NATIONAL MARINE FISHERIES SERVICE
ENDANGERED SPECIES ACT SECTION 7
BIOLOGICAL OPINION

Title:	Biological Opinion on the Issuance of Permit No. 19508 for Scientific Research on Sea Turtles along the Eastern Coast of Florida and the Northern and Eastern Gulf of Mexico
Consultation Conducted By:	Endangered Species Act Interagency Cooperation Division, Office of Protected Resources, National Marine Fisheries Service, National Oceanic and Atmospheric Administration, U.S. Department of Commerce
Action Agencies:	Permits and Conservation Division, Office of Protected Resources, National Marine Fisheries Service, National Oceanic and Atmospheric Administration, U.S. Department of Commerce
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Approved:	Donna S. Wieting Director, Office of Protected Resources
Date:	FEB 27 2017
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1 INTRODUCTION

The Endangered Species Act of 1973, as amended (ESA; 16 U.S.C. 1531 et seq.) establishes a national program for conserving threatened and endangered species of fish, wildlife, plants, and the habitat they depend on. Section 7(a)(2) of the ESA requires Federal agencies to insure that their actions are not likely to jeopardize the continued existence of endangered or threatened species or adversely modify or destroy their designated critical habitat. Federal agencies must do so in consultation with National Marine Fisheries Service (NMFS) for threatened or endangered species (ESA-listed), or designated critical habitat that may be affected by the action that are under NMFS jurisdiction (50 C.F.R. §402.14(a)). If a Federal action agency determines that an action "may affect, but is not likely to adversely affect" endangered species, threatened species, or designated critical habitat and NMFS concur with that determination for species under NMFS jurisdiction, consultation concludes informally (50 C.F.R. §402.14(b)).

Section 7(b)(3) of the ESA requires that at the conclusion of consultation the NMFS provides an opinion stating whether the Federal agency's action is likely to jeopardize ESA-listed species or destroy or adversely modify their designated critical habitat. If NMFS determines that the action is likely to jeopardize listed species or destroy or adversely modify designated critical habitat, NMFS provides a reasonable and prudent alternative that allows the action to proceed in compliance with section 7(a)(2) of the ESA. If an incidental take is expected, section 7(b)(4) requires the Services to provide an incidental take statement that specifies the impact of any incidental taking and includes reasonable and prudent measures to minimize such impacts and terms and conditions to implement the reasonable and prudent measures.

The action agency for this consultation is the NMFS, Office of Protected Resources, Permits and Conservation Division (hereafter referred to as "the Permits Division") for its issuance of a scientific research and enhancement of propagation or survival permit pursuant to section 10(a)(1)(A) of the ESA. The Permits Division proposes to issue scientific research Permit No. 19508 for the tagging, measuring, and sampling (blood, stomach, fecal, and tissue) of sea turtles in the Indian River Lagoon and Trident Turning Basin of Florida, and the northern and eastern Gulf of Mexico offshore waters.

This consultation, biological opinion, and incidental take statement, were completed in accordance with section 7(a)(2) of the statute (16 U.S.C. 1536 (a)(2)), associated implementing regulations (50 C.F.R. §§401-16), and agency policy and guidance was conducted by NMFS Office of Protected Resources Endangered Species Act Interagency Cooperation Division.This biological opinion (opinion) and incidental take statement were prepared by NMFS Office of Protected Resources Endangered Species Act Interagency Cooperation Division in accordance with section 7(b) of the ESA and implementing regulations at 50 C.F.R. §402.

This document represents the NMFS opinion on the effects of these actions on endangered and threatened species and designated critical habitat for those species. A complete record of this consultation is on file at the NMFS Office of Protected Resources in Silver Spring, Maryland.

1.1 Background

This ongoing research is the combination of three different projects into one permit. Project 1, which focuses on the Indian River Lagoon, has been underway since 1982; Project 2 in the Trident Turning Basin was initiated in 1993. Both of these permits were authorized under Permit No. 14506 to Dr. Llewellyn Ehrhart at the University of Central Florida. Dr. Katherine Mansfield began Project 3 in the offshore waters of the northern and eastern Gulf of Mexico under Permit No. 16733 through the NMFS Southeast Fisheries Science Center. Dr. Mansfield has assumed leadership of the previous Projects 1 and 2, and in combination with her current work on Project 3 is consolidating all this work into one permit, which is the proposed Permit No. 19508. Consultation under ESA section 7 was conducted for each previous permit and modification request for research on Projects 1, 2 and 3. Each consultation resulted in the issuance of a biological opinion concluding that the issuance each permits was not likely to jeopardize the continued existence of currently ESA-listed species, and was not likely to destroy or adversely modify designated critical habitat.

1.2 Consultation History

The following dates are important to the history of the current consultation:

- The permit application was submitted on April 9, 2015 and early technical assistance/review of the permit was requested of the ESA Interagency Cooperation Division on May 11, 2016.
- On August 24, 2016, the NMFS' Permits Division deemed the application complete.
- On August 24, 2016, the completed initiation package was sent from the NMFS' Permits Division to the ESA Interagency Cooperation Division.
- On October 4, 2016, the ESA Interagency Cooperation Division initialized formal consultation on Permit No. 19508.

2 DESCRIPTION OF THE PROPOSED ACTION

"Action" means all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by federal agencies. The proposed action is the issuance of the scientific research Permit No. 19508 to Dr. Katherine Mansfield, the University of Central Florida, pursuant to Section 10(a)(1)(a) of the ESA, to conduct scientific research on green, loggerhead, Kemp's ridley, hawksbill, and leatherback sea turtles.

The purpose of the proposed permit is the continuation of two long-term projects on juvenile marine turtle populations in two eastern Florida developmental habitats and one on oceanic juveniles in the Gulf of Mexico. Project locations are: the central Indian River Lagoon; the Trident Turning Basin, Cape Canaveral Air Force Station; and the northern and eastern Gulf of Mexico waters offshore of Louisiana to western Florida. Turtles will be captured using standardized netting methods to assess population structure, abundance, distribution, habitat, sex ratios, physiology, genetics, and epidemiology. The proposed annual take of each sea turtle species under Permit No. 19508 is found in Table 1.

Table 1. Proposed annual take of sea turtles under Permit No. 19508.

Species	Listing Unit	Number of Animals	Take Action	Collect Method	Procedures
Green Sea Turtle	North Atlantic DPS[1]	360	Capture/ Handle/ Release	Net, Tangle	Epibiota removal; Lavage; Mark: flipper tag, PIT[2] tag; Measure; Photograph/Video; Sample: blood, cloacal swab, fecal, scute scraping, tissue; Weigh
Green Sea Turtle	North Atlantic DPS	75	Capture/ Handle/ Release	Net, Tangle	Epibiota removal; Lavage; Mark: flipper tag, PIT tag; Measure; Photograph/Video; Sample: blood, cloacal swab, fecal, scute scraping, tissue; Weigh; Instrument: epoxy attachment (e.g. satellite tag, VHF[3] tag)
Loggerhead Sea Turtle	Northwest Atlantic DPS	100	Capture/ Handle/ Release	Net, Tangle	Epibiota removal; Lavage; Mark: flipper tag, PIT tag; Measure; Photograph/Video; Sample: blood, cloacal swab, fecal, scute scraping, tissue; Weigh
Loggerhead Sea Turtle	Northwest Atlantic DPS	15	Capture/ Handle/ Release	Net, Tangle	Epibiota removal; Lavage; Mark: flipper tag, PIT tag; Measure; Photograph/Video; Sample: blood, cloacal swab, fecal, scute scraping, tissue; Weigh; Instrument: epoxy attachment (e.g. satellite tag, VHF tag)
Kemp's ridley Sea Turtle	Range-wide	4	Capture/ Handle/ Release	Net, Tangle	Epibiota removal; Lavage; Mark: flipper tag, PIT tag; Measure; Photograph/Video; Sample: blood, cloacal swab, fecal, scute scraping, tissue; Weigh
Kemp's ridley Sea Turtle	Range-wide	25	Capture/ Handle/ Release	Net, Tangle	Epibiota removal; Lavage; Mark: flipper tag, PIT tag; Measure; Photograph/Video; Sample: blood, cloacal swab, fecal, scute scraping, tissue; Weigh; Instrument: epoxy attachment (e.g. satellite tag, VHF tag)
Hawksbill Sea Turtle	Range-wide	3	Capture/ Handle/ Release	Net, Tangle	Epibiota removal; Lavage; Mark: flipper tag, PIT tag; Measure; Photograph/Video; Sample: blood, cloacal swab, fecal, scute scraping, tissue; Weigh
Hawksbill Sea Turtle	Range-wide	5	Capture/ Handle/ Release	Net, Tangle	Epibiota removal; Lavage; Mark: flipper tag, PIT tag; Measure; Photograph/Video; Sample: blood, cloacal swab, fecal, scute scraping, tissue; Weigh; Instrument: epoxy attachment (e.g. satellite tag, VHF tag)
Leatherback Sea Turtle	Range-wide	2	Capture/ Handle/ Release	Net, Tangle	Epibiota removal; Lavage; Mark: flipper tag, PIT tag; Measure; Photograph/Video; Sample: blood, cloacal swab, fecal, scute scraping, tissue; Weigh

[1]DPS = distinct population segment; [2]PIT = passive integrated transponder; [3]VHF = very high frequency

2.1 Capture

Turtles will be captured in the Central Region of the Indian River Lagoon System, Florida by large-mesh tangle nets, constantly attended, deployed for up to six hours in the central region of the Indian River Lagoon System on Florida's east coast (Ehrhart et al. 2007). The nets will be consistent with those used previously by the project and will consist of webbing hung from a braided polypropylene top line suspended at the surface by floats attached during deployment. Two nets will typically be tied end-to-end and deployed. The anchor will be lowered to the bottom as the boat moves to ensure that the anchor has penetrated the bottom and is holding. Then, a float will be attached to the top line at the point where the webbing begins and the net mesh begins to enter the water. Two or three workers will tend the net as it is paid out and deployment will begin at the upwind end of the netting site. Large-hoop dip nets will be used to aid in the capture and boarding of entangled turtles. Captured turtles will be transferred to a third boat for all procedures to be performed. The turtles will be detained only long enough for standard data collection and turtles will be kept on-board a work-up vessel in the shade and cooled/kept moist with wet towels.

Turtles in the Trident Turning Basin will be captured using both tangle nets and large dip nets, with protocols consistent with the previous years of research on this project (Redfoot and Ehrhart 2013). Capture methods will be similar to those described in the Indian River Lagoon System. The tangle net will consist of nylon twine mesh hung from a braided polypropylene top line and a continuous lead core bottom line. Two tangle nets will be used, set individually and suspended from floats attached at regular intervals to the top line during deployment. Each net will be checked on a regular basis by elevating the top line from the bow of a small boat. Any given portion of a tangle net will be checked approximately every 15 minutes by pulling hand over hand along the top line from the bow of a boat. Turtles will also be opportunistically captured with long handled, large-hoop dip nets.

Oceanic juvenile (neonate) sea turtles (approximately 11 to 25 centimemters in shell length) in the Gulf of Mexico will be captured by dip-net from a boat in the turtles' offshore, oceanic, blue-water habitats (typically along frontal zones and in floating Sargassum habitats, up to 120 miles offshore). Vessels will depart from the following ports: Venice, LA; Orange Beach, AL; and Marco Island, Sarasota, Cortez, Apalachicola, and Pensacola, FL (Witherington et al. 2012a; Putman and Mansfield 2015). The turtles will be held in medium-sized plastic storage tubs and covered with moist towels during the time of data collection and until they are released. Turtles will be kept in the shade, including inside the main cabin of the vessel in a temperature-controlled area.

2.2 Measuring and Weighing

Measurements of straight carapace length (standard carapace length), maximum straight carapace length, straight carapace width, head width, and body depth will be made with forestry calipers. Curved carapace length, curved carapace width, plastron length, and tail length measurements will be made with a cloth tape. Weight will be obtained with a spring scale. All measurements will be made using the protocol described by Bolten (1999). A separate set of calipers and tapes will be used for turtles afflicted with fibropapillomatosis. All measuring tools will be disinfected after use.

2.3 Flipper and Passive Integrated Transponder Tagging

Captured turtles will be checked for flipper tags and scanned for Passive Integrated Transponder (PIT) tags. Those that are not already tagged will be flipper tagged with Inconel metal tags on a scale proximal to the body on the trailing edge of each front flipper, and a PIT tag will be inserted subcutaneously in the right front flipper. The application protocol described in Research and Management Techniques for the Conservation of Sea Turtles (Eckert et al. 1999) will be used. Aseptic technique will be used for all flipper and PIT tagging per the new NMFS guidelines. A separate set of applicators will be used with turtles afflicted with fibropapillomatosis.

Prepackaged, sterile PIT tags will be used and the site of injection wiped with alcohol swabs or betadine both before and after insertion. Turtles over 25 centimeters straight carapace length will receive two flipper tags and one PIT tag. Those that are 15 to 25 centimeters straight carapace length will receive one flipper tag and one PIT tag. In the unlikely event of turtles under 15 centimeters straight carapace length, decisions will be made on a case-by-case basis as to whether the turtle is robust enough for a PIT tag. Any turtles under 15 centimeters straight carapace length will not receive any flipper tags, and PIT tags will only be inserted if a veterinarian or PI Mansfield is present. Turtles greater than 30 centimeters straight carapace length will be PIT tagged in the triceps superficialis muscle or an alternative site on the dorsal front flipper using a local anesthetic, per NMFS sea turtle tagging guidelines. Tag loss for Inconel tags is expected, but it is impossible to predict how long they will stay in place.

2.4 Tissue, Stomach, Fecal and Blood Sampling

Blood will be drawn into evacuated blood collection tubes from the dorsal cervical sinus (Wibbels et al. 1998) of each turtle for genetic analysis to estimate population origins, epidemiological and stable isotope research, and for sex determination. Blood volume by weight protocols presented by Wibbels et al. (1998) will be followed, although most sampling will be 4 milliliters of blood or less. Needles will be either 20-gauge or 22-gauge, depending on size of the turtle. Aseptic technique will be used, per NMFS guidelines. Many of the turtles captured offshore are of a size that is similar to the smaller sizes captured for the inshore projects. The blood collection site is the same as that of larger turtles; however, the smaller turtles (especially green turtles) are notoriously difficult to work with for blood draws. As such, the blood draw attempts will be limited to no more than two attempt per turtle to reduce stress.

Skin biopsies will be collected using the protocol described by Dutton and Balazs (1995), and the aseptic technique described in NMFS guidelines. The skin biopsy will be obtained using a 4-millimeter sterile biopsy punch. If needed, a coagulant powder will be used to control bleeding after tissue (skin) sampling. Scute biopsies will be collected using the protocol described by Bjorndal et al. (2010).

The second right costal will be cleaned with an alcohol swab after removing algae and epibionts. A sterile, 4- millimeter or 6- millimeter biopsy punch will be used to sample both the posterior medial and anterior lateral corner of the second right costal. Pressure will then be applied with a twisting motion to move the biopsy through the layers of scute until the innermost layer of keratin is pierced. Skin biopsies will be used for genetic analysis to estimate population origins and for epidemiological and stable isotope research, and scute samples will be used for additional stable isotope analysis. Epibionts (e.g., leeches, leech eggs) will be removed using forceps. The removal site will then be swabbed with either isopropyl alcohol or betadine.

Samples of food items consumed by juvenile green turtles will be obtained by a lavage of the esophagus using a modification of the methods described by Legler (1977), Balazs (1980), and Forbes and Limpus (1993). Each turtle will be placed on its back with its posterior slightly elevated. A soft plastic veterinarian's stomach tube, lubricated with vegetable oil, will then be carefully inserted through the mouth and down the length of the esophagus. A 9-millimeter outside diameter, 6-millimeter inside diameter tube will be used with turtles in the 20 centimeter to 35 centimeter straight carapace length size classes; a 13-millimeter outside diameter and 8-millimeter inside diameter tube will be used with turtles in size classes larger than 35 centimeters straight carapace length. A moderate volume of water will be pumped through the tube using a veterinarian's double action stomach pump as the tube is gently moved up and down the length of the esophagus. Turtles will be lavaged for no more than 45 seconds and generally for less than 30 seconds. The lavage procedure was approved by Lawrence Herbst DVM, Ph.D. (Albert Einstein College of Medicine, Bronx, NY), and George Balazs (National Marine Fisheries Service, Pacific Islands Fisheries Science Center, Honolulu, HI), a marine turtle researcher experienced with lavage. Only one sample will be obtained per individual.

Fecal samples will also be collected opportunistically from the boat deck, dock, or holding container (and external to the turtles) from all species when turtles are being held for data collection. Gut microbiota will be collected by using a sterile cotton swab inserted into the cloaca. As there are no published protocols for collection of gut microbiota from juvenile turtles, the protocol is based off of previous studies of gut microbiota in other large marine taxa (Nelson et al. 2012) and protocols for cloacal swabs taken from nesting turtles (Santoro et al. 2006; Al-Bahry et al. 2011). A 15-centimeter sterile cotton swab will be inserted greater than10 centimeters into the cloaca to obtain bacterial samples from turtles larger than 30 centimeters straight carapace length, and inserted greater than 5 centimeters in turtles smaller than 30 centimeters straight carapace length.

2.5 Satellite Tagging

Satellite transmitters will include Argos and Fast-lock GPS/Argos satellite tags or similar manufactured specifically for use on marine turtles (e.g., Wildlife Computers, Sirtrack, Microwave Telemetry). Transmitters will not exceed 5 percent of the turtle's weight in air and transmitter designs and attachment methods will be selected to minimize drag (Jones et al. 2011; Jones et al. 2013). In all attachment methods, the anterior portion of the carapace will first be cleaned of sediment and algae. Coarse sandpaper will then be used to scuff up the attachment site. The satellite tag will be attached to the turtle using either a two-part marine epoxy followed by a steel-reinforced epoxy putty (turtles greater than 30 centimeters straight carapace length) or a thin, flexible marine adhesive, aquarium silicone-silicone-acrylic attachment, or a modified epoxy method that incorporates a layer of neoprene as a platform for the transmitter (turtles less than 30 centimeters straight carapace length).

For oceanic juvenile sea turtles, satellite transmitters will be small, solar-powered units weighing 4 to 12 grams and measuring approximately 1.5 to 3 centimeters or smaller. All tags and attachments weigh less than 3 to 5 percent of the turtles weight in air. Per Mansfield et al. (2012), for satellite tags weighing 9 to 12 centimeters or greater, researchers determined that turtles that were greater than 10 to 12 centimeters straight carapace length and weighing at least 300 grams in air were robust enough to handle and adapt to tags of this size and the associated attachment material. For Kemp's ridleys, loggerheads, and hawksbills, the attachment technique will include pre-treating the turtles' shell with manicure acrylic and then attaching two strips neoprene to either side of the turtle's vertebral ridge using veterinary or toupée/hair extension glue (Mansfield et al. 2012). Clear aquarium silicone will then be used to affix the tag to the neoprene (Mansfield et al. 2012). For green turtles, the transmitters will be attached with a thin, flexible marine adhesive. Both attachment methods are flexible and allow for some animal growth. Oceanic stage turtles are predominantly surface-dwelling animals; tags and tag antennae are often exposed to air, thereby minimizing hydrodynamic drag associated with the tag attachment site and ensuring regular communication with overhead satellites. The turtles will cleanly shed the tags as they grow.

Acoustic (sonic) transmitters will be attached to the posterior carapace, following sanding, using either a small cable tie tether embedded in two-part marine epoxy or direct attachment via two-part marine epoxy and/or steel-reinforced epoxy putty, or flexible marine adhesive (turtles greater than 30 centimeters straight carapace length). These tags broadcast frequencies at a much higher spectrum range than what sea turtles and most fish are capable of hearing. Turtles may be outfitted with both a satellite and acoustic transmitter if their combined weight in air is less than 5 percent of the turtle's weight. One or two coats of an ablative, anti-fouling paint will be applied to the transmitter(s) and attachment(s) to minimize growth of barnacles and other epibiota, thereby reducing drag and extending transmitter life. The direct attachment processes will take approximately 2-3 hours and are described by Mansfield et al. (2009) for epoxy/epoxy putty, Seney et al. (2010) for epoxy/epoxy putty and epoxy/neoprene, and Mansfield and colleagues (Mansfield et al. 2012; Putman and Mansfield 2015) for flexible adhesives.

For the tether acoustic tag attachment technique, a small piece of cable tie, forming a semi-circular loop, will be embedded in a small amount of quick-setting marine epoxy on one of the furthest posterior marginal scutes (Mansfield 2006). The loop will serve as an anchor for an additional 8 to 10 centimeter cable tie tether attached to the battery end of the transmitter, extending only 3 to 4 centimeters beyond the edge of the carapace. By keeping the transducer end of the tag away from the turtle, this method limits the acoustic signal attenuation caused by the body of the turtle, but the tether will be short enough that the transmitter will not drag on the bottom and the tether cannot become entangled on rocks or debris. The turtle will be released close to where it was captured. Satellite and acoustic tag transmission duration is expected to depend entirely on tag attachment durations. Depending on the species and life stage, the researchers expect tags to be retained for several months to a year to a year and a half. Tags should shed cleanly from the turtles' carapaces as the turtles grow and/or as they shed their scute material.

2.6 Action Area

Action area means all areas affected directly, or indirectly, by the Federal action, and not just the immediate area involved in the action (50 CFR 402.02). The proposed action would occur in three study areas: the Indian River Lagoon and Trident Turning Basin, Florida (Figure 1) and the northern and eastern Gulf of Mexico (Figure 2).

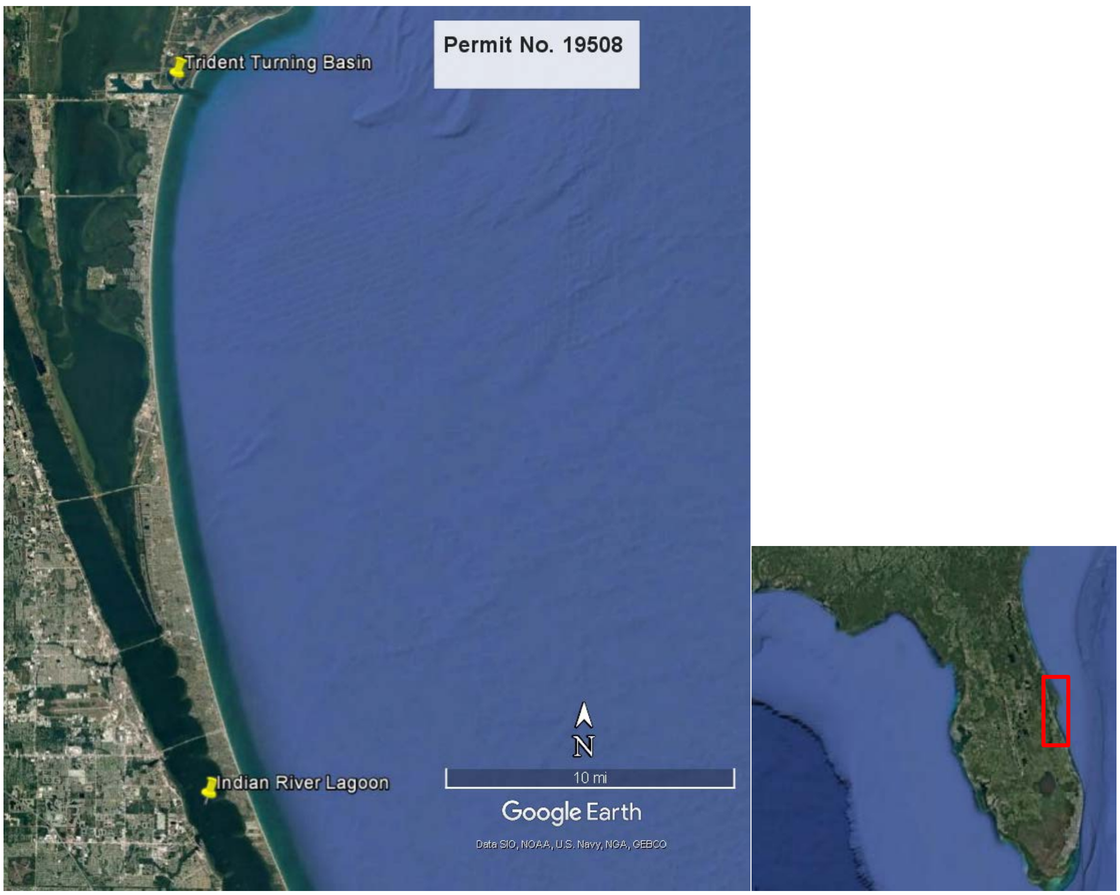

Figure 1. Action area for Permit No. 19508, the Indian River Lagoon and Trident Turning Basin, Broward County, Florida.

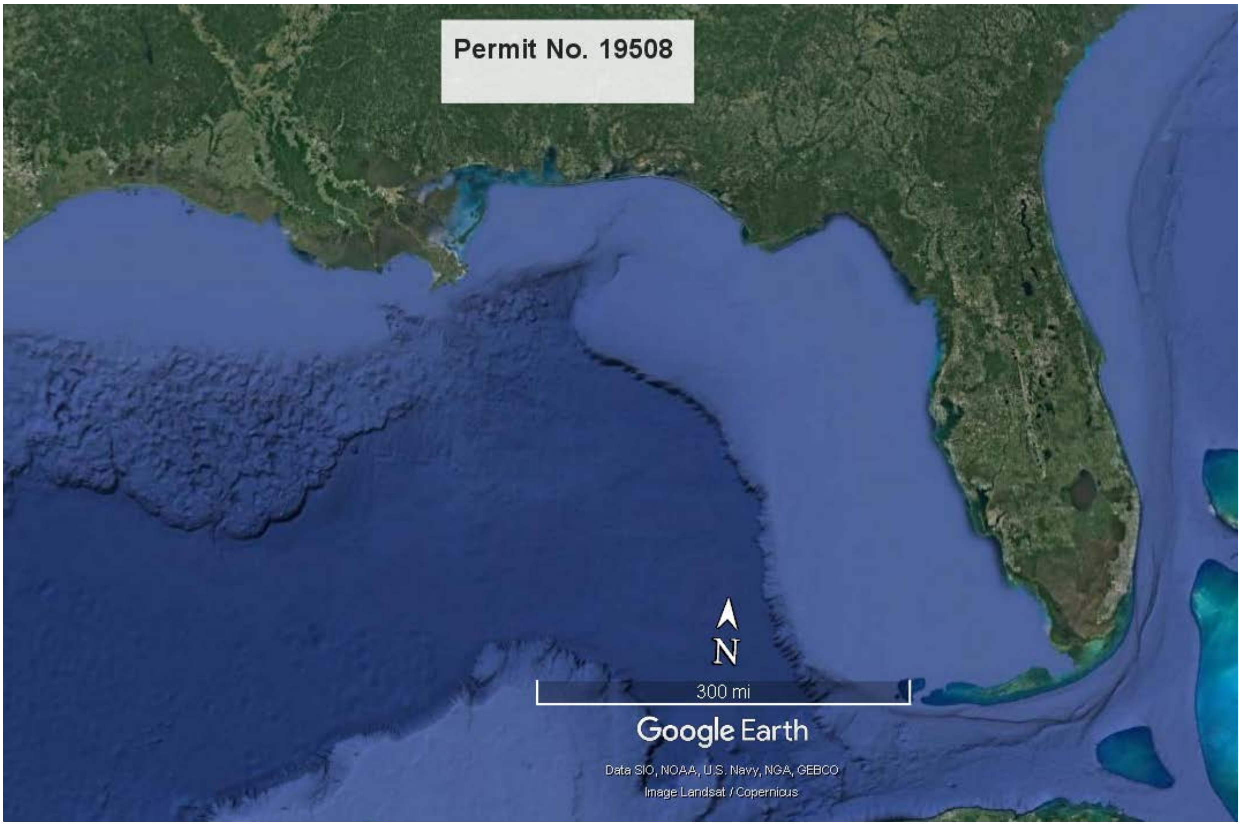

Figure 2. Action area for Permit No. 19508, the offshore waters of the northern and eastern Gulf of Mexico.

2.7 Terms and Conditions

Section 10(a)(1) of the ESA requires the prescription of terms and conditions as part of the scientific research permit. The Permits Division proposes to include the following terms and conditions in Permit No. 19508. The text below was taken directly from the proposed permit provided to us in the consultation initiation package.

The activities authorized herein must occur by the means, in the areas, and for the purposes set forth in the permit application, and as limited by the Terms and Conditions specified in this permit, including attachments and appendices. Permit noncompliance constitutes a violation and is grounds for permit modification, suspension, or revocation, and for enforcement action.

A. Duration of Permit

1. Personnel listed in Condition C.1 of this permit (hereinafter "Researchers") may conduct activities authorized by this permit through March 15, 2022. This permit expires on the date indicated and is non-renewable. This permit may be extended by the Director, NMFS Office of Protected Resources, pursuant to applicable regulations and the requirements of the ESA.

2. Researchers must immediately stop permitted activities and the Permit Holder must contact the Chief, NMFS Permits and Conservation Division (hereinafter "Permits Division") for written permission to resume

   a. If serious injury or mortality[1] of protected species occurs.

   b. If authorized take[2] is exceeded in any of the following ways:

      i. More animals are taken than allowed in Table 1.

      ii. Animals are taken in a manner not authorized by this permit.

      iii. Protected species other than those authorized by this permit are taken.

   c. Following reporting requirements at Condition E.2.

3. The Permit Holder may continue to possess biological samples[3] acquired[4] under this permit after permit expiration without additional written authorization, provided the samples are maintained as specified in this permit.

B. Number and Kind(s) of Protected Species, Location(s) and Manner of Taking

1. The tables in Table 1 outline the number of protected species, by species, authorized to be taken, and the locations, manner, and time period in which they may be taken.

2. Researchers working under this permit may collect visual images (e.g., photographs, video) in addition to the photo-identification or behavioral photo-documentation authorized in Table 1 as needed to document the permitted activities, provided the collection of such images does not result in takes.

3. The Permit Holder may use visual images and audio recordings collected under this permit, including those authorized in Table 1, in printed materials (including commercial or scientific publications) and presentations provided the images and recordings are accompanied by a statement indicating that the activity was

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[1] 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.

[2] By regulation, a take under the MMPA means to harass, hunt, capture, collect, or kill, or attempt to harass, hunt, capture, collect, or kill any marine mammal. This includes, without limitation, any of the following: the collection of dead animals, or parts thereof; the restraint or detention of a marine mammal, no matter how temporary; tagging a marine mammal; the negligent or intentional operation of an aircraft or vessel, or the doing of any other negligent or intentional act which results in disturbing or molesting a marine mammal; and feeding or attempting to feed a marine mammal in the wild. 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.

[3] Biological samples include, but are not limited to: carcasses (whole or parts); and any tissues, fluids, or other specimens from live or dead protected species; except feces, urine, and spew collected from the water or ground.

[4] Authorized methods of sample acquisition are specified in Table 1.

conducted pursuant to NMFS ESA Permit No. 19508. This statement must accompany the images and recordings in all subsequent uses or sales.

4. The Chief, Permits Division may grant written approval for personnel performing activities not essential to achieving the research objectives (e.g., a documentary film crew) to be present, provided

   a. The Permit Holder submits a request to the Permits Division specifying the purpose and nature of the activity, location, approximate dates, and number and roles of individuals for which permission is sought.

   b. Non-essential personnel/activities will not influence the conduct of permitted activities or result in takes of protected species.

   c. Persons authorized to accompany the Researchers for the purpose of such non-essential activities will not be allowed to participate in the permitted activities.

   d. The Permit Holder and Researchers do not require compensation from the individuals in return for allowing them to accompany Researchers.

