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

Title: Biological Opinion and Conference on the Bureau of Ocean Energy Management's Proposal to Fund a Study on Shoal Ecosystem Dynamics at Frying Pan Shoals, North Carolina

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

Action Agency: U.S. Department of Interior, Bureau of Ocean Energy Management, Office of Strategic Resources

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1 INTRODUCTION

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

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

The action agency for this consultation is the Bureau of Ocean Energy Management (BOEM). BOEM proposes to fund research activities on shoal ecosystem dynamics at Frying Pan Shoals, North Carolina.

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

On July 5, 2022, the U.S. District Court for the Northern District of California issued an order vacating the 2019 regulations that were revised or added to 50 C.F.R. part 402 in 2019 ("2019 Regulations," see 84 FR 44976, August 27, 2019) without making a finding on the merits. On September 21, 2022, the U.S. Court of Appeals for the Ninth Circuit granted a temporary stay of the district court's July 5 order. On November 14, 2022, the Northern District of California issued an order granting the government's request for voluntary remand without vacating the 2019 regulations. The District Court issued a slightly amended order 2 days later on November

16, 2022. As a result, the 2019 regulations remain in effect, and we are applying the 2019 regulations here. For purposes of this consultation and in an abundance of caution, we considered whether the substantive analysis and conclusions articulated in the biological opinion and incidental take statement would be any different under the pre-2019 regulations. We have determined that our analysis and conclusions would not be any different.

This document represents the NMFS opinion on the effects of these actions on five distinct population segments (DPS) of Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*; Gulf of Maine, New York Bight, Chesapeake, Carolina, and South Atlantic DPSs), shortnose sturgeon (*Acipenser brevirostrum*), giant manta ray (*Manta birostris*), North Atlantic DPS green turtle (*Chelonia mydas*), Northwestern Atlantic DPS loggerhead sea turtle (*Caretta caretta*), leatherback sea turtle (*Dermochelys coriacea*), Kemp's ridley sea turtle (*Lepidochelys kempii*), hawksbill sea turtle (*Eretmochelys imbricata*), North Atlantic right whale (*Eubalaena glacialis*), fin whale (*Balaenoptera physalus*), sei whale (*Balaenoptera borealis*), and proposed critical habitat for North Atlantic Ocean DPS green sea turtle. A complete record of this consultation is on file electronically at the NMFS Office of Protected Resources in Silver Spring, Maryland.

1.1 Background

BOEM oversees conventional and renewable energy and marine mineral resource activities on the nation's Outer Continental Shelf. BOEM sponsors environmental and socioeconomic studies needed to understand and manage the environmental impacts caused by offshore energy and marine minerals activities.

BOEM is funding the proposed project to study the physical and biological characteristics of Frying Pan Shoals, a cape-associated shoal off Cape Fear in Southeastern North Carolina, to better understand impacts from potential dredging in the future. One of the primary objectives is to study fish ecology, particularly associations with habitats of Frying Pan Shoals. Along with other Federally-managed fish species, the proposed capture methods could take Atlantic sturgeon, protected under the ESA. The range of other ESA-listed species, in particular ESA-listed sea turtles, overlaps spatially and temporally with activities that will be conducted as part of BOEM's activity.

Dr. Fred Scharf, a Principal Investigator (PI) for this project, is also the Responsible Party for an existing ESA Section 10(a)(1)(A) Permit No. 23200-01 issued to the University of North Carolina, Wilmington, for Atlantic sturgeon research activities in the coastal rivers and estuaries of North Carolina basins, including directed take of Atlantic sturgeon. Directed take research on Atlantic sturgeon has been analyzed in a previous 2017 programmatic consultation for sturgeon research (FPR-2016-9176; imported to ECO as OPR-2016-00009) and the 2022 reinitiation (OPR-2021-03447). This consultation analyzes incidental take of threatened and endangered species as part of BOEM's action.

1.2 Consultation History

This opinion is based on information provided in the biological assessment BOEM prepared for this consultation (BOEM 2023). Our communication with the BOEM regarding this consultation is summarized as follows:

- **February 2023**: BOEM and NMFS engaged in technical assistance on the development of the biological assessment.
- **March 15, 2023**: BOEM submitted initiation materials to the NMFS Southeast Region Office.
- **March 31, 2023**: The consultation was transferred from the Protected Resources Division of the Southeast Regional Office to the NMFS Office of Protected Resources, ESA Interagency Cooperation Division in Silver Spring, Maryland.
- **April 25, 2023**: BOEM and NMFS met to discuss the action, and to share conservation measures to incorporate into the proposed action.
- **May 10, 2023**: We determined the initiation package was complete and initiated consultation with BOEM as of March 31, 2023.

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 will 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.

This ESA section 7 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 and designated and proposed critical habitat.

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

Endangered Species Act-Listed Species and Proposed or Designated Critical Habitat Present in the Action Area (Section 5): We identify the ESA-listed species and designated and proposed critical habitat that are likely to co-occur with the stressors produced by the proposed action in space and time.

Potential Stressors (Section 6): We identify the stressors that could occur as a result of the proposed action and affect ESA-listed species and designated critical habitat. We include a section (Section 7.1) for stressors that are not likely to adversely affect the species that are analyzed further in this opinion.

We also identify those *Species and Critical Habitat Not Likely to be Adversely Affected* and detail our effects analysis for these species and critical habitats (Sections 7.2 and 7.3).

Status of Species Likely to be Adversely Affected (Section 8): We examine the status of each species that may be adversely affected by the proposed action.

*Environmental Baseline (*Section 9): We describe the environmental baseline in the action area as the condition of the listed species in the action area, without the consequences to the listed species 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 from ongoing agency activities or existing agency facilities that are not within the agency's discretion to modify are part of the environmental baseline.

Effects of the Action (Section 10): We evaluate the effects of the action on ESA-listed species. 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 will not occur but for the proposed action and 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 (50 C.F.R § 402.02). These are broken into analyses of exposure, response, and risk, as described below for the species that are likely to be adversely affected by the action.

Exposure, Response, and Risk Analyses (Sections 10.2, 10.3, and 10.4): We identify the number, age (or life stage), and sex of ESA-listed individuals that are likely to be exposed to the stressors and the populations or subpopulations to which those individuals belong. This is our exposure analysis. We evaluate the available evidence to determine how individuals of those ESA-listed species are likely to respond given their probable exposure. This is our response analysis (Section 10.3). We assess the consequences of these responses of individuals that are likely to be exposed to the populations those individuals represent, and the species those populations comprise. This is our risk analysis (Section 10.4).

Cumulative Effects (Section 11): 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 that are reasonably certain to occur within the action area (50 C.F.R. §402.02). Effects from future Federal actions that are unrelated to the proposed action are not considered because they require separate ESA section 7 compliance.

Integration and Synthesis (Section 12): 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 will reasonably be expected to:

- Reduce appreciably the likelihood of survival and recovery of ESA-listed species in the wild by reducing its numbers, reproduction, or distribution, and state our conclusion as to whether the action is likely to jeopardize the continued existence of such species.

The results of our jeopardy and destruction and adverse modification analyses are summarized in the *Conclusion* (Section 13). If, in completing the last step in the analysis, we determine that the action under consultation is likely to jeopardize the continued existence of ESA-listed species or destroy or adversely modify designated critical habitat, then we must identify Reasonable and Prudent Alternative(s) to the action, if any, or indicate that to the best of our knowledge there are no reasonable and prudent alternatives (see 50 C.F.R. §402.14(h)(3)).

An *Incidental Take Statement* (Section 14) is included for those actions for which take of ESA-listed species is reasonably certain to occur in keeping with the revisions to the regulations specific to ITSs (80 FR 26832, May 11, 2015: ITS rule). The ITS specifies the impact of the take, reasonable and prudent measures to minimize the impact of the take, and terms and conditions to implement the reasonable and prudent measures (ESA section 7 (b)(4); 50 C.F.R. §402.14(i)).

We also provide discretionary *Conservation Recommendations* (Section 15) that may be implemented by action agency (50 C.F.R. §402.14(j)). Finally, we identify the circumstances in which *Reinitiation of Consultation* (Section 16) is required (50 C.F.R. §402.16).

2.1 Evidence Available for the Consultation

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

- Information submitted by BOEM;
- Government reports (including NMFS biological opinions and stock assessment reports);
- NOAA technical memos; and
- Peer-reviewed scientific literature.

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

3 DESCRIPTION OF THE PROPOSED ACTION

"Action" means all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by federal agencies (50 C.F.R. § 402.02).

BOEM proposes to fund a project to study the physical and biological characteristics of Frying Pan Shoals, a cape-associated shoal off Cape Fear, North Carolina. The purpose of this study is to better understand impacts from potential dredging in the future, and to study fish ecology, particularly associations with Frying Pan Shoals.

The information presented here is based primarily on the biological assessment provided by BOEM as part of the initiation package (BOEM 2023).

3.1 Proposed Activities

In order to achieve the research objectives, there are four main components to the action:

1. Geophysical and geological surveys: Characterize shoal morphology and sedimentary attributes (Completed, Consultation PCTS # NER-2018-15093 [ECO: GARFO-2018-00323]);
2. Oceanographic Observations: Field deployment and measurements to support subsequent modeling of sediment transport and oceanographic dynamics associated with the shoal and nearby river plume;
3. Benthic and Plankton Sampling: Collection of surface sediment, benthos, and plankton for baseline characterization; and
4. Fish Sampling: Collection, identification, and tracking of coastal fishes in the vicinity of the shoal.

In preparation for the survey, and to characterize the shoal morphology and sedimentary attributes area, BOEM previously conducted geophysical and geological surveys. BOEM requested consultation on their geological and geophysical surveys to support identification, delineation, monitoring, and scientific investigation of sand resources in the Atlantic and Gulf of Mexico Outer Continental Shelf. The NMFS Greater Atlantic Regional Fisheries Office responded with a letter of concurrence, concluding that BOEM's action was not likely to adversely affect any ESA-listed species or critical habitat (see consultation record PCTS # NER-2018-15093 [ECO: GARFO-2018-00323]). Because the first component of the research was previously consulted upon, and we are not aware of any new information that changes our understanding of the effects of that portion of the action, it will not be reevaluated in this consultation but is included in the environmental baseline. This consultation focuses on the three remaining components of BOEM's proposed action: oceanographic observations, benthic and plankton sampling, and fish sampling.

3.1.1 Duration and Timing of Research

The three components of the considered in this consultation will begin in 2023, and end in 2025. Fieldwork will be conducted seasonally four times a year (one sampling event in each of the seasons: spring, summer, fall, and winter) in 30-day increments, for a total of 10 sampling events over the course of the proposed action.

3.1.2 Oceanographic Observations

The oceanographic observations proposed will involve the field deployment of moored buoys and instrumentation that will take measurements to support subsequent modeling of sediment transport and oceanographic dynamics associated with the shoal and nearby river plume. Free-floating drifters will also be deployed to track ocean currents.

Ten fixed instruments will be used during each sampling event. Five moorings will be equipped with a combination of oceanographic measurement devices to include a current, temperature, and depth instrument, an acoustic Doppler current profiler, and/or temperature/salinity instruments. These instruments will be housed within a frame, and moored to a 363 kilogram concrete anchor attached with approximately 10 meters of floating line with a whale-safe link to a surface marker (Figure 1a).

The other five fixed instruments used as part of the oceanographic observation research will be wave-observing buoys. Wave-observing buoys will be chain-anchored to the seafloor with a whale-safe weak link with two surface flats, requiring about 10 meters of floating line between the anchor and first float, then two sections of approximately 20 meters of floating line between the next float and the buoy (Figure 1b). The chain anchor weighs 57 kilograms. Weak links used in all equipment have a breaking strength that is in compliance with NMFS regulations.

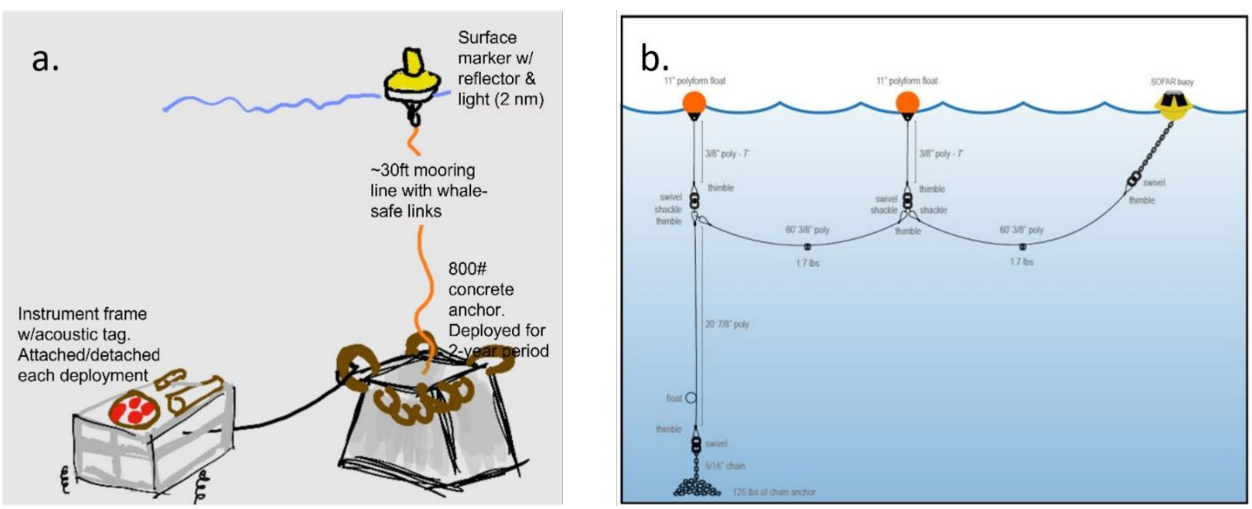

Figure 1. Oceanographic observation instrumentation diagrams. 1a. Configuration for fixed mooring. 1b. Configuration for wave-observing buoys.

Moorings, buoys, and instrumentation will be deployed over 3 days and then retrieved over 3 days during the course of a 30-day sampling event. All concrete anchors will be removed at the conclusion of the study.

The proposed action will also deploy 10 near-surface drifters during 1 sampling season. The drifters are 30.5 centimeters in diameter and 61 centimeters tall, free-floating just beneath the ocean's surface. They are equipped with a GPS location device, and used to characterize surface ocean currents. At the end of the sampling season, the drifters will be tracked and recovered.

3.1.3 Benthic and Plankton Sampling

To conduct a baseline characterization of the benthos of Frying Pan Shoals, the proposed action will collect surface sediment, benthic organisms, and plankton. This will involve sediment sampling, plankton and ichthyoplankton collection, and the use of holographic imaging equipment to assess plankton in the action area.

Sediment and benthic infauna sampling will occur at 10 offshore stations within Frying Pan Shoals, with 4 replicates taken at each station. A Petite Ponar grab sampler (6.8 kilograms; 0.15 by 0.15 meters) will be used.

Plankton and ichthyoplankton sampling will be conducted at 15 offshore stations using nets. Plankton stratified net tows will occur at 2 depth strata using close-open-close nets by General Oceanics (100 centimeters in diameter) and neuston nets (similar in size to close-open-close nets). The close-open-close nets sample the water column (see Figure 2), while the neuston nets sample along the surface. Ichthyoplankton sampling will also use neuston and close-open-close nets at 15 offshore stations.

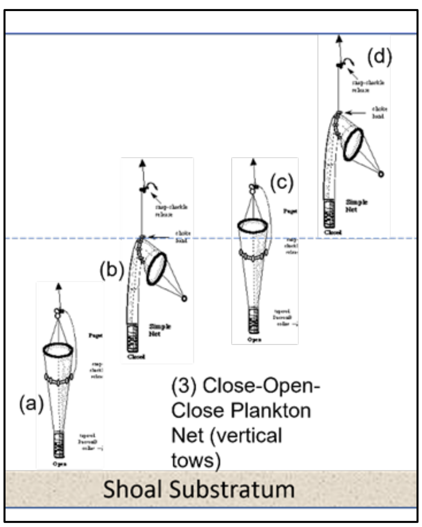

Figure 2. Diagram of close-open-close net

Holographic imaging equipment will be used to investigate plankton abundance and distribution on Frying Pan Shoals. The holographic imaging equipment will be a LISST-holo2 by Sequoia Scientific (13.3 by 76.7 centimeters; 1 kilogram in water). The device will be towed through the water on a <50-meter line, or on a <30-meter line if used to obtain a vertical profile. During this profiling, the vessel will be traveling at less than 4 knots between sample stations.

3.1.4 Fish Sampling

Fish sampling will be conducted as part of the proposed action to collect, identify, and track fishes in the vicinity of the shoal. Fish sampling will occur for 2 to 3 days during each seasonal sampling event. Each gear type will be used in every sampling event. The sampling will involve the use of a variety of capture techniques, handling, measuring, and sampling of captured target species, as well as the deployment of moored acoustic receivers.

The location of the sampling will influence the target species, and the gear used. Small, juvenile fishes will be targeted for capture using 7.6-meter semi-balloon otter trawl in waters less than 15 meters deep. Larger fishes will be targeted for capture using a 20-meter commercial otter trawl and longlines, used in waters greater than 15 meters deep. Sampling effort for each gear type will occur at 25 to 30 sites per season, for a maximum of 300 tows/sets for the entire proposed action.

Small, juvenile fishes will be targeted using the semi-balloon otter trawl that will be towed for 10 minutes at 1.5 to 2.0 knots. Larger fishes will be targeted using a 20-meter commercial otter trawl and longlines. The 20-meter commercial otter trawl will be towed for less than 20 minutes (bottom time) at 3.0 to 3.5 knots. Longlining will use 600-meters of 272-kilogram test monofilament with about 40 hooks (6/0 to 15/0 circle hooks [approximately 13 to 30 millimeter spacing between the hook and shank]) for 1-hour soak times, fished at the ocean bottom.

Captured fish will be handled, identified, measured, and have a genetic tissue sample taken (i.e., fin clip for genetic analysis). The larger fishes will be sampled for further research (e.g., measured, tissue sampled, and internally tagged). Fishes for internal tagging to include red drum (*Sciaenops ocellatus*), several coastal sharks (blacknose [*Carcharhinus acronotus*], sandbar [*C. plumbeus*], and blacktip [*C. limbatus*]), cobia (*Rachycentron canadum*), and southern flounder (*Paralichthys lethostigma*). Because of their expected presence in the action area, ESA-listed Atlantic sturgeon may also be captured during fish sampling. All handling, holding, sampling, measuring, and release of Atlantic sturgeon will be done in accordance with sturgeon handling protocols (Kahn 2010).

Twenty moored acoustic receivers will be deployed year-round in the study area. Each acoustic receiver will be anchored to the seafloor; the preferred plan is to use a very short line (~2 meters) to a float and use an acoustic release and retrieval system; if this design is not feasible at the study area, the anchor will have a 10-meter of floating line to a surface float and include a whale-safe weak link.

3.1.5 Sampling Sites

There are 15 sampling sites within the action area where biological sampling will occur (i.e., the benthic, plankton, and fish sampling). Nine sites are on Frying Pan Shoals itself (“on-Shoal sites”) and 6 are further off the shoals (“off-Shoal sites; Figure 3). The depth ranges for the on-Shoal sites is between 1 meter to 9 meters. For the off-Shoal sites, the water depths reach up to 30 meters. The purpose in having sampling sites on and off Frying Pan Shoals is to better understand the potential connectivity between the shoal habitat and the surrounding area.

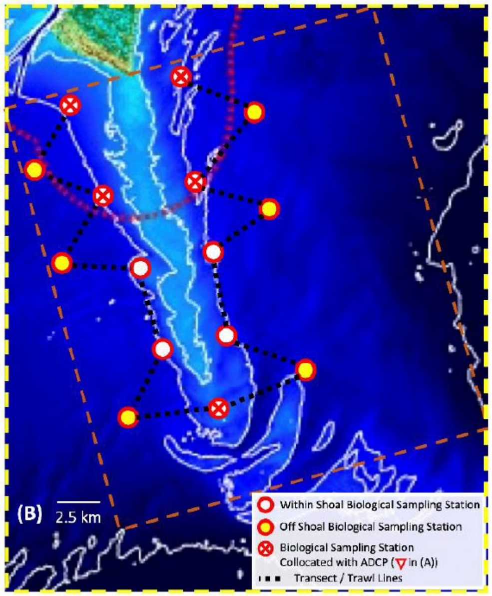

Figure 3. Sampling sites on Frying Pan Shoals

Figure 3 also shows the general path of the transect and trawling that will occur as part of the proposed action.

3.1.6 Vessel Activity

There are 2 research vessels that will be used as part of the proposed action.

- Research Vessel (R/V) *Cape Fear*
  - Length overall: 6.4 meters
  - Draft: 2 meters
  - Maximum transit speed: 10 knots
  - Used in the Fish Sampling research
- R/V *Sea Hawk*
  - Length overall: 10.4 meters
  - Draft: 1 meter
  - Maximum transit speed: 20 knots
  - Used in the Oceanographic Observation and Benthic and Plankton research

Transit speed for all vessels is not anticipated to exceed 20 knots. Vessels will transit from Wilmington, North Carolina, to the fieldwork site of Frying Pan Shoals, approximately 28 nautical miles in each direction. The route will use the Cape Fear River.

3.1.7 Conservation Measures

BOEM will implement a variety of conservation measures as part of its proposed action to limit the effects of its research activities on the environment. These conservation measures will lead to avoidance and minimization of potential effects to ESA-listed species and designated and proposed critical habitat in the action area to assist in the conservation of these resources.

3.1.7.1 Minimize Collision with Vessels

- Observer Requirements – Protected species observers (PSOs) and/or individuals with experience and/or training to ensure effectiveness of protocol, i.e., an individual maintaining dedicated watch during transit and operation.
- Adhere to Vessel Strike Avoidance Protocol ‑vessel speed limits and minimum distances to reduce risk of vessel interaction with protected species (e.g., 10-knot vessel speed limit during transit in North Atlantic right whale critical habitat during calving season; BOEM 2023).
- If PSOs observe ESA-listed marine mammals, sea turtles, or fishes, vessel operators and crew must slow down or stop the vessel, or alter course if animals are within the distances described below, to avoid striking such animals. These requirements apply when the vessel is in transit and while conducting research, but do not apply when compliance will create an imminent and serious threat to a person or vessel.
- If an ESA-listed whale is identified within 500 yards of the forward path of the vessel:
  - All vessels must steer a course that increases the distance from the whale at a speed of 10 knots or less until the 500 yard minimum separation distance has been established.
- If an ESA-listed whale is sighted within 100 yards of the forward path of a vessel:
  - The vessel operator must reduce speed and shift the engine to neutral. Engines must not be engaged until the whale has moved outside of the vessel's path and beyond 500 yards. If stationary, the vessel must not engage engines until the ESA-listed whale has moved beyond 500 yards. A single cetacean at the surface may indicate the presence of submerged animals near the vessel; therefore, precautionary measures should always be exercised.
- If one or more cetaceans (whales, dolphins, or porpoises) are sighted while a vessel is underway:
  - Attempt to remain parallel to the animal's course, if feasible. Avoid excessive speed or abrupt changes in direction until the cetacean has left the area.
- If one or more sea turtles are sighted while the vessel is underway:
  - Attempt to maintain a distance of 50 yards or greater from the animal(s) whenever possible.

3.1.7.2 Avoid Impacts to Live Bottom Habitat

- Instrument Deployment: Ensure that all instruments placed in contact with the seafloor are properly secured to minimize bottom disturbance and not in areas of live habitat (e.g., seagrass). Use retrievable instruments, when possible, to avoid abandoning deployed equipment on the seafloor.

3.1.7.3 Avoid or Minimize Impacts to Species during In-Water Work

- If there is a sighting of any ESA-listed species within 100 yards of the work area:

  - Suspend deployment of all instruments or gear. Work already in progress may continue if that activity is not expected to adversely affect the animal(s).

3.1.7.4 Minimize Vessel Waste and Discharge

- Adhere to BOEM Marine Pollution Control Plan ‑proactive plan to manage accidental discharges or spills
- Adhere to BOEM Marine Debris Awareness Program ‑proactive plan to manage trash and debris (BOEM 2023).

3.1.7.5 Minimize Entanglement

- Operators will keep lines, cables, chains, and ropes taut to avoid creating loops and suspensions.
- Stiff line materials should be used for towing and kept taut during operations.
- At all times during equipment/buoy deployment, maintenance, or retrieval of equipment/buoy:
  - Ensure that any equipment/buoys attached to the seafloor use the best available mooring systems. All mooring lines and ancillary attachment lines must use one or more of the following measures to reduce entanglement risk: shortest practicable line length, rubber sleeves, weak-links, chains, cables or similar equipment types that prevent lines from looping, wrapping, or entrapping protected species. Buoys, lines (chains, cables, or coated rope systems), swivels, shackles, and anchor designs must prevent any potential entanglement of listed species while ensuring the safety and integrity of the structure or device. When possible, field crews should use retrievable equipment to avoid abandoning material on the seafloor.
  - During all equipment/buoy deployment and retrieval operations, equipment/buoys should be lowered and raised slowly to minimize risk to listed species and benthic habitat. Additionally, PSOs should monitor for listed species in the area prior to and during deployment and retrieval and work should be stopped if listed species are observed in the area to minimize entanglement risk.
- All buoys and/or surface markers must be properly labeled with owner and contact information.

3.1.7.6 Handling Protocols for Incidentally Caught ESA-Species

- Report interactions to nmfs.gar.incidental-take@noaa.gov and nmfs.hq.esa.consultations@noaa.gov.
- All captured sturgeon must be handled in accordance with the procedures outlined in "A Protocol for Use of Shortnose, Atlantic, Gulf, and Green Sturgeons" by Kahn and Mohead 2010.
- In the event a sea turtle is captured, adhere to sea turtle handling and release guidelines at 50 C.F.R. § 233.206, Handling and Resuscitation Requirements.

- Any specimen taken incidentally during the course of fishing or scientific research activities must be handled with due care to prevent injury to live specimens, observed for activity, and returned to the water according to the following procedures:
    - Sea turtles that are actively moving or determined to be dead as described in paragraph (d)(1)(i)(C) of this section must be released over the stern of the boat. In addition, they must be released only when fishing or scientific collection gear is not in use, when the engine gears are in neutral position, and in areas where they are unlikely to be recaptured or injured by vessels.
    - Resuscitation must be attempted on sea turtles that are comatose, or inactive, as determined in paragraph (d)(1) of this section, by:
        - Placing the turtle on its bottom shell (plastron) so that the turtle is right side up and elevating its hindquarters at least 6 inches (15.2 cm) for a period of 4 hours and up to 24 hours. The amount of the elevation depends on the size of the turtle; greater elevations are needed for larger turtles.
        - Periodically, rock the turtle gently left to right and right to left by holding the outer edge of the shell (carapace) and lifting one side about 3 inches (7.6 cm) then alternate to the other side.
        - Gently touch the eye and pinch the tail (reflex test) periodically to see if there is a response.
        - Sea turtles being resuscitated must be shaded and kept damp or moist but under no circumstance be placed into a container holding water. A water-soaked towel placed over the head, carapace, and flippers is the most effective method in keeping a turtle moist.
        - Sea turtles that revive and become active must be released over the stern of the boat only when fishing or scientific collection gear is not in use, when the engine gears are in neutral position, and in areas where they are unlikely to be recaptured or injured by vessels. Sea turtles that fail to respond to the reflex test or fail to move within 4 hours (up to 24, if possible) must be returned to the water in the same manner as that for actively moving turtles.
        - A turtle is determined to be dead if the muscles are stiff (rigor mortis) and/or the flesh has begun to rot; otherwise the turtle is determined to be comatose or inactive and resuscitation attempts are necessary.
- Any specimen taken incidentally during the course of fishing or scientific research activities must not be consumed, sold, landed, offloaded, transshipped, or kept below deck.
- Contact the Northeast Marine Mammal and Sea Turtle Standing and Entanglement Hotline at 866-755-NOAA (6622) for further instructions and guidance on handling, retention, and/or disposal of the animal.

3.1.7.7 Reporting Requirements

- Sighting of any injured, dead, or entangled ESA-listed species:
  - Immediately report to NMFS at: https://www.fisheries.noaa.gov/report.
  - Sightings of any injured or dead listed species must be immediately reported, regardless of whether the injury or death is related to survey operations, to NMFS and the appropriate regional NOAA stranding hotline.
    - Marine Mammals and Sea Turtles: 866-755-6622
    - Sturgeon: (978) 281-9328
    - Giant Manta Ray: 727-824-5312
  - If the project proponent's activity is responsible for the injury or death, they must ensure that the vessel assists in any salvage effort as requested by NMFS. When reporting sightings of injured or dead listed species, the following information must be included:
    - Time, date, and location (latitude/longitude) of the first discovery (and updated location information if known and applicable);
    - Species identification (if known) or description of the animal(s) involved;
    - Condition of the animal(s) (including carcass condition if the animal is dead);
    - Observed behaviors of the animal(s), if alive;
    - If available, photographs or video footage of the animal(s); and
    - General circumstances under which the animal was discovered.
    - Record the date, time, location, species, number of animals, distance and bearing from the vessel, and direction of travel for all sightings of ESA-listed species.
- Sightings of North Atlantic right whale:
  - Report sighting within2hours of occurrence when practicable and no later than 24 hours after occurrence (to https://www.fisheries.noaa.gov/report). Right whale sightings in any location may also be reported to the U.S. Coast Guard via VHF channel 16 and through the WhaleAlert App (http://www.whalealert.org/).
- Sighting of any injured, dead, or entangled North Atlantic right whales:
  - Report sighting immediately to the U.S. Coast Guard via VHF Channel 16.
- If a live or dead marine protected species becomes entangled in buoy or equipment lines, immediately contact the applicable NMFS stranding coordinator using the reporting contact details (see Reporting Requirements section) and provide any on-water assistance requested.

4 POTENTIAL STRESSORS

The proposed action involves multiple activities that can create stressors. Stressors are any physical, chemical, or biological modifications to land, air, or water.

During consultation, we deconstructed the proposed action to identify stressors that are reasonably certain to result from the proposed activities. These can be categorized as pollution from vessels (e.g., exhaust, fuel, oil, and trash), vessel strikes, vessel noise and disturbance, habitat alteration (i.e., benthic disturbance), equipment strike, capture and entanglement of non-target species in research equipment (plankton sampling nets, towed equipment, trawls, and longlines), and directed research activities.

Below we provide information on the potential stressors. The proposed action includes several conservation measures described in Section 3.1.6. that are designed to minimize effects that may result from these potential stressors. While we consider all of these measures important and expect them to be effective in minimizing the effects of potential stressors, they do not completely eliminate the identified stressors. Nevertheless, we treat them as part of the proposed action and fully consider them when evaluating the effects of the proposed action (Section 10).

4.1 Pollution

The operation of the research vessels permitted under the proposed research permit may result in pollution from exhaust, fuel, oil, trash, and other debris. Air and water quality are the basis of a healthy environment for all species. Emissions pollute the air, which could be harmful to air-breathing organisms and lead to ocean pollution (Duce et al. 1991; Chance et al. 2015). Emissions also cause increased greenhouse gases (carbon dioxide, methane, nitrous oxide, and other fluorinated gases) that can deplete the ozone, affect natural earth cycles, and ultimately contribute to climate change (see https://www.epa.gov/ghgemissions/overview-greenhouse-gases for additional information). The release of marine debris such as paper, plastic, wood, glass, and metal associated with vessel operations can also have adverse effects on marine species most commonly through entanglement or ingestion (Gall and Thompson 2015). The lethal and non-lethal effects to air breathing marine animals such as marine mammals, sea turtles, and birds are well documented, and marine debris is known to also adversely affects marine fishes (Gall and Thompson 2015).

4.2 Vessel Strike

Transit of any research vessel in waters inhabited by ESA-listed marine mammals, sea turtles, and fishes carries the risk of striking an animal. Responses to a vessel strike can involve death, serious injury, or minor, non-lethal injuries. The probability of a vessel collision and the associated response depends, in part, on the size and speed of the vessel.

