National Marine Fisheries Service
Endangered Species Act Section 7
Biological Opinion

Title:	Biological Opinion on the Issuance of Permit No. 19697 for Scientific Research on Sea Turtles in the Coastal Waters of Puerto Rico
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 Agency:	NOAA's National Marine Fisheries Service, Office of Protected Resources, Permits and Conservation Division
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NATIONAL MARINE FISHERIES SERVICE
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Approved:	Donna S. Wieting Donna S. Wieting Director, Office of Protected Resources
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TABLE OF CONTENTS

Page

List of Tables

List of Figures

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, NMFS provides an opinion stating whether the Federal agency's action is likely to jeopardize ESA-listed species or destroy or adversely modify designated critical habitat. If NMFS determines that the action is likely to jeopardize listed species or destroy or adversely modify 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 NMFS 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 permit (Appendix A) pursuant to section 10(a)(1)(A) of the ESA. The Permits Division proposes to issue scientific research Permit No. 19697 for the measuring, weighing, photographing/videoing, tagging (flipper, passive integrated transponder (PIT), and satellite), sampling (blood and tissue), ultrasound, and tumor removal of green and hawksbill sea turtles in the coastal waters of Puerto Rico, including Mona, Monito, and Desecheo Islands, and the Culebra Archipelago.

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 (hereafter referred to as "we").This biological 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 ESA-listed species and designated critical habitats. A complete record of this consultation is on file at the NMFS Office of Protected Resources in Silver Spring, Maryland.

1.1 Background

The permit application is to continue long-term projects studying green and hawksbill sea turtle aggregations in the coastal waters of Puerto Rico, including Mona, Monito, and Desecheo Islands, and the Culebra Archipelago. Proposed research would involve vessel surveys for abundance counts and capture by hand or tangle nets to assess the population structure, trends in relative abundance, habitat utilization, genetics, zoogeography, and epidemiology of sea turtles in their foraging habitats.

This ongoing research is the continuation of previous research that began in 2005. This project directly addresses several priority 1 and 2 tasks of both the hawksbill and the green turtle Atlantic recovery plans (NMFS and USFWS 1991, 1993). Ongoing longterm surveys have contributed to the implementation of protection measures for the following marine turtle habitats: Mona and Monito Islands: the "waters extending seaward tree nautical miles from the mean high water line" of Mona and Monito Islands were designated critical habitat for hawksbill turtles by NMFS on September 2, 1998; Culebra Archipelago: the coastal waters of the Culebra Archipelago were designated critical habitat for green turtles by NMFS in 1998; Desecheo Island: the waters surrounding Desecheo Island were designated as a marine reserve by the Department of Natural and Environmental Resources of Puerto Rico in 2002.

The proposed permit will continue to provide valuable information necessary for wildlife managers and agencies on the state and federal levels to make management decisions regarding the recovery and conservation of green and hawksbill turtles. This is the only long-term study of its kind in Puerto Rico. The Mona and Monito surveys have been conducted annually for 24 consecutive years and they are one of the few surveys worldwide that have been ongoing for such an extended period of time. The data obtained by achieving the objectives outlined above will contribute to the understanding of the demographics of these aggregations, the attributes of the coastal areas that make these preferred developmental habitat for these species, the heretofore poorly understood movements of immature marine turtles between developmental habitats and their eventual movement to adult foraging habitats, by use of satellite tagging and flipper tagging, and the epidemiology of diseases afflicting marine turtles.

1.2 Consultation History

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

- The permit application was submitted on September 15, 2015 and early technical assistance/review of the permit was requested of the ESA Interagency Cooperation Division on November 19, 2015.

- On January 22, 2016, the ESA Interagency Cooperation Division provided comments on the application.
- On April 20, 2016, the NMFS Permits Division deemed the application complete.
- On June 2, 2016, the completed initiation package was sent from the NMFS Permits Division to the ESA Interagency Cooperation Division.
- On December 8, 2016, the ESA Interagency Cooperation Division initialized formal consultation on Permit No. 19697.

2 THE ASSESSMENT FRAMEWORK

Section 7(a)(2) of the ESA requires Federal agencies, in consultation with NMFS, to ensure 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.

"*Jeopardize the continued existence of*" 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 C.F.R. §402.02.

"*Destruction or adverse modification*" means a direct or indirect alteration that appreciably diminishes the value of designated critical habitat for the conservation of an ESA-listed species. Such alterations may include, but are not limited to, those that alter the physical or biological features essential to the conservation of a species or that preclude or significantly delay development of such features (50 C.F.R. §402.02).

An ESA section 7 assessment involves the following steps:

Description of the Proposed Action (Section 3), *Action Area* (Section 3.7), and *Interrelated and Interdependent Actions* (Section 3.8). We describe the proposed action, identify any interrelated and interdependent actions, and describe the action area with the spatial extent of those stressors.

Status of Endangered Species Act Protected Resources (Section 4): We identify the ESA-listed species and designated critical habitat that are likely to co-occur with those stressors in space and time and evaluate the status of those species and habitat. In this Section, we also identify those *Species and Designated Critical Habitat Not Likely to be Adversely Affected* (Section 4.1), and those *Species Likely to be Adversely Affected* (Section 4.2).

Environmental Baseline (Section 5): 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.

Effects of the Action (Section 6): 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. 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. 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. The adverse modification analysis considers the impacts of the proposed action on the essential habitat features and conservation value of designated critical habitat.

Cumulative Effects (Section 6.6): Cumulative effects are the effects to ESA-listed species and designated critical habitat of future state or private activities that are reasonably certain to occur within the action area 50 C.F.R. §402.02. Effects from future Federal actions that are unrelated to the proposed action are not considered because they require separate ESA section 7 compliance.

Integration and Synthesis (Section 6.7): In this section, we integrate the analyses in the opinion to summarize the consequences to ESA-listed species and designated critical habitat under NMFS' jurisdiction.

Conclusion (Section 7); With full consideration of the status of the species and the designated critical habitat, we consider the effects of the action within the action area on populations or subpopulations and on essential habitat features when added to the environmental baseline and the cumulative effects to determine whether the action could reasonably be expected to:

- Reduce appreciably the likelihood of survival and recovery of ESA-listed species in the wild by reducing its numbers, reproduction, or distribution, and state our conclusion as to whether the action is likely to jeopardize the continued existence of such species; or
- Appreciably diminish the value of designated critical habitat for the conservation of an ESA-listed species, and state our conclusion as to whether the action is likely to destroy or adversely modify 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, then we must identify reasonable and prudent alternative(s) to the action, if any, or indicate that to the best of our knowledge there are no reasonable and prudent alternatives. See 50 C.F.R. §402.14.

In addition, we include an *Incidental Take Statement* (Section 8) that specifies the impact of the take, reasonable and prudent measures to minimize the impact of the take, and terms and conditions to implement the reasonable and prudent measures. ESA section 7 (b)(4); 50 C.F.R. §402.14 (i). We also provide discretionary *Conservation Recommendations* (Section 9) that may be implemented by action agency. 50 C.F.R. §402.14 (j). Finally, we identify the circumstances in which *Reinitiation of Consultation* is required (Section 10). 50 C.F.R. §402.16.

To comply with our obligation to use the best scientific and commercial data available, we collected information identified through searches of google scholar, web of science, literature cited sections of peer reviewed articles, species listing documentation, and reports published by government and private entities. This opinion is based on our review and analysis of various information sources, including:

- Information submitted by the Permits Division and the applicant
- Government reports (including NMFS biological opinions and stock assessment reports)
- NOAA technical memos
- Peer-reviewed scientific literature

These resources were used to identify information relevant to the potential stressors and responses of ESA-listed species and designated critical habitat under NMFS' jurisdiction that may be affected by the proposed action to draw conclusions on risks the action may pose to the continued existence of these species and the value of designated critical habitat for the conservation of ESA-listed species.

