation, 97: 265-268.

Gilman, E., D. Kobayashi, T. Swenarton, N. Brothers, P. Dalzell, and I. Kinan-Kelly. 2007. Reducing sea turtle interactions in the Hawaii-based longline swordfish fishery. Biological Conservation 139, 19-28.

GMFMC. 2007. Final Amendment 27 to the reef fish fishery management plan and Amendment 14 to the shrimp fishery management plan. Including the Supplemental Environmental Impact Statement, Regulatory Impact Review, and Regulatory Flexibility Act Analysis). June 2007. pp.380. Gulf of Mexico Fishery Management Council, 2203 North Lois Avenue, Suite 1100, Tampa, Florida 33607.

Grant, S.C.H. and P.S. Ross. 2002. Southern Resident killer whales at risk: toxic chemicals in the British Columbia and Washington environment. Canadian Technical Report of Fisheries and Aquatic Sciences 2412. Fisheries and Oceans Canada., Sidney, B.C.: 124.

Green, J.A., P.J. Butler, A.J. Woakes, and I.L. Boyd. 2004. Energetics of the moult fast in female macaroni penguins Eudyptes chrysolophus. Journla of Avian Biology 35: 153-161.

Gregory, L.F., T.S. Gross, A.B. Bolten, K.A. Bjorndal, and J.L.J. Guillette. 1996. Plasma Corticosterone Concentrations Associated with Acute Captivity Stress in Wild Loggerhead Sea Turtles (Caretta caretta). General and Comparative Endocrinology 104: 312-320.

Groombridge, B., and R. Luxmoore. 1989. The green turtle and hawksbill (Reptilia: Cheloniidae): world status, exploitation and trade. CITES Secretariat; Lausanne, Switzerland.

Guseman, J. L. and L.M. Ehrhart. 1992. Ecological geography of Western Atlantic loggerheads and green turtles: evidence from remote tag recoveries. In: Proceedings of the 11th Annual Workshop on Sea Turtle Biology and Conservation, Vol. 302 (Salmon, M. and Wyneken, J., eds.). pp. 50 (abstract). U.S. Department of Commerce NOAA Technical Memorandum, NMFS-SEFSC.

Hare, S.R., N.J. Mantua, and R.C. Francis. 1999. Inverse production regimes: Alaskan and west coast salmon. Fisheries, 24: 6-14.

Harrington, F.H. and A.M. Veitch. 1992. Calving success of woodland caribou exposed to low-level jet fighter overflights. Arctic 45: 213-218.

Hartwell, S.I. 2004. Distribution of DDT in sediments off the central California coast. Marine Pollution Bulletin, 49: 299-305.

Hays, G.C., S. Akesson, A.C. Broderick, F. Glen, B.J. Godley, P. Luschi, C. Martin, J.D. Metcalfe, and F. Papi. 2001. The diving behaviour of green turtles undertaking oceanic migration to and from Ascension Island: dive durations, dive profiles and depth distribution. J Exp Biol 204, 4093-4098.

Hazel, J., I.R. Lawler, H. Marsh, and S. Robson. 2007. Vessel speed increases collision risk for the green turtle Chelonia mydas. Endangered Species Research 3: 105–113.

Henwood, T. A. and L.H. Ogren. 1987. Distribution and migrations of immature Kemp's ridley turtles (Lepidochelys kempii) and green turtles (Chelonia mydas) off Florida, Georgia, and South Carolina. Northeast Gulf Science 9: 153-159.

Heppell, S.S., L.B. Crowder, D.T. Crouse, S.P. Epperly, and N.B. Frazer. 2003. Population models for Atlantic loggerheads: past, present, and future. In Bolten, A.B. and B.E. Witherington (Eds.) Loggerhead Sea Turtles. Smithsonian Institution Press, Washington, D.C.

Hildebrand, H. 1963. Hallazgo del area de anidacion de la tortuga “lora” Lepidochelys kempii (Garman), en la costa occidental del Golfo de Mexico (Rept. Chel.). Ciencia Mexico 22: 105-112.