5. Researchers must comply with the following conditions related to the manner of taking:

<u>Capture/Survey Methods</u>

1. Entanglement Netting

   a. Nets 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. If water temperatures are $\leq 10^{o}$C or $\geq 30^{o}$C, nets must be checked at less than 20-minute intervals. "Net checking" is defined as a thorough 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.

   d. 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.

   e. Researchers must plan for unexpected circumstances or demands of the research activities and have the ability and resources to meet net checking requirements 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).

f. Marine Mammals: Nets must not be put in the water when marine mammals are observed within the vicinity of the research; marine mammals must be allowed to either leave or pass through the area safely before net setting is initiated.

   i. 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.

   ii. If marine mammals remain within the vicinity of the research area, nets must be removed.

   iii. If a marine mammal is entangled, researchers must:

      A. Stop netting activities and immediately free the animal,

      B. Notify the appropriate NMFS Regional Stranding Coordinator as soon as possible (http://www.nmfs.noaa.gov/pr/health/coordinators.htm)

      C. Report the incident as specified in Condition E.2,

      D. Suspend permitted activities until the Permits Division has granted approval to continue research per Condition E.2.

g. Fibropapillomatosis (FP) Nets: Nets used at sites where FP is known to occur must be thoroughly disinfected prior to use in areas where FP is either not known to be present, is considered uncommon, or where there is limited or no information on FP prevalence. Drying nets in sunlight may be used as an additional measure to inactivate FP-associated herpes virus.

General Handling, Resuscitation, and Release

Researchers must:

a. Handle turtles according to procedures specified in 50 CFR 223.206(d)(1)(i). Use care when handling live animals to minimize any possible injury.

b. Use appropriate resuscitation techniques on any comatose turtle prior to returning it to the water.

c. When possible, transfer injured, compromised, or comatose animals to rehabilitation facilities and allow them an appropriate period of recovery before return to the wild.

d. Have an experienced veterinarian, veterinary technician, or rehabilitation facility (i.e., medical personnel) on call for emergencies.

1. If an animal becomes highly stressed, injured, or comatose during capture or handling or is found to be compromised upon capture, Researchers must forego or cease activities that will further significantly stress the animal (erring on the side of caution) and contact the on call medical personnel as soon as possible. Compromised turtles include animals that are obviously weak, lethargic, positively buoyant, emaciated, or that have severe injuries or other abnormalities resulting in debilitation. One of the following options must be implemented (in order of preference):

   a. Based on the instructions of the veterinarian, if necessary, immediately transfer the animal to the veterinarian or to a rehabilitation facility to receive veterinary care.

   b. If medical personnel cannot be reached at sea, the Permit Holder should err on the side of caution and bring the animal to shore for medical evaluation and rehabilitation as soon as possible.

   c. If the animal cannot be taken to a rehabilitation center due to logistical or safety constraints, allow it to recuperate as conditions dictate, and return the animal to the sea.

2. In addition to Condition A.2, the Permit Holder is responsible for following the status of any sea turtle transported to rehab as a result of permitted activities and reporting the final disposition (death, permanent injury, recovery and return to wild, etc.) of the animal to the Chief, Permits Division.

3. While holding sea turtles, Researchers must

   a. Protect sea turtles from temperature extremes (ideal air temperature range is between 70°F and 80°F).

   b. Provide adequate air flow

   c. Keep sea turtles moist when the temperature is ≥ 75°F.

   d. Keep the area surrounding the turtle free of materials that could be accidentally ingested.

4. During release, turtles must be lowered as close to the water’s surface as possible to prevent injury.

5. Researchers must carefully monitor newly released turtles’ 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.

Handling, Measuring, Weighing, PIT and Flipper Tagging

1. Refer to “requirements for handling and sampling sea turtles” below for more information on the requirements for handling and sampling sea turtles.

2. Researchers must

   a. Clean and disinfect all equipment (tagging equipment, tape measures, etc.) and surfaces that comes in contact with sea turtles between the processing of each turtle.

   b. Maintain a designated set of instruments and other items should be used on turtles with fibropapillomatosis. Items that come into contact with sea turtles with FP should not be used on turtles without tumors. All measures possible should be exercised to minimize exposure and cross-contamination between affected turtles and those without apparent disease, including use of disposable gloves and thorough disinfection of equipment and surfaces. Appropriate disinfectants include 10% bleach and other viricidal solutions with proven efficacy against herpes viruses.

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

   d. Clean and disinfect

      i. flipper tags (*e.g.*, to remove oil residue) before use;

      ii. tag applicators, including the tag injector handle, between sea turtles; and

      iii. the application site before the tag pierces the animal’s skin.

   e. PIT Tagging

      i. Use new, sterile tag applicators (needles) each time.

      ii. The application site must be cleaned and then scrubbed with two replicates of a medical disinfectant solution (*e.g.*, Betadine, Chlorhexidine) followed by 70% isopropyl alcohol before the applicator pierces the animal’s skin. If it has been exposed to fluids from another animal, the injector handle must be disinfected between animals.

      iii. Turtles < 15 cm SCL

      PIT tag implantation in turtles under 15 cm SCL must be performed by Dr. Mansfield or a veterinarian and may only be conducted in accordance with an approved veterinary protocol that considers the need for anesthesia, surgical implantation, and pain management.

iv. Turtles < 30 cm SCL

1. Researchers must have specialized experience to tag turtles < 30 cm SCL.
2. PIT tags must be inserted into the thickest part of the triceps superficialis muscle*. The tag must occupy no more than an estimated 20% of the muscle's total volume and length. To determine eligibility, pinch the muscle forward and assess the tag size relative to the muscle size. Alternative sites may be used provided: 1) there is sufficient mass to accommodate the tag (≤ 20%) and 2) there is minimal risk of injury to vital structures or other anatomical features.
3. Local anesthetic (e.g., lidocaine) must be used.

*The preferable site for Kemp's ridleys is the left triceps superficialis muscle to maximize the chances of tag detection, as the nesting project in Rancho Nuevo scans the left front flipper.

2. Marking the Carapace

a. Researchers must use non-toxic paints or markers that do not generate heat or contain xylene or toluene.

b. Markings should be easily legible using the least amount of paint or media necessary to re-identify the animal.

b. Sampling

1. Blood sampling

a. Blood samples must be directly taken by or supervised by experienced personnel.

b. New disposable needles must be used on each animal.

c. Collection sites must be thoroughly cleaned prior to sampling using Chlorhexidine-alcohol solution or betadine followed by 70% alcohol. Two (2) applications of alcohol may be used if disinfectant solutions may affect intended analyses.

d. Samples must not be taken if an animal cannot be adequately immobilized for blood sampling or conditions on the boat preclude the safety and health of the turtle.

e. Attempts (needle insertions) to extract blood from the neck must be limited to a total of four, two on either side. Best practices must be followed, including retraction of the needle to the level of the subcutis prior to redirection to avoid lacerating vessels and causing other unnecessary soft tissue injury.

f. Blood Volume Limits

i. *Sample volume.* The volume of blood withdrawn must be the minimal volume necessary to complete permitted activities. A single sample must not exceed 3 ml per 1 kg of animal.

ii. *Sampling period.* Cumulative blood volume taken from a single turtle must not exceed the maximum safe limit described above within a 45-day period. 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.

iii. *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 make efforts to contact other researchers working in the area that could capture the same turtles to ensure that none of the above limits are exceeded.

ii. *Turtles weighing 1 kg or less.* A single sample must not exceed 6% of total blood volume. Total blood volume is estimated as 7% of total body weight. If additional samples are to be taken in less than two months on the same turtle, sample size must not exceed 3 ml/kg of turtle.

2. Biopsy Sampling

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

b. Turtles brought on-board the vessel for sampling:

i. For small samples (*e.g.*, biopsy punches): Aseptic techniques must be used at all times. Samples must be collected from the trailing edge of a flipper if possible and practical (preference should be given to a rear flipper if practical). At a minimum, the tissue surface must be thoroughly swabbed with a medical disinfectant solution (*e.g.*, Betadine, Chlorhexidine) followed by alcohol before sampling. The procedure area and Researchers' hands must be clean.

c. Turtles not boarded for sampling

a. Turtles must be sampled [using a pole-biopsy or for leatherbacks: via shallow carapacial scrapes] in the location most safely and easily accessed by the researcher.

b. Samples may be collected from anywhere on the limbs or neck, avoiding the head.

ii. If it can be easily determined (through markings, tag number, etc.) that a sea turtle has been recaptured and has been already sampled under this permit, no additional biopsy samples may be collected from the animal during the same permit year.

3. Gastric Lavage

i. The washing must not exceed three minutes.

ii. 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 must be elevated slightly to assist in drainage.

iii. Researchers must thoroughly clean equipment prior to disinfection (viruses can remain protected in organic matter, the disinfectant can't get to them if they're protected in this matter).

iv. A separate set of equipment must be used for infected and non-infected animals.

4. Fecal Sampling. Turtles must be larger than 50 cm SCL for digital extraction of feces.

<u>Instrument Attachments</u>

1. A maximum of 2 tags may be placed on an animal at one time.

2. Acoustic or satellite tags:

a. Total combined weight of all transmitter attachments and media must not exceed 5% of the animal's body mass.

b. Each attachment must be made so that there is minimal risk of entanglement. The transmitter attachment must 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 half of the turtle's carapace length. It must include a corrosive, breakaway link that will release the unit after its battery life.

c. Transmitters must not be placed at the peak height of the carapace whenever possible.

d. Researchers must make attachments as hydrodynamic as possible.

e. Adequate ventilation around the head of the turtle must be provided during the attachment of transmitters if attachment materials produce fumes. Turtles must not be held in water during application to prevent skin or eye contact with harmful chemicals.

Non-Target Species

2. Submerged Aquatic Vegetation (SAV; e.g., seagrass) Coral Communities, Hard and Live Bottom Habitat

a. Researchers must take all practicable steps including the use of charts, GIS, sonar, fish finders, or other electronic devices to determine characteristics and suitability of bottom habitat prior to using gear to identify SAV, coral communities, and live/hard bottom habitats and avoid setting gear in such areas.

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

c. If research gear is lost, diligent efforts would be made to recover the lost gear to avoid further damage to benthic habitat and impacts related to "ghost fishing."

d. *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.

e. *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:

i. 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.

ii. 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.

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

6. Transfer of Sea Turtle Biological Samples

   a. Samples may be sent to the Authorized Recipients listed in Table 2 provided that

      i. The analysis or curation is related to the research objectives of this permit.

      ii. A copy of this permit accompanies the samples during transport and remains on site during analysis or curation.

   b. Samples remain in the legal custody of the Permit Holder while in the possession of Authorized Recipients.

   c. The transfer of biological samples to anyone other than the Authorized Recipients in Table 2 requires written approval from the Chief, Permits Division.

   d. Samples cannot be bought or sold.

C. Qualifications, Responsibilities, and Designation of Personnel

1. At the discretion of the Permit Holder, the following Researchers may participate in the conduct of the permitted activities in accordance with their qualifications and the limitations specified herein:

   a. Principal Investigator – Katherine Mansfield

   b. Co-Investigator(s) – See Table 2 for list of names and corresponding activities.

   c. Research Assistants – personnel identified by the Permit Holder or Principal Investigator and qualified to act pursuant to Conditions C.2, C.3, and C.4 of this permit.

2. Individuals conducting permitted activities must possess qualifications commensurate with their roles and responsibilities. The roles and responsibilities of personnel operating under this permit are as follows:

   a. The Permit Holder is ultimately responsible for activities of individuals operating under the authority of this permit. Where the Permit Holder is an institution/facility, the Responsible Party is the person at the institution/facility who is responsible for the supervision of the Principal Investigator.

b. The Principal Investigator (PI) is the individual primarily responsible for the taking, import, export and related activities conducted under the permit. The PI must be on site during activities conducted under this permit unless a Co-Investigator named in Condition C.1 is present to act in place of the PI.

c. Co-Investigators (CIs) are individuals who are qualified to conduct activities authorized by the permit, for the objectives described in the application, without the on-site supervision of the PI. CIs assume the role and responsibility of the PI in the PI's absence.

d. Research Assistants (RAs) are individuals who work under the direct and on-site supervision of the PI or a CI. RAs cannot conduct permitted activities in the absence of the PI or a CI.

3. Personnel involved in permitted activities must be reasonable in number and essential to conduct of the permitted activities. Essential personnel are limited to

a. individuals who perform a function directly supportive of and necessary to the permitted activity (including operation of vessels or aircraft essential to conduct of the activity),

b. individuals included as backup for those personnel essential to the conduct of the permitted activity, and

c. individuals included for training purposes.

4. Persons who require state or Federal licenses or authorizations (e.g., veterinarians) to conduct activities under the permit must be duly licensed/authorized and follow all applicable requirements when undertaking such activities.

5. Permitted activities may be conducted aboard vessels or aircraft, or in cooperation with individuals or organizations, engaged in commercial activities, provided the commercial activities are not conducted simultaneously with the permitted activities.

6. The Permit Holder cannot require or receive direct or indirect compensation from a person approved to act as PI, CI, or RA under this permit in return for requesting such approval from the Permits Division.

7. The Permit Holder may add CIs by submitting a request to the Chief, Permits Division that includes a description of the individual's qualifications to conduct and oversee the activities authorized under this permit. If a CI will only be responsible for a subset of permitted activities, the request must also specify the activities for which they would provide oversight.

8. Submit requests to add CIs or change the PI by one of the following:

   a. the online system at https://apps.nmfs.noaa.gov;

   b. an email attachment to the permit analyst for this permit; or

   c. a hard copy mailed or faxed to the Chief, Permits Division, Office of Protected Resources, NMFS, 1315 East-West Highway, Room 13705, Silver Spring, MD 20910; phone (301)427-8401; fax (301)713-0376.

D. Possession of Permit

1. This permit cannot be transferred or assigned to any other person.

2. The Permit Holder and persons operating under the authority of this permit must possess a copy of this permit when

   a. Engaged in a permitted activity.

   b. A protected species is in transit incidental to a permitted activity.

   c. A protected species taken or imported under the permit is in the possession of such persons.

3. A duplicate copy of this permit must accompany or be attached to the container, package, enclosure, or other means of containment in which a protected species or protected species part is placed for purposes of storage, transit, supervision or care.

E. Reports

1. The Permit Holder must submit annual, final, and incident reports containing the information and in the format specified by the Permits Division.

   a. Reports must be submitted to the Permits Division by one of the following:

      i. the online system at https://apps.nmfs.noaa.gov;

      ii. an email attachment to the permit analyst for this permit; or

      iii. a hard copy mailed or faxed to the Chief, Permits Division.

   b. You must contact your permit analyst for a reporting form if you do not submit reports through the online system.

2. Incident reports: must be submitted within two weeks of serious injury and mortality events or exceeding authorized takes, as specified in Conditions A.2 and B.1.

   a. The incident report must include a complete description of the events and identification of steps that will be taken to reduce the potential for additional serious injury and research-related mortality or exceeding authorized take.

b. In addition to the written report, the Permit Holder must contact the Permits Division by phone (301-427-8401) as soon as possible, but no later than within two business days of the incident.

c. 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 this permit.

3. Annual reports describing activities conducted during the previous permit year (from month/day to month/day) must

   a. be submitted by [insert date here and at top of first page] each year for which the permit is valid, and

   b. include a tabular accounting of takes and a narrative description of activities and effects.

4. A final report summarizing activities over the life of the permit must be submitted by (insert date 180 days post expiration), or, if the research concludes prior to permit expiration, within 180 days of completion of the research.

5. Research results must be published or otherwise made available to the scientific community in a reasonable period of time. Copies of technical reports, conference abstracts, papers, or publications resulting from permitted research must be submitted the Permits Division.

F. <u>Notification and Coordination</u>

1. The Permit Holder must provide written notification of planned field work to the applicable NMFS Region at least two weeks prior to initiation of each field trip/season. If there will be multiple field trips/seasons in a permit year, a single summary notification may be submitted per year.

   a. Notification must include the

      i. locations of the intended field study and/or survey routes;

      ii. estimated dates of activities; and

      iii. number and roles of participants (for example: PI, CI, veterinarian, boat driver, safety diver, animal restrainer, Research Assistant “in training”).

   b. Notification must be sent to the following Assistant Regional Administrator for Protected Resources:

Southeast Region, NMFS, 263 13th Ave South, St. Petersburg, FL 33701; phone (727)824-5312; fax (727)824-5309

Email (preferred): nmfs.ser.research.notification@noaa.gov

2. To the maximum extent practical, 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. Contact the Regional Office listed above for information about coordinating with other Permit Holders.

G. Observers and Inspections

1. NMFS may review activities conducted under this permit. At the request of NMFS, the Permit Holder must cooperate with any such review by

    a. allowing an employee of NOAA or other person designated by the Director, NMFS Office of Protected Resources to observe permitted activities; and

    b. providing all documents or other information relating to the permitted activities.

H. Modification, Suspension, and Revocation

1. Permits are subject to suspension, revocation, modification, and denial in accordance with the provisions of subpart D [Permit Sanctions and Denials] of 15 CFR part 904.

2. The Director, NMFS Office of Protected Resources may modify, suspend, or revoke this permit in whole or in part

    a. in order to make the permit consistent with a change made after the date of permit issuance with respect to applicable regulations prescribed under section 4 of the ESA;

    b. in a case in which a violation of the terms and conditions of the permit is found;

    c. in response to a written request[5] from the Permit Holder;

    d. if NMFS determines that the application or other information pertaining to the permitted activities (including, but not limited to, reports pursuant to

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[5] The Permit Holder may request changes to the permit related to: the objectives or purposes of the permitted activities; the species or number of animals taken; and the location, time, or manner of taking or importing protected species. Such requests must be submitted in writing to the Permits Division in the format specified in the application instructions.

Section E of this permit and information provided to NOAA personnel pursuant to Section G of this permit) includes false information; and

e. if NMFS determines that the authorized activities will operate to the disadvantage of threatened or endangered species or are otherwise no longer consistent with the purposes and policy in Section 2 of the ESA.

3. Issuance of this permit does not guarantee or imply that NMFS will issue or approve subsequent permits or modifications for the same or similar activities requested by the Permit Holder, including those of a continuing nature.

I. Penalties and Permit Sanctions

1. A person who violates a provision of this permit, ESA, or the regulations at 50 CFR 222-226 is subject to civil and criminal penalties, permit sanctions, and forfeiture as authorized under the ESA, and 15 CFR part 904.

2. The NMFS Office of Protected Resources shall be the sole arbiter of whether a given activity is within the scope and bounds of the authorization granted in this permit.

a. The Permit Holder must contact the Permits Division for verification before conducting the activity if they are unsure whether an activity is within the scope of the permit.

b. Failure to verify, where the NMFS Office of Protected Resources subsequently determines that an activity was outside the scope of the permit, may be used as evidence of a violation of the permit, the ESA, and applicable regulations in any enforcement actions.

Table 2. Approved personnel as co-investigators for Permit No. 19508.

Name of Co-Investigator	Activities
Dean Bagley	All activities, except PIT tagging <15 cm SCL turtles and all satellite tagging
Llewellyn Ehrhart	Inshore/coastal capture, measure, weigh, flipper tagging
William Edward Redfoot	Inshore/coastal capture, measure, weigh, flipper tagging, lavage, and satellite tagging >30 cm SCL
Erin Sney	All activities, except PIT tagging <15 cm SCL turtles
Brian Shamblin	Sample holding and analysis
Michael Walsh	All activities, except capture (inshore and offshore) and satellite tagging

Table 3. Authorized recipients of samples for Permit No. 19508.

Sample Type	Disposition	Authorized Recipient
University of Central Florida	Blood and tissue	Analysis and curation any remaining samples

Requirements for Handling and Sampling Sea Turtles

Conditions have been included in the permit for research procedures that involve the handling and sampling of sea turtles. These conditions include requirements provided by a suite of expert veterinarians to minimize and mitigate potential impacts to the study animals. This information is being provided to help understand the permit requirements and standard veterinary protocols for sea turtles.

I. Permit requirements for antiseptic practices and research techniques

Measures required to minimize risk of infection and cross-contamination between individuals generally fall under the categories of clean, aseptic, and sterile techniques. Clean technique applies to noninvasive procedures that result in contact with skin or mucous membranes. Aseptic technique is used for brief, invasive procedures that result in any degree of internal contact, e.g. drawing blood. Sterile technique applies to longer invasive procedures, such as laparoscopy or surgery. Reusable instruments for procedures requiring aseptic or sterile technique should be sterilized by standard autoclave or cold sterilization procedures. Instruments that do not have internal contact, e.g. tagging pliers and PIT tag applicators, should be disinfected using a broadcidal solution and the product-recommended contact time between individuals.

Clean technique:

1. Routine hand washing or use of non-sterile disposable gloves.
2. Cleaning and disinfection of equipment between individuals.

Aseptic technique:

1. Disinfection of hands or use of new non-sterile disposable gloves (preferred)
2. Disinfection of the turtle's skin using a surgical scrub (e.g. betadine scrub or chlorhexidine gluconate)† followed by application of 70% alcohol (isopropyl or ethanol) (minimum requirement).*
3. Clean work area.
4. Use of sterile instruments or new disposable items (e.g. needles and punch biopsies) between individuals.

† Alcohol alone may be used in lieu of surgical scrub if necessary to avoid interference with research objectives, e.g. isotopic analysis.

* Multiple applications and scrubbing should be used to achieve thorough cleansing of the procedure site as necessary. A minimum of two alternating applications of surgical scrub and alcohol are to be used for PIT tag application sites and drilling into the carapace, due to potential increased risk of infection.

<u>Sterile technique:</u>

1. To be conducted in accordance with approved veterinary protocol that considers analgesia/anesthesia, use of antimicrobials, anticipated risks and response measures, and exclusionary criteria for animal candidacy.
2. Direct veterinary attendance
3. Disinfection of hands and use of sterile disposable gloves
4. Dedicated site (surgery room) or work area modified to reduce contamination
5. Surgical preparation of skin
6. Sterile instruments

Table 4. Research procedures and required sterile techniques for Permit No. 19508.

Research Procedure	Required Technique
Handling, gastric lavage, and cloacal lavage	Clean technique
Tissue sampling (biopsy punch or comparable)	Aseptic technique
Blood sampling	Aseptic technique
PIT tagging	Aseptic technique; 2 applications of surgical scrub and alcohol
Flipper tagging	Aseptic technique
Carapace drilling for instrument attachment or bone biopsy	Aseptic technique; 2 applications of surgical scrub and alcohol
Bone biopsy (other than carapace)	Sterile
Laparoscopy (+/- biopsy)	Sterile
Large skin, muscle, fat biopsy, other tissue biopsy	Sterile

II. <u>Minimum requirements for pain management and field techniques</u>

Procedures used for sea turtle research include those anticipated to cause short term pain or distress, such as tagging, as well more invasive procedures where relatively longer periods of pain or discomfort may result. The minimum requirements below consider animal welfare and relative benefits and risks of different modes of pain management under field and laboratory conditions. Additional measures are encouraged whenever possible, including sedation or anesthesia for invasive procedures, e.g. laparoscopy, when release does not immediately follow the procedure and full recovery can be assessed.

Table 5. Research procedures and minimum requirements for pain management and field techniques for Permit No. 19508.

Research Procedure	Minimum Requirement
Tissue sampling (biopsy punch or comparable)	None
Blood sampling	None
PIT tagging	Local anesthetic if <30 cm SCL
Flipper tagging	None
Carapace drilling for instrument attachment or bone biopsy	Systemic analgesic
Bone biopsy (other than carapace)	Local anesthetic and systemic analgesic
Laparoscopy	Local anesthetic and systemic analgesic
Laparoscopy biopsy	Local anesthetic, sedation, and systemic analgesic

2.8 Interrelated and Interdependent Actions

Interrelated actions are those that are part of a larger action and depend on that action for their justification. Interdependent actions are those that do not have independent use, apart from the action under consideration. For the proposed permit, there are no interrelated or interdependent actions.

3 THE ASSESSMENT FRAMEWORK

Section 7(a)(2) of the ESA requires Federal agencies, in consultation with NMFS, to insure that their actions either are not likely to jeopardize the continued existence of endangered or threatened species; or adversely modify or destroy their designated critical habitat.

"To jeopardize the continued existence of an ESA-listed species" means to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of an ESA-listed species in the wild by reducing the reproduction, numbers, or distribution of that species (50 CFR §402.02). The jeopardy analysis considers both survival and recovery of the species.

Section 7 assessment involves the following steps:

1) We identify the proposed action and those aspects (or stressors) of the proposed action that are likely to have direct or indirect effects on the physical, chemical, and biotic environment within the action area, including the spatial and temporal extent of those stressors.

2) We identify the ESA-listed species and designated critical habitat that are likely to co-occur with those stressors in space and time.

3) We describe the environmental baseline in the action area including: past and present impacts of Federal, state, or private actions and other human activities in the action area; anticipated impacts of proposed Federal projects that have already undergone formal or early section 7 consultation, impacts of state or private actions that are contemporaneous with the consultation in process.

4) We identify the number, age (or life stage), and gender of ESA-listed individuals that are likely to be exposed to the stressors and the populations or subpopulations to which those individuals belong. We also consider whether the action "may affect" designated critical habitat. This is our exposure analysis.

5) We evaluate the available evidence to determine how individuals of those ESA-listed species are likely to respond given their probable exposure. We also consider how the action may affect designated critical habitat. This is our response analyses.

6) We assess the consequences of these responses of individuals that are likely to be exposed to the populations those individuals represent, and the species those populations comprise. This is our risk analysis.

7) The adverse modification analysis considers the impacts of the proposed action on the essential habitat features and conservation value of designated critical habitat.

8) We describe any cumulative effects of the proposed action in the action area.

   Cumulative effects, as defined in our implementing regulations (50 CFR §402.02), are the effects of future state or private activities, not involving Federal activities, that are reasonably certain to occur within the action area. Future Federal actions that are unrelated to the proposed action are not considered because they require separate section 7 consultation.

9) We integrate and synthesize the above factors by considering the effects of the action to the environmental baseline and the cumulative effects to determine whether the action could reasonably be expected to:

   a) Reduce appreciably the likelihood of both survival and recovery of the ESA-listed species in the wild by reducing its numbers, reproduction, or distribution; or

   b) Reduce the conservation value of designated or proposed critical habitat. These assessments are made in full consideration of the status of the species and critical habitat.

10) We state our conclusions regarding jeopardy and the destruction or adverse modification of designated critical habitat.

If, in completing the last step in the analysis, we determine that the action under consultation is likely to jeopardize the continued existence of ESA-listed species or destroy or adversely modify designated critical habitat, we must identify a reasonable and prudent alternative to the action. The reasonable and prudent alternative must not be likely to jeopardize the continued existence of ESA-listed species nor adversely modify their designated critical habitat and it must meet other regulatory requirements.

To comply with our obligation to use the best scientific and commercial data available, we used several sources to identify information relevant to the species, the potential stressors associated with the proposed action, and the potential responses of sea turtles to those stressors. We conducted electronic searches, using google scholar and the online database web of science, and considered all lines of evidence available through published and unpublished sources that represent evidence of adverse consequences or the absence of such consequences. We relied on information submitted by the Permits Division (applications and annual reports), government reports (including previously issued NMFS biological opinions, NMFS Science Center reports, and stock assessment reports), NOAA technical memos, peer-reviewed scientific literature, and other information. We organized the results of electronic searches using commercial bibliographic software. We also consulted with subject matter experts, within the NMFS as well as the academic and scientific community. When the information presented contradictory results, we described all results, evaluated the merits or limitations of each study, and explained how each was similar or dissimilar to the proposed action to come to our own conclusion based on our expert opinion.

4 STATUS OF ENDANGERED SPECIES ACT PROTECTED RESOURCES

This section identifies the ESA-listed species that potentially occur within the action area that may be affected by Permit No. 19508 (Figure 1). It then summarizes the biology and ecology of those species and what is known about their life histories in the action areas. The status is determined by the level of risk that the ESA-listed species and designated critical habitat face, based on parameters considered in documents such as recovery plans, status reviews, and listing decisions. This section also breaks down the species and designated critical habitats that may be affected by the proposed action, describing whether or not those species and designated critical habitats are likely to be adversely affected by the proposed action. The species and designated critical habitats deemed likely to be adversely affected by the proposed action are carried forward through the remainder of this opinion.

This section helps to inform the description of the species' current "reproduction, numbers, or distribution" as described in 50 CFR 402.02. More detailed information on the status and trends of these ESA-listed resources and their biology and ecology, can be found in the listing regulations and critical habitat designations published in the Federal Register, status reviews, recovery plans, and on the NMFS web site (www.nmfs.noaa.gov/pr/species/).

The species potentially occurring within the action area that may be affected by the proposed action are listed in Table 6, along with their regulatory status.

Table 6. ESA-listed species and designated critical habitat that may be affected by the Permit Division's proposed Permit No. 19508.

Species	ESA Status	Critical Habitat	Recovery Plan
Green sea turtle (*Chelonia mydas*): North Atlantic DPS	Threatened 81 FR 20057 04/06/2016	Designated; Not in the Action Area	63 FR 28359 Notice North Atlantic 10/29/1991
Hawksbill sea turtle (*Eretmochelys imbricata*)	Endangered 35 FR 8491 06/02/1970	Designated; Not in the Action Area	57 FR 38818 Notice U.S. Caribbean, Atlantic, and Gulf of Mexico 08/27/1992
Kemp's ridley sea turtle (*Lepidochelys kempii*)	Endangered 35 FR 18319 12/02/1970	--	75 FR 12496 Notice U.S. Caribbean, Atlantic, and Gulf of Mexico (draft) 03/16/2010
Leatherback sea turtle (*Dermochelys coriacea*)	Endangered 35 FR 8491 06/02/1970	Designated; Not in the Action Area	63 FR 28359 Notice U.S. Caribbean, Atlantic, and Gulf of Mexico 10/29/1991
Loggerhead sea turtle (*Caretta caretta*): Northwest Atlantic DPS	Threatened 76 FR 58868 09/22/2011	79 FR 39856 07/10/2014	74 FR 2995 Notice Northwest Atlantic 01/16/2009

4.1 Species and Critical Habitat Not Likely to be Adversely Affected

NMFS uses two criteria to identify the ESA-listed or designated critical habitat that are not likely to be adversely affected by the proposed action, as well as the effects of activities that are interrelated to or interdependent with the Federal agency's proposed action. The first criterion is exposure, or some reasonable expectation of a co-occurrence, between one or more potential stressors associated with the proposed activities and ESA-listed species or designated critical habitat. If we conclude that an ESA-listed species or designated critical habitat is not likely to be exposed to the proposed activities, we must also conclude that the species or designated critical habitat is not likely to be adversely affected by those activities.

The second criterion is the probability of a response given exposure. ESA-listed species or designated critical habitats that are exposed to potential stressors but are likely to be unaffected by the exposure are also not likely to be adversely affected by the proposed action.

An action warrants a "may affect, not likely to be adversely affected" finding when its effects are wholly beneficial, insignificant or discountable. Beneficial effects have an immediate positive effect without any adverse effects to the species or habitat. Beneficial effects are usually discussed when the project has a clear link to the ESA-listed species or its specific habitat needs and consultation is required because the species may be affected.

Insignificant effects relate to the size or severity of the impact and include those effects that are undetectable, not measurable, or so minor that they cannot be meaningfully evaluated. Insignificant is the appropriate effect conclusion when plausible effects are going to happen, but will not rise to the level of constituting an adverse effect. That means the ESA-listed species may be expected to be affected, but not harmed or harassed.

Discountable effects are those that are extremely unlikely to occur. For an effect to be discountable, there must be a plausible adverse effect (i.e., a credible effect that could result from the action and that would be an adverse effect if it did impact a listed species), but it is very unlikely to occur.