3 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. 19697 to Carlos E. Diez, Departamento de Recursos Naturales y Ambientales de Puerto Rico (Department of Natural and Environmental Resources of Puerto Rico), Programa de Especies Protegidas (Protected Species Program), pursuant to section 10(a)(1)(a) of the ESA, to conduct research on green and hawksbill sea turtles.

The purpose of the purposed permit is the continuation of a long-term project studying green and hawksbill sea turtle aggregations in the coastal waters of Puerto Rico, including Mona, Monito, and Desecheo Islands, and the Culebra Archipelago. Turtles will be captured using tangle nets or by hand to assess the population structure, trends in relative abundance, habitat utilization, genetics, zoogeography, and epidemiology of sea turtles in their foraging habitats. The proposed annual take of each sea turtle species under Permit No. 19697 is found in Table 1.

Table 1. Proposed annual take of sea turtles under Permit No. 19697.

Species	Listing Unit	Number of Animals	Take Action	Collect Method	Procedures
Green Sea Turtle	North Atlantic DPS[1]	130	Capture/ Handle/ Release	Hand, Tangle/Dip Net	Count/survey; Mark: carapace; Tag: flipper, PIT[2]; Measure; Photograph/Video; Sample: blood, tissue; Weigh
Green Sea Turtle	North Atlantic DPS	10	Capture/ Handle/ Release	Hand, Tangle/Dip Net	Count/survey; Mark: carapace; Tag: flipper, PIT; Measure; Photograph/Video; Sample: blood, tissue; Weigh; Ultrasound; Tumor removal
Green Sea Turtle	North Atlantic DPS	10	Capture/ Handle/ Release	Hand, Tangle/Dip Net	Count/survey; Mark: carapace; Tag: flipper, PIT; Measure; Photograph/Video; Sample: blood, tissue; Weigh; Tumor removal; Instrument, epoxy attachment (e.g. satellite tag, VHF[3] tag)
Hawksbill Sea Turtle	Range-wide	140	Capture/ Handle/ Release	Hand, Tangle/Dip Net	Count/survey; Mark: carapace; Tag: flipper, PIT[2]; Measure; Photograph/Video; Sample: blood, tissue; Weigh
Hawksbill Sea Turtle	Range-wide	10	Capture/ Handle/ Release	Hand, Tangle/Dip Net	Count/survey; Mark: carapace; Tag: flipper, PIT; Measure; Photograph/Video; Sample: blood, tissue; Weigh; Tumor removal; Instrument, epoxy attachment (e.g. satellite tag, VHF[3] tag)

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

3.1 Capture

Surveys around Mona and Monito Islands are carried out with on average three observers snorkeling for one-hour periods at about 15 meter spacing parallel over reef habitat, or with observers swimming close together in cliff wall habitats. Sighted turtles are counted by category (species, immature/adult, new (re)capture/previously captured during the year) and any turtle not already captured during the year (evident by a dot of red paint, which is applied before release) is briefly pursued for attempted capture. Any captured turtles are immediately brought upon a boat for holding until processing (up to six individuals, as per boat capacity), while surveys continue until the one-hour period concludes. Captured turtles are kept separated in their normal, upright position on the padded floor of the boat, covered with regularly moistened towels in the shade to prevent overheating from sun exposure.

In Culebra Archipelago, turtle capture methods depend on the targeted habitat type. The method for capturing turtles on seagrass pastures is by tangle net-assisted capture adapted from Collazo et al. (1992). A single tangle net measuring approximately two hundred meters long and nine meters high is used. This net is typically deployed for up to 1 hour sessions in about six to eight meters water depth with highly visible floats attached every ten meters. A minimum of six swimmers will snorkel continuously along the net to rapidly extract any turtles that collides with the net. At least one boat is used for deploying, attending and retrieval of the net. Where netting is conducted in proximity to shallow seagrass beds, extreme care is taken to prevent propeller or grounding damage to the seabed. No boat anchors are used. Bycatches are uncommon, typically occurring only at Manglar Bay, and has been limited to spotted eagle rays, southern stingrays, and nurse sharks. All bycatch is removed from the net as soon as possible and released alive at the location of capture. Captured turtles are kept in their normal, upright position on the padded floor of the boat, covered with regularly moistened towels in the shade to prevent overheating from sun exposure and separated by placing them within plastic containers. All turtles are kept separated (e.g. in plastic containers on a different vessel).

3.2 Measuring, Marking and Weighing

Straight and curved measurements to the nearest 0.1 centimeters are taken from all turtles caught. Measures taken include carapace length (from nuchal notch to the tip of the longest postcentral tip using both appropriately ranged tree calipers for straight carapace length, and tape measures for curved carapace length. Turtles are weighed by restraining them inside woven bags and manually suspending the bags from appropriately ranged spring scales to measure body mass to the nearest 0.1 kilogram. To minimize observer measurement errors, measurements are taken by experienced researchers only. Captured turtles are immediately physically examined, and given a dot of bright non-toxic acrylic/latex Eco Paint applied to the carapace to help avoid unnecessary intraseasonal recaptures. This dot of paint lasts up to one month on the carapace of the turtle. Saturation tagging and capture-recapture methods conducted at various times throughout the year for the next several years will allow the researchers to obtain many population parameters such as patterns of turtle aggregation density, rate of recruitment, somatic growth rates, and turtle migration between survey sites. All equipment (particularly weighing bags and scales, calipers and tagging pliers) is disinfected with bleach solution and then thoroughly rinsed for every turtle processed in Culebra Archipelago. Procedures follow NMFS Sea Turtle Research Techniques Manual (NMFS SEFSC 2008).

3.3 Flipper and Passive Integrated Transponder Tagging

All turtles greater than 25 centimeters straight carapace length are tagged in both front flippers along the inside edge of the first or second scale (counting from the base of the flipper) using monel, inconel or plastic (Roto) tags. Prior to any tagging, all tags will be cleaned and disinfected before use. Applicators will be cleaned between animals. The insertion site skin surfaces are disinfected with saturated isopropyl alcohol wipes. Plastic tags are applied only to individuals greater than thirty-five centimeters straight carapace length. Additionally, turtles smaller than thirty-five centimeters and larger than twenty centimeters are tagged with PIT tags and inserted in the frontal right shoulder muscle (turtles greater than twenty-five centimeters straight carapace length are tagged with a PIT tag only). Local anesthesia (e.g., lidocaine) will be applied before tag insertion. Should the insertion site bleed, it will be swabbed with 10 percent povidone-iodine solution and pressure will be applied until bleeding stops. No turtles less than twenty centimeters straight carapace length will be tagged. Tagging allows the identification of individuals, necessary for obtaining growth rate, recruitment, migration and other population parameter data. If an animal is already tagged (e.g., PIT tag), no additional tagging of the same type will be performed.

3.4 Tissue and Blood Sampling

Blood or tissue samples will be taken from some individuals and archived for future molecular or pathological studies, which would be used to address tasks of the species' recovery plans. For example, serum samples will be used to measure testosterone levels for sex determination and red blood cells for DNA analysis to determine molecular origin of the turtles. Blood will be taken from the sinuses in the dorsal side of the neck (Owens and Ruiz 1980). Either a syringe and needle or a vacuum tube with needle holder system will be used for obtaining blood from the dorsal cervical sinus (Owens 1999). For turtles from 0.5 to 5 kilograms, a 1 inch 21 gauge needle will be used, while 1.5 inch needle will be used for larger turtles (over 5 kilograms), following NMFS-SEFSC (2008). Blood collection will not exceed 3 milliliters per kilogram of body mass per individual. Samples will be preserved for lab analysis on ice, frozen or in a dimethyl sulfoxide buffer solution, following NMFS-SEFSC (2008). For tissue sampling, the sample site will be along the posterior edge of a rear or front flipper in soft tissue. The area will be soaked and scrubbed with 10 percent povidone-iodine solution followed by an isopropyl alcohol wipe, then thoroughly swab again with 10 percent povidone-iodine solution prior to sampling. Sterile biopsy punch tools will be used and size will vary according to turtle size. Only one biopsy or tissue sample will be taken per individual. Samples will be preserved for lab analysis on ice, frozen or in a dimethyl sulfoxide buffer solution, following NMFS-SEFSC (2008).