Hirth, H. F. 1971. Synopsis of biological data on the green sea turtle, Chelonia mydas. FAO Fisheries Synopsis 85: 1-77.

Hirth, H.F. 1997. Synopsis of the biological data on the green turtle Chelonia mydas (Linnaeus 1758). p. 120 pp.

Hockersmith, E.E., W.D. Muir, S.G. Smith, B.P. Sandford, R.W. Perry, N.S. Adams, and D.W. Rondorf. 2003. Comparison of Migration Rate and Survival between

Radio-Tagged and PIT-Tagged Migrant Yearling Chinook Salmon in the Snake and Columbia Rivers. North American Journal of Fisheries Management 23: 404-413.

Hoff, R.Z. and G. Shigenaka. 2003. Response considerations for sea turtles. In: G. Shigenaka (editor), Oil and Sea Turtles: Biology, Planning, and Response. NOAA National Ocean Service. p: 49-68.

Hoopes, L.A., A.M. Landry, Jr., and E.K. Stabenau. 2000. Physiological effects of capturing Kemp's ridley sea turtles, Lepidochelys kempii, in entanglement nets. Canadian Journal of Zoology 78: 1941-1947.

Huerta, P., H. Pineda, A. Aguirre, T. Spraker, L. Sarti, and A. Barragán. 2002. First confirmed case of fibropapilloma in a leatherback turtle (Dermochelys coriacea), p. 193. In A. Mosier, A. Foley, and B. Brost (ed.), Proceedings of the 20th Annual Symposium on Sea Turtle Biology and Conservation. National Oceanic and Atmospheric Administration technical memorandum NMFS-SEFSC-477. U.S. Department of Commerce, Washington, D.C.

Hurrell, J.W. 1995. Decadal trends in the North Atlantic Oscillation: regional temperatures and precipitation. Science, 269: 676-679.

IUCN. 1996. Marine Turtle Specialist Group. Lepidochelys kempii. In: IUCN 2010. IUCN Red List of Threatened Species. <www.iucnredlist.org>.

Iwata, H., S. Tanabe, N. Sakai, and R. Tatsukawa. 1993. Distribution of persistent organochlorines in the oceanic air and surface seawater and the role of ocean on their global transport and fate. Environmental Science and Technology, 27: 1080-1098.

Johnson, S.A. and L.M. Ehrhart. 1996. Reproductive Ecology of the Florida Green Turtle: Clutch Frequency. Journal of Herpetology 30: 407-410.

Kamezaki, N., Y. Matsuzawa, O. Abe, H. Asakawa, T. Fujii, K. Goto, S. Hagino, M. Hayami, M. Ishii, T. Iwamoto, T. Kamata, H. Kato, J. Kodama, Y. Kondo, I. Miyawaki, K. Mizobuchi, Y. Nakamura, Y. Nakashima, H. Naruse, K. Omuta, M. Samejima, H. Suganuma, H. Takeshita, T. Tanaka, T. Toji, M. Uematsu, A. Yamamoto, T. Yamato, and I. Wakabayashi. 2003. Loggerhead turtles nesting in Japan. Pages 210-217 in Bolten, A.B. and B.E. Witherington (editors). Loggerhead Sea Turtles. Smithsonian Books, Washington D.C.

Keller, J.M., J.R. Kucklick, M.A. Stamper, C.A. Harms, and P.D. McClellan-Green. 2004. Associations between Organochlorine Contaminant Concentrations and Clinical Health Parameters in Loggerhead Sea Turtles from North Carolina, USA. Environmental Health Perspectives 112: 1074-1079.

Keller, J.M., P.D. McClellan-Green, J.R. Kucklick, D.E. Keil, and M.M. Peden-Adams. 2006. Effects of Organochlorine Contaminants on Loggerhead Sea Turtle Immunity: Comparison of a Correlative Field Study and <italic>In Vitro</italic> Exposure Experiments. Environ Health Perspect: 114.

