National Marine Fisheries Service
Endangered Species Act
Section 7 Biological Opinion

Title: Biological Opinion on the Issuance of a Permit (Number 24387) to the National Marine Fisheries Service's Northeast Fisheries Science Center to conduct research on sea turtles and Atlantic sturgeon pursuant to section 10(a)(1)(A) of the Endangered Species Act of 1973

Consultation Conducted By: Endangered Species Act (ESA) Interagency Cooperation Division, Office of Protected Resources, National Marine Fisheries Service, National Oceanic and Atmospheric Administration, U.S. Department of Commerce

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

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Approved:

DAMON RANDALL.KIMBERLY.BETH.1365821093

Digitally signed by DAMON RANDALL.KIMBERLY.BETH.1365821093
Date: 2022.06.13 12:17:29 -04'00'

Kim Damon-Randall
Director, Office of Protected Resources

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1 INTRODUCTION

The Endangered Species Act (ESA) of 1973, as amended (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 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. Federal agencies must do so in consultation with the National Marine Fisheries Service (NMFS) for threatened or endangered species (ESA-listed) or designated critical habitat that may be affected by the proposed action that are under NMFS jurisdiction (50 C.F.R. §402.14(a)). If a Federal action agency determines that an action "may affect, but is not likely to adversely affect" endangered species, threatened species, or designated critical habitat and NMFS concurs with that determination for species under NMFS jurisdiction, consultation concludes informally (50 C.F.R. §402.14(b)). When an action "may affect, but is likely to adversely affect" threatened or endangered species, NMFS engages in formal consultation (50 CFR 402.14(g).

Section 7(b)(3) of the ESA requires that at the conclusion of consultation, NMFS provides an opinion stating whether the Federal agency's action is likely to jeopardize ESA-listed species or destroy or adversely modify designated critical habitat. If NMFS determines that the action is likely to jeopardize ESA-listed species or destroy or adversely modify critical habitat, in accordance with the ESA section 7(b)(3)(A), 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 reasonably certain to occur, section 7(b)(4), as implemented by 50 CFR 402.14(g)(7), requires NMFS to provide an Incidental Take Statement (ITS), which exempts take incidental to an otherwise lawful action, and specifies the impact of any incidental taking, including reasonable and prudent measures, considered necessary or appropriate, to minimize such impacts and terms and conditions to implement the reasonable and prudent measures. When the incidental take of ESA-listed marine mammals is reasonable certain to occur, the ITS specifies those measures that are necessary to comply with section 101(a)(5) of the Marine Mammal Protection Act of 1972 and applicable regulations with regard to such taking. 50 C.F.R. §402.14(i)(iii).

The Federal action agency for this consultation is the NMFS, Office of Protected Resources, Permits and Conservation Division (Permits Division). The Permits Division proposes to issue a permit to the NMFS Northeast Fisheries Science Center (NEFSC) to conduct research on sea turtles and Atlantic sturgeon pursuant to section 10(a)(1)(A) of the ESA.

This consultation was completed in accordance with section 7(a)(2) of the statute (16 U.S.C. 1536 (a)(2)), associated implementing regulations (50 C.F.R. §§402.01-402.17), and agency policy and guidance. This biological opinion (opinion) was prepared by the NMFS Office of Protected Resources ESA Interagency Cooperation Division (hereafter referred to as "we" or "us"). This document represents NMFS' opinion on the effects of the proposed action on ESA-listed species and critical habitat that has been designated for those species. This opinion reflects the best available scientific information on the status and life history of ESA-listed species, the stressors resulting from the proposed action, the likely effects of those stressors on ESA-listed species and their habitats, the consequences of those effects to the fitness and survival of individuals, and the risk that those consequences pose to the survival and recovery of the threatened or endangered populations they represent.

A complete record of this consultation is on file at the NMFS Office of Protected Resources in Silver Spring, Maryland.

1.1 Background

The incidental capture of ESA-listed sea turtles and Atlantic sturgeon in commercial fishing gear threatens their recovery, and reducing this threat is a NMFS priority. The NEFSC conducts research on gear modifications aimed at reducing bycatch of these species in trawl and gillnet fisheries. The proposed bycatch reduction research involves the directed take of ESA-listed sea turtles and Atlantic sturgeon through capture and post-capture handling and research procedures. On December 30, 2016, we issued a biological opinion (NMFS 2016) on the Permits Division issuance of a five-year research permit (No. 17225) to the NEFSC to conduct research on sea turtles and Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*) pursuant to section 10(a)(1)(A) of the ESA. The 2016 opinion concluded that the proposed action was not likely to jeopardize the continued existence of: Gulf of Maine DPS, New York Bight DPS, Chesapeake Bay DPS, Carolina DPS, or South Atlantic DPS Atlantic sturgeon; or green (*Chelonia mydas*), hawksbill (*Eretmochelys imbricata*), leatherback (*Dermochelys coriacea*), Kemp's ridley (*Lepidochelys kempii*), or loggerhead (*Caretta caretta*) sea turtles. We also concluded that the proposed action would not likely result in the destruction or adverse modification of loggerhead sea turtle designated critical habitat.

1.2 Consultation History

Our communication with the Permits Division and the applicant (NEFSC) regarding this consultation is summarized below:

- On May 11, 2021, the NEFSC submitted a new permit application (File No. 24387) to continue the bycatch reduction study currently being conducted under Permit No. 17225.
- On May 13, 2021, the Permits Division requested early technical assistance from us.
- On May 17, 2021, we provided comments on the NEFSC permit application.
- On May 27, 2021 we had a conference call with the Permits Division, NEFSC, and the NMFS Greater Atlantic Regional Office to discuss the permit application.
- On July 13, 2021, the NEFSC submitted a revised permit application.
- On July 19, 2021, the Permits Division sent comments to the NEFSC. The NEFSC addressed those comments and submitted a revised permit application on August 3rd.

- On August 11, 2021, the Permits Division deemed the revised application (File No. 24387) complete.
- On August 27, 2021, we met with the Permits Division to provide additional technical assistance.
- On October 28, 2021, the Permits Division sent us a memo formally requesting initiation of the consultation, along with an initiation package.
- On November 9, 2021, the Permits Division, in accordance with the regulations at 50 C.F.R. section 222.304, granted an extension to the NEFSC to continue the activities authorized in Permit No. 17225 (set to expire on December 30, 2021) until 1) NMFS had made a decision on the new permit application (File No. 24387); or 2) the NEFSC had exhausted the total number of unused takes authorized for the fifth year of the permit.
- In November 2021, the Office of Protected Resources Marine Mammals and Sea Turtles Division provided comments on the NEFSC permit application. The NEFSC responded to those comments, including an explanation as to why the requested gillnet soak times and trawl tow times were needed to meet research objectives.
- On January 27, 2022, we sent the Permits Division follow up questions regarding their consultation initiation package.
- On February 9, 2022, the Permits Division responded to our questions and provided additional information as requested.
- On February 24, 2022, we notified the Permits Division that their consultation package was complete and we were initiating formal consultation on the proposed action as of February 22, 2022.
- On February 24, 2022, the Permits Division provided us with updated responses to our follow up questions and a revised draft permit with changes based on our comments. Changes included: 1) a permit condition to address avoiding seasonal aggregations of Atlantic sturgeon, 2) a permit condition to minimize the likelihood of spatial/temporal overlap with smalltooth sawfish, 3) a mitigation measure to retrieve nets immediately if a sturgeon or sea turtle is observed captured, 4) a reduction in the number of authorized Atlantic sturgeon mortalities (due to capture) to better reflect a conservative estimate of the risk associated with these activities and 5) a change in the distribution of sea turtle authorized mortalities to better reflect the higher likelihood of capturing a loggerhead or Kemp's ridley as compared to other turtle species.

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 reduce appreciably the likelihood of both the survival and recovery of an ESA-listed species in the wild by reducing the reproduction, numbers, or distribution of that species" (50 C.F.R. §402.02).

"Destruction or adverse modification" means a direct or indirect alteration that appreciably diminishes the value of critical habitat for the conservation of an ESA-listed species as a whole (50 C.F.R. §402.02).

This ESA section 7 formal consultation involves the following steps:

Description of the Proposed Action (Section 3): We describe the proposed action and those aspects (or stressors) of the proposed action that may have effects on the physical, chemical, and biotic environment. This section also includes the avoidance and minimization measures that have been incorporated into the project to reduce the effects to ESA-listed species.

Action Area (Section 4): We describe the action area with the spatial extent of the stressors from the action.

Species and Designated Critical Habitat that May be Affected (Section 5): We identify the ESA-listed species and designated critical habitat that are likely to co-occur with those stressors in space and time, and evaluate the status of those species and critical habitats. This section is divided into two subsections: 5.1) species and critical habitats that may be affected by the action, but are not likely to be adversely affected, and 5.2) species and critical habitats that may be affected by the action and are likely to be adversely affected. Species and critical habitats in subsection 5.1 are analyzed and not discussed further in the opinion. Species and critical habitats in subsection 5.2 are described in greater detail, identifying the current status of the species, their trends in abundance, recovery criteria, and designated critical habitat.

Environmental Baseline (Section 6): We describe the environmental baseline in the action area and the condition of the listed species or its designated critical habitat in the action area, without the consequences to the listed species or designated critical habitat caused by the proposed action. 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 impacts of state or private actions which are contemporaneous with the consultation in process. The consequences to listed species or designated critical habitat from ongoing agency activities or existing agency facilities that are not within the agency's discretion to modify are part of the environmental baseline (50 C.F.R. §402.02).

Effects of the Action (Section 7): We evaluate the effects of the action on ESA-listed species and designated critical habitat. Effects of the action are all consequences to listed species or critical habitat that are caused by the proposed action, including the consequences of other activities that are caused by the proposed action. A consequence is caused by the proposed action if it would not occur but for the proposed action and it is reasonably certain to occur. Effects of the action may occur later in time and may include consequences occurring outside the immediate area involved in the action. During our evaluation, we determined that some stressors were not likely to adversely affect ESA-listed species (Section 7.1). The stressors that we determined were likely to adversely affect ESA-listed species or critical habitats were carried forward for additional analyses (Section 7.2). For those stressors likely to adversely affect ESA-listed species, we identify the number, age (or life stage), and gender if possible, of ESA-listed individuals that are likely to be exposed to the stressors and the populations or subpopulations to which those individuals belong to the extent possible based on available data. This is our exposure analysis (Section 7.2.1). We evaluate the available evidence to determine how individuals of those ESA-listed species are likely to respond given their probable exposure. This is our response analysis (Section 7.2.2).

Cumulative Effects (Section 8): We describe the cumulative effects in the action area. Cumulative effects are the effects to ESA-listed species and designated critical habitat 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 C.F.R. §402.02).

Integration and Synthesis (Section 9): We integrate and synthesize by adding the effects of the action and cumulative effects to the environmental baseline in full consideration of the status of the species and critical habitat likely to be adversely affected, to formulate our opinion as to whether the action would reasonably be expected to: 1) reduce appreciably the likelihood of both the survival and recovery of the ESA-listed species in the wild by reducing its reproduction, numbers, or distribution; or 2) appreciably diminish the value of designated critical habitat as a whole for the conservation of an ESA-listed species.

Conclusion (Section 10): We state our conclusions regarding whether the action is likely to jeopardize the continued existence of ESA-listed species or result in the destruction or adverse modification of designated critical habitat. If, in completing the last step in the analysis, we determine that the action under consultation is likely to jeopardize the continued existence of ESA-listed species or destroy or adversely modify designated critical habitat, we must identify a reasonable and prudent alternative(s) to the action, if any, or indicate that to the best of our knowledge there are no reasonable and prudent alternatives (see 50 C.F.R. §402.14(h)(3)).

Incidental Take Statement: An ITS is included for those actions for which incidental take of ESA-listed species is reasonably certain to occur (50 CFR 402.14(i) and 50 CFR 402.14(g)(7)). Directed take of ESA-listed species resulting from research activities pursuant to section 10(a)(1)(A) of the ESA would not be included in an ITS

Conservation Recommendations (Section 11): As suggestions for the action agency's future ESA section 7(a)(1) actions, we also provide discretionary conservation recommendations (50 C.F.R. §402.14(j)).

Reinitiation Notice (Section 12): Finally, we identify the circumstances in which reinitiation of consultation is required (50 C.F.R. §402.16).

2.1 Evidence Available for this Consultation

To conduct the analyses necessary for this opinion and to comply with our obligation to use the best scientific and commercial data available, we considered all lines of evidence available through published and unpublished sources. We conducted electronic literature searches throughout this consultation, including within the NMFS Office of Protected Resources' electronic library. These searches were used to identify information relevant to the potential stressors and responses of ESA-listed species and designated critical habitat under NMFS' jurisdiction that may be affected by the proposed action to draw conclusions on risks the action may pose to the continued existence of these species and the value of designated (or proposed) critical habitat for the conservation of ESA-listed species. We also made use of the information and sources provided in the Permits Division's initiation package and follow up communications.

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 (50 C.F.R. §402.02.).

The Permits Division's proposed action is to issue a research permit to the NEFSC pursuant to Section 10(a)(1)(A) of the ESA of 1973, as amended (ESA; 16 U.S.C. 1531 et seq). 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. The purpose of the proposed permit issuance is to allow an exception to the prohibition on takes established under the ESA. The permit would authorize the permit holder to study Atlantic sturgeon and loggerhead, Kemp's ridley, green, hawksbill, and leatherback sea turtles in state and federal waters of the U.S. Atlantic Ocean Exclusive Economic Zone (EEZ) from Massachusetts to the Georgia/Florida border. The purpose of the research permitted would be to test and evaluate trawl and gillnet modifications to minimize or prevent future fisheries interactions with sea turtles and sturgeon. The permit would expire five years after the date of issuance and may be extended for up to one year per Federal regulation.

The research will be conducted in two separate parts with two different goals. The northern portion (from the New Hampshire/Massachusetts border to Cape Hatteras, NC) will evaluate the target/landed and discarded catch rates when modified gear is used in federally-permitted commercial fisheries. We refer to this as the Fishery Dependent Sampling (FDS) portion of the proposed action. The main objective of the research in the FDS areas is to test the ability of gear modifications to retain the target catch as well as other landed species and to reduce discards. The capture of ESA-listed species in the FDS is covered under the ITS of the NMFS (2021a) biological opinion titled: "Endangered Species Act Section 7 Consultation on the: (a) Authorization of the American Lobster, Atlantic Bluefish, Atlantic Deep-Sea Red Crab, Mackerel/Squid/Butterfish, Monkfish, Northeast Multispecies, Northeast Skate Complex, Spiny Dogfish, Summer Flounder/Scup/Black Sea Bass, and Jonah Crab Fisheries and (b) Implementation of the New England Fishery Management Council's Omnibus Essential Fish Habitat Amendment 2" (NMFS 2021a). The modified gear is not demonstrably different than what was considered during section 7 consultation for these fisheries. Thus, collection of FDS scientific data will be on sea turtles and sturgeon incidentally captured as a result of interactions with these fisheries.

Separate studies will occur in the southern Atlantic Coast portion of the action area (from the Virginia/North Carolina border to the Georgia/Florida border) and will include capture and sampling activities of sea turtles and Atlantic sturgeon through Fishery Independent Sampling (FIS). The FIS will also evaluate the effectiveness of the experimental gears at preventing interactions with sea turtles and Atlantic sturgeon and, if not prevented, at reducing injury and mortality to sea turtles and Atlantic sturgeon from bycatch. The information gained through both separate research activities (i.e., FDS and FIS) will be used to evaluate, develop, and implement conservation recovery efforts for sea turtles and Atlantic sturgeon pursuant to the reasonable and prudent measures of the 2021 commercial fisheries opinion (NMFS 2021a) and section 7(a)(2) of the ESA.

As shown in Figure 1 below, the FDS and FIS areas overlap from the Virginia/North Carolina border to Cape Hatteras, North Carolina. As a condition of the permit, prior to conducting any projects within the FDS/FIS overlap area the researcher will notify the Permits Division as to which authority the sampling will be covered under (i.e., either FDS which is covered under the ITS of the NMFS (2021a) biological opinion or FIS which is covered under this opinion) in order to fully account for the take of ESA-listed species within this overlap area.

Together, the two parts of these separate research activities will test the hypothesis that the experimental gear can significantly reduce sea turtle and Atlantic sturgeon bycatch while maintaining current levels of targeted catch. The work in the northern portion of the action area with authorized fisheries will assess the catch rates of landed and discarded fish catch using the modified fishing gear. The fishery independent research in the southern portion will assess the effectiveness of the bycatch reduction devices at reducing the catch of ESA-listed species where interaction rates, particularly with sea turtles, are expected to be higher. In both studies, a paired design with an experimental and control gear will be used.

3.1 Capture Methods

For the FDS portion of the proposed action, gears will be tested in the commercial fisheries as they normally operate to more accurately assess the impact of the modifications. As discussed above, all captures of ESA-listed species in the FDS areas will be covered under the 2021 fisheries biological opinion (NMFS 2021a); thus, the FDS capture methods are not described in this opinion. However, because research procedures conducted on ESA-listed species are not covered under the existing 2021 opinion, these sampling procedures (described in Section 3.2 below) in the FDS areas are included as part of the proposed action for this opinion.

Research in the FIS area will use a paired sampling design with a control and experimental gear design. The sampling will test the experimental gear (either trawls equipped with a Bycatch Reduction Device or gillnets modified to reduce protected species catch) against the control net. The control sampling gear will be the same gear currently used in the commercial fishery and will not be modified.

For gillnets, the control nets are commercial monkfish gillnets typical of those used in the Mid-Atlantic region. They are 300 feet long, 12 meshes deep, and made of 0.90 mm diameter, 12 inch stretched mesh size, green nylon monofilament netting. The headrope is made of 3/8 inch polypropylene (PP) ropes with standard gillnet floats spaced every 12 feet. The footrope consists of 75 pounds per 600 feet of lead line. Tie-down lines (48 inches long) are spaced every 24 feet. The experimental gillnet is exactly the same as the control net in terms of netting materials, headrope, and footrope, but is 8 meshes deep instead of 12 meshes. In addition, tie-down lines in the experimental nets are spaced every 12 feet and are 24 inches long, instead of 48 inches. The tie-down lines are on every float in the experimental nets as opposed to every other float in the control nets. Other modifications to experimental gear may be tested, including raised footropes and/or visual deterrents. Visual deterrents may include illumination with light-emitting diodes or chemical lightsticks. All nets will be built and fished in compliance with the Harbor Porpoise, Atlantic Large Whale, and Bottlenose Dolphin Take Reduction Plans (NOAA 2022).

The soak duration of gillnets in the FIS will be limited to one hour, which includes the time that it takes to completely remove/retrieve the net from the water. The areas around the nets will be continuously monitored for surfacing marine mammals that may encounter the nets. The nets will be removed from the water every hour, unless there is evidence an animal has entered the net and is captured, at which time the net will be retrieved immediately and animals brought on board for research procedures. In prior years, the NEFSC conducted their gillnet FIS study on the fishing vessel Salvation, a 32 foot, five gross ton vessel with a 10 foot beam, 2 foot draft and 250 horsepower outboard engine mounted on a stern bracket. The NEFSC anticipates contracting this vessel for the gillnet FIS portion of the proposed action.

Control trawl gears proposed for the FIS work include traditional two and four seam flounder trawls and scallop trawls. Experimental gears may include two and four seam flounder trawls, fly nets, and scallop trawls, which may be modified by installing a sea turtle excluder device (TED) to test the ability of the target catch to be retained in gear with a TED installed. Although subject to modifications, trawls used in past research had 320 x 6 inch fishing circles and an 80 foot footrope. The experimental topless designs have included headrope lengths of 108, 133, 147 and 160 feet. The topless trawls have been rigged with sweeps on travelers made of small rubber discs (cookies) with interspersed lead cookies and rigged with 16 eight inch plastic floats. A cable grid, consisting of a grid made of cable encased in an extension (tube of webbing) that locks the cable grid in place to hold its shape, will be used for TED experimental trawl tows. In prior years, the NEFSC conducted their trawl FIS study on steel hull stern trawling vessels ranging from 85-90 feet long and 670-800 horsepower. The NEFSC anticipates contracting these or similarly configured vessels for the trawl FIS portion of the proposed action. Trawl gear times will be limited to 55 minutes, including hauling (i.e., 45 minute towing, 10 minute hauling). If there is evidence that an animal is already captured in the trawl net, the animal will be removed immediately from the gear.

For capture of sea turtles and Atlantic sturgeon in FIS sampling, researchers must adhere to the conditions specified in the permit designed to minimize adverse effects to these species. While attempting to capture sea turtles or Atlantic sturgeon netting activity must be restricted when temperature (and dissolved oxygen [DO] concentrations for sturgeon) thresholds are reached. Researchers must manually monitor nets and trawls, checking for fish or turtle strikes, and removing captured animals as soon as detected. In addition, researchers must plan for unexpected circumstances (e.g. inclement weather) or demands of the research activities and have the ability and resources to retrieve nets to remove catch at all times.

Researchers may use tangle nets and trawling gear to capture sturgeon in water temperatures between 0°C and 28°C and at DO concentrations of at least 4.5 mg/l or ~55 percent saturation (measured at the surface and the depth sampled). When removing sturgeon from a capture gear, they must be supported by a sling or net, minimizing handling and using smooth rubber gloves to transfer them. Animals should be kept in water to the maximum extent possible to reduce stress. Upon removing a non-responsive or overly stressed sturgeon from capture gear, researchers must resuscitate it by passing water over its gills by manually rocking it in a forward motion for up to 30 minutes until it responds with strong opercula movement. To minimize the potential to capture large numbers of Atlantic sturgeon, researchers will purposefully avoid gillnetting and trawling activities in locations where sturgeon are known to aggregate on a seasonal basis. A complete listing of the proposed permit conditions can be found in the Permits Division's draft permit (NMFS 2021b)

3.2 Sampling Methods

Trained scientific data collectors and/or co-investigators will be aboard each vessel participating in the study and will collect all relevant catch information. The data collectors will be trained in protected species handling and sampling by NEFSC staff experienced in sea turtle and Atlantic sturgeon data collection.

3.2.1 Specific Research Methodologies for Sea Turtles

All captured sea turtles will be handled according to the procedures outlined in 50 CFR 223.206(d)(1) and summarized in this section. Any turtles taken incidentally during the course of FDS or FIS activities will be handled with due care to prevent further injury to live specimens. The majority of handling takes will be accomplished within 30 minutes for a standard work up (measurements, tissue samples, flipper tags, passive integrated transponder [PIT] tags) but no longer than one hour. If an hour has expired, turtle sampling activities will be ceased and the turtle will be returned to the water. A copy of the Sea Turtle Handling and Resuscitation Requirements Wheelhouse card will be aboard all vessels.

Based on similar past research conducted by the NEFSC, typically one sea turtle will be captured at a time, but no more than three at a time. When more than one turtle is captured, the situation will be evaluated and a decision will be made to either keep the other turtles on board for sampling or to return them back into the water. If deck space allows and there is more than one qualified turtle sampler on board, as many turtles that can be managed by the crew will be sampled at one time. Turtles brought on board to be sampled will be kept away from each other to prevent injuries to the turtles themselves and crew members.

