# National Marine Fisheries Service
# Endangered Species Act Section 7
# Biological And Conference Opinion

**Title:** Biological and Conference Opinion on the Proposed Implementation of a Program for the Issuance of Permits for Research and Enhancement Activities on Threatened and Endangered Sea Turtles Pursuant to Section 10(a) of the Endangered Species Act (2018 Reinitiation)

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

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# 1 INTRODUCTION

The Endangered Species Act of 1973, as amended (ESA; 16 U.S.C. §1531 et seq.) establishes a national program for conserving threatened and endangered species of fish, wildlife, plants, and the habitat they depend on. Section 7(a)(2) of the ESA requires Federal agencies to insure that any actions they authorize, fund or carry out 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 the National Marine Fisheries Service (NMFS) for threatened or endangered species (i.e., 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 under NMFS jurisdiction and NMFS, concurs with that determination, consultation concludes informally (50 CFR §402.14(b)).

The Federal action agency shall confer with the NMFS for species under NMFS jurisdiction on any action which is likely to jeopardize the continued existence of any proposed species or result in the destruction or adverse modification of proposed critical habitat (50 CFR §402.10). If requested by the Federal agency and deemed appropriate, the conference may be conducted in accordance with the procedures for formal consultation in §402.14.

Section 7(b)(3) of the ESA requires that at the conclusion of consultation (or conference) NMFS provides an opinion stating whether the Federal agency’s action is likely to jeopardize ESA-listed species (or species proposed for listing) or destroy or adversely modify their designated (or proposed) critical habitat. If NMFS determines that the action is likely to jeopardize ESA-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) of the ESA requires NMFS to provide an incidental take statement (ITS) 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 NMFS, Office of Protected Resources (OPR), Permits and Conservation Division (hereafter referred to as the Permits Division). The Permits Division proposes to implement a program for the issuance of permits for research and enhancement activities on ESA-listed sea turtles.

Consultation in accordance with section 7(a)(2) of the ESA, associated implementing regulations (50 C.F.R. §402), and agency policy and guidance was conducted by the NMFS OPR ESA Interagency Cooperation Division (hereafter referred to as the Interagency Cooperation Division). This biological and conference opinion (opinion) and ITS were prepared by the Interagency Cooperation Division in accordance with section 7(b) of the ESA and implementing regulations at 50 CFR §402.

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

## 1.1 Background

The ESA mandates the protection and conservation of threatened and endangered species, and prohibits the taking[1], import, and export of these species, with limited exceptions for scientific research and enhancement of propagation or survival, pursuant to ESA section 10(a)(1)(A) and its implementing regulations (50 CFR §222).

The Permits Division issues 10(a)(1)(A) permits authorizing activities that result in either directed take or incidental take of other ESA-listed species (i.e., not the targeted research species). Since 1977, NMFS and the U.S. Fish and Wildlife Service (USFWS) have shared jurisdiction for the recovery and conservation of sea turtles listed under the ESA as codified in regulations at 50 CFR 222.309. NMFS leads the conservation and recovery of sea turtles in the marine environment, and the USFWS has the lead for the conservation and recovery of sea turtles in the terrestrial environment including nesting beaches and rehabilitation facilities. Hence, the Permits Division processes and manages permits for research on sea turtles when they are in the marine environment, from when they enter the sea as post-hatchlings through adult life stages. This includes permitting the temporary holding and transport of sea turtles taken in the water to a land-based facility for research procedures, before returning the animal to the marine environment near the point of capture.

Since January 1, 2005, approximately 103 scientific research and enhancement permits have been issued by the Permits Division. At present there are 41 existing section 10(a)(1)(A) scientific research permits issued by the Permits Division for sea turtles (NMFS 2017a). Sea turtle research permits often use similar techniques and research activities which have been modified over time to improve the scientific understanding of sea turtle biology and ecology. Adjustments in research techniques have also been made to reduce adverse impacts to sea turtles being researched. Considering the large number of individual permits, including the section 7(a)(2) consultations over a substantial number of years, NMFS high level of understanding of the potential effects to sea turtles under a variety of research techniques, and the workload to consider and issue permits individually, the Permits Division has proposed to implement a new sea turtle research and enhancement permitting program (hereafter referred to as the Program). The Program would set an annual permit cycle, fixed reporting schedule, programmatic mortality

[1] "Take" under the ESA means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct (§4(19)). "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).

limits for the lethal take of sea turtles, programmatic incidental take limits for the take of non-target ESA-listed species, and the ability to issue individual permits for up to ten years (NMFS 2017a). Evaluating all permits at the same time each year and having a programmatic consultation in place is expected to: 1) enhances species conservation and management via a holistic assessments of impacts which should minimize impacts to species from duplication of research effort, 2) reduces the Permits Division processing time for scientific research and enhancement permit applications, and 3) create efficiency by consolidating multiple section 7 consultations into one programmatic process.

On September 28, 2017, the Permits Division requested a formal programmatic ESA section 7 consultation to ensure that the Program is not likely to jeopardize ESA-listed species or to destroy or adversely modify designated critical habitat. That consultation was finalized on December 21, 2017 (PCTS: FPR-2017-9230).

On April 30, 2018, the Permits Division requested reinitiation of formal consultation to include the use of acoustic deterrent devices (ADDs) in the wild to assess sea turtle interactions in fisheries. On July 17, 2018, the Permits Division submitted an amended request for reinitiation to also include tank-based acoustic studies for ADDs and to test auditory evoked potential (AEDs). The intent of this research is learn more about sea turtle hearing capabilities and to help reduce turtle bycatch in fishing gear.

## 1.2 Consultation History

This opinion is based on information obtained from (1) the NMFS Permits Division biological assessment (BA), and supporting documents, on the implementation of a permitting program for the issuance of permits for research activities on ESA-listed sea turtles, (2) correspondence and discussions between the Permits Division and the Interagency Cooperation Division, and (3) the available scientific information for analyzing the effects of the proposed action on ESA-listed species. Our communication with the Permits Division regarding this consultation is summarized as follows:

- **April 28, 2016**: The Permits Division and the Interagency Cooperation Division finalized an internal NMFS document titled *Terms of Reference for ESA section 7 Programmatic Consultations on the Scientific Research and Enhancement Permitting Program*.
- **September 28, 2017**: The Permits Division submitted a sea turtle programmatic consultation initiation package (including the BA and supporting documents) to the Interagency Cooperation Division.
- **October 30, 2017**: The Permits Division requested adding three distinct population segments (DPSs) (East Indian-West Pacific and Southwest Pacific green turtle and South Pacific loggerhead) to the consultation based on new information.
- **November 1, 2017**: The Interagency Cooperation Division responded with an email indicating that they agreed with the addition of the three sea turtle DPSs mentioned above.

- **November 3, 2017**: In an email to the Permits Division, the Interagency Cooperation Division recommended conferencing on the recently proposed critical habitat for the main Hawaiian islands insular DPS of false killer whale. The Permits Division responded that they agreed to conferencing on this proposed critical habitat as part of the programmatic consultation.
- **November 2, 2017**: The Interagency Cooperation Division and Permits Division met to discuss the major issues with the draft BA. Discussion revolved around three main issues: (1) estimating delayed (unobserved) sea turtle mortality, (2) the effects of trawling as a sea turtle capture method, and (3) the Program sunset date (i.e., 20 years).
- **November 14, 2017**: The Interagency Cooperation Division and Permits Division met to discuss minor issues and requests for clarification with the draft BA. Agreement was reached on all points raised. Agreement was also reached on removal of the Program sunset date.
- **November 15, 2017**: The Permits Division emailed the Interagency Cooperation Division requesting the addition of turtle research procedures involving acoustics to the Program. These include studies of Auditory Evoked Potential (AEP) and Acoustic Deterrent Devices (ADD) to reduce sea turtle bycatch in fishing gear.
- **November 21, 2017**: In a meeting, the Interagency Cooperation Division indicated that adding the requested acoustics research would delay the completion of the consultation substantially because of the additional time and analysis needed to consider acoustic effects. The Permits Division agreed to address acoustic research either separately or as a reinitiation of this consultation Program at a later date.
- **November 21, 2017**: The Permits Division provided a written response to the Interagency Cooperation Division regarding the issues with the BA that were raised during the November 2, 2017 meeting (see above). The Permits Division reiterated the rationale for the estimated delayed mortality rate and assessment of the effects of research trawling on sea turtles provide in the BA.
- **November 21, 2017**: The Interagency Cooperation Division officially accepted the initiation package, including supplementary information provided and program changes agreed to after BA submittal. The Interagency Cooperation Division notified the Permits Division that formal consultation has been initiated in a memo titled "Initiation of formal consultation pursuant to section 7 of the ESA on a proposed sea turtle research and enhancement permitting program."
- **November 28, 2017**: The Interagency Cooperation Division provided the Permits Division with the Description of Action and Action Area sections of the draft opinion, and a draft incidental take table for non-target ESA-listed species, for review.
- **December 13, 2017**: The Interagency Cooperation Division provided the Permits Division with a revised draft ITS, including incidental take of sea turtles, for review. The Interagency Cooperation Division also requested minor additional information.

- **December 21, 2017**: The Interagency Cooperation Division finalized its section 7 biological opinion and determined that the Permit Division's permitting program is not likely to jeopardize the continued existence of any ESA-listed or proposed species, or destroy or adversely modify designated or proposed critical habitat.
- **April 30, 2018**: The Permits Division request reinitiation of consultation on the sea turtle permitting program to include the use of ADDs in the wild.
- **July 13, 2018**: The Interagency Cooperation Division state that the request was not complete and that we required a new request for reinitiation because the tank-based acoustic experiments (ADD and AEP) conducted in a facility were not considered part of the tank-based research in the original consultation.
- **July 17, 2018**: The Permits Division submitted an amended request for consultation to include tank-based acoustic studies for ADDs and AEDs. The memo requested a completion date of September 2018, however a mutually agreed to completion date of March 2019 was agreed to.

# 2 THE ASSESSMENT FRAMEWORK

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

*"Jeopardize the continued existence of"* means to engage in an action that reasonably would be expected, directly or indirectly, to appreciably reduce 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:

1. We describe the proposed action and those aspects (or stressors) of the proposed action that may have direct or indirect effects on the physical, chemical, and biotic environment within the action area, including the spatial and temporal extent of those stressors. We identify any interrelated and interdependent actions.
2. We identify the ESA-listed species and designated critical habitat that are likely to co-occur with those stressors in space and time.
3. We describe the environmental baseline in the action area including: past and present impacts of Federal, state, or private actions and other human activities in the action area; anticipated impacts of proposed Federal projects that have already undergone formal or early section 7 consultation, impacts of state or private actions that are contemporaneous with the consultation in process.
4. We identify the number, age (or life stage), and gender of ESA-listed individuals that are likely to be exposed to the stressors and the populations or subpopulations to which those individuals belong. We also consider whether the action "may affect" designated critical habitat. This is our exposure analysis.
5. We evaluate the available evidence to determine how individuals of those ESA-listed species are likely to respond given their probable exposure. We also consider how the action may affect designated critical habitat. This is our response analyses.
6. We assess the consequences of these responses of individuals that are likely to be exposed to the populations those individuals represent, and the species those populations comprise. This is our risk analysis.
7. The adverse modification analysis considers the impacts of the proposed action on the essential habitat features and conservation value of designated critical habitat.

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

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

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

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

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

If, in completing the last step in the analysis, we determine that the action under consultation is likely to jeopardize the continued existence of ESA-listed species or destroy or adversely modify designated critical habitat, 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 (50 C.F.R. §402.14).

In addition, we include an ITS 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 that may be implemented by the action agency (50 C.F.R. §402.14(j)). Finally, we identify the circumstances in which reinitiation of consultation is required (50 C.F.R. §402.16).

To comply with our requirement to use the best scientific and commercial information available we conducted electronic and manual searches to identify information relevant to the potential stressors and responses of the sea turtles and other ESA-listed species that may be affected by the proposed action. Sources included journal articles, published reports, grey literature, internet sites, unpublished data, and personal communications. This information was evaluated to draw conclusions about the likely risks to the continued existence of these species and the conservation value of their designated critical habitat.

# 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 Permits Division has requested programmatic consultation on a Program for the issuance of research and enhancement permits for ESA-listed sea turtles. There is no sunset date on the Program. The Program combines elements from the existing approach for issuing sea turtle permits with elements that are completely new. Both the existing and the new features of the Program are identified and discussed in this section of the opinion, which is organized as follows: (1) overall process for issuing and managing directed take permits under section 10(a)(1)(A) of the ESA; (2) directed take permit terms and conditions applicable via regulation to all permits; (3) annual sea turtle permit cycle; (4) research activities and associated mitigation measures that will be authorized as part of the Program; (5) approach for processing applications and authorizing take under the Program; (6) approach for monitoring the effects of permitting sea turtle research; (7) the Permits Division internal program review and adaptive management approach; and (8) requirements for reporting on the Program to the Interagency Cooperation Division.

## 3.1 Overall Process for Issuing Sea Turtle Directed Take Permits

The Permits Division’s mission is to “protect and conserve marine mammals and threatened and endangered species by providing special exceptions for take, import, and export that maximize recovery value and minimize individual and cumulative impacts as directed under ESA section 10(a)(1)(A) and its regulations” (NMFS 2017a). Permits issued pursuant to section 10(a)(1)(A) of the ESA must be for activities that are likely to further the conservation of the affected species with the ultimate goal of bringing the species to the point where listing under the ESA is no longer necessary. The overall process that the Permits Division follows for issuance of section 10(a)(1)(A) permits is shown in Figure 1. The objectives of this program remain the same as they were prior to reinitiation.

Section 10(d) of the ESA and implementing regulations at 50 CFR 222 identify the following criteria specific to issuance or modification of research and enhancement permits:

- Whether the permit was applied for in good faith
- Whether the permit, if granted and exercised, will not operate to the disadvantage of such endangered species
- Whether the permit would be consistent with the purposes and policy set forth in section 2 of the ESA (i.e., providing a means to conserve endangered and threatened species’ ecosystems and providing programs for the conservation of such species

Applicants seeking a section 10(a)(1)(A) permit must submit an application to NMFS the Permits Division. The ESA and NMFS implementing regulations establish information requirements for permit applicants. The Permits Division’s ESA section 10(a)(1)(A) application instructions for research and enhancement permits are provided in Appendix A. The applicant must provide sufficient information about the activity to allow NMFS to determine whether permit issuance would comply with all applicable statutory and regulatory issuance criteria and to assess the potential environmental impacts of permit issuance. Permit applications must include a discussion of how the proposed activities and resulting information will promote the conservation and recovery of ESA-listed species.

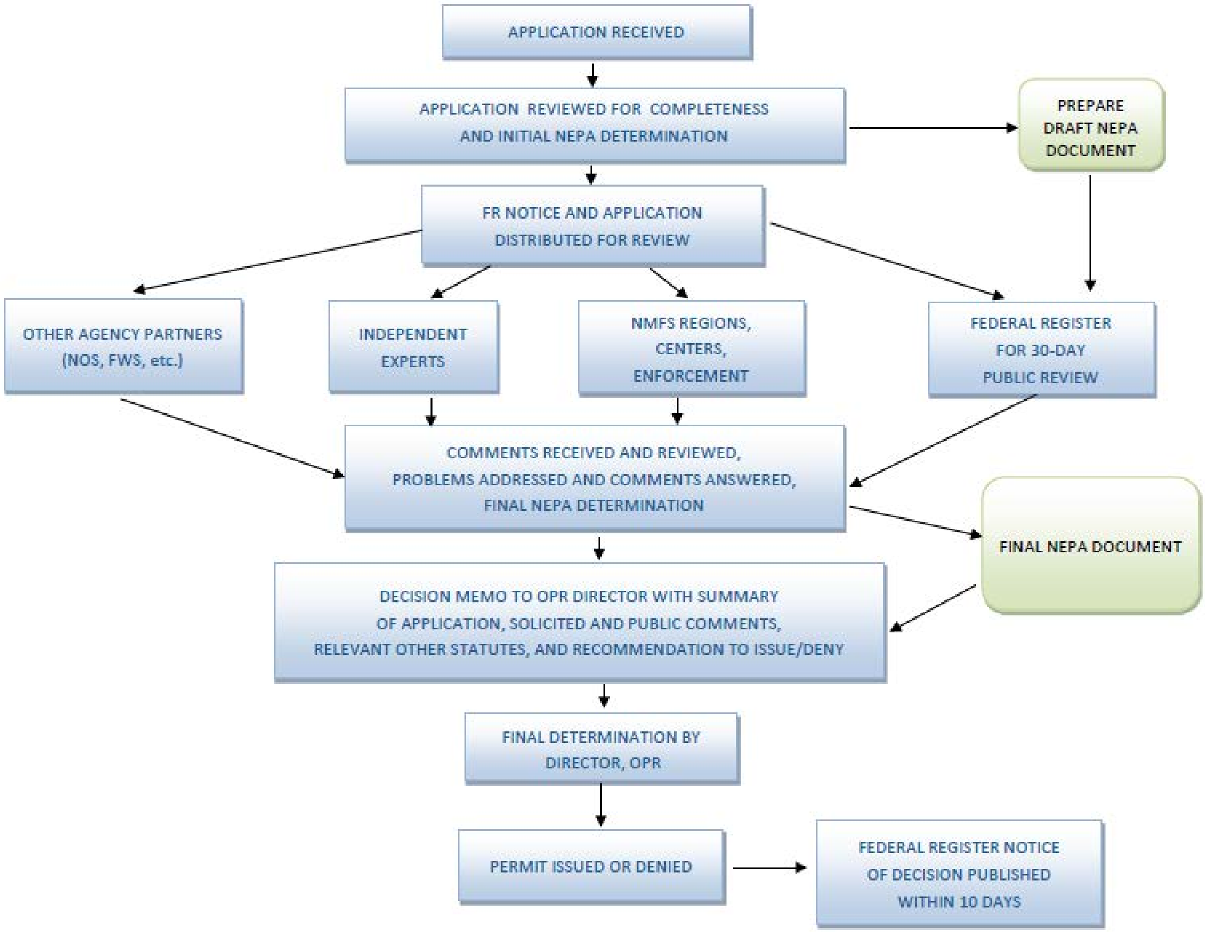


**Figure 1. Flow chart of the overall process for issuing directed take permits under section 10(a)(1)(A) of the Endangered Species Act (NMFS 2017a).**

To complete their application researchers need to address the following specific questions:

- How the action will enhance or benefit the wild population/species
- Whether the project has broader significance beyond the applicant's goals
- Why the work must take an ESA-listed species
- How research is bona fide and likely to be published in a refereed scientific journal
- How the work will contribute to understanding the species' biology or ecology, contribute to identified objectives of a species' recovery plan or otherwise respond to

recommendations of a scientific body charged with management of the species, and contribute significantly to identifying, evaluating, or resolving conservation problems

- For enhancement, how the work will enhance the health the survival, conservation, and recovery of the species in the wild, or will enhance the propagation of the species for conservation and recovery purposes
- How the research is not unnecessarily duplicative of other work
- The anticipated effects of the activities to protected species
- How the applicant will minimize impacts of the activities, in particular mortality
- How the applicant will coordinate activities with other Permit Holders

Applicants are encouraged to link research objectives to priorities identified in NMFS ESA-listed species recovery plans. Examples of objectives in research permits that are tied to sea turtle recovery plan objectives include:

- Improve in-water abundance estimates of sea turtles;
- Document the presence and progression of fibropapillomatosis (FP) disease in sea turtle populations;
- Determine distribution and seasonal movements for all life stages;
- Evaluate growth rates and determine age at sexual maturity;
- Identify important marine habitats;
- Determine breeding population origins for U.S. juvenile and subadult populations;
- Implement large-scale in-water surveys to estimate indices of abundance and determine trends;
- Assess, categorize, and map neritic habitats used by sea turtles; and
- Develop gear modifications to prevent or minimize interactions with fishing gear.

Permit applications that satisfy some but not all of the applicable criteria for permit issuance are returned to the applicant with an explanation of the deficiencies. Applicants then have 60 days to provide the deficient information to the Permits Division. The permit process cannot proceed further until the Permits Division has the necessary information to complete the application.

Once a complete application has been received, the Permits Division reviews to determine all listed species that may be affected (directly or indirectly) by the research or enhancement activities and the nature of the effects. As part of the Program, the Permits Division will carefully review requested sea turtle take numbers and researcher qualifications, especially for activities that have an associated risk of mortality. For sea turtle permits, these include capture in trawl and pound net gear and procedures that require the use of general anesthesia, including certain imaging methods and laparoscopy. Permits Division analysts will be looking for applicants to demonstrate how they will minimize impacts from riskier procedures by including details such as: 1) how gear will be deployed and monitored; 2) whether a sea turtle veterinarian is identified that can perform or directly supervise the activities requiring medical credentials; and 3) inclusion of a veterinary-approved protocol for all medical procedures.

In the past, section 7(a)(2) consultations between the Permits Division and the Interagency Cooperation Division for sea turtle research permits were conducted either on individual section 10 (a)(1)(A) permits or on several similar permits combined (i.e., "batched consultation"). Under the Program, the Permits Division will be responsible for ensuring that submitted permit applications that fall within the scope of this consultation are processed in accordance with the requirements of the opinion. Applications whose scope (area, activities, nature, etc.) or take levels fall outside the Program parameters will be processed separately. The Permits Division will seek individual consultation with the Interagency Cooperation Division for such permit requests. An example of such a request is gear modification research conducted by NMFS Science Centers that requires fishing gear be operated for tow times or at depths exceeding the limits specified for the Program.

The Permits Division sends permit applications out for scientific review and publishes a Notice of Receipt in the Federal Register to begin a mandatory 30-day public review and comment period. NMFS may extend the comment period and hold public hearings on the application if deemed necessary. The Permits Division distributes research permit applications to several reviewers, who may include the NMFS Office of Law Enforcement, state agencies, and appropriate NMFS scientists and other federal agencies. After the close of the public comment period, the Permits Division reviews all comments received from reviewers and the public, and all substantive comments are addressed by either the Permits Division or the applicant. The Permits Division then re-evaluates the issuance criteria for each permit in consideration of comments received and responses from the applicant, and makes a final recommendation to the OPR Office Director on whether to issue or deny the permit. The Permits Division will use a checklist (Appendix B) to document whether an application does or does not meet ESA issuance criteria and the other requirements discussed above.

If the permit is issued, a Federal Register Notice of Issuance is published within ten days, and the permit holder must date and sign the permit and return a copy of the signature page to the Permits Division as certification of their acceptance of the permit terms and conditions (50 CFR 222.303). If the permit is denied, the OPR Office Director must provide the applicant with an explanation for the denial (50 CFR 222.303). The applicant or any party opposed to a permit may seek judicial review of the terms and conditions of such permit or of a decision to deny such permit. Review may be obtained by filing a petition for review with the appropriate U.S. District Court as provided for by law (50 CFR 222.303).

## 3.2 General Permit Terms and Conditions

As stated in the Permits Division's ESA permit template (Appendix C), activities authorized in a permit must occur by the means, in the areas, and for the purposes set forth in the permit application, and are limited by the terms and conditions in a permit. Permit noncompliance constitutes a violation of the ESA and may be grounds for permit modification, suspension, or revocation, and for enforcement action. A description of the general terms and conditions common to permits issued by the Permits Division for all species is provided here. Additional terms and conditions specific to permits issued under the Program are described in the sections to follow.

All research and enhancement permits contain terms and conditions that address the following:

- Duration of permit
- Number and kinds of protected species, locations, and manner of taking
- Qualifications, responsibilities, and designation of personnel
- Possession of permit
- Reports
- Notification and coordination
- Observers and inspections
- Permit modification, suspension, and revocation
- Penalties and permit sanctions
- Acceptance of permit

#### *3.2.1.1 Duration of Permits (50 CFR 222.304)*

Each permit specifies an expiration date. Historically the Permits Division has issued ESA permits for up to five years, although the ESA does not limit the duration of a permit. As part of the Program the Permits Division may issue ESA permits for up to ten years. A permit may be extended if the applicant has submitted a new application for work of a continuing nature (50 CFR 222.304). A Permit Holder operating under an extension may continue such activities as were authorized by the permit until a decision has been made on the renewal application. To ensure that environmental analyses prepared for issuance of the permit under the ESA and the National Environmental Policy Act (NEPA) remain valid in extending the permit, the Permits Division conditions the extension such that no additional take of species is authorized over the life of the extension. Rather, the extension allows the Permit Holder to continue take of ESA-listed species authorized in the last year of the permit over an additional 12 months or until the Permit Holder has reached the take limit in the last year of the permit. The permit also clarifies that the Permit Holder may continue to possess biological samples of the target species acquired under the permit after permit expiration without additional written authorization.

#### *3.2.1.2 Number and Kinds of Protected Species, Locations and Manner of Taking (50 CFR 216.36, 222.301(e), and 222.308(d))*

Each permit contains a table outlining the number of animals authorized to be taken (by species and listing unit), and the locations, manner, and time frame in which they may be taken. In addition, authorized personnel working under a permit may take photographs and video incidental to research or enhancement provided it does not result in take not authorized by the permit.

### *3.2.1.3 Qualifications, Responsibilities, and Designation of Personnel (50 CFR 216.3, 216.35(f-i), 216.36, and 216.41(c)(iii) and (iv))*

All research and enhancement permits identify by name the researchers (Principal Investigator [PI] and Co-investigators [CIs]) authorized to direct and supervise the permitted activities. Individuals conducting permitted activities must possess qualifications commensurate with their roles and responsibilities. The roles and responsibilities of personnel operating under a permit are as follows:

- The Permit Holder is ultimately responsible for activities of individuals operating under the permit. Where the Permit Holder is an institution, the Responsible Party is the person at the institution who is responsible for the supervision of the PI.
- The 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 CI is present to act in place of the PI.
- CIs are individuals who are qualified to conduct activities authorized by the permit without the onsite supervision of the PI. CIs assume the role and responsibility of the PI in the PI’s absence.
- Research Assistants work under the direct and on site supervision of the PI or CI. They cannot conduct permitted activities in the absence of the PI or CI and are not named in the permit.
- Specific to sea turtle applications, the applicant must also identify a 24-hr on-call veterinarian (with sea turtle experience) and local permitted rehabilitation facility that researchers can contact in the event of an emergency during field activities.

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

- Individuals who perform a function directly supportive of and necessary to the permitted activity (including operation of vessels or aircraft)
- Individuals included as backup for essential personnel, and
- Individuals included for training purposes

Persons who require state or Federal licenses to conduct activities authorized under a permit (e.g., veterinarians, pilots) must be duly licensed when undertaking such activities. Permitted activities may be conducted on vessels or aircraft or in cooperation with individuals engaged in commercial activities, provided the commercial activities are not conducted simultaneously with the permitted activities, except with written approval of the Permits Division Chief, such as for a news article or documentary film. The Permit Holder cannot require direct or indirect compensation from persons requesting to conduct activities under the permit. For permits held by NMFS offices, the Permits Division may allow the Responsible Party or PI to designate additional CIs and must provide a copy of the letter designating the individual to the Permits Division on the day of designation.

#### *3.2.1.4 Possession of Permit (50 CFR 216.35(i) and (j), 222.301(d)(1) and (2), 222.305), and 222.308(d))*

Permits cannot be transferred or assigned to any other person. The Permit Holder and persons operating under the authority of a permit must possess a copy of the permit when engaged in a permitted activity. A copy of the permit must be attached to any means of containment in which a protected species or protected species part is placed for purposes of storage, transit, supervision or care.

#### *3.2.1.5 Reports (50 CFR 216.38, 216.41(c)(ii), 222.301(h) and (i), and 222.308(d))*

Permit Holders must submit annual and incident reports, and papers or publications resulting from the activities authorized by a permit. Research results must be published or otherwise made available to the scientific community in a reasonable period of time. Annual reports must be submitted at the conclusion of each year for which a permit is valid, due 30 days after the end of each reporting period (either a calendar year or a 12-month period). The Permits Division will then have 30 days to review the reports and, if needed, request additional information from permit holders. The Permits Division will send reminders to any permit holder who has not sent in their report. After an additional 30-day grace period, if the report is not received the permit may be suspended until it is received and approved by the Permits Division. The Permits Division may take additional measures to ensure that reports are received in a timely manner including: (1) Suspending the permit until the report is received and approved by the Permits Division. (2) Deferring or returning modification requests for an active permit until the report is received, (3) Deferring or returning an application for a new permit until the report is received, and (4) Notifying the NMFS Office of Law Enforcement of a permit violation due to failure to report.

As required by conditions of the permit, each annual report must include the following:

- A table reporting the number of animals taken, by activity and location
- Observed effects and frequency of effects from permitted activities for target and non-target animals
- Problems or unforeseen effects encountered and steps to resolve such problems
- Discussion of any serious injuries, mortalities, or unauthorized species taken
- Efforts to conduct post-research monitoring
- Efforts to coordinate and collaborate with other Permit Holders and NMFS Regional Offices
- Progress to meeting the objectives, including citations of reports, publications resulting from the reporting period
- Additional information as required by the permit on a case-by-case basis to monitor impacts of specific activities to animal health, effectiveness of protocols, etc.

Appendix D includes the Permits Division's annual report form, which has been revised to improve the Permits Division's monitoring capabilities and inform other section 7 consultations. On a case-by-case basis, the Permits Division may determine that a permit also requires additional reporting to closely monitor and evaluate the impacts of specific research procedures. This may occur when more information is needed on the potential for harm or injury of a research procedure or when new scientific information (reports, publications, presentations, etc.) indicates that an activity may warrant closer monitoring for impacts to the target species or other portions of the environment. When such a report is required, the permit also will contain a requirement for annual reauthorization. In this scenario, the permit is temporarily suspended at the end of each permit year (12-month period) and the Permit Holder must report on the work that occurred during the year as noted above and any additional monitoring requirements, such as re-sighting data, photographs or tag transmissions of target animals, for the Permits Division's review. Based on review of the report, veterinarian and expert opinions as warranted, and relevant information from the literature, the Permits Division may modify, discontinue or reauthorize the activities under the permit for the next permit year.

Incident reports are required for any events of serious injury or exceeding take authorized by the permit. Incident reports must be submitted within two weeks of the incident and describe the events and steps that will be taken to reduce the potential for additional incidents. If the activity is not authorized or the Permit Holder reaches their mortality take limit, as required by the permit, researchers must immediately cease permitted activities until the Permits Division allows the work to resume. The Permits Division reviews the report and facts relevant to the incident, such as a necropsy report for mortality, and determines whether the methods and protocols and/or permit requirements, such as mitigation measures or take numbers, need to be modified before work can resume.

- After the conclusion of research or permit expiration, the last annual report due for the permit must include the above details for annual reports in addition to:
- Whether the objectives were met and what was learned;
- An explanation of why objectives were not accomplished, if applicable;
- A description of how the activities benefited the species, promoted recovery, or conserved the target species and fulfilled objectives listed in the recovery or conservation plan; and
- Identification of any additional or improved mitigation measures.

This information is merged into the annual report form for the last year that a report is due to streamline reporting, resulting in a combined annual/final report.

#### *3.2.1.6 Notification and Coordination*

Permit Holders must provide written notification of planned fieldwork to the applicable NMFS Assistant Regional Administrator at least two weeks prior to initiation of a field trip/season and must include the locations of the intended field study and/or survey routes, estimated dates of research, and number and roles of participants. Permit Holders must coordinate activities with 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, repeated disturbance of animals.

#### *3.2.1.7 Observers and Inspections (50 CFR 216.36, 222.301(g), (i) and (j), and 222.308(d))*

At the request of NMFS, the Permit Holder must allow an employee of NMFS or another designated other person to observe permitted activities. The Permit Holder must provide documents or other information relating to the permitted activities upon request.

#### *3.2.1.8 Modification, Suspension, and Revocation (50 CFR 216.36, 216.39, 216.40, and 222.306; 15 CFR Part 904 Subpart D)*

Permits are subject to suspension, revocation, modification, and denial in accordance with the provisions of subpart D of 15 CFR part 904. The OPR Office Director may modify, suspend, or revoke a permit in whole or in part under the following circumstances:

- To make the permit consistent with a change in the regulations prescribed under section 103 of the Marine Mammal Protection Act (MMPA) or section 4 of the ESA
- In a case in which a violation of the terms and conditions of the permit is found
- In response to a written request from the Permit Holder
- If NMFS determines that the application or other information pertaining to the permitted activities includes false information
- 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

Permit Holders may also request modifications. Because ESA regulations do not distinguish between types of modifications, the Permits Division adopts MMPA regulations defining major and minor amendments (50 CFR 216.39) for issuance of ESA and joint ESA/MMPA permits. As such, a “major” modification to an ESA permit is a request to change any of the following:

- The number or type of species to be taken/imported/exported
- The location where animals are taken/imported/exported
- The manner in which animals are taken/imported/exported such that it would result in an increased level of take or risk of adverse impact
- Increase the duration for more than 12 months

Public comment periods are required for major modifications. Minor modifications (e.g., modifying tag designs that result in equivalent or lesser impacts) and authorization letters (e.g., adding co-investigators) do not require public comment periods. Issuance of a permit does not guarantee or imply that NMFS will issue or approve subsequent permits or modifications for the same or similar activities including those of a continuing nature, requested by a Permit Holder.

#### *3.2.1.9 Penalties and Permit Sanctions (50 CFR 216.36, 216.40(a), 222.301(f), and 222.306(e)*

A person who violates a provision of a permit, the ESA, or the regulations at 50 CFR 216 and 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. In addition, per ESA regulation, permits shall not be altered, erased, or mutilated, and any permit which has been altered, erased, or mutilated shall immediately become invalid. OPR is the sole arbiter of whether a given activity is within the scope and bounds of the authorization granted in a permit. The Permit Holder must contact the Permits Division for verification before conducting an activity if they are unsure whether an activity is within the scope of the permit. Failure to verify, where the Permits Division 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.

#### *3.2.1.10 Acceptance of Permit (50 CFR 216.33(e)(3)(i) and (ii))*

When a permit is issued by signature of the OPR Office Director, the Permit Holder must date and sign the permit, and return a copy of the original signature to the Permits Division. The permit is effective upon the Permit Holder's signing of the permit. In signing an ESA permit, the Permit Holder

- Agrees to abide by all terms and conditions set forth in the permit, all restrictions and relevant regulations under 50 CFR Parts 222-226, and all restrictions and requirements under the ESA
- Acknowledges that the authority to conduct certain activities specified in the permit is conditional and subject to authorization by the Office Director
- Acknowledges that the permit does not relieve the Permit Holder of the responsibility to obtain any other permits, or comply with other Federal, State, local, or international laws or regulations

## 3.3 Annual Permit Cycle

To date, the Permits Division has processed individual sea turtle research permit requests as they are received, batching the processing of requests that have a similar nature and scope where possible. However, issuing permits on a case-by-case basis provides less opportunity for authorizing and monitoring annual take of ESA-listed species than does a holistic program approach. To address this, the Permits Division will implement an annual permit cycle for the Program. All of the permit issuance requirements identified above will still apply. Minor permit modifications and authorizations, often administrative in nature, that do not increase the risk of adverse impacts to the species and can often be processed within a few weeks, will continue to be processed throughout the year as they are received.

The Permits Division will set an application deadline for all sea turtle researchers each year. The Permits Division will have six months to (1) review and process all sea turtle research permit requests for the upcoming year, (2) conduct an evaluation of the level of requested take for all permits requested for each species, DPS, and life stage, and (3) issue permits authorizing research activities and take, as appropriate, following the detailed procedures described herein as part of the proposed action. If a permit request is received after the submission deadline, at the Permits Division Deputy Division Chief's discretion, the request may either be merged into the batch or the applicant will have to wait until the next permit cycle for the request to be processed. This decision will largely be based on the completeness and complexity of the request.

## 3.4 Sea Turtle Research Activities and Associated Mitigation Measures

The following is a description of the general activities that may be authorized by the Permits Division as part of the Program. The authorized research methods and protocols are commonly accepted by the sea turtle research community and have been reviewed by the NMFS National Sea Turtle Coordinator and OPR's Veterinary Medical Officer for effects to sea turtles (NMFS 2017a). The Permits Division will require mitigation measures to minimize impacts to protected species when authorizing sea turtle research activities. Associated mitigation measures for a given method are included within the permit template of Appendix C, with species-specific conditions beginning at Condition B.5. In addition to these standard protocols, researchers are required to consider and describe in their permit application additional precautionary measures they can take to further minimize potential impacts of their research on individual sea turtles. The Permits Division will seek individual consultation outside the scope of the programmatic for methodologies that are not described here or for studies with methods that by design would not be able to follow the standard mitigation measures.

### 3.4.1 Sea Turtle Parts

The Permits Division may authorize the collection, receipt or import of sea turtle parts, tissues, and carcasses when the source of the part was taken from the marine environment. This may include any of the following activities:

- the import of tissues and parts from the high seas for research purposes when the Permits Division is authorizing the initial collection (or take) of the samples from live animals,
- the development and maintenance of cell lines from sea turtle tissues for future research and study,
- the permanent transfer or receipt of samples for research purposes from other NMFS Section 10 permit holders or other legal sources, and
- the salvage of carcasses or parts when mortality of the animal is authorized under a NMFS Section 10(a)(1)(A) permit so that the holder may legally retain the carcass for transfer to the Sea Turtle Stranding and Salvage Network (STSSN) for necropsy.

Because these activities would only involve the use of parts, they are not in and of themselves expected to adversely affect any sea turtle populations or species. Applicants are required to demonstrate that the source of the parts (i.e., the original taking from the live animal) was legal in cases where the Permits Division is not authorizing the parts collection in conjunction with the initial sample collection from live sea turtles.

### 3.4.2 Remote Visual and Acoustic Surveys

As part of the Program, researchers may conduct visual surveys of sea turtles by vessel and aircraft to assess habitat and to document seasonal abundance and spatial distribution of sea turtle populations. Visual surveys from a vessel may be conducted from large research vessels and from smaller motorized vessels. Surveys are typically conducted at slow speeds ranging from five to ten knots. Vessel survey activities may include conducting line-transect surveys, or temporarily tracking animals from a distance to observe behavior or retrieve short-term transmitter attachments once shed.

Manned aerial surveys predominantly use a twin- or single-engine, fixed high-wing aircraft such, as the DeHavilland Twin Otter, or a helicopter, such as the two-bladed, single-engine light utility helicopter Robinson R22 or R44. Photographs and video may be taken during flights. Surveys are typically flown at 500 feet or higher but may be flown as low as 300 feet depending on the type of aircraft, research objectives, and other factors (e.g., weather). Aircraft are flown at speeds ranging from 35 to 110 knots. During capture efforts, researchers may conduct aerial line transects, and aircraft may act as spotters to guide the capture vessel to the vicinity of turtle aggregations. Aerial surveys often involve limited circling (approximately two to three passes) from a distance only to verify sightings, although in some instances they may be used for activities that require longer observation and/or in closer proximity of target sea turtles.

Unmanned aircraft system (UAS) surveys may also be authorized as part of the Program. UAS units can be fixed wing, such as the Puma AE, or rotary units capable of vertical take-off and landing (VTOL), such as the APH-22 hexacopter. The size of UAS units varies from less than one meter in diameter for VTOL units to the ten-foot wingspan of the Puma. UAS may be launched directly from the capture vessel to search for animals. Once sea turtles are sighted, the capture vessel will move to the vicinity of a sighted animal to permit observation and evaluation of behavior and condition before attempting capture. The aircraft may repeatedly circle, follow, or hover over an animal for an extended period of time to more accurately define and maintain its location. For UAS, the time spent over the animal will be limited by the UAS battery life, typically 15 to 30 minutes for VTOL units and 45 minutes for fixed wing units based on currently available models. Fixed wing UAS are typically operated at 100 feet or higher but VTOL units may be flown at lower altitudes of approximately 50 feet to collect images (e.g., photogrammetry).

In cases where the Permits Division would authorize take for potential harassment of sea turtles from UAS activities, the applicants must demonstrate that the unit:

- has an auto-return feature to prevent mid-flight failure and the potential for injury to sea turtles;

- will be piloted by a trained, qualified crew member;
- has a ground control station with a trained, dedicated UAS visual monitor working with the pilot; and
- will be operated only within line of sight.

Remotely operated vehicles (ROVs), including autonomous underwater vehicles (AUVs), may also be authorized as part of the Program to closely track sea turtles and observe and record foraging and dive behaviors. Models in current use for turtle tracking are approximately two m in length and include the Ocean Server Iver II, the Benthos mini-Rover, and the REMUS 100. ROVs may be attached to the research vessel by a tether that can be several hundred meters long. Tethers would be much too rigid to present a risk of sea turtle entanglement.

Tracking of animals with an ROV may occur upon sighting a target animal during a vessel survey or upon release of a captured animal outfitted with an acoustic transmitter. The ROV is deployed from the side of the vessel and maneuvered towards the turtle, maintaining a minimum distance of three to five meters. In some instances, two AUVs are deployed together when tracking a tagged animal to increase positional resolution of its location. AUVs are outfitted with sensors to detect acoustic tag transmissions and are able to then alter their path in order to follow a moving transmitter. The AUVs process these detections to position the acoustic tag in three-dimensional space with a resolution of less than 10 meters over 30 times a minute. Working in tandem to increase the spatial resolution, the AUVs can communicate through an acoustic transducer to plan movements and exchange information. When using two units, to minimize influence on turtle behavior, the AUVs are programmed to not get within 15 meters of the estimated turtle location. This distance may vary depending on the study objectives and capabilities (e.g., sensors) of the unit. AUVs may be operated underwater or at the surface to allow for visual monitoring of their positions from the research vessel. Tracking may occur for ten hours or more depending on ROV battery life or turtle tag attachment duration. Throughout tracking operations, researchers may deploy a directional hydrophone over the side of the vessel monitoring the AUVs to constantly monitor the approximate location of the tagged turtle in reference to the AUVs. This will ensure that the AUVs do not lose the acoustically tagged turtle and that the AUVs are maintaining the programmed buffer distance.

Other methods of remote detection of sea turtles that would be authorized in the Program are multibeam, side-scan, and imaging sonars (e.g., DIDSON). Vessels deploying these devices operate at low speeds (two to seven knots). High-frequency sound pulses (120 kilohertz (kHz) to 1.8 megahertz (MHz) are transmitted by the sonar transducers and reflect off the seafloor and objects in the water column, producing real-time acoustic backscatter images of bottom topography and location of sea turtles in the study area. When testing the effectiveness of a particular type of acoustic gear for detecting and/or imaging sea turtles, turtles may be followed at a distance once they are detected, to keep them within the acoustic beam. The duration of this type of directed acoustic effort typically does not exceed five to ten minutes.

### 3.4.3 Capture and Collection Methods

Researchers use a variety of sampling methods and techniques for capturing sea turtles. Capture methods for sea turtles include selective methods that are only likely to result in the capture of the target animals, and non-selective netting methods (e.g., trawls and entanglement nets) that may also result in capture of non-target species. The most commonly authorized sea turtle capture methods are by hand, dip net, and entanglement net; other methods are authorized less frequently. Sea turtle researchers typically request a combination of capture methods in their permit applications. Individual turtles may be targeted for recapture over the course of a field season or in subsequent years based on the study objectives (e.g., monitoring of health, life history studies, etc.) or to remove transmitters. This section describes the currently available capture methods that the Permits Division may authorize as part of the Program. Future improvements in capture methods over time will be evaluated and incorporated into the Program provided that (1) they do not increase the risk to listed species (target and non-target) or critical habitat above the level considered in this consultation and (2) the Permit Holder can adhere to the standard mitigation measures for these methods provided in Appendix C.

There are a number of standard practices that minimize risk of injury upon capture that generally apply to all authorized sea turtle capture methods. For examples, turtles are fully supported during lifting by hand or within nets to prevent injurious distribution of weight or stress on the neck and appendages. Sea turtles typically are boarded through the lowest point in the gunwale or other area of the vessel unless fully supported within a net. Some capture vessels are modified (e.g., with cut-outs in the gunwale or modified bows or sterns) to facilitate boarding. Once on board the vessel turtles are placed onto cushioned surfaces to prevent injury. Other mitigation measures associated with capture using particular methods are described in more detail below.

#### *3.4.3.1 Hand Capture*

Most hand-capture techniques fall into one of three categories: those in which boats are directly involved in the pursuit and capture; those in which barrier nets of some kind are used; and those involving the use of SCUBA and/or snorkeling gear (Ehrhart and Ogren 1999). There are variations in the specific capture technique under different conditions and vessel configurations. One approach involves positioning a diver on the bow of the vessel and scan the water for turtles. When a turtle is located the vessel will pursue the turtle and maneuver into a position for the diver to dive into the water and capture the turtle by hand. In some cases this involves pursuing the animal until it begins to tire. In other cases the turtle is simply followed at a relatively slow speed until it stops or slows down or quiescent turtles on the bottom are searched for (Ehrhart and Ogren 1999). Turtles sleeping or resting quietly on the bottom can, in some instances, be approached stealthily and captured directly by a free diver or a SCUBA diver. Once within range, the diver captures the turtle by placing one hand on the leading edge of the carapace and the other hand on the trailing edge and guiding the turtle to the surface. Once at the surface, the onboard crew will lift the turtle over the gunwale with the aid of the diver in the water.

#### *3.4.3.2 Selective Hand Deployed Capture Nets*

Sea turtle researchers use a variety of capture nets that are deployed by hand and target a particular animal or group of animals. These selective capture methods have little to no potential for interaction with non-target species.

A dip net is a small-mesh net affixed to a rigid hoop that is affixed to a long pole. The hoop diameter can vary depending on the species and life stage targeted, but is generally one meter or smaller. Sea turtles are dip netted from the sea surface, typically by research personnel aboard a vessel. Once in the net, the turtle is carefully lifted out of the water and placed on the deck of the research vessel.

A cast net, or throw net, is a circular net bordered by weights and connected to a line for retrieval. Nets used by turtle researchers vary in size from approximately one to four meters in diameter. Cast nets are manually thrown upon sighting a turtle at the surface, and immediately retrieved to bring the turtle onboard the vessel.

A breakaway hoop net consists of a rigid hoop, a net fastened with breakaway stays that detach upon capture, a guiding pole, and line affixed around the net opening that cinches it closed and maintains control and attachment once deployed. The hoop diameter is wide enough to fit easily over the targeted turtle and keep the front flippers loosely held at the sides, which is essential for safe capture. A researcher positioned on the bow guides the breakaway hoop net over the turtle. Upon capture, the net detaches from the hoop and the opening is cinched using the line to enclose the turtle. Additional personnel aid in maneuvering the turtle onto the research platform, which may consist of a research vessel modified for boarding or other platform designed to safely and securely restrain the animal. The breakaway hoop net is primarily used to capture leatherback sea turtles but may be used to capture any sea turtle species.

An encircle net, or strike net, is a net deployed from the research vessel in a quick fashion to encircle the target sea turtle (or group of turtles) upon sighting. Per established protocols (Ehrhart and Ogren 1999; Witzell and Schmid 2004) nets may be up to 300 meters long with a 36 centimeter stretch-mesh nylon webbing, four meters depth, braided polyfoam float line, and braided leadcore line. When a turtle is sighted, the net is deployed off the stern of the research vessel at relatively high speed, encircling the turtle, and held closed until the turtle is observed entangled in the net or until 20 minutes has elapsed without sighting the animal. Upon entanglement in the net, a diver may enter the water to assist with disentanglement and transfer to the vessel. If necessary, webbing is carefully cut from animals to minimize any adverse effects of entanglement and to aid in their removal from the net. Encircle nets are not deployed if marine mammals are in the area and are immediately retrieved if marine mammals are sighted after net deployment.

#### *3.4.3.3 Entanglement Net*

A large mesh entanglement net is a commonly used type of fixed gear for capturing turtles, typically in shallow waters (often referred to as “gill nets” in fisheries use). Nets are typically 100 meters or less in length with webbing made of 18-gauge twisted nylon twine and a stretched mesh size ranging from 20 to 51 centimeters (knot to knot). The mesh is suspended from a foam core braided polyethylene top line with fixed bullet-shaped polystyrene foam floats at approximately ten-meter intervals. The bottom line consists of a continuous lead core line. Anchors attached to both ends of the net keep it in position and prevent drifting of the lead line. Net heights vary depending upon the depth in which the net will be set such that the netting extends throughout the water column and provides slack for entangled turtles to reach the surface to breathe. From one to four nets may be deployed for a project depending on the study design, study area, and applicant’s resources. As part of the Program, the Permits Division will consider variations in length and configuration of entanglement nets provided that the applicant has demonstrated that he/she has sufficient resources to adhere to standard permitting requirements for continuous net monitoring (see Appendix C for details) and to process and release turtles in a timely manner. For example, a minimum of two research vessels and eight crew members are typically needed to adequately monitor and tend four nets that are each 100 meters long.

Entanglement nets are a non-selective gear type as there is potential for bycatch and incidental take of protected species, especially marine mammals. To mitigate this risk, the study site is visually surveyed for marine mammals prior to and during net deployment. If marine mammals are sighted near the netting sight, nets either are not be deployed or are pulled in, and netting activity ceases until marine mammals have left the area (see Appendix C for more details). Entanglement nets must be visually monitored every 30 minutes or less, as required by permit conditions, or whenever there is movement of the net indicating an animal may be entangled. When turtles encounter the net and become entangled they will be quickly removed from the net and boarded for processing.

#### *3.4.3.4 Pound Nets*

Pound nets are stationary gear that direct fish and other marine life into enclosures or “pounds” by means of barriers called “leads.” Most pound nets also have a middle section or “heart” located in between the lead and the pound. As animals swim along the lead into the heart they are directed into the pound by way of a mesh tunnel. Once in the pound, sea turtles can reach the surface to breathe. Animals captured in the net are collected by gathering up the bottom of the pound, working from the tunnel wall to the back wall of the pound until the catch is concentrated in the back of the pound. Sea turtles are then removed by hand and placed into the research vessel.

As a requirement of the Program, hearts and pounds are must have 1.75 inch stretched mesh to minimize the risk of entanglement for sea turtles. Other than mesh size, the exact design of pound nets used in turtle research (e.g., lead mesh size and length, pound area, and use of escape panels for small fish) could vary. The Permits Division would only authorize a particular proposed pound net design if the adverse effects are equivalent to or less than those analyzed in the scope of this consultation. Another requirement of the permit is that pound nets (including the entire pound, heart, and leader) would have to be checked daily by researchers, unless weather conditions prevented safe passage to the nets. Pound nets are not selective and catch numerous species, including many species of fish. Bycatch in pound nets generally remain alive in good condition as they can swim freely in the pound until the net is checked and they are released. No marine mammal interactions have ever been documented by researchers using pound nets (NMFS 2017a).

#### *3.4.3.5 Seine Nets*

Seine nets are used to capture sea turtles that are in close proximity to the shoreline. These nets have double float and lead lines and are deployed approximately 100 to 200 meters offshore in a straight or slightly curved line running parallel with the shoreline. Once the seine is set a boat at each end of the net pulls it toward the beach at a speed of about two to three knots. When the ends of the net are close to the beach the net is pulled onto the beach by hand. The boats may assist by doubling back out along each side of the net, and attach to the cork line about 20 meters from the beach and pull the net toward the beach. In some cases, entanglement nets (described above) can be used as a set net placed over a mud bottom substrate and/or deployed in the manner of a seine net from the vessel or on shore. When using an entanglement net as a seine net one side of the net would be set with an anchor and the other side would be deployed from the vessel in a circular fashion and slowly pulled in back onto the vessel or onto shore within a few minutes of deployment. The deployment of entanglement nets as a seine net is expected to take less than ten minutes. The net setting and retrieval process will be rapid, and therefore any turtles that might become entangled in the net will quickly be brought to water shallow enough for them to reach the surface to breathe, and they will be disentangled as quickly as possible.

Seine nets are a non-selective gear type as there is potential for bycatch and incidental take of protected species, especially marine mammals. Similar to entanglement nets, to mitigate this risk the study site is visually surveyed for marine mammals prior to and during net deployment. If marine mammals are sighted near the netting sight, seine nets either are not be deployed or are pulled in, and netting activity ceases until marine mammals have left the area (see Appendix C for more details).

#### *3.4.3.6 Trawling*

Trawls are nets dragged behind vessels that are used to capture marine organisms (i.e., fish, shrimp, and turtles) on the sea floor or within the water column. There are many different types of trawl nets and deployment configurations. One example of a trawl net configuration used to capture sea turtles is a paired otter/flat trawl (such that one net is towed on each side) (Figure 2). Turtles and other marine life are captured in the cod end which consists of four inch stretch mesh. Trawls nets are brought on-board using winches and turtles are removed from the net in a manner where they are safely placed on deck. Trawling is generally only used to capture hard-shelled species. If a leatherback is captured and cannot be safely boarded and released, it is freed in the water without bringing the net on board by untying the cod end of the trawl. Due to the increased risk of mortality or serious injury associated with this gear, as a condition of any permit authorized under the Program, trawls nets cannot be towed for more than 30 minutes bottom time and at depths exceeding 20 meters.

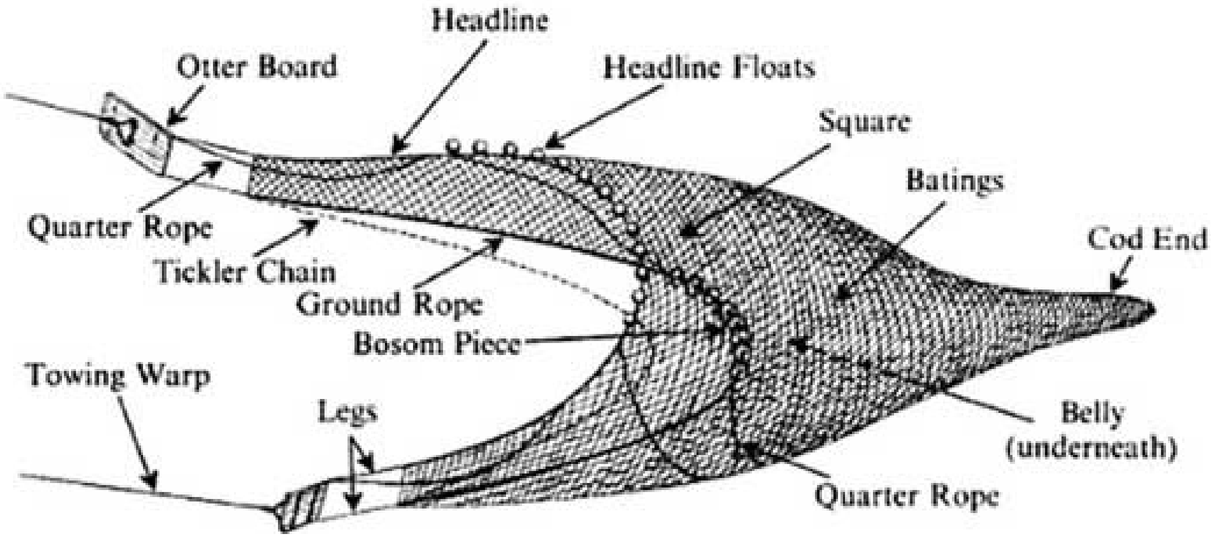


**Figure 2. Standard otter trawl design (Source: http://www.grantontrawlers.com/steam%20trawler.html).**

Trawls are non-selective gear that can also result in the capture of other species, including many species of fish, sharks, invertebrates and marine mammals. As with tangle netting, permit requirements are in place to minimize the risk of capturing marine mammals by monitoring for their presence before and during tows; trawl nets are not deployed or are immediately retrieved if marine mammals are sighted within the area.

### *3.4.3.7 Bycatch Reduction Studies*

Bycatch reduction studies are designed to test modifications to fishing gear in an effort to reduce sea turtle bycatch and bycatch mortality rates. Examples include the evaluation of new or improved turtle excluder devices (TEDs) in trawl fisheries and deterrent devices such as lights to tangle nets. This type of research could be authorized as part of the Program (and covered under this programmatic consultation) provided that the gear type matches one described above and the applicant can adhere to the required mitigation measures (provided in Appendix C) for that particular gear type. If the applicant requests to use a capture method not described above (e.g., longlines) or cannot follow the standard mitigation measures (e.g., trawl in depths greater than 20 m), the action would fall outside the scope of the Program and require individual section 7 consultation.

#### *3.4.3.8 Capture under Another Authority*

Applicants may request authorization to conduct research procedures on sea turtles that have already been legally taken (i.e., captured) under a separate ESA authority. This may include turtles captured under another researcher's section 10 permit or the incidental take of turtles authorized under a previously issued section 7 biological opinion for a commercial fishery. Turtles may also be obtained after disentanglement from fishing gear under the authority of the STSSN if the animals are deemed fit for research by consultation with a veterinarian or by following a veterinary-approved protocol. In all cases, the applicant must demonstrate how the source of the turtle is legal under the ESA before the Permits Division would authorize research on the animals as part of the Program. Because the capture and effects of capture have already been analyzed when they were authorized previously, those capture methods are not addressed as part of this programmatic consultation.

### 3.4.4 Research Procedures on Captured Sea Turtles

This section describes the research procedures that would be authorized by the Permits Division as part of the Program. Standard protocols and required mitigation measures associated with these procedures are also discussed here and described in more detail in Appendix C.

#### *3.4.4.1 Handling, Transportation, and Holding*

As part of the Program, researchers are required to comply with commonly accepted handling practices and holding times. While an animal is on deck or on shore, precautions are taken to make the animal comfortable, prevent injury, and minimize stress. Each turtle is kept separate (especially those prone to conspecific aggression), placed on top of padding or other cushioned device (e.g., tire) within a confined area or container, and sheltered from the elements. The upper head may be covered with a wet cloth to keep the turtle calm. With the exception of sterile, disposable equipment (e.g, needles, scalpel blades), all gear (e.g., tag applicators, measuring tapes, etc.) that comes into contact with animals must be cleaned and disinfected before use and between animals. Disposable gloves must be used whenever possible, and are required if there is any risk of contact with breaches in the skin (e.g., biopsies, administering hemostasis) or to minimize opportunity for contamination of sterile instruments. For circumstances where disposable gloves are impractical, good hand sanitation (thorough washing) between animals is required. If sea turtles with FP may be encountered, a designated separate set of equipment for turtles with tumors must be available and used only for turtles with observable FP. Every effort must be made to minimize turtle handling time. Handling time for research procedures vary based on the activities the animal will receive but in most cases turtles are released within 60 minutes and almost all will be released within a few hours. Sea turtles must be released from the vessel in a safe manner near the point of capture. For more details on sea turtle handling and holding practices see Appendix C. Appendix C also includes an additional attachment (i.e., Attachment 1) of protocols and requirements for handling and monitoring captured leatherbacks.

Attachment 1 is only included in the permit when the permit holder is targeting leatherbacks using selective capture methods (e.g., hand, breakaway hoop net).

If researchers are requesting to transport turtles to a facility for temporary holding and additional research procedures, applicants must provide details demonstrating how the turtles will be monitored and cared for during transport. The type of information that must be provided is specified by regulation at 50 CFR 222.308. When transport and holding in a facility is authorized, as a condition of the permit researchers must transport, maintain and care for sea turtles following the USFWS' "Standard Permit Conditions for Care and Maintenance of Captive Sea Turtles" (USFWS 2013). For facilities in Florida, researchers must follow the Florida Fish and Wildlife Conservation Commission Marine Turtle Conservation Handbook Section 4, Holding Marine Turtles in Captivity (FFWCC 2016).

As described in Appendix C, researchers are required to contact their designated on-call veterinarian or permitted rehabilitation facility if an injured, comatose or compromised sea turtle is encountered. This veterinary consultation will determine whether the animal is suitable for research, should be returned to the water, or should be transported for rehabilitation and treatment. In most cases, the Permits Division will not authorize research on compromised animals if the procedures would further stress the animal to the degree that survival would likely be affected. Rare exceptions may be allowed if the research objectives are tied to health assessments or identified management needs to aid a species' recovery, and only after close consultation with OPR's Veterinary Medical Officer for sea turtles. In such cases, a sea turtle veterinarian would have to be consulted and activities would only be conducted at his/her discretion following an Institutional Animal Care and Use Committee- or veterinary-approved protocol.

Researchers may temporarily hold turtles captured in the wild in a tank for studies that require multiple days to complete or controlled conditions, such as for behavioral or physiological studies. This most often involves transporting turtles to designated facilities with specific capabilities. Upon completion, animals are returned to the wild near the point of capture. Tank-based studies will be considered to fall within the scope of the Program provided that the research does not result in turtle injury or mortality and the researchers adhere to the standard protocols and mitigation measures for procedures and captive care as described in this opinion and detailed in Appendix C.

#### *3.4.4.2 Examination, Measurements and Monitoring*

#### External Examination and Photography

Upon capture, each turtle is assessed (i.e., looking for signs of illness, injury, epibiont load, etc.) to determine its general state of health and suitability for subsequent research procedures. A common practice is to photograph captured turtles to document condition, physical characteristics, and any tags, distinguishing marks, old injuries, or lesions.

### Oral/ophthalmic/vent examination

The mouth, eyes, and vent may be examined for signs of injury, ingestion of hooks or marine debris (plastics, tar balls), and tumors. Some researchers conduct more in-depth evaluations, all of which included under this category are characterized as non-invasive methods of visual assessment and data collection. Researchers infrequently propose more involved examinations, which typically are conducted in collaboration with a veterinarian. For example, ophthalmic examinations may employ fluorescein staining (a common veterinary diagnostic) to evaluate the integrity of cornea, evaluation of the anterior chamber using a slit lamp (ophthalmological instrument), or ultrasonography.

### Morphometrics

Measurements and weight are standard, non-invasive procedures performed on all sea turtles captured and provide critical information related to life stage, sexual maturation, growth rates, and nutritional condition. Turtles are measured using a soft measuring tape to collect curved carapace, plastron, and tail lengths and widths. Calipers are used to measure straight carapace length (SCL), width, and body depth. Less commonly, specific aspects of anatomy, such as the jaw and oral cavity (with the aid of a bite block or oral speculum), are measured for specific research interests. Sea turtles are weighed using various types of scales, depending on their size. In all instances, animals are supported using containers, specially-designed harnesses, or netting that allow safe lifting practices and provide adequate support of the body to prevent injury.

### Monitoring Vital Parameters

Vital parameters may be measured as part of specific research objectives (e.g., physiological studies) or as a means of monitoring animals that appear more sensitive to the stress of capture (such as leatherbacks, as required in Appendix C), or as deemed prudent based on the discretion of an attending veterinarian. These are rapid, non-invasive or minimally invasive procedures that measure health parameters across tissue membranes or surfaces.

Heart rate is monitored using a Doppler blood flow detector, electrocardiogram, or ultrasonography probe. For Doppler flow detectors and visual ultrasonography, ultrasound gel is applied to the skin and a hand-held instrument (transducer) is passed lightly over the skin to locate pulsatile flow within blood vessels or the heart. Electrocardiograms involve the placement of electrical adhesive, leads, clips, or probes in various configurations on the skin to measure electrical activity of the heart. A pulse oximeter is a medical device that indirectly measures the amount of oxygen in a patient's blood (as opposed to measuring oxygen saturation directly through a blood sample). Although this device is inaccurate for measuring blood oxygen levels in sea turtles, it can be used as an alternative measure of sea turtle heart rate. Pulse oximetry probes come in various configurations that can be applied to the skin or inserted into the cloaca.

Turtle respiration rate is simply monitored by visual detection of inhalation and exhalation. Body temperature is measured in turtles using either a thermometer probe inserted into the cloaca or externally using an infrared thermometer (typically the neck/shoulder regions or prefemoral areas). Cloacal thermometers consist of a flexible thermistor probe (or equivalent) that is lubricated and gently inserted into the cloaca to the level of the caudal plastron or until resistance is encountered. To estimate overall health of the animals, researchers may measure the relative fat content of turtles using Bioelectrical Impedance Analysis (BIA). BIA non-invasively measures the resistance of body tissues to the flow of a harmless, low-level electrical current. The percent of fat tissue is determined by measuring the speed and strength of the current. Researchers typically use a handheld analyzer which runs on a 9-volt battery. The instrument includes an Ohm resistor which allows calibration checks. During testing, small electrodes would be placed on the opposite limbs of the body. The test generally takes only 5 to 20 seconds and elicits no response from sea turtles.

### 3.4.4.3 *Identification Tags and Markings*

#### Metal Flipper Tagging

Metal flipper tags that are uniquely numbered are used to identify individual sea turtles. When properly applied, metal flipper tags can remain attached for over a decade. A routine practice for all personnel that work with sea turtles is to carefully inspect each encountered turtle for existing flipper tags. If existing tags are found and are in good condition, no additional flipper tags are applied. If tags are damaged, detaching, or deteriorating, they may be removed and new ones applied. For turtles greater than 30 centimeters SCL, the standard 681 Inconel flipper tags (http://www.nationalband.com/) are used; smaller tags (e.g., 1005 Monel series) are used for turtles from 20 to 30 centimeters SCL. Turtles less than 20 centimeters SCL are not tagged.

The specific location of tag placement depends on the tagging program and species. To accommodate future growth in young turtles, flipper tags are placed with additional space (about 15 to 30 percent) between the edge of the flipper and the curve of the tag. To avoid injury and minimize tag loss, researchers ensure that the piercing tab of the tag is within the receiver portion and is securely folded (crimped). The standard practice is to apply two flipper tags (one on the right and one of the left) to the caudal margin of the proximal front or rear flippers. Double tagging minimizes the probability of complete tag loss. Single tags may be applied if only one tag needs to be replaced or if a flipper is missing or has any other abnormality that would pose increased risks from tagging. As with all invasive procedures that involve piercing the skin, metal flipper tagging must adhere to the Permits Division’s aseptic techniques detailed in Appendix C. Prior to use, tags are washed in hot, soapy water and disinfected to minimize the possibility of infection. Applicators are cleaned and disinfected before use and between animals.

#### Passive Integrated Transponder Tagging

PIT tags are small rice-sized microchips that emit a unique code when activated by a PIT tag reader. These tags provide another means of identifying individual sea turtles and are thus vital to sea turtle research. PIT tags are internally injected and are not subject to tag loss due to environmental conditions as are external tags. Since they are not self-powered, PIT tags can provide life-long identification. PIT tags typically are used in combination with metal flipper tags because not all individuals who may encounter a tagged turtle will have access to a PIT tag reader (e.g., the public encountering a stranded turtle). Researchers with tag readers scan all encountered turtles for PIT tags and only insert a PIT tag if one is not already detected.

Prior to insertion, each sterile PIT tag is tested by scanning it with a PIT tag reader. PIT tags are inserted using an injector that is provided by the manufacturer. The exact location of PIT tag insertion depends on the program and species. On hardshell turtles, the PIT tag would typically be inserted into the triceps muscle complex or within the soft, fleshy area dorsal to the wrist bones of the front flipper at a seam between the scales and nearly parallel with the skin of the flipper and with the needle directed proximally. Other locations would be authorized as part of the Program if determined to be appropriate and if expected to have the same effect on the animal as intramuscular insertion. The most commonly used locations for hard-shelled turtle species are the flipper blade and triceps muscle area of the front flippers. In Hawaii, it has been standard practice to insert the tag in a rear flipper since 1998. Leatherback turtles are tagged in the shoulder region (Dutton and McDonald 1994). As with all invasive procedures that involve piercing the skin, PIT tagging must adhere to the Permits Division’s aseptic techniques detailed in Appendix C.

Turtles must be greater than 30 centimeters SCL to receive the standard 12 millimeter PIT tag (the size most frequently used for sea turtles), which uses a 12 gauge injector. For turtles between 16 to 30 centimeters SCL, a smaller 10 millimeter PIT tag (16 gauge injector) and local anesthetic must be used (see Appendix C for details). Additional steps to minimize impacts would be required for turtles between 16 to 30 centimeters SCL (see Appendix C for details). PIT tagging of turtles less than 16 centimeters SCL will not be not authorized as part of the Program.

**Shell Marking**

The carapace of hardshell sea turtles may be temporarily marked for easy identification of individuals during the research season to avoid recapturing animals. Researchers apply paint, such as a non-toxic paint stick used for livestock, to mark the carapace shell, using as little paint as necessary to easily identify the animal. The Permits Division will not authorize the use of xylene or toulene-based paints, or any other potentially harmful or toxic paints, particularly those containing tributyltin or cyanide. Additionally, researchers may not use paints with exothermic curing reactions or reflective paints.

Etching tools (e.g., Dremel Moto-Tool with a "pear-shaped" bit) are used to place an etch or groove in the carapace of hardshell sea turtles. The bit is disinfected before use. The etch or groove is only made in the keratin layers of the scute and does not injure the underlying living tissue. Etching is not done on turtles with scutes that are too thin to be etched without risk of injury. Non-toxic paint is applied to the etched grooves in some instances to improve the visibility of animals post-capture.

For studies related to reproductive activity, the plastron of males may be marked using a minimally invasive protocol based on Blanvillain et al. (2008). Male sea turtles are placed in a recumbent position (carapace down). The entire plastron is delineated using a non-toxic marker and an additional line is drawn around the area of softness to highlight this area for photodocumentation and comparison with other parameters.

**Oxytetracycline**

Oxytetracycline injection is a means of chemically marking the bone to validate the "ring counting" technique of skeletochronological (aging) studies and to calibrate bone growth if the turtle strands dead and is recovered (Frazier 1985). Turtles are injected with the antibiotic tetracycline or oxytetracycline. Administration is according to a veterinary-approved protocol (NMFS 2008) that defines the dosage, injection site, and procedure.

#### *3.4.4.4 Biological Sampling*

**Epibiont Collection**

Numerous organisms occur as epibiota on sea turtles and may be collected by researchers by various physical means, such as use of forceps, scraping devices, and swabs. All collection procedures, including detachment of barnacles, most be done in a manner that avoids injury to the underlying skin.

**Swabs**

Swabs are collected from the skin, eyelids, and orifices (mouth, nares, cloaca) of sea turtles for various purposes, including DNA recovery, cytology, and characterization of microbiota. This sampling collects surface or naturally exfoliating materials and does not injure the skin or mucosal surface. For oral swabbing, a bite block or speculum is used to transiently hold the mouth open for safe collection. For cloacal swabs, the swab is not inserted beyond the point of any resistance (to avoid accidental perforation). Palpebral swabs are collected with care so as not to abrade the sensitive cornea. The specific type of swab, gauze, or similar material/instrument depends on the research objective.

**Skin Biopsy**

Tissue samples (biopsies) are used for various purposes, including genetic analyses, isotope analyses, and disease studies. Included under skin biopsies is sampling that aims to specifically collect keratin (i.e., for isotopic, heavy metal or other analyses). A new, sterile biopsy punch, razor, or surgical blade is used on each sample. Skin biopsies are limited to two biopsies per animal per sampling event, and two sampling events per 12-month interval unless additional sampling is defined in a veterinarian-approved protocol.

Skin biopsies typically are 6 mm in diameter or less and are collected from specific areas of the body, depending on their intended use. For example, samples for genetic analysis are most often collected from edges of the flipper webbing for hard-shelled species. Skin overlying the shoulder areas or specific areas of the shell may be targeted for isotopic analysis and specific types of skin lesions, e.g., fibropapillomas, may be sampled for disease studies. The tissue surface would be cleaned and disinfected following the required aseptic technique and disposable gloves must be worn. Sterile biopsy punch, forceps, surgical scissors, or an additional blade may be used to extract and trim the sample. Analgesia (i.e., use of local anesthetics) under the direction of a veterinarian is encouraged when possible for biopsies of any size. A veterinarian-approved protocol is required for biopsies larger than 6 millimeters.

There are instances when sea turtles cannot be safely boarded onto a vessel, but may be sampled using a biopsy pole. Samples are collected from anywhere on the limbs or neck (avoiding the head) that are most safely accessible to the researcher. Samples from leatherbacks are collected via shallow carapacial scrapes. The sampling gear consists of a 1-cm diameter sterile stainless steel corer attached to a two to four meter anodized steel sectional aluminum pole. The vessel comes alongside the leatherback in the water and scrapes the carapace at an oblique angle to collect a superficial skin sample.

**Soft Tissue Biopsy**

Soft tissue biopsies include surgical collection of samples of skeletal muscle, tumors, lesions, or fat, which are used for physiological and health studies. Because this is a surgical procedure, soft tissue biopsies must follow a veterinarian-approved protocol and are only performed by a veterinarian or under direct veterinary supervision. This procedure must follow the provisions in Appendix C, including aseptic techniques and pain management. Sampling of soft tissues may occur in a facility or under field conditions provided that an appropriate designated surgery area is used.

**Blood Sampling**

Blood sampling is a minimally invasive method to study sea turtle population genetics, sex ratios, health, contaminants, and stable isotopes. Sampling may only occur if directly taken by or supervised by experienced personnel. Blood is most frequently collected from the dorsal cervical sinus (external jugular vein) of the turtle’s neck, but also may be collected from other peripheral vessels. For example, vessels at the base of the rear flippers and adjacent to the phalanges are alternate collection sites in leatherbacks. Turtles are adequately restrained during the collection to prevent movement. The sample site is cleaned and disinfected before drawing blood following the required aseptic techniques. New disposable needles are used on each animal and no more than two attempts are allowed per needle. The needle size is dependent on the size of the animal, e.g., a 21 or 22 gauge, 1 to 1.5 inch needle is adequate for adults (Owens and Ruiz 1980); a 23 gauge, 0.5 inch needle is appropriate for smaller animals; longer spinal needles are needed to reach the cervical sinuses of leatherbacks. Attempts (needle insertions) to extract blood would be limited to a total of four, two on either side of the neck or other site. During blood sampling, lateral movement of the needle and unnecessarily deep insertion are avoided to prevent injury. The needle is retracted to the level of the subcutis prior to redirection. No blood may be collected should conditions on the boat preclude the safety and health of the turtle. Permits conservatively limit total blood volume collected to no more than three mL per one kg of turtle body mass. Collection of larger volumes requires a veterinarian-approved protocol. Severely compromised or injured turtles would not be sampled for blood unless specifically authorized by the Permits Division or deemed necessary to facilitate clinical assessment in the field. In addition, researchers would follow protocols to ensure a proper sampling period between samplings as outlined in Appendix C.

**Tear Collection**

Sea turtle tears are collected for physiological studies. Tear collection methods will be authorized as part of the Program provided that they are non-invasive, comply with required safe handling practices, and do not pose any risk to the turtles eyes.

**Fecal and Urine Sampling**

Fecal and urine samples are collected for sea turtle diet analyses, health evaluations, and other purposes. Fecal samples may be voluntarily voided following capture, collected from larger turtles (greater than 50 centimeters SCL) using a lubricated, gloved finger, or by fecal loops, swabs, or cloacal lavage (using a red rubber catheter). To avoid injury, objects inserted into the cloaca must never be forced beyond the point of any resistance. Cloacal lavage generally uses small fluid volumes (approximately 5 to 20 milliliters of saline, depending on size). Urine is collected opportunistically when the bladder is voided following capture.

**Gastric Lavage**

Gastric lavage is used in hardshell sea turtles to obtain samples of ingested food for diet-related analyses. Standard procedures generally follow those described by (Eckert et al. 1999a). This procedure is only done by experienced personnel or under their direct supervision. Clear, flexible, vinyl tubing is used for the lavage procedure. Two tubes may be used, one for introduction of water for lavage and another for retrieval. Prior to use, the tube ends are heat treated if necessary to remove any sharp edges. Tube length is compared with the turtle to identify the length of necessary insertion into the esophagus, which is marked for reference. The tubes are not inserted beyond this point or beyond the point of any resistance. The turtle is placed with its caudal end elevated. The mouth is opened, and a padded bite block or speculum is inserted to prevent the jaws from closing. Once the turtle’s position has been stabilized, the tubing is lubricated with vegetable oil or non-toxic water-based gel and inserted into the esophagus. Water is pumped into the esophagus (e.g., using a doubleaction, veterinary stomach pump). The forthcoming fluid and any ingesta is discharged through the retrieval tube. The lavage continues for approximately 30-45 seconds as the tube is passed up and down the length of the esophagus. Lavage does not exceed three minutes to avoid aspiration. Upon completion, the turtle is left with its caudal end elevated until researchers are certain that all of the fluid has been discharged. The tubes are then removed followed by the bite block or speculum, and the head is elevated to prevent aspiration. The procedure is aborted if any element of the procedure becomes unstable.

#### 3.4.4.5 Laparoscopy and Associated Internal Tissue Sampling

Laparoscopy involves the use of an endoscope to directly view inside the body (coelomic) cavity. This invasive procedure is typically used in research on sea turtle reproduction to confirm the sex of immature individuals, characterize stage of maturation and the reproductive cycle, and as a means for collecting biopsies of internal organs. As a surgical procedure, laparoscopy is only performed by or under the supervision of a qualified veterinarian and must follow a veterinarian-approved protocol that includes consideration of aseptic technique, analgesia, and a plan for response to any unplanned complications, as required in Appendix C. Sedation is not required but is recommended if conditions allow. Laparoscopy is not performed on any compromised animals (those that are obviously weak, lethargic, positively buoyant, emaciated, or that have severe injuries or other abnormalities resulting in debilitation).

The procedure begins with a surgical incision at the port of entry, typically within the prefemoral area. A trocar is used to penetrate the body cavity and insert a cannula for passage of the endoscope. If introduction of gas (insufflation) is necessary for visualization, medical grade carbon dioxide is used. Upon completion of the procedure, the gas is expelled using one of multiple techniques and the surgical site is sutured closed using an absorbable suture. The turtle is monitored prior to release to ensure recovery and buoyancy control.

As part of the laparoscopic procedure, internal organs and tissues (e.g., gonads, muscle, liver, kidney, spleen, and mesenteric fat), may be sampled using surgical endoscopic instruments for physiological and health-related studies. As with the endoscopic procedure in general, this sampling is performed by or directly supervised by a qualified veterinarian.

#### 3.4.4.6 Transmitter Attachments

Researchers use a variety of instruments and transmitters to track turtle movements and collect data on habitat use, dive behavior, physiology, foraging events, and associated environmental parameters. Commonly used types of instruments include acoustic, radio, and satellite transmitters, time-depth recorders (TDRs), pop-up archival tags, animal-borne video, audio, and environmental data collection systems (AVEDS) also referred to as “Crittercams©”, and less commonly, stomach pills. While the size, weight and dimensions vary by tag type, all tracking devices authorized as part of the Program must meet the Permits Division’s standard mitigation measures (see Appendix C) to reduce drag (e.g., hydrodynamic shape, tag placement) and to minimize the risk of entanglement. Transmitter attachment methods will also vary based on the research objectives, study design, and target species (hardshells vs leatherbacks). Attachment methods that may be authorized as part of the Program include suction-cup, adhesive (epoxy/resin/putty), wired/tied attachments by drilling through the carapace or pygal region, and ingestion (stomach pills). Each of these methods is discussed in more detail below. Though previously authorized for use on sea turtles in section 10 research permits, the Program does not include authorization of harnessed-based attachments.

Depending on the study objectives, multiple tag components may be housed into one tag package to minimize impacts to the target sea turtle. In other cases multiple tag attachments (up to three maximum) that remain attached for varying durations may be needed. For example, a researcher may place a short-term suction-cup attached AVED and a longer-term satellite transmitter on an animal to collect different types of data. The use of multiple tags can also provide information for assessing tag accuracy, tag failure rate and turtle post-release mortality rate. In some instances (e.g., TDR tags), researchers would recapture the animal to remove the tag and download the information it recorded. These animals would be intentionally captured twice. When reviewing requests to attach transmitters to sea turtles under the Program, the Permits Division would ensure that the tag type, attachment method, and expected attachment duration are appropriate for and consistent with the applicant's objectives, are not unnecessarily duplicative (when attaching more than one tag), and are likely to yield meaningful data. This ensures that the research is bona fide and meets ESA issuance criteria.

**Suction-cup Attachment**

Suction-cups are used for the short-term attachment of AVEDS, radio transmitters, TDRs or acoustic transmitters to monitor short-term movements, dive behavior, and foraging ecology. Suction-cup tags are attached upon capture and work-up of an animal or remotely by pole during a close approach by the vessel. Small amounts of a temporary adhesive (e.g., denture adhesive) may be used to lengthen the duration of attachment. Suction-cup attachments have been shown to last for up to nine days in studies of leatherbacks, although most typically lasted for 48 hours or less.

**Adhesive Attachment**

Tags requiring longer attachment times for hardshell sea turtles use an adhesive, such as an epoxy, marine putty, resin, and fiberglass strips. Neoprene or silicone may be used to accommodate the physical features of smaller, growing sea turtles (Mansfield et al. 2012). During the attachment process, turtles are held out of water in a well-ventilated area to prevent unnecessary contact with curing compounds used for the attachment. All epoxies, resin, and other compounds must be tested prior to use to ensure that they will not cause thermal injury while curing. The carapace is thoroughly cleaned and prepared using a mild abrasive and solvent wash to promote adhesion. Tags are applied directly to the carapace at a location that minimizes drag while maintaining satellite transmission quality, typically to the posterior region of turtles, in particular the last vertebral and costal scutes. Attachment media may also encompass sections of the surrounding scutes, but is minimized and applied to be as hydrodynamic as possible. All surfaces of the transmitter except the saltwater switch and bottom are covered with anti-fouling paint to prolong function. In some instances, adhesive is used to affix a metal base plate to the carapace on which a tag is attached so that the tag can be released from the turtle after a pre-determined time period using a corrosive link. Battery life and duration of attachment depend on the species, life stage, attachment method, and individual behavior, but can last a year or more. Tags, or base plates, detach as the shell grows and the scutes are naturally shed, or are scraped off on underwater structures. These factors result in shorter attachment durations for younger juvenile turtles and some other life stages.

**Carapace Drilling**

Sea turtle researchers have developed methods for tag attachment that involve drilling through the carapace. Acoustic tags may be secured to the posterior marginal scutes using coated wire or zip ties in addition to or in lieu of marine epoxy products. The wire or zip tie is run through holes drilled into the marginal scute and secured with small aluminum clamps. A sterile drill bit is used for each individual turtle and cleaned with alcohol prior to drilling holes. The outermost edge of the posterior marginal scute is drilled to avoid damaging any tissue beyond the carapace itself. A putty may also be applied to the scute under the tag to prolong attachments.

Pop-up Archival Tags (PATs) may be attached to the caudal carapace by tether. Using this technique, a sterilized drill bit is used to create a hole through one of the pygal bones (caudal-most carapace margin in hardshell species) or the pygal (in leatherbacks). The skin is thoroughly disinfected prior to drilling. The attachment tethers have a weak link to prevent accidental entanglement and corrodible elements that result in detachment over time. The tags themselves are programed to detach after a designated interval or if certain environmental parameters are met. PATs attached using this technique typically last a year or less.

The medial ridge direct attachment method was designed for leatherbacks and allows accommodation of tags that are specifically designed for this species (Figure 3). After cleansing of the skin along the medial ridge, two to three small holes are drilled through the ridge using a sterilized drill bit. Monofilament or coated wire tether (swabbed with triple antibiotic ointment) is threaded through an acetal polyoxymethylene resin disk. Once passed through the hole, the monofilament is secured with a second acetal polyoxymethylene resin disk (swabbed with triple antibiotic ointment) and a metal crimp so that the tether is tight and secure. Any excess monofilament is cut off, and the process is repeated for the second monofilament tether. These tags are very low profile and pose little risk of entanglement. The tag releases once the crimp corrodes, and may be designed to release from as little as 30 days to up to a year.

**Figure 3. Direct carapace attachment on leatherback. Photo courtesy of Sandra Ferraroli, Centre National de la Recherche Scientifique.**

**Stomach Pills**

This procedure has primarily been authorized for research on leatherbacks but could be used on any turtle species. The stomach pill possesses a thermistor to detect stomach temperature, and a transmitter to relay data to a satellite-linked data recorder mounted on the turtle's carapace to provide details on the foraging events and patterns of sea turtles at sea. By design, pills thus far used in sea turtles can only be used in conjunction with an externally attached satellite tag that can collect and transmit the data. The pill is coated with a dissolvable, biocompatible material (e.g., ethylcellulose) to temporarily increase the pill's diameter to increase retention time in the stomach (Casey et al. 2010). Coating diameter is based on pill size (technology is making pills smaller quickly) and the size of the animal. Pills may only be used according to a veterinary-approved protocol. The pill is inserted into the turtle's esophagus using a lubricated flexible rubber tube. Once the coating dissolves, the pill would be small enough to pass through the pyloric sphincter, into the small intestine and then be passed by the animal, within two weeks of ingestion. Administration of the pill takes only one to two minutes.

#### *3.4.4.7 Non-invasive Imaging*

Diagnostic imaging includes multiple methods that are commonly used in veterinarian medicine to visualize internal structures. Though rarely performed under NMFS permits, turtles may be transported to a facility for imaging or imaged in the field using portable units. If necessary, turtles are restrained, sedated, or anesthetized under veterinarian supervision.

### Radiography

Radiography (X-rays) uses electromagnetic radiation to image internal structures, which are recognized by their shape and density. Portable units are readily available for potential field use. Generally, animals are manually restrained; sedation usually is not required. Radiation exposure during imaging is well within the safety limits set for general medical use. Intravenously or orally administered contrast material might be used to improve visualization of specific structures, evaluate function (e.g., digestive and urinary systems), or assess blood flow. Only contrast agents with demonstrated safety in animals are used and a veterinarian-approved protocol is required.

### Computed Tomography

Computed tomography (CT) also uses electromagnetic radiation, but allows better distinction of specific tissue densities, as well as cross-sectional and 3-D imaging, which allows better visualization than standard radiography. These machines are large and require turtles to be taken to an imaging facility. Sedation or anesthesia are typically necessary, as the turtle must remain motionless during imaging. Contrast agents are used for CT as with radiography. It typically takes less than a minute to image a sea turtle, depending on the size of the turtle and area of interest.

### Magnetic Resonance Imaging

Magnetic resonance imaging (MRI) uses magnetic fields and radio waves to image internal structures, and is preferred for imaging soft tissues. As with CT, MRI units are large, non-portable machines. Sea turtles must remain motionless during imaging, thus sedation or anesthesia is often necessary. Imaging takes longer than for CT, approximately 20 to 45 minutes on average. Duration depends on the size of the turtle and the aspect of anatomy that is being imaged.

### Ultrasound

Ultrasonography uses high frequency sound waves to image internal structures. In sea turtle research this method is most often used to image the gonads for reproductive studies, but other organ systems and tissues can be imaged as well. Portable units allow ultrasonography to be performed under field conditions and no sedation or anesthesia is necessary with this procedure. An ultrasound probe is placed against the skin overlying the area of interest. A special acoustic coupling gel is used to facilitate transmission.

### *3.4.4.8 Acoustic Research*

The inclusion of acoustic research in sea turtle permitting program will help improve our understanding of sea turtle hearing in order to advance deterrent devices to mitigate sea turtle interactions with fisheries.

**AEP Tank Trials**

AEPs are electrical responses produced when the central nervous system is stimulated by sound. The methodology used to measure hearing sensitivity is described by Dow Piniak et al. (2012; 2016) and Harms et al. (2009; 2014) and was developed when measuring hearing in juvenile green sea turtles and hatchling leatherback sea turtles. Software (e.g., SigGen, BioSig) run by a laptop computer generates sound stimuli through an underwater speaker and records evoked potentials from a three-electrode array. Needle electrodes (27 gauge) are inserted sub-dermally (just under the scute/skin two to four millimeters), one at the top of the head (recording electrode) and one in the deltoid muscle in the shoulder (reference electrode) or inserted sub-dermally over the ear, along the midline of the skull and a ground electrode placed in the water. The electrodes are single use and individually packaged (sterile) and prior to insertion the area is cleaned with betadine. A third electrode is placed in the seawater as a ground. The system and acoustic field is calibrated with a hydrophone at the location of the turtle’s head when the turtle is not present and background noise is measured to ensure that thresholds are not masked by background noise.

Turtles are isolated from vibrations, lightly restrained by wrapping them with stretchy lycra material to prevent swimming movement (as myogenic artifact can mask AEPs), and placed completely submerged at a depth that still allows them to lift their heads to the surface to breathe normally (at least 10 cm beneath the surface to move away the air-water interface where the acoustic field can be unpredictable) (Figure 4).

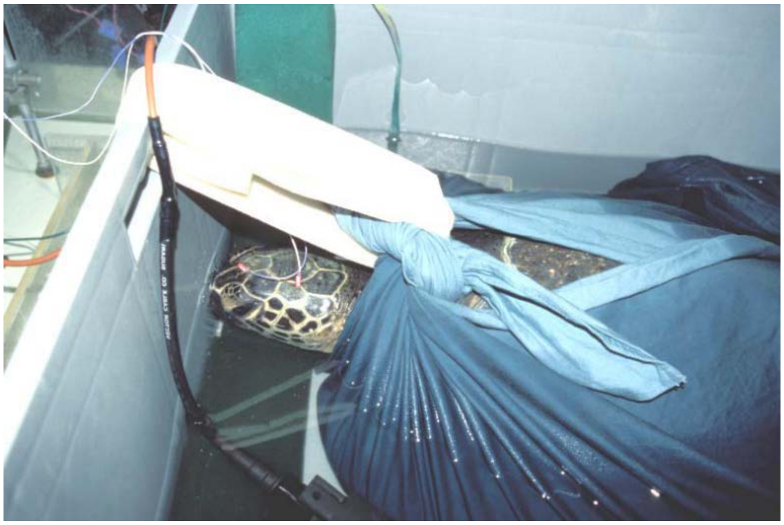

**Figure 4. Green sea turtle with electrodes.**

Trials may be conducted with any captured post-hatchling, juvenile, subadult or adult sea turtle that appears to be healthy. AEP experiments would not exceed 75 minutes. Animals that appear compromised (as defined by permit conditions in Appendix C, p. 9) may not be used for acoustics research and permit requirements for handling and treatment of such animals would immediately come into play. Sea turtles would be raised manually to the surface every 45 to 60 seconds (or earlier as determined by pre-test observations of normal breath cycles). Stimuli are presented as 100 millisecond tones ramped with a 20 millisecond rise-fall time. Measurements are typically made at the following frequencies: 50, 100, 200, 300, 400, 600, 800, 1600, and 3200 Hertz (with additional frequencies if needed) at decreasing amplitudes until an AEP response can no longer be detected; however, other frequencies may be used by researchers depending on their study objectives and design and preliminary results.

AEPs may also be measured in response to a broadband click stimulus. The system is paused when the turtle lifts its head or moves in any way so that all records are obtained from the turtle with its head in the same location in the acoustic field. If at any point the turtle seems stressed (excessive movement or breathing), tests would be terminated.

Anesthesia or sedation would only be used as a last resort after testing manual restraint on several individuals. If anesthesia is used, methodology would follow those developed for using evoked potentials to measure visual spectral sensitivity in sea turtles (Harms et al. 2007) and more recently for hearing in green sea turtles (Harms et al. 2009). Anesthesia would be induced with medetomidine 50 µg/kg (or dexmedetomidine 25 µg/kg) and ketamine 5 mg/kg combined IV in the dorsal cervical sinus. However, other anesthetics may be used by researchers as directed by their attending veterinarian. Turtles would be manually ventilated using a custom-designed double-cuffed extended endotracheal tube at a rate of two breaths in quick succession every two to three minutes with additional ventilations during pauses in hearing measurements. Medetomidine would be reversed with atipamezole (0.25 mg/kg half IV and half IM). As a requirement of the permit, an experienced veterinarian would oversee all tests where anesthesia or sedation is used, would deliver anesthesia/sedation drugs, and monitor the health of the turtles through measurement of AEPs. Experiments using anesthesia or sedation would not exceed 60 minutes. The use of anesthetics and comparable dosages were analyzed in the BA (see Section 2.5.9 (NMFS 2017a)) for other facility-based procedures, such as laparoscopy, that require sedation. As was concluded in the programmatic opinion (p. 248;(NMFS 2017b)), we expect any risk of mortality or complications from their use to be low based on the expertise of the attending veterinarian and the Permit Division's standard mitigation measures (see Appendix C (NMFS 2017b) and Appendix G).

## ADD Tank Trials

ADDs are low-intensity sound sources designed to deter animals from potentially harmful fishing gear. Behavioral responses of post-hatchling and juvenile loggerhead, green, and Kemp's ridley sea turtles to sound stimuli that might be used in potential ADDs may be measured using an overhead video camera and, when available, a ROTAG datalogger device. The ROTAG is a low-power datalogger which is attached to the turtle's carapace and incorporates a three-axis accelerometer gyroscope and magnetometer to record the turtle's pitch, roll, and heading; a pressure sensor to record turtle depth; a hydrophone to record the turtle's received underwater acoustic sound field; a temperature gauge; and two VHF radio telemetry transmitters and antennas for tag and turtle tracking (www.loggerheadinstruments.com; Tyson et al. In Review).

Sound signals would be generated using an amplified underwater speaker. The effectiveness of each frequency, intensity, and presentation rate combination will be determined by comparing the turtle's behavior during set intervals, for example a 30-minute baseline period prior to each test, a 30-minute test period, and a 30-minute recovery period immediately following each test trial. Researchers would record and measure the distance between the turtle and the speaker, location in the sound field, presence or absence of startle response, activity, orientation, and breathing rates, and use these data to determine if the turtles were deterred from the speaker. Individual sea turtles may be tested multiple times to determine if sea turtles habituate or, conversely, become sensitized to the sounds presented.

The resulting audiograms, along with those available in literature and current ongoing research (Bartol and Ketten 2006; Bartol et al. 1999; Dow Piniak 2012; Dow Piniak et al. 2012; Dow Piniak et al. 2016; Lavendar et al. 2014; Martin et al. 2012) would be used as a guide in generating potential test ADD signals.

**ADDs in the Wild**

As part of bycatch reduction studies, researchers may test the use of ADDs in the wild by attaching them to capture gear commonly used in fisheries to test their efficacy in reducing sea turtle bycatch and assess sea turtle interactions with the gear. ADDs are low-intensity sound sources designed to deter animals from potentially harmful fishing gear. Although ADDs have been successfully used to reduce some species of marine mammal bycatch (Barlow and Cameron 2003), researchers have recently begun evaluating these devices for use with sea turtles. The use of ADDs in the wild has been previously permitted for the NMFS Southeast Fisheries Science Center (SEFSC) under Permit No. 16733-06. The use of ADDs for scientific research is a growing field, particularly as it relates to reducing bycatch in fisheries.

The ADD unit consists of a battery, recorder to broadcast the sound, transducer, and an amplified speaker to emit the signals. These units can be deployed in several ways. In one configuration, the speaker is submerged underwater attached to the net while the remaining components are housed in a separate waterproof box that floats at the water surface and serve as a means of locating the ADD. In a second configuration, ADD components are encased in an underwater housing suitable for shallow-water deployments. These designs could alter slightly over time through trial and error in determining what set-up works best in the field. The ADD emits an intermittent tonal signal set by the researcher. We anticipate that ADDs could operate for up to

24 hours for pound nets and 12 hours for tangle nets. Authorization of ADDs in the wild would be contingent upon: 1) The parameters of the ADD sounds (duty cycle, sound level, and frequency) have been tested on sea turtles in a tank-based study (e.g., AEP or behavioral tests) conducted in a facility or other acoustic studies conducted in the wild; 2) The results of such acoustic trials indicate that animals have not been seriously injured or killed; and 3) Independent review by a bioacoustic expert who is not affiliated with the project. This review is in addition to any other expert reviews required when processing sea turtle permit requests as previously described for our program. Permit Holders are required to monitor and maintain capture nets (i.e., tangle nets and pound nets) in the wild according to the standard permit mitigation measures discussed above in Section 3.4.3 *Capture and Collection Methods*. .

As an example of how ADDs are used in turtle research, the following describes how the SEFSC plans to test ADDs for sea turtle bycatch reduction for North Carolina fisheries. This description serves as the current parameters of acoustic exposure that the Permit's Division may permit.

**SEFSC Bycatch Reduction Research**

To investigate the use of acoustic cues as potential bycatch reduction devices, active or inactive (control) ADDs are submerged on netting or supporting stakes of nets such as pound nets or tangle nets. An example study design is having ADDs generate alternating 200 to 500 Hz tones, 1 second in length, presented every 10 seconds at approximately 135 to 140 dB re: 1µPa at 1m (root-mean-square [RMS] source level). These sounds are within the known or expected hearing range of the target sea turtle species. Researchers would place up to three ADDs at the entrance to the heart of the pound net. For tangle nets, ADDs would be spaced evenly along its length so that the acoustic level is roughly equitable along the length of the net. Researchers would be required to check the nets routinely and record all fish and turtle catch. Researchers also would record acoustic background sound measurements at several locations along the net to examine the ADD sound field. Researchers would collect morphometric data on all captured turtles. Captured turtles may also be tagged prior to release. Marking or tagging would assist in identification of re-encountered individuals.

For the sea turtle permit program, in consultation with bioacoustic experts, Dr. Wendy Piniak (NMFS OPR) and Dr. Amy Scholik-Schlomer (NMFS OPR) the Permits Division has developed the limits and mitigation measures to permitting acoustics in the wild for sea turtle research based on the best available science on hearing for sea turtles, marine mammals, and fishes. The Permits Division will limit the authorization of ADDs in the wild to research permitted along the U.S. East coast, from Virginia waters of the Chesapeake Bay to Florida, and the Gulf of Mexico within 10 nautical miles of shore to accommodate foreseeable studies over the next ten years.

Research will occur in very shallow waters (less than 10 meters deep) due to the practical constraints of where pound and tangle nets can be set. Based on past hearing studies researchers would be authorized to play signals that are below 1 kHz and no louder than 150 dB re: 1µPa at 1m (RMS source level) from individual units. We expect most studies would focus on frequency ranges where turtles are known to have the best hearing, or maximum sensitivity (i.e., 200 to 500 Hz). Further, based on acoustic modelling of this sound source when used in shallow waters, ADDs are expected to have a very short attenuation distance to background levels.

### 3.4.5 New Sea Turtle Research Methods, Procedures, and Mitigation Measures

As new technologies are developed and techniques improved, the Permits Division anticipates new research procedures or protocols may be proposed by sea turtle researchers. For example, the use of UAS for sea turtle research is expected to grow over time as this relatively new technology evolves (i.e., new sensors and payload components that can collect different types of information are likely to be developed). Improvements in sea turtle tag design and attachment methods are also expected as this field of study grows and technology evolves (e.g., the miniaturization of solar cell technology with longer battery life), allowing units to be placed on smaller animals and/or for longer durations. These units would be authorized under the Program as long as their effects are equivalent to those analyzed in this BA, and the researcher can meet our standard permit mitigation measures.

Since additional risks may be associated with new or experimental procedures, the Permits Division will only authorize a new procedure (i.e., one that is not explicitly discussed above) as part of the Program if, after reviewing the best available scientific information, they determine that (1) the procedure is effective at achieving the research objectives, and (2) any adverse effects on sea turtles resulting from the procedure are less than or equal to the adverse effects of any of the procedures previously authorized or described above for the same research objectives. Therefore, the Permits Division does not expect new research methods or changes in protocols to result in a level of impact not evaluated as part of this programmatic consultation. If the adverse effects are greater than considered in this programmatic opinion, reinitiation is required.

Similarly, if NMFS develops new recommendations or best practices for sea turtle research, the Permits Division’s standard mitigation measures and permit requirements (described above and in Appendix C) would be revised to be consistent with such recommendations to minimize impacts to the extent possible. For example, as new information becomes available on the impacts of tag units and attachment methods, such as studies analyzing drag forces to smaller turtles, the Permits Division’s standard mitigation measures for the Program would be revised to minimize the potential impacts of transmitters and instruments to the extent possible.

## 3.5 Authorizing Take Under the Sea Turtle Research Permitting Program

As part of the Program, the Permits Division will authorize take of captured sea turtles through the issuance of section 10 research permits. Permits for research on turtle parts alone, such as for cell line development, would not authorize the take of live animals, and the numbers of parts could be unlimited. This section discusses the Permits Division proposed approach for authorizing non-lethal and lethal take for research activities on live animals in the wild.

### 3.5.1 Sea Turtle Take Levels Authorized

There is no specified limit or cap on the number of sea turtles that may be taken non-lethally for the Program as a whole. However, individual permits issued under the Program will have specified limits for non-lethal take and lethal take, as applicable. As shown in Figure 5, past sea turtle take numbers authorized by the Permits Division were considerably higher than reportedly used take on an annual basis. As part of the Program, permit applicants will be asked to provide additional justification for their requested take numbers in an effort to make authorized take levels more in line with reported take levels. Non-lethal take of unidentified/hybrid turtles would be allowed under the Program. If an unidentified/hybrid sea turtle dies, then the mortality would be attributed to all the possible sea turtle species and DPSs (based on ocean basin) until genetic testing is done to confirm the identity. No lethal take would be authorized up-front in individual permits for unidentified/hybrid turtles. The Permits Division estimates a modest annual increase (approximately 10 percent) in reported take of sea turtles associated with vessel-based captures or research procedures on captured turtles (NMFS 2017a). Both authorized and reported take numbers for remote survey methods are expected to decrease significantly as a result of the 2016 NMFS' Interim Guidance on the ESA Term Harass (NMFS 2016c).

As a condition of their permit, researchers will be required to follow specific protocols to avoid, minimize, and mitigate the unintended adverse effects that may result from research activities (e.g., capture, handling, and performing various invasive procedures). While these precautionary measures have proven highly effective at reducing the adverse impacts of research, some risk of sea turtle mortality still remains. Two types of lethal take may occur as a result of research authorized under the Program: (1) observed mortalities reported by the researcher, and (2) delayed or "unobserved" mortalities that occurs at some time after the sea turtle is released back into the wild. As part of the Program, the Permits Division would authorize lethal take within specified levels for the Program as a whole. Lethal take would also be authorized for individual permits (that are within the Program) on a case-by-case basis based on researcher requests and supporting justification. For individual permits, lethal take would be authorized over the permit duration, up to a maximum of ten years. The Permits Division's lethal take limits for the Program are shown in Table 1.

Each species would have a ten-year lethal take limit by ocean basin (Atlantic versus Pacific). For green and loggerhead turtles which have multiple DPSs considered in this opinion, the 10-year lethal take limit will represent the combined take limit for all DPSs within that particular ocean basin. The Permits Division would not authorize take for a species across ocean basins (i.e., in both the Atlantic and Pacific) as the species subjected to research under NMFS jurisdiction do not migrate between the Atlantic and Pacific Ocean basins.

The proposed approach for authorizing lethal take also includes a reserve lethal take buffer that would not be authorized up front in research permits. The reserve buffer provides the Program some flexibility for unanticipated events, such as the Deepwater Horizon oil spill in 2010, that may result in the need for increased research effort. The reserve lethal take could also be used to modify a research permit for which the authorized lethal take limit has been reached (or exceeded) to allow research to continue. These decisions will be made on a case-by-case basis. The Permits Division will carefully consider the circumstances resulting in a researcher exceeding their turtle lethal take limit, the amount of lethal take left that could be authorized (initial limit and reserve) within a given ten-year period, and any other relevant factors before authorizing any additional lethal take through permit modification.

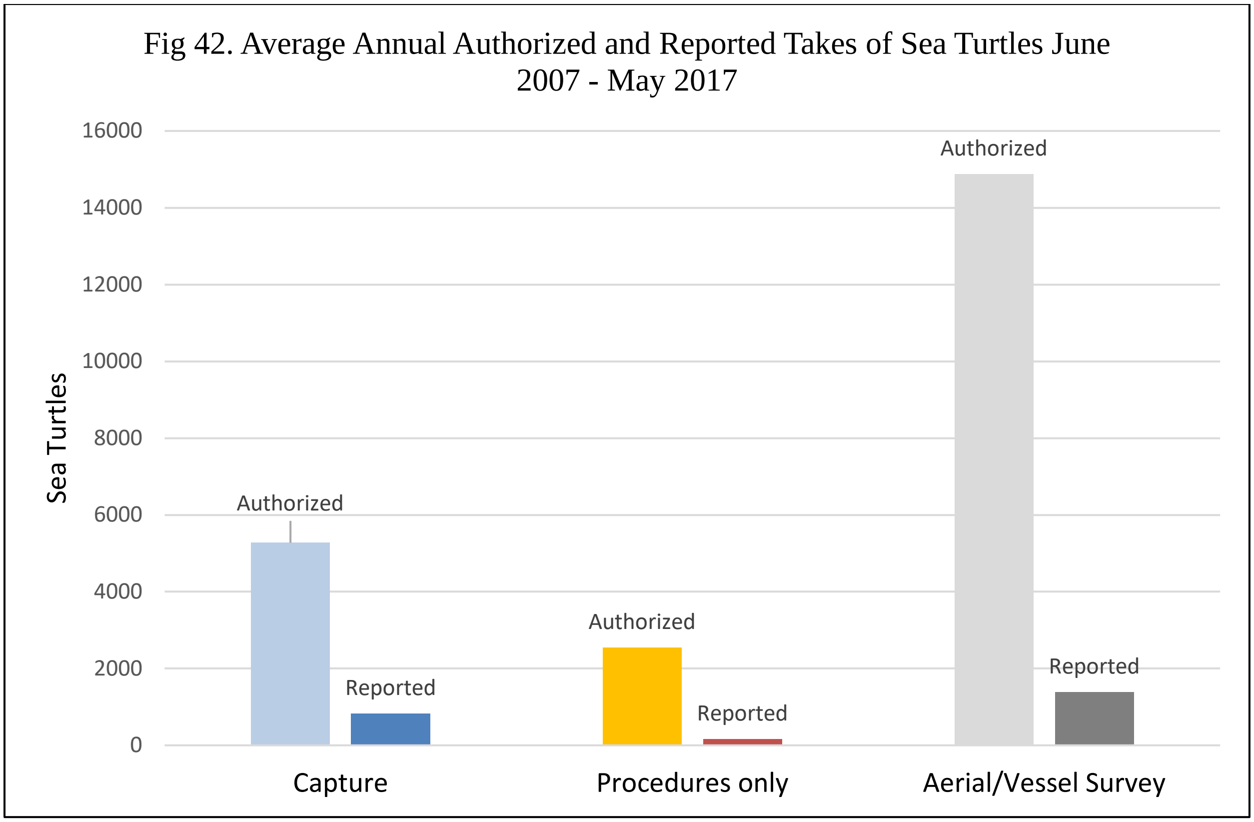


**Figure 5. Average Annual Authorized and Reported Takes of Sea Turtles, June 2007 through May 2017 (NMFS 2017a).**

### 3.5.2 Allocating Authorized Lethal Take Among Research Permits

As discussed in Section 3.3, the Program would establish an annual permit cycle for processing new sea turtle permit applications and major modifications. The annual cycle will allow Permits Division staff to review and evaluate all requests for directed sea turtle take, along with all previously authorized take under the programmatic framework, for the upcoming year at one time. Once the annual window for submitting new research permit applications is closed, the Permits Division can estimate the number of lethal takes that are anticipated in the upcoming year for purposes of comparison with the lethal take limit levels established for each species by ocean basin. In the first year that the programmatic framework is in place (i.e., 2018), the

Program will evaluate the lethal takes requested by all applicants for that year's annual permit cycle against the lethal take limits. In subsequent years under the programmatic framework, the pool of active permits within the Program will include both newly issued permits, and permits issued in previous permit application cycles. Moving forward, authorizations of sea turtle lethal take for a given year must consider previously authorized lethal take in permits under the Program. Because most existing active permits (issued prior to the Program) authorize mortality as a single low take number for multiple species combined per permit, such takes cannot be deducted from the individual species lethal take limits; rather, the lethal takes authorized under existing permits and which have already undergone separate section 7 consultation, are considered as part of the baseline for this programmatic consultation.