3.5 Ultrasound and Tumor Removal

The researchers have established normal ultrasonographic anatomy of sea turtle eyes, liver, kidneys, urinary bladder, esophagus, intestinal loops, and heart. These images are used to compare turtles affected with fibropapillomatosis tumors that may have internal organ involvement. Ultrasound examinations are performed using a portable Micromaxx ultrasound system. Smaller sea turtles will be imaged using an 8 to 12 megahertz transducer, while larger animals require a 1 to 2 megahertz transducer to allow for better visualization of deeper organs. The ultrasound will be used to image the esophagus, liver, gall bladder, stomach, heart, intestines, urinary bladder, and kidneys.

Small external fibropapillomatosis tumors will be removed from selected candidate animals by Samuel Rivera, the veterinarian at the United States Fish and Wildlife Service Culebra Wildlife Refuge. Turtles are hand-carried from where the research vessel docks to the facility (approximately 500 feet). The ideal surgery candidate will be a turtle that has an overall good body condition index, based on comparative biometric data that has been collected at the location. The tumors that will be removed are those that are necrotic, large, and impeding movement or prone to injury, in locations that in the near future may represent a survival threat. It is currently common practice to avoid the use of general anesthetics (with veterinary approval) whenever possible, since a local anaesthetic incurs less risk of mortality, is adequate for reducing apparent pain, and allows a much shorter post-operative observation period (Wood et al., 1982; Wibbels et al., 1990). In cases of massive tumor spread, only the worst tumors will be removed. Only those turtles where surgery can significantly improve their quality of life and have a good prognosis for long-term survival will undergo surgery. Surgery sites will be closed using absorbable suture. The animals will be released shortly after surgery. The researchers will follow procedures as stated on NMFS permit conditions related to Tumor Removal Surgery. Removing massive numbers of tumor in one animal may compromise its health, so only select tumors will be removed. Some animals with multiple tumor masses will be released with some of these still intact.

3.6 Satellite Tagging

Up to 10 juvenile and/or adult hawksbill turtles and up to 10 juvenile and/or adult green turtles per year may be fitted with satellite transmitters and/or sonic tags. Turtles selected for satellite transmitter and/or sonic tags application will be either healthy adults (male or female) or larger (greater than 40 centimeters straight carapace length) immatures. Turtles will be detained for transmitter application confined in a small boat. Satellite transmitters used will be Wildlife Computers model SPOT-311B or similar instruments. The sonic tags used are plastic covered cylinders model CHP-87 Sonotronics, Tucson AZ or Vemco V16-1L transmitters. The transmitters will be affixed to the central section of the turtles' carapace using epoxy and/or resined fiberglass using the method further described following Balazs et al. (1996) and Van Dam et al. (2008). However, whenever possible, transmitters will not be placed at the peak height of the carapace to make attachments as hydrodynamic as possible (Jones et al. 2011). The application area of the turtle carapace is scrubbed with a plastic brush, cleaned of external biota, then lightly sandpapered, wiped with isopropyl alcohol, and left to dry. The subject turtle will remain dry and minimally restrained in the normal plastron-down position for the duration of the procedure. The sonic tag attachment site is the trailing edge of the carapace, where tags are best protected from abrasion. A small amount of inert flexible material, such as silicone elastomer, is applied to create a level attachment surface. The sonic tag is attached using quick-setting, 1 centimeter layer of epoxy. The transmitter is placed and small strips of fiberglass are placed covering both the edge of the transmitter and the carapace. Turtles are held for 1 to 2 hours after attaching the transmitters to allow adhesives to set. From the time of capture until release, procedures (e.g., satellite tag attachment) may take up to 3 hours for each turtle. As soon as the epoxy has substantially set, the turtle is released as close as possible to the site of capture. The average retention of a transmitter is 8 months, however tags could last up to 1 year.

3.7 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 the coastal waters of Puerto Rico, including Mona, Monito, and Desecheo Islands, and the Culebra Archipelago (Figure 1).

Figure 1. Action area for Permit No. 19697. The coastal waters of Puerto Rico, including the islands of Mona, Monito, and Desecheo, and the Culebra Archipelago.

3.8 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 issuance of Permit No. 19697, there are no interrelated or interdependent actions.

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. 19697 (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 2, along with their regulatory status.

Table 2. ESA-listed species that may be affected by the issuance of Permit No. 19697.

Species	ESA Status	Critical Habitat	Recovery Plan
Green sea turtle (*Chelonia mydas*): North Atlantic DPS	Threatened 81 FR 20057 04/06/2016	63 FR 46693 09/02/1998	FR Notice Not Available U.S. Atlantic 1991
Hawksbill sea turtle (*Eretmochelys imbricata*)	Endangered 35 FR 8491 06/02/1970	63 FR 46693 Atlantic 09/02/1998	57 FR 38818 U.S. Caribbean, Atlantic, and Gulf of Mexico 1992
Elkhorn coral (*Acropora palmata*)	Threatened 71 FR 26852 05/09/2006	73 FR 72210 Florida, Puerto Rico, St. John/St. Thomas, St. Croix 11/26/2008	80 FR 12146 Range-wide 2015
Staghorn coral (*Acropora cervicornis*)	Threatened 71 FR 26852 05/09/2006	73 FR 72210 Florida, Puerto Rico, St. John/St. Thomas, St. Croix 11/26/2008	80 FR 12146 Range-wide 2015

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.

In 1998, NMFS designated critical habitat for the green sea turtle to include the coastal waters surrounding Culebra Island, Puerto Rico, and the hawksbill sea turtle to include the coastal waters surrounding Mona and Monito Islands, Puerto Rico (63 FR 46693). Therefore, the action area overlaps with the designated critical habitat for green sea turtles. Designated critical habitat for green turtles including the waters surrounding the island of Culebra from the mean high water line seaward to three nautical miles. These waters include Culebra's outlying Keys including Cayo Norte, Cayo Ballena, Cayos Geniqui, Isla Culebrita, Arrecife Culebrita, Cayo de Luis Pena, Las Hermanas, El Mono, Cayo Lobo, Cayo Lobito, Cayo Botijuela, Alcarraza, Los Gemelos, and Piedra Steven. Sea grasses are a principal dietary component of juvenile and adult green turtles. The Culebra Archipelago is important green sea turtle development and feeding habitat that includes sea grasses such as *Thalassia testudium*. The coral reefs and other topographic features within these waters provide green turtles with shelter during inter-foraging periods. In April 2016, NMFS removed the range-wide and breeding population listings of the green sea turtle, and listed eight distinct population segments (DPSs) as threatened and three as endangered (81 FR 20057). The designated critical habitat in the coastal waters surrounding Culebra Island, Puerto Rico, remain in effect for the North Atlantic DPS of green sea turtle.

Designated critical habitat for hawksbill sea turtles includes the waters surrounding the islands of Mona and Monito, Puerto Rico, from the mean high water line seaward to three nautical miles. Therefore, the action area overlaps with the designated critical habitat for hawksbill sea turtles. The coral reefs of Mona and Monito Islands provide foraging habitat (e.g. sponges) for hawksbill sea turtles, and the ledges and caves of the reefs provide shelter for rest and refuge from predators.

In 2008, NMFS designated critical habitat for the elkhorn and staghorn corals to include the waters of Florida, Puerto Rico, St. John/St. Thomas, and St. Croix (73 FR 72210). The designated areas contains substrate that NMFS has determined to be an essential physical feature for the conservation of the species and that may require special management considerations or protection.