Larger turtles brought on board will be supported atop a spare car tire. Smaller turtles that do not fit atop the tire will be placed on a padded milk crate. Both of these containers have been proven to prevent turtles from crawling around the deck and risking self-inflicted injury. Live specimens will be protected from temperature extremes of heat and cold and kept moist during sampling. The area surrounding the turtle will not contain any materials that could be accidentally ingested. After data collection, live and resuscitated turtles will be released over the stern when gear is not in use, the engine is in neutral, and in areas where the turtle is unlikely to be recaptured or injured by other vessels. Released turtles will be observed carefully and observations about the animal's ability to swim and dive in a normal manner will be recorded. If a sea turtle that has already been sampled during the project gets unintentionally recaptured during the same project, it will be immediately released and capture efforts will be moved accordingly to avoid another recapture.

Turtles are determined to be dead if the muscles are in rigor mortis or the flesh has begun to rot. Otherwise, the turtle is determined to be comatose or inactive and resuscitation must be attempted. A comatose turtle will be placed on its plastron with its hind quarters elevated at least six inches for at least four hours and up to 24 hours. The turtle will be periodically rocked gently side to side by holding the outer edge of the shell and lifting one side about three inches, then alternate to the other side. Periodically, reflex tests (gently touching the eye or pinching the tail) will be conducted to see if there is a response. Turtles that revive and become active are sampled according to the guidelines for live animals. Turtles that show no response are to be sampled according to the guidelines for dead specimens. Fresh dead turtles will be retained whole, whenever feasible, and brought to shore for necropsy. All of NMFS safe handling protocols for sea turtles will be followed. An on-call veterinarian will be contacted prior to field work to discuss care and transport plans if an injured sea turtle is captured.

Standard sampling procedures for sea turtles include measurements, tissue samples, flipper tags, and PIT tags. In addition, turtles will be photographed and/or video recorded whenever feasible. At the request of NMFS Sea Turtle Age and Growth Lab, flippers and eyes may also be taken from dead turtles.

All straight line measurements including straight carapace length, straight carapace width, and plastron length will be taken with calipers. All curved measurements including curved carapace length, curved carapace width, and tail length will be taken with a flexible tape measure of at least six feet. Due to irregularities in the ridges, leatherback turtles' curved lengths will be measured along the midline ridge. Carapace width does not follow the curvature of the ridges but is measured spanning from ridge crest to ridge crest. Turning adult leatherbacks on their carapace for plastron and tail measurements is impractical and will not be performed.

If existing tags are found, the tag identification numbers will be recorded and new tags will not be applied. The sampling protocols will be consistent with those included in the programmatic biological opinion for sea turtle research (NMFS 2017b). Only turtles >20 cm straight carapace length (SCL) will be tagged with Inconel tags. Inconel tags are metal tags that are attached to the trailing edge of a sea turtles flipper to provide a means of unique identification. Inconel is a metal alloy that was designed to be particularly resistant to degradation in extreme environments, including the ocean. For turtles 20-30 cm SCL, only series 1005 tags will be used. For turtles >30 cm SCL, only Standard 681 tags will be used. All tags are to be cleaned and disinfected before being used. Applicators will be cleaned and disinfected between animals. Prior to tag application, betadine will be applied to the application site followed by a scrub of 70 percent alcohol. When handling and/or tagging turtles displaying fibropapilloma tumors or lesions, researchers will clean all equipment that comes in contact with the turtle with a mild bleach solution between the processing of each turtle and maintain a separate set of sampling equipment for handling animals displaying fibropapilloma tumors or lesions.

For hard-shelled sea turtles, the preferred tagging site is adjacent to the first large scale, closest to the animal's carapace. For leatherback turtles, the tag will be applied approximately 5 cm (~2 inches) out from the base of the tail. The tag will be positioned so that it is firmly set in the skin of the flipper, but with some overhang (approximately 1/3 length of tag) after attachment. This will ensure that the tag does not inhibit the free movement of the flipper.

All sea turtles will be checked for passive integrated transponder or PIT tags. A PIT tag is a small inert microprocessor incased in glass which is injected into the shoulder muscle or flipper of sea turtles as a method of identifying individuals. Only turtles larger than 16 cm SCL will receive PIT tags, if scanning reveals no PIT tag present. All PIT tags will be 10 mm and will be applied with a size 16 gauge injector. The application site will be cleaned and scrubbed with two replicates of a medical disinfectant solution (e.g., betadine, chlorhexidine) followed by 70 percent alcohol before the applicator pierces the animal’s skin. Researchers must insert the PIT tag into the thickest part of the triceps superficialis muscle. The tag must occupy no more than an estimated 20 percent of the muscle’s total volume and length. Leatherback sea turtles will be tagged in the center of the dorsal musculature (triceps complex) of the forelimb and hardshelled sea turtles will be tagged in the triceps superficialis. The preferable site for Kemp's ridleys is in the left triceps superficialis.

For sampling of tissues (i.e., biopsy) of live turtles, aseptic techniques will be used at all times by using medical disinfectant solution (e.g., betadine, chlorhexidine) followed by 70 percent alcohol. Biopsy punches are sterile and packaged as sealed units (Acu-punch Brand, 6 mm diameter); these punches are designed to obtain a circular skin plug, are disposable, and will not be used on more than one turtle. The default sampling site will be at the base of the rear flipper. A sample will be taken from this site and subsequently cleaned with a disposable alcohol/ betadine pad. Two samples are taken on each turtle to ensure the recovery of genetic material for sampling. The tissue plugs will be placed into vials containing a suitable storage solution – supersaturated NaCl solution.

3.2.2 Specific Research Methodologies for Atlantic Sturgeon

All sampling procedures, and handling of Atlantic sturgeon will be conducted following the guidelines in Kahn and Mohead (2010). Only standard handling procedures of measuring, weighing, PIT tagging, and tissue sampling (i.e., fin clip) will be completed. Due to the planned routine sampling procedures, the expected total time to complete sampling is less than five minutes, and will not exceed the 15 minute maximum. A rectangular holding tank with approximate dimensions of 8'x2.5'x3' will be used to place the sturgeon for measurement and sampling. The tank will be filled with sea water to allow the fish to breathe. Prior to release, sturgeon will be examined and, if necessary, recovered by placing in the water, gently moving the fish in a forward direction to allow water to oxygenate the gills. The investigator will watch the fish upon release to make sure it stays submerged. If an Atlantic sturgeon that has already been sampled during the project gets unintentionally recaptured during the same project, it will be immediately released and capture efforts will be moved accordingly to avoid another recapture.

As with sea turtles, typically one Atlantic sturgeon will be captured at a time, but no more than three are expected from one net haul. If multiple sturgeon are captured during a single haul of a trawl or gillnet, the first will be placed on the wedge and the deck hose will be immediately turned on to run water over the gills. Other sturgeon caught after the first will be quickly measured, PIT tagged (if time permits), and released back into the water. When more than one sturgeon is captured, the situation will be evaluated and a decision will be made to either keep the other fish on board for sampling or to return them back into the water. If deck space allows and there is more than one qualified sturgeon sampler on board, as many sturgeon that can be managed by the crew will be sampled at one time.

Atlantic sturgeon will be photographed and/or videoed. Standardized length measurements will be taken as described in Kahn and Mohead (2010). Atlantic sturgeon will also be scanned for PIT tags and, if present, the PIT tag number will be recorded. If a PIT tag is not found, sturgeon over 300 mm total length (TL) will be tagged and the identifying number recorded. PIT tags will be located to the left of the spine, immediately anterior to the dorsal fin and posterior to the dorsal scutes. After the tag is inserted, it will be scanned to ensure that it is readable prior to releasing the fish. Since smaller juvenile sturgeon are more difficult to properly PIT tag, and thus more susceptible to harming as a result of this procedure (Henne et al. 2010), only 8mm PIT tags would be used on smaller sturgeon (300 – 350 mm TL), while 11.9 mm tags would be used on sturgeon above 350 mm TL. Animals smaller than 300 mm TL will not be tagged with any other type of tags.

All tissue sampling of Atlantic sturgeon will be conducted in accordance with Kahn and Mohead (2010). Tissues samples (i.e., fin clips) will be collected for genetic analysis to identify each captured Atlantic sturgeon to its DPS. A small (1.0 cm^2) tissue sample will be collected from the trailing margins of soft fin tissue (pectoral or dorsal fins) using sharp sanitized scissors. To minimize any impact of sampling tissue for genetic tissue samples, care will be used when collecting. Instruments will be changed or disinfected and gloves changed between each fish sampled to avoid possible disease transmission or cross contamination of genetic material. The protocol for genetic tissue sampling will be either preservation of a fin clip in RNAlater, an aqueous, non-toxic tissue storage reagent, or other NMFS-approved protocol. Genetic samples will be sent for analysis and archiving to the U.S. Geological Survey's Leetown Science Center.

3.3 Proposed Sample Sizes

The numbers of individuals captured and research techniques performed provided in the draft NEFSC research permit for the proposed action are shown in the tables below. Take of Atlantic sturgeon is authorized at the species level rather than the DPS level in the permit. For our effects analysis below (Section 7), we proportion the authorized Atlantic sturgeon by DPS based on information on stock composition from captures along the Atlantic coast. Table 1 shows the sublethal take (average annual and 5-year maximum) from research procedures on turtles and sturgeon captured by FDS sampling. Any lethal take of ESA-listed species associated with FDS captures is authorized in the NMFS (2021a) fisheries opinion. Table 2 shows the sublethal take (average annual and 5-year maximum) from research procedures on turtles and sturgeon captured by FIS sampling. Table 3 shows the lethal take (average annual and 5-year maximum) of turtles and sturgeon authorized from captured in FIS sampling.

Table 1. Proposed average annual and 5-year maximum sublethal take from FDS sampling in the Northeast portion of the action area which includes U.S. state and federal waters from the New Hampshire/Massachusetts border south to Cape Hatteras, North Carolina.

Species	Listing Unit/Stock	Life Stage	Expected Sublethal Take Avg. annual / 5-year maximum	Procedure
Sturgeon, Atlantic	Range-wide (NMFS Endangered/ Threatened)	Adult/ Subadult/ Juvenile	Trawl: 20 / 100 Gillnet: 41 / 123	Mark, PIT tag; Measure; Photograph/Video; Sample, fin clip; Weigh
Turtle, green sea	Range-wide (NMFS Threatened)	Adult/ Subadult/ Juvenile	Trawl or Gillnet: 2 / 6	Mark, flipper tag; Mark, PIT tag; Measure; Photograph/Video; Sample, tissue ; Weigh
Turtle, Kemp's ridley sea	Range-wide (NMFS Endangered)	Adult/ Subadult/ Juvenile	Trawl or Gillnet: 2 / 6	Mark, flipper tag; Mark, PIT tag; Measure; Photograph/Video; Sample, tissue ; Weigh

Turtle, leatherback sea	Range-wide (NMFS Endangered)	Adult/ Subadult/ Juvenile	Trawl or Gillnet: 2 / 6	Mark, flipper tag; Mark, PIT tag; Measure; Photograph/Video; Sample, tissue ; Weigh
Turtle, loggerhead sea	Northwest Atlantic Ocean DPS (NMFS Threatened)	Adult/ Subadult/ Juvenile	Trawl: 3 / 15 Gillnet: 12 / 34	Mark, flipper tag; Mark, PIT tag; Measure; Photograph/Video; Sample, tissue ; Weigh

Table 2. Proposed average annual and 5-year maximum sublethal take from FIS sampling in the Southeast portion of the action area which includes U.S. waters from the Virginia/North Carolina border south to the Georgia/Florida border.

Species	Listing Unit/Stock	Life Stage	Expected Sublethal Take Avg. annual / 5-year maximum	Procedure
Sturgeon, Atlantic	Range-wide (NMFS Endangered/ Threatened)	Adult/ Subadult/ Juvenile	Trawl: 61 / 122 Gillnet: 41 / 82	Mark, PIT tag; Measure; Photograph/Video; Sample, fin clip; Weigh
Turtle, green sea	Range-wide (NMFS Threatened)	Adult/ Subadult/ Juvenile	Trawl: 5 / 10 Gillnet: 2 / 10	Mark, flipper tag; Mark, PIT tag; Measure; Photograph/Video; Sample, tissue ; Weigh
Turtle, hawksbill	Range-wide (NMFS Threatened)	Adult/ Subadult/ Juvenile	Trawl: 2 / 10 Gillnet: 2 / 10	Mark, flipper tag; Mark, PIT tag; Measure; Photograph/Video; Sample, tissue ; Weigh
Turtle, Kemp's ridley sea	Range-wide (NMFS Endangered)	Adult/ Subadult/ Juvenile	Trawl: 29 / 145 Gillnet: 8 / 40	Mark, flipper tag; Mark, PIT tag; Measure; Photograph/Video; Sample, tissue ; Weigh
Turtle, leatherback sea	Range-wide (NMFS Endangered)	Adult/ Subadult/ Juvenile	Trawl: 2 / 10 Gillnet: 2 / 10	Mark, flipper tag; Mark, PIT tag; Measure; Photograph/Video; Sample, tissue ; Weigh
Turtle, loggerhead sea	Northwest Atlantic Ocean DPS (NMFS Threatened)	Adult/ Subadult/ Juvenile	Trawl: 52 / 260 Gillnet: 33 / 165	Mark, flipper tag; Mark, PIT tag; Measure; Photograph/Video; Sample, tissue ; Weigh

Table 3. Proposed annual and 5-year maximum lethal take from FIS sampling in the Southeast portion of the action area (note: lethal take from FDS sampling covered under a different biological opinion).

Species	Listing Unit/Stock	Life Stage	Expected Lethal Take Trawl or Gillnet Annual limit / 5-year maximum
Sturgeon, Atlantic	Range-wide (NMFS Endangered/ Threatened)	Adult/ Subadult/ Juvenile	7 / 10
Turtle, green sea	Range-wide (NMFS Threatened)	Adult/ Subadult/ Juvenile	1 / 1
Turtle, hawksbill	Range-wide (NMFS Threatened)	Adult/ Subadult/ Juvenile	1 / 1
Turtle, Kemp's ridley sea	Range-wide (NMFS Endangered)	Adult/ Subadult/ Juvenile	6 / 6
Turtle, leatherback sea	Range-wide (NMFS Endangered)	Adult/ Subadult/ Juvenile	1 / 1
Turtle, loggerhead sea	Northwest Atlantic Ocean DPS (NMFS Threatened)	Adult/ Subadult/ Juvenile	6 / 6

4 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 action area for the project is segregated in two parts: the fishery dependent study (FDS) location, and the fishery independent study (FIS) location (Figure 1). The FDS includes state and federal waters of the Atlantic Ocean to the EEZ from the New Hampshire/Massachusetts border south to Cape Hatteras, North Carolina. The FIS includes state and federal waters of the Atlantic Ocean to the EEZ from the Virginia/North Carolina border south to the Georgia/Florida border.

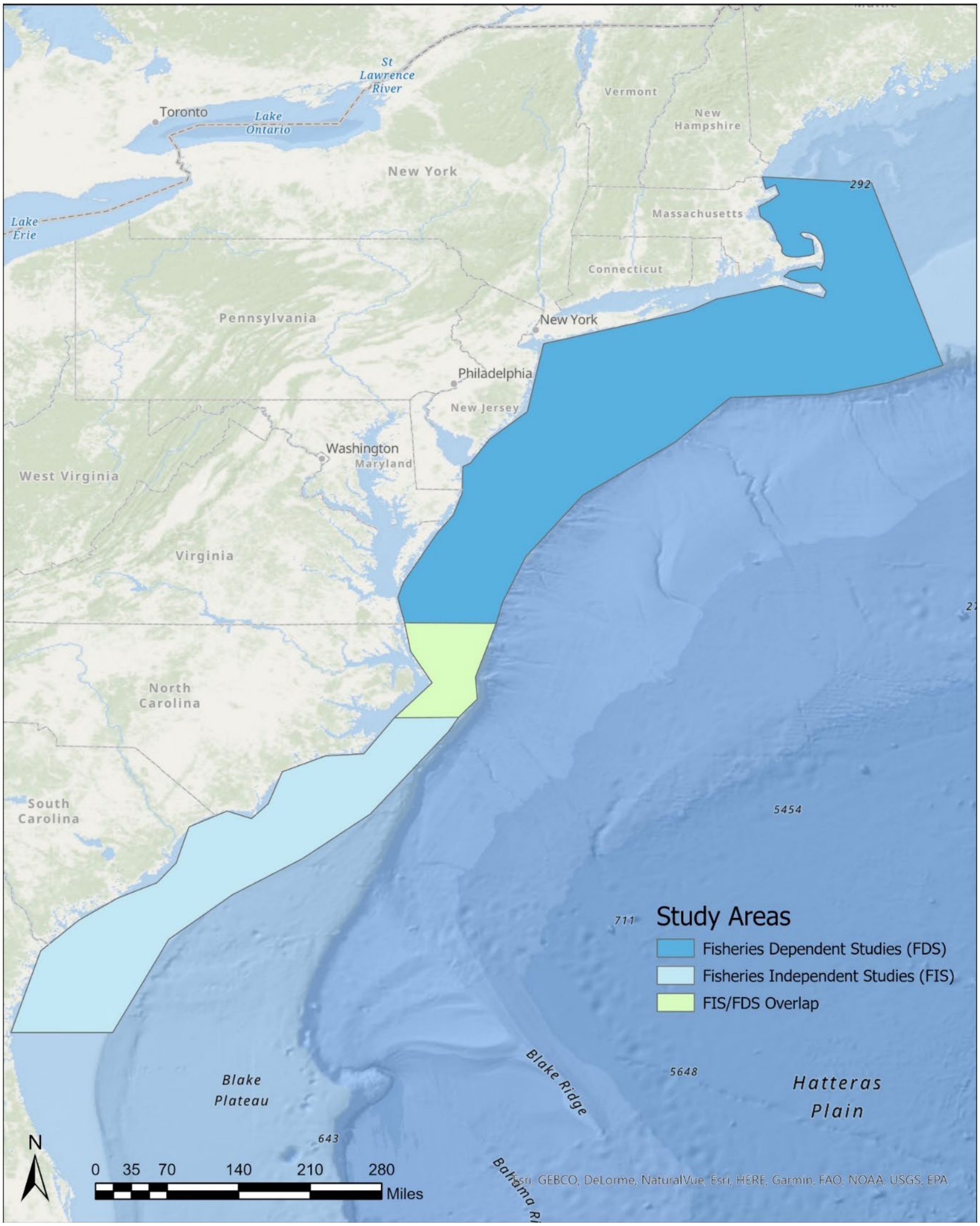

Figure 1. Action area for proposed NEFSC research showing sampling locations for FDS and FIS, as well as the FDS/FIS overlap area.

5 Species and Designated Critical Habitat that May be Affected

This section identifies the ESA-listed species and designated critical habitat that occur within the action area and overlap with the action in time and space such that they may be affected by the proposed action. This section also identifies the regulatory status of those species (Table 4). Section 5.1 identifies those species and critical habitats that may be affected but are not likely to be adversely affected by the proposed action because the effects of the proposed action, evaluated by each stressor, were deemed insignificant, discountable, or fully beneficial. In Section 5.2, we provide a summary of the biology, ecology, and population status of those species that are likely to be adversely affected by one or more stressors created by the proposed action and detail information on their life histories in the action area, if known. The species that are likely to be adversely affected by the proposed action are carried forward in our effects analysis (Section 7).

5.1 Species and Critical Habitat Not Likely to be Adversely Affected

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

The second criterion is the probability of a response given exposure. An ESA-listed species or designated critical habitat that co-occurs with a stressor of the action but is not likely to respond to the stressor is also not likely to be adversely affected by the proposed action.

The probability of an effect on a species or designated critical habitat is a function of exposure intensity and susceptibility of a species to a stressor's effects (i.e., probability of response). 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. *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. *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 extremely unlikely to occur (USFWS and NMFS 1998). We applied these criteria to the ESA-listed species in Table 4. We summarize our results below for ESA-listed species and critical habitat that are not likely to be adversely affected by any stressor created by the proposed action.

Table 4. ESA-listed species and designated (or proposed) critical habitat that may be affected by the proposed action.

Species	ESA Status	Critical Habitat	Recovery Plan
Marine Mammals – Cetaceans			
North Atlantic Right Whale (*Eubalaena glacialis*)	E – 73 FR 12024	81 FR 4837	70 FR 32293 08/2004
Blue Whale (*Balaenoptera musculus)*	E – 35 FR 18319	-- --	07/1998 10/2018
Sei Whale (*Balaenoptera borealis*)	E – 35 FR 18319	-- --	12/2011
Sperm Whale (*Physeter macrocephalus*)	E – 35 FR 18319	-- --	75 FR 81584 12/2010
Fin Whale (*Balaenoptera physalus)*	E – 35 FR 18319	-- --	75 FR 47538 07/2010
Marine Reptiles			
Green Turtle (*Chelonia mydas*) – North Atlantic DPS	T – 81 FR 20057	63 FR 46693*	FR Not Available 10/1991 – U.S. Atlantic
Hawksbill Turtle (*Eretmochelys imbricata)*	E – 35 FR 8491	63 FR 46693*	57 FR 38818
Kemp's Ridley Turtle (*Lepidochelys kempii*)	E – 35 FR 18319	-- --	03/2010 – U.S. Caribbean, Atlantic, and Gulf of Mexico 09/2011
Leatherback Turtle (*Dermochelys coriacea*)	E – 35 FR 8491	44 FR 17710* and 77 FR 4170*	10/1991 – U.S. Caribbean, Atlantic, and Gulf of Mexico 63 FR 28359
Loggerhead Turtle (*Caretta caretta*) – Northwest Atlantic Ocean DPS	T – 76 FR 58868	79 FR 39855	74 FR 2995 10/1991 – U.S. Caribbean, Atlantic, and Gulf of Mexico 01/2009 – Northwest Atlantic
Fishes			
Atlantic Sturgeon (*Acipenser oxyrinchus oxyrinchus*) – Carolina DPS	E – 77 FR 5913	82 FR 39160*	-- --

Species	ESA Status	Critical Habitat	Recovery Plan
Atlantic Sturgeon (*Acipenser oxyrinchus oxyrinchus*) – Chesapeake Bay DPS	E – 77 FR 5879	82 FR 39160*	-- --
Atlantic Sturgeon (*Acipenser oxyrinchus oxyrinchus*) – Gulf of Maine DPS	E – 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*	-- --
Shortnose Sturgeon (*Acipenser brevirostrum*)	E – 32 FR 4001	-- --	63 FR 69613
Ocean Whitetip Shark (*Carcharinus lonigmanus*)	T - 83 FR 4153	-- --	-- --
Giant Manta Ray (*Mobula birostris*, formerly *Manta birostris*)	T – 83 FR 2916	-- --	-- --
Smalltooth Sawfish (*Pristis pectinata*) – U.S. portion of range DPS	E – 68 FR 15674	74 FR 45353*	74 FR 3566 01/2009

*Indicates that critical habitat exists for this species, but does not overlap with the action area.