**Table 1. Proposed ten-year lethal take limits for observed mortalities over the term of the programmatic consultation.**

| **Atlantic Lethal Take Limits for Observed Research Mortality** | | | |
|---|---|---|---|
| | **Ten year Duration Limits** | | |
| **Species (DPSs)** | **Column A Authorized in permits** | **Column B Reserve buffer** | **Column C Total over 10 years** |
| Green (*North Atlantic, South Atlantic*) | 10 | 5 | 15 |
| Hawksbill | 5 | 3 | 8 |
| Kemp's ridley | 10 | 5 | 15 |
| Leatherback | 10 | 5 | 15 |
| Loggerhead (*Northwest Atlantic*) | 10 | 5 | 15 |
| Olive ridley | 5 | 3 | 8 |

| **Pacific Lethal Take Limits for Observed Research Mortality** | | | |
|---|---|---|---|
| | **Ten year Duration Limits** | | |
| **Species (DPSs)** | **Column A Authorized in permits** | **Column B Reserve buffer** | **Column C Total over 10 years** |
| Green (*Central West Pacific, Central South Pacific, Central North Pacific, East Pacific*) | 5 | 2 | 7 |
| Hawksbill | 5 | 2 | 7 |
| Leatherback | 1 | 1 | 2 |
| Loggerhead (*North Pacific*) | 5 | 2 | 7 |
| Olive ridley | 5 | 2 | 7 |

Lethal take is authorized in less than ten percent of current permits for activities that would fall under the scope of the programmatic. Therefore, based on past permit applications, the Permits Division anticipates that sea turtle lethal take will not be authorized for the large majority of permits issued under the Program. Provided that the lethal take numbers requested by all applicants for the year's permit cycle are within the ten-year lethal take limits (Column A, Table 1) for each species and ocean basin, lethal takes would be authorized as requested. This assumes that all applications and proposed take numbers have been deemed bona fide by the Permits Division and are recommended for issuance. The permit applicant must fully justify their requested level of lethal take to the Permits Division, particularly if the requested level exceeds the anticipated level based on prior research experience. The Permits Division will only authorize observed lethal take if the researcher can justify the numbers (e.g., past report of death, requesting riskier methods, etc.) and demonstrate that the research and research methodologies are warranted for the conservation and recovery of the species. If the request cannot be justified, the applicant's request for a research mortality may be lowered or the application may be denied.

Though not anticipated, if the pool of lethal take requests in a given year's cycle exceeds the prescribed lethal take limits for a species/ocean basin, the Permits Division will contact affected researchers to discuss options for reducing the anticipated mortality so as not to exceed the Program limits. Options may include reducing the number of lethal takes, number of captures by gear type, or changing the protocols or procedures requested. The Permits Division will initially contact new applicants in a given permit cycle to reduce the anticipated mortalities for a given species and ocean basin to the allowable levels. Researchers with permits issued in previous years may also be contacted to assess their flexibility in reducing their previously authorized lethal take limit or in altering their research approach for the upcoming years.

### 3.5.3 Monitoring Sea Turtle Take

The Permits Division will monitor and track sea turtle take (lethal and non-lethal) from capture, handling, and both non-invasive and invasive procedures, as information from researchers is reported throughout the year. As a condition of the permit, Permit Holders must notify the Permits Division of each research mortality within two business days, followed by submission of a written incident report detailing the research mortality within two weeks. Efforts must be made to necropsy turtles that die as a result of research activities and results provided to the Permits Division for review as part of the report. Sea turtle necropsies may only be conducted by authorized personnel. Mortalities that are determined to have occurred prior to authorized activities (e.g., decomposed carcass pulled up in a trawl) would not be counted against the researcher's permit or the Program's limit as these deaths are already accounted for and monitored by the STSSN via the necropsy report. All other observed mortalities would count against the researcher's permit and the lethal take limits. Upon review of the incident, the permit could be modified in a number of ways to ensure that best practices are used to minimize further mortality. These include options such as: 1) improving protocols and methods that likely resulted in or contributed to the mortality; 2) limiting authorized capture numbers or specific procedures; and 3) requiring additional coordination among researchers or monitoring of the species. If a Permit Holder reaches or exceeds their limit of observed (authorized) mortalities specified in their permit, they also must stop their research activities until they receive approval from the Permits Division to resume work. Before issuing a modification to a permit that has exceeded its mortality limit, the Permits Division must determine that the change will not likely result in a mortality level that exceeds the Program's lethal take limits for any species/ocean basin combination.

Sea turtle observed mortalities that occur as part of the Program may include both mortality of the target research turtle species as well as incidental mortality of non-target sea turtles species. The latter scenario could occur in the event that a researcher wants to work solely on one species but could incidentally kill another species during fieldwork involving non-selective capture methods. To ensure that mortality of non-target turtle species is accounted for in the Program, such mortalities will be deducted from the overall Program limits as they occur. Such cases are expected to be extremely rare because capture mortalities are rare to begin with, and many researchers study the majority of the species found in their waters.

The Permits Division will closely monitor sea turtle mortality occurring under research permits issued as part of the Program. Every effort will be made to avoid exceeding the lethal take limits established for each species and ocean basin. The online database titled Authorizations and Permits for Protected Species (APPS) will be used to track the annual number of authorized sea turtle takes allocated in issued permits and the number of takes reported as used each year. The Permits Division can run a report in APPS to evaluate these takes at any time for each species by location.

### 3.5.4 Addressing Scenarios When a Lethal Take Limit Has Been Exceeded

It is possible that a ten-year authorized lethal take limit (Column A, Table 1), as proposed for the Program as a whole, would be exceeded due to a combination of management uncertainty associated with monitoring mortality and the low lethal take limits established for some species/ocean basin combinations (e.g., Pacific leatherbacks). The risk of exceeding a lethal take limit may increase if researchers due not adhere (either intentionally or unintentionally) to the research techniques, procedures and mitigation measures specified as a condition of their permit. If a ten-year lethal take Program limit has been exceeded for a particular species/ocean basin combination, the Permits Division could make use of the reserve buffer (Column B, Table 1) to allow research to continue for that species and within that ocean basin. The lethal takes in the reserve buffer could be used if a mortality occurs under a permit that authorizes no lethal takes or if a researcher exceeds the lethal take limit authorized for their individual permit (e.g., two mortalities reported when only one is authorized). If, upon review of the incident, the Permits Division determines that additional lethal take needs to be authorized for the permit, they would be drawn from the reserve buffer if Column A takes are all allocated. Additional lethal take will be authorized only after the Permits Division has made all other efforts to reduce the likelihood of another mortality occurring under the permit. The reserve buffer of lethal takes will be used sparingly in the Program and limited to cases where the original (Column A, Table 1) lethal take limit was unexpectedly exceeded due to circumstances beyond the control of the researcher or the Permits Division (see 3.5.1 above for discussion of the use of reserve take). Reported sea turtle mortalities would be monitored closely to avoid exceeding the total ten-year lethal take limits (Column C, Table 1). The Permits Division would initiate discussions with the Interagency Cooperation division about reinitiation if all Column A lethal takes for a species/ocean basin have been authorized for a given ten-year period, and at least one authorized lethal take has been drawn from the buffer reserve (Column B. Table 1).

### 3.5.5 Incidental Take of Non-target Species

In addition to the effects on sea turtles, the authorized research activities may result in the incidental take of other ESA-listed species. Because incidental take is rare during turtle research, the Permits Division will manage an annual cap on incidental take for non-target species authorized within the ITS of this programmatic biological opinion (i.e., the ITS will not be included in the permits themselves, as is currently done). Because the risk of mortality of non-target species cannot be completely eliminated, the proposed incidental take annual cap will include both non-lethal and lethal takes. By not authorizing incidental take by permit, the incidental take cap allows the Permits Division to keep the level of take for non- target species lower for the Program as a whole (which is included in the baseline of other section 7 consultations).

If a non-target ESA-listed species is incidentally taken, the permit holder must stop work and notify the Permits Division as described in its permit. The Permits Division will deduct the incidental take from the Program’s annual cap for that particular non-target species or DPS. The Permits Division will then evaluate the factors that caused the incidental take to occur. As necessary, the permit may be modified to account for any changes in protocols, methods or mitigation measures required to minimize the chance of additional incidental take before research is allowed to resume.

On rare occasions, a sea turtle researcher may incidentally take a turtle species that is not included on their research permit (e.g., capture of a loggerhead under a permit that only authorizes take of leatherbacks). Incidental lethal take of a non-target sea turtle species will not be exempted under the programmatic ITS as described above for other non-target species, Instead, as discussed above (Section 3.5.3), it will be considered as part of the takes evaluated pursuant to the Program-wide lethal take limits along with the directed take for that particular species or DPS.

### 3.6 Internal Program Review

The Permits Division will conduct an internal review of the Program after one full annual permit cycle, including submission of annual reports, has been completed. The internal review will evaluate program operations to determine whether resources (time, staff, expertise etc.) need adjustment, identify challenges or problems that arose and lessons learned, and identify ways to improve how the Program functions. Specific aspects of the Program that will be assessed include:

- Permit cycle – Are the majority of applicants submitting requests on time? Is the volume of requests in a cycle manageable in addition to other workload? Is the six-month processing window adequate?
- Take allocation – Are the levels of mortality requested and authorized in line with what was expected based on past data? Are the lethal take limits and incidental take estimates sufficient or over-estimated?
- Reporting schedule – Are Permit Holders submitting annual and incident reports on time? Is NMFS getting the details needed to assess the Program?
- Lessons learned – What other challenges or problems arose and how were they resolved? Does the process need revision?
- Future issues – Are there issues on the horizon based on funding announcements, trending research interests, species status, new information/papers, etc., that would require re-initiation?

The Permits Division will continue to conduct internal reviews of the Program on a regular basis (approximately every 12 to 16 months), as other taxa/species programmatic consultations are completed, or more frequently as needed.

### 3.7 Adaptive Management

Adaptive management will be an integral component of the Program. Through adaptive management the Permits Division will ensure they are meeting the dual Program objectives of authorizing sea turtle research necessary for the conservation and recovery of ESA-listed species while mitigating and minimizing any adverse effects on individual turtles and turtle populations. At the program level, the Permits Division will continually evaluate and, as appropriate, modify the standard permit terms and conditions and required research protocols and mitigation measures based on new information received from permit holders, published papers, or other relevant sources. Adaptive management will also provide the Permits Division with the flexibility to include new sea turtle research methods, procedures, and protocols as part of the Program over time. Research methods, procedures, and protocols not specifically addressed in this consultation would be authorized as part of the Program only if they meet the specified criteria described in Section 3.4.5 above. The Permits Division will also continually monitor and evaluate available information regarding the status of each species (or DPS) to ensure that the basis for justification of the Program's authorized lethal take limits is still valid.

Reported incidences of mortality or serious injury to an ESA-listed species will be further investigated by the Permits Division to determine the causal factors, and additional mitigation measures may be added, either program–wide or to an individual permit, as warranted. The Permits Division can adaptively manage individual permits, through either minor or major modifications, as is necessary to avoid exceeding a lethal take limit or to mitigate adverse effects from research activities. Any aspect (e.g., species, take numbers, methods, mitigation measures, etc.) of a permit can be modified at any time based on new information on either the potential impacts of permitted activities on the species (or habitat) or the species baseline (e.g., status, threats, habitat range, etc.).

## 3.8 Reporting to the Interagency Cooperation Division

Continued close collaboration and an on-going dialogue between the Permits Division and the Interagency Cooperation Division will be an important component of the adaptive approach to managing the Program. The Permits Division will summarize and compile information from the annual reports submitted by sea turtle researchers (Appendix D) into an annual Program report. The Permits Division will submit the annual Program report to the Interagency Cooperation Division within 30 days of receiving and reviewing all the annual reports from permit holders. The annual Program report to the Interagency Cooperation Division will synthesize data such as the number and percentage of takes used for lethal and nonlethal activities, the frequency of observed effects of activities, and the number and kinds of non-target species incidentally taken.

Annual reports will also include notifying the Interagency Cooperation Division if new information becomes available indicating that the estimated delayed mortality rate has changed. This information will be conveyed and discussed in the report, including references to literature and other reports that were the basis for this determination. If new information indicates that a procedure or capture method has greater impacts (e.g., reduced fitness, increased mortality risk) than those analyzed in this consultation, the Permits Division will consult (either formally or informally) with the Interagency Cooperation Division and use the additional documentation to modify individual permits as needed. The timing of the annual reporting will allow for the Permits Division and the Interagency Cooperation Division to confer with on such matters before the next year's permit cycle begins. The Permits Division will also continue to work closely with the Interagency Cooperation Division to routinely check-in (e.g., every five years or more frequently as needed) on how the Program is functioning overall, and to determine whether new information indicates that the Permits Division should request re-initiation of this consultation.

# 4 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. We have determined that there are no interrelated or interdependent actions resulting from the Permits Division implementation of the Program for the issuance of permits for research activities on ESA-listed sea turtles.

# 5 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 C.F.R. §402.02). The Permits Division proposes to issue ESA Section 10(a)(1)(A) scientific research permits for research activities on sea turtles within all U.S. waters and the high seas of the Pacific and Atlantic Oceans.

In the Pacific, this includes the U.S. west coast from California to Washington and their associated embayments and estuaries, Hawaii, and all U.S. Pacific territories: Guam, Commonwealth of Northern Mariana Islands, Palmyra Atoll, Johnston Atoll, America Samoa, Bajo Nuevo Bank, Baker Island, Howland Island, Jarvis Island, Kingman Reef, Midway Islands, Serranilla Bank, and Wake Island (Figure 6). The shaded area in light green is an approximation of where research may occur. See Appendix E for locations of active Section 10(a)(1)(A) sea turtle research permits in the Pacific ocean as of June 30, 2017.

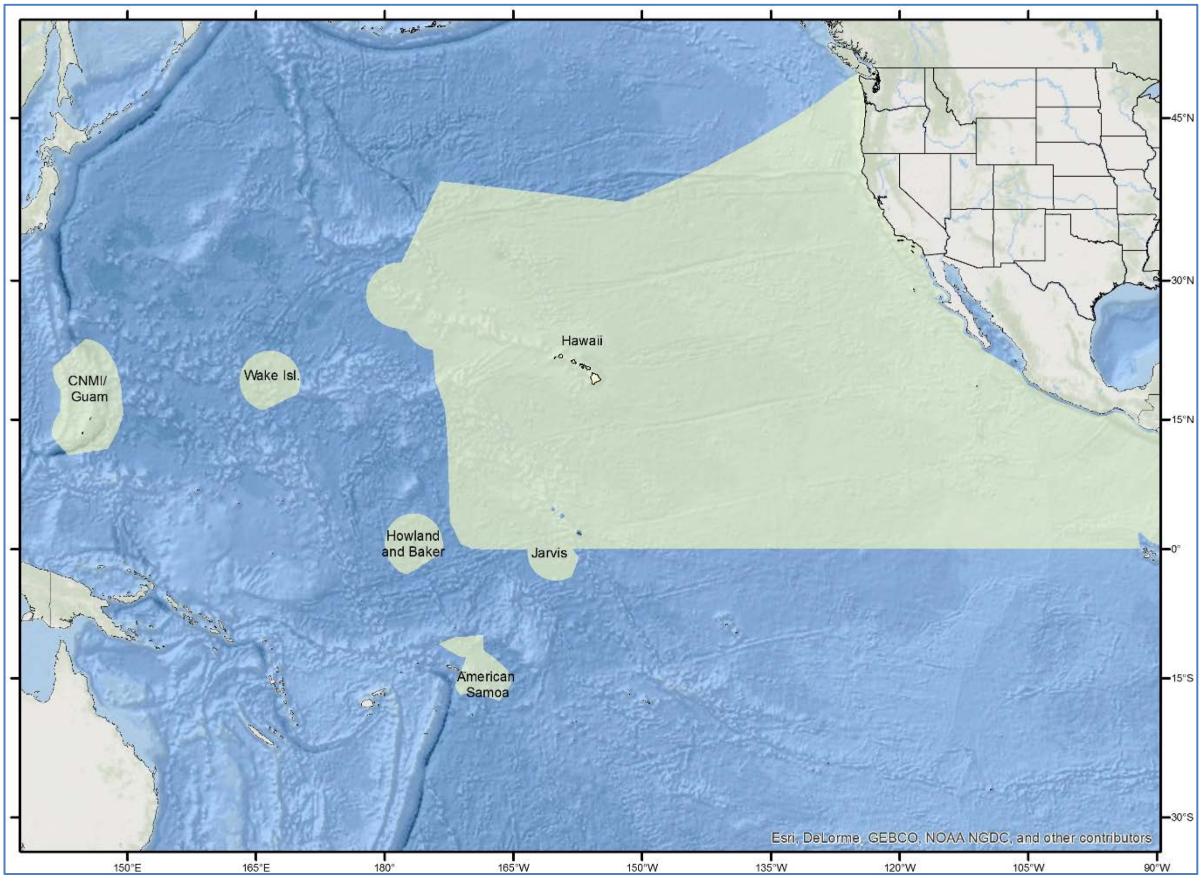


**Figure 6. Scope of the action area of research in the Pacific Ocean (shaded area), including United States territories.**

In the Atlantic, this includes the U.S. east coast from Maine to Florida, Gulf of Mexico, Caribbean Sea, U.S. Virgin Islands, Navassa Island, and Puerto Rico and their associated embayments and estuaries (Figure 7). The shaded area in gray is an approximation of where research may occur. For tank-based acoustic research, turtles may be captured within the action area and temporarily transported from the wild to any facility permitted to hold sea turtles in the United States. For acoustic studies in the wild, turtles may be captured when encountered within ten nautical miles of shore in waters along the U.S. east coast, from Virginia (starting at the waters of the Chesapeake Bay) to Florida, and in the Gulf of Mexico. The majority of activity would occur in U.S. waters except when NMFS researchers are working within fisheries observer programs or in conjunction with marine mammal surveys on the high seas. See Appendix E for locations of active Section 10(a)(1)(A) sea turtle research permits in the Atlantic ocean, Gulf of Mexico, and Caribbean as of June 30, 2017.

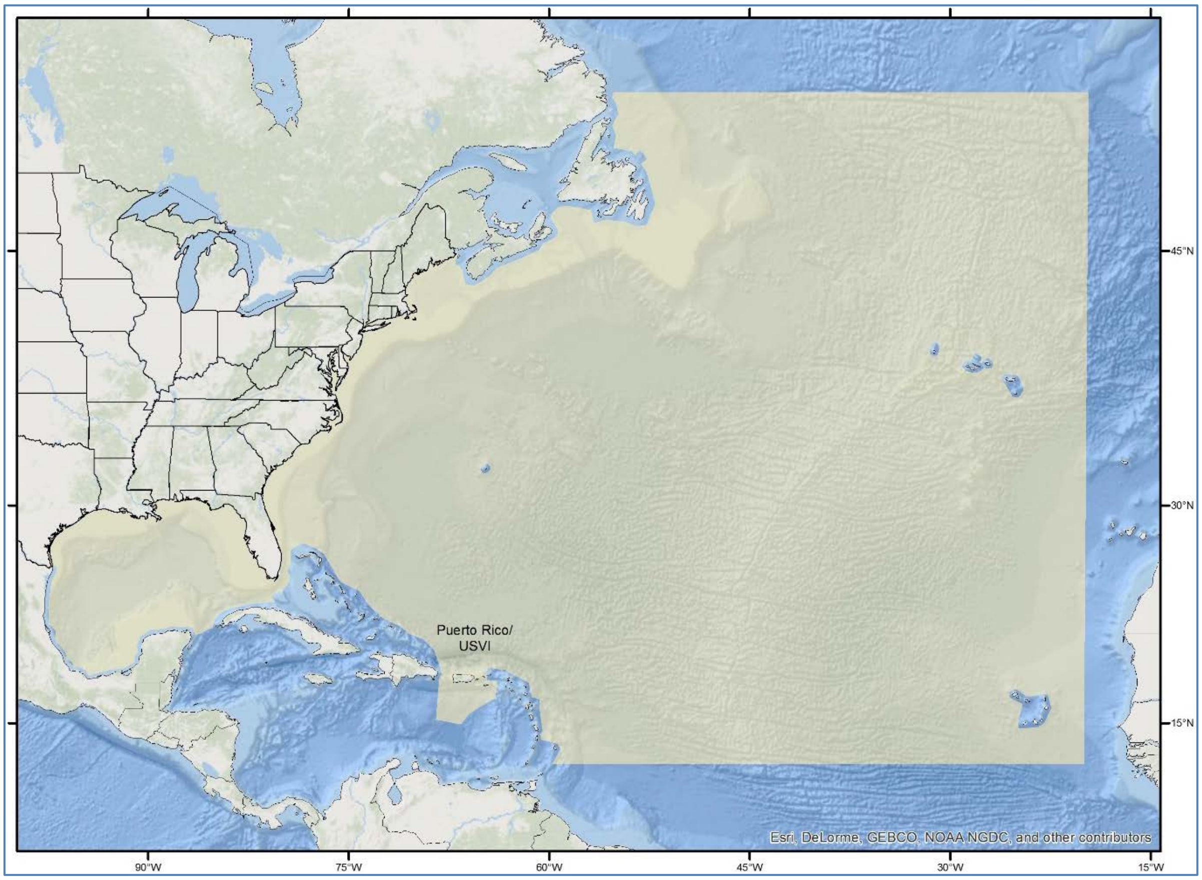


**Figure 7. Scope of the action area of research in the Atlantic Ocean (shaded area), including the Gulf of Mexico, and Caribbean waters.**

Although some sea turtle species have been anecdotally documented in Alaska waters, observations are too rare to include this area within the scope of the action area at this time. For example, only two loggerhead sea turtles have been reported in Alaska waters over the last fifty years. Therefore, the Permits Division does not believe that such an extremely low sighting frequency would support a research program or yield meaningful data in Alaska in the foreseeable future. Inclusion of Alaska would be reconsidered as part of a request to re-initiate the consultation should new information become available indicating an increasing trend in turtle sightings and interest from researchers with sufficient resources (e.g., funding) to work in Alaska.

Research would not be conducted continuously in all locations within the action area; however, NMFS anticipates research could occur in any sector of the action area in the foreseeable future as funding or valid research objectives arise.

# 6 STATUS OF ENDANGERED SPECIES ACT (ESA) PROTECTED RESOURCES

This section identifies the ESA-listed species that potentially occur within the action area that may be affected by the Program. It then summarizes the biology and ecology of those species and what is known about their life histories in the action area. 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 listing decisions, status reviews, and recovery plans. 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. The species potentially occurring within the action area that may be affected by the proposed actions are listed in Table 2, along with their regulatory status.

**Table 2. Threatened and endangered species that may be affected by the proposed action.**

| Species | ESA Status | Critical Habitat | Recovery Plan |
|---|---|---|---|
| **Marine Mammals – Cetaceans** | | | |
| Blue Whale (*Balaenoptera musculus*) | E – 35 FR 18319 | -- -- | 07/1998 |
| Bowhead Whale (*Balaena mysticetes*) | E – 35 FR 18319 | -- -- | -- -- |
| False Killer Whale (*Pseudorca crassidens*) Main Hawaiian Islands Insular DPS | E – 77 FR 70915 | 83 FR 35062 | -- -- |
| Fin Whale (*Balaenoptera physalus*) | E – 35 FR 18319 | -- -- | 75 FR 47538 |
| Gulf of Mexico Bryde's Whale (*Balaenoptera edeni*) | E – 81 FR 88639 (Proposed) | -- -- | -- -- |
| Humpback Whale (*Megaptera novaeangliae*) Central America DPS | E – 81 FR 62259 | -- -- | 11/1991 |
| Humpback Whale (*Megaptera novaeangliae*) Mexico DPS | T – 81 FR 62259 | -- -- | 11/1991 |
| Humpback Whale (*Megaptera novaeangliae*) Western North Pacific DPS | E – 81 FR 62259 | -- -- | 11/1991 |
| Killer Whale (*Orcinus orca*) Southern Resident DPS | E – 70 FR 69903 | 71 FR 69054 | 73 FR 4176 |
| North Atlantic Right Whale (*Eubalaena glacialis*) | E – 73 FR 12024 | 59 FR 28805 and 81 FR 4837 | 70 FR 32293 |
| Sei Whale (*Balaenoptera borealis*) | E – 35 FR 18319 | -- -- | 12/2011 |

| Species | ESA Status | Critical Habitat | Recovery Plan |
|---|---|---|---|
| Sperm Whale (*Physeter macrocephalus*) | E – 35 FR 18319 | -- -- | 75 FR 81584 |
| **Marine Mammals – Pinnipeds** | | | |
| Guadalupe Fur Seal (*Arctocephalus townsendi*) | T – 50 FR 51252 | -- -- | -- -- |
| Hawaiian Monk Seal (*Neomonachus schauinslandi*) | E – 41 FR 51611 | 80 FR 50925, 53 FR 18988, and 51 FR 16047 | 72 FR 46966 |
| **Marine Reptiles** | | | |
| Green Turtle (*Chelonia mydas*) North Atlantic DPS | T – 81 FR 20057 | 63 FR 46693 | FR Not Available 11/1991 |
| Green Turtle (*Chelonia mydas*) South Atlantic DPS | T – 81 FR 20057 | -- -- | -- -- |
| Green Turtle (*Chelonia mydas*) Central West Pacific DPS | E – 81 FR 20057 | -- -- | 63 FR 28359 |
| Green Turtle (*Chelonia mydas*) Central South Pacific DPS | E – 81 FR 20057 | -- -- | 63 FR 28359 |
| Green Turtle (*Chelonia mydas*) Central North Pacific DPS | T – 81 FR 20057 | -- -- | 63 FR 28359 |
| Green Turtle (*Chelonia mydas*) East Pacific DPS | T – 81 FR 20057 | -- -- | 63 FR 28359 |
| Hawksbill Turtle (*Eretmochelys imbricata*) | E – 35 FR 8491 | 63 FR 46693 | 63 FR 28359 and 57 FR 38818 |
| Kemp's Ridley Turtle (*Lepidochelys kempii*) | E – 35 FR 18319 | -- -- | 9/2011 |
| Leatherback Turtle (*Dermochelys coriacea*) | E – 35 FR 8491 | 44 FR 17710 and 77 FR 4170 | 63 FR 28359 and 10/1991 |
| Loggerhead Turtle (*Caretta caretta*) North Pacific Ocean DPS | E – 76 FR 58868 | -- -- | 63 FR 28359 |
| Loggerhead Turtle (*Caretta caretta*) Northeast Atlantic Ocean DPS | E – 76 FR 58868 | -- -- | -- -- |
| Loggerhead Turtle (*Caretta caretta*) Northwest Atlantic Ocean DPS | T – 76 FR 58868 | 79 FR 39856 | 74 FR 2995 |
| Olive Ridley Turtle (*Lepidochelys olivacea*) Mexico's Pacific Coast Breeding Colonies | E – 43 FR 32800 | -- -- | 63 FR 28359 |
| Olive Ridley Turtle (*Lepidochelys olivacea*) All Other Areas | T – 43 FR 32800 | -- -- | -- -- |

| Species | ESA Status | Critical Habitat | Recovery Plan |
|---|---|---|---|
| **Fishes** | | | |
| Atlantic Salmon (*Salmo salar*) Gulf of Maine DPS | E – 74 FR 29344 and 65 FR 69459 | 74 FR 29300 | 70 FR 75473 and 81 FR 18639 (Draft) |
| Atlantic Sturgeon (*Acipenser oxyrinchus oxyrinchus*) Carolina DPS | E – 77 FR 5913 | 82 FR 39160 | -- -- |
| Atlantic Sturgeon (*Acipenser oxyrinchus oxyrinchus*) Chesapeake DPS | E – 77 FR 5879 | 82 FR 39160 | -- -- |
| Atlantic Sturgeon (*Acipenser oxyrinchus oxyrinchus*) Gulf of Maine DPS | T – 77 FR 5879 | 82 FR 39160 | -- -- |
| Atlantic Sturgeon (*Acipenser oxyrinchus oxyrinchus*) New York Bight DPS | E – 77 FR 5879 | 82 FR 39160 | -- -- |
| Atlantic Sturgeon (*Acipenser oxyrinchus oxyrinchus*) South Atlantic DPS | E – 77 FR 5913 | 82 FR 39160 | -- -- |
| Bocaccio (*Sebastes paucispinis*) Puget Sound/Georgia Basin DPS | E – 75 FR 22276 and 82 FR 7711 | 79 FR 68041 | 81 FR 54556 (Draft) |
| Chinook Salmon (*Oncorhynchus tshawytscha)* California Coastal ESU | T – 70 FR 37160 | 70 FR 52488 | 81 FR 70666 |
| Chinook Salmon (*Oncorhynchus tshawytscha)* Central Valley Spring-Run ESU | T – 70 FR 37160 | 70 FR 52488 | 79 FR 42504 |
| Chinook Salmon (*Oncorhynchus tshawytscha)* Lower Columbia River ESU | T – 70 FR 37160 | 70 FR 52629 | 78 FR 41911 |
| Chinook Salmon (*Oncorhynchus tshawytscha)* Puget Sound ESU | T – 70 FR 37160 | 70 FR 52629 | 72 FR 2493 |
| Chinook Salmon (*Oncorhynchus tshawytscha)* Sacramento River Winter-Run ESU | E – 70 FR 37160 | 58 FR 33212 | 79 FR 42504 |
| Chinook Salmon (*Oncorhynchus tshawytscha)* Snake River Fall-Run ESU | T – 70 FR 37160 | 58 FR 68543 | 80 FR 67386 (Draft) |
| Chinook Salmon (*Oncorhynchus tshawytscha)* Snake River Spring/Summer Run ESU | T – 70 FR 37160 | 64 FR 57399 | 81 FR 74770 (Draft) |
| Chinook Salmon (*Oncorhynchus tshawytscha)* Upper Columbia River Spring-Run ESU | E – 70 FR 37160 | 70 FR 52629 | 72 FR 57303 |
| Chinook Salmon (*Oncorhynchus tshawytscha)* Upper Willamette River ESU | T – 70 FR 37160 | 70 FR 52629 | 76 FR 52317 |
| Chum Salmon | T – 70 FR 37160 | 70 FR 52629 | 78 FR 41911 |

| Species | ESA Status | Critical Habitat | Recovery Plan |
|---|---|---|---|
| (*Oncorhynchus keta*)<br>Columbia River ESU | | | |
| Chum Salmon<br>(*Oncorhynchus keta*)<br>Hood Canal Summer-Run ESU | T – 70 FR 37160 | 70 FR 52629 | 72 FR 29121 |
| Coho Salmon<br>(*Oncorhynchus kisutch*)<br>Central California Coast ESU | E – 70 FR 37160 | 64 FR 24049 | 77 FR 54565 |
| Coho Salmon<br>(*Oncorhynchus kisutch*)<br>Lower Columbia River ESU | T – 70 FR 37160 | 81 FR 9251 | 78 FR 41911 |
| Coho Salmon<br>(*Oncorhynchus kisutch*)<br>Oregon Coast ESU | T – 73 FR 7816 | 73 FR 7816 | 81 FR 90780 |
| Coho Salmon<br>(*Oncorhynchus kisutch*)<br>Southern Oregon and Northern California Coasts ESU | T – 70 FR 37160 | 64 FR 24049 | 79 FR 58750 |
| Eulachon<br>(*Thaleichthys pacificus*)<br>Southern DPS | T – 75 FR 13012 | 76 FR 65323 | 9/2017 |
| Giant Manta Ray<br>(*Manta birostris*) | T – 83 FR 2916 | -- -- | -- -- |
| Green Sturgeon<br>(*Acipenser medirostris*)<br>Southern DPS | T – 71 FR 17757 | 74 FR 52300 | 2010 (Outline) |
| Gulf Sturgeon<br>(*Acipenser oxyrinchus desotoi*) | T – 56 FR 49653 | 68 FR 13370 | 09/1995 |
| Nassau Grouper<br>(*Epinephelus striatus*) | T – 81 FR 42268 | -- -- | -- -- |
| Oceanic Whitetip Shark<br>(*Carcharhinus longimanus*) | T – 83 FR 4153 | -- -- | -- -- |
| Scalloped Hammerhead Shark<br>(*Sphyrna lewini*)<br>Central and Southwest Atlantic DPS | T – 79 FR 38213 | -- -- | -- -- |
| Scalloped Hammerhead Shark<br>(*Sphyrna lewini*)<br>Eastern Atlantic DPS | E – 79 FR 38213 | -- -- | -- -- |
| Scalloped Hammerhead Shark<br>(*Sphyrna lewini*)<br>Eastern Pacific DPS | E – 79 FR 38213 | -- -- | -- -- |
| Scalloped Hammerhead Shark<br>(*Sphyrna lewini*)<br>Indo-West Pacific DPS | T – 79 FR 38213 | -- -- | -- -- |
| Shortnose Sturgeon<br>(*Acipenser brevirostrum*) | E – 32 FR 4001 | -- -- | 63 FR 69613 |
| Smalltooth Sawfish<br>(*Pristis pectinata*)<br>U.S. portion of range DPS | E – 68 FR 15674 | 74 FR 45353 | 74 FR 3566 |
| Sockeye Salmon | E – 70 FR 37160 | 58 FR 68543 | 80 FR 32365 |

| Species | ESA Status | Critical Habitat | Recovery Plan |
|---|---|---|---|
| (*Oncorhynchus nerka*)<br>Snake River ESU | | | |
| Steelhead Trout<br>(*Oncorhynchus mykiss*)<br>California Central Valley DPS | T – 71 FR 834 | 70 FR 52487 | 79 FR 42504 |
| Steelhead Trout<br>(*Oncorhynchus mykiss*)<br>Central California Coast DPS | T – 71 FR 834 | 70 FR 52487 | 81 FR 70666 |
| Steelhead Trout<br>(*Oncorhynchus mykiss*)<br>Lower Columbia River DPS | T – 71 FR 834 | 70 FR 52629 | 78 FR 41911 |
| Steelhead Trout<br>(*Oncorhynchus mykiss*)<br>Middle Columbia River DPS | T – 71 FR 834 | 70 FR 52629 | 74 FR 50165 |
| Steelhead Trout<br>(*Oncorhynchus mykiss*)<br>Northern California DPS | T – 71 FR 834 | 70 FR 52487 | 81 FR 70666 |
| Steelhead Trout<br>(*Oncorhynchus mykiss*)<br>Puget Sound DPS | T – 72 FR 26722 | 81 FR 9251 | -- -- |
| Steelhead Trout<br>(*Oncorhynchus mykiss*)<br>Snake River Basin DPS | T – 71 FR 834 | 70 FR 52629 | 81 FR 74770<br>(Draft) |
| Steelhead Trout<br>(*Oncorhynchus mykiss*)<br>South-Central California Coast DPS | T – 71 FR 834 | 70 FR 52487 | 78 FR 77430 |
| Steelhead Trout<br>(*Oncorhynchus mykiss*)<br>Southern California DPS | E – 71 FR 834 | 70 FR 52487 | 77 FR 1669 |
| Steelhead Trout<br>(*Oncorhynchus mykiss*)<br>Upper Columbia River DPS | T – 71 FR 834 | 70 FR 52629 | 72 FR 57303 |
| Steelhead Trout<br>(*Oncorhynchus mykiss*)<br>Upper Willamette River DPS | T – 71 FR 834 | 70 FR 52629 | 76 FR 52317 |
| Yelloweye Rockfish<br>(*Sebastes rubberimus*)<br>Puget Sound/Georgia Basin DPS | T – 75 FR 22276<br>and 82 FR 7711 | 79 FR 68041 | 81 FR 54556<br>(Draft) |
| **Marine Invertebrates and Plants** | | | |
| *Acropora globiceps* Coral | T – 79 FR 53851 | -- -- | -- -- |
| *Acropora jacquelineae* Coral | T – 79 FR 53851 | -- -- | -- -- |
| *Acropora retusa* Coral | T – 79 FR 53851 | -- -- | -- -- |
| *Acropora speciosa* Coral | T – 79 FR 53851 | -- -- | -- -- |
| Black Abalone<br>(*Haliotis cracherodii*) | E – 74 FR 1937 | 76 FR 66805 | -- -- |
| Boulder Star Coral | T – 79 FR 53851 | -- -- | -- -- |

| Species | ESA Status | Critical Habitat | Recovery Plan |
|---|---|---|---|
| (*Orbicella franksi*) | | | |
| Elkhorn Coral (*Acropora palmata*) | T – 79 FR 53851 | 73 FR 72210 | 80 FR 12146 |
| *Euphyllia paradivisa* Coral | T – 79 FR 53851 | -- -- | -- -- |
| *Isopora crateriformis* Coral | T – 79 FR 53851 | -- -- | -- -- |
| Johnson's Seagrass (*Halophila johnsonii*) | T – 63 FR 49035 | 65 FR 17786 | 67 FR 62230 |
| Lobed Star Coral (*Orbicella annularis*) | T – 79 FR 53851 | -- -- | -- -- |
| Mountainous Star Coral (*Orbicella faveolata*) | T – 79 FR 53851 | -- -- | -- -- |
| Rough Cactus Coral (*Mycetophyllia ferox*) | T – 79 FR 53851 | -- -- | -- -- |
| Pillar Coral (*Dendrogyra cylindrus*) | T – 79 FR 53851 | -- -- | -- -- |
| *Seriatopora aculeata* Coral | T – 79 FR 53851 | -- -- | -- -- |
| Staghorn Coral (*Acropora cervicornis*) | T – 79 FR 53851 | 73 FR 72210 | 80 FR 12146 |
| White Abalone (*Haliotis sorenseni*) | E – 66 FR 29046 | 66 FR 29046 (Not Prudent) | 73 FR 62257 |

## 6.1 Species and Designated Critical Habitat Not Likely to be Adversely Affected

NMFS uses two criteria to identify the ESA-listed or 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 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 habitat that is exposed to a potential stressor but is likely to be unaffected by the exposure is also not likely to be adversely affected by the proposed action. We applied these criteria to the ESA-listed species in Table 2 and we summarize our results below.

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.

**ESA-Listed Species Not Likely to be Adversely Affected**

- Cetaceans: blue whale, fin whale, sei whale, sperm whale, North Atlantic right whale, bowhead whale, false killer whale Main Hawaiian Islands Insular DPS, humpback whale Central America DPS, humpback whale Mexico DPS, humpback whale Western North Pacific DPS, killer whale Southern Resident DPS
- Pinnipeds: Hawaiian monk seal, Guadalupe fur seal
- Fishes:
  - Oceanic whitetip shark
  - Giant manta ray
- Pacific Salmonids:
  - Chinook salmon ESUs: California coastal, Central Valley spring-run, Lower Columbia River, Puget Sound, Sacramento River winter-run, Snake River fall-run, Snake River spring/ summer-run, Upper Columbia River spring-run, Upper Willamette River
  - Coho salmon ESUs: Central California coast, Oregon coast, Lower Columbia River, Southern Oregon & Northern California coasts
  - Chum salmon ESUs: Columbia River, Hood Canal summer-run
  - Sockeye salmon ESU: Snake River
  - Steelhead trout DPSs: Central California coast, California Central Valley, Lower Columbia River, Middle Columbia River, Northern California, Snake River Basin Puget Sound, South-Central California coast, Southern California, Upper Columbia River, Upper Willamette River
- Rockfish (*Sebastes sp.*): yelloweye rockfish, bocaccio
- Eulachon Southern DPS
- White abalone and black abalone
- Corals: boulder star, lobed star, mountainous star, elkhorn, staghorn, pillar, rough cactus, *Acropora globiceps, Acropora jacquelineae*, *Acropora retusa, Acropora speciose, Euphyllia paradivisa, Isopora crateriformis, Seriatopora aculeate*
- Johnsons's seagrass

**Proposed Species Not Likely to be Adversely Affected**

- Bryde's whale Gulf of Mexico subspecies

**Designated Critical Habitat Not Likely to be Adversely Affected**

- Sea Turtles: green North Atlantic DPS, hawksbill, leatherback, loggerhead Northwest Atlantic DPS
- Cetaceans: North Atlantic right whale, killer whale
- Fish species: smalltooth sawfish U.S. range, green sturgeon Southern DPS, Gulf sturgeon
- Hawaiian monk seal
- Black abalone
- Corals: elkhorn, staghorn
- Johnson's seagrass
- False killer whale Main Hawaiian Islands Insular DPS

The rationale for reaching the determination of "not likely to adversely affect" for each of these species and/or their designated critical habitat is discussed below.

### 6.1.1 ESA-listed and Proposed Cetacean Species

ESA-listed cetaceans that could potentially occur within the action area include the following: blue whale, fin whale, sei whale, sperm whale, North Atlantic right whale, bowhead whale, false killer whale Main Hawaiian Islands Insular DPS, humpback whale Central America DPS, humpback whale Mexico DPS, humpback whale Western North Pacific DPS, and killer whale Southern Resident DPS. In addition, one large whale species that could potentially occur within the action area has been proposed for ESA-listing: Bryde's whale Gulf of Mexico subspecies. While it is possible that these cetacean species could be subject to harassment and/or harm from sea turtle research vessels or entanglement in turtle capture netting gear, the likelihood of this occurring is so low that we consider these effects discountable. To date, there have been no reported interactions or take (i.e., vessel strike, capture/entanglement in gear, or harassment) of cetaceans by sea turtle researchers permitted by the Permits Division. In addition to the small spatial overlap, mitigation measures are in place to prevent interactions and adverse effects from occurring. In the event that marine mammals are encountered during permitted research activities, as a condition of their permit, researchers must follow the NMFS Marine Mammal Approach and Viewing Guidelines applicable to the particular NMFS region with jurisdiction over the study area. Additionally, all nets must be closely attended and continuously monitored. Netting cannot be initiated if marine mammals are within the vicinity (100-foot radius) of the planned netting area, and nets must be pulled if marine mammals enter the research area and remain there after nets have been deployed. Additional mitigation measures implemented by researchers include the use of fishing gear that complies with the Harbor Porpoise Take Reduction Plan and the Atlantic Large Whale Take Reduction Plan, and the use of nets outfitted with acoustic pingers to deter marine mammal interactions. In the event any research vessel is within range to be detected by a cetacean, the cetacean is expected to have either no response, or to respond with minor adjustments to their behavior, which will be temporary. These behavioral adjustments are expected to have negligible impacts on ESA-listed cetacean species and will not rise to the level of take.

#### *6.1.1.1 Acoustic Research, ADDs in the Wild*

The following listed large whale species generally overlap with the action area for ADD research in the wild:

- North Atlantic right whale (*Eubalaena glacialis*);
- Fin whale (*Balaenoptera physalus*); and
- Sei whale (*B. borealis*)

Although other proposed or listed large whales, such as the blue whale (*B. musculus musculus*), sperm whale (*Physeter macrocephalus*) and Gulf of Mexico Bryde's whale (*B. edeni*), are found in U.S. waters, they use deeper, offshore waters or have been rarely documented in U.S. waters. Hence, these species do not have a reasonable likelihood of being exposed to the proposed ADDs and thus are not evaluated further.

Though expected to be a rare occurrence, North Atlantic right, fin, and sei whales have the potential to be present in coastal waters where ADDs could be tested. These whales are considered low frequency cetaceans with a predicted hearing range from 7 Hz to 35 kHz (NMFS 2016f). Thus, these whales may be capable of hearing the proposed ADD sounds if they are in very close proximity (see below modelling). Even though these species could use coastal waters generally, the likelihood of their spatial and temporal overlap with ADDs used on tangle or pound nets is very low. Due to the large size of these species, the habitat these whales are known to use is generally greater than 10 m deep, while tangle and pound nets by design must be set in shallower waters, usually less than 5 meters deep but no deeper than 10 meters deep.

Further, when ADDs are used on tangle nets, researchers must monitor for the presence of any marine mammals before setting nets and while netting. Researchers must wait for observed marine mammals to leave the area before setting the net, and if already deployed, pull the nets out of the water until the animals are gone. This significantly reduces the potential for large whales to be exposed to ADDs during tangle net operations.

In the unlikely event that a large whale could be in the vicinity of a net and hear the ADD sounds, the exposure would be extremely minimal and brief. Animals may hear the sound but may not respond or move away from the sound source. According to NMFS (2016f), a non-impulsive sound source (such as ADDs) would have to be played for 24 hours at a minimum of 179 dB SELcum within 7 m of baleen whales to result in TTS and within 0.3 m at a minimum of 199 dB SELcum to result in PTS. Given the ADD's source level, and the internal guidance defining "harass" under the ESA, we do not anticipate that the use of ADDs would result in take of these large whales.

Given the extremely low likelihood of interaction between sea turtle research activities and ESA-listed or proposed cetaceans,  and the mitigation measures in place as a condition of research permits issued under section 10, we find the likelihood of sea turtle ADD research resulting in adverse effects to cetaceans so low as to be discountable. Therefore, we determine that the proposed action is not likely to adversely affect blue whales, fin whales, sei whales, sperm whales, North Atlantic right whales, bowhead whales, false killer whales Main Hawaiian Islands Insular DPS, humpback whales Central America DPS, humpback whales Mexico DPS, humpback whales Western North Pacific DPS, and killer whales Southern Resident DPS.

### 6.1.2 Cetacean Designated Critical Habitat

Designated critical habitat for three cetaceans can potentially overlap with the proposed research activities: North Atlantic right whale, southern resident DPS killer whale, and the false killer whale Main Hawaiian Islands Insular DPS can also potentially overlap with the proposed research activities.

Critical habitat was initially designated for the North Atlantic right whale in 1994 and replaced by NMFS with a new designation in January 2016. The new critical habitat designation includes Unit 1 in the Gulf of Maine (GOM) and Georges Bank region and Unit 2 off the Southeast U.S. coast. The physical and biological features essential to the conservation of the North Atlantic right whale found in these areas include a combination of the following biological and physical oceanographic features: 1) the physical oceanographic conditions and structures of the GOM and Georges Bank region that combine to distribute and aggregate *C. finmarchicus* for right whale foraging, namely prevailing currents and circulation patterns, bathymetric features (basins, banks, and channels), oceanic fronts, density gradients, and temperature regimes; 2) low flow velocities in Jordan, Wilkinson, and Georges Basins that allow diapausing *C. finmarchicus* to aggregate passively below the convective layer to that copepods are retained in the basins; 3) late stage *C. finmarchicus* in dense aggregations in the GOM and Georges Bank region; and 4) diapausing *C. finmarchicus* in aggregations in the GOM and Georges Bank region. The essential physical and biological feature for right whale calving habitat include: 1) calm sea surface conditions of Force 4 or less on the Beaufort Wind Scale; 2) sea surface temperatures from a minimum of 7 degrees Celsius and never more than 17 degrees Celsius; 3) water depths of 6 to 28 meters, where these features simultaneously co-occur over contiguous areas of at least 231 $nm^2$ of ocean waters during the months of November through April.

The designated critical habitat for the North Atlantic right whale overlaps with the action area for use of ADDs in the wild. Anthropogenic noise is not identified as a physical or biological feature essential for conservation of the species. The use of ADDs is not expected to affect any physical or biological feature identified in the critical habitat designation.

On November 29, 2006, NMFS designated critical habitat for the Southern Resident killer whale (71 FR 69054). The critical habitat consists of approximately 6,630 $km^2$ in three areas: the Summer Core Area in Haro Strait and waters around the San Juan Islands; Puget Sound; and the

Strait of Juan de Fuca. It provides the following physical and biological features essential to the conservation of Southern Resident killer whales: water quality to support growth and development; prey species of sufficient quantity, quality and availability to support individual growth, reproduction and development, as well as overall population growth; and inter-area passage conditions to allow for migration, resting, and foraging.

On July 24 2018, NMFS published a final rule for the false killer whale Main Hawaiian Islands Insular DPS critical habitat (82 FR 35062). The rule designates approximately 49,701 $km^2$ (19,184 miles squared) of marine habitat from the 45-meter depth contour to the 3200-meter depth contour around the main Hawaiian Islands from Niihau east to Hawaii. Specific biological and physical features essential for the conservation of this DPS include the following: (1) Island-associated marine habitat that supports all life stages, including a wide range of depths for false killer whales to travel, forage, and move freely around and between the main Hawaiian Islands, (2) Prey species (i.e., large pelagic fish and squid) of sufficient quantity, quality, and availability to support individual growth, reproduction, and development, as well as overall population growth, (3) Waters free of pollutants of a type and amount harmful to false killer whales, (4) Habitat free of anthropogenic noise that would significantly impair the value of the habitat for false killer whales' use or occupancy.

While the proposed research activities would directly overlap with some of these essential features, very few if any, effects are possible. The proposed activities would not significantly alter the physical or oceanographic conditions within the action area, as only minor changes in water flow, current and noise level would be expected from vessel traffic, and no changes in ocean bathymetry would occur. The capture gears used by turtle researchers will not collect *C. finmarchius*, an important food source of North Atlantic right whales. While some research activities may temporarily disturb *C. finmarchius* aggregations, these disturbances will be minimal in time and space. Similarly, the effect of sea turtle research gear on killer whale or false killer whale prey quantity, quality and availability is expected to be insignificant. Finally, the proposed activities would in no way alter the sea state, temperature, water quality or water depth, and so effects to these features are deemed discountable.

Given the biological and physical features used to designate critical habitat, we determine that the proposed action would not destroy or adversely modify either the North Atlantic right whale or southern resident killer whale designated critical habitat. We also determine that the proposed action would not destroy or adversely modify the proposed critical habitat for false killer whale Main Hawaiian Islands Insular DPS.

### 6.1.3 Sea Turtle Designated Critical Habitat

Designated critical habitat for the following turtle species can potentially overlap with the proposed research activities: North Atlantic DPS green, hawksbill, leatherback, and Northwest Atlantic DPS loggerhead. In 1998, NMFS designated critical habitat for the North Atlantic 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). 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.

On September 2, 1998, NMFS established critical habitat for hawksbill sea turtles around Mona and Monito Islands, Puerto Rico from the mean high water line seaward to three nautical miles (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.

Critical habitat was designated on July 10, 2014 for the Northwest Atlantic DPS of loggerhead sea turtle and includes 38 occupied marine areas in the Atlantic Ocean and Gulf of Mexico. These areas contain one or a combination of habitat types: nearshore reproductive habitat, foraging habitat, winter area, breeding areas, constricted migratory corridors, and/or *Sargassum* habitat. The physical and biological features (formerly referred to as primary constituent elements in the original designation) essential to the conservation of the Northwest Atlantic DPS of Loggerhead Sea Turtles found in nearshore reproductive habitat are (1) nearshore waters directly off the highest density nesting beaches and their adjacent beaches as identified in 50 CFR 17.95(c) to 1.6 km (1 mile) offshore; (2) waters sufficiently free of obstructions or artificial lighting to allow transit through the surf zone and outward toward open water; and (3) waters with minimal man-made structures that could promote predators (i.e., nearshore predator concentration caused by submerged and emergent offshore structures), disrupt wave patterns necessary for orientation, and/ or create excessive longshore currents. The essential physical and biological features found in loggerhead migratory habitat are (1) constricted continental shelf area relative to nearby continental shelf waters that concentrate migratory pathways; and (2) passage conditions to allow for migration to and from nesting, breeding, and/or foraging areas. The essential physical and biological features found in loggerhead breeding habitat are (1) high densities of reproductive male and female loggerheads; (2) proximity to primary Florida migratory corridor; and (3) proximity to Florida nesting grounds.

On March 23, 1979, leatherback critical habitat was identified adjacent to Sandy Point, St. Croix, Virgin Islands from the 183 meter isobath to mean high tide level between 17° 42'12" N and 65°50'00" W (44 FR 17710). This habitat is essential for nesting, which has been increasingly threatened since 1979, when tourism increased significantly, bringing nesting habitat and people into close and frequent proximity. The designated critical habitat is within the Sandy Point

National Wildlife Refuge. On January 20, 2012, NMFS issued a final rule to designate additional critical habitat for the leatherback sea turtle (50 CFR 226). This designation includes approximately 43,798 square kilometers stretching along the California coast from Point Arena to Point Arguello east of the 3,000 m depth contour; and 64,760 square kilometers stretching from Cape Flattery, Washington to Cape Blanco, Oregon east of the 2,000 meters depth contour. The designated areas comprise approximately 108,558 square kilometers of marine habitat and include waters from the ocean surface down to a maximum depth of 80 meters. They were designated specifically because of the occurrence of prey species, primarily *scyphomedusae* of the order *Semaeostomeae* (i.e., jellyfish), of sufficient condition, distribution, diversity, abundance and density necessary to support individual as well as population growth, reproduction, and development of leatherbacks.

While the proposed sea turtle research activities would directly overlap with the essential features of sea turtle critical habitat, very few if any, effects are possible. The temporary operation of a vessel and gear (e.g., stationary nets and trawl) to catch sea turtles is expected to result in little to no alteration of the identified essential features of sea turtle critical habitat, which include access to habitat, water chemistry, live bottom habitat, and availability of prey species. Mitigation measures as a condition of research permit would prevent setting or dragging nets over live bottom. The proposed activities would have no anticipated impact on migratory pathways or habitat features essential for sea turtle shelter (i.e., coral reefs, ledges and other structure), nor would they significantly alter the physical or oceanographic conditions within the action area. Only minor changes in water flow and current would be expected from research vessel traffic and capture gear. Because research vessel activity and use of capture gear is short-term and temporary (i.e., not a permanent structure), the proposed research activities would not prevent turtles from accessing marine habitat and nesting beaches. Due to the mesh sizes and gear configurations used to capture sea turtles, the effect of research gear on turtle prey items identified as essential features of critical habitat (e.g., sea grasses, jellyfish) is also expected to be insignificant.

Given the biological and physical features used to designate critical habitat, we determine that the proposed action would not destroy or adversely modify the designated critical habitat of the North Atlantic DPS green, hawksbill, leatherback, or Northwest Atlantic DPS loggerhead.

### 6.1.4 ESA-listed Pinniped Species

Two species of ESA-listed pinnipeds that could potentially occur within the action area are the Hawaiian monk seal and Guadalupe fur seal. While it is possible that these species could be subject to harassment and/or harm from sea turtle research vessels or entanglement in turtle capture netting gear, the likelihood of this occurring is so low that we consider these effects discountable. To date, there have been no reported interactions or take (i.e., vessel strike, capture/entanglement in gear, or harassment) of pinnipeds by sea turtle researchers permitted by the Permits Division. In addition to the small spatial overlap, mitigation measures are in place to prevent interactions and adverse effects from occurring. In the event that marine mammals are encountered during permitted research activities, as a condition of their permit, researchers must follow the NMFS Marine Mammal Approach and Viewing Guidelines applicable to the particular NMFS region with jurisdiction over the study area. Additionally, all nets must be closely attended and continuously monitored. Netting cannot be initiated if marine mammals are within the vicinity (100-foot radius) of the planned netting area, and nets must be pulled if marine mammals enter the research area and remain there after nets have been deployed. In the event any research vessel is within range to be detected by a Guadalupe fur seal or Hawaiian monk seal the individual is expected to have either no response, or to respond with minor adjustments to their behavior, which will be temporary. These behavioral adjustments are expected to have negligible impacts on individual seals and will not rise to the level of take.

Given the extremely low likelihood of interaction between sea turtle research activities and ESA-listed pinnipeds, and the mitigation measures in place as a condition of research permits issued under section 10, and the negligible behavioral response of ESA-listed seals if they were to be encountered, we determine that the proposed action is not likely to adversely affect Hawaiian monk seals or Guadalupe fur seals.

### 6.1.5 Pinniped Designated Critical Habitat

Hawaiian monk seal critical habitat was originally designated on April 30, 1986 (51 FR 16047) and was extended on May 26, 1988 (53 FR 18988). It includes all beach areas, sand spits, and islets (including all beach crest vegetation to its deepest extent inland), lagoon waters, inner reef waters, and ocean waters out to a depth of 37 meters around the northwestern Hawaiian Islands breeding atolls and islands. On September 21, 2015, NMFS published a final rule to revise designated critical habitat for Hawaiian monk seals (80 FR 50925), extending the current designation in the northwestern Hawaiian Islands out to the 200 m depth contour (including Kure Atoll, Midway Islands, Pearl and Hermes Reef, Lisianski Island, Laysan Island, Maro Reef, Gardner Pinnacles, French Frigate Shoals, Necker Island, and Nihoa Island). It also designated six new areas in the main Hawaiian Islands (i.e., terrestrial and marine habitat from 5 m inland from the shoreline extending seaward to the 200 m depth contour around Kaula, Niihau, Kauai, Oahu, Maui, Nui, and Hawaii). The physical and biological features identified for these areas also include adequate prey quality and quantity for juvenile and adult monk seal foraging.

While the proposed sea turtle research activities could directly overlap with the essential features of Hawaiian monk seal critical habitat, very few if any, effects are possible. The temporary operation of vessels and gear (e.g., stationary nets and trawl) to catch sea turtles would not significantly alter the physical or oceanographic conditions within the action area. Only minor changes in water flow and current would be expected from research vessel traffic and capture gear. Any effects of these activities on the identified essential features of Hawaiian monk seal critical habitat would be insignificant. Because research vessel activity and use of capture gear is short-term and temporary (i.e., not a permanent structure and in place for several hours or overnight at most), the proposed research activities would not prevent monk seals from accessing marine habitat or haul out behavior. While certain types of turtle research gear (e.g., tangle nets) could potentially capture Hawaiian monk seal prey, the expected frequency of this occurring is extremely low. As such, the effect of bycatch in sea turtle research gear on the quality and quantity of Hawaiian monk seal prey is also expected to be insignificant.

Given the biological and physical features used to designate critical habitat, we determine that the proposed action would not destroy or adversely modify the designated critical habitat of the Hawaiian monk seal.

### 6.1.6 ESA-listed and Proposed Fish Species

There are 27 ESA-listed Pacific salmonid species (i.e., ESUs and DPSs) that could potentially occur within the action area (see above for list). Three other ESA-listed fish species that could potentially occur within the action area are the yelloweye rockfish, bocaccio, the Southern DPS of eulachon, oceanic whitetip sharks, and giant manta rays. While it is possible that any of these fish species could be subject to harassment and/or harm from sea turtle research vessels or entanglement in turtle capture netting gear, the likelihood of this occurring is so low that we consider these effects discountable. To date, there have been no reported interactions or take (i.e., vessel strike, capture/entanglement in gear, or harassment) of any of these fish species by sea turtle researchers permitted by the Permits Division. The relative abundance of these species in the Action Area is low, and, given the small amount of spatiotemporal overlap, these fish populations are not likely to be affected by turtle research activities. These species are generally not susceptible to impacts from vessel transit, and are unlikely to become entangled in turtle research gear due to their small size relative to net mesh sizes and gear configurations used to capture sea turtles.

Given the extremely low likelihood of interaction between sea turtle research activities (with the exception of acoustic research) and these ESA-listed or proposed fish species, we find the likelihood of these activities adversely affecting fish species so low as to be discountable. Therefore, we determine that the proposed action is not likely to adversely affect any ESA-listed Pacific salmonids, yelloweye rockfish, bocaccio, Southern DPS of eulachon, oceanic whitetip shark, or giant manta ray.

All ESA-listed fish species are further evaluated in the Effects Analysis for acoustic research.

### 6.1.7 Fish Species Designated Critical Habitat

Designated critical habitat for the following ESA-listed fish species can potentially overlap with the proposed research activities: smalltooth sawfish U.S. range, green sturgeon Southern DPS, and Gulf sturgeon.

Critical habitat for smalltooth sawfish was designated in 2009 and includes two major units: Charlotte Harbor (221,459 acres) and Ten Thousand Islands/Everglades (619,013 acres). These two units include essential sawfish nursery areas. Within the nursery areas, two features were identified as essential to the conservation of the species: red mangroves (*Rhizophora mangle*), and euryhaline habitats with water depths less than or equal to 0.9 meters.

Critical habitat was designated for Southern DPS of green sturgeon on October 9, 2009, and includes marine, coastal bay, estuarine, and freshwater areas (74 FR 52300). Only the marine portion of designated Southern DPS of green sturgeon critical habitat occurs with the action area and thus may be affected by the proposed action. Critical habitat within marine waters includes areas within the 60 fathom (110 m [361ft]) isobath from Monterey Bay to the U.S.-Canada border. Many coastal bays and estuaries are designated as critical habitat, including: San Francisco Estuary and Humboldt Bay in California; Coos, Winchester, Yaquina, and Nehalem bays in Oregon; Willapa Bay and Grays Harbor in Washington; and the lower Columbia River estuary from the mouth to river km 74 to the Bonneville Dam. Physical and biological features considered in the designation of the marine areas of Southern DPS of green sturgeon critical habitat include (1) a migratory pathway necessary for the safe and timely passage of Southern DPS fish within marine and between estuarine and marine habitats, (2) nearshore marine waters with adequate dissolved oxygen (DO) levels and acceptably low levels of contaminants (e.g., pesticides, organochlorines, elevated levels of heavy metals) that may disrupt the normal behavior, growth, and viability of sub-adult and adult green sturgeon, and (3) abundant prey items for sub-adults and adults, which may include benthic invertebrates and fishes (74 FR 52300).

Critical Habitat for gulf sturgeon was established in 2003 (68 FR 13370) and consists of 14 geographic units encompassing 2,783 river kilometers as well as 6,042 square kilometers of estuarine and marine habitat. Primary constituent elements for the conservation of Gulf Sturgeon are abundant food items, riverine spawning sites with substrates suitable for egg deposition and development, riverine aggregation areas, a flow regime necessary for normal behavior, growth, and survival, water and sediment quality necessary for normal behavior, growth, and viability of all life stages, and safe and unobstructed migratory pathways. As with green sturgeon, only the marine portion of designated gulf sturgeon critical habitat occurs with the action area and thus may be affected by the proposed action.

While the proposed sea turtle research activities could directly overlap with the essential features of designated sawfish and sturgeon critical habitat, very few if any, effects are possible. The temporary operation of vessels and gear (e.g., stationary nets and trawl) to catch sea turtles would not significantly alter the physical or oceanographic conditions within the action area. Only minor changes in water flow and current would be expected from research vessel traffic and capture gear. The underwater sound scape or the addition of anthropogenic noise is not identified as a physical or biological feature essential for conservation of these ESA-listed fish species. The use of ADDs is not expected to affect any physical or biological feature identified in any critical habitat designation. Any effects of these activities on the identified essential features of sawfish and sturgeon critical habitat are expected to be insignificant. It is also unlikely that turtle research gear will interact with sturgeon prey items. The freshwater and riverine areas that are included in the critical habitat designations for gulf sturgeon and green sturgeon do not overlap with the proposed action area and therefore were not further considered in this analysis.

Given the biological and physical features used to designate critical habitat, we determine that the proposed action would not destroy or adversely modify the designated critical habitat of smalltooth sawfish U.S. range, green sturgeon Southern DPS, or Gulf sturgeon.

### 6.1.8 ESA-listed Abalone Species

Two species of ESA-listed abalone that could potentially occur within the action area off the west coast are the white abalone and black abalone. These invertebrate species inhabit very specific, narrowly defined habitats primarily within the intertidal and subtidal zones. White abalone are found in open low and high relief rock or boulder habitat that is interspersed with sand channels, usually at depths of between 80 and 100 feet. Black abalone can typically be found in areas of moderate to high surf, wedged into crevices, cracks, and holes of intertidal and shallow subtidal rocks, where they are fairly concealed. The abundance of these two species in the Action Area is extremely low. Considering the small amount of anticipated spatiotemporal overlap between turtle research activities and ESA-listed abalone, the likelihood of impacts to white or black abalone from the proposed action is so low as to be discountable. Therefore, we determine that the proposed action is not likely to adversely affect either white or black abalone.

### 6.1.9 Abalone Designated Critical Habitat

NMFS designated critical habitat for the black abalone on October 27, 2011 (76 FR 66805). This designation includes approximately 360 square kilometers of rocky intertidal and subtidal habitat within five segments of the California coast between the Del Mar Landing Ecological Reserve to the Palos Verdes Peninsula, as well as on the Farallon Islands, Año Nuevo Island, San Miguel Island, Santa Rosa Island, Santa Cruz Island, Anacapa Island, Santa Barbara Island, and Santa Catalina Island. This designation includes rocky intertidal and subtidal habitats from the mean higher high water line to a depth of about six meters (relative to the mean lower low water line), as well as the coastal marine waters encompassed by these areas. While the proposed sea turtle research activities could directly overlap with the essential features of black abalone designated critical habitat, very few if any, effects are possible. The temporary operation of vessels and gear (e.g., stationary nets and trawl) to catch sea turtles would not significantly alter the physical or oceanographic conditions within the action area. Only minor changes in water flow and current would be expected from research vessel traffic and capture gear. Any effects of these activities on the identified essential features of black abalone critical habitat are expected to be insignificant.

Given the biological and physical features used to designate critical habitat, we determine that the proposed action would not destroy or adversely modify black abalone designated critical habitat.

### 6.1.10 ESA-listed Coral Species

Fourteen species of ESA-listed coral could potentially occur within the action area. However, as a condition of any research permit authorized under the Program, no gear may be set, anchored on, or pulled across coral or hard/live bottom habitats. In addition, 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 coral communities, and live/hard bottom habitats and avoid setting gear in such areas. 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."

Given the permit conditions and mitigation measures (provided in detail in Appendix C) that would be in place as part of the Program, we determine that the proposed action is not likely to adversely affect any of the following ESA-listed coral species: boulder star, lobed star, mountainous star, elkhorn, staghorn, pillar, rough cactus, *Acropora globiceps, Acropora jacquelineae, Acropora retusa, Acropora speciose, Euphyllia paradivisa, Isopora crateriformis,* and *Seriatopora aculeate*.

### 6.1.11 Coral Species Designated Critical Habitat

Critical habitat units for elkhorn and staghorn coral were designated in 2008 and include Florida (portions of Southeastern Florida and the Florida Keys), Puerto Rico, St. Thomas/St. John, and St. Croix. The Florida unit comprises approximately 1,329 square miles of marine habitat; Puerto Rico approximately 1,383 square miles; St. Thomas/St. John approximately 121 square miles; and St. Croix approximately 126 square miles. Thus, the total area covered by the designation is approximately 2,959 square miles. Within the geographic area occupied by a listed species, critical habitat consists of specific areas on which are found those physical or biological features essential to the conservation of the species. The feature essential to the conservation of acroporid corals is substrate of suitable quality and availability in water depths from the mean high water line to 30 meters to allow for successful sexual and asexual reproduction. Successful sexual and asexual reproduction includes flourishing larval settlement, recruitment, and reattachment of coral fragments (73 FR 72210). "Substrate of suitable quality and availability" means consolidated hard bottom or dead coral skeletons free from fleshy macroalgae or turf algae and sediment cover.

Sea turtle research activities as part of the proposed action are not likely to affect the essential physical and biological features of designated critical habitat identified for these coral species. As discussed above, the use of research gear in coral habitat would be considered a violation of the permit conditions specified in Appendix C. The proposed activities would have no anticipated impact on the physical or oceanographic conditions within the action area. Only minor changes in water flow and current would be expected from research vessel traffic through areas that contain ESA-listed coral species.

Given the permit conditions and mitigation measures that would be in place as part of the Program, we determine that the proposed action would not destroy or adversely modify elkhorn or staghorn coral designated critical habitat.

### 6.1.12 Johnson's Seagrass

Johnson's Seagrass was listed as threatened on September 14, 1998. Johnson's seagrass has been found only along an approximately 200-kilometer stretch of coastline in southeastern Florida between Sebastian Inlet and north Biscayne Bay. While sea turtle research activities considered for this action may overlap with areas where Johnson's seagrass occurs, the Permits Division has placed a condition on research permits such that research will not be allowed to be "conducted over, on, or immediately adjacent to Johnson's seagrass or in Johnson's seagrass critical habitat." Additional seagrass mitigation measures include setting anchors by hand, setting anchors when water visibility is acceptable, and diligent efforts to recover gear that may be lost to avoid further damage to seagrass habitat and impacts related to "ghost fishing." Routine vessel traffic has been shown to result in scaring of some seagrass species. However, since researchers are directed to avoid conducting research in Johnson seagrass critical habitat, we expect minimal vessel traffic in these areas and propeller damage is discountable.

Given the permit conditions and mitigation measures (provided in detail in Appendix C) that would be in place as part of the Program, we determine that the proposed action is not likely to adversely affect Johnson's seagrass.

### 6.1.13 Johnson's Seagrass Designated Critical Habitat

Ten areas within the geographic range of Johnson's seagrass were designated as critical habitat for Johnson's seagrass on April 5, 2000. These ten areas and their approximate acreage (in parentheses) include: a portion of the Indian River Lagoon, north of the Sebastian Inlet Channel (5.7); a portion of the Indian River Lagoon, south of the Sebastian Inlet Channel (2.0); a portion of the Indian River Lagoon near the Fort Pierce Inlet (4.3); a portion of the Indian River Lagoon, north of the St. Lucie Inlet (2770); a portion of Hobe Sound (900); a site on the south side of Jupiter Inlet (4.3); a site in central Lake Worth Lagoon (15.0); a site in Lake Worth Lagoon, Boynton Beach (95.5); a site in Lake Wyman, Boca Raton (20.0); and a portion of Biscayne Bay (18,757). These designated areas account for approximately 22,574 acres or 9,139 hectares.

Sea turtle research activities as part of the proposed action are not expected to overlap with Johnson's seagrass designated critical habitat since, as discussed above, this would be considered a violation of the permit conditions specified in Appendix C. Given the permit conditions and mitigation measures that would be in place as part of the Program, we determine that the proposed action would not destroy or adversely modify Johnson's seagrass designated critical habitat.

## 6.2 Species Likely to be Adversely Affected

This opinion examines 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 C.F.R. 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 critical habitat designations published in the Federal Register, status reviews, recovery plans, and on NMFS Web site: http://www.nmfs.noaa.gov/pr/species/esa/listed.htm. No critical habitat is likely to be adversely affected as a result of the Program. The ESA-listed species that are likely to be adversely affected are listed below:

**Species Likely to be Adversely Affected**

- Green sea turtle DPSs: North Atlantic, South Atlantic, East Indian-West Pacific, Central West Pacific, Southwest Pacific, Central South Pacific, Central North Pacific, and East Pacific
- Hawksbill sea turtle
- Kemp's ridley sea turtle
- Leatherback sea turtle
- Loggerhead sea turtle DPSs: Northwest Atlantic, Northeast Atlantic, North Pacific, and South Pacific
- Olive ridley sea turtle populations: Mexico's Pacific coast, all other breeding populations
- Atlantic salmon Gulf of Maine DPS
- Smalltooth sawfish U.S. portion of range DPS
- Atlantic sturgeon DPSs: Gulf of Maine, New York Bight, Chesapeake Bay, Carolina, and South Atlantic
- Shortnose sturgeon
- Green sturgeon Southern DPS
- Gulf sturgeon
- Nassau grouper
- Scalloped hammerhead DPSs: Eastern Pacific, Central and Southwest Atlantic, and Indo-West Pacific

NMFS has released its ESA Biennial Report to Congress (NMFS 2017d). In it, sea turtles in NMFS' jurisdiction were summarized with abundance trends, and recovery priority numbers (Table 3).

**Table 3. ESA-listed sea turtle species abundance trends, and recovery priority numbers (through September 20, 2016).**

| ESA-listed Species and Distinct Population Segment(s) | Trend for 2017 | Recovery Priority Number[1] | New Proposed Recovery Priority Number[2] |
|---|---|---|---|
| **Green sea turtle** | | | |
| North Atlantic | Increasing | 5 | 8 |
| South Atlantic | Mixed[3] | 5 | 10 |
| Central West Pacific | Unknown | 3 | 12 |
| Central South Pacific | Unknown | 3 | 12 |
| Central North Pacific | Increasing | 7 | 17 |
| East Pacific | Mixed[3] | 5 | 15 |
| **Hawksbill sea turtle** | Mixed[3] | 3 | 6 |
| **Kemp's ridley sea turtle** | Unknown | 5 | 1 |
| **Leatherback sea turtle** | Atlantic: Stable<br>Pacific: Decreasing<br>Global: Mixed[3] | Atlantic: 5<br>Pacific: 3<br>Global: 1 | Atlantic: 10<br>Pacific: 16<br>Global: 3 |
| **Loggerhead sea turtle** | | | |
| Northwest Atlantic Ocean | Stable | 5 | 8 |
| North Pacific Ocean | Stable | 3 | 22 |
| **Olive ridley sea turtle** | | | |
| Breeding colony populations of Pacific coast Mexico | Mixed[3] | 5 | 10 |
| Rangewide | Mixed[3] | 5 | 15 |

[1] Recovery Priority Numbers designated according to guidelines published by NMFS on June 15, 1990 (55 FR 24296). [2] Draft Revised Recovery Priority Guidelines published on May 31, 2017 (82 FR 24944). [3] Mixed = status varying by population location.

### 6.2.1 Green Sea Turtle

The green sea turtle is globally distributed and commonly inhabits nearshore and inshore waters, occurring throughout tropical, subtropical and, to a lesser extent, temperate waters (Figure 8).

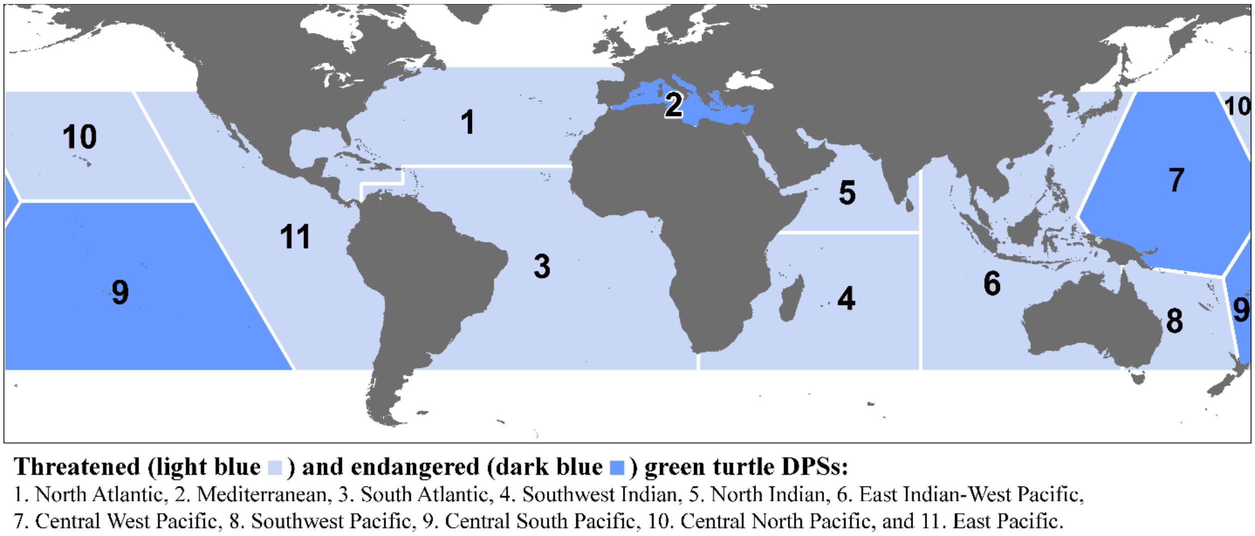


**Figure 8. Map depicting range and distinct population segment boundaries for green turtles.**

The green sea turtle is the largest of the hardshell marine turtles, growing to a weight of 350 pounds (159 kilograms) and a SCL of greater than 3.3 feet (1 meter) (Figure 9). The species was listed under the ESA on July 28, 1978.

**Figure 9. Green sea turtle. Photos: Mark Sullivan, NOAA (left), Andy Bruckner, NOAA (right).**

On April 6, 2016, NMFS listed eleven distinct population segments (DPSs) of green sea turtles as threatened or endangered under the ESA (Table 4). 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.

**Table 4. Summary of green sea turtle listing and recovery plan information.**

| Species | Common Name | Distinct Population Segment | ESA Status | Recent Review Year | Listing | Recovery Plan | Critical Habitat |
|---|---|---|---|---|---|---|---|
| *Chelonia mydas* | Green Turtle | North Atlantic (4 sub-populations) | Threatened | 2015 | 81 FR 20057 04/06/2016 43 FR 32800 07/28/1978 | FR N/A 1991 | 63 FR 46693 Puerto Rico 1998 |
| *Chelonia mydas* | Green Turtle | South Atlantic | Threatened | 2015 | 81 FR 20057 04/06/2016 43 FR 32800 07/28/1978 | N/A | None Designated |
| *Chelonia mydas* | Green Turtle | East Indian-West Pacific | Threatened | 2015 | 81 FR 20057 04/06/2016 43 FR 32800 07/28/1978 | N/A | None Designated |
| *Chelonia mydas* | Green Turtle | Central West Pacific | Endangered | 2015 | 81 FR 20057 04/06/2016 43 FR 32800 07/28/1978 | N/A | None Designated |
| *Chelonia mydas* | Green Turtle | Southwest Pacific | Threatened | 2015 | 81 FR 20057 04/06/2016 43 FR 32800 07/28/1978 | N/A | None Designated |
| *Chelonia mydas* | Green Turtle | Central South Pacific | Endangered | 2015 | 81 FR 20057 04/06/2016 43 FR 32800 07/28/1978 | N/A | None Designated |
| *Chelonia mydas* | Green Turtle | Central North Pacific | Threatened | 2015 | 81 FR 20057 04/06/2016 43 FR 32800 07/28/1978 | N/A | None Designated |
| *Chelonia mydas* | Green Turtle | East Pacific | Threatened | 2015 | 81 FR 20057 04/06/2016 43 FR 32800 07/28/1978 | 63 FR 28359 1998 | None Designated |

The DPSs considered in this biological opinion for which take could be authorized are: the North Atlantic, South Atlantic, Central West Pacific, Southwest Pacific, Central South Pacific, Central North Pacific, and East Pacific DPSs. The East Indian-West Pacific and Southwest Pacific DPSs of green are also included, despite being a foreign water population because these DPSs could be caught on the high seas.

We used information available in the 2007 five-year review (NMFS and USFWS 2007b) and 2015 Status Review (Seminoff et al. 2015) to summarize the life history, population dynamics and status of the species, as follows.

**Life History**

Age at first reproduction for females is twenty to forty 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 two to five 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.

### Population Dynamics

The following is a discussion of the species' population and its variance over time. This section includes population growth rate, genetic diversity, and distribution as it relates to the green sea turtle.

Worldwide, nesting data at 464 sites indicate that 563,826 to 564,464 females nest each year (Seminoff et al. 2015). Table 5 shows by DPS the number of nesting females, nesting sites and the percentage of nesting females at the largest nesting site.

**Table 5. Green sea turtle nesting abundance in each distinct population segment (Seminoff et al. 2015).**

| Distinct Population Segment | Abundance Estimate (nesting females) | Number of Nesting Sites | Largest Nesting Site | Percentage at largest nesting site |
|---|---|---|---|---|
| North Atlantic | 167,424 | 73 | Tortuguero, Costa Rica | 79% |
| South Atlantic | 63,332 | 51 | Poilão, Guinea-Bissau | 46% |
| East Indian-West Pacific | 77,009 | 58 | Wellesley Group, Australia | 32% |
| Central West Pacific | 6,518 | 51 | Federated States of Micronesia | 22% |
| Southwest Pacific | 83,058 | 12 | Northern Great Barrier Reef, Australia | 38% |
| Central South Pacific | 2,677 | 59 | Scilly Atoll, French Polynesia | 36% |
| Central North Pacific | 3,846 | 12 | East Island, French Frigate Shoals, Hawaii | 96% |
| East Pacific | 20,062 | 39 | Colola, Mexico | 58% |

### Population Growth Rate

Many nesting sites worldwide suffer from a lack of consistent, standardized monitoring, making it difficult to characterize population growth rates for a DPS. Available information on the population growth rates and trends for each of the distinct population segments is presented below.

#### *6.2.1.1 North Atlantic Distinct Population Segment*

Compared to other DPSs, the North Atlantic DPS exhibits the highest nester abundance, with approximately 167,424 females at seventy-three 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 seventy-nine percent of nesting females for the DPS (Seminoff et al. 2015).

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. (2008a) 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.

#### *6.2.1.2 South Atlantic Distinct Population Segment*

The South Atlantic DPS has fifty-one nesting sites, with an estimated nester abundance of 63,332. The largest nesting site is at Poilão, Guinea-Bissau, which hosts forty-six percent of nesting females for the DPS (Seminoff et al. 2015).

Of the fifty-one nesting sites, many have insufficient data to determine population growth rates or trends. Of the nesting sites where data are available, such as Ascension Island, Suriname, Brazil, Venezuela, Equatorial Guinea, and Guinea-Bissau, there is evidence that population abundance is increasing.

#### *6.2.1.3 East Indian-West Pacific Distinct Population Segment*

There are fifty-eight nesting sites for the East Indian-West Pacific DPS, with a total nester abundance estimated at 77,009. The largest nesting site is the Wellesley Group, three islands in the Gulf of Carpentaria off northern Australia. This group hosts thirty-two percent of the nesting females for the DPS (Seminoff et al. 2015).

There are no estimates of population growth. There is variation in the nesting abundance trends across nesting sites, with some showing increase while others are decreasing. Broadly, there is a decrease in nesting females throughout the DPS, with the exception of Malaysia and the Philippines showing an increase, attributed to successful conservation efforts.

#### *6.2.1.4 Central West Pacific Distinct Population Segment*

There are fifty-one nesting sites in the Central West Pacific DPS, with an estimated 6,518 nesting females. The largest nesting site is in the Federated States of Micronesia, which hosts twenty-two percent of the nesting females for the DPS (Seminoff et al. 2015).

There are no estimates of population growth rates. Long-term nesting data is lacking for many of the nesting sites in the Central West Pacific DPS, making it difficult to assess population trends. The only site which as long-term data available, Chichijima, Japan, shows a positive trend in population growth.

#### *6.2.1.5 Southwest Pacific Distinct Population Segment*

Nesting sites for the Southwest Pacific Ocean DPS are widely distributed throughout the region. With proximate nesting sites grouped, there are twelve nesting sites in the Southwest Pacific DPS, with an estimated 83,058 nesting females. The largest nesting site is at the northern Great Barrier Reef, Australia, which hosts thirty-eight percent of the nesting females for the DPS (Seminoff et al. 2015).

There are no estimates of population growth rates. Only two nesting sites in the Southwest Pacific DPS have more than fifteen years of data: Raine Island and Heron Island, both in the northern Great Barrier Reef. Both sites show a slight increasing population trend.

#### *6.2.1.6 Central South Pacific Distinct Population Segment*

Nesting abundance information for the Central South Pacific DPS is limited, but is considered to be at low levels and spread out over a large geographic area. There are fifty-nine known nesting sites (twenty-two are unquantified), with an estimated 2,677 nesting females. The largest nesting site is at Scilly Atoll in French Polynesia, which hosts thirty-six percent of the nesting females for the DPS (Seminoff et al. 2015).

There are no estimates of population growth. The DPS suffers from a lack of consistent, systematic nesting monitoring, with no nesting site having even five years of continuous data. What data are available indicate steep declines at Scilly Atoll due to illegal harvest, with some smaller nesting sites (e.g., Rose Atoll) showing signs of stability.

#### *6.2.1.7 Central North Pacific Distinct Population Segment*

There are thirteen known nesting sites for the Central North Pacific DPS, with an estimated 3,846 nesting females. The DPS is very thoroughly monitored, and it is believed there is little chance that there are undocumented nesting sites. The largest nesting site is at French Frigate Shoals, Hawaii, which hosts ninety-six percent of the nesting females for the DPS (Seminoff et al. 2015).

Nesting surveys have been conducted since 1973 for green turtles in the Central North Pacific DPS. Nesting abundance at East Island, French Frigate Shoals, increases at 4.8 percent annually.

#### *6.2.1.8 East Pacific Distinct Population Segment*

There are thirty-nine nesting sites for the East Pacific DPS, with an estimated 20,062 nesting females. The largest nesting site is at Colola, Mexico, which hosts fifty-eight percent of the nesting females for the DPS (Seminoff et al. 2015).

There are no estimates of population growth. Only one nesting site in the East Pacific DPS at Colola, Mexico, has sufficient long-term data to determine population trends. Data analysis indicates that the population there is increasing and is likely to continue to do so.

**Genetic Diversity**

Globally, the green turtle is divided into eleven distinct population segments; available information on the genetic diversity for each of the distinct population segments is presented below.

#### *6.2.1.9 North Atlantic Distinct Population Segment*

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).

#### *6.2.1.10 South Atlantic Distinct Population Segment*

The South Atlantic DPS is characterized as having shallow structuring, and dominated by a common shared haplotype. Individuals from nesting sites in Brazil, Ascension Island, and western Africa have a shared haplotype found in high frequencies. Green turtles from rookeries in the eastern Caribbean however, are dominated by a different haplotype (Seminoff et al. 2015).

#### *6.2.1.11 East Indian-West Pacific Distinct Population Segment*

Genetic studies have been conducted on over twenty-two of fifty-eight rookeries in the East Indian-West Pacific DPS, revealing a complex population structure. Sixteen regional genetic stocks have been identified, with a few common and widespread haplotypes throughout the region. Rare or unique haplotypes are present at most rookeries (Seminoff et al. 2015).

#### *6.2.1.12 Central West Pacific Distinct Population Segment*

The Central West Pacific DPS is made up of insular rookeries separated by broad geographic distances. Rookeries that are more than 1,000 kilometers apart are significantly differentiated, while rookeries 500 kilometers apart are not (Seminoff et al. 2015). Mitochondrial DNA analyses suggest that there are at least seven independent stocks in the region (Dutton et al. 2014).

#### *6.2.1.13 Southwest Pacific Distinct Population Segment*

Of the sampled rookeries in the Southwest Pacific DPS, genetic testing shows significant population sub-structuring. Four regional genetic stocks have been identified (Dethmers et al. 2006; Jensen 2010). The DPS is characterized as having high genetic diversity due to a variety of highly divergent lines found at nesting sites.

### *6.2.1.14 Central South Pacific Distinct Population Segment*

There is very limited information available for the Central South Pacific DPS. Mitochondrial DNA studies indicate at least two genetic stocks in the DPS: American Samoa and French Polynesia. Overall, there is a moderate level of diversity for the DPS, and the presence of unique haplotypes (Seminoff et al. 2015).

### *6.2.1.15 Central North Pacific Distinct Population Segment*

The majority of nesting for the Central North Pacific DPS is centered at one site on French Frigate Shoals, and there is little diversity in nesting areas. Overall, the Central North Pacific DPS has a relatively low level of genetic diversity and stock sub-structuring (Seminoff et al. 2015).

### *6.2.1.16 East Pacific Distinct Population Segment*

Rare and unique haplotypes are present in the East Pacific DPS. Genetic sampling has identified four regional stocks in the Eastern Pacific DPS: Revillagigedos Archipelago, Mexico, Michoacán, Mexico, Central America (Costa Rica), and the Galápagos Islands, Ecuador (Seminoff et al. 2015).

**Distribution**

The green sea turtle occupies the coastal waters of over 140 countries worldwide; nesting occurs in more than eighty countries. The green sea turtle is distributed in tropical, subtropical, and to a lesser extent, temperate waters (Figure 10).

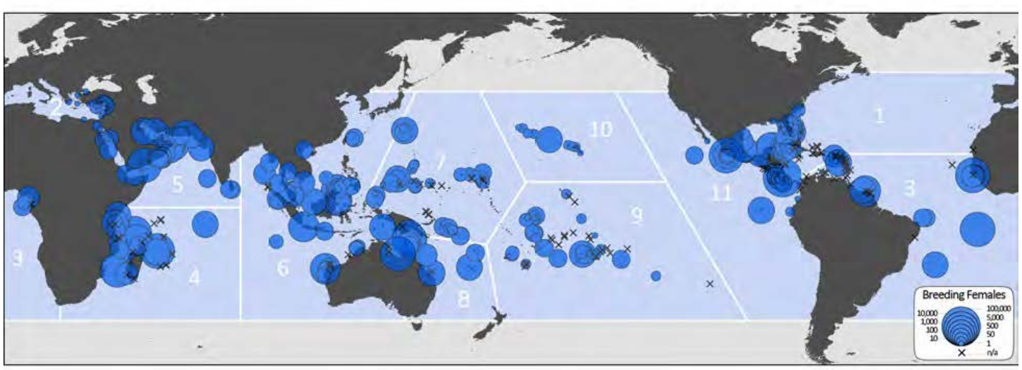


**Figure 10. Map of all *Chelonia mydas* nesting sites indicating delineation of distinct population segments (Seminoff et al. 2015).**

### *6.2.1.17 North Atlantic Distinct Population Segment*

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 Figure 10). Nesting occurs primarily in Costa Rica, Mexico, Florida and Cuba (Figure 11).

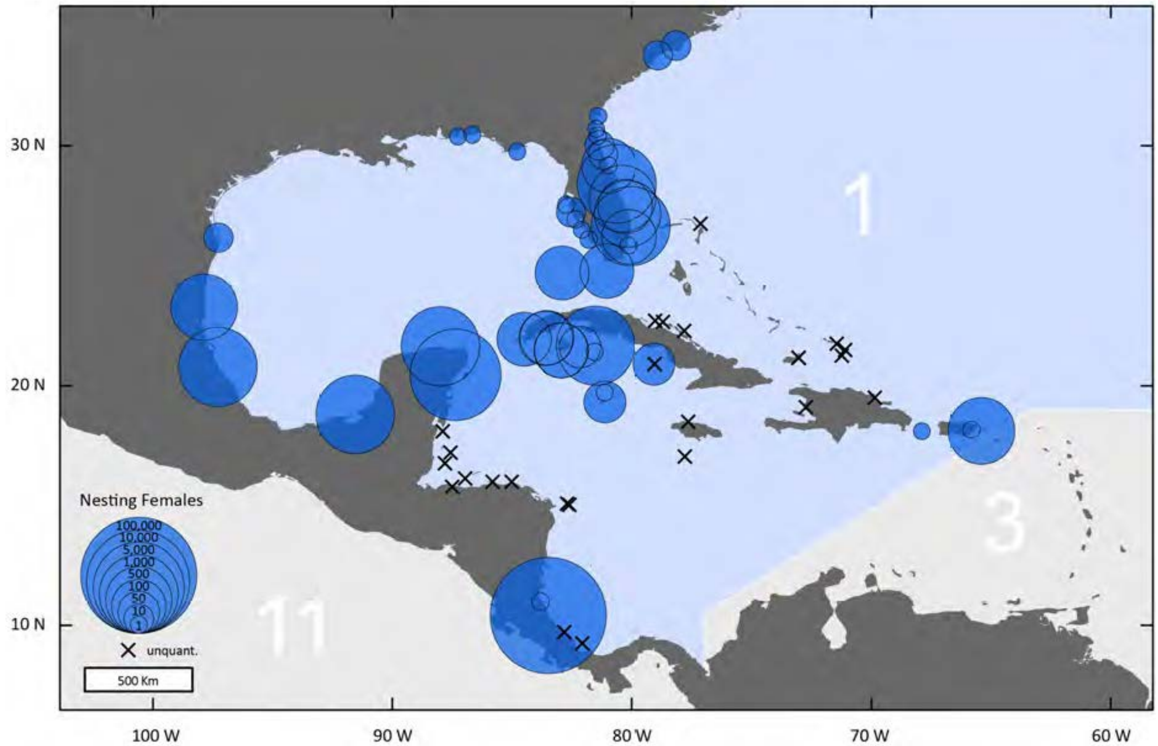


**Figure 11. Close up of nesting distribution of green turtles in the western North Atlantic distinct population segment (water body labeled '1'). Size of circles indicates estimated nester abundance. Locations marked with an 'x' indicate sites lacking abundance information (Seminoff et al. 2015).**

### *6.2.1.18 South Atlantic Distinct Population Segment*

Nesting for the green turtle South Atlantic DPS occurs on both sides of the Atlantic Ocean, along the western coast of Africa, Ascension Island, the U.S. Virgin Islands in the Caribbean and eastern South America, from Brazil north to the Caribbean (Figure 8). Juveniles and adults can be found on feeding grounds in the Caribbean and the nearshore waters of Brazil, Uruguay and Argentina. In the east, South Atlantic DPS green turtles can be found on foraging grounds off the coast of west Africa, from Equatorial Guinea, Gabon, Congo, Angola and Principe Island (Figure 12).

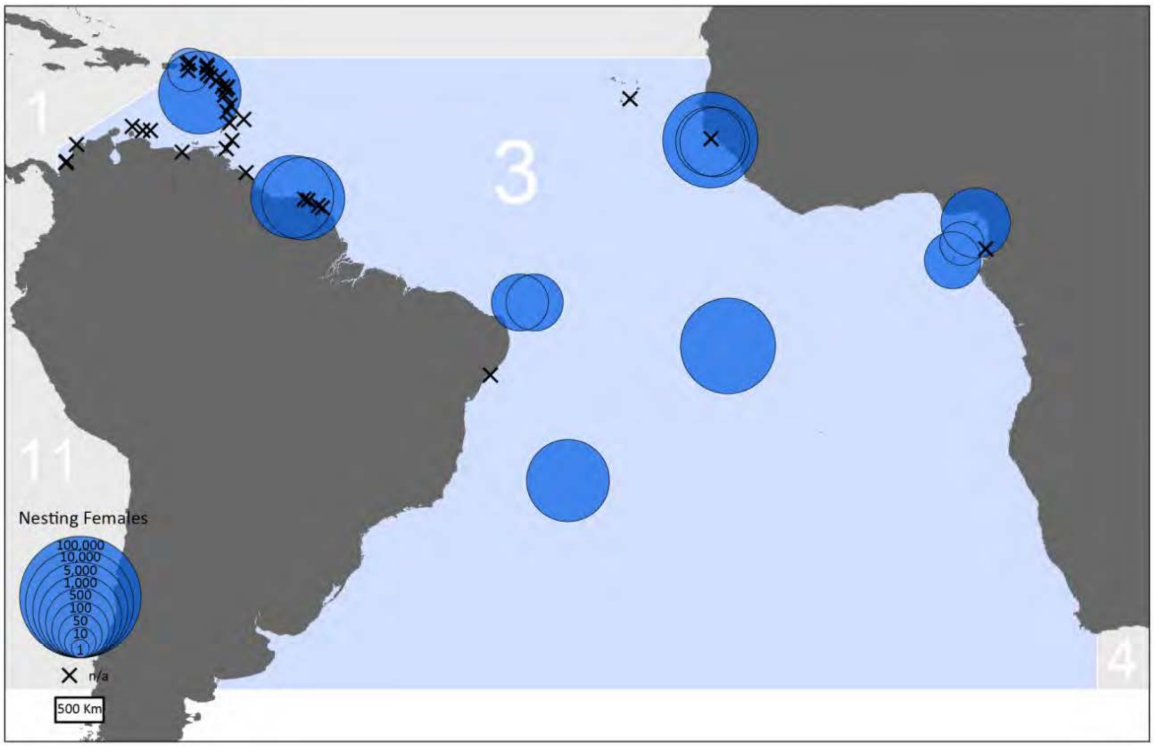


**Figure 12. Nesting distribution of green turtles in the South Atlantic distinct population segment (water body labeled '3'). Size of circles indicates estimated nester abundance. Locations marked with an 'x' indicate sites lacking abundance information (Seminoff et al. 2015).**

### 6.2.1.19 East Indian-West Pacific Distinct Population Segment

The East Indian-West Pacific DPS green turtle is found in the Indian Ocean from southeast Asia through western Australia (Figure 8). The East Indian-West Pacific DPS comprises nesting sites in Northern Australia, Indonesia, Malaysia, Peninsular Malaysia and the Philippine Turtle Islands. The DPS is spread throughout the eastern Indian Ocean, east of Sri Lanka, south to western and northern Australia, Indonesia, Malaysia, and Taiwan, and north to Japan (Figure 13).

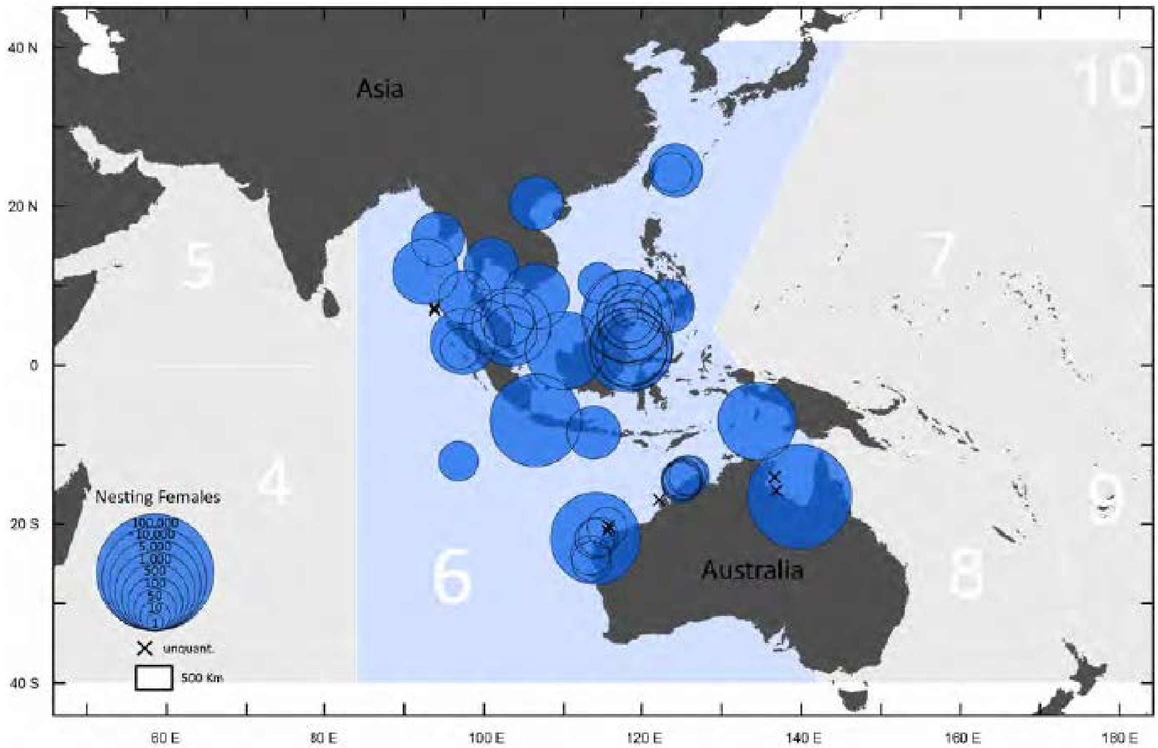


**Figure 13. Nesting distribution of green turtles in the East Indian-West Pacific distinct population segment (water body labeled '6'). Size of circles indicates estimated nester abundance. Locations marked with an 'x' indicate sites lacking abundance information (Seminoff et al. 2015).**

### *6.2.1.20 Central West Pacific Distinct Population Segment*

The Central West Pacific DPS is composed of nesting assemblages in the Federated States of Micronesia, the Japanese islands of Chichijima and Hahajima, the Marshall Islands, and Palau (Figure 8). Green turtles in this DPS are found throughout the western Pacific Ocean, in Indonesia, the Philippines, the Marshall Islands and Papua New Guinea (Figure 14).

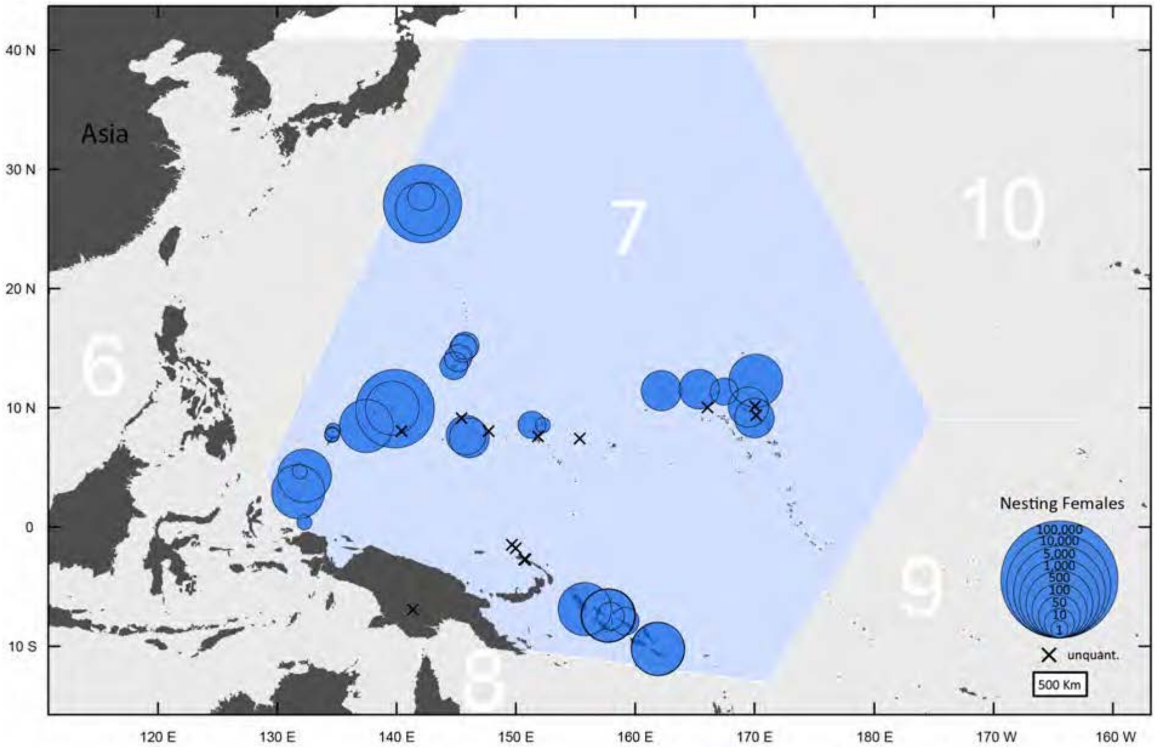


**Figure 14. Nesting distribution of green turtles in the Central West Pacific distinct population segment (water body labeled '7'). Size of circles indicates estimated nester abundance. Locations marked with an 'x' indicate sites lacking abundance information (Seminoff et al. 2015).**

### *6.2.1.21 Southwest Pacific Distinct Population Segment*

The Southwest Pacific DPS green turtle is found in the Pacific Ocean near eastern Australia and northern New Zealand (Figure 8). The Southwest Pacific DPS extends off the eastern coast of Australia, south of Papua New Guinea and goes east to encompass Vanuatu and New Caledonia. Major nesting sites for the DPS include the Great Barrier Reef, eastern Torres Strait and the northern Great Barrier Reef. Nesting also occurs in New Caledonia, Vanuatu and the Coral Sea Islands (Figure 15).

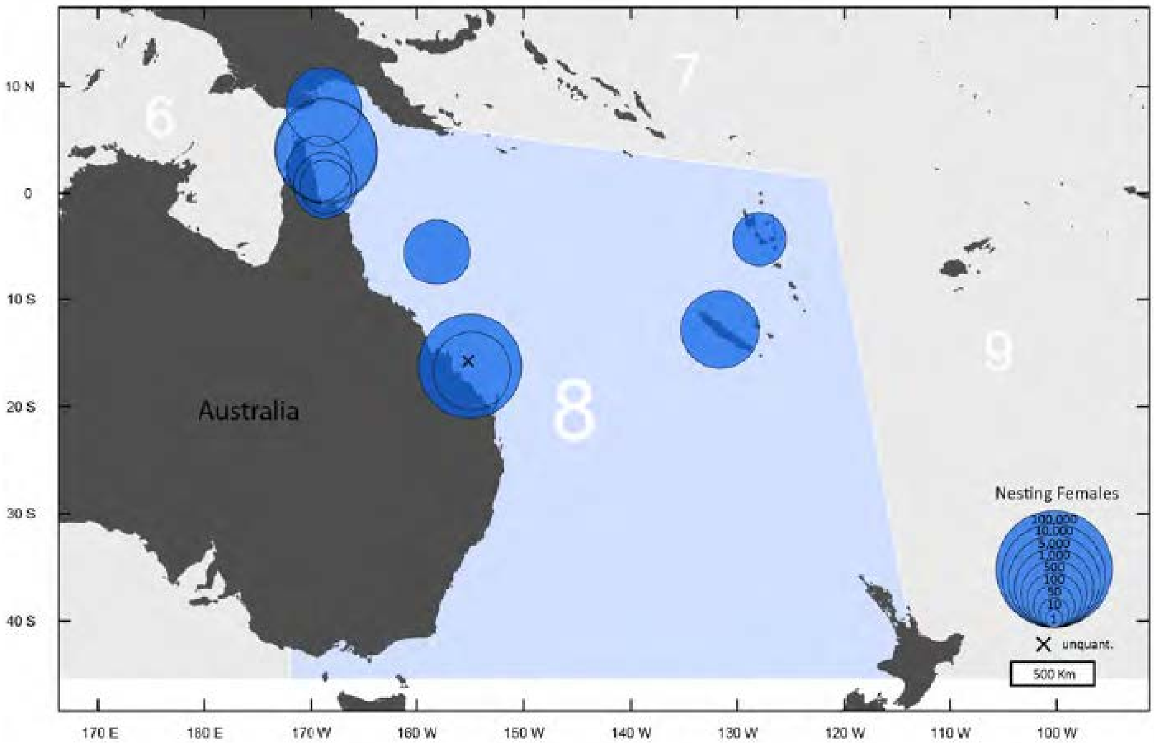


**Figure 15. Nesting distribution of green turtles in the Southwest Pacific distinct population segment (water body labeled '8'). Size of circles indicates estimated nester abundance. Locations marked with an 'x' indicate sites lacking abundance information (Seminoff et al. 2015).**

### *6.2.1.22 Central South Pacific Distinct Population Segment*

The Central South Pacific DPS extends from north from northern New Zealand to Fiji, Tuvalu, and Kiribati and east to include French Polynesia (Figure 8). Nesting occurs sporadically throughout the geographic distribution of the population, with isolated locations having relatively low to moderate nesting activity (Figure 16).