4.3 Operational Noise and Visual Disturbance from Vessels

Research vessels associated with the proposed action may cause visual or auditory disturbances to ESA-listed species and more generally disrupt their behavior, which may negatively influence essential functions such as breeding, feeding, and sheltering. Studies have shown that vessel operation can result in changes in the behavior of marine mammals, sea turtles, and fishes (Patenaude et al. 2002; Richter et al. 2003; Hazel et al. 2007; Smultea et al. 2008; Holt et al. 2009; Luksenburg and Parsons 2009; Noren et al. 2009). In many cases, particularly when responses are observed at great distances, it is thought that animals are likely responding to sound more than the visual presence of vessels (Evans et al. 1992; Blane and Jaakson 1994; Evans et al. 1994), or the particle motion created by the operational sound. Nonetheless, it is generally not possible to distinguish responses to the visual presence of vessels from those to the sounds associated with those vessels. Moreover, at close distances, animals may not differentiate between visual and acoustic disturbances created by vessels and simply respond to the combined disturbance.

4.4 Habitat Alteration

Activities that interact with bottom habitat can potentially result in habitat loss, damage, or alteration. These activities can alter or damage bottom habitat, which could, in turn, cause impacts that degrade habitat for other ESA-listed resources (e.g., impacts to habitat (like seagrass) for prey, causing a decline in prey, etc.). The proposed action involves the use gear and equipment that will come into contact with the ocean bottom. The fishing gear to be used to capture target species (e.g., otter trawls) will drag along the ocean floor while in use. Petite Ponar grabs will collect sediment samples. The mooring equipment and anchors associated with the oceanographic instrumentation will rest on the seafloor. Sedimentation in and near benthic habitats such as seagrass can reduce available light, water quality, and degrade the suitability of surrounding habitat (inhibiting the growth of seagrass beds) (Saunders et al. 2017), reducing foraging habitat for ESA-listed species like green sea turtles.

4.5 Equipment Strike

A variety of equipment proposed for use could strike an ESA-listed species during deployment. The equipment includes anchors, moorings, oceanographic instruments and associated lines, fishing gear (e.g., longlines, plankton nets, and trawls), holographic imaging gear, and bottom-grab samplers (e.g., clamshell bottom snapper). ESA-listed species could be incidentally captured in the fishing gear (especially the trawls and longlines). Equipment strike could result in injury or harm to varying degrees, depending on the size of the individual relative to the size and weight of the gear.

4.6 Entanglement

Gear that has lines or is towed in the water also poses an entanglement risk. This gear includes anchors, moorings, oceanographic instruments, and associated lines, fishing gear (e.g., longlines, plankton nets, and trawls), holographic imaging gear, and bottom-grab samplers (e.g., clamshell bottom snapper). Entanglement can result in death or injury of cetaceans, sea turtles, and fishes (Moore et al. 2009; Deakos and H. 2011; Van Der Hoop et al. 2013; Duncan et al. 2017).

4.7 Incidental Capture

The fishing gear proposed for use during the study (e.g., longlines, plankton nets, trawls) could incidentally capture non-target species, in particular ESA-listed sea turtles and fishes. Incidental capture in fishing gear like trawls and longlines can cause harm, injury, or mortality to individuals that are captured.

4.8 Atlantic Sturgeon Research Activities

The proposed action will fund directed research activities focusing on fish ecology at Frying Pan Shoals, including directed research on ESA-listed Atlantic sturgeon if they are incidentally captured during the fish sampling. Section 10(a)(1)(A) research permits allow for directed research activities to be conducted on ESA-listed species provided the animal was captured under authority (e.g., capture that has been exempted in an incidental take statement). The subsequent directed research activities include handling, measuring, biological sampling, and tagging once incidental capture occurs. The handling and other research activities could result in stress, behavioral responses, injury, infection, and mortality. Because of the nature of the directed research activities, we do not expect other ESA-listed species in the action area to be exposed to those stressors, because they are not the species targeted for research but individuals of the species that are not being targeted by gear could be incidentally captured.

The directed research activities will occur under the authority of and in accordance with the principal investigator's existing Section 10(a)(1)(A) research permit, which was the subject of previous consultation. The directed research activities for Atlantic sturgeon have been considered in previous consultations (2022 reinitiation: OPR-2021-03447; and the 2017 original consultation: FPR-2016-9176; imported to ECO as OPR-2016-00009). Because the effects of the directed take activities on Atlantic sturgeon have already been analyzed in previous Section 7 consultation, we will not reconsider those effects in this consultation.

5 Action Area

Action area means all areas affected directly, or indirectly, by the Federal action, and not just the immediate area involved in the action (50 C.F.R. §402.02).

The proposed action will take place off the coast of North Carolina, and include the Frying Pan Shoals region (Figure 4). Field activities will be conducted within an area 8 kilometers across and 21 kilometers long.

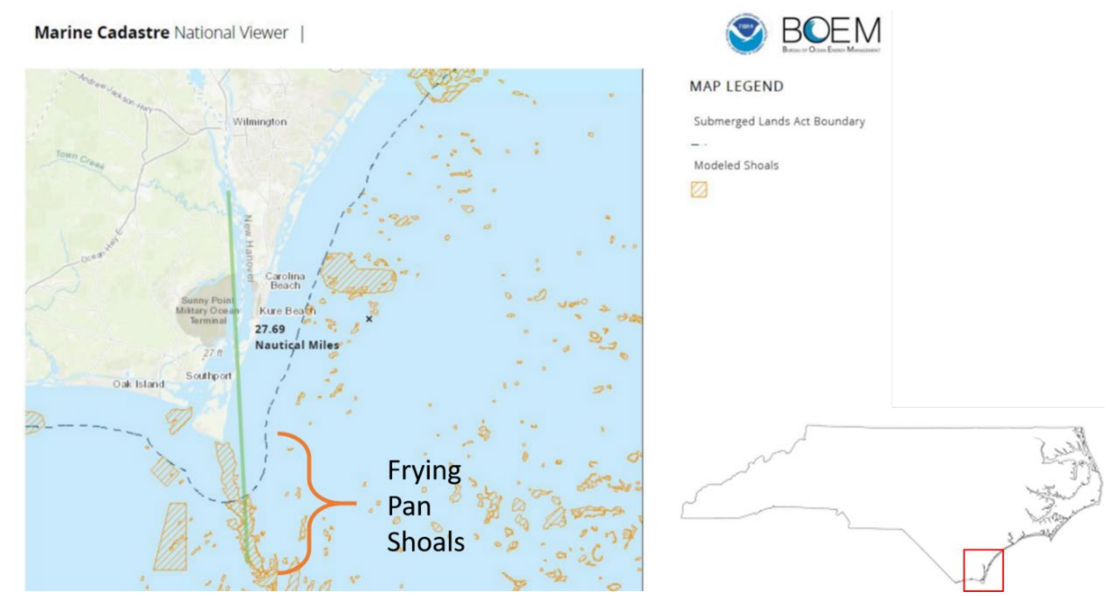

Figure 4. Map of action area. Right: inset map of North Carolina, with location of action area outlined in red. Left: map of Frying Pan Shoals and vessel route from Wilmington.

Frying Pan Shoals is a cape-associated shoal characterized by fine, unconsolidated sediment. The action area includes the vessel route from Wilmington, North Carolina, through the Cape Fear River to the fieldwork site. The Cape Fear River has a major tidal influence in the shoal, with salinity varying from 24 to 36 practical salinity units (BOEM 2023).

6 Endangered Species Act-Listed Species and Designated and Proposed Critical Habitat Present in the Action Area

This section identifies the ESA-listed species and designated and proposed critical habitat that potentially occur within the action area (Table 1) that may be affected by the proposed action.

Table 1. Threatened and endangered species and designated and 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
Fin Whale (*Balaenoptera physalus*)	E – 35 FR 18319	-- --	75 FR 47538 07/2010
Sei Whale (*Balaenoptera borealis*)	E – 35 FR 18319	-- --	12/2011
Marine Reptiles			
Green Turtle (*Chelonia mydas*) – North Atlantic DPS	T – 81 FR 20057	63 FR 46693* 88 FR 46572 (proposed)	FR Not Available 10/1991 – U.S. Atlantic

Species	ESA Status	Critical Habitat	Recovery Plan
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			
Giant Manta Ray (*Mobula birostris*, formerly *Manta birostris*)	T – 83 FR 2916	-- --	-- --
Shortnose Sturgeon (*Acipenser brevirostrum*)	E – 32 FR 4001	-- --	63 FR 69613 12/1998
Atlantic Sturgeon (*Acipenser oxyrinchus oxyrinchus*) – Carolina DPS	E – 77 FR 5913	82 FR 39160	-- --
Atlantic Sturgeon (*Acipenser oxyrinchus oxyrinchus*) – Chesapeake DPS	E – 77 FR 5879	82 FR 39160*	-- --
Atlantic Sturgeon (*Acipenser oxyrinchus oxyrinchus*) – Gulf of Maine DPS	T – 77 FR 5879	82 FR 39160*	-- --
Atlantic Sturgeon (*Acipenser oxyrinchus oxyrinchus*) – New York Bight DPS	E – 77 FR 5879	82 FR 39160*	-- --
Atlantic Sturgeon (*Acipenser oxyrinchus oxyrinchus*) – South Atlantic DPS	E – 77 FR 5913	82 FR 39160*	-- --

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

In the biological assessment, BOEM reached a not likely to adversely affect determination for effects to the following critical habitats: Northwest Atlantic DPS loggerhead sea turtle, Carolina DPS Atlantic sturgeon, and North Atlantic right whale. Our analysis determined that the stressors from the proposed action did not have any plausible route to effect on the physical and biological features (PBFs) of the critical habitats. As such, we concluded that there is no effect from the proposed action on the critical habitats for Northwest Atlantic DPS loggerhead sea turtle, Carolina DPS Atlantic sturgeon, and North Atlantic right whale, and these were not considered in this consultation.

7 Species and Critical Habitat Not Likely to be Adversely Affected

This section identifies 1) potential stressors associated with the proposed action that may affect, but are not likely to adversely affect any ESA-listed species or critical habitat under NMFS jurisdiction that may occur within the action area (as described in Table 1), and 2) those ESA-listed species and critical habitats that are not likely to be adversely affected by any of the potential stressors associated with the proposed action.

NMFS uses two criteria to identify the ESA-listed species or 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 proposed critical habitat. If we conclude that an ESA-listed species or proposed critical habitat is not likely to be exposed to the proposed activities, we must also conclude that the species or critical habitat is not likely to be adversely affected by those activities.

The second criterion is the probability of a response given exposure. An ESA-listed species or proposed 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. We applied these criteria to the species ESA-listed in Table 1 and we summarize our results below.

The probability of an effect on a species or 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 will be an adverse effect if it did impact a listed species), but it is extremely unlikely to occur (NMFS and USFWS 1998).

For the purpose of condensing our discussion in this section and the following sections, we combine the species by taxa. In our discussion, we refer to the following categories of ESA-listed species:

- ESA-listed sea turtles
    - Green sea turtle (North Atlantic DPS), hawksbill sea turtle, Kemp's ridley sea turtle, leatherback sea turtle, and loggerhead sea turtle (Northwest Atlantic Ocean, DPS).

- ESA-listed whales
  - Fin whale, North Atlantic right whale, and sei whale.
- ESA-listed fishes
  - Atlantic sturgeon (Carolina, Chesapeake, Gulf of Maine, New York Bight, and South Atlantic DPSs), giant manta ray, and shortnose sturgeon.

7.1 Stressors Not Likely to Adversely Affect Species

There are a number of stressors that could result from the proposed action, as described in Section 4. We consider several of these stressors not likely to adversely affect species, and provide our rationale in the sections below. We also discuss the effects of these stressors on proposed critical habitat in Section 7.3 below.

7.1.1 Pollution

Pollution in the form of vessel exhaust, fuel or oil spills or leaks, and trash or other debris resulting from the use of vessels as part of the proposed action could result in impacts to ESA-listed marine mammals, sea turtles, and fishes.

Vessel exhaust (i.e., air pollution) will occur during the entirety of the proposed action, during all vessel transit and operations, and could affect air-breathing ESA-listed species such as marine mammals and sea turtles. It is unlikely that vessel exhaust resulting from the operation of the vessels will have a measurable impact on ESA-listed marine mammals or sea turtles given the relatively short duration of the proposed action (a few days four times a year for two and half years), the brief amount of time that whales and sea turtles spend at the surface, and the expected dissipation of exhaust in the air as the vessel transits. For these reasons, the effects that may result from vessel exhaust on ESA-listed marine mammals and sea turtles are considered insignificant.

Trash or other debris resulting from the proposed action may affect ESA-listed marine mammals, sea turtles, and fishes, which could involve injestion or entanglement. If any equipment were lost during use, that would also constitute marine debris. Any marine debris (e.g., plastic, paper, wood, metal, glass) that might be released will be accidental. BOEM follows standard, established guidance on the handling and disposal of marine trash and debris during the research activities. BOEM has not reported any previous incidents regarding the accidental release of debris or trash, or the loss of any equipment. Because the potential for accidental release of debris is extremely unlikely to occur, we find that the effects from this potential stressor on ESA-listed marine mammals, sea turtles, and fishes are discountable.

Discharges from research vessels in the form of leakages of fuel or oil are possible, though effects of any spills to ESA-listed species considered in this opinion will be minimal, if they occur at all. The potential for fuel or oil leakages is extremely unlikely. An oil or fuel leak could pose a significant risk to the vessel and its crew and actions to correct a leak should occur immediately to the extent possible. To our knowledge, none of these leakages has occurred during BOEM's prior research activities. Therefore, we conclude that the effects on ESA-listed species that may result from this stressor (discharge) are discountable.

In summary, the effects from pollution may affect but are not likely to adversely affect ESA-listed species, and will not be carried forward in this consultation.

7.1.2 Vessel Strike

Transit of any research vessel in waters inhabited by ESA-listed whales carries the risk of striking an animal. The probability of a vessel collision and the associated response depends, in part, on the size and speed of the vessel. The majority of vessel strikes of large cetaceans occur when vessels are traveling at speeds greater than approximately 10 knots, with vessels traveling faster, especially large vessels (80 meters or greater), being more likely to cause serious injury or death (Laist et al. 2001; Jensen and Silber 2004; Vanderlaan and Taggart 2007; Conn and Silber 2013).

The vessels proposed for use in the proposed action will be less than 10 meters long. The maximum speed the vessels will reach is 20 knots during transit. During research activities like capture and netting, vessels will be travelling much slower, between 2 and 5 knots. While sampling, or retrieving and deploying equipment, the vessel will be idle.

As noted above, vessels larger than 80 meters are more likely to cause serious injury or death should they strike ESA-listed large whales, but smaller vessels are still capable of causing injury or harm, as described in the examples below. Because of their smaller size (10.4 and 6.4 meters) and increased maneuverability, as well as the presence of a dedicated watch, the vessels that BOEM uses in its proposed action are less of a concern for vessel strike of ESA-listed large whales.

While vessel strikes of ESA-listed whales during research activities are possible, we are aware of only two instances of a research vessel striking a large cetacean in thousands of hours at sea (e.g., the R/V *Auk* and R/V *Pacific Star*; (Peters 2009; Wiley et al. 2016), both occurring in 2009. These incidents involved larger vessels (15 meters and 49 meters long, respectively) than BOEM will use as part of its proposed action. We consider this event extremely rare given that only two instances of research vessel strikes for cetaceans have ever been reported over the years of similar research and enhancement activities carried out under ESA/MMPA permits (Wiley et al. 2016), and none during similar BOEM research activities.

The proposed action takes place in waters less than 20 meters deep. The path of vessel transit from Wilmington to Frying Pan Shoals will be the Cape Fear River, a location where fin, sei, or North Atlantic right whales will not be present due to the shallow depths and inshore location. If whales are encountered during the proposed action, it will be during research activities on the deeper area of Frying Pan Shoals further offshore.

We generally expect the movement of ESA-listed species, including marine mammals, to be away from or parallel to the research vessels. The generally slow movement of the research vessels during most of its travels reduces the risk of vessels reaching a speed where vessel strike could occur. BOEM's conservation measures include conducting vessel activity and transit in such a way as to minimize risk of vessel strike (e.g., vessel speed limits and dedicated watch during vessel operation). Given the rarity of vessel strikes of large cetaceans during research activities based on historical data and none during BOEM research activities, we believe a vessel strike of North Atlantic right, fin, or sei whales during research vessel transits is extremely unlikely to occur. Therefore, we conclude that the potential for vessel strike and its effects on ESA-listed whales are discountable.

Vessel strike poses an injury and mortality risk for sea turtles, although the extent and frequency of its occurrence is not well known (Lutcavage et al. 1997b). Based on behavioral observations of sea turtle avoidance of small vessels, green turtles may be susceptible to vessel strikes at speeds as low as 2 knots (Hazel et al. 2007). If an animal is struck by a vessel, responses can include death, serious injury, and/or minor, non-lethal injuries, with the associated response depending on the size and speed of the vessel, among other factors (Laist et al. 2001; Jensen and Silber 2004; Vanderlaan and Taggart 2007; Conn and Silber 2013).

The likelihood of vessel strikes of sea turtles during BOEM's action is expected to be extremely unlikely given that researchers will adhere to slow vessel transit speeds and the observers on lookout for protected species will also be able to spot sea turtles that surface for air, or which are basking, or feeding at the surface. Overall, the action will be of limited duration (four times a year), and BOEM has not reported vessel strikes of sea turtles in past research activities. Therefore, we conclude that the potential for vessel strike and its effects on ESA-listed sea turtles are discountable.

Sturgeon have been struck and killed by vessels or by the blades of vessel propellers, They have been struck and killed by large commercial vessels, as well as smaller recreational vessels. The risk of injury and mortality could be high in areas with high vessel traffic navigating channels dredged to the depth of the vessels including the Hudson River, Delaware River, and James River and is an emerging threat in the Savannah River, Cooper River, and Cape Fear River. It is not known how many sturgeon are struck by vessels and survive their injuries. Balazik et al. (2012) states that Atlantic sturgeon spend the majority of the time in deeper, cooler waters within1meter of the bottom. We are not aware of reports of vessel strike for Carolina DPS, Chesapeake DPS, Gulf of Maine DPS, New York Bight DPS, and South Atlantic DPS of Atlantic sturgeon in the action area. Vessel strike is generally considered a low-risk threat to Carolina DPS, Chesapeake DPS, Gulf of Maine DPS, New York Bight DPS, and South Atlantic DPS of Atlantic sturgeon and shortnose sturgeon (NMFS 2018) because they generally are not at the water's surface.

A sturgeon that comes into contact with a boat propeller or hull could suffer an injury or mortality. Sturgeon are susceptible to vessel strikes due to their large size and frequent use of coastal waterways with heavy commercial vessel traffic, and vessel strike has been identified as a threat to recovery for ESA-listed sturgeon species, especially Atlantic sturgeon (ASSRT 2007;

SSSRT 2010; Demetras et al. 2020; NMFS 2022c). Shortnose sturgeon may not be as susceptible due to their smaller size in comparison to Atlantic sturgeon. There has been only one confirmed incidence of a ship strike on a shortnose sturgeon in the Kennebec River, and two suspected ship strike mortalities in the Delaware River (NMFS 2010a), all outside the action area, and neither of which were associated with BOEM surveys.

There is a lack of information on the abundance and distribution of shortnose sturgeon in the Cape Fear River. In the past, it was believed that the species had been extirpated, until a few individuals were captured in the late 1980s to the mid-1990s. Based on information from these captures, shortnose sturgeon are thought to occupy the Cape Fear River estuary, and the Brunswick River channel (NMFS 2010a). We expect exposure to vessel activity to occur while the vessel is transiting through the river between Frying Pan Shoals and Wilmington. The most recent population estimate based on mark-recapture data (from 1995) is less than 50 individuals (Dial 2018).

The vessels to be used in the proposed action have relatively shallow drafts (1 to 2 meters). The depth of the Cape Fear River varies from Wilmington down to the estuary, with the channel depth ranging from about 6 meters to more than 40 meters. Water depths outside the channel can be as shallow as 0.3 to 0.6 meters. In order to safely navigate the river, vessels will transit within the maintained navigation channel.

Due to the low expected abundance of shortnose sturgeon in the action area, and that the vessels will transit through Atlantic and shortnose sturgeon habitat in the channel (allowing for sufficient space between the bottom and the vessel itself), we consider the likelihood of vessel strike for Atlantic and shortnose sturgeon to be extremely unlikely and thus discountable.

Vessel strikes pose a risk to giant manta rays, with documented cases of individuals with injuries likely caused by contact with boat propellers (Pate and Marshall 2020). Due to their distribution, if manta rays were exposed to the proposed action, it will be during the sampling activities and vessel transit while on Frying Pan Shoals. During vessel transit, personnel will implement measures to minimize collision with vessels, including keeping watch while underway, and changing course in the event a protected species is sighted. Due to their size, giant manta rays are conspicuous while at the surface, and we expect that will allow them to be sighted and avoided. Due to this, we consider the likelihood of vessel strike for giant manta rays to be extremely unlikely to occur, and thus discountable.

Because we have concluded that the risk from the stressor of vessel strike is discountable, we conclude that vessel strike is not likely to adversely affect ESA-listed whales, sea turtles, or fishes, and will not be carried forward in this consultation.

7.1.3 Operational Noise and Visual Disturbance from Vessels

Assessing whether sounds produced by vessels may adversely affect ESA-listed species involves understanding the characteristics of the sounds produced by the vessels, the species that may be present in the vicinity of the sound, and the effects that sound may have on the physiology and behavior of those species. Although it is known that sound is important for marine mammal communication, navigation, and foraging (NRC 2003; NRC 2005), there are many unknowns in assessing impacts of sound, such as the potential interaction of different effects and the significance of responses by marine mammals to sound exposures (Nowacek et al. 2007; Southall et al. 2007). Other ESA-listed species, such as sea turtles, are often considered less sensitive to anthropogenic sound, but given that much less is known about how they use sound, the impacts of anthropogenic sound are difficult to assess (Popper et al. 2014; Nelms et al. 2016). Nonetheless, depending on the circumstances, exposure to anthropogenic sounds may result in auditory injury, changes in hearing ability, masking of important sounds, behavioral responses, and other physical and physiological responses.

Research vessels may cause auditory disturbance to ESA-listed species and more generally can disrupt their behavior. We expect that any research vessel used during the proposed action will add to the local noise environment in the action area due to the research vessel's propulsion and other noise characteristics of the research vessel's machinery.

We expect that the two research vessels will not add significantly to the local noise environment in their operating area due to the propulsion and other noise characteristics of the vessel's machinery. Any contribution is likely small in the overall environment of regional ambient sound levels. A research vessel's transit past a marine mammal will be brief and is not likely to impact any individual's ability to feed, reproduce, or avoid predators. Brief interruptions in communication via masking are possible, but unlikely given the habits of marine mammals to move away from the research vessels, either as a result of engine noise, the physical presence of the research vessel, or both (Lusseau 2006). In addition, during much of the time the research vessels will be traveling at relatively slow speeds, reducing the amount of noise produced by the propulsion system. The source levels of sounds that will be generated by research vessels (i.e., vessel noise) are below that which could cause physical injury or temporary hearing threshold shifts, and they are unlikely to mask cetaceans ability to hear mates and other conspecifics for any significant amount of time (Hildebrand 2009; NOAA 2018).

Very little research exists on sea turtle responses to vessel noise disturbance. Currently, there is nothing in the available literature specifically aimed at studying and quantifying sea turtle response to vessel noise. However, a study examining vessel strike risk to green sea turtles suggests that sea turtles may habituate to vessel sound and may be more likely to respond to the sight of a vessel rather than the sound of a vessel, although both may play a role in prompting reactions (Hazel et al. 2007). Regardless of the specific stressor associated with vessels to which turtles are responding, they only appear to show responses (i.e., avoidance behavior) at approximately 10 meters or closer (Hazel et al. 2007). Therefore, the noise from research vessels is not likely to affect sea turtles from further distances, and disturbance may only occur if a sea turtle hears a vessel nearby or sees it as it approaches. These responses appear limited to non-injurious, minor changes in behavior based on the limited information available on sea turtle response to vessel noise.

All fishes can detect vessel noise due to its low-frequency content and their hearing capabilities. Therefore, ESA-listed fishes could be exposed to a range of vessel noises, depending on the source and context of the exposure. In the near field, fish are able to detect water motion, as well as visually locate an oncoming vessel. In these cases, most fishes located in close proximity that detect the vessel either visually, or via sound and motion in the water will be capable of avoiding the vessel or move away from the area affected by vessel sound. Thus, fish are more likely to react to vessel noise at close range than to vessel noise emanating from a greater distance away. Because of the characteristics of vessel noise and fishes' tendency to move away from the vessels, the continuous, low-frequency sound produced from research vessel operation is unlikely to result in direct injury, hearing impairment, or other trauma to fishes.

The contribution of vessel noise by any research vessel is likely very small in the overall regional sound field. Vessel activity associated with the proposed action will occur over the course of a few days, four times a year. Any research vessel transit past a cetacean or sea turtle will be brief and not likely impact any individual's ability to feed, reproduce, or avoid predators. Brief interruptions in communication via masking are possible, but unlikely given the habits of marine mammals to move away from vessels, either as a result of engine noise, the physical presence of the vessel, or both (Mitson and Knudsen 2003; Lusseau 2006). Also, as stated, sea turtles may habituate and appear to be less affected by vessel noise at distances greater than 10 meters (Hazel et al. 2007). In addition, during operations, the research vessels typically will be traveling at slow speeds, reducing the amount of noise produced by the propulsions system (Kite-Powell et al. 2007; Vanderlaan and Taggart 2007). The distance between the research vessel and observed marine mammals, per avoidance protocols, will also minimize the potential for acoustic disturbance from engine noise.

Because the potential acoustic interference from engine noise will be so minor that it cannot be meaningfully evaluated, we find that the risk from this potential stressor is insignificant. Therefore, we conclude that acoustic interference from vessel sound sources and/or engine noise may affect, but is not likely to adversely affect ESA-listed fin, sei, and North Atlantic right whales, sea turtles, and fishes and will not be carried forward in this consultation.

7.1.4 Habitat Alteration

Frying Pan Shoals is a cape-associated shoal characterized by fine, unconsolidated sediment. Sediment sampling will not occur in known areas of seagrass. The bottom grab sediment sampling will have a small footprint (e.g., Petite Ponar, 0.15 by 0.15 meters), extracting a sediment sample from the top 5 centimeters of sediment. Any sediment transport or resuspension during sampling is expected to be minimal and temporary due to the relatively small and shallow size of the sample.

Any sediment transport or resuspension during the deployment or retrieval of moorings and oceanographic equipment is expected to be minimal and temporary due the relatively small size of the equipment. The mooring configuration for oceanographic equipment and buoys has a footprint of about 1 meter square. The oceanographic instrumentation will be deployed for about one month at a time before being retrieved, along with all mooring tackle. Given the overall small impact of these equipment, and the temporary nature of the impact, we expect that the overall habitat alteration will be minimal.

Trawls, like those used in commercial fishing, can cause a variety of detrimental impacts to benthic habitat, including physical damage to the substrate (e.g., ploughing, scraping), resuspension of sediments, and destruction of benthic biota, which can decrease the amount of available prey items for other species like ESA-listed fishes and sea turtles. The degree of impact to an area depends on a variety of factors, like the frequency of trawling, the substrate types, the weight of the gear, the towing speed, and local oceanographic factors (e.g., currents, tides). Physical impacts from trawling appear to be more severe at greater depths (>1,000 meters). This is thought to be because, at that depth, water movement is less pronounced (i.e., currents and tides are not moving sediment back into place like at shallower depths). At shallower depths, macrobenthos can recolonize more quickly, provided trawling does not occur too frequently (Jones 1992). Both of the trawls proposed for this action will be fished on the seafloor, thus can potentially cause habitat impacts.

In the action area, trawling will be limited to water depths about 30 meters or less. The trawls used in fisheries (like those considered in the referenced paper) are typically much larger and heavier than the trawls to be used for the proposed action (a 7.6-meter semi-balloon otter trawl, and a 20-meter otter trawl). The duration of towing for the proposed action is also much more limited; trawls will be towed for no more than 20 minutes, compared to commercial trawls that can be towed for hours. Trawling will be highly localized and only occur about 30 days over 2.5 years, so impacts will be temporary and have a small spatial scope. Any impacts to benthic fauna that may also be prey for ESA-listed fishes or sea turtles will be temporary and localized, and the length of time between sampling events will allow for these benthic biota to recolonize. Because the effects of minor benthic disturbance and turbidity from trawling over such a small time and area cannot be meaningfully detected, the effects to fishes and sea turtles are insignificant.

The longline gear proposed for use in this action will be fished on the bottom, meaning that it could cause impacts to benthic habitat. The impacts could include disturbance to the benthos from the gear making contact with the bottom, causing resuspension of sediment. We will expect only minor impacts to habitat from because of the proposed action. Because of the fairly limited amount of longline effort (about 30 days total over 2.5 years) over a localized area, we cannot meaningfully assess the effects, thus we consider the effects to fishes and sea turtles are insignificant.

The amount of habitat available to ESA-listed species within the action area, and the overall small footprint of impacts from these activities means the effects of any habitat loss, damage, or alteration to ESA-listed sea turtles and fishes that utilize the habitat will be insignificant. Therefore, we believe that the effects from habitat loss, damage, or alteration may affect, but are not likely to adversely affect ESA-listed species.

7.1.5 Equipment Strike

Equipment that could strike ESA-listed species in the action area includes anchors, moorings, oceanographic instruments, and associated lines, holographic imaging gear, and bottom-grab samplers (e.g., clamshell bottom snapper). This could occur while the equipment is being lowered into the water, set on the ocean floor, or towed by the vessel at relatively slow speeds.

For ESA-listed marine mammals, sea turtles, or fishes, equipment could potentially cause harm or injury if they are struck. However, in order to be struck, a species will need to be directly in the path of the equipment. For these mobile ESA-listed species, the conservation measures include requirements for observers and restrictions about stopping use of sampling equipment when ESA-listed species are observed in the work area. Generally, we believe that species are able to detect the equipment moving through the water and move out of the way. We are not aware of any reports of equipment strike using similar equipment from BOEM or other researchers.

Due to this, we consider the likelihood of equipment strike for ESA-listed whales, sea turtles, and fishes to be extremely unlikely to occur, and thus discountable. Therefore, we believe that the effects from equipment strike may affect, but are not likely to adversely affect ESA-listed species.

7.1.6 Entanglement

Entanglement in fishing gear is a significant problem for ESA-listed whales. The fishing gear under consideration in this opinion includes trawl and longline gear. Instances of baleen whales (i.e., the ESA-listed whales considered in this opinion) interacting with longlines are characterized as entanglement in the gear, and have only occasionally been reported (Gilman et al. 2006a). As for trawls, the risk of entanglement will be in the lines towing the net, or in the net itself while it is being deployed.

Based on recent reports (2016 to 2020) of large whale entanglement in the Atlantic Ocean off the East Coast overlapping with the action area, North Atlantic right whales comprise the majority of reported entanglement instances (n=51). Gear type is not always known (n=40), but in cases where it is, pot/trap is a common entanglement type (n=8) (Henry et al. 2022). Of the nine reports of fin whale entanglement over the study period, five were with unknown gear, two were entangled in pot/trap gear, one in a weir (net), and one was entangled with hook/monofilament gear. There was one report of a sei whale entanglement in Florida, in an unknown gear type (Henry et al. 2022). We are not aware of any reports of ESA-listed fin, sei, or North Atlantic right whales becoming entangled in longline or trawl gear in the action area.

The sampling activity for the proposed action will take place in relatively shallow waters, from one meter to 30 meters deep. Given their habitat preferences, we believe it is unlikely that North Atlantic right, fin, and sei whales will be in waters overlapping with the proposed action area and thus potentially exposed to the fishing gear used in the research.

For the purposes of our discussion here, we consider entanglement of ESA-listed sea turtles and fishes in the equipment used in this action (e.g., wrapped in the lines associated with the towed gear) separately from a sea turtle or fish being entrapped in the capture gear (i.e., plankton nets, trawls, and longlines), which we characterize as incidental capture. See the discussion in Section 10.2.1 for further information on the potential for the incidental capture of sea turtles, and Sections 7.2.2, 7.2.3, and 10.2.2. for a discussion of the potential for incidental capture of giant manta rays, shortnose sturgeon, and Atlantic sturgeon, respectively.