The action areas co-occur with designated critical habitat of Northwestern Atlantic DPS loggerhead sea turtles, specifically nearshore reproductive, breeding, *Sargassum*, and migratory habitat. The primary constituent elements of reproductive habitat include: (1) nearshore waters directly off the highest density nesting beaches and their adjacent beaches as identified in 50 CFR 17.95(c) to 1.6 km offshore; (2) waters sufficiently free of obstructions or artificial lighting to allow transit through the surf zone and outward toward open water; and (3) waters with minimal manmade structures that could promote predators (i.e., nearshore predator concentration caused by submerged and emergent offshore structures), disrupt wave patterns necessary for orientation, and/or create excessive longshore currents. The primary constituent elements of breeding habitat include: (1) high densities of reproductive male and female loggerheads; (2) proximity to primary Florida migratory corridor; and (3) proximity to Florida nesting grounds. The primary constituent elements of *Sargassum* habitat include: (1) convergence zones, surface-water downwelling areas, the margins of major boundary currents (Gulf Stream), and other locations where there are concentrated components of the *Sargassum* community in water temperatures suitable for the optimal growth of *Sargassum* and inhabitance of loggerheads; (2) *Sargassum* in concentrations that support adequate prey abundance and cover; (3) available prey and other material associated with *Sargassum* habitat including, but not limited to, plants and cyanobacteria and animals native to the *Sargassum* community such as hydroids and copepods; and (4) sufficient water depth and proximity to available currents to ensure offshore transport (out of the surf zone), and foraging and cover requirements by *Sargassum* for post-hatchling loggerheads, i.e., greater than 10 m depth. The primary constituent elements of migratory habitat include: (1) constricted continental shelf area relative to nearby continental shelf waters that concentrate migratory pathways and (2) passage conditions to allow for migration to and from nesting, breeding, and/or foraging areas. We do not expect any stressors associated with the proposed actions to alter habitat features of the action area such as those identified above, or alter passage conditions. Therefore, we do not expect the proposed actions to affect winter or migratory loggerhead critical habitat.

Although threatened Johnson's sea grass (*Halophila johnsonii*) and its designated critical habitat (65 FR 17786) can be found in or near the lagoon areas of the study area, the researchers would not be authorized to conduct research activities on or around this species or its critical habitat as a condition of the permit.

Gulf sturgeon (*Acipenser oxyrinchus desotoi*) and its critical habitat are found along the northern coast of the Gulf of Mexico. Although researchers plan to depart from ports in these areas while conducting Project 3, they expect to travel offshore and away from gulf sturgeon habitat to find the age class of turtles they are investigating. Because target sea turtles would be captured by dip net, there is no chance a sturgeon could be incidentally captured if the species were to overlap in area.

During this consultation, we determined that no ESA-listed species or designated critical habitat will be affected by these research activities other than the targeted sea turtle species. Permit No. 19508 researchers will be targeting green, hawksbill, Kemp's ridley, leatherback, and loggerhead turtles only. Therefore, issuance of Permit No. 19508 is not likely to destroy or adversely modify designated critical habitat.

4.2 Species and Critical Habitat Likely to be Adversely Affected

During this consultation, we examined the status of each species that would be affected by the proposed action. The status is determined by the level of risk that the ESA-listed species face, based on parameters considered in documents such as recovery plans, status reviews, and listing decisions. The species status section helps to inform the description of the species' current "reproduction, numbers, or distribution" as described in 50 CFR §402.02. More detailed information on the status and trends of these ESA-listed species, and their biology and ecology can be found in the listing regulations and designated critical habitat designations published in the Federal Register, status reviews, recovery plans, and on these NMFS Web sites: [http://www.nmfs.noaa.gov/pr/species/index.htm, others].

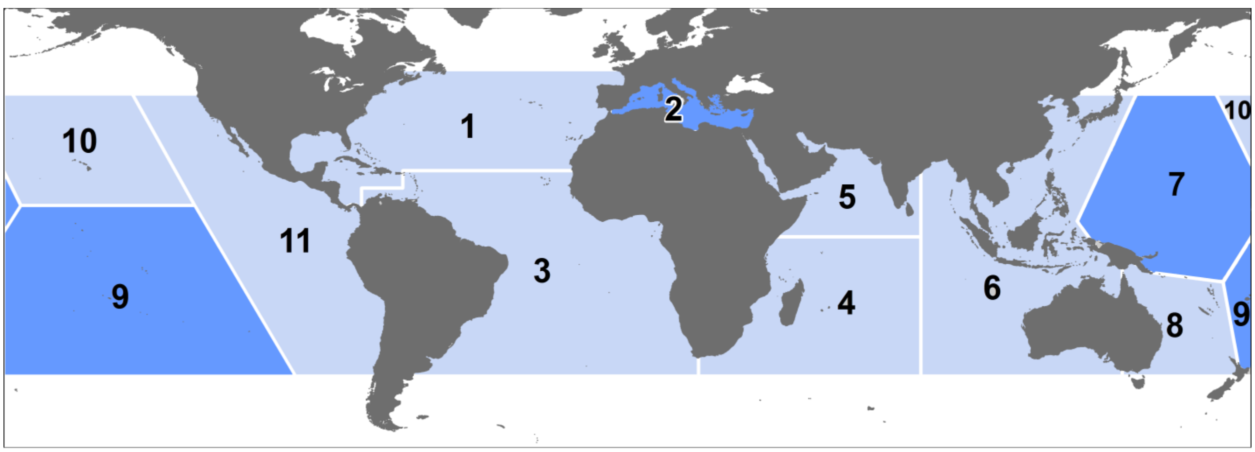
4.2.1 Green Sea Turtle, North Atlantic Distinct Population Segment

Green sea turtles were listed under the ESA on July 28, 1978 (43 FR 32800). The species was separated into two listing designations: endangered for breeding populations in Florida and the Pacific coast of Mexico and threatened in all other areas throughout its range. On April 6, 2016, NMFS listed eleven DPSs of green sea turtles as threatened or endangered under the ESA (81 FR 20057) (Table 7).

Table 7. Green sea turtle information bar, North Atlantic Distinct Population Segment

Species	Common Name	Distinct Population Segment	ESA Status	Critical Habitat	Recovery Plan
Chelonia mydas	Green sea turtle	North Atlantic	Threatened 81 FR 20057 2016	63 FR 46693 1998	63 FR 28359 Notice North Atlantic 1991

Eight DPSs are listed as threatened: Central North Pacific, East Indian-West Pacific, East Pacific, North Atlantic, North Indian, South Atlantic, Southwest Indian, and Southwest Pacific. Three DPSs are listed as endangered: Central South Pacific, Central West Pacific, and Mediterranean (Figure 3).



Threatened (light blue) and endangered (dark blue) green turtle DPSs:
1. North Atlantic, 2. Mediterranean, 3. South Atlantic, 4. Southwest Indian, 5. North Indian, 6. East Indian-West Pacific, 7. Central West Pacific, 8. Southwest Pacific, 9. Central South Pacific, 10. Central North Pacific, and 11. East Pacific.

Figure 3. Map depicting Distinct Population Segment boundaries for green sea turtles.

4.2.1.1 Species Description

The green sea turtle (*Chelonia mydas*) is the largest of the hardshell marine turtles, growing to a weight of 350 pounds (159 kilograms) and a straight carapace length of greater than 3.3 feet (1 meter). It has a circumglobal distribution, occurring throughout nearshore tropical, subtropical and, to a lesser extent, temperate waters. Their shell is black, gray, green, brown, or yellow on top and yellowish white on bottom (Figure 4).

Figure 4. Green sea turtle, *Chelonia mydas*. Credit: Andy Bruckner, National Oceanic and Atmospheric Administration.

4.2.1.2 Life History

Age at first reproduction for females is 20 to 40 years. Green sea turtles lay an average of three nests per season with an average of 100 eggs per nest. The remigration interval (i.e., return to natal beaches) is 2 to 5 years. Nesting occurs primarily on beaches with intact dune structure, native vegetation and appropriate incubation temperatures during summer months. 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. During this life stage, green sea turtles feed close to the surface on a variety of marine algae and other life associated with drift lines and debris. Adult turtles exhibit site fidelity and migrate hundreds to thousands of kilometers from nesting beaches to foraging areas. Green sea turtles spend the majority of their lives in coastal foraging grounds, which include open coastlines and protected bays and lagoons. Adult green turtles feed primarily on seagrasses and algae, although they also eat jellyfish, sponges and other invertebrate prey.

4.2.1.3 Population Dynamics

The following is a discussion of the species' population and its variance over time. This section is broken down into: abundance, population growth rate, genetic diversity, and distribution as it relates to the North Atlantic DPS green sea turtle.

Abundance

Worldwide, nesting data at 464 sites indicate that 563,826 to 564,464 females nest each year (Seminoff et al. 2015). Compared to other DPSs, the North Atlantic DPS exhibits the highest nester abundance, with approximately 167,424 females at 73 nesting sites and available data indicate an increasing trend in nesting. The largest nesting site in the North Atlantic DPS is in Tortuguero, Costa Rica, which hosts 79 percent of nesting females for the DPS (Seminoff et al. 2015).

Population Growth Rate

For the North Atlantic DPS, the available data indicate an increasing trend in nesting. There are no reliable estimates of population growth rate for the DPS as a whole, but estimates have been developed at a localized level. Modeling by Chaloupka et al. (2008) using data sets of 25 years or more show the Florida nesting stock at the Archie Carr National Wildlife Refuge growing at an annual rate of 13.9 percent, and the Tortuguero, Costa Rica, population growing at 4.9 percent.

Genetic Diversity

The North Atlantic DPS has a globally unique haplotype, which was a factor in defining the discreteness of the population for the DPS. Evidence from mitochondrial DNA studies indicates that there are at least 4 independent nesting subpopulations in Florida, Cuba, Mexico and Costa Rica (Seminoff et al. 2015). More recent genetic analysis indicates that designating a new western Gulf of Mexico management unit might be appropriate (Shamblin et al. 2016).

Distribution

Green turtles from the North Atlantic DPS range from the boundary of South and Central America (7.5°N, 77°W) in the south, throughout the Caribbean, the Gulf of Mexico, and the U.S. Atlantic coast to New Brunswick, Canada (48°N, 77°W) in the north. The range of the DPS then extends due east along latitudes 48°N and 19°N to the western coasts of Europe and Africa.

4.2.1.4 Status

Once abundant in tropical and subtropical waters, green sea turtles worldwide exist at a fraction of their historical abundance, as a result of over-exploitation. Globally, egg harvest, the harvest of females on nesting beaches and directed hunting of turtles in foraging areas remain the three greatest threats to their recovery. In addition, bycatch in drift-net, long-line, set-net, pound-net and trawl fisheries kill thousands of green sea turtles annually. Increasing coastal development (including beach erosion and re-nourishment, construction and artificial lighting) threatens nesting success and hatchling survival. On a regional scale, the different DPSs experience these threats as well, to varying degrees. Differing levels of abundance combined with different intensities of threats and effectiveness of regional regulatory mechanisms make each DPS uniquely susceptible to future perturbations.

Historically, green turtles in the North Atlantic DPS were hunted for food, which was the principle cause of the population’s decline. Apparent increases in nester abundance for the North Atlantic DPS in recent years are encouraging but must be viewed cautiously, as the datasets represent a fraction of a green sea turtle generation, up to 50 years. While the threats of pollution, habitat loss through coastal development, beachfront lighting, and fisheries bycatch continue, the North Atlantic DPS appears to be somewhat resilient to future perturbations.

4.2.1.5 Status Within the Action Area

Four regions support nesting concentrations of particular interest in the North Atlantic DPS: Costa Rica (Tortuguero), Mexico (Campeche, Yucatan, and Quintana Roo); U.S. (Florida), and Cuba. Seminoff et al. (2015) identified 73 nesting sites within the North Atlantic DPS, although some represent numerous individual beaches. Tortuguero, Costa Rica is the most important nesting concentration for green turtles in the North Atlantic DPS. In 2010, the estimated number of nesters was 30,052-64,396 (Seminoff et al. 2015). In the U.S., green turtles nest primarily along the central and southeast coast of Florida where an estimated 8,426 females nest annually.

4.2.1.6 Critical Habitat

On September 2, 1998, NMFS designated critical habitat for green sea turtles (63 FR 46694), which include coastal waters surrounding Culebra Island, Puerto Rico. Seagrass beds surrounding Culebra provide important foraging resources for juvenile, subadult and adult green sea turtles. Additionally, coral reefs surrounding the island provide resting shelter and protection from predators. This area provides important developmental habitat for the species. Activities that may affect the critical habitat include beach renourishment, dredge and fill activities, coastal construction, and freshwater discharge. Due to its location, this critical habitat would be accessible by individuals of the North Atlantic DPS.

4.2.1.7 Recovery Goals

See the 1991 Recovery Plan for the Atlantic green sea turtle for complete down-listing criteria for the following recovery goals:

> 1) The level of nesting in Florida has increased to an average of 5,000 nests per year for at least 6 years. Nesting data must be based on standardized surveys.
>
> 2) At least 25 percent (105 km) of all available nesting beaches (420 km) is in public ownership and encompass at least 50 percent of nesting activity.
>
> 3) A reduction in stage class mortality is reflected in higher counts of individuals on foraging grounds.
>
> 4) All priority one tasks have been successfully implemented.

4.2.2 Hawksbill Sea Turtle

Hawksbill sea turtles received protection on June 2, 1970 (35 FR 8491) under the Endangered Species Conservation Act and, since 1973, have been listed as endangered under the ESA (Table 8).

Table 8. Hawksbill sea turtle information bar.

Species	Common Name	Distinct Population Segment	ESA Status	Critical Habitat	Recovery Plan
Eretmochelys imbricata	Hawksbill sea turtle	N/A	Endangered 35 FR 8491 1970	63 FR 46693 Atlantic 1998	57 FR 38818 Atlantic 1992

4.2.2.1 Species Description

The hawksbill turtle has a circumglobal distribution throughout tropical and, to a lesser extent, subtropical oceans. The hawksbill sea turtle has a sharp, curved, beak-like mouth and a "tortoiseshell" pattern on its carapace which has radiating streaks of brown, black, and amber (Figure 5).

Figure 5. Hawksbill sea turtle, *Eretmochelys imbricata*. Credit: Jordan Wilkerson.

4.2.2.2 Life History

Hawksbill sea turtles reach sexual maturity at 20 to 40 years of age. Females return to their natal beaches every 2 to 5 years to nest (an average of 3 to 5 times per season). Clutch sizes are large (up to 250 eggs). Sex determination is temperature dependent, with warmer incubation producing more females. Hatchlings migrate to and remain in pelagic habitats until they reach approximately 22 to 25 cm in straight carapace length. As juveniles, they take up residency in coastal waters to forage and grow. As adults, hawksbills use their sharp beak-like mouths to feed on sponges and corals. Hawksbill sea turtles are highly migratory and use a wide range of habitats during their lifetimes (Musick and Limpus 1997; Plotkin 2003). Satellite tagged turtles have shown significant variation in movement and migration patterns. Distance traveled between nesting and foraging locations ranges from a few hundred to a few thousand kilometers (Miller et al. 1998; Horrocks et al. 2001).

4.2.2.3 Population Dynamics

The following is a discussion of the species' population and its variance over time. This section is broken down into: abundance, population growth rate, genetic diversity, and distribution as it relates to the hawksbill sea turtle.

Abundance

Surveys at 88 nesting sites worldwide indicate that 22,004 to 29,035 females nest annually (NMFS and USFWS 2013). In general, hawksbills are doing better in the Atlantic and Indian Ocean than in the Pacific Ocean, where despite greater overall abundance, a greater proportion of the nesting sites are declining.

Population Growth Rate

From 1980 to 2003, the number of nests at three primary nesting beaches (Rancho Nuevo, Tepehuajes, and Playa Dos) increased 15 percent annually (Heppell et al. 2005); however, due to recent declines in nest counts, decreased survival at other life stages, and updated population modeling, this rate is not expected to continue (NMFS and USFWS 2015).

Genetic Diversity

Populations are distinguished generally by ocean basin and more specifically by nesting location. Our understanding of population structure is relatively poor. Genetic analysis of hawksbill sea turtles foraging off the Cape Verde Islands identified three closely-related haplotypes in a large majority of individuals sampled that did not match those of any known nesting population in the western Atlantic, where the vast majority of nesting has been documented (McClellan et al. 2010; Monzón-Argüello et al. 2010). Hawksbills in the Caribbean seem to have dispersed into separate populations (rookeries) after a bottleneck roughly 100,000 to 300,000 years ago (Leroux et al. 2012).

Distribution

The hawksbill has a circumglobal distribution throughout tropical and, to a lesser extent, subtropical waters of the Atlantic, Indian, and Pacific Oceans. In their oceanic phase, juvenile hawksbills can be found in Sargassum mats; post-oceanic hawksbills may occupy a range of habitats that include coral reefs or other hard-bottom habitats, sea grass, algal beds, mangrove bays and creeks (Musick and Limpus 1997; Bjorndal and Bolten 2010).

4.2.2.4 Status

Long-term data on the hawksbill sea turtle indicate that 63 sites have declined over the past 20 to 100 years (historic trends are unknown for the remaining 25 sites). Recently, 28 sites (68 percent) have experienced nesting declines, 10 have experienced increases, three have remained stable, and 47 have unknown trends. The greatest threats to hawksbill sea turtles are overharvesting of turtles and eggs, degradation of nesting habitat, and fisheries interactions. Adult hawksbills are harvested for their meat and carapace, which is sold as tortoiseshell. Eggs are taken at high levels, especially in Southeast Asia where collection approaches 100 percent in some areas. In addition, lights on or adjacent to nesting beaches are often fatal to emerging hatchlings and alters the behavior of nesting adults. The species' resilience to additional perturbation is low.

4.2.2.5 Status Within the Action Area

Within the U.S., hawksbills are most common in Puerto Rico and its associated islands and in the U.S. Virgin Islands. In the continental U.S., hawksbills are found primarily in Florida and Texas, though they have been recorded in all the Gulf States and along the east coast as far north as Massachusetts. In Florida, hawksbills are observed on the reefs off Palm Beach, Broward, Miami-Dade, and Monroe Counties. Most sightings involve post-hatchlings and juveniles. These small turtles are believed to originate from nesting beaches in Mexico. The most significant nesting within the U.S. occurs in Puerto Rico and the U.S. Virgin Islands, specifically on Mona Island and Buck Island, respectively.

4.2.2.6 Critical Habitat

On September 2, 1998, NMFS established critical habitat for hawksbill sea turtles around Mona and Monito Islands, Puerto Rico (63 FR 46693). Aspects of these areas that are important for hawksbill sea turtle survival and recovery include important natal development habitat, refuge from predation, shelter between foraging periods, and food for hawksbill sea turtle prey. The critical habitat for hawksbill does not occur in the action area for the proposed permit.

4.2.2.7 Recovery Goals

See the 1998 Recovery Plan for U.S. Pacific populations of hawksbill sea turtles for complete down-listing criteria for the following recover criteria:

1) All regional stocks that use U.S. waters have been identified to source beaches based on reasonable geographic parameters.

2) Each stock must average 1,000 females estimated to nest annually (or a biologically reasonable estimate based on the goal of maintaining a stable population in perpetuity) over six years.

3) All females estimated to nest annually at "source beaches" are either stable or increasing for 25 years.

4) Existing foraging areas are maintained as healthy environments.

5) Foraging populations are exhibiting statistically significant increases at several key foraging grounds within each stock region.

6) All Priority 1 tasks have been implemented.

7) A management plan designed to maintain sustained populations of turtles is in place.

8) Ensure formal cooperative relationship with regional sea turtle management program.

9) International agreements are in place to protect shared stocks.

4.2.3 Kemp's Ridley Sea Turtle

Kemp's ridley was first listed under the Endangered Species Conservation Act (35 FR 8491) and listed as endangered under the ESA since 1973 (Table 9).

Table 9. Kemp's Ridley sea turtle information bar.

Species	Common Name	Distinct Population Segment	ESA Status	Critical Habitat	Recovery Plan
Lepidochelys kempii	Kemp's ridley sea turtle	None Designated	Endangered 35 FR 18319 1970	--	75 FR 12496 U.S. Caribbean, Atlantic, and Gulf of Mexico 2011

4.2.3.1 Species Description

The Kemp's ridley is considered to be the most endangered sea turtle, internationally (Zwinenberg 1977; Groombridge 1982; TEWG 2000). Its range extends from the Gulf of Mexico to the Atlantic coast, with nesting beaches limited to a few sites in Mexico and Texas. Kemp's ridley sea turtles the smallest of all sea turtle species, with a nearly circular top shell and a pale yellowish bottom shell (Figure 6).

Figure 6. Kemp's ridley sea turtle, *Lepidochelys kempii*. Credit: National Oceanic and Atmospheric Administration.

4.2.3.2 Life History

Adult Kemp's ridley sea turtles have an average straight carapace length of 2.1 ft (65 cm). Females mature at 12 years of age. The average remigration is 2 years. Nesting occurs from April to July in large arribadas, primarily at Rancho Nuevo, Mexico. Females lay an average of 2.5 clutches per season. The annual average clutch size is 97 to 100 eggs per nest. The nesting location may be particularly important because hatchlings can more easily migrate to foraging grounds in deeper oceanic waters, where they remain for approximately 2 years before returning to nearshore coastal habitats. Juvenile Kemp's ridley sea turtles use these nearshore coastal habitats from April through November, but move towards more suitable overwintering habitat in deeper offshore waters (or more southern waters along the Atlantic coast) as water temperature drops. Adult habitat largely consists of sandy and muddy areas in shallow, nearshore waters less than 120 ft (37 m) deep, although they can also be found in deeper offshore waters. As adults, *they* forage on swimming crabs, fish, jellyfish, mollusks, and tunicates (NMFS and USFWS 2011).

4.2.3.3 Population Dynamics

The following is a discussion of the species' population and its variance over time. This section is broken down into: abundance, population growth rate, genetic diversity, and distribution as it relates to the Kemp's ridley sea turtle.

Abundance

Of the sea turtles species in the world, the Kemp's ridley has declined to the lowest population level. Nesting aggregations at a single location (Rancho Nuevo, Mexico) were estimated at 40,000 females in 1947. By the mid-1980s, the population had declined to an estimated 300 nesting females. In 2014, there were an estimated 10,987 nests and 519,000 hatchlings released from three primary nesting beaches in Mexico (NMFS and USFWS 2015). The number of nests in Padre Island, Texas has increased over the past two decades, with one nest observed in 1985, four in 1995, 50 in 2005, 197 in 2009, and 119 in 2014 (NMFS and USFWS 2015).

Population Growth Rate

From 1980 to 2003, the number of nests at three primary nesting beaches (Rancho Nuevo, Tepehuajes, and Playa Dos) increased 15 percent annually (Heppell et al. 2005); however, due to recent declines in nest counts, decreased survival at other life stages, and updated population modeling, this rate is not expected to continue (NMFS and USFWS 2015).

Genetic Diversity

Genetic variability in Kemp's ridley turtles is considered to be high, as measured by heterozygosis at microsatellite loci (NMFS and USFWS 2011). Additional analysis of the mitochondrial DNA taken from samples of Kemp's ridley turtles at Padre Island, Texas, showed six distinct haplotypes, with one found at both Padre Island and Rancho Nuevo (Dutton et al. 2006).

Distribution

The Kemp's ridley occurs from the Gulf of Mexico and along the Atlantic coast of the U.S. (TEWG 2000). Kemp's ridley sea turtles have occasionally been found in the Mediterranean Sea, which may be due to migration expansion or increased hatchling production (Tomas and Raga 2008). The vast majority of individuals stem from breeding beaches at Rancho Nuevo on the Gulf of Mexico coast of Mexico. During spring and summer, juvenile Kemp's ridleys occur in the shallow coastal waters of the northern Gulf of Mexico from south Texas to north Florida. In the fall, most Kemp's ridleys migrate to deeper or more southern, warmer waters and remain there through the winter (Schmid 1998). As adults, many turtles remain in the Gulf of Mexico, with only occasional occurrence in the Atlantic Ocean (NMFS and USFWS 2011).

4.2.3.4 Status

The Kemp's ridley was listed as endangered in response to a severe population decline, primarily the result of egg collection. In 1973, legal ordinances prohibited the harvest of sea turtles from May to August, and in 1990, the harvest of all sea turtles was prohibited by presidential decree. In 2002, Rancho Nuevo was declared a Sanctuary. A successful head-start program has resulted in the reestablishment of nesting at Texan beaches. While fisheries bycatch remains a threat, the use of turtle excluder devices mitigates take. Fishery interactions and strandings, possibly due to forced submergence, appear to be the main threats to the species. It is clear that the species is steadily increasing; however, the species' limited range and low global abundance make it vulnerable to new sources of mortality as well as demographic and environmental randomness, all of which are often difficult to predict with any certainty. Therefore, its resilience to future perturbation is low.

4.2.3.5 Status Within the Action Area

During the mid-20th century, the Kemp's ridley was abundant in the Gulf of Mexico. Historic information indicates that tens of thousands of Kemp's ridleys nested near Rancho Nuevo, Mexico, during the late 1940s (Hildebrand 1963). From 1978 through the 1980s, arribadas were 200 turtles or less, and by 1985, the total number of nests at Rancho Nuevo had dropped to approximately 740 for the entire nesting season, which was a projection of roughly 234 turtles (USFWS and NMFS 1992; TEWG 2000). Beginning in the 1990s, an increasing number of beaches in Mexico were being monitored for nesting, and the total number of nests on all beaches in Tamaulipas and Veracruz in 2002 was over 6,000; the rate of increase from 1985 ranged from 14-16 percent (TEWG 2000; USFWS 2002; Heppell et al. 2005). In 2006, approximately 7,866 nests were laid at Rancho Nuevo with the total number of nests for all the beaches in Mexico estimated at about 12,000 nests, which amounted to about 4,000 nesting females based on three nests per female per season (Rostal et al. 1997; USFWS 2006; Rostal 2007). Considering remigration rates, the population included approximately 7,000 to 8,000 adult female turtles at that time (Márquez et al. 1989; TEWG 2000; Rostal 2007). The 2007 nesting season included an arribada of over 4,000 turtles over a three-day period at Rancho Nuevo (NMFS and USFWS 2007b). The increased recruitment of new adults is illustrated in the proportion of first time nesters, which has increased from 6 percent in 1981 to 41 percent in 1994. NMFS (2015) identified noticeable drops in the number of nests in Texas and Mexico in 2010, 2013, and 2014.

4.2.3.6 Critical Habitat

No critical habitat has been designated for Kemp's ridley turtles.

4.2.3.7 Recovery Goals

See the 2011 revised Recovery Plan for the Kemp's ridley sea turtle for complete down-listing criteria for the following recovery goals:

1) A population of at least 10,000 nesting females in a season (as estimated by clutch frequency per female per season) distributed at the primary nesting beaches (Rancho Nuevo, Tepehuajes, and Playa Dos) in Mexico is attained. Methodology and capacity to implement and ensure accurate nesting female counts have been developed.

2) Recruitment of at least 300,000 hatchlings to the marine environment per season at the three primary nesting beaches (Rancho Nuevo, Tepehuajes, and Playa Dos) in Mexico is attained to ensure a minimum level of known production through in situ incubation, incubation in corrals, or a combination of both.

3) An average population of at least 40,000 (Hildebrand 1963) nesting females per season (as measured by clutch frequency per female per season and annual nest counts) over a 6-year period distributed among nesting beaches in Mexico and the U.S. is attained. Methodology and capacity to ensure accurate nesting female counts have been developed and implemented.

4) Ensure average annual recruitment of hatchlings over a 6-year period from in situ nests and beach corrals is sufficient to maintain a population of at least 40,000 nesting females per nesting season distributed among nesting beaches in Mexico and the U.S into the future. This criterion may rely on massive synchronous nesting events (i.e., arribadas) that will swamp predators as well as rely on supplemental protection in corrals and facilities.

4.2.4 Leatherback Sea Turtle

The species was first listed under the Endangered Species Conservation Act (35 FR 8491) and listed as endangered under the ESA since 1973 (Table 10).

Table 10. Leatherback sea turtle information bar.

Species	Common Name	Distinct Population Segment	ESA Status	Critical Habitat	Recovery Plan
Dermochelys coriacea	Leatherback sea turtle	None Designated	Endangered 35 FR 8491 06/02/1970	44 FR 17710 1979	63 FR 28359 Notice U.S. Caribbean, Atlantic, and Gulf of Mexico 1992

4.2.4.1 Species Description

The leatherback sea turtle is unique among sea turtles for its large size, wide distribution (due to thermoregulatory systems and behavior), and lack of a hard, bony carapace. It ranges from tropical to subpolar latitudes, worldwide. Leatherbacks are the largest living turtle, reaching lengths of six feet long, and weighing up to one ton. Leatherback sea turtles have a distinct black leathery skin covering their carapace with pinkish white skin on their belly (Figure 7).

Figure 7. Leatherback sea turtle, *Dermochelys coriacea*. Credit: R. Tapilatu.

4.2.4.2 Life History

Age at maturity has been difficult to ascertain, with estimates ranging from 5 to 29 years (Spotila et al. 1996; Avens et al. 2009). Females lay up to seven clutches per season, with more than 65 eggs per clutch and eggs weighing greater than 80 grams (Reina et al. 2002; Wallace et al. 2007). The number of leatherback hatchlings that make it out of the nest on to the beach (i.e., emergent success) is approximately 50 percent worldwide (Eckert et al. 2012). Females nest every 1 to 7 years. Natal homing, at least within an ocean basin, results in reproductive isolation between five broad geographic regions: eastern and western Pacific, eastern and western Atlantic, and Indian Ocean. Leatherback sea turtles migrate long, transoceanic distances between their tropical nesting beaches and the highly productive temperate waters where they forage, primarily on jellyfish and tunicates. These gelatinous prey are relatively nutrient-poor, such that leatherbacks must consume large quantities to support their body weight. Leatherbacks weigh ~33 percent more on their foraging grounds than at nesting, indicating that they probably catabolize fat reserves to fuel migration and subsequent reproduction (James et al. 2005; Wallace et al. 2006). Sea turtles must meet an energy threshold before returning to nesting beaches. Therefore, their remigration intervals (the time between nesting) are dependent upon foraging success and duration (Hays 2000; Price et al. 2004).

4.2.4.3 Population Dynamics

The following is a discussion of the species' population and its variance over time. This section is broken down into: abundance, population growth rate, genetic diversity, and spatial distribution as it relates to the leatherback sea turtle.

Abundance

Leatherbacks are globally distributed, with nesting beaches in the Pacific, Atlantic, and Indian oceans. Detailed population structure is unknown, but is likely dependent upon nesting beach location. Based on estimates calculated from nest count data, there are between 34,000 and 94,000 adult leatherbacks in the North Atlantic (TEWG 2007). In contrast, leatherback populations in the Pacific are much lower. Overall, Pacific populations have declined from an estimated 81,000 individuals to less than 3,000 total adults and subadults (Spotila et al. 2000). Population abundance in the Indian Ocean is difficult to assess due to lack of data and inconsistent reporting. Available data from southern Mozambique show that approximately 10 females nest per year from 1994-2004, and about 296 nests per year counted in South Africa (NMFS 2013c).

Population Growth Rate

Population growth rates for leatherback sea turtles vary by ocean basin. Counts of leatherbacks at nesting beaches in the western Pacific indicate that the subpopulation has been declining at a rate of almost 6 percent per year since 1984 (Tapilatu et al. 2013). Leatherback subpopulations in the Atlantic Ocean however are showing signs of improvement. Nesting females in South Africa are increasing at an annual rate of 4 to 5.6 percent, and from 9 to 13 percent in Florida and the U.S. Virgin Islands (TEWG 2007), believed to be a result of conservation efforts.

Genetic Diversity

Analyses of mitochondrial DNA from leatherback sea turtles indicates a low level of genetic diversity, pointing to possible difficulties in the future if current population declines continue (Dutton et al. 1999). Further analysis of samples taken from individuals from rookeries in the Atlantic and Indian oceans suggest that each of the rookeries represent demographically independent populations (NMFS 2013c).

Distribution

Leatherback sea turtles are distributed in oceans throughout the world. Leatherbacks occur throughout marine waters, from nearshore habitats to oceanic environments (Shoop and Kenney 1992). Movements are largely dependent upon reproductive and feeding cycles and the oceanographic features that concentrate prey, such as frontal systems, eddy features, current boundaries, and coastal retention areas (Benson et al. 2011).