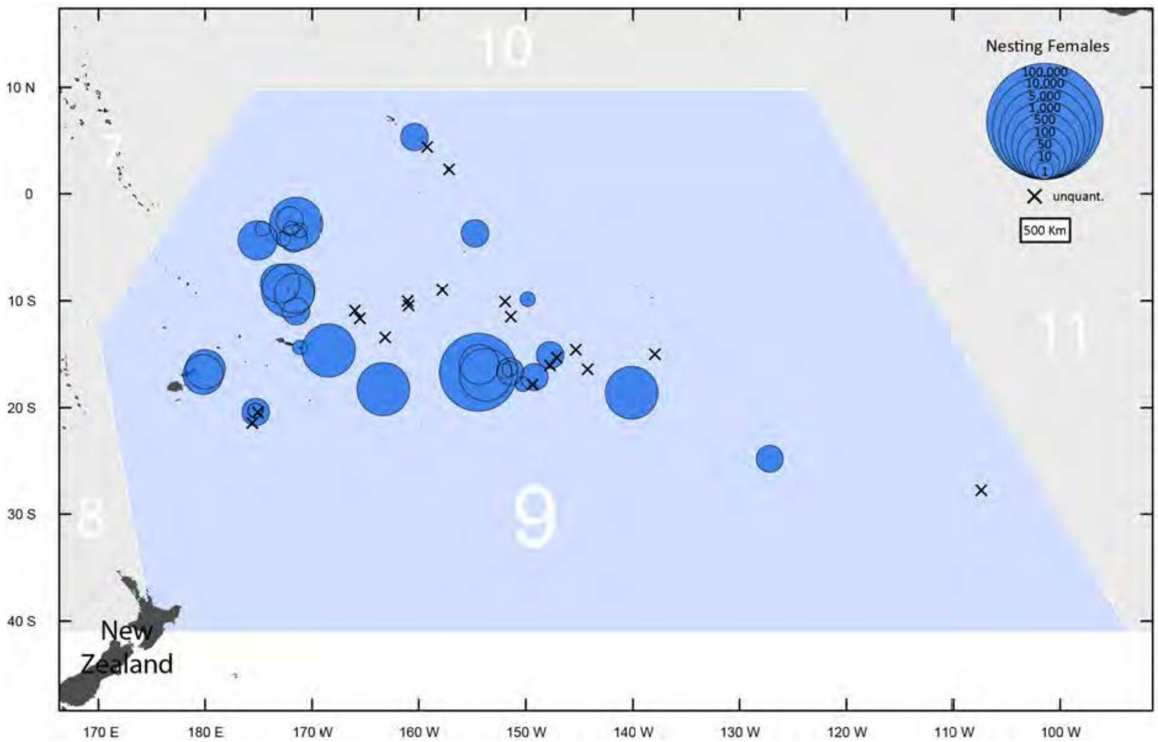


**Figure 16. Nesting distribution of green turtles in the Central South Pacific distinct population segment (water body labeled '9'). Size of circles indicates estimated nester abundance. Locations marked with an 'x' indicate sites lacking abundance information (Seminoff et al. 2015).**

### *6.2.1.23 Central North Pacific Distinct Population Segment*

Green turtles in the Central North Pacific DPS are found in the Hawaiian Archipelago and Johnston Atoll (Figure 8). The major nesting site for the DPS is at East Island, French Frigate Shoals, in the Northwestern Hawaiian Islands; lesser nesting sites are found throughout the Northwestern Hawaiian Islands and the Main Hawaiian Islands (Figure 17).

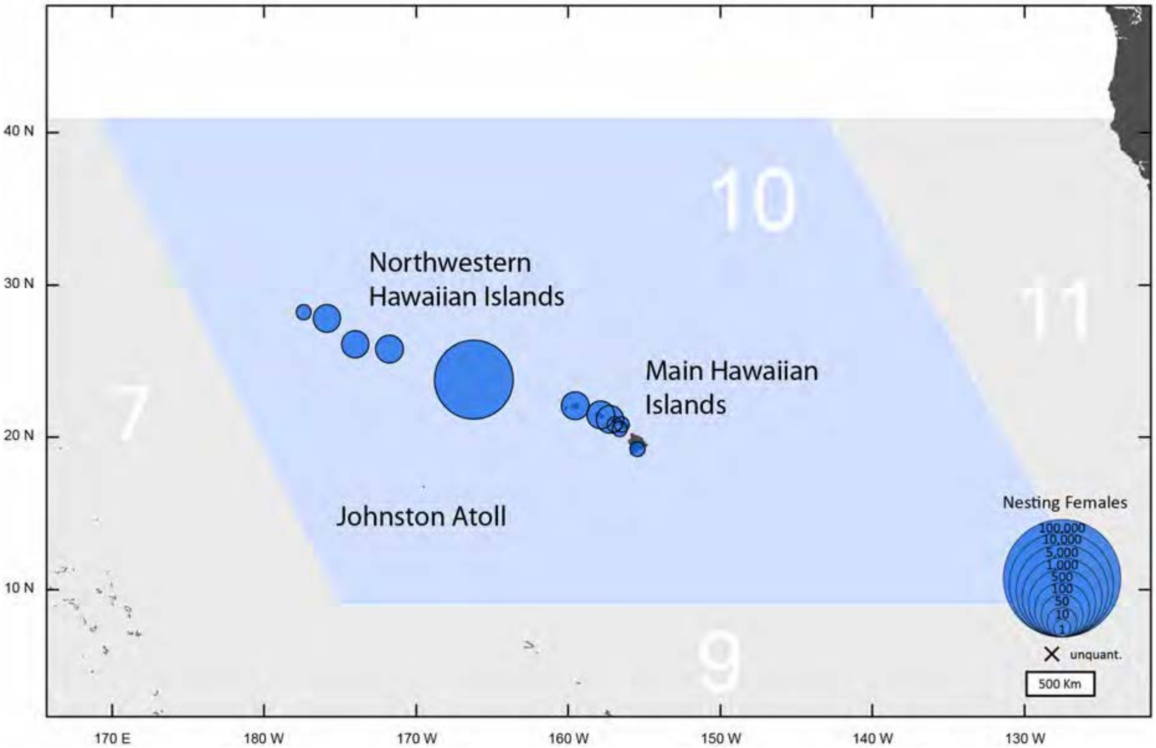


**Figure 17. Nesting distribution of green turtles in the Central North Pacific distinct population segment (water body labeled '10'). Size of circles indicates estimated nester abundance (Seminoff et al. 2015).**

### *6.2.1.24 East Pacific*

Green turtles in the East Pacific DPS are found from the California/Oregon border south to central Chile (Figure 8). Major nesting sites occur at Michoacán, Mexico, and the Galá3pagos Islands, Ecuador. Smaller nesting sites are found on the Pacific coast of Costa Rica, and in the Revillagigedos Archipelago, Mexico. Scattered nesting occurs in Columbia, Ecuador, Guatemala and Peru (Seminoff et al. 2015).

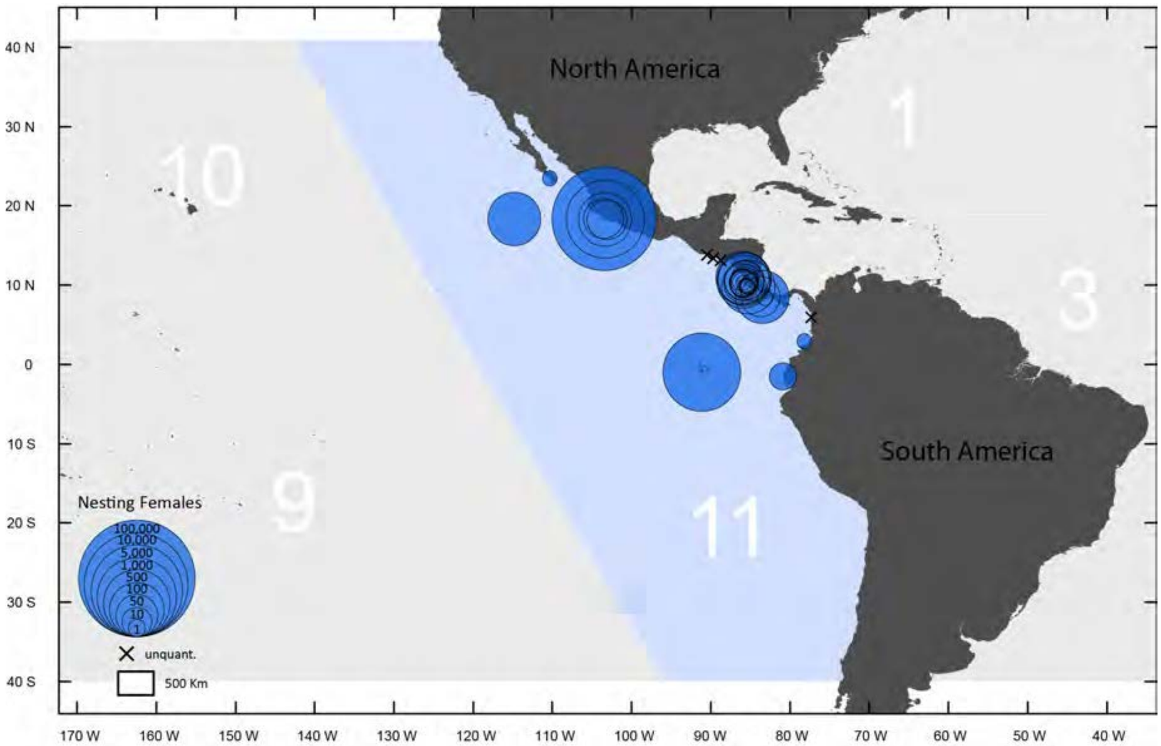


**Figure 18. Nesting distribution of green turtles in the East Pacific distinct population segment (water body labeled '11'). Size of circles indicates estimated nester abundance. Locations marked with an 'x' indicate sites lacking abundance information (Seminoff et al. 2015).**

**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.

#### 6.2.1.25 North Atlantic Distinct Population Segment

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.

#### 6.2.1.26 South Atlantic Distinct Population Segment

Though there is some evidence that the South Atlantic DPS is increasing, there is a considerable amount of uncertainty over the impacts of threats to the South Atlantic DPS. The DPS is threatened by habitat degradation at nesting beaches, mortality from fisheries bycatch remains a primary concern.

#### 6.2.1.27 East Indian-West Pacific Distinct Population Segment

The East Indian-West Pacific DPS is relatively large, though it has been reduced from historic levels due to overutilization for commercial and subsistence purposes. Green turtles and their eggs are still harvested for consumption in some areas. Other current threats to the DPS include mortality from incidental bycatch, and predation by feral pigs, dogs and foxes.

#### 6.2.1.28 Central West Pacific Distinct Population Segment

The Central West Pacific DPS is impacted by incidental bycatch in fishing gear, predation of eggs by ghost crabs and rats, and directed harvest eggs and nesting females for human consumption. Historically, intentional harvest of eggs from nesting beaches was one of the principal causes for decline, and this practice continues today in many locations. The Central West Pacific DPS has a small number of nesting females and a widespread geographic range. These factors, coupled with the threats facing the DPS and the unknown status of many nesting sites makes the DPS vulnerable to future perturbations.

#### 6.2.1.29 Southwest Pacific Distinct Population Segment

Green turtle populations in the Southwest Pacific DPS declined due to intense harvest in the last century. The Southwest Pacific DPS is currently under threat from incidental bycatch in fishing gear, although conservation programs in Australia, New Caledonia and Vanuatu are in place to mitigate the impacts. Although the directed commercial harvest of eggs and nesting females is prohibited in Australia, harvest occurs in the neighboring countries of Fiji, New Caledonia, Papua New Guinea and Indonesia. Boat strike, bycatch in shark control programs, increases in sea surface temperatures due to climate change all threaten the DPSs. Populations at the two largest nesting beaches in the DPS are stable or increasing, but uncertainty about population trends in other parts of the DPS still warrant concern.

#### *6.2.1.30 Central South Pacific Distinct Population Segment*

Historically, the Central South Pacific DPS declined due to harvest of eggs and females for human consumption or for their shells, a practice that still continues throughout the region. Incidental bycatch in commercial and artisanal fishing gear, lack of regulatory mechanisms and climate change are significant threats to the long-term viability of the DPS.

#### *6.2.1.31 Central North Pacific Distinct Population Segment*

Green turtles in the Hawaiian Archipelago were subjected to hunting pressure for subsistence and commercial trade, which was largely responsible for the decline in the region. Though the practice has been banned, there are still anecdotal reports of harvest. Incidental bycatch in fishing gear, ingestion of marine debris, and the loss of nesting habitat due to sea level rise are current threats to the population. Although these threats persist, the increase in annual nesting abundance, continuous scientific monitoring, legal enforcement and conservation programs are all factors that favor the resiliency of the DPS.

#### *6.2.1.32 East Pacific Distinct Population Segment*

The population decline for the East Pacific DPS was primarily caused by commercial harvest of green turtles for subsistence and other uses (e.g., sea turtle oil as a cold remedy). Conservation laws are in place in several countries across the range of the DPS, but enforcement is inconsistent, limiting effectiveness. Incidental bycatch in commercial fishing gear, continued harvest, coastal development and beachfront lighting are all continuing threats for the DPS. The observed increases in nesting abundance for the largest nesting aggregation in the region (Michocán, Mexico), a stable trend at Galápagos, and record high numbers at sites in Costa Rica suggest that the population is resilient, particularly in Mexico.

**Designated Critical Habitat**

#### *6.2.1.33 North Atlantic Distinct Population Segment*

On September 2, 1998, NMFS designated critical habitat for green sea turtles, which include coastal waters surrounding Culebra Island, Puerto Rico (Figure 19). 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. The only designated critical habitat for green sea turtles is in Culebra Island, Puerto Rico.

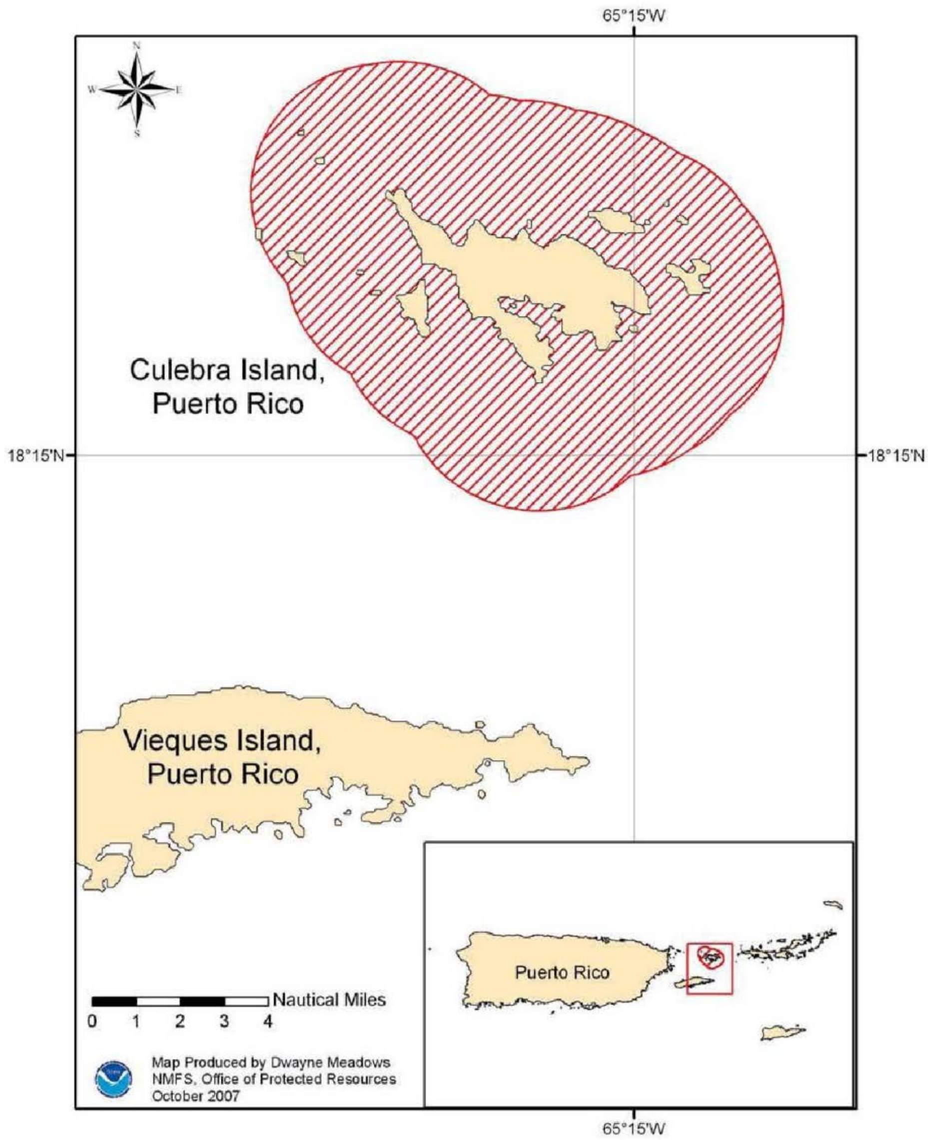


**Figure 19. Map depicting green turtle designated critical habitat in Culebra Island, Puerto Rico.**

#### Recovery Goals

See the 1998 and 1991 recovery plans for the Pacific, East Pacific and Atlantic populations of green turtles for complete down-listing/delisting criteria for recovery goals for the species (NMFS and USFWS 1991; NMFS and USFWS 1998b). Broadly, recovery plan goals emphasize the need to protect and manage nesting and marine habitat, protect and manage populations on nesting beaches and in the marine environment, increase public education, and promote international cooperation on sea turtle conservation topics.

### 6.2.2 Hawksbill Sea Turtle

The hawksbill turtle has a circumglobal distribution throughout tropical and, to a lesser extent, subtropical oceans (Figure 20).

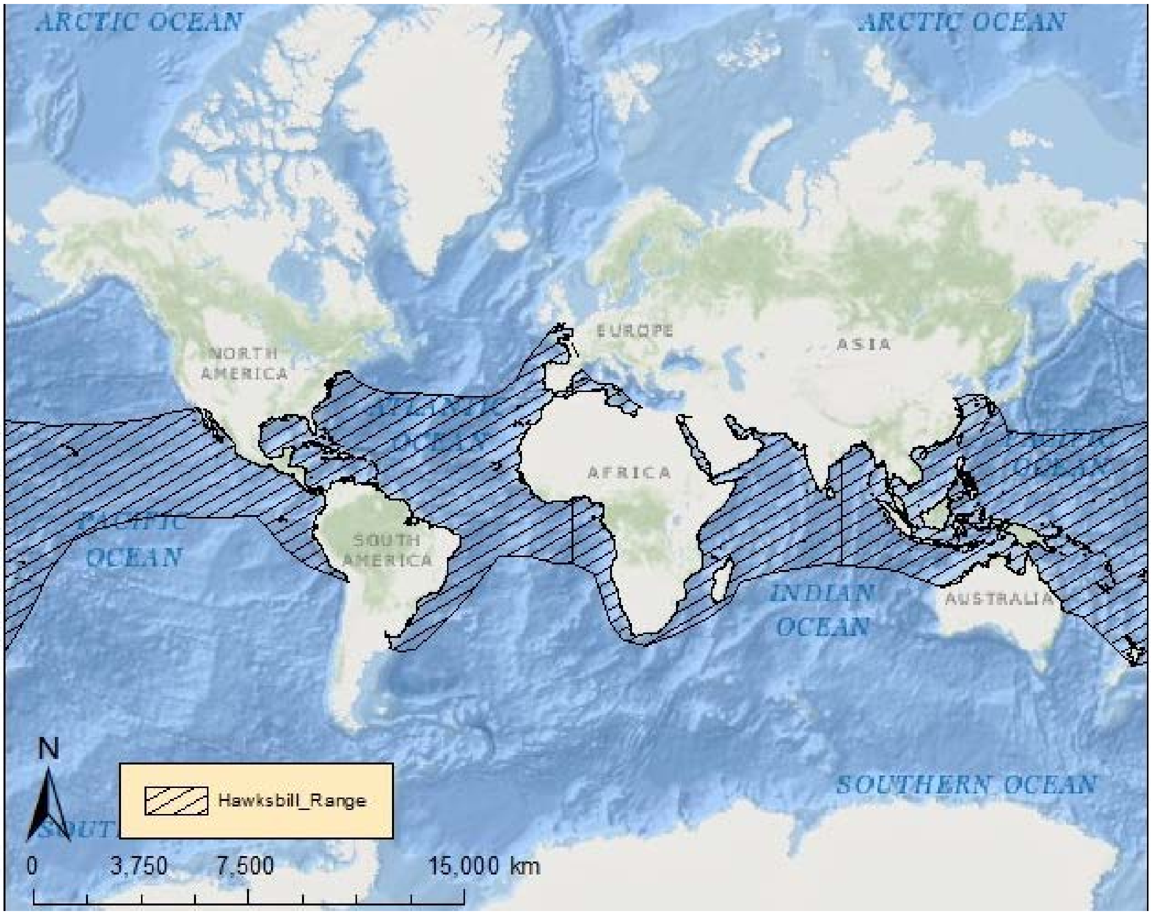


**Figure 20. Map identifying the range of the endangered hawksbill sea turtle.**

The hawksbill sea turtle has a sharp, curved, beak-like mouth and a "tortoiseshell" pattern on its carapace, with radiating streaks of brown, black, and amber (Figure 21).

**Figure 21. Hawksbill sea turtle. Photos: Tom Moore, NOAA (left), Jordan Wilkerson (right).**

The species was first listed under the Endangered Species Conservation Act and listed as endangered under the ESA since 1973 (Table 6).

**Table 6. Summary of hawksbill sea turtle listing and recovery plan information.**

| Species | Common Name | Distinct Population Segment | ESA Status | Recent Review Year | Listing | Recovery Plan | Critical Habitat |
|---|---|---|---|---|---|---|---|
| *Eretmochelys imbricata* | Hawksbill Turtle | None Designated | Endangered | 2013 | 35 FR 8491 6/2/1970 | 57 FR 38818 Atlantic 1992 | 63 FR 46693 Puerto Rico 1998 |
| *Eretmochelys imbricata* | Hawksbill Turtle | None Designated | Endangered | 2013 | 35 FR 8491 6/2/1970 | 63 FR 28359 Pacific 1998 | None Designated |

We used information available in the 2007 and 2013 five-year reviews (NMFS and USFWS 2007c; NMFS and USFWS 2013a) to summarize the life history, population dynamics and status of the species, as follows.

### Life History

Hawksbill sea turtles reach sexual maturity at twenty to forty years of age. Females return to their natal beaches every two to five years to nest and nest an average of three to five 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 twenty two to twenty five centimeters in SCL. 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 (Horrocks et al. 2001; Miller et al. 1998).

### Population Dynamics

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

Surveys at eighty eight nesting sites worldwide indicate that 22,004 to 29,035 females nest annually (NMFS and USFWS 2013a). 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.

From 1980 to 2003, the number of nests at three primary nesting beaches (Rancho Nuevo, Tepehuajes, and Playa Dos) increased fifteen 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 2013a).

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).

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 (Bjorndal and Bolten 2010; Musick and Limpus 1997).

### Status

Long-term data on the hawksbill sea turtle indicate that sixty-three sites have declined over the past twenty to one hundred years (historic trends are unknown for the remaining twenty-five sites). Recently, twenty-eight sites (sixty-eight percent) have experienced nesting declines, ten have experienced increases, three have remained stable, and forty-seven 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 one hundred 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.

### Designated Critical Habitat

On September 2, 1998, NMFS established critical habitat for hawksbill sea turtles around Mona and Monito Islands, Puerto Rico (Figure 22). 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.

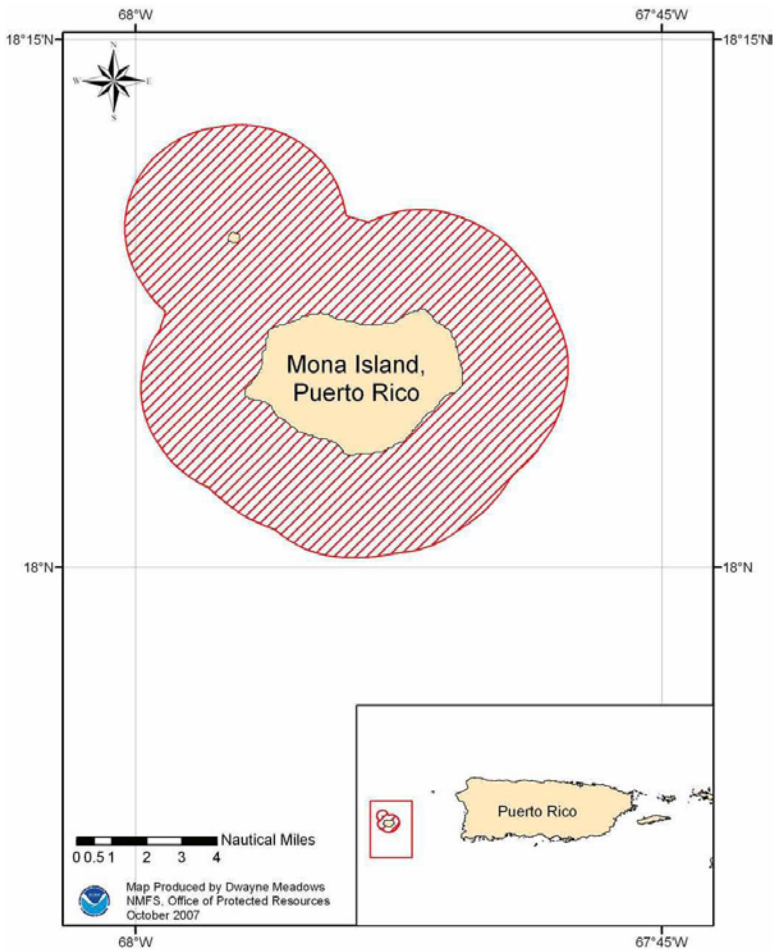


**Figure 22. Map depicting hawksbill sea turtle critical habitat; the coastal waters surrounding Mona and Monito Islands, Puerto Rico.**

### Recovery Goals

See the 1992 Recovery Plan for the U.S. Caribbean, Atlantic and Gulf of Mexico (NMFS and USFWS 1993) and the 1998 Recovery Plan for the U.S. Pacific populations (NMFS and USFWS 1998c) of hawksbill sea turtles, for complete down listing/delisting criteria for each of their respective recovery goals. The following items were the top recovery actions identified to support in the Recovery Plans:

1. Identify important nesting beaches
2. Ensure long-term protection and management of important nesting beaches
3. Protect and manage nesting habitat; prevent the degradation of nesting habitat caused by seawalls, revetments, sand bags, other erosion-control measures, jetties and breakwaters
4. Identify important marine habitats; protect and manage populations in marine habitat

5. Protect and manage marine habitat; prevent the degradation or destruction of important [marine] habitats caused by upland and coastal erosion
6. Prevent the degradation of reef habitat caused by sewage and other pollutants
7. Monitor nesting activity on important nesting beaches with standardized index surveys
8. Evaluate nest success and implement appropriate nest-protection on important nesting beaches
9. Ensure that law-enforcement activities prevent the illegal exploitation and harassment of sea turtles and increase law-enforcement efforts to reduce illegal exploitation
10. Determine nesting beach origins for juveniles and subadult populations

### 6.2.3 Kemp's Ridley Sea Turtle

The Kemp's ridley turtle is considered to be the most endangered sea turtle, internationally (Groombridge 1982; Zwinenberg 1977). Its range extends from the Gulf of Mexico to the Atlantic coast, with nesting beaches limited to a few sites in Mexico and Texas (Figure 23).

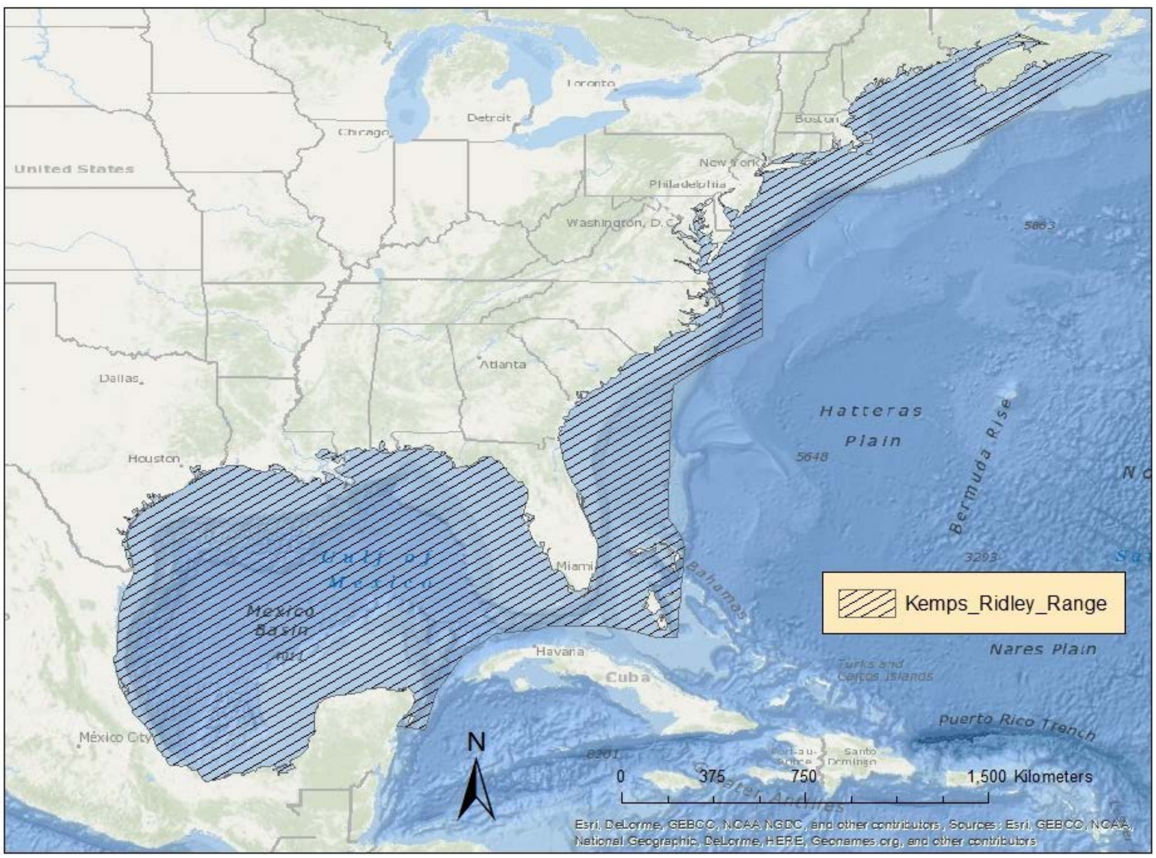


**Figure 23. Map identifying the range of the Kemp's ridley sea turtle.**

Kemp's ridley sea turtles the smallest of all sea turtle species, with a nearly circular top shell and a pale yellowish bottom shell (Figure 24).

**Figure 24. Kemp's ridley sea turtle. Photos: National Oceanic and Atmospheric Administration (left), National Park Service (right).**

The species was first listed under the Endangered Species Conservation Act and listed as endangered under the ESA since 1970 (Table 7).

**Table 7. Summary of Kemp's ridley sea turtle listing and recovery plan information.**

| Species | Common Name | Distinct Population Segment | ESA Status | Recent Review Year | Listing | Recovery Plan | Critical Habitat |
|---|---|---|---|---|---|---|---|
| *Lepidochelys kempii* | Kemp's Ridley Turtle | None Designated | Endangered | 2015 | 35 FR 18319 12/02/1970 | 75 FR 12496 U.S. Caribbean, Atlantic, and Gulf of Mexico 2011 | None Designated |

We used information available in the revised recovery plan (NMFS and USFWS 2011) and the 2015 five-year review (NMFS and USFWS 2015) to summarize the life history, population dynamics and status of the species, as follows.

## Life History

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

### Population Dynamics

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

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

From 1980 to 2003, the number of nests at three primary nesting beaches (Rancho Nuevo, Tepehuajes, and Playa Dos) increased fifteen 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 variability in Kemp's ridley turtles is considered to be high, as measured by heterozygosis at microsatellite loci (NMFS and USFWS 2011). Additional analysis of the mitochondrial DNA taken from samples of Kemp's ridley turtles at Padre Island, Texas, showed six distinct haplotypes, with one found at both Padre Island and Rancho Nuevo (Dutton et al. 2006).

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

### Designated Critical Habitat

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

### Recovery Goals

See the 2011 Final Bi-National (U.S. and Mexico) Revised Recovery Plan for Kemp's ridley sea turtles for complete down listing/delisting criteria for each of their respective recovery goals (NMFS and USFWS 2011). The following items were identified as priorities to recover Kemp's ridley sea turtles:

1. Protect and manage nesting and marine habitats.
2. Protect and manage populations on the nesting beaches and in the marine environment.
3. Maintain a stranding network.
4. Manage captive stocks.
5. Sustain education and partnership programs.
6. Maintain, promote awareness of and expand U.S. and Mexican laws.
7. Implement international agreements.
8. Enforce laws.

### 6.2.4 Leatherback Sea Turtle

The leatherback sea turtle is unique among sea turtles for its large size, wide distribution (due to thermoregulatory systems and behavior), and lack of a hard, bony carapace. It ranges from tropical to subpolar latitudes, worldwide (Figure 25).

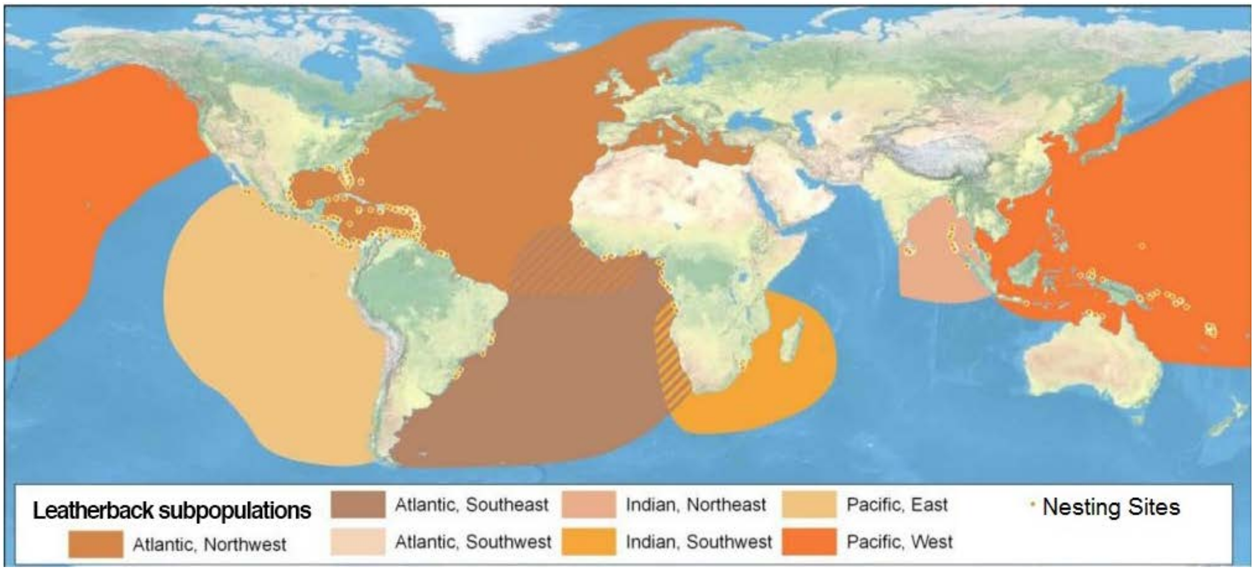


**Figure 25. Map identifying the range of the leatherback sea turtle with the seven subpopulations and nesting sites. Adapted from (Wallace et al. 2010a).**

Leatherbacks are the largest living turtle, reaching lengths of six feet long, and weighing up to one ton. Leatherback sea turtles have a distinct black leathery skin covering their carapace with pinkish white skin on their belly (Figure 26).

**Figure 26. Leatherback sea turtle adult and hatchling. Photos: R. Tapilatu (left), N. Pilcher (right).**

The species was first listed under the Endangered Species Conservation Act and listed as endangered under the ESA since 1970 (Table 8).

**Table 8. Summary of leatherback sea turtle listing and recovery plan information.**

| Species | Common Name | Distinct Population Segment | ESA Status | Recent Review Year | Listing | Recovery Plan | Critical Habitat |
|---|---|---|---|---|---|---|---|
| *Dermochelys coriacea* | Leatherback Turtle | None Designated | Endangered | 2013 | 35 FR 8491 6/2/1970 | FR N/A Atlantic 1992 | 44 FR 17710 U.S. Virgin Islands 1979 |
| *Dermochelys coriacea* | Leatherback Turtle | None Designated | Endangered | 2013 | 35 FR 8491 6/2/1970 | 63 FR 28359 Pacific 1998 | 77 FR 4170 Pacific 2012 |

We used information available in the 2013 five-year review (NMFS and USFWS 2013b) and the critical habitat designations to summarize the life history, population dynamics and status of the species, as follows.

### Life History

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

**Population Dynamics**

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

Leatherbacks are globally distributed, with nesting beaches in the Pacific, Atlantic, and Indian oceans. Detailed population structure is unknown, but is likely dependent upon nesting beach location. Based on estimates calculated from nest count data, there are between 34,000 and 94,000 adult leatherbacks in the North Atlantic (TEWG 2007). In contrast, leatherback populations in the Pacific are much lower. Overall, Pacific populations have declined from an estimated 81,000 individuals to less than 3,000 total adults and subadults (Spotila et al. 2000). Deriving abundance estimates from nest counts divided by average clutch frequency from (NMFS and USFWS 2013b) give as West Pacific subpopulation estimate of 562 nesting females. Population abundance in the Indian Ocean is difficult to assess due to lack of data and inconsistent reporting. Available data from southern Mozambique show that approximately ten females nest per year from 1994 to 2004, and about 296 nests per year counted in South Africa (NMFS and USFWS 2013b).

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

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

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

**Status**

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

**Designated Critical Habitat**

On March 23, 1979, leatherback critical habitat was identified adjacent to Sandy Point, St. Croix, Virgin Islands from the 183 meter isobath to mean high tide level between 17° 42'12" N and 65°50'00" W (Figure 27). This habitat is essential for nesting, which has been increasingly threatened since 1979, when tourism increased significantly, bringing nesting habitat and people into close and frequent proximity. The designated critical habitat is within the Sandy Point National Wildlife Refuge. Leatherback nesting increased at an annual rate of thirteen percent from 1994 to 2001; this rate has slowed according to nesting data from 2001 to 2010 (NMFS and USFWS 2013b).

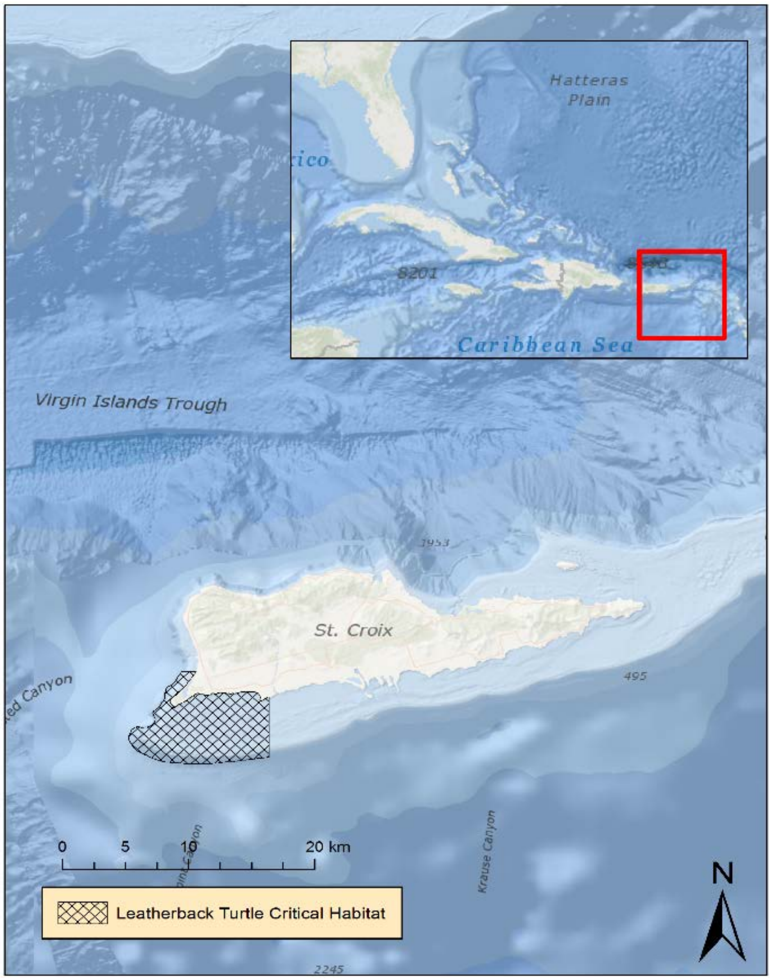


**Figure 27. Map depicting leatherback sea turtle designated critical habitat in the United States Virgin Islands.**

January 20, 2012, NMFS issued a final rule to designate additional critical habitat for the leatherback sea turtle. This designation includes approximately 43,798 square kilometers stretching along the California coast from Point Arena to Point Arguello east of the 3000 m depth contour; and 64,760 square kilometers stretching from Cape Flattery, Washington to Cape Blanco, Oregon east of the 2,000 meters depth contour (Figure 28). The designated areas comprise approximately 108,558 square kilometers of marine habitat and include waters from the ocean surface down to a maximum depth of 80 meters. They were designated specifically because of the occurrence of prey species, primarily scyphomedusae of the order Semaeostomeae (i.e., jellyfish), of sufficient condition, distribution, diversity, abundance and density necessary to support individual as well as population growth, reproduction, and development of leatherbacks.

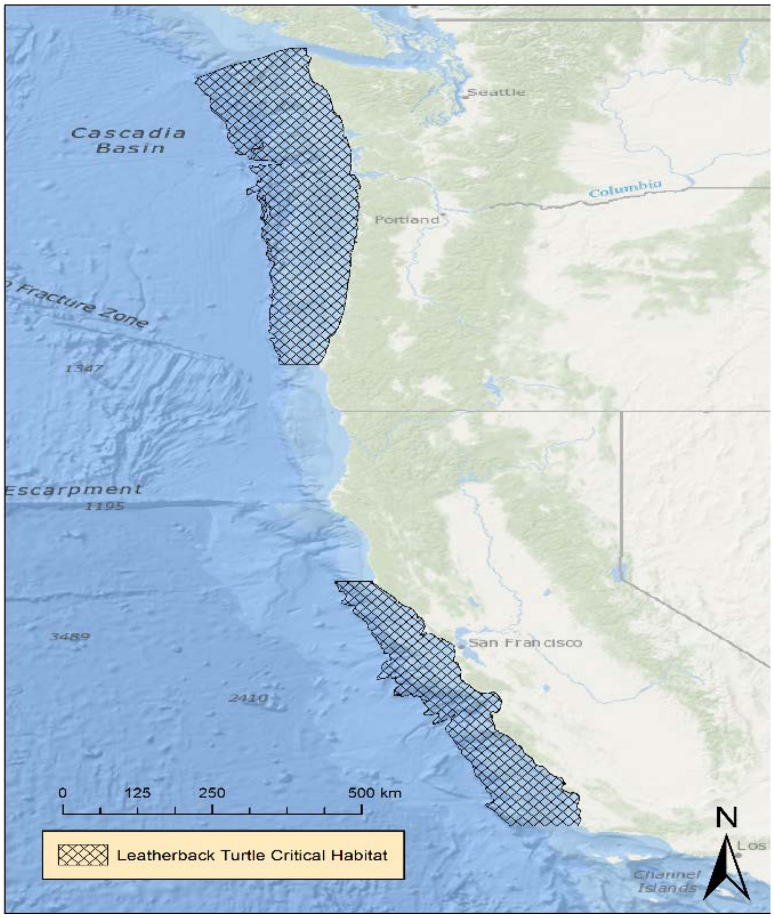


**Figure 28. Map depicting leatherback sea turtle designated critical habitat along the United States Pacific coast.**

### Recovery Goals

See the U.S. Pacific (NMFS and USFWS 1998a) and U.S. Caribbean, Gulf of Mexico and Atlantic Recovery Plans (NMFS and USFWS 1992) for leatherback sea turtles for complete down listing/delisting criteria for each of their respective recovery goals. The following items were the top five recovery actions identified to support in the Leatherback Five Year Action Plan:

1) Reduce fisheries interactions
2) Improve nesting beach protection and increase reproductive output
3) International cooperation
4) Monitoring and research
5) Public engagement

### 6.2.5 Loggerhead Sea Turtle

Loggerhead sea turtles are circumglobal, and are found in the temperate and tropical regions of the Indian, Pacific and Atlantic Oceans (Figure 29).

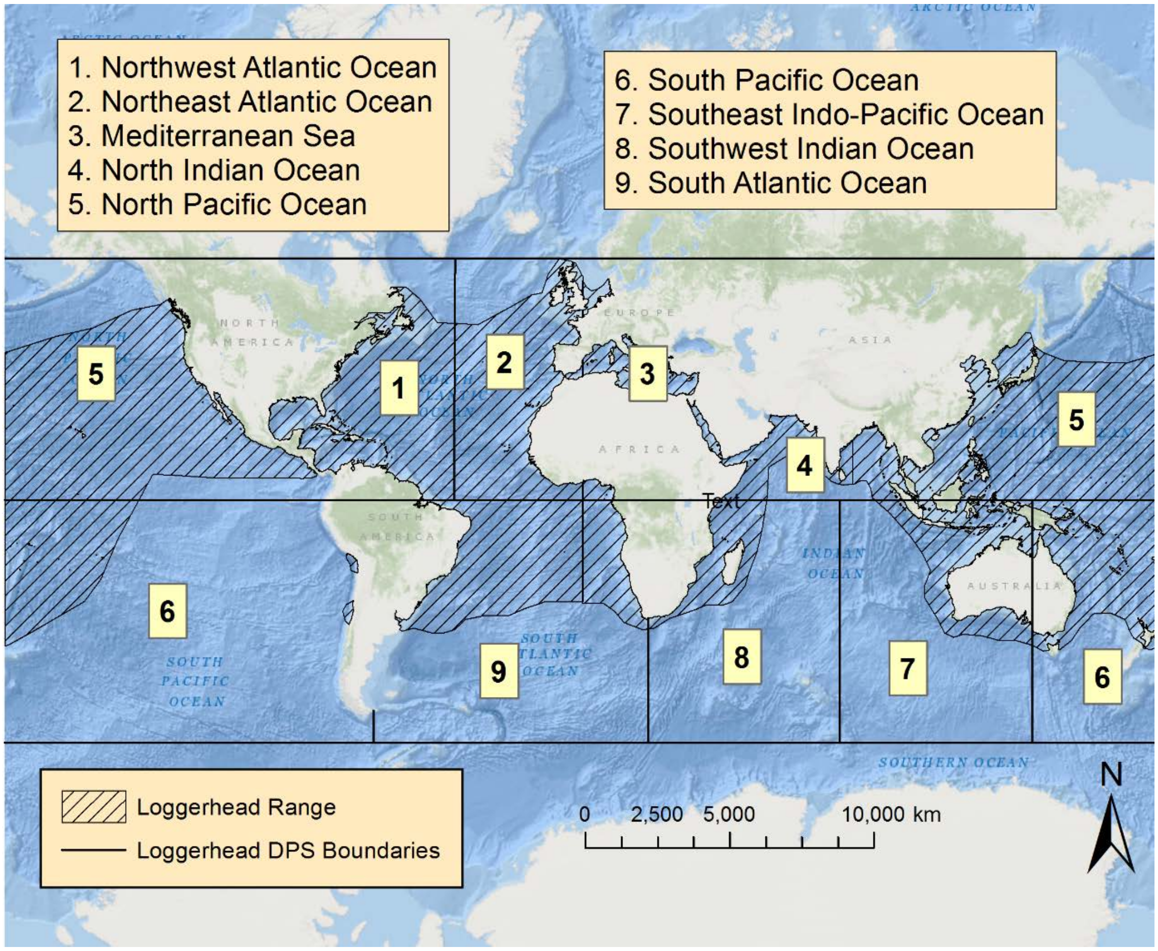


**Figure 29. Map identifying the range and distinct population segment boundaries of the loggerhead sea turtle.**

The loggerhead sea turtle is distinguished from other turtles by its large head and powerful jaws (Figure 30).

**Figure 30. Loggerhead sea turtle. Photos: National Oceanic and Atmospheric Administration (left), Marco Giuliano, Fondazione Cetacea (right).**

The species was first listed as threatened under the Endangered Species Act in 1978. On September 22, 2011, the NMFS designated nine DPSs of loggerhead sea turtles: South Atlantic Ocean and Southwest Indian Ocean as threatened as well as Mediterranean Sea, North Indian Ocean, North Pacific Ocean, Northeast Atlantic Ocean, Northwest Atlantic Ocean, South Pacific Ocean, and Southeast Indo-Pacific Ocean as endangered (Table 9). Recent ocean-basin scale genetic analysis supports this conclusion, with additional differentiation apparent based upon nesting beaches (Shamblin et al. 2014).

**Table 9. Summary of loggerhead sea turtle listing and recovery plan information.**

| Species | Common Name | Distinct Population Segment | ESA Status | Recent Review Year | Listing | Recovery Plan | Critical Habitat |
|---|---|---|---|---|---|---|---|
| *Caretta caretta* | Loggerhead Turtle | Northwest Atlantic Ocean | Threatened | 2009 | 76 FR 58868 09/22/2011 43 FR 32800 07/28/1978 | 74 FR 2995 2008 | 79 FR 39856 Atlantic/GOM 2014 |
| *Caretta caretta* | Loggerhead Turtle | Northeast Atlantic Ocean | Endangered | 2009 | 76 FR 58868 09/22/2011 43 FR 32800 07/28/1978 | N/A | None Designated |
| *Caretta caretta* | Loggerhead Turtle | North Pacific Ocean | Endangered | 2009 | 76 FR 58868 09/22/2011 43 FR 32800 07/28/1978 | 63 FR 28359 1998 | None Designated |
| Caretta caretta | Loggerhead Turtle | South Pacific Ocean | Endangered | 2009 | 76 FR 58868 09/22/2011 43 FR 32800 07/28/1978 | N/A | None Designated |

The DPSs considered in this biological opinion for which take could be authorized are: the North Pacific Ocean and Northwest Atlantic Ocean DPSs. The Northeast Atlantic Ocean DPS and South Pacific Ocean DPS of loggerhead are also included, despite being a foreign water population because the DPS could be caught on the high seas. Animals cannot be visually distinguished by DPS.

We used information available in the 2009 status review (Conant et al. 2009) and the final listing rule (76 FR 58868) to summarize the life history, population dynamics and status of the species, as follows.

**Life History**

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

**Population Dynamics**

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

There is general agreement that the number of nesting females provides a useful index of the species’ population size and stability at this life stage, even though there are doubts about the ability to estimate the overall population size (Bjorndal et al. 2005). Adult nesting females often account for less than one percent of total population numbers. The global abundance of nesting female loggerhead turtles is estimated at 43,320 to 44,560 (Spotila 2004). Abundance estimates for the loggerhead sea turtle DPSs and recovery units (prior to the designation of DPSs) are found in Table 10.

**Table 10. Loggerhead sea turtle abundance estimates for distinct population segments and recovery units.**

| Distinct Population Segment | Abundance Estimate | Citations |
|---|---|---|
| Northwest Atlantic Ocean | 53,000 to 92,000 nests annually | (NMFS SEFSC 2009) |
| Northeast Atlantic Ocean | 12,000 nests annually | (Lino et al. 2010; Marco et al. 2010) |
| North Pacific Ocean | 2,300 nesting females annually; 43,320 to 44,560 individuals | (Matsuzawa 2011; Seminoff et al. 2014) |
| South Pacific Ocean | 200 nesting females annually | (Wabnitz and Andréfouët 2008) |
| Northern Recovery Unit | 5,215 nests, on average; 1989 to 2008 | (NMFS and USFWS 2008) |
| Peninsular Florida Recovery Unit | >10,000 nesting females annually | (Ehrhart et al. 2003) |
| Greater Caribbean Recovery Unit | 903 to 2,700 nests annually | (Ehrhart et al. 2003; NMFS and USFWS 2008; Zurita et al. 2003) |
| Dry Tortugas Recovery Unit | 246 nests annually | (NMFS and USFWS 2007d) |
| Gulf of Mexico Recovery Unit | 100 to 999 nesting females annually | (NMFS SEFSC 2009) |

### Population Growth Rate

Available information on the population growth rates and trends for each of the distinct population segments is presented below.

#### *6.2.5.1 Northwest Atlantic Ocean Distinct Population Segment*

Using a stage/age demographic model, the adult female population size of the DPS is estimated at 20,000 to 40,000 females, and 53,000 to 92,000 nests annually (NMFS SEFSC 2009).

The Peninsular Florida Recovery Unit hosts more than 10,000 females nesting annually, which constitutes eighty-seven percent of all nesting effort in the DPS (Ehrhart et al. 2003). Nest counts taken at index beaches in Peninsular Florida show a significant decline in loggerhead nesting from 1989 to 2006, most likely attributed to mortality of oceanic-stage loggerheads caused by fisheries bycatch (Witherington et al. 2009). Loggerhead nesting on the Archie Carr National Wildlife Refuge (representing individuals of the Peninsular Florida subpopulation) has fluctuated over the past few decades. There was an average of 9,300 nests throughout the 1980s, with the number of nests increasing into the 1990s until it reached an all-time high in 1998, with 17,629 nests. From that point, the number of loggerhead nests at the Refuge have declined steeply to a low of 6,405 in 2007, increasing again to 15,539, still a lower number of nests than in 1998 (Bagley et al. 2013).

The Northern Recovery Unit, from North Carolina to northeastern Florida, and is the second largest nesting aggregation in the DPS, with an average of 5,215 nests from 1989 to 2008, and approximately 1,272 nesting females(NMFS and USFWS 2008). For the Northern recovery unit, nest counts at loggerhead nesting beaches in North Carolina, South Carolina and Georgia declined at 1.9 percent annually from 1983 to 2005 (NMFS and USFWS 2007d).

The Gulf of Mexico Recovery Unit has between one hundred to 999 nesting females annually, and a mean of 910 nests per year. The nesting subpopulation in the Florida panhandle has exhibited a significant declining trend from 1995 to 2005 (Conant et al. 2009; NMFS and USFWS 2007d). Recent model estimates predict an overall population decline of 17 percent for the St. Joseph Peninsula, Florida subpopulation of the Northern Gulf of Mexico recovery unit (Lamont et al. 2014).

The Greater Caribbean Recovery Unit encompasses nesting subpopulations in Mexico to French Guiana, the Bahamas, and the Lesser and Greater Antilles. The majority of nesting for this recovery unit occurs on the Yucatán peninsula, in Quintana Roo, Mexico, with 903 to 2,331 nests annually (Zurita et al. 2003). Other significant nesting sites are found throughout the Caribbean, and including Cuba, with approximately 250 to 300 nests annually (Ehrhart et al. 2003) and over one hundred nests annually in Cay Sal in the Bahamas (NMFS and USFWS 2008).

The population growth rate for each of the four of the recovery units for the Northwest Atlantic DPS (Peninsular Florida, Northern, Northern Gulf of Mexico, and Greater Caribbean) all exhibit negative growth rates (Conant et al. 2009).

#### *6.2.5.2 Northeast Atlantic Ocean Distinct Population Segment*

Loggerheads of the Northeast Atlantic Ocean DPS nest on the islands of the Cape Verde Archipelago, off the coast of western Africa. Boavista Island hosts the largest nesting aggregation, with over 10,000 nests annually, making it the third largest loggerhead nesting population in the world (Marco et al. 2010). Annually, about 1,000 nests were observed in 2009 at Sal island, and the islands of Maio and Sao Nicolau support about 500 nests each (Lino et al. 2010; Marco et al. 2010). Limited nesting occurs on beaches along the coast of Morocco and Senegal (Fretey 2001).

There was not sufficient time series nesting data to calculate population growth rates for the Northeast Atlantic Ocean DPS in the 2009 status review (Conant et al. 2009).

#### *6.2.5.3 North Pacific Ocean Distinct Population Segment*

The North Pacific Ocean DPS has a nesting population of about 2,300 nesting females (Matsuzawa 2011). Loggerhead abundance on foraging grounds off the Pacific Coast of the Baja California Peninsula, Mexico, was estimated to be 43,226 individuals (Seminoff et al. 2014).

Overall, Gilman (2009) estimated that the number of loggerheads nesting in the Pacific has declined by eighty percent in the past twenty years. There was a steep (fifty to ninety percent) decline in the annual nesting population in Japan during the last half of the twentieth century (Kamezaki et al. 2003). Since then, nesting has gradually increased, but is still considered to be depressed compared to historical numbers, and the population growth rate is negative (-0.032) (Conant et al. 2009).

#### *6.2.5.4 South Pacific Ocean Distinct Population Segment*

The South Pacific Ocean DPS has a nesting population of approximately 200 females annually (Wabnitz and Andréfouët 2008).

Overall, Gilman (2009) estimated that the number of loggerheads nesting in the Pacific has declined by eighty percent in the past twenty years. Eastern Australia supported one of the major global loggerhead nesting assemblages until recently (Limpus 1985). For many years, the nesting population at Queensland was in decline; there were approximately 3,500 females in the 1976 and 1977 nesting season, and less than 500 in 1999, representing an 86 percent reduction in the size of the annual nesting population in twenty-three years (Limpus and Reimer 1994; Limpus 1985; Limpus and Limpus 2003). From 2000 to 2009, there has been an increasing number of females nesting. Despite that increase, the arithmetic mean of the log negative population growth rate calculated for various nesting beaches in eastern Australia range from -0.013 to -0.075 (Conant et al. 2009). Population modeling focusing on a nesting beach in Queensland, Australia indicates that the loss of only a few hundred adult and sub-adult females would lead to the extinction of the population in eastern Australia in less than one hundred years (Heppell et al. 1996).

**Genetic Diversity**

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

#### *6.2.5.5 Northwest Atlantic Ocean Distinct Population Segment*

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

#### *6.2.5.6 Northeast Atlantic Ocean Distinct Population Segment*

The Cape Verde Archipelago hosts the highest concentration of Northeast Atlantic Ocean DPS nesting, with most nesting occurring on Boa Vista Island. Mitochondrial DNA analysis of nesting females on Boa Vista Island reveals that the Cape Verde nesting assemblage is genetically distinct from other rookeries, and more similar to Northwest Atlantic Ocean rookeries than those in the nearby Mediterranean (Conant et al. 2009; Monzón-Argüello et al. 2009).

#### *6.2.5.7 North Pacific Ocean Distinct Population Segment*

Recent mitochondrial DNA analysis using longer sequences has revealed a more complex population sub-structure for the North Pacific Ocean DPS. Previously, five haplotypes were present, and now, nine haplotypes have been identified in the North Pacific Ocean DPS. This evidence supports the designation of three management units in the North Pacific Ocean DPS: 1) the Ryukyu management unit (Okinawa, Okinoerabu, and Amami), 2) Yakushima Island management unit and 3) Mainland management unit (Bousou, Enshu-nada, Shikoku, Kii and Eastern Kyushu) (Matsuzawa et al. 2016). Genetic analysis of loggerheads captured on the feeding grounds of Sanriku, Japan, found only haplotypes present in Japanese rookeries (Nishizawa et al. 2014).

#### *6.2.5.8 South Pacific Ocean Distinct Population Segment*

South Pacific Ocean DPS loggerheads possess three haplotypes, including one dominant haplotype not found elsewhere (Conant et al. 2009).

**Distribution**

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

#### *6.2.5.9 Northwest Atlantic Ocean Distinct Population Segment*

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

#### *6.2.5.10 Northeast Atlantic Ocean Distinct Population Segment*

Loggerheads from the eastern Atlantic can migrate west to feeding grounds. Individuals from the Cape Verde nesting beaches can be found in foraging aggregations in Nicaragua (4 percent), Panama (3.8 percent), Azores and Madiera (7.2 percent), Canary Islands and Andalusia (6.2 percent), Gulf of Mexico (2.0 percent), the southern Atlantic coast of Florida (2.5 percent), and Brazil (1.0 percent) (Masuda 2010). Juvenile loggerheads from Cape Verde are thought to drift predominantly westward using the southern branch of the North Atlantic gyre (Monzón-Argüello et al. 2012).

#### *6.2.5.11 North Pacific Ocean Distinct Population Segment*

Hatchlings from Japanese nesting beaches use the North Pacific Subtropical Gyre and the Kurishio Extension to migrate to foraging grounds. Two major juvenile foraging areas have been identified in the North Pacific Basin: Central North Pacific and off of Mexico’s Baja California Peninsula. Both of these feeding grounds are frequented by individuals from Japanese nesting beaches (Abecassis et al. 2013; Seminoff et al. 2014).

#### *6.2.5.12 South Pacific Ocean Distinct Population Segment*

Loggerheads hatched on beaches in the southwest Pacific range widely in the southern portion of the basin, with individuals from nesting beaches in western Australia found as far east as Peruvian coast foraging areas (Boyle et al. 2009). Loggerheads from Australia and New Caledonia do not appear to go north of the equator. Loggerhead sea turtles are also present in the waters offshore northern Chile and Peru, where they comprise the majority of sea turtle bycatch in commercial fisheries (Alfaro-Shigueto et al. 2011; Donoso and Dutton 2010).

**Status**

Once abundant in tropical and subtropical waters, loggerhead 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 greatest threats to their recovery. In addition, bycatch in drift-net, long-line, set-net, pound-net and trawl fisheries kill thousands of loggerhead 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.

#### *6.2.5.13 Northwest Atlantic Ocean Distinct Population Segment*

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

#### *6.2.5.14 Northeast Atlantic Ocean Distinct Population Segment*

Due to the on-going harvest of females, low hatchling and emergence success, and mortality of juveniles and adults from fishing bycatch, the Northeast Atlantic Ocean DPS is predicted to have a high likelihood of decline (Conant et al. 2009).

#### *6.2.5.15 North Pacific Ocean Distinct Population Segment*

Neritic juveniles and adults in the North Pacific Ocean DPS are at risk of mortality from coastal fisheries in Japan and Baja California, Mexico. Habitat degradation in the form of coastal development and armoring pose a threat to nesting females. Based on these threats and the relatively small population size, the Biological Review Team concluded that the North Pacific Ocean DPS is currently at risk of extinction (Conant et al. 2009).

#### *6.2.5.16 South Pacific Ocean Distinct Population Segment*

Based on nest count data from the past thirty years, and mortality of juveniles and adults from fishery bycatch, the South Pacific Ocean DPS is at risk, and is likely to decline in the foreseeable future (Conant et al. 2009; Limpus 2008).

**Designated Critical Habitat**

#### *6.2.5.17 Northwest Atlantic Ocean Distinct Population Segment*

NMFS has designated critical habitat for the Northwest Atlantic Ocean DPS loggerhead sea turtles. On July 10, 2014, NMFS and FWS designated critical habitat for the Northwest Atlantic Ocean DPS loggerhead sea turtles along the U.S. Atlantic and Gulf of Mexico coasts from North Carolina to Mississippi. These areas contain one or a combination of nearshore reproductive habitat, winter area, breeding areas, and migratory corridors. The critical habitat is categorized into 38 occupied marine areas and 685 miles of nesting beaches (Figure 31).

The physical or biological features and primary constituent elements identified for the different habitat types include waters adjacent to high density nesting beaches, waters with minimal obstructions and manmade structures, high densities of reproductive males and females, appropriate passage conditions for migration, conditions that support sargassum habitat, available prey, and sufficient water depth and proximity to currents to ensure offshore transport of post-hatchlings.

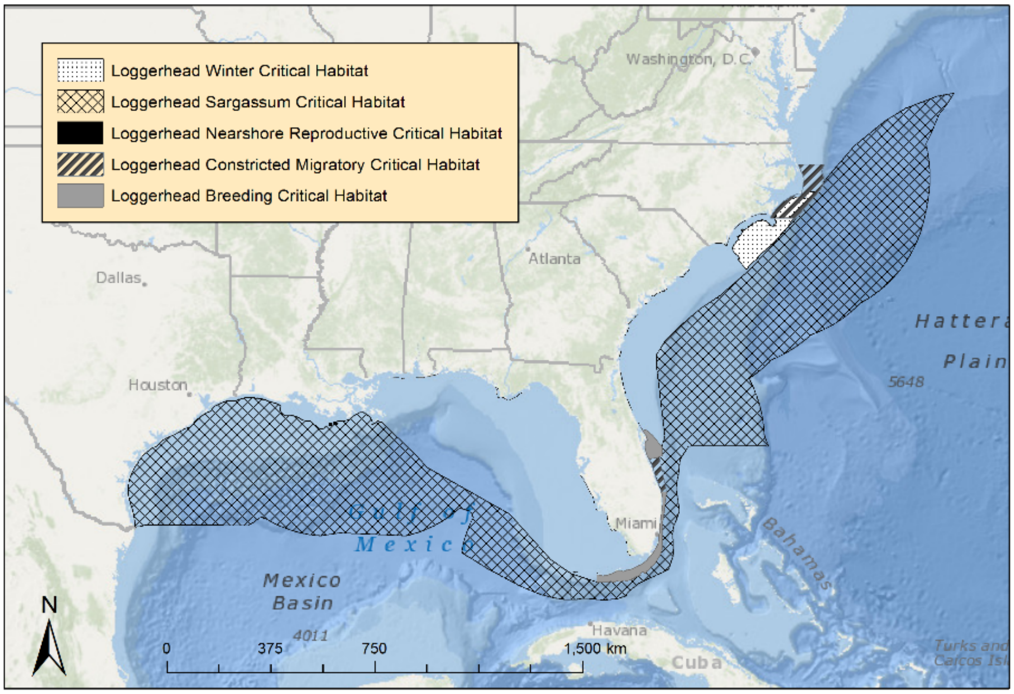


**Figure 31. Map depicting loggerhead turtle designated critical habitat.**

## Recovery Goals

See the 2008 Final Recovery Plan (NMFS and USFWS 2008) for the Northwest Atlantic Population of Loggerheads for complete down listing/delisting criteria for each of the following recovery objectives.

1. Ensure that the number of nests in each recovery unit is increasing and that this increase corresponds to an increase in the number of nesting females.
2. Ensure the in-water abundance of juveniles in both neritic and oceanic habitats is increasing and is increasing at a greater rate than strandings of similar age classes.
3. Manage sufficient nesting beach habitat to ensure successful nesting.
4. Manage sufficient feeding, migratory and inter-nesting marine habitats to ensure successful growth and reproduction.
5. Eliminate legal harvest.
6. Implement scientifically based nest management plans.
7. Minimize nest predation.
8. Recognize and respond to mass/unusual mortality or disease events appropriately.
9. Develop and implement local, state, Federal and international legislation to ensure long-term protection of loggerheads and their terrestrial and marine habitats.
10. Minimize bycatch in domestic and international commercial and artisanal fisheries.
11. Minimize trophic changes from fishery harvest and habitat alteration.
12. Minimize marine debris ingestion and entanglement.
13. Minimize vessel strike mortality.

### 6.2.6 Olive Ridley Sea Turtle

The olive ridley sea turtle is a small, mainly pelagic, sea turtle with a circumtropical distribution (Figure 32).

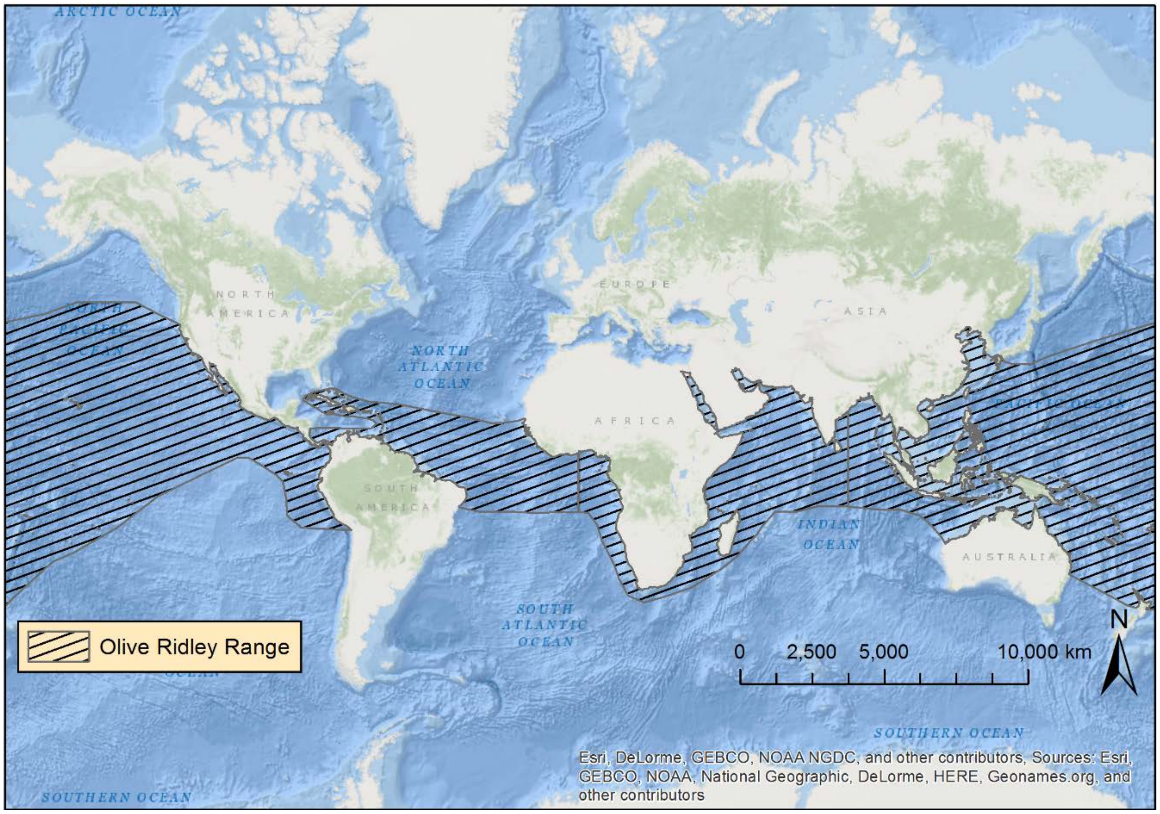


**Figure 32. Map identifying the range of the olive ridley sea turtle.**

Olive ridley sea turtles are olive or grayish-green in color, with a heart-shaped carapace (Figure 33).

**Figure 33. Olive ridley sea turtle. Photo: Reuven Walder (left), Michael Jensen (right).**

The species was listed under the ESA on July 28, 1978. The species was separated into two listing designations: endangered for breeding populations on the Pacific coast of Mexico, and threatened wherever found except where listed as endangered (i.e., in all other areas throughout its range) (Table 11).

**Table 11. Summary of olive ridley sea turtle listing and recovery plan information.**

| Species | Common Name | Distinct Population Segment | ESA Status | Recent Review Year | Listing | Recovery Plan | Critical Habitat |
|---|---|---|---|---|---|---|---|
| *Lepidochelys olivacea* | Olive Ridley Turtle | Mexico's Pacific coast breeding population | Endangered | 2014 | 43 FR 32800 7/28/1978 | 63 FR 28359 U.S. Pacific 1998 | None Designated |
| *Lepidochelys olivacea* | Olive Ridley Turtle | All other populations | Threatened | 2014 | 43 FR 32800 7/28/1978 | 63 FR 28359 U.S. Pacific 1998 | None Designated |

We used information available in the 2014 five-year review (NMFS and USFWS 2014) to summarize the life history, population dynamics and status of the threatened olive ridley sea turtle, as follows.

**Life History**

Olive ridley females mature at ten to eighteen years of age. They lay an average of two clutches per season (three to six months in duration). The annual average clutch size is one hundred to 110 eggs per nest. Olive ridleys commonly nest in successive years. Females nest in solitary or in arribadas, large aggregations coming ashore at the same time and location. As adults, olive ridleys forage on crustaceans, fish, mollusks, and tunicates, primarily in pelagic habitats.

**Population Dynamics**

The following is a discussion of the species' population and its variance over time. This section includes: abundance, population growth rate, genetic diversity, and spatial distribution as it relates to the endangered range-wide population of the olive ridley sea turtle.

***6.2.6.1 Mexico's Pacific Coast Breeding Population***

Olive ridley sea turtles are thought to be the most abundant species of sea turtle. Shipboard transects along the Mexico and Central American coasts between 1992 and 2006 indicate an estimated 1.39 million adults. There are six primary arribada nesting beaches in Mexico, the largest being La Escobilla, with about one million nesting females annually. There are several monitored nesting beaches where solitary nesting occurs. At Nuevo Vallarta, about 4,900 nests are laid annually.

Based on the number of olive ridleys nesting in Mexico, populations appear to be increasing in one location (La Escobilla: from 50,000 nests in 1988 to more than one million in 2000), decreasing at Chacahua, and stable at all others. At-sea estimates of olive ridleys off of Mexico and Central America also support an increasing population trend.

#### 6.2.6.2 All Other Populations

Globally, olive ridley sea turtles can be found in tropical and subtropical waters in the Atlantic, Pacific and Indian Oceans. The range of the endangered Pacific coast breeding population extends as far south as Peru and up to California. Olive ridley sea turtles of the Pacific coast breeding colonies nest on arribada beaches at Mismaloya, Ixtapilla and La Escobilla, Mexico. Solitary nesting takes place all along the Pacific coast of Mexico.

Olive ridley sea turtles are thought to be the most abundant species of sea turtle, and can be found in the Atlantic, Indian and Pacific Oceans. There is no global estimate of olive ridley abundance, and we rely on nest counts and nesting females to estimate abundance in each of the ocean basins, described below. However, Eguchi et al. (2007) estimated a weighted average of the yearly abundance estimates as 1.39 million (confidence interval: 1.15 to 1.62 million).

In the Western Atlantic, two arribada nesting beaches occur in Suriname and French Guiana. The Cayenne Peninsula in French Guiana hosts about 2,000 nests annually, while the Galibi Nature Reserve in Suriname had 335 nests in 1995. Solitary nesting also occurs elsewhere in Suriname, Guyana and French Guiana, although no abundance estimates are available. In Sergipe, Brazil, solitary nesting amounted to about 2,600 nests in 2002 and 2003.

In the Eastern Atlantic, there are no arribada nesting beaches, but solitary nesting occurs in several countries along the western coast of Africa, from Gambia to Angola. For many countries, there are no abundance estimates available. For beaches with data available (Angola, the Republic of Congo, the Democratic Republic of Congo, Equatorial Guinea and Guinea Bissau), nest counts are low, with most monitoring taking place for only a few years. The most abundant nesting beaches are Orango National Park in Guinea Bissau, which had between 170 and 620 nests from 1992 to 1994; and the Republic of Congo, which had between 300 and 600 nests annually from 2003 to 2010 (NMFS and USFWS 2014).

In the Indian Ocean, three arribada nesting beaches are found in India, amounting to 150,000-200,000 nesting females annually. Solitary nesting also occurs elsewhere in the region, in eastern Africa, Oman, India, Pakistan, and other southeast Asian countries; for many, there are no estimates available. The largest recorded solitary nesting beach is in Myanmar, when in 1999, 700 nests were counted (NMFS and USFWS 2014).

There are no known arribada nesting beaches in the western Pacific Ocean; however, some solitary nesting occurs in Australia, Brunei, Malaysia, Indonesia and Vietnam. Data are lacking for many sites. Terengganu, Malaysia had ten nests in 1998 and 1999. Alas Purwo, Indonesia, had 230 nests annually from 1993 to 1998.

In the eastern Pacific Ocean (excluding breeding populations in Mexico), there are arribada nesting beaches in Nicaragua, Costa Rica and Panama. La Flor, Nicaragua had 521,440 effective nesting females in 2008 and 2009; Chacocente, Nicaragua had 27,947 nesting females over the same period (Gago et al. 2012). Two other arribada nesting beaches are in Nicaragua, Masachapa and Pochomil, but there are no abundance estimates available. Costa Rica hosts two major arribada nesting beaches; Ostional has between 3,564 and 476,550 turtles per arribada, and Nancite has between 256 and 41,149 turtles per arribada. Panama has one arribada nesting beach, with 8,768 turtles annually.

There are several solitary nesting beaches in the East Pacific Ocean (excluding breeding populations in Mexico); however no abundance estimates are available for beaches in El Salvador, Honduras, Nicaragua, Costa Rica, Panama, Columbia and Ecuador. On Hawaii Beach in Guatemala, 1,004 females were recorded in 2005 (NMFS and USFWS 2014).

**Population Growth**

Population growth rate and trend information for the threatened population of olive ridley sea turtles is difficult to discern, owing to its range over a large geographic area, and a lack of consistent monitoring data in all nesting areas. Below, we present the any known population trend information for olive ridley sea turtles by ocean basin (NMFS and USFWS 2014).

Nesting at arribada beaches in French Guiana appears to be increasing, while in Suriname, nesting has declined by more than ninety percent since 1968. Solitary nesting also occurs elsewhere in Suriname, Guyana and French Guiana; no trend data are available. Solitary nesting in Brazil appears to be increasing, with one hundred nests recorded in 1989 to 1990, to 2,606 in 2002 to 2003.

In the Eastern Atlantic, trend data is not available for most solitary nesting beaches. Nest counts in the Republic of Congo decreased from 600 nests in 2003 and 2004 to less than 300 in 2009 and 2010.

The three arribada nesting beaches in India: Gahirmatha, Rushikulya, and Devi River are considered stable over three generations. There is no trend data available for several solitary nesting beaches in the Indian Ocean. However, even for the few beaches with short-term monitoring, the nest counts are believed to represent a decline from earlier years.

There are no arribada nesting beaches in the Western Pacific Ocean. Data are lacking or inconsistent for many solitary nesting beaches in the Western Pacific, so it is not possible to assess population trends for these sites. Nest counts at Alas Purwo, Indonesia, appear to be increasing, the nest count at Terengganu, Malaysia, is thought to be a decline from previous years.

Population trends at Nicaraguan arribada nesting beaches are unknown or stable (La Flor). Ostional, Costa Rica arribada nesting beach is increasing, while trends Nancite, Costa Rica, and Isla Cañas, Panama, nesting beaches are declining. For most solitary nesting beaches in the East Pacific Ocean, population trends are unknown, except for Hawaii Beach, Guatemala, which is decreasing.

**Genetic Diversity**

Genetic studies have identified four main lineages for the olive ridley: east India, Indo-Western Pacific, Atlantic, and the eastern Pacific. In the eastern Pacific, rookeries on the Pacific Coasts of Costa Rica and Mexico were not genetically distinct, and fine-scale population structure was not found when solitary and arribada nesting beaches were examined. There was no population subdivision among olive ridleys along the east India coastline. Low levels of genetic diversity among Atlantic French New Guinea and eastern Pacific Baja California nesting sites are attributed to a population collapse caused by past overharvest (NMFS and USFWS 2014).

**Distribution**

Globally, olive ridley sea turtles can be found in tropical and subtropical waters in the Atlantic, Pacific and Indian Oceans. Major nesting arribada beaches are found in Nicaragua, Costa Rica, Panama, India and Suriname. The range of the endangered Pacific coast breeding population extends as far south as Peru and up to California. Olive ridley sea turtles of the Pacific coast breeding colonies nest on arribada beaches at Mismaloya, Ixtapilla and La Escobilla, Mexico. Solitary nesting takes place all along the Pacific coast of Mexico.

**Status**

#### *6.2.6.3 Mexico's Pacific Coast Breeding Population*

In the first half of the twentieth century, there was an estimated ten million olive ridleys nesting on the Pacific coast of Mexico. Olive ridleys became targeted in a fishery in Mexico and Ecuador, which severely depleted the population; there was an estimated one million olive ridleys by 1969. Olive ridley breeding populations on the Pacific coast of Mexico were listed as endangered in response to this severe population decline. Legal harvest of olive ridleys has been prohibited, although illegal harvest still occurs. The population is threatened by incidental capture in fisheries, exposure to pollutants and climate change. In spite of the severe population decline, the olive ridley breeding populations on the Pacific coast of Mexico appear to be resilient, evidenced by the increasing population.

#### *6.2.6.4 All Other Populations*

It is likely that solitary nesting locations once hosted large arribadas; since the 1960s, populations have experienced declines in abundance of fifty to eighty percent. Many populations continue to decline. Olive ridley sea turtles continue to be harvested as eggs and adults, legally in some areas, and illegally in others. Incidental capture in fisheries is also a major threat. The olive ridley sea turtle is the most abundant sea turtle in the world; however, several populations are declining as a result of continued harvest and fisheries bycatch. The large population size of the range-wide population, however, allows some resilience to future perturbation.

**Designated Critical Habitat**

No critical habitat has been designated for olive ridley sea turtles.

**Recovery Goals**

There has not been a Recovery Plan prepared specifically for olive ridley sea turtles of the breeding populations of the Pacific coast of Mexico. The 1998 Recovery Plan was prepared for olive ridleys found in the U.S. Pacific. Olive ridley sea turtles found in the Pacific could originate from the Pacific coast of Mexico or from another nesting population. As such, the recovery goals in the 1998 Recovery Plan for the U.S. Pacific olive ridley sea turtle can apply to both listed populations. See the 1998 Recovery Plan for the U.S. Pacific olive ridley sea turtles for complete down listing/delisting criteria for their recovery goals. The following items were the recovery criteria identified to consider delisting:

1. All regional stocks that use U.S. waters have been identified to source beaches based on reasonable geographic parameters
2. Foraging populations are statistically significantly increasing at several key foraging grounds within each stock region
3. All females estimated to nest annually at source beaches are either stable or increasing for over ten years
4. Management plan based on maintaining sustained populations for turtles is in effect
5. International agreements in place to protect shared stocks

### 6.2.7 Gulf of Maine Atlantic Salmon

The Atlantic salmon is an anadromous fish, occupying freshwater streams in North America (Figure 34). Adult Atlantic salmon are silver-blue with dark spots. They average 8-12 pounds but can get as large as 30 pounds.

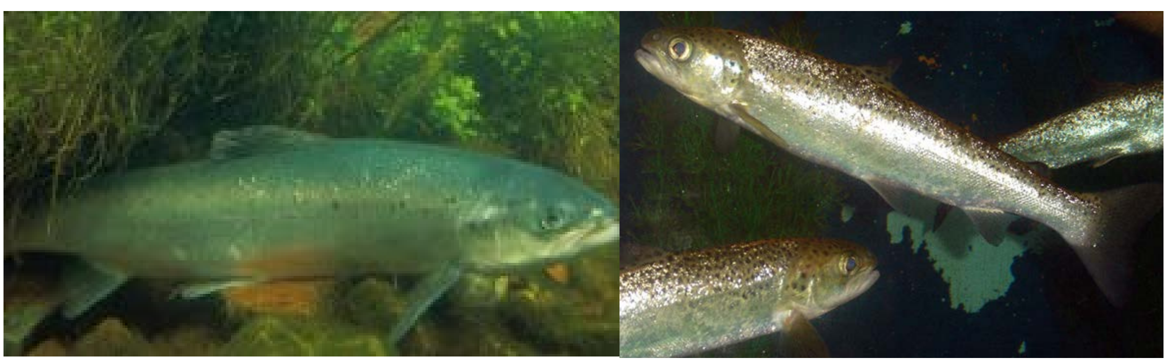

**Figure 34. Atlantic salmon. Photo: William Hartley, United States Fish and Wildlife Service (left), Betty Holmes, NOAA Northeast Fisheries Science Center (right).**

There are three Atlantic salmon DPSs in the United States: Long Island Sound, Central New England, and the GOM (Fay et al. 2006a). The GOM DPS Atlantic salmon are found in watersheds throughout Maine (Figure 35).

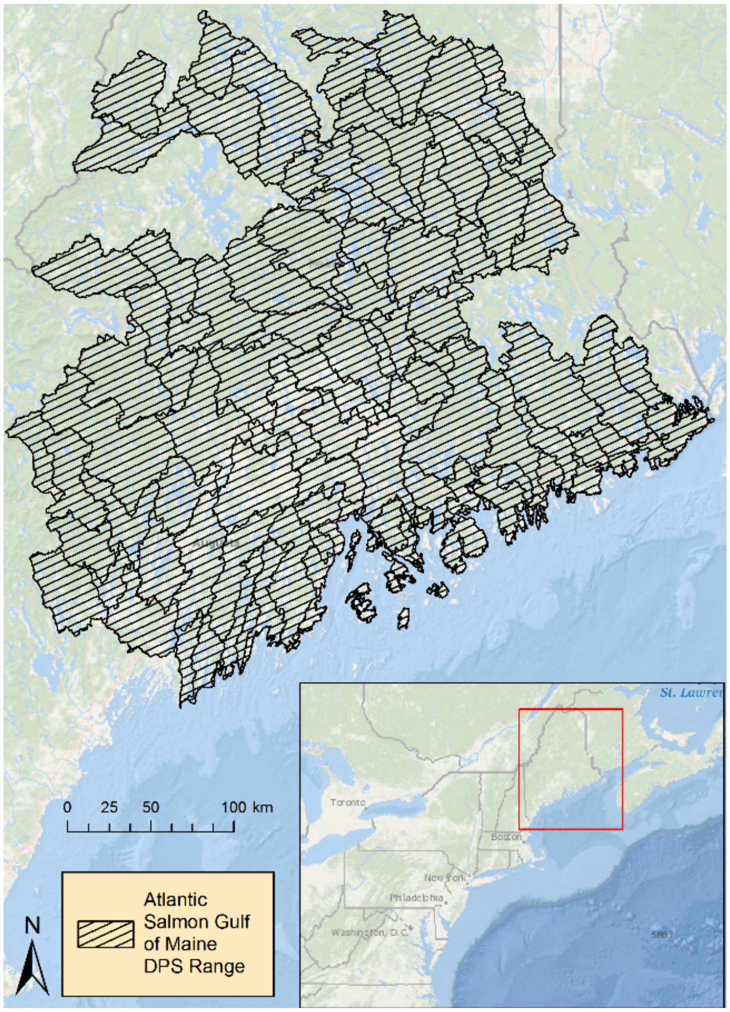


**Figure 35. Map identifying the range of Gulf of Maine Atlantic salmon.**

The GOM DPS was first listed as endangered by the U. S. Fish and Wildlife Service and NMFS on November 17, 2000 (Table 12). The listing was refined by the Services on June 19, 2009, to include all anadromous Atlantic salmon whose freshwater range occurs in the watersheds from the Androscoggin River northward along the Maine coast to the Dennys River, and wherever these fish occur in the estuarine and marine environment.

**Table 12. Summary of Atlantic salmon listing and recovery plan information.**

| Species | Common Name | Distinct Population Segment | ESA Status | Recent Review Year | Listing | Recovery Plan | Critical Habitat |
|---|---|---|---|---|---|---|---|
| *Salmo salar* | Atlantic salmon | Gulf of Maine | Endangered | 2006 | 74 FR 29344 06/19/2009 | 70 FR 75473 2005 Draft Plan 2016 | 74 FR 29300 Maine |

We used information available in the 2006 status review (Fay et al. 2006a) and recent scientific publications to summarize the life history, population dynamics and status of the species, as follows.

**Life History**

Atlantic salmon have a complex life history that ranges from territorial rearing in rivers to extensive feeding migrations on the high seas. Most adult Atlantic salmon ascend the rivers of New England beginning in the spring, continuing into the fall with the peak occurring in June. Adult Atlantic salmon typically spawn around early November and eggs hatch in late March or April. Preferred spawning habitat is a gravel substrate with adequate water circulation to keep the buried eggs well oxygenated. Juveniles spend about two years feeding in freshwater until they weigh approximately two ounces and are six inches in length. Smoltification (the physiological and behavioral changes required for the transition to saltwater) usually occurs at age two for GOM DPS Atlantic salmon. GOM DPS Atlantic salmon migrate more than 4,000 kilometers in the open ocean to reach feeding areas in the Davis Strait between Labrador and Greenland. The majority of GOM DPS Atlantic salmon (about ninety percent) spend two winters at sea before reaching maturity and returning to their natal rivers, with the remainder spending one or three winters at sea. At maturity, GOM DPS Atlantic salmon typically weigh between eight to fifteen pounds and average thirty inches in length. Atlantic salmon are iteroparous (i.e., capable of spawning more than once).

**Population Dynamics**

GOM DPS Atlantic salmon can be found in at least eight rivers in Maine: Dennys River, East Machias River, Machias River, Pleasant River, Narraguagus River, Ducktrap River, Sheepscot River, Cove Brook, Penobscot River, Androscoggin River and the Kennebec River. The GOM DPS Atlantic salmon is genetically distinct from other Atlantic salmon populations in Canada, and can be further delineated into stocks: Downeast Coastal stock which includes the Dennys, East Machias, Machias, Pleasant and Narraguagus Rivers; Penobscot Bay stock; and the Merrymeeting Bay (Sheepscot) stock. The hatchery supplementation programs for the Penobscot and Merrymeeting Bays stocks use river-specific broodstock (USASAC 2016). The conservation hatchery program plays a significant role in the persistence of GOM DPS Atlantic salmon. Adult returns of GOM DPS Atlantic salmon captured in six Maine rivers from 1997 to 2004 ranged from 567 to 1,402. These counts include both wild and hatchery origin fish. Each year, the majority (ninety-two to ninety-eight percent) of adult returns were found in the Penobscot River; the Narraguagus River supported between 0.8 to 4.1 percent of adult returns during those years (Fay et al. 2006a). In 2015, four million juvenile salmon (eggs, fry, parr and smolts) and 4,271 adults were stocked in the Connecticut, Merrimack, Saco, Penobscot and five other coastal rivers in Maine (USASAC 2016). The total number of adult returns to U.S. rivers in 2015 was 921, the majority (eighty percent) of which were of hatchery origin. The fact that so few of the returning adults are naturally-reared is concerning to managers; the reliance on hatcheries can pose risks such as artificial selection, inbreeding depression and outbreeding depression (Fay et al. 2006a). There is no population growth rate available for GOM DPS Atlantic salmon. However, the consensus is that the DPS exhibits a continuing declining trend (NOAA 2016).

**Status**

Historically, Atlantic salmon occupied U.S. rivers throughout New England, with an estimated 300,000 to 500,000 adults returning annually (Fay et al. 2006a). Of the three DPSs found in the United States, native salmon in the Long Island Sound and Central New England DPSs were extirpated in the 1800s. Several rivers within these DPSs are presently stocked with GOM DPS salmon. The GOM DPS Atlantic salmon was listed as endangered in response to population decline caused by many factors, including overexploitation, degradation of water quality and damming of rivers, all of which remain persistent threats (Fay et al. 2006a). Coastal development poses a threat as well, as artificial light can disrupt and delay fry dispersal (Riley et al. 2013). Climate change may cause changes in prey availability and thermal niches, further threatening Atlantic salmon populations (Mills et al. 2013). Even with current conservation efforts, returns of adult Atlantic salmon to the GOM DPS rivers remain extremely low, with an estimated extinction risk of nineteen to seventy-five percent in the next one hundred years (Fay et al. 2006a). Estimated Atlantic salmon returns to U.S. rivers from 2005 to 2015 range from a low in 2014 of 450 to a high in 2011 of 4,178 (USASAC 2016). Based on the information above, the species would likely have a low resilience to additional perturbations.

**Designated Critical Habitat**

NMFS and the USFWS designated critical habitat for the GOM DPS on June 19, 2009, which identified essential physical and biological features of Atlantic salmon spawning and rearing sites and migration routes. These include freshwater and estuary migratory sites free from physical and biological barriers that can delay or prevent spawning migrations or smolt emigration, and freshwater and estuary migration sites with abundant, diverse native fish communities to serve as a protective buffer against predation. The action area for this opinion does not overlap with designated critical habitat for the GOM DPS of Atlantic salmon.

**Recovery Goals**

See the 2016 Draft Recovery Plan for the GOM DPS Atlantic Salmon (USFWS and NMFS 2016), for complete down listing/delisting criteria for each of their respective recovery goals. Recovery actions identified in the Draft Recovery Plan include the following:

1) Enhance connectivity between ocean and freshwater habitats important for recovery
2) Maintain the genetic diversity of Atlantic salmon populations over time
3) Increase adult spawners through the conservation hatchery program

4) Increase Atlantic salmon survival through increased ecosystem understanding and identification of spatial and temporal constraints to salmon marine productivity to inform and support management actions that improve survival

5) Consult with all involved Tribes on a government-to-government basis

6) Collaborate with partners and engage interested parties in recovery efforts

### 6.2.8 Smalltooth Sawfish, U.S. Portion of Range

The smalltooth sawfish (*Pristis pectinata*) is a tropical marine and estuarine elasmobranch. Although they are rays, sawfish physically resemble sharks, with only the trunk and especially the head ventrally flattened. Smalltooth sawfish are characterized by their "saw," a long, narrow, flattened rostral blade with a series of transverse teeth along either edge (NMFS 2009c) (Figure 36).

**Figure 36. Smalltooth sawfish. Photo: Florida Museum of Natural History (left), R. Dean Grubbs (right).**

Although this species is reported to have a circumtropical distribution, NMFS identified smalltooth sawfish from the southeast United States as a DPS. Within the U.S., smalltooth sawfish have been captured in estuarine and coastal waters from New York southward through Texas, although peninsular Florida has historically been the region of the United States with the largest number of recorded captures (NMFS 2010c) (Figure 37).

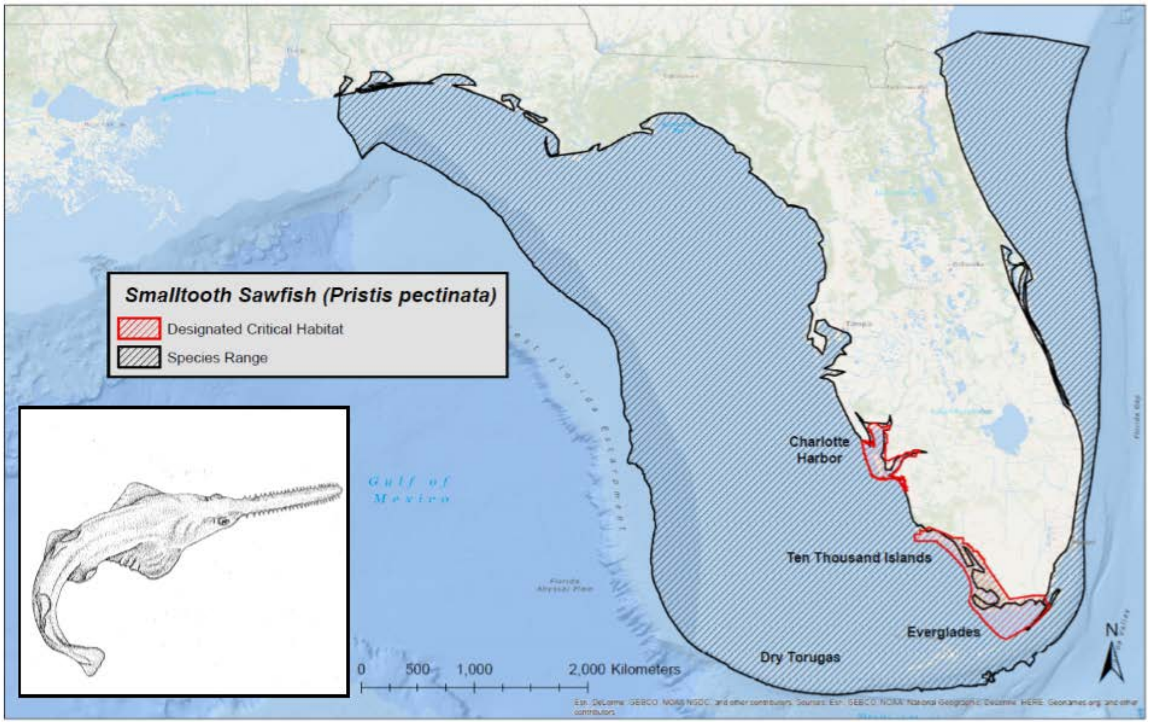


**Figure 37. Smalltooth sawfish range and designated critical habitat.**

The U.S. DPS of smalltooth sawfish was listed as endangered under the ESA effective May 1, 2003 (Table 13).

**Table 13. Summary of smalltooth sawfish listing and recovery plan information.**

| Species | Common Name | Distinct Population Segment | ESA Status | Recent Review Year | Listing | Recovery Plan | Critical Habitat |
|---|---|---|---|---|---|---|---|
| *Pristis pectinata* | Sawfish, smalltooth | U.S. portion of range | Endangered | 2010 | 68 FR 15674 04/01/2003 | 74 FR 3566 2009 | 74 FR 45353 Florida |

## Life History

Smalltooth sawfish size at sexual maturity has been reported as 360 centimeters total length (TL) by Simpfendorfer (2005). Carlson and Simpfendorfer (2015) estimated that sexual maturity for females occurs between 7 and 11 years of age. As in all elasmobranchs, smalltooth sawfish are viviparous; fertilization is internal. The gestation period for smalltooth sawfish is estimated at five months based on data from the largetooth sawfish (Thorson 1976). Females move into shallow estuarine and nearshore nursery areas to give birth to live young between November and July, with peak parturition occurring between April and May (Poulakis et al. 2011). Litter sizes range between 10 and 20 individuals (Bigalow and Schroeder 1953; Carlson and Simpfendorfer 2015; Simpfendorfer 2005).

Neonate smalltooth sawfish are born measuring 67 to 81 centimeters TL and spend the majority of their time in the shallow nearshore edges of sand and mud banks (Poulakis et al. 2011; Simpfendorfer et al. 2010). Once individuals reach 100 to 140 centimeters TL they begin to expand their foraging range. Capture data suggests smalltooth sawfish in this size class may move throughout rivers and estuaries within a salinity range of 18 and 30 (practical salinity units). Individuals in this size class also appear to have the highest affinity to mangrove habitat (Simpfendorfer et al. 2011). Juvenile sawfish spend the first 2 to 3 years of their lives in the shallow waters provided in the lower reaches of rivers, estuaries, and coastal bays (Simpfendorfer et al. 2008; Simpfendorfer et al. 2011). As smalltooth sawfish approach 250 centimeters TL they become less sensitive to salinity changes and begin to move out of the protected shallow-water embayments and into the shorelines of barrier islands (Poulakis et al. 2011). Adult sawfish typically occur in more open-water, marine habitats (Poulakis and Seitz 2004).

**Population Dynamics**

The abundance of smalltooth sawfish in U.S. waters has decreased dramatically over the past century. Efforts are currently underway to provide better estimates of smalltooth sawfish abundance (NMFS 2014b). Current abundance estimates are based on encounter data, genetic sampling, and geographic extent. Carlson and Simpfendorfer (2015) used encounter densities to estimate the female population size to be 600. Chapman et al. (2011) analyzed genetic data from tissue samples (fin clips) to estimate the effective genetic population size as 250 to 350 adults (95 percent confidence interval from 142 to 955). Simpfendorfer (2002) estimated that the U.S. population may number less than five percent of historic levels based on the contraction of the species' range.

The abundance of juveniles encountered in recent studies (Poulakis et al. 2014; Seitz and Poulakis 2002; Simpfendorfer and Wiley 2004) suggests that the smalltooth sawfish population remains reproductively viable. The overall abundance appears to be stable (Wiley and Simpfendorfer 2010). Data analyzed from the Everglades portion of the smalltooth sawfish range suggests that the population growth rate for that region may be around five percent per year (Carlson and Osborne 2012; Carlson et al. 2007). Intrinsic rates of growth ($\lambda$) for smalltooth sawfish have been estimated at 1.08 to 1.14 per year and 1.237 to 1.150 per year by Simpfendorfer (2000) and Carlson and Simpfendorfer (2015) respectively. However, these intrinsic rates are uncertain due to the lack of long-term abundance data.

Chapman et al. (2011) investigated the genetic diversity within the smalltooth sawfish population. The study reported that the remnant population exhibits high genetic diversity (allelic richness, alleles per locus, heterozygosity) and that inbreeding is rare. The study also suggested that the protected population will likely retain greater than 90 percent of its current genetic diversity over the next century.

Recent capture and encounter data suggest that the current distribution is focused primarily to south and southwest Florida from Charlotte Harbor through the Dry Tortugas (Poulakis and Seitz 2004; Seitz and Poulakis 2002). Water temperatures (no lower than 16 to 18 degrees Celsius) and the availability of appropriate coastal habitat (shallow, euryhaline waters and red mangroves) are the major environmental constraints limiting the distribution of smalltooth sawfish (Bigalow and Schroeder 1953).

**Status**

The decline in the abundance of smalltooth sawfish has been attributed to fishing (primarily commercial and recreational bycatch), habitat modification (including changes to freshwater flow regimes as a result of climate change), and life history characteristics (i.e., slow-growing, relatively late-maturing, and long-lived species) (NMFS 2009c; Simpfendorfer et al. 2011). These factors continue to threaten the smalltooth sawfish population. Recent records indicate there is a resident reproducing population of smalltooth sawfish in south and southwest Florida from Charlotte Harbor through the Dry Tortugas, which is also the last U.S. stronghold for the species (Poulakis and Seitz 2004; Seitz and Poulakis 2002; Simpfendorfer and Wiley 2004). Recent information indicates the smalltooth sawfish population is likely stable or increasing (Carlson and Osborne 2012; Carlson and Simpfendorfer 2015). While the overall abundance appears to be stable, low intrinsic rates of population increase suggest that the species is particularly vulnerable to rapid population declines (NMFS 2010c).

**Designated Critical Habitat**

Critical habitat for smalltooth sawfish was designated in 2009 and includes two major units: Charlotte Harbor (221,459 acres) and Ten Thousand Islands/Everglades (619,013 acres) (Figure 37). These two units include essential sawfish nursery areas. Within the nursery areas, two features were identified as essential to the conservation of the species: red mangroves (*Rhizophora mangle*), and euryhaline habitats with water depths less than or equal to 0.9 meters. The action area for this biological opinion overlaps with smalltooth sawfish designated critical habitat. Based on our analysis above (see Section 6.1), we determine that the proposed action is not likely to adversely affect smalltooth sawfish designated critical habitat.

**Recovery Goals**

The 2009 Smalltooth Sawfish Recovery Plan (NMFS 2009c) contains complete downlisting/delisting criteria for each of the three following recovery goals:

1. Minimize human interactions and associated injury and mortality.
   Specific criteria include: a) educational programs, b) handling and release guidelines, c) injury and mortality regulations, and d) other State and/or Federal measures (not including those provided under the ESA.
2. Protect and/or restore smalltooth sawfish habitats.

Specific criteria include: a) protection of existing mangrove shoreline habitat, b) assurance of availability and accessibility of both mangrove and non-mangrove habitat sufficient to support subpopulations of juvenile sawfish, c) appropriate freshwater flow regimes, and d) identification and protection of habitat areas utilized by adult smalltooth sawfish.

3. Ensure smalltooth sawfish abundance increases substantially and the species reoccupies areas from which it had been previously extirpated.
   Specific criteria include: a) annual increases in the relative abundance of juvenile smalltooth sawfish, b) annual increases in the relative abundance of adult smalltooth sawfish, and c) verified records of adult smalltooth sawfish in outer regions of the species range.

### 6.2.9 Atlantic Sturgeon

Sturgeon are among the most primitive of the bony fishes. The Atlantic sturgeon is a long-lived (approximately 60 years), late maturing, iteroparous, estuarine dependent species (ASSRT 2007; Dadswell 2006). Atlantic sturgeon are anadromous, spawning in freshwater but spending most of their subadult and adult life in the marine environment. They can grow to approximately 14 feet long and can weigh up to 800 pounds. Atlantic sturgeon are bluish-black or olive brown dorsally (on their back) with paler sides, a white belly, and have five major rows of dermal "scutes" (Figure 38).

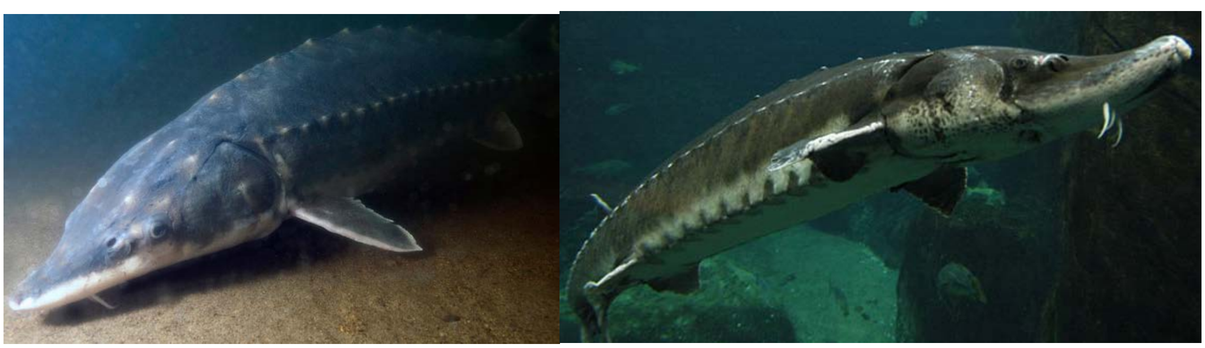

**Figure 38. Atlantic sturgeon. Photo: Robert Michelson (left), NOAA (right).**

Five DPSs of Atlantic sturgeon were listed under the ESA in 2012 (Table 14). The GOM DPS is listed as threatened while the New York Bight, Chesapeake Bay, Carolina, and South Atlantic DPSs are listed as endangered (Figure 39).

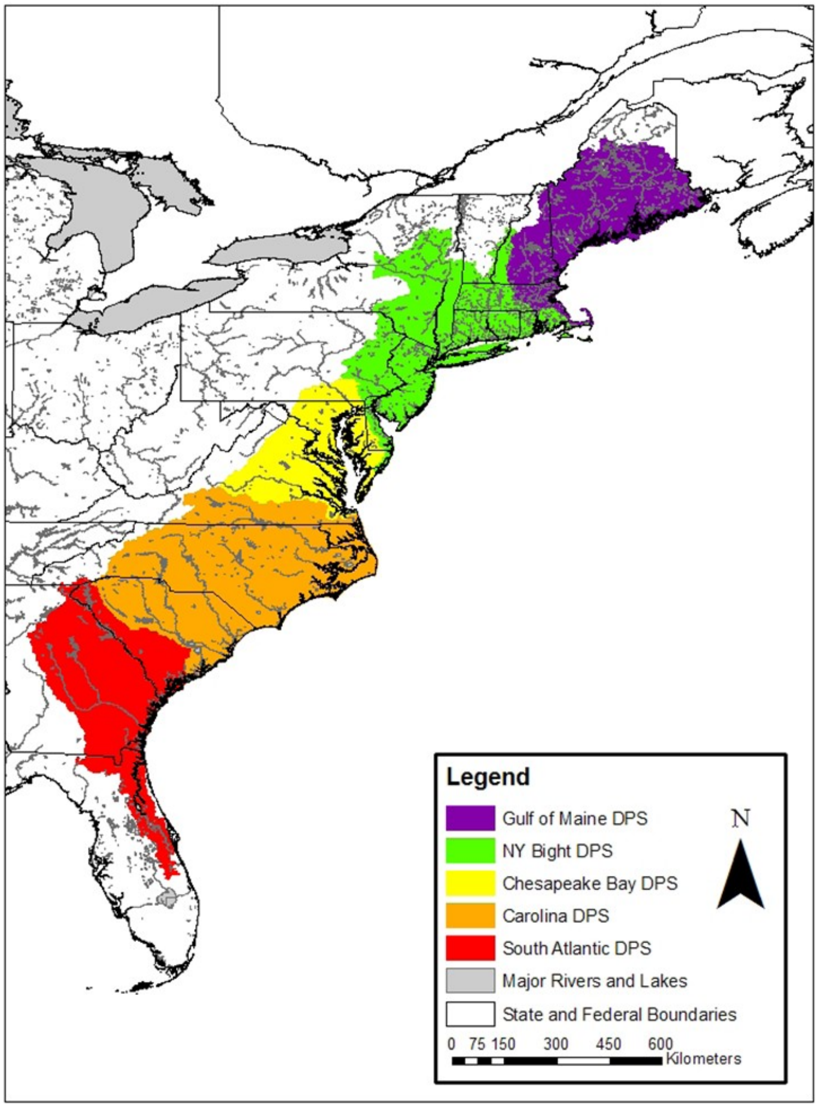


**Figure 39. Range and boundaries of the five Atlantic sturgeon Distinct Population Segments.**

**Table 14. Summary of Atlantic sturgeon listing and recovery plan information.**

| Species | Common Name | Distinct Population Segment | ESA Status | Recent Review Year | Listing | Recovery Plan | Critical Habitat |
|---|---|---|---|---|---|---|---|
| *Acipenser oxyrinchus oxyrinchus* | Atlantic sturgeon | Gulf of Maine | Threatened | 2007 | 77 FR 5880 02/06/2012 | N/A | 82 FR 39160 Gulf of Maine 2017 |
| *Acipenser oxyrinchus oxyrinchus* | Atlantic sturgeon | New York Bight | Endangered | 2007 | 77 FR 5880 02/06/2012 | N/A | 82 FR 39160 New York Bight 2017 |
| *Acipenser oxyrinchus oxyrinchus* | Atlantic sturgeon | Chesapeake Bay | Endangered | 2007 | 77 FR 5880 02/06/2012 | N/A | 82 FR 39160 Chesapeake Bay 2017 |
| *Acipenser oxyrinchus oxyrinchus* | Atlantic sturgeon | Carolina | Endangered | 2007 | 77 FR 5914 02/06/2012 | N/A | 82 FR 39160 Carolina 2017 |
| *Acipenser oxyrinchus oxyrinchus* | Atlantic sturgeon | South Atlantic | Endangered | 2007 | 77 FR 5914 02/06/2012 | N/A | 82 FR 39160 South Atlantic 2017 |

This section provides general information on the Atlantic sturgeon coast-wide population, including information about the species life history, population dynamics, and status. The subsections that follow provide information and characteristics particular to each of the five listed DPSs of Atlantic sturgeon.