Lagueux, C. 2001. Status and distribution of the green turtle, Chelonia mydas, in the Wider Caribbean Region, pp. 32-35. In: K. L. Eckert and F. A. Abreu Grobois

(eds.), 2001 Proceedings of the Regional Meeting: Marine Turtle Conservation in the Wider Caribbean Region: A Dialogue for Effective Regional Management. Santo Domingo, 16-18 November 1999. WIDECAST, IUCN-MTSG, WWF, and UNEP-CEP.

Laurent, L. Casale, P. Bradai, M. N. Godley, B. J. Gerosa, G. Broderick, A. C. Schroth, W. Schierwater, B. Levy, A. M. Freggi, D. 1998. Molecular resolution of marine turtle stock composition in fishery bycatch: a case study in the Mediterranean. Molecular Ecology 7: 1529-1542.

Law, R. J., R. L. Stringer, C. R. Allchin, and B. R. Jones. 1996. Metals and organochlorines in sperm whales (Physeter macrocephalus) stranded around the North Sea during the 1994/1995 winter. Marine Pollution Bulletin 32(1): 72-77.

Law, R.J., C.F. Fileman, A.D. Hopkins, J.R. Baker, J. Harwood, D.B. Jackson, S. Kennedy, A.R. Martin, and R.J. Morris. 1991. Concentrations of trace metals in the livers of marine mammals (seals, porpoises and dolphins) from waters around the British Isles. Marine Pollution Bulletin 22: 183-191.

Lewison, R.L., L.B. Crowder, and D.J. Shaver. 2003. The impact of turtle excluder devices and fisheries closures on loggerhead and Kemp's ridley strandings in the western Gulf of Mexico. Conservation Biology 17(4): 1089-1097.

Lewison, R.L., S.A. Freeman, and L.B. Crowder. 2004. Quantifying the effects of fisheries on threatened species: the impact of pelagic longlines on loggerhead and leatherback sea turtles. Ecology Letters 7: 221-231.

Lima, S.L. 1998. Stress and decision making under the risk of predation: recent developments from behavioral, reproductive, and ecological perspecitves. Advances in the Study of Behavior 27: 215-290.

Limpus, C.J. and D.J. Limpus. 2003. Loggerhead turtles in the equatorial and southern Pacific Ocean: a species in decline. Pages 199-209 in Bolten, A.B. and B.E. Witherington (editors). Loggerhead Sea Turtles. Smithsonian Books, Washington D.C.

Loehefener, R. R., W. Hoggard, C. L. Roden, K. D. Mullin, and C. M. Rogers. 1989. Petroleum structures and the distribution of sea turtles. In: Proc. Spring Ternary Gulf of Mexico Studies Meeting, Minerals Management Service, U.S. Department of the Interior.

Lutcavage, M. and J.A. Musick. 1985. Aspects of the biology of sea turtles in Virginia. Copeia 1985: 449-459.

Lutcavage, M. E., P. L. Lutz, G. D. Bossart, and D. M. Hudson. 1995. Physiologic and clinicopathologic effects of crude oil on loggerhead sea turtles. Arch. Environ. Contam. Toxicol. 28: 417–422

Lutcavage, M. E. and P.L. Lutz. 1997. Diving physiology. In: The Biology of Sea Turtles, Vol. vol. 1 (Lutz, P. L. and Musick, J. A., eds.). pp. 277–296. CRC Press, Boca Raton, Florida.

Lutcavage, M. E., P. Plotkin, B. Witherington, and P. L. Lutz. 1997. Human impacts on

sea turtle survival. In: The Biology of Sea Turtles, Vol. vol. 1 (Lutz, P. L. and Musick, J. A., eds.): 387-432. CRC Press, Boca Raton, Florida.

Lutz, P.L. and T.B. Bentley. 1985. Respiratory Physiology of Diving in the Sea Turtle. Copeia 1985: 671-679.