5.1.1 Shortnose Sturgeon

Shortnose sturgeon are benthic fish that occur in large coastal rivers of eastern North America. They range from as far south as the St. Johns River, Florida (possibly extirpated from this system) to as far north as the Saint John River in New Brunswick, Canada. Shortnose sturgeon are believed to spend most of their lives in their natal rivers, but occasionally migrate relatively short distances along the coast. Shortnose sturgeon are considered an amphidromous fish species which migrates between fresh and saltwater. Unlike anadromous and catadromous fish, which migrate explicitly for the purposes of breeding, amphidromous fish migrate for other purposes such as feeding. During their coastal migrations, they tend to stay nearshore and enter neighboring river systems as they move (Bemis and Kynard 1997; SSSRT 2010). These movements are generally limited by geographic distance between river mouths, with greater movement between geographically proximate rivers. Movement between larger groups of rivers at greater geographic distance rarely occurs (King et al. 2001; Kynard et al. 2000). When coastal migrations have been documented, shortnose sturgeon do not appear to spend significant time in the marine environment and generally stay close to shore (Altenritter et al. 2018).

Historical records of shortnose sturgeon capture in fisheries off the Atlantic coast are rare. For example, no interactions with shortnose sturgeon have been reported in the northeast commercial fisheries since 2005, and there have been only 12 observed shortnose sturgeon (annual average of 0.4) since the inception of bycatch data collection by the Northeast Fisheries Observer Program in 1989 (NMFS 2021a). In addition, there are no records of shortnose sturgeon captured during the Northeast Area Monitoring and Assessment Program (NEAMAP) trawl surveys, which have been conducted in nearshore coastal waters from the Gulf of Maine to Cape Hatteras since 2006.

Based on the best available information, we consider it extremely unlikely that the proposed FIS gillnet or trawl capture gear considered in this opinion would interact with shortnose sturgeon. Vessel strikes are also considered extremely unlikely to occur. Shortnose sturgeon are primarily demersal, occupying the bottom of the water column, and would rarely be at risk from moving vessels, which need sufficient water to navigate without encountering the bottom (NMFS 2021a). Given the species distribution, there is very limited potential overlap with the small number of vessels participating in the proposed research considered in this opinion.

In summary, given the extremely low abundance of shortnose sturgeon within the action area and the extremely unlikely (i.e., discountable) co-occurrence with stressors associated with the proposed research activities, we conclude that the proposed action may affect, but is not likely to adversely affect shortnose sturgeon. Critical habitat has not been designated for shortnose sturgeon.

5.1.2 Smalltooth Sawfish - U.S. portion of range DPS

The majority of smalltooth sawfish encounters at present are from the southwest coast of Florida between the Caloosahatchee River and Florida Bay. Outside of this core area, smalltooth sawfish appear more common on the west coast of Florida and in the Florida Keys than on the east coast, and occurrences decrease the greater the distance from the core area (Simpfendorfer and Wiley 2004). From 1915 through 2018 there have been only three published records of captures in North Carolina: one in 1937, one in 1963 and one in 1999 (NMFS 2018b). Records from South Carolina and Georgia are equally sparse. In South Carolina, the species was taken with some regularity, based on multiple State Museum and newspaper records, until about 1938, with the last reported capture in 1958 (NMFS 2018b). There are only two recent records of sawfish documented in Georgia. One was documented by a bottom longline fishery observer in 2002 and one was captured by a research trawl off Cumberland Island in 2015 (NMFS 2018b). The 2002 capture was the first record of a smalltooth sawfish north of Florida since 1963. Smalltooth sawfish are euryhaline, occurring in waters with a broad range of salinities from freshwater to full seawater (Simpfendorfer 2001). Many encounters are reported at the mouths of rivers or other sources of freshwater inflows, suggesting estuarine areas may be an important factor in the species distribution (Simpfendorfer and Wiley 2004). The majority of the research that will be conducted will occur offshore where historic interactions with smalltooth sawfish are rare. Given the location (i.e., both latitude and relative to shore) of the proposed FIS research, the probability of smalltooth sawfish migrating into the action area is very small. Because of the very small probability of smalltooth sawfish occurring in the action area, and even lower probability of smalltooth sawfish venturing into areas where FIS sampling will be done, the probability of encountering a smalltooth sawfish during the proposed research activities is considered discountable. Therefore, NMFS concludes this action may affect, but is not likely to adversely affect smalltooth sawfish. Smalltooth sawfish critical habitat is not designated in the action area and, therefore, there will be no effect to designated critical habitat for this species.

5.1.3 Giant Manta Ray

Giant manta rays are commonly found offshore in oceanic waters, but are sometimes found in shallow waters (less than 10 m) during the day (Lawson et al. 2017; Miller and Klimovich 2017). In the Atlantic Ocean, giant manta rays have been observed as far north as New Jersey. The only abundance data for giant manta rays in the Atlantic comes from two sources, neither of which overlap with the action area; the Flower Garden Banks Marine Sanctuary in the Gulf of Mexico, with more than 70 individuals, and in the waters off Brazil, with about 60 individuals (Miller and Klimovich 2017).

Giant manta rays are a very rare occurrence in the U.S. bottom longline, trawl, and gillnet fisheries operating in the western Atlantic (NMFS 2021a). NEFSC observer data from 2001-2018 confirm that two giant manta rays (both in 2014) and seven unknown ray species were captured in bottom otter trawl gear, and another four rays captured in gillnet gear may have been giant manta rays. From 2008 through 2016, Southeast fisheries observers documented three giant manta rays in bottom longline fisheries (one in the Gulf of Mexico reef fish fishery and two in the South Atlantic shark bottom longline research fishery). During 2005-2012 ten giant manta rays were reported caught in Coastal Migratory Pelagics gillnet gear. Bycatch of manta rays is also low in the Southeast U.S. gillnet fisheries. The NMFS Southeast Gillnet Observer Program covers all anchored (sink and stab), strike, and drift gillnet fishing by vessels operating in waters from Florida to North Carolina and the Gulf of Mexico. From 1998-2015 the number of mantas (i.e., all species) observed captured in these fisheries ranged from 0 to 16, with no mantas of any species being observed caught as bycatch since 2013.

Given their low abundance in the study area and the relatively small amount of vessel activity proposed for FIS sampling, it is also extremely unlikely that there will be interactions between giant manta rays and the research vessels or FIS sampling gear proposed for this action. Since it is extremely unlikely that giant manta rays would interact with sampling gear or vessels, any effects of the proposed action on giant manta rays are discountable. Therefore, we conclude that this action may affect, but is not likely to adversely affect giant manta rays.

5.1.4 Oceanic Whitetip Shark

In the western Atlantic, oceanic whitetip sharks occur from Maine to Argentina, including the Caribbean and Gulf of Mexico. This highly migratory species is usually found offshore in the open ocean, on the outer continental shelf, or around oceanic islands (Bonfil et al. 2008; Young et al. 2018). Although oceanic whitetip sharks could potentially interact with the proposed research activities, these sharks are typically found farther offshore and in deeper water than the proposed study area. As a surface-dwelling species, oceanic whitetip sharks are also unlikely to interact with the proposed research bottom trawl gear that is fished deeper in the water column. There have not been any observed interactions between the commercial fisheries covered by the NEFSC Observer Program and oceanic whitetip sharks since the beginning of the program in

1989 (NEFSC observer/sea sampling database, unpublished data). Given their offshore distribution and the relatively small amount of vessel activity proposed for FIS sampling, it is also extremely unlikely that there will be interactions between oceanic whitetip sharks and the research vessels proposed for this action. In summary, we find that the likelihood that the proposed research activities would interact with oceanic whitetip sharks is discountable. Therefore, we conclude that this action may affect, but is not likely to adversely affect oceanic whitetip sharks.

5.1.5 Large Whale Species

The ESA-listed large whales shown in Table 4 could intermittently occur in the vicinity of an active FIS study location, and thus may be inadvertently approached or unintentionally exposed to interactions with vessels when the proposed permitted research takes place. However, such encounters are expected to be extremely rare, and if they do occur any effects are expected to minor and short-term, with the whales temporarily leaving the area for a short period of time if disturbed. Although large whales are susceptible to entanglement in gillnet gear, the proposed research methods in terms of capture gear and mitigations (e.g., limited soak times, continuous monitoring) provided in the draft permit are designed to limit large whale interactions and any potential impacts resulting from such interactions. These include the following:

- Researchers must make every effort to prevent interactions with marine mammals and must be aware of the presence and location of marine mammals at all times.
- Researchers must discontinue deployment of tangle nets and trawls when large whales are observed in the vicinity of the study area.
- Large whales must be allowed to leave or pass through the area safely before researchers can return to deploying gear.
- All tangle nets must be removed from the water if marine mammals remain in the vicinity of the study area.
- If a North Atlantic right whale is seen, researchers must maintain a distance of at least 460 meters (500 yards) from the animal.

Given the relatively small amount of vessel activity proposed for FIS sampling, the relatively low abundance of large whales in the study area, and the proposed mitigation measures, it is also extremely unlikely (i.e., discountable) that there will be any vessel strikes of large whales from the research vessels proposed for this action. Any disturbance of large whales resulting from vessel movement or noise would likely by minor and short-term, resulting in only insignificant effects on these species.

In summary, we find that any effects resulting from the proposed research activities on large whales are either discountable (i.e., for vessel strike and entanglement in fishing gear) or insignificant (i.e., for vessel noise and disturbance). Therefore, we conclude that this action may affect, but is not likely to adversely affect blue whales, fin whales, sei whales, sperm whales, and North Atlantic right whales.

5.1.6 North Atlantic Right Whale Critical Habitat

Critical habitat for North Atlantic right whales was designated in 1994 and expanded in 2016. Presently, North Atlantic right whale designated critical habitat includes two major units: Unit 1 which is located in the Gulf of Maine and Georges Bank Region, and Unit 2 which is located off the coast of North Carolina, South Carolina, Georgia, and Florida. Since Unit 1 only overlaps with the FDS sampling area, any effects on Unit 1 are covered under a different opinion [i.e., (NMFS 2021a)]. For this opinion, we focus on the effects to physical and biological features of critical habitat resulting from the proposed FIS sampling activities, which overlap only with Unit 2.

Unit 2 consists of an important calving area and contains the following physical and biological features essential to the conservation of the species: sea surface conditions associated with Force four or less on the Beaufort Scale, sea surface temperatures of 7 to 17 °Celsius, and 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. While the proposed research activities would directly overlap with some of these essential features, very few if any, effects are possible. For example, 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 the research vessel, and no changes in ocean bathymetry would occur. In summary, we find that any effects resulting from the proposed research activities on North Atlantic right whale critical habitat would be insignificant. Therefore, we conclude that this action may affect, but is not likely to adversely affect North Atlantic right whale critical habitat.

5.1.7 Northwest Atlantic DPS Loggerhead Sea Turtle Critical Habitat

On July 10, 2014, NMFS and the U.S. Fish and Wildlife Service designated critical habitat for the Northwest Atlantic Ocean DPS of loggerhead turtles along the U.S. Atlantic and Gulf of Mexico coasts from North Carolina to Mississippi (79 FR 39856) (Figure 2). The critical habitat is categorized into 38 occupied marine areas and 1,102.4 km (685 miles) of nesting beaches. These areas contain one or a combination of nearshore reproductive habitat, winter area, breeding areas, and migratory corridors.

As discussed previously, any effects of FDS sampling on ESA-listed species or critical habitat are covered under the 2021 fisheries biological opinion (NMFS 2021a). Potential overlap between the proposed FIS study area (see Figure 1) and loggerhead critical habitat occurs in the following areas and habitat types:

- North Carolina constricted migratory habitat, offshore winter habitat, and nearshore reproductive habitat;
- South Carolina nearshore reproductive habitat;
- Georgia nearshore reproductive habitat, and;
- EEZ east coast *Sargassum* habitat.

NMFS identified physical and biological features (PBFs) essential for the conservation of loggerhead sea turtles for each of these habitat types as follows:

- Constricted Migratory Critical Habitat: 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.
- Winter Critical Habitat: 1) Water temperatures above 10° C during the colder months of November through April, 2) continental shelf waters in proximity to the western boundary of the Gulf Stream, and 3) water depths between 20 and 100 meters.
- Nearshore Reproductive Critical Habitat: 1) Nearshore waters with direct proximity to nesting beaches that support critical aggregations of nesting turtles (e.g., highest density nesting beaches) 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 manmade structures that could promote predators (i.e., nearshore predator concentration caused by submerged and emergent offshore structures), disrupt wave patterns necessary for orientation, and/or create excessive longshore currents.
- Sargassum Critical Habitat: 1) Convergence zones, surface-water downwelling areas, and other locations where there are concentrated components of the Sargassum community in water temperatures suitable for the optimal growth of Sargassum and inhabitance of loggerheads, 2) Sargassum in concentrations that support adequate prey abundance and cover, 3) available prey and other material associated with Sargassum habitat such as, but not limited to, plants and cyanobacteria and animals endemic to the Sargassum community such as hydroids and copepods, and 4) sufficient water depth and proximity to available currents to ensure offshore transport, and foraging and cover requirements by Sargassum for post-hatchling loggerheads, i.e., > ten meters depth to ensure not in surf zone.

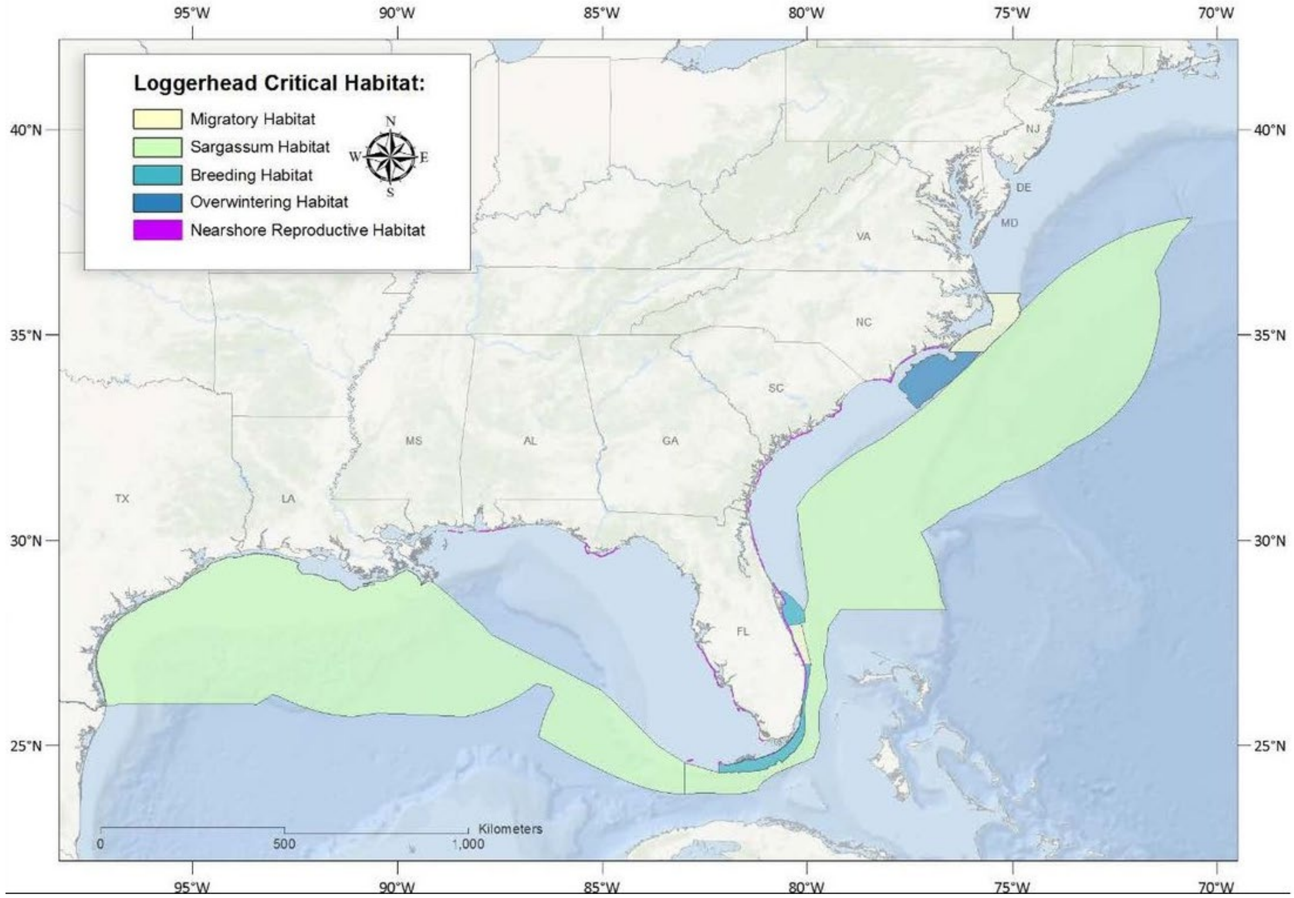

Figure 2. Map identifying designated critical habitat for the Northwest Atlantic Ocean DPS of loggerhead turtle.

The anticipated volume, location, and times that the proposed FIS research capture gear will overlap with loggerhead critical habitat will not result in significant impacts on the movement of sea turtles through the surf zone and outward toward open water or during coastal migrations. Research vessel movement, setting and retrieving gillnets, and dragging trawls through the water column could all result in some disturbance of Sargassum and the biotic communities they support. However, given the low level of FIS research sampling proposed within the U.S. EEZ, we anticipate that the amount of Sargassum critical habitat disturbed will be extremely small relative to the large area designated as this type of habitat along the Atlantic Coast (Figure 2). Therefore, any effects of the proposed action on Sargassum critical habitat will likely be insignificant. In addition, research vessels will likely try to avoid Sargassum to minimize the risk of fouling vessel propellers and sea turtle vessel strike.

In summary, we determine that the stressors associated with the proposed research activities will have an insignificant effect on the above-mentioned essential physical and biological features. Given the biological and physical features used to designate critical habitat, we determine that the proposed action is not likely to adversely affect loggerhead sea turtle Northwest Atlantic DPS designated critical habitat.

5.2 Status of Species Likely to be Adversely Affected

This opinion examines the status of the following ESA-listed species (or DPSs) that are likely to be adversely affected by the proposed action: green turtle – North Atlantic DPS; hawksbill turtle; Kemp's ridley turtle; leatherback turtle; loggerhead turtle – Northwest Atlantic DPS; Atlantic sturgeon - Gulf of Maine DPS, New York Bight DPS, Chesapeake Bay DPS, South Atlantic DPS, and Carolina DPS.

The evaluation of adverse effects in this opinion begins by summarizing the biology and ecology of those species that are likely to be adversely affected 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 face based on parameters considered in documents such as recovery plans, status reviews, and listing decisions. This helps to inform the description of the species' current "reproduction, numbers, or distribution" that is part of the jeopardy determination 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' website: (https://www.fisheries.noaa.gov/species-directory/threatened-endangered).

5.2.1 Green Sea Turtle – North Atlantic DPS

The green turtle is globally distributed and commonly inhabits nearshore and inshore waters, occurring throughout tropical, sub-tropical and, to a lesser extent, temperate waters. Green turtles from the North Atlantic DPS range from the boundary of South and Central America (7.5° North, 77° West) in the south, throughout the Caribbean, the Gulf of Mexico, and the U.S. Atlantic coast to New Brunswick, Canada (48° North, 77° West) in the north (Figure 3). The range of the North Atlantic DPS then extends due east along latitudes 48° North and 19° North to the western coasts of Europe and Africa (Figure 3). Nesting occurs primarily in Costa Rica, Mexico, Florida, and Cuba.

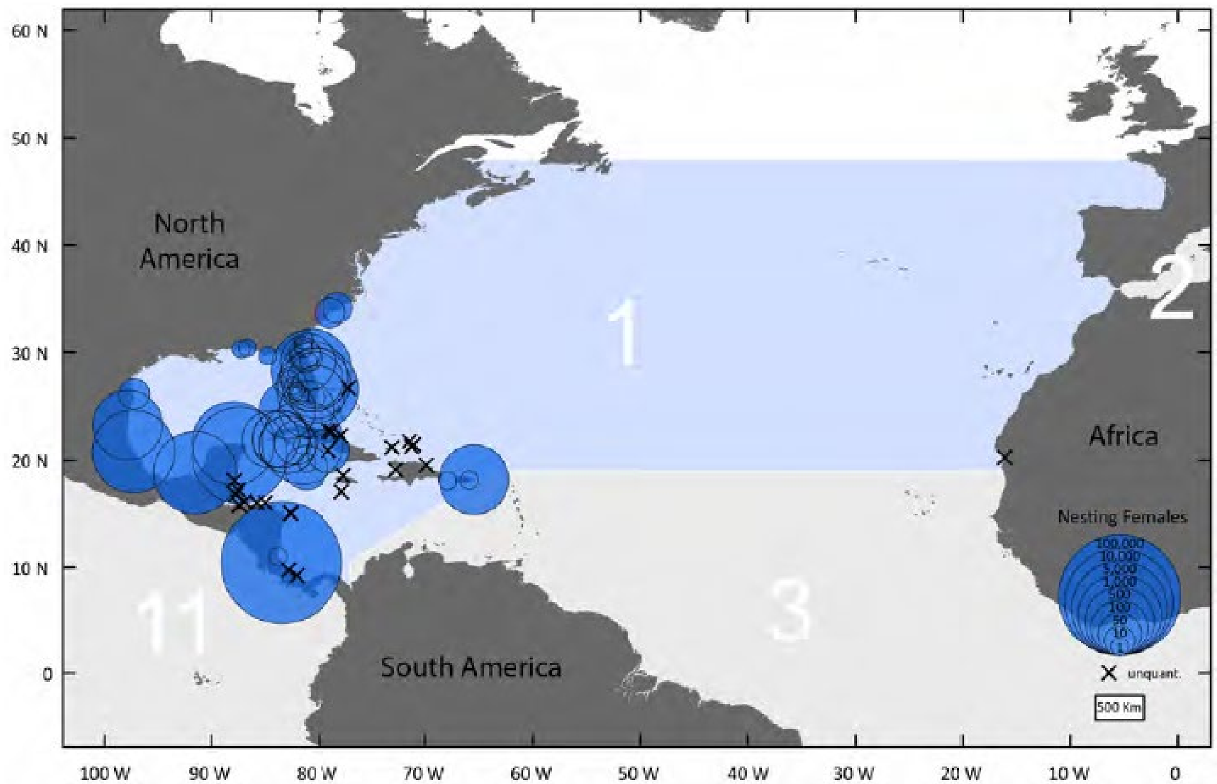

Figure 3. Geographic range of the North Atlantic DPS of green turtles, with location and abundance of nesting females (Seminoff et al. 2015a).

The green turtle was listed under the ESA on July 28, 1978 (43 FR 32800). The species was separated into two ESA-listing designations: endangered for breeding populations in Florida and the Pacific coast of Mexico and threatened in all other areas throughout its range. On April 6, 2016, NMFS listed 11 DPSs of green turtles as threatened or endangered under the ESA. The North Atlantic DPS of green turtle, which is the only DPS that overlaps with the action area, is ESA-listed as threatened.

Life History

Age at first reproduction for females is 20 to 40 years. Green 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 turtles feed close to the surface on a variety of marine algae and other life associated with drift lines and debris. Adult sea turtles exhibit site fidelity and migrate hundreds to thousands of kilometers from nesting beaches to foraging areas. Green 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 green sea turtle occupies the coastal waters of over 140 countries worldwide; nesting occurs in more than 80 countries. Worldwide, nesting data at 464 sites indicate that 563,826 to 564,464 females nest each year (Seminoff et al. 2015a). Compared to other DPSs, the North Atlantic DPS exhibits the highest nester abundance, with approximately 167,424 females at 73 nesting sites (Figure 3), and available data indicate an increasing trend in nesting. The largest nesting site for the North Atlantic DPS is in Tortuguero, Costa Rica, which hosts 79 percent of nesting females for the DPS (Seminoff et al. 2015a).