4.2.4.4 Status

The leatherback sea turtle is an endangered species whose once large nesting populations have experienced steep declines in recent decades. The primary threats to leatherback sea turtles include: fisheries bycatch, harvest of nesting females, and egg harvesting. As a result of these threats, once large rookeries are now functionally extinct, and there have been range-wide reductions in population abundance. Other threats include loss of nesting habitat due to development, tourism, and sand extraction. Lights on or adjacent to nesting beaches alter nesting adult behavior and are often fatal to emerging hatchlings as they are drawn to light sources and away from the sea. Plastic ingestion is common in leatherbacks and can block gastrointestinal tracts leading to death. Climate change may alter sex ratios (as temperature determines hatchling sex), range (through expansion of foraging habitat), and habitat (through the loss of nesting beaches, as a result of sea-level rise. The species' resilience to additional perturbation is low.

4.2.4.5 Status Within the Action Area

North Atlantic leatherbacks likely number 34,000-94,000 individuals, with females numbering 18,800 and the eastern Atlantic segment numbering 4,700 (TEWG 2007). Trends and numbers include only nesting females and are not a complete demographic or geographic cross-section. In 1996, the entire western Atlantic population was characterized as stable at best (Spotila et al. 1996), with roughly 18,800 nesting females. A subsequent analysis indicated that by 2000, the western Atlantic nesting population had decreased to about 15,000 nesting females (NMFS 2005). Spotila et al. (1996) estimated that the entire Atlantic basin, including all nesting beaches in the Americas, the Caribbean, and West Africa, totaled approximately 27,600 nesting females, with an estimated range of 20,082-35,133. This is consistent with other estimates of 34,000-95,000 total adults (20,000-56,000 adult females; 10,000-21,000 nesting females) (TEWG 2007).

In the Caribbean, Atlantic and Gulf of Mexico, leatherback populations are generally increasing. In the United States, the Atlantic coast of Florida is one of the main nesting areas in the continental United States. Data from this area reveals a general upward trend of, though with some fluctuation. Florida index nesting beach data from 1989-2014, indicate that number of nests at core index nesting beach ranged from 27 to 641 in 2014. In the U.S. Caribbean, nesting in Puerto Rico, St. Croix, and the U.S. Virgin Islands continues to increase as well, with some shift in the nesting between these two islands.

4.2.4.6 Critical Habitat

On March 23, 1979, leatherback critical habitat was identified adjacent to Sandy Point, St. Croix, Virgin Islands from the 183 m isobath to mean high tide level between 17° 42'12" N and 65°50'00" W (44 FR 17710). This habitat is essential for nesting, which has been increasingly threatened since 1979, when tourism increased significantly, bringing nesting habitat and people into close and frequent proximity; however, studies do not support significant critical habitat deterioration.

On January 20, 2012, NMFS issued a final rule to designate additional critical habitat for the leatherback sea turtle (50 CFR 226). This designation includes approximately 43,798 km2 stretching along the California coast from Point Arena to Point Arguello east of the 3000 m depth contour; and 64,760 km2 stretching from Cape Flattery, Washington to Cape Blanco, Oregon east of the 2,000 m depth contour. The designated areas comprise approximately 108558 km2 of marine habitat and include waters from the ocean surface down to a maximum depth of 80 m. They were designated specifically because of the occurrence of prey species, primarily scyphomedusae of the order Semaeostomeae (i.e., jellyfish), of sufficient condition, distribution, diversity, abundance and density necessary to support individual as well as population growth, reproduction, and development of leatherbacks.

4.2.4.7 Recovery Goals

See the 1992 Recovery Plan for the U.S. Caribbean, Atlantic, and Gulf of Mexico for complete down-listing criteria for the following recovery goals:

> 1) The adult female population increases over the next 25 years, as evidenced by a statistically significant trend in the number of nests at Culebra, Puerto Rico, St. Croix, USVI, and along the east coast of Florida.
>
> 2) Nesting habitat encompassing at least 75 percent of nesting activity in USVI, Puerto Rico and Florida is in public ownership.
>
> 3) All priority one tasks have been successfully implemented.

4.2.5 Loggerhead Sea Turtle, Northwest Atlantic Distinct Population Segment

The species was first listed as threatened under the Endangered Species Act in 1978 (43 FR 32800) (Table 11). On September 22, 2011, the NMFS designated nine distinct population segments (DPSs) of loggerhead sea turtles: South Atlantic Ocean and southwest Indian Ocean as threatened as well as Mediterranean Sea, North Indian Ocean, North Pacific Ocean, northeast Atlantic Ocean, northwest Atlantic Ocean, South Pacific Ocean, and southeast Indo-Pacific Ocean as endangered (75 FR 12598).

Table 11. Loggerhead sea turtle information bar, Northwest Atlantic Distinct Population Segment.

Species	Common Name	Distinct Population Segment	ESA Status	Critical Habitat	Recovery Plan
Caretta caretta	Loggerhead sea turtle	Northwest Atlantic	Threatened 76 FR 58868 09/22/2011	79 FR 39856 Atlantic and GOM 2014	74 FR 2995 Notice Northwest Atlantic 2009

4.2.5.1 Species Description

Loggerhead sea turtles are circumglobal, and are found in the temperate and tropical regions of the Indian, Pacific and Atlantic Oceans. The loggerhead sea turtle is distinguished from other turtles by its large head and powerful jaws (Figure 8). Recent ocean-basin scale genetic analysis supports this conclusion, with additional differentiation apparent based upon nesting beaches (Shamblin et al. 2014).

Figure 8. Loggerhead sea turtle, *Caretta caretta*. Credit: National Oceanic and Atmospheric Administration.

4.2.5.2 Life History

Mean age at first reproduction for female loggerhead sea turtles is 30 years (SD = 5). Females lay an average of three clutches per season. The annual average clutch size is 112 eggs per nest. The average remigration interval is 2.7 years. Nesting occurs on beaches, where warm, humid sand temperatures incubate the eggs. Temperature determines the sex of the turtle during the middle of the incubation period. Turtles spend the post-hatchling stage in pelagic waters. The juvenile stage is spent first in the oceanic zone and later in the neritic zone (i.e., coastal waters). Coastal waters provide important foraging habitat, inter-nesting habitat, and migratory habitat for adult loggerheads.

4.2.5.3 Population Dynamics

The following is a discussion of the species' population and its variance over time. This section is broken down into: abundance, population growth rate, genetic diversity, and spatial distribution as it relates to the loggerhead sea turtle.

Abundance

There is general agreement that the number of nesting females provides a useful index of the species' population size and stability at this life stage, even though there are doubts about the ability to estimate the overall population size (Bjorndal et al. 2005). Adult nesting females often account for less than 1 percent of total population numbers. The global abundance of nesting female loggerhead turtles is estimated at 43,320 to 44,560 (Spotila 2004).

Using a stage/age demographic model, the adult female population size of the DPS is estimated at 20,000 to 40,000 females, and 53,000 to 92,000 nests annually (NMFS SEFSC 2009). Based on genetic information, the Northwest Atlantic Ocean DPS is further categorized into five recovery units corresponding to nesting beaches. These are: Northern Recovery Unit, Peninsular Florida Recovery Unit, Dry Tortugas Recovery Unit, Northern Gulf of Mexico Recovery Unit, and the Greater Caribbean Recovery Unit.

Population Growth Rate

The population growth rate for each of the four of the recovery units for the Northwest Atlantic DPS (Peninsular Florida, Northern, Northern Gulf of Mexico, and Greater Caribbean) all exhibit negative growth rates (Conant et al. 2009) Nest counts taken at index beaches in Peninsular Florida show a significant decline in loggerhead nesting from 1989-2006, most likely attributed to mortality of oceanic-stage loggerheads caused by fisheries bycatch (Witherington et al. 2009). Loggerhead nesting on the Archie Carr National Wildlife Refuge (representing individuals of the Peninsular Florida subpopulation) has fluctuated over the past few decades. There was an average of 9,300 nests throughout the 1980s, with the number of nests increasing into the 1990s until it reached an all-time high in 1998, with 17,629 nests. From that point, the number of loggerhead nests at the Refuge have declined steeply to a low of 6,405 in 2007, increasing again to 15,539, still a lower number of nests than in 1998 (Bagley et al. 2013).

For the Northern recovery unit, nest counts at loggerhead nesting beaches in North Carolina, South Carolina and Georgia declined at 1.9 percent annually from 1983 to 2005 (NMFS and USFWS 2007c). The nesting subpopulation in the Florida panhandle has exhibited a significant declining trend from 1995-2005 (NMFS and USFWS 2007c; Conant et al. 2009). Recent model estimates predict an overall population decline of 17 percent for the St. Joseph Peninsula, Florida subpopulation of the Northern Gulf of Mexico recovery unit (Lamont et al. 2014).

Genetic Diversity

There are nine loggerhead DPSs, which are geographically separated and genetically isolated, as indicated by genetic, tagging, and telemetry data. Our understanding of the genetic diversity and population structure of the different loggerhead DPSs is being refined as more studies examine samples from a broader range of specimens using longer mitochondrial DNA sequences.

Based on genetic analysis of nesting subpopulations, the Northwest Atlantic Ocean DPS is further divided into five recovery units: Northern, Peninsular Florida, Dry Tortugas, Northern Gulf of Mexico, and Greater Caribbean (Conant et al. 2009). A more recent analysis using expanded mitochondrial DNA sequences revealed that rookeries from the Gulf and Atlantic coasts of Florida are genetically distinct, and that rookeries from Mexico's Caribbean coast express high haplotype diversity (Shamblin et al. 2014). Furthermore, the results suggest that the Northwest Atlantic Ocean DPS should be considered as ten management units: (1) South Carolina and Georgia, (2) central eastern Florida, (3) southeastern Florida, (4) Cay Sal, Bahamas, (5) Dry Tortugas, Florida, (6) southwestern Cuba, (7) Quintana Roo, Mexico, (8) southwestern Florida, (9) central western Florida, and (10) northwestern Florida (Shamblin et al. 2012).

Distribution

Loggerheads are circumglobal, occurring throughout the temperate and tropical regions of the Atlantic, Pacific, and Indian oceans, returning to their natal region for mating and nesting. Adults and sub-adults occupy nearshore habitat. While in their oceanic phase, loggerheads undergo long migrations using ocean currents. Individuals from multiple nesting colonies can be found on a single feeding ground.

Loggerhead hatchlings from the western Atlantic disperse widely, most likely using the Gulf Stream to drift throughout the Atlantic Ocean. Mitochondrial DNA evidence demonstrates that juvenile loggerheads from southern Florida nesting beaches comprise the vast majority (71 to 88 percent) of individuals found in foraging grounds throughout the western and eastern Atlantic: Nicaragua, Panama, Azores and Madiera, Canary Islands and Adalusia, Gulf of Mexico and Brazil (Masuda 2010).

4.2.5.4 Status

Due to declines in nest counts at index beaches in the United States and Mexico, and continued mortality of juveniles and adults from fishery bycatch, the Northwest Atlantic Ocean DPS is at risk and likely to decline in the foreseeable future (Conant et al. 2009).

4.2.5.5 Status Within the Action Area

The greatest concentration of loggerheads occurs in the Atlantic Ocean and the adjacent Caribbean Sea, primarily on the Atlantic coast of Florida, with other major nesting areas located on the Yucatán Peninsula of Mexico, Columbia, Cuba, and South Africa (Márquez 1990; LGL Ltd. 2007). Among the five subpopulations (also termed recovery units) in the Northwest Atlantic Ocean DPS, loggerhead females lay 53,000-92,000 nests per year in the southeastern US and the Gulf of Mexico, and the total number of nesting females are 32,000-56,000 (TEWG 1998; NMFS 2001).

Loggerheads associated with the South Florida recovery unit occur in higher frequencies in the Gulf of Mexico (where they represent about 10 percent of the loggerhead captures). The peninsular Florida recovery unit is the largest loggerhead nesting assemblage in the Northwest Atlantic Ocean DPS. A near-complete state-wide nest census (all beaches including index nesting beaches) undertaken from 1989 to 2007 showed a mean of 64,513 loggerhead nests per year, representing approximately 15,735 nesting females annually (NMFS and USFWS 2008). The statewide estimated total for 2010 was 73,702 (FFWCC 2016). The 2010 index nesting number is the largest since 2000. With the addition of data through 2010, the nesting trend for the Northwest Atlantic Ocean DPS is slightly negative and not statistically different from zero (no trend) (NMFS and USFWS 2010).

An analysis of Florida index nesting beach data shows a 26 percent nesting decline between 1989 and 2008, and a mean annual rate of decline of 1.6 percent despite a large increase in nesting for 2008, to 38,643 nests (NMFS and USFWS 2008; Witherington et al. 2009; www.myfwc.com 2016). In 2009, nesting levels, while still higher than the lows of 2004, 2006, and 2007, dropped below 2008 levels to approximately 32,717 nests, but in 2010, a large increase was seen, with 47,880 nests on the index nesting beaches (FFWCC 2016). Although not directly comparable to these index nesting numbers, nesting counts from 2011-2015 have shown a generally stable trend (www.seaturtle.org 2016).

The south Florida recovery unit of loggerheads may be critical to the survival of the species in the Atlantic because of the recovery unit's size, and in the past it was considered second in size only to the Oman nesting aggregation (NMFS and USFWS 1991). The South Florida recovery unit increased at about 5.3 percent per year from 1978-1990, and was initially increasing at 3.9-4.2 percent after 1990. An analysis of nesting data from 1989-2005, a period of more consistent and accurate surveys than in previous years, showed a detectable trend and, more recently (1998-2005), analysis revealed evidence of a declining trend of approximately 22.3 percent (FFWCC 2006, 2007; Witherington et al. 2009). Nesting data from the Archie Carr Refuge (one of the most important nesting locations in southeast Florida) over the last six years shows nests declined from approximately 17,629 in 1998 to 7,599 in 2004, also suggesting a decrease in recovery unit size. Loggerhead nesting is thought to consist of just 60 nesting females in the Caribbean and Gulf of Mexico (www.nmfs.noaa.gov/pr 2006). Based on the small sizes of almost all nesting aggregations in the Atlantic, the large numbers of individuals killed in fisheries, and the decline of the only large nesting aggregation, the DPS is determined to be in decline (Conant et al. 2009).

4.2.5.6 Critical Habitat

NMFS has designated critical habitat for the Northwest Atlantic Ocean DPS loggerhead sea turtles (Figure 9). On July 10, 2014, NMFS and FWS designated critical habitat for the Northwest Atlantic Ocean DPS loggerhead sea turtles along the U.S. Atlantic and Gulf of Mexico coasts from North Carolina to Mississippi (79 FR 39856). These areas contain one or a combination of nearshore reproductive habitat, winter area, breeding areas, and migratory corridors. The critical habitat is categorized into 38 occupied marine areas and 685 miles of nesting beaches. The physical or biological features and primary constituent elements identified for the different habitat types include waters adjacent to high density nesting beaches, waters with minimal obstructions and manmade structures, high densities of reproductive males and females, appropriate passage conditions for migration, conditions that support Sargassum habitat, available prey, and sufficient water depth and proximity to currents to ensure offshore transport of post-hatchlings.

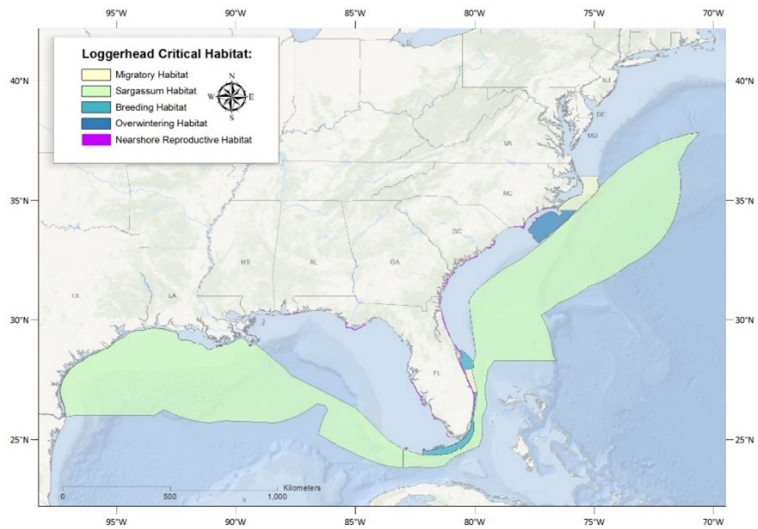


Figure 9. Map identifying designated critical habitat for the Northwest Atlantic Ocean distinct population segment of loggerhead sea turtle.

4.2.5.7 Recovery Goals

See the 2009 Final Recovery Plan for the Northwest Atlantic population of loggerhead for complete down-listing criteria for the following recovery goals:

1) Ensure that the number of nests in each recovery unit is increasing and that this increase corresponds to an increase in the number of nesting females.

2) Ensure the in-water abundance of juveniles in both neritic and oceanic habitats is increasing and is increasing at a greater rate than strandings of similar age classes.

3) Manage sufficient nesting beach habitat to ensure successful nesting.

4) Manage sufficient feeding, migratory, and inter-nesting marine habitats to ensure successful growth and reproduction.

5) Eliminate legal harvest.

6) Implement scientifically based nest management plans.

7) Minimize nest predation.

8) Recognize and respond to mass/unusual mortality or disease events appropriately.

9) Develop and implement local, state, Federal, and international legislation to ensure long-term protection of loggerheads and their terrestrial and marine habitats.

10) Minimize bycatch in domestic and international commercial and artisanal fisheries.

11) Minimize trophic changes from fishery harvest and habitat alteration.

12) Minimize marine debris ingestion and entanglement.

13) Minimize vessel strike mortality.

5 ENVIRONMENTAL BASELINE

The "environmental baseline" includes the past and present impacts of all Federal, state, 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 which are contemporaneous with the consultation in process (50 CFR 402.02).

5.1 Climate Change

There is no question that our climate is changing. The globally-averaged combined land and ocean surface temperature data, as calculated by a linear trend, show a warming of approximately 0.85° Celsius over the period 1880 to 2012 (IPCC 2014). Each of the last three decades has been successively warmer at the Earth's surface than any preceding decade since 1850 (IPCC 2014). Burning fossil fuels has increased atmospheric carbon dioxide concentrations by 35 percent with respect to pre-industrial levels, with consequent climatic disruptions that include a higher rate of global warming than occurred at the last global-scale state shift (the last glacial-interglacial transition, approximately 12,000 years ago) (Barnosky et al. 2012). Ocean warming dominates the increase in energy stored in the climate system, accounting for more than 90 percent of the energy accumulated between 1971 and 2010 (IPCC 2014). It is virtually certain that the upper ocean (zero to 700 meters) warmed from 1971 to 2010 and it likely warmed between the 1870s and 1971 (IPCC 2014). On a global scale, ocean warming is largest near the surface, and the upper 75 meters warmed by 0.11° Celsius per decade over the period 1971 to 2010 (IPCC 2014). There is high confidence, based on substantial evidence, that observed changes in marine systems are associated with rising water temperatures, as well as related changes in ice cover, salinity, oxygen levels, and circulation. Higher carbon dioxide concentrations have also caused the ocean rapidly to become more acidic, evident as a decrease in pH by 0.05 in the past two decades (Doney 2010).

This climate change is projected to have substantial direct and indirect effects on individuals, populations, species, and the structure and function of marine ecosystems in the near future. It is most likely to have the most pronounced effects on species whose populations are already in tenuous positions (Isaac 2009). As such, we expect the extinction risk of ESA-listed species to rise with global warming. Primary effects of climate change on individual species include habitat loss or alteration, distribution changes, altered and/or reduced distribution and abundance of prey, changes in the abundance of competitors and/or predators, shifts in the timing of seasonal activities of species, and geographic isolation or extirpation of populations that are unable to adapt. Secondary effects include increased stress, disease susceptibility, and predation.

The Northern Hemisphere (where a greater proportion of ESA-listed species occur) is warming faster than the Southern Hemisphere, although land temperatures are rising more rapidly than over the oceans (Poloczanska et al. 2009). In the western North Atlantic, sea surface temperatures have been unusually warm in recent years (Blunden and Arndt 2016). A study by

(Polyakov et al. 2010), suggests that the North Atlantic overall has been experiencing a general warming trend over the last 80 years of 0.031 ± 0.006 ºCelsius per decade in the upper 2,000 meters of the ocean. The ocean along the United States eastern seaboard is also much saltier than historical averages (Blunden and Arndt 2014). The direct effects of climate change will result in increases in atmospheric temperatures, changes in sea surface temperatures, patterns of precipitation, and sea level.

For sea turtles, temperature regimes generally lead toward female-biased nests (Hill et al. 2015). Acevedo-Whitehouse and Duffus (2009) proposed that the rapidity of environmental changes, such as those resulting from global warming, can harm immunocompetence and reproductive parameters in wildlife to the detriment of population viability and persistence. An example of this is the altered sex ratios observed in sea turtle populations worldwide (Mazaris et al. 2008; Reina et al. 2009; Robinson et al. 2009; Fuentes et al. 2010).

This does not appear to have yet affected population viabilities through reduced reproductive success, although nesting and emergence dates of days to weeks in some locations have changed over the past several decades (Poloczanska et al. 2009). Altered ranges can also result in the spread of novel diseases to new areas via shifts in host ranges (Simmonds and Eliott 2009; Schumann et al. 2013).

Changes in global climatic patterns will likely have profound effects on the coastlines of every continent by increasing sea levels and the intensity, if not the frequency, of hurricanes and tropical storms (Wilkinson and Souter 2008). A half-degree-Celsius increase in temperatures during hurricane season from 1965-2005 correlated with a 40 *percent* increase in cyclone activity in the Atlantic. Sea levels have risen an average of 1.7 mm/year over the 20th century due to glacial melting and thermal expansion of ocean water; this rate will likely increase. The current pace is nearly double this, with a 20-year trend of 3.2 mm/year (Blunden and Arndt 2014). This is largely due to thermal expansion of water, with minor contributions from melt water (Blunden and Arndt 2014). Based on computer models, these phenomena would inundate nesting beaches of sea turtles, change patterns of coastal erosion and sand accretion that are necessary to maintain those beaches, and would increase the number of turtle nests destroyed by tropical storms and hurricanes (Wilkinson and Souter 2008). Inundation itself reduces hatchling success by creating hypoxic conditions within inundated eggs (Pike et al. 2015). In addition, flatter beaches preferred by smaller sea turtle species would be inundated sooner than would steeper beaches preferred by larger species (Hawkes et al. 2014). The loss of nesting beaches, by itself, would have catastrophic effects on sea turtle populations globally if they are unable to colonize new beaches that form or if the beaches do not provide the habitat attributes (sand depth, temperature regimes, refuge) necessary for egg survival. In some areas, increases in sea level alone may be sufficient to inundate sea turtle nests and reduce hatching success (Caut et al. 2009). Storms may also cause direct harm to sea turtles, causing "mass" strandings and mortality (Poloczanska et al. 2009). Increasing temperatures in sea turtle nests alters sex ratios, reduces incubation times (producing smaller hatchling), and reduces nesting success due to exceeded thermal tolerances

(Fuentes et al. 2009; Fuentes et al. 2010; Fuentes et al. 2011). Smaller individuals likely experience increased predation (Fuentes et al. 2011).

5.2 Habitat Degradation

A number of factors may be directly or indirectly affecting ESA-listed species in the action area by degrading habitat. In-water construction activities (e.g., pile driving associated with shoreline projects) in both inland waters as well as coastal waters in the action area can produce sound levels sufficient to disturb sea turtles under some conditions. Pressure levels from 190-220 decibels to 1 micropascal were reported for piles of different sizes in a number of studies (NMFS 2006c). The majority of the sound energy associated with pile driving is in the low frequency range (less than 1,000 Hertz) (Reyff 2003; Illingworth Rodkin Inc. 2004), which is the frequency range at which sea turtles hear best. Dredging operations also have the potential to emit sounds at levels that could disturb sea turtles. Depending on the type of dredge, peak sound pressure levels from 100 to 140 dB re 1 micropascal were reported in one study (Clarke et al. 2003). As with pile driving, most of the sound energy associated with dredging is in the low-frequency range, less than 1,000 Hertz (Clarke et al. 2003).

Several measures have been adopted to reduce the sound pressure levels associated with in-water construction activities or prevent exposure of sea turtles to sound. For example, a six-inch block of wood placed between the pile and the impact hammer used in combination with a bubble curtain can reduce sound pressure levels by about 20 decibels (NMFS 2008b). Alternatively, pile driving with vibratory hammers produces peak pressures that are about 17 dB lower than those generated by impact hammers (Nedwell and Edwards 2002). Other measures used in the action area to reduce the risk of disturbance from these activities include avoidance of in-water construction activities during times of year when sea turtles may be present; monitoring for sea turtles during construction activities; and maintenance of a buffer zone around the project area, within which sound-producing activities would be halted when sea turtles enter the zone (NMFS 2008b).

Marine debris is a significant concern for listed species and their habitats. Marine debris accumulates in gyres throughout the oceans. The input of plastics into the marine environment also constitutes a significant degradation to the marine environment. In 2010, an estimated 4.8-12.7 million metric tons of plastic entered the ocean globally (Baulch and Simmonds 2015).

For sea turtles, marine debris is a problem due primarily to individuals ingesting debris and blocking the digestive tract, causing death or serious injury (Lutcavage et al. 1997; Laist et al. 1999). Schuyler et al. (2015) estimated that, globally, 52 *percent* of individual sea turtles have ingested marine debris. Gulko and Eckert (2003) estimated that between one-third and one-half of all sea turtles ingest plastic at some point in their lives; this figure is supported by data from Lazar and Gracan (2011), who found 35 *percent* of loggerheads had plastic in their gut. A Brazilian study found that 60 *percent* of stranded green sea turtles had ingested marine debris (Bugoni et al. 2001). Loggerhead sea turtles had a lesser frequency of marine debris ingestion. Plastic is possibly ingested out of curiosity or due to confusion with prey items. Marine debris consumption has been shown to depress growth rates in post-hatchling loggerhead sea turtles, elongating the time required to reach sexual maturity and increasing predation risk (McCauley and Bjorndal 1999). Sea turtles can also become entangled and die in marine debris, such as discarded nets and monofilament line (NRC 1990; Lutcavage et al. 1997; Laist et al. 1999).

5.3 Fisheries

Globally, 6.4 million tons of fishing gear is lost in the oceans every year (Wilcox et al. 2015). Fishery interaction remains a major factor in sea turtle recovery and, frequently, the lack thereof. It is estimated that 62,000 loggerhead sea turtles have been killed as a result of incidental capture and drowning in shrimp trawl gear in 2001(Epperly et al. 2002). Although turtle excluder devices and other bycatch reduction devices have significantly reduced the level of bycatch to sea turtles and other marine species in U.S. waters, mortality still occurs in Gulf of Mexico waters. In addition to commercial bycatch, recreational hook-and-line interaction also occurs. Cannon and Flanagan (1996) reported that from 1993 to 1995, at least 170 Kemp's ridley sea turtles were hooked or tangled by recreational hook-and-line gear in the northern Gulf of Mexico. Of these, 18 were dead stranded turtles, 51 were rehabilitated turtles, five died during rehabilitation, and 96 were reported as released by fishermen.

5.3.1 Federal Activities

Threatened and endangered sea turtles are adversely affected by several types of fishing gears used throughout the action area. Gillnet, longline, other types of hook-and-line gear, trawl gear, and pot fisheries have all been documented as interacting with sea turtles. Available information suggests sea turtles can be captured in any of these gear types when the operation of the gear overlaps with the distribution of sea turtles. For all fisheries for which there is a Fishery Management Plan (FMP) or for which any federal action is taken to manage that fishery, impacts have been evaluated under section 7. Formal section 7 consultation has been conducted on the following fisheries, occurring at least in part within the action area, found likely to adversely affect threatened and endangered sea turtles: American lobster, 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 (HMS) fishery, Gulf of Mexico/South Atlantic spiny lobster, and Gulf of Mexico stone crab. An incidental take statement has been issued for the take of sea turtles in each of the fisheries. A brief summary of each consultation is provided below but more detailed information can be found in the respective biological opinions.

The only fishery that has been determined by NMFS to reduce the reproduction, numbers, or distribution of ESA-listed sea turtles, and thereby reduce appreciably their likelihood of survival and recovery, is the pelagic longline component of the Atlantic highly migratory species fishery. On June 14, 2001, NMFS released a biological opinion that found that the continued operation of the Atlantic pelagic longline fishery was likely to jeopardize the continued existence of both loggerhead and leatherback sea turtles. To avoid jeopardy to these species, a reasonable and prudent alternative was developed. The reasonable and prudent alternative required the closure of the Northeast Distant Statistical Area of the Atlantic Ocean to pelagic longlining and the enactment of a research program to develop or modify fishing gear and techniques to reduce sea turtle interactions and mortality associated with such interactions. On June 1, 2004, NMFS released another opinion on the Atlantic pelagic longline fishery which stated that the fishery was still likely to jeopardize the continued existence of leatherback sea turtles. Another reasonable and prudent alternative was then developed to attempt to remove jeopardy. The RPA required that NMFS (1) reduce post-release mortality of leatherbacks, (2) improve monitoring of the effects of the fishery, (3) confirm the effectiveness of the hook and bait combinations that are required as part of the proposed action, and (4) take management action to avoid long-term elevations in leatherback takes or mortality. NMFS stated in the opinion that this reasonable and prudent alternative must be implemented in its entirety to avoid jeopardy. A brief summary of each consultation is provided below but more detailed information can be found in the respective biological opinions.

NMFS found the operation of the Atlantic bluefish fishery was likely to adversely affect Kemp's ridley and loggerhead sea turtles, but not likely to jeopardize their continued existence (NMFS 2010a). The majority of commercial fishing activity in the North and Mid-Atlantic occurs in the late spring to early fall, when bluefish (and sea turtles) are most abundant in these areas (NMFS 2005).

NMFS' consultation on the Atlantic Herring fishery FMP concluded that the federal herring fishery may adversely affect loggerhead, leatherback, Kemp's ridley, and green sea turtles as a result of capture in gear used in the fishery, but not jeopardize their continued existence. NMFS currently authorizes the use of trawl, purse seine, and gillnet gear in the commercial herring fishery (64 FR 4030). There is no direct evidence of takes of ESA-listed species in the herring fishery from the NMFS sea sampling program. However, observer coverage of this fishery has been minimal. Sea turtles have been captured in comparable gear used in other fisheries that occur in the same area as the herring fishery. Consultation on the Atlantic herring fishery was reinitiated on March 23, 2005 due to new information on the effects of the fishery on the Gulf of Maine DPS of Atlantic salmon and sea turtles. That consultation was completed in February 2010 and determined that the herring fishery is not likely to adversely affect any ESA-listed species, including sea turtles. Murray (2006) estimated zero sea turtle takes in trawl gear by the Atlantic herring fishery. In addition, over the five year period from 2004 to 2008, higher than normal observer coverage occurred in the herring fishery, without any observed takes of sea turtles.

The Atlantic mackerel/squid/butterfish fisheries are managed under a single FMP that includes both the short-finned squid and long-finned squid fisheries. The most recent biological opinion concluded that the continued authorization of the FMP was likely to adversely affect sea turtles, but not jeopardize their continued existence (NMFS 2010g). Trawl gear is the primary fishing gear for these fisheries, but several other types of gear may also be used, including hook-and-line, pot/trap, dredge, pound net, and bandit gear. Entanglements or entrapments of sea turtles have been recorded in one or more of these gear types.