**Life History**

The general life history pattern of Atlantic sturgeon is that of a long lived, late maturing, iteroparous, anadromous species. Atlantic sturgeon spawn in freshwater, but spend most of their subadult and adult life in the marine environment.

Traditionally, it was believed that spawning within all populations occurred during the spring and early summer months. More recent studies, however, suggest that spawning occurs from late summer to early autumn in two tributaries of the Chesapeake Bay (James River and York River, Virginia) and in the Altamaha River, Georgia (Balazik et al. 2012; Hager et al. 2014).

Sturgeon eggs are highly adhesive and are deposited on the bottom substrate, usually on hard surfaces (e.g., cobble) (Smith and Clugston 1997). Hatching occurs approximately 94 to 140 hours after egg deposition, and larvae assume a demersal existence (Smith et al. 1980). The yolksac larval stage is completed in about 8 to 12 days, during which time the larvae move downstream to rearing grounds over a 6 to 12-day period (Kynard and Horgan 2002). During the first half of their migration downstream, movement is limited to nighttime. During the day, larvae use benthic structure (e.g., gravel matrix) as refugia (Kynard and Horgan 2002). During the latter half of migration when larvae are more fully developed, movement to rearing grounds occurs both day and night. The larvae grow rapidly and are 4” to 5 1/2" long at a month old (MSPO 1993). At this size, the young sturgeon bear teeth and have sharp, closely spaced spine-tipped scutes. As growth continues, they lose their teeth, the scutes separate and lose their sharpness.

Juvenile Atlantic sturgeon continue to move downstream into brackish waters, and eventually become residents in estuarine waters. Juvenile Atlantic sturgeon are resident within their natal estuaries for two to six years, depending on their natal river of origin, after which they emigrate as subadults to coastal waters (Dovel 1983) or to other estuaries seasonally (Waldman et al. 2013). Atlantic sturgeon undertake long marine migrations and utilize habitats up and down the East Coast for rearing, feeding, and migrating (Bain 1997; Dovel 1983; Stevenson 1997). Migratory subadults and adults are normally located in shallow (10-50m) nearshore areas dominated by gravel and sand substrate (Stein et al. 2004a). Tagging and genetic data indicate that subadult and adult Atlantic sturgeon may travel widely once they emigrate from rivers (Bartron 2007; Wirgin et al. 2015). Once in marine waters, subadults undergo rapid growth (Dovel 1983; Stevenson 1997). Despite extensive mixing in coastal waters, Atlantic sturgeon display high site fidelity to their natal streams.

Atlantic sturgeon have been aged to 60 years (Mangin 1964), but this should be taken as an approximation because the age validation studies conducted to date show ages cannot be reliably estimated after 15-20 years (Stevenson and Secor 2000). Vital parameters of sturgeon populations generally show clinal variation with faster growth, earlier age at maturation, and shorter life span in more southern systems. Spawning intervals range from one to five years for male Atlantic sturgeon (Collins et al. 2000; Smith 1985) and three to five years for females (Schueller and Peterson 2010; Stevenson and Secor 2000). Fecundity of Atlantic sturgeon is correlated with age and body size, ranging from approximately 400,000 to 8 million eggs (Dadswell 2006; Smith et al. 1982; Van Eenennaam and Doroshov 1998). The average age at which 50 percent of Atlantic sturgeon maximum lifetime egg production is achieved is estimated to be 29 years, approximately 3-10 times longer than for most other bony fish species (Boreman 1997).

Atlantic sturgeon feed on molluscs, polychaeta worms, gastropods, shrimps, pea crabs, decapods, amphipods, isopods, and small fishes in the marine environment (Collins et al. 2006; Guilbard et al. 2007; Savoy 2007). The sturgeon "roots" in the sand or mud with its snout, like a pig, to dislodge worms and molluscs that it sucks into its protrusible mouth, along with considerable amounts of mud. The Atlantic sturgeon has a stomach with very thick, muscular walls that resemble the gizzard of a bird. This gizzard enables it to grind such food items as molluscs and gastropods (MSPO 1993).

### Population Dynamics

The Atlantic sturgeon's historic range included major estuarine and riverine systems that spanned from Hamilton Inlet on the coast of Labrador, Canada, to the Saint Johns River in Florida (ASSRT 2007; Smith and Clugston 1997). Atlantic sturgeon have been documented as far south as Bermuda and Venezuela (Lee et al. 1980). Historically, Atlantic sturgeon were present in approximately 38 rivers in the United States from St. Croix, Maine, to the Saint Johns River, Florida, of which 35 rivers have been confirmed to have had historic spawning populations. Atlantic sturgeon are currently present in 36 rivers, and spawning occurs in at least 21 of these (ASSRT 2007). Other estuaries along the U.S. Atlantic Coast formed by rivers that do not support Atlantic sturgeon spawning populations may still be important as rearing habitats.

Atlantic sturgeon throughout their range exhibit ecological separation during spawning that has resulted in multiple, genetically distinct, interbreeding population segments. Studies have consistently found populations to be genetically diverse and indicate that there are between seven and ten populations that can be statistically differentiated (Grunwald et al. 2008; King et al. 2001; Waldman et al. 2002; Wirgin et al. 2007). However, there is some disagreement among studies, and results do not include samples from all rivers inhabited by Atlantic sturgeon. Recent studies conducted indicate that genetically distinct populations of spring and fall-run Atlantic sturgeon can exist within a given river system (Balazik et al. 2017; Balazik and Musick 2015; Farrae et al. 2017).

### Status

In 2012, NMFS listed the New York Bight and Chesapeake Bay DPSs as endangered and the GOM DPS as threatened based on low population sizes and the level of continuing threats such as degraded water quality, habitat impacts from dredging, bycatch in state and federally managed fisheries, and vessel strikes. Historically, each of these DPSs likely supported more than 10,000 spawning adults (ASSRT 2007; MSPO 1993; Secor and Niklitschek 2002). The best available data indicate that current numbers of spawning adults for each DPS are one to two orders of magnitude smaller than historical levels (ASSRT 2007; Kahnle et al. 2007). The Carolina and South Atlantic DPSs were estimated to have declined to less than three and six percent of their historical population sizes, respectively (ASSRT 2007). Both of these DPSs were listed as endangered in 2012 due to a combination of habitat curtailment and alteration, bycatch in commercial fisheries, and inadequacy of regulatory mechanisms in ameliorating these impacts and threats. The largest estimated adult Atlantic sturgeon populations are currently found in the Hudson (3,000), Altamaha (1,325), Delaware (1,305), Kennebec (865), Savannah (745), and James (705). Published estimates of Atlantic sturgeon juvenile abundance are available in the following river systems: 4,314 age 1 fish in the Hudson in 1995 (Peterson et al. 2000); 3,656 age 0-1 fish in the Delaware in 2014(Hale et al. 2016); between 1,072 to 2,033 age 1-2 fish on average from 2004-2007 in the Altamaha - (Schueller and Peterson 2010); and 154 age 1 fish in 2010 in the Satilla (Fritts et al. 2016).

**Designated Critical Habitat**

NMFS designated critical habitat for each ESA-listed DPS of Atlantic sturgeon in August of 2017. Physical and biological features determined to be essential for Atlantic sturgeon reproduction and recruitment include (1) suitable hard bottom substrate in low salinity waters for settlement of fertilized eggs, refuge, growth, and development of early life stages, (2) transitional salinity zones for juvenile foraging and physiological development, (3) water of appropriate depth and absent physical barriers to passage, (4) unimpeded movement of adults to and from spawning sites, and (5) water quality conditions that support spawning, survival, growth, development, and recruitment. The action area for this opinion does not overlap with areas proposed as critical habitat for any of the five Atlantic sturgeon DPSs.

### *6.2.9.1 Gulf of Maine Atlantic Sturgeon*

The GOM DPS of Atlantic sturgeon was listed as threatened on February 6, 2012. The GOM DPS historically supported at least four spawning subpopulations; however, today it is suspected that only two extant subpopulations exist (Penobscot and Kennebec) (ASSRT 2007). The Kennebec River is the primary spawning and nursery area for GOM Atlantic sturgeon. Ripe female Atlantic sturgeon with enlarged, fully mature eggs ready to be fertilized have been found in the Kennebec River from mid-July through early August (MSPO 1993). Prior to any commercial fishing, the Kennebec supported approximately 10,000 to 15,000 spawning adults (ASSRT 2007; MSPO 1993). The construction of the Edwards Dam in 1837 was believed to have caused the commercial sturgeon catch to decline over 50 percent (MSPO 1993). Severe pollution in the river from the 1930's through the early 1970's is also believed to have been a major factor in the continued decline of the sturgeon population in the Kennebec. In 2007, the Atlantic Sturgeon Status Review Team (ASSRT) concluded that, due to stressors related to poor water quality, dredging, and commercial bycatch, there was a moderate risk (i.e., greater than 50 percent chance) of the Kennebec subpopulation of Atlantic sturgeon becoming endangered within the next 20 years.

It was speculated that the Penobscot subpopulation was extirpated until a fisherman captured an adult Atlantic sturgeon in 2005, and a gill net survey directed toward Atlantic sturgeon captured seven in 2006 (ASSRT 2007). The ASSRT concluded that the Penobscot subpopulation also had a moderate risk of becoming endangered due to its potentially small size (likely less than 300 spawning adults), increased dredging projects, and poor water quality (ASSRT 2007). Within the Penobscot, substrate has been severely degraded by upstream mills, and water quality has been negatively affected by the presence of coal deposits and mercury hot spots. The potential for commercial bycatch was also viewed as a moderate threat to this subpopulation due to its small size.

### *6.2.9.2 New York Bight Atlantic Sturgeon*

The New York Bight DPS was listed as endangered under the ESA on February 6, 2012. The New York Bight, ranging from Cape Cod to the Delmarva Peninsula, historically supported four or more spawning subpopulations, but currently this DPS only supports two known spawning subpopulations: Delaware and Hudson River. The Delaware River once supported the largest spawning subpopulation of Atlantic sturgeon in the United States, with 3,200 metric tons of landings in 1888 (ASSRT 2007; Secor and Niklitschek 2002; Secor and Waldman 1999). Population estimates based on juvenile mark and recapture studies and commercial logbook data, indicate that the Delaware subpopulation has continued to decline rapidly since 1990. Based on genetic analyses, the majority of subadults captured in the Delaware Bay are thought to be of Hudson River origin (ASSRT 2007). However, a more recent study by Hale et al. (2016) suggests that a spawning population of Atlantic Sturgeon exists in the Delaware River and that some level of early juvenile recruitment is continuing to persist despite current depressed population levels. They estimated that 3,656 (95 percent confidence interval from 1,935 to 33,041) juveniles (ages 0 to 1) used the Delaware River estuary as a nursery in 2014. These findings suggest that the Delaware River spawning subpopulation contributes more to the New York Bight DPS than was formerly considered.

The ASSRT found that the Delaware River subpopulation had a moderately high risk (greater than 50 percent chance) of becoming endangered in the next 20 years, due to the loss of adults from ship strikes. Other stressors contributing to this conclusion that were ranked as moderate risk were dredging, water quality, and commercial bycatch (ASSRT 2007). Dredging in the upper portions of the river near Philadelphia were considered detrimental to successful Atlantic sturgeon spawning as this is suspected to be the historical spawning grounds of Atlantic sturgeon. Though dredging restrictions are in place during the spawning season, the continued degradation of suspected spawning habitat likely increases the instability of the subpopulation and could lead to its endangerment in the foreseeable future (ASSRT 2007).

The Hudson River currently supports the largest U.S. subpopulation of Atlantic sturgeon spawning adults. Historically, it supported an estimated 6,000 to 8,000 spawning females (Kahnle et al. 2007; Secor 2002). Long-term surveys indicate that the Hudson River subpopulation has been stable and/or slightly increasing since 1995 in abundance (ASSRT 2007). The ASSRT concluded that the Hudson River subpopulation had a moderate risk (less than 50 percent chance) of becoming endangered in the next 20 years due to the threat of commercial bycatch (ASSRT 2007). Other stressors, such as water quality, have improved since the 1980s and no longer seem to present a significant threat to the Hudson River population (ASSRT 2007).

#### *6.2.9.3 Chesapeake Bay Atlantic Sturgeon*

The Chesapeake Bay DPS was listed as endangered under the ESA on February 6, 2012. Historically, Atlantic sturgeon were common throughout the Chesapeake Bay and its tributaries (Kahnle et al. 1998, Wharton 1957, Bushnoe et al. 2005). Based on U.S. Fish Commission landings data, approximately 20,000 adult female Atlantic sturgeon inhabited the Chesapeake Bay and its tributaries prior to development of a commercial fishery in 1890 (Secor 2002).

Chesapeake Bay rivers once supported at least six historical spawning subpopulations (ASSRT 2007), but today reproducing populations are only known to occur in the James and York Rivers. However, the presence of telemetry tagged Atlantic sturgeon in freshwater portions of Chesapeake Bay tributaries during the summer/fall spawning season (late July to mid-October) suggests that spawning may also occur in the Rappahannock, Potomac, Nanticoke, and Pocomoke Rivers.

The James River supports the largest population of Atlantic sturgeon within the DPS. Balazik et al. (2012) reported empirical evidence that James River Atlantic sturgeon spawn in the fall, and a more recent study indicates that Atlantic sturgeon also spawn in the spring in the James River (i.e., dual spawning races) (Balazik and Musick 2015). Genetic analysis of tissue samples suggest effective populations in the James River range from around 40 to 100 (O'Leary et al. 2014). The ASSRT concluded that the James River had a moderately high risk (greater than 50 percent chance) of becoming endangered in the next 20 years, due to anticipated impacts from commercial bycatch. Dredging and ship strikes were also identified as threats (i.e., moderate risk) that contribute to the risk of extinction for the James subpopulation of Atlantic sturgeon.

The York River has a much smaller population, with annual spawning abundance estimates for 2013 of 75 (Kahn et al. 2014). The effective population size of the York River population ranges from 6 to 12 individuals, the smallest effective population size for any Atlantic sturgeon subpopulation along the Atlantic Coast. The total York River adult Atlantic sturgeon abundance is estimated at 289 individuals. The highest ranked stressor for the York River was commercial bycatch, which received a moderate risk rank (ASSRT 2007).

#### *6.2.9.4 Carolina Atlantic Sturgeon*

The Carolina DPS was listed as endangered under the ESA on February 6, 2012. The Carolina DPS ranges from the Albemarle Sound to the Santee-Cooper River and consists of seven extant subpopulations; one subpopulation (Sampit) is believed to be extirpated. The current abundance of these subpopulations is likely less than 3 percent of their historical abundance based on 1890s commercial landings data (ASSRT 2007; Secor and Niklitschek 2002).

Water quality issues represented either a moderate or moderately high risk for most subpopulations within this DPS (ASSRT 2007). The Pamlico Sound suffers from eutrophication and experiences periodically low DO events and major fish kill events, mainly in the Neuse Estuary of the Sound. The Cape Fear River is a blackwater river; however, the low DO concentrations in this river can also be attributed to eutrophication. Water quality is also a problem in Winyah Bay, where portions of the Bay have high concentrations of dioxins that can adversely affect sturgeon development (Chambers et al. 2012). Commercial bycatch was a concern for all of the subpopulations examined by the ASSRT. The Cape Fear and Santee-Cooper rivers were found to have a moderately high risk (greater than 50 percent) of becoming endangered within the next 20 years due to impeded habitat from dams. The Cape Fear and Santee-Cooper are the most impeded rivers along the range of the species, where dams are located in the lower coastal plain and impede between 62 to 66 percent of the habitat available between the fall line and mouth of the river (ASSRT 2007). The ASSRT concluded that the limited habitat in which sturgeon could spawn and utilize for nursery habitat in these rivers likely leads to the instability of these subpopulations and to the entire DPS being at risk of endangerment.

#### *6.2.9.5 South Atlantic Sturgeon*

The South Atlantic DPS was listed as endangered under the ESA on February 6, 2012. This DPS historically supported eight spawning subpopulations but currently supports five extant spawning subpopulations (ASSRT 2007). The Altamaha and ACE Basin subpopulations support the largest number of spawning adults. The current abundance of these subpopulations are suspected to be less than six percent of their historical abundance, extrapolated from the 1890s commercial landings (ASSRT 2007; Secor and Niklitschek 2002). Peterson et al. (2008) reported that approximately 324 and 386 adults per year returned to the Altamaha River in 2004 and 2005, respectively. Few captures have been documented in subpopulations other than the Altamaha and ACE Basin within this DPS, and these smaller systems are suspected to contain less than one percent of their historic abundance (ASSRT 2007). The ASSRT found that the South Atlantic DPS of Atlantic sturgeon had a moderate risk (greater than 50 percent) of becoming endangered in the next 20 years due primarily to dredging, degraded water quality, and commercial fisheries bycatch.

### 6.2.10 Shortnose Sturgeon

The shortnose sturgeon is the smallest of the three sturgeon species that occur in eastern North America; they grow up to 4.7 feet (1.4 meters) and weigh up to 50.7 pounds (23 kilograms). It has a short, conical snout with four barbells in front of its large underslung mouth. Five rows of bony plates (called scutes) occur along its body: one on the back, two on the belly, and one on each side. The body coloration is generally olive-yellow to gray or bluish on the back, and milky-white to dark yellow on the belly. The peritoneum (body cavity lining) is black (Figure 40).

**Figure 40. Shortnose sturgeon. Photo: Nancy Haley, NOAA (left), University of Maine (right).**

Shortnose sturgeon were initially listed as endangered on March 11, 1967 under the Endangered Species Preservation Act of 1966. In 1994, the species was listed as endangered throughout its range under the ESA (Table 15). Critical habitat has not been designated for shortnose sturgeon.

Shortnose sturgeon occur along the Atlantic Coast of North America, from the St. John River in Canada to the St. Johns River in Florida (Figure 41).

**Table 15. Summary of shortnose sturgeon listing and recovery plan information.**

| Species | Common Name | Distinct Population Segment | ESA Status | Recent Review Year | Listing | Recovery Plan | Critical Habitat |
|---|---|---|---|---|---|---|---|
| *Acipenser brevirostrum* | Shortnose sturgeon | N/A | Endangered | 2010 | 32 FR 4001 03/11/1967 | 63 FR 69613 1998 | None Designated |

**Life History**

The shortnose sturgeon is a relatively slow growing, late maturing, and long-lived fish species. The maximum recorded size of shortnose sturgeon was collected from the Saint John River, Canada, measuring 143 centimeters TL and weighing 23 kilograms (Dadswell et al. 1984). Shortnose sturgeon typically live longer in the northern portion of their range compared to the southern portion (Gilbert 1989). The maximum ages reported of female shortnose sturgeon by river system include 67 years for the St. John River (New Brunswick), 40 years for the Kennebec River, 37 years for the Hudson River, 34 years for the Connecticut River, 20 years for the Pee Dee River, and ten years for the Altamaha River (Dadswell et al. 1984; Gilbert 1989). Female shortnose sturgeon generally outlive and outgrow males, which seldom exceed 30 years of age (Dadswell et al. 1984; Gilbert 1989). Shortnose sturgeon also exhibit sexually dimorphic growth and maturation patterns across latitudes (Dadswell et al. 1984). In the northern parts of its range, males reach maturity at 5 to 11 years, while females mature between 7 and 18 years. Shortnose sturgeon in southern rivers typically grow faster, mature at younger ages (2 to 5 years for males and 4 to 5 for females), but attain smaller maximum sizes than those in the north which grow throughout their longer lifespans (Dadswell et al. 1984).

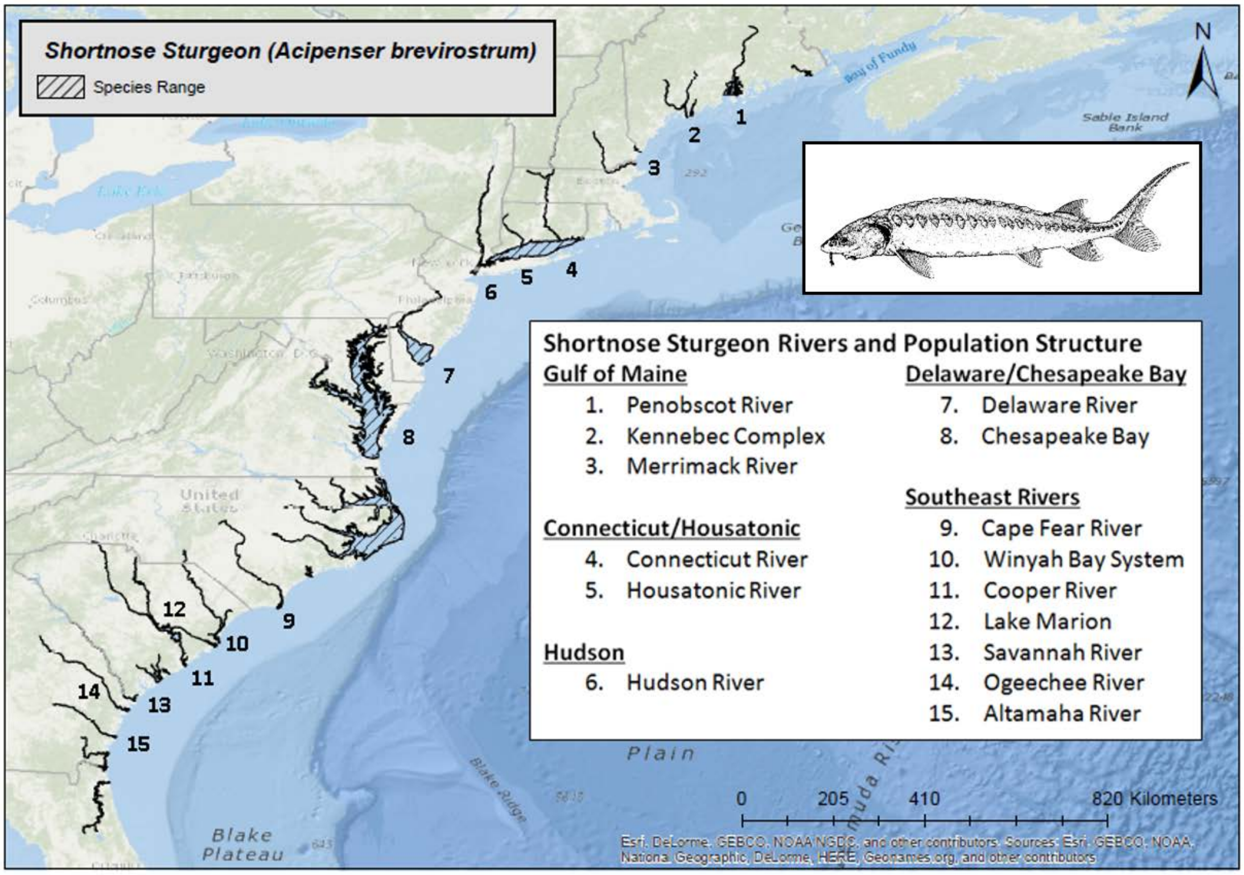


**Figure 41. Geographic range of shortnose sturgeon.**

Shortnose sturgeon are amphidromous, inhabiting large coastal rivers or nearshore estuaries within river systems (Buckley and Kynard 1985; Kieffer and Kynard 1993). They spawn in upper, freshwater areas, and feed and overwinter in both fresh and saline habitats. During the summer and winter months, adults occur primarily in freshwater tidally influenced river reaches (Buckley and Kynard 1985). Older juveniles or subadults tend to move downstream in the fall and winter as water temperatures decline and the salt wedge recedes. In the spring and summer, they move upstream and feed mostly in freshwater reaches; however, these movements usually occur above the saltwater/freshwater river interface (Dadswell et al. 1984; Hall et al. 1991). While shortnose sturgeon do not undertake the long marine migrations documented for Atlantic sturgeon, telemetry data indicate that shortnose sturgeon do make localized coastal migrations (Dionne et al. 2013). Non-spawning movements include rapid, directed post-spawning movements to downstream feeding areas in the spring, and localized, wandering movements in the summer and winter (Buckley and Kynard 1985; Dadswell et al. 1984). Young-of-the-year shortnose sturgeon are believed to move downstream after hatching (Dovel 1983) but remain within freshwater habitats.

Shortnose sturgeon have been found in waters with temperatures as low as 2 to 3ºC (Dadswell et al. 1984) and as high as 34ºC (Heidt and Gilbert 1979). However, temperatures above 28ºC are thought to adversely affect shortnose sturgeon (Kynard 1997). Shortnose sturgeon are known to occur at a wide range of depths from a minimum depth of 0.6 m up to 30 m (Dadswell 1979; Dadswell et al. 1984). Shortnose sturgeon exhibit tolerance to a wide range of salinities from freshwater (Taubert 1980) to waters with salinity of 30 parts-per-thousand (Holland and Yelverton 1973). Shortnose sturgeon typically occur in the deepest parts of rivers or estuaries where suitable oxygen and salinity levels are present (Gilbert 1989).

Spawning occurs from late winter/early spring (southern rivers) to mid to late spring (northern rivers) depending upon location and water temperature. Shortnose sturgeon spawning migrations are characterized by rapid, directed and often extensive upstream movement (NMFS 1998). Mature males will spawn every other year or annually depending on the river they inhabit (Dadswell 1979; NMFS 1998). Age at first spawning for females is around five years post-maturation, with spawning occurring approximately every three to five years (Dadswell 1979). Shortnose sturgeon are believed to spawn at discrete sites within their natal river (Kieffer and Kynard 1996), typically at the farthest upstream reach of the river, if access is not obstructed by dams (NMFS 1998). Spawning occurs over channel habitats containing gravel, rubble, or rock-cobble substrates (Dadswell 1979; NMFS 1998). Additional environmental conditions associated with spawning activity include decreasing river discharge following the peak spring freshet, water temperatures ranging from 6.5 to 18ºC, and bottom water velocities of 0.4 to 0.8 m/sec (Dadswell 1979; Hall et al. 1991; Kieffer and Kynard 1996; NMFS 1998).

Estimates of annual egg production for shortnose sturgeon are difficult to calculate and are likely to vary greatly in this species because females do not spawn every year. Fecundity estimates that have been made range from 27,000 to 208,000 eggs/female, with a mean of 11,568 eggs/kg body weight (Dadswell et al. 1984). At hatching, shortnose sturgeon are 7 to 11 mm long and resemble tadpoles (Buckley and Kynard 1981). In 9 to 12 days, the yolk sac is absorbed and the sturgeon develops into larvae which are about 15 mm TL (Buckley and Kynard 1981). Sturgeon larvae are believed to begin downstream migrations at about 20 mm TL.

Shortnose sturgeon are benthic omnivores that feed on crustaceans, insect larvae, worms, mollusks (Collins et al. 2008; Moser and Ross 1995; Savoy and Benway 2004), oligochaete worms (Dadswell 1979) and off plant surfaces (Dadswell et al. 1984). Subadults feed indiscriminately, consuming aquatic insects, isopods, and amphipods along with large amounts of mud, stones, and plant material (Bain 1997; Dadswell 1979).

**Population Dynamics**

Historically, shortnose sturgeon are believed to have inhabited nearly all major rivers and estuaries along the entire east coast of North America. NMFS's Shortnose Sturgeon Recovery Plan identifies 19 populations based on the fish's strong fidelity to natal rivers and the premise that populations in adjacent river systems did not interbreed with any regularity (NMFS 1998). Both mtDNA and nDNA analyses indicate effective (with spawning) coastal migrations are occurring between adjacent rivers in some areas, particularly within the GOM and the Southeast

(King et al. 2014). The currently available genetic information suggests that shortnose sturgeon can be separated into smaller groupings that form regional clusters across their geographic range (SSSRT 2010). Both regional population and metapopulation structures may exist according to genetic analyses and dispersal and migration patterns (King et al. 2014; Wirgin et al. 2010). The Shortnose Sturgeon Status Review Team (SSSRT) concluded shortnose sturgeon across their geographic range include five genetically distinct groupings each of which have geographic ecological adaptations: 1) GOM; 2) Connecticut and Housatonic Rivers; 3) Hudson River; 4) Delaware River and Chesapeake Bay; and 5) Southeast (SSSRT 2010). Two additional geographically separate populations occur behind dams in the Connecticut River (above the Holyoke Dam) and in Lake Marion on the Santee-Cooper River system in South Carolina (above the Wilson and Pinopolis Dams). Although these populations are geographically isolated, genetic analyses suggest individual shortnose sturgeon move between some of these populations each generation (Quattro et al. 2002; Wirgin et al. 2005; Wirgin et al. 2010). The SSSRT recommended that each riverine population be considered as a separate management/recovery unit (SSSRT 2010). The distribution of shortnose sturgeon is disjointed across their range, with northern populations separated from southern populations by a distance of about 400 kilometers near their geographic center in Virginia.

**Status**

The 2010 SSSRT conducted a three-step risk assessment for shortnose sturgeon at a riverine scale: (1) assess population health, (2) populate a “matrix of stressors” by ranking threats, and (3) review assessment by comparing population health scores to stressor scores. The Hudson River had the highest estimated adult abundance (30,000 to 61,000), followed by the Delaware (12,000), Kennebec Complex (9,000), and Altamaha (6,000) (SSSRT 2010). The SSSRT found evidence of an increasing abundance trend for the Kennebec Complex and ACE Basin populations; a stable trend for the Merrimack, Connecticut, Hudson, Delaware, Winyah Bay Complex, Cooper, Savannah, Ogeechee, and Altamaha populations; and a declining trend only for the Cape Fear population (all other populations had an unknown trend) (SSSRT 2010).

The SSSRT summarized continuing threats to the species in each of the 29 identified populations (SSSRT 2010). Dams represent a major threat to seven shortnose sturgeon populations and a moderate threat to seven additional populations. Dredging represents a major threat to one shortnose sturgeon population (Savannah River), a moderately high threat to three populations, and a moderate threat to seven populations. Fisheries bycatch represents a major threat to one shortnose sturgeon population (Lakes Marion and Moultrie in Santee-Cooper Reservoir System), a moderately high threat to four populations, and a moderate threat to ten populations (SSSRT 2010). Water quality represents a major threat to one shortnose sturgeon population (Potomac River), a moderately high threat to six populations, a moderate threat to 13 populations, and a moderately low threat to one population. Specific sources of water quality degradation affecting shortnose sturgeon include coal tar, wastewater treatment plants, fish hatcheries, industrial waste, pulp mills, sewage outflows, industrial farms, water withdrawals, and non-point sources.

Impingement/entrainment at power plants and treatment plants was rated as a moderate threat to two shortnose sturgeon populations (Delaware and Potomac).

The SSSRT examined the relationship between population health scores and associated stressors/threats for each shortnose sturgeon riverine population and concluded the following: 1) despite relatively high stressor scores, the Hudson and Kennebec River populations appear relatively healthy; 2) shortnose sturgeon in the Savannah River appear moderately healthy, but their status is perilous; 3) shortnose in the ACE system are of moderate health with low stress and may be most able to recover (SSSRT 2010). Climate warming has the potential to reduce abundance or eliminate shortnose sturgeon in many rivers, particularly in the South (Kynard et al. 2016).

The SSSRT reported results of an age-structured population model using the RAMAS software (Akçakaya and Root 2007) to estimate shortnose sturgeon extinction probabilities for three river systems: Hudson, Cooper, and Altamaha. The estimated probability of extinction was zero for all three populations under the default assumptions, despite the long (100-year) horizon and the relatively high year-to-year variability in fertility and survival rates. The estimated probability of a 50 percent decline was relatively high (Hudson 0.65, Cooper 0.32, Altamaha 0.73), whereas the probability of an 80 percent decline was low (Hudson 0.09, Cooper 0.01, Altamaha 0.23) (SSSRT 2010). The largest shortnose sturgeon adult populations are found in the Northeastern rivers: Hudson 56,708 adults (Bain et al. 2007); Delaware 12,047 (ERC 2006); and Saint Johns greater than 18,000 adults (Dadswell 1979). Shortnose sturgeon populations in southern rivers are considerably smaller by comparison.

**Designated Critical Habitat**

No critical habitat has been designated for the shortnose sturgeon.

**Recovery Goals**

The Shortnose Sturgeon Recovery Plan was developed in 1998. The long-term recovery objective, as stated in the Plan, is to recover all 19 discrete populations to levels of abundance at which they no longer require protection under the ESA (NMFS 1998). To achieve and preserve minimum population sizes for each population segment, essential habitats must be identified and maintained, and mortality must be monitored and minimized. Accordingly, other key recovery tasks discussed in the Plan are to define essential habitat characteristics, assess mortality factors, and protect shortnose sturgeon through applicable federal and state regulations.

### 6.2.11 Green Sturgeon, Southern Distinct Population Segment

Green sturgeon are long-lived, late-maturing, iteroparous, anadromous species that spawn infrequently in natal streams, and spend substantial portions of their lives in marine waters. Although they are members of the class of bony fishes, the skeleton of sturgeons is composed mostly of cartilage. Sturgeon have five rows of characteristic bony plates on their body (called scutes). Green sturgeon have an olive green to dark green back, a yellowish green-white belly, and a white stripe beneath the lateral scutes (Adams et al. 2002) (Figure 42). Green sturgeon occur in the nearshore Eastern Pacific Ocean from Alaska to Mexico (Moyle 2002).

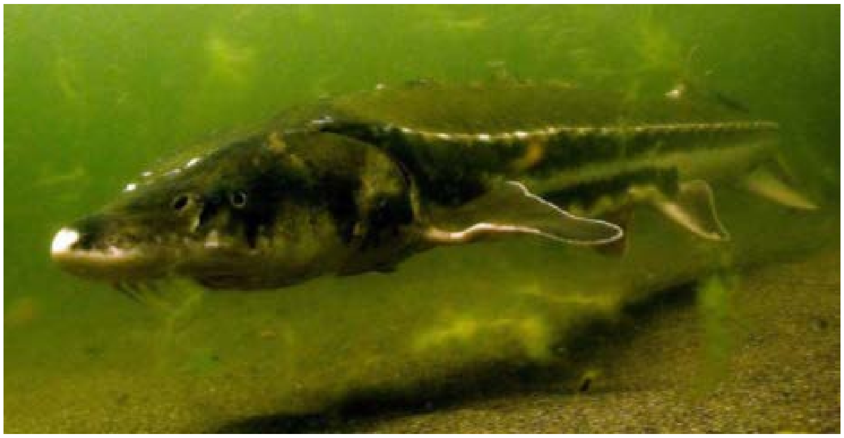

**Figure 42. Adult green sturgeon. Photo: Thomas Dunklin.**

NMFS has identified two DPSs of green sturgeon; northern and southern (Israel et al. 2009). In 2006, NMFS determined that the southern DPS green sturgeon (Figure 43) warranted listing as a threatened species under the ESA (71 FR 17757) (Table 16).

**Table 16. Summary of green sturgeon listing and recovery plan information.**

| Species | Common Name | Distinct Population Segment | ESA Status | Recent Review Year | Listing | Recovery Plan | Critical Habitat |
|---|---|---|---|---|---|---|---|
| *Acipenser medirostris* | Green sturgeon | Southern | Threatened | 2015 | 71 FR 17757 04/07/2006 | Recovery Plan Outline 2010 | 74 FR 52300 Pacific 2009 |

**Life history**

Green sturgeon reach sexual maturity at approximately fifteen years of age (Van Eenennaam et al. 2006), and may spawn every three to five years throughout their long lives (Tracy 1990). Southern DPS green sturgeon spawn in cool (14 to 17 degrees Celsius), deep, turbulent areas with clean, hard substrates. Six discrete spawning sites have been identified in the upper Sacramento River between Gianella Bridge (RK 320.6) and the Keswick dam (RK 486) (Poytress et al. 2013). Spawning has also been confirmed in the Feather River near the Thermalito Afterbay Outlet (RK 95) (Seesholtz et al. 2015). Adult diet includes shrimp, mollusks, amphipods, and even small fish (Houston 1988; Moyle et al. 1992). Juveniles in the Sacramento River delta feed on opossum shrimp, *Neomysis mercedis*, and *Corophium* amphipods (Radtke 1966).

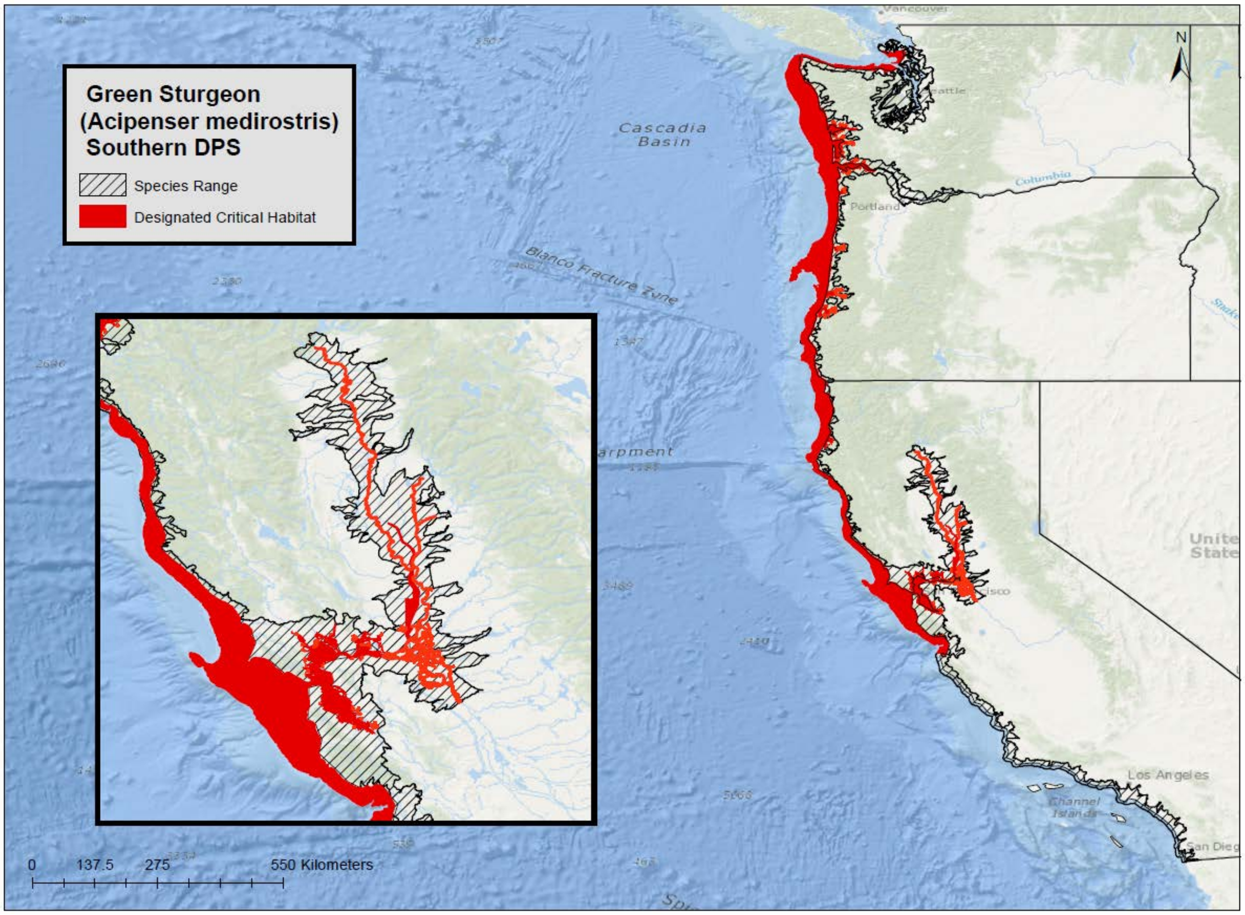


**Figure 43. Geographic range (within the contiguous US) and designated critical habitat for green sturgeon, southern distinct population segment.**

In preparation for spawning, adult Southern DPS green sturgeon enter San Francisco Bay between mid-February and early-May, and migrate rapidly (on the order of a few weeks) up the Sacramento River (Heublein et al. 2009). Spawning occurs from April through early July, with peaks of activity that depend on a variety of factors including water temperature and water flow rates (Poytress et al. 2009; Poytress et al. 2010). Post-spawn fish typically congregate and hold for several months in a few deep pools in the upper mainstream Sacramento River near spawning sites and migrate back downstream when river flows increase in fall. They re-enter the ocean during the winter months (November through January) and begin their marine migration north along the coast (California Fish Tracking Consortium database).

Green sturgeon larvae are different from all other sturgeon because of the absence of a distinct swim-up or post-hatching stage. Larvae grow fast; young fish grow to 74 mm 45 days after hatching (Deng 2000). Larvae and juveniles migrate downstream toward the Sacramento-San Joaquin Delta/Estuary, where they rear for one to four years before migrating out to the Pacific Ocean as subadults (Nakamoto et al. 1995). Once at sea, subadults and adults occupy coastal waters to a depth of 110 m from Baja California, Mexico to the Bering Sea, Alaska (Erickson and Hightower 2007). Seasonal migrations are known to occur. Fish congregate in coastal bays and estuaries of Washington, Oregon, and California during summer and fall. In winter and spring, similar aggregations can be found from Vancouver Island to Hecate Strait, British Columbia, Canada (Lindley et al. 2008).

**Population Dynamics**

Israel et al. (2009) detailed genetic analysis of 20 collections of green sturgeon samples and 10 microsatellite loci and examined DPS composition in different estuaries along the US west coast. The study upholds the Northern and Southern DPS determination of spawning rivers. Telemetry studies and unpublished data also confirm the DPS structure (Lindley et al. 2011; Lindley et al. 2008). Individuals from the threatened Southern DPS and the non-listed Northern DPS regularly co-occur in non-natal estuaries including the Columbia River estuary, Willapa Bay, and Grays Harbor. Schreier et al. (2016) found that majority of green sturgeon sampled from 2010-2012 in the Columbia River estuary and Willapa Bay were assigned to the Southern DPS, while green sturgeon from Grays Harbor were assigned nearly even proportions between the two DPSs. The authors suggest that the Columbia River may serve as alternative spawning habitat for green sturgeon as climate change occurs.

Based on survey data from 2010-14, the total number of adults in the Southern DPS population is estimated to be 1,348 (95 percent confidence interval ± 524) (Mora 2015; NMFS 2015c). The spawning population of the Southern DPS in the Sacramento River congregates in a limited area of the river compared to potentially available habitat (NMFS 2015c). This is concerning given that a catastrophic or targeted poaching event affecting just a few holding areas could affect a significant portion of the adult population.

**Status**

Attempts to evaluate the status of southern DPS green sturgeon have been met with limited success due to the lack of reliable long-term data. The final rule listing Southern DPS green sturgeon indicates that the principle factor for the decline in the DPS is the reduction of spawning to a limited area in the Sacramento River caused primarily by impoundments, but they also face threats from water temperature, water flow, and commercial and recreational bycatch. Many of the principle factors considered when listing Southern DPS green sturgeon as threatened in 2006 are relatively unchanged. Recent studies confirm that the spawning area utilized by Southern DPS green sturgeon is small (NMFS 2015c). Confirmation of spawning in the Feather River is encouraging and the decommissioning of the Red Bluff Diversion Dam and breach of Shanghai Bench makes spawning conditions more favorable, although Southern DPS green sturgeon still encounter impassible barriers in the Sacramento, Feather and other rivers that limit their spawning range (NMFS 2015c). Entrainment as well as stranding in flood diversions during high water events also negatively affect Southern DPS green sturgeon. The prohibition of retention in commercial and recreational fisheries has eliminated a known threat and likely had a very positive effect on the overall population, although recruitment indices are not presently available. Climate change has the potential to impact Southern DPS green sturgeon in the future, but it is unclear how changing oceanic, nearshore and river conditions will affect the population overall (NMFS 2015c). The recovery potential for Southern DPS green sturgeon is considered moderate to high; however, certain life history characteristics (e.g., long-lived, delayed maturity) indicate recovery could take many decades, even under the best circumstances (NMFS 2010a).

**Designated Critical Habitat**

Critical habitat was designated for Southern DPS green sturgeon on October 9, 2009, and includes marine, coastal bay, estuarine, and freshwater areas. The action area for this biological opinion overlaps with Southern DPS green sturgeon designated critical habitat. Based on our analysis above (Section 6.1), we determine that the proposed action is not likely to adversely affect Southern DPS green sturgeon designated critical habitat.

**Recovery Goals**

The final recovery plan for Southern DPS green sturgeon has not been released. According to the recovery outline, key recovery needs and implementation measures identified include additional spawning and egg/larval habitat as well as additional research and monitoring (NMFS 2010a).

### 6.2.12 Gulf Sturgeon

The Gulf sturgeon was listed as threatened on September 30, 1991 (Table 17). NMFS and the USFWS jointly manage Gulf sturgeon under the ESA. NMFS is responsible for consultations on actions affecting Gulf sturgeon and their critical habitat in marine habitats. USFWS is responsible for Gulf sturgeon consultations in riverine habitats. In estuarine habitats, responsibility is divided based on the action agency involved: USFWS consults with the Department of Transportation, the USEPA, the U.S. Coast Guard, and the Federal Emergency Management Agency; NMFS consults with the Department of Defense, U.S. Army Corps of Engineers, the Bureau of Ocean Energy Management, and any other federal agencies not specifically mentioned at 50 CFR 226.214. In 2009, NMFS and USFWS conducted a 5-year review and found Gulf sturgeon continued to meet the definition of a threatened species (USFWS and NMFS 2009).

The current range of the Gulf sturgeon extends from Lake Pontchartrain in Louisiana east to the Suwannee river system in Florida (Figure 44). Within that range, seven major rivers are known to support reproducing populations: Pearl, Pascagoula, Escambia, Yellow, Choctawhatchee, Apalachicola, and Suwannee (USFWS and NMFS 2009).

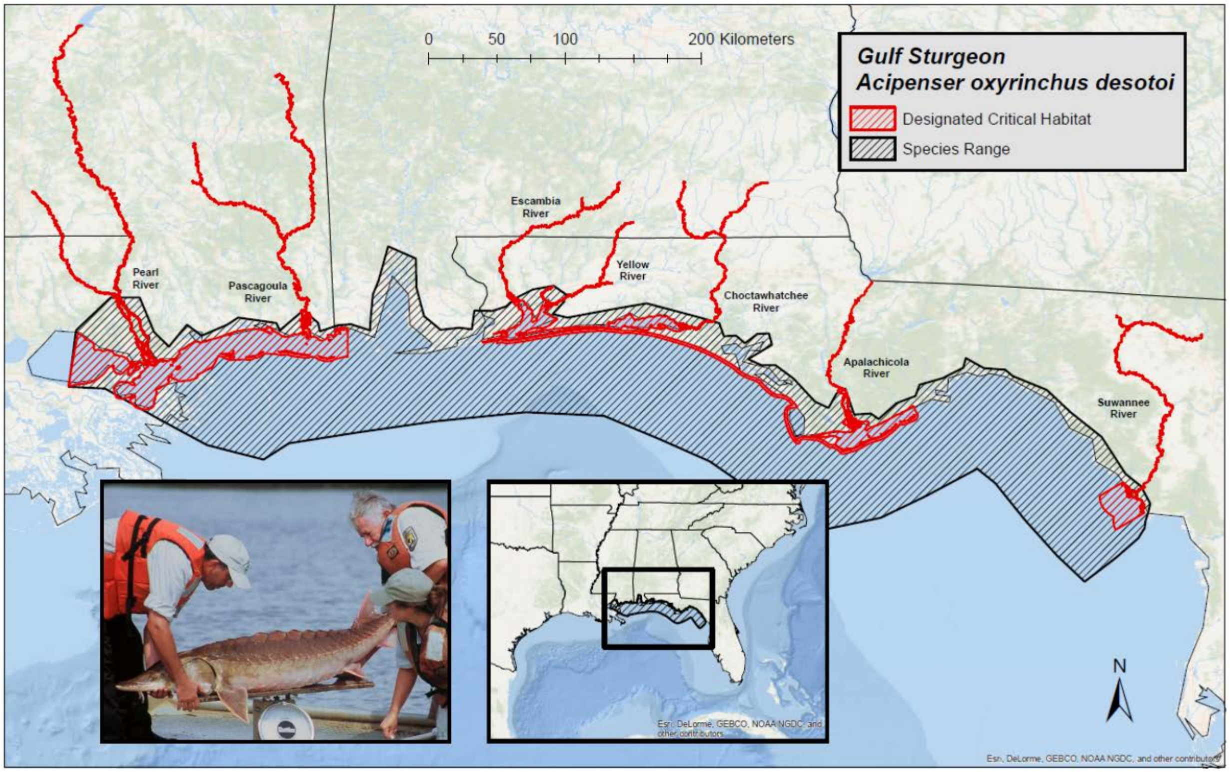


**Figure 44. Geographic range and designated critical habitat of the Gulf sturgeon.**

Gulf sturgeon are benthic fusiform fish with an extended snout, vertical mouth, five rows of scutes (bony plates surrounding the body), four barbels (slender, whisker-like feelers anterior to the mouth used for touch and taste), and a heterocercal (upper lobe is longer than lower) caudal fin. Adults range from 6 to 8 feet in length and weigh up to 200 pounds; females grow larger than males (USFWS and NMFS 2009).

**Table 17. Summary of Gulf sturgeon listing and recovery plan information.**

| Species | Common Name | Distinct Population Segment | ESA Status | Recent Review Year | Listing | Recovery Plan | Critical Habitat |
|---|---|---|---|---|---|---|---|
| *Acipenser oxyrinchus desotoi* | Gulf sturgeon | None | Threatened | 2009 | 56 FR 49653 09/30/1991 | FR N/A 1995 | 68 FR 13370 Gulf of Mexico 2003 |

## Life history

Gulf sturgeon are long-lived, with some individuals reaching at least 42 years in age. Surveys in the Suwannee River suggest that a more common maximum age may be around 25 years (Sulak and Clugston 1999). Age at sexual maturity for females ranges from 8 to 17 years, and for males from 7 to 21 years (Huff 1975). In general, gulf sturgeon spawn up-river in spring, spend winter months in near-shore marine environments, and utilize pre- and post-spawn staging and nursery areas in the lower rivers and estuaries (Heise et al. 2005; Heise et al. 2004). There is some evidence of autumn spawning in the Suwannee River, however there is uncertainty as to whether this spawning is due to environmental conditions or represents a genetically distinct population (Randall and Sulak 2012). Gulf sturgeon spawn at intervals ranging from 3 to 5 years for females and 1 to 5 years for males (Fox et al. 2000; Smith 1985). The spring migration to up-river spawning sites begins in mid-February and continues through May. Fertilization is external; females deposit their eggs in the upper reaches of and show preference for hard, clean substrate (e.g., bedrock covered in gravel and small cobble).

Upon hatching from their eggs, gulf sturgeon larvae spend the first few days of life sheltered in interstitial spaces at the spawning site (Kynard and Parker 2004). At the onset of feeding, age-0 gulf sturgeon disperse and are often found on shallow sandbars and rippled sand shoals (less than 4 meters depth) (Sulak and Clugston 1998). Young-of-the-year spend 6 to 10 months slowing working their way downstream feeding on aquatic insects (e.g., mayflies and caddisflies), worms (oligochaetes), and bivalve mollusks, and arrive in estuaries and river mouths by mid-winter (Sulak and Clugston 1999) where they will spend their next 6 years developing. After spawning, adult gulf sturgeon migrate downstream to summer resting and holding areas in the mid to lower reaches of the rivers where they may hold until November (Wooley and Crateau 1985). While in freshwater adults lose a substantial amount of their weight, but regain it upon entering the estuaries. Sub adult and non-spawning adults also spend late spring through fall in these holding areas (Foster and Clugston 1997). By early December all adult and sub-adult gulf sturgeon return to the marine environment to forage on benthic (bottom dwelling) invertebrates along the shallow nearshore (2 to 4 meters depth), barrier island passes, and in unknown off-shore locations in the gulf (Carr et al. 1996; Fox et al. 2002; Huff 1975; Ross et al. 2009). Juvenile gulf sturgeon overwinter in estuaries, river mouths, and bays; juveniles do not enter the nearshore/offshore marine environments until around age 6 (Sulak and Clugston 1999). Gulf sturgeon show a high degree of river-specific fidelity (Rudd et al. 2014). Adult and sub-adult gulf sturgeon fast while in freshwater environments and are almost entirely dependent on the estuarine/marine environment for food (Gu et al. 2001; Wooley and Crateau 1985). Some juveniles (ages 1 to 6) will also fast in the freshwater summer holding areas, but the majority feed year round in the estuaries, river mouths, and bays (Sulak et al. 2009).

**Population Dynamics**

Currently, seven rivers are known to support reproducing populations of Gulf sturgeon. The most recent abundance estimates were reported in the 5-Year Status Review conducted in 2009 (USFWS and NMFS 2009). The largest estimated populations of Gulf sturgeon are found in the Suwannee (14,000), the Choctawhatchee (3,314), and the Yellow (911) rivers (USFWS and NMFS 2009). The most recent population estimates for the other four rivers with known reproducing populations are all below 500.

Gulf sturgeon abundance trends are typically assessed on a riverine basis. In general, gulf sturgeon populations in the eastern portion of the range appear to be stable or slightly increasing, while populations in the western portion are associated with lower abundances and higher uncertainty (USFWS and NMFS 2009). Pine and Martell (2009) reported that, due to low recapture rates and sparse data, the population viability of gulf sturgeon is currently uncertain.

When grouped by genetic relatedness, five regional or river-specific stocks emerge: (1) Lake Pontchartrain and Pearl River; (2) Pascagoula River; (3) Escambia, Blackwater and Yellow Rivers; (4) Choctawhatchee River; and (5) Apalachicola, Ochlocknee and Suwanee Rivers (Rudd et al. 2014; Stabile et al. 1996). Gene flow is low in Gulf sturgeon stocks, with each stock exchanging less than one mature female per generation (Waldman and Wirgin 1998).

**Status**

The decline in the abundance of gulf sturgeon has been attributed to targeted fisheries in the late 19th and early 20th centuries, habitat loss associated with dams and sills, habitat degradation associated with dredging, de-snagging, and contamination by pesticides, heavy metals, and other industrial contaminants, and certain life history characteristics (e.g., slow growth and late maturation) (56 FR 49653). Effects of climate change (warmer water, sea level rise and higher salinity levels) could lead to accelerated changes in habitats utilized by Gulf sturgeon. The rate that climate change and corollary impacts are occurring may outpace the ability of the Gulf sturgeon to adapt given its limited geographic distribution and low dispersal rate. In general, gulf sturgeon populations in the eastern portion of the range appear to be stable or slightly increasing, while populations in the western portion are associated with lower abundances and higher uncertainty (USFWS and NMFS 2009).

**Designated Critical Habitat**

Designated critical habitat for gulf sturgeon was established in 2003 and consists of 14 geographic units encompassing 2,783 river kilometers as well as 6,042 square kilometers of estuarine and marine habitat. Primary constituent elements for the conservation of Gulf Sturgeon are abundant food items, riverine spawning sites with substrates suitable for egg deposition and development, riverine aggregation areas, a flow regime necessary for normal behavior, growth, and survival, water and sediment quality necessary for normal behavior, growth, and viability of all life stages, and safe and unobstructed migratory pathways.

**Recovery Goals**

The 1995 Recovery Plan outlined three recovery objectives: (1) to prevent further reduction of existing wild populations of Gulf sturgeon within the range of the subspecies; (2) to establish population levels that would allow delisting of the Gulf sturgeon by management units (management units could be delisted by 2023 if required criteria are met); (3) to establish, following delisting, a self-sustaining population that could withstand directed fishing pressure within management units (USFWS and GSMFC 1995). The most recent Gulf sturgeon 5-year review recommended that criteria be developed in a revised recovery plan (USFWS and NMFS 2009).

### 6.2.13 Nassau Grouper

Adult Nassau grouper are large (up to 0.45 meters or 1.5 feet), have distinctive black and white stripes, and are generally found in shallow reef habitats (Figure 45).

**Figure 45. Nassau grouper. Photo: C. Dahlgren**

The Nassau grouper is a large, long-lived, slow growing fish species primarily occupying nearshore waters throughout the Caribbean, south Florida, Bermuda, and the Bahamas (Figure 46). The Nassau grouper was listed as threatened on June 29, 2016 (Table 18).

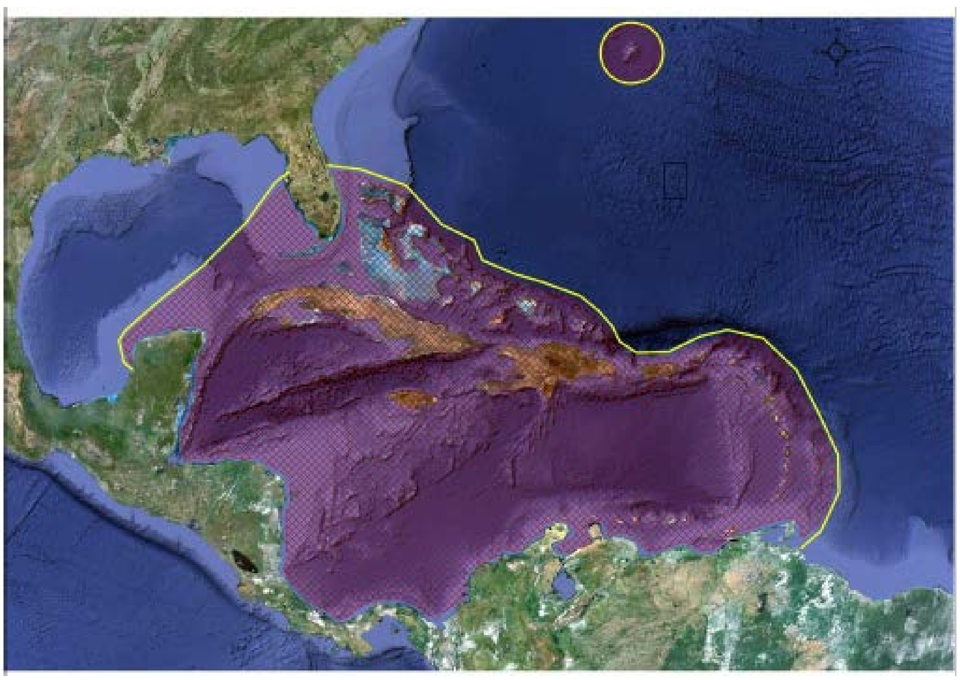

**Figure 46. Map identifying the range of the Nassau grouper. From NMFS Biological Report (NMFS 2013).**

**Table 18. Summary of Nassau grouper listing and recovery plan information.**

| Species | Common Name | Distinct Population Segment | ESA Status | Recent Review Year | Listing | Recovery Plan | Critical Habitat |
|---|---|---|---|---|---|---|---|
| *Epinephelus striatus* | Nassau grouper | None | Threatened | 2013 | 81 FR 42268 06/29/2016 | N/A | None Designated |

We used information available in the 2013 status review (NMFS 2013b) and recent scientific publications to summarize the life history, population dynamics and status of the species, as follows.

**Life History**

Nassau groupers spawn once a year in spawning aggregations, ranging in size from a few dozen to thousands of fish spawning at once. Nassau groupers move in groups towards the spawning aggregation sites parallel to the coast or along the shelf edge. Spawning runs occur from late fall through winter (i.e., a month or two before spawning is likely). Sea surface temperature is thought to be a key factor in the timing of spawning, with spawning occurring at temperatures around 25 degrees Celsius. Spawning aggregation sites are located near significant geomorphological features, such as reef projections (as close as 50 meters to shore) and close to a drop-off into deep water over a wide depth range (six to sixty meters). Sites are usually several hundred meters in diameter, with soft corals, sponges, stony coral outcrops, and sandy depressions. Nassau groupers stay on the spawning site for up to three months, spawning at the full moon or between the new and full moons. Spawning occurs within twenty minutes of sunset over the course of several days. Historically, there have been an estimated fifty known spawning aggregation sites in insular areas throughout the Caribbean; many of these aggregations no longer form. Current spawning locations are found in Mexico, Bahamas, Belize, Cayman Islands, the Dominican Republic, Cuba, Puerto Rico and the U.S. Virgin Islands.

Fertilized eggs are transported offshore by ocean currents. Thirty-five to forty days after hatching, larvae recruit from oceanic environments to demersal habitats (at a size of about 32 millimeters total length). Juveniles inhabit macroalgae, coral clumps, and seagrass beds, and are relatively solitary. As they grow they occupy progressively deeper areas and offshore reefs, and can be found in schools of up to forty individuals. When not spawning, adults are most commonly found in waters less than one hundred meters deep. Nassau grouper diet changes with age. Juveniles eat plankton, pteropods, amphipods, and copepods. Adults are unspecialized piscivores, bottom-dwelling ambush suction predators (NMFS 2013b).

Male and female Nassau groupers reach sexual maturity at lengths between 40 and 45 centimeters standard length, at about four to five years old. It is thought that sexual maturity is more determined by size, rather than age. Otolith studies indicate that the minimum age at maturity is between four and eight years; most groupers have spawned by age seven (Bush et al.

2006). Nassau grouper is a long-lived species with maximum longevity estimated up to 29 years (Bush et al. 1996).

**Population Dynamics**

The following is a discussion of the species' population and its variance over time. This section includes abundance, population growth rate, genetic diversity, and spatial distribution as it relates to the Nassau grouper.

There is no range-wide abundance estimate available for Nassau grouper. The species is characterized as having patchy abundance due largely to differences in habitat availability or quality, and differences in fishing pressure in different locations. Although abundance has been reduced compared to historical levels, spawning still occurs and abundance is increasing in some locations, such as the Cayman Islands and Bermuda.

There is no population growth rate available for Nassau grouper. Available information from observations of spawning aggregations has shown steep declines (Aguilar-Perera 2006; Claro and Lindeman 2003; Sala et al. 2001); however, some aggregation sites are comparatively robust and show signs of increase (Vo et al. 2014; Whaylen et al. 2004).

Early genetic analyses indicated high gene flow throughout the geographic range of Nassau grouper, but were unable to determine the relative contributions of populations (Hateley 2005; Hinegardner and Rosen 1972). A recent study on Nassau grouper genetic variation found strong genetic differentiation across Caribbean subpopulations, likely due to barriers created by ocean currents and larval distribution (Jackson et al. 2014). While this study indicated some instances of genetic differentiation, the results do not indicate a high degree of population structuring across the range. Bernard et al. (2016) found that genetic diversity across temporal collections at the U.S. Virgin Islands spawning aggregation was relatively high; no marked differences were found between the U.S. Virgin Islands and Cayman spawning aggregations. These results suggest that external recruitment is an important driver of the U.S. Virgin Islands Nassau grouper population recovery and that, despite an apparent genetic bottleneck, the genetic diversity of the U.S. Virgin Islands Nassau grouper has not been severely compromised (Bernard et al. 2016).

Nassau grouper is distributed throughout the Caribbean, south to the northern coast of South America (Figure 46). Current Nassau grouper distribution is considered equivalent to its historical range, although abundance has been severely depleted.

**Status**

Nassau grouper possess life history characteristics that increase vulnerability to harvest, including slow growth to a large size, late maturation, formation of large spawning aggregations, and occurrence in shallow water. Two different aspects of fishing affect Nassau grouper populations: fishing effort throughout the non-spawning months and fishing effort directed at spawning aggregations or migratory access to spawning aggregations. Since grouper species were historically reported collectively in landings data (i.e., "groupers"), it is not possible to know how many Nassau grouper were harvested, or to estimate historic abundance based on fishery dependent data. Few formal stock assessments have been conducted for the Nassau grouper. One recent published assessment conducted in the Bahamas indicates fishing mortality needs to be reduced from the 1998 to 2001 levels, otherwise the stocks are likely to be overexploited relative to biological reference points (Cheung et al. 2013).

Lacking information from stock assessments or population estimates, changes in Nassau grouper spawning aggregations have been used as a proxy for population status. Historically, tens of thousands of Nassau grouper spawned at aggregation sites throughout the Caribbean. That these large spawning aggregations occurred in predictable locations at regular times made the species susceptible to over-fishing, and was a primary cause of its decline. At some sites, spawning aggregations have decreased by over 80 percent in the last 25 years (e.g., Belize), or have disappeared entirely (e.g., Mexico) (Aguilar-Perera 2006; Sala et al. 2001). Nassau grouper spawning aggregations within U.S. Virgin Island waters were overfished until their disappearance in the 1970s and 1980s.

The most serious ongoing threats to Nassau grouper are fishing at spawning aggregations and inadequate law enforcement. Many Caribbean countries have banned or restricted Nassau grouper harvest, and it is believed that current areas of higher abundance are correlated with effective regulations. In some locations, spawning aggregations are increasing. In the early 2000s, Nassau grouper were found gathering at Grammanik Bank, a mesophotic coral reef adjacent to one of the previously extinct U.S. Virgin Islands aggregation sites. Although harvest has decreased due to management measures, Nassau grouper populations remain vulnerable to unregulated harvest.

Since Nassau grouper are dependent upon coral reefs at various points in their life history, loss of coral reef habitat due to climate change represents a potential threat to this species. However, the overall impact of climate change on Nassau grouper populations is still largely unknown at this time. Recent studies suggest that the highly invasive Pacific red lionfish (*Pterois volitans*) may also pose a threat to Nassau grouper through direct competition for food and shelter (Cheung et al. 2013; O'Farrell et al. 2014; Raymond et al. 2015).

**Designated Critical Habitat**

No critical habitat has been designated for the Nassau grouper.

**Recovery Goals**

NMFS has not prepared a recovery plan for the Nassau grouper.

### 6.2.14 Scalloped Hammerhead

This section provides general information on the scalloped hammerhead shark species, including information about the species’ life history, population dynamics, and status. The subsections that follow provide information and characteristics particular to each of the three listed DPSs of scalloped hammerhead considered in this opinion.

Hammerhead sharks are recognized by their laterally expanded head that resembles a hammer, hence the common name "hammerhead." The scalloped hammerhead shark is distinguished from other hammerheads by a noticeable indentation on the center and front portion of the head, along with two more indentations on each side of this central indentation, giving the head a "scalloped" appearance. It has a broadly arched mouth and the back of the head is slightly swept backward (Figure 47).

**Figure 47. Scalloped hammerhead shark. Photo: NOAA (left), Brian Skerry, National Geographic (right).**

Scalloped hammerheads are moderately large coastal pelagic sharks found worldwide in coastal warm temperate and tropical seas in the Atlantic, Pacific and Indian Oceans between 46°N and 36°S (Miller et al. 2014) (Figure 48). Four scalloped hammerhead shark DPSs were listed in July 2014: Eastern Pacific DPS and Eastern Atlantic DPS (entirely foreign) were listed as endangered and the Central and Southwest Atlantic DPS and Indo-West Pacific DPS were listed as threatened (Table 19).

**Table 19. Summary of scalloped hammerhead shark listing and recovery plan information.**

| Species | Common Name | Distinct Population Segment | ESA Status | Recent Review Year | Listing | Recovery Plan | Critical Habitat |
|---|---|---|---|---|---|---|---|
| *Sphyrna lewini* | Scalloped Hammerhead shark | Eastern Pacific | Endangered | N/A | 79 FR 38213 07/03/2014 | N/A | None Designated |
| *Sphyrna lewini* | Scalloped Hammerhead shark | Central & Southwest Atlantic | Threatened | N/A | 79 FR 38213 07/03/2014 | N/A | None Designated |
| *Sphyrna lewini* | Scalloped Hammerhead shark | Indo-West Pacific | Threatened | N/A | 79 FR 38213 07/03/2014 | N/A | None Designated |

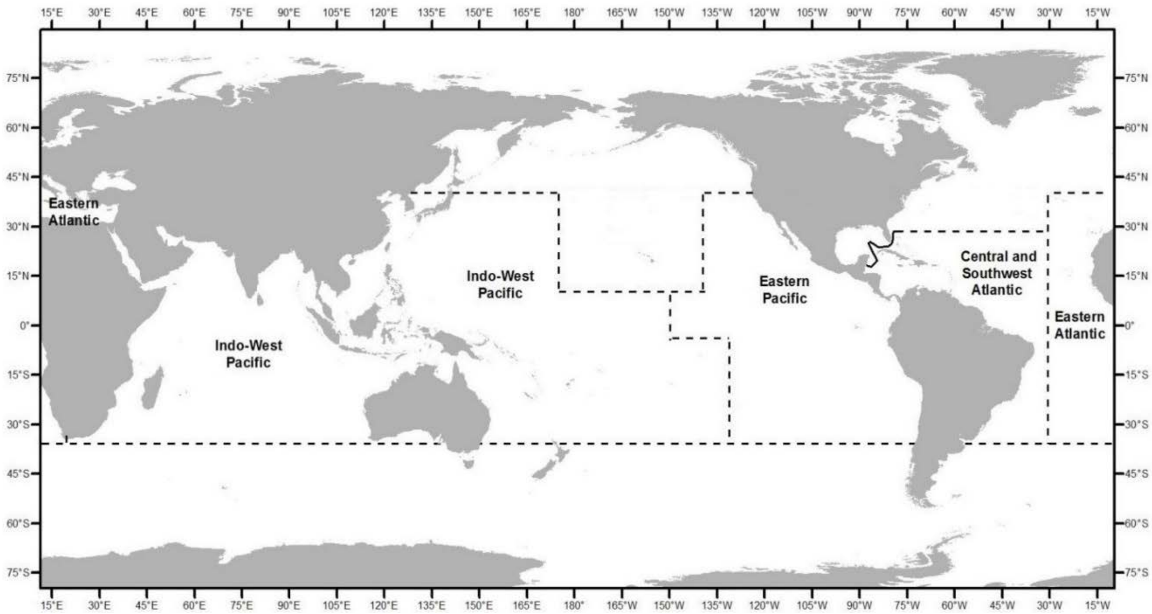


**Figure 48. Map depicting the distinct population segments for the scalloped hammerhead shark.**

## Life History

The scalloped hammerhead shark gives birth to live young (i.e., "viviparous"), with a gestation period of 9 to 12 months (Branstetter 1987; Stevens and Lyle 1989) which may be followed by a one-year resting period (Liu and Chen 1999). Females attain maturity around 6.5 to 8 feet (2.0 to 2.5 meters) TL, while males reach maturity at smaller sizes (range 4 to 6.5 feet [1.3 to 2.0 meters] TL). The age at maturity differs by region. For example, in the Gulf of Mexico, Branstetter (1987) estimated that females mature at about 15 years of age and males at around nine to ten years of age. In northeastern Taiwan, Chen et al. (1990) calculated age at maturity to be 4 years for females and 3.8 years for males. On the east coast of South Africa, age at sexual maturity for females was estimated at 11 years (Dudley and Simpfendorfer 2006). Parturition, however, does not appear to vary by region and may be partially seasonal (Harry et al. 2011), with neonates present year round but with abundance peaking during the spring and summer months (Adams and Paperno 2007; Duncan and Holland 2006; Harry et al. 2011; Noriega et al. 2011). Females move inshore to birth, with litter sizes anywhere between one and 41 live pups. Off the coast of northeastern Australia, Noriega et al. (2011) found a positive correlation between litter size and female shark length for scalloped hammerheads, as did White et al. (2008) in Indonesian waters. However, off the northeastern coast of Brazil, Hazin et al. (2001) found no such relationship. Size at birth is estimated between one and two feet (0.3 to 0.6 meters) TL.

Scalloped hammerheads are found over continental shelves and the shelves surrounding islands, as well as adjacent deep waters, but is seldom found in waters cooler than 22 degrees Celsius (Compagno 1984; Schulze-Haugen and Kohler 2003). They range from the intertidal and surface to depths of up to 450-512 meters (Klimley 1993), with occasional dives to even deeper waters (Jorgensen et al. 2009). Scalloped hammerheads have also been documented entering enclosed bays and estuaries (Compagno 1984). Neonates and juveniles inhabit nearshore nursery habitats for up to one year or more as these areas provide valuable refuge from predation (Duncan and Holland 2006). Scalloped hammerheads are high trophic level, opportunistic predators whose diet includes crustaceans, fish and cephalopods.

**Population Dynamics**

Scalloped hammerhead sharks are highly mobile and partly migratory and are likely the most abundant of the hammerhead species (Maguire 2006); however the risk of local depletions is of concern. Scalloped hammerhead sharks have a life history that is susceptible to overharvesting, and according to the most recent stock assessment the Northwestern Atlantic and Gulf of Mexico stock has declined to a relatively low level of abundance in recent years (Hayes et al. 2009). Populations in other parts of the world are assumed to have suffered similar declines, however data to conduct stock assessments on those populations are currently lacking.

Based on information related to genetic variation among populations, behavior and physical factors, and differences in international regulatory mechanisms, the scalloped hammerhead Extinction Risk Analysis team identified six DPSs: Northwest Atlantic and Gulf of Mexico; Central and Southwest Atlantic; Eastern Atlantic; Indo-West Pacific; Central Pacific; and Eastern Pacific (Miller et al. 2014).

**Status**

Based on a combination of fisheries dependent and fisheries independent data, it is estimated that hammerhead shark populations have experienced drastic population declines, in excess of 90 percent, in several parts of their global range (Gallagher et al. 2014). The primary factors responsible for the decline of the ESA-listed scalloped hammerhead DPSs are overutilization, due to both catch and bycatch of these sharks in fisheries, and inadequate regulatory mechanisms for protecting these sharks, with illegal fishing identified as a significant problem (Miller et al. 2014). More details on the status of each DPS are provided in the DPS subsections below.

**Designated Critical Habitat**

No critical habitat has been designated for the scalloped hammerhead shark.

**Recovery Goals**

NMFS has not prepared a recovery plan for the scalloped hammerhead shark.

#### *6.2.14.1 Eastern Pacific Distinct Population Segment*

Historical estimates of effective population size (or the number of breeding individuals in the population) in the eastern Pacific range from 34,995 to 43,551 individuals (Nance et al. 2011). Using 15 microsatellite loci and mitochondrial DNA (mtDNA) from eastern Pacific tissue samples, Nance et al. (2011) discovered that the current effective population size is significantly smaller (one to three orders of magnitude) than the historical effective population size, indicating that scalloped hammerheads in the eastern Pacific experienced a bottleneck and suffered significant declines. While current abundance data for this DPS are sparse, local and regional population declines have been indicated from recent fishery dependent data. Using fishing mortality estimates calculated from 1997 and 1998 catches, the INP (2006) estimated that the scalloped hammerhead shark population in the Gulf of Tehuantepac (Mexico) is decreasing by six percent per year. In Michoacán, hammerheads represent 70 percent of the catch, with fishing effort concentrated in breeding areas and directed towards juveniles and pregnant females (CITES 2012). In Costa Rica, shark catches reported by artisanal and longline fisheries have shown a dramatic decline (~ 50 percent) after reaching a maximum of 5,000 tons in 2000 (SINAC 2012). Available data on relative abundance of pelagic sharks in general in the Costa Rica exclusive economic zone (EEZ) suggest sharp declines (approximately 58 percent) between 1991 and 2002 (Arauz et al. 2004). Evidence of heavy fishing pressure by industrial/commercial and artisanal fisheries, high at-vessel fishing mortality, limited regulatory mechanisms and poor enforcement indicate that the Eastern Pacific DPS is currently at or near a level of abundance and productivity that places its current and future persistence in question (Miller et al. 2014).

#### *6.2.14.2 Central and Southwest Atlantic Distinct Population Segment*

While scalloped hammerhead sharks in the northwest Atlantic may currently be in a rebuilding phase, populations found further south in the Atlantic could still be in danger of decline (Miller et al. 2014). Historical landings data indicate that large numbers of hammerhead sharks were removed by longliners off the coast of Brazil in the late 20$^{th}$ century (Amorim et al. 1998). Although abundance estimates and quality catch data are unavailable for this DPS, the evidence of heavy fishing pressure on this species off the coast of Brazil, Central America, and the Caribbean, with documented large numbers of juvenile and neonate landings, suggests this DPS is likely approaching a level of abundance and productivity that places its current and future persistence in question (Miller et al. 2014). Overutilization by industrial/commercial fisheries combined with high at-vessel fishing mortality were ranked by the Extinction Risk Analysis team as the greatest risks to the persistence of this DPS. Overutilization by artisanal fisheries, lack of adequate regulatory mechanisms, illegal, unreported and unregulated fishing, and the schooling behavior of the species were ranked as moderate risks.

#### *6.2.14.3 Indo-West Pacific Distinct Population Segment*

The Indo-West Pacific DPS range covers a very large area and abundance estimates for this entire DPS are unavailable. However, documented trends in abundance in particular areas suggest significant depletions of local populations. Data collected from East Lombok, Indonesia, suggest potential population declines as the proportion of scalloped hammerheads in the Tanjung Luar artisanal longline fishery catch decreased from 15 percent to 2 percent from 2001 to 2011 (FAO 2013). Scalloped hammerhead sharks off the coast of South Africa are also thought to be experiencing similar decreases in population size. Analyses of fishery-independent data from beach protection programs have revealed drastic declines in catch rates since the early 1950s. From 1952-1972, Ferretti et al. (2010) estimated a decline of 99.3 percent in scalloped hammerhead catch rates off Main Beach in South Africa, and a decline of 86 percent from 1961-1972 off Brighton Beach, South Africa. Estimates of the decline in hammerhead abundance in Australia's northwest marine region, based on analysis of catch-per-unit-effort data from 1996-2005, range from 58-76 percent (Heupel and McAuley 2007). Data from protective shark meshing programs off beaches in New South Wales and Queensland also suggest significant declines in hammerhead populations off the east coast of Australia. Over a 35 year period, the number of hammerheads caught per year in beach protection nets has decreased by more than 90 percent, from over 300 individuals in 1973 to less than 30 in 2008 (Reid and Krogh 1992). Similarly, data from the Queensland shark control program indicates a 63 percent decline in scalloped hammerhead shark abundance between 2005 and 2010 (QPIF 2011).

Evidence of heavy fishing pressure by industrial, commercial and artisanal fisheries, reports of significant illegal, unreported, unregulated fishing, especially off the coast of Australia, and high at-vessel mortality rates have likely led to overutilization of the Indo-West Pacific DPS. Coupled with inadequate regulatory measures, especially in the Western Indian Ocean and Indonesian waters, and habitat degradation, the present and future threats facing this DPS indicate it is approaching a level of abundance and productivity that places its current and future persistence in question (Miller et al. 2014).

# 7 ENVIRONMENTAL BASELINE

The "environmental baseline" includes the past and present impacts of all Federal, state, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of state or private actions which are contemporaneous with the consultation in process (50 C.F.R. §402.02). We focus our discussion of the environmental baseline on threats to all ESA-listed species in those areas where sea turtle research primarily occurs, with a particular emphasis on threats affecting ESA-listed sea turtles.

## 7.1 Global Climate Change

There is a large and growing body of literature on past, present, and future impacts of global climate change, exacerbated and accelerated by human activities. Effects of climate change include sea level rise, increased frequency and magnitude of severe weather events, changes in air and water temperatures, and changes in precipitation patterns, all of which are likely to impact ESA resources. NOAA's climate information portal provides basic background information on these and other measured or anticipated climate change effects (see https://www.climate.gov).

In order to evaluate the implications of different climate outcomes and associated impacts throughout the 21st century, many factors have to be considered. The amount of future greenhouse gas emissions is a key variable. Developments in technology, changes in energy generation and land use, global and regional economic circumstances, and population growth must also be considered.

A set of four scenarios was developed by the Intergovernmental Panel on Climate Change (IPCC) to ensure that starting conditions, historical data, and projections are employed consistently across the various branches of climate science. The scenarios are referred to as representative concentration pathways (RCPs), which capture a range of potential greenhouse gas emissions pathways and associated atmospheric concentration levels through 2100 (IPCC 2014). The RCP scenarios drive climate model projections for temperature, precipitation, sea level, and other variables: RCP2.6 is a stringent mitigation scenario; RCP2.5 and RCP6.0 are intermediate scenarios; and RCP8.5 is a scenario with no mitigation or reduction in the use of fossil fuels. The IPCC future global climate predictions (2014 and 2018) and national and regional climate predictions included in the Fourth National Climate Assessment for U.S. states and territories (2018) use the RCP scenarios.

The increase of global mean surface temperature change by 2100 is projected to be 0.3 to 1.7°C under RCP2.6, 1.1 to 2.6°C under RCP 4.5, 1.4 to 3.1°C under RCP6.0, and 2.6 to 4.8°C under RCP8.5 with the Arctic region warming more rapidly than the global mean under all scenarios (IPCC 2014). The Paris Agreement aims to limit the future rise in global average temperature to 2°C, but the observed acceleration in carbon emissions over the last 15 to 20 years, even with a lower trend in 2016, has been consistent with higher future scenarios such as RCP8.5 (Hayhoe et al. 2018).

The globally-averaged combined land and ocean surface temperature data, as calculated by a linear trend, show a warming of approximately 1.0°C from 1901 through 2016 (Hayhoe et al. 2018). The IPCC Special Report on the Impacts of Global Warming (2018) (IPCC 2018) noted that human-induced warming reached temperatures between 0.8 and 1.2°C above pre-industrial levels in 2017, likely increasing between 0.1 and 0.3°C per decade. Warming greater than the global average has already been experienced in many regions and seasons, with most land regions experiencing greater warming than over the ocean (Allen et al. 2018). Annual average temperatures have increased by 1.8°C across the contiguous U.S. since the beginning of the 20th century with Alaska warming faster than any other state and twice as fast as the global average since the mid-20th century (Jay et al. 2018). Global warming has led to more frequent heatwaves in most land regions and an increase in the frequency and duration of marine heatwaves (Allen et al. 2018). Average global warming up to 1.5°C as compared to pre-industrial levels is expected to lead to regional changes in extreme temperatures, and increases in the frequency and intensity of precipitation and drought (Allen et al. 2018).

Several of the most important threats contributing to the extinction risk of ESA-listed species, particularly those with a calcium carbonate skeleton such as corals and mollusks as well as species for which these animals serve as prey or habitat, are related to global climate change. The main concerns regarding impacts of global climate change on coral reefs and other calcium carbonate habitats generally, and on ESA-listed corals and mollusks in particular, are the magnitude and the rapid pace of change in greenhouse gas concentrations (e.g., carbon dioxide and methane) and atmospheric warming since the Industrial Revolution in the mid-19th century. These changes are increasing the warming of the global climate system and altering the carbonate chemistry of the ocean [ocean acidification; (IPCC 2014)]. As carbon dioxide concentrations increase in the atmosphere, more carbon dioxide is absorbed by the oceans, causing lower pH and reduced availability of calcium carbonate. Because of the increase in carbon dioxide and other greenhouse gases in the atmosphere since the Industrial Revolution, ocean acidification has already occurred throughout the world's oceans, including in the Caribbean, and is predicted to increase considerably between now and 2100 (IPCC 2014).

The Atlantic Ocean appears to be warming faster than all other ocean basins except perhaps the southern oceans (Cheng et al. 2017). In the western North Atlantic Ocean surface temperatures have been unusually warm in recent years (Blunden and Arndt 2016). A study by (Polyakov et al. 2009) suggests that the North Atlantic Ocean overall has been experiencing a general warming trend over the last 80 years of 0.031±0.0006 degrees Celsius per decade in the upper 2,000 meters (6,561.7 feet) of the ocean. Additional consequences of climate change include increased ocean stratification, decreased sea-ice extent, altered patterns of ocean circulation, and decreased ocean oxygen levels (Doney et al. 2012). Since the early 1980s, the annual minimum sea ice extent (observed in September each year) in the Arctic Ocean has decreased at a rate of

11 to 16 percent per decade (Jay et al. 2018). Further, ocean acidity has increased by 26 percent since the beginning of the industrial era (IPCC 2014) and this rise has been linked to climate change. Climate change is also expected to increase the frequency of extreme weather and climate events including, but not limited to, cyclones, tropical storms, heat waves, and droughts (IPCC 2014).

Climate change has the potential to impact species abundance, geographic distribution, migration patterns, and susceptibility to disease and contaminants, as well as the timing of seasonal activities and community composition and structure (Evans and Bjørge 2013; IPCC 2014; Kintisch 2006; Learmonth et al. 2006; MacLeod et al. 2005; McMahon and Hays 2006; Robinson et al. 2005). Though predicting the precise consequences of climate change on highly mobile marine species is difficult (Simmonds and Isaac 2007), recent research has indicated a range of consequences already occurring. For example, in sea turtles, sex is determined by the ambient sand temperature (during the middle third of incubation) with female offspring produced at higher temperatures and males at lower temperatures within a thermal tolerance range of 25 to 35°C (Ackerman 1997). Increases in global temperature could skew future sex ratios toward higher numbers of females (NMFS and USFWS 2007a; NMFS and USFWS 2007d; NMFS and USFWS 2013a; NMFS and USFWS 2013b; NMFS and USFWS 2015). These impacts will be exacerbated by sea level rise. The loss of habitat because of climate change could be accelerated due to a combination of other environmental and oceanographic changes such as an increase in the frequency of storms and/or changes in prevailing currents, both of which could lead to increased beach loss via erosion (Antonelis et al. 2006; Baker et al. 2006).

Changes in the marine ecosystem caused by global climate change (e.g., ocean acidification, salinity, oceanic currents, dissolved oxygen levels, nutrient distribution) could influence the distribution and abundance of lower trophic levels (e.g., phytoplankton, zooplankton, submerged aquatic vegetation, crustaceans, mollusks, forage fish), ultimately affecting primary foraging areas of ESA-listed species including marine mammals, sea turtles, and fish. Marine species ranges are expected to shift as they align their distributions to match their physiological tolerances under changing environmental conditions (Doney et al. 2012). (Hazen et al. 2012) examined top predator distribution and diversity in the Pacific Ocean in light of rising sea surface temperatures using a database of electronic tags and output from a global climate model. They predicted up to a 35 percent change in core habitat area for some key marine predators in the Pacific Ocean, with some species predicted to experience gains in available core habitat and some predicted to experience losses. Notably, leatherback turtles were predicted to gain core habitat area, whereas loggerhead turtles and blue whales were predicted to experience losses in available core habitat. (McMahon and Hays 2006) predicted increased ocean temperatures will expand the distribution of leatherback turtles into more northern latitudes. The authors noted this is already occurring in the Atlantic Ocean. (MacLeod 2009) estimated, based upon expected shifts in water temperature, 88 percent of cetaceans will be affected by climate change, with 47 percent predicted to experience unfavorable conditions (e.g., range contraction). (Willis-Norton et al. 2015) acknowledged there will be both habitat loss and gain, but overall climate change could result in a 15 percent loss of core pelagic habitat for leatherback turtles in the eastern South Pacific Ocean.

Similarly, climate-related changes in important prey species populations are likely to affect predator populations. For example, blue whales, as predators that specialize in eating krill, are likely to change their distribution in response to changes in the distribution of krill (Clapham et al. 1999; Payne et al. 1986; Payne et al. 1990). (Pecl and Jackson 2008) predicted climate change will likely result in squid that hatch out smaller and earlier, undergo faster growth over shorter life-spans, and mature younger at a smaller size. This could have negative consequences for species such as sperm whales, whose diets can be dominated by cephalopods. For ESA-listed species that undergo long migrations, if either prey availability or habitat suitability is disrupted by changing ocean temperatures regimes, the timing of migration can change or negatively impact population sustainability (Simmonds and Eliott 2009).

This review provides some examples of impacts to ESA-listed species and their habitats that may occur as the result of climate change. While it is difficult to accurately predict the consequences of climate change to a particular species or habitat, a range of consequences are expected that are reasonably likely to change the status of the species and the condition of their habitats.

Sea turtles occupy a wide range of terrestrial and marine habitats, and many aspects of their life history have been demonstrated to be closely tied to climatic variables such as ambient temperature and storminess (Hawkes et al. 2009). Sea turtles have temperature-dependent sex determination, and many populations produce highly female-biased offspring sex ratios, a skew likely to increase further with global warming (Patrício et al. 2017). In addition to altering sex ratios, increased temperatures in sea turtle nests can result in reduced incubation times (producing smaller hatchling), reduced clutch size, and reduced nesting success due to exceeded thermal tolerances (Azanza-Ricardo et al. 2017; Fuentes et al. 2010; Fuentes et al. 2011; Fuentes et al. 2009).

Other climatic aspects, such as extreme weather events, precipitation, ocean acidification and sea level rise also have potential to affect marine turtle populations. Changes in global climatic patterns will likely have profound effects on the coastlines of every continent, thus directly impacting sea turtle nesting habitat (Wilkinson and Souter 2008). In some areas, increases in sea level alone may be sufficient to inundate turtle nests and reduce hatching success by creating hypoxic conditions within inundated eggs (Caut et al. 2009; Pike et al. 2015). Flatter beaches, preferred by smaller sea turtle species, would likely be inundated sooner than would steeper beaches preferred by larger species (Hawkes et al. 2014). Relatively small increases in sea level can result in the loss of a large proportion of nesting beaches in some locations. For example, a study in the northwestern Hawaiian Islands predicted that up to 40 percent of green turtle nesting beaches could be flooded with 0.9 m of sea level rise (Baker et al. 2006). The loss of nesting beaches would have catastrophic effects on sea turtle populations globally if they are unable to colonize new beaches that form, or if the newly formed beaches do not provide the habitat attributes (sand depth, temperature regimes, refuge) necessary for egg survival.

Changing patterns of coastal erosion and sand accretion, combined with an anticipated increase in the number and severity of extreme weather events, may further exacerbate the effects of sea level rise on turtle nesting beaches (Wilkinson and Souter 2008). Extreme weather events may directly harm sea turtles, causing “mass” strandings and mortality (Poloczanska et al. 2009). Studies examining the spatio-temporal coincidence of marine turtle nesting with hurricanes, cyclones and storms suggest that cyclical loss of nesting beaches, decreased hatching success and hatchling emergence success could occur with greater frequency in the future due to global climate change (Hawkes et al. 2009).

Global climate change may affect the ESA-listed fish species and DPSs considered in this opinion. Thermal changes of just a few degrees Celsius can substantially alter fish protein metabolism (McCarthy and Houlihan 1997), response to aquatic contaminants (Reid 1997), reproductive performance (Van Der Kraak and Pankhurst 1997), smolt development (McCormick et al. 1997), species distribution limits (McCarthy and Houlihan 1997), and community structure of fish populations (Schindler 2001). Apart from direct changes to anadromous fish survival, increased water temperatures may alter habitat, including the availability of prey (ISAB 2007).

Shortnose and Atlantic sturgeon are tolerant to water temperatures up to approximately 28° C; these temperatures are experienced naturally in some areas of rivers during the summer months. If temperature rises beyond thermal limits for extended periods, habitat could be lost; this could be the case if southern habitats warm, resulting in range loss (Lassalle et al. 2010). As water temperatures increase, juvenile sturgeon may experience elevated mortality due to lack of cooler water refuges. The Atlantic salmon GOM DPS may be particularly vulnerable to elevated water temperature regimes since Maine is near the southern extent species’ range in North America (Fay et al. 2006b). Rising temperatures could also exacerbate existing water quality problems associated with DO and temperature.

Salinity plays an important role in the movement and distribution of some nearshore and estuarine fish species (Simpfendorfer et al. 2011). Rising sea levels associated with climate change will likely shift the salt wedge upstream in affected rivers. Given the importance of salinity, changes in freshwater flow regimes into estuaries as a result of climate change will affect fish populations by potentially changing their distributions. Anadromous fish species (e.g., sturgeon and salmon) spawn in fresh water reaches of rivers because early life stages have little to no tolerance for salinity. If the salt wedge moves further upstream, sturgeon spawning and rearing habitat could be restricted. In river systems with dams or natural falls that are impassable by sturgeon, the extent that spawning or rearing may be shifted upstream to compensate for the shift in the movement of the salt wedge would be limited. Simpfendorfer et al. (2011) found that juvenile smalltooth sawfish moved farther inland into estuary reaches within their preferred salinity range. Sea level rise will also likely impact important sawfish mangrove habitats as sediment surface elevations for mangroves will not keep pace with conservative projected rates sea level rise (Gilman et al. 2008).

Changes in precipitation patterns are anticipated as a result of global climate change. The increased rainfall predicted in some areas may increase runoff and scour spawning areas, and flooding events could cause temporary water quality issues. Increased extremes in river flow (i.e., periods of flooding and low flow) can alternatively disrupt and fill in spawning habitat that sturgeon and salmon rely upon (ISAB 2007). In some areas, longer and more frequent droughts are predicted, in combination with increased water withdrawal for human use, may cause loss of habitat including loss of access to spawning habitat. Drought conditions in the spring may also expose eggs and larvae in rearing habitats. If a river becomes too shallow or flows become intermittent, anadromous fish may become susceptible to strandings or habitat restrictions. Low flow and drought conditions are also expected to cause additional water quality issues. Any of the conditions associated with climate change are likely to disrupt river ecology, causing shifts in community structure and the type and abundance of prey. Additionally, cues for spawning migration and spawning could occur earlier in the season, which might affect prey availability in rearing habitat. Overall, it is likely that global climate change would increase pressures on the survival and recovery of ESA-listed sturgeon and salmon populations considered in this opinion.

Nassau grouper are found in a wide range of temperatures but spawning occurs within a narrow temperature range around 25 degrees Celsius. If sea surface temperatures rise, the geographic range of the species may shift in response to such changes. Changes in reproductive output or seasonal timing are also possible with unknown consequences for population abundance. One of the other potential effects of climate change on Nassau grouper is the loss of structural habitat in coral reef ecosystems (Munday et al. 2008). Increased sea surface temperatures have been responsible for coral loss through bleaching and disease, and bioerosion may reduce three dimensional structure in affected areas (Alvarez-Filip et al. 2009), reducing adult habitat for Nassau grouper (Coleman and Koenig 2010; Rogers and Beets 2001).

## 7.2 Habitat Degradation

The modification and destruction of habitat remains one of the primary threats to many threatened and endangered species. In this section we summarize the impacts of habitat degradation on the ESA-listed species within the action area. This section is divided into two subsections: (1) the effects of anthropogenic stressors (e.g., development, erosion control, lighting, and pollution) on sea turtle terrestrial nesting habitat, and (2) the effects of general anthropogenic stressors (e.g., land-use changes, run-off, and population increase) on aquatic habitats used by turtles and fish species considered in this opinion. The effects of human activities on aquatic habitats located within the action area is further discussed subsequent sections addressing the following threats: marine debris, pollutants, oil spills, sound, power plants, dredging, and hydromodification.

### 7.2.1 Terrestrial Habitat

Destruction and modification of sea turtle nesting habitat is occurring worldwide. The main anthropogenic threats impacting nesting habitat include coastal development/construction, placement of erosion control structures and other barriers to nesting, beachfront lighting, vehicular and pedestrian traffic, sand extraction, beach erosion, beach sand placement, beach pollution, removal of native vegetation, and planting of non-native vegetation. Development near coastal areas continues and is a major problem as more and more people are moving to or visiting coastal areas. Development impacts may include the construction of roads, highways, public infrastructure, hotels, condominiums, houses, harbors, and nearshore shoreline stabilization structures (e.g., groins, jetties, breakwaters). Such development can deter or interfere with sea turtle nesting, affect nest success, and degrade nesting habitat.

Nesting habitat is threatened by rigid shoreline protection or “coastal armoring” such as sea walls, rock revetments, and sandbag installations. Many miles of once productive nesting beach have been permanently lost to this type of shoreline protection. 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). At many ocean inlets along the U.S. Atlantic coast jetties have been constructed perpendicular to the shore to keep transported sand from closing the inlet channel. Witherington et al. (2005) found a significant negative relationship between loggerhead nesting density and distance from the nearest of 17 ocean inlets on the Atlantic coast of Florida. The effect of inlets in lowering nesting density was observed both updrift and downdrift of the inlets, leading researchers to propose that beach instability from both erosion and accretion may discourage loggerhead nesting.

Numerous beaches in the southeastern U.S. are eroding due to both natural (e.g., storms, sea level changes, waves, shoreline geology) and anthropogenic (e.g., construction of armoring structures, groins, and jetties; coastal development; inlet dredging) factors. Such shoreline erosion leads to a loss of nesting habitat for sea turtles. Beach nourishment is a commonly used engineering solution to offset the loss of sandy beaches due to erosion. Although beach nourishment provides more sand, the quality of that sand, and hence the nesting beach, is typically less suitable than pre-existing natural beaches. Characteristics are engineered beaches via nourishment include (1) increased beach compaction, which can decrease nesting success, alter nest-chamber geometry, and alter nest concealment, and (2) escarpments, which can block turtles from reaching nesting areas (Ackerman 1980; Mann 1978; Mortimer 1990). For eggs and hatchlings, nourishment can decrease survivorship and affect development by altering beach characteristics such as sand compaction, gaseous environment, hydric environment, contaminant levels, nutrient availability, and thermal environment (Grain et al. 1995). In addition, nests can be covered with excess sand if nourishment is implemented in areas with incubating eggs. Sand mining (i.e., the removal of beach sand for upland construction) can also seriously reduce or degrade sea turtle nesting habitat and interfere with hatchling movement to sea (NMFS 2003).

Erosion of nesting beaches can occur as a result of coastal development when native dune vegetation, which enhances beach stability and acts as an integral buffer zone between land and sea, is degraded or destroyed. This in turn often leaves insufficient nesting opportunities above the high tide line, and nests may be washed out. Hawksbill turtles prefer to nest under vegetation and are, therefore, particularly affected by beachfront development and the associated clearing of dune vegetation (Mortimer and Donnelly 2007). Non-native vegetation has invaded many coastal areas and often out competes native species. Non-native vegetation is usually less-stabilizing and can lead to increased erosion and degradation of suitable nesting habitat. Exotic vegetation may also form impenetrable root mats that can prevent proper nest cavity excavation, invade and desiccate eggs, or trap hatchlings.

The presence of lights on or adjacent to nesting beaches alters the behavior of nesting adults and is often fatal to emerging hatchlings as they are attracted to light sources and drawn away from the sea (Witherington 1992). Artificial lighting may deter adult female turtles from emerging from the ocean to nest and can disorient emerging hatchlings away from the ocean. Hatchlings have a tendency to orient toward the brightest direction, which on natural, undeveloped beaches is commonly toward the broad open horizon of the sea. However, on developed beaches, the brightest direction is often away from the ocean and toward lighted structures. Hatchlings unable to find the ocean, or delayed in reaching it, are likely to incur higher mortality risk from dehydration, exhaustion, or predation. Hatchlings lured into lighted parking lots or toward streetlights can get crushed by passing vehicles.

Coastal development brings large numbers of people into close contact with sea turtle nesting areas. Human debris, beach equipment, and ruts lefts by vehicles may interfere with turtle hatchling’s progress towards the ocean (Conant et al. 2009). Trash left on the beach may attract terrestrial and avian predators to sea turtle nesting sites. Vehicle traffic on nesting beaches can also contribute to sand compaction, which hinders nest construction and hatchling emergence, and erosion, especially during high tides or on narrow beaches where driving is concentrated on the high beach and foredune.

### 7.2.2 Aquatic Habitat

Many stream, riparian, and coastal areas within the action area have been degraded by the effects of land and water use associated with urbanization, road construction, forest management, agriculture, mining, transportation, water development, and other human activities. Development activities contribute to a variety of interrelated factors that lead to the decline of ESA-listed fish species considered in this opinion. These include reduced in-channel and off-channel habitat, restricted lateral channel movement, increased flow velocities, increased erosion, decreased cover, reduced prey sources, increased contaminants, increased water temperatures, degraded water quality, and decreased water quantity.

Urbanization and increased human population density within a watershed result in changes in stream habitat, water chemistry, and the biota (plants and animals) that live there. In many cases, these changes negatively impact species, particularly those with small population sizes like the ESA-listed species within the action area. The most obvious effect of urbanization is the loss of natural vegetation, which results in an increase in impervious cover and dramatic changes to the natural hydrology of urban and suburban streams (O'Driscoll et al. 2010). Urbanization generally results in land clearing, soil compaction, modification and/or loss of riparian buffers, and modifications to natural drainage features. The increased impervious cover in urban areas leads to increased volumes of runoff, increased peak flows and flow duration, and greater stream velocity during storm events (Bledsoe and Watson 2001; Booth et al. 1995). Runoff from urban areas also contains chemical pollutants from vehicles and roads, industrial sources, and residential sources (Connor et al. 2003). Urban runoff is typically warmer than receiving waters and can significantly increase temperatures, particularly in smaller streams (O'Driscoll et al. 2010). Municipal wastewater treatment plants replace septic systems, resulting in point discharges of nutrients and other contaminants not removed in the processing (Booth et al. 1995). Municipalities with combined sewer/stormwater overflows or older treatment systems may directly discharge untreated sewage following heavy rainstorms. Urban and suburban nonpoint and point source discharges affect water quality and quantity in basin surface waters (O'Driscoll et al. 2010). Dikes and levees constructed to protect infrastructure and agriculture have isolated floodplains from their river channels and restricted fish access (Bayley 1995). The many miles of roads and rail lines that parallel streams within the action area have degraded stream bank conditions and decreased floodplain connectivity by adding fill to floodplains (O'Driscoll et al. 2010). Culvert and bridge stream crossings have similar effects and create additional problems for fish when they act as physical or hydraulic barriers that prevent fish access to spawning or rearing habitat, or contribute to adverse stream morphological changes upstream and downstream of the crossing itself.

Modification and loss of smalltooth sawfish habitat, especially nursery habitat, is a contributing factor in the decline of the species. Activities such as agricultural and urban development, commercial activities, dredge-and-fill operations, boating, erosion, and diversions of freshwater runoff contribute to these losses (SAFMC 1998). In Florida, coastal development often involves the removal of mangroves and the armoring of shorelines through seawall construction. Changes to the natural freshwater flows into estuarine and marine waters through construction of canals and other water control devices have had other impacts including: altered temperatures, salinity, and nutrient regimes; reduced both wetlands and submerged aquatic vegetation; and degraded vast areas of coastal habitat utilized by smalltooth sawfish (Gilmore 1995; Reddering 1988; Whitfield and Bruton 1989). Juvenile sawfish may be particularly susceptible to habitat modification and loss due to their affinity for shallow, estuarine nursery habitats. While habitat modification is not the primary reason for the decline of smalltooth sawfish abundance, it is a contributing factor and almost certainly hampers species recovery.

## 7.3 Marine Debris

Marine debris is a significant concern for ESA-listed species and sea turtles in particular. The initial developmental stages of all turtle species are spent in the open sea. During this time both the juvenile turtles and their buoyant food are drawn by advection into fronts (convergences, rips, driftlines). The same process accumulates large volumes of marine debris, such as plastics and lost fishing gear, in ocean gyres (Carr 1987). An estimated four to twelve million metric tons of plastic enter the oceans annually (Jambeck et al. 2015). It is thought that sea turtles eat plastic because it closely resembles jellyfish, a common natural prey item (Schuyler 2014).

Ingestion of plastic debris can block the digestive tract which can cause turtle mortality as well as sub-lethal effects including dietary dilution, reduced fitness, and absorption of toxic compounds (Laist et al. 1999; Lutcavage et al. 1997). Santos et al. (2015) found that a surprisingly small amount of plastic debris was sufficient to block the digestive tract and cause death. They reported that 10.7 percent of green turtles in Brazilian waters were killed by plastic ingestion, while 39.4 percent had ingested enough plastic to have killed them. These results suggest that debris ingestion is a potentially important source of turtle mortality, one that may be masked by other causes of death. Gulko and Eckert (2003) estimated that between one-third and one-half of all sea turtles ingest plastic at some point in their lives. A more recent study by Schuyler et al. (2015) estimates that 52 percent of sea turtles globally have ingested plastic debris. Schuyler et al. (2016) synthesized the factors influencing debris ingestion by turtles into a global risk model, taking into account the area where turtles are likely to live, their life history stage, the distribution of debris, the time scale, and the distance from stranding location. They found that oceanic life stage turtles are at the highest risk of debris ingestion. Base on this model, olive ridley turtles are the most at-risk species; green, loggerhead, and leatherback turtles were also found to be at a high and increasing risk from plastic ingestion (Schuyler 2014). The regions of highest risk to global turtle populations are off the east coasts of the U.S., Australia, and South Africa; the east Indian Ocean, and Southeast Asia.

In addition to ingestion risks, sea turtles can also become entangled in marine debris such as fishing nets, monofilament line, and fish-aggregating devices (FADs) (Laist et al. 1999; Lutcavage et al. 1997; NRC 1990). An estimated 640,000 tons of fishing gear is lost, abandoned, or discarded at sea each year throughout the world’s oceans (Macfadyen et al. 2009). These “ghost nets” drift in the ocean and can fish unattended for decades (ghost fishing), killing huge numbers of marine animals. Turtles, in particular, are affected by ghostnets due to their tendency to use floating objects for shelter and as foraging stations (Dagorn et al. 2013; Kiessling 2003).

## 7.4 Pollutants

Coastal habitats are often in close proximity to major sources of pollutants and heavy metals, which make their way into the marine environment from industrial, domestic and agricultural sources. Persistent organic pollutants (POPs) are organic compounds that are resistant to environmental degradation through chemical, biological, and photolytic processes. These contaminants bioaccumulate through the food chain and can result in lethal and sublethal effects on marine organisms.