The lines for the equipment towed during use will be taut, and use stiff line materials to prevent entanglement. As per the conservation measures, the moored and anchored equipment will use the shortest practicable line length, or other available measures to reduce entanglement risk (e.g., rubber sleeves or similar). Furthermore, if an ESA-listed species is sighted within 91 meters of the work area, deployment of all instruments and gear will be suspended. We are not aware of any reports from other similar actions of an ESA-listed sea turtle or fish becoming entangled in the lines of similar research equipment.

Due to this, we consider the likelihood of entanglement for ESA-listed whales, sea turtles, and fishes to be extremely unlikely to occur, and thus discountable. Therefore, we believe that the effects from entanglement may affect, but are not likely to adversely affect ESA-listed species.

7.1.7 Stressors Considered Further

The only potential stressor associated with the proposed action that is likely to adversely affect ESA-listed sea turtles and Atlantic sturgeon is incidental capture in sampling gear.

The incidental capture of ESA-listed species could result in a wide range of responses including injury, disruption of normal activities, stress responses, and infection, some of which might lead to mortality for the individual. This stressor and the potential responses are further analyzed and evaluated in our effects analysis below (Section 10).

7.2 Species Not Likely to be Adversely Affected

There are a number of ESA-listed species, as well as designated and proposed critical habitat, that could potentially be in the action area and possibly be exposed to the stressors associated with the proposed action. As discussed previously, most of the stressors associated with the proposed action are not likely to adversely affect any of the listed species in the action area but incidental capture may result in adverse effects for some ESA-listed species.

7.2.1 Fin, Sei, and North Atlantic Right Whales

Both fin and sei whales are regarded as having an offshore distribution. Sei whales are thought to spend their winters at lower latitudes in the Northern Hemisphere, and move to higher latitudes in the summer to feed. Sei whales are believed to migrate along the continental shelf, preferring offshore waters, although will occasionally come inshore to follow copepod prey (NMFS 2011a). In the North Atlantic, fin whales' migration pattern is complex, with some whales remaining present year-round, while others demonstrate seasonal movements in and out of high-latitude feeding areas, including movements from offshore to inshore (NMFS 2010b). The sampling activity for the proposed action will take place in relatively shallow waters, from 1 - 30 meters deep. Given their habitat preferences, we think it is unlikely that fin and sei whales will be in waters overlapping with the proposed action area.

North Atlantic right whales occupy coastal habitat, varying with season. The proposed action will occur during all four seasons of the year, and take place off the coast of North Carolina, overlapping spatially and temporally with the range of the North Atlantic right whale. Sightings of North Atlantic right whales in January were in an average water depth of 15.5 meters, and an average of 13.8 meters in March in the area off Florida, Georgia, South Carolina, and North Carolina (including area where the action will occur) (Good 2008). The northern extent of the calving habitat overlaps with the action area, and it was predicted to be optimal calving habitat in January (Good 2008). Calving season for North Atlantic right whales in the southeastern United States runs from mid-November to mid-April, although in recent years, the timing of the occupancy of North Atlantic right whales in the region has shifted with no individuals sighted past March (or earlier, in some years) (Surrey-Marsden et al. 2018; Pettis et al. 2021). In the event a North Atlantic right whale is present in the action area, it will likely be during calving over winter, or their movement northward in spring, and southward in the fall.

Longlines can pose a risk to a ESA-listed whales, but the incidental capture risk is believed to be more pronounced to odontecetes (toothed whales) who are attracted to the gear to remove bait or caught fish and then become caught on the hook (Gilman et al. 2006a). We are not aware of any reports of an ESA-listed fin, sei, or North Atlantic right whale being incidentally captured on longlines.

The sampling equipment that is proposed for use varies in size. The plankton and ichythoplankton nets are too small (100 centimeters in diameter) to warrant a concern for the incidental capture of a large whale. The fish sampling will use larger gear (7.6-meter semi-ballon otter trawl in shallow [<15 meters deep] water, 20-meter otter trawl in deeper [>15 meters deep] water), which could overlap with the range of North Atlantic right whales in the action area.

Small odoncetes (i.e., toothed whales, dolphins) are more likely to be incidentally captured in trawls than baleen whales (like the ESA-listed whales considered in this opinion). It is thought that, because the trawls are collecting fish, it creates a feeding opportunity for toothed whales (whose prey includes fish) (Zollett and Rosenberg 2005). Compiled reports of observer data from bottom trawl fisheries in the mid-Atlantic from 2012 to 2016 show that the cetacean species captured are exclusively dolphins (Chavez-Rosales et al. 2018). Based on this information, we do not believe that the trawls proposed for use pose a risk of incidental capture to ESA-listed fin, sei, or North Atlantic right whales considered in this opinion.

The conservation measures included as part of the proposed action include a requirement to stop work if a marine species (including any ESA-listed whale) is sighted within 91 meters of the sampling. Given the above information, ESA-listed fin, sei, and North Atlantic right whales are extremely unlikely to be captured during the research activities in the proposed action. For this reason, the proposed action may affect but is not likely to adversely affect ESA-listed whales, as all effects are discountable.

7.2.2 Giant Manta Ray

The giant manta ray inhabits tropical, subtropical, and temperate bodies of water and is commonly found offshore, in oceanic waters, and near productive coastlines (Marshall et al. 2009; Kashiwagi et al. 2011). They also occasionally occur within estuaries (e.g., lagoons and bays) and Intracostal Waterways. According to recent studies (Farmer et al. 2022), giant manta rays were most commonly detected at productive nearshore and shelf-edge upwelling zones at surface thermal frontal boundaries within a temperature range of approximately 20 to 30°C (degrees Celsius). In terms of range, within the Northern hemisphere, the species has been documented as far north as New York on the United States east coast (Farmer et al. 2022). Giant manta rays are found off the Florida Atlantic Coast in April, but, as water temperatures warm in June through October, giant manta rays occur in higher numbers in the area north of Cape Hatteras, North Carolina, to New York (Farmer et al. 2022). The proposed action overlaps spatially and temporally with the distribution of giant manta rays, with the possibility of interaction during the summer and fall sampling events.

Bycatch of giant manta rays in the Atlantic Ocean has been observed in purse-seine, trawl, gillnet, and longline fisheries; however, as was noted in a study by Oliver et al. (2015) as cited in (Miller 2017), based on the available data, giant manta rays do not appear to be a significant component of the bycatch from these fisheries. Based on Northeast Fisheries Observer Program data for the period 2010 to 2019, two giant manta rays were observed in bottom trawl gear (both in 2014) and two unidentified manta rays were observed in gillnet gear (both in 2015). However, none have been observed in longline gear over that time and none have been captured in any NMFS Northeast Fisheries Science Center-conducted or funded surveys or research (NMFS 2021). The trawl gear proposed for use in the proposed action is also smaller than what is typical for commercial fisheries. The volume and spatial extent of research trawl and longline effort in the action area is also much lower than for the many commercial fisheries. Therefore, giant manta rays are extremely unlikely to be captured during the research activities in the proposed action. For this reason, the proposed action may affect, but is not likely to adversely affect giant manta rays, as all effects are discountable.

7.2.3 Shortnose Sturgeon

Shortnose sturgeon mainly occupy the deep channel sections of large rivers. Only adults occur in marine waters, with some adults making coastal migrations between river systems; this has been observed in river systems north of the action area (e.g., Penobscot River to Merrimack River via the Gulf of Maine; Merrimack River to Connecticut River via the Gulf of Maine and Long Island Sound; Connecticut River to Hudson River via Long Island Sound and the East River) (NMFS 2010a). Typically, their distribution in rivers and inshore bays occurs from the estuary or river mouth up to the first impassible barrier (e.g., a dam or falls).

Generally, shortnose sturgeon are thought to occupy several rivers in North Carolina, but their presence is only confirmed in the Cape Fear River (NMFS 2010a). The Cape Fear River estuary likely serves as a migration or staging corridor for spawning shortnose sturgeon, possibly in the Brunswick River (up near Wilmington, North Carolina) (NMFS 2010a).

Although shortnose sturgeon could occur in the study area, we expect that the species will primarily occur in the transit corridor and not in the study area proposed for fishing; therefore, incidental capture is extremely unlikely to occur and thus discountable. We conclude that shortnose sturgeon are not likely to be adversely affected by the proposed action.

7.2.4 Hawksbill Sea Turtles

The hawksbill turtle has a circumglobal distribution throughout tropical and, to a lesser extent, subtropical oceans. Small juvenile hawksbills (5 to 21 centimeter straight carapace length) have been found in association with *Sargassum* spp. in the Atlantic Ocean (Musick and Limpus 1997b). Post-oceanic hawksbills are typically associated with coral reefs and associated habitats. There are nesting sites in the Caribbean, including Puerto Rico and the U. S. Virgin Islands (NMFS and USFWS 2013a). Hawksbill sea turtles have only rarely been observed nesting in the continental United States. In North Carolina, there is a single recorded instance of nesting taking place in 2015, which is considered to be the northernmost nesting by hawksbill sea turtles in the Western Atlantic (Finn et al. 2016).

Hawksbill sea turtles are rare in the mid-Atlantic, with only occasional sightings (Witzell 1983; Witherington et al. 2012). In North Carolina, hawksbills are considered infrequent visitors, with two strandings reported in North Carolina from 1989 to 2012 (Epperly et al. 1995b; Avens et al. 2021). There are no records of hawksbill sea turtles being incidentally captured in the coastal trawl research surveys conducted by the NMFS Science Centers in and around the action area.

We conclude that the effects of the proposed action to hawksbill turtles are discountable. Because the proposed action will take place in an area where we do not expect hawksbill sea turtles to be, we do not expect them to be adversely affected by the proposed action.

7.3 Critical Habitat Not Likely to be Adversely Affected

The action area includes the waters of the Atlantic Ocean, off Frying Pan Shoals, North Carolina, where the research will occur, as well as the locations where the research vessels and aircraft will transit to and from the survey area (e.g., the Cape Fear River). There is a proposed critical habitat area that overlaps with the action area that is not likely to be adversely affected by the proposed action, and we present our rationale for this conclusion below.

7.3.1 Proposed Critical Habitat for North Atlantic DPS Green Sea Turtles

On July 19, 2023, critical habitat was proposed for six DPSs of green sea turtle, including the North Atlantic DPS, which overlaps with the action area (88 FR 46572). The features essential to the conservation of the DPS are reproductive, migratory, benthic foraging/resting, and surface-pelagic foraging/resting (*Sargassum*). There are two essential features that overlap with the action area: migratory and benthic foraging/resting.

- Migratory: From the mean high water line to 20 meters depth (North Atlantic DPS), sufficiently unobstructed waters that allow for unrestricted transit of reproductive individuals between benthic foraging/resting and reproductive areas.
- Benthic Foraging/Resting: From the mean high water line to 20 meters depth, underwater refugia and food resources (i.e., seagrasses, macroalgae, and/or invertebrates) of sufficient condition, distribution, diversity, abundance, and density necessary to support survival, development, growth, and/or reproduction.

The proposed action will not involve any work that creates obstructions or structures in waters that will restrict the transit of reproductive individuals to benthic foraging/resting areas in the action area. The vessel activity and the use of equipment itself could constitute a disturbance that might obstruct reproductive green sea turtles temporarily.

Activity associated with the proposed action will occur over the course of several days, four times a year. Any disturbance created by the proposed action (e.g., vessel activity, use of equipment), will be temporary and limited in geographic area. Due to the size of the action area, and the available space within the proposed critical habitat, individuals will be able to move away to avoid any temporary disturbance posed by the action. Any effects to the migratory PBF will be small, temporary, and not able to be meaningfully detected.

The proposed action also involves activities that could cause impacts to benthic habitat (e.g., placement of fixed moorings for instrumentation and wave buoys, the use of bottom trawls and longlines). As discussed in Section 7.1.4, because Frying Pan Shoals is characterized by fine, unconsolidated sediment, with no known seagrass areas, we do not expect impacts to that aspect of the benthic foraging PBF. Invertebrates in the sediment that are also green turtle prey might be disturbed during the sediment grabs. However, due to the small size of the equipment, the amount of sediment disturbed will be minimal, and any subsequent impacts to invertebrates will be small and not able to be meaningfully detected.

For these reasons, we find that the effects to the proposed critical habitat will be insignificant. We conclude that the proposed action may affect, but is not likely to adversely affect proposed North Atlantic DPS green sea turtle critical habitat.

7.4 Summary of Effects Determinations for Potential Stressors Associated with the Proposed Action

Table 2 depicts our effects analysis by potential stressor for each ESA-listed species and designated critical habitat considered in this consultation.

Table 2. ESA-listed species potentially exposed by the stressors resulting from the proposed action

Species Present in the Action Area	Pollution	Vessel Strike	Vessel Noise and Disturbance	Habitat Alteration (Benthic Disturbance)	Equipment Strike	Incidental Capture
North Atlantic Right Whale	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA
Fin Whale	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA
Sei Whale	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA
Green Turtle North Atlantic DPS	NLAA	NLAA	NLAA	NLAA	NLAA	**LAA**
Hawksbill Turtle	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA
Kemp's Ridley Turtle	NLAA	NLAA	NLAA	NLAA	NLAA	**LAA**
Leatherback Turtle	NLAA	NLAA	NLAA	NLAA	NLAA	**LAA**
Loggerhead Turtle Northwest Atlantic Ocean DPS	NLAA	NLAA	NLAA	NLAA	NLAA	**LAA**
Giant Manta Ray	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA
Atlantic Sturgeon (all DPSs)	NLAA	NLAA	NLAA	NLAA	NLAA	**LAA**
Shortnose Sturgeon	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA

8 Status of Species Likely to be Adversely Affected

This opinion examines the status of ESA-listed sea turtles and Atlantic sturgeon that may be adversely affected by the proposed action.

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," which 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 this NMFS Web site: https://www.fisheries.noaa.gov/find-species.

One factor affecting the rangewide status of sea turtles, fishes, and aquatic habitat at large is climate change. Climate change will be discussed in the *Environmental Baseline* section (Section 9).

8.1 Loggerhead Sea Turtle—Northwest Atlantic Ocean DPS

Loggerhead turtles are circumglobal, and are found in continental shelf and estuarine environments throughout the temperate and tropical regions of the Atlantic, Indian, and Pacific Oceans. Northwest Atlantic Ocean DPS of loggerhead turtles are found along eastern North America, Central America, and northern South America.

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 listed as threatened (75 FR 12598).

8.1.1 Life History

Loggerhead turtles share a general life history pattern similar to other sea turtles. Females lay their eggs on coastal beaches where the eggs incubate in sandy nests. The eight stages of the life cycle and the ecosystems those stages generally use include: egg (terrestrial zone), hatchling (terrestrial zone), hatchling swim frenzy and transitional (neritic zone), juvenile (oceanic zone), juvenile (neritic zone), adult (oceanic zone), adult (neritic zone), nesting female (terrestrial zone) (NMFS and USFWS 2008a). Loggerhead turtles reach sexual maturity between 20 to 38 years of age, although this varies widely among populations (Frazer and Ehrhart 1985; NMFS 2001). Mean age at first reproduction for female loggerhead turtles is 30 years. The annual mating season occurs from late March through early June, and females lay eggs throughout the summer months. Females lay an average of four clutches per season (Murphy and Hopkins 1984), and an average remigration interval is 3.7 years (Tucker 2010). The annual average clutch size is 100 to 126 eggs per nest (Dodd 1988). Eggs incubate for 42 to 75 days before hatching (NMFS and USFWS 2008a). Nesting occurs on beaches, where warm, humid sand temperatures incubate the eggs. Temperature determines the sex of the loggerhead turtle during the middle of the incubation period.

The majority of nesting occurs at the western rims, concentrated in the north and south temperate zones and subtropics, of the Atlantic and Indian Oceans (NRC 1990a). For the Northwest Atlantic Ocean DPS of loggerhead turtles, most nesting occurs along the East coast of the U.S., from southern Virginia to Alabama. Additional nesting occurs along the northern and western Gulf of Mexico, eastern Yucatán peninsula, at Cay Sal Bank in the eastern Bahamas (Addison and Morford 1996; Addison 1997), off the southwestern coast of Cuba (Gavilan 2001), and along the coasts of Central America, Colombia, Venezuela, and the eastern islands of the Caribbean Sea. Non-nesting, adult females are reported throughout the Atlantic Ocean, Gulf of Mexico, and Caribbean Sea. Little is known about the distribution of adult males who are seasonally abundant near nesting beaches.

Habitat uses within continental shelf and estuarine environments vary by life stage. Loggerhead 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 loggerhead turtles are omnivorous and forage on crabs, mollusks, jellyfish, and vegetation at or near the water's surface, whereas subadults and adults typically prey on benthic invertebrates such as mollusks and decapod crustaceans in hardbottom habitats in coastal waters.

As post-hatchlings, loggerhead turtles hatched on beaches enter the "oceanic juvenile" life stage, migrating offshore and becoming associated with *Sargassum* habitats, drift lines, and other convergence zones (Carr 1986; Witherington 2002; Conant et al. 2009b). Oceanic juveniles grow at rates of 2.9 to 5.4 centimeters per year (Snover 2002; Bjorndal et al. 2003) over a period as long as 7 to 12 years (Bolten et al. 1998) before moving to more coastal habitats. Studies have suggested that not all loggerhead turtles follow the model of circumnavigating the North Atlantic Gyre as pelagic juveniles, followed by permanent settlement into benthic environments (Laurent et al. 1998; Bolten and Witherington 2003). These studies suggest some animals may either remain in the oceanic habitat in the North Atlantic Ocean longer than hypothesized or they move back and forth between oceanic and coastal habitats interchangeably (Witzell 2002). When immature loggerhead turtles reach 40 to 60 centimeters, they begin to reside in coastal inshore waters of the continental shelf throughout the Atlantic Ocean and Gulf of Mexico (Witzell 2002).

After departing the oceanic zone, neritic juveniles in the Northwest Atlantic Ocean inhabit continental shelf waters from Cape Cod Bay, Massachusetts, south through Florida, the Bahamas, Cuba, and the Gulf of Mexico. Estuarine waters of the U.S., including areas such as Long Island Sound, Chesapeake Bay, Pamlico and Core Sounds, Mosquito and Indian River Lagoons, Biscayne Bay, Florida Bay, and numerous embayments fringing the Gulf of Mexico, comprise important inshore habitat. Along the shorelines of the Atlantic Ocean and Gulf of Mexico, essentially all shelf waters are inhabited by loggerhead turtles (Conant et al. 2009b).

Like juveniles, non-nesting adults also use the neritic zone. However, these adults do not use the relatively enclosed shallow-water estuarine habitats with limited ocean access as frequently as juveniles do. Areas such as Pamlico Sound, North Carolina, and the Indian River Lagoon, Florida, are regularly used by juveniles but not by adults. Adults do tend to use estuarine areas with more access to the open ocean, such as the Chesapeake Bay in the mid-Atlantic Ocean. Shallow-water habitats with large expanses of access to the open ocean, such as Florida Bay, provide year-round resident foraging areas for significant numbers of female and male adults (Conant et al. 2009b).

Loggerhead turtles are circumglobal, occurring throughout the temperate and tropical regions of the Atlantic, Indian, and Pacific Oceans, returning to their natal region for mating and nesting. Adults and subadults 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%) of individuals found in foraging grounds throughout the western and eastern Atlantic Ocean: Nicaragua, Panama, Azores and Madeira, Canary Islands and Andalusia, Gulf of Mexico, and Brazil (Masuda 2010).

Offshore, adults primarily inhabit continental shelf waters, from New York through Florida, the Bahamas, Cuba, and the Gulf of Mexico. Seasonal use of shelf waters in the mid-Atlantic Ocean, especially offshore of New Jersey, Delaware, and Virginia during summer months, and offshore shelf waters, such as Onslow Bay (off the North Carolina coast), during winter months has been documented (Hawkes et al. 2007; Hawkes et al. 2014). Satellite telemetry has identified the shelf waters along the west coast of Florida, the Bahamas, Cuba, and the Yucatán peninsula as important resident areas for adult females that nest in Florida (Foley et al. 2008; Girard et al. 2009; Hart et al. 2012). The southern edge of the Grand Bahama Bank is important habitat for nesting on the Cay Sal Bank in the Bahamas, but nesting females are also resident in the bights of Eleuthera, Long Island, and Ragged Islands. They also reside in Florida Bay. Moncada et al. (2010) report the recapture in Cuban waters of five adult females originally flipper-tagged in Quintana Roo, Mexico, indicating that Cuban shelf waters likely also provide foraging habitat for adult females that nest in Mexico.

8.1.2 Population Dynamics

It is difficult to estimate the overall abundance for sea turtle populations because individuals spend most of their time in water, where they are difficult to count, especially considering their large range and use of many different and distance habitats. Females, however, converge on their natal beaches to lay eggs and nests are easily counted. The total number of annual U.S. nest counts for the Northwest Atlantic DPS of loggerhead turtles is over 110,000 (NMFS and USFWS 2023).

In-water estimates of abundance include juvenile and adult life stages of loggerhead turtle males and females are difficult to perform on a wide scale. In the summer of 2010, NMFS'S Northeast Fisheries Science Center and Southeast Fisheries Science Center estimated the abundance of juvenile and adult loggerhead turtles along the continental shelf between Cape Canaveral, Florida and the mouth of the Gulf of St. Lawrence, Canada, based on the Atlantic Marine Assessment Program for Protected Species aerial line-transect sighting survey and satellite tagged loggerhead turtles (NMFS 2011b). They provided a preliminary regional abundance estimate of 588,000 individuals (approximate inter-quartile range of 382,000 to 817,000 individuals) based on positively identified loggerhead turtle sightings (NMFS 2011). A separate, smaller aerial survey, conducted in the southern portion of the Mid-Atlantic Bight and Chesapeake Bay in 2011 and 2012, demonstrated uncorrected loggerhead turtle abundance ranging from a spring high of 27,508 to a fall low of 3,005 loggerhead turtles (NMFS and USFWS 2023). We are not aware of any current rangewide in-water estimates for the Northwest Atlantic Ocean DPS of loggerhead turtle.

Table 3. Northwest Atlantic Ocean DPS loggerhead sea turtle nest counts 2016 to 2020 (NMFS and USFWS 2023)

State	2016 Nests	2017 Nests	2018 Nests	2019 Nests	2020 Nests
Virginia	4	10	8	10	12
North Carolina	1,622	1,195	765	2,293	1,331
South Carolina	6,646	5,231	2,762	8,774	5,552
Georgia	3,289	2,155	1,735	3,950	2,786
Florida	122,707	96,912	91,451	106,373	105,185
Alabama	233	178	91	113	97
Mississippi	1	10	3	1	1
Texas	6	8	6	8	3
Quintana Roo	5,367	3,142	4,681	3,639	3,935
TOTALS	**139,675**	**108,841**	**101,502**	**125,161**	**118,902**

More recent nesting data for North Carolina shows a total of 1,448 loggerhead nests in 2021, and 1,906 nests in 2022 (Table 3). Loggerhead nests make up the majority of all sea turtle nests in North Carolina (usually between 96 to 97%, depending on the year). Bald Head Island is a sea turtle nesting beach immediately adjacent to Frying Pan Shoals, which has hosted loggerhead nests for every year for which we have systematic survey data available (2009 to present). Of the 25 monitored nesting beaches, Bald Head Island usually hosts the third-highest number of loggerhead nests every year (147 in 2022), behind Cape Lookout (428 in 2022) and Cape

Hatteras National Seashore (361 nests in 2022). Another beach immediately south of Bald Head Island, Oak Island, also hosts a number of loggerhead nests annually—139 nests in 2022. [1]

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

The Northern Recovery Unit, from North Carolina to northeastern Florida, and is the second largest nesting aggregation in the Northwest Atlantic Ocean DPS of loggerhead turtle, with an average of 5,215 nests from 1989 through 2008, and approximately 1,272 nesting females per year (NMFS and USFWS 2008a). The nesting trend from daily beach surveys showed a significant decline of 1.3% annually from 1989 through 2008. Aerial surveys of nests showed a 1.9% decline annually in nesting in South Carolina from 1980 through 2008. Overall, there is strong statistical data to suggest the Northern Recovery Unit has experienced a long-term decline over that period. Data since that analysis are showing improved nesting numbers and a departure from the declining trend. Nesting in Georgia has shown an increasing trend since comprehensive nesting surveys began in 1989. Nesting in North Carolina and South Carolina has begun to show a shift away from the declining trend of the past. Increases in nesting were seen from 2009 through 2012.

The Peninsular Florida Recovery Unit is the largest nesting aggregation in the Northwest Atlantic Ocean DPS of loggerhead turtle, with an average of 64,513 nests per year from 1989 through 2007, and approximately 15,735 nesting females per year (NMFS and USFWS 2008a). Following a 52% increase between 1989 through 1998, nest counts declined sharply (53%) from 1998 through 2007. However, annual nest counts showed a strong increase (65%) from 2007 through 2017 (FFWCC 2018). Index nesting beach surveys from 1989 through 2013 has identified three trends. From 1989 through 1998, there was a 30% increase that was then followed by a sharp decline over the subsequent decade. Large increases in nesting occurred since then. From 1989 through 2013, the decade-long decline had reversed and there was no longer a demonstrable trend. From 1989 through 2016, the Florida Fish and Wildlife Research

[1] http://www.seaturtle.org/nestdb/index.shtml?view=1&year=2022 Accessed June 28, 2023.

Institute concluded that there was an overall positive change in the nest counts, but the change was not statistically significant.

The Dry Tortugas, Gulf of Mexico, and Greater Caribbean Recovery Units are much smaller nesting assemblages, but they are still considered essential to the continued existence of loggerhead turtles. The Dry Tortugas Recovery Unit includes all islands west of Key West, Florida. The only available data for the nesting subpopulation on Key West comes from a census conducted from 1995 through 2004 (excluding 2002), which provided a range of 168 to 270 (mean of 246) nests per year, or about 60 nesting females (NMFS and USFWS 2007e). There was no detectable trend during this period (NMFS and USFWS 2008a).

The Gulf of Mexico Recovery Unit has between 100 to 999 nesting females annually, and a mean of 910 nests per year. Analysis of a dataset from 1997 through 2008 of index nesting beaches in the northern Gulf of Mexico shows a declining trend of 4.7% annually. Index nesting beaches in the panhandle of Florida has shown a large increase in 2008, followed by a decline in 2009 through 2010 before an increase back to levels similar to 2003 through 2007 in 2011.

The Greater Caribbean Recovery Unit encompasses nesting subpopulations in Mexico to French Guiana, the Bahamas, and the Lesser and Greater Antilles. The majority of nesting for this recovery unit occurs on the Yucatán peninsula, in Quintana Roo, Mexico, with 903 to 2,331 nests annually (Zurita et al. 2003a). Other significant nesting sites are found throughout the Caribbean Sea, and including Cuba, with approximately 250 to 300 nests annually (Ehrhart et al. 2003), and over 100 nests annually in Cay Sal in the Bahamas . Survey effort at nesting beaches has been inconsistent, and not trend can be determined for this subpopulation (NMFS and USFWS 2008a). Zurita et al. (2003b) found an increase in the number of nests on 7 of the beaches on Quintana Roo, Mexico from 1987 through 2001, where survey effort was consistent during the period. Nonetheless, nesting has declined since 2001, and the previously reported increasing trend appears to not have been sustained (NMFS and USFWS 2008a).

Nesting data are the best current indicator of population trends in sea turtles, but in-water data also provide some insight. In-water research suggests the abundance of neritic juveniles is steady or increasing. Although Ehrhart et al. (2007) found no significant regression-line trend in a long-term dataset, researchers have observed notable increases in catch per unit effort (Ehrhart et al. 2007; Epperly et al. 2007b; Arendt et al. 2009). Researchers believe that this increase in catch per unit effort is likely linked to an increase in abundance of juveniles. Although it is unclear whether this increase in abundance represents a true population increase among juveniles or merely a shift in spatial occurrence. Bjorndal et al. (2005) caution about extrapolating localized in-water trends to the broader population and relating localized trends in neritic sites to population trends at nesting beaches. The apparent overall increase in the abundance of the largest oceanic/neritic juveniles (historically referred to as small benthic juveniles), which could indicate a relatively large number of individuals around the same age may mature in the near future (TEWG 2009). However, in-water studies throughout the eastern U.S. indicate a substantial decrease in the abundance of the smallest oceanic/neritic juvenile loggerhead turtles, a patter corroborated by stranding data (TEWG 2009).

8.1.3 Status

Based on the currently available information, the overall nesting trend of the Northwest Atlantic Ocean DPS of loggerhead turtle appears to be stable, neither increasing or decreasing, for over two decades (NMFS and USFWS 2023). Destruction and modification of terrestrial and marine habitats threaten the Northwest Atlantic Ocean DPS of loggerhead turtles. On beaches, threats and interfere with successful nesting, egg incubation, hatchling emergence, and transit to the sea include erosion, erosion control, coastal development, artificial lighting, beach use, and beach debris (NMFS and USFWS 2023). In the marine environment, threats that interfere with foraging and movement include marine debris, oil spills and other pollutants, harmful algal blooms, and noise pollution (NMFS and USFWS 2023).

8.1.4 Status in the Action Area

The U.S. Navy has mapped numerous sightings of loggerhead turtles off the coast of North Carolina, especially during spring and summer (DoN 2008a; DoN 2008b). Most records are for shelf waters, but there are also sightings on the shelf break and farther offshore; sightings of loggerhead turtles were by far the most numerous of any sea turtle. Similarly, from 2010 to 2017, loggerhead sea turtles comprised the majority of sea turtle sightings, and were sighted in and near the action area throughout the year during the Atlantic Marine Assessment Programs for Protected Species (Palka et al. 2021). Females stay closer to the shore after nesting but move farther offshore towards the end of summer (Hopkins-Murphy et al. 2003). The Mid-Atlantic Bight represents important late-spring to summer habitat for loggerhead sea turtles, with tagged loggerheads occupying shelf waters and performing dives in waters between 30 and 70 meters deep (Patel et al. 2018). Satellite tagging of juvenile loggerhead turtles in the Chesapeake Bay and off North Carolina showed two different movement strategies: some individuals stayed on the shelf in a north–south pattern, and others exhibited an oceanic dispersal strategy into the Gulf Stream to the North Atlantic Ocean (Mansfield et al. 2009). During colder temperatures (below 20 °C), shelf-dwelling turtles moved south of Cape Hatteras, North Carolina, to inhabit waters between North Carolina's Outer Banks and the western edge of the Gulf Stream. Individuals also exhibited strong seasonal movements to Virginia (summer foraging habitat) and North Carolina (winter habitat). Patel et al. (2018) captured loggerhead sea turtles off North Carolina in February. Of all sea turtle species, loggerheads are most frequently incidentally captured in NMFS Science Center spring and fall coastal surveys (e.g., 65 out of 104 of all sea turtle species captured in and near the action area in bottom trawl surveys, data from 2000 to present) (PSIT 2023). They are the most common sea turtle caught as bycatch by the pound-net fisheries in Pamlico Sound (Epperly et al. 2007a). Tagged adults and large juvenile loggerhead turtles have been tracked moving through the action area (Winton et al. 2018).

8.1.5 Critical Habitat

Critical habitat for the Northwest Atlantic DPS loggerhead sea turtle was designated in 2014.

8.1.6 Recovery Goals

In response to the current threats facing the species, NMFS developed goals to recover loggerhead turtle populations. These threats will be discussed in further detail in the Environmental Baseline of this consultation. See the 2009 Final Recovery Plan for the Northwest Atlantic Population of loggerhead turtles for complete down-listing/delisting criteria for each of the following recovery objectives (NMFS 2008).

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

8.2 Green Sea Turtle—North Atlantic DPS

The green turtle has a circumglobal distribution and commonly inhabits nearshore and inshore waters, occurring throughout tropical, sub-tropical and, to a lesser extent, temperate waters. The North Atlantic DPS of green turtle is found in the North Atlantic Ocean and Gulf of Mexico. The species was listed under the ESA on July 28, 1978 (43 FR 32800). The species was separated into two listing designations: endangered for breeding populations in Florida and the Pacific coast of Mexico and threatened in all other areas throughout its range. On April 6, 2016, NMFS listed eleven DPSs of green turtles as threatened or endangered under the ESA (81 FR 20057). The North Atlantic DPS of green turtle is listed as threatened.