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

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

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

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

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

The federal monkfish fishery occurs from Maine to the North Carolina/South Carolina border and is jointly managed by the New England Fishery Management Council and Mid-Atlantic Fishery Management Council, under the Monkfish FMP (NMFS 2010b). The current commercial fishery operates primarily in the deeper waters of the Gulf of Maine, Georges Bank, and southern New England, and effort has recently increased dramatically in the mid-Atlantic. The monkfish fishery uses several gear types that may entangle sea turtles, including gillnet, trawl gear and scallop dredges, which are the principal gear types that have historically landed monkfish. Monkfish (also known as "goosefish" or "angler") are found in inshore and offshore waters from the northern Gulf of St. Lawrence to Florida, although primarily distributed north of Cape Hatteras. As fishing effort moves further south, there is a greater potential for interactions with sea turtles.

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

Multiple gear types are used in the Northeast Multispecies fishery FMP, which manages 15 different commercial fisheries. Data indicated that gear type of greatest concern is the sink gillnet gear, which has taken loggerhead and leatherback sea turtles (i.e., in buoy lines and/or net panels). The Northeast multi species sink gillnet fishery has historically occurred from the periphery of the Gulf of Maine to Rhode Island in water as deep as 360 feet. In recent years, more of the effort in the fishery has occurred in offshore waters and into the Mid-Atlantic. Participation in this fishery has declined because extensive groundfish conservation measures have been implemented; the latest of these occurring under Amendment 13 to the Multispecies FMP. Consultation on the Northeast Multispecies fishery was reinitiated on April 2, 2008, based on new information on the capture of loggerhead sea turtles in this fishery (NMFS 2010c).

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

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

Indirect effects of shrimp trawling on sea turtles would include the disturbance of the benthic habitat by the trawl gear. The effect bottom trawls have on the seabed is mainly a function of bottom type. In areas where repeated trawling occurs, fundamental shifts in the structure of the benthic community have been documented (Auster et al. 1996) which may affect the availability of prey items for foraging turtles. The overall effect to benthic communities that may result from long-term and chronic disturbance from shrimp fishing is not understood and needs further evaluation.

The primary gear types for the spiny dogfish fishery are sink gillnets, otter trawls, bottom long line, and driftnet gear (NMFS 2010d). Spiny dogfish are landed in every state from Maine to North Carolina, throughout a broad area with the distribution of landings varying by area and season. During the fall and winter months, spiny dogfish are captured principally in Mid-Atlantic waters from New Jersey to North Carolina. During the spring and summer months, spiny dogfish are landed mainly in northern waters from NY to ME. Sea turtles can be incidentally captured in all gear sectors of this fishery. Although there have been delays in implementing the FMP, quota allocations are expected to be substantially reduced over the 4.5-year rebuilding schedule; this should result in a substantial decrease in effort directed at spiny dogfish. The reduction in effort should be of benefit to protected turtle species by reducing the number of gear interactions that occur.

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

Traditionally, the main gear types used in the skate fishery (NMFS 2010h) include mobile otter trawls, gillnet gear, hook and line, and scallop dredges, although bottom trawling is by far the most common gear type with gillnet gear is the next most common gear type. The Northeast skate complex is comprised of seven different skate species. The seven species of skate are distributed along the coast of the northeast United States from the tide line to depths exceeding 700m (383 fathoms). There have been no recorded takes of ESA-listed species in the skate fishery. However, given that sea turtles interactions with trawl and gillnet gear have been observed in other fisheries, sea turtle takes in gear used in the skate fishery may be possible where the gear and sea turtle distribution overlap.

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

The Summer Flounder, Scup and Black Sea Bass fisheries (NMFS 2010e) are known to interact with sea turtles. Otter trawl gear is used in the commercial fisheries for all three species. Floating traps and pots/traps are used in the scup and black sea bass fisheries, respectively. Significant measures have been developed to reduce the take of sea turtles in summer flounder trawls and trawls that meet the definition of a summer flounder trawl (which would include fisheries for other species like scup and black sea bass). TEDs are required throughout the year for trawl nets fished from the North Carolina/South Carolina border to Oregon Inlet, North Carolina, and seasonally (March 16-January 14) for trawl vessels fishing between Oregon Inlet, North Carolina, and Cape Charles, Virginia.

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

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

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

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

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

The commercial Gulf of Mexico/South Atlantic spiny lobster fishery (NMFS 2013b) consists of diving, bully net and trapping sectors; recreational fishers are authorized to use bully net and hand-harvest gears. The consultation determined that, although evidence that the commercial trap sector of the fishery adversely affects these species, the continued authorization of the fishery would not jeopardize the continued existence of green, hawks bill, Kemp's ridley leatherback, and loggerhead sea turtles.

The Gulf of Mexico stone crab fishery (NMFS 2013b) is unique in that only the claws of the crab are harvested (Muller et al. 2006). The fishery operates primarily nearshore and fishing techniques have changed little since the implementation of the federal Stone Crab Fishery Management Plan. The commercial and recreational fishery consists of trap/pot, and recreational hand harvest. Stone crab traps are known to adversely affect sea turtles via entanglement and forced submergence. The fishery is currently management through spatial-temporal closures, effort limitations, harvest limitations, permit requirements, trap construction requirements, and a passive trap limitation program managed by the State of Florida. Recreational fishers must follow the same guidelines as commercial fishers unless otherwise noted. The consultation determined the continued authorization of the fishery would not jeopardize the continued existence of green, hawksbill, Kemp's ridley leatherback, and loggerhead sea turtles.

5.3.2 State or Private Fisheries

Various fishing methods used in state fisheries, including trawling, pot fisheries, fly nets, and gillnets are known to incidentally take listed species, but information on these fisheries is sparse (NMFS SEFSC 2001). Although few of these state regulated fisheries are currently authorized to incidentally take listed species, several state agencies have approached NMFS to discuss applications for a section 10(a)(1)(B) incidental take permit. Since the NMFS issuance of a section 10(a)(1)(B) permit requires formal consultation under section 7 of the ESA, the effects of these activities are considered in section 7 consultation. Any fisheries that come under a section 10(a)(1)(B) permit in the future will likewise be subject to section 7 consultation. Although the past and current effects of these fisheries on listed species is currently not determinable, NMFS believes that ongoing state fishing activities may be responsible for seasonally high levels of observed stranding of sea turtles on both the Atlantic and Gulf of Mexico coasts. Most of the state data are based on extremely low observer coverage or sea turtles were not part of data collection; thus, these data provide insight into gear interactions that could occur but are not indicative of the magnitude of the overall problem. In addition to the lack of interaction data, there is another issue that complicates the analysis of impacts to sea turtles from these fisheries. Certain gear types may have high levels of sea turtle takes, but very low rates of serious injury or mortality. For example, the hook and line takes rarely result in death, but trawls and gillnets frequently do. Leatherbacks seem to be susceptible to a more restricted list of fisheries, while the hard shelled turtles, particularly loggerheads, seem to appear in data on almost all of the state fisheries.

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

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

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

Pound nets are a passive, stationary gear that are known to incidentally capture loggerhead sea turtles in Massachusetts, Rhode Island, New Jersey, Maryland, New York (Morreale and Standora 1998), Virginia (Bellmund et al. 1987) and North Carolina (Epperly et al. 2000). Although pound nets are not a significant source of mortality for loggerheads in New York (Morreale and Standora 1998) and North Carolina (Epperly et al. 2000), they have been implicated in the stranding deaths of loggerheads in the Chesapeake Bay from mid-May through early June (Bellmund et al. 1987). Pound net leaders with greater than or equal to 12 inches (30.5 cm) stretched mesh and leaders with stringers have been documented to incidentally take sea turtles (Bellmund et al. 1987; NMFS SEFSC 2001).

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

5.4 Dredging

Marine dredging vessels are common within U.S. coastal waters. Construction and maintenance of federal navigation channels and dredging in sand mining sites have been identified as sources of sea turtle mortality and are currently being undertaken along the U.S. East Coast, such as in Port Everglades, Florida. Hopper dredges in the dredging mode are capable of moving relatively quickly compared to sea turtle swimming speed and can thus overtake, entrain, and kill sea turtles as the suction draghead(s) of the advancing dredge catch up to resting or swimming turtles. Entrained sea turtles rarely survive. Relocation trawling frequently occurs in association with dredging projects to reduce the potential for dredging to injure or kill sea turtles (Dickerson et al. 2007). Dredging has been documented to capture or kill 168 sea turtles from 1995 to 2009 in the Gulf of Mexico, including 97 loggerheads, 35 Kemp's ridleys, 32 greens, and three unidentified sea turtles (USACE 2010).

5.5 United States Military Activities

Naval activities conducted during training exercises in designated naval operating areas and training ranges have the potential to adversely harm sea turtles and sturgeon. Species occurring in the action area could experience stressors from several naval training ranges or facilities listed below. Listed individuals travel widely in the North Atlantic and could be exposed to naval activities in several ranges.

- The Virginia Capes, Cherry Point, and Jacksonville-Charleston Operating Areas, which are situated consecutively along the migratory corridor for sea turtles, and
- The Key West, Gulf of Mexico, Bermuda, and Puerto Rican Complexes have the potential to overlap the range of sea turtles species.

Naval activities to which individuals could be exposed include, among others, vessel and aircraft transects, munition detonations, and sonar use.

Anticipated impacts from harassment include changes from foraging, resting, and other behavioral states that require lower energy expenditures to traveling, avoidance, and behavioral states that require higher energy expenditures and, therefore, would represent significant disruptions of the normal behavioral patterns of the animals that have been exposed. Behavioral responses that result from stressors associated with these training activities are expected to be temporary and would not affect the reproduction, survival, or recovery of these species.

From 2009-2012, NMFS issued a series of biological opinions to the US Navy for training activities occurring within their Virginia Capes, Cherry Point, and Jacksonville Range Complexes that anticipated annual levels of take of listed species incidental to those training activities through 2014. During the proposed activities 344 hardshell sea turtles (any combination of green, hawksbill, Kemp's ridley, olive ridley, or northwest Atlantic loggerhead sea turtles) per year were expected to be harassed as a result of their behavioral responses to mid- and high-frequency active sonar transmissions.

In 2013, NMFS issued a biological opinion to the United States Navy on all testing and training activities in the Atlantic basin and Gulf of Mexico (Table 12) (NMFS 2013a). These actions would include the same behavioral and hearing loss effects as described above, but would also include other sub-lethal injuries that lead to fitness consequences and mortality that can lead to the loss of individuals from their populations.

Table 12. Annual total of model-predicted impacts on sea turtles for training activities using sonar and other active non-implusive acoustic sources for U.S. Navy testing activities in the North Atlantic.

Sea turtle species	Harassment Temporary threshold shift	Injury Permanent threshold shift
Hardshell sea turtles	12,131	11
Kemp's ridley	263	0
Leatherback	8,806	9
Loggerhead	16,624	16

5.6 Pollutants

The Gulf of Mexico is a sink for massive levels of pollution from a variety of marine and terrestrial sources, which ultimately can interfere with ecosystem health and particularly that of sea turtles. Sources include the petrochemical industry in and along the Gulf of Mexico, wastewater treatment plants, septic systems, industrial facilities, agriculture, animal feeding operations, and improper refuse disposal. The Mississippi River drains 80 percent of United States cropland (including the fertilizers, pesticides, herbicides, and other contaminants that are applied to it) and discharges into the Gulf of Mexico (MMS 1998). Agricultural discharges and discharges from large urban centers (e.g., Tampa) contribute contaminants as well as coliform bacteria to Gulf of Mexico habitats (Garbarino et al. 1995). These contaminants can be carried long distances from terrestrial or nearshore sources and ultimately accumulate in offshore pelagic environments (USCOP 2004). The ultimate impacts of this pollution are poorly understood.

Significant attention has been paid to nutrient enrichment of Gulf of Mexico waters, which leads to algal blooms (including harmful algal blooms), oxygen depletion, loss of seagrass and coral reef habitat, and the formation of a hypoxic “dead zone” (USCOP 2004). This hypoxic event occurs annually from as early as February to as late as October, spanning roughly 12,700 square kilometers (although in 2005 the “dead zone” grew to a record size of 22,000 square kilometers) from the Mississippi River Delta to Galveston, Texas (MMS 1998; Rabalais et al. 2002; LUMCON 2005). Although sea turtles do not extract oxygen from sea water, numerous staple prey items of sea turtles, such as fish, shrimp, and crabs, do and are killed by the hypoxic conditions (Craig et al. 2001). More generally, the “dead zone” decreases biodiversity, alters marine food webs, and destroys habitat (Craig et al. 2001; Rabalais et al. 2002). High nitrogen loads entering the Gulf of Mexico from the Mississippi River is the likely culprit; nitrogen concentrations entering the Gulf of Mexico have increased three fold over within 60 years (Rabalais et al. 2002).

5.7 Oil Spills and Releases

Oil pollution has been a significant concern in the Gulf of Mexico for several decades due to the large amount of extraction and refining activity in the region. Routine discharges into the northern Gulf of Mexico (not including oil spills) include roughly 88,200 barrels of petroleum per year from municipal and industrial wastewater treatment plants and roughly 19,250 barrels from produced water discharged overboard during oil and gas operations (MMS 2007b; USN 2008). These sources amount to over 100,000 barrels of petroleum discharged into the northern Gulf of Mexico annually. Although this is only 10 percent of the amount discharged in a major oil spill, such as the Exxon Valdez spill (roughly 1 million barrels), this represents a significant and “unseen” threat to Gulf of Mexico wildlife and habitats. Generally, accidental oil spills may amount to less than 24,000 barrels of oil discharged annually in the northern Gulf of Mexico, making non-spilled oil normally one of the leading sources of oil discharge into the Gulf of Mexico, although incidents such as the 2010 Deepwater Horizon incident are exceptional (MMS 2007b). The other major source from year to year is oil naturally seeping into the northern Gulf of Mexico. Although exact figures are unknown, natural seepage is estimated at between 120,000 and 980,000 barrels of oil annually (MacDonald et al. 1993; MMS 2007b).

Although non-spilled oil is the primary contributor to oil introduced into the Gulf of Mexico, concern over accidental oil spills is well-founded (Campagna et al. 2011). Over five million barrels of oil and one million barrels of refined petroleum products are transported in the northern Gulf of Mexico daily (MMS 2007b); worldwide, it is estimated that 900,000 barrels of oil are released into the environment as a result of oil and gas activities (Epstein and Selber 2002). Even if a small fraction of the annual oil and gas extraction is released into the marine environment, major, concentrated releases can result in significant environmental impacts. Oil released into the marine environment contains aromatic organic chemicals known to be toxic to a variety of marine life; these chemicals tend to dissolve into the air to a greater or lesser extent, depending on oil type and composition (Yender et al. 2002).

Several oil spills have affected the northern Gulf of Mexico over the past few years, largely due to hurricanes. The impacts of Hurricane Ivan in 2004 on the Gulf Coast included pipeline damage causing 16,000 barrels of oil to be released and roughly 4,500 barrels of petroleum products from other sources (USN 2008). The next year, Hurricane Katrina caused widespread damage to onshore oil storage facilities, releasing 191,000 barrels of oil (LHR 2010). Another 4,530 barrels of oil were released from 70 other smaller spills associated with hurricane damage. Shortly thereafter, Hurricane Rita damaged offshore facilities resulting in 8,429 barrels of oil released (USN 2008).

Major oil spills have impacted the Gulf of Mexico for decades (NMFS 2010i). Until 2010, the largest oil spill in North America (Ixtoc oil spill) occurred in the Bay of Campeche (1979), when a well “blew out,” allowing oil to flow into the marine environment for nine months, releasing 2.8-7.5 million barrels of oil. Oil from this release eventually reached the Texas coast, including the Kemp’s ridley sea turtle nesting beach at Rancho Nuevo, where 9,000 hatchlings were airlifted and released offshore (NOAA 2010). Over 7,600 cubic meters of oiled sand was eventually removed from Texas beaches, and 200 gallons of oil were removed from the area around Rancho Nuevo (NOAA 2010). Eight dead and five live sea turtles were recovered during the oil spill event; although causes of deaths were not determined, oiling was suspected to play a part (NOAA 2010). Also in 1979, the oil tanker Burmah Agate collided with another vessel near Galveston, Texas, causing an oil spill and fire that ultimately released 65,000 barrels of oil into estuaries, beachfronts, and marshland along the northern and central Texas coastline (NMFS 2010i). Clean up of these areas was not attempted due to the environmental damage such efforts would have caused. Another 195,000 barrels of oil are estimated to have been burned in a multi-month-long fire aboard the Burmah Agate (NMFS 2010i). The tanker Alvenus grounded in 1984 near Cameron, Louisiana, spilling 65,500 barrels of oil, which spread west along the shoreline to Galveston (NMFS 2010i). One oiled sea turtle was recovered and released (NOAA 2010). In 1990, the oil tanker Megaborg experienced an accident near Galveston during the lightering process and released 127,500 barrels of oil, most of which burned off in the ensuing fire (NMFS 2010i).

On April 20 2010, a fire and explosion occurred aboard the semisubmersible drilling platform Deepwater Horizon roughly 80 km southeast of the Mississippi Delta. The platform had 17,500 barrels of fuel aboard, which likely burned, escaped, or sank with the platform. However, once the platform sank, the riser pipe connecting the platform to the wellhead on the seafloor broke in multiple locations, initiating an uncontrolled release of oil from the exploratory well. Over the next three months, oil was released into the Gulf of Mexico, resulting in oiled regions of Texas, Louisiana, Mississippi, Alabama, and Florida and widespread oil slicks throughout the northern Gulf of Mexico that closed more than one-third of the US Gulf of Mexico Exclusive Economic Zone to fishing due to contamination concerns. Apart from the widespread surface slick, massive undersea oil plumes formed, possibly through the widespread use of dispersants and reports of tarballs washing ashore throughout the region were common. Although estimates vary, roughly 4.1 million barrels of oil were released directly into the Gulf of Mexico (USDOI 2012). During surveys in offshore oiled areas, 1,050 sea turtles were seen and half of these were captured. Of the 520 sea turtles captured, 394 showed signs of being oiled (Witherington et al. 2012b). A large majority of these were juveniles, mostly green (311) and Kemp's ridley sea turtles (451). An additional 78 adult or subadult loggerheads were observed (Witherington et al. 2012b). Captures of sea turtles along the Louisiana's Chandeleur Islands in association with emergency sand berm construction resulted in 185 loggerheads, eight Kemp's ridley, and a single green sea turtle being captured and relocated (Dickerson and Bargo 2012). In addition, 274 nests along the Florida panhandle were relocated that ultimately produced 14,700 hatchlings, but also had roughly 2 percent mortality associated with the translocation (MacPherson et al. 2012). Females that laid these nests continued to forage in the area, which was exposed to the footprint of the oil spill (Hart et al. 2014). Large areas of Sargassum were affected, with some heavily oiled or dispersant-coated Sargassum sinking and other areas accumulating oil where sea turtles could inhale, ingest, or contact it (USDOI 2012; Powers et al. 2013). Of 574 sea turtles observed in these Sargassum areas, 464 were oiled (USDOI 2012).

Use of dispersants can increase oil dispersion, raising the levels of toxic constituents in the water column, but speeding chemical degradation overall (Yender et al. 2002). Although the effects of dispersant chemicals on sea turtles is unknown, testing on other organisms have found currently used dispersants to be less toxic than those used in the past (NOAA 2010). It is possible that dispersants can interfere with surfactants in the lungs (surfactants prevent the small spaces in the lungs from adhering together due to surface tension, facilitating large surface areas for gas exchange), as well as interfere with digestion, excretion, and salt gland function (NOAA 2010). The most toxic chemicals associated with oil can enter marine food chains and bioaccumulate in invertebrates such as crabs and shrimp to a small degree (prey of some sea turtles) (Law and Hellou 1999), but generally do not bioaccumulate or biomagnify in finfish (Varanasi et al. 1989; Meador et al. 1995; Yender et al. 2002). Sea turtles are known to ingest and attempt to ingest tar balls, which can block their digestive systems, impairing foraging or digestion and potentially causing death (NOAA 2010), ultimately reducing growth, reproductive success, as well as increasing mortality and predation risk (Fraser 2014). Tarballs were found in the digestive tracts of 63 percent of post hatchling loggerheads in 1993 following an oil spill and 20 percent of the same species and age class in 1997 (Fraser 2014). Oil exposure can also cause acute damage on direct exposure to oil, including skin, eye, and respiratory irritation, reduced respiration, burns to mucous membranes such as the mouth and eyes, diarrhea, gastrointestinal ulcers and bleeding, poor digestion, anemia, reduced immune response, damage to kidneys or liver, cessation of salt gland function, reproductive failure, and death (Vargo et al. 1986; NOAA 2010). Nearshore spills or large offshore spills can oil beaches on which sea turtles lay their eggs, causing birth defects or mortality in the nests (NOAA 2010).

Oil can also cause indirect effects to sea turtles through impacts to habitat and prey organisms. Seagrass beds may be particularly susceptible to oiling as oil contacts grass blades and sticks to them, hampering photosynthesis and gas exchange (Wolfe et al. 1988)s. If spill cleanup is attempted, mechanical damage to seagrass can result in further injury and long-term scarring. Loss of seagrass due to oiling would be important to green sea turtles, as this is a significant component of their diets (NOAA 2010). The loss of invertebrate communities due to oiling or oil toxicity would also decrease prey availability for hawksbill, Kemp's ridley, and loggerhead sea turtles (NOAA 2010). Furthermore, Kemp's ridley and loggerhead sea turtles, which commonly forage on crustaceans and mollusks, may ingest large amounts of oil due oil adhering to the shells of these prey and the tendency for these organisms to bioaccumulate the toxins found in oil (NOAA 2010). It is suspected that oil adversely affected the symbiotic bacteria in the gut of herbivorous marine iguanas when the Galapagos Islands experienced an oil spill, contributing to a more than 60 percent decline in local populations the following year. The potential exists for green sea turtles to experience similar impacts, as they also harbor symbiotic bacteria to aid in their digestion of plant material (NOAA 2010). Dispersants are believed to be as toxic to marine organisms as oil itself.

5.8 Entrainment, Entrapment, and Impingement in Power Plants

There are dozens of power plants in coastal areas of the action area, from South Carolina to Texas (Muyskens et al. 2015). Sea turtles have been affected by operation of cooling-water systems of electrical generating plants. We do not have data for many of these, but have reason to believe that impacts to particularly loggerhead and green sea turtles may be important. For example, in over 40 years of operation at the St. Lucie Nuclear Power Plant in Florida, 16,600 sea turtles have been captured to avoid being drawn into cooling structures (which likely would kill sea turtles that enter), and 297 have died (NMFS 2016). These included: 9552 loggerheads (including 180 mortalities), 6886 green (including 112 mortalities), 42 leatherback (no mortalities), 67 Kemp's ridley (including four mortalities), and 65 hawksbill sea turtles (including one mortality) (NMFS 2016). Only since 2001 have the mortalities been classified as causally (or non-causally) related to operation of St. Lucie Nuclear Power Plant, and not all mortalities were causal to St. Lucie Nuclear Power Plant operations: 59 percent of dead loggerheads were causal to St. Lucie Nuclear Power Plant operation, 46 percent of greens, and none of hawksbills (no leatherback or Kemp's ridley mortalities occurred since 2001) (NMFS 2016).

Effects from cooling system operations generally involve stress, injury, and mortality from being captured, entrained, or impinged by cooling water intake systems. Cooling water discharge (which is warmer than the surrounding water temperature) can alter habitat around the outflow pipe. This can present advantages (such as shelter from cold water temperatures that may stun sea turtles and allow for unseasonal growth of marine plants that green sea turtles may forage upon) and disadvantages (such as altering normal ecology sea turtles and sturgeon rely upon and result in individuals depending on unnatural conditions that can be problematic if a plant is decommissioned or goes offline) for ESA-listed species.

5.9 Seismic Surveys and Oil and Gas Development

The northern Gulf of Mexico is the location of massive industrial activity associated with oil and gas extraction and processing. Over 4,000 oil and gas structures are located outside of state waters in the northern Gulf of Mexico; 90 percent of these occur off Louisiana and Texas (USN 2009). This is both detrimental and beneficial for sea turtles. These structures appreciably increase the amount of hard substrate in the marine environment and provide shelter and foraging opportunities for species like loggerhead sea turtles (Parker Jr. et al. 1983; Stanley and Wilson 1989). However, the Bureau of Ocean Energy Management requires that structures must be removed within one year of lease termination. Many of these structures are removed by explosively severing the underwater supportive elements, which produces a shock wave that kills, injures, or disrupts marine life in the blast radius (Gitschlag et al. 1997).

For sea turtles, this means death or serious injury for individuals within a few hundred meters of the structure and overt behavioral (potentially physiological) impacts for individuals further away from the structure (Duronslet et al. 1986; Klima et al. 1988). Although observers and procedures are in place to mitigate impacts to sea turtles (i.e., not blasting when sea turtles are present), not all sea turtles are observed all the time, and low-level sea turtle injury and mortality still occurs (Gitschlag and Herczeg 1994; Gitschlag et al. 1997). Two loggerheads were killed in August 2010, and one Kemp's ridley was killed in July 2013, along with several additional stunning or sub-lethal injuries reported over the past five years. In an August 28, 2006 opinion, NMFS issued incidental take for Bureau of Ocean Energy Management-permitted explosive structure removals (NMFS 2006a). These levels were far surpassed by the *Deepwater Horizon* incident.

5.10 Hurricanes

The Gulf of Mexico is prone to major tropical weather systems, including tropical storms and hurricanes. The impacts of these storms on sea turtles in the marine environment is not known, but storms can cause major impacts to sea turtle eggs on land, as nesting frequently overlaps with hurricane season, particularly Kemp's ridley sea turtles (NRC 1990). Embryos (in eggs) or hatchlings can drown during heavy rainfalls, and major topographic alteration to beaches can cause hatchlings to die by preventing their entry to marine waters (NRC 1990). Kemp's ridley sea turtles are likely highly sensitive to hurricane impacts, as their only nesting locations are in a limited geographic area along southern Texas and northern Mexico (Milton et al. 1994).

5.11 Vessel Strikes

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

Vessel strikes are a poorly-studied threat, but have the potential to be an important source of mortality to sea turtle populations (Work et al. 2010). All sea turtles must surface to breathe, and several species are known to bask at the surface for long periods. Although sea turtles can move rapidly, sea turtles apparently are not able to avoid vessels moving at more than 4 km/hour; most vessels move faster than this in open water (Hazel et al. 2007; Work et al. 2010).

Given the high level of vessel traffic in the Gulf of Mexico and along the Atlantic coast, frequent injury and mortality could affect sea turtles in the region. Hazel et al. (2007) suggested that green sea turtles may use auditory cues to react to approaching vessels rather than visual cues, making them more susceptible to strike as vessel speed increases. Each state along the east coast of the U.S. and the Gulf of Mexico has several hundred thousand recreational vessels registered, including Florida with nearly one million which is the highest number of registered boats in the United States (USCG 2003, 2005; NMMA 2007). Private and commercial vessel operations also have the potential to interact with sea turtles. For example, shipping traffic in Massachusetts Bay is estimated at 1,200 ship crossings per year with an average of three per day. Vessels servicing the offshore oil and gas industry are estimated to make 115,675 to 147,175 trips annually, and many commercial vessels travel to and from some of the largest ports in the US (MMS 2007a; USN 2008).

Sea turtles may also be harassed by the high level of helicopter activity over Gulf of Mexico waters. It is estimated that between roughly 900,000 and 1.5 million helicopter take-offs and landings are undertaken in association with oil and gas activities in the Gulf of Mexico annually (NRC 1990; USN 2008). This likely includes numerous overflights of sea turtles, an activity which has been observed to startle and at least temporarily displace sea turtles (USN 2009).

5.12 Scientific Research and Permits

Scientific research similar to that which would be conducted under Permit No. 19508 has and will continue to impact ESA-listed sea turtles within the action area. Authorized research on ESA-listed sea turtles includes: capturing/handling; satellite, sonic or PIT tagging; lavage, ultrasound, laparoscopy, and imaging. Annual takes of ESA-listed species resulting from research activities that are currently permitted by NMFS within the action area can be seen in Tables 13 through 17 for green, hawksbill, Kemp’s ridley, leatherback, loggerhead, and sea turtles from 2009 to 2016. The actual number of individual sea turtles affected by scientific research is not known. However, for all species, the number affected is assumed to be less than the total number authorized. This is because, if researchers meets or exceed the number of turtle takes allowed in their permit, they must stop the activity and notify the Permits Division. A permit modification or new permit and a new or re-initiated ESA section 7 consultation would be done prior to the continuation of the research activity. Additional take of sea turtles permitted would be reflected in new or modified permits and hence also reflected in the tables below.

Table 13. Green sea turtle takes permitted in the Atlantic Ocean from 2009 to 2016.

Year	Capture/ Handling/ Restraint	Satellite, sonic or PIT tagging	Blood/ tissue collection	Lavage	Ultrasound	Laparoscopy	Imaging	Mortality
2009	3,093	3,093	3,009	1,860	555	74	72	6
2010	3,753	3,753	3,669	2,480	555	74	72	6
2011	4,255	4,255	3,505	2,990	564	74	72	20
2012	3,354	3,354	2,622	2,210	704	74	72	18.2
2013	5,001	5,001	4,325	3,654	1,903	398	396	4.2
2014	4,336	3,686	3,660	3,044	1,408	324	324	4.2
2015	4,280	3,630	3,610	3,044	1,408	324	324	4.2
2016	2,960	2,960	2,940	1,734	1,408	324	324	4.2
Total	31,032	29,732	27,340	21,016	8,505	1,666	1,656	67

Permit Nos.: 1450, 1462, 1501, 1506, 1507, 1518, 1522, 1526, 1527, 1540, 1544, 1551, 1552, 1570, 1571, 1576, 10014, 10022, 13306, 13307, 13543, 13544, 13573, 14506, 14508,14622, 14655, 14726, 14949, 15112, 15135, 15552, 15556, 15575, 15606, 15802, 16134, 16146, 16174, 16194, 16253, 16556, 16598, 16733, 17183, 17304, 17355, 17381, 17506, and 18069. All DPSs included, but numbers are mostly the Atlantic Ocean DPS.

Table 14. Hawksbill sea turtle takes permitted in the Atlantic Ocean from 2009 to 2016.

Year	Capture/ Handling/ Restraint	Satellite, sonic or PIT tagging	Blood/ tissue collection	Lavage	Ultrasound	Mortality
2009	1,088	1,088	1,081	464	254	0
2010	1,424	1,424	1,417	534	254	0
2011	1,959	1,959	1,955	914	255	0
2012	1,462	1,456	1,452	904	255	0
2013	1,423	1,417	1,415	844	320	39
2014	1,114	1,108	1,106	550	66	39
2015	1,032	1,026	1,026	550	66	39
2016	1,106	1,050	1,013	500	66	39
Total	10,608	10,528	10,465	5,260	1,536	156

Permit Nos.: 1462, 1501, 1506, 1507, 1518, 1526, 1527, 1540, 1544, 1551, 1552, 1570, 1571, 1576, 1599, 10014, 10022, 13306, 13307, 13543, 13544, 14272, 14508, 14726, 14506, 14508, 14622, 14655, 14726, 14949, 15112, 15135, 15552, 15566, 15575, 15606, 15802, 16134, 16146, 16194, 16253, 16598, 16733, 17183, 17304, 17355, 17381, and 17506

Table 15. Kemp's ridley sea turtle takes permitted in the Atlantic Ocean from 2009 to 2016.

Year	Capture/ Handling/ Restraint	Satellite, sonic or PIT tagging	Blood/ tissue collection	Lavage	Ultrasound	Laparoscopy	Imaging	Mortality
2009	1,394	1,394	1,195	425	371	53	53	5
2010	1,402	1,402	1,203	426	371	53	53	5
2011	2,210	2,210	1,368	976	400	53	53	9
2012	2,229	2,219	1,561	972	450	53	53	7.2
2013	2,836	2,852	2,190	1,627	990	213	218	3.2
2014	2,010	2,026	1,964	706	619	160	165	3.2
2015	1,833	1,849	1,819	706	619	160	165	3.2
2016	1,420	1,436	1,406	300	264	125	125	3.2
Total	15,334	15,388	12,706	6,138	4,084	870	885	39

Permit Nos.: 1462, 1501, 1506, 1507, 1526, 1527, 1540, 1544, 1551, 1552, 1570, 1571, 1576, 10014, 10022, 13306, 13543, 13544, 14508, 14726, 14506, 14622, 14655, 14726, 15112, 15135, 15552, 15566, 15575, 15606, 15802, 16134, 16194, 16253, 16556, 16598, 16733, 17183, 17304, 17355, 17381, 17506, and 18069.