Many nesting sites worldwide suffer from a lack of consistent, standardized monitoring, making it difficult to characterize population growth rates for a DPS. For the North Atlantic DPS of green turtle, the available data indicate an increasing trend in nesting. There are no reliable estimates of population growth rate for the DPS as a whole, but estimates have been developed at a localized level. Modeling by Chaloupka et al. (2008) using data sets for 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.

The North Atlantic DPS of green turtle 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 four independent nesting sub-populations in Florida, Cuba, Mexico, and Costa Rica (Seminoff et al. 2015a). More recent genetic analysis indicates that designating a new western Gulf of Mexico management unit might be appropriate (Shamblin et al. 2016).

Hearing

Sea turtles lack an external ear pinnae or eardrum. Instead, they have a cutaneous layer and underlying subcutaneous fatty layer that function as a tympanic membrane. The subcutaneous fatty layer receives and transmits sounds to the middle ear and into the cavity of the inner ear (Ridgway et al. 1969b). The functional morphology of the sea turtle ear is poorly understood, however it has been suggested that aquatic turtle ears are adapted for hearing underwater sounds and vibration (Christensen-Dalsgaard et al. 2012; Ketten 2008; Lenhardt 1982).

The role of hearing in sea turtles remains unclear, however they likely use sound for navigation, locating prey, avoiding predators, and environmental awareness (Piniak et al. 2016). Electrophysiological and behavioral studies of sea turtle hearing have documented that most species of sea turtles can detect low-frequency acoustic and/or vibratory stimuli underwater and in air (Bartol and Ketten 2006; Bartol et al. 1999; Dow Piniak et al. 2012; Lavender et al. 2014; Martin et al. 2012; Piniak et al. 2016; Piniak 2012; Ridgway et al. 1969b). Sea turtles generally are most sensitive to underwater and aerial sounds below 1,000 Hz, though variation in sensitivity and frequencies of maximum sensitivity exist between species and age classes (see

Piniak, 2012 for species comparisons). Sea turtles are also known to behaviorally respond to low-frequency sounds, lending supporting that sea turtles detect and respond to these sounds when present in their environment. Studies focused on responses of sea turtles to impulsive sounds (*e.g.*, seismic airguns) documented behavioral responses such as increased swimming, diving, and aversion (DeRuiter and Doukara 2012; McCauley et al. 2000b; O'Hara and Wilcox 1990).

Status

Once abundant in tropical and sub-tropical waters, green 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 sea 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 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. These threats will be discussed in further detail in the environmental baseline section of this opinion.

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 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 (Seminoff et al. 2015a).

Critical Habitat

No critical habitat has been designated for the North Atlantic DPS of green sea turtle.

Recovery Goals

In response to the current threats facing the species, NMFS developed goals to recover green turtle populations. 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. For complete downlisting/delisting criteria for recovery goals for the species see the 1991 recovery plan for the Atlantic populations of green turtles (NMFS and USFWS 1991).

5.2.2 Hawksbill Turtle

The hawksbill turtle has a circumglobal distribution throughout tropical and, to a lesser extent, sub-tropical oceans (Figure 4).

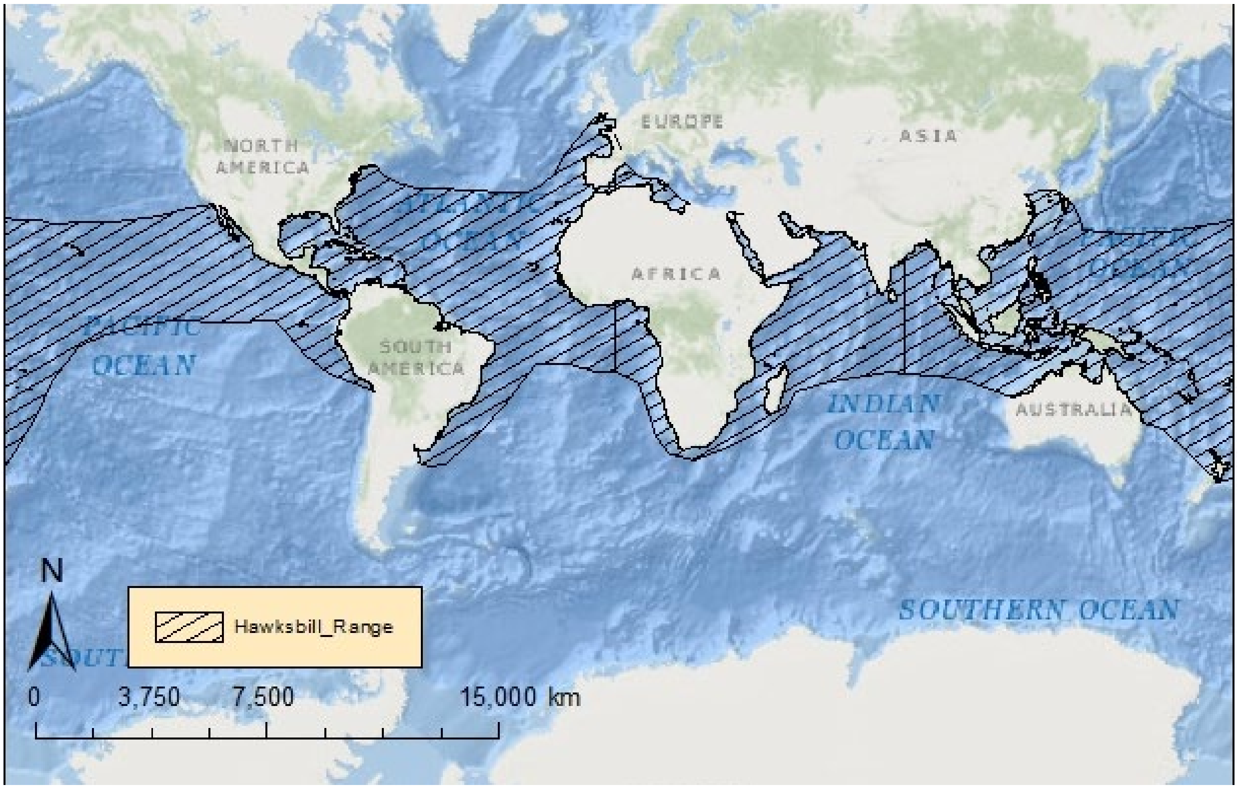

Figure 4. Map identifying the range of the endangered hawksbill turtle.

The species was first listed under the Endangered Species Conservation Act and has been listed as endangered under the ESA since 1973.

Life History

Hawksbill turtles reach sexual maturity at 20 to 40 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 22 to 25 cm in straight carapace length. As juveniles, they take up residency in coastal waters to forage and grow. As adults, hawksbill turtles use their sharp beak-like mouths to feed on sponges and corals. Hawksbill turtles are highly migratory and use a wide range of habitats during their lifetimes (Musick and Limpus 1997; Plotkin 2003). Satellite tagged sea turtles have shown significant variation in movement and migration patterns. Distance traveled between nesting and foraging 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: abundance, population growth rate, genetic diversity, and spatial distribution as it relates to the hawksbill turtle.

Surveys at 88 nesting sites worldwide indicate that 22,004 to 29,035 females nest annually (NMFS 2013b). In general, hawksbill turtles 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 through 2003, the number of nests at three primary nesting beaches (Rancho Nuevo, Tepehaujes, and Playa Dos) increased 15 percent annually (Heppell et al. 2005); however, due to recent declines in nest counts, decreased survival at other life stages, and updated population modeling, this rate is not expected to continue (NMFS 2013b).

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 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; Monzon-Arguello et al. 2010). Hawksbill turtles in the Caribbean Sea 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 turtle has a circumglobal distribution throughout tropical and, to a lesser extent, sub-tropical waters of the Atlantic, Indian, and Pacific Oceans. In their oceanic phase, juvenile hawksbill turtles can be found in Sargassum mats; post-oceanic hawksbill turtles 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).

Hearing

See *Hearing* subsection for green sea turtles above (Section 5.2.1) for a general discussion of hearing in sea turtles.

Status

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

Critical Habitat

Critical habitat designated for the hawksbill sea turtle does not overlap with the action area for this opinion.

Recovery Goals

See the 1993 Recovery Plans for the U.S. Caribbean, Atlantic, and Gulf of Mexico population of hawksbill turtles for complete downlisting/delisting criteria for recovery goals. The following items were the top recovery actions identified to support in the recovery plans:

- Identify important nesting beaches.
- Ensure long-term protection and management of important nesting beaches.
- Protect and manage nesting habitat; prevent the degradation of nesting habitat caused by seawalls, revetments, sand bags, other erosion-control measures, jetties, and breakwaters.
- Identify important marine habitats; protect and manage populations in marine habitat.
- Protect and manage marine habitat; prevent the degradation or destruction of important (marine) habitats caused by upland and coastal erosion.
- Prevent the degradation of reef habitat caused by sewage and other pollutants.
- Monitor nesting activity on important nesting beaches with standardized index surveys.
- Evaluate nest success and implement appropriate nest-protection on important nesting beaches.
- Ensure that law-enforcement activities prevent the illegal exploitation and harassment of sea turtles and increase law-enforcement efforts to reduce illegal exploitation.
- Determine nesting beach origins for juveniles and sub-adult populations.

5.2.3 Kemp's Ridley Turtle

The Kemp's ridley sea turtle range extends from the Gulf of Mexico to the Atlantic coast, with nesting beaches limited to a few sites in Mexico and Texas (Figure 5). The species was first listed under the Endangered Species Conservation Act and has been listed as endangered under the ESA since 1973.

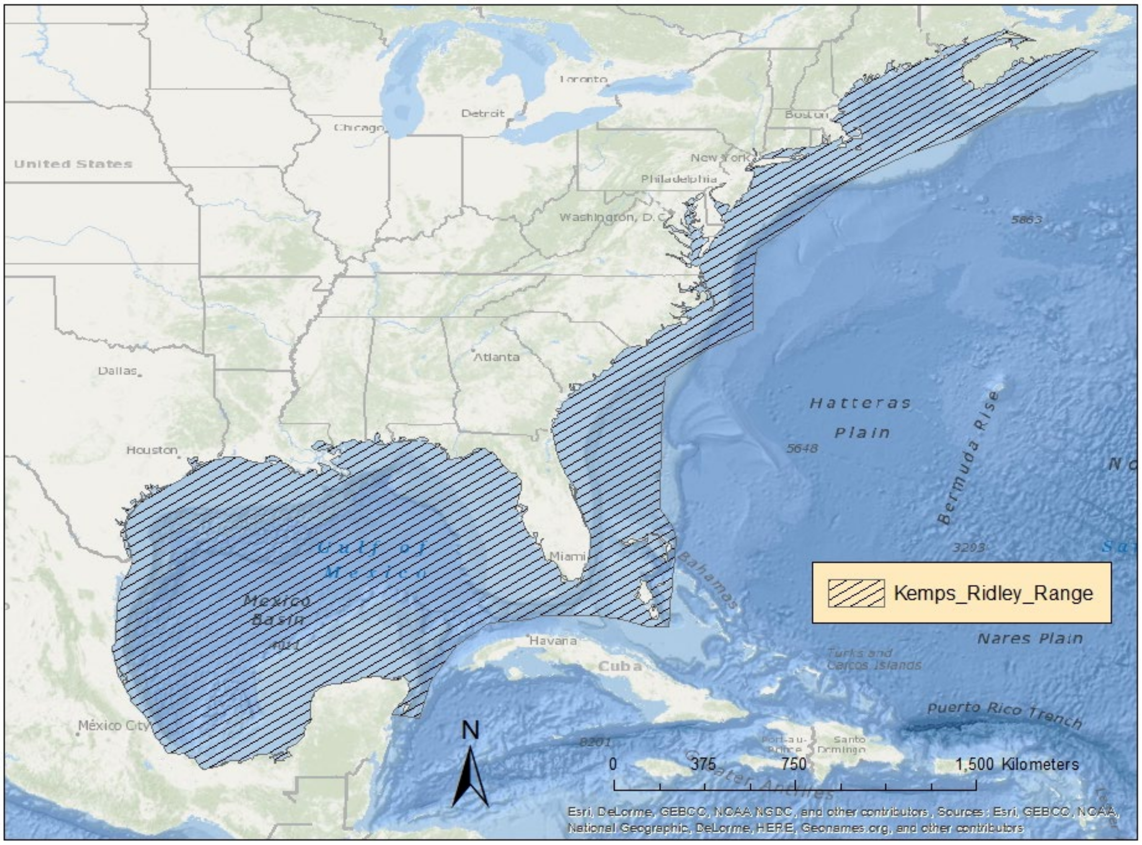

Figure 5. Map identifying the range of the endangered Kemp's ridley turtle.

Life History

Females mature at 12 years of age. The average remigration interval 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 97 to 100 eggs per nest. The nesting location may be particularly important because hatchlings can more easily migrate to foraging grounds in deeper oceanic waters, where they remain for approximately two years before returning to nearshore coastal habitats. Juvenile Kemp's ridley 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 37 m deep, although they can also be found in deeper offshore waters. As adults, Kemp's ridley turtles forage on swimming crabs, fish, jellyfish, mollusks, and tunicates (NMFS et al. 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 distributions as it relates to the Kemp's ridley turtle.

Of the sea turtle 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. From 1980 through 2003, the number of nests at three primary nesting beaches (Rancho Nuevo, Tepehuajes, and Playa Dos) increased 15 percent annually (Heppell et al. 2005); however, due to recent declines in nest counts, decreased survival of immature and adult sea turtles, and updated population modeling, this rate is not expected to continue (NMFS and USFWS 2015b). In 2014, there were an estimated 10,987 nests and 519,000 hatchlings released from three primary nesting beaches in Mexico (NMFS and USFWS 2015b). The number of nests in Padre Island, Texas has increased over the past two decades, with one nest observed in 1985, four in 1995, 50 in 2005, and 197 in 2014 (NMFS and USFWS 2015b).

Genetic variability in Kemp's ridley turtles is considered to be high, as measured by heterozygosis at microsatellite loci (NMFS et al. 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 of these also being found at Rancho Nuevo (Dutton et al. 2006).

The vast majority of Kemp's ridley turtles originate from breeding beaches at Rancho Nuevo on the Gulf of Mexico coast of Mexico. During spring and summer, juvenile Kemp's ridley turtles occur in the shallow coastal waters along the Atlantic continental shelf from New England to Florida, and from the northern Gulf of Mexico from Texas to north Florida. In the fall, most Kemp's ridley turtles migrate to deeper or more southern, warmer waters and remain there through the winter (Schmid 1998). As adults, many sea turtles remain in the Gulf of Mexico, with only occasional occurrence in the Atlantic Ocean (NMFS et al. 2011).

Hearing

See *Hearing* subsection for green sea turtles above (Section 5.2.1) for a general discussion of hearing in sea turtles.

Status

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

Critical Habitat

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

Recovery Goals

In response to the current threats facing the species, NMFS developed goals to recover Kemp's ridley turtle populations. These threats will be discussed in further detail in the environmental baseline section of this opinion. See the 2011 Final Bi-National (U.S. and Mexico) Revised Recovery Plan for Kemp's ridley turtles for complete downlisting/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 turtles:

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

5.2.4 Leatherback Sea Turtle

Leatherback sea turtles are listed as endangered under the ESA throughout their global range. The leatherback turtle has the most extensive global distribution of any reptile and is distributed throughout the oceans of the world (Figure 6) from the equator to subpolar regions in both hemispheres. Leatherback turtles spend the majority of their lives at sea, where they develop, forage, migrate, and mate, nesting on beaches on every continent except Europe and Antarctica, and several islands of the Caribbean and the Indo-Pacific (Eckert et al. 2012b; NMFS and USFWS 2020). Seven populations are currently recognized: (1) Northwest Atlantic; (2) Southeast Atlantic; (3) Southwest Atlantic; (4) Northeast Indian; (5) Southwest Indian; (6) West Pacific; and (7) East Pacific Ocean populations (NMFS and USFWS 2020). For purposes of this opinion, we focus on the Northwest Atlantic population.

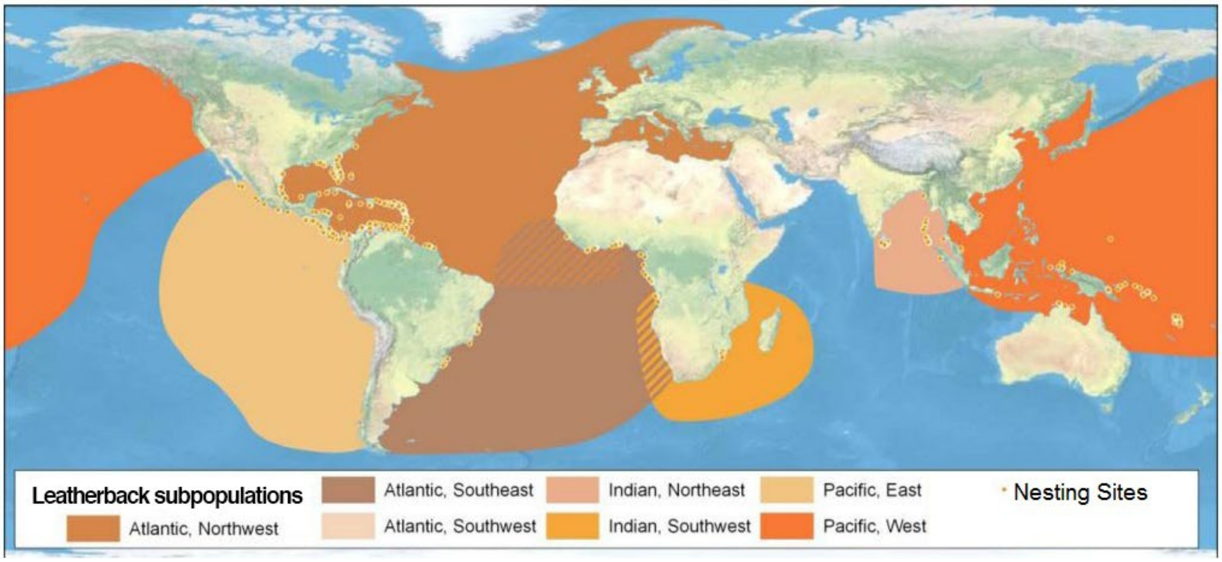

Figure 6. Map identifying the range of endangered leatherback turtle [adapted from Wallace et al. (2013)].

Life History

Age at maturity has been difficult to ascertain, with estimates ranging from five to 29 years (Avens et al. 2009; Spotila et al. 1996). Females lay up to seven clutches per season, with more than 65 eggs per clutch and eggs weighing greater than 80 grams (Reina et al. 2002; Wallace et al. 2007). The average clutch frequency based on data from Northwest Atlantic nesting beaches is 5.5 clutches per season (NMFS and USFWS 2020). The number of leatherback turtle hatchlings that make it out of the nest on the beach (i.e., emergent success) is approximately 50 percent worldwide (Eckert et al. 2012a). 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 undertake the longest migrations of any sea turtle, migrating long, transoceanic distances between their tropical nesting beaches and the highly productive temperate waters where they forage. During migrations or long distance movements, leatherbacks maximize swimming efficiency by traveling within 15 feet of the surface (Eckert 2002).

Leatherback turtles primarily feed on gelatinous zooplankton such as cnidarians (jellyfish and siphonophores) and tunicates (salps and pyrosomas) (Bjorndal 1997; USFWS 1998). These gelatinous prey are relatively nutrient-poor, such that leatherbacks must consume large quantities to support their body weight and energetic needs. Leatherback sea turtles feed from near the surface to depths exceeding 1,000 m, including nocturnal feeding on tunicate colonies within the deep scattering layer (Spotila 2004). Although leatherback sea turtles can dive deeper than any other reptile, most foraging dives are less than 80 m (Shillinger et al. 2011). Leatherback turtles weigh about 33 percent more on their foraging grounds than at nesting, indicating that they probably catabolize fat reserves to fuel migration and subsequent reproduction (Aguirre et al. 2006; James et al. 2005). 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 dynamics and its variance over time. This section includes abundance, population growth rate, genetic diversity, and spatial distribution as it relates to the leatherback turtle.

Sea turtles are difficult to study across all life stages due to their extensive distribution, certain cryptic life stages, complex life history, and remote habitats. As a result, status and trends of sea turtle populations are usually based on data collected on nesting beaches (e.g., number of adult females, number of nests, nest success, etc.). The spatial structure of male sea turtles and their fidelity to specific coastal areas is unknown; however, we describe the status of sea turtle populations based on the nesting beaches that females return to when they mature. We make inferences about the growth or decline of leatherback populations based on numbers of nests and trends in numbers of nests.

Based on the best available data, the total index of nesting female abundance for the leatherback Northwest Atlantic DPS is 20,659 females (NMFS and USFWS 2020). The total index of nesting female abundance for this DPS only includes available nesting data from recently and consistently monitored nesting beaches, and assumes a 3-year remigration interval. Nesting in the Northwest Atlantic population is characterized by many small nesting beaches. Only one site, Grande Riviere in Trinidad, hosts more than 5,000 nesting females, representing 29 percent of the total index of nesting female abundance. Relatively large nesting aggregations are also found in Matura (Trinidad), Chiriqui Beach (Panama), and Cayenne/Remire Montjoly (French Guiana) (NMFS and USFWS 2020). There are no leatherback nesting sites located within the action area for this opinion.

Although nesting trends vary by site, the leatherback Northwest Atlantic population appears to exhibit an overall decreasing trend in annual nesting activity (NMFS and USFWS 2020). This conclusion is supported by significant declines that have been observed at nesting beaches with the greatest historical or current nesting female abundance, most notably in Trinidad and Tobago (Grande Riviere, Fishing Pond, and Tobago), Suriname, and French Guiana (Awala-Yalimapo). The NALWG (2018) used a Bayesian regression model to estimate trends for all nesting sites, nesting aggregations, and for the regional population (which is equivalent to DPS) during three temporal scenarios: 1990 to 2017, 1998 to 2017, and 2008 to 2017. Overall nest trends were as follows:

- From 1990 to 2017: –4.21 percent annually (95 percent CI = −6.66 to −2.23)
- From 1998 to 2017: −5.37 percent annually (95 percent CI = −8.09 to −2.61)

- From 2008 to 2017: −9.32 percent annually (95 percent CI = −12.9 to −5.57)

The Northwest Atlantic leatherback population has a broad spatial distribution, for both foraging and nesting. There is significant genetic population structure, with subpopulations connected via various levels of gene flow and metapopulation dynamics (NMFS and USFWS 2020). Tagging and telemetry studies indicate considerable mixing of leatherback turtles among nesting beaches and at multiple foraging areas throughout the North Atlantic Ocean. The spatial distribution and structure of the Northwest Atlantic population likely reduces the risk of extinction (NMFS and USFWS 2020). The wide distribution of nesting and foraging areas likely buffers this population against local catastrophes or environmental changes. The fine-scale population structure, with movement of individuals and genes among nesting aggregations, indicates that this population has the capacity to withstand other catastrophic events.