8.2.1 Life History

Green turtles share a general life history pattern similar to other sea turtles. Females lay their eggs on coastal beaches where the eggs incubate in sandy nests. Mating occurs in waters off nesting beaches. Females are usually 20 to 40 years at first reproduction. Green turtles lay an average of 3 nests per season with an average of 100 eggs per nest. The remigration interval (i.e., return to natal beaches) is 2 to 5 years for females. Males are known to reproduce every year (Balazs 1983). In the southeastern U.S., females generally nest between June through September, and peak nesting occurs in June through July (Witherington and Ehrhart 1989)**;** in the action area, nesting can begin as early as May. During the nesting season, females nest at approximately 2 week intervals, laying an average of 3 to 4 clutches (Johnson and Ehrhart 1996) of approximately 110 to 115 eggs. Eggs incubate for approximately 2 months before hatching. 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. This early oceanic phase remains one of the mostly poorly understood aspects of the life history of green turtles (NMFS and USFWS 2007b). Green turtles exhibit particularly slow growth rates of about 1 to 5 centimeters per year (Green 1993; McDonald-Dutton and Dutton 1998), which may be attributed to their largely herbivorous, low-net energy diet (Bjorndal 1982). At approximately 20 to 25 centimeters carapace length, juveniles leave the pelagic environment and enter nearshore developmental habitats such as protected lagoons and open coastal areas rich in seagrass and marine algae. Growth studies using skeletochronology indicate that green turtles in the western Atlantic Ocean shift from the oceanic phase to nearshore developmental habitats after approximately 5 to 6 years (Zug and Glor 1998; Bresette et al. 2006). Within the developmental habitats, juveniles begin the switch to a more herbivorous diet, and by adulthood feed almost exclusively on seagrasses and algae (Rebel 1974), although some populations are known to also feed heavily on invertebrates (Carballo et al. 2002). Adult green 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. Green turtles mature slowly, requiring 20 to 50 years to reach sexual maturity (Chaloupka and Musick 1997; Hirth and USFWS 1997).

With the exception of post-hatchlings, green turtles live in nearshore tropical and subtropical waters. Green turtles nest on sandy beaches of mainland shores, barrier islands, coral islands, and volcanic islands. While in coastal habitats, green turtles exhibit site fidelity to specific foraging and nesting grounds, and it is clear they are capable of "homing in" on these sites if displaced (McMichael et al. 2003; Hart et al. 2013).

8.2.2 Population Dynamics

The green turtle occupies the coastal waters of over 140 countries worldwide; nesting occurs in more than 80 countries (Hirth and USFWS 1997). Worldwide, nesting data at 464 sites indicate that 563,826 to 564,464 females nest each year (Seminoff et al. 2015). Compared to other DPSs, the North Atlantic DPS of green turtle exhibits the highest nester abundance, with approximately 167,424 females at 73 nesting sites, and available data indicate an increasing trend in nesting. The largest nesting site in the North Atlantic DPS of green turtle is in Tortuguero, Costa Rica (on the Caribbean Sea coast), which hosts 79% of nesting females for the North Atlantic DPS (Seminoff et al. 2015).

Many nesting sites worldwide suffer from a lack of consistent, standardized monitoring, making it difficult to characterize population growth rates from 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 North Atlantic DPS as a whole, but estimates have been developed at a localized level. Modeling by Chaloupka et al. (2008) using data sets of 25 years or more show the Florida nesting stock at the Archie Carr National Wildlife Refuge growing at an annual rate of 13.9%, and the Tortuguero, Costa Rica, population growing at 4.9%.

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 North Atlantic DPS. Evidence from mitochondrial DNA studies indicates that there are at least four independent nesting subpopulations in Florida, Cuba, Mexico, and Costa Rica (Seminoff et al. 2015). Additional genetic analysis indicates that designating a new western Gulf of Mexico management unit might be appropriate (Shamblin et al. 2016).

In the continental U.S., green turtle nesting occurs along the coast of the Atlantic Ocean, primarily along the central and southeast coast of Florida where an estimated 200 to 1,100 females nest each year (Meylan et al. 1994; Weishampel et al. 2003). Occasional nesting has also been documented along the Gulf Coast of Florida, Georgia, North Carolina, and Texas (Meylan et al. 1995). At Bald Head Island, the nesting beach immediately adjacent to Frying Pan Shoals, green sea turtles nest fairly regularly in low numbers, with anywhere from 1 to 4 nests during the time periods of 2009 to 2014, 2017, and 2021 to 2022. At other nesting beaches near the action area, green sea turtle nesting is less frequent, with 2 nests reported just north of the action area at Kure Beach from 2009 to 2022 (one each in 2011 and 2017), and none at Caswell Beach, and one at Oak Island (2010), both south of Frying Pan Shoals.[2]

Since 1989, the pattern of green turtle nesting has generally shown biennial peaks in abundance with a positive trend during the10 years of regular monitoring at index nesting beaches. From 1989 through 2016, green turtle nest counts across Florida have increased approximately 100-fold from a low of 267 in the early 1990s to a high of 27,975 in 2015. Green turtle nesting tends to follow a biennial pattern of fluctuation. Apparent increases in nester abundance for the North

[2] http://www.seaturtle.org/nestdb/index.shtml?view=1&year=2009 Accessed June 28, 2023.

Atlantic DPS of green turtle in recent years are encouraging, but must be viewed cautiously, as the datasets represent a fraction of green turtle generation, up to 50 years.

Green turtles from the North Atlantic DPS range from the boundary of South and Central America (7.5 degrees North, 77 degrees West) in the south, throughout the Caribbean Sea, the Gulf of Mexico, and the U.S. Atlantic coast to New Brunswick, Canada (48 degrees North, 77 degrees West) in the north. The range of the North Atlantic DPS of green turtle then extends due east along latitudes 48 degrees North and 19 degrees North to the western coasts of Europe and Africa. Nesting occurs primarily in Costa Rica, Mexico, Florida, and Cuba.

In the waters of the Atlantic Ocean and Gulf of Mexico, green turtles are distributed throughout inshore and nearshore waters from Texas to Massachusetts. Principal benthic foraging areas in the southeastern U.S. include Aransas Bay, Matagorda Bay, Laguna Madre, and the Gulf inlets of Texas (Hildebrand 1982; Doughty 1984; Shaver 1994), the Gulf of Mexico off Florida from Yankeetown to Tarpon Springs (Caldwell and Carr 1957; Carr 1984), Florida Bay and the Florida Keys (Schroeder and Foley 1995), the Indian River Lagoon system in Florida (Ehrhart 1983), and the Atlantic Ocean off Florida from Brevard through Broward Counties (Guseman and Ehrhart 1992; Wershoven and Wershoven 1992). The summer developmental habitat for green turtles also encompasses estuarine and coastal waters from North Carolina to as far north as Long Island Sound . Additional important foraging areas in the western Atlantic Ocean include the Culebra archipelago and other Puerto Rico coastal waters, the south coast of Cuba, the Mosquito Coast of Nicaragua, the Caribbean Sea coast of Panama, scattered areas along Colombia and Brazil (Hirth 1971), and the northwestern coast of the Yucatán Peninsula.

The complete nesting range of green turtles within the southeastern U.S. includes sandy beaches between Texas and North Carolina, as well as the U.S. Virgin Islands and Puerto Rico (NMFS and USFWS 1991a; Dow et al. 2007). The vast majority of green turtle nesting within the southeastern U.S. occurs in Florida (Johnson and Ehrhart 1994; Meylan et al. 1995). Principal nesting areas in the U.S. are in eastern Florida, predominantly Brevard south through Broward Counties.

8.2.3 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 for food and other products. 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. Other threats include pollution, habitat loss through coastal development or stabilization, destruction of nesting habitat from storm events, and oil spills. 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. While the threats continue, the green turtle appears to be somewhat resilient to future perturbations.

Historically, green turtles in the North Atlantic DPS were hunted for food, which was the principle cause of the population's decline. Apparent increases in nester abundance for the North Atlantic DPS in recent years are encouraging but must be viewed cautiously, as the datasets represent a fraction of a green 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 of green turtle appears to be somewhat resilient to future perturbations.

8.2.4 Status in the Action Area

Important feeding areas for green turtles in U.S. waters are primarily located in Florida and southern Texas, but Long Island Sound and inshore waters of North Carolina appear to be important to juveniles during summer months (NMFS and USFWS 2007a). Juvenile green turtles are the second most commonly bycaught sea turtle species by the pound in net fisheries in the Pamlico Sound (Epperly et al. 1995a; Epperly et al. 2007a). Immature green turtles aggregate in certain neritic areas to forage. Modeling of young sea turtle dispersal after hatching showed relatively high abundances of young green turtles on the U.S. Atlantic coast (ages 0.5 to 1.5 years) and within the Sargasso Sea (ages 2.5 to 3.5 years) (Putman et al. 2020). Satellite tagging of juvenile green turtles showed movement along the Gulf Stream in oceanic (greater than 200 meters water depth) waters (Mansfield et al. 2021). A majority of the tagged green turtles left the Gulf Stream around Cape Hatteras, North Carolina, and traveled into the western Sargasso Sea. Modeling and tagging of young (and harder to spot) green turtles suggest that there might be more individuals in the seismic survey area than indicated by observational data for older age classes. Although sightings are limited and most records are of stranding or bycatch, relatively high concentrations of green turtles are expected to occur offshore from North Carolina in the spring, summer, and autumn based on sighting per unit effort modeling (DoN 2008a; DoN 2008b). Most sightings from 2010 through 2017 were made on the shelf during the summer (Palka et al. 2021).

8.2.5 Critical Habitat

Critical habitat was proposed for five DPSs of green sea turtle, including the North Atlantic DPS, which has critical habitat proposed in the action area. See Section 7.3.4 for more details.

8.2.6 Recovery Goals

In response to the current threats facing the species, NMFS developed goals to recover green turtle populations. These threats will be discussed in further detail in the Environmental Baseline of this consultation. See the 1998 and 1991 recovery plans for the Pacific, East Pacific, and Atlantic populations of green turtles for complete down-listing/delisting criteria for recovery goals for the species (NMFS 1991b). 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. The following items were identified as major priorities to recover green turtles in the Atlantic Ocean:

1. Provide long-term protection to important nesting beaches;
2. Ensure at least 60% hatch success on major nesting beaches;
3. Implement effective lighting ordinances or lighting plans on nesting beaches;
4. Determine distribution and seasonal movements for all life stages in marine environment;
5. Minimize mortality from commercial fisheries; and
6. Reduce threat to pollution and foraging habitat from marine pollution.

8.3 Leatherback Sea Turtle

The leatherback turtle ranges from tropical to subpolar latitudes, worldwide. The species was first listed under the Endangered Species Conservation Act (35 FR 8491) and listed as endangered under the ESA since 1973.

8.3.1 Life History

Leatherback turtles share a general life history pattern similar to other sea turtles. Females lay their eggs on coastal beaches where the eggs incubate in sandy nests. While a robust estimate of the life span does not exist, the current best estimate for the maximum age is 43 (Avens et al. 2009). Age at maturity has been difficult to ascertain, with estimates ranging from 16 to 29 years (Spotila et al. 1996). On average, they reach maturity at approximately 20 years (Jones et al. 2011).

Females usually lay up 5 to 7 clutches (7 to 15 days apart) per nesting season (3 to 6 months generally during the summer), with 20 to more than 100 eggs per clutch and eggs weighing greater than 80 grams (Reina et al. 2002; Wallace et al. 2007) (Eckert et al. 2012; Eckert et al. 2015). The number of leatherback turtle hatchlings that make it out of the nest on to the beach (i.e., emergent success) is approximately 50% worldwide (Eckert et al. 2012) and approximately 30% of the eggs may be infertile. Eggs hatch after about 2 months (60 to 65 days) (Eckert et al. 2015). Females nest on sandy, tropical beaches at intervals of every 1 to 11 (average of 2 to 4) years (Eckert et al. 2015). Nesting females exhibit low site-fidelity to their natal beaches, returning to the same region, but not necessarily the same beach, to nest (Dutton et al. 1999; Dutton et al. 2007). Females have been observed with fertility spans as long as 25 years (Hughes 1996). Natal homing, at least within an ocean basin, results in reproductive isolation between five broad geographic regions: eastern and western Atlantic Ocean, Indian Ocean, and eastern and western Pacific Ocean.

In the Northwest Atlantic Ocean, the sex ratio appears to be skewed toward females. Hatchling sex ratios range from 30 to 100% females in Suriname, Tobago, Colombia, and Costa Rica (Dutton et al. 1985; Mrosovsky 1994; Godfrey et al. 1996; Mickelson and Downie 2010; Patino-Martinez et al. 2012). The proportion of females documented in foraging individuals and strandings ranges from 57 to 70% (Murphy et al. 2006; James et al 2007; TEWG 2007), and the ratio of females to males during an individual breeding season is thought to be closer to 1:1 (Stewart and Dutton 2014). Reports of nearshore and onshore stranding data from the Atlantic Ocean and Gulf of Mexico coasts indicate that 60% of strandings were females (TEWG 2007b).

James et al. (2007) collected size and sex data from large subadult and adult leatherback turtles off Nova Scotia and also concluded a bias toward females at a rate of 1.86:1.

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

Leatherback turtles migrate long, transoceanic distances between their tropical nesting beaches and the highly productive temperate waters where they forage, primarily on jellyfish and tunicates. These gelatinous prey are relatively nutrient-poor, such that leatherback turtles must consume large quantities to support their body weight. Leatherback turtles weigh about 33% more on their foraging grounds than at nesting, indicating that they probably catabolize fat reserves to fuel migration and subsequent reproduction (James et al. 2005b; Wallace et al. 2006). Sea turtles must meet an energy threshold before returning to nesting beaches. Therefore, their remigration intervals (the time between nesting) are dependent upon prey availability foraging success and duration (Hays 2000; Price et al. 2004).

Unlike other sea turtles, leatherback turtles have several unique traits that enable them to live in cold water. For example, leatherback turtles have a countercurrent circulatory system (Greer et al. 1973), a thick layer of insulating fat (Goff and Lien 1988; Davenport et al. 1990), gigantothermy (Paladino et al. 1990), and they can increase their body temperature through increased metabolic activity (Southwood et al. 2005; Bostrom and Jones 2007). These adaptations allow leatherback turtles to be comfortable in a wide range of temperatures, which helps them travel further than any other sea turtle species (NMFS and USFWS 1995). For example, a leatherback turtle may swim more than 10,000 kilometers (6,000 miles) in a single year (Eckert 2006; Eckert et al. 2006; Benson et al. 2007a; Benson et al. 2011). They search for food between latitudes 71 degrees North and 47 degrees South, in all oceans, and travel extensively to and from their tropical nesting beaches.

While leatherback turtles will look for food in coastal waters, they appear to prefer the open ocean at all life stages (Heppell et al. 2003). Leatherback turtles have pointed tooth-like cusps and sharp-edged jaws that are adapted for a diet of soft-bodied prey such as jellyfish and salps. A leatherback turtle's mouth and throat also have backward-pointing spines that help retain jelly-like prey as water is expelled. Leatherback turtles favorite prey occur commonly in temperate and northern or subarctic latitudes and likely has a strong influence on their distribution in these areas (Plotkin 1995). Leatherback turtles are known to be deep divers, with recorded depths in excess of 1 kilometer for almost 90 minutes, but they may also come into shallow waters to locate prey items. In the Atlantic Ocean, they are found as far north as the North Sea, Barents Sea, Newfoundland, and Labrador, and as far south as Argentina and the Cape of Good Hope, South Africa (NMFS USFWS 2013). In the U.S., important nesting areas include Florida, St. Croix, and Puerto Rico. Other islands of the Caribbean Sea south to Brazil and Venezuela are also important nesting areas in the Western Atlantic Ocean (NMFS USFWS 2013). From 2009 to 2022, there is only one record of a leatherback nest at Bald Head Island, immediately next to Frying Pan Shoals, which occurred in 2010. At other beaches in the vicinity of the action area, there are similarly low numbers of leatherback nests over the same time period; there were no leatherback nests at Kure Beach, and one each at Caswell Beach and Oak Island, both in 2022.[3]

The survival and mortality rates for leatherback turtles are difficult to estimate and vary by location. For example, the annual mortality rate for leatherback turtles that nested at Playa Grande, Costa Rica, was estimated to be 34.6% in 1993 through 1994 and 34% in 1994 through 1995 (Spotila et al. 2000). In contrast, overall survival rates for nesting females is relatively high at 85% (Pfaller et al. 2018), with mean estimated annual survival rates of 70 to 99% in French Guiana (Rivalan et al. 2005), 89% in St. Croix (Dutton et al. 2005), and 89 to 96% on the coast of the Atlantic Ocean of Florida (Stewart et al. 2007b; Stewart et al. 2014), respectively. For the St. Croix population the average annual juvenile survival rate was estimated to be approximately 63% and the total survival rate from hatchling to first year of reproduction for a female was estimated to be between 0.4% and 2% (assuming age at first reproduction is between 9 and 13 years (Eguchi et al. 2006)). Spotila et al. (1996) estimated first-year survival rates for leatherback turtles at 6.25%.

Migratory routes of leatherback turtles are not entirely known; however, information from satellite tags have documented long travels between nesting beaches and foraging areas in the Atlantic Ocean and Pacific Ocean basins (Ferraroli et al. 2004; Hays et al. 2004; James et al. 2005a; Eckert 2006; Eckert et al. 2006; Benson et al. 2007a; Benson et al. 2011). Leatherback turtles nesting in the northwest Atlantic Ocean move throughout most of the North Atlantic Ocean from the equator to about 50 degrees North latitude. Leatherback turtles nesting in Central America and Mexico travel thousands of miles through tropical and temperate waters of the South Pacific Ocean (Eckert and Sarti 1997; Shillinger et al. 2008). Data from satellite tagged animals suggest that they may be traveling in search of seasonal aggregations of jellyfish (Shenker 1984; Starbird et al. 1993; Bowlby et al. 1994; Suchman and Brodeur 2005; Benson et al. 2007b; Graham 2009).

8.3.2 Population Dynamics

Leatherback turtles are globally distributed, with nesting beaches in the Atlantic, Indian, and Pacific Oceans. Movements of adults and subadults span across all major ocean basins and range from equatorial waters to temperate high-latitude regions (Shillinger and Bailey 2015). Leatherback turtles originating from the same nesting beach may forage in diverse and geographically distant regions, with variance among individuals (Eckert 2006; Eckert et al. 2006b; Hays et al 2006; Benson et al. 2011; Witt et al. 2011; Namboothri et al. 2012a). Conversely, leatherback turtles from different nesting beaches may move to the same foraging regions as adults (Fosette et al. 2010b, 2014). Patterns of leatherback turtle movements between

[3] http://www.seaturtle.org/nestdb/index.shtml?view=1&year=2022 Accessed June 28, 2023.

nesting beaches and foraging areas are complex, and appear to be linked to ocean currents that facilitate hatchling dispersal (Gaspar et al. 2012) or adult movements throughout the oceans (Lambardi et al. 2008). Adults are known to return to the same foraging areas after nesting (Seminoff et al. 2012), and hatchlings from different nesting beaches may reach the same foraging areas, creating a mosaic of overlapping population ranges. Wallace et al. (2010) identified seven global regional management units (subpopulations) by reviewing the genetic data available and performing a spatial analysis of these genetic data combined with nesting, tagging, and tracking data, these include northwest Atlantic Ocean, southwest Atlantic Ocean, southeast Atlantic Ocean, northeast Indian Ocean, west Pacific Ocean, and east Pacific Ocean.

Detailed population structure is unknown, but is likely dependent upon nesting beach location and influenced by physical barriers (i.e., landmasses), current systems, and long migrations. The total index of nesting female abundance in the Northwest Atlantic Ocean is 20,659 females. Based on estimates calculated from nesting data, there are approximately 18,700 (10,000 to 31,000 nesting females) total adult leatherback turtles in the North Atlantic Ocean (TEWG 2007a). The total index of nesting female abundance in the Southwest Atlantic Ocean is approximately 27 females. The total index of nesting female abundance in the Southeast Atlantic Ocean is approximately 9,198 females. The total index of nesting female abundance in the Southwest Indian Ocean is approximately 149 females. The total index of nesting female abundance in the Northeast Indian Ocean is approximately 109 females. The total index of nesting female abundance in the West Pacific Ocean is approximately 1,277 females. The total index of nesting female abundance in the East Pacific Ocean is approximately 755 females. The total index of nesting female abundance is likely an underestimate because we did not have adequate data from many nesting beaches, which have the potential for being unmonitored or unidentified.

Declines in nesting can occur rapidly in populations of leatherback turtles. In the Pacific Ocean, nesting has declined precipitously in recent decades (Benson et al. 2015). Aerial surveys of nesting beaches in Mexico detected declines from 70,000 nesting females in 1982 to fewer than 250 in 1998, with an annual mortality rate of 22.7% . The Terengganu, Malaysia nesting population was reduced to less than 1% of its original size between the 1950s and 1995 (Chan and Liew 1996) and is no considered functionally extinct. Significant declines in nesting have been documented for other nesting aggregations, such as Gabon, French Guiana, and Indonesia.

Population growth rates for leatherback turtles vary by ocean basin. Leatherback turtles in the Northwest Atlantic Ocean exhibit a decreasing nest trend at nesting beaches with the greatest known nesting female abundance. This decline has become more pronounced (2008 through 2017), and the available nest data reflect a steady decline for more than a decade (Eckert and Mitchell 2018). Leatherback turtles in the Southwest Atlantic Ocean exhibit an increasing, although variable, nest trend (nearly 5% average annual increase, with the largest increase occurring in the past decade). Leatherback turtles in the Southeast Atlantic Ocean exhibit a declining nest trend (8.6% annually) at the largest nesting aggregation (Gabon). Leatherback turtles in the Southwestern Indian Ocean exhibit a slightly decreasing nest trend at monitored nesting beaches (South Africa). Leatherback turtles in the Northeast Indian Ocean exhibit a drastic population decline with extirpation of its largest nesting aggregation in Malaysia. The overall nest trend has drastically decreased over the past several decades. Leatherback turtles in the West Pacific Ocean exhibit low hatching success and a declining nest and population trend. Based on NMFS's PVA model (Martin et al. 2020; Siders et al. 2023), leatherback sea turtles in the West Pacific population are declining at about 6% per year (95% CI: -23.8% to 12.2%). Leatherback turtles in the East Pacific Ocean exhibit a decreasing trend since monitoring began, with a 97.4% decline (depending on the nesting beach) since the 1980s or 1990s Wallace et al. (2013). Despite intense conservation efforts, the decline in nesting has not been reverse as of 2011 (Benson et al. 2015). Based on high nest numbers and mean trends across four index beaches (i.e., Tierra Colorada, Barra Cruz/Grande, Cahuitan, and Las Baulas), NMFS (2023) estimate a weighted average trend of -8.1% for the East Pacific leatherback population.

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

Subpopulations are reproductively isolated with little to no gene flow connecting them. However, within some subpopulations there is fine-scale genetic structure. Genetic analyses using microsatellite data revealed fine-scale genetic differentiation among neighboring subpopulations in the Northwest Atlantic Ocean including: Trinidad, French Guiana/Suriname, Florida, Costa Rica, and St. Croix (Dutton and H. 2013). Tagging studies indicate individual movement and gene flow among nesting aggregations.

In the Atlantic Ocean, equatorial waters appear to be a barrier between breeding populations. In the northwestern Atlantic Ocean, post-nesting female migrations appear to be restricted to north of the equator but the migration routes vary (Eckert et al. 2012; Saba 2013 as cited in NMFS USFWS 2013). Genetic studies support the satellite telemetry data indicating a strong difference in migration and foraging fidelity between the breeding populations in the northern and southern hemispheres of the Atlantic Ocean (Dutton et al. 2013b; Stewart et al. 2013 as cited in NMFS USFWS 2013).

8.3.3 Status

The leatherback turtle is an endangered species whose once large nesting populations have experienced steep declines in recent decades. The status of the subpopulations in the Atlantic, Indian, and Pacific Oceans are generally declining, except for the subpopulation in the Southwest Atlantic Ocean, which is slightly increasing. Leatherback turtles show a lesser degree of nest site fidelity than occurs with hardshell sea turtle species.

The primary threats to leatherback turtles include fisheries interactions (bycatch), harvest of nesting females, and egg harvesting. Because of these threats, once large rookeries are now functionally extinct, and there have been range-wide reductions in population abundance. Other threats include loss of nesting habitat due to development, tourism, vegetation changes, sand extraction, beach nourishment, shoreline stabilization, and natural disasters (e.g., storm events and tsunamis) as well as cold-stunning, vessel interaction, pollution (contaminants, marine debris and plastics, petroleum products, petrochemicals), ghost fishing gear, natural predation, parasites, and disease. Artificial lights on or adjacent to nesting beaches alter nesting adult female behavior and are often fatal to post-nesting females and emerging hatchlings as they are drawn to light sources and away from the sea. Ingestion of marine debris (plastic) is common in leatherback turtles and can block gastrointestinal tracts leading to death. Climate change may alter sex ratios (as temperature determines hatchling sex) and nest success, range (through expansion of foraging habitat as well as alter spatial and temporal patterns), and habitat (through the loss of nesting beaches, because of sea-level rise and storms). Oceanographic regime shifts possibly impact foraging conditions that may affect nesting female size, clutch size, and egg size of populations. The species' resilience to additional perturbation is low.

8.3.4 Status in the Action Area

Leatherback turtle sightings off North Carolina are frequent during summer, although sightings have been reported for all seasons; most sightings were on the shelf, with fewer along the shelf break and in offshore waters (DoN 2008a; DoN 2008b; Conley et al. 2017; Palka et al. 2021). Sightings per unit effort modeling based on line transects and platform of opportunity data shows some overlap of leatherback occurrence with the northeastern portion of the seismic survey area (DoN 2008a). During (CETAP 1982) surveys, leatherback turtles were sighted off North Carolina during spring, summer, and fall. Some leatherback turtles tagged outside of Cape Cod, Massachusetts, seemed to forage relatively close to the coast of North Carolina during the summer; in the autumn and spring, they showed longer distance movements and movement offshore, including over the seismic survey area (Dodge et al. 2014). In the Southeast Fisheries Science Center's Spring Trawl Survey that takes place annually throughout the coastal waters of the southeast, three leatherbacks have been incidentally captured in the bottom trawl near the action area (PSIT 2023). Off Beaufort, north of the action area, researchers tagged 20 leatherbacks in May of 2017 and 2018, who were present in the area foraging on cannonball jellyfish (*Stomolophus meleagris*). These tagged leatherback turtles were tracked on the coastal shelf (i.e., a "coastal residency") before moving offshore (Palka et al. 2021).

8.3.5 Critical Habitat

Designated critical habitat for leatherback turtles is outside the action area.

8.3.6 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 of this consultation. See the 1991 Recovery Plans for the U.S. Caribbean, Gulf of Mexico, and Atlantic leatherback turtles for complete downlisting/delisting criteria for each of their respective recovery goals. The following items were the top five recovery actions identified to support in the Leatherback Five Year Action Plan:

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

8.4 Kemp's Ridley Sea Turtle

The Kemp's ridley turtle is considered to be the most endangered sea turtle, internationally (Zwinenberg 1977; Groombridge 1982). The Kemp's ridley turtle occurs from the Gulf of Mexico and along the Atlantic coast of the U.S., with nesting beaches limited to a few sites in Mexico and Texas (TEWG 2000). The species was first listed under the ESA and listed as endangered under the ESA since 1970.

8.4.1 Life History

Kemp's ridley turtles share a general life history pattern similar to other sea turtles. Females lay their eggs on coastal beaches where the eggs incubate in sandy nests. After 45 to 58 days of embryonic development, the hatchlings emerge and swim offshore into deeper, oceanic waters where they feed and grow until returning at a larger size. Their return to nearshore coastal habitats typically occurs around 2 years of age (Ogren 1989), although the time spent in the oceanic habitat may vary from 1 to 4 years or perhaps more (TEWG 2000). Females generally reach maturity at 12 years of age, but may range from 5 to 16 years. The average remigration is 2 years, although some animals nest annually. Nesting occurs from April through July in arribadas (large aggregations) mainly on beaches in the Gulf of Mexico, but primarily at Rancho Nuevo, Mexico. Historic records indicate a nesting range from Mustang Island, Texas, in the north to Veracruz, Mexico, in the south. Kemp's ridley turtles have also recently been nesting along the Atlantic coast of the U.S., with nests recorded from beaches in Florida, Georgia, North Carolina, South Carolina, and Virginia. In and near the action area, Kemp's ridley sea turtle nesting is uncommon, with three nests recorded from 2009 to 2022, one at Bald Head Island in 2020, and two at Caswell Beach in 2021, and one in 2023.[4]

Females lay an average of 2.5 clutches per season. The annual average clutch size is 97 to 100 eggs per nest. The nesting location may be particularly important because hatchlings can more easily migrate to foraging grounds in deeper oceanic waters, where they remain for approximately 2 years before returning to nearshore coastal habitats from April through November, but move towards more suitable overwintering habitat in deeper offshore waters (or

[4] http://www.seaturtle.org/nestdb/index.shtml?view=1&year=2023

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 meters 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 and USFWS 2011).

8.4.2 Population Dynamics

Of the sea turtles species in the world, the Kemp's ridley has declined to the lowest population level. Nesting aggregations at a single location (Rancho Nuevo, Mexico) were estimated at 40,000 females in 1947. By the mid-1980s, the population had declined to an estimated 300 nesting females. Nesting steadily increased through the 1990s, and then accelerated during the first decade of the 21st century. Following a significant, unexplained one-year decline in 2010, Kemp's ridley turtle nests in Mexico reached a record high of 21,797 in 2012 (NPS 2013). In 2013, there was a second significant decline, with 16,385 nests recorded. In 2014, there were an estimated 10,987 nests and 519,000 hatchlings released from three primary nesting beaches in Mexico (NMFS and USFWS 2015). The number of nests in Padre Island, Texas has increased over the past two decades, with 1 nest observed in 1985, 4 in 1995, 50 in 2005, 197 in 2009, and 119 in 2014 (NMFS and USFWS 2015).

From 1980 through 2003, the number of nests at three primary nesting beaches (Rancho Nuevo, Tepehuajes, and Playa Dos) increased 15% annually (Heppell et al. 2005); however, due to recent declines in nest counts, decreased survival at other life stages, and updated population modeling, this rate is not expected to continue (NMFS and USFWS 2015). In fact, nest counts dropped by more than a third in 2010 and continue to remain below predictions (Caillouet et al. 2018).

Genetic variability in Kemp's ridley turtles is considered to be high, as measured by heterozygosis at microsatellite loci (NMFS and USFWS 2011). Additional analysis of the mitochondrial DNA taken from samples of Kemp's ridley turtles at Padre Island, Texas, showed six distinct haplotypes, with one found at both Padre Island and Rancho Nuevo (Dutton et al. 2006). Additionally, the genetic diversity of immature Kemp's ridley turtles foraging in the northern Gulf of Mexico (along the Florida panhandle) closely correspond to that of nesting females in Rancho Nuevo, Mexico (Lamont et al. 2021). Despite recent declines in Kemp's ridley turtle populations, a recent study found that genetic diversity, as assessed through the mitochondrial genome, has remained stable (Frandsen et al. 2020).

Juvenile Kemp's ridley turtles, possibly carried by oceanic currents, have been recorded as far north as Nova Scotia. The vast majority of individuals stem from breeding beaches at Rancho Nuevo on the Gulf of Mexico coast of Mexico. During spring and summer, juvenile Kemp's ridley turtles occur in the shallow coastal waters of the northern Gulf of Mexico from south 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 and USFWS 2011).

Kemp's ridley turtle nesting population was exponentially increasing (NMFS et al. 2011); however, since 2009 there has been concern over the slowing of recovery (Gallaway et al. 2016a; Gallaway et al. 2016b; Plotkin 2016).

8.4.3 Status

Kemp's ridley turtles face many of the same threats as other sea turtle species, including destruction of nesting habitat from storm events, oceanic events such as cold-stunning, pollution (plastics, petroleum products, petrochemicals, etc.), ecosystem alterations (nesting beach development, beach nourishment and shoreline stabilization, vegetation changes, etc.), poaching, global climate change, fisheries interactions, natural predation, and disease.