Table 16. Leatherback sea turtle takes permitted in the North Atlantic Ocean from 2009 to 2016.

Year	Capture/ Handling/ Restraint	Satellite, sonic or PIT tagging	Blood/ tissue collection	Lavage	Ultrasound	Laparoscopy	Imaging	Mortality
2009	1,357	1,357	1,331	197	188	0	0	2
2010	1,421	1,421	1,394	197	188	0	0	1
2011	1,709	1,709	1,682	197	189	0	0	3.4
2012	736	736	709	187	189	0	0	2.6
2013	842	835	808	312	254	65	65	1.6
2014	653	646	620	135	66	65	65	1.6
2015	647	640	620	135	66	65	65	1.6
2016	634	627	617	125	66	65	65	1.6
Total	7,999	7,971	7,781	1,485	1,206	260	260	15.4

Permit Nos.: 1506, 1527, 1540, 1544, 1551, 1552, 1557, 1570, 1571, 1576, 10014, 13543, 14506, 14586, 14655, 14726, 15112, 15552, 15556, 15575, 15672, 15802, 16109, 16194, 16253, 16556, 16733, 17355, and 17506.

Table 17. Loggerhead sea turtle takes permitted in the North Atlantic Ocean from 2009 to 2016.

Year	Capture/ Handling/ Restraint	Satellite, sonic or PIT tagging	Blood/ tissue collection	Lavage	Ultrasound	Laparoscopy	Imaging	Mortality
2009	5,462	5,462	5,044	1,165	1,322	109	123	111
2010	5,464	5,464	5,046	1,205	1,322	109	116	111
2011	7,165	7,165	6,097	1,420	1,667	148	114	122.2
2012	4,791	4,791	3,741	1,370	1,429	161	114	29.8
2013	5,909	5,909	4,859	2,609	2,519	401	354	24.8
2014	4,052	3,912	3,862	1,460	1,543	292	240	24.8
2015	3,935	3,795	3,795	1,470	1,543	292	240	7.8
2016	3,510	3,510	3,510	1,255	1,543	292	240	7.8
Total	40,288	40,008	35,954	11,954	12,888	1,804	1,541	439.2

Permit Nos.: 1450, 1462, 1501, 1506, 1507, 1522, 1526, 1527, 1540, 1544, 1551, 1552, 1570, 1571, 1576, 1599, 10014, 10022, 13306, 13307, 13543, 13544, 14249, 14622, 14506, 14508, 14622, 14655, 14726, 15112, 15552, 15566, 15575, 15606, 15802, 16134, 16146, 16194, 16253, 16556, 16598, 16733, 17183, 17304, 17355, 17381, 17506, and 18069. All DPSs are included, but numbers are mostly the Northwest Atlantic Ocean DPS.

6 EFFECTS OF THE ACTION

ESA Section 7 regulations define “effects of the action” as the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated or interdependent with that action, that will be added to the environmental baseline (50 CFR 402.02). Indirect effects are those that are caused by the proposed action and are later in time, but are reasonably certain to occur. This effects analyses section is organized following the stressor, exposure, response, risk assessment framework.

As was stated in Section 3, this biological opinion includes both a jeopardy analysis and an adverse modification analysis.

The jeopardy analysis relies upon the regulatory definition of “to jeopardize the continued existence of a listed species,” which is “to engage in an action that would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species” (50 CFR §402.02). Therefore, the jeopardy analysis considers both survival and recovery of the species.

The Permits Division proposed to issue Permit No. 19508 for the capturing; handling; examining; measuring; weighing; photographing/videoing; flipper and PIT tagging; marking; scute sampling; tissue/blood/stomach/fecal sampling; and satellite transmitter attaching of green, hawksbill, Kemp’s ridley, leatherback and loggerhead sea turtles in the Indian River Lagoon and Trident Turning Basin of Florida and the northern and eastern Gulf of Mexico.

In this section, we describe the potential stressors associated with the proposed actions, the probability of individuals of ESA-listed species being exposed to these stressors based on the best scientific and commercial evidence available, and the probable responses of those individuals (given probable exposures) based on the available evidence. As described in Section 3 of this opinion, for any responses that would be expected to reduce an individual’s fitness (i.e., growth, survival, annual reproductive success, or lifetime reproductive success), the assessment would consider the risk posed to the viability of the population(s) those individuals comprise and to the ESA-listed species those populations represent. For this consultation, we are particularly concerned about behavioral and stress-based physiological disruptions and potential unintentional mortality that may result in animals that fail to feed, reproduce, or survive because these responses are likely to have population-level consequences as well as the potential for mortality. The purpose of this assessment and, ultimately, of this consultation is to determine if it is reasonable to expect the proposed action to have effects on ESA-listed species that could appreciably reduce their likelihood of surviving and recovering in the wild.

6.1 Stressors Associated with the Proposed Action

Stressors are any physical, chemical, or biological entity that may induce an adverse response either in an ESA-listed species or their designated critical habitat. The issuance of Permit No. 19508 would authorize several research activities that may expose sea turtles to a variety of stressors. Each research activity presents a unique set of stressors. The potential stressors we expect to result from the proposed action are:

1) capture;

2) handing and restraint following capture;

3) measuring, photographing, and weighing;

4) tissue, stomach, fecal and blood sampling, and

5) application of flipper tags, PIT tags, and satellite transponders

6.2 Mitigation to Minimize or Avoid Exposure

Several aspects of the proposed action are designed to minimize ESA-listed species' exposure to the potential stressors associated with the proposed research activities. These include the experience and measures taken by the researchers themselves and the terms and conditions specified in the permits, as proposed by the Permits Division.

Project 1 in the central region of the Indian River Lagoon, Florida, is a year-round project that began in 1982 and intended to continue indefinitely. Project 2 in the Trident Turning Basin of Cape Canaveral Air Force Station is a seasonal project that began in 1993. The research in the northern and eastern Gulf of Mexico offshore waters began in 2011 with the NMFS Southeast Fishery Science Center. The proposed Permit No. 19508 is a combination of all three of these projects is of a continuing nature to the previous protocols and procedures. All previous activities were thoroughly analyzed and found they would not jeopardize listed species, appreciably reduce the likelihood of survival or recovery of sea turtles, or destroy or adversely modify designated critical habitat.

The principal investigator, Dr. Katherine Mansfield and her CI's have extensive experience in marine turtle capture, handling, and research. Dr. Mansfield has 22 years of marine turtle experience and the co-investigators L.M. Ehrhart, W.E. Redfoot, D.A. Bagley, and E.E. Seney (University of Central Florida) have 41, 33, 27, and 15 years of marine turtle experience, respectively. Co-investigators M.T. Walsh (veterinarian, University of Florida) and B.M. Shamblin (University of Georgia) have 26 and 11 years of marine turtle experience, respectively.

To minimize the effects of the actions proposed for the current permit, the applicant will:

1) Negative impacts on the turtles will be minimized by: covering turtles with wet towels and keeping them in the shade while being held, disinfecting tagging equipment, disinfecting holding areas and tubs, following antiseptic protocol when drawing blood or taking biopsies, reducing hydrodynamic drag from transmitters via transmitter profile, placement, and attachment method, and releasing the turtles as soon as possible.

2) Turtles that are compromised (e.g., obviously weak, lethargic, positively buoyant, emaciated, have severe injuries or other abnormalities resulting in debilitation) will be reported to the Florida Fish and Wildlife Conservation Commission stranding hotline (or

nearest state's stranding network, if offshore) and transferred to an appropriate rehabilitator at the Florida Fish and Wildlife Conservation Commission's (or other state's) direction. Compromised turtles will not be tagged or have skin, scute, blood, lavage, or cloacal swab samples taken.

3) All incidentally captured animals (e.g., bony fishes and elasmobranchs) will be untangled and released as quickly as possible.

In addition to these mitigation measures taken by the applicant, the Permits Division proposed to include mitigation measures as part of the terms and conditions of the permit found in Section 2.7 of this document.

The Permits Division will require individuals conducting the research activities to possess qualifications commensurate with their roles and responsibilities. In accordance, the only personnel authorized to conduct the research would be the primary investigator Dr. Katherine Mansfield, listed CI's, and research assistants. We anticipate that requiring that the research be conducted by experienced personnel will further minimize impacts to the ESA-listed cetaceans that may be exposed to the stressors, as these individuals should be able to recognize adverse responses and cease or modify their research activities accordingly.

6.3 Exposure Analysis

Exposure analyses identify the ESA-listed species that are likely to co-occur with the actions' effects on the environment in space and time, and identify the nature of that co-occurrence. The exposure analysis also identifies, as possible, the number, age or life stage, and gender of the individuals likely to be exposed to the actions' effects and the population(s) or subpopulation(s) those individuals represent. The Permits Division proposes to issue Permit No. 19508 of research activities of a continuing nature that have been ongoing for several years and NMFS includes research effort and subsequent exposure and response data in its assessment of exposure where data are available.

Permit No. 19508 has previous annual reports and supplementary data available to help NMFS estimate the likely future levels of exposure. Research permits have required the applicants to report activities every year. These reports provide us with the opportunity to evaluate the applicants' past performance as a mechanism to estimate future performance (individual exposure, response, and take). We believe this is the best tool available to us to estimate the exposure, response, and take that ESA-listed species will be exposed to under the following proposed permits.

Project 1 in the central region of the Indian River Lagoon System of Florida is a now 34-year project. Project 2 in the Trident Turning Basin of Cape Canaveral, Florida, has been on-going since 1993. The current permit for both projects 1 and 2 is Permit No. 14506. The applicant's annual reports from 2010 through 2014 were available to evaluate the activities these two projects have undertaken in the recent past (Table 18). A summary of the proposed exposures, including the cumulative exposure over the entire five-year duration of the permit, can be seen below in Table 19.

Table 18. Number of annual takes that occurred from 2010 through 2014 during past performance of Project 1 and 2 under Permit No. 14506.

Sea turtle species	Life Stage	Procedures	Actual Take[1]
Green	All except hatchling	Epibiota removal; Lavage; Mark: flipper tag, PIT tag; Measure; Photograph/Video; Sample: blood, cloacal swab, fecal, scute scraping, tissue; Weigh; Instrument: epoxy attachment (e.g. satellite tag, VHF tag)	830
Loggerhead	All except hatchling	Epibiota removal; Lavage; Mark: flipper tag, PIT tag; Measure; Photograph/Video; Sample: blood, cloacal swab, fecal, scute scraping, tissue; Weigh; Instrument: epoxy attachment (e.g. satellite tag, VHF tag)	162
Kemp's ridley	All except hatchling	Epibiota removal; Lavage; Mark: flipper tag, PIT tag; Measure; Photograph/Video; Sample: blood, cloacal swab, fecal, scute scraping, tissue; Weigh; Instrument: epoxy attachment (e.g. satellite tag, VHF tag)	0
Hawksbill	All except hatchling	Epibiota removal; Lavage; Mark: flipper tag, PIT tag; Measure; Photograph/Video; Sample: blood, cloacal swab, fecal, scute scraping, tissue; Weigh; Instrument: epoxy attachment (e.g. satellite tag, VHF tag)	0
Leatherback	All except hatchling	Epibiota removal; Lavage; Mark: flipper tag, PIT tag; Measure; Photograph/Video; Sample: blood, cloacal swab, fecal, scute scraping, tissue; Weigh;	0

[1]Individual turtles are allowed to be subjected to procedures once per year.

Table 19. Number of exposures to activities expected under Permit No. 19508 over the permit's lifespan.

Sea turtle species	Life Stage	Procedures	Takes per Individual Animal[1]	No. of Animals Authorized per Year	Cumulative No. Animals Over Five Years	Cumulative Takes per Animal Over Five Years[2]
Green	All except hatchling	Epibiota removal; Lavage; Mark: flipper tag, PIT tag; Measure; Photograph/Video; Sample: blood, cloacal swab, fecal, scute scraping, tissue; Weigh; Instrument: epoxy attachment (e.g. satellite tag, VHF tag)	1	435	2,175	5
Loggerhead	All except hatchling	Epibiota removal; Lavage; Mark: flipper tag, PIT tag; Measure; Photograph/Video; Sample: blood, cloacal swab, fecal, scute scraping, tissue; Weigh; Instrument: epoxy attachment (e.g. satellite tag, VHF tag)	1	115	575	5
Kemp's ridley	All except hatchling	Epibiota removal; Lavage; Mark: flipper tag, PIT tag; Measure; Photograph/Video; Sample: blood, cloacal swab, fecal, scute scraping, tissue; Weigh; Instrument: epoxy attachment (e.g. satellite tag, VHF tag)	1	29	145	5
Hawksbill	All except hatchling	Epibiota removal; Lavage; Mark: flipper tag, PIT tag; Measure; Photograph/Video; Sample: blood, cloacal swab, fecal, scute scraping, tissue; Weigh; Instrument: epoxy attachment (e.g. satellite tag, VHF tag)	1	8	40	5
Leatherback	All except hatchling	Epibiota removal; Lavage; Mark: flipper tag, PIT tag; Measure; Photograph/Video; Sample: blood, cloacal swab, fecal, scute scraping, tissue; Weigh;	1	2	10	5

[1]Individual turtles are subjected to procedures one time per year. [2]Total number of times an individual turtle can be captured and handled over the lifespan of the permit.

The North Atlantic DPS of green turtles has an estimated 30,058 to 64,396 female nesters in 2010 with an increasing population (Seminoff et al. 2015). The Northwest Atlantic DPS of loggerhead is estimated at 32,000 to 56,000 nesting females with populations in decline or not enough information to make a trend (TEWG 1998; NMFS 2001). Gallaway et al. (2013) estimated that nearly 189,000 female Kemp's ridley sea turtles over the age of two years were alive in 2012. Extrapolating based on sex bias, the authors estimated that nearly a quarter million age-two or older Kemp's ridleys alive now with counts show that the population trend is increasing towards recovery. North Atlantic leatherbacks likely number 34,000 to 94,000 individuals, with females numbering 18,800 and the eastern Atlantic segment numbering 4,700 (TEWG 2007) and populations in the Caribbean and Atlantic Ocean are generally stable or increasing. Although no historical records of abundance are known, hawksbill sea turtles are considered to be severely depleted due to the fragmentation and low use of current nesting beaches (NMFS and USFWS 2007a). Worldwide, an estimated 21,212 to 28,138 hawksbills nest each year among 83 sites. Among the sites with historic trends, all show a decline during the past 20 to 100 years. Based on these current population estimates, the proposed exposure to research activities represents a small portion of the population for each species of sea turtle.

6.4 Response Analysis

Given the exposure estimated above, in this section we describe the range of responses among ESA-listed sea turtles that may result from the stressors associated with the research activities that would be authorized under Permit No. 19508. These include stressors associated the following activities: capture; handling and restraint following capture; measuring, photographing and weighing; scute, tissue, stomach, fecal and blood sampling; and application of flipper tags, PIT tags, and satellite transponders. For the purposes of consultation, our assessment tries to detect potential lethal, sub-lethal (or physiological), or behavioral responses that might reduce the fitness of individuals. Our response analysis considers and weighs evidence of adverse consequences, as well as evidence suggesting the absence of such consequences.

There is mounting evidence that wild animals respond to human disturbance in the same way that they respond to predators (Harrington and Veitch 1992; Lima 1998; Gill et al. 2001; Frid 2003; Beale and Monaghan 2004; Romero 2004). These responses manifest themselves as stress responses (in which an animal perceives human activity as a potential threat and undergoes physiological changes to prepare for a flight or fight response), interruptions of essential behavioral or physiological events, alteration of an animal's time budget, or some combinations of these responses (Sapolsky et al. 2000; Frid and Dill 2002; Romero 2004; Walker et al. 2005). These responses have been associated with abandonment of sites (Sutherland and Crockford 1993), reduced reproductive success (Giese 1996; Müllner et al. 2004), and the death of individual animals (Feare 1976; Daan 1996; Bearzi 2000).

Stress is an adaptive response and does not normally place an animal at risk. However, distress involves a stress response resulting in a biological consequence to the individual. The stress response of fish and reptiles involves the hypothalamic-pituitary-adrenal axis being stimulated by a stressor, causing a cascade of physiological responses, such as the release of the stress hormones cortisol, adrenaline (epinephrine), glucocorticosteroids, and others (Barton 2002;

Bayunova et al. 2002; Wagner et al. 2002; Lankford et al. 2005; Busch and Hayward 2009; McConnachie et al. 2012; Atkinson et al. 2015). These hormones subsequently can cause short-term weight loss, the release of glucose into the blood stream, impairment of the immune and nervous systems, elevated heart rate, body temperature, blood pressure, fatigue, cardiovascular damage, and alertness, and other responses (Aguilera and Rabadan-Diehl 2000; Guyton and Hall 2000; Dierauf and Gulland 2001; Wagner et al. 2002; Romero 2004; NMFS 2006b; Busch and Hayward 2009; Omsjoe et al. 2009; Queisser and Schupp 2012), particularly over long periods of continued stress (Sapolsky et al. 2000; Desantis et al. 2013).

In some species, stress can also increase an individual's susceptibility to gastrointestinal parasitism (Greer 2008). In highly-stressful circumstances, or in species prone to strong "fight-or-flight" responses, more extreme consequences can result, including muscle damage and death (Curry and Edwards 1998; Cowan and Curry 2002; Herraez et al. 2007; Cowan and Curry 2008). The most widely-recognized indicator of vertebrate stress, cortisol, normally takes hours to days to return to baseline levels following a significantly stressful event, but other hormones of the hypothalamic-pituitary-adrenal axis may persist for weeks.

Several studies have suggested that stress can adversely impact female reproduction through alterations in the estrus cycle (Herrenkohl and Politch 1979; Moberg 1991; Rivier and Rivest 1991; Mourlon et al. 2011). This is likely due to changes in sex steroids and growth hormone levels associated with the stress response (Sapolsky et al. 2000). Komesaroff et al. (1998) found that estrus may inhibit the stress response to some extent, although several studies suggest estrus and the follicular stage may be susceptible to stress-induced disruption (see Rivier (1991) and Moberg (1991) for reviews). Most of these studies were conducted with single or multiple invasive methodologies or chronic stress; we do not expect stressors associated with the proposed research to be nearly as stressful. Overall, we do not expect reproduction to be impaired primarily because of the lack extreme stressors used by studies to induce adverse reproductive impacts and the acute nature of the stressors involved.

In sum, the common underling stressor of a human disturbance as could be caused by the research activities that would be authorized under Permit Nos. 20197 and 19627 may lead to a variety of different stress related responses. However, given the short duration of the activities and listed procedures, we do not anticipate these responses to result in negative fitness consequences. In addition to possibly causing a stress related response, each research activity is likely to produce unique responses as detailed further below.

6.4.1 Capture

Capture can cause stress responses in sea turtles (Gregory 1994; Hoopes et al. 1998; Gregory and Schmid 2001; Jessop et al. 2003, 2004; Thomson and Heithaus 2014). We also expect behavioral responses (attempts to break away via rapid swimming and biting) as well as physiological responses such as the release of stress hormones (Stabenau et al. 1991; Gregory et al. 1996; Hoopes et al. 2000; Gregory and Schmid 2001; Harms et al. 2003).

Capture techniques under Permit No. 19508 include use of large-mesh tangle nets and large-hoop dip nets. The turtles would be held in a manner to minimize the stress to them. If done correctly, the effects are of tangle nets or dip nets would be expected to be minimal. NMFS expects that individual turtles would experience no more than short-term stresses during these types of capture activities and that these stresses would dissipate within a short period of time. NMFS expects no mortalities or serious injuries from these capture activities.

6.4.2 Handling and Restraint

Handling and restraint activities may markedly affect metabolic rate (St. Aubin and Geraci 1988), reproduction (Mahmoud and Licht 1997), and hormone levels (Gregory et al. 1996). Handling has been shown to result in progressive changes in blood chemistry indicative of a continued stress response (Hoopes et al. 2000; Gregory and Schmid 2001). The additional on-board holding time imposes an additional stressor on these already acidotic turtles (Hoopes et al. 2000). It has been suggested that the muscles used by sea turtles for swimming might also be used during lung ventilation (Butler et al. 1984). Thus, an increase in breathing effort in negatively buoyant animals may have heightened lactate production. Understanding the physiological effects of capture and handling methodology is essential to conducting research on endangered sea turtles, since safe return to their natural habitat is required. However, literature pertaining to the physiological effects of capture and handling on sea turtles is scarce. No additional mortalities or injuries are expected as a result of this research.

6.4.3 Measuring, Photographing, and Weighing

Once sea turtles have been captured, individuals will be handled and exposed to various activities of greater or lesser degrees of invasiveness. Each sea turtle will be exposed to morphometric measurement, including carapace size and individual weight. Although these activities are not considered invasive, we expect individual sea turtles to experience a continued stress response due to the handling and restraint necessary to conduct these activities.

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

6.4.4 Tissue, Stomach, Fecal, and Blood Sampling

Sea turtles will also be biopsied during the course of the research. We expect that this will involve stress associated with pain stimuli (Balazs 1999). Although the skin will be breached and tissue exposed, we expect disinfection protocols to make the risk of infection minimal from the small hole that will be produced by the biopsy punch. Disinfection of biopsy punches and surgical equipment will also reduce the risk of pathogen spread between individuals.

Sea turtles are also expected to experience a short-term stress response in association with the handling, restraint, and pain associated with blood sampling. Taking a blood sample from the sinuses in the dorsal side of the neck is a routine procedure (Owens 1999), although it requires knowledgeable and experienced staff to do correctly and requires the animal to be restrained (Wallace and George 2007; DiBello et al. 2010). According to Owens (1999), with practice, it is possible to obtain a blood sample 95 percent of the time, and the sample collection time should be about 30 seconds in duration.

The applicants have experience in blood sampling and no sea turtle mortalities have occurred during the previous blood sampling activity from the applicant, that we are aware of, nor are we aware of any meaningful pathological consequences by sampled individuals on the part of the applicant. Sample collection sites are always sterilized prior to needle insertions, which would be limited to two on either side of the neck. Bjorndal et al. (2010) found that repeated scute, blood, and skin sampling of the same individual loggerhead sea turtles did not alter growth, result in scarring, or impact other physiological or health parameters.

NMFS does not expect that individual turtles would experience more than short-term stress during scute sampling. Scute sampling is a minimally invasive procedure that involves collecting a small amount of keratin from the oute1most edge of the scutes of the carapace. Because the keratin layer has no nerve endings or blood vessels, scute scraping would not be expected to result in bleeding, discomfort or pain to the turtle. These procedures are non-lethal and we do not expect these methods to have sub-lethal effects. We acknowledge that pain, handling discomfort, possible hemorrhage at the site or risk of infection could occur, but procedure mitigation efforts (such as pressure and disinfection) lessen those possibilities. We believe that drawing blood or tissue biopsy in the manner described appears to have little probability of harming or producing sub-lethal effects as long as the procedure is conducted by an experienced biologist.

6.4.5 Application of Tags, and Satellite Transponders

All sea turtles will be scanned or visually inspected for PIT and flipper tags, respectively. If either of these is absent, then individuals will be tagged with them. Turtles that have lost external tags must be re-tagged if captured again at a later date, which subjects them to additional effects of tagging. Both procedures involve the implantation of tags in or through skin and/or muscle of the flippers. The PIT tags remain internal while flipper tags have both internal and external components. For both, internal tag parts are expected to be biologically inert. In addition to the stress sea turtles are expected to experience by handling and restraint associated with inspection and tagging, we expect an additional stress response associated with the short-term pain experienced during tag implantation (Balazs 1999), although this will be reduced by a standard injection of an anesthetic. We expect disinfection methods proposed by the applicant should mitigate infection risks from tagging. Wounds are expected to heal without infection.

Researchers applying for all permits have routinely applied tags. Tags are designed to be small, physiologically inert, and not hinder movement or cause chafing; we do not expect the tags themselves to negatively impact sea turtles (Balazs 1999). Flipper tags occasionally come off of turtle flippers, which may cause tissue ripping and subsequent trauma and infection risk; an observation reported occasionally be researchers under the proposed permits considered here. However, individuals who have lost flipper tags have not been observed to be in any different body condition than turtles lacking tags or those who still retain their tags. Based upon these experiences, behavioral responses may or may not be evident during tag implantation; when evident, behavioral responses will be fleeting, and lasting effects resulting in pathological consequences are not expected.

Carapace-mounted transmitters would be attached to the turtles' scutes. A low-heat-producing marine epoxy or fiberglass resin and cloth would be used to attach equipment in order to prevent harm to the animal. Attachment of satellite, sonic, or radio tags with epoxy is a commonly used and permitted technique by NMFS. The permit would also require that the researchers provide adequate ventilation around the turtle's head during the attachment of all transmitters. To prevent skin or eye injury due to the chemicals in the resin, transmitter attachment procedures would not take place in the water. In previous studies with these types of techniques, the actual attachment of the sonic tags has shown that that turtles would likely experience some small additional stress from attaching the transmitters, but not significant increases in stress or discomfort to the turtle beyond what was experienced during other research activities. Recaptured turtles previously tagged show very minimal to no signs of injury from the attachments (Keinath et al. 1989). The energetic costs of swimming for an instrumented turtle may be increased, resulting in major effects such as changed in activity, behavior, metabolism, habitat selection, and other key aspects of the animals' life history.

Transmitters, as well as biofouling of the tag, attached to the carapace of turtles increase hydrodynamic drag and affect lift and pitch. For example, Watson and Granger (1998) performed wind tunnel tests on a full-scale juvenile green turtle and found that, at small flow angles representative of straight-line swimming, a transmitter mounted on the carapace increased drag by 27 to 30 percent, reduced lift by less than 10 percent, and increased pitch moment by 11 to 42 percent. It is likely that this type of transmitter attachment would negatively affect the swimming energetics of the turtle. However, based on the results of hardshell sea turtles equipped with this tag setup, NMFS is unaware of transmitters resulting in any serious injury to these species. These tags are unlikely to become entangled due to their streamlined profile and will typically be shed after about one year, posing no long-term risks to the turtle. The permit would require the researchers streamline the attachment materials so that neither buoyancy nor drag would affect the turtle's swimming ability, in addition to reducing the risk of entanglement. There would be no gap allowed between the transmitter and the turtle. All transmitters would be attached in the most hydrodynamic manner possible, minimizing the epoxy footprint. Removal of the transmitters at the end of the experiment is a non-invasive procedure and is not expected to result in any significant stress above that which has occurred during recapture. The transmitter attachment (ties) will break away and release the sonic tag after its life is finished in case, for some unexpected reason, the researchers are unable to recapture an animal to remove it.

Sonic tags/transponders emit a moderate to high frequency sonic pulse detectable using an underwater directional hydrophone (Yano and Tanaka 1991). Triangulation of the acoustic signal allows researchers to determine turtle locations. The sonic transmitters would have a frequency of approximately 50 to 80 kilohertz. This frequency level is not expected to adversely affect turtles. Sea turtles have low-frequency hearing sensitivity and are potentially affected by sound energy in the band below 1,000 Hertz (Lenhardt 2003). Bartol et al. (1999) found the effective bandpass of the loggerhead sea turtle to be between at least 250 and 1,000 hertz. Ridgeway et al. (1969) found the maximum sensitivity of green sea turtle hearing to fall within 300 to 500 hertz with a sharp decline at 750 hertz. Since the sonic tags authorized for sea turtle tracking research would be well above this hearing threshold, these tags would not be heard by the turtles. NMFS would not expect the transmitters to interfere with turtles' normal activities after they are released. Another important consideration is whether the sounds emitted by the sonic transmitters would attract potential predators, primarily sharks. Unfortunately, hearing data on sharks is limited. Casper and Mann (2004) examined the hearing abilities of the nurse shark and results showed that this species detects low-frequency sounds from 100 to 1,000 hertz, with best sensitivity from 100 to 400 hertz. Myrberg (2001) explained that audiograms have been published on elasmobranchs. Although we do not have hearing information for all the sharks that could potentially prey on sea turtles, estimates for hearing sensitivity in available studies provided ranges of 25 to 1,000 hertz. In general, these studies found that shark hearing is not as sensitive as in other tested fishes, and that sharks are most sensitive to low-frequency sounds (Casper et al. 2003). Thus, it appears that the sonic transmitters would not attract potential shark predators to the turtles, because the frequency of the sonic tags is well above the 1,000 hertz threshold.

6.5 Risk Analysis

In this section we assess the consequences of the responses to the individuals that have been exposed, the populations those individuals represent, and the species those populations comprise. Whereas the Response Analysis (Section 6.4) identified the potential responses of ESA-listed species to the proposed action, this section summarizes our analysis of the expected risk to individuals, populations, and species given the expected exposure to those stressors (as described in Section 6.3) and the expected responses to those stressors (as described in Section 6.4).

We measure risks to individuals of endangered or threatened species using changes in the individuals' fitness, which may be indicated by changes the individual's growth, survival, annual reproductive success, and lifetime reproductive success. When we do not expect ESA-listed animals exposed to an action's effects 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.

Biopsy, tissue, scute, blood, fecal sampling, and flipper/PIT tagging are all activities that will break the integument and create the potential for infection or other physiological disruptions. The applicant and co-investigators generally have extensive procedures in place to reduce the potential for infection or disease transmission. To date, the applicants have not documented a case of infection or mortality in sea turtles, which were exposed to these research activities. Based on this past performance and the rigor of aseptic conditions, we do not expect any individuals to develop infections or experience other pathological conditions associated with these activities.

Flipper- and satellite-tagged sea turtles will experience a greater degree of drag through the water than they otherwise would. This drag would be experienced continually over years after flipper tags are applied and over shorter periods of months to a year for tags applied to the carapace. However, we expect the amount of drag to be minimal. To date, many thousands of sea turtles have been flipper tagged in relatively standard ways, and we are unaware of flipper tagging leading to reduced growth, impaired mobility or altered migration, deteriorated body condition, or other outcomes that could impair the survival, growth, or reproductive potential of any individual sea turtle.

Any time a turtle is removed from its natural habitat and handled, it undoubtedly experiences stress. However, based on observations over decades of research, the applicant's proposed procedures have had minor, if any, adverse effects on the captured turtles. This is evidenced by the subsequent recapture of previously encountered sea turtles as well as telemetry data that do not indicate abnormalities in turtle movement or behavior post-encounter. Many turtles have been recaptured from the applicant's in-water netting programs have later been observed on nesting beaches as adults; some turtles captured inshore and exhibiting fibropapillomas have later been recaptured with regressed or no tumors. Negative impacts on the turtles will be minimized by covering turtles with wet towels and keeping them in the shade while being held, disinfecting tagging equipment, disinfecting holding areas and tubs, following antiseptic protocol when drawing blood or taking biopsies, reducing hydrodynamic drag from transmitters via transmitter profile, placement, and attachment method, and releasing the turtles as soon as possible.

The research activities that would take place under Permit No. 19508 are not expected to result in sea turtle mortality. The research activities under the proposed permits will result in temporary stress to the sea turtles that is not expected to have more than short-term effects on individual North Atlantic green, hawksbill, Kemp's ridley, leatherback, and Northwest Atlantic loggerhead sea turtles.

6.6 Cumulative Effects

"Cumulative effects" are those effects of future state or private activities, not involving Federal activities, that are reasonably certain to occur within the action areas of the Federal actions subject to consultation (50 CFR 402.02). Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA.