The Northwest Atlantic population exhibits spatial diversity, as demonstrated by insular and continental nesting, diverse foraging habitats, multiple foraging areas, and moderate genetic diversity. Diverse nesting location and habitat provide the population some level of resilience against short-term spatial and temporal changes in the environment; however, high-abundance nesting occurs only at few locations (e.g., Trinidad, French Guiana, and Panama) (NMFS and USFWS 2020). The foraging diversity likely provides resilience against local reductions in prey availability or catastrophic events, such as oil spills, by limiting exposure to a limited proportion of the total population. Its moderate genetic diversity may provide the Northwest Atlantic population with the raw material necessary for adapting to long-term environmental changes (NMFS and USFWS 2020).

Hearing

See *Hearing* subsection for green sea turtles above (Section 5.2.1) for a general discussion of hearing in sea turtles.

Status

The primary global threats to leatherback turtles include fisheries bycatch, harvest of nesting females, and egg harvesting. Additional threats to the Northwest Atlantic leatherback population include habitat loss, predation, disease, vessel strike, pollution, climate change, oil and gas activities, natural disasters, and channel dredging. Coastal development and shoreline armoring, erosion (natural and anthropogenic), and artificial lighting are some of the most significant stressors on nesting beach habitat, reducing nesting and hatching success (productivity). Habitat loss is also anticipated to increase over time with additional development and climate change. 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). Plastic ingestion is also common in leatherbacks and can block gastrointestinal tracts leading to death. Because of these threats, once large rookeries are now functionally extinct, and there have been range-wide reductions in population abundance.

This Northwest Atlantic leatherback population exhibits a decreasing nest trend that has become more pronounced in recent years (2008 to 2017), and the available nesting data reflect a steady decline for more than a decade (Group 2018; NMFS and USFWS 2020). Despite the population's abundance, spatial distribution, and diversity, the declining nest trends and productivity are of concern and place the Northwest Atlantic leatherback population's continued persistence in question. Overall, the latest 5-year leatherback status review concluded that the Northwest Atlantic leatherback population has a high extinction risk (NMFS and USFWS 2020).

Critical Habitat

Leatherback sea turtle critical habitat is not designated in the action area.

Recovery Goals

In response to the current threats facing the species, NMFS developed goals to recover leatherback turtle populations. These threats will be discussed in further detail in the environmental baseline section of this opinion. See the 1992 Recovery Plans for the U.S. Caribbean, Atlantic, and Gulf of Mexico leatherback turtles for complete downlisting/delisting criteria for each of their respective recovery goals (NMFS and USFWS 1992). The following items were the top five recovery actions identified to support in the Leatherback Five Year Action Plan:

- Reduce fisheries interactions.
- Improve nesting beach protection and increase reproductive output.
- International cooperation.
- Monitoring and research.
- Public engagement.

5.2.5 Loggerhead Sea Turtle – Northwest Atlantic Ocean DPS

Loggerhead turtles are circumglobal and are found in the temperate and tropical regions of the Pacific, Indian, and Atlantic Oceans. Northwest Atlantic Ocean DPS of loggerhead turtles are found along eastern North America, Central America, and northern South America (Figure 7).

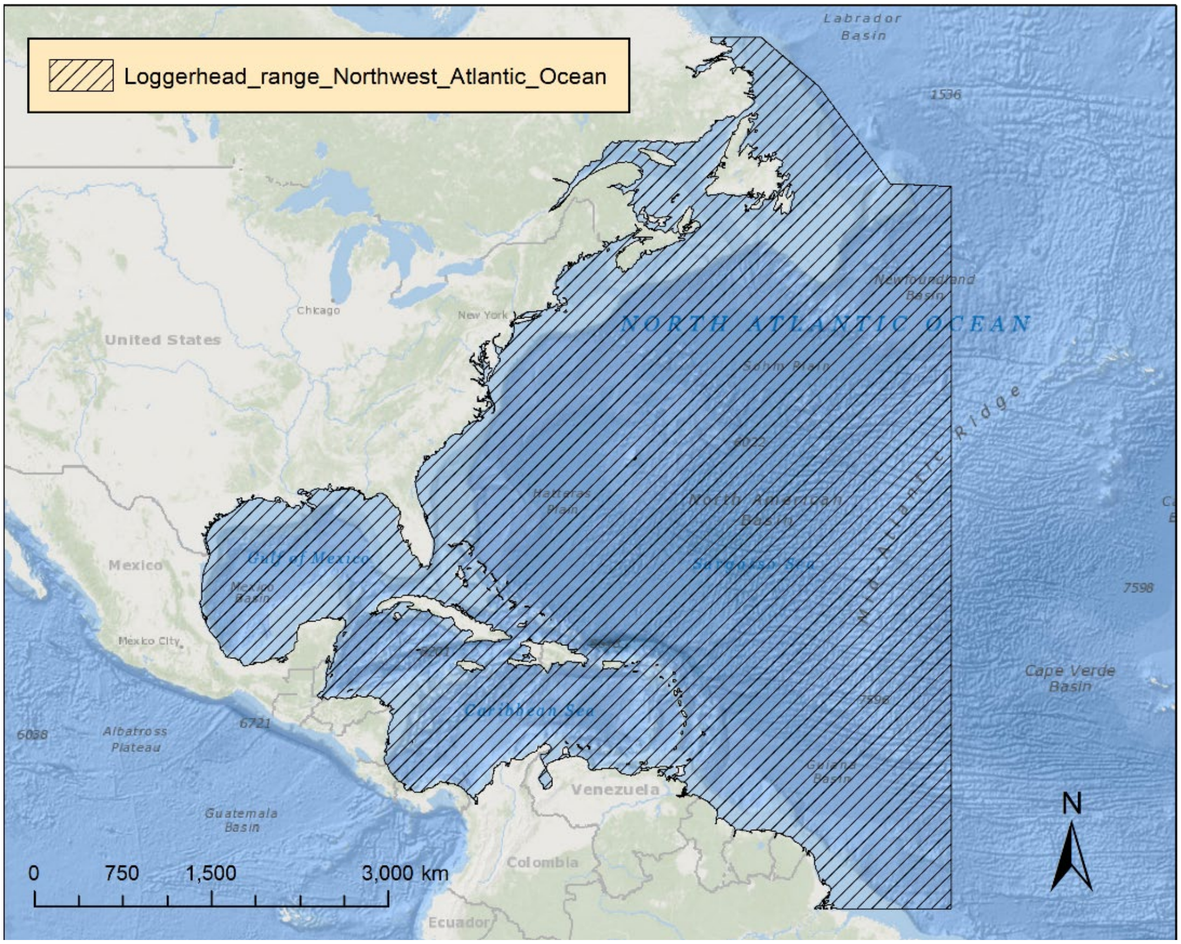

Figure 7. Map identifying the range of the Northwest Atlantic Ocean DPS of loggerhead turtles.

The species was first listed as threatened under the ESA in 1978 (43 FR 32800). On September 22, 2011, the NMFS designated nine DPSs of loggerhead turtles, with the Northwest Atlantic Ocean DPS of loggerhead turtle listed as threatened.

We used information available in the 2009 Status Review (Conant et al. 2009), the final ESA-listing rule, and the scientific literature to summarize the life history, population dynamics, and status of the species, as follows.

Life History

Mean age at first reproduction for female loggerhead turtles is 30 years. 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 sea turtle during the middle of the incubation period. Loggerhead sea 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 loggerhead turtles. Neritic juvenile loggerheads forage on crabs, mollusks, jellyfish and vegetation, whereas adults typically prey on benthic invertebrates such as mollusks and decapods.

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 Northwest Atlantic Ocean DPS of loggerhead turtle.

The global abundance of nesting female loggerhead turtles is estimated at 43,320 to 44,560. Using a stage/age demographic model, the adult female population size of the Northwest Atlantic Ocean DPS is estimated at 20,000 to 40,000 females, and 53,000 to 92,000 nests annually (NMFS 2009). In 2010, there were estimated to be approximately 801,000 loggerhead turtles (greater than 30 cm in size, inter-quartile range of approximately 521,000–1,111,000) in northwestern Atlantic continental shelf region based on aerial surveys (NMFS 2011).

Based on genetic information, the Northwest Atlantic Ocean DPS of loggerhead turtle is further categorized into five recovery units corresponding to nesting beaches. These are the Northern Recovery Unit, Peninsular Florida Recovery Unit, Dry Tortugas Recovery Unit, Northern Gulf of Mexico Recovery Unit, and the Greater Caribbean Recovery Unit. 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 Sea coast express high haplotype diversity (Shamblin et al. 2014). Furthermore, the results suggest that the Northwest Atlantic Ocean DPS should be considered as 10 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).

A comparison of recent five-year-annual-average loggerhead nest counts with comparable data from other regions reveals that, worldwide, Florida is the most important nesting area for this species, likely hosting more than 40 percent of the nests laid globally (Ceriani et al. 2019). The Peninsular Florida Recovery Unit constitutes the large majority of nesting effort in the Northwest Atlantic Ocean DPS. From 1989 to 2018, this unit averaged an estimated 70,935 nests annually based on the Florida Fish and Wildlife Conservation Commission Statewide Nesting Beach Survey, and 47,433 nest annually based on the Florida Index Nesting Beach Survey (Ceriani et al. 2019). The Northern Recovery Unit, from North Carolina to northeastern Florida, is the second largest nesting aggregation in the Northwest Atlantic Ocean DPS, with an average of 5,215 nests from 1989 through 2008, and approximately 1,272 nesting females during this timeframe (NMFS and USFWS 2008).

Nesting on Florida index beaches showed an increase between 1989 and 1998 but a steep decline between 1998 and 2006 (Witherington et al. 2009). The nesting sub-population in the Florida panhandle has exhibited a significant declining trend from 1995 through 2005 (Conant et al.

2009; NMFS and USFWS 2007b). Population model estimates predict an overall population decline of 17 percent for the St. Joseph Peninsula, Florida sub-population of the Northern Gulf of Mexico recovery unit (Lamont et al. 2014). However, more recent information about sea turtle nest counts in Florida indicate from 2007-2015 there has been an increase based upon the 26 core index beaches within 2015 (52,647) nests compared to 2013 and 2014; but this was lower than nest count data from 2012. Ceriani et al. (2019) found that annual loggerhead nest counts varied greatly in Florida between 1989 and 2018. While shorter time frames within the time series (e.g., before and after 2007) produced linear trends which may support both pessimistic (Witherington et al. 2009) and optimistic conclusions, the overall 30-yr pattern portrayed a general non-monotonic trend with wide fluctuations. For the Northern Recovery Unit, nest counts at loggerhead turtles nesting beaches in North Carolina, South Carolina, and Georgia declined at 1.9 percent annually from 1983 through 2005 (NMFS and USFWS 2007b).

Loggerhead turtles are circumglobal, occurring throughout the temperate and tropical regions of the Pacific, Indian, and Atlantic Oceans, returning to their natal region for mating and nesting. Adults and sub-adults occupy nearshore habitat. While in their oceanic phase, loggerhead turtles undergo long migrations using ocean currents. Individuals from multiple nesting colonies can be found on a single feeding ground. Loggerhead turtle hatchlings from the western Atlantic Ocean disperse widely, most likely using the Gulf Stream to drift throughout the Atlantic Ocean. Mitochondrial DNA evidence demonstrates that juvenile loggerhead turtles 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 Ocean: Nicaragua, Panama, Azores and Madeira, Canary Islands and Adalusia, Gulf of Mexico, and Brazil (Masuda 2010).

Hearing

See *Hearing* subsection for green sea turtles above (Section 5.2.1) for a general discussion of hearing and vocalization in sea turtles.

Status

Due to declines in nest counts at index beaches in the U.S. and Mexico, and continued mortality of juveniles and adults from fishery bycatch, Conant et al. (2009) found the Northwest Atlantic Ocean DPS of loggerhead turtle was at risk and likely to decline in the foreseeable future. In the NMFS Fiscal Year 2019-2020 ESA Report to Congress, the population trend for this DPS is shown as stable (NMFS 2022e).

Critical Habitat

See Section 5.1.7 for a discussion of loggerhead sea turtle Northwest Atlantic DPS designated critical habitat.

Recovery Goals

In response to the current threats facing the species, NMFS developed goals to recover loggerhead sea turtle populations. These threats will be discussed in further detail in the environmental baseline section of this opinion. See the 2008 Final Recovery Plan for the Northwest Atlantic Population of Loggerheads (NMFS and USFWS 2008) for complete downlisting/delisting criteria for each of the following recovery objectives:

- 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.
- 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.
- Manage sufficient nesting beach habitat to ensure successfully nesting.
- Manage sufficient feeding, migratory, and interesting marine habitats to ensure successful growth and reproduction.
- Eliminate legal harvest.
- Implement scientifically based nest management plans.
- Minimize nest predation.
- Recognize and respond to mass/unusual mortality or disease event appropriately.
- Develop and implement local, state, Federal, and international legislation to ensure long-term protection of loggerhead sea turtles and their terrestrial and marine habitats.
- Minimize bycatch in domestic and international commercial and artisanal fisheries.
- Minimize trophic changes from fishery harvest and habitat alteration.
- Minimize marine debris ingestions and entanglement.
- Minimize vessel strike mortality.

5.2.6 Atlantic Sturgeon

Five DPSs of Atlantic sturgeon were listed under the ESA in 2012. The Gulf of Maine DPS is listed as threatened while the New York Bight, Chesapeake Bay, Carolina, and South Atlantic DPSs are listed as endangered (Figure 8).

Sturgeon are among the most primitive of the bony fishes.

<u>Life History</u>

The general life history pattern of Atlantic sturgeon is that of a long lived (approximately 60 years), late maturing, iteroparous, anadromous species (ASSRT 2007; Dadswell 2006). 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 (Smith 1985). More recent studies, however, suggest that spawning occurs from late summer to early autumn in three tributaries (James River and York River, Virginia, and Nanticoke River, Maryland) of the Chesapeake Bay (Balazik et al. 2012; Hager et al. 2014; Secor et al. 2021), Roanoke River, North Carolina (Smith et al. 2015), Edisto River, South Carolina (Collins et al. 2000), and in the Altamaha River, Georgia (Ingram and Peterson 2016). 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 yolk sac larval stage is completed in about eight to 12 days, during which time the larvae move downstream to rearing grounds over a six 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 5.5 inches long at a month old (MSPO 1993).

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 one to six years (Fox and Peterson 2019), 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 (10-50 meter) nearshore areas dominated by gravel and sand substrate (Stein et al. 2004). 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)(Rothermel et al. 2020; Rulifson et al. 2020; Wippelhauser et al. 2017). 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 as annuli become harder to read accurately (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 two to five years for females (Breece et al. 2021; Hager et al. 2020; Schueller and Peterson 2010; Stevenson and Secor 2000). For Atlantic sturgeon from the York River, Virginia, Hager et al. (2020) found that both males and females return to spawn at more frequent intervals than has been reported in the literature (males once every 1.13 years and females once every 2.19 years, on average). Similarly, Breece et al. (2021) reported mean spawning intervals for Hudson River Atlantic sturgeon of 1.66 years for females and 1.28 years for males, Breece et al. (2021) with many fish spawning in consecutive years.

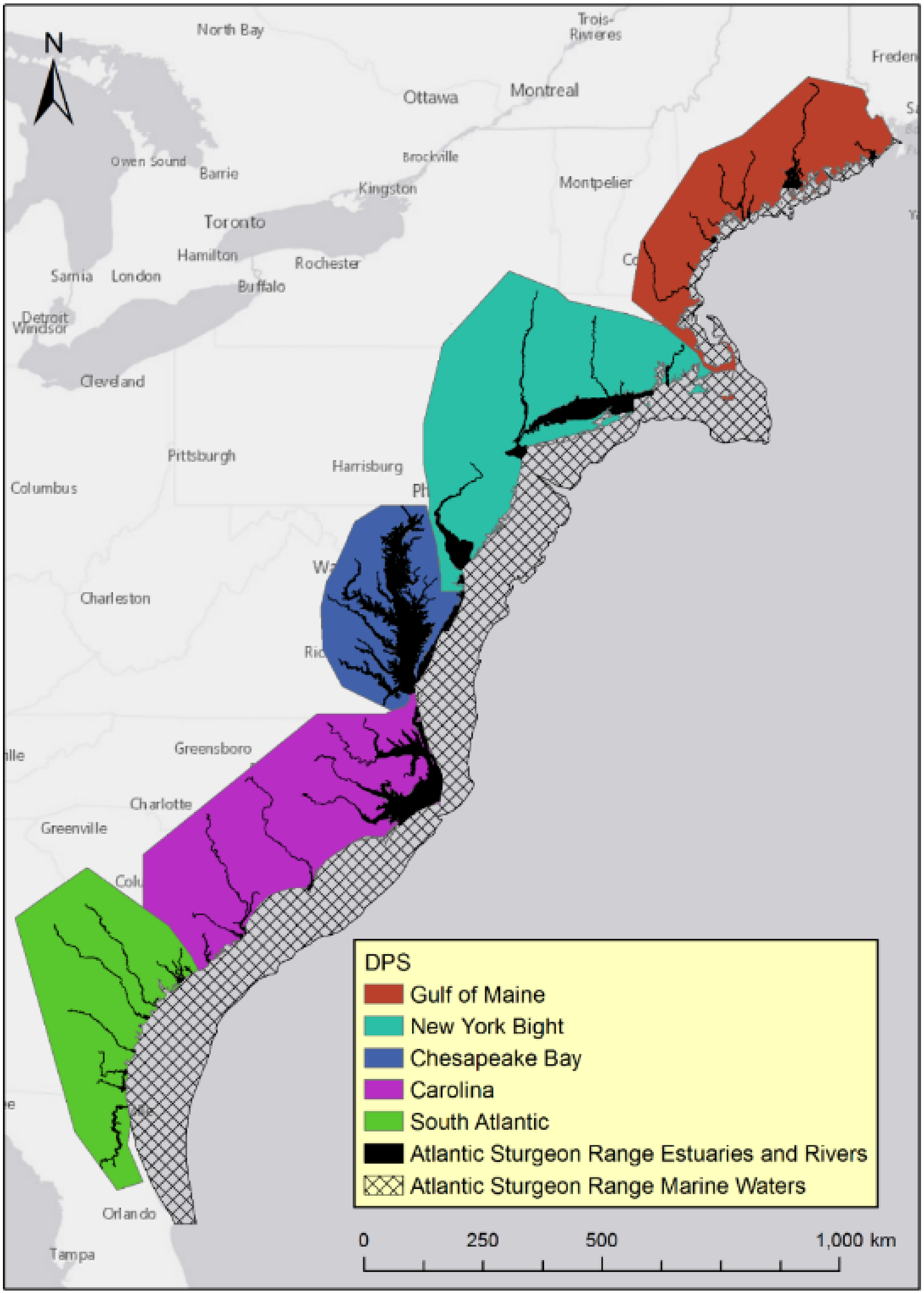

Figure 8. U.S. range of the five Atlantic sturgeon DPSs.

Fecundity of Atlantic sturgeon is correlated with age and body size, ranging from approximately 400,000 to two million eggs (Dadswell 2006; Mitchell et al. 2020; 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 to 10 times longer than for most other bony fish species (Boreman 1997).

Atlantic sturgeon feed on mollusks, 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 mollusks 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 enables it to grind such food items as mollusks and gastropods (MSPO 1993).

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 Atlantic sturgeon.

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 presence is currently documented 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. More recently, White et al. (2021) presented a range-wide microsatellite genetic baseline for Atlantic sturgeon that is comprised of 2510 individuals from 18 genetically distinct groups collected in 13 rivers and one estuary. 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).

Hearing

While sturgeon have swim bladders, they are not known to be used for hearing, and thus sturgeon appear to only rely directly on their ears for hearing. Popper (2005) reported that studies measuring responses of the ear of European sturgeon (*Acipenser sturio*) using physiological methods suggest sturgeon are likely capable of detecting sounds from below 100 Hz to about 1 kHz, indicating that sturgeon should be able to localize or determine the direction of origin of sound. Meyer and Popper (2002) recorded auditory evoked potentials of varying frequencies and intensities for lake sturgeon (*Acipenser fulvescens*) and found that lake sturgeon can detect pure tones from 100 Hz to 2 kHz, with best hearing sensitivity from 100 to 400 Hz. They also compared these sturgeon data with comparable data for Oscar (*Astronotus ocellatus*) and goldfish (*Carassius auratus*) and reported that the auditory brainstem responses for the lake sturgeon were more similar to goldfish (which is considered a hearing specialist that can hear up to five kHz) than to the oscar (which is a non-specialist that can only detect sound up to 400 Hz); these authors, however, felt additional data were necessary before lake sturgeon could be considered specialized for hearing (Meyer and Popper 2002). Lovell et al. (2005) also studied sound reception and the hearing abilities of paddlefish (*Polyodon spathula*) and lake sturgeon. Using a combination of morphological and physiological techniques, they determined that paddlefish and lake sturgeon were responsive to sounds ranging in frequency from 100 to 500 Hz, with the lowest hearing thresholds from frequencies in a bandwidth of between 200 and 300 Hz and higher thresholds at 100 and 500 Hz; lake sturgeon were not sensitive to sound pressure. We assume that the hearing sensitivities reported for these other species of sturgeon are representative of the hearing sensitivities of all DPSs of Atlantic sturgeon.

Status

In 2012, NMFS listed five DPSs of Atlantic sturgeon (Gulf of Maine, New York Bight, Chesapeake Bay, Carolina, and South Atlantic) 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 number of spawning adults in the Hudson River spawning population is only hundreds per year (Kazyak et al. 2020). There are no spawning run estimates for the Delaware River population but the new genetic analyses indicate that the Delaware River spawning population is likely very small and a fraction of the size of the Hudson River spawning population (White et al. 2021) (NMFS 2022d).

An Atlantic sturgeon population abundance estimate was also derived from Northeast Area Monitoring and Assessment Program (NEAMAP) trawl survey data from 2007 to 2012 (Kocik et al. 2013). The NEAMAP estimates were based on sampling in a large portion of the marine range of the five DPSs (Cape Cod, Massachusetts to Cape Hatteras, North Carolina) in known sturgeon coastal migration areas, and during times of year that sturgeon are expected to be migrating north and south. {Kocik, 2013 #257@@author-year} provided a range of abundance estimates based on alternative catchability rates, defined as the product of the probability of capture given encounter (i.e. net efficiency) and the fraction of the population within the sampling domain (availability) (see Table 16 from Kocik et al. 2013). {NMFS, 2017 #267@@author-year} applied the NEAMAP derived estimate (i.e., 67,776 fish from Kocik et al. 2013) based on a 50 percent catchability rate as a conservative estimated annual abundance of Atlantic sturgeon subadults (that are of a size vulnerable to capture in commercial sink gillnet and otter trawl gear) and adults. While we still consider this to be a reasonable abundance estimate of the subadult and adult population, we recognize its shortcomings including the limited geographic extent of sampling, age of the data (10 to 15 years old), and assumptions regarding gear catchability. We partitioned this estimate across DPSs, using the proportions developed by {Kazyak, 2021 #6@@author-year} to arrive at the following subadult and adult abundance estimates for each DPS: Gulf of Maine and Canada (combined) 2,033 fish; New York Bight 17,283; Chesapeake Bay 6,642; Carolina 15,317; and South Atlantic 25,890.