Lutz, P. L. and M. Lutcavage. 1989. The effects of petroleum on sea turtles: applicability to Kemp‘s ridley. In: C.W. Caillouet, Jr. and A.M. Landry, Jr. (editors), Proceedings of the First International Symposium on Kemp‘s Ridley Sea Turtle Biology, Conservation and Management. TAMU-SG89-105: 52-54.

Mann, T.M. 1977. Impact of developed coastline on nesting and hatchling sea turtles in southeastern Florida. Unpublished M.S. Thesis. Florida Atlantic University; Boca Raton, Florida.

Mantua, N.J., S.R. Hare, Y. Zhang, J.M. Wallace, and R.C. Francis. 1997. A Pacific interdecadal climate oscillation with impacts on salmon production. Bulletin of the American Meteorological Society, 78: 1069-1079.

Margaritoulis, D., R. Argano, I. Baran, F. Bentivegna, M.N. Bradai, J.A. Camiñas, P. Casale, G. De Metrio, A. Demetropoulos, G. Gerosa, B.J. Godley, D.A. Haddoud, J. Houghton, L. Laurent, and B. Lazar. 2003. Loggerhead turtles in the Mediterranean Sea: present knowledge and conservation perspectives. Pages 175-198 in Bolten, A.B. and B.E. Witherington (editors). Loggerhead Sea Turtles. Smithsonian Books, Washington D.C.

Marquez, M.R. 1994. Synopsis of biological data on the Kemp's ridley turtle, Lepidochelys kempi (Garman, 1880). NOAA Tech. Mere. NMFS-SEFSC-343: 1-91.

Martin, R. E. and R.G. Ernst. 2000. Physical and Ecological Factors Influencing Sea Turtle Entrainment Levels at the St. Lucie Nuclear Plant. 62 pp.

Matkin, C.O. and E. Saulitis. 1997. Restoration notebook: killer whale (Orcinus orca). Exxon Valdez Oil Spill Trustee Council, Anchorage, Alaska.

Mazaris, A.D., G. Matsinos, and J.D. Pantis. 2009. Evaluating the impacts of coastal squeeze on sea turtle nesting. Ocean & Coastal Management 52: 139-145.

McKenzie, C., B.J. Godley, R.W. Furness, and D.E. Wells. 1999. Concentrations and patterns of organochlorine contaminants in marine turtles from Mediterranean and Atlantic waters. Marine Environmental Research 47: 117-135.

Mearns, A.J. 2001. Long-term contaminant trends and patterns in Puget Sound, the Straits of Juan de Fuca, and the Pacific Coast. In: Droscher, T. (Ed.), 2001 Puget Sound Research Conference. Puget Sound Action Team, Olympia, Washington.

Meylan, A. M., B. Schroeder, and A. Mosier. 1994. Marine turtle nesting activity in the state of Florida, 1979-1992, p. 83. In: K. A. Bjorndal, A. B. Bolten, D. A. Johnson, and P. J. Eliazar (comps.), Proceedings of the Fourteenth Annual Symposium on Sea Turtle Biology and Conservation. NOAA Technical Memorandum NMFS-SEFSC-351

Meylan, A., Schroeder B., and A. Mosier. 1995. Sea turtle nesting activity in the state of

Florida 1979-1992. State of Florida Department of Environmental Protection Florida Marine Research Institute. Florida marine research publications (52): 57pp.

Mills, S.K. and J.H. Beatty. 1979. The propensity interpretation of fitness. Philosophy of Science, 46: 263-286.

Milton, S., P. Lutz, and G. Shigenaka. 2003. Oil toxicity and impacts on sea turtles. In: G. Shigenaka (editor), Oil and Sea Turtles: Biology, Planning, and Response. NOAA National Ocean Service. p: 35-47.

Moore, C.J., S.L. Moore, M.K. Leecaster, and S.B. Weisberg. 2001. A Comparison of Plastic and Plankton in the North Pacific Central Gyre. Marine Pollution Bulletin 42: 1297-1300.

Morreale, S.J. and E.A. Standora. 1998. Early life stage ecology of sea turtles in northeastern U.S. waters. NOAA Technical Memorandum NMFS-SEFSC-413. 49 pp.