Capture of targeted species will be performed by hand or net and all research activities will take place aboard vessels so that no activity would adversely affect the shelter and dietary components of the sea turtles or the physical features of the designated critical habitat. The applicant will keep boat speeds to a minimum in shallow areas to not disturb the sea bed. In addition, boats will be tied up to existing buoys and piers, and if anchoring is necessary, will be done in sand. Tangle nets that are used will be set in sandy bottom locations only. The quality and quantity of available substrate nor the physical, chemical, or biological features that form the designated critical habitat will be affected. The Permits Division has determined that the issuance of Permit No. 19697 is not likely to adversely affect the designated critical habitat for green and hawksbill sea turtles, and elkhorn and staghorn coral due to the nature of activities. It is extremely unlikely that the research activities will affect the designated critical habitat, therefore, the actions are discountable. We concur with the Permits Division that the issuance of Permit No. 19697 is not likely to adversely affect the designated critical habitat for the four previously mentioned species and so they are not addressed further in this opinion.

4.2 Species 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

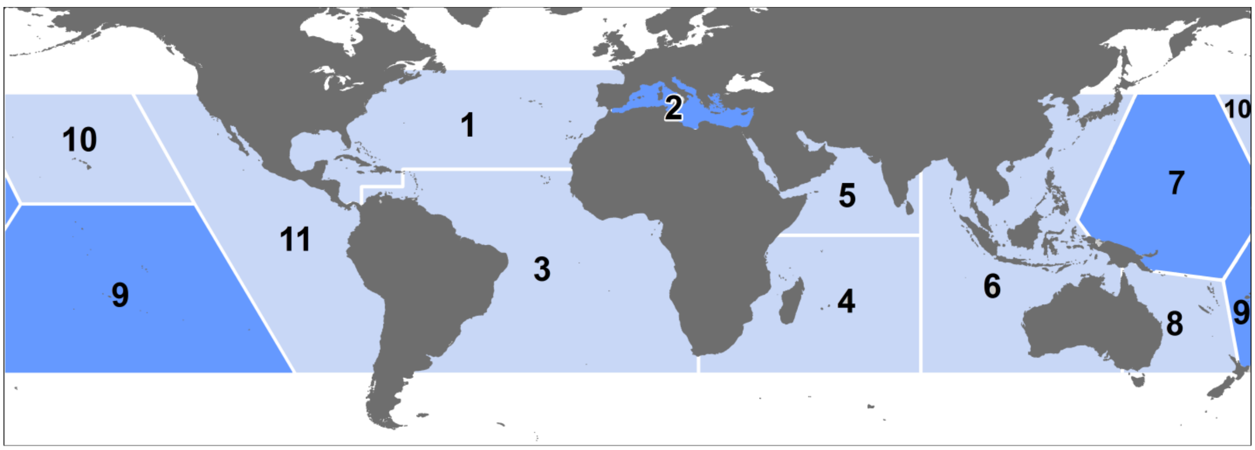
Green sea turtles were listed under the ESA on July 28, 1978 (43 FR 32800). The species was separated into two listing designations: endangered for breeding populations in Florida and the

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 3).

Table 3. 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 04/06/2016	63 FR 46693 09/02/1998	FR Notice Not Available U.S. 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 2).



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 2. 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 3).

Figure 3. 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); United States (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 United States, green turtles nest primarily along the central and southeast coast of Florida where an estimated 8,426 females nest annually.

The importance of the Culebra archipelago as green turtle developmental habitat has been well documented. Researchers have established that Culebra coastal waters support juvenile and subadult green turtle populations and have confirmed the presence of a small population of adults (Collazo et al. 1992). Additionally, the coral reefs and other topographic features within these waters provide green turtles with shelter during interforaging periods that serve as refuge from predators.

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 six 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 4).

Table 4. 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 06/02/1970	63 FR 46693 Atlantic 09/02/1998	57 FR 38818 U.S. Caribbean, Atlantic and Gulf of Mexico 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 4).

Figure 4. 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

In the Atlantic, hawksbill population increase has been greater in the Insular Caribbean than along the Western Caribbean Mainland or the eastern Atlantic (including Sao Tomé and Equatorial Guinea). Nesting populations of Puerto Rico appeared to be in decline until the early 1990's, but have universally increased during the survey periods. Mona Island now hosts 199-332 nesting females annually, and the other sites combined host 51-85 nesting females annually (NMFS and USFWS 2007). The U.S. Virgin Islands have a long history of tortoiseshell trade (Schmidt 1916). At Buck Island Reef National Monument, protection has been in force since 1988, and during that time, hawksbill nesting has increased by 143 percent to 56 nesting females annually, with apparent spill over to beaches on adjacent St. Croix. However, St. John populations did not increase, perhaps due to the proximity of the legal turtle harvest in the British Virgin Islands.

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.

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 and applicable adjacent waters, 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 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.

5.2.1 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 an 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 have been conducted on the following fisheries, occurring at least in part within the action area, found likely to adversely affect threatened and endangered sea turtles: Atlantic bluefish, Atlantic herring, Atlantic mackerel/squid/butterfish, Atlantic sea scallop, Atlantic swordfish/tuna/shark/billfish, coastal migratory pelagic, dolphin-wahoo, Gulf of Mexico reef fish, monkfish, Northeast multispecies, South Atlantic snapper-grouper, Southeast shrimp trawl, spiny dogfish, red crab, skate, commercial directed shark, summer flounder/scup/black sea bass fisheries, tilefish, Atlantic highly migratory species fishery, Gulf of Mexico /South Atlantic spiny lobster, and Gulf of Mexico stone crab. 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.

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

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

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

5.2.2 State or Private Activities

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).

Recreational fishermen have reported hooking turtles when fishing from boats, piers, and beach, banks, and jetties. Commercial fishermen fishing for reef fish and for sharks with both single rigs and bottom longlines have also reported hooked turtles. A detailed summary of the known impacts of hook and line incidental captures to loggerhead sea turtles can be found in the Turtle Expert Working Group reports (TEWG 1998, 2000, 2007).

5.3 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 ESA-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 United States (MMS 2007; 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).

5.4 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 U.S. 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 U.S. Navy on all testing and training activities in the Atlantic basin and Gulf of Mexico (Table 5) (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 5. Annual total of model-predicted impacts on sea turtles for training activities using sonar and other active non-implusive acoustic sources for United States Navy testing activities in the North Atlantic.

	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

5.5 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).

5.6 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.

5.7 Oil and Gas Exploration

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

The 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.

5.8 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).

Although beach nourishment, or placing sand on beaches, may provide more sand, the quality of that sand, and hence the nesting beach, may be less suitable than pre-existing natural beaches. Sub-optimal nesting habitat may cause decreased nesting success, place an increased energy burden on nesting females, result in abnormal nest construction, and reduce the survivorship of eggs and hatchlings (Mann 1978; Ackerman 1980; Mortimer 1990).

Beach armoring (e.g., bulkheads, seawalls, soil retaining walls, rock revetments, sandbags, and geotextile tubes) can impede a turtle's access to upper regions of the beach/dune system, thereby limiting the amount of available nesting habitat (Mazaris et al. 2009). Impacts also can occur if structures are installed during the nesting season. For example, unmarked nests can be crushed or uncovered by heavy equipment, nesting turtles and hatchlings can get caught in construction debris or excavations, and hatchlings can get trapped in holes or crevices of exposed riprap and geotextile tubes. In many areas of the world, sand mining (removal of beach sand for upland construction) seriously reduce or degrade/destroy sea turtle nesting habitats or interfere with hatchling movement to sea (NMFS 2003).