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 prohibited the harvest of sea turtles from May through August, and in 1990, the harvest of all sea turtles was prohibited by presidential decrees in Mexico. 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 use of sea turtle excluder devices mitigates take. Fishery interactions and strandings, possibly due to forced submergence, appear to be the main threats to the species. The *Deepwater Horizon* oil spill event reduced nesting abundance and associated hatchling production as well as exposures to oil in the oceanic environment which has resulted in large losses of the population across various age classes, and likely had an important population-level effect on the species. We do not have understanding of those impacts on the population trajectory for the species into the future. The species' limited range and low global abundance make it vulnerable to new sources of mortality as well as demographic and environmental randomness, all of which are often difficult to predict with any certainty. Therefore, its resilience to future perturbation is low.

8.4.4 Status in the Action Area

Hatchlings are carried by the prevalent currents off the nesting beaches and do not appear in the neritic zone until they are about 2 years old (Musick and Limpus 1997a). Those juvenile and immature Kemp's ridley turtles that migrate northward past Cape Hatteras, North Carolina probably do so in April and return southward in November (Musick et al. 1994). North of Cape Hatteras, North Carolina, juvenile and immature Kemp's ridley turtles prefer shallow water areas, particularly along North Carolina and in the Chesapeake Bay, Long Island Sound, and Cape Cod Bay (Danton and Prescott. 1988; Morreale et al. 1989; Musick et al. 1994; Frazier et al. 2007).

Numerous sightings of Kemp's ridley turtles have been reported off North Carolina in all seasons (DoN 2008a; DoN 2008b; Palka et al. 2021), with most in winter and summer (DoN 2008a; DoN 2008b). Strandings have also been reported during all seasons except winter, and mostly in spring and fall (DoN 2008a; DoN 2008b). Modelling of young sea turtle dispersal after hatching showed a portion of Kemp's ridley turtles age 1.5 years concentrating mainly in shelf waters off

North Carolina (Putman et al. 2020). According to data from the NMFS Science Center research surveys, Kemp's ridley sea turtles are incidentally captured in and near the action area via bottom trawl in fall and spring (PSIT 2023).

8.4.5 Critical Habitat

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

8.4.6 Recovery Goals

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

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

8.5 Atlantic Sturgeon—Gulf of Maine, New York Bight, Chesapeake, Carolina, and South Atlantic DPSs

Atlantic sturgeon occupy ocean waters and associated bays, estuaries, and coastal river systems from Hamilton Inlet, Labrador, Canada to Cape Canaveral, Florida (Stein et al. 2004b; ASMFC 2006). Atlantic sturgeon spawn in freshwater, but spend most of their adult life in the marine environment. Atlantic sturgeon are listed as five DPSs under the ESA. Five DPSs were listed under the Endangered Species Act on February 6, 2012. The Gulf of Maine DPS was listed as threatened, and the New York Bight, Chesapeake Bay, Carolina, and South Atlantic DPSs were listed as endangered.

Since adult and subadult Atlantic sturgeon from all five DPSs can be found in the marine environment where the action takes place, we consider the status of each of the five DPSs of Atlantic sturgeon here.

8.5.1 Life History

The general life history pattern of Atlantic sturgeon is that of a long lived, late-maturing, iteroparous, anadromous species. Spawning intervals range from once every 1 to 5 years for males (Smith 1985; Bain 1997; Collins et al. 2000b; Schueller and Peterson 2010) and 3 to 5 years for females (Vladykov and Greeley 1963; Bain 1997; Stevenson and Secor 1999; Schueller and Peterson 2010). Fecundity increases with age and body size, ranging from 400,000 to 8 million eggs (Smith et al. 1982; Van Eenennaam and Doroshov 1998; Dadswell 2006). The average age at which 50% of maximum lifetime egg production is achieved is estimated to be 29 years, approximately 3 to 10 times longer than for other bony fish species examined (Boreman 1997).

Spawning adults swim upriver in late winter to spring, depending on the population; in the south, migration occurs between February and March, in the mid-Atlantic, migration occurs between April and May, and in Canada, migration occurs between May and June. A small spawning migration may also take place in the fall, again depending on the population (ASSRT 2007). Spawning occurs in flowing water between the salt wedge and fall line of large rivers.

Sturgeon eggs are highly adhesive and are deposited in freshwater or tidal freshwater reaches of rivers on the bottom substrate, usually on hard surfaces such as cobble (Gilbert 1989; Smith and Clugston 1997). Hatching occurs approximately 94 to 140 hours after egg deposition, and larvae assume a bottom-dwelling existence (Smith et al. 1980). The yolk sac larval stage is completed in about 8 to 12 days, during which time larvae move downstream to rearing grounds over a 6 to 12 day period (Kynard and Horgan 2002). During the daytime, larvae use benthic structure (e.g., gravel matrix) as refugia (Kynard and Horgan 2002). Juvenile sturgeon continue to move further downstream into waters ranging from zero to up to 10 parts per thousand salinity. Older juveniles are more tolerant of higher salinities as juveniles typically spend at least 2 years and sometimes as many as 5 years in freshwater before eventually becoming coastal residents as subadults (Smith 1985; Boreman 1997; Schueller and Peterson 2010).

Atlantic sturgeon feed primarily on soft-bodied benthic invertebrates like polychaetes, isopods, and amphipods in the saltwater environment, while in fresh water, they feed on oligochaetes, gammarids, mollusks, insects, and chironomids (Moser and Ross 1995; Johnson et al. 1997; Haley 1998; Haley 1999; Brosse et al. 2002; Guilbard et al. 2007; Savoy 2007; Collins et al. 2008). Diets vary latitudinally and seasonally, though universally researchers have found that polychaetes constitute a major portion of Atlantic sturgeon diets. In North Carolina, Moser and Ross (1995) determined Atlantic sturgeon fed on 32% polychaetes, 28% isopods, 12% mollusks, and then other items. The directed movement of subadult and adult Atlantic sturgeon in the spring is from saltwater waters to river estuaries. River estuaries provide foraging opportunities for subadult and adult Atlantic sturgeon in addition to providing access to spawning habitat. The directed movement of subadult and adult Atlantic sturgeon reverses in the fall as the fish move back into saltwater waters for the winter.

There are gaps in our understanding about the offshore marine distribution of Atlantic sturgeon. Much of the available data point to Atlantic sturgeon using relatively nearshore, shallow water habitats, less than 20 meters in the marine environment, but there are reports of Atlantic sturgeon being captured in waters 75 meters deep (Sokolowski et al. 2012).

8.5.2 Population Dynamics

Subadult and adult Atlantic sturgeon from all five DPSs (Carolina DPS, Chesapeake DPS, Gulf of Maine DPS, New York Bight DPS, and South Atlantic DPS) occur in the marine environment. NMFS (2021) used data from Kocik et al. (2013) to derive an estimate of 67,776 Atlantic sturgeon in the marine environment, which includes adults and subadults of sufficient size to be captured in the nets used during the surveys. The surveys examined by Kocik et al. (2013) took place from Cape Cod, Massachusetts, to Cape Hatteras, North Carolina. This estimate was generated given assumptions about the calculations (e.g., catchability, net efficiency and availability) (NMFS 2021). To the best of our knowledge, there is no other more recent or rangewide population estimate of Atlantic sturgeon in the marine environment.

8.5.2.1 Gulf of Maine DPS

An open population estimate of marine-oriented Atlantic sturgeon (subadult and adult) foraging in the Saco River from May to November is between 1,400 and 6,800 individuals annually (Flanigan et al. 2021). The Kennebec River effective population size and 95% confidence limits (CL) were estimated at 67.0 (52.0 to 89.1) and 79.4 (60.3 to 111.7) by Waldman et al. (2019) (n = 62) and White et al. (2021b) (n = 48). Effective population size is essentially an estimate of the number of breeding individuals in a population required to maintain the amount of genetic variability observed within samples from that population. Furthermore, two larval Atlantic sturgeon were captured just above the Kennebec River estuary between 24 and 25 °C in mid-July, confirming successful reproduction in this location (Wippelhauser et al. 2017). It is thought the Penobscot may have historically supported a spawning population, but it is possibly extirpated (ASMFC 2017b). Wippelhauser et al. (2017) suggest Atlantic sturgeon use the upper Kennebec River, the Kennebec River estuary, and the Androscoggin River estuary for reproduction (NMFS 2022b). It is unknown whether the Merrimack River supports a reproductive population of Atlantic sturgeon (ASMFC 2017b). In addition, while the Androscoggin represents an additional known spawning location for this DPS, non-spawning individuals were observed to use the Penobscot, Androscoggin, Saco, Merrimack, St. John, and Minas Passage (Altenritter et al. 2017; Novak et al. 2017; Wippelhauser et al. 2017). Survival rates of all ages is estimated to be approximately 74% annually (95% confidence limits, 15 to 99%) (ASMFC 2017b).

8.5.2.2 New York Bight DPS

The Connecticut, Hudson, and Delaware Rivers all support reproductive populations while the Taunton River population appears to be extirpated. A recent assessment of relatedness of these populations to others along the coast reveals, as was the case at the time of listing, that the Hudson and Delaware populations appear to be a separate group from other populations but also different from one another (White et al. 2021b). The Connecticut River was not included in that study. A recent study using acoustic telemetry to estimate spawning duration and return intervals shows that Hudson River adults return much more frequently than previously thought; females every 1.66 years and males every 1.28 years (Breece et al. 2021). This is in agreement with recent studies conducted in the York River (Hager et al. 2020), both suggesting females, in particular, spawn more often than previously thought. In the Hudson River, males were on spawning grounds on average from May 27 through July 11 and females from June 8 through June 29. The average male is also more likely to travel further upriver than the average female (Breece et al. 2021).

There are a number of updated abundance estimates for each river. The Hudson River most likely supports the largest population of Atlantic sturgeon in the United States. Effective population estimates for the Hudson River are 156 (95% CL, 138.3 to 176.1; n = 459) (Waldman et al. 2019) and 145.1 (82.5 to 299.4; n = 3070 (White et al. 2021b). Kazyak et al. (2020) produced an abundance estimate of the 2014 adult spawning run size of 466 individuals (95% CL, 310 to 745). While this spawning run size is nearly identical to that estimated by Kahnle et al. (2007), monitoring of relative abundance of juveniles from 2004 through 2019 has shown production may have doubled during those 16 years (Pendleton and Adams 2021).

In the Delaware River, the effective population size has been estimated to be 40 (95% CL, 34.7 to 46.2; n = 108) and 60.4 (42 to 85.6; n = 488) by Waldman et al. (2019) and White et al. (2021b), respectively. The significant difference between estimates is likely due to sample size. Therefore, White et al. (2021b) estimate is likely most accurate. Additionally, a recent close-kin mark-recapture estimate was produced for the Delaware River and suggests there are fewer than 250 adults (census) in the Delaware River population (White et al. 2022).

In the Connecticut River, despite only limited collection of juvenile sturgeon (n = 47), there is an estimate of effective population size of 2 (95% CL, 2-2.7) (Waldman et al. 2019). This will suggest there has been a single spawning event in the Connecticut River that produced all of the juvenile fish collected or the spawning adults were so closely related as to be indistinguishable from a single pair. Either way, it is clear there is limited genetic diversity in this population and, unless these adults continue returning to the Connecticut River, it could take approximately 20 years to learn whether these juveniles have survived in sufficient numbers to sustain this new population.

Recent survival estimates do not suggest much of an improvement since the last estimates made during the commercial fishery (Boreman 1997; Kahnle et al. 1998). Melnychuk et al. (2017) provided an updated estimate of survival of Hudson River Atlantic sturgeon of approximately 88.22%, while for similar life stages over a longer time frame, the Atlantic States Marine Fisheries Service (ASMFC 2017b) estimated survival of the entire New York Bight to be 91% (95% confidence limits, 71 to 99%).

Distribution of fish from the different populations of Atlantic sturgeon in the New York Bight DPS have also been updated since 2017. The range of Atlantic sturgeon can be measured from north to south or inshore to offshore. While there has been no change to the range along the East Coast, there are detection data of acoustic transmitters much further offshore than had previously been documented.

To understand movement along the coast, White et al. (2021a) assessed the river of origin of Atlantic sturgeon harvested during the commercial fishery. This was a duplication of a study done by Waldman et al. (1996), but showed fish harvested in the Hudson River were from many locations other than the Hudson. The makeup of the harvested fish in the 1990s was 82.3% Hudson, 7.3% Delaware, 4.7% James River spring run, 2.4% St. Lawrence, 2.1% Kennebec, 1.3% Pee Dee spring run, rather than 98% Hudson as had been estimated during the fishery. The reasons for the difference are likely a more thorough baseline consisting of 18 known populations rather than only 9 (White et al. 2021b) and the use of microsatellite DNA rather than mitochondrial. However, Wirgin et al. (2018) sampling 148 subadult sturgeon in the Hudson River estuary and relying on microsatellite DNA, found 142 of those were of Hudson River origin with additional contributions from the Kennebec (2), Delaware (2), Ogeechee (1), and James (1) Rivers. This may suggest adults are more likely to enter estuaries than subadults are.

In terms of nearshore habitat use, Breece et al. (2018a) showed habitat selection is driven by depth, time of year, sea surface temperature, and light absorption by seawater, while sex and natal river do not seem to be important predictors of habitat selection. Therefore, regardless of the makeup of the mixed populations in these estuarine areas, the drivers of where the fish are located affect all sexes and populations similarly. Inshore and offshore movement is highly dependent on photoperiod and temperature, with fish residing offshore from November to January and inshore from June to September (Ingram et al. 2019). Fish gradually move inshore from February to May but rapidly move offshore during October (Ingram et al. 2019). In the Delaware Bay, when fish have moved inshore for the spring and summer months, Breece et al. (2018b) showed Atlantic sturgeon prefer shallow water and warmer bottom temperatures primarily in the eastern portion of the bay during residency but that this preference changes to deep, cool water and the western edge of the bay during migration.

Kazyak et al. (2021) studied the offshore composition of sturgeon between Cape Hatteras and Cape Cod (mid-Atlantic, which comprises the New York Bight, Chesapeake Bay, and part of the Carolina DPSs) and found that 37.5% and 30.7% of all bycaught fish in this region were from the New York Bight and Carolina DPSs, respectively. This was primarily driven by 27.3% of fish from the Albemarle complex and 26.2% from the Hudson River. Estuarine bycatch in this area was primarily from Albemarle Complex, with many of the samples being obtained in waters of North Carolina, and most offshore fish were from the Hudson and James Rivers.

8.5.2.3 Chesapeake DPS

There are still only three known spawning populations for the Chesapeake DPS in the James, York, and Nanticoke Rivers. Edwards et al. (2020) noted an adult male Atlantic sturgeon was detected at the saltwater interface of the Patuxent River, something that may indicate potential spawning. However, Kahn et al. (2019) noted that telemetry detections are not a sufficient indicator of whether a male is spawning. Because males are often in spawning condition during non-spawning situations (Van Eenennaam et al. 1996), even if this individual had been captured and observed in spawning condition, that will not have been enough to suggest spawning was occurring in the Patuxent River.

Monitoring in the York River reveals that males return to spawn every 1.13 years and females every 2.19 years (Hager et al. 2020). Males in the Nanticoke River system return to spawn every 1.68 years (calculated from Table 2 in (Secor et al. 2022)) but there is insufficient information to estimate female return intervals. Hager et al. (2020) show spawning in the York River occurs on descending temperatures from 25.1 °C to 21.5 °C. This narrow temperature window is bounded by increased egg mortality at 25 °C and peak bioenergetic growth around 22 °C. Secor et al. (2022) similarly show adults present on Nanticoke River spawning grounds from 26.7 °C down to 17.8 °C with most fish leaving the system by 20 °C. Spawning in both systems appears to be driven by temperature and photoperiod with a peak of spawning around the autumn equinox (Hager et al. 2020; Secor et al. 2022). Sex ratios when spawning range from approximately 64 to 75% male in the York River, though the overall population appears to be approximately 51% male (95% CL, 43 to 58%; (Kahn et al. 2021)).

A recent assessment of relatedness of all Atlantic sturgeon populations showed that when all populations along the coast are grouped, the James River (spring and fall runs) is most closely related to rivers in the northeast, while the York River is most closely related to rivers in the southeast (White et al. 2021b). The York River population was distinct when compared to those southeastern rivers; the James River, meanwhile, when compared to northeastern rivers, remains closely related to a group of rivers in Canada and Maine but is differentiated from the Hudson and Delaware rivers. At this point in the analysis, Program COLONY, which was used to estimate closeness of relationships, could have identified three clusters (James spring and fall, Hudson and Delaware, and Maine/Canada), but did not. When compared only with rivers from Maine and Canada (White et al. 2021b), then the James River spring and fall runs both appear to be unique but can be further separated from each other when compared to one another (Balazik et al. 2017) (White et al. 2021b)). This analysis shows that the York River population (and Nanticoke River population, which appear to form an upper Chesapeake Bay metapopulation [J. Kahn, unpublished data]) is significantly different from the two James River populations at the most basic level of comparison.

Considerable advances have been made in understanding the abundance of each of these populations. There are no estimates of abundance for any life stage in the James River. The York River has estimates of adult abundance on spawning runs from 2014 through 2019 (Table 5). Census estimates of adult Atlantic sturgeon on spawning runs in the Nanticoke River in 2020 and 2021 are 36 (25 to 55) and 74 (52 to 109; Nick Coleman, personal communication, email November 29, 2022). Effective population size of the James River (as a single spawning population) was estimated from 116 samples to be 32 (28.8 to 35.5; (Waldman et al. 2019)). White et al. (2021b) assessed the James River spring (n = 45) and fall (n = 131) spawning adults separately and identified effective population sizes of 24.7 (21 to 29.4) and 85.5 (61.1 to 127.5), respectively. The lone effective population estimate for the York River (n = 203) is 9.3 (6.9 to

11.8; (White et al. 2021b)) and for the Nanticoke River (n = 32) is 12.2 (6.7 to 21.9; (Secor et al. 2022)).

Table 4. Estimated abundance of spawning runs in the Pamunkey River, the primary spawning tributary of the York River, derived from a model relying on capture probability (Kahn et al. 2021) and a mark recapture heterogeneity model (Kahn et al. 2019)

Year	Male*	Female*	Spawning abundance*	95% CL*	Jackknife model†	95% CL†
2014	117	41	158	127-189	152	115-215
2015	125	68	192	154-230	182	145-243
2016	112	38	149	120-179	219	166-298
2017	150	68	218	175-260	215	167-292
2018	92	30	122	98-145	154	112-222
2019	153	86	239	192-286	330	257-434

*estimates from Kahn et al. 2021, † estimates from Kahn et al. 2019

Several recent survival estimates have been produced. At the DPS level, the Chesapeake Bay DPS is estimated to have an apparent annual survival of approximately 88% (95% CL, 46 to 99%; (ASMFC 2017b)). A recent estimate for adult York River Atlantic sturgeon by Kahn et al. (2023) shows much higher survival than other estimates with an annual apparent survival of 99.2% (97.9 to 99.7%). The Kahn et al. (2023) estimate was higher because it accounted for different detection probabilities between sexes and identified tag loss rates of 12.8% through concurrent mark recapture research.

Oceanic distribution of the Chesapeake Bay DPS is best known from the analysis by Kazyak et al. (2021). This is the same information as presented for the New York Bight DPS because both populations occupy waters between Cape Hatteras and Cape Cod. Rothermel et al. (2020), like Ingram et al. (2019) noted an inshore movement in the spring and offshore movement in the fall and winter. And like Breece et al. (2018b), Atlantic sturgeon appear to prefer warmer, shallower water while residing offshore.

8.5.2.4 Carolina DPS

There is scant information available on the population status of the Carolina DPS. Spawning likely occurs in the Roanoke, Tar/Pamlico, Neuse, Cape Fear, Pee Dee, Santee, and Cooper rivers. Census abundance is not available for any system. The effective population size of juveniles collected in the Albemarle Sound is approximately 19 (95% CL, 16.5 to 20.6; n = 88; (Waldman et al. 2019)) to 29.5 (24.2 to 36.3; n = 71; (White et al. 2021b)). There is also a new effective population size estimate for the Pee Dee River spring (n = 66) and fall (n = 50) spawning runs, amounting to 13.5 (11.9 to 15.3) and 82 (60.3 to 122.1), respectively (White et al.

2021b). The ASMFC (2017b) produced an updated survival estimate for the entire Carolina DPS, suggesting Atlantic sturgeon survival rates are approximately 78% (95% CL, 39 to 99%). A mark-recapture model looking at juvenile abundance from 1996 to 2019 in the Edisto River found an average of 845 individuals (Takacs 2022).

Relatedness of known spawning populations was also assessed for the Carolina DPS, both in terms of its relationships to other populations outside of the DPS and within. Once the York River is isolated as being unique and different from all other southeastern populations, those populations then break into two groups with a bit of overlap. One group is the Albemarle Complex, Pee Dee spring run, Pee Dee fall run, Edisto spring run, Ogeechee spring run, and Satilla river populations while the other group is the Albemarle Complex, Pee Dee fall run, Edisto fall run, Savannah, Ogeechee fall run, and Altamaha populations (White et al. 2021b). When compared amongst each other further, those groupings break out into the Albemarle Complex, Pee Dee spring run, and Pee Dee fall run separate from the rest of the southeastern rivers (White et al. 2021b).

As mentioned in the discussion of the New York Bight DPS sturgeon distribution, the Carolina DPS made up 30.7% of detections between Cape Cod and Cape Hatteras. This DPS also makes up 6.2% of detections south of Cape Hatteras (Kazyak et al. 2021). From Cape Cod to Florida, Carolina DPS fish were most likely to be encountered in nearshore waters. Rulifson et al. (2020b), relying on acoustic telemetry, showed that, similar to that which has been documented for New York Bight and Chesapeake Bay DPS fish, Carolina DPS sturgeon move inshore and offshore seasonally. The greatest number of detections along the North Carolina Atlantic Coast occur from November to April (Rulifson et al. 2020b).

8.5.2.5 South Atlantic DPS

The Edisto and Ogeechee rivers appear to have a spring and a fall run (White et al. 2021b). When exploring the possibility of spring and fall spawning migrations, without any knowledge of the reproductive condition of the individuals, Vine et al. (2019a) identified temperature as a primary driver of upriver movement in both the spring and fall. In the spring, Atlantic sturgeon moved upriver as temperatures increased between 11 and 15 °C and in the fall, as temperatures were descending, between 29 and 24 °C (Vine et al. 2019a). For Atlantic sturgeon, discharge did not influence upriver movement (Vine et al. 2019a).

New abundance estimates were also produced in the South Atlantic DPS since 2017. A census estimate was produced in the upper 20 kilometers of the Savannah River (river kilometers 281 to 301) to estimate the number of purported spawning adults in that stretch on a given day over 50 sampling occasions. The maximum estimate of daily abundance in those 20 kilometers was 35 to 55 adults of unknown sex (Vine et al. 2019b). Effective population estimates were also produced for many rivers in the South Atlantic DPS. The Edisto River (n = 145) was estimated to have an effective population of 60 (95% CL, 51.9 to 69.0; (Waldman et al. 2019)), but was broken into two spawning populations by White et al. (2021b) following the identity of two distinct spawning groups (Farrae et al. 2017) for estimates of a spring run (n = 123) of 16.4 (12.8 to 20.6) and a fall run (n = 373) of 47.9 (25.3 to 88.8). The Savannah River was estimated to have an effective population size (n = 161) of approximately 123 (103.1 to 149.4) and also (n = 134) of approximately 154.5 (99.6 to 287.7) by Waldman et al. (2019) and White et al. (2021b), respectively. The Ogeechee River (n = 200) was estimated to have an effective population of 26 (23.9 to 28.2; (Waldman et al. 2019)), but was also broken into two spawning populations by White et al. (2021b) for estimates of a spring run (n = 92) of 31.1 (24.3 to 40.2) and a fall run (n = 55) of 56.5 (36.3 to 103.6). The Altamaha River appears to support the largest Atlantic sturgeon population in the South Atlantic DPS, and one of the largest on the East Coast, with effective population estimates of 149 (128.7 to 174.3; n = 245; (Waldman et al. 2019)) and 141.7 (73.4 to 399; n = 189; (White et al. 2021b)). The effective population estimates for the Satilla River population are 21 (18.7 to 23.2; n = 68; (Waldman et al. 2019)) and 11.4 (9.1 to 13.9; n = 74; (White et al. 2021b)). Work in the St. Mary’s River on the Florida Georgia border captured 25 fish including 14 river resident juveniles. Analysis of those individuals reveals an effective population size of 1 (1.3 to 2.0) but this is a known under-estimate since those individuals were from a single spawning event (Fox et al. 2018; Waldman et al. 2019). The St. Johns River in Florida does not appear to support an extant population (Fox and Peterson 2019). Survival within the entire DPS was estimated to be approximately 86% (54-99%; (ASMFC 2017b)).

The relatedness of the populations reveals three groups of related clusters within this DPS. The first cluster includes the Edisto spring run, the Ogeechee Spring run, and the Satilla River populations; the second includes the Edisto River fall run and Ogeechee River fall run; and the third includes the largest populations of the Savannah and Altamaha Rivers, but also the Ogeechee River fall run (White et al. 2021b). As was seen with other rivers with dual spawning populations, the spring and fall runs are genetically differentiated.

South of Cape Hatteras, Kazyak et al. (2021) showed that 91.2% of fisheries bycatch was from the South Atlantic DPS. In terms of population level distribution and susceptibility to commercial fisheries, 35.7% were from the Altamaha River, 21.4% from the Edisto River fall-run, 18.9% from the Savannah River, 7.2% from the Ogeechee River (both spring and fall), 5.5% Satilla, 3.7% Pee Dee (both spring and fall), and 2.0% Edisto spring-run. In the south, most offshore fish were from the Altamaha, followed by the Savannah (Kazyak et al. 2021). Within river movement studies also revealed that age-1 fish that were tagged in the summer remained in the rivers and overwintered before out-migrating between December and March (Fox and Peterson 2019). When observing the likelihood of becoming a coastally wandering subadult or remaining a river resident for another year, Fox and Peterson (2019) found that 36.7% returned as age 2 fish while 30.4% out migrated as age 2. The St. Johns River, the furthest south in the South Atlantic DPS, has periodic use by subadults and adults, but is not spawning or rearing habitat anymore.

8.5.3 Status

Atlantic sturgeon were once present in 38 river systems and, of these, spawned in 35 of them. Individuals are currently present in 36 rivers, and spawning occurs in at least 20 of these . The decline in abundance of Atlantic sturgeon has been attributed primarily to the large U.S. commercial fishery that existed for the Atlantic sturgeon from the 1870s through the mid-1990s. The fishery collapsed in 1901 and landings remained at between 1 to 5% of the pre-collapse peak until ASMFC placed a two generation moratorium on the fishery in 1998 (ASMFC 1998). The majority of the populations show no signs of recovery, and new information suggests that stressors such as bycatch, ship strikes, and low dissolved oxygen can and do have substantial impacts on populations . Additional threats to Atlantic sturgeon include habitat degradation from dredging, damming, and poor water quality . Climate change related impacts on water quality (e.g., temperature, salinity, dissolved oxygen, contaminants) have the potential to impact Atlantic sturgeon populations using impacted river systems. These effects are expected to be more severe for southern portions of the U.S. range of Atlantic sturgeon (Carolina and South Atlantic DPSs). None of the spawning populations are currently large or stable enough to provide any level of certainty for continued existence of any of the DPSs.

8.5.4 Status in the Action Area

Broadly, there have been only a few studies focusing on Atlantic sturgeon in North Carolina waters. Rulifson et al. (2020), relying on acoustic telemetry, showed that, similar to what has been documented for New York Bight and Chesapeake Bay DPS fish, Carolina DPS sturgeon move inshore and offshore seasonally. The greatest number of detections along the North Carolina Atlantic Coast occur from November to April (Rulifson et al. 2020b).

There are multiple lines of evidence to indicate the mixing of several DPSs of Atlantic sturgeon in North Carolina waters. For example, along with the presence of the Carolina DPS, acoustic detection data from Albemarle Sound have included subadults and adults from Cape Fear River, James River, Virginia, and areas of Connecticut, Delaware, South Carolina, and Georgia (Post et al. 2014). Genetic data from Atlantic sturgeon sampled from North Carolina also demonstrated the presence of several DPSs (ASMFC 2017b; Kazyak et al. 2021). This mixing makes determination of the DPS assignment in real time challenging for any sampled Atlantic sturgeon.

8.5.5 Critical Habitat

Critical habitat for all five DPSs of Atlantic sturgeon was designated in 2017. The critical habitat the Carolina DPS falls within the action area. See Section 7.3.3 for more details.

8.5.6 Recovery Goals

A recovery plan has not been completed for the listed Atlantic sturgeon DPSs. However, a recovery outline has been prepared (NMFS 2018). A recovery outline is an interim guidance to guide recovery efforts until a full recovery plan is developed and approved. NMFS'S vision, stated in the recovery outline, is that subpopulations of all five Atlantic sturgeon DPSs must be present across the historical range. These subpopulations must be of sufficient size and genetic diversity to support successful reproduction and recovery from mortality events. The recruitment of juveniles to the subadult and adult life stages must also increase and that increased recruitment must be maintained over many years. Recovery of these DPSs will require conservation of the riverine and marine habitats used for spawning, development, foraging, and growth by abating threats to ensure a high probability of survival into the future. The outline includes a recovery action to implement region-wide initiatives to improve water quality in sturgeon spawning rivers, with specific focus on eliminating or minimizing human-caused anoxic zones.

9 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).

9.1 Climate Change

There is a large and growing body of literature on past, present, and future impacts of global climate change, exacerbated and accelerated by human activities. Some of the likely effects commonly mentioned are sea level rise, increased frequency of severe weather events, and change in air and water temperatures. NOAA's climate information portal provides basic background information on these and other measured or anticipated effects (see http://www.climate.gov).

This section provides some examples of impacts to ESA-listed species and their habitats that have occurred or may occur as the result of climate change in the action area. 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 for our Cumulative Effects analysis (Section 11), 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.

The rising concentrations of greenhouse gases in the atmosphere, now higher than any period in the last 800,000 years, have also affected the chemistry of the ocean, causing it to become more acidic. Ocean acidification negatively affects crustaceans, crabs, mollusks, and other calcium carbonate-dependent organisms such as pteropods (free-swimming pelagic sea snails and sea slugs) which are an important part of the food web in the waters of the Northwest Atlantic Ocean. Some studies in the nutrient-rich regions have found that food supply may play a role in determining the resistance of some organisms to ocean acidification (Ramajo et al. 2016; Markon et al. 2018). Reduction in prey items can create a collapse of the zooplankton populations and thereby result in potential cascading reduction of prey at various levels of the food web, thereby reducing the availability of the larger prey items of marine mammals and sea turtles.

Large-scale changes in the earth's climate are in turn causing changes locally to the waters off North Carolina's climate and environment. Climate change impacts can vary widely depending on depth since deeper areas may experience different temperature fluctuations than shallow areas. Over the last 100 years, sea surface temperatures have increased across much of the Northwest Atlantic Ocean, consistent with the global trend of increasing sea surface temperature due to anthropogenic climate change (Beazley et al. 2021). The effects of ocean warming have already been observed in the marine ecosystem across the Northwest Atlantic Ocean, through northward shifts in the range of commercially harvested fish and their catch distribution (Pinsky and Fogarty 2012).

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 (Macleod et al. 2005; Robinson et al. 2005; Kintisch 2006; Learmonth et al. 2006; McMahon and Hays 2006; Evans and Bjørge 2013; IPCC 2014). Though predicting the precise consequences of climate change on highly mobile marine species is difficult (Simmonds and Isaac 2007), recent research has indicated a range of consequences already occurring. 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 sea turtles and fishes in the action area. Also, marine species ranges are expected to shift as they align their distributions to match their physiological tolerances under changing environmental conditions (Doney et al. 2012).

Climate change impacts on sea turtles currently cannot be predicted with any degree of certainty; however, significant impacts to the hatchling sex ratios of sea turtles may result (NMFS and USFWS 2007c). 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 potentially skew future sex ratios toward higher numbers of females (NMFS and USFWS 2007c).

The effects from increased temperatures may be intensified on developed nesting beaches where shoreline armoring and construction have denuded vegetation. Erosion control structures could potentially result in the permanent loss of nesting beach habitat or deter nesting females (NRC 1990b). These impacts will be exacerbated by sea level rise. If females nest on the seaward side of the erosion control structures, nests may be exposed to repeated tidal overwash (NMFS and

USFWS 2007e). Sea level rise from global climate change is also a potential problem for areas with low-lying beaches where sand depth is a limiting factor, as the sea may inundate nesting sites and decrease available nesting habitat (Daniels et al. 1993; Fish et al. 2005; Baker et al. 2006). The loss of habitat as a result 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).