Kazyak et al. (2021) performed a mixed-stock analysis of 1704 Atlantic sturgeon encountered across the U.S. Atlantic Coast. Fish sampled north of Cape Cod, MA and south of Cape Hatteras, NC were dominated by individuals from regional stocks; however, extensive stock mixing was found in the mid-Atlantic region, particularly in coastal environments where individuals from all five DPSs were commonly observed. Of the 41 individuals captured north of Cape Cod, 87.8 percent assigned to the Kennebec River population, which is the only population in the Gulf of Maine DPS, with the remainder assigned to Canadian Rivers. In the region sampled between Cape Hatteras and Cape Cod, 37.5 percent of individuals assigned to populations in the New York Bight DPS and 30.7 percent to populations in the Carolina DPS. Individual-based assignment testing indicated that Atlantic sturgeon sampled south of Cape Hatteras were primarily from the South Atlantic (91.2 percent) and Carolina (6.2 percent) DPSs.

Critical Habitat

Atlantic sturgeon critical habitat is not designated in the action area.

Atlantic Sturgeon DPS Specific Information

Gulf of Maine DPS

The Gulf of Maine DPS of Atlantic sturgeon was listed as threatened on February 6, 2012. The Gulf of Maine 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 Gulf of Maine 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. It was speculated that the Penobscot subpopulation was extirpated until a fisherman captured an adult Atlantic sturgeon in 2005, and a gillnet survey directed toward Atlantic sturgeon captured seven in 2006 (ASSRT 2007). There is no current evidence that spawning is occurring in the Penobscot River (NMFS 2022c). Acoustic tag detections suggest that the adults that forage in the Penobscot River travel to the Kennebec River to spawn (Altenritter et al. 2017; Wippelhauser et al. 2017). 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.

There are no abundance estimates for the Gulf of Maine DPS or for the Kennebec River spawning population. Another method for assessing the number of spawning adults is through determinations of effective population size, which measures how many adults contributed to producing the next generation based on genetic determinations of parentage from the offspring. The effective population size of the Gulf of Maine DPS was assessed in two studies based on sampling of adult Atlantic sturgeon captured in the Kennebec River in multiple years. The studies yielded very similar results which were an effective population size of: 63.4 (95% CI=47.3-91.1) (ASMFC 2017a) and 67 (95% CI=52.0–89.1) (Waldman et al. 2019). The status of the Gulf of Maine DPS has likely neither improved nor declined from what it was when the DPS was listed as threatened in 2012 (NMFS 2022c).

New York Bight DPS

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 River and Hudson River. 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). Kazyak et al. (2020) used side scan sonar technology in conjunction with detections of previously tagged Atlantic sturgeon to estimate a Hudson River spawning run size of 466 sturgeon (95% CRI = 310-745) in 2014. The estimates of effective population size for the Hudson River spawning population range from 144 to 198 (NMFS 2022d). Long-term surveys indicate that the Hudson River subpopulation has been stable and/or slightly increasing since 1995 (ASSRT 2007)(ASSRT 2007). Recent analyses suggest that the abundance of juvenile Atlantic sturgeon belonging to the Hudson River spawning population has increased, with double the average catch rate for the period from 2012-2019 compared to the previous eight years, from 2004-2011 (Pendleton and Adams 2021).

The Delaware River estuary once supported large numbers of Atlantic sturgeon, with 3,200 metric tons of commercial fisheries landings in 1888 (ASSRT 2007; Secor 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 estimates of effective population size for the Delaware River spawning population range from 40 to 109 (NMFS 2022d). In 2007, the Atlantic Sturgeon Status Review Team 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 vessel 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 Delaware subpopulation (ASSRT 2007).

The New York Bight DPS demographic risk is categorized as “high” due to its low productivity (e.g., relatively few adults compared to historical levels and irregular spawning success), low abundance (e.g., only a few known spawning populations and low DPS abundance, overall), and limited spatial distribution (e.g., limited spawning habitat within each of the few known rivers that support spawning) (NMFS 2022d). The New York Bight DPS’ potential to recover is, however, also high because man-made threats that have a major impact on the species' ability to persist have been identified (e.g., bycatch in federally-managed fisheries, vessel strikes), the DPS’ response to those threats are well understood, management or protective actions to address major threats are primarily under U.S. jurisdiction or authority, and management or protective actions are technically feasible with respect to reducing fisheries bycatch even if they require further testing (e.g., gear modifications to minimize dredge or fishing gear interactions) (NMFS 2022d).

Chesapeake Bay DPS

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). 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). At present, the Chesapeake Bay DPS has low abundance and the current numbers of spawning adults are one to two orders of magnitude smaller than historical levels. Despite research efforts, natal juveniles are rarely captured which suggests that the Chesapeake Bay DPS has low reproductive success (NMFS 2022b). 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, York, and Nanticoke rivers. Based on available information for the genetic composition and the estimated abundance of Atlantic sturgeon in marine waters, NMFS (2013a) estimated that subadult and adult abundance of the Chesapeake Bay DPS was 8,811 fish. Atlantic sturgeon belonging to the Chesapeake Bay DPS are still captured and killed as a result of fishery interactions, vessel strikes, and dredging.

The James River supports the largest population of Atlantic sturgeon within the DPS. A total of 373 different adult-sized Atlantic sturgeon (i.e., total count does not include recaptures of the same fish) were captured in the James River from 2009 through spring 2014 (Balazik and Musick 2015). Estimates of James River effective population size from separate studies and based on different age classes are similar, ranging from 32 to 62 sturgeon (NMFS 2022b). 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). In 2007, the Atlantic Sturgeon Status Review Team 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 (ASSRT 2007).

Kahn et al. (2019) estimated a spawning run size of up to 222 adults (but with yearly variability) in the Pamunkey River, a tributary of the York River in Virginia, based on captures of tagged adults from 2013-2018. The highest ranked stressor for the York River was commercial bycatch, which received a moderate risk rank (ASSRT 2007). New information for the Nanticoke River system suggests a small adult population based on a small total number of captures (i.e., 26 sturgeon) and the high rate of recapture across several years of study (Secor et al. 2021).

Carolina DPS

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 three percent of their historical abundance based on 1890s commercial landings data (ASSRT 2007; Secor 2002).

Water quality issues represent 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 dissolved oxygen events and major fish kill events, mainly in the Neuse Estuary of the Sound. The Cape Fear River is a natural blackwater river; however, the low dissolved oxygen 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 Atlantic Sturgeon Status Review Team. 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 Atlantic Sturgeon Status Review Team 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.

South Atlantic DPS

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 populations (ASSRT 2007). The Altamaha and the Ashepoo, Savannah, Combahee and Edisto 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. These estimates however, were conducted in the spring. Ingram and Peterson (2016) used acoustic telemetry to show that adults in the Altamaha River display two different spawning migration strategies, those that enter the river in the spring and hold until spawning in the fall and those that enter the river in the fall and move directly to spawning habitat. The abundance of adults in the lower Altamaha River in the spring is approximately 37 percent of the spawning adult population in the fall. Few captures have been documented in subpopulations other than the Altamaha and the Ashepoo, Combahee and Edisto Basin within this DPS, and these smaller systems are suspected to contain less than one percent of their historic abundance (ASSRT 2007). The Atlantic Sturgeon Status Review Team 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 Environmental Baseline

The "environmental baseline" refers to the condition of the listed species or its designated critical habitat in the action area, without the consequences to the listed species or designated critical habitat caused by the proposed action. 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. The consequences to listed species or designated critical habitat from ongoing agency activities or existing agency facilities that are not within the agency's discretion to modify are part of the environmental baseline (50 C.F.R. §402.02; 84 FR 44976 published August 27, 2019). The following information summarizes the principal natural and human-caused phenomena in the action area believed to affect the survival and recovery of the ESA-listed species discussed in Section 5.2.

6.1 Global Climate Change

There is a large and growing body of literature on past, present, and anticipated 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-listed 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).

This section provides some examples of impacts to ESA-listed species and their habitats that have occurred or may occur in the action area as the result of climate change. We address climate change as it has affected ESA-listed species and continues to affect species, and we look to the foreseeable future to consider effects that we anticipate will occur as a result of ongoing activities. While the consideration of future impacts may also be suited to our cumulative effects analysis (Section 8), it is discussed here to provide a comprehensive analysis of the effects 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 likely to change the status of the species and the condition of their habitats both within and outside of the action area.

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; RCP4.5 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). As there remains a fair amount of uncertainty regarding the implementation of mitigation measures with the goal of curbing pollutants contributing to global climate change, our ESA analyses are conducted under the status quo conditions outlined in RCP8.5.

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).

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). 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).

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. McMahon and Hays (2006) predicted increased ocean temperatures will expand the distribution of leatherback turtles into more northern latitudes. 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).

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 (Becker et al. 2018; Silber et al. 2017; Simmonds and Isaac 2007), recent research has indicated a range of consequences already occurring.

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(Patrício et al. 2021). Over time, this can reduce genetic diversity, or even population viability, if males become a small proportion of populations (Hulin et al. 2009). Sea surface temperatures on loggerhead foraging grounds has also been linked to the timing of nesting, with higher temperatures leading to earlier nesting (Mazaris et al. 2009; Schofield et al. 2009). Green sea turtles emerging from nests at cooler temperatures likely absorb more yolk that is converted to body tissue than do hatchlings from warmer nests (Ischer et al. 2009). However, warmer temperatures may also decrease the energy needs of a developing embryo (Reid et al. 2009). Impacts on sea turtle nesting from loss of habitat will likely be exacerbated by sea level rise. The loss of leatherback nesting 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).

Information on current effects of global climate change on Atlantic sturgeon is not available. While it is speculated that future climate change may affect sturgeon, it is difficult to predict the magnitude and scope of those potential impacts. Atlantic sturgeon could be affected by changes in river ecology resulting from increases in precipitation and changes in water temperature which may affect recruitment and distribution in these rivers. The effects of increased water temperature and decreased water availability are likely to have a more immediate effect on Atlantic sturgeon populations that migrate and spawn in river systems with existing water temperatures that are at or near the maximum for the species, including the South Atlantic and Carolina DPSs. Atlantic sturgeon prefer water temperatures up to approximately 28°C (82.4°F); these temperatures are experienced naturally in some areas of rivers during the summer months. If river temperatures rise and temperatures above 28°C are experienced in larger areas, sturgeon may be excluded from some habitats. The increased rainfall predicted by some models in some areas may increase runoff and scour spawning areas, while flooding events could cause temporary decreases in water quality. Rising temperatures predicted for all of the U.S. could exacerbate existing water quality problems with changes in dissolved oxygen and temperature.

Increased droughts (and water withdrawal for human use) predicted by some models in some areas 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, all Atlantic sturgeon life stages, including adults, may become susceptible to strandings or habitat restriction. 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 causing a mismatch in prey that are currently available to developing sturgeon in rearing habitat.

Changes in oceanic conditions could also affect the marine distribution of Atlantic sturgeon or their marine and estuarine prey resources. Rising sea level may result in the salt wedge moving upstream in affected rivers. Atlantic sturgeon spawning occurs in fresh water reaches of rivers because early life stages have little to no tolerance for salinity. In river systems with dams or natural falls that are impassable by sturgeon, movement of the salt wedge further upstream would further restrict Atlantic sturgeon spawning and rearing habitat.

The effects of climate change on ESA-listed sea turtles and Atlantic sturgeon will not occur independently from other stressors. Rather, the anthropogenic stressors already affecting the fitness and survival of Atlantic sturgeon – including bycatch, loss of migratory habitat from dams, contamination of riverine habitat and overall decreased water quality – will be compounded by the anticipated effects of climate change.

6.2 Fisheries Directed Harvest and Bycatch

Past directed commercial fisheries contributed to the steady decline in the population abundance of many ESA-listed anadromous fish species, including Atlantic sturgeon. Between 1890 and 1905, Atlantic sturgeon populations were drastically reduced due to overfishing for sale of meat and caviar. Harvest records indicate that fisheries for sturgeon were conducted in every major coastal river along the Atlantic coast at one time, with fishing effort concentrated during spawning migrations (Smith 1985). Approximately 3,350 metric tons (7.4 million pounds) of sturgeon (Atlantic and shortnose combined) were landed in 1890 (Smith and Clugston 1997). The sturgeon fishery during the early years (1870 to 1920) was concentrated in the Delaware River and Chesapeake Bay systems. During the 1970s and 1980s sturgeon fishing effort shifted to the South Atlantic, which accounted for nearly 80 percent of total U.S. landings (64 metric tons). Prompted by research on juvenile production between 1985 and 1995 (Peterson et al. 2000), the Atlantic sturgeon fishery was closed by the ASMFC in 1998 when a coast-wide fishing moratorium was imposed for 20-40 years, or at least until 20 year classes of mature female Atlantic sturgeon were present (ASMFC 2008). NMFS followed this action by closing the EEZ to Atlantic sturgeon take in 1999. Poaching of Atlantic sturgeon continues and is a potentially significant threat to the species, but the present extent and magnitude of such activity is largely unknown.

Although directed fishing for Atlantic sturgeon is prohibited under the ESA, large numbers are still captured as "bycatch" in fishing operations targeting other species. The available bycatch data for FMP fisheries indicate that sink gillnets and bottom otter trawl gear pose the greatest risk to Atlantic sturgeon; although, Atlantic sturgeon are also caught by hook and line, fyke nets, pound nets, drift gillnets and crab pots (ASFMC 2017).

Commercial fisheries bycatch also represents a significant threat to sea turtles throughout the action area, as sea turtles are highly vulnerable to incidental capture in many fisheries gears including tangle nets, trawls and longlines. Finkbeiner et al. (2011) compiled cumulative estimates of sea turtle bycatch across fisheries of the United States between 1990 and 2007, before and after implementation of fisheries-specific bycatch mitigation measures. Pre- and post-regulatory strata were identified for each fishery based on the first year a sea turtle bycatch mitigation strategy was mandated. For the Atlantic region, an annual mean of 345,800 turtle interactions and 70,700 deaths was estimated for the pre-regulatory strata across all fisheries included in this study. By comparison, an annual mean of 137,700 turtle interactions and 4,500 deaths was estimated for the post-regulatory strata.

6.2.1 Federally Managed Fisheries

In the Northwest Atlantic, NMFS Greater Atlantic Regional Office (GARFO) manages federal fisheries from Maine to Cape Hatteras, North Carolina; however, the management areas for some of these fisheries range from Maine through Virginia, while others extend as far south as Key West, Florida. The NMFS Southeast Regional Office (SERO) manages federal fisheries from Cape Hatteras, North Carolina to Texas, including Puerto Rico and the U.S. Virgin Islands. Both NMFS regional offices have conducted ESA section 7 consultation on all federal fisheries authorized under their jurisdiction.

Each of the most recent GARFO and SERO fishery consultations noted above have considered adverse effects to green, Kemp's ridley, loggerhead, and leatherback sea turtles. In each of the fishery opinions, NMFS concluded that the ongoing action was likely to adversely affect but was not likely to jeopardize the continued existence of any sea turtle species. Each of these opinions included an ITS exempting a certain amount of lethal or non-lethal take resulting from interactions with the fisheries. Table 5 below shows the incidental take of ESA-listed turtles and Atlantic sturgeon exempted as a result of the 2021 biological opinion on the American Lobster, Atlantic Bluefish, Atlantic Deep-Sea Red Crab, Mackerel/Squid/Butterfish, Monkfish, Northeast Multispecies, Northeast Skate Complex, Spiny Dogfish, Summer Flounder/Scup/Black Sea Bass, and Jonah Crab Fisheries. Table 6 shows the exempted take for sea turtles from all other current section 7 fisheries consultations on the U.S. Atlantic coast.

Table 5. Average annual exempted take of sea turtles and Atlantic sturgeon over a 5-year period as a result of the 2021 biological opinion on the American Lobster, Atlantic Bluefish, Atlantic Deep-Sea Red Crab, Mackerel/Squid/Butterfish, Monkfish, Northeast Multispecies, Northeast Skate Complex, Spiny Dogfish, Summer Flounder/Scup/Black Sea Bass, and Jonah Crab fisheries (NMFS 2021a).

	Average Annual Total Take	**Average Annual Lethal Take**
Sea Turtles		
Green, North Atlantic DPS	Gillnet: 2 Trawl: 6.4	Gillnet: 1.6 Trawl: 3.2
Kemp's ridley	Gillnet: 47.8 Trawl: 10.6	Gillnet: 37.4 Trawl: 5.4
Loggerhead, NWA DPS	Gillnet: 207.2 Trawl: 190.8 Pot/trap: 1	Gillnet: 161.6 Trawl: 95.4 Pot/trap: 0.8
Leatherback	Gillnet: 10.4 Trawl: 8 Pot/trap: 10	Gillnet: 8.2 Trawl: 4 Pot/trap: 6.4
Any combination of turtle species	Vessel strike: 3	Vessel strike: 3
Atlantic Sturgeon		
Atlantic sturgeon, Gulf of Maine DPS	Gillnet: 55 Trawl: 68	Gillnet: 11 Trawl: 4
Atlantic sturgeon, New York Bight DPS	Gillnet: 448 Trawl: 556	Gillnet: 90 Trawl: 28
Atlantic sturgeon, Chesapeake Bay DPS	Gillnet: 68 Trawl: 83	Gillnet: 13 Trawl: 4
Atlantic sturgeon, Carolina DPS	Gillnet: 16 Trawl: 20	Gillnet: 3 Trawl: 1
Atlantic sturgeon, South Atlantic DPS	Gillnet: 35 Trawl: 44	Gillnet: 7 Trawl: 2

Table 6. Exempted take for sea turtles from all other current section 7 fisheries consultations on the U.S. Atlantic coast.

Fishery Management Plan	Date	Loggerhead	Kemp's ridley	Green	Leatherback
American lobster	July 31, 2014	1 (lethal or non-lethal)	0	0	7 (lethal or non-lethal)
Atlantic sea scallop	July 12, 2012 (amended November 2018)	322 (92 lethal) over 2 years in dredges; 700 (330 lethal) over 5 years in trawls	3 (2 lethal) in dredges and trawls combined	2 (lethal) in dredges and trawls combined	2 (lethal) in dredges and trawls combined
Red Crab	February 6, 2002	1 (lethal or non-lethal)	0	0	1 (lethal or non-lethal)
Coastal migratory pelagics	June 18, 2015, amended 2017	27 over 3 years (7 lethal)	8 over 3 years (2 lethal)	31 over 3 years (9 lethal)*	1 over 3 years (1 lethal)
South Atlantic snapper-grouper	December 1, 2016	629 (208 lethal) over 3 years	180 (59 lethal) over 3 years	111 (42 lethal) over 3 years	6 (5 lethal) over 3 years
Southeastern U.S. shrimp	April 26, 2021	72,670 (2,150 lethal) over 5 years	84,495 (8,505 lethal) over 5 years	21,214 (1,700 lethal) over 5 years	130 (5 lethal) over 5 years
HMS fisheries, excluding pelagic longline	January 10, 2020	91 (51 lethal) over 3 years	22 (11 lethal) over 3 years	46 (21 lethal) over 3 years	7 (3 lethal) over 3 years
HMS, pelagic longline	May 15, 2020	1080 (280 lethal) over 3 years	21 (8 lethal) combined Kemp's ridley, green (includes N. Atlantic and S. Atlantic DPS), hawksbill, or olive ridley over 3 years	996 (275 lethal) over 3 years	HMS, pelagic longline
South-Atlantic dolphin-wahoo	August 27, 2003	12 (2 lethal)	3 (1 lethal) combination of Kemp's ridley, green, or hawksbill	12 (1 lethal)	South-Atlantic dolphin- wahoo

For Atlantic sturgeon, incidental take from fisheries bycatch is also exempted for the following fisheries:

- Atlantic sea scallop - 1 sublethal annually, 1 lethal every 20 years from any DPS;
- Coastal Migratory Pelagics - 12 sublethal every 3 years, 0 lethal across all DPSs;
- Southeastern U.S. Shrimp (every 5 years) – Gulf of Maine DPS 2 sublethal, 0 lethal; New York Bight DPS 7 sublethal, 2 lethal; Chesapeake DPS 19 sublethal, 4 lethal; Carolina DPS 66 sublethal, 15 lethal; S. Atlantic DPS 103 sublethal, 24 lethal;
- HMS fisheries, excluding pelagic longline (every 3 years) – Gulf of Maine DPS 34 sublethal, 8 lethal; New York Bight DPS 170 sublethal, 36 lethal; Chesapeake DPS 40 sublethal, 9 lethal; Carolina DPS 10 sublethal, 5 lethal; S. Atlantic DPS 75 sublethal, 19 lethal;

Table 7 shows the estimated average annual turtle interactions in select commercial fishing gears in the Mid-Atlantic and Georges Bank regions. The 2017 Atlantic Sturgeon Benchmark Stock Assessment (ASFMC 2017) estimated that, on average, 1,139 Atlantic sturgeon (295 lethal; 25 percent) were caught in gillnet fisheries and 1,062 (41 lethal; 4 percent) were caught in otter trawl fisheries each year from 2000-2015. Atlantic sturgeon bycatch estimates for Northeast gillnet and trawl gear from 2011-2015 (approximately 761 fish per year for gillnets, 777 per year for trawls) are substantially lower than those from 2006-2010 (approximately 1,074 fish per year for gillnets, 1,016 per year for trawls) (ASFMC 2017).

Table 7. Estimated average annual turtle interactions in select commercial fishing gears in the Mid-Atlantic and Georges Bank regions. Numbers in parentheses are adult equivalents.

Gear	Years	Area	Estimated Interactions (adult equivalents)	Mortalities (adult equivalents)	Source
Sea Scallop Dredge	2009-2014	Mid-Atlantic	Loggerhead: 22 (2)	9-19* (1-2)	Murray (2015)
Sink Gillnet	2012-2016	Mid-Atlantic	Loggerhead: 141(3.8) Kemp's ridley: 29 Leatherbacks: 5.4 Unid. hardshell: 22.4	Loggerhead: 111.4 Kemp's ridley: 23 Leatherbacks: 4.2 Unid. hardshell: 17.6	Murray (2018)
Bottom Trawl	2014-2018	Mid-Atlantic and Georges Bank	Loggerhead: 116.6 (36.4) Kemp's ridley: 9.2 Green: 3.2 Leatherbacks: 5.2	Loggerhead: 54.4 (17.4) Kemp's ridley: 4.6 Green: 1.6 Leatherbacks: 2.6	Murray (2020)

*Of these interactions, 9-19 would result in mortality depending on whether loggerheads that interacted with chain mats without being captured (the unobservable but quantifiable interactions) survived.

6.2.2 State Managed Fisheries

Several fisheries for species not managed by a federal fishery management plan occur in state waters of the action area. Gear types used in these fisheries include hook-and-line, gillnet, trawl, pound net and weir, trap/pot, seines, and channel nets. Sea turtles and sturgeon interact with these fishing gears in state waters. In most cases, there is limited observer coverage of these fisheries, and the extent of interactions with ESA-listed species is difficult to estimate.

In 2013, after amending their commercial fishing regulations to minimize incidental capture, the Georgia Department of Natural Resources received an ESA section 10 permit for incidental take of Atlantic sturgeon in the commercial shad fishery in state waters. The incidental take permit (ITP) allows the capture and live release of up to 180 Atlantic sturgeon annually, with a maximum of five incidental mortalities per year. A mortality rate of approximately 2.3 percent is anticipated based on recent research. The North Carolina Division of Marine Fisheries (NCDMF) developed a Conservation Plan to address Atlantic sturgeon take in the state's inshore gillnet fishery, and submitted an application for an ESA ITP to NMFS in April of 2012. In July 2014, NCDMF received an ESA section 10 permit for incidental take of Atlantic sturgeon that allows for take of up to 2,927 juvenile and small subadult Atlantic sturgeon annually, primarily in the form of capture and harassment, but in some cases lethal take.