5.9 Pollutants

Coastal runoff, marina and dock construction, dredging, aquaculture, oil and gas exploration and extraction, increased under water noise and boat traffic can degrade marine habitats used by sea turtles (Colborn et al. 1996). The development of marinas and docks in inshore waters can negatively impact nearshore habitats. An increase in the number of docks built increases boat and vessel traffic. Fueling facilities at marinas can sometimes discharge oil, gas, and sewage into sensitive estuarine and coastal habitats. Although these contaminant concentrations do not likely affect the more pelagic waters, the species of turtles analyzed in this biological opinion travel between near shore and offshore habitats and may be exposed to and accumulate these contaminants during their life cycles.

There are studies on organic contaminants and trace metal accumulation in green and leatherback sea turtles (Aguirre et al. 1994; Corsolini et al. 2000). Mckenzie et al. McKenzie et al. (1999) measured concentrations of chlorobiphenyls and organochlorine pesticides in sea turtles tissues collected from the Mediterranean (Cyprus, Greece) and European Atlantic waters (Scotland) between 1994 and 1996. Omnivorous loggerhead turtles had the highest organochlorine contaminant concentrations in all the tissues sampled, including those from green and leatherback turtles (Storelli et al. 2008). It is thought that dietary preferences were likely to be the main differentiating factor among species. Decreasing lipid contaminant burdens with turtle size were observed in green turtles, most likely attributable to a change in diet with age.

Sakai et al (1995) found the presence of metal residues occurring in loggerhead turtle organs and eggs. Storelli et al. (1998) analyzed tissues from twelve loggerhead sea turtles stranded along the Adriatic Sea (Italy) and found that characteristically, mercury accumulates in sea turtle livers while cadmium accumulates in their kidneys, as has been reported for other marine organisms like dolphins, seals and porpoises (Law et al. 1991). No information on detrimental threshold concentrations are available, and little is known about the consequences of exposure of organochlorine compounds to sea turtles. Research is needed on the short- and long-term health and fecundity effects of chlorobiphenyl, organochlorine, and heavy metal accumulation in sea turtles.

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).

5.10 Disease and Non-native Species Introductions

A disease known as fibropapilloma, is a major threat to green turtles in some areas of the world. Fibropapilloma is characterized by tumorous growths, which can range in size from very small to extremely large, and are found both internally and externally. Large tumors can interfere with feeding and essential behaviors, and tumors on the eyes can cause permanent blindness (Foley et al. 2005). Fibropapilloma was first described in green turtles in the Florida Keys in the 1930s. Since then it has been recorded in many green turtle populations around the world, most notably present in green turtles of Hawaii, Florida, and the Caribbean. In Florida, up to 50 percent of the immature green turtles captured in the Indian River Lagoon are infected, and there are similar reports from other sites in Florida, including Florida Bay, as well as from Puerto Rico and the U.S. Virgin Islands. In addition, scientists have documented fibropapilloma in populations of loggerhead, olive ridley, and flatback turtles (Huerta et al. 2000). The effects of fibropapilloma at the population level are not well understood and could be a serious threat to their recovery. The cause of the disease remains unknown. Research to determine the cause of this disease is a high priority and is underway.

An increased human presence at some nesting beaches or close to nesting beaches has lead to secondary threats such as the introduction of exotic fire ants, feral hogs, dogs and an increased presence of native species (e.g. raccoons, armadillos, and opossums) which raid and feed on turtle eggs. Non-native vegetation has invaded many coastal areas and often outcompetes native species. Non-native vegetation is usually less-stabilizing and can lead to increased erosion and degradation of suitable nesting habitat. Non-native vegetation may also form impenetrable root mats that can prevent proper nest cavity excavation, invade and desiccate eggs, or trap hatchlings. In light of these issues, conservation and long-term protection of sea turtle nesting and foraging habitats is an urgent and high priority need.

5.11 Scientific Research and Permits

Scientific research similar to that which would be conducted under Permit No. 19697 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; blood/tissue collecting, 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 Table 6 and 7 for green and hawksbill 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 6. 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 7. 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

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.

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.

In this section, we describe the potential stressors associated with the proposed action, 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. We do not expect different responses to each activity from based on the species of sea turtle. That is, we expect green turtle and hawksbill turtle responses to each of the procedures to be similar. Hence, we summarize the likely stress and risk to each species together.

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. 19697 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 with handing and restraint following capture;

2) measuring, photographing, weighing;

3) tissue and blood sampling;

4) ultrasonic examination;

5) tumor removal, and

6) 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 permit, as proposed by the Permits Division (Appendix 1).

The permit application is to continue longterm projects studying green and hawksbill sea turtle aggregations in the coastal waters of Puerto Rico, including Mona, Monito, and Desecheo Islands, and Culebra Archipelago. The Mona and Monito surveys have been conducted annually for 24 consecutive years and they are one of the few worldwide projects that have been ongoing for such an extended period of time. Other coastal areas of Puerto Rico that are included in the action area have had ongoing research since 2005, under the original Permit No. 1518. The proposed procedures have been performed by Carlos E. Diaz and co-investigators for over fifteen years with no known resulting injury or mortality to any individual. 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.

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

1) Handle animals with the greatest care.

2) Captured individuals are kept covered and wet to prevent overheating from sun exposure. Turtles are usually released very near to the point of capture as soon as possible. In the case of animals caught by netting, these are attended to immediately by swimmers patrolling the net. A knife to cut away net material is carried in case turtles cannot be untangled manually and in order to cut away a section of net and free the animal. In areas were manatees or other marine mammals might be present, visual inspection to detect manatees will be conducted before deploying the net. If manatees or other marine mammals are detected, the net will not be deployed that day. Animals hand-captured will be brought to the surface immediately to allow them to breathe. It is important to mention that most of the hand-captures are achieved by free-diving observers who face much greater air limitations than turtles.

3) Prior to any external tagging, all tags will be cleaned and disinfected before use. Applicators will be cleaned between animals. The insertion site skin surfaces are disinfected with saturated isopropyl alcohol wipes. For passive integrated transponder tags, local anesthesia (e.g., lidocaine) will be applied before tag insertion. Should the insertion site bleed, it will be swabbed with 10 percent povidone-iodine solution and pressure will be applied until bleeding stops.

4) For blood and tissue sampling, the area will be soaked and scrubbed with 10 percent povidone-iodine solution followed by an isopropyl alcohol wipe, then thoroughly swabbed again with 10% povidone-iodine solution prior to sampling. Sterile biopsy punch tools and needles will be used and size will vary according to turtle size. Only one biopsy sample will be taken from a turtle to prevent more stress.

5) Turtles selected for satellite transmitter and/or sonic tags application will be either healthy adults (male or female) or larger (greater than forty centimeters carapace length) immatures. Transmitters will not be placed at the peak height of the carapace to make attachments as hydrodynamic as possible.

In addition to these mitigation measures taken by the applicant, the Permits Division will include mitigation measures as part of the terms and conditions (Section B5) of the permit found in Appendix A 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 Carlos E. Diez, listed Co-Investigator’s, and research assistants. We anticipate that requiring that the research be conducted by experienced personnel will further minimize impacts to the ESA-listed species 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 issuance of Permit No. 19697 will authorize research activities 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. 19697 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.

The applicant's original Permit No. 1518 and its six accompanying annual reports from 2005 through 2011 were available to evaluate these research activities. The following Permit No. 14949 has four annual reports from 2011 through 2015 including an environmental assessment done under the National Environmental Policy Act (NEPA), which determined that the proposed research activities could result in low level of short-term effects on sea turtles and resulted in a finding of no significant impact pursuant to NEPA. The applicant's annual reports from 2005 through 2015 are summarized in Table 8. 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 9.

Table 8. Number of annual takes that occurred from 2005 through 2015 during past performance of Permit No. 1518 and 14949.