Other changes in the marine ecosystem caused by global climate change (e.g., ocean acidification, salinity, oceanic currents, dissolved oxygen levels, nutrient distribution, etc.) could influence the distribution and abundance of lower trophic levels (e.g., phytoplankton, zooplankton, submerged aquatic vegetation, crustaceans, mollusks, forage fish, etc.) which could ultimately affect the primary foraging areas of sea turtles.

Specific information regarding potential climate change impacts on loggerheads is also available. Modeling suggests an increase of 2 °C in air temperature will result in a sex ratio of over 80% female offspring for loggerheads nesting near Southport, North Carolina. The same increase in air temperatures at nesting beaches in Cape Canaveral, Florida, will result in close to 100% female offspring. Such highly skewed sex ratios could undermine the reproductive capacity of the species. More ominously, an air temperature increase of 3°C is likely to exceed the thermal threshold of most nests, leading to egg mortality (Hawkes et al. 2007). Warmer sea surface temperatures have also been correlated with an earlier onset of loggerhead nesting in the spring (Weishampel et al. 2004), short inter-nesting intervals (Hays et al. 2002), and shorter nesting seasons (Pike et al. 2006).

Global climate change can be expected to have various impacts on all sea turtles, including leatherbacks. Global climate change is likely to also influence the distribution and abundance of jellyfish, the primary prey item of leatherbacks (NMFS and USFWS 2007d). Several studies have shown leatherback distribution is influenced by jellyfish abundance (Houghton et al. 2006; Witt et al. 2006; Witt et al. 2007); however, more studies need to be done to monitor how changes to prey items affect distribution and foraging success of leatherbacks so population-level effects can be determined. According to a recent study on loggerhead distribution in the mid-Atlantic, loggerheads are predicted to shift their habitat use to the northern regions of the Northwest Atlantic continental shelf in order to occupy waters with suitable sea surface temperatures (Patel et al. 2021).

Global climate change may affect Atlantic sturgeon in the future. For example, rising sea level may shift the salt wedge 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. Similarly, juvenile Atlantic sturgeon have limited tolerance to salinity and remain in waters with varying salinity. If the salt wedge moves further upstream, sturgeon spawning and rearing habitat could be restricted. In river systems with dams or natural falls that are impassable by sturgeon, the extent that spawning or rearing may be shifted upstream to compensate for the shift in the movement of the salt wedge will be limited. For most spawning rivers, there are no predictions on the timing or extent of any salt wedge shifts that may occur; thus, it is not possible to predict any future loss in spawning or rearing habitat. However, in all river systems, spawning occurs miles upstream of the salt wedge. It is unlikely that shifts in the location of the salt wedge will eliminate freshwater spawning or rearing habitat, but, if habitat is severely restricted, productivity or survivability may decrease.

The increased rainfall predicted in some areas may increase runoff and scour spawning areas, and flooding events could cause temporary water quality issues. Increased extremes in river flow (i.e., periods of flooding and low flow) can alternatively disrupt and fill in spawning habitat that sturgeon rely upon (ISAB 2007). Atlantic sturgeon are uniquely evolved to live in their habitats. Because of this specificity, broad-scale changes in environment, can pose adaptation challenges. Rising temperatures could exacerbate existing water quality problems associated with dissolved oxygen and temperature. Atlantic sturgeon are tolerant to water temperatures up to approximately 28°C; these temperatures are experienced naturally in some areas of rivers during the summer months. If river temperatures rise above 28°C in large areas, sturgeon may be excluded from some habitats. In addition, temperature triggers spawning behavior. Warmer water temperatures can initiate spawning earlier in a season for salmon, and the same can be true for sturgeon (ISAB 2007). If water temperatures increase, juvenile sturgeon may experience elevated mortality due to lack of cooler water refuges. If temperature rises beyond thermal limits for extended periods, habitat could be lost; this could be the case if southern habitats warm, resulting in range loss (Lassalle et al. 2010). Apart from direct changes to sturgeon survival, altered water temperatures may alter habitat, including the availability of prey (ISAB 2007).

Some models predict longer and more frequent droughts (and water withdrawal for human use) that 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, Atlantic sturgeon may become susceptible to strandings or habitat restrictions. Low flow and drought conditions are also expected to cause additional water quality issues. Any of the conditions associated with climate change are likely to disrupt river ecology causing shifts in community structure and the type and abundance of prey. Additionally, cues for spawning migration and spawning could occur earlier in the season, which might affect prey availability for developing sturgeon in rearing habitat. Overall, it is likely that global warming will increase pressures on Atlantic sturgeon survival and recovery throughout their ranges.

9.2 Coastal Development

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

North Carolina is comprised of large stretches of ocean shoreline, mostly in the form of broad sandy beaches—and extensive estuarine shoreline, consisting of bays, sand bars, islands, and river mouths. The Outer Coastal Plain, or Tidewater, lies closest to the ocean. This area is extremely flat with poor drainage, and it is dominated by lagoons, sea marsh, and broad sandy beaches. Wetlands are a dominant feature, and streams are brackish and subject to tidal influence (USACE 2022). The land cover nearest to Frying Pan Shoals (i.e., Bald Head Island) is characterized as emergent wetland, experienced no land-use change from 1992 to 2006, and is considered as unsuitable for urban growth (Claggett et al. 2015). However, it bears mentioning that land-use changes to areas further inland, outside the Outer Coastal Plain can impact the watershed as a whole (e.g., increases in impervious surface cover and a reduction in vegetation due to construction and development causing habitat degradation). Populations in Brunswick and New Hanover counties (the two coastal counties adjacent to the action area) is expected to increase into 2030, as is urban growth (Claggett et al. 2015).

In addition, managing risk for coastal areas in and near the action area from storms, flooding, hurricanes, erosion, and sea level rise is an on-going necessity. This can mean the installation of flood reduction measures, shoreline armoring, or numerous other means to protect coastal areas. The U.S. Army Corps of Engineers performed an analysis identifying the risks and vulnerabilities to increased hurricane and storm damage as a result of sea level rise within the Army Corps' South Atlantic Division area of responsibility, which includes the action area (USACE 2021). The analysis identified recommendations for more localized coastal storm risk feasibility studies that could include ecosystem restoration, shoreline stabilization, and the use of dredged material to achieve these goals (USACE 2021).

BOEM conducts geological and geophysical surveys to characterize sand resources that could later be used in dredging and other coastal development projects, as well as to identify sites for further scientific research, as is the case for the proposed action. These "sand surveys" take place throughout the Atlantic coast in less than 50 meters of water, from Cape Cod, Massachusetts, to Texas. The sand surveys use a variety of techniques including sediment coring, sediment sampling, and acoustic sources to gather data. BOEM has previously consulted on these activities (Consultation PCTS # NER-2018-15093 [ECO: GARFO-2018-00323]).

Coastal development projects that involve dredging (e.g., periodic beach nourishment, sediment extraction/placement for constructing coastal armoring projects) occur in and near the action area. The Wilmington District of the U.S. Army Corps of Engineers performed beach nourishment at Carolina and Kure Beaches in 2019 (adjacent to the action area), which typically occur on a periodic, five-year basis.

Dredging and filling operations impact important habitat features of Atlantic sturgeon as they disturb benthic fauna, eliminate deep holes, and alter rock substrates (Smith and Clugston 1997).

Dredging operations may also pose risks to anadromous fish species by destroying or adversely modifying benthic feeding areas, disrupting spawning migrations, and filling spawning habitat with suspended fine sediments. As benthic omnivores, sturgeon are particularly sensitive to modifications of the benthos that affect the quality, quantity and availability of prey species. Nellis et al. (2007) documented that dredge spoil drifted 12 kilometers downstream over a ten-year period in the Saint Lawrence River, and that those spoils have significantly less macrobenthic biomass compared to control sites. Hatin et al. (2007) reported avoidance behavior by Atlantic sturgeon during dredging operations and McQuinn and Nellis (2007) found that Atlantic sturgeon were substrate dependent and avoided dredge spoil dumping grounds.

In addition to indirect impacts, hydraulic dredging can directly harm sturgeon and sea turtles by lethally entraining fish up through the dredge drag-arms and impeller pumps. Between 1990 and 2005, 10 Atlantic sturgeon were reported captured by hopper dredges (ASSRT 2007). Atlantic sturgeon have been taken in both hydraulic pipeline and bucket-and-barge operations in the Cape Fear River, North Carolina (Moser and Ross 1995). Mechanical dredges (i.e., clamshell) have also been documented to kill Atlantic sturgeon (Hastings 1983). Dickerson (2006) reported 15 Atlantic sturgeon taken in dredging activities conducted by the U.S. Army Corps of Engineers from 1990-2010, most captured by hopper dredge (ASSRT 2007).

On land, coastal development can cause impacts to sea turtles. Coastal development can deter or interfere with sea turtle nesting, affect nest success, and degrade nesting habitat. Many nesting beaches have already been significantly degraded or destroyed. Nesting habitat is threatened by rigid shoreline protection or “coastal armoring” such as sea walls, rock revetments, and sandbag installations. Many miles of once productive nesting beach have been permanently lost to this type of shoreline protection. Nesting habitat can be also reduced by beach nourishment projects, which result in altered beach and sand characteristics, affecting nesting activity and success. In some areas, timber and marine debris accumulation, as well as sand mining reduce available nesting habitat (Bourgeois et al. 2009). The presence of lights on or adjacent to nesting beaches alters the behavior of nesting adults and is often fatal to emerging hatchlings as they are attracted to light sources and drawn away from the sea (Witherington 1992).

9.3 Incidental Bycatch and Entanglement

Directed harvest of Atlantic and shortnose sturgeon is prohibited in U.S. waters. However, sturgeon are taken incidentally in fisheries targeting other species in rivers, estuaries, and marine waters throughout their range (Collins et al. 1996; ASSRT 2007). Atlantic sturgeon (from all five DPSs) are at risk of bycatch-related mortality in fisheries operating within and beyond the action area. Because sturgeon mix extensively in marine waters and may access several river systems, they are subject to being caught in multiple fisheries throughout their range. Commercial fishery bycatch represents a significant threat to the viability of listed sturgeon species and populations. Bycatch could have a substantial impact on the status of Atlantic sturgeon, especially in rivers or estuaries that do not currently support a large subpopulation (< 300 spawning adults per year).

Reported mortality rates of sturgeon (Atlantic and shortnose) captured in inshore and riverine fisheries range from 8% to 20% (Collins et al. 1996; Bahn et al. 2012).

Sturgeon are particularly vulnerable to being caught in commercial gill nets; therefore, fisheries using this type of gear account for a high percentage of sturgeon bycatch and bycatch mortality. Sturgeon have also been documented in the following gears: otter trawls, pound-nets, fyke/hoop nets, catfish traps, shrimp trawls, and recreational hook and line fisheries. During observed fishing trips using trawls, the majority of Atlantic sturgeon captures occurred in waters 20 meters deep or less (ASMFC 2017b).

Fisheries that use gill nets can be especially problematic for Atlantic sturgeon, with immediate mortality rates of 22% for sink gill net fisheries and 10% in drift gill net fisheries, totaling to an estimated mortality of up to 1,500 adult Atlantic sturgeon annually (Stein et al. 2004a). Gear modifications in commercial gill net fisheries can reduce the amount of Atlantic sturgeon bycatch (Hager et al. 2021). In 2014, NMFS issued a 10-year incidental take permit to the State of North Carolina under ESA Section 10(a)(1)(B) to authorize incidental take of Atlantic sturgeon from all five DPSs in its inshore commercial and recreational anchored gillnet fisheries. The permit requires attending the nets, restrictions on net size, length, soak times, and configuration, requirements for fisheries observers and reporting, and a closure of the fishery(ies) if the take limits are exceeded.[5]

Fishery interaction remains a major factor in sea turtle recovery and, frequently, the lack thereof. Wallace et al. (2010) estimated that worldwide 447,000 sea turtles are killed each year from bycatch in commercial fisheries. Although sea turtle excluder devices and other bycatch reduction devices have significantly reduced the level of bycatch to sea turtles and other marine species in U.S. waters, mortality still occurs.

In North Carolina, several state fisheries use large (≥ 4 inches) stretched mesh gillnets to target southern flounder (*Paralichthys lethostigma*), striped bass (*Morone saxatilis*), shad (*Alosa spp*), and catfishes (*Ictalurus spp.*). Other gear types, including small mesh gillnets (< 4 inches) and pound-nets, targeting different fish species, are also common in state fisheries. Because these waters are important coastal foraging habitat for ESA-listed sea turtles, especially green, Kemp's ridley, and loggerhead, fisheries in the state waters of North Carolina are a continuing source of incidental capture and mortality for sea turtles (Epperly et al. 2007b; Snoddy and Williard 2010). In 2012, the State of North Carolina applied to NMFS for an incidental take permit under the ESA for an exemption from the take prohibitions for sea turtles incidentally captured in the state's gillnet fisheries. The incidental take permit was issued, and expires in August 2023. The permit requires restrictions on soak times, net sizes and configurations, take reporting, fisheries

[5] https://www.fisheries.noaa.gov/action/incidental-take-permit-north-carolina-division-marine-fisheries-atlantic-sturgeon Accessed July 12, 2023.

observers, tagging of any incidentally taken sea turtles, and a closure of the fishery(ies) if incidental take is exceeded.[6]

Recreational fishing occurs throughout the action area. Commercial and recreational fisheries may impact sea turtles as they migrate through the action area through direct interactions (i.e., incidental take or bycatch) and indirectly through competition for prey resources and other impacts on prey populations.

Incidental bycatch in commercial fisheries is identified as a major contributor to past declines, and threat to future recovery, for all of the sea turtle species (NMFS and USFWS 1991b; NMFS and USFWS 1992; NMFS and USFWS 1993; NMFS and USFWS 2008b; NMFS et al. 2011). Domestic fisheries often capture, injure, and kill sea turtles at various life stages. Sea turtles in the pelagic environment are exposed to U.S. Atlantic pelagic longline fisheries. Sea turtles in the benthic environment in waters off the coastal United States are exposed to a suite of other fisheries in federal and state waters. These fishing methods include trawls, gillnets, purse seines, hook-and-line gear (including bottom longlines and vertical lines [e.g., bandit gear, handlines, and rod-reel]), pound-nets, and trap fisheries. The Southeast U.S. shrimp fisheries have historically been the largest fishery threat to benthic sea turtles in the southeastern United States, and continue to interact with and kill large numbers of sea turtles each year. Gear modifications to gill nets common in the monkfish fishery (*Lophius americanus*) can reduce the amount of sea turtle bycatch, as was demonstrated by Galvez et al. (2022). In a study that took place during February and March off the coast of North Carolina, the control gill net caught 19 loggerheads, and the experimental net caught 6 (Galvez et al. 2022). The joint NMFS and USFWS Loggerhead Biological Review Team determined that the greatest threats to the Northwest Atlantic DPS of loggerheads result from cumulative fishery bycatch in neritic and oceanic habitats (Conant et al. 2009a). Leatherbacks also face threats from incidental bycatch and entanglement throughout their range. Over a 15-year period, there were 261 leatherback entanglements in fixed-gear fisheries in Massachusetts using pot/trap gear for lobster, whelk, and fish traps. All of the entanglements had the buoy/trap lines wrapped around the leatherback' neck or front flippers. Most leatherbacks (n=224) were disentangled and released alive, with some limited observational evidence that they survived; however 47 leatherbacks were found dead in the gear (Dodge et al. 2022).

Even if incidentally captured sea turtles are released from fishing nets alive, post-release mortality is a possibility. Of 13 green and Kemp's ridley sea turtles captured in gillnet fisheries in the lower Cape Fear River between June and October 2007, four were either a confirmed or suspected mortality post release, based on satellite tracking data. The entanglement times for these individuals varied between 30 and 218 minutes (mean=121.75 minutes). Entanglement

[6] https://www.fisheries.noaa.gov/action/incidental-take-permit-north-carolina-division-marine-fisheries-sea-turtles Accessed July 12, 2023

times for the nine surviving post-release sea turtles were generally lower overall (mean=70 minutes; entanglement duration times between 20 and 212 minutes) (Snoddy and Williard 2010).

Of all sea turtle species, leatherbacks seem to be the most vulnerable to entanglement in fishing gear, especially gillnet and pot/trap lines. This vulnerability may be because of their body type (large size, long pectoral flippers, and lack of a hard shell), their attraction to gelatinous organisms and algae that collect on buoys and buoy lines at or near the surface, their method of locomotion, and/or their attraction to the light sticks used to attract target species in longline fisheries. From 1990-2000, 92 entangled leatherbacks were reported from New York through Maine and many other stranded individuals exhibited evidence of prior entanglement (Dwyer et al. 2003). Zug and Parham (1996) point out that a combination of the loss of long-lived adults in fishery-related mortalities and a lack of recruitment from intense egg harvesting in some areas has caused a sharp decline in leatherback sea turtle populations. This represents a significant threat to survival and recovery of the species worldwide.

9.4 Vessel Strike

Atlantic sturgeon are susceptible to vessel strikes due to their large size and frequent use of coastal waterways with heavy commercial vessel traffic (ASSRT 2007). The factors relevant to determining the risk to sturgeon from vessel strikes are currently unknown, but are likely related to size and speed of the vessels, navigational clearance (i.e., depth of water and draft of the vessel) in the area where the vessel is operating, and the behavior of sturgeon in the area (e.g., foraging, migrating, etc.). We are not aware of any systematic studies of vessel strike and Atlantic sturgeon specific to the action area; however, that vessel traffic and Atlantic sturgeon overlap within the action area, we presume it is a possibility. Here we discuss how vessel strike mortality affects Atlantic sturgeon DPSs in other river systems throughout its range.

Vessel strike is a known problem for Atlantic sturgeon, causing injury and mortality, but one that is not comprehensively understood throughout its range, largely because it is difficult to track and observe. In this section, we discuss the few known studies on Atlantic sturgeon vessel strike. Atlantic sturgeon in the Delaware River are at a moderately high risk of extinction because of ship strikes, and sturgeon in the James River are at a moderate risk from ship strikes (ASSRT 2007). A study on telemetered adult and subadult Atlantic sturgeon in the Delaware River indicated that individuals exhibit no behavioral responses to vessels, and select habitat based on sediment type (DiJohnson 2019). Balazik et al. (2012) estimated up to 80 sturgeon were killed between 2007 and 2010 in these two river systems. Since 2007, researchers from Virginia Commonwealth University have observed at least 150 sturgeon mortalities on the James River that were largely a consequence of vessel interaction (Secor 2017). Brown and Murphy (2010) examined 28 dead Atlantic sturgeon from the Delaware River from 2005 through 2008 and found that fifty% of the mortalities resulted from apparent vessel strikes, and 71% of these (10 out of 14) had injuries consistent with being struck by a large vessel. Eight of the fourteen vessel-struck sturgeon were adult-sized fish which, given the time of year the fish were observed, were likely migrating through the river to or from the spawning grounds. Ship strikes may also be threatening Atlantic sturgeon populations in the Hudson River where large ships move from the river mouth to ports upstream through narrow shipping channels. The channels are dredged to the approximate depth of the ships, usually leaving less than 2 meters of clearance between the bottom of ships and the river bottom. Any aquatic life along the bottom is at risk of being sucked up through the large propellers of these ships.

Because all sea turtles must surface to breathe and several species are known to bask at the sea surface for long periods, they are vulnerable to vessel strike. Vessel strikes are a poorly-studied threat to sea turtles, but have the potential to be highly significant given that they can result in serious injury and mortality (Work et al. 2010). To our knowledge, there is little systematic evidence quantifying sea turtle vessel strikes, but there are some sources. Ataman et al. (2021) cataloged injuries on nesting female loggerhead sea turtles in southeastern Florida, and found that of 60 individuals whose injuries could be identified, 75% of those were from vessel strikes. Although sea turtles can move somewhat rapidly, they apparently are not adept at avoiding vessels that are moving at more than 2.6 knots; most vessels move far faster than this in open water (Hazel and Gyuris 2006; Hazel et al. 2007; Work et al. 2010). Both live and dead sea turtles are often found with deep cuts and fractures indicative of a collision with a vessel hull or propeller (Hazel et al. 2007). Hazel et al. (2007) suggests that green turtles may use auditory clues to react to approaching vessels rather than visual cues, making them more susceptible to vessel strike or vessel speed increases.

9.5 Aquatic Nuisance Species

Aquatic nuisance species are aquatic and terrestrial organisms, introduced into new habitats throughout the U.S. and other areas of the world that produce harmful impacts on aquatic ecosystems and native species (http://www.anstaskforce.gov). They are also referred to as invasive, alien, or non-indigenous species. Invasive species have been referred to as one of the top four threats to the world's oceans (Raaymakers and Hilliard 2002; Raaymakers 2003; Terdalkar et al. 2005; Pughiuc 2010). Introduction of these species is cited as a major threat to biodiversity, second only to habitat loss (Wilcove et al. 1998). A variety of vectors are thought to have introduced non-native species including, but not limited to aquarium and pet trades, recreation, hull fouling, and ballast water discharges from ocean-going vessels. Common impacts of invasive species are alteration of habitat and nutrient availability, as well as altering species composition and diversity within an ecosystem (Strayer 2010). Shifts in the base of food webs, a common result of the introduction of invasive species, can fundamentally alter predator-prey dynamics up and across food chains (Moncheva and Kamburska 2002), potentially affecting prey availability and habitat suitability for ESA-listed species. The invasive blue catfish has become a more notable threat to native fish in the Chesapeake Bay region. A recent analysis of stomach contents reveals that 22 of 560 fish sampled (4%) comprising 27 species consumed Atlantic sturgeon during the fall spawning period (Bunch et al. 2021). The primary consumers of Atlantic sturgeon were striped bass (1 of 8 guts, 12.5%), carp (6 of 52 guts, 11.5%), and blue catfish (8 of

131 guts, 6%). No hard parts were present and the assumption is that the Atlantic sturgeon DNA was either from eggs or larvae that were quickly digested (Bunch et al. 2021).

Currently, there is little information on the level of aquatic nuisance species and the impacts of these invasive species may have on fish and sea turtles in the action area through the duration of the project. Therefore, the level of risk and degree of impact to ESA-listed sea turtles and fish is unknown.

9.6 Scientific Research

Regulations for section 10(a)(1)(A) of the ESA allow issuance of permits authorizing take of certain ESA-listed species for the purposes of scientific research. Prior to the issuance of such a permit, the proposal must be reviewed for compliance with section 7 of the ESA. Scientific research permits issued by NMFS currently authorize studies on ESA-listed species in the Atlantic Ocean, some of which occur in portions of the action area. ESA-listed sea turtles and Atlantic sturgeon have been the subject of field studies for decades. The primary objective of most of these field studies has generally been monitoring populations or gathering data for behavioral and ecological studies. Over time, NMFS has issued dozens of permits on an annual basis for various forms of "take" of sturgeon and sea turtles in the action area from a variety of research activities. For each permit, the biological opinion concluded that permit issuance was not likely to jeopardize the continued existence of the species or DPS. The directed research activities for Atlantic sturgeon have been considered in previous consultations (2022 reinitiation: OPR-2021-03447; and the 2017 original consultation: FPR-2016-9176; imported to ECO as OPR-2016-00009). For ESA-listed sea turtles, directed research activities have been considered to two previous consultations, in 2017 under FPR-2017-9230 and in the reinitiated consultation, OPR-2018-00087.

ESA-listed sea turtle and sturgeon research includes approach, capture, handling, restraint, tagging, biopsy, blood or tissue sampling, lavage, ultrasound, imaging, antibiotic (tetracycline) injections, laparoscopy, and mortality. Most authorized take is sublethal with some resulting in mortality.

9.7 Impact of the Baseline on Endangered Species Act-Listed Species

Collectively, the stressors described above have had, and likely continue to have, lasting impacts on the ESA-listed species in the action area likely to be adversely affected by the proposed action. Some of these stressors result in mortality or serious injury to individual animals (e.g., incidental bycatch, entanglement), whereas others result in more indirect (e.g., climate change that impacts prey availability, pollution, habitat degradation from coastal development) or non-lethal (e.g., scientific research) impacts.

We consider the best indicator of the environmental baseline on ESA-listed resources to be the status and trends of those species. As noted in Section 8, for many of the species considered in this consultation, there is uncertainty about their status. If the species is declining in abundance, it is possible that the suite of conditions described in this *Environmental Baseline* section is limiting their recovery. However, it is also possible that their populations are at such low levels (e.g., due to past overfishing) that even when the species' primary threats are removed, the species may not be able to achieve recovery. At small population sizes, species may experience phenomena such as demographic stochasticity, inbreeding depression, and Allee effects, among others, that cause their limited population size to become a threat in and of itself. A thorough review of the status and trends of each species for which NMFS has found the action is likely to cause adverse effects is discussed in the *Status of Species Likely to be Adversely Affected* section of this opinion (Section 8).

10 Effects of the Action

Section 7 regulations define "effects of the action" as 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 will 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 (50 C.F.R. §402.02).

This effects analyses section is organized following the stressor, exposure, response, risk assessment framework.

10.1 Definition of Take, Harm, and Harass

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" (16 U.S.C. §1532(19)). Harm is defined by regulation (50 C.F.R. §222.102) as "an act which actually kills or injures fish or wildlife. Such an act may include significant habitat modification or degradation which actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns, including, breeding, spawning, rearing, migrating, feeding, or sheltering." NMFS does not have a regulatory definition of "harass." However, on December 21, 2016, NMFS 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."

We categorize two forms of take, lethal and sublethal take. Lethal take is expected to result in immediate, imminent, or delayed but likely mortality. Sublethal take is when effects of the action are below the level expected to cause death, but are still expected to cause injury, harm, or harassment. Harm, as defined by regulation (50 C.F.R. §222.102), includes acts that actually kill or injure wildlife and acts that may cause significant habitat modification or degradation that actually kill or injure fish or wildlife by significantly impairing essential behavioral patterns, including, breeding, spawning, rearing, migrating, feeding, or sheltering. Thus, for sublethal take we are concerned with harm that does not result in mortality but is still likely to injure an animal.

In the following sections, we consider the exposures that could cause an effect on ESA-listed species that are likely to co-occur with the stressors we have determined are likely to adversely affect these species in space and time, and identify the nature of that co-occurrence. We consider the frequency and intensity of exposures that could cause an effect on ESA-listed species and, as possible, the number, age or life stage, and gender of the individuals likely to be exposed to the action's effects and the population(s) or subpopulation(s) those individuals represent. We also consider the responses of ESA-listed species to exposures and the potential reduction in fitness associated with these responses.

10.2 Exposure Analysis

In this section, we quantify the likely exposure of ESA-listed species to the activities and associated stressors that may result from the proposed action.

10.2.1 Sea Turtles

The proposed action spatially and temporally overlaps with ESA-listed sea turtles species and/or DPSs (see Table 1); including North Atlantic DPS green turtle, Kemp's ridley turtle, leatherback turtle, and Northwest Atlantic DPS loggerhead turtle. During the proposed research activities, ESA-listed sea turtles may be present with targeted fish species. Sea turtles found in the area of sturgeon research may be subjected to incidental capture in the trawl nets, plankton nets, and the longline gear used in the research.

Broadly, in the U.S. Mid-Atlantic, sea turtles are present seasonally, following a general pattern of emigrating from southern latitudes in the spring, and going south in the fall (Shoop and Kenney 1992; Musick and Limpus 1997). However, in and near the action area, sea turtles considered in this consultation can be present at all times of the year, depending on local factors. Adult female loggerhead sea turtles occur regularly in the area throughout the year, even in winter if the water temperatures are moderate enough due to the influence of the nearby Gulf Stream (Griffin et al. 2013). The waters in and near the action area are a known migratory corridor for loggerhead sea turtles. Most of the tagged adult female loggerheads from nesting beaches in Georgia and South Carolina migrated north as far as New Jersey from May to October, and then south to foraging habitats past Cape Hatteras in November to March (Griffin et al. 2013). Thus, it is possible that adult loggerheads could be exposed to the proposed action potentially in every sampling season.

Juvenile Kemp's ridley and green sea turtles are known to forage in the coastal waters of North Carolina (Snoddy and Williard 2010). Individuals captured in gillnet fisheries from June to October in the lower Cape Fear River affixed with satellite tags largely remained in the lower Cape Fear River, as well as areas immediately around the Frying Pan Shoals area (Snoddy and Williard 2010). Researchers tagged juvenile green sea turtles incidentally caught in pound-nets in Back Sound and Core Sound, North Carolina (Williard et al. 2017). Tagged juvenile green turtles exited coastal foraging areas in the fall. Some stayed in neritic waters off North and South

Carolina over winter, in waters less than 200 meters deep, while others moved offshore, past the continental shelf into oceanic waters, largely following the Gulf Stream (Williard et al. 2017).

Leatherback sea turtles could also be present in the action area during the proposed action, and thus exposed. Just south of the action area near Myrtle Beach, South Carolina, a few leatherbacks have been captured in research surveys in the past during coastal bottom trawls in the spring (May) (PSIT 2023). Coastal waters in the mid-Atlantic over the continental shelf, including those overlapping with the action area, were identified as being high-use areas for tagged adult male, female, and subadults, especially in summer and fall (Dodge et al. 2014). Leatherback nesting has been observed in North Carolina, so is it possible that nesting females and hatchlings could be exposed to the proposed action.

According to records of incidental capture during research ecology surveys, Kemp's ridley sea turtles have been captured in and near the action area via bottom trawl in spring (April, May), summer (July), and fall (October) (PSIT 2023). As described earlier, juvenile Kemp's ridleys forage in North Carolina waters (Snoddy and Williard 2010). Very occasionally, Kemp's ridley nests have been observed in North Carolina on beaches near the action area, so it is possible that nesting females and hatchlings could be present and exposed to the proposed action.

There are several known nesting beaches in or near Frying Pan Shoals. Bald Head Island is immediately adjacent to Frying Pan Shoals. Within about 30 miles in both directions, there are other North Carolina nesting beaches to the north (Kure Beach, Carolina Beach, Wrightsville Beach) and south of Frying Pan Shoals (Caswell Beach, Oak Island, Holden Beach, Ocean Isle Beach). Of the sea turtles present in the action area, loggerhead sea turtles are the most abundant species nesting on North Carolina beaches within the action area, followed by green sea turtles. Leatherbacks are occasionally observed nesting on North Carolina beaches; leatherback nests were reported in 2018, 2012, 2010, and 2009. Kemp's ridley sea turtles have been documented nesting near the action area, but only rarely, with three documented occurrences, one in 2020, and two in 2021.[7]

For sea turtle species in the action area, nesting season starts in May and runs through August, with the most activity occurring in June and July. The proposed action will not take place on the nesting beach; the activities will be vessel-based in-water sampling, so we do not expect the proposed action to impact nesting. Any sea turtles that were encountered during the proposed action will likely be female sea turtles going to or returning from nesting. Incubation time varies slightly by species, but generally is about 60 days. Based on the timing, the proposed action could occur when hatchlings are emerging from their nests and entering the ocean.

In summary, based on the available information, the following species and life stages of sea turtles could be potentially exposed to the proposed action: adult loggerheads while migrating to and from foraging grounds (May to March), adult female loggerheads before and after nesting

[7] http://www.seaturtle.org/nestdb/?view=1

(May to September), juvenile foraging Kemp's ridley sea turtles (June to October), juvenile foraging green sea turtles (spring through fall), and while moving from coastal foraging grounds to offshore areas in winter, adult female green turtles before and after nesting, and sea turtle hatchlings emerging from their nests (loggerhead and green sea turtles mostly, but also potentially leatherbacks). Leatherback adults and subadults could also be exposed to the proposed action while migrating, likely in spring through fall.

To estimate the amount of expected exposure that might occur during the proposed action, we examined incidental capture records from research surveys conducted in the region. The Northeast and Southeast Fisheries Science Centers have regularly conducted surveys in the area for years, and the Protected Species Incidental Take database tracks instances of incidental capture during those surveys. Records span a time period of over thirty years, from 1991 to 2022. The Science Center surveys use gear types similar to those proposed for use in BOEM's action. The surveys take place spring through fall (typically March or April through early November). The Science Center surveys occur throughout the U.S. Atlantic coast.