A variety of heavy metals have been found in sea turtles tissues in levels that increase with turtle size. These include arsenic, barium, cadmium, chromium, copper, iron, lead, manganese, mercury, nickel, selenium, silver, and zinc, (Barbieri 2009; Fujihara et al. 2003; García-Fernández et al. 2009; Godley et al. 1999; Storelli et al. 2008). Cadmium has been found in leatherbacks at the highest concentration compared to any other marine vertebrate (Gordon et al. 1998). Newly emerged hatchlings have higher concentrations than are present when laid, suggesting that metals may be accumulated during incubation from surrounding sands (Sahoo et al. 1996). Arsenic has been found to be very high in green turtle eggs (Van de Merwe et al. 2009). Sea turtle tissues have been found to contain organochlorines, including chlorobiphenyl, chlordane, lindane, endrin, endosulfan, dieldrin, perfluorooctane sulfonate, perfluorooctanoic acid, DDT, and PCB (Alava et al. 2006; Gardner et al. 2003; Keller et al. 2005; Oros et al. 2009; Storelli et al. 2007). PCB concentrations are reportedly equivalent to those in some marine mammals, with liver and adipose levels of at least one congener being exceptionally high (Davenport et al. 1990; Oros et al. 2009). Levels of PCBs found in green sea turtle eggs are considered far higher than what is fit for human consumption (Van de Merwe et al. 2009).

Several studies have reported correlations between organochlorine concentration level and indicators of sea turtle health or fitness. Organochlorines have the potential to suppress the immune system of loggerhead sea turtles and may affect metabolic regulation (Keller et al. 2006; Oros et al. 2009). Accumulation of these contaminants can also lead to deficiencies in endocrine, developmental and reproductive health (Storelli et al. 2007). Females from sexual maturity through reproductive life should have lower levels of contaminants than males because contaminants are shared with progeny through egg formation. Balazs (1991) suggested that environmental contaminants are a possible factor contributing to the development of the viral disease FP in sea turtles by reducing immune function. Day et al. (2007) investigated mercury toxicity in loggerhead sea turtles by examining trends between blood mercury concentrations and various health parameters. They concluded that subtle negative impacts of mercury on sea turtle immune function are possible at concentrations observed in the wild. Keller et al. (2004) investigated the possible health effects of organochlorine contaminants, such as polychlorinated biphenyls (PCBs) and pesticides on loggerhead sea turtles. Although concentrations were relatively low compared with other species, they found significant correlations between organochlorine contaminants levels and health indicators for a wide variety of biologic functions, including immunity and homeostasis of proteins, carbohydrates, and ions.

The life histories of sturgeon species (i.e., long lifespan, extended residence in estuarine habitats, benthic foraging) predispose them to long-term, repeated exposure to environmental contamination and potential bioaccumulation of heavy metals and other toxicants (Dadswell 1979). Shortnose sturgeon collected from the Delaware and Kennebec Rivers had total toxicity equivalent concentrations of polychlorinated dibenzo-p-dioxins, polychlorinated dibenzofurans, PCBs, DDE, aluminum, cadmium, and copper all above adverse effect concentration levels reported in the literature (Brundage III 2008). Dioxin and furans were detected in ovarian tissue from shortnose sturgeon caught in the Sampit River/Winyah Bay system (South Carolina).

Heavy metals and organochlorine compounds accumulate in sturgeon tissue, but their long-term effects are not well studied (Ruelle and Keenlyne 1993). High levels of contaminants, including chlorinated hydrocarbons, in several other fish species are associated with reproductive impairment (Billsson 1998; Cameron et al. 1992; Giesy et al. 1986; Hammerschmidt et al. 2002), reduced survival of larval fish (McCauley et al. 2015; Willford et al. 1981), delayed maturity and posterior malformations (Billsson 1998). Pesticide exposure in fish may affect anti-predator and homing behavior, reproductive function, physiological maturity, swimming speed, and distance (Beauvais et al. 2000; Scholz et al. 2000; Waring and Moore 2004). Sensitivity to environmental contaminants also varies by life stage. Early life stages of fish appear to be more susceptible to environmental and pollutant stress than older life stages. (Rosenthal and Alderdice 1976). Early life stage Atlantic and shortnose sturgeon are vulnerable to PCB and Tetrachlorodibenzo-p-dioxin (TCDD) toxicities of less than 0.1 parts per billion (Chambers et al. 2012). Increased doses of PCBs and TCDD have been correlated with reduced physical development of Atlantic sturgeon larvae, including reductions in head size, body size, eye development and the quantity of yolk reserves (Chambers et al. 2012). Juvenile shortnose sturgeon raised for 28 days in North Carolina's Roanoke River had a 9 percent survival rate compared to a 64 percent survival rate at non-riverine control sites (Cope et al. 2011). The reduced survival rate could not be correlated with contaminants, but significant quantities of retene, a paper mill by-product with dioxin-like effects on early life stage fish, were detected in the river (Cope et al. 2011).

Dwyer et al. (2005) compared the relative sensitivities of common surrogate species used in contaminant studies to 17 ESA-listed species including Atlantic sturgeons. The study examined 96-hour acute water exposures using early life stages where mortality is an endpoint. Chemicals tested were carbaryl, copper, 4-nonphenol, pentachlorophenal and permethrin. Of the ESA-listed species, Atlantic sturgeon were ranked the most sensitive species tested for four of the five chemicals (Atlantic and shortnose sturgeon were found to be equally sensitive to permethrin). Additionally, a study examining the effects of coal tar, a byproduct of the process of destructive distillation of bituminous coal, indicated that components of coal tar are toxic to shortnose sturgeon embryos and larvae in whole sediment flow-through and coal tar elutriate static renewal (Kocan et al. 1993).

## 7.5 Oil Spills

Oil pollution has been a significant concern in the Gulf of Mexico for several decades due to the large amount of extraction and refining activity in the region. Routine discharges into the northern Gulf of Mexico (not including oil spills) include roughly 88,200 barrels of petroleum per year from municipal and industrial wastewater treatment plants and roughly 19,250 barrels from produced water discharged overboard during oil and gas operations (MMS 2007; USN

2008). These sources amount to over 100,000 barrels of petroleum discharged into the northern Gulf of Mexico annually. Although this is only 10 percent of the amount discharged in a major oil spill, such as the Exxon Valdez spill (roughly 1 million barrels), this represents a significant and “unseen” threat to Gulf of Mexico wildlife and habitats. Generally, accidental oil spills may amount to less than 24,000 barrels of oil discharged annually in the northern Gulf of Mexico, making non-spilled oil normally one of the leading sources of oil discharge into the Gulf of Mexico, although incidents such as the 2010 Deepwater Horizon incident are exceptional (MMS 2007). The other major source from year to year is oil naturally seeping into the northern Gulf of Mexico. Although exact figures are unknown, natural seepage is estimated at between 120,000 and 980,000 barrels of oil annually (MacDonald et al. 1993; MMS 2007).

Although non-spilled oil is the primary contributor to oil introduced into the Gulf of Mexico, concern over accidental oil spills is well-founded (Campagna et al. 2011). From 2006 to 2015, U.S. outer continental shelf oil production averaged approximately 0.5 billion barrels per year (Anderson et al. 2012). It is estimated that 3.2 million tons of oil is released into the environment annually with 10 percent attributed to natural seepage, and the rest as a result of oil and gas activities (Epstein and Selber 2002). Even if a small fraction of the annual oil and gas extraction is released into the marine environment, major, concentrated releases can result in significant environmental impacts. Oil released into the marine environment contains aromatic organic chemicals known to be toxic to a variety of marine life; these chemicals tend to dissolve into the air to a greater or lesser extent, depending on oil type and composition (Yender et al. 2002).

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

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

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

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

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

## 7.6 Vessel Strikes

Nearshore marine habitats occupied by ESA-listed species often feature both heavy commercial and recreational vessel traffic. Vessel strikes represent a recognized threat to several taxa of large air breathing marine vertebrates, including sea turtles. Many recovered turtles display injuries that appear to result from interactions with vessels and their associated propulsion systems

(Work et al. 2010). Impact from a boat hull or outboard motor, or cuts from a propeller can kill or severely injure turtles. Turtles may use auditory cues to react to approaching vessels rather than visual cues, making them more susceptible to strike as vessel speed increases (Hazel et al. 2007). Results from a study by Hazel et al. (2007) suggest that green turtles cannot consistently avoid being struck by vessels moving at relatively moderate speeds (i.e., greater than four kilometers per hour). Vessel strikes have been identified as one of the important mortality factors in several near shore turtle habitats worldwide (Denkinger et al. 2013). However, available information is sparse regarding the overall magnitude of this threat or the impact on sea turtle populations globally.

High levels of vessel traffic in nearshore areas along the U.S. Atlantic and Gulf of Mexico coasts result in frequent injury and mortality of sea turtles. From 1997 to 2005, nearly 15 percent of all stranded loggerheads in this region were documented as having sustained some type of propeller or collision injury, although it is not known what proportion of these injuries were sustained ante-mortem versus post mortem. In one study from Virginia, Barco et al. (2016) found that all 15 dead loggerhead turtles encountered with signs of acute vessel interaction were apparently normal and healthy prior to human-induced mortality. For example, the incidence of propeller wounds of stranded turtles from the U.S. Atlantic and Gulf of Mexico doubled from about ten percent in the late 1980s to about 20 percent in 2004. Singel et al. (2007) reported a tripling of boat strike injuries in Florida from the 1980’s to 2005. Over this time period, in Florida alone over 4,000 (~500 live; ~3500 dead) sea turtle strandings were documented with propeller wounds, which represents 30 percent of all sea turtle strandings for the state (Singel et al. 2007). These studies suggest that the threat of vessel strikes to sea turtles may be increasing over time as vessel traffic continues to increase in the southeastern U.S. and throughout the world.

Vessel strikes were identified as a source of mortality for green sea turtles in Hawaii waters, although reported incidence rates among stranded turtles are not as high as in the southeastern United States. Chaloupka et al. (2008b) reported that 2.5 percent of green turtles found dead on Hawaiian beaches between 1982 and 2003 had been killed by boat strike. Vessel strikes have also been reported as a potentially important threat to sea turtle populations by researches in other parts of the world including the Canary Islands (Orós et al. 2005), Italy (Casale et al. 2010), and the Galápagos Islands (Denkinger et al. 2013; Parra et al. 2011).

Sturgeon are also susceptible to vessel strikes due to their large size and frequent use of coastal waterways with heavy commercial vessel traffic. The factors relevant to determining the risk to sturgeon from vessel strikes are currently unknown, but are likely related to size and speed of the vessels, navigational clearance (i.e., depth of water and draft of the vessel) in the area where the vessel is operating, and the behavior of sturgeon in the area (e.g., foraging, migrating, etc.). The ASSRT determined Atlantic sturgeon in the Delaware River are at a moderately high risk of extinction because of ship strikes, and sturgeon in the James River are at a moderate risk from ship strikes (ASSRT 2007). Balazik et al. (2012) estimated up to 80 sturgeon were killed between 2007 and 2010 in these two river systems. Brown and Murphy (2010) examined 28 dead

Atlantic sturgeon from the Delaware River from 2005 through 2008 and found that fifty percent of the mortalities resulted from apparent vessel strikes, and 71 percent of these (10 out of 14) had injuries consistent with being struck by a large vessel. Eight of the fourteen vessel-struck sturgeon were adult-sized fish which, given the time of year the fish were observed, were likely migrating through the river to or from the spawning grounds. Ship strikes may also be threatening Atlantic sturgeon populations in the Hudson River where large ships move from the river mouth to ports upstream through narrow shipping channels. The channels are dredged to the approximate depth of the ships, usually leaving less than six feet of clearance between the bottom of ships and the river bottom. Any aquatic life along the bottom is at risk of being sucked up through the large propellers of these ships.

Large Atlantic sturgeon are most often killed by ship strikes because their size means they are unable to pass through the ship's propellers without making contact. Shortnose sturgeon may not be as susceptible due to their smaller size in comparison to Atlantic sturgeon. There has been only one confirmed incidence of a ship strike on a shortnose sturgeon in the Kennebec River, and two suspected ship strike mortalities in the Delaware River (SSSRT 2010). Green sturgeon and smalltooth sawfish may also been susceptible to ship strikes but there is no available information on this threat to these species.

### 7.7 Anthropogenic Sound

As anthropogenic noise continues to rise throughout the world's oceans, there is growing concern about the impact of sound on sea turtles. There are limited data on the hearing abilities of sea turtles, their uses of sounds, and their vulnerability to sound exposure. The functional morphology of the sea turtle ear is poorly understood and debated. Some evidence suggests that sea turtles are able to detect (Bartol and Ketten 2006; Bartol et al. 1999; Martin et al. 2012; Ridgway et al. 1969) and behaviorally respond to acoustic stimuli (DeRuiter and Doukara 2012; McCauley et al. 2000; Moein et al. 1995; O'Hara and Wilcox 1990). Sea turtles may use sound for navigation, locating prey, avoiding predators, and general environmental awareness (Dow Piniak et al. 2012). Anthropogenic sound within the action area includes explosions, seismic airguns/oil and gas exploration, pile driving, active sonar, offshore wind farms, shipping noise, and continuous sound sources.

To evaluate the possible vulnerability of sea turtles to sound, it is necessary to extrapolate from other animal groups. Some scientists believe using data from marine mammals is the best surrogate, however others find that unsatisfactory and are inclined to use data from fish (Popper et al. 2014). The rationale is that the hearing range for sea turtles is more closely related to fish than that of any marine mammal, and the functioning of the basilar papilla in the turtle ear is dissimilar to the functioning of the cochlea in mammals (Popper et al. 2014). Morphological examinations of green and loggerhead sea turtles (Lenhardt et al. 1985; Ridgway et al. 1969; Wever 1978) describe the sea turtle ear as reptilian with a few underwater modifications, supporting the assessment that the sea turtle ear is more similar to that of a fish than a mammal.

Ridgway et al. (1969) collected the first measurements of sea turtle hearing sensitivity by using both aerial and vibrational sound stimuli to collect measurements of the cochlear response potential of three juvenile green sea turtles. Turtles responded to aerial stimuli between 100 and 1000 Hertz (Hz) and vibrational stimuli between 30 and 700 Hz, with maximum sensitivity between 300 and 500 Hz for both stimuli with a rapid decline in sensitivity in lower and higher frequencies. They found 2000 Hz was the upper limit for observation of cochlear potentials without injury and suggested the practical hearing range of the green turtle did not exceed 1000 Hz.

More recent measurements of sea turtle hearing have been made using auditory evoked potentials (AEPs). This is an electrical response of the central auditory nervous system after stimulation by sound detectable by the ear, and can be recorded using electrodes. Bartol et al. (1999) measured the hearing of thirty-five juvenile loggerhead sea turtles, by collecting short latency AEPs (auditory brainstem responses, or ABRs), recorded in response to two types of vibrational stimuli: 1) low-frequency clicks and 2) tone bursts delivered directly to the tympanum using a mechanical vibrator. They measured a mean threshold in response to click stimuli of -10.8 decibels (dB) re: 1 gram root mean squared (rsm) ± 2.3 dB standard deviation (SD), and a hearing range from tone bursts from 250 Hz to 750 Hz. The most sensitive threshold was the lowest frequency tested, 250 Hz, with a mean threshold of -23.3 dB re: 1g rms ± 2.3 dB SD. Bartol and Ketten (2006) measured ABRs in two juvenile and six sub-adult green sea turtles, and two juvenile Kemp's ridley sea turtle's ears partially submerged using an aerial tonal stimuli. Sub-adult Pacific green turtles responded to stimuli between 100 and 500 Hz, with maximum sensitivity between 200 and 400 Hz, while juvenile Atlantic greens responded to stimuli between 100 and 800 Hz, with maximum sensitivity between 600 and 700 Hz. Kemp's ridleys responded stimuli between 100 and 500 Hz with maximum sensitivity between 100 and 200 Hz.

Wendy Dow Piniak et al. (2012) developed techniques to measure fully submerged underwater sea turtle hearing and recorded AEPs underwater and in air in five juvenile green sea turtles. Green sea turtle AEP signals exhibited a frequency-doubling signature similar to that seen in fish. Juvenile green sea turtles responded to stimuli between 50 and 1600 Hz in water and 50 and 800 Hz in air, with ranges of maximum sensitivity between 50 and 400 Hz in water and 300 and 400 Hz in air. In both media, sensitivity decreased sharply after 400 Hz. Martin et al. (2012) used similar underwater methodologies to record AEPs in one adult loggerhead and recorded responses to frequencies between 100 and 1131 Hz with greatest sensitivity between 200 and 400 Hz. Both studies using this newly developed methodology found that green and loggerhead sea turtles responded to a broader and higher range of frequency sensitivity than previously reported by Bartol et al. (1999), Bartol and Ketten (2006), and Ridgway et al. (1969) in air and at the water's surface.

Leatherback sea turtles are morphologically and physiologically unique among the sea turtle species. Dow Piniak et al. (2012) found leatherback sea turtle hatchlings are able to detect sounds underwater and in air, responding to stimuli between 50 and 1200 Hz in water and 50 and

1600 Hz in air with maximum sensitivity between 100 and 400 Hz in water (84 dB re: 1 micro Pascal-rms at 300 Hz) and 50 and 400 Hz in air (62 dB re: 20 micro Pascal-rms at 300 Hz). Hearing sensitivity in both media declined considerably above 400 Hz.

### Explosions

In-water explosions (e.g., TNT) produce a spherical shock wave with a large oscillating gas bubble which radiates sound. Some explosives have an instantaneous pressure rise-time followed by exponential decay, while the rise time for some may be longer, with a slower decay of the pulse (Urick 1983). The rise time is important because it affects the frequency signature of the explosion, with longer rise times having higher frequencies. Knowledge gaps inhibit the use of biological (fish kill) models to predict the risk to fish and other animals from the pressure wave generated by an explosion. Explosions are described by metrics such as amplitude, energy and time-space characteristics of the pressure wave (Popper et al. 2014). Explosions may result in not only sea turtle death (Klima et al. 1988), but acoustic annoyance, physical discomfort to soft tissue areas, and injurious effects (e.g., gastrointestinal injury, carapace damage) (Viada et al. 2008).

### Seismic Airguns/Oil and Gas Exploration

Offshore seismic surveys involve the use of high energy sound sources operated in the water column to probe below the seafloor. Most seismic sources involve the rapid release of compressed air to produce an impulsive signal. The signal is directed downward to the seabed, and reflected upwards again. The returned signal is received and processed to give profiles of the seafloor. This technique is essential for oil and gas exploration and development. Airguns are used as an acoustic source for seismic exploration. They produce an air bubble from a compressed air supply; the air bubble first expands rapidly, but has a slower rise time to peak pressure than with explosions. The sound impulse generated by a single airgun is omnidirectional with frequencies typically 20 to 50 Hz with declining energy at frequencies above 200 Hz. A study of ambient sound in the North Atlantic (Nieukirk et al. 2004) showed that airgun activity contributes significantly to ocean sound sound levels and can appear to be more continuous than impulsive sounds because of the reverberation from the surface and seabed.

McCauley et al. (2000) conducted trials with caged sea turtles and an approaching-departing single air gun to gauge behavioral responses of green and loggerhead sea turtles. Their findings showed behavioral responses to an approaching air gun array at 166 dB re: 1 micro Pascal rms and avoidance around 175 dB re: 1 micro Pascal rms. From measurements of a seismic vessel operating 3D air gun arrays in 100 to 120 meters water depth this corresponds to behavioral changes at around 2 kilometers and avoidance around 1 kilometer. Sea turtle habitats mostly occur in shallower water, often less than 20 meters deep. The propagation of an air gun array in such water depths may be vastly different than that for the array measured in 120 meter water depth. One would generally expect that sound propagation in water less than 20 meters deep would be significantly worse, that is the signal would not carry as far. But under some circumstances dictated by the seabed properties, this may not be so. Avoidance behavior and physiological responses from airgun exposure may affect the natural behaviors of sea turtles (McCauley et al. 2000).

Oil and gas exploration and extraction presently occurs in many important sea turtle nesting and foraging habitats and generates high-intensity, low-frequency, impulsive sounds within the leatherback hearing range. In a report prepared for the International Association of Oil and Gas Producers Exploration and Production Sound and Marine Life Joint Industry Project, leatherback sea turtles are shown to be present in eleven of the thirteen oil and gas industry offshore interest areas (Thorson et al. 2005). The explosive removal methods of offshore structures in the marine environment can impact sea turtles, as discussed above. Even with protective measures in place, there have been observations of sea turtles affected by explosive platform removals (Viada et al. 2008).

**Pile Driving**

Pile driving is commonly used for the construction of foundations for a large number of structures including bridges, buildings, retaining walls, harbor facilities, offshore wind turbines, and offshore structures for the oil and gas industry. It always involves multiple strikes over an extended period of time, with an average strike interval of 1.0 to 1.5 seconds. Pile driving can generate sounds into the water column if the pile is driven in water or on land near water. The impulsive sounds generated by impact pile driving are characterized by a relatively rapid rise time to a maximal pressure value followed by a decay period that may include a period of diminishing, oscillating maximal and minimal pressures (Illingworth and Rodkin 2001; Illingworth and Rodkin 2007; Reyff 2012). Peak levels resulting from impact pile driving vary substantially and depend on numerous factors such as pile type and diameter, hammer size, and substrate. The predominant energy in pile impact impulses is at frequencies below approximately 2000 Hz with most occurring below 1000 Hz (Laughlin 2006; Reyff 2008; Reyff 2012).

Impact pile driving occurs over small spatial and temporal scales and produces high-intensity, low-frequency, impulsive sounds with high peak pressures that can be detected by sea turtles (Dow Piniak et al. 2012). Peak sound pressure levels are useful for characterizing pile driving strikes, but do not account for the total energy of the sound. Vibratory pile driving produces a continuous sound with peak pressures lower than those observed in impulses generated by impact pile driving (Popper et al. 2014).

**Active Sonar**

Active sonar and echo sounders are in operation throughout the world's oceans as well as in freshwater lakes and rivers. The primary sonar characteristics that vary with application are the frequency band, signal type (pulsed or continuous), rate of repetition, and source level. They can be roughly divided into three categories depending on their primary frequency of operation; low frequency for 1 kHz and less, mid frequency for 1 to 10 kHz, and high frequency for 10 kHz and greater. Low, and possibly mid, frequency sonars are most relevant to fishes and sea turtles because of the low frequency hearing ranges of these animals. Sonar usually operates with duty cycles below 10 to 20 percent and with generally brief durations. However, multipath propagation can often be substantial for many of these systems, effectively prolonging the sonar sounds well beyond their nominal durations. Low frequency systems are designed for long-range detection (Popper et al. 2014). For example, the U.S. Navy SURTASS Low Frequency Active system is described by Friedman (2006) as a vertical line array of 18 elements operating between 100 and 500 Hz. Signals projected include combinations of swept frequency and tones pulses, totaling up to 100 seconds in length with individual signals of the order of 10 seconds. The interval between transmissions varies between 6 and 15 minutes. Naval sonar also occurs intermittently (although while active, the sound is continuous), and often in designated areas or ranges. However many of these areas/ranges provide habitat for sea turtles.

While leatherback hatchlings appear to be capable of detecting low-frequency sonar (less than 1000 Hz), frequencies for the peak sound pressure level for mid-frequency sonar (2000 to 8000 Hz) appear out the range of sea turtle hearing sensitivity (Dow Piniak et al. 2012). However, Dow Piniak et al. (2012) did not expose leatherbacks to the high sound pressure levels of mid-frequency sonar, and is possible that turtles are able to detect these higher frequencies at increased sound pressure levels.

**Offshore Wind Farms**

The construction of offshore wind farms generates high-intensity sounds (pile driving). In this case, the spatial and temporal scales of pile driving could be quite large, as offshore wind farms can span tens of kilometers and require many months to install. However once in place, turbines generate continuous, moderate levels of low frequency sound that can be detected by leatherback sea turtles. Depending on environmental variables (wind speed) and turbine type, leatherbacks are unlikely to be able to detect these sounds at large distances away from the source, however wind farms could disrupt leatherback behavior or habitat use depending on their placement (Dow Piniak et al. 2012).

### Continuous Sound Sources

The most common and best-studied continuous sounds in the oceans are those produced by ships as well as smaller vessels. However, continuous sounds are also produced by other sources, such as vibratory pile drivers and vessels dredging for aggregates (Robinson et al. 2011). In addition, over long distances, emissions from seismic surveys or impact pile driving may appear to be continuous as a result of multipath effects.

Shipping noise is a combination of the relatively continuous sound generated by large ocean tankers and more intermittent sounds generated by local inshore boat traffic. The frequency and sound pressure level of individual vessels varies widely by overall size, and engine and propeller size and configuration. The low-frequency sound created by commercial shipping can be heard in every ocean of the world and can be detected by leatherback sea turtles. Areas of high use by commercial vessels (e.g., inshore ports and shipping lanes), and those used by recreational vessels (e.g., nearshore waters and inshore ports) overlap with sea turtle reproductive and foraging habitat at many locations.

The sounds of vessels are predominately low frequency (i.e., below 1 kilohertz) from onboard machinery, hydrodynamic flow around the hull, and from propeller cavitation, which is typically the dominant source of sound (Ross 1987; Ross 1993). Estimated source levels can range from less than 150 dB to over 190 dB (re 1 mico Pascal-rms at 1 meter) for the largest commercial vessels (Arveson and Vendittis 2000; Hildebrand 2009; McKenna et al. 2012; Richardson et al. 1995). Low frequency sounds from larger vessels can travel hundreds of kilometers and can increase ambient noise levels over large areas of the ocean, interfering with sound communication in species using the same frequency range (see Southall (2005)). Samuel et al. (2005) recorded levels of up to 113 dB re: 1 micro Pascal (200 to 700 Hz) for small, recreational boats during high-use seasons in juvenile loggerhead, green and Kemp’s ridley sea turtle habitat in the Peconic Bay Estuary system in Long Island, New York. While these levels may not directly damage hearing, they may mask important auditory cues. Tens of thousands of large commercial vessels are typically underway at any point in time, concentrated in high-traffic sea lanes and ports, presenting an effectively continuous noise source in many parts of the ocean.

The number of large commercial ships has doubled between 1965 and 2003 to nearly 100,000. Shipping industry analysts have forecast that the volume of cargo shipped will again double or triple by 2025, with an expected attendant increase in the amount of ambient noise entering the ocean from commercial shipping (NRC 2003). In much of the northern hemisphere, shipping noise is the dominant source of underwater noise below 300 Hz (Ross 1987; Ross 1993). Vessel operations have increased over time and as a result have increased low-frequency ambient noise levels in some areas (Andrew et al. 2002; Curtis et al. 1999; McDonald et al. 2006; NRC 2003). One of the most serious implications of this increase in shipping noise is the impact it may have in masking sounds of biological importance.

## 7.8 Disease

Fibropapillomatosis is a neoplastic disease that can negatively impact ESA-listed sea turtle populations. FP has long been present in sea turtle populations with the earliest recorded mention from the late 1800s in the Florida Keys (Hargrove et al. 2016). FP has been reported in every species of marine turtle but is of greatest concern in green turtles, the only known species where this disease has reached a panzootic status (Williams Jr et al. 1994). Historical data indicate that the disease rose in prevalence most noticeably in the 1980s. Prevalence rates as high as 45 to 50 percent have been reported within some local green turtle populations (Hargrove et al. 2016; Jones et al. 2015). FP primarily affects medium-sized immature turtles in coastal foraging pastures.

FP is characterized by both internal and external tumorous growths, which can range in size from very small to extremely large. Large tumors can interfere with feeding and essential behaviors, and tumors on the eyes can cause permanent blindness (Foley et al. 2005). Renan de Deus Santos et al. (2017) assessed stress responses (corticosterone, glucose, lactate, and hematocrit) to capture and handling in green sea turtles with different FP severity levels. Their findings suggest that moderate FP severity may affect a turtle's ability to adequately feed themselves (as evidenced by poor body condition), and advanced-stage FP severity may result in an impaired corticosterone response. While FP can result in reduced individual fitness and survival, documented mortality rates in Australia and Hawaii are low. The mortality impact of FP is not currently exceeding population growth rates in some intensively monitored populations (e.g., Florida and Hawaii in the U.S., and the Southern Great Barrier Reef stock in Queensland, Australia) as evidenced by increasing nesting trends despite the incidence of FP in immature foraging populations (Hargrove et al. 2016). Recovery from FP through natural processes has been documented in cases where the affliction is not too severe. Despite some conflicting conclusions, the overwhelming consensus among turtle researchers is that, at present, FP does not significantly impact the overall survival of sea turtle populations (Hargrove et al. 2016). However, FP cannot be discounted as a potential threat to sea turtle populations (particularly green turtles) as the distribution, prevalence rate, severity, and environmental co-factors associated with the disease have the capacity to change over time (Jones et al. 2015).

Environmental factors likely play a role in the development of FP. Most sites with a high frequency of FP tumors are areas with some degree of water quality degradation resulting from altered watersheds (Hargrove et al. 2016). Chemical contaminants which can affect sea turtle immune systems may be part of a multifactorial problem that leads to FP (Herbst 1994). An increased concentration of arginine in the diet of green turtles as a result of invasive macroalgae blooms has also been linked to an increasing prevalence of the disease (Van Houtan et al. 2010). Water temperature may also be a factor in lesion development and growth rate as warmer water temperatures during summer have been shown to promote lesion growth in some regions (Jones et al. 2015). Natural biotoxins have also been implicated as a co-factor involved in FP development. Despite there being a strong positive correlation between the prevalence of FP in green turtle populations and areas with degraded water quality, it is difficult to identify one specific causal contaminant or a combination of such working synergistically to lead to FP formation.

Expression of FP differs across ocean basins and to some degree within basins (Hargrove et al. 2016). Turtles in the Southeast U.S., Caribbean, Brazil, and Australia rarely have oral tumors, whereas such tumors are common and often severe in Hawaiian turtles. Internal tumors (on vital organs) have been found in turtles from the Atlantic and Hawaii, but are only rarely reported in Australia. Liver tumors appear to be common in Florida, but are not reported from Hawaii (Hargrove et al. 2016).

Fish diseases and parasitic organisms occur naturally in the water. Many fish species are highly susceptible to parasites and disease, particularly during early life stages. Native fish have co-evolved with such organisms and individuals can often carry diseases and parasites at less than lethal levels. While disease organisms commonly occur among wild fish populations, under favorable environmental conditions these organisms are not expected to cause population-threatening epizootics. However, outbreaks may occur when stress from disease and parasites is compounded by other stressors such as diminished water quality, flows, and crowding (Guillen 2003; Spence and Hughes 1996). At higher than normal water temperatures fish species may become stressed and lose their resistance to diseases (Spence and Hughes 1996). Consequently, diseased fish become more susceptible to predation and are less able to perform essential functions, such as feeding, swimming, and defending territories (McCullough 1999). The introduction of non-indigenous fish pathogens to wild fish populations through aquaculture operations also represents a threat to some fish populations. The aquarium industry is another possible source for transfer of non-indigenous pathogens or non-indigenous species from one geographic area to another, primarily through release of aquaria fish into public waters.

Salmonids are susceptible to numerous bacterial, viral, and fungal diseases. The more common bacterial diseases in New England waters include furunculosis, bacterial kidney disease, enteric redmouth disease, coldwater disease, and vibriosis (Egusa and Kothekar 1992; Olafesen and Roberts 1993; USFWS and Gaston 1988). Furunculosis, which is particularly widespread, can be a significant source of mortality in wild Atlantic salmon populations if river water temperatures become unusually high for extended periods (USFWS and Gaston 1988). Whirling disease is a parasitic infection caused by the microscopic parasite *Myxobolus cerebrali*. Infected fish continually swim in circular motions and eventually expire from exhaustion. The disease occurs both in the wild salmonids and in hatcheries. Saprolegnia is a fungal disease of Atlantic salmon and is primarily found in adult males. It invades the epidermis and is associated with the presence of high levels of androsteroids (Olafesen and Roberts 1993; USFWS and Gaston 1988).

In 1996, the first occurrence of the infectious salmon anemia (ISA) virus in North America was found in an aquaculture facility in New Brunswick, Canada (Fay et al. 2006b). The first outbreak of ISA in the United States was reported in 2001 in an aquaculture facility in Cobscook Bay, Maine. Approximately 925,000 fish were removed from aquaculture pens throughout the Bay that year, and eventually all cultured salmon in the Bay had to be removed (Fay et al. 2006b). While captive fish have the highest risk for transmission and outbreaks of diseases such as ISA, wild fish that must pass near aquaculture facilities are at risk of encountering both parasites and pathogens from hatchery operations. Although substantial progress has been made in recent years to reduce the risks to wild fish posed by aquaculture, this remains a potential threat.

There are over 30 identified parasites of Atlantic salmon including external parasites such as gill maggot, freshwater louse, and leech, and internal parasites such as trematodes (flukes), cestodes (tapeworms), acanthocephalans (spiny-headed worms) and nematodes (round worms) (Hoffman 1999; Scott and Scott 1988). Several species of sea lice, a marine ectoparasite found in Atlantic and Pacific coastal waters, can cause deadly infestations of farm-grown salmon and may also affect wild salmon.

There have been very few incidences of disease in wild populations of sturgeon species and most disease related mortality has been documented in captive rearing facilities (SSSRT 2010). While some disease organisms have been identified from wild Atlantic sturgeon, they are unlikely to threaten the survival of the wild populations (ASSRT 2007). Parasites, including flatworms and roundworms, have been documented in Atlantic sturgeon but are not considered a threat to populations of this species. Thirteen taxa of parasites have been identified in shortnose sturgeon including four coelenterates, two nematodes, three leeches, one arthropod, and the sea lamprey. The degree of parasite infestation is believed to be quite low and, in general, shortnose sturgeon do not appear to be harmed by these parasites (SSSRT 2010). Parasites are known to occur in both wild-caught and cultivated Nassau grouper, predominantly in the viscera and gonads. These include encysted larval tapeworms, nematode, isopods, and trematodes (Manter 1947; Thompson and Munro 1978). However, the impact of parasites on populations of Nassau grouper is largely unknown.

There are no studies indicating that diseases or parasitism represent a threat factor for populations of green sturgeon or Gulf sturgeon (USFWS and NMFS 2009). There is also no information to indicate that disease is a factor affecting populations of scalloped hammerhead (Miller et al. 2014) or smalltooth sawfish (NMFS 2010c). Like most sharks, scalloped hammerheads likely carry a range of external parasites including leeches and copepods but there are no studies suggesting parasites are negatively affecting the fitness or survival of this species (Miller et al. 2014).

### 7.9 Industrial and Power Generating Plants

Industrial and power generating plants (e.g., hydro, steam, coal, nuclear) located within the action area can adversely affect ESA-listed species including sturgeon, salmon, sawfish and sea turtles. Stressors caused by these operations include impingement and entrainment, thermal discharges, chemical discharges, and the indirect effect of prey reduction. Impingement occurs when organisms are trapped against cooling water intake screens, racks, or removal equipment by the force of moving water. Adult, juvenile, and larval sturgeon are known to be killed or injured due to impingement on cooling water intake screens (Dadswell et al. 1984; Hoff and Klauda 1979). Sea turtles entering coastal or inshore areas can also be affected by impingement in such systems. There is limited information on power plant impingement rates for sea turtles. Based on long-term monitoring data for the past 40 years, an average of 415 sea turtles were captured per year near the nuclear power plant in St. Lucie, Florida. Operation of this power plant has resulted in about seven turtle mortalities per year over this time period, mostly loggerheads and greens (NMFS 2016a). Entrainment occurs when marine organisms enter the intake water flow and pass through the cooling water intake structure and into a cooling water system. While sea turtles and adult sturgeon, salmon and sawfish are too large to be entrained, early life stages of ESA-listed fish species (e.g., eggs and larvae) are potentially susceptible to power plant entrainment.

Some power plants use “once-through-cooling” technology that withdraws large volumes of water from adjacent oceans, bays and rivers, pumps the water through the plant to cool the reactors, and then discharges the heated water back to rivers. There are approximately 550 “once-through-cooling” power plants currently operating in the U.S. (Turner-Tomaszewicz and Seminoff 2012). Cooling water discharge can alter habitat around the outflow pipe. Some discharges have been measured as high as 46 degrees Celsius (Hester and Doyle 2011). This can potentially present both advantages (e.g., provide thermal refuge 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 (e.g., alter normal ecological processes that sea turtles and fish 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. Sturgeon experience lower survival when water temperatures exceed 28 degrees Celsius (Niklitschek and Secor 2005). Increases in water temperature have also been shown to increase the susceptibility of sturgeon to hypoxia (Secor and Niklitschek 2001). Simpfendorfer and Wiley (2004) reported the occurrence of smalltooth sawfish in the warm water outfalls of power stations in Florida during the coldest time of year. They postulate that this potentially represents the use by sawfish of power plant outfall areas as thermal refugia; alternatively, sawfish may become trapped in the warm water outflow as surrounding temperatures decline below their tolerance level (Simpfendorfer and Wiley 2004). Chemical discharges from cooling water intake structure may include radionuclides such as tritium, strontium, nickel, and cesium. Chlorine, lithium hydroxide, boron, and total suspended solids may also be discharged from cooling water intake structures.

Recent regulations have been implemented by the U.S. Environmental Protection Agency (USEPA) to reduce the risk of jeopardizing the continued existence of federally-listed species due to the impact of impingement and entrainment of cool water intakes at industrial facilities. Specifically, the USEPA promulgated a Clean Water Act section 316(b) regulation on August 15, 2014, establishing standards for cooling water intake structures (79 FR 48300-439 2015) and mandating the best technology available to reduce impingement and entrainment of aquatic organisms. As the rule is implemented it will include a number of provisions designed to reduce and monitor the take of ESA-listed species at the cooling water intakes.

### 7.10 Dredging

Riverine, nearshore, and offshore coastal areas are often dredged to support commercial shipping, recreational boating, construction of infrastructure, and marine mining. Dredging in spawning and nursery grounds modifies habitat quality, and limits the extent of available habitat in some rivers where anadromous fish habitat has already been impacted by the presence of dams. Dredging and filling operations impact important habitat features of Atlantic sturgeon as they disturb benthic fauna, eliminate deep holes, and alter rock substrates (Smith and Clugston 1997). Dredging operations may also pose risks to anadromous fish species by destroying or adversely modifying benthic feeding areas, disrupting spawning migrations, and filling spawning habitat with resuspended fine sediments. As benthic omnivores, sturgeon are particularly sensitive to modifications of the benthos that affect the quality, quantity and availability of prey species. Nellis et al. (2007) documented that dredge spoil drifted 12 kilometers downstream over a ten-year period in the Saint Lawrence River, and that those spoils have significantly less macrobenthic biomass compared to control sites. Hatin et al. (2007) reported avoidance behavior by Atlantic sturgeon during dredging operations and McQuinn and Nellis (2007) found that Atlantic sturgeon were substrate dependent and avoided dredge spoil dumping grounds. Indirect effects of dredging related to water quality include changes in DO and salinity gradients in and around dredged channels (Campbell and Goodman 2004; Jenkins et al. 1993; Secor and Niklitschek 2001). Adult shortnose sturgeon can tolerate at least short periods of low DO and high salinities, but juveniles are less tolerant of these conditions in laboratory studies. Collins et al. (2000) concluded harbor modifications in the lower Savannah River have altered hydrographic conditions for juvenile sturgeon by extending high salinities and low DO upriver.

In addition to indirect impacts, hydraulic dredging can directly harm sturgeon and sea turtles by lethally entraining fish up through the dredge drag-arms and impeller pumps. Large marine animals that are entrained in hydraulic dredges rarely survive the encounter. Hopper dredges, in particular, are capable of moving relatively quickly compared to turtles and fish which can be overtaken and entrained by the suction draghead of the advancing dredge. A total of 609 incidental takes (lethal or sublethal interactions) of sea turtles have been documented from hopper dredging activities in the southeastern U.S. from 1980 through 2006 (Dickerson et al. 2007). Dickerson (2006) reported 15 Atlantic sturgeon taken in dredging activities conducted by the United States Corps of Engineers from 1990 to 2010, most captured by hopper dredge. Notably, these reports include only those trips when an observer was on board to document capture. Atlantic sturgeon have also been taken in both hydraulic pipeline and bucket-and-barge operations in the Cape Fear River, North Carolina (Moser and Ross 1995), and by mechanical dredges in the Delaware River (Hastings 1983).

Reductions in entrainment rates for sea turtles have been achieved through gear modifications, operational changes, time-area restrictions, and the capture and relocation of turtles away from dredge sites (Dickerson et al. 2007). Dickerson et al. (2007) studied the effectiveness of turtle relocation trawling in reducing the incidental take of sea turtles in hopper dredge operations. They found that relocation trawling can be an effective management option provided that a substantial amount of trawling effort is conducted either at the onset of dredging or early in the project.

### 7.11 Hydromodification

Hydromodification is generally defined as a change in natural channel form, watershed hydrologic processes and runoff characteristics (i.e., interception, infiltration, overland flow, interflow and groundwater flow) associated with alterations in stream and rivers flows and sediment transport due to anthropogenic activities. Such changes often result in negative impacts to water quality, quantity, and aquatic habitats.

#### 7.11.1 Dams

Dams are used to impound water for water resource projects such as hydropower generation, irrigation, navigation, flood control, industrial and municipal water supply, and recreation. Dams can also have profound effects on anadromous fish species by fragmenting populations, impeding access to spawning and foraging habitat, and altering natural river hydrology and geomorphology, water temperature regimes, and sediment and debris transport processes (Pejchar and Warner 2001; Wheaton et al. 2004). The loss of historic habitat can ultimately affect anadromous fish in two ways: 1) it forces fish to spawn in sub-optimal habitats that can lead to reduced reproductive success and lower recruitment, and 2) it reduces the carrying capacity (physically) of these species and affects the overall health of the ecosystem (Patrick 2005). Physical injury and direct mortality occurs as fish pass through turbines, bypasses, and spillways. Other effects of passage through dam structures may include disorientation, stress, delay in passage, exposure to high concentrations of dissolved gases, elevated water temperatures, and increased vulnerability to predation. Activities associated with dam maintenance, such as dredging and minor excavations along the shore, release silt and other fine river sediments that can be deposited in nearby spawning habitat. Dams can also reduce habitat diversity by forming a series of homogeneous reservoirs; these changes generally favor different predators, competitors and prey, than were historically present in the ecosystem (Auer 1996).

The suitability of riverine habitat for sturgeon and salmon spawning and rearing depends on annual fluctuations in water flow, which can be greatly altered or reduced by the presence and operation of dams (Cooke and Leach 2004; Jager et al. 2001). Effects on spawning and rearing may be most dramatic in hydropower facilities that operate in peaking mode (Auer 1996; Secor and Niklitschek 2002). Daily peaking operations store water above the dam when demand is low and release water for electricity generation when demand is high, creating substantial daily fluctuations in flow and temperature regimes. Kieffer and Kynard (2012) reported extreme flow fluctuations for hydroelectric power generation on the Connecticut River affected access to shortnose sturgeon spawning habitat, possibly deterred spawning, and left rearing shoals either completely scoured during high flows or dry and exposed during low flows.

Obstructed fish passage and degraded habitat caused by dams is considered the greatest impediment to self-sustaining anadromous fish populations in Maine (NRC 2004). GOM DPS Atlantic salmon are not well adapted to the artificially created and maintained impoundments resulting from dam construction (NRC 2004). Other aquatic species that thrive in impounded riverine habitat have proliferated and significantly altered the prey resources available to salmon, as well as the abundance and species composition of salmon competitors and predators. The National Inventory of Dams Program lists 639 dams (over four feet high) in Maine, over half of which are located within the range of the GOM DPS (USACOE National Inventory of Dams Program, http://nid.usace.army.mil/cm_apex/f?p=838:12). The larger hydroelectric dams and storage projects within the GOM DPS are primarily located in the Penobscot, Kennebec, and Androscoggin watersheds. With the exception of several of the licensed West Branch Penobscot dams, and three unlicensed storage dams on the East Branch Penobscot, all of the larger dams in the basin are licensed to operate solely in a "run-of-the-river" mode, which means inflow generally equals outflow. GOM DPS salmon habitat is also degraded as a result of bypassed reaches of natural river channels that re-route river flows within the Penobscot, Kennebec, and Androscoggin watersheds through forebays or penstocks. Many smaller dams still remain on smaller rivers and streams within the GOM DPS range. While most small dams do not generate hydroelectricity, many continue to impact substantial amounts of Atlantic salmon spawning and rearing habitat.

The detrimental effects of dams on populations of shortnose and Atlantic sturgeon are generally well documented (Cooke and Leach 2004; Kynard 1998). Perhaps the largest impact dams have on sturgeon is the loss of upriver spawning and rearing habitat. Migrations of sturgeon in rivers without barriers are wide-ranging with total distances exceeding 200 kilometers or more, depending on the river system (Kynard 1997). Although some rivers have dams constructed at the fall line that have not impacted sturgeon spawning, in many other rivers dams have blocked sturgeon upriver passage, restricting spawning activities to areas below the impoundment and leaving sturgeon vulnerable to perturbations of natural river conditions at different life stages (Cooke and Leach 2004; Kynard 1997). Observations of sturgeon spawning immediately below dams further suggests that they are unable to reach their preferred spawning habitat upriver. Overall, 91 percent of historic Atlantic sturgeon habitat seems to be accessible, but the quality of the remaining portions of habitat as spawning and nursery grounds is unknown, therefore estimates of percentages of availability do not necessarily equate to functionality (ASSRT 2007). Thus, dams may one of the primary causes of the extirpation of sturgeon subpopulations on the east coast.

On the west coast, green sturgeon spawning areas have been lost or significantly altered by dams. The final rule listing Southern DPS green sturgeon indicates that the principle factor in the decline of this DPS is the reduction of spawning to a limited area, due largely to impassable barriers on the Sacramento River (Keswick Dam) and the Feather River (Oroville Dam) (71 FR 17757; April 7, 2006). The Southern DPS of green sturgeon are currently concentrated into one spawning area outside of their natural habitat in the Sacramento River, making them vulnerable to catastrophic extinction (Adams et al. 2007).

Despite decades of effort, fish passage infrastructure retrofitted at hydroelectric dams has largely failed to restore anadromous fish to historical spawning habitat (Brown et al. 2013). While improvements to fish passage are often required when hydroelectric dams go through Federal Energy Regulatory Commission relicensing, the relicensing process occurs infrequently, with some licenses lasting up to 50 years. Over 95 percent of dams on the eastern seaboard are not hydroelectric facilities, and are thus not subject to continual relicensing or fish passage improvement measures (ASMFC 2008). Sturgeon appear unable to use some fishways (e.g., ladders) but have been transported in fish lifts (Kynard 1998). Data on the effects of the fish lift at the Holyoke Hydroelectric Project on the Connecticut River suggest that fish lifts that successfully attract other anadromous species (i.e., shad, salmon etc.) do a poor job of attracting sturgeon: attraction and lifting efficiencies for shortnose sturgeon at the Holyoke Project are estimated around 11 percent (ASSRT 2007).

### 7.11.2 Water Diversions

Like many regions throughout the world, the U.S. is experiencing increasing demand for fresh, clean water. Population growth and agricultural needs frequently conflict with water availability. The twentieth century saw tremendous increases in dam construction, irrigation practices for agriculture, recreational use of waterbodies, and the use of waterways for waste disposal, both sanitary and industrial. Water use in the western U.S. presents a particular concern because the western states are characterized by low precipitation and extended periods of draught.

The withdrawal of large volumes of water from rivers for multiple uses can have direct and indirect impacts on fish species. The amount and extent of water withdrawals or diversions for agriculture impacts streams and their inhabitants by reducing water flow/velocity and DO levels, which can have negative effects on listed species and their designated critical habitat. Water diversions and withdrawals for agricultural irrigation or other purposes can directly impact fish populations by constraining available spawning and rearing habitat. Adequate water quantity and quality are critical to all salmonid life stages, especially adult migration and spawning, fry emergence, and smolt emigration. Low flow events may delay anadromous fish migrations or lengthen fish presence in a particular water body until favorable flow conditions permit fish migration along the migratory corridor or into the open ocean. Survival of eggs, fry, and juveniles are also mediated by streamflow. Water withdrawals may dewater redds thus reducing egg survival. Other potential detrimental impacts of water diversions include increases in nutrient loading, sediments (from bank erosion), and water temperature. Flow management, in combination with the effects of climate change (i.e., droughts), has further decreased the delivery of suspended particulate matter and fine sediment to estuaries. Low river flows may constrain conditions necessary for important salmonid refuge habitat (shade, woody debris, overhanging vegetation), making fish more vulnerable to predation, elevated temperatures, crowding, and disease.

Juvenile sturgeon and salmon are also susceptible to entrainment through unscreened agricultural water-diversion pipes lining levees and riverbanks. Mussen et al. (2014) found that green sturgeon, in particular, were not as adept at avoiding entrainment as some other species due to their poor ability to detect the flow acceleration and directional changes near the pipe inlet. Data on entrainment of Southern DPS green sturgeon is limited. In the final listing rule, the threat posed by juvenile entrainment to the continued existence of the Southern DPS was considered to be uncertain (71 FR 17757). Although the actual number entrained in water diversions is unknown, with over 3,300 water diversions operating in the Sacramento-San Joaquin watershed (a large majority of which are unscreened) this represent a potentially major threat to out-migrating juvenile green sturgeon (Mussen et al. 2014). Entrainment risk is further increased because the downstream migration of juvenile green sturgeon (May to August) coincides with peak agricultural water extraction in this watershed. Green sturgeon entrainment has been reported at pumping operations at the state and federal water export facilities in the Sacramento-San Joaquin River Delta. From 1986 through 2001, an estimated 79 green sturgeon have been killed annually at these two facilities combined (Adams et al. 2007).

Water withdrawal may impact Atlantic salmon habitat in the main stem areas of the Penobscot, Kennebec, and Androscoggin Rivers. Because of the large size of these watersheds there are a variety of consumptive water uses, including municipal water supplies, snow making, mills, golf course and agricultural irrigation, and industrial cooling. Depending upon the location of current water uses, impacts to Atlantic salmon habitat may be occurring in headwater areas and tributaries of these watersheds (Fay et al. 2006b).

Diversion of freshwater run-off in the southeastern U.S. has contributed to the decline of smalltooth sawfish. Construction of a 1,400 mile network of canals, levees, locks, and other water control structures that modulate freshwater flow have had profound impacts on hydrological regimes in south Florida (Serafy et al. 1997). Sawfish are now either extirpated or severely depleted in areas where they were once considered abundant due to the destruction and modification of their habitat.

## 7.12 Scientific Research and Enhancement Permits

Information obtained from scientific research is essential for understanding the status of ESA-listed species, obtaining specified critical biological information, and achieving species recovery goals. Research on ESA-listed species is granted an exemption to the ESA take prohibitions of section 9 through the issuance of section 10(a)(1)(A) permits. Research activities authorized through scientific research permits can produce various stressors on wild and captive animals resulting from capture, handling, and research procedures. As required by regulation, research conducted under a section 10(a)(1)(A) research permit cannot operate to the disadvantage of the species. Scientific research permits issued by NMFS are conditioned with mitigation measures to ensure that the impacts of research activities on target and non-target ESA-listed species are as minimal as possible. Section 10(a)(1)(A) permits are also issued to research facilities and educational display facilities for the captive research and educational display of ESA-listed species.

### 7.12.1 Sea Turtle Research

As of 2017, there were forty-one Section 10(a)(1)(A) scientific research permits that authorize the study of sea turtles. Three of these permits are solely for the receipt and study of sea turtle parts for purposes such as cell line development; they do not authorize take of live animals. Thirty permits authorize research on live animals in Atlantic waters (including the Gulf of Mexico and Caribbean) and eight authorize research in Pacific waters (see Appendix E for locations of active sea turtle research permits as of June 30, 2017). Permits for study of wild animals authorize take of post-hatchling through adult life stages. On average, from 2007 to 2017 approximately 2,370 turtle (all species) takes were reported within the program in any given year. This includes an annual average of 831 sea turtles taken by capture with subsequent procedures, 157 sea turtles taken by conducting procedures only (i.e., capture authorized through different permit), and 1,382 sea turtles taken only during remote surveys. Both authorized and reported take numbers for remote survey methods are expected to decrease significantly as a result of the 2016 NMFS' Interim Guidance on the ESA Term Harass (NMFS 2016c). The most commonly authorized sea turtle capture methods in research permits from 2007-2017 were hand and/or dip nets and tangle nets (Figure 49). Average annual reported captures over this time frame, by species and capture method, are shown in Table 20.

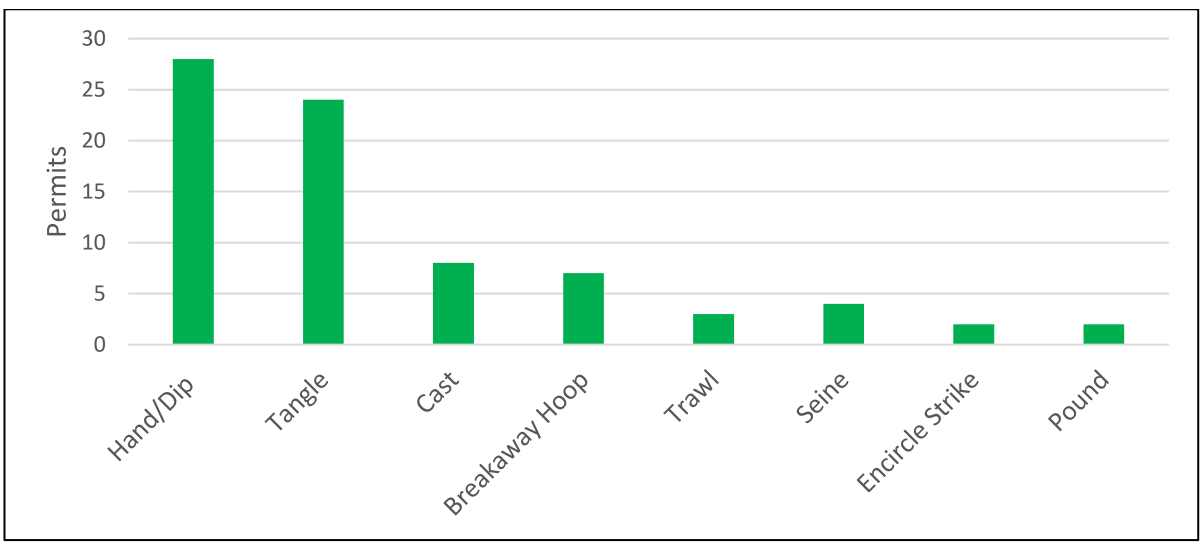


**Figure 49. Frequency of Capture Methods Authorized in Sea Turtle Research Permits from June 2007 to May 2017 (N = 43 permits).**

Mortality is rarely authorized by the Permits Division in sea turtle research permits. Five permits, all for research in the Atlantic ocean basin, authorize lethal take between 2007 and 2017. By capture gear, the reported mortalities of green and Kemp's ridley (four combined) over the past ten years were turtles captured in pound nets; the one loggerhead reported mortality was from trawl gear. In addition to the lethal takes shown in Table 21, there was one other permit (Permit No. 15315) that authorized a relatively high number of sea turtle lethal takes to conduct a short-term study evaluating an experimental tangle net design in North Carolina waters. This permit authorized the lethal take of five Kemp's ridley, 15 green, and five loggerhead sea turtles over the 19-month life of the permit. This permit was considered exceptional because it authorized methods that did not adhere to the standard mitigation measures and procedures (e.g., night sampling and unattended tangle nets) for capture of sea turtles. Two Kemp's ridleys and two green turtles died during this study.

**Table 20. Average annual reported captures by turtle species and capture method from 2007 to 2017.**

| Species | Sea Turtle Capture Method | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Hand or Dip | Tangle | Seine | Cast | Pound | Trawl | Breakaway Hoop | Encircle Strike |
| Green | 293 | 302 | 15 | 71 | 8 | 4 | 8 | 20 |
| Hawksbill | 68 | 12 | < 1 | 12 | < 1 | < 1 | 2 | 0 |
| Kemp's ridley | 30 | 21 | 6 | 9 | 7 | 25 | 8 | 23 |
| Leatherback | 1 | 1 | 1 | 1 | 1 | 1 | 3 | 0 |
| Loggerhead | 110 | 40 | 15 | 31 | 18 | 78 | 28 | 6 |
| Olive ridley | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Most permits authorize a minimum set of standard procedures on all captured sea turtles including handling, examination, morphometrics, photography, marking, and skin biopsy. Other commonly requested procedures by turtle researchers include transmitter attachments, blood and tissue collection, and lavage. Less commonly requested research activities such as laparoscopy, imaging, ultrasound and tank-based studies have also been authorized on some permits depending on the particular study objectives. No deaths were reported as a result of a research procedure or the use of anesthesia, and no serious injuries have been reported during research over the last ten years.

**Table 21. Number of lethal takes authorized and reported, by species, from June 2007 to July 2017.**

| Species | Authorized lethal take over duration of permit | Reported Mortalities |
|---|---|---|
| Green | 6 | 2 |
| Hawksbill | 3 | 0 |
| Kemp's ridley | 6 | 2 |
| Leatherback | 4 | 0 |
| Loggerhead | 13 | 1 |
| Olive ridley | 2 | 0 |
| Unidentified/Any species | 9 | 0 |
| **Total** | **43** | **5** |

### 7.12.2 Research on Other ESA-listed Species

In addition to sea turtles, the Permits Division issues section 10(a)(1)(A) permits for research on other ESA-listed species considered in this opinion including Atlantic sturgeon, shortnose sturgeon and smalltooth sawfish. Since 2006, conservative mitigation measures implemented by NMFS through permit conditions (e.g., reduced soak times at warmer temperatures or lower DO concentrations, minimal holding or handling time) and additional precautions taken by sturgeon researchers have significantly reduced the lethal and sublethal effects of capture in gill, trammel and trawl nets on Atlantic and shortnose sturgeon. From 2006 through 2016, researchers reported only two shortnose sturgeon killed by capture gear out of 7,019 captured, for a capture mortality rate of 0.03 percent. Since they were listed in 2012, the mortality rate associated with Atlantic sturgeon capture in scientific research is 0.22 percent (14 killed out of 6,466 captured). In 2017 the Permits Division implemented a program for the issuance of permits for research and enhancement activities on Atlantic sturgeon and shortnose sturgeon. A section 7 programmatic consultation biological opinion determined that this action would not likely jeopardize the continued existence of ESA-listed species and would not likely result in the destruction or adverse modification of critical habitat. In addition to the required mitigation measures designed to reduce lethal take and sub-lethal effects on sturgeon, the Program establishes annual limits on sturgeon mortality resulting from research activities by subpopulation (i.e., spawning stock) and life stage. Relative mortality limits are calculated as a proportion of the estimated population size and are based on the relative health of the population. A health index is calculated by NMFS based on the best available information on the population including abundance, population trends, known threats, and information on spawning activity. For adults/subadults and juveniles, relative annual maximum mortality limits are set at 0.4, 0.6, and 0.8 percent of the estimated population size for sturgeon populations with a health index rating of "low," "medium," and "high," respectively. For populations where there is insufficient information to calculate a health index or there is no estimate of population size, the default maximum mortality limit is conservatively established at one fish per year. Maximum annual mortality limits can be exceeded in any given year by up to two times (i.e., 2X), as long as the five-year moving average is within the established maximum annual mortality limit for that population and life stage.

There are currently three permits issued for research on smalltooth sawfish. The NMFS Permits Division and Interagency Cooperation Division are currently working on a programmatic consultation on a program for the issuance of permits for research and enhancement activities on the U.S. DPS of smalltooth sawfish. Since their listing in 2003, only one smalltooth sawfish mortality has been reported as a result of research authorized under a section 10(a)(1)(A) permit. As with turtles and sturgeon, mitigation measures implemented by NMFS through permit conditions and additional precautions taken by researchers have significantly reduced the lethal and sublethal effects of research activities on smalltooth sawfish.

With the exception of Atlantic salmon and Gulf sturgeon, scientific research permits for other ESA-listed species considered in this opinion are issued by the NMFS regional office with jurisdiction over that particular species. The USFWS issues section 10(a)(1)(A) permits for Atlantic salmon. For Gulf sturgeon, a special rule promulgated at the time of listing (56 FR 49658) gives the states permitting authority to allow taking of this species, in accordance with applicable state laws, for educational purposes, scientific purposes, and enhancement of propagation.

## 7.13 Directed Harvest of Sea Turtles

Sea turtles have been harvested throughout history as both a protein source (for meat or eggs) and as raw material in the manufacture of ornaments and artifacts. A threat unique to hawksbill turtles is the tortoiseshell trade. Tortoiseshell is made from hawksbill scutes and is used to produce products such as sunglasses, bracelets, and boxes that are often sold illegally on the black market (Shattuck 2011). In many parts of the world, the customs and traditions associated with the harvest, consumption and artistic use of sea turtle products have been passed from generation to generation and have developed cultural meaning and significance over time (Campbell 2003).

For many centuries, the harvest of sea turtles and turtle eggs was primarily limited to small-scale, artisanal and subsistence fisheries. Although small-scale turtle fisheries still exist today, by the mid-20$^{th}$ century directed turtle harvest was dominated by large-scale commercial operations with access to global markets (Stringell et al. 2013). From the 1950s to 1970s, commercial fisheries in Mexico accounted for about one-half of the global sea turtle harvest, consisting mainly of green and olive ridley turtles (Márquez 1990). During the peak of Mexico's sea turtle exploitation in 1968, it is estimated that the national take was over 380,000 turtles (Cantu and Sanchez, 1999 as cited in (Humber et al. 2014). By the late 1960s, the global capture of sea turtles had peaked at an estimated 17,000 tons (FAO 2011). Based on Japanese commercial import data, between 1970 and 1986 an estimated two million turtles (mostly hawksbills, greens, and olive ridleys) were harvested to satisfy the demand for turtle products in Japan alone (Milliken and Tokunaga 1987). To maximize efficiency, commercial harvesting effort was often concentrated at mass nesting sites or arribadas with high densities of breeding adult turtles. With the introduction of mechanized fishing in the 1970s to India's Orissa coast, an area known to support the world's largest olive ridley arribada, turtle take increased sharply to an estimated 50,000 adults per breeding season (Tripathy and Choudhury 2007). In Ecuador, during the 1970s, an estimated 100,000 to 148,000 olive ridley turtles were killed each year for both consumption of meat and the expanding turtle leather market (Alava et al. 2005).

Increased conservation awareness at the international scale has led to greater protection of marine turtles in recent decades. The Convention on International Trade in Endangered Species (CITES), which went into effect in 1975, helped to reduce demand and promote regional cooperation in increasing turtle populations. All six ESA-listed sea turtles are listed in CITES Appendix I, which provides the greatest level of protection, including a prohibition on commercial trade. Marine turtle species have also been listed on the International Union for Conservation of Nature Red List of Threatened Species since 1982 (IUCN 2017). In 1981, Ecuador, one of the two largest turtle harvesting nations at the time, banned the export of sea turtle products. In 1990, following international pressures, Mexico, the other major turtle exporter, closed commercial fisheries and instituted a moratorium on the take of turtles and eggs (Senko et al. 2014).

As of 2014, there were 42 countries and territories that reported sea turtle harvest through legally authorized fisheries (Humber et al. 2014). Collectively, an estimated 42,000 turtles are killed each year in these countries and territories. Over 80 percent of these are green turtles, followed by hawksbills (8.2 percent), loggerheads (2.5 percent), olive ridley (0.6 percent), and leatherback (0.1 percent)(Humber et al. 2014). Geographically, the legal take of sea turtles is currently concentrated in two regions: the Indo-Pacific region accounts for 63 percent and the wider Caribbean region accounts for 35 percent. The countries of Papua New Guinea (36 percent), Nicaragua (22 percent) and Australia (16 percent) combined account for almost three-quarters of the current legal take of sea turtles (Humber et al. 2014).

Humber et al. (2014) documented the change in the legal take of sea turtles over the past three decades. Just considering the 46 countries that still allow sea turtle directed take (including the four with current moratoria), turtle harvest has decreased by more than 60 percent over the past three decades. The average number of turtles killed in these fisheries annually has declined steadily over time: 116,420 in the 1980s; 68,844 turtles in the 1990s; and 45,387 in the 2000s (Humber et al. 2014). One of the major changes in species taken over the past three decades has been in the nearly complete cessation of the olive ridley harvest on the Pacific coast of Colombia from nearly 40,000 turtles per year in the early 1980s to fewer than ten turtles per year in the 1990s and 2000s. While legal directed take of sea turtles has declined significantly, illegal harvest may still represent a significant source of sea turtle mortality, one that is more difficult to estimate. The scale of global illegal take is likely to be severely underreported due to the inherent difficulty in collecting data on such activity (Humber et al. 2014).

## 7.14 Fisheries Bycatch

Bycatch occurs when fisheries interact with living marine resources (e.g., marine mammals, sea turtles, non-market fish species, corals, or seabirds) that are not the target species for commercial sale. Bycatch represents a global threat to many ESA-listed species. Populations of marine megafauna (e.g., turtles, dolphins, sharks) can be particularly sensitive to the detrimental effects of bycatch due to life history parameters such as slow growth, late age at maturity, and low reproductive rates (Hall et al. 2017). Highly migratory, transboundary species that spend large amounts of time in ocean jurisdictions lacking adequate bycatch mitigation measures, monitoring or enforcement are often most vulnerable to this threat.

While mitigation and minimization measures have reduced U.S. fisheries bycatch in recent years, large numbers of ESA-listed species are still routinely captured in federal and state commercial fisheries targeting other species. Some ESA-listed species also interact with recreational hook-and-line fisheries. Fisheries management plans (FMPs) developed for federally regulated fisheries with ESA-listed species bycatch are required to undergo section 7 consultation, including a NMFS issued biological opinion and an ITS. The ITS includes the anticipated amount of take (lethal and nonlethal) and reasonable and prudent measures (RPMs) with specific terms and conditions for mitigating and minimizing the adverse effects of the proposed action on ESA-listed species and designated critical habitat. Some state-managed fisheries with ESA-listed species bycatch have also been the subject of section 7 consultations with NMFS for issuance of ESA section 10(a)(1)(B) incidental take permits (ITPs). ITPs are issued based on NMFS approval of a state's Conservation Plan, which includes ESA-listed species mitigation and minimization measures. Take levels provided for in an ITS or ITP represent an upper limit of authorized take, and do not necessarily reflect the reported amount of take by the fishery in any given year.

### 7.14.1 Bycatch of Sea Turtles

In this section, we summarize the best available information on fisheries bycatch of ESA-listed sea turtles. First, we provide an overview of the types of fisheries and fishing gears that typically interact with sea turtles, and the relative magnitude of this threat to sea turtle populations. Next, we discuss the global threat that fisheries bycatch represents to ESA-listed sea turtles captured on the high seas and in foreign waters. We then describe the primary federal and state fisheries operating within U.S. waters that result in sea turtle bycatch based on information from (1) previously issued NMFS biological opinions addressing the effects of fisheries bycatch on turtles, (2) bycatch estimates based on observer reported data, and (3) other sources of fisheries bycatch information as available in the published literature and unpublished reports. The summary of U.S. commercial fisheries bycatch of sea turtles is organized by major ocean basin (Atlantic and Pacific) and by type of fishery (i.e., species targeted, gears used and/or locations fished) or FMP within a particular ocean basin. More detailed information on the effects of U.S. fisheries bycatch on sea turtles and the specific mitigation measures in place to minimize those effects, can be found in the biological opinions referenced below.

##### *7.14.1.1 Overview*

Bycatch of ESA-listed sea turtles occurs in a diversity of fisheries throughout the broad geographic oceanic ranges of these species. Sea turtle bycatch occurs in both large-scale commercial fishing operations as well as small-scale, artisanal fisheries throughout the world. Fishing gears that are known to interact with sea turtles include trawls, longlines, purse seines, gillnets, pound nets, dredges and to a lesser extent, pots and traps (Finkbeiner et al. 2011; Lewison et al. 2013).

Trawl vessels typically pull one or more large funnel-shaped nets through the water where target and non-target species are captured in a bag at the end of the net, termed a cod-end. For sea turtles, coastal or shallow bottom trawls used to capture shrimp and other coastal fish can result in high bycatch levels (Finkbeiner et al. 2011). When sea turtles enter the cod-end they are unable to escape, and will die if the duration of a trawl operation exceeds the physiological capacity for a sea turtle to remain submerged without surfacing to breathe.

Gillnets are comprised of vertical panels that are used to form walls of nets of varying lengths and mesh sizes. The primary threat to sea turtles is entanglement in the gillnet mesh, which can result in injury or death from drowning (Lewison et al. 2013).

Pound nets are a stationary net gear that work by corralling migrating fish through a series of funnels into a holding pen. Turtles may become entangled in a vertically hung leader net, which is set perpendicular to shore to divert fish to the mouth of the pound net. In some regions, the holding pen is open (i.e., has no roof) and in others, it is enclosed. If turtles enter a pen that is enclosed, they are unable to reach the surface to breathe and drown (Lewison et al. 2013).

Purse seines consist of a wall of netting that is set in a circle around a school of targeted fish. The bottom of the net is pulled shut (i.e., “pursed”) to form a bag that is then hauled on board the ship. Purse seiners often set nets around natural floating debris and FADs because target fish species are attracted to these objects. Turtles can become entangled in the tethered ropes, buoys, or floats that are part of the FAD. There is some evidence that the use of FADs in purse seine fisheries has resulted in increased sea turtle bycatch (Gilman and Lundin 2010).

Longlines are a series of hundreds or thousands of hooks that hang off a mainline of variable length set at discrete depths to target large pelagic fish species such as tunas and swordfish. Much of the longline bycatch of sea turtles occurs when the lines are set shallowly (0 to 100 meters), a depth range where all sea turtle species dive extensively (Lewison et al. 2013). Sea turtles can be hooked while trying to ingest bait from longline hooks or become entangled when their flippers encounter the hooked branch or mainlines.

Sea turtle bycatch rates (i.e., individuals captured per unit of fishing effort) and mortality rates (i.e., individuals killed per number captured) can vary widely both within and across particular fisheries due to a combination of factors. These include gear types and gear configurations, fishing methods (e.g., depth fished, soak times), fishing locations, fishing seasons, time fished (i.e., day versus night), and turtle handling and release techniques used (Lewison et al. 2013; Wallace et al. 2010b). Henwood (1987) found a strong positive correlation between shrimp trawl tow time and mortality rate of turtles bycaught in commercial shrimp trawlers. Similarly, Murray (2009) found that sea turtle mortality rates in sink gillnet gear was largely a function of soak time. Differences in bycatch rates among gear deployment practices and gear configurations have driven many of the bycatch reduction strategies in longline vessels (Lewison et al. 2013; Watson et al. 2005). Shallow-set longlines (less than 50 meters) have been shown to result in higher turtle bycatch rates than deeper sets (Beverly et al. 2009; Gilman et al. 2006); leatherbacks are caught more often during nighttime longline sets compared to daytime sets; increased longline soak times have resulted in higher catches of loggerhead turtles (Gilman et al. 2006); and switching from J-shaped hooks with squid bait to circle hooks with fish bait resulted in significant declines in loggerhead (83 percent) and leatherback (90 percent) bycatch in the Hawaii longline swordfish fishery (Gilman et al. 2007). Estimated turtle mortality rates from capture in longline gear have also been shown to vary widely (8 percent to over 30 percent) depending on numerous factors including hook type used, set depth, and hook location (Casale et al. 2008; Chaloupka et al. 2004).

If mortality is not directly observed during gear retrieval, it may occur after the turtle is released due to physiological stress and injury suffered during capture. Entanglement in fishing gear and/or plastics can result in severe ulcerative dermatitis, and amputation of flippers (Orós et al. 2005). Although rates of post-release mortality and serious injury are essential to understanding the impact of bycatch on sea turtle populations, it is a major knowledge gap for many fisheries that interact with turtles (Lewison et al. 2013). Recent studies indicate that underwater entrapment in fishing gear (i.e., trawls and gillnets) followed by rapid decompression when gear is brought to the surface may cause gas bubble formation within the blood stream (i.e., embolism) and tissues leading to organ injury, impairment, and even post-release mortality in some bycaught turtles (Fahlman et al. 2017; Garcia-Parraga et al. 2014). Swimmer et al. (2006) used pop-off satellite archival tags to compare post-release mortality and dive behavior of olive ridley's captured with longline gear (n = 9) with those captured by hand at the surface (n = 5). No clear differences were found in dive behavior between longline-caught and hand captured turtles and the only mortality event recorded was that of a hand captured turtle. The authors conclude that olive ridley turtles that are lightly hooked and handled properly survive, and generally behave normally following interactions with shallow-set longline gear (Swimmer et al. 2006).

There have been some major advancements in sea turtle bycatch reduction technologies and management approaches in the past few decades. Direct gear and fishery modifications such as changes to bait type, modifying gear to make it less visible or attractive to sea turtles, making gear less likely to cause direct mortality, or changing the way that gear is deployed are all examples of bycatch mitigation techniques that have been employed to reduce sea turtle bycatch in trawl, passive net, and longline large-scale fisheries (Hall et al. 2017; Lewison et al. 2013). Time-area closures have also proven effective at reducing sea turtle bycatch in commercial fishing gear (Dunn et al. 2011). Sea turtle bycatch mitigation measures and fisheries regulations implemented for particular fisheries are discussed further below.

In 2003, NMFS developed a National Bycatch Strategy that identified concrete actions necessary for reducing bycatch in U.S. fisheries (Benaka and Dobrzynski 2004). This document was recently updated and expanded to enhance the effectiveness of existing bycatch reduction approaches. The 2016 National Bycatch Reduction Strategy identifies several key objectives including: (1) improved monitoring of bycatch and bycatch mortality, (2) conduct research to improve bycatch estimates, (3) implement management measures to further reduce the effects of bycatch, and (4) more emphasis on enforcement to ensure compliance with bycatch measures (NMFS 2016d). The most effective way to monitor sea turtle bycatch is to place trained observers aboard fishing vessels. Although observer programs have increased in recent decades, many fisheries still lack the level of observer coverage necessary to produce reliable estimates of bycatch and associated mortalities needed to assess fishery impacts on ESA-listed species. In 2007, NMFS established a new regulation (72 FR 43176) to annually review sea turtle interactions across fisheries, identify those that require monitoring, and require fishermen to accommodate observers if requested. This annual process should help NMFS and the fishing industry learn more about sea turtle interactions with fishing operations, continually evaluate existing measures to reduce sea turtle takes, and determine whether additional measures to address prohibited sea turtle takes may be necessary to avoid exceeding established take limits.

#### *7.14.1.2 Global Perspective*

Estimating sea turtle interactions and mortality rates associated with commercial fisheries globally remains challenging because a relatively small proportion of fisheries worldwide adequately monitor bycatch (Long and Schroeder 2004). Wallace et al. (2010b) compiled a global database of reported marine turtle bycatch from 1990 to 2008 in gillnet, longline, and trawl fisheries. The total reported marine turtle bycatch from the sources used in this study was around 85,000 turtles. However, due to the small percentage of fishing effort observed and reported (typically less than one percent of total fleets), and to a global lack of bycatch information from small-scale fisheries, the authors note that this likely underestimates the true total by at least two orders of magnitude. Based on these results, they conclude that bycatch is a moderate or high threat for more than three-fourths of all sea turtle regional management units, and represents the greatest overall threat to sea turtles globally (Wallace et al. 2010b). Lewison et al. (2014) used the same 1990-2008 bycatch database as Wallace et al. 2010 to identify global hotspots of turtle bycatch intensity. High-intensity sea turtle bycatch was most prevalent in three regions: the eastern Pacific Ocean, southwest Atlantic Ocean, and Mediterranean Sea (Figure 50).

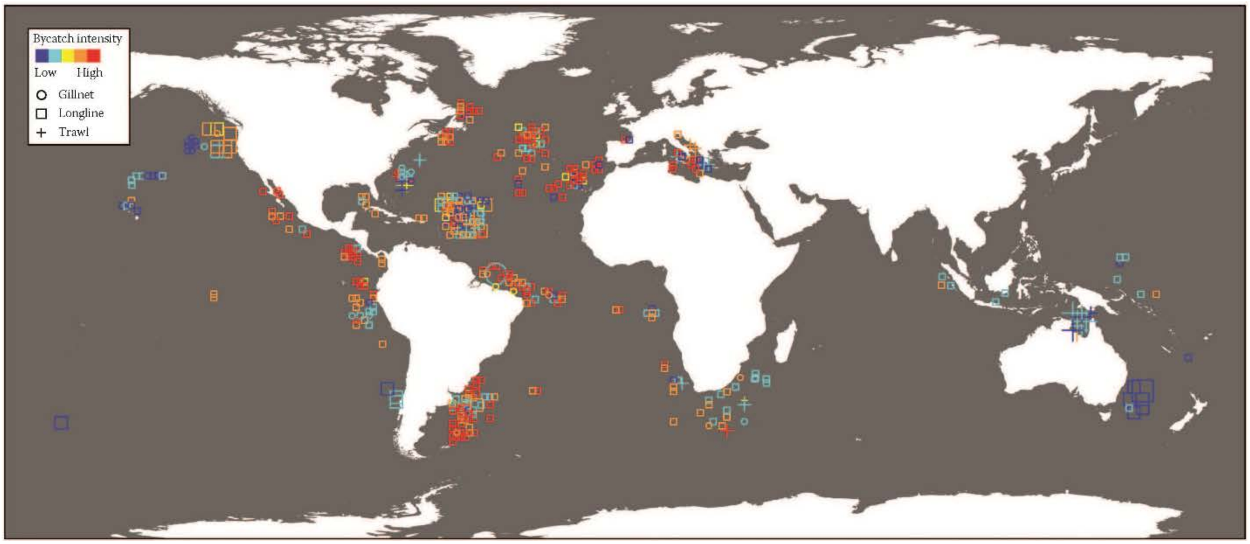


**Figure 50. Map of global documented bycatch records of sea turtles from 1990 to 2008, across gillnets, longlines, and trawls where bycatch intensity of each record is ranked from high (red) to low (blue). Symbol size corresponds to the amount of fishing effort for each data record (Lewison et al. 2013).**

Wallace et al. (2011) found differences in the relative impacts of global fisheries bycatch on different turtle species, as well as differences by gear types. Loggerheads, olive ridleys, and leatherbacks had the highest average bycatch scores, with 80 percent of loggerhead, 75 percent of olive ridley, and 50 percent of leatherback regional management units classified as high bycatch areas. The average bycatch scores for the other turtle species in this study were moderate, and no other species had more than 30 percent of its regional management units scored as high bycatch. By gear type, gillnets were identified as the gear of primary concern most frequently for leatherbacks, green turtles, and hawksbills; longlines were identified as the gear of primary concern for loggerheads; and trawls were identified as the gear of primary concern for olive ridleys. Such interspecific differences, in terms of which gears have the highest impacts, are likely due to a combination of differences in turtle species' life histories and habitat use, and fishing effort by gear type across the global regions occupied by these species (Lewison et al. 2013).

Several studies have reported foreign fisheries as a significant source of mortality for populations of leatherback and loggerhead sea turtles. Pelagic longline bycatch has been implicated as a proximate cause for regional declines in loggerhead and leatherback populations in the Pacific (Lewison et al. 2004b; Spotila et al. 2000). Lewison et al. (2004b) compiled fisheries landings data from 40 nations and turtle bycatch data from 13 international observer programs to estimate global longline bycatch of loggerhead and leatherback turtles. Based on this study, between

60,000 and 250,000 loggerheads and between 9,000 and 60,000 leatherbacks were captured in pelagic longline fisheries globally in 2000. High levels of bycatch continue to be reported in Pacific Ocean longline and gillnet fisheries operating in 'hotspot" areas where loggerheads are known to congregate (Peckham et al. 2007). The western Pacific and South China Sea longline fisheries are dominated by Japan and Taiwan (Long and Schroeder 2004), while the eastern Pacific longline effort is primarily from Chile, Ecuador, Costa Rica, and Spanish fleets (operating out of Peru), in addition to the United States. Dominant longline fisheries in the Atlantic include Brazil, Canada, Japan, Portugal, Spain, Taiwan, United States, Uruguay, and the Caribbean (Long and Schroeder 2004). Interactions and mortality with coastal and artisanal fisheries in Mexico and the Asian region likely represent the most serious threats to the loggerhead North Pacific DPS population (Conant et al. 2009; Peckham et al. 2007). Coastal pound net fisheries off Japan may also pose a significant threat to this loggerhead population (Conant et al. 2009).

Commercial fisheries operating in coastal waters near arribadas (i.e., mass nesting areas) can result in high numbers of adult olive ridely mortalities. This is evident in the eastern Indian Ocean, where thousands of olive ridley carcasses from a large arribada on the Orissa coast have washed ashore annually since expansion of the shrimp trawl fishery in the mid-1970s (Wright and Mohanty 2006). From 1999 to 2006, over 10,000 olive ridley carcasses per year have been documented on the Orissa coast (Wright and Mohanty 2006). Shrimp trawlers off the coast of Central America have historically killed tens of thousands of sea turtles annually, most of which are olive ridleys (Arauz 1996). Trawl fishing was banned in Costa Rican waters in 2013 as a result of litigation over the impacts of bycatch on marine ecosystems (Arias 2013). Based on observer program data, an estimated 699,600 olive ridleys (including 92,300 adult females) and 23,000 green turtles were bycaught in the Costa Rican longline fishery from 1999 to 2010 (Dapp et al. 2013). While the large number of olive ridleys caught in this fishery has been associated with declines in nesting turtles at nearby arribada beaches, the population level impact of this bycatch is difficult to quantify (Dapp et al. 2013). Compared to capture in shrimp trawls, mortality rates of olive ridley's from longline capture are typically low in Costa Rica (Whoriskey et al. 2011), and the effects of post-release mortality or reduced fitness are largely unknown.

Whereas bycatch in large-scale industrial and commercial fisheries (e.g., pelagic longlines and shrimp trawlers) has been associated with sea turtle population declines, small-scale, artisanal fisheries can also pose a significant threat due to a range of factors. Small-scale fisheries often have large fleet sizes, concentrated fishing effort in highly productive coastal waters where many sea turtle species occur, and limited control and enforcement measures for mitigating bycatch (Ortiz et al. 2016). In addition, many small-scale fisheries are not adequately monitored, making it difficult to fully assess the impact these fisheries may have on sea turtle populations. Alfaro-Shigueto et al. (2011) assessed the impact of bycatch on marine turtles from three small-scale fisheries (longline, bottom set nets and driftnet fisheries) out of three Peruvian fishing ports. They estimated these fisheries resulted in the annual bycatch of about 5,900 turtles (3,200 loggerhead, 2,400 green, 240 olive ridley, and 70 leatherback). Since this study covered only a small portion of the nation's nearshore fishing effort, the authors suggest that the number of turtles captured per year in all Peruvian small-scale fisheries is likely to be in the tens of thousands. They conclude that the Peruvian small-scale fisheries have the potential to severely impact sea turtles populations in the Pacific, especially green, loggerhead and leatherback turtles (Alfaro-Shigueto et al. 2011). Peru's small-scale, nearshore gillnet fishery may also exert significant pressure on Pacific green sea turtle populations (Lewison et al. 2014; Ortiz et al. 2016; Wallace et al. 2010b).

In 1989, the U.S. passed legislation aimed at reducing the impact of global shrimp trawl fisheries bycatch on sea turtle populations. Section 609 of Public Law 101-162 prohibits the import of shrimp harvested with technology that may adversely affect certain species of sea turtles (16 U.S.C. 1537). The shrimp import prohibition does not apply if the Department of State certifies to Congress that the harvesting nation has a regulatory program and an incidental take rate comparable to that of the United States (that is, require and enforce the use of TEDs), or, alternatively, that the fishing environment in the harvesting nation does not pose a threat of the incidental taking of sea turtles (64 FR 36946). Nations that seek to import shrimp into the U.S. must be certified annually. Approximately 40 countries are currently certified to export shrimp to the U.S. Although most certifications are done on a national basis, State Department guidelines allow for import of individual shipments of TED-harvested shrimp from uncertified countries. The State Department and NOAA Fisheries can, if requested, inspect portions of a nation's shrimp trawl fleet for adequate use of TEDs. NMFS has provided extensive TED training throughout the world to further encourage and promote the use of these effective bycatch mitigation devices in foreign shrimp trawl fisheries.

#### *7.14.1.3 U.S. Fisheries: Atlantic Ocean Basin (including Gulf of Mexico and Caribbean)*

This subsection describes the impact of U.S. commercial fisheries bycatch on sea turtle populations within the Atlantic Ocean, Gulf of Mexico, and Caribbean Sea. The primary turtle species captured in U.S. fisheries in Atlantic and Gulf of Mexico fisheries is the loggerhead (Moore et al. 2009). The southeastern U.S. comprises one of the largest aggregate nesting rookeries for loggerhead sea turtles in the world, and the continental shelf provides critical ontogenetic habitats for this population. Thus, because a large number of individuals are present throughout areas of high fishing activity, loggerheads interact with a greater number of fishing fleets and gear types in the Atlantic than other sea turtle species (Moore et al. 2009).

**Southeast Shrimp Trawl Fishery**

The Southeast shrimp trawl fishery in the Atlantic and Gulf of Mexico has historically accounted for the overwhelming majority (up to 98 percent) of sea turtle bycatch in U.S. fisheries (Finkbeiner et al., 2011). Regulations that went into effect in the early 1990's require shrimp trawlers in the Atlantic and Gulf of Mexico to modify their gear with TEDs designed to allow turtles to escape trawl nets and avoid drowning. TEDs consist of metal bars inserted into the neck of a trawl; when a turtle encounters the bars, it is forced out of an opening in the bottom of the net while smaller organisms such as shrimp continue through the bars into the bag end of the trawl (Lewison et al. 2013). There is an exception allowed to the NMFS TED requirement in the Southeast shrimp trawl fishery for skimmer, pusher-head, and wing net (butterfly) trawls. Vessels fishing with these types of trawls are currently allowed to use limited tow times in lieu of TEDs, as short duration tow times has a similar effect of mitigating turtle bycatch. However, due to the difficulty of enforcing limited tow times, in December 2016 NMFS proposed a rule (81 FR 91097) to withdraw the tow time requirement and require all skimmer trawl, pusher-head trawl, and wing net (butterfly trawl) vessels rigged for fishing to use TEDs (with the exception of vessels participating in the Biscayne Bay, Florida wing net fishery).

Analyses by Epperly and Teas (2002) indicated that, while early versions of TEDs were effective for some species, the minimum requirements for the escape opening dimension were too small for larger sea turtles, particularly loggerheads and leatherbacks. NMFS implemented revisions to the TED regulations in 2003 to address this issue (68 FR 8456, February 21, 2003). The revised TED regulations were estimated to reduce shrimp trawl related mortality by 94 percent for loggerheads and 97 percent for leatherbacks (NMFS 2014c). Finkbeiner et al. (2011) compared sea turtle bycatch estimated before and after the 2003 TED enlargement regulations. In the late 1990's, the southeast shrimp trawl fishery resulted in an estimated 340,500 sea turtle interactions and 133,400 mortalities. By comparison, by 2007 this fishery resulted in an estimated 69,300 interactions and 3,700 mortalities (Finkbeiner et al. 2011). The decline in sea turtle bycatch over this period can be attributed to a combination of the revised TED regulations and a significant decrease in fishing effort. Time-area closures have also been implemented to reduce sea turtle bycatch in shrimp trawl fisheries operating in particularly sensitive areas. In 2000, the state of Texas implemented a no-take marine protected area along Padre Island within five miles of the southern Texas coast from December 1 through July 15 each year to protect nesting Kemp's ridleys from capture in shrimp trawls (Lewison et al. 2003).

Although mitigation measures have greatly reduced the impact on sea turtle populations, the shrimp trawl fishery is still responsible for large numbers of turtle mortalities each year. The Gulf of Mexico fleet accounts for a large percentage of the sea turtle bycatch in this fishery. In 2010, the Gulf of Mexico shrimp trawl fishery had an estimated bycatch mortality of 5,166 turtles (18 leatherback, 778 loggerhead, 486 green and 3,884 Kemp's ridley). By comparison, the southeast Atlantic fishery had an estimated bycatch mortality of 1,033 turtles (8 leatherback, 673 loggerhead, 28 green and 324 Kemp's ridley) in 2010 (NMFS 2014c).

In 2014, NMFS issued a biological opinion for reinitiation of the section 7 consultation on the southeast shrimp trawl fishery (NMFS 2014c). Unlike most other fisheries, conventional observer programs are not effective for determining the numbers of sea turtle interactions and mortalities in this fishery. As a result, the ITS for this opinion is based on monitoring fishing effort and TED compliance rate as a surrogate for monitoring take. The baseline effort levels for this fishery, as established in the ITS, are 132,900 days fished in the Gulf of Mexico and 14,560 trips in the South Atlantic. The baseline TED compliance level is 88 percent.

**Pelagic Longline Fishery**

The U.S. Atlantic pelagic longline fishery began in the early 1960s. This fishery is currently comprised of five distinct fishing sectors: Gulf of Mexico yellowfin tuna fishery; southern Atlantic swordfish fishery; Mid-Atlantic and New England swordfish and tuna fishery; U.S. Atlantic Distant Water swordfish fishery; and the Caribbean tuna and swordfish fishery. The pelagic longline fishery mainly interacts with leatherback sea turtles and pelagic juvenile loggerhead sea turtles. The estimated average annual bycatch in this fishery (all geographic areas combined) between 1992-2002 was 912 loggerhead interactions (including 7 captured dead) and 846 leatherback interactions (including 11 captured dead) (NMFS 2004). These mortality estimates do not account for post-release mortality, which historically was likely substantial (NMFS 2014c).

NMFS has taken numerous steps to reduce sea turtle bycatch and bycatch mortality in domestic longline fisheries. In 2001, NMFS implemented requirements for U.S. flagged vessels with pelagic longline gear on board to have line clippers and dipnets to remove gear on incidentally captured sea turtles (66 FR 17370). Specific handling and release guidelines designed to minimize injury to sea turtles were also implemented. In 2004, NMFS issued a biological opinion on reinitiation of a section 7 consultation on the Atlantic pelagic longline fishery (NMFS 2004). This opinion concluded that the pelagic longline fisheries were likely to jeopardize the continued existence of leatherback sea turtles. An RPA was provided to avoid jeopardy that included take reduction measures related to fishing gear, bait, disentanglement gear, and training. NMFS published a final rule in 2004 to implement management measures to reduce sea turtle bycatch and bycatch mortality in the Atlantic pelagic longline fishery (69 FR 40734). These measures effectively reduced post-release mortality rates by reducing the number of turtles that swallow hooks which engage in the gut or throat, decreasing the number of turtles that are foul-hooked, and improving handling and gear removal protocols. Incidental take of sea turtles over any three-year period, as specified in the RPA ITS of the 2004 opinion, are as follows:

- Kemp's ridley, olive ridley, green, and hawksbill (combined): 105 total, including up to 18 lethal.
- Leatherback: 1,764 total, including up to 252 lethal.
- Loggerhead, Northwest Atlantic DPS: 1,905, including up to 339 lethal.

Since 2004, bycatch estimates for both loggerheads and leatherbacks in pelagic longline gear have been well below the average prior to implementation of gear regulations under the RPA (Garrison, Stokes, & Fairfield, 2012). The pelagic longline fishery resulted in an estimated 259 loggerhead and 268 leatherback sea turtle interactions in 2014 (NMFS, 2015). NMFS is currently reviewing a request for reinitiation of section 7 consultation on the pelagic longline fishery based on the following: (1) information indicating that the net mortality rate and total mortality estimates for leatherbacks specified in the 2004 RPA were exceeded (although the take level specified in the ITS has not been exceeded), (2) changes in information about leatherback and loggerhead sea turtle populations, and (3) new information about sea turtle mortality associated with pelagic longline fishing gear.

**Federal Shark Fisheries**

In 2012, NMFS issued an updated biological opinion on the federal shark fisheries managed under the Consolidated Highly Migratory Species FMP (NMFS 2012c). Gears used to capture sharks in these fisheries include bottom longlines, gillnets (drift, strike, and sink nets), and commercial and recreational rod-and-reel and handlines. The ITS for this opinion exempted take of ESA-listed sea turtle species as follows:

- Green, North Atlantic DPS: up to 57 captures every three years of which 24 could be lethal.
- Hawksbill: up to 18 captures every three years of which nine could be lethal.
- Kemp’s ridley: up to 36 captures every three years of which 15 could be lethal.
- Leatherback: up to 18 captures every three years of which nine could be lethal.
- Loggerhead, Northwest Atlantic DPS: up to 126 captures every three years of which 78 could be lethal.

**Scallop Fishery**

Sea turtles overlap seasonally with the Atlantic sea scallop fishery in the Mid-Atlantic region from Cape Cod, Massachusetts to southern Virginia when turtles migrate to this area to forage in early summer (Murray 2015). Loggerheads account for the large majority of interactions with this fishery. An estimated 200 interactions between loggerheads and scallop dredge fishing gear occurred on average annually from 2001 to early 2006 (Murray 2011). Subsequent fishing effort reductions and gear modifications implemented in this fishery reduced these interactions to less than 100 per year from late 2006 to 2008, and to an estimated 22 per year from 2009 to 2014 (Murray 2015).

In 2012, NMFS issued a biological opinion on the continued authorization of the Atlantic sea scallop FMP (NMFS 2012d). An amended ITS for this opinion was issued in 2015 with the following levels of anticipated sea turtle take:

- Green: annual lethal take of up to two individuals in dredge and trawl gear combined.
- Kemp’s ridley: annual take of up to three individuals in dredge and trawl gear combined, of which up to two takes are anticipated to be lethal.
- Leatherback: annual lethal take of up to two individuals in dredge and trawl gear combined.
- Loggerhead, Northwest Atlantic DPS: (a) the take of no more than 322 individuals over any consecutive two-year period in dredge gear, of which up to 92 may be lethal, and (b)

the take of no more than 700 individuals over any consecutive five-year period in trawl gear, of which up to 330 may be lethal.

**Federally Managed Gillnet and Trawl Fisheries**

Gillnets and bottom trawls are commonly used gears by many of the commercial fisheries operating in the northeastern U.S. Atlantic EEZ from North Carolina through Maine. These fisheries are also known to interact with large numbers of sea turtles, particularly loggerheads. 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 EEZ off of North Carolina and Virginia (67 FR 71895, December 3, 2002). This rule was in response to a direct need to reduce the impact of this fishery on sea turtles. The rule was subsequently modified on April 26, 2006, by requiring 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.

In 2013, NMFS issued a “batched” section 7 biological opinion on the following fisheries: Northeast multispecies; monkfish; spiny dogfish; Atlantic bluefish; Northeast skate complex; mackerel/squid/butterfish; and summer flounder /scup/black sea bass (NMFS, 2013). Gill net gear is used by five of the seven fisheries, and bottom trawl gear is used by six of the seven fisheries covered by this opinion. The “batched” FMP opinion includes an ITS (amended March 10, 2016) that exempts the following take of ESA-listed sea turtles:

Loggerhead sea turtle Northwest Atlantic DPS: up 1,345 individuals over any consecutive five-year period in gillnet gear, of which up to 835 may be lethal; up to 1,020 individuals over any consecutive five-year period in trawl gear, of which up to 335 may be lethal; and the annual take of up to one individual in trap/pot gear, which may be lethal or non-lethal.

Leatherback sea turtle: annual observed take of up to four individuals in gillnet gear, of which up to three may be lethal; annual observed take of up to four individuals in bottom trawl gear, of which up to two may be lethal; and annual observed take of up to four individuals in trap/pot gear, which may be lethal or non-lethal

Kemp’s ridley sea turtle: annual observed take of up to four individuals in gillnet gear, of which up to three may be lethal; and the annual observed take of up to three individuals in bottom trawl gear, of which up to two may be lethal.

Green sea turtle: annual observed take of up to four individuals in gillnet gear, of which up to three may be lethal; and annual observed take of up to three individuals in bottom trawl gear, of which up to two may be lethal.

**Coastal Migratory Pelagics**

Sea turtles occasionally interact with commercial gillnets targeting king mackerel, Spanish mackerel, and cobia managed under the coastal migratory pelagics FMP. In 2015, NMFS issued a biological opinion on reinitiation of a section 7 consultation on the FMP for coastal migratory pelagics in the Atlantic and Gulf of Mexico (NMFS 2015b). Sea turtle incidental take authorized over any three-year period as provided for in the ITS of this opinion is as follows:

- Green, North Atlantic DPS: 31 total, including up to nine lethal.
- Hawksbill: one (lethal or non-lethal).
- Kemp's ridley: eight total, including up to two lethal.
- Leatherback: one (lethal or non-lethal).
- Loggerhead, Northwest Atlantic DPS: 27 total, including up to seven lethal.

**South Atlantic Snapper-Grouper Complex**

The South Atlantic commercial snapper-grouper fishery occurs in the U.S. federal waters from North Carolina through Florida. Four fishing methods are used in this fishery: vertical line (handline, hydraulic, or electric), longline, black sea bass pots, and powerheads or spears. In 2006, NMFS issued a biological opinion on the continued authorization of the South Atlantic snapper-grouper fishery (NMFS 2006b). Sea turtle incidental take authorized over any three-year period as provided for in the ITS of this opinion is as follows:

- Green: 39 total, including up to 14 lethal.
- Hawksbill: four total, including up to three lethal.
- Kemp's ridley: 19 total, including up to eight lethal.
- Leatherback: 25 total, including up to 15 lethal.
- Loggerhead: 202 total, including up to 67 lethal.

**Reef Fish Fisheries**

In 2011, NMFS issued a biological opinion on the continued authorization of the reef fish fisheries in the Gulf of Mexico (NMFS 2011b). Fishing gears used in these fisheries that may interact with sea turtles include commercial bottom longlines and bandit rigs (a type of vertical line gear), and recreational hook-and-line gear. This opinion also addresses the anticipated take of sea turtles by these fisheries due to vessel strikes. Sea turtle incidental take authorized over any three-year period as provided for in the ITS of this opinion are as follows:

- Green: 116 total, including up to 75 lethal.
- Hawksbill: nine total, including up to eight lethal.
- Kemp's ridley: 108 total, including up to 41 lethal.
- Leatherback: 11 (lethal or non-lethal).
- Loggerhead: 1,044 total, including up to 572 lethal.

In 2011, NMFS issued a biological opinion on the continued authorization of the reef fish fisheries in Puerto Rico and the U.S. Virgin Islands (NMFS 2011a). Fishing gears used in these fisheries that may interact with sea turtles include traps and hook-and-line gear. This opinion also addresses the anticipated take of sea turtles by these fisheries due to vessel strikes. Sea turtle incidental take authorized over any three-year period as provided for in the ITS of this opinion are as follows:

- Green: 75 (lethal or non-lethal).
- Hawksbill: 51 total, including up to 48 lethal.
- Leatherback: 18 (lethal or non-lethal).

**Spiny Lobster Fisheries**

ESA-listed sea turtle distributions overlap with spiny lobster fisheries operating in the Gulf of Mexico, South Atlantic, and the Caribbean. However, sea turtle interactions with fishing gear used to catch spiny lobster are rare. Based on a 2011 biological opinion (NMFS 2011c), NMFS anticipates the following average annual turtle take (lethal or nonlethal) by the U.S. Caribbean spiny lobster fishery: four green, four hawksbill, and three leatherback. Similarly, based on a 2009 biological opinion (NMFS 2009a), NMFS anticipates the following average annual turtle take (lethal or nonlethal) by spiny lobster fisheries from North Carolina through Texas: one loggerhead, one green, and one hawksbill, leatherback, or Kemp's ridley in combination.

**Gulf of Mexico Stone Crab Fishery**

In 2009, NMFS issued a biological opinion on the continued authorization of the Gulf of Mexico stone crab fishery that occurs off Florida's west coast (NMFS 2009b). Commercial and recreational crab traps and pots authorized in this fishery can adversely affect sea turtles via entanglement and forced submergence. Sea turtle incidental take authorized over any three-year period as provided for in the ITS of this opinion is as follows:

- Green: four total, including up to one lethal.
- Hawksbill: one (lethal or non-lethal).
- Kemp's ridley: three total, including up to two lethal.
- Leatherback: one (lethal or non-lethal).
- Loggerhead: 16 total, including up to four lethal.

**Fisheries in State Waters**

Various fishing gears (e.g., trawls, pots, pound nets and gillnets) used in state waters from Maine through Texas are known to incidentally take sea turtles. However, information on turtle bycatch in these coastal, nearshore fisheries is often sparse. State managed fisheries bycatch estimates are often based on extremely low observer coverage, and historically sea turtles have not always been included in the data collection effort. Thus, these data may provide insights into gear interactions that could potentially occur but are often not indicative of the magnitude of the overall threat to sea turtles from bycatch in state fisheries. Although the past and current effects of state managed fisheries on sea turtles is currently not determinable, NMFS believes that ongoing state fishing activities may be responsible for seasonally high levels of observed sea turtles strandings in state waters on both the Atlantic and Gulf of Mexico coasts (see Section 7.15 Sea Turtle Stranding below).

In 2002, NMFS issued a biological opinion on sea turtle conservation measures for the Virginia pound net fishery in response to a proposed NMFS rule that prohibited pound net leaders measuring 12 inches and greater (stretched mesh) and pound net leaders with stringers in the Virginia waters of the mainstem Chesapeake Bay and portions of Virginia tributaries from May 8 to June 30 each year (67 FR 15160; March 29, 2002). Another formal consultation on the Virginia pound net fishery was completed in 2004 in response to new information on the effects of the fishery and issuance of a proposed rule prohibiting the use of offshore pound net leaders. The 2004 opinion included an ITS for the anticipated incidental take of loggerhead (507), leatherback (2), Kemp's ridley (103), and green sea turtles (3) in the Virginia pound net fishery (no lethal take was authorized). Section 7 consultation on this action was reinitiated in 2017 due to (1) recent changes to the fishery through the February 2015 amendments (80 FR 6925) to the pound net regulations under the MMPA and ESA (namely the expanded use of modified pound net leaders), (2) new information on listed species interactions (i.e., incidental takes) that were not considered in the previous 2004 opinion, and (3) new species listings for distinct population segments (DPSs) of loggerhead and green sea turtles as well as five DPSs of Atlantic sturgeon.

In 2013, NMFS issued an incidental take Section 10(a)(1)(B) permit (Permit No. 16230) to the state of North Carolina authorizing the take of listed sea turtles incidental to large and small mesh gill net fishing. Authorized take in this fishery includes an estimated 165 green sea turtle mortalities and 49 Kemp’s ridley mortalities. For hawksbill, leatherback, and loggerhead turtles, incidental take was expressed in terms of observed numbers (from observer program data) since insufficient observer data existed to model an estimated annual take level for these species.

#### *7.14.1.4 U.S. Fisheries: Pacific Ocean Basin*

This subsection describes the impact of U.S. commercial fisheries bycatch on sea turtle populations within the Pacific Ocean basin, including fisheries operations along the U.S. West Coast and the Pacific Islands region. The primary turtle species of concern for U.S. fisheries bycatch in the Pacific are leatherbacks and loggerheads, due to their critical conservation status (Moore et al. 2009).

**West Coast Longline Fishery**

The west coast longline fishery operates in the north Pacific ocean, mainly from the U.S. EEZ west to 140 º W longitude and from the equator to 35 º N (NMFS 2016b). This fishery primarily targets bigeye tuna, although other tuna and non-tuna species are also caught and retained. As of 2016 there was only one boat participating in this fishery, although fishing effort is expected to increase in the future (NMFS 2016b). Sea turtle incidental take authorized over a ten-year period (starting in 2016) as provided for in the ITS of the 2016 biological opinion (NMFS 2016b) on this fishery is as follows:

- Green, East Pacific DPS and Central North Pacific DPS: one total (lethal or non-lethal).
- Leatherback: four total, including up to two lethal.
- Loggerhead, North Pacific DPS: one (lethal or non-lethal).

- Olive ridley: six total (lethal or non-lethal).

**Hawaii Pelagic Longline**

Domestic longline fishing around Hawaii consists of two separately managed fisheries: a deep-set fishery that primarily targets bigeye tuna and a shallow-set fishery that targets swordfish.

The shallow-set fishery operates almost entirely north of Hawaii. The deep-set fishery operates primarily to the south of Hawaii between the equator and 35° N, although in some years this fishery expands northward and overlaps with the shallow-set fishery.

In 1999, the shallow-set longline fishery targeting swordfish was closed by court order due to high levels of sea turtle bycatch. Before the closure took effect, an estimated 417 loggerheads and 110 leatherbacks (McCracken 2000) were captured annually (with about 40 percent mortality) (Gilman et al. 2007) in Hawaii's longline fisheries (shallow and deep-set combined). Subsequent court orders led to regulations in 2001 prohibiting all Hawaii longline vessels from targeting swordfish until 2004. When the shallow-set fishery was reopened in 2004 it was restricted to considerably less fishing effort than pre-2001 levels. As a result, the deep-set fishery targeting tuna made up an increasingly larger proportion of Hawaii's longline fishing effort since 2004. A final rule published in 2004 (69 FR 17329) established a limited shallow-set swordfish fishery and required the use of circle hooks with mackerel-type bait, a combination that had proven effective at reducing interactions with leatherback and loggerhead turtles in the Atlantic longline fishery (Watson et al. 2005). The use of circle hooks with mackerel-type bait reduced sea turtle interaction rates by approximately 90 percent for loggerheads and 83 percent for leatherbacks compared to the previous period 1994-2002 when the shallow-set fishery was operating without these requirements (Gilman et al. 2007). Annual sea turtle bycatch limits (17 loggerhead or 16 leatherback turtles) were also established for the swordfish fishery as part of the 2004 rule. From 2005 through 2014, the Hawaii-based longline fisheries resulted in an estimated total of 15 loggerhead and 17 leatherback mortalities in the shallow-set fishery and 16 loggerhead, 45 leatherback, and 264 olive ridley mortalities in the deep-set fishery (NMFS 2014a).

In addition to gear restrictions and bycatch limits, Hawaii longline vessel operators are required to take an annual NMFS protected species workshop that instructs fishermen in mitigation, handling, and release techniques for sea turtles, seabirds, and marine mammals. Longline fishermen must carry and use specific equipment, and follow certain procedures for handling and releasing sea turtles, seabirds, and marine mammals that may be caught incidentally.

In 2012, NMFS issued a biological opinion on the continued operation of the Hawaii shallow-set longline fishery (NMFS 2012a). Sea turtle incidental take authorized over a continuous two-year calendar period in the ITS of this opinion is as follows:

- Green: six total, including up to two lethal.
- Leatherback: 52 total, including up to 12 lethal.

- Loggerhead North Pacific DPS: 68 total, including up to 14 lethal.
- Olive ridley: four total, including up to two lethal.

In 2014, NMFS issued a biological opinion on the continued operation of the Hawaii deep-set longline fishery (NMFS 2014a). Sea turtle incidental take authorized over a three-year period in the ITS of this opinion is as follows:

- Green: nine total, including up to nine lethal.
- Leatherback: 72 total, including up to 27 lethal.
- Loggerhead North Pacific DPS: nine total, including up to nine lethal.
- Olive ridley: 99 total, including up to 96 lethal.

**American Samoa Longline**

The pelagic longline fishery based in American Samoa is a limited access fishery with a maximum of 60 vessels under the federal permit program. This fishery targets tunas is the EEZ surrounding American Samoa, and has been monitored under a mandatory observer program since March 2006. Since the observer program went into effect, annual reported sea turtle interactions have ranged from a low of one turtle (in 2007, 2008 and 2012) to a high of 14 turtles (in 2011) (NMFS 2007-2017). Observer coverage represents approximately 20 percent of the entire fishing effort in this fishery. In 2015, NMFS issued a biological opinion on the continued operation of the American Samoa longline fishery (NMFS 2015a). Sea turtle incidental take authorized over a three-year period in the ITS of this opinion is as follows:

- Green: 60 total, including up to 54 lethal. These are divided proportionally by DPS as follows: Central South Pacific 50 percent; Southwest Pacific 33 percent; East Pacific 12 percent; Central West Pacific three percent; and East Indian-West Pacific two percent.
- Hawksbill: six total, including up to three lethal.
- Leatherback: 69 total, including up to 49 lethal.
- Loggerhead, South Pacific DPS: six total, including up to three lethal.
- Olive ridley: 33 total, including up to 10 lethal.