Sea turtle species	Life Stage	Procedures	Actual Take[1]
Green	All except hatchling	Count/survey; Mark: carapace; Tag: flipper, PIT; Measure; Photograph/Video; Sample: blood, tissue; Weigh; Tumor removal; Instrument, epoxy attachment (e.g. satellite tag, VHF[3] tag)	495
Hawksbill	All except hatchling	Count/survey; Mark: carapace; Tag: flipper, PIT; Measure; Photograph/Video; Sample: blood, tissue; Weigh; Tumor removal; Instrument, epoxy attachment (e.g. satellite tag, VHF[3] tag)	936

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

Table 9. Number of exposures to activities expected under Permit No. 19697 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	Count/survey; Mark: carapace; Tag: flipper, PIT; Measure; Photograph/Video; Sample: blood, tissue; Weigh; Tumor removal; Instrument, epoxy attachment (e.g. satellite tag, VHF[3] tag)	1	150	750	5
Hawksbill	All except hatchling	Count/survey; Mark: carapace; Tag: flipper, PIT; Measure; Photograph/Video; Sample: blood, tissue; Weigh; Tumor removal; Instrument, epoxy attachment (e.g. satellite tag, VHF[3] tag)	1	150	750	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). 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 2007). 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. 19697. These include stressors associated the following activities: capture with handing and restraint following capture; measuring, photographing, weighing; tissue and blood sampling; ultrasonic examination; tumor removal, 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.

The common underling stressor of a human disturbance caused by the research activities that would be authorized under Permit No. 19697 may lead to a variety of different stress related responses which we discuss below.

6.4.1 Capture, Handling and Restraint

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. 19697 include by hand or dip/tangle 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. Under the applicant's previous Permit No. 1518 (2005-2011), twenty-nine hawksbill sea turtles were recaptured at Desecheo Island. In the Culebra Archipelago from 2004-2005, one hundred and fifty-one green turtles were captured with twenty-seven percent being captured for the first time, and seventy-three percent were recaptures from previous years. All recaptured turtles had increases in growth and were in good health.

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 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.

Straight and curved carapace measurements are taken for each captured turtle using both appropriately ranged tree calipers and tape measures. Turtles are weighed by restraining them inside woven bags and manually suspending the bags from appropriately ranged spring scales to measure body mass. To minimize observer measurement errors, measurements are taken by experienced researchers only. All equipment (particularly weighing bags and scales, calipers and tagging pliers) is disinfected with bleach solution and then thoroughly rinsed for every turtle. Procedures follow NMFS Sea Turtle Research Techniques Manual (NMFS SEFSC 2008).

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

6.4.3 Tissue and Blood Sampling

Taking a blood sample from the sinuses in the dorsal side of the neck is a routine procedure (Owens 1999), is a non-lethal and is not expected to have any sub-lethal effects. According to Owens (1999), with practice, it is possible to obtain a blood sample 95% of the time and the sample collection time should be about 30 seconds in duration. Effects of drawing blood samples with syringes from the dorsal side of the neck of turtles, could include pain, handling discomfort, possible hemorrhage at the site or risk of infection. To mitigate these effects, the needle would be slowly advanced while applying gentle negative pressure to the syringe until blood freely flows into the syringe. Once the blood is collected, direct pressure would be applied to the site to ensure clotting and prevent subsequent blood hemorrhaging (Stoskopf 1993). Bjorndal et al. (2010) found that turtles exhibited rapid healing at the tissue sampling site with no infection or scarring, and that the sampling did not adversely impact turtle physiology or health. The blood or tissue sample site would then be disinfected and checked again after recovery prior to release. Additionally, all of the researchers responsible for obtaining these samples will have received extensive experience in the procedure.

Blood or tissue samples will be taken from some individuals and archived for future molecular or pathological studies, which would be used to address tasks of the species' recovery plans. Blood will be taken from the sinuses in the dorsal side of the neck (Owens and Ruiz 1980). Either a syringe and needle or a vacuum tube with needle holder system will be used for obtaining blood from the dorsal cervical sinus (Owens 1999). For turtles from 0.5 to 5 kilograms, a 1 inch 21-gauge needle will be used, while 1.5 inch needle for larger turtles (over 5 kilograms), following NMFS SEFSC (2008). Blood collection will not exceed 3 milliliters/kilogram of body mass per individual. For tissue sampling, the sample site will be along the posterior edge of a rear or front flipper in soft tissue. The area will be soaked and scrubbed with 10 percent povidone-iodine solution followed by an isopropyl alcohol wipe, then thoroughly swab again with 10 percent povidone-iodine solution prior to sampling. Sterile biopsy punch tools will be used and size will vary according to turtle size. Only one biopsy or tissue sample will be taken per individual.

Effects of these procedures would be low-level pain, handling discomfort, possible hemorrhage at the site. There is a small risk of infection. Mitigation to minimize or avoid these risks (such as pressure and disinfection) lessen those possibilities. The sea turtles are to experience a short-term stress response in association with the handling, restraint, and pain associated with blood sampling. The applicants have experience in tissue and blood sampling and no sea turtle mortalities have occurred during the previous sampling activity from the applicant under Permit Nos. 1518 and 14949 that we are aware of, nor are we aware of any meaningful pathological consequences by sampled individuals on the part of the applicant.

6.4.4 Ultrasonic Examination

Ultrasonography is a noninvasive technique (Owens 1999) commonly used in human medicine, that assists in determining the presence of fibropapillomatosis tumors or other abnormal features using a portable ultrasound machine on board the research vessel and takes a maximum of 10 minutes per turtle. Turtles remain largely impassive while inverted. A clear, water-based gel would be applied to the inguinal area of the turtle and smooth-ended transducer would then be pushed up against the skin and used to visualize the area.

The researchers have established normal ultrasonographic anatomy of the eyes, liver, kidneys, urinary bladder, esophagus, intestinal loops, and heart. These images are used to compare turtles affected with fibropapillomatosis that may have internal organ involvement. Ultrasound examinations are performed using a portable ultrasound system. Smaller sea turtles will be imaged using an 8 to 12 megahertz transducer, while larger animals require a 1 to 2 megahertz transducer to allow for better visualization of deeper organs.

Like the procedures discussed above, the researcher has done ultrasonic examination of sea turtles under previous permits. It is a short-duration, non-invasive procedure, with no evidence of harm to turtles under previous permits.

6.4.5 Tumor Removal

The removal of tumors is invasive and potentially hazardous to the turtle. Familiarization with sea turtle anatomy is essential prior to doing surgery. It is also important to use aseptic techniques at all times to prevent infections. Tumor(s) would be removed with the use of electrosurgery, which allows coagulation of the blood vessels as the tissue is dissected, resulting in minimal blood loss. Effects of surgery could include pain, handling discomfort, possible hemorrhage at the site with a risk of infection. Particular caution is necessary to avoid an entry that is too deep; striking vital organs during surgery has the potential of inducing severe bleeding and mortality. It is currently common practice to avoid the use of general anesthetics (with veterinary approval) whenever possible, since a local anaesthetic incurs less risk of mortality, is adequate for reducing apparent pain, and allows a much shorter post-operative observation period (Wibbels et al. 1990). Turtles will be held for 24 hours following recovery from anesthesia and closely monitored to evaluate breathing and diving capability and released once normal buoyancy has been confirmed.

Small external fibropapillomatosis tumors will be removed from selected candidate animals by Samuel Rivera, the veterinarian at the U.S. Fish and Wildlife Service Culebra Wildlife Refuge. Turtles are transported by hand-carrying from the dock where the research vessel docks to the facility (approximately 500 feet). The ideal surgery candidate will be a turtle that has an overall good body condition index, based on comparative biometric data that has been collected at the location. The tumors that will be removed are those that are necrotic, large, and impeding movement or prone to injury, in locations that in the near future may represent a survival threat. In cases of massive tumor spread, only the worst tumors will be removed. Only those turtles where surgery can significantly improve their quality of life and have a good prognosis for long-term survival will undergo surgery. Surgery sites will be closed using absorbable suture. The animals will be released shortly after surgery. The researchers will follow procedures as stated on NMFS permit conditions related to Tumor Removal Surgery. Some animals with multiple tumor masses will be released with some of these still intact.