Mortimer, J.A. 1990. The Influence of Beach Sand Characteristics on the Nesting Behavior and Clutch Survival of Green Turtles (Chelonia mydas). Copeia 1990: 802-817.

Mrosovsky, N., G.D. Ryan, and M.C. James. 2009. Leatherback turtles: The menace of plastic. Marine Pollution Bulletin 58: 287-289.

Murphy, T. M. and S.R. Hopkins. 1984. Aerial and ground surveys of marine turtle nesting beaches in the southeast region. pp. 67 pp. LaMER, Inc. Green Pond, South Carolina.

Murray, K.T. 2006. Estimated average annual bycatch of loggerhead sea turtles (Caretta caretta) in U.S. Mid-Atlantic bottom otter trawl gear, 1996-2004. NMFS Northeast Fisheries Science Center Reference Document 06-19.

Musick, J. A. and C.J. Limpus. 1997. Habitat utilization and migration in juvenile sea turtles. In: The Biology of Sea Turtles, Vol. vol. 1 (Lutz, P. L. and Musick, J. A., eds.): 137-164. CRC Press, Boca Raton, Florida.

NMFS. 1997a. Section 7 consultation on the continued hopper dredging of channels and borrow areas in the southeastern United States. National Marine Fisheries Service Southeast Regional Office, September 25, 1997.

NMFS. 1997b. Endangered Species Act section 7 consultation on Navy activities off the southeastern United States along the Atlantic Coast. Biological Opinion. May 15, 1997.

NMFS. 2001. Stock assessments of loggerhead and leatherback sea turtles and an assessment of the impact of the pelagic longline fishery on the loggerhead and leatherback sea turtles of the Western North Atlantic. U.S. Department of Commerce, National Marine Fisheries Service, Miami, Florida, SEFSC Contribution PRD-00/01-08; Parts I-III and Appendices I-V1.

NMFS. 2003. Endangered Species Act section 7 consultation on Gulf of Mexico Outer Continental Shelf oil and gas lease sales 189 and 197. Biological Opinion. August

30.

NMFS. 2008. Recovery Plan for Southern Resident Killer Whales (Orcinus orca). National Marine Fisheries Service, Northwest Region, Seattle, Washington. 251pp.

NMFS. 2010. Sea turtles, dolphins, and whales and the Gulf of Mexico oil spill. Turtles documented by species current as of October 17, 2010. <http://www.nmfs.noaa.gov/pr/health/oilspill.htm>

NMFS-SEFSC. 2001. Stock assessments of loggerhead and leatherback sea turtles and an assessment of the impact of the pelagic longline fishery on the loggerhead and leatherback sea turtles of the Western North Atlantic. NOAA Technical Memorandum, NMFS-SEFSC-455. 226 pp.

NMFS-SEFSC. 2006. Sea Turtle Research Permit Application, File No. 1551.

NMFS and USFWS. 1991. Recovery Plan for U.S. Population of Atlantic Green Turtle. National Marine Fisheries Service, Washington, D.C.

NMFS and USFWS. 1992. Recovery Plan for the Kemps' Ridley Sea Turtle. National Marine Fisheries Service, Washington, D.C. 40pp.

NMFS and USFWS. 2007. Green sea turtle (Chelonia mydas) 5-year review: Summary and evaluation. National Marine Fisheries Service, Silver Spring, MD. 109 pp.

NMFS and USFWS. 2009. Loggerhead sea turtle (Caretta caretta) 2009 status review under the U.S. Endangered Species Act. Report of the Loggerhead Biological Review Team to the National Marine Fisheries Service. Silver Spring, MD. 222 pp.

NMFS and USFWS. 2010. Draft Bi- National Recovery Plan for the Kemp's Ridley Sea Turtle (Lepidochelys kempii), Second Revision. National Marine Fisheries Service. Silver Spring, MD.

NRC. 1990. Decline of the sea turtles: causes and prevention. National Academy Press, Washington, D.C. 274 pp.