During this consultation, we searched for information on future state, tribal, local, or private (non-Federal) actions reasonably certain to occur in the action area. We did not find any information about non-Federal actions other than what has already been described in the Environmental Baseline (Section 5), which we expect will continue in the future. Anthropogenic effects include climate change, ship strikes, sound, military activities, fisheries, pollution, and scientific research, although some of these activities would involve a federal nexus and thus, but subject to future ESA section 7 consultation. An increase in these activities could result in an increased effect on ESA-listed species; however, the magnitude and significance of any anticipated effects remain unknown at this time. The best scientific and commercial data available provide little specific information on any long-term effects of these potential sources of disturbance on sea turtle populations.

6.7 Integration and Synthesis

The Integration and synthesis section is the final step in our assessment of the risk posed to species and critical habitat because of implementing the proposed action. In this section, we add the Effects of the Action (Section 6) to the Environmental Baseline (Section 5) and the Cumulative Effects (Section 6.6) to formulate the agency's biological opinion as to whether the proposed action is likely to: (1) reduce appreciably the likelihood of both the survival and recovery of a ESA-listed species in the wild by reducing its numbers, reproduction, or distribution; or (2) reduce the value of designated or proposed critical habitat for the conservation of the species. These assessments are made in full consideration of the Status of ESA-Listed Species (Section 4).

The following discussions separately summarize the probable risks the proposed action poses to threatened and endangered species and critical habitat that are likely to be exposed. These summaries integrate the exposure profiles presented previously with the results of our response analyses for each of the actions considered in this opinion.

We expect all targeted sea turtles to experience some degree of stress response to handling and restraint following capture, blood, scute, stomach, fecal and tissue sampling, and PIT/flipper tagging and satellite transponder attachment. We also expect many of these individuals to respond behaviorally by attempting to fight when initially captured, startle when blood sampled, biopsied, or tagged, and strongly swim away when released. We do not expect more than temporary displacement or removal of individuals for a period of hours from small areas as a result of the proposed actions. Individuals responding in such ways may temporarily cease feeding, breeding, resting, or otherwise disrupt vital activities. However, we do not expect that these disruptions will cause a measureable impact to any individual's growth or reproduction.

We expect all tagged individuals to experience additional physiological reactions associated with foreign body penetration into the muscle, including inflammation, scar tissue development, and/or a small amount of drag associated with the applied tags. We also do not expect any pathological responses to procedures that breach the skin. A small metabolic cost to individuals held for several hours will also occur. Responses here should be limited to wound healing that should not impair the survival, growth, or reproduction of any individual.

Overall, we do not expect any population to experience a fitness consequence as a result of the proposed actions and, by extension, do not expect species-level effects.

7 CONCLUSION

After reviewing the current status of the ESA-listed species, the environmental baseline within the action area, the effects of the proposed action, any effects of interrelated and interdependent actions, and cumulative effects, it is NMFS' biological opinion that the proposed actions are not likely to jeopardize the continued existence or recovery of the North Atlantic green, hawksbill, Kemp's ridley, leatherback, and Northwest Atlantic loggerhead sea turtles. Further, we do not expect the issuance of Permit No. 19508 to destroy or adversely modify the designated critical habitat for the loggerhead turtle.

8 INCIDENTAL TAKE STATEMENT

Section 9 of the ESA and Federal regulations pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without a 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 regulation to include significant habitat modification or degradation that results in death or injury to ESA-listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. Harass is further defined as an act that "creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering" (NMFSPD 02-110-19). Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Section 7(b)(4) and section 7(o)(2) provide that taking that is incidental to an otherwise lawful agency action is not considered to be prohibited taking under the ESA if that action is performed in compliance with the terms and conditions of an incidental take statement.

All activities associated with the issuance of Permit No. 19508 involves directed take for the purposes of scientific research. Therefore, the NMFS does not expect the proposed action would incidentally take threatened or endangered species such that an incidental take statement is not warranted.

9 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 the threatened and endangered species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on ESA-listed species or critical habitat, to help implement recovery plans or develop information (50 CFR §402.02).

The Endangered Species Act Interagency Cooperation Division recommends that annual reports submitted to the Permits Division require detail on the exposure and response of listed individuals to permitted activities. The specific activities that each sea turtle is exposed should be identified. A minimum of general comments on response can be informative regarding methodological, population, researcher-based responses in future consultations. The number and types of responses observed should be summarized and include responses of both target and non-target individuals. This will greatly aid in analyses of likely impacts of future activities.

The Permits Division should work with the sea turtle recovery team and the research community to develop protocols that would have sufficient power to determine the cumulative impacts (that is, includes the cumulative lethal, sub-lethal, and behavioral consequences) of existing levels of research on individuals populations of sea turtles. The Permits Division should review the annual reports and final reports submitted by researchers that have conducted research on sea turtles as well as any data and results that can be obtained from the permit holders. This should be used to estimate the numbers of sea turtles killed and harassed by these investigations, and how the harassment affects the life history of individual animals.

In order for the Office of Protected Resources, Endangered Species Act Interagency Cooperation Division to be kept informed of actions minimizing or avoiding adverse effects on, or benefiting, ESA-listed species or their designated critical habitat, the Permits Division should notify the Endangered Species Act Interagency Cooperation Division of any conservation recommendations they implement in their final action.

10 Reinitiation of Consultation

This concludes formal consultation for the Permits Division proposed issuance of Permit No. 19508. As 50 CFR 402.16 states, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded, (2) new information reveals effects of the agency action that may affect ESA-listed species or designated 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 ESA-listed species or designated critical habitat that was not considered in this opinion, or (4) a new species is ESA-listed or designated critical habitat designated that may be affected by the action.

11 References

Acevedo-Whitehouse, K., and A.L.J. Duffus. 2009. Effects of environmental change on wildlife health. Philosophical Transactions of the Royal Society of London B Biological Sciences 364(1534):3429-3438.

Aguilera, G., and C. Rabadan-Diehl. 2000. Vasopressinergic regulation of the hypothalamic-pituitary-adrenal axis: Implications for stress adaptation. Regulatory Peptides 2296(1-2):23-29.

Al-Bahry, S.N., I.Y. Mahmoud, M. Al-Zadjali, A. Elshafie, A. Al-Harthy, and W. Al-Alawi. 2011. Antibiotic resistant bacteria as bio-indicator of polluted effluent in the green turtles, *Chelonia mydas* in Oman. Marine Environmental Research 71(139-144).

Atkinson, S., D. Crocker, D. Houser, and K. Mashburn. 2015. Stress physiology in marine mammals: How well do they fit the terrestrial model? Journal of Comparative Physiology B Biochemical, Systemic and Environmental Physiology 185(5):463-486.

Auster, P.J., R.J. Malastesta, R.W. Langton, L. Watling, P.C. Valentine, C.L.S. Donaldson, E.W. Langton, A.N. Shepart, 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.

Avens, L., J.C. Taylor, L.R. Goshe, T.T. Jones, and M. Hastings. 2009. Use of skeletochronological analysis to estimate the age of leatherback sea turtles *Dermochelys coriacea* in the western North Atlantic. Endangered Species Research 8(3):165-177.

Bagley, D.A., W.E. Redfoot, and L.M. Ehrhart. 2013. Marine turtle nesting at the Archie Carr NWR: Are loggerheads making a comeback? Page 167 *in* T. Tucker, L. Belskis, A. Panagopoulou, A. Rees, M. Frick, K. Williams, R. LeRoux, and K. Stewart, editors. Thirty-Third Annual Symposium on Sea Turtle Biology and Conservation. National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southeast Fisheries Science Center, Baltimore, Maryland.

Balazs, G. 1980. Field methods for sampling the dietary components of green turtles (*Chelonia mydas*). Herpetological Review 11(1):5-6.

Balazs, G.H. 1999. Factors to consider in the tagging of sea turtles. Pages 101-109 *in* K.L. Eckert, K.A. Bjorndal, F.A. Abreu-Grobois, and M. Donnelly editors. Research and Management Techniques for the Conservation of Sea Turtles, International Union for Conservation of Nature and Natural Resources, Survival Service Commission, Marine Turtle Specialist Group Publication No. 4.

Barnosky, A.D., E.A. Hadly, J. Bascompte, E.L. Berlow, J.H. Brown, M. Fortelius, W.M. Getz, J. Harte, A. Hastings, and P.A. Marquet. 2012. Approaching a state shift in Earth's biosphere. Nature 486(7401):52-58.

Bartol, S.M., J.A. Musick, and M. Lenhardt. 1999. Evoked potentials of the loggerhead sea turtle (*Caretta caretta).* Copeia 1999:836-840.

Barton, B.A. 2002. Stress in fishes: A diversity of responses with particular reference to changes in circulating corticosteroids. Integrative and Comparative Biology 42(3):517-525.

Baulch, S., and M.P. Simmonds. 2015. An update on research into marine debris and cetaceans. IWC Scientific Committee, San Diego, California.

Bayunova, L., I. Barannikova, and T. Semenkova. 2002. Sturgeon stress reactions in aquaculture. Journal of Applied Ichthyology 18(4-6):397-404.

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

Bearzi, G. 2000. First report of a common dolphin (*Delphinus delphis*) death following penetration of a biopsy dart. Journal of Cetacean Research and Management 2(3):217-221.

Bellmund, S.A., J.A. Musick, R.C. Klinger, R.A. Byles, J.A. Keinath, and D.E. Barnard. 1987. Ecology of sea turtles in Virginia. College of William and Mary, Virginia Institute of Marine Science, Gloucester Point, Virginia.

Benson, S.R., T. Eguchi, D.G. Foley, K.A. Forney, H. Bailey, C. Hitipeuw, B.P. Samber, R.F. Tapilatu, V. Rei, P. Ramohia, J. Pita, and P.H. Dutton. 2011. Large-scale movements and high-use areas of western Pacific leatherback turtles,Dermochelys coriacea. Ecosphere 2(7):art84.

Bjorndal, K.A., and A.B. Bolten. 2010. Hawksbill sea turtles in seagrass pastures: success in a peripheral habitat. Marine Biology 157:135-145.

Bjorndal, K.A., A.B. Bolten, and M.Y. Chaloupka. 2005. Evaluating trends in abundance of immature green turtles, *Chelonia mydas*, in the greater Caribbean. Ecological Applications 15(1):304-314.

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(3):271-273.

Blunden, J., and D.S. Arndt. 2014. State of climate in 2013. Bulletin of the American Meteorological Society 95(7):S1-S257.

Blunden, J., and D.S. Arndt. 2016. State of the Climate in 2015. Bulletin of the American Meteorological Society 97(8):1-300.

Bolten, A.B. 1999. Techniques for measuring sea turtles. Pages 110-114 *in* K.L. Eckert, K.A. Bjorndal, F.A. Abreu-Grobois, and M. Donnelly editors. Research and Management Techniques for the Conservation of Sea Turtles, International Union for Conservation of Nature and Natural Resources, Survival Service Commission Marine Turtle Specialist Group Publication No. 4.

Bugoni, L., L. Krause, and M.V. Petry. 2001. Marine debris and human impacts on sea turtles in southern Brazil. Marine Pollution Bulletin 42(12):1330-1334.

Busch, D.S., and L.S. Hayward. 2009. Stress in a conservation context: A discussion of glucocorticoid actions and how levels change with conservation-relevant variables. Biological Conservation 142(12):2844-2853.

Butler, P.J., W.K. Milsom, and A.J. Woakes. 1984. Respiratory cardio vascular and metabolic adjustments during steady state swimming in the green turtle *Chelonia mydas*. Journal of Comparative Physiology B Biochemical Systemic and Environmental Physiology 154(2):167-174.

Campagna, C., F.T. Short, B.A. Polidoro, R. McManus, B.B. Collette, N.J. Pilcher, Y.S. de Mitcheson, S.N. Stuart, and K.E. Carpenter. 2011. Gulf of Mexico oil blowout increases risks to globally threatened species. BioScience 61(5):393-397.

Cannon, A.C., and J.P. Flanagan. 1996. Trauma and treatment of Kemp's ridley sea turtles caught on hook-and-line by recreational fisherman. Sea Turtles Biology and Conservation Workshop.

Casper, B.M., P.S. Lobel, and H.Y. Yan. 2003. The hearing sensitivity of the little skate, *Raja erinacea*: A comparison of two methods. Environmental Biology of Fishes 68:371-379.

Casper, B.M., and D. Mann. 2004. The hearing abilities of the nurse shark, *Ginglymostoma cirratum*, and the yellow stingray, *Urobatis jamaicensis*. American Elasmobranch

Society Meeting, University of South Florida, College of Marine Science, St. Petersburg, Florida.
Caut, S., E. Guirlet, and M. Girondot. 2009. Effect of tidal overwash on the embryonic development of leatherback turtles in French Guiana. Marine Environmental Research 69(4):254-261.
Chaloupka, M., K.A. Bjorndal, G.H. Balazs, A.B. Bolten, L.M. Ehrhart, C.J. Limpus, H. Suganuma, S. Troeeng, and M. Yamaguchi. 2008. Encouraging outlook for recovery of a once severely exploited marine megaherbivore. Global Ecology and Biogeography 17(2):297-304.
Clarke, D., C. Dickerson, and K.J. Reine. 2003. Characterization of underwater sounds produced by dredges. Third Specialty Conference on Dredging and Dredged Material Disposal, Orlando, Florida.
Conant, T.A., P.H. Dutton, T. Eguchi, S.P. Epperly, C.C. Fahy, M.H. Godfrey, S.L. MacPherson, E.E. Possardt, B.A. Schroeder, J.A. Seminoff, M.L. Snover, C.M. Upite, and B.E. Witherington. 2009. Loggerhead sea turtle (*Caretta caretta*) 2009 status review under the U.S. Endangered Species Act. National Oceanic and Atmospheric Administration, National Marine Fisheries Service.
Cowan, D.E., and B.E. Curry. 2008. Histopathology of the alarm reaction in small odontocetes. Journal of Comparative Pathology 139(1):24-33.
Cowan, D.F., and B.E. Curry. 2002. Histopathological assessment of dolphins necropsied onboard vessels in the eastern tropical Pacific tuna fishery. National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southwest Fisheries Science Center.
Craig, J.K., L.B. Crowder, C.D. Gray, C.J. McDaniel, T.A. Henwood, and J.G. Hanifen. 2001. Ecological effects of hypoxia on fish, sea turtles & marine mammals in the northwestern Gulf of Mexico. Coastal and Estuarine Studies 58:269-291.
Curry, B.E., and E.F. Edwards. 1998. Investigation of the potential influence of fishery-induced stress on dolphins in the eastern tropical Pacific Ocean: Research planning. National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southwest Fisheries Science Center.
Daan, N. 1996. Multispecies assessment issues for the North Sea. Pages 126-133 *in* E.K. Pikitch, D.D. Huppert, and M.P. Sissenwine, editors. American Fisheries Society Symposium 20, Seattle, Washington.
Desantis, L.M., B. Delehanty, J.T. Weir, and R. Boonstra. 2013. Mediating free glucocorticoid levels in the blood of vertebrates: Are corticosteroid-binding proteins always necessary? . Functional Ecology 27:107-119.
DiBello, A., C. Valastro, D. Freggi, V. Saponaro, and D. Grimaldi. 2010. Ultrasound-guided vascular catheterization in loggerhead sea turtles (*Caretta caretta*). Journal of Zoo and Wildlife Medicine 41(3):516-518.
Dickerson, D., C. Theriot, M. Wolters, C. Slay, T. Bargo, and W. Parks. 2007. Effectiveness of relocation trawling during dredging for reducing inciodental take of sea turtles. Pages 509-530 World Dredging Congress.
Dickerson, D.D., and T. Bargo. 2012. Occurrence of a sea turtle congregation near Louisiana Chandeleur Islands following the *Deepwater Horizon* oil spill. Page 11 *in* T.T. Jones and B.P. Wallace, editors. Thirty-First Annual Symposium on Sea Turtle Biology and

Conservation. National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southeast Fisheries Science Center, San Diego, California.

Dierauf, L., and M. Gulland. 2001. Marine mammal unusual mortality events. Pages 69-81 CRC Handbook of Marine Mammal Medicine, CRC Press, Boca Raton, Florida.

Doney, S.C. 2010. The growing human footprint on coastal and open-ocean biogeochemistry. Science 328(5985):1512-1516.

Duronslet, M.J., C.W. Caillouet, S. Manzella, K.W. Indelicato, C.T. Fontaine, D.B. Revera, T. Williams, and D. Boss. 1986. The effects of an underwater explosion on the sea turtles *Lepidochelys kempii* and *Caretta caretta* with observations of effects on other marine organisms. National Oceanic and Atmospheric Administration, National Marine Fisheries Service.

Dutton, P.H., and G. Balazs. 1995. Simple biopsy technique for sampling skin for DNA analysis of sea turtles. Marine Turtle Newsletter 69:9-10.

Dutton, P.H., B.W. Bowen, D.W. Owens, A. Barragan, and S.K. Davis. 1999. Global phylogeography of the leatherback turtle (*Dermochelys coriacea*). Journal of Zoology 248:397-409.

Dutton, P.H., V. Pease, and D. Shaver. 2006. Characterization of mtDNA variation among Kemp's ridleys nesting on Padre Island with reference to Rancho Nuevo genetic stock. Page 189 Twenty-Sixth Annual Conference on Sea Turtle Conservation and Biology.

Eckert, K., B. Wallace, J. Frazier, S. Eckert, and P. Pritchard. 2012. Synopsis of the biological data on the leatherback sea turtle (Dermochelys coriacea). .172.

Eckert, K.L., K.A. Bjorndal, F.A. Abreu-Grobois, and M. Donnelly 1999. Research and Management Techniques for the Conservation of Sea Turtles. International Union for Conservation of Nature and Natural Resources, Survival Service Commission Marine Turtle Specialist Group Publication No. 4.

Ehrhart, L.M., W.E. Redfoot, and D.A. Bagley. 2007. Marine turtles of the central region of the Indian River Lagoon System. Florida Scientist 70(4):415-434.

Epperly, S., L. Avens, L. Garrison, T. Henwood, W. Hoggard, J. Mitchell, J. Nance, J. Poffenberger, C. Sasso, E. Scott-Denton, and C. Yeung. 2002. Analysis of sea turtle bycatch in the commercial shrimp fisheries of southeast U.S. waters and the Gulf of Mexico. National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southeast Fisheries Science Center.

Epperly, S.P., J. Braun-McNeill, A.L. Bass, D.W. Owens, and R.M. Patterson. 2000. Inwater population index surveys: North Carolina, USA. NOAA Technical Memorandum, Sinaloa, Mexico.

Epstein, P.R., and J. Selber. 2002. Oil, a life cycle analysis of its health and environmental impacts. Center for Health and the Global Environment, Harvard Medical School, Boston, Massachusetts.

Feare, C.J. 1976. Desertion and abnormal development in a colony of Sooty terns infested by virus-infected ticks. Ibis 118:112-115.

FFWCC. 2006. Long-term monitoring program reveals a decline in Florida loggerhead sea turtle nesting Florida Fish and Wildlife Conservation Commission.

FFWCC. 2007. Florida statewide nesting beach survey data–2005 season. Florida Fish and Wildlife Conservation Commission.

FFWCC. 2016. Index nesting beach survey totals (1989-2016). Florida Fish and Wildlife Conservation Commission, Tallahassee, Florida.

Forbes, G., and C.J. Limpus. 1993. A non-lethal method for retrieving stomach contents from sea turtles. Wildlife Research 20:339-343.

Fraser, G.S. 2014. Impacts of offshore oil and gas development on marine wildlife resources. Pages 191-217 *in* J.E. Gates, D.L. Trauger, and B. Czech, editors. Peak Oil, Economic Growth, and Wildlife Conservation, Springer Publishers, New York.

Frid, A. 2003. Dall's sheep responses to overflights by helicopter and fixed-wing aircraft. Biological Conservation 110(3):387-399.

Frid, A., and L.M. Dill. 2002. Human-caused disturbance stimuli as a form of predation risk. Conservation Ecology 6(1):1-16.

Fuentes, M.M.P.B., M. Hamann, and C.J. Limpus. 2010. Past, current and future thermal profiles of green turtle nesting grounds: Implications from climate change. Journal of Experimental Marine Biology and Ecology 383:56-64.

Fuentes, M.M.P.B., C.J. Limpus, and M. Hamann. 2011. Vulnerability of sea turtle nesting grounds to climate change. Global Change Biology 17:140-153.

Fuentes, M.M.P.B., J.A. Maynard, M. Guinea, I.P. Bell, P.J. Werdell, and M. Hamann. 2009. Proxy indicators of sand temperature help project impacts of global warming on sea turtles in northern Australia. Endangered Species Research 9:33-40.

Gallaway, B.J., C.W. Caillouet Jr., P.T. Plotkin, W.J. Gazey, J.G. Cole, and S.W. Raborn. 2013. Kemps Ridley Stock Assessment Project: Final report. Gulf States Marine Fisheries Commission, Ocean Springs, Mississippi.

Garbarino, J.R., H.C. Hayes, D.A. Roth, R.C. Antweiler, T.I. Brinton, and H.E. Taylor. 1995. Heavy metals in the Mississippi River.

Giese, M. 1996. Effects of human activity on adelie penguin *Pygoscelis adeliae* breeding success. Biological Conservation 75(2):157-164.

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(2):265-268.

Gitschlag, G.R., and B.A. Herczeg. 1994. Sea turtle observations at explosive removals of energy structures. Marine Fisheries Review 56(2):1-8.

Gitschlag, G.R., B.A. Herczeg, and T.R. Barcak. 1997. Observations of sea turtles and other marine life at the explosive removal of offshore oil and gas structures in the Gulf of Mexico. Gulf Research Reports 9(4):247-262.

GMFMC. 2007. Final Amendment 27 to the reef fish fishery management plan and Amendment 14 to the shrimp fishery management plan. Gulf of Mexico Fishery Management Council, Tampa, Florida.

Greer, A.W. 2008. Trade-offs and benefits: Implications of promoting a strong immunity to gastrointestinal parasites in sheep. Parasite Immunology 30(2):123-132.

Gregory, L.F. 1994. Capture stress in the loggerhead sea turtle (*Caretta caretta*). Master's thesis. University of Florida, Gainsville, Florida.

Gregory, L.F., T.S. Gross, A. Bolten, K. Bjorndal, and 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.

Gregory, L.F., and J.R. Schmid. 2001. Stress responses and sexing of wild Kemp's ridley sea turtles (*Lepidochelys kempii*) in the northwestern Gulf of Mexico. General and Comparative Endocrinology 124:66-74.

Groombridge, B. 1982. Kemp's ridley or Atlantic ridley, *Lepidochelys kemii* (Garman 1880). Pages 201-208 *in* B. Groombridge and L. Wright, editors. The IUCN Amphibia, Reptilia Red Data Book.
Gulko, D., and K.L. Eckert. 2003. Sea Turtles: An Ecological Guide. Mutual Publishing, Honolulu, Hawaii.
Guyton, A.C., and J.E. Hall. 2000. Textbook of Medical Physiology, 10th edition. W.B. Saunders Company, Phildelphia, Pennsylvania.
Harms, C.A., K.M. Mallo, P.M. Ross, and A. Segars. 2003. Venous blood gases and lactates of wild loggerhead sea turtles (*Caretta caretta*) following two capture techniques. Journal of Wildlife Diseases 39(2):366-374.
Harrington, F.H., and A.M. Veitch. 1992. Calving success of woodland caribou exposed to low-level jet fighter overflights. Arctic 45(3):213-218.
Hart, K.M., M.M. Lamont, A.R. Sartain, and I. Fujisaki. 2014. Migration, foraging, and residency patterns for northern gulf loggerheads: Implications of local threats and international movements. PLoS ONE 9(7):e103453.
Hawkes, L.A., A.C. Broderick, H. Godfrey, B. Godley, and M.J. Witt. 2014. The impacts of climate change on marine turtle reproductoin success. Pages 287-310 *in* B. Maslo and L. Lockwood, editors. Coastal Conservation, Cambridge University Press, Cambridge.
Hays, G.C. 2000. The implications of variable remigration intervals for the assessment of population size in marine turtles. J Theor Biol 206(2):221-227.
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.
Heppell, S.S., D.T. Crouse, L.B. Crowder, S.P. Epperly, W. Gabriel, T. Henwood, R. Márquez, and N.B. Thompson. 2005. A population model to estimate recovery time, population size, and management impacts on Kemp’s ridley sea turtles. Chelonian Conservation and Biology 4(4):767-773.
Herraez, P., E. Sierra, M. Arbelo, J.R. Jaber, A. Espinosa de los Monteros, and A. Fernandez. 2007. Rhabdomyolysis and myoglobinuric nephrosis (capture myopathy) in a striped dolphin. Journal of Wildlife Diseases 43(4):770-774.
Herrenkohl, L.R., and J.A. Politch. 1979. Effects of prenatal stress on the estrous cycle of female offspring as adults. Experientia 34:1240.
Hildebrand, H.H. 1963. Hallazgo del area de anidacion de la tortuga marina "lora", *Lepidochelys kempi* (Garman), en la costa occidental del Golfo de Mexico (Rept., Chel.). Ciencia, Mexico 22:105-112.
Hill, J.E., F.V. Paladino, J.R. Spotila, and P.S. Tomillo. 2015. Shading and watering as a tool to mitigate the impacts of climate change in sea turtle nests. PLoS ONE 10(6):e0129528.
Hoopes, L.A., A.M. Landry Jr., and E.K. Stabenau. 1998. Preliminary assessment of stress and recovery in Kemp's ridleys captured by entanglement netting. Page 201 *in* S.P. Epperly and J. Braun, editors. Seventeeth Annual Sea Turtle Symposium.
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.
Horrocks, J.A., L.A. Vermeer, B. Krueger, M. Coyne, B.A. Schroeder, and G.H. Balazs. 2001. Migration routes and destination characteristics of post-nesting hawksbill turtles satellite-tracked from Barbados, West Indies. Chelonian Conservation and Biology 4(1):107-114.

Illingworth Rodkin Inc. 2004. Conoco/Phillips 24-inch steel pile installation – Results of underwater sound measurements. Conoco, Phillips Company.

IPCC. 2014. Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, R.K. Pachauri and L.A. Meyer (eds.)], Geneva, Switzerland.

Isaac, J.L. 2009. Effects of climate change on life history: Implications for extinction risk in mammals. Endangered Species Research 7(2):115-123.

James, M.C., R.A. Myers, and C.A. Ottensmeyer. 2005. Behaviour of leatherback sea turtles, *Dermochelys coriacea*, during the migratory cycle. Proceedings of the Royal Society Biological Sciences Series B 272(1572):1547-1555.

Jessop, T.S., J.M. Sumner, C.J. Limpus, and J.M. Whittier. 2003. Interactions between ecology, demography, capture stress, and profiles of corticosterone and glucose in a freeliving population of Australian freshwater crocodiles. General and Comparative Endocrinology 132(1):161-170.

Jessop, T.S., J.M. Sumner, C.J. Limpus, and J.M. Whittier. 2004. Interplay between plasma hormone profiles, sex and body condition in immature hawksbill turtles (*Eretmochelys imbricata*) subjected to a capture stress protocol. Comparative Biochemistry and Physiology A Molecular and Integrative Physiology 137(1):197-204.

Jones, T.T., B. Bostrom, M. Carey, B. Imlach, J. Mikkelsen, P. Ostafichuk, S. Eckert, P. Opay, Y. Swimmer, J.A. Seminoff, and D.R. Jones. 2011. Determining transmitter drag and best-practice attachment procedures for sea turtle biotelemetry. NOAA Technical Memorandum.

Jones, T.T., K.S. Van Houtan, B.L. Bostrom, P. Ostafichuk, J. Mikkelsen, E. Tezcan, M. Carey, B. Imlach, and J.A. Seminoff. 2013. Calculating the ecological impacts of animal-borne instruments on aquatic organisms. Methods in Ecology and Evolution 4(12):1178-1186.

Keinath, J.A., R.A. Byles, and J.A. Musick. 1989. Satellite telemetry of loggerhead turtles in the western North Atlantic. Pages 75-76 Ninth Annual Workshop on Sea Turtle Conservation and Biology.

Klima, E.F., G.R. Gitschlag, and M.L. Renaud. 1988. Impacts of the explosive removal of offshore petroleum platforms on sea turtles and dolphins. Marine Fisheries Review 50(3):33-42.

Komesaroff, P.A., M. Esler, I.J. Clarke, M.J. Fullerton, and J.W. Funder. 1998. Effects of estrogen and estrous cycle on glucocorticoid and catecholamine responses to stress in sheep. American Journal of Physiology - Endocrinology and Metabolism 275(4):E671-E678.

Laist, D.W., J.M. Coe, and K.J. O'Hara. 1999. Marine debris pollution. Pages 342-366 *in* J.R. Twiss Jr. and R.R. Reeves, editors. Conservation and Management of Marine Mammals, Smithsonian Institution Press, Washington, D.C.

Lamont, M.M., I. Fujisaki, and R.R. Carthy. 2014. Estimates of vital rates for a declining loggerhead turtle (Caretta caretta) subpopulation: implications for management. Marine Biology 161(11):2659-2668.

Lankford, S.E., T.E. Adams, R.A. Miller, and J.J. Cech Jr. 2005. The cost of chronic stress: Impacts of a nonhabituating stress response on metabolic variables and swimming performance in sturgeon. Physiological and Biochemical Zoology 78:599-609.

Law, R.J., and J. Hellou. 1999. Contamination of fish and shellfish following oil spill incidents. Environmental Geoscience 6:90-98.

Lazar, B., and R. Gračan. 2011. Ingestion of marine debris by loggerhead sea turtles, *Caretta caretta*, in the Adriatic Sea. Marine Pollution Bulletin 62(1):43-47.

Legler, J.M. 1977. Stomach flushing: a technique for chelonian dietary studies. Herpetologica 33:281-284.

Lenhardt, M.L. 2003. Effects of noise on sea turtles. First International Conference on Acoustic Communication by Animals, University of Maryland.

Leroux, R.A., P.H. Dutton, F.A. Abreu-Grobois, C.J. Lagueux, C.L. Campbell, E. Delcroix, J. Chevalier, J.A. Horrocks, Z. Hillis-Starr, S. Troeng, E. Harrison, and S. Stapleton. 2012. Re-examination of population structure and phylogeography of hawksbill turtles in the wider Caribbean using longer mtDNA sequences. Journal of Heredity 103(6):806-820.

LGL Ltd. 2007. Environmental assessment of a marine geophysical survey by the R/V *Marcus G. Langseth* off Central America, January–March 2008. Prepared for the Lamont-Doherty Earth Observatory, Palisades, NY, and the National Science Foundation, Arlington, VA, by LGL Ltd., Environmental Research Associates, Ontario, Canada.

LHR. 2010. Energy, oil & gas. Louisiana Hurricane Resources.

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.

LUMCON. 2005. Mapping of dead zone completed. Louisiana Universities Marine Consortium, Chauvin, Louisiana.

Lutcavage, M.E., P. Plotkin, B.E. Witherington, and P.L. Lutz. 1997. Human impacts on sea turtle survival. Pages 387-409 *in* P.L. Lutz and J.A. Musick, editors. The Biology of Sea Turtles, CRC Press, Boca Raton, Florida.

MacDonald, I.R., N.L. Guinasso Jr., S.G. Ackleson, J.F. Amos, R. Duckworth, R. Sassen, and J.M. Brooks. 1993. Natural oil slicks in the Gulf of Mexico visible from space. Journal of Geophysical Research 98(C9):16351-16364.

MacPherson, S.L., R.N. Trindell, B.A. Schroeder, L.A. Patrick, D.K. Ingram, K.P. Frutchey, J.A. Provancha, A.M. Lauritsen, B.S. Porter, A.M. Foley, A.B. Meylan, B.E. Witherington, and M.K. Pico. 2012. Sea turtle nest translocation effort in the Florida panhandle and Alabama, USA, in response to the *Deepwater Horizon* (MC-252) oil spill in the Gulf of Mexico. Page 15 *in* T.T. Jones and B.P. Wallace, editors. Thirty-First Annual Symposium on Sea Turtle Biology and Conservation. National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southeast Fisheries Science Center, San Diego, California.