6.4.6 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. 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). Stress from tagging 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.

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. 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.

The transmitters will be affixed to the central section of the turtles' carapace using epoxy and/or resined fiberglass using the method further described following Balazs et al. (1996) and Van Dam et al. (2008). However, whenever possible, transmitters will not be placed at the peak height of the carapace to make attachments as hydrodynamic as possible (Jones et al. 2011). Turtles are held for 1 to 2 hours after attaching the transmitters to allow adhesives to set. From the time of capture until release, procedures (e.g., satellite tag attachment) may take up to 3 hours for each turtle. No mortalities have resulted from the application of tags and transmitters under this applicant's prior Permits No. 1518 and 14949. The researchers have successfully recaptured tagged turtles and have found them to be in good health.

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.

Tissue and blood 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 have 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. 19697 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 and hawksbill 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).

Here we summarize the probable risks the proposed action poses to threatened and endangered species 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.

As discussed above, we do not expect different responses to each activity from based on the species of sea turtle. That is, we expect green turtle and hawksbill turtle responses to each of the procedures to be similar. Hence, we summarize the likely risk to each species together.

We expect all targeted sea turtles to experience some degree of stress response to handling and restraint following capture, blood and tissue sampling, tumor removal, 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 turtle DPS or hawksbill sea turtles. Further, we do not expect the issuance of Permit No. 19697 to destroy or adversely modify any designated critical habitat.

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. 19697 involves directed take for the purposes of scientific research. Therefore, 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 ESA 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, ESA 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 ESA 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. 19697. 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.

Ackerman, R.A. 1980. Physiological and ecological aspects of gas exchange by sea turtle eggs. American Zoologist 20(3):575-583.

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.

Aguirre, A.A., G.H. Balazs, B. Zimmerman, and F.D. Galey. 1994. Organic contaminants and trace metals in the tissues of green turtles (*Chelonia mydas*) afflicted with fibropapillomas in the Hawaiian Islands. Marine Pollution Bulletin 28(2):109-114.

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.

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.

Balazs, G.H., R.K. Miya, and S.C. Beavers. 1996. Procedures to attach a satellite transmitter to the carapace of an adult green turtle, *Chelonia mydas*. Pages 21-26 *in* Proceedings of the 15th Annual Symposium on Sea Turtle Biology and Conservation. US Department of Commerce, NOAA Technical Memo NMFS-SEFSC-387, Miami, Florida.

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.

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., 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.

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.

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.

Colborn, T., D. Dumanoski, and J.P. Myers. 1996. Our stolen future: are we threatening our fertility, intelligence, and survival? A scientific detective story. Dutton Publishing, New York, New York.

Collazo, J.A., R. Boulan, and T.L. Tallevast. 1992. Abundance and growth patterns of *Chelonia mydas* in Culebra, Puerto Rico. Journal of Herpetology 26(3):293-300.

Corsolini, S., S. Aurigi, and S. Focardi. 2000. Presence of polychlorobiphenyls (PCBs) and coplanar congeners in the tissues of the Mediterranean loggerhead turtle *Caretta caretta*. Marine Pollution Bulletin 40(11):952-960.

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.

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.

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.

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.

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

Foley, A.M., B.A. Schroeder, A.E. Redlow, K.J. Fick-Child, and W.G. Teas. 2005. Fibropapillomatosis in stranded green turtles (Chelonia mydas) from the eastern United

States (1980-98): Trends and associations with environmental factors. Journal of Wildlife Diseases 41(1):29-41.

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.

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.

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.

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.

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.

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.

Huerta, P., H. Pineda, A.A. Aguirre, T.R. Spraker, L. Sarti, and A. Barragan. 2000. First confirmed case of fibropapilloma in a leatherback turtle (*Dermochelys coriacea*). Page 193 *in* Proceedings of the 20th Annual Symposium on Sea Turtle Biology and Conservation. U.S. Department of Commerce, NOAA Technical Memorandum NMFS-SESFC-477.

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.

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.

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.

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., C.F. Fileman, A.D. Hopkins, J.R. Baker, J. Harwood, D.B. Jackson, S. Kennedy, A.R. Martin, and R.J. Morris. 1991. Concentrations of trace metals in the livers of marine mammals (seals, porpoises and dolphins) from waters around the British Isles. Marine Pollution Bulletin 22(4):183-191.

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.

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.

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.

Mann, T.M. 1978. Impact of developed coastline on nesting and hatchling sea turtles in southeastern Florida. Master's Thesis, Florida Marine Research Publications.

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.

Mazaris, A.D., G. Matsinos, and J.D. Pantis. 2009. Evaluating the impacts of coastal squeeze on sea turtle nesting. Ocean and Coastal Management 52(2):139-145.

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.

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

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.

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. 2007. Eastern Gulf of Mexico OCS oil and gas lease sale 224. 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.

Mortimer, J.A. 1990. The influence of beach sand characteristics on the nesting behavior and clutch survival of green turtles (*Chelonia mydas*). Copeia 1990(3):802-817.

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.

NMFS. 2003. Biological opinion on the continued operation of Atlantic shark fisheries (commercial shark bottom longline and drift gillnet fisheries and recreational shark fisheries) under the Fishery Management Plan for Atlantic tunas, swordfish, and sharks (HMS FMP) and the proposed rule for Draft Amendment 1 to the HMS FMP. National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Office of Protected Resources, Silver Spring, 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. 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. 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 Atlantic green turtle *Chelonia mydas*. National Oceanic and Atmospheric Administration, National Marine Fisheries Service and U.S. Fish and Wildlife Service, Washington, D.C.

NMFS, and USFWS. 1993. Recovery plan for the hawksbill turtle (*Eretmochelys imbricata*) in the U.S. Caribbean Sea, Atlantic Ocean, and Gulf of Mexico. National Oceanic and Atmospheric Administration, National Marine Fisheries Service and U.S. Fish and Wildlife Service, Washington, D.C.

NMFS, and USFWS. 2007. 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. 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. 2008. Sea turtle reserach techniques manual. NOAA Technical Memorandum.

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

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.

Owens, D.W., and G.J. Ruiz. 1980. New method of obtaining blood and cerebrospinal fluid from marine turtles. Herpetologica 36:14-20.

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.

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.

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).

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.

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.

Schmidt, J. 1916. Marking experiments with turtles in the Danish West Indies. Danmarks Fiskeri-og Harundersogelser Meddelelser 5(1):1-26.

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.

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.

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.

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.

Storelli, M.M., G. Barone, A. Storelli, and G.O. Marcotrigiano. 2008. Total and subcellular distribution of trace elements (Cd, Cu and Zn) in the liver and kidney of green turtles (*Chelonia mydas*) from the Mediterranean Sea. Chemosphere 70(5):908-913.

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

Stoskopf, M. 1993. Anaesthesia. Pages 161-167 *in* L. Brown, editor. Aquaculture for Veterinarians, Pergamon Press, Oxford.

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.

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.

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.

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.

Van Dam, R.P., C.E. Diez, G.H. Balazs, L.A.C. Colon, W.O. McMillan, and B. Schroeder. 2008. Sex-specific migration patterns of hawksbill turtles breeding at Mona Island, Puerto Rico. Endangered Species Research 4:85-94.

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.

Wibbels, T., D.W. Owens, C.J. Limpus, P.C. Reed, and M.S. Amoss Jr. 1990. Seasonal changes in serum gonadal steroids associated with migration, mating, and nesting in the loggerhead sea turtle (*Caretta caretta)*. General and Comparative Endocrinology 79(1):154-164.

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.

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.

12 APPENDICES

12.1 Appendix A, Permit 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. 19697. 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 April 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 of Appendix 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.

[1] This permit does not allow for unintentional serious injury and mortality caused by the presence or actions of researchers listed in Appendix 1. 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 Marine Mammal Protection Act 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.