NCDMF reported that no Atlantic sturgeon were observed in 958 observed tows conducted from 2001 to 2008 by commercial shrimp trawlers working in North Carolina waters (NCDMF 2014). Collins et al. (1996) reported that of 1,534 juvenile Atlantic sturgeon tagged in the Altamaha River, Georgia, 38 out of 97 (39 percent) were recaptured in shrimp trawls with the remainder captured in gillnet fisheries. Seven adult Atlantic sturgeon were captured (one killed) by a single shrimp trawler off Winyah Bay, South Carolina in October 2008 (Damon-Randall et al. 2010).

Information on the number of Atlantic sturgeon captures and mortalities in non-federal fisheries, which primarily occur in state waters, is extremely limited. An Atlantic sturgeon "reward program" provided commercial fishermen monetary rewards for reporting captures of Atlantic sturgeon in Maryland's Chesapeake Bay (Mangold et al. 2007). The data from this program show that Atlantic sturgeon have been caught in a wide variety of gear types, including hook and line, pound nets, gillnets, crab pots, eel pots, hoop nets, trawls, and fyke nets. Pound nets (58.9 percent) and gillnets (40.7 percent) accounted for the vast majority of captures (NMFS 2021a). Of the more than 2,000 Atlantic sturgeon reported in the reward program over 16 years (1996-2012), an estimated 10 fish died due to capture in commercial gear (NMFS 2021a).

6.3 Vessel Strike

Large sturgeon are susceptible to vessel collisions. The factors relevant to determining the risk to sturgeon from vessel strikes 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.). Multiple studies have shown that Atlantic sturgeon are unlikely to move away from vessels or avoid areas with vessel activity (Balazik et al. 2020; DiJohnson 2019; Reine et al. 2014). In 2012, when Atlantic sturgeon were listed, vessel strikes were considered a primary threat to the New York Bight and Chesapeake Bay DPSs. In particular, sturgeon from the Hudson River spawning population were likely to be impacted by vessel strikes from large commercial vessels in the Delaware and James rivers due to the sturgeon's use of those non-natal estuaries. The ASSRT determined Atlantic sturgeon in the Delaware River are at a moderately high risk of extinction because of vessel strikes, and sturgeon in the James River are at a moderate risk from vessel strikes (ASSRT 2007). Balazik et al. (2012) estimated up to 80 sturgeon were killed by vessel strike between 2007 and 2010 in these two river systems combined. 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. Based on evidence of Atlantic sturgeon vessel strikes since the listing, it is now apparent that vessel strikes are also occurring in the Hudson River (NMFS 2022d). For example, the New York Department of Environmental Conservation reported that at least 17 dead Atlantic sturgeon with vessel strike injuries were found in the river in 2019, of which at least 10 were adults (NMFS 2022d). Reported vessel strikes represent only minimum counts of the number of Atlantic sturgeon that are actually struck and killed by vessels because the majority of carcasses are either not found are not reported.

Propeller and collision injuries from private and commercial vessels are also a significant threat to ESA-listed sea turtles. Turtles swimming or feeding at or just beneath the surface of the water are particularly vulnerable to vessel strikes, which can result in serious injury and death (Hazel et al. 2007). 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).

Many recovered turtles display injuries that appear to result from interactions with vessels and their associated propulsion systems (Work et al. 2010). This is particularly true in nearshore areas with high vessel traffic along the U.S. Atlantic and Gulf of Mexico coasts. From 1997 to 2005, nearly 15 percent of all stranded loggerheads in the U.S. Atlantic and Gulf of Mexico were documented as having sustained some type of propeller or collision injury; although it is not known what proportion of these injuries were post or ante-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.

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.

The Sea Turtle Stranding and Salvage Network reports a large number of vessel interactions (propeller injury) with sea turtles off coastal states such as New Jersey and Florida, where there are high levels of vessel traffic. The Virginia Aquarium & Marine Science Center Strandings Program reported an average of 62.3 sea turtle strandings per year in Virginia waters due to boat strikes from 2009-2014 (Barco 2015). The large majority of these (~ 87 percent) were dead strandings. By sea turtle species, 73.3 percent of Virginia vessel strike strandings from 2009-2014 were loggerhead, 20.3 percent Kemp's ridley, 3.5 percent green, and 2.9 percent leatherback (Barco 2015).

6.4 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.

Currently, there are 15 active sea turtle research permits with study areas that overlap the action area for this biological opinion. All but two of these permits fall within the scope of the NMFS (2017b) sea turtle research permit programmatic biological opinion. Of the seven research permits authorizing direct sea turtle capture, four authorize capture methods where there is no corresponding risk of forced submergence, and thus no incidental mortality issued (e.g., dip nets, cast nets, hand capture, or pound nets). The three remaining permits have directed takes authorized using trawls or tangle nets where unintended mortality is issued within the permit. Permit No. 23851 (South Carolina Department of Natural Resources) includes bottom trawling durations of 30 minutes (and 12 minute retrieval) and authorizes five incidental mortalities over 10 years; and Permit No. 21233 (NMFS Southeast Fisheries Science Center) includes capture by tangle or trawl nets fished at 30 minute intervals prior to checking and authorizes up to nine incidental mortalities over ten years (NMFS 2021c). The sea turtle research programmatic established mortality banks for each species, which represent the maximum total number of mortalities that could be authorized and used over each ten-year period. Table 8 shows the sea turtle mortality bank limits, lethal takes authorized, and lethal takes reported in the Atlantic

Ocean. Only one sea turtle lethal take (Kemp's ridley) has been reported since 2018 when the programmatic opinion took effect.

Table 8. Programmatic mortality bank limits and takes of sea turtles in the Atlantic Ocean. Bank limits and takes are authorized over 10 years (2018-2027) (NMFS 2022a).

Sea Turtle Species	Mortality Bank Limit	Authorized Lethal Takes	Reported Lethal Takes in 2021	Cumulative Reported Lethal Takes (2018-2027)
Green	10	3	0	0
Kemp's ridley	10	3	0	1
Hawksbill	5	1	0	0
Olive	5	1	0	0
Leatherback	10	3	0	0
Loggerhead	10	4	0	0

In 2017, we completed a programmatic consultation with the Permits Division on the implementation of a new sturgeon research program. Scientific research permits authorized under the sturgeon research program promote sturgeon conservation and recovery, and result in a net benefit to ESA-listed species and DPSs. As a condition of their permit, sturgeon researchers are 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. In addition to these standard protocols, as a condition of their permit researchers are required to consider additional precautionary measures to further minimize potential impacts on sturgeon. While these precautionary measures have proven highly effective at reducing detrimental impacts of research, and continue to improve over time, there remains some risk of sturgeon mortality, either (1) "in-hand" mortality as a direct result of capture, handling or performing a procedure, or (2) delayed mortality due to invasive procedures (e.g., surgery, gastric lavage) performed on captured fish. As such, some small amount of lethal take (i.e., mortality) is authorized for Atlantic sturgeon research through established mortality banks. Mortality banks limit the allowable lethal take for each spawning subpopulation based on its estimated abundance and a calculated river system health index. For details on sturgeon research permit mortality bank limits see the NMFS (2017a) biological opinion.

Currently, there are 14 active Atlantic sturgeon permits with study areas that overlap with the action area for this biological opinion, all of which currently fall within the scope of the 2017 sturgeon research programmatic biological opinion. However, excluding the applicant's current permit (Permit No. 17225), there are only two active permits (Permit Nos. 20458 and 20351) authorized to capture and sample Atlantic sturgeon in open marine areas coinciding with the proposed action's reach (NMFS 2021c). All the other active sturgeon permits have described action areas exclusively within river systems, beginning at the marine estuary to freshwater river tributaries.

6.5 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. 1969a) and behaviorally respond to acoustic stimuli (DeRuiter and Doukara 2012; McCauley et al. 2000a; 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.

In-water 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). 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. McCauley et al. (2000a) 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 two kilometers and avoidance around one kilometer. Avoidance behavior and physiological responses from airgun exposure may affect the natural behaviors of sea turtles (McCauley et al. 2000a). The most common 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). 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 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 micro 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 and potentially masking sounds of biological importance.

6.6 Military Operations

In 2018, NMFS issued a biological opinion (with revised ITS issued in October 2019) on the U.S. Navy Atlantic Fleet's military readiness training and testing activities and the promulgation of regulations for incidental take of marine mammals (NMFS 2018a). The action area includes the Gulf of Mexico and the western Atlantic, with some activities overlapping the action area for the proposed research permit. NMFS concluded that the action is not likely to jeopardize the continued existence of any ESA-listed species. The number and type of takes of sea turtles due to exposure to impulsive and non-impulsive acoustic stressors, ship shock trials, and vessel strike that are exempted for this action are shown in Table 9. The 2018 opinion also anticipates the take of no more than six Atlantic sturgeon (up to one from the Gulf of Maine DPS, one from the New York Bight DPS, six from the Chesapeake Bay DPS, six from the Carolina DPS, and one from the South Atlantic DPS) combined from all DPSs over a 7-year period. The ITS did not specify the amount or extent of take of Atlantic sturgeon, but rather used a surrogate expressed as a distance to reach effects in the water column with injury and sub-injury from acoustic stresses.

6.7 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, and 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. 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.

Table 9. The number of lethal and non-lethal takes of ESA-listed sea turtles anticipated from Navy Atlantic fleet training and testing activities (NMFS 2018a).

Turtle Species	Impulsive and Non-Impulsive Acoustic Stressors (annual take)				Vessel Strike	
	Harassment (TTS/Behavioral)	Harm (PTS)	Harm (Slight Lung Injury)	Mortality	Mortality (over 7-year period)	Sublethal harm (annually)
Green – North Atlantic DPS	76/5,076	8	-	-	77	4
Hawksbill	313/24	-	-	-	-	4
Kemp's ridley	28/6,660	5			28	5
Loggerhead – Northwest Atlantic	772/46,178	80	17	2	105	11
Leatherback	348/3,299	22	2	-	7	3

Turtle Species	Small and Large Ship Shock Trials (over 7-year period)			
	Harassment (TTS)	Harm (PTS)	Harm (Slight Lung Injury)	Mortality
Green – North	36	2	-	-
Hawksbill	4	1	-	-
Kemp's ridley	27	2	2	-
Loggerhead	622	32	9	2
Leatherback	384	14	3	-

In addition to ingestion risks, sea turtles can also become entangled in marine debris such as fishing nets, monofilament line, and fish-aggregating devices (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 ghost nets due to their tendency to use floating objects for shelter and as foraging stations (Dagorn et al. 2013; Kiessling 2003).

6.8 Pollution

Anthropogenic sources of marine pollution, while difficult to attribute to a specific federal, state, local, or private action, may affect ESA-listed species in the action area. Sources of pollutants in the action area include atmospheric loading of pollutants (e.g., polychlorinated biphenyls or PCBs); storm water runoff from coastal towns, cities, and villages; runoff into rivers emptying into bays; groundwater discharges; sewage treatment plant effluents; and oil spills. Oil spills, resulting from anthropogenic activities (e.g., commercial vessel traffic/shipping), directly and indirectly affect all components of the marine ecosystem. Degraded water quality from point and non-point sources can impact protected species. Run-off can introduce pesticides, herbicides, and other contaminants into the system on which these species depend. Contaminants could degrade habitat if pollution and other factors reduce the food available to marine animals.

A variety of heavy metals have been found in sea turtle 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, dichloro-diphenyl-trichloroethane (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 fibropapillomatosis 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 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, dichlorodiphenyldichloroethylene (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 EFFECTS OF THE ACTION

Section 7 regulations define "effects of the action" as all consequences to ESA-listed species or designated critical habitat that are caused by the proposed action, including the consequences of other activities that are caused by the proposed action. A consequence is caused by the proposed action if it would not occur but for the proposed action and it is reasonably certain to occur (50 C.F.R. §402.02). Effects of the action may occur later in time and may include consequences occurring outside the immediate area involved in the action (50 C.F.R. §402.17).

At the start of Section 5, we provided a complete list of ESA-listed species and designated critical habitat that may be affected by the proposed action. Further, in Section 5.1 we explained that some ESA-listed species and designated critical habitats were not likely to be adversely affected by any of the stressors associated with the proposed action. This is because any effects on these species and critical habitats were extremely unlikely to occur such that they were discountable, or the size or severity of the impact was so low as to be insignificant, including those effects that are undetectable, not measurable, or so minor that they cannot be meaningfully evaluated.

In this section, we focus on those species that are likely to be adversely affected by one or more stressors created by the proposed action. In Section 7.1, we discuss the stressors associated with the proposed action that we determined are not likely to adversely affect ESA-listed species. We do not carry these stressors forward in our effects analysis since there is no meaningful potential for these stressors to affect the survival or recovery of ESA-listed species. Finally, in Section 7.2, we analyze those stressors that are likely to result in adverse effects to ESA-listed species.

7.1 Stressors Not Likely to Adversely Affect ESA-listed Species

This section discusses stressors we determined may affect, but are not likely to adversely affect ESA-listed sea turtles and Atlantic sturgeon because the effects of the stressors would be either insignificant or discountable.

7.1.1 Vessel Strike, Noise and Physical Disturbance

As discussed in Section 6.3 above, vessel strike represents a threat to both sea turtles and sturgeon. Vessel strike risk to these species is generally greater in areas with a high volume of vessel activity. For benthic species, such as Atlantic sturgeon, vessel strikes generally occur in nearshore, shallow water areas where the fish are more likely to come in contact with, or be sucked into, the vessel's propeller. Most of the FIS sampling proposed for this study would be in offshore areas where this is extremely unlikely to occur. There have been no reported incidents of vessel strike with any ESA-listed species in similar past research activities conducted by the NEFSC. In addition, we anticipate that trained researchers on-board these vessels will be highly vigilant to the presence of sea turtles (or other species) at or near the surface while the vessel is in transit or when fishing gear is in the water. Given the extremely small amount of vessel activity proposed for FIS sampling, the low density of ESA-listed species in the study area, and the safety measures that will be in place to avoid a vessels strike, it is extremely unlikely that there will be any vessel strikes of sea turtles or Atlantic sturgeon from the two research vessels proposed for FIS sampling as part of this action. Therefore, we find that any effects of vessels strike resulting from the proposed research activities on ESA-listed sea turtles or Atlantic sturgeon are discountable.

Vessel noise and physical disturbance could result in a behavioral reactions from sea turtles and sturgeon that are exposed. However, any such reaction would likely be short-term and minor, with the animal returning to its previous state shortly after the FIS research vessel passes through the area. Thus, we find that any effects of vessel noise or physical disturbance resulting from the proposed research activities on ESA-listed sea turtles or Atlantic sturgeon are insignificant.

In summary, we find that the stressors associated with vessels, including strike, vessel noise, and physical disturbance, resulting from the proposed action are not likely to adversely affect ESA-listed sea turtles or Atlantic sturgeon.

7.2 Stressors Likely to Adversely Affect ESA-listed Species

In this section of the opinion, we assess the probable effects of authorizing the proposed research on sea turtles and Atlantic sturgeon. The stressors resulting from research procedures that could affect sea turtles and Atlantic sturgeon are capture, handling, PIT tagging, flipper tagging (turtles only), and tissue sampling. When the proposed take of ESA-listed species is intentional and directed under a research program, the exposure is understood and will result in handling along with various procedures that result in different responses, each carry differing levels of risk to ESA-listed species. Impacts from the research activities covered under this permit range from no effect, minor effect, to mortality to individual animals. Scientific research to assess bycatch reduction gear and handling and research techniques is recognized by NMFS as an important means of gathering valuable information for the conservation and recovery of the species, while at the same time, limiting the impacts on wild animals.

7.2.1 Exposure Analysis

For research conducted under a section 10(a)(1)(A) permit, our exposure analysis is based on the number of animals (by species or DPS and life stage) that are authorized to be taken during research activities (as shown in Table 1 through Table 3 above). While the actual number of takes during research activities is often less than what is authorized in the permit, for our jeopardy analysis we conservatively use the authorized amount to represent the maximum potential impact to the species or DPS from the proposed action. Annual reports will be provided to NMFS detailing all research conducted, including the actual number of sea turtles and Atlantic sturgeon taken.

For Atlantic sturgeon, the number of takes authorized in the research permit are provided for the entire species but are not further broken down by DPS. For our analysis, we used information on stock composition of Atlantic sturgeon captured along the Atlantic coast based on a mixed-stock analysis presented by Kazyak et al. (2021). While this study also captured sturgeon in rivers and estuarine waters, we only used the results from the offshore composition to match the action area for the proposed NEFSC research. The authors presented results for three latitudinal regions: "North" (i.e., north of Cape Cod, MA); "Mid" (i.e., Cape Cod through Cape Hatteras, NC), and "South" (i.e., south of Cape Hatteras to Florida border). For the FDS sampling, where captures are covered by the ITS in the NMFS (2021a) fisheries opinion but research procedures are covered here, we used information from for the offshore captures in the "MID" region (n=633) to assign Atlantic sturgeon takes by DPS as follows: 2% Gulf of Maine DPS, 54% New York Bight DPS, 22% Chesapeake Bay DPS, 6% Carolina DPS, and 16% South Atlantic DPS. For the FIS sampling, where both captures and research procedures are covered by this opinion, we used information from for the offshore captures in the "South" region (n=122) to assign Atlantic sturgeon takes by DPS as follows: 0% Gulf of Maine DPS, 2% New York Bight DPS, 3% Chesapeake Bay DPS, 11% Carolina DPS, and 84% South Atlantic DPS.

Sea Turtles

In this research the capture of ESA-listed sea turtles along the northeast Atlantic Coast is covered by the incidental coverage in the NMFS 2021 fisheries opinion. Additional FIS research proposed with directed take, conducted outside of these commercial fisheries along the southeast Atlantic Coast will result in the capture of sea turtles for research purposes. The average annual number of captures using trawl and gillnet gear (combined) anticipated for each sea turtle species (or DPS) are as follows: North Atlantic DPS green 8, Kemp's ridley 43, leatherback 5, Northwest Atlantic DPS loggerhead 91, and hawksbill 5. The maximum number of sea turtle captures authorized over the 5-year life of the permit using trawl and gillnet gear (combined) is as follows: North Atlantic DPS green 21, Kemp's ridley 191, leatherback 21, Northwest Atlantic DPS loggerhead 426, and hawksbill 21. By life stage, the anticipated number of captures of sea turtles could include any combination of juveniles, subadults, or adults.

The following research procedures will be performed on all sea turtles that are captured alive in the FDS and FIS sampling: handling/measure/weigh, tissue samples, flipper tags, and PIT tags. The average annual number of individual turtles (captured in both FDS and FIS sampling combined) that these procedures will be conducted on by species (or DPS) are as follows: North Atlantic DPS green 9, Kemp's ridley 39, leatherback 6, Northwest Atlantic DPS loggerhead 100, and hawksbill 4. The maximum number of individual turtles (captured in both FDS and FIS sampling combined) that these procedures will be conducted on by species (or DPS) over the 5-year life of the permit is as follows: North Atlantic DPS green 26, Kemp's ridley 191, leatherback 26, Northwest Atlantic DPS loggerhead 474, and hawksbill 20. By life stage, the anticipated number of sea turtles that the research procedures would be conducted on could include any combination of juveniles, subadults, or adults.

Atlantic Sturgeon

Similar to turtles, the capture of ESA-listed Atlantic sturgeon along the northeast Atlantic Coast is covered by the incidental coverage in the NMFS 2021 fisheries opinion (NMFS 2021a), but subsequent research procedures that are part of this project will be considered here. Additional FIS research proposed with directed take, conducted outside of these commercial fisheries along the southeast Atlantic Coast will result in the capture of Atlantic sturgeon for research purposes. The average annual number of captures using trawl and gillnet gear (combined) anticipated for Atlantic sturgeon is 109. The maximum number of Atlantic sturgeon captures authorized over the 5-year life of the permit using trawl and gillnet gear (combined) is 214. By DPS, we estimate that approximately 84% of these captures will be from the South Atlantic DPS, 11% Carolina DPS, 3% Chesapeake Bay, and 2% New York Bight. By life stage, the anticipated number of captures of Atlantic sturgeon could include any combination of juveniles, subadults, or adults.

The following research procedures will be performed on all Atlantic sturgeon captured alive in the FDS and FIS sampling: handling/measure/weigh, tissue samples, and PIT tags. The average annual number of individual sturgeon that these procedures will be conducted on is 61 from FDS northeast sampling and 102 from FIS southeast sampling (total 163). The maximum number of individual sturgeon that these procedures will be conducted on over the 5-year life of the permit is 223 from FDS northeast sampling and 204 from FIS southeast sampling (total 427). By DPS, we estimate that approximately 16% of the FDS (northeast study area) captures (n = 61 annual / 223 over 5 years) will be from the South Atlantic DPS, 6% Carolina DPS, 22% Chesapeake Bay, 54% New York Bight, and 2% Gulf of Maine DPS. For the FIS (southeast study area) captures (n = 102 annual / 204 over 5 years) we estimate that approximately 84% will be from the South Atlantic DPS, 11% Carolina DPS, 3% Chesapeake Bay, and 2% New York Bight. By life stage, the anticipated number of Atlantic sturgeon that the research procedures would be conducted on could include any combination of juveniles, subadults, or adults.

7.2.2 Response Analysis

Sea Turtles

Sea turtles are particularly prone to capture in entanglement nets as a result of their body configuration and behavior. The primary threat to sea turtles is becoming trapped in the mesh of nets, preventing the animal from reaching the surface to breathe, and resulting in injury or death from drowning. 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). 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 1994; 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).

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).

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.

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.

While capture in non-research entanglement nets has been shown to result in injury and mortality, standard mitigation measures that researchers would be required to follow will likely minimize the extent of these impacts. In particular, researchers would be required to continuously monitor and physically check entanglement nets, thus allowing them to respond quickly to remove captured turtles from the net and safely bring the animal 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). The soak duration of gillnets in the FIS will be limited to one hour, which includes the time that it takes to completely remove/retrieve the net from the water. The nets will be removed from the water every hour, unless there is evidence an animal has entered the net and is captured, at which time the net will be retrieved immediately and animals brought on board to process. Researchers must manually monitor nets and trawls, checking for fish or turtle strikes, and removing captured animals as soon as detected. In addition, researchers must plan for unexpected circumstances (e.g. inclement weather) or demands of the research activities, and have the ability and resources to retrieve nets to remove catch at all times.

Trawls pose a greater risk of impacts from forced submergence to sea turtles compared to 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). Though rare, mortality has been observed in summer trawl tows as short as 15 minutes (Sasso and Epperly 2006). For the proposed research, all trawling gear are planned to be deployed for 55 minutes, with approximately 45 minutes bottom-tow time. The association between tow times and sea turtle deaths was updated and reanalyzed by Epperly et al. (2002) and Sasso and Epperly (2006), studying seasonal differences in water temperature and the likelihood of mortality. In both warmer and cooler seasons, a rapid escalation in the mortality rate did not occur until after 50 minutes (Sasso and Epperly 2006), confirming the finding of Henwood and Stuntz (1987). There is also a risk of gas embolism and decompression sickness in sea turtles captured in trawls (Fahlman et al. 2017).