On Frying Pan Shoals, there are 7 records of incidental capture of sea turtles during Science Center surveys, 6 loggerheads, and 1 Kemp's ridley sea turtle, all captured during bottom trawl surveys. Given what we know about the presence of other sea turtle species in and around the action area, and needing to account for the likelihood of capture of those species, we are expanding our examination of incidental captures to include those that occurred near the action area as well.

For this analysis, we limited the records to those that occurred south of Cape Hatteras, as the narrow coastal shelf, currents, and prevailing water temperatures in that area serve as a natural dividing line between the Virginian (northern) ecoregion, and the Carolinian (southern) ecoregion (Rulifson et al. 2020b). This narrowed the dataset to reflect information that most closely matched with the action area, and will likely be a more accurate reflection of the species and number of turtles that might be exposed. Within this area, we looked at records of incidental capture that occurred in the coastal marine environment of North Carolina, excluding records of capture in bays or sounds, or in deep water past the continental shelf, choosing captures that occurred in areas similar to the action area.

There were 143 total captures of sea turtles in trawl nets in this area. The majority (n=93) were loggerhead sea turtles, followed by Kemp's ridley (n=49), and green turtles (n=1). There are records of incidental capture of leatherback sea turtles elsewhere in North and South Carolina (n=3), captured during trawl surveys, so we cannot rule out the possibility of the species being taken during the proposed action. Using these data to estimate an average number of takes by trawl per year, this amounts to 2.5 Kemp's ridley sea turtles and 3.2 loggerhead sea turtles.

The proposed action will take place over 2.5 years, with four sampling events, one in each season. Records from the PSIT (2023) data only cover the proposed action seasons for spring, summer, and fall, so we had to adjust the average number of takes to account for the winter sampling season in the proposed action. To get the total estimated exposure for the duration of the action, we multiply that corrected annual average by 2.5 years. The results of these calculations for loggerhead and Kemp's ridley sea turtles are displayed in Table 6, rounded up to the nearest whole number. For green sea turtles, the PSIT (2023) data indicated that there was only one capture. While we cannot calculate an estimated exposure for leatherbacks, the available information indicates that they are present in the region and have been captured during similar trawl surveys in the past. If we conservatively assume that the proposed action could expose at least 1 green sea turtle and 1 leatherback per year, this amounts to 3 individuals for each species over the course of the action.

Due to a lack of information, it is difficult to estimate sea turtle exposure to incidental capture in the longline gear. There are no records of longline capture during Science Center surveys in or near the action area, although records exist elsewhere throughout the Science Center's survey area (e.g., Georgia, Florida, Virginia). The lack of records could be due to the location of surveys that use longlines (i.e., these types of Science Center surveys do not occur in or near the action area). Because of the available information, we must assume that incidental capture of sea turtles during the proposed action may occur, even if the PSIT (2023) database does not have any records of incidental capture by longline specifically in the action area. Given that we cannot rule out that exposure to longline capture might occur, and that the available information indicates it happens at a low level overall, we conservatively assume that one individual of each species could be exposed over the course of the action.

Plankton and neuston nets are also proposed for use in the research activities. Although comparatively much smaller than the other sampling gear, plankton and neuston nets are still capable of incidentally capturing sea turtles, particularly smaller, post-hatchling turtles. These nets are fished at or near the surface, where sea turtle hatchlings could be encountered. The PSIT (2023) database has two records of loggerhead sea turtles being captured in plankton and neuston nets in the Gulf of Mexico. While the lack of information makes it difficult to quantify exposure, the timing of the action, especially the sampling seasons that will occur in summer and fall, when we expect hatchlings to be emerging from the nests, and that there are hundreds of sea turtle nests annually (largely loggerhead and green) in or immediately adjacent to the action area, we believe loggerhead and green turtle hatchlings may be captured in plankton or neuston nets. Kemp's ridley sea turtles and leatherbacks hatchlings may also be incidentally captured in the plankton and neuston nets, but it is less likely than for loggerhead and green sea turtles. Kemp's ridley and leatherback sea turtles nest on North Carolina beaches, but at comparatively lower numbers. Given that we cannot rule out that exposure to capture in plankton or neuston nets might occur, and that the available information indicates it happens at a low level overall, we conservatively assume that one individual each of Kemp's ridley and leatherback, and two individuals of loggerhead and green sea turtles could be exposed over the course of the action.

Table 5. Total estimated sea turtle exposure

Sea Turtle	Estimated Total Exposure: Incidental Capture in Trawl	Estimated Total Exposure: Incidental Capture in Longline	Estimated Total Exposure: Incidental Capture in Plankton or Neuston Nets	Total Exposure by Species
Loggerhead	10	1	2	13
Kemp's Ridley	8	1	1	10
Green	3	1	2	6
Leatherback	3	1	1	5

Because of the amount of sampling that will occur within a sampling event, and the relatively limited geographic range where the sampling will take place, there is some chance that incidentally captured sea turtles may be captured more than once. We are not able to quantify this, but we cannot rule it out as a possibility. We discuss this topic futher in Section 10.3.3.

10.2.2 Atlantic Sturgeon

The proposed action spatially and temporally overlaps with ESA-listed Atlantic sturgeon DPSs (see Table 1), including Gulf of Maine, New York Bight, Chesapeake, Carolina, and South Atlantic DPSs. During the proposed research activities, ESA-listed Atlantic sturgeon may be present and captured in the sampling gear.

This discussion will focus on the trawls proposed for use during BOEM's research activities. We do not expect incidental capture to occur in plankton or neuston nets. In addition to being smaller than the trawls used in the proposed action, and thus unlikely to capture Atlantic sturgeon, plankton and neuston nets will not be fished at the ocean bottom, so we do not expect them to encounter and thus incidentally capture Atlantic sturgeon. Longlines are not regarded as posing a great risk of bycatch for Atlantic sturgeon; incidences of sturgeon bycatch in other gear types, primarily gill nets are greater and the focus of bycatch reduction efforts (NMFS 2022a). There are no records of Atlantic sturgeon incidentally captured in the PSIT (2023) database. Although the longlines in the proposed action will be fished on the bottom, near where Atlantic sturgeon will be, the longlines will not be baited with items that Atlantic sturgeon eat, thus we believe that longlines in the proposed action do not pose a risk of exposing Atlantic sturgeon to incidental catch.

Studies focusing on Atlantic sturgeon in the New York Bight have found that Atlantic sturgeon appear to prefer waters 20 meters or less (Dunton et al. 2010), with no captures occurring in waters greater than 20 meters (Dunton et al. 2015). Other observations have found Atlantic sturgeon in deeper waters (up to 50 meters) (Stein et al. 2004b; ASMFC 2017a), and even as deep as 75 meters (Colette and Klein-MacPhee 2002). In South Carolina, tagged Atlantic sturgeon were detected up to 24 kilometers from shore, placing them in waters 10 to 20 meters deep (Collins and Smith 1997).

There is also evidence that Atlantic sturgeon habitat use in the marine environment changes with season. Erickson et al. (2011) found that male and female adult Atlantic sturgeon occupied deeper marine waters in the mid-Atlantic (Delaware and Virginia) during the fall and winter (16.1 to 24.4 meters; October through March) than in the spring and summer (9.9 to 12.9 meters). Similarly, reports of Atlantic sturgeon habitat use in and near the BOEM's Maryland Wind Energy Area off the coast of Maryland indicate individuals prefer inshore, shallow water during warmer months, with an increase in detection in deeper waters, further offshore during winter months (Secor and Bailey 2017). It is possible that the movement of adult Atlantic sturgeon in the marine environment is driven by physical conditions; other life stages of Atlantic sturgeon also make seasonal movements in rivers and estuaries, likely driven by water temperature or prey availability (ASMFC 2017a).

Annual winter bottom-trawling cruises took place from 1988 to 2006 from mid-January to early February in waters slightly north of the action area (Cape Charles, Virginia, to Cape Hatteras, North Carolina) (Laney et al. 2007). With a few exceptions, the surveys took place in waters less than 20 meters deep. Over the course of the study, 2,819 tows were conducted, and 146 Atlantic sturgeon were captured in water depths between 9.1 and 21.3 meters, in 4.2% of tows (ranging from zero to 12.6% per year). The total length of individuals ranged between 577 and 1,517 millimeters (average: 967 millimeters), making most of the catch comprised of subadults. The highest frequency of Atlantic sturgeon capture occurred at tow depths around 12 meters. A more recent and comprehensive review of the data from the same surveys (i.e., to 2016) showed the average depth of capture was 15.3 meters (Rulifson et al. 2020a).

Rulifson et al. (2020a) deployed receivers to detect satellite-tagged fishes off Cape Hatteras, extending about 20 kilometers offshore. From 2008 to 2011, 24 individual Atlantic sturgeon were detected (653 detections), and 67 individuals were detected from 2012 to 2014 (854 detections). There was a seasonal trend in the number of detections during both receiver deployments events, with the majority of detections in fall and through winter, occurring from late October to around mid- to late April. Only one Atlantic sturgeon detection occurred in summer during the study. The predicted presence likelihood of Atlantic sturgeon is possibly linked to sea surface temperature and air temperature, with the likelihood of presence declining to around zero at air temperatures past 20 °C, and at sea surface temperatures approaching 30 °C (Rulifson et al. 2020a). According to (PSIT 2023) data, there are two records of incidental capture of Atlantic sturgeon in or near the action area, one in November, and the other in April.

From this information, we can assume that the highest likelihood of incidental capture of Atlantic sturgeon will be during late fall to early spring, with lower chance of capture during summer, and that these exposed individuals will be subadults and adults. Adults and subadults occupy the coastal marine environment from fall through early spring (Wickliffe et al. 2019). The action area covers water depths from1meter to 30 meters. All 15 sampling sites will be sampled in each season throughout the year.

Atlantic sturgeon, when found in rivers, can be reliably considered to be in their natal rivers, and thus we can more confidently assign them to a particular DPS. However, when in the marine environment, Atlantic sturgeon form mixed stock aggregations. Therefore, when examining potential exposure of Atlantic sturgeon on Frying Pan Shoals, we need to consider that individuals from all five DPSs could be present. For example, the Atlantic sturgeon detected in the marine environment off Cape Hatteras in the Rulifson et al. (2020a) study were originally tagged in rivers and coastal estuaries throughout the species' range (Chesapeake Bay, Connecticut River, Hudson River, South Carolina, Albemarle Sound, North Carolina, and the Delaware River estuary).

Kazyak et al. (2021) looked at stock composition of 1,704 captured Atlantic sturgeon throughout their range. Juveniles were defined as individuals less than 500 millimeters in total length (n=129), subadults as those between 500 and 1,500 millimeters (n=1186), and adults as individuals above 1,500 millimeters (n=147). For individuals captured in what was deemed the southern region of the study (below Cape Hatteras, including the action area), the majority originated from the South Atlantic DPS (91.2%), with the highest proportion coming from the Altamaha River, Georgia. Other contributing stocks included the Carolina DPS (6.2%) (Albemarle Complex, North Carolina, and the Pee Dee River, South Carolina), as well as the Chesapeake (James and York Rivers, Virginia), New York Bight (Hudson and Delaware Rivers), and the Gulf of Maine (Kennebec River), although to a much lesser degree than the South Atlantic DPS. Individuals captured directly within the action area were assigned to the South Atlantic DPS, and one to the Carolina DPS. From these results, we can assume that the majority of Atlantic sturgeon potentially exposed to the proposed action will be from the South Atlantic DPS, with exposure of individuals from the Carolina, Chesapeake, New York Bight, and Gulf of Maine DPSs also possible.

The proposed action will use the trawls for a maximum of 2 - 3 days each per 30-day sampling event (4 per year, 1 in each season). There will be a maximum of 30 trawls (20 minute tows) total per sampling event. There will be 10 sampling events, 1 in each season throughout the year, likely starting in late summer of 2023.

There will be 2 types of trawls used in the proposed action; a 20-meter otter trawl, and a 7.6-meter semi-balloon trawl. Both are large enough to capture the juveniles (>500 millimeters), subadult (<500 millimeters) and adult (<1,500 millimeters) Atlantic sturgeon that could be present in the action area. Based on the available information, we expect that subadult Atlantic sturgeon are the life stage most likely to be exposed. We anticipate that both sexes will be exposed.

We are not aware of any Atlantic sturgeon density estimates for the action area, or elsewhere throughout the species range. As discussed previously, there is a lack of comprehensive abundance information for the Atlantic sturgeon DPSs as well. As such, we must rely on other sources of information to estimate the amount of exposure of Atlantic sturgeon that may occur as a result of the use of the trawl during the proposed action.

From 1988 to 2016, several government agencies conducted an annual cooperative tagging cruise in the coastal marine waters off Virginia and North Carolina (Cape Charles, Virginia, to Cape Hatteras, North Carolina). The survey used trawl nets similar to those in the proposed action, and took place in waters similar in depth to the proposed action (>20 meters deep). These cruises captured Atlantic sturgeon, and this dataset represents the only systematic survey effort in the vicinity of the action area that we are aware of. Laney et al. (2007) summarizes the Atlantic sturgeon catch data until 2006, and the co-authors have provided the data from subsequent cruises (until the study ended in 2016) (B. Versak, Maryland Department of Natural Resources, personal communication to C. Cairns, NMFS June 28, 2023). From this information, we can calculate an encounter rate for Atlantic sturgeon, and apply it to the winter sampling events in the proposed action to estimate exposure of Atlantic sturgeon. Owing to its proximity to the proposed action, and the temporal scope of the available data, we consider Laney et al. (2007) and the subsequent data to 2016 to be the best available information for calculating winter exposure of Atlantic sturgeon in the proposed action.

During the annual winter cooperative tagging cruises from 1998 to 2016, 188 tows out of 4,278 encountered sturgeon, meaning that the trawls encountered sturgeon 4.4% of the time. Of those 188 tows, 274 Atlantic sturgeon were captured; the data from Laney et al. (2007) indicate that most of the time a single sturgeon was captured, and more rarely two or three at a time, with one notable tow capturing 6 sturgeon at once. Based on the expected timing of the beginning of the 2.5 year research cycle (late summer 2023), BOEM will sample in two winter seasons. If we apply the 4.4% encounter rate to the BOEM winter sampling events, which will include a total of 60 tows (30 per sampling event), three of those tows could encounter sturgeon. If we conservatively assume that a maximum of 3 sturgeon were captured in those three tows, we calculate that 9 sturgeon could be captured during the winter sampling.

The Laney et al. (2007) and subsequent data are suitable for generating estimates of exposure during the winter sampling, but it is still necessary to calculate Atlantic sturgeon exposure for the other sampling seasons in the proposed action. As described above, there are seasonal differences to Atlantic sturgeon habitat use, and thus we expect different amount of exposure during other seasons. Dunton et al. (2015) conducted bottom trawl surveys in the coastal marine waters off Long Island, New York, during a stratified random survey from 2005 to 2007 in waters up to 30 meters deep. The survey occurred year-round, used a similar-sized trawl, and the same tow times (20 minutes) as the proposed action. From this survey, Dunton et al. (2015) generated catch per unit effort of Atlantic sturgeon in all months of the year. Although it is not the same geographic location as the proposed action, we are not aware of any other information that can be a suitable source for estimating exposure in the proposed action. We believe that the setting, gear type, and methodology used in Dunton et al. (2015) are similar enough to the proposed action that applying the catch per unit effort from that study to the proposed action is reasonable, with some adjustments. Based on this, we consider this to be the best available information for spring and fall calculating exposure for the proposed action.

BOEM’s sampling events will occur seasonally. Based on the data presented by Dunton et al. (2015), we summed the total number of sturgeon captured and the total number of minutes of tow time by season to calculate a catch per unit effort by season to apply to BOEM’s action. We used Dunton et al. (2015) to calculate catch per unit effort for BOEM’s spring and fall sampling events only. Since the information presented by Rulifson et al. (2020a) indicates that Atlantic sturgeon are not likely to be in the area in summer, and this information is more reflective of summer conditions in the action area, we are not using Dunton et al. (2015) to calculate summertime catch per unit effort for the proposed action.

Dunton et al. (2015) presented their catch per unit effort in sturgeon per minute. BOEM will conduct a maximum of 30 tows (20 minutes each) per sampling event, for 600 minutes per event.

Table 6. Estimated catch per unit effort for Atlantic sturgeon in spring and fall captured by trawl during the proposed action

Season	Catch Per Unit Effort (Sturgeon/Minute) Calculated from Dunton et al. (2015)	Atlantic Sturgeon Captured Per Event	Number of BOEM Sampling Events	Total Estimated Atlantic Sturgeon Exposed
Spring	0.01488	8.95	2	18
Fall	0.01718	10.3	3	31

The total number of Atlantic sturgeon exposed to incidental capture by trawl during all sampling events in the proposed action is 58 juveniles, subadults, and adults. Based on Kazyak et al. (2021), we expect that the majority (n=53) of those exposed will be from the South Atlantic DPS, 4 from the South Atlantic DPS, and the remainder of those exposed (n=1) coming from either the Chesapeake, New York Bight, or Gulf of Maine DPSs. As with sea turtles, there is some chance that incidentally captured Atlantic sturgeon could be recaptured during the sampling, although we are not able to quantify it. We discuss the response of Atlantic sturgeon to potential recapture in Section 10.3.3.

10.3 Response Analysis

As discussed in *The Assessment Framework* (Section 2) of this opinion, response analyses determine how ESA-listed resources are likely to respond after exposure to an action’s effects on the environment or directly on ESA-listed species themselves. For the purposes of consultation, our assessments try to detect potential lethal, sublethal (or physiological), or behavioral responses that might result in reduced fitness of ESA-listed individuals. Ideally, response analyses will consider and weigh evidence of adverse consequences as well as evidence suggesting the absence of such consequences.

10.3.1 Potential Response of ESA-Listed Sea Turtles and Atlantic Sturgeon to Incidental Capture

During capture, the captured sea turtles and Atlantic sturgeon could experience stress, harm and injury at being entangled by the trawl nets. The captured sea turtles could experience stress, harm, or injury at being incidentally captured by the trawl nets or the longlines. If the stress response is severe enough, mortality might occur.

10.3.1.1 ESA-listed Sea Turtles

Capture in research gear can result in stress responses in sea turtles (Gregory 1994; Hoopes et al. 1998; Gregory and Schmid 2001; Jessop et al. 2003; Jessop et al. 2004; Thomson and Heithaus 2014). We also expect behavioral responses (attempts to break away via rapid swimming and biting), as well as physiological responses such as the release of stress hormones (Stabenau et al. 1991; Gregory et al. 1996; Hoopes et al. 2000; Gregory and Schmid 2001; Harms et al. 2003). Sea turtles forcibly submerged in any type of restrictive gear eventually suffer fatal consequences from prolonged anoxia and/or seawater infiltration of the lungs (Lutcavage et al. 1997a). Trawl studies have found that no mortality or serious injury occurred in tows of 50 minutes or less, but these increased rapidly to 70% after 90 minutes (Henwood and Stuntz 1987; Epperly et al. 2002). However, mortality has been observed in summer trawl tows as short as 15 minutes (Sasso and Epperly 2006). Metabolic changes that can impair a sea turtle’s ability to function can occur within minutes of a forced submergence. Serious injury and mortality are likely due to acid-base imbalances resulting from accumulation of carbon dioxide and lactate in the bloodstream (Lutcavage et al. 1997a); this imbalance can become apparent in captured, submerged sea turtles after a few minutes (Stabenau et al. 1991). Sea turtles entangled in nets exhibiting lethargy can die even with professional supportive care, possibly due to severe exertion resulting in muscle damage (Phillips et al. 2015).

The proposed action will use longlines. Longlining will use 600-meters of 272-kilogram test monofilament with about 40 hooks (6/0 to 15/0 circle hooks [approximately 13 to 30 millimeter spacing between the hook and shank]) for 1-hour soak times, fished at the ocean bottom.

Sea turtles can be hooked while trying to ingest bait from longline hooks or become entangled when their flippers encounter the hooked branch or mainlines. Differences in bycatch rates among gear deployment practices and gear configurations have driven many of the bycatch reduction strategies in longline vessels (Watson et al. 2005; Lewison et al. 2013). Shallow-set longlines (less than 50 meters) have been shown to result in higher turtle bycatch rates than deeper sets (Gilman et al. 2006b; Beverly et al. 2009); leatherbacks are caught more often during nighttime longline sets compared to daytime sets; increased longline soak times have resulted in higher catches of loggerhead turtles (Gilman et al. 2006b); and switching from J-shaped hooks with squid bait to circle hooks with fish bait resulted in significant declines in loggerhead (83%) and leatherback (90%) bycatch in the Hawaii longline swordfish fishery (Gilman et al. 2007). Estimated turtle mortality rates from capture in longline gear have also been shown to vary widely (8% to over 30%) depending on numerous factors including hook type used, set depth, and hook location (Chaloupka et al. 2004; Casale et al. 2008).

Several mitigation measures are in place as part of the proposed action that should minimize the risk of adverse effects on sea turtles (see Section 3.1.7 for details) from hooking or other incidental capture. All sea turtles captured as part of the proposed action must be handled according to procedures specified in 50 C.F.R. § 223.206(d)(1)(i). Researchers must use care when handling an incidentally captured sea turtle to minimize any possible injury; and appropriate resuscitation techniques must be used on any comatose turtle prior to returning it to the water.

Sublethal effects that might have an impact on sea turtles are the turtle's ability to swim, forage, or migrate. These remain very difficult to quantify or monitor. For capture, to result in significant fitness consequences to live animals, we assume that an individual turtle could not compensate for lost feeding opportunities by either immediately feeding at another location, by feeding shortly after release, or by feeding at a later time. There is no indication this is the case. Similarly, temporary disruptions of swim speed or direction are expected to be inconsequential because animals can resume these behaviors almost immediately following release. Further, these sorts of behavioral disruptions may be similar to natural disruptions such as those resulting from predator avoidance, or fluctuations in oceanographic conditions. Therefore, in most cases, behavioral responses of sea turtles to capture in a net are unlikely to lead to fitness consequences, reduced reproductive success, or long-term implications for the population.

All capture methods are expected to result in some level of stress to the target animals and temporarily disrupt activities such as resting, foraging, and migration. However, these interruptions for individual turtles are relatively short-lived and any physiological effects are expected to be compensated by intrinsic homeostatic mechanisms. For turtles, capture can result in raised levels of stress hormones and can cause some discomfort. Based on past observations, these effects are expected to dissipate within a day (Stabenau and Vietti 2003). Trawls also have the potential to result in delayed mortality that cannot be observed. A number of factors, such as size, species, water temperature, severity of entanglement, and others can intensify the effects resulting from capture. A sea turtle could die as a direct result of forced submergence in the net; however, we think this is unlikely. The short tow time (20 minutes) is expected to minimize the likelihood of lengthy forced submergence. As per the handling protocols, the careful handling of any captured Atlantic sturgeon and sea turtles is expected to result in a low potential for mortality. In addition, such observed mortalities are expected to be rare as evidenced by reported take data of similar research activities (NMFS 2021).

The location of the hooking and the hook type can cause differences in likelihood of incidental capture, and outcomes for captured sea turtles. Wide circle hooks (like those selected for use in the proposed action), have been shown to reduce capture rates of leatherback and hard-shelled sea turtles, compared to J-hooks common used in some longline fisheries (Gilman and Huang 2017). To reduce sea turtle bycatch, NMFS promulgated regulations requiring circle hooks in Atlantic pelagic longline fisheries. After being de-hooked and released, incidentally captured sea turtles can still suffer from and succumb to the injuries caused by longline hooks. Following incidental capture in longline fisheries, post-release mortality was inferred for 4 loggerheads that had been deeply hooked (i.e., ingested the hook, and hooked in the esophagus) (Swimmer et al. 2014). In cases where leatherbacks were incidentally captured in longline fisheries, using careful disentanglement practices, post-release tracking indicated that individuals survived and were tracked for hundreds of days following release (Bond and James 2021). Where the hooking occurs on the sea turtle (i.e., mouth, flipper, or ingested) appears to affect the degree of injury and likelihood of survival. In cases where capture does occur, wide circle hooks pose a reduced risk of individuals getting deeply hooked (Gilman and Huang 2017). Overall, because of the hook type that will be used in the proposed action, we believe this limits the likelihood of mortality of incidentally captured sea turtles. Records of incidentally captured sea turtles in longline gear during similar research over a longer period indicate that mortality (and even capture) of sea turtles in these types of activities is rare (NMFS 2021). Incidentally captured sea turtles hooked on parts of their bodies (e.g., mouth, flippers) may suffer injury. In these instances, researchers will adhere to standard handling protocols to safely remove the hooks, and thus minimize further harm to hooked individuals.

In addition, the conservative capture and handling methods employed as part of the action, especially the limited tow and set times and post-capture monitoring prior to release, are considered standard safe practices, and will further reduce the likelihood of mortality (Zollett and Swimmer 2019). Additionally, these methods will not affect the physical or biological environment.

10.3.1.2 Atlantic Sturgeon

Entanglement in gillnets, trammel nets, and trawl nets can constrict a sturgeon's gills, resulting in increased stress and risk of suffocation (Collins et al. 2000a; Moser et al. 2000; Kahn and Mohead 2010). Sturgeon stress and mortality associated with capture in nets has been directly related to environmental conditions. However, except for very rare instances, results from previous sturgeon research indicate that capture in nets does not cause any effects on the vast majority of fish beyond 24 hours. For all species of sturgeon, research has revealed that stress from capture is affected by temperature, dissolved oxygen, 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 dissolved oxygen concentrations, combined with longer times between net checks, were more at risk to mortality and stress (Kahn and Mohead 2010). As part of the proposed action, the tow times will be limited to 20 minutes, the same amount of time as prescribed by standard research protocols. This is expected minimize the amount of stress a captured sturgeon may experience.

Since 2006, conservative mitigation measures implemented by NMFS through permit conditions (e.g., limits to trawl times, minimal holding or handling time) and additional precautions taken by sturgeon researchers have significantly reduced the lethal and sublethal effects of capture in trawl nets on Atlantic sturgeon. The proposed action will adhere to these same conservation measures. These mitigation measures (as described in Section 3.1.7) should minimize the risk of adverse effects on Atlantic sturgeon. All Atlantic sturgeon captured will be handled according to standard protocols (e.g., (Kahn and Mohead 2010)). Researchers must use care when handling an incidentally captured Atlantic sturgeon to minimize any possible injury; and appropriate resuscitation techniques must be used on any ailing individual prior to returning it to the water. If the required mitigation techniques are adhered to, we expect that individual Atlantic sturgeon will experience no more than short-term stresses during these types of incidental capture activities and that these stresses will dissipate within a short period.

10.3.1.3 Summary

Based on the response of sea turtles and Atlantic sturgeon to similar capture methods, and the protective measures in place in the proposed action, we expect no more than short-term stress responses from captured Atlantic sturgeon and sea turtles, and possible injuries in cases where sea turtles are captured by hooking in longline. We do not expect ESA-listed sea turtles or Atlantic sturgeon to experience long-term detrimental effects from capture.

10.3.2 Potential Response of ESA-Listed Sea Turtles and Atlantic Sturgeon to Handling and Release

During handling, the captured sea turtles could experience stress and discomfort at being handled. This will occur in addition to the stress of being captured. If the stress response is severe enough, mortality might occur.

All handling procedures are designed to mitigate potential impacts associated with handling animals, sampling, etc., and will be implemented to promote efficiencies and minimize stress to individuals during the proposed action.

For sea turtles, capture and handling activities may markedly affect metabolic rate (St. Aubin and Geraci 1988), reproduction (Mahmoud and Licht 1997), and hormone levels (Gregory et al. 1996). Handling has been shown to result in progressive changes in blood chemistry indicative of a continued stress response (Hoopes et al. 2000; Gregory and Schmid 2001). The additional on-board holding time imposes an additional stressor on these already acidotic turtles (Hoopes et al. 2000). It has been suggested that the muscles used by sea turtles for swimming might also be used during lung ventilation (Butler et al. 1984). Thus, an increase in breathing effort in negatively buoyant animals may have heightened lactate production. Understanding the physiological effects of capture methodology is essential to conducting research on ESA-listed sea turtles, because safe return to their natural habitat is required. However, literature pertaining to the physiological effects of capture on sea turtles is scarce. If captured during the proposed action, sea turtles will be handled and evaluated as quickly as possible to minimize stresses resulting from their capture.

Despite their general hardiness, handling sturgeon after capture can lead to severe stress or even mortality if done improperly or in combination with unfavorable environmental conditions such as elevated water temperatures or low dissolved oxygen (Moser et al. 2000; Kahn and Mohead 2010). Handling stress generally increases the longer sturgeon are held out of the water. Total handling time and associated stress will be greater for individual sturgeon undergoing invasive procedures. Signs of handling stress are redness around the neck and fins and soft fleshy areas, excess mucus production on the skin, and a rapid flaring of the gills. Sturgeon may also inflate their swim bladder when held out of water, and, if they are not returned to neutral buoyancy prior to release, they will float and possibly be susceptible to sunburn and bird attacks (Moser et al. 2000; Kahn and Mohead 2010). A study by Moser and Ross (1995) suggested that, under certain circumstances, pre-spawning adults that are captured may interrupt or abandon their spawning migrations after being handled (Moser and Ross 1995). However, based on telemetry data and other observations of individual animals captured on the spawning ground, Kahn et al. (2014) found that adult sturgeon did not stray far from the site of capture and many immediately returned to spawning behavior as soon as they were released.

Although sturgeon can be sensitive to handling stress, handling of fish by researchers will be kept to a minimum, as per the conservation measures in the proposed action. These protocols minimize potential handling stress and indirect effects resulting from handling. 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.

10.3.2.1 Summary

Based on the response of sea turtles and Atlantic sturgeon to similar handling methods, and the protective measures in place in the proposed action, we expect no more than short-term stress responses from handled sea turtles or Atlantic sturgeon. We do not expect ESA-listed sea turtles or Atlantic sturgeon to experience long-term detrimental effects from handling.

10.3.3 Potential Response to ESA-Listed Sea Turtles and Atlantic Sturgeon to Recapture

Because of the frequency of sampling in the proposed action, individual Atlantic sturgeon of any DPS and ESA-listed sea turtles could potentially be captured more than once during a sampling event, possibly within the same day. Cumulative physiological stress can result from net abrasion, injury, and handling of sturgeon and turtles when individuals are captured multiple times within a relatively short period (i.e., a few hours). Recaptured animals that have not properly recovered from stressors associated with the previous capture have a higher risk of mortality.

For recaptured fish, researchers will still be required to adhere to the protocols and mitigation measures for safe handling of sturgeon (discussed in Section 3.1.7), including returning fish to the net pen for observation to ensure full recovery (return to equilibrium, reaction to touch stimuli, return of full movement) prior to release. Recaptured fish may need more time to achieve full recovery prior to release. Similarly for recaptured turtles, researchers will still be required to adhere to the protocols and mitigation measures for safe handling of sea turtles and ensure they are active and healthy prior to release. Recaptured turtles may need more time to achieve full recovery prior to release.

While the recapture of sea turtles and Atlantic sturgeon in a given sampling event may result in increased levels of stress responses, those responses are not likely to manifest into any long-term adverse effects, or mortality. This conclusion can be reached as long as all of the sampling protocols and mitigation measures are followed.

10.4 Risk Analysis

In this section, we assess the consequences of the responses of the individuals that have been exposed, the populations those individuals represent, and the species those populations comprise.

We measure risks to individuals of threatened or endangered species based upon effects on the individual's fitness, which may be indicated by changes to the individual's growth, survival, annual reproductive fitness, and lifetime reproductive success. We expect the numbers of the following species to be exposed to the incidental capture:

- 58 juvenile/subadult and adult Atlantic sturgeon, either sex
  - South Atlantic DPS (n=53), Carolina DPS (n=4), Chesapeake, New York Bight, and Gulf of Maine DPS (n=1)
- Post-hatchling, juvenile, subadult and adults of either sex
  - 13 Northwest Atlantic DPS loggerhead sea turtles
  - 6 North Atlantic Ocean DPS green sea turtles
  - 5 leatherback sea turtles
  - 10 Kemp's ridley sea turtles

Our exposure estimates stem from the best available information on species abundance estimates and information about incidental capture during similar activities in and around the action area. Based upon information presented in the *Response Analysis*, ESA-listed sea turtles exposed to incidental capture could be injured, harmed, exhibit changes in behavior, suffer stress or even mortality. ESA-listed Atlantic sturgeon could be injured, harmed, exhibit changes in behavior, suffer stress or even mortality.