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 table in Appendix 1 outlines 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 Appendix 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 of Appendix 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 conducted pursuant to a NMFS Permit. 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.

[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 Attachment 3.

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

   a. Capture/Survey Methods: Entanglement Netting

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

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

      iii. 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 ≤ 10ºC or ≥ 30ºC, nets must be checked at less than 20-minute intervals. "Net checking" is defined as a complete and thorough visual check of the net either by snorkeling the net in clear water or by pulling up on the top line such that the full depth of the net is viewed along the entire length.

      iv. 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.

      v. 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).

      vi. 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.

         A. 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.

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

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

            1) Stop netting activities and immediately free the animal,

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

3) Report the incident as specified in Condition E.2,

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

vii. FP Nets: Nets used at sites where fibropapillomatosis (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.

b. General Handling, Resuscitation, and Release

i. Researchers must

A. Handle turtles according to procedures specified in 50 CFR 223.206(d)(1)(i) (see Attachment 2). 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.

ii. 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.

iii. 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.

iv. 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.

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

vi. 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.

c. <u>Handling, Measuring, Weighing, PIT and Flipper Tagging</u>

i. Refer to Attachment 3 for more information on the requirements for handling and sampling sea turtles.

ii. 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 FP. 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

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

2) tag applicators, including the tag injector handle, between sea turtles; and

3) the application site before the tag pierces the animal's skin.

E. PIT Tagging

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

2) 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.

3) <u>Turtles < 20 cm SCL</u> – are not authorized to be PIT tagged.

4) <u>Turtles 20 - 30 cm SCL</u> - Researchers must have specialized experience to tag these sized turtles.

5) 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 ($\leq$ 20%) and 2) there is minimal risk of injury to vital structures or other anatomical features.

6) Local anesthetic (e.g., lidocaine) must be used.

iv. Marking the Carapace

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

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

d. Sampling

i. 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

1) *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.

2) *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.

3) *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.

4) *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.

ii. <u>Biopsy Sampling</u>

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

B. 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.

e. <u>Instrument Attachments: Acoustic or satellite tags</u>

i. Up to 2 transmitters (one satellite and one sonic tag) may be placed on an animal at one time where authorized in Table 1.

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

iii. 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.

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

v. Researchers must make attachments as hydrodynamic as possible.

vi. 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.

f. <u>Holding</u>: Turtles held in a facility must be maintained and cared for under the "Standard Permit Conditions for Care and Maintenance of Captive Sea Turtles" issued by the U.S. Fish and Wildlife Service.

g. <u>Tumor Removal Surgery</u>

i. This surgery must be done following a veterinary-approved protocol.

ii. Turtles must not be released until fully recovered from surgery and the veterinarian has deemed the turtle releasable. If the animal requires more than 48 hours recovery time, researchers must provide necessary veterinary care until the animal can be safely released.

iii. Researchers must carefully examine recaptured animals that have had tumors removed to determine the condition of sutured areas. If additional care due to effects of earlier surgery is warranted, researchers must provide animals with that care. If veterinarians observe healing problems related to previous surgery, veterinarians must review post operative holding procedures and improve them accordingly (e.g., increase holding time or change other procedures that would address the problem).

iv. Researchers must submit their approved Institutional Animal Care and Use Committee (IACUC) form to Chief, Permits Division, (fax: 301-713-0376) before initiating any FP tumor surgery covered by this permit.

Non-Target Species

i. Bycatch: All incidentally captured species (e.g., fishes) must be released alive as soon as possible.

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

i. 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.

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

iii. 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."

iv. *Seagrass species*. Researchers must avoid conducting research over, on, or immediately adjacent to any seagrass species. If these species cannot be avoided, then the following avoidance/minimization measures must be implemented:

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

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

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

6. Transfer of Sea Turtle Biological Samples

a. Samples may be sent to the Authorized Recipients listed in Attachment 1 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. The transfer of biological samples to requires written approval from the Chief, Permits Division.

c. 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 – Carlos E. Diez (See Attachment 1 for list of activities.)

b. Co-Investigator(s) –See Attachment 1 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 to conduct activities authorized under the permit (e.g., veterinarians, pilots) must be duly licensed 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 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 Condition A.2.

   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. Notification and Coordination

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:

For activities in PR:
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 Section E of this permit and information provided to NOAA personnel pursuant to Section G of this permit) includes false information; and

[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.

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, the 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.

Attachment 1: NMFS-Approved Personnel for Permit No. 19697.

The following individuals are approved in the conduct of the permitted activities pursuant to the terms and conditions under Section C (Qualifications, Responsibilities, and Designation of Personnel) of this permit and in accordance with their qualifications and the limitations specified herein.

Name (Role)	Activities
Carlos E. Diez *(Principal Investigator)*	*All research activities* (i.e. Count/survey; Epibiota removal; Instrument, epoxy attachment (e.g., satellite tag, VHF tag); Mark, carapace (temporary); Mark, flipper tag; Mark, PIT tag; Measure; Photograph/Video; Sample, blood; Sample, tissue; Tracking; Weigh) *Except:* Collect tumors and Ultrasound
Samuel Rivera *(Co-Investigator)*	Collect tumors Sample, blood Sample, tissue Ultrasound
Robert P Van Dam *(Co-Investigator)*	*All research activities* (i.e. Count/survey; Epibiota removal Instrument, epoxy attachment (e.g., satellite tag, VHF tag); Mark, carapace (temporary); Mark, flipper tag; Mark, PIT tag; Measure; Photograph/Video; Sample, blood; Sample, tissue; Tracking; Weigh) *Except:* Collect tumors and Ultrasound

Attachment 2: 50 CFR 223.206 Exceptions to prohibitions relating to sea turtles.

(d)(1) *Handling and resuscitation requirements.*

(i) Any specimen taken incidentally during the course of fishing or scientific research activities must be handled with due care to prevent injury to live specimens, observed for activity, and returned to the water according to the following procedures:

(A) Sea turtles that are actively moving or determined to be dead as described in paragraph (d)(1)(i)(C) of this section must be released over the stern of the boat. In addition, they must be released only when fishing or scientific collection gear is not in use, when the engine gears are in neutral position, and in areas where they are unlikely to be recaptured or injured by vessels.

(B) Resuscitation must be attempted on sea turtles that are comatose, or inactive, as determined in paragraph (d)(1) of this section, by:

(1) Placing the turtle on its bottom shell (plastron) so that the turtle is right side up and elevating its hindquarters at least 6 inches (15.2 cm) for a period of 4 up to 24 hours. The amount of the elevation depends on the size of the turtle; greater elevations are needed for larger turtles. Periodically, rock the turtle gently left to right and right to left by holding the outer edge of the shell (carapace) and lifting one side about 3 inches (7.6 cm) then alternate to the other side. Gently touch the eye and pinch the tail (reflex test) periodically to see if there is a response.

(2) Sea turtles being resuscitated must be shaded and kept damp or moist but under no circumstance be placed into a container holding water. A water-soaked towel placed over the head, carapace, and flippers is the most effective method in keeping a turtle moist.

(3) Sea turtles that revive and become active must be released over the stern of the boat only when fishing or scientific collection gear is not in use, when the engine gears are in neutral position, and in areas where they are unlikely to be recaptured or injured by vessels. Sea turtles that fail to respond to the reflex test or fail to move within 4 hours (up to 24, if possible) must be returned to the water in the same manner as that for actively moving turtles.

(C) A turtle is determined to be dead if the muscles are stiff (rigor mortis) and/or the flesh has begun to rot; otherwise the turtle is determined to be comatose or inactive and resuscitation attempts are necessary.

Attachment 3: 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.

<u>Clean technique:</u>

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

<u>Aseptic technique:</u>

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 <u>minimum of two</u> 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.

Sterile technique:

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

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. Minimum requirements for pain management and field techniques

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.

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
Large skin, muscle, fat biopsy, other tissue biopsy	Local anesthetic and systemic analgesic