Mahmoud, I.Y., and P. Licht. 1997. Seasonal changes in gonadal activity and the effects of stress on reproductive hormones in the common snapping turtle, *Chelydra serpentina*. General and Comparative Endocrinology 107(3):359-372.

Mansfield, K.L. 2006. Sources of mortality, movements and behavior of sea turtles in Virginia. Doctoral dissertation. College of William and Mary, Gloucester Point, Virginia.

Mansfield, K.L., V.S. Saba, J.A. Keinath, and J.A. Musick. 2009. Satellite tracking reveals a dichotomy in migration strategies among juvenile loggerhead turtles in the Northwest Atlantic. Marine Biology 156:2555-2570.

Mansfield, K.L., J. Wyneken, D. Rittschoff, M. Walsh, C.W. Lim, and P.M. Richards. 2012. Satellite tag attachment methods for tracking neonate sea turtles. Marine Ecology Progress Series 457:181-192.

Márquez, M.R. 1990. Sea turtles of the world. An annotated and illustrated catalogue of sea turtle species known to date.

Márquez, M.R., A. Villanueva, and P.M. Burchfield. 1989. Nesting population, and production of hatchlings of Kemp's ridley sea turtle at Rancho Nuevo, Tamaulipas, Mexico. Pages 16-19 *in* C.W.C. Jr. and A.M.L. Jr., editors. First International Symposium on Kemp's Ridley Sea Turtle Biology, Conservation, and Management.

Masuda, A. 2010. Natal Origin of Juvenile Loggerhead Turtles from Foraging Ground in Nicaragua and Panama Estimated Using Mitochondria DNA.

Mazaris, A.D., A.S. Kallimanis, S.P. Sgardelis, and J.D. Pantis. 2008. Do long-term changes in sea surface temperature at the breeding areas affect the breeding dates and reproduction performance of Mediterranean loggerhead turtles? Implications for climate change. Journal of Experimental Marine Biology and Ecology 367:219-226.

McCauley, S., and K. Bjorndal. 1999. Conservation implications of dietary dilution from debris ingestion: Sublethal effects in post-hatchling loggerhead sea turtles. Conservation biology 13(4):925-929.

McClellan, C.M., J. Braun-McNeill, L. Avens, B.P. Wallace, and A.J. Read. 2010. Stable isotopes confirm a foraging dichotomy in juvenile loggerhead sea turtles. Journal of Experimental Marine Biology and Ecology 387:44-51.

McConnachie, S.H., K.V. Cook, D.A. Patterson, K.M. Gilmour, S.G. Hinch, A.P. Farrell, and S.J. Cooke. 2012. Consequences of acute stress and cortisol manipulation on the physiology, behavior, and reproductive outcome of female Pacific salmon on spawning grounds. Hormones and Behavior 62(1):67-76.

McFee, W.E., D.L. Wolf, D.E. Parshley, and P.A. Fair. 1996. Investigations of marine mammal entanglement associated with a seasonal coastal net fishery. NOAA Technical Memorandum.

Meador, J.P., R. Stein, and U. Varanasi. 1995. Bioaccumulation of polycyclic aromatic hydrocarbons by marine organisms. Reviews of Environmental Contamination and Toxicology 143:79-165.

Miller, J.D., K.A. Dobbs, C.J. Limpus, N. Mattocks, and A.M. Landry Jr. 1998. Long-distance migrations by the hawksbill turtle, *Eretmochelys imbricata*, from north-eastern Australia. Wildlife Research 25(1):89-95.

Milton, S.L., S. Leone-Kabler, A.A. Schulman, and P.L. Lutz. 1994. Effects of Hurricane Andrew on the sea turtle nesting beaches of South Florida. Bulletin of Marine Science 54:974-981.

MMS. 1998. Gulf of Mexico OCS oil and gas lease sales 171, 174, 177, and 180, Western Planning Area, Final Environmental Impact Statement. U.S. Department of the Interior, Minerals Management Service.

MMS. 2007a. Eastern Gulf of Mexico OCS oil and gas lease sale 224. U.S. Department of the Interior, Minerals Management Service.

MMS. 2007b. Gulf of Mexico OCS oil and gas lease sales: 2007-2012, Western planning area sales 204, 207, 210, 215, and 218; Central planning area sales 205, 206, 208, 213, 216, and 222. Final Environmental Impact Statement. U.S. Department of the Interior, Minerals Management Service.

Moberg, G.P. 1991. How behavioral stress disrupts the endocrine control of reproduction in domestic animals. Journal of Dairy Science 74:304-311.

Monzón-Argüello, C., C. Rico, A. Marco, P. López, and L.F. López-Jurado. 2010. Genetic characterization of eastern Atlantic hawksbill turtles at a foraging group indicates major undiscovered nesting populations in the region. Journal of Experimental Marine Biology and Ecology.

Morreale, S.J., and E.A. Standora. 1998. Early life stage ecology of sesa turtles in northeastern U.S. waters. NOAA Technical Memorandum.

Mourlon, V., L. Naudon, B. Giros, M. Crumeyrolle-Arias, and V. Daugé. 2011. Early stress leads to effects on estrous cycle and differential responses to stress. Physiology & Behavior 102:304-310.

Muller, R.G., T.M. Bert, and S.D. Gerhard. 2006. The 2006 Stock Assessment Update for the Stone Crab, *Menippe* spp. Fishery in Florida. Florida Fish and Wildlife Commission Florida Marine Research Institute, St. Petersburg, Florida.

Müllner, A., K. Eduard Linsenmair, and M. Wikelski. 2004. Exposure to ecotourism reduces survival and affects stress response in hoatzin chicks (*Opisthocomus hoazin*). Biological Conservation 118(4):549-558.

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. National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Northeast Fisheries Science Center.

Musick, J.A., and C.J. Limpus. 1997. Habitat utilization and migration in juvenile sea turtles. Pages 137-163 *in* P. Lutz and J.A. Musick, editors. The Biology of Sea Turtles, CRC Press, Boca Raton, Florida.

Muyskens, J., D. Keating, and S. Granados. 2015. Mapping how the United States generates its electricity. The Washington Post, Washington, D.C.

Myrberg Jr, A.A. 2001. The acoustical biology of elasmobranchs. Environmental Biology of Fishes 60:31-45.

Nedwell, J., and B. Edwards. 2002. Measurement of underwater noise in the Arun River during piling at county wharf, Littlehampton. Subacoustech Ltd, Southampton, UK.

Nelson, A.M., S.T. Walk, S. Taube, M. Taniuchi, E.R. Houpt, C.E. Wobus, and V.B. Young. 2012. Disruption of the human gut microbiota following norovirus infection. PLoS ONE 7(10):e48224.

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. National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southeast Fisheries Science Center, Baltimore, Maryland.

NMFS. 2005. Biological opinion on the continued authorization of reef fish fishing under the Gulf of Mexico (GOM) reef fish fishery management plan (RFFMP) and proposed amendment 23. National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southeast Regional Office, Protected Resources Division.

NMFS. 2006a. Biological opinion on permitting structure removal operations on the Gulf of Mexico outer continental shelf and the authorization for take of marine mammals incidental to structure removals on the Gulf of Mexico outer continental shelf. National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Silver Spring, Maryland.

NMFS. 2006b. Biological opinion on the 2006 Rim-of-the-Pacific Joint Training Exercises (RIMPAC). National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Office of Protected Resources, Silver Spring, Maryland.

NMFS. 2006c. Biological opinion on the issuance of Section 10(a)(1)(A) permits to conduct scientific research on the southern resident killer whale (*Orcinus orca*) distinct population segment and other endangered or threatened species. National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Northwest Region, Seattle, Washington.

NMFS. 2007. Endangered Species Act Section 7 consultation on the Continued Authorization of Fishing under the Fishery Management Plan (FMP) for Coastal Migratory Pelagic Resources in Atlantic and Gulf of Mexico. National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Office of Protected Resources.

NMFS. 2008a. Endangered Species Act Section 7 Consultation on the Continued Authorization of Shark Fisheries (Commercial Shark Bottom Longline, Commercial Shark Gillnet and Recreational Shark Handgear Fisheries) as Managed under the Consolidated Fishery Management Plan for Atlantic Tunas, Swordfish, and Sharks (Consolidated HMS FMP) including Amendment 2 to the Consolidated HMS FMP. National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Office of Protected Resources.

NMFS. 2008b. Recovery plan for southern resident killer whales (*Orcinus orca*). National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Northwest Region, Seattle, Washington.

NMFS. 2010a. Endangered Species Act Section 7 Consultation on the Atlantic Bluefish Fishery Management Plan. Consultation No. F/NER/2007/09036. National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Office of Protected Resources.

NMFS. 2010b. Endangered Species Act Section 7 Consultation on the Authorization of fisheries under the Monkfish Fishery Management Plan. Consultation No. F/NER/2008/01754. National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Office of Protected Resources.

NMFS. 2010c. Endangered Species Act Section 7 Consultation on the Authorization of fisheries under the Northeast Multispecies Fishery Management Plan. Consultation No. F/NER/2008/01755. National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Office of Protected Resources.

NMFS. 2010d. Endangered Species Act Section 7 Consultation on the Authorization of fisheries under the Spiny Dogfish Fishery Management Plan. Consultation No. F/NER/2008/01757. National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Office of Protected Resources.

NMFS. 2010e. Endangered Species Act Section 7 Consultation on the Authorization of fisheries under the Summer Flounder, Scup and Black Sea Bass Fishery Management Plan. Consultation No. F/NER/2003/00956. National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Office of Protected Resources.

NMFS. 2010f. Endangered Species Act Section 7 Consultation on the Continued Implementation of Management Measures for the American Lobster Fishery. Consultation No. F/NER/2003/00956. National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Office of Protected Resources.

NMFS. 2010g. Endangered Species Act Section 7 Consultation on the Federal Atlantic Mackerel, Squid and Atlantic Butterfish Fishery Management Plan. Consultation No. F/NER/2010/09091. National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Office of Protected Resources.

NMFS. 2010h. Endangered Species Act Section 7 Consultation on the Northeast Skate Complex Fishery Management Plan. Consultation No. F/NER/2008/01756. National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Office of Protected Resources.

NMFS. 2010i. Other significant oil spills in the Gulf of Mexico. National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Office of Response and Restoration, Emergency Response Division, Silver Spring, Maryland.

NMFS. 2013a. Biological Opinion on the U.S. Navy's Atlantic Fleet Training and Testing Activities from November 2013 through Novermber 2018. National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Office of Protected Resources.

NMFS. 2013b. Fisheries of the United States 2013. Silver Spring, Maryland.

NMFS. 2013c. Leatherback Sea Turtle (Dermochelys coriacea) 5-Year Review: Summary and Evaluation.*in* N.a. USFWS, editor.

NMFS. 2016. Biological Opinion on Continued Opeation of St. Lucie Nuclear Power Plant, Units 1 and 2 in St. Lucie County, Florida. National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Silver Spring, Maryland.

NMFS, and USFWS. 1991. Recovery plan for U.S. population of loggerhead turtle (*Caretta caretta*). National Oceanic and Atmospheric Administration, National Marine Fisheries Service and U.S. Fish and Wildlife Service, Washington, D.C.

NMFS, and USFWS. 2007a. Hawksbill sea turtle (*Eretmochelys imbricata*) 5-year review: Summary and evaluation National Oceanic and Atmospheric Administration, National Marine Fisheries Service and U.S. Fish and Wildlife Service, Silver Spring, Maryland.

NMFS, and USFWS. 2007b. Kemp's ridley sea turtle (*Lepidochelys kempii*) 5-year review: Summary and evaluation. National Oceanic and Atmospheric Administration, National Marine Fisheries Service and U.S. Fish and Wildlife Service, Silver Spring, Maryland.

NMFS, and USFWS. 2007c. Loggerhead sea turtle (*Caretta caretta*) 5-year review: Summary and evaluation. National Marine Fisheries Service and U.S. Fish and Wildlife Service, Silver Spring, Maryland.

NMFS, and USFWS. 2008. Draft recovery plan for the northwest Atlantic population of the loggerhead sea turtle (*Caretta caretta*): Second revision. National Oceanic and Atmospheric Administration, National Marine Fisheries Service and U.S. Fish and Wildlife Service, Silver Spring, Maryland.

NMFS, and USFWS. 2010. Final draft report: Summary report of a meeting of the NMFS/USFWS cross-agency working group on joint listing of North Pacific and Northwest Atlantic loggerhead turtle distinct population segments. National Oceanic and Atmospheric Administration, National Marine Fisheries Service and U.S. Fish and Wildlife Service, Silver Spring, Maryland.

NMFS, and USFWS. 2011. Bi-National Recovery Plan for the Kemp's Ridley Sea Turtle (*Lepidochelys kempii*), Second Revision. National Oceanic and Atmospheric Administration, National Marine Fisheries Service and U.S. Fish and Wildlife Service, Silver Spring, Maryland.

NMFS, and USFWS. 2013. Hawksbill sea turtle (*Eretmochelys imbricata*) 5-year review: Summary and evaluation National Oceanic and Atmospheric Administration, National Marine Fisheries Service and U.S. Fish and Wildlife Service, Silver Spring, Maryland.

NMFS, and USFWS. 2015. Kemp's ridley sea turtle (*Lepidochelys kempii*) 5-year review: Summary and evaluation. National Oceanic and Atmospheric Administration, National Marine Fisheries Service and U.S. Fish and Wildlife Service.

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. 2009. An assessment of loggerhead sea turtles to estimate impacts of mortality reductions on population dynamics. NMFS Southeast Fisheries Science Center Contribution PRD-08/09-14.

NMMA. 2007. 2006 recreational boating statistical abstract. National Marine Manufacturers Association, Chicago, Illinois.

NOAA. 2010. Oil and Sea Turtles: Biology, Planning, and Response. National Oceanic and Atmospheric Administration, National Ocean Service, Office of Response and Restoration, Emergency Response Division, Seattle, Washington.

NRC. 1990. Sea turtle mortality associated with human activities. National Academy Press, National Research Council Committee on Sea Turtle Conservation, Washington, D.C.

Omsjoe, E.H., A. Stein, J. Irvine, S.D. Albon, E. Dahl, S.I. Thoresen, E. Rustad, and E. Ropstad. 2009. Evaluating capture stress and its effects on reproductive success in Svalbard reindeer. Canadian Journal of Zoology 87(1):73-85.

Owens, D.W. 1999. Reproductive cycles and endocrinology in research and management techniques for the conservation of sea turtles. International Union for Conservation of Nature and Natural Resources, Survival Service Commission, Marine Turtle Specialist Group.

Parker Jr., R.O., D.R. Colby, and T.D. Willis. 1983. Estimated amount of reef habitat on a portion of the U.S. South Atlantic and Gulf of Mexico continental shelf. Bulletin of Marine Science 33(4):935-940.

Pike, D.A., E.A. Roznik, and I. Bell. 2015. Nest inundation from sea-level rise threatens sea turtle population viability. Royal Society Open Science 2:150127.

Plotkin, P. 2003. Adult migrations and habitat use. Pages 225-241 *in* L. Lutz, J.A. Musick, and J. Wyneken, editors. Biology of sea turtles, volume II, CRC Press, Boca Raton, Florida.

Poloczanska, E.S., C.J. Limpus, and G.C. Hays. 2009. Vulnerability of marine turtles in climate change. Pages 151-211 *in* D.W. Sims, editor. Advances in Marine Biology, Academic Press, Burlington.

Polyakov, I.V., V.A. Alexeev, U.S. Bhatt, E.I. Polyakova, and X. Zhang. 2010. North Atlantic warming: patterns of long-term trend and multidecadal variability. Climate Dynamics 34:439-457.

Powers, S.P., F.J. Hernandez, R.H. Condon, J.M. Drymon, and C.M. Free. 2013. Novel pathways for injury from offshore oil spills: Direct, sublethal and indirect effects of the *Deepwater Horizon* oil spill on pelagic *Sargassum* communities. PLoS ONE 8(9):e74802.

Prescott, R.L. 1988. Leatherbacks in Cape Cod Bay, Massachusetts, 1977-1987. NOAA Technical Memorandum, Proceedings of the Eighth Annual Workshop on Sea Turtle Conservation and Biology.

Price, E.R., B.P. Wallace, R.D. Reina, J.R. Spotila, F.V. Paladino, R. Piedra, and E. Velez. 2004. Size, growth, and reproductive output of adult female leatherback turtles *Dermochelys coriacea*. Endangered Species Research 5:1-8.

Putman, N.F., and K.L. Mansfield. 2015. Direct evidence of swimming reveals a new paradigm of dispersal in the sea turtle "lost years". Current Biology 25:1-7.

Queisser, N., and N. Schupp. 2012. Aldosterone, oxidative stress, and NF-κB activation in hypertension-related cardiovascular and renal diseases. Free Radical Biology and Medicine 53:314-327.

Rabalais, N., R. Turner, and D. Scavia. 2002. Beyond science into policy: Gulf of Mexico hyposiz and the Mississippi River. BioScience 52(2).

Redfoot, W.E., and L.M. Ehrhart. 2013. Trends in size class distribution, recaptures, and abundance of juvenile green turtles (*Chelonia mydas*) utilizing a rock riprap lined embayment at Port Canaveral, Florida, USA, as developmental habitat. Chelonian Conservation and Biology 12(2):252-261.

Reina, R.D., P.A. Mayor, J.R. Spotila, R. Piedra, and F.V. Paladino. 2002. Nesting ecology of the leatherback turtle, *Dermochelys coriacea*, at Parque Nacional Marino Las Baulas, Costa Rica: 1988-1989 to 1999-2000. Copeia 2002(3):653-664.

Reina, R.D., J.R. Spotila, F.V. Paladino, and A.E. Dunham. 2009. Changed reproductive schedule of eastern Pacific leatherback turtles *Dermochelys coriacea* following the 1997-98 El Niño to La Niña transition. Endangered Species Research 7:155-161.

Reyff, J.A. 2003. Underwater sound levels associated with constuction of the Benicia-Martinez Bridge. lllingworth and Rodkin, Inc.

Ridgeway, S.H., E.G. Wever, J.G. McCormick, J. Palin, and J.H. Anderson. 1969. Hearing in the giant sea turtle, *Chelonia mydas*. Proceedings of the National Academy of Science 64:884-890.

Rivier, C., and S. Rivest. 1991. Effect of stress on the activity of the Hypothalamic-Pituitary-Gonadal Axis: Peripheral and Central Mechanisms. Biology of Reproduction 45:523-532.

Robinson, R.A., H.Q.P. Crick, J.A. Learmonth, I.M.D. Maclean, C.D. Thomas, F. Bairlein, M.C. Forchhammer, C.M. Francis, J.A. Gill, B.J. Godley, J. Harwood, G.C. Hays, B. Huntley, A.M. Hutson, G.J. Pierce, M.M. Rehfisch, D.W. Sims, M.B. Santos, T.H. Sparks, D.A. Stroud, and M.E. Visser. 2009. Travelling through a warming world: Climate change and migratory species. Endangered Species Research 7:87-99.

Romero, L.M. 2004. Physiological stress in ecology: Lessons from biomedical research. Trends in Ecology and Evolution 19(5):249-255.

Rostal, D.C. 2007. Reproductive physiology of the ridley sea turtle. Pages 151-165 *in* P.T. Plotkin, editor. Biology and Conservation of Sea Turtles, Johns Hopkins University Press, Baltimore, Maryland.

Rostal, D.C., J.S. Grumbles, R.A. Byles, M.R. Marquez, and D.W. Owens. 1997. Nesting physiology of Kemp's ridley sea turtles, *Lepidochelys kempii*, at Rancho Nueveo, Tamaulipas, Mexico, with observation on population estimates. Chelonian Conservation and Biology 2(4):538-547.

Santoro, M., G. Hernandez, M. Caballero, and F. García. 2006. Aerobic bacterial flora of nesting green turtles (*Chelonia mydas*) from Tortuguero National Park, Costa Rica. Journal of Zoo and Wildlife Medicine 37(4):549-552.

Sapolsky, R.M., L.M. Romero, and A.U. Munck. 2000. How do glucocorticoids influence stress responses? Integrating permissive, suppressive, stimulatory, and preparative actions. Endocrine Reviews 21(1):55-89.

Schmid, J.R. 1998. Marine turtle populations on the west-central coast of Florida: Results of tagging studies at the Cedar Keys, Florida, 1986-1995. Fishery Bulletin 96(3):589-602.

Schumann, N., N.J. Gales, R.G. Harcourt, and J.P.Y. Arnould. 2013. Impacts of climate change on Australian marine mammals. Australian Journal of Zoology 61(2):146-159.

Schuyler, Q.A., C. Wilcox, K.A. Townsend, K.R. Wedemeyer-Strombel, G. Balazs, E. van Sebille, and B.D. Hardesty. 2015. Risk analysis reveals global hotspots for marine debris ingestion by sea turtles. Global Change Biology.

Seminoff, J.A., C.D. Allen, G.H. Balazs, P.H. Dutton, T. Eguchi, H.L. Haas, S.A. Hargrove, M. Jensen, D.L. Klemm, A.M. Lauritsen, S.L. MacPherson, P. Opay, E.E. Possardt, S. Pultz, E. Seney, K.S. Van Houtan, and R.S. Waples. 2015. Status review of the green turtle (*Chelonia mydas*) under the Endangered Species Act. National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southwest Fisheries Science Center.

Seney, E.E., B.M. Higgins, and A.M.J. Landry. 2010. Satellite transmitter attachment techniques for small juvenile sea turtles. Journal of Experimental Marine Biology and Ecology 384:61-67.

Shamblin, B.M., A.B. Bolten, F.A. Abreu-Grobois, K.A. Bjorndal, L. Cardona, C. Carreras, M. Clusa, C. Monzon-Arguello, C.J. Nairn, J.T. Nielsen, R. Nel, L.S. Soares, K.R. Stewart, S.T. Vilaca, O. Turkozan, C. Yilmaz, and P.H. Dutton. 2014. Geographic patterns of genetic variation in a broadly distributed marine vertebrate: New insights into loggerhead turtle stock structure from expanded mitochondrial DNA sequences. PLoS ONE 9(1):e85956.

Shamblin, B.M., A.B. Bolten, K.A. Bjorndal, P.H. Dutton, J.T. Nielsen, F.A. Abreu-Grobois, K.J. Reich, B.E. Witherington, D.A. Bagley, and L.M. Ehrhart. 2012. Expanded mitochondrial control region sequences increase resolution of stock structure among North Atlantic loggerhead turtle rookeries. Marine Ecology Progress Series 469:145-160.

Shamblin, B.M., P.H. Dutton, D.J. Shaver, D.A. Bagley, N.F. Putman, K.L. Mansfield, L.M. Ehrhart, L.J. Pena, and C.J. Nairn. 2016. Mexican origins for the Texas green turtle foraging aggregation: A cautionary tale of incomplete baselines and poor marker resolution. Journal of Experimental Marine Biology and Ecology:10 pp.

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

Simmonds, M.P., and W.J. Eliott. 2009. Climate change and cetaceans: Concerns and recent developments. Journal of the Marine Biological Association of the United Kingdom 89(1):203-210.

Spotila, J.R. 2004. Sea turtles: A complete guide to their biology, behavior, and conservation. John Hopkins University Press, Baltimore. 227p.

Spotila, J.R., A.E. Dunham, A.J. Leslie, A.C. Steyermark, P.T. Plotkin, and F.V. Paladino. 1996. Worldwide population decline of *Dermochelys coriacea*: Are leatherback turtles going extinct? Chelonian Conservation and Biology 2(2):209-222.

Spotila, J.R., R.D. Reina, A.C. Steyermark, P.T. Plotkin, and F.V. Paladino. 2000. Pacific leatherback turtles face extinction. Nature 405:529-530.

St. Aubin, D.J., and J.R. Geraci. 1988. Capture and handling stress suppresses circulating levels of thyroxine (T4) and triiodothyronine (T3) in beluga whale, *Delphinapterus leucas*. Physiological Zoology 61(2):170-175.

Stabenau, E.K., T.A. Heming, and J.F. Mitchell. 1991. Respiratory, acid-base and ionic status of Kemp's ridley sea turtles (*Lepidochelys kempi*) subjected to trawling. Comparative Biochemistry and Physiology A Molecular and Integrative Physiology 99A(1/2):107-111.

Stanley, D.R., and C.A. Wilson. 1989. Utilization of offshore platforms by recreational fishermen and scuba divers off the Louisiana coast. Bulletin of Marine Science 44(2):767-775.

Sutherland, W.J., and N.J. Crockford. 1993. Factors affecting the feeding distribution of red breasted geese, *Branta ruficollis*, wintering in Romania. Biological Conservation 63:61-65.

Tapilatu, R.F., P.H. Dutton, M. Tiwari, T. Wibbels, H.V. Ferdinandus, W.G. Iwanggin, and G.H. Nugroho. 2013. Long-term decline of the western Pacific leatherback, *Dermochelys coriacea*: A globally important sea turtle population. Ecosphere 4:15.

TEWG. 1998. An assessment of the Kemp's ridley (*Lepidochelys kempii*) and loggerhead (*Caretta caretta*) sea turtle populations in the Western North Atlantic. NOAA Technical Memorandum, Turtle Expert Working Group, Miami, Florida.

TEWG. 2000. Assessment update for the Kemp's ridley and loggerhead sea turtle populations in the western North Atlantic. National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southeast Fisheries Science Center, Turtle Expert Working Group.

TEWG. 2007. An assessment of the leatherback turtle population in the Atlantic Ocean. National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southeast Fisheries Science Center, Turtle Expert Working Group.

Thomson, J.A., and M.R. Heithaus. 2014. Animal-borne video reveals seasonal activity patterns of green sea turtles and the importance of accounting for capture stress in short-term biologging. Journal of Experimental Marine Biology and Ecology 450:15-20.

Tomas, J., and J.A. Raga. 2008. Occurrence of Kemp's ridley sea turtle (*Lepidochelys kempii*) in the Mediterranean. Marine Biodiversity Records 1:1-2.

USACE. 2010. Sea turtle data warehouse. U.S. Army Corps of Engineers.

USCG. 2003. 2002 national recreational boating survey state data report. United States Coast Guard, Columbus, Ohio.

USCG. 2005. Boating statistics - 2005. United States Coast Guard, Washington D.C.

USCOP. 2004. An ocean blueprint for the 21st century. U.S. Commission on Ocean Policy, Washington, D.C.

USDOI. 2012. Natural Resource Damage Assessment: April 2012 status update for the *Deepwater Horizon* oil spill. U.S. Department of the Interior.

USFWS. 2002. Report on the Mexico/United States of America population restoration project for the Kemp's ridley sea turtle, *Lepidochelys kempii*, on the coasts of Tamaulipas and Veracruz, Mexico. U.S. Fish and Wildlife Service.

USFWS. 2006. Report on the Mexico/United States of America population restoration project for the Kemp's ridley sea turtle, *Lepidochelys kempii*, on the coasts of Tamaulipas, and Veracruz, Mexico. United States Fish and Wildlife Service.

USFWS, and NMFS. 1992. Recovery plan for the Kemp's ridley sea turtle (*Lepidochelys kempii*). U.S. Fish and Wildlife Service and National Marine Fisheries Service, St. Petersburg, Florida.

USN. 2008. Biological evaluation for the Gulf of Mexico rangle complex. U.S. Navy.

USN. 2009. Gulf of Mexico range complex final environmental impact statement/overseas environmental impact statement (EIS/OEIS) volume 1 (version 3). United States Navy, Norfolk, Virginia.

Varanasi, U., J.E. Stein, and M. Nishimoto. 1989. Biotransformation and disposition of polycyclic aromatic hydrocarbons (PAH) in fish. Pages 94-149 *in* U. Varanasi, editor. Metabolism of polycyclic aromatic hydrocarbons in the aquatic environment, CRC Press, Boca Raton, Florida.

Vargo, S., P. Lutz, D. Odell, E.V. Vleet, and G. Bossart. 1986. Study of the effects of oil on marine turtles. U.S. Department of the Interior, Minerals Management Service, Vienna, Virginia.

Wagner, E.J., R.E. Arndt, and B. Hilton. 2002. Physiological stress responses, egg survival and sperm motility for rainbow trout broodstock anesthetized with clove oil, tricaine methanesulfonate or carbon dioxide. Aquaculture 211:353-366.

Walker, B.G., P. Dee Boersma, and J.C. Wingfield. 2005. Physiological and behavioral differences in magellanic Penguin chicks in undisturbed and tourist-visited locations of a colony. Conservation biology 19(5):1571-1577.

Wallace, B.P., and R.H. George. 2007. Alternative techniques for obtaining blood samples from leatherback turtles. Chelonian Conservation and Biology 6(1):147-149.

Wallace, B.P., S.S. Kilham, F.V. Paladino, and J.R. Spotila. 2006. Energy budget calculations indicate resource limitation in Eastern Pacific leatherback turtles. Marine Ecology Progress Series 318:263-270.

Wallace, B.P., P.R. Sotherland, P. Santidrian Tomillo, R.D. Reina, J.R. Spotila, and F.V. Paladino. 2007. Maternal investment in reproduction and its consequences in leatherback turtles. Oecologia 152(1):37-47.

Wibbels, T., J. Hanson, G. Balazs, Z.-M. Hillis-Starr, and B. Phillips. 1998. Blood sampling techniques for hatchling cheloniid sea turtles. Herpetological Review 29(4):218-220.

Wilcox, C., G. Heathcote, J. Goldberg, R. Gunn, D. Peel, and B.D. Hardesty. 2015. Understanding the sources and effects of abandoned, lost, and discarded fishing gear on marine turtles in northern Australia. Conservation biology 29(1):198-206.

Wilkinson, C., and D. Souter. 2008. Status of Caribbean coral reefs after bleaching and hurricanes in 2005. Global Coral Reef Monitoring Network, and Reef and Rainforest Research Centre, Townsville.

Witherington, B., S. Hirama, and R. Hardy. 2012a. Young sea turtles of the pelagic *Sargassum*-dominated drift community: habitat use, population density, and threats. Marine Ecology Progress Series 463:1-22.

Witherington, B., P. Kubilis, B. Brost, and A. Meylan. 2009. Decreasing annual nest counts in a globally important loggerhead sea turtle population. Ecological Applications 19(1):30-54.

Witherington, B., B. Schroeder, S. Hirama, B. Stacy, M. Bresette, J. Gorham, and R. DiGiovanni. 2012b. Efforts to rescue oiled turtles at sea during the BP *Deepwater Horizon* blowout event, April-September 2010. Page 21 *in* T.T. Jones and B.P. Wallace, editors. Thirty-First Annual Symposium on Sea Turtle Biology and Conservation.

National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southeast Fisheries Science Center, San Diego, California.

Wolfe, S.H., J.A. Reidenauer, and D.B. Means. 1988. An ecological characterization of the Florida Panhandle. U.S. Fish and Wildlife Service and Minerals Management Service, New Orleans, Louisiana.

Work, P.A., A.L. Sapp, D.W. Scott, and M.G. Dodd. 2010. Influence of small vessel operation and propulsion system on loggerhead sea turtle injuries. Journal of Experimental Marine Biology and Ecology 393(1-2):168-175.

www.myfwc.com. 2016. Loggerhead nesting in Florida. Florida Fish and Wildlife Conservation Commission.

www.nmfs.noaa.gov/pr. 2006. National Marine Fisheries Service, Office of Protected Resources.

www.seaturtle.org. 2016. Sea turtle nest monitoring system. seaturtle.org.

Yender, R., J. Michel, and C. Lord. 2002. Managing seafood safety after an oil spill. National Oceanic and Atmospheric Administration, National Ocean Service, Office of Response and Restoration, Seattle, Washington.

Zwinenberg, A.J. 1977. Kemp's ridley, Lepidochelys kempii (Garman 1880), undoubtedly the most endangered marine turtle today (with notes on the current status of Lepidochelys olivacea). Bulletin of the Maryland Herpetological Society 13(3):378-384.