NRC. 2003. National Research Council: Ocean noise and marine mammals. National Academies Press, Washington, D.C. 192 pp.

Ogren, L. H. 1989. Distribution of juvenile and sub-adult Kemp's ridley sea turtle: Preliminary results from 1984-1987 surveys. In: First International Symposium on Kemp's Ridley Sea Turtle Biology, Conservation and Management, Oct. 1-4, 1985. Galveston, Texas, (Caillouet, C. W. and Landry, A. M., eds.): 116-123. Texas A&M University.

Owens, D.W. and G.W. Ruiz. 1980. New methods of obtaining blood and cerebrospinal fluid from marine turtles. Herpetologica, 36(1):17-20.

Peters, A. and K.J.F. Verhoeven. 1994. Impact of Artificial Lighting on the Seaward Orientation of Hatchling Loggerhead Turtles. Journal of Herpetology 28: 112-114.

Pichel, W.G., J.H. Churnside, T.S. Veenstra, D.G. Foley, K.S. Friedman, R.E. Brainard,

J.B. Nicoll, Q. Zheng, and P. Clemente-Colón. 2007. Marine debris collects within the North Pacific Subtropical Convergence Zone. Marine Pollution Bulletin 54: 1207-1211.

Pritchard, P. C. H. 1969. Endangered species: Kemp's ridley turtle. Florida Naturalist 49: 12-19.

Read, A.J. 2007. Do circle hooks reduce the mortality of sea turtles in pelagic longlines? A review of recent experiments. Biological Conservation 135, 155-169.

Rebel, T. P. 1974. Sea turtles and the turtle industry of the West Indies, Florida and the Gulf of Mexico. University of Miami Press, Coral Gables, Florida.

Richards, P.M. 2007. Estimated takes of protected species in the commercial directed shark bottom longline fishery 2003, 2004, and 2005. NMFS Southeast Fisheries Science Center Contribution PRD-06/07-08, June 2007. 21pp.

Romero, L.M. 2004. Physiological stress in ecology: lessons from biomedical research. Trends in Ecology and Evolution, 19: 249-255.

Sakai, H., H. Ichihashi, H. Suganuma, and R. Tatsukawa. 1995. Heavy metal monitoring in sea turtles using eggs. Marine Pollution Bulletin 30: 347-353.

Salmon, M., and B.E. Witherington. 1995. Artificial Lighting and Seafinding by Loggerhead Hatchlings: Evidence for Lunar Modulation. Copeia 1995: 931-938.

Schmid, J. R. and W.N. Witzell. 1997. Age and growth of wild Kemp's ridley turtles (Lepidochelys kempii): cumulative results of tagging studies in Florida. Chelonian Conservation and Biology 2: 532-537.

Schroeder, B.A., A.M. Foley, and D.A. Bagley. 2003. Nesting patterns, reproductive migrations, and adult foraging areas of loggerhead turtles. Pages 114-124 in Bolten, A.B. and B.E. Witherington (editors). Loggerhead Sea Turtles. Smithsonian Books, Washington D.C.

Seminoff, J.A. 2004. Green turtle (Chelonia mydas). Red List assessment. <http://www.iucn-mtsg.org/>

Seminoff, J.A., A. Resendiz, S. Hidalgo, and W.J. Nichols. 2002. Diet of the East Pacific green turtle, *Chelonia mydas*, in the central Gulf of California, México. Journal of Herpetology 36: 447-453

Shaver, D. J. 1991. Feeding ecology of wild and head-started Kemp's ridley sea turtles in south Texas waters. Journal of Herpetology 25: 327-334.

Shoop, C.R. and R.D., Kenney. 1992. Seasonal distributions and abundance of loggerhead and leatherback sea turtles in waters of the northeastern United States. Herpetol. Monogr, 6:43-67.

Skalski, J., S. Smith, R. Iwamoto, J. Williams and A. Hoffmann. 1998. Use of passive integrated transponder tags to estimate survival of migrant juvenile salmonids in the Snake and Columbia rivers. Canadian Journal of Fisheries and Aquatic Sciences 55: 1484-1493.