**West Coast Drift Gillnet Fishery for Highly Migratory Species**

The West coast drift gillnet fishery targets swordfish and thresher sharks in the U.S. EEZ and adjacent high seas off the coasts of California, Oregon, and Washington (NMFS 2013a). In 2001, NMFS established Pacific Sea Turtle Conservation Areas that prohibit drift gillnet fishing in large portions of the historical fishing grounds, either seasonally or conditionally, to protect endangered leatherback and loggerhead sea turtle populations (66 FR 44549; August 24, 2001). Oregon and Washington state laws currently prohibit landings caught with drift gillnet gear, although vessels still fish drift gillnets in federal waters off these states and land their catch in California. The drift gillnet fishery can also be closed during El Niño events in order to reduce bycatch of loggerhead turtles that move further north on the warm El Niño currents from Mexico into U.S. waters (72 FR 31756, June 8, 2007).

In 2013, NMFS issued a biological opinion on the continued authorization of the West Coast drift gillnet fishery (NMFS 2013a). Sea turtle incidental take authorized over a five-year period in the ITS of this opinion is as follows:

- Green: two total, including up to one lethal.
- Leatherback: ten total, including up to seven lethal.
- Loggerhead: seven total, including up to four lethal.
- Olive ridley: two total, including up to one lethal.

**Pacific Purse Seine Fishery**

The U.S. commercial purse seine fishery operating in the western and central Pacific is managed under the authority of the South Pacific Tuna Treaty Act of 1988 (16 U.S.C. Chapter 16C). The treaty area, where U.S. and other treaty member nations fish, extends from Palau eastward to the Line Islands of Kiribati (approximately 15°N to 15°S and 125°E to 140°W) and includes some of the world's most productive tuna fishing grounds (NMFS 2006a). Although there is potential for bycatch mortality or serious injury, based on historical observer reports turtles captured in this fishery are generally released alive and healthy (NMFS 2006a). The best available data do not indicate that take in the form of mortality is likely to result to any sea turtle species due to interactions with the Pacific purse seine fishery. Turtle bycatch in this fishery may result in harassment and/or temporary harm. In 2006, NMFS issued a biological opinion for the continued authorization of this fishery with an ITS that exempts the following non-lethal take of sea turtles annually: 14 green, 14 hawksbill, 11 leatherback, 11 loggerhead, and 11 olive ridley.

### 7.14.2 Bycatch of Other ESA-Listed Species

#### *7.14.2.1 Atlantic and Shortnose Sturgeon*

Atlantic and shortnose sturgeon are taken incidentally in fisheries targeting other species in rivers, estuaries, and marine waters throughout their range (ASSRT 2007; Collins et al. 1996). Sturgeon are benthic feeders and as a result they are generally captured near the seabed unless they are actively migrating (Moser and Ross 1995). Sturgeon are particularly vulnerable to being caught in commercial gill nets; therefore, fisheries using this type of gear account for a high percentage of sturgeon bycatch and bycatch mortality. Sturgeon have also been documented in the following gears: otter trawls, pound nets, fyke/hoop nets, catfish traps, shrimp trawls, and recreational hook and line fisheries.

Estimated rates of Atlantic sturgeon caught as bycatch in federal fisheries are highly variable and somewhat imprecise due to small sample sizes of observed trips. An estimated 1,385 individual Atlantic sturgeon were killed annually from 1989 to 2000 as a result of bycatch in offshore gill net fisheries operating from Maine through North Carolina (Stein et al. 2004b). From 2001-2006 an estimated 649 Atlantic sturgeon were killed annually in offshore gill net and otter trawl fisheries. From 2006 to 2010 an estimated 391 Atlantic sturgeon were killed (out of 3,118 captured) annually in Northeast federal fisheries (Miller and Shepherd 2011).

Several federally regulated fisheries that may encounter Atlantic sturgeon have fishery management plans (FMPs) that have undergone section 7 consultation with NMFS. On December 16, 2013, NMFS issued a "batched" section 7 biological opinion on the following fisheries: Northeast multispecies; monkfish; spiny dogfish; Atlantic bluefish; Northeast skate complex; mackerel/squid/butterfish; and summer flounder /scup/black sea bass. The majority (73 percent) of all Atlantic sturgeon bycatch mortality in New England and Mid-Atlantic waters is attributed to the monkfish sink gill net fishery (ASMFC 2007). Observer data from 2001 to 2006 shows 224 recorded interactions between the monkfish fishery and Atlantic sturgeon, with 99 interactions resulting in death, a 44 percent mortality rate. For all seven fisheries combined, the following take of Atlantic sturgeon was authorized annually: 1,331 trawl interactions of which 42 may be lethal and 1,229 gill net interactions of which 155 may be lethal. The 2012 NMFS biological opinion on the Southeast shrimp trawl fishery exempted the take of Atlantic sturgeon as follows: 1,731 total interactions, including 243 captures of which 27 are expected to be lethal every three years. In 2012, NMFS provided an updated biological opinion on the Federal shark fisheries, including the smoothhound fishery on ESA-listed species. For the federal smoothhound fishery and shark fisheries combined, NMFS exempted the take of 321 Atlantic sturgeon over a three-year span, with 66 of those takes expected to be lethal.

Given the high prevalence of gill net and otter trawl use in nearshore coastal and inland fisheries, state managed fisheries may have a greater impact on Atlantic and shortnose sturgeon than federal fisheries using these same gear types. Commercially important state fisheries that interact with sturgeon include those targeting shrimp, Atlantic croaker, weakfish, striped bass, black drum, spot, shad, and spiny dogfish.

#### *7.14.2.2 Gulf Sturgeon*

Direct take of Gulf sturgeon is prohibited in all four states within the current range of the species. However, fisheries directed at other species that employ various trawling and entanglement gear in areas that gulf sturgeon regularly occupy pose a risk of incidental bycatch. Gulf sturgeon are occasionally incidentally captured in state managed shrimp fisheries in bays and sounds along the northern Gulf of Mexico. Gulf sturgeon bycatch has also been documented in entanglement gear (trammel and gill nets) used to target gar in the Pearl River in southeast Louisiana, where (USFWS and NMFS 2009). While state regulations prohibit the taking or possession of gulf sturgeon (including roe), there is no available data to determine bycatch capture or mortality rates (NMFS 2014c).

Relocation trawling, associated mostly with the removal of sea turtles to avoid interactions with channel dredging and beach nourishment projects, has successfully moved several Gulf sturgeon in recent years. These captures in near-shore waters illustrate the relative vulnerability of Gulf sturgeon to incidental bycatch in fisheries that use trawls (USFWS and NMFS 2009).

The Florida "net ban", approved by voter referendum in November 1994 and implemented in July 1995, made unlawful the use of entangling nets (i.e., gill and trammel nets) in Florida state waters. Other forms of nets (i.e., seines, cast nets, and trawls) were restricted, but not totally eliminated. Implementation of the net ban in Florida has likely benefited Gulf sturgeon as they are residents of near-shore waters during much of their life span.

Federal fisheries that NMFS authorizes in the Gulf of Mexico have likely had a minor impact on Gulf sturgeon. This is because Gulf sturgeon occur in the Gulf of Mexico only during winter months and during that time, most migrate alongshore and to barrier island habitats within shallower state waters (NMFS 2014c).

#### *7.14.2.3 Green Sturgeon*

Take of Southern DPS green sturgeon in federal fisheries was prohibited as a result of the ESA 4(d) protective regulations issued in June of 2010 (75 FR 30714). Green sturgeon are occasionally encountered as bycatch in Pacific groundfish fisheries (Al-Humaidhi 2011), although the impact of these fisheries on green sturgeon populations is estimated to be small (NMFS 2012b). NMFS (2012b) estimates between 86 and 289 Southern DPS green sturgeon are annually encountered as bycatch in the state-regulated California halibut bottom trawl fishery.

Approximately 50 to 250 green sturgeon are encountered annually by recreational anglers in the lower Columbia River (NMFS 2015c), of which 86 percent are expected to be Southern DPS green sturgeon based on the higher range estimate of Israel et al. (2009). In Washington, recreational fisheries outside of the Columbia River may encounter up to 64 Southern DPS green sturgeon annually (Kirt Hughes, Washington Dept. of Fish and Wildlife, pers. comm. to NMFS, January 30, 2015) cited in (NMFS 2015c). Southern DPS green sturgeon are also captured and released by California recreational anglers. Based on self-reported catch card data, an average of 193 green sturgeon were caught and released annually by California anglers from 2007 to 2013 (NMFS 2015c). Recreational catch and release can potentially result in indirect effects on green sturgeon, including reduced fitness and increased vulnerability to predation. However, the magnitude and impact of these effects on Southern DPS green sturgeon are not well studied.

#### *7.14.2.4 Smalltooth Sawfish*

The primary reason for the decline in smalltooth sawfish abundance has been bycatch in various commercial fishing gear, including gill nets, otter trawls, trammel nets, and seines (NMFS 2010c). The long, toothed rostrum of the smalltooth sawfish causes this species to be particularly vulnerable to entanglement in fishing nets. The majority of historical documented landings of smalltooth sawfish were from otter trawl fisheries. Total Gulf of Mexico landings dropped continually from around five metric tons in 1950 to less than 0.2 metric tons in 1978 (NMFS 2010c). Data gathered by Louisiana shrimp trawlers from 1945 to 1978 indicate a decline in smalltooth sawfish bycatch from a high of 34,900 pounds in 1949 to less than 1,500 pounds in most years after 1967 (Simpfendorfer 2002). Anecdotal information collected by NMFS port agents indicates that smalltooth sawfish are now taken very rarely in the shrimp trawl fishery. Smalltooth sawfish have been captured incidentally in federal shark fisheries using drift gillnets and bottom longlines, although interaction rates with these fisheries are relatively low.

Smalltooth sawfish are also occasionally captured in recreational hook-and-line fisheries targeting shark, red drum, snook, and tarpon (NMFS 2010c).

The Florida net ban has led to a reduction in the number of smalltooth sawfish incidentally captured in nearshore commercial fisheries since 1995. The net ban made unlawful the use of entangling nets (i.e., gill and trammel nets) in Florida state waters. Other forms of nets (i.e., seines, cast nets, and trawls) were restricted but not completely eliminated.

#### *7.14.2.5 Nassau Grouper*

Nassau grouper were protected from directed fisheries throughout their U.S. range prior to the ESA listing in 2016. In U.S. federal waters, including those federal waters around Puerto Rico and the U.S. Virgin Islands take and possession of Nassau grouper have been prohibited since 1990. Since 1993, a ban on fishing/possessing Nassau grouper was implemented for the state of Florida and has since been enacted in all U.S. state waters. The species was fully protected in Puerto Rico in 2004 and in the U.S. Virgin Islands in 2006. The 2010 Nassau grouper bycatch estimate in U.S. commercial fisheries was 1,044 fish (NMFS 2013c).

Nassau grouper are also occasionally reported by recreational anglers fishing in Florida and Puerto Rico as part of the NMFS Marine Recreational Information Program. Statistical estimates of total U.S. recreational catch of Nassau grouper over the past five years (2012 to 2016) range from zero to 2,320 fish (NMFS Fisheries Statistics Division, pers. comm. to NMFS OPR, July 24, 2017). However, these estimates are considered highly imprecise due to the rare event nature of Nassau grouper catches in recreational survey data. While the large majority of Nassau grouper caught recreationally are reported as released alive, there is little information available to estimate recreational fishery post-release mortality rates for this species.

#### *7.14.2.6 Atlantic Salmon*

Commercial bycatch is not thought to be a major source of mortality for GOM DPS Atlantic salmon. Beland (1984 cited in (Fay et al. 2006b) reported that fewer than 100 salmon per year were caught incidental to other commercial fisheries in the coastal waters of Maine. A more recent study found that bycatch of Maine Atlantic salmon in herring fisheries is not a significant mortality source (ICES 2004). Commercial fisheries for white sucker, alewife, and American eel conducted in state waters also have the potential to incidentally catch Atlantic salmon.

Recreational angling occurs for many freshwater fish species throughout the range of the GOM DPS Atlantic salmon. As a result, Atlantic salmon can be incidentally caught (and released) by anglers targeting other species such as striped bass or trout. Studies on the effects of catch and release on trout and salmon have concluded that exhaustive exertion may result in significant physiological disturbances including mortality (Brobbel et al. 1996; Graham et al. 1982; Wood et al. 1983a). Conditions that contribute to Atlantic salmon post-release mortality include elevated water temperatures, exposure of the fish to air after capture, extremely soft water, low oxygen levels, low river flow and improper handling (Booth et al. 1995). The potential also exists for anglers to misidentify juvenile Atlantic salmon as brook trout, brown trout, or landlocked salmon. A maximum length for landlocked salmon and brown trout (25 inches) has been adopted in Maine in an attempt to avoid the accidental harvest of sea-run Atlantic salmon due to misidentification.

#### *7.14.2.7 Scalloped Hammerhead*

Scalloped hammerhead sharks are both targeted and taken as bycatch in many global fisheries (e.g., bottom and pelagic longlines, coastal gillnet fisheries, artisanal fisheries). This species is highly desired for the shark fin trade because of its fin size and high fin ray count. In the United States, scalloped hammerhead sharks are mainly caught as bycatch in longline and coastal gillnet fisheries and are known to suffer high post-release mortality rates (76 FR 72891). Many of the scalloped hammerhead sharks captured in U.S. fisheries are not from an ESA-listed DPS since the only non-foreign listed DPSs are the Central and Southwest Atlantic, Eastern Pacific, and Indo-West Pacific.

The NMFS Pelagic Observer Program reported 100 scalloped hammerhead bycaught in the U.S. Atlantic pelagic longline fishery in 2015, including 51 released dead (NMFS 2015d). Another 126 unidentified hammerhead sharks were also reported captured in this fishery, presumably some of which were scalloped hammerheads. In 2014, 138 scalloped hammerheads were caught during observed bottom longline trips in the sandbar shark research fishery in the Gulf of Mexico and Southern Atlantic (NMFS 2015d). In 2015, seven scalloped hammerheads were caught (five of which were released dead) during observed Southeast sink gillnet trips targeting Atlantic sharpnose, blacknose, and other shark species (NMFS 2015d). In the Pacific, shark bycatch occurs primarily in the Hawaii-based pelagic longline fishery. An observer program has been in place since 1995 with targeted coverage of 25 percent in the deep-set sector and 100 percent in the shallow-set sector. Observer data from 1995-2006 indicated a very low catch of scalloped hammerhead sharks in this fishery (56 individuals on 26,507 sets total, both fishery sectors combined) (Miller et al. 2013). Scalloped hammerheads are also occasionally caught in U.S. recreational fisheries, although recreational catch estimates are often unreliable due to the rare event nature of capture and species identification issues.

## 7.15 Sea Turtle Strandings

As discussed above, bycatch studies are often compromised by limited data, lack of spatial coverage, and difficulty estimating the effects of post-capture mortality or reduced fitness (Lewison et al. 2004a; Tomás et al. 2008). Supplemental information regarding the effects of bycatch and other potential threats on sea turtles can be derived from strandings data (i.e., turtles that wash ashore, dead or alive, or are found floating dead or alive, generally in a weakened condition). In this section we summarize information obtained from sea turtle strandings program reports and published papers based on strandings in U.S. waters and globally.

Previous studies have used turtle strandings data to evaluate sea turtle health, age, size composition, diet, reproductive status, and population trends. The cause of stranding (i.e., bycatch, ship strikes, biotoxins, and disease) can sometimes be inferred from stranded turtles, although it is often recorded as "unknown" because there is no clear indicator (i.e., lesions, tumors, fishing gear) on the carcass or because the carcass is too decomposed to determine. Fishery interactions, in particular, can be difficult to assess in stranded turtles as some fishing gears leave little or no evidence on the body (either in the form of attached gear or specific injuries), while others cannot always be attributed with certainty to a particular fishery. In addition, bycaught turtles that are released alive may be more susceptible to other mortality factors (e.g., ship strikes, disease) due to increased stress and/or injuries suffered during capture.

The relationship between unobserved turtle mortality at sea and observed strandings is not well-studied (Hart et al. 2006). Because carcasses decompose while entrained in currents and eddies, the number of recorded sea turtle strandings likely represents a minimum estimate of mortality (Epperly et al. 1996). Epperly et al. (1996) compared estimates of sea turtle mortalities from North Carolina's winter trawl fishery in 1991-1992 to the number of turtles stranded on beaches adjacent to the fishing grounds. They found that the number of dead turtle strandings accounted for only 7 to 13 percent of the estimated fishery-induced mortalities. They attributed this discrepancy to offshore bottom currents, which normally transport lifeless turtles away from the beach during the winter.

Although inferences from reported strandings may be subject to a number of caveats, when considered over wide spatio-temporal extents and in conjunction with other data sources, strandings data can offer useful insights into turtle distributions, life histories, and vulnerability to various sources of mortality (Tomás et al. 2008). While the cause of a turtle stranding is not always determinable, strandings data have been used by researchers to indicate the relative impacts of various anthropogenic and natural stressors on turtle populations.

Long-term time series strandings data from several studies suggest that anthropogenic factors, particularly fisheries, are responsible for a relatively large proportion of mortalities in many sea turtle populations globally. Casale et al. (2010) used stranding data to investigate mortality factors in loggerhead turtles stranded in the waters around Italy from 1980-2008. They found that mortalities due to anthropogenic factors, primarily from bycatch, were two to three times as prevalent as natural mortalities in stranded loggerheads. In addition to bycatch in longlines and trawls, entanglement in ghost-gear or other debris and boat strikes were identified as important anthropogenic sources of mortality in this study.

Orós et al. (2016) analyzed the causes of stranding of 1,860 loggerhead turtles admitted to a rehabilitation center on Gran Canaria Island, Spain from 1998 to 2014. Entanglement in fishing gear and/or plastics accounted for 64 percent of the strandings with a known cause (20 percent were recorded as "unknown" cause), followed by ingestion of hooks and monofilament lines (15 percent), infectious disease (7 percent), and boat strike (7 percent). The cause of mortality could not be determined for 70 percent of the 226 loggerheads that were dead when admitted to the rehabilitation center; 12 percent died from entanglement, 9 percent from trauma, and 6 percent from ingestion of hooks (Orós et al. 2016). This study also reported a decrease in the number of annual strandings attributed to crude oil after 2006, presumably linked to the designation of the Canary Islands as a Particularly Sensitive Sea Area in 2005 by the International Maritime Organization (Camacho et al. 2013).

Panagopoulos et al. (2003) used strandings data from 1992 to 2000 to evaluate causes of sea turtle mortality in the waters around mainland Greece and the Greek Islands. A total of 1,080 turtle strandings were reported, of which nearly 93 percent were loggerheads. About 80 percent of turtles that were recovered with injuries showed signs of incidental capture in fishing gear. Of these, 46 percent were injured due to hook ingestion and/or entanglement; the remaining 34 percent were intentionally hit on the head, presumably after incidental capture in fishing gear (Panagopoulos et al. 2003).

Tomás et al. (2008) analyzed sea turtle strandings (n = 619) over a 14 year period (1993 to 2006) from the Mediterranean Sea near Valencia in eastern Spain. Loggerhead turtles accounted for 98 percent of recorded strandings. Interactions with longline fisheries accounted for 43.5 percent of observed stranding for which a likely cause was identified.

Strandings data have also been used to document the relative impact of disease in sea turtles, particularly the tumor forming disease FP (see section 7.6 for more details on this disease). Elevated mortality rates dues to the combination of disease and fisheries bycatch can be particularly impactful on turtle populations. Chaloupka et al. (2008b) investigated cause-specific temporal and spatial trends in sea turtle strandings in the Hawaiian Archipelago over a 22-year period (1982–2003). Green turtles comprised 97 percent of the 3,861 strandings recorded over this period. Fibropapillomatosis was the most common known cause of the green turtle strandings in this study (28 percent), followed by hook-and-line fishing gear-induced trauma (7 percent), gill net fishing gear-induced trauma (5 percent), boat strike (2.5 percent), and shark attack (2.7 percent) (Chaloupka et al. 2008b). Miscellaneous causes comprised 5.4 percent of strandings whereas 49 percent of green turtle strandings could not be attributed to any known cause. Estimated mortality rates (i.e., conditional probability) were 88 percent for FP, 69 percent for gill net gear and 52 percent for hook-and-line gear.

Poli et al. (2014) analyzed sea turtle strandings on the coast of Paraíba State, Northeastern Brazil, from August 2009 to July 2010. A total of 124 strandings were recorded in this period, 85 percent of which were green turtles and 12 percent hawksbill. The presence of external tumors, suggestive of FP, was found in nearly one-third of the strandings in this study. Twenty individuals had synthetic anthropogenic debris in the gastrointestinal tract. Other traces of human interactions were observed in 43 individuals, such as injuries caused by entanglement in fishing lines or nets, collisions with vessels, direct contact with oil spills and lesions caused by sharp or spiked objects (Poli et al. 2014).

Sea turtle mass stranding events have also been documented in the literature. Alava et al. (2005) studied the olive ridely mass mortality events that occurred in Ecuador in 1999. From August through September of that year a total of 1,113 turtles were stranded (99 percent were olive ridleys). The cause of this stranding event was not clear. The majority of dead turtles in the mass stranding events did not exhibit discernable injuries or other external damage that might have suggested prior interactions with fisheries. Other possible alternative explanations for the strandings put forward by the authors include thermal stress or hypothermia due to the presence of cold currents such as the Humboldt Current and the presence of an epizootic event or outbreak (e.g., bacteria or virus) that affected migratory olive ridleys in waters off Ecuador.

#### 7.15.1 Sea Turtle Stranding and Salvage Network

The Sea Turtle Stranding and Salvage Network (STSSN) was established in the southeastern United States and Gulf of Mexico in 1980, in Hawaii in 1982, and in the NMFS Southwest Region through the California Marine Mammal Stranding Network in 1983 in response to sea turtles washing up on beaches or floating in the water, dead or in need of assistance. The STSSN is organized through a structure that consists of Atlantic, west Pacific, and east Pacific coordinators, and there is a coordinator for each state. The network consists of trained volunteers, municipal, state and federal employees and their designated agents who operate under the direction of the state and national coordinators. Network participants document marine turtle strandings and incidental captures, including any fishing gear or other marine debris associated with the stranded turtle, in their respective states and enter that data into a central database.

Based on data collected by NOAA, in the Atlantic and Gulf of Mexico between 2005 and 2015, 3,928 in-water stranded sea turtles were reported to the STSSN (NMFS 2016e). The species composition of these events was 1,641 loggerheads, 1,659 green turtles, 47 leatherbacks, 80 hawksbills, 390 Kemp's ridleys and 111 unidentified species. The term “in-water stranded sea turtles” can be described as any animal encountered that is cold stunned, sick, injured, entangled or dead. In the Hawaiian Islands, 972 in-water strandings were reported between 2005 and 2015. The species composition of these events was 913 greens, one leatherback, 47 hawksbills, six olive ridleys and one unknown turtle species.

Leatherbacks, green turtles, loggerheads, and olive ridleys off the United States west coast face anthropogenic and natural threats that can result in both live and dead strandings. However, reported turtle strandings off the West Coast are significantly less common compared to strandings off the Atlantic and Gulf of Mexico coasts or Hawaii. In Oregon and Washington, 41 in-water strandings were reported between 2005 and 2015: 14 greens, one leatherback, four olive ridleys and one unknown species. In California, 60 sea turtles have been reported through the STSSN from 2005 to 2015: four loggerheads, 45 greens, five leatherbacks, four olive ridleys and two unknown species (NMFS 2016e). About 350 turtle strandings along the entire west coast were reported to NMFS between 1958 and 2009 (LeRoux 2012). The causes of these strandings included illness-related, marine debris (entanglement and ingestion), boat collisions, fisheries interactions, and power plant entrainments. Approximately one-third of the stranding incidents involved the capture and release of live turtles, the majority of which were stranded due to power plant entrainment. The remaining two-thirds involved either live animals that were transported to rehabilitation facilities and died or animals found dead; in many cases the direct cause of death was not determined (LeRoux 2012).

# 8 EFFECTS OF THE ACTION

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 C.F.R. §402.02). This effects section is organized following the stressor, mitigation, 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 appreciably reduce 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 C.F.R. §402.02). Therefore, the jeopardy analysis considers both survival and recovery of the species.

The destruction and adverse modification analysis considers whether the action produces "a direct or indirect alteration that appreciably diminished the value of critical habitat for the conservation of a 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).

## 8.1 Stressors Associated with the Proposed Action

The following research activities that would be authorized under the Program create stressors that could pose a risk to ESA-listed sea turtles:

1) Research vessel operations create stressors of vessel presence, sounds, and potential vessel/propeller strikes.
2) Aerial surveys using manned or unmanned aircraft create stressors of aircraft presence and sounds.
3) Underwater tracking of sea turtles by ROVs and AUVs, create stressors of vehicle presence, sound, and potential collision with vehicle body or attachments (e.g., tethers).
4) Acoustic surveys involving sonar transducers used to detect sea turtles, create stressors of introducing man-made sounds into the environment.
5) Capture of sea turtles is a stressor that may result from any of the following authorized methods: hand capture, dip net, cast (or throw) net, breakaway hoop net, encircle (or strike) net, entanglement (or gill) net, pound net, seine net, or trawl.
6) Recapture of sea turtles using any of the capture methods identified above.
7) Holding, handling, and transport of sea turtles for procedures, measurements and monitoring vital parameters.
8) Morphometric measuring and weighing sea turtles and the monitoring of vital parameters.

9) Turtle shell marking using paint or shell etching.

11) Oral and ophthalmic examinations that may employ fluorescein staining or use of a slit lamp.

12) Piercing skin for attachment of a flipper tag and injection of PIT tag under sea turtle skin.

13) Injection of oxytetracycline for aging studies.

14) Biological sampling including: epibiota collection, swabs, skin biopsy, scute scraping, blood sampling, tear collection, soft tissue biopsy, and urine/fecal collection.

15) Gastric lavage procedure that involves orally inserting plastic tubing into the turtle's esophagus and pumping of water to discharge stomach contents.

16) Insertion of a laparoscope/laparoscopic biopsy instrument through small surgical incision and use of a trocar to penetrate the body cavity and insert a cannula for passage of the endoscope; sampling internal organs and tissues as part of a laparoscopic procedure, and the use of local or general anesthetization depending on the procedure being performed.

17) Fecal collection that may involve using a lubricated, gloved finger, or by fecal loops, swabs, or cloacal lavage using a rubber catheter.

18) Attachment of suction-cups to turtle shell and attachment of turtle tags using an adhesive such as epoxy, marine putty, resin, fiberglass strips, neoprene, or silicone.

19) Drilling the turtle carapace for attachment of acoustic tags.

20) Insertion of a stomach pill transmitter into turtle's esophagus.

21) Non-invasive imaging techniques including X-rays, CT, MRI, and ultrasound.

22) Acoustic research studies including AEPs during tank trials, and ADDs during tank trials and trials in the wild that introduce man-made sounds into the environment.

The following potential stressors associated with activities authorized under the Program could pose a risk to ESA-listed non-target species (i.e., Atlantic salmon, smalltooth sawfish, Atlantic sturgeon, shortnose sturgeon, green sturgeon, Gulf sturgeon, Nassau grouper, and scalloped hammerhead) are:

1) Interactions between research vessels and non-target fish species including effects of vessel sounds, physical presence, and potential vessel/propeller strikes

2) Incidental capture of non-target species in entanglement (or gill) nets, pound nets, seine nets, or trawl nets

3) Incidental recapture of non-target species in any of the capture methods above

## 8.2 Mitigation to Minimize or Avoid Exposure

As a condition of their permit, researchers will be required to follow specific protocols to avoid, minimize, and mitigate the unintended detrimental effects that may result from research activities such as capture, handling, or performing various invasive procedures. Specific permit conditions to mitigate adverse effects on both target and non-target ESA-listed species are described for each research activity in Section 3.4 above, with more details provided in Appendix C. In addition to standard protocols, a permit condition will require each researcher to consider additional precautionary measures that can be taken to further minimize impacts on individual sea turtles.

Mitigation to minimize or avoid exposure of ESA-listed species to adverse effects is a core principle of the Permits Division's mission to "protect and conserve marine mammals and threatened and endangered species by providing special exceptions for take, import, and export that maximize recovery value and minimize individual and cumulative impacts as directed under ESA section 10(a)(1)(A) and its regulations" (NMFS 2017a). Specific mitigation criteria the Permits Division considers when issuing permits include: (1) whether alternative non-endangered species or population stocks can and should be used, (2) how the research is not unnecessarily duplicative of other work, (3) how the applicant will coordinate activities with other Permit Holders; and (4) how the applicant will minimize impacts of the activities, in particular to avoid or minimize mortality.

In addition to the minimization and avoidance measures in the research permit or specified as a condition of the permit, the Permits Division has proposed an adaptive management approach that will continuously update and improve the mitigation measures. The mitigation measures included in sea turtle research permits authorized under the program can be modified by the Permits Division at any time based on investigation into a researcher reported incident of take, new information regarding potential impacts of authorized activities, or demonstrated improvements to the standard protocols for turtle research.

### 8.2.1 Acoustic Research

Appendix G details the mitigation measures that will be included in permits authorizing acoustic based research in the lab and in the wild based on the capture gear used (for work in the wild) and the acoustic characteristics of the sound source. Sound source limits are based on 1) the parameters of the sound source requested, 2) recommendations from experts on sea turtle hearing, and 3) the best available science on sea turtle hearing and impacts of sound to sea turtles and other protected species.

#### Tank-based Studies

Some mitigation measures for tank-based research are identified in the above description of those trials (Section 3.4.4.8 *Acoustic Research*). These include the limit of trial durations and the use of sedation, inherent in the study design. Tank-based studies on sea turtles to date have tested

ADDs just over 150 dB re: 1μPa at 1m (RMS source level). The Permits Division would not allow any single ADD unit to exceed 150 dB re: 1 μPa at 1m (RMS source level) as an upper limit. The sound source level limit could be lower than 150 dB in individual permits based on the nature of the request by limiting the source level to that requested. Limiting sounds of individual ADDs to no greater than 150 dB re: 1μPa at 1m (RMS source level) will provide researchers room to broaden testing to advance our understanding of sea turtle hearing and behavioral responses to sound beyond what we know. It also allows for a minimal cumulative sound level increase where the isopleths of two neighboring units emitting 140 dB re: 1μPa at 1m sounds (RMS source level) could slightly overlap in coverage (e.g., resulting in a potential maximum source level of 143 dB re: 1μPa at 1m). We expect that these limits will effectively avoid or minimize impacts to marine mammals based on the best available information on their hearing and NMFS' guidance on assessing the effect of anthropogenic sound on for marine mammal hearing (NMFS 2016f).

**ADDs in the wild**

The duration of ADD exposure in the wild is inherently limited by the battery life of the unit. When ADDs are deployed on pound nets, the nets would be checked more frequently than every 24 hours to replace batteries in the ADDs (current battery life lasts 8 to 10 hours). When used on tangle nets, ADDs could last for the duration of the set because researchers would be present and able to replace batteries in units as needed. Therefore, we anticipate that ADDs could operate for up to 24 hours for pound nets and 12 hours for tangle nets. Authorization of ADDs in the wild would be contingent upon:

1) The parameters of the ADD sounds (duty cycle, sound level, and frequency) have been tested on sea turtles in a tank-based study (e.g., AEP or behavioral tests) conducted in a facility or other acoustic studies conducted in the wild;
2) The results of such acoustic trials indicate that animals have not been seriously injured or killed; and
3) Independent review by a bioacoustic expert who is not affiliated with the project. This review is in addition to any other expert reviews required when processing sea turtle permit requests as previously described for our program.

Permit Holders are required to monitor and maintain capture nets in the wild according to the standard permit mitigation measures previously provided for this consultation. Briefly, pound nets must be checked every 24 hours and tangle nets must be continuously monitored with manual net checks every 20 to 30 minutes. In addition, as described above, each permit would include standard mitigation for the use of ADDs on capture gear to minimize impacts to target and non-target species.

## 8.3 Sea Turtle Exposure to Stressors

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 annual number of sea turtle takes requested by researchers, authorized by the Permits Division, and actually conducted is expected to fluctuate somewhat over the course of the Program. Requested takes may vary due to changes in researcher objectives or available funding sources. Authorized takes may vary due to changes in requested take levels, sea turtle population sizes, trends or health, or other factors affecting maximum mortality limit levels. Actual takes may also vary due to changes in authorized take levels, distribution and abundance of sea turtles, and effectiveness of capture gear. Authorized take numbers for 'survey-only' methods (Section 3.5) are expected to significantly decrease because of NMFS' new internal policy defining 'harass' under the ESA (NMFS 2016c). Thus, a significant portion of the takes authorized for stand-alone surveys should no longer be needed. Future authorized take numbers are expected to be more in line with the annual reported take data for surveys that occur in conjunction with vessel-based captures or research procedures. Despite the unpredictable nature of sea turtle directed research total take numbers, the proposed lethal take limits establish program-wide limits on the number of sea turtles that may be killed during research activities.

Data from the past ten years of sea turtle research (June 2007 to May 2017) represent the best available information regarding the exposure of sea turtles to activities authorized as part of the Program (Table 22). However, we recognize that these numbers are subject to change in the future.

**Table 22. Total authorized takes of sea turtles by capture method in permits from June 2007 to May 2017.**

| Species | Sea Turtle Capture Method | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Hand or Dip | Tangle | Seine | Cast | Pound | Trawl | Breakaway Hoop | Encircle Strike |
| Green | 14,509 | 11,672 | 1,890 | 4,180 | 1,480 | 1,227 | 2,285 | 1,210 |
| Hawksbill | 6,250 | 2,126 | 215 | 2,465 | 215 | 185 | 1,115 | 95 |
| Kemp's ridley | 4,590 | 4,034 | 1,400 | 2,475 | 1,400 | 1519 | 2,005 | 1,680 |
| Leatherback | 1,255 | 174 | 150 | 575 | 150 | 84 | 885 | 130 |
| Loggerhead | 10,663 | 5,337 | 3,076 | 5,350 | 3,020 | 3,933 | 4,250 | 1,030 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Olive ridley | 1,936 | 146 | 106 | 100 | 50 | 15 | 100 | 0 |
| Unidentified | 213 | 136 | 136 | 211 | 136 | 36 | 213 | 2 |

The number of animals that may be taken non-lethally in the Permit Division's program as a whole will be unlimited. However, the Permits Division expects the number of applicants to remain at current levels for the foreseeable future (NMFS 2017a). Thus, they do not expect the overall magnitude of cumulative authorized take numbers for sea turtles in the Program to increase significantly. Modest growth in reported takes annually for each capture method is estimated at approximately ten percent (NMFS 2017a), with the exception of trawling captures which are expected to increase by approximately 25 percent (Amy Hapeman, NMFS OPR, pers. comm. to Maureen Trnka, NMFS OPR, November 21, 2017) (Table 23).

In order to insure that the proposed action is not likely to jeopardize any of these species, we analyze the impacts to the species as if 100 percent of the average authorized sea turtle capture takes over the last ten years will occur each year into the foreseeable future.

**Table 23. Number of sea turtle exposures by capture type projected over the next ten years based on previously authorized takes and future growth estimates for each method.**

| **Species** | **Sea Turtle Capture Method** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Hand or Dip (+10%) | Tangle (+10%) | Seine (+10%) | Cast (+10%) | Pound (+10%) | Trawl (+25%) | Breakaway Hoop (+10%) | Encircle Strike (+10%) | TOTAL (10 years) |
| Green | 15,960 | 12,839 | 2,079 | 4,598 | 1,628 | 1,534 | 2,514 | 1,331 | **42,482** |
| Hawksbill | 6,875 | 2,339 | 237 | 2,712 | 237 | 231 | 1,227 | 105 | **13,960** |
| Kemp's ridley | 5,049 | 4,437 | 1,540 | 2,723 | 1,540 | 1,899 | 2,206 | 1,848 | **21,241** |
| Leatherback | 1,381 | 191 | 165 | 633 | 165 | 105 | 974 | 143 | **3,756** |
| Loggerhead | 11,729 | 5,871 | 3,384 | 5,885 | 3,322 | 4,916 | 4,675 | 1,133 | **40,915** |
| Olive ridley | 2,130 | 161 | 117 | 110 | 55 | 19 | 110 | 0 | **2,701** |
| Unidentified | 234 | 150 | 150 | 232 | 150 | 45 | 234 | 2 | **1,197** |
| **TOTAL (10 years)** | **43,358** | **25,988** | **7,670** | **16,892** | **7,096** | **8,749** | **11,938** | **4,562** | |

Based on past research and sea turtle takes, most research authorized under the Program will be for the take of juveniles, subadults and/or adults often in some grouped combination (e.g., subadult and adults). Sea turtle takes are usually authorized in nearshore waters (i.e., neritic zone). Very few permits authorize takes specifically for post-hatchlings as only a few researchers have objectives or study designs specific to this life stage. In most cases where researchers have requested takes for posthatchlings, these takes are authorized in combination with other life stages because sampling of this life stage is opportunistic and/or the capture gear is non-selective. In almost all cases, takes are authorized for males and females combined; it is rare that a researcher has an objective that is gender-specific.

Additionally, we cannot predict the number of research procedures that will be performed on individual turtles. In general, most turtles captured are typically subjected to a basic suite of procedures including morphometrics (e.g., weight, measurements), identification marking (e.g., flipper tag, PIT tag), marking (e.g., carapace painting, shell etching), and sampling (e.g., blood, tissue, fecal, urine). Some turtles will be subjected to additional procedures such as transmitter attachment(s), gastric lavage, laparoscopy, internal tissue sampling, and non-invasive imaging. In order to insure that the action is not likely to jeopardize listed sea turtles, we base our analysis on the estimated number of sea turtles captured (Table 23), with the assumption that all captured turtles could be exposed to any research procedures that are a part of the Program.

Although the Program would not establish limits on sub-lethal takes from capture or research procedures, by proxy sea turtle captures are limited in effect by the lethal take limits. That is, if a ten-year lethal take limit is reached for a particular species (or DPS) and ocean basin, no more captures (and therefore no more procedures) would be authorized within that ten-year period for that species (or DPS) and ocean basin. To reduce the likelihood of this occurring, the Permits Division will closely monitor and manage lethal take limits, conservatively authorizing lethal take within individual permits, and retaining some lethal take as “reserve” for unexpected events that may result in higher levels of mortality than anticipated. Any mortality that is caused by a research activity will be reported promptly due to permit terms and conditions. Further, the circumstances that lead to the death of the turtle, will be assessed and reviewed under the adaptive management process, which could lead to changes in the research techniques or activities conducted in the future. In addition, consistent with its obligations under the ESA, the Permits Division will effectively limit captures and procedures to only those it determines are necessary to achieve the objectives of research that will aid in the recovery of ESA-listed species.

## 8.4 Sea Turtle Responses to Stressors

The potential and likely responses of sea turtles exposed to stressors associated with the research activities is summarized below consistent with the stressors previously identified (Section 8.1).

### 8.4.1 Research Vessel Interactions

Interactions between research vessels and sea turtles create stressors of vessel presence, sounds, and potential vessel/propeller strikes. Research vessels will be used to observe, track, and pursue turtles for capture. They will also serve as platforms to deploy various equipment such as AUS, ROV, autonomous underwater vehicles, or acoustic monitoring devises.

The mere presence of research vessels is not known to disturb sea turtles. Boats routinely approach sea turtles in the wild with turtle exhibiting little to no behavior response. Sounds created by the vessel are also not known to elicit a strong behavioral response from sea turtles. The combination of vessel presence (turtle visually noticing the vessel) and the sounds produced by the vessel may create a minor behavioral response of swimming or diving away from the vessel. Such behavior is within the normal repertoire of sea turtle behavior. Vessels deploying equipment to capture or monitor sea turtles generally operate at low speeds (two to seven knots) when near sea turtles.

The reporting of striking of a sea turtle by a permitted researcher has always been a requirement of research permits. Throughout the history of the Permits Division, no reports of a vessel striking a sea turtle have been submitted. Researchers engaging in the hand capture of sea turtles would use vessels to closely approach turtles. Purposeful close approach to sea turtles to hand capture it may increase the risk of striking a turtle. Researchers would use highly skilled vessel operators that can safely position the vessel near the target individual, only near enough for a researcher to jump near the target sea turtle. Risk of vessel strike is not an issue for cast or dip netting because vessels will be stopped or moving very slowly when sea turtles are captured. Because, no permit holders have reported a vessel strike of a sea turtle in the history of the Permit Division's program we believe there is very low risk of vessel-strike to sea turtles. We do not expect vessel strikes to occur while encirclement netting is conducted as the vessel is making a wide circle around the animal rather than directly approaching it in close proximity.

In summary we expect the responses, if any, of sea turtles to research vessels to be minor behavioral responses in the form of swimming away from the vessel or diving below the water surface.

### 8.4.2 Surveys by Manned and Unmanned Aircraft

Aerial surveys using manned aircraft create stressors of aircraft presence and sound. Sea turtles may or may not respond to the presence of a manned aircraft, depending upon the altitude of and proximity of the aircraft to the turtle. Studies of the reaction of sea turtles to aerial surveys are not available in the literature. This may be because scientists and researchers have generally not considered aerial surveys to pose a substantial threat to sea turtles. Although little data exist for sea turtle research, manned aerial surveys have been conducted on marine mammals by several researchers (e.g., (Acevedo-Whitehouse et al. 2010; Durban et al. 2015; Goebel et al. 2015; Hodgson et al. 2013)). Marine mammals show either no reaction to the aircraft, or minor short-term evasive behaviors such as swimming away or diving.

In decades of aerial surveys by the NMFS Southwest Fisheries Science Center, researchers have very rarely observed behavior indicative of a startle or evasive response (e.g., change in travel direction or surfacing behavior) by turtles when flying overhead at 650 feet in altitude in Partenavia and Twin Otter aircraft; these two aircraft types are among the quietest available for marine wildlife surveys. Other sea turtle researchers have reported minor swimming or diving responses to aerial surveys.

Unmanned aircraft (i.e., UAS) are a technological advance of already permitted and analyzed aerial surveys using manned aircraft. Since UASs are smaller and quieter than manned aircraft, they are expected to result in similar or less startle and evasive responses in the sea turtles than manned aircraft. In general, UAS platforms elicit fewer, if any, behavioral responses compared to manned aircraft or vessel approaches on targeted marine mammal species (Smith et al. 2016). The NMFS Southwest Fisheries Science Center used UAS over killer whales and found that at thirty feet, there were no behavioral reactions to UAS. The use of UAS was permitted in 2008 over humpback whales in Alaska, and no observed reactions were noted in the permit annual report (see Table 1 in (Smith et al. 2016). Because researchers are just starting to employ UAS for sea turtle research, the Permits Division is gathering information on behavioral responses of sea turtles to their operation to validate that assumption. To date, the information provided by researchers suggests that even minor behavioral responses rare when UAS are operated for momentary observation of sea turtles.

Sea turtles may exhibit temporary startle and evasive such as swimming and diving behaviors in response to manned or unmanned aircraft. Swimming and diving are normal and routine sea turtle behaviors that may be associated with stressor avoidance, foraging, or migration. In addition, researchers would be required as a condition of a permit to document any behavioral responses to inform management decisions on the continued and future use of UAS.

### 8.4.3 Underwater Tracking by Remotely Operated and Autonomous Vehicles

The tracking of sea turtles using ROV or autonomous underwater vehicles is new technology developed within the last decade. This type of research is expected to continue and increase because it allows researchers to collect behavioral and biological data, and in some cases, alleviates the necessity to attach instruments to target animals. We expect that sea turtles would have little to no response to underwater tracking by ROV and AUV units. The target animals may not even be aware of the vehicle's presence. Animals that are aware of its presence may have varied behavioral responses ranging from approaching the unit for investigation to a startle response or evasive behaviors, moving away from the vehicle (Smolowitz et al. 2015). Smolowitz et al. (2015) documented a suite of intra-and inter-specific behaviors by sea turtles indicating that the presence of the ROV did not appear to substantially disrupt the species' behavior. Likewise, Patel et al. (2016) noted that any response to the ROV were seen only 7.3 percent of the time. When turtles did react, responses were brief and included circling the ROV, or rubbing, biting or head butting the vehicle. Animals are expected to resume their prior behaviors and recover from any incurred stress as soon as the encounter ends.

The tethers on ROVs are thick and somewhat rigid, such that we do not believe they pose a substantive risk of entanglement to the target animals or to other marine life. Smolowitz et al. (2015) reported no entanglements in encounters with 70 loggerhead sea turtles using a 250 meter tether. Patel et al. (2016) noted a couple cases in which the tether became briefly hooked around a flipper of a sea turtle from which the animal quickly swam out.

Sea turtles may exhibit temporary startle and evasive such as swimming away from an ROV or autonomous underwater vehicle. They may also approach an underwater vehicle to investigate, bump, or rub it.

### 8.4.4 Acoustic Surveys and Sonar Transducers

Multibeam, side-scan, and imaging sonars (e.g., DIDSON) are acoustic devices used to detect sea turtles. High-frequency sound pulses (120 kHz to 1.8 MHz) are transmitted by the sonar transducers and reflect off the seafloor and objects in the water column, producing real-time acoustic backscatter images of bottom topography and location of sea turtles in the study area. When testing the effectiveness of a particular type of acoustic gear for detecting and/or imaging sea turtles, turtles may be followed at a distance once they are detected, to keep them within the acoustic beam. The duration of this type of directed acoustic effort will not exceed five to ten minutes.

All of the acoustic survey methods are remote activities that involve no more than brief encounters with the target sea turtles. Sea turtles may exhibit temporary startle and evasive such as swimming and diving behaviors in response to acoustic devices similar to behaviors that may be associated with stressor avoidance, foraging, or migration.

### 8.4.5 Capture

Capture of sea turtles by hand, dip net, cast net, breakaway hoop, encircle net, entanglement net, pound net, seine net and trawl net is a stressor that may involve the brief pursuit/following of animals by the research vessel. Capture may be selective for an identified individual or non-selective as is the case with pound, seine or trawl nets. Some nets are continuously monitored with others are not. Potential responses to capture are rapid swimming, diving, biting, and other attempts to escape, and physiological stress.

We have previously noted that swimming and diving are routine and normal behaviors that are associated with predator avoidance, feeding, and migration. Biting and other aggressive behaviors or a prolonged increase in swimming effort in attempts to evade capture are expected in some turtles. This behavior may last several seconds to several minutes until individuals escape or are captured. Capture can cause stress responses in sea turtles (Gregory 1994; Gregory and Schmid 2001; Hoopes et al. 1998; Jessop et al. 2003; Jessop et al. 2004; Thomson and Heithaus 2014). The physiological response of releasing stress hormones has been documented by multiple researchers (Gregory et al. 1996; Gregory and Schmid 2001; Harms et al. 2003; Hoopes et al. 2000; Stabenau et al. 1991). This stress is similar to the stress of evading a predator and may incur a metabolic cost of energy expected during evasive behavior as well as forgone foraging opportunities.

The Program's mitigation measures are designed to minimize the stress of capture on sea turtles. Because many of the effects of capture are similar across methods, discussion of effects are grouped here for efficiency.

#### *8.4.5.1 Selective Capture Methods: Hand Capture, Dip Net, Cast Net, Breakaway Hoop, and Encircle Net*

Capture by hand, and with cast, breakaway hoop, dip and encircle nets pose low risk to the target sea turtles because researchers are able to immediately remove captured individuals from the water and eliminate the possibility of drowning or other injury. Hoop netting has been used successfully by researchers to catch pinnipeds and small cetaceans (Asper 1975). This method has been adapted for turtles by researchers at Dalhousie University and has been employed successfully on Atlantic leatherbacks in a study by researchers from the National Aquarium in Baltimore as well as by NMFS science center staff to capture loggerhead, green, olive ridley, and leatherback sea turtles in the Eastern Tropical Pacific. These capture methods are considered simple and non-invasive but may result in raised levels of stressor hormones.

Although individuals will be rapidly removed from these net types, responses associated with subsequent stressors will continue. For example, handling has been shown to result in progressive changes in blood chemistry indicative of a continued stress response (Gregory and Schmid 2001; Hoopes et al. 2000). Studies conducted to assess the effects of direct capture on Atlantic leatherback turtles indicated relatively stable physiologic status and mild adrenocortical stress response associated with one-hour capture duration, and supported the general safety of direct capture in this species (Innis et al. 2010). Further, given that captures for leatherbacks will be performed with a veterinarian on-board vessels to continuously monitor the turtle and respond, if necessary, according to established veterinarian approved protocols, the risk of serious injury or mortality from hoop net capture is not expected for this species. There is a minimal risk of vessel-strike to sea turtles with the method of hand capture, and little to no risk for cast nets, dip nets, and encirclement netting as discussed in the Research Vessel Interaction Section (8.4.1).

The NMFS Pacific Islands Fisheries Science Center Marine Turtle Research Program captures ESA-listed sea turtles (green, hawksbill, loggerhead, leatherback and olive ridley) using various methods including scoop nets, tangle nets, pens, and by hand. Based on strandings data from the NMFS Pacific Islands Marine Turtle Research Program, none of the dead stranded 135 turtles (combined species) that were previously tagged and released turtles (from 1982 through February 2006) by the program had died as a result of research related stressors (NMFS 2006c). NMFS does not expect that individual turtles would experience more than short-term stress and temporary physiological changes during these type of captures. No injury or mortality would be expected from these capture methods when following the Permit Division's standard mitigation measures. Potential impacts from repeated capture of an individual sea turtle in a short period of time during research is not expected. Such impacts can be minimized by temporarily marking the carapace to avoid unintentional recaptures within the same field season. If recapture occurs, most animals will have sufficient time to recover from the stress of capture before recapture is likely to occur days later.

#### *8.4.5.2 Non-Selective Capture Methods: Entanglement Net, Pound Net, Seine Net, and Trawl*

Sea turtles that are forcibly submerged undergo respiratory and metabolic stress that can lead to severe disturbance of their acid-base balance. While most voluntary dives by sea turtles appear to be aerobic, showing little if any increases in blood lactate and only minor changes in acid-base status (pH level of the blood) (Lutz and Bentley 1985), sea turtles that are stressed as a result of being forcibly submerged through entanglement consume oxygen stores, triggering an activation of anaerobic glycolysis, and subsequently disturbing their acid-base balance, sometimes to lethal levels. It is likely that the rapidity and extent of the physiological changes that occur during forced submergence are functions of the intensity of struggling as well as the length of submergence (Lutcavage and Lutz 1997). Other factors to consider in the effects of forced submergence include the size of the turtle, ambient water temperature, and multiple submergences. Larger sea turtles are capable of longer voluntary dives than small turtles, so juveniles may be more vulnerable to the stress due to handling. During the warmer months, routine metabolic rates are higher, so the impacts of the stress may be magnified. With each forced submergence, lactate levels increase and require a long (even as much as 20 hours) time to recover to normal levels. Turtles are probably more susceptible to lethal metabolic acidosis if they experience multiple captures in a short period of time, because they would not have had time to process lactic acid loads (Lutcavage and Lutz 1997).

**Entaglement Net**

Entanglement nets are a type of passive, stationary fishing gear that incidentally captures turtles. Sea turtles readily enter this net and usually are able to come to the surface to breathe. Thus, they are minimally stressed within the confines of the net. However, turtles may attempt to swim vigorously, attempting to elude capture. Turtles will become entangled in the webbing of the net itself, which results in constriction marks around their head and flippers and may lead to their death due to forced submergence and traumatic injury. Forced submergence from entanglement in or impingement on net gear is likely comparable to forced submergence in other kinds of fishing gear, given that both instances involve sea turtles unable to reach the surface in a relatively stressful situation. Sea turtles forcibly submerged in any type of restrictive gear eventually suffer fatal consequences from prolonged anoxia and/or seawater infiltration of the lung (Lutcavage and Lutz 1997). Types of injuries sustained during net capture include abrasions and injury from other taxa caught in nets (e.g., stingrays, sharks). Leatherback sea turtles may be more vulnerable to injury than other species because of their delicate skin and bone structure (Ryder et al. 2006). Sea turtles may also experience damage to appendages if the entanglement is prolonged and compromises blood flow.

Capture could result in restricted access to air, intense struggling, and physiologic injuries such as induction of a systemic stress response, hypoxia, or various other changes in blood chemistry (Gregory et al. 1996, Jessop et al. 2004). Because sea turtles rely on anaerobic metabolism during periods of activity, struggles to escape nets would likely result in the build-up of lactate, metabolic acidosis, and changes in ion concentrations in sea turtles' blood that could have deleterious effects on normal physiological function (Gregory and Schmid 2001; Harms et al. 2003; Hoopes et al. 2000; Stabenau et al. 1991; Stabenau and Vietti 2003).

Hoopes et al. (2000) noted that blood lactate levels of turtles caught by entanglement nets were only slightly elevated over captive reared animals compared to lactate concentrations in trawl caught turtles as reported by others. While it appears that captures have the potential to result in temporary changes in blood chemistry of sea turtles, it also appears that animals quickly returned to the marine environment after removal from the gear can recover from the short-term stress of capture (Hoopes et al. 2000). Hoopes et al. (2000) concluded that entanglement netting is an appropriate "low stress" method for researchers working on turtles in shallow, coastal areas.

The rapidity and extent of the physiological changes that occur during forced submergence likely are functions of the intensity of struggling as well as the duration of submergence (Lutcavage and Lutz 1997). Additional factors that may influence the intensity of effects resulting from capture include the size or species of the turtle, location in the net, ambient water temperature, and multiple submergences. Larger sea turtles are capable of longer voluntary dives than small turtles, so juveniles may be more vulnerable to entanglement stress. Larger turtles have a larger lung capacity than smaller turtles and, the bigger the turtle, the greater chance it has of reaching the surface after being entangled. During warmer months, routine metabolic rates are higher, so the impacts of the stress due to entanglement may be magnified at that time.

While capture in non-research entanglement nets has been shown to result in injuries, such injuries are not anticipated as a result of the Permit Division's permitted research due to standard mitigation measures that researchers would be required to follow. In particular, researchers would be required to continuously monitor and physical check entanglement nets, thus allowing them to respond quickly to remove captured turtles from the net and safely bring aboard the research vessel. Entanglement time, depth of entanglement, and severity of entanglement may have an effect on the health status of turtles upon release from the net and effect probability of post-release survival (Snoddy et al. 2009). Prolonged anaerobiosis due to entanglement in fishing gear or restraint may leave sea turtles exhausted and vulnerable to other threats upon release from gear (Snoddy et al. 2009). Sea turtles subjected to forced submergence may require an extended period of time at the surface to rest, recover, and repay oxygen debt (Stabenau and Vietti 2003). Holding the animals on deck while conducting research procedures provides animals time to recover from the capture event. For this reason, we expect most animals to recover from the physiological effects of capture. Entanglement nets have been successfully and safely employed by the NMFS Southwest Fisheries Science Center permitted researchers to sample green turtles in San Diego Bay, California since the early 1990s and in the San Gabriel River/Los Alamitos Bay/Seal Beach National Wildlife Refuge since 2010.

**Pound Net**

If a sea turtle cannot breathe properly or cannot reach the surface for air, the turtle can drown as a result of forced submergence (Sasso and Epperly 2006). Pound nets are a passive, stationary fishing gear that enclose animals in a pen, usually allowing them to surface and breathe until the turtles are removed from the pound. Forced submergence from entanglement in or impingement on pound net gear is comparable to forced submergence in other kinds of fishing gear, given that both instances involve sea turtles unable to reach the surface in a relatively stressful situation. Rarely, turtles are entangled in the webbing of the pound net itself, the tunnel, heart, or the lead which results in constriction marks around their head and flippers. This may lead to their death due to forced submergence, as occurred in three cases reported by the NMFS Southeast Fisheries Science Center for Permit No. 16733. As a result, in June 2017, the Permit's Division revised mitigation requirements for pound nets by reducing the allowable stretched mesh size to one and three quarters inches to prevent future entanglements. Since this change, we expect future pound net captures to have a very low potential for mortality.

**Seine Net and Trawl**

Trawls pose a greater risk of impacts from forced submergence to sea turtles than the other authorized capture gears. A study examining the relationship between tow time and sea turtle mortality showed that mortality was strongly dependent on trawling duration, with no mortality or serious injury in tows of 50 minutes or less, but increasing rapidly to 70 percent mortality after 90 minutes (Epperly et al. 2002; Henwood and Stuntz 1987). In line with this data (the best information available at the time), the Permit's Division previously allowed tow times for up to 50 minutes. NMFS researchers updated and reanalyzed the association between tow times and sea turtle deaths (Epperly et al. 2002; Sasso and Epperly 2006). Seasonal differences in the likelihood of mortality for sea turtles caught in trawl gear were apparent. For example, the observed mortality exceeded one percent after ten minutes of towing in the winter (defined by the authors as December through February), while the observed mortality did not exceed one until after 50 minutes in the summer (March through November) (Sasso and Epperly 2006). Intermediate tow times (10 to 200 minutes in summer and 10 to 150 minutes in winter) result in a rapid escalation of mortality, and eventually reach a plateau of high mortality, but will not equal 100 percent, as a sea turtle caught within the last hour of a long tow will likely survive (Epperly et al. 2002; Sasso and Epperly 2006). In both seasons, a rapid escalation in the mortality rate did not occur until after 50 minutes (Sasso and Epperly 2006) as had been found by Henwood and Stuntz (1987).

Though rare, mortality has been observed in summer trawl tows as short as 15 minutes (Sasso and Epperly 2006). Serious injury and mortality, when it occurs, is likely due to acid-base imbalances resulting from accumulation of carbon dioxide and lactate in the bloodstream (Lutcavage and Lutz 1997); this imbalance can become apparent in captured, submerged sea turtles after a few minutes (Stabenau et al. 1991). Although extremely rare, sea turtles entangled in nets exhibiting lethargy can die even with professional supportive care, possibly due to severe exertion resulting in muscle damage (Phillips et al. 2015). Fahlman et al. (2017) correlate trawl gear depth with the risk of developing gas embolisms and their severity in loggerhead sea turtles. Though trawl captures for research would not be deployed for the durations and at the depths typically used in commercial fisheries, we recognize there is risk of gas embolism and decompression sickness in sea turtles captured in trawls. Even at trawl depths of up to 20 meters, moderate to severe gas embolisms that go untreated could result in death (Fahlman et al. 2017). For this reason, trawls may pose an added risk of delayed mortality after the capture event that goes unseen and undocumented. Most animals are expected to have a very low likelihood of delayed mortality; most animals that are captured are observed to be in good physical condition, consistent with Category 1 of NMFS' post-interaction mortality guidance (NMFS 2017c).

To minimize the risk of mortality, the Permits Division has set forth requirements of the permit: trawl tows and seine pulls must be limited to 30 minutes bottom time and trawl tow depths no deeper than 20 meters. In July 2017, a permit holder (Permit No. 19621) reported the death of an emaciated loggerhead while in transit to a rehabilitation facility after capture by trawl. This was a rare event. In most cases, we do not expect observed mortalities because captured sea turtles have time to recover from the stress of capture during holding for examination prior to release. This holding time should help minimize risks from the accumulation of other stressors that can cumulatively impair physiological function or result in sublethal or delayed effects that cannot be observed upon capture. In addition, veterinary assistance would be sought for any comatose, injured or compromised animals as a requirement of the permit. Researchers must also try to resuscitate any comatose animals.

Five comatose turtles were reported during research trawling activities conducted under a section 10(a)(1)(A) permit (Permit No. 1245) from 2000 to 2003. The trawl tow times that resulted in the capture of comatose turtles were 30 minutes, the maximum tow time authorized under sea turtle research permits. Four of these turtles were intubated successfully and returned to the wild in good condition. The fifth turtle, a loggerhead, exhibited limited movement after capture and became very lethargic (Stender 2001). The individual was intubated, which resulted in the disabled turtle moving around the deck. Alternating periods of activity and lethargy occurred repeatedly. At one point, the turtle was so active that it was tagged in anticipation of release, but again showed signs of problems. The turtle was returned to the lab for observation, blood samples were taken, and the turtle was kept in a covered, outdoor tank with a minimal amount of water for observation overnight. By 9:00 am the next day, the turtle had died. A necropsy showed that the turtle was healthy in all respects except that water had caused the anterior lobes of the lungs to swell and cease to function properly. There have been no other reports of comatose sea turtles as a result of research trawl capture since 2003.

Satellite tracking data is available in published studies on sea turtles released after research trawling (Arendt et al. 2012a; Arendt et al. 2012b; Arendt et al. 2012c). Satellite tagged turtles caught by trawl in these studies all behaved normally, including normal dive patterns, migrations and movements between foraging and breeding grounds, following release. Transmitters remained attached from 7 days to over 400 days, with most having transmissions and tracks for at least several months. One study trawl captured 34 juvenile loggerhead sea turtles between May 2004 and August 2007 with tow bottom times ranging from 9 to 21 minutes (Arendt et al. 2012c). In another study, 29 adult male loggerheads were captured by trawling from April 2006 through April 2007 with a tow bottom time of 15 minutes (Arendt et al. 2012b). There were no apparent injuries or health risks to any trawl captured turtles in these studies.

#### *8.4.5.3 Summary of Sea Turtle Response to Capture*

Sublethal effects that might have an impact on sea turtles are the turtle's ability to swim, forage, or migrate. These remain very difficult to quantify or monitor. For capture, to result in significant fitness consequences to live animals, we would have to assume that an individual turtle could not compensate for lost feeding opportunities by either immediately feeding at another location, by feeding shortly after release, or by feeding at a later time. There is no indication this is the case. Similarly, temporary disruptions of swim speed or direction are expected to be inconsequential because they can resume these behaviors almost immediately following release. Further, these sorts of behavioral disruptions may be similar to natural disruptions such as those resulting from predator avoidance, or fluctuations in oceanographic conditions. Therefore, in most cases, behavioral responses of sea turtles to capture in a net are unlikely to lead to fitness consequences, reduced reproductive success, or long-term implications for the population.

All capture methods are expected to result in some level of stress to the target animals and temporarily disrupt activities such as resting, foraging, and migration. However, these interruptions for individual turtles are relatively short-lived and any physiological effects are expected to be compensated by intrinsic homeostatic mechanisms. The harassment of turtles during capture can result in raised levels of stressor hormones and can cause some discomfort. Based on past observations of similar research, these effects are expected to dissipate within a day (Stabenau and Vietti 2003). A number of factors, such as size, species, water temperature, severity of entanglement, and others can intensify the effects resulting from capture. A small number of turtles may die as a direct result of forced submergence in the net. Such observed mortalities are expected to be uncommon as evidenced by historical reported take data. Trawls also have the potential to result in delayed mortality that cannot be observed. Additionally, these methods will not affect the physical or biological environment. No long-term, population level effect is expected from any capture method.

### 8.4.6 Recapture

Turtles could be captured more than once during a sampling day. Cumulative physiological stress can result from capture and handling of captured sea turtles. Recaptured animals that have not properly recovered from stressors associated with the previous capture have a higher risk of mortality. As a mitigation measure to minimize the risks associated with recapture, as a condition of the permit, turtles may be sampled no more than two times during the same permit year. With this mitigation measure in place, permit holders will have incentive to avoid recapturing the same sea turtles if it can be easily determined (through markings, tag number, etc.) that a sea turtle has already been sampled. Although recaptures may still occur, we anticipate they will be limited in number because of this permit condition. For recaptured turtles, researchers will still be required to adhere to the sampling protocols and mitigation measures for safe handling of sea turtles and ensure they are active and healthy prior to release. Recaptured turtles may need more time to achieve full recovery prior to release.

While the recapture of sea turtles in a given day may result in increased levels of stress responses, those responses are not likely to manifest into any long-term adverse effects, reduced fitness, or mortality. This conclusion can be reached as long as all of the sampling protocols, mitigation measures, and any other required conditions of the sturgeon research permit are followed by all permit holders.

### 8.4.7 Holding, Handling, and Transport

Capture and handling activities may markedly affect metabolic rate (St. Aubin and Geraci 1988), reproduction (Mahmoud and Licht 1997), and hormone levels (Gregory et al. 1996). Handling has been shown to result in progressive changes in blood chemistry indicative of a continued stress response (Gregory and Schmid 2001; Hoopes et al. 2000). The additional on-board holding time imposes an additional stressor on these already acidotic turtles (Hoopes et al. 2000). It has been suggested that the muscles used by sea turtles for swimming might also be used during lung ventilation (Butler et al. 1984). Thus, an increase in breathing effort in negatively buoyant animals may have heightened lactate production. Understanding the physiological effects of capture methodology is essential to conducting research on endangered sea turtles, since safe return to their natural habitat is required. However, literature pertaining to the physiological effects of capture on sea turtles is scarce. Turtles would be worked up as quickly as possible to minimize stresses resulting from their capture.

Animals obtained from other legal sources likely have experienced the same type of stress from capture as discussed above prior to research. In most cases, the Permit’s Division requires that animals must appear to be in good condition before they can be used for research. Researchers must forego research on animals that are injured, comatose or compromised. The exceptions to this requirement are rare cases when the Permit’s Division allows research on disentangled animals to collect much needed data on post-interaction survival in fishing gear as an identified management and conservation need to further recovery of the species. The decision to use a compromised sea turtle would be left to the discretion of the attending veterinarian, who upon assessment of each animal, determines whether the animal may undergo research procedures. Permit No. 15726 is such an example in which researchers may receive leatherbacks from the local disentanglement and stranding network once they are disentangled from pot gear at sea.

Healthy and compromised animals may receive research procedures including a direct tag attachment while under the direction of an attending veterinarian onboard. Evidence shows that the subsequent use of disentangled turtles for research has no apparent adverse effects, with disentangled sea turtles returning to typical migrations and behavior after release (Innis et al. 2010; López-Mendilaharsu et al. 2009). One instance has been documented of a very short duration of satellite tag transmission, which could indicate a mortality, or tag failure (Innis et al. 2010). More recently, Dr. Lutcavage's research has shown that holding compromised leatherback sea turtles for tagging aids the animal's ability to physiologically recovery from the stress of entanglement. Analysis of paired blood samples (post-capture and pre-release samples) from this study suggests that increased respiration during holding ameliorates observed acidosis in leatherbacks (Innis et al. 2014)

### 8.4.8 Morphometrics and Monitoring of Vital Parameters

Once sea turtles have been captured, individuals may be handled and exposed to various activities of greater or lesser degrees of invasiveness. Each sea turtle may 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.

Turtles should be handled in such a way as to avoid injury to the turtles themselves and to the researchers. Measuring 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.

The measuring 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.

We expect that the general monitoring of vital parameters of turtles would not elicit any long lasting discomfort or stress to the animals. Visually monitoring respiration would have no expected impact on sea turtles as it does not require contacting the animal. Ultrasound and heart rate monitoring procedures would involve handling and restraint, as well as imaging with a device emitting sound pulses well above the levels audible to sea turtles. Such monitoring will not have any more than short-term effects on sea turtles. Although a temperature probe could be mildly uncomfortable to the turtle, the probe would be sterile and no tissue surface would be pierced. We do not expect that the cloacal temperature recording would cause any significant additional stress or discomfort to the turtle beyond what was experienced during other research activities.

Bioelectrical Impediance Analysis (BIA) is expected to be fast, safe, and non-invasive. BIA has been used previously in other animals, including humans, and we believe that it can be used on sea turtles with no harmful effects. The amount of current in the body during testing is too small to be felt by a human. A review of this procedure can be found in "Body composition analysis of animals: A handbook of non-destructive methods" (Speakman 2001). Due to its non-invasive design, we do not expect the BIA testing to cause any additional stress or discomfort to the turtle beyond what was experienced during capture, collection of measurements, and tagging. Similarly, a pulse oximeter is a non-invasive method. It would not result in any additional stress to the animal and would provide beneficial information that could be used to manage stress and other effects of research activities on the animal.

### 8.4.9 Shell Marking

Marking the sea turtles for identification can include carapace painting, shell etching, and plastron marking. Researchers have temporarily marked turtle shells for over a decade with no visible effects to turtles when following the Permit Division's standard permit requirements. Temporary marks must be non-toxic. Previous permit holders have reported that temporary marks wore off of the shell within weeks and showed no evidence of any problems associated with it. NMFS believes that the turtle would feel the vibration of the etching tool but would not experience pain.

We do not expect that individual turtles would experience more than short-term stresses as a result of this activity. No injury is expected from this activity, and turtles will be marked as quickly as possible to minimize stress.

### 8.4.10 Oral and Ophthalmic Examination

The mouth, eyes, and vent may be examined for signs of injury, ingestion of hooks or marine debris (plastics, tar balls), and tumors. Ophthalmic exam procedures are considered invasive, but with minimal risk. When conducted by trained personnel, we do not expect the procedure to result in injury or harm. NMFS researchers have conducted oral measurements on more than 200 turtles with no detectable ill effects. The turtle may experience discomfort while its mouth is gagged for oral measurements, but no lasting negative effect is anticipated. Aseptic requirements are designed to minimize the risk of either introducing a new pathogen into a population or amplifying the rate of transmission from animal to animal of an endemic pathogen when handling animals. Given the precautions that would be taken by the researchers to ensure the safety of the turtles and the permit conditions relating to handling, NMFS expects that the activities would have minimal and insignificant effects on the animals.

### 8.4.11 Flipper and Passive Integrated Transponder Tagging

Flipper and PIT tagging involve the implantation of tags in or through skin and/or muscle of the flippers. The PIT tags remain internal while flipper tags have both internal and external components. For both, internal tag parts are expected to be biologically inert. In addition to the stress sea turtles are expected to experience by handling and restraint associated with inspection and tagging, we expect an additional stress response associated with the short-term pain experienced during tag implantation (Balazs 1999) although this will be reduced by a standard injection of an anesthetic. Internal PIT tags should be sterilized and the area of insertion should be disinfected. Turtles should be injected with a PIT tag into the shoulder muscle area of the right front flipper. If any bleeding occurs after the tag has been injected, researchers should hold a swab soaked in povidone iodine to the injection site until the bleeding has stopped.

We expect disinfection methods should mitigate infection risks from tagging. Wounds are expected to heal without infection. Researchers that have recaptured individuals report never seeing evidence of infection resulting from tagging. Tags are designed to be small, physiologically inert, and not hinder movement or cause chafing; we do not expect the tags themselves to negatively impact sea turtles (Balazs 1999). The proposed methods are standard worldwide and not widely known to result in decreased survival, reproduction, or prolonged health effects (Balazs 1999; NMFS SEFSC 2008; Stapleton and Eckert 2008). The proposed tagging methods have been regularly employed in sea turtle research with little lasting impact on the individuals tagged and handled (Balazs 1999).

These tagging activities are minimally invasive and all tag types have negative effects associated with them, especially concerning tag retention. Plastic tags can become brittle, break and fall off underwater, and titanium tags can bend during implantation and thus not close properly, leading to tag loss. Flipper tags occasionally come off turtle flippers, which may cause tissue ripping and subsequent trauma and infection risk. However, individuals who have lost flipper tags have not been observed to be in any different body condition than turtles lacking tags or those who retain their tags. Turtles that have lost external tags would be re-tagged if captured again later, which subjects them to additional effects of tagging. PIT tags have the advantage of being encased in glass, which makes them inert, and are positioned inside the turtle where loss or damage over time due to abrasion, breakage, corrosion or age is virtually non-existent (Balazs 1999; MacDonald and Dutton 1996). Currently available PIT tags are designed with a coating that promotes growth of muscle fibers to heal and hold the PIT tag in place when injected into muscle.

Turtles can experience some discomfort during the tagging procedures and these procedures will produce some level of pain. The discomfort is usually short and highly variable between individuals (Balazs 1999). Most barely seem to notice, while a few others exhibit a marked response. However, we expect the stresses to be minimal and short-term and that the small wound-site resulting from a tag applied to the flipper should heal completely in a short period of time. Similarly, turtles that must be re-tagged should also experience minimal short-term stress and heal completely in a short period of time. Re-tagging is not expected to appreciably affect these turtles. Given the precautions that would be taken by researchers to ensure the safety of the turtles and the permit conditions relating to handling and tagging and using aseptic techniques, we expect that the activities would have minimal and insignificant effects on the animals. We do not expect mortality or long-term adverse effects to the turtle due to attachment of the flipper tags or insertion of PIT tags.

#### 8.4.12 Oxytetracycline

Tetracycline injections are performed in many species to establish tracers in bone growth so that once the animal dies, post-mortem procedures can determine the individual's growth rate (Coles et al. 2001). In addition, this antibiotic likely has a short-term effect of boosting health by acting against many types of pathogenic bacteria, although a recent study showed significant bacterial resistance to oxytetracycline in sea turtles (Foti et al. 2009). A study of the pharmacokinetics of oxytetracycline in loggerhead sea turtles did not identify any negative effects (including lack of response at the injection site, food consumption, flipper movement, and activity) (Harms et al. 2004). However, a Kemp's ridley sea turtle responded with skin exfoliation and ventral erythema after repeated injection; both conditions disappeared after oxytetracycline was discontinued (Harms et al. 2004). The single low dose (10 to 15 milligrams/kilogram) and intravenous or intramuscular administration of several smaller volume injections (less than 10 milliliters/site) will reduce the risk of these adverse effects. Several animals that have been injected in recent years by the Southwest Fisheries Science Center have been recaptured. Each of the animals was in good condition and no ill effects from oxytetracycline injection were observed.

The results of these studies indicate that the dosage generally used to produce a tetracycline mark in the bones of sea turtles does not appear to harm either the animals injected or those in their immediate surroundings. Furthermore, although tetracycline injection can potentially result in bacterial resistance, it appears that wild individuals may already host tetracycline-resistant bacteria, suggesting a one-time injection of oxytetracycline would not cause the turtles harm in this respect.

#### 8.4.13 Biological Sampling

Biological sampling activities can result in raised levels of stressor hormones in sea turtles and would be in addition to any stresses or effects already experienced during capture. Sterile techniques should be utilized to minimize the possibility of infection at the biopsy sites. Biological sampling should not be performed on any compromised animals (e.g., those that are emaciated or having heavy parasite loads, bacterial infections, etc.).

##### *8.4.13.1 Epibiota Collection*

Removal of epibiota would not be expected to significantly affect the animal because epibiota can be removed in a relatively non-invasive manner. Although the turtle may experience short-term stress or discomfort, this stress would not be significant. Growth of barnacles, algae, and other marine life (epiphytes) on sea turtles is considered a negative factor for sea turtles, as this growth introduces additional mass and drag into the hydrodynamic performance of the individual sea turtle. Removal of these materials is expected to aid sea turtles by reducing their metabolic requirements for locomotion in water. Hence, we consider this activity beneficial to individual sea turtles. Therefore, we conclude that epibiota removal is not likely to adversely affect sea turtles.

#### *8.4.13.2 Swabs*

All forms of swabbing are minimally invasive or opportunistic. Any discomfort experienced by the turtle would be temporary and would not have any lasting effects. All the turtles sampled by the NMFS Southeast Fisheries Science Center Beaufort Laboratory exhibited normal behavior as they were released, and of those that have been recaptured, none have shown an adverse effect. We expect that the animal would experience discomfort but that the stress from these procedures would be insignificant and short-term. No injury is expected from these procedures.

#### *8.4.13.3 Skin Biopsy*

During skin biopsy, it is not expect that individual turtles will experience more than short-term stresses during tissue sampling (for genetic and stable isotope analyses). It is no expected that the collection of a tissue sample will cause any additional significant stress or discomfort to the turtle beyond what was experienced during the other research activities.

No adverse effects have been noted when tissue sampling animals in central California by the NMFS Southwest Fisheries Science Center (NMFS 2017a). Researchers who examined hard-shelled turtles re-captured two to three weeks after initial capture and sample collection noted that the sample collection site was almost completely healed (NMFS 2017a). Sampling sites on turtles re-captured in San Diego Bay after several months to years have completely healed and have shown no signs of infection. In areas such as San Diego Bay, California, and St. Croix, U.S. Virgin Islands, animals remain in the study area long term, indicating that sampling does not produce any adverse effects on their behavior (NMFS 2017a).

Sterile techniques will be utilized to minimize the possibility of infection at the biopsy site. All tissue biopsy samples would be collected, handled, stored, and shipped in such a manner as to ensure human safety from injury or zoonotic disease transmission as well as provide for the protection of the sea turtles that are sampled. Bjorndal et al. (2010) found that repeated skin sampling of the same individual loggerhead sea turtles did not alter growth, result in scarring, or impact other physiological or health parameters.

#### *8.4.13.4 Scute Scraping*

Scute scrapings would allow researchers to collect splinters of scute material in a non-invasive manner with little effect on the turtles. Keratin collected from the outermost edge of the marginal scutes is of sufficient thickness and texture to provide a sufficient sample mass while minimizing the risk of penetrating through the keratin layer. Whether via scrapings or a core, because the keratin layer has no nerve endings or blood vessels, sampling is not expected to result in discomfort or pain to the turtle and little to no bleeding. Researchers would avoid scraping too deeply and causing injury to the turtle; however, should a deep scrape occur, the result would be minor bleeding and minor discomfort to the turtle (less than what would be expected during a skin biopsy. Bjorndal et al. (2010) found that repeated scute sampling of the same individual loggerhead sea turtles did not alter growth, result in scarring, or impact other physiological or health parameters. Therefore, we do not expect that individual turtles would experience more than short-term stress from handling during this procedure.

#### *8.4.13.5 Blood Sampling*

Sea turtles are expected to experience a short-term stress response in association with the handling, restraint, and pain associated with blood sampling. Taking a blood sample from the sinuses in the dorsal side of the neck is a routine procedure (Owens 1999), although it requires knowledgeable and experienced staff to do correctly and requires the animal to be restrained (DiBello et al. 2010; Wallace and George 2007). According to Owens (1999), with practice, it is possible to obtain a blood sample 95 percent of the time, and the sample collection time should be about 30 seconds in duration. Blood sampling volume would be conditioned to only allow a conservative amount of blood (Section 3.4.4.4) to be drawn during each event. Blood hormones and heart rate have been measured in animals that have had this amount of blood drawn from them and no stress has been observed (NMFS 2017a).

No sea turtle mortalities have occurred during previous blood sampling activity from researchers, that we are aware of, nor are we aware of any meaningful pathological consequences by sampled individuals on the part of any researchers. Aseptic techniques would minimize the risk of infection and spread of pathogens. All blood samples would be collected, handled, stored, and shipped in such a manner as to ensure human safety from injury or zoonotic disease transmission as well as provide for the protection of the sea turtles that are sampled. Bjorndal et al. (2010) found that repeated blood sampling of the same individual loggerhead sea turtles did not alter growth, result in scarring, or impact other physiological or health parameters.

#### *8.4.13.6 Tear Collection*

Tear collection is not expected to result in any impact more than temporary discomfort to the animal. The method is minimally invasive. Therefore, we do not expect that individual turtles would experience more than short-term stress from handling during this procedure.

#### *8.4.13.7 Soft Tissue Biopsy*

Appropriate topical anesthesic will be employed to minimize any pain or discomfort associated with fat and larger tissue sampling of sea turtles. We do not expect that these methods will cause any additional stress or discomfort to the turtle beyond what was experienced during the capture, collection of measurements, and tagging.

The NMFS Southeast Fisheries Science Center discussed the safety of the fat sampling procedure for sea turtles with several veterinarians (Drs. Greg Lewbart, Andy Stamper, Craig Harms, and Elizabeth Chittick). All agreed that this procedure is simple, routine, and that risk to the turtles can be managed. The amount of tissue removed would be small and would not deplete the turtle's fat stores. According to Dr. Harms, small pieces of fat are often intentionally discarded during clinical surgeries to improve visualization of the underlying musculature. The superficial incision would not penetrate the body cavity, making it minimally invasive. The main risk of the procedure is secondary infection at the incision site. However, required sterile techniques would reduce this risk.

#### *8.4.13.8 Urine and Fecal collection*

Fecal samples will be collected either after turtles have defecated during biological sampling or by digital extraction of feces from the cloaca using a lubricated, gloved finger, or by fecal loops, swabs, or cloacal lavage. Those turtles that do not defecate during the sampling period would be temporarily overturned onto the carapace and restrained. While wearing lubricated latex gloves, a finger will be inserted into the cloaca of the turtle to feel for the presence of a fecal mass. The cloacal lavage is brief, lasting only minutes. No injury or lasting effects are expected from this procedure. Only sufficiently large turtles would be subject to digital extraction of feces. Urine sample collection will be collected on an opportunistic basis and is not expected to result in harm or injury of sea turtles. Researchers would not attempt to expel urine from captured sea turtles.

We do not expect that individual turtles would normally experience more than short-term stresses and possibly some minor discomfort as a result of these activities. No injury or lasting effects are expected from this procedure. The NMFS Beaufort Laboratory conducted fecal sampling, and turtles exhibited normal behavior as they were released.

### 8.4.14 Gastric Lavage

The feeding habits of turtles can be determined by a variety of methods, but the method used under this research permit is gastric lavage or stomach flushing. This comparatively simple and reliable technique has been used to successfully sample the gut contents of various vertebrate animal groups without harm to the animal (Forbes 1999). This technique has been successfully used on green, hawksbill, olive ridley and loggerhead turtles ranging in size from twenty-five to one hundred and fifteen centimeters curved carapace length. Forbes (1999) stated that many individual turtles have been lavaged more than three times without any known detrimental effect. Individuals that have been recaptured from the day after the procedure up to three years later appear to be healthy and to feed normally. As well, laparoscopic examination of the intestines following the procedure has not detected any swelling or damage to the intestines.

While individual turtles are likely to experience discomfort during this procedure, we do not expect individual turtles to experience more than short-term stress. Injuries and mortalities are not anticipated. This is supported in the literature by cases of animals repeatedly re-sighted, recaptured and in some cases resampled. Fuentes et al. (2006) noted that nine of seventy-six juvenile green sea turtles were resampled days to weeks after the initial capture (by free-dive) and lavage event. Seven of these animals were sampled twice within days of the original sampling; one animal was lavaged three times in one week, and one animal was sampled four times within a three-week period. Dr. Kristen Hart has recaptured twenty-one of the animals she has lavaged in the U.S. Virgin Islands (Permit No. 16146) and the Dry Tortugas (Permit No. 17381) (NMFS 2017a). Some animals have been recaptured several times since first lavage, some as many as eleven times. All of these turtles had gained weight and increased in size upon recapture. In an earlier study, Dr. Hart documented recaptures of juvenile hawksbills in the U.S. Virgin Islands, demonstrating that lavage is a safe procedure that does not affect an animal's residency, site fidelity, or ability to forage; reported growth rates were within other published ranges for the species, and in some cases higher than other areas (Hart et al. 2013b). Therefore, we do not believe that lavage will result in more than short-term stress from the actual lavage procedure; when performed by trained qualified researchers no injury or mortality is expected.

#### 8.4.15 Laparoscopy, Internal Tissue Sampling, and Anesthesia

Laparoscopy is a form of surgery that involves a small incision being made allowing access by a miniature camera and sampling equipment into the body cavity. This procedure allows direct viewing of organs and tissues (such as reproductive tracts to confirm sex) as well as sampling (such as biopsies of internal organs). However, as with any surgical procedure, laparoscopy introduces the risk of infection not only at the surgical site, but also within the body cavity. The procedure also requires veterinary staff experienced in the procedure and sea turtle anatomy in order to be performed safely. The procedure is likely to be very stressful for subjects, as it involves restraining the individual in a head-down position for an extended period. Although anesthesia (local and/or systemic) is also involved, a degree of pain can be expected at least with the sutured surgical site after the procedure is complete and anesthesia has worn off.

Even though laparoscopy has the potential to cause lethal or major sub-lethal injury, few studies have been conducted evaluating the effects of laparoscopy on sea turtles. Owens (1999) reports a mortality rate of one to two percent associated with the procedure in sea turtles. The two most common sources of mortality are excessive bleeding due to poor placement and death due to non-specific symptoms in a turtle that has already been compromised due to other conditions. For example, sea turtles with a heavy parasite load, a severe bacterial infection, or obesity may succumb during surgery (Eckert et al. 1999b). Permit holders under this programmatic will avoid such risk because the procedure may not be performed on compromised animals. In addition, all laparoscopic procedures would be conducted by or under the direct guidance of a veterinarian. Some animals may float and be unable to dive properly after the procedure. When given adequate recovery time in controlled conditions, the animal can absorb or expel excess air. In cases where this does not occur, a special effort, such as reopening the suture site, to remove the excess air may have to be made. No animals would be released until they are swimming normally and a veterinarian has given approval for release.

Even though laparoscopy has the potential to cause lethal or sub-lethal injury, few studies have been conducted evaluating the effects of laparoscopy on sea turtles. Perhaps the best study on the long-term effects of laparoscopy was conducted over thirty years ago when sea turtles were being farmed for commercial use. Wood et al. (1983b) performed laparoscopy on over fifty sea turtles in an aquaculture facility where all individuals were retained and monitored. No individual died or appeared to suffer long-term injury as a result of procedures conducted in less aseptic conditions and using less-refined methods than required by the Permit's Division.

More recently, Dobbs et al. (2007) reported findings after conducting laparoscopy on 225 free-ranging adult nesting hawksbill sea turtles in Australia. Individuals were released following the procedure. The researchers found stitches were gone in individuals returning to lay additional nests, but those individuals that returned to lay additional nests took on average one day longer to return than individuals that did not undergo laparoscopy (Dobbs et al. 2007). Some individuals were re-sighted in subsequent nesting seasons (Dobbs et al. 2007). Of the 225 hawksbill sea turtles, twenty-seven were injured during laparoscopy, which included (twenty-four of twenty-seven received lung punctures and the other three injuries were blood vessel punctures of egg yolks or ovaries (Dobbs et al. 2007)). This may be a unique feature of hawksbill sea turtles, as researchers noted that hawksbill lungs extended around the gut when the turtle was inverted for laparoscopy; a condition that was not found in green or loggerhead sea turtles (Dobbs et al. 2007). The researchers modified their methods so as to reduce the potential for injury (Dobbs et al. 2007). One sea turtle with lung puncture was seen to nest again the same season, and five were seen nesting in subsequent seasons (Dobbs et al. 2007). No such injuries or mortalities have been reported by permitted researchers in the Permit Division's program from laparoscopy. In the NMFS Southeast Fisheries Science Center application for Permit No. 16733, the applicant noted that they have performed laparoscopies intermittently for twenty years, and fat biopsy in conjunction with laparoscopy for ten years, and none of the large numbers of turtles recaptured over the years (often multiple times) following these procedures has exhibited adverse effects.

The purpose of administering anesthesia is to reduce the stress and pain associated with these procedures. These drugs have the potential for side effects that can be adverse, even in light of the potential benefits for which they are administered. Examples of animal recovery are provided here. Loggerhead sedation with a combination of medetomidine and 5 milligrams/kilogram ketamine and intubated with 0.5 to 2.0 percent sevoflurane was achieved in a mean time of just under nine minutes and anesthesia lasted 110 to 325 minutes in six juveniles (Chittick et al. 2002). Recovery times took 5 to 124 minutes (Chittick et al. 2002). Breathing, blood acidity, oxygenation, and body temperature all remained within safe ranges (Chittick et al. 2002). Doses of 3 to 8 milligrams/kilogram were insufficient to fully sedate leatherback sea turtles and supplementary doses of 2 to 9 milligrams/kilogram had to be administered (Harms et al. 2007). No apparent ill effects were found and anaesthetized individuals were found to return at the same rate as non-anaesthetized individuals (Harms et al. 2007). Green sea turtles were anaesthetized underwater with 5 milligrams/kilogram ketamine without lasting effect (Harms et al. 2007).

Anesthesia took 5 to 8 minutes to take effect and lasted 71 to 77 minutes (Harms et al. 2007). In another study, three loggerheads anesthetized with 18 milligrams/kilogram ketamine seemed to take full effect within 10 minutes (George et al. 1989). Ketamine alone appeared to cause only mild sedation and other drugs were necessary for deeper anesthesia (George et al. 1989). Recovery times of up to three hours were necessary (George et al. 1989). Leatherback recovery from sedation (6 milligrams/kilogram body weight of ketamine and 30 micrograms/kilogram body weight of dexmedetomidine) took 6 to 33 minutes in air, with an average time of 13.5 minutes, with almost two hours from injection to full recovery (Harms et al. 2014). All individuals were released in good condition (Harms et al. 2014). Based on the expertise of the attending veterinarian and the Permit Division’s standard mitigation measures for performing these procedures, we believe that the risk of mortality or other complications is low.

### 8.4.16 Transmitter Attachments

All external tag units would result in increased drag forces while the unit is attached; this varies widely from days to weeks or months based on the method of attachment. Invasive tag designs for leatherbacks also would result in temporary harm and injury at the tag site. Stomach pills may result in temporary discomfort during placement but should not result in injury. The standard mitigation measures for transmitters set forth by the Permits Division are designed to minimize impacts from drag forces, harm and injury to the animal and risk of entanglement. More details on the types of anticipated effects are provided for each attachment method below.

#### *8.4.16.1 Suction cup attachment*

Suction-cup mounted tags, such as animal-borne video and environmental data collection systems (AVEDS) or “Crittercams©”, would cause hydrodynamic drag for the turtles while tags are attached. However, we believe that they would have negligible effects on the movements of turtles. In a NMFS Southwest Fisheries Science Center study of Crittercam©-equipped green turtles, telemetered turtles exhibited normal diving behavior and swimming speeds (Seminoff et al. 2006). AVEDS would detach within about a day or less indicating that any effects would be very short-term. In a study of video camera equipped leatherback sea turtles, telemetered turtles exhibited normal diving behavior, and swimming speeds while foraging on jellyfish prey (NMFS 2017a). Jones et al. (2011) conducted tests to quantify the drag forces of different externally-attached biotelemetry devices using 3-D sea turtle models. Measured drag forces varied widely based on tag placement, shape and size. Drag increases were high, in some cases over 100 percent, for AVEDS-type units (Jones et al. 2011). However, the authors noted that although some of these tag designs are not in line within their overall recommendations, exceptions for these units are acceptable for short-term attachments where locomotion is not the animal’s primary activity (e.g., local foraging vs long migrations). Further, archival video camera tags attached by suction cups are designed for short-term deployments exclusively (i.e., hours). Deployment durations have typically been two to four hours with the longest deployment spanning five days before the apparatus fell off the carapace without assistance. Other types of suction-cup attached units typically last from 24 to 48 hours. Therefore, any unanticipated effects would be short-lived, and are not likely to translate to significant impacts, such as a permanent shift in habitat use or reduced reproductive success, to the tagged animal.

#### *8.4.16.2 Adhesive attachment*

Attachment of satellite, acoustic, or radio tags with epoxy is a commonly used and permitted technique by NMFS. Transmitters, as well as biofouling of the tag, attached to the carapace of turtles have the potential to increase hydrodynamic drag and affect lift and pitch. Because biofouling can increase drag and negatively affect tag transmissions if epibiota cover the saltwater switch, many researchers coat the majority of the tag with a biofouling paint before attachment. 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 at the peak of 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. More recently, tests by Jones et al. (2011) determined that drag forces can be high depending on the shape, size and placement of the tag; however, drag can be substantially reduced to 17 percent or lower if the tag is shifted off the peak of the carapace (Jones et al. 2011). Based on the recommendations of Jones et al. (2011), the Permit’s Division no longer authorizes harness-based attachment designs for sea turtles. Further, our standard mitigation measures for transmitters are in line with the recommendations of the report, including requirements to make attachments as hydrodynamic as possible, reduce risk of entanglement, and attach tags off the peak of the carapace whenever possible.

Researchers have successfully tracked turtles from nesting to foraging grounds (Hart et al. 2012; Hart et al. 2013a; Shaver et al. 2005; Van Dam et al. 2008). Shaver et al. (2017) has recorded females returning to nest after having a transmitter attached across inter-nesting seasons. Others have documented tagged animals using the same foraging areas, inter-nesting habitat, or home range after tagging (Hawkes et al. 2011; MacDonald et al. 2012; MacDonald et al. 2013; Madrak et al. 2016; Olson et al. 2012; Shaver et al. 2017). This information suggests that having a transmitter attached using adhesive methods does not impact a sea turtle’s migration, feeding, and mating behavior. Hatchlings, post-hatchlings, and juveniles grow much faster than subadult or adult individuals do. The attachment mechanism can impair growth if not flexible enough to either grow with the individual or break away as its base expands. Mansfield et al. (2012) evaluated potential impacts to tagging neonates by comparing tagged with non-tagged turtles and found no significant differences in growth, condition, swimming behavior and feeding, suggesting that the attachment does not pose more than minimal energetic costs. The authors also noted that because neonates are not continuously actively swimming, energetic costs may be further reduced to this age class. Taking information on turtle movements into account with the Permit Division’s standard mitigation measures for transmitters, we do not anticipate that the proposed methods pose any long-term risks to the turtle. The transmitters would not result in any serious injury. We expect that the proposed materials or methods would not significantly interfere with the turtles' normal activities, growth, movement, feeding, or other critical life functions after they are released.

Schmid noted that radio/sonic telemetered Kemp's ridley turtles exhibited surface durations of one to two seconds and submergence durations of one to two minutes upon release and continuing for several hours, but longer surface and submergence intervals were observed after 24 hours and this respiratory pattern continued through the remainder of the monitoring sessions (Schmid et al. 2002). Furthermore, telemetric monitoring has demonstrated that Kemp's ridley turtles that were captured and handled resume their activities and foraging during their seasonal occurrence in nearshore waters (Schmid 2003; Schmid 2004; Schmid et al. 2002; Schmid et al. 2003) and return to capture sites following winter migrations (Schmid and Witzell 2006). Recaptured turtles by Schmid have not displayed any noticeable long-term effects to capture and repeated recapture. Multiple recaptures of turtles suggest that capture and tagging does not impede their site fidelity to nearshore foraging grounds (Schmid 1995; Schmid 1998; Witzell and Schmid 2003; Witzell and Schmid 2004).

For tag attachments that require vessel-based tracking of animals, little to no disturbance of the target animal is expected as researchers do not intend to get close enough to influence the animal's behavior. Further, in coastal areas where recreational and commercial boating activity is common in areas inhabited by turtles, they may become accustomed to these interactions and suffer no adverse effects.

### 8.4.17 Drilling through Carapace

Acoustic tags may be secured by wired or tied attachments. Pop-up archival tags may be attached to the caudal carapace by tether, and medial ridge direct attachment is specific for leatherback tag attachment. For much of the same reasons as provided above for adhesively tagged units, we do not expect long-term impacts from these tag methods (wires and tethered units). Wire attachments are often used in conjunction with an adhesive putty, the effects are expected to be similar, resulting in some level of drag to the animal. When placed on the marginal scutes versus the middle of the carapace, we expect that tags would result in less drag.

Researchers studying the movements and home ranges of green turtles outfitted with both radio and sonic transmitters concluded that the transmitters and the tagging experience left no lasting effect on habitat use patterns (Seminoff et al. 2002). All tagged turtles in the study were resighted 444 times, ranging from 16 to 61 resightings each. The authors concluded that the tags had negligible impacts on tagged animals because "(1) telemetered turtles seemed to exhibit normal behavior, swimming ability and physical appearance; (2) during tracking efforts, turtles returned to areas of initial capture, suggesting that the transmitters and the tagging experience left no lasting effect on habitat use patterns; (3) the maximum weight of transmitter packages during this study was 1.2 percent of body mass, and studies on fish (Mellas and Haynes 1985) have shown that a transmitter will not cause negative effects if its weight is less than 2 percent of the tracked individual's body mass; (4) the use of transmitter fairings as applied to the VHF transmitters used in this study has been shown to substantially reduce hydrodynamic drag of backpack mounted satellite transmitters in experimental conditions (Watson and Granger 1998); and (5) during tracking sessions, both telemetered and non-telemetered turtles were seen in the same areas exhibiting roughly similar surface behavior, even swimming within meters of our tracking vessel; thus, suggesting negligible effects of the transmitter packages."

Avens et al. (2003) investigated homing behavior in juvenile loggerhead sea turtles tagged with tethered radio transmitters. Turtles displayed fidelity to the site of capture, with some animals being recaptured in the same season or across years. Studies have not yet been done to evaluate the drag of a tethered tag unit. However, we have no reason to believe that impacts would be greater than those identified for adhesive attachment. Drilling through the shell is invasive but not likely to result in harm to the animal (Avens et al. 2003). No bleeding is expected because the site is not vascularized and the animal should feel no pain. Once the tag is shed, the scute would grow back, resulting in no lasting effects to the carapace. A discussion of potential acoustic impacts is provided here for acoustic tags, which could be attached via epoxy, putty, and/or wire.

#### *8.4.17.1 Acoustic Tag Transmission*

Signals from sonic or acoustic tags would be tracked underwater using a directional hydrophone. Transmissions typically have a frequency of approximately 25 to 80 kHz. This frequency level is not expected to adversely affect turtles. Sea turtles have low-frequency hearing sensitivity and are potentially affected by sound energy in the band below 1,000 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 Hz. Ridgway et al. (1969) found the maximum sensitivity of green sea turtle hearing to fall within 300 to 500 Hz with a sharp decline at 750 Hz. Since these tags authorized for sea turtle tracking research would be well above this hearing threshold, these tags would not be heard by the turtles. We would not expect the transmitters to interfere with turtles' normal activities after they are released.

Another important consideration is whether the sounds emitted by these transmitters would attract potential predators, primarily sharks. Unfortunately, hearing data on sharks is limited. Casper et al. (2004) examined the hearing abilities of the nurse shark (*Ginglymostoma cirratum*), and results showed that this species detects low frequency sounds from 100 to 1,000 Hz with best sensitivity from 100 to 400 Hz. Although we don't have hearing information for all the sharks that could potentially prey on sea turtles, estimates for hearing sensitivity in available studies provided ranges of 20 to 1,000 Hz. In general, these studies found that shark hearing is not as sensitive as in other tested fishes, and that sharks are most sensitive to low frequency sounds (Banner 1967; Casper et al. 2003; Casper and Mann 2007; Casper and Mann 2009; Kritzler and Wood 1961). Thus, we do not expect acoustic transmitters would attract potential shark predators to the turtles, given the frequency of the tags is well above the 1,000 Hz threshold.

### *8.4.17.2 Leatherback Long-term Attachments*

The medial ridge of the leatherback sea turtle provides enough dense tissue for an anchor and is far removed from any vital structures. We expect animals to experience minimal pain or discomfort because the integument at the site of attachment is not rich in nerve endings. Similarly, minimal bleeding is expected. The risk for carapacial infection or osteomyelitis (bone infection) is extremely low even in the case of hardware failure and breakout due in large part to the leatherback's inherent natural ability to heal from major natural injuries encountered in the environment. The overall risks of the deployments are less than the risks animals (e.g., females) face from courting males, fishing gear, and other natural or human-induced trauma. The size, shape, and footprint of the attachment is substantially smaller than the previously authorized harness method, thereby resulting in reduced hydrodynamic effects to the tagged animal (Jones et al. 2011). For this reason, the Permit's Division has stopped authorizing the use of harnesses on leatherback sea turtles since 2010.

Dr. Lutcavage's telemetry data also shows that these tags do not disrupt migration patterns to nesting beaches (Dodge et al. 2015; Dodge et al. 2014) and a review of Dr. Lutcavage's annual reports (for Permit No. 15726) monitoring the health of animal's post-tagging indicates that transmitter attachments do not appear to result in long-term harm or to appreciably reduce reproductive fitness (resightings on nesting beaches with no visible scars at the tagging location). During previous telemetry deployments using no longer authorized harness-based attachments from central California foraging grounds, most leatherback turtles (greater than 70 percent) returned to areas of initial capture after over-wintering in tropical latitudes (Benson et al. 2011), suggesting that the transmitters and the tagging experience left no lasting effect on habitat use patterns. The use of satellite-linked transmitters designed for attachment to medial ridge of a leatherback carapace have been shown to substantially reduce hydrodynamic drag in comparison with transmitters attached with previously authorized shoulder harnesses (Jones et al. 2011). Hence, the Permit's Division believes that more streamlined medial ridge attached tags will lessen impacts to this species while still providing valuable long-term data on migrations and movements. The Permits Division requires researchers to attach tags so that they are not placed at the peak height of the carapace to reduce drag effects as recommended by Jones et al. (2011). In addition, Casey and Southwood (2008) observed that turtles tagged with the medial ridge method did not visibly react to the procedure and the tag site on the carapace looked healthy post-tagging.

Casey and Southwood (2008) tagged female leatherbacks under Permit No. 1557 in this manner while ovipositing during the nesting season on St. Croix; they noted that twelve of nineteen females returned to the beach to nest again indicating that nesting was not impacted by the tag attachment. All twelve animals behaved normally and the wound site did not have signs of infection, chaffing, or necrosis. Two of the twelve tags had shed prior to the animal's return to the beach. Of the seven females that did not return to nest, four turtles begin a post-nesting migration with the tag attached, some of which are thought to have nested elsewhere based on movements. Tags transmitted for at least one to two months each. The remaining three tags are believed to have been shed by the turtles based on the two observed animals that returned to the St. Croix nesting beach without tags. Researchers reported for Permit No. 1557 (in 2009 and 2010) tagging twelve and three turtles, respectively, noting a similar ease of tagging and behavior of animals. Transmissions from all tags ranged between 150 to 300 days and demonstrated that animals continued to migrate across the North Atlantic, possibly to nesting beaches. Based on these reports, the proposed tagging method would not be expected to reduce the numbers, distribution, or reproduction of sea turtles in the wild or reduce the likelihood of survival and recovery of these species.

Several researchers have directly attached satellite tags and TDRs to the caudal peduncle (e.g., NMFS Southwest Fisheries Science Center in other countries and the NMFS Southeast Fisheries Science Center in Florida) and medial ridge of leatherbacks, with no resulting mortalities or long-term injuries. Instruments are small, lightweight, and streamlined to minimize drag. From initial long-term tracks of leatherbacks, it appears that movement, survival, foraging, and predator avoidance are not affected. A nesting leatherback tagged by the NMFS Southeast Fisheries Science Center nested a second time with the tag attached to the caudal peduncle with no deleterious effects, suggesting that reproduction is not affected.

### 8.4.18 Stomach Pills

We expect no harm to the animal from the ingestion of a stomach pill and only minor, temporary stress. Insertion of the recorder is a quick procedure, with the turtle's mouth is usually held open for less than one minute. A previous study has shown that a stomach temperature pill, model STP3, inserted in this manner is eventually pushed into the stomach by peristaltic action and food ingestion (Southwood et al. 2005). The recorders are small enough to easily pass through the digestive tract of a turtle. Recordings of gastrointestinal tract temperatures are expected for approximately twelve to thirteen days using this technique (Casey et al. 2010). In a previous study, pills fed to leatherback turtles were excreted within ten days of ingestion (Southwood et al. 2005). Stomach pills were used by Casey et al. (2010) to infer foraging behavior by leatherback turtles during the inter-nesting period at Sandy Point National Wildlife Reserve, St. Croix, U.S. Virgin Islands. They reported that eleven of nineteen turtles returned to the Sandy Point National Wildlife Reserve to nest eight to thirty-one days following instrument deployments, and that all turtles that returned to nest there displayed normal nesting behavior. Furthermore, eight of nineteen turtles were re-sighted at the Sandy Point National Wildlife Reserve two years after instrument deployments. They reported that the external instrument attachment sites for the medial ridge tag unit had healed and were in good condition for all remigrants, providing evidence that the direct attachment technique is safe for use with leatherbacks and does not cause lasting damage to the carapace.

### 8.4.19 Non-invasive Imaging

X-ray, CT, MRI, and ultrasound are all non-invasive procedures that would be supervised by a veterinarian. These procedures would involve handling and restraint, as well as imaging with some devices emitting sound pulses that are well above the levels audible to sea turtles. Although the turtle may experience short-term stress or discomfort during imaging, this stress would not be significant. Any stresses associated with this activity are expected to be minimal and short-term. No lasting effects of imaging are expected. Exposure to radiation during x-ray is expected to be minimal and pose no more risk than for a human. X-ray is a routine procedure for animals in rehab. Exposure to an MRI would not be expected to affect an animal’s ability to orient when returned to the wild. To study mechanisms of sea turtle orientation and navigation, Fuxjager et al. (2011) exposed loggerhead hatchlings to different simulated magnetic fields to see how they behaved and oriented. The authors did not report any evidence of disorientation or harm to the subjects after exposure and all animals were released on the nesting beach after the trial was completed. As discussed in the context of laparoscopy, sedation for imaging, has an inherent risk of mortality. However, animals would be under the constant care of a veterinarian in a facility that should allow them to respond to any emergency. Compromised animals would not be sedated. As a result, risk of death is not quantifiable, and is expected to be very low.

### 8.4.20 Acoustic Research

Though data are limited, sea turtles in general seem to be most sensitive to low frequency sounds. Sea turtle hearing generally is tested in younger life stages (e.g., post-hatchlings and juveniles) because researchers expect that like humans, hearing is better or optimal in younger animals and declines naturally with age. Dow Piniak et al. (2012) demonstrated that leatherback hatchlings hear sounds in water from 50 to 1200 Hz with best sensitivity from 100 to 400 Hz.

Martin et al. (2012) reported that adult loggerhead sea turtles hear sounds in water best at 100 to 400 Hz but can hear tones ranging from 50 to 800 Hz. Lavendar et al. (2014) found similar results with post-hatchling and juveniles but observed that these life stages may hear sounds up to 1000 Hz. Dow Piniak (2012) determined that hawksbills can hear sounds ranging between 50 and 1600 Hz with maximum sensitivity 200 to 400 Hz. In addition, Bartol et al. (1999) determined that loggerhead sea turtles hear sounds best at 100 Hz but can hear tones ranging from 50 to 800 Hz. Ridgway et al. (1969) described juvenile green turtles as hearing sounds from 60 to 1000 Hz with best sensitivity at 300 to 500 Hz; however, this work was not based on AEP trials but rather cochlear potentials. Dow Piniak et al. (2016) found similar results for green juvenile sea turtles (50 to 1600 Hz hearing range, with maximum sensitivity from 200 to 400 Hz). Bartol and Ketten (2006) tested the hearing of partially submerged greens and Kemp’s ridleys. While some of their results overlap with other studies in terms of the hearing range for greens, because of the trial design, the data are not directly comparable to other studies. No data is available for olive ridleys. Although audiograms are not available for all hardshell species, we expect the hearing of these groups to be comparable to that reported for other hardshell species in the literature.

### *8.4.20.1 Tank-based Studies*

In the SEFSC's past collection of AEPs in juvenile sea turtles, they have successfully measured hearing sensitivity using the manual restraint protocols described above. However, individuals respond differently to restrained submersion (with regard to blood oxygen and lactate levels). Previous studies on wild hatchling leatherback sea turtles in Trinidad, and captive juvenile green turtles in Vancouver, British Columbia, have shown that manual restraint is ideal for individuals who are not stressed by light manual restraint; however, chemical restraint (anesthesia or sedation) was more suitable for individuals who are stressed by light manual restraint (better blood oxygen and lower lactate levels) (Harms et al. 2009; Harms et al. 2014).