As described above, the proposed action will result in temporary effects, largely behavioral or physiological (stress response) with some potential for injury or mortality to the exposed ESA-listed sea turtles and Atlantic sturgeon. The potential for adverse effects to result in injury or mortality is low in part due to the required minimization measures (e.g., standard capture methods, brief handling time, and adherence to safe release protocols) in the proposed action. As such, we believe the fitness consequences to ESA-listed sea turtles and Atlantic sturgeon exposed to the incidental capture will have a minimal effect on the population of the species.

11 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.

We expect that those aspects described in the *Environmental Baseline* (Section 9) will continue to impact ESA-listed resources into the foreseeable future. We expect climate change, vessel strikes, fisheries (entanglement and incidental capture), coastal development, pollution, entanglement, invasive species, and scientific research activities to continue into the future with continuing impacts to ESA-listed Atlantic sturgeon and sea turtles. Because of recent trends and based on available information, we expect the amount and frequency of fishing and vessel activity to persist in the action area, and that ESA-listed sea turtles and Atlantic sturgeon will continue to be impacted, in the action area, and throughout its range.

During this consultation, we searched for information on future state, tribal, local or private (non-Federal) actions that were reasonably certain to occur in the action area. We conducted electronic searches of *Google* and other electronic search engines for other potential future state or private activities that are likely to occur in the action area.

Future tribal, state, and local government actions will likely be in the form of legislation, administrative rules, or policy initiatives and fishing permits. Activities occurring in the action area are primarily those conducted under state management. These actions may include changes in ocean policy and increases and decreases in the types of activities currently seen in the action area, including changes in the types of fishing activities, resource extraction, and designation of marine protected areas, any of which could influence the status of listed species in the action area in the future. Government actions are subject to political, legislative and fiscal uncertainties. As a result, any analysis of cumulative effects is difficult, particularly when taking into account the geographic scope of the action area, the various authorities involved in the action, and the changing economies of the region.

Because of recent trends and based on available information, we expect the amount and frequency of vessel activity to persist in the action area, and that ESA-listed species will continue to be impacted (e.g., vessel strike of Atlantic sturgeon, and to a lesser extent, sea turtles).

Future activities could include BOEM-related dredging activities, and the development or renewal of Section 10(a)(1)(B) incidental take permits for state fisheries. The purpose of the study is to better understand impacts to fish associated with the shoal during potential dredging in the future. This research in the proposed action can increase understanding of ESA-listed Atlantic sturgeon movements and presence of ESA-listed sea turtles, better describe the potential risk of interaction, and determine how to reduce risk of interaction with BOEM-dredging activities. In addition, should the state of North Carolina request any renewals for Section 10(a)(1)(B) incidental take permits for their inshore fisheries impacting ESA-listed sea turtles and Atlantic sturgeon, or applications for new incidental take permits, these applications will be subject to future review and ESA section 7 consultation.

12 Integration and Synthesis

The *Integration and Synthesis* section is the final step in our assessment of the risk posed to species as a result of implementing the proposed action. In this section, we add the *Effects of the Action* (Section 10) to the *Environmental Baseline* (Section 9) and the *Cumulative Effects* (Section 11) to formulate the agency's biological opinion as to whether the proposed action is likely to 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. This assessment is made in full consideration of the *Status of the Species Likely to be Adversely Affected* (Section 8).

Below we summarize the probable risks the proposed action poses to threatened and endangered species. This summary integrates the exposure profile presented previously with the results of our response analysis for the activities considered in this opinion that may result in incidental capture of species of ESA-listed sea turtles and fishes.

12.1 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 will 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.

Based on our effects analysis, adverse effects to ESA-listed Atlantic sturgeon and sea turtles are likely to result from the action. The following discussions summarize the probable risks that research activities pose to ESA-listed Atlantic sturgeon and sea turtles. These summaries integrate our exposure, response, and risk analyses from Section 10.

12.1.1 Atlantic Sturgeon—Gulf of Maine, New York Bight, Chesapeake, Carolina, and

South Atlantic DPS

Within the action area, Atlantic sturgeon of the Gulf of Maine, New York Bight, Chesapeake, Carolina, and South Atlantic DPSs may be exposed to incidental capture from the use of trawls associated with the research activities.

Atlantic sturgeon populations declined drastically between 1880 and 1905, followed by a century of commercial fishing that kept populations depressed. Atlantic sturgeon were listed as threatened in the Gulf of Maine and endangered in the four DPSs south of there in 2012. In either case, there is not much information about population abundance and what does exist does not indicate that populations of either Atlantic have increased. These populations face threats from degraded water quality, bycatch, vessel strikes, and invasive species.

The Gulf of Maine DPS of Atlantic sturgeon is listed as threatened and includes six river systems. The Kennebec River is the primary spawning and nursery area for Gulf of Maine Atlantic sturgeon. The removal of the Edwards Dam in 1999 resulted in 17 additional miles of historical spawning habitat accessible to Kennebec River Atlantic sturgeon and improved water quality. The Kennebec River population is regarded as being in good condition, based on the following criteria: regular spawning; juveniles present and progressing through age classes; no major ongoing threats; two minor threats (water quality and impingement/entrainment); and a relatively large estimated effective population size.

The New York Bight DPS of Atlantic sturgeon is listed as endangered and includes seven river systems, only three of which are known spawning populations: Delaware, Hudson, and Connecticut rivers. Recent spawning estimates of the Hudson River suggest the abundance has not changed since the end of the commercial fishery (Kazyak et al. 2020). Water quality, dredging, and ship strikes remain stressors to New York Bight DPS Atlantic sturgeon. The Hudson and Delaware populations both exhibit regular spawning, have juveniles present and progressing through age classes and relatively large estimated effective population sizes.

The Chesapeake DPS of Atlantic sturgeon is listed as endangered and includes six river systems, only three of which are known spawning populations (James, York, and Nanticoke rivers). White et al. (2021b) indicates that there are two genetically distinct spawning runs in the James River during the spring and the fall, as well as showing the York River population is genetically distinct from the James River population(s). The James River population exhibits regular spawning and has juveniles present. The York and James River population have a relatively large estimated effective population size. The York population has a small abundance.

The Carolina DPS of Atlantic sturgeon is listed as endangered and includes eight river systems, five of which are known spawning populations (Roanoke, Tar/Pamlico, Neuse, Pee Dee, and Cape Fear rivers; ASMFC 2017a). Smith et al. (2015) identified fall spawning in the Roanoke River. White et al. (2021b) identified spring and fall spawning populations in the Pee Dee River system. The spring run in the Pee Dee is more closely related to spring runs in the South Atlantic DPS of Atlantic sturgeon than to the fall counterpart in the Pee Dee River. The Roanoke population exhibits an average adult survival rate of 84%, regular spawning, juveniles present and progressing through age classes and a relatively small estimated effective population size.

The South Atlantic DPS of Atlantic sturgeon is listed as endangered and includes10 river systems. Currently, this DPS supports six known spawning populations: Ashepoo, Combahee, and Edisto Basin, Savannah, Ogeechee, Altamaha, Satilla, and St. Mary's. As with the James River, the Ogeechee and Edisto rivers support both a spring and fall spawning population (White et al. 2021b). The spring spawning populations are more closely related to one another than to the fall populations within the same river basin. The Savannah and Altamaha populations exhibit a robust average adult survival rate, regular spawning, juveniles present and progressing through age classes, and relatively large estimated effective population sizes. The Ashepoo, Combahee, and Edisto Basin, Ogeechee, and Satilla populations are somewhat smaller compared to the Altamaha and Savannah, and juvenile progression through age classes has not been confirmed in these systems.

We do not expect any mortalities of any DPS of Atlantic sturgeon to occur. No reduction in numbers is anticipated as part of the proposed action. There are expected to be 58 Atlantic sturgeon incidentally captured because of the proposed research activities, 53 from the South Atlantic DPS, 4 from the Carolina DPS, and the remaining individual from either the Chesapeake, New York Bight, or Gulf of Maine DPSs. We anticipate that juveniles, subadults, and adults of either sex may be taken. We anticipate temporary physiological and behavioral responses (e.g., stress, changes in metabolic rate and blood chemistry, loss of foraging opportunities, and flight response), with individuals returning to normal shortly after the exposure has ended, and thus do not anticipate any delay in reproduction as a result. Therefore, no reduction in reproduction is expected because of the proposed action. No reduction in the distribution of Gulf of Maine, New York Bight, Chesapeake, Carolina, or South Atlantic DPS of Atlantic sturgeon from the Northwest Atlantic Ocean off North Carolina or changes to the geographic range of the species are expected because of the BOEM research activities.

A recovery plan for Atlantic sturgeon (of any DPS) has not yet been prepared. There is a recovery outline, which serves as interim guidance for recovery efforts until a full recovery plan is developed and approved. NMFS'S vision is that subpopulations of all five Atlantic sturgeon DPSs must be present across the historical range, and these subpopulations must be of sufficient size and genetic diversity to support successful reproduction and recovery from mortality events. The recruitment of juveniles to the subadult and adult life stages must also increase and that increased recruitment must be maintained over many years. Recovery of these DPSs will require conservation of the riverine and marine habitats used for spawning, development, foraging, and growth by abating threats to ensure a high probability of survival into the future. The outline includes a recovery action to implement region-wide initiatives to improve water quality in sturgeon spawning rivers, with specific focus on eliminating or minimizing human-caused anoxic zones.

Because no mortalities or measurable effects on the abundance, distribution, and reproduction of Gulf of Maine, New York Bight, Chesapeake, Carolina, or South Atlantic DPS of Atlantic sturgeon populations are expected because of the incidental capture of animals during the proposed action, we do not anticipate the research activities will impede the recovery objectives for any DPS of Atlantic sturgeon. In conclusion, we believe the effects associated with the proposed action will not appreciably reduce the likelihood of survival and recovery of Gulf of Maine, New York Bight, Chesapeake, Carolina, or South Atlantic DPS of Atlantic sturgeon in the wild by reducing the reproduction, numbers, or distribution of these populations or impeding recovery objectives.

12.1.2 Loggerhead Sea Turtles Northwest Atlantic DPS

Adult, juvenile, and post-hatchling Northwest Atlantic DPS of loggerhead turtles are present in the action area and are expected to be exposed to incidental capture from the use of trawls and longlines associated with the research activities.

Based on the currently available information, the overall nesting trend of the Northwest Atlantic Ocean DPS of loggerhead turtle appears to be stable, neither increasing or decreasing, for over two decades (NMFS and USFWS 2023). Destruction and modification of terrestrial and marine habitats threaten the Northwest Atlantic Ocean DPS of loggerhead turtles. On beaches, threats and interfere with successful nesting, egg incubation, hatchling emergence, and transit to the sea include erosion, erosion control, coastal development, artificial lighting, beach use, and beach debris (NMFS and USFWS 2023). In the marine environment, threats that interfere with foraging and movement include marine debris, oil spills and other pollutants, harmful algal blooms, and noise pollution (NMFS and USFWS 2023).

It is difficult to estimate the overall abundance for sea turtle populations because individuals spend most of their time in water, where they are difficult to count, especially considering their large range and use of many different and distance habitats. Females, however, converge on their natal beaches to lay eggs and nests are easily counted. The total number of annual U.S. nest counts for the Northwest Atlantic DPS of loggerhead turtles is over 110,000 (NMFS and USFWS 2023).

In water estimates of abundance, which include juvenile and adult life stages of loggerhead turtle males and females, are difficult to perform on a wide scale. In the summer of 2010, NMFS's Northeast Fisheries Science Center and Southeast Fisheries Science Center estimated the abundance of juvenile and adult loggerhead turtles along the continental shelf between Cape Canaveral, Florida and the mouth of the Gulf of St. Lawrence, Canada, based on the Atlantic Marine Assessment Program for Protected Species aerial line-transect sighting survey and satellite tagged loggerhead turtles (NMFS 2011b). They provided a preliminary regional abundance estimate of 588,000 individuals (approximate inter-quartile range of 382,000 to 817,000 individuals) based on positively identified loggerhead turtle sightings (NMFS 2011). A separate, smaller aerial survey, conducted in the southern portion of the Mid-Atlantic Bight and Chesapeake Bay in 2011 and 2012, demonstrated uncorrected loggerhead turtle abundance ranging from a spring high of 27,508 to a fall low of 3,005 loggerhead turtles (NMFS and USFWS 2023). We are not aware of any current rangewide in-water estimates for the Northwest Atlantic Ocean DPS of loggerhead turtle.

Nesting data are the best current indicator of population trends in sea turtles, but in-water data also provide some insight. In-water research suggests the abundance of neritic juveniles is steady or increasing. Although Ehrhart et al. (2007) found no significant regression-line trend in a long-term dataset, researchers have observed notable increases in catch per unit effort (Ehrhart et al. 2007; Epperly et al. 2007b; Arendt et al. 2009). Researchers believe that this increase in catch per unit effort is likely linked to an increase in abundance of juveniles. Although it is unclear whether this increase in abundance represents a true population increase among juveniles or merely a shift in spatial occurrence. Bjorndal et al. (2005) caution about extrapolating localized in-water trends to the broader population and relating localized trends in neritic sites to population trends at nesting beaches. The apparent overall increase in the abundance of the largest oceanic/neritic juveniles (historically referred to as small benthic juveniles), which could indicate a relatively large number of individuals around the same age may mature in the near future (TEWG 2009). However, in-water studies throughout the eastern U.S. indicate a substantial decrease in abundance of the smallest oceanic/neritic juvenile loggerhead turtles, a pattern corroborated by stranding data (TEWG 2009).

We do not expect any mortalities of Northwest Atlantic Ocean DPS loggerhead sea turtles. No reduction in numbers is anticipated as part of the proposed action. There are expected to be 13 Northwest Atlantic Ocean DPS loggerhead sea turtles incidentally captured because of the proposed research activities. We anticipate that post-hatchling, juveniles, and adults of both sexes may be taken. We anticipate temporary physiological and behavioral responses (e.g., stress, changes in metabolic rate and blood chemistry, loss of foraging opportunities, and flight response), with individuals returning to normal shortly after the exposure has ended, and thus do not anticipate any delay in reproduction as a result. Therefore, no reduction in reproduction is expected because of the proposed action. No reduction in the distribution of Northwest Atlantic Ocean DPS of loggerhead turtles from the Northwest Atlantic Ocean off North Carolina or changes to the geographic range of the species are expected because of the BOEM research activities.

The 2009 Final Recovery Plan (NMFS 2008) for the Northwest Atlantic Population of loggerhead turtle lists recovery objectives for the species. The following recovery objectives are relevant to the impacts of the proposed action:

- 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 feeding, migratory, and interesting marine habitats to ensure successful growth and reproduction.
- Develop and implement local, state, Federal, and international legislation to ensure long-term protection of loggerhead turtles and their terrestrial and marine habitats.

- Minimize trophic changes from fishery harvest and habitat alteration.
- Minimize marine debris ingestion and entanglement.
- Minimize vessel strike mortality.

Because no mortalities or measurable effects on the abundance, distribution, and reproduction of Northwest Atlantic Ocean DPS of loggerhead turtle populations are expected because of the proposed action, we do not anticipate the research activities will impede the recovery objectives for Northwest Atlantic Ocean DPS of loggerhead turtles. In conclusion, we believe the effects associated with the proposed action will not appreciably reduce the likelihood of survival and recovery of Northwest Atlantic Ocean DPS of loggerhead turtles in the wild by reducing the reproduction, numbers, or distribution of the species or impeding recovery objectives.

12.1.3 Green Sea Turtles North Atlantic DPS

Adult, juvenile, and post-hatchling North Atlantic DPS of green turtles are present in the action area and are expected to be exposed to incidental capture from the use of trawls and longlines associated with the research activities.

Once abundant in tropical and subtropical waters, green turtles worldwide exist at a fraction of their historical abundance, as a result of over-exploitation for food and other products. 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. Other threats include pollution, habitat loss through coastal development or stabilization, destruction of nesting habitat from storm events, artificial lighting, poaching, global climate change, natural predation, disease, cold-stunning events, and oil spills.

Historically, green turtles in the North Atlantic DPS were hunted for food, which was the principle cause of the population's decline. While the threats of pollution, habitat loss through coastal development, beachfront lighting, and fisheries bycatch continue, the North Atlantic DPS of green turtle appears to be somewhat resilient to future perturbations.

For the North Atlantic DPS of green turtle the available data indicate an increasing trend in nesting. There is no reliable estimates of population growth rate of the North Atlantic DPS as a whole, but estimates have been developed at a localized level. Apparent increases in nester abundance for the North Atlantic DPS of green turtle in recent years are encouraging, but must be viewed cautiously, as the datasets represent a fraction of green turtle generation, up to 50 years.

We do not expect any mortalities of North Atlantic DPS green sea turtles. No reduction in numbers is anticipated as part of the proposed action. There are expected to be 6 North Atlantic DPS sea turtles incidentally captured because of the proposed research activities. We anticipate that post-hatchling, juveniles, and adults of both sexes may be taken. We anticipate temporary physiological and behavioral responses (e.g., stress, changes in metabolic rate and blood chemistry, loss of foraging opportunities, and flight response), with individuals returning to normal shortly after the exposure has ended, and thus do not anticipate any delay in reproduction as a result. Therefore; no reduction in reproduction is expected because of the proposed action. No reduction in the distribution of North Atlantic DPS of green turtles from the Northwest Atlantic Ocean off North Carolina or changes to the geographic range of the species are expected because of BOEM's research activities.

The Recovery Plan (NMFS 1991b) for the U.S. Atlantic population of green turtle lists recovery objectives for the species. The following recovery objectives are relevant to the impacts of the proposed action:

- Determine distribution and seasonal movements for all life stages in marine environment; and
- Reduce threat to pollution and foraging habitat from marine pollution.

Because no mortalities or measurable effects on the abundance, distribution, and reproduction of North Atlantic DPS of green turtles are expected because of the proposed action, we do not anticipate the research activities will impede the recovery objectives for Kemp's ridley turtles. In conclusion, we believe the effects associated with the proposed action will not appreciably reduce the likelihood of survival and recovery of North Atlantic DPS of green turtles in the wild by reducing the reproduction, numbers, or distribution of the species or impeding recovery objectives.

12.1.4 Leatherback Sea Turtles

Adult, juvenile, and post-hatchling leatherback sea turtles are present in the action area and are expected to be exposed to incidental capture from the use of trawls and longlines associated with the research activities.

The leatherback turtle is an endangered species whose once large nesting populations have experienced steep declines in recent decades. The status of the subpopulations in the Atlantic, Indian, and Pacific Oceans are generally declining, except for the subpopulation in the Southwest Atlantic Ocean, which is slightly increasing.

The primary threats to leatherback turtles include fisheries interactions (bycatch), harvest of nesting females, and egg harvesting. Because of these threats, once large rookeries are now functionally extinct, and there have been range-wide reductions in population abundance. Other threats include loss of nesting habitat due to development, tourism, vegetation changes, sand extraction, beach nourishment, shoreline stabilization, and natural disasters (e.g., storm events and tsunamis) as well as cold-stunning, vessel interaction, pollution (contaminants, marine debris and plastics, petroleum products, petrochemicals), ghost fishing gear, natural predation, parasites, and disease. Artificial lights on or adjacent to nesting beaches alter nesting adult female behavior and are often fatal to post-nesting females and emerging hatchlings as they are drawn to light sources and away from the sea. Ingestion of marine debris (plastic) is common in leatherback turtles and can block gastrointestinal tracts leading to death. Climate change may alter sex ratios (as temperature determines hatchling sex) and nest success, range (through expansion of foraging habitat as well as alter spatial and temporal patterns), and habitat (through the loss of nesting beaches, because of sea-level rise and storms). Oceanographic regime shifts possibly impact foraging conditions that may affect nesting female size, clutch size, and egg size of populations. The species' resilience to additional perturbation is low.

Detailed population structure is unknown, but is likely dependent upon nesting beach location and influenced by physical barriers (i.e., land masses), current systems, and long migrations. The total index of nesting female abundance in the Northwest Atlantic Ocean is 20,659 females. Based on estimates calculated from nesting data, there are approximately 18,700 (10,000 to 31,000 nesting females) total adult leatherback turtles in the North Atlantic Ocean (TEWG 2007a).

Population growth rates for leatherback turtles vary by ocean basin. Leatherback turtles in the Northwest Atlantic Ocean exhibit a decreasing nest trend at nesting beaches with the greatest known nesting female abundance. This decline has become more pronounced (2008 through 2017), and the available nest data reflect a steady decline for more than a decade (Eckert and Mitchell 2018).

We do not expect any mortalities of leatherback sea turtles to occur. No reduction in numbers is anticipated as part of the proposed action. There are expected to be 5 leatherback sea turtles incidentally captured because of the proposed research activities. We anticipate that post-hatchling, juveniles, and adults of both sexes may be taken. We anticipate temporary physiological and behavioral responses (e.g., stress, changes in metabolic rate and blood chemistry, loss of foraging opportunities, and flight response), with individuals returning to normal shortly after the exposure has ended, and thus do not anticipate any delay in reproduction as a result. Therefore, no reduction in reproduction is expected because of the proposed action. No reduction in the distribution of leatherback sea turtles off North Carolina or changes to the geographic range of the species are expected because of the BOEM research activities.

The 1991 Recovery Plan (NMFS 1991a) for the U.S. Caribbean, Gulf of Mexico, and Atlantic Ocean for the population of leatherback turtle lists recovery objectives for the species. The following recovery objective is relevant to the impacts of the proposed action:

- Monitoring and research.

Because no mortalities or measurable effects on the abundance, distribution, and reproduction of leatherback turtle populations are expected because of the proposed action, we do not anticipate the research activities will impede the recovery objectives for leatherback turtles. In conclusion, we believe the effects associated with the proposed action will not appreciably reduce the likelihood of survival and recovery of leatherback turtles in the wild by reducing the reproduction, numbers, or distribution of the species or impeding the recovery objectives.

12.1.5 Kemp's Ridley Sea Turtles

Adult, juvenile, and post-hatchling Kemp's ridley sea turtles are present in the action area and are expected to be exposed to incidental capture from the use of trawls and longlines associated with the research activities.

Kemp's ridley turtles face many of the same threats as other sea turtle species, including destruction of nesting habitat from storm events, oceanic events such as cold-stunning, pollution (plastics, petroleum products, petrochemicals, etc.) ecosystem alterations (nesting beach development, beach nourishment and shoreline stabilization, vegetation changes, etc.), poaching, global climate change, fisheries interactions, natural predation, and disease.

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 prohibited the harvest of sea turtles from May through August, and in 1990, the harvest of all sea turtles was prohibited by presidential decrees in Mexico. In 2002, Rancho Nuevo was declared a sanctuary. A successful head-start program resulted in re-establishment of nesting on Texas beaches. While fisheries bycatch remains a threat, the use of sea turtle excluder devices mitigates take. Fishery interactions and strandings, possibly due to forced submergence, appear to be the main threats to the species. The *Deepwater Horizon* oil spill event reduced nesting abundance and associated hatchling production as well as exposures to oil in the oceanic environment which has resulted in large losses of the population across various age classes, and likely had an important population-level effect on the species. We do not have an understanding of those impacts on the population trajectory for the species into the future. The species' limited range and low global abundance make it vulnerable to new sources of mortality as well as demographic and environmental randomness, all of which are often difficult to predict with any certainty. Therefore, its resilience to future perturbation is low.

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. Nesting steadily increased through the 1990s, and then accelerated during the first decade of the 21st century. Following a significant, unexplained one-year decline in 2010, Kemp's ridley turtle nests in Mexico reached a record high of 21,797 in 2012 (NPS 2013). In 2013, there was a second significant decline with 16,385 nests recorded. In 2014, there were an estimated 10,987 nests and 519,000 hatchlings released from three primary nesting beaches in Mexico (NMFS and USFWS 2015). The number of nests in Padre Island, Texas has increased over the past two decades, with 1 nest observed in 1985, 4 in 1995, 50 in 2005, 197 in 2009, 209 in 2012, and 119 in 2014 (NMFS and USFWS 2015).

From 1980 through 2003, the number of nests at three primary nesting beaches (Rancho Nuevo, Tepehuajes, and Playa Dos) increased 15% annually (Heppell et al. 2005); however, due to recent declines in nest counts, decreased survival at other life stages, and updated population modeling, this rate is not expected to continue (NMFS and USFWS 2015). In fact, nest counts dropped by more than a third in 2010 and continue to remain below predictions (Caillouet et al. 2018). Kemp's ridley turtle nesting population was exponentially increasing (NMFS et al. 2011); however, since 2009 there has been concern over the slowing of recovery (Gallaway et al. 2016a; Gallaway et al. 2016b; Plotkin 2016).

We do not expect any mortalities of Kemp's ridley sea turtles to occur. No reduction in numbers is anticipated as part of the proposed action. There are expected to be 10 Kemp's ridley sea turtles incidentally captured because of the proposed research activities. We anticipate that post-hatchling, juveniles, and adults of both sexes may be taken. We anticipate temporary physiological and behavioral responses (e.g., stress, changes in metabolic rate and blood chemistry, loss of foraging opportunities, and flight response), with individuals returning to normal shortly after the exposure has ended, and thus do not anticipate any delay in reproduction as a result. Therefore, no reduction in reproduction is expected because of the proposed action. No reduction in the distribution of Kemp's ridley turtles from the Northwest Atlantic Ocean off North Carolina or changes to the geographic range of the species are expected because of the BOEM research activities.

The 2011 Final BI-National (U.S. and Mexico) Revised Recovery Plan (NMFS and USFWS 2011) for the population of Kemp's ridley turtle lists recovery objectives for the species. The following recovery objectives are relevant to the impacts of the proposed action:

- Protect and manage nesting and marine habitats;
- Protect and manage populations on nesting beaches and in the marine environment;
- Maintain, promote awareness of and expand U.S. and Mexican laws; and
- Enforce laws.

Because no mortalities or measurable effects on the abundance, distribution, and reproduction of Kemp's ridley turtle populations are expected because of the proposed action, we do not anticipate the research activities will impede the recovery objectives for Kemp's ridley turtles. In conclusion, we believe the effects associated with the proposed action will not appreciably reduce the likelihood of survival and recovery of Kemp's ridley turtles in the wild by reducing the reproduction, numbers, or distribution of the species or impeding the recovery objectives.

13 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's biological opinion that the proposed action is not likely to jeopardize the continued existence of North Atlantic DPS green turtle, hawksbill sea turtle, Kemp's ridley sea turtle, leatherback sea turtle, Northwest Atlantic Ocean DPS loggerhead sea turtle, Gulf of Maine, New York Bight, Chesapeake, Carolina, and South Atlantic DPS Atlantic sturgeon.

NMFS also concludes that the proposed action is not likely to adversely affect the hawksbill sea turtle, giant manta ray, shortnose sturgeon, and fin, sei, and North Atlantic right whale. Also, the proposed action will not adversely affect the designated critical habitat of Northwest Atlantic Ocean DPS of loggerhead turtle, Atlantic sturgeon Carolina DPS, North Atlantic right whale, and proposed critical habitat for North Atlantic green sea turtle.

14 Incidental Take Statement

Section 9 of the ESA and Federal regulations pursuant to section 4(d) of the ESA prohibit the take of threatened and endangered 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 (16 U.S.C. §1532(19)). "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, spawning, rearing, migrating, feeding, or sheltering (50 C.F.R. §222.102).

Section 9 take prohibitions do not apply to threatened species without section 4(d) rules as specified in section 9(a)(1)(g). The ESA does not prohibit the take of threatened species unless special regulations have been promulgated, pursuant to section 4(d), to promote the conservation of the species. ESA section 4(d) rules have been promulgated for North Atlantic DPS of green turtles and Northwest Atlantic Ocean DPS of loggerhead turtles; therefore, section 9 take prohibitions apply to these two species.

This incidental take statement includes numeric limits on the take of these species because specific amounts of take were analyzed in our jeopardy analysis. These numeric limits provide guidance to the action agency on its requirements to reinitiate consultation if the amount of take estimated in the jeopardy analysis of this opinion is exceeded.

Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity (50 C.F.R. §402.02). Section 7(b)(4) of the ESA requires that, when a proposed agency action is found to be consistent with section 7(a)(2) of the ESA and the proposed action may incidentally take individuals of ESA-listed species, we issue a statement that specifies the impact of any incidental taking of threatened or endangered species. To minimize such impacts, reasonable and prudent measures, and term and conditions to implement the measures, must be provided. Only incidental take resulting from the agency actions and any specified reasonable and prudent measures and terms and conditions identified in the incidental take statement are exempt from the taking prohibition of section 9(a), pursuant to section 7(o) of the ESA. 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 incidental take statement.

14.1 Amount or Extent of Take

Section 7(b)(4) and its implementing regulations require NMFS to specify the impact of any incidental take of threatened or endangered species; that is, the amount or extent, of such incidental taking on the species (50 C.F.R. §402.14(i)(1)(i)).

Based on the information provided in this opinion, we anticipate that BOEM's funding a proposed research study on the physical and biological characteristics of Frying Pan Shoals, North Carolina, to be conducted over the next two and half years will result in the incidental capture of:

- 53 South Atlantic DPS Atlantic sturgeon, juvenile/subadult and adult, of either sex;
- 4 Carolina DPS Atlantic sturgeon, juvenile/subadult and adult, of either sex;
- 1 Chesapeake, New York Bight, or Gulf of Maine DPS Atlantic sturgeon, juvenile/subadult and adult, of either sex;
- 13 Northwest Atlantic DPS loggerhead sea turtles, post-hatchling, juvenile, subadult and adult, of either sex;
- 6 North Atlantic Ocean DPS green sea turtles, post-hatchling, juvenile, subadult and adult, of either sex;
- 5 Leatherback sea turtles, post-hatchling, juvenile, subadult and adult, of either sex; and
- 10 Kemp's ridley sea turtles, post-hatchling, juvenile, subadult and adult, of either sex.

14.2 Reasonable and Prudent Measures

"Reasonable and prudent measures" are measures that are necessary or appropriate to minimize the amount or extent of incidental take (50 C.F.R. §402.02). The measures described below must be undertaken by the NSF and the NMFS Permits Division so that they become binding conditions for the exemption in section 7(o)(2) to apply.

We believe the reasonable and prudent measure described below is necessary and appropriate to minimize the impacts of incidental take on threatened and endangered species:

1. BOEM must implement a program to mitigate and report the potential effects of the action on any incidentally captured ESA-listed sea turtles or Atlantic sturgeon.

14.3 Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the ESA, the Federal action agency must comply with the following terms and conditions.

The terms and conditions detailed below for the reasonable and prudent measure includes monitoring and minimization measures, where needed:

To implement the reasonable and prudent measure:

1. BOEM must provide a final report describing instances of incidental take of ESA-listed sea turtles and Atlantic sturgeon (see Section 14.1). The report must detail the species taken, number of species taken, the time and date of taking, the manner of taking, the effects of the taking (e.g., individual response), description of mitigation that occurred, and any other relevant information pertaining to effects of the action to sea turtles and/or Atlantic sturgeon. The report shall be submitted to nmfs.hq.esa.consultations@noaa.gov,

referencing the ECO tracking number (OPR-2023-00400) in the subject line, within 60 days of the conclusion of the research activities.

2. In the event of a mortality of an incidentally captured ESA-species, BOEM must stop research immediately and contact nmfs.hq.esa.consultations@noaa.gov referencing the ECO tracking number (OPR-2023-00400) in the subject line, within 24 hours of the event. In that notification, BOEM must provide the information described in the term and condition above.

15 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 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).

- We request that BOEM provide a copy of any report generated by associated researchers about the results of the research activities, to aid NMFS in future consultations.

In order for NMFS'S Office of Protected Resources Endangered Species Act Interagency Cooperation Division to be kept informed of actions minimizing or avoiding adverse effects on, or benefiting, ESA-listed species or their critical habitat, BOEM should notify the Endangered Species Act Interagency Cooperation Division if they implement this conservation measure in their final action.

16 Reinitiation Notice

As 50 C.F.R. §402.16 states, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if:

(1) The amount or extent of taking specified in the incidental take statement 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 ESA-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.

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