Potential sea turtle responses to capture include rapid swimming, diving, biting, and other attempts to escape, and physiological stress. Due to the mitigation measures in place, we anticipate the large majority of sea turtles captured in gillnets and trawl nets would quickly recover from the physiological effects of capture. In most cases, we do not expect injury or mortality because captured sea turtles will have time to recover from any stress associated with 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.

Although the risk of serious injury or mortality from capture in entanglement (gill) nets and trawl nets is low, there is still the potential for this to occur in a small number of turtles. The proposed research permit authorizes the following levels of lethal take (i.e., mortality) of sea turtles from capture in trawls or gillnets: Kemp’s ridley – up to 6 annually but no more than 6 total over the five-year permit; Northwest Atlantic DPS loggerhead – up to 6 annually or 6 total over the five-year permit; green - up to 1 annually or 1 total over the five-year permit; leatherback - up to 1 annually or 1 total over the five-year permit; hawksbill - up to 1 annually or 1 total over the five-year permit. Sea turtle mortalities resulting from the proposed action could include any combination of juveniles, subadults, or adults.

The anticipated effects of proposed sampling of sea turtles (e.g., biopsy, PIT and Inconel flipper tagging, restraining, measuring, weighing) are expected to be minimal, and are not likely to manifest into any long-term adverse effects, reduced fitness, or mortality (NMFS 2017b). Only minor short-term stress, discomfort, pain, and chance of infection are expected during skin biopsy sampling and PIT and flipper tagging. Risk of infection would be minimized by the standard measures in the draft permit requiring the use of aseptic practices. In past studies, reactions of sea turtles to sampling has ranged from no reaction to a mild reaction, including pulling away a flipper or minor bleeding at the site. Overall, though, such impacts from handling and sampling are anticipated to be nominal and will be managed with measures designed to keep animals as calm as possible until released. Mitigation measures and research protocols required as a condition of the research permit further reduce the risk and severity of sub-lethal effects from authorized research activities. 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. Consequently, handling and sampling procedures are not expected to result in any additional injury or mortality (NMFS 2017a).

Atlantic Sturgeon

Entanglement in gillnets and trawl nets 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. 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 to mortality and stress (Kahn and Mohead 2010). 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 post release. As a condition of their permit, researchers will be required to take necessary precautions while deploying capture gear to ensure sturgeon are not unnecessarily harmed, including: (1) continuously monitoring nets, (2) removing animals from nets as soon as capture is recognized, and (3) following the required water temperature, minimum DO level, and net set duration permit conditions. These actions are expected to substantially reduce the likelihood of injuring or killing sturgeon during research activities.

Atlantic sturgeon mortality from Northeast Fisheries Observer Program data (NMFS 2013a) collected from commercial otter trawl fisheries has been estimated at five percent Atlantic coast-wide. Contributing to the mortality are commonly extended durations of commercial trawling tows ranging from 60 to 180 minutes. By comparison, the duration of trawling tows for the proposed research is limited to 55 minutes, including 10 minutes of retrieval time. While the proposed tow time is less than the average commercial trawl tow time, it is still greater than the maximum tow times approved by the Permits Division under the sturgeon research programmatic (i.e., 30 minutes), thus elevating the risk of mortality to sturgeon.

Due to the mitigation measures in place, we anticipate the large majority of sturgeon captured would quickly recover from the physiological effects of capture in gillnets and trawl nets (NMFS 2017a). Proposed mitigation measures, including continuously monitoring nets where possible, removing catch from nets when capture is recognized, and following the required water temperature and DO requirements, will substantially reduce the likelihood of mortality or serious injury of sturgeon during capture. In most cases, we do not expect injury or mortality because captured sturgeon will have time to recover from any stress associated with 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.

However, it is not possible to eliminate all risks to sturgeon captured by tangle nets and trawl nets, including the risk of rare entanglement causing gill occlusion and suffocation. The proposed research permit authorizes the following level of lethal take (i.e., mortality) of Atlantic sturgeon from capture in trawls or gillnets during FIS sampling in the southeast portion of the action area: up to 7 mortalities in any one year, and up to 10 total mortalities over the 5-year life of the permit. As discussed above, based on the proposed location of FIS captures, we anticipate the large majority (i.e., around 84% or 8 to 9 fish over 5 years) of these fish would be from the South Atlantic DPS, with a smaller number from the Carolina DPS (i.e., around 11% or 1 to 2 fish over fish years). Given the small total number of anticipated mortalities (i.e., 10) and anticipated stock composition in the study area, there is a low probability of Atlantic sturgeon mortalities from the New York Bight DPS and Chesapeake Bay DPS as a result of capture during FIS sampling. If this were to occur, we would not expect more than one mortality from either of these DPSs over the 5-year life of the permit. Atlantic sturgeon mortalities resulting from the proposed action could include any combination of juveniles (marine interval) (Bain 1997), subadults or adults.

While the capture of Atlantic sturgeon in gillnets and trawls may result in short-term negative effects (i.e., elevated stress levels, net abrasion), with the exception of those very 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 (NMFS 2017a). This conclusion can be reached as long as all of the sampling protocols, mitigation measures, and any other required conditions of the proposed research permit are closely followed by the researchers.

Although generally considered a hardy species, routine handling and sampling procedures (i.e., restraining, moving, measuring, weighing, tagging, and tissue sampling) can result in raised levels of stress in Atlantic sturgeon. Sturgeon are sensitive to handling stress when environmental factors (e.g., water temperatures, dissolved oxygen concentration) are unfavorable, or they have been held for long periods of time. Sturgeon tend to inflate their swim bladder when stressed or handled in air (Moser et al. 2000). If not returned to neutral buoyancy prior to release, they tend to float and would be susceptible to sunburn and bird attacks. Although sturgeon can be sensitive to handling stress, handling of fish by researchers will be kept to a minimum. Sturgeon researchers will follow NMFS recommended research protocols developed by Kahn and Mohead (2010) and endorsed by Damon-Randall et al. (2010) in order to minimize potential handling stress and indirect effects resulting from handling. Permit conditions require that once a fish is captured the total handling time for onboard procedures do not exceed 20 minutes. However, since fish will not need to be anesthetized for the procedures proposed, handling times will be considerably lower (i.e., under two minutes) and recovery times, though variable, are expected to last for approximately 30 seconds on average. Researchers will be required to maintain captured sturgeon in net pens or in onboard aerated tanks until they are processed, at which time they will be transferred to another processing station onboard the research vessel. Following processing, fish will be returned to the net pen for observation to ensure full recovery (return to equilibrium, reaction to touch stimuli, return of full movement) prior to release. While handling can increase stress if done incorrectly, when researchers follow the appropriate protocols the stress of handling does not increase above the initial stress response from capture, and is believed to have no long-term adverse effects on sturgeon.

To limit the chance of infection occurring from tissue sampling, researchers will be required to follow disinfection protocols described in the permit conditions. Based on results from previous studies, this procedure does not appear to result in any injury or long-term adverse effect on Atlantic sturgeon (Kahn and Mohead 2010). Sturgeon bleed very little, if at all, after the procedure, and researchers report healing occurs within days to a couple of weeks. There is also no indication that the removal of such a small portion of the fin impairs the sturgeon’s ability to swim. Thus, while tissue sampling may result in short-term negative effects (i.e., elevated stress levels, bleeding), responses to this activity are not likely to manifest into any long-term adverse effects, reduced fitness, or mortality (NMFS 2017a).

PIT tags, which are biologically inert, have not been shown to cause some of the problems associated with other fish tagging methods such as scarring, tissue damage, or adversely effects on growth and survival (Brännäs et al. 1994). Previous studies have demonstrated that when PIT tags are inserted into animals having large body sizes relative to the tag size, this procedure has no adverse effect on the growth, survival, reproductive success, or behavior of individual animals (Brännäs et al. 1994; Clugston 1996; Elbin and Burger 1994; Hockersmith et al. 2003; Jemison et al. 1995; Skalski et al. 1998). All sturgeon that will be exposed to PIT tagging as part of the proposed action will be relatively large (> 300 mm). While PIT tagging Atlantic sturgeon may result in short-term negative effects (i.e., elevated stress levels, bleeding), responses to this activity are not likely to manifest into any long-term adverse effects, reduced fitness, or mortality (NMFS 2017a).

In summary, the anticipated effects of proposed sampling of Atlantic sturgeon (e.g., biopsy, PIT tagging, restraining, measuring, weighing) are expected to be minimal and are not likely to manifest into any long-term adverse effects, reduced fitness, or mortality (NMFS 2017a). Only minor short-term stress, discomfort, pain, and chance of infection are expected during skin biopsy sampling and PIT tagging. Risk of infection would be minimized by the standard measures in the draft permit requiring the use of aseptic practices. This conclusion can be reached as long as all of the sampling protocols, mitigation measures, and any other required conditions of the proposed research permit are followed by the researchers (NMFS 2017a).

8 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 C.F.R. §402.02). Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA.

During this consultation, we searched for information on future State, tribal, local, or private actions that were reasonably certain to occur in the action area. We conducted electronic searches of business journals, trade journals, and newspapers using Google Scholar, and other electronic search engines. We did not find any information about non-Federal actions other than what has already been described in the Environmental Baseline (Section 6), most of which we expect would continue in the future. In particular, we are reasonably certain that threats associated with climate change, pollution, vessel strike, and bycatch will continue in the future. An increase in these activities could similarly increase the magnitude of their effects on ESA-listed species, and for climate change an increase in the future is considered likely to occur. For many of the activities and associated threats identified in the environmental baseline, and other unforeseen threats, the magnitude of increase and the significance of any anticipated effects remain unknown. The best scientific and commercial data available provide little specific information on any long-term effects of these potential sources of disturbance on populations of ESA-listed species. 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 Species and Designated Critical Habitat that May be Affected (Section 5) and Environmental Baseline (Section 6) sections.

9 INTEGRATION AND SYNTHESIS

The *Integration and Synthesis* section is the final step in our assessment of the risk posed to species and critical habitat as a result of implementing the proposed action and the effects caused by the action that are reasonably certain to occur. In this section, we add the *Effects of the Action* (Section 7) to the *Environmental Baseline* (Section 6) and the *Cumulative Effects* (Section 8) to formulate the agency's biological opinion as to whether the proposed action is likely to: (1) reduce appreciably the likelihood of both the survival and recovery of a ESA-listed species in the wild by reducing its numbers, reproduction, or distribution; or (2) reduce appreciably the value of designated critical habitat for the conservation of the species. These assessments are made in full consideration of the *Status of the Species Likely to be Adversely Affected* (Section 5.2).

The following discussions separately summarize the probable risks the proposed action poses to threatened and endangered species as described above.

9.1 Jeopardy Analysis

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

9.1.1 Atlantic Sturgeon

In 2012, NMFS listed five DPSs of Atlantic sturgeon under the ESA. The Gulf of Maine DPS is currently listed as threatened while the New York Bight, Chesapeake Bay, Carolina, and South Atlantic DPSs are currently listed as endangered. Primary threats contributing to the sharp decline of Atlantic sturgeon populations in the 20th century were commercial fisheries, habitat curtailment, and alteration from dams and dredging. Efforts made over the past few decades to reduce the impact of these threats have slowed the rate of decline for many sturgeon populations. While fisheries bycatch, vessel strikes, and impingement and entrainment still represent sources of mortality, the impact of these activities on sturgeon populations 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.

The proposed action would have both sublethal and lethal adverse effects on Atlantic sturgeon. Based on our sturgeon exposure and response analysis (Section 7.2), we determine that sub-lethal effects on Atlantic sturgeon resulting from handling and research procedures authorized under the proposed research permit will be minimal, short-term, and are not likely to result in any reduced fitness or loss of fecundity to individual fish. Similarly, while the capture of Atlantic sturgeon in gillnets and trawls may result in short-term negative effects (i.e., elevated stress levels, net abrasion), with the exception of those very rare instances of mortality, the capture methods proposed are not expected to result in reduced fitness or have any long-term adverse effects on individual sturgeon. Our conclusion regarding the minimal impact of sublethal adverse effects are based on the commitment by researchers during the permitting process to adhere to the required mitigation measures and research protocols specified in the permit for avoiding and minimizing adverse effects on Atlantic sturgeon.

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 sturgeon, mortality of juveniles or subadults affects future reproductive potential and could have effects on a population for decades. Given their large body size and high fecundity, mortality of adult sturgeon can result in negative population-level impacts, particularly in very small Atlantic sturgeon populations typical of many river systems throughout their range.

The proposed research permit authorizes the following level of lethal take (i.e., mortality) of Atlantic sturgeon from capture in trawls or gillnets during FIS sampling in the southeast portion of the action area: up to 7 mortalities in any given year, and up to 10 mortalities over the 5-year life of the permit. Of these mortalities, we expect no more than 9 would be from the South Atlantic DPS, 2 from the Carolina DPS, 1 from the New York Bight DPS, and 1 from the Chesapeake Bay DPS. Given the proposed study area, mortalities would likely be of subadult and adult Atlantic sturgeon. Since all sampling will occur on the Atlantic coast (and not in rivers or estuaries), we anticipate that the mortalities for a given DPS would be distributed across the different river system populations proportional to the relative abundance within each river system. For example, we would expect the large majority of South Atlantic DPS mortalities would be from fish originating in the Altamaha River, Savannah River, and ACE Basin (i.e., Ashepoo, Combahee and Edisto rivers), with very few (if any) originating from smaller systems that comprise this DPS.

Based on available information for the genetic composition and the estimated abundance of Atlantic sturgeon in marine waters, NMFS (2013a) estimated the subadult and adult abundance of each DPS as follows: Gulf of Maine 7,455; New York Bight 34,566; Chesapeake Bay 8,811; Carolina 1,356; and South Atlantic 14,911. Considering the anticipated levels of lethal take for each DPS, the proposed action would result in the mortality of less than 0.2 percent of the total subadult and adult population of any DPS over the 5-year permit. This level of relative mortality, which likely represent a conservative upper limit based on the assumption that all authorized lethal takes would be used, is not expected to significantly affect the viability of any of the Atlantic sturgeon DPSs.

The impacts expected to occur on Atlantic sturgeon DPSs in the action area are not anticipated to result in appreciable reductions in overall reproduction or numbers. Therefore, we do not anticipate any measurable or detectable reductions in survival rate or trajectory of recovery of any ESA-listed Atlantic sturgeon DPS. In addition, no reduction in the distribution or current geographic range of Atlantic sturgeon DPSs is expected as a result of the proposed action. Based on the evidence available, including the Environmental Baseline, Effects of the Action, and Cumulative Effects, effects resulting from stressors caused by issuance of the proposed research permit to the NEFSC, would not be expected to appreciably reduce the likelihood of the survival of any of the Atlantic sturgeon DPSs (i.e., Gulf of Maine, New York Bight, Chesapeake Bay, Carolina, or South Atlantic) in the wild by reducing the reproduction, numbers, or distribution of these populations. We also conclude that effects from issuance of the proposed research permit to the NEFSC would not be expected, directly or indirectly, to appreciably reduce the likelihood of recovery of any of the Atlantic sturgeon DPSs in the wild by reducing the reproduction, numbers, or distribution of this species.

9.1.2 Sea Turtles

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. Bycatch reduction devices have reduced the incidental take of sea turtles in many U.S. commercial fisheries, including those operating within the action area. TEDs, which are required in federal shrimp trawl fisheries, are estimated to have reduced mortality of sea turtles by approximately 95 percent (NMFS 2014). Mitigation measures required in other federal and state fisheries (e.g., gillnet, pelagic longline, pound nets) have also resulted in reduced sea turtle interactions and mortality rates. Increased conservation awareness at the international scale has also 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 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.

While sea turtle populations are still at risk, efforts made over the past few decades to reduce the impact of the major threats have slowed the rate of decline. Abundance trends for several populations (or subpopulations) of ESA-listed sea turtles are currently reported as being stable or increasing based on trends in estimated adult female nesters. These include the green turtle North Atlantic DPS which has shown an increasing population trend in recent years, the loggerhead Northwest Atlantic DPS which is reported as having a stable population trend, and the Northwest Atlantic leatherback subpopulation which is also reported as having a stable population trend

(NMFS 2022e). It is likely that some current threats to sea turtles, such as global climate change, will increase in the future. Marine debris and habitat degradation could also increase, while other threats are likely to remain at current levels or possibly decrease. However, it is difficult to predict the magnitude of sea turtle threats in the future or their impact on sea turtle populations.

The proposed action would have both sublethal and lethal effects on ESA-listed sea turtles. Based on our exposure and response analysis (Section 7.2), we determine that sub-lethal effects on sea turtles resulting from handling and research procedures authorized under the proposed action will be minimal, and are not likely to manifest into any long-term adverse effects, reduced fitness, or mortality. Only minor short-term stress, discomfort, pain, and chance of infection are expected during skin biopsy sampling and PIT and flipper tagging. Similarly, while the capture of sea turtles in gillnets and trawls may result in short-term negative effects (i.e., elevated stress levels, net abrasion), with the exception of those very rare instances of capture mortality, these activities are not expected to result in reduced fitness or have any long-term adverse effects on individual sea turtles. Our conclusion regarding the minimal impact of sublethal effects are based on the assumption that researchers will adhere to the required mitigation measures and research protocols specified in the permit for avoiding and minimizing adverse effects on ESA-listed sea turtles.

The proposed research permit authorizes the following levels of lethal take (i.e., mortality) of sea turtles from capture in trawls or gillnets: Kemp's ridley – up to 6 annually or 6 total over the five-year permit; Northwest Atlantic DPS loggerhead – up to 6 annually or 6 total over the five-year permit; green - up to 1 annually or 1 total over the five-year permit; leatherback - up to 1 annually or 1 total over the five-year permit; hawksbill - up to 1 annually or 1 total over the five-year permit. Sea turtle mortalities resulting from the proposed action could include any combination of juveniles, subadults, or adults. The mortality of any individual sea turtle from a population represents the loss of 100 percent of that turtle's reproductive potential. Mortality of an adult female nester can result in negative population levels impacts. For long-lived species, such as sea turtles, mortality of juveniles or subadults affects future reproductive potential and could have effects on a population for decades. However, for all five species (or DPSs), the authorized number of lethal takes in the proposed research permit represents an extremely small fraction of the estimated population size.

For the Kemp's ridley sea turtle an estimated nesting female abundance of 4,872 was derived from information in the most recent 5-year status review for this species (NMFS and USFWS 2015). Even if all mortalities from the proposed action were nesting females, the lethal take of six Kemp's ridley turtles would represent the loss of less than 0.15 percent of the nesting female population over a five year period. This extremely low estimated mortality rate will not result in an appreciable reduction in overall reproduction, numbers, or distribution of this species. It is also highly conservative since mortalities would likely include a mix of juveniles, adult males, and adult females.

The adult female population size of the loggerhead Northwest Atlantic DPS is estimated at 20,000 to 40,000 females (NMFS 2009). Even if all mortalities from the proposed action were nesting females, the lethal take of six loggerhead turtles would represent the loss of less than 0.04 percent of the nesting female population (based on the lower limit of estimated abundance) over a five year period. This extremely low estimated mortality rate will not result in an appreciable reduction in overall reproduction, numbers, or distribution of this DPS. It is also highly conservative since mortalities would likely include a mix of juveniles, adult males, and adult females.

For the North Atlantic DPS green turtle the estimated nesting female abundance based on the latest 5-year status review is 167,424 (Seminoff et al. 2015b). The lethal take of one green turtle over five years will not result in an appreciable reduction in overall reproduction, numbers, or distribution of this species.

The estimated total index of nesting female abundance for the Northwest Atlantic leatherback population is 20,659 females (NMFS and USFWS 2020). The lethal take of one leatherback turtle over five years will not result in an appreciable reduction in overall reproduction, numbers, or distribution of this species.

Based on data from hawksbill sea turtle nesting sites worldwide, this species has an estimated 22,000 to 29,000 annual female nesters (NMFS 2013b). The lethal take of one hawksbill turtle over five years will not result in an appreciable reduction in overall reproduction, numbers, or distribution of this species.

Based on the evidence available, including the Environmental Baseline, Effects of the Action, and Cumulative Effects, effects resulting from stressors caused by the proposed issuance of a research permit to the NEFSC, would not be expected to appreciably reduce the likelihood of the survival of the following ESA-listed sea turtles in the wild by reducing the reproduction, numbers, or distribution of these populations: green sea turtle – North Atlantic DPS; hawksbill sea turtle; Kemp’s ridley sea turtle; leatherback sea turtle; and loggerhead sea turtle – Northwest Atlantic DPS. We also conclude that effects from the proposed issuance of a research permit to the NEFSC would not be expected, directly or indirectly, to appreciably reduce the likelihood of recovery of the following ESA-listed sea turtles in the wild by reducing the reproduction, numbers, or distribution of this species: green sea turtle – North Atlantic DPS; hawksbill sea turtle; Kemp’s ridley sea turtle; leatherback sea turtle; and loggerhead sea turtle – Northwest Atlantic DPS. Therefore, we do not anticipate any measurable or detectable reductions in survival rate or trajectory of recovery of any ESA-listed sea turtle species or DPS.

10 CONCLUSION

After reviewing the current status of the ESA-listed species, the environmental baseline within the action area, the effects of the proposed action, and cumulative effects, it is NMFS' biological opinion that the proposed action is not likely to jeopardize the continued existence of: green sea turtle – North Atlantic DPS; hawksbill sea turtle; Kemp's ridley sea turtle; leatherback sea turtle; loggerhead sea turtle – Northwest Atlantic DPS; Atlantic sturgeon - Gulf of Maine DPS, New York Bight DPS, Chesapeake Bay DPS, South Atlantic DPS, and Carolina DPS.

It is also NMFS' biological opinion that the proposed action is not likely to adversely affect the following ESA-listed species and critical habitat: shortnose sturgeon; smalltooth sawfish – U.S. portion of range DPS; giant manta ray; oceanic whitetip shark; blue whale, fin whale, sei whale, sperm whale; North Atlantic right whale; North Atlantic right whale designated critical habitat; and loggerhead sea turtle Northwest Atlantic DPS designated critical habitat. Therefore, the action is not likely to jeopardize any of these species or result in the destruction or adverse modification of these designated critical habitats.

11 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. NMFS has issued interim guidance on the term "harass," defining it as to "create the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding, or sheltering" (NMFS 2016b).

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.

Since we determined that all take resulting from the proposed action would be directed take, there is no ITS associated with this opinion.

12 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 C.F.R. §402.02). There are no conservation recommendations associated with this action.

13 Reinitiation Notice

This concludes formal consultation on the Permits Division's proposed action to issue a permit (Permit No. 24387) to the NEFSC for bycatch reduction research on sea turtles and Atlantic sturgeon pursuant to section 10(a)(1)(A) of the Endangered Species Act of 1973. Consistent with 50 C.F.R. §402.16(a), reinitiation of formal consultation is required and shall be requested by the Federal agency or by the Service, where discretionary Federal involvement or control over the action has been retained or is authorized by law and:

(1) The amount or extent of taking or the surrogate specified in the ITS 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 previously considered.
(3) The identified action is subsequently modified in a manner that causes an effect to the listed species or designated critical habitat that was not considered in this opinion.
(4) A new species is listed, or critical habitat designated under the ESA that may be affected by the action.

14 References

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