AEP tests are short in duration (75 min or less depending on use of sedation) and are designed to measure the lowest sound level of a particular frequency the organism is sensitive to. To measure this the researcher begins with the loudest level (the speakers the SEFSC have used in the past is <150dB re: 1uPa), and progressively decrease the sound pressure level until the individual no longer detects the sound. Signals (short pings) are only produced for as long as it takes to get an AEP recording that indicates the turtle has detected the sound. As turtles can detect louder frequencies better, the loudest levels are generally produced for a short duration (often seconds for frequencies turtles are able to detect well). Per past collection and measurement protocols, the longest any signal is played is approximately two minutes. A large majority of the time spent during an AEP test is spent around the threshold level (the quietest level a turtle is able to detect). Due to the short duration of the experiment, the limited upper sound pressure level of loudest level played, and that turtles are exposed to the loudest signals for a short period of time, no hearing damage (temporary threshold shift (TTS) or permanent threshold shift (PTS) is anticipated during AEP tests.

No adverse effects are anticipated from manual or chemical restraint while collecting AEPs. Two recent investigations of sea turtle hearing using AEPs have included continuous veterinary monitoring and investigations of health and blood gas values (Dow Piniak et al. 2016; Harms et al. 2009). Harms et al. (2009) and Piniak et al. (2016) obtained aerial AEPs from five juvenile green sea turtles using manual restraint and underwater AEPs from four manually restrained juvenile green turtles and two anesthetized juvenile green turtles (including one turtle using both methods). Excessive movement by three manually restrained turtles prevented AEP recordings. They determined manual restraint was superior to anesthesia for turtles that did not resist restraint (better blood venous oxygen, successful AEPs), and anesthesia was superior to manual restraint for turtles that resisted restraint (marked increases in lactate and unsuccessful AEPs)(Harms et al. 2009). All turtles fed normally at the next scheduled feeding, and no adverse consequences were noted either behaviorally or in regularly monitored growth and weight gain (Harms et al. 2009). Harms et al. (2014) and Dow Piniak et al. (2012) obtained aerial AEPs from seven sedated (midazolam at 2 or 3 mg/kg) and manually restrained (using light elastic wrap) hatchling leatherback turtles and five anesthetized hatchling leatherback turtles, and underwater AEPs from eleven sedated and manually restrained hatchling leatherback turtles. All turtles were monitored through AEP collection to full recovery (normal blood gas values, see Harms et al. (2014) for additional details). Hatchling release after AEP collection was scored qualitatively as good, fair, or poor based on vigor of hatchling crawling towards the ocean. All hatchlings scored well except for one fair and one poor release in the midazolam in water group. These two hatchlings had not emerged from their nests and were collected during nest excavations (such hatchlings were not used in subsequent AEP studies)(Harms et al. 2014). Though other studies have not included continuous veterinary monitoring, additional studies on hawksbills (Dow Piniak 2012) green (Piniak, unpublished data), and loggerhead (Piniak unpublished data) hatchlings all manually restrained using light elastic wrap have observed no adverse impacts and similar good releases back to the ocean after AEP collection.

Anesthesia or sedation will only be used following a veterinary-approved protocol and as a last resort if manual restraint is not adequate. An experienced veterinarian will oversee all tests where anesthesia or sedation is used, will deliver the anesthesia/sedation drugs, and will monitor the health of the turtles during AEPs. If adverse reactions are noted, reversal drugs and emergency procedures will be implemented. The programmatic BO (on p. 248;(NMFS 2017a)), concluded that we expect any risk of mortality or complications from their use to be low based on the expertise of the attending veterinarian and the Permits Division standard mitigation measures (see Appendix C of (NMFS 2017a) and Appendix G of this document). For these reasons, we do not expect the use of anesthesia or sedation to result in harm, injury or death of any animal.

No adverse effects are anticipated from tank studies to examine behavioral responses to potential ADD signals. The frequencies and sound levels chosen for the ADDs are determined based on the audiograms produced during previous AEP studies of sea turtles (with respect to appropriate frequencies and sound pressure levels) and previous tank studies. Because ADD sound pressure levels will be limited to 150dB, the sounds are played intermittently (e.g., on a duty cycle with portions of quiet) and exposure times are of short duration (less than 1 hour), no hearing damage (TTS or PTS) is anticipated during AEP tests. While ADDs are potentially a novel sound for turtles, the ADD level of 150 dB (maximum level 1m from the speaker) is quieter than some other prevalent sources of natural and anthropogenic sound in their nearshore environment (for example recreational vessels and fishing boats). The signal is extremely short, allowing the animal’s hearing to recover within the duty cycle before the next ping. E.g., for an ADD trial that emits a 1-second ping every 10 seconds, the animal has 9 seconds to recover after each signal. Similar studies were conducted by the SEFSC from 2010-2011 with twelve juvenile loggerhead turtles caught in pound nets in Back Sound, North Carolina. All turtles were given 18 to 24 hours to acclimate to the tank before testing. Eleven of the twelve turtles acclimated to the tank (exhibited normal swimming and resting behavior) and their behavior was monitored before, during, and after simulated ADD signals presented using an underwater speaker. One turtle did not acclimate to the tank (continuously swam in circles in the tank) and was not tested. All turtles were released in good health less than 48 hours after collection near the collection location and swam away from the release location normally.

#### *8.4.20.2 ADDs in the Wild*

SEFSC researchers have previously examined the behavioral responses of loggerhead sea turtles to a simulated low frequency tonal ADD (300 Hz, 152 dB re: 1 μPa-rms source level) in a tank environment. Researchers observed no adverse effects by loggerheads other than a mild, aversive response to ADDs. Turtles responded by orienting away and increasing their distance from the ADD (Dow Piniak 2012). These results suggested that low frequency tonal ADDs had the potential to warn sea turtles of the presence of fishing gear and suggested that field tests of ADDs were warranted.

Studies conducted in Baja, Mexico have examined the use of low-frequency acoustic devices to reduce interaction rates of sea turtles with nets. Dr. Piniak in collaboration with Ocean Discovery Institute, NOAA Fisheries Biologists, engineers, and gillnet fishers examined the potential for acoustic cues to be used as a bycatch reduction technique for sea turtles (Piniak et al. in prep). They developed a novel low-frequency ADD and designed an acoustic cue to exploit the low-frequency hearing capabilities of sea turtles that are outside the hearing range of flatfish species (the target catch in the Baja bottom-set gillnet fishery and the NC gillnet and pound net fisheries). The ADDs, placed every 20 meters along the net, generated alternating 200 and 400 and 300 and 500 Hz tones, 1 second in length, presented every 10 seconds at 139 dB re: 1μPa at 1m (RMS source level). The presence of ADDs on nets reduced catch rate of green turtles by 60% (n=23 paired trials, randomization test, p=0.02) (Piniak et al. in prep). During bottom-set gillnet trials the presence of ADDs elicited no change in catch rate of fish (n=26 paired trials, Wilcoxon test, p=0.82).

McCauley et al. (2000) is one of the few studies that has direct evidence of behavioral impacts to sea turtles from anthropogenic noise, in this case, airgun signals (an impulsive sound source). Using captive green and loggerhead sea turtles, the authors noted exposures over 166 dB (received level) resulted in increased swimming, and animals may show signs of avoidance for sounds above 175 dB (received level). The McCauley study source levels were substantially higher than the proposed sound level limit of 150 dB (RMS source level) for our program. O'Hara and Wilcox (1990) attempted to create a sound barrier using seismic airguns to deter loggerhead sea turtles from the entrance of a Florida Power & Light cooling water canal. Two airguns presented every 15 seconds resulted in some animals surfacing or moving away from the sound source at a distance of 30 m. However, some animals moved to locations directly below the airguns. They predicted the airguns produced sound levels of 200 dB re: 1μPa at 1 m (25 to 1,000 Hz), however, the authors did not measure received levels or map the sound field to take into account reflections of sound by the canal walls (possibly creating areas of high-intensity sound and "dead" zones) that may have factored into the observed movements of some animals. Hence, the test design and its results may not translate to animals exposed to sound in open water. Moein (1995) also tested the responses of loggerhead turtles to airguns and whether they habituate to noise with a net enclosure in the York River, Virginia. Source sound levels ranging from 175 to 179 dB for frequencies between 100 to 1000 Hz were presented every 5 to 6 seconds for 5 minutes, discontinued for 10 minutes and then presented for another 5 minutes during each of 6 trials. Received sound levels were not measured. Observed responses indicated that most animals exhibited an avoidance response, moving away from the source at first exposure during the first trial, but may become habituated to the sound for subsequent exposures even days after the initial exposure. The author conducted AEPs to test the animals' hearing thresholds before and after the airgun trials. The AEP results indicated that the airgun trials may have resulted initially in TTS; however, their hearing returned to normal by the time they were re-tested 2 weeks after the trial. No information is available on the potential for anthropogenic noise to result in acoustic masking for sea turtles.

Dr. Scholik-Schlomer of the Office of Protected Resources was consulted to evaluate the potential for harassment and injury from ADD exposure to protected marine species, including sea turtles, fish, and marine mammals, based on the ADD limits proposed for our program. Noise-induced hearing loss can occur if an animal is exposed to a sound source at a level loud enough and/or long enough to cause TTS or PTS in hearing. Although these thresholds have not been developed directly for sea turtles yet, others (e.g., U.S. Department of Navy) have applied TTS and PTS levels for marine mammal and fish species as surrogates for estimating TTS and PTS in sea turtles (Department of Navy 2017). Using this information and a modified version of the NMFS Optional User Spreadsheet, we calculated the distance at which an animal would have to remain to develop TTS and PTS for 24 hours using a typical propagation model for shallow water (practical spreading, 15 log R). The model also took into account the cumulative sound exposure level (max of 153 dB SELcum source level) as a result of using more than one ADD at the same time on nets. Using the Navy Phase III sea turtle thresholds (which use marine mammals as a conservative surrogate), the model indicates that a sea turtle would have to remain within 0.4 meters of the ADD for 24 hours to cause a PTS and within approximately 9 meters to cause a TTS. This model is an extremely conservative evaluation and thus is a highly unlikely scenario for the following reasons:

- ADDs will be used in shallow waters where the depth of the water column is often shallower/shorter than the wavelength of the signals. This decreases sound propagation distance (increases attenuation). Hence, the likelihood of sounds travelling 9 m is very low.
- Sounds are played intermittently rather than continuously, giving animals time to recover between signal emissions.

- When tangle netting, animals must be retrieved from the net as soon as they are observed but no more than 20 to 30 min after entanglement, making exposure minimal upon entanglement.
- In other fixed deployments (including pound nets), we expect that the animal will not be exposed for 24 hours. Rather, we expect the animal to move away from the immediate vicinity of an effective ADD if it finds the sound annoying or results in discomfort.

Turtles are captured in the pound portion of the pound net (after traveling through the opening of the heart they pass through the tunnel into the pound). Pound nets can vary in size, but are generally 30 feet (9.14 m) x 30 (9.14 m) feet. The entrance opening (where ADDs are set) is approximately 3 meters wide, allowing sea turtles to pass back out of the heart if the ADD sounds disturb them. When in the heart of the pound, the closest that turtles would be to the ADDs is 24 feet (greater than 7.3 meters). Hence, we believe that if an animal is disturbed by the sounds but stays in the heart, the animal would have space within the heart to move beyond the distance (9 meters) at which it could develop TTS over the 24-hr period. Once in the pound, animals would be beyond the 9-meter TTS range.

Based on this analysis we believe that the potential for permanent changes in behavior, noise-induced hearing loss, or auditory injury of sea turtles from the use of ADDs as proposed is not reasonably likely to occur. Given the available information on sea turtle hearing and the mitigation that would be included in the permit, we expect minimal negative effects to sea turtles as a result of acoustic research; effects could involve a mild behavioral aversion response to the ADD devices as described above. We would not expect ADD use to result in more than temporary disturbance of sea turtles exposed to sounds. Animals may temporarily change their activity, orientation, and breathing rates. We do not expect the use of ADDs to result in harm or injury to sea turtles. Based on this information, though audiograms are not available for every sea turtles species, we expect the hearing ranges of other hardshell species, and consequently the potential impacts of sound, to be comparable to those in the literature. If effective, this research could have the positive impact of helping prevent incidental capture and ultimately leading to the development of effective bycatch mitigation measures in fisheries. The benefit of avoiding capture is expected to substantially outweigh any temporary disturbance or avoidance sea turtles experience.

### 8.5 Sea Turtle Risk Analysis

The risk to individual sea turtles posed by the Program is determined by assessing the effects of the responses of sea turtles to the stressors created by the research activities. Below we address the risks of sub-lethal effects, observed research mortality, and unobserved delayed mortality where a turtle dies after release but the death was the result of the research activity. Once the risk to individuals is determined, the risk to a population and species (including DPS) is assessed.

### 8.5.1 Sub-lethal Effects

Based on our response analysis above, we determine that many of the stressors created by the research activities would result in minor behavioral responses by individual sea turtles. The presence and sounds created by vessels, manned and unmanned aircraft, underwater tracking vehicles, acoustic sensor devices may not elicit any identifiable behavioral or physiological response. If a response is elicited, as in acoustic-based research, the response would be a turtle swimming or diving away from the stressor and the long-term impact would be minimal. This level of response would be temporary and not lead to a reduction in fitness of an individual sea turtle. Capture of turtles could result in behaviors indicative of avoidance or attempts to escape as well as physiological stress response. With the rare exception of mortality (discussed below) that could occur in non-selective capture gears, we do not expect that individual turtles would experience more than short-term stress and temporary physiological changes during capture and subsequent holding and handling. Based on previous researcher reports, there is some small risk that trawl captured sea turtles will be comatose upon capture. However, given the extensive mitigation measures and protocols in place for handling and resuscitating compromised sea turtles, we anticipate that, with the very rare exception of mortality that may occur (discussed above), compromised trawl captured sea turtles will be successfully rehabilitated prior to release.

Stressors associated with many of the research procedures conducted on sea turtles will also result in sub-lethal effects of short-term stress and/or pain. These include shell marking, flipper and PIT tagging, oxytetracycline injection, epibiota collection, swabs, skin biopsies, scute scraping, blood sampling, tear collection, tissue biopsy, urine and fecal sampling, lavage, laparoscopy, anesthesia, stomach pills, and transmitter attachment involving drilling, epoxy or suction cups. Sub-lethal effects on sea turtles resulting from research activities authorized under the proposed action will be minimal, short-term, and are not likely to result in any reduced fitness or loss of fecundity to individual turtles. Mitigation measures and research protocols required as a condition of the research permit further reduce the risk of sub-lethal effects from authorized research activities. No serious injuries have been reported to the Permits Division by sea turtle researchers over the last ten years. While external tag units would result in increased drag forces while the unit is attached, standard mitigation measures for transmitters set forth by the Permits Division are designed to minimize impacts from drag forces, harm and injury to the animal and risk of entanglement. Although they could remain attached for several weeks or months at a time, transmitters are not expected to result in the reduced fitness of individual turtles as long as the required mitigation measures and procedures are followed.

Since sub-lethal effects are not likely to result in reduced fitness or fecundity of individuals, it follows that sub-lethal effects from research activities are not likely to negatively impact sea turtles populations. Therefore, we determine that the authorized sublethal take of sea turtles as part of the proposed action is not likely to affect the survival or recovery of ESA-listed sea turtle species or DPSs. These conclusions can be reached as long as all sampling protocols, mitigation measures, and any other required conditions of the sea turtle research permit are followed by all permit holders. In addition, as part of the adaptive management approach that is an integral part of the Program, the Permits Division will continuously monitor and evaluate the sub-lethal effects of authorized activities. If the sub-lethal effects associated with a particular activity are greater than anticipated, the Permits Division will reevaluate the authorization of the activity in permits and consider additional mitigation measures as necessary.

### 8.5.2 Research Mortality

Based on our response analysis above, we determine that stressors associated with the capture of sea turtles in non-selective gear (i.e., trawl, entanglement, pound, and seine nets) could result in the mortality of individual sea turtles. Based on past sea turtle research, mortalities due to capture are expected to be very rare. From 2007-2017 there were only five reported sea turtle research mortalities out of 9,881 reported captures (i.e., mortality rate of 0.0005). Four of the five were captured in pound nets (two Kemp ridley's and two greens) and one was captured in a trawl net (loggerhead).

Lethal take limits represent the maximum number of sea turtles that can be killed every ten years as part of the proposed action; the actual number of sea turtle mortalities resulting from the proposed action may be considerably smaller since mortalities are rare events. In addition, the Permits Division will take a conservative approach to authorizing lethal take in individual permits, and will not authorize the "reserve" lethal take up front as this will be retained as a buffer for unexpected events. Table 24 shows each species and DPS with their current abundance estimate, abundance trend, and ten-year lethal take limits that are part of the Program, and the impact to the population assuming the lethal take limit is reached. Lethal take limits for the Program would be established for each species and ocean basin. Since there is more than one green turtle DPS per ocean basin, the green turtle lethal take limits shown in Table 24 are based on the conservative assumption that the entirety of lethal take authorized within a ten-year period could come from a single DPS within a particular ocean basin (e.g., all 15 lethal takes from the North Atlantic DPS and zero from the South Atlantic DPS; or visa-versa).

**Table 24. ESA-listed sea turtle species with abundance estimates, abundance trends, ten-year lethal take limits and population impact.**

| Species | Distinct Population Segment | Abundance estimate | Abundance Trend | Lethal Take Limits for Research Mortality (Total over 10 years= Authorized + Reserve Buffer) | Population Impact Over 10 Years |
|---|---|---|---|---|---|
| Green | North Atlantic | 167,424 Nesting females[1] | Increasing[11] | 15 | 0.0090% |
| Green | South Atlantic | 63,332 Nesting females[1] | Mixed[11] | 15 | 0.0237% |
| Green | East Indian-West Pacific | 77,009 Nesting females[1] | Mixed[1] | 0 | 0 |

| | | | | | |
|---|---|---|---|---|---|
| Green | Central West Pacific | 6,518 Nesting females[1] | Unknown[11] | 7 | 0.1074% |
| Green | Southwest Pacific | 83,058 Nesting females[1] | Increasing[1] | 0 | 0 |
| Green | Central South Pacific | 2,677 Nesting females[1] | Unknown[11] | 7 | 0.2615% |
| Green | Central North Pacific | 3,846 Nesting females[1] | Increasing[11] | 7 | 0.1820% |
| Green | East Pacific | 20,062 Nesting females[1] | Mixed[11] | 7 | 0.0349% |
| Hawksbill | Worldwide | 22,004 Nesting females[2] | Mixed[11] | 15 (Atlantic + Pacific) | 0.0682% |
| Kemp's ridley | Worldwide | 4,872 Nesting females[3] | Unknown[11] | 15 (Atlantic only) | 0.3079% |
| Leatherback | Northwest Atlantic subpopulation | 34,000 Adults[4] | Stable[11] | 15 | 0.0441% |
| Leatherback | West Pacific subpopulation | 562 Nesting females[5] | Decreasing[11] | 2 | 0.3559% |
| Loggerhead | Northwest Atlantic | 53,000 Nests annually[6] | Stable[11] | 15 | 0.0283% |
| Loggerhead | Northeast Atlantic | 12,000 Nests annually[7] | Unknown[12] | 0 | 0 |
| Loggerhead | North Pacific | 43,320 Individuals[8] | Stable[11] | 7 | 0.0162% |
| Loggerhead | South Pacific | 200 Nesting females[9] | Decreasing[12] | 0 | 0 |
| Olive ridley | Worldwide | 1.39 million Adults[10] | Mixed[11] | 15 (Atlantic + Pacific) | 0.0011% |

[1] (Seminoff et al. 2015); [2] (NMFS and USFWS 2013a); [3] Derived from (NMFS and USFWS 2015); [4] (TEWG 2007); [5] Derived from (NMFS and USFWS 2013b); [6] (NMFS SEFSC 2009); [7] (Lino et al. 2010; Marco et al. 2010); [8] (Matsuzawa 2011; Seminoff et al. 2014); [9] (Wabnitz and Andréfouët 2008); [10] (Eguchi et al. 2007); [11] (NMFS 2017d); [12] (Conant et al. 2009).

The East Indian-West Pacific and Southwest Pacific DPSs of green and Northeast Atlantic Ocean DPS and South Pacific Ocean DPS of loggerhead are also included, despite being a foreign water population because these DPSs could be caught on the high seas through capture under another authority. The Permits Division would not authorize any lethal take for those four DPSs under the Program.

### 8.5.3 Delayed Mortality

Based on our response analysis above, we determine that stressors associated with the capture of sea turtles in trawl nets could result in the delayed (unobserved) mortality of individual sea turtles. Sea turtles caught by trawl have an increased risk of delayed mortality due to forced submergence. Underwater entrapment in fishing gear followed by rapid decompression may cause gas bubble formation within the blood stream (embolism) and tissues leading to organ injury, impairment, and even mortality in some individuals.

As part of our risk analysis, we evaluate the anticipated delayed mortality from trawl capture. Available information for estimating a delayed mortality rate due to sea turtle research activities is sparse. Based on historical data, the Permits Division calculated an observed research mortality rate of 0.0005 from reported take data for all species combined over a ten-year period (i.e., five observed mortalities out of 9,881 reported capture takes over the previous ten years). As an assessment of the potential for delayed mortality, based on expert opinion the Permits Division predicts that the delayed mortality rate may be as high as twice the observed research mortality rate, or 0.0010, of all sea turtles captured (i.e., all species combined) (NMFS 2017a). On average, permitted researchers reported taking approximately 1,100 sea turtles by capture (all methods) in a given year. Using the above estimates for delayed mortality rate and captures (0.0010 and 1,100), this translates to an annual delayed mortality estimate of approximately 1.11 turtles, all species combined.

Although the above approach provides us with an estimate of delayed mortality, we have identified several shortcomings for using this approach in our risk analysis. First, the doubling of the observed research mortality rate to determine the delayed mortality rate is based on expert opinion rather than empirical data. Second, while the observed mortality rate was based on turtles captured using all capture methods, our turtle response analysis indicates that the risk of delayed mortality from turtle research capture is only from capture in trawl nets. Third, the estimated number of delayed mortalities is expressed for all species combined; however, for our risk analysis we must separately assess the risk to each species or DPS.

To address these shortcomings, we developed an estimate of delayed mortality based on information on turtle health as provided in past sea turtle researcher annual reports. We focused on reports from researchers who used trawl nets to capture sea turtles. Since sea turtle delayed mortality is likely related to trawl tow time (Fahlman et al. 2017), to take a conservative approach we used data from trawl captured sea turtles with 30 minute tow times, the maximum that would be authorized under the Program. We found only one research permit that met the criteria for our delayed mortality estimate (Permit No. 1245). Under this permit, from 2000 to 2003, 3,020 trawling events resulted in 925 loggerheads, 67 Kemp’s ridley, and 8 green sea turtles captured. Of those 1,000 turtles captured, five were collected comatose and required intubation. Four intubated turtles were returned to the wild after normal behavior was observed. The fifth turtle also appeared to return to normal health and at one point was so active that it was tagged in anticipation of release. However, the turtle became lethargic again and eventually died in the lab (see Section 8.3.2 for more details). The necropsy showed that the turtle was healthy in all respects except that water had caused the anterior lobes of the lungs to swell and cease to function properly. Although the death occurred in the lab and not after release into the wild, this incident indicates that, although very rare, delayed mortality after trawl capture is possible, even after the turtle has shown initial signs of returning to normal health. Based on this information, we assign an estimated delayed mortality rate of 0.1 percent (i.e., one out of 1,000 turtles captured in trawls using 30 minute tow times).

Next, we apply the delayed mortality rate estimated above to the anticipated number of trawl captures in the Program for each species or DPS. The average annual number of authorized turtle takes from trawl capture over the last ten years (June 2007 to May 2017) by species are as follows: green, 122.7; hawksbill, 18.5; Kemp's ridley, 151.9; leatherback, 8.4; loggerhead, 393.3; olive ridley, 1.5; and unidentified, 3.6. This equates to the following proportions of the trawl captures by species: 17.53 percent green, 2.64 percent hawksbill, 21.70 percent Kemp's ridley, 1.20 percent leatherback, 56.19 percent loggerhead, and 0.21 percent olive ridley. Based on our exposure analysis above, we estimate the proposed action will result in 8,749 sea turtle captures by trawl (Table 23) over any given ten-year period. This is a highly conservative estimate of trawl captures because, since it is based on past authorized levels, it assumes that 100 percent of authorized trawl captures will be utilized by researchers. From 2007 to 2017, only 16 percent of authorized trawl captures resulted in actual trawl capture take as reported by researchers.

Using these proportions, we estimate the number of turtles that may be captured by trawl for each species, and calculate the estimated number of delayed mortalities that may result from these trawl captures over a ten-year period (Table 25). For species with more than one DPS, we make the conservative assumption that 100 percent of the estimated trawl captures for the species could potentially come from any of the individual DPSs (e.g., all 1,533.7 trawl captures of green turtles could be from the North Atlantic DPS). The estimated delayed mortalities were conservatively rounded up to the nearest integer and added to the anticipated observed research mortalities (based on lethal take limits) to arrive at the total estimated mortalities over ten-years for each species or DPS.

The Permits Division will re-evaluate delayed mortality rates if the program has a substantial increase in 1) reported mortalities over several years, or 2) reported take levels for all activities that require capture or handling animals beyond historic levels. As with the research mortality rate, the delayed mortality rate will be re-assessed and adjusted as more data are collected or new information indicates an increased risk of delayed mortality from research methods. For example, delayed mortality resulting from the stress of capture may change if new data on decompression sickness from trawl capture becomes available. The Permits Division will also evaluate all new procedures for their risk to cause mortality (or a reduction of fitness) based on the best available data. Because the Permits Division will know how many takes are authorized for capture and handling of turtles each year, as part of monitoring the program, they will be able to provide us with an update on whether the estimated delayed mortality rate changes when reporting annually to the Interagency Cooperation Division. The impact of mortality on sea turtle populations as a result of the proposed action is estimated by dividing the total estimated mortality by the abundance estimate for each species (or DPS) as shown in Table 25.

### 8.5.4 Summary

Based on our risk analysis, accidental mortality as a result of research activities authorized under the Program will likely have an extremely small impact on ESA-listed sea turtles at the species or DPS level. For most species and DPSs, research related mortalities will result in a decrease of less than 0.15 percent of the population every ten years. The populations that could potentially be most impacted are (in order of impact): West Pacific DPS of leatherback (0.53 percent), Kemp's ridley (0.35 percent), Central South Pacific DPS of green turtle (0.34 percent), and Central North Pacific DPS of green turtle (0.25 percent). Considering that such changes are projected over a ten year period, these estimated declines still represent a very small proportion of each population (i.e., from 0.025 to 0.053 percent annually). Since the abundance estimates used to calculate these proportions are of nesting females only, the estimated population impacts could be even smaller since some of the mortalities will likely be males or juveniles. In addition, as discussed above, several conservative assumptions were made in estimating the anticipated observed research and delayed mortalities for each species (or DPS). Thus, the proportion of each ESA-listed sea turtle population lethally taken (as shown in Table 25) likely represents a highly conservative estimate of the impact on these populations. In summary, there is no indication that the anticipated small amount of lethal take resulting from turtle research activities authorized as part of the Program poses a threat to the recovery of any ESA-listed sea turtle species or DPS.

## 8.6 Non-Target Species Exposure and Response Analysis

Several non-target ESA-listed species will be exposed to activities conducted under the Program. These species are Atlantic salmon, smalltooth sawfish, Atlantic sturgeon, shortnose sturgeon, green sturgeon, Gulf sturgeon, Nassau grouper, and scalloped hammerhead. Below we address the exposure, response, and risk to these species.

**Table 25. Proportion of all trawl captures, anticipated trawl captures, ten-year lethal take limits, estimated delayed mortalities, abundance estimates and population impact for each turtle species or distinct population segment.**

| | | | Number of Turtles Over 10 Year Period | | | | |
|---|---|---|---|---|---|---|---|
| Species and DPS | Proportion of All Trawl Captured Sea Turtles by Species | Anticipated trawl captures over 10 years (proportion of 8,749 turtles) | Estimated Delayed Mortality (0.1% of trawl captures) | Lethal Take Limits | Total Estimated Mortality | Abundance estimate | Population Impact (Total mortality divided by abundance) |
| Green North Atlantic | 17.53% | 1,533.70 | 1.53 | 15 | 17 | 167,424 Nesting females | 0.0101% |
| Green South Atlantic | 17.53% | 1,533.70 | 1.53 | 15 | 17 | 63,332 Nesting females | 0.0268% |
| Green Central West Pacific | 17.53% | 1,533.70 | 1.53 | 7 | 9 | 6,518 Nesting females | 0.1380% |
| Green Central South Pacific | 17.53% | 1,533.70 | 1.53 | 7 | 9 | 2,677 Nesting females | 0.3362% |
| Green Central North Pacific | 17.53% | 1,533.70 | 1.53 | 7 | 9 | 3,846 Nesting females | 0.2340% |
| Green East Pacific | 17.53% | 1,533.70 | 1.53 | 7 | 9 | 20,062 Nesting females | 0.0449% |
| Hawksbill | 2.64% | 230.97 | 0.23 | 15 | 16 | 22,004 Nesting females | 0.0727% |
| Kemp's ridley | 21.70% | 1,898.53 | 1.90 | 15 | 17 | 4,872 Nesting females | 0.3489% |
| Leatherback Northwest Atlantic subpopulation | 1.20% | 104.99 | 0.10 | 15 | 16 | 34,000 Adults | 0.0471% |
| Leatherback West Pacific subpopulation | 1.20% | 104.99 | 0.10 | 2 | 3 | 562 Nesting females | 0.5338% |
| Loggerhead Northwest Atlantic | 56.19% | 4,916.06 | 4.92 | 15 | 20 | 53,000 Nests annually | 0.0377% |
| Loggerhead North Pacific | 56.19% | 4,916.06 | 4.92 | 7 | 12 | 43,320 Individuals | 0.0277% |
| Olive ridley | 0.21% | 18.37 | 0.02 | 15 | 16 | 1.39 million Adults | 0.0012% |

### 8.6.1 Vessel Interactions

Sea turtle research vessels could potentially interact with the following non-target ESA-listed fish species as part of the proposed action: Atlantic salmon, smalltooth sawfish, Atlantic sturgeon, shortnose sturgeon, green sturgeon, Gulf sturgeon, Nassau grouper, and scalloped hammerhead. Vessel strike is identified as a threat to populations of Atlantic and shortnose sturgeon (ASSRT 2007; SSSRT 2010), but these interactions are limited mostly to shipping vessels heading to and from major ports in river environments. Green sturgeon, Gulf sturgeon and smalltooth sawfish may also be affected by vessel strike, although there is little available information on the impact of this threat on these or any other ESA-listed fish species considered in this opinion. While a sea turtle research vessel strike could result is serious injury or death, the likelihood of this occurring is extremely small (i.e., discountable) given that (1) there has never been a reported incident of a vessel strike on any species (listed or non-listed) by a NMFS permitted sea turtle researcher (NMFS 2017a), (2) vessel strikes of any marine fish species are generally a rare event, (3) turtle research vessels account for a very small fraction of vessel activity in the action area, and (4) research vessel operators are expected to be vigilant and proceed carefully to minimize risk of vessel strike and unnecessary disturbance when ESA-listed species may be in the area. In the unlikely event that a research vessel strikes an ESA-listed species, the researcher will be required to report the incident to the Permits Division.

The presence of a research vessel may disturb non-target fishes resulting in their movement away from the vessel for a short time. Reactions may include a brief startle response, diving, submerging, or attempting to evade the vessel or personnel. Based on the anticipated responses, any disruptions are expected to be temporary in nature, with animals resuming normal behaviors shortly after the exposure. No reduction in fitness or overall health of individual fish is anticipated due to the presence of sea turtle research vessels.

### 8.6.2 Capture by Entanglement, Pound, Seine, or Trawl Nets

Nets used by researchers to capture sea turtles could potentially interact with the following non-target ESA-listed fish species within the action area: Atlantic salmon, smalltooth sawfish, Atlantic sturgeon, shortnose sturgeon, green sturgeon, Gulf sturgeon, Nassau grouper, and scalloped hammerhead. The non-selective capture methods authorized as part of the Program that could result in the incidental capture of fish species are entanglement nets, pound nets, seines, and trawls. Some interactions between ESA-listed fish species and turtle research gear would likely occur as a result of the proposed action. If any non-target ESA-listed species is incidentally captured or harmed by research activities, all activities would be suspended until the Permits Division has granted approval to continue research.

Animals entangled or captured in nets can become stressed, harmed, injured, and/or die. Animals may experience additional stress and other adverse effects during subsequent handling for disentanglement and release. Signs of stress include reduced respiration and prolonged struggling while being held. Impacts to each species or taxa that may be affected by the proposed action are described below.

Except for pound nets, permits authorizing stationary netting would require that nets be continuously monitored for entanglements. This will ensure that all incidentally captured animals will be freed from the net as quickly as possible. As a result, the effects of temporary entanglement are, in most instances, expected to be minor and short-term, with resumption of normal behaviors to occur shortly after release. Pound nets are required to be checked every 24-hrs. However, fish should be able to swim freely within the pound until researchers are able to release them. Sea turtle research permits that authorize trawling would set a limit on the tow duration to minimize impacts to turtles and incidentally caught non-target species. Additional mitigation measures, as a condition of sea turtle research permits, designed to minimize effects on particular species, are describe below. Even with the required mitigation measures in place, we anticipate that some very small proportion of these interactions will result in mortality due to the effects of capture (e.g., entanglement in trawl net or other capture gear). The anticipated number of takes (lethal and sublethal) of ESA-listed fish species as a result of sea turtle research authorized under the Program is provided below for each non-target species or DPS that may be affected.

#### *8.6.2.1 Atlantic Salmon, Gulf of Maine Distinct Population Segment*

Adult Atlantic salmon ascend GOM rivers beginning in the spring and continuing into the fall, with the peak occurring in June. Salmon smolts leave the rivers and enter the sea during May and June to begin their ocean migration. Sea turtle research that occurs in the spring and early summer has the greatest potential for interacting with migrating adult and juvenile salmon. Based on currently authorized sea turtle research permits, the spatial overlap between research gear and GOM Atlantic salmon occurs exclusively in the marine environment. While future turtle research may occur in the lower portions of GOM rivers, we anticipate that sea turtle research in this region will continue to occur primarily in the marine environment.

Given the typical mesh size, location, set times, and water depth of sea turtle research gear, there is a low likelihood of Atlantic salmon incidental capture. Large net mesh sizes, that are often used for turtle research, are expected to have no effect on juvenile Atlantic salmon as these fish are too small to be vulnerable to entanglement. Interactions with adult Atlantic salmon are also not expected to occur with net mesh sizes of 12" or greater for the same reason. Incidental capture of large adult Atlantic salmon by sea turtle researchers could potentially occur with net mesh sizes of 12” or less. As smolts migrate from the rivers they tend to travel near the water surface. Atlantic salmon in the ocean are pelagic and also highly surface oriented (Kocik and Sheehan 2006). As such, Atlantic salmon are likely more vulnerable to sea turtle capture gears that occupy that upper portion of the water column. If an Atlantic salmon is taken as part of the proposed action it is most likely to be caught in an entanglement net or trawl.

While adult Atlantic salmon may be present in the action area year-round, based on historical commercial fisheries bycatch data, they are rarely captured in fishing nets in the marine environment. Northeast Fisheries Observer Program data indicate a total of 15 individual Atlantic salmon caught from 1989 through 2013 (NMFS 2013c). There is no information available on the genetics of these fish, so we do not know how many of these salmon were part of the GOM DPS. Of the observed incidentally caught Atlantic salmon, ten were listed as “discarded” (presumably alive) and five were listed as mortalities. The incidental takes of Atlantic salmon occurred using sink gillnets (11) and bottom otter trawls (4). Incidental capture of Atlantic salmon in sea turtle research nets are expected to be considerably lower than those reported by the Northeast Fisheries Observer Program since turtle research effort is extremely small compared to observed commercial fishing effort within the action area.

When captured in nets, Atlantic salmon mortality is usually the result of suffocation, exacerbated by high water temperatures and/or low DO. Wilkie et al. (1997) showed that salmon suffered 30 percent mortality when stressed for just six minutes in 23ºC water. Elevated water temperatures also make salmon more vulnerable to delayed mortality associated with their capture, which can occur for up to three days after being released (Wilkie et al. 1997). Atlantic salmon also suffer from impaired respiratory abilities when DO is below 5 milligrams per liter (Kazakov and Khalyapina 1981).

Capturing and handling salmon causes physiological stress and can result in physical injury such as scale loss. Although relatively high mortality rates have been reported for salmon captured in commercial gillnets, mortality risk can be effectively reduced when appropriate mitigation measures are implemented. While Atlantic salmon captured in turtle research gear could be injured due to stress from capture and handling, in most cases long-term or delayed effects of properly handled adult salmon are expected to be minimal, assuming researchers follow the sampling procedures and mitigation measures specified in their permit.

Although interactions between turtle research gear and GOM Atlantic salmon are expected to occur infrequently, it is likely that some small amount of incidental take will occur as part of the Program. While the incidental capture of GOM Atlantic salmon in capture gear used by turtle researchers (i.e., entanglement nets, pounds nets, seines and trawls) may result in short-term negative effects (i.e., elevated stress levels, net abrasion), with the exception of those extremely rare instances of capture mortality, these activities are not expected to result in reduced fitness or have any long-term adverse effects on individual fish. This conclusion can be reached as long as all of the sampling protocols, mitigation measures, and any other required conditions of the sea turtle research permit are closely followed by all permit holders.

We estimate that the Program will result in the take of up to three GOM DPS Atlantic salmon, including the lethal take of up to one GOM DPS Atlantic salmon, over any ten-year period. To arrive at this estimate we considered the history of sea turtle research interactions with Atlantic salmon, the mitigation measures in place to avoid future interactions, and the potential future

GOM DPS population growth that could increase the risk of exposure to sea turtle research sampling gear.

#### *8.6.2.2 Smalltooth Sawfish, U.S. Portion of Range Distinct Population Segment*

Spatial overlap documented in the ranges of sea turtle species and the U.S. portion of range smalltooth sawfish DPS is the main variable considered in anticipating future interactions with smalltooth sawfish and research authorized under the Program. Smalltooth sawfish are found in the peninsula of Florida, most commonly in the Everglades region at the southern tip of the state. This is also one of the most active geographic areas for sea turtle researchers. The Permits Division anticipates issuing several sea turtle research permits within the range of the smalltooth sawfish as part of the Program (NMFS 2017a). Sawfish coastal migratory behavior by individual adults and large juveniles in northeast Florida has been documented. These migratory movements are limited largely by cold intolerance (about 16 to 18 degrees Celsius and also by the lack of appropriate coastal foraging and habitat. Thus, the likelihood of turtle research gear interacting with sawfish becomes increasingly more remote as you move north up the Atlantic coast.

The morphology of the smalltooth sawfish causes it to be particularly vulnerable to entanglement in any type of non-selective netting gear used in sea turtle research, including the relatively small-mesh webbing used in trawls, seines, and entanglement nets. The long toothed rostrum of the species penetrates easily through nets, causing the animal to become entangled when it attempts to escape. The entanglement nets and trawl nets used in sea turtle research can result in the take of smalltooth sawfish based on historical data on incidental captures in commercial fisheries (Simpfendorfer and Wiley 2005). Henshall (1894) noted that the smalltooth sawfish "does considerable damage to turtle nets and other set nets by becoming entangled in the meshes and is capable of inflicting severe wounds with its saw, if interfered with." Reports of smalltooth sawfish becoming entangled in fishing nets are common in the early literature from areas where they were once common, but are now rare (if not extirpated), including Florida (Snelson 1981), Louisiana (Simpfendorfer 2002), and Texas (Baughman 1943). Reported smalltooth sawfish injuries and mortalities in commercial fishing operations were due largely to the difficulty of safely removing sawfish from fishing gear without damaging the gear. This often meant removal of the saw before returning the fish to the water to starve to death, or killing the sawfish in the net and dropping the carcass overboard. The Permits Division has implemented the following mitigation measures designed to minimize adverse effects and the risk of mortality if a sawfish is captured incidentally:

- Researchers operating in areas where sawfish are present are required to be trained by a member of the NMFS sawfish recovery team to discuss proper handling procedures.
- When attempting to handle and release an incidentally captured sawfish, researchers must use caution and follow safe-handling procedures specified in the NMFS Sawfish Handling and Release Guidelines.

- Researchers must keep the fish in the water at all times and cutting the net from the rostrum and body of the animal (no attempts should be made to disentangle the rostrum from the net).
- Adverse interactions with sawfish should be documented, including any pertinent details of the interaction (e.g., gear type, what was done to handle and release the animals, location, date, size, water and air temperatures, and photos if possible).

Although interactions between turtle research gear and smalltooth sawfish are expected to occur infrequently, it is likely that some small amount incidental take will occur as part of the Program. A total of four smalltooth sawfish interactions have been reported by researchers or commercial vessels in the last 15 years in the northern range of sawfish; one lethal and three non-lethal. Incidental take statements in a 2016 batched biological opinion for three sea turtle permit actions (Permit Nos. 18926, 19528, and 19621) authorized up to five smalltooth sawfish takes (all non-lethal) over the five years of the permitted actions. While the incidental capture of smalltooth sawfish in capture gear used by turtle researchers (i.e., entanglement nets, pounds nets, seines and trawls) may result in short-term negative effects (i.e., elevated stress levels, net abrasion), with the exception of those extremely rare instances of capture mortality, these activities are not expected to result in reduced fitness or have any long-term adverse effects on individual fish. This conclusion can be reached as long as all of the sampling protocols, mitigation measures, and any other required conditions of the sea turtle research permit are closely followed by all permit holders.

We estimate that the Program will result in the take of up to five U.S. portion of range DPS of smalltooth sawfish, including the lethal take of up to two smalltooth sawfish, over any ten year period. To arrive at this estimate we considered the history of sea turtle research interactions with smalltooth sawfish, the mitigation measures in place to avoid or minimize the effects of future interactions, and the potential future smalltooth sawfish population growth that could increase the risk of exposure to sea turtle research sampling gear.

#### *8.6.2.3 Sturgeon Species*

The proposed action anticipates multiple sea turtle research permits may be issued within the ranges of all five DPSs of Atlantic sturgeon, shortnose sturgeon, Gulf sturgeon, and Southern DPS green sturgeon. There have been no reported incidental takes of sturgeon during permitted sea turtle research. However, the use of non-selective capture gear (e.g., entanglement nets and trawls) by turtle researchers could result in the future incidental capture of these sturgeon species. Due to their life history, all four sturgeon species considered in this opinion could potentially interact with sea turtle research gear in marine, coastal, and estuarine environments.

Entanglement in research nets used to capture sea turtles can constrict a sturgeon's gills, resulting in increased stress and risk of suffocation (Collins et al. 2000; Kahn and Mohead 2010; Moser et al. 2000). Sturgeon stress and mortality associated with capture in nets has been directly related to environmental conditions. However, except for very rare instances, results from previous sturgeon research indicate that capture in nets does not cause any effects on the vast majority of fish beyond 24 hours. For all species of sturgeon, research has revealed that stress from capture is affected by temperature, DO, and salinity, and this vulnerability may be increased by the research-related stress of capture, holding, and handling (Kahn and Mohead 2010). Other factors affecting the level of stress or mortality risk from netting include the amount of time the fish is caught in the net, mesh size, net composition, and, in some instances, the researcher's experience level or preparedness. Analysis of the empirical evidence suggests that individuals collected in high water temperatures and low DO concentrations, combined with longer times between net checks, were more at risk of elevated stress and mortality (Kahn and Mohead 2010). As a condition of their permit, turtle researchers will be required to take necessary precautions while deploying capture gear to ensure target and non-target ESA-listed species are not unnecessarily harmed, including: (1) continuously monitoring nets, (2) removing animals from nets as soon as capture is recognized, and (3) limiting the time and depth for use of trawling gear. These actions are expected to substantially reduce the likelihood of injuring or killing sturgeon during research activities. Sturgeon may also be incidentally captured in pound nets and seines during sea turtle research. Since fish trapped in these gears would typically be free swimming, as opposed to gilled or confined, the likelihood of stress or injury from pound nets or seines is lower than from entanglement nets or trawls.

Although interactions between turtle research gear and ESA-listed sturgeon species are expected to occur infrequently, it is likely that some small amount incidental take will occur as part of the Program. Only one currently active sea turtle permit has an ITS for an ESA-listed species of sturgeon (Permit No. 19621 ITS for Atlantic and shortnose sturgeon take). While the incidental capture of ESA-listed sturgeon species in capture gear used by turtle researchers (i.e., entanglement nets, pounds nets, seines and trawls) may result in short-term negative effects (i.e., elevated stress levels, net abrasion), with the exception of those extremely rare instances of capture mortality, these activities are not expected to result in reduced fitness or have any long-term adverse effects on individual sturgeon. This conclusion can be reached as long as all of the sampling protocols, mitigation measures, and any other required conditions of the sea turtle research permit are closely followed by all permit holders. While the proposed mitigation measures will likely minimize the adverse effects of this take, a very small number of sturgeon mortalities may still occur due to the stress and injury associated with capture and handling.

We estimate that the Program will result in the take of up to six Atlantic sturgeon (all five DPSs combined), including the lethal take of up to one Atlantic sturgeon, over any ten year period. We estimate that the Program will result in the take of up to three shortnose sturgeon, including the lethal take of up to one shortnose sturgeon, over any ten year period. We estimate that the Program will result in the take of up to five Gulf sturgeon, including the lethal take of up to one Gulf sturgeon, over any ten-year period. We estimate that the Program will result in the take of up to two Southern DPS green sturgeon, including the lethal take of up to one Southern DPS green sturgeon, over any ten-year period.

To arrive at these estimates we considered the history of sea turtle research interactions with ESA-listed sturgeon species, the mitigation measures in place to avoid or minimize the effects of future interactions, and the potential future sturgeon population growth that could increase the risk of exposure to sea turtle research sampling gear.

#### *8.6.2.4 Nassau Grouper*

Nassau grouper's distribution include Bermuda, Florida, Bahamas and the Caribbean Sea. Due to their life history, Nassau grouper presence would overlap with sea turtle research in both marine and coastal environments. Although there have been no reported interactions with Nassau grouper by permitted sea turtle researchers, this species could potentially be captured in trawls, seines or pound nets used for sea turtle capture. Incidental capture in entanglement nets is less likely given the large net mesh sizes typically used by turtle researchers in comparison with the body size (or girth) of Nassau grouper. Nassau grouper form large aggregations to spawn, which makes them particularly vulnerable to capture in fishing gear during these times of year. To mitigate the potential interaction with Nassau grouper at times of spawning, as part of the Program the Permits Division would require researchers to avoid known spawning aggregation areas when using non-selective capture methods.

While the incidental capture of Nassau grouper in capture gear used by turtle researchers (i.e., entanglement nets, pounds nets, seines and trawls) may result in short-term negative effects (i.e., elevated stress levels, net abrasion), these activities are not expected to result in reduced fitness or have any long-term adverse effects on individual fish. This conclusion can be reached as long as all of the sampling protocols, mitigation measures, and any other required conditions of the sea turtle research permit are closely followed by all permit holders.

We estimate that the Program will result in the take of up to two Nassau grouper, including the lethal take of up to one Nassau grouper, over any ten year period. To arrive at this estimate we considered the history of sea turtle research interactions with Nassau grouper, the mitigation measures in place to avoid or minimize the effects of future interactions, and the potential future Nassau grouper population growth that could increase the risk of exposure to sea turtle research sampling gear.

#### *8.6.2.5 Scalloped Hammerhead Shark*

The scalloped hammerhead shark is circumglobal species inhabiting warm temperate and tropical seas. They can be found over continental and insular shelves as well as adjacent deep waters, ranging from intertidal and surface to depths exceeding 400 meters. As part of the Program, sea turtle research permits may be issued within the range of any of the three scalloped hammerhead DPSs (Eastern Pacific, Central and Southwest Atlantic, and Indo-West Pacific) considered in this opinion. Scalloped hammerhead sharks are commonly caught in commercial gillnet and trawl fisheries (Miller et al. 2013). Although there have been no reported interactions with scalloped hammerhead by permitted sea turtle researchers, this species could potentially be captured incidentally in any of the non-selective capture gears used for to capture sea turtles.

Turtle researchers at the NMFS Pacific Islands Fisheries Science Center have listed this species as a potential bycatch in past research permits.

Hammerhead sharks are obligate ram ventilators and have been known to suffer high mortality rates in bottom longline fisheries (Macbeth and Macbeth 2009; Morgan and Burgess 2007). However, longlines will not be authorized for sea turtle research under the Program. Sharks can also experience high mortality rates in commercial gill (entanglement) net fisheries with long (i.e., 12 to 48 hour) soak times. However, as a condition of the permit, all bycatch must be released immediately upon capture and all sea turtle research gear, except pound nets, must be monitored continuously. With continuous net monitoring, turtle researchers will be able to respond quickly to bycatch in order minimize the effects of capture on individual sharks. If a scalloped hammerhead shark is incidentally captured by a sea turtle researcher, we anticipate the effects to be minor in nature (i.e., short-term stress) and dissipate shortly after release. While the incidental capture of scalloped hammerhead sharks in capture gear used by turtle researchers (i.e., entanglement nets, pounds nets, seines and trawls) may result in short-term negative effects (i.e., elevated stress levels, net abrasion), these activities are not expected to result in reduced fitness or have any long-term adverse effects on individual fish. This conclusion can be reached as long as all of the sampling protocols, mitigation measures, and any other required conditions of the sea turtle research permit are closely followed by all permit holders.

Although interactions between turtle research gear and scalloped hammerhead sharks are expected to occur infrequently, it is likely that some small amount incidental take will occur as part of the Program. While the incidental capture of scalloped hammerhead sharks in capture gear used by turtle researchers (i.e., entanglement nets, pounds nets, seines and trawls) may result in short-term negative effects (i.e., elevated stress levels, net abrasion), with the exception of those extremely rare instances of capture mortality, these activities are not expected to result in reduced fitness or have any long-term adverse effects on individual sharks. This conclusion can be reached as long as all of the sampling protocols, mitigation measures, and any other required conditions of the sea turtle research permit are closely followed by all permit holders.

We estimate that the Program will result in the take of up to two scalloped hammerhead sharks from any of the three DPSs (Eastern Pacific, Central and Southwest Atlantic, and Indo-West Pacific) combined, including the lethal take of up to one scalloped hammerhead shark, over any ten year period. To arrive at this estimate we considered the history of sea turtle research interactions with scalloped hammerheads, the mitigation measures in place to avoid or minimize the effects of future interactions, and the potential future scalloped hammerhead population growth that could increase the risk of exposure to sea turtle research sampling gear.

### 8.6.3 Acoustic Research

#### *8.6.3.1 Tank-based Studies*

We anticipate no route of effect to other listed species or designated critical habitat because 1) these trials would occur in a tank in a permitted facility and 2) permit holders are required to follow the permit conditions (found in Appendix C) to safely capture, handle, sample, and hold animals. These permit conditions include abiding by U.S. Fish and Wildlife Service's (USFWS) care and maintenance requirements when animals are temporarily held in a facility. USFWS requirements include quarantine of wild animals in captivity to prevent disease transmission to other animals. USFWS holding protocols can be found at: https://www.fws.gov/northflorida/seaturtles/Captive_Forms/20130213_revised%20_standard_permit_conditions_for_captive_sea_turtles.pdf). Therefore, any impacts to non-target animals or critical habitat would not extend beyond those impacts previously described and analyzed in the programmatic biological opinion (NMFS 2017b) for issuance of any associated procedures (e.g., capture, handling, exam, etc.) that fall within the scope of the consultation. We find it extremely unlikely (i.e., discountable) that tank-based acoustic research activities would result in adverse effects on non-target ESA-listed sea turtles, other listed species or designated critical habitat. Therefore, we concur with the Permits Division that tank-based acoustic studies as proposed when combined with other authorized take activities in the wild (e.g., capture) may affect but are not likely to adversely affect non-target sea turtles, other listed species or designated critical habitat, as concluded for the original programmatic consultation. We expect no effect to non-target species in the wild from the tank-based studies carried out in captive facilities.

#### *8.6.3.2 ADDs in the Wild*

Very few studies have been conducted on the below listed species so some of the hearing ranges discussed are from surrogate species or species in the same taxa or genus. The following table identifies the listed fishes and their hearing ranges which may be found in the area where ADDs may be used by researchers:

**Table 26. Hearing ranges of ESA-listed fishes in the area where ADDs may be used by researchers.**

| Species and Listing Units | Hearing Range (Hz) |
|---|---|
| Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*) Gulf of Maine, New York Bight, Chesapeake Bay, Carolina, and South Atlantic distinct population segments (DPSs) | ~100 – 1,000 Hz |
| Giant manta ray (*Manta birostris*) | <100 – 1,000 Hz; best between 20 – 100 Hz |
| Gulf sturgeon (*Acipenser oxyrinchus desotoi*) | ~100 – 1,000 Hz |
| Oceanic whitetip shark (*Carcharhinus longimanus*) | <100 – 1,000 Hz; best between 20 – 100 Hz |
| Nassau grouper (*Epinephelus striatus*) | 100 – 300 Hz |
| Scalloped hammerhead shark (*Sphyrna lewini*) Central and Southwest Atlantic DPS | <100 – 1,000 Hz; best between 20 – 100 Hz |
| Shortnose sturgeon (*A. brevirostrum*) | ~100 – 1,000 Hz |

| | |
|---|---|
| Smalltooth sawfish<br>(*Pristis pectinata*) | ~100 – 1,000 Hz |

Permanent hearing loss or PTS has not been documented in fish; sensory hair cells of the inner ear in fish can regenerate after they are damaged (Department of Navy 2017). Studies examining the effects of sound exposures from Surveillance Towed Array Sensor System Low-Frequency Active sonar on fish hearing where the maximum received sound pressure levels were 193 dB re 1 μPa showed temporary hearing loss in some species (rainbow trout and char fish) (Department of Navy 2017). Mid-frequency active sonar (210 dB re 1 μPa received sound level) tested on four fish species (rainbow trout, channel catfish, largemouth bass, and yellow perch) did not result in hearing loss. The sound pressure levels (dB) produced by the ADD (less than 153dB) are well below levels predicted to cause physiological damage to marine species; however, they may cause behavioral responses in the fish species that are able to detect them. Studies of the effects of long-duration sounds with sound pressure levels below 170 to 180 dB re 1 μPa (source level) indicate that there is little to no effect of long-term exposure on species that lack hearing specialization (Amoser and Ladich 2003; Scholik and Yan 2001; Smith et al. 2004).

Many hearing generalist fish species have hearing ranges that overlap with the range of the ADD frequencies that could be authorized for research. For example, tuna responded to sound frequencies that overlap with frequencies sea turtles respond to which may result in sound frequencies used to deter sea turtles in the longline fishery, also deter the target species, tuna (Bartol and Ketten 2006). The hearing sensitivity of manta rays is unknown but that of most elasmobranchs is very acute. Studies have shown sharks most sensitive to low frequency sounds in the vicinity of 100 Hz, the frequency often produced by struggling prey (Department of Navy 2017). However, sharks are not known to be attracted to continuous signals or higher frequencies; best hearing sensitivity if ~20 Hz and drops off above 1000 Hz (Casper and Mann 2006; Casper and Mann 2009). Although audiograms have not been develop for listed bony fishes such as sturgeon (*Acipenser* spp.) and smalltooth sawfish, their hearing ranges may overlap with ADDs in a similar manner as Atlantic salmon. Initial studies by Meyer and Popper (unpublished) measuring responses of the ear using physiological methods suggest that a species of *Acipenser* may be able to detect sounds from below 100 Hz to perhaps 1,000 Hz or a bit more; however, thresholds were not determined (Popper 2005). Other studies suggest sturgeon species could detect sounds up to 400 or 500 Hz (Lovell et al. 2005; Meyer et al. 2010). Red grouper (*Epinephelus morio*) produce sounds between 100 to 300 Hz for communication; hence, the hearing sensitivity for this genus, *Epinephelus*, should be within this range (Wall et al. 2011).

Auditory masking may occur for some fish species whose hearing range overlaps with the frequencies produced by the ADDs. Masking could hinder a fish's ability to detect predators – increasing predation risk – or affect communication in fish (Department of Navy 2013). However, we expect listed fish to move away from the immediate vicinity of an ADD resulting in insignificant effects from auditory masking.

Information on impacts to sensitive life stages (larval fish or shark pups) is very limited. A review of the literature does not indicate that shark pups are any more sensitive than adults to acoustic noise. Larvae for most species would be dispersed in the coastal environment. Listed sturgeon species spawn in tidal freshwater areas and do not emerge into the coastal environment until almost two years of age. Nassau grouper and some reef fish may be vulnerable to masking if they use auditory cues from the reef for navigation. However, larval life stages of grouper and reef fish are not likely to be found in the action area of the U.S. East Coast as described for ADDs in the wild. Not only would it be impractical to set a tangle or pound net on or directly next to a reef, the Permit Division’s standard permit conditions (Appendix C) preclude researchers from setting nets over reefs and living bottom habitat. Finally, as discussed previously for sea turtles, because we expect ADD sounds to be localized with short propagation, only the occasional individual fish may be affected, but not adversely affected. For these reasons, we believe various life stages of these listed fish species would have a similar response as already discussed in this section.

We expect ESA-listed fish species to have similar behavioral responses as sea turtles, with responses such as a brief startle or temporarily moving away from the sound source. Therefore, we concur that the use of ADDs in the wild may affect but is not likely to affect ESA-listed fish species.

### 8.7 Non-Target Species Risk Analysis

Based on our exposure and response analysis of the effects of the Program on non-target ESA-listed fish species, we anticipate that a small number of takes will occur as a result of incidental capture in sea turtle research gear. The large majority of these takes are not expected to result in reduced fitness or have any long-term adverse effects on individual fish. However, a small number of interactions could result in mortality (i.e., lethal take) of individual fish from any of the following ESA-listed species: Atlantic salmon, smalltooth sawfish, Atlantic sturgeon, shortnose sturgeon, green sturgeon, Gulf sturgeon, Nassau grouper, and scalloped hammerhead. Lethal interactions would reduce the population size, compared to their numbers in the absence of the proposed action, assuming all other variables remained the same. Lethal interactions would also result in a potential reduction in future reproduction, assuming some individuals would be females and would have otherwise survived to reproduce. A lethal capture of an adult female would remove this level of reproductive output from the species. Whether the reductions in numbers and reproduction of the species or DPS would appreciably reduce its likelihood of survival depends on the probable effect the changes in numbers and reproduction would have relative to current population sizes and trends. As part of our risk analysis, we assess the likely effects those mortalities may have on the viability of the populations those individuals represent, and the species those populations comprise.

### 8.7.1 Atlantic Salmon, Gulf of Maine Distinct Population Segment

The observed declines in Atlantic salmon suggests that the combined impacts from ongoing activities described in the *Environmental Baseline, Cumulative Effects,* and the *Status of ESA-Listed Species* are continuing to cause the population to deteriorate. For the population to remain stable, Atlantic salmon must replace themselves through successful reproduction at least once over the course of their reproductive lives, and at least one offspring must survive to reproduce itself. If the survival rate to maturity is greater than the mortality rate of the population, the loss of breeding individuals would be exceeded through recruitment of new breeding individuals from successful reproduction of Atlantic salmon that were not seriously injured or killed.

The most recent data available on the population trend of Atlantic salmon indicate that their abundance within the range of the GOM DPS has been generally declining since the 1800s (Fay et al. 2006a). Contemporary estimates of abundance for the entire GOM DPS have rarely exceeded 5,000 individuals in any given year since 1967, and appear to have stabilized at very low levels since 2000 (Fay et al. 2006a). After a period of slow population growth between the 1970s and the early 1980s, adult returns of salmon in the GOM DPS peaked around 1985 and declined through the 1990s and early 2000s. Adult returns have been increasing again over the last few years. The population growth observed in the 1970s is likely attributable to favorable marine survival and increases in hatchery capacity. Marine survival remained relatively high throughout the 1980s, and salmon populations in the GOM DPS remained relatively stable until the early 1990s. In the early 1990s, marine survival rates decreased, leading to the declining trend in adult abundance observed throughout 1990s and early 2000s. The increase in the abundance of returning adult salmon observed between 2008 and 2011 may be an indication of improving marine survival. Adult returns for the GOM DPS remain well below conservation spawning escapement (CSE) goals that are widely used (ICES 2015) to describe the status of individual Atlantic salmon populations. When CSE goals are met, Atlantic salmon populations are generally self-sustaining. When CSE goals are not met (i.e., less than 100 percent), populations are not reaching full potential; and this can be indicative of a population decline. For all GOM DPS rivers in Maine, current Atlantic salmon populations (including hatchery contributions) are well below CSE levels required to sustain themselves (Fay et al. 2006a), which is further indication of their poor population status.

While the abundance trend information for Atlantic salmon is either stable or declining, we believe the extremely small numbers of anticipated lethal interactions attributed to sea turtle research will not have any measurable effect on that trend. We anticipate no more than one GOM Atlantic salmon mortality every ten years, or 0.1 mortalities per year on average, due to the proposed action. This represents about 0.01 percent of the estimated adult returns in 2015, and about 0.02 percent of the lowest value of estimated adult returns (i.e., 405 fish in 2014) over the past several decades (USASAC 2016). The anticipated mortalities represent an even smaller proportion of the number of adult Atlantic salmon that are stocked in Maine rivers every year (e.g., 3,066 in 2015). Similarly, we do not anticipate any long-term adverse effects on either individual fish or the GOM DPS resulting from the capture and live release of Atlantic salmon by turtle researchers.

Recent efforts to help Atlantic salmon recover include hatchery supplementation, dam removal, improving road crossings that block passage or degrade stream habitat, protecting riparian corridors, reducing the impact of irrigation water withdrawals, limiting effects of recreational and commercial fishing, reducing the effects of finfish aquaculture, outreach and education, and research activities. Improving the survival of Atlantic salmon in the marine environment is an important part of meeting the objective of GOM DPS Atlantic salmon recovery.

The proposed research activities have numerous mitigation measures intended to reduce the probability of interaction and to minimize the probability of mortality in the event of interactions. No acoustic research of ADDs would take place in the range of the GOM DPS of Atlantic salmon. In summary, there is no indication that the anticipated extremely small amount of Atlantic salmon take (lethal or sublethal) resulting from turtle research activities poses a threat to the recovery of the GOM DPS of Atlantic salmon.

### 8.7.2 Smalltooth Sawfish, U.S. Portion of Range Distinct Population Segment

The abundance of smalltooth sawfish in U.S. waters has decreased dramatically over the past century. However, recent information indicates the smalltooth sawfish population is likely stable or increasing (Carlson and Osborne 2012; Carlson and Simpfendorfer 2015). Data analyzed from the Everglades portion of the smalltooth sawfish range suggests that the population growth rate for that region may be around five percent per year (Carlson and Osborne 2012; Carlson et al. 2007). Intrinsic rates of growth ($\lambda$) for smalltooth sawfish have been estimated at 1.08-1.14 per year and 1.237 to 1.150 per year by Simpfendorfer (2000) and Carlson and Simpfendorfer (2015) respectively. Although this rate is very slow, any potential lethal interactions and probable nonlethal interactions with turtle sampling gear are not likely to occur at levels sufficient to reverse these trends. Chapman et al. (2011) found the remnant smalltooth sawfish population exhibits high genetic diversity (allelic richness, alleles per locus, heterozygosity) and will likely retain greater than 90 percent of its current genetic diversity over the next century. NMFS is currently funding several actions identified in the recovery plan for smalltooth sawfish including adult satellite tagging studies and monitoring take in commercial fisheries. Additionally, NMFS has developed safe handling guidelines for the species. For acoustic-based research, audiograms have not been developed for smalltooth sawfish, however their hearing ranges may overlap with ADDs in a similar manner as Atlantic salmon (Table 26). If any overlap occurs with the frequency of the acoustic work, we would expect the fish to move away for the immediate vicinity, resulting in insignificant effects from auditory masking.

We expect that the very small numbers of lethal interactions (i.e., up to two every ten years) attributed to sea turtle research will not have any measurable effect on the smalltooth sawfish population trend. Similarly, we do not anticipate any long-term adverse effects on either individual fish or the population resulting from the capture and live release of smalltooth sawfish by turtle researchers. In summary, there is no indication that the anticipated small amount of smalltooth sawfish take resulting from turtle research activities authorized as part of the Program poses a threat to the recovery of the U.S. portion of the range DPS of this species.

### 8.7.3 Sturgeon Species

Due to their life history traits, sturgeon populations are more sensitive to adult mortality than many other species of fish (Boreman 1997; Gross et al. 2002; Secor et al. 2002). Given their large body size and high fecundity, mortality of adult sturgeon can result in negative population levels impacts, especially in very small sturgeon subpopulations found within some particular river systems. The viability of some sturgeon populations may also be highly sensitive to increases in juvenile mortality that result in chronic reductions in the number of subadults that recruit into the adult breeding population (Anders et al. 2002; Gross et al. 2002; Secor et al. 2002). The mortality of any individual fish from a population represents the loss of 100 percent of that fish's reproductive potential. For long-lived species, such as Atlantic and shortnose sturgeon, mortality of juveniles or subadults affects future reproductive potential and could have effects on a population for decades.

The largest estimated adult Atlantic sturgeon river populations are currently found within the New York Bight DPS (3,000 in Hudson River; 1,305 in Delaware River), the South Atlantic DPS (1,325 in the Altamaha River; 745 in the Savannah River), GOM DPS (865 in Kennebec River), and the Chesapeake DPS (705 in the James River). The Carolina DPS of Atlantic sturgeon likely has the smallest adult population size among the five ESA-listed DPSs, although a population estimate has only been published for one river system (Roanoke) within this DPS. Published estimates of Atlantic sturgeon juvenile abundance are available in the following river systems: 4,314 age 1 fish in the Hudson in 1995 (Peterson et al. 2000); 3,656 age 0-1 fish in the Delaware in 2014(Hale et al. 2016); between 1,072 to 2,033 age 1-2 fish on average from 2004 to 2007 in the Altamaha - (Schueller and Peterson 2010); and 154 age 1 fish in 2010 in the Satilla (Fritts et al. 2016).

The 2010 SSSRT conducted a three-step risk assessment for shortnose sturgeon at a riverine scale: (1) assess population health, (2) populate a "matrix of stressors" by ranking threats, and (3) review assessment by comparing population health scores to stressor scores. The Hudson River had the highest estimated adult abundance (30,000 to 61,000), followed by the Delaware (12,000), Kennebec Complex (9,000), and Altamaha (6,000) (SSSRT 2010). The SSSRT found evidence of an increasing abundance trend for the Kennebec Complex and ACE Basin populations; a stable trend for the Merrimack, Connecticut, Hudson, Delaware, Winyah Bay Complex, Cooper, Savannah, Ogeechee, and Altamaha populations; and a declining trend only for the Cape Fear population (all other populations had an unknown trend) (SSSRT 2010).

The largest estimated populations of Gulf sturgeon are found in the Suwannee (14,000), Choctawhatchee (3,314), and Yellow (911) rivers (USFWS and NMFS 2009). The most recent population estimates for the other four rivers with known reproducing populations are all below

500. In general, gulf sturgeon populations in the eastern portion of the range appear to be stable or slightly increasing, while populations in the western portion are associated with lower abundances and higher uncertainty (USFWS and NMFS 2009).

Based on survey data from 2010 to 2014, the total number of adults in the Southern DPS population is estimated to be 1,348 (95 percent confidence interval ± 524) (Mora 2015; NMFS 2015c). The recovery potential for Southern DPS green sturgeon is considered moderate to high; however, certain life history characteristics (e.g., long-lived, delayed maturity) indicate recovery could take many decades, even under the best circumstances (NMFS 2010a).

Although sturgeon populations can be particularly sensitive to anthropogenic sources of mortality, the number of sturgeon mortalities resulting from the proposed action are expected to be extremely small relative to the population sizes of the affected ESA-listed species or DPSs. For Atlantic sturgeon, only one lethal take is anticipated every ten years for any of the five ESA-listed DPSs combined. Similarly, we anticipate that the proposed action will result in the lethal take of up to one Gulf sturgeon, one Southern DPS green sturgeon, and one shortnose sturgeon over any ten-year period. These lethal take estimates represent a very small fraction of the total population, even for the smallest sturgeon populations, based on available abundance information. One mortality every ten years also represents a mortality rate that is several orders of magnitude lower than the commercial fishing bycatch mortality rate of three percent estimated by Kahnle et al. (1998) to keep the Hudson River Atlantic sturgeon population stable or increasing. For acoustic-based research, audiograms have not been developed for sturgeon, however their hearing ranges may overlap with ADDs in a similar manner as other bony fishes (Table 26). If any overlap occurs with the frequency of the acoustic work, we would expect the fish to move away for the immediate vicinity, resulting in insignificant effects from auditory masking. As such, research on sea turtle ADDs in the wild is not likely to adversely affect ESA-listed sturgeon species.

We expect that the very small numbers of lethal interactions (i.e., up to one every ten years) attributed to sea turtle research will not have any measurable effect on sturgeon population sizes or abundance trends. Similarly, we do not anticipate any long-term adverse effects on either individual fish or the population resulting from the capture and live release of sturgeon by turtle researchers. In summary, there is no indication that the anticipated small amount of take resulting from turtle research activities authorized as part of the Program poses a threat to the recovery of any of the five DPSs of Atlantic sturgeon, shortnose sturgeon, Gulf sturgeon, or the Southern DPS of green sturgeon.

### 8.7.4 Nassau Grouper

There is no range-wide abundance estimate or population growth rate available for Nassau grouper. Although relative abundance has been reduced compared to historical levels, spawning still occurs and abundance is increasing in some locations, such as the Cayman Islands and Bermuda. Available information from observations of spawning aggregations has shown steep declines (Aguilar-Perera 2006; Claro and Lindeman 2003; Sala et al. 2001); however, some aggregation sites are comparatively robust and show signs of increase (Vo et al. 2014; Whaylen et al. 2004).

We expect that the very small numbers of lethal interactions (i.e., one every ten years) attributed to sea turtle research will not have any measurable effect on Nassau grouper population size or growth rate. Similarly, we do not anticipate any long-term adverse effects on either individual fish or the population resulting from the capture and live release of Nassau grouper by turtle researchers. While Nassau grouper populations are particularly vulnerable to anthropogenic mortality during the formation of large spawning aggregations, the Program includes mitigation measures designed to minimize this risk during these critical periods in the species life history. For acoustic-based research, red grouper (*Epinephelus morio*) produce sounds between 100 to 300 Hz for communication, so Nassau grouper should be in this range (Table 26). If any overlap occurs with the frequency of the acoustic work, we would expect the fish to move away for the immediate vicinity, resulting in insignificant effects from auditory masking. Nassau grouper and some reef fish may be vulnerable to masking if they use auditory cues from the reef for navigation. However, larval life stages of grouper and reef fish are not likely to be found in the action area of the U.S. east coast as described for ADDs in the wild. In summary, there is no indication that the anticipated small amount of take resulting from turtle research activities authorized as part of the Program poses a threat to the recovery of Nassau grouper.

### 8.7.5 Scalloped Hammerhead Shark

According to the most recent stock assessment, the Northwestern Atlantic and Gulf of Mexico scalloped hammerhead stock has declined to a relatively low level of abundance in recent years (Hayes et al. 2009). Populations in other parts of the world are assumed to have suffered similar declines, however data to conduct stock assessments on those populations are currently lacking. Historical estimates of effective population size in the Eastern Pacific DPS range from 34,995 to 43,551 individuals (Nance et al. 2011). Nance et al. (2011) estimate that the current effective population size is significantly smaller (one to three orders of magnitude) than the historical effective population size, indicating that scalloped hammerheads in the eastern Pacific experienced a bottleneck and suffered significant declines. Although abundance estimates and quality catch data are unavailable for the Central and Southwest Atlantic DPS, the evidence of heavy fishing pressure off the coast of Brazil, Central America, and the Caribbean, with documented large numbers of juvenile and neonate landings, suggests this DPS is likely approaching a level of abundance and productivity that places its current and future persistence in question (Miller et al. 2014). Abundance estimates are also lacking for the Indo-West Pacific DPS, although documented trends in abundance in particular areas suggest significant depletions of local populations.

Scalloped hammerhead sharks have a life history that is susceptible to overharvesting (i.e., long-lived, late maturity, low reproductive rates). Although data are limited, the available information indicates that the three DPSs of scalloped hammerhead that occur within the action area remain at risk from both directed and incidental take by commercial fisheries. Any additional sources of anthropogenic mortality will compound the risk to hammerhead populations from fishing operations. However, the anticipated number of mortalities (one every ten years for any of the three DPSs combined) resulting from the proposed action are orders of magnitude smaller than the anticipated mortalities from future commercial fisheries based on historical data. For acoustic-based research, scalloped hammerheads have a range similar to bony fish with a sensitivity from 20 to 100 Hz (Table 26). If any overlap occurs with the frequency of the acoustic work, we would expect the sharks to move away for the immediate vicinity, resulting in insignificant effects from auditory masking. As such, research on sea turtle ADDs in the wild is not likely to adversely affect ESA-listed scalloped hammerhead sharks. In addition, we do not anticipate any long-term adverse effects on either individual fish or the population resulting from the capture and live release of scalloped hammerhead sharks by turtle researchers. In summary, there is no indication that the anticipated small amount of take resulting from turtle research activities authorized as part of the Program poses a threat to the recovery of the following scalloped hammerhead DPSs: Eastern Pacific, Central and Southwest Atlantic, and Indo-West Pacific.

# 9 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 area of the Federal action 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.

This section attempts to identify the likely changes present in the future and their impact on ESA-listed or proposed species and their critical habitats in the action area. This section is not meant to be a comprehensive socio-economic evaluation, but a brief outlook on future changes on the environment. Projections are based upon recognized organizations producing best-available information and reasonable rough-trend estimates of change stemming from these data. However, all changes are based upon projections that are subject to error and alteration by complex economic and social interactions. During this consultation, we searched for information on future state, tribal, local, and private (non-Federal) actions reasonably certain to occur in the action area. Based on this search, we expect the same threats currently facing the species as described in the Environmental Baseline (Section 7) will continue in the future. These include global climate change, habitat degradation, marine debris, pollutants, oil spills, anthropogenic sound, industrial and power generating plants, dredging, hydromodification projects, and fisheries bycatch. For sea turtles, stranding data indicate mortality can result from various natural causes, including cold stunning, as well as human activities, such as incidental capture in state fisheries, ingestion of or entanglement in debris, vessel strikes, and degradation of nesting habitat. We anticipate the effects of these stressors to continue in the future. While some of these threats would involve a federal nexus and be subject to future ESA section 7 consultation, others will be entirely under the jurisdiction of state, tribal, or local authorities. An increase in these threats could result in increased effects to ESA-listed species, and for some (e.g., global climate change and habitat degradation) an increase in the future is considered reasonably certain to occur.

Probably one of the most certain future changes that ESA-listed species within the action area are likely to experience is that of global climate change. Even under predictions that consider stringent mitigation measures to reduce carbon dioxide emissions (IPCC Representative Concentration Pathway 2.5), by the end of the 21st century (relative to 1986 to 2005) global temperatures are likely to rise between 0.3 degrees Celsius and 1.7 degrees Celsius, sea level is expected to rise between 0.26 and 0.55 meters, and increased ocean acidification is almost certain (IPCC 2014). In less stringent Representative Concentration Pathways, greater increases in global temperature, sea level, and ocean pH are predicted. Other climate changes such as increase drought and/or precipitation in some areas and changes in the frequency of extreme weather events are also likely to occur (IPCC 2014). The impact of these changes on ESA-listed species are even more difficult to predict than the future climate scenarios themselves, but they will likely have direct, indirect, positive, and/or negative effects depending on the species and the particular climatic changes. Nonetheless, future impacts from global climate change on ESA-listed species are virtually certain to occur.

Anthropogenic threats that ESA-listed species experiences due to population growth, development, and land use changes are also likely to increase. Between 2014 and 2060 the U.S. population is expected to increase from 319 million to 417 million (Colby and Ortman 2014). With this population increase, the negative impacts of associated land use changes, pollution, contaminants, habitat degradation and destruction, and water quality issues described for ESA-listed species in the Environmental Baseline are likely to increase, although the level of which remain unknown at this time. For turtles, future beachfront development, lighting, and beach erosion control projects are likely to reduce or degrade sea turtle nesting habitats and/or interfere with hatchling movement to the sea. These ongoing activities will likely continue along the Gulf and Atlantic coasts as coastal populations continue to grow in these regions.

The harmful effects of marine debris on sea turtles and other ESA-listed species are expected to continue into the future, and may increase in some parts of the action area. Ribic (2010), documented regional differences in amounts and trends of marine debris along the U.S. Atlantic coast from 1997 to 2007. The Northeast region, with a relatively small percentage population increase, had low land-based and general-source debris loads and no increases over the ten-year study period. The Mid-Atlantic region, with an increasing coastal population, had heavy land-based and general-source debris loads that increased over time. The Southeast Atlantic region had low land-based and general-source debris loads and no increases despite the largest percentage increase in coastal population over the study period. Ribic (2010) assessed trends of marine debris for the U.S. Pacific Coast and Hawaii from 1998 to 2007. They found that debris loads decreased over time for all source categories (i.e., land-based, general source, and ocean-based) in all regions except for land-based and general-source loads in the North Pacific Coast region, which were unchanged.

For the remainder of activities and associated threats to the ESA-listed species identified in the Environmental Baseline, and other unforeseen threats, the magnitude of increase and the significance of any anticipated effects remain unknown. Thus, this opinion assumes effects in the future would be similar to those in the past and, therefore, are reflected in the anticipated trends described in the Status of the Species (Section 6) and Environmental Baseline (Section 7).

# 10 INTEGRATION AND SYNTHESIS

The Integration and Synthesis section is the final step in our assessment of the risk posed to species due to implementation of the proposed action. In this section, we add the Effects of the Action (Section 8) to the Environmental Baseline (Section 7) and the Cumulative Effects (Section 9) to formulate the agency's biological opinion as to whether the proposed action is likely to appreciably reduce the likelihood of both the survival and recovery of a ESA-listed species in the wild by reducing its numbers, reproduction, or distribution. These assessments are made in full consideration of the Status of the Species (Section 6).

## 10.1 Sea Turtles

In this section, we summarize the status of sea turtle species and DPSs in light of past, current, and anticipated future threats as presented in the Environmental Baseline and Cumulative Effects sections of this opinion. Finally, we integrate the results of our sea turtle exposure, response, and risk analyses to evaluate the probable risk the proposed action poses to the survival and recovery of the sea turtle species and DPSs considered in this opinion.

### 10.1.1 Sea Turtle Research Permitting Program: Summary

As discussed throughout this opinion, there are several key components of the Permits Division's Program that are designed to minimize adverse effects on individual sea turtles and to mitigate risks to the survival and recovery of sea turtle populations. While the proposed lethal take limits determine the upper limit on research allowed, the Permits Division would continually evaluate each permit application to ensure that the proposed research (including requested take levels) is necessary for the conservation and recovery of sea turtle populations. The Permits Division proposes to issue more invasive procedures, which have a higher risk associated with adverse effects, with caution and conservatively.

ESA regulations require that all research and enhancement permits issued by the Permits Division must meet specific regulatory issuance criteria. These include: (1) the permit will be used in a manner consistent with the ESA goal of listed-species conservation and will not be used to the disadvantage of species, (2) the research is bona fide and necessary for the survival and recovery of species, (3) a surrogate (non-listed) species cannot be used instead, (4) the permit holder has the necessary expertise, facilities, or other resources to achieve research objectives, and (5) the validity and need for the proposed research is reviewed by other researchers and species experts. These criteria are designed to reduce adverse effects and risk by decreasing the likelihood that ESA-listed species will be exposed to stressors from research activities that are either duplicative, extraneous or will not result in information (e.g., data, published papers) that can be used for the conservation of ESA-listed species.

In addition to regulatory issuance criteria, all permit holders authorized under the Program are required to follow general permit terms and conditions. These include: (1) reporting requirements that are necessary to track take (lethal and sublethal) and monitor the effects of authorized research activities on sea turtle populations, (2) notification and coordination requirements designed to maximize efficiency and minimize duplicative research efforts that could result in higher levels of exposure to stressors than absolutely necessary, and (3) requirements related to the qualifications, responsibilities, and designation of personnel designed to assure that mitigation measures are closely followed and all procedures are performed using the required standard protocols. Also included in all research and enhancement permits issued by the Permits Division are terms and conditions related to permit modification, suspension, and revocation. These assure that the Permits Division can take the appropriate measures a permit holder’s actions result in increased risk to individual sea turtles (or other ESA-listed species) or to the populations they comprise, beyond what was authorized in the permit. In addition, the Permits Division can modify a research or enhancement permit if, based on new information, it determines that the previously authorized activities will unnecessarily expose individual turtles to stressors or will result in a greater risk to the survival and recovery of threatened and endangered species.

Another integral component of the Program for reducing risk and avoiding jeopardy or adverse modification over time is the adaptive management approach. This is particularly important considering that the Program (and this opinion) does not have a sunset date. Based on historical data, over time the development of new and improved sea turtle research protocols, required as a condition of the permit, have greatly reduced adverse effects and mortalities resulting from research activities. The adaptive management approach allows the Permits Division to continually update mitigation measures designed specifically to reduce adverse effects on sea turtles as well as ESA-listed species taken incidentally as part of the proposed action. Also part of the adaptive management approach, as new information is made available regarding risks to sea turtles from certain capture methods or procedures, the Permits Division can make program level or individual permit level changes, as necessary, to further reduce the risk to ESA-listed species or their critical habitat.

The adaptability and flexibility of the Program is viewed as a beneficial feature for addressing the potential impacts of climate change on ESA-listed species considered in this opinion. As discussed in Section 7.1 above, environmental changes resulting from climate change may affect sea turtles in a number of ways. The Program’s adaptive management approach allows Permits Division to respond to any changes in the status, health, or distribution of sea turtle populations due to climate change, and make the necessary and timely program-level or permit level adjustments to avoid jeopardy or adverse modification to ESA-listed species in the action area.

Continued close collaboration and an on-going dialogue between the Permits Division and the Interagency Cooperation Division will also be an important component of the proposed adaptive approach to managing the Program. Annual program reports and periodic program evaluations (every 5-years or more often as needed) will allow NMFS OPR to evaluate if the assumptions made in the effects analysis for this opinion are still valid. If new information indicates that a procedure has greater impacts than those analyzed in this opinion, the Permits Division will consult (either informally or formally) with the Interagency Cooperation Division and use the additional documentation to modify individual permits as needed.

### 10.1.2 Current Status and Threats: Summary

As discussed in the Environmental Baseline (Section 7), the major anthropogenic stressors that contributed to the sharp decline of sea turtle populations in the past include habitat degradation, direct harvest, commercial fisheries bycatch, and marine debris. While sea turtle populations are still at risk, efforts made over the past few decades to reduce the impact of these threats have slowed the rate of decline for many sea turtle populations. Increasing abundance trends have now been reported for several populations (or subpopulations) of ESA-listed sea turtles (see Table 24 above for details).

Bycatch reduction devices have reduced the incidental take of sea turtles in many U.S. commercial fisheries. TEDs, which are required in federal shrimp trawl fisheries, are estimated to have reduced mortality of sea turtles by approximately 95 percent (NMFS 2014c). Mitigation measures required in other federal and state fisheries (e.g., gill net, pelagic longline, pound nets) have also resulted in reduced sea turtle interactions and mortality rates (see Section 7.14.1 for details). In 2001, NMFS published as a final rule (66 FR 67495) requiring people participating in scientific research or fishing activities to handle and resuscitate (as necessary) incidentally caught sea turtles to help further reduce sea turtle mortalities and injuries due to capture. Increased conservation awareness at the international scale has led to greater global protection of sea turtles. All six ESA-listed sea turtles are listed in CITES Appendix I and many countries now have regulations banning turtle harvest and export. Among the countries that still allow directed take of sea turtles, harvest has decreased by more than 60 percent over the past three decades (Humber et al. 2014). Implementation of the Clean Water Act of 1972 resulted in estuarine and coastal water quality improvements throughout the range of many sea turtle species. While vessel strikes, power plants, dredging, pollutants, oil spills, and hydromodification still represent sources of mortality, sea turtle mortalities resulting from these activities within the action area are expected to either remain at current levels, or possibly decrease with additional research efforts, conservation measures, and the continued implementation of existing environmental regulations. In addition, many activities that result in sea turtle take have already undergone formal section 7 consultation and are covered for take by an existing ITS; some of which would presumably need to reinitiate consultation with NMFS in the future to continue the activity.

Based on our Cumulative Effects analysis (Section 9), it is likely that some current threats to sea turtles will increase in the future. These include global climate change, marine debris, and habitat degradation. It is difficult to predict the magnitude of these threats in the future or their impact on sea turtle populations, particularly considering that the Program has no sunset date.

### 10.1.3 Sea Turtle Exposure, Response, and Risk Analyses: Summary

The proposed action would have both sublethal and lethal effects on ESA-listed sea turtles. Based on our Sea Turtle Response Analysis (Section 8.4), we determine that sub-lethal effects resulting from research activities authorized under the proposed action will be minimal, short-term, and are not likely to result in any reduced fitness or loss of fecundity to individual turtles. Mortality of sea turtles will be limited in the proposed action by the ten-year observed research lethal take limits established for each species (or DPS) within each ocean basin (i.e., Atlantic and Pacific). The proposed action may also result in a very low level of delayed mortality of sea turtles captured using trawl nets. From our Sea Turtle Risk Analysis (Section 8.5), we determine that the anticipated mortality resulting from the proposed action (observed research mortality plus delayed mortality) is not likely to impact the survival or recovery of any of the sea turtle species or DPSs considered in this consultation. The anticipated levels of mortality represent an extremely small fraction of the estimated female nesting or adult population sizes of the sea turtle species and DPSs evaluated. For most species and DPSs, research related mortalities will result in a decrease of less than 0.15 percent of the population every ten years. The populations that could potentially be most impacted are (in order of impact over a ten-year period): West Pacific DPS of leatherback (0.53 percent), Kemp's ridley (0.35 percent), Central South Pacific DPS of green turtle (0.34 percent), and Central North Pacific DPS of green turtle (0.25 percent).

Considering that such changes are projected over any ten year period into the future, these estimated declines represent a very small proportion of each population (i.e., from 0.025 to 0.053 percent annually). The proportion of each ESA-listed sea turtle population impacted likely represents a highly conservative estimate based on several conservative assumptions that went into our risk assessment. As described above, the effects of these activities are expected to be low-level, short-duration stress that individual turtles would experience. The research authorized under this Program, including research dealing with fisheries bycatch issues, is expected to have a net benefit to the species as a whole, which will lead to more-informed management decisions. Therefore, we do not anticipate a decline of even this small proportion of the population in every year going forward. In summary, there is no indication that the anticipated small number of lethal take resulting from turtle research activities authorized as part of the Program poses a threat to the survival or recovery of any ESA-listed sea turtle species or DPS. A decline in any ESA-listed sea turtle species population could trigger reinitiation (see Section 14).

#### 10.1.4 Overall Summary

Several components of the proposed action would mitigate adverse effects and assure that research activities permitted under the Program are for the benefit of ESA-listed species and their designated critical habitat. These include: (1) regulatory issuance criteria designed to reduce adverse effects and risk resulting from research activities that are either duplicative, extraneous or will not result in information that can be used for species recovery, (2) general permit terms and conditions that provide the Permits Division with the information necessary to manage their Program, monitor take and the impacts on ESA-listed species, evaluate permit compliance, and modify or revoke permits as necessary to mitigate adverse effects to individuals and reduce the risk to the survival and recovery of ESA-listed populations, (3) species and habitat specific terms and conditions designed to mitigate and minimize the take (both directed and incidental) of ESA-listed species resulting from particular research activities, (4) proposed sea turtle research mortality limits that limit the lethal take (and by proxy sublethal take) that can be authorized for each species or DPS, and (5) an adaptive management approach that provides the Permits Division flexibility to make program level changes as new information regarding species status, threats, effects of research activities, improved protocols or technologies is made available.

Efforts made over the past few decades to reduce the impact of major threats from directed harvest, fisheries bycatch, habitat degradation and pollution have slowed the rate of decline for many sea turtle populations. Some sea turtle populations within the action area have experienced an increasing abundance trend in recent years. The sub-lethal effects on sea turtles resulting from research activities authorized under the proposed action will be minimal, short-term, and are not likely to result in any reduced fitness or loss of fecundity to individual turtles. The anticipated level of research related sea turtle mortalities, in combination with mortalities from outside threats (as described in the Environmental Baseline, Section 7 and Cumulative Effects, Section 9), does not significantly alter the likelihood of survival and recovery of these sea turtle species. Additionally, as has been demonstrated in the past, adverse effects (sublethal and lethal) to sea turtles and other ESA-listed species resulting from research activities are expected to continue to decrease over time with new mitigation measures, research techniques, and technologies.

In summary, we determine that the proposed action will not appreciably reduce the likelihood of both the survival and recovery of any of the ESA-listed sea turtle species or DPSs considered in this consultation.

## 10.2 Gulf of Maine Atlantic Salmon

The GOM DPS Atlantic salmon was listed as endangered in response to population decline caused by many factors, including overexploitation, degradation of water quality and damming of rivers, all of which remain persistent threats (Fay et al. 2006a). There are a number of actions underway or planned to help Atlantic salmon recover including hatchery supplementation, dam removal, protecting riparian habitat, reducing the impact of irrigation water withdrawals, and limiting the effects of recreational and commercial fishing. Even with current conservation efforts, returns of adult Atlantic salmon to the GOM DPS rivers remain extremely low. The total number of adult returns to U.S. rivers in 2015 was 921, the majority (eighty percent) of which were of hatchery origin. The DPS likely has a low resilience to additional perturbations (NOAA 2016).

Based on our Exposure and Response Analysis above (Section 8.6), we estimate that the proposed action will result in the death of no more than one GOM DPS Atlantic salmon every ten years. While the abundance trend information for Atlantic salmon is either stable or declining, based on our Risk Analysis (Section 8.7.1) we believe the very small numbers of lethal interactions attributed to sea turtle research will not have any measurable effect on that trend. Similarly, we do not anticipate any long-term adverse effects on either individual fish or the GOM DPS resulting from the capture and live release of Atlantic salmon by turtle researchers. In summary, we determine that the proposed action will not appreciably reduce the likelihood of both the survival and recovery of the GOM DPS of Atlantic salmon.

## 10.3 Smalltooth Sawfish, U.S. Portion of Range

The abundance of smalltooth sawfish has decreased dramatically over the past century and the U.S. population may be at less than five percent of historic levels based on the contraction of the species' range (Simpfendorfer 2002). The decline in the abundance of smalltooth sawfish has been attributed to fishing (primarily commercial and recreational bycatch), habitat modification (including changes to freshwater flow regimes due to climate change), and life history characteristics (i.e., slow-growing, relatively late-maturing, and long-lived species) (NMFS 2009c; Simpfendorfer et al. 2011). These factors continue to threaten the smalltooth sawfish population. However, recent information indicates the smalltooth sawfish population is likely stable or increasing (Carlson and Osborne 2012; Carlson and Simpfendorfer 2015). The remnant population exhibits high genetic diversity and that inbreeding is rare (Chapman et al. 2011). The female population size is estimated at around 600 (Carlson and Simpfendorfer 2015). Chapman et al. (2011) estimate the effective genetic population size as 250 to 350 adults. The abundance of juveniles encountered in recent studies (Poulakis et al. 2014; Seitz and Poulakis 2002; Simpfendorfer and Wiley 2004) suggests that the smalltooth sawfish population remains reproductively viable.

Based on our Exposure and Response Analysis above (Section 8.6), we estimate that the proposed action will result in the death of no more than two smalltooth sawfish every ten years. Based on our Risk Analysis (Section 8.7.2), we expect that the very small numbers of lethal interactions attributed to sea turtle research will not have any measurable effect on the smalltooth sawfish population trend. Similarly, we do not anticipate any long-term adverse effects on either individual fish or the population resulting from the capture and live release of smalltooth sawfish by turtle researchers. In summary, we determine that the proposed action will not appreciably reduce the likelihood of both the survival and recovery of the smalltooth sawfish.

## 10.4 Sturgeon: Atlantic, Shortnose, Green, and Gulf

ESA-listed sturgeon populations within the action area have declined sharply over the past century. As discussed in the Environmental Baseline section, the major anthropogenic stressors that contributed to the sharp decline of sturgeon populations were commercial fisheries, habitat curtailment and alteration from dams and dredging, and degraded water quality. While sturgeon are still at risk from anthropogenic threats, some of the major threats that contributed to sharp population declines in the past have either been eliminated or reduced. Efforts made over the past few decades to reduce the impact of these threats have slowed the rate of decline for many sturgeon populations.

The GOM DPS of Atlantic sturgeon is listed as threatened and includes six river systems. The Kennebec River is the primary spawning and nursery area for GOM Atlantic sturgeon. The removal of the Edwards Dam in 1999 resulted in 17 additional miles of historical spawning habitat accessible to Kennebec River Atlantic sturgeon and improved water quality. The New York Bight DPS of Atlantic sturgeon is listed as endangered and includes seven river systems, only three of which are known spawning subpopulations: Delaware, Hudson River, with intermittent spawning in the Connecticut. Long-term surveys indicate that the Hudson River subpopulation has been stable and/or slightly increasing since 1995 in abundance (ASSRT 2007). Some of the stressors to New York Bight DPS Atlantic sturgeon, while still present, have been reduced over the past few decades. Water quality in the Hudson has improved markedly since the 1980s and is no longer considered a major threat to this subpopulation (ASSRT 2007). Similarly, restrictions on dredging in the upper portions of the Delaware have likely had beneficial impacts on Atlantic sturgeon spawning success. The Chesapeake DPS of Atlantic sturgeon is listed as endangered and includes seven river systems, only two of which are known spawning subpopulations (James and York rivers). A recent study by Balazik and Musick (2015) indicates that two races of Atlantic sturgeon repeatedly spawn during two different times (spring and fall) and places in the James River, and possibly the groups have become genetically distinct from each other. The Carolina DPS of Atlantic sturgeon is listed as endangered and includes eight river systems, only one of which is a known spawning subpopulation (Roanoke River). Smith et al. (2015) identified fall spawning in the Roanoke River, suggesting there may be two populations (spring and fall) of spawners in this system. The South Atlantic DPS of Atlantic sturgeon is listed as endangered and includes ten river systems. Currently, this DPS supports six known spawning subpopulations: ACE Basin, Savannah, Ogeechee, Altamaha, Satilla, and St. Mary’s. Farrae et al. (2017) found genetically distinct fall- and spring-spawned Atlantic sturgeon in the Edisto River (part of the ACE Basin), and genetic diversity of both groups was on the higher end of published population diversity values. There are no known major existing threats in any of the ten river populations within this DPS; several face minor threats, mainly water quality and bycatch.

For shortnose sturgeon, the largest adult subpopulations are found in the Northeastern rivers (i.e., Hudson, Delaware, Kennebec and St. John). Shortnose sturgeon subpopulations in southern rivers are considerably smaller by comparison with the largest in this region occurring in the Altamaha and Savannah Rivers. Population trend estimates are available for six shortnose sturgeon spawning stocks: St John, Kennebec, Hudson, and Satilla are all decreasing slightly (-1 percent); Delaware and Ogeechee are stable (0 percent). The SSSRT evaluated the extinction risk for three shortnose subpopulations (Hudson, Cooper, and Altamaha) and concluded that the estimated probability of extinction was zero for all three under the default assumptions, despite the long (100-year) horizon and the relatively high year-to-year variability in fertility and survival rates.

Many of the principle factors considered when listing Southern DPS green sturgeon as threatened in 2006 are relatively unchanged. Confirmation of spawning in the Feather River is encouraging and the decommissioning of the Red Bluff Diversion Dam and breach of Shanghai Bench makes spawning conditions more favorable, although Southern DPS green sturgeon still encounter impassible barriers in the Sacramento, Feather and other rivers that limit their spawning range (NMFS 2015c). Entrainment as well as stranding in flood diversions during high water events also negatively affect Southern DPS green sturgeon. The prohibition of retention in commercial and recreational fisheries has eliminated a known threat and likely had a very positive effect on the overall population, although recruitment indices are not presently available. The recovery potential for Southern DPS green sturgeon is considered moderate to high; however, certain life history characteristics (e.g., long-lived, delayed maturity) indicate recovery could take many decades, even under the best circumstances (NMFS 2010a).

The decline in the abundance of gulf sturgeon has been attributed to targeted fisheries in the late 19th and early 20th centuries, habitat loss associated with dams and sills, habitat degradation associated with dredging, de-snagging, and contamination by pesticides, heavy metals, and other industrial contaminants, and certain life history characteristics (e.g., slow growth and late maturation) (56 FR 49653). In general, gulf sturgeon populations in the eastern portion of the range appear to be stable or slightly increasing, while populations in the western portion are associated with lower abundances and higher uncertainty (USFWS and NMFS 2009).

Based on our Exposure and Response Analysis above (Section 8.6), we estimate that the proposed action will result in the death of no more than one Atlantic sturgeon (all DPSs combined), shortnose sturgeon, Southern DPS of green sturgeon, or Gulf sturgeon every ten years. Based on our risk analysis (Section 8.7.3), we expect that the very small numbers of lethal interactions attributed to sea turtle research will not have any measurable effect on the population trends of these ESA-listed sturgeon species. Similarly, we do not anticipate any long-term adverse effects on either individual fish or their populations resulting from the capture and live release of sturgeon by turtle researchers. In summary, we determine that the proposed action will not appreciably reduce the likelihood of both the survival and recovery of the following ESA-listed sturgeon species: Atlantic sturgeon DPSs (Gulf of Maine, New York Bight, Chesapeake, Carolina, and South Atlantic), shortnose sturgeon, Southern DPS of green sturgeon, and Gulf sturgeon.

### 10.5 Nassau Grouper

The most serious ongoing threats to Nassau grouper are fishing at spawning aggregations and inadequate law enforcement. Many Caribbean countries have banned or restricted Nassau grouper harvest, and it is believed that current areas of higher abundance are correlated with effective regulations. In some locations, spawning aggregations are increasing. Although harvest has decreased due to management measures, Nassau grouper populations remain vulnerable to unregulated harvest.

Based on our Exposure and Response Analysis above (Section 8.6), we estimate that the proposed action will result in the death of no more than one Nassau grouper every ten years. Based on our Risk Analysis (Section 8.7.4) we believe the very small numbers of lethal interactions attributed to sea turtle research will not have any measurable effect on the Nassau grouper population trend. Similarly, we do not anticipate any long-term adverse effects on either individual fish or the population resulting from the capture and live release of Nassau grouper by turtle researchers. In summary, we determine that the proposed action will not appreciably reduce the likelihood of both the survival and recovery of Nassau grouper.

## 10.6 Scalloped Hammerhead

The primary factors responsible for the decline of the ESA-listed scalloped hammerhead DPSs are overutilization, due to both catch and bycatch of these sharks in fisheries, and inadequate regulatory mechanisms for protecting these sharks, with illegal fishing identified as a significant problem (Miller et al. 2014). The threat of overfishing is likely to continue into the future as scalloped hammerheads remain unprotected throughout wide portions of their range.

Based on our Exposure and Response Analysis above (Section 8.6), we estimate that the proposed action will result in the death of no more than one scalloped hammerhead (all DPSs combined) every ten years. Based on our Risk Analysis (Section 8.7.5) we believe the very small numbers of lethal interactions attributed to sea turtle research will not have any measurable effect on the population trends for the scalloped hammerhead DPSs considered in this opinion. Similarly, we do not anticipate any long-term adverse effects on either individual fish or the population resulting from the capture and live release of scalloped hammerhead by turtle researchers. In summary, we determine that the proposed action will not appreciably reduce the likelihood of both the survival and recovery of the following scalloped hammerhead DPSs: Eastern Pacific, Central and Southwest Atlantic, and Indo-West Pacific.

# 11 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's biological opinion that the proposed action is not likely to jeopardize the continued existence of the North Atlantic DPS of green sea turtle or to destroy or adversely modify its designated critical habitat.

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's biological opinion that the proposed action is not likely to jeopardize the continued existence of the following green sea turtle DPSs: South Atlantic, East Indian-West Pacific, Central West Pacific, Southwest Pacific, Central South Pacific, Central North Pacific, and East Pacific. No critical habitat has been designated or proposed for these DPSs; therefore, none will be affected.

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's biological opinion that the proposed action is not likely to jeopardize the continued existence of the hawksbill sea turtle or to destroy or adversely modify its designated critical habitat.

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's biological opinion that the proposed action is not likely to jeopardize the continued existence of the Kemp's ridley sea turtle. No critical habitat has been designated or proposed for this species; therefore, none will be affected.

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's biological opinion that the proposed action is not likely to jeopardize the continued existence of the leatherback sea turtle or to destroy or adversely modify its designated critical habitat.

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's biological opinion that the proposed action is not likely to jeopardize the continued existence of the Northwest Atlantic loggerhead sea turtle or to destroy or adversely modify its designated critical habitat.

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's biological opinion that the proposed action is not likely to jeopardize the continued existence of the following loggerhead sea turtle DPSs:

Northeast Atlantic, North Pacific, and South Pacific. No critical habitat has been designated or proposed for these DPSs; therefore, none will be affected.

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's biological opinion that the proposed action is not likely to jeopardize the continued existence of the following olive ridley sea turtle populations: Mexico's Pacific coast and all other breeding populations. No critical habitat has been designated or proposed for this species; therefore, none will be affected.

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's biological opinion that the proposed action is not likely to jeopardize the continued existence of the GOM DPS of Atlantic salmon or to destroy or adversely modify its designated critical habitat.

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's biological opinion that the proposed action is not likely to jeopardize the continued existence of the U.S. portion of range DPS of smalltooth sawfish or to destroy or adversely modify its designated critical habitat.

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's biological opinion that the proposed action is not likely to jeopardize the continued existence or to destroy or adversely modify designated critical habitat of the following Atlantic sturgeon DPSs: Gulf of Maine, New York Bight, Chesapeake Bay, Carolina, and South Atlantic.

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's biological opinion that the proposed action is not likely to jeopardize the continued existence of shortnose sturgeon. No critical habitat has been designated or proposed for this species; therefore, none will be affected.

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's biological opinion that the proposed action is not likely to jeopardize the continued existence of Southern DPS of green sturgeon or to destroy or adversely modify its designated critical habitat.

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's biological opinion that the proposed action is not likely to jeopardize the continued existence of Gulf sturgeon or to destroy or adversely modify its designated critical habitat.

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's biological opinion that the proposed action is not likely to jeopardize the continued existence of Nassau grouper. No critical habitat has been designated or proposed for this species; therefore, none will be affected.

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's biological opinion that the proposed action is not likely to jeopardize the continued existence of the following DPSs of scalloped hammerhead shark: Eastern Pacific, Central and Southwest Atlantic, and Indo-West Pacific. No critical habitat has been designated or proposed for these DPSs; therefore, none will be affected.

# 12 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 which “create 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” (NMFS 2016c). 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 this ITS.

## 12.1 Amount or Extent of Take

Section 7 regulations require NMFS to specify the impact of any incidental take of endangered or threatened species; that is, the amount or extent, of such incidental taking on the species (50 CFR § 402.14(i)(1)(i)). The amount of take represents the number of individuals that are expected to be taken by the proposed action. The extent of take represents the “extent of land or marine area that may be affected by an action” and may be used if we cannot assign numerical limits for animals that could be incidentally taken during the course of an action (51 FR 19953).

As discussed in our Sea Turtle Risk Analysis (Section 8.5), there is a risk of delayed mortality associated with sea turtles captured in trawl nets as part of the Program. To conduct our risk analysis, we estimated the number of delayed mortalities that may occur within the Program for each species or DPS (as shown in Table 25 above) based on assumptions regarding the number of trawl captures and our calculated estimate of the delayed mortality rate based on researcher reports. The Program establishes a lethal take limit (as shown in Table 1) by species and ocean basin only for turtle mortalities that are observed and reported by researchers. However, these limits would not account for delayed mortalities, which would not be observed and, therefore, would not be authorized to researchers in individual permits. Therefore, for purposes of this programmatic opinion, we include the estimated sea turtle delayed mortalities that we anticipate will occur under the Program as part of the incidental take statement for this opinion. The anticipated incidental lethal take of sea turtles resulting from research trawl captures authorized under the Program, over any given ten-year period, is shown by turtle species in Table 27. These numbers are based on rounding up of the delayed mortality estimates calculated for our Sea Turtle Risk Analysis above. For sea turtle species with more than one DPS within the action area, incidental take is expressed as a combined take limit for the species due to the difficulty of predicting the number of takes by DPS in any given year.

As part of the proposed action, any incidental take (lethal or nonlethal) of non-target sea turtle species (or DPS) that is observed and reported by researchers will be included with the directed take for that particular species (or DPS), and therefore will not be covered under this ITS. This could occur if a sea turtle researcher captures a turtle species or DPS that their permit does not authorize them to take.

Activities authorized as part of the Program may also result in the incidental take of non-target ESA-listed species. Atlantic salmon, Atlantic sturgeon, shortnose sturgeon, Gulf sturgeon, green sturgeon, Nassau grouper, and scalloped hammerhead may be exposed to stressors resulting from incidental capture in non-selective capture gears (entanglement or gill nets, trawls, pound nets and seines) used to capture sea turtles. Anticipated incidental take of non-target species was determined based on our evaluation of the proposed action and information provided by the Permits Division in its BA (Table 27). Incidental take estimates of the numbers of individuals by species, were developed by considering the following: (1) level of historical incidental take that has occurred under sea turtle research permits authorized by the Permits Division, (2) mitigation measures in place to avoid future incidental take of non-target species, (3) population trends of each non-target species (as available), and (4) projected changes in environmental conditions or sea turtle research focus that could potentially affect the spatial/temporal overlap between non-target species and turtle research activities. For the five DPSs of Atlantic sturgeon and three DPSs of scalloped hammerhead that occur in the action area, incidental take is expressed as a combined take limit for each species due to the difficulty of predicting the number of takes by DPS in any given year.