Spotila, J.R., M.P. O‘Connor, and F.V. Paladino. 1997. Thermal biology. In: P.L. Lutz and J. A. Musick (editors), The Biology of Sea Turtles. CRCPress. Boca Raton, Florida: 297-341.

St. Aubin, D.J. and J.R. Geraci. 1988. Capture and handling stress suppresses circulating levels of thyroxine (T4) and triiodothyronine (T3) in beluga whales Delphinapterus leucas. Physiol. Zool. 61: 170–175.

Stearns, S.C. 1992. The evolution of life histories. Oxford University Press, 249pp.

Storelli, M.M., G. Barone, A. Storelli, and G.O. Marcotrigiano. 2008. Total and subcellular distribution of trace elements (Cd, Cu and Zn) in the liver and kidney of green turtles (Chelonia mydas) from the Mediterranean Sea. Chemosphere 70: 908-913.

Storelli, M. M., E. Ceci and G.O. Marcotrigiano. 1998. Distribution of heavy metal residues in some tissues of Caretta caretta (Linnaeus) specimens beached along the Adriatic Sea (Italy). Bulletin of Environmental Contamination and Toxicology 60: 546-552.

Storelli, M.M., and G.O. Marcotrigiano. 2003. Heavy metal residues in tissues of marine turtles. Marine Pollution Bulletin 46: 397-400.

Stoskopf, M. K. 1993. Shark pharmacology and toxicology. Pages 809–816 in M. Stoskopf, editor. Fish medicine. Saunders, Philadelphia.

Taylor, A.H., M.B. Jordan, and J.A. Stephens. 1998. Gulf Stream shifts following ENSO events. Nature, 393: 638.

TEWG. 1998. An assessment of the Kemp’s ridley (Lepidochelys kempii) and loggerhead (Caretta caretta) sea turtle populations in the western North Atlantic. U.S. Dep. Commer. NOAA Tech. Memo. NMFS-SEFSC-409, 96 pp.

TEWG. 2000. Assessment update for the Kemp's ridley and loggerhead sea turtle populations in the western North Atlantic. U.S. Dep. Commer. NOAA Tech. Mem. NMFS-SEFSC-444, 115 pp.

Thompson, W. L. 2004. Future directions in estimating abundance of rare or elusive species. Pages 389–399 in W. L. Thompson, editor. Sampling rare or elusive species. Island Press, Washington, D.C.

Troëng, S. and E. Rankin. 2005. Long-term conservation efforts contribute to positive green turtle Chelonia mydas nesting trend at Tortuguero, Costa Rica. Biological Conservation 121: 111-116.

Tucker, A.D. 2010. Nest site fidelity and clutch frequency of loggerhead turtles are better elucidated by satellite telemetry than by nocturnal tagging efforts: Implications for stock estimation. Journal of Experimental Marine Biology and Ecology 383: 48-55.

Watson, J.W., S.P. Epperly, A.K. Shah, and D.G. Foster. 2005. Fishing methods to reduce sea turtle mortality associated with pelagic longlines. Canadian Journal of Fisheries and Aquatic Sciences 62: 965-981.

Watson, J.W., D.G. Foster, S. Epperly, and A. Shah. 2004. Experiments in the western Atlantic Northeast Distant Waters to evaluate sea turtle mitigation measures in the pelagic longline fishery. Report on experiments conducted in 2001 -2003. February 4, 2004. 123 pp.

Watson, W. and R. Granger. 1998. Hydrodynamic Effect of a Satellite Transmitter on a Juvenile Green Turtle (*Chelonia mydas*). The Journal of Experimental Biology 201: 2497-2502.

Walker, B.G., P.R. Boersma, and J.C. Wingfield. 2006. Habituation of adult Magellenic penguins to human visitation as expressed through behavior and corticosterone secretion. Conservation Biology, 20: 146-154.

Weishampel, J.F., D.A. Bagley, L.M. Ehrhart, and B.L. Rodenbeck. 2003. Spatiotemporal patterns of annual sea turtle nesting behaviors along an East Central Florida beach. Biological Conservation 110: 295-303.

Wershoven, J. L. and R.W. Wershoven. 1992. Juvenile green turtles in their nearshore habitat of Broward County, Florida: a five year review. In: Proceedings of the 11th Annual Workshop on Sea Turtle Biology and Conservation, Vol. 302 (Salmon, M. and Wyneken, J., eds.): 121-123. U.S. Department of Commerce NOAA Technical Memorandum, NMFS-SEFSC.

Williams, E.H., L. Bunkley-Williams, E.C. Peters, B. Pinto-Rodriguez, R. Matos-Morales, A.A. Mignucci-Giannoni, K.V. Hall, J.V. Rueda-Almonacid, J. Sybesma, I.B. De Calventi, and R.H. Boulon. 1994. An Epizootic of Cutaneous Fibropapillomas in Green Turtles Chelonia mydas of the Caribbean: Part of a Panzootic? Journal of Aquatic Animal Health 6: 70-78.

Williams, S. L. 1988. Thalassia testudinum productivity and grazing by green turtles in a highly disturbed seagrass bed. Marine Biology 98: 447-455.

Williams, R., R.W. Trites, and D.E. Bain. 2002. Behavioural responses of killer whales (Orcinus orca) to whale-watching boats: Opportunistic observations and experimental approaches. Journal of Zoology, 256: 255-270.

Witherington, B.E. 1992. Behavioral responses of nesting sea turtles to artificial lighting. Herpetologica 48(1): 31-39.

Witherington, B. E. 1994. Flotsam, jetsam, post-hatchling loggerheads, and the advecting surface smorgasbord. In: Proc. 14th Ann. Symp. Sea Turtle Biology and Conservation, K. A. Bjorndal, A. B. Bolten, D. A. Johnson, and P. J. Eliazar, compilers. NOAA Technical Memorandum. NMFS-SEFSC-351, Miami, Fla. 166pp.

Witherington, B.E. 1999. Reducing threats to nesting habitat. Pages 179-183 in Eckert, K.L., K.A. Bjorndal, F.A. Abreu-Grobois, and M. Donnelly (editors). Research and Management Techniques for the Conservation of Sea Turtles. IUCN/SSC Marine Turtle Specialist Group Publication No. 4.

Witherington, B.E. 2002. Ecology of neonate loggerhead turtles inhabiting lines of downwelling near a Gulf Stream front. Marine Biology 140: 843-853.

Witherington, B. E. and K. A. Bjorndal. 1991. Influences of artificial lighting on the seaward orientation of hatchling loggerhead turtles, Caretta caretta. Biol. Cons. 55(2): 139-149.

Witherington, B. and L.M. Ehrhart. 1989. Hypothermic stunning and mortality of marine turtles in the Indian River Lagoon system, Florida. Copeia 1989: 696-703.

Witherington, B., S. Hirama, and A. Mosier. 2003. Effects of beach armoring structures on marine turtle nesting. Florida Fish and Wildlife Conservation Commission final project report to the U.S. Fish and Wildlife Service. 26pp.

Witherington, B., S. Hirama, and A. Mosier. 2007. Changes to armoring and other barriers to sea turtle nesting following severe hurricanes striking Florida beaches. Florida Fish and Wildlife Conservation Commission final project report to the U.S. Fish and Wildlife Services. 11pp.

Witzell, W. N., A.L. Bass, M.J. Bresette, D.A. Singewald, and J.C. Gorham. 2002. Origin of immature loggerhead sea turtles (Caretta caretta) at Hutchinson Island, Florida: evidence from DNA markers. Fishery Bulletin 100: 624-631.

Wright, I.E., S.D. Wright, and J.M. Sweat. 1998. Use of passive integrated transponder (PIT) tags to identify manatees (Trichechus manatus latirostris). Marine Mammal Science 14(3): 5.