**Table 27. Authorized incidental take of sea turtles due to delayed mortality and of incidentally captured non-target ESA-listed species resulting from the Program over any given ten-year period.**

| ESA-listed species or Distinct Population Segment | Non-lethal Take (Number of individuals over 10 years) | Lethal Take (Number of individuals over 10 years) |
|---|---|---|
| **Green Sea Turtle** All DPSs combined: North Atlantic, South Atlantic, West Pacific, South Pacific, North Pacific, and East Pacific | None | 2 |
| **Hawksbill Sea Turtle** | None | 1 |
| **Kemp's ridley Sea Turtle** | None | 2 |
| **Leatherback Sea Turtle** All DPSs combined: Northwest Atlantic and West Pacific | None | 1 |
| **Loggerhead Sea Turtle** All DPSs combined: Northwest Atlantic and North Pacific | None | 5 |
| **Olive ridley Sea Turtle** | None | 1 |
| **Atlantic Salmon** Gulf of Maine DPS | 3 | 1 |
| **Smalltooth Sawfish** U.S. Portion of Range DPS | 5 | 2 |
| **Atlantic Sturgeon** All DPSs combined: Gulf of Maine, New York Bight, Chesapeake, Carolina, and South Atlantic | 6 | 1 |
| **Shortnose Sturgeon** | 3 | 1 |
| **Gulf Sturgeon** | 5 | 1 |
| **Green Sturgeon** Southern DPS | 2 | 1 |
| **Nassau Grouper** | 2 | 1 |
| **Scalloped Hammerhead** All DPSs combined: Eastern Pacific, Central and Southwest Atlantic, and Indo-West Pacific | 2 | 1 |

## 12.2 Effects of the Take

In this opinion, we have determined that the amount of anticipated incidental take of sea turtles due to delayed mortality, coupled with other effects of the proposed action, is not likely to result in jeopardy to any of the ESA-listed sea turtle species or DPSs evaluated in this opinion. We have also determined that the amount of anticipated take, coupled with other effects of the proposed action, is not likely to result in jeopardy to any of the following non-target species: Atlantic salmon GOM DPS; smalltooth sawfish U.S. portion of range DPS; Atlantic Sturgeon DPSs (Gulf of Maine, New York Bight, Chesapeake, Carolina, and South Atlantic), shortnose sturgeon, Gulf sturgeon, green sturgeon Southern DPS, Nassau grouper, and scalloped hammerhead DPSs (Eastern Pacific, Central and Southwest Atlantic, and Indo-West Pacific). Refer to Section 8.3 Exposure, Response and Risk Analysis for details regarding how we reached these determinations.

## 12.3 Reasonable and Prudent Measures

“Reasonable and prudent measures” are nondiscretionary measures to minimize the amount or extent of incidental take (50 CFR 402.02). Section 7(b)(4) of the ESA requires that when a proposed agency action is found to be consistent with section 7(a)(2) of the ESA and the proposed action may incidentally take individuals of ESA-listed species, NMFS will issue a statement that specifies the impact of any incidental taking of endangered or threatened species. To minimize such impacts, reasonable and prudent measures, and terms and conditions to implement the measures, must be provided. Only incidental take resulting from the agency actions and any specified reasonable and prudent measures and terms and conditions identified in the ITS are exempt from the taking prohibition of section 9(a), pursuant to section 7(o) of the ESA.

The measures described below are nondiscretionary, and must be undertaken by the Permits Division so that they become binding conditions for the exemption in section 7(o)(2) to apply. NMFS believes the reasonable and prudent measures described below are necessary and appropriate to minimize the impacts of incidental take on threatened and endangered species:

**Reasonable and prudent measure #1**: All section 10(a)(1)(A) sea turtle research permits authorized as part of the proposed action will include required terms and conditions (as described below) to minimize the impacts of incidental take on non-target ESA-listed species.

**Reasonable and prudent measure #2**: The Permits Division will monitor and evaluate the incidental take of ESA-listed species resulting from the proposed action and report the impacts of such incidental take to the Interagency Cooperation Division.

## 12.4 Terms and Conditions

To be exempt from the prohibitions of section 9 of the ESA, the Permits Division must comply with the following terms and conditions, which implement the Reasonable and Prudent Measures described above and outlines the mitigation, monitoring and reporting measures required by the section 7 regulations (50 CFR 402.14(i)). These terms and conditions are nondiscretionary. If the Permits Division fails to ensure compliance with these terms and conditions and their implementing reasonable and prudent measures, the protective coverage of section 7(o)(2) may lapse.

*Terms and Conditions Required to Implement Reasonable and Prudent Measure # 1*

The Permits Division will assure that all section 10(a)(1)(A) sea turtle research permits authorized as part of the proposed action will include the following required terms and conditions:

*All Non-target ESA-listed Species*

1. All incidentally captured species (e.g., fishes) must be released alive as soon as possible.
2. If any ESA-listed non-target species are taken (captured, injured, etc.) during research, Researchers must stop activities and submit an incident report (see Section 3.2.1.5 Reports for details). Adverse interactions must be documented in the report, including any pertinent details of the interaction (gear type, what was done to handle and release the animals, location, date, size, water and air temperature, and photos if possible).

*Smalltooth Sawfish Specific Terms and Conditions*

3. Researchers operating in areas where sawfish are present are required to contact the smalltooth sawfish recovery coordinator in the NMFS Southeast Regional Office for training requirements on proper handling procedures.
4. When attempting to handle and release an incidentally captured sawfish, researchers must use extreme caution, following procedures specified in the NMFS Sawfish Handling and Release Guidelines (Appendix F), or as otherwise modified by NMFS in the future to reflect best management practices for handling and releasing sawfish.
5. Researchers must keep the fish in the water at all times while cutting the net from the rostrum and body of the animal (no attempts should be made to disentangle the rostrum from the net).
6. Adverse interactions with sawfish should be documented, including any pertinent details of the interaction (type of gear type, what was done to handle and release the animals, location, date, size, water & air temp, and photos if possible).

*Terms and Conditions Required to Implement Reasonable and Prudent Measure # 2*

1. The Permits Division will include an incidental take section in their annual Program report (see Section 3.8, Reporting to the Interagency Cooperation Division). This section of the report will include the following:
   a) The number of individuals incidentally taken by species (or DPS), life stage, and type of take (i.e., nonlethal and lethal)

b) A copy of each incident report, which includes the dates, locations, gear types, and any other relevant information that may assist in evaluating the impacts of incidental take on ESA-listed populations, DPS(s), or species

c) Any permits modifications (e.g., changes in protocols, methods, or mitigation measures) made by the Permits Division in response to an incidental take occurrence in order to minimize the chance of additional incidental take by the permit holder in the future.

2. In addition to the annual reporting requirement, the Permits Division will maintain a file with real-time updates on incidental take numbers (by species/DPS and type of take) resulting from the proposed action. This file will be stored on a shared network drive accessible to the Interagency Cooperation Division.

# 13 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).

- We recommend that the Permits Division continue to work collaboratively with the Interagency Cooperation Division to explore opportunities for developing and consulting on research programmatics for other ESA-listed species and/or taxa (e.g., cetaceans and pinnipeds).
- We recommend that the Permits Division considering requesting that researchers collect and report information on any ESA-listed fish species captured incidentally during sea turtle research. This may include collection of biological data, morphometrics, or tag information. Depending on the species, turtle researchers may need special training for handling and collecting information from ESA-listed fish.
- We recommend that the Permits Division encourage researchers to conduct research that will help improve our understanding of the delayed mortality risk for sea turtles subjected to research activities, particularly trawl captured turtles.
- We recommend that the Permits Division consider requiring that researchers report satellite tracking study information that could be used to assess post-release survival and health of sea turtles. This could include number of days tracked, movement, diagnostic data on satellite tag status and reason for tag failure (Hays et al. 2007), as well as data on recaptured turtles (e.g., overall health, growth rate).
- When issuing permits for sea turtle research conducted within the range of GOM Atlantic salmon, we recommend that the Permits Division consider limitations on the use of small net mesh capture gear (i.e., less than12 inches) to minimize potential interactions with adult salmon.
- We recommend the Permits Division consider modifying the required reporting form for research permits to collect additional information that can further assist managers in protecting and conserving ESA-listed species. For example, the Permits Division could request researchers to provide population abundance estimates as they become available (e.g., unpublished data). Such information would not only better inform the Permits Division's future issuance of research permits, but could also be used in recovery plans and five-year species status reviews.
- We recommend that the Permits Division work to establish protocols for data sharing among permitted researchers. While many researchers in the community collaborate, having a national standard for data sharing among researchers could improve the quality of research produced. Data sharing may also reduce adverse impacts to ESA-listed species and critical habitat by minimizing duplicative research efforts.

- We recommend that the Permits Division continue to work collaboratively with the NMFS's Regional Offices to organize meetings and workshops to ensure that the results of all research programs or other studies on specific threatened or endangered species are communicated and coordinated among the different investigators and other interested parties. Meeting participants should include regional species recovery coordinators, academic institutions, researchers, USFWS species experts, state agencies, and other stakeholders.

# 14 REINITIATION NOTICE

This concludes formal consultation for the OPR Permits and Conservation Division proposal to implement a program for the issuance of permits for research and enhancement activities on ESA-listed sea turtles. Since the Program does not have a definitive sunset (or expiration) date, there is no pre-determined end date on this biological opinion. As discussed above (see *Integration and Synthesis* Section 10), the dynamic and adaptive elements of the Program (i.e., adaptive management approach) are critically important for reducing risk and avoiding jeopardy or adverse modification over time. The standard reinitiation triggers, which apply to all biological opinions, provide an additional safeguard against jeopardy or adverse modification over time. 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 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 critical habitat that was not considered in this opinion, or (4) a new species is ESA-listed or critical habitat designated that may be affected by the action. Each of these standard reinitiation triggers is discussed below in the context of this consultation.

As described in Section 12 (above), the proposed action may result in some small level of incidental take of the following ESA-listed species or DPSs: Atlantic salmon GOM DPS; smalltooth sawfish U.S. portion of range DPS; Atlantic Sturgeon DPSs (Gulf of Maine, New York Bight, Chesapeake, Carolina, and South Atlantic), shortnose sturgeon, Gulf sturgeon, green sturgeon Southern DPS, Nassau grouper, and scalloped hammerhead DPSs (Eastern Pacific, Central and Southwest Atlantic, and Indo-West Pacific). The proposed action may also result in some small level of incidental (lethal) take of the sea turtle species and DPSs due to delayed mortality from the effects of trawl capture. Reinitiation of formal consultation is required if the incidental take of any of these species (or DPSs) exceeds the anticipated levels (trigger #1) specified in Table 27 (above). Since delayed mortality would not be observed or reported by researchers, this incidental take would be exceeded if the assumptions regarding the anticipated number of trawl captures or the delayed mortality rate are exceeded.

Given the adaptive management approach that is built into the proposed action, we anticipate that reinitiation trigger #2 (above) will have limited application in the context of this consultation. That is, the Program is structured such that new information regarding the effects of research activities on ESA-listed species and/or critical habitat can be incorporated into the Program without the need for reinitiation, assuming such changes are designed to be more protective, or at least equally protective, as those evaluated in this consultation. Some examples may include: (1) changes in general permit conditions to improve the monitoring of take or administration of the Program, (2) adding new mitigation measures to further minimize adverse effects (either directed or incidental) on ESA-listed species, or (3) applying updated information regarding delayed mortality risk from certain capture methods (e.g., trawls) or research procedures to the management of the sea turtle lethal take limits established by the Program. Reinitiation trigger #2 could also apply if new information indicates that any of the key assumptions that went into the effects analysis have been violated. For this opinion, this includes assumptions regarding the number of sea turtles annually exposed to capture in trawl nets as part of the Program and how sea turtles respond to capture in research trawl nets.

Based on information obtained from permit holders or other sources, the Permits Division may determine that one of the ten-year lethal take limits for observed sea turtle mortalities (as shown in Table 1) for a particular species (or DPS) has been exceeded. While exceeding a mortality limit may adversely affect ESA-listed species in a manner or to an extent not considered in this opinion, depending on the particular circumstances, such an incident may not automatically trigger reinitiation of formal consultation. Given the flexibility and adaptability built into the Program, we anticipate that, in many instances, adverse effects resulting from exceeding a lethal take limit can be addressed through informal consultation and Program modifications not requiring reinitiation of formal consultation. Continued close collaboration and an on-going dialogue between the Permits Division and the Interagency Cooperation Division will be an important component of the proposed adaptive approach to managing the Program. As soon as it is determined that a ten-year lethal take limit is likely to be or has been exceeded, the Permits Division and the Interagency Cooperation Division will consult informally to evaluate the impacts on the affected sea turtle population and species (or DPS), and work collaboratively on solutions for mitigating adverse effects. Reinitiation of formal consultation may be required if informal consultation does not result in Program changes that adequately address the adverse effects resulting from exceeding a lethal take limit.

Reinitiation trigger #3 (above) could be invoked if the Permits Division modifies the proposed action such that the adverse effects to ESA-listed species or designated critical habitat are greater than those effects considered in this opinion under the Program. For example, any proposed increase in the ten-year mortality limits shown in Table 1 could result in adverse effects to sea turtle populations beyond those considered in this opinion. Such a change to the Program, therefore, would trigger reinitiation of formal consultation. The Permits Division would initiate discussions with the Interagency Cooperation Division about reinitiation if all Column A (Table 1) lethal takes for a species/ocean basin have been authorized for a given ten-year period, and at least one authorized lethal take has been drawn from the buffer reserve (Column B, Table 1).

Since additional risks may be associated with new or experimental procedures, the Permits Division will only authorize a new procedure (i.e., one that is not explicitly discussed above) as part of the Program if, after reviewing the best available scientific information, they determine that (1) the procedure is effective at achieving the research objectives, and (2) any adverse effects on sea turtles resulting from the procedure are less than or equal to the adverse effects of any of the procedures previously authorized or described above for the same research objectives. Therefore, the Permits Division does not expect new research methods or changes in protocols to result in a level of impact not evaluated as part of this programmatic consultation. If the adverse effects are greater than considered in this programmatic opinion, reinitiation is required.

As discussed in the Description of the Proposed Action (Section 3), the Permits Division would work closely with the Interagency Cooperation Division throughout implementation of its Program. The two divisions will routinely (e.g., every 5 years or more frequently as needed) check-in on how the Program is functioning overall, and determine whether new information indicates that the Permits Division should request re-initiation of this consultation.

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Appendix A: Endangered Species Scientific Research and Enhancement Permit Application Instructions

# National Marine Fisheries Service

# Endangered Species Scientific Research and Enhancement Permit Application

***OMB No. 0648-0084***
***Expires: 12/31/2019***

# Endangered Species Scientific Research and Enhancement Permit Application

## TABLE OF CONTENTS

# Introduction

### What is this application for?

- This application is for requesting an Endangered Species Act (ESA) scientific research or enhancement permit to take[1], import, or export National Marine Fisheries Service (NMFS) protected species, including:
    - Sawfish (largetooth and smalltooth)
    - Sea turtles (in-water)
    - Sturgeon (Atlantic and shortnose)

### What is this application <u>not</u> for?

- Research or enhancement activities on sea turtles on land or in rehabilitation
- Research or enhancement activities on marine mammals
- Only importing, exporting, or receiving protected species parts
- Commercial or educational photography
- Public display
- To apply for one of these permits, visit: http://www.nmfs.noaa.gov/pr/permits/types.html

### When should I apply?

- At least 1 year before your project will begin

### What is the process for getting a permit?

1. Follow these instructions and contact the Permits and Conservation Division at 301-427-8401 with any questions.
2. Submit your application via APPS (https://apps.nmfs.noaa.gov/).
    a. An assigned permit analyst will contact you and review the application.
3. Address any questions on the application. To facilitate processing, reference the application File No. in all correspondence.
    a. Once complete, we will publish a notice in the *Federal Register*, which starts a mandatory 30-day public comment period.
    b. Concurrently, we will send your application to subject matter experts in partner institutions and federal and state agencies for review.
    c. We will also request consultation under section 7 of the ESA to assess impacts to ESA-listed species. The ESA consultation can take up to 6 months.
4. Address any questions received during the comment period and consultation.
    a. We will then draft the permit and supporting documentation (including National Environmental Policy Act analyses and documentation of ESA issuance criteria), which will be reviewed by various NMFS offices including a legal review by General Counsel.

[1] A take under the ESA means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to do any of the preceding.

b. A Biological Opinion will be issued to determine if the activity will jeopardize the species or adversely modify critical habitat.
c. The Office Director will make a final decision.

## Important information

- If you do not follow these instructions, your application will be withdrawn and you will be asked to resubmit a new application that includes the information required.

- If we request additional information and do not receive it within 60 days, we may withdraw your application.

- Your permit may only authorize what is in your application; therefore, it must be a stand-alone document that describes all proposed activities even when you reference previous permits or published literature.

- When a question does not apply (i.e., N/A), explain why.

- Your application should be free of grammatical errors and readable to a lay person.

- You are highly encouraged to contact us at 301-427-8401 with questions in advance of submitting your application.

## How do I use APPS?

- Refer to Chapter 2 (“How to Use the System”).

- When starting from your portfolio, click on the link of your file number under the File Number column to take you to the application.

- **Save your application every 20 minutes or you will lose information!**

- You do not have to complete an application in one session.  Your application will remain in draft mode until you submit.

- An * means it is a required field.

- If you cut and paste from Word, special characters and formatting may be lost.

- Attachments cannot be larger than 10MB – contact us if you have larger files.

## Questions?

- Contact the Permits and Conservation Division at 301-427-8401.

# Application Instructions

## Project Information

***File Number***

- This number is automatically generated and cannot be changed.  To facilitate processing, reference this File No. in correspondence with our office.

****Project Title*** (up to 255 characters)

- Provide a concise title to include the activity, species (or taxa if multiple species), location, and purpose of the study.  For example:
  - *Vessel surveys, sampling, and tagging sea turtles in the Gulf of Mexico to characterize population structure, forging ecology, and movement patterns.*

****Project Status***

- The project status (New or Renewal) is automatically selected based on your answers in the pre-application guide (PAG).  Do not change this field.

***Previous Federal or State Permit #***

- If applicable, enter your most recent and closely related NMFS permit number. Otherwise leave blank.  State permit numbers are not applicable.

****Permits Requested***

- One or more permit will be listed based on your answers in the PAG.  If the options listed are incorrect, please call us at 301-427-8401 for assistance.

****Where Will the Activities Occur?***

- One or more general locations will be listed based on your answers in the PAG. If a location is incorrect, please call us at 301-427-8401 for assistance.

****Research Timeframe***

- Enter the desired start and end dates of the entire project in the following format: MM/DD/YYYY.  The start date must not be prior to the date you submit the application and should be at least 1 year after the date you submit.  The end date must be within five years of the start date because permits are generally valid for a five-year period.  In some cases, a ten-year permit may be authorized.

****Sampling Season/Project Duration*** (up to 1,000 characters)

- Describe the annual field season(s) including the months and frequency of fieldwork (i.e., how many times per year and how frequently will you conduct your activities?).  If this includes year-round research, indicate when activities are most likely to occur and how frequently.

***Abstract*** (up to 2,000 characters)

- Federal regulations require the following information be published in the *Federal Register* Notice of Receipt that initiates a mandatory 30-day public comment period:
  - Purpose of the research or enhancement
  - Target and non-target species (common and scientific names)
  - Proposed take activities (e.g., capture, sampling, tagging), import, or export
  - Numbers of animals to be taken or imported/exported or number of animals from which specimens will be imported/exported, by species or taxa, annually
  - Specific geographic locations of take and locations from which animals or samples will be imported or to where they will be exported, if applicable
  - Requested duration of the permit

## Project Description Page

***Project Purpose:  Hypothesis/Objectives and Justification*** (up to 64,000 characters)

- Discuss the **purpose** of your project including your hypotheses and/or objectives.

- Briefly **summarize published findings** related to your objectives.  If you previously held or worked under a permit, use literature citations from that work to show how you previously met your objectives; or, use other published literature on the subject.  Describe how this study is different from, builds upon, or duplicates past research.

- If proposing **novel procedures**, include a discussion on results from pilot studies or studies on other species, if available.

- Explain how you determined your **sample size/take numbers**.  For example, did you base your numbers on previous encounter rates or abundance estimates for your study area?  If appropriate for your study, include a power analysis or other sample size estimation to show whether the sample size is sufficient to provide statistically significant or otherwise robust results appropriate for your study.

- The information above should **support how your proposed research is *bona fide***, including how the results of your research are likely to published in a refereed scientific journal.

- Discuss why your project must involve ESA-listed species.

- Discuss how your project will, as applicable:
  - contribute to the objectives identified in the **species' recovery plan** or otherwise respond to recommendations of a scientific body charged with management of the species;

    - contribute significantly to understanding the basic biology or ecology of the species; and
    - contribute significantly to identifying, evaluating, or resolving conservation problems.

- For enhancement, describe how your work will enhance the survival and recovery of the species in the wild, or will enhance the propagation of the species for recovery purposes.

***Project Description*** (up to 64,000 characters)

- **Your permit may only authorize what you describe in your application**.

- Provide a **brief overview** of a day on the water of the suite of activities you intend to perform on each animal during an encounter or capture event including where your work would happen, especially if different projects occur in different locations.
    - For sturgeon, provide location (i.e. river, bay, ocean basin) for each Take Action[2] you describe.

- **Methods**: Provide **clear descriptions of all methods** for each species, by Distinct Population Segment (DPS) where applicable, and the **number of animals by age class[3] and sex** you expect to take by each method/procedure **annually**.

- The **methods must match what is in the take table**.
    - There should be a narrative description for each Take Action, Observe/Collect Method[4,] and Procedure[5] in the take table, and the take numbers and procedures in the narrative must match the table.
    - Reference take table lines in the narrative that correspond to the take actions and procedures, as needed.
    - If you have multiple projects, it is helpful to name them by project number or title and include project names in the Details column of the take table.

- Indicate the **number of times known individuals will be intentionally taken** in a year as driven by your objectives and study design (e.g., recapture for instrument retrieval or multiple biopsy samples per year). If recapturing animals,

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[2] The Take Action is a generalized overview of how animals will be taken. You may only have one Take Action for each Take Row. Examples: Capture/handle release; Harass.

[3] Define how age classes (e.g., early life stage fishes (ELS; includes eggs and larvae), post-hatchling turtles, juvenile, subadult, adult) are differentiated, by taxa or species.

[4] The Observe/Collect Method is the method of observation (e.g., survey, vessel) or capture (e.g., net). Select only one observe/collect method per take table row.

[5] Procedures are the individual activities you conduct on animals that have been captured/taken by a certain Take Action and Observe/Collect Method. Examples: sample, blood, fin clip, and swabs; external tagging.

indicate whether they will be immediately released without processing or fully or partially processed (i.e., what will be done to them on recapture).

- If some animals may be **unintentionally recaptured** in a year estimate how many and indicate whether they will be immediately released without processing or fully or partially processed.

- If some animals will only get a **subset of procedures**, list them on separate rows in the take table and make sure it is clear in the narrative. Explain how you decide which animals receive which procedures.

- If animals are being **captured under another legal source** (e.g., bycaught in commercial federal fishery) prior to research, identify the legal authority (e.g., ESA section 7 biological opinion with incidental take statement; another ESA section 10 permit) for the capture of these animals. Note: Annual take numbers requested for your research activities cannot exceed the number authorized for the original capture.

- Describe the **size** of animals for which you are requesting take.
    - For turtles, indicate the minimum size of the animals for the procedures you are requesting.
    - For sturgeon:
        - Include total length for each age class proposed.
        - Make sure you have indicated in the Objectives section above the purpose of working with each life stage/size.
        - In the details of the Take Table, define the size range of the targeted life stage.

- **Figures and photographs** are useful to illustrate your methods (e.g., tags and instrument attachments, nets and net deployment), especially for ESA consultations. You can attach them on the Supplemental Information page.

- Cite **references** for the methods where applicable, but do not substitute a literature citation for a complete description of the methods.

- Include a brief statement on the **purpose** of each procedure/how it relates to meeting your objectives.

- **Mitigation** measures that are standard protocols may be included in this methodology, or in Mitigation section below.

- See table below for examples of information to include when describing your methods.

| Take action/ procedures | Example details to include in methods |
|---|---|
| **Active acoustics** | -Sound source (e.g., sidescan sonar, underwater speaker, acoustic deterrent device)<br>-Source depth in water column<br>-Frequency (bandwidth)<br>-Maximum source level<br>-Maximum received level<br>-Distance to target and non-target animals<br>-Signal duration and duty cycle<br>-Duration of exposure<br>-Ambient sound level, when known<br>-Propagation loss model results, when available<br>-Post playback monitoring |
| **Administer drugs or other substances** (e.g., stable isotopes, bone marking, anesthesia) | -Name of each drug/chemical and its purpose<br>-Name of any drug reversal or emergency response drugs<br>-Dosage of each<br>-Delivery method and route (e.g., intramuscular, intravenous, subcutaneous, topical, immersion)<br>-Location of administration on body<br>-Duration of drug<br>-Personnel that would administer drug (e.g., veterinarian or veterinary technician; state license requirements)<br>-Post drug administration monitoring |
| **Aerial and vessel surveys (manned)** | -Type of survey craft and vessel<br>-Type of survey (e.g., line transect, photogrammetry)<br>-Number of surveys per year<br>-Minimum and maximum altitude/approach distance<br>-Air/ vessel speed<br>-Protocols for breaking track to ID species<br>-Duration spent with group or individual/day |
| **Auditory brainstem response or evoked potential** | -Type of measurement equipment (suction cup or needle electrodes )<br>-Handling/restraint methods<br>-Handling duration<br>-Data collection and analysis method<br>-Whether animal will be transported to a facility (complete the Transport Section in Take Table) |
| **Captive experiments** | -In addition to describing the procedures that will be performed on the animals, describe their care and maintenance, including a complete description of the facilities where they will be maintained. This includes but is not limited to:<br>• dimensions of the pools or other holding facilities<br>• number, sex, and age of animals by species to be held in each tank/enclosure<br>• water supply, amount, and quality<br>• diet, amount and type<br>• sanitation practices.<br>-Indicate the final disposition of animals after completion of experiments. |

| Take action/ procedures | Example details to include in methods |
|---|---|
| **Capture and restraint** | -Type of capture (e.g., hand or net (gill [drift or anchored], trawl, seine) and gear description<br>-Deployment methods (e.g., boat approach and net set, tow or soak times)<br>-Configuration, duration, and monitoring of net sets (how often net set is checked)<br>-Numbers of animals captured at a time<br>-Number of animals processed at a time<br>-Anesthesia/sedation (see drug administration)<br>-Dimensions and type of holding container<br>-Number and roles of personnel (must be adequate to perform all activities without harming excess captured animals; else they must be released immediately)<br>-Additional equipment or personnel necessary for capturing and handling excess numbers<br>-Duration of restraint/holding from capture to release<br>-Sea turtles: If handling sea turtles without a veterinarian present, identify an on-call veterinarian or nearby permitted rehabilitation facility available for emergencies<br>-Release |
| **Export/import samples** | -Type of sample (e.g., blood, muscle, gonad)<br>-Country sending samples to, country of origin, or high seas<br>-Designated port of entry/import or export<br>-How sample/animal is taken in foreign country or on the high seas and legal take authority<br>-Type of storage/shipping, including preservatives, etc.<br>-Analysis<br>-Re-import/export if samples remain after analysis |
| **External instruments** (a table is helpful for multiple tag types) | -Type of instrument<br>-Location on body<br>-Dimensions<br>-Mass in air or water<br>-Percentage of body mass<br>-Minimum size of animal to receive each tag type<br>-Maximum footprint/maximum number of tags/animal<br>-Method of attachment (e.g., remote suction cup; restraint and epoxy/resin; monofilament line)<br>-For remote deployment: number of attempts per animal/day, minimum approach distance and angle<br>-Pain management if required (see Administration of Drugs)<br>-Will it be coated with antifouling paint?<br>-Duration of attachment procedure<br>-Duration of instrument retention on animal<br>-Release mechanism or recapture to remove<br>-Type of data collection (e.g., archival requiring retrieval)<br>-Type of data collection<br>-How will you determine which animals receive which tags or more than one tag?<br>-Post-tag monitoring |

| Take action/ procedures | Example details to include in methods |
|---|---|
| **Internal instruments** | -Type of instrument<br>-Dimensions<br>-Mass in air or water<br>-Percentage of body mass<br>-Size of animals (including minimum size) to receive an internal instrument<br>-Location within body<br>-Cleaning/sterile preparation<br>-Insertion method (e.g., surgical implant, injection, stomach tube) and any applied coating on the tag (e.g., antibiotic)<br>-Local anesthetic or anesthesia/sedation (see Administer drugs) if applicable<br>-Personnel that would implant tag<br>-Duration of insertion procedure<br>-Duration of instrument retention<br>-How stomach pills are voided<br>-For sea turtles: include veterinary-approved protocol for stomach pills<br>-Type of data collection |
| **Intrusive sampling** (e.g., blood, digital fecal extraction, laparoscopy, lavage, muscle, scute, skin, swabs); remote or under restraint | -Type of tissues<br>-Size or volume of sample (diameter and depth or total volume)<br>-Location on body<br>-Number of samples per animal per capture event and per year, sampling intervals (e.g., for serial blood samples)<br>-Sampling equipment description and disinfection<br>-If restrained: cleansing site; left open or wound closure<br>-If remote: collection method (e.g., pole sampling), minimum approach distance, number of attempts per animal<br>-Minimum size of animal to receive each procedure<br>-Pain management or sedation (drugs and dosages as above)<br>-Whether animal will be transported to a facility for temporary holding (see Transport information in Take Table below)<br>-Personnel that would perform intrusive procedures (see Personnel section below to include details on training and experience)<br>-For sea turtles, include a veterinary-approved protocol for laparoscopy, tumor removal surgery, and bone biopsy<br>-Sample storage and analysis |
| **Marking** (e.g., bone mark (OTC, fluorescent), flipper tag, Floy/dart tags, paing, PIT tag, shell etching) | -Type of mark<br>-Location on body<br>-Method of application<br>-Disinfection procedures<br>-Duration of mark<br>-Dimensions of tag or mark<br>-Size of animals to receive tags including minimum size<br>-Total number and combination of tags or marks on each animal<br>-For turtles:<br>    -Local anesthetic for PIT tagging turtles <30 cm SCL<br>    -Veterinary-approved protocol for PIT tagging turtles <15 cm SCL<br>    -Type of paint (non-toxic only) |

| **Take action/ procedures** | **Example details to include in methods** |
|---|---|
| **Non-intrusive sampling** (e.g., behavioral observations, diagnostic imaging, collecting voided feces and urine, photogrammetry) | -Approach method<br>-Sampling method (e.g., X-ray; genetic tissue from fin)<br>-Minimum and maximum approach distance<br>-Within sight of animals or not (e.g., from a blind)?<br>-Frequency of observations/sampling/day<br>-Duration of observations/sampling/day<br>-Data or sample collection and analysis<br>-Whether animal will be transported to a facility for temporary holding (see Transport information in Take Table below) |
| **Unmanned Aircraft Systems** (UAS) or **Underwater Remotely Operated Vehicles** (ROVs) | **For UAS**, same details for aerial surveys and also:<br>-Type of UAS – fixed wing or vertical takeoff and landing<br>-Payload components – what is the UAS carrying and for what purpose?<br>-Size and mass of UAS<br>-Will the UAS ever be beyond the line of sight?<br>-Does the device have an auto-return feature should the device fail?<br>-Ground control station description (what it is, where it will be located - on shore or on vessel, number of stations, and how close the station will be to animals)<br>-Spotter roles (e.g., one spotter monitoring the UAS, another for monitoring the ground control station)<br>-Battery life<br>-Do you have the appropriate FAA permits/authorizations (including pilot licenses)?<br>**For ROV**, same details as for vessel surveys and also:<br>-Description and size of ROV<br>-Whether it is tethered or wireless<br>-Battery life<br>-Deployment method, in relation to capture and release of animal, if applicable<br>-Whether there will be a live video feed on the boat |

**Non-target species and conspecifics**: Indicate the **estimated number and type of non-target species** that may be encountered in your study area annually, and whether and how they may be incidentally harassed, captured, or otherwise affected. This includes but is not limited to marine mammals and ESA-listed species such as fish, sea turtles, sea birds and plants.

- For ESA species designated by DPS, specify the DPSs that are likely to be encountered.
- Explain how you will avoid them or minimize impacts to them (e.g., not in area during time of study; would not approach closer than 100 meters; would halt operations until non-target species moved out of study area).
- If takes to non-target animals may occur, include these on separate rows in the Take Table to include incidental take (e.g., harassment or capture) of non-target conspecifics.

## Project Supplemental Information

***Attach a Supplemental Information File***

- You may attach supplemental files here.

****Status of the Affected Species*** (up to 2,000 characters)

- As applicable, indicate the status of the species or stock as follows:
  - ESA - threatened or endangered; and
  - Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) - Appendix I, I, or III

  Species information is available at the following web sites:
    http://www.nmfs.noaa.gov/pr/species/
    http://www.fws.gov/
    http://www.cites.org/

****Lethal Take*** (up to 2,000 characters)

- If authorization for harm[6] or mortalities[7] (euthanasia/intentional[8] or accidental/unintentional) is proposed:
  - What activities could result in harm or mortality?

  - Explain why it's not feasible to use other methods that won't result in harm or mortality.
    - For euthanasia, indicate if it is for humane reasons (e.g., if working with compromised/comatose animals) or euthanasia for directed lethal take.
    - If a wild fish or turtle is requested for directed lethal take where it is required to be euthanized for scientific research purposes, explain how the research will directly benefit the species or fulfill a critically important research need with a conservation benefit.
    - Directed research requiring euthanasia of captive sturgeon is an optional disposition for such animals.

  - What is the maximum number of animals of each species/DPS and age class that could be harmed, unintentionally die, or be euthanized annually?  Over the life of the permit?

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[6] Harm is defined an act which actually kills or injures fish or wildlife. Such an act may include significant habitat modification or degradation where it actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns, including breeding, spawning, rearing, migrating, feeding or sheltering.

[7] Caused by the presence or actions of researchers including but not limited to harm or deaths resulting from infections related to intrusive procedures, sustained during capture and handling, or while attempting to escape capture.

[8] This includes unintentional euthanasia for humane reasons (e.g., if working with compromised/comatose animals).  Only in rare instances may wild fish or turtles be sacrificed in directed research, unless there are clear, documented conservation benefits outweighing the loss.

- Justify the number of mortalities.

- How is euthanasia decided, conducted, and who conducts it?
    - For sea turtles, euthanasia must be determined and performed by an on-call veterinarian or permitted rehabilitation facility.

- What are the protocols for necropsy and carcass disposal?

***Anticipated Effects on Animals** (up to 64,000 characters)

- Using the **best available science** (i.e., literature citations or other cited data sources) and your experience (e.g., personal communication), discuss how each take action and procedure listed in the take table (e.g., tissue sampling, marking, and instrumentation) will affect target and non-target animals (short-term and long-term).

- Include such things as typical **behavioral and physiological responses**, worst-case responses, % of animals that normally respond, how long it takes for animals to recover, and the time it takes wounds to heal.

- Also include an assessment of such things as:
    - condition of animals on recapture/resight
    - recovery from sedation and handling
    - post-release behavior (immediate and long-term)
    - habitat use for animals in resident populations (e.g., telemetry data, resightings)
    - healing from intrusive sampling
    - healing from intrusive tag deployments
    - tag retention
    - effects to nesting female sea turtles if working during the nesting period

- Condition of **bycaught non-target species**. Will they be released alive or is a certain percentage expected to be unintentionally harmed or killed?

- For **novel procedures or operating in more extreme environmental conditions**, discuss the most likely anticipated responses based on literature from studies on other species, if available.

- Summarize any **mortalities** that have occurred during the previous ten years of your permitted research using the same or similar techniques; include circumstances and cause of death.

- Discuss the anticipated **effects on the species or DPS**, especially if mortalities or reproductive effects are possible. On what is your determination based?

***Measures to Minimize Negative Effects*** (up to 64,000 characters)

- **Mitigation and monitoring**: You may include mitigation and monitoring protocols here, in the Project Description section, or in the Anticipated Effects section. If included in another section, simply reference the section where the following information is found:

  - For each Take Action, Observe/Collect Method, and Procedure, describe your standard **mitigation to avoid or minimize the potential for adverse impacts** identified above.

  - Describe your short- and long-term **post-procedure monitoring** protocols.

  - If monitoring or mitigation is not feasible for specific procedures, species, situations, etc., explain why.

  - For sea turtles: if a proposed method (as indicated in the above methods table) or your institution requires a veterinary-approved protocol, attach the full protocol, any veterinary comments/recommendations, and the signed approval. This protocol may include an approved Institutional Animal Care and Use Committee (IACUC)[9] proposal to aid our assessment of impacts of your work under the ESA.

- **Research Coordination**: Describe how you will collaborate or coordinate with other researchers in your action area. Who are they? Explain **how** this will occur. For example, will it involve sharing vessels, samples, or data? Will it involve timing surveys to avoid disturbance or repeated captures of the same animals?

***Attach a References File***

- Attach a **bibliography** of references cited in this application. Referenced materials must be made available upon request, as needed for evaluation of the application, or preparation of any necessary ESA or NEPA analyses.

***Resources Needed to Accomplish Objectives*** (up to 2,000 characters and attach files if necessary)

- Explain how your expertise, facilities, and resources are adequate to accomplish your proposed objectives and activities.

- Attach copies of any relevant formal research proposals, contracts, grant awards, or letters of agreement that would demonstrate financial or logistical resources.

- Indicate the status of any other international, federal, state, or local authorizations you have applied for, secured, or will apply for.

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[9] For **sea turtle** research: **NMFS researchers** are **required** to submit the NMFS IACUC-approved protocols and assurance letter.

***Disposition of Tissue Samples** (up to 2,000 characters)

- Indicate the disposition of any remaining samples after your project is complete.
  - State whether samples will be consumed in analysis, destroyed, or exported back to facility/researcher
  - If applicable, list the name and location of the person or institution that will store/curate samples. Indicate if you will retain legal custody of the archived samples or if you wish to permanently transfer the samples once your project is complete.

***Public Availability of Product/Publications** (up to 800 characters)

- Describe the end products of your proposed project and how they will be made available to the public.

## Project Locations

- You will first describe where you plan to work. Then, for each location, you will use the Take Table to list the species you expect to encounter and the take procedures you will conduct in those locations.

- Add New Location: provide information about one (or more) study areas
  - General area (ocean basin)
  - State(s), as applicable.

- Enter Location Details, as applicable:
  - Waterbody: enter names of rivers, estuaries, bays, etc.
  - Latitude and longitude of your study area
  - River miles (Begin Mile and End Mile)
  - Limits of your study area (e.g., to the U.S. EEZ, to the edge of the continental shelf, to 50m depth)
  - Names of land masses where research will occur (e.g., islands, rookeries).

- Attach File: Attach a high quality map(s) with the correct scale that clearly shows the location of your proposed activity and any environmental aspects of interest. If possible, include a shapefile, Google Earth kmz/kml, or ASCII text file with lat/long data and the associated basic metadata with your electronic application submission.

## Take Table

The take table represents the **estimated** number of animals you may take **annually** during your research.

The options that appear in the dropdown menus in the take table are based on the species group you indicated in the Pre-application Guide and the location that you have selected. If you are having difficulties, please first check that the previous fields were entered correctly.

*Columns you will fill out in the take table:*

1) **Select**: Leave this box blank unless you need to copy, move, or delete the line following the instructions above.

2) **Species**: Use the drop down list to select. Species are listed alphabetically by common name and/or category (e.g., dolphin, bottlenose). If the species you are looking for is not on the drop-down menu, double check your location (species are populated based on location). If you are still having problems, contact us at 301-427-8401.

3) **Listing Unit/Stock**: Select the applicable ESA listing unit/stock. Choose Range-wide if, for example, your location has multiple stocks of the same species and you cannot distinguish between them while in the field.

4) **Production/Origin**: Select from the drop-down list. Categories include Wild, Captive, Rehabilitation Facility (for marine mammals only), or All.

5) **Life Stage**: Select from the drop-down list. You may enter take information for more than one life stage (e.g., adult versus juvenile) on separate rows or select a combination of life stages for one take category. Include specified ages if they differ for each procedure in the Details column.

6) **Sex**: Select from the drop-down list. If your activity targets only one sex, indicate which. If it targets both and they can be targeted separately, enter separate rows for male and female; otherwise select Male and Female.

7) **Expected Take**: This represents a reasonable estimate of the maximum number of individuals you will take, import, or export, annually.

   **For vessel surveys of sea turtles that do not involve capture**, you will be required to count every animal you approach within 50 yards, regardless of whether a behavioral reaction has occurred. Count 1 take per animal observed per day when you know it is the same animal. If unable to identify the animal, count each turtle seen as a new take.

   **For aerial surveys of sea turtles** flown at an altitude lower than 700 ft[10], count 1 take per sea turtle observed per day, regardless of the number of passes over the same animal.

8) **Takes Per Animal**: Estimate the number of times the same individual will be taken annually, if known.

10 We are looking for data to establish minimum thresholds for when take is likely to occur from vessel and aerial approaches.

9) **Take Action**: The “take action” is a generalized overview of how animals will be taken. If more than one action is proposed, you must enter the takes on separate rows.

10) **Observe/Collect Method**: Select the method of observation (e.g., survey, vessel) or collection/capture. Select only one observe/collect method per row. If various methods will be used, you must provide take information in separate rows for each observe method.

11) **Procedures**: Provide specific information on the research activities that will be conducted. A separate pop-up window will appear with a species-specific list of activities. Hold down the Control key to select all activities to be performed concurrently. Choose Other if your proposed activity is not listed. In the Details box (see below), briefly describe what the Other means.

12) **Transport**: If you chose transport as a Procedure, enter information about the transport.

    a) **Mode(s) of transportation**: Describe the mode of transportation. Include a description of the vehicle or other platform used to transport animals.

    b) **The name of the transportation company, if applicable, and the qualifications of the common carrier to transport live animals**: If a contractor or other entity will do the transportation, enter information in the box. Otherwise, click on N/A.

    c) **Maximum length of time from capture to arrival at destination**: How long will the animals be in transport?

    d) **Description of the container (e.g., cage, tank) used to hold the animal during transit**: Include the material of the container and its dimensions.

    e) **Any special care procedures (e.g., moisture, medicines) to be administered during transport**: How will the animals be cared for during transport?

    f) **A statement as to whether the animals will be accompanied by a veterinarian or some similarly qualified person**: If so, give the name, affiliation, contact information for each person.

    g) **Destination**: Use the drop down list to select the destination. If your destination is not on the list, click on the “New Facility” button to add it. If the animals will be taken to a laboratory or aquarium, provide details of the location. If the animals will be released in another waterbody, provide details of the location.

h) **How will the animals be contained at the destination facility?**: Describe the containment system for the animals, quarantine procedures, and effluent treatment.

i) **The final disposition of the animals**: Describe, for example, whether the animal will be released or retained in permanent captivity.

13) **Begin Date**: Populated with the Begin Date you entered on the Project Information page. You may change the date to coincide with a specific project time shorter than the overall duration of the project. You cannot enter a date that is earlier than your original Begin Date.

14) **End Date**: Populated with the End Date you entered on the Project Information page. You may change the date to coincide with a specific project time shorter than the overall duration of the project. You cannot enter a date that is later than the End Date you previously entered.

15) **Details**: Enter up to 255 characters in this text box to provide details on each take table row. This is especially useful for clarifying age class, takes, specific activities, or projects.

## National Environmental Policy Act (NEPA) Considerations

In addition to providing information on effects to the target and non-target species in other sections of the application, provide information as requested below on potential environmental effects to determine if your activity may be categorically excluded from the requirement to prepare an environmental assessment or environmental impact statement under NEPA. If you believe any of the criteria are "not applicable" you must explain why.

1) If your activities will involve equipment (e.g., scientific instruments) or techniques that are new, untested, or otherwise have unknown or uncertain impacts on the biological or physical environment, please describe the equipment and techniques and provide any information about the use of these in the natural environment. In addition, please discuss the degree to which they are likely to be adopted by others for similar activities or applied more broadly.

2) Describe the physical characteristics of your project location, including:
    a. Whether you will be working in or near unique geographic areas including but not limited to Critical Habitat for endangered or threatened species, Essential Fish Habitat, National Marine Sanctuaries, Marine Protected Areas, State or National Parks, Wilderness Areas, Wildlife Refuges, Wild and Scenic Rivers, etc.

    b. Next, discuss how your activities could impact the physical environment in those locations, such as by direct alteration of substrate during use of anchoring vessels or buoys, erecting blinds or other structures, or ingress and egress of researchers, and measures you will take to minimize these impacts.

c. Is there potential to cause direct or indirect physical, chemical or biological alterations of the waters or substrate, including loss of, or injury to, benthic organisms (e.g., sea grass, corals), prey species and their habitat, and other ecosystem components? Could your actions reduce the quality and/or quantity of Essential Fish Habitat? If so, please provide additional details below:

- What is the degree of alteration (low, medium, high)?
- Approximately how much area (square footage) of habitat/substrate (e.g., seafloor, estuary or river bed) will be disturbed?

3) Briefly describe important scientific, cultural, or historic resources (e.g., archeological resources, animals used for subsistence, sites listed in or eligible for listing in the National Register of Historic Places) in your project area and discuss measures you will take to ensure your work does not cause loss or destruction of such resources.

4) Discuss whether your project involves activities known or suspected of introducing or spreading invasive species, intentionally or not, (e.g., transporting animals or tissues, discharging ballast water, use of boats/equipment at multiple sites). Describe measures you would take to prevent the possible introduction or spread of non-indigenous or invasive species, including plants, animals, microbes, or other biological agents.

## Project Contacts

As the person entering the application, you will automatically be assigned the following roles: **Applicant/Permit Holder, Principal Investigator,** and **Primary Contact**. See Chapter 2 for directions on how to change who is assigned to these roles, and the table below.

| Project Contact | Must be named in the permit application | Able to make changes to application, request changes to the permit, and submit reports; will receive automatic emails from APPS. | Description of qualifications required |
|---|---|---|---|
| **Applicant/ Permit Holder** | ✓ | ✓ | ✓ |
| **Applicant or Responsible Party*** | ✓ | ✓ | |
| **Principal Investigator** | ✓ | ✓ | ✓ |
| **Primary Contact** | ✓ | ✓ | |
| **Co-Investigator** | ✓ | | ✓ |
| **Authorized Recipients** | ✓ | | |
| **Research Assistants** | | | |

* The Applicant or Responsible Party may also be the PI or a CI if participating in the research; therefore, the description of qualifications is required if they are listed as the PI or a CI.

To prevent duplicate entries, **you MUST ALWAYS SEARCH the database for the person before entering a new contact.** To facilitate the search, start with only putting the last name in APPS search box.

A project must have a **Responsible Party** if the Applicant/Permit Holder is an organization, institution, or agency. The Responsible Party or Applicant/Permit Holder is an official who has the legal authority to bind the organization, institution, or agency and is ultimately responsible for the activities of any individual operating under the authority of the permit.

The **Principal Investigator** (PI) is the individual primarily responsible for the take, import, export, and any related activities conducted under the permit. There can only be one PI on a permit. The PI:

- must have qualifications, knowledge and experience relevant to the activities authorized by the permit
- must be on site during activities conducted under the permit unless a Co-Investigator is present to act in place of the PI
- may also be the Applicant/Permit Holder and Primary Contact.

**Co-investigators** (CIs) are individuals who are qualified and authorized to conduct or directly supervise activities conducted under a permit without the on-site supervision of the PI.

- You may add CIs to the application if the PI will not always be present during the permitted activities.
- CIs can also be added or removed once a permit has been issued.

**Authorized Recipients** (ARs) are persons or institutions authorized to receive samples for the purposes of analysis or curation related to the objectives of your permit. The PI and CIs may also be ARs. ARs should not be CIs if they are only performing the analysis and are not overseeing the study or publishing the results (i.e., they are only providing an analytical service).

Include a table listing the names of the PI and CIs, and the specific procedures they will oversee or conduct. **Attach the following table on the Supplemental Information page**.

Example Table Attachment:  Personnel Roles

| Name/Affiliation | Role | Activities |
|---|---|---|
| Researcher name, Affiliation, City, State | Principal Investigator, Co-investigator, or Authorized Recipient | Specific activities they will conduct under the permit and whether they are supervising |
| John Smith, Ph.D., University A, City, State | Principal Investigator and Authorized Recipient | Supervise and perform all activities under the permit |
| Jane Smith, Institution B, City, State | Co-investigator | All activities excluding anesthesia during captures and UAS |
| Jane Doe, Ph.D., Institution C, City, State | Co-investigator | Oversee and conduct captures, anesthesia, and surgical implantation of sonic tags |
| John Doe, Ph.D., University D, City, State | Co-investigator and Authorized Recipient | Collect skin biopsy samples and create cell lines |
| Laboratory E, City, State | Authorized Recipient | Receive subset of fin clip samples for DNA sequencing |

### *Qualifications and Experience*

Federal Regulations require that persons authorized as the PI or CIs have qualifications commensurate with their duties.  In addition, the names of the PI and CIs are sent to the NOAA Office of Law Enforcement to determine if any violations of the ESA and other environmental laws have occurred.

The permit applicant is therefore required to submit the following information about the qualifications and experience of the PI and all CIs to demonstrate they have qualifications commensurate with their duties as stipulated in the Personnel Table.  **A CV or resume must be up to date and contain all relevant information below**.  If sufficient experience is not provided, additional information will be required and the personnel will not be authorized to conduct the proposed activities unless sufficient experience is demonstrated.

1) **Contact information -** All documentation submitted will be publicly available. **DO NOT include personal information** (e.g., social security number, date of birth, nationality, or home phone/ address-unless it is also the business phone/address).
   - Name (first middle last)
   - Business phone, e-mail, and mailing address

2) **Relevant education and training**
   - Degree, major, name of institution, year received
   - Applicable certificates or licenses, year received
   - Other relevant training or certification, year received

3) **Relevant experience**
    - Job title, affiliation/location, and dates of relevant experience
    - Detailed description of when and how the individual obtained training and experience in the methods they will be conducting and/or supervising as outlined in the Personnel Table. This should include objective metrics such as:
        - The specific level of training received and who trained them
        - The number of hours/months/years they have been performing the activities
        - Which and how many procedures they have performed successfully and on what species/age class (this is especially important for intrusive procedures such as blood and biopsy sampling, intrusive tagging, etc.)
        - Whether and to what extent they have performed the activities without supervision or supervised the proposed activities
        - What permits they have been PI or CI under and for what species and activities

4) **List of grants awarded demonstrating available resources relevant to the proposed activities or history of securing resources for similar work**

5) **Annotated publication history relevant to the activities being conducted under the permit**

### Submit Application

See Chapter 2 for how to submit your application and check on its status.

## Additional Information

Under section 10(a)(1)(A) of the ESA, persons may be authorized to take threatened and endangered species for purposes of scientific purposes or enhancing the survival or propagation of the species. Interested persons are required to submit an application in accordance with the ESA and the implementing regulations at 50 CFR part 222. These instructions for applying for a research or enhancement permit are drawn from, but do not substitute for, ESA regulations. These regulations are available at the following web site: http://www.gpo.gov/. ESA section 10(a)(1)(A) is available at: http://www.nmfs.noaa.gov/pr/pdfs/laws/esa_section10.pdf. Under NEPA, Federal agencies must assess the effects of federal actions on the environment. Under section 7 of the ESA, Federal agencies must ensure that the permitted activities will not jeopardize the continued existence of the species or result in adverse modification of critical habitat.

## Paperwork Reduction Act Statement

The information requested in this application is required and is used to determine whether the activities described in the application are consistent with the purposes and policies of the Acts and their implementing regulations.

**Public reporting burden for this collection of information is estimated to average 50 hours per response**, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to the Chief, Permits and Conservation Division, Office of Protected Resources, F/PR1, NOAA/National Marine Fisheries Service, 1315 East-West Highway, Silver Spring, MD 20910.

All permit documentation, including the application, permit and amendments, reports, inventory information, and any other associated documents are considered public information and as such, are subject to the Freedom of Information Act. Notwithstanding any other provision of the law, no person is required to respond to, nor shall any person be subject to a penalty for failure to comply with, a collection of information subject to the requirements of the Paperwork Reduction Act, unless that collection of information displays a currently valid OMB Control Number.

***OMB No. 0648-0084***
***Expires: 12/31/2019***

Appendix B. Application Review Checklist for Section 10(a)(1)(A) and NEPA Criteria

Protected Resources Permits and Conservation Division
Review of Protected Species Research or Enhancement Permit Application

File No. ____________________ Applicant: ________________________________

Species/location: ______________________________________________________________

| **Criterion** | **Criterion met?(Y/N)** | **How?** |
|---|---|---|
| **Application Requirements** | | |
| Followed all instructions and used current OMB-approved version | | |
| Application signed by appropriate person (individual applicant or Responsible Party verified) | | |
| **Application Requirements and Information for Section 7 Consultation** | | |
| Objectives are tied to recovery priorities (see issuance criteria below) | | |
| Methods are described in sufficient detail to evaluate potential effects by species/age/sex/location including critical habitat | | |
| Sample size is justified/ reasonably likely to occur | | |
| Best available science is used to discuss possible adverse impacts and how they would be minimized or mitigated | | |
| Proposed monitoring is appropriate to evaluate effects of research and recovery of animals post-handling or sampling | | |
| Lethal take is justified | | |
| Provisions for disposition of species at conclusion are described | | |
| Have applied for, secured, or will apply for funding; and/or, have demonstrated record of securing funding | | |
| **Issuance Criteria the Office Director Considers (50 CFR 222.308(c))** | | |

| Criterion | Criterion met?(Y/N) | How? |
|---|---|---|
| The permit has been "applied for in good faith:" i.e., the applicant has demonstrated their intent to act consistent with the requirements of the ESA, regulations, and permit conditions; and their capability is consistent with what they purport to accomplish | | |
| The proposed activity "will not operate to disadvantage of listed species:" | | |
| Consistent with the purposes of the ESA (section 2), results would contribute to the objectives identified in the species' recovery plan or otherwise respond to recommendations of a scientific body charged with management of the species; contribute significantly to understanding the basic biology or ecology of the species; and contribute significantly to identifying, evaluating, or resolving conservation problems. | | |
| Would further a bona fide and necessary or desirable scientific purpose; or enhance propagation or survival | | |
| Personnel have adequate qualifications to carry out the proposed action and adequate facilities for captive care | | |
| Proposed activities cannot be conducted using an alternative species or stock (not listed) | | |
| Expert opinions have been considered and addressed | | |
| Applicant has demonstrated compliance with IACUC requirements (required for NMFS turtle applicants only) | | |
| **NEPA NAO 216-6A Extraordinary Circumstances – if not met, EA or EIS required** | | |

| **Criterion** | **Criterion met?(Y/N)** | **How?** |
|---|---|---|
| Applicant has described methods and mitigation with sufficient detail for PR1 to evaluate potential effects on target and non-target species and the physical environment | | |
| No potentially significant effect on human health or safety | | |
| No potentially significant effect on a geographic area with unique environmental characteristics (e.g., park lands, prime farmlands, wetlands and floodplains, wild and scenic rivers, sole source aquifers, marine protected areas, national marine sanctuaries, national estuarine reserves, or national marine monuments) | | |
| No potentially significant effect on species or habitats protected by the ESA, MMPA, MSA, or MBTA | | |
| No potential generation, use, storage, transport, or disposal of significant quantities of hazardous or toxic substances, (e.g., materials used at laboratories or maintenance facilities | | |
| No potentially significant effect on properties listed or eligible for listing on the National Register of Historic Places authorized by the NHPA, National Historic Landmarks designated by the Secretary of the Interior, or the National Monuments designated through the Antiquities Act; Federally recognized Tribal and Native Alaskan lands, cultural or natural resources, or religious or cultural sites | | |
| No disproportionately high or adverse effect on the health or the | | |

| Criterion | Criterion met?(Y/N) | How? |
|---|---|---|
| environment of minority or low-income communities | | |
| No significant potential to introduce or spread invasive species (e.g., zebra mussels, cordgrass | | |
| No potential violation of Federal, State, or local law or requirements imposed for protection of the environment | | |
| No uncertain environmental effects or unique or unknown risks | | |

Analyst: ________________________ Date: ______________

Appendix C. Section 10(a)(1)(A) Permit Template

Permit No. XXXXX-0X
Expiration Date: month dd, yyyy
Reports Due: month dd, annually

# PERMIT TO TAKE PROTECTED SPECIES[1] FOR SCIENTIFIC PURPOSES

## I. Authorization

This permit is issued to Name of Permit Holder, Affiliation, address (hereinafter "Permit Holder;" Responsible Party: Name), pursuant to the provisions of the Endangered Species Act of 1973 (ESA; 16 U.S.C. 1531 *et seq*.) and the regulations governing the taking, importing, and exporting of endangered and threatened species (50 CFR Parts 222-226).

## II. Abstract

The objective(s) of the permitted activity, as described in the application, is/are to [briefly summarize objectives].

## III. Terms and Conditions

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 appendices and attachments. 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 month dd, yyyy. 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 or Principal Investigator must contact the Chief, NMFS Permits and Conservation Division (hereinafter "Permits Division") for written permission to resume:

[1] "Protected species" include species listed as threatened or endangered under the ESA, and marine mammals.

a. If serious injury or mortality[2] of protected species occurs / reaches that specified in Tables X of Appendix 1.

b. If authorized take[3] is exceeded in any of the following ways:

i. More animals are taken than allowed in Tables X 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.

c. Following incident reporting requirements at Condition E.2.

3. The Permit Holder may continue to possess biological samples[4] acquired[5] under this permit after permit expiration without additional written authorization provided a copy of this permit is kept with the samples and they are maintained as specified in this permit.

B. Number and Kinds of Protected Species, Locations and Manner of Taking

1. The tables in Appendix 1 outlines the authorized species or distinct population segment (DPS) authorized; number of animals to be taken; number of animals from which parts may be received, imported and exported; and the manner of take, locations, and time period.

2. Researchers working under this permit may collect images (e.g., photographs, video) and audio recordings 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 or recordings 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 X of Appendix 1, in printed

[2] This permit allows for /does not allow for unintentional serious injury and mortality caused by the presence or actions of researchers up to the limit in Table X of Appendix 1. This includes, but is not limited to: deaths of dependent young by starvation following research-related death of a lactating female; deaths resulting from infections related to sampling procedures or invasive tagging; and deaths or injuries sustained by animals during capture and handling, or while attempting to avoid researchers or escape capture. Note that for marine mammals, a serious injury is defined by regulation as any injury that will likely result in mortality. [Use as applicable]

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

[4] 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.

[5] Authorized methods of sample acquisition are specified in Appendix 1.

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 NMFS ESA Permit No. XXXXX. This statement must accompany the images and recordings in all subsequent uses or sales.

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

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

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

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

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

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

   a. <u>Capture/Survey Methods</u>

      1. Hand Capture and Dip Net

         a. Researchers must be aware of the increased stress and physiological alterations that accompany capture and minimize these effects by keeping in-water chase activities and associated exertion as brief as possible. For capture by dip net, turtles must be removed from the net as quickly and safely as possible.

         b. The number of attempts to capture an individual turtle is limited to 3 attempts per day.

      2. Breakaway Hoop Net

         a. Researchers must follow the procedures for handling and monitoring leatherbacks included as Attachment X to this permit.

b. Researchers must ensure that only personnel experienced with the hoop net capture technique conduct the capture using this technique.

c. The Permit Holder must be aware of the increased stress and physiological alterations that accompany capture and minimize these effects by keeping in-water chase activities and associated exertion as brief as possible. This includes efficient and safe removal of turtles from the net.

d. The number of attempts to capture a leatherback sea turtle with the hoop net is limited to 5 per 24-hour period. If Researchers are unsuccessful after the first 3 attempts, they must wait a minimum of 4 hours before making the final 2 attempts for the day. Unless otherwise stipulated in the permit, only turtles behaving normally with no evidence of external trauma may be approached.

3. Entanglement Net

a. Mesh size of net must be designed to minimize bycatch of non-sea turtle species.

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

c. Nets must be checked at intervals of less than 30 minutes, and more frequently whenever turtles or other organisms are observed in the net. If water temperatures are $\leq 10^{o}$C ($50^{o}$F) or $\geq 30^{o}$C ($86^{o}$F), nets must be checked at less than 20-minute intervals. “Net checking” is defined as a thorough check of the net either by snorkeling the net in clear water (entire net must be visible) or by pulling up on the top line such that the full depth of the net is viewed along the entire length. The intervals given are the maximum time between viewing any single point of the net (i.e., each point of the net must be viewed every 30 or 20 minutes, depending on water temperature).

d. The surface float line of all nets must be observed continuously for movement indicating an animal has encountered the net. When this occurs, the net must be immediately and thoroughly checked.

e. Researchers must plan for unexpected circumstances or demands of the research activities and have the ability and resources to meet the 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). Contingencies for inclement weather must be in place (e.g., if inclement weather is predicted that would prevent meeting the net checking requirements, the net must be removed in advance).

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

   i. Should any marine mammals enter the research area after the nets have been deployed, the lead line must be raised and dropped in an attempt to make marine mammals in the vicinity aware of the net.

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

   iii. If a marine mammal becomes entangled or dies, Researchers must:

      A. Stop netting activities immediately.

      B. If the animal is alive, immediately free it from the net in a same manner (including cutting the net as necessary) and proceed to step D.

      C. If the animal is dead, hold the carcass and follow the directions of the NMFS Regional Stranding Coordinator.

      D. Notify the appropriate NMFS Regional Stranding Coordinator within 8 hours (see Attachment X or go to: http://www.nmfs.noaa.gov/pr/health/coordinators.htm),

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

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

g. Netting in Areas Where Fibropapilloma (FP) is Known to Occur: Nets used at sites where FP is known to occur must be thoroughly cleaned and 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. Nets must be disinfected using a broadcidal solution and the product-recommended contact time or by thoroughly drying nets in sunlight to inactivate FP-associated herpesvirus. Appropriate disinfectants include 70% isopropyl alcohol, 10% bleach, and other viricidal solutions with proven efficacy against herpesviruses.

4. Trawl

a. Tow times must not exceed 30 minutes bottom time and depth may not exceed 20 m.

b. Marine Mammals

i. Trawling must not be initiated when marine mammals, except dolphins or porpoises, are observed within the vicinity of the study area, and the marine mammals must be allowed to either leave or pass through the area safely before trawling is initiated.

ii. Researchers must make every effort to prevent interactions with marine mammals. Researchers must be aware of the presence and location of marine mammals at all times as they conduct trawling activities.

iii. If a marine mammal enters the net, becomes entangled or dies, Researchers must:

A. Stop trawling activities immediately.

B. If the animal is alive, immediately free it from the net in a safe manner and proceed to step D.

C. If the animal is dead, hold the carcass and follow the directions of the NMFS Regional Stranding Coordinator.

D. Notify the appropriate NMFS Regional Stranding Coordinator within 8 hours (see Attachment X or go to:

http://www.nmfs.noaa.gov/pr/health/coordinators.htm).

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

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

5. Pound Net

   a. Pound nets and leaders must be thoroughly checked every 24 hours or less. Net checking is defined as a thorough check of the net such that the full depth of the net and leader are visible along the entire length.

   b. Unless otherwise authorized under ESA Section 7 or ESA Section 10(a)(1)(B), the Permit Holder must set, maintain, and manage his/her own pound nets, must not participate as part of a fishery, and must not retain any fish bycatch.

   c. Mesh size of the pound and heart must be 1 3/4” stretched mesh or less to reduce sea turtle entanglement and minimize sea turtle mortality.

6. Seine Net

   a. Seine net pulls must not exceed 30 minutes.

   b. Marine Mammals: The net must not be pulled when marine mammals are observed within the study area, and the marine mammals must be allowed to either leave or pass through the area safely before net pulling is initiated. Should marine mammals enter the study area after the net has been deployed, the net must be raised and dropped in an attempt to make marine mammals in the vicinity aware of the net. If marine mammals remain within the study area, the net must be removed.

7. Aerial Surveys for Following, Hovering or Circling over Turtles

*Manned Aircraft*

   a. Aerial surveys must be flown at an altitude of 300' or higher.

   b. Each encounter must not exceed 45 min.

c. Aerial surveys must not be conducted over marine mammal haul out areas. Avoid flying over marine mammals to prevent harassment.

*Unmanned Aircraft Systems (UAS)*

a. You are authorized to use a fixed wing/vertical take-off and landing (VTOL) unmanned aircraft system (UAS).

b. Each encounter must not exceed 45 min.

c. UAS must be flown at an altitude of XXX feet.

b. <u>Turtles Captured Under Another Authority Prior to Research Activities</u>

1. Research activities may be performed on sea turtles from other sources only if the Permit Holder can demonstrate that the sea turtles were taken legally (e.g., covered by the incidental take statement [ITS] of an ESA Section 7 biological opinion with a "no jeopardy" conclusion or an ESA Section 10 permit such as an ESA incidental take permit or scientific research permit).

2. Researchers must only use turtles that have been freed by the disentanglement network if the proposed actions are reasonably expected not to alter the course of the turtle's recovery or survival outcome.

c. <u>General Handling, Resuscitation, and Release</u>

1. Researchers must:

a. Use care when handling live animals to minimize any possible injury.

b. Use the following resuscitation techniques on any comatose turtle.

i. Place the turtle on its plastron so that the turtle is right side up and elevate its hindquarters at least 6 inches for a period of 4 up to 24 hours. The amount of the elevation depends on the size of the turtle; greater elevations are needed for larger turtles. Periodically, rock the turtle gently left to right and right to left by holding the outer edge of the carapace and lifting one side about 3 inches then alternate to the other side. If the turtle is not moving, gently touch the eye and pinch the tail (reflex test) periodically to see if there is a response.

ii. 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.

iii. A turtle is determined to be dead if the muscles are stiff (rigor mortis) and/or the flesh has begun to rot, or if cardiac arrest is determined by Doppler, ECG, or ultrasonography. Otherwise, the turtle is assumed to be comatose or inactive and resuscitation attempts are necessary. Return all dead turtles to shore for necropsy.

c. Have an experienced veterinarian on call for emergencies and a permitted rehabilitation facility(ies) identified should veterinary care be required on shore (e.g., treatment of an injured or distressed turtle). Both the veterinarian and facility should be made aware of the dates and times of the research activity to ensure availability.

2. If an animal becomes highly stressed, injured, or comatose during capture or handling, or is found to be compromised or injured upon capture, Researchers must forego or cease activities that will further stress the animal (erring on the side of caution) and contact the on call veterinarian 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. Follow the instructions of the veterinarian, and, if necessary, immediately transfer the animal to the veterinarian or to a permitted rehabilitation facility to receive veterinary care.

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

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

3. 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 NMFS Permits Division. Every effort must be made to release the animal at the site of capture.

4. In the event an animal dies or is sent to rehab as a result of research activities, the Permit Holder must, within two weeks, submit an incident report as described in Condition E.2. A necropsy should be performed, except where not feasible such as in remote areas with limited personnel. Gross necropsy findings should be included as part of an incident report. Final necropsy findings (e.g., histology and other analyses) must be submitted when complete.

5. While holding sea turtles out of water, Researchers must:

    a. Protect sea turtles from temperature extremes (ideal air temperature range is between 70°F (21.1°C) and 80°F (26.7°C).

    b. Provide adequate air flow.

    c. Keep sea turtles moist when the temperature is ≥ 75°F (23.9°C).

    d. Prevent sea turtles from sustaining any injuries.

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

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

7. Researchers must carefully monitor newly released turtles' apparent ability to swim and dive in a normal manner. If a turtle is not behaving normally upon release, recapture the turtle, if safely feasible, and contact your on-call veterinarian (see condition c.2 above).

    For research activities occurring aboard commercial fishing vessels or in conjunction with other NMFS research, Researchers must carefully observe newly released turtles and record observations on the turtle's apparent ability to swim and dive.

8. Extra care must be exercised when handling, sampling and releasing leatherbacks. Field and laboratory observations indicate that leatherbacks have more friable skin and softer bones and are more susceptible to certain types of external trauma. Researchers must:
    a. only board leatherbacks if they can be safely brought on board the vessel.
    b. handle and support leatherbacks from underneath.
    c. not turn leatherbacks on their carapace.

d. Handling, Measuring, Weighing, and Marking

1. Refer to Attachment X for more information on the requirements for handling and sampling sea turtles.

2. Researchers must:

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

    b. Maintain a designated set of instruments for use on turtles with fibropapillomas (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 70% isopropyl alcohol, 10% bleach, and other viricidal solutions with proven efficacy against herpesviruses.

    c. Examine turtles for existing flipper and passive integrated transponder (PIT) tags before attaching or inserting new ones. All flippers must be checked. No more than one external flipper tag, per flipper, may be attached (includes existing flipper tags). If existing tags are found, all tag identification numbers must be recorded and promptly reported to the Cooperative Marine Turtle Tagging Program (CMTTP) at the Archie Carr Center for Sea Turtle Research (ACCSTR): http://accstr.ufl.edu/resources/report-a-tag/ or by email: accstr@ufl.edu. Researchers must have PIT tag readers capable of reading 125, 128, 134.2, and 400 kHz tags.

    d. Clean and disinfect:

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

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

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

3. Flipper Tagging

    a. The application site must be cleaned and then scrubbed with a medical disinfectant solution (e.g., Betadine, Chlorhexidine) followed by 70% alcohol before the applicator pierces the animal’s skin.

    b. Animals less than 20 cm straight carapace length (SCL), nuchal notch to pygal tip, may not be flipper tagged.

    c. For turtles 20-30 cm SCL, only 1005 series tags or similar (~ 4.8 x 11.1 mm) may be used.

    d. Standard 681 tags can only be used for turtles greater than 30 cm SCL.

    e. No more than one tag per flipper and two flipper tags per turtle may be applied.

4. Passive Integrated Transponder (PIT) Tagging

    a. Use a new, sterile needle each time.

    b. The application site must be cleaned and then scrubbed with two replicates of a medical disinfectant solution (e.g., Betadine, Chlorhexidine) followed by 70% alcohol (disinfectant/alcohol/disinfectant/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.

    c. Turtles must be at least 16 cm SCL to receive a PIT tag under standard field conditions.

    d. <u>For turtles 16-30 cm SCL:</u>

        i. Researchers must have specialized experience to tag small turtles of this size.

ii. Only 10 mm PIT tags and a 16 gauge injector needle may be used.

iii. PIT tags must be inserted into the thickest part of the triceps superficialis muscle. The tag must occupy no more than an estimated 20% of the muscle's total volume and length. To determine eligibility, pinch the muscle forward and assess the tag size relative to the muscle size. Alternative sites may be used provided: 1) there is sufficient mass to accommodate the tag (≤ 20%) and 2) there is minimal risk of injury to vital structures or other anatomical features.

iv. Local anesthetic (e.g., carbocaine, lidocaine) must be used prior to PIT tag injection.

5. Marking the Carapace

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

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

e. <u>Biological Sampling</u>

1. Blood Sampling

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

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

c. Collection sites must be thoroughly swabbed with a medical disinfectant solution (e.g., Betadine, Chlorhexidine) followed by 70% alcohol before sampling. 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/holding platform 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 and immediate removal of the needle if the animal begins to move. Individual needles can only be used for one or two attempts before the needle must be replaced. Needles must be changed immediately if they contact other surfaces or otherwise become contaminated or damaged.

f. Blood Volume Limits

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

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

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

iv. *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 2 months on the same turtle, sample size must not exceed 3 ml/kg of turtle.

2. Biopsy Sampling

a. A new sterile biopsy punch, scalpel blade or scissors must be used on each turtle.

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

   i. Samples may only be taken from the limbs, neck, carapace, or shoulder region as described in the application. Sensitive areas must be avoided.

   ii. For small skin samples (6 mm diameter or smaller): Aseptic techniques must be used at all times. At a minimum, the tissue surface must be thoroughly swabbed with a medical disinfectant solution (e.g., Betadine, Chlorhexidine) followed by 70% alcohol before sampling. Two applications of alcohol may be used if disinfectants may interfere with analyses. The procedure area and Researchers' hands must be clean.

   iii. For larger skin and fat samples:

      1. A veterinary-approved pain management protocol must be followed.

      2. Sterile techniques must be used. For procedures conducted on vessels or under other field conditions, a designated surgery area should be utilized and kept as clean as possible (e.g., use of disposable surgical drapes) to minimize risk of contamination.

c. Turtles not boarded for sampling:

   i. Turtles must be sampled [using a pole-biopsy (6 mm diameter or smaller) or for leatherbacks via shallow carapacial scrapes] in the location most safely and easily accessed by the Researcher.

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

d. If it can be easily determined (through markings, tag number, etc.) that a sea turtle has been recaptured and has been already sampled under this permit, turtles may be sampled no more than two times during the same permit year.

3. Gastric Lavage

a. Lavage must be directly taken by or supervised by experienced personnel.

b. The washing must not exceed three minutes.

c. Once the samples have been collected, water must be turned off and water and food allowed to drain until all flow has stopped. The posterior of the turtles must be elevated slightly to assist in drainage.

d. Researchers must thoroughly clean and disinfect equipment after each use.

e. Compromised animals must not be lavaged.

4. Cloacal Lavage

a. Use a new catheter or thoroughly disinfect catheters between turtles.

b. Lubricate the catheter prior to insertion.

c. Do not attempt to further insert the catheter once resistance is encountered.

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

6. Laparoscopy and Internal Tissue Sampling

a. Compromised animals must not be subjected to laparoscopy.

b. This procedure must be performed or directly (in-person) overseen by an experienced veterinarian.

c. A veterinary-approved pain management protocol must be followed.

d. Any use of sedation or anesthesia must be under a veterinary-approved protocol and directly attended by a veterinarian.

f. <u>Instrument Attachments</u>

1. [Placeholder to specify max. # tags on an animal at one time and tag combinations as needed. Example: No more than 2

transmitters/instruments on an animal at one time, no more than one of which may be a satellite tag.]

2. External units: TDRs, acoustic or satellite tags, and Crittercams

Telemetry devices and attachment material selection and protocol should first use best available, current published methods, especially with regard to risk for thermal injury. Products not previously used for animal attachment should be tested (including monitoring of temperature) by mock application prior to use on sea turtles. The following considerations must be incorporated into tag selection and application:

a. The frontal area of the tag must be minimized and the tag must have a low profile.

b. The tag must be streamlined and cover as small of an area on the sea turtle as possible.

c. Adhesives, use of base plates, and building up of adhesive material should be minimized.

d. To the degree possible, avoid placing the tag at the peak height of the carapace. Place tags slightly anterior or posterior to the peak where uplinks will be maintained and the salt water switch will still be exposed to the air during breathing but the frontal area is minimized.

e. The antenna length and diameter must be minimized to reduce risk of entanglement and/or drag.

f. 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. For tethered instruments, the lanyard length 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.

g. Adequate ventilation must be provided around the head of the turtle 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.

h. For hard-shelled turtles, procedures for drilling through marginal scutes must follow aseptic techniques with two alternating applications of medical disinfectant (e.g., Betadine, Chlorhexidine) followed by 70% alcohol. A separate drill bit must be used for each turtle. Bits may be reused if sterilized by autoclave or cold sterilization (e.g., gluteraldehyde) before reuse. Similar aseptic protocols must be used for direct attachment of devices to leatherbacks, with sterilized drill bits used for each turtle.

i. Crittercam: Attachments must be made so that turtles are able to move freely without impairment.

3. Stomach pills: Use of “smart” pills or other devices intended to be ingested and passed or otherwise retrieved must be used according to a veterinary-approved protocol that includes the minimum size of sea turtle to be used and clear explanation of safety relative to body size and monitoring of transmitter, administration of the pill, and anticipated risk for obstruction and complications.

g. Holding

1. Maximum holding time of an animal from the time of capture/removal from the net to release must not exceed:
   - 1 hour for standard work-up (no transmitter attachments);
   - 3 hours if receiving a transmitter attachment;
   - 36 hours for animals temporarily held in a facility.

2. Turtles temporarily held in a facility must be transported, maintained and cared for following the "Standard Permit Conditions for Care and Maintenance of Captive Sea Turtles" issued by the U.S. Fish and Wildlife Service (available at: https://www.fws.gov/northflorida/seaturtles/Captive_Forms/20130213_revised%20_standard_permit_conditions_for_captive_sea_turtles.pdf ) and if in the State of Florida, following Florida Fish and Wildlife Conservation Commission Marine Turtle Conservation Handbook, Section 4, Holding Turtles in Captivity.

3. Any use of sedation or anesthesia, such as for imaging, must be under a veterinary-approved protocol and directly attended by a veterinarian.

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Non-Target Species [include based on applicable methods and species overlap with the action]

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

2. [placeholder for manatee conditions.]

3. If any listed non-target species are taken (captured, injured, etc.) during research, Researchers must stop activities per Condition A.2 and submit an incident report per Condition E.2. Adverse interactions must be documented in the report, including any pertinent details of the interaction (gear type, what was done to handle and release the animals, location, date, size, water and air temperature, and photos if possible).

4. Smalltooth Sawfish requirements

    1. Researchers operating in areas where sawfish are present are required to contact Adam Brame, at (727) 209-5958 or adam.brame@noaa.gov, for training requirements on proper handling procedures.

    2. When attempting to handle and release an incidentally captured sawfish, Researchers must use extreme caution, using procedures specified in NMFS Sawfish Handling and Release Guidelines, found at: http://www.nmfs.noaa.gov/sfa/hms/compliance/workshops/protected_species_workshop/sawfish_sturgeon/sawfish_release_guidelines_placard.pdf

    3. Researchers must keep the sawfish in the water at all times and cut the net from the rostrum and body of the animal (do NOT disentangle the rostrum from the net).

    4. In the event a sawfish is incidentally captured, in addition to following Conditions A.2 and E.2, the Permit Holder must notify Adam Brame at the NMFS Southeast Regional Office at (727) 209-5958 or adam.brame@noaa.gov.

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

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

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

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

d. *Johnson's seagrass and critical habitat.* No research activities will be conducted over, on, or immediately adjacent to Johnson's seagrass or in Johnson's seagrass critical habitat.

e. *Other seagrass species*. Researchers must avoid setting and deploying gear over, on, or immediately adjacent to any non-listed seagrass species. If these non-listed species cannot be avoided, then the following avoidance/minimization measures must be implemented:

i. 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.

ii. 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.

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

6. North Atlantic Right Whale
If a right whale is seen, Researchers must maintain a distance of at least 460 meters (500 yards) from the animal. Please report all right whale sightings to NMFS Sighting Advisory System:

- in any location to the U.S. Coast Guard on channel 16,
- from VA to ME to 978-585-8473, and
- from NC to FL to 904-237-4220.

7. For Humpback Whales in Hawaii

If a humpback whale is observed in the area, Researchers and vessels must maintain a distance of at least 91.4 meters (100 yards) and aircraft must maintain a distance of at least 300 meters (1,000 feet).

8. Hawaiian Monk Seals

a. To minimize disturbance of Hawaiian monk seals:

Consult with the NMFS Hawaiian Monk Seal Research Program and either the U.S. Fish and Wildlife Service (USFWS) at Midway or the State of Hawaii Department of Land and Natural Resources (DLNR) at Kure for approval of any land-based activities to avoid harassment of monk seals;

i. Do not enter the water when monk seals are present, and if approached by a seal, leave the area.

ii. Report any opportunistic monk seal sightings to the NMFS Pacific Islands Fisheries Science Center, Hawaiian Monk Seal Research Program, NOAA IRC, 1845 WASP Blvd, Building 176, Honolulu, HI 96818.

In the main Hawaiian Islands: Tracy Mercer; Tracy.Mercer@noaa.gov; phone (808)725-5718; fax (808)725-5567

In the Northwestern Hawaiian Islands: Thea Johanos; Thea.Johanos-Kam@noaa.gov; phone (808)725-5709; fax (808)725-5567

6. Transfer of Sea Turtle Biological Samples

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

i. The analysis or curation is related to the research objectives of this permit.
ii. A copy of this permit accompanies the samples during transport and remains on site during analysis or curation.

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

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

d. Samples cannot be bought or sold.

C. Qualifications, Responsibilities, and Designation of Personnel

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

a. Principal Investigator – [name].

b. Co-Investigator(s) – [names and duties] /or/ See Appendix 2 for list of names and corresponding activities.

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

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

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

   b. The Principal Investigator (PI) is the individual primarily responsible for the taking, import, export and related activities conducted under the permit. This includes coordination of field activities of all personnel working 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 the activity),

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

   c. individuals included for training purposes.

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

5. Permitted activities may be conducted aboard vessels or aircraft, or in cooperation with individuals or organizations, engaged in commercial activities, provided the commercial activities are not conducted simultaneously with the permitted activities, except as specifically provided for in an Incidental Take Statement or Incidental Take Permit for the specific commercial activity.

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 or PI 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.

7. The Permit Holder or PI may designate additional CIs without prior approval from the Chief, Permits Division provided:

    a. A copy of the letter designating the individual and specifying their duties under the permit is forwarded to the Permits Division by facsimile or email on the day of designation.

    b. The copy of the letter is accompanied by a summary of the individual's qualifications to conduct and supervise the permitted activities.

    c. The Permit Holder acknowledges that the designation is subject to review and revocation by the Chief, Permits Division.

8. Where the Permit Holder is an institution/facility, the Responsible Party may request a change of PI 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.

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

    a. the online system at https://apps.nmfs.noaa.gov;
    b. an email attachment to the permit analyst for this permit; or
    c. a hard copy mailed or faxed to the Chief, Permits Division, Office of Protected Resources, NMFS, 1315 East-West Highway, Room 13705, Silver Spring, MD 20910; phone (301)427-8401; fax (301)713-0376.

D. Possession of Permit

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

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

   a. Engaged in a permitted activity.

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

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

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

E. Reporting

1. The Permit Holder must submit incident, annual, and final 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 Reporting

   a. If a serious injury or mortality occurs/the total number of mortalities is reached, or authorized takes have been exceeded as specified in Conditions A.2 and B.5.x, the Permit Holder must:
      i. Contact the Permits Division by phone (301-427-8401) as soon as possible, but no later than 2 business days of the incident;
      ii. Submit a written report within 2 weeks of the incident as specified below; and
      iii. Receive approval from the Permits Division before resuming work. 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.

b. Any time a serious injury or mortality of a protected species occurs, a written report must be submitted within two weeks.

c. The incident report must include 1) a complete description of the events and 2) identification of steps that will be taken to reduce the potential for additional serious injury and research-related mortality or exceeding authorized take.

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 their effects.

4. A final report summarizing activities over the life of the permit must be submitted by (insert date 90 days post expiration), or, if the research concludes prior to permit expiration, within 90 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.

6. The Permit Holder must submit with the annual report data on disturbance rates of marine mammals specific to UAS operations. Details should include, but not be limited to: species, altitude and angle of approach, context of exposure (e.g., behavioral states), and observed behavioral responses to the UAS.

F. Notification and Coordination

1. NMFS Regional Offices are responsible for ensuring coordination of the timing and location of all research activities in their areas to minimize unnecessary duplication, harassment, or other adverse impacts from multiple researchers.

2. The Permit Holder must ensure written notification of planned field work for each project is provided to the NMFS Regional Offices listed below at least two weeks prior to initiation of each field trip/season.

   a. Notification must include:
      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 Administrators for Protected Resources as applicable to the location of your activity:

For activities in WA, OR, CA, and Antarctic:
West Coast Region, NMFS, 501 West Ocean Blvd., Suite 4200, Long Beach, CA 90802-4213; phone (562)980-4005; fax (562)980-4027
Email (*preferred*): WCR.research.notification@noaa.gov;

For activities in HI, American Samoa, Guam, and Northern Mariana Islands:
Pacific Islands Region, NMFS, 1845 Wasp Blvd., Building 176, Honolulu, HI 96818; phone (808)725-5000; fax (808)973-2941
Email *(preferred)*: nmfs.pir.research.notification@noaa.gov;

For activities in NC, SC, GA, FL, AL, MS, LA, TX, PR, and USVI:
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; and

For activities in ME, VT, NH, MA, NY, CT, NJ, DE, RI, MD, and VA:
Greater Atlantic Region, NMFS, 55 Great Republic Drive, Gloucester, MA 01930; phone (978)281-9328; fax (978)281-9394
Email (*preferred*): NMFS.GAR.permit.notification@noaa.gov

3. Researchers must coordinate their activities with other permitted researchers to avoid unnecessary disturbance of animals or duplication of efforts. Contact the applicable Regional Offices listed above for information about coordinating with other Permit Holders.

G. <u>Observers and Inspections</u>

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 and document permitted activities; and

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

H. <u>Modification, Suspension, and Revocation</u>

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[6] 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

   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. <u>Penalties and Permit Sanctions</u>

1. A person who violates a provision of this permit, the MMPA, ESA, or the regulations at 50 CFR 216 and 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.

[6] 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.

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 MMPA, the ESA, and applicable regulations in any enforcement actions.

J. Acceptance of Permit

1. In signing this permit, the Permit Holder:

a. agrees to abide by all terms and conditions set forth in the permit, all restrictions and relevant regulations under 50 CFR Parts 216, and 222-226, and all restrictions and requirements under the MMPA, and the ESA;

b. acknowledges that the authority to conduct certain activities specified in the permit is conditional and subject to authorization by the Office Director; and

c. acknowledges that this permit does not relieve the Permit Holder of the responsibility to obtain any other permits, or comply with any other Federal, State, local, or international laws or regulations.

| | |
|---|---|
| ______________________________ | __________________ |
| Donna S. Wieting<br>Director, Office of Protected Resources<br>National Marine Fisheries Service | Date Issued |
| ______________________________ | __________________ |
| [name of Permit Holder or Responsible Party]<br>[permit holder’s/RP’s title and institution]<br>Permit Holder /or/ Responsible Party | Date Effective |

## Appendix 1: Tables Specifying the Kind(s) of Protected Species, Location(s), and Manner of Taking

## Appendix 2: NMFS-Approved Personnel and Authorized Recipients for Permit No. XXXXX-0X.

The following individuals are approved to act as Co-Investigators pursuant to the terms and conditions under Section C (Qualifications, Responsibilities, and Designation of Personnel) of this permit.

| Name of Co-Investigator | Activities |
|---|---|
| Dr. John Smith | Aerial surveys |
| Dr. Jane Doe | All research activities |
| | |
| | |
| | |

Biological samples authorized for collection or acquisition in Table(s) X of Appendix 1 may be transferred to the following Authorized Recipients for the specified disposition, consistent with Condition B.6 of the permit:

| Authorized Recipient | Sample Type | Disposition |
|---|---|---|
| Researchers name, affiliation, City, State | Whole blood and serum | Analysis and curation of remaining samples |
| Researcher's name, affiliation, City, State | Skin | Analysis (samples consumed in analysis) |
| | | |
| | | |
| | | |

## Attachment 1: Procedures for handling and monitoring leatherbacks during leatherback capture-related work (revised 7/20/2017).

The following is the protocol for handling turtles captured under Permit No. XXXXX. These requirements incorporate recommendations made by a panel of veterinarians with experience capturing leatherback turtles in the Pacific, Atlantic, and Gulf of Mexico.

**Personnel requirements**
To effectively monitor leatherback turtles during capture and handling, researchers must have a designated medical observer on each capture outing team. Whenever possible, this observer should be an experienced[7] veterinarian; however, a licensed/registered veterinary technician[8] is

[7] "Experienced" refers to a documented history of working with sea turtles under conditions requiring proficiency in emergency procedures and resuscitation.
[8] Must be trained in the methods defined herein and legally authorized to administer emergency medications within the area of study, which may vary by State/Territory.

also acceptable if the period of restraint[9] will be 30 minutes or less. If a technician serves this role, a veterinarian must be reachable by cellular or satellite phone or radio (as appropriate) in case of emergency. The observer must be a veterinarian if the period of restraint will last longer than 30 minutes or if any surgical procedures will be performed (excludes superficial skin biopsy). For any captures, at least one individual must have the dedicated role of monitoring vital rates, behavior, and ensuring temperature control. This individual should not have any other duties that limit their attentiveness to these responsibilities. Moreover, monitoring and delegation of responsibilities should be coordinated such that the period of restraint is as brief as required to accomplish research objectives.

**Capture, boarding, handling time, monitoring**

The number of attempts to capture an individual leatherback sea turtle is limited to 5 per 24-hour period. If researchers are unsuccessful after the first 3 attempts, they must wait a minimum of 4 hours before making the final 2 attempts to capture that individual on the day. Unless otherwise stipulated in the permit, only turtles observed to be normal (e.g., normal swimming and diving behavior) and with no evidence of external traumatic wounds may be approached. **Any animal deemed to be in distress at any time during the pre-capture period must be avoided.**

Upon capture, the turtle should be immediately released if it is found to have any previously unapparent traumatic injuries, abnormal behavior, or other abnormalities that are deemed by the research leader or veterinarian/technician to create an additional risk of complication. The period of restraint should not exceed one hour unless deemed medically necessary (e.g., for attempted CPR, medical assessment, treatment); an interval of 30 minutes or less is preferred.

The following monitoring is required for short and prolonged periods of restraint. A "fill-in-the-blank" observation sheet is used and must be retained as part of each animal's permanent capture record.

*Restraint interval <30 minutes*

| Parameter | Frequency |
|---|---|
| Responsiveness/activity level | Throughout |
| Respiration rate | Upon capture, every 20 minutes |
| Heart rate*( by Doppler, ultrasound, or ECG)) | Upon capture, every 20 minutes |

*Restraint interval ≥30 minutes*

| Parameter | Frequency |
|---|---|
| Responsiveness/activity level | Throughout |
| Respiration rate | Upon capture, every 20 minutes |
| Heart rate*(by Doppler, ultrasound, or ECG) | Upon capture, every 20 minutes |
| Point-of-care analyzer* (for blood gases, electrolytes, glucose) | Upon capture, every 30 minutes |
| Body temperature* | Upon capture, every 20 minutes |

*Only conducted if boarded/accessible

[9] Defined as time from entering the net until release.

Below are general guidelines based on previous studies and medical opinion regarding alteration of these parameters that should trigger immediate assessment by the medical observer and chief scientist:

| Parameter | Trigger threshold |
|---|---|
| Responsiveness | Reduction in response to procedures or noxious stimuli |
| Respiration rate | Apnea for periods >2 min. |
| Heart rate | <20 bpm |
| Blood pH | <7.2 (temperature corrected) |
| Potassium | >6.8 mmol/l |
| Glucose | <60 mg/dl |
| Body temperature | Alteration of initial body temperature by >2˚F or 1˚C (or if temperature exceeds 86˚F/30˚C) |

**The chief scientist for each outing must be trained by a veterinarian in the following information and procedures:**

- Acceptable parameters for responsiveness, respiration rate, heart rate, blood gas parameters, potassium concentration, and temperature.
- Recognition and appropriate response to situations that suggest abortion of further animal work, and initiation of release.
- Safe water reintroduction and monitoring of a turtle in possible distress.
- Appropriate first aid measures for animals in distress. These measures may include intubation, artificial respiration, and administration of pharmaceuticals to stimulate respiration and/or cardiac contraction (to be administered by a veterinarian or licensed technician under consultation with a veterinarian).

In addition to animal monitoring equipment, each outing must include an emergency field kit for intervention. This kit will be available to the medical observer and includes, but is not limited to, the following:

- Means of ventilatory support (e.g., oxygen cylinder, demand breathing valve, 5 L Ambu bag)
- Endotracheal tubes (non-cuffed 10, 12, 14, and 16; other sizes as appropriate)
- Oral speculum and appropriate sized blade
- Water-based lubricant
- Disinfectants (e.g., betadine scrub, isopropyl alcohol)
- Sterile gauze
- Medical tape
- Needles, catheters, syringes, extension sets (size appropriate)
- Emergency medications: (e.g., doxapram, epinephrine, lidocaine, sodium bicarbonate, furosemide, and dexamethasone sodium phosphate; at discretion of attending veterinarian)
- Sterile saline

# Attachment X:  Requirements for Handling and Sampling Sea Turtles

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

## I. Permit requirements for antiseptic practices and research techniques

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

Clean technique:

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

Aseptic technique:

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

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

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

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 (6 mm diameter or smaller) | 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 | Aseptic technique; 2 applications of surgical scrub and alcohol |
| Laparoscopy (+/- biopsy) | Sterile |
| Large skin, fat, or 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 (6 mm diameter or smaller) | None |
| Blood sampling | None |
| PIT tagging | Local anesthetic if <30 cm SCL |
| Flipper tagging | None |
| Carapace drilling for instrument attachment | Systemic analgesic |
| Laparoscopy | Local anesthetic and systemic analgesic |
| Laparoscopy biopsy | Local anesthetic, sedation, and systemic analgesic |
| Large skin, fat, or other tissue biopsy | Local anesthetic and systemic analgesic |

Appendix D. Permits Division Annual Report Form for Section 10(a)(1)(A) Permit Holders

## Protected Species Permit
## Report Form

We highly recommend you submit your report via APPS at https://apps.nmfs.noaa.gov.

If you do not submit your report online, request an electronic copy to complete and return

- by email attachment to the permit analyst for this permit; or
- by hard copy mailed or faxed to the Chief, Permits Division, Office of Protected Resources, NMFS, 1315 East-West Highway, Suite 13705, Silver Spring, MD 20910; phone (301)427-8401; fax (301)713-0376.

**Permit Number**: **Date Prepared**:

**Permit Holder's Name**:

**Reporting Period**: (please check one)

☐ Annual #1 [date to date]
☐ Annual #2 [date to date]
☐ Annual #3 [date to date]
☐ Annual #4 [date to date]
☐ Combined Annual # 5/Final [date to date]

☐ Annual #5 [date to date]
☐ Annual #6 [date to date]
☐ Annual#7 [date to date]
☐ Annual #8 [date to date]
☐ Annual #9 [date to date]
☐ Combined Annual #10/Final [date to date]

**Contact Name**: **Contact Email**:

**Contact Phone Number**:
(Contact = person submitting report)

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**Part I: Take Table.**

**Enter the actual number of animals taken during this annual reporting period.**

Take tables from permits are inserted here with a column to be filled for "Actual number of animals taken."

If you conducted activities or took protected species for which you were not authorized, you must enter these takes on separate lines of the table. Explain what happened in Part II, #4 below.

**Part II**: **Narrative.**

**Review Section E of your permit to ensure you address any reporting specific to your research**.

**Provide complete answers to the best of your ability. We acknowledge that monitoring during and after certain research activities is often opportunistic. If a question is not applicable, explain why.**

1. What progress did you make toward **meeting your objectives** this year? Summarize what you did and if and how you met your objectives. List citations for any reports, publications, and presentations from this reporting period. We may request electronic copies.

2. Summarize **how animals reacted to specific activities**. Include normal and abnormal responses of target and non-target animals. To the extent feasible, provide quantitative data and estimate the proportion of animals (%) that had those reactions.

3. Explain your efforts to conduct **follow-up monitoring**. Report your findings. Photographs are useful to document things like wound healing. We are especially interested in:

- animal responses to new/novel procedures
- time it takes to resume normal in-water behavior after harassment
- time it takes to re-populate rookeries or haul outs after harassment
- condition of animals on resight or recapture
- recovery from sedation and handling and post-release behavior
- healing at site of intrusive sampling (e.g., biopsy)
- healing at site of intrusive tag deployment (e.g., surgical tag implants requiring sutures, remotely deployed dart/barb, fully implantable, medial ridge, and pygal tags)
- tag retention and tag breakage

4. Did **serious injuries or mortalities** occur **or** did you **take a protected species you were not permitted** to take? If so, and you already submitted an incident report, please briefly describe the event here and refer to the incident report.

If such an incident occurred and you have not yet reported it, provide a full description of the incident (date and location of event; species and circumstances of how the take occurred; photographs; necropsy and histopathology reports, or other information to confirm cause of death or extent of injuries; etc.). Also, include steps that were or will be taken to reduce the possibility of it happening again.

5. Describe **any other problems** encountered during this reporting period and steps taken or proposed to resolve them. Examples include equipment failure, weather delays, safety issues, and unanticipated effects to habitats or other species.

6. What efforts did you make to **coordinate** with the applicable NMFS Regional Office(s) and **collaborate** with other researchers? How did you collaborate (for example, avoiding field work at the same time or working together on the same animals, sharing vessels, sharing data)?

**Only for the FINAL REPORT: In addition to the questions above:**

7. Did you meet your objectives for the permit? What did you learn?

8. If you did not meet your objectives, explain why. For example, if you did not tag or mark as many animals as needed to meet your sample size, explain why and how that impacted your ability to meet the goals of your study.

9. For ESA-listed or MMPA-depleted target species: Explain how the results of your permitted work benefitted or promoted their recovery or conservation. How did your research contribute to fulfilling Recovery or Conservation Plan objectives (as applicable)? Explain.

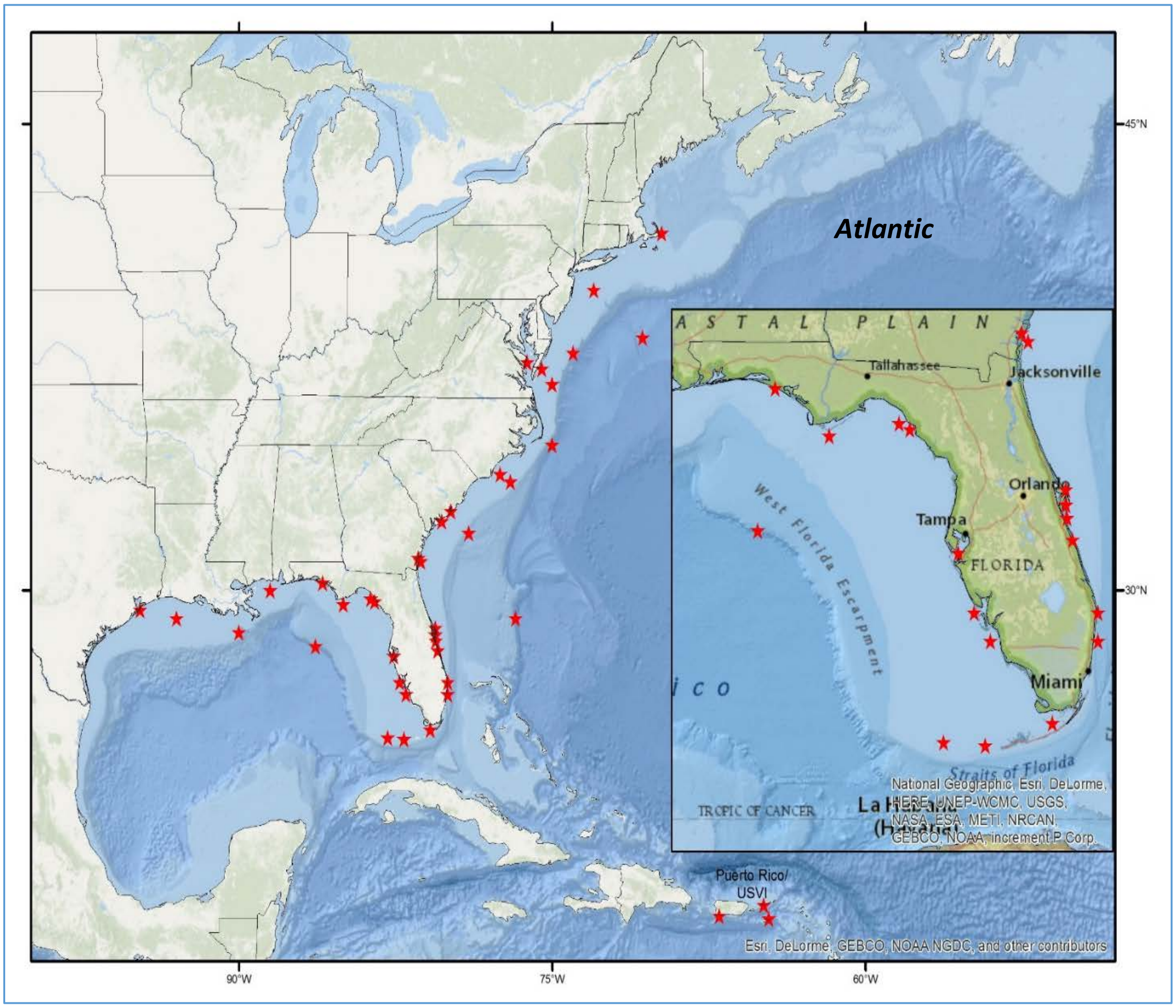
10. Did you identify any additional or improved mitigation measures?

**Feedback (optional)**

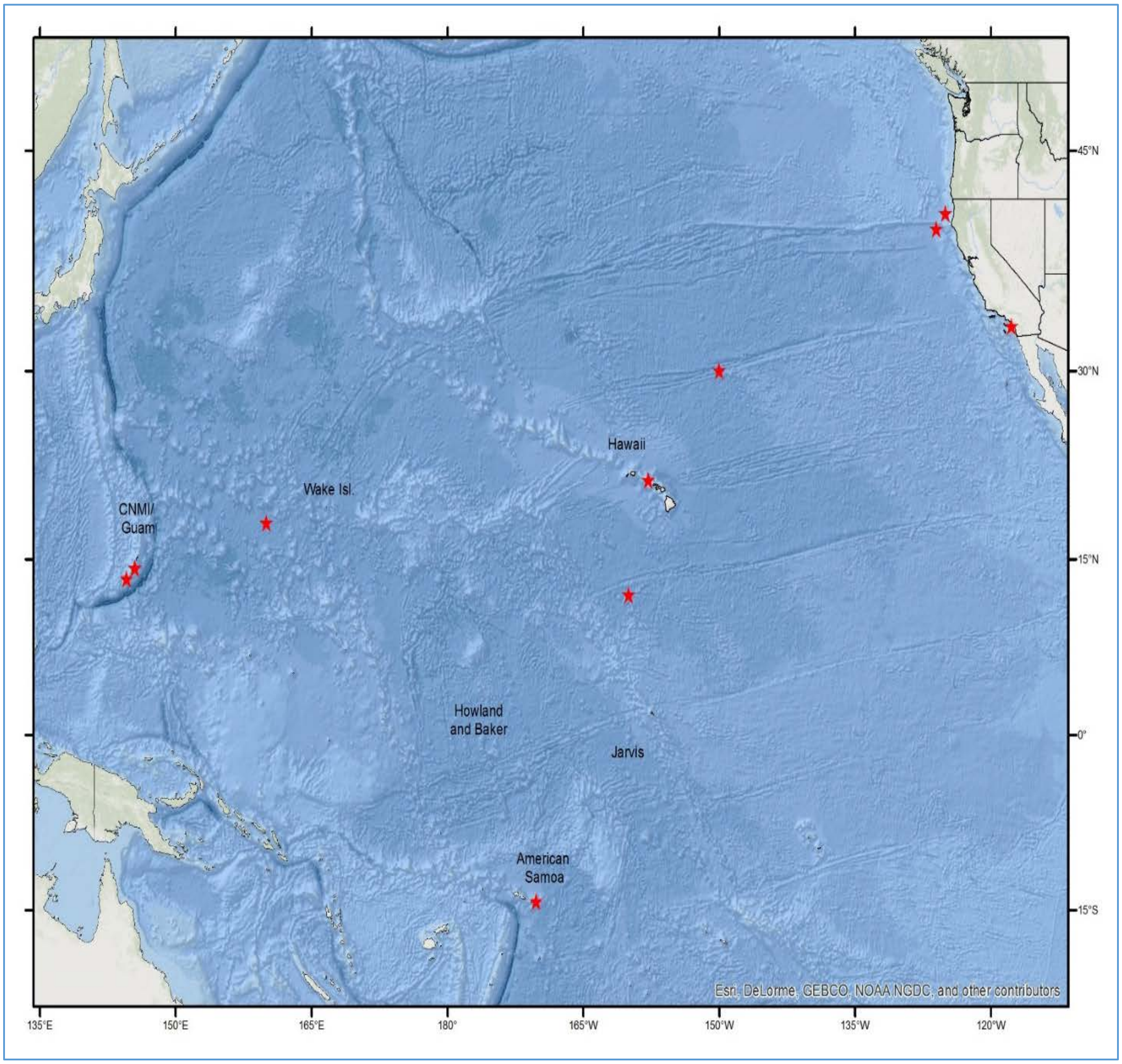
11. We appreciate any feedback on APPS and your permit. For example, did you have any problems using APPS? Were any permit conditions difficult to comply with or unclear? Were your permitted take numbers appropriate?

Appendix E. Locations (denoted by red stars) of Active Section 10(a)(1)(A) Sea Turtle Research Permits

Active Permits in the Atlantic (with Florida Inset) as of June 30, 2017



Active Permits in the Pacific as of June 30, 2017



Appendix F. NMFS Sawfish Handling and Release Guidelines -

# Sawfish Handling and Release Guidelines

*Keep as much of the sawfish in the water as possible.*

## *Use extreme caution when handling and releasing sawfish as the saw can thrash violently from side to side*

**For sawfish caught on longline gear:**

- **Use line cutting poles, boltcutters, long-handled dehookers and boat hooks to aid in removing gear, including hooks, from the sawfish**
- **If the sawfish is hooked and not entangled, cut the line as close to the hook as possible. Remove the hook with a dehooker, if possible**
- **If the sawfish is hooked and line is tangled around the saw (rostrum), remove all line with a boat hook or line cutting pole, then cut the line as close to the hook as possible. Remove the hook with a dehooker, if possible**
- **If hooked internally, do NOT attempt to remove the hook, use line cutting pole or boat hook to remove as much line as possible**

**For sawfish caught in trawl or gill net gear:**

- **DO NOT REMOVE THE FISH'S SAW (ROSTRUM)**
- **Leave the sawfish, especially the gills, in the water as much as possible**
- **Use line cutting pole or knife to cut any net tangled around the saw by cutting the mesh along the length of the saw**
- **Once mesh is cut, work it free with a boat hook or line cutting pole**

**In your logbook, document as much information as possible including:**

- Date and time of encounter
- Location (GPS coordinates)
- Habitat (water depth, bottom type)
- Estimated total length of sawfish including saw
- Description of gear that could not safely be removed from the animal
- Markings, scars, wounds
- If present, record tag number and type (shape and color) (tags are found on or below the dorsal fins), but do not remove the tag
- Details of capture (bait, hook size/type, mesh size, length of gear)
- Sex of sawfish, if known (male sawfish, like sharks, have two claspers at the base of the pelvic fins)

***Do not remove the saw or injure the sawfish in any way.***

***With a little extra effort, and the proper use of required tools, endangered smalltooth sawfish can be returned to the water with little or no damage.***

***Smalltooth sawfish are listed as endangered under the Endangered Species Act and "take" of listed species is prohibited under section 9 of the Endangered Species Act. Any sawfish caught while fishing must be released as quickly as possible. More information can be found at http://www.nmfs.noaa.gov/pr/species/fish/smalltoothsawfish.htm***

## Appendix G: DTP Permit Conditions for the Use of ADDs

*The following conditions would be included in permits authorizing acoustics in addition to standard conditions already required for capture, including pound nets and tangle nets, handling and holding animals in a permitted facility (see Appendix C, for those existing conditions).*

### Acoustic Tank-Based Trials

1. Researchers may only use sedation or anesthesia following a veterinary-approved protocol and when directly attended by a veterinarian.
2. Each trial is limited to no more than 75 minutes, 60 minutes if anesthesia or sedation is required.
3. Source sounds may be used that emit tones/signals ranging from (frequency range to be listed in permit based on study design; e.g,. 200-3200 Hz) at 150 dB re: 1 μPa at 1 m.

### Acoustic Deterrent Devices (ADDs) in the Wild

1. Researchers may attach [X number] ADDs to pound nets [identify locations in pound design] for bycatch reduction trials.
2. Researchers may attach [X number] ADDs to tangle nets [include locations or spacing] for bycatch reduction trials.
3. ADDs may be used that emit signals ranging from (frequency range with a max of 1 kHz to be listed in permit based on study design; e.g, 200-500 Hz) at 150 dB re: 1 μPa at 1 m.
4. Do not set or locate nets with ADDs in such a manner as to prevent or deter sea turtles from accessing nesting habitat during the